Supplementary Materials for

Direct arene C–H fluorination with $^{18}F^-$ via organic photoredox catalysis

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Movies S1 to S3 (.mp4)

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1. Materials and Methods

1.1 General Reagent Information

Commercially available reagents were purchased from Sigma-Aldrich, Acros, Alfa Aesar, or TCI, Matrix Scientific, Combi-Blocks, Oakwood Chemical, Chem Impex International, and Fisher Scientific and were used as received unless otherwise noted. Diethyl ether (Et_2O), dichloromethane (DCM), tetrahydrofuran (THF), toluene (PhMe), and dimethylformamide (DMF) were dried by passing through activated alumina under nitrogen prior to use. Other common solvents and chemical reagents were purified by standard published methods as noted or used as received. All catalyst and substrate syntheses were run under a nitrogen atmosphere unless specified otherwise.

The following compounds employed as reagents in the photoredox-catalyzed C-H (radio)fluorination were obtained from commercial vendors and used as received: diphenyl ether, biphenyl, naphthalene, 2-bromoansiole, 2-chloroanisole, 2-methoxyacetophenone, 2-methoxybenzonitrile, *o*-anisaldehyde, *p*-anisaldehyde, 4-methoxyacetophenone, 4-methoxybenzophenone, 3-methoxyacetophenone, mesitylene, 3,5-dimethoxypyridine, 2-chloro-5-fluoro-6-methoxyquinoline, 2-methylbenzo[*d*]oxazole, clofibrate, and fenofibrate.

1.2 General Analytical Information

Proton, carbon, and fluorine nuclear magnetic resonance spectra (^{1}H NMR, ^{13}C NMR, ^{19}F NMR) were recorded on a Bruker Avance 400 (^{1}H NMR at 400 MHz, ^{13}C NMR at 100 MHz, and ^{19}F NMR at 376 MHz), a Bruker Avance III 600 (^{1}H NMR at 600 MHz, ^{13}C NMR at 151 MHz, and ^{19}F NMR at 565 MHz) spectrometer, an Inova 700 MHz (^{1}H NMR at 700 MHz, ^{13}C NMR at 176 MHz), and a Bruker Avance III HD 850 (^{1}H NMR at 850 MHz, ^{13}C NMR at 214 MHz). Chemical shifts for protons are reported in parts per million downfield from tetramethylsilane and are referenced to residual protium in the solvent (^{1}H NMR: $CHCl_3$ at 7.26 ppm, MeOD at 3.31 ppm, acetone-d_6 at 2.05 ppm and DMSO- d_6 at 2.50 ppm). Chemical shifts for carbon signals are reported in parts per million downfield from tetramethylsilane and are referenced to the carbon resonances of the solvent peak (^{13}C NMR: $CDCl_3$ at 77.16 ppm, MeOD at 49.00 ppm, acetone-d_6 at 29.84 ppm (CD_3) and at 206.46 (C=O), and DMSO- d_6 at 39.52 ppm). Chemical shifts for fluorine signals are reported in parts per million downfield from tetramethylsilane and are referenced to hexafluorobenzene, which was added as an internal standard. Solvent-dependent ^{19}F values of hexafluorobenzene are obtained from Togni *et al.* (*48*) [^{19}F NMR: C_6F_6($CDCl_3$) at -161.64 ppm, C_6F_6(MeOD) at -165.37 ppm, C_6F_6(acetone-d_6) at -164.67 ppm, C_6F_6(DMSO- d_6) at -162.45 ppm]. ^{1}H, ^{13}C and ^{19}F NMR data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, hept = heptet, dd = doublet of doublets, ddd = doublet of doublet of doublets, m = multiplet, bs = broad singlet, app = apparent), coupling constants (Hz), and integration. Attenuated total reflectance FTIR spectra were recorded on a Bruker Alpha FTIR Spectrometer with the Plantinum ATR attachment. Spectra were averaged over 24 scans with a spectral resolution of 4 cm^{-1}. Data processing was performed using Bruker's OPUS spectroscopy software. High Resolution Mass Spectra (HRMS) were obtained via direct infusion using a Thermo LTQ FT mass spectrometer with positive mode electrospray ionization, via gas chromatography using an Exactive GC gas chromatographic system in positive mode chemical ionization, equipped with a Trace 1300 SSL injector and TriPlus RSH autosampler, or via liquid chromatography using Waters Acquity H-class liquid chromatograph system coupled to a Thermo LTQ FT mass spectrometer with positive mode electrospray ionization. The instrumental control, data acquisition and data processing for HRMS were performed with Thermo's Xcalibur and TraceFinder software packages. Thin layer chromatography (TLC) was performed on SiliaPlate 250 µm thick silica gel plates provided by Silicycle or on Alumina N 200 µm thick aluminium oxide plates (polyester backed) provided by Sorbtech. Visualization was accomplished with short wave UV light (254 nm), or development with iodine, ninhydrin solution, cerium ammonium molybdate or potassium permanganate solution followed by heating. Column chromatography was performed using SiliaFlash P60 silica gel (40-63 µm) purchased from Silicycle or using Acros Organics aluminium oxide (basic, Brockmann I, 50-200 µm, 60 Å). Reverse-phase flash

liquid chromatography was performed using a Biotage® Isolera One instrument with a Biotage® SNAP Ultra C18 cartridge (30 g). Unless noted all reactions were run under an atmosphere of nitrogen in flame-dried glassware with magnetic stirring. Irradiation of photochemical reactions was carried out using a PAR38 Royal Blue aquarium LED lamp (Model #6851) fabricated with high-power Cree XR-E LEDs as purchased from Ecoxotic (www.ecoxotic.com) with standard borosilicate glass vials purchased from Fischer Scientific. For all photolyses, reactions were stirred using a PTFE coated magnetic stir bar on a magnetic stir plate. GC quantitation experiments were performed on an Agilent 6850 series instrument equipped with a split- mode capillary injection system and Agilent 5973 network mass spec detector (MSD). Yield refers to isolated yield of analytically pure material unless otherwise noted. GC yields were determined using 3-bromotoluene as an internal standard. All other reagents were obtained from commercial sources and used without further purification unless otherwise noted.

1.3 Photoreactor Configuration (LEDs)

Reactions were irradiated using a simple photoreactor consisting of two Par38 Royal Blue Aquarium LED lamps (Model #6851) is shown in which one reaction (2 dram vial) is irradiated with a foil barrier preventing irradiation by two lamps. In order to ensure that the reactions are run near room temperature, a simple cooling fan was installed perpendicular to the reactor to aid in heat dissipation (generated from both nonradiative decay pathways of the excited state catalysts and the heat generated from high power LEDs). The vial was positioned on a stir plate approximately 3-4 cm from a Par38 LED lamp supplying blue light (λ = 440-460 nm). An equilibrium temperature of 33 °C was measured with a standard alcohol thermometer. While a number of other blue LED sources are effective, we have found that LED emitters with high luminous flux and narrow viewing angle give the best results. Reaction optimizations were performed on a 16-well proprietary photoreactor with the following parameters.

Basic Parameters:

Input: AC 100 – 240 V 50/60 Hz
Output: 12 W
Light-emitting angle: 45º
Pulse current: 700 mA
Lumens (LM): 130 -140 LM
Wavelength: 465-470 nm; Max wavelength: 467.5 nm
Working temperature: -10 - +60 ºC
LED lifetime：100000 hours
Size: 20cm*20cm*20cm

Fig. S1. Side-on (top left) and top-down (top right) views of the simple photoreactor.

1.4. Radiochemistry

All chemicals are analytical grade and used without further purification. Ultrapure water was obtained from a Millipore MilliQ Gradient A10 system. Pre-conditioned Sep-PAK® light QMA cartridge were purchased form ABX Corporation, and were flushed with 10 ml of water before use. The 450 nm OEM blue diode laser used (OEM-SD-450, 450nm, the power rating is 3.5W after fiber coupling). for the photochemical experiments was purchased from Changchun New Industries Optoelectronics Tech. Co., Ltd. A schematic of the reaction set-up is shown in section 5.3 (Fig. S3). Glass backed thin layer chromatography (TLC) plates coated with silica gel 60F254 were used for radio-TLC analysis and were purchased from EMD-Millipore.

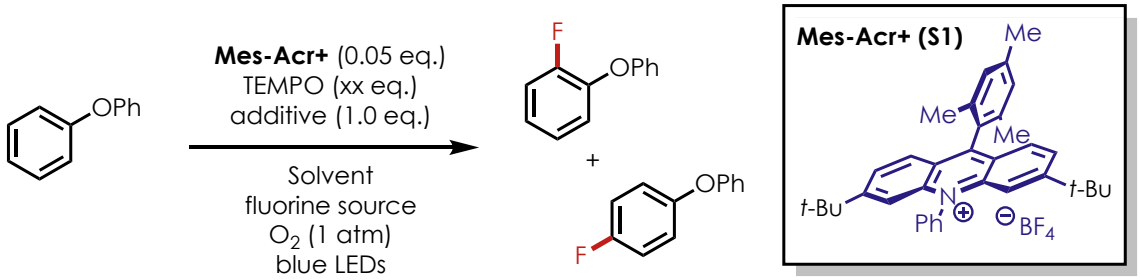
[^{18}F]Fluoride was produced via the ^{18}O(p,n)^{18}F reaction by proton irradiation (40μA, 2-5min) of an [^{18}O]H_2O containing target in a GE PETTrace cyclotron. The [^{18}F]fluoride (ca. 1.2-2.2Ci) was delivered to the synthesis module in a bolus of [^{18}O]H_2O by stream of argon. The aqueous solution of [^{18}F]fluoride was passed through a QMA cartridge (water preconditioning) to trap [^{18}F]fluoride before elution into the reactor vessel with a aqueous solution of 20% w/w tetrabutylammonium bicarbonate (TBAB). This solution was azeotropically dried by heating the reaction vessel to 100 °C and drawing vacuum (ca. 1 kPa) for 5 min, followed by simultaneous vacuum draw and nitrogen stream for a further 6 minutes. The dried [^{18}F]TBAF was cooled to 50 °C before addition of anhydrous MeCN. The mixture was transferred out of the reactor under N_2 pressure into a sterile vial to yield a solution of [^{18}F]TBAF (1.1-1.8 Ci, average = 1.5 Ci) in MeCN. 10-100 μL aliquots of this solution were then used for manual methodology experiments.

Radio-TLC analysis was performed using a Bioscan AR 2000 Radio-TLC scanner (Ekert and Ziegler) ^{18}F activity was counted using a CRC-25 PET detector from Capintec. Analytical reversed-phase high-performance liquid chromatography (HPLC) was accomplished on a SHIMADZU chromatography system (Model CBM-20A) and analyzed using LabSolutions software. The λ absorbance detector and the model 2200 scaler ratemeter radiation detector were added to the HPLC system. HPLC conditions are listed accordingly for each experiment (Section 5).

All radiochemical yields (RCY) quoted are decay corrected and are reported as isolated RCY other than Section 5.4. An aliquot of the reaction mixture (typically 400-800μCi) was taken for radio-HPLC analysis. The activity injected into HPLC was measured (this activity was denoted by α) and the time of injection was recorded. The fraction corresponding to radiolabeled product was collected and the activity was measured (this activity was denoted by β). The decay-corrected RCY was calculated by dividing the decay-corrected β by α. All RCY were calculated with respect to the starting ^{18}F activity of the eluted fluoride. The identities of the ^{18}F-labeled compounds were confirmed by comparison to authentic ^{19}F standards. The following fluorination standards were obtained from commercial vendors and used as received: 4-fluorophenoxybenzene **(2)**, 4-fluorobiphenyl **(3)** , 1-fluoronaphthalene **(4)**, 2-bromo-4-fluoroanisole **(5)**, 2-chloro-4-fluoroanisole **(6)**, methyl 5-fluoro-2-methoxybenzoate **(8)**, 1-(5-fluoro-2-methoxyphenyl)ethenone **(9)**, 5-fluoro-2-methoxybenzonitrile **(10)**, 5-fluoro-2-methoxybenzaldehyde **(11)**, 3-fluoro-4-methoxybenzaldehyde **(15),** 1-(3-fluoro-4-methoxyphenyl)ethenone **(16)**, methyl 3-fluoro-4-methoxybenzoate **(18)**, 1-(4-fluoro-3-methoxyphenyl)ethenone **(20, [4-F])** and 2-fluoromesitylene **(25)**. The preparation of aromatic fluorinated standards **(7, 12, 13, 14, 17, 19, 20 [2-F], 21-24, 26-42)** are found in section 3.3.

2. Optimization Studies for Arene C-H ^{19}F-fluorination

Table S1: Selected optimization table for photoredox-catalyzed C-H fluorination



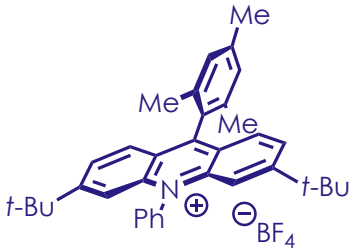
entry	additive	TEMPO eq.	fluoride source	solvent [M]†	total yield*,‡
1	NBu_4HSO_4	0.20	sat. KF solution	DCE[0.10]	6%
2	NBu_4Cl	0.20	sat. KF solution	DCE [0.10]	4%
3	NBu_4BF_4	0.20	sat. KF solution	DCE [0.10]	3%
4	NBu_4PF_6	0.20	sat. KF solution	DCE [0.10]	0%
5	none	0.20	sat. KF solution	DCE [0.10]	<1%
6	NBu_4HSO_4	0.20	sat. KF solution	MeCN [0.10]	2%
7	NBu_4HSO_4	0.20	sat. KF solution	TFT [0.10]	0%
8	NBu_4HSO_4	0.50	KF (10 eq.)	DCE [0.10]	9%
9	NBu_4HSO_4	0.50	CsF (10 eq.)	DCE [0.10]	12%
10	NBu_4HSO_4 (0.50 eq)	0.50	CsF (10 eq.)	DCE [0.10]	17%

Reactions were performed using diphenyl ether (0.50 mmol), catalyst **S1** (0.05 eq.) under O_2
*Yields determined by gas chromatography analysis using 3-bromotoluene as the internal standard
† DCE: 1,2 Dichloroethane; TFT: α, α, α Trifluorotoluene; MeCN: Acetonitrile
‡ Greater than 10:1 ratio of 4-fluoro product typically detected; **13:1 ratio detected for entry 10**

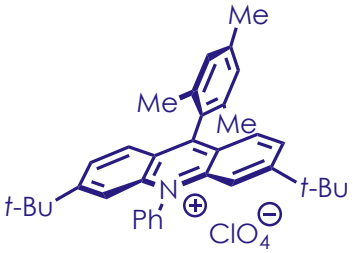
Table S1. Optimization of photoredox-catalyzed C-H fluorination for diphenyl ether

3. Experimental Procedures: Catalyst and Substrate Synthesis

3.1 Preparation of Acridinium Photocatalysts



9-Mesityl-3,6-di-*tert*-butyl-10-phenylacridinium tetrafluoroborate (S1) The title compound was prepared according to a published procedure; spectra data are in agreement with literature values. (*23*)



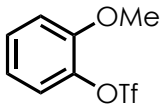
9-Mesityl-3,6-di-*tert*-butyl-10-phenylacridinium perchlorate (1) To a dry, clean round-bottomed flask was added 9-mesityl-3,6-di-*tert*-butyl-10-phenylacridinium tetrafluoroborate (150 mg, 0.262 mmol, 1.0 eq.), which was dissolved in 10 mL of dry acetone. Then an excess of sodium perchlorate (approximately 10-15 eq.) was added to the solution and the reaction was stirred for 2 h. After 2 h. the reaction was diluted with DCM (40 mL) and a formation of a precipitate was observed. This precipitate was dissolved in deionized H_2O (40 mL) and the two layers were separated. The aqueous layer was extracted with 20 mL DCM and the organic layers were combined and washed with brine. The organic layer was then dried over Na_2SO_4 and concentrated. The resulting product (yellow-orange amorphous solid) was then resuspended in dry diethyl ether and sonicated to yield a bright yellow solid which was collected by vacuum filtration (150 mg, 98% yield).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.95 (t, *J* = 7.6 Hz, 2H), 7.88 (t, *J* = 7.5 Hz, 1H), 7.83 – 7.74 (m, 6H), 7.41 (s, 2H), 7.16 (s, 2H), 2.48 (s, 3H), 1.88 (s, 6H), 1.29 (s, 18H).
^{13}C NMR (176 MHz, $CDCl_3$) δ 163.55, 162.33, 142.35, 140.22, 137.13, 136.42, 131.84, 131.63, 129.54, 129.04, 128.41, 128.33, 127.53, 124.25, 115.30, 36.79, 30.37, 21.43, 20.43.

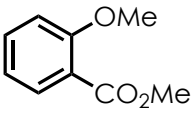
IR (thin film): 2956.5784, 2912.2719, 2871.2659, 1611.6495, 1575.68, 1455.0618, 1440.7732, 1098.8189, 1079.2542, 1059.5842, 1030.7769, 849.4037, 620.8047

HRMS (ESI): Calculated for $C_{36}H_{40}N$ $(M+)^+$: 486.31553; found: 486.31408.

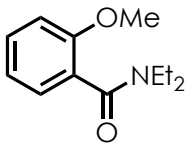
3.2 Preparation of Arene Substrates (S2-S27)



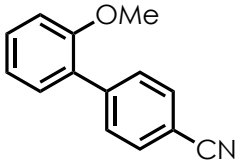
2-Methoxyphenyl trifluoromethanesulfonate (S2) The title compound was prepared according to a published procedure; spectra data are in agreement with literature values. (*49*)



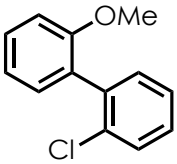
Methyl 2-methoxybenzoate (S3) The title compound was prepared according to a published procedure; spectra data are in agreement with literature values. (*50*)



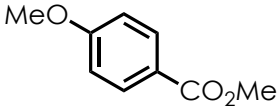
***N,N*-diethyl-2-methoxybenzamide (S4)** The title compound was prepared according to a published procedure; spectra data are in agreement with literature values. (*51*)



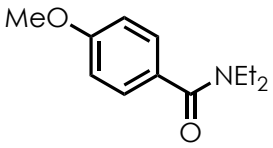
2'-Methoxy-[1,1'-biphenyl]-4-carbonitrile (S5) The title compound was prepared according to a published procedure (*52*); spectra data are in agreement with literature values. (*53*)



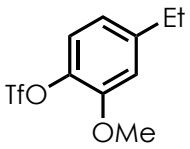
2-Chloro-2'-methoxy-1,1'-biphenyl (S6) The title compound was prepared according to a published procedure; spectra data are in agreement with literature values. (*52*)



Methyl 4-methoxybenzoate (S7) The title compound was prepared according to a published procedure; spectra data are in agreement with literature values. (*54*)



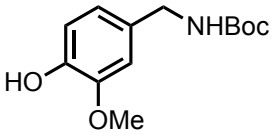
***N,N*-diethyl-4-methoxybenzamide (S8)** The title compound was prepared according to a published procedure; spectra data are in agreement with literature values. (*55*)



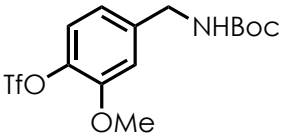
4-Ethyl-2-methoxyphenyl trifluoromethanesulfonate (S9) To a dry, clean round bottomed flask equipped with a stir bar was added 4-ethyl-2-methoxyphenol (457 mg, 3.00 mmol, 1.0 eq.) and the solid was dissolved in 30 mL of DCM under N_2. The solution was cooled to 0 ºC before pyridine (0.48 mL, 6.00 mmol, 2.0 eq.) was added to the solution. Trifluoromethanesulfonic anhydride (0.61 mL, 3.60 mmol, 1.2 eq.) was then added to the reaction dropwise and the solution was stirred for 15 minutes before being warmed to room temperature. The reaction was then run for 2 h. before being quenched with DI water. The reaction was then diluted with DCM before the layers were separated. The aqueous layer was extracted once with DCM (10 mL) and the organic layers were combined, washed sequentially with 10 mL of dilute HCl (2.0 M) and brine, dried over Na_2SO_4 and concentrated. The crude product was purified via flash chromatography (10% EtOAc) to yield 4-ethyl-2-methoxyphenyl trifluoromethanesulfonate as a yellow oil (810 mg, 95%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.12 (d, *J* = 8.3 Hz, 1H), 6.86 (d, *J* = 2.1 Hz, 1H), 6.79 (dt, *J* = 8.3, 1.3 Hz, 1H), 3.90 (s, 3H), 2.66 (q, *J* = 7.6 Hz, 2H), 1.26 (t, *J* = 7.7 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 151.21, 146.11, 136.92, 122.16, 120.15, 118.91 (q, *J* = 320.5 Hz), 112.84, 56.16, 28.98, 15.46.
^{19}F NMR (376 MHz, $CDCl_3$) δ -73.75.

HRMS (ESI): Calculated for $C_{10}H_{11}F_3O_4S$ $(M+H)^+$: 285.03989; found: 285.04028.



***Tert*-butyl (4-hydroxy-3-methoxybenzyl)carbamate (S10)** was prepared according to a published procedure; spectra data are in agreement with literature values. (*56*)

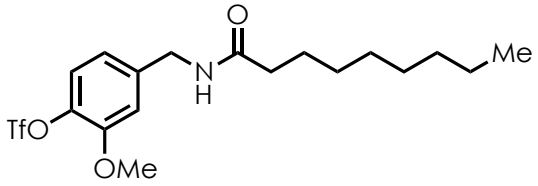


4-(((*Tert*-butoxycarbonyl)amino)methyl)-2-methoxyphenyl trifluoromethanesulfonate (S11) *Tert*-butyl (4-hydroxy-3-methoxybenzyl)carbamate (0.834 g, 3.29 mmol, 1.0 eq.) was added to a dry, clean round bottomed flask equipped with a stir bar and dissolved in 30 mL of DCM under N_2. The solution was cooled to 0 ºC before pyridine (0.53 mL, 6.59 mmol, 2.0 eq.) was added to the solution. Trifluoromethanesulfonic anhydride (0.67 mL, 4.00 mmol, 1.2 eq.) was then added to the reaction dropwise and the solution was stirred for 15 minutes before being warmed to room temperature. The reaction was then run for 2 h. before being quenched with DI water. The reaction

was then diluted with DCM before the layers were separated. The aqueous layer was extracted once with DCM (10 mL) and the organic layers were combined, washed sequentially with 10 mL of dilute HCl (2.0 M) and brine, dried over Na_2SO_4 and concentrated. The crude product was purified via flash chromatography (10 to 20% EtOAc) to yield 4-(((*Tert*-butoxycarbonyl)amino)-methyl)-2-methoxyphenyl trifluoromethanesulfonate as a white solid (1.15 g, 91%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.15 (d, *J* = 8.3 Hz, 1H), 6.97 (s, 1H), 6.86 (dd, *J* = 8.3, 2.0 Hz, 1H), 4.97 (s, 1H), 4.30 (d, *J* = 6.3 Hz, 2H), 3.89 (s, 3H), 1.46 (s, 9H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 156.06, 151.56, 141.03, 137.92, 122.53, 119.56, 118.85 (q, *J* = 320.5 Hz), 112.28, 80.03, 56.27, 44.34, 28.48.
^{19}F NMR (376 MHz, $CDCl_3$) δ -73.78.

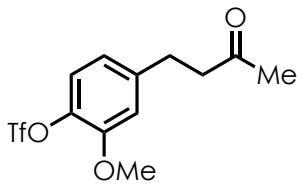
HRMS (ESI): Calculated for $C_{14}H_{18}F_3NO_6S$ $(M+Na)^+$: 408.06993; found: 408.06909.



2-Methoxy-4-(nonanamidomethyl)phenyl trifluoromethanesulfonate (S12) To a dry, clean round bottomed flask equipped with a stir bar was added nonivamide (354.0 mg, 1.21 mmol, 1.0 eq.) and the solid was dissolved in 12 mL of DCM under N_2. The solution was cooled to 0 ºC before triethylamine (0.18 mL, 1.33 mmol, 1.1 eq.) and 1,1,1-trifluoro-N-phenyl-N-((trifluoromethyl)sulfonyl)methanesulfonamide (440 mg, 1.23 mmol, 1.02 eq.) were sequentially added. The reaction was stirred at 0 ºC for 15 minutes before being warmed to room temperature. The reaction was then run for 4 h. before being quenched with DI water. The reaction was then diluted with DCM before the layers were separated. The aqueous layer was extracted once with DCM (10 mL) and the organic layers were combined, washed sequentially with 10 mL of dilute HCl (2.0 M) and brine, dried over Na_2SO_4 and concentrated. The crude product was purified via flash chromatography (40% EtOAc) to yield 2-methoxy-4-(nonanamidomethyl)phenyl trifluoromethanesulfonate as an off-white solid (439 mg, 86%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.15 (d, *J* = 8.3 Hz, 1H), 6.96 (d, *J* = 2.0 Hz, 1H), 6.86 (dd, *J* = 8.3, 2.0 Hz, 1H), 5.81 (s, 1H), 4.43 (d, *J* = 6.0 Hz, 2H), 3.89 (s, 3H), 2.26 – 2.16 (m, 2H), 1.66 (p, *J* = 7.6 Hz, 2H), 1.36 – 1.18 (m, 10H), 0.87 (t, *J* = 7.0 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 173.40, 151.61, 140.46, 138.01, 122.59, 119.93, 118.84 (q, *J* = 320.4 Hz), 112.72, 56.30, 43.18, 36.86, 31.93, 29.44, 29.43, 29.28, 25.88, 22.75, 14.19.
^{19}F NMR (376 MHz, $CDCl_3$) δ -73.77.

HRMS (ESI): Calculated for $C_{18}H_{26}F_3NO_5S$ $(M+Na)^+$: 448.13762; found: 448.13638.

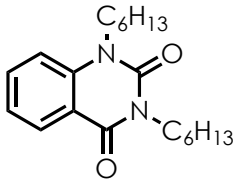


2-methoxy-4-(3-oxobutyl)phenyl trifluoromethanesulfonate (S13) (NT-06-180) To a dry, clean round bottomed flask equipped with a stir bar was added zingerone (971.0 mg, 5.00 mmol, 1.0 eq.) and the solid was dissolved in 50 mL of DCM under N_2. The solution was cooled to 0 ºC before

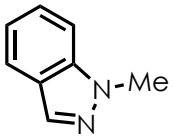
triethylamine (0.76 mL, 5.50 mmol, 1.1 eq.) and 1,1,1-trifluoro-N-phenyl-N-((trifluoromethyl)sulfonyl)methanesulfonamide (440 mg, 1.23 mmol, 1.02 eq.) were sequentially added. The reaction was stirred at 0 ºC for 15 minutes before being warmed to room temperature. The reaction was then run for 4 h. before being quenched with DI water. The reaction was then diluted with DCM before the layers were separated. The aqueous layer was extracted once with DCM (10 mL) and the organic layers were combined, washed sequentially with 20 mL of dilute HCl (2.0 M) and brine, dried over Na_2SO_4 and concentrated. The crude product was purified via flash chromatography (40% to 50% EtOAc) to yield 2-methoxy-4-(3-oxobutyl)phenyl trifluoromethanesulfonate as an cream-colored liquid (1.39 g, 85%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.06 (d, *J* = 8.3 Hz, 1H), 6.85 (d, *J* = 2.1 Hz, 1H), 6.74 (dd, *J* = 8.3, 2.0 Hz, 1H), 3.83 (s, 3H), 2.85 (t, *J* = 7.5 Hz, 2H), 2.74 (t, *J* = 7.5 Hz, 2H), 2.10 (s, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 207.25, 151.14, 143.08, 137.04, 122.18, 120.52, 118.75 (q, *J* = 320.3 Hz), 113.40, 56.04, 44.63, 29.93, 29.42.
^{19}F NMR (565 MHz, $CDCl_3$) δ -73.67.

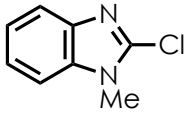
HRMS (ESI): Calculated for $C_{12}H_{13}F_3O_5S$ $(M+H)^+$: 327.05203; found: 327.05085



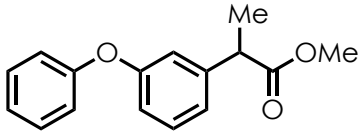
1,3-dihexylquinazoline-2,4(1*H*,3*H*)-dione (S14) The title compound was prepared according to a published procedure; spectra data are in agreement with literature values. (*23*)



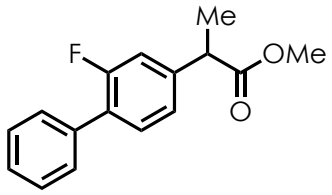
1-methyl-1*H*-indazole (S15) The title compound was prepared according to a published procedure; spectra data are in agreement with literature values. (*23*)



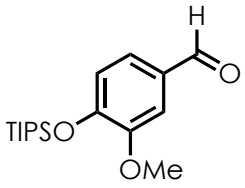
2-chloro-1-methyl-1*H*-benzo[*d*]imidazole (S16) The title compound was prepared according to a published procedure; spectra data are in agreement with literature values. (*57*)



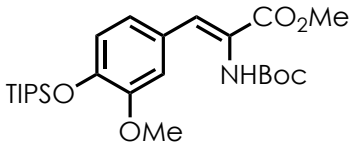
Methyl 2-(3-phenoxyphenyl)propanoate (S17) The title compound was prepared according to a published procedure; spectral data are in agreement with literature values. (*58*)



Methyl 2-(2-fluoro-[1,1'-biphenyl]-4-yl)propanoate (S18) The title compound was prepared according to a published procedure; spectral data are in agreement with literature values. (*59*)



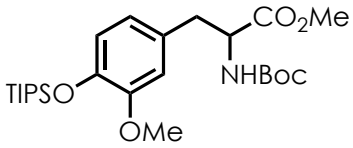
3-Methoxy-4-((triisopropylsilyl)oxy)benzaldehyde (S19) The title compound was prepared according to a published procedure; spectra data are in agreement with literature values. (*60*)



Methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(3-methoxy-4-((triisopropylsilyl)oxy)phenyl)acrylate (S20) Methyl 2-((*tert*-butoxycarbonyl)amino)-2-(dimethoxyphosphoryl)acetate (2.58 g, 8.67 mmol, 1.2 eq.) was added to a flame dried round bottomed flask equipped with a stir bar and dissolved in 10 mL of dry DCM under N_2. Then 1,8-diazabicyclo[5.4.0]undec-7-ene (1.09 mL, 7.23 mmol, 1.0 eq.) was added via syringe and the mixture was stirred at room temperature for 15 minutes. While the phosphonate ester solution was stirring, a solution of 3-methoxy-4-((triisopropylsilyl)oxy)benzaldehyde (2.23 g, 7.23 mmol, 1.0 eq.) in 10 mL DCM was prepared. This benzaldehyde solution was added to the phosphonate ester solution dropwise at room temperature. Reaction conversion was monitored via TLC (reaction takes approximately 4 h.) and at the end of the reaction, the solution was concentrated and loaded onto Celite. The crude reaction mixture was then purified via flash chromatography (10 to 20 % EtOAc) to yield methyl 2-((*tert*-butoxycarbonyl)-amino)-3-(3-methoxy-4-((triisopropylsilyl)oxy)phenyl)propanoate as a white solid (2.00 g, 58%)

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.20 (bs, 1H), 7.14 (s, 1H), 7.02 (d, *J* = 7.9 Hz, 1H), 6.80 (d, *J* = 8.2 Hz, 1H), 6.25 (bs, 1H), 3.77 (s, 3H), 3.75 (s, 3H), 1.36 (bs, 9H), 1.25 – 1.16 (m, 3H), 1.05 (d, *J* = 7.6 Hz, 18H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 166.31, 153.28, 150.58, 146.97, 132.02, 127.36, 123.85, 122.58, 120.21, 113.29, 80.56, 55.21, 52.30, 28.09, 17.83, 12.86.

HRMS (ESI): Calculated for $C_{25}H_{41}NO_6Si$ $(M+H)^+$: 480.27760; found: 480.27620.

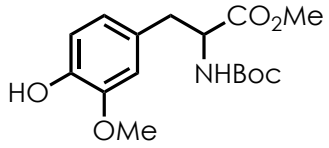


Methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(3-methoxy-4-((triisopropylsilyl)oxy)phenyl)acrylate (S21) To a dry, clean round bottomed flask equipped with

a stir bar was added methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(3-methoxy-4-((triisopropylsilyl)oxy)phenyl)acrylate (2.30 g, 4.79 mmol, 1.0 eq.), which was then dissolved in 60 mL of a THF:EtOH (2:1) solution. 10% Palladium on carbon (153.0 mg, 1.44 mmol, 0.30 eq.) was added to the solution and the reaction was placed under N_2. The solution was purged and backfilled with H_2 before being placed under a H_2 atmosphere (1 atm) overnight (reaction is typically done in about 2-3 hours). Once the reaction was complete, the solution was run through a Celite plug and concentrated. The crude mixture was then purified by flash chromatography (10% EtOAc:Hex) to yield methyl 2-((*tert*-butoxycarbonyl)amino)-3-(3-methoxy-4-((triisopropylsilyl)oxy)phenyl)propanoate as a white solid (2.26 g, 98%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 6.78 (d, *J* = 8.0 Hz, 1H), 6.59 (d, *J* = 2.1 Hz, 1H), 6.54 (dd, *J* = 8.1, 2.1 Hz, 1H), 4.94 (d, *J* = 7.8 Hz, 1H) + rotamer at 4.67 (bs), 4.53 (q, *J* = 6.7 Hz, 1H) + rotamer at 4.34 (bs), 3.77 (s, 3H), 3.67 (s, 3H), 3.03 – 2.96 (m, 2H), 1.42 (s, 9H), 1.27 – 1.15 (m, 3H), 1.08 (d, *J* = 7.4 Hz, 18H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 172.66, 155.22, 150.94, 144.70, 129.11, 121.50, 120.53, 113.20, 80.00, 55.55, 54.69, 52.26, 38.21, 28.46, 18.03, 12.98.

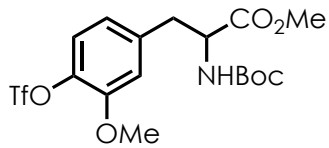
HRMS (ESI): Calculated for $C_{25}H_{43}NO_6Si$ $(M+Na)^+$: 504.27522; found: 504.27398.



Methyl 2-((*tert*-butoxycarbonyl)amino)-3-(4-hydroxy-3-methoxyphenyl)propanoate (S22) Methyl 2-((*tert*-butoxycarbonyl)amino)-3-(3-methoxy-4-((triisopropylsilyl)oxy)phenyl)propanoate (2.00g, 4.15 mmol, 1.0 eq.) was added to a clean, dry round bottomed flask equipped with a stir bar and the solid was dissolved in 35 mL of THF under N_2. The solution was then cooled to 0 ºC before a solution of tetrabutylammonium fluoride (1.0 M in THF, 4.6 mL, 4.57 mmol, 1.1 eq.) was added dropwise to the reaction mixture. The reaction was then warmed to room temperature and allowed to stir for 2 h. At the end of the reaction, the reaction was quenched with 15 mL NH_4Cl solution before being diluted with EtOAc. The layers were separated and the aqueous layer was extracted twice with 10 mL EtOAc. The organic layers were combined, dried over Na_2SO_4, concentrated and purified by flash chromatography (40-50% EtOAc:Hex) to yield methyl 2-((*tert*-butoxycarbonyl)amino)-3-(4-hydroxy-3-methoxyphenyl)propanoate as a white solid (1.25 g, 93%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 6.82 (d, *J* = 8.0 Hz, 1H), 6.65 – 6.56 (m, 2H), 5.57 (s, 1H), 4.97 (d, *J* = 8.3 Hz, 1H) + rotamer at 4.71 (bs), 4.54 (q, *J* = 6.6 Hz, 1H) + rotamer at 4.34 (bs), 3.86 (s, 3H), 3.71 (s, 3H), 3.01 (qd, *J* = 14.0, 6.0 Hz, 2H) + rotamer at 2.88 (bs), 1.42 (s, 9H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 172.59, 155.23, 146.61, 144.83, 127.86, 122.22, 114.51, 111.77, 80.06, 55.97, 54.69, 52.33, 38.13, 28.45.

HRMS (ESI): Calculated for $C_{16}H_{23}NO_6$ $(M+Na)^+$: 348.14179; found: 348.14087.

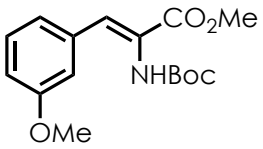


Methyl 2-((*tert*-butoxycarbonyl)amino)-3-(3-methoxy-4 (((trifluoromethyl)sulfonyl)oxy)phenyl)-propanoate (S23) To a dry, clean round bottomed flask equipped with a stir bar was added methyl 2-((*tert*-butoxycarbonyl)amino)-3-(4-hydroxy-3-

methoxyphenyl)propanoate (1.25 g, 3.84 mmol, 1.0 eq.) and the solid was dissolved in 30 mL of DCM under N_2. The solution was cooled to 0 ºC before pyridine (0.62 mL, 7.68 mmol, 2.0 eq.) was added to the solution. Trifluoromethanesulfonic anhydride (0.78 mL, 4.61 mmol, 1.2 eq.) was then added to the reaction dropwise and the solution was stirred for 15 minutes before being warmed to room temperature. The reaction was then run for 2 h. before being quenched with DI water. The reaction was then diluted with DCM before the layers were separated. The aqueous layer was extracted once with DCM (10 mL) and the organic layers were combined, washed sequentially with 10 mL of dilute HCl (2.0 M) and brine, dried over Na_2SO_4 and concentrated. The crude product was purified via flash chromatography (10% EtOAc) to yield methyl 2-((*tert*-butoxycarbonyl)amino)-3-(3-methoxy-4 (((trifluoromethyl)sulfonyl)oxy)phenyl)-propanoate as a white solid (1.67 g, 95%).

^{1}H NMR (600 MHz, $CDCl_3$) ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.12 (d, *J* = 8.2 Hz, 1H), 6.81 (d, *J* = 2.0 Hz, 1H), 6.73 (d, *J* = 8.4 Hz, 1H), 5.05 (d, *J* = 8.2 Hz, 1H) + rotamer at 4.86 (bs), 4.60 (d, *J* = 7.1 Hz, 1H) + rotamer at 4.38 (bs), 3.88 (s, 3H), 3.70 (s, 3H), 3.13 (dd, *J* = 14.0, 5.9 Hz, 1H), 3.02 (dd, *J* = 14.0, 6.8 Hz, 1H) + rotamer at 2.91 (bs), 1.40 (s, 9H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 172.10, 155.09, 151.31, 138.11, 137.84, 122.40, 121.71, 118.83 (q, *J* = 320.3 Hz), 114.18, 80.29, 56.24, 54.28, 52.47, 38.46, 28.36.
^{19}F NMR (376 MHz, $CDCl_3$) δ -73.76.

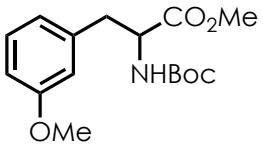
HRMS (ESI): Calculated for $C_{17}H_{22}F_3NO_8S$ $(M+Na)^+$: 480.09106; found: 480.08988.



Methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(3-methoxyphenyl)acrylate (S24)
Methyl 2-((*tert*-butoxycarbonyl)amino)-2-(dimethoxyphosphoryl)acetate (2.500 g, 8.40 mmol, 1.2 eq.) was added to a flame dried round bottomed flask equipped with a stir bar and dissolved in 15 mL of dry DCM under N_2. Then 1,8-diazabicyclo[5.4.0]undec-7-ene (1.06 mL, 7.00 mmol, 1.0 eq.) was added via syringe and the mixture was stirred at room temperature for 15 minutes. While the phosphonate ester solution was stirring, a solution of 2-methoxybenzaldehyde (0.9530 g, 7.00 mmol, 1.0 eq.) in 15 mL DCM was prepared. This benzaldehyde solution was added to the phosphonate ester solution dropwise at room temperature. Reaction conversion was monitored via TLC (reaction takes approximately 4 h.) and at the end of the reaction, the solution was concentrated and loaded onto Celite. The crude reaction mixture was then purified via flash chromatography (20 to 30% EtOAc) to yield methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(3-methoxyphenyl)acrylate as a white solid (1.84 g, 86%)

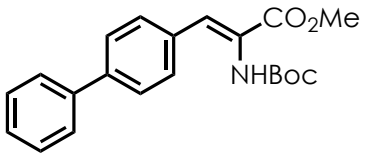
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.52 (d, *J* = 7.7 Hz, 1H), 7.34 (bs, 1H), 7.30 (t, *J* = 7.8 Hz, 1H), 6.95 (t, *J* = 7.7 Hz, 1H), 6.92 (d, *J* = 8.3 Hz, 1H), 6.40 (bs, 1H), 3.87 (s, 2H), 3.84 (s, 2H), 1.38 (s, 10H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 166.25, 157.13, 152.87, 130.42, 129.80, 125.70, 123.76, 123.17, 120.65, 111.15, 80.77, 55.77, 52.58, 28.16.

HRMS (ESI): Calculated for $C_{16}H_{21}NO_5$ $(M+Na)^+$: 330.13122; found: 330.13130.

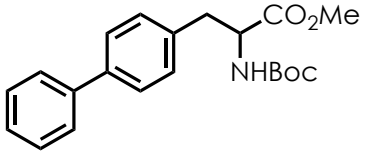


Methyl 2-((*tert*-butoxycarbonyl)amino)-3-(3-methoxyphenyl)propanoate (S25)

To a dry, clean round bottomed flask equipped with a stir bar was added methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(3-methoxyphenyl)acrylate (1.84 g, 5.99 mmol, 1.0 eq.), which was then dissolved in 60 mL of a THF:EtOH (2:1) solution. 10% Palladium on carbon (191 mg, 0.30 mmol, 0.10 eq.) was added to the solution and the reaction was placed under N_2. The solution was purged and backfilled with H_2 before being placed under a H_2 atmosphere (1 atm) overnight (reaction is typically done in about 2-3 hours). Once the reaction was complete, the solution was run through a Celite plug and concentrated. The crude mixture was then purified by flash chromatography (10 to 20% EtOAc:Hex) to yield methyl 2-((*tert*-butoxycarbonyl)amino)-3-(3-methoxyphenyl)propanoate as a white solid (1.75 g, 95%). The spectra data are in agreement with literature values. (*61*)



Methyl (*Z*)-3-([1,1'-biphenyl]-4-yl)-2-((*tert*-butoxycarbonyl)amino)acrylate (S26) Methyl 2-((*tert*-butoxycarbonyl)amino)-2-(dimethoxyphosphoryl)acetate (1.783 g, 6.00 mmol, 1.2 eq.) was added to a flame dried round bottomed flask equipped with a stir bar and dissolved in 15 mL of dry DCM under N_2. Then 1,8-diazabicyclo[5.4.0]undec-7-ene (0.75 mL, 5.00 mmol, 1.0 eq.) was added via syringe and the mixture was stirred at room temperature for 15 minutes. While the phosphonate ester solution was stirring, a solution of biphenyl-4-carboxaldehyde (0.9111 g, 5.00 mmol, 1.0 eq.) in 15 mL DCM was prepared. This benzaldehyde solution was added to the phosphonate ester solution dropwise at room temperature. Reaction conversion was monitored via TLC (reaction takes approximately 4 h.) and at the end of the reaction, the solution was concentrated and loaded onto Celite. The crude reaction mixture was then purified via flash chromatography (20 to 30% EtOAc) to yield methyl (*Z*)-3-([1,1'-biphenyl]-4-yl)-2-((*tert*-butoxycarbonyl)amino)acrylate as a white solid (1.56 g, 88%). The spectra data are in agreement with literature values. (*62*)



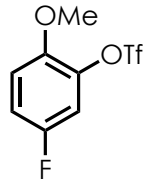
Methyl 3-([1,1'-biphenyl]-4-yl)-2-((*tert*-butoxycarbonyl)amino)propanoate (S27) To a dry, clean round bottomed flask equipped with a stir bar was added methyl (*Z*)-3-([1,1'-biphenyl]-4-yl)-2-((*tert*-butoxycarbonyl)amino)acrylate (1.55 g, 4.39 mmol, 1.0 eq.), which was then dissolved in 20 mL of a THF:EtOH (3:1) solution. 10% Palladium on carbon (93.3 mg, 0.20 mmol, 0.10 eq.) was added to the solution and the reaction was placed under N_2. The solution was purged and backfilled with H_2 before being placed under a H_2 atmosphere (1 atm) overnight (reaction is typically done in about 2-3 hours). Once the reaction was complete, the solution was run through a Celite plug and concentrated. The crude mixture was then purified by flash chromatography (10 to 20% EtOAc:Hex) to yield methyl 3-([1,1'-biphenyl]-4-yl)-2-((*tert*-butoxycarbonyl)amino)propanoate as a white solid (1.34 g, 97%). The spectra data are in agreement with literature values. (*63*)

3.3 Preparation of aromatic fluorinated standards (7, 12, 13, 14, 17, 19, 20 [2-F], 21-24, 26-42) and corresponding synthetic intermediates (i-1 – i-39)

The following fluorination standards were obtained from commercial vendors and used as received: 4-fluorophenoxybenzene **(2)**, 4-fluorobiphenyl **(3)** , 1-fluoronaphthalene **(4)**, 2-bromo-4-fluoroanisole **(5)**, 2-chloro-4-fluoroanisole **(6)**, methyl 5-fluoro-2-methoxybenzoate **(8)**, 1-(5-fluoro-2-methoxyphenyl)ethenone **(9)**, 5-fluoro-2-methoxybenzonitrile **(10)**, 5-fluoro-2-methoxybenzaldehyde

(11), 3-fluoro-4-methoxybenzaldehyde **(15),** 1-(3-fluoro-4-methoxyphenyl)ethenone **(16)**, methyl 3-fluoro-4-methoxybenzoate **(18)**, 1-(4-fluoro-3-methoxyphenyl)ethenone **(20, [4-F])** and 2-fluoromesitylene **(25)**.

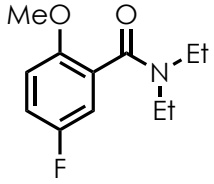
General Method A (Synthesis of 26 and 27)
To a clean, dry 2 dram vial containing a Teflon-coated magnetic stir bar was added 380.0 mg of cesium fluoride (2.50 mmol, 10 eq.) under an inert atmosphere. The vial was then removed from the inert atmosphere and a series of reagents were added: 0.0125 mmol of **S1** (0.05 eq.), tetrabutylammonium hydrogensulfate (2.50 mmol, 1.0 eq.), 2,2,6,6-tetramethyl-1-piperidinyloxy (0.125 mmol, 0.50 eq.), and arene (0.25 mmol, 1.0 eq.). The reagent mixture was then dissolved in solvent (2.5 mL, 0.1 M) and DI water (0.25 mL, 1.0 M) was subsequently added. The vial was then sealed with a Teflon-lined septum screw cap. The septum was pierced with a disposable steel needle connected to a balloon containing positive oxygen pressure. A vent needle was inserted and the reaction medium was sparged for 10 minutes by bubbling oxygen through the mixture. The vent needle was removed and the positive oxygen pressure was maintained. The vial was positioned on a stir plate approximately 3-4 cm from a Par38 LED lamp supplying blue light (λ = 440-460 nm) and irradiated for a designated time. The crude reaction mixture was then concentrated in vacuo and purified by reverse-phase flash liquid chromatography (conditions noted in each entry).



5-Fluoro-2-methoxyphenyl trifluoromethanesulfonate (7) 5-fluoro-2-methoxyphenol (0.426 g, 3.00 mmol, 1.0 eq.) was added to a dry, clean round bottomed flask equipped with a stir bar and dissolved in 20 mL of DCM under N_2. The solution was cooled to 0 ºC before pyridine (0.48 mL, 6.00 mmol, 2.0 eq.) was added to the solution. Trifluoromethanesulfonic anhydride (0.60 mL, 3.60 mmol, 1.2 eq.) was then added to the reaction dropwise and the solution was stirred for 15 minutes before being warmed to room temperature. The reaction was then run for 2 h. before being quenched with DI water. The reaction was then diluted with DCM before the layers were separated. The aqueous layer was extracted once with DCM (10 mL) and the organic layers were combined, washed sequentially with 10 mL of dilute HCl (2.0 M) and brine, dried over Na_2SO_4 and concentrated. The crude product was purified via flash chromatography (10 to 20% EtOAc) to yield 5-fluoro-2-methoxyphenyl trifluoromethanesulfonate as a yellow oil (757 mg, 92%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.05 (ddd, *J* = 9.1, 7.7, 3.0 Hz, 1H), 7.02 – 6.97 (m, 2H), 3.88 (s, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 155.90 (d, *J* = 243.1 Hz), 148.30 (d, *J* = 3.2 Hz), 138.30 (d, *J* = 11.0 Hz), 118.87 (q, *J* = 320.3 Hz), 115.68 (d, *J* = 22.4 Hz), 113.69 (d, *J* = 8.8 Hz), 110.81 (d, *J* = 26.9 Hz), 56.68.
^{19}F NMR (376 MHz, $CDCl_3$) δ -73.68, -120.14 (td, *J* = 7.8, 5.1 Hz).

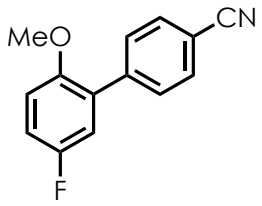
HRMS (ESI): Calculated for $C_8H_6F_4O_4S$ $(M)^+$: 273.9923; found: 273.9997.



***N*,*N*-diethyl-5-fluoro-2-methoxybenzamide (12)** To a clean, dry round bottomed flask equipped with a stir bar was added 5-fluoro-2-methoxybenzoic acid (851 mg, 5.00 mmol, 1.0 eq.). The solid was dissolved in PhMe (10 mL) before a catalytic amount of DMF (19.4 μL, 0.25 mmol, 0.05 eq.) and thionyl chloride (0.73 mL, 10.0 mmol, 2.0 eq.) was added. The reaction was allowed to stir for 2 h. before being concentrated under reduced pressure to yield the acid chloride as a pale yellow solid. The crude product was then dissolved in 10 mL of DCM under N_2 and cooled to 0 ºC. Triethylamine (1.74 mL, 12.5 mmol, 2.5 eq.) and diethylamine (0.67 mL, 6.5 mmol, 1.3 eq.) were sequentially added and the reaction mixture was stirred at 0 ºC for 30 min. before warming up to room temperature, where it was stirred further for an additional hour. At the end of the reaction, the mixture was quenched with 10 mL dilute acid (3 N HCl solution) and the layers were separated. The aqueous layer was extracted with 2 x 10 mL of DCM and the organic layers were combined. The organic layers were washed sequentially with saturated $NaHCO_3$ solution and brine, dried over Na_2SO_4 and concentrated to yield a yellow liquid. The crude product was then purified by flash chromatography (50% EtOAc:Hex) to yield *N*,*N*-diethyl-5-fluoro-2-methoxybenzamide as a pale yellow liquid (1.01 g, 89%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 6.96 (ddd, *J* = 9.1, 8.0, 3.1 Hz, 1H), 6.87 (dd, *J* = 8.0, 3.1 Hz, 1H), 6.80 (dd, *J* = 9.1, 4.1 Hz, 1H), 3.74 (s, 3H), 3.57 – 3.43 (m, 2H), 3.10 (q, *J* = 7.2 Hz, 2H), 1.19 (t, *J* = 7.2 Hz, 3H), 1.00 (t, *J* = 7.2 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 167.24 (d, *J* = 1.8 Hz), 156.81 (d, *J* = 240.3 Hz), 151.35 (d, *J* = 2.1 Hz), 128.03 (d, *J* = 6.9 Hz), 115.91 (d, *J* = 22.8 Hz), 114.45 (d, *J* = 24.4 Hz), 112.18 (d, *J* = 8.0 Hz), 56.14, 42.79, 38.91, 13.93, 12.81.
^{9}F NMR (376 MHz, $CDCl_3$) δ -123.19 (td, *J* = 8.0, 4.1 Hz).

HRMS (ESI): Calculated for $C_{12}H_{16}FNO_2$ $(M+H)^+$: 226.1243; found: 226.1232.

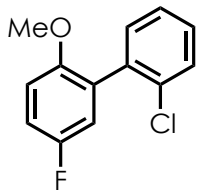


5'-Fluoro-2'-methoxy-[1,1'-biphenyl]-4-carbonitrile (13) To a dry, clean 3-neck round bottomed flask equipped with a stir bar and a condenser was added (5-fluoro-2-methoxyphenyl)boronic acid (357 mg, 2.10 mmol, 1.05 eq.), potassium carbonate (829 mg, 6.00 mmol, 3.0 eq.) and 4-bromobenzonitrile (364 mg, 2.00 mmol, 1.0 eq.). The flask was then transferred to a glovebox (N_2), where tetrakis(triphenylphosphine)-palladium(0) (231.1 mg, 0.200 mmol, 0.10 eq.) was added to the mixture. The flask was then sealed with rubber septa, brought out of the glovebox and placed under positive N_2 pressure. 1,2-Dimethoxyethane (13 mL) and degassed H_2O (4 mL) were then added to the reaction mixture and stirred. The suspension was then purged and backfilled three times with N_2 before being heated to 80 ºC for 22 h. At the end of the reaction, the mixture was cooled to room temperature and subsequently diluted with ether. The suspension was then neutralized with 2 N HCl solution (10 mL) and the layers were separated. The aqueous layer was then extracted twice with ether (2 x 10 mL) and the organic layers were combined. The organic layers were then washed sequentially with $NaHCO_3$ solution and brine, dried over Na_2SO_4 and concentrated to yield an off-white solid. The crude product was then purified by flash chromatography (10 to 15% EtOAc:Hex) to yield a white solid (426 mg, 94%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.69 (d, *J* = 8.4 Hz, 1H), 7.62 (d, *J* = 8.4 Hz, 1H), 7.07 (ddd, *J* = 9.0, 7.8, 3.2 Hz, 1H), 7.03 (dd, *J* = 8.8, 3.1 Hz, 1H), 6.94 (dd, *J* = 9.0, 4.4 Hz, 1H), 3.80 (s, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 156.98 (d, *J* = 239.8 Hz), 152.44 (d, *J* = 2.4 Hz), 142.09, 129.65 (d, *J* = 7.3 Hz), 117.08 (d, *J* = 23.8 Hz), 115.62 (d, *J* = 22.6 Hz), 112.41 (d, *J* = 8.2 Hz), 56.06.

^{19}F NMR (376 MHz, $CDCl_3$) δ -123.36 (td, *J* = 8.3, 4.6 Hz).

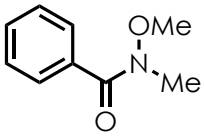
HRMS (ESI): Calculated for $C_{14}H_9ClFNO$ $(M+H)^+$: 228.0825; found: 228.0814.



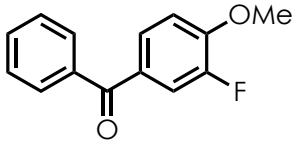
2'-Chloro-5-fluoro-2-methoxy-1,1'-biphenyl (14) To a dry, clean 3-neck round bottomed flask equipped with a stir bar and a condenser was added (2-chlorophenyl)boronic acid (1.06 g, 6.80 mmol, 1.7 eq.) and potassium carbonate (1.38 g, 10.0 mmol, 2.5 eq.). The flask was transferred into a glovebox (N_2), where tetrakis(triphenylphosphine)-palladium(0) (231.1 mg, 0.200 mmol, 0.10 eq.) was added to the mixture. The flask was then sealed with rubber septa, brought out of the glovebox and placed under positive N_2 pressure. 1,2-Dimethoxyethane (27 mL) and degassed H_2O (5 mL) were then added to the reaction mixture and stirred. 2-Bromo-4-fluoroanisole (0.52 mL, 4.00 mmol, 1.0 eq.) was added to the reaction before the suspension was purged and backfilled three times with N_2. The reaction was then heated to 80 ºC for 22 h. At the end of the reaction, the mixture was cooled to room temperature and subsequently diluted with ether. The suspension was then neutralized with 2 N HCl solution (10 mL) and the layers were separated. The aqueous layer was then extracted twice with ether (2 x 10 mL) and the organic layers were combined. The organic layers were then washed sequentially with $NaHCO_3$ solution and brine, dried over Na_2SO_4 and concentrated. The crude product was then purified by flash chromatography (10 to 15% EtOAc:Hex) to yield a colorless liquid (900 mg, 95%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.50 (dt, *J* = 7.6, 3.0 Hz, 1H), 7.33 (dd, *J* = 5.9, 3.7 Hz, 3H), 7.10 (ddd, *J* = 9.0, 8.0, 3.2 Hz, 1H), 6.98 (dd, *J* = 8.6, 3.2 Hz, 1H), 6.94 (dd, *J* = 9.0, 4.4 Hz, 1H), 3.78 (s, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 156.74 (d, *J* = 238.9 Hz), 153.13 (d, *J* = 2.2 Hz), 136.74 (d, *J* = 1.8 Hz), 133.84, 131.60, 129.86 (d, *J* = 8.0 Hz), 129.53, 129.02, 126.62, 117.89 (d, *J* = 23.3 Hz), 115.21, 112.09 (d, *J* = 8.3 Hz), 56.30.
^{19}F NMR (376 MHz, $CDCl_3$) δ -124.24 (td, *J* = 8.2, 4.4 Hz).

HRMS (ESI): Calculated for $C_{13}H_{10}ClFO$ $(M)^+$: 236.0404; found: 236.0256.

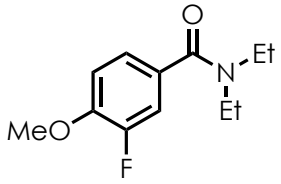


***N*-methoxy-*N*-methylbenzamide (i-1)** was prepared according to a published procedure; spectra data are in agreement with literature values. (*64*)



(3-Fluoro-4-methoxyphenyl)(phenyl)methanone (17) To a clean, dry round-bottomed flask equipped with a stir bar was added 4-bromo-2-fluoroanisole (0.38 mL, 2.94 mmol, 0.91 eq.) under N_2. Then THF (20 mL) was added and the reaction was cooled to -78 ºC. A solution of nBuLi (2.5 M in

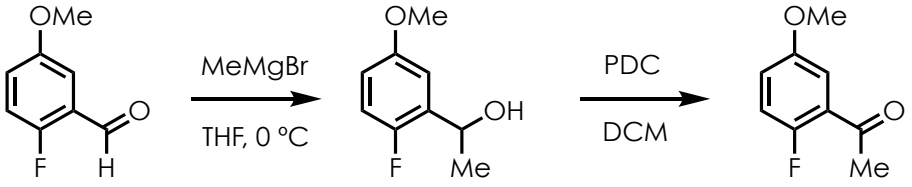
hexanes, 1.3 mL, 3.23 mmol, 1.0 eq.) was added dropwise under positive N_2 pressure and the reaction was allowed to stir for 20 minutes. A solution of *N*-methoxy-*N*-methylbenzamide (0.535 g, 3.24 mmol, 1.0 eq.) in THF (5 mL) was prepared and added dropwise to the aryllithium species under positive N_2 pressure. The solution was allowed to stir at -78 ºC for 1.5 h and subsequently quenched at -78ºC with *i*-PrOH (5 mL) and DI H_2O (5 mL), and allowed to warm to room temperature. Ether (10 mL) and DI H_2O (10 mL) were then added to the reaction mixture and the layers were separated. The aqeuous layer was extracted with ether (10 mL x 2) and the organic layers were combined. The combined organic fractions were washed with brine, dried over Na_2SO_4 and concentrated. The crude mixture was purified via flash chromatography (10 to 20% EtOAc:Hex) to yield (3-fluoro-4-methoxyphenyl)(phenyl)methanone as a white solid (0.447 g, 60%). The spectral data for the product are in agreement with literature values. (*65*)



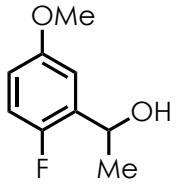
***N*,*N*-diethyl-3-fluoro-4-methoxybenzamide (19)** To a clean, dry round bottomed flask equipped with a stir bar was added 3-fluoro-4-methoxybenzoic acid (0.680 mg, 4.00 mmol, 1.0 eq.). The solid was dissolved in PhMe (10 mL) before a catalytic amount of DMF (16.0 μL, 0.20 mmol, 0.05 eq.) and thionyl chloride (0.58 mL, 8.00 mmol, 2.0 eq.) was added. The reaction was allowed to stir for 2 h. before being concentrated under reduced pressure to yield the acid chloride as a pale yellow solid. The crude product was then dissolved in 10 mL of DCM under N_2 and cooled to 0 ºC. Triethylamine (1.40 mL, 10.0 mmol, 2.5 eq.) and diethylamine (0.54 mL, 5.2 mmol, 1.3 eq.) were sequentially added and the reaction mixture was stirred at 0 ºC for 30 min. before warming up to room temperature, where it was stirred further for an additional hour. At the end of the reaction, the mixture was quenched with 10 mL dilute acid (3 N HCl solution) and the layers were separated. The aqueous layer was extracted with 2 x 10 mL of DCM and the organic layers were combined. The organic layers were washed sequentially with saturated $NaHCO_3$ solution and brine, dried over Na_2SO_4 and concentrated to yield a yellow liquid. The crude product was then purified by flash chromatography (50% EtOAc:Hex) to yield *N*,*N*-diethyl-3-fluoro-4-methoxybenzamide as pale yellow liquid (0.79 g, 88%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.04 – 6.93 (m, 2H), 6.86 (t, *J* = 8.5 Hz, 1H), 3.77 (s, 3H), 3.43 – 3.02 (m, 4H, 2 rotamers), 1.05 (bs, 6H, 2 rotamers).
^{13}C NMR (151 MHz, $CDCl_3$) δ 151.61 (d, *J* = 247.4 Hz), 148.30 (d, *J* = 10.4 Hz), 129.59 (d, *J* = 5.6 Hz), 122.70 (d, *J* = 3.7 Hz), 114.64 (d, *J* = 19.5 Hz), 112.83 (d, *J* = 2.1 Hz), 56.00, 43.20, 39.32, 13.92, 12.66.
^{19}F NMR (376 MHz, $CDCl_3$) δ -129.35 – -145.34 (m).

HRMS (ESI): Calculated for $C_{12}H_{16}FNO_2$ $(M+H)^+$: 226.1243; found: 226.1232.



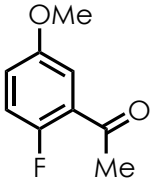
i-2, 94% **20 (2-F), 87%**



1-(2-Fluoro-5-methoxyphenyl)ethan-1-ol (i-2) To a clean, dry 2-neck round bottomed flask equipped with a stir bar was added 2-fluoro-5-methoxybenzaldehyde (0.50 mL, 4.00 mmol, 1.0 eq.), which was then dissolved in THF (10 mL) under N_2. The reaction was cooled to 0 ºC before a solution of methylmagnesium bromide (3.0 M in THF, 1.6 mL, 4.80 mmol, 1.2 eq.) was added dropwise. The reaction was then warmed up to room temperature and allowed to stir for 5 h. After the reaction was complete, the solution was quenched with HCl solution (3 N, 10 mL) and diluted with EtOAc (15 mL). The layers were separated and the aqueous layer was extracted once with 10 mL of EtOAc. The organic layers were combined, washed with brine, dried over Na_2SO_4 and concentrated. The crude product was purified via flash chromatography (10 to 30% EtOAc:Hex) to yield 1-(2-fluoro-5-methoxyphenyl)ethan-1-ol (0.64 g, 94%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.00 (dd, *J* = 6.0, 3.2 Hz, 1H), 6.92 (t, *J* = 9.4 Hz, 1H), 6.72 (dt, *J* = 8.9, 3.6 Hz, 1H), 5.14 (qd, *J* = 6.5, 2.6 Hz, 1H), 3.77 (s, 3H), 2.33 (s, 1H),1.47 (d, *J* = 6.6 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 155.89 (d, *J* = 2.0 Hz), 153.95 (d, *J* = 237.5 Hz), 133.55 (d, *J* = 15.3 Hz), 115.90 (d, *J* = 23.8 Hz), 113.55 (d, *J* = 8.2 Hz), 111.36 (d, *J* = 4.5 Hz), 64.54 (d, *J* = 2.5 Hz), 55.82, 24.11.
^{19}F NMR (376 MHz, $CDCl_3$) δ -130.65 (dt, *J* = 10.1, 4.6 Hz).

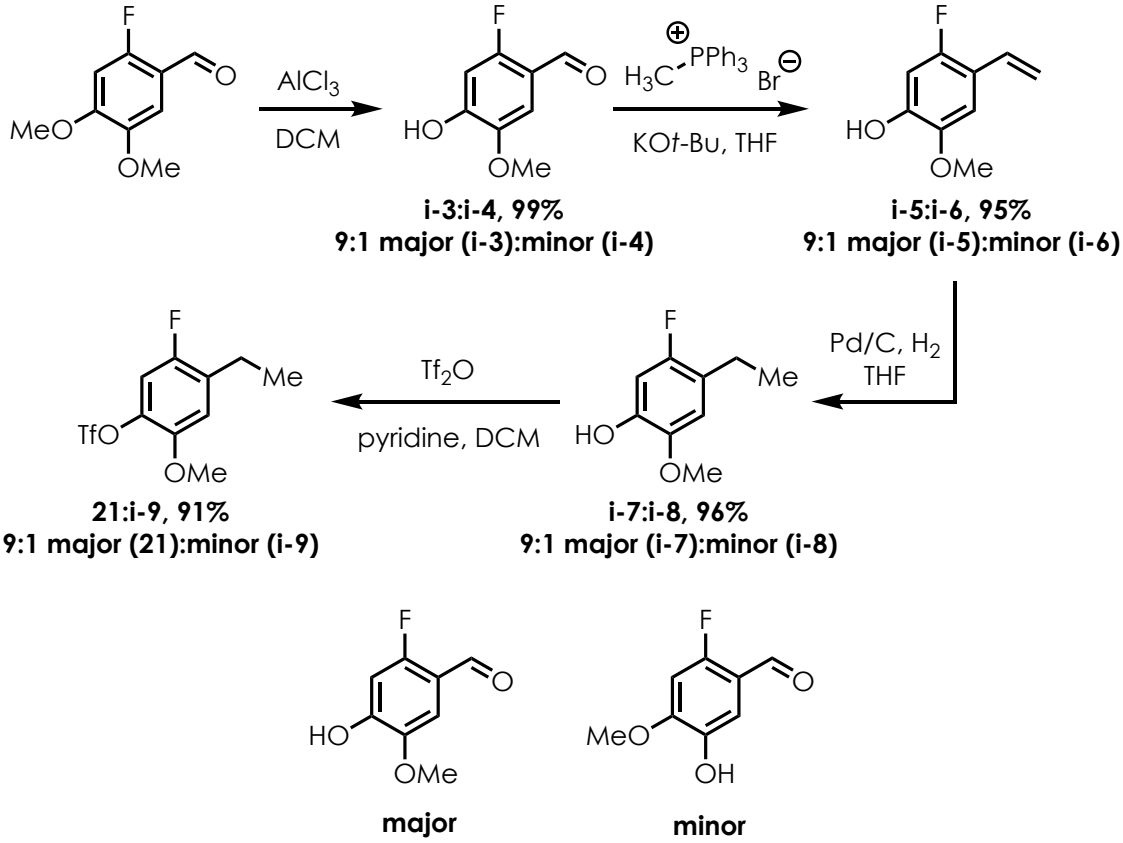
HRMS (ESI): Calculated for $C_9H_{11}FO_2$ $(M+)^+$: 170.07430; found: 170.0731



1-(2-Fluoro-5-methoxyphenyl)ethan-1-one (20, 2-F) To a clean, dry round bottomed flask equipped with a stir bar was added 1-(2-fluoro-5-methoxyphenyl)ethan-1-ol (0.53 g, 3.12 mmol, 1.0 eq.), which was then dissolved in 10 mL of DCM. Pyridinium dichromate (3.52 g, 9.36 mmol, 3.0 eq.) was then added to the reaction mixture and allowed to stir overnight. At the end of the reaction, the solution was diluted with 20 mL of DCM and filtered through Celite. The filtrate was then concentrated and purified via flash chromatography (5-10% EtOAc:Hex) to yield 1-(2-fluoro-5-methoxyphenyl)ethan-1-one as a colorless liquid (0.45 g, 87%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.32 – 7.28 (m, 1H), 7.04 – 7.02 (m, 1H), 7.02 (d, *J* = 1.9 Hz, 1H), 3.78 (s, 3H), 2.61 (d, *J* = 5.4 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 195.83 (d, *J* = 3.8 Hz), 156.99 (d, *J* = 247.9 Hz), 155.68 (d, *J* = 1.9 Hz), 125.58 (d, *J* = 14.4 Hz), 121.79 (d, *J* = 8.8 Hz), 117.72 (d, *J* = 26.4 Hz), 112.60 (d, *J* = 2.7 Hz), 55.91, 31.57 (d, *J* = 8.1 Hz).
^{19}F NMR (376 MHz, CDCl3) δ -119.33 (dt, *J* = 8.1, 4.8 Hz).

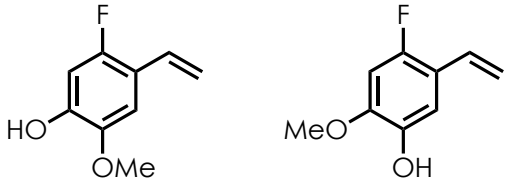
HRMS (ESI): Calculated for $C_9H_9FO_2$ $(M+H)^+$: 169.06593; found: 169.0656.



2-Fluoro-4-hydroxy-5-methoxybenzaldehyde (i-3, major) and 2-fluoro-5-hydroxy-4-methoxybenzaldehyde (i-4, minor) To a clean, dry round bottomed flask equipped with a stir bar was added 2-fluoro-4,5-dimethoxybenzaldehyde (1.84 g, 10.0 mmol, 1.0 eq.), which was then dissolved in 100 mL of DCM. Aluminum trichloride (8.00 g, 60.0 mmol, 6.0 eq.) was then added in three portions to the reaction mixture and the reaction was kept under N_2 for 20 h. The reaction was then carefully poured into ice (caution: exothermic!) and stirred until all the ice was melted. The organic layer was then separated, dried over $MgSO_4$ and concentrated to yield an off-white solid. The crude product (1.68 g, 98.8%) was clean by ^{1}H-NMR analysis and showed an approximate 9:1 ratio of the major isomer 2-fluoro-4-hydroxy-5-methoxybenzaldehyde to the minor isomer 2-fluoro-5-hydroxy-4-methoxybenzaldehyde. The assigned peaks for the products are in agreement with reported spectra (*66*) and the crude product was carried forward without further purification.

Major:
^{1}H NMR (600 MHz, $CDCl_3$) δ 10.21 (s, 1H), 7.29 (d, *J* = 6.1 Hz, 1H), 6.71 (d, *J* = 10.9 Hz, 1H), 6.38 (d, *J* = 1.6 Hz, 1H), 3.93 (s, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 185.97 (d, *J* = 6.9 Hz), 161.63 (d, *J* = 253.0 Hz), 153.15 (d, *J* = 13.4 Hz), 143.81 (d, *J* = 2.0 Hz), 116.58 (d, *J* = 9.0 Hz), 107.64 (d, *J* = 3.4 Hz), 102.90 (d, *J* = 26.3 Hz), 56.61.
^{19}F NMR (376 MHz, $CDCl_3$) δ -128.32. (ddd, *J* = 11.0, 6.1, 1.5 Hz)
Minor:
^{1}H NMR (600 MHz, $CDCl_3$) δ 10.21 (s, 1H), 7.35 (d, *J* = 6.7 Hz, 1H), 6.65 (d, *J* = 11.2 Hz, 1H), 5.52 (s, 1H), 3.97 (s, 3H).
^{13}C assignments for the minor isomer were not provided due to low abundance.
^{19}F NMR (376 MHz, $CDCl_3$) δ -128.58 **(multiplet not assigned due to low abundance)**

HRMS (ESI): Calculated for $C_8H_7FO_3$ $(M+H)^+$: 171.0448; found: 171.0457.



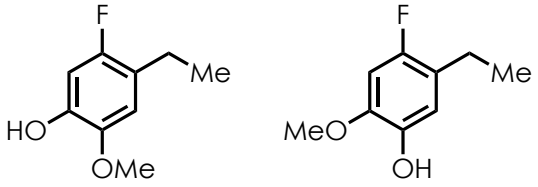
major **minor**

5-Fluoro-2-methoxy-4-vinylphenol (i-5, major) and 4-fluoro-2-methoxy-5-vinylphenol (i-6, minor) To a clean, dry two-neck round bottomed flask equipped with an addition funnel and a stir bar was added methyltriphenylphosphonium bromide (5.29 g, 14.8 mmol, 1.5 eq.), which was dissolved in dry THF (20 mL). The reaction was then placed under N_2 and potassium *tert*-butoxide (2.77 g, 24.7 mmol, 2.5 eq.) was added to the mixture, which turned bright yellow, and the suspension was stirred for 10 minutes. A solution of 2-fluoro-4-hydroxy-5-methoxybenzaldehyde and 2-fluoro-5-hydroxy-4-methoxybenzaldehyde (9:1) in THF (10 mL) was prepared and transferred to the addition funnel, where it was then added to the ylide suspension. The reaction was then stirred overnight at room temperature and when the reaction was complete, it was quenched with saturated ammonium chloride solution (15 mL) and diluted with DCM (20 mL). The layers were separated and the aqueous layer was extracted twice with DCM (2 x 10 mL). The organic layers were collected and washed with brine, dried over Na_2SO_4 and concentrated. The crude product was then purified via flash chromatography (15 to 30% EtOAc:Hex) to yield a pale, off-white solid (1.57 g, 95%) containing a 9:1 ratio of 5-fluoro-2-methoxy-4-vinylphenol to 4-fluoro-2-methoxy-5-vinylphenol.

Major:
^{1}H NMR (600 MHz, $CDCl_3$) δ 6.92 (d, *J* = 6.8 Hz, 1H), 6.81 (dd, *J* = 17.7, 11.2 Hz, 1H), 6.65 (d, *J* = 10.9 Hz, 1H), 5.75 (s, 1H), 5.64 (dd, *J* = 17.7, 1.1 Hz, 1H), 5.24 (dd, *J* = 11.2, 1.1 Hz, 1H), 3.90 (s, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 155.14 (d, *J* = 243.1 Hz), 146.40 (d, *J* = 13.1 Hz), 143.20 (d, *J* = 2.6 Hz), 129.21 (d, *J* = 3.8 Hz), 116.52 (d, *J* = 13.8 Hz), 113.60 (d, *J* = 4.6 Hz), 107.76 (d, *J* = 5.3 Hz), 102.86 (d, *J* = 27.8 Hz), 56.50.
^{19}F NMR (376 MHz, $CDCl_3$) δ -125.67.

Minor:
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.03 (d, *J* = 7.3 Hz, 1H), 6.79 (dd, *J* = 17.7, 11.2 Hz, 1H), 6.58 (d, *J* = 11.2 Hz, 1H), 5.65 (dd, *J* = 17.7, 1.1 Hz, 1H), 5.33 (s, 1H), 5.24 (dd, *J* = 11.2, 1.0 Hz, 1H), 3.87 (s, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 154.20 (d, *J* = 242.3 Hz), 146.75 (d, *J* = 10.1 Hz), 141.81 (d, *J* = 2.6 Hz), 128.74 (d, *J* = 3.8 Hz), 117.59 (d, *J* = 13.7 Hz), 114.30 (d, *J* = 4.4 Hz), 111.14 (d, *J* = 4.9 Hz), 99.36 (d, *J* = 28.6 Hz), 56.32.
^{19}F NMR (376 MHz, $CDCl_3$) δ -126.55.

HRMS (ESI): Calculated for $C_9H_9FO_2$ $(M+H)^+$: 169.0656; found: 169.0665.



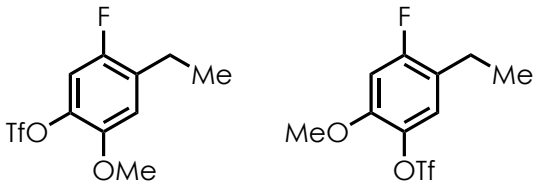
major **minor**

4-Ethyl-5-fluoro-2-methoxyphenol (i-7, major) and 5-ethyl-4-fluoro-2-methoxyphenol (i-8, minor) To a dry, clean round bottomed flask equipped with a stir bar was added a solid containing a 9:1 mixture of 5-fluoro-2-methoxy-4-vinylphenol and 4-fluoro-2-methoxy-5-vinylphenol (1.54 g, 9.16 mmol, 1.0 eq.), which was then dissolved in 20 mL of a THF. 10% Palladium on carbon (97.5 mg, 0.92 mmol, 0.10 eq.) was added to the solution and the reaction was placed under N_2. The solution was purged and backfilled with H_2 before being placed under a H_2 atmosphere (1 atm) overnight (reaction is typically done in about 2-3 hours). Once the reaction was complete, the solution was run through a Celite plug and concentrated. The crude mixture was then purified by flash chromatography (10% EtOAc:Hex) to yield a colorless liquid (1.50 g, 96%) containing a (9:1) mixture of 4-ethyl-5-fluoro-2-methoxyphenol to 5-ethyl-4-fluoro-2-methoxyphenol.

Major:
^{1}H NMR (600 MHz, $CDCl_3$) δ 6.65 (d, *J* = 7.1 Hz, 2H), 6.64 (d, *J* = 10.4 Hz, 2H), 5.63 (s, 1H), 5.63 (s, 1H), 3.86 (s, 3H), 2.59 (qd, *J* = 7.6, 1.3 Hz, 2H), 1.20 (t, *J* = 7.6 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 155.18 (d, *J* = 237.1 Hz), 144.30 (d, *J* = 12.6 Hz), 142.80 (d, *J* = 2.5 Hz), 121.43 (d, *J* = 17.8 Hz), 111.59 (d, *J* = 6.7 Hz), 102.66 (d, *J* = 28.2 Hz), 56.55, 22.03 (d, *J* = 2.4 Hz), 14.97.
^{19}F NMR (376 MHz, $CDCl_3$) δ -126.85 (dd, *J* = 10.3, 7.4 Hz)

Minor:
^{1}H NMR (600 MHz, $CDCl_3$) δ 6.75 (d, *J* = 7.4 Hz, 1H), 6.58 (d, *J* = 10.7 Hz, 1H), 5.36 (s, 1H), 3.84 (s, 3H). 2.60-2.55 (m, 2H), 1.20-1.17 (m, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 154.29 (d, *J* = 236.5 Hz), 144.79 (d, *J* = 10.0 Hz), 141.48 (d, *J* = 2.8 Hz), 122.71 (d, *J* = 17.6 Hz), 114.77 (d, *J* = 6.3 Hz), 99.38 (d, *J* = 28.6 Hz), 56.30, 21.61 (d, *J* = 2.6 Hz), 14.70.
^{19}F NMR (376 MHz, $CDCl_3$) δ -127.56 (dd, *J* = 10.7, 7.5 Hz).

HRMS (ESI): Calculated for $C_9H_{11}FO_2$ $(M)^+$: 170.0734; found: 170.0749.



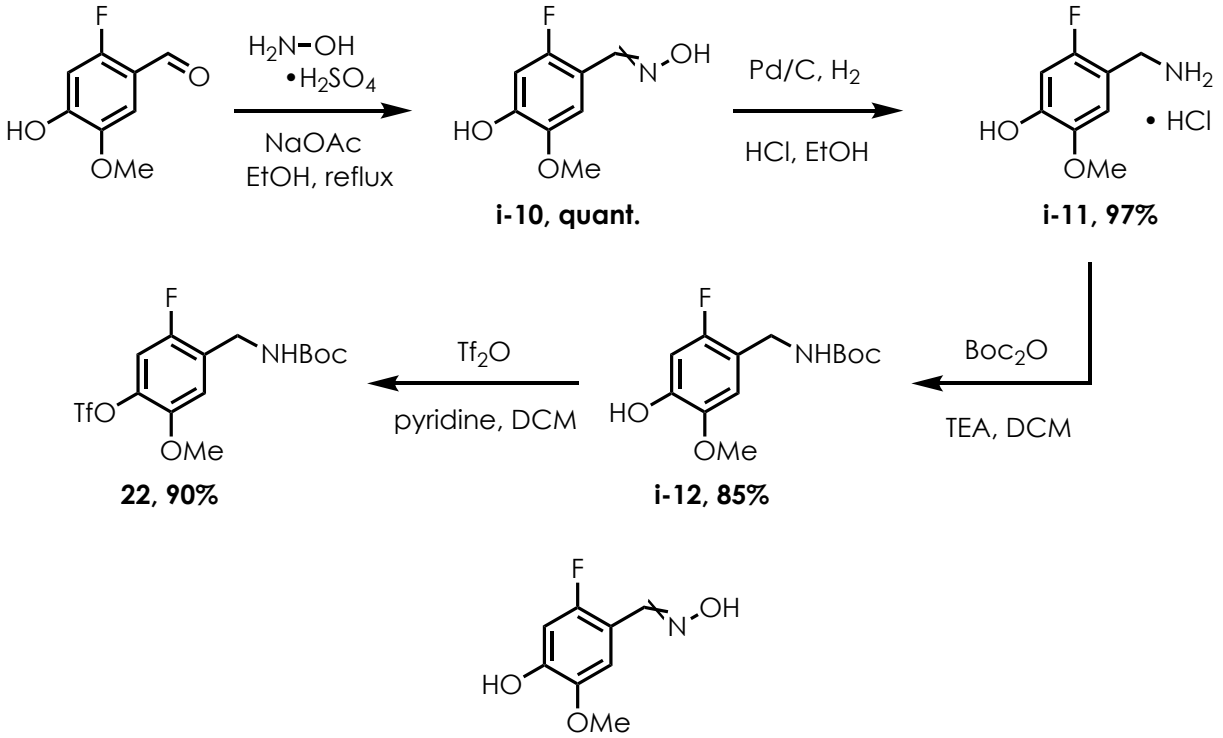
major **minor**

4-Ethyl-5-fluoro-2-methoxyphenyl trifluoromethanesulfonate (21, major) and 5-ethyl-4-fluoro-2-methoxyphenyl trifluoromethanesulfonate (i-9, minor) To a dry, clean round bottomed flask equipped with a stir bar was added a 9:1 mixture of 4-ethyl-5-fluoro-2-methoxyphenol to 5-ethyl-4-fluoro-2-methoxyphenol (1.10 g, 6.46 mmol, 1.0 eq.), which was then dissolved in 20 mL of DCM under N_2. The solution was cooled to 0 ºC before pyridine (1.0 mL, 12.9 mmol, 2.0 eq.) was added to the solution. Trifluoromethanesulfonic anhydride (1.31 mL, 7.76 mmol, 1.2 eq.) was then added to the reaction dropwise and the solution was stirred for 15 minutes before being warmed to room temperature. The reaction was then run for 2 h. before being quenched with DI water. The reaction was then diluted with DCM before the layers were separated. The aqueous layer was extracted once with DCM (10 mL) and the organic layers were combined, washed sequentially with 10 mL of dilute HCl (2.0 M) and brine, dried over Na_2SO_4 and concentrated. The crude product was purified via flash chromatography (10% EtOAc) to yield a yellow liquid (1.77 g, 91%) consisting of a 9:1 mixture of 4-ethyl-5-fluoro-2-methoxyphenyl trifluoromethanesulfonate to 5-ethyl-4-fluoro-2-methoxyphenyl trifluoromethanesulfonate.

Major:
^{1}H NMR (600 MHz, $CDCl_3$) δ 6.94 (d, J = 8.9 Hz, 1H), 6.86 (d, J = 6.8 Hz, 1H), 3.88 (s, 3H), 2.67 (qd, J = 7.6, 1.4 Hz, 2H), 1.24 (t, J = 7.7 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 153.78 (d, *J* = 241.6 Hz), 147.92 (d, *J* = 3.0 Hz), 136.05 (d, *J* = 11.1 Hz), 132.12 (d, *J* = 17.5 Hz), 118.87 (q, *J* = 320.3 Hz), 113.82 (d, *J* = 5.7 Hz), 110.27 (d, *J* = 28.1 Hz), 56.66, 22.50 (d, *J* = 2.2 Hz), 14.24 (d, *J* = 1.2 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -73.71, -125.35.

Minor:
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.06 (d, *J* = 7.1 Hz, 1H), 6.72 (d, *J* = 10.8 Hz, 1H), 3.87 (s, 3H), 2.61 (qd, *J* = 7.5, 1.2 Hz, 2H), 1.20 (t, *J* = 7.6 Hz, 3H).
^{13}C NMR (151 MHz, Chloroform-*d*) δ 160.09 (d, *J* = 247.4 Hz), 150.48 (d, *J* = 10.6 Hz), 134.58 (d, *J* = 3.4 Hz), 123.37 (d, *J* = 19.1 Hz), 123.12 (d, *J* = 7.8 Hz), 118.90 (q, *J* = 320.3 Hz), 101.40 (d, *J* = 28.7 Hz), 56.53, 21.43 (d, *J* = 2.2 Hz), 14.19.
^{19}F NMR (376 MHz, $CDCl_3$) δ -73.68, -114.61.

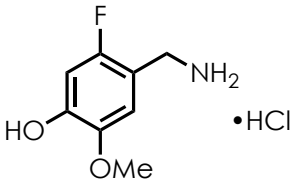
HRMS (ESI): Calculated for $C_{10}H_{10}F_4O_4S$ $(M+H)^+$: 303.0309; found: 303.0412.



2-Fluoro-4-hydroxy-5-methoxybenzaldehyde oxime (i-10) To a clean, dry two-neck round bottomed flask equipped with a condenser and a stir bar was added 2-fluoro-4-hydroxy-5-methoxybenzaldehyde (681 mg, 4.00 mmol, 1.0 eq.), which was then dissolved in EtOH (8 mL) and placed under N_2. Hydroxylamine sulfate (629 mg, 4.80 mmol, 1.2 eq.) and sodium acetate (328 mg, 4.00 mmol, 1.0 eq.) were then added successively to the reaction mixture and the suspension was refluxed for 4 h. Once the reaction was complete, it was cooled to room temperature and concentrated under reduced pressure. The crude mixture was then resuspended in CH_2Cl_2 (10 mL), filtered and washed with CH_2Cl_2. The filtrate was then concentrated and purified via flash chromatography (30% EtOAc:Hex) to yield 2-fluoro-4-hydroxy-5-methoxybenzaldehyde oxime as a white solid (740 mg, 99%).

^{1}H NMR (600 MHz, DMSO-d_6) δ 11.20 (s, 1H), 10.00 (s, 1H), 8.08 (s, 1H), 7.14 (d, *J* = 6.9 Hz, 1H), 6.64 (d, *J* = 11.5 Hz, 1H), 3.76 (s, 3H).
^{13}C NMR (151 MHz, DMSO-d_6) δ 154.74 (d, *J* = 242.8 Hz), 149.38 (d, *J* = 11.8 Hz), 144.84 (d, *J* = 1.7 Hz), 141.55 (d, *J* = 2.3 Hz), 110.12 (d, *J* = 12.1 Hz), 108.02 (d, *J* = 4.8 Hz), 103.23 (d, *J* = 25.4 Hz), 56.01.
^{19}F NMR (376 MHz, DMSO) δ -127.84 (dt, *J* = 11.6, 5.6 Hz).

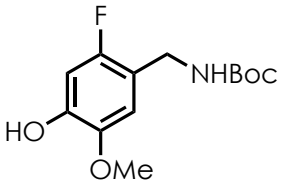
HRMS (ESI): Calculated for $C_8H_8FNO_3$ $(M+H)^+$: 186.05609; found: 186.05579.



4-(Aminomethyl)-5-fluoro-2-methoxyphenol hydrochloride (i-11) To a dry, clean round bottomed flask equipped with a stir bar was added 2-fluoro-4-hydroxy-5-methoxybenzaldehyde oxime (0.699 g, 3.78 mmol, 1.0 eq.), which was then dissolved in 50 mL of EtOH.10% Palladium on carbon (40.2 mg, 0.38 mmol, 0.10 eq.) and HCl (14 N, 2.73 mL, 90 mmol, 24 eq.) were added to the solution and the reaction was placed under N_2. The solution was purged and backfilled with H_2 before being placed under a H_2 atmosphere (1 atm) overnight (reaction is typically done in about 2-3 hours). Once the reaction was complete, the solution was run through a Celite plug and concentrated. The crude product was then reconstituted in EtOH and concentrated again to remove excess HCl. This process yields 4-(aminomethyl)-5-fluoro-2-methoxyphenol hydrochloride as a tan-grey solid (0.760 g, 97%).

^{1}H NMR (600 MHz, DMSO-d_6) δ 9.87 (s, 1H), 8.39 (s, 3H), 7.21 (d, *J* = 7.3 Hz, 1H), 6.70 (d, *J* = 11.0 Hz, 1H), 3.91 (d, *J* = 5.1 Hz, 2H), 3.75 (s, 3H).
^{13}C NMR (151 MHz, DMSO-d_6) δ 154.50 (d, *J* = 238.8 Hz), 148.35 (d, *J* = 11.6 Hz), 144.30 (d, *J* = 2.0 Hz), 114.45 (d, *J* = 4.8 Hz), 109.69 (d, *J* = 16.1 Hz), 103.02 (d, *J* = 25.6 Hz), 56.33, 35.50 (d, *J* = 3.5 Hz).
^{19}F NMR (376 MHz, DMSO-d_6) δ -125.73 (dd, *J* = 10.8, 7.3 Hz).

HRMS (ESI): Calculated for $C_8H_{10}FNO_2$ $(M+H)^+$: 172.07683; found: 172.07653 (only free amine mass detected).

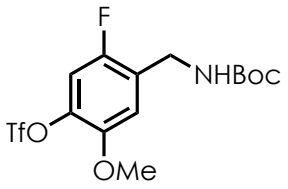


***Tert*-butyl (2-fluoro-4-hydroxy-5-methoxybenzyl)carbamate (i-12)** To a dry, clean round bottomed flask equipped with a stir bar was added 4-(aminomethyl)-5-fluoro-2-methoxyphenol hydrochloride (300 mg, 1.45 mmol, 1.0 eq.), which was dissolved in 10 mL of DCM. The suspension is then placed under N_2 and cooled to 0 ºC before successive additions of triethylamine (0.66 mL, 4.77 mmol, 3.3 eq.) and di-*tert*-butyl dicarbonate (0.34 mL, 1.46 mmol, 1.01 eq.). The reaction is allowed to stir for 30 min. before it is warmed to room temperature and stirred overnight. At the end of the reaction, the reaction was quenched with DI H_2O and the layers separated. The aqueous layer was extracted with DCM (2 x 5 mL) and the organic layers were combined, dried over $MgSO_4$ and concentrated under reduced pressure. The crude product was purified via flash chromatography (30 to

40% EtOAc:Hex) to yield *tert*-butyl (2-fluoro-4-hydroxy-5-methoxybenzyl)carbamate as a white solid (333.0 mg, 85%)

^{1}H NMR (600 MHz, $CDCl_3$) δ 6.76 (d, *J* = 6.5 Hz, 1H), 6.59 (dd, *J* = 11.2, 4.7 Hz, 1H), 6.36 (bs, 1H), 5.06 (d, *J* = 17.1 Hz, 1H), 4.22 (t, *J* = 5.3 Hz, 2H), 3.77 (s, 3H), 1.42 (s, 9H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 156.14, 155.21 (d, *J* = 238.1 Hz), 145.97 (d, *J* = 12.4 Hz), 143.10 (d, *J* = 2.1 Hz), 116.14 (d, *J* = 16.6 Hz), 111.87 (d, *J* = 5.6 Hz), 102.78 (d, *J* = 27.0 Hz), 79.69, 56.35, 38.42, 28.39.
^{19}F NMR (376 MHz, $CDCl_3$) δ -127.03 (d, *J* = 8.5 Hz).

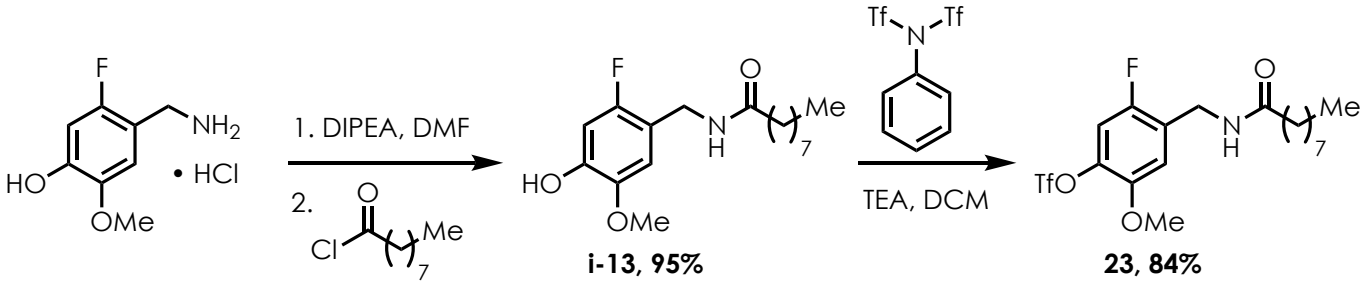
HRMS (ESI): Calculated for $C_{13}H_{18}FNO_4$ $(M+Na)^+$: 294.11123; found: 294.11040.

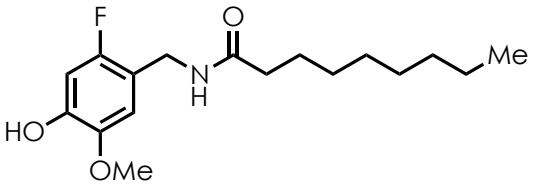


4-(((*Tert*-butoxycarbonyl)amino)methyl)-5-fluoro-2-methoxyphenyl trifluoromethanesulfonate (22) To a dry, clean round bottomed flask equipped with a stir bar was added *tert*-butyl (2-fluoro-4-hydroxy-5-methoxybenzyl)carbamate (0.197 g, 0.777 mmol, 1.0 eq.) and the solid was dissolved in 20 mL of DCM under N_2. The solution was cooled to 0 ºC before pyridine (0.13 mL, 1.56 mmol, 2.0 eq.) was added to the solution. Trifluoromethanesulfonic anhydride (0.16 mL, 0.932 mmol, 1.2 eq.) was then added to the reaction dropwise and the solution was stirred for 15 minutes before being warmed to room temperature. The reaction was then run for 2 h. before being quenched with DI water. The reaction was then diluted with DCM before the layers were separated. The aqueous layer was extracted once with DCM (10 mL) and the organic layers were combined, washed sequentially with 10 mL of dilute HCl (2.0 M) and brine, dried over Na_2SO_4 and concentrated. The crude product was purified via flash chromatography (10% EtOAc) to yield 4-(((*tert*-butoxycarbonyl)amino)methyl)-5-fluoro-2-methoxyphenyl trifluoromethanesulfonate as a white solid (269 mg, 90%).

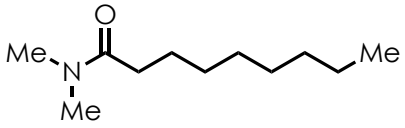
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.04 (d, *J* = 6.6 Hz, 1H), 6.97 (d, *J* = 8.8 Hz, 1H), 4.98 (t, *J* = 6.3 Hz, 1H), 4.34 (d, *J* = 6.4 Hz, 2H), 3.88 (s, 3H), 1.45 (s, 9H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 156.02, 153.55 (d, *J* = 242.3 Hz), 148.16 (d, *J* = 3.2 Hz), 137.20 (d, *J* = 10.8 Hz), 127.22 (d, *J* = 14.7 Hz), 118.81 (q, *J* = 320.6 Hz), 113.80, 110.65 (d, *J* = 27.2 Hz), 80.19, 56.81, 38.43, 28.47.
^{19}F NMR (376 MHz, $CDCl_3$) δ -73.77, -125.87 (t, *J* = 7.8 Hz).

HRMS (ESI): Calculated for $C_{14}H_{17}F_4NO_6S$ $(M+Na)^+$: 426.06051; found: 426.05936.





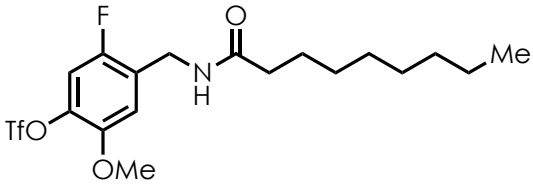
***N*-(2-fluoro-4-hydroxy-5-methoxybenzyl)nonanamide (i-13)** To a dry, clean round bottomed flask equipped with a stir bar was added 4-(aminomethyl)-5-fluoro-2-methoxyphenol hydrochloride (190 mg, 0.915 mmol, 1.0 eq.) which was then dissolved in DMF (2 mL) under N_2. *N,N*-Diisopropylethylamine (0.32 mL, 1.83 mmol, 2.0 eq.) was then added to the solution, which was stirred for an hour at room temperature. Nonanoyl chloride (162 mg, 0.915 mmol, 1.0 eq.) was then added dropwise to the reaction and the reaction was allowed to stir for 5 h. At the end of the reaction, the mixture was diluted with EtOAc (15 mL) and DI H_2O (25 mL). The layers were separated and the aqueous layer extracted twice with EtOAc (2 x 10 mL). The organic layers were then combined, washed sequentially with 20% LiCl solution (twice) and brine, dried over $MgSO_4$ and concentrated. The crude mixture was purified via flash chromatography (40 to 50% EtOAc:Hex) to yield *N*-(2-fluoro-4-hydroxy-5-methoxybenzyl)nonanamide as an off-white solid (261.3 mg, 95%). The isolated product contains minor impurity *N*,*N*-dimethylnonanamide (i-14, *vide infra)*, which is inseparable from the desired product. Its spectral data are in agreement with literature values. (*67*)



***N*,*N*-dimethylnonanamide (i-14)**

^{1}H NMR (600 MHz, $CDCl_3$) δ 6.82 (d, *J* = 6.8 Hz, 1H), 6.65 (d, *J* = 10.5 Hz, 1H), 5.94 (s, 1H), 5.82 (t, *J* = 6.1 Hz, 1H), 4.37 (dd, *J* = 5.9, 1.2 Hz, 2H), 3.84 (s, 3H), 2.22 – 2.06 (m, 2H), 1.62 (dq, *J* = 14.7, 7.1 Hz, 2H), 1.26 (dqt, *J* = 19.8, 13.0, 5.3 Hz, 10H), 0.86 (t, *J* = 7.1 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 173.25, 155.54 (d, *J* = 238.2 Hz), 146.14 (d, *J* = 12.6 Hz), 143.07 (d, *J* = 2.5 Hz), 115.90 (d, *J* = 16.9 Hz), 112.28 (d, *J* = 5.6 Hz), 102.73 (d, *J* = 27.3 Hz), 56.56, 37.43 (d, *J* = 3.2 Hz), 36.91, 31.92, 29.42, 29.39, 29.27, 25.84, 22.76, 14.21.
^{19}F NMR (376 MHz, $CDCl_3$) δ -126.99 (td, *J* = 11.4, 10.9, 6.3 Hz).

HRMS (ESI): Calculated for $C_{17}H_{26}FNO_3$ $(M+H)^+$: 312.19695; found: 312.19606.

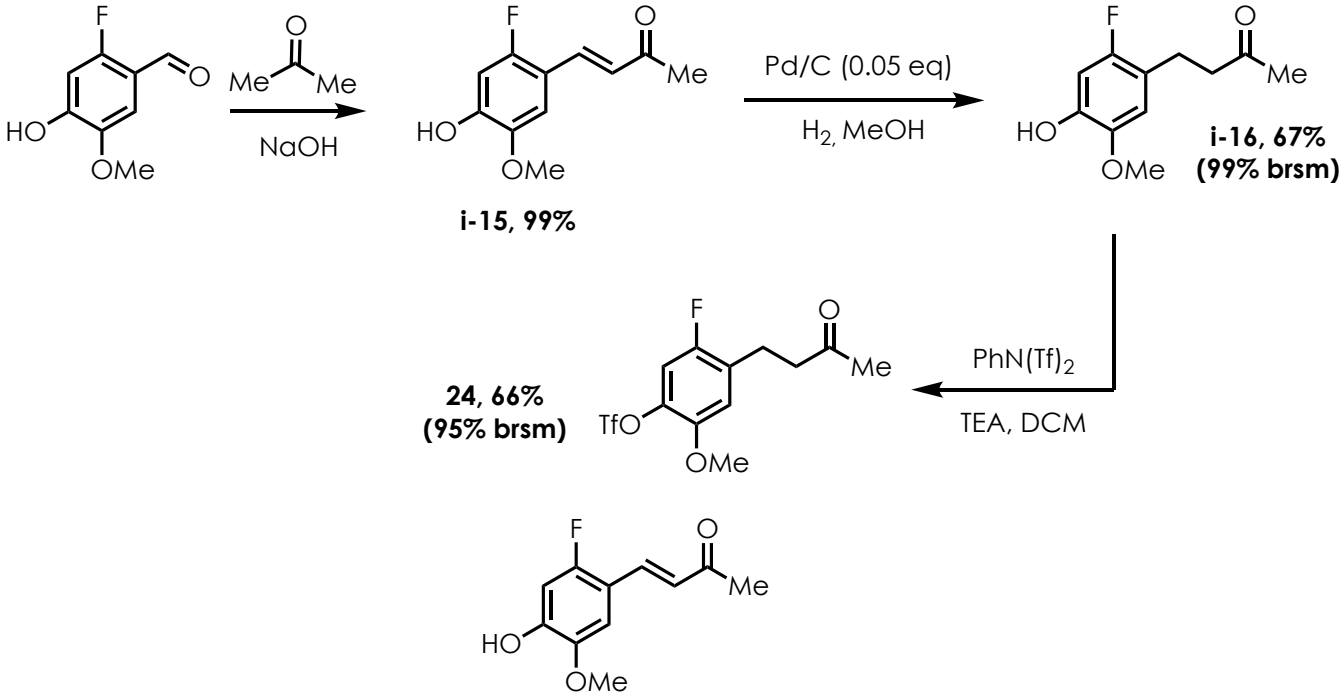


5-Fluoro-2-methoxy-4-(nonanamidomethyl)phenyl trifluoromethanesulfonate (23) To a dry, clean round bottomed flask equipped with a stir bar was added *N*-(2-fluoro-4-hydroxy-5-methoxybenzyl)nonanamide (248 mg, 0.795 mmol, 1.0 eq.), which was then dissolved in 10 mL of DCM under N_2. The solution was then cooled to 0 ºC before triethylamine (0.12 mL, 0.874 mmol, 1.1 eq.) and 1,1,1-trifluoro-N-phenyl-N-((trifluoromethyl)sulfonyl)methanesulfonamide (290 mg, 0.811 mmol, 1.02 eq.) were added consecutively to the reaction and the mixture was stirred for an additional 15 min. The reaction was then warmed to room temperature and stirred overnight before being quenched with DI water. The reaction was then diluted with DCM before the layers were separated. The aqueous layer was extracted once with DCM (10 mL) and the organic layers were combined, washed sequentially with 10 mL of dilute HCl (2.0 M) and brine, dried over Na_2SO_4 and concentrated. The crude product was purified via flash chromatography (30 to 40% EtOAc) to yield 5-

fluoro-2-methoxy-4-(nonanamidomethyl)phenyl trifluoromethanesulfonate as an off-white solid (295.2 mg, 84%). The isolated product contains a minor amount of impurity *N*,*N*-dimethylnonanamide (i-14, *vide supra*).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.02 (d, *J* = 6.6 Hz, 1H), 6.93 (d, *J* = 8.8 Hz, 1H), 6.39 (t, *J* = 5.9 Hz, 1H), 4.40 (d, *J* = 6.1 Hz, 2H), 3.83 (s, 3H), 2.18 (t, *J* = 7.6 Hz, 2H), 1.59 (t, *J* = 7.3 Hz, 2H), 1.27 – 1.16 (m, 10H), 0.84 (t, *J* = 7.1 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 173.67, 153.55 (d, *J* = 242.8 Hz), 148.05 (d, *J* = 3.1 Hz), 137.14 (d, *J* = 10.9 Hz), 126.71 (d, *J* = 16.1 Hz), 118.73 (q, *J* = 320.5 Hz), 114.19 (d, *J* = 4.8 Hz), 110.52 (d, *J* = 27.1 Hz), 56.67, 37.07 (d, *J* = 3.2 Hz), 36.60, 31.85, 29.37, 29.35, 29.21, 25.78, 22.67, 14.08.
^{19}F NMR (376 MHz, $CDCl_3$) δ -73.61 (d, *J* = 2.7 Hz), -125.49 (t, *J* = 7.8 Hz).

HRMS (ESI): Calculated for $C_{18}H_{25}F_4NO_5S$ $(M+H)^+$: 444.14622; found: 444.14498.

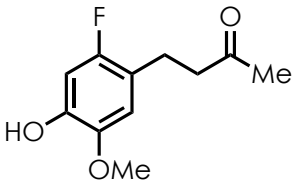


(*E*)-4-(2-fluoro-4-hydroxy-5-methoxyphenyl)but-3-en-2-one (i-15) To a dry, clean two-neck round bottomed flask equipped with an addition funnel and a stir bar was added 2-fluoro-4-hydroxy-5-methoxybenzaldehyde (341.3 mg, 2.01 mmol, 1.0 eq.), which was then dissolved in acetone (11 mL, 2.0 M) and placed under N_2. An aqueous solution (1 N) of NaOH was transferred to the addition funnel, which was then added dropwise to the reaction mixture. The mixture was stirred at room temperature for 12 h. The reaction turned a bright yellow color upon addition of NaOH solution. At the end of the reaction, the reaction was neutralized with 2 N HCl, and the acetone was evaporated off under reduced pressure. The crude mixture was then diluted with EtOAc and the layers were separated. The aqueous layer was washed with EtOAc (2 x 15 mL) and the organic layers were combined, washed with brine, and dried with Na_2SO_4. The crude mixture was then concentrated and purified via column chromatography (50-60% EtOAc:Hex) to yield (*E*)-4-(2-fluoro-4-hydroxy-5-methoxyphenyl)but-3-en-2-one as a pale yellow solid (421.0 mg, 99%)

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.64 (d, *J* = 16.4 Hz, 1H), 6.97 (d, *J* = 6.5 Hz, 1H), 6.70 (d, *J* = 10.9 Hz, 1H), 6.61 (d, *J* = 16.4 Hz, 1H), 6.11 (bs, 1H), 3.91 (s, 3H), 2.38 (s, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 198.76, 156.96 (d, *J* = 248.1 Hz), 149.32 (d, *J* = 12.9 Hz), 143.59 (d, *J* = 2.2 Hz), 136.09 (d, *J* = 3.6 Hz), 126.68 (d, *J* = 4.9 Hz), 113.58 (d, *J* = 12.9 Hz), 108.44 (d, *J* = 4.2 Hz), 103.27 (d, *J* = 27.6 Hz), 56.52, 27.25.
^{19}F NMR (565 MHz, $CDCl_3$) δ -121.06 (ddd, *J* = 10.6, 6.7, 3.9 Hz).

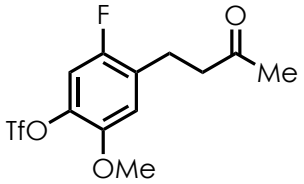
HRMS (ESI): Calculated for $C_{11}H_{11}FO_3$ $(M+H)^+$: 211.07650; found: 211.07588



4-(2-Fluoro-4-hydroxy-5-methoxyphenyl)butan-2-one (i-16) To a dry, clean round bottomed flask equipped with a stir bar was added (*E*)-4-(2-fluoro-4-hydroxy-5-methoxyphenyl)but-3-en-2-one (0.421.4 g, 2.01 mmol, 1.0 eq.), which was then dissolved in 10 mL of MeOH. 10% Palladium on carbon (21.3 mg, 0.201 mmol, 0.10 eq.) was added to the solution and the reaction was placed under N_2. The solution was purged and backfilled with H_2 before being placed under a H_2 atmosphere (1 atm) overnight. The reaction was checked by TLC and no further conversion was observed after 12 h. The solution was then run through a Celite plug and concentrated. The crude product was then purified via column chromatography (30-50% EtOAc:Hex) to yield 4-(2-fluoro-4-hydroxy-5-methoxyphenyl)butan-2-one as a pale-yellow liquid (0.283 g, 67%) with (*E*)-4-(2-fluoro-4-hydroxy-5-methoxyphenyl)but-3-en-2-one recovered (134.8 mg, 32%) [99% brsm].

^{1}H NMR (600 MHz, $CDCl_3$) δ 6.66 (d, *J* = 6.9 Hz, 1H), 6.62 (d, *J* = 10.5 Hz, 1H), 5.63 (s, 1H), 3.84 (s, 3H), 2.82 (t, *J* = 7.4 Hz, 2H), 2.72 (t, *J* = 7.4 Hz, 2H), 2.13 (s, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 208.17, 155.35 (d, *J* = 237.2 Hz), 144.85 (d, *J* = 12.3 Hz), 142.79 (d, *J* = 2.7 Hz), 118.14 (d, *J* = 17.6 Hz), 112.48 (d, *J* = 6.3 Hz), 102.75 (d, *J* = 27.7 Hz), 56.56, 44.17, 30.18, 23.38 (d, *J* = 2.1 Hz).
^{19}F NMR (565 MHz, $CDCl_3$) δ -126.09 (td, *J* = 11.1, 6.8 Hz).

HRMS (ESI): Calculated for $C_{11}H_{13}FO_3$ $(M+H)^+$: 213.09215; found: 213.09174

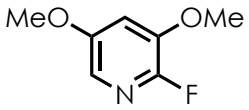


5-fluoro-2-methoxy-4-(3-oxobutyl)phenyl trifluoromethanesulfonate (24) To a dry, clean round bottomed flask equipped with a stir bar was added 4-(2-fluoro-4-hydroxy-5-methoxyphenyl)butan-2-one (272.7 mg, 1.40 mmol, 1.0 eq.), which was then dissolved in 20 mL of DCM under N_2. The solution was then cooled to 0 ºC before triethylamine (0.21 mL, 1.54 mmol, 1.1 eq.) and 1,1,1-trifluoro-N-phenyl-N-((trifluoromethyl)sulfonyl)methanesulfonamide (512 mg, 1.43 mmol, 1.02 eq.) were added consecutively to the reaction and the mixture was stirred for an additional 15 min. The reaction was then warmed to room temperature and stirred overnight before being quenched with DI water. The reaction was then diluted with DCM before the layers were separated. The aqueous layer was extracted once with DCM (20 mL) and the organic layers were combined, washed sequentially with 10 mL of dilute HCl (2.0 M) and brine, dried over Na_2SO_4 and concentrated. The crude product was purified via flash chromatography (20 to 30% EtOAc) to yield 5-fluoro-2-methoxy-4-(3-oxobutyl)phenyl trifluoromethanesulfonate as a pale-yellow liquid (300.8 mg,

66%) with 4-(2-fluoro-4-hydroxy-5-methoxyphenyl)butan-2-one recovered (90.1 mg, 33%) [99% brsm].

^{1}H NMR (600 MHz, $CDCl_3$) δ 6.92 (d, *J* = 8.9 Hz, 1H), 6.89 (d, *J* = 6.7 Hz, 1H), 3.85 (s, 3H), 2.88 (t, *J* = 7.4 Hz, 2H), 2.76 (t, *J* = 7.3 Hz, 2H), 2.13 (s, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 207.06, 153.79 (d, *J* = 242.1 Hz), 147.81 (d, *J* = 3.1 Hz), 136.35 (d, *J* = 11.1 Hz), 129.06 (d, *J* = 16.8 Hz), 118.76 (q, *J* = 320.4 Hz), 114.92 (d, *J* = 5.5 Hz), 110.41 (d, *J* = 27.7 Hz), 56.68, 43.21, 29.95, 23.44 (d, *J* = 1.9 Hz).
^{19}F NMR (565 MHz, $CDCl_3$) δ -73.62, -124.62 (t, *J* = 7.7 Hz).

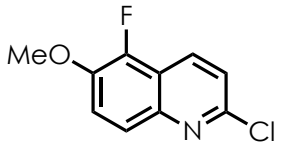
HRMS (ESI): Calculated for $C_{12}H_{12}F_4O_5S$ $(M+H)^+$: 345.04142; found: 345.04071



2-Fluoro-3,5-dimethoxypyridine (26) The title compound was prepared from 3,5-dimethoxypyridine according to **General Method A** with an irradiation time of 24 h. The crude mixture was purified via flash LC with (20% acetonitrile:water to 30% acetonitrile:water with 0.1% TFA) to afford a yellow oil (2.5 mg, 6.5%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.32 (t, *J* = 2.7 Hz, 1H), 6.87 (dd, *J* = 8.4, 2.6 Hz, 1H), 3.87 (s, 3H), 3.85 (s, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 154.75 (d, *J* = 3.3 Hz), 148.20 (d, *J* = 232.0 Hz), 143.16 (d, *J* = 29.2 Hz), 119.85 (d, *J* = 14.2 Hz), 110.54 (d, *J* = 4.3 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -92.72 (d, *J* = 8.4 Hz).

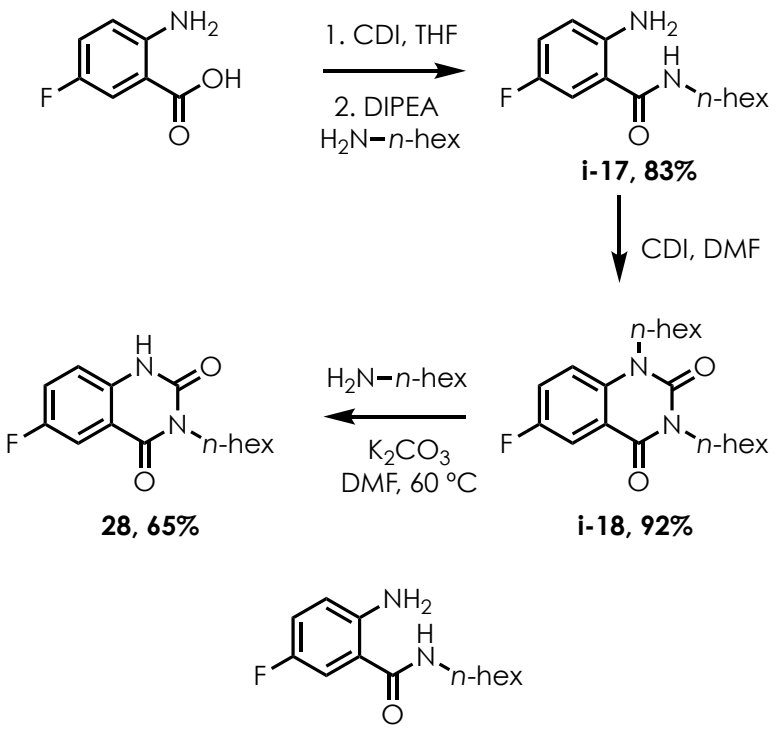
HRMS (ESI): Calculated for $C_7H_8FNO_2$ $(M+H)^+$: 158.06118; found: 158.06084.



2-Chloro-5-fluoro-6-methoxyquinoline (27) The title compound was prepared from 2-chloro-6-methoxyquinoline according to **General Method A** with an irradiation time of 24 h. The crude mixture was purified via flash LC with (20% acetonitrile:water to 30% acetonitrile:water with 0.1% TFA) to afford a yellow oil (2.5 mg, 5%)

^{1}H NMR (700 MHz, $CDCl_3$) δ 8.32 (dd, *J* = 8.8, 0.8 Hz, 1H), 7.83 – 7.76 (m, 1H), 7.54 (t, *J* = 9.0 Hz, 1H), 7.40 (d, *J* = 8.8 Hz, 1H), 4.05 (s, 3H).
^{13}C NMR (176 MHz, $CDCl_3$) δ 149.57, 145.56 (d, *J* = 252.7 Hz), 143.92 (d, *J* = 9.3 Hz), 142.75 (d, *J* = 1.4 Hz), 131.45 (d, *J* = 4.5 Hz), 124.75 (d, *J* = 4.4 Hz), 122.88 (d, *J* = 2.7 Hz), 119.66 (d, *J* = 2.5 Hz), 118.47 (d, *J* = 13.9 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -144.92 (d, *J* = 8.4 Hz).

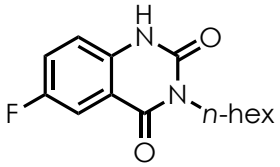
HRMS (ESI): Calculated for $C_{10}H_7ClFNO$ $(M+H)^+$: 212.02729; found: 212.02690.



2-Amino-5-fluoro-*N*-hexylbenzamide (i-17) To a dry, clean round bottomed flask equipped with a stir bar was added 2-amino-5-fluorobenzoic acid (1.86 g, 12.0 mmol, 1.0 eq.), which was then dissolved in THF (24 mL) under N_2. Carbonyldiimidazole (2.05 g, 12.6 mmol, 1.05 eq.) was then added to the reaction mixture and the suspension was allowed to stir for 30 min. *N,N*-Diisopropylethylamine (2.5 mL, 14.4 mmol, 1.2 eq.) and *n*-hexylamine (1.7 mL, 13.2 mmol, 1.1 eq.) were then sequentially added to the reaction mixture and the reaction was allowed to stir overnight (done in about 5-6 h.). At the end of the reaction, the mixture was quenched with 1 N HCl (15 mL) and diluted with EtOAc (20 mL) before the pH was adjusted to 7 with 2 M NaOH. The layers were separated and the aqueous layer was extracted once with 10 mL of ETOAc. The organic layers were then combined, washed consecutively with saturated $NaHCO_3$ solution and brine, dried over Na_2SO_4 and concentrated. The crude product was purified via flash chromatography (30 to 50% EtOAc:Hex) to yield 2-amino-5-fluoro-*N*-hexylbenzamide as a pale yellow solid (2.38 g, 83%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.01 (dd, *J* = 9.2, 2.9 Hz, 1H), 6.95 (ddd, *J* = 8.9, 7.9, 2.9 Hz, 1H), 6.63 (dd, *J* = 8.9, 4.7 Hz, 1H), 5.98 (s, 1H), 5.25 (s, 2H), 3.39 (td, *J* = 7.2, 5.7 Hz, 2H), 1.66 – 1.53 (m, 3H), 1.45 – 1.23 (m, 6H), 0.97 – 0.80 (m, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 168.38 (d, *J* = 2.3 Hz), 154.64 (d, *J* = 236.0 Hz), 144.85, 119.50 (d, *J* = 22.5 Hz), 118.56 (d, *J* = 7.1 Hz), 117.09 (d, *J* = 5.4 Hz), 113.10 (d, *J* = 22.7 Hz), 39.99, 31.64, 29.72, 26.83, 22.71, 14.16.
^{19}F NMR (376 MHz, $CDCl_3$) δ -127.59 (dt, *J* = 8.3, 4.3 Hz).

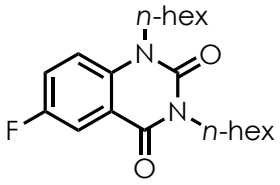
HRMS (ESI): Calculated for $C_{13}H_{19}FN_2O$ $(M+H)^+$: 239.15541; found: 239.15467.



6-Fluoro-3-hexylquinazoline-2,4(1*H*,3*H*)-dione (i-18) To a dry, clean round bottomed flask equipped with a stir bar was added 2-amino-5-fluoro-*N*-hexylbenzamide (2.38 g, 10.0 mmol, 1.0 eq.), which was then dissolved in DMF (20 mL) under N_2. Carbonyldiimidazole (2.11 g, 13.0 mmol, 1.30 eq.) was then added to the reaction mixture and the suspension was allowed to stir overnight. At the end of the reaction, the mixture was diluted with EtOAc (30 mL) and DI H_2O (40 mL). The layers were separated and the aqueous layer extracted twice with EtOAc (2 x 15 mL). The organic layers were then combined, washed sequentially with 20% LiCl solution (twice) and brine, dried over $MgSO_4$ and concentrated to yield 6-fluoro-3-hexylquinazoline-2,4(1*H*,3*H*)-dione as a pale, off-white solid (2.44 g, 92%) that was analytically pure by ^{1}H and ^{13}C NMR. The crude product was carried onto the next synthetic step without further purification.

^{1}H NMR (600 MHz, $CDCl_3$) δ 10.93 (s, 1H), 7.79 (dd, *J* = 8.3, 2.9 Hz, 1H), 7.35 (td, *J* = 8.4, 2.9 Hz, 1H), 7.15 (dd, *J* = 8.8, 4.0 Hz, 1H), 4.11 – 4.03 (m, 2H), 1.77 – 1.60 (m, 2H), 1.45 – 1.37 (m, 2H), 1.37 – 1.26 (m, 4H), 0.89 (t, *J* = 6.9 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 161.70 (d, *J* = 2.9 Hz), 158.67 (d, *J* = 244.1 Hz), 152.32, 135.23, 123.16 (d, *J* = 24.4 Hz), 117.07 (d, *J* = 7.6 Hz), 115.89 (d, *J* = 7.8 Hz), 113.82 (d, *J* = 24.2 Hz), 41.41, 31.62, 27.93, 26.74, 22.68, 14.19.
^{19}F NMR (376 MHz, CDCl3) δ -117.93 (td, *J* = 8.1, 4.1 Hz).

HRMS (ESI): Calculated for $C_{14}H_{17}FN_2O_2$ $(M+H)^+$: 265.13468; found: 265.13404.

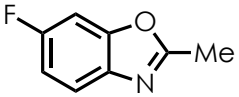


6-Fluoro-1,3-dihexylquinazoline-2,4(1*H*,3*H*)-dione (28) To a dry, clean round bottomed flask equipped with a stir bar was added 6-fluoro-3-hexylquinazoline-2,4(1*H*,3*H*)-dione (2.44 g, 9.20 mmol, 1.0 eq.) and potassium carbonate (6.36 g, 46 mmol, 5.0 eq.). The solids were dissolved in DMF (28 mL) under N_2 before 1-bromohexane (3.9 mL, 27.6 mmol, 3.0 eq.) was added dropwise. The reaction was then heated to 60 ºC and stirred overnight. At the end of the reaction, the mixture was diluted with ether (30 mL) and DI H_2O (40 mL). The layers were separated and the aqueous layer extracted twice with ether (2 x 15 mL). The organic layers were then combined, washed sequentially with 20% LiCl solution and brine, dried over $MgSO_4$ and concentrated. The crude product was purified via flash chromatography (5 to 10% EtOAc:Hex) to yield 6-fluoro-1,3-dihexylquinazoline-2,4(1*H*,3*H*)-dione as an off-white solid (2.08 g, 65%).

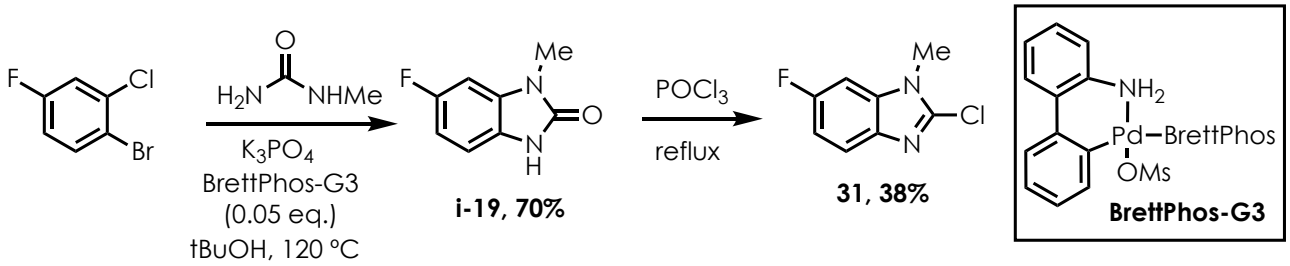
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.86 (dd, *J* = 8.2, 3.1 Hz, 1H), 7.35 (ddd, *J* = 9.3, 7.6, 3.1 Hz, 1H), 7.13 (dd, *J* = 9.2, 3.9 Hz, 1H), 4.10 – 3.99 (m, 4H), 1.74 – 1.59 (m, 4H), 1.47 – 1.15 (m, 12H), 0.86 (dt, *J* = 11.6, 6.9 Hz, 6H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 160.90 (d, *J* = 2.7 Hz), 158.16 (d, *J* = 244.1 Hz), 136.34 (d, *J* = 1.7 Hz), 122.63 (d, *J* = 24.0 Hz), 117.15 (d, *J* = 7.6 Hz), 115.50 (d, *J* = 7.3 Hz), 114.61 (d, *J* = 23.8 Hz), 44.15, 42.24, 31.58, 31.54, 27.81, 27.35, 26.73, 26.54, 22.65, 22.64, 14.11, 14.06.
^{19}F NMR (376 MHz, $CDCl_3$) δ -119.59 (td, *J* = 7.9, 4.0 Hz).

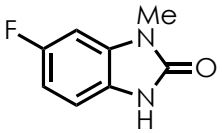
HRMS (ESI): Calculated for $C_{20}H_{29}FN_2O_2$ $(M+H)^+$: 349.2291; found: 349.2280.

3-fluoro-1-methyl-1*H*-indazole (26) The title compound was prepared according to a published procedure; spectra data are in agreement with literature values. (*68*)



6-fluoro-2-methylbenzo[*d*]oxazole The title compound was prepared according to a published procedure (*69*); spectra data are in agreement with literature values. (*70*)

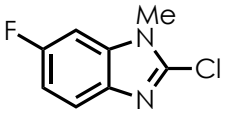




6-fluoro-1-methyl-1,3-dihydro-2*H*-benzo[*d*]imidazol-2-one (i-19) The title compound was prepared by adapting a procedure from Buchwald *et al*. (*71*). An oven-dried test tube equipped with a magnetic stir bar and a Teflon screw-cap was charged with BrettPhos-G3 (22.7 mg, 25.0 μmmol, 0.05 eq.), 1-methylurea (92.60 mg, 1.25 mmol, 2.5 eq.) and K_3PO_4 (254.7 mg, 1.2 mmol, 2.4 eq.). The tube was evacuated and backfilled with nitrogen (repeated two additional times). t-BuOH (2 mL) and 1-bromo-2-chloro-4-fluorobenzene (59.8 μL, 0.500 mmol, 1.0 eq.) were sequentially added via syringe and the punctured cap was replaced with a new one under a stream of nitrogen. The test tube was placed in a preheated oil bath at 110 ºC and stirred for 14 h. After cooling to room temperature, the mixture was diluted with EtOAc (5 mL), filtered through a short silica plug (EtOAc rinse) and concentrated using a rotary evaporator. The residue was purified using silica gel chromatography (50 to 80% EtOAc:Hex) to afford 6-fluoro-1-methyl-1,3-dihydro-2*H*-benzo[*d*]imidazol-2-one as a white solid (58.5 mg, 70%).

^{1}H NMR (600 MHz, MeOD) δ 7.00 (dd, *J* = 8.6, 4.4 Hz, 1H), 6.94 (s, 1H), 6.83 – 6.76 (m, 1H), 3.37 (s, 3H), 2.12 (t, *J* = 2.3 Hz, 1H).
^{13}C NMR (151 MHz, MeOD) δ 160.13 (d, *J* = 236.1 Hz), 157.40, 133.05 (d, *J* = 12.5 Hz), 125.62, 110.66 (d, *J* = 9.4 Hz), 108.79 (d, *J* = 24.3 Hz), 97.17 (d, *J* = 29.1 Hz), 27.18.
^{19}F NMR (376 MHz, MeOD) δ -123.16 (td, *J* = 9.3, 4.5 Hz).

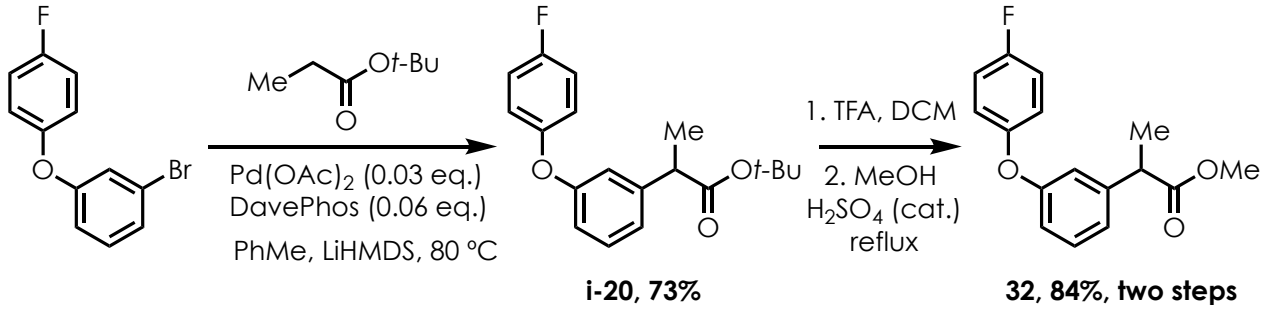
HRMS (ESI): Calculated for $C_8H_7FN_2O$ $(M+H)^+$: 167.06151; found: 167.06227

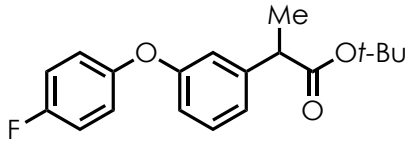


2-chloro-6-fluoro-1-methyl-1*H*-benzo[*d*]imidazole (31) The title compound was synthesized according to a published procedure (*72*); the compound was purified via flash chromatography (20 to 30% EtOAc:Hex) with basic aluminum oxide as the stationary phase (substrate: 91.5 mg, 0.55 mmol; product: 38.3 mg, 38%)

^{1}H NMR (850 MHz, $CDCl_3$) δ 7.65 (dd, *J* = 8.8, 4.6 Hz, 1H), 7.14 – 6.94 (m, 2H), 3.78 (s, 3H).
^{13}C NMR (214 MHz, $CDCl_3$) δ 160.12 (d, *J* = 241.7 Hz), 141.01s, 137.34, 135.61 (d, *J* = 13.1 Hz), 120.31 (d, *J* = 9.9 Hz), 111.60 (d, *J* = 25.0 Hz), 96.63 (d, *J* = 27.9 Hz), 31.05.
^{19}F NMR (376 MHz, $CDCl_3$) δ -117.17.

HRMS (ESI): Calculated for $C_8H_6ClFN_2$ $(M+H)^+$: 185.02848; found: 185.02762



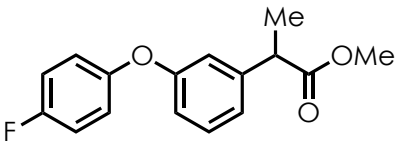


***Tert*-butyl 2-(3-(4-fluorophenoxy)phenyl)propanoate (i-20)** To a clean, dry 3-neck round bottomed flask equipped with a stir bar and a condenser were added palladium (II) acetate (33.7 mg, 0.15 mmol, 0.03 eq.) and 2-dicyclohexylphosphino-2′-(*N*,*N*-dimethylamino)biphenyl (DavePhos, 118.1 mg, 0.30 mmol, 0.06 eq.) under an inert atmosphere. The flask was sealed with rubber septa and placed under a positive N_2 pressure. The solids were then dissolved in PhMe (15 mL) and stirred for 15 min. before a solution of lithium bis(trimethylsilyl)amide (1.0 M in hexanes, 12.5 mL, 12.5 mmol, 2.5 eq.) was added dropwise. The reaction was stirred for an additional 15 minutes before it was cooled to -10 ºC. *Tert*-butyl propionate (1.7 mL, 11.5 mmol, 2.3 eq.) was then added dropwise to the reaction mixture and stirred for an additional 10 minutes. 1-Bromo-3-(4-fluorophenoxy)benzene (0.90 mL, 5.00 mmol, 1.0 eq.) was then added dropwise and the reaction was allowed to warm to room temperature before being heated to 80 ºC and stirred overnight. At the end of the reaction, the reaction mixture was filtered through a silica plug and concentrated to yield a liquid. The crude product was then purified via flash chromatography (2 to 5% EtOAc:Hex) to yield *tert*-butyl 2-(3-(4-fluorophenoxy)phenyl)propanoate as a yellow liquid (1.15 g, 73%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.28 (t, *J* = 7.9 Hz, 1H), 7.07 – 7.01 (m, 3H), 7.02 – 6.96 (m, 2H), 6.95 (t, *J* = 2.2 Hz, 1H), 6.86 (dd, *J* = 8.2, 2.7 Hz, 1H), 3.60 (q, *J* = 7.2 Hz, 1H), 1.45 (d, *J* = 7.2 Hz, 3H), 1.41 (s, 9H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 173.48, 158.91 (d, *J* = 241.6 Hz), 157.84, 153.01 (d, *J* = 2.5 Hz), 143.35, 129.84, 122.38, 120.59 (d, *J* = 8.2 Hz), 117.57, 116.80, 116.37 (d, *J* = 23.2 Hz), 80.70, 46.46, 28.01, 18.48.
^{19}F NMR (376 MHz, $CDCl_3$) δ -120.14 (td, *J* = 8.0, 4.1 Hz).

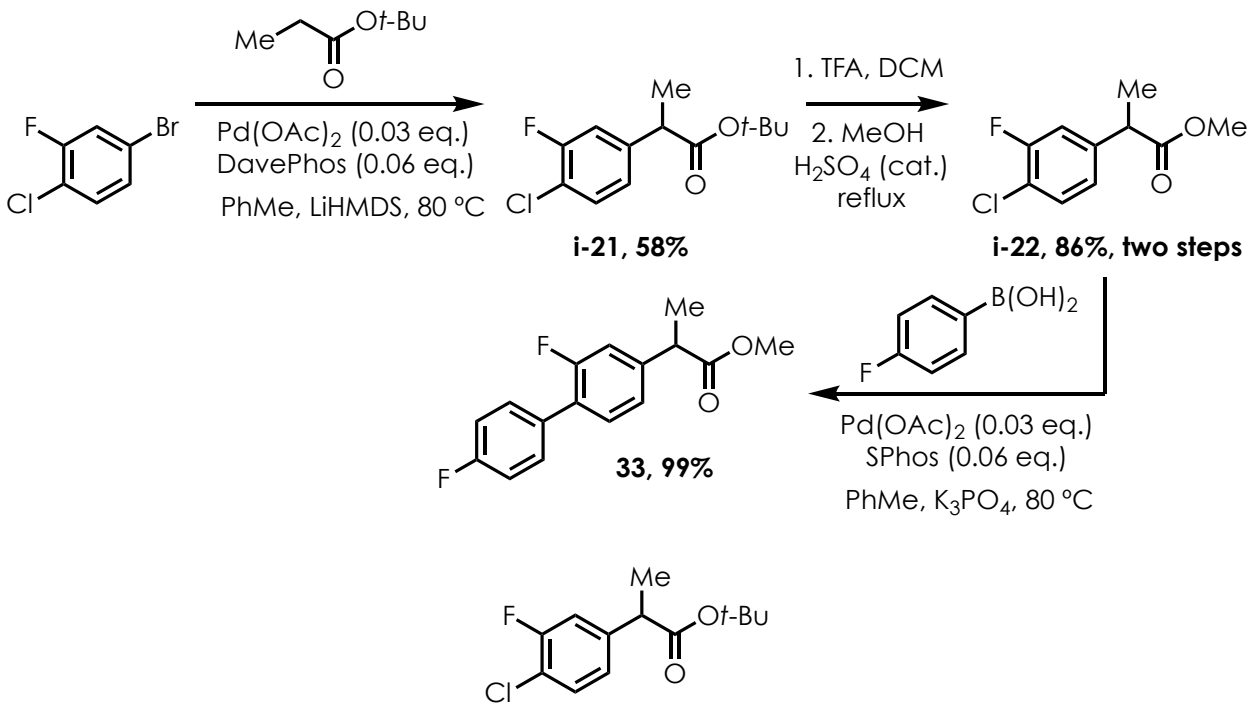
HRMS (ESI): Calculated for $C_{19}H_{21}FO_3$ $(M+H)^+$: 317.1553; found: 317.1557.



Methyl 2-(3-(4-fluorophenoxy)phenyl)propanoate (32) To a clean, dry round bottomed flask equipped with a stir bar was added *tert*-butyl 2-(3-(4-fluorophenoxy)phenyl)propanoate (1.15 g, 3.63 mmol, 1.0 eq.), which was then dissolved in 8.6 mL of DCM. Trifluoroacetic acid (8.6 mL) was then added to the solution and the reaction was stirred for 2 h. At the end of the reaction, the mixture was concentrated under reduced pressure and reconstituted in 10 mL of DCM. TLC analysis suggested full conversion to the desired product, thus the crude was then re-concentrated to remove excess trifluoroacetic acid and was carried forward to the esterification without further purification. The dry crude was then dissolved in 10 mL of dry MeOH under N_2 and a catalytic amount of sulfuric acid was added to the solution. The reaction was then refluxed for 3 h. At the end of the reaction, the solution was concentrated, diluted with ether and neutralized with saturated $NaHCO_3$ solution. The layers were then separated and the aqueous layer was extracted once with 10 mL of ether. The organic layers were combined, washed with brine, dried over Na_2SO_4 and concentrated. The crude product was purified via column chromatography (5 to 15% EtOAc:Hex) to yield methyl 2-(3-(4-fluorophenoxy)phenyl)propanoate as a colorless liquid (0.851 g, 84%)

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.26 (t, *J* = 7.9 Hz, 1H), 7.05 – 7.00 (m, 3H), 7.00 – 6.96 (m, 2H), 6.96 – 6.94 (m, 1H), 6.83 (ddd, *J* = 8.2, 2.5, 1.0 Hz, 1H), 3.70 (q, *J* = 7.2 Hz, 1H), 3.66 (s, 3H), 1.49 (d, *J* = 7.2 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 174.68, 158.96 (d, *J* = 241.7 Hz), 157.98, 152.75 (d, *J* = 2.6 Hz), 142.68, 129.97, 122.28, 120.70 (d, *J* = 8.3 Hz), 117.61, 116.74, 116.39 (d, *J* = 23.2 Hz), 52.14, 45.34, 18.58.
^{19}F NMR (376 MHz, $CDCl_3$) δ -119.87 (ddd, *J* = 12.3, 8.0, 4.6 Hz).

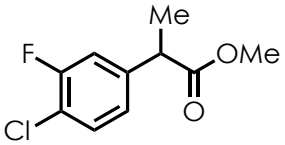
HRMS (ESI): Calculated for $C_{16}H_{15}FO_3$ $(M+H)^+$: 275.1083; found: 275.1073.



***Tert*-butyl 2-(4-chloro-3-fluorophenyl)propanoate (i-21)** To a clean, dry 3-neck round bottomed flask equipped with a stir bar and a condenser were added palladium (II) acetate (33.7 mg, 0.15 mmol, 0.03 eq.), 2-dicyclohexylphosphino-2′-(*N*,*N*-dimethylamino)biphenyl (DavePhos, 118.1 mg, 0.30 mmol, 0.06 eq.), and lithium bis(trimethylsilyl)amide (2.09 g, 12.5 mmol, 2.5 eq.) under an inert atmosphere. The flask was sealed with rubber septa and placed under a positive N_2 pressure. The solids were then dissolved in PhMe (15 mL) and stirred for 15 min. at room temperature before the solution was cooled to -10 ºC. *Tert*-butyl propionate (1.7 mL, 11.5 mmol, 2.3 eq.) was then added dropwise to the reaction mixture and stirred for an additional 10 minutes. 4-bBromo-1-chloro-2-fluorobenzene (0.61 mL, 5.00 mmol, 1.0 eq.) was then added dropwise and the reaction was allowed to warm to room temperature before being heated to 80 ºC and stirred overnight. At the end of the reaction, the reaction mixture was filtered through a silica plug and concentrated to yield a liquid. The crude product was then purified via flash chromatography (5 to 10% DCM:Hex) to yield *tert*-butyl 2-(4-chloro-3-fluorophenyl)propanoate as a pale yellow liquid (0.760 g, 58%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.31 (t, *J* = 8.0 Hz, 1H), 7.10 (dd, *J* = 10.2, 2.1 Hz, 1H), 7.01 (dd, *J* = 8.4, 2.1 Hz, 1H), 3.57 (q, *J* = 7.2 Hz, 1H), 1.42 (d, *J* = 7.2 Hz, 3H), 1.39 (s, 9H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 172.96, 158.10 (d, *J* = 248.6 Hz), 142.07 (d, *J* = 6.6 Hz), 130.55, 124.09 (d, *J* = 3.7 Hz), 119.43 (d, *J* = 17.6 Hz), 115.85 (d, *J* = 21.5 Hz), 81.16, 45.97 (d, *J* = 1.6 Hz), 27.99, 18.42.
^{19}F NMR (376 MHz, $CDCl_3$) δ -118.27 (dd, *J* = 10.1, 7.7 Hz).

HRMS (ESI): Calculated for $C_{13}H_{16}ClFO_2$ $(M+H)^+$: 259.08956; found: 259.15081.

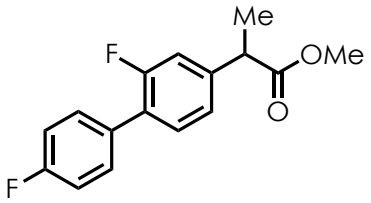


Methyl 2-(4-chloro-3-fluorophenyl)propanoate (i-22) To a clean, dry round bottomed flask equipped with a stir bar was added *tert*-butyl 2-(4-chloro-3-fluorophenyl)propanoate (0.648 g, 2.50

mmol, 1.0 eq.), which was then dissolved in 5.9 mL of DCM. Trifluoroacetic acid (5.9 mL) was then added to the solution and the reaction was stirred for 2 h. At the end of the reaction, the mixture was concentrated under reduced pressure and reconstituted in 10 mL of DCM. TLC analysis suggested full conversion to the desired product, thus the crude was then re-concentrated to remove excess trifluoroacetic acid and was carried forward to the esterification without further purification. The dry crude was then dissolved in 10 mL of dry MeOH under N_2 and a catalytic amount of sulfuric acid was added to the solution. The reaction was then refluxed for 3 h. At the end of the reaction, the solution was concentrated, diluted with ether and neutralized with saturated $NaHCO_3$ solution. The layers were then separated and the aqueous layer was extracted once with 10 mL of ether. The organic layers were combined, washed with brine, dried over Na_2SO_4 and concentrated. The crude product was purified via column chromatography (5 to 10% DCM:Hex) to yield methyl 2-(4-chloro-3-fluorophenyl)propanoate as a colorless liquid (0.468 g, 86%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.31 (td, *J* = 7.8, 1.7 Hz, 1H), 7.10 (dt, *J* = 10.0, 1.7 Hz, 1H), 7.02 (dd, *J* = 8.3, 2.1 Hz, 1H), 3.69 (q, *J* = 7.3 Hz, 1H), 3.66 (t, *J* = 1.2 Hz, 3H), 1.47 (dd, *J* = 7.2, 1.5 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 174.14, 158.12 (d, *J* = 248.8 Hz), 141.32 (d, *J* = 6.5 Hz), 130.69, 124.14 (d, *J* = 3.7 Hz), 119.75 (d, *J* = 17.6 Hz), 115.93 (d, *J* = 21.5 Hz), 52.31, 44.82, 18.44.
^{19}F NMR (376 MHz, $CDCl_3$) δ -114.86 (ddd, *J* = 11.0, 7.7, 3.4 Hz).

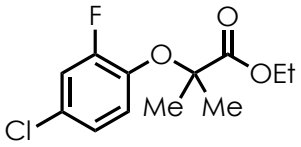
HRMS (ESI): Calculated for $C_{10}H_{10}ClFO_2$ $(M+H)^+$: 217.04261; found: 217.04216.



Methyl 2-(2,4'-difluoro-[1,1'-biphenyl]-4-yl)propanoate (33) To a clean, dry 2 dram vial equipped with a stir bar was added potassium phosphate tribasic (212.3 mg, 1.00 mmol, 2.0 eq.) and (4-fluorophenyl)boronic acid (70.0 mg, 0.500 mmol, 1.0 eq.). The vial was then brought into the glovebox (N_2), where palladium (II) acetate (2.3 mg, 10.0 μmol, 0.02 eq.) and dicyclohexyl(2',6'-dimethoxy-[1,1'-biphenyl]-2-yl)phosphine (SPhos, 8.2 mg, 20.0 μmol, 0.04 eq.) were added consecutively to the solids. Dry toluene (1 mL) was added, the vial was then sealed with a septum cap and the reaction was stirred for approximately 2 min. before the addition of methyl 2-(4-chloro-3-fluorophenyl)propanoate (108.3 mg, 88.9 μL, 0.500 mmol, 1.0 eq.). The vial was resealed with the septum cap, brought out of the glovebox and heated at 90 ºC for 19 h. At the end of the reaction, the the vial was cooled to room temperature before being diluted with ether (10 mL), filtered through a silica plug and concentrated to yield a liquid. The crude product was then purified via flash chromatography (20 to 30% DCM:Hex) to yield methyl 2-(2,4'-difluoro-[1,1'-biphenyl]-4-yl)propanoate as a colorless liquid (136 mg, 99%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.50 (ddt, *J* = 6.9, 5.4, 1.6 Hz, 2H), 7.35 (t, *J* = 8.0 Hz, 1H), 7.16 – 7.10 (m, 4H), 3.76 (q, *J* = 7.2 Hz, 1H), 3.70 (s, 3H), 1.54 (d, *J* = 7.2 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 174.53, 162.55 (d, *J* = 247.2 Hz), 159.71 (d, *J* = 248.1 Hz), 142.07 (d, *J* = 7.5 Hz), 131.56 (d, *J* = 3.3 Hz), 130.78 (d, *J* = 3.9 Hz), 130.71 (dd, *J* = 8.1, 3.1 Hz), 126.97 (d, *J* = 13.4 Hz), 123.72 (d, *J* = 3.6 Hz), 115.54 (d, *J* = 21.5 Hz), 115.42 (d, *J* = 23.4 Hz), 52.36, 45.02, 18.54.
^{19}F NMR (376 MHz, $CDCl_3$) δ -114.44 (ddd, *J* = 14.2, 8.8, 5.2 Hz), -117.61 (dd, *J* = 11.5, 8.1 Hz).

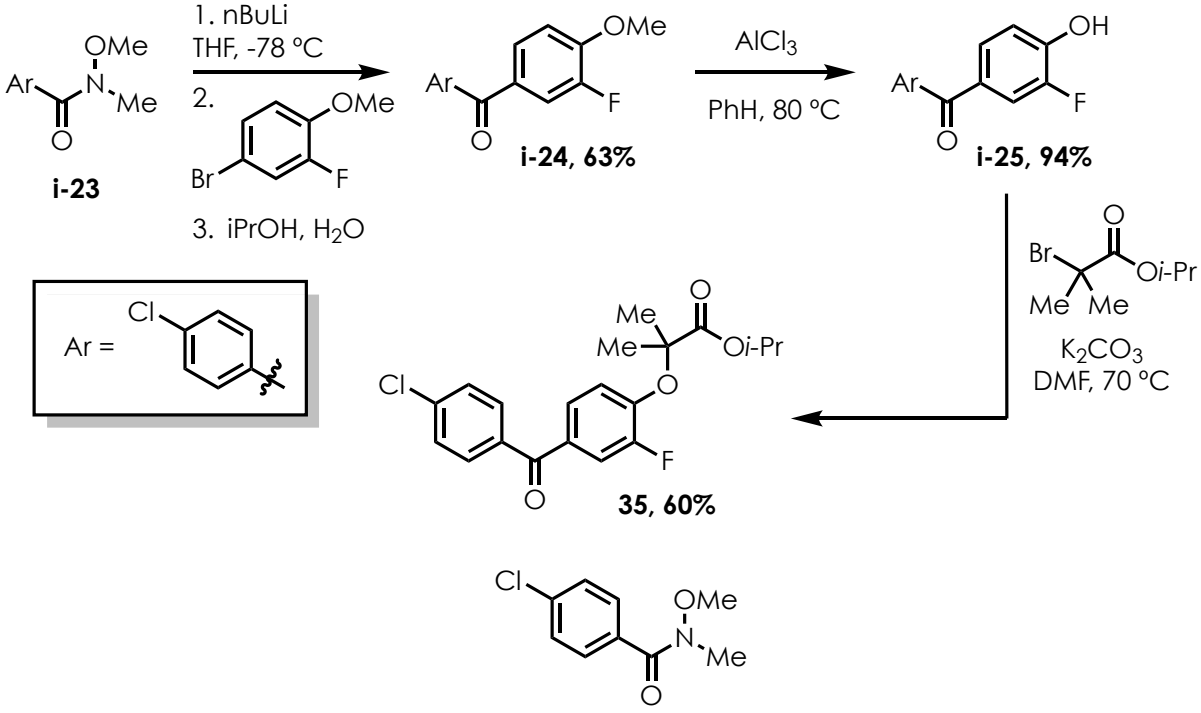
HRMS (ESI): Calculated for $C_{16}H_{14}F_2O_2$ $(M+H)^+$: 277.07899; found: 277.08288.



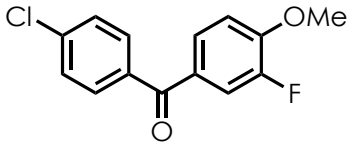
Ethyl 2-(4-chloro-2-fluorophenoxy)-2-methylpropanoate (34) To a dry, clean 3-neck round bottomed flask equipped with a condenser and a stir bar was added potassium carbonate (1.73 g, 12.5 mmol, 2.5 eq.) and 4-chloro-2-fluorophenol (733 mg, 5.00 mmol, 1.0 eq.). The flask was then sealed with rubber septa and the solids were then dissolved in DMF (10 mL) under N_2. Ethyl 2-bromo-2-methylpropanoate (1.47 mL, 10.0 mmol, 2.0 eq.) was added dropwise via syringe and the reaction was heated to 70 ºC overnight. At the end of the reaction, the reaction was cooled to room temperature before being diluted with ether (15 mL) and water (30 mL). The layers were separated and the aqueous layer was extracted twice with 10 mL of ether. The organic layers were combined, washed sequentially with 20% LiCl solution (15 mL) and brine (15 mL), dried over $MgSO_4$ and concentrated to yield a yellow oil. The crude product was then purified via flash chromatography (5-20% EtOAc:Hex) to yield ethyl 2-(4-chloro-2-fluorophenoxy)-2-methylpropanoate as an oil (0.885 g, 68%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.07 (dd, *J* = 10.5, 2.5 Hz, 1H), 6.99 – 6.95 (m, 1H), 6.92 (t, *J* = 8.6 Hz, 1H), 4.22 (q, *J* = 7.2 Hz, 2H), 1.55 (d, *J* = 2.4 Hz, 6H), 1.26 (t, *J* = 7.3 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 173.46, 155.12 (d, *J* = 250.4 Hz), 141.92 (d, *J* = 11.1 Hz), 128.26 (d, *J* = 9.2 Hz), 124.23 (d, *J* = 3.8 Hz), 123.50 (d, *J* = 2.0 Hz), 117.29 (d, *J* = 22.8 Hz), 81.41, 61.64, 24.97, 14.15.
^{19}F NMR (376 MHz, $CDCl_3$) δ -119.87 – -135.56 (m).

HRMS (ESI): Calculated for $C_{12}H_{14}ClFO_3$ $(M+H)^+$: 261.0688; found: 261.0682.



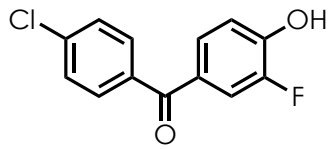
4-Chloro-*N*-methoxy-*N*-methylbenzamide (i-23) was prepared according to a published procedure; spectra data are in agreement with literature values. (*73*)



(4-Chlorophenyl)(3-fluoro-4-methoxyphenyl)methanone (i-24) To a clean, dry round-bottomed flask equipped with a stir bar was added 4-bromo-2-fluoroanisole (0.88 mL, 6.79 mmol, 0.91 eq.) under N_2. Then THF (45 mL) was added and the reaction was cooled to -78 ºC. A solution of nBuLi (2.5 M in hexanes, 3.0 mL, 7.48 mmol, 1.0 eq.) was added dropwise under positive N_2 pressure and the reaction was allowed to stir for 20 minutes. A solution of 4-chloro-*N*-methoxy-*N*-methylbenzamide (1.49 g, 7.49 mmol, 1.0 eq.) in THF (10 mL) was prepared and added dropwise to the aryllithium species under positive N_2 pressure. The solution was allowed to stir at -78 ºC for 1.5 h and subsequently quenched at -78ºC with *i*-PrOH (10 mL) and DI H_2O (10 mL), and allowed to warm to room temperature. Ether (20 mL) and DI H_2O (20 mL) were then added to the reaction mixture and the layers were separated. The aqeuous layer was extracted with ether (10 mL x 2) and the organic layers were combined. The combined organic fractions were washed with brine, dried over Na_2SO_4 and concentrated. The crude mixture was purified via flash chromatography (10 to 20% EtOAc:Hex) to yield 4-chlorophenyl)(3-fluoro-4-methoxyphenyl)methanone as a white solid (1.25 g, 63%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.72 – 7.68 (m, 2H), 7.62 – 7.54 (m, 2H), 7.48 – 7.45 (m, 2H), 7.02 (t, *J* = 8.4 Hz, 1H), 3.98 (s, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 151.98 (d, *J* = 248.6 Hz), 151.91 (d, *J* = 10.7 Hz), 138.83, 136.07, 131.27, 130.13 (d, *J* = 5.0 Hz), 128.82, 127.73 (d, *J* = 3.3 Hz), 117.86 (d, *J* = 19.1 Hz), 112.41 (d, *J* = 2.1 Hz), 56.50.
^{19}F NMR (376 MHz, $CDCl_3$) δ -133.81 – -133.89 (m).

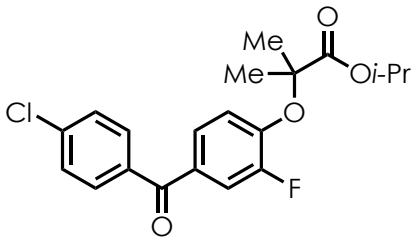
HRMS (ESI): Calculated for $C_{14}H_{10}ClFO_2$ $(M+H)^+$: 265.04261; found: 265.04216.



(4-Chlorophenyl)(3-fluoro-4-hydroxyphenyl)methanone (i-25) To a clean, dry 2-neck round bottomed flask equipped with a stir bar was added (4-chlorophenyl)(3-fluoro-4-methoxyphenyl)methanone (1.23 g, 4.63 mmol, 1.0 eq.), which was then dissolved in benzene (50 mL) under N_2. Aluminum chloride (3.70 g, 27.8 mmol, 6.0 eq.) was then added in three portions to the solution and the reaction mixture was refluxed overnight. At the end of the reaction, the reaction was quenched with ice (approx. 10 g), and the layers were separated. The aqueous layer was extracted twice with DCM (10 mL) and the organic layers were combined. The organic fractions were then washed with saturated ammonium chloride solution, dried over $MgSO_4$ and concentrated. The crude product was purified via flash chromatography (30 to 40% EtOAc:Hex) to yield (4-chlorophenyl)(3-fluoro-4-hydroxyphenyl)methanone as a pink solid (1.10 g, 95%).

^{1}H NMR (600 MHz, Acetone-d_6) δ 9.64 (s, 1H), 7.80 – 7.71 (m, 2H), 7.61 – 7.56 (m, 3H), 7.53 (ddd, *J* = 8.3, 2.1, 0.9 Hz, 1H), 7.14 (t, *J* = 8.5 Hz, 1H).
^{13}C NMR (151 MHz, Acetone-d_6) δ 193.24 (d, *J* = 1.5 Hz), 151.91 (d, *J* = 243.0 Hz), 150.48 (d, *J* = 12.9 Hz), 138.60, 137.50, 132.10, 130.26 (d, *J* = 4.7 Hz), 129.49, 128.74 (d, *J* = 2.9 Hz), 118.49 (d, *J* = 19.3 Hz), 118.29 (d, *J* = 2.8 Hz).
^{19}F NMR (376 MHz, Acetone-d_6) δ -137.61 (dd, *J* = 11.7, 8.5 Hz).

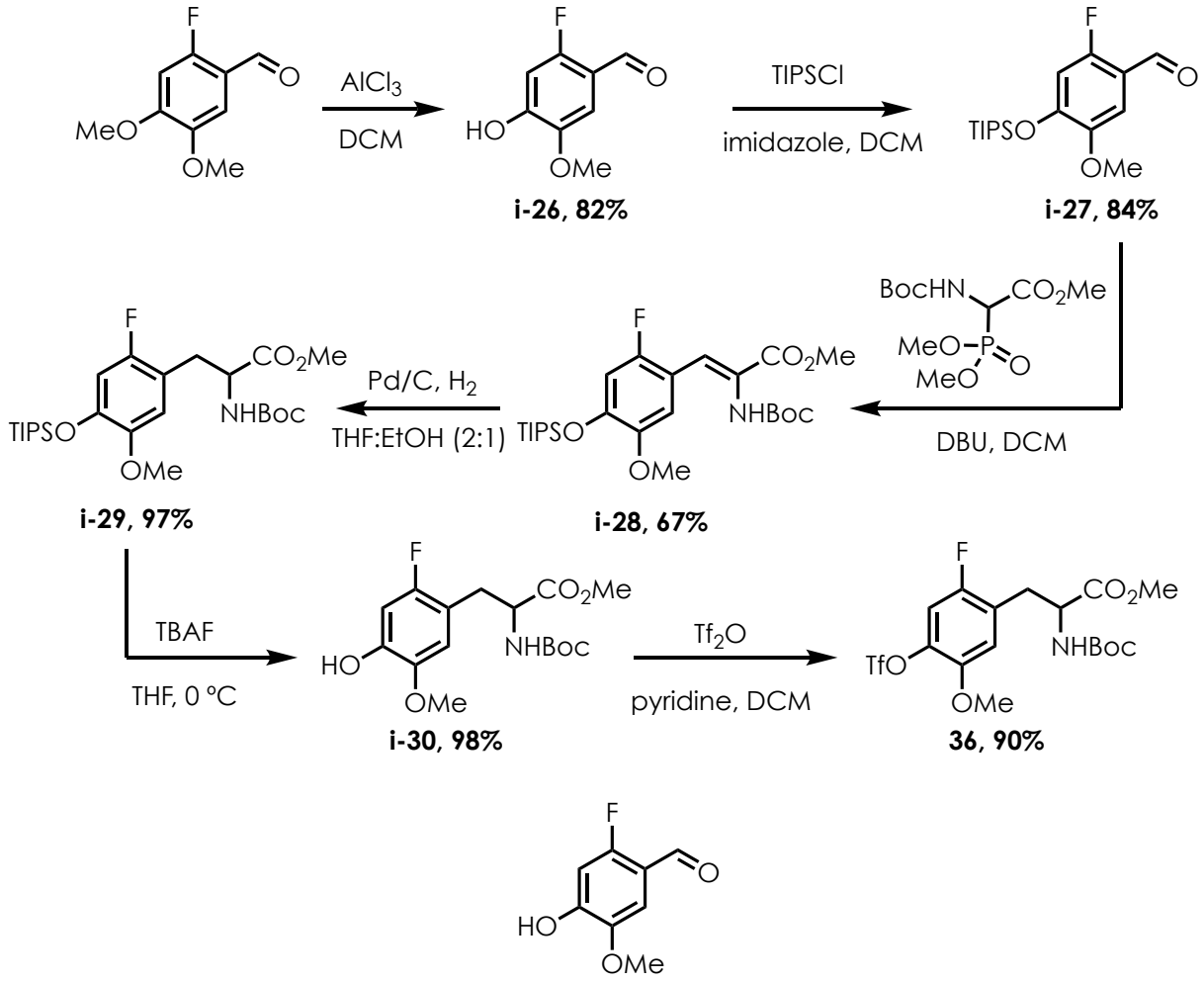
HRMS (ESI): Calculated for $C_{13}H_8ClFO_2$ $(M+H)^+$: 251.02696; found: 251.02653.



Isopropyl 2-(4-(4-chlorobenzoyl)-2-fluorophenoxy)-2-methylpropanoate (35) To a dry, clean 3-neck round bottomed flask equipped with a condenser and a stir bar was added potassium carbonate (1.49 g, 10.8 mmol, 2.5 eq.) and (4-chlorophenyl)(3-fluoro-4-hydroxyphenyl)methanone (1.08 mg, 4.31 mmol, 1.0 eq.). The flask was then sealed with rubber septa and the solids were then dissolved in DMF (10 mL) under N_2. Isopropyl 2-bromo-2-methylpropanoate (1.45 mL, 8.62 mmol, 2.0 eq.) was added dropwise via syringe and the reaction was heated to 70 ºC overnight. At the end of the reaction, the reaction was cooled to room temperature before being diluted with ether (15 mL) and water (30 mL). The layers were separated and the aqueous layer was extracted twice with 10 mL of ether. The organic layers were combined, washed sequentially with 20% LiCl solution (15 mL) and brine (15 mL), dried over $MgSO_4$ and concentrated to yield a pink-red solid. The crude product was then purified via flash chromatography (5-20% EtOAc:Hex) to yield isopropyl 2-(4-(4-chlorobenzoyl)-2-fluorophenoxy)-2-methylpropanoate as a pink-red solid (983 mg, 60%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.72 – 7.65 (m, 2H), 7.57 (dd, *J* = 11.3, 2.1 Hz, 1H), 7.48 – 7.42 (m, 3H), 6.92 (t, *J* = 8.2 Hz, 1H), 5.09 (hept, *J* = 6.3 Hz, 1H), 1.65 (s, 6H), 1.22 (d, *J* = 6.3 Hz, 6H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 193.31 (d, *J* = 1.4 Hz), 172.73, 153.63 (d, *J* = 248.9 Hz), 147.88 (d, *J* = 10.9 Hz), 138.89, 135.86, 131.44 (d, *J* = 5.4 Hz), 131.25, 128.80, 126.63 (d, *J* = 3.5 Hz), 119.16, 118.29 (d, *J* = 20.4 Hz), 81.12, 69.54, 25.28, 21.65.
^{19}F NMR (376 MHz, $CDCl_3$) δ -129.29 (dd, *J* = 11.4, 8.0 Hz).

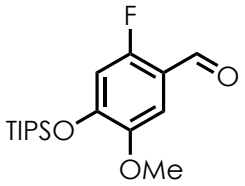
HRMS (ESI): Calculated for $C_{20}H_{20}ClFO_4$ $(M+H)^+$: 379.11068; found: 379.10971.



2-Fluoro-4-hydroxy-5-methoxybenzaldehyde (i-26) To a clean, dry round bottomed flask equipped with a stir bar was added 2-fluoro-4,5-dimethoxybenzaldehyde (1.04 g, 5.64 mmol, 1.0 eq.), which was then dissolved in 80 mL of DCM. Aluminum trichloride (4.51 g, 33.8 mmol, 6.0 eq.) was then added in three portions to the reaction mixture and the reaction was kept under N_2 for 20 h. The reaction was then carefully poured into ice (caution: exothermic!) and stirred until all the ice was melted. The organic layer was then separated, dried over $MgSO_4$, concentrated and purified via flash chromatography (DCM to 10% EtOAc:DCM) to provide 2-fluoro-4-hydroxy-5-methoxybenzaldehyde (0.785 g, 82%) as a white solid and the isomeric 2-fluoro-5-hydroxy-4-methoxybenzaldehyde (97.0 mg, 10%) as a pale yellow solid.

^{1}H NMR (600 MHz, $CDCl_3$) δ 10.21 (s, 1H), 7.29 (d, *J* = 6.1 Hz, 1H), 6.72 (d, *J* = 10.9 Hz, 1H), 6.35 (d, *J* = 1.4 Hz, 1H), 3.94 (s, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 185.96 (d, *J* = 6.7 Hz), 161.63 (d, *J* = 253.0 Hz), 153.13 (d, *J* = 13.5 Hz), 143.79 (d, *J* = 2.1 Hz), 116.60 (d, *J* = 9.1 Hz), 107.63 (d, *J* = 3.4 Hz), 102.90 (d, *J* = 26.3 Hz), 56.61.
^{19}F NMR (376 MHz, $CDCl_3$) δ -128.30 (dt, *J* = 10.2, 4.7 Hz).

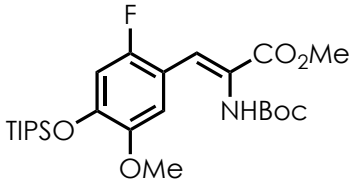
HRMS (ESI): Calculated for $C_8H_7FO_3$ $(M+H)^+$: 171.04250; found: 171.04477.



2-Fluoro-5-methoxy-4-((triisopropylsilyl)oxy)benzaldehyde (i-27) To a clean, dry round bottomed flask equipped with a stir bar was added 2-fluoro-4-hydroxy-5-methoxybenzaldehyde (681 mg, 4.00 mmol, 1.0 eq.) and imidazole (545 mg, 8.00 mmol, 2.0 eq.). The solids were dissolved in 20 mL of DCM under N_2 and the solution was cooled to 0 ºC. Triisopropylsilyl chloride (1.0 mL, 4.80 mmol, 1.2 eq.) was then added to the reaction mixture dropwise and the reaction was then warmed to room temperature and stirred for 6 h. At the end of the reaction, the mixture was concentrated under reduced pressure, loaded onto Celite and purified via column chromatography (2 to 10% EtOAc:Hex) to yield a colorless oil (1.09 g, 84%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 10.17 (d, *J* = 2.6 Hz, 1H), 7.24 (dd, *J* = 6.7, 1.9 Hz, 1H), 6.61 (dd, *J* = 11.3, 2.2 Hz, 1H), 3.80 (s, 3H), 1.25 (dt, *J* = 15.0, 7.5 Hz, 3H), 1.06 (dd, *J* = 7.6, 2.7 Hz, 18H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 185.95 (d, *J* = 6.0 Hz), 160.76 (d, *J* = 253.4 Hz), 153.23 (d, *J* = 12.2 Hz), 148.31 (d, *J* = 2.1 Hz), 117.24 (d, *J* = 8.8 Hz), 108.42 (d, *J* = 3.7 Hz), 108.12 (d, *J* = 23.4 Hz), 55.81, 17.82, 12.96.
^{19}F NMR (376 MHz, $CDCl_3$) δ -129.93 (ddd, *J* = 10.7, 7.2, 3.4 Hz).

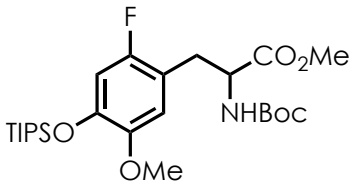
HRMS (ESI): Calculated for $C_{17}H_{27}FO_3Si$ $(M+H)^+$: 327.17863; found: 327.17776.



Methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxy-4-((triisopropylsilyl)oxy)phenyl)acrylate (i-28)
Methyl 2-((*tert*-butoxycarbonyl)amino)-2-(dimethoxyphosphoryl)acetate (1.08 g, 3.62 mmol, 1.2 eq.) was added to a flame dried round bottomed flask equipped with a stir bar and dissolved in 6 mL of dry DCM under N_2. Then 1,8-diazabicyclo[5.4.0]undec-7-ene (0.46 mL, 3.02 mmol, 1.0 eq.) was added via syringe and the mixture was stirred at room temperature for 15 minutes. While the phosphonate ester solution was stirring, a solution of 2-fluoro-5-methoxy-4-((triisopropylsilyl)oxy)benzaldehyde (2.23 g, 7.23 mmol, 1.0 eq.) in 6 mL DCM was prepared. This benzaldehyde solution was added to the phosphonate ester solution dropwise at room temperature. Reaction conversion was monitored via TLC (reaction takes approximately 4 h.) and at the end of the reaction, the solution was concentrated and loaded onto Celite. The crude reaction mixture was then purified via flash chromatography (10 to 20% EtOAc) to yield methyl (Z)-2-((tert-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxy-4-((triisopropylsilyl)oxy)phenyl)acrylate as a white solid (1.01 g, 67%)

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.38 (s, 1H), 7.17 (d, *J* = 6.9 Hz, 1H), 6.61 (d, *J* = 11.2 Hz, 1H), 3.85 (s, 3H), 3.76 (s, 3H), 1.39 (s, 9H), 1.26 (dt, *J* = 14.9, 7.5 Hz, 3H), 1.09 (d, *J* = 7.5 Hz, 18H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 166.14, 155.63 (d, *J* = 246.5 Hz), 148.10 (d, *J* = 11.8 Hz), 147.41, 122.76 (d, *J* = 4.3 Hz), 114.28 (d, *J* = 13.9 Hz), 111.77, 108.08 (d, *J* = 25.3 Hz), 81.02, 56.00, 52.74, 28.26, 17.96, 13.00.
^{19}F NMR (376 MHz, $CDCl_3$) δ -120.13.

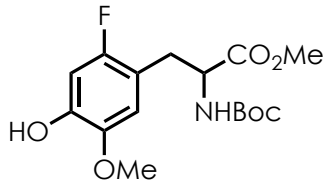
HRMS (ESI): Calculated for $C_{25}H_{40}FNO_6Si$ $(M+H)^+$: 498.26817; found: 498.26692.



Methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxy-4-((triisopropylsilyl)oxy)phenyl)propanoate (i-29) To a dry, clean round bottomed flask equipped with a stir bar was added methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxy-4-((triisopropylsilyl)oxy)phenyl)acrylate (0.977 g, 1.96 mmol, 1.0 eq.), which was then dissolved in 12 mL of a THF:EtOH (2:1) solution. 10% Palladium on carbon (20.9 mg, 0.20 mmol, 0.10 eq.) was added to the solution and the reaction was placed under N_2. The solution was purged and backfilled with H_2 before being placed under a H_2 atmosphere (1 atm) overnight (reaction is typically done in about 2-3 hours). Once the reaction was complete, the solution was run through a Celite plug and concentrated. The crude mixture was then purified by flash chromatography (10% EtOAc:Hex) to yield methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxy-4-((triisopropylsilyl)oxy)phenyl)propanoate as a white solid (0.950 g, 97%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 6.58 (d, *J* = 10.7 Hz, 1H), 6.56 (d, *J* = 7.7 Hz, 1H), 5.05 (d, *J* = 8.3 Hz, 1H) + rotamer at 4.80 (s), 4.52 (q, *J* = 6.8 Hz, 1H) + rotamer at 4.36 (s), 3.75 (s, 3H), 3.69 (s, 3H), 3.03 (qd, *J* = 14.0, 6.3 Hz, 2H), 1.41 (s, 9H), 1.27 – 1.20 (m, 3H), 1.07 (d, *J* = 7.5 Hz, 18H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 172.49, 155.22 (d, *J* = 238.6 Hz), 155.15, 147.43 (d, *J* = 2.6 Hz), 145.46 (d, *J* = 11.4 Hz), 114.58 (d, *J* = 17.4 Hz), 114.26 (d, *J* = 6.2 Hz), 108.20 (d, *J* = 25.3 Hz), 79.97, 56.20, 53.93, 52.41, 31.73, 28.43, 17.96, 12.91.
^{19}F NMR (376 MHz, $CDCl_3$) δ -126.06 (dd, *J* = 10.8, 7.3 Hz).

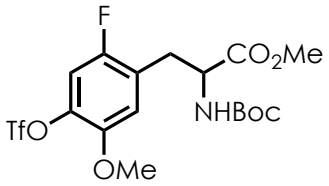
HRMS (ESI): Calculated for $C_{25}H_{42}FNO_6Si$ $(M+Na)^+$: 522.26579; found: 522.26462.



Methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-4-hydroxy-5-methoxyphenyl)propanoate (i-30) Methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxy-4-((triisopropylsilyl)oxy)phenyl)propanoate (0.925 g, 1.85 mmol, 1.0 eq.) was added to a clean, dry round bottomed flask equipped with a stir bar and the solid was dissolved in 20 mL of THF under N_2. The solution was then cooled to 0 ºC before a solution of tetrabutylammonium fluoride (1.0 M in THF, 2.0 mL, 2.04 mmol, 1.1 eq.) was added dropwise to the reaction mixture. The reaction was then warmed to room temperature and allowed to stir for 2 h. At the end of the reaction, the reaction was quenched with 15 mL NH_4Cl solution before being diluted with EtOAc. The layers were separated and the aqueous layer was extracted twice with 10 mL EtOAc. The organic layers were combined, dried over Na_2SO_4, concentrated and purified by flash chromatography (40-50% EtOAc:Hex) to yield methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-4-hydroxy-5-methoxyphenyl)propanoate as a white solid (0.620 g, 98%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 6.64 (d, *J* = 10.2 Hz, 1H), 6.58 (d, *J* = 6.7 Hz, 1H), 5.68 (s, 1H), 5.07 (d, *J* = 8.3 Hz, 1H) + rotamer at 4.79 (s), 4.52 (q, *J* = 6.8 Hz, 1H) + rotamer at 4.36 (s), 3.84 (s, 3H), 3.73 (s, 3H), 3.11 – 2.96 (m, 2H) + rotamer at 2.87 (s), 1.41 (s, 9H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 172.43, 155.82 (d, *J* = 238.0 Hz), 155.20, 145.66 (d, *J* = 12.3 Hz), 142.96 (d, *J* = 2.6 Hz), 113.33 (d, *J* = 18.0 Hz), 112.82 (d, *J* = 4.1 Hz), 102.74 (d, *J* = 28.2 Hz), 80.05, 56.54, 54.02, 52.49, 31.61, 28.44.
^{19}F NMR (376 MHz, $CDCl_3$) δ -125.14 (dd, *J* = 10.3, 6.8 Hz).

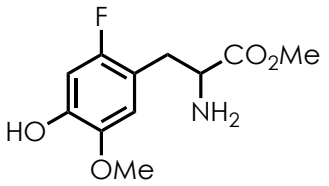
HRMS (ESI): Calculated for $C_{16}H_{22}FNO_6$ $(M+Na)^+$: 366.13236; found: 366.13142.



Methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxy-4-(((trifluoromethyl)sulfonyl)oxy)phenyl)propanoate (36) To a dry, clean round bottomed flask equipped with a stir bar was added methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-4-hydroxy-5-methoxyphenyl)propanoate (0.570 g, 1.75 mmol, 1.0 eq.) and the solid was dissolved in 20 mL of DCM under N_2. The solution was cooled to 0 ºC before pyridine (0.28 mL, 3.50 mmol, 2.0 eq.) was added to the solution. Trifluoromethanesulfonic anhydride (0.36 mL, 2.10 mmol, 1.2 eq.) was then added to the reaction dropwise and the solution was stirred for 15 minutes before being warmed to room temperature. The reaction was then run for 2 h. before being quenched with DI water. The reaction was then diluted with DCM before the layers were separated. The aqueous layer was extracted once with DCM (10 mL) and the organic layers were combined, washed sequentially with 10 mL of dilute HCl (2.0 M) and brine, dried over Na_2SO_4 and concentrated. The crude product was purified via flash chromatography (10% EtOAc) to yield methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxy-4-(((trifluoromethyl)sulfonyl)oxy)phenyl)-propanoate as a white solid (720 mg, 90%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 6.96 (d, *J* = 8.6 Hz, 1H), 6.83 (d, *J* = 6.4 Hz, 1H), 5.15 (d, *J* = 8.3 Hz, 1H) + rotamer at 4.98 (s), 4.58 (q, *J* = 7.2 Hz, 1H) + rotamer at 4.41 (s), 3.86 (s, 3H), 3.72 (s, 3H), 3.18 (dd, *J* = 14.1, 5.9 Hz, 1H), 3.03 (dd, *J* = 14.1, 7.3 Hz, 1H) + rotamer at 2.92 (s), 1.38 (s, 9H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 171.94, 155.06, 154.20 (d, *J* = 242.4 Hz), 147.87 (d, *J* = 2.9 Hz), 137.02 (d, *J* = 11.0 Hz), 124.49 (d, *J* = 17.2 Hz), 118.76 (q, *J* = 320.4 Hz), 115.26 (d, *J* = 4.9 Hz), 110.50 (d, *J* = 28.1 Hz), 80.26, 56.73, 53.37, 52.61, 32.09, 28.30.
^{19}F NMR (376 MHz, $CDCl_3$) δ -73.59 (d, *J* = 2.9 Hz), -123.68 (d, *J* = 7.7 Hz).

HRMS (ESI): Calculated for $C_{17}H_{21}F_4NO_8S$ $(M+Na)^+$: 498.08164; found: 498.08065.

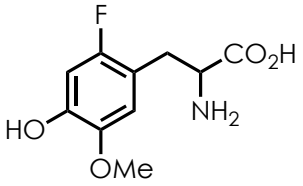


Methyl 2-amino-3-(2-fluoro-4-hydroxy-5-methoxyphenyl)propanoate (i-31) To a dry, clean round bottomed flask equipped with a stir bar was added methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxy-4-(((trifluoromethyl)sulfonyl)oxy)phenyl)propanoate (0.300 g, 0.874 mmol, 1.0 eq.). The fluoroarene was then dissolved in 4 mL of DCM under N_2 and the stirring solution was cooled

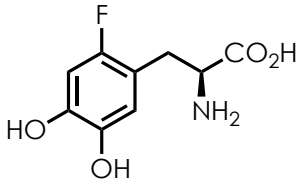
to 0 ºC. Trifluoroacetic acid (1 mL) was added dropwise to the reaction and substrate conversion was observed by TLC. Once the reaction was complete, the solution was concentrated under reduced pressure (to remove excess TFA) and reconstituted in 10 mL DCM. This new solution was then cooled to 0 ºC before dropwise addition of triethylamine (0.13 mL, 0.917 mmol, 1.05 eq.). The reaction mixture was allowed to stir for 2 h. Once the reaction was complete, it was diluted with H_2O (10 mL) and DCM (10 mL). The organic layers were combined, washed with an additional portion of water (10 mL), dried over $MgSO_4$, and concentrated under reduced pressure. The crude product was used without further purification (0.210 g, 99%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 6.60 (d, *J* = 6.8 Hz, 1H), 6.55 (d, *J* = 10.5 Hz, 1H), 3.75 (s, 3H), 3.74 – 3.71 (m, 2H), 3.70 (s, 3H), 3.61 (bs, 2H), 3.00 (dd, *J* = 13.9, 5.3 Hz, 1H), 2.84 (dd, *J* = 13.9, 7.6 Hz, 1H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 175.23, 155.62 (d, *J* = 237.7 Hz), 145.87 (d, *J* = 12.4 Hz), 143.36 (d, *J* = 2.4 Hz), 113.54 (d, *J* = 17.6 Hz), 113.13 (d, *J* = 6.2 Hz), 103.16 (d, *J* = 27.6 Hz), 56.37, 54.67, 52.22, 34.06.
^{19}F NMR (376 MHz, $CDCl_3$) δ -125.24 (dd, *J* = 10.6, 6.5 Hz).

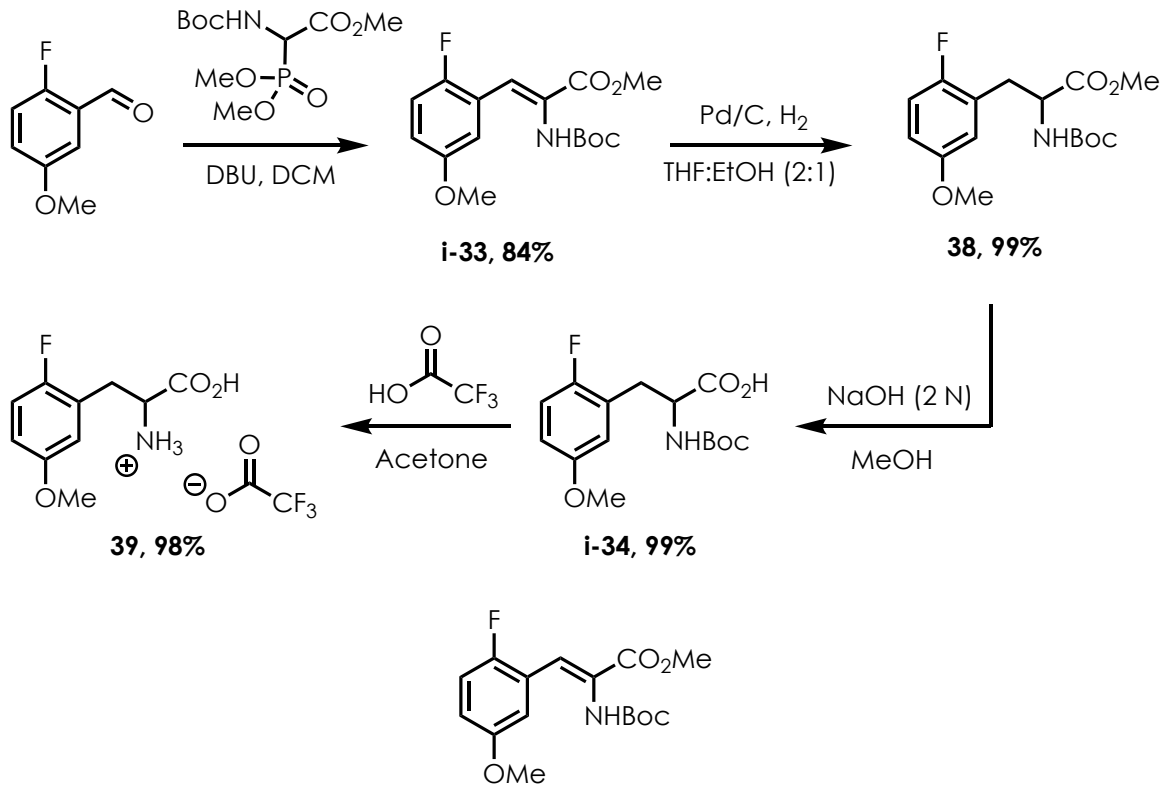
HRMS (ESI): Calculated for $C_{11}H_{14}FNO_4$ $(M+H)^+$: 244.09796; found: 244.09880



2-Amino-3-(2-fluoro-4-hydroxy-5-methoxyphenyl)propanoic acid (i-32) The title compound was prepared from methyl 2-amino-3-(2-fluoro-4-hydroxy-5-methoxyphenyl)propanoate according to a published procedure (*74*) for the non-fluorinated congener (methyl 2-amino-3-(4-hydroxy-5-methoxyphenyl)propanoate); spectra data are in agreement with literature values. (*75*)



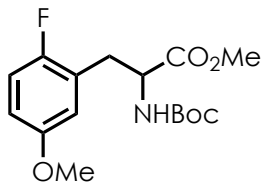
6-Fluoro-L-3,4-dihydroxyphenylalanine (37) The title compound was prepared according to a published procedure; spectral data are in agreement with literature values. (*76*)



Methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxyphenyl)acrylate (i-33)
Methyl 2-((*tert*-butoxycarbonyl)amino)-2-(dimethoxyphosphoryl)acetate (1.783 g, 6.00 mmol, 1.2 eq.) was added to a flame dried round bottomed flask equipped with a stir bar and dissolved in 15 mL of dry DCM under N_2. Then 1,8-diazabicyclo[5.4.0]undec-7-ene (0.75 mL, 5.00 mmol, 1.0 eq.) was added via syringe and the mixture was stirred at room temperature for 15 minutes. While the phosphonate ester solution was stirring, a solution of 2-fluoro-5-methoxybenzaldehyde (0.7707 g, 5.00 mmol, 1.0 eq.) in 15 mL DCM was prepared. This benzaldehyde solution was added to the phosphonate ester solution dropwise at room temperature. Reaction conversion was monitored via TLC (reaction takes approximately 4 h.) and at the end of the reaction, the solution was concentrated and loaded onto Celite. The crude reaction mixture was then purified via flash chromatography (20 to 30% EtOAc) to yield methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxyphenyl)-acrylate as a white solid (1.37 g, 84%)

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.34 (bs, 1H), 7.25 (dd, *J* = 9.7, 2.9 Hz, 1H), 6.97 (td, *J* = 9.1, 3.1 Hz, 1H), 6.83 (dd, *J* = 9.1, 4.5 Hz, 1H), 6.46 (s, 1H), 3.84 (s, 3H), 3.83 (s, 3H), 1.38 (s, 9H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 166.01, 156.69 (d, *J* = 238.2 Hz), 153.51 (d, *J* = 2.1 Hz), 152.43, 125.76, 124.50 (d, *J* = 8.2 Hz), 122.44, 116.48 (d, *J* = 23.2 Hz), 115.80 (d, *J* = 24.3 Hz), 111.99 (d, *J* = 8.3 Hz), 81.05, 56.32, 52.72, 28.13.
^{19}F NMR (376 MHz, $CDCl_3$) δ -123.87.

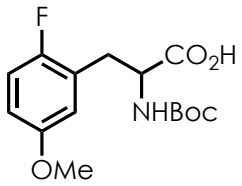
HRMS (ESI): Calculated for $C_{16}H_{20}FNO_5$ $(M+Na)^+$: 348.12180; found: 348.12177.



Methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxyphenyl)propanoate (38)
To a dry, clean round bottomed flask equipped with a stir bar was added methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxyphenyl)acrylate (1.37 g, 4.21 mmol, 1.0 eq.), which was then dissolved in 20 mL of a THF:EtOH (2:1) solution. 10% Palladium on carbon (89.6 mg, 0.20 mmol, 0.10 eq.) was added to the solution and the reaction was placed under N_2. The solution was purged and backfilled with H_2 before being placed under a H_2 atmosphere (1 atm) overnight (reaction is typically done in about 2-3 hours). Once the reaction was complete, the solution was run through a Celite plug and concentrated. The crude mixture was then purified by flash chromatography (10 to 20% EtOAc:Hex) to yield methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxyphenyl)propanoate (1.34 g, 97%) as a white solid.

^{1}H NMR (600 MHz, $CDCl_3$) δ 6.90 (td, *J* = 8.5, 3.1 Hz, 1H), 6.81 (dd, *J* = 8.8, 3.1 Hz, 1H), 6.76 (dd, *J* = 9.1, 4.4 Hz, 1H), 5.18 (d, *J* = 8.1 Hz, 1H) + rotamer at 5.03 (d, *J* = 7.4 Hz), 4.51 (q, *J* = 7.2 Hz, 1H) + rotamer at 4.33 (bs), 3.79 (s, 3H), 3.70 (s, 3H), 3.08 (dd, *J* = 13.6, 5.5 Hz, 1H), 2.98 (dd, *J* = 13.7, 7.8 Hz, 1H), 1.38 (s, 9H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 172.70, 156.83 (d, *J* = 238.3 Hz), 155.26, 153.88 (d, *J* = 2.1 Hz), 126.46 (d, *J* = 7.3 Hz), 117.98 (d, *J* = 23.0 Hz), 114.22 (d, *J* = 22.6 Hz), 111.18 (d, *J* = 8.3 Hz), 79.83, 55.96, 53.77, 52.29, 32.99, 28.36.
^{19}F NMR (376 MHz, $CDCl_3$) δ -124.13 (td, *J* = 8.2, 4.2 Hz).

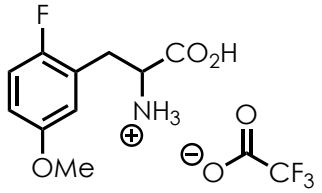
HRMS (ESI): Calculated for $C_{16}H_{22}FNO_5$ $(M+Na)^+$: 350.13745; found: 350.13731.



2-((*Tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxyphenyl)propanoic acid (i-34)
To a dry, clean round bottomed flask equipped with a stir bar was added methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxyphenyl)propanoate (327.0 mg, 1.00 mmol, 1.0 eq.). The solid was dissolved in MeOH (5 mL) and a 2 N solution of sodium hydroxide (2.0 mL, 4.00 mmol, 4.0 eq.) was slowly added to the methanol solution. The reaction was then stirred at room temperature until all of the starting material was consumed (monitored via TLC). Upon completion of hydrolysis, the reaction mixture was diluted with EtOAc (15 mL) and dilute HCl solution was added until solution pH < 2.0. The layers were then separated and the aq. layer was extracted with two additional portions of EtOAc (2 x 10 mL). The organic layers were combined, washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure to reveal 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxyphenyl)propanoic acid as a white solid. The isolated product was sufficiently pure to be used without further purification (310 mg, 99%).

^{1}H NMR (600 MHz, Acetone-d_6) δ 11.11 (bs, 1H), 7.02 (dd, *J* = 9.3, 2.6 Hz, 1H), 6.99 – 6.92 (m, 2H), 6.09 (d, *J* = 8.7 Hz, 1H) + rotamer at 5.69 (d, *J* = 8.4 Hz), 4.47 (td, *J* = 9.2, 4.8 Hz, 1H) + rotamer at 4.39 (bs), 3.85 (s, 3H), 3.27 (dd, *J* = 13.7, 4.9 Hz, 1H), 2.89 (dd, *J* = 13.6, 9.8 Hz, 1H), 1.33 (s, 9H).
^{13}C NMR (151 MHz, Acetone-d_6) δ 173.69, 157.46 (d, *J* = 235.7 Hz), 156.24, 155.07 (d, *J* = 2.1 Hz), 128.57 (d, *J* = 7.6 Hz), 118.51 (d, *J* = 23.5 Hz), 114.39 (d, *J* = 22.6 Hz), 112.25 (d, *J* = 8.5 Hz), 79.13, 56.33, 53.99, 33.19, 28.47.
^{19}F NMR (376 MHz, Acetone-d_6) δ -126.24 – -126.44 (m).

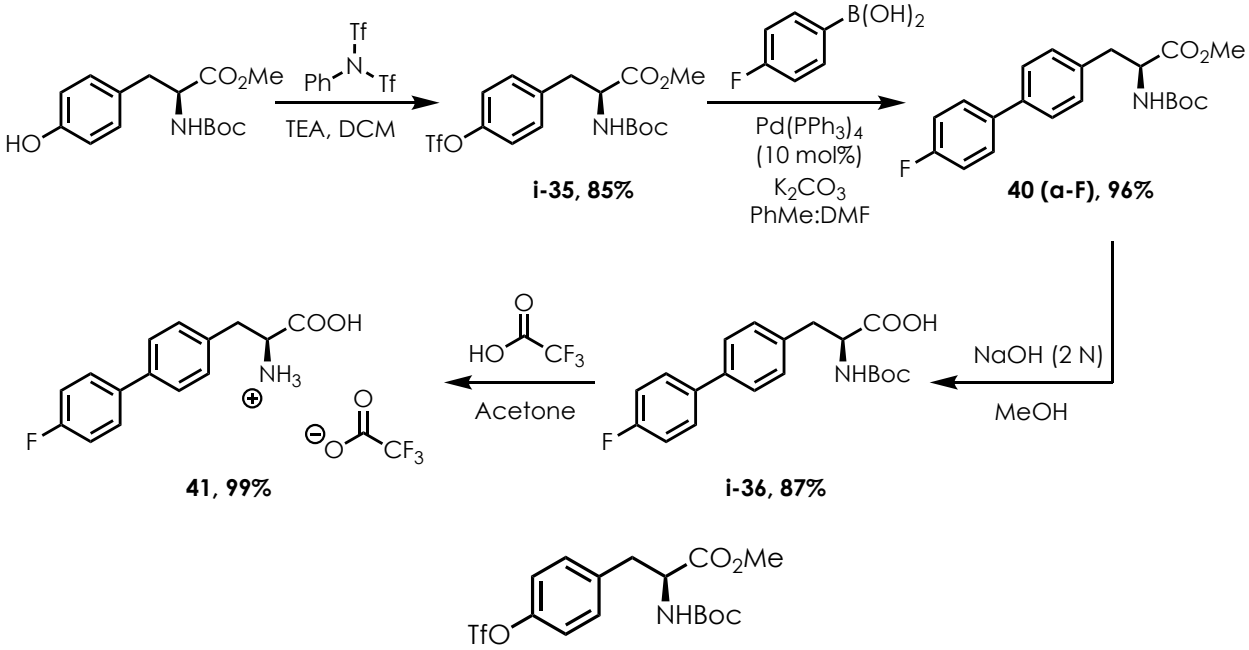
HRMS (ESI): Calculated for $C_{15}H_{20}FNO_5$ $(M+Na)^+$: 336.12180; found: 336.12168.



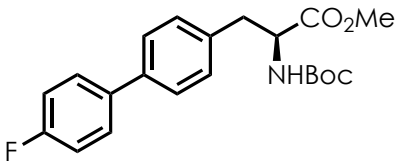
2-Fluoro-5-methoxy-*DL*-phenylalanine trifluoroacetate salt (39) To a dry, clean round bottomed flask equipped with a stir bar was added 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxyphenyl)propanoic acid (235.0 mg, 0.750 mmol, 1.0 eq.). The solid was dissolved in acetone (10 mL) and the solution was cooled to 0 ºC. Trifluoroacetic acid (2 mL) was added dropwise to the reaction solution and after 10 minutes of stirring, was allowed to warm to room temperature. The reaction was allowed to stir for 3 hours and upon the completion of the reaction, the solvents were removed under reduced pressure. Excess trifluoroacetic acid was azeotropically removed with small amounts of toluene and diethyl ether. A brown crystalline solid (2-fluoro-5-methoxy-*DL*-phenylalanine trifluoroacetate salt) was isolated and was analyzed without further purification (240.0 mg, 98%).

^{1}H NMR (600 MHz, DMSO) δ 13.91 (bs, 1H), 8.28 (bs, 2H), 7.10 (td, *J* = 8.7, 3.2 Hz, 1H), 7.03 (dd, *J* = 9.0, 3.2 Hz, 1H), 6.99 (dd, *J* = 9.0, 4.5 Hz, 1H), 4.38 (bs, 1H), 4.09 (t, *J* = 7.0 Hz, 1H), 3.77 (s, 3H), 3.14 (dd, *J* = 13.9, 6.6 Hz, 1H), 2.97 (dd, *J* = 13.9, 7.3 Hz, 1H).
^{13}C NMR (151 MHz, DMSO) δ 170.46, 158.01 (q, *J* = 30.9 Hz), 155.96 (d, *J* = 235.6 Hz), 154.00 (d, *J* = 1.5 Hz), 124.55 (d, *J* = 7.7 Hz), 117.81 (d, *J* = 23.3 Hz), 117.28 (q, *J* = 300.1 Hz), 114.63 (d, *J* = 22.5 Hz), 111.97 (d, *J* = 8.4 Hz), 55.90, 51.78, 30.98.
^{19}F NMR (376 MHz, DMSO) δ -73.51, -124.19 (td, *J* = 8.7, 4.6 Hz).

HRMS (ESI): Calculated for $C_{10}H_{12}FNO_3$ $(M+H)^+$: 214.08739; found: 214.08765 (only free amine mass detected).



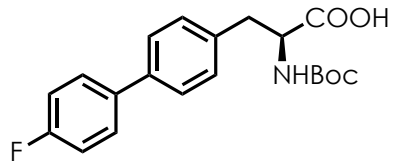
***N*-Boc-4-(trifluoromethanesulfonyl)-*L*-phenylalanine methyl ester (i-35)** The title compound was prepared according to a published procedure; spectra data are in agreement with literature values. (*77*)



Methyl (*S*)-2-((*tert*-butoxycarbonyl)amino)-3-(4'-fluoro-[1,1'-biphenyl]-4-yl)propanoate (40, a-F) To a clean, dry round bottomed flask equipped with a stir bar was added (4-fluorophenyl)boronic acid (276.4 mg, 1.98 mmol, 1.3 eq.) and potassium carbonate (546.1 mg, 3.95 mmol, 2.6 eq.). The flask containing the solids was then transferred into an N_2 glovebox, where tetrakis(triphenylphos-phine)palladium(0) (175.6 mg, 0.152 mmol, 0.10 eq.) was added. The flask was then sealed with a rubber septum and subsequently removed from the glovebox. The flask was then placed under a positive N_2 pressure and the solids in the flask were dissolved in a 10:1 PhMe:DMF mixture (15.4 mL, 0.1 M). A prepared solution of *N*-Boc-4-(trifluoromethanesulfonyl)-*L*-phenylalanine methyl ester (649.5 mg, 1.52 mmol, 1.0 eq.) in PhMe (~0.4 M) was then added, and the reaction was stirred at 100 ºC overnight. Upon completion (confirmed by consumption of substrate by TLC), the reaction was filtered through Celite into a separatory funnel, and diluted with EtOAc (10 mL) and water (20 mL). The layers were separated and the aq. layer was extracted with one portion of EtOAc (10 mL). The organic layers were combined and washed with two portions of LiCl solution and one portion of brine before being dried over $MgSO_4$ and concentrated. The crude mixture was then purified by column chromatography (10 to 30% EtOAc:Hex) to yield methyl (*S*)-2-((*tert*-butoxycarbonyl)amino)-3-(4'-fluoro-[1,1'-biphenyl]-4-yl)propanoate as a white solid (0.5430 g, 96%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.55 – 7.49 (m, 2H), 7.48 (d, *J* = 7.6 Hz, 2H), 7.22 (d, *J* = 7.9 Hz, 2H), 7.12 (td, *J* = 8.6, 1.9 Hz, 2H), 5.18 (d, *J* = 8.6 Hz, 1H) + rotamer at 5.03 (bs), 4.66 (q, *J* = 6.7 Hz, 1H) + rotamer at 4.46 (bs), 3.20 (dd, *J* = 13.9, 5.8 Hz, 1H), 3.10 (dd, *J* = 13.9, 6.4 Hz, 1H), 1.45 (s, 9H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 172.34, 162.38 (d, *J* = 246.2 Hz), 155.16, 138.82, 136.82 (d, *J* = 3.2 Hz), 135.16, 129.78, 128.50 (d, *J* = 7.8 Hz), 127.05, 115.59 (d, *J* = 21.3 Hz), 79.92, 54.41, 52.23, 37.86, 28.27.
^{19}F NMR (376 MHz, $CDCl_3$) δ -115.54 (td, *J* = 8.7, 8.2, 4.6 Hz).

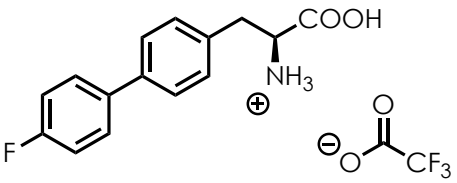
HRMS (ESI): Calculated for $C_{21}H_{24}FNO_4$ $(M+Na)^+$: 396.15818; found: 396.15813.



(*S*)-2-((*Tert*-butoxycarbonyl)amino)-3-(4'-fluoro-[1,1'-biphenyl]-4-yl)propanoic acid (i-36) To a dry, clean round bottomed flask equipped with a stir bar was added methyl (*S*)-2-((*tert*-butoxycarbonyl)amino)-3-(4'-fluoro-[1,1'-biphenyl]-4-yl)propanoate (444.0 mg, 1.19 mmol, 1.0 eq.). The solid was dissolved in MeOH (5 mL) and a 2 N solution of sodium hydroxide (2.4 mL, 4.76 mmol, 4.0 eq.) was slowly added to the methanol solution. The reaction was then stirred at room temperature until all of the starting material was consumed (monitored via TLC). Upon completion of hydrolysis, the reaction mixture was diluted with EtOAc (15 mL) and dilute HCl solution was added until solution pH < 2.0. The layers were then separated and the aq. layer was extracted with two additional portions of EtOAc (2 x 10 mL). The organic layers were combined, washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure to reveal (*S*)-2-((*tert*-butoxycarbonyl)amino)-3-(4'-fluoro-[1,1'-biphenyl]-4-yl)propanoic acid as a white solid. The isolated product was sufficiently pure to be used without further purification (374.0 mg, 87%).

^{1}H NMR (600 MHz, Acetone-d_6) δ 11.25 (s, 1H), 7.68 (dd, *J* = 8.6, 5.5 Hz, 2H), 7.58 (d, *J* = 7.9 Hz, 2H), 7.39 (d, *J* = 7.9 Hz, 2H), 7.22 (t, *J* = 8.8 Hz, 2H), 6.11 (d, *J* = 8.5 Hz, 1H) + rotamer at 5.71 (d, *J* = 7.0 Hz), 4.46 (td, *J* = 8.7, 4.9 Hz, 1H) + rotamer at 4.37 (bs), 3.25 (dd, *J* = 13.9, 5.0 Hz, 1H), 3.05 (dd, *J* = 13.9, 9.0 Hz, 1H), 1.36 (s, 9H).
^{13}C NMR (151 MHz, Acetone-d_6) δ 173.57, 163.29 (d, *J* = 244.3 Hz), 156.32, 139.11, 138.06 (d, *J* = 3.2 Hz), 137.85, 130.84, 129.53 (d, *J* = 8.2 Hz), 127.61, 116.41 (d, *J* = 21.5 Hz), 79.32, 55.72, 37.81, 28.55.
^{19}F NMR (376 MHz, Acetone-d_6) δ -117.66 (tt, *J* = 8.3, 5.1 Hz).

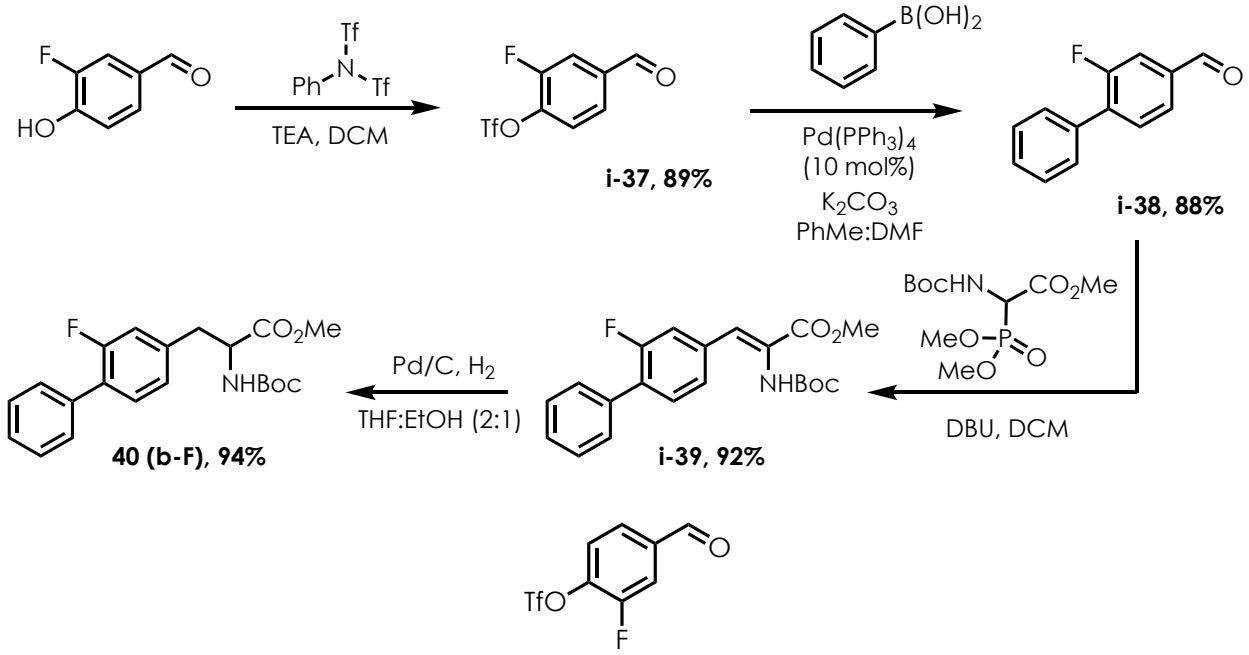
HRMS (ESI): Calculated for $C_{20}H_{22}FNO_4$ $(M+Na)^+$: 382.14253; found: 382.14239.



(*S*)-2-Amino-3-(4'-fluoro-[1,1'-biphenyl]-4-yl)propanoic acid trifluoroacetate salt (41)
To a dry, clean round bottomed flask equipped with a stir bar was added (*S*)-2-((*tert*-butoxycarbonyl)amino)-3-(4'-fluoro-[1,1'-biphenyl]-4-yl)propanoic acid (334.6 mg, 0.931 mmol, 1.0 eq.). The solid was dissolved in acetone (10 mL) and the solution was cooled to 0 ºC. Trifluoroacetic acid (2 mL) was added dropwise to the reaction solution and after 10 minutes of stirring, was allowed to warm to room temperature. The reaction was allowed to stir for 3 hours and upon the completion of the reaction, the solvents were removed under reduced pressure. Excess trifluoroacetic acid was azeotropically removed with small amounts of toluene and diethyl ether. An off-white solid [(*S*)-2-amino-3-(4'-fluoro-[1,1'-biphenyl]-4-yl)propanoic acid trifluoroacetate salt] was isolated and was analyzed without further purification (345.7 mg, 99%).

^{1}H NMR (600 MHz, CD_3CN) δ 7.69 – 7.65 (m, 2H), 7.64 (d, *J* = 8.3 Hz, 2H), 7.37 (d, *J* = 8.2 Hz, 2H), 7.25 – 7.18 (m, 2H), 4.30 (dd, *J* = 8.1, 5.5 Hz, 1H), 3.36 (dd, *J* = 14.7, 5.5 Hz, 1H), 3.19 (dd, *J* = 14.8, 8.1 Hz, 1H). (NH_3 and COOH peaks not observed)
^{1}H NMR (600 MHz, MeOD) δ 7.65 – 7.60 (m, 4H), 7.38 (d, *J* = 8.2 Hz, 2H), 7.18 (t, *J* = 8.8 Hz, 2H), 4.27 (dd, *J* = 7.9, 5.3 Hz, 1H), 3.36 (dd, *J* = 14.6, 5.4 Hz, 1H), 3.19 (dd, *J* = 14.5, 7.9 Hz, 1H). (NH_3 and COOH peaks not observed)
^{13}C NMR (151 MHz, CD_3CN) δ 169.73, 163.52 (d, *J* = 244.7 Hz), 159.11 (q, *J* = 39.5 Hz), 140.34, 137.40 (d, *J* = 3.3 Hz), 133.97, 131.18, 129.69 (d, *J* = 8.3 Hz), 128.39, 116.64 (d, *J* = 21.6 Hz), 116.24 (q, *J* = 286.8 Hz), 55.28, 35.74.
^{13}C NMR (151 MHz, MeOD) δ 171.35, 164.00 (d, *J* = 245.1 Hz), 141.01, 138.14 (d, *J* = 3.2 Hz), 134.74, 131.05, 129.75 (d, *J* = 8.1 Hz), 128.60, 116.62 (d, *J* = 21.5 Hz), 55.17, 37.01. (TFA peaks not observed)
^{19}F NMR (376 MHz, CD_3CN) δ -76.76, -116.95 – -117.08 (m).
^{19}F NMR (376 MHz, MeOD) δ -77.09, -117.79 (ddd, *J* = 14.1, 9.5, 5.4 Hz).

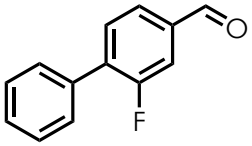
HRMS (ESI): Calculated for $C_{15}H_{14}FNO_2$ $(M+H)^+$: 260.10813; found: 260.10836 (only free amine mass detected).



2-Fluoro-4-formylphenyl trifluoromethanesulfonate (i-37) The title compound was prepared according to a published procedure (*78*); spectra data are provided herein.

^{1}H NMR (600 MHz, $CDCl_3$) δ 9.98 (d, *J* = 1.9 Hz, 1H), 7.81 – 7.69 (m, 2H), 7.54 (dd, *J* = 8.6, 6.8 Hz, 1H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 189.28 (d, *J* = 2.0 Hz), 154.28 (d, *J* = 257.4 Hz), 140.95 (d, *J* = 13.8 Hz), 137.30 (d, *J* = 5.0 Hz), 126.92 (d, *J* = 3.8 Hz), 124.62, 118.73 (q, *J* = 320.7 Hz), 117.67 (d, *J* = 18.8 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -72.79 (d, *J* = 4.9 Hz), -124.44 (dpd, *J* = 10.0, 4.9, 2.3 Hz).

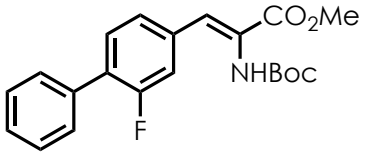
HRMS (ESI): Calculated for $C_8H_4F_4O_4S$ $(M+Na)^+$: 294.96588; found: 294.96607.



2-Fluoro-[1,1'-biphenyl]-4-carbaldehyde (i-38) To a clean, dry round bottomed flask equipped with a stir bar was added phenylboronic acid (949.0 mg, 7.79 mmol, 1.3 eq.) and potassium carbonate (2.15 g, 15.6 mmol, 2.6 eq.). The flask containing the solids was then transferred into an N_2 glovebox, where tetrakis(triphenylphosphine)palladium(0) (692 mg, 0.599 mmol, 0.10 eq.) was added. The flask was then sealed with a rubber septum and subsequently removed from the glovebox. The flask was then placed under a positive N_2 pressure and the solids in the flask were dissolved in a 10:1 PhMe:DMF mixture (55 mL, 0.1 M). A prepared solution of 2-fluoro-4-formylphenyl trifluoromethane-sulfonate (1.63 g, 5.99 mmol, 1.0 eq.) in PhMe (~0.4 M) was then added, and the reaction was stirred at 100 ºC overnight. Upon completion (confirmed by consumption of substrate by TLC), the reaction was filtered through Celite into a separatory funnel, and diluted with EtOAc (10 mL) and water (20 mL). The layers were separated and the aq. layer was extracted with one portion of EtOAc (10 mL). The organic layers were combined and washed with two portions of LiCl solution and one portion of brine before being dried over $MgSO_4$ and concentrated. The crude mixture was then purified by column chromatography (10 to 30% EtOAc:Hex) to yield 2-fluoro-[1,1'-biphenyl]-4-carbaldehyde as a white solid (1.05 g, 88%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 10.01 (d, *J* = 1.8 Hz, 1H), 7.74 (dd, *J* = 7.8, 1.6 Hz, 1H), 7.67 (dd, *J* = 10.3, 1.6 Hz, 1H), 7.63 (t, *J* = 7.6 Hz, 1H), 7.59 (dt, *J* = 8.1, 1.5 Hz, 2H), 7.51 – 7.46 (m, 2H), 7.46 – 7.42 (m, 1H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 190.75 (d, *J* = 2.1 Hz), 160.08 (d, *J* = 251.1 Hz), 137.14 (d, *J* = 6.6 Hz), 135.37 (d, *J* = 13.8 Hz), 134.57 (d, *J* = 1.5 Hz), 131.57 (d, *J* = 3.4 Hz), 129.15 (d, *J* = 3.1 Hz), 128.84, 128.78, 126.18 (d, *J* = 3.4 Hz), 116.46 (d, *J* = 23.7 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -118.11.

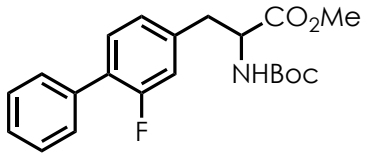
HRMS (ESI): Calculated for $C_{13}H_9FO$ $(M+H)^+$: 201.07102; found: 201.07122.



Methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-[1,1'-biphenyl]-4-yl)acrylate (i-39)
Methyl 2-((*tert*-butoxycarbonyl)amino)-2-(dimethoxyphosphoryl)acetate (0.884 g, 5.30 mmol, 1.2 eq.) was added to a flame dried round bottomed flask equipped with a stir bar and dissolved in 15 mL of dry DCM under N_2. Then 1,8-diazabicyclo[5.4.0]undec-7-ene (0.67 mL, 4.42 mmol, 1.0 eq.) was added via syringe and the mixture was stirred at room temperature for 15 minutes. While the phosphonate ester solution was stirring, a solution of 2-fluoro-[1,1'-biphenyl]-4-carbaldehyde (0.8840 g, 4.42 mmol, 1.0 eq.) in 12 mL DCM was prepared. This benzaldehyde solution was added to the phosphonate ester solution dropwise at room temperature. Reaction conversion was monitored via TLC (reaction takes approximately 4 h.) and at the end of the reaction, the solution was concentrated and loaded onto Celite. The crude reaction mixture was then purified via flash chromatography (20 to 30% EtOAc) to yield methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-[1,1'-biphenyl]-4-yl)acrylate as a white solid (1.51 g, 92%)

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.56 (dt, *J* = 8.1, 1.5 Hz, 2H), 7.48 – 7.41 (m, 3H), 7.40 – 7.34 (m, 3H), 7.26 (bs, 1H), 6.41 (bs, 1H), 3.88 (s, 3H), 1.43 (s, 9H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 165.97, 159.60 (d, *J* = 247.7 Hz), 152.40, 135.42, 135.36, 130.61 (d, *J* = 3.9 Hz), 129.76 (d, *J* = 13.7 Hz), 129.08 (d, *J* = 3.2 Hz), 128.65, 128.17 (d, *J* = 2.4 Hz), 128.13, 126.22 (d, *J* = 3.2 Hz), 124.88, 116.91 (d, *J* = 24.4 Hz), 81.47, 52.95, 28.24.
^{19}F NMR (376 MHz, $CDCl_3$) δ -116.07 (t, *J* = 8.8 Hz).

HRMS (ESI): Calculated for $C_{21}H_{22}FNO_4$ $(M+Na)^+$: 394.14253; found: 394.14247.

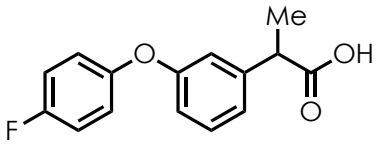


Methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-[1,1'-biphenyl]-4-yl)propanoate (40, b-F)
To a dry, clean round bottomed flask equipped with a stir bar was added methyl (*Z*)-2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-[1,1'-biphenyl]-4-yl)acry-late (1.51 g, 4.07 mmol, 1.0 eq.), which was then dissolved in 27 mL of a THF:EtOH (2:1) solution. 10% Palladium on carbon (86.5 mg, 0.20 mmol, 0.10 eq.) was added to the solution and the reaction was placed under N_2. The solution was purged and backfilled with H_2 before being placed under a H_2 atmosphere (1 atm) overnight (reaction is typically done in about 2-3 hours). Once the reaction was complete, the solution was run through a Celite plug and concentrated. The crude mixture was then purified by flash chromatography (10 to

30% EtOAc:Hex) to yield methyl 2-((*tert*-butoxycarbonyl)amino)-3-(2-fluoro-5-methoxyphenyl)propanoate (1.43 g, 94%) as a white solid.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.56 (dt, *J* = 8.1, 1.5 Hz, 2H), 7.47 (t, *J* = 7.7 Hz, 2H), 7.42 – 7.35 (m, 2H), 7.04 – 6.99 (m, 1H), 6.97 (d, *J* = 11.3 Hz, 1H), 5.10 (d, *J* = 8.3 Hz, 1H) + rotamer at 4.85 (bs), 4.66 (dt, *J* = 8.2, 5.9 Hz, 1H) + rotamer at 4.47 (bs), 3.79 (s, 3H), 3.21 (dd, *J* = 13.9, 5.6 Hz, 1H), 3.10 (dd, *J* = 13.9, 6.2 Hz, 1H), 1.46 (s, 9H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 172.19, 159.65 (d, *J* = 248.2 Hz), 155.16, 137.67 (d, *J* = 7.7 Hz), 135.59, 130.85 (d, *J* = 3.9 Hz), 129.04 (d, *J* = 3.0 Hz), 128.75 (d, *J* = 12.1 Hz), 128.56, 127.76, 125.44 (d, *J* = 3.4 Hz), 117.10 (d, *J* = 23.0 Hz), 80.23, 54.33, 52.53, 37.91, 28.40.
^{19}F NMR (376 MHz, $CDCl_3$) δ -118.03 (t, *J* = 9.7 Hz).

HRMS (ESI): Calculated for $C_{21}H_{24}FNO_4$ $(M+Na)^+$: 396.15818; found: 396.15814.



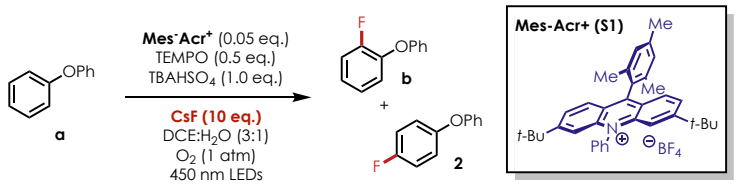
2-(3-(4-Fluorophenoxy)phenyl)propanoic acid (42)
To a dry, clean round bottomed flask equipped with a stir bar was added methyl 2-(3-(4-fluorophenoxy)phenyl)propanoate (256.0 mg, 0.933 mmol, 1.0 eq.). The solid was dissolved in MeOH (5 mL) and a 2 N solution of sodium hydroxide (2.4 mL, 4.76 mmol, 4.0 eq.) was slowly added to the methanol solution. The reaction was then stirred at room temperature until all of the starting material was consumed (monitored via TLC). Upon completion of hydrolysis, the reaction mixture was diluted with EtOAc (15 mL) and dilute HCl solution was added until solution pH < 2.0. The layers were then separated and the aq. layer was extracted with two additional portions of EtOAc (2 x 10 mL). The organic layers were combined, washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure to reveal 2-(3-(4-fluorophenoxy)phenyl)propanoic acid as a white solid. The isolated product was sufficiently pure to be used without further purification (220.0 mg, 91%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 11.15 (s, 1H), 7.28 (t, *J* = 7.8 Hz, 1H), 7.08 – 7.01 (m, 3H), 7.00 – 6.96 (m, 3H), 6.84 (dd, *J* = 8.3, 2.4 Hz, 1H), 3.71 (q, *J* = 7.1 Hz, 1H), 1.50 (d, *J* = 7.2 Hz, 3H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 180.71, 159.02 (d, *J* = 241.9 Hz), 158.06, 152.64 (d, *J* = 2.7 Hz), 141.82, 130.07, 122.40, 120.81 (d, *J* = 8.2 Hz), 117.74, 116.96, 116.48 (d, *J* = 23.2 Hz), 45.33, 18.15.
^{19}F NMR (376 MHz, $CDCl_3$) δ -119.75 (dt, *J* = 8.8, 4.8 Hz).

HRMS (ESI): Calculated for $C_{15}H_{13}FO_3$ $(M+H)^+$: 261.09215; found: 261.09362.

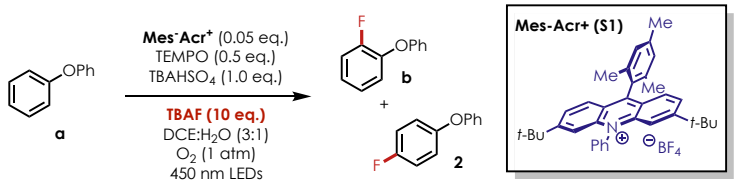
4. Synthesis and Analysis of Fluorinated HPLC Standards for Arene C-H Fluorination

4.1 General C-H fluorination procedure for CsF as the fluorine source



Photocatalyst **S1** (1.4mg, 0.0025mmol, 0.05eq.), diphenyl ether (8.5mg, 0.05mmol, 1.0eq.), $TBAHSO_4$ (8.5mg, 0.025mmol, 0.5eq.), TEMPO (3.9mg, 0.025mmol, 0.5eq.) and CsF (76.0mg, 0.5mmol, 10eq) were weighed and added sequentially to a dried glass vial equipped with a stir bar. 225μL DCE and 75μL H_2O was added. The vial was then sealed with a Teflon-lined septum screw cap. The septum was then pierced with a disposable steel needle connected to an oxygen-filled balloon. A vent needle was inserted and the reaction medium was sparged for 1 minutes by bubbling oxygen through the mixture. Then the vent needle was removed, and the oxygen balloon was maintained, providing approximately 1 atm of oxygen to the vial headspace for the course of the reaction. The reaction flask was then placed on a stir plate and illuminated with blue LED lamps (455 nm). Analysis the reaction by HPLC at 2.5 h and 24 h.

4.2 General C-H fluorination procedure for TBAF as the fluorine source



Photocatalyst **S1** (1.4mg, 0.0025mmol, 0.05eq.), diphenyl ether (8.5mg, 0.05mmol, 1.0eq.), TEMPO (3.9mg, 0.025mmol, 0.5eq.) were weighed and added sequentially to a dried glass vial equipped with a stir bar. 500μL anhydrous TBAF (1M in THF) was added. The vial was then sealed with a Teflon-lined septum screw cap. The septum was then pierced with a disposable steel needle connected to an oxygen-filled balloon. A vent needle was inserted and the reaction medium was sparged for 1 minutes by bubbling oxygen through the mixture. Then the vent needle was removed, and the oxygen balloon was maintained, providing approximately 1 atm of oxygen to the vial headspace for the course of the reaction. The reaction flask was then placed on a stir plate and illuminated with blue LED lamps (455 nm). Analysis the reaction by HPLC at 2.5 h and 24 h.

4.3 General HPLC condition

Column: Phenomenex, Kinetex® Aeris PEPTIDE 3.6u XB-C18, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: 5% to 45% solvent B, 2 to 22 min: 45% to 50% solvent B, 22 to 28 min: 50% to 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

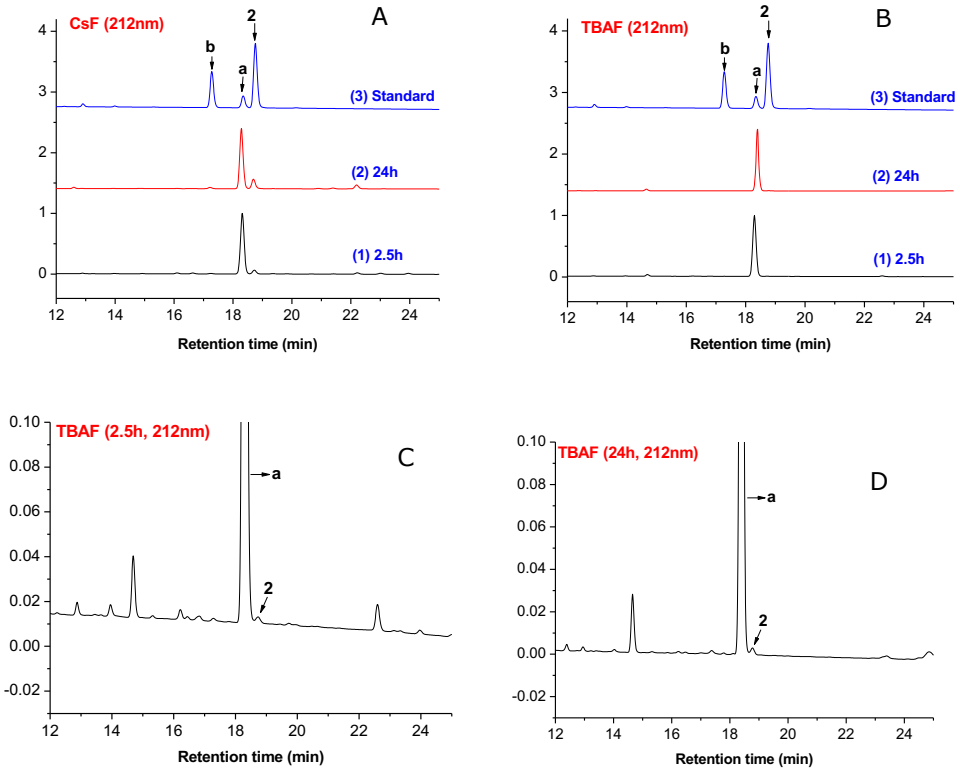


Fig. S2. Overlaid (**A** and **B**) or enlarged (**C** and **D**) UV-HPLC chromatograms (at 212nm) for the crude reaction mixture of CsF or TBAF system at 2.5 h and 24 h

Fluorine source	**Reaction time**	**Area ratio** (**2**:**a**)
CsF	2.5 h	1:15.12
	24 h	1:5.765
TBAF	2.5 h	1:262.48
	24 h	1:218.8

Table S2. Time and ^{19}F-source dependent C-H fluorination of diphenyl ether

5. Experimental Procedures for Radiochemistry

5.1 Synthesis of [^{18}F]TBAF, [^{18}F]CsF, [^{18}F]KF, K[^{18}F]F-kryptofix

5.1.1 General procedure for the preparation of [^{18}F]TBAF

[^{18}F]TBAF was prepared on a TRACERLab FXFN (General Electric, GE) automated radiochemistry synthesis module. Before [^{18}F]fluoride delivery, ports in the module were charged under ambient atmosphere as follows:

- Port 1: A combination of 70ul tetrabutylammonium bicarbonate (TBAB) solution (20%, w/w), 53μL H_2O, and 477 μL MeCN (Total volume: 600 μL)
- Port 3: anhydrous MeCN (1 mL)
- Port 4: anhydrous MeCN (1 mL)

[^{18}F]Fluoride was produced via the $^{18}O(p,n)^{18}F$ reaction by proton irradiation (40μA, 2-5min) of an [^{18}O]H_2O containing target in a GE PETTrace cyclotron. The [^{18}F]fluoride (ca. 1.2-2.2Ci) was delivered to the synthesis module in a bolus of [^{18}O]H_2O by stream of argon. The aqueous solution of [^{18}F]fluoride was passed through a QMA cartridge (water preconditioning) to trap [^{18}F]fluoride before elution into the reactor vessel with a solution of TBAB (contents of Port 1). This solution was azeotropically dried by heating the reaction vessel to 100 °C and drawing vacuum (ca. 1 kPa) for 5 min, followed by simultaneous vacuum draw and nitrogen stream for a further 6 minutes. The dried [^{18}F]TBAF was cooled to 50 °C before addition of anhydrous MeCN (contents of Port 3). The mixture was transferred out of the reactor under N_2 pressure into a sterile vial to yield a solution of [^{18}F]TBAF (1.1-1.8 Ci, average = 1.5 Ci) in MeCN. 10-100 μL aliquots of this solution were then used for manual methodology experiments.

5.1.2 General procedure for the preparation of [^{18}F]CsF solution

First Method: 0.9% cesium chloride as the eluent.

QMA-light Sep-Paks were preconditioned with 10mL of 0.9% cesium chloride solution, followed by 10 mL of water before use. Target rinse (200 mCi) was then passed through the QMA-light Sep-Pak to trap the fluoride-18. The QMA cartridge was washed with additional 10mL ultrapure water to remove any residual [^{18}O]H_2O and then eluted with 1mL of 0.9% cesium chloride solution to yield an aqueous solution of [^{18}F]CsF (~150 mCi) into a 5mL glass tube for use.

Second Method: 0.9% cesium carbonate as the eluent.

QMA cartridge were preconditioned with 10mL of 0.9% cesium carbonate solution, followed by 10 mL of water before use. Target rinse (200 mCi) was then passed through the QMA-light Sep-Pak to trap the fluoride-18. The QMA cartridge was washed with additional 10mL ultrapure water to remove any residual [^{18}O]H_2O and then eluted with 1mL of 0.9% cesium carbonate solution to yield an aqueous solution of [^{18}F]CsF (~150 mCi) into a 5mL glass tube for use.

Third Method: 0.9% cesium fluoride as the eluent.

QMA-light Sep-Paks were preconditioned with 10mL of 0.9% cesium fluoride solution, followed by 10 mL of water before use. Target rinse (200 mCi) was then passed through the QMA cartridge to trap the fluoride-18. The QMA cartridge was washed with additional 10mL ultrapure water to remove any residual [^{18}O]H_2O and then eluted with 1mL of 0.9% cesium fluoride solution to yield an aqueous solution of [^{18}F]CsF (~150 mCi) into a 5mL glass tube for use.

Fourth Method: A mixture of 4.2mg CsCl (0.025mmol) and [^{18}F]TBAF (10~20mCi)

The **S1** (1.4mg, 0.0025mmol, 0.05eq.), diphenyl ether (8.5mg, 0.05mmol, 1.0eq.), CsCl (4.2mg, 0.025mmol, 0.5eq.), $TBAHSO_4$ (8.5mg, 0.025mmol, 0.5eq.), TEMPO (3.9mg, 0.025mmol, 0.5eq.) were weighed into a 2.5mL dried glass vial equipped with a stir bar and dissolved in 175μL DCE and 75μL H_2O. Then a 50μL aliquot of [^{18}F]TBAF in DCE (typically 10-20 mCi, preparation method: MeCN in [^{18}F]TBAF was dried by heating to 100°C and argon stream for 5min, then cooled to RT before addition of 200μL anhydrous DCE) was added to the reaction vial via syringe.

Fifth Method: A mixture of 7.6mg CsF (0.05mmol) and [^{18}F]TBAF (10~20mCi)

The **S1** (1.4mg, 0.0025mmol, 0.05eq.), diphenyl ether (8.5mg, 0.05mmol, 1.0eq.), CsF (7.6mg, 0.05mmol, 1.0eq.), $TBAHSO_4$ (8.5mg, 0.025mmol, 0.5eq.), TEMPO (3.9mg, 0.025mmol, 0.5eq.) were weighed into a 2.5mL dried glass vial equipped with a stir bar and dissolved in 175μL DCE and 75μL H_2O. Then a 50μL aliquot of [^{18}F]TBAF in DCE (typically 10-20 mCi) was added to the reaction vial via syringe.

5.1.3 General procedure for the preparation of [^{18}F]KF solution

QMA-light Sep-Paks were preconditioned with 10mL of 0.9% potassium perchlorate solution, followed by 10 mL of water before use. Target rinse (200 mCi) was then passed through the QMA-light Sep-Pak to trap the fluoride-18. The QMA cartridge was washed with additional 10mL ultrapure water to remove any residual [^{18}O]H_2O and then eluted with 1mL of 0.9% potassium perchlorate solution to yield an aqueous solution of [^{18}F]KF (~150 mCi) into a 5mL glass tube for use.

5.1.4 General procedure for the preparation of K[^{18}F]F-kryptofix solution

K[^{18}F]F-kryptofix preparation was conducted on a TRACERLab FXFN (General Electric, GE) automated radiochemistry synthesis module which is same as [^{18}F]TBAF preparation procedure. The ^{18}F was released from the QMA cartridge by passing K_2CO_3 solution through the cartridge and allowed to enter into the reactor. Kryptofix K2.2.2 solution was added into the reactor and the whole mixture was dried at 95°C in combination of nitrogen flow and vacuum. Then 1mL anhydrous MeCN was added to yield K[^{18}F]F-kryptofix (~1.3 Ci) for use.

5.2 General HPLC Conditions

Four general sets of HPLC conditions were used. Conditions A, B, C were normally used for HPLC yield calculation of different substrates. Condition D were used for [^{18}F]labeled product purification.

HPLC Condition A:

Column: Phenomenex, Kinetex® 5μm EVO C18 100 Å, 250 x 4.6 mm LC Column.
Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;
Grad/isocrat: 0 to 2 min: 5% to 45% solvent B, 2 to 22 min: 45% to 50% solvent B, 22 to 28 min: 50% to 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B.
Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

HPLC Condition B:

Column: Phenomenex, Kinetex® 5μm EVO C18 100 Å, 250 x 4.6 mm LC Column.
Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;
Grad/isocrat: 0 to 2 min: 30% to 50% solvent B, 2 to 22 min: 50% to 50% solvent B, 22 to 28 min: 50% to 95% solvent B, 28 to 28.1 min: 95% to 30% solvent B, 28.1 to 30 min: isocratic elution at 30% solvent B.
Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

HPLC Condition C:

Column: Phenomenex, Kinetex® 5μm EVO C18 100 Å, 250 x 4.6 mm LC Column.
Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;
Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B.
Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

HPLC Condition D:

Column: Phenomenex, Kinetex® 5μm F5 100 Å, 250 x 4.6 mm LC Column
Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;
Grad/isocrat: 0 to 2 min: 20% to 45% solvent B, 2 to 22 min: 45% to 60% solvent B, 22 to 28 min: 60% to 95% solvent B, 28 to 28.1 min: 95% to 20% solvent B, 28.1 to 30 min: isocratic elution at 20% solvent B.
Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

5.3 General procedure for the synthesis of ^{18}F-fluoroarenes

General procedure A: Photocatalyst **1** (1.5mg, 0.0025mmol, 0.05 to 0.01 eq.), substrate (0.05 to 0.25mmol, 1.0eq.), TEMPO (3.9mg, 0.025mmol, 0.5 to 0.1 eq) were weighed into a 1.5mL microcentrifuge tube and dissolved in 50-70μL anhydrous MeCN and 400μL t-BuOH. The resulting solution was transferred to a 5mL v-vial via a pipette, and then a 30-50μL aliquot of [^{18}F]TBAF in MeCN (typically 10-30 mCi) [total volume of MeCN is 100μL] was immediately added to the reaction vial via pipette. Decay in [^{18}F]TBAF activity was monitored upon addition of [^{18}F]TBAF to the substrate solution. The reaction v-vial was then fixed on an iron support and cooled to using an ice-acetone bath. A needle connected to an oxygen-filled balloon was inserted to the bottom of the v-vial and the reaction medium was continuously sparged with oxygen throughout the entire reaction time (30 min. to 1 h.). The reaction was then irradiated top-down with the optic fiber of an OEM blue diode laser (OEM-SD-450, 450 nm, 3.5W after fiber coupling) for 30 min to 1 h. **^{18}F activity was recorded at the end of the reaction**. The resulting solution was diluted with MeCN (0.3-0.5 mL). An aliquot of the reaction mixture (typically 400-800μCi) was taken for radio-HPLC analysis. The activity injected into HPLC was measured (this activity was denoted by α) and the time was recorded. The fraction corresponding to radiolabeled product was collected and the activity was measured (this activity was denoted by β). The radiochemical yields of all [^{18}F]-labeled molecules were isolated via HPLC. The decay-corrected RCY were was calculated by dividing the decay-corrected β by α. All RCY were calculated with respect to the starting ^{18}F activity of the eluted fluoride. [^{18}F]-Radiolabeled products were confirmed by the co-injection of commercial or synthesized ^{19}F standards via HPLC. General Method A (Section 3-3) was used for the positive identification of desired fluorinated congener; mass detection of the desired ^{19}F-fluorination products indicates the compatibility of the arene for radiofluorination. Quality control (QC) was run separately to ensure the purity of isolated radiolabeled compounds.

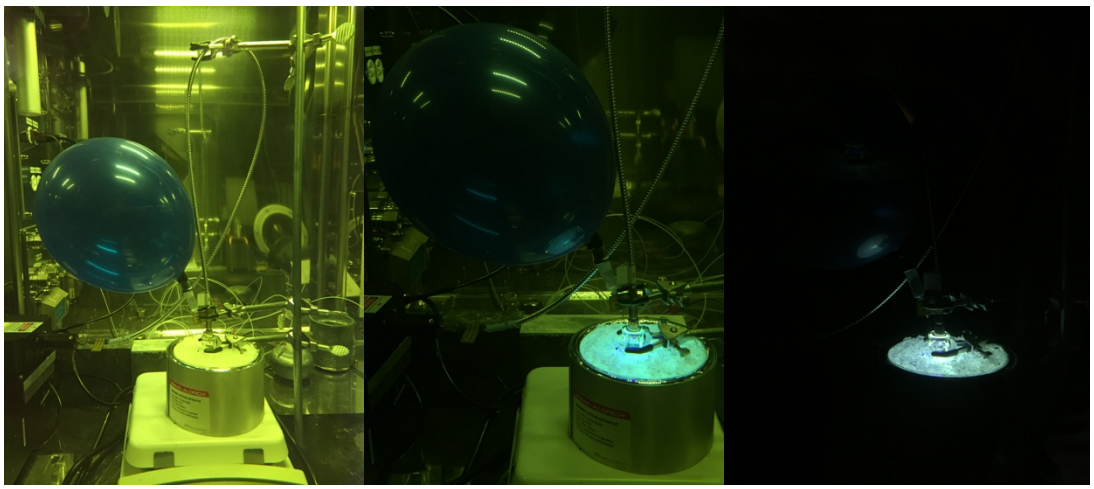
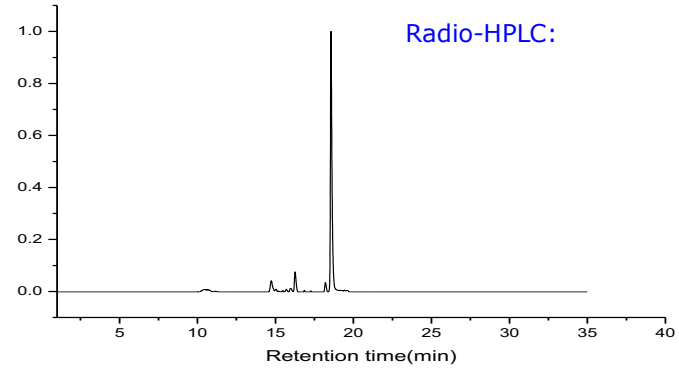


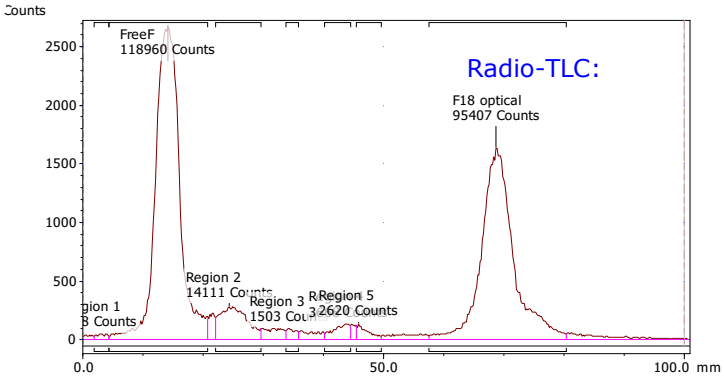
Fig. S3. Reaction set-up for photoredox-catalyzed arene radiofluorination

5.4 Comparision of isolation, radio-TLC and radio-HPLC yields for the radiofluorination of diphenyl ether.

A



B



Name	Start (mm)	End (mm)	Retention (RF)	Area (Counts)	%ROI (%)	%Total (%)
Region 1	1.8	4.3	0.032	878	0.37	0.35
FreeF	4.3	20.8	0.141	118960	50.16	46.87
Region 2	22.1	29.6	0.243	14111	5.95	5.56
Region 3	33.7	35.8	0.342	1503	0.63	0.59
Region 4	40.3	44.5	0.440	3668	1.55	1.44
Region 5	45.5	49.6	0.458	2620	1.10	1.03
F18 optical	57.5	80.5	0.687	95407	40.23	37.59
7 Peaks				237146	100.00	93.43

C

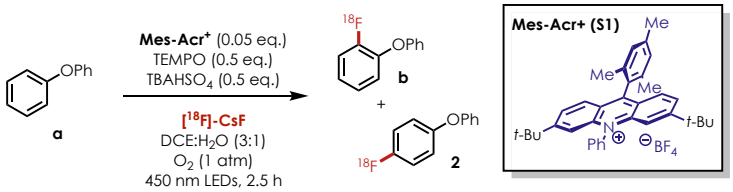
Yield Analysis Method	Yield of 2 and a
HPLC isolation	28.7%
Radio-HPLC	> 80%
Radio-TLC	40.23%

Fig. S4. Comparison of isolation, radio-HPLC (**A**) and radio-TLC (**B**) yields for the radio-fluorination of diphenyl ether with corresponding yields (**C**).

5.5 Summary of Reaction Optimization for Arene Radiofluorination

5.5.1 Evaluation of fluorine sources

5.5.1.1 ^{18}F-CsF as the fluorine source:



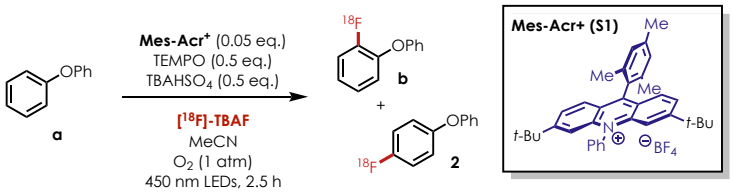
Method A:

Photocatalyst **S1** (1.5mg, 0.0025mmol, 0.05eq.), diphenyl ether (8.5mg, 0.05mmol, 1.0eq.), $TBAHSO_4$ (8.5mg, 0.025mmol, 0.5eq.), TEMPO (3.9mg, 0.025mmol, 0.5eq.) were weighed into a 2.5mL dried glass vial equipped with a stir bar and dissolved in 225µL DCE. The vial was then sealed with a Teflon-lined septum screw cap. The septum was then pierced with a disposable steel needle connected to an oxygen-filled balloon. A vent needle was inserted and the reaction medium was sparged for 1 min by bubbling oxygen through the mixture. Then the vent needle was removed, and the oxygen balloon was maintained, providing approximately 1 atm of oxygen to the vial headspace for the course of the reaction. Then a 75µL aliquot of [^{18}F]CsF in H_2O (typically 10-30 mCi, see section 5.1.2) was added to the reaction vial via syringe. The reaction flask was then placed on a stir plate and illuminated with blue LED lamps (450 nm). After 2.5 h, an aliquot of the reaction mixture (typically 400-800µCi) was taken for radio-HPLC analysis using HPLC condition B and the isolated and decay-corrected yield was calculated. The isolated yields of **2** and **b** are listed in Table S3.

Method B:

Photocatalyst **S1** (1.5mg, 0.0025mmol, 0.05eq.), diphenyl ether (8.5mg, 0.05mmol, 1.0eq.), $TBAHSO_4$ (8.5mg, 0.025mmol, 0.5eq.), TEMPO (3.9mg, 0.025mmol, 0.5eq.), CsCl (4.2mg, 0.025mmol, 0.5eq.) or CsF (7.6mg, 0.05mmol, 1.0eq.) were weighed into a 2.5mL dried glass vial equipped with a stir bar and dissolved in in 175µL DCE and 75µL H_2O. The vial was then sealed with a Teflon-lined septum screw cap. The septum was then pierced with a disposable steel needle connected to an oxygen-filled balloon. A vent needle was inserted and the reaction medium was sparged for 1 min by bubbling oxygen through the mixture. Then the vent needle was removed, and the oxygen balloon was maintained, providing approximately 1 atm of oxygen to the vial headspace for the course of the reaction. Then a 50µL aliquot of [^{18}F]TBAF in DCE (typically 10-30 mCi, see section 5.1.2) was added to the reaction vial via syringe. The reaction flask was then placed on a stir plate and illuminated with blue LED lamps (450 nm). After 2.5 h, an aliquot of the reaction mixture (typically 400-800µCi) was taken for radio-HPLC analysis using HPLC condition B and the isolated and decay-corrected yield was calculated. The isolated yields of **2** and **b** are listed in Table S3.

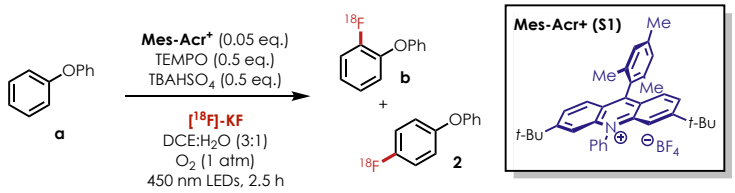
5.5.1.2 ^{18}F-TBAF as the fluorine source:



Photocatalyst **S1** (1.5mg, 0.0025mmol, 0.05eq.), diphenyl ether (8.5mg, 0.05mmol, 1.0eq.), $TBAHSO_4$ (3.9mg, 0.025mmol, 0.5eq.) and TEMPO (3.9mg, 0.025mmol, 0.5eq.) were weighed into a 2.5mL dried glass vial equipped with a stir bar and dissolved in 400µL anhydrous MeCN. The vial was then sealed with a Teflon-lined septum screw cap. The septum was then pierced with a disposable steel needle connected to an oxygen-filled balloon. A vent needle was inserted and the reaction

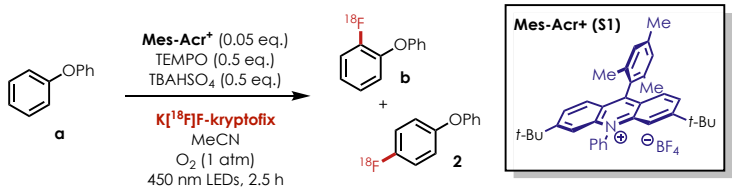
medium was sparged for 1 min by bubbling oxygen through the mixture. Then the vent needle was removed, and the oxygen balloon was maintained, providing approximately 1 atm of oxygen to the vial headspace for the course of the reaction. Then a 100µL aliquot of [^{18}F]TBAF in anhydrous MeCN (typically 10-30 mCi, see section 5.1.2) was added to the reaction vial via syringe. The reaction flask was then placed on a stir plate and illuminated with blue LED lamps (450 nm). After 2.5 h, an aliquot of the reaction mixture (typically 400-800µCi) was taken for radio-HPLC analysis using HPLC condition B and the isolated and decay-corrected yield was calculated. The isolated yields of **2** and **b** are listed in Table S3.

5.5.1.3 ^{18}F-KF as the fluorine source:



Photocatalyst **S1** (1.5mg, 0.0025mmol, 0.05eq.), diphenyl ether (8.5mg, 0.05mmol, 1.0eq.), $TBAHSO_4$ (8.5mg, 0.025mmol, 0.5eq.), TEMPO (3.9mg, 0.025mmol, 0.5eq.) were weighed into a 2.5mL dried glass vial equipped with a stir bar and dissolved in 225µL DCE. The vial was then sealed with a Teflon-lined septum screw cap. The septum was then pierced with a disposable steel needle connected to an oxygen-filled balloon. A vent needle was inserted and the reaction medium was sparged for 1 min by bubbling oxygen through the mixture. Then the vent needle was removed, and the oxygen balloon was maintained, providing approximately 1 atm of oxygen to the vial headspace for the course of the reaction. Then a 75µL aliquot of [^{18}F]KF in H_2O (typically 10-30 mCi, see section 5.1.2, which was eluted from QMA with 0.9% potassium perchlorate) was added to the reaction vial via syringe. The reaction flask was then placed on a stir plate and illuminated with blue LED lamps (450 nm). After 2.5 h, an aliquot of the reaction mixture (typically 400-800µCi) was taken for radio-HPLC analysis using HPLC condition B and the isolated and decay-corrected yield was calculated. The isolated yields of **2** and **b** are listed in Table S3.

5.5.1.4 K[^{18}F]F-kryptofix as the fluorine source:



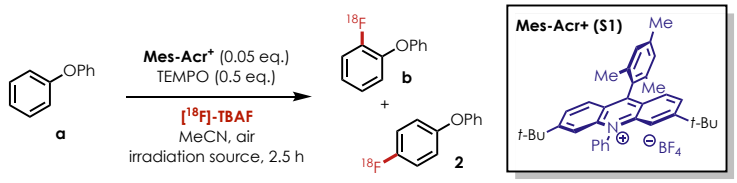
Photocatalyst **S1** (1.5mg, 0.0025mmol, 0.05eq.), diphenyl ether (8.5mg, 0.05mmol, 1.0eq.), TBAHSO (3.9mg, 0.025mmol, 0.5eq.), TEMPO (3.9mg, 0.025mmol, 0.5eq.) were weighed into a 2.5mL dried glass vial equipped with a stir bar and dissolved in 400µL anhydrous MeCN. The vial was then sealed with a Teflon-lined septum screw cap. The septum was then pierced with a disposable steel needle connected to an oxygen-filled balloon. A vent needle was inserted and the reaction medium was sparged for 1 min by bubbling oxygen through the mixture. Then the vent needle was removed, and the oxygen balloon was maintained, providing approximately 1 atm of oxygen to the vial headspace for the course of the reaction. Then a 100µL aliquot of K[^{18}F]F-kryptofix in anhydrous MeCN (typically 10-30 mCi, see section 5.1.2) was added to the reaction vial via syringe. The reaction flask was then placed on a stir plate and illuminated with blue LED lamps (450 nm). After 2.5 h, an aliquot of the reaction mixture (typically 400-800µCi) was taken for radio-HPLC analysis using HPLC condition B and the isolated and decay-corrected yield was calculated. The isolated yields of **2** and **b** are listed in Table S3.

Entry	^{18}F-Fluoride	Isolated yield of 2*	Isolated yield of b*
1	**^{18}F-CsF** (First Method: ^{18}F on QMA was eluted with 0.9% CsCl)	Trace	nd
2	**^{18}F-CsF** (Second Method: ^{18}F on QMA was eluted with 0.9% Cs_2CO_3)	nd	nd
3	**^{18}F-CsF** (Third Method: ^{18}F on QMA was eluted with 0.9% CsF)	nd	nd
4	**^{18}F-CsF** (Fourth Method: [^{18}F]TBAF mixed with CsCl)	nd	nd
5	**^{18}F-CsF** (Fifth Method: [^{18}F]TBAF mixed with CsF)	nd	nd
6	**^{18}F-TBAF**	0.572%	trace
7	**^{18}F-KF** (^{18}F on QMA was eluted with 0.9% $KClO_4$)	nd	nd
8	**K[^{18}F]F-kryptofix**	0.39%	trace

*nd = not detected

Table S3. Evaluation of ^{18}F-fluoride sources for the direct C–H fluorination of diphenyl ether.

5.5.2 Evaluation of Irradiation sources



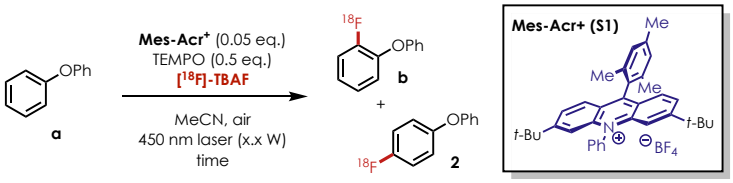
5.5.2.1 Laser as the light source

Photocatalyst **S1** (1.5mg, 0.0025mmol, 0.05eq.), diphenyl ether (8.5mg, 0.05mmol, 1.0eq.), TEMPO (3.9mg, 0.025mmol, 0.5eq.) were weighed into a 2.5mL dried glass vial and dissolved in 400μL anhydrous MeCN. The resulting solution was transferred to a 5mL v-vial sealed via a 200μL pipette, and a 100μL aliquot of [^{18}F]TBAF in MeCN (typically 10-30 mCi, prepared as described above) was added to the reaction vial via pipette. After counting the activity added, the reaction v-vial was fixed on an iron support and cooled to 0°C by using ice-acetone bath. Then the surface of reaction medium was irradiated directly with a laser spot from the optic fiber of an OEM blue diode laser (OEM-SD-450, 450nm, the power is 1.0 W after fiber coupling). Irradiation was carried out for 2.5 h. The resulting solution was diluted with MeCN (0.5 mL). An aliquot of the reaction mixture (typically 400-800μCi) was taken for radio-HPLC analysis using HPLC condition B and the isolated and decay-corrected yield was calculated. The isolated yields of **2** and **b** are listed in Table S4.

Entry	Light source	Isolated yield of 2	Isolated yield of b
1	**455nm LEDs**	0.572%	trace
2	**450nm Laser**	28.6%	1.33%

Table S4. Evaluation of irradiation sources for the direct C–H fluorination of diphenyl ether.

5.5.3 Evaluation of time-dependent laser power rating

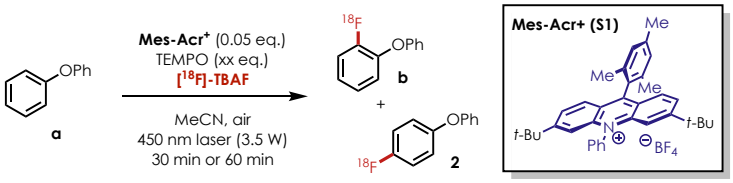


The reaction was run under the same conditions as the procedure in **5.5.2.1** The laser power rating was set at 1.0 W and 3.5W (maximum power of the laser) respectively and the reaction was analyzed by HPLC every 30 minutes. The isolated yields of **2** and **b** are listed in Table S5.

Entry	Laser power rating	Reaction time	Isolated yield of 2	Isolated yield of b
1	**1.0 W**	30min	2.67%	Trace
2		60min	7.68%	0.64%
3		90min	11.98%	1.60%
4		120min	19.38%	1.78%
5		150min	25.74%	2.64%
6	**3.5 W**	30min	8.23%	0.24%
7		60min	12.44%	0.90%
8		90min	16.20%	1.39%
9		120min	19.16%	1.70%
10		150min	20.40%	2.04%

Table S5. Evaluation of laser power rating for the direct C–H fluorination of diphenyl ether.

5.5.4 Evaluation of TEMPO loading

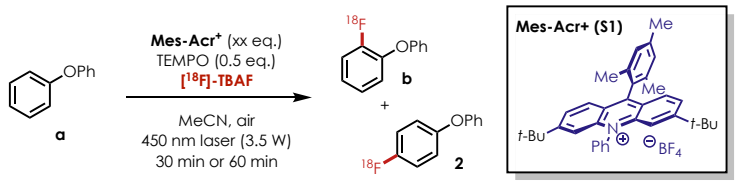


The reaction was run under the same conditions as the procedure in 5.5.2.1, with the laser power rating set at 3.5W. TEMPO loadings from 3.9mg (0.025mmol, 0.5eq.) to 7.8mg (0.05mmol, 1.0eq.) were analyzed. The reaction was analyzed by HPLC after 30 and 60 minutes of irradiation. The isolated yields of **2** and **b** are listed in Table S6.

Entry	TEMPO Loading	Reaction time	Isolated yield of 2	Isolated yield of b
1	3.9mg (0.5eq)	30min	8.23%	0.24%
2		60min	12.44%	0.90%
3	7.8mg (1.0eq)	30min	5.96%	0.13%
4		60min	8.07%	0.62%

Table S6. Evaluation of TEMPO loading for the direct C–H fluorination of diphenyl ether.

5.5.5 Evaluation of catalyst loading

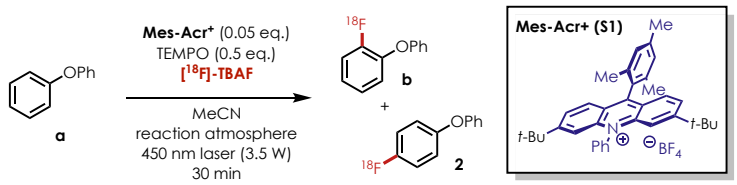


The reaction was run under the same conditions as the procedure in 5.5.2.1, with the laser power rating set at 3.5W. Photocatalyst (**S1**) loadings from 3.9mg (0.025mmol, 0.5eq.) to 7.8mg (0.05mmol, 1.0eq.) were analyzed. The reaction was analyzed by HPLC after 30 and 60 minutes of irradiation. The isolated yields of **2** and **b** are listed in Table S7.

Entry	Catalyst Loading	Reaction time	Isolated yield of 2	Isolated yield of b
1	**1.5mg (0.05eq)**	30min	8.23%	0.24%
2		60min	12.44%	0.90%
3	**3.0mg (0.1eq)**	30min	8.78%	0.20%
4		60min	15.60%	0.82%

Table S7. Evaluation of photocatalyst loading for the direct C−H fluorination of diphenyl ether.

5.5.6 Evaluation of reaction atmosphere

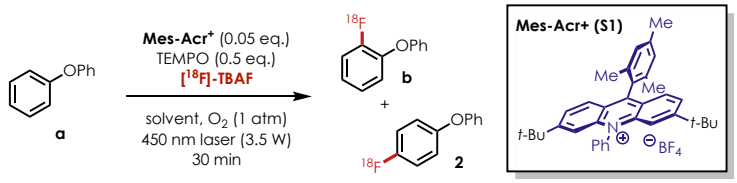


The reaction was run under the same conditions as the procedure in 5.5.2.1, with the laser power rating set at 3.5W. The reaction solution was either sparged with O_2 or N_2 for the entirety of the reaction. The reaction was analyzed by HPLC after 30 and 60 minutes of irradiation. The isolated yields of **2** and **b** are listed in Table S8.

Entry	Atmosphere	Reaction time	Isolated yield of 2	Isolated yield of b
1	Air (Stationary contact)	30min	8.23%	0.24%
2		60min	12.44%	0.90%
3	O_2 (bubbling)	30min	25.84%	2.01%
4	N_2 (bubbling)	30min	2.79%	Trace

Table S8. Evaluation of reaction atmosphere for the direct C−H fluorination of diphenyl ether.

5.5.8 Solvent Screening



The reaction was run under the same conditions as the procedure in 5.5.2.1, with the laser power rating set at 3.5W. The reaction solution was sparged with O_2 for the entirety of the reaction. The isolated yields of **2** and **b** are listed in Table S9.

Entry	Solvent	Isolated yield of 2*	Isolated yield of b*
1	MeCN	25.84%	2.01%
2	DCE†	8.97%	0.27%
3	DMSO	nd	nd
4	DMF	nd	nd
5	THF	0.27%	nd
6	MeOH	nd	nd
7	MeCN:t-BuOH=1:4 (Catalyst **S1**)	37.1±12% (n=5)	2±1% (n=5)
8	MeCN:t-BuOH=1:4 (Catalyst **1**)	38.2±10% (n=5)	1.75±0.7% (n=5)
9	t-BuOH	1.95%	trace

* nd = not detected; †The reaction time is 25min, because DCE volatilized completely.

Table S9. Evaluation of reaction solvent for the direct C−H fluorination of diphenyl ether.

5.5.9 Miscellaneous optimizations

The reactions below were run under these conditions unless specified otherwise:

The catalyst **S1** (1.5mg, 0.0025mmol, 0.05eq.), diphenyl ether (8.5mg, 0.05mmol, 1.0eq.), TEMPO (3.9mg, 0.025mmol, 0.5eq.) were weighed into a 2.5mL dried glass vial and dissolved in 500μL MeCN:t-BuOH=1:4 The resulting solution was transferred to a 5mL v-vial sealed via a 200μL pipette, and a 100μL aliquot of [^{18}F]TBAF in MeCN (typically 10-30 mCi, prepared as described above) was added to the reaction vial via pipette. After counting the activity added, the reaction v-vial was fixed on an iron support and cooled to 0°C by using ice-acetone bath. The reaction solution was then sparged with O_2 before the surface of reaction medium was irradiated directly with a laser spot from the optic fiber of an OEM blue diode laser (OEM-SD-450, 450nm, the power is 3.5 W after fiber coupling). The reaction solution was kept under an O_2 sparge for the remainder of reaction irradiation (30 mins). The resulting solution was diluted with MeCN (0.5 mL). An aliquot of the reaction mixture (typically 400-800μCi) was taken for radio-HPLC analysis using HPLC condition B and the isolated and decay-corrected yield was calculated. The isolated yields of **2** and **b** are listed in the corresponding tables.

5.5.9.1 Evaluation of substrate concentration

(A) S1 (1.5mg, 2.5μmol), diphenyl ether (8.5mg, 50μmol), TEMPO (3.9mg, 25μmol)
(B) S1 (1.5mg, 2.5μmol), diphenyl ether (1.7mg, 10μmol), TEMPO (3.9mg, 25μmol)
(C) S1 (0.3mg, 0.5μmol), diphenyl ether (1.7mg, 10μmol), TEMPO (0.8mg, 5μmol)

Entry	Condition	Isolated yield of 2	Isolated yield of b
1	**A**	37.1±12% (n=5)	2±1% (n=5)
2	**B**	7.88%	0.30%
3	**C**	5.57%	0.24%

Table S10. Evaluation of substrate concentration for the direct C–H fluorination of diphenyl ether.

5.5.9.2 Reaction controls

Entry	Condition	Isolated yield of 2*	Isolated yield of b*
1	Model reaction	37.1±12% (n=5)	2±1% (n=5)
2	No TEMPO	3.04%	0.18%
3	No catalyst	nd	nd

* nd = not detected

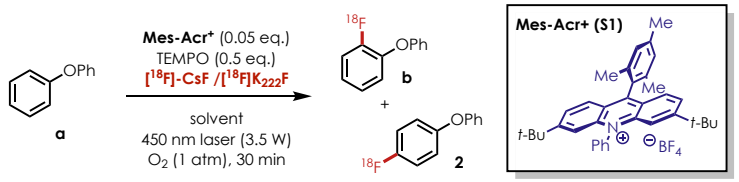
Table S11. Reaction controls for the direct C–H fluorination of diphenyl ether.

5.5.9.3 Evaluation of excess water

Entry	Condition	Isolated yield of 2	Isolated yield of b
1	Model reaction	37.1±12% (n=5)	2±1% (n=5)
2	With 5% H_2O	4.83%	0.40%

Table S12. Impact of excess water on the direct C–H fluorination of diphenyl ether.

5.5.9.4 Expansion of compatible [^{18}F] sources under optimized conditions



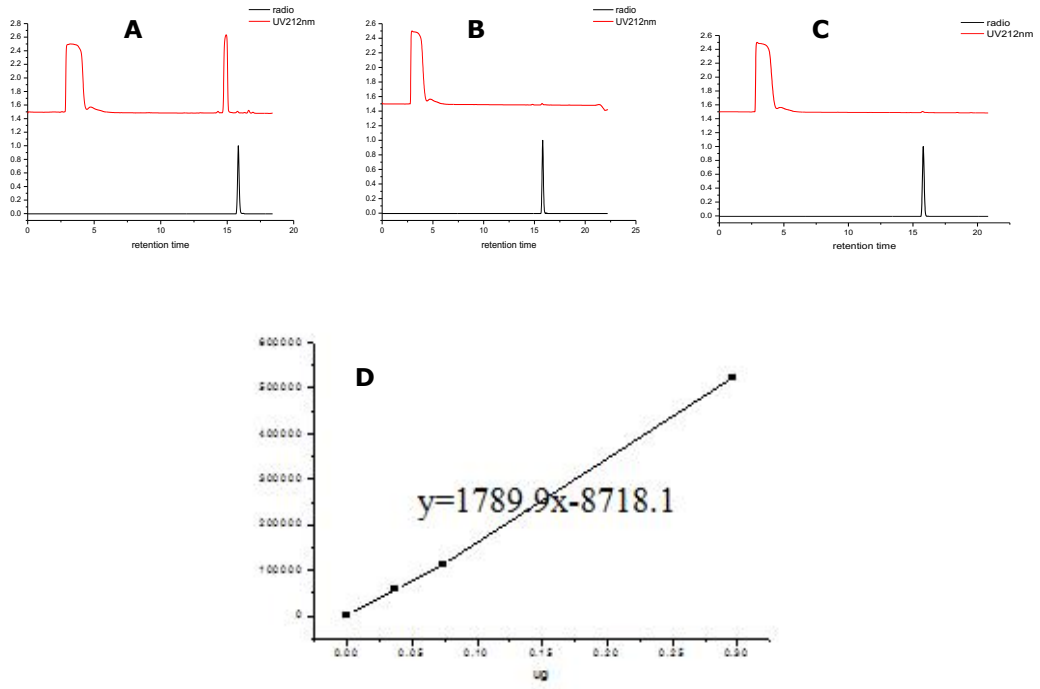
[^{18}F]CsF and [^{18}F]K_{222}F were generated according to the procedures in 5.5.1

Entry	Condition	Isolated yield of 2	Isolated yield of b
1	[^{18}F]CsF as the fluorine source and t-BuOH as the solvent	21.2%	0.83%
2	[^{18}F]K_{222}F as the fluorine source and t-BuOH/MeCN as the solvent	26.2%	1.5%

Table S13. Compatibility of [^{18}F]CsF and [^{18}F]K_{222}F for the direct C–H fluorination of diphenyl ether.

5.5.10 Molar activity calculations

Molar activity (the measured radioactivity per mole of compound)was calculated using a standard curve of the corresponding fluorinated arene. An example for calculating molar activity is shown below. A ^{19}F standard curve [Y axis = UV area, X axis =mass(μg)] was created from the HPLC trace for a standard solution of 1-fluoro-4-phenoxybenzene . The radiolabeled product was collected and purified via HPLC; the UV area overlapping with radio peak was then recorded. The standard curve was used to calculate the mass and mole number. Dividing the product activity by the mole number gives the molar activity in Ci/μmol. In this example, [^{18}F]-1-fluoro-4-phenoxybenzene isolated has a molar activity of 1.37Ci/μmol, which is decay corrected from the end of bombardment (EOB).



E

Trace	Injected dose (p-product)	Integral Area	Molar activity Decay corrected (EOB)
A	115μCi	817897	1.28Ci/μmol
B	85μCi	627625	1.48Ci/μmol
C	63μCi	593897	1.36Ci/μmol

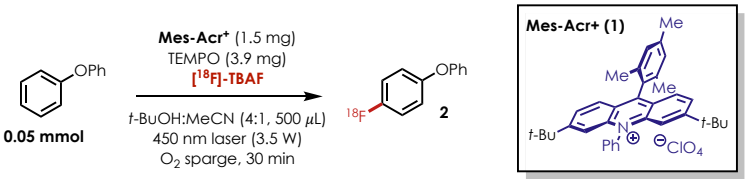
Fig. S5. Radio-HPLC and UV traces for [^{18}F]-1-fluoro-4-phenoxybenzene (**A, B, C**); standard curve generated from the UV traces (**D**); calculation of molar activity using the standard curve (**E**)

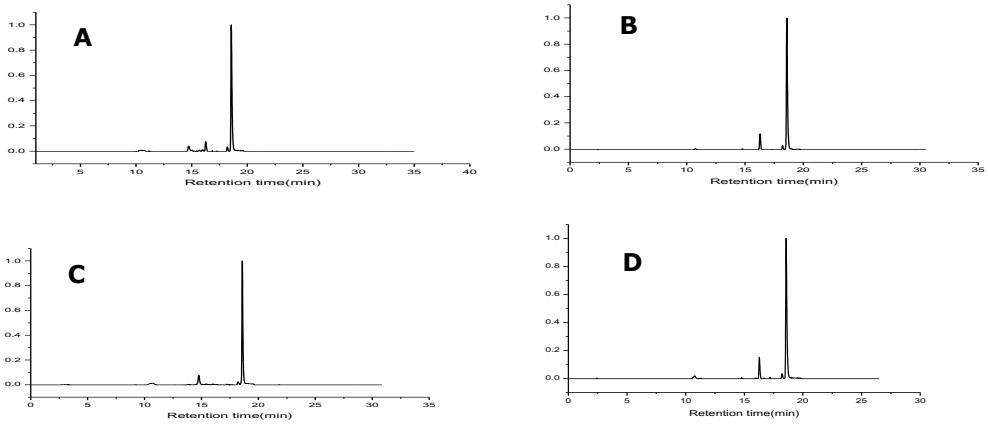
5.6 Radio-HPLC analysis and characterization for ^{18}F-radiolabeled arenes

5.6.1 General information: All the labelling reactions are carried out using general procedure A from the section 5.3 unless specified otherwise. The amounts of photocatalyst **1** (1.5mg.) and TEMPO (3.9mg) were kept consistent for all radiolabeling experiments. The respective molar equivalents of **1** and TEMPO (with respect to the arenes) are as follows: 1) Arene (0.05 mmol/0.10 mmol/0.125 mmol/0.25 mmol); 2) Photocatalyst **1** (0.05 eq./0.025 eq./0.02 eq./0.01 eq.); 3) TEMPO (0.5eq. /0.25eq. /0.2eq. /0.1eq.) Three replicate experiments were used to calculate RCYs (five replicates were run for **2**). The co-injection of the hot product and standard are offset by 0.04-0.06 min due to the distance of the UV and radio detector. The red HPLC traces in the following spectra were obtained with a UV signal at 212nm. The black HPLC traces are the radio signal for the crude and isolated radiolabeled products. HPLC conditions for analysis and purification are listed for each radiolabeled product.

The following fluorination standards were obtained from commercial vendors and used as received: 4-fluorophenoxybenzene **(2)**, 4-fluorobiphenyl **(3)** , 1-fluoronaphthalene **(4)**, 2-bromo-4-fluoroanisole **(5)**, 2-chloro-4-fluoroanisole **(6)**, methyl 5-fluoro-2-methoxybenzoate **(8)**, 1-(5-fluoro-2-methoxyphenyl)ethenone **(9)**, 5-fluoro-2-methoxybenzonitrile **(10)**, 5-fluoro-2-methoxybenzaldehyde **(11)**, 3-fluoro-4-methoxybenzaldehyde **(15),** 1-(3-fluoro-4-methoxyphenyl)ethenone **(16)**, methyl 3-fluoro-4-methoxybenzoate **(18)**, 1-(4-fluoro-3-methoxyphenyl)ethenone **(20, [4-F])** and 2-fluoromesitylene **(25)**. The preparation of aromatic fluorinated standards **(7, 12, 13, 14, 17, 19, 20 [2-F], 21-24, 26-42)** are found in section 3.3.

5.6.2 Radio-HPLC traces for ^{18}F-radiolabeled arenes, decay corrected isolated radiochemical yields (RCY), Radio-HPLC traces for quality control (QC) and co-injection, and HPLC conditions for isolating the corresponding ^{18}F-radiolabeled arenes.





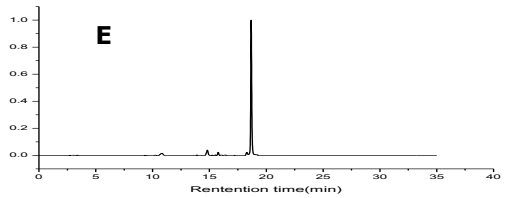


Fig. S6 Radio-HPLC traces for **2**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **2**	RCY(Decay corrected) **b**
Run 1	32.0%	1.7%
Run 2	40.9%	1.9%
Run 3	49.6%	2.8%
Run 4	30.0%	1.2%
Run 5	38.7%	1.3%
Average	**38.2±10%**	**1.8±1%**

Table S14. Average radiochemical yields for **2** and b

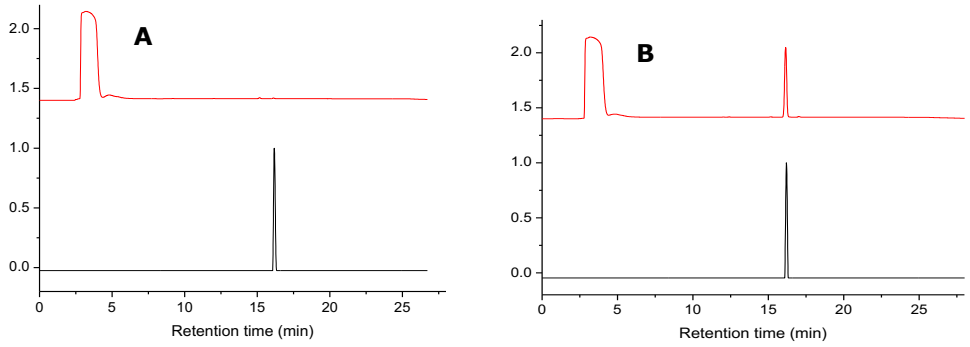


Fig. S7. HPLC traces of QC (**A**) and co-injection (**B**) for **2**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;Grad/isocrat: 0 to 2 min: 20% to 45% solvent B, 2 to 22 min: 45% to 60% solvent B, 22 to 28 min: 60% to 95% solvent B, 28 to 28.1 min: 95% to 20% solvent B, 28.1 to 30 min: isocratic elution at 20% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

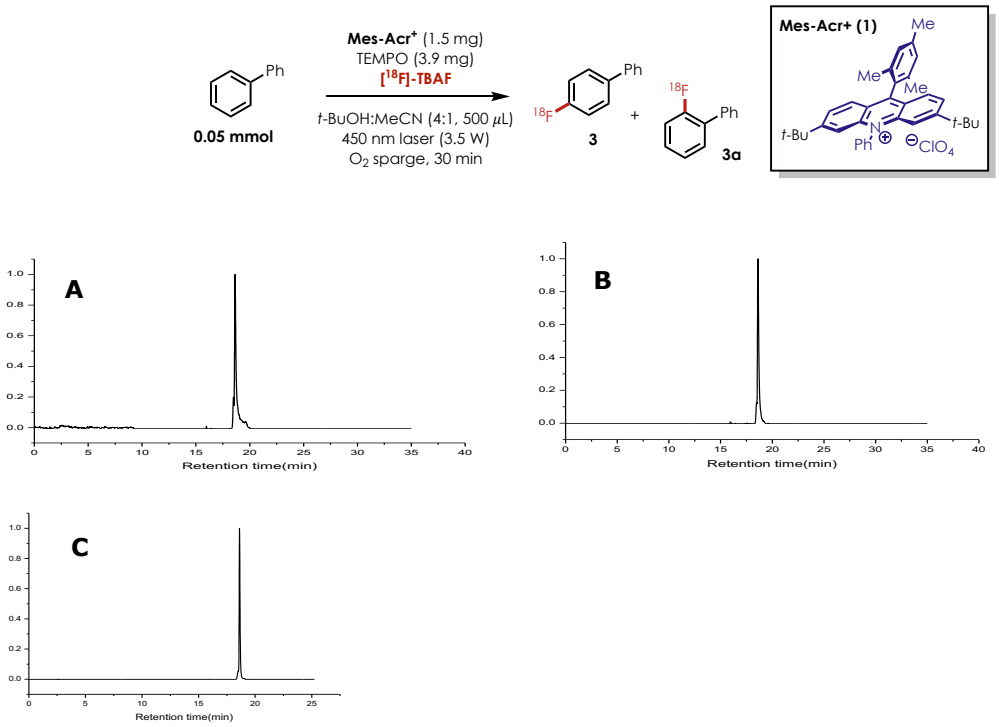


Fig. S8. Radio-HPLC traces of **3**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;Grad/isocrat: 0 to 2 min: 20% to 45% solvent B, 2 to 22 min: 45% to 60% solvent B, 22 to 28 min: 60% to 95% solvent B, 28 to 28.1 min: 95% to 20% solvent B, 28.1 to 30 min: isocratic elution at 20% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **3**
Run 1	30.6%
Run 2	50.6%
Run 3	36.7%
Average	**39.3±10%**

Table S15. Average radiochemical yields for **3**

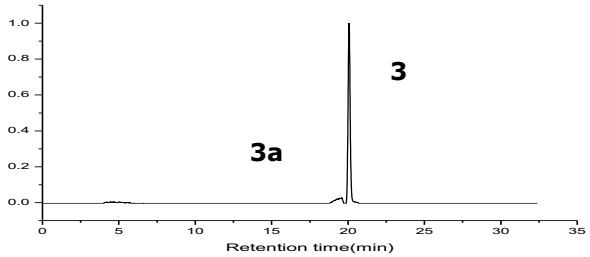


Fig. S9. Radio-HPLC trace of 3a (left peak) and 3 (right peak)

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

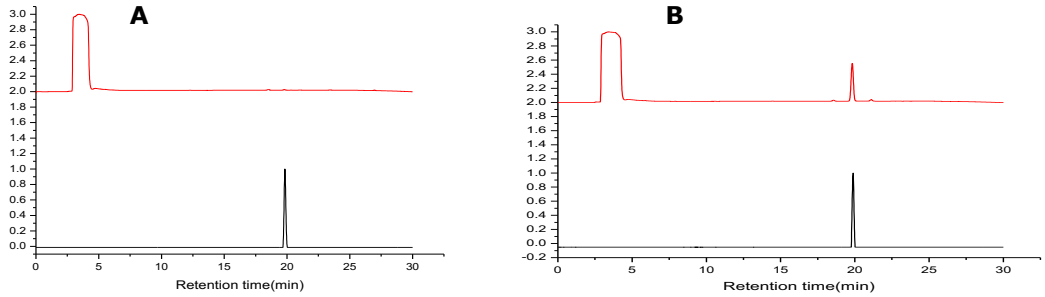


Fig. S10. HPLC traces of QC(**A**) and co-injection(**B**) for **3**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;Grad/isocrat: 0 to 2 min: 20% to 45% solvent B, 2 to 22 min: 45% to 60% solvent B, 22 to 28 min: 60% to 95% solvent B, 28 to 28.1 min: 95% to 20% solvent B, 28.1 to 30 min: isocratic elution at 20% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

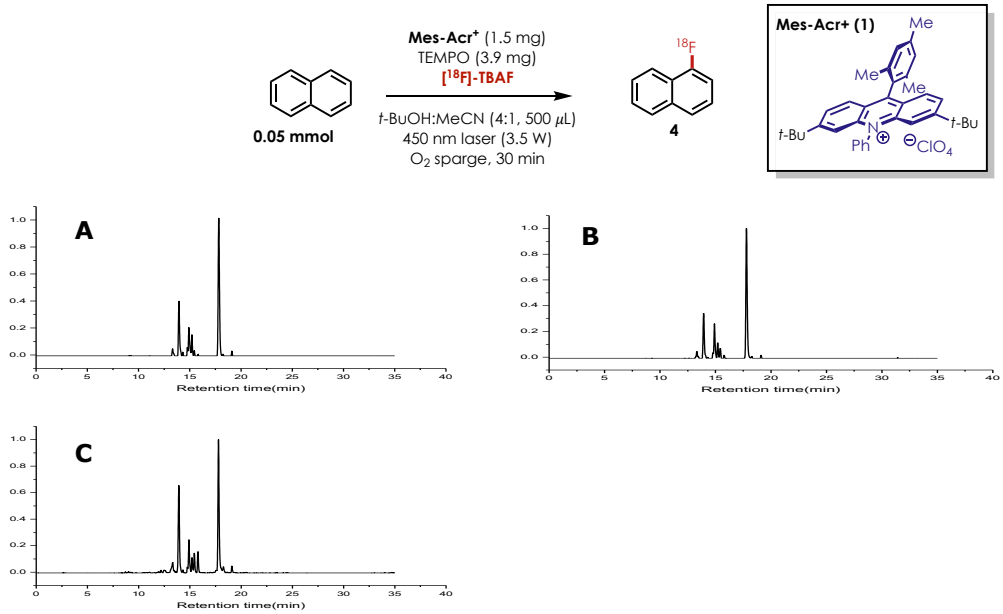


Fig. S11. Radio-HPLC traces of **4**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **4**
Run 1	20.3%
Run 2	20.1%
Run 3	22.2%
Average	**20.9±1%**

Table S16. Average radiochemical yields for **4**

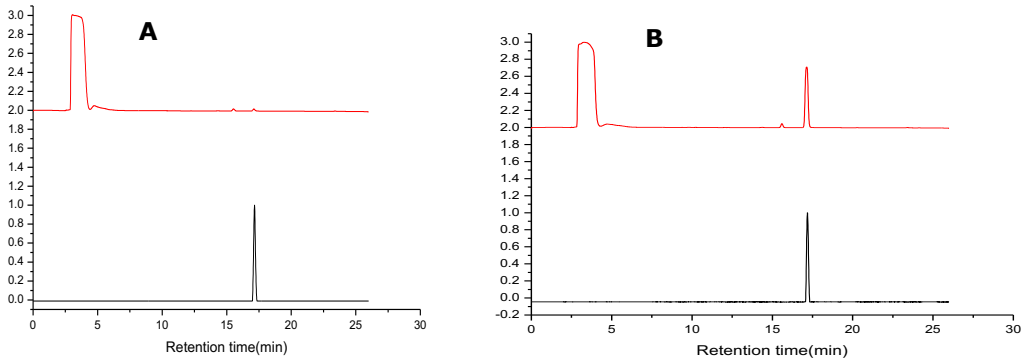
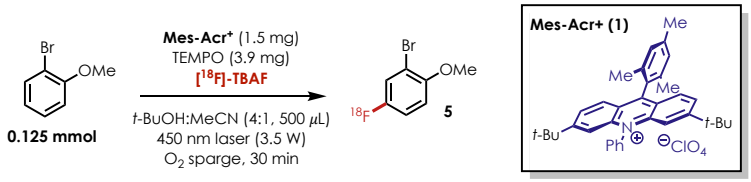


Fig. S12. HPLC traces of QC(**A**) and co-injection(**B**) for **4**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;Grad/isocrat: 0 to 2 min: 20% to 45% solvent B, 2 to 22 min: 45% to 60% solvent B, 22 to 28 min: 60% to 95% solvent B, 28 to 28.1 min: 95% to 20% solvent B, 28.1 to 30 min: isocratic elution at 20% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.



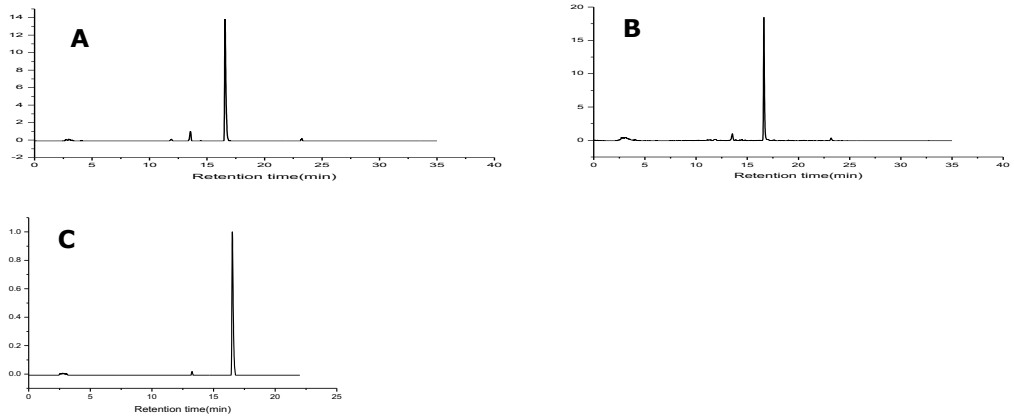


Fig. S13. Radio-HPLC traces of **5**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **5**
Run 1	8.9%
Run 2	9.7%
Run 3	9.0%
Average	**9.2±0.5%**

Table S17. Average radiochemical yields for **5**

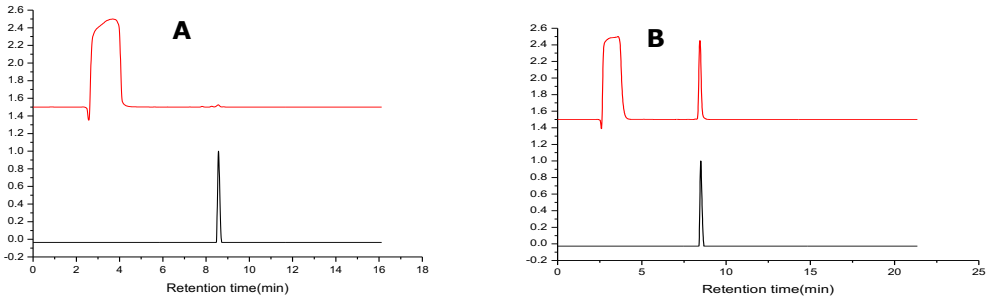


Fig. S14. HPLC traces of QC(**A**) and co-injection(**B**) for **5**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 55% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

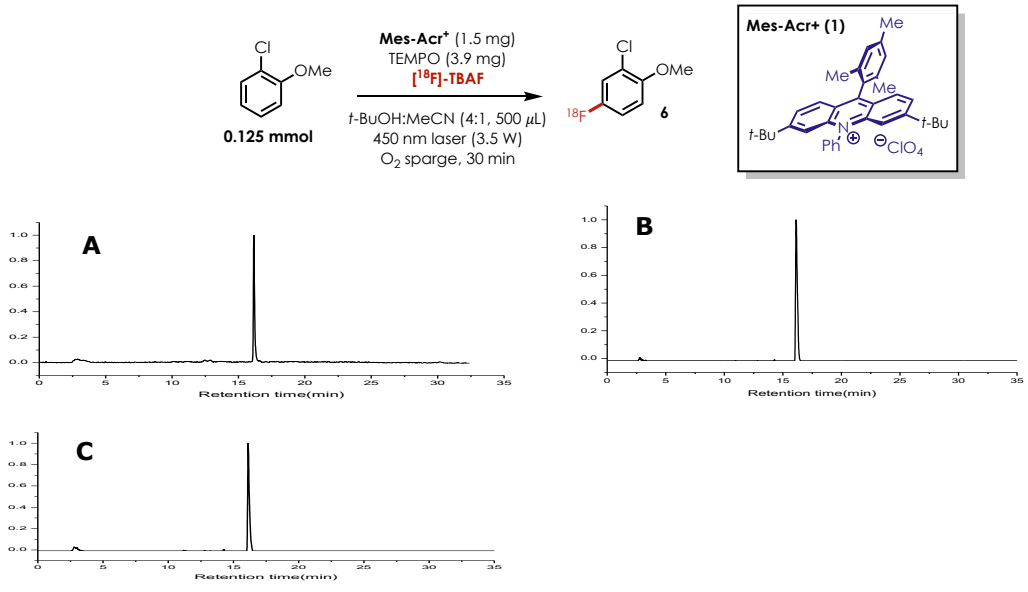


Fig. S15. Radio-HPLC traces of **6**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **6**
Run 1	16.0%
Run 2	15.4%
Run 3	13.8%
Average	**15.1±1%**

Table S18. Average radiochemical yields for **6**

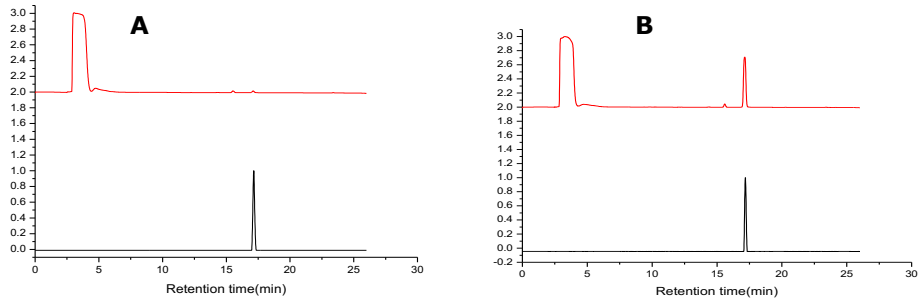


Fig. S16. HPLC traces of QC(**A**) and co-injection(**B**) for **6**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;Grad/isocrat: 0 to 2 min: 20% to 45% solvent B, 2 to 22 min: 45% to 60% solvent B, 22 to 28 min: 60% to 95% solvent B, 28 to 28.1 min: 95% to 20% solvent B, 28.1 to 30 min: isocratic elution at 20% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

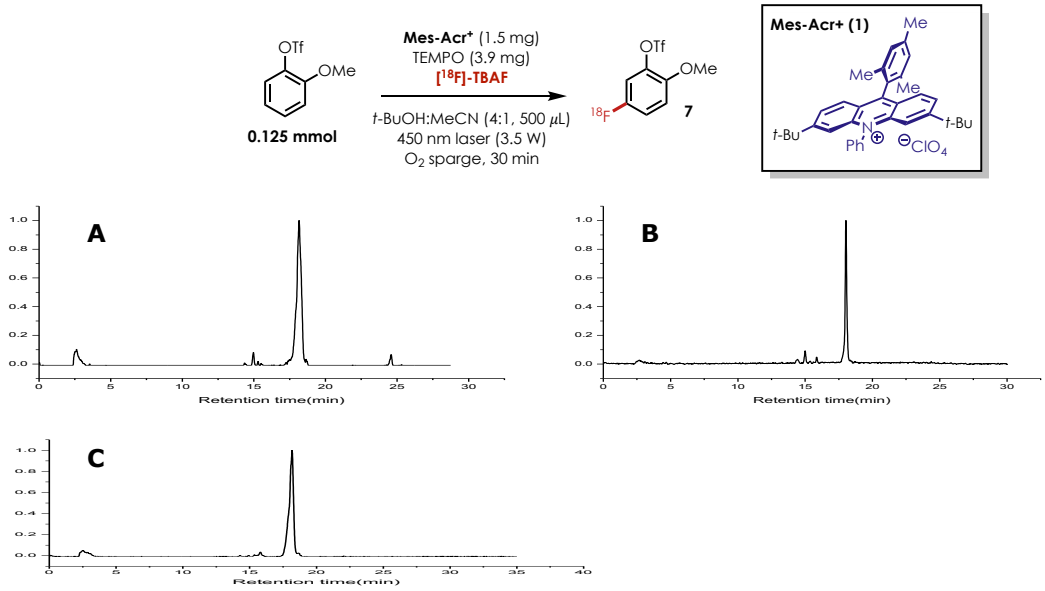


Fig. S17. Radio-HPLC traces of **7**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **7**
Run 1	32.5%
Run 2	23.1%
Run 3	27.4%
Average	**27.7±5%**

Table S19. Average radiochemical yields for **7**

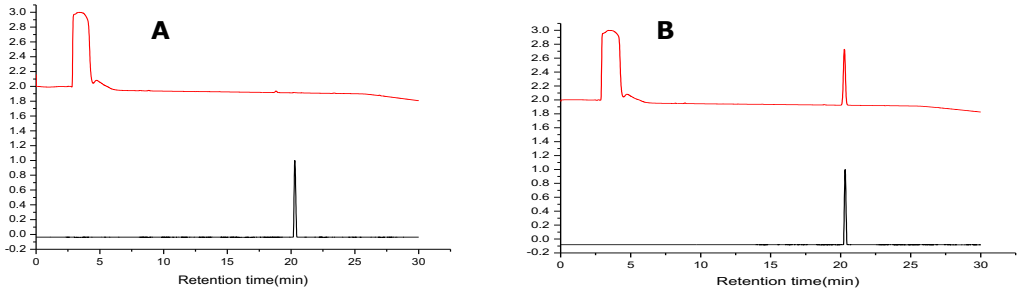
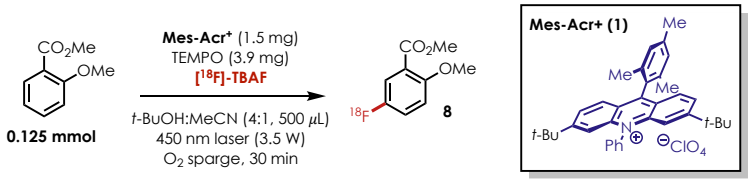


Fig. S18. HPLC traces of QC(**A**) and co-injection(**B**) for **7**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;Grad/isocrat: 0 to 2 min: 20% to 45% solvent B, 2 to 22 min: 45% to 60% solvent B, 22 to 28 min: 60% to 95% solvent B, 28 to 28.1 min: 95% to 20% solvent B, 28.1 to 30 min: isocratic elution at 20% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.



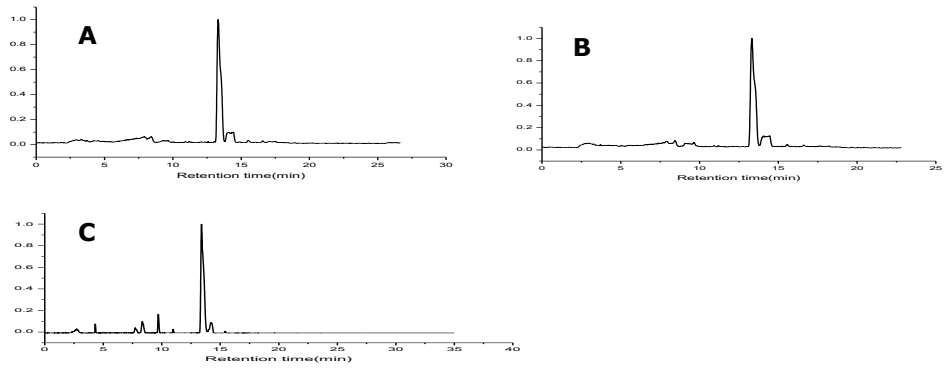


Fig. S19. Radio-HPLC traces of **8**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **8**
Run 1	21.4%
Run 2	29.1%
Run 3	19.9%
Average	**23.5±5%**

Table S20. Average radiochemical yields for **8**

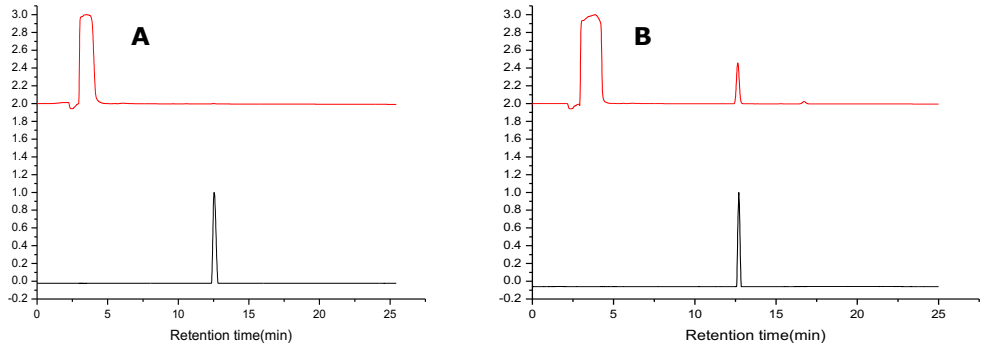
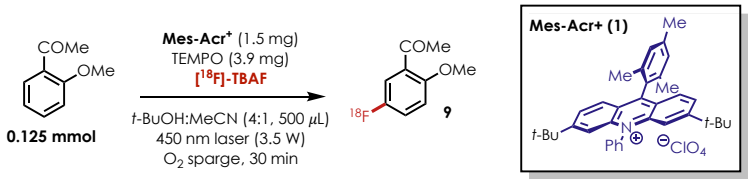


Fig. S20. HPLC traces of QC(**A**) and co-injection(**B**) for **8**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 35% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.



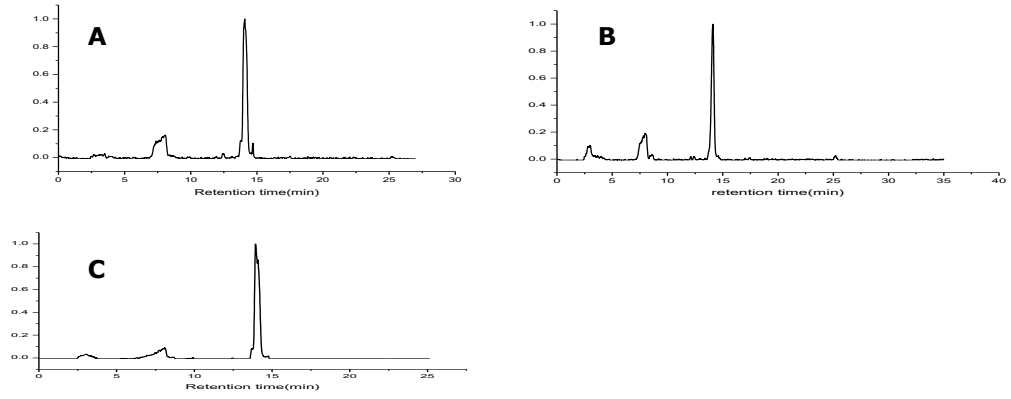


Fig. S21. Radio-HPLC traces of **9**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **9**
Run 1	25.3%
Run 2	22.7%
Run 3	25.9%
Average	**24.6±2%**

Table S21. Average radiochemical yields for **9**

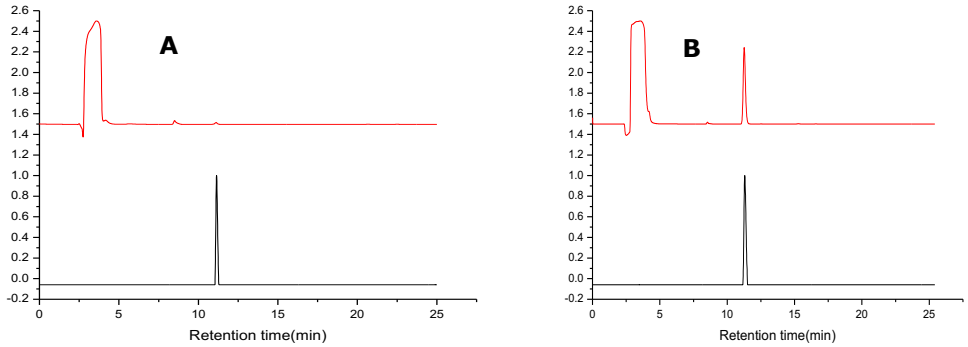


Fig. S22. HPLC traces of QC(**A**) and co-injection(**B**) for **9**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 40% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

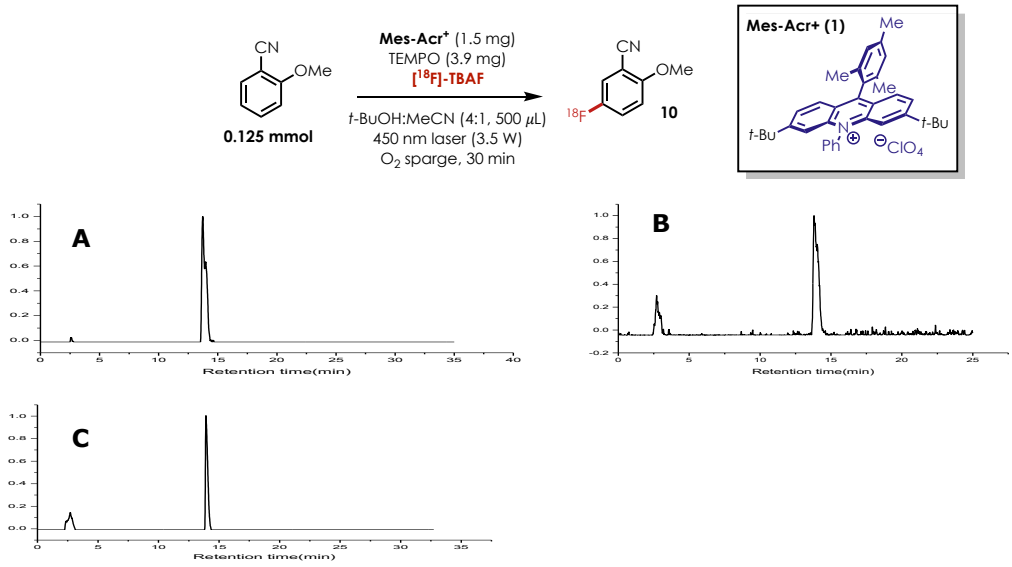


Fig. S23. Radio-HPLC traces of **10**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **10**
Run 1	12.9%
Run 2	8.9%
Run 3	11.5%
Average	11.1±2%

Table S22. Average radiochemical yields for **10**

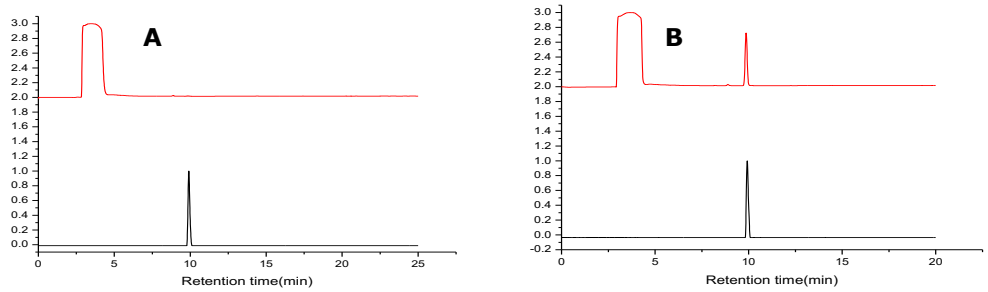


Fig. S24. HPLC traces of QC(**A**) and co-injection(**B**) for **10**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;Grad/isocrat: 0 to 2 min: 20% to 45% solvent B, 2 to 22 min: 45% to 60% solvent B, 22 to 28 min: 60% to 95% solvent B, 28 to 28.1 min: 95% to 20% solvent B, 28.1 to 30 min: isocratic elution at 20% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C

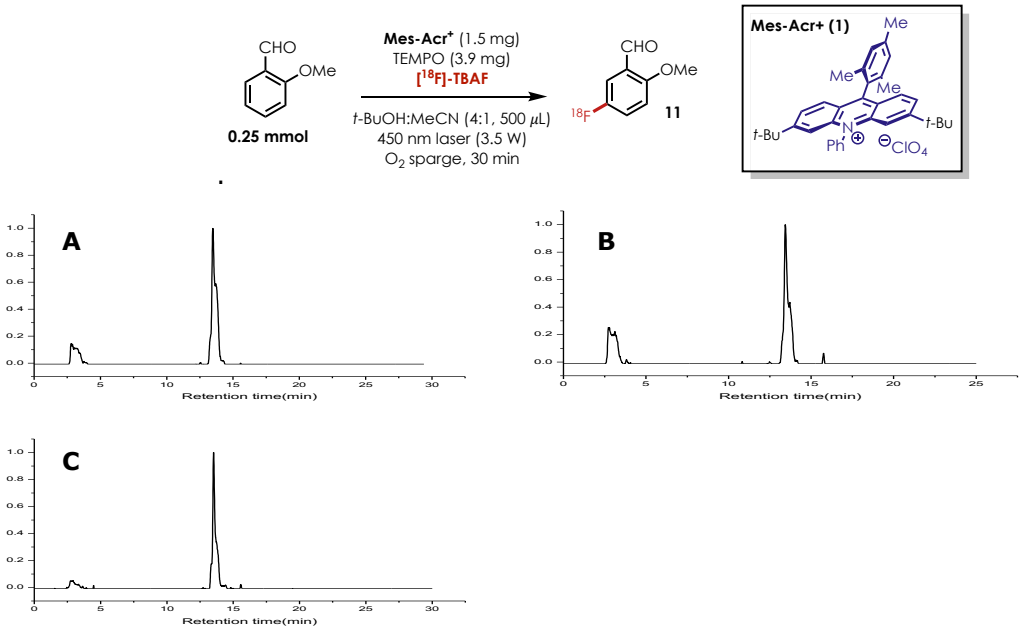


Fig. S25. Radio-HPLC traces of **11**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **11**
Run 1	27.7%
Run 2	21.3%
Run 3	21.5%
Average	**23.5±4%**

Table S23. Average radiochemical yields for **11**

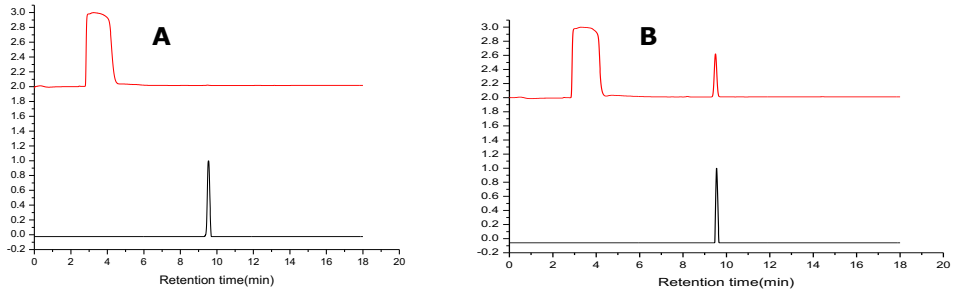


Fig. S26. HPLC traces of QC(**A**) and co-injection(**B**) for **11**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;Grad/isocrat: 0 to 2 min: 20% to 45% solvent B, 2 to 22 min: 45% to 60% solvent B, 22 to 28 min: 60% to 95% solvent B, 28 to 28.1 min: 95% to 20% solvent B, 28.1 to 30 min: isocratic elution at 20% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

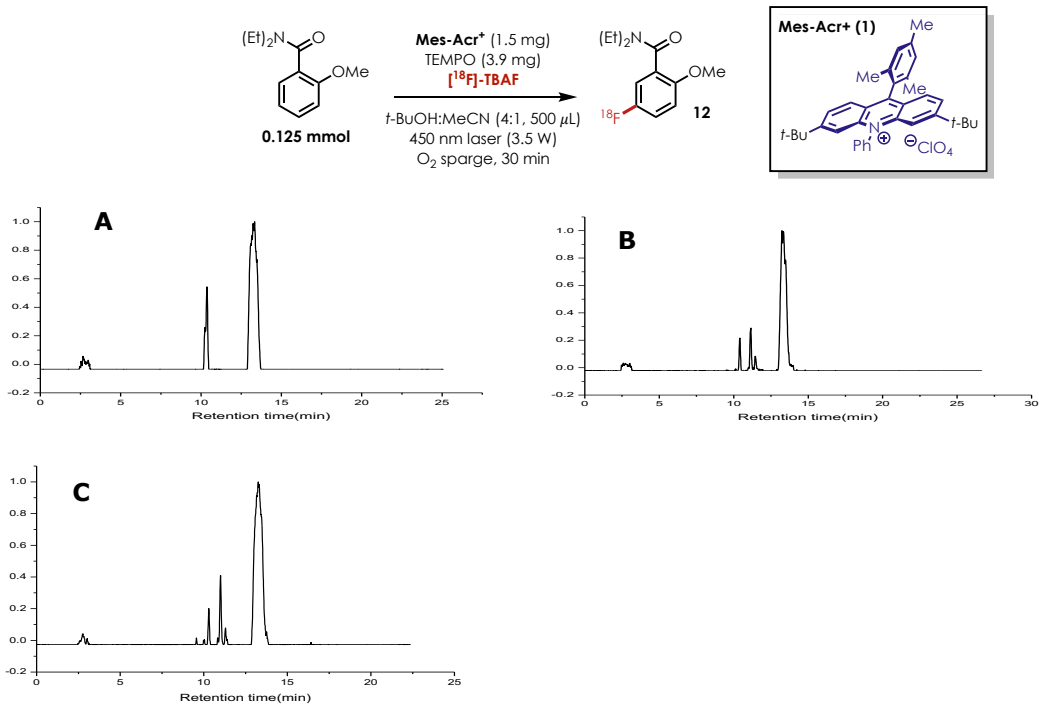


Fig. S27. Radio-HPLC traces of **12**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **12**
Run 1	13.4%
Run 2	13.2%
Run 3	14.8%
Average	**13.8±1%**

Table S24. Average radiochemical yields for **12**

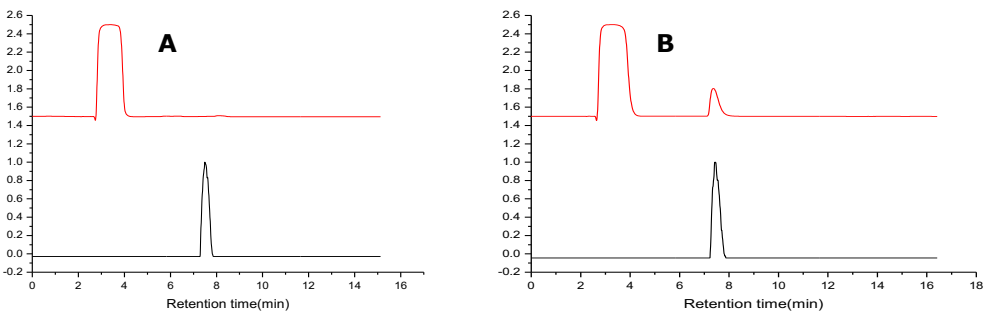


Fig. S28. HPLC traces of QC(**A**) and co-injection(**B**) for **12**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 40% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

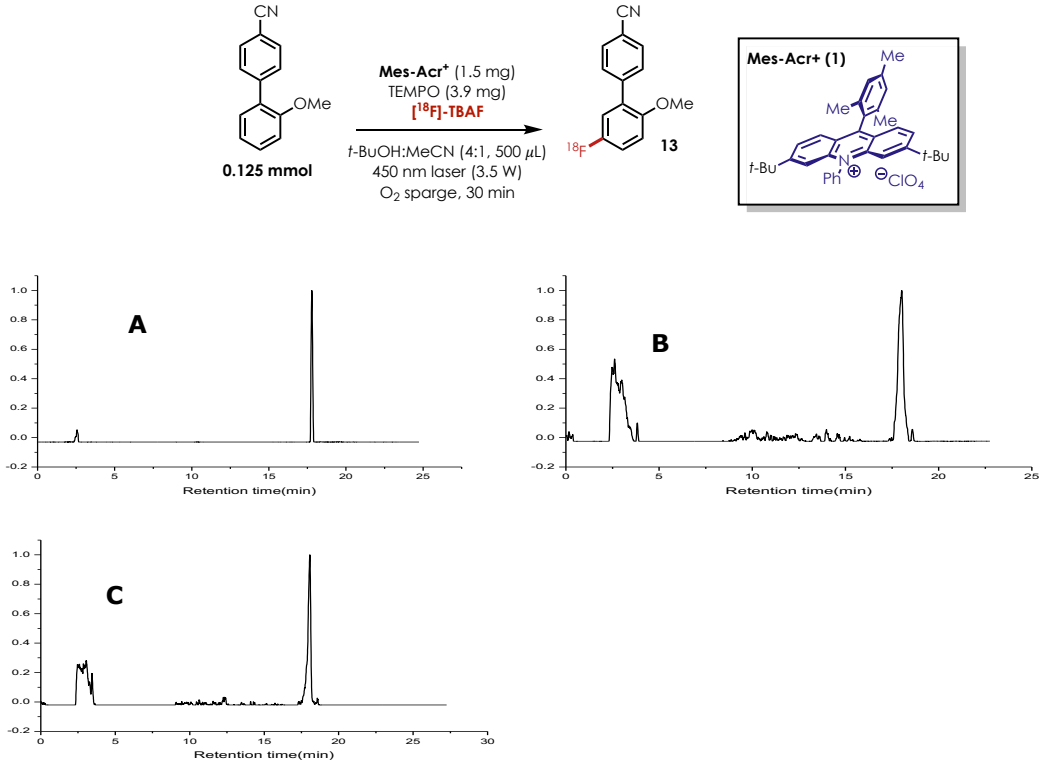


Fig. S29. Radio-HPLC traces of **13**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **13**
Run 1	4.2%
Run 2	4.7%
Run 3	3.3%
Average	**4.1±0.6%**

Table S25. Average radiochemical yields for **13**

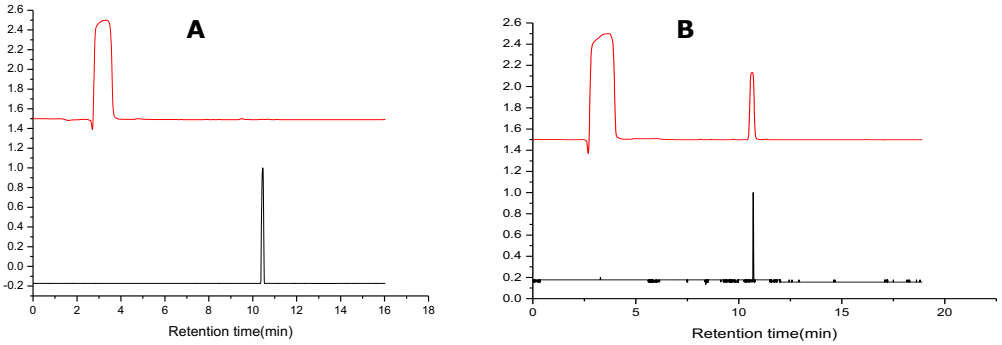
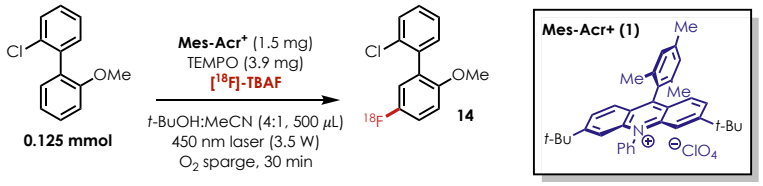


Fig. S30. HPLC traces of QC(**A**) and co-injection(**B**) for **13**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 55% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.



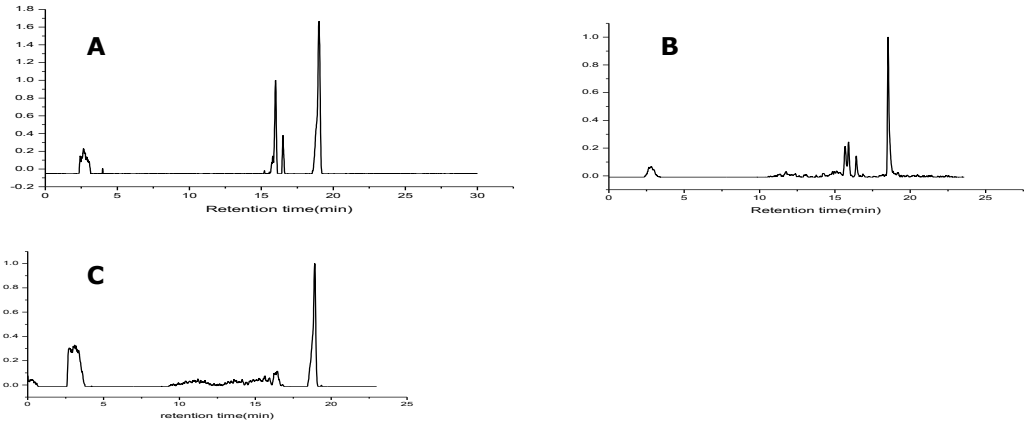


Fig. S31. Radio-HPLC traces of **14**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **14**
Run 1	4.7%
Run 2	6.6%
Run 3	9.8%
Average	**7.0±3%**

Table S26. Average radiochemical yields for **14**

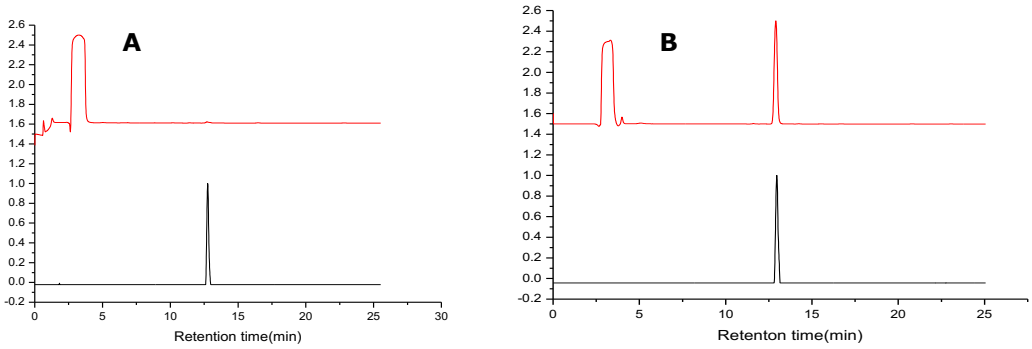


Fig. S32. HPLC traces of QC(**A**) and co-injection(**B**) for **14**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 55% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

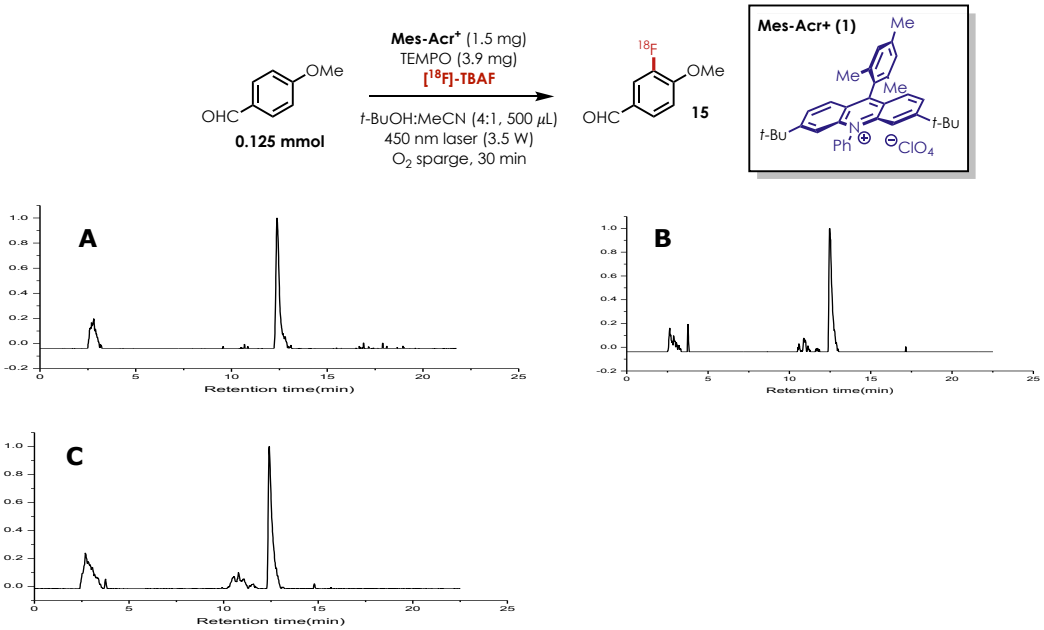


Fig. S33. Radio-HPLC traces of **15**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **15**
Run 1	4.3%
Run 2	5.2%
Run 3	7.5%
Average	**5.7±1%**

Table S27. Average radiochemical yields for **15**

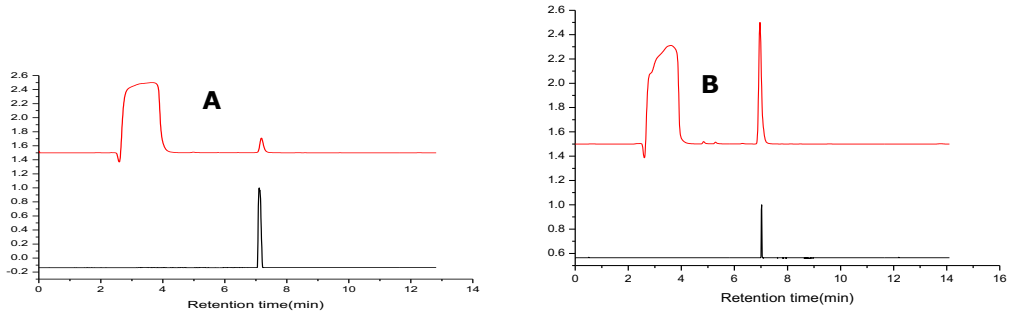
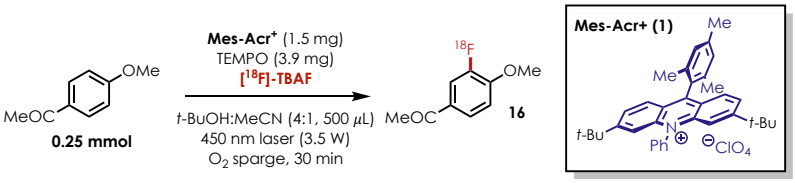


Fig. S34. HPLC traces of QC(**A**) and co-injection(**B**) for **15**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 45% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.



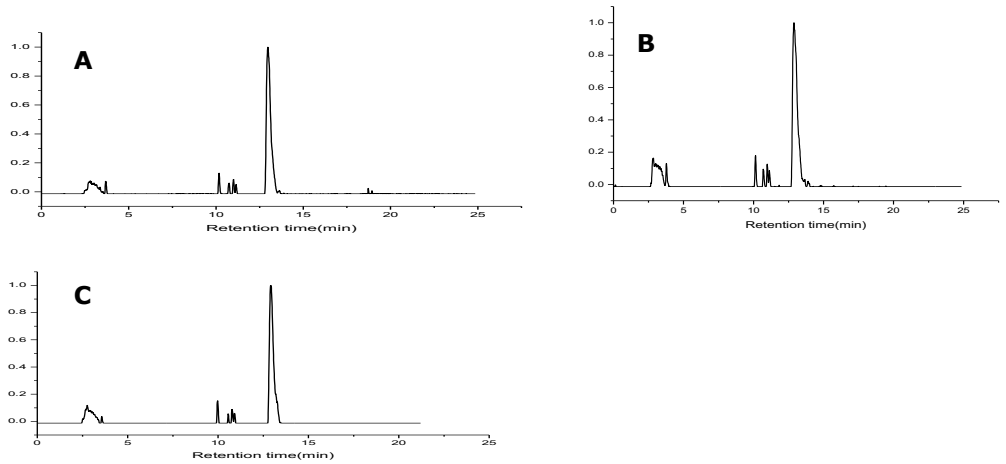


Fig. S35. Radio-HPLC traces of **16**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **16**
Run 1	10.2%
Run 2	12.2%
Run 3	9.2%
Average	**10.5±1%**

Table S28. Average radiochemical yields for **16**

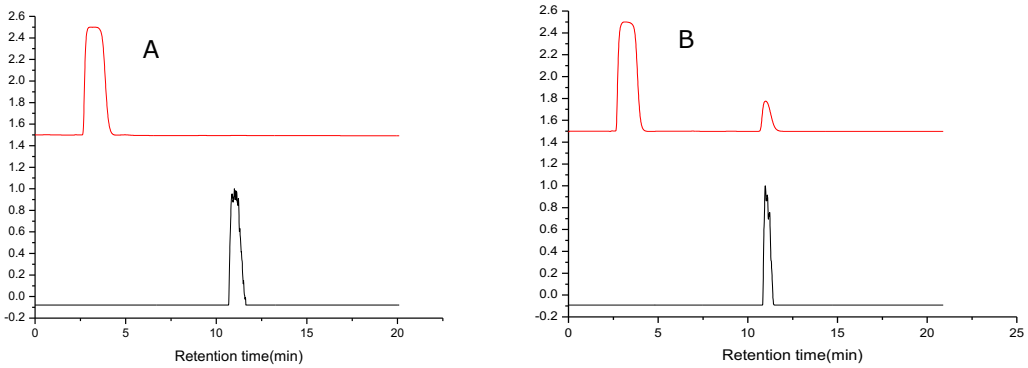


Fig. S36. HPLC traces of QC(**A**) and co-injection(**B**) for **16**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 35% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

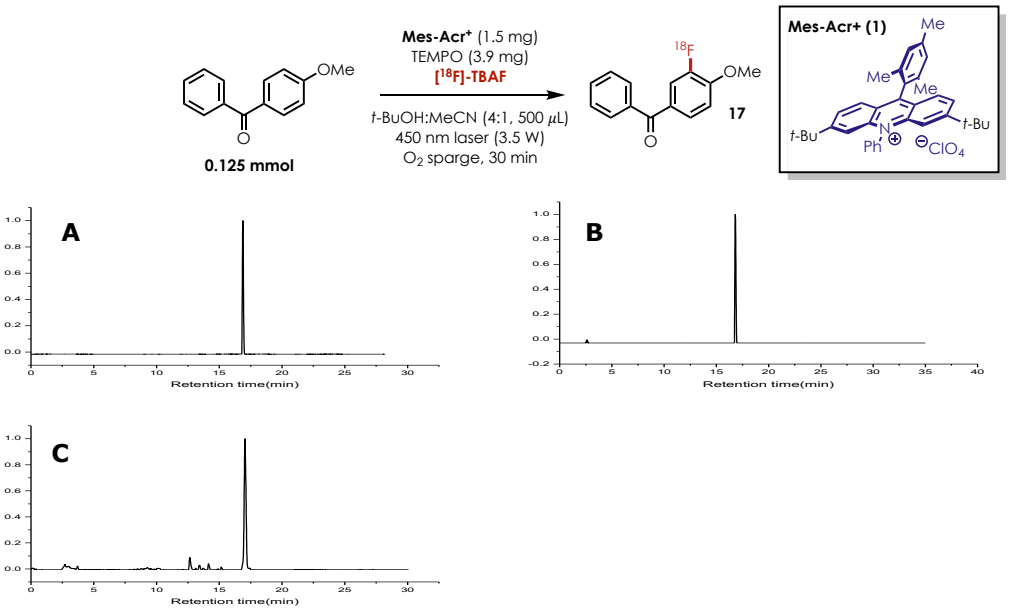


Fig. S37. Radio-HPLC traces of **17**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **17**
Run 1	7.0%
Run 2	6.1%
Run 3	6.8%
Average	**6.6±0.5%**

Table S29. Average radiochemical yields for **17**

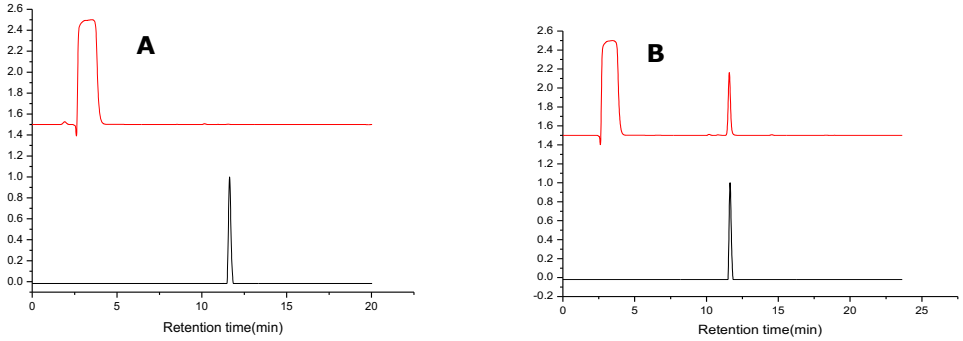


Fig. S38. HPLC traces of QC(**A**) and co-injection(**B**) for **17**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 50% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

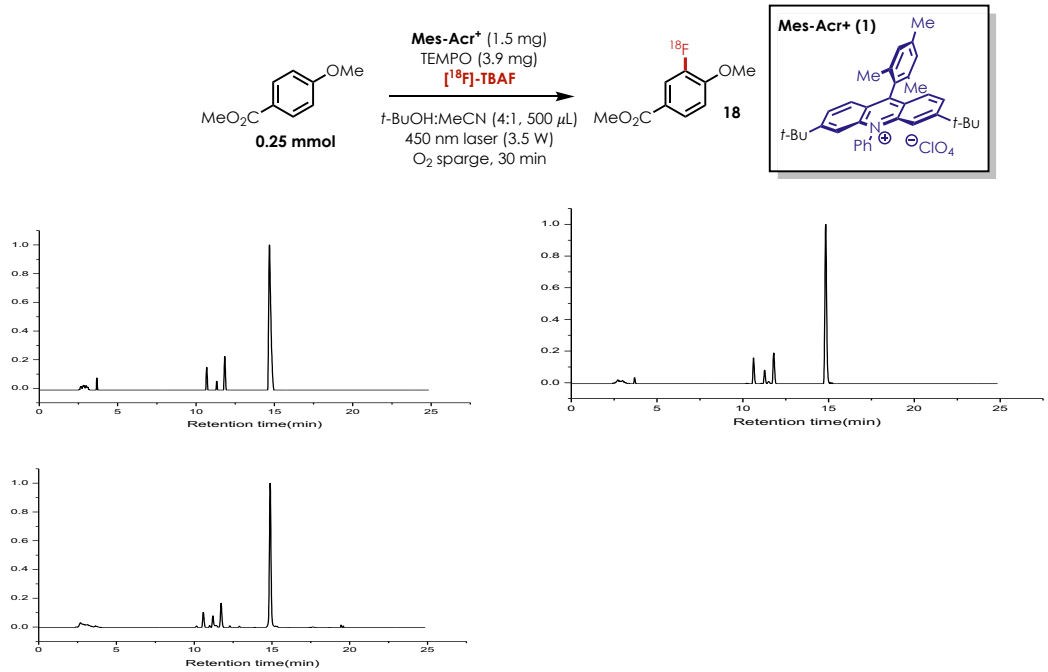


Fig. S39. Radio-HPLC traces of **18**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **18**
Run 1	8.2%
Run 2	12.1%
Run 3	4.7%
Average	**8.3±4%**

Table S30. Average radiochemical yields for **18**

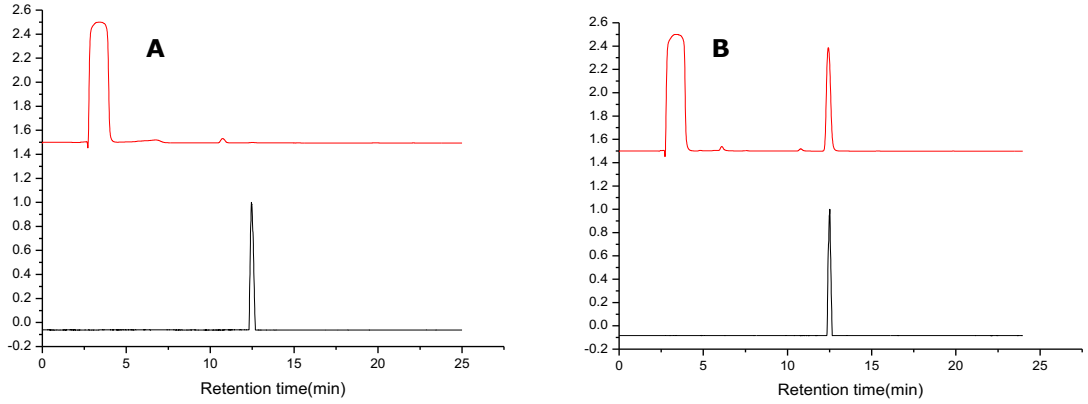


Fig. S40. HPLC traces of QC(**A**) and co-injection(**B**) for **18**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 40% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

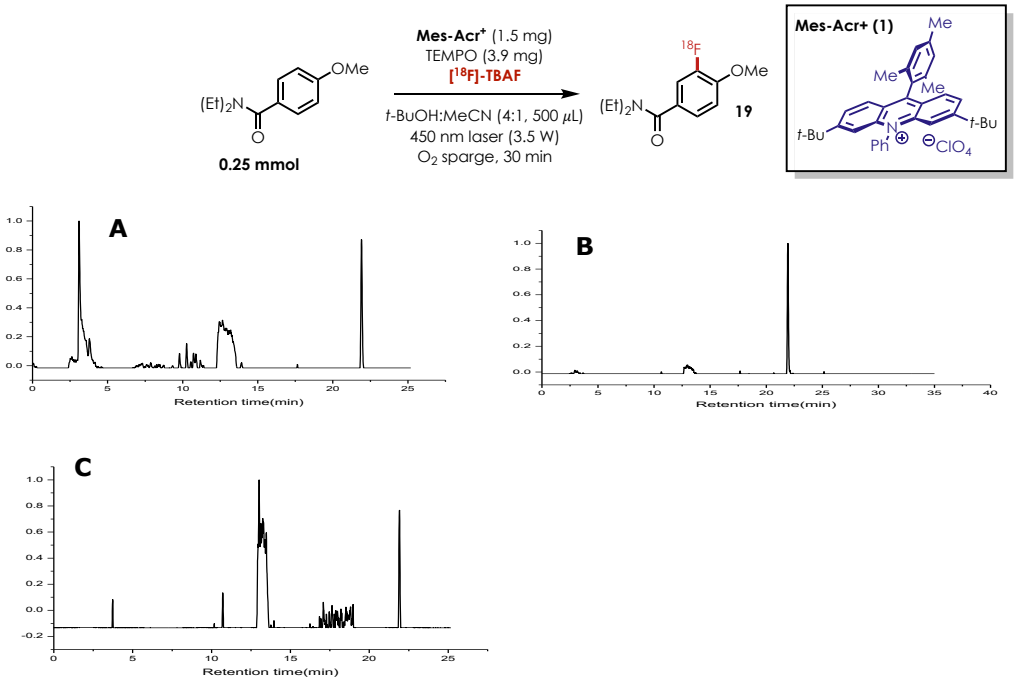


Fig. S41. Radio-HPLC traces of **19**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **19**
Run 1	4.8%
Run 2	3.2%
Run 3	3.6%
Average	**3.9±0.9%**

Table S31. Average radiochemical yields for **19**

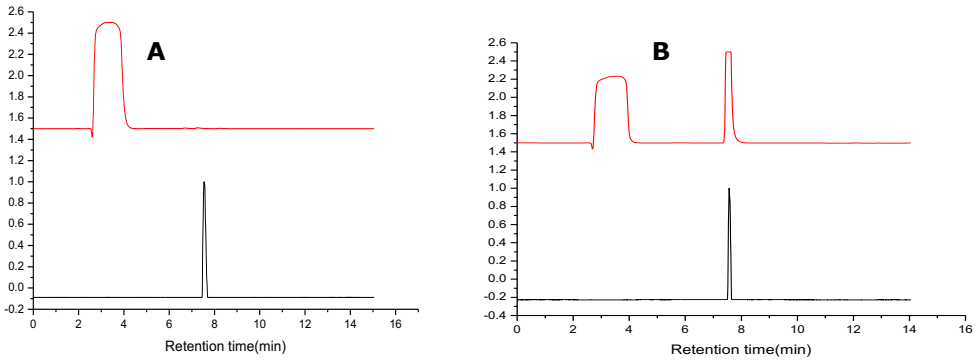


Fig. S42. HPLC traces of QC(**A**) and co-injection(**B**) for **19**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 40% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

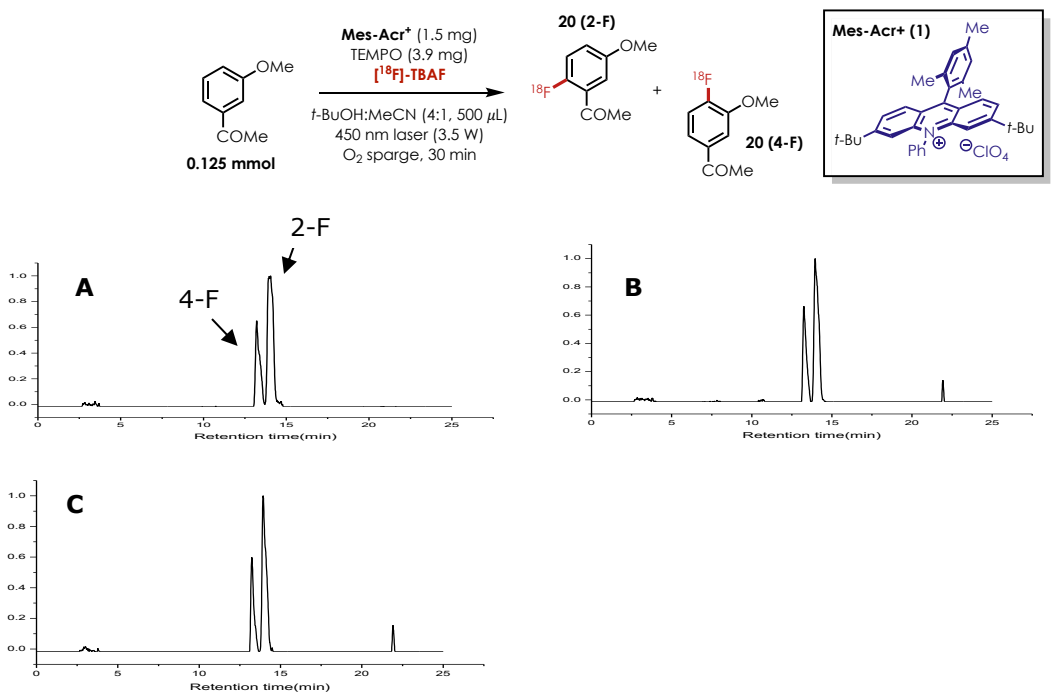


Fig. S43. Radio-HPLC traces of **20**

HPLC condition: Column: Phenomenex, Kinetex® 5μm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **20(2-F)**	RCY(Decay corrected) **20(4-F)**
Run 1	15.4%	8.7%
Run 2	14.5%	7.3%
Run 3	14.6%	7.4%
Average	**14.8±0.6%**	**7.8±0.9%**

Table S32. Average radiochemical yields for **20(2-F)** and **20(4-F)**

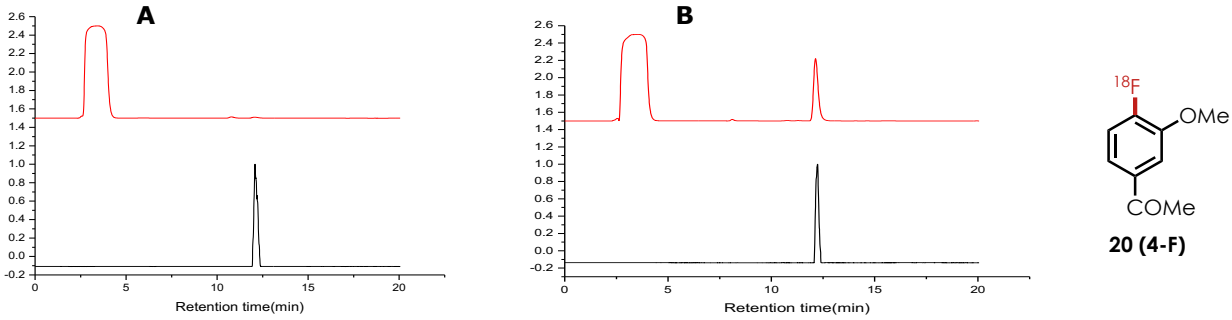


Fig. S44. HPLC traces of QC(**A**) and co-injection(**B**) for **20(4-F)**

HPLC condition: Column: Phenomenex, Kinetex® 5μm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:55% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

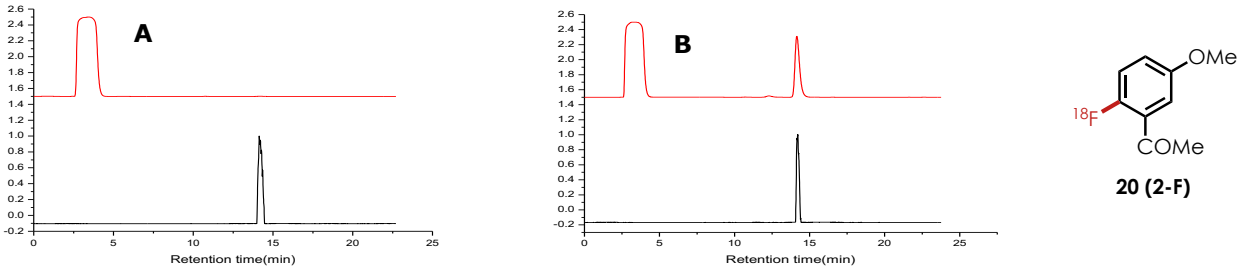


Fig. S45. HPLC traces of QC(**A**) and co-injection(**B**) for **20(2-F)**

HPLC condition: Column: Phenomenex, Kinetex® 5μm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:35% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

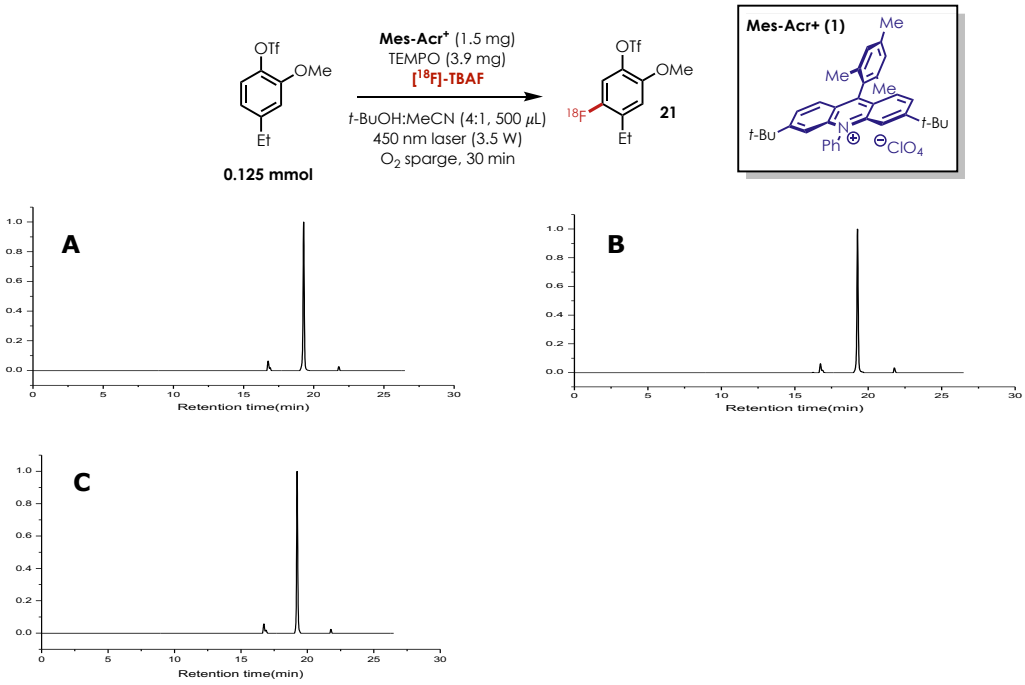


Fig. S46. Radio-HPLC traces of **21**

HPLC condition: Column: Phenomenex, Kinetex® 5μm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **21**
Run 1	33.5%
Run 2	32.0%
Run 3	37.5%
Average	**34.3±3%**

Table S33. Average radiochemical yields for **21**

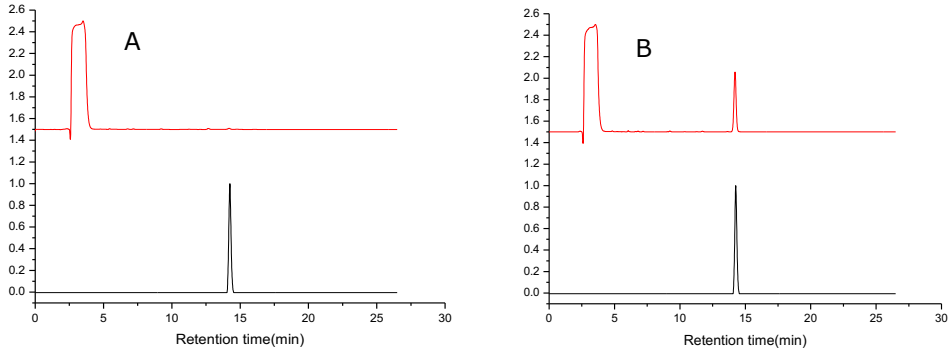


Fig. S47. HPLC traces of QC(**A**) and co-injection(**B**) for **21**

HPLC condition: Column: Phenomenex, Kinetex® 5μm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:60% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

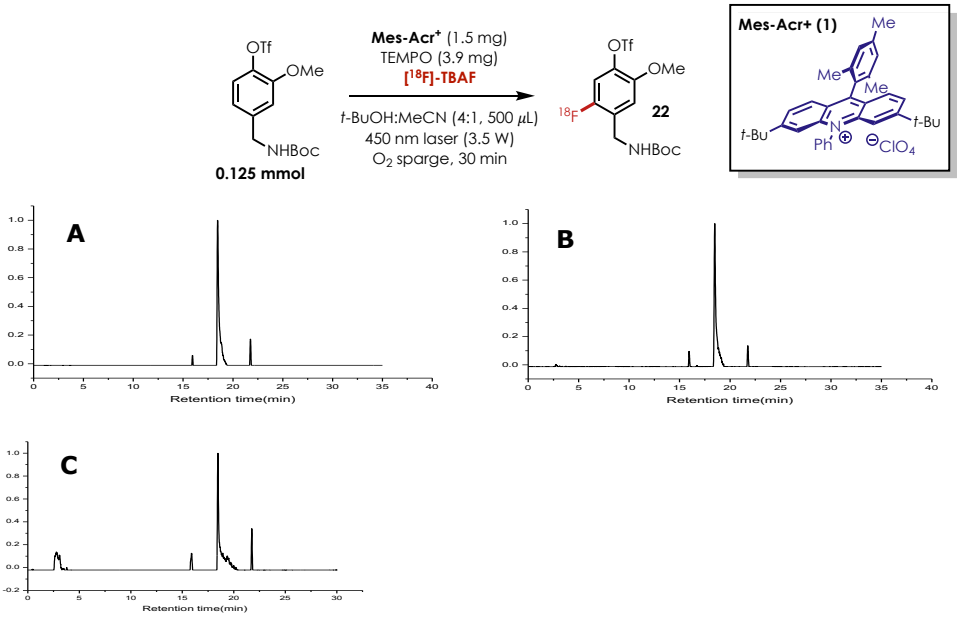


Fig. S48. Radio-HPLC traces of **22**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **22**
Run 1	11.6%
Run 2	16.5%
Run 3	10.9%
Average	**13±3%**

Table S34. Average radiochemical yields for **22**

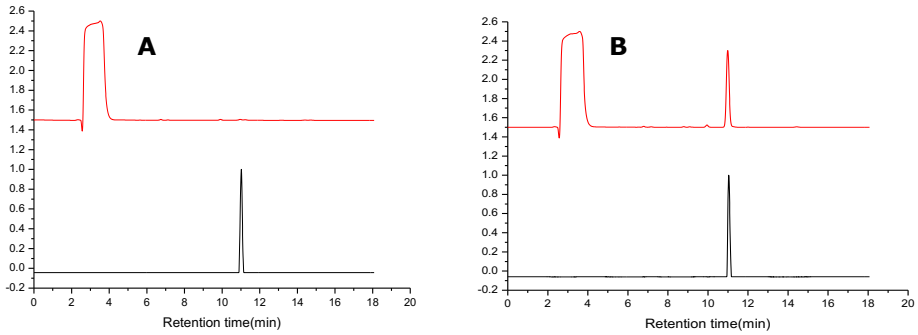


Fig. S49. HPLC traces of QC(**A**) and co-injection(**B**) for **22**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:60% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

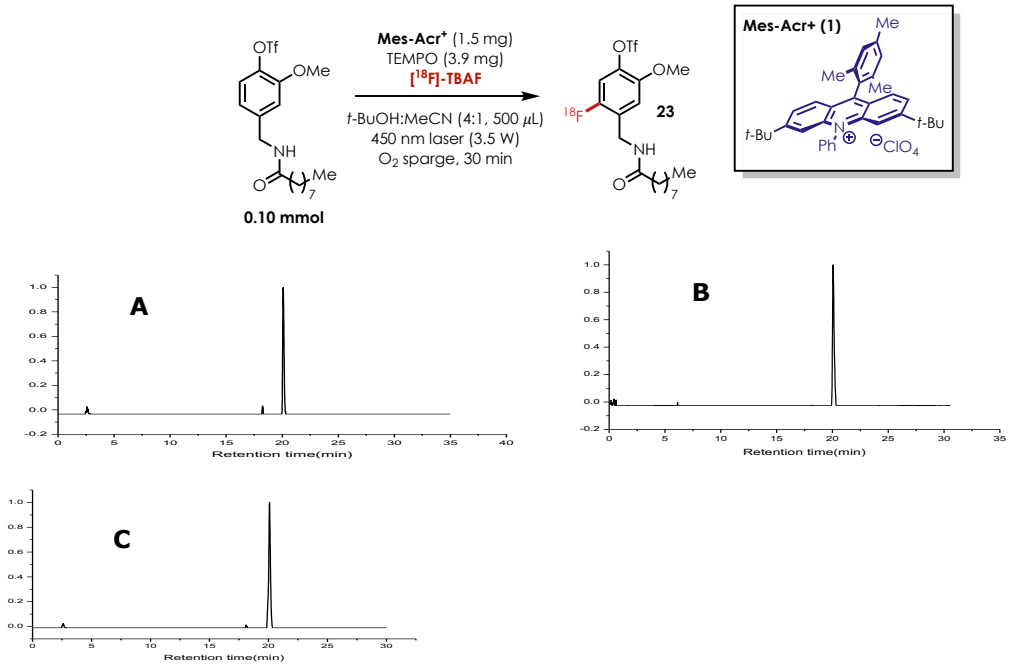


Fig. S50. Radio-HPLC traces of **23**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **23**
Run 1	6.0%
Run 2	5.5%
Run 3	5.7%
Average	**5.7±0.3%**

Table S35. Average radiochemical yields for **23**

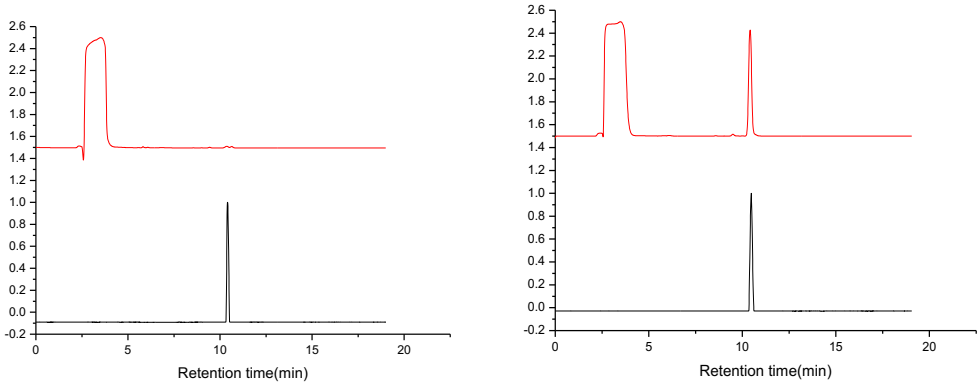


Fig. S51. HPLC traces of QC(**A**) and co-injection(**B**) for **23**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 65% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

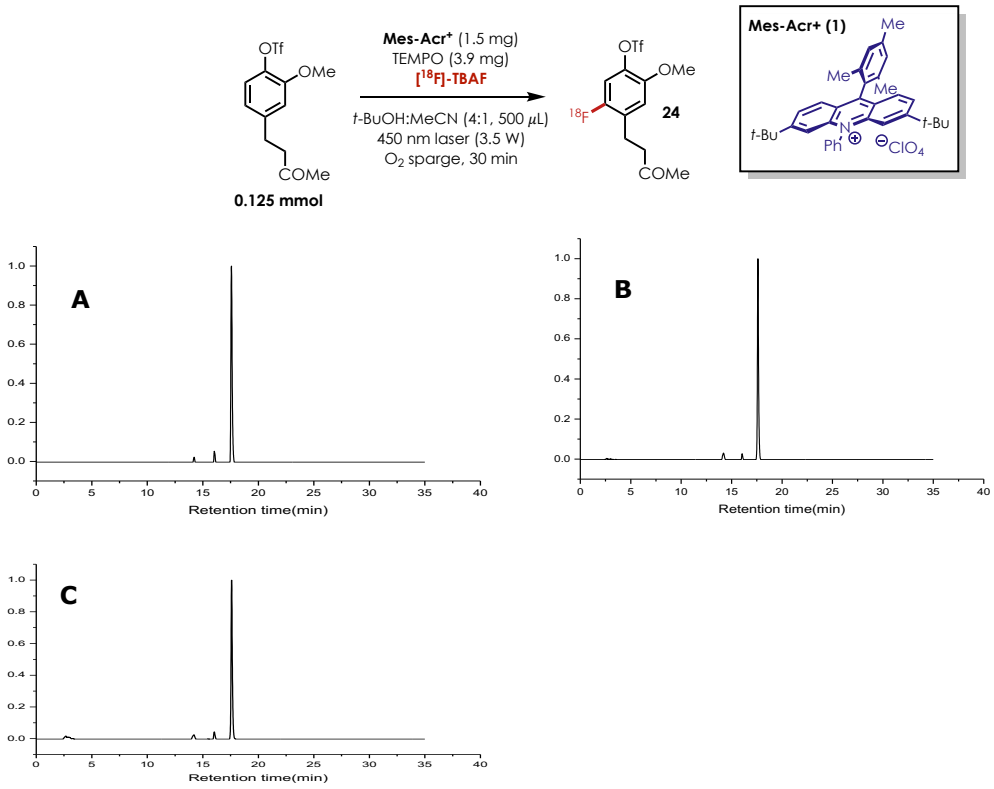


Fig. S52. Radio-HPLC traces of **24**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **24**
Run 1	26.5%
Run 2	28.9%
Run 3	26.3%
Average	**27.2±2%**

Table S36. Average radiochemical yields for **24**

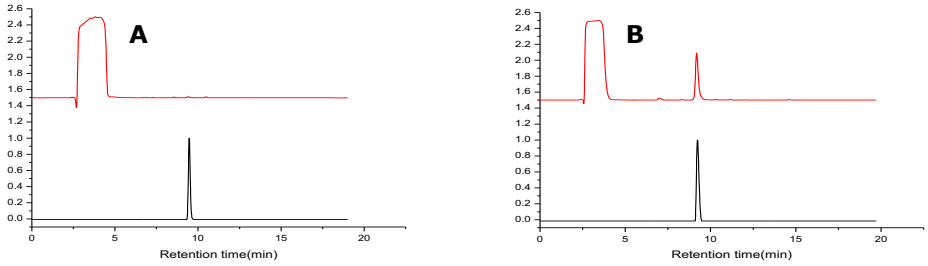


Fig. S53. HPLC traces of QC(**A**) and co-injection(**B**) for **24**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 60% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

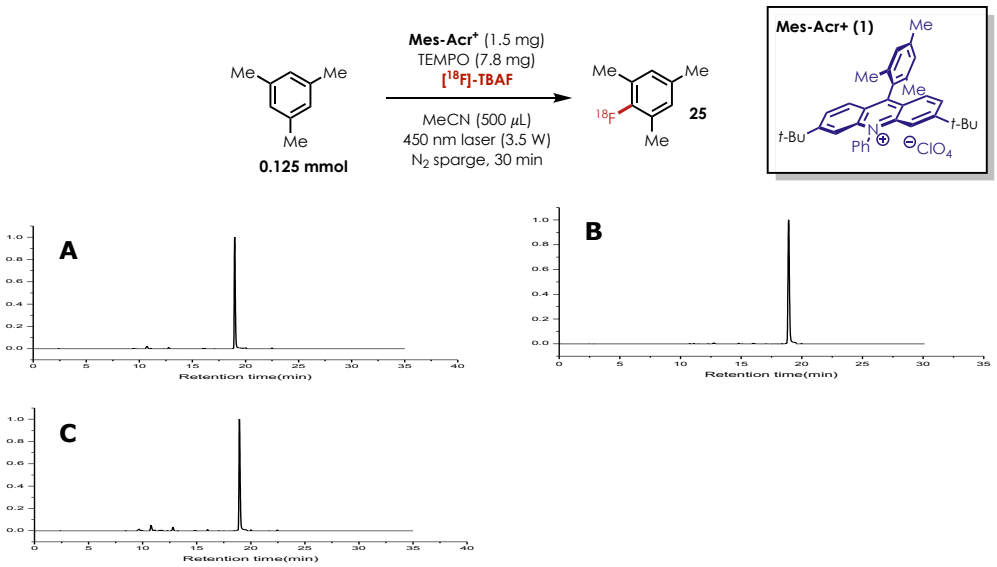


Fig. S54. Radio-HPLC traces of **25**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **25**
Run 1	48.2%
Run 2	40.2%
Run 3	61.5%
Average	**50±11%**

Table S37. Average radiochemical yields for **25**

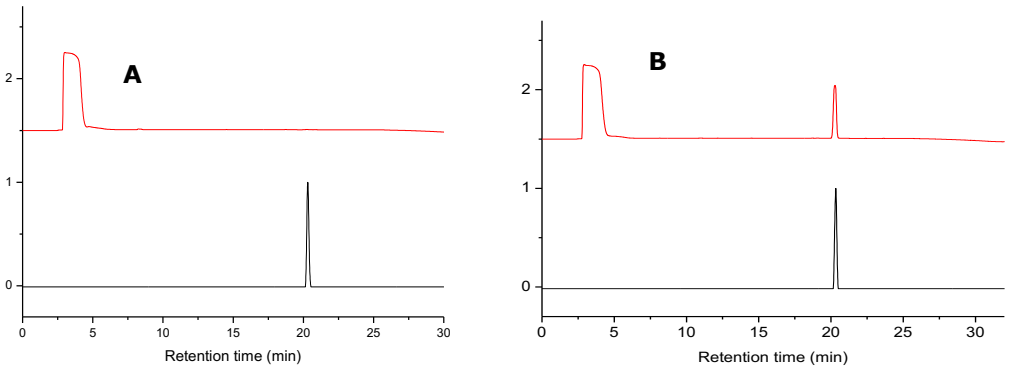


Fig. S55. HPLC traces of QC(**A**) and co-injection(**B**) for **25**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;Grad/isocrat: 0 to 2 min: 20% to 45% solvent B, 2 to 22 min: 45% to 60% solvent B, 22 to 28 min: 60% to 95% solvent B, 28 to 28.1 min: 95% to 20% solvent B, 28.1 to 30 min: isocratic elution at 20% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C

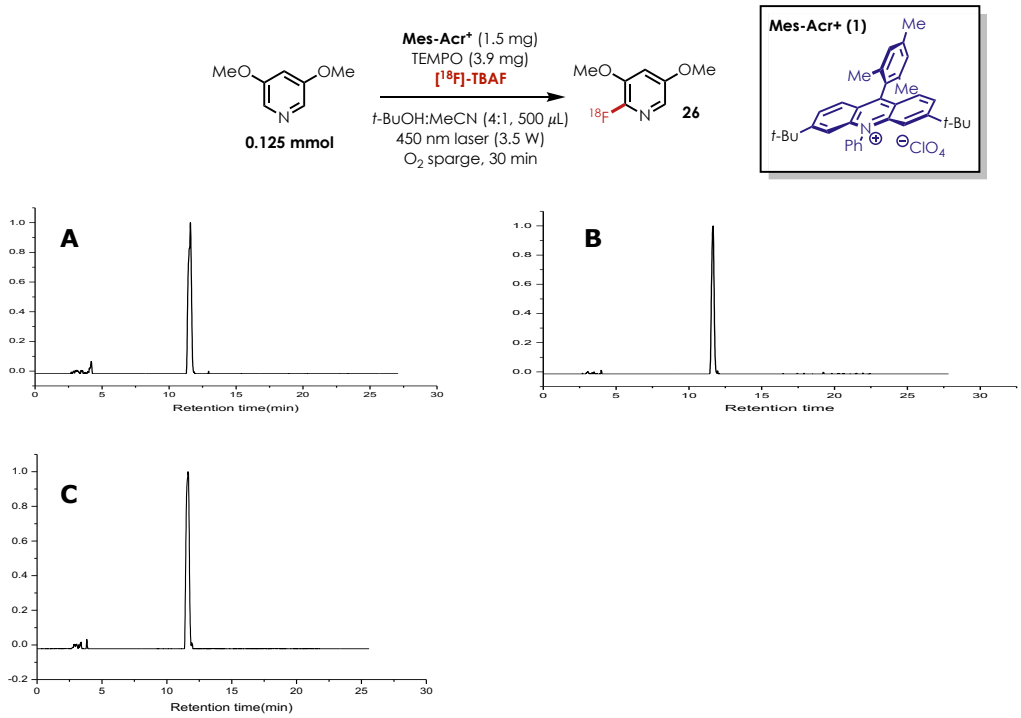


Fig. S56. Radio-HPLC traces of **26**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **26**
Run 1	13.1%
Run 2	9.7%
Run 3	10.6%
Average	**11.1±2%**

Table S38. Average radiochemical yields for **26**

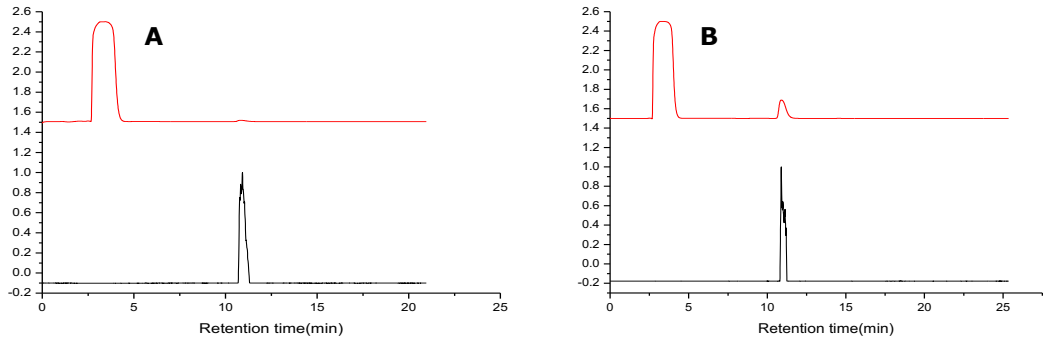


Fig. S57. HPLC traces of QC(**A**) and co-injection(**B**) for **26**

HPLC condition: Column: Phenomenex, Kinetex® 5μm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:30% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

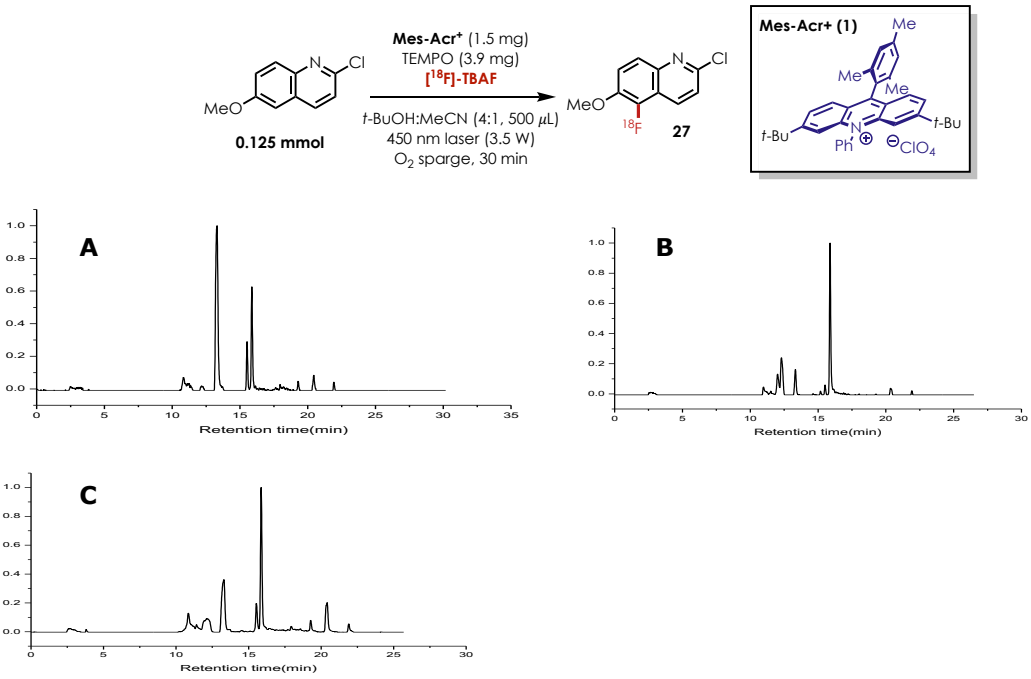


Fig. S58. Radio-HPLC traces of **27**

HPLC condition: Column: Phenomenex, Kinetex® 5μm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **27**
Run 1	5.6%
Run 2	6.6%
Run 3	5.7%
Average	**6.0±0.6%**

Table S39. Average radiochemical yields for **27**

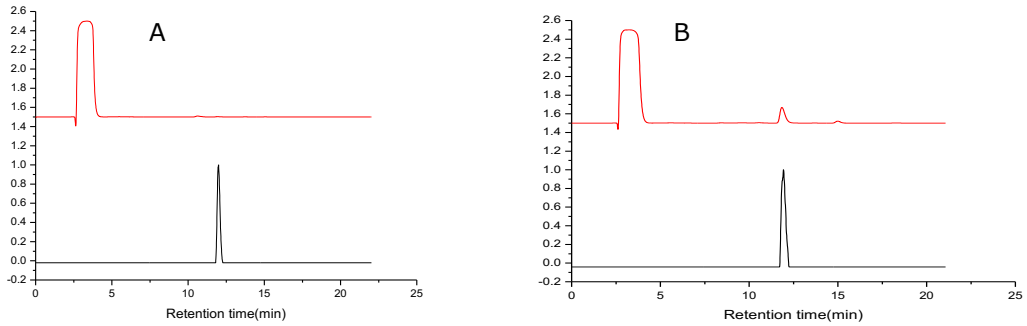


Fig. S59. HPLC traces of QC(**A**) and co-injection(**B**) for **27**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:45% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

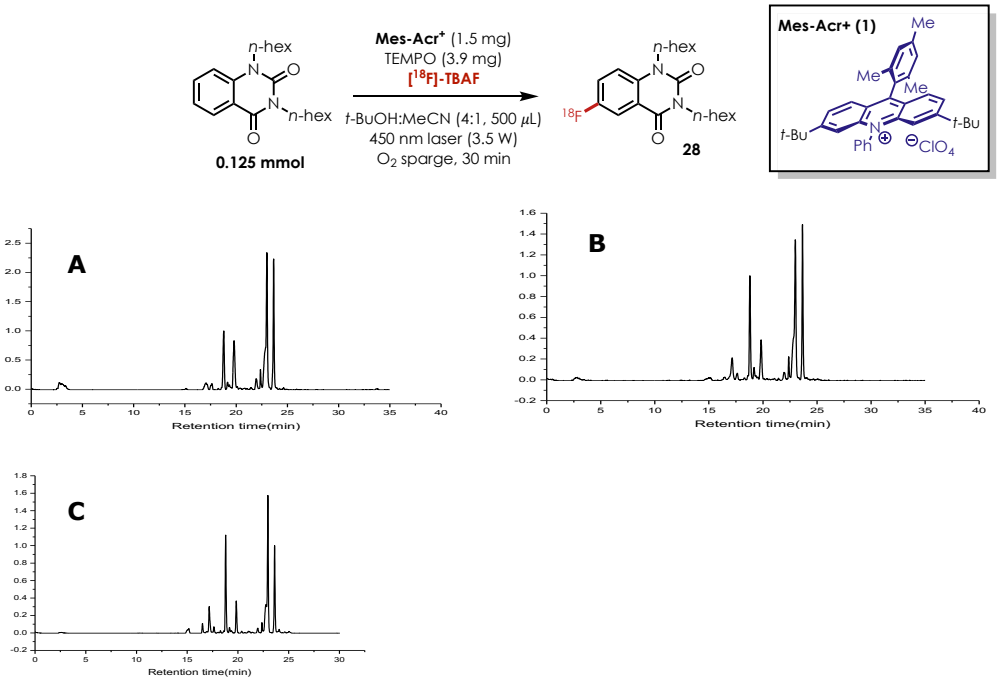


Fig. S60. Radio-HPLC traces of **28**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **28**
Run 1	16.1%
Run 2	19.4%
Run 3	18.3%
Average	**17.9±2%**

Table S40. Average radiochemical yields for **28**

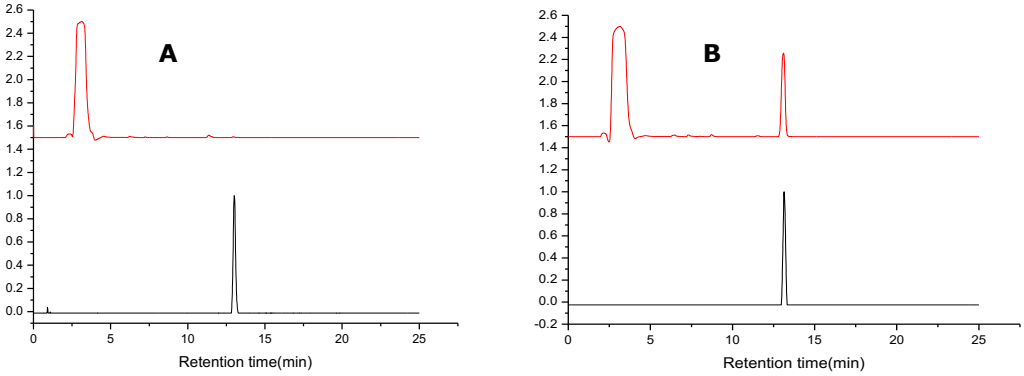


Fig. S61. HPLC traces of QC(**A**) and co-injection(**B**) for **28**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 70% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

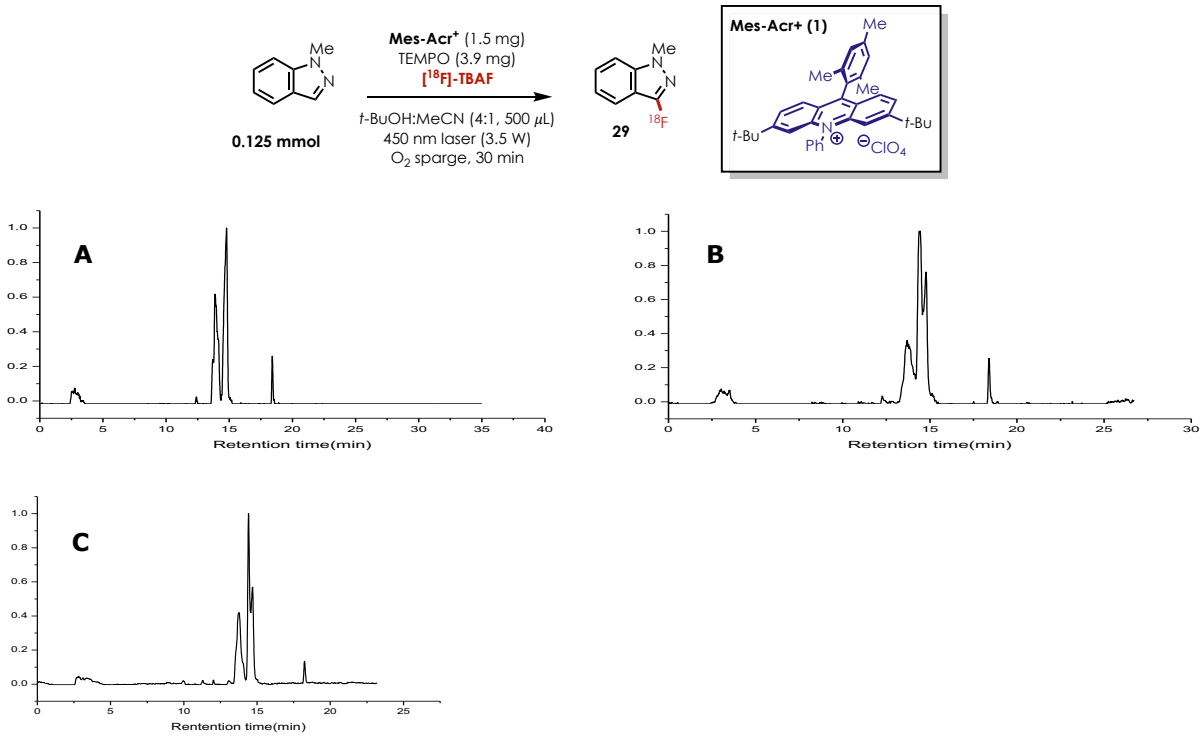


Fig. S62. Radio-HPLC traces of **29**

HPLC condition: Column: Phenomenex, Kinetex® 5μm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **29**
Run 1	13.1%
Run 2	17.2%
Run 3	13.0%
Average	**14.4±0.3%**

Table S41. Average radiochemical yields for **29**

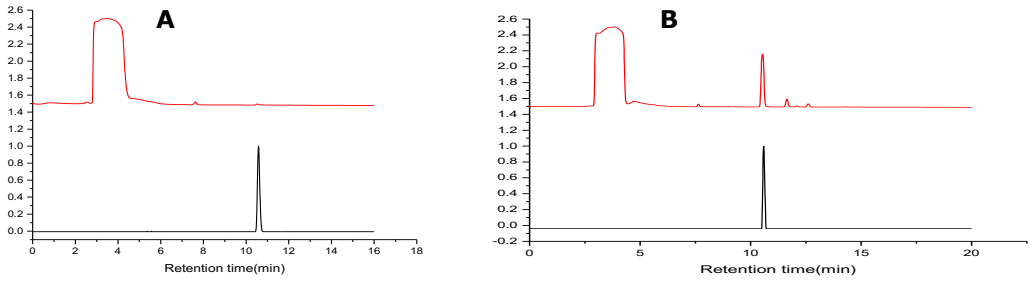


Fig. S63. HPLC traces of QC(**A**) and co-injection(**B**) for **29**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

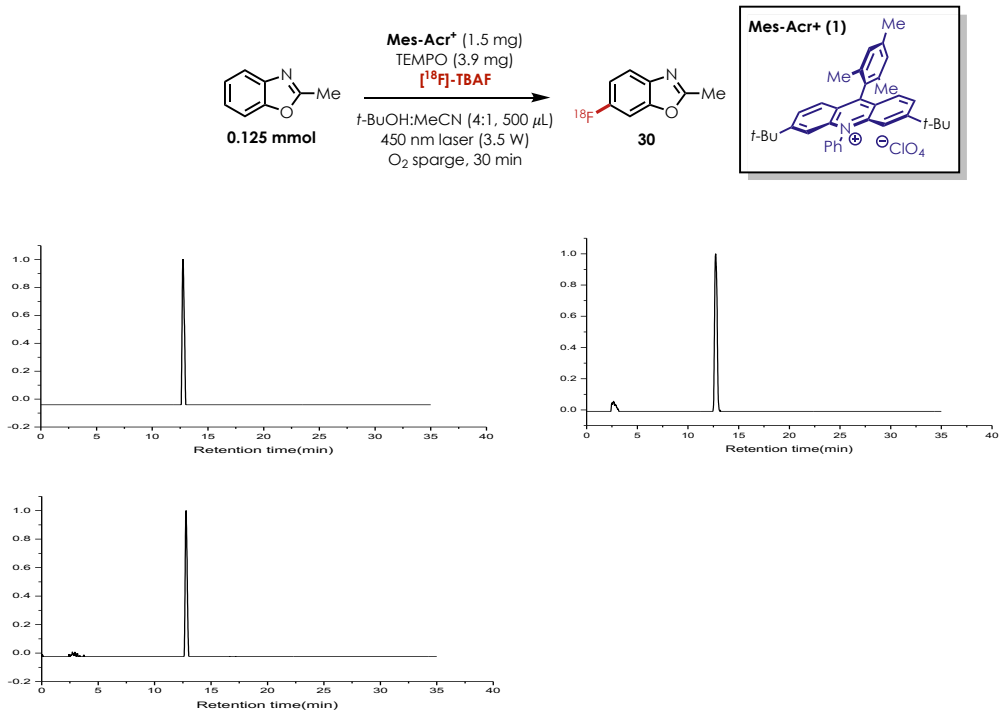


Fig. S64. Radio-HPLC traces of **30**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C

Run number	RCY(Decay corrected) **30**
Run 1	7.6%
Run 2	6.7%
Run 3	7.0%
Average	**7.1±0.5%**

Table S42. Average radiochemical yields for **30**

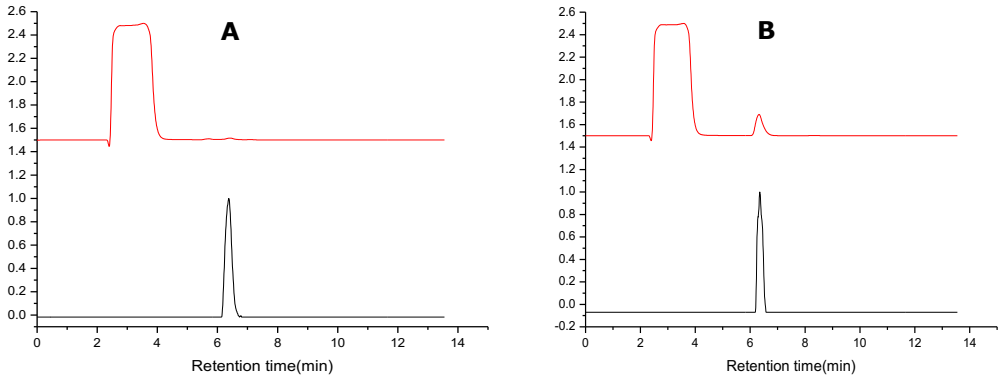


Fig. S65. HPLC traces of QC(**A**) and co-injection(**B**) for **30**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 35% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

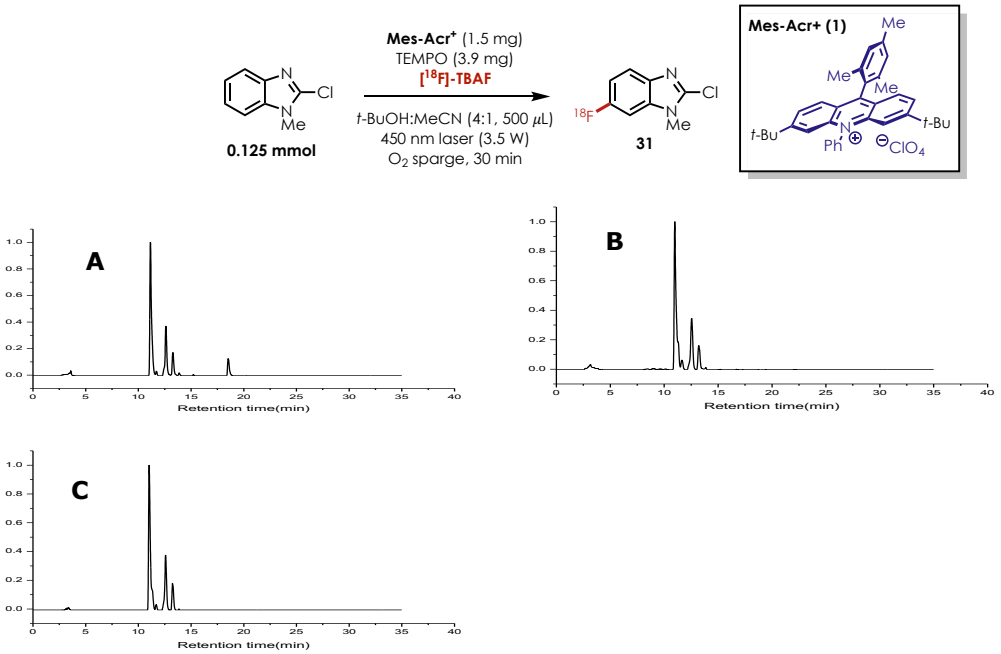


Fig. S66. Radio-HPLC traces of **31**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **31**
Run 1	10.1%
Run 2	12%
Run 3	10.8%
Average	**11.1±1%**

Table S43. Average radiochemical yields for **31**

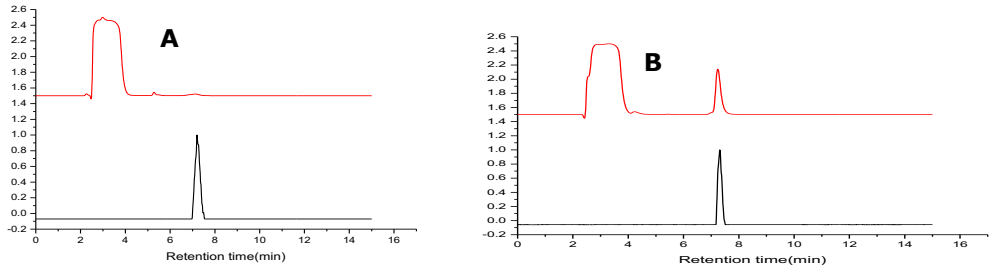


Fig. S67. HPLC traces of QC(**A**) and co-injection(**B**) for **31**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 30% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

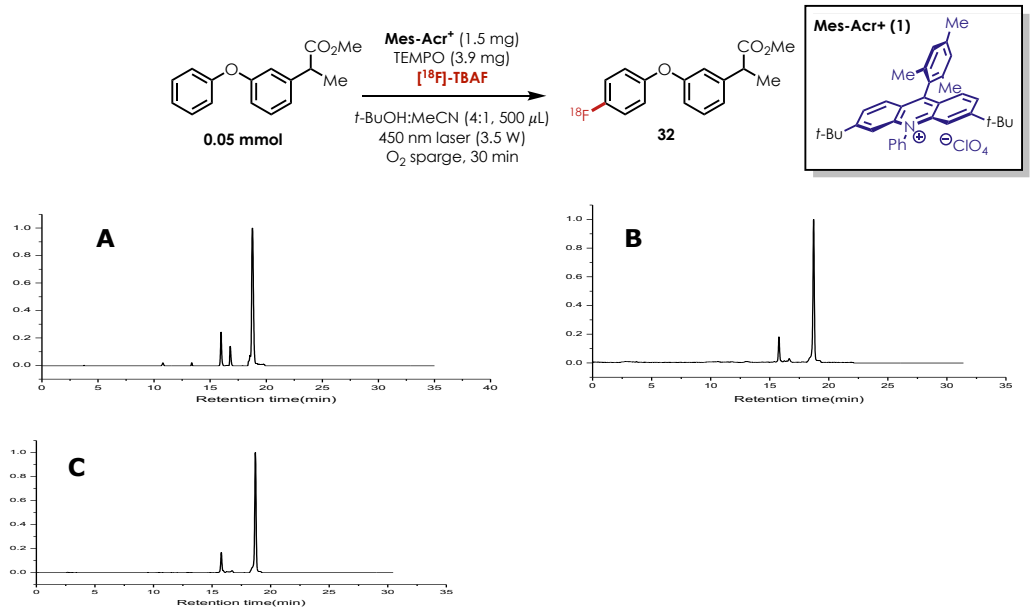


Fig. S68. Radio-HPLC traces of **32**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **32**
Run 1	38.8%
Run 2	40.4%
Run 3	39.6%
Average	**39.6±1%**

Table S44. Average radiochemical yields for **32**

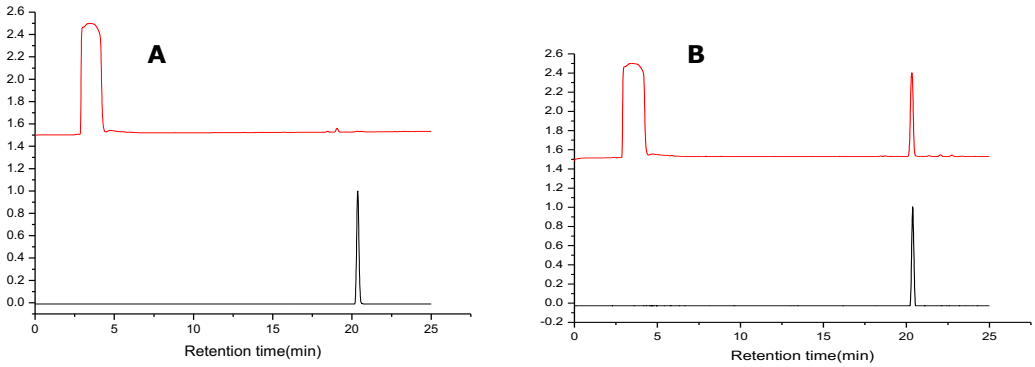


Fig. S69. HPLC traces of QC(**A**) and co-injection(**B**) for **32**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

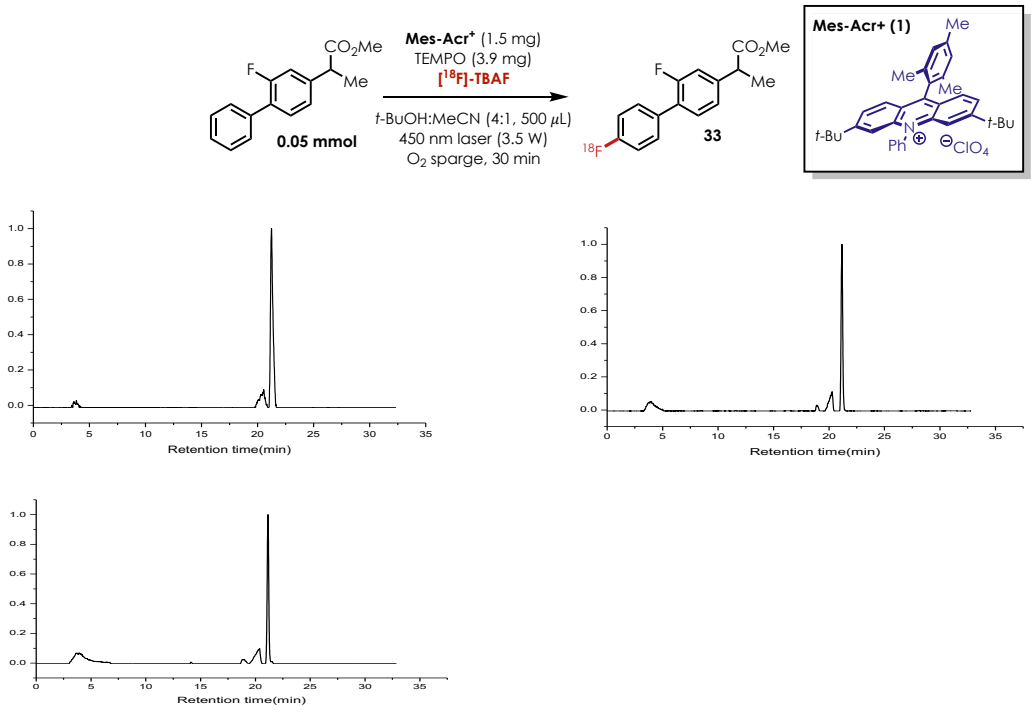


Fig. S70. Radio-HPLC traces of **33**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;Grad/isocrat: 0 to 2 min: 20% to 45% solvent B, 2 to 22 min: 45% to 60% solvent B, 22 to 28 min: 60% to 95% solvent B, 28 to 28.1 min: 95% to 20% solvent B, 28.1 to 30 min: isocratic elution at 20% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **33**
Run 1	43%
Run 2	32.9%
Run 3	34.4%
Average	**36.8±6%**

Table S45. Average radiochemical yields for **33**

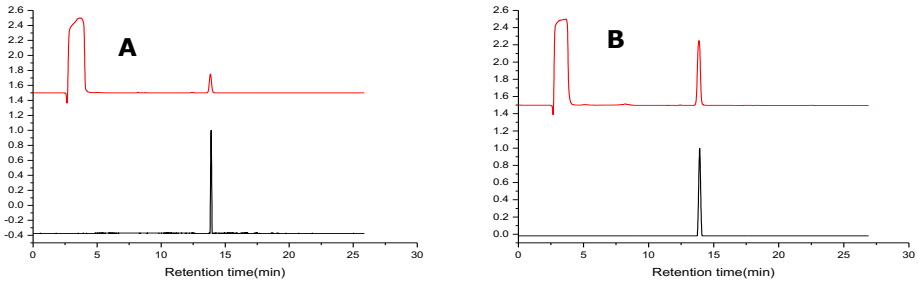
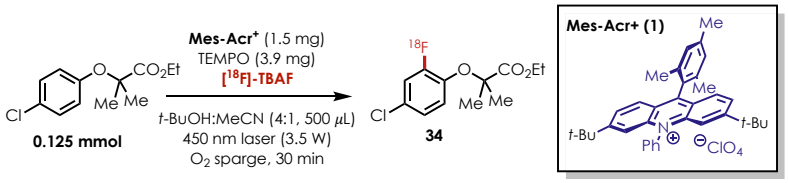


Fig. S71. HPLC traces of QC(**A**) and co-injection(**B**) for **33**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:55% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.



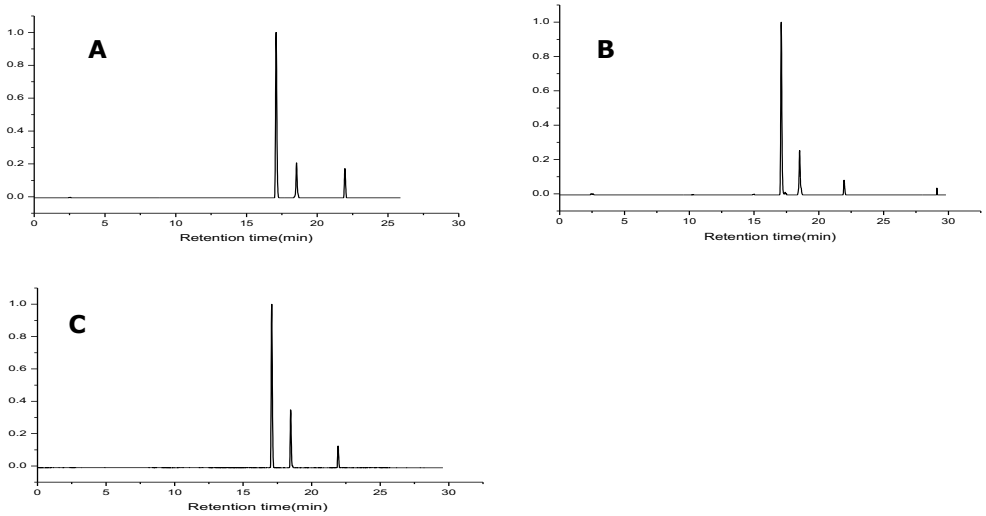


Fig. S72. Radio-HPLC traces of **34**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **34**
Run 1	4.0%
Run 2	3.7%
Run 3	3.5%
Average	**3.7±0.3%**

Table S46. Average radiochemical yields for **34**

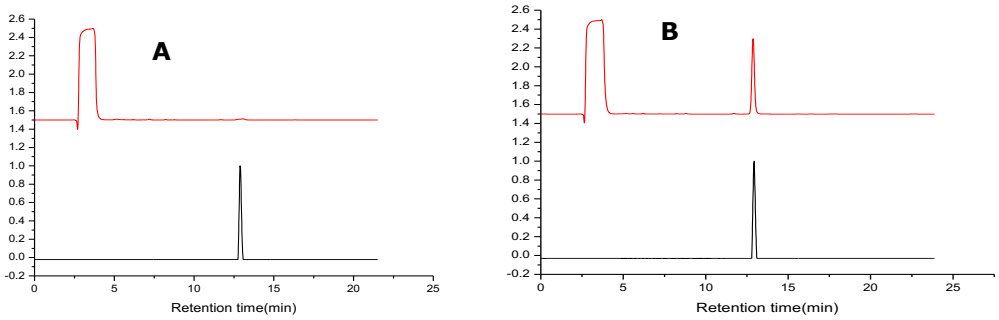
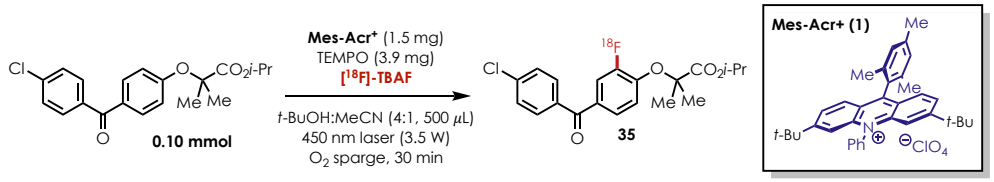
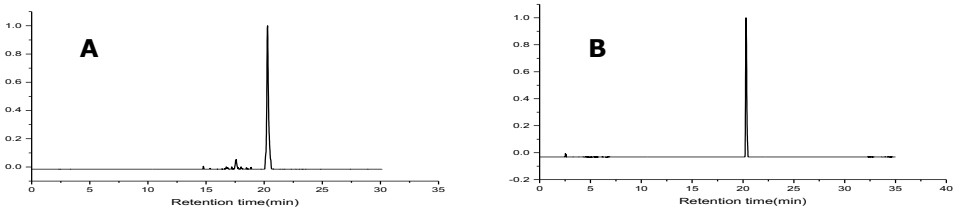


Fig. S73. HPLC traces of QC(**A**) and co-injection(**B**) for **34**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:55% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.





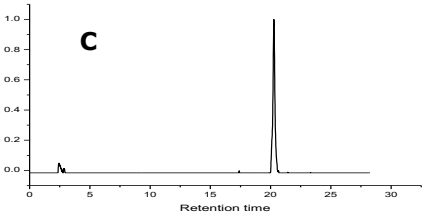


Fig. S74. Radio-HPLC traces of **35**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **35**
Run 1	6.0%
Run 2	5.2%
Run 3	5.5%
Average	**5.6±0.4%**

Table S47. Average radiochemical yields for **35**

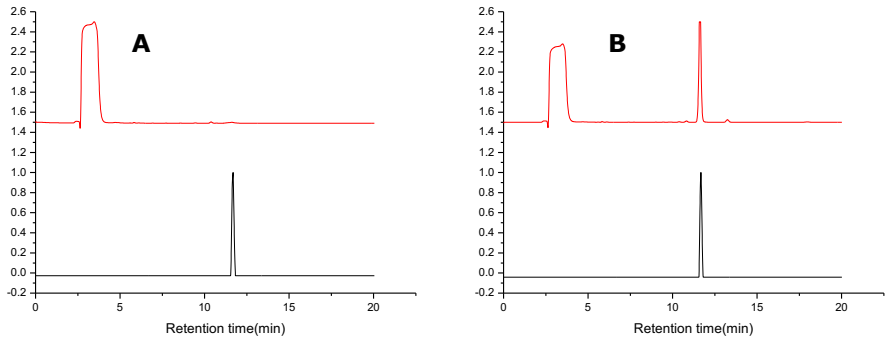


Fig. S75. HPLC traces of QC(**A**) and co-injection(**B**) for **35**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:65% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

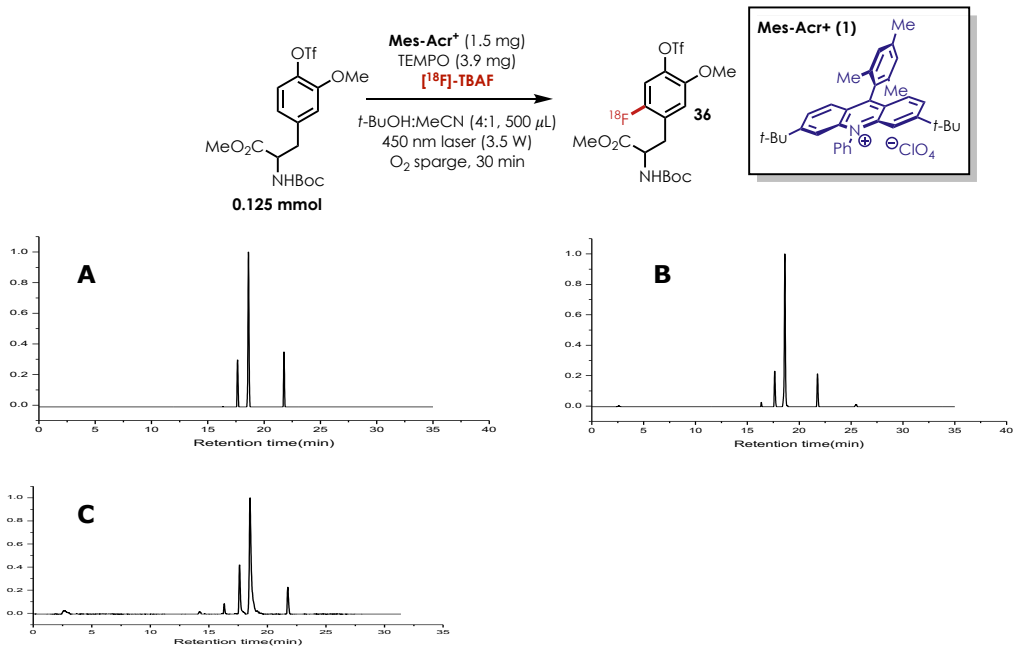


Fig. S76. Radio-HPLC traces of **36**

HPLC condition: Column: Phenomenex, Kinetex® 5µm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **36**
Run 1	8.0%
Run 2	8.3%
Run 3	9.8%
Average	**8.7±1%**

Table S48. Average radiochemical yields for **36**

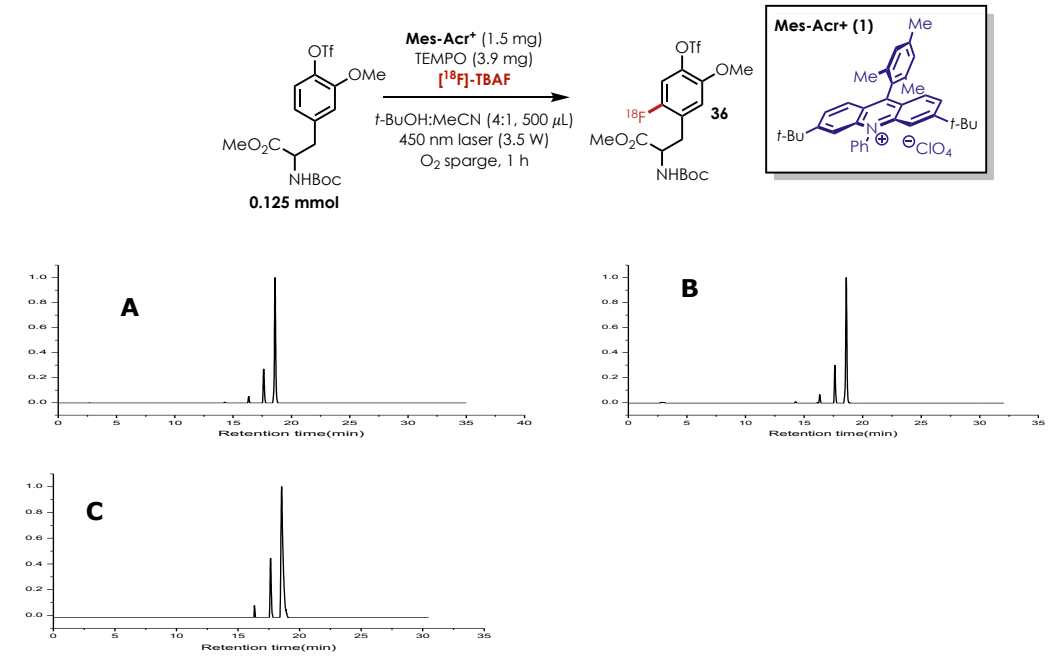


Fig. S77. Radio-HPLC traces of **36**

HPLC condition: Column: Phenomenex, Kinetex® 5μm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **36**
Run 1	21.4%
Run 2	20.6%
Run 3	21.7%
Average	**21.2±0.5%**

Table S49. Average radiochemical yields for **36**

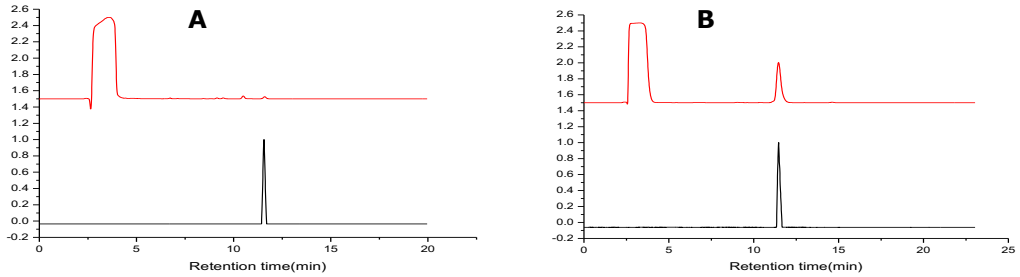
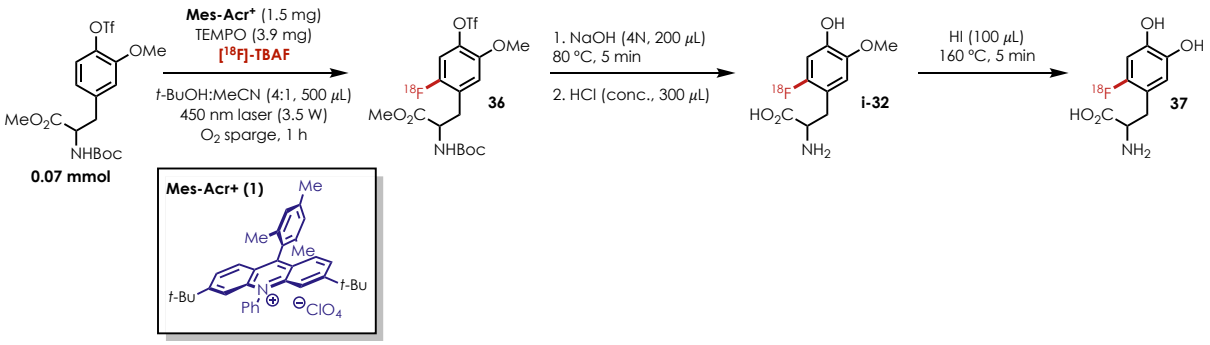


Fig. S78. HPLC traces of QC(**A**) and co-injection(**B**) for **36**

HPLC condition: Column: Phenomenex, Kinetex® 5μm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:60% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

5.6.3 Synthesis of [^{18}F]DOPA (37):



5.6.3.1 Synthesis of i-32 and 37:

Compound **36** was obtained using the procedure described above with 0.07mmol of the non-fluorinated congener (13.6±0.5% (n=3) isolated RCY). The purified compound **36** was collected in a 5ml V-Vial, to which 200μL of 4N NaOH solution was added. The V-vial was sealed with a Teflon-lined septum screw cap equipped with a vent needle. The solution was heated at 80°C with a positive N_2 flow for 5min. The N_2 flow was then stopped and the vent needle removed before 300μL of concentrated HCl was added to quench the reaction. 200μL of saturated $NaHCO_3$ solution was subsequently added to the vial and the solution was diluted with DI H_2O to about 1 mL of reaction volume before being analyzed and purified on HPLC to obtain the isolated intermediate **i-32** in 13.2±0.6% (n=3) RCY.

Intermediate **i-32** was then placed in a 5 mL V-Vial, to which was added 100 μL of HI. The reaction vessel was then sealed with a Teflon-lined septum screw cap and heated for 5 min at 160°C in a preheated heating block. The V-Vial was then removed from the heating bath and cooled to room temperature with an ice bath. 100μL of saturated NaHCO3 was added to quench the reaction and the resulting solution was diluted to 1mL with DI H_2O before being analyzed and purified on HPLC to yield isolated **^{18}F-DOPA (37)** in 12.3±1%(n=3) RCY. [^{18}F]DOPA RCY was calculated as the products of each decay corrected deprotection RCY of each deprotection step and the initial isolated decay corrected RCY of **36**. Column conditions for the purification are listed below.

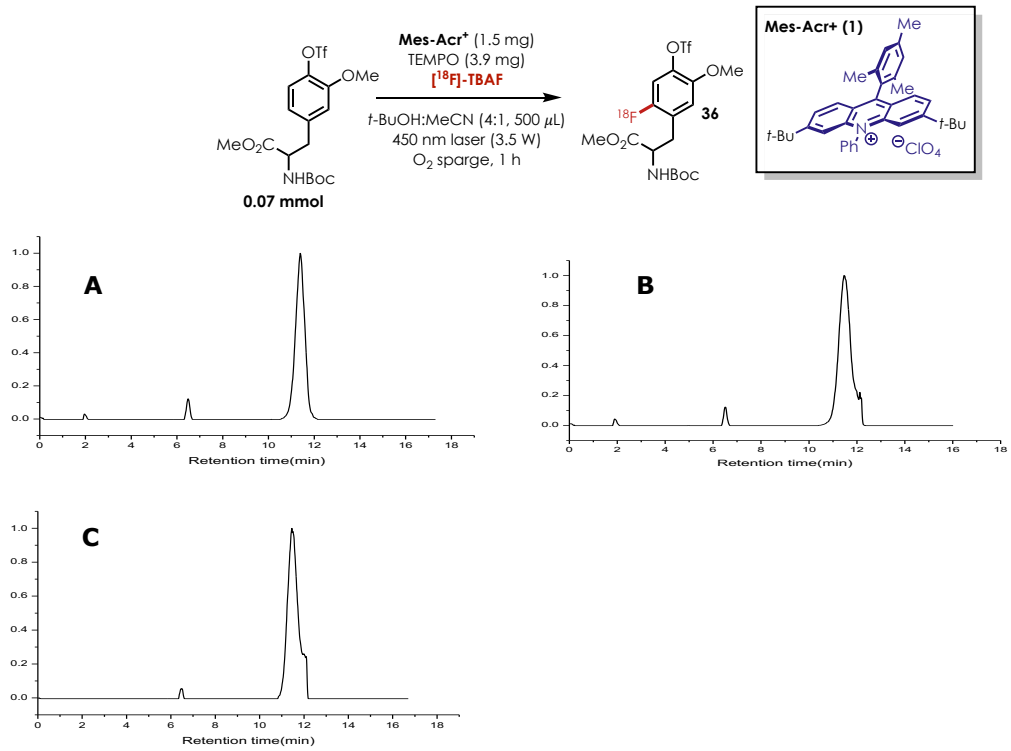


Fig. S79. Radio-HPLC traces of **36**

HPLC condition: Column: Gemini 5μm EVO C18 110 Å, 250 x 10.0 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 60% solvent B. Flow rate: 5mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **36**
Run 1	14.1%
Run 2	13.1%
Run 3	13.5%
Average	**13.6±0.5%**

Table S50. Average radiochemical yields for **36**

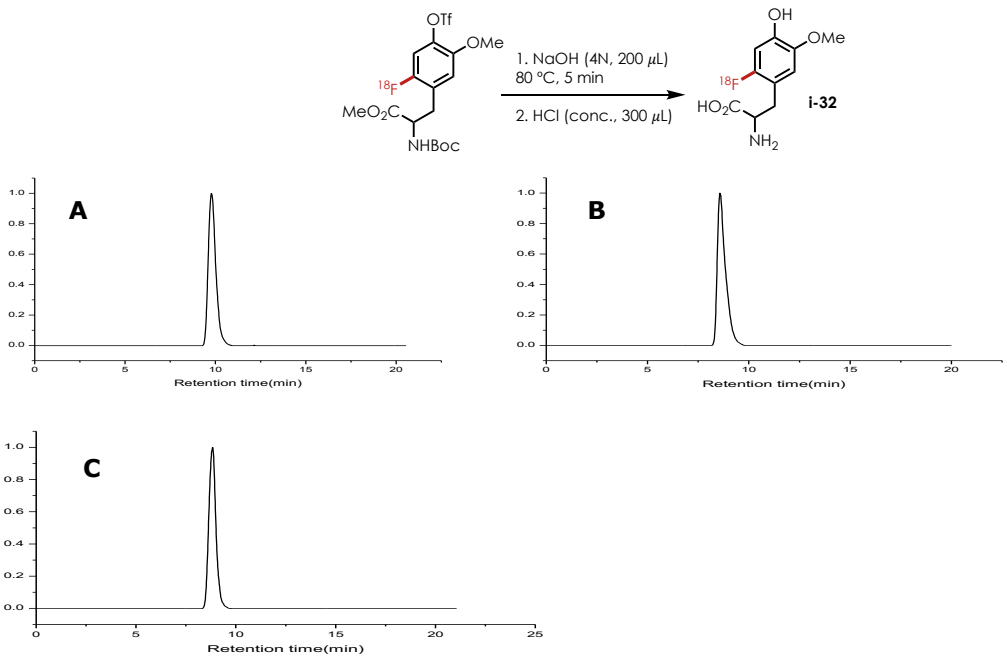


Fig. S80. Radio-HPLC traces of **i-32**

HPLC condition: Column: Phenomenex, Kinetex® 5μm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 3% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	Deprotection RCY (Decay corrected) **i-32**	Actual RCY(Decay corrected) **i-32**
Run 1	98.1%	13.8%
Run 2	97.1%	12.7%
Run 3	96.0%	13.0%
Average	**97.1±1%**	**13.2±0.6%**

Table S51. Average deprotection and actual radiochemical yields for **i-32**

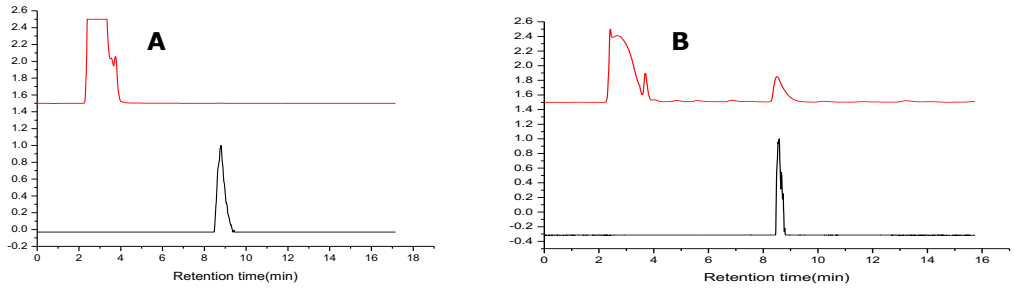


Fig. S81 HPLC traces of QC(**A**) and co-injection(**B**) for **i-32**

HPLC condition: Column: Phenomenex, Kinetex® 5μm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min: 3% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

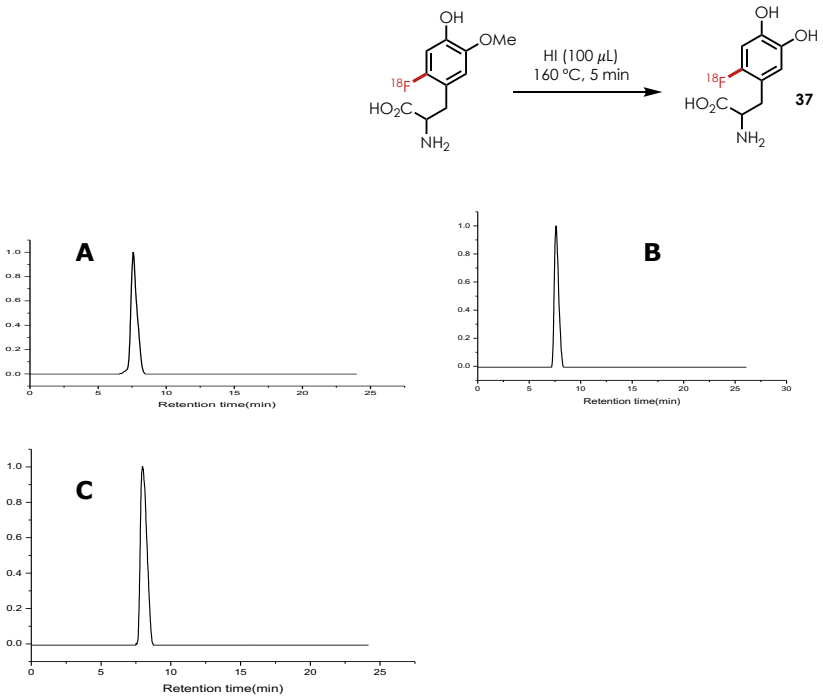


Fig. S82. Radio-HPLC traces of **37**

HPLC condition: Column: Phenomenex® 4µm Hydro-RP 80 Å, 150 x 4.6 mm LC Column. Solvent A: 70mM KH_2PO_4 in water isocrat: 0 to 35 min: 100% solvent A. Flow rate: 0.8 mL/min, column temperature: 19 to 21 °C.

Run number	Deprotection RCY (Decay corrected) **37**	Actual RCY(Decay corrected) **37**
Run 1	96.7%	13.4%
Run 2	91.6%	11.7%
Run 3	90.0%	11.7%
Average	**92.8±4%**	**12.2±1%**

Table S52. Average deprotection and actual radiochemical yields for **37**

Average RCY (Decay corrected) of [^{18}F]-DOPA after deprotection: 12.2 ± 1.0%

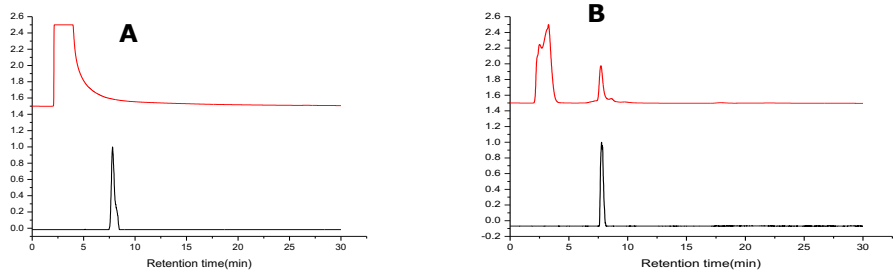
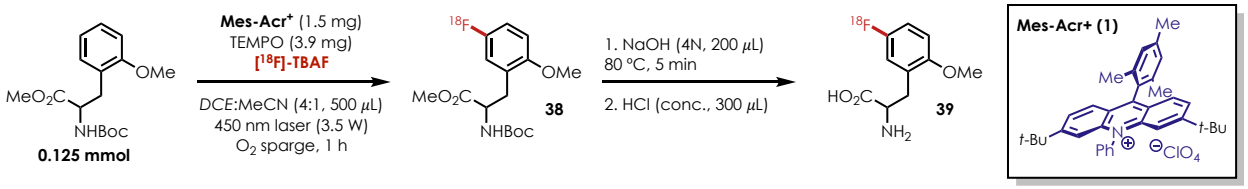


Fig. S83. HPLC traces of QC(**A**) and co-injection(**B**) for **37**

HPLC condition: Column: Phenomenex® 4µm Hydro-RP 80 Å, 150 x 4.6 mm LC Column. Solvent A: 70mM KH_2PO_4 in water isocrat: 0 to 35 min: 100% solvent A. Flow rate: 0.8 mL/min, column temperature: 19 to 21 °C.

5.6.4 Synthesis of [^{18}F]2-methoxy-5-fluoro-phenylalanine (39)



Compound **38** was obtained following a modified version of procedure A, using 0.125mmol of substrate in a 4:1 DCE:MeCN solution under an anaerobic atmosphere (N_2 sparge) with 0.8 equiv of TEMPO (5.0±0.5% (n=3) isolated RCY). The product **38** was collected in a 5ml V-Vial without further purification, to which 200μL of 4N NaOH solution was added. The V-vial was sealed with a Teflon-lined septum screw cap equipped with a vent needle. The solution was heated at 80°C with a positive N_2 flow for 5min. The N_2 flow was then stopped and the vent needle removed before 300μL of concentrated HCl was added to quench the reaction. The solution was diluted with DI H_2O before being analyzed and purified on HPLC to obtain **[^{18}F]2-Methoxy-5-fluoro-phenylalanine (39)** in 4.9±0.5%,(n=2) RCY. Collected product **39** was then dried under reduced pressure rotary evaporator to remove excess MeCN from the solution. The solution of **39** was then neutralized to pH 7 by adding NaOH (1N) and phosphate-buffered saline (PBS, 10X). **39** was reformulated in a 1X PBS solution for use in PET imaging studies.

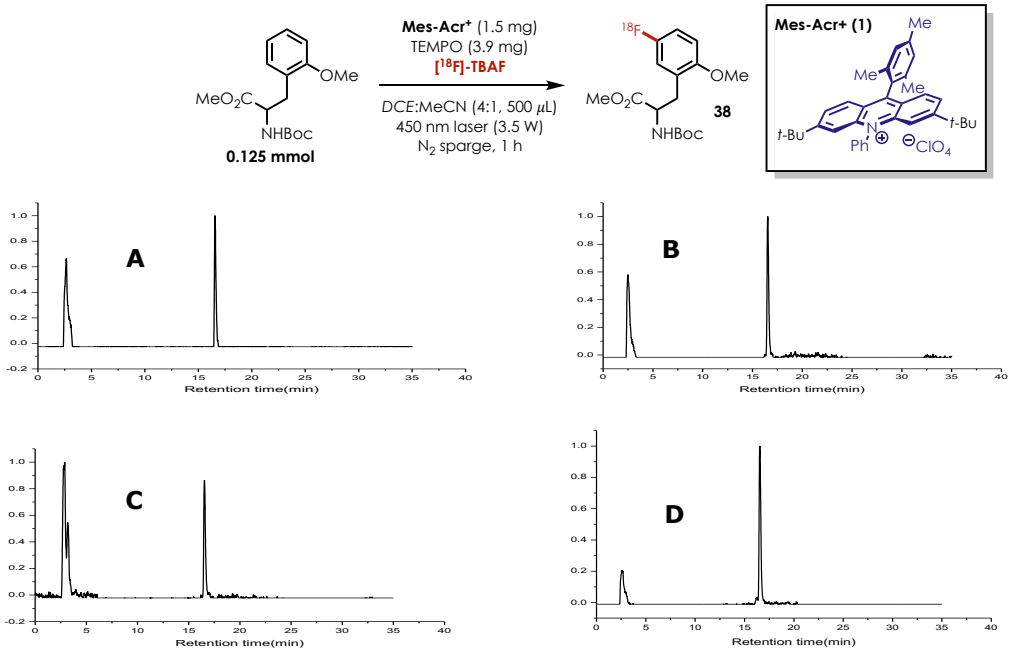


Fig. S84 Radio-HPLC traces of **38**

HPLC condition: Column: Phenomenex, Kinetex® 5μm EVO C18 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile; Grad/isocrat: 0 to 2 min: isocratic elution at 5% solvent B, 2 to 22 min: 5% to 95% solvent B, 22 to 28 min: isocratic elution at 95% solvent B, 28 to 28.1 min: 95% to 5% solvent B, 28.1 to 30 min: isocratic elution at 5% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **38**
Run 1	5.5%
Run 2	4.6%
Run 3	5.0%
Average	**5.0±0.5%**
Run4	8.4%(from 50min reaction)

Table S53. Average radiochemical yields for **38**

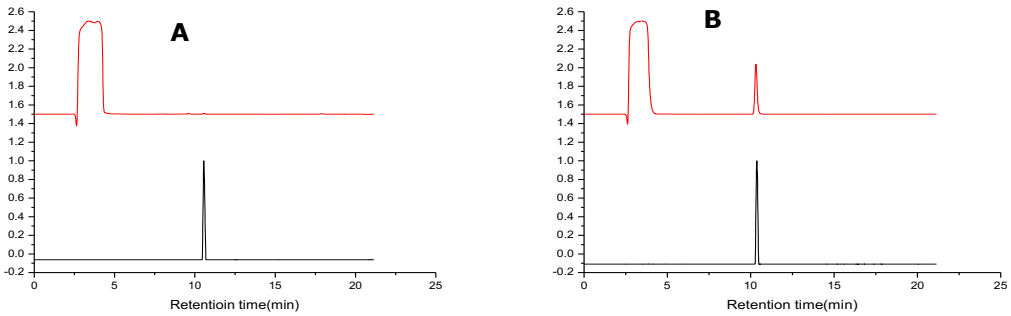


Fig. S85. HPLC traces of QC(**A**) and co-injection(**B**) for **38**

HPLC condition: Column: Phenomenex, Kinetex® 5μm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:50% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

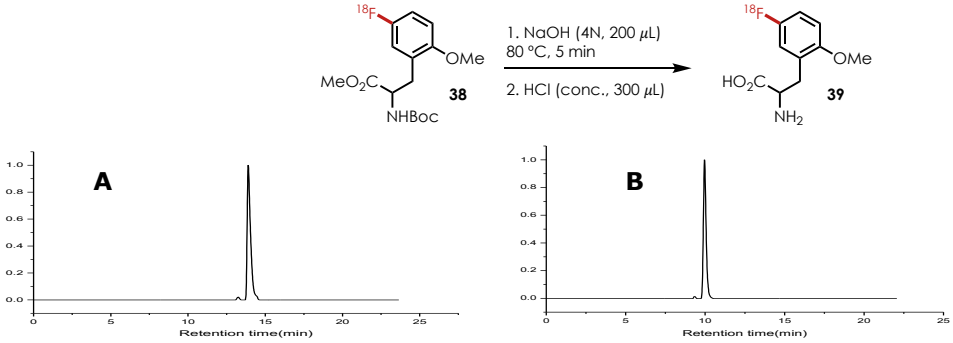


Fig. S86. Radio-HPLC traces of **39**

HPLC condition for (A): Column: Phenomenex, Kinetex® 5μm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:15% solvent B. Flow rate: 0.8 mL/min, column temperature: 19 to 21 °C.
HPLC condition for (B): Column: Phenomenex, Kinetex® 5μm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:15% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	Deprotection RCY(Decay corrected) **39**	Actual RCY(Decay corrected) **39**
Run 1	97.6%	5.4%
Run 2	96.9%	4.5%
Average	**97.3±0.4%**	**4.9±0.5%**

Table S54. Average radiochemical yields for **39**

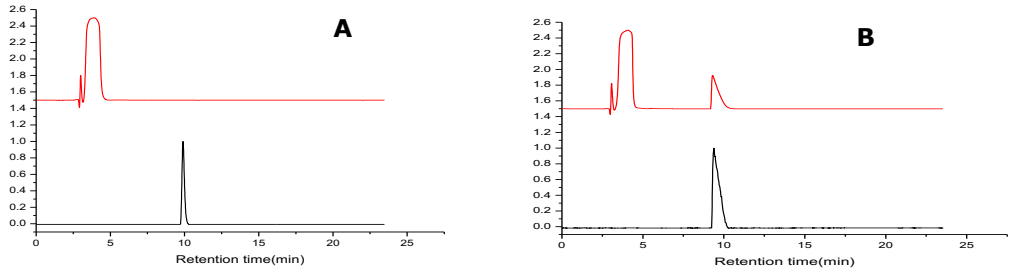
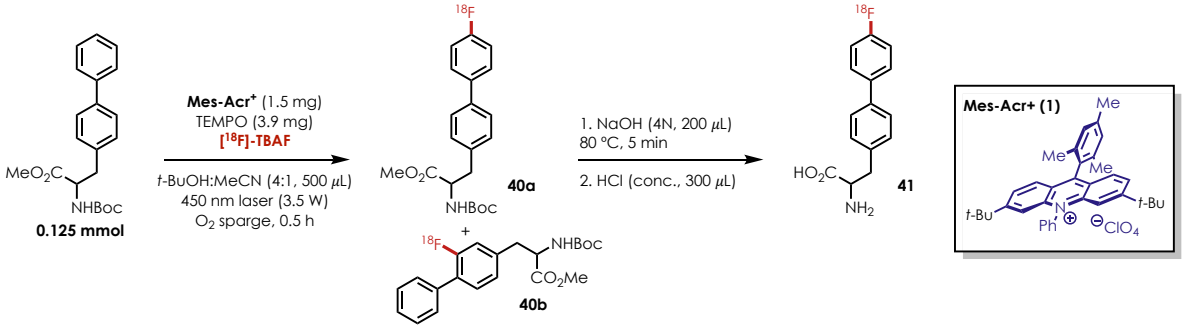


Fig. S87. HPLC traces of QC(**A**) and co-injection(**B**) for **39**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:15% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

5.6.5 Synthesis of [^{18}F]4-(4'-fluorophenyl)phenylalanine (41)



Compounds **40a** and **40b** was obtained using procedure A with 0.125mmol of the nonfluorinated congener (21.5±2% and 11.3±1% (n=3) isolated RCYs respectively). The product **40a** was collected in a 5ml V-Vial without further purification, to which 200µL of 4N NaOH solution was added. The V-vial was sealed with a Teflon-lined septum screw cap equipped with a vent needle. The solution was heated at 80°C with a positive N_2 flow for 5min. The N_2 flow was then stopped and the vent needle removed before 300µL of concentrated HCl was added to quench the reaction. The solution was diluted with DI H_2O and MeCN before being analyzed and purified on HPLC to obtain **[^{18}F]4-(4'-fluoro-phenyl)phenylalanine (41)** in 20.5% (n=1) RCY. The collected product was then put on the rotary evaporator to remove excess MeCN from the solution. The solution of **41** was then neutralized to pH 7 by adding NaOH (1N) and PBS (10X). **41** was reformulated in a 1X PBS solution for use in PET imaging studies.

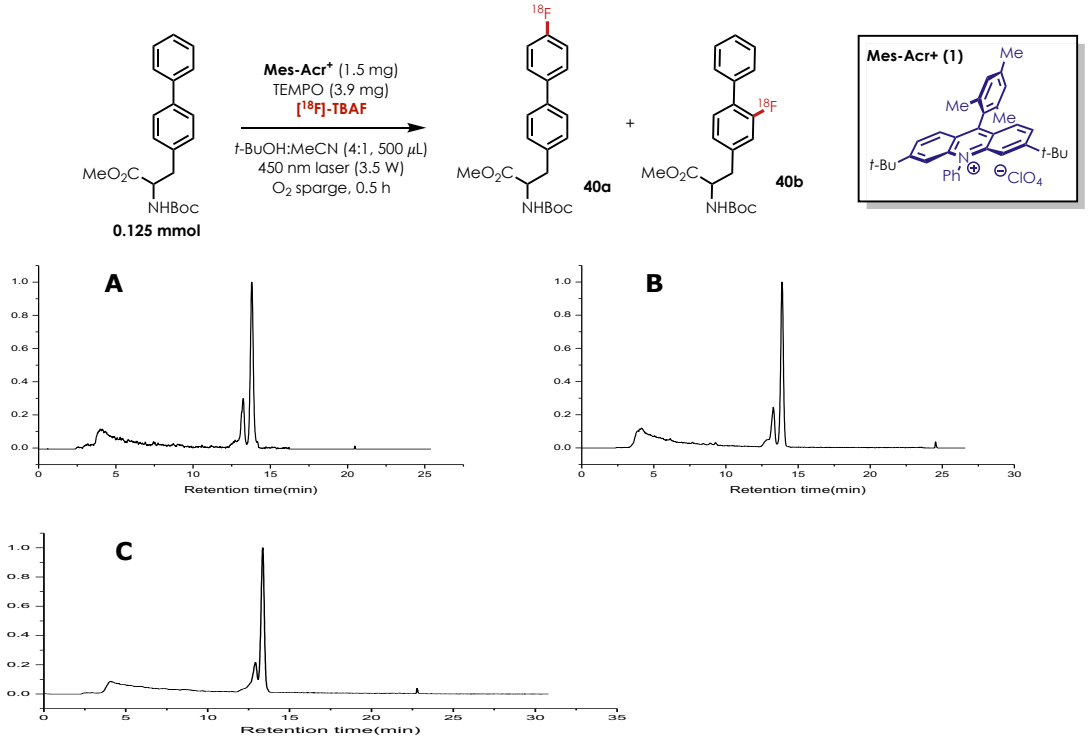


Fig. S88. Radio-HPLC traces of **40 (40a and 40b)**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:55% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

Run number	RCY(Decay corrected) **40a**	RCY(Decay corrected) **40b**
Run 1	23.6%	11.5%
Run 2	21.1%	10.0%
Run 3	19.8%	12.3%
Average	**21.5±2%**	**11.3±1%**

Table S55. Average radiochemical yields for **40a** and **40b**

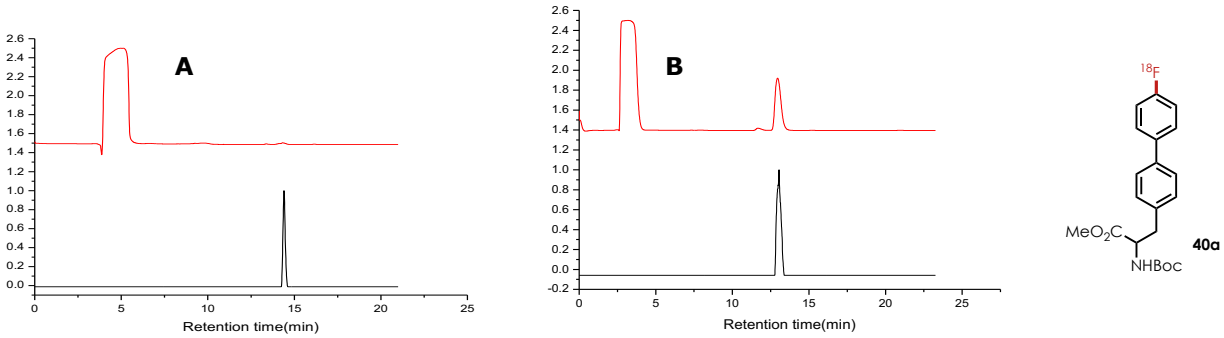


Fig. S89. HPLC traces of QC(**A**) and co-injection(**B**) for **40a**

HPLC condition for (A): Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:55% solvent B. Flow rate: 0.8-1 mL/min, column temperature: 19 to 21 °C.
HPLC condition for (B): Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:55% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

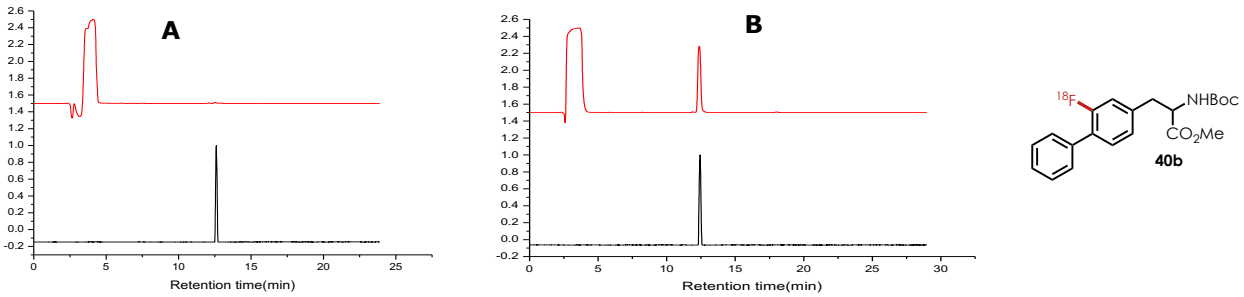
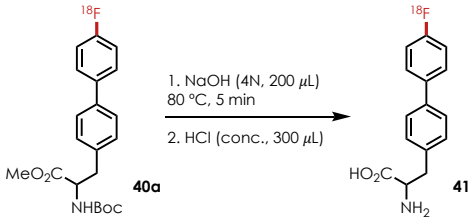


Fig. S90. HPLC traces of QC(**A**) and co-injection(**B**) for **40b**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:55% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.



Run number	Deprotection RCY(Decay corrected)	Actual RCY(Decay corrected)
Run 1	93.2%	20.5%

Table S56. Radiochemical yield for **41**

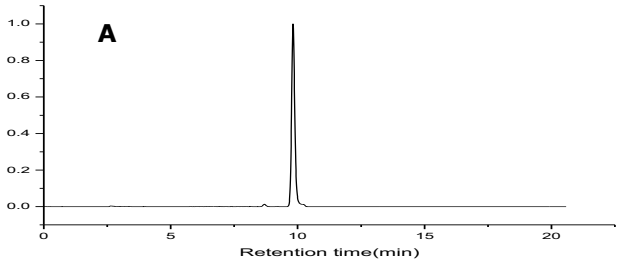
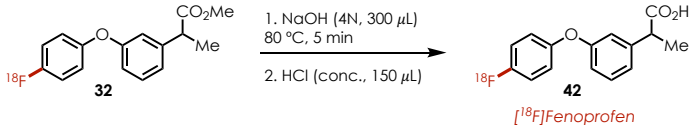


Fig. S91. Radio-HPLC trace of **41**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:30% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

5.6.6 Synthesis of [^{18}F]Fenoprofen (42):



Compound **32** was obtained as detailed in section **5.6.2**. The product **32** was collected in a 5ml V-Vial without further purification, to which 300µL of 4N NaOH solution was added. The V-vial was sealed with a Teflon-lined septum screw cap equipped with a vent needle. The solution was heated at 80°C with a positive N_2 flow for 5min. The N_2 flow was then stopped and the vent needle removed before 150µL of concentrated HCl was added to quench the reaction. The solution was diluted with DI H_2O and MeCN before being analyzed and purified on HPLC to obtain **[^{18}F]Fenoprofen (42)** in 35.8% (n=1) RCY. The collected product was then put on the rotary evaporator to remove excess MeCN from the solution. The solution of **42** was then neutralized to pH 7 by adding NaOH (1N) and PBS (10X). **42** was reformulated in a 1X PBS solution for use in PET imaging studies.

Run number	Deprotection RCY (Decay corrected)	Actual RCY (Decay corrected)
Run 1	93.1%	35.8%

Table S57. Radiochemical yield for **42**

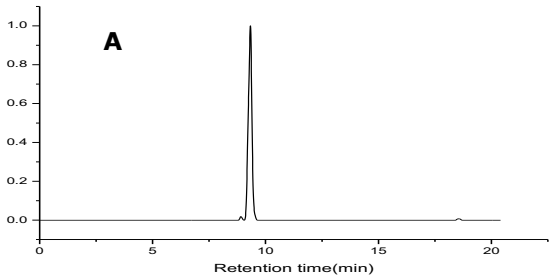


Fig. S92. Radio-HPLC trace of **42**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:50% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

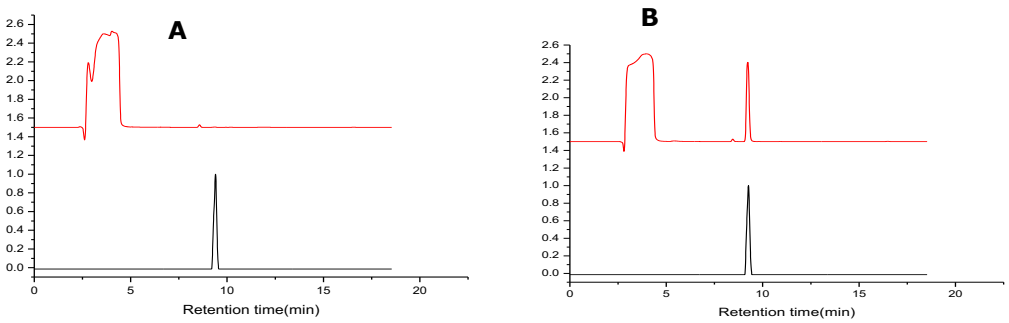


Fig. S93. HPLC traces of QC(**A**) and co-injection(**B**) for **42**

HPLC condition: Column: Phenomenex, Kinetex® 5µm F5 100 Å, 250 x 4.6 mm LC Column. Solvent A: 0.1%TFA water; Solvent B: 0.1%TFA acetonitrile;isocrat: 0 to 35 min:50% solvent B. Flow rate: 1 mL/min, column temperature: 19 to 21 °C.

6. Positron Emission Tomography (PET) and Computed Tomography (CT) Imaging Studies

6.1 *Ex vivo* PET/CT Imaging of Mouse Ear Inflammation Models

Materials and Methods

All animal studies conformed to protocol approved by the University of North Carolina Institutional Animal Care and Use Committee. Female 10-12-week-old nude mice (Division of Comparative Medicine, University of North Carolina at Chapel Hill) were housed at constant temperature (23°C) and relative humidity (60%) with a fixed 12 h light: 12 h dark cycle and had free access to food and water. Acute inflammation was induced by topical application of 10 μL 12-*o*-tetradecanoylphorbol-13-acetate (TPA) acetone solution (125μg/ml) to the inner and outer surface of the right ear of each mouse as previously described (*79*, *80*). Six hours after TPA exposure, mice received an intravenous bolus injection of [^{18}F]Fenoprofen (-5.8 MBq). At 1 h post-injection (p.i.), the animals were euthanized and the ears were harvested and subjected to a 10-min static PET scan (SuperArgus 4R, SEDECAL, Madrid, Spain). After PET scans, the ears were wet-weighed and counted in a gamma counter. The percentage-injected dose per gram (% ID/g) was determined and the results were reported as mean ± SD. To investigate the pharmacokinetics of [^{18}F]Fenoprofen, dynamic PET acquisitions was started and [^{18}F]Fenoprofen was administered in a rapid bolus through the tail vein catheter. Thirty minutes of dynamic PET data were acquired following [^{18}F]Fenoprofen administration. Dynamic PET data were binned into 14 frames (3×20s, 4×60s, 4×120s, 3×300s) and frames were reconstructed using non-scatter-corrected 3D ordered-subset expectation maximization (OSEM3D). Static PET data were reconstruction into a single frame by OSEM 3D.

Results of Inflammation Experiments

Rapid [^{18}F]Fenoprofen accumulation in the heart and liver were observed in nude mouse (N=1) following a rapid intravenous bolus injection. PET time-activity curve (TAC) is shown in **Fig. S94-G**, and tabulated data is listed in table. Following initial distribution (<1 min), uptake was observed to be stable over 30 minutes of PET imaging. Six hours after TPA application, the treated ears exhibited edema. Accumulation of [^{18}F]Fenoprofen in TPA-treated ear and normal ear was measured using PET imaging. Quantitative analysis showed significant higher uptake of [^{18}F]Fenoprofen in TPA-treated inflamed ear (1.48 ± 0.57, N=3) as compared with normal ear (0.64 ± 0.10, N=4) ($P < 0.05$). *Ex vivo* gamma counting validated PET quantification result, with (4.82 ± 0.58) % ID/g (N=4) in TPA treated ear and (3.08 ± 1.03) % ID/g (N=12) in normal ear, respectively ($p<0.05$). The relatively higher value obtained from gamma counting is probably due to the thin thickness of ear, which make positron annihilation less efficient. The coronal slices, maximum intensity projection (MIP) static PET image, and CT image of a representative TPA-treated ear (**S94-A, S94-C** and **S94-E**) or normal ear (**S94-B**, **S94-D** and **S94-F**) were shown in **Fig. S94.**

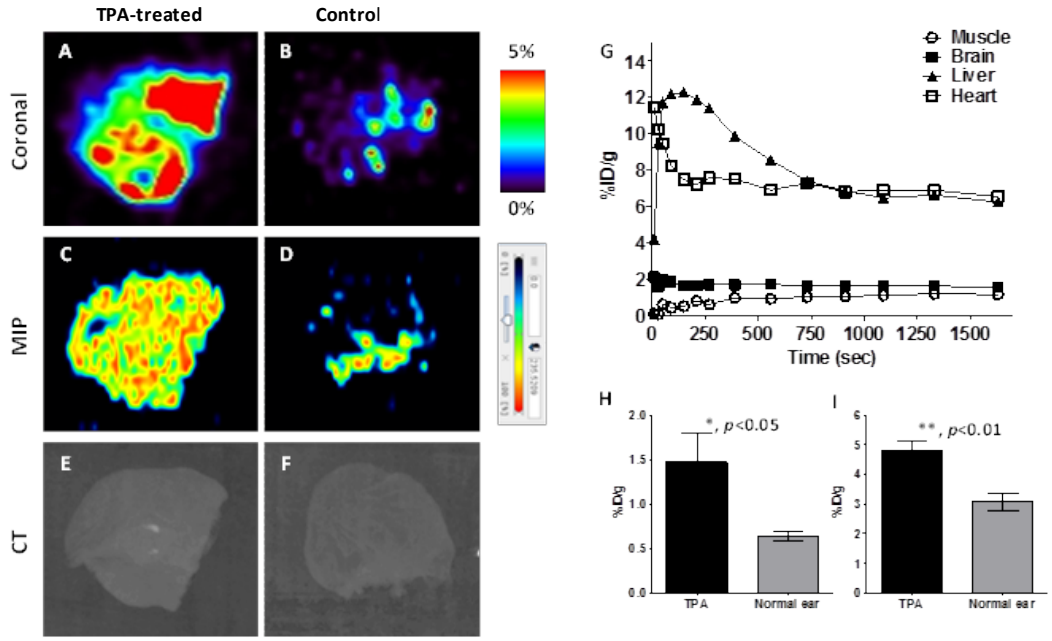


Fig. S94: *Ex vivo* [^{18}F]Fenoprofen PET imaging. Coronal slice, maximum intensity projection (MIP) static PET image, and CT image of representative TPA-treated ear (A, C and E) or normal ear (B, D and F) harvested from the mice injected intravenously with [^{18}F]Fenoprofen. (G) Dynamic PET time-activity curve (tac) of organ ROIs in nude mice injected with a rapid intravenous bolus of [^{18}F]Fenoprofen, imaged for 30 minutes post-injection. (H) Uptake of [^{18}F]Fenoprofen in TPA-treated or normal ear measured by ROIs hand-drawn on static *ex vivo* PET images. (I) Uptake of [^{18}F]Fenoprofen in TPA-treated or normal ear measured by gamma counting.

Sample	N	%ID/g(mean±SD)
TPA treated ear	4	4.82±0.58
Normal ear	12	3.08±1.3

Table S58. [^{18}F]Fenoprofen uptake in TPA-treated ear and normal ear, quantified by ex vivo gamma counting.

6.2 *In vivo* PET/CT Imaging of Mouse Tumor Models

Materials and Methods

All animal studies conformed to protocol approved by the University of North Carolina Institutional Animal Care and Use Committee. Human breast cancer cell line MCF-7 and human glioblastoma cell line U87MG were obtained from American Type Culture (Manassas, VA, USA) and cultured in Eagle's Minimum Essential Medium (EMEM) (Gibco, Grand Island, NY, USA) supplemented with 10% fetal bovine serum (FBS) (Omega Scientific, Tarzana, CA, USA) at 37˚C in an atmosphere containing 5% CO_2. Tumor model was established in 4- to 6- week old female nude mice (Division of Comparative Medicine, the University of North Carolina at Chapel Hill). For U87MG tumor model, the tumor cells were suspended in PBS (2× 107/ml) and mixed with 1:1 Matrigel (*v:v*). Then a 100 μL cell suspension was inoculated subcutaneously at the flank. For MCF-7 tumor model, a slow-release 17-β-estradiol (7.5 mg/pellet, 60-day slow release; 125 μg/day) was implanted. In brief, the mouse was anesthetized under 2% isoflurane. The skin on the lateral side of the neck of the mouse was lifted, then a 3-5 mm incision was made. With a pair of forceps, a small pocket beyond the incision site was

created, and the pellet was introduced. The incision site was closed with a 5-0 silk suture. Four days later, MCF-7 cells were harvested, resuspended in PBS (2× 107/ml) and mixed 1:1 Matrigel (*v:v*). Then a 100 µL cell suspension was inoculated subcutaneously at the flank.

Results of *in vivo* PET/CT Imaging (MCF7 and U87MG Tumors)

The MCF7 or U87MG tumor bearing mice received an intravenous injection of ^{18}F-PET agents (-5.5 MBq). At 1 h, 3 h and 4.5 h post-injection (p.i.), the animals were anesthetized under 2% isoflurane and subjected to 10-min static PET scan (SuperArgus 4R, SEDECAL, Madrid, Spain). The percentage-injected dose per gram (% ID/g) of major organs were calculated and reported as mean ± SD. PET data were reconstruction into a single frame by OSEM 3D.

[^{18}F]4-(4'-fluoro-phenyl)phenylalanine (**41**) showed relatively high background level in MCF7 tumor models at all time points (**Fig. S95**). The tumor uptake of **41** was 4.11 ± 0.36 %ID/g, 3.69 ± 0.66 %ID/g and 3.19 ± 0.64 %ID/g at 1 h, 3 h and 4.5 h respectively post-injection (p.i.). [^{18}F]2-Methoxy-5-fluoro-phenylalanine (**39**) had tumor uptake of 8.24 ± 0.90 %ID/g, 5.94 ± 1.34 %ID/g and 4.13 ± 1.88 %ID/g at 1 h, 3 h and 4.5 h respectively post-injection (p.i.). High liver uptake was observed for **41** with tumor to liver uptake ratio of 0.36 ± 0.01, 0.45 ± 0.02 and 0.55 ± 0.01 at 1 h, 3 h and 4.5 h. **39** displayed significantly lower tumor to liver uptake ratio [3.63 ± 0.29, 4.88 ± 0.45 and 4.06 ± 0.65 at the respective time points]. **39** also demonstrated prominent uptake in the U87MG xenografts. The tumor uptake was 5.64 ± 0.60 %ID/g, 4.64 ± 0.47 %ID/g and 2.93 ± 1.07 %ID/g at 1 h, 3 h and 4.5 h respectively p.i. The coronal slices of static PET images are shown in **Fig. S95**.

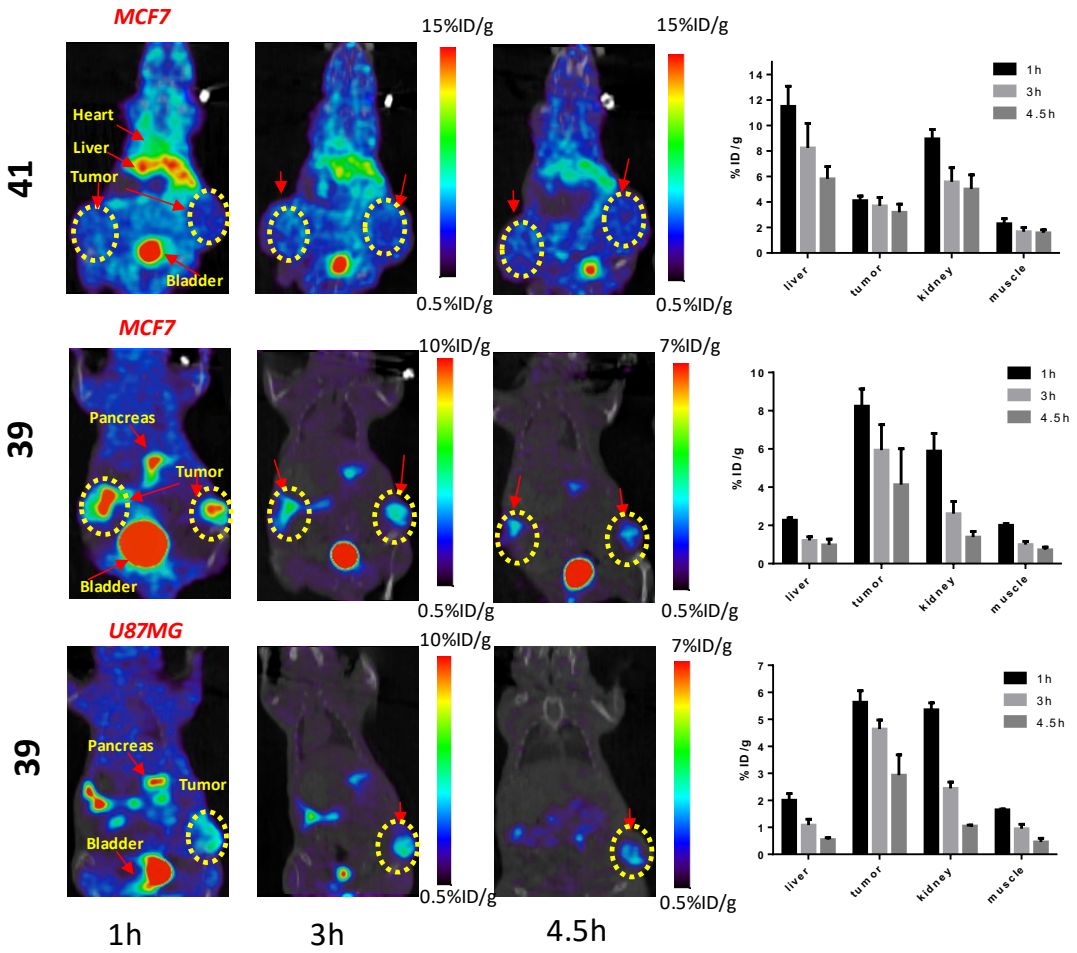


Fig. S95 Representative PET/CT images of MCF7 model at 1, 3 and 4.5h post injection of **41** and the quantitative uptake of major organs derived from PET images (first panel), MCF7 model after injection of **39** (second panel) and U87MG model after injection of **39** (third panel).

7. Mechanism Proposal and Computational Data

All computations were carried out in the Gaussian 09 program suite (*81*) at the B3LYP/6-31G+(d,p) level of theory. Natural population analyses (NPA atomic charges and molecular orbital populations) were performed using the NBO formalism and the NPA values were calculated in 1,2-dicholorethane according to a prior procedure from our laboratory (*25*).

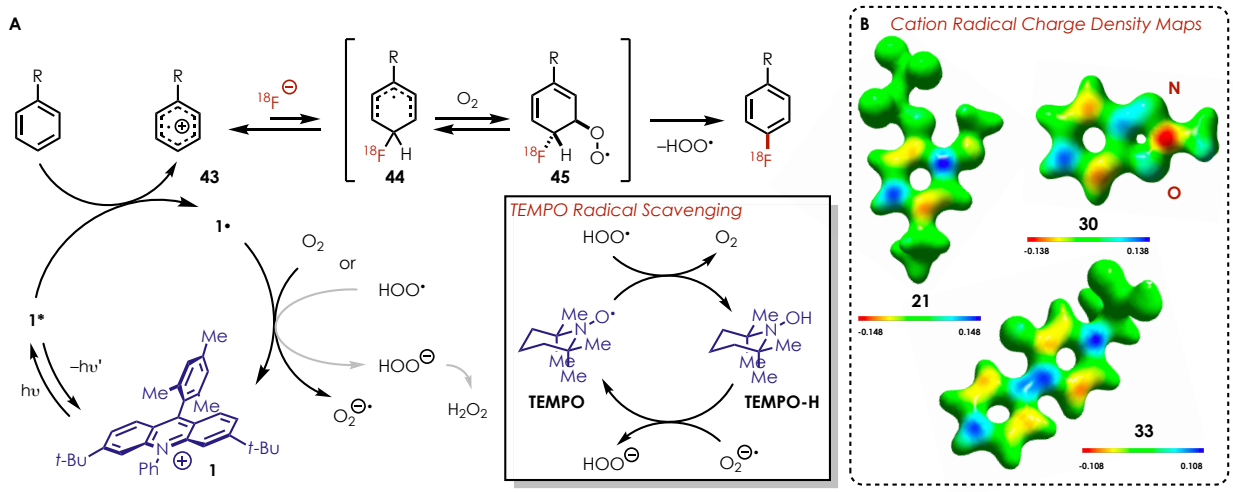


Fig. S96. (**A**) Mechanistic Proposal for Oxidative C–H ^{18}F-Fluorination of Aromatics. (**B**) LUMO charge density maps calculated at the B3LYP/6-31G+(d,p) level correspond to the cation radicals of the starting arenes for **21**, **30** and **33**. The darkest blue carbon atoms on the arenes indicate the most likely reactivity sites (See figs. S100 and S101 for more details).

I. 2-substituted methoxyarenes

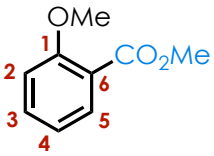
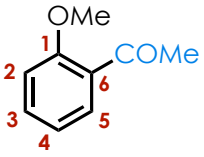
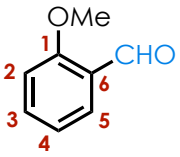
Arene	Ground state	Radical cation	Difference
	1. -1.174 2. 0.507 3. -0.301 4. -0.025 5. -0.598 6. 1.116	1. -1.008 2. 0.507 3. -0.248 4. 0.067 5. -0.598 6. 1.116	1. 0.166 2. -0.379 3. 0.053 4. 0.092 5. 0.436 6. 0.342
	1. -1.008 2. 0.416 3. -0.292 4. -0.053 5. -0.922 6. 1.365	1. -0.595 2. 0.564 3. -0.396 4. 0.137 5. -0.654 6. 0.693	1. 0.413 2. -0.148 3. -0.204 4. 0.190 5. 0.268 6. -0.672
	1. -0.853 2. 0.440 3. -0.309 4. 0.050 5. -1.145 6. 1.490	1. -0.491 2. 0.705 3. -0.461 4. 0.264 5. -1.384 6. 1.351	1. 0.362 2. 0.265 3. -0.152 4. 0.214 5. -0.239 6. -0.139

Fig. S97. Natural population analyses for the ground state and radical cation of selected 2-substituted methoxyarenes

II. 4-substituted methoxyarenes

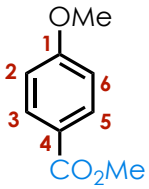
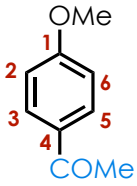
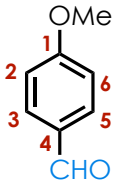
Arene	Ground state	Radical cation	Difference
	1. -0.356 2. 0.580 3. -0.501 4. -0.019 5. -0.359 6. 0.021	1. -0.446 2. 0.720 3. -0.583 4. 0.264 5. -0.341 6. 0.142	1. -0.090 2. 0.140 3. -0.082 4. 0.283 5. 0.018 6. 0.121
	1. -0.371 2. 0.566 3. -1.584 4. 0.794 5. 0.191 6. -0.024	1. -0.452 2. 0.772 3. -1.553 4. 0.849 5. 0.227 6. 0.099	1. -0.081 2. 0.206 3. 0.031 4. 0.055 5. 0.036 6. 0.123
	1. -0.349 2. 0.792 3. -1.368 4. 0.560 5. 0.126 6. -0.036	1. -0.433 2. 0.956 3. -1.425 4. 0.659 5. 0.200 6. 0.090	1. -0.084 2. 0.164 3. -0.057 4. 0.099 5. 0.074 6. 0.126

Fig. S98. Natural population analyses for the ground state and radical cation of selected 4-substituted methoxyarenes

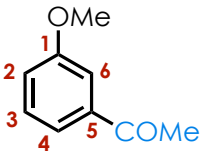
Arene	Ground state	Radical cation	Difference
	1. -0.344 2. 0.534 3. -0.706 4. -0.887 5. 0.562 6. 0.405	1. -0.477 2. 0.682 3. -0.661 4. -0.760 5. 0.513 6. 0.651	1. -0.133 2. 0.139 3. 0.045 4. 0.127 5. -0.049 6. 0.246

Fig. S99. Natural population analysis for the ground state and radical cation of 3-methoxyacetophenone

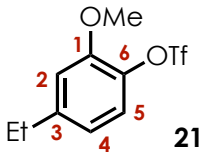
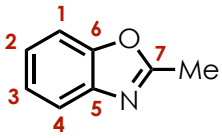
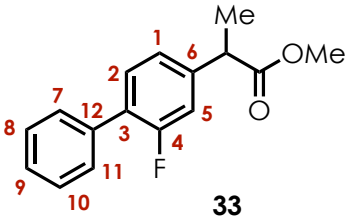
Arene	Ground state	Radical cation	Difference
 **21**	1. -0.571	1. -0.451	1. 0.080
	2. 0.192	2. -0.372	2. -0.564
	3. 0.324	3. 0.155	3. -0.169
	4. -0.772	4. -0.594	4. 0.178
	5. 0.674	5. 0.598	5. -0.076
	6. -0.092	6. 0.589	6. 0.687
Arene	**Ground state**	**Radical cation**	**Difference**
 **30**	1. -0.626	1. -0.594	1. 0.032
	2. -0.244	2. -0.083	2. 0.161
	3. -0.197	3. -0.184	3. 0.013
	4. -0.872	4. -0.627	4. 0.245
	5. 0.759	5. 0.638	5. -0.121
	6. 0.505	6. 0.685	6. 0.180
	7. 0.611	7. 0.437	7. -0.174
Arene	**Ground state**	**Radical cation**	**Difference**
 **33**	1. -0.333	1. -0.475	1. -0.142
	2. -0.264	2. -0.176	2. 0.088
	3. 0.538	3. 0.077	3. -0.461
	4. -0.270	4. 0.114	4. 0.384
	5. -0.259	5. -0.328	5. -0.069
	6. 0.009	6. 0.097	6. 0.088
	7. -0.393	7. -0.263	7. 0.130
	8. -0.171	8. -0.365	8. -0.194
	9. -0.178	9. -0.084	9. 0.094
	10. -0.035	10. -0.368	10. -0.333
	11. -0.064	11. -0.018	11. 0.046
	12. 0.453	12. 1.359	12. 0.906

Fig. S100. Natural population analyses for the ground state and radical cation of methoxyarenes listed in Fig. S96 (**21**, **30**, **33**)

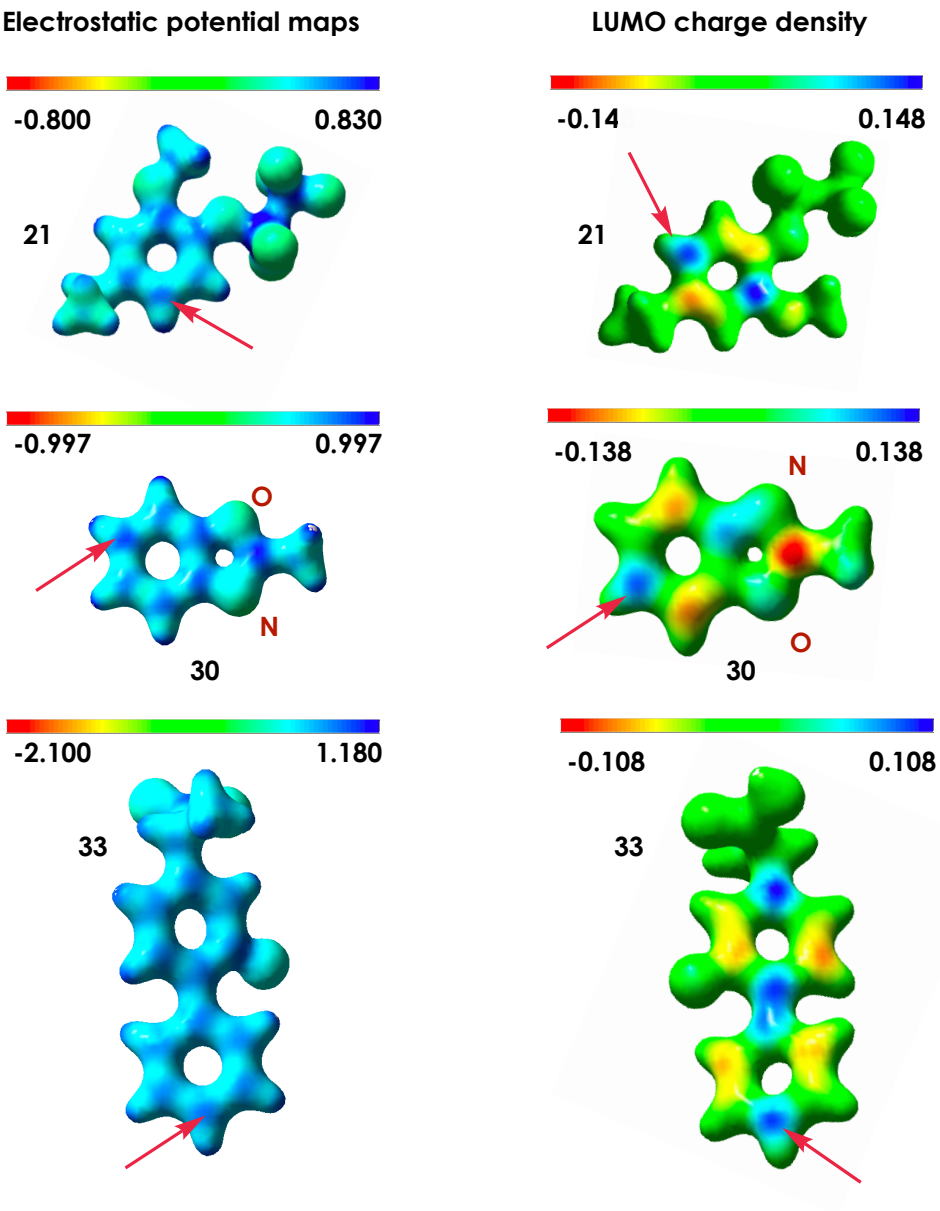
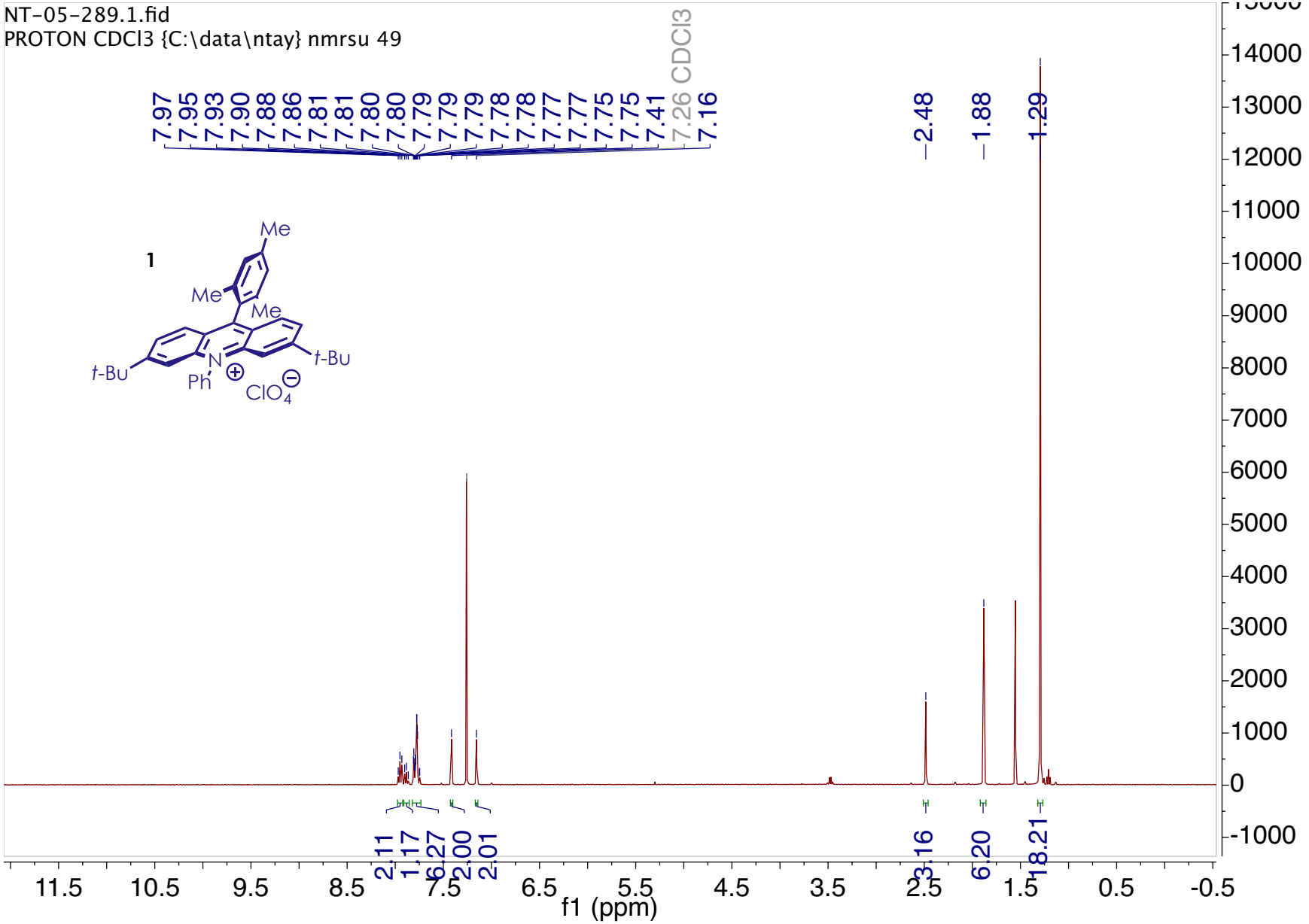
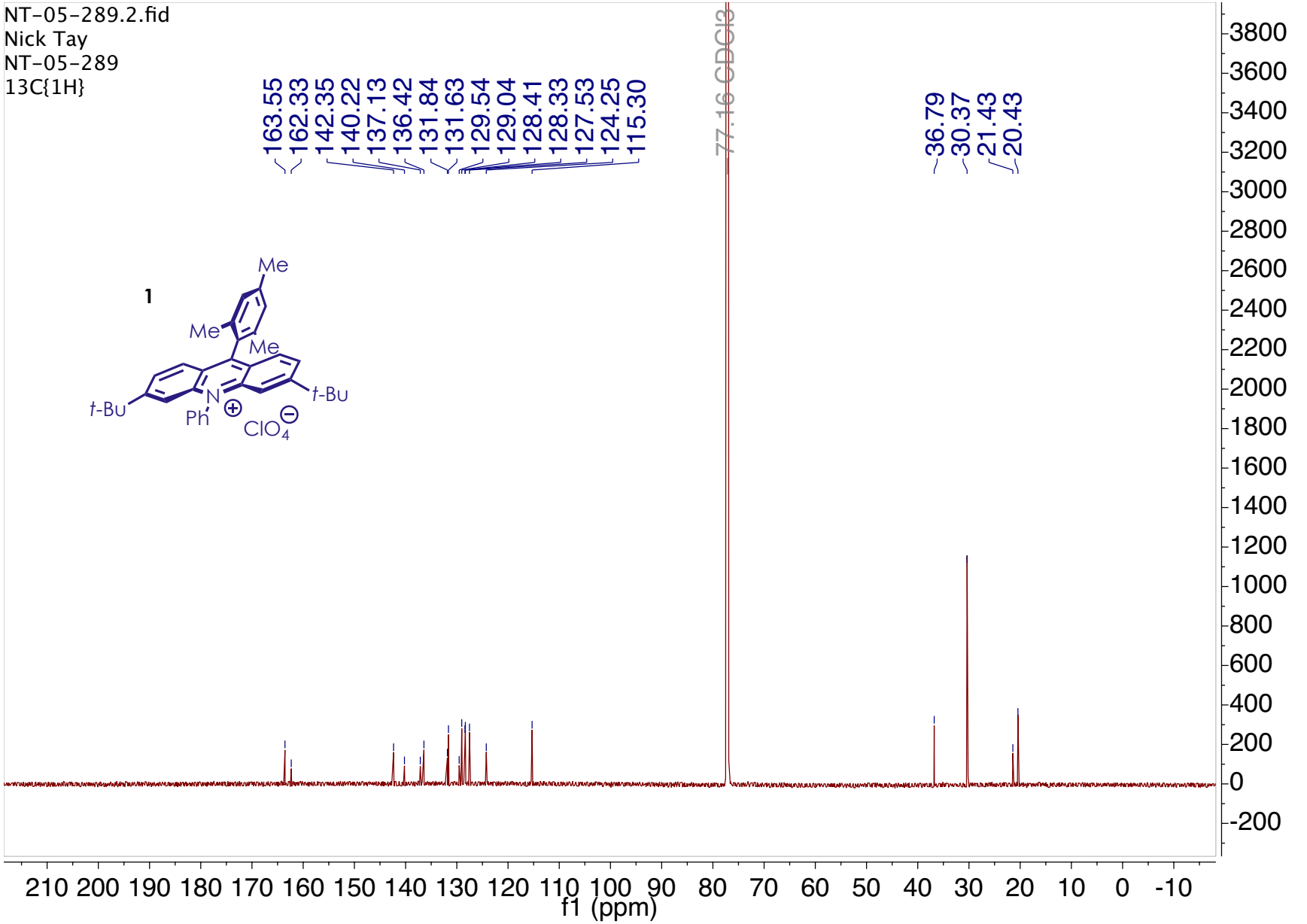
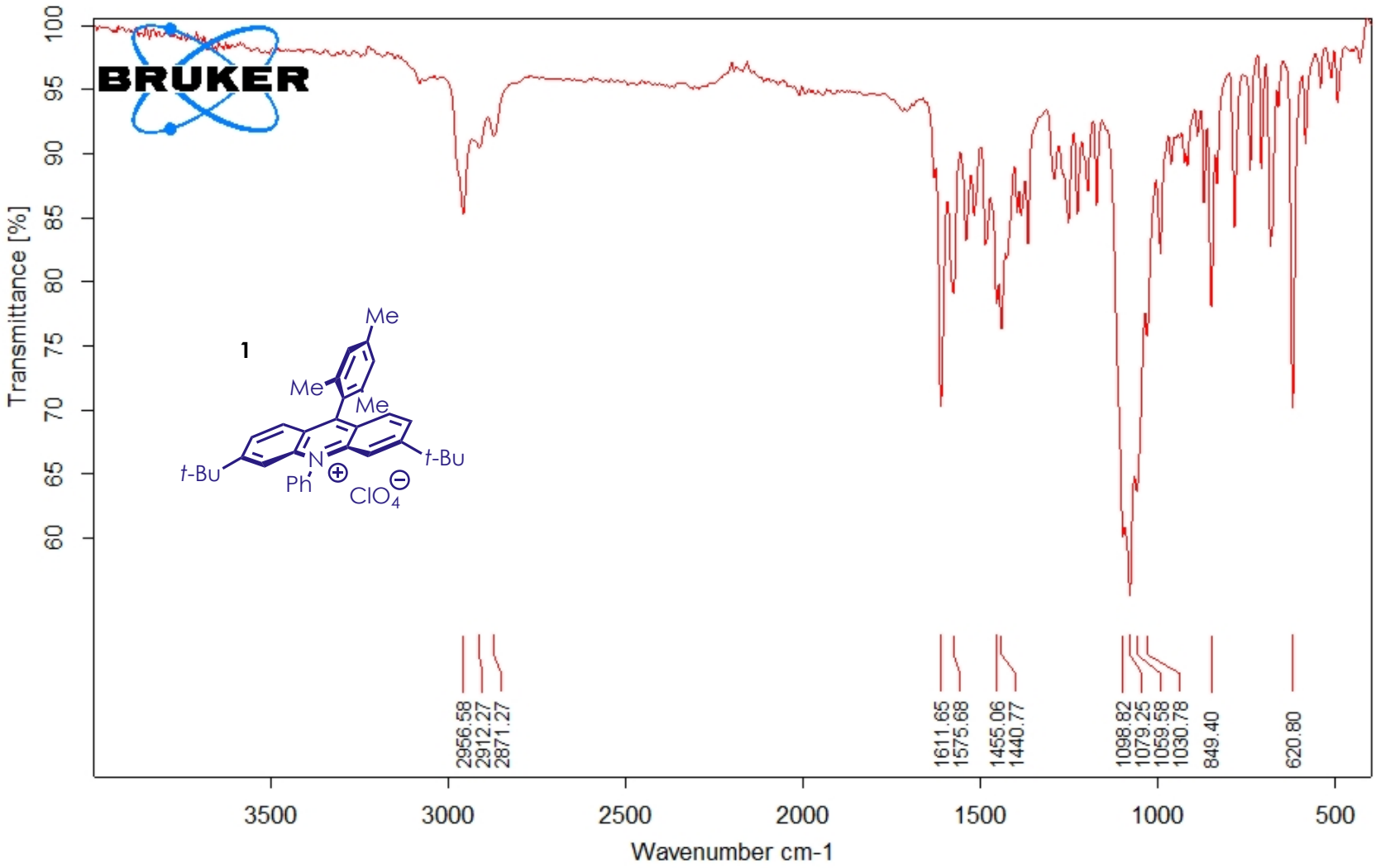


Fig. S101. A comparison of electrostatic potentials (left) and LUMO charge density (right) maps for the methoxyarenes listed in Fig. S96. Red arrows indicate the reactive arene C-H site (**21**, **30**, **33**)

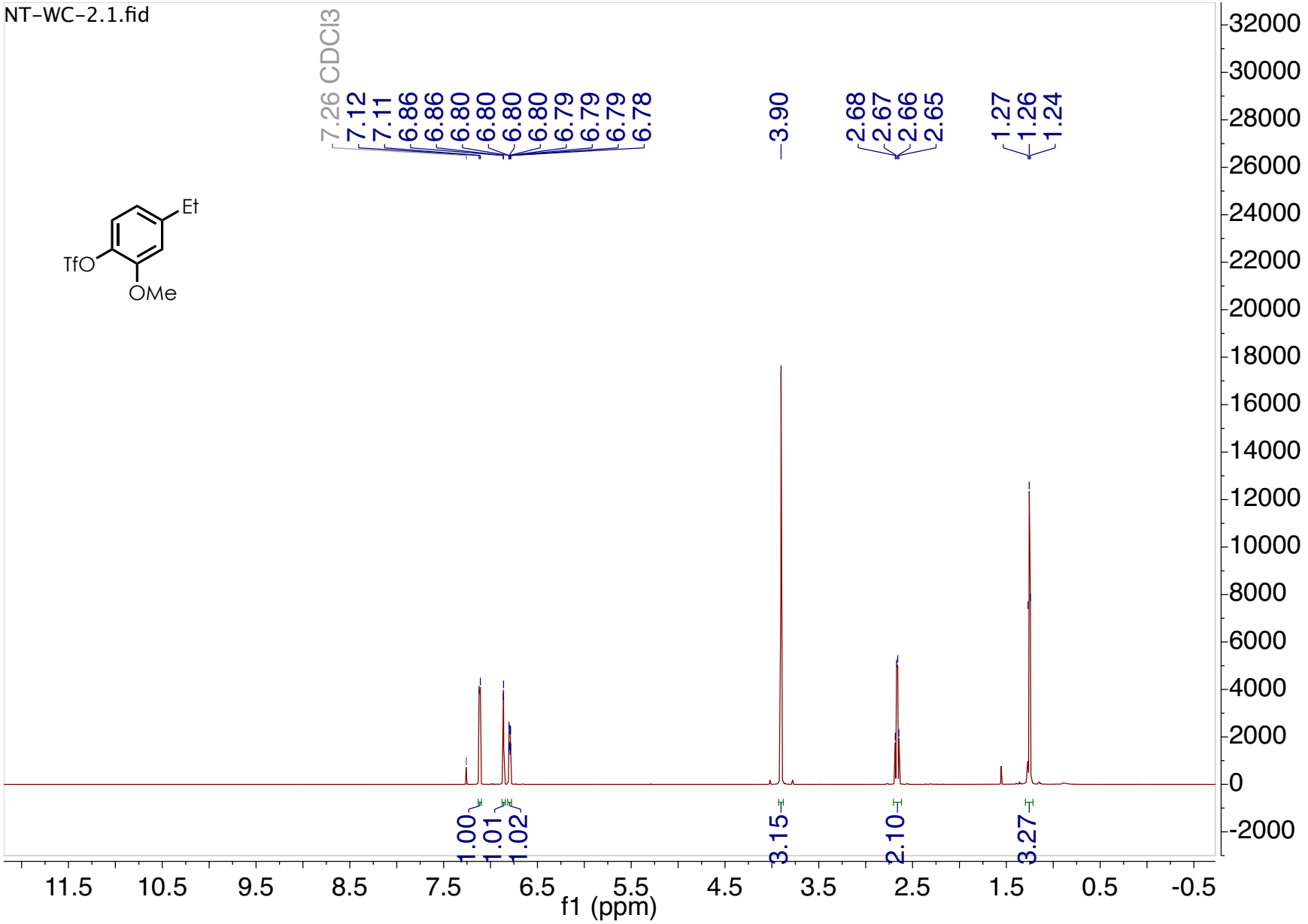
8. Spectra data for new compounds (^{1}H NMR, ^{13}C NMR, and ^{19}F NMR; IR)




NT-05-289.2.fid
Nick Tay
NT-05-289
13C{1H}
163.55
162.33
142.35
140.22
137.13
136.42
131.84
131.63
129.54
129.04
128.41
128.33
127.53
124.25
115.30
77.16 CDCl3
36.79
30.37
21.43
20.43
1
Me
Me
Me
t-Bu
t-Bu
N
Ph
ClO4
f1 (ppm)



C:\OPUS_7.2.139.1294\MEAS\NT-5-289.0	NT-5-289	Instrument type and / or accessory	7/30/2018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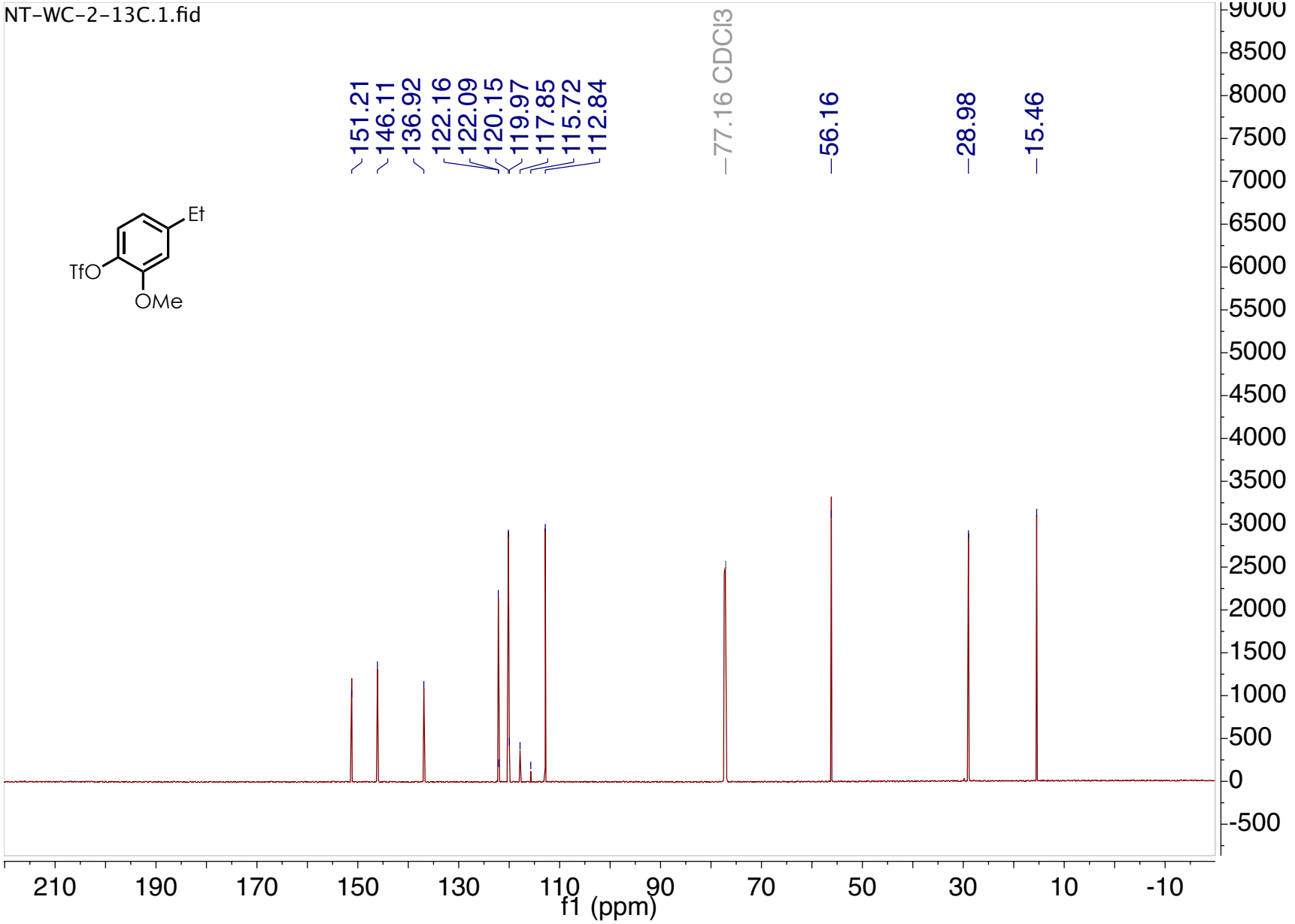
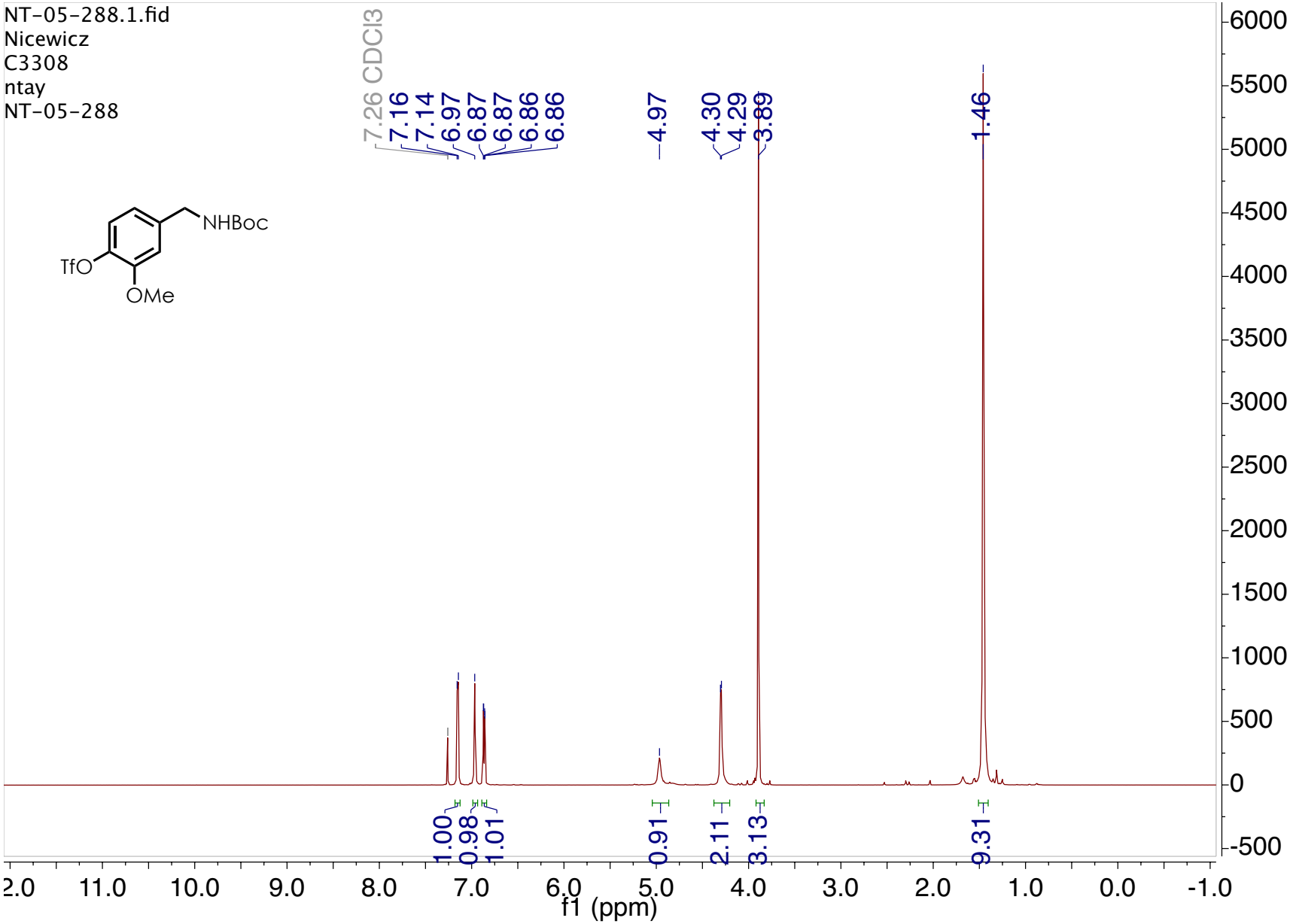
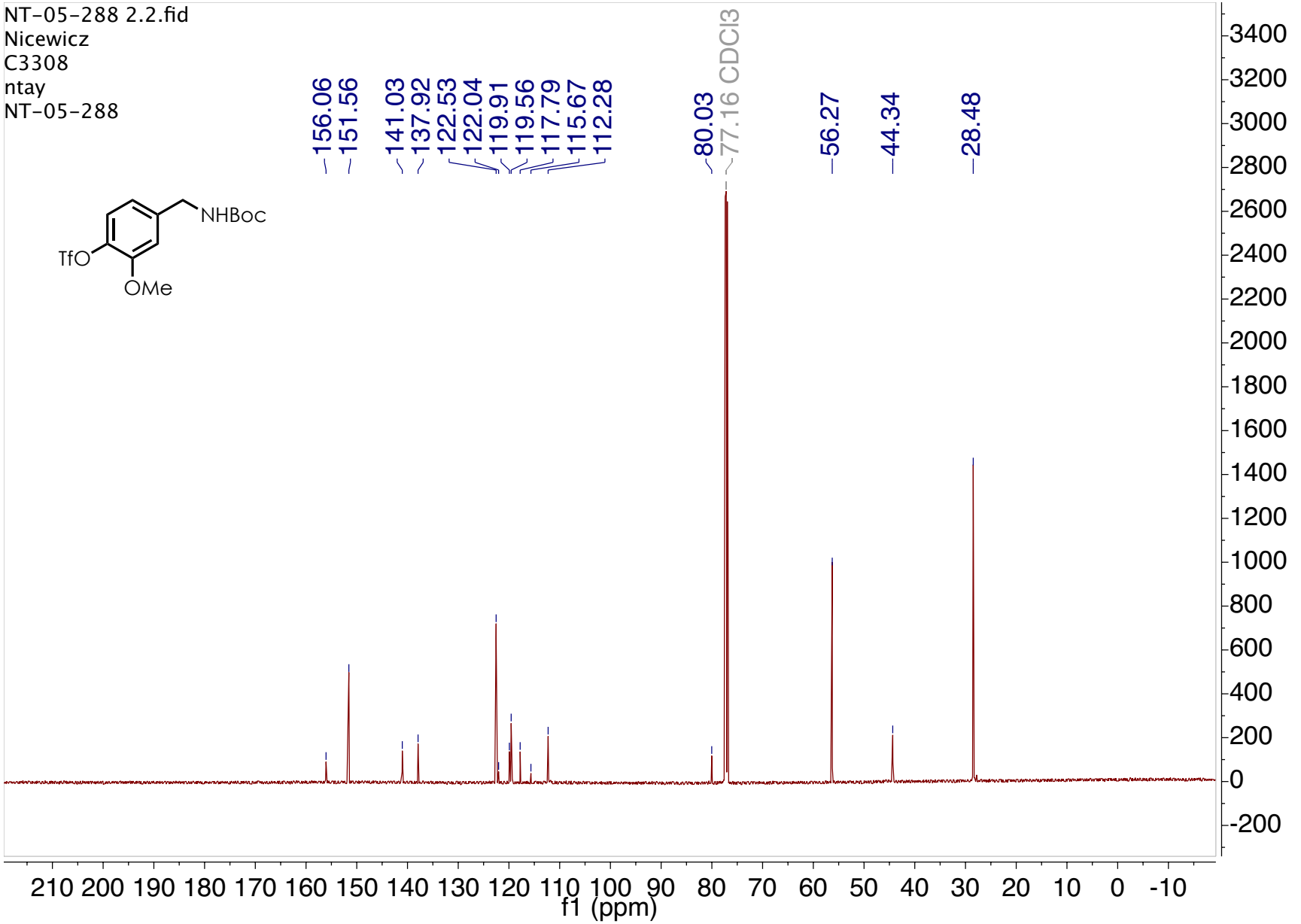
7.12
7.11
6.86
6.86
6.80
6.80
6.80
6.80
6.79
6.79
6.79
6.78
3.90
2.68
2.67
2.66
2.65
1.27
1.26
1.24
Et
TfO
OMe
1.00
1.01
1.02
3.15
2.10
3.27
11.5
10.5
9.5
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
-0.5
f1 (ppm)
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000


NT-WC-2-13C.1.fid
151.21
146.11
136.92
122.16
122.09
120.15
119.97
117.85
115.72
112.84
77.16 CDCl3
56.16
28.98
15.46
Et
TfO
OMe
f1 (ppm)


NT-05-288.1.fid
Nicewicz
C3308
ntay
NT-05-288
7.26 CDCl3
7.16
7.14
6.97
6.87
6.87
6.86
6.86
4.97
4.30
4.29
3.89
1.46
NHBoc
TfO
OMe
1.00
0.98
1.01
0.91
2.11
3.13
9.31
f1 (ppm)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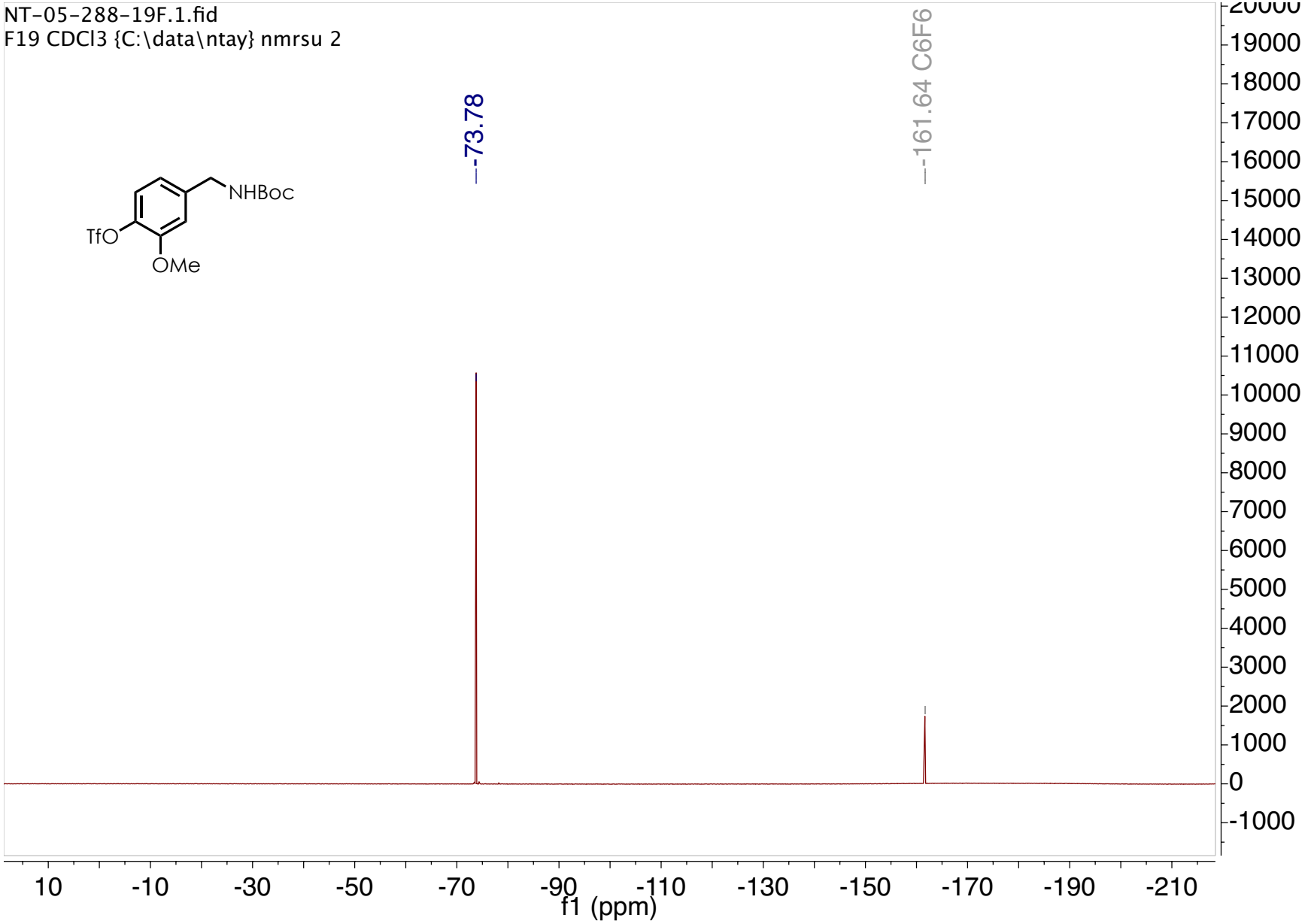
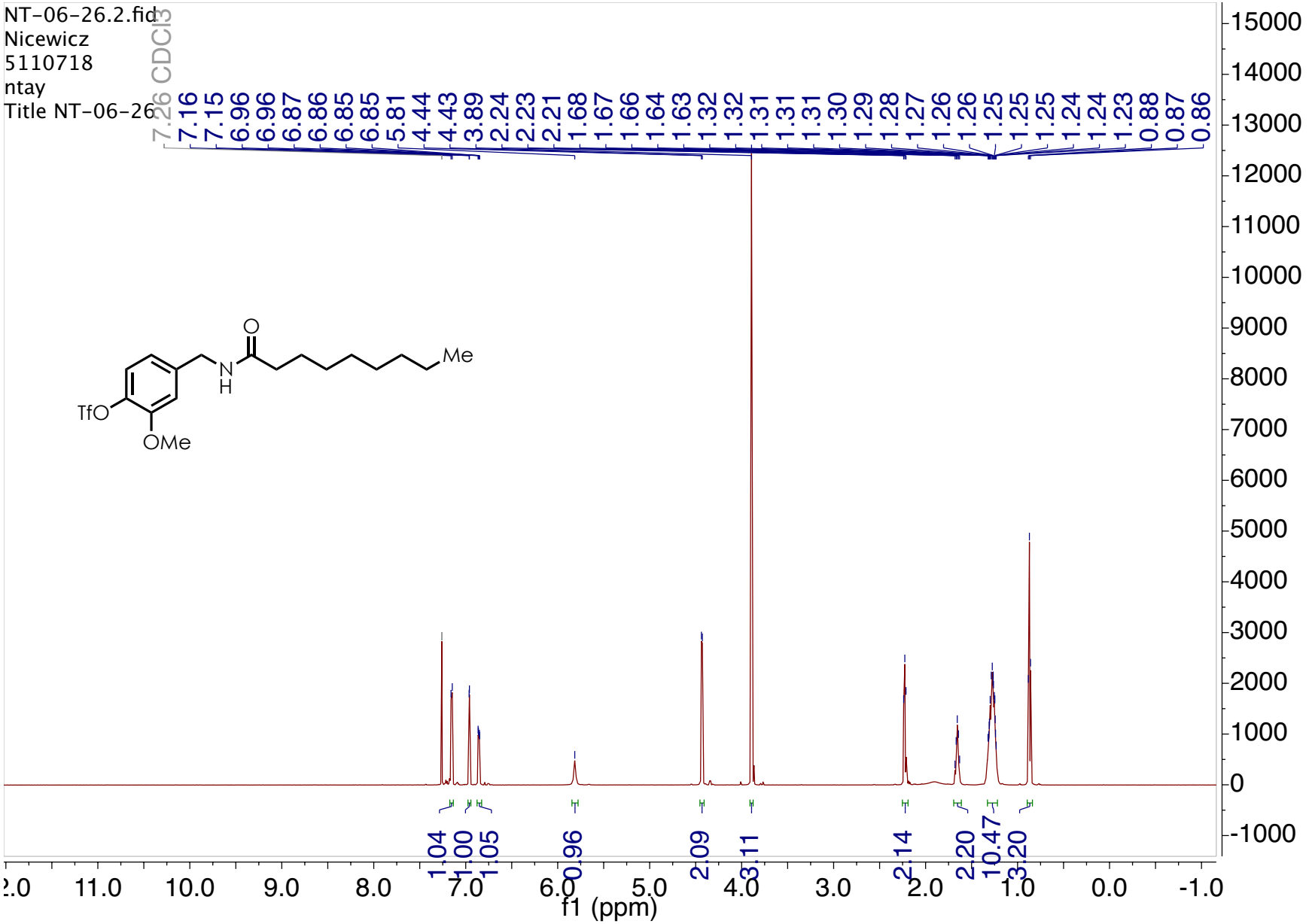
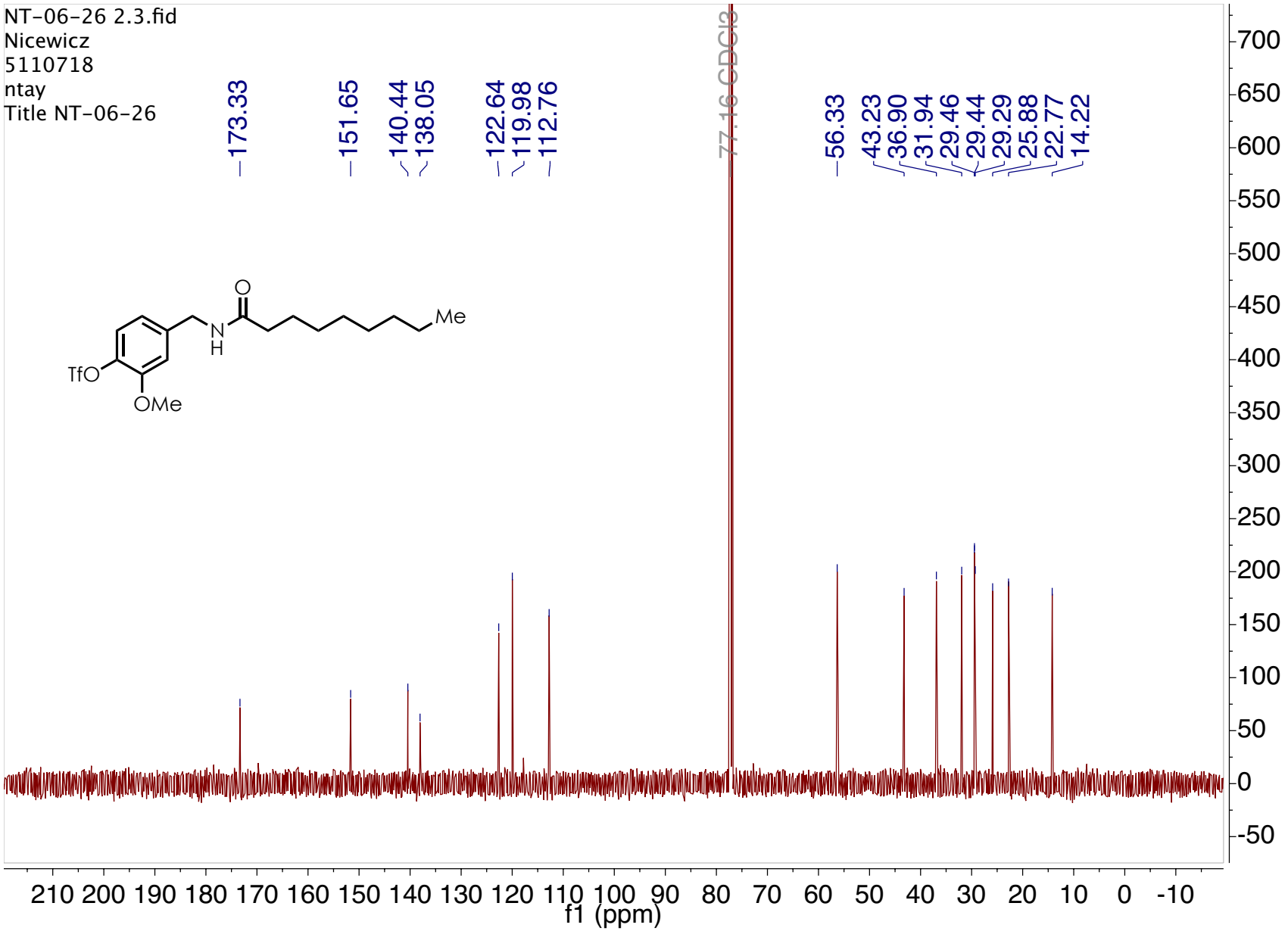
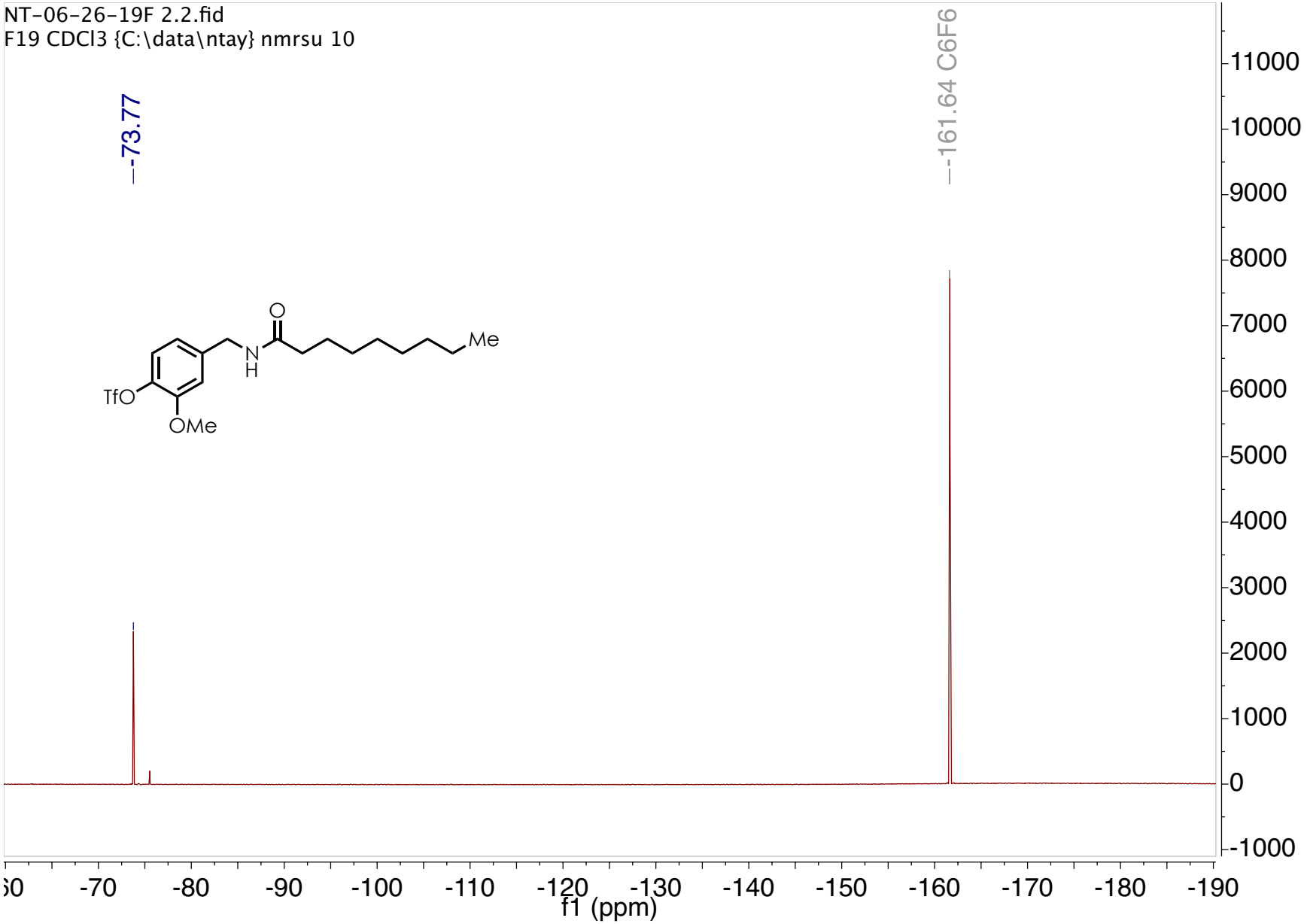
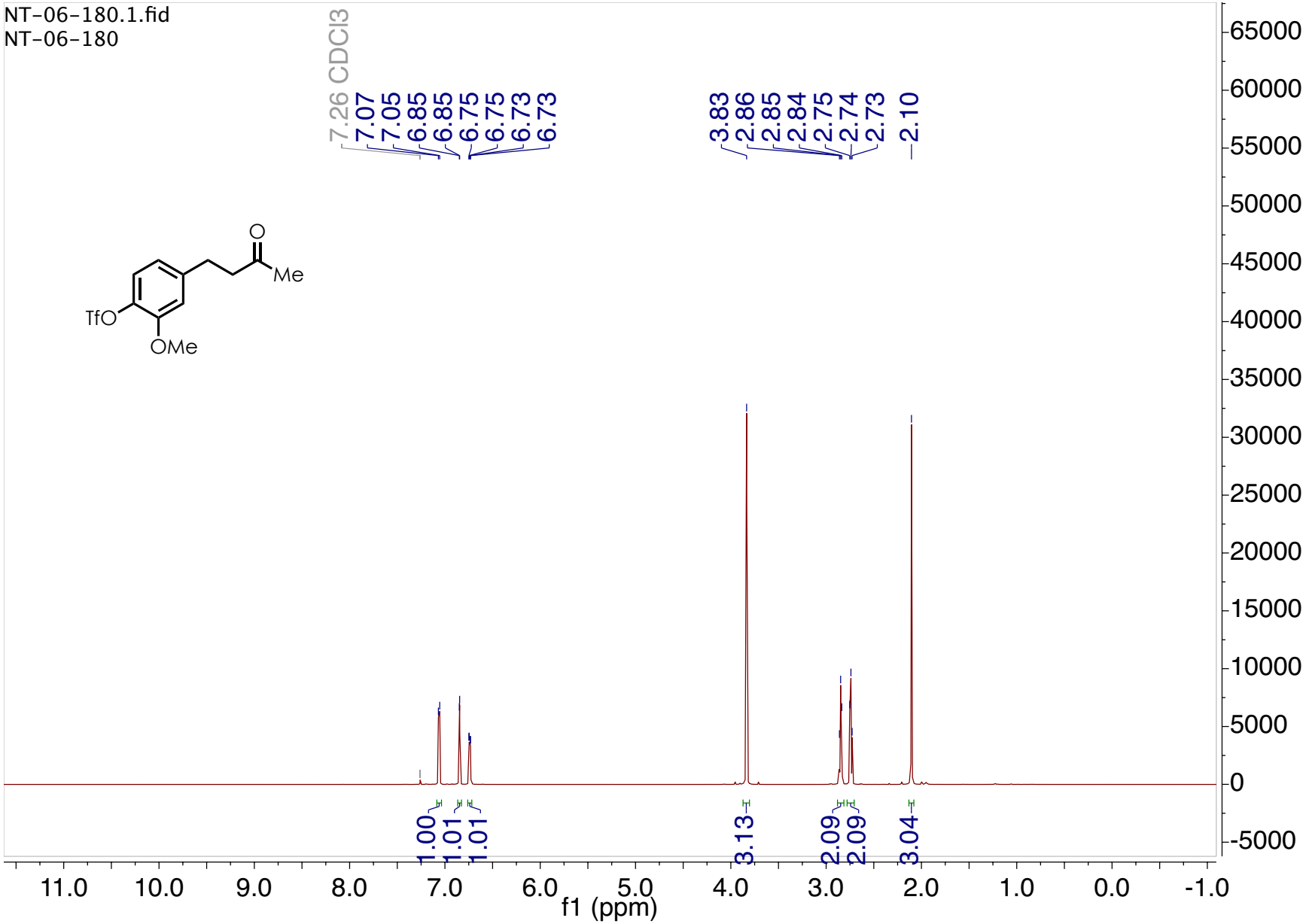
Nicewicz
C3308
ntay
NT-05-288
156.06
151.56
141.03
137.92
122.53
122.04
119.91
119.56
117.79
115.67
112.28
80.03
77.16 CDCl3
56.27
44.34
28.48
NHBoc
TfO
OMe
f1 (ppm)

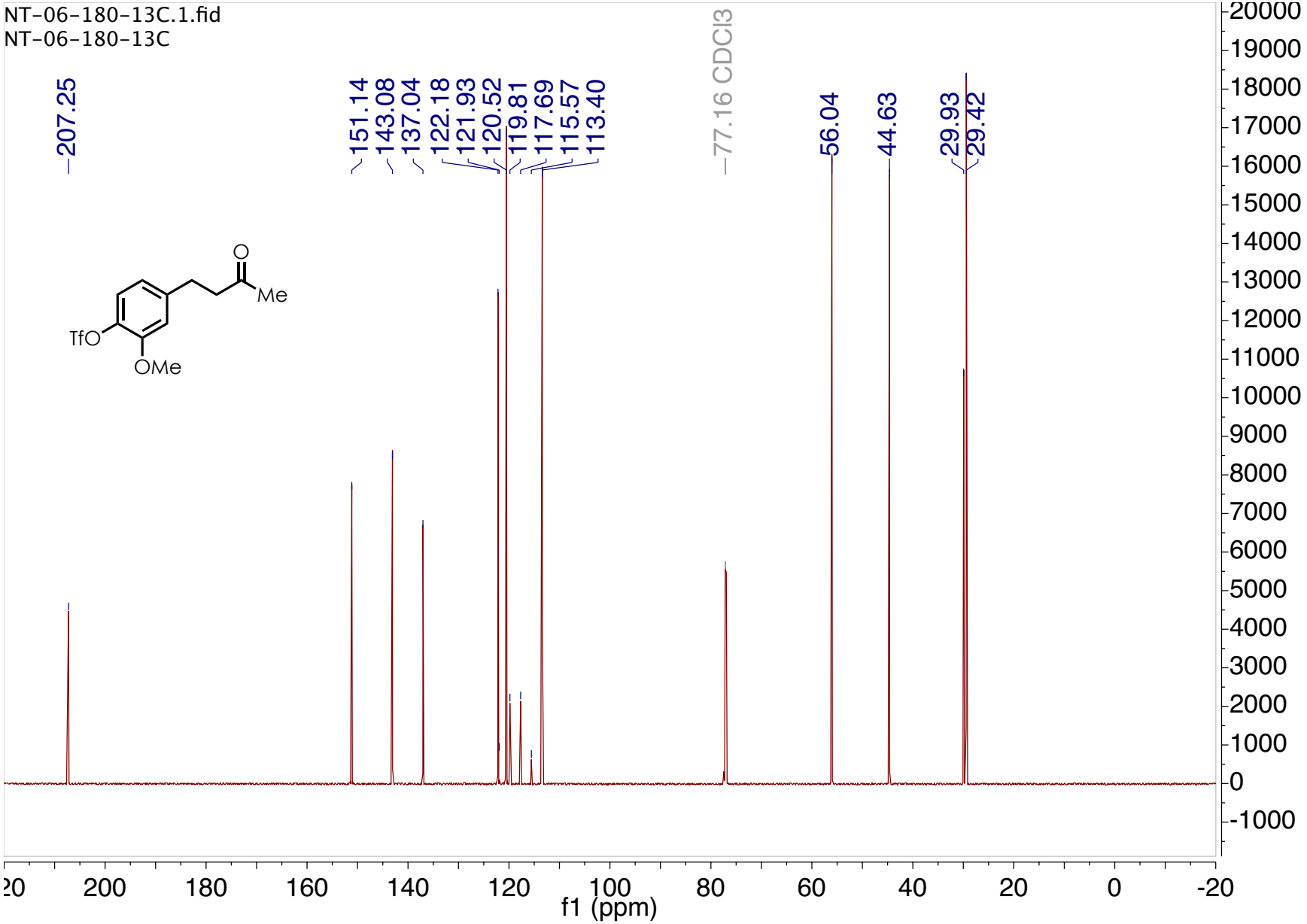

NT-05-288-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 2
-73.78
-161.64 C6F6
NHBoc
TfO
OMe
20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

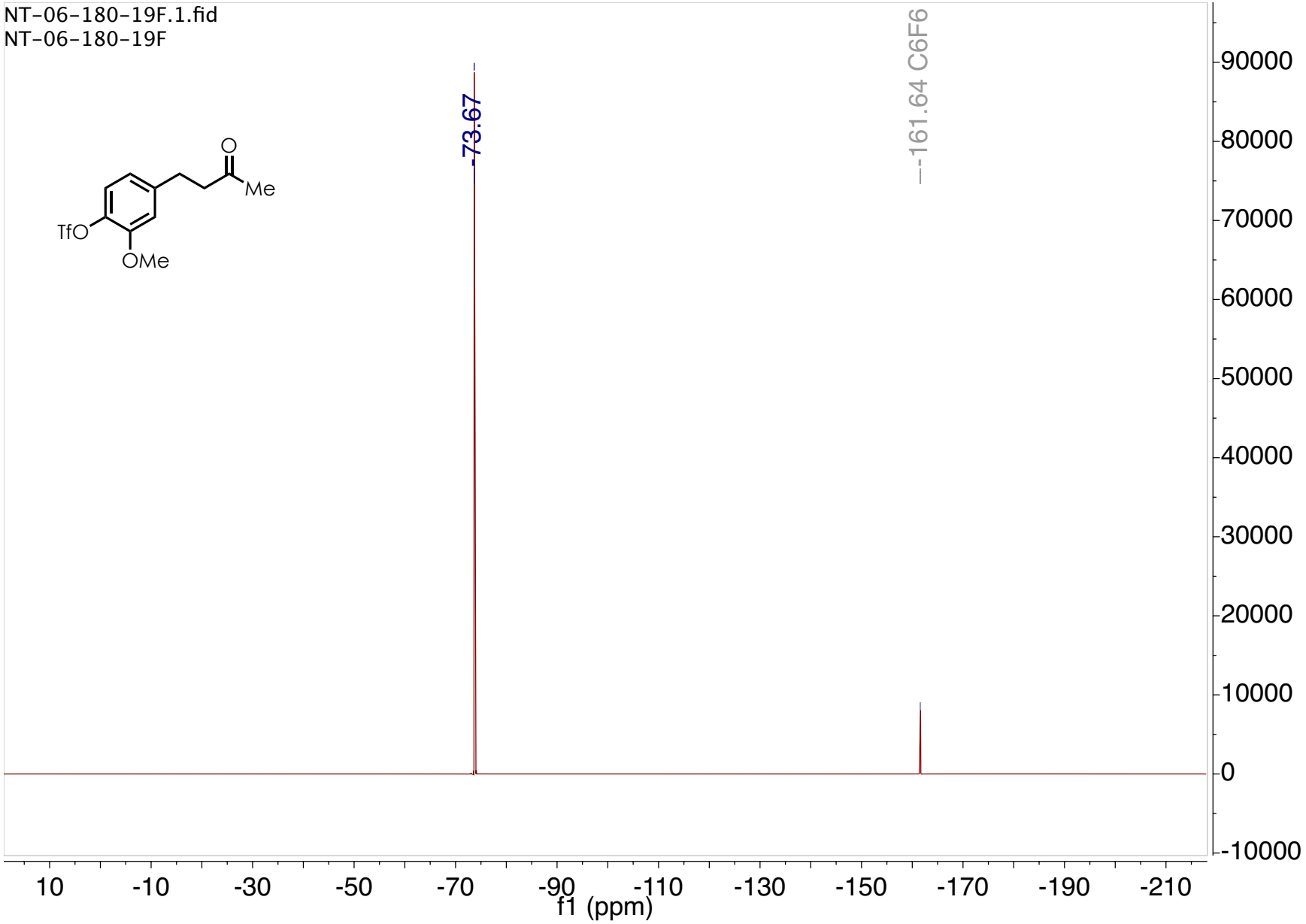

NT-06-26.2.fid
Nicewicz
5110718
ntay
Title NT-06-26
7.26 CDCl3
7.16 7.15 6.96 6.96 6.87 6.86 6.85 6.85 5.81 4.44 4.43 3.89 2.24 2.23 2.21 1.68 1.67 1.66 1.64 1.63 1.32 1.32 1.31 1.31 1.31 1.30 1.29 1.28 1.27 1.26 1.26 1.25 1.25 1.25 1.24 1.24 1.23 0.88 0.87 0.86
O
N
H
Me
TfO
OMe
1.04 1.00 1.05 0.96 2.09 3.11 2.14 2.20 10.47 3.20
15000 14000 13000 12000 11000 10000 9000 8000 7000 6000 5000 4000 3000 2000 1000 0 -1000
2.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1.0
f1 (ppm)

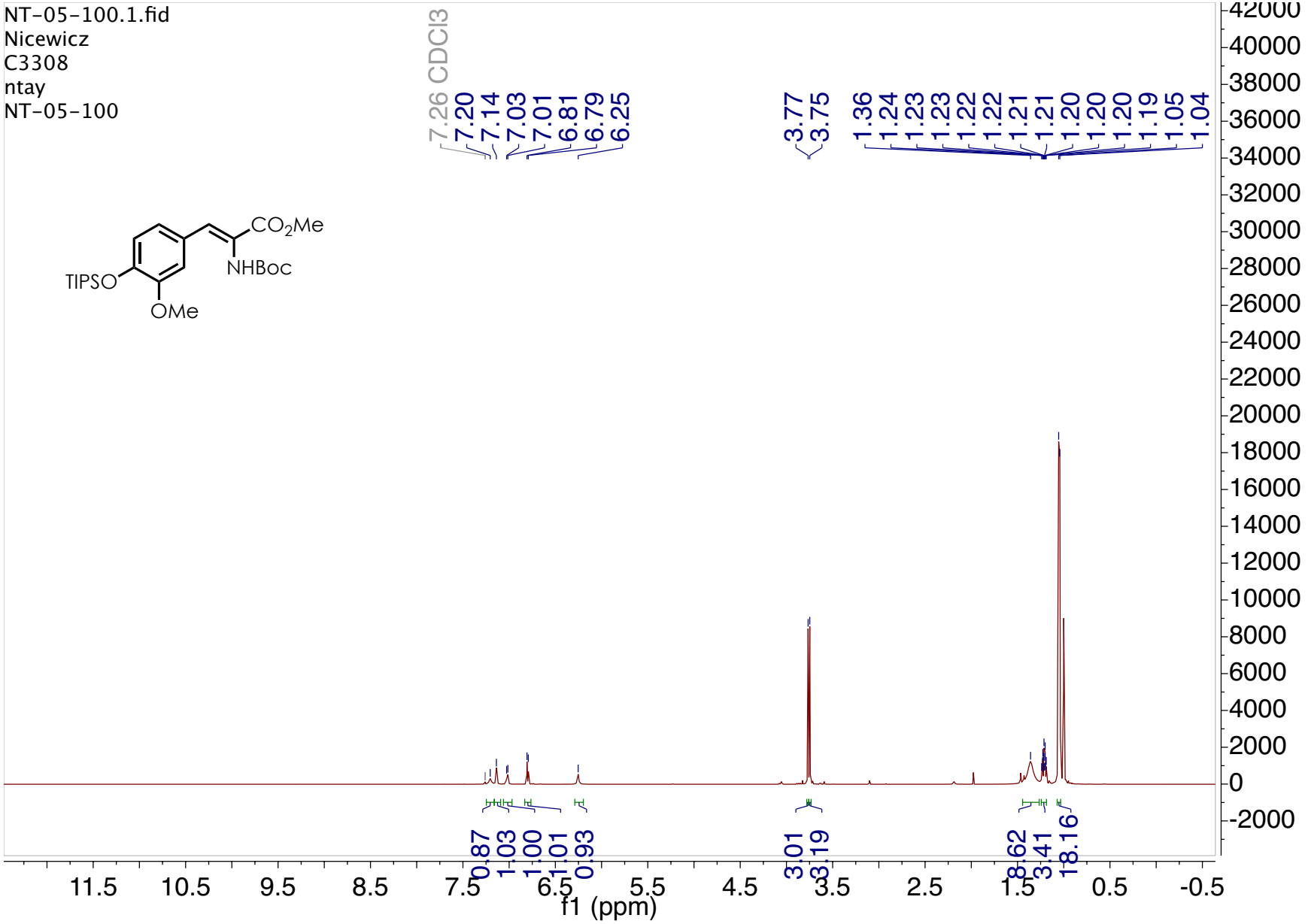

NT-06-26 2.3.fid
Nicewicz
5110718
ntay
Title NT-06-26
173.33
151.65
140.44
138.05
122.64
119.98
112.76
77.16 CDCl3
56.33
43.23
36.90
31.94
29.46
29.44
29.29
25.88
22.77
14.22
O
N
H
Me
TfO
OMe
f1 (ppm)


NT-06-26-19F 2.2.fid
F19 CDCl3 {C:\data\ntay} nmrsu 10
-73.77
-161.64 C6F6
O
N
H
Me
TfO
OMe
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
f1 (ppm)


NT-06-180.1.fid
NT-06-180
7.26 CDCl3
7.07
7.05
6.85
6.85
6.75
6.75
6.73
6.73
3.83
2.86
2.85
2.84
2.75
2.74
2.73
2.10
O
Me
TfO
OMe
1.00
1.01
1.01
3.13
2.09
2.09
3.04
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)


NT-06-180-13C.1.fid
NT-06-180-13C
207.25
151.14
143.08
137.04
122.18
121.93
120.52
119.81
117.69
115.57
113.40
77.16 CDCl3
56.04
44.63
29.93
29.42
O
Me
TfO
OMe
f1 (ppm)


NT-06-180-19F.1.fid
NT-06-180-19F
-73.67
-161.64 C6F6
O
Me
TfO
OMe
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
-10000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)


NT-05-100.1.fid
Nicewicz
C3308
ntay
NT-05-100
7.26 CDCl3
7.20
7.14
7.03
7.01
6.81
6.79
6.25
3.77
3.75
1.36
1.24
1.23
1.23
1.22
1.22
1.21
1.21
1.20
1.20
1.20
1.19
1.05
1.04
CO2Me
NHBoc
TIPSO
OMe
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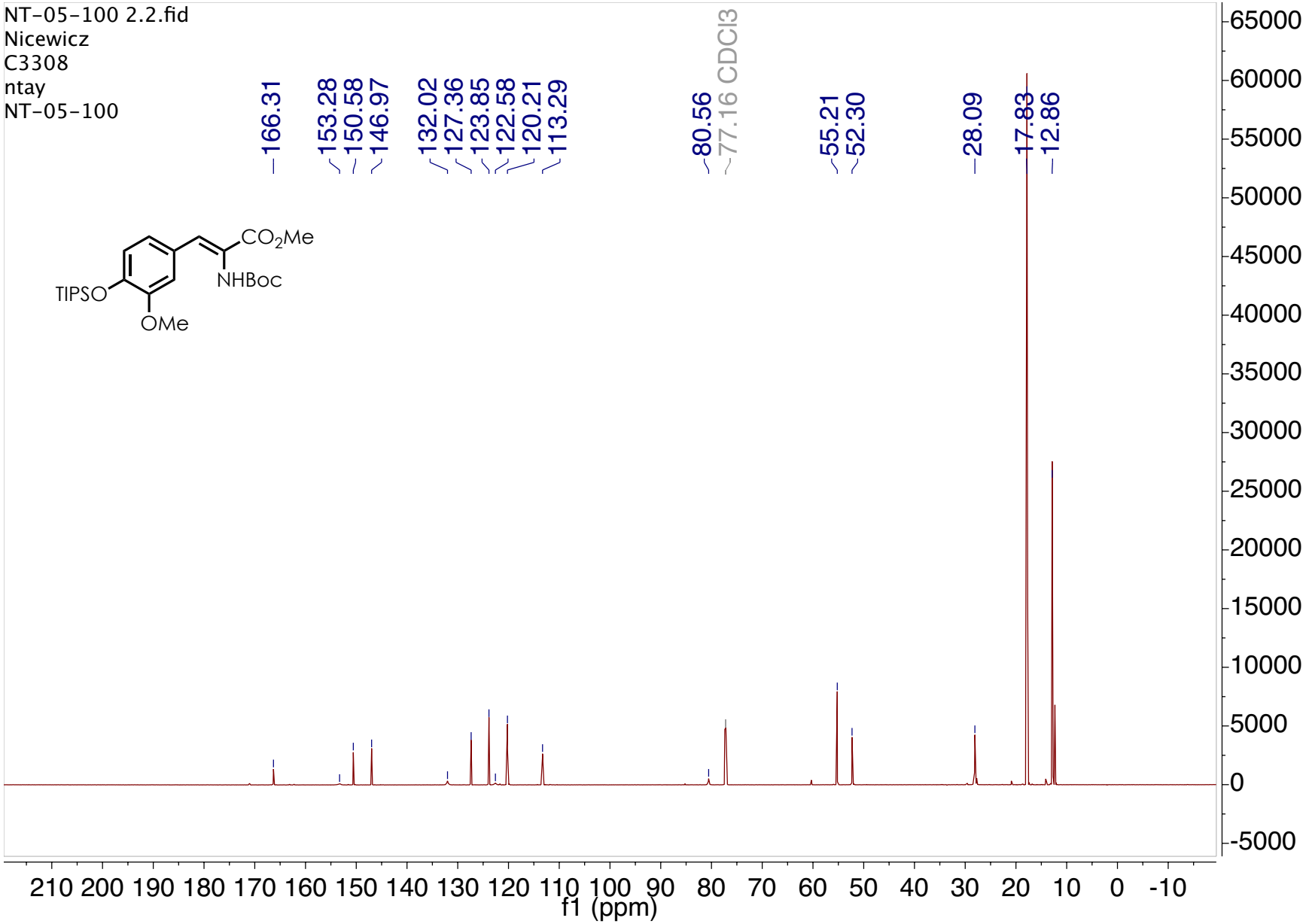
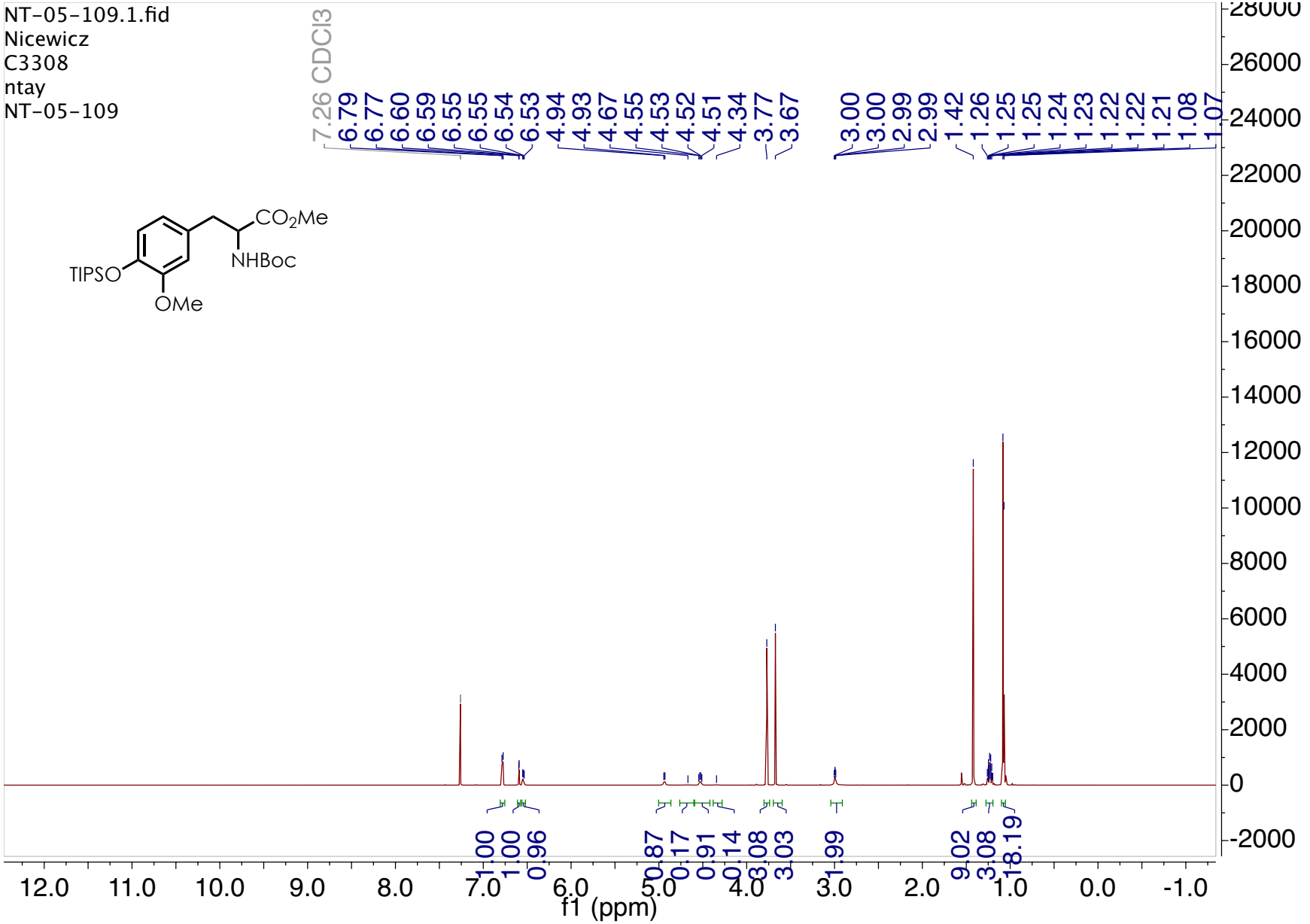
1.00
1.01
0.93
3.01
3.19
8.62
3.41
18.16
f1 (ppm)


NT-05-100 2.2.fid
Nicewicz
C3308
ntay
NT-05-100
166.31
153.28
150.58
146.97
132.02
127.36
123.85
122.58
120.21
113.29
80.56
77.16 CDCl3
55.21
52.30
28.09
17.83
12.86
CO2Me
NHBoc
TIPSO
OMe
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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C3308
ntay
NT-05-109
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6.55
6.55
6.54
6.53
4.94
4.93
4.67
4.55
4.53
4.52
4.51
4.34
3.77
3.67
3.00
3.00
2.99
2.99
1.42
1.26
1.25
1.25
1.24
1.23
1.22
1.22
1.21
1.08
1.07
CO2Me
NHBoc
TIPSO
OMe
1.00
1.00
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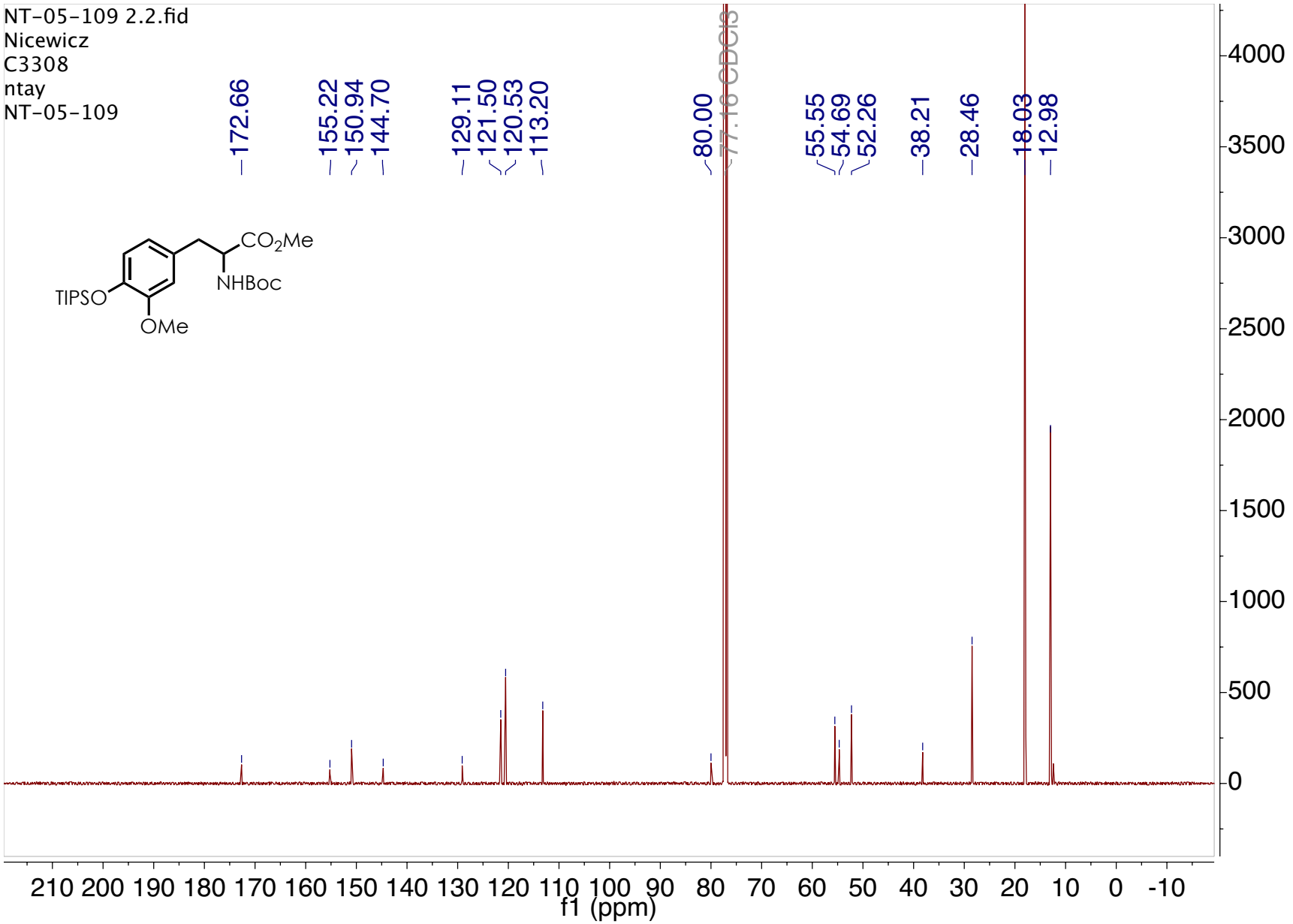
0.87
0.17
0.91
0.14
3.08
3.03
1.99
9.02
3.08
18.19
f1 (ppm)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C3308
ntay
NT-05-109
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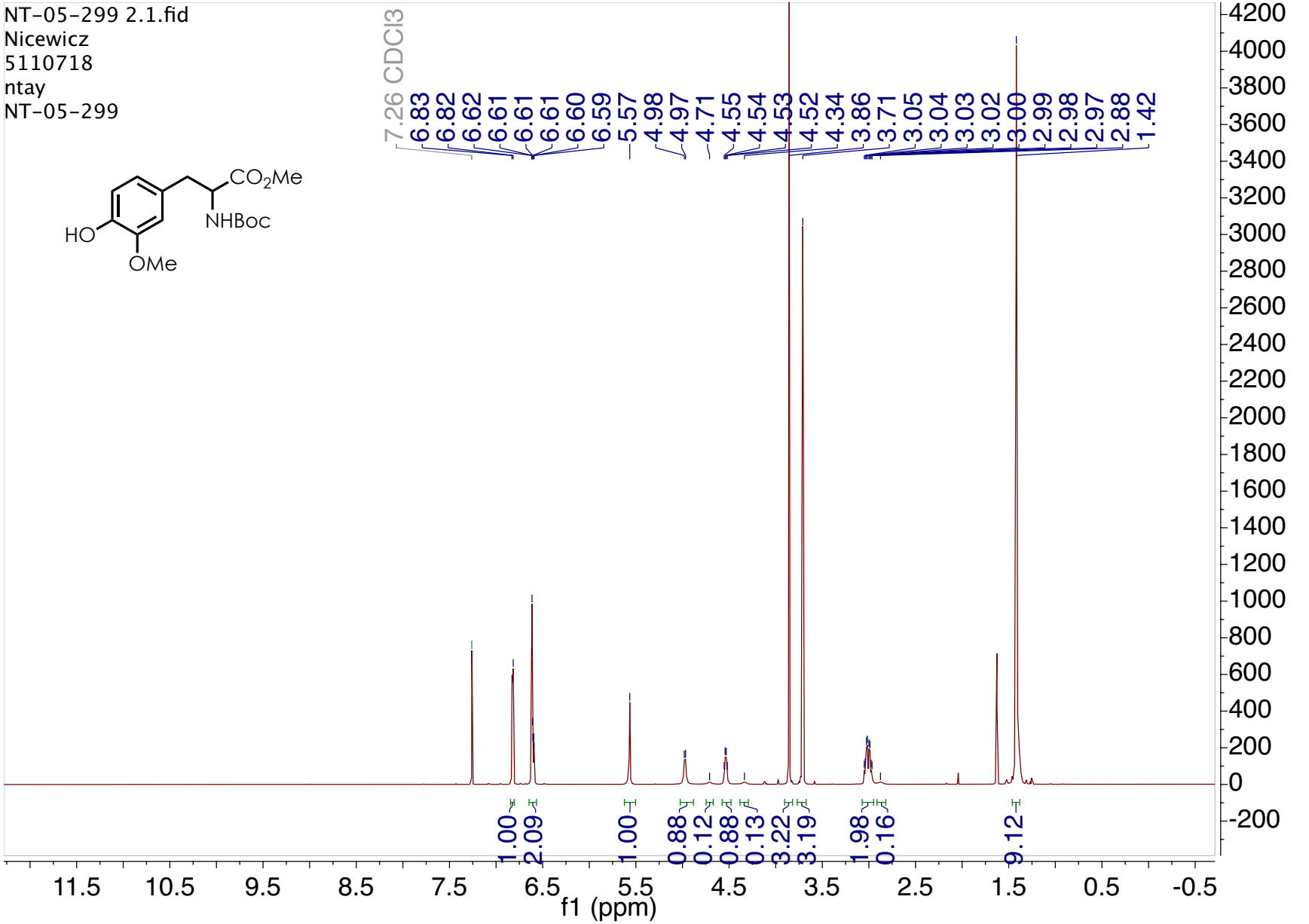
150.94
144.70
129.11
121.50
120.53
113.20
80.00
77.16 CDCl3
55.55
54.69
52.26
38.21
28.46
18.03
12.98
CO2Me
NHBoc
TIPSO
OMe
4000
3500
3000
2500
2000
1500
1000
500
0
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


NT-05-299 2.1.fid
Nicewicz
5110718
ntay
NT-05-299
CO2Me
NHBoc
HO
OMe
7.26 CDCl3
6.83
6.82
6.62
6.61
6.61
6.61
6.60
6.59
5.57
4.98
4.97
4.71
4.55
4.54
4.53
4.52
4.34
3.86
3.71
3.05
3.04
3.03
3.02
3.00
2.99
2.98
2.97
2.88
1.42
1.00
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1.00
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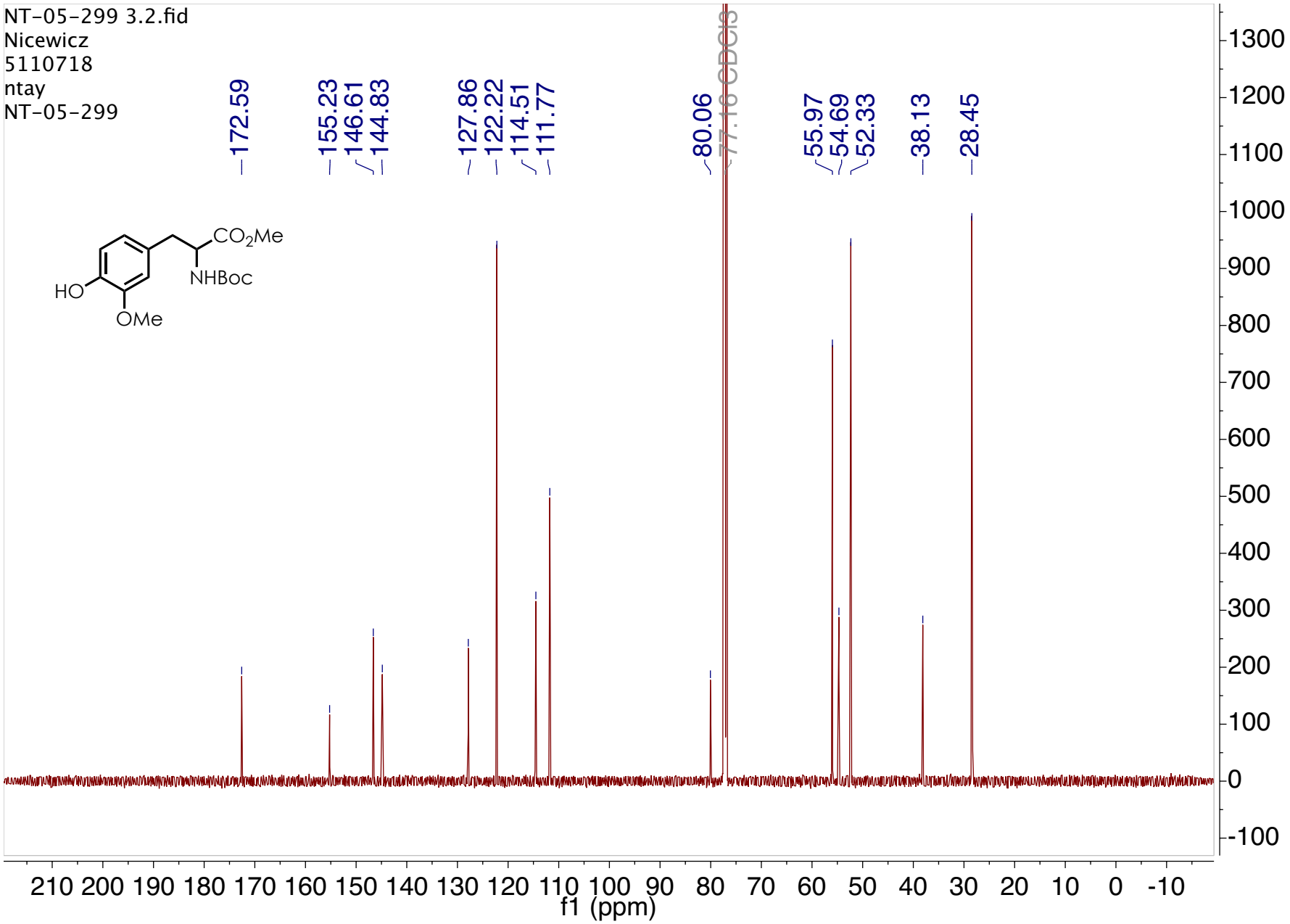
0.12
0.88
0.13
3.22
3.19
1.98
0.16
9.12
f1 (ppm)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Nicewicz
5110718
ntay
NT-05-299
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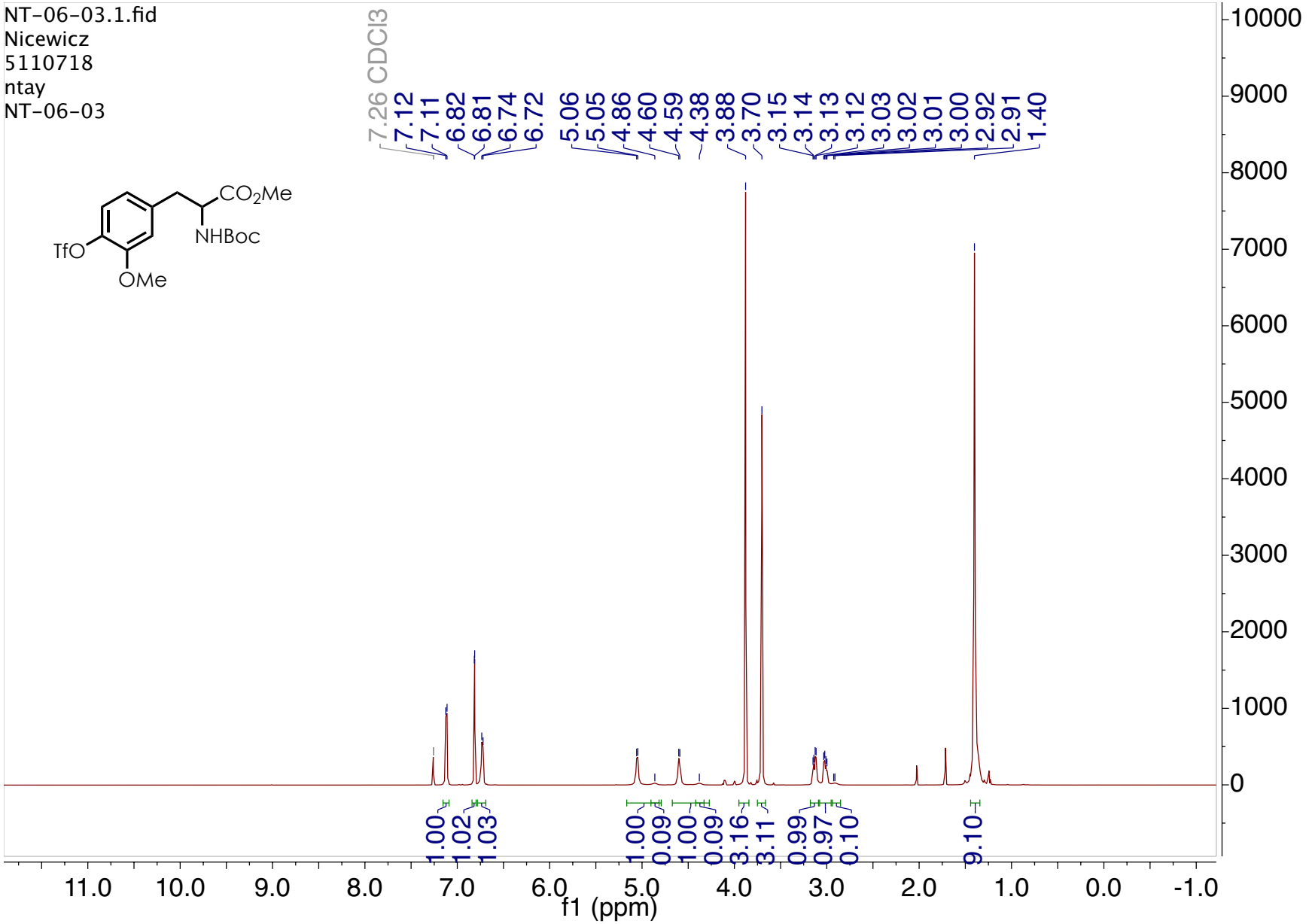
146.61
144.83
127.86
122.22
114.51
111.77
80.06
77.16 CDCl3
55.97
54.69
52.33
38.13
28.45
CO2Me
NHBoc
HO
OMe
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


NT-06-03.1.fid
Nicewicz
5110718
ntay
NT-06-03
7.26 CDCl3
7.12
7.11
6.82
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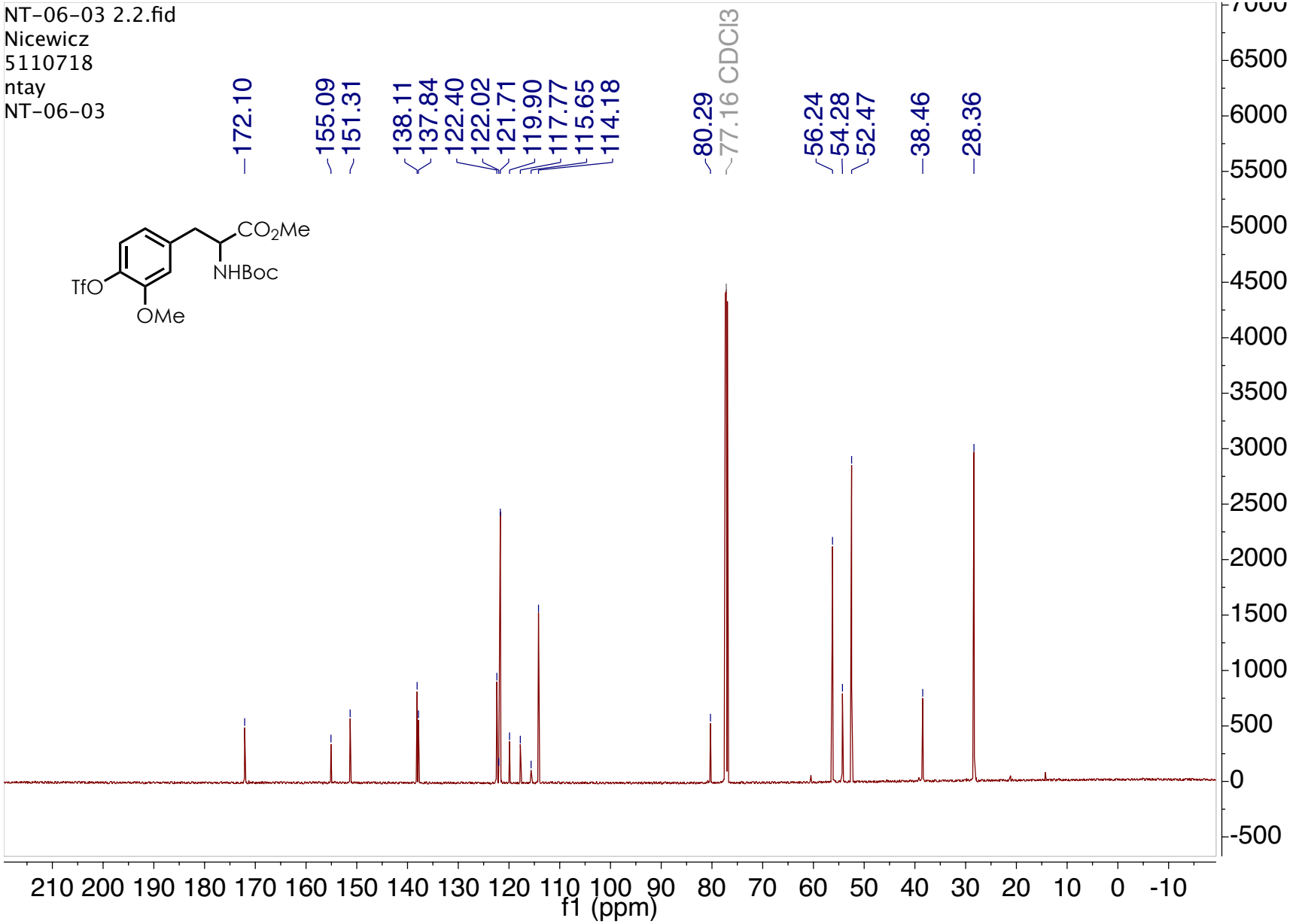
6.74
6.72
5.06
5.05
4.86
4.60
4.59
4.38
3.88
3.70
3.15
3.14
3.13
3.12
3.03
3.02
3.01
3.00
2.92
2.91
1.40
CO2Me
NHBoc
TfO
OMe
1.00
1.02
1.03
1.00
0.09
1.00
0.09
3.16
3.11
0.99
0.97
0.10
9.10
f1 (ppm)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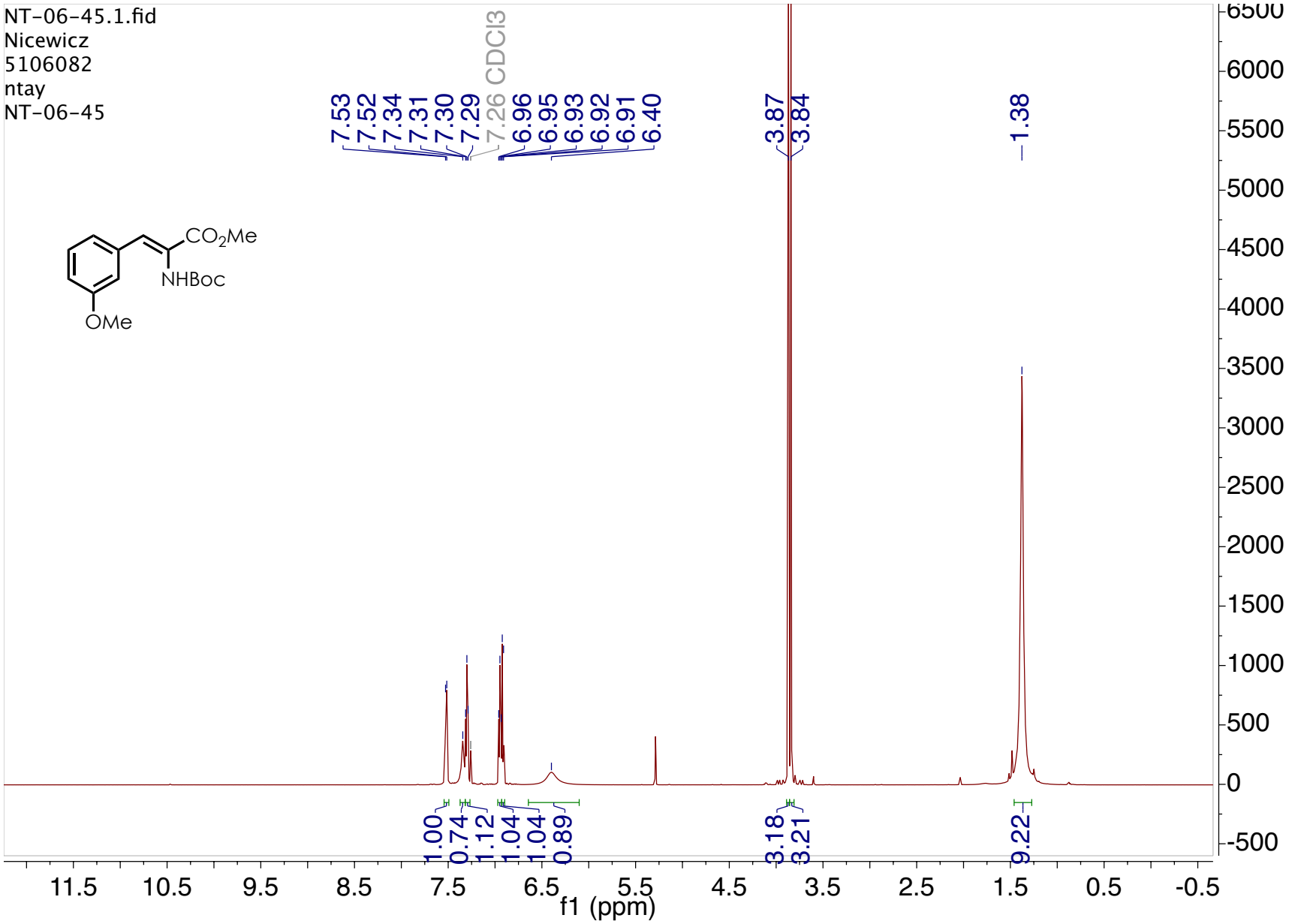
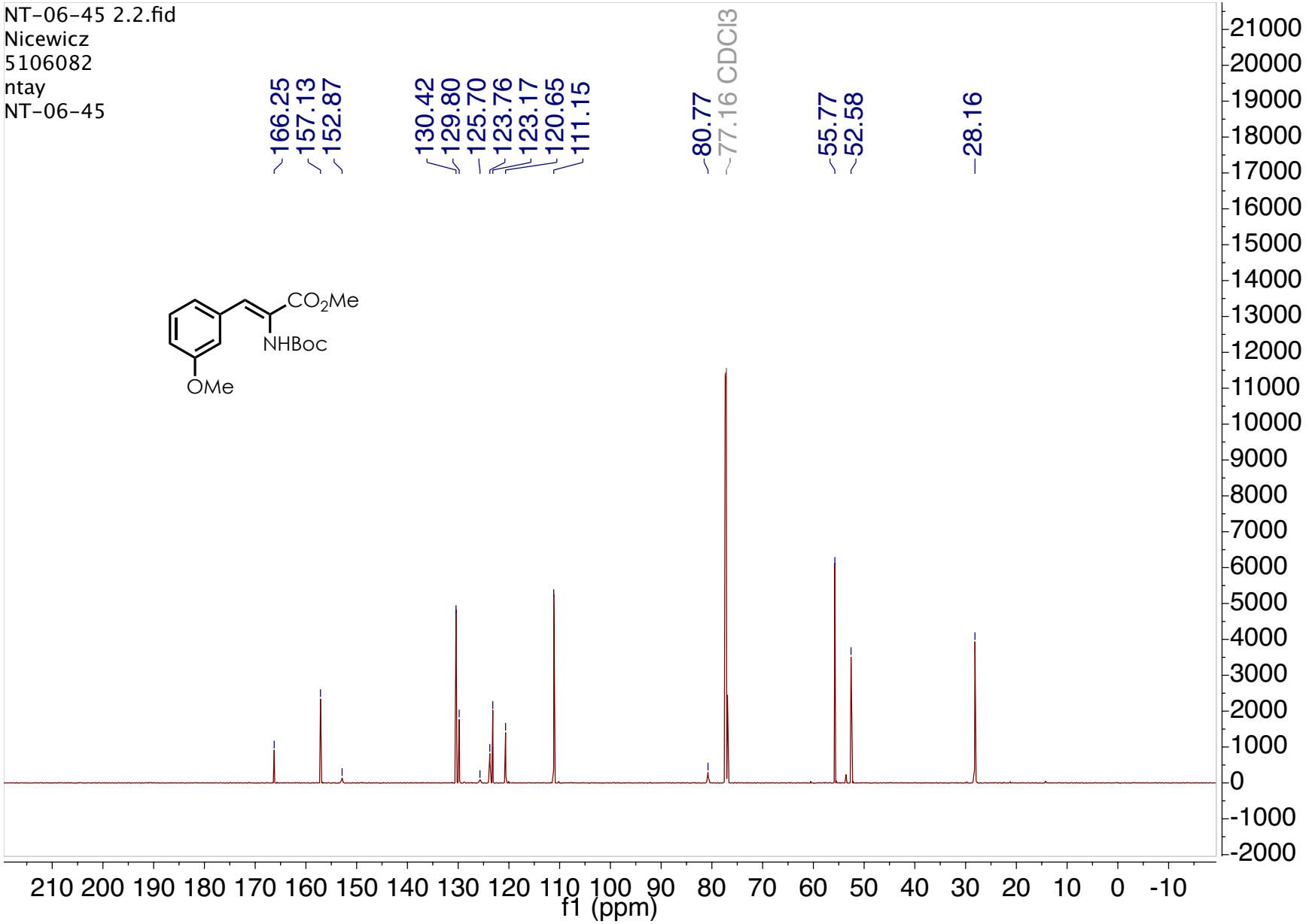
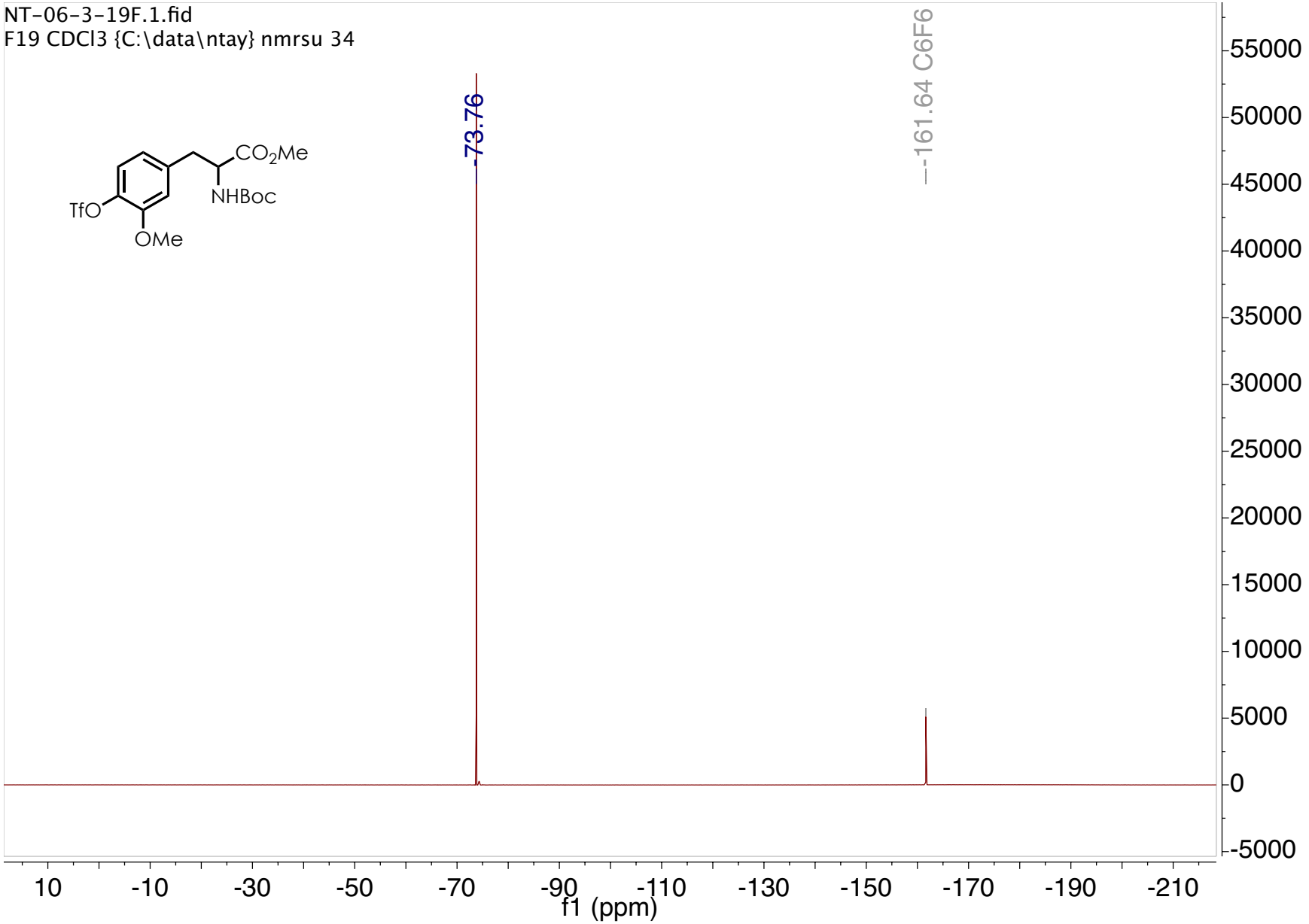
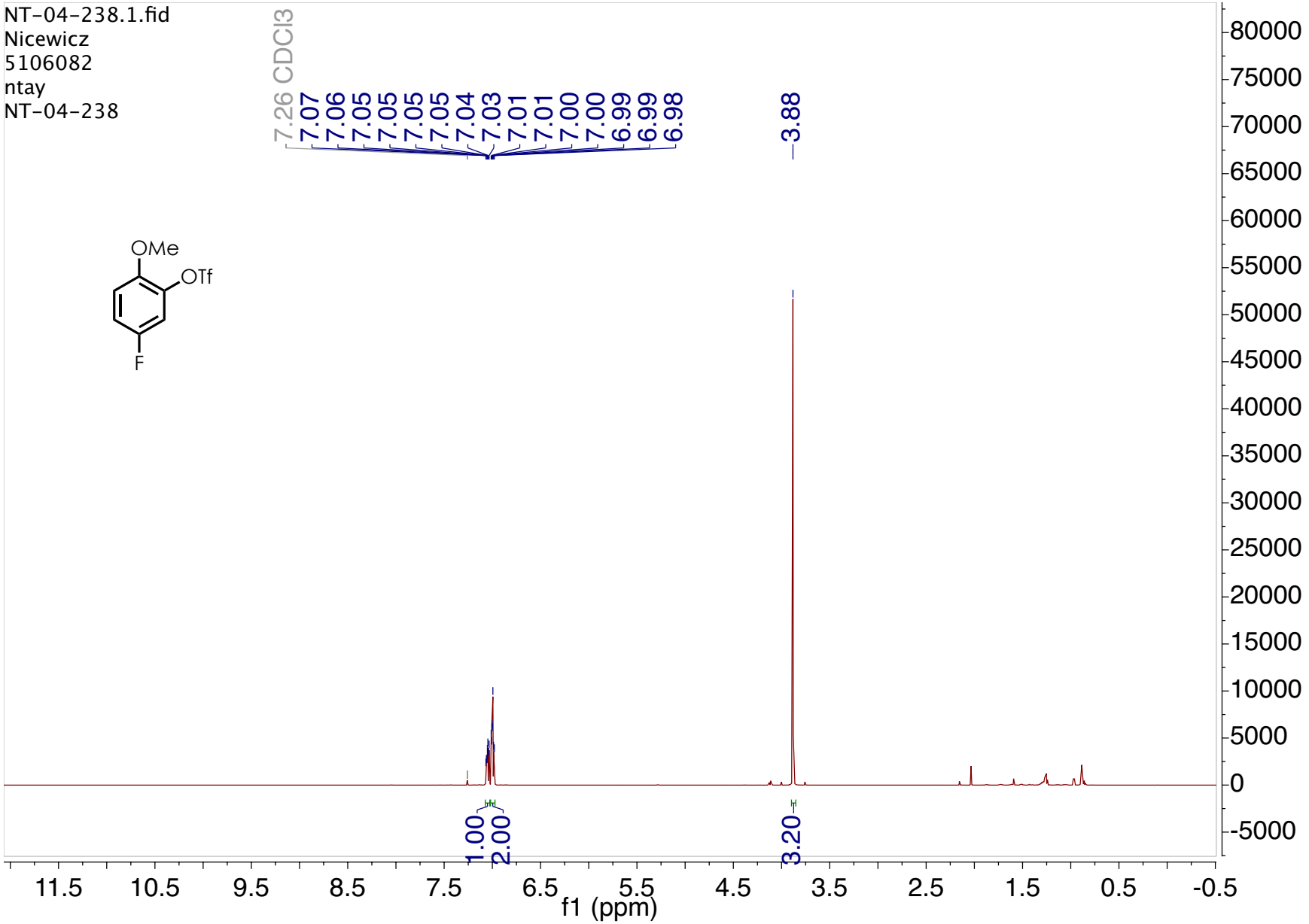
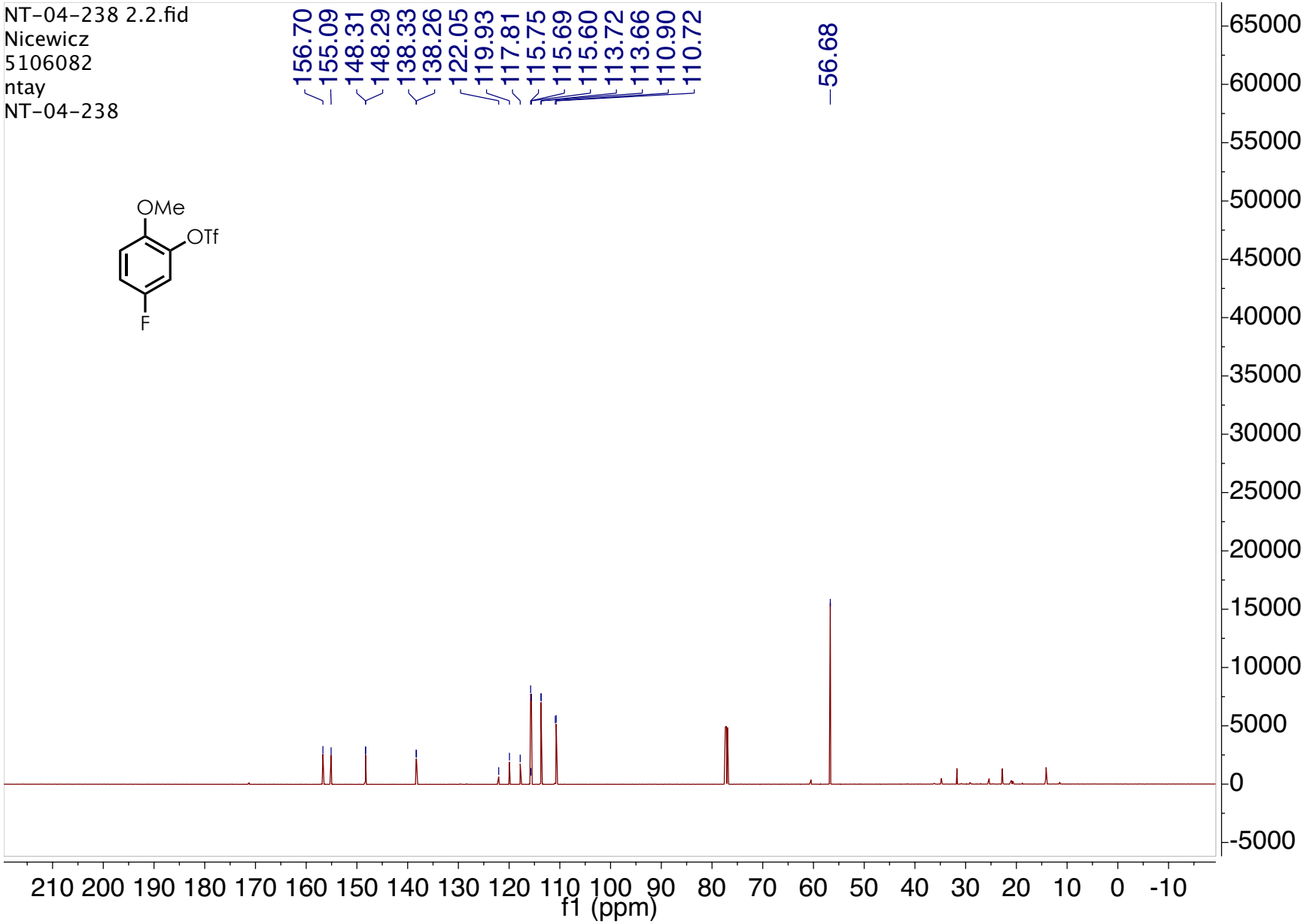
5110718
ntay
NT-06-03
172.10
155.09
151.31
138.11
137.84
122.40
122.02
121.71
119.90
117.77
115.65
114.18
80.29
77.16 CDCl3
56.24
54.28
52.47
38.46
28.36
CO2Me
NHBoc
TfO
OMe
f1 (ppm)

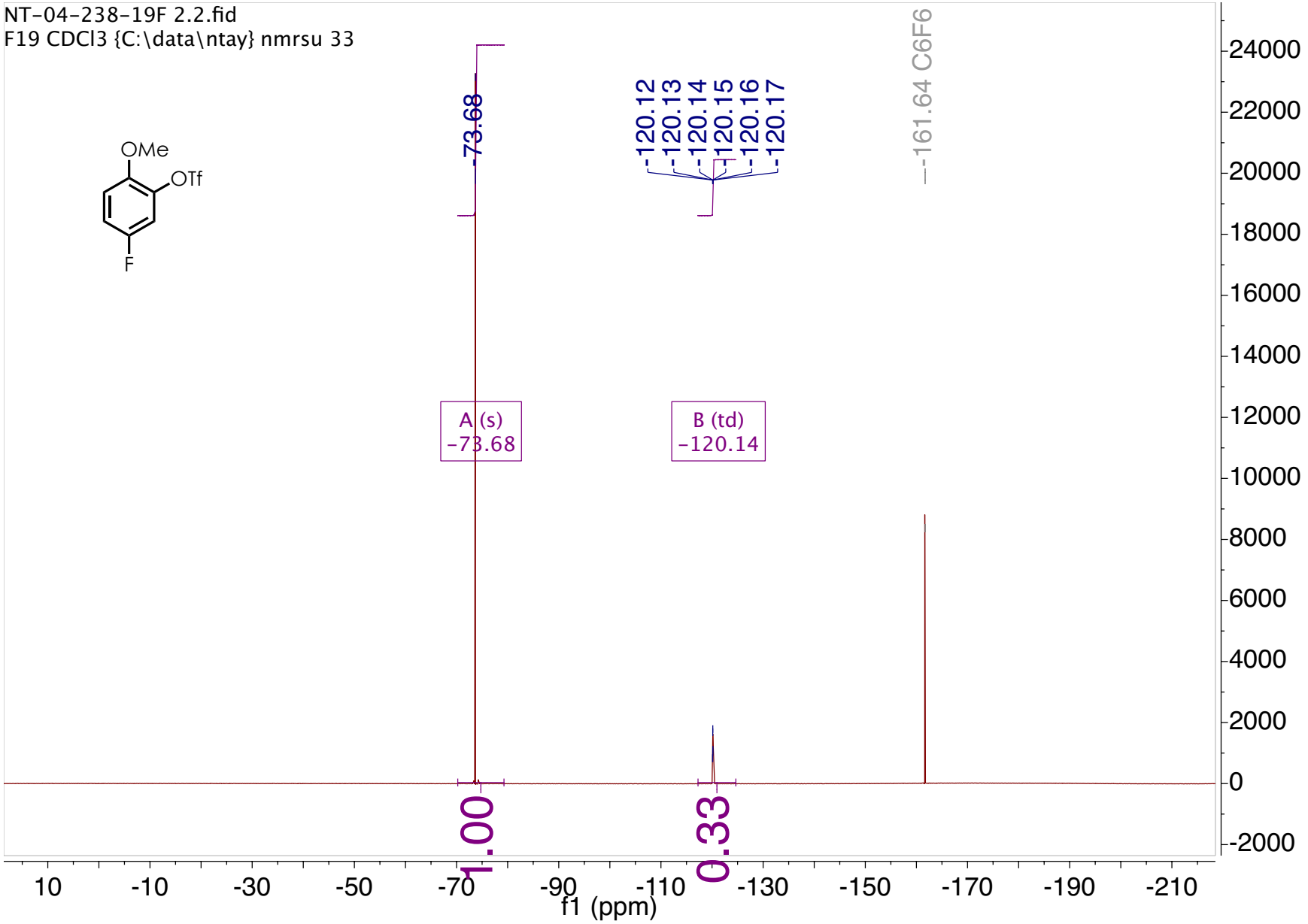

NT-06-45.1.fid
Nicewicz
5106082
ntay
NT-06-45
7.53
7.52
7.34
7.31
7.30
7.29
7.26 CDCl3
6.96
6.95
6.93
6.92
6.91
6.40
3.87
3.84
1.38
CO2Me
NHBoc
OMe
1.00
0.74
1.12
1.04
1.04
0.89
3.18
3.21
9.22
f1 (ppm)

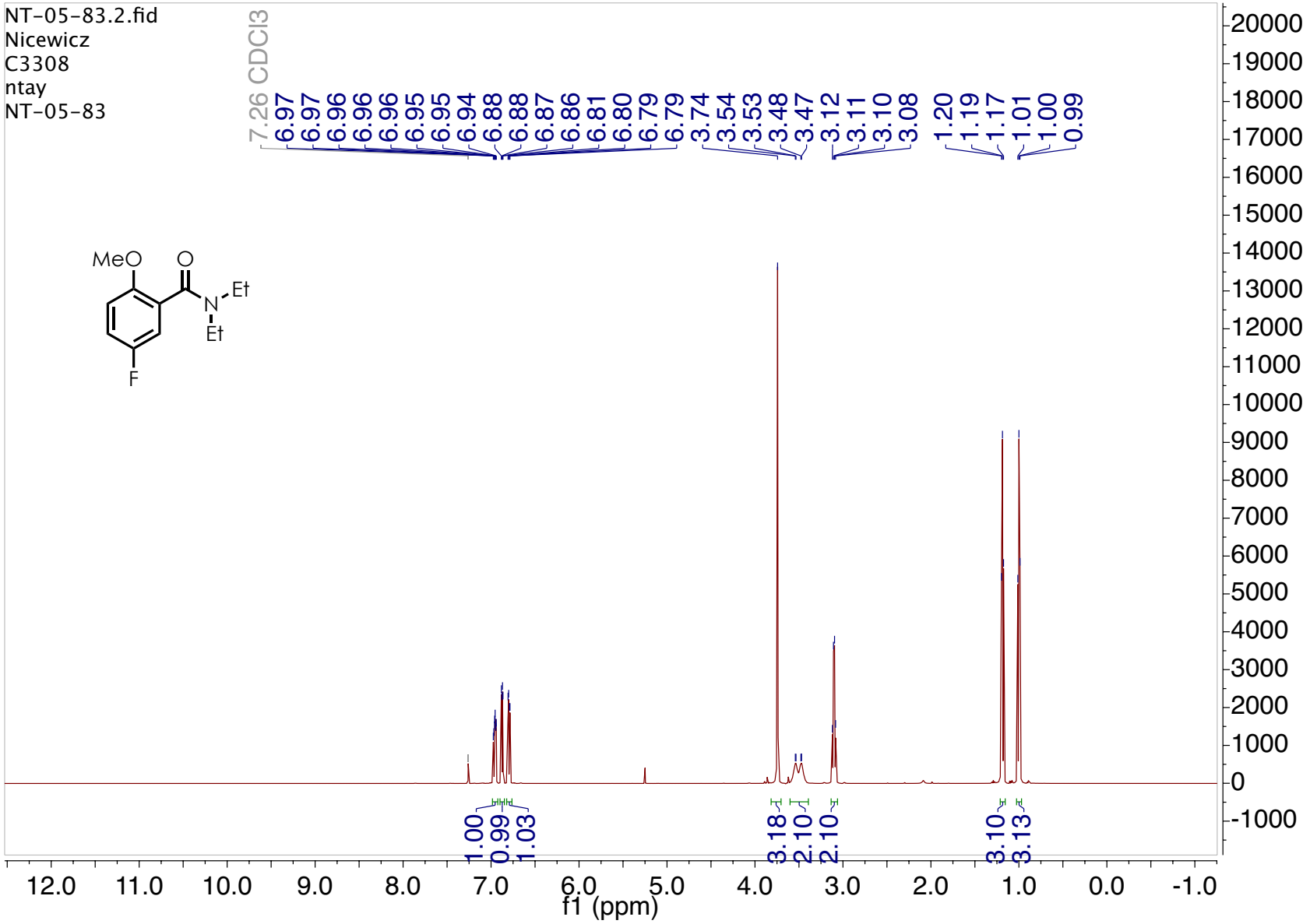

NT-06-45 2.2.fid
Nicewicz
5106082
ntay
NT-06-45
166.25
157.13
152.87
130.42
129.80
125.70
123.76
123.17
120.65
111.15
80.77
77.16 CDCl3
55.77
52.58
28.16
CO2Me
NHBoc
OMe
21000
20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
-2000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

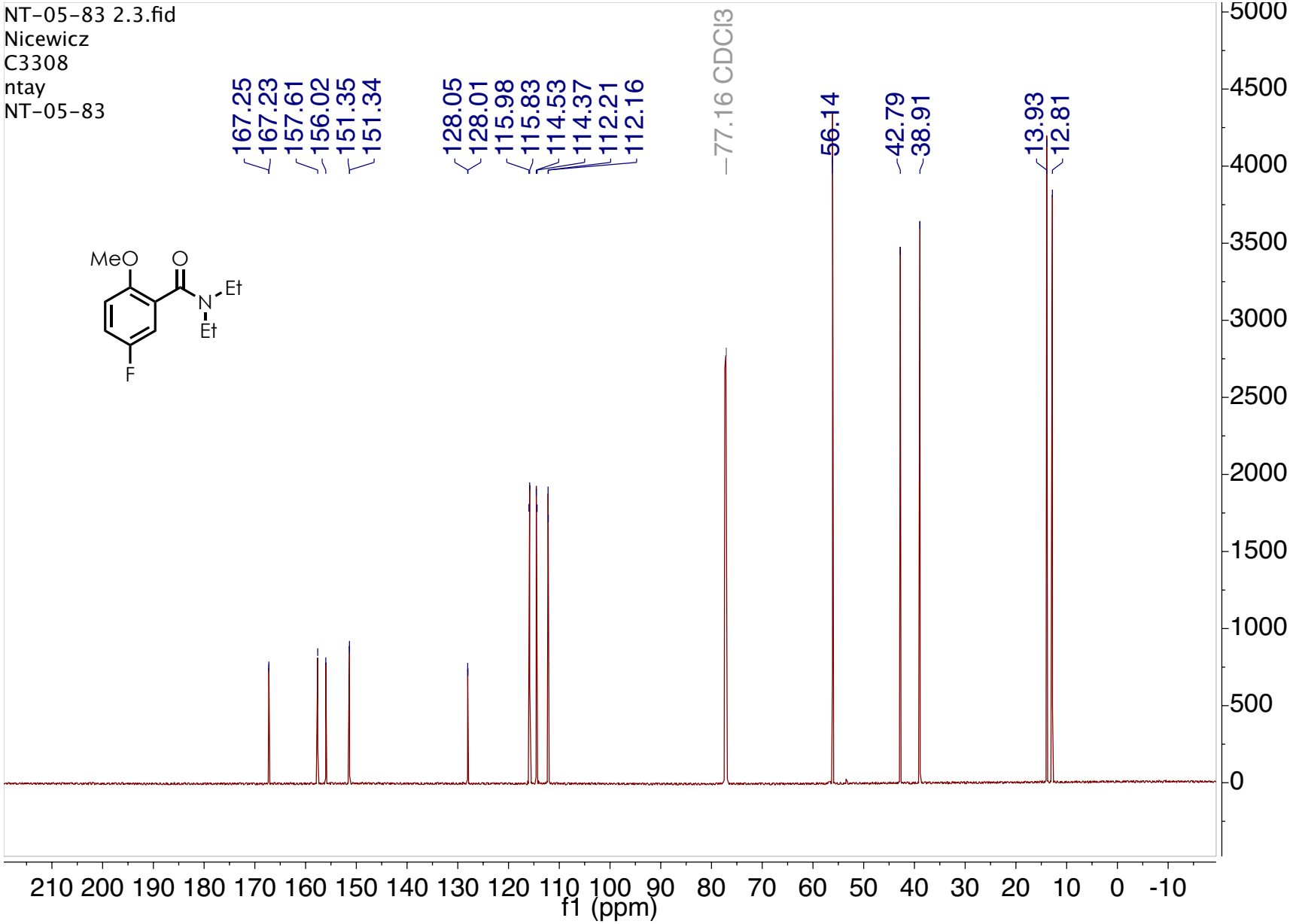

NT-06-3-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 34
-73.76
-161.64 C6F6
CO2Me
NHBoc
TfO
OMe
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

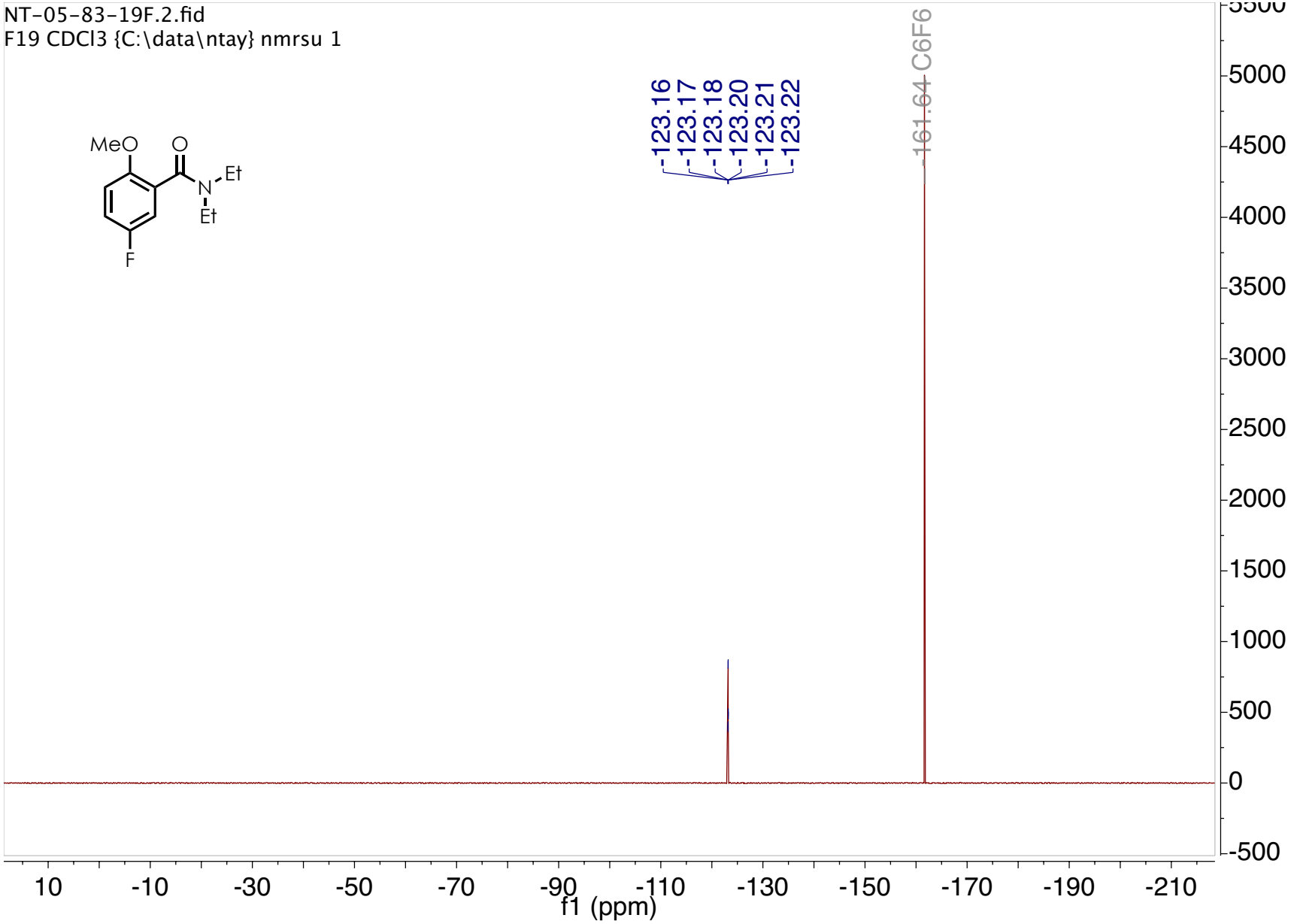

NT-04-238.1.fid
Nicewicz
5106082
ntay
NT-04-238
7.26 CDCl3
7.07
7.06
7.05
7.05
7.05
7.05
7.04
7.03
7.01
7.01
7.00
7.00
6.99
6.99
6.98
3.88
OMe
OTf
F
1.00
2.00
3.20
f1 (ppm)

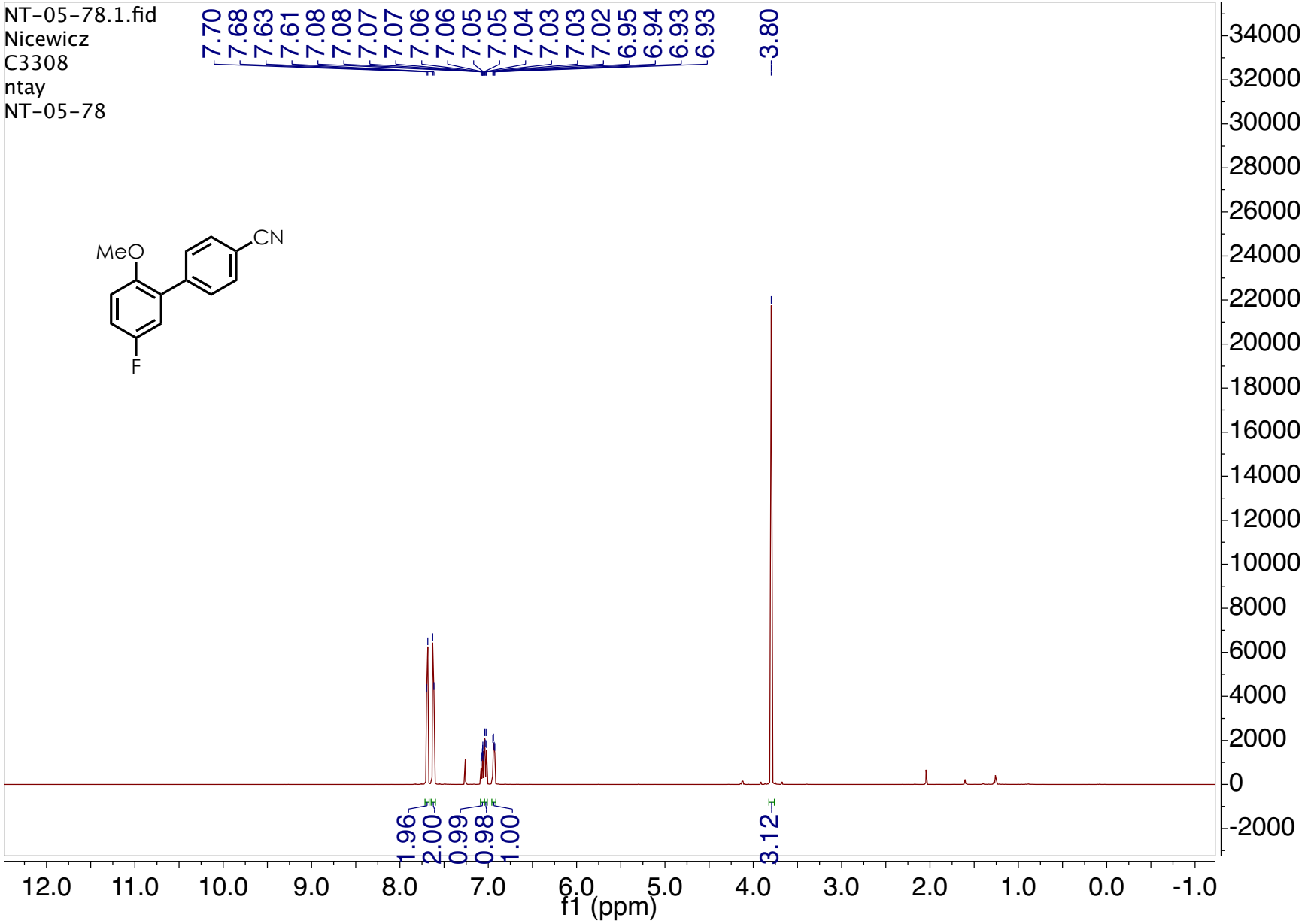

NT-04-238 2.2.fid
Nicewicz
5106082
ntay
NT-04-238
156.70
155.09
148.31
148.29
138.33
138.26
122.05
119.93
117.81
115.75
115.69
115.60
113.72
113.66
110.90
110.72
56.68
OMe
OTf
F
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

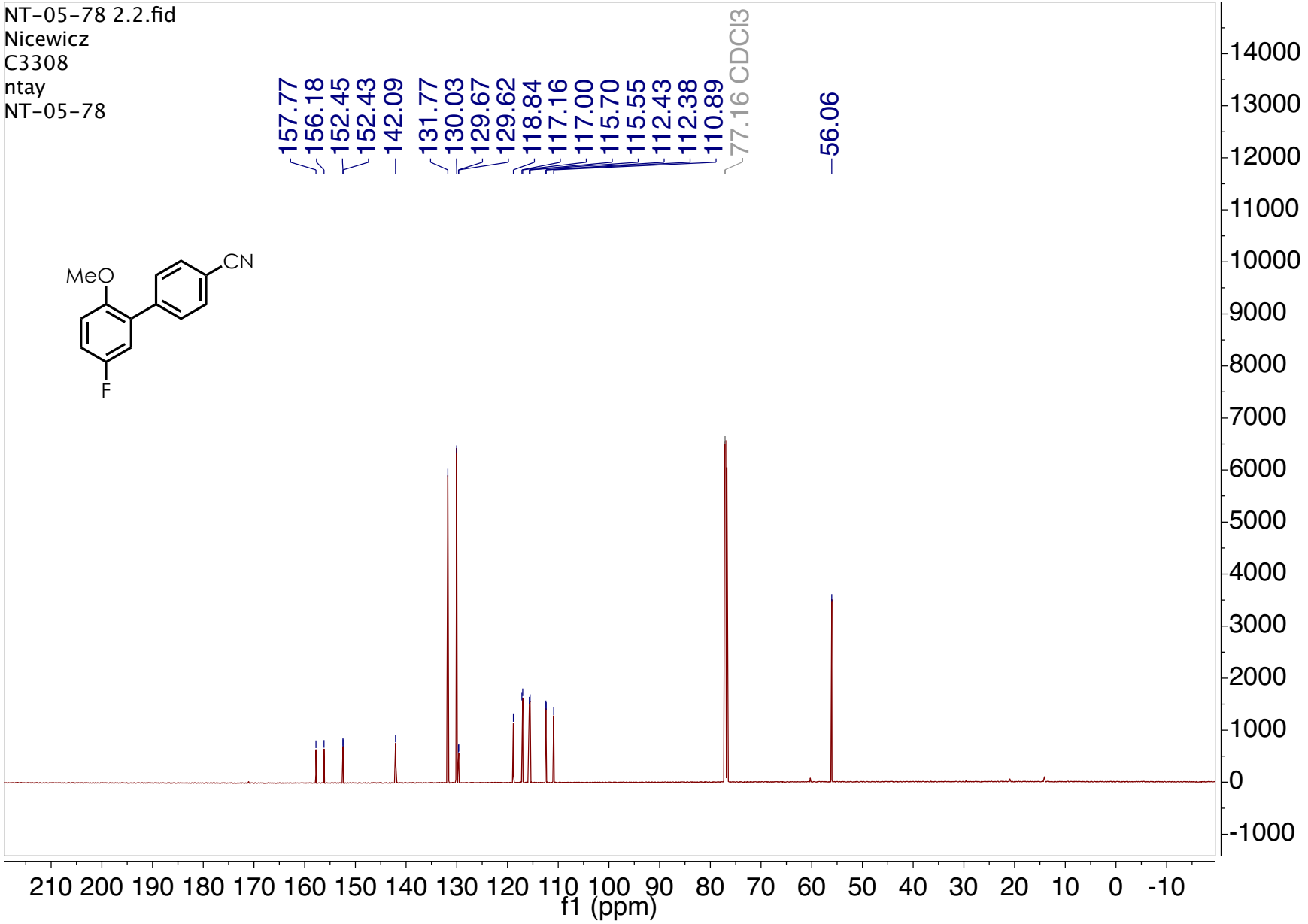

NT-04-238-19F 2.2.fid
F19 CDCl3 {C:\data\ntay} nmrsu 33
OMe
OTf
F
-73.68
-120.12
-120.13
-120.14
-120.15
-120.16
-120.17
-161.64 C6F6
A (s)
-73.68
B (td)
-120.14
1.00
0.33
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

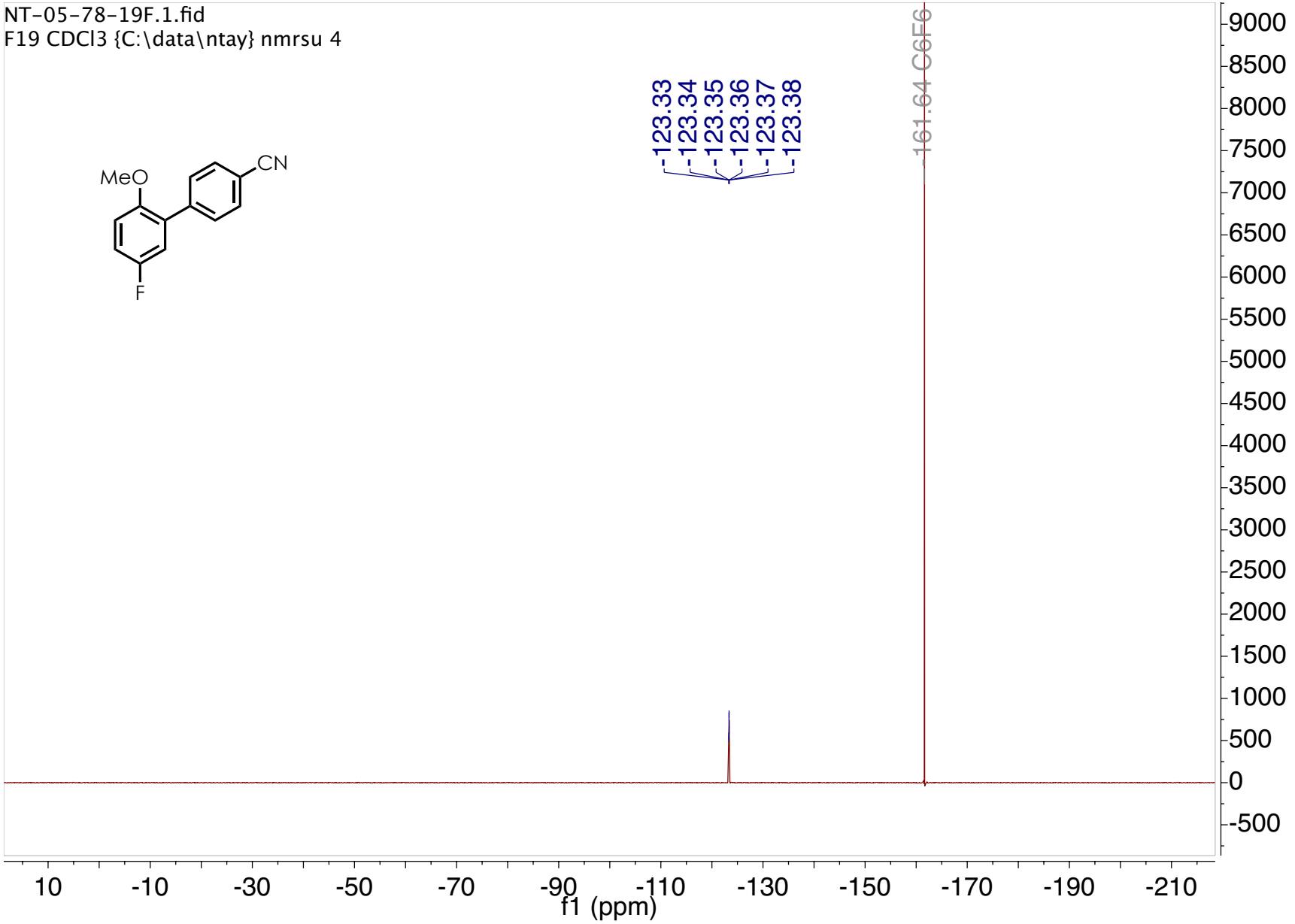

NT-05-83.2.fid
Nicewicz
C3308
ntay
NT-05-83
7.26 CDCl3
6.97
6.97
6.96
6.96
6.96
6.95
6.95
6.94
6.88
6.88
6.87
6.86
6.81
6.80
6.79
6.79
3.74
3.54
3.53
3.48
3.47
3.12
3.11
3.10
3.08
1.20
1.19
1.17
1.01
1.00
0.99
MeO
O
N
Et
Et
F
1.00
0.99
1.03
3.18
2.10
2.10
3.10
3.13
f1 (ppm)

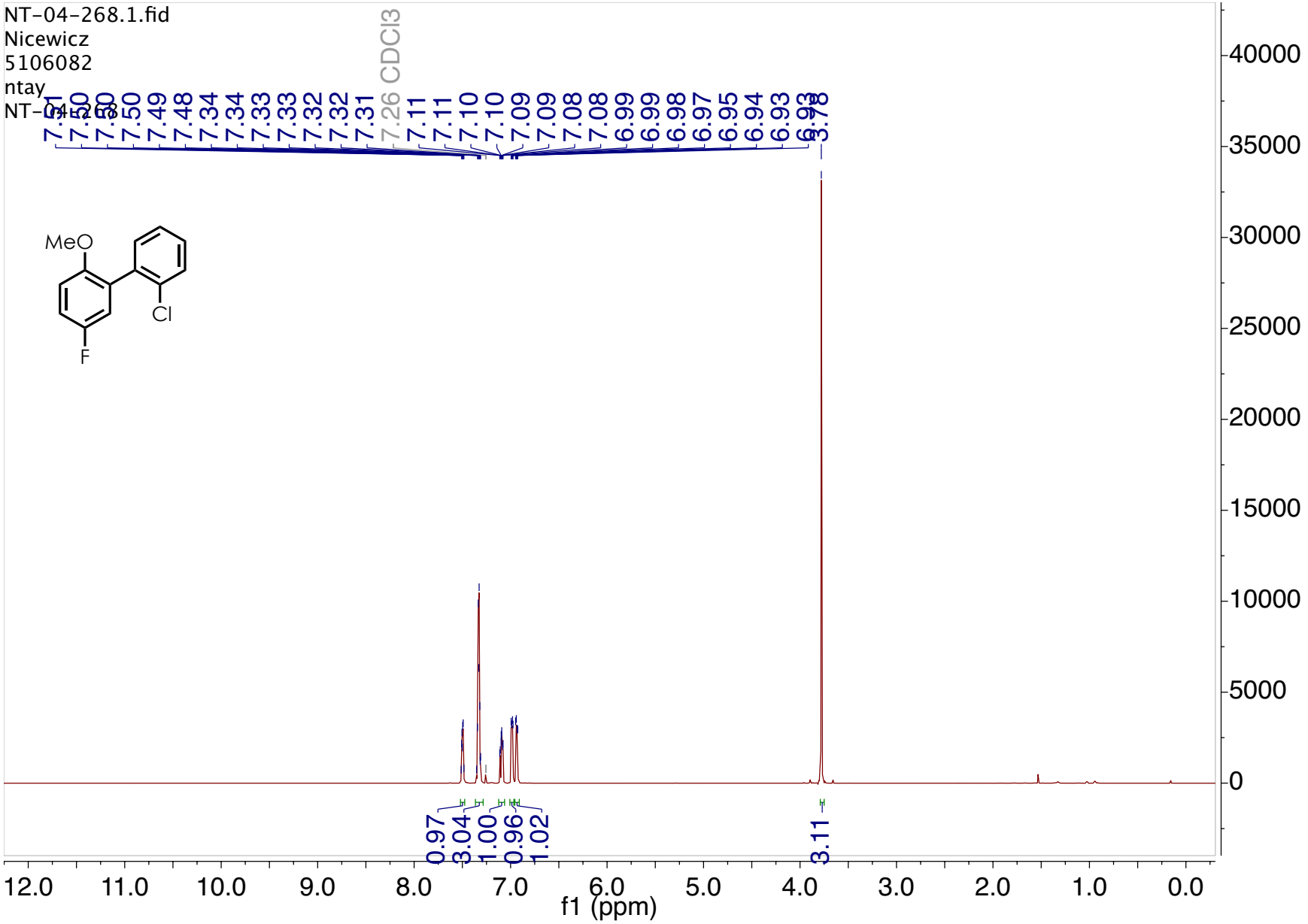

NT-05-83 2.3.fid
Nicewicz
C3308
ntay
NT-05-83
167.25
167.23
157.61
156.02
151.35
151.34
128.05
128.01
115.98
115.83
114.53
114.37
112.21
112.16
77.16 CDCl3
56.14
42.79
38.91
13.93
12.81
MeO
O
N
Et
Et
F
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

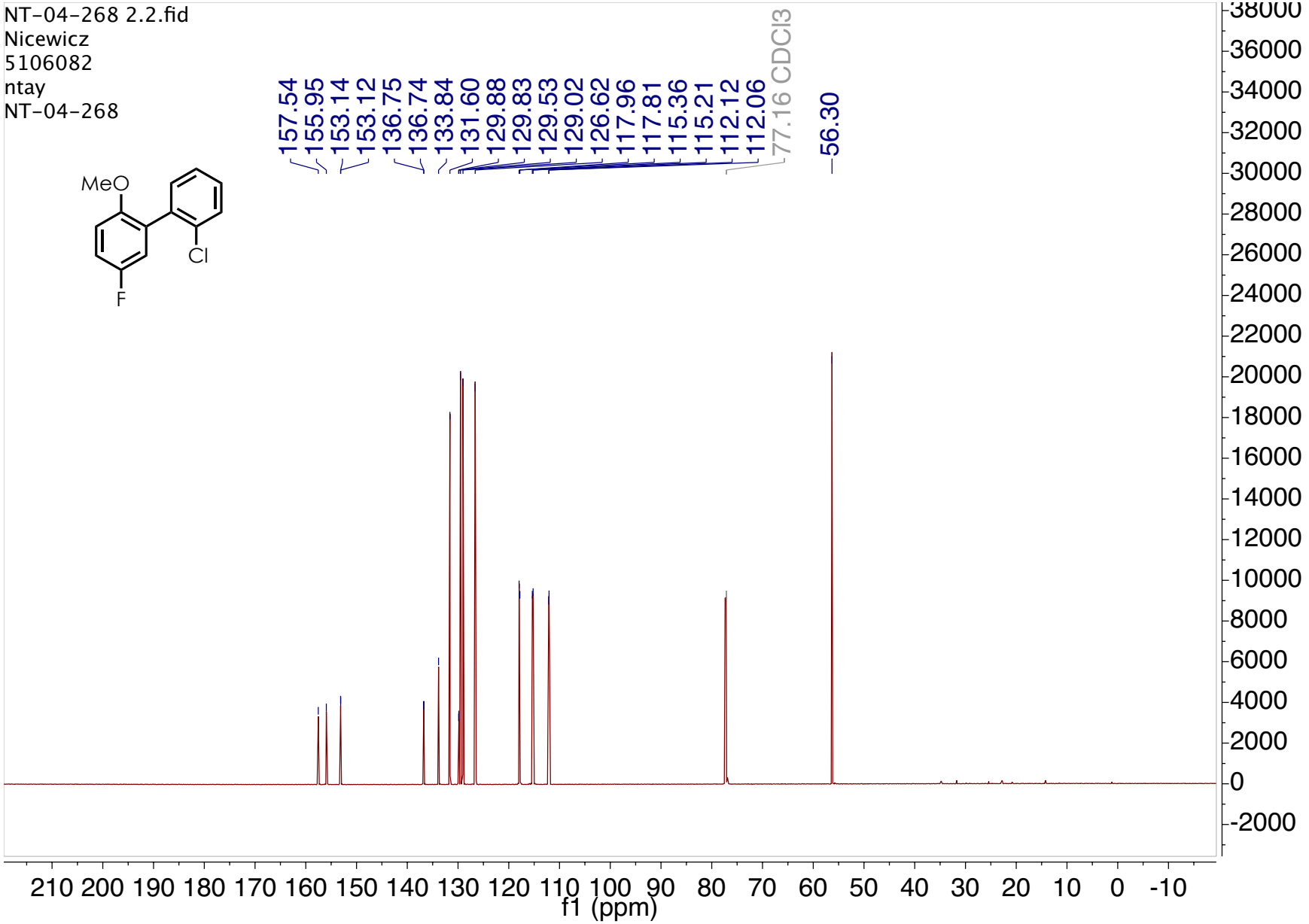

NT-05-83-19F.2.fid
F19 CDCl3 {C:\data\ntay} nmrsu 1
MeO
O
N
Et
Et
F
-123.16
-123.17
-123.18
-123.20
-123.21
-123.22
-161.64 C6F6
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

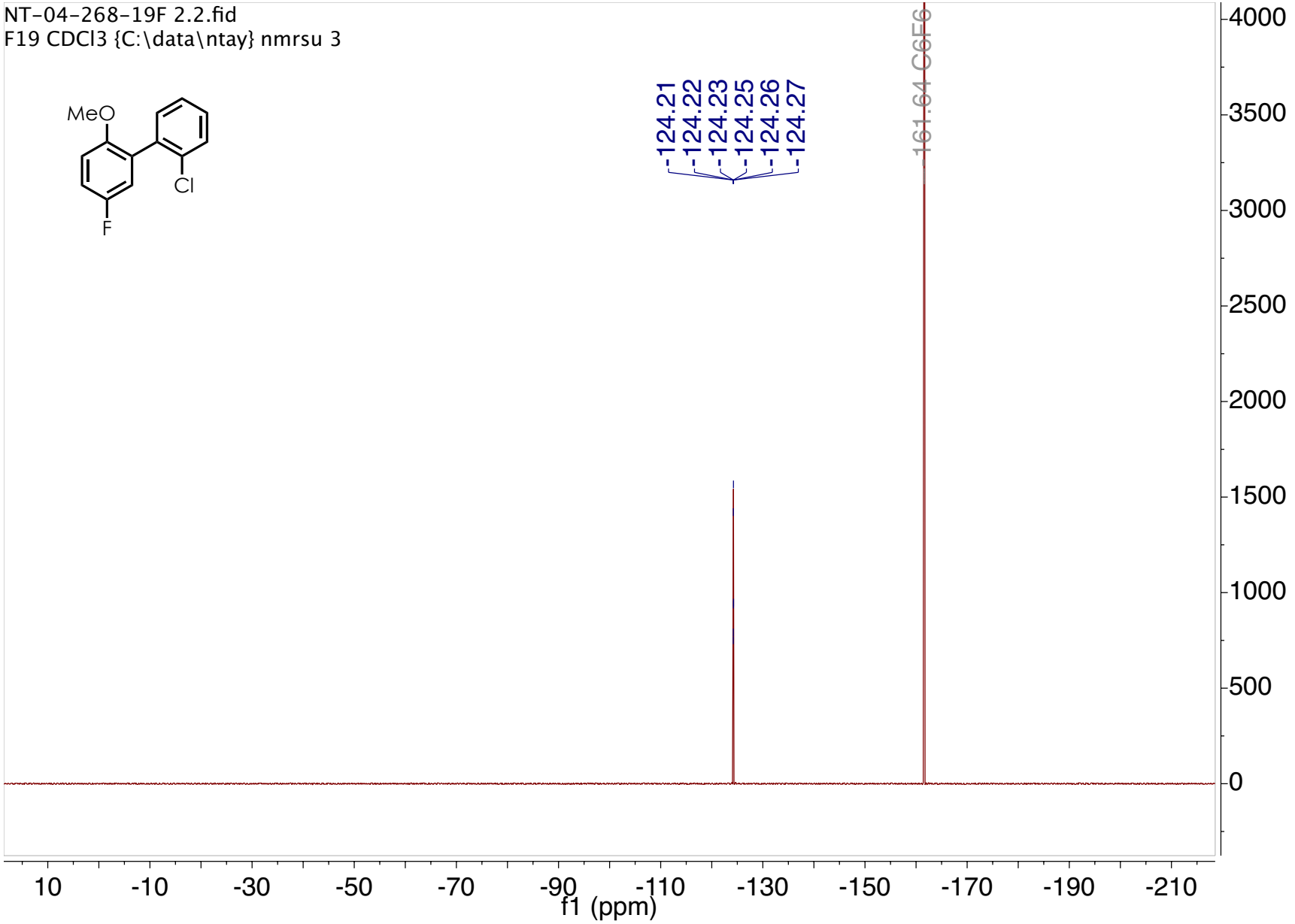

NT-05-78.1.fid
Nicewicz
C3308
ntay
NT-05-78
7.70
7.68
7.63
7.61
7.08
7.08
7.07
7.07
7.06
7.06
7.05
7.05
7.04
7.03
7.03
7.02
6.95
6.94
6.93
6.93
3.80
MeO
CN
F
1.96
2.00
0.99
0.98
1.00
3.12
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

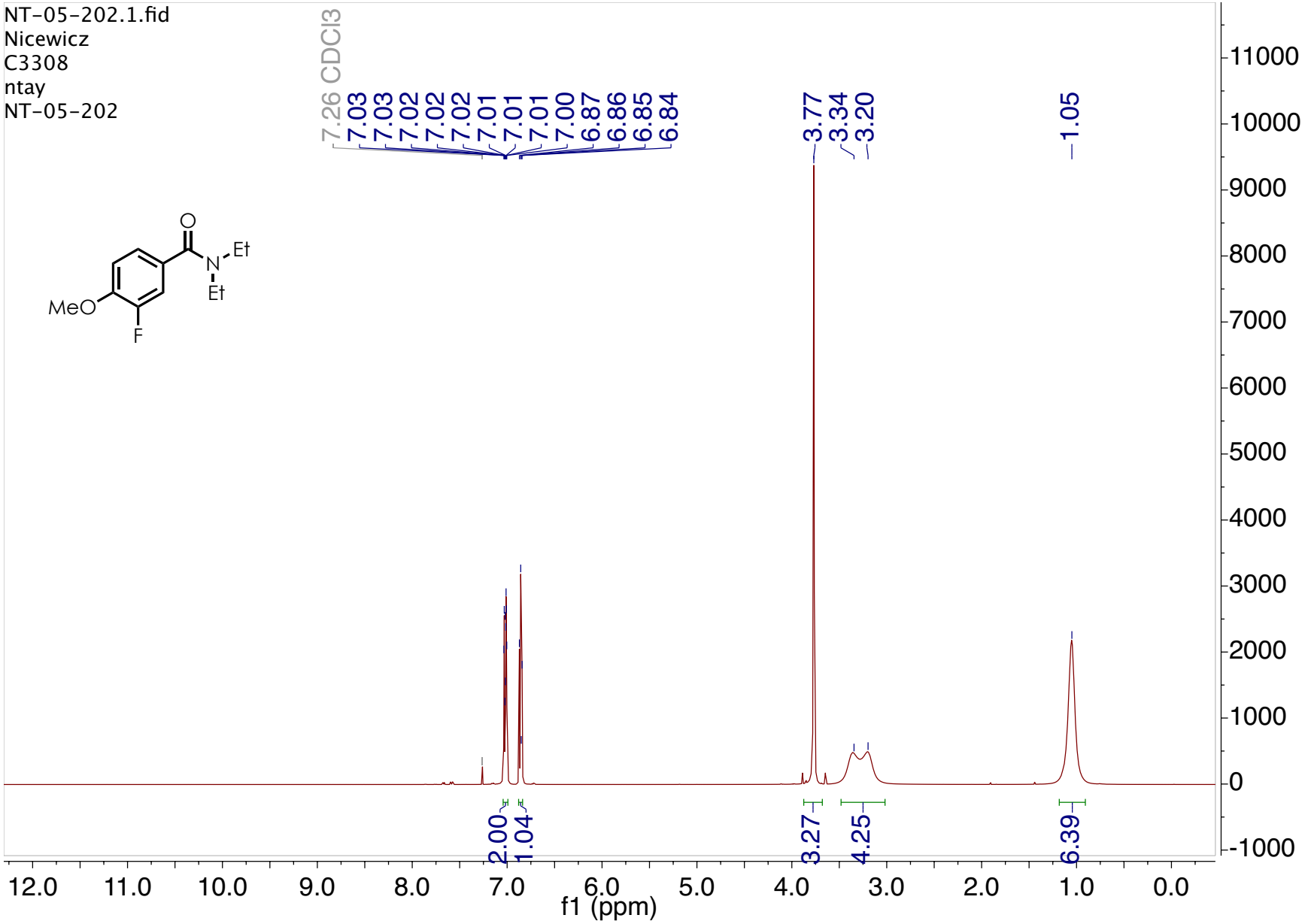

NT-05-78 2.2.fid
Nicewicz
C3308
ntay
NT-05-78
157.77
156.18
152.45
152.43
142.09
131.77
130.03
129.67
129.62
118.84
117.16
117.00
115.70
115.55
112.43
112.38
110.89
77.16 CDCl3
56.06
MeO
CN
F
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

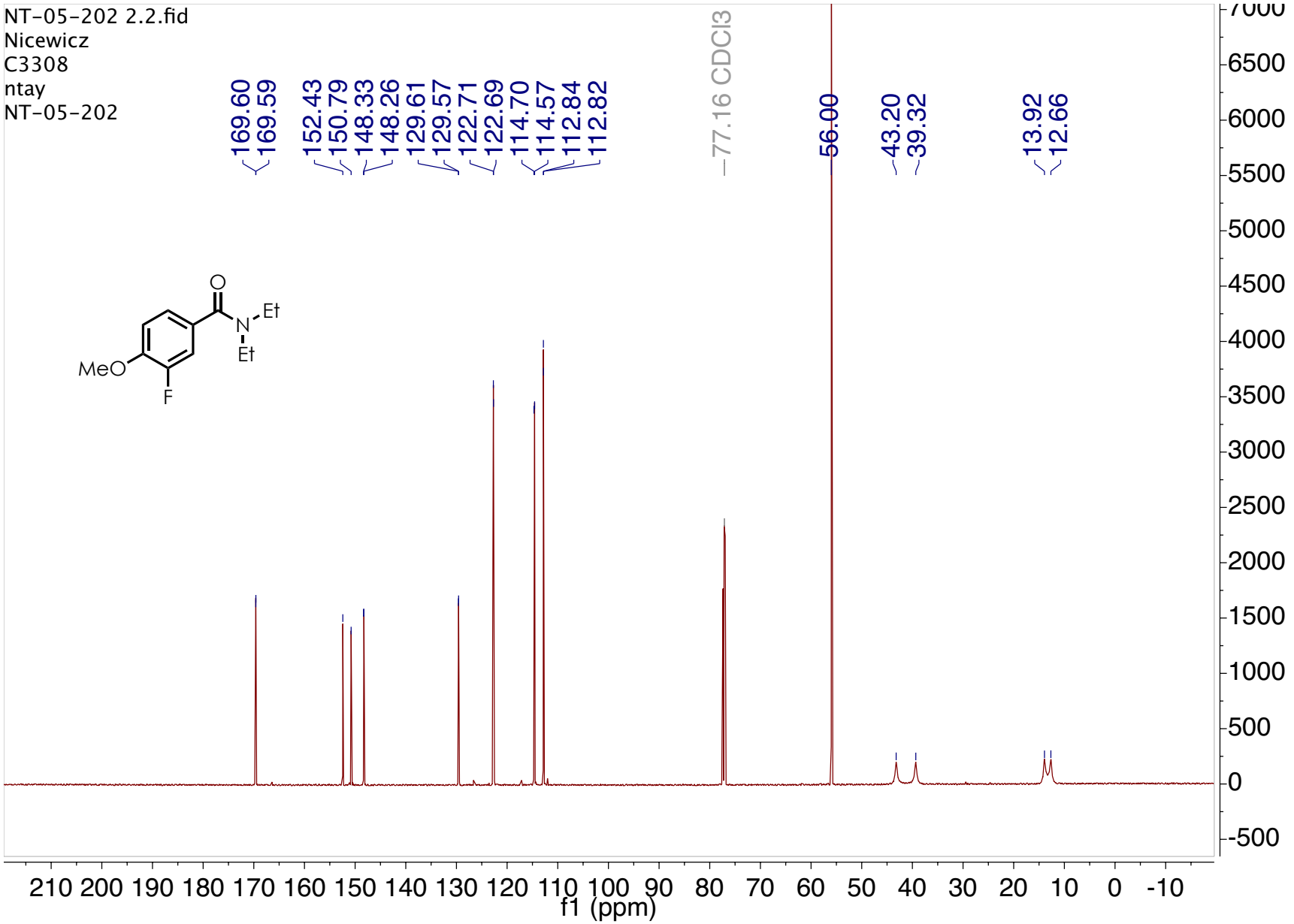

NT-05-78-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 4
MeO
CN
F
-123.33
-123.34
-123.35
-123.36
-123.37
-123.38
-161.64 C6F6
9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

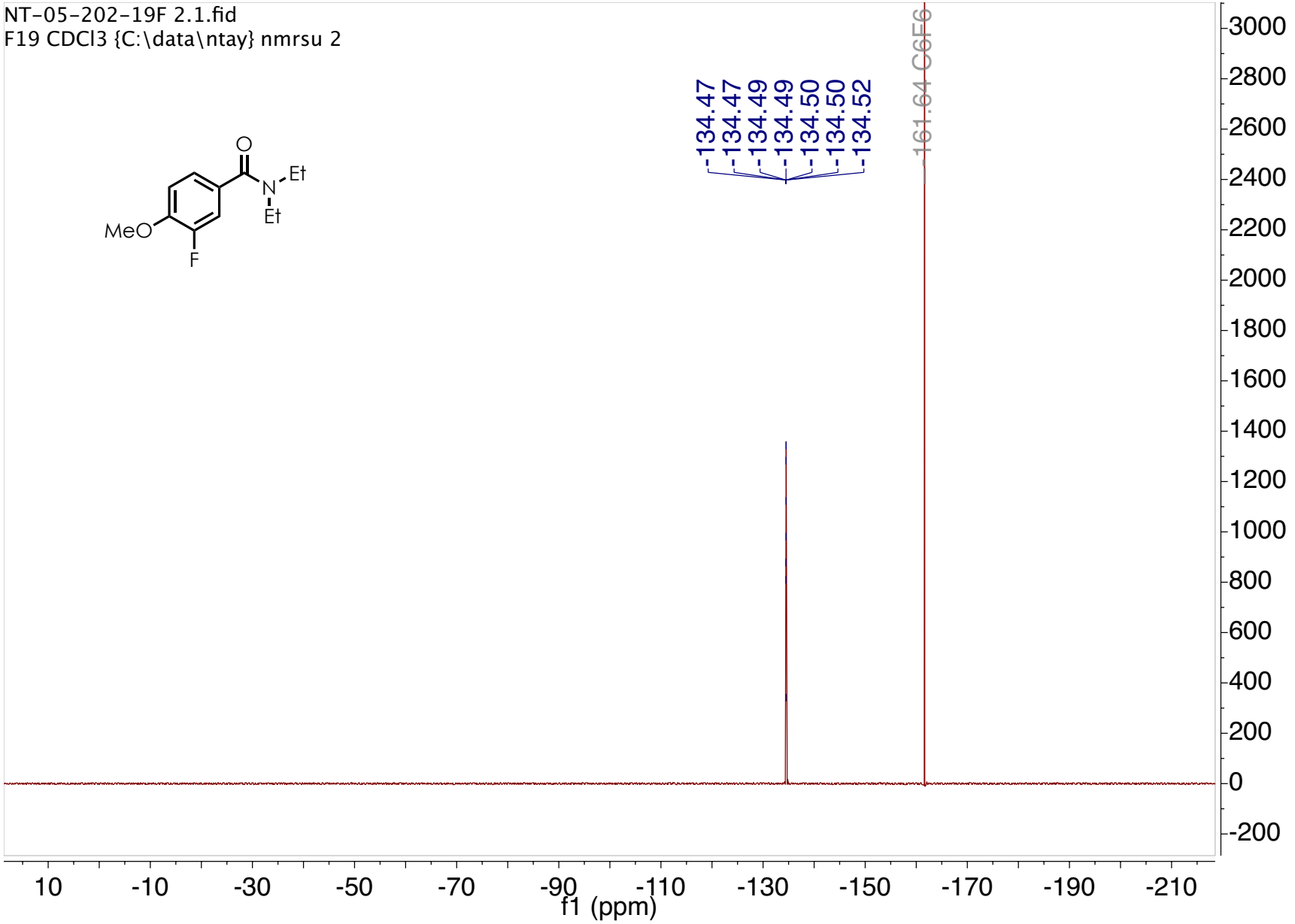

NT-04-268.1.fid
Nicewicz
5106082
ntay
NT-04-268
7.51
7.50
7.50
7.50
7.49
7.48
7.34
7.34
7.33
7.33
7.32
7.32
7.31
7.26 CDCl3
7.11
7.11
7.10
7.10
7.09
7.09
7.08
7.08
6.99
6.99
6.98
6.97
6.95
6.94
6.93
6.93
3.78
MeO
Cl
F
0.97
3.04
1.00
0.96
1.02
3.11
40000
35000
30000
25000
20000
15000
10000
5000
0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
f1 (ppm)

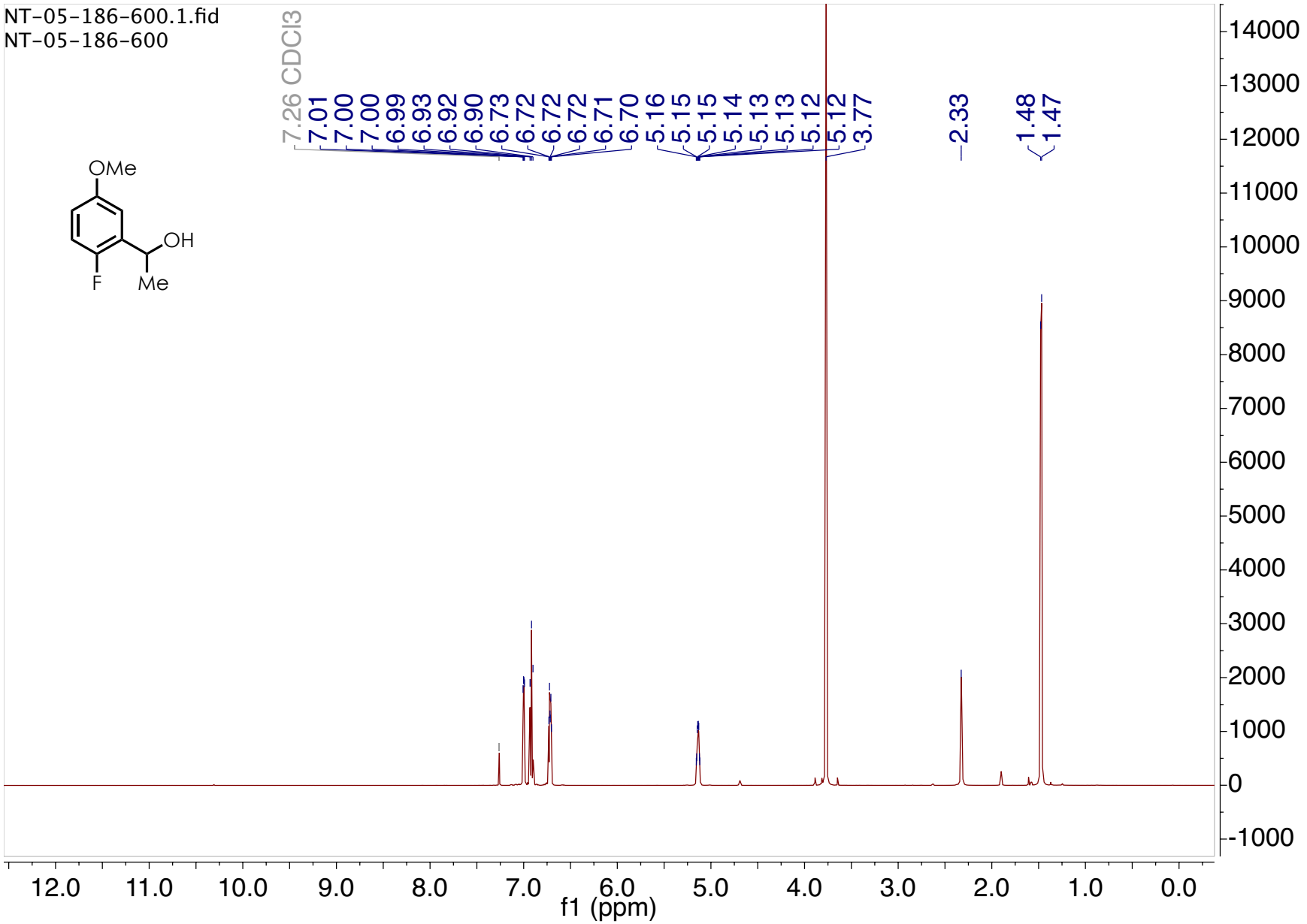

NT-04-268 2.2.fid
Nicewicz
5106082
ntay
NT-04-268
157.54
155.95
153.14
153.12
136.75
136.74
133.84
131.60
129.88
129.83
129.53
129.02
126.62
117.96
117.81
115.36
115.21
112.12
112.06
77.16 CDCl3
56.30
MeO
Cl
F
38000
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

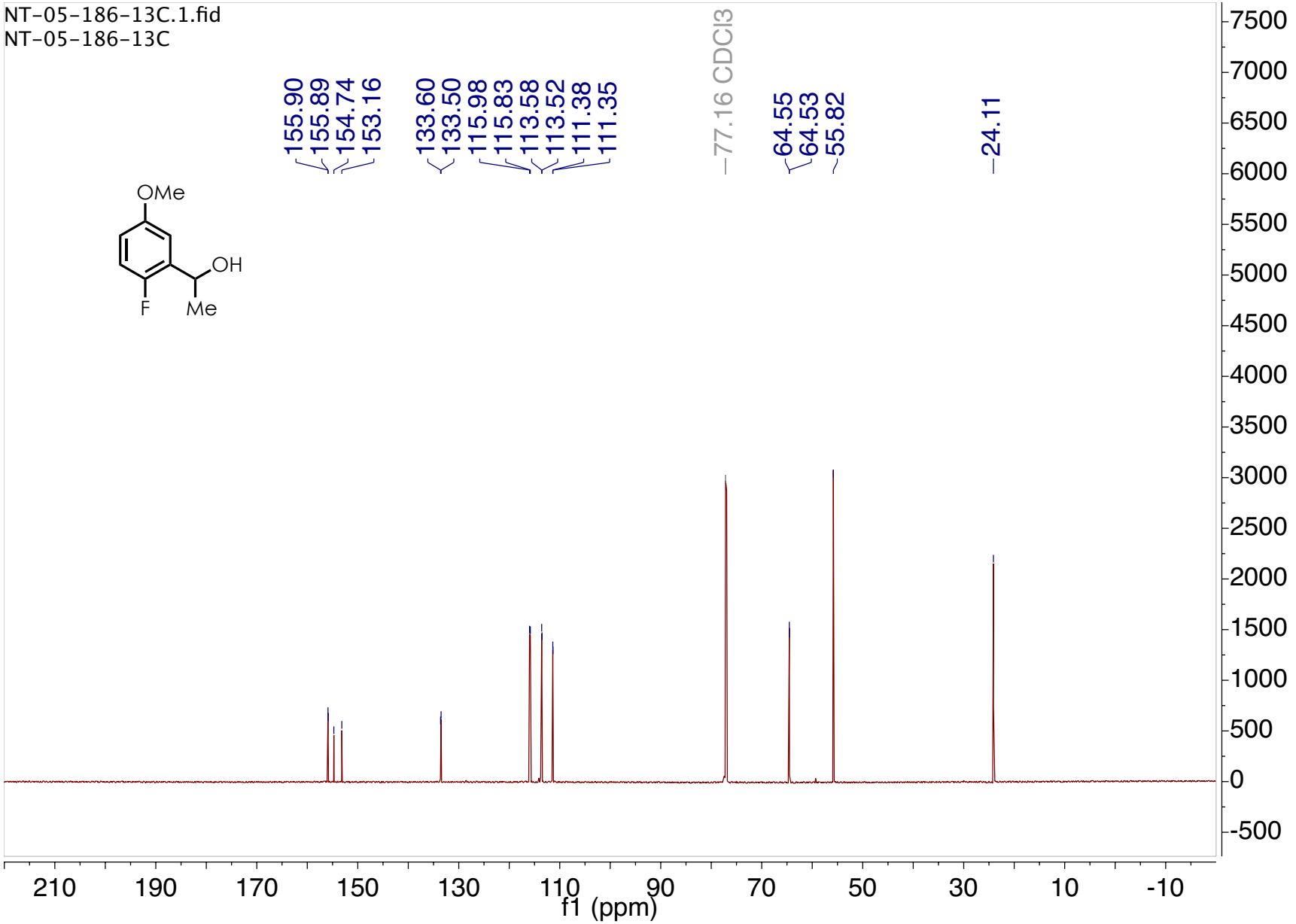

NT-04-268-19F 2.2.fid
F19 CDCl3 {C:\data\ntay} nmrsu 3
MeO
Cl
F
-124.21
-124.22
-124.23
-124.25
-124.26
-124.27
-161.64 C6F6
4000
3500
3000
2500
2000
1500
1000
500
0
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

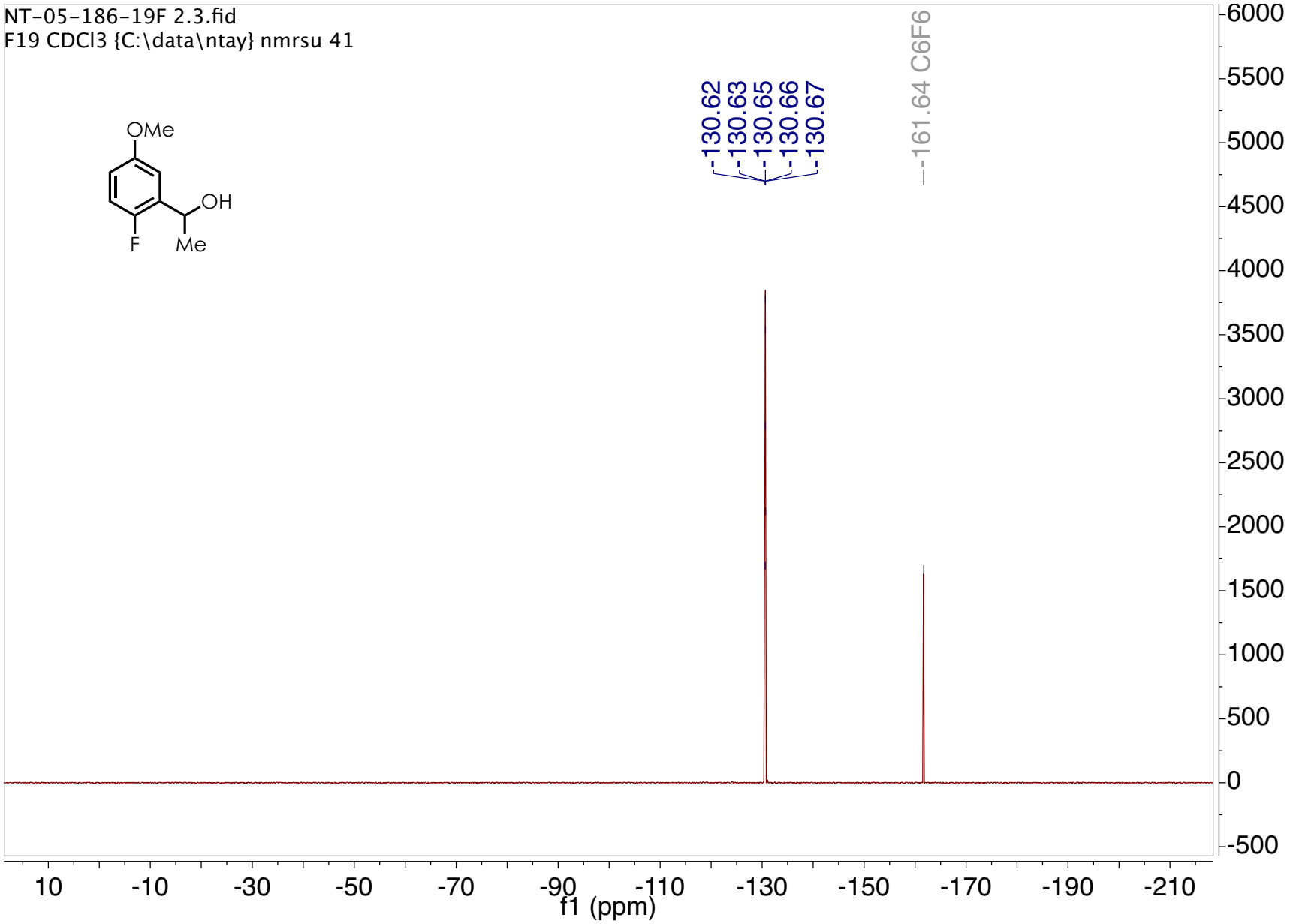

NT-05-202.1.fid
Nicewicz
C3308
ntay
NT-05-202
7.26 CDCl3
7.03
7.03
7.02
7.02
7.02
7.01
7.01
7.01
7.00
6.87
6.86
6.85
6.84
3.77
3.34
3.20
1.05
MeO
F
O
N
Et
Et
2.00
1.04
3.27
4.25
6.39
f1 (ppm)

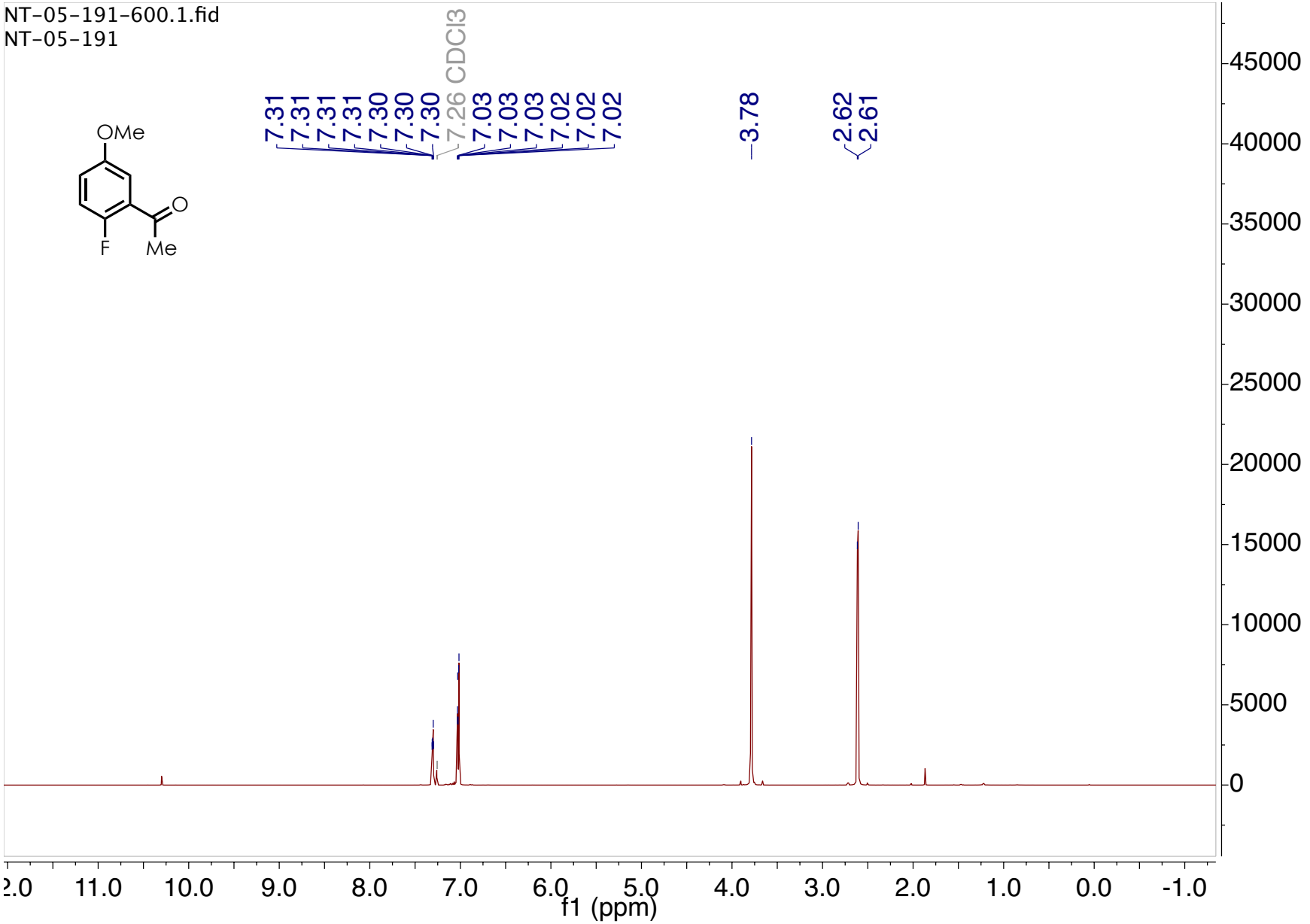

NT-05-202 2.2.fid
Nicewicz
C3308
ntay
NT-05-202
169.60
169.59
152.43
150.79
148.33
148.26
129.61
129.57
122.71
122.69
114.70
114.57
112.84
112.82
77.16 CDCl3
56.00
43.20
39.32
13.92
12.66
O
N
Et
Et
MeO
F
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

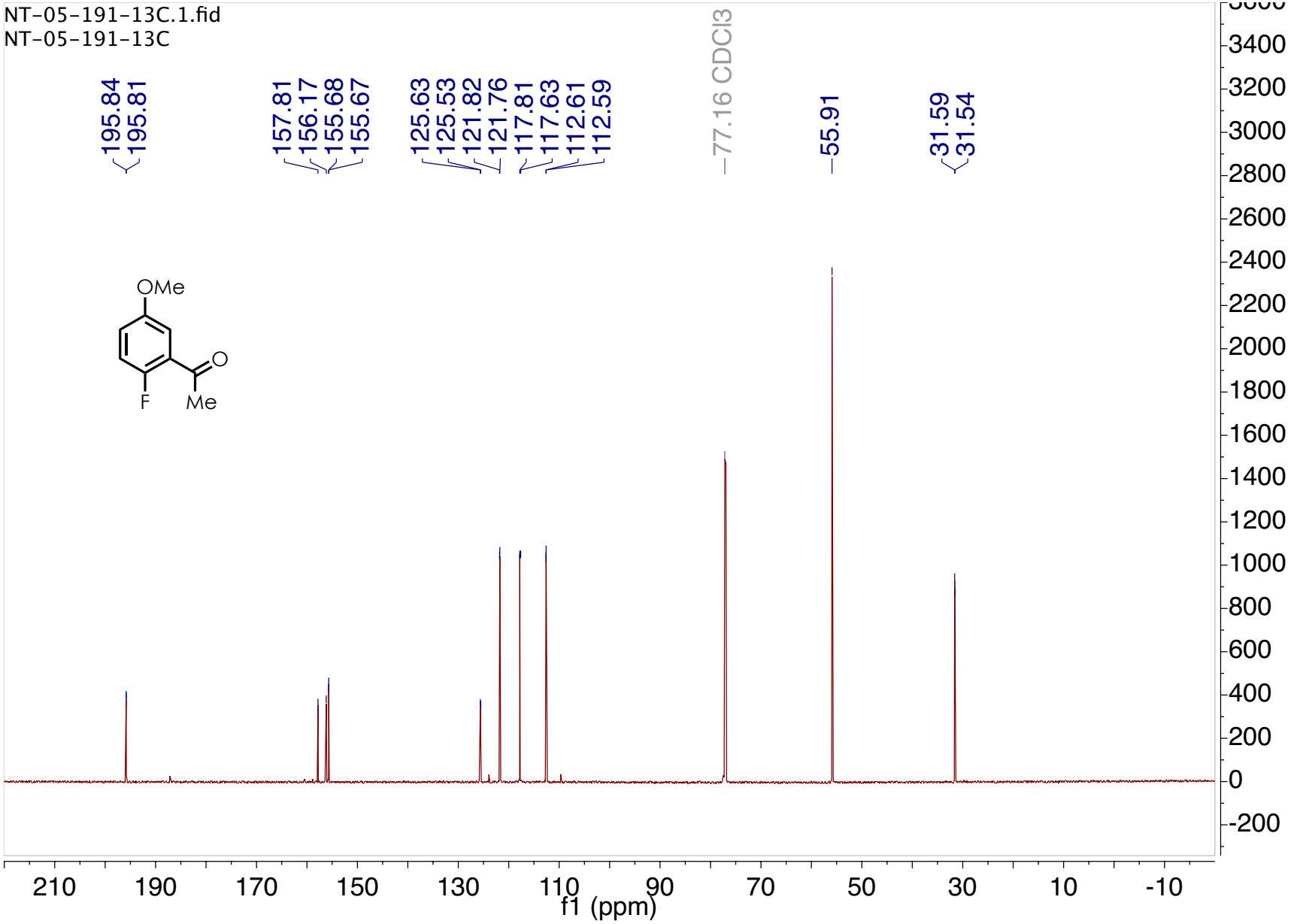

NT-05-202-19F 2.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 2
-134.47
-134.47
-134.49
-134.49
-134.50
-134.50
-134.52
-161.64 C6F6
O
N
Et
Et
MeO
F
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

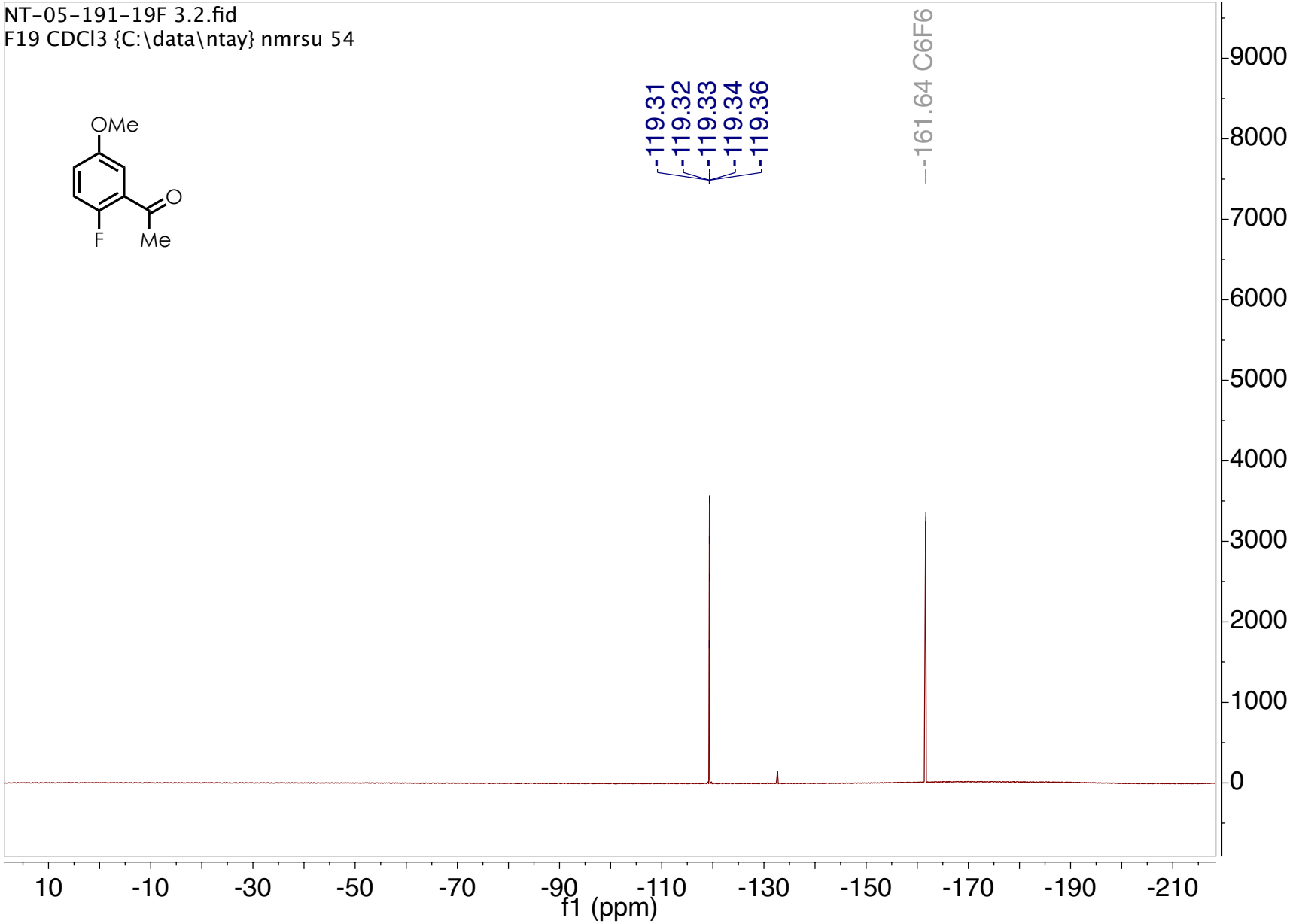

NT-05-186-600.1.fid
NT-05-186-600
7.26 CDCl3
7.01
7.00
7.00
6.99
6.93
6.92
6.90
6.73
6.72
6.72
6.72
6.71
6.70
5.16
5.15
5.15
5.14
5.13
5.13
5.12
5.12
3.77
2.33
1.48
1.47
OMe
OH
F
Me
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
f1 (ppm)

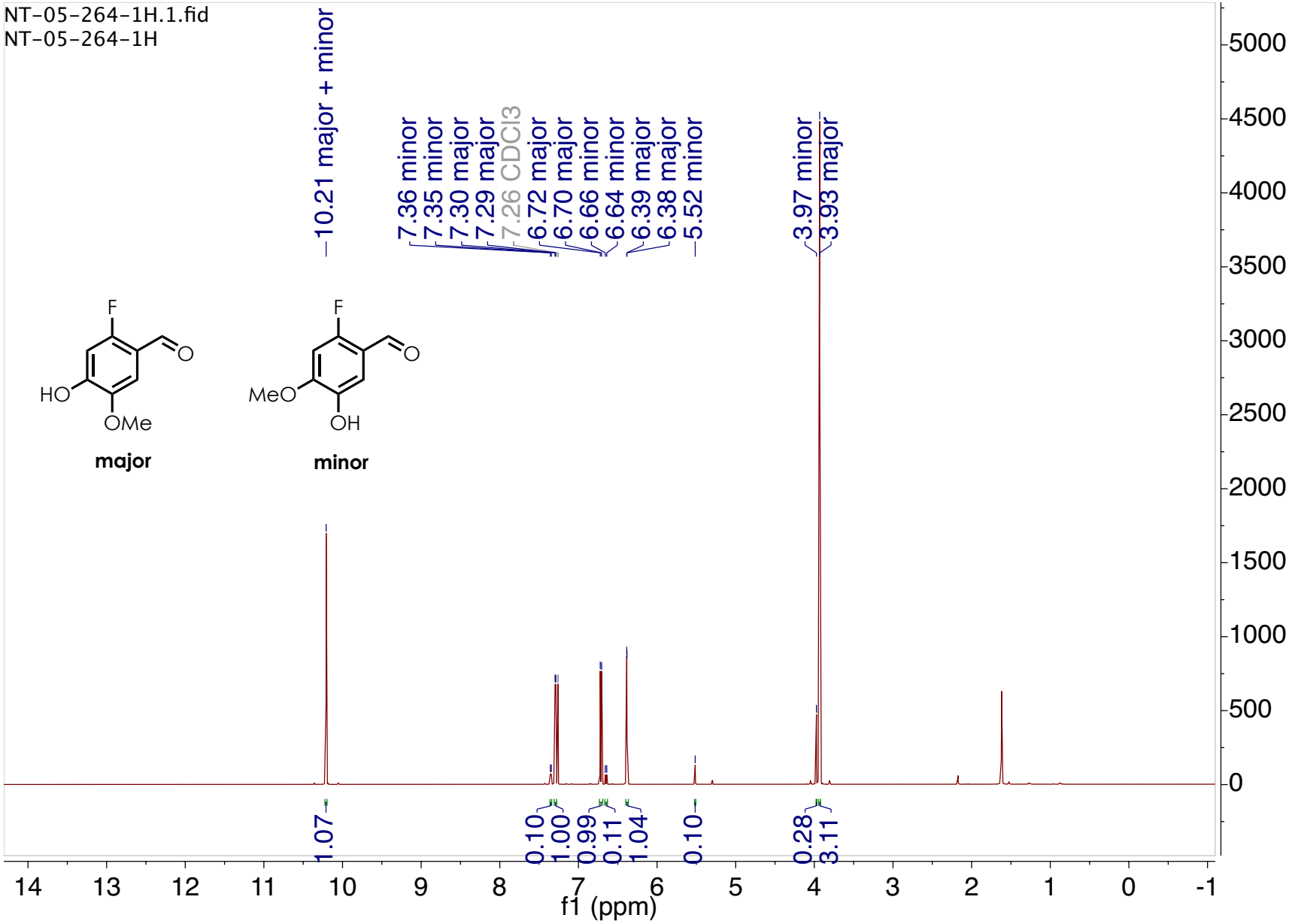

NT-05-186-13C.1.fid
NT-05-186-13C
155.90
155.89
154.74
153.16
133.60
133.50
115.98
115.83
113.58
113.52
111.38
111.35
77.16 CDCl3
64.55
64.53
55.82
24.11
OMe
OH
F
Me
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

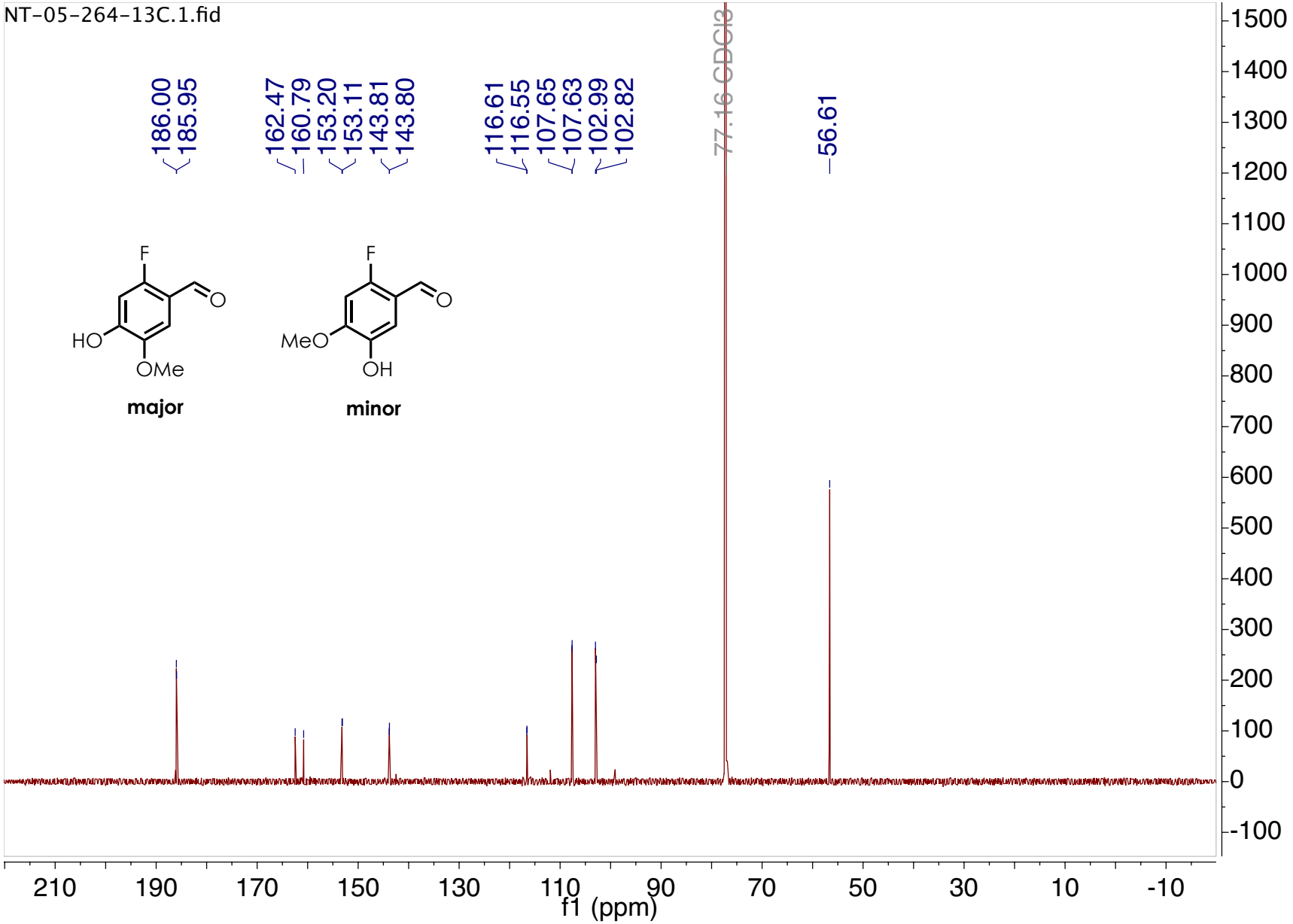

NT-05-186-19F 2.3.fid
F19 CDCl3 {C:\data\ntay} nmrsu 41
OMe
OH
F
Me
-130.62
-130.63
-130.65
-130.66
-130.67
-161.64 C6F6
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

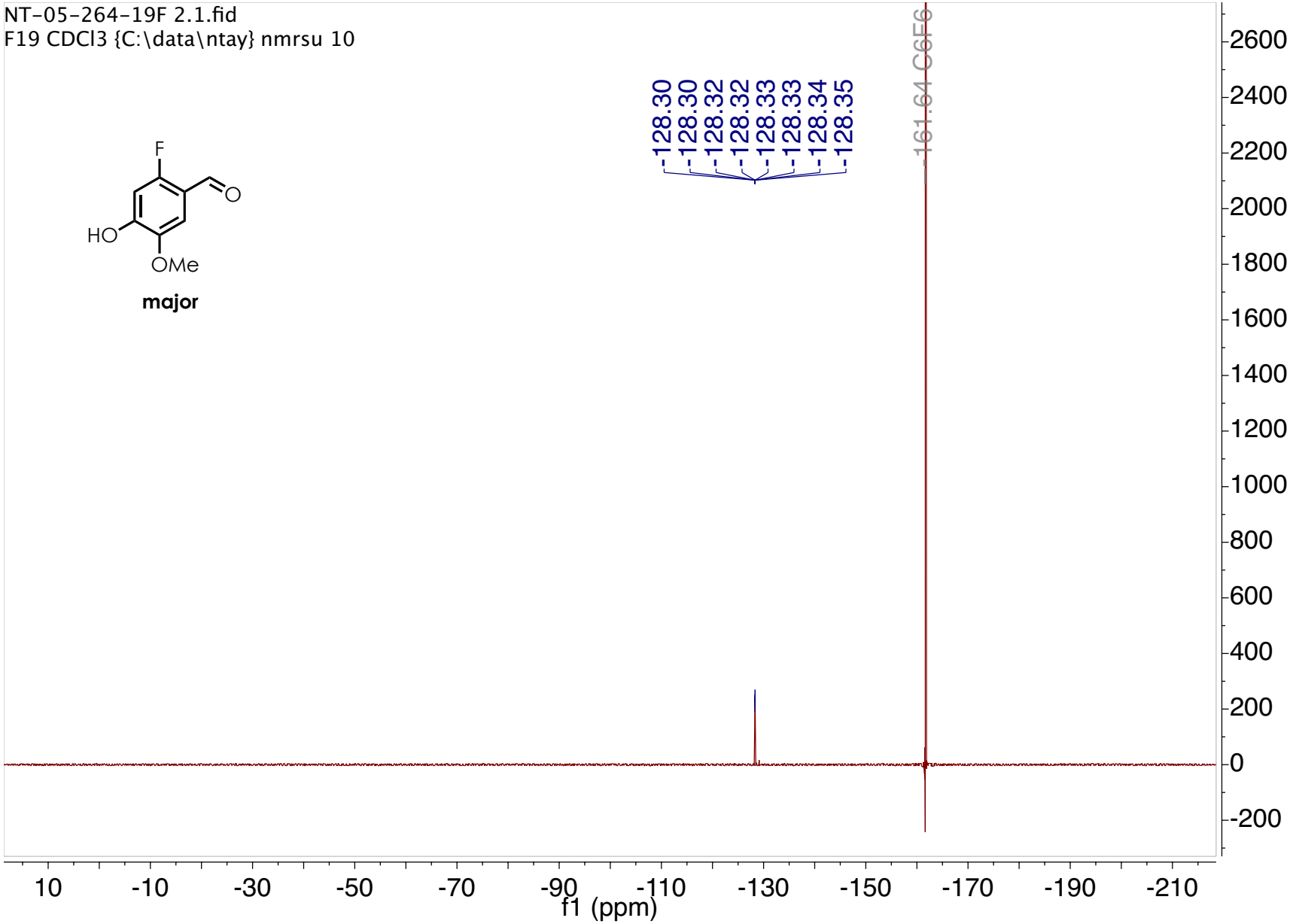

NT-05-191-600.1.fid
NT-05-191
OMe
O
F
Me
7.31
7.31
7.31
7.31
7.30
7.30
7.30
7.26 CDCl3
7.03
7.03
7.03
7.02
7.02
7.02
3.78
2.62
2.61
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
2.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

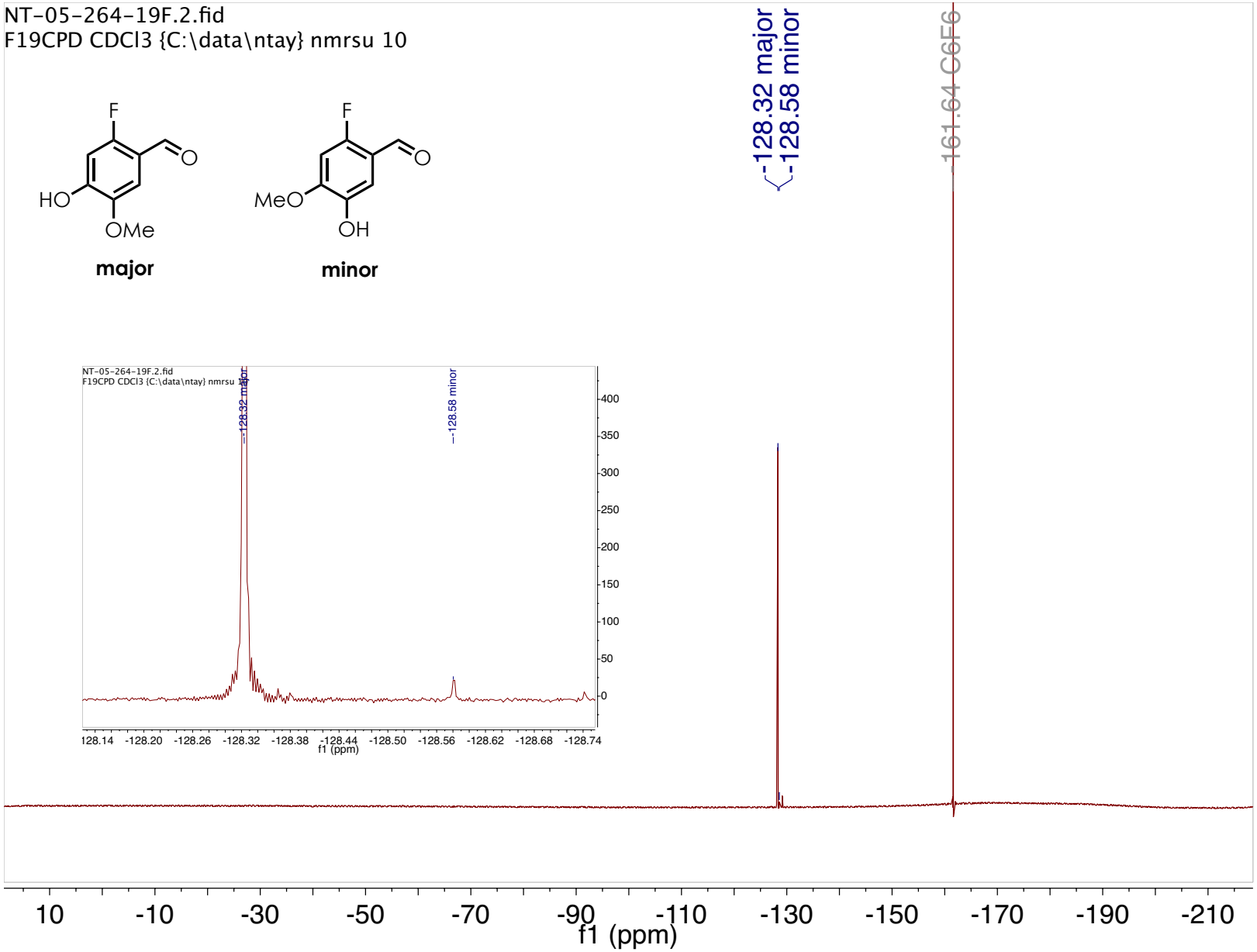

NT-05-191-13C.1.fid
NT-05-191-13C
195.84
195.81
157.81
156.17
155.68
155.67
125.63
125.53
121.82
121.76
117.81
117.63
112.61
112.59
77.16 CDCl3
55.91
31.59
31.54
OMe
O
F
Me
f1 (ppm)

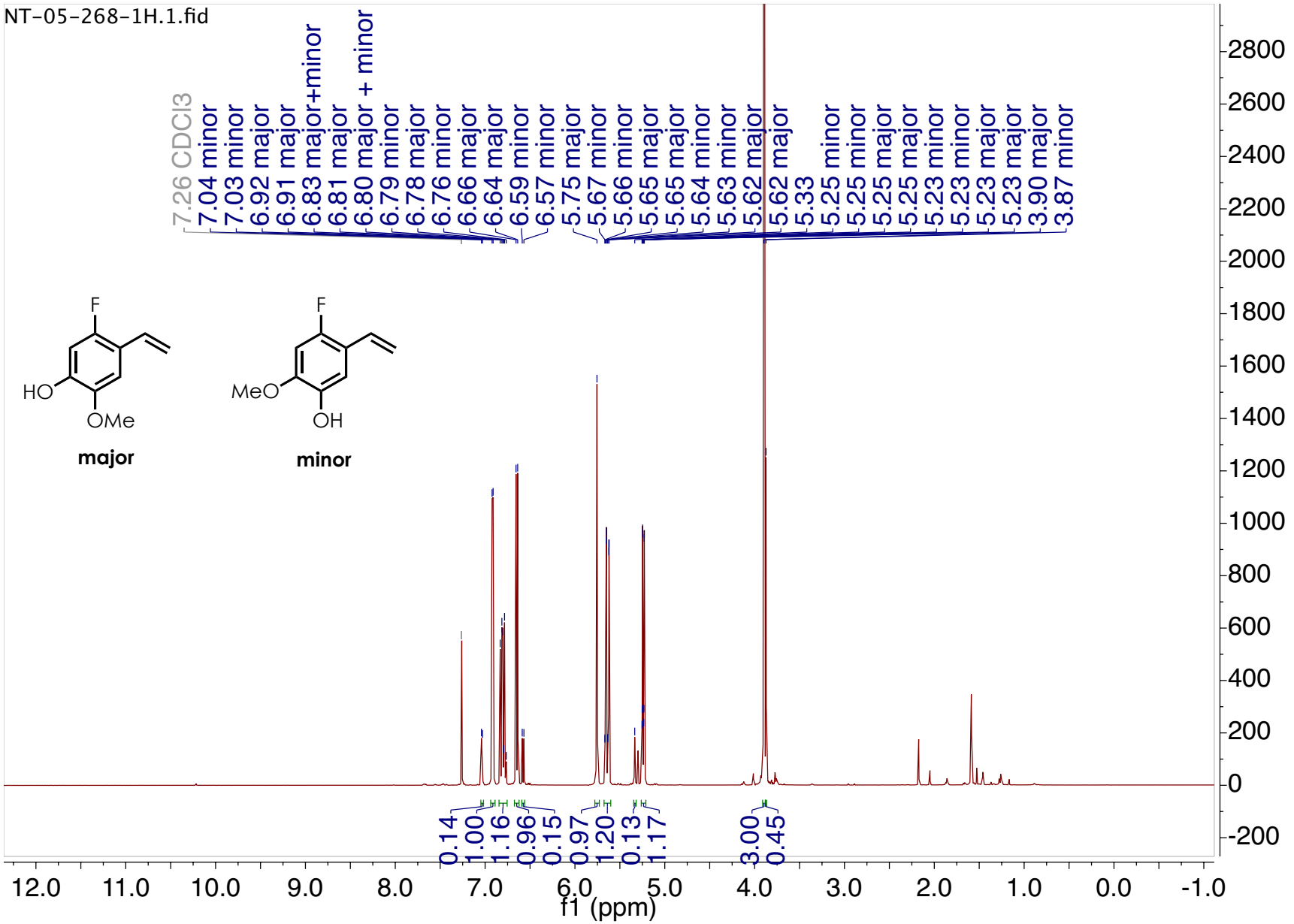

NT-05-191-19F 3.2.fid
F19 CDCl3 {C:\data\ntay} nmrsu 54
OMe
O
F
Me
-119.31
-119.32
-119.33
-119.34
-119.36
-161.64 C6F6
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

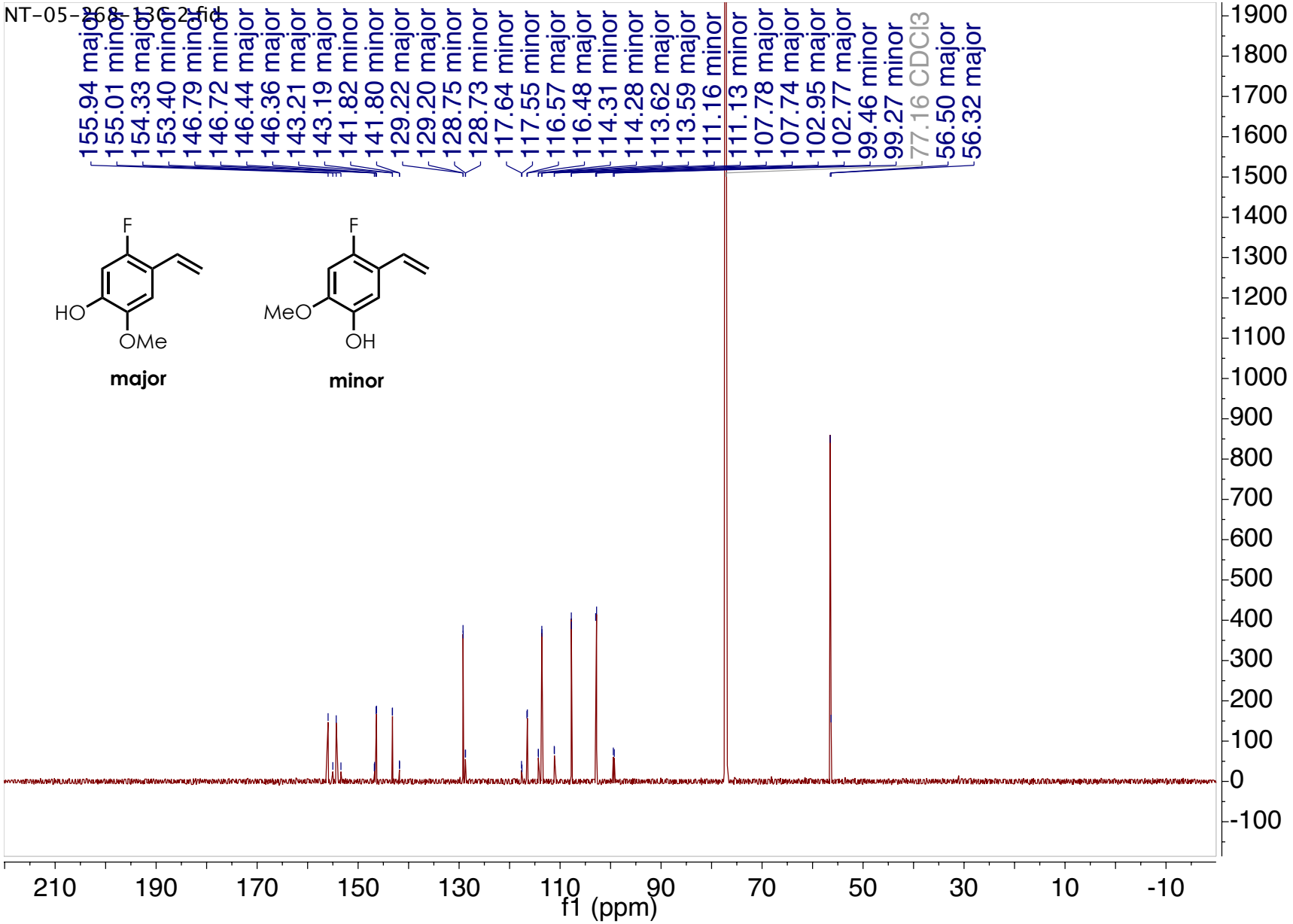

NT-05-264-1H.1.fid
NT-05-264-1H
10.21 major + minor
7.36 minor
7.35 minor
7.30 major
7.29 major
7.26 CDCl3
6.72 major
6.70 major
6.66 minor
6.64 minor
6.39 major
6.38 major
5.52 minor
3.97 minor
3.93 major
F
HO
OMe
major
F
MeO
OH
minor
1.07
0.10
1.00
0.99
0.11
1.04
0.10
0.28
3.11
f1 (ppm)

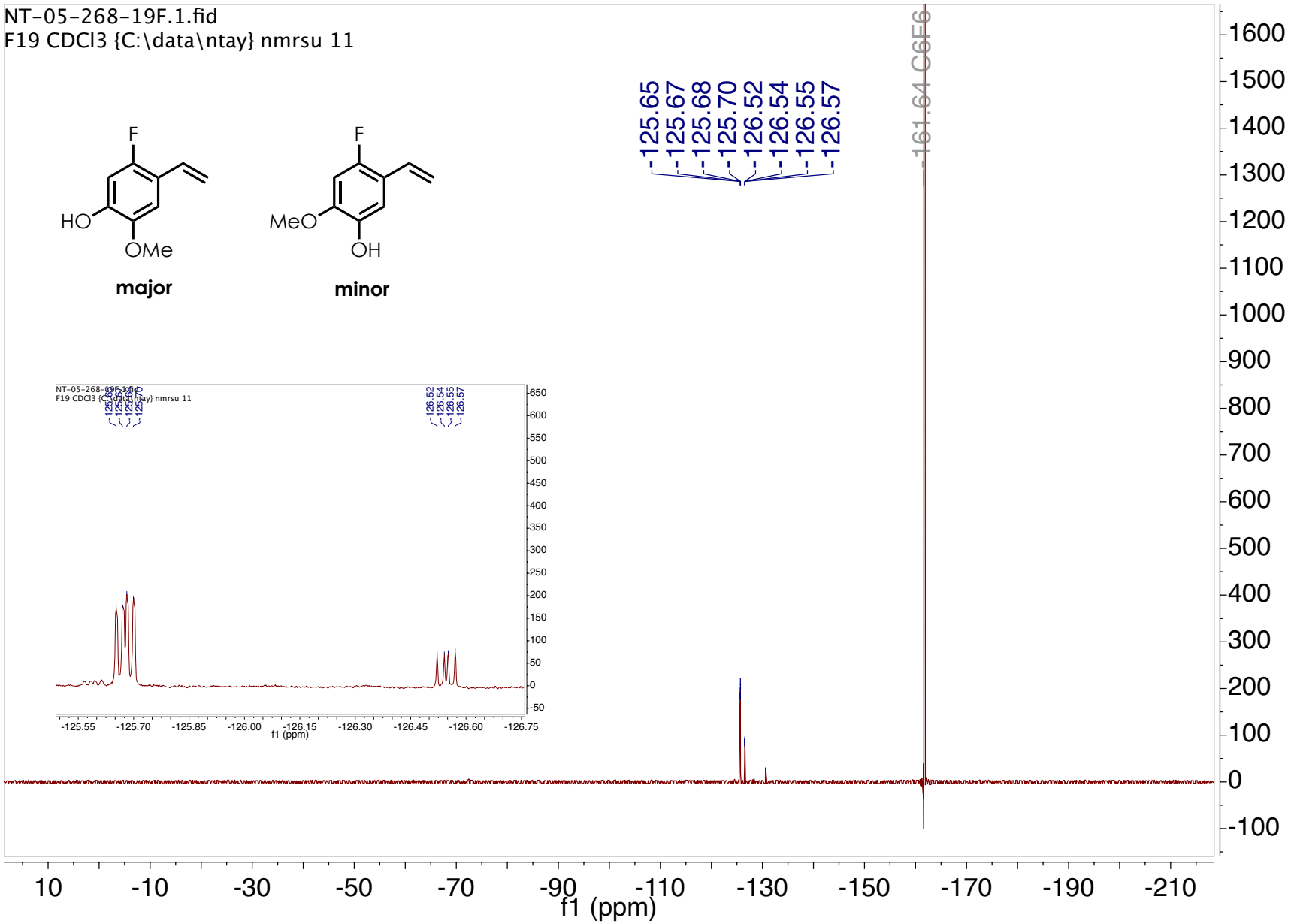

NT-05-264-13C.1.fid
186.00
185.95
162.47
160.79
153.20
153.11
143.81
143.80
116.61
116.55
107.65
107.63
102.99
102.82
77.16 CDCl3
56.61
F
HO
OMe
O
major
F
MeO
OH
O
minor
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

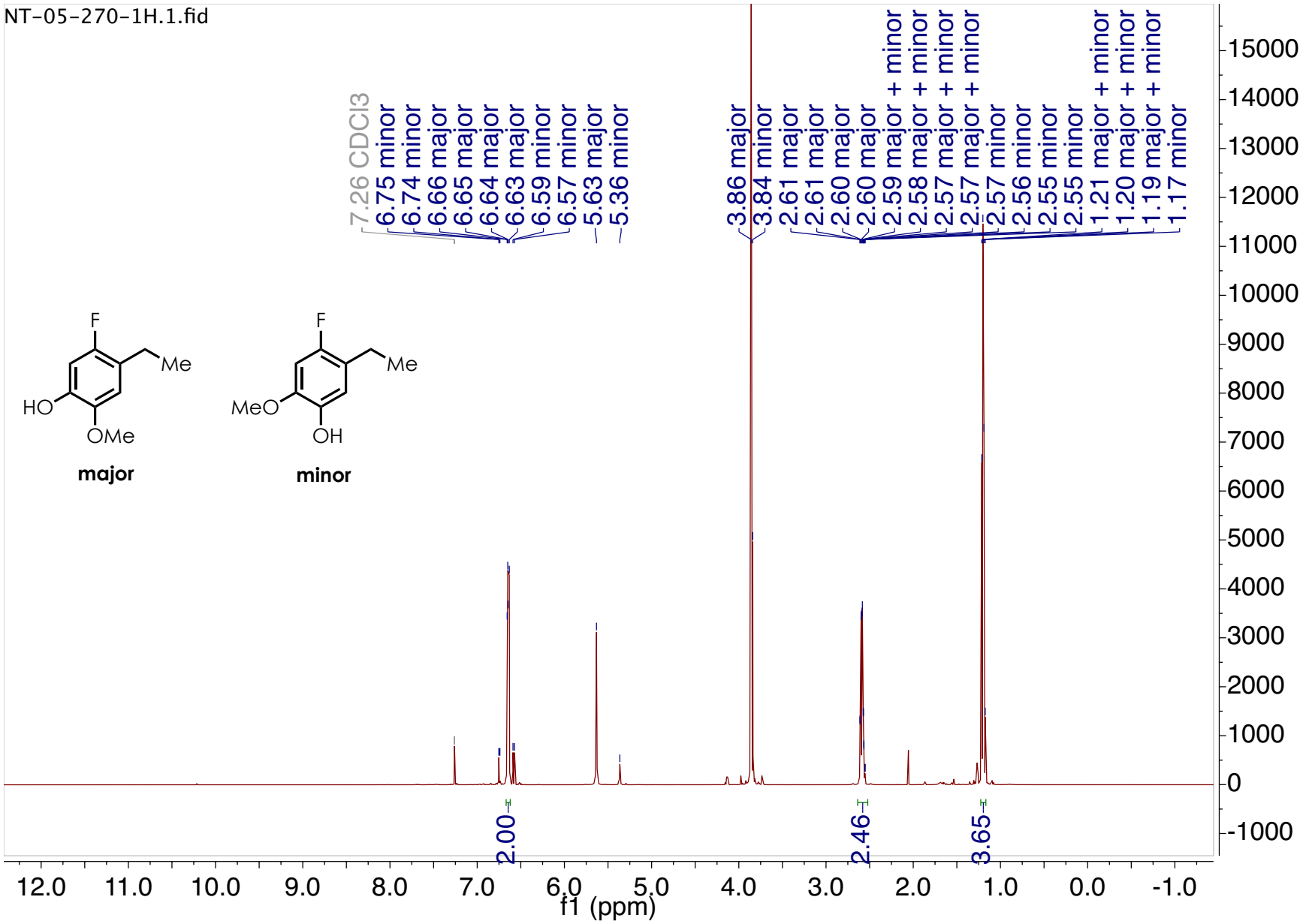

NT-05-264-19F 2.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 10
F
O
HO
OMe
major
-128.30
-128.30
-128.32
-128.32
-128.33
-128.33
-128.34
-128.35
-161.64 C6F6
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

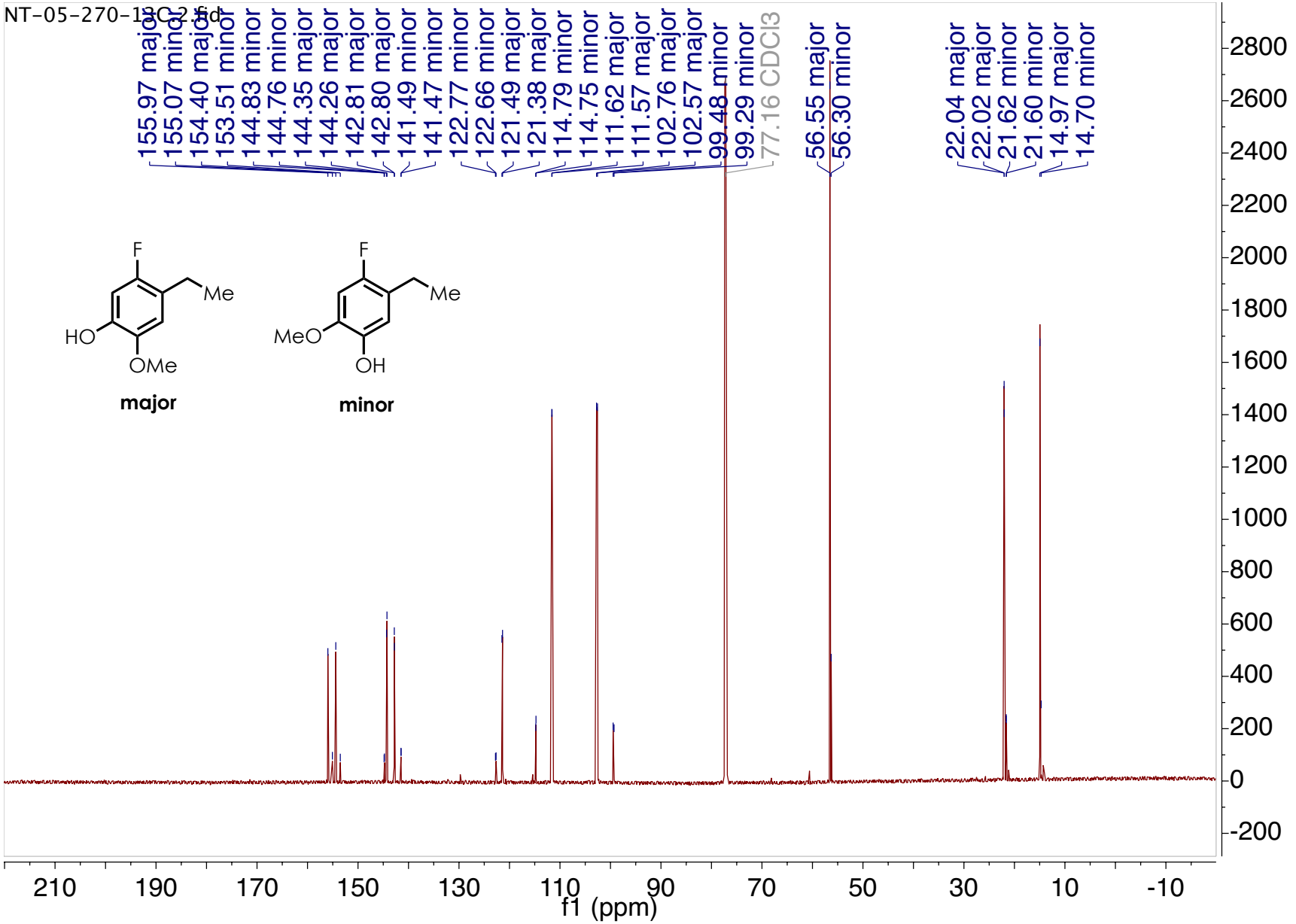

NT-05-264-19F.2.fid
F19CPD CDCl3 {C:\data\ntay} nmrsu 10
F
HO
OMe
O
major
F
MeO
OH
O
minor
-128.32 major
-128.58 minor
-161.64 C6F6
NT-05-264-19F.2.fid
F19CPD CDCl3 {C:\data\ntay} nmrsu
-128.32 major
-128.58 minor
f1 (ppm)
f1 (ppm)

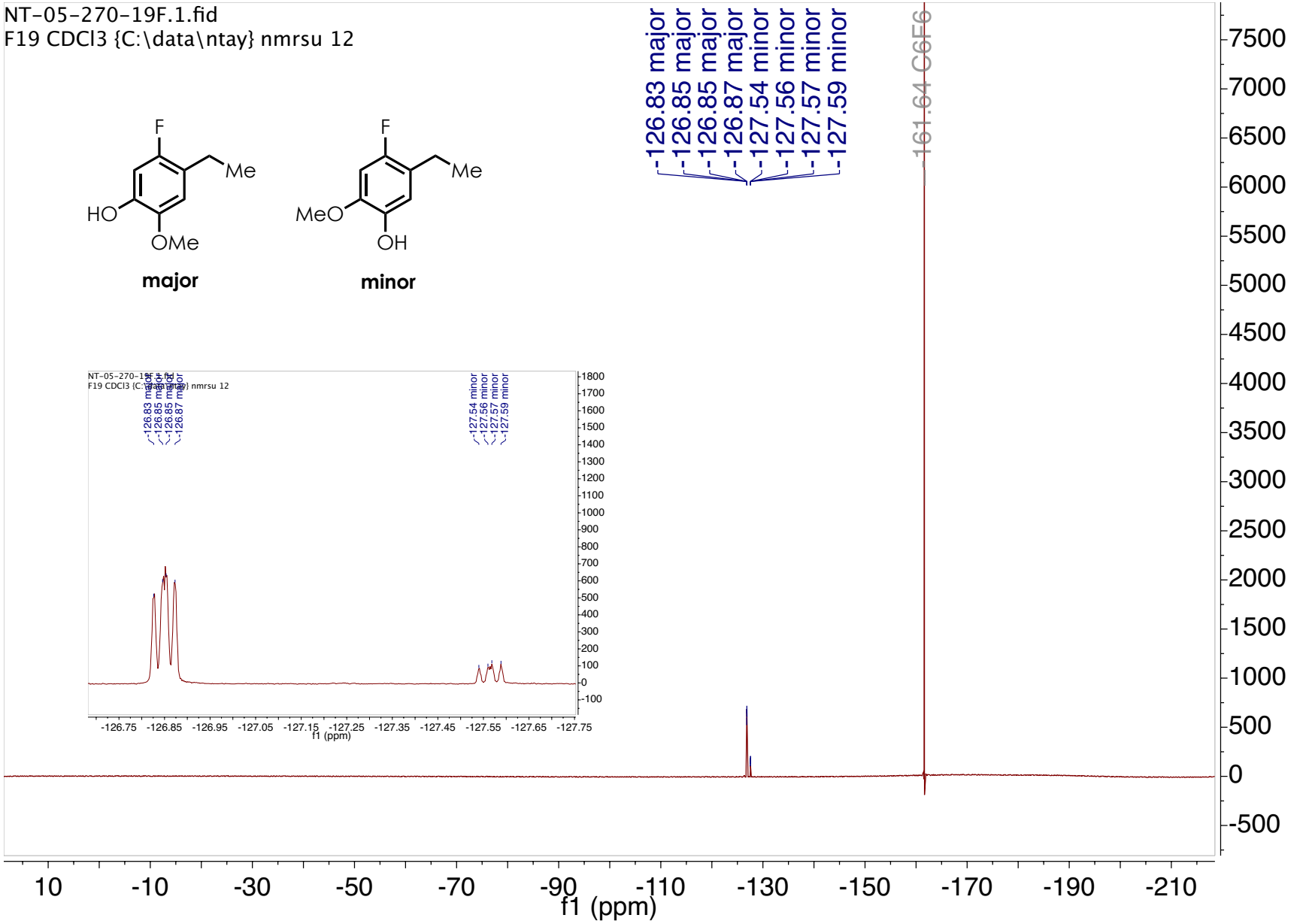

NT-05-268-1H.1.fid
7.26 CDCl3
7.04 minor
7.03 minor
6.92 major
6.91 major
6.83 major+minor
6.81 major
6.80 major + minor
6.79 minor
6.78 major
6.76 minor
6.66 major
6.64 major
6.59 minor
6.57 minor
5.75 major
5.67 minor
5.66 minor
5.65 major
5.65 major
5.64 minor
5.63 minor
5.62 major
5.62 major
5.33
5.25 minor
5.25 minor
5.25 major
5.25 major
5.23 minor
5.23 minor
5.23 major
5.23 major
3.90 major
3.87 minor
F
HO
OMe
major
F
MeO
OH
minor
0.14
1.00
1.16
0.96
0.15
0.97
1.20
0.13
1.17
3.00
0.45
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

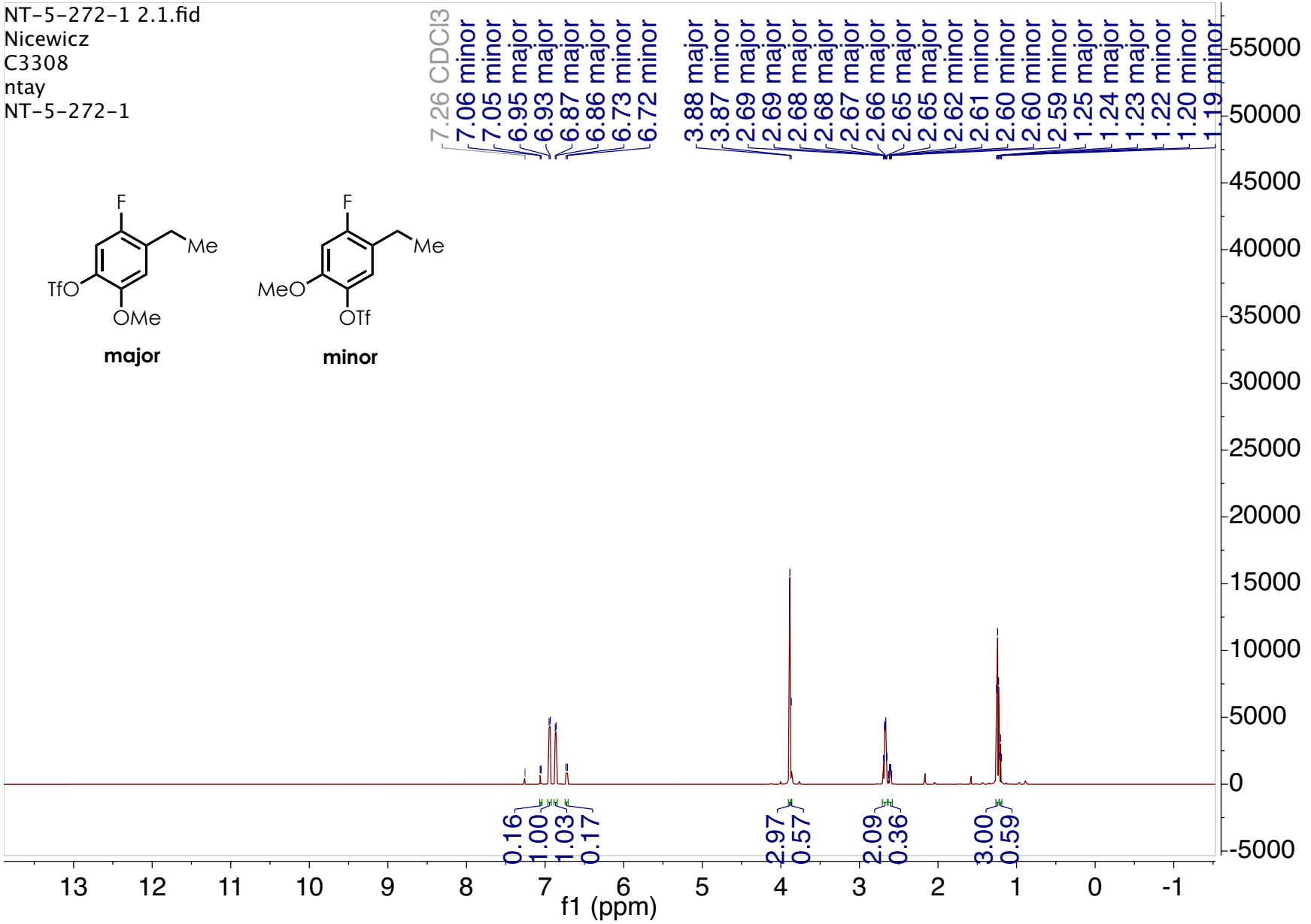

NT-05-268-13C-2.fid
155.94 major
155.01 minor
154.33 major
153.40 minor
146.79 minor
146.72 minor
146.44 major
146.36 major
143.21 major
143.19 major
141.82 minor
141.80 minor
129.22 major
129.20 major
128.75 minor
128.73 minor
117.64 minor
117.55 minor
116.57 major
116.48 major
114.31 minor
114.28 minor
113.62 major
113.59 major
111.16 minor
111.13 minor
107.78 major
107.74 major
102.95 major
102.77 major
99.46 minor
99.27 minor
77.16 CDCl3
56.50 major
56.32 major
F
HO
OMe
major
F
MeO
OH
minor
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

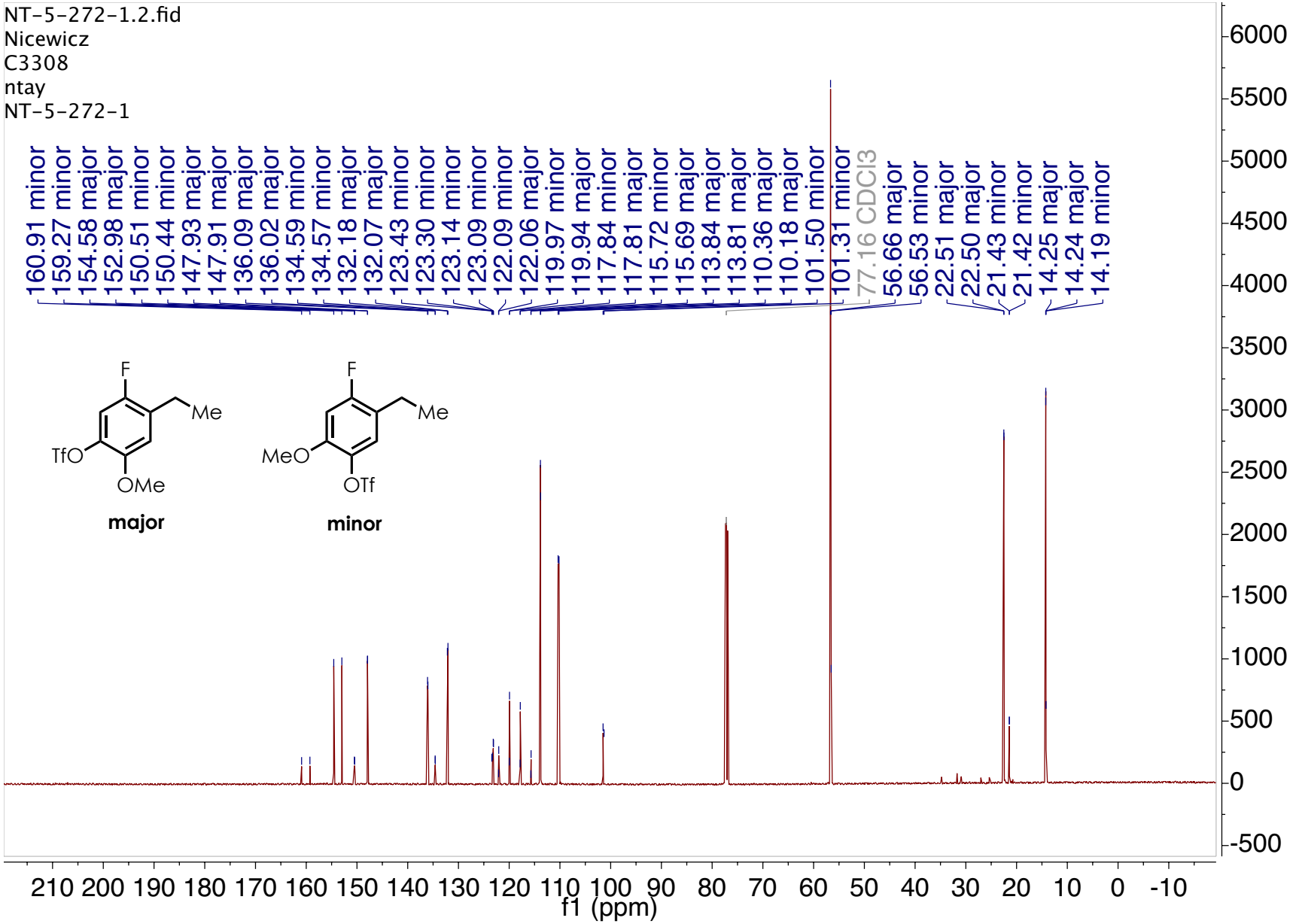

NT-05-268-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 11
F
HO
OMe
major
F
MeO
OH
minor
-125.65
-125.67
-125.68
-125.70
-126.52
-126.54
-126.55
-126.57
-161.64 C6F6
f1 (ppm)

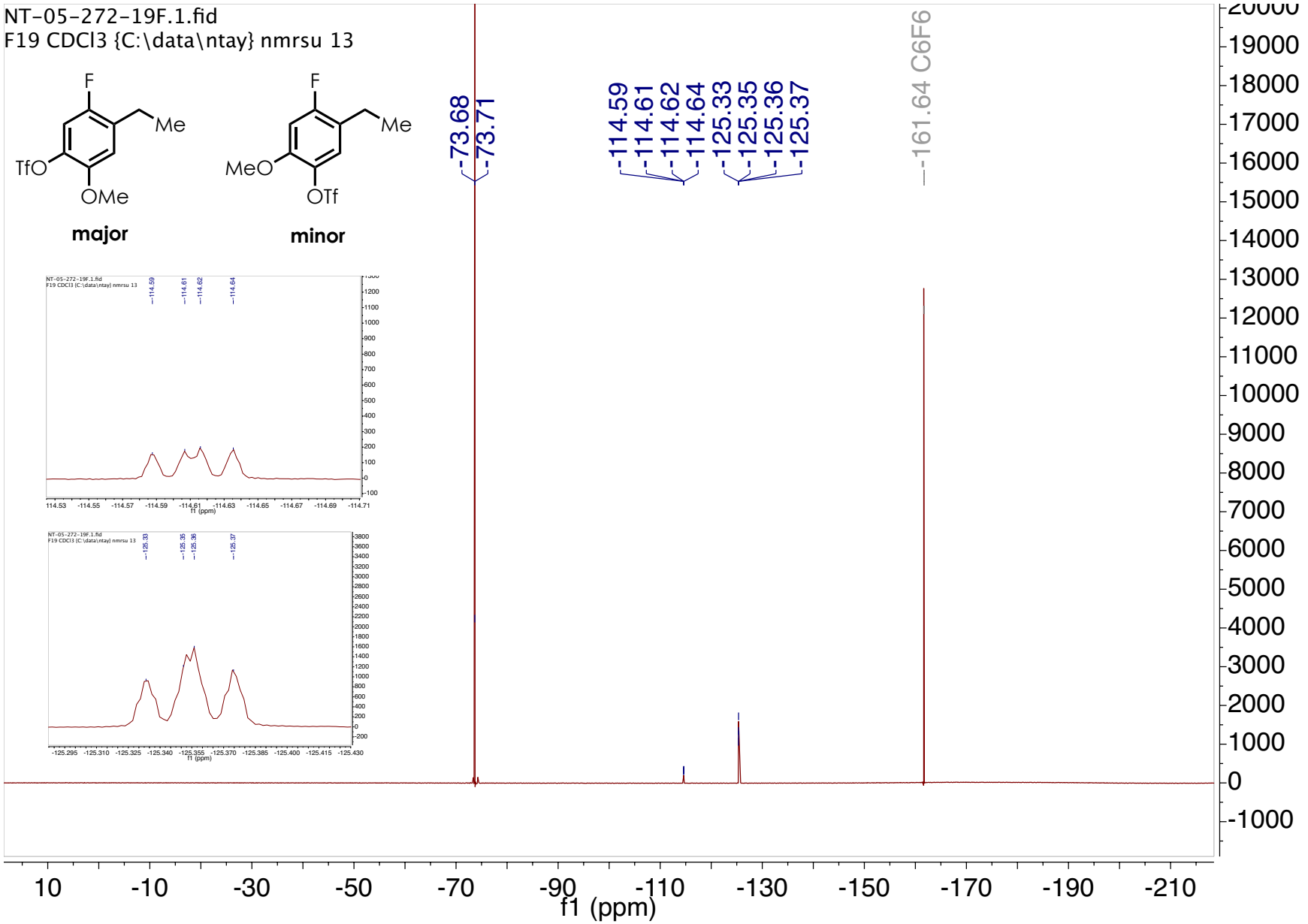

NT-05-270-1H.1.fid
7.26 CDCl3
6.75 minor
6.74 minor
6.66 major
6.65 major
6.64 major
6.63 major
6.59 minor
6.57 minor
5.63 major
5.36 minor
3.86 major
3.84 minor
2.61 major
2.61 major
2.60 major
2.60 major
2.59 major + minor
2.58 major + minor
2.57 major + minor
2.57 major + minor
2.57 minor
2.56 minor
2.55 minor
2.55 minor
1.21 major + minor
1.20 major + minor
1.19 major + minor
1.17 minor
F
Me
HO
OMe
major
F
Me
MeO
OH
minor
2.00
2.46
3.65
f1 (ppm)

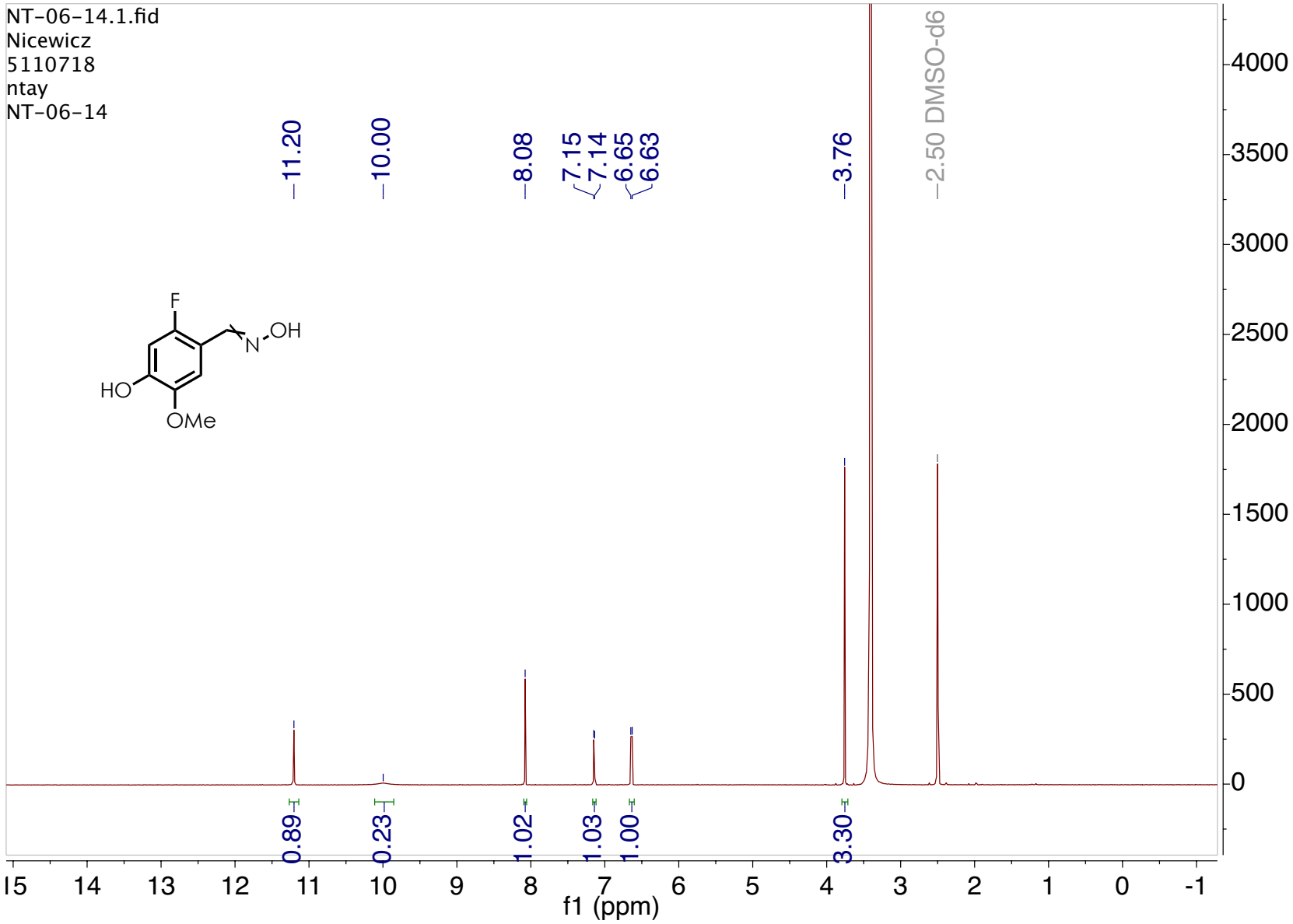

NT-05-270-13C-2.fid
155.97 major
155.07 minor
154.40 major
153.51 minor
144.83 minor
144.76 minor
144.35 major
144.26 major
142.81 major
142.80 major
141.49 minor
141.47 minor
122.77 minor
122.66 minor
121.49 major
121.38 major
114.79 minor
114.75 minor
111.62 major
111.57 major
102.76 major
102.57 major
99.48 minor
99.29 minor
77.16 CDCl3
56.55 major
56.30 minor
22.04 major
22.02 major
21.62 minor
21.60 minor
14.97 major
14.70 minor
F
Me
HO
OMe
major
F
Me
MeO
OH
minor
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

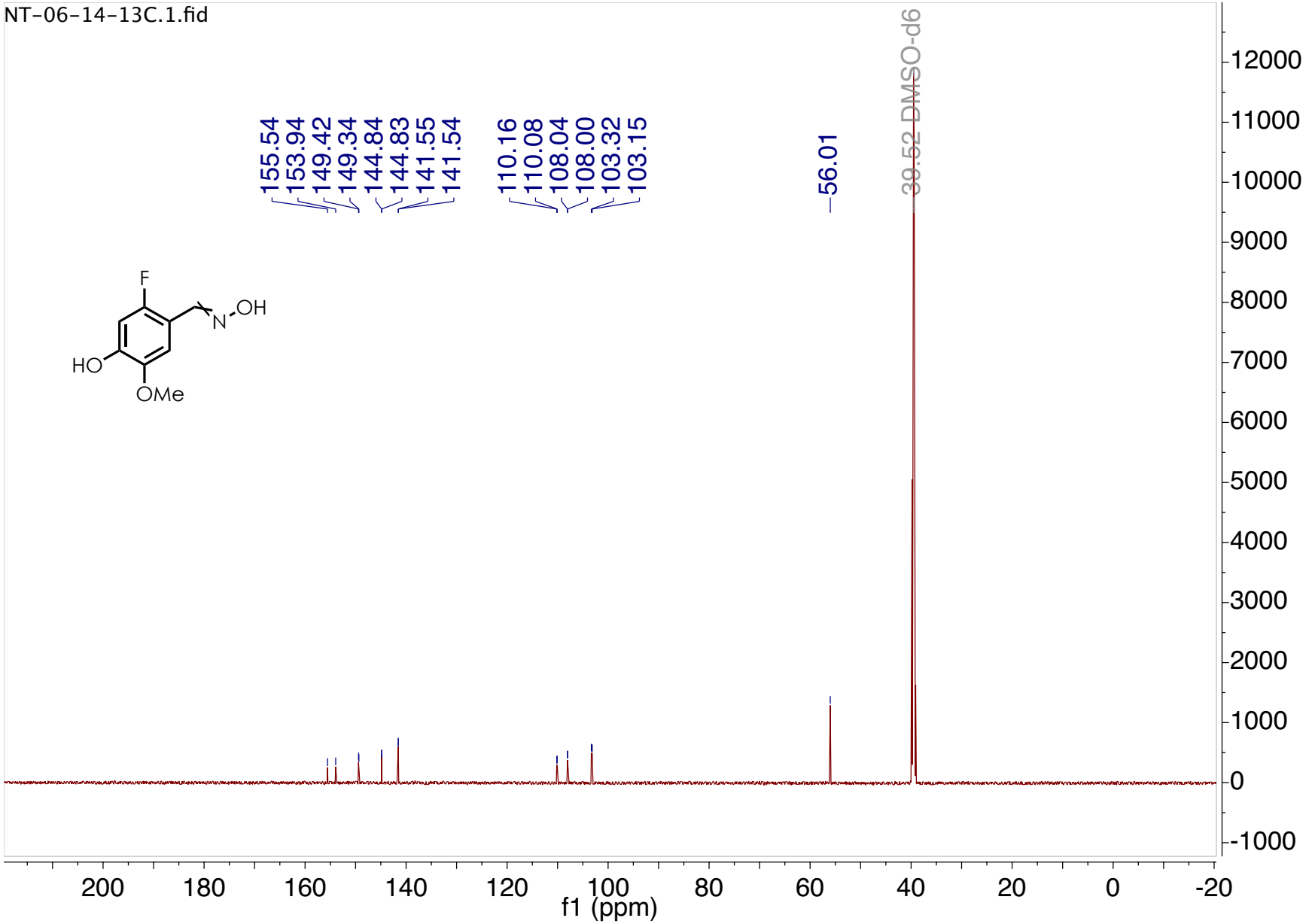

NT-05-270-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 12
F
Me
HO
OMe
major
F
Me
MeO
OH
minor
-126.83 major
-126.85 major
-126.85 major
-126.87 major
-127.54 minor
-127.56 minor
-127.57 minor
-127.59 minor
-161.64 C6F6
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)
-126.75
-126.85
-126.95
-127.05
-127.15
-127.25
-127.35
-127.45
-127.55
-127.65
-127.75
f1 (ppm)

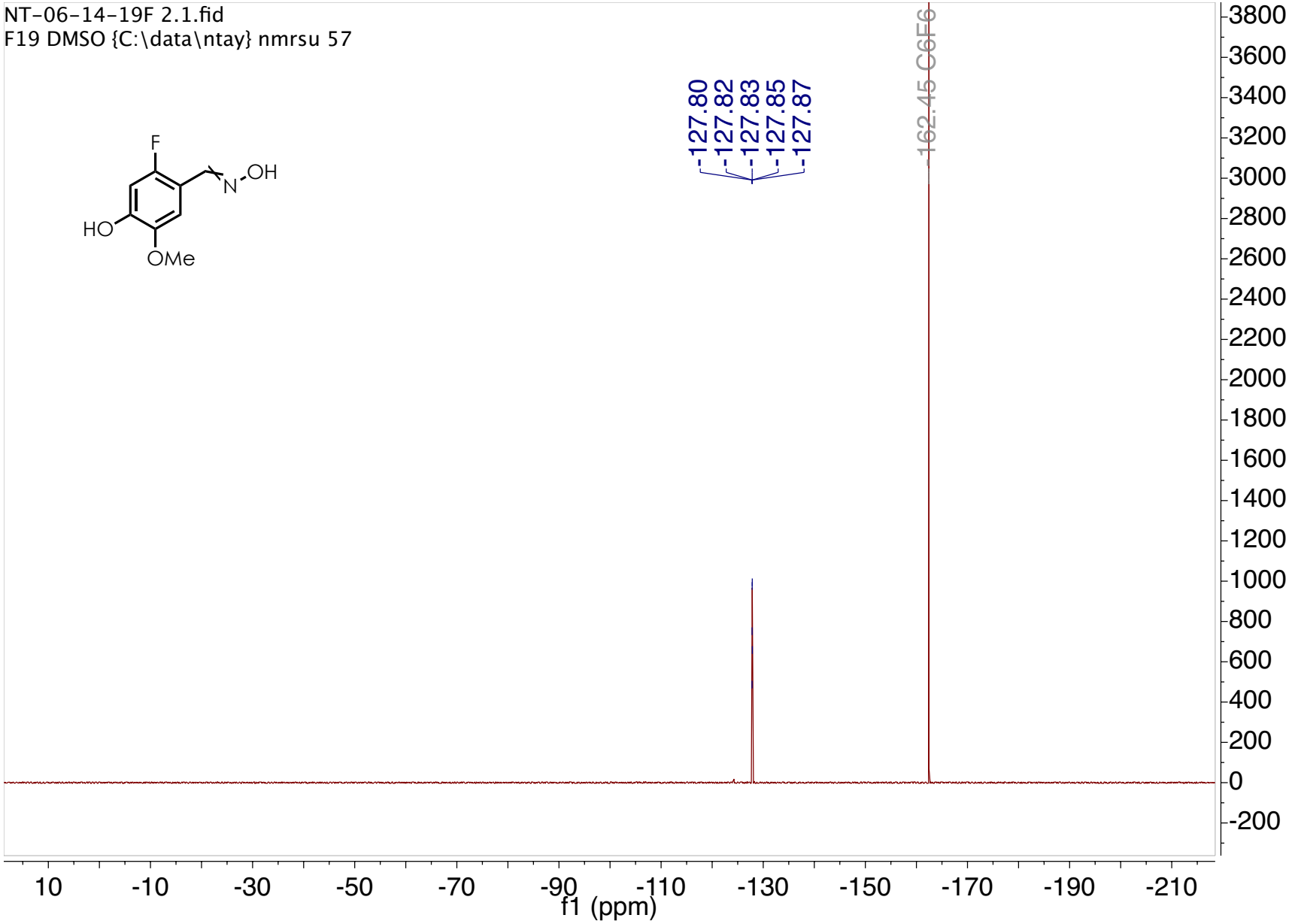

NT-5-272-1 2.1.fid
Nicewicz
C3308
ntay
NT-5-272-1
7.26 CDCl3
7.06 minor
7.05 minor
6.95 major
6.93 major
6.87 major
6.86 major
6.73 minor
6.72 minor
3.88 major
3.87 minor
2.69 major
2.69 major
2.68 major
2.68 major
2.67 major
2.66 major
2.65 major
2.65 major
2.62 minor
2.61 minor
2.60 minor
2.60 minor
2.59 minor
1.25 major
1.24 major
1.23 major
1.22 minor
1.20 minor
1.19 minor
F
Me
TfO
OMe
major
F
Me
MeO
OTf
minor
0.16
1.00
1.03
0.17
2.97
0.57
2.09
0.36
3.00
0.59
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
f1 (ppm)

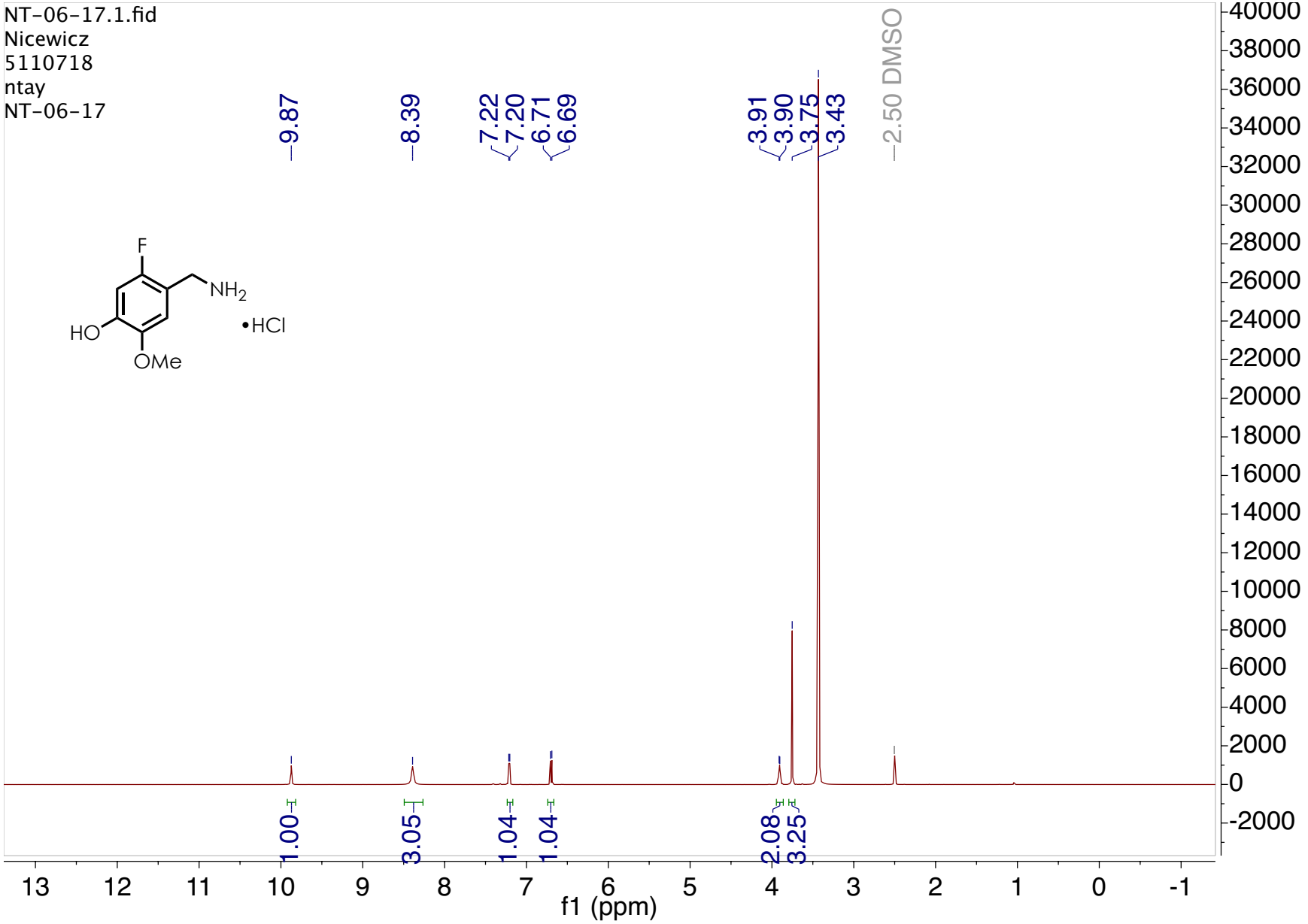

NT-5-272-1.2.fid
Nicewicz
C3308
ntay
NT-5-272-1
160.91 minor
159.27 minor
154.58 major
152.98 major
150.51 minor
150.44 minor
147.93 major
147.91 major
136.09 major
136.02 major
134.59 minor
134.57 minor
132.18 major
132.07 major
123.43 minor
123.30 minor
123.14 minor
123.09 minor
122.09 minor
122.06 major
119.97 minor
119.94 major
117.84 minor
117.81 major
115.72 minor
115.69 major
113.84 major
113.81 major
110.36 major
110.18 major
101.50 minor
101.31 minor
77.16 CDCl3
56.66 major
56.53 minor
22.51 major
22.50 major
21.43 minor
21.42 minor
14.25 major
14.24 major
14.19 minor
F
Me
TfO
OMe
major
F
Me
MeO
OTf
minor
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

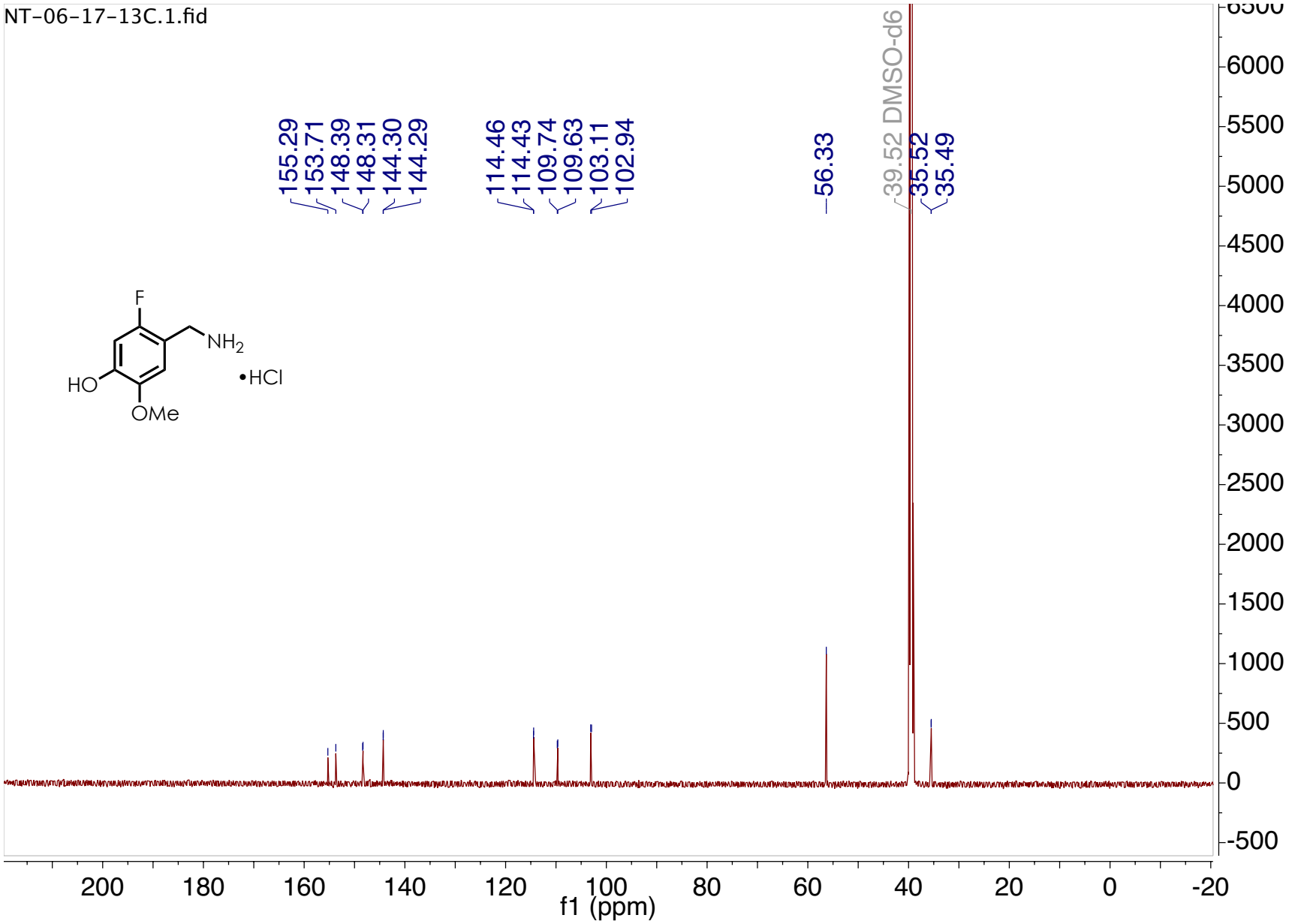

NT-05-272-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 13
F
Me
TfO
OMe
major
F
Me
MeO
OTf
minor
-73.68
-73.71
-114.59
-114.61
-114.62
-114.64
-125.33
-125.35
-125.36
-125.37
-161.64 C6F6
f1 (ppm)

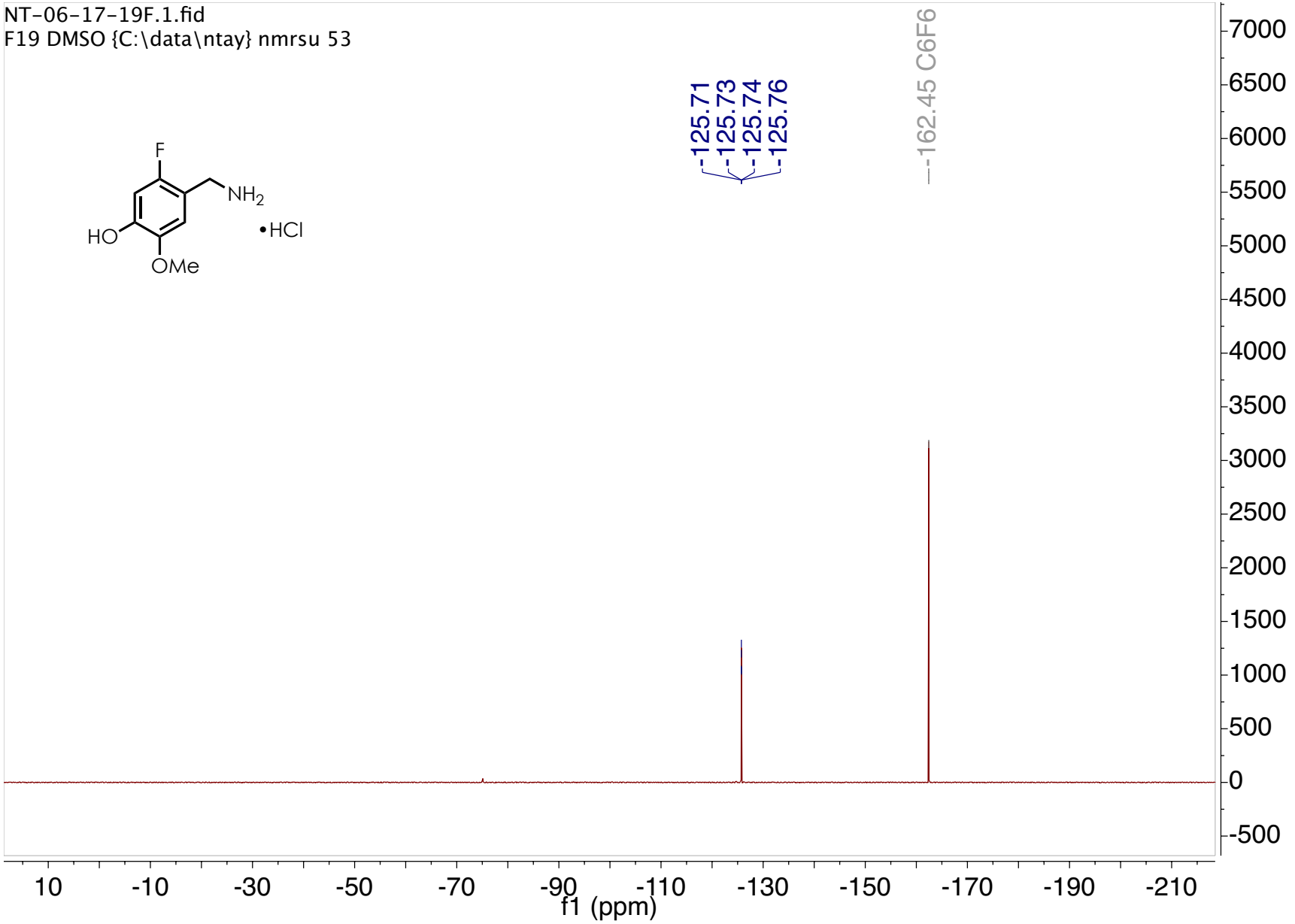

NT-06-14.1.fid
Nicewicz
5110718
ntay
NT-06-14
11.20
10.00
8.08
7.15
7.14
6.65
6.63
3.76
2.50 DMSO-d6
F
N
OH
HO
OMe
0.89
0.23
1.02
1.03
1.00
3.30
f1 (ppm)

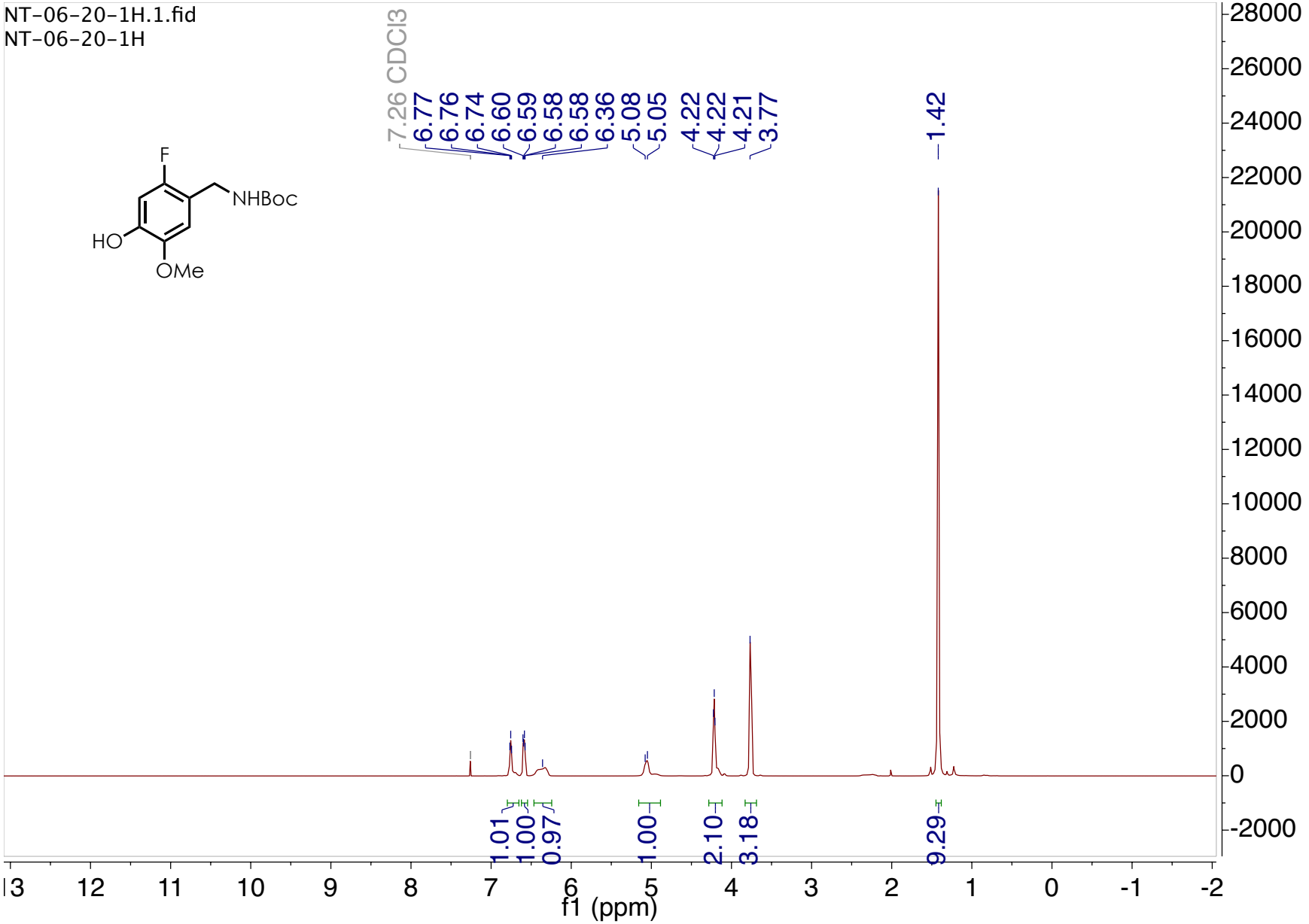

NT-06-14-13C.1.fid
155.54
153.94
149.42
149.34
144.84
144.83
141.55
141.54
110.16
110.08
108.04
108.00
103.32
103.15
56.01
39.52 DMSO-d6
F
N
OH
HO
OMe
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
200
180
160
140
120
100
80
60
40
20
0
-20
f1 (ppm)

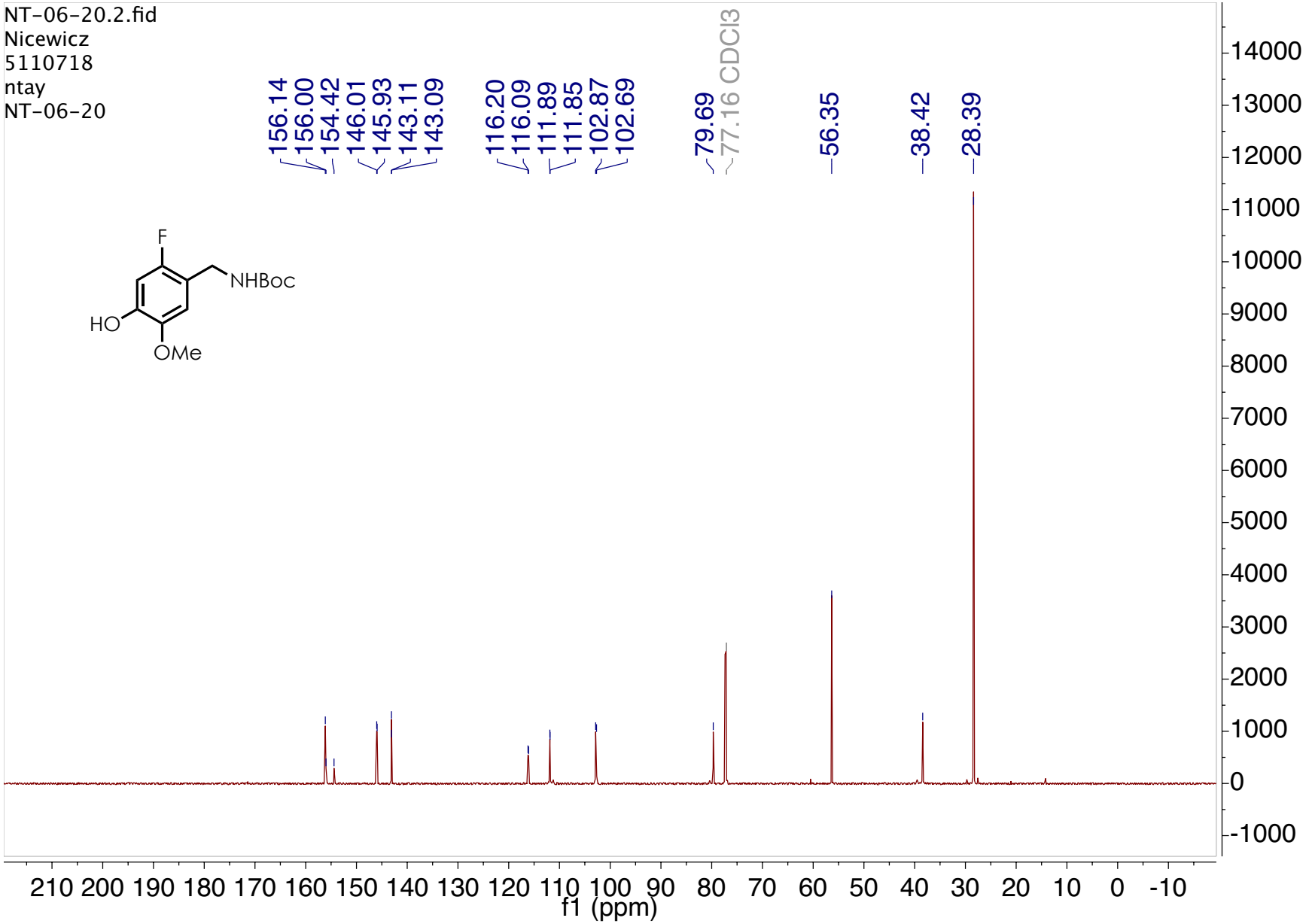

NT-06-14-19F 2.1.fid
F19 DMSO {C:\data\ntay} nmrsu 57
F
N
OH
HO
OMe
-127.80
-127.82
-127.83
-127.85
-127.87
-162.45 C6F6
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

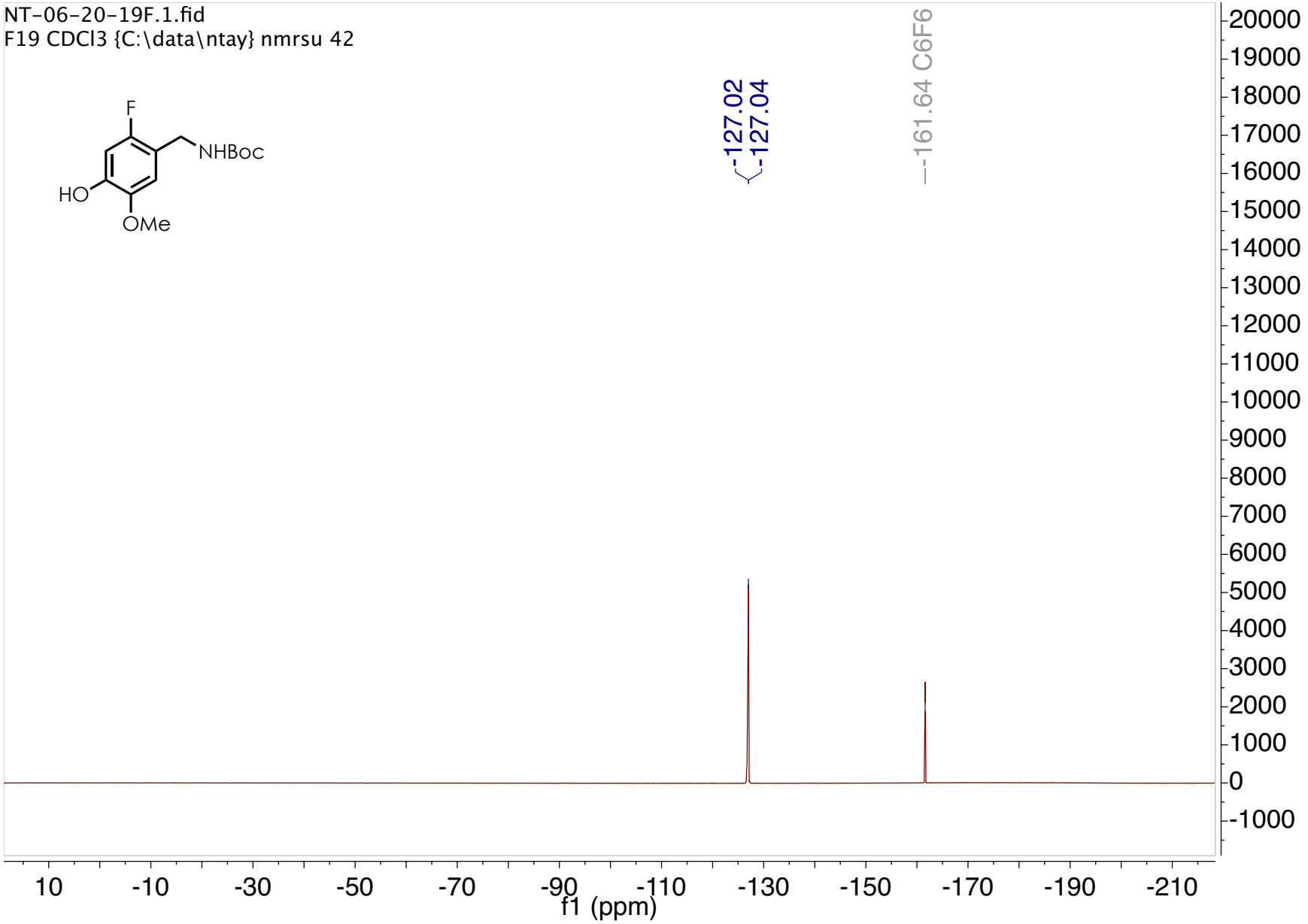

NT-06-17.1.fid
Nicewicz
5110718
ntay
NT-06-17
9.87
8.39
7.22
7.20
6.71
6.69
3.91
3.90
3.75
3.43
2.50 DMSO
F
NH2
HO
•HCl
OMe
1.00
3.05
1.04
1.04
2.08
3.25
f1 (ppm)

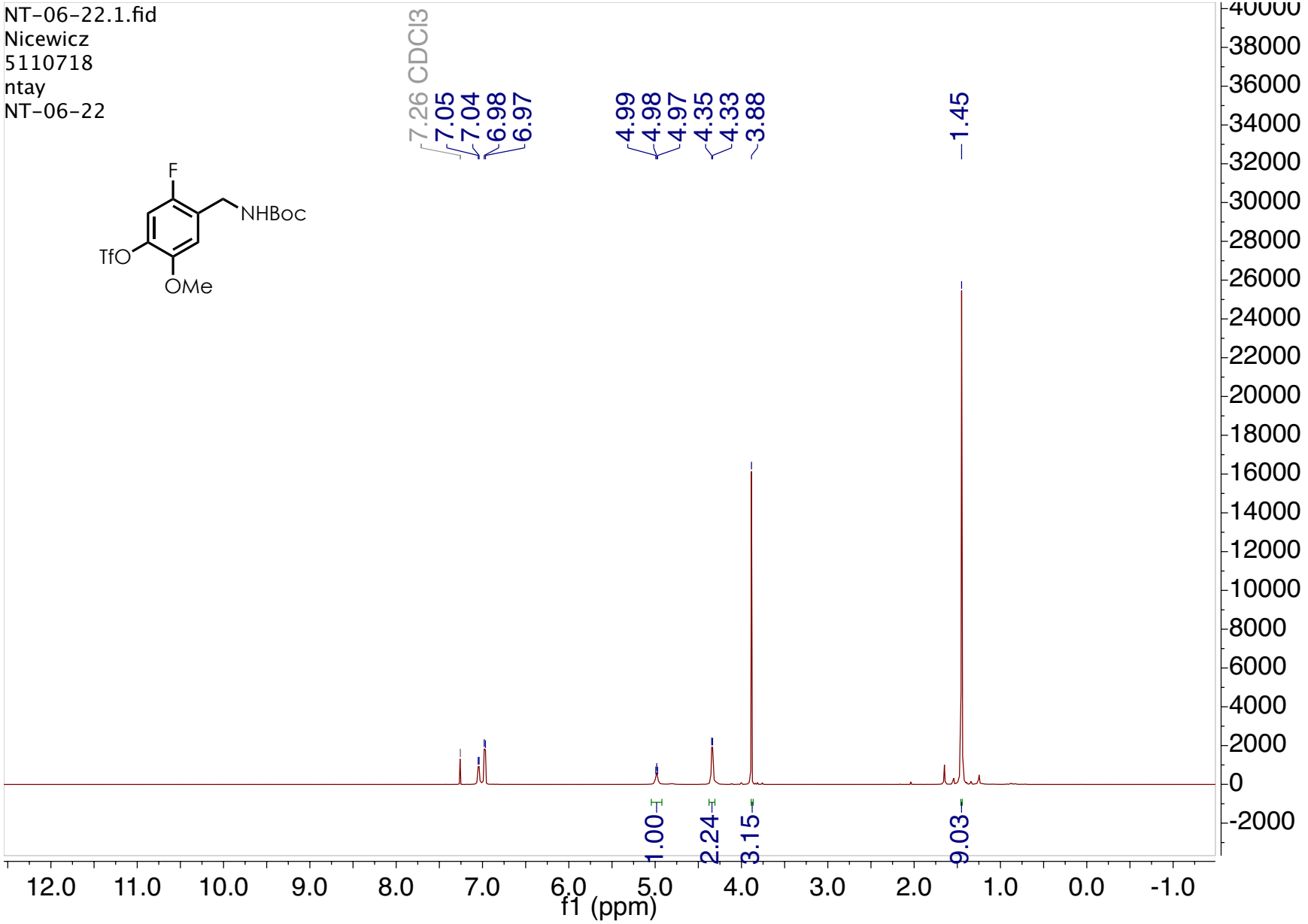

NT-06-17-13C.1.fid
155.29
153.71
148.39
148.31
144.30
144.29
114.46
114.43
109.74
109.63
103.11
102.94
56.33
39.52 DMSO-d6
35.52
35.49
F
NH2
•HCl
HO
OMe
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
200
180
160
140
120
100
80
60
40
20
0
-20
f1 (ppm)

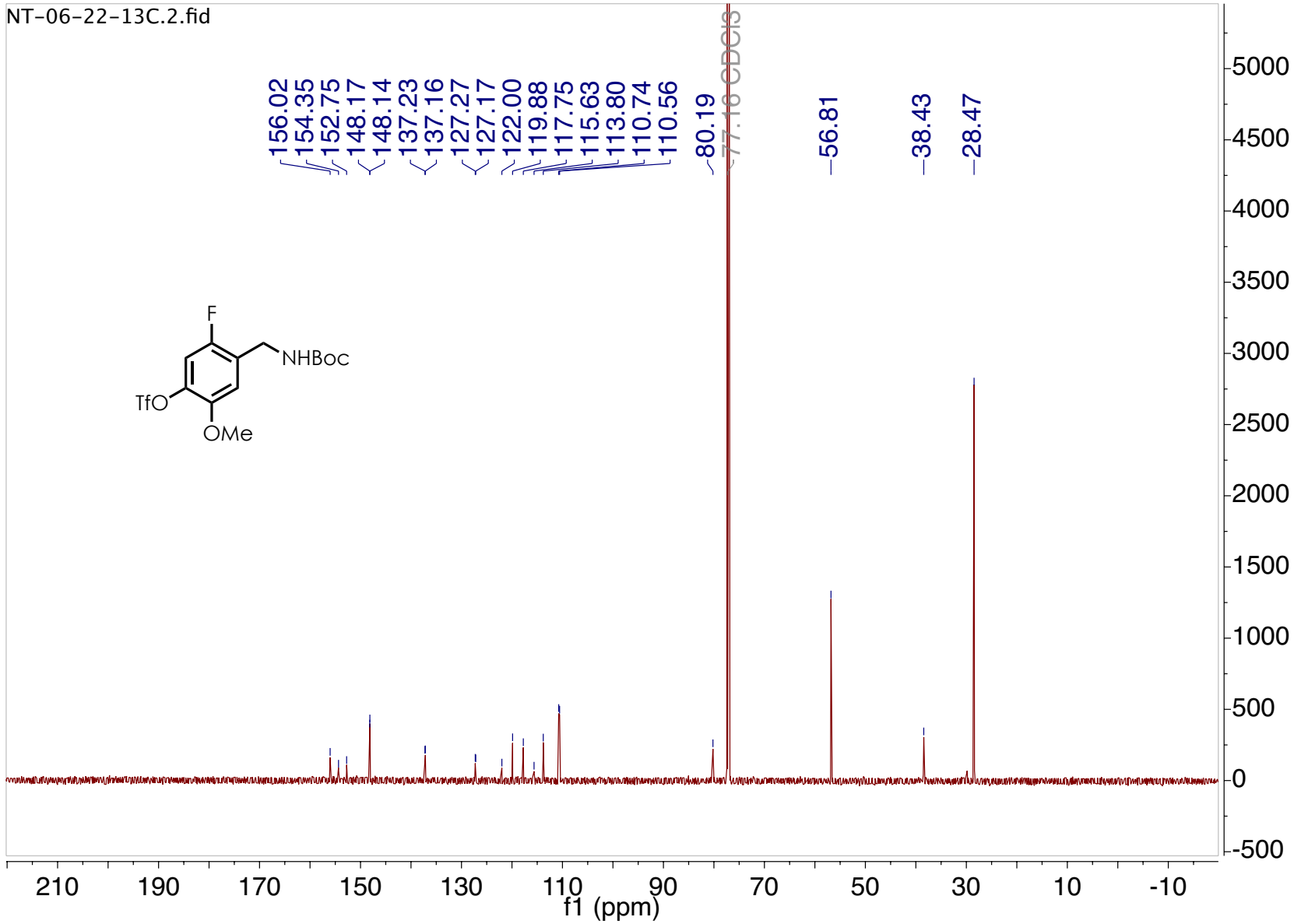

NT-06-17-19F.1.fid
F19 DMSO {C:\data\ntay} nmrsu 53
F
NH2
HO
•HCl
OMe
-125.71
-125.73
-125.74
-125.76
-162.45 C6F6
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

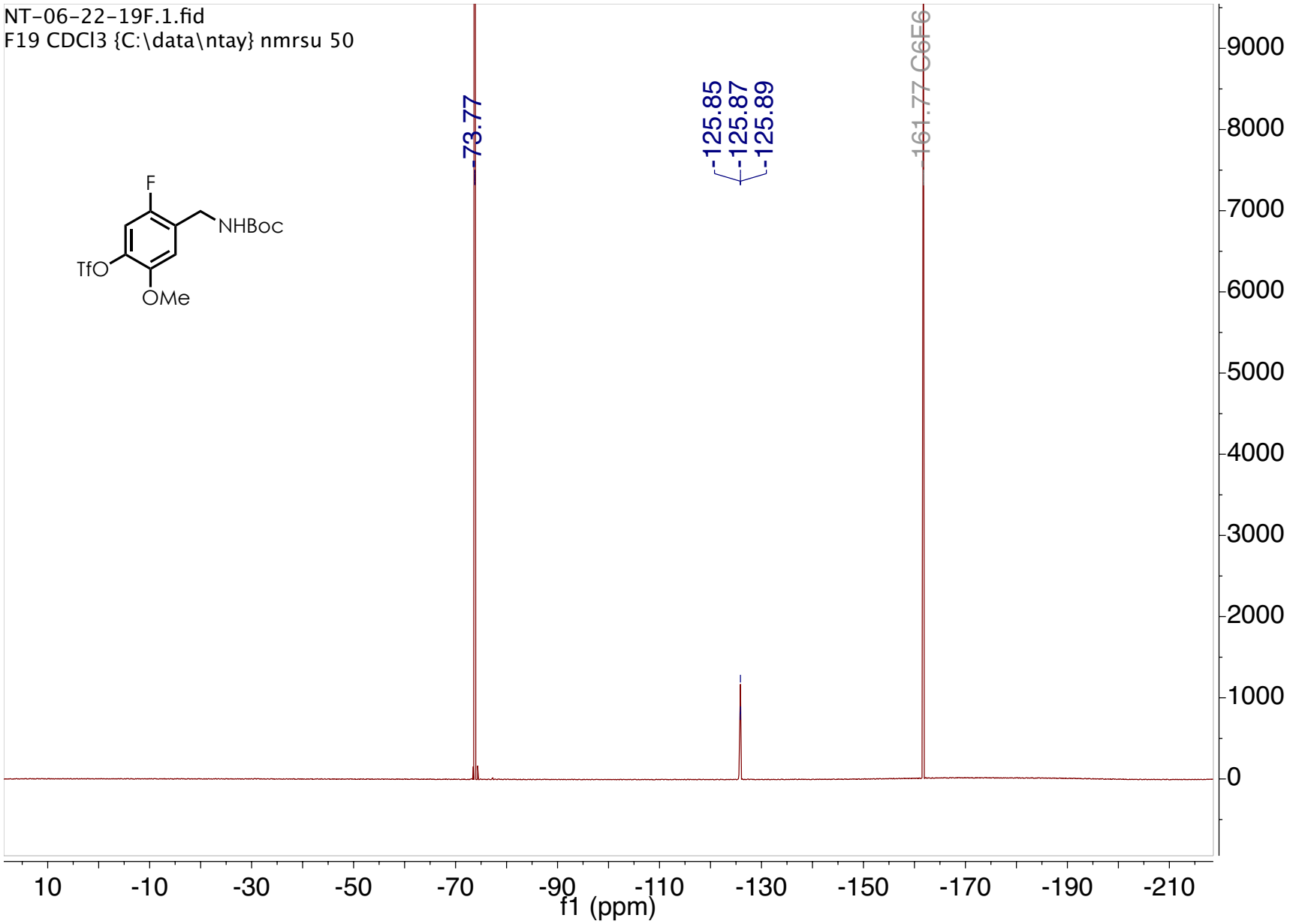

NT-06-20-1H.1.fid
NT-06-20-1H
7.26 CDCl3
6.77
6.76
6.74
6.60
6.59
6.58
6.58
6.36
5.08
5.05
4.22
4.22
4.21
3.77
1.42
F
NHBoc
HO
OMe
1.01
1.00
0.97
1.00
2.10
3.18
9.29
f1 (ppm)

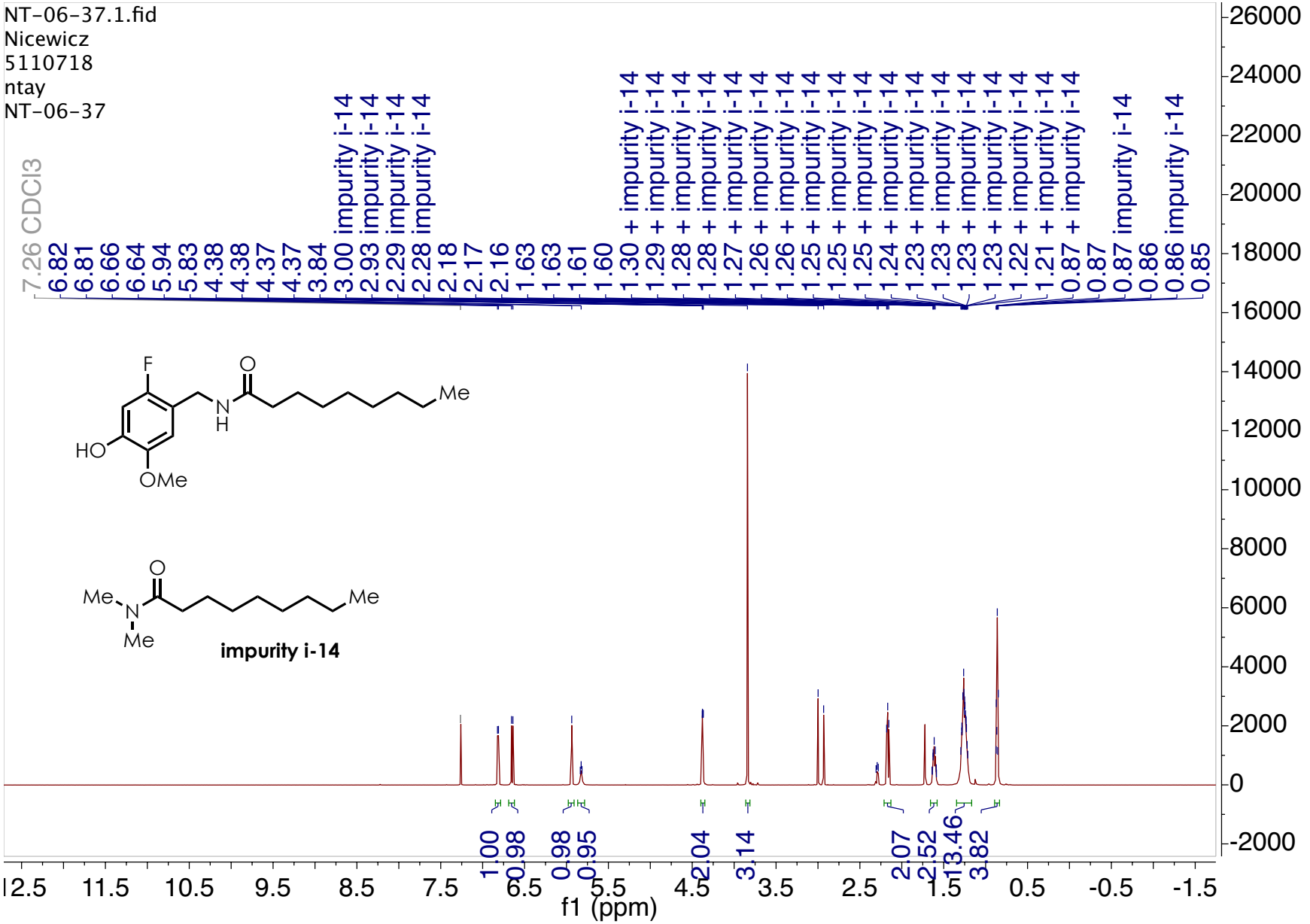

NT-06-20.2.fid
Nicewicz
5110718
ntay
NT-06-20
156.14
156.00
154.42
146.01
145.93
143.11
143.09
116.20
116.09
111.89
111.85
102.87
102.69
79.69
77.16 CDCl3
56.35
38.42
28.39
F
NHBoc
HO
OMe
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

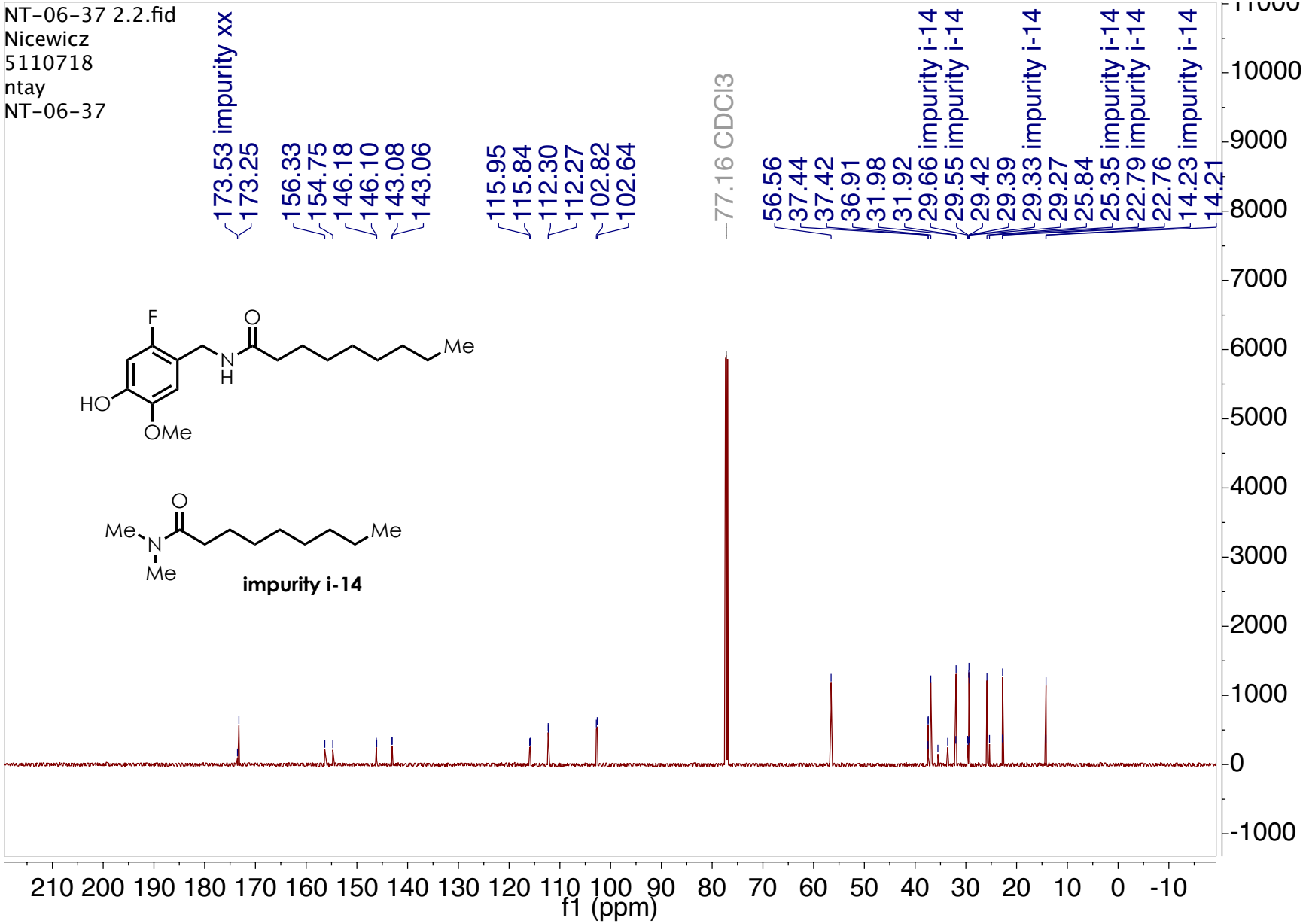

NT-06-20-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 42
F
NHBoc
HO
OMe
-127.02
-127.04
-161.64 C6F6
20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

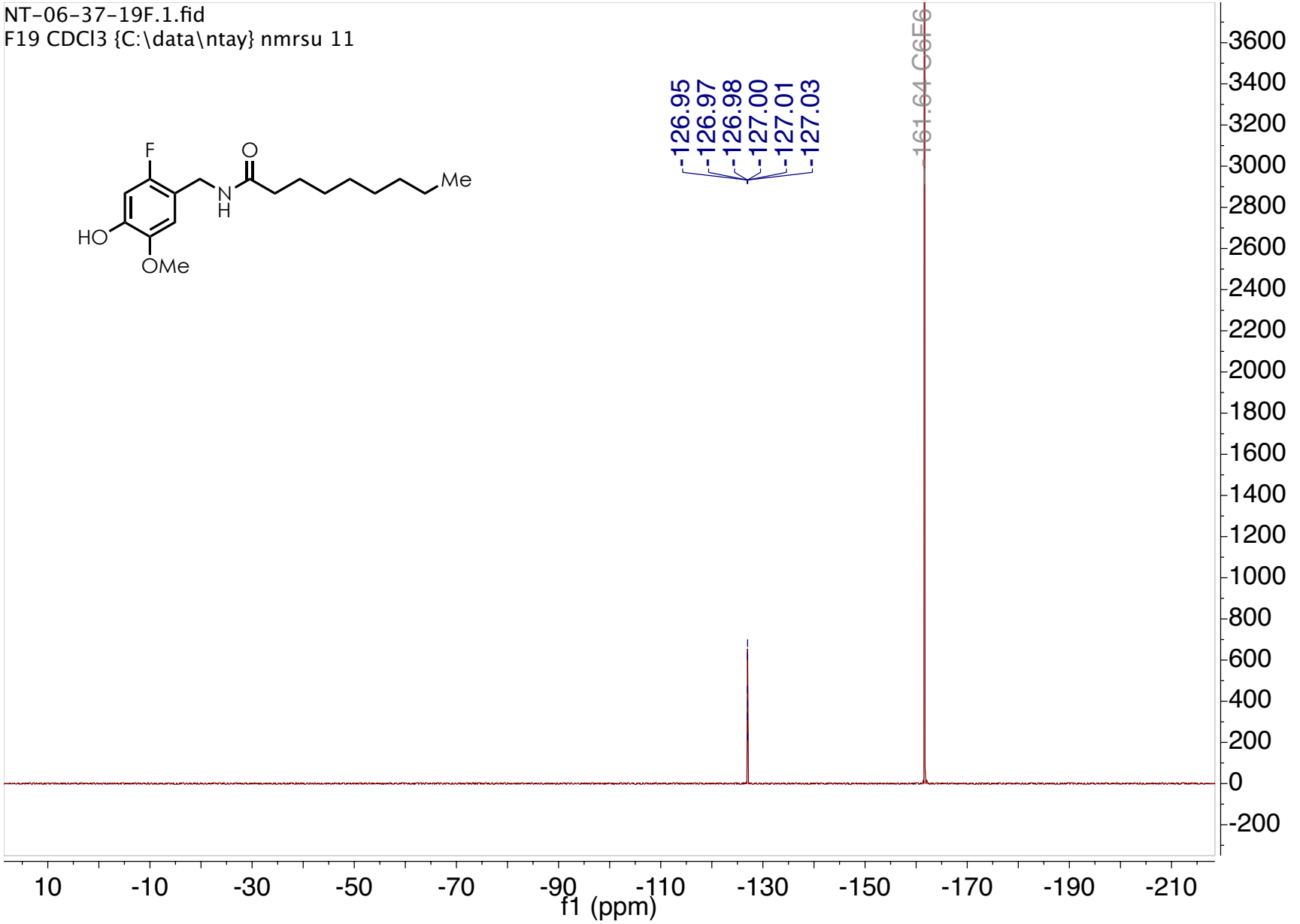

NT-06-22.1.fid
Nicewicz
5110718
ntay
NT-06-22
7.26 CDCl3
7.05
7.04
6.98
6.97
4.99
4.98
4.97
4.35
4.33
3.88
1.45
F
NHBoc
TfO
OMe
1.00
2.24
3.15
9.03
f1 (ppm)

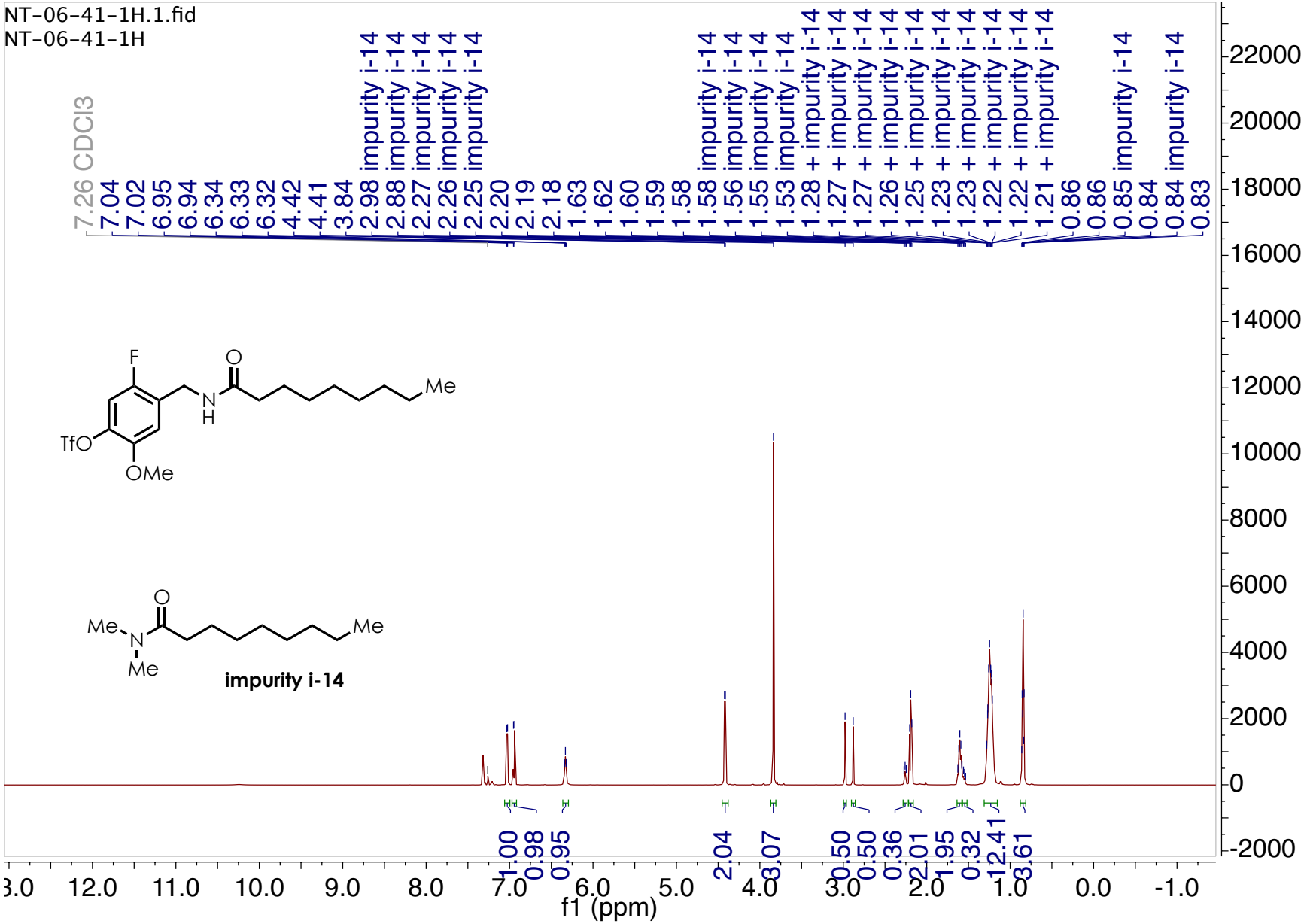

NT-06-22-13C.2.fid
156.02
154.35
152.75
148.17
148.14
137.23
137.16
127.27
127.17
122.00
119.88
117.75
115.63
113.80
110.74
110.56
80.19
77.16 CDCl3
56.81
38.43
28.47
F
NHBoc
TfO
OMe
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

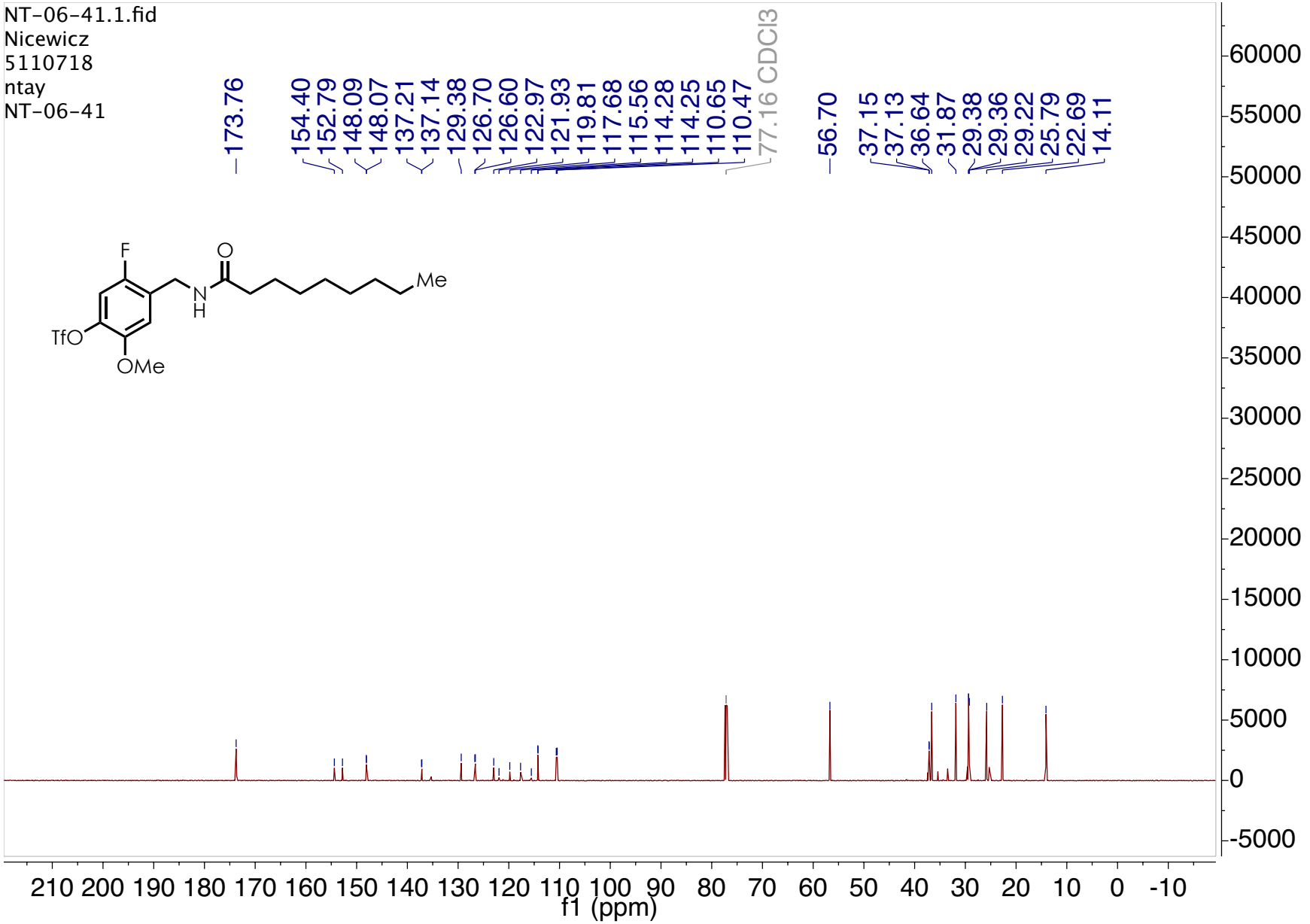

NT-06-22-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 50
F
NHBoc
TfO
OMe
-73.77
-125.85
-125.87
-125.89
-161.77 C6F6
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

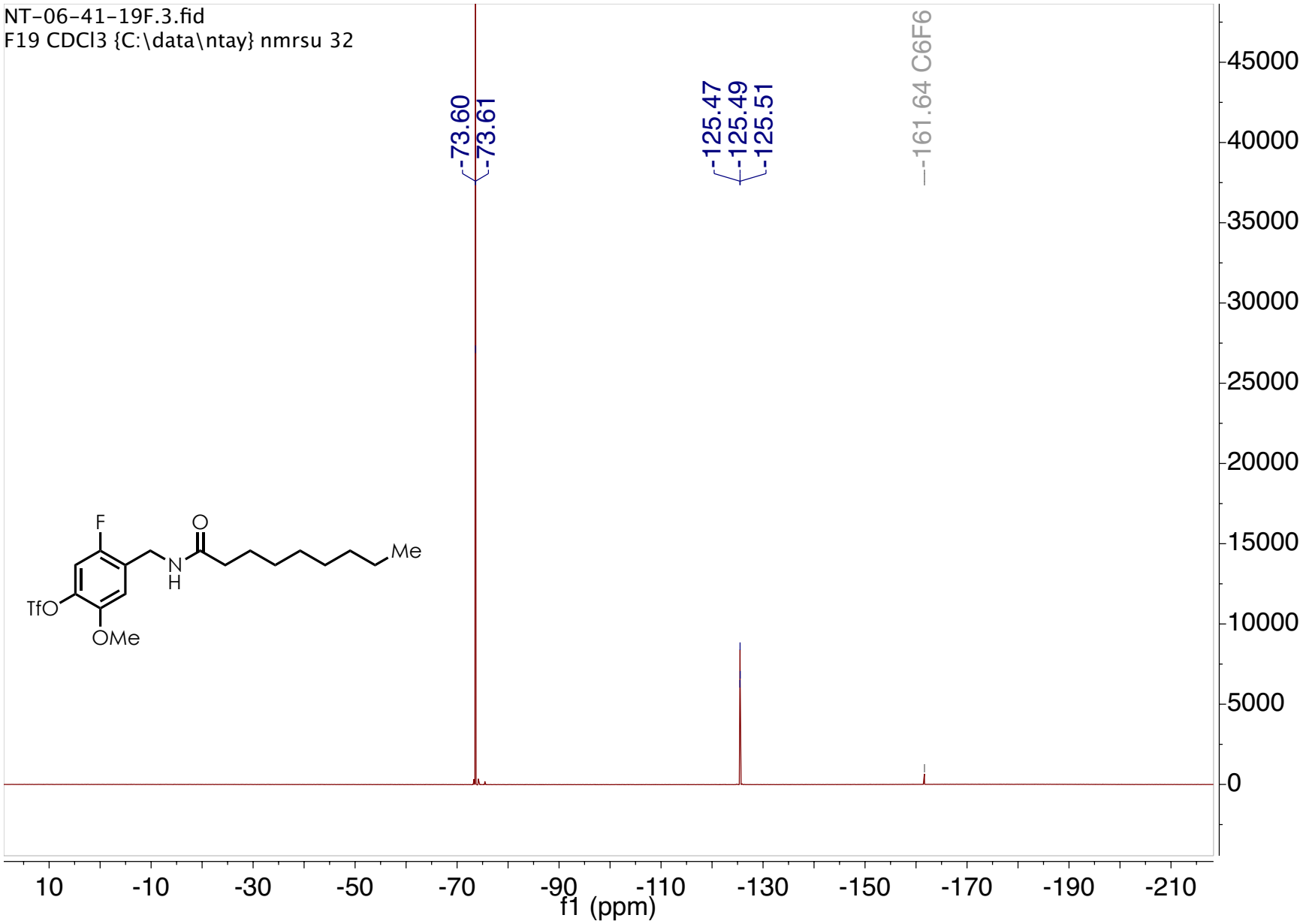

NT-06-37.1.fid
Nicewicz
5110718
ntay
NT-06-37
7.26 CDCl3
6.82 6.81 6.66 6.64 5.94 5.83 4.38 4.38 4.37 4.37 3.84 3.00 impurity i-14 2.93 impurity i-14 2.29 impurity i-14 2.28 impurity i-14 2.18 2.17 2.16 1.63 1.63 1.61 1.60 1.30 + impurity i-14 1.29 + impurity i-14 1.28 + impurity i-14 1.28 + impurity i-14 1.27 + impurity i-14 1.26 + impurity i-14 1.26 + impurity i-14 1.25 + impurity i-14 1.25 + impurity i-14 1.25 + impurity i-14 1.24 + impurity i-14 1.23 + impurity i-14 1.23 + impurity i-14 1.23 + impurity i-14 1.23 + impurity i-14 1.22 + impurity i-14 1.21 + impurity i-14 0.87 + impurity i-14 0.87 0.87 impurity i-14 0.86 0.86 impurity i-14 0.85
F
O
N
H
Me
HO
OMe
O
Me
N
Me
Me
impurity i-14
1.00 0.98 0.98 0.95 2.04 3.14 2.07 2.52 3.46 3.82
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
12.5 11.5 10.5 9.5 8.5 7.5 6.5 5.5 4.5 3.5 2.5 1.5 0.5 -0.5 -1.5
f1 (ppm)

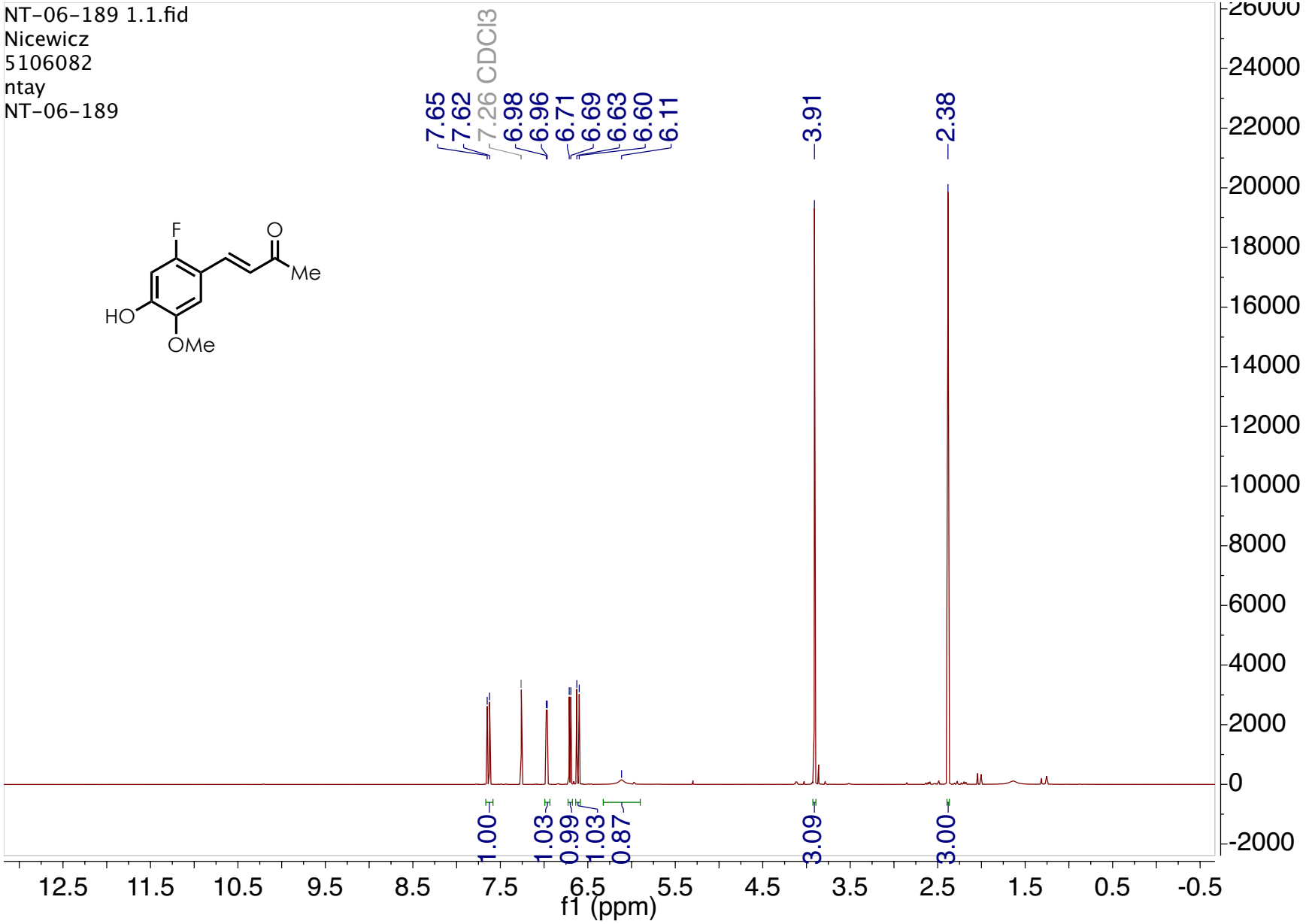

NT-06-37 2.2.fid
Nicewicz
5110718
ntay
NT-06-37
173.53 impurity xx
173.25
156.33
154.75
146.18
146.10
143.08
143.06
115.95
115.84
112.30
112.27
102.82
102.64
77.16 CDCl3
56.56
37.44
37.42
36.91
31.98
31.92
29.66 impurity i-14
29.55 impurity i-14
29.42
29.39
29.33 impurity i-14
29.27
25.84
25.35 impurity i-14
22.79 impurity i-14
22.76
14.23 impurity i-14
14.21
F
O
N
H
Me
HO
OMe
O
Me
N
Me
Me
impurity i-14
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

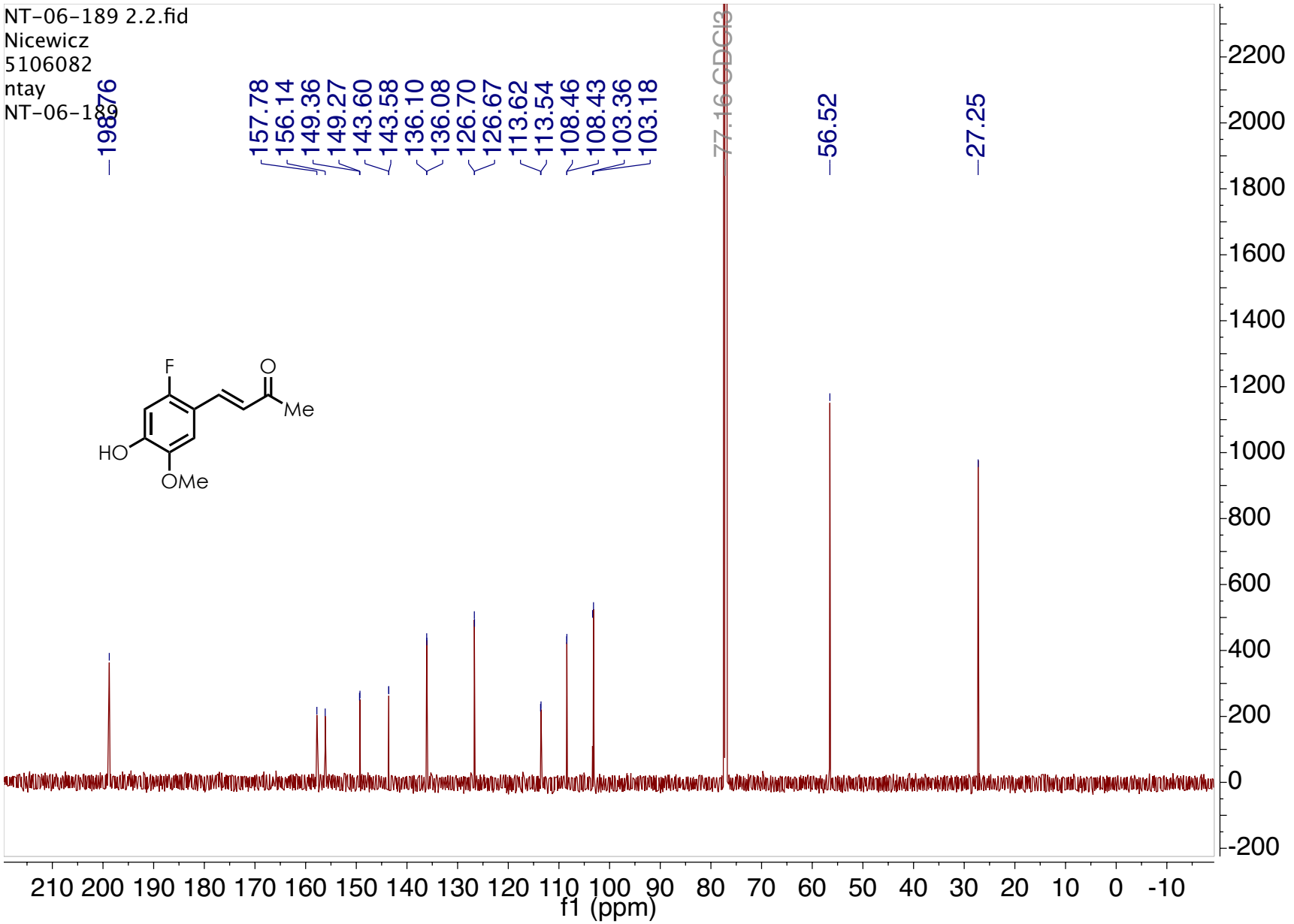

NT-06-37-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 11
F
O
N
H
Me
HO
OMe
-126.95
-126.97
-126.98
-127.00
-127.01
-127.03
-161.64 C6F6
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

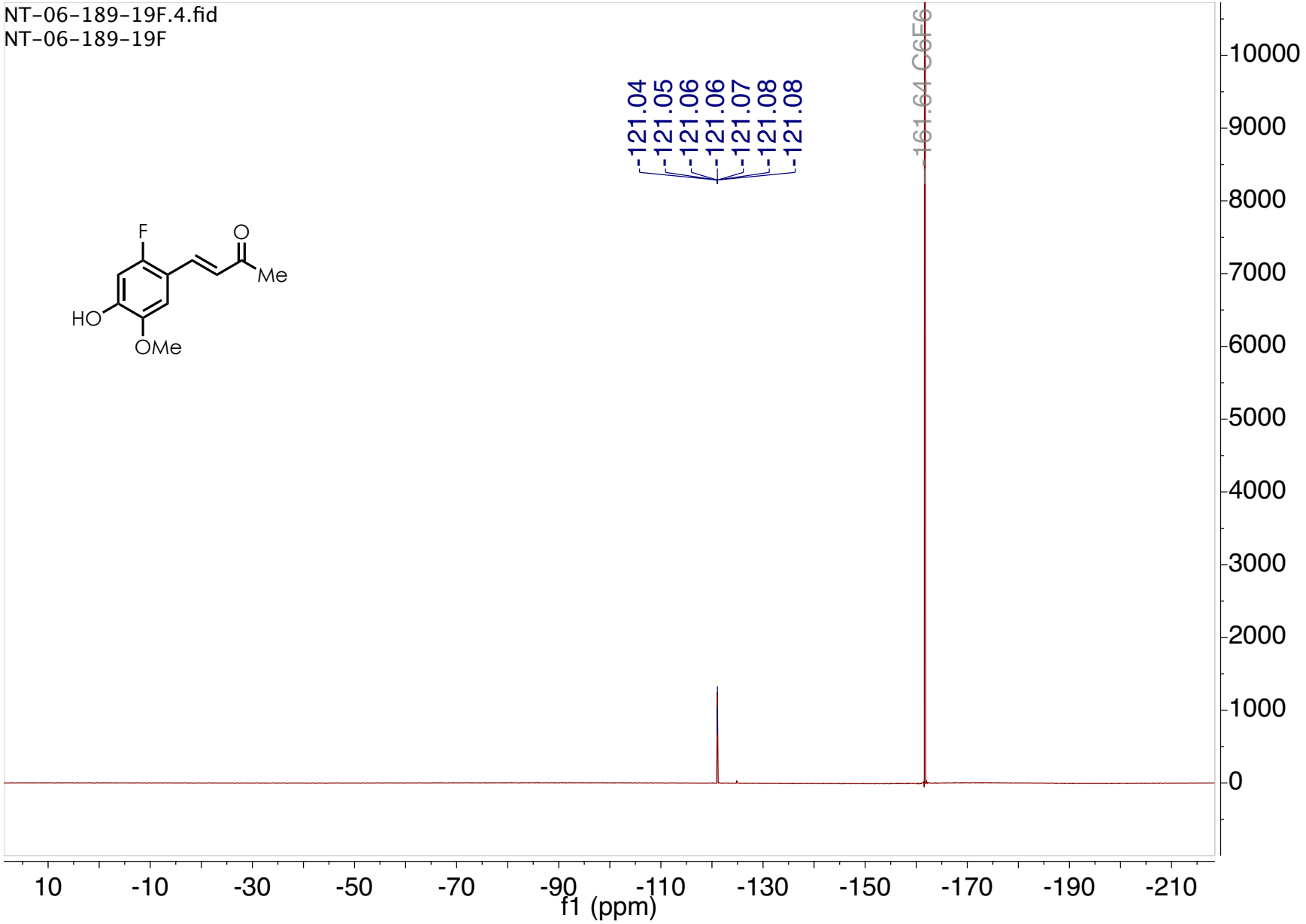

NT-06-41-1H.1.fid
NT-06-41-1H
7.26 CDCl3
7.04 7.02 6.95 6.94 6.34 6.33 6.32 4.42 4.41 3.84 2.98 impurity i-14 2.88 impurity i-14 2.27 impurity i-14 2.26 impurity i-14 2.25 impurity i-14 2.20 2.19 2.18 1.63 1.62 1.60 1.59 1.58 1.58 impurity i-14 1.56 impurity i-14 1.55 impurity i-14 1.53 impurity i-14 1.28 + impurity i-14 1.27 + impurity i-14 1.27 + impurity i-14 1.26 + impurity i-14 1.25 + impurity i-14 1.23 + impurity i-14 1.23 + impurity i-14 1.22 + impurity i-14 1.22 + impurity i-14 1.21 + impurity i-14 0.86 0.86 0.85 impurity i-14 0.84 0.84 impurity i-14 0.83
F
O
N
H
Me
TfO
OMe
O
Me
N
Me
Me
impurity i-14
1.00 0.98 0.95 2.04 3.07 0.50 0.50 0.36 2.01 1.95 0.32 12.41 3.61
22000 20000 18000 16000 14000 12000 10000 8000 6000 4000 2000 0 -2000
3.0 12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1.0
f1 (ppm)

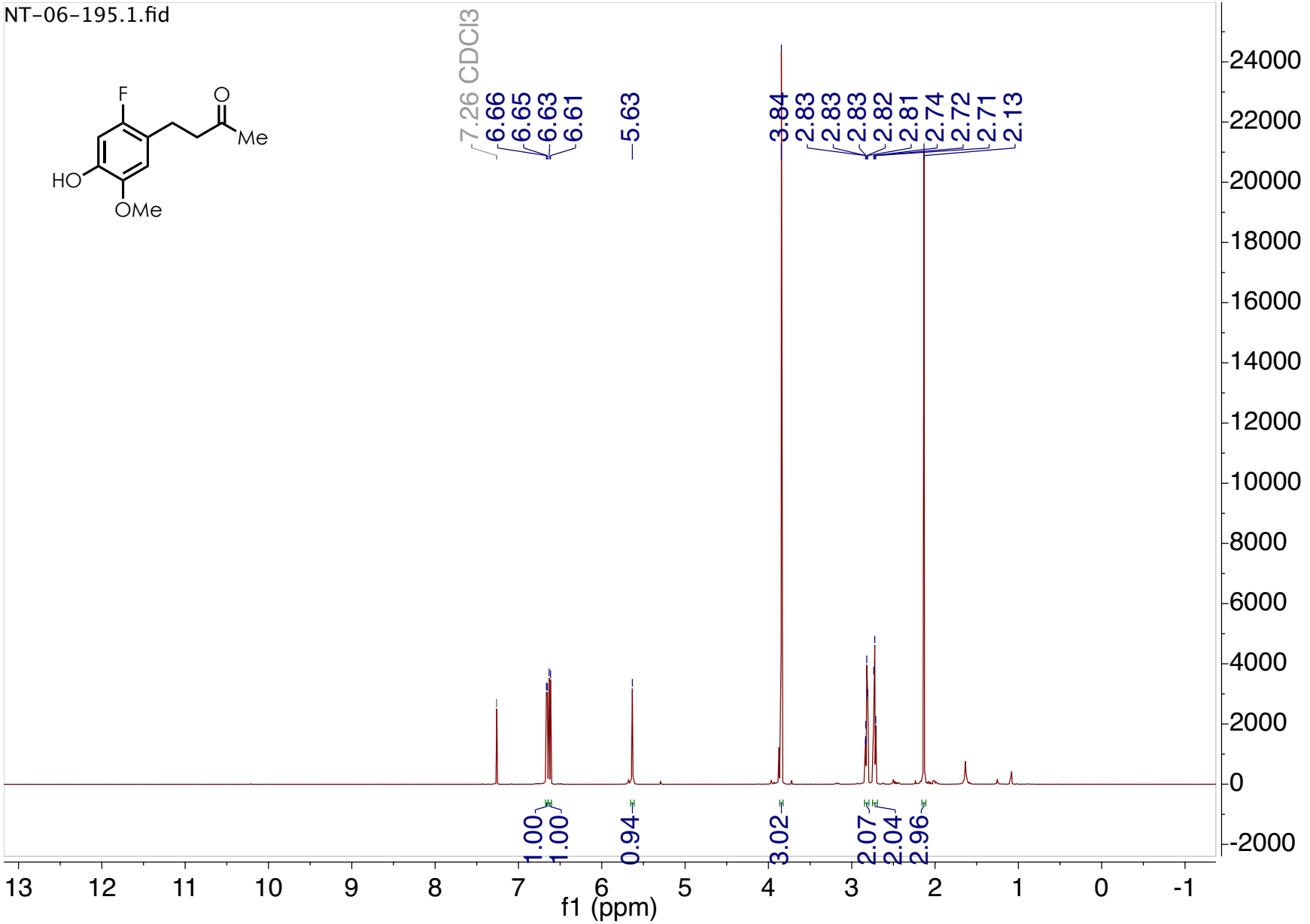

NT-06-41.1.fid
Nicewicz
5110718
ntay
NT-06-41
173.76
154.40
152.79
148.09
148.07
137.21
137.14
129.38
126.70
126.60
122.97
121.93
119.81
117.68
115.56
114.28
114.25
110.65
110.47
77.16 CDCl3
56.70
37.15
37.13
36.64
31.87
29.38
29.36
29.22
25.79
22.69
14.11
F
O
N
H
Me
TfO
OMe
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

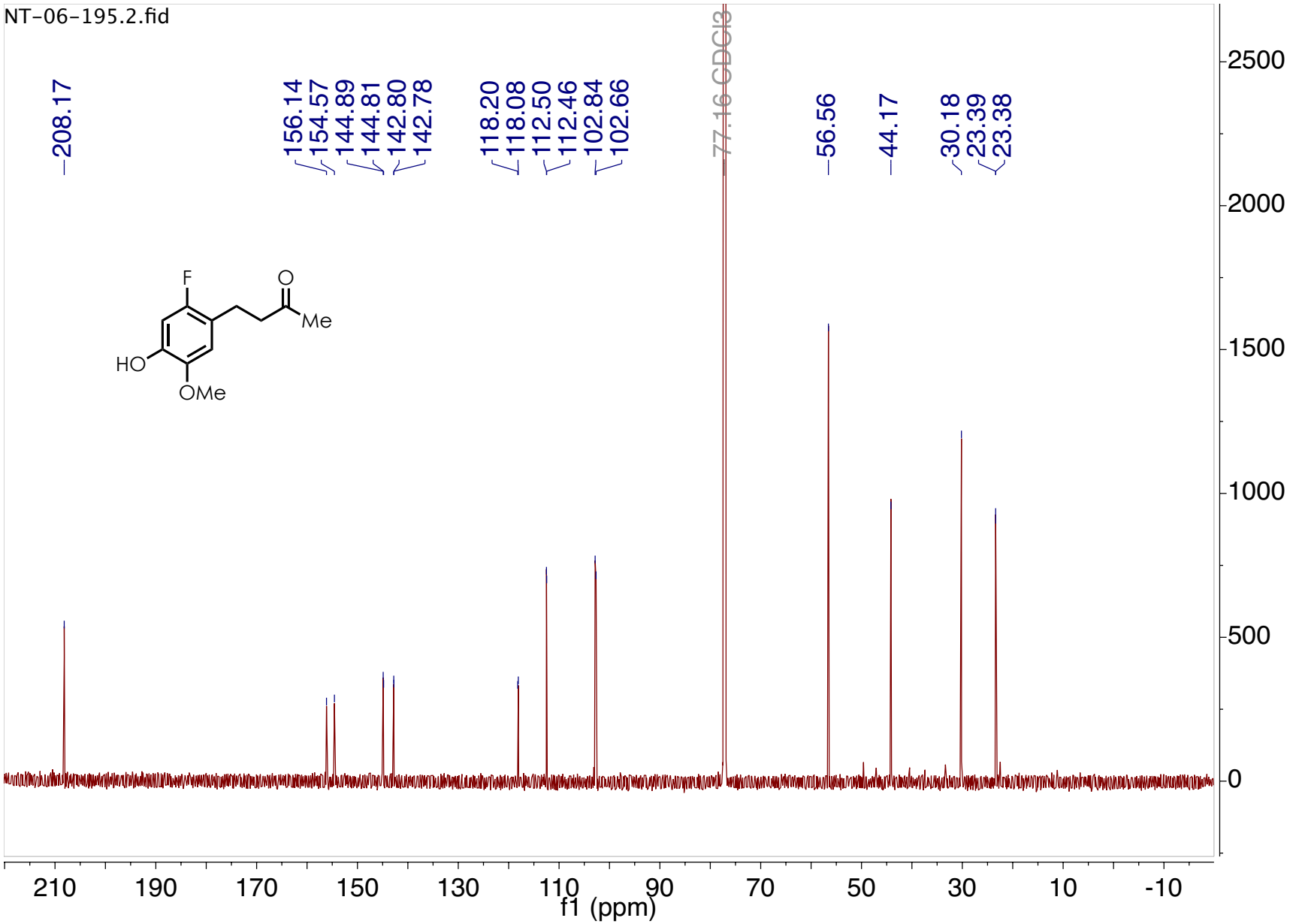

NT-06-41-19F.3.fid
F19 CDCl3 {C:\data\ntay} nmrsu 32
-73.60
-73.61
-125.47
-125.49
-125.51
-161.64 C6F6
F
O
N
H
Me
TfO
OMe
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

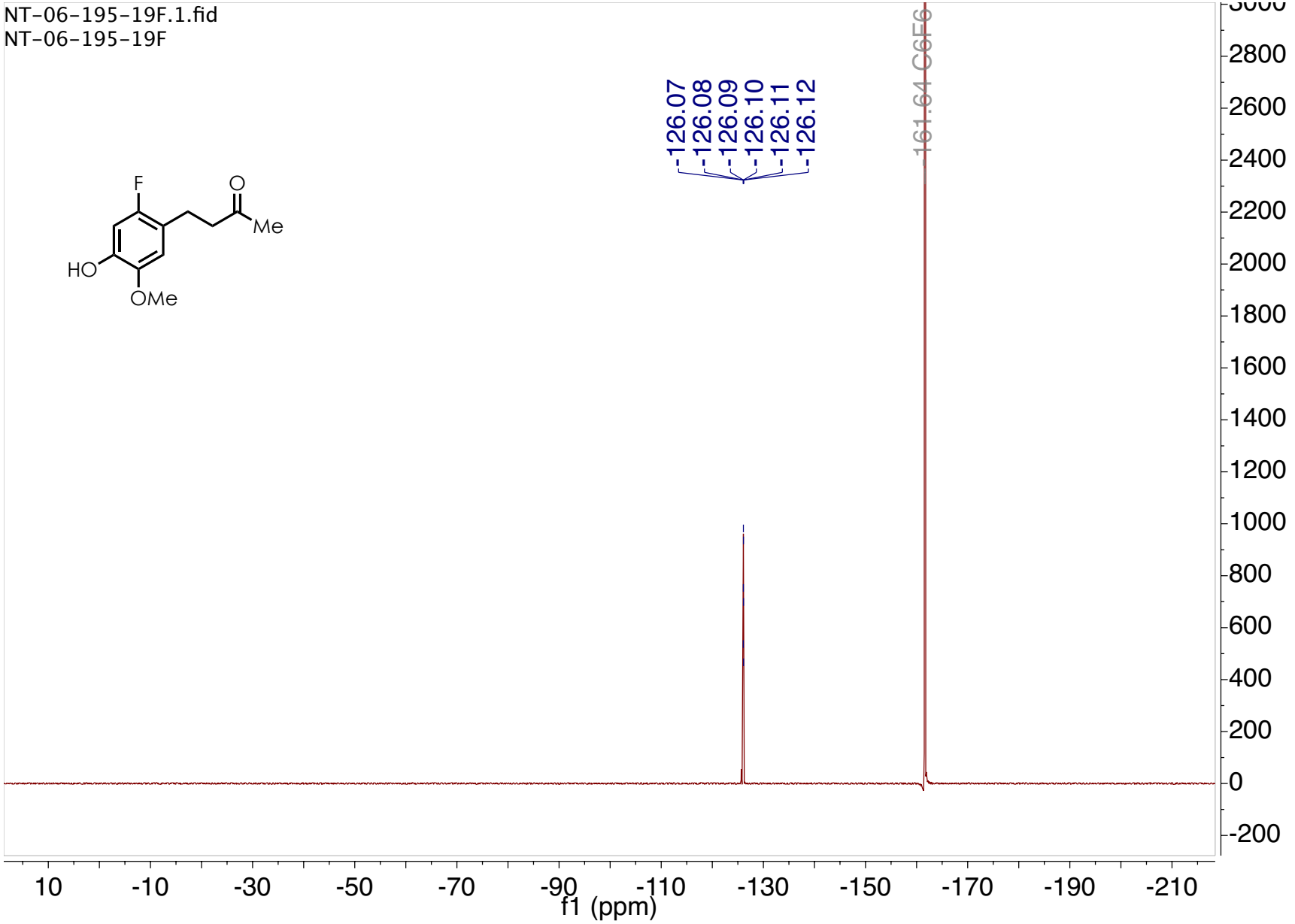

NT-06-189 1.1.fid
Nicewicz
5106082
ntay
NT-06-189
7.65
7.62
7.26 CDCl3
6.98
6.96
6.71
6.69
6.63
6.60
6.11
3.91
2.38
F
O
Me
HO
OMe
1.00
1.03
0.99
1.03
0.87
3.09
3.00
f1 (ppm)

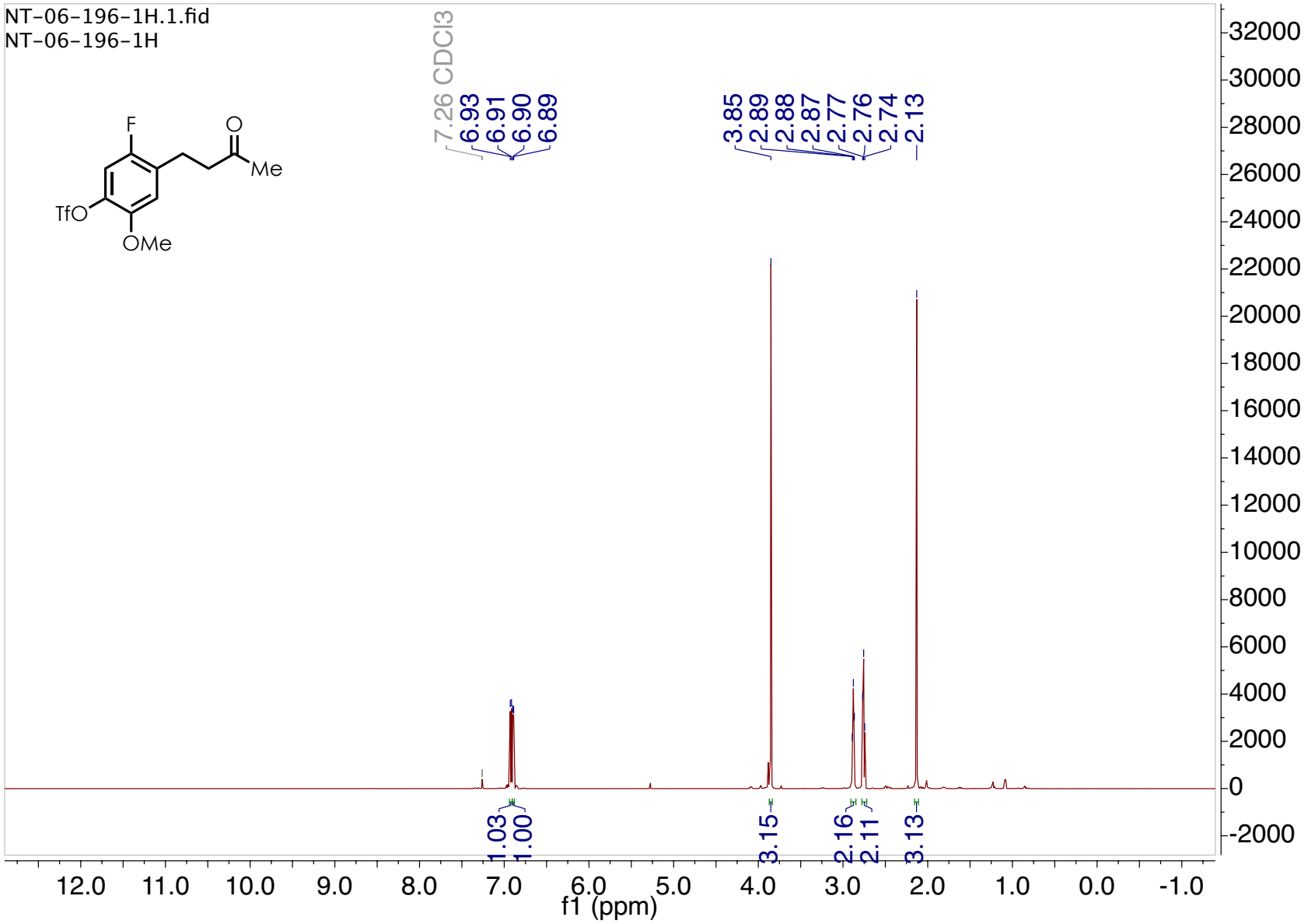

NT-06-189 2.2.fid
Nicewicz
5106082
ntay
NT-06-189
198.76
157.78
156.14
149.36
149.27
143.60
143.58
136.10
136.08
126.70
126.67
113.62
113.54
108.46
108.43
103.36
103.18
77.16 CDCl3
56.52
27.25
F
O
Me
HO
OMe
f1 (ppm)

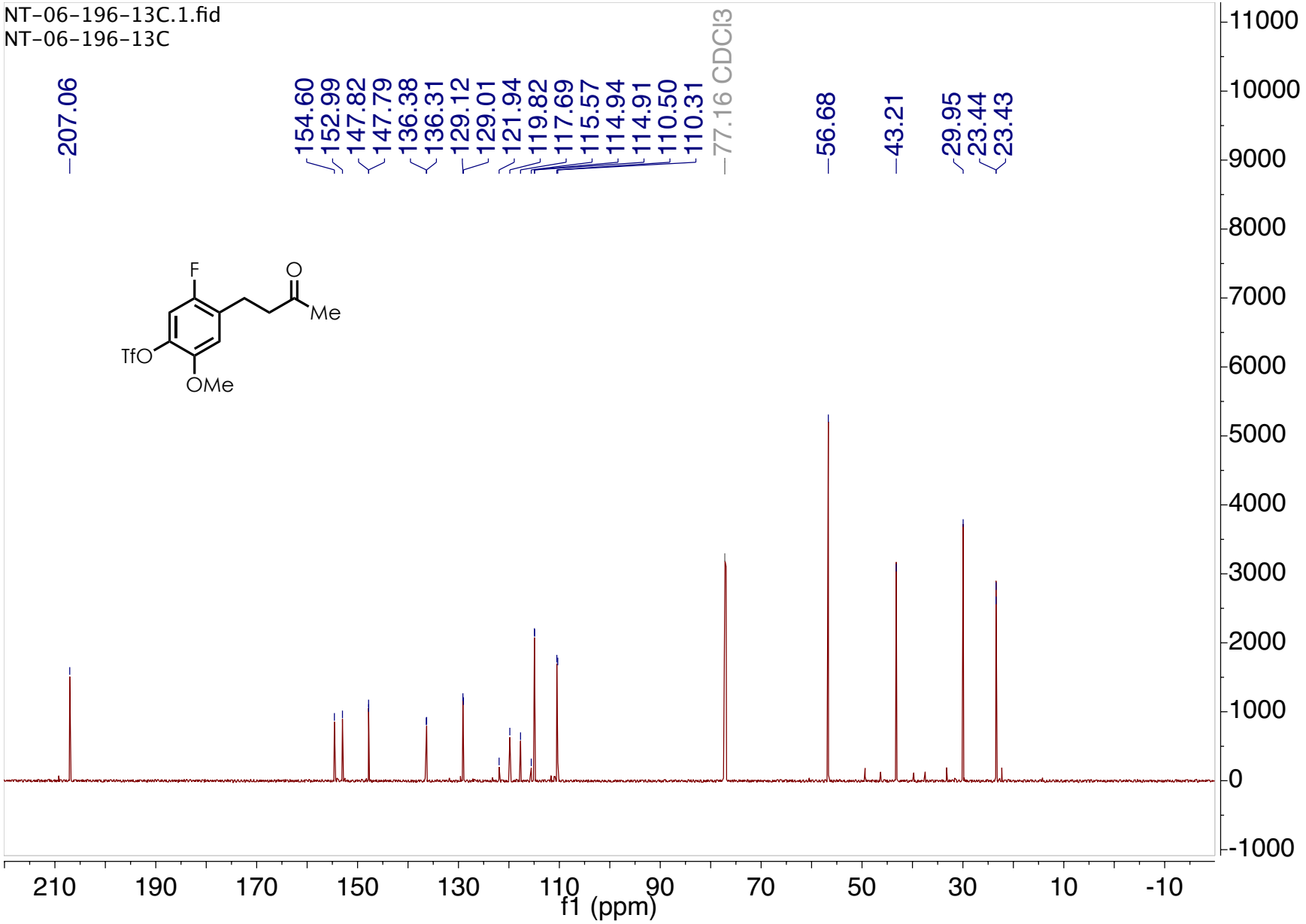

NT-06-189-19F.4.fid
NT-06-189-19F
-121.04
-121.05
-121.06
-121.06
-121.07
-121.08
-121.08
-161.64 C6F6
F
O
Me
HO
OMe
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

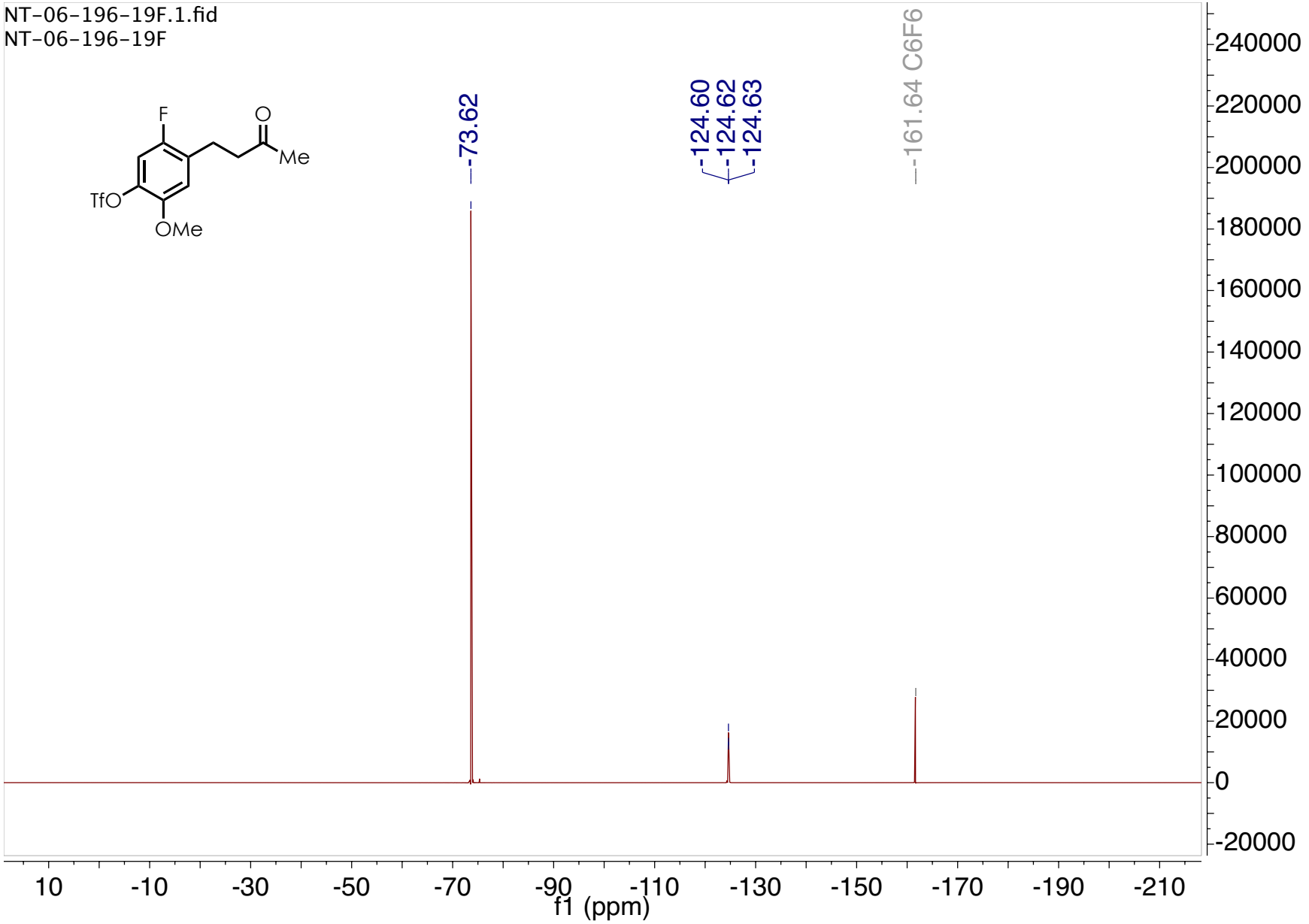

NT-06-195.1.fid
F
O
Me
HO
OMe
7.26 CDCl3
6.66
6.65
6.63
6.61
5.63
3.84
2.83
2.83
2.83
2.82
2.81
2.74
2.72
2.71
2.13
1.00
1.00
0.94
3.02
2.07
2.04
2.96
f1 (ppm)

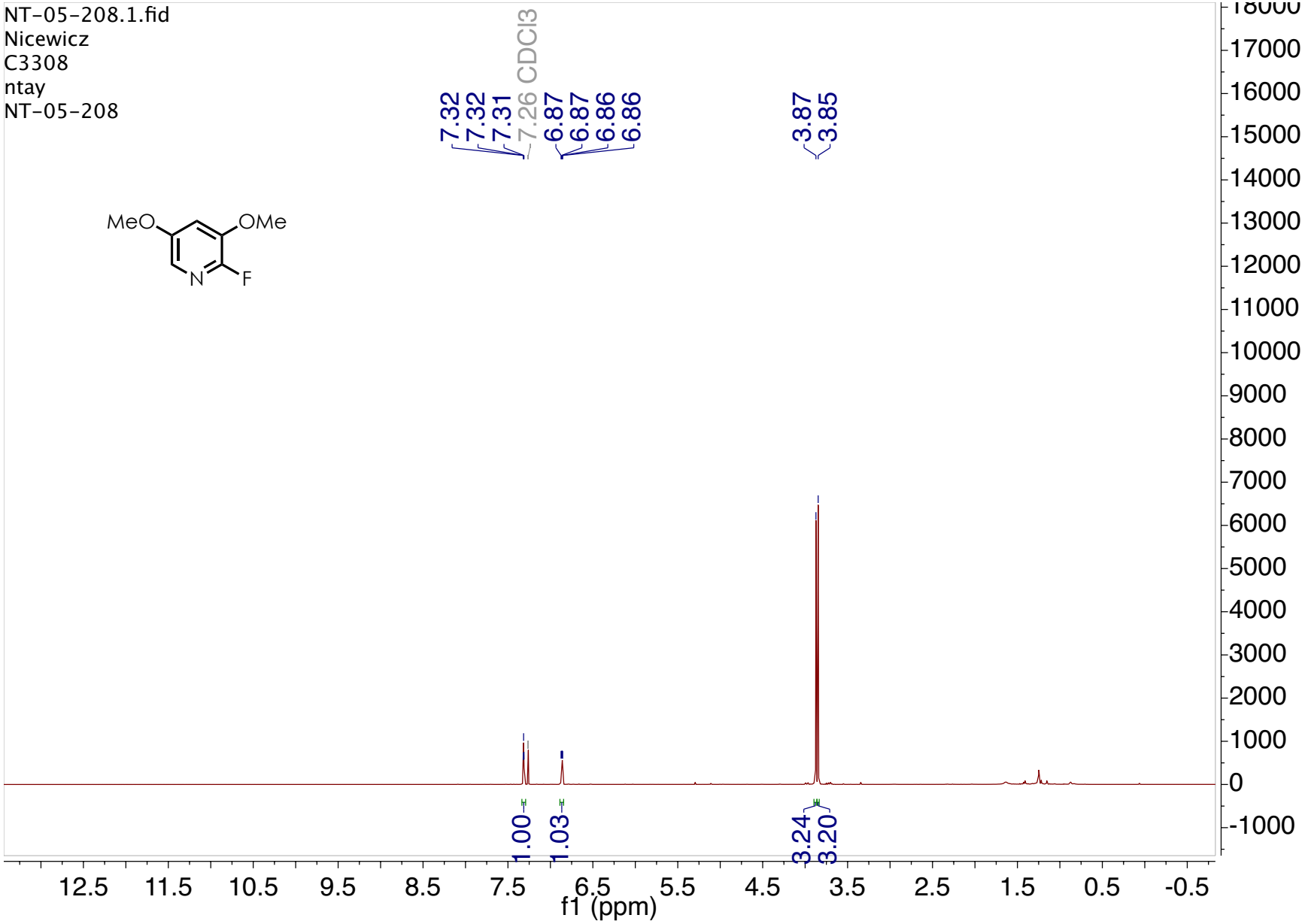

NT-06-195.2.fid
208.17
156.14
154.57
144.89
144.81
142.80
142.78
118.20
118.08
112.50
112.46
102.84
102.66
77.16 CDCl3
56.56
44.17
30.18
23.39
23.38
F
O
Me
HO
OMe
2500
2000
1500
1000
500
0
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

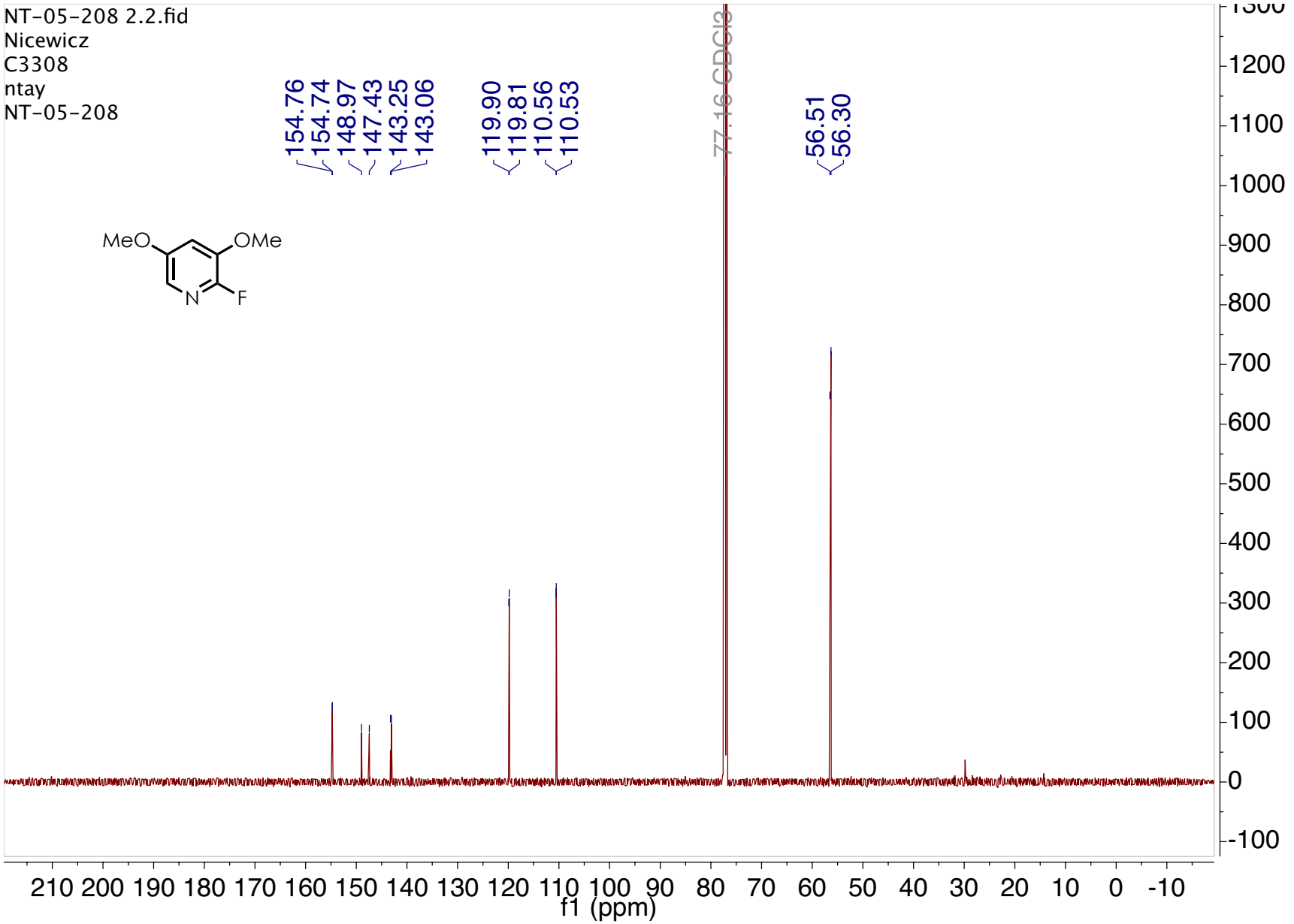

NT-06-195-19F.1.fid
NT-06-195-19F
-126.07
-126.08
-126.09
-126.10
-126.11
-126.12
-161.64 C6F6
F
O
Me
HO
OMe
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

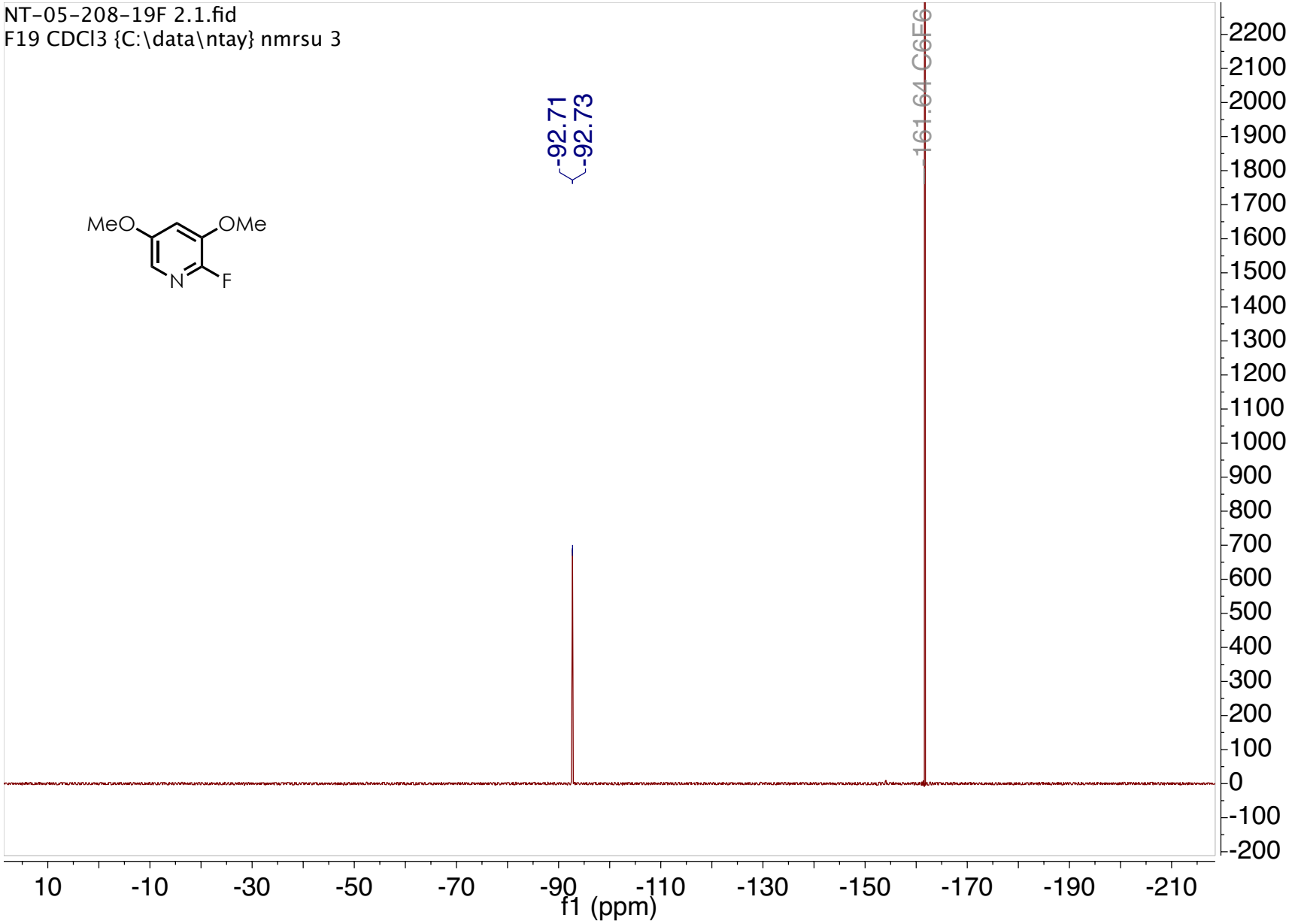

NT-06-196-1H.1.fid
NT-06-196-1H
F
O
Me
TfO
OMe
7.26 CDCl3
6.93
6.91
6.90
6.89
3.85
2.89
2.88
2.87
2.77
2.76
2.74
2.13
1.03
1.00
3.15
2.16
2.11
3.13
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

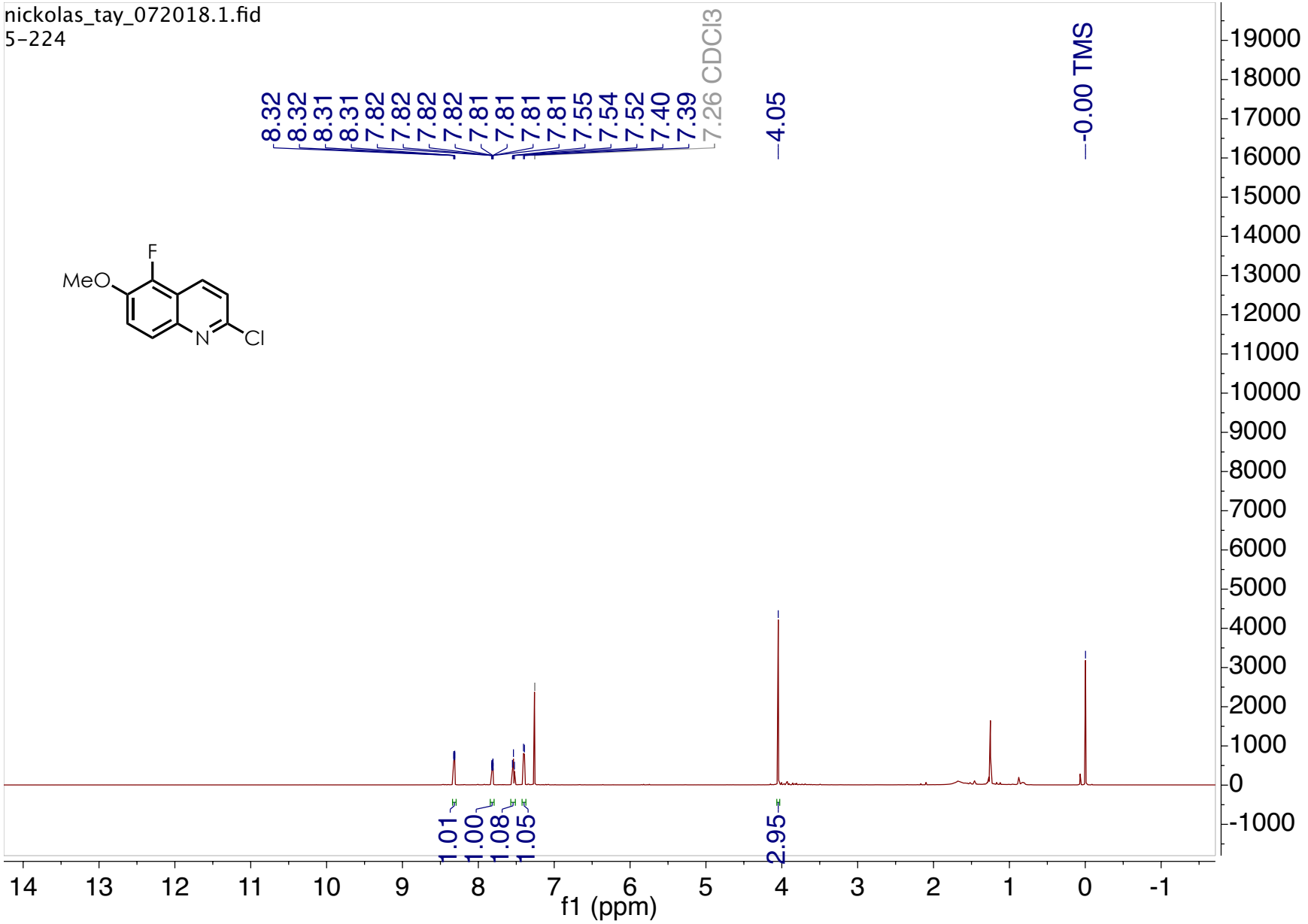

NT-06-196-13C.1.fid
NT-06-196-13C
207.06
154.60
152.99
147.82
147.79
136.38
136.31
129.12
129.01
121.94
119.82
117.69
115.57
114.94
114.91
110.50
110.31
77.16 CDCl3
56.68
43.21
29.95
23.44
23.43
F
O
Me
TfO
OMe
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

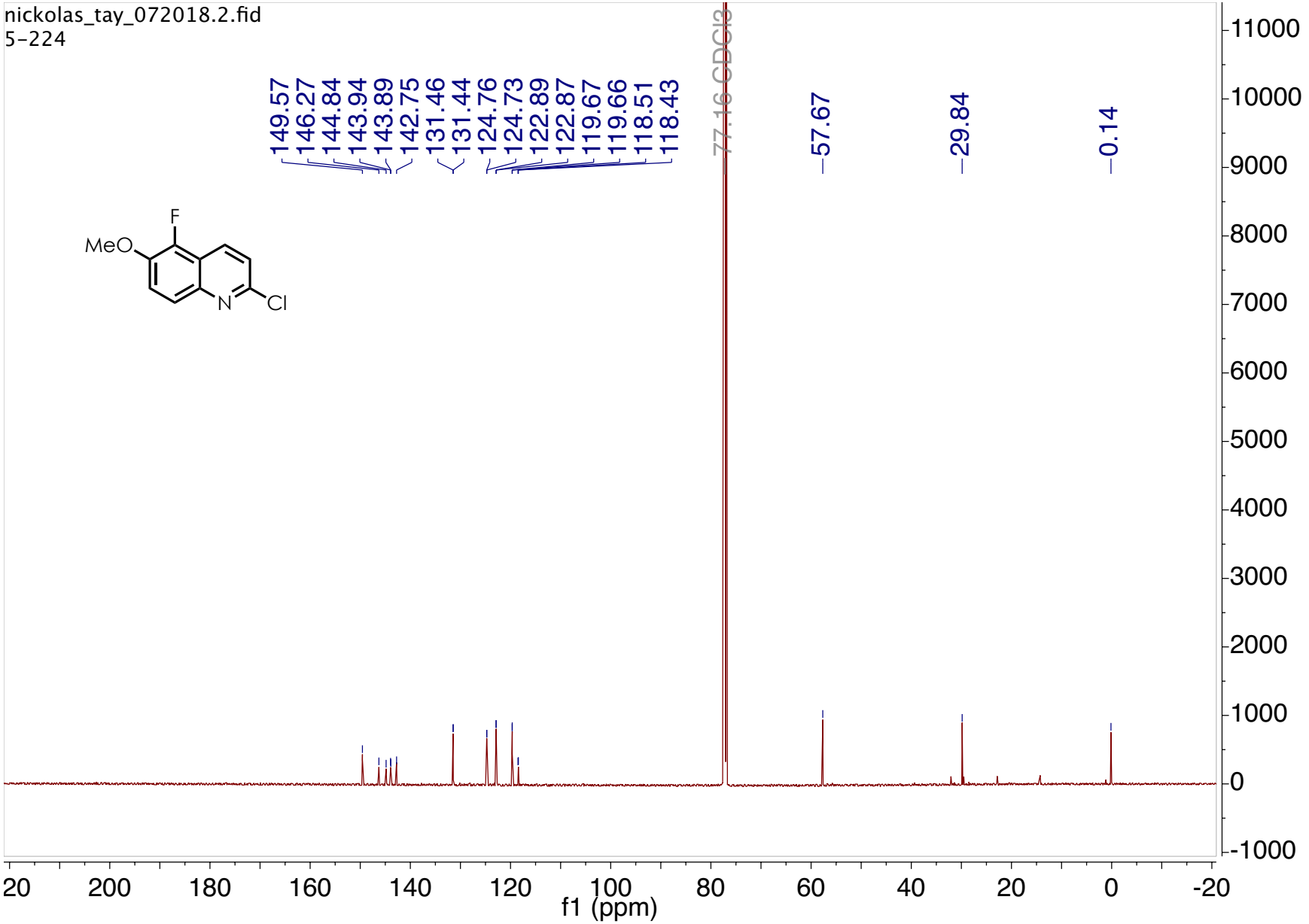

NT-06-196-19F.1.fid
NT-06-196-19F
F
O
Me
TfO
OMe
-73.62
-124.60
-124.62
-124.63
-161.64 C6F6
240000
220000
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
-20000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

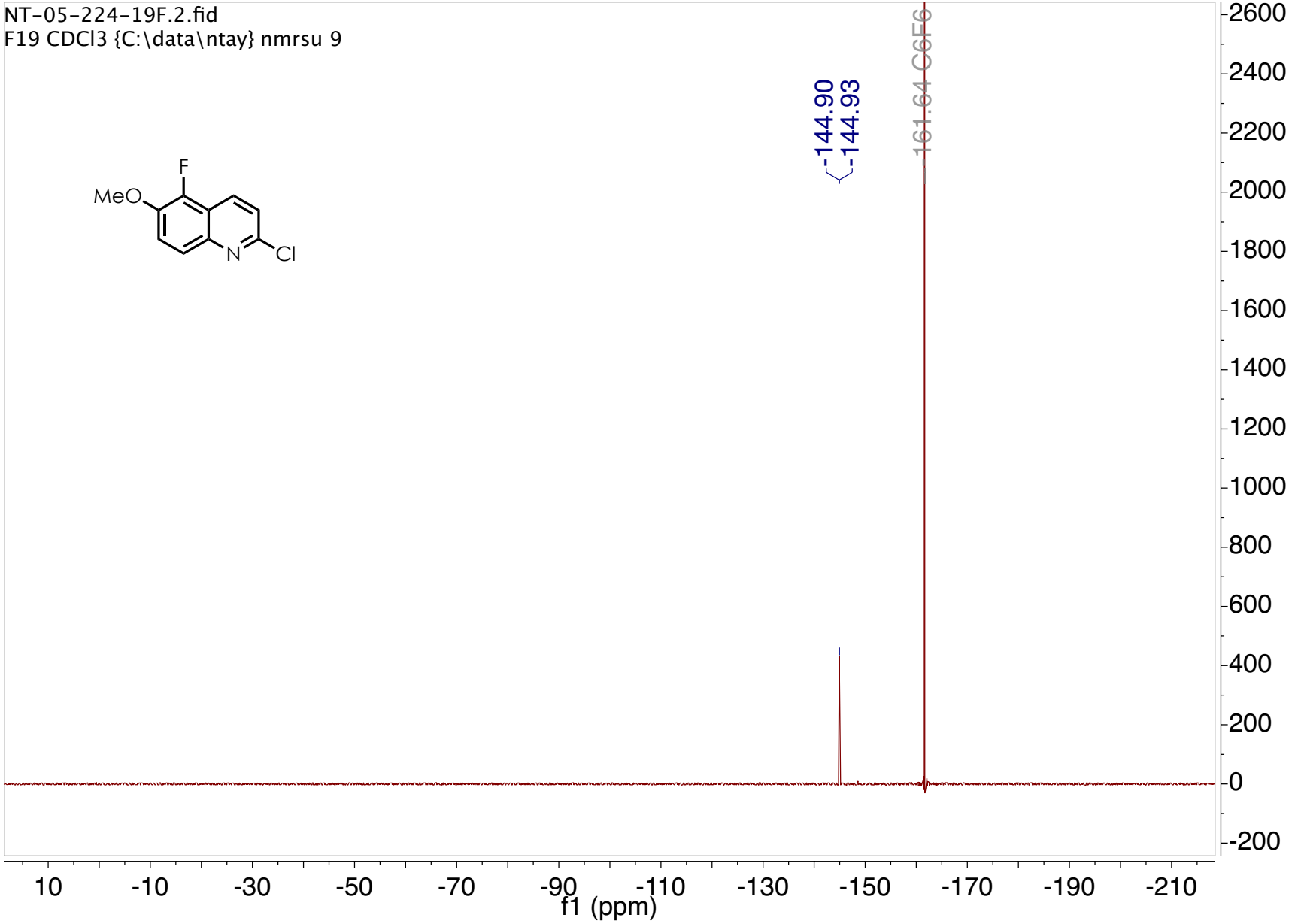

NT-05-208.1.fid
Nicewicz
C3308
ntay
NT-05-208
7.32
7.32
7.31
7.26 CDCl3
6.87
6.87
6.86
6.86
3.87
3.85
MeO
OMe
N
F
1.00
1.03
3.24
3.20
f1 (ppm)

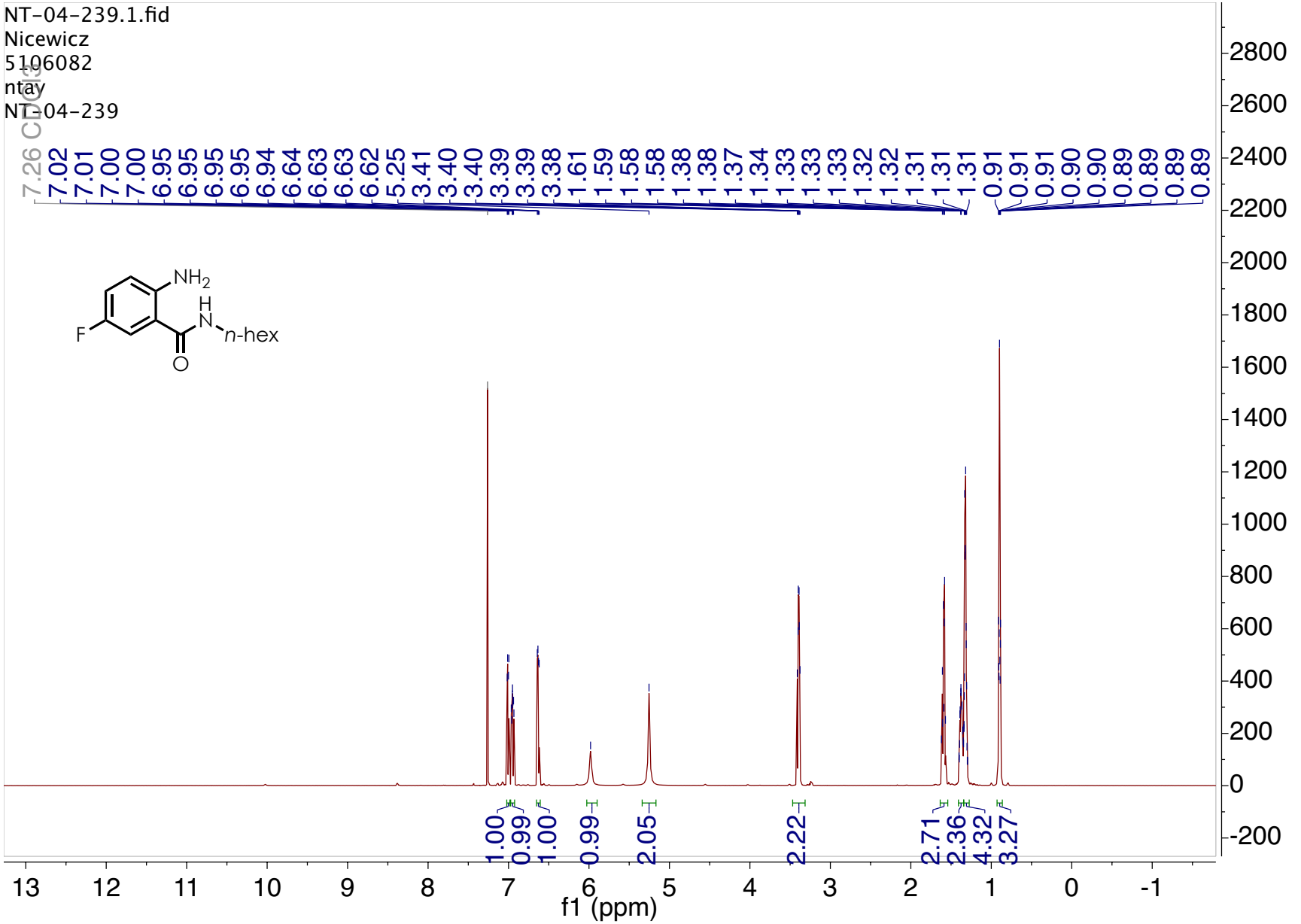

NT-05-208 2.2.fid
Nicewicz
C3308
ntay
NT-05-208
154.76
154.74
148.97
147.43
143.25
143.06
119.90
119.81
110.56
110.53
77.16 CDCl3
56.51
56.30
MeO
OMe
N
F
f1 (ppm)

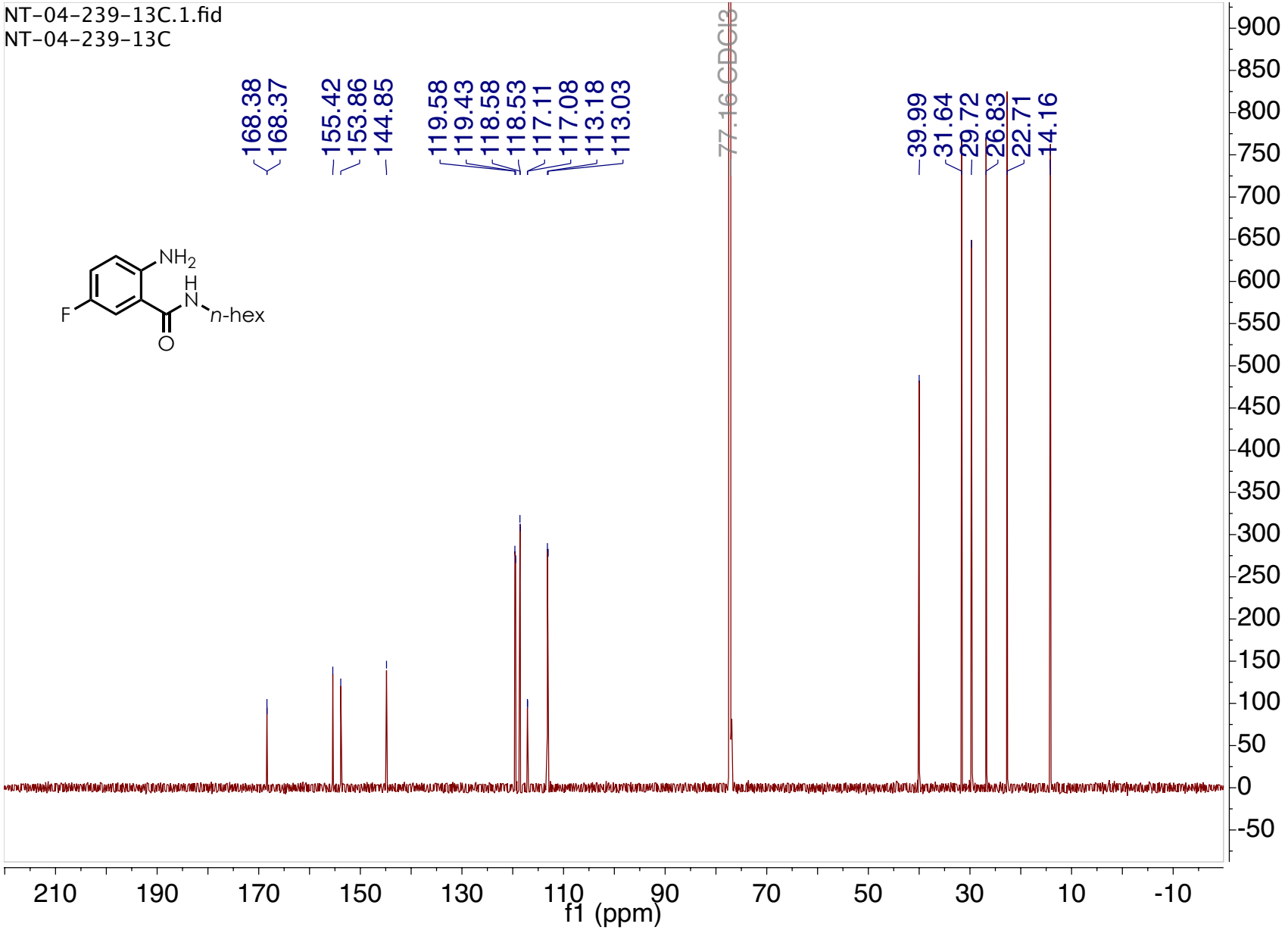

NT-05-208-19F 2.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 3
-92.71
-92.73
-161.64 C6F6
MeO
OMe
N
F
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

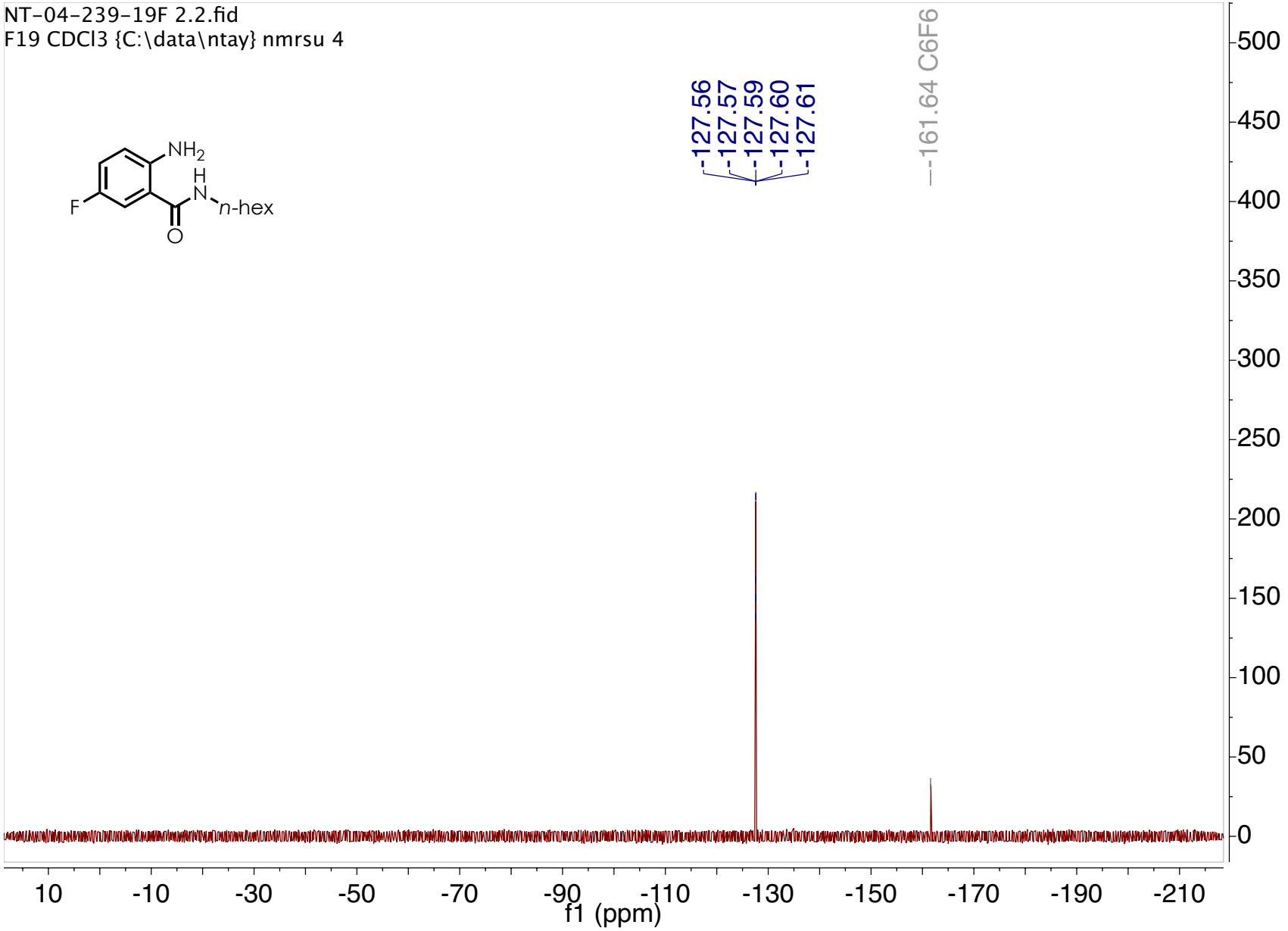

nickolas_tay_072018.1.fid
5-224
8.32
8.32
8.31
8.31
7.82
7.82
7.82
7.81
7.81
7.81
7.81
7.55
7.54
7.52
7.40
7.39
7.26 CDCl3
4.05
-0.00 TMS
F
MeO
N
Cl
1.01
1.00
1.08
1.05
2.95
f1 (ppm)

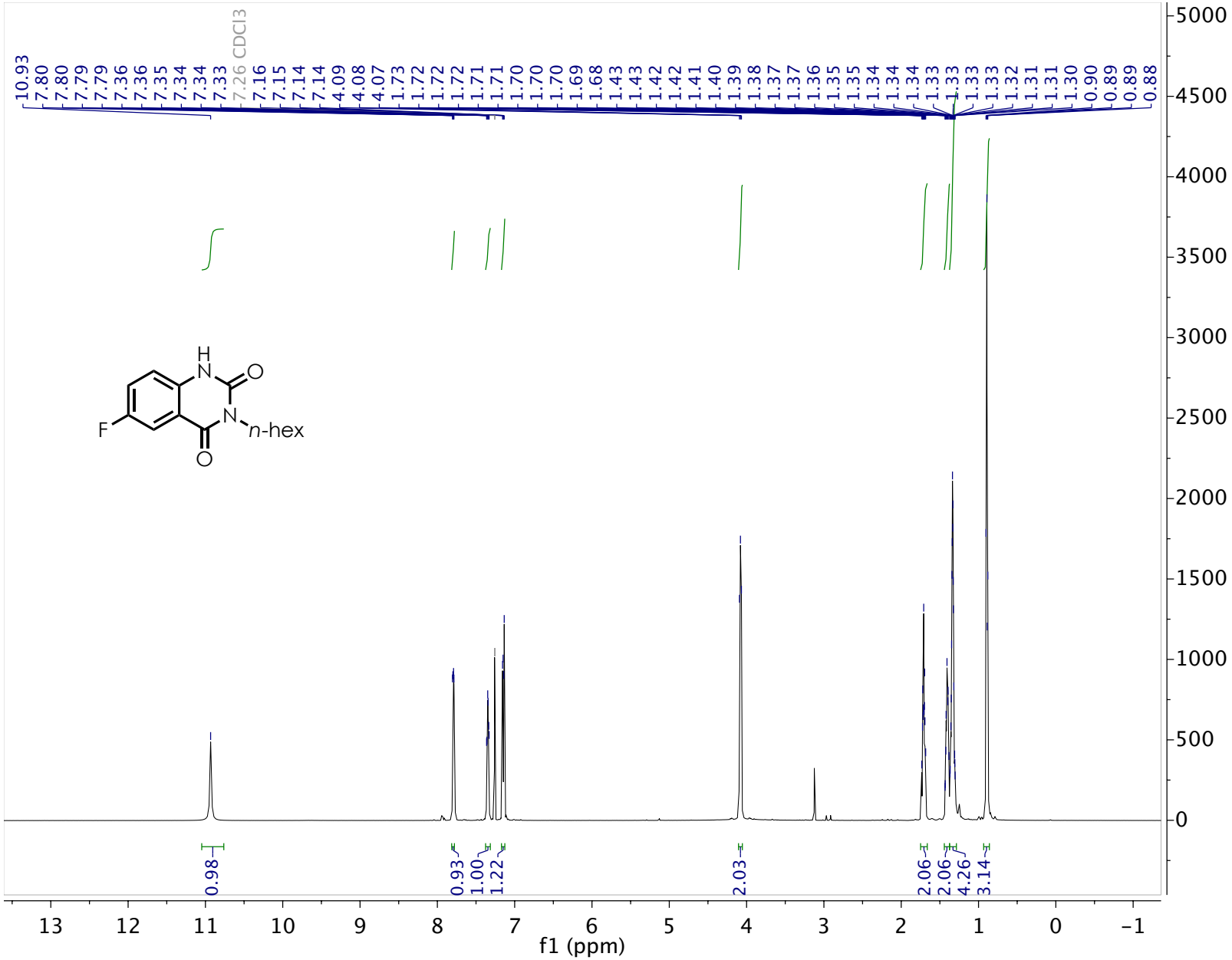

nickolas_tay_072018.2.fid
5-224
149.57
146.27
144.84
143.94
143.89
142.75
131.46
131.44
124.76
124.73
122.89
122.87
119.67
119.66
118.51
118.43
77.16 CDCl3
57.67
29.84
0.14
F
MeO
N
Cl
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
20
200
180
160
140
120
100
80
60
40
20
0
-20
f1 (ppm)

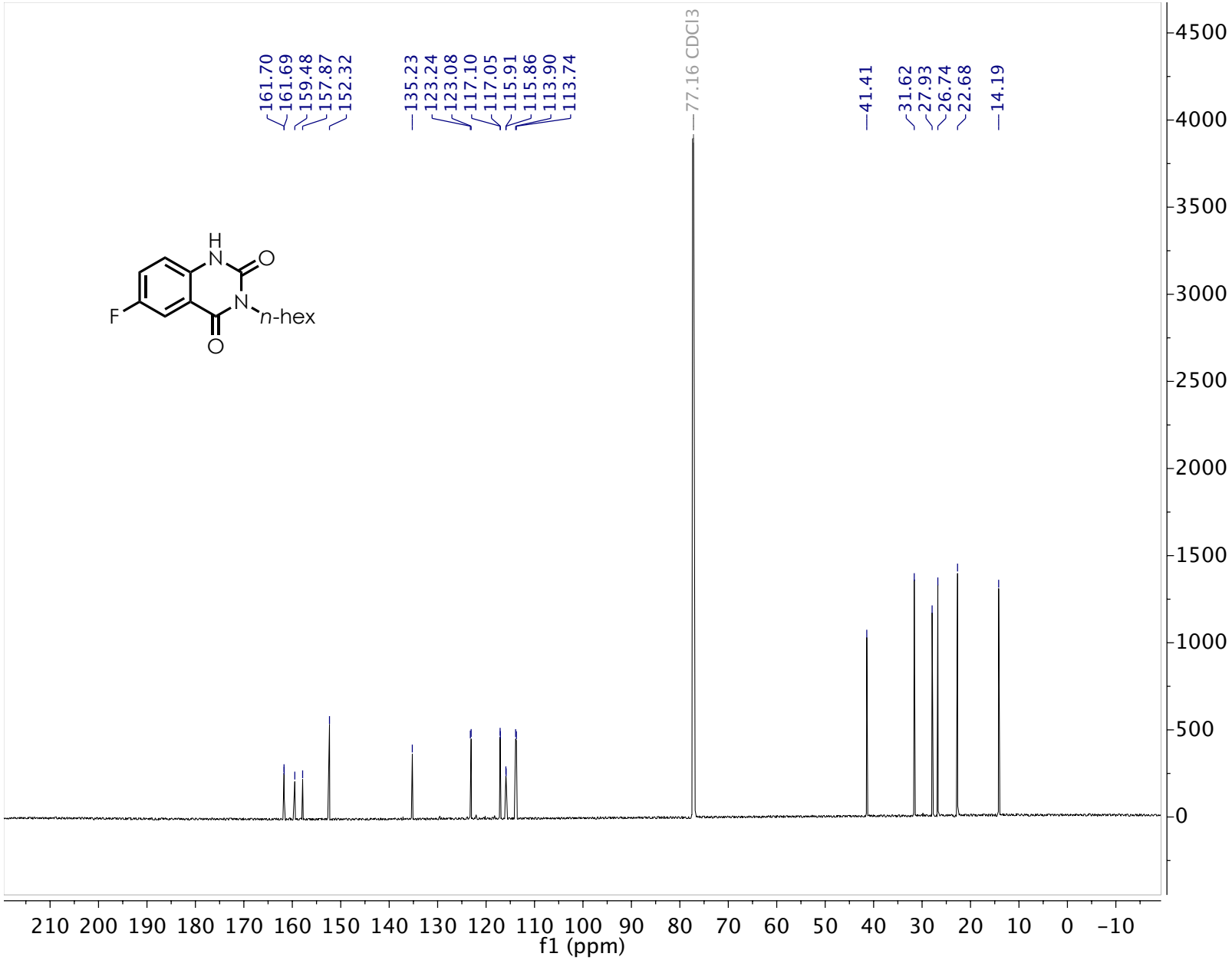

NT-05-224-19F.2.fid
F19 CDCl3 {C:\data\ntay} nmrsu 9
F
MeO
N
Cl
-144.90
-144.93
-161.64 C6F6
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

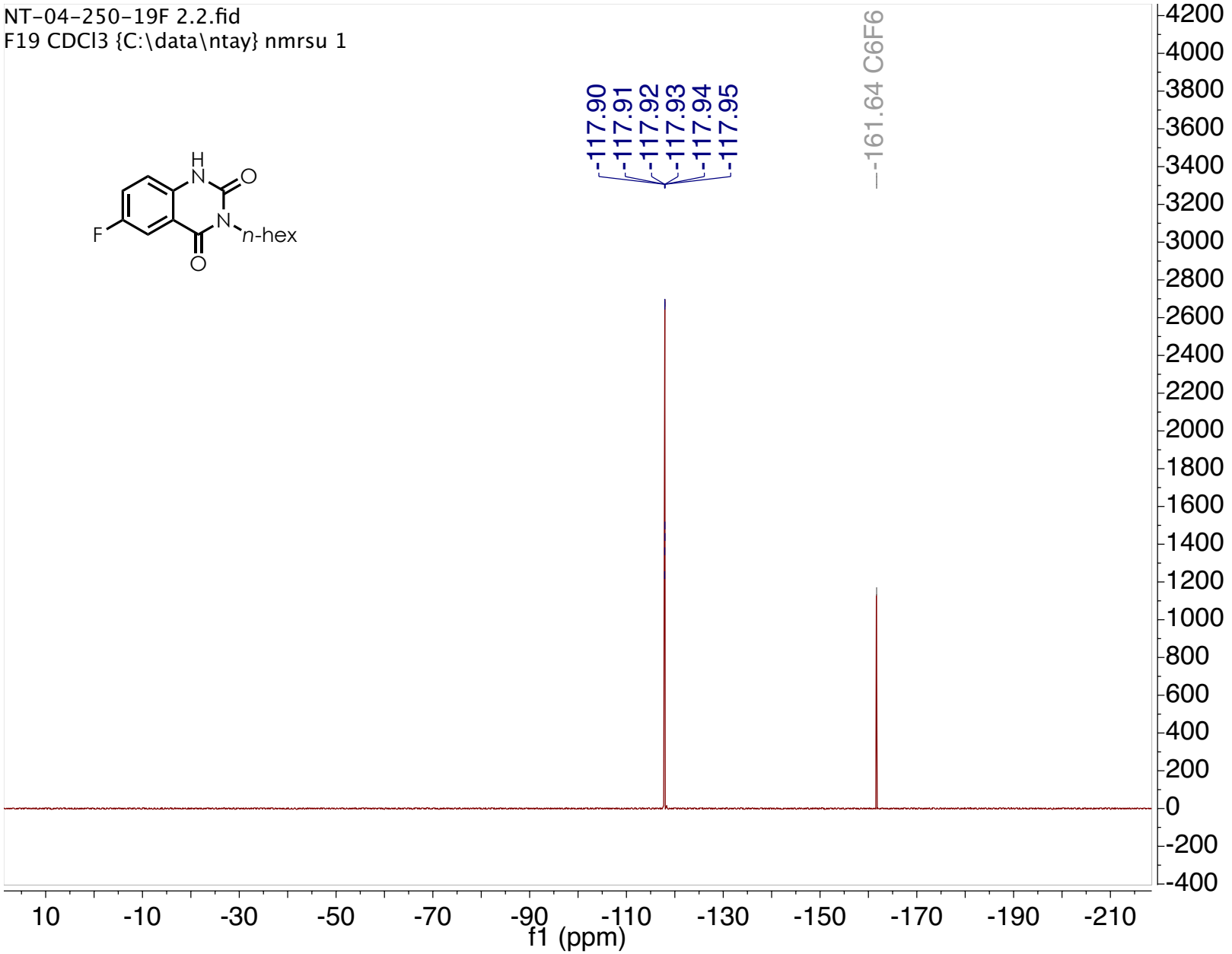

NT-04-239.1.fid
Nicewicz
5106082
ntay
NT-04-239
7.26 CDCl3
7.02 7.01 7.00 7.00 6.95 6.95 6.95 6.95 6.94 6.64 6.63 6.63 6.62 5.25 3.41 3.40 3.40 3.39 3.39 3.38 1.61 1.59 1.58 1.58 1.38 1.38 1.37 1.34 1.33 1.33 1.33 1.32 1.32 1.31 1.31 1.31 0.91 0.91 0.91 0.90 0.90 0.89 0.89 0.89 0.89
NH2
H
N
n-hex
F
O
1.00 0.99 1.00 0.99 2.05 2.22 2.71 2.36 4.32 3.27
2800 2600 2400 2200 2000 1800 1600 1400 1200 1000 800 600 400 200 0 -200
13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1
f1 (ppm)

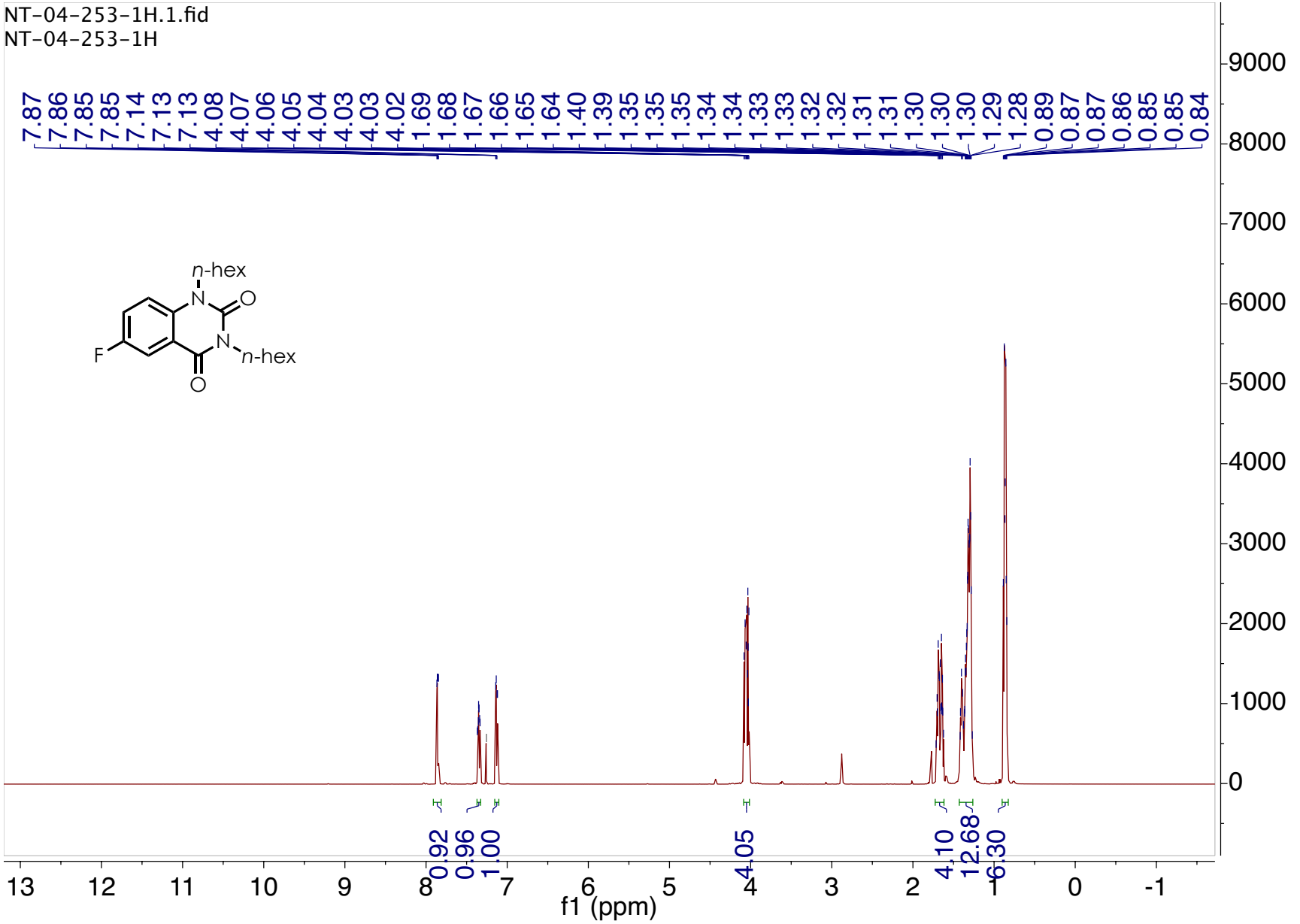

NT-04-239-13C.1.fid
NT-04-239-13C
168.38
168.37
155.42
153.86
144.85
119.58
119.43
118.58
118.53
117.11
117.08
113.18
113.03
77.16 CDCl3
39.99
31.64
29.72
26.83
22.71
14.16
NH2
H
N
n-hex
F
O
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
-50
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

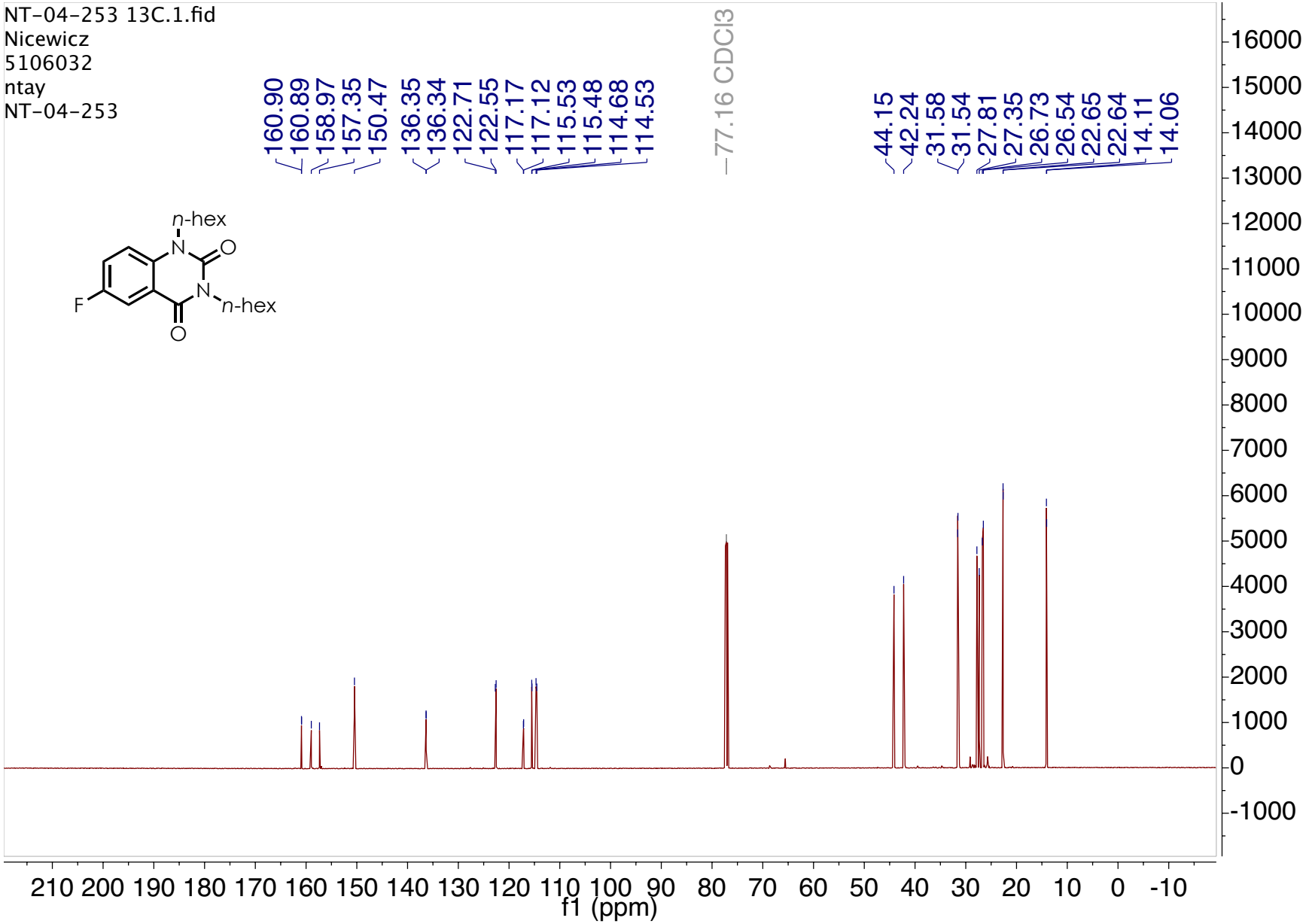

NT-04-239-19F 2.2.fid
F19 CDCl3 {C:\data\ntay} nmrsu 4
NH2
H
N
n-hex
F
O
-127.56
-127.57
-127.59
-127.60
-127.61
-161.64 C6F6
500
450
400
350
300
250
200
150
100
50
0
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

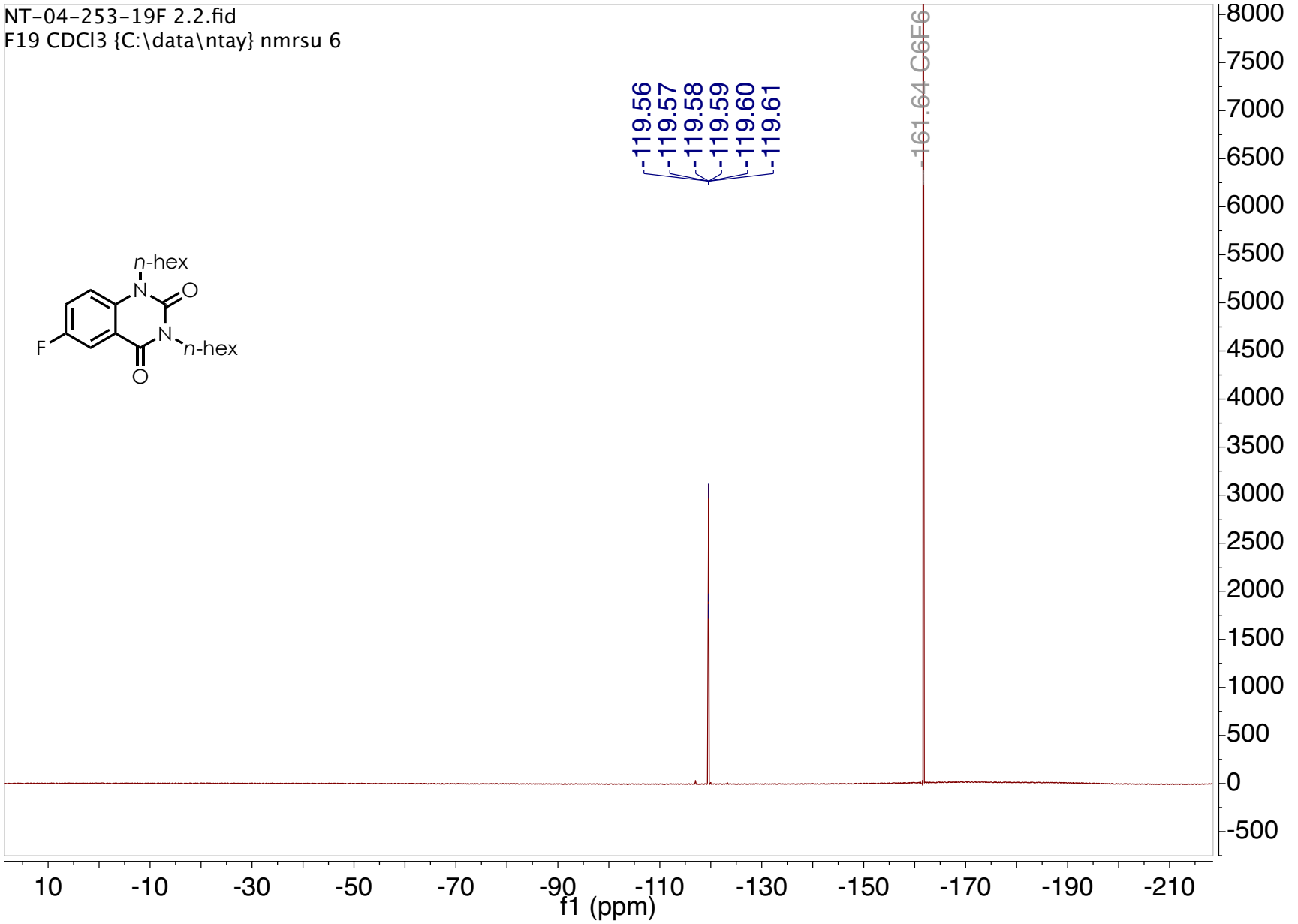

10.93
7.80
7.80
7.79
7.79
7.36
7.36
7.35
7.34
7.34
7.33
7.26 CDCl3
7.16
7.15
7.14
7.14
4.09
4.08
4.07
1.73
1.72
1.72
1.72
1.71
1.71
1.70
1.70
1.70
1.69
1.68
1.43
1.43
1.42
1.42
1.41
1.40
1.39
1.38
1.37
1.37
1.36
1.35
1.35
1.34
1.34
1.34
1.33
1.33
1.33
1.33
1.32
1.31
1.31
1.30
0.90
0.89
0.89
0.88
H
N
O
N
n-hex
F
O
0.98
0.93
1.00
1.22
2.03
2.06
2.06
4.26
3.14
f1 (ppm)

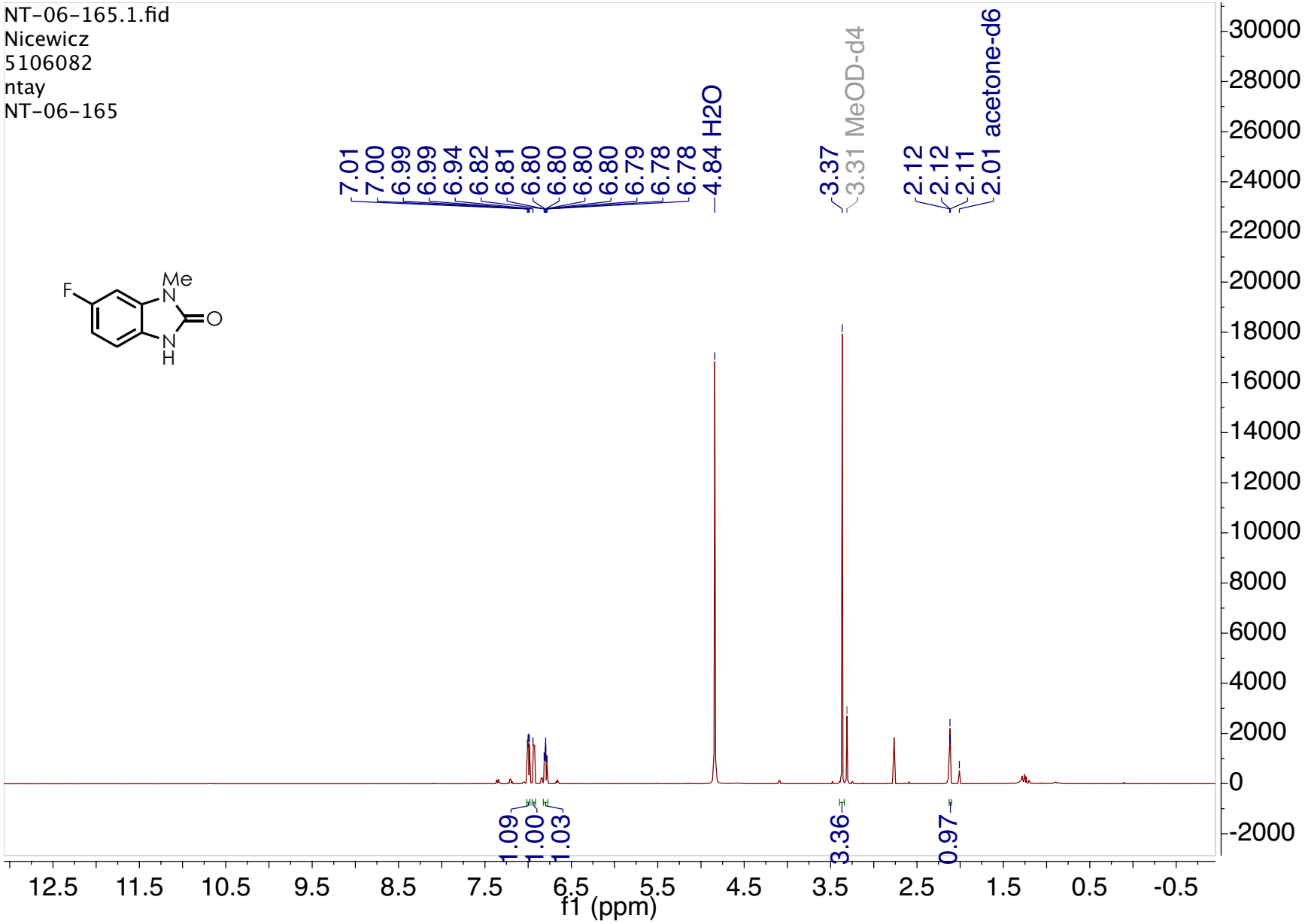

161.70
161.69
159.48
157.87
152.32
135.23
123.24
123.08
117.10
117.05
115.91
115.86
113.90
113.74
77.16 CDCl3
41.41
31.62
27.93
26.74
22.68
14.19
H
N
O
N
n-hex
F
O
4500
4000
3500
3000
2500
2000
1500
1000
500
0
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

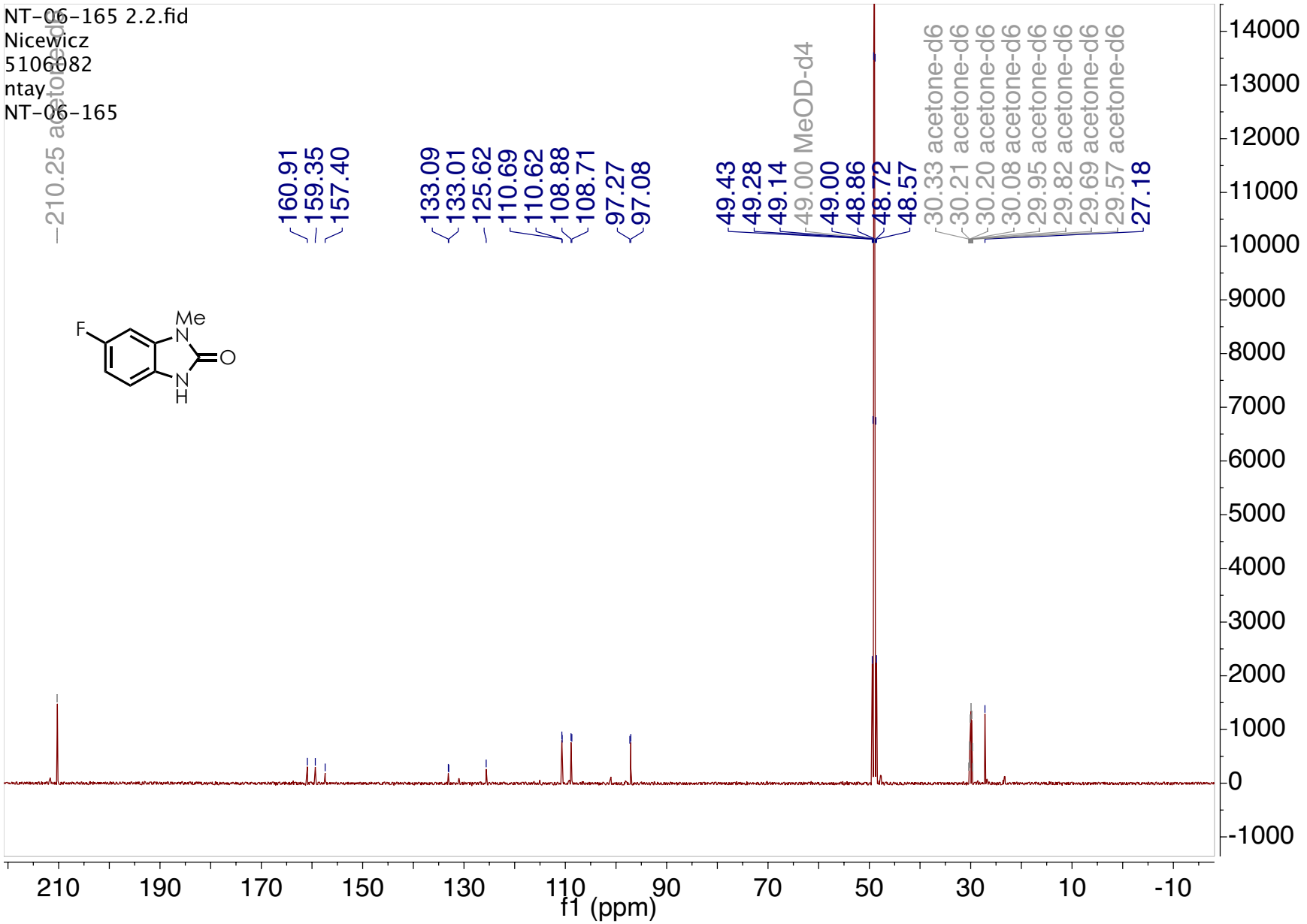

NT-04-250-19F 2.2.fid
F19 CDCl3 {C:\data\ntay} nmrsu 1
-117.90
-117.91
-117.92
-117.93
-117.94
-117.95
-161.64 C6F6
H
N
O
N
n-hex
F
O
4200
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
-400
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

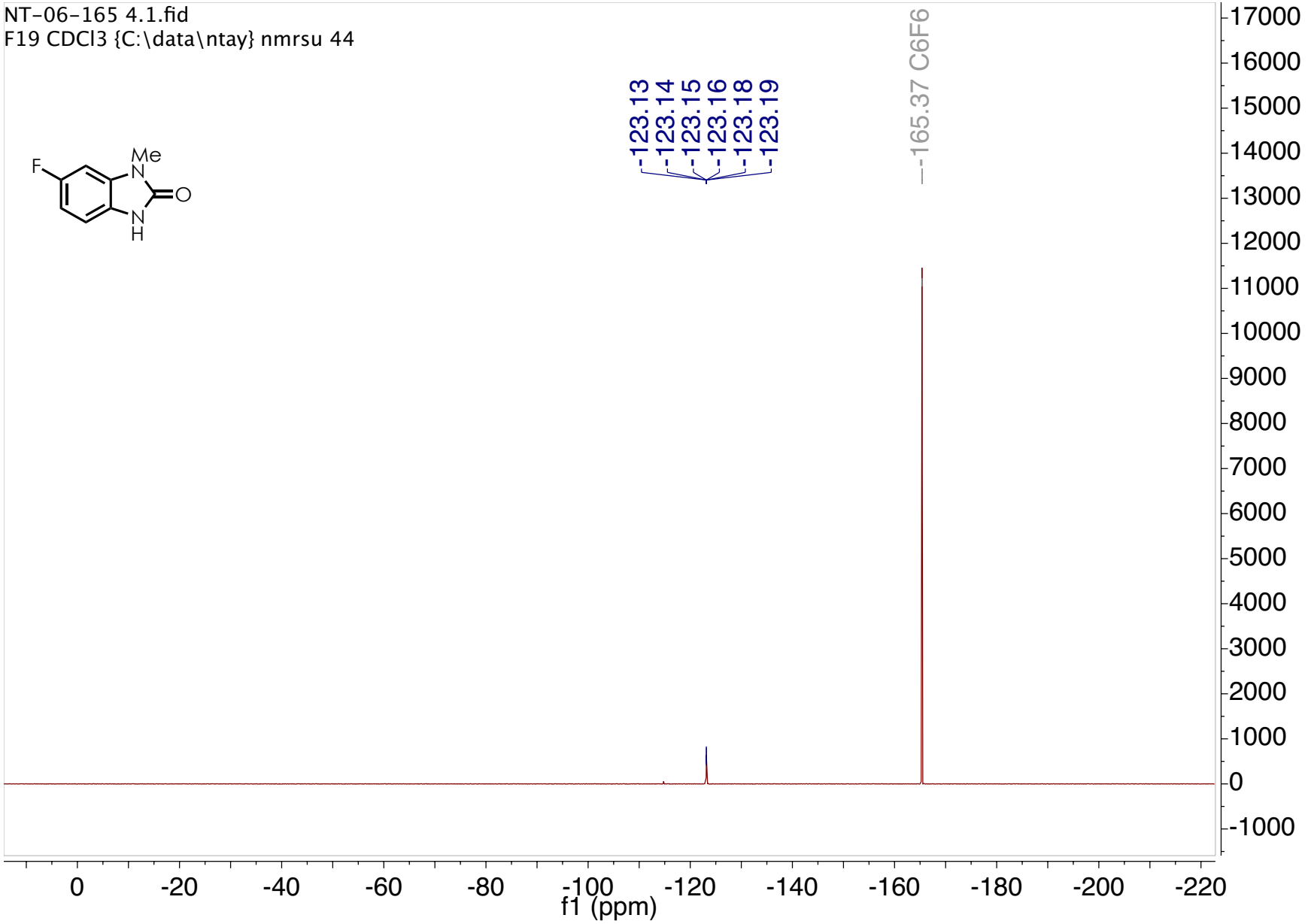

NT-04-253-1H.1.fid
NT-04-253-1H
7.87 7.86 7.85 7.85 7.14 7.13 7.13 4.08 4.07 4.06 4.05 4.04 4.03 4.03 4.02 1.69 1.68 1.67 1.66 1.65 1.64 1.40 1.39 1.35 1.35 1.35 1.34 1.34 1.33 1.33 1.32 1.32 1.31 1.31 1.30 1.30 1.30 1.29 1.28 0.89 0.87 0.87 0.86 0.85 0.85 0.84
n-hex
N
O
N
n-hex
F
O
0.92 0.96 1.00 4.05 4.10 12.68 6.30
13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1
f1 (ppm)
9000 8000 7000 6000 5000 4000 3000 2000 1000 0

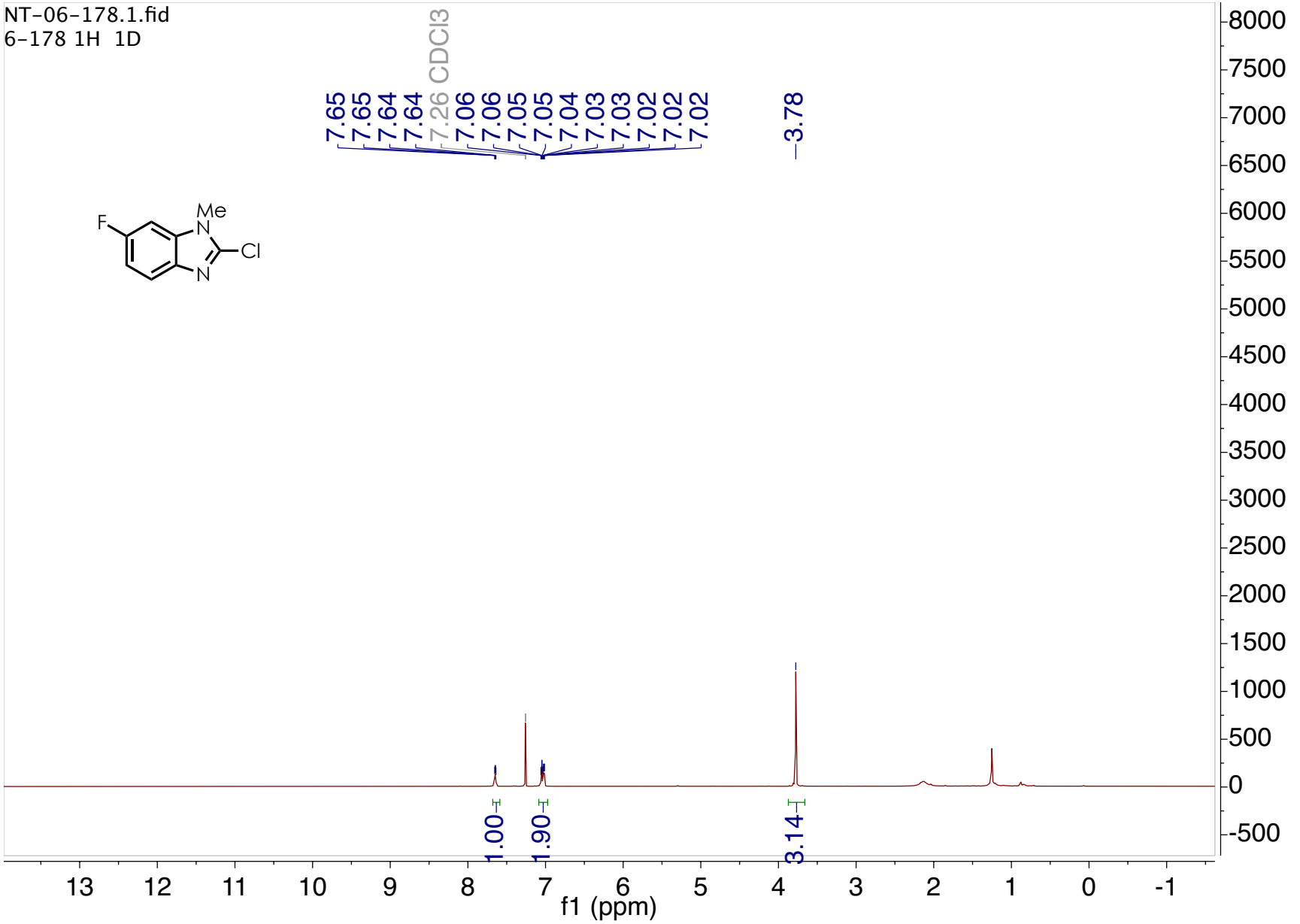

NT-04-253 13C.1.fid
Nicewicz
5106032
ntay
NT-04-253
160.90
160.89
158.97
157.35
150.47
136.35
136.34
122.71
122.55
117.17
117.12
115.53
115.48
114.68
114.53
77.16 CDCl3
44.15
42.24
31.58
31.54
27.81
27.35
26.73
26.54
22.65
22.64
14.11
14.06
n-hex
N
O
N
n-hex
F
O
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

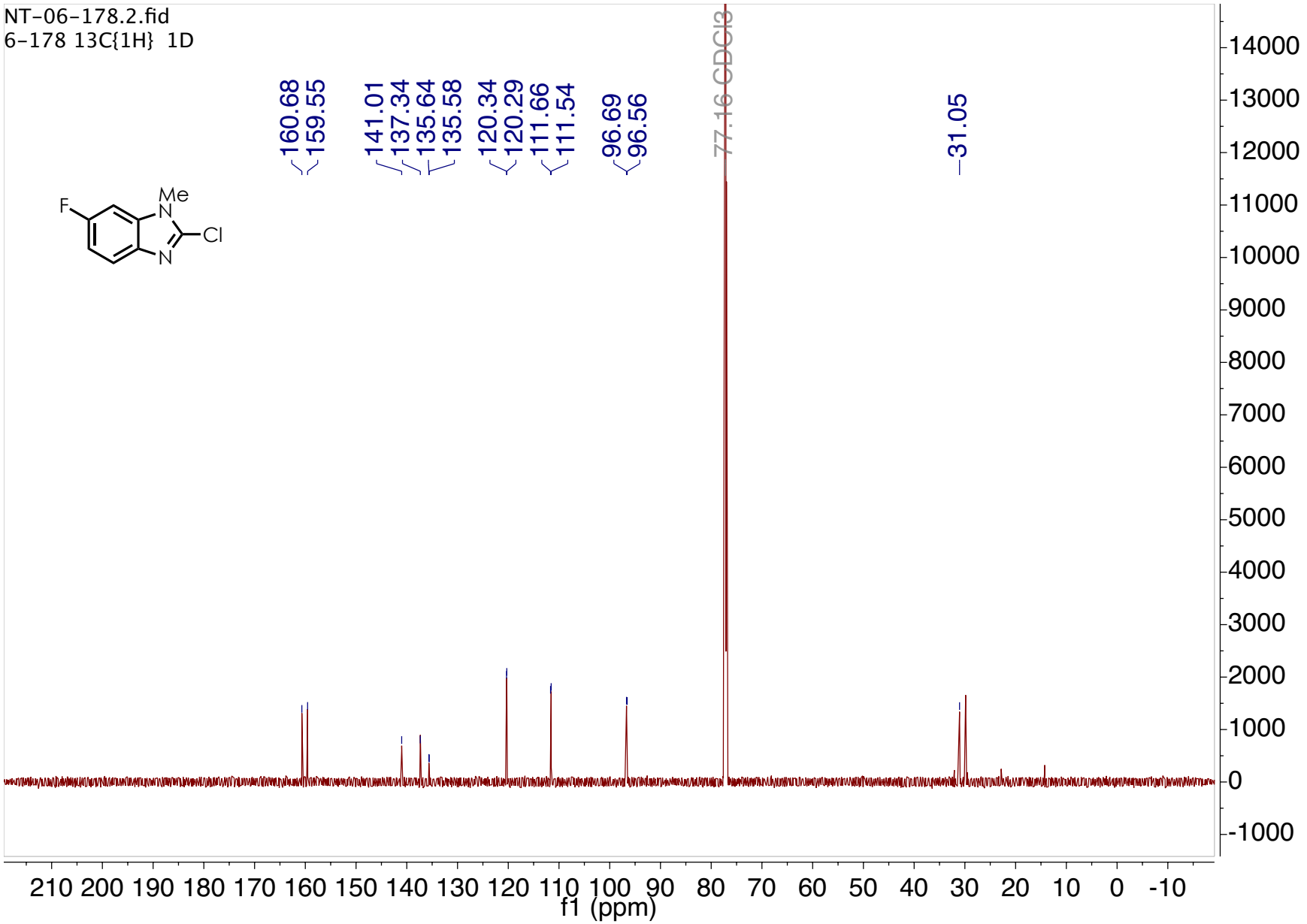

NT-04-253-19F 2.2.fid
F19 CDCl3 {C:\data\ntay} nmrsu 6
-119.56
-119.57
-119.58
-119.59
-119.60
-119.61
-161.64 C6F6
n-hex
N
O
N
n-hex
F
O
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

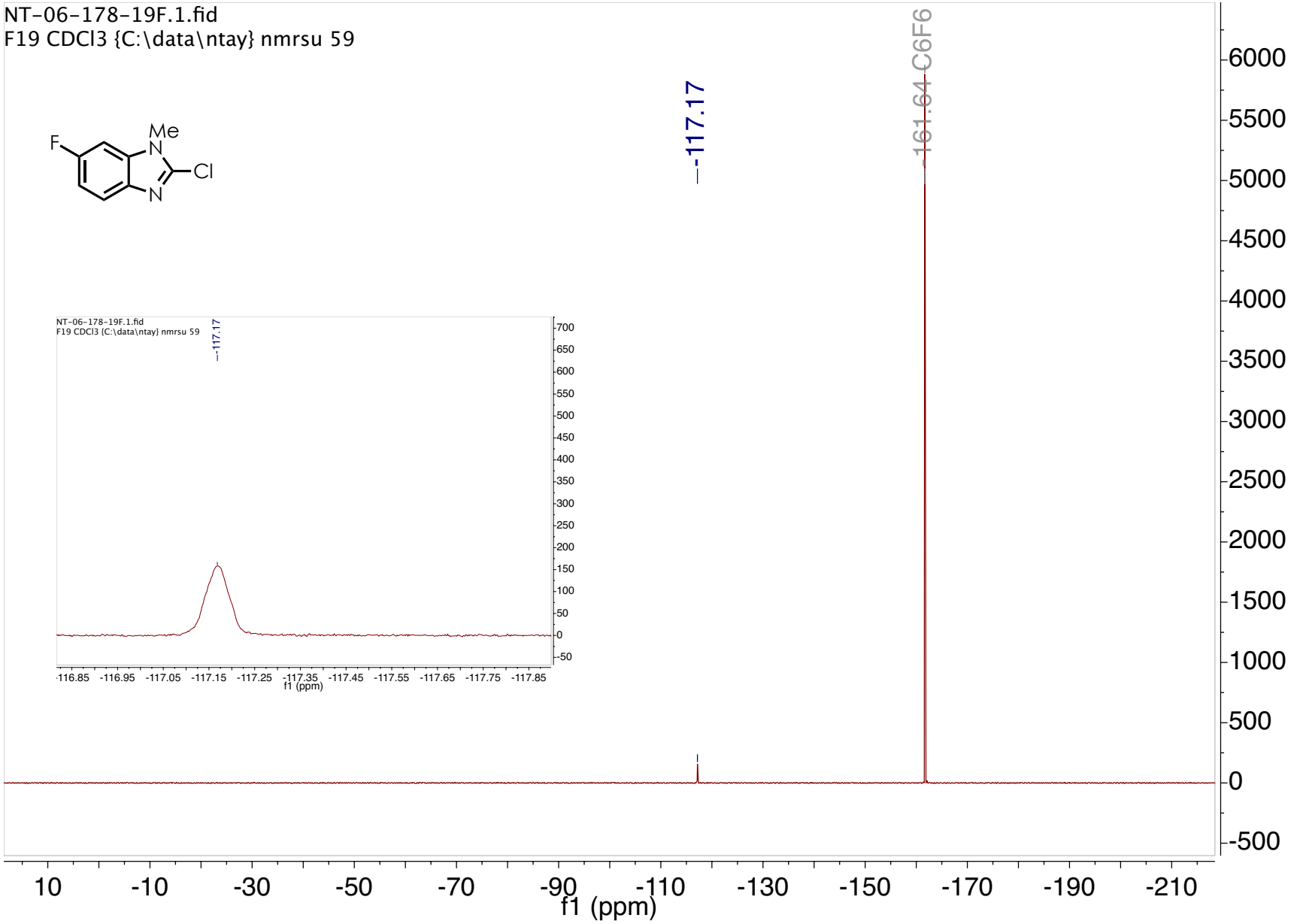

NT-06-165.1.fid
Nicewicz
5106082
ntay
NT-06-165
7.01
7.00
6.99
6.99
6.94
6.82
6.81
6.80
6.80
6.80
6.80
6.79
6.78
6.78
4.84 H2O
3.37
3.31 MeOD-d4
2.12
2.12
2.11
2.01 acetone-d6
F
Me
N
O
N
H
1.09
1.00
1.03
3.36
0.97
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
12.5
11.5
10.5
9.5
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
-0.5
f1 (ppm)

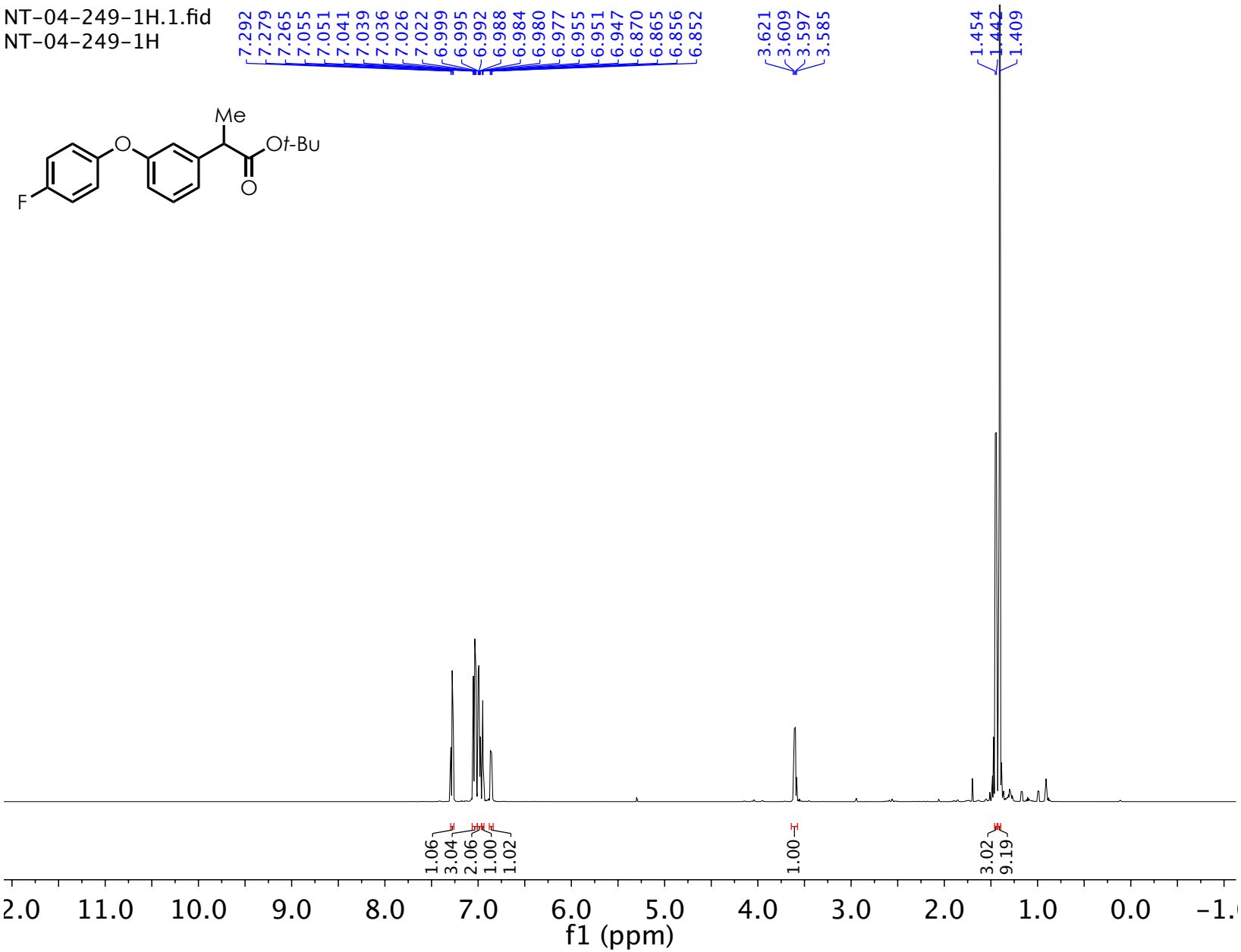

NT-06-165 2.2.fid
Nicewicz
5106082
ntay
NT-06-165
210.25 acetone-d6
160.91
159.35
157.40
133.09
133.01
125.62
110.69
110.62
108.88
108.71
97.27
97.08
49.43
49.28
49.14
49.00 MeOD-d4
49.00
48.86
48.72
48.57
30.33 acetone-d6
30.21 acetone-d6
30.20 acetone-d6
30.08 acetone-d6
29.95 acetone-d6
29.82 acetone-d6
29.69 acetone-d6
29.57 acetone-d6
27.18
F
Me
N
O
N
H
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

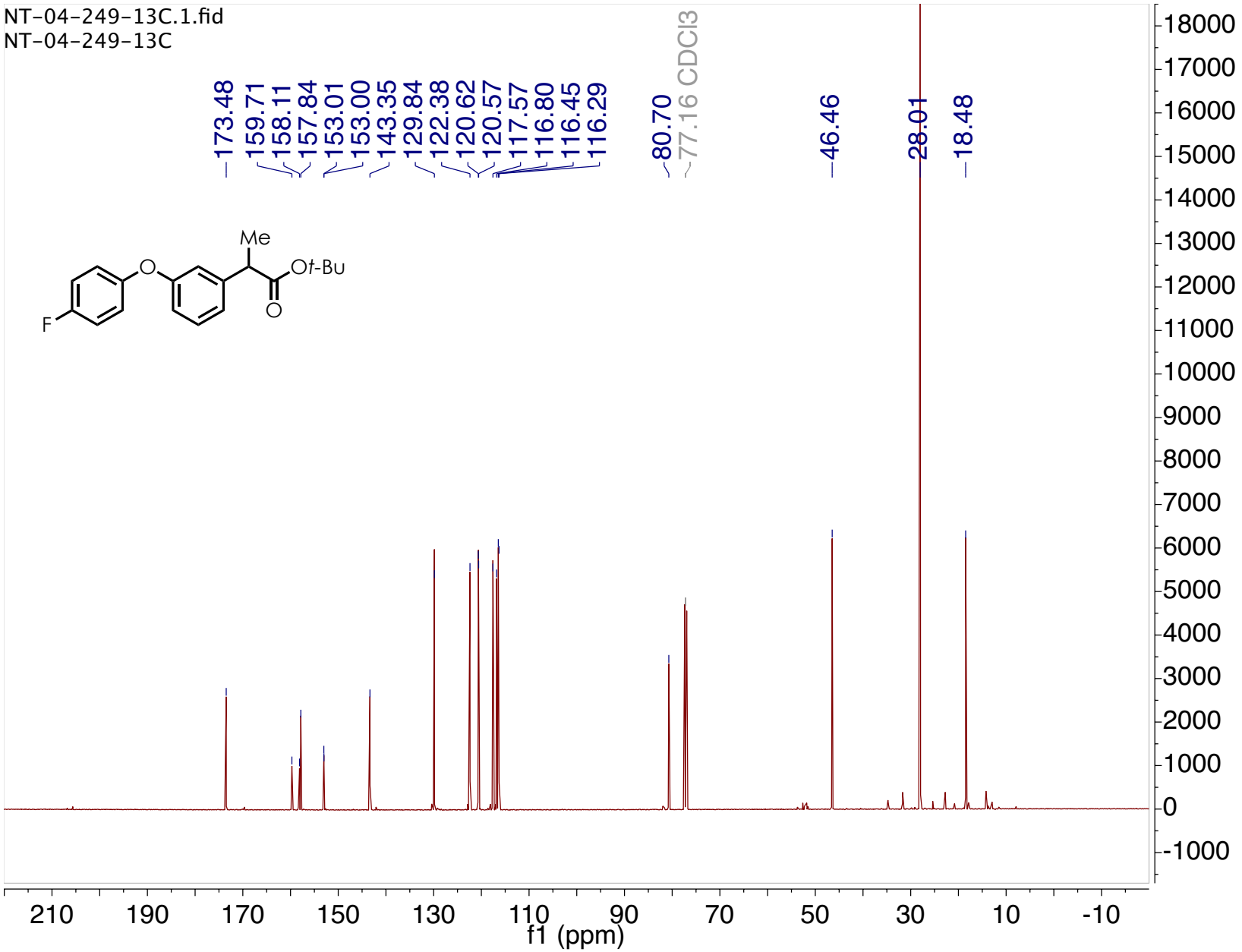

NT-06-165 4.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 44
-123.13
-123.14
-123.15
-123.16
-123.18
-123.19
-165.37 C6F6
F
Me
N
O
N
H
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
f1 (ppm)

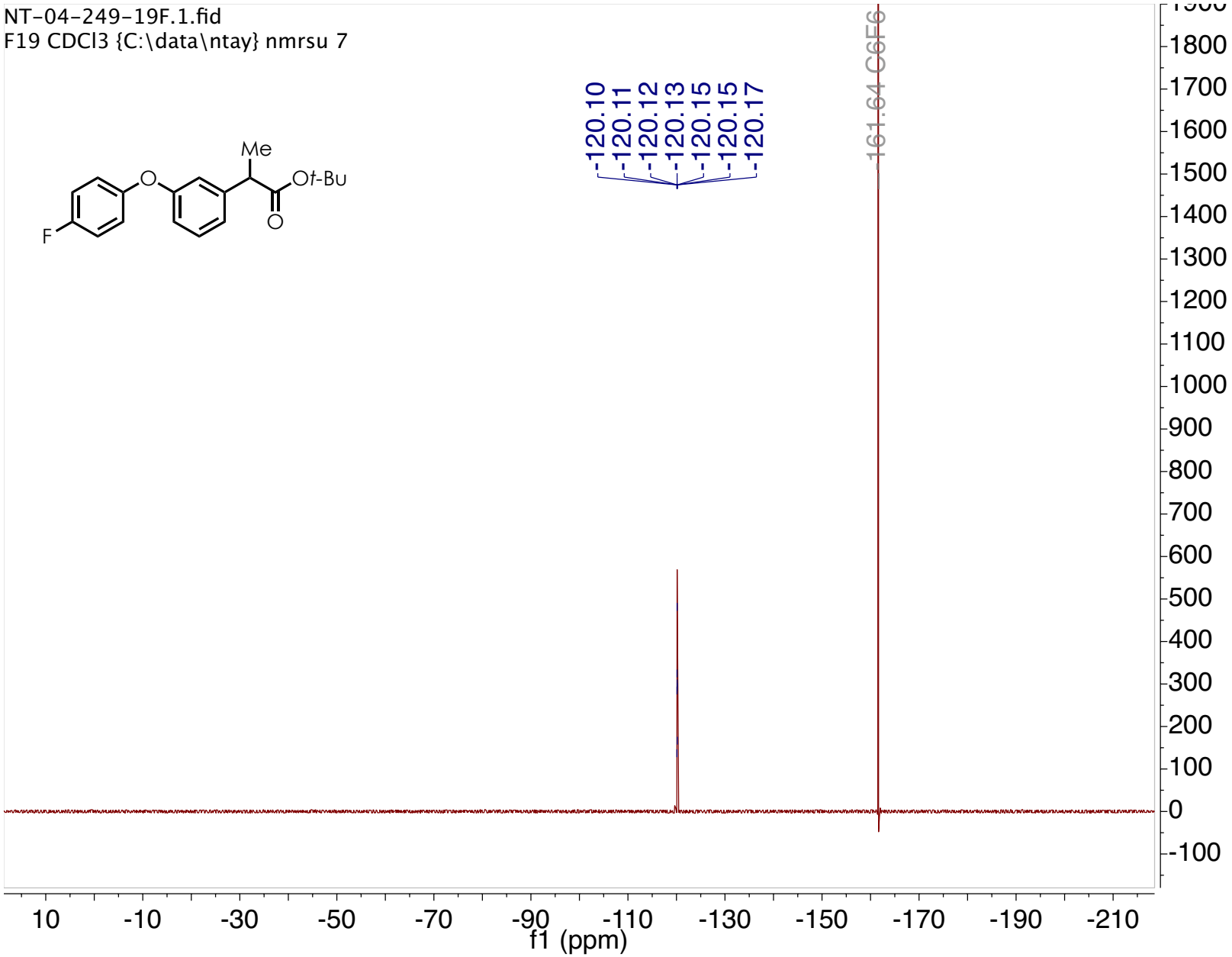

NT-06-178.1.fid
6-178 1H 1D
CDCl3
7.65
7.65
7.64
7.64
7.26
7.06
7.06
7.05
7.05
7.04
7.03
7.03
7.02
7.02
7.02
3.78
Me
N
F
Cl
N
1.00
1.90
3.14
f1 (ppm)

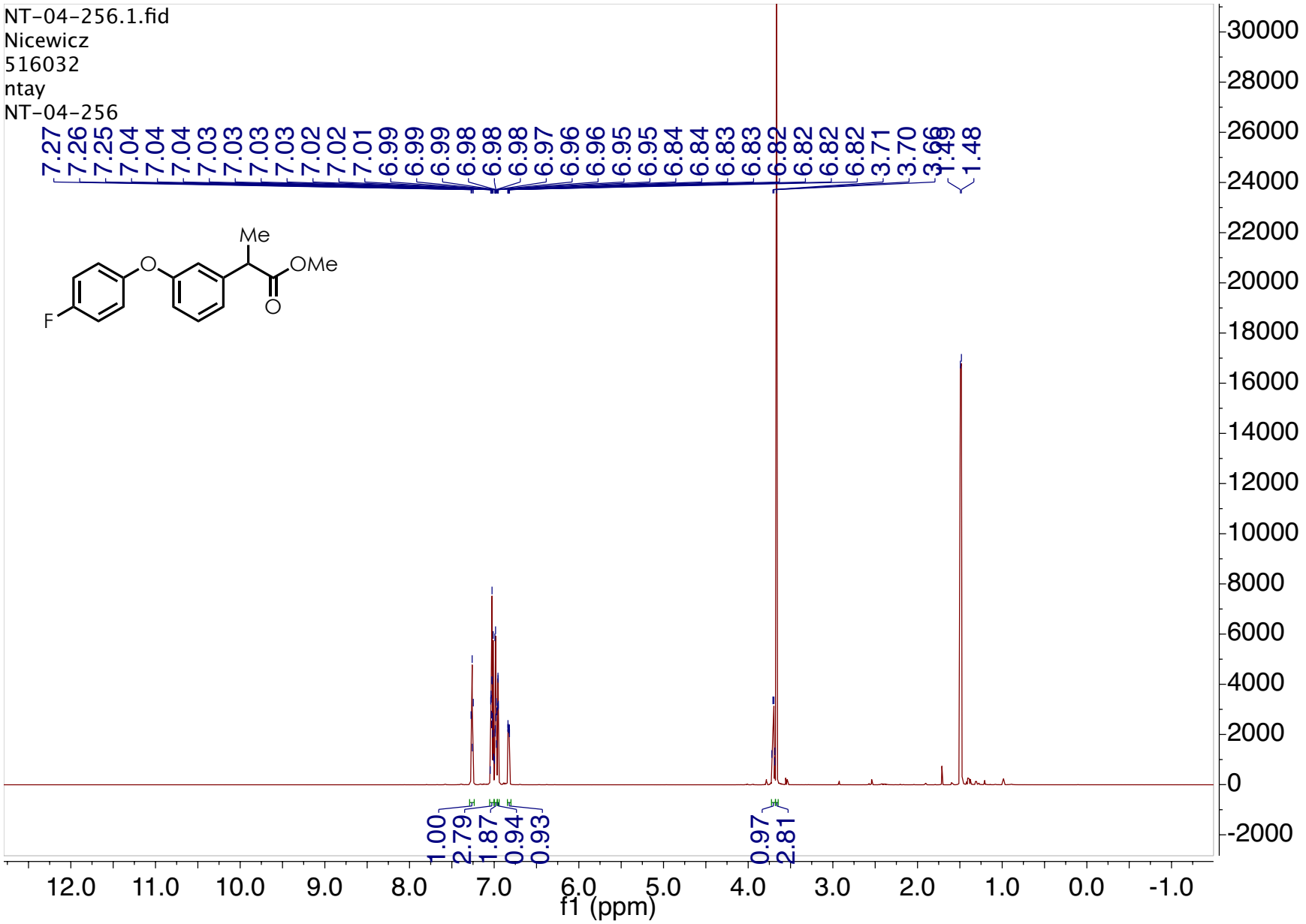

NT-06-178.2.fid
6-178 13C{1H} 1D
160.68
159.55
141.01
137.34
135.64
135.58
120.34
120.29
111.66
111.54
96.69
96.56
77.16 CDCl3
31.05
F
Me
N
Cl
N
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

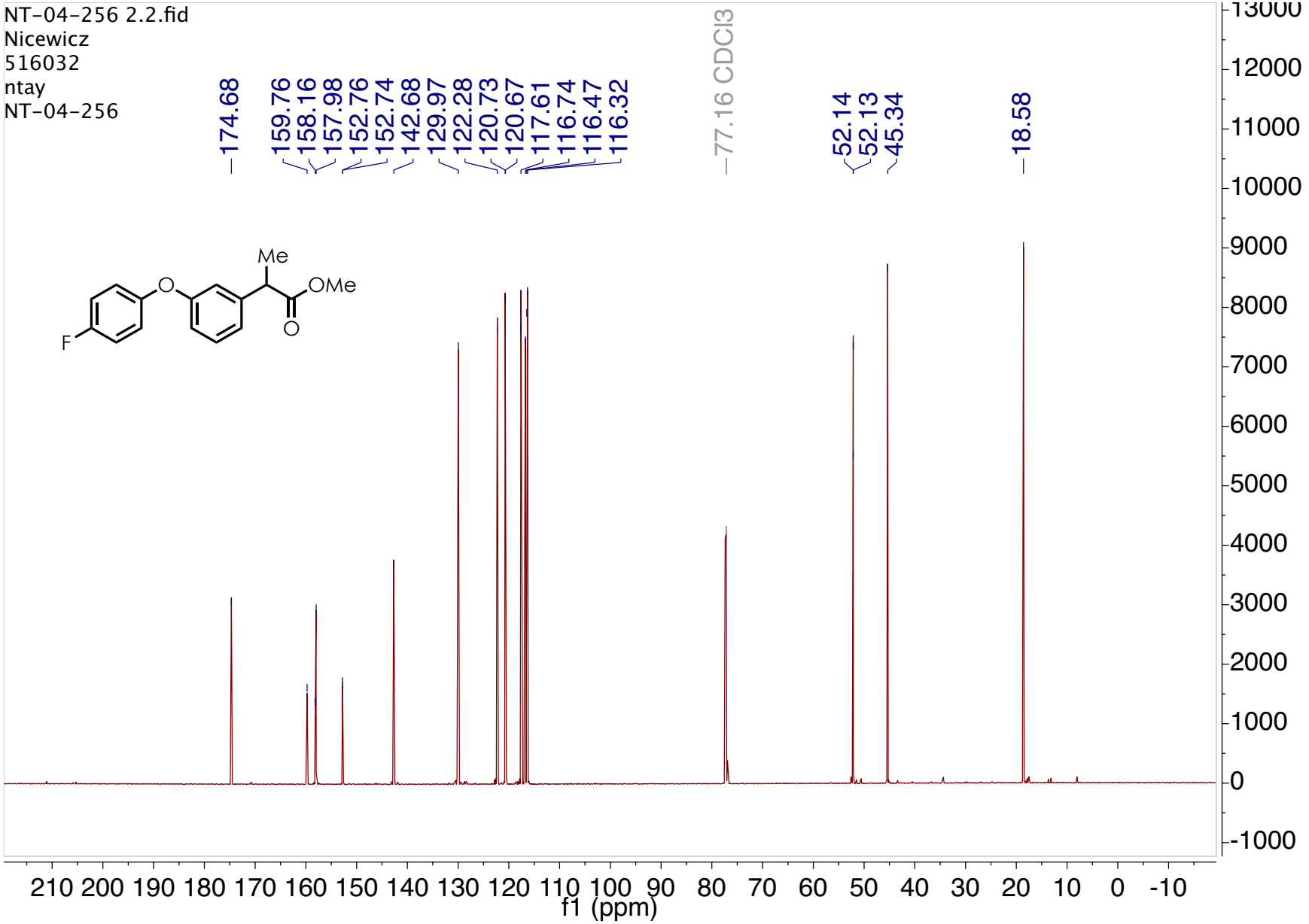

NT-06-178-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 59
F
Me
N
Cl
N
-117.17
161.64 C6F6
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)
NT-06-178-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 59
-117.17
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
-50
-116.85
-116.95
-117.05
-117.15
-117.25
-117.35
-117.45
-117.55
-117.65
-117.75
-117.85
f1 (ppm)

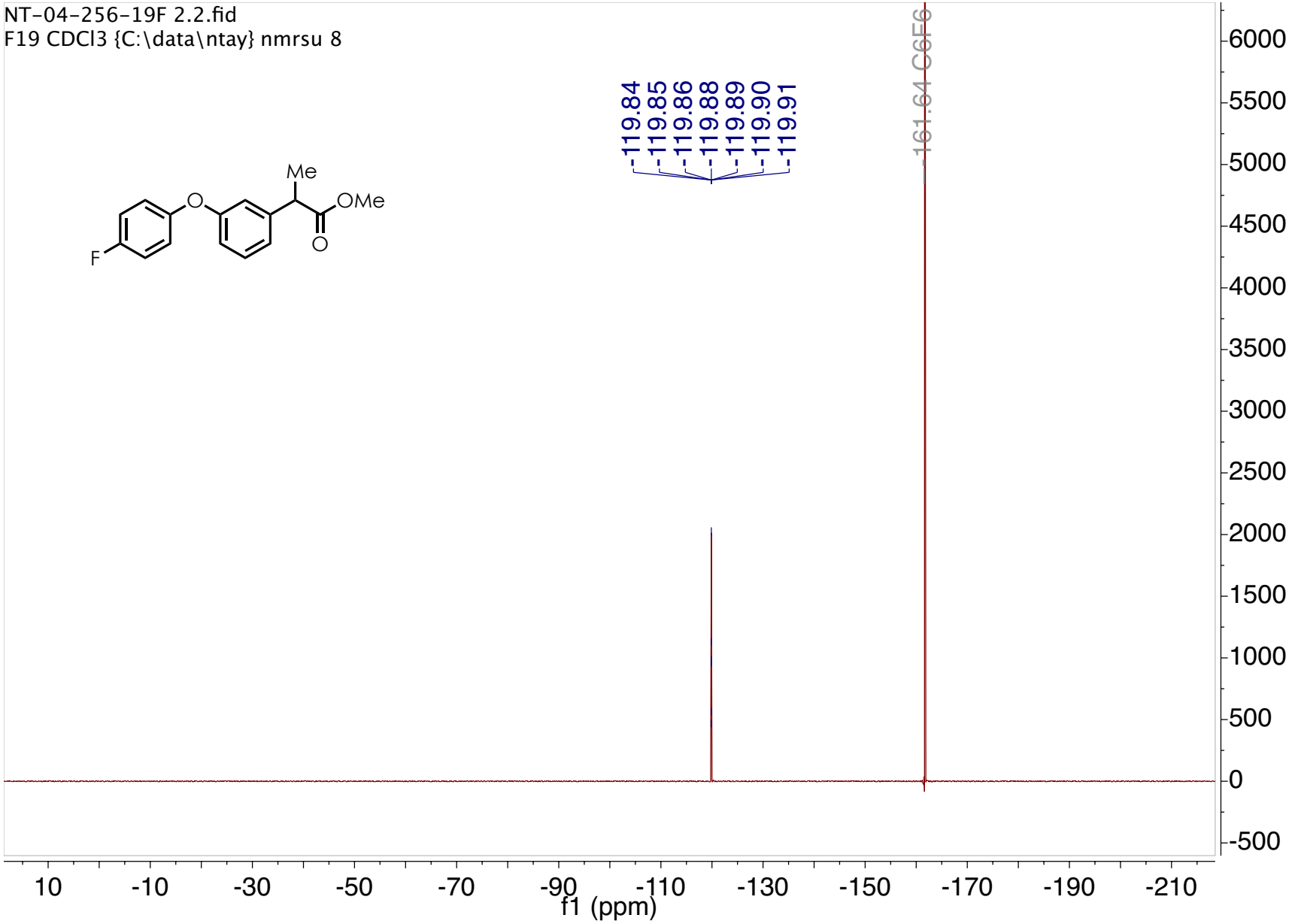

NT-04-249-1H.1.fid
NT-04-249-1H
7.292
7.279
7.265
7.055
7.051
7.041
7.039
7.036
7.026
7.022
6.999
6.995
6.992
6.988
6.984
6.980
6.977
6.955
6.951
6.947
6.870
6.865
6.856
6.852
3.621
3.609
3.597
3.585
1.454
1.442
1.409
Me
Ot-Bu
O
O
F
1.06
3.04
2.06
1.00
1.02
1.00
3.02
9.19
2.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
f1 (ppm)

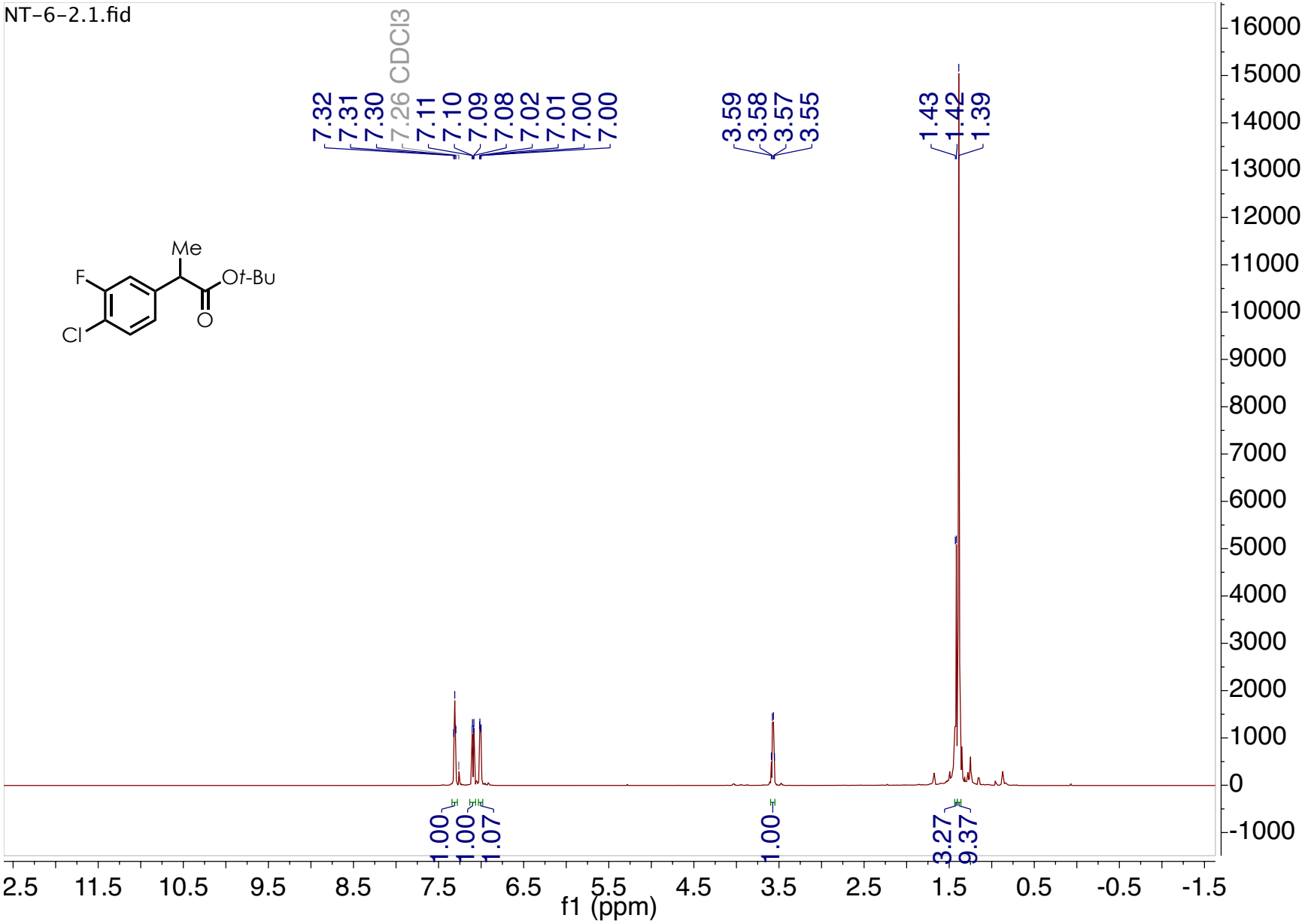

NT-04-249-13C.1.fid
NT-04-249-13C
173.48
159.71
158.11
157.84
153.01
153.00
143.35
129.84
122.38
120.62
120.57
117.57
116.80
116.45
116.29
80.70
77.16 CDCl3
46.46
28.01
18.48
Me
Ot-Bu
O
O
F
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

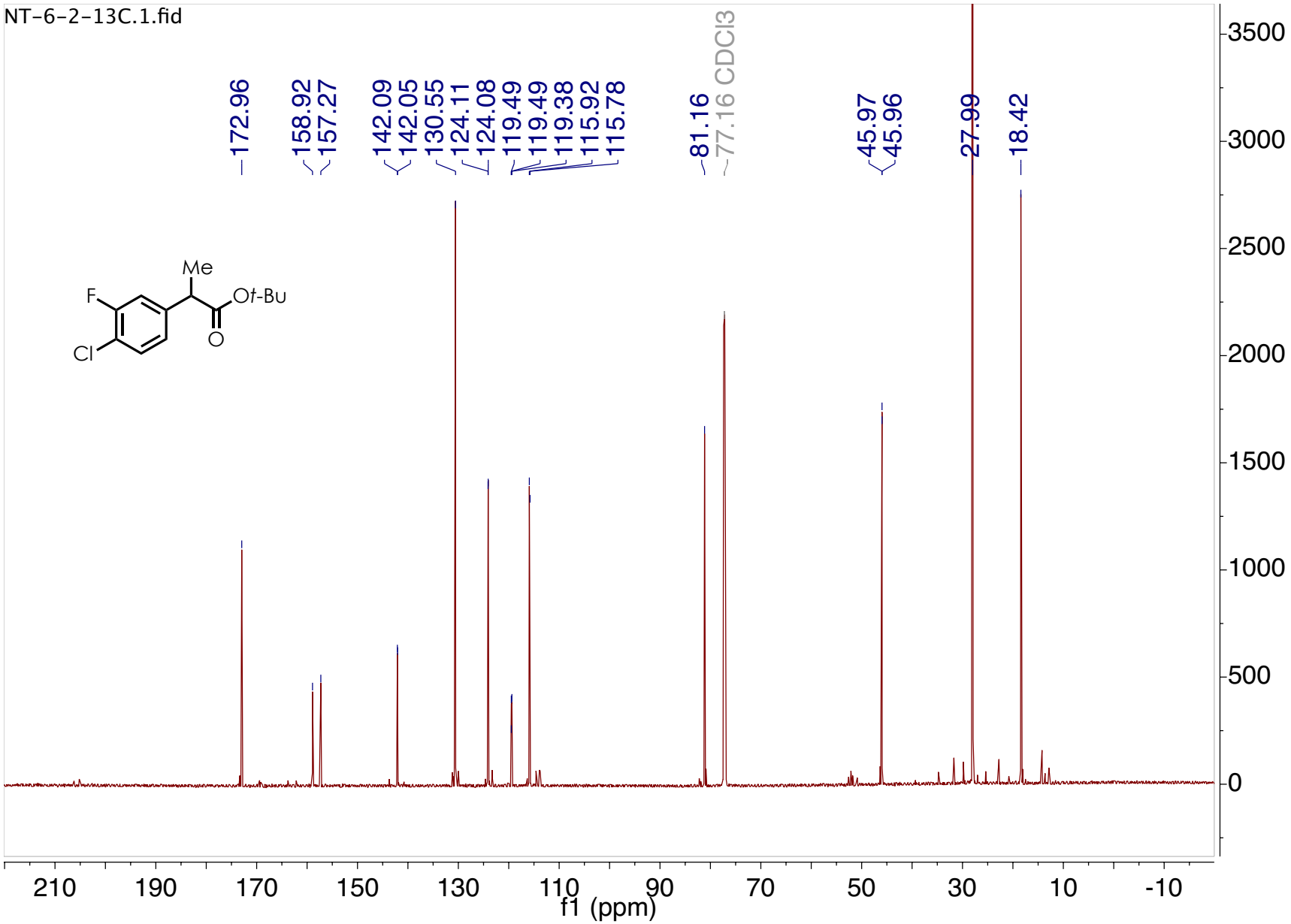

NT-04-249-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 7
Me
O
Ot-Bu
O
F
-120.10
-120.11
-120.12
-120.13
-120.15
-120.15
-120.17
-161.64 C6F6
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

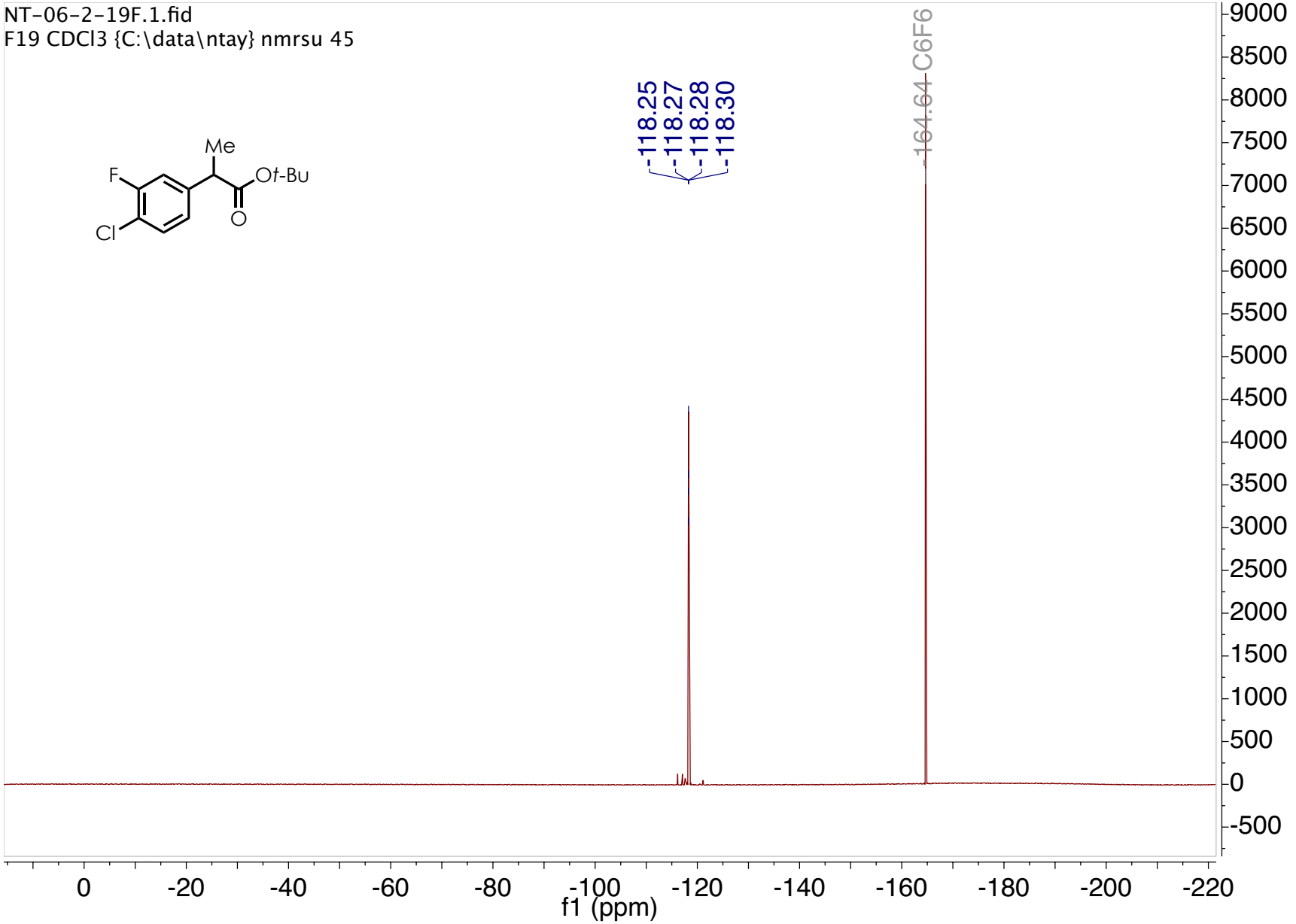

NT-04-256.1.fid
Nicewicz
516032
ntay
NT-04-256
7.27 7.26 7.25 7.04 7.04 7.04 7.03 7.03 7.03 7.03 7.02 7.02 7.01 6.99 6.99 6.99 6.98 6.98 6.98 6.97 6.96 6.96 6.95 6.95 6.84 6.84 6.83 6.83 6.82 6.82 6.82 6.82 3.71 3.70 3.66 3.49 1.48
Me
OMe
O
O
F
1.00 2.79 1.87 0.94 0.93 0.97 2.81
30000 28000 26000 24000 22000 20000 18000 16000 14000 12000 10000 8000 6000 4000 2000 0 -2000
12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1.0
f1 (ppm)

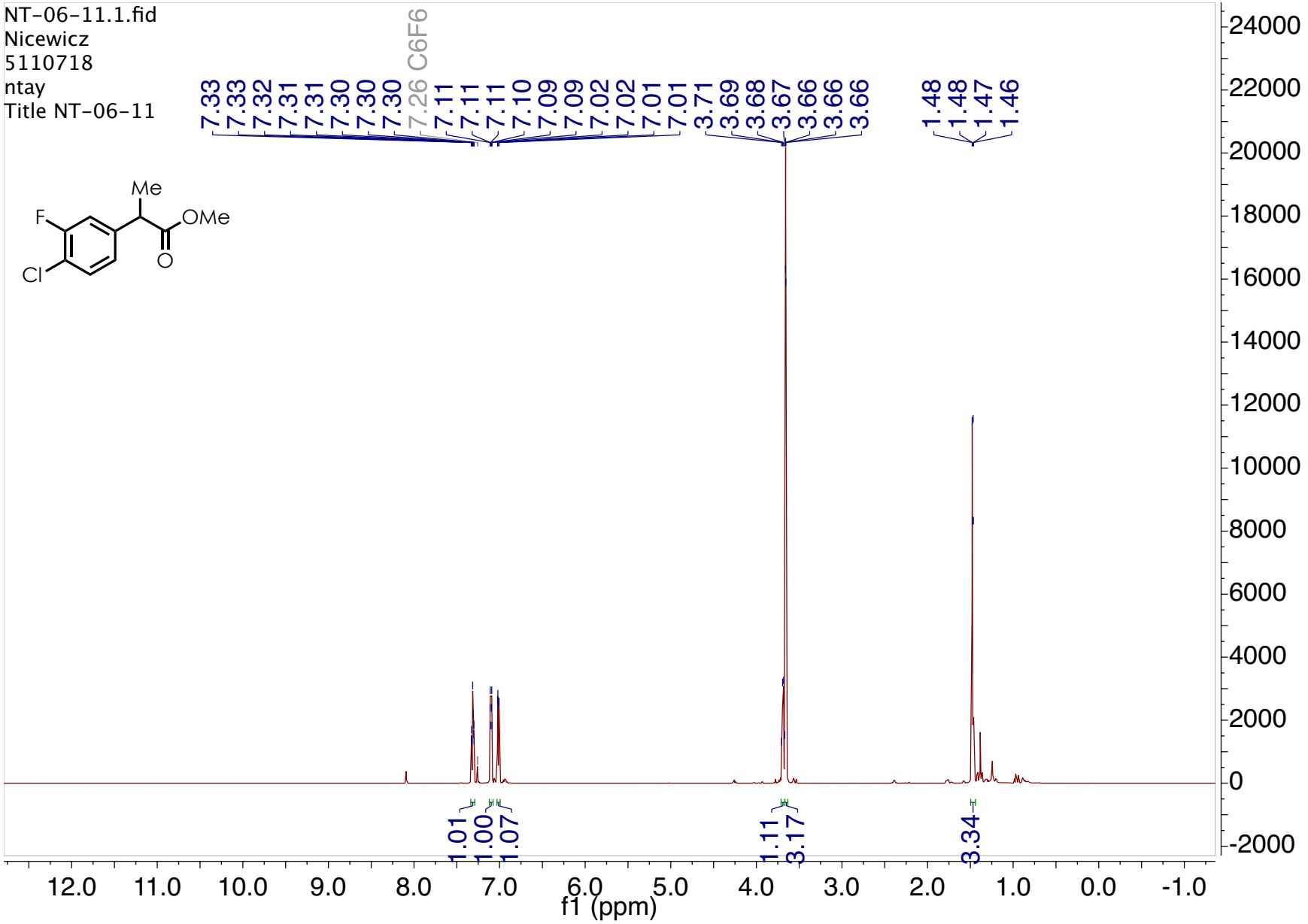

NT-04-256 2.2.fid
Nicewicz
516032
ntay
NT-04-256
174.68
159.76
158.16
157.98
152.76
152.74
142.68
129.97
122.28
120.73
120.67
117.61
116.74
116.47
116.32
77.16 CDCl3
52.14
52.13
45.34
18.58
Me
OMe
O
O
F
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

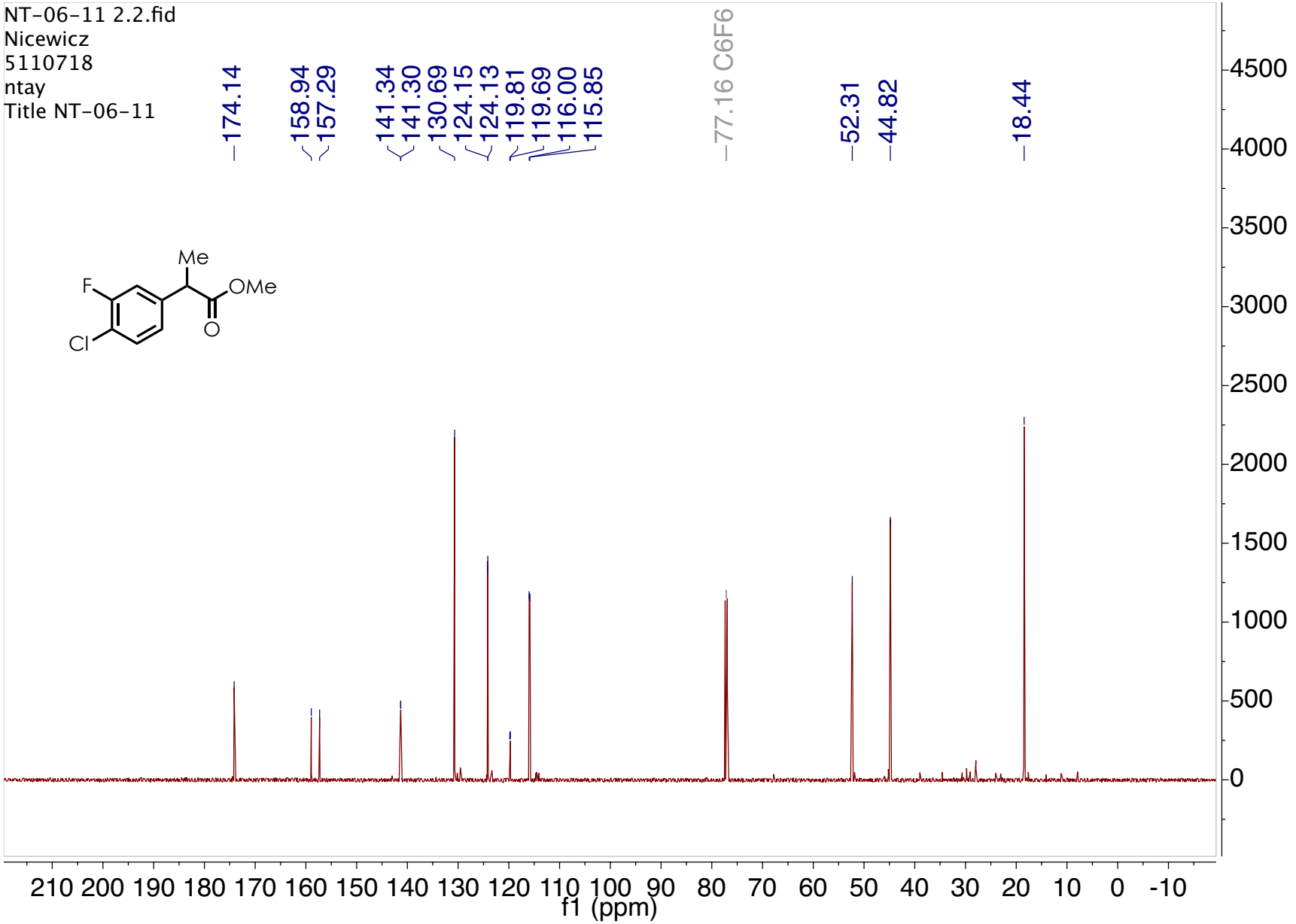

NT-04-256-19F 2.2.fid
F19 CDCl3 {C:\data\ntay} nmrsu 8
-119.84
-119.85
-119.86
-119.88
-119.89
-119.90
-119.91
-161.64 C6F6
Me
OMe
O
O
F
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

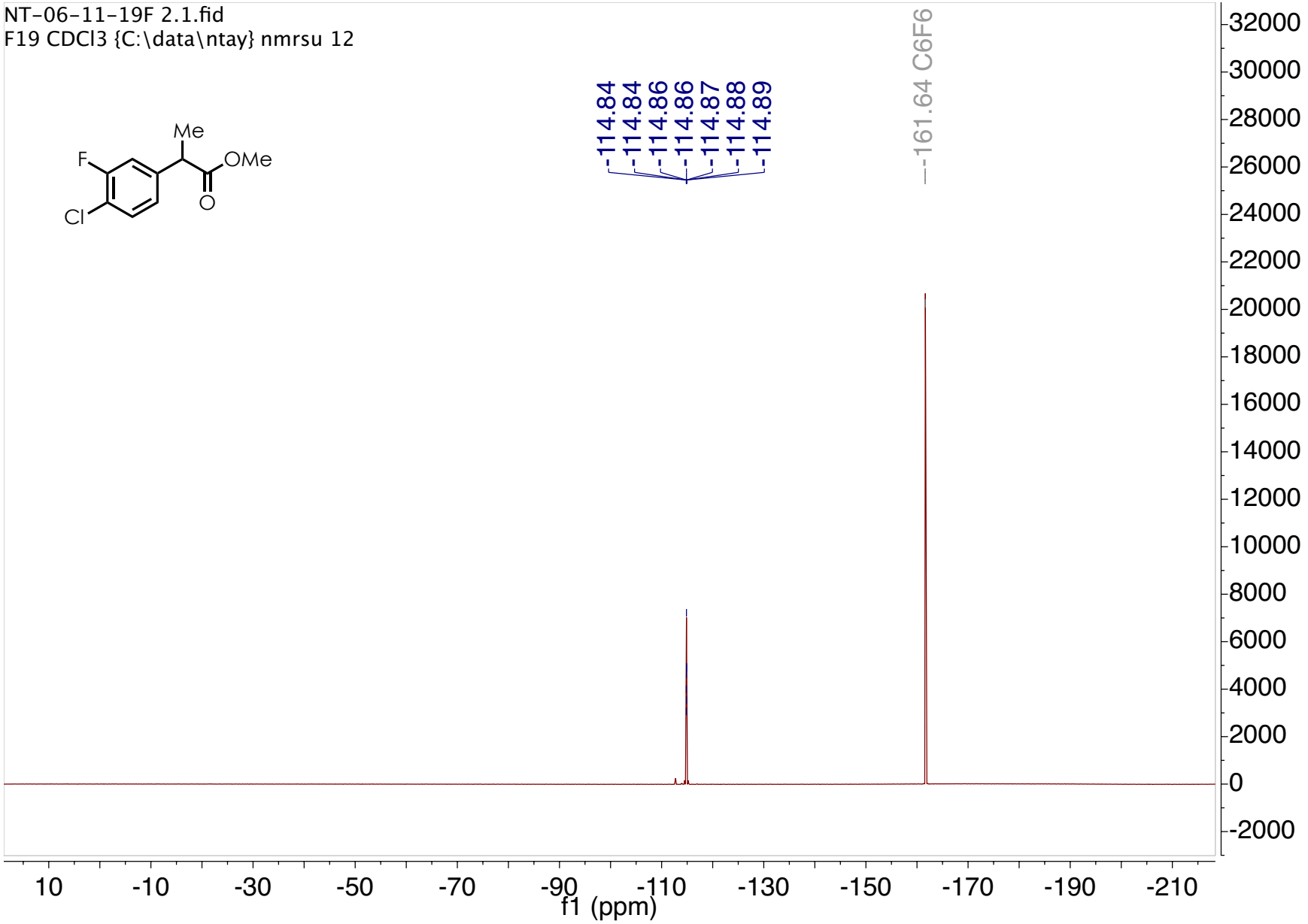

NT-6-2.1.fid
7.32
7.31
7.30
7.26 CDCl3
7.11
7.10
7.09
7.08
7.02
7.01
7.00
7.00
3.59
3.58
3.57
3.55
1.43
1.42
1.39
Me
F
Cl
Ot-Bu
O
1.00
1.00
1.07
1.00
3.27
9.37
f1 (ppm)

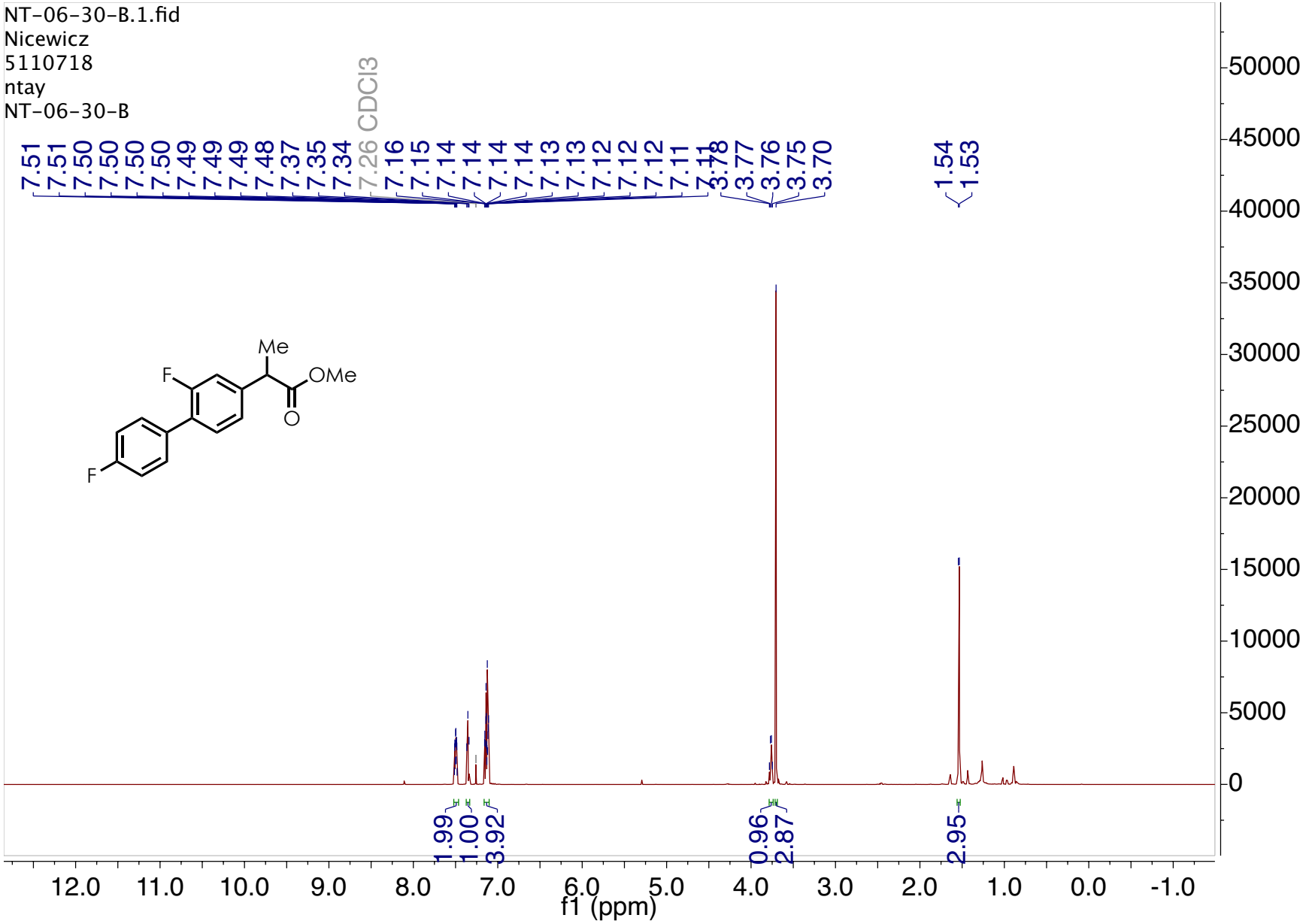

NT-6-2-13C.1.fid
172.96
158.92
157.27
142.09
142.05
130.55
124.11
124.08
119.49
119.49
119.38
115.92
115.78
81.16
77.16 CDCl3
45.97
45.96
27.99
18.42
Me
F
Ot-Bu
Cl
O
3500
3000
2500
2000
1500
1000
500
0
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

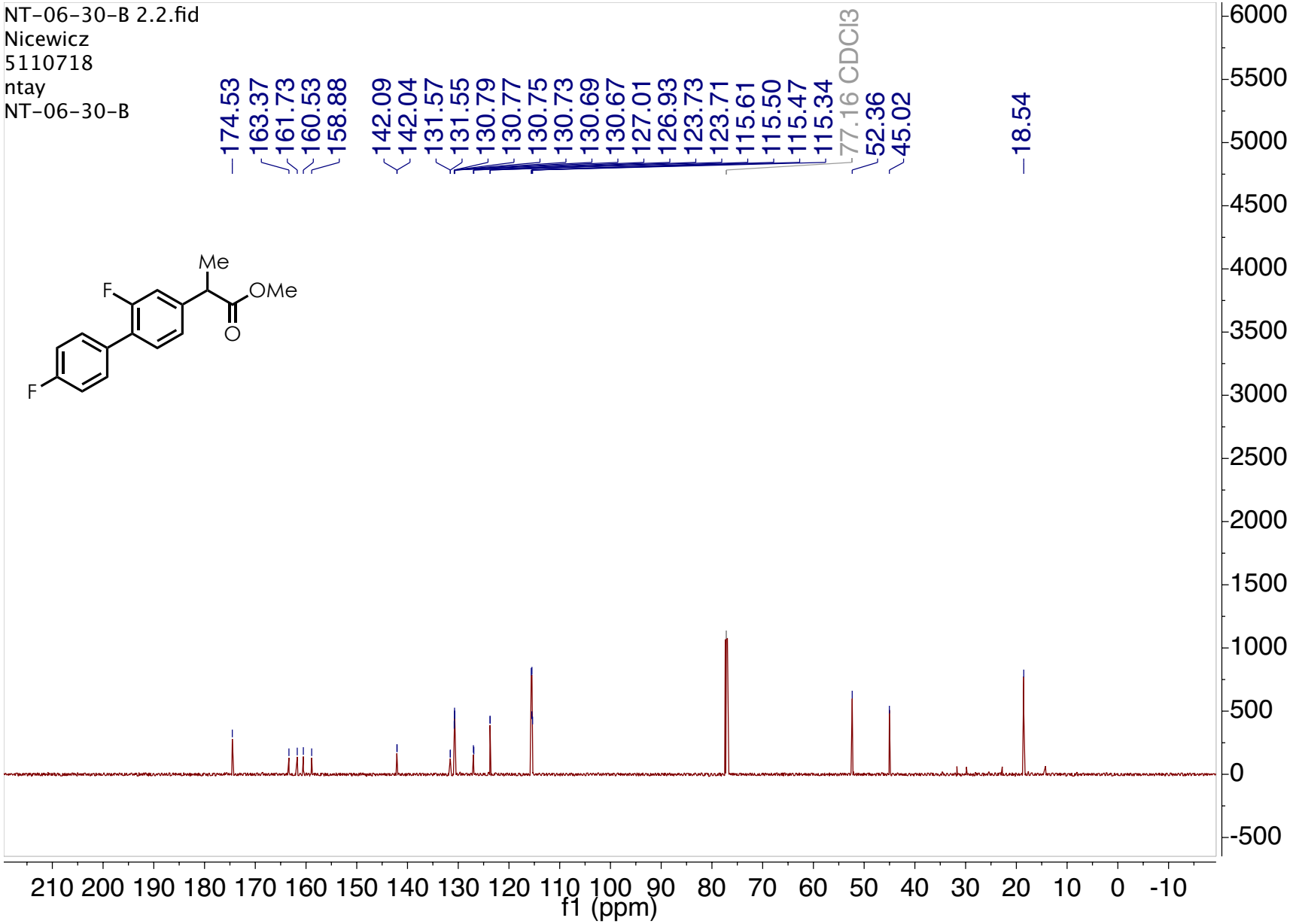

NT-06-2-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 45
Me
F
Ot-Bu
Cl
O
-118.25
-118.27
-118.28
-118.30
-164.64 C6F6
9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
f1 (ppm)

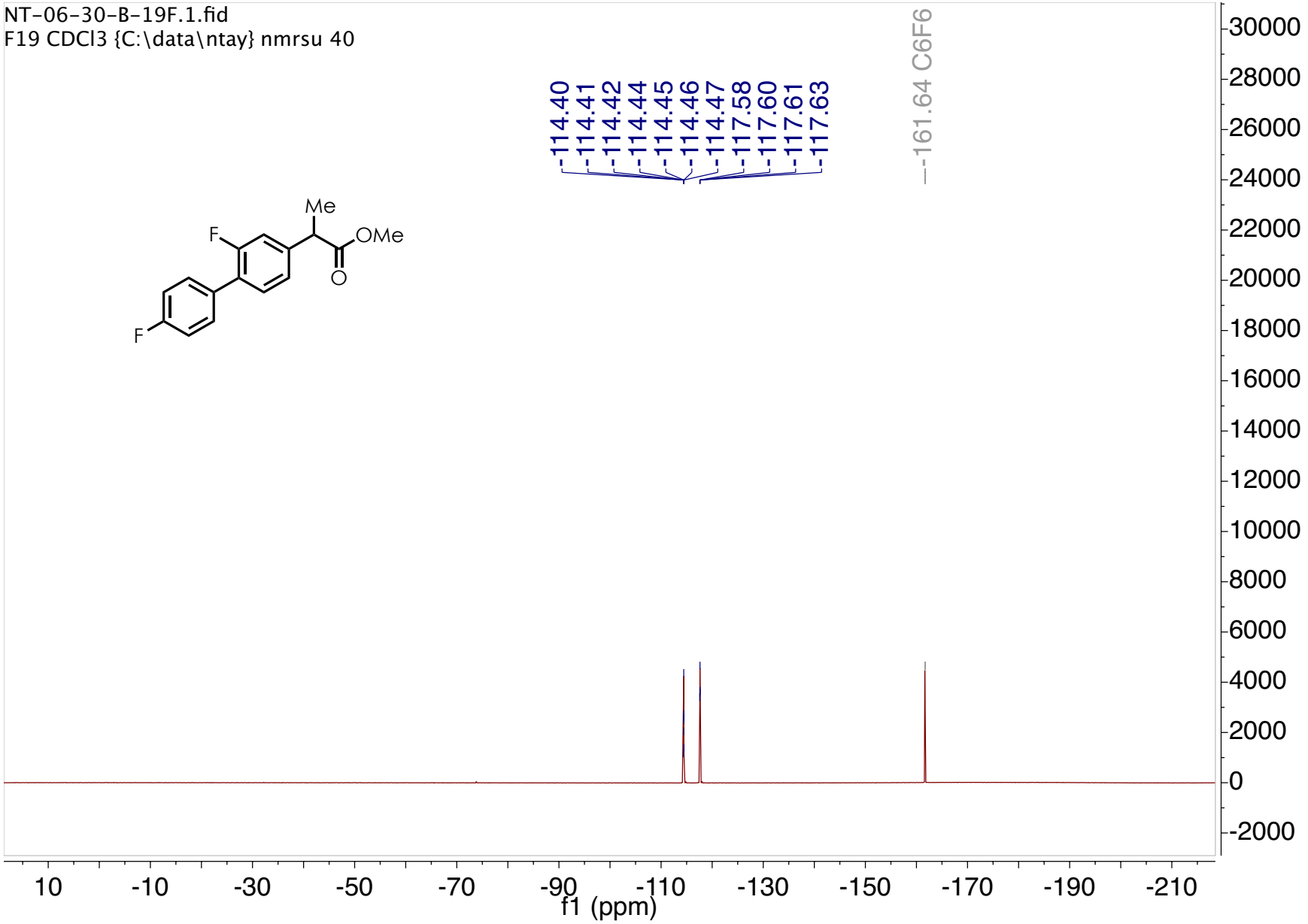

NT-06-11.1.fid
Nicewicz
5110718
ntay
Title NT-06-11
C6F6
7.33 7.33 7.32 7.31 7.31 7.30 7.30 7.30 7.26 7.11 7.11 7.11 7.10 7.09 7.09 7.02 7.02 7.01 7.01 3.71 3.69 3.68 3.67 3.66 3.66 3.66 1.48 1.48 1.47 1.46
Me
F
OMe
Cl
O
1.01 1.00 1.07 1.11 3.17 3.34
f1 (ppm)

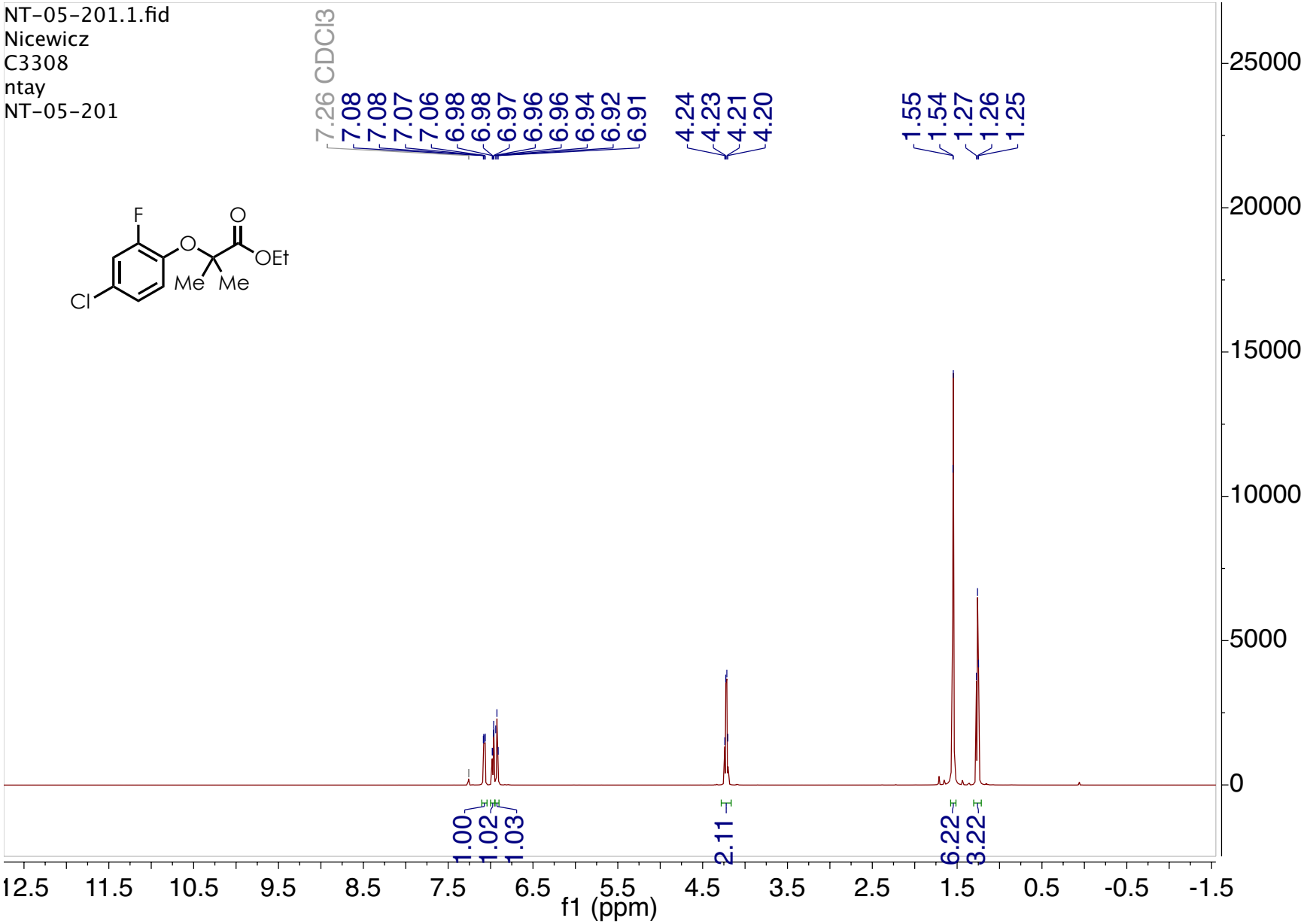

NT-06-11 2.2.fid
Nicewicz
5110718
ntay
Title NT-06-11
174.14
158.94
157.29
141.34
141.30
130.69
124.15
124.13
119.81
119.69
116.00
115.85
77.16 C6F6
52.31
44.82
18.44
Me
F
OMe
Cl
O
4500
4000
3500
3000
2500
2000
1500
1000
500
0
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

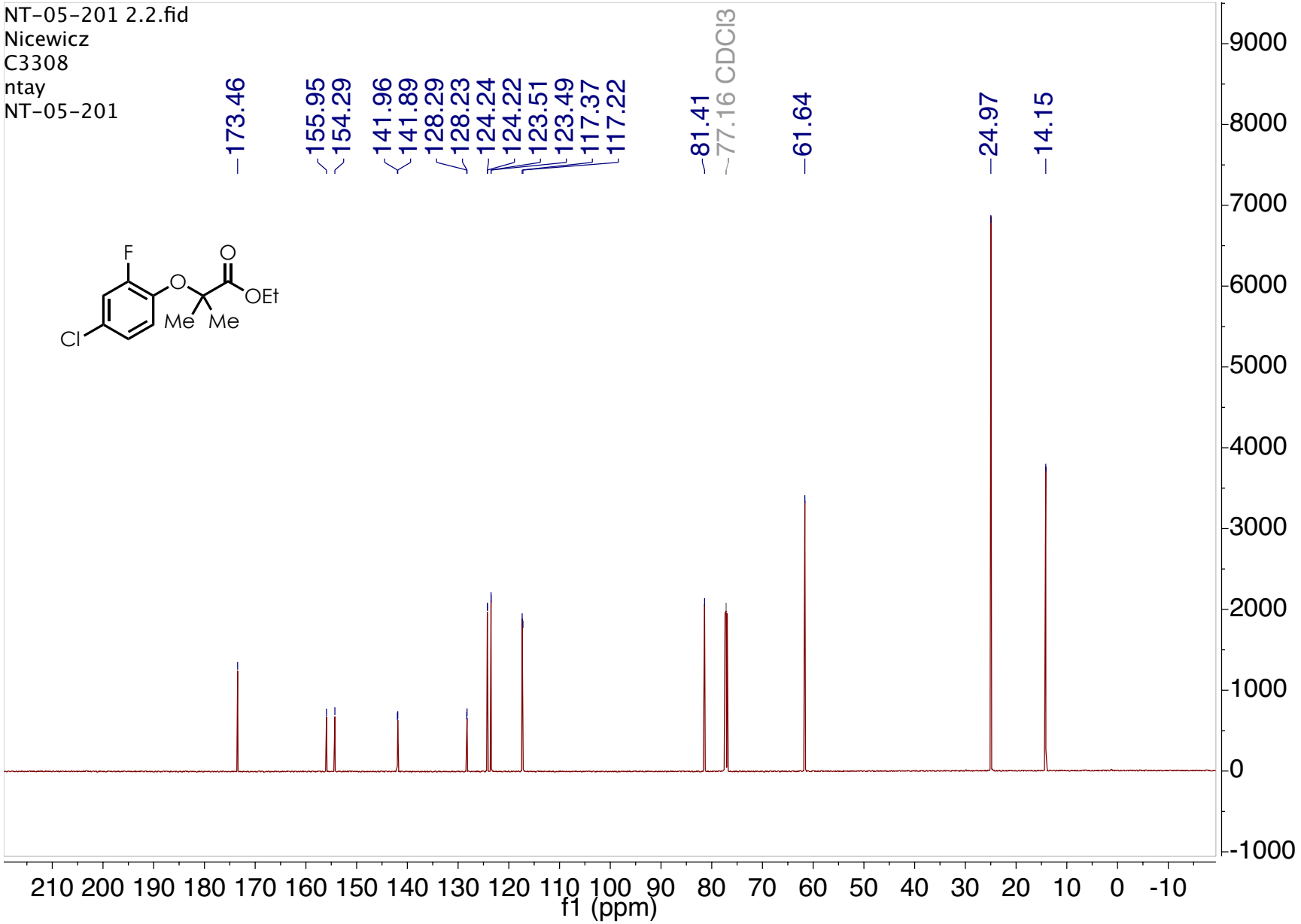

NT-06-11-19F 2.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 12
Me
F
OMe
O
Cl
-114.84
-114.84
-114.86
-114.86
-114.87
-114.88
-114.89
-161.64 C6F6
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

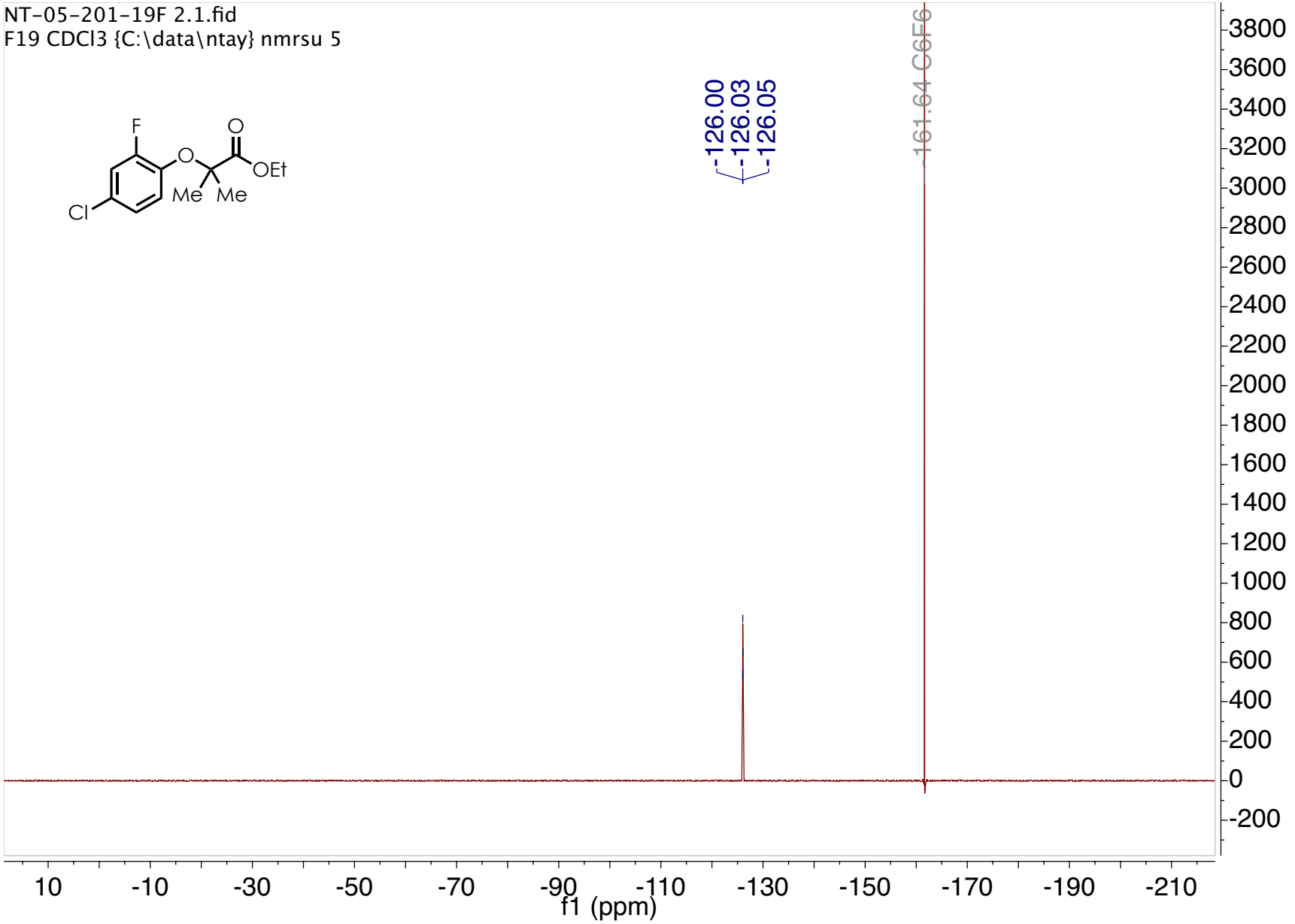

NT-06-30-B.1.fid
Nicewicz
5110718
ntay
NT-06-30-B
CDCl3
7.51 7.51 7.50 7.50 7.50 7.50 7.49 7.49 7.49 7.48 7.37 7.35 7.34 7.26 7.16 7.15 7.14 7.14 7.14 7.14 7.13 7.13 7.12 7.12 7.12 7.11 7.11 3.78 3.77 3.76 3.75 3.70
1.54 1.53
Me
F
OMe
O
F
1.99 1.00 3.92 0.96 2.87 2.95
50000 45000 40000 35000 30000 25000 20000 15000 10000 5000 0
12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1.0
f1 (ppm)

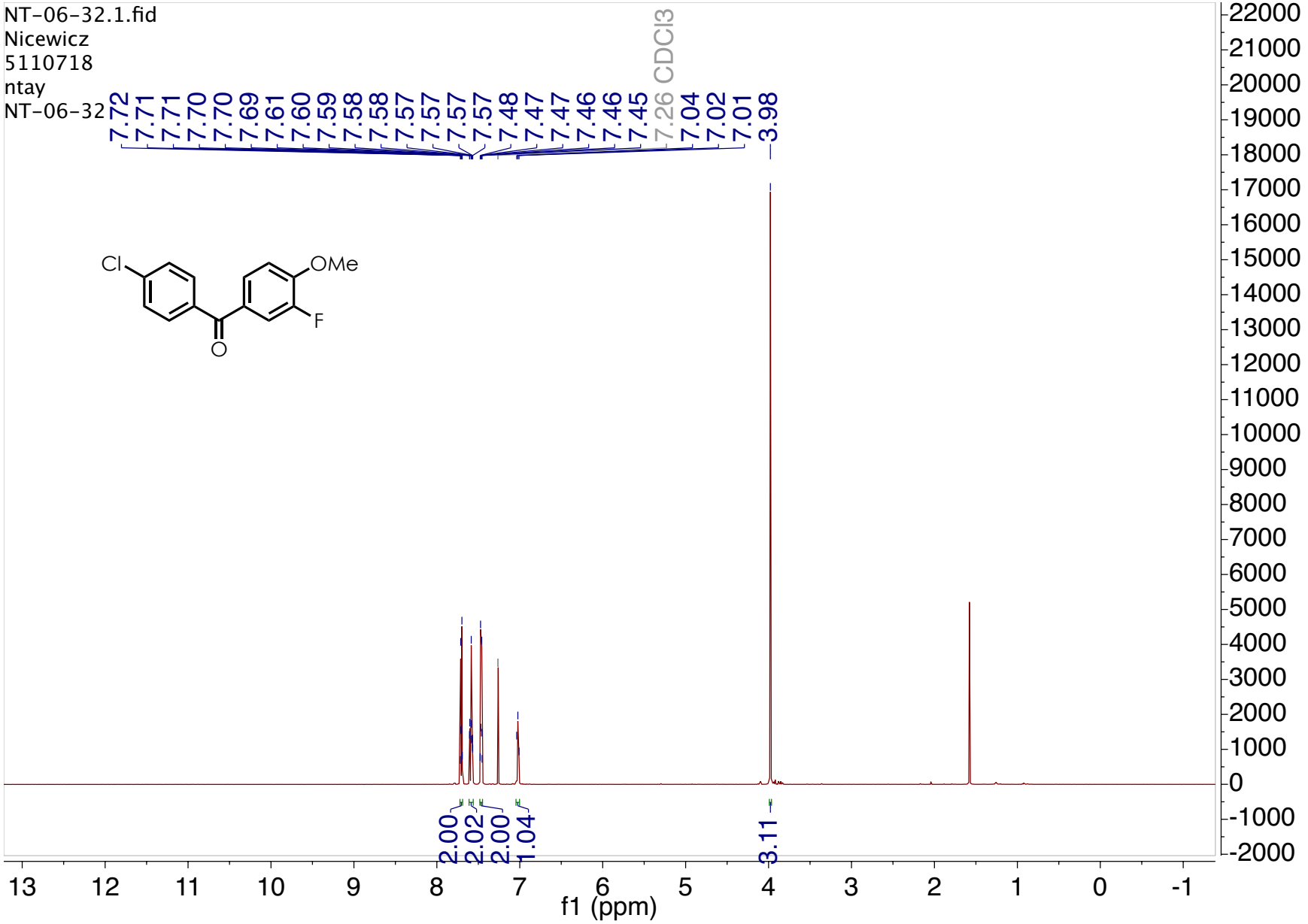

NT-06-30-B 2.2.fid
Nicewicz
5110718
ntay
NT-06-30-B
174.53
163.37
161.73
160.53
158.88
142.09
142.04
131.57
131.55
130.79
130.77
130.75
130.73
130.69
130.67
127.01
126.93
123.73
123.71
115.61
115.50
115.47
115.34
77.16 CDCl3
52.36
45.02
18.54
Me
F
OMe
O
F
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

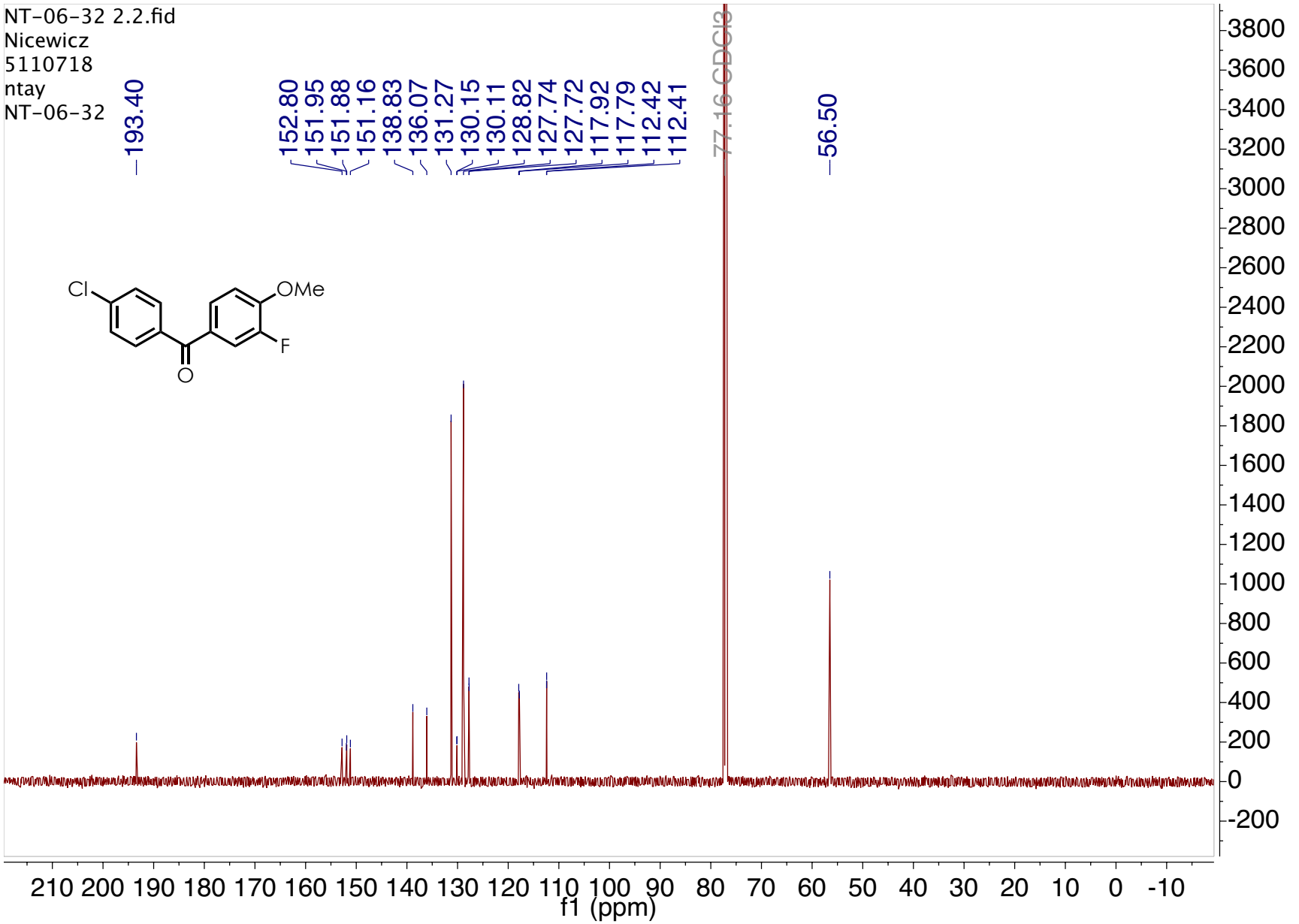

NT-06-30-B-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 40
-114.40
-114.41
-114.42
-114.44
-114.45
-114.46
-114.47
-117.58
-117.60
-117.61
-117.63
-161.64 C6F6
Me
F
OMe
O
F
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

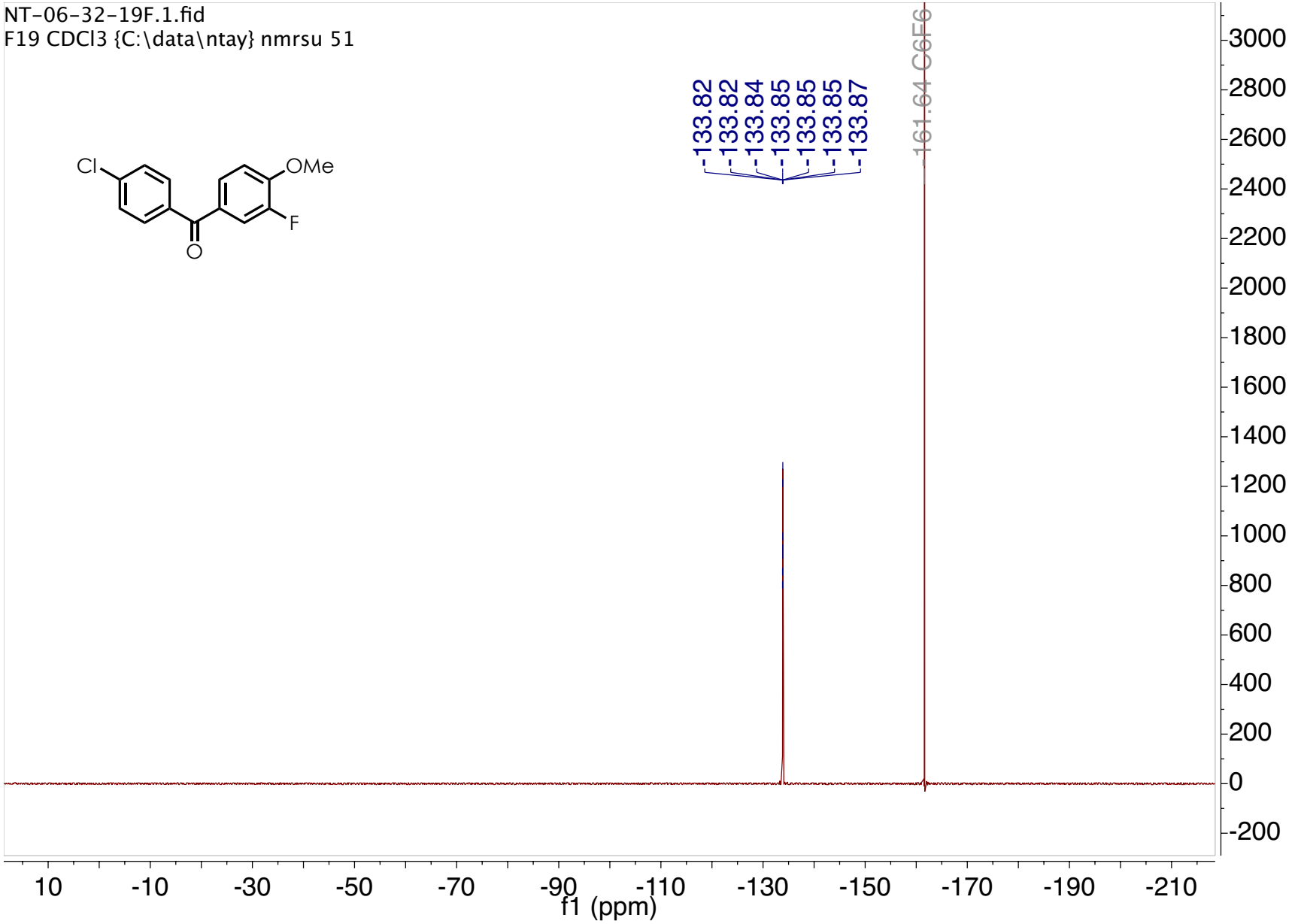

NT-05-201.1.fid
Nicewicz
C3308
ntay
NT-05-201
7.26 CDCl3
7.08
7.08
7.07
7.06
6.98
6.98
6.97
6.96
6.96
6.94
6.92
6.91
4.24
4.23
4.21
4.20
1.55
1.54
1.27
1.26
1.25
F
O
O
OEt
Me
Me
Cl
25000
20000
15000
10000
5000
0
1.00
1.02
1.03
2.11
6.22
3.22
12.5
11.5
10.5
9.5
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
-0.5
-1.5
f1 (ppm)

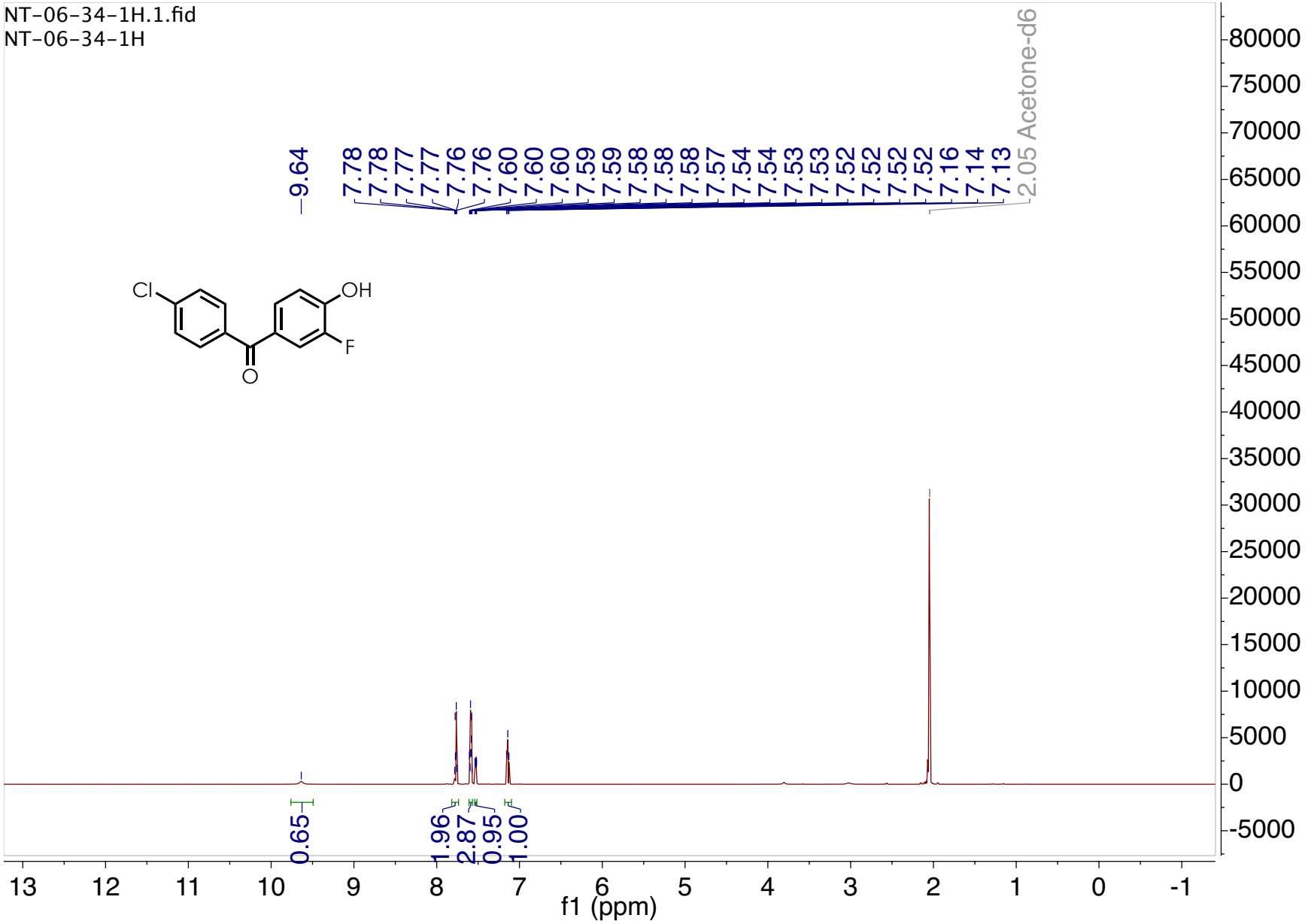

NT-05-201 2.2.fid
Nicewicz
C3308
ntay
NT-05-201
173.46
155.95
154.29
141.96
141.89
128.29
128.23
124.24
124.22
123.51
123.49
117.37
117.22
81.41
77.16 CDCl3
61.64
24.97
14.15
F
O
O
OEt
Me
Me
Cl
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

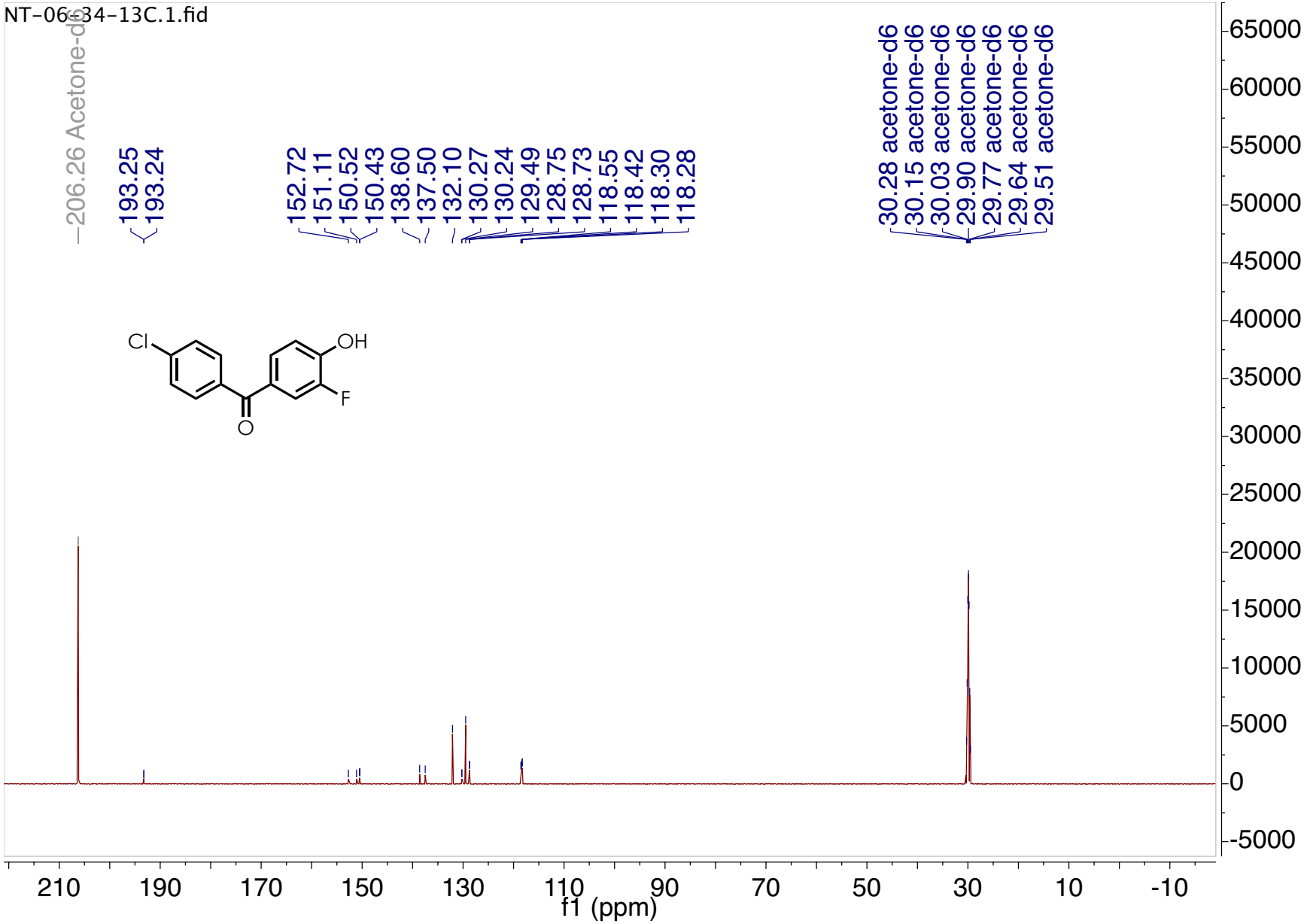

NT-05-201-19F 2.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 5
F
O
O
OEt
Me
Me
Cl
-126.00
-126.03
-126.05
-161.64 C6F6
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

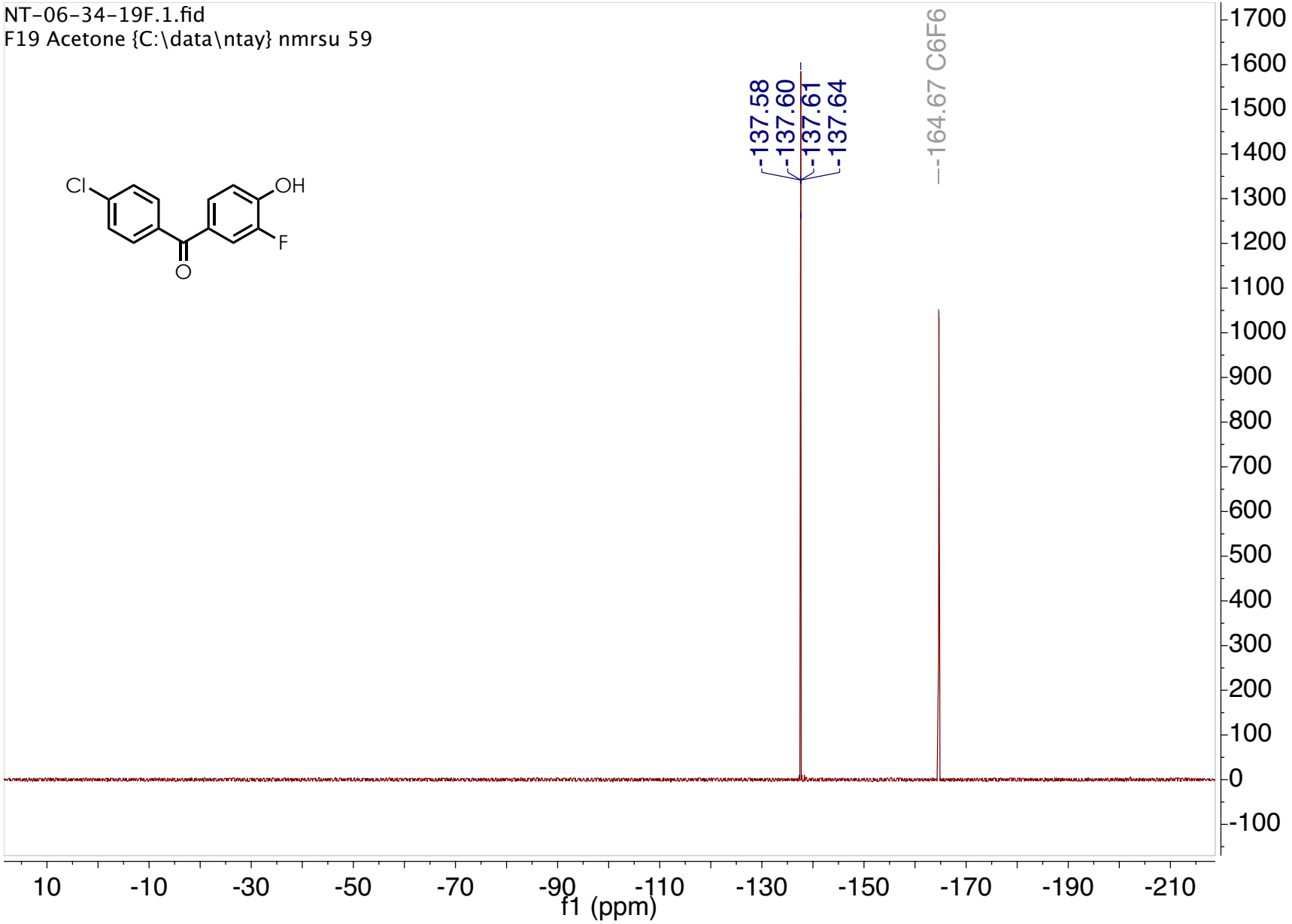

NT-06-32.1.fid
Nicewicz
5110718
ntay
NT-06-32
7.72
7.71
7.71
7.70
7.70
7.69
7.61
7.60
7.59
7.58
7.58
7.57
7.57
7.57
7.57
7.48
7.47
7.47
7.46
7.46
7.45
7.26 CDCl3
7.04
7.02
7.01
3.98
Cl
OMe
F
O
2.00
2.02
2.00
1.04
3.11
22000
21000
20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
-2000
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
f1 (ppm)

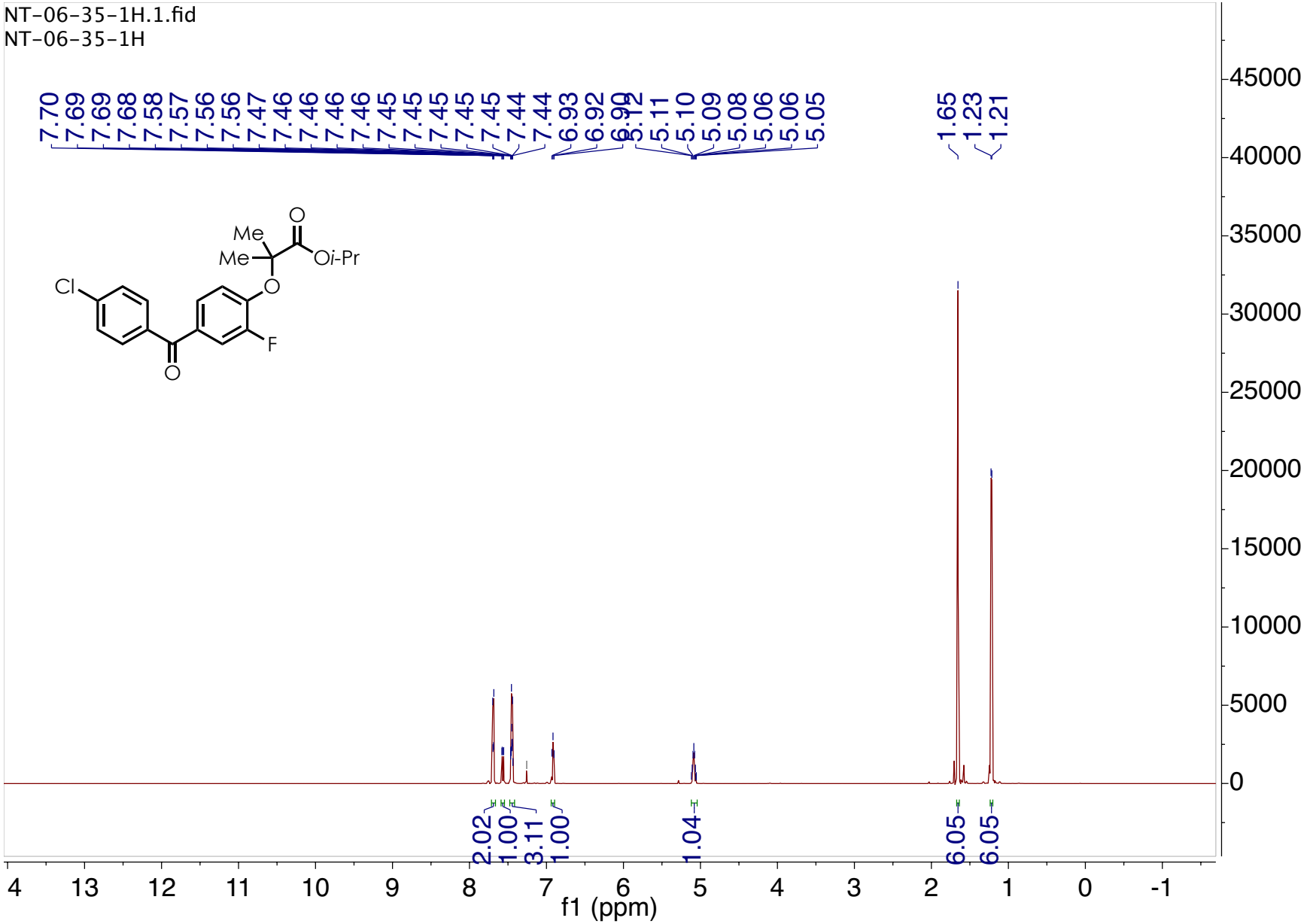

NT-06-32 2.2.fid
Nicewicz
5110718
ntay
NT-06-32
193.40
152.80
151.95
151.88
151.16
138.83
136.07
131.27
130.15
130.11
128.82
127.74
127.72
117.92
117.79
112.42
112.41
77.16 CDCl3
56.50
Cl
OMe
F
O
f1 (ppm)

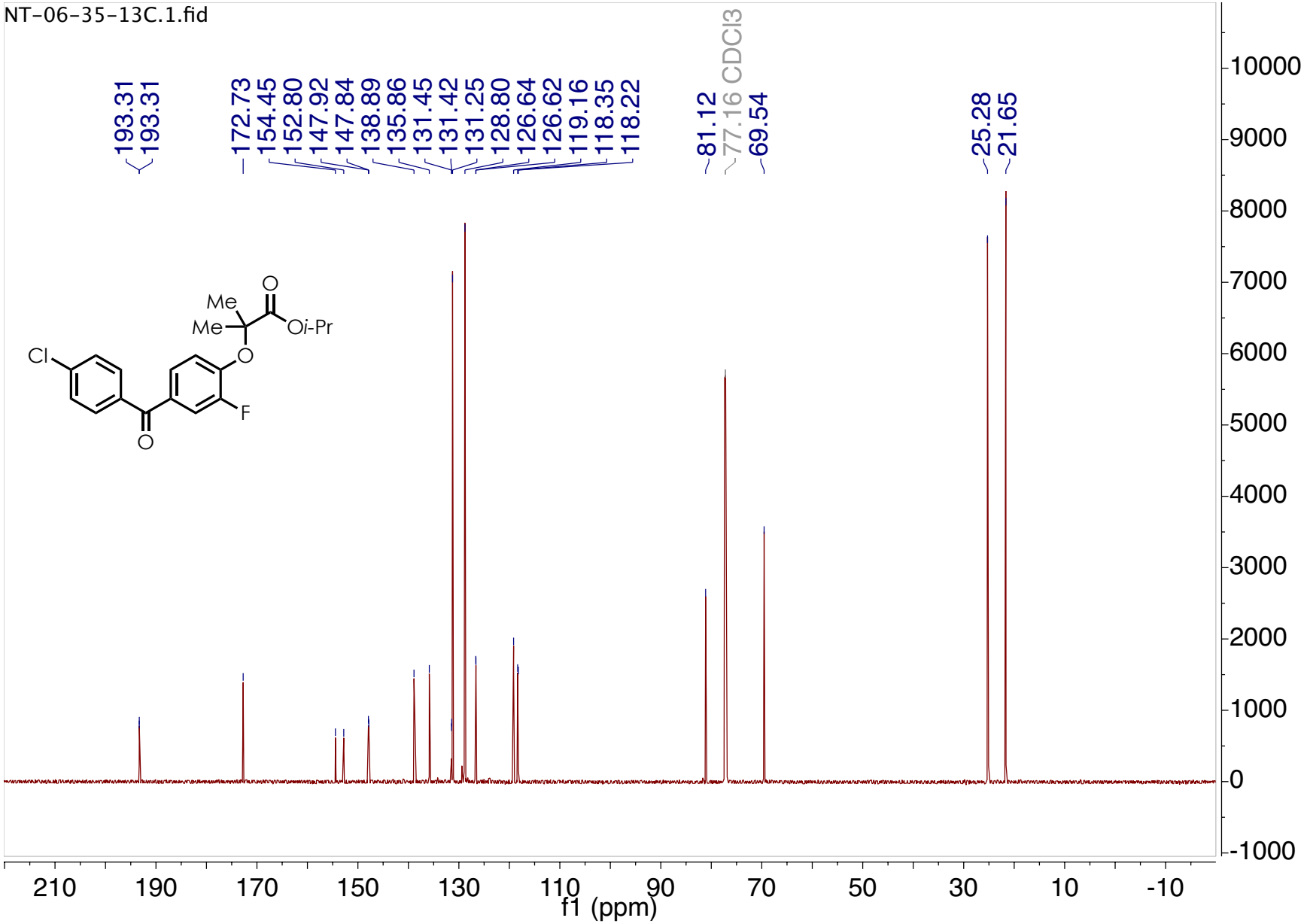

NT-06-32-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 51
Cl
OMe
F
O
-133.82
-133.82
-133.84
-133.85
-133.85
-133.85
-133.87
-161.64 C6F6
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

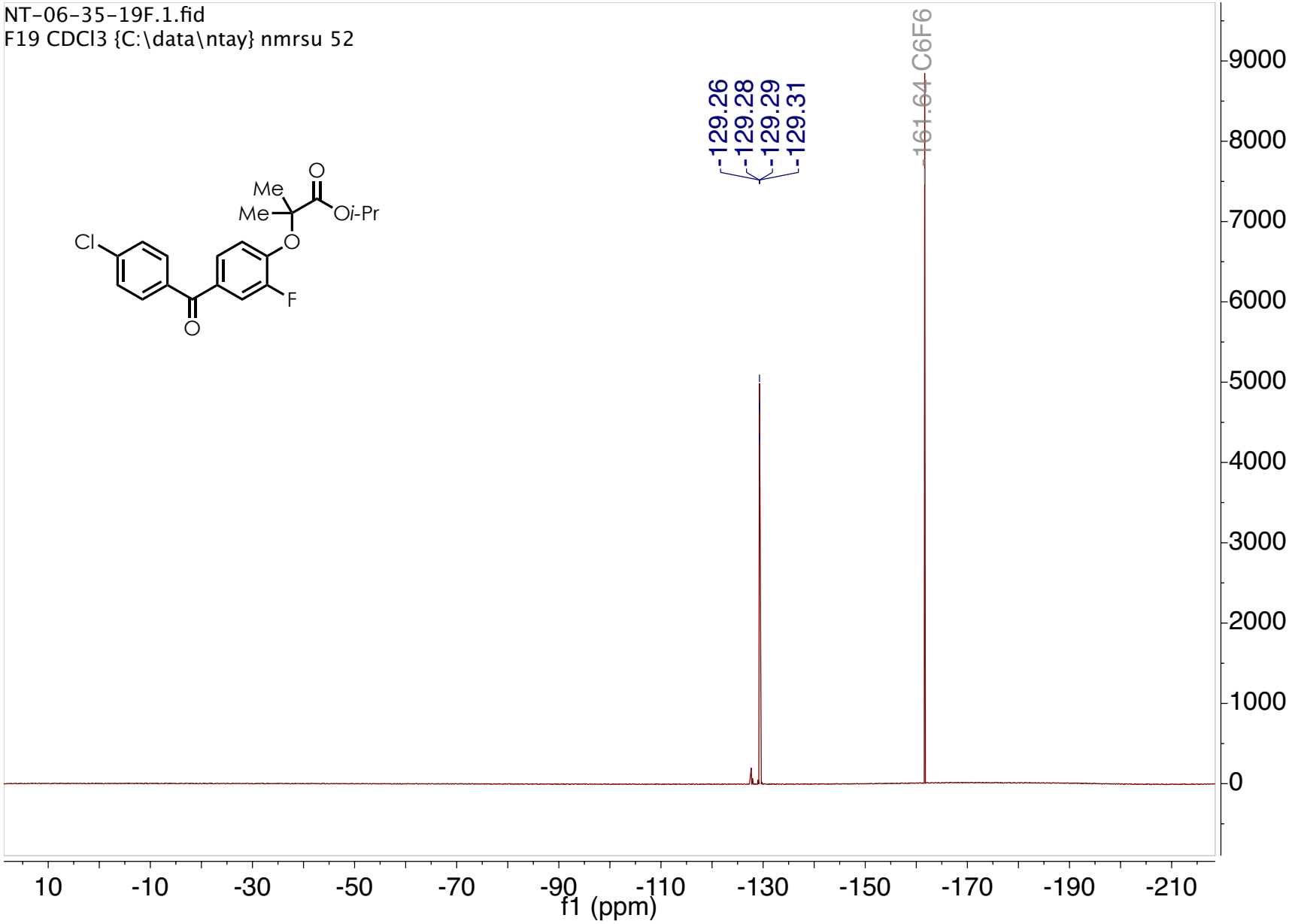

NT-06-34-1H.1.fid
NT-06-34-1H
9.64
7.78
7.78
7.77
7.77
7.76
7.76
7.60
7.60
7.60
7.59
7.59
7.58
7.58
7.58
7.57
7.54
7.54
7.53
7.53
7.52
7.52
7.52
7.52
7.16
7.14
7.13
2.05 Acetone-d6
Cl
OH
F
O
0.65
1.96
2.87
0.95
1.00
f1 (ppm)

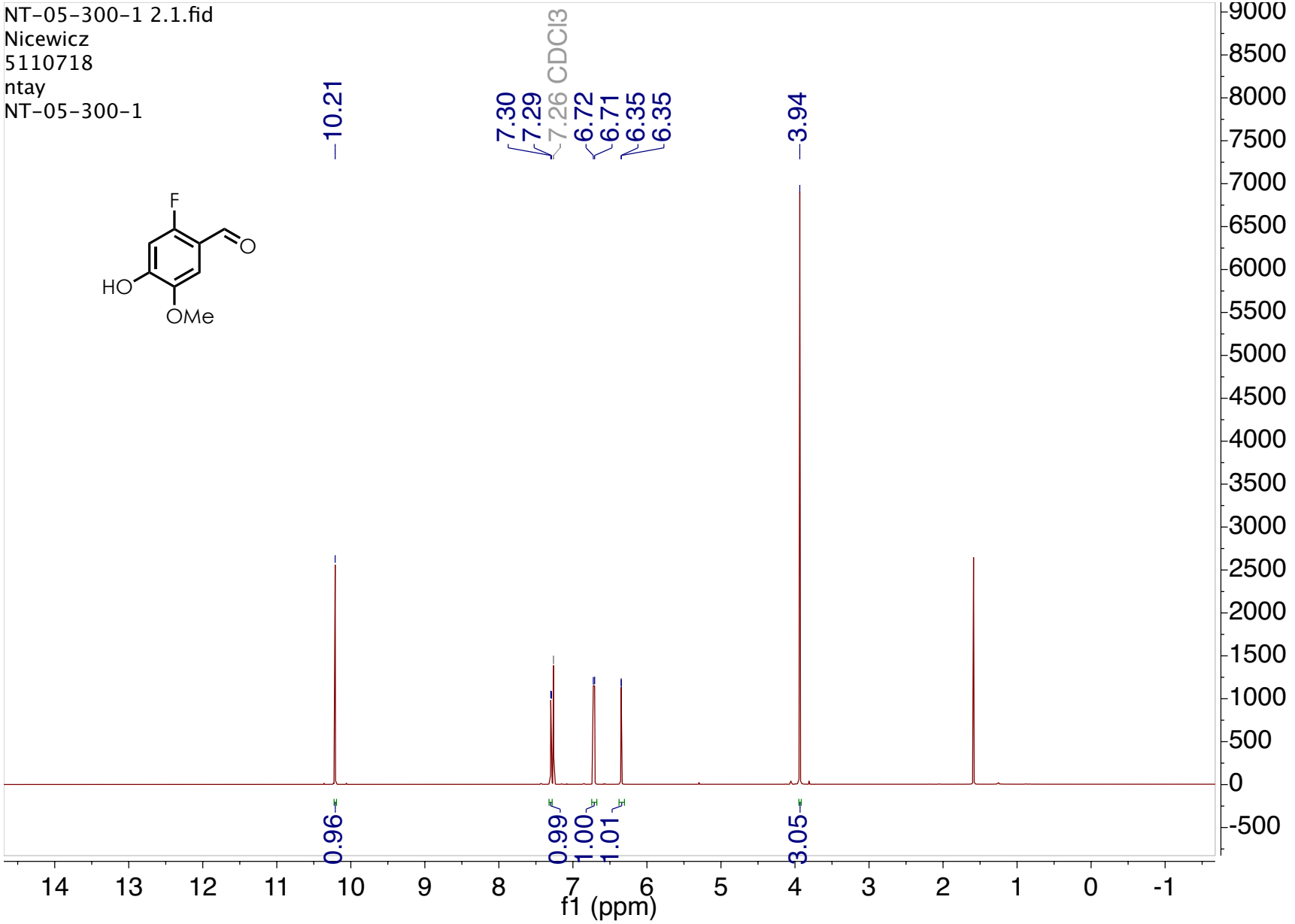

NT-06-34-13C.1.fid
206.26 Acetone-d6
193.25
193.24
152.72
151.11
150.52
150.43
138.60
137.50
132.10
130.27
130.24
129.49
128.75
128.73
118.55
118.42
118.30
118.28
30.28 acetone-d6
30.15 acetone-d6
30.03 acetone-d6
29.90 acetone-d6
29.77 acetone-d6
29.64 acetone-d6
29.51 acetone-d6
Cl
OH
F
O
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

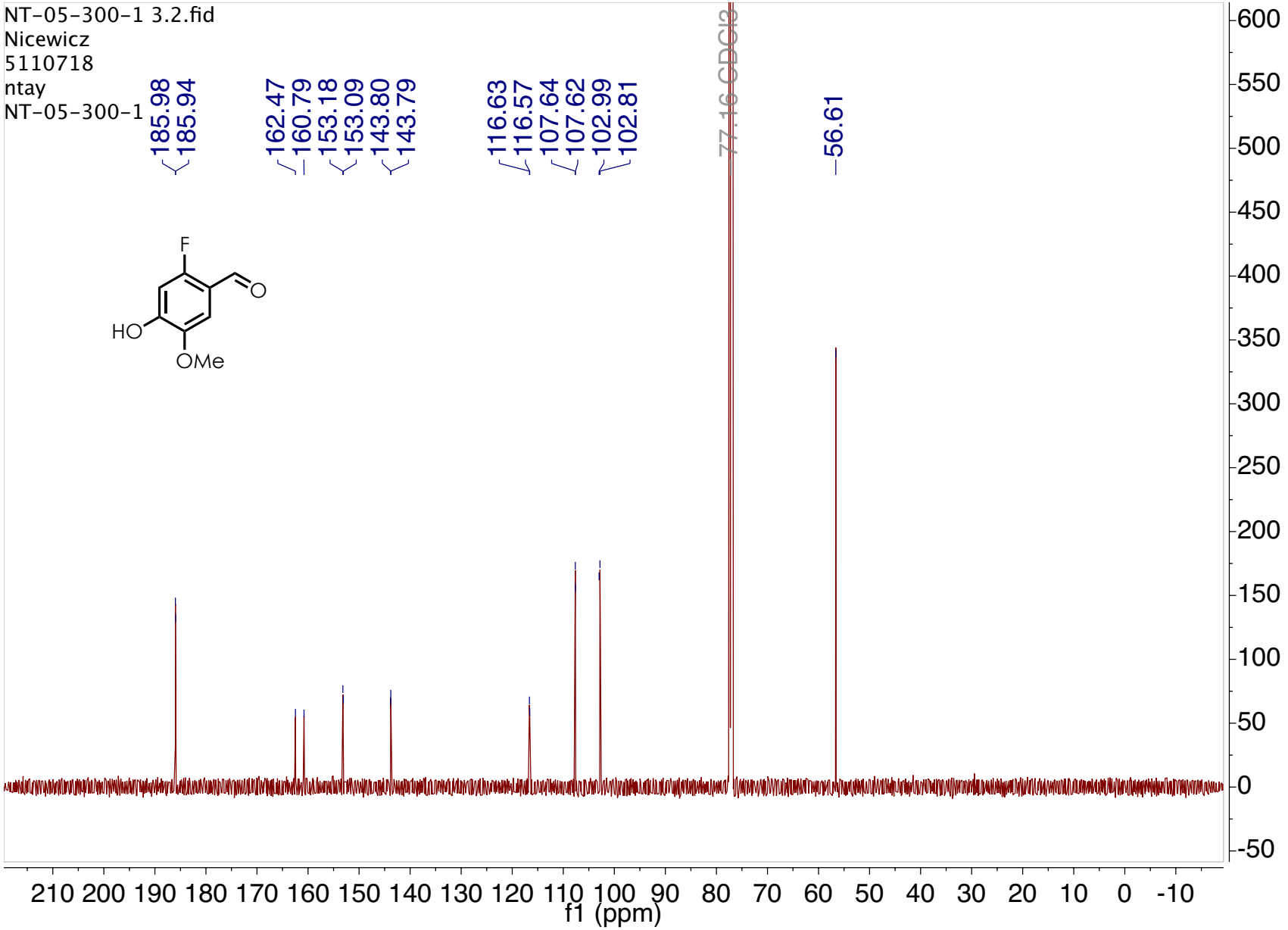

NT-06-34-19F.1.fid
F19 Acetone {C:\data\ntay} nmrsu 59
Cl
OH
F
O
-137.58
-137.60
-137.61
-137.64
-164.67 C6F6
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

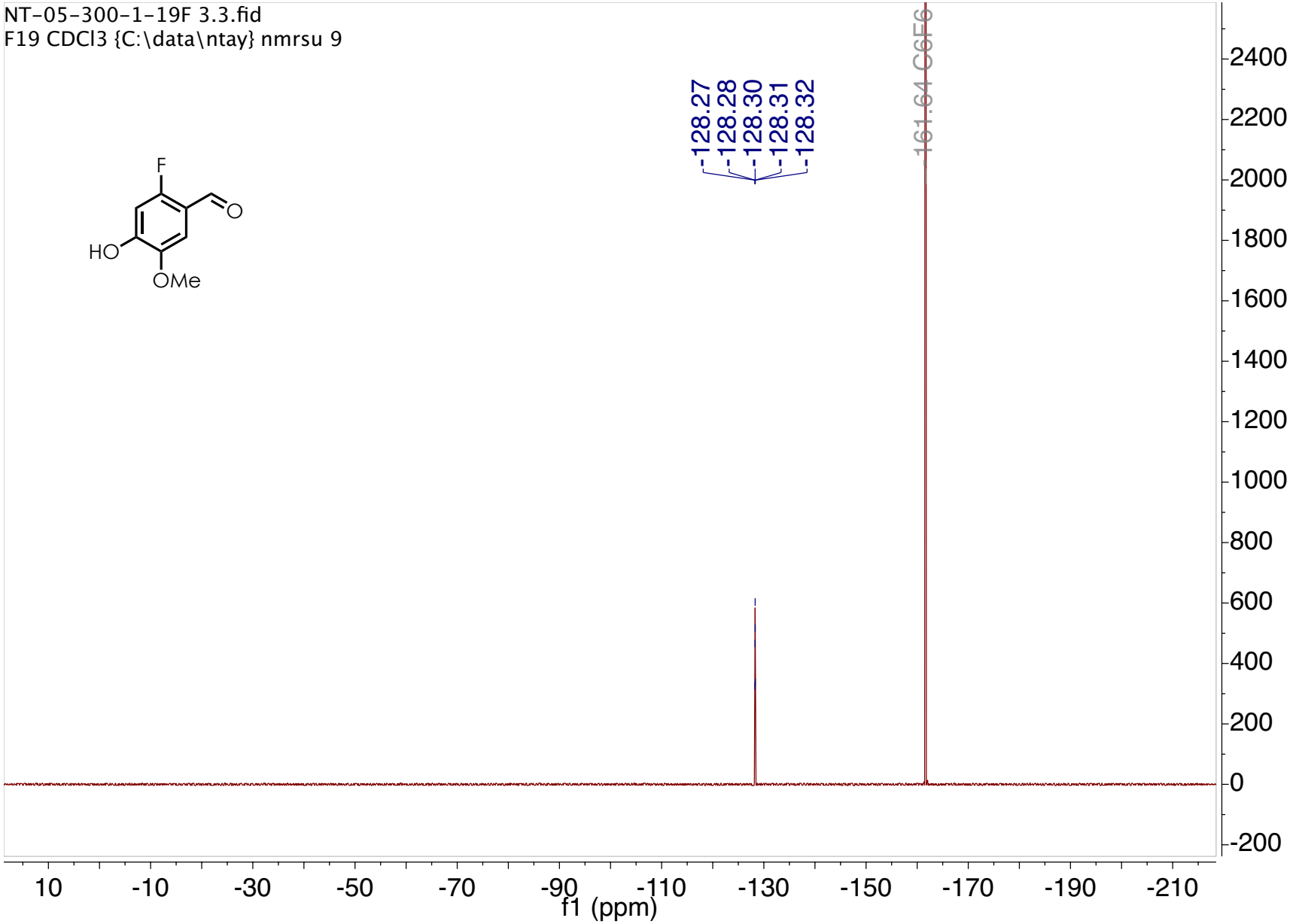

NT-06-35-1H.1.fid
NT-06-35-1H
7.70
7.69
7.69
7.68
7.58
7.57
7.56
7.56
7.47
7.46
7.46
7.46
7.46
7.45
7.45
7.45
7.45
7.45
7.44
7.44
6.93
6.92
6.90
5.12
5.11
5.10
5.09
5.08
5.06
5.06
5.05
1.65
1.23
1.21
Me
Me
O
Oi-Pr
O
Cl
F
O
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
2.02
1.00
3.11
1.00
1.04
6.05
6.05
4
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
f1 (ppm)

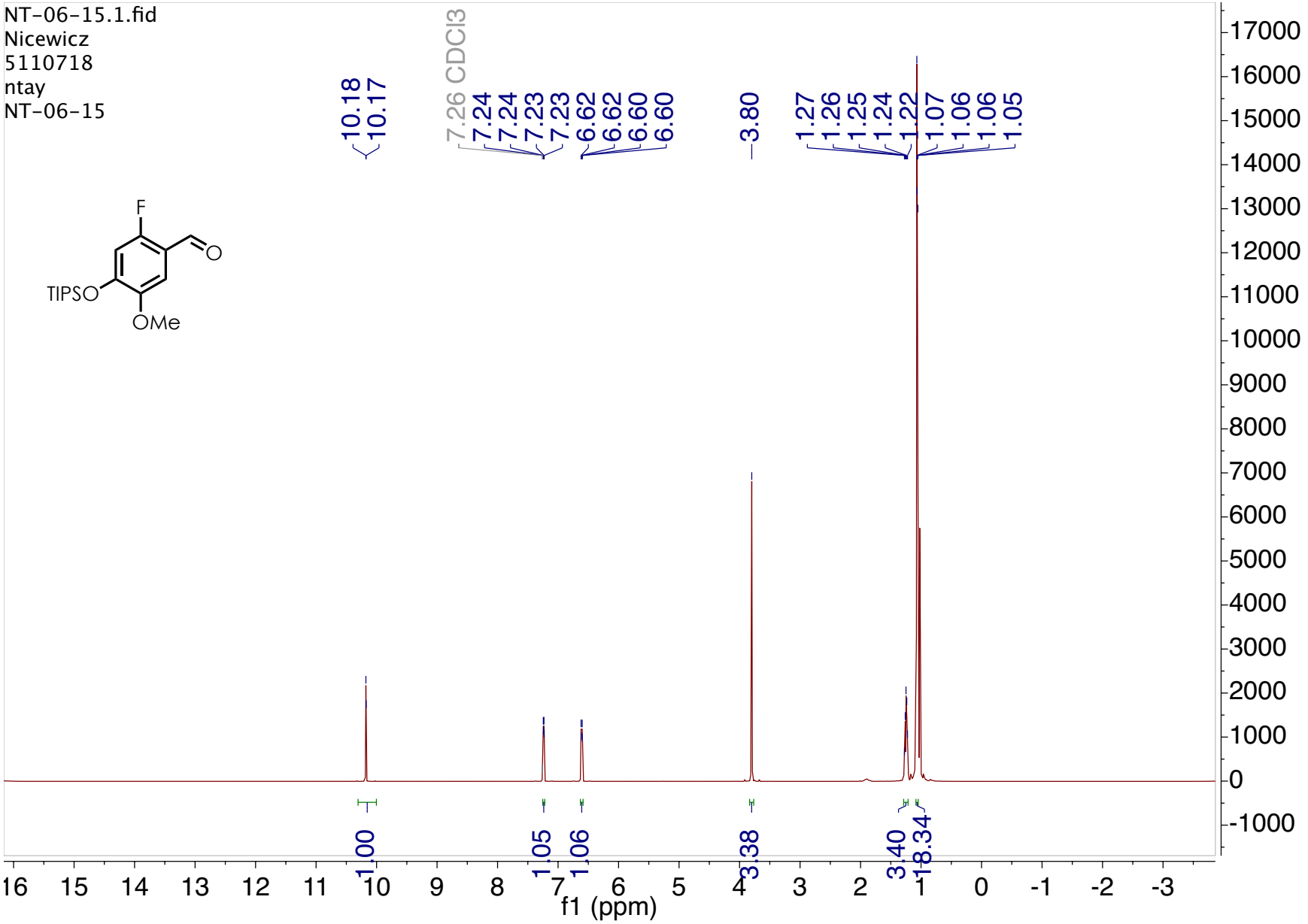

NT-06-35-13C.1.fid
193.31
193.31
172.73
154.45
152.80
147.92
147.84
138.89
135.86
131.45
131.42
131.25
128.80
126.64
126.62
119.16
118.35
118.22
81.12
77.16 CDCl3
69.54
25.28
21.65
Me
Me
O
Oi-Pr
O
Cl
F
O
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

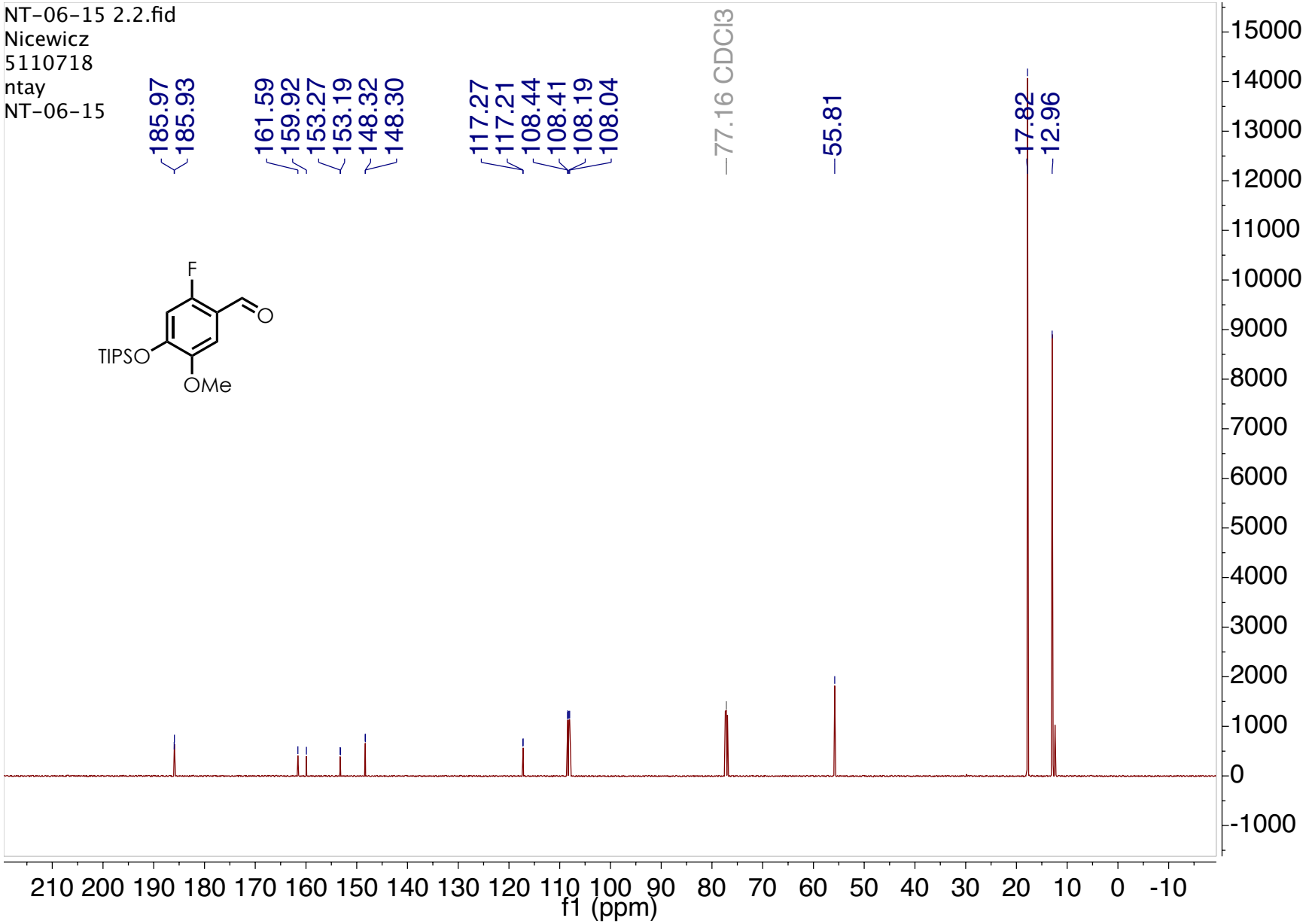

NT-06-35-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 52
-129.26
-129.28
-129.29
-129.31
-161.64 C6F6
Me
Me
O
Oi-Pr
Cl
O
F
O
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

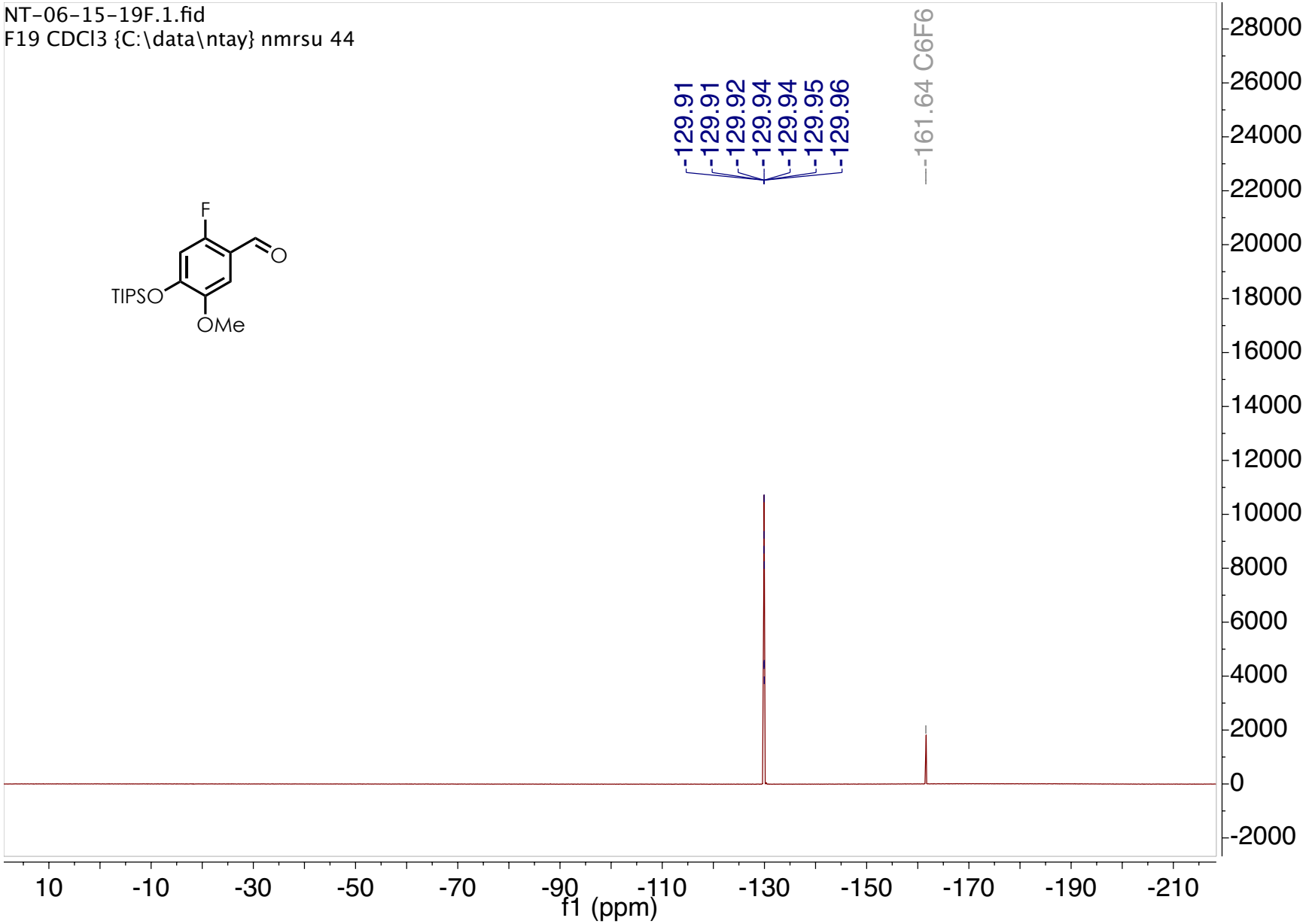

NT-05-300-1 2.1.fid
Nicewicz
5110718
ntay
NT-05-300-1
10.21
7.30
7.29
7.26 CDCl3
6.72
6.71
6.35
6.35
3.94
F
O
HO
OMe
0.96
0.99
1.00
1.01
3.05
f1 (ppm)

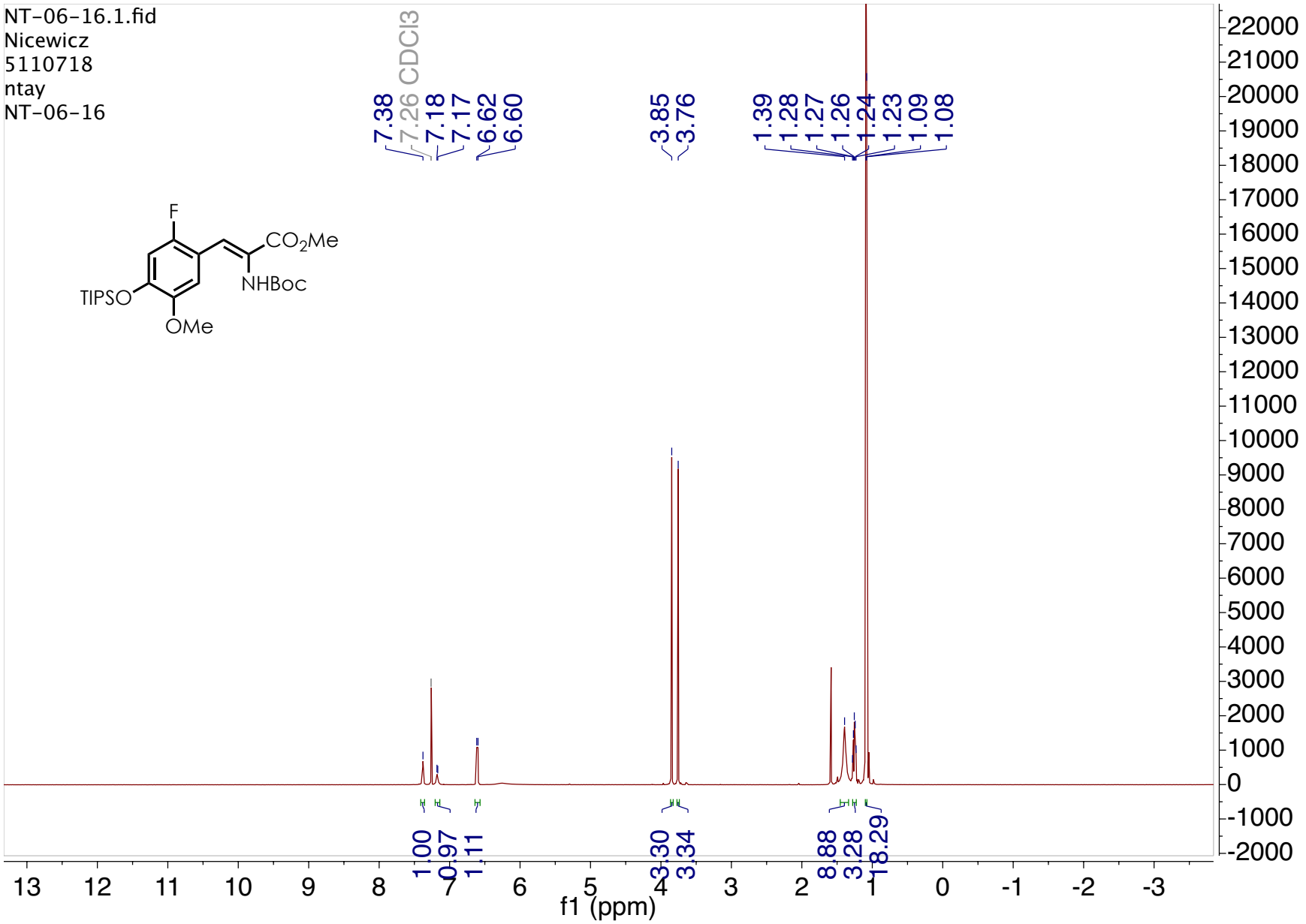

NT-05-300-1 3.2.fid
Nicewicz
5110718
ntay
NT-05-300-1
185.98
185.94
162.47
160.79
153.18
153.09
143.80
143.79
116.63
116.57
107.64
107.62
102.99
102.81
77.16 CDCl3
56.61
F
O
HO
OMe
600
550
500
450
400
350
300
250
200
150
100
50
0
-50
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

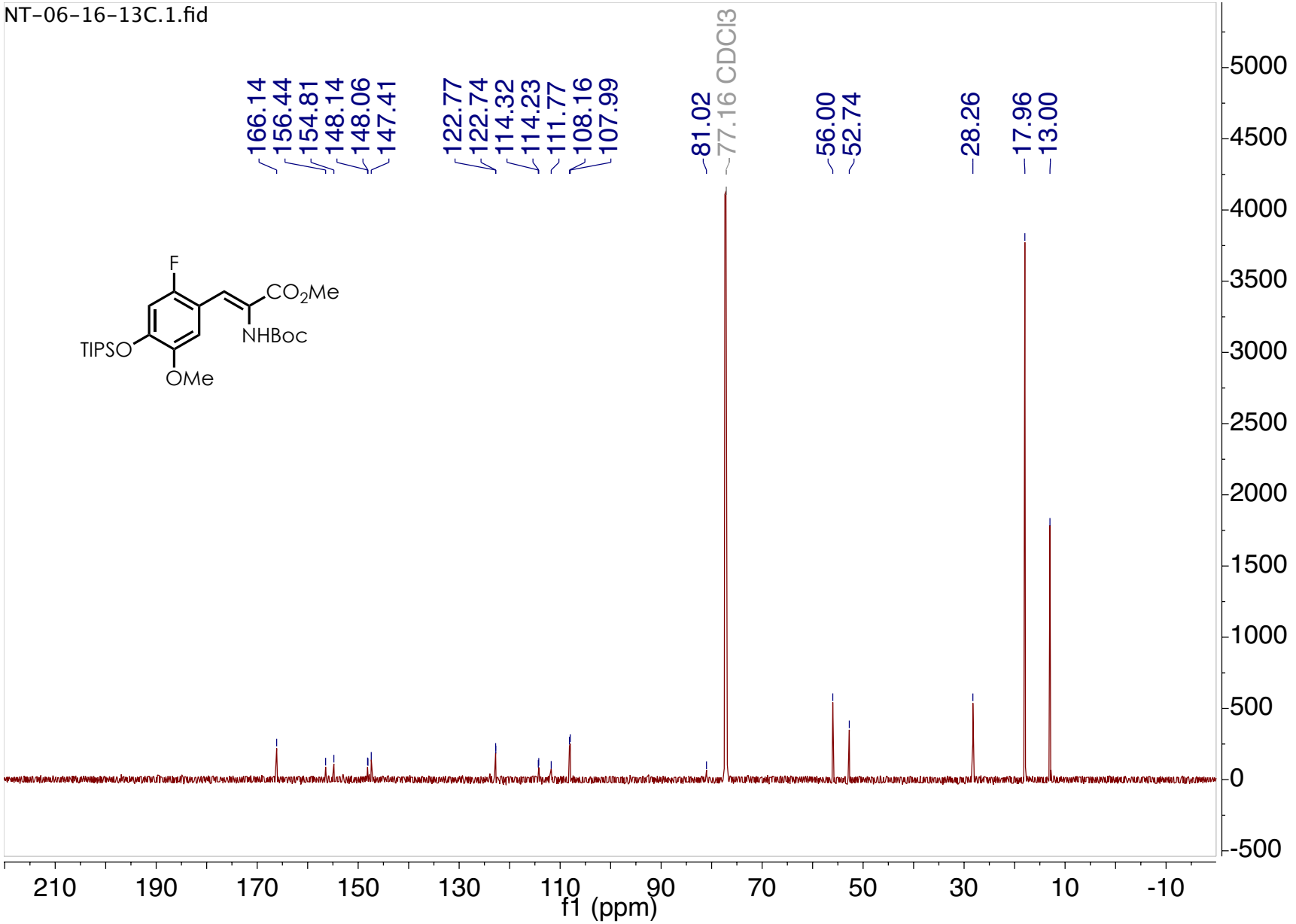

NT-05-300-1-19F 3.3.fid
F19 CDCl3 {C:\data\ntay} nmrsu 9
-128.27
-128.28
-128.30
-128.31
-128.32
-161.64 C6F6
F
O
HO
OMe
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

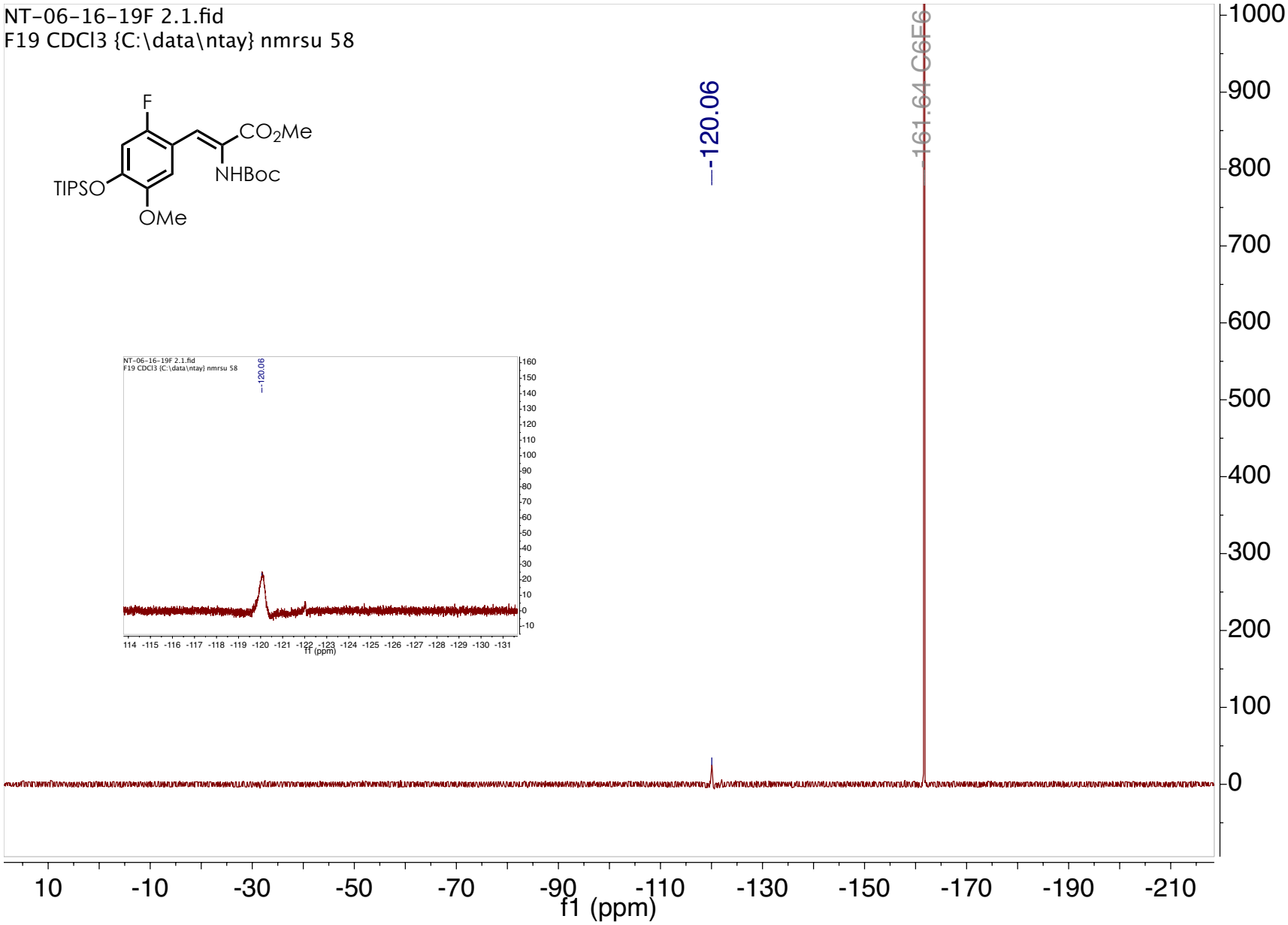

NT-06-15.1.fid
Nicewicz
5110718
ntay
NT-06-15
10.18
10.17
7.26 CDCl3
7.24
7.24
7.23
7.23
6.62
6.62
6.60
6.60
3.80
1.27
1.26
1.25
1.24
1.22
1.07
1.06
1.06
1.05
F
O
TIPSO
OMe
1.00
1.05
1.06
3.38
3.40
18.34
f1 (ppm)

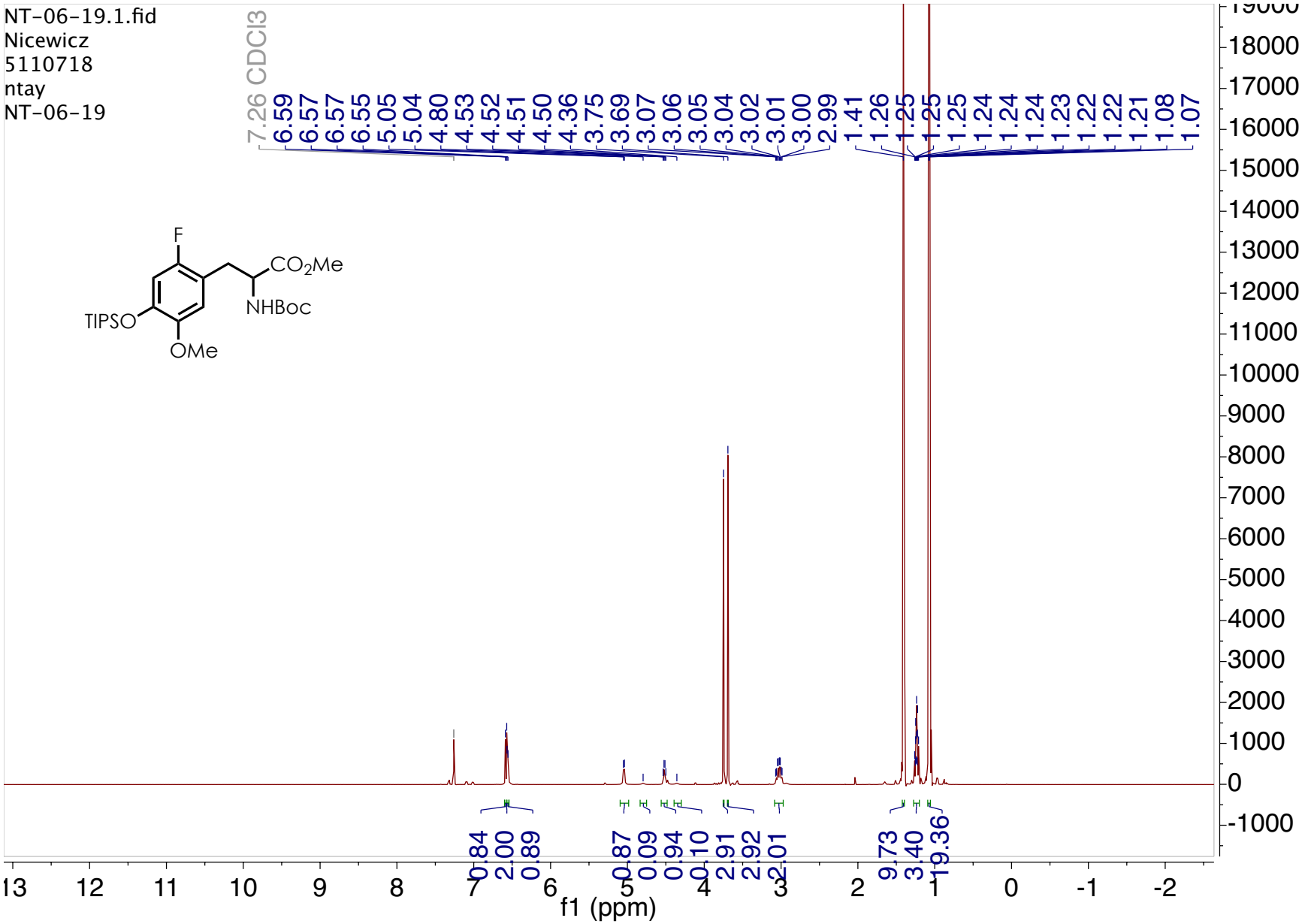

NT-06-15 2.2.fid
Nicewicz
5110718
ntay
NT-06-15
185.97
185.93
161.59
159.92
153.27
153.19
148.32
148.30
117.27
117.21
108.44
108.41
108.19
108.04
77.16 CDCl3
55.81
17.82
12.96
F
O
TIPSO
OMe
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

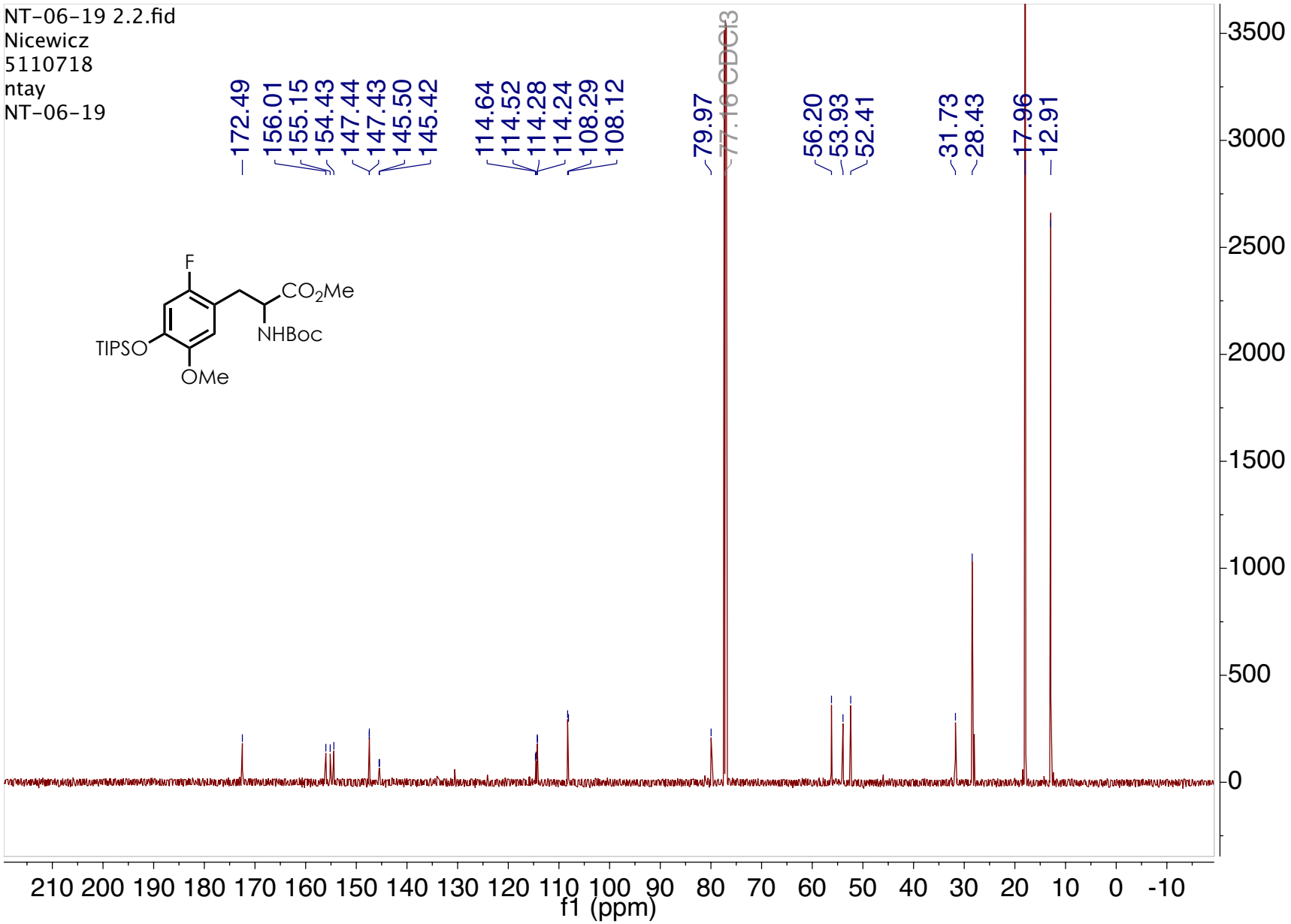

NT-06-15-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 44
-129.91
-129.91
-129.92
-129.94
-129.94
-129.95
-129.96
-161.64 C6F6
F
O
TIPSO
OMe
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

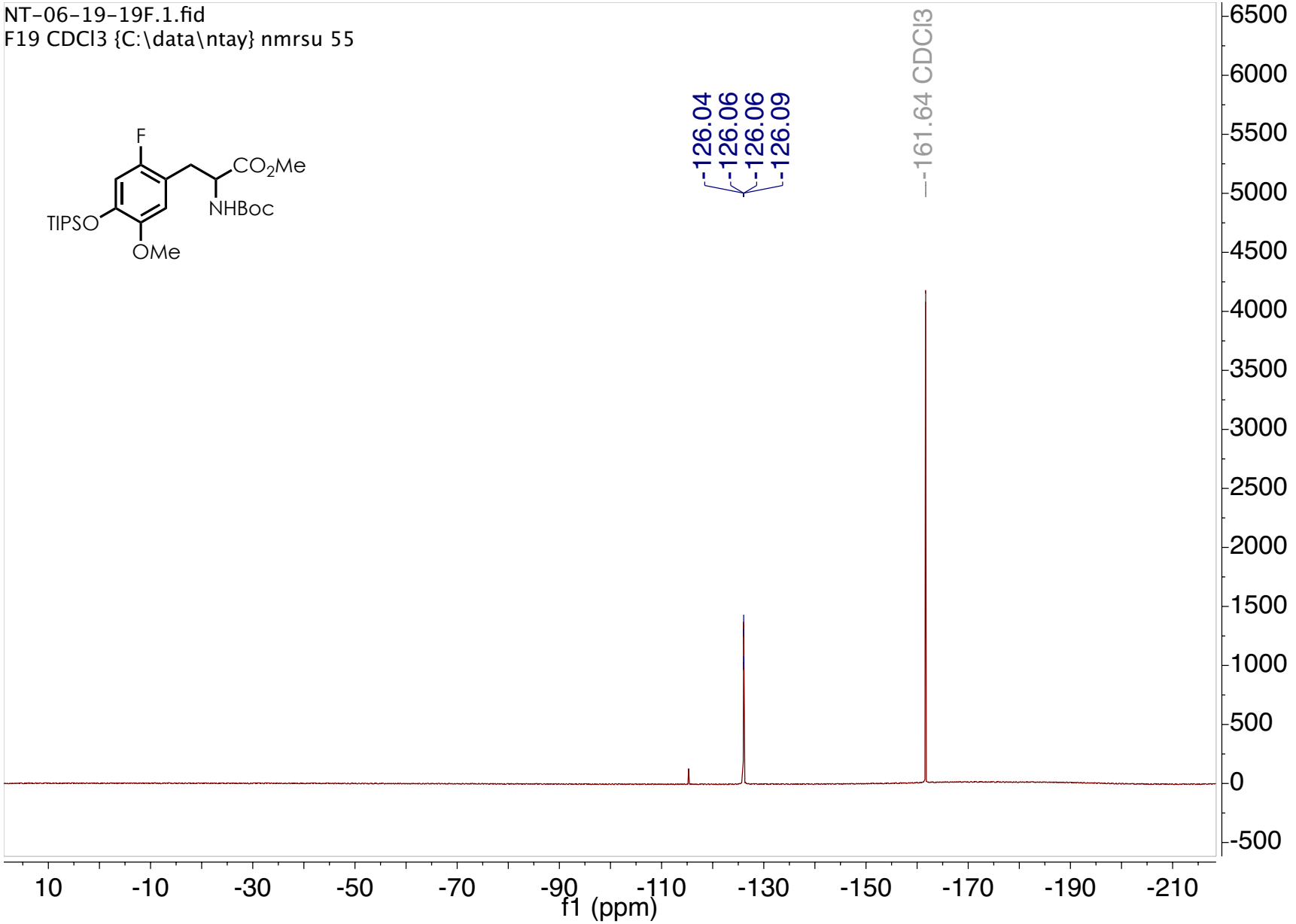

NT-06-16.1.fid
Nicewicz
5110718
ntay
NT-06-16
7.38
7.26 CDCl3
7.18
7.17
6.62
6.60
3.85
3.76
1.39
1.28
1.27
1.26
1.24
1.23
1.09
1.08
F
CO2Me
NHBoc
TIPSO
OMe
1.00
0.97
1.11
3.30
3.34
8.88
3.28
18.29
f1 (ppm)

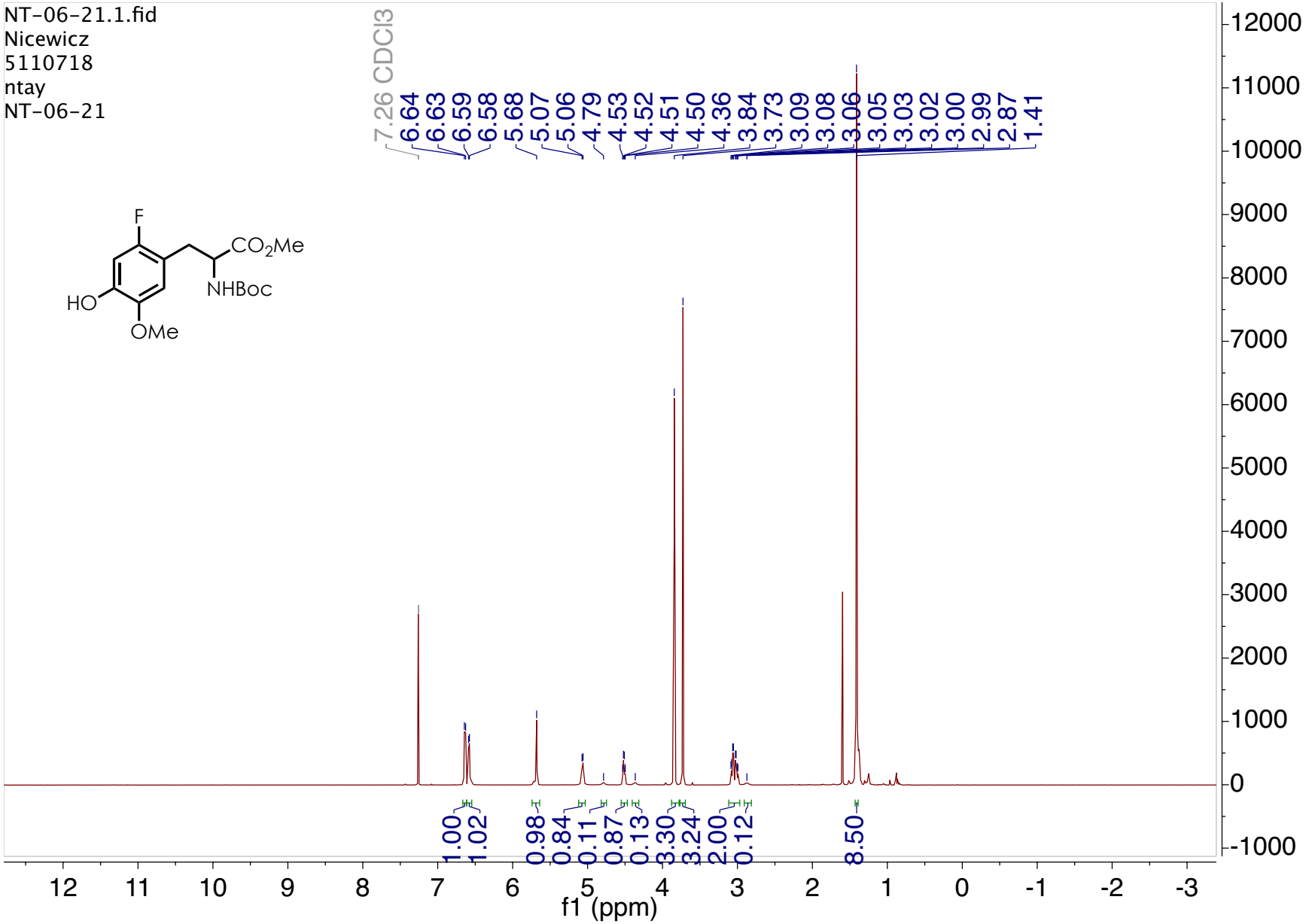

NT-06-16-13C.1.fid
166.14
156.44
154.81
148.14
148.06
147.41
122.77
122.74
114.32
114.23
111.77
108.16
107.99
81.02
77.16 CDCl3
56.00
52.74
28.26
17.96
13.00
F
CO2Me
NHBoc
TIPSO
OMe
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

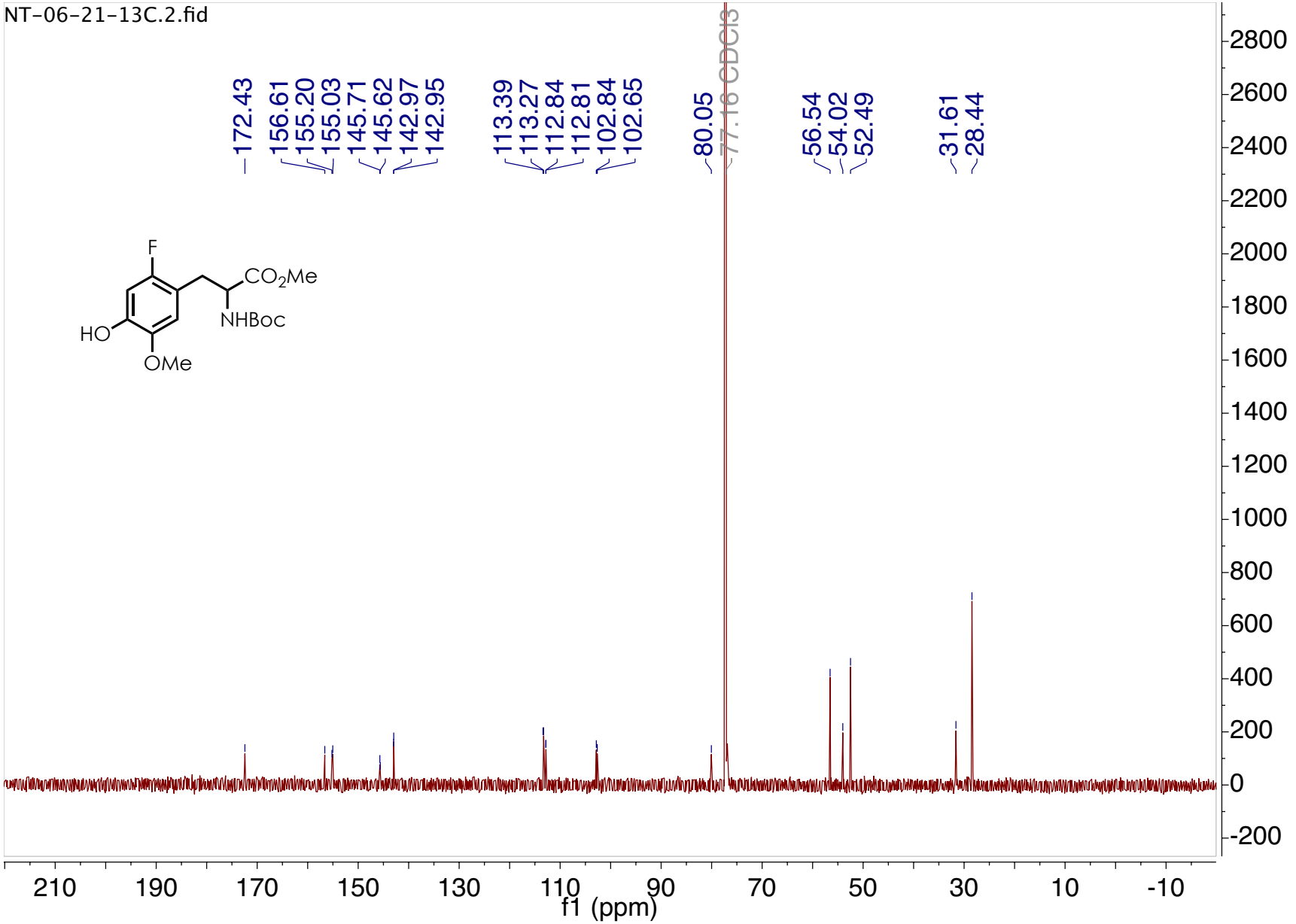

NT-06-16-19F 2.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 58
F
CO2Me
NHBoc
TIPSO
OMe
-120.06
-161.64 C6F6
f1 (ppm)

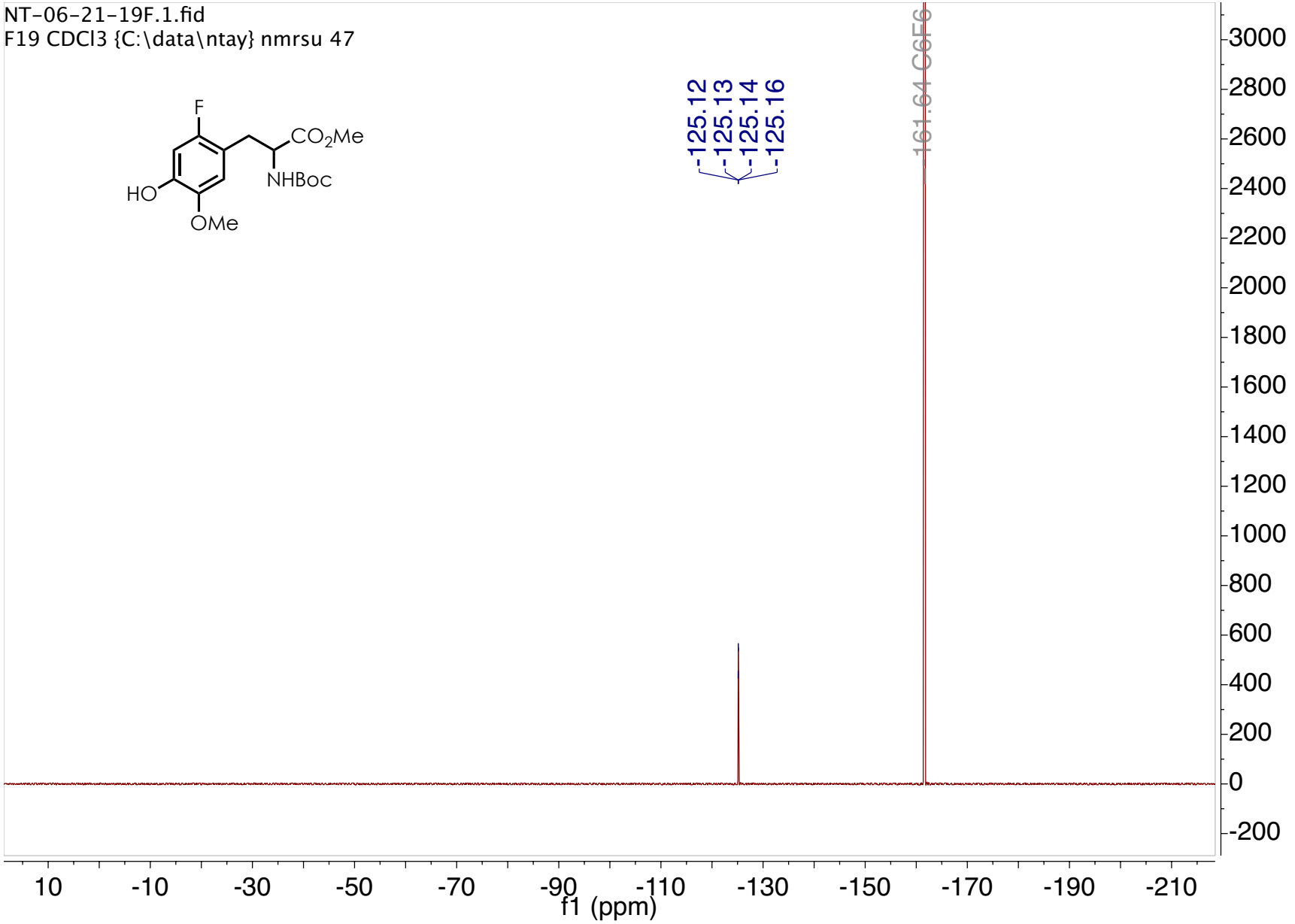

NT-06-19.1.fid
Nicewicz
5110718
ntay
NT-06-19
7.26 CDCl3
6.59 6.57 6.57 6.55 5.05 5.04 4.80 4.53 4.52 4.51 4.50 4.36 3.75 3.69 3.07 3.06 3.05 3.04 3.02 3.01 3.00 2.99 1.41 1.26 1.25 1.25 1.25 1.24 1.24 1.24 1.23 1.22 1.22 1.21 1.08 1.07
F
CO2Me
NHBoc
TIPSO
OMe
0.84 2.00 0.89 0.87 0.09 0.94 0.10 2.91 2.92 2.01 9.73 3.40 19.36
f1 (ppm)

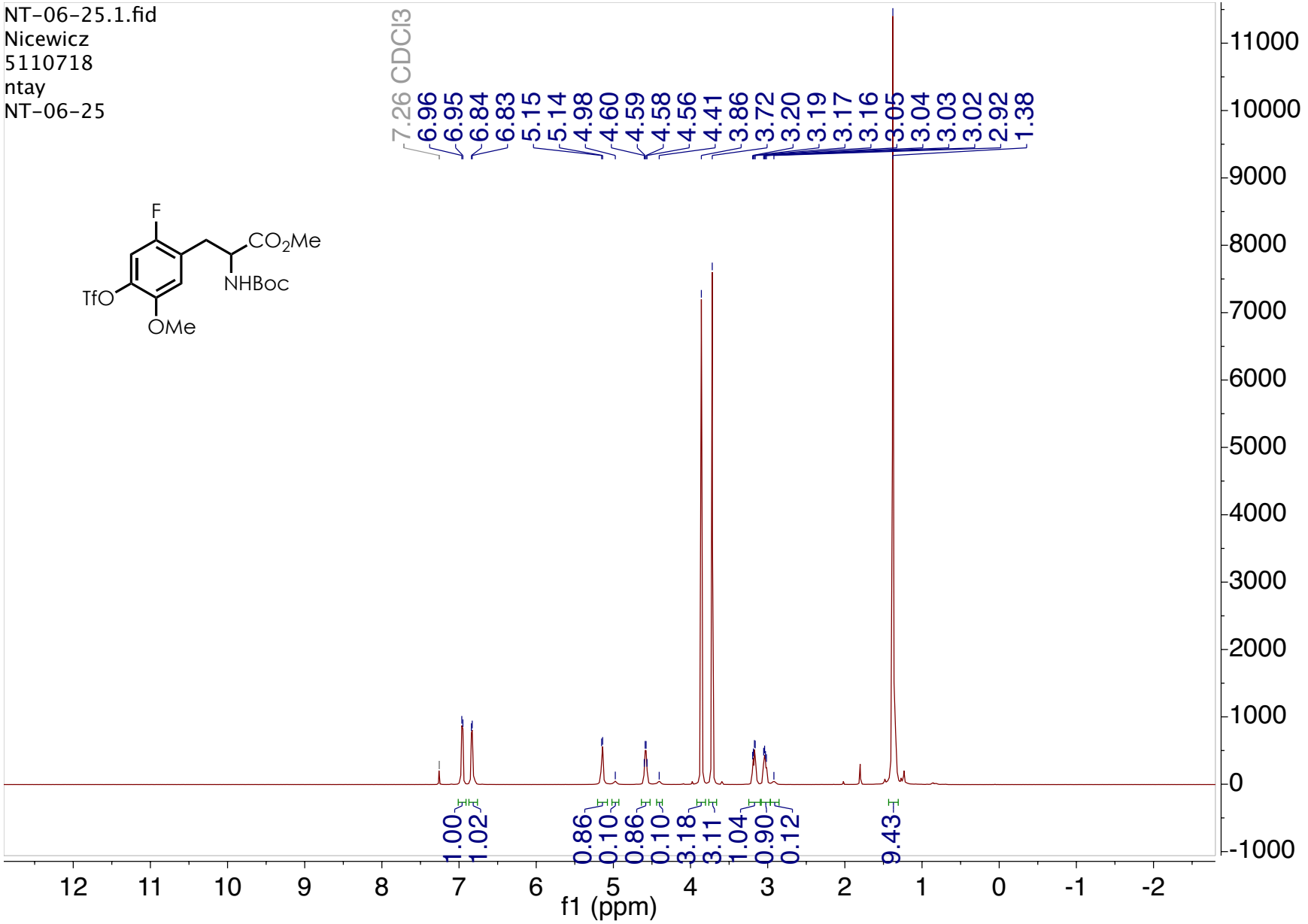

NT-06-19 2.2.fid
Nicewicz
5110718
ntay
NT-06-19
172.49
156.01
155.15
154.43
147.44
147.43
145.50
145.42
114.64
114.52
114.28
114.24
108.29
108.12
79.97
77.16 CDCl3
56.20
53.93
52.41
31.73
28.43
17.96
12.91
F
CO2Me
NHBoc
TIPSO
OMe
3500
3000
2500
2000
1500
1000
500
0
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

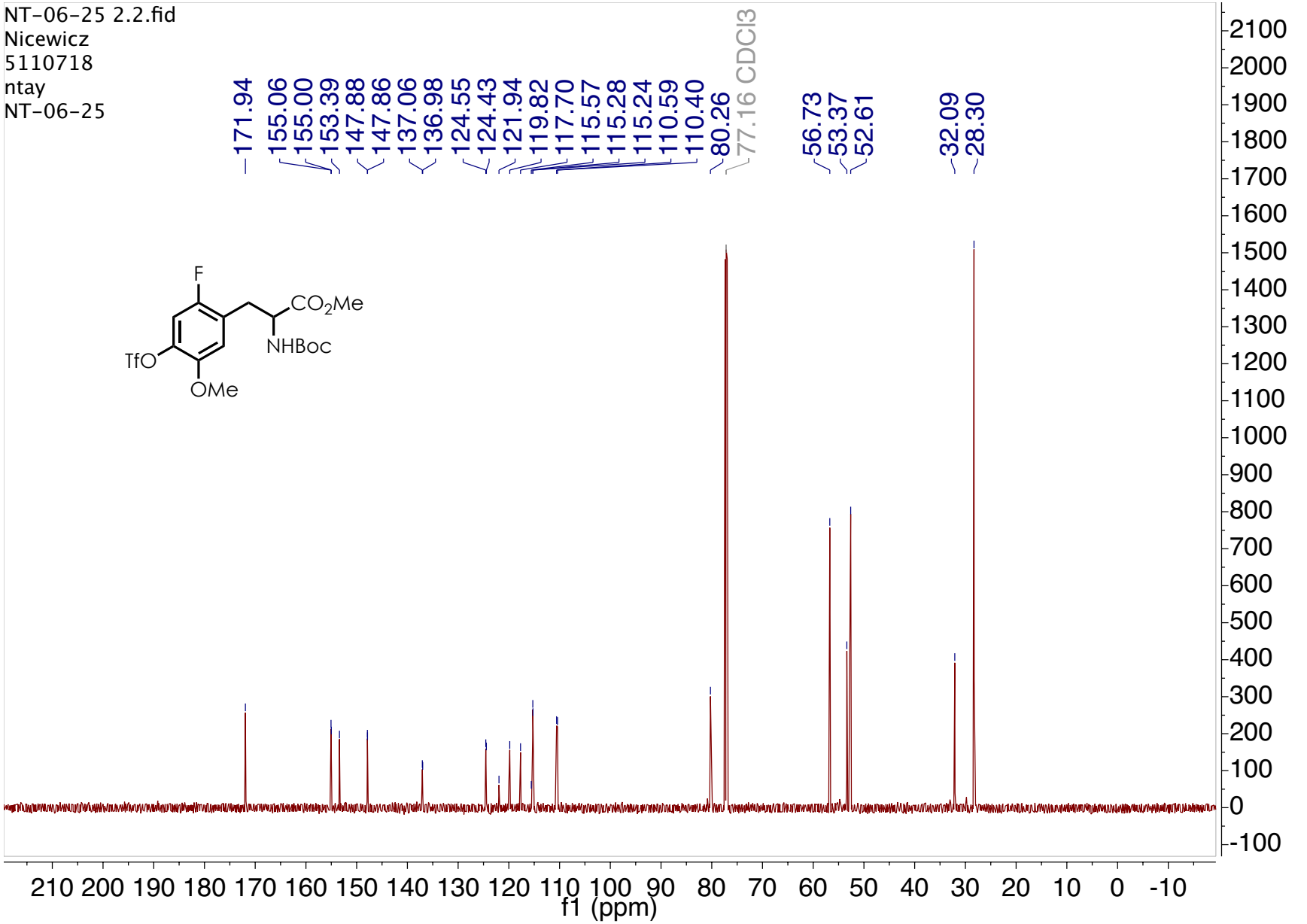

NT-06-19-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 55
F
CO2Me
NHBoc
TIPSO
OMe
-126.04
-126.06
-126.06
-126.09
-161.64 CDCl3
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

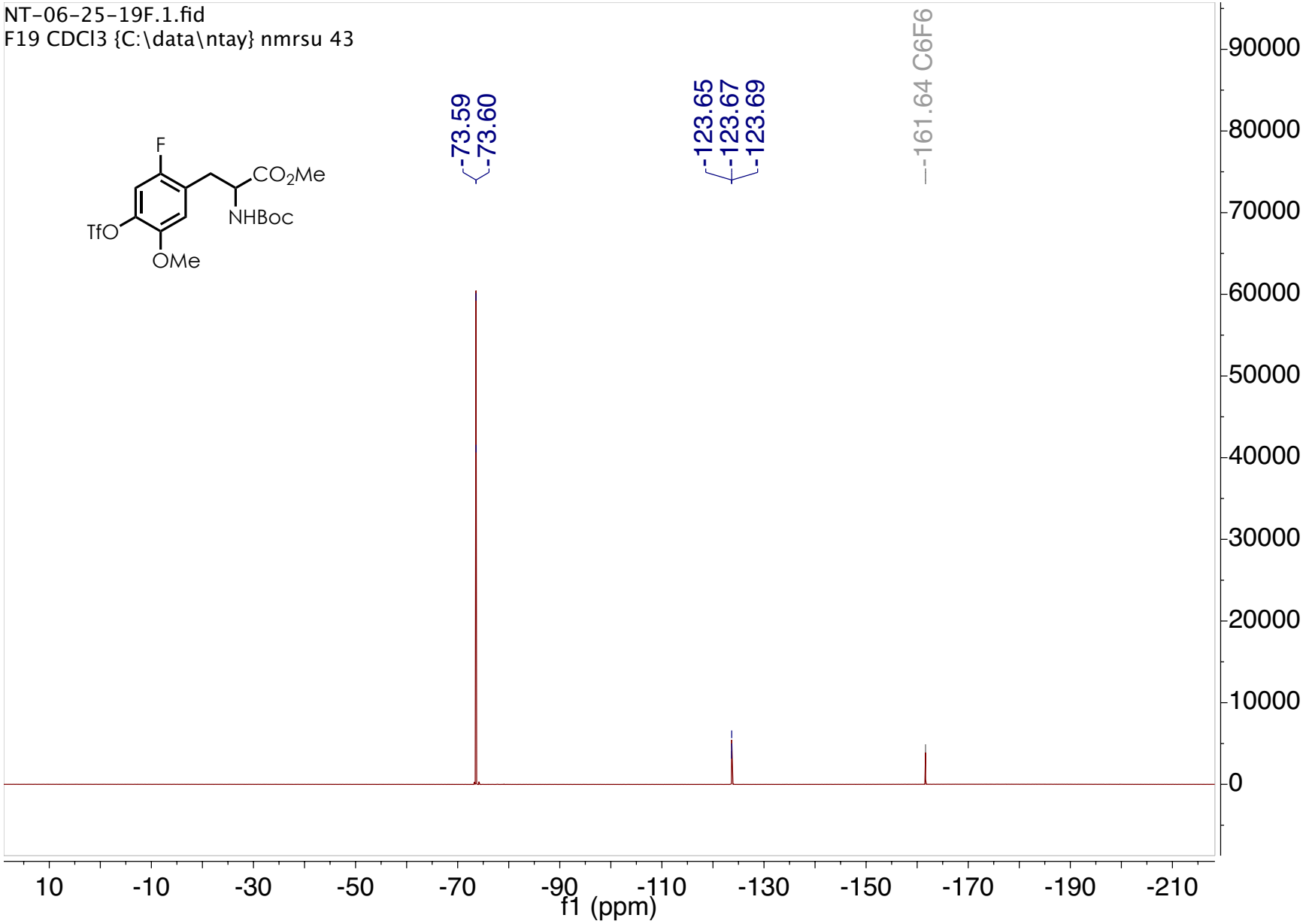

NT-06-21.1.fid
Nicewicz
5110718
ntay
NT-06-21
7.26 CDCl3
6.64
6.63
6.59
6.58
5.68
5.07
5.06
4.79
4.53
4.52
4.51
4.50
4.36
3.84
3.73
3.09
3.08
3.06
3.05
3.03
3.02
3.00
2.99
2.87
1.41
F
CO2Me
NHBoc
HO
OMe
1.00
1.02
0.98
0.84
0.11
0.87
0.13
3.30
3.24
2.00
0.12
8.50
f1 (ppm)

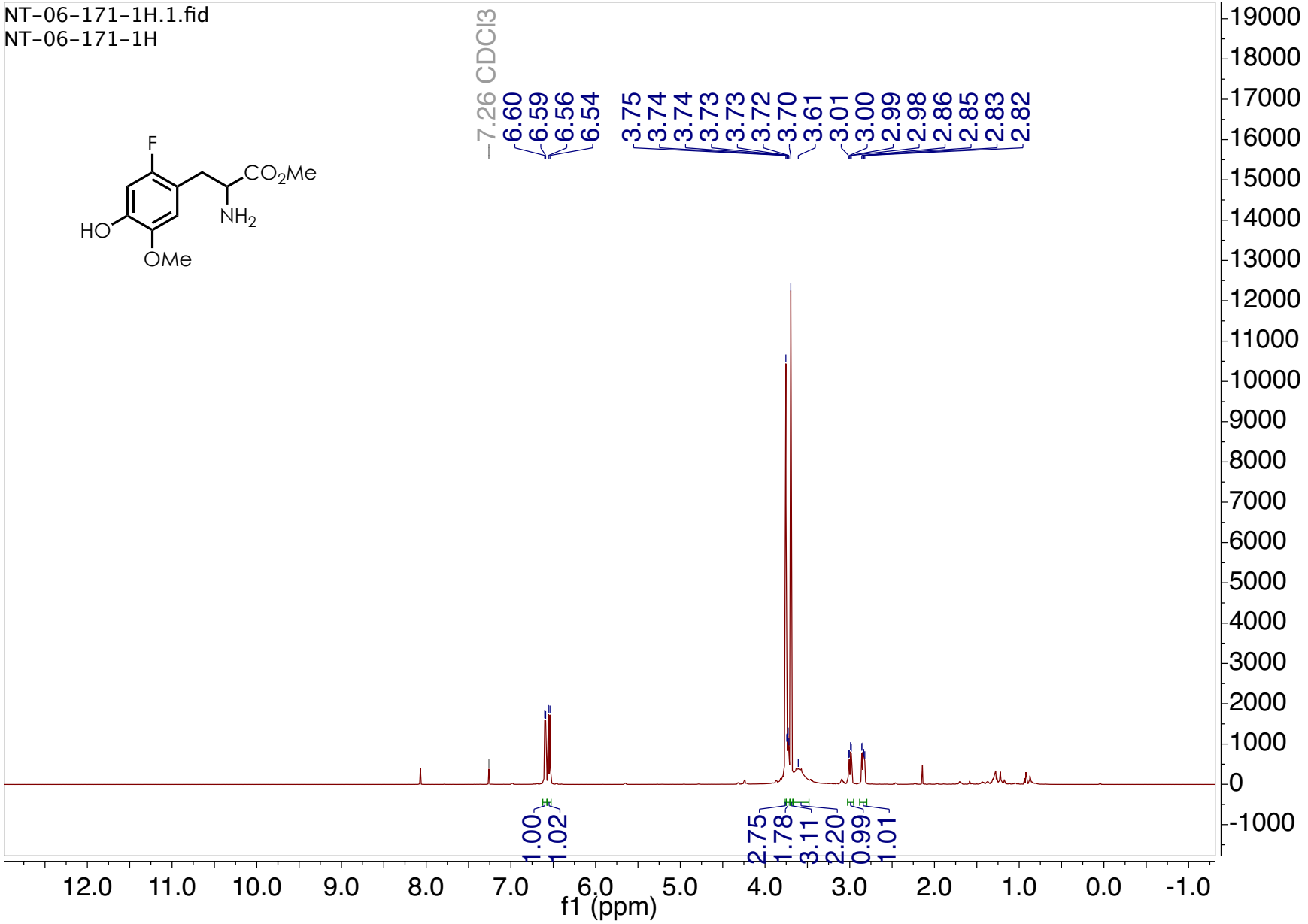

NT-06-21-13C.2.fid
172.43
156.61
155.20
155.03
145.71
145.62
142.97
142.95
113.39
113.27
112.84
112.81
102.84
102.65
80.05
77.16 CDCl3
56.54
54.02
52.49
31.61
28.44
F
CO2Me
NHBoc
HO
OMe
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

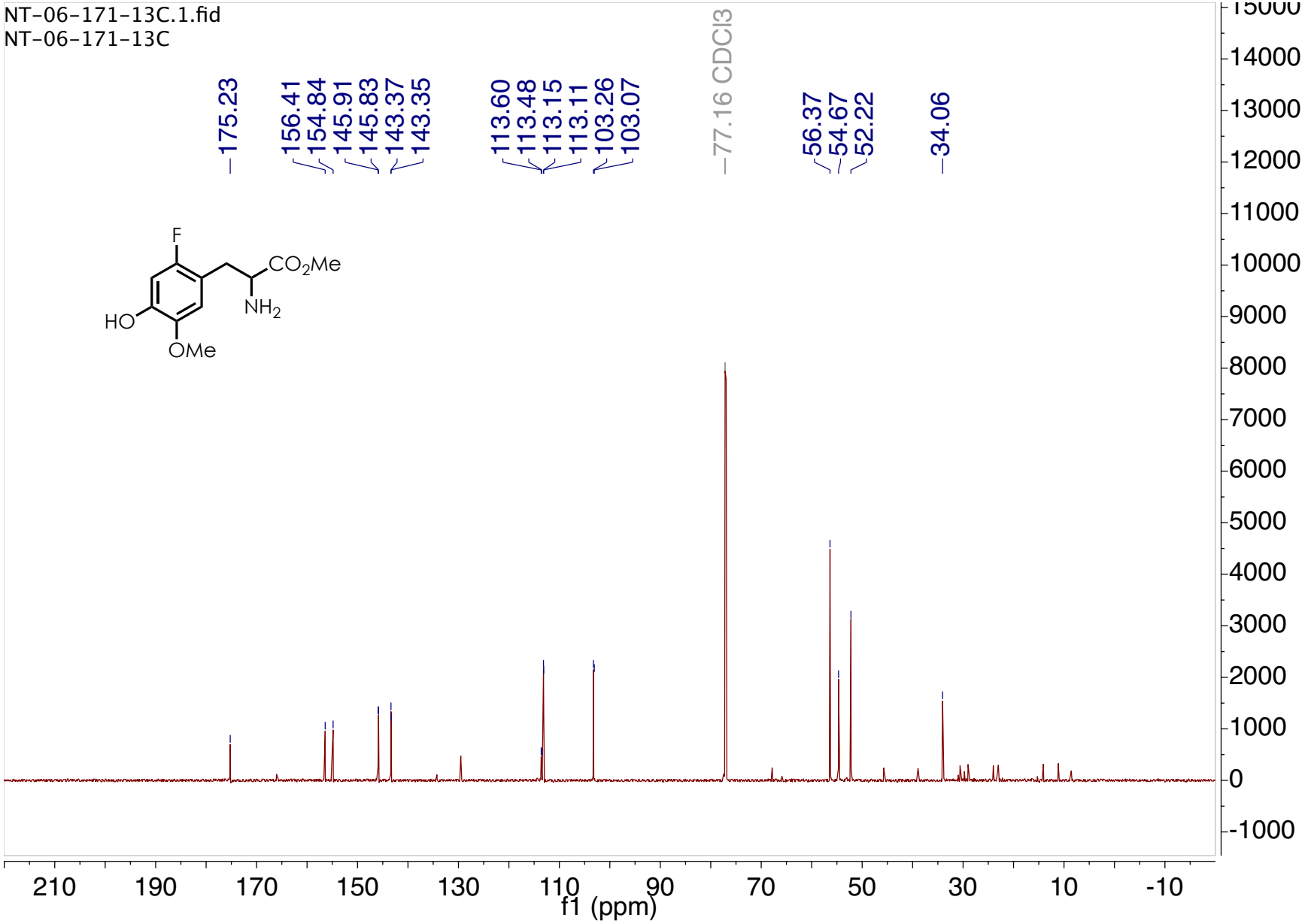

NT-06-21-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 47
F
CO2Me
NHBoc
HO
OMe
-125.12
-125.13
-125.14
-125.16
-161.64 C6F6
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

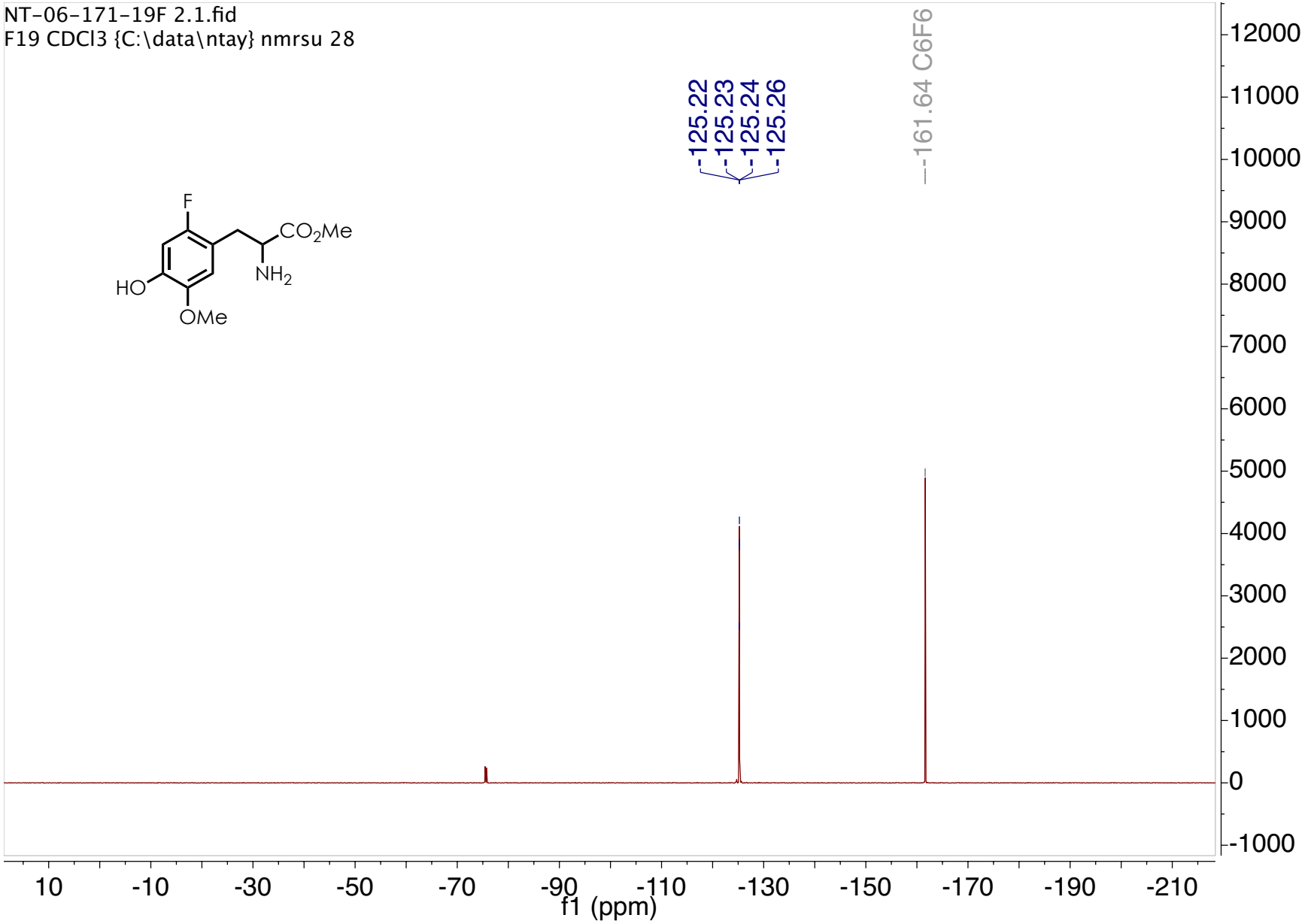

NT-06-25.1.fid
Nicewicz
5110718
ntay
NT-06-25
7.26 CDCl3
6.96
6.95
6.84
6.83
5.15
5.14
4.98
4.60
4.59
4.58
4.56
4.41
3.86
3.72
3.20
3.19
3.17
3.16
3.05
3.04
3.03
3.02
2.92
1.38
F
CO2Me
NHBoc
TfO
OMe
1.00
1.02
0.86
0.10
0.86
0.10
3.18
3.11
1.04
0.90
0.12
9.43
f1 (ppm)

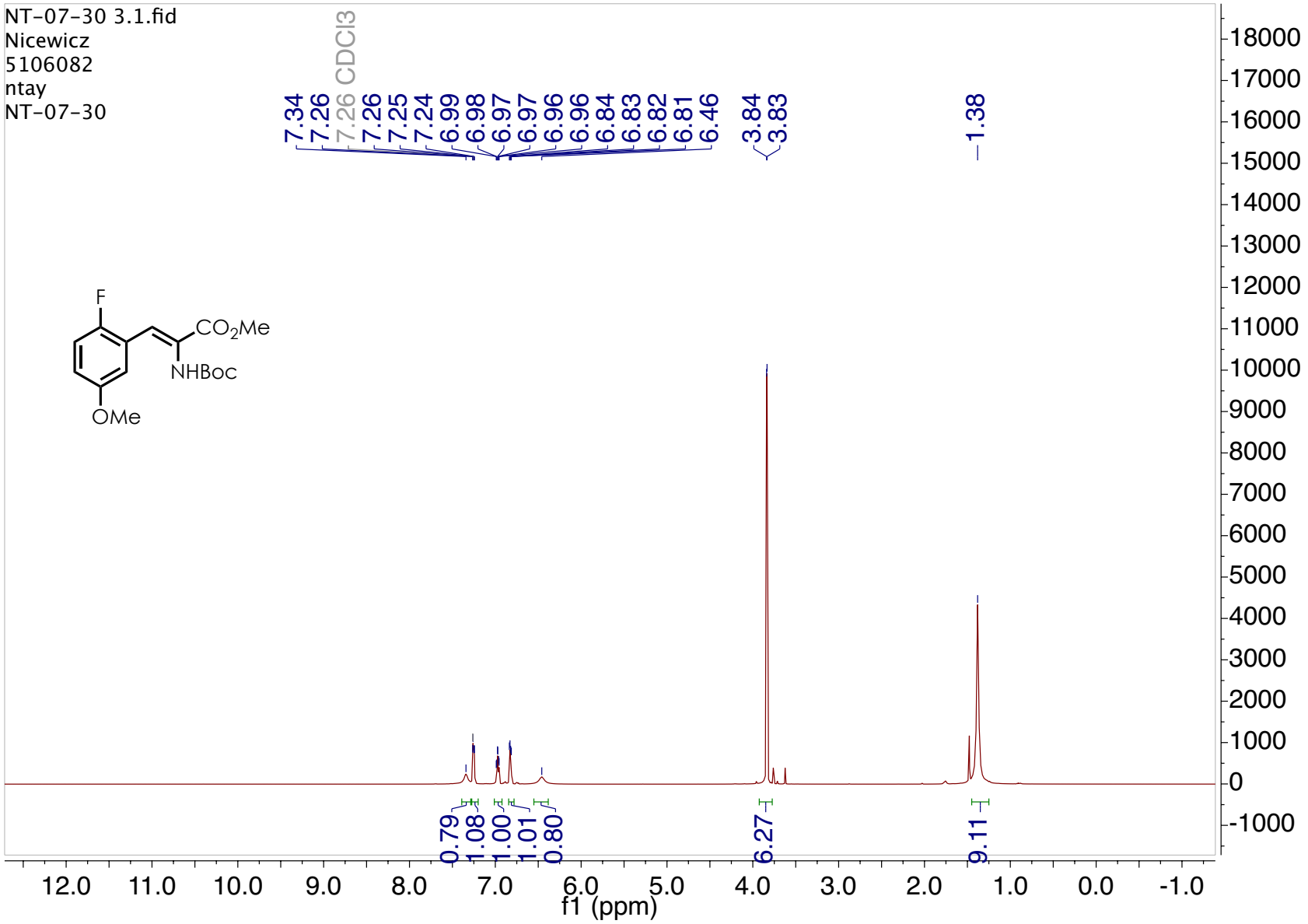

NT-06-25 2.2.fid
Nicewicz
5110718
ntay
NT-06-25
171.94
155.06
155.00
153.39
147.88
147.86
137.06
136.98
124.55
124.43
121.94
119.82
117.70
115.57
115.28
115.24
110.59
110.40
80.26
77.16 CDCl3
56.73
53.37
52.61
32.09
28.30
F
CO2Me
NHBoc
TfO
OMe
f1 (ppm)

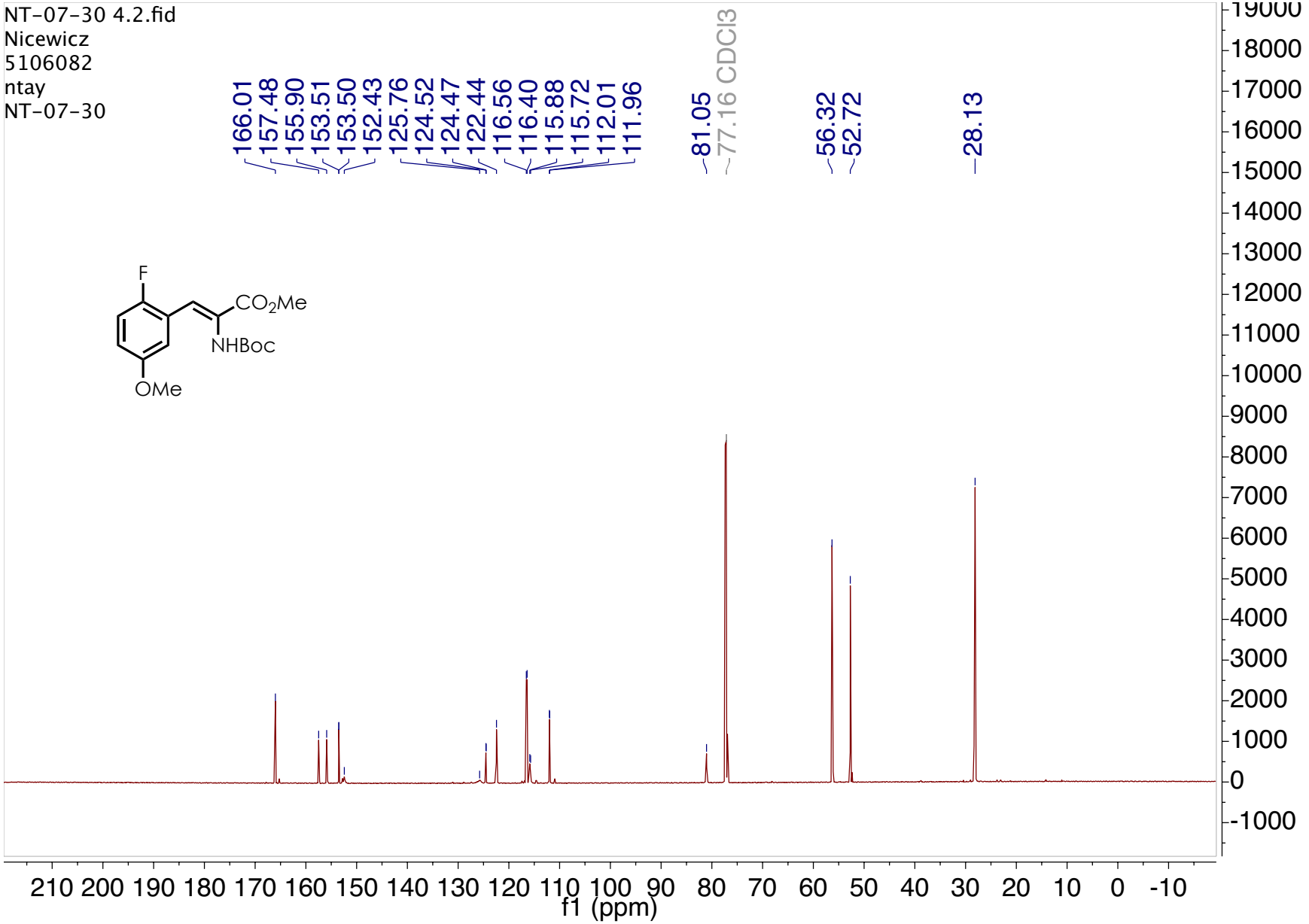

NT-06-25-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 43
F
CO2Me
NHBoc
TfO
OMe
-73.59
-73.60
-123.65
-123.67
-123.69
-161.64 C6F6
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

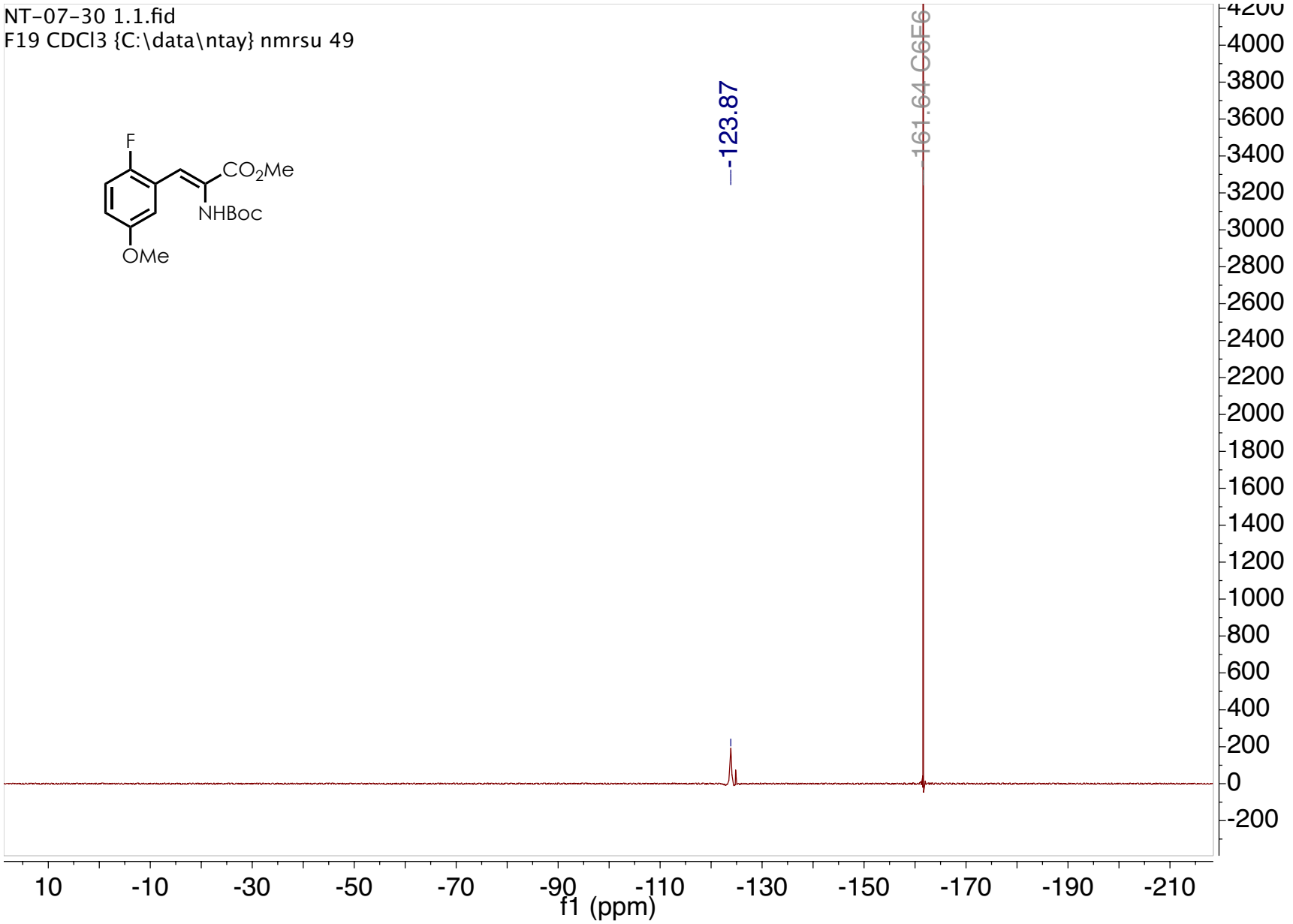

NT-06-171-1H.1.fid
NT-06-171-1H
F
CO2Me
NH2
HO
OMe
7.26 CDCl3
6.60
6.59
6.56
6.54
3.75
3.74
3.74
3.73
3.73
3.72
3.70
3.61
3.01
3.00
2.99
2.98
2.86
2.85
2.83
2.82
1.00
1.02
2.75
1.78
3.11
2.20
0.99
1.01
f1 (ppm)

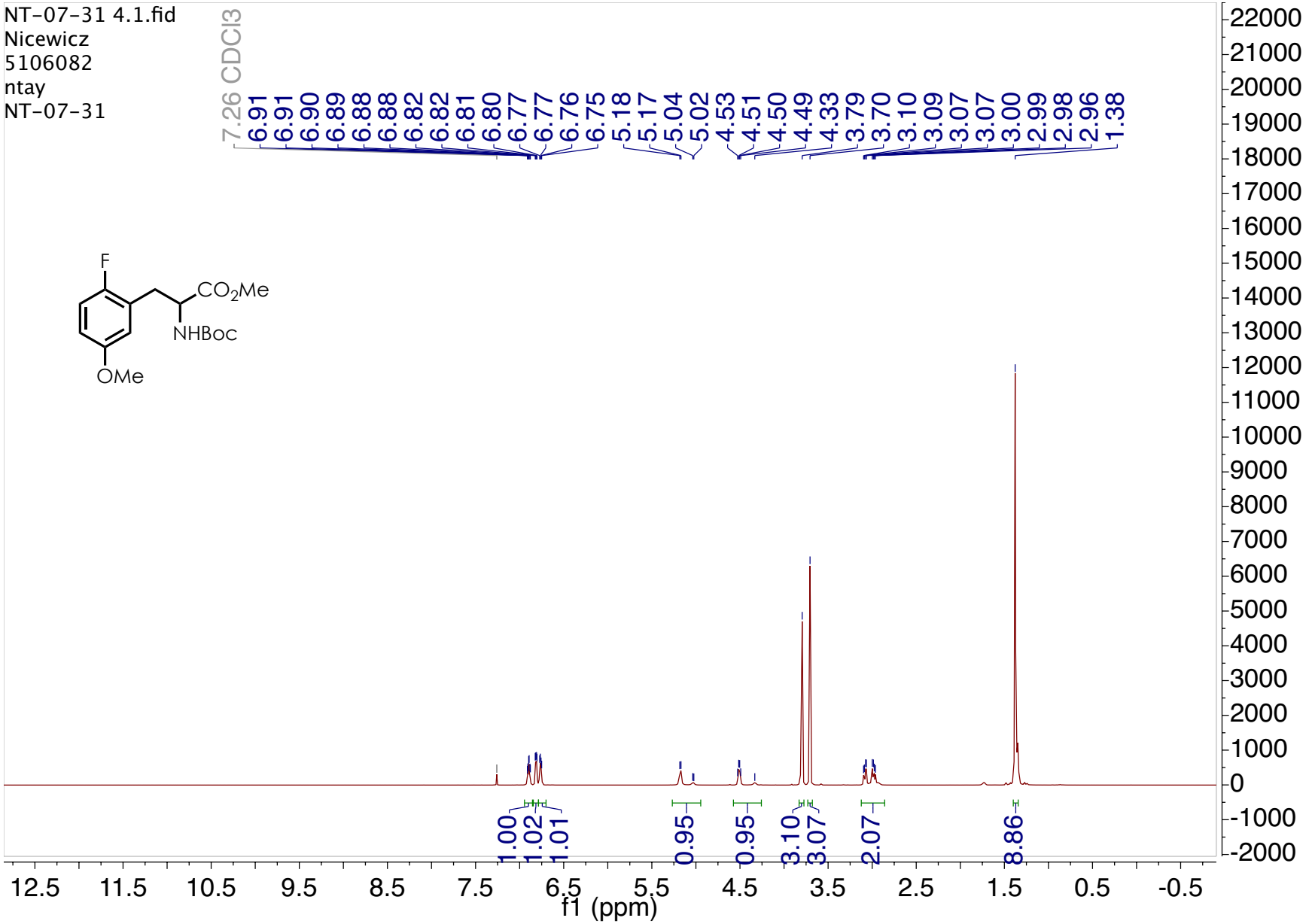

NT-06-171-13C.1.fid
NT-06-171-13C
175.23
156.41
154.84
145.91
145.83
143.37
143.35
113.60
113.48
113.15
113.11
103.26
103.07
77.16 CDCl3
56.37
54.67
52.22
34.06
F
CO2Me
NH2
HO
OMe
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

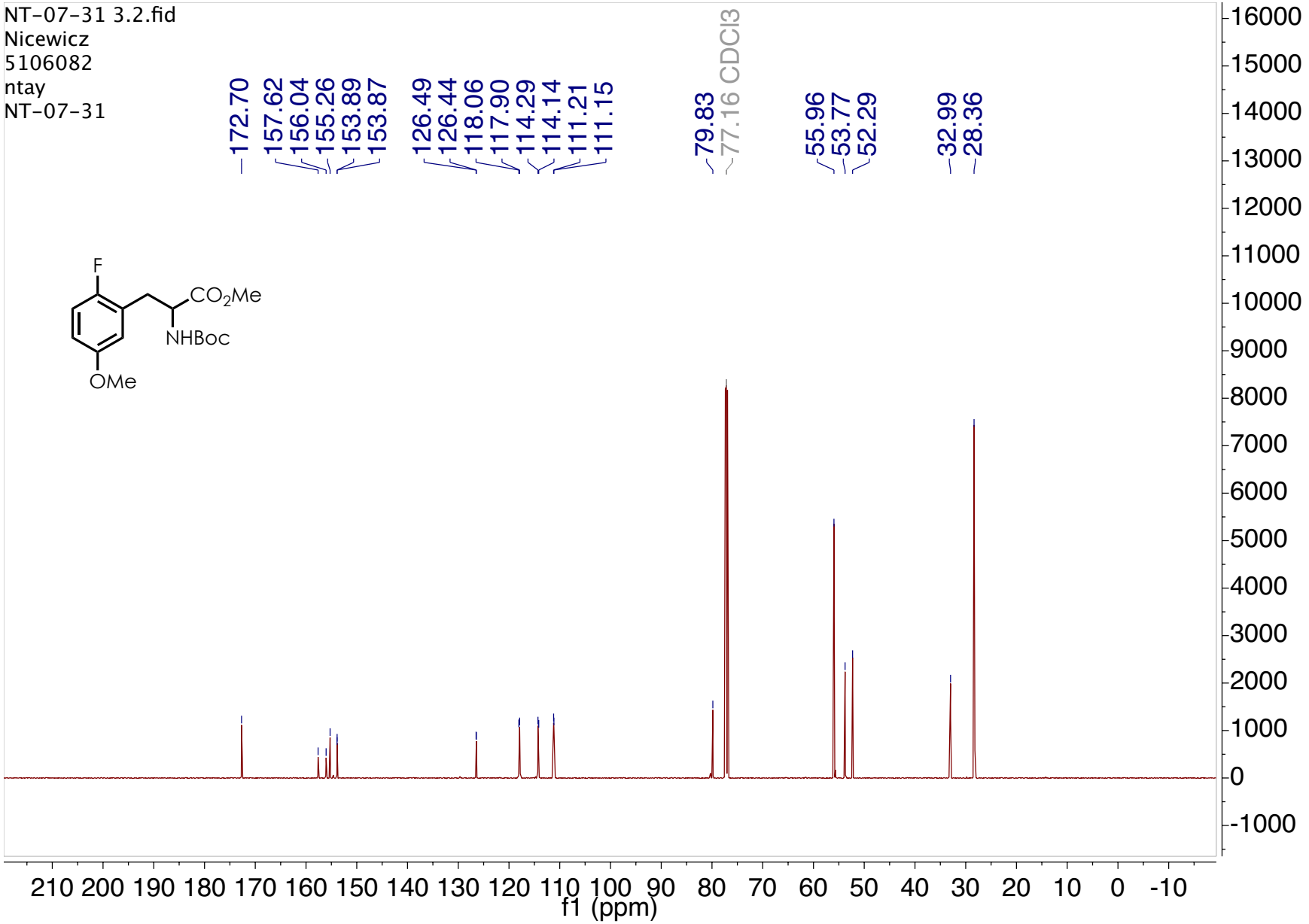

NT-06-171-19F 2.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 28
-125.22
-125.23
-125.24
-125.26
-161.64 C6F6
F
CO2Me
NH2
HO
OMe
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

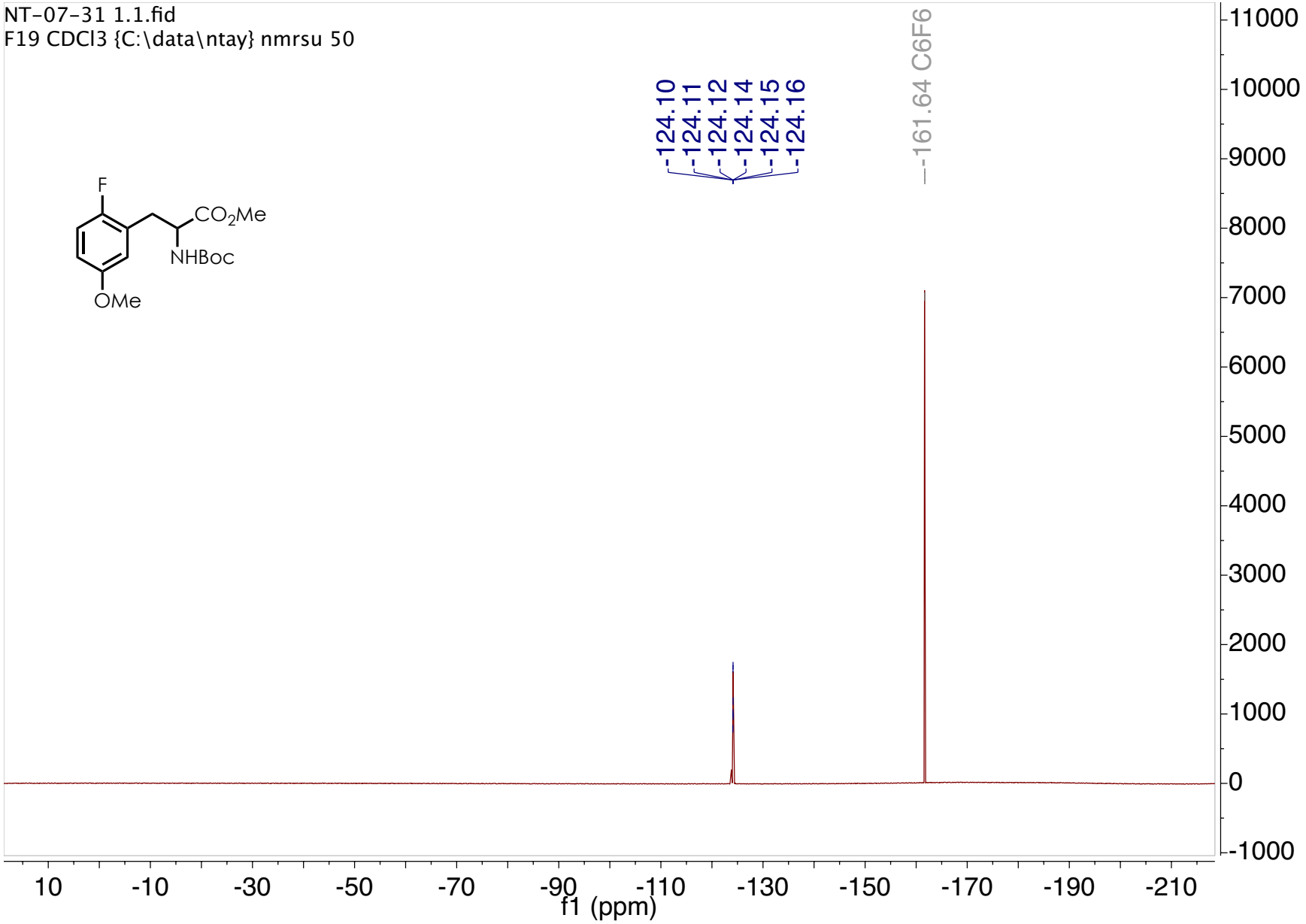

NT-07-30 3.1.fid
Nicewicz
5106082
ntay
NT-07-30
7.34
7.26
7.26 CDCl3
7.26
7.25
7.24
6.99
6.98
6.97
6.97
6.96
6.96
6.84
6.83
6.82
6.81
6.46
3.84
3.83
1.38
F
CO2Me
NHBoc
OMe
0.79
1.08
1.00
1.01
0.80
6.27
9.11
f1 (ppm)

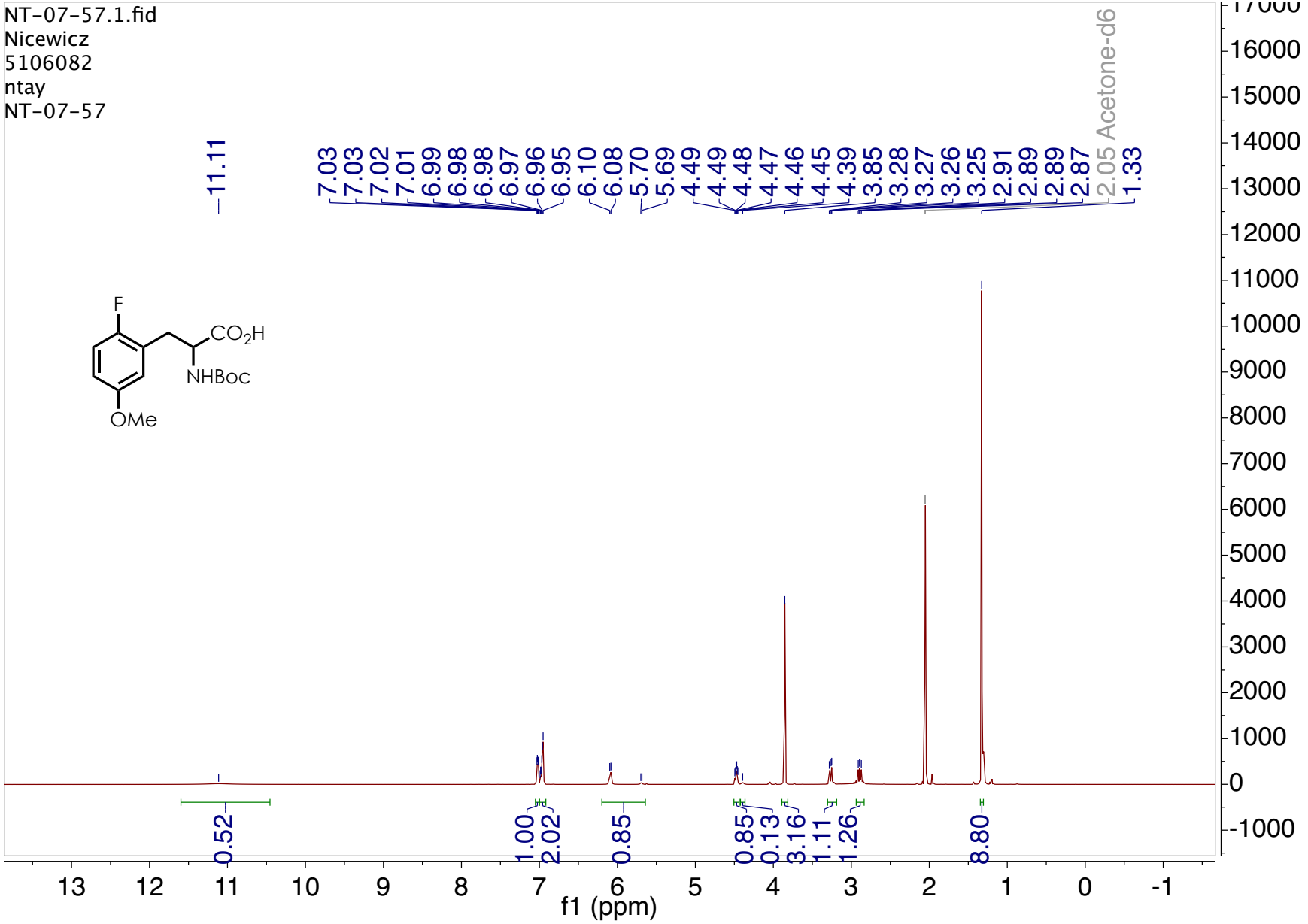

NT-07-30 4.2.fid
Nicewicz
5106082
ntay
NT-07-30
166.01
157.48
155.90
153.51
153.50
152.43
125.76
124.52
124.47
122.44
116.56
116.40
115.88
115.72
112.01
111.96
81.05
77.16 CDCl3
56.32
52.72
28.13
F
CO2Me
NHBoc
OMe
f1 (ppm)

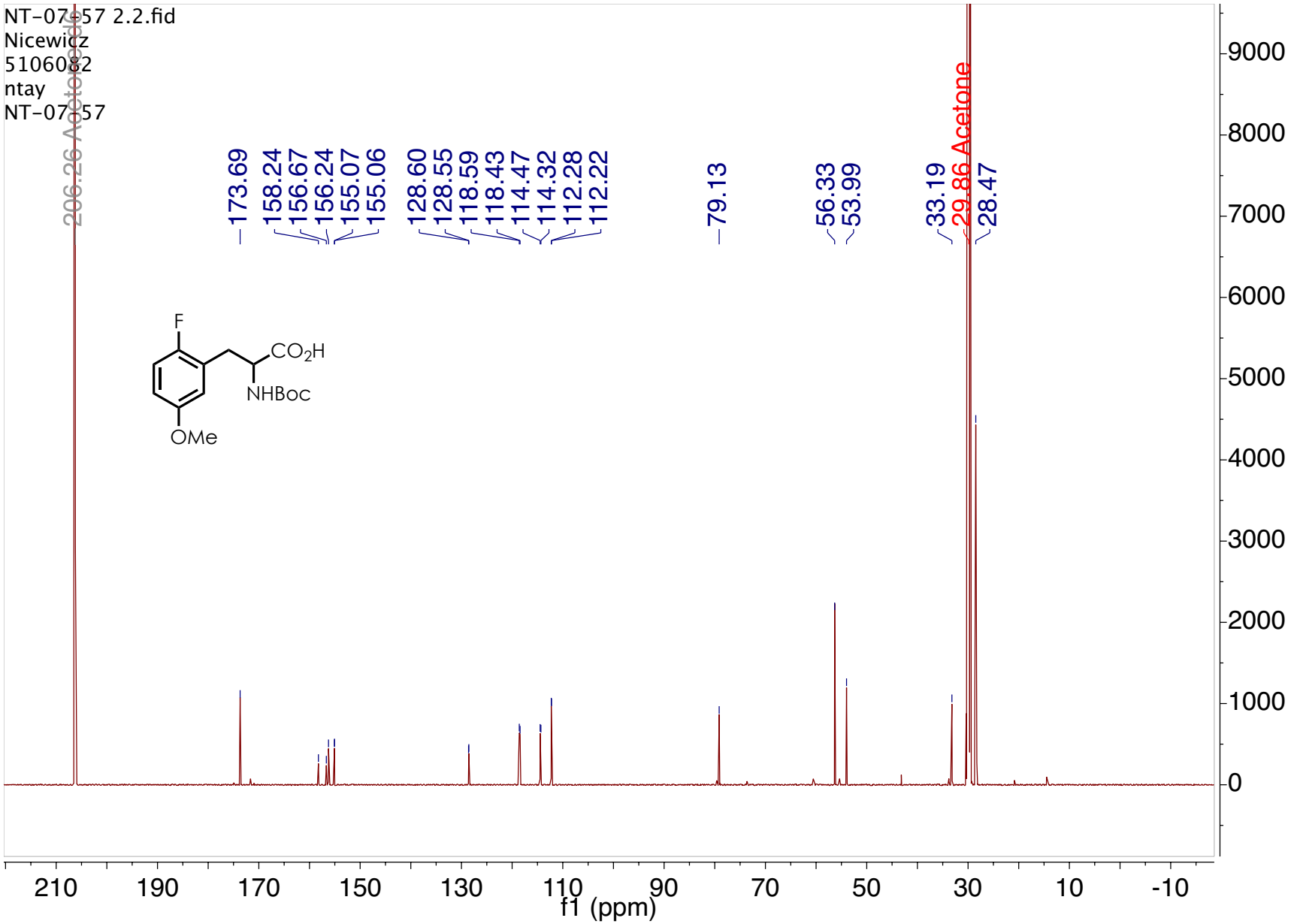

NT-07-30 1.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 49
F
CO2Me
NHBoc
OMe
-123.87
-161.64 C6F6
4200
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

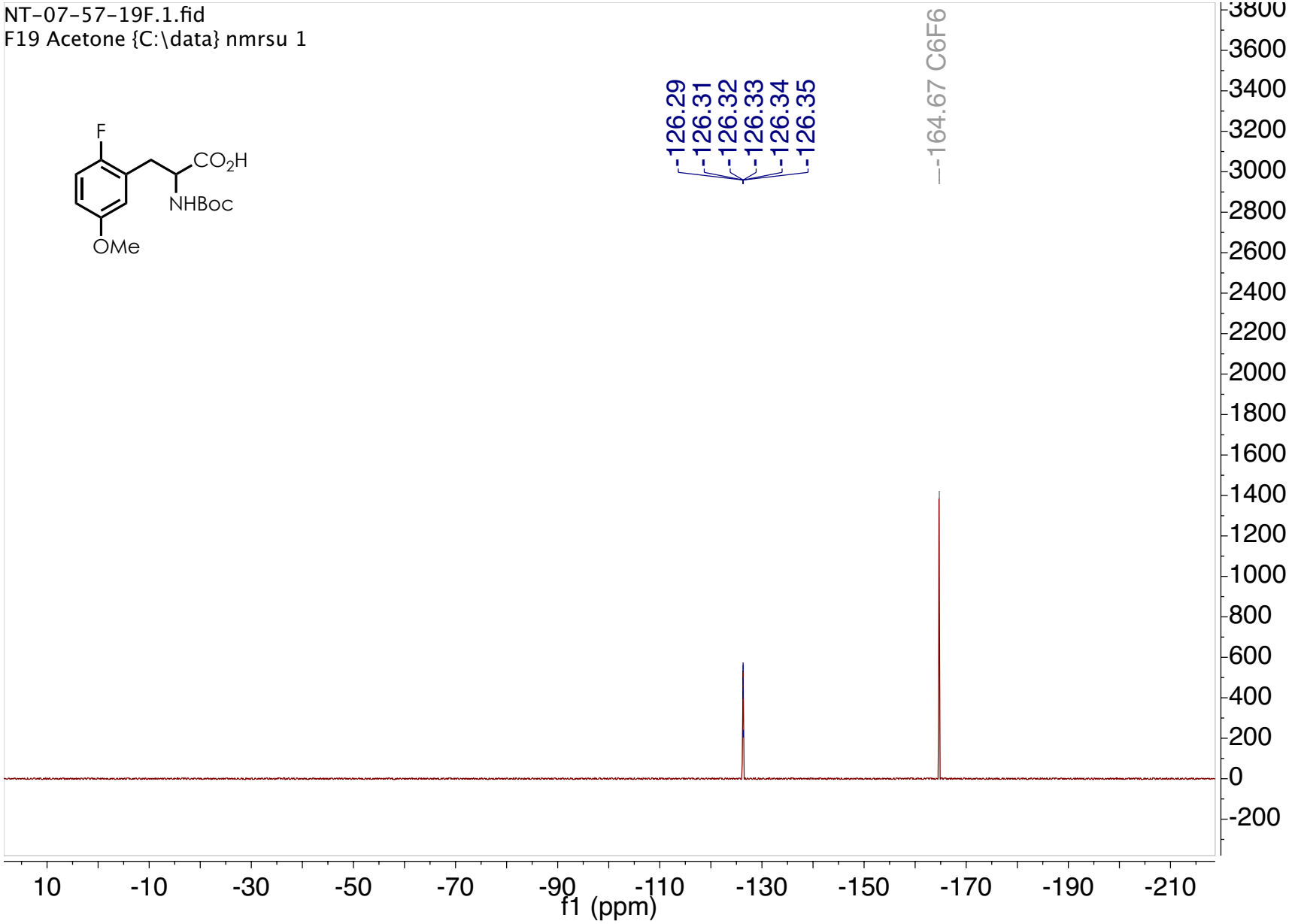

NT-07-31 4.1.fid
Nicewicz
5106082
ntay
NT-07-31
7.26 CDCl3
6.91 6.91 6.90 6.89 6.88 6.88 6.82 6.82 6.81 6.80 6.77 6.77 6.76 6.75 5.18 5.17 5.04 5.02 4.53 4.51 4.50 4.49 4.33 3.79 3.70 3.10 3.09 3.07 3.07 3.00 2.99 2.98 2.96 1.38
F
CO2Me
NHBoc
OMe
1.00 1.02 1.01 0.95 0.95 3.10 3.07 2.07 8.86
f1 (ppm)

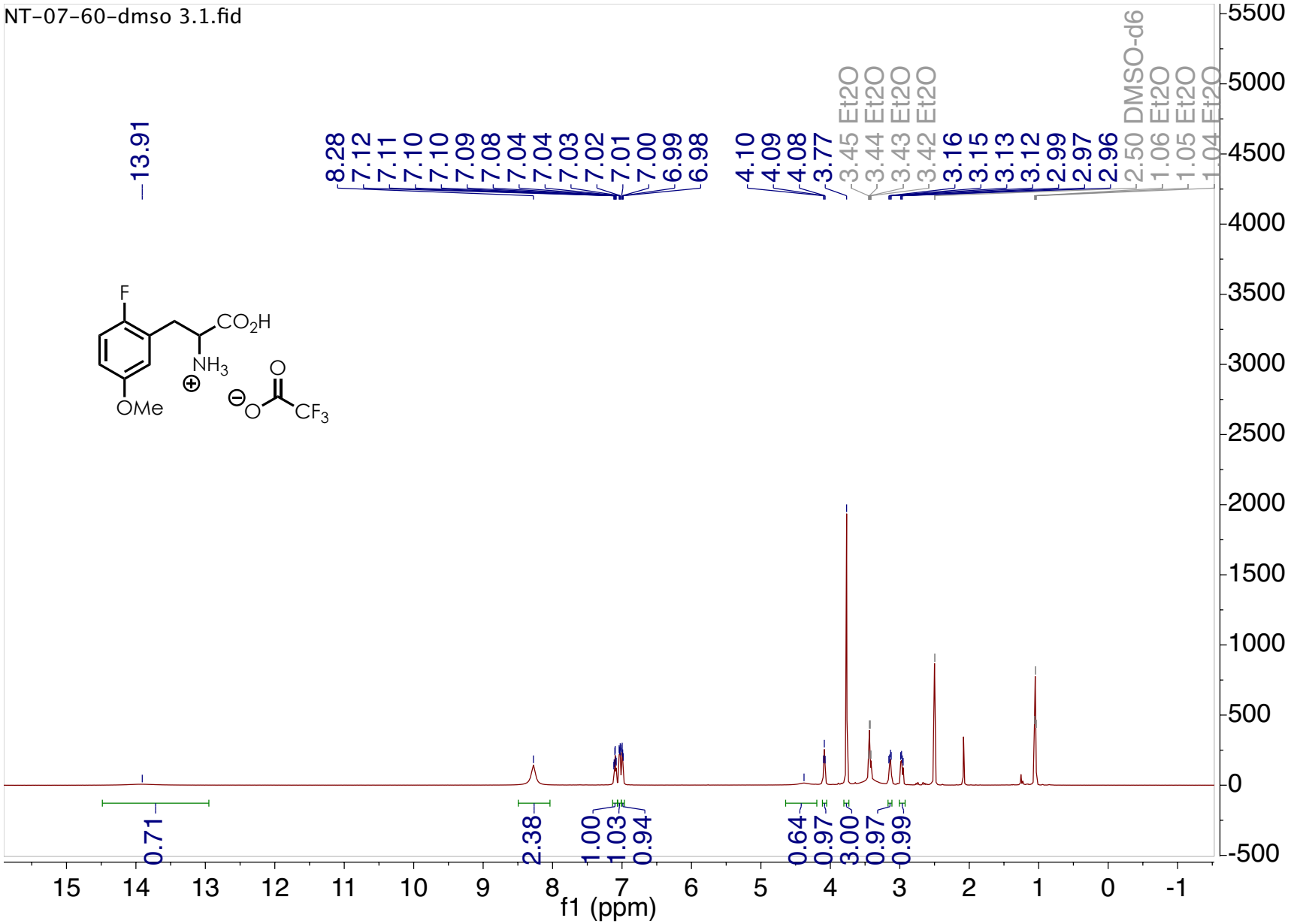

NT-07-31 3.2.fid
Nicewicz
5106082
ntay
NT-07-31
172.70
157.62
156.04
155.26
153.89
153.87
126.49
126.44
118.06
117.90
114.29
114.14
111.21
111.15
79.83
77.16 CDCl3
55.96
53.77
52.29
32.99
28.36
F
CO2Me
NHBoc
OMe
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

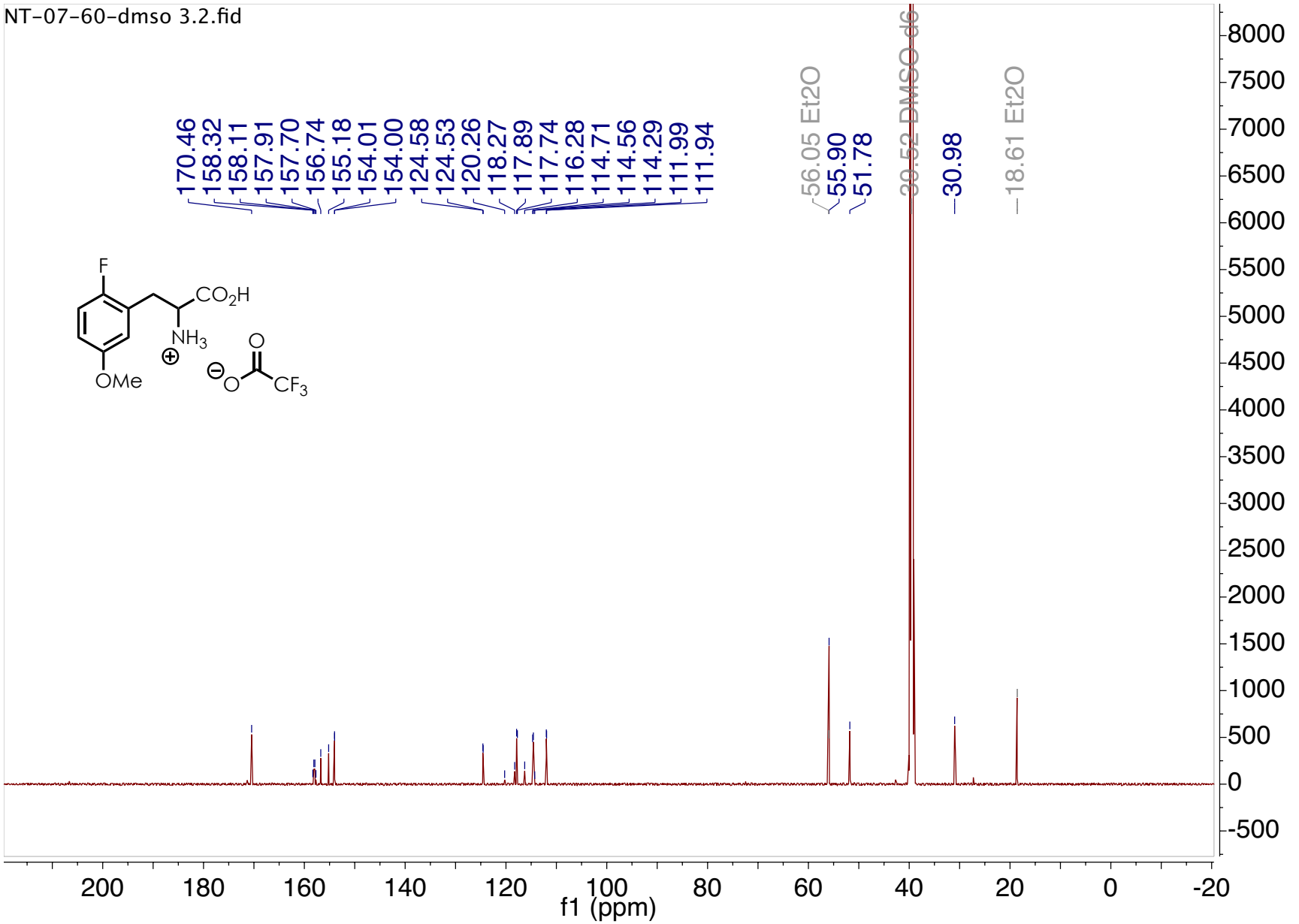

NT-07-31 1.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 50
-124.10
-124.11
-124.12
-124.14
-124.15
-124.16
-161.64 C6F6
F
CO2Me
NHBoc
OMe
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

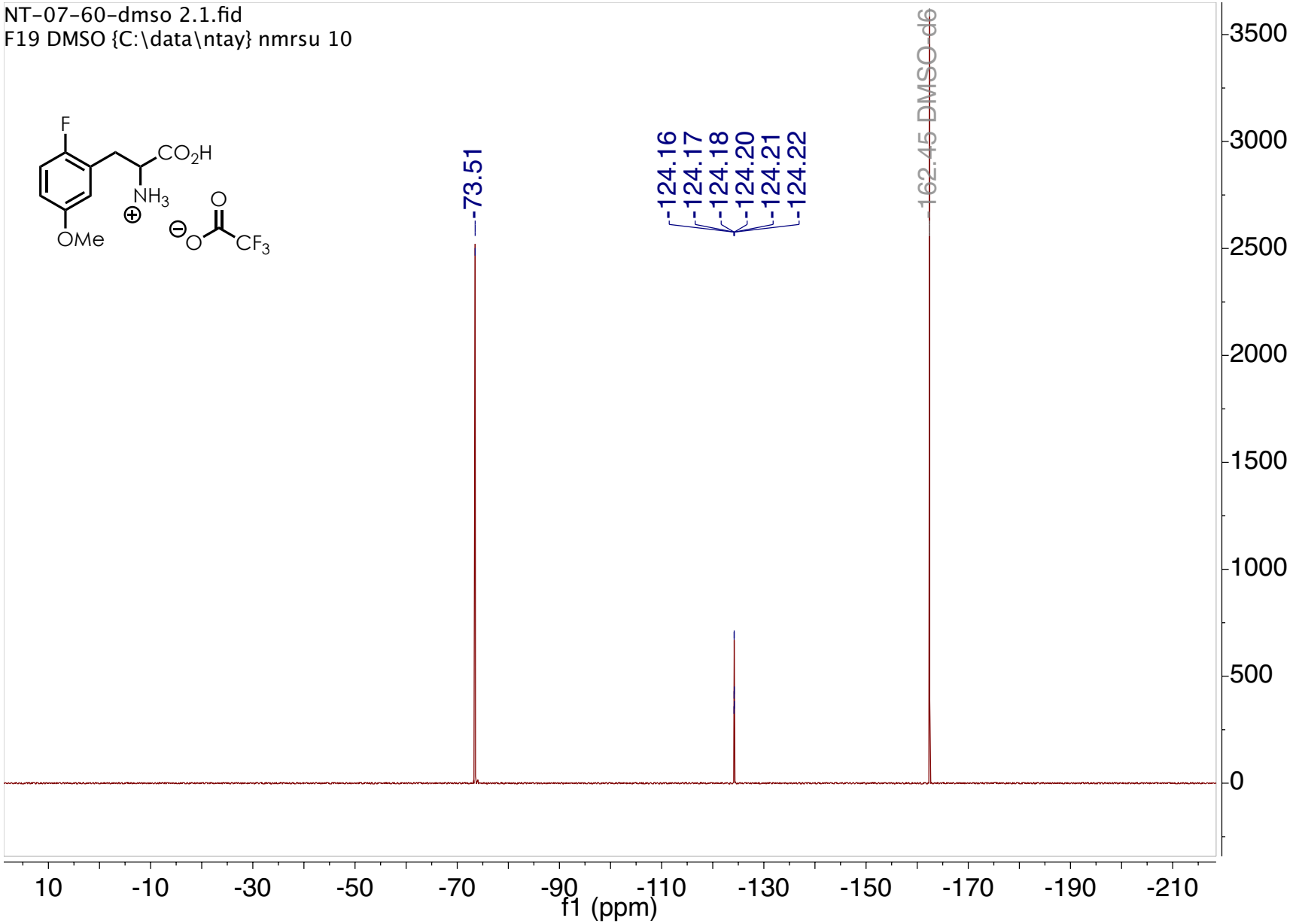

NT-07-57.1.fid
Nicewicz
5106082
ntay
NT-07-57
11.11
7.03
7.03
7.02
7.01
6.99
6.98
6.98
6.97
6.96
6.95
6.10
6.08
5.70
5.69
4.49
4.49
4.48
4.47
4.46
4.45
4.39
3.85
3.28
3.27
3.26
3.25
2.91
2.89
2.89
2.87
2.05 Acetone-d6
1.33
F
CO2H
NHBoc
OMe
0.52
1.00
2.02
0.85
0.85
0.13
3.16
1.11
1.26
8.80
f1 (ppm)

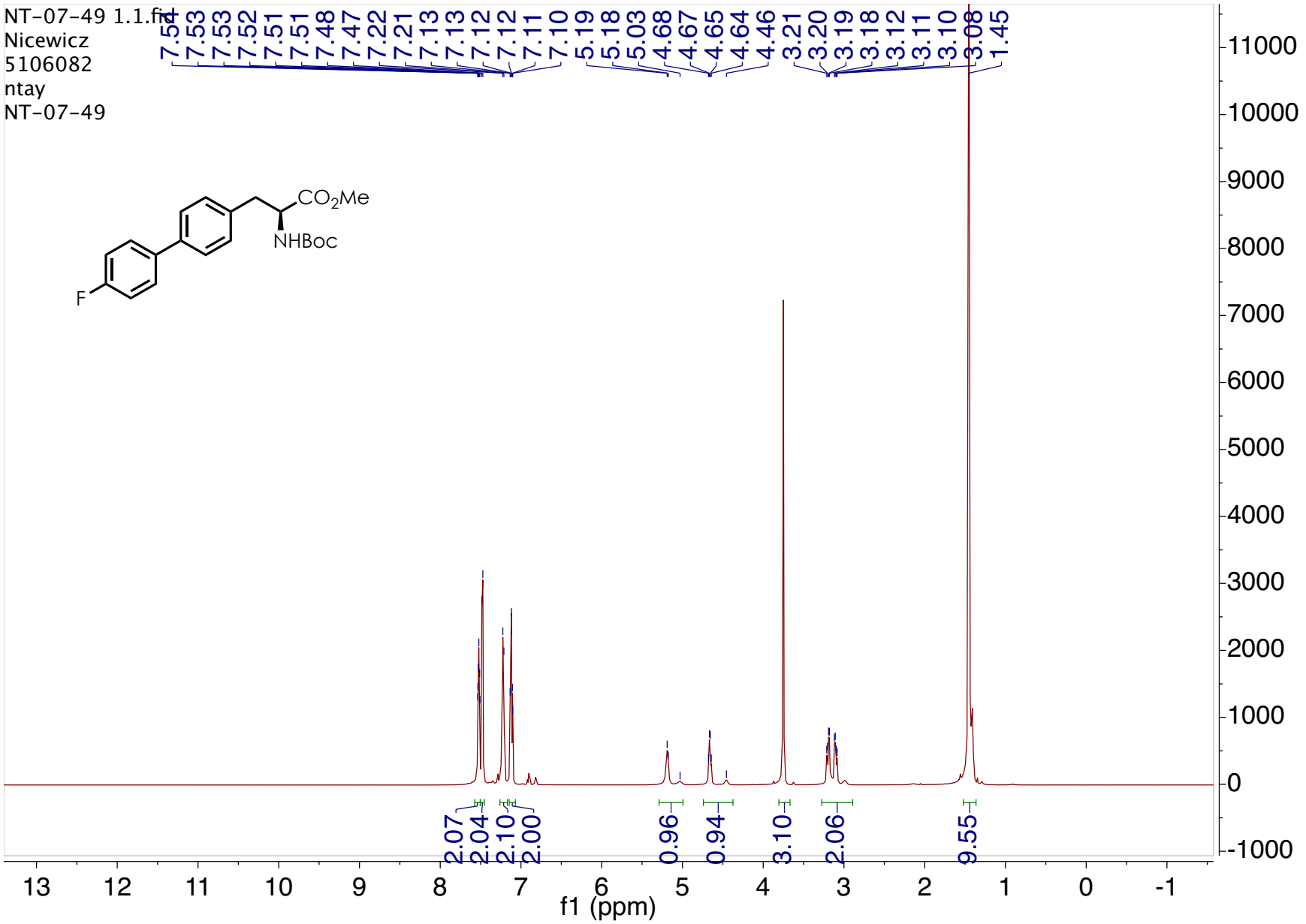

NT-07-57 2.2.fid
Nicewicz
5106082
ntay
NT-07-57
206.26 Acetone
173.69
158.24
156.67
156.24
155.07
155.06
128.60
128.55
118.59
118.43
114.47
114.32
112.28
112.22
79.13
56.33
53.99
33.19
29.86 Acetone
28.47
F
CO2H
NHBoc
OMe
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

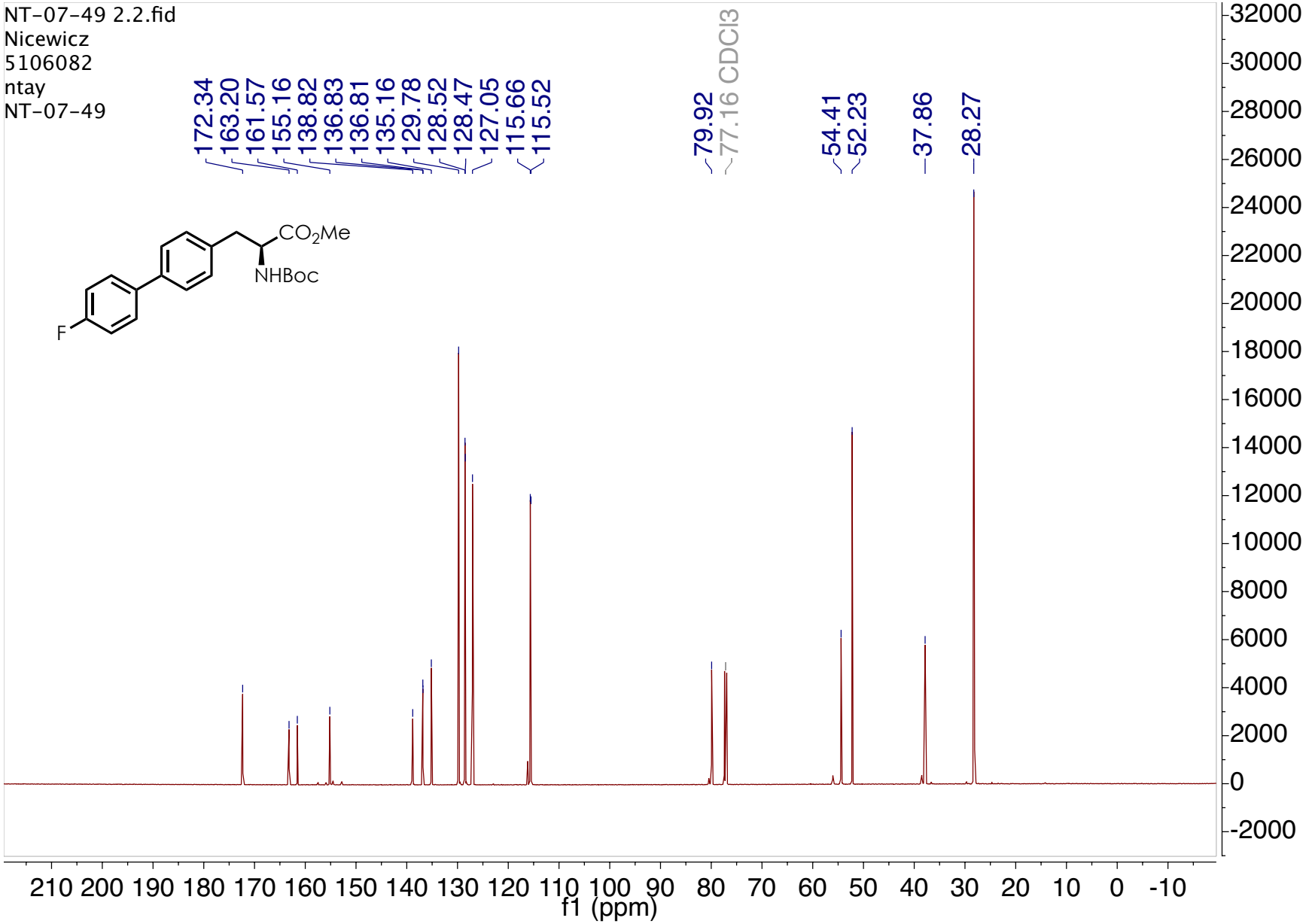

NT-07-57-19F.1.fid
F19 Acetone {C:\data} nmrsu 1
F
CO2H
NHBoc
OMe
-126.29
-126.31
-126.32
-126.33
-126.34
-126.35
-164.67 C6F6
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

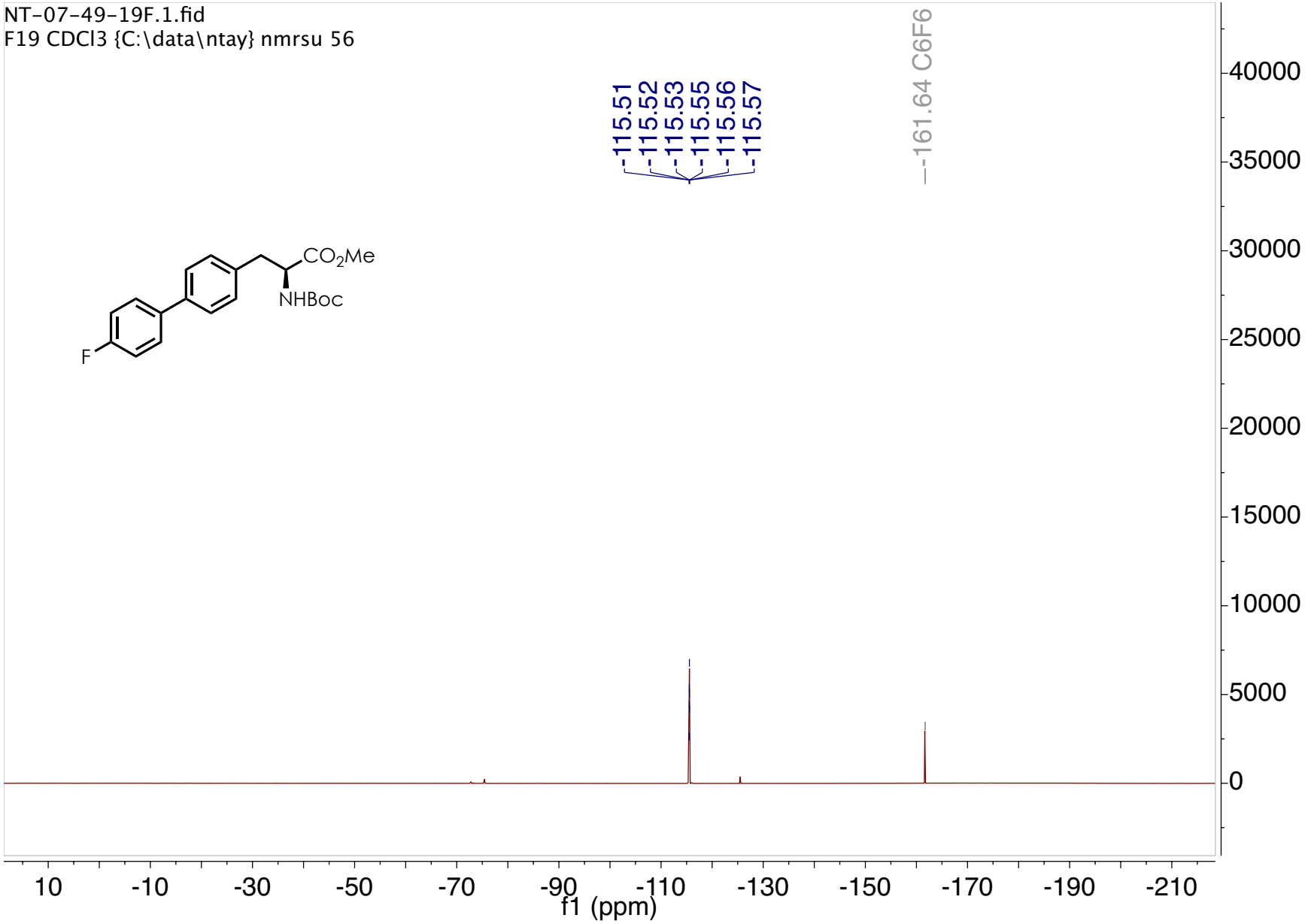

NT-07-60-dmso 3.1.fid
13.91
8.28
7.12
7.11
7.10
7.10
7.09
7.08
7.04
7.04
7.03
7.02
7.01
7.00
6.99
6.98
4.10
4.09
4.08
3.77
3.45 Et2O
3.44 Et2O
3.43 Et2O
3.42 Et2O
3.16
3.15
3.13
3.12
2.99
2.97
2.96
2.50 DMSO-d6
1.06 Et2O
1.05 Et2O
1.04 Et2O
F
CO2H
NH3
OMe
O
O
CF3
0.71
2.38
1.00
1.03
0.94
0.64
0.97
3.00
0.97
0.99
f1 (ppm)

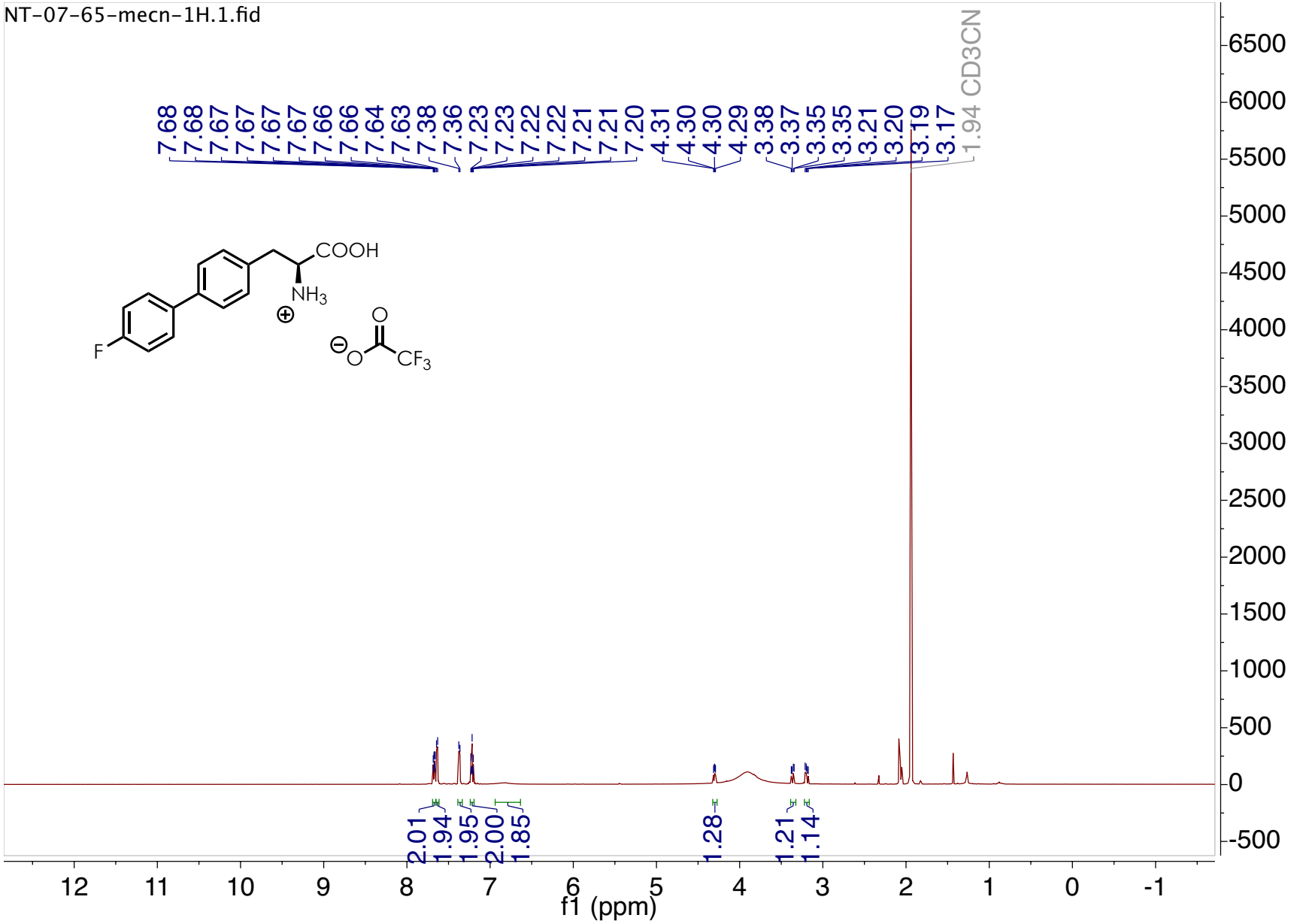

NT-07-60-dmso 3.2.fid
170.46
158.32
158.11
157.91
157.70
156.74
155.18
154.01
154.00
124.58
124.53
120.26
118.27
117.89
117.74
116.28
114.71
114.56
114.29
111.99
111.94
56.05 Et2O
55.90
51.78
39.52 DMSO-d6
30.98
18.61 Et2O
F
CO2H
NH3
OMe
O
O
CF3
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
200
180
160
140
120
100
80
60
40
20
0
-20
f1 (ppm)

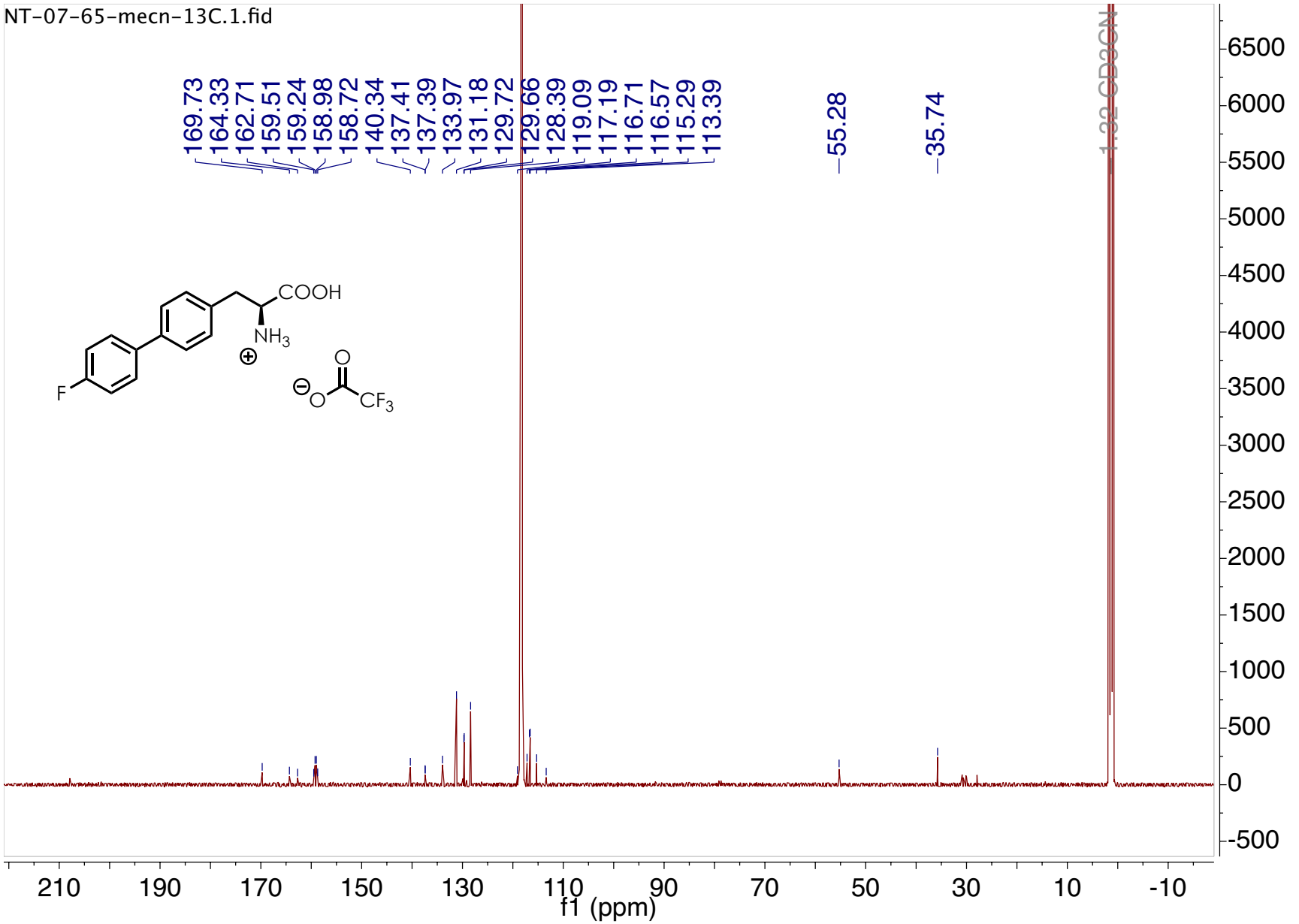

NT-07-60-dmso 2.1.fid
F19 DMSO {C:\data\ntay} nmrsu 10
F
CO2H
NH3
OMe
O
O
CF3
-73.51
-124.16
-124.17
-124.18
-124.20
-124.21
-124.22
-162.45 DMSO-d6
3500
3000
2500
2000
1500
1000
500
0
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

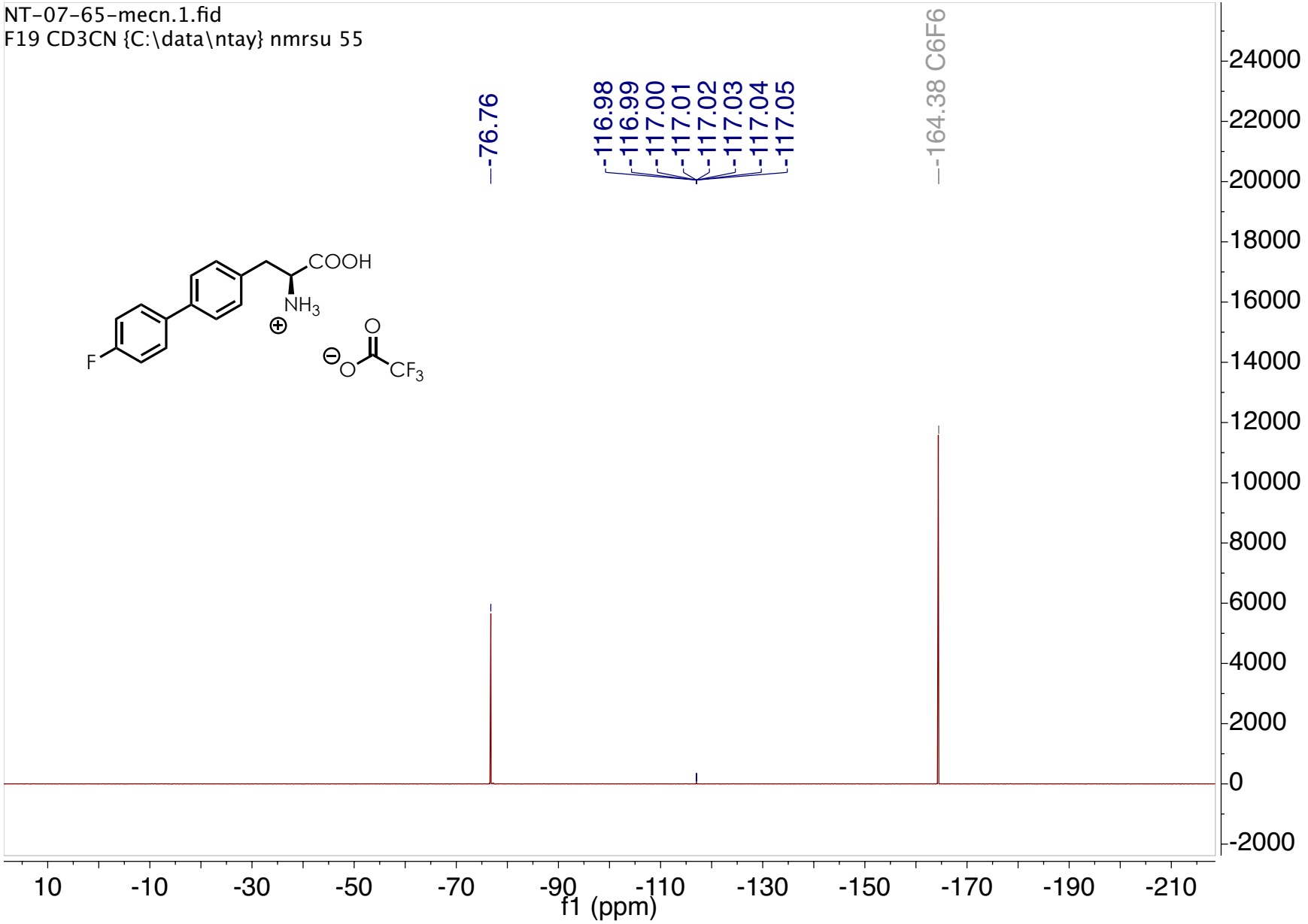

NT-07-49 1.1.fid
Nicewicz
5106082
ntay
NT-07-49
7.54
7.53
7.53
7.52
7.51
7.51
7.48
7.47
7.22
7.21
7.13
7.13
7.12
7.12
7.11
7.10
5.19
5.18
5.03
4.68
4.67
4.65
4.64
4.46
3.21
3.20
3.19
3.18
3.12
3.11
3.10
3.08
1.45
CO2Me
NHBoc
F
2.07
2.04
2.10
2.00
0.96
0.94
3.10
2.06
9.55
f1 (ppm)

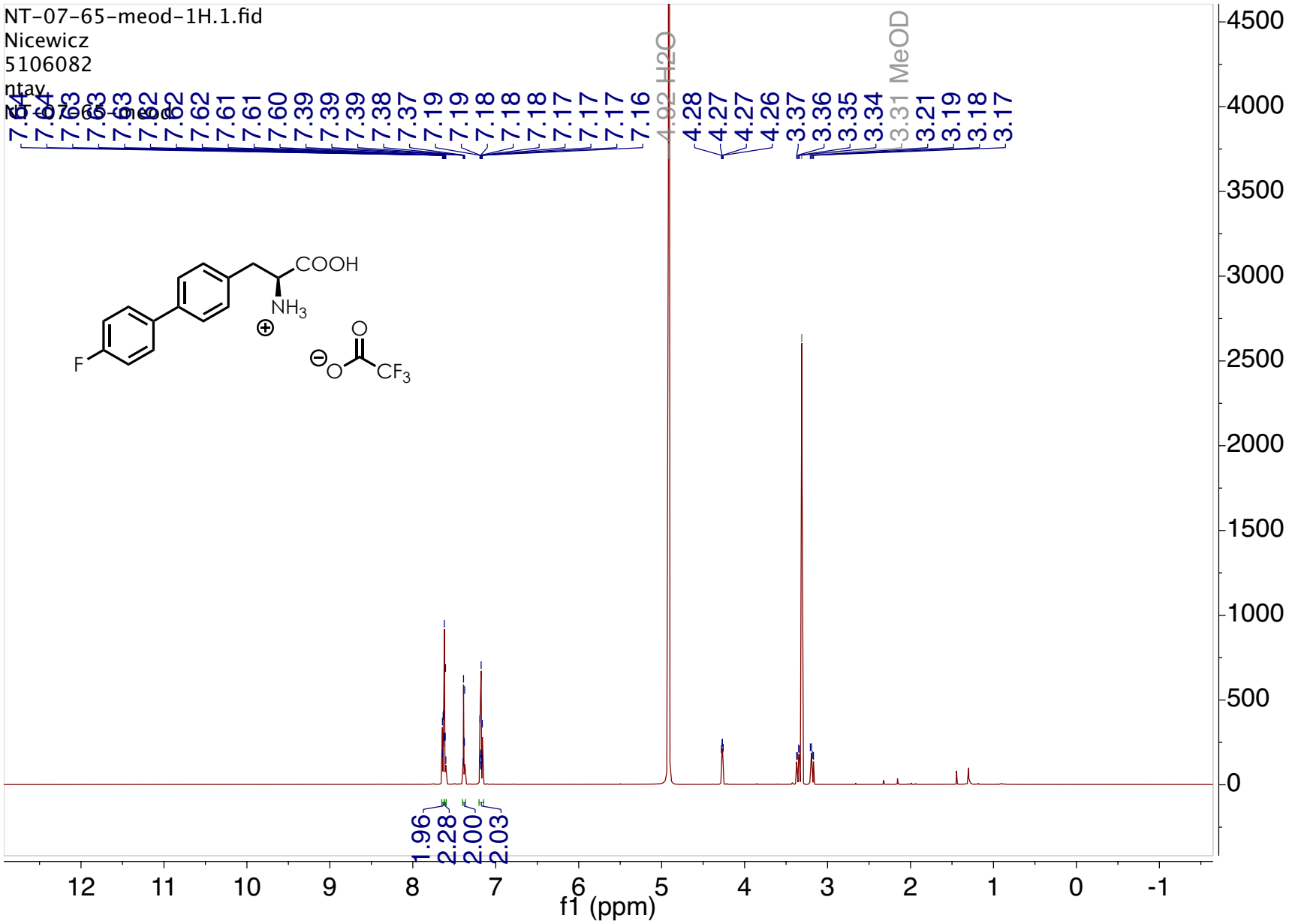

NT-07-49 2.2.fid
Nicewicz
5106082
ntay
NT-07-49
172.34
163.20
161.57
155.16
138.82
136.83
136.81
135.16
129.78
128.52
128.47
127.05
115.66
115.52
79.92
77.16 CDCl3
54.41
52.23
37.86
28.27
CO2Me
NHBoc
F
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

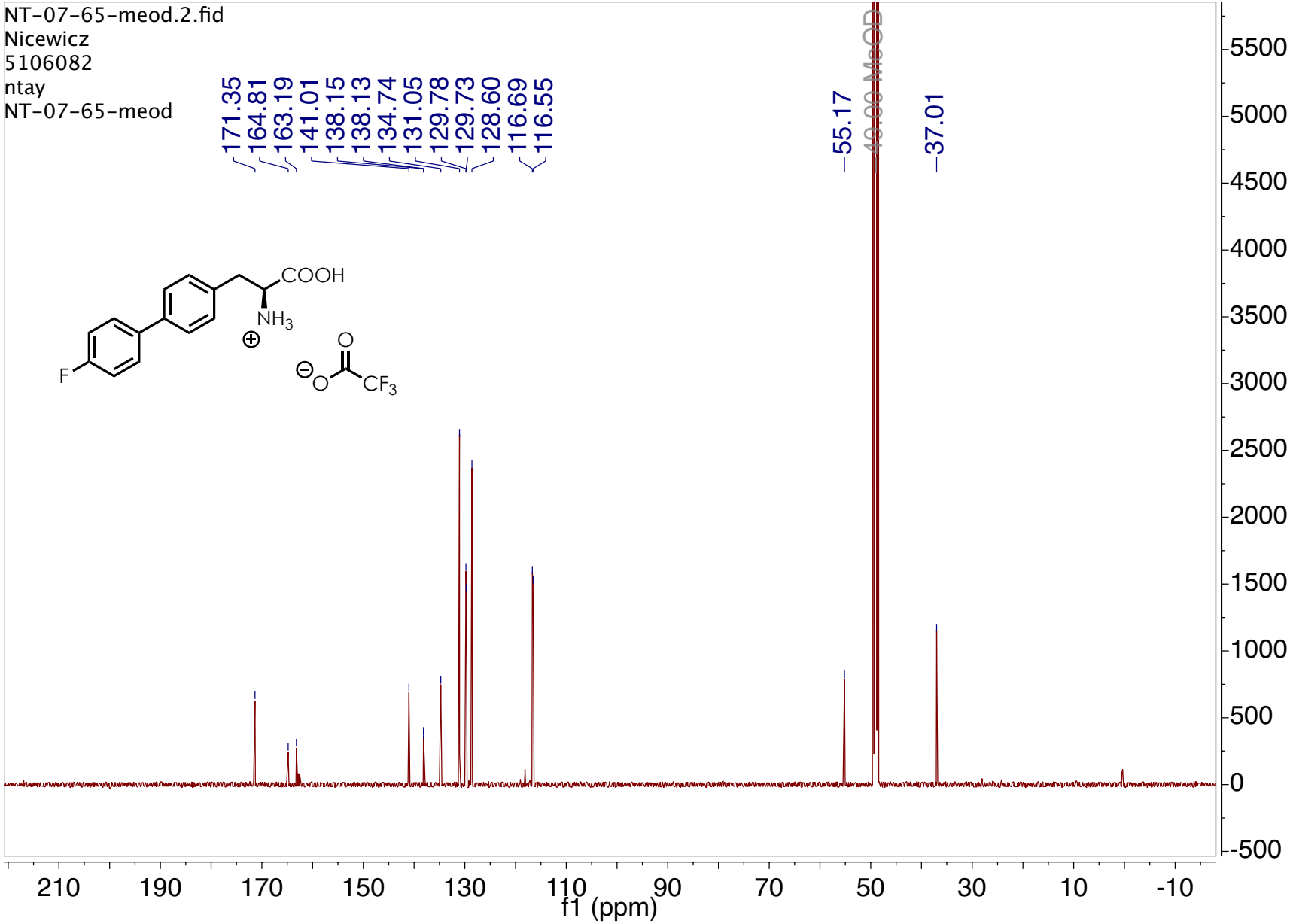

NT-07-49-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 56
-115.51
-115.52
-115.53
-115.55
-115.56
-115.57
-161.64 C6F6
CO2Me
NHBoc
F
40000
35000
30000
25000
20000
15000
10000
5000
0
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

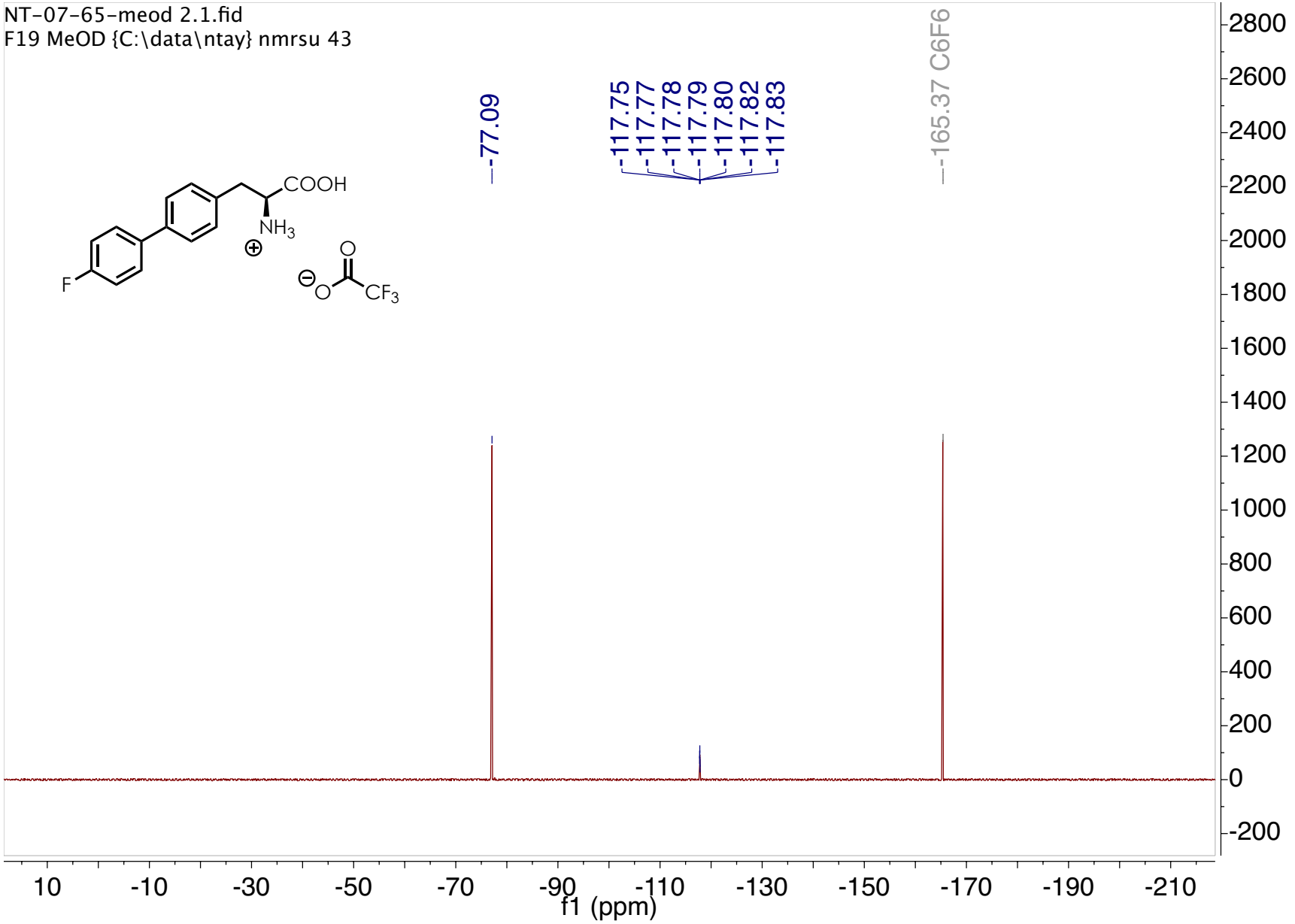

NT-07-65-mecn-1H.1.fid
7.68
7.68
7.67
7.67
7.67
7.67
7.66
7.66
7.64
7.63
7.38
7.36
7.23
7.23
7.22
7.22
7.21
7.21
7.20
4.31
4.30
4.30
4.29
3.38
3.37
3.35
3.35
3.21
3.20
3.19
3.17
1.94 CD3CN
COOH
NH3
F
O
O
CF3
2.01
1.94
1.95
2.00
1.85
1.28
1.21
1.14
f1 (ppm)

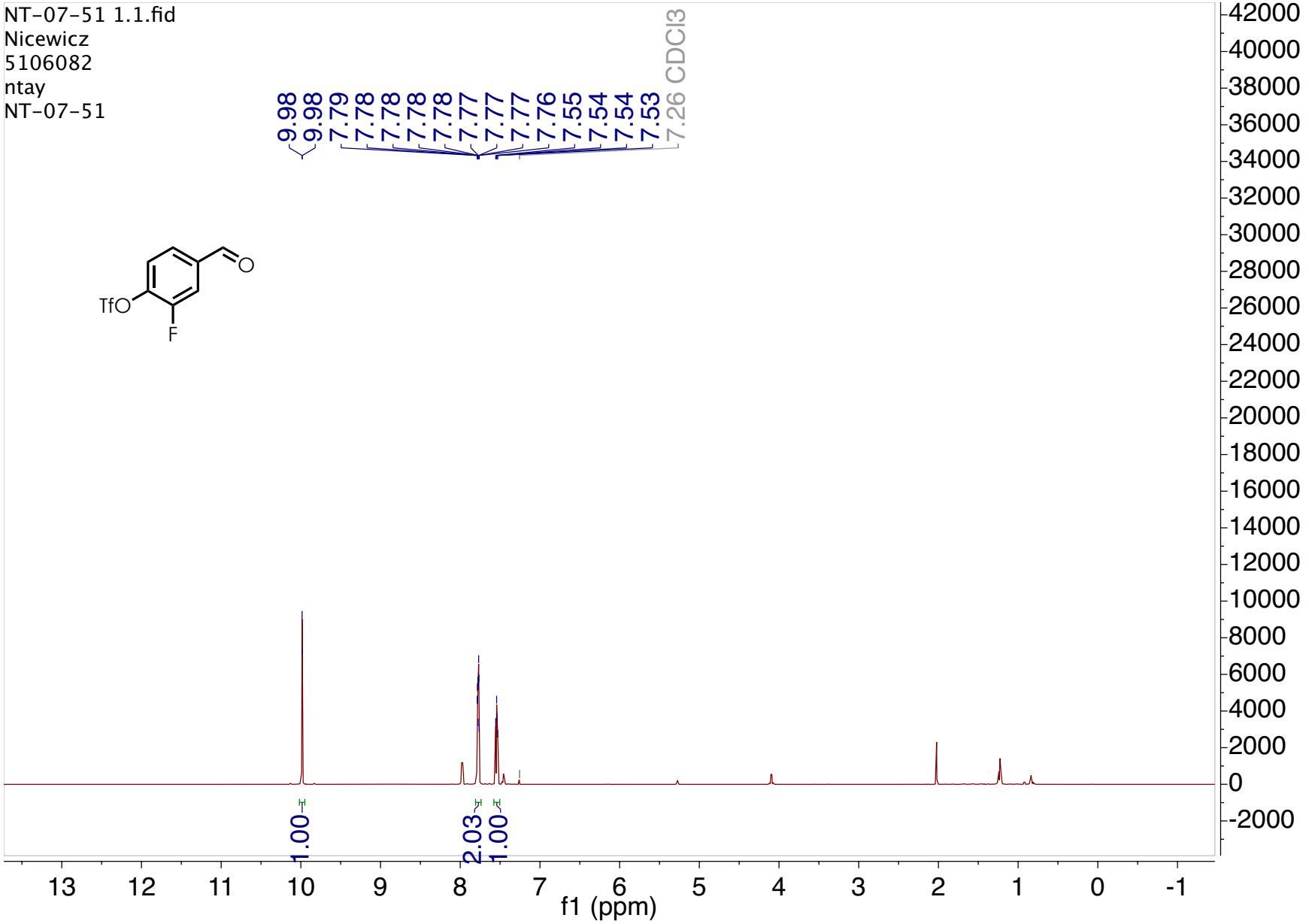

NT-07-65-mecn-13C.1.fid
169.73
164.33
162.71
159.51
159.24
158.98
158.72
140.34
137.41
137.39
133.97
131.18
129.72
129.66
128.39
119.09
117.19
116.71
116.57
115.29
113.39
55.28
35.74
1.32 CD3CN
COOH
NH3
F
O
O
CF3
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

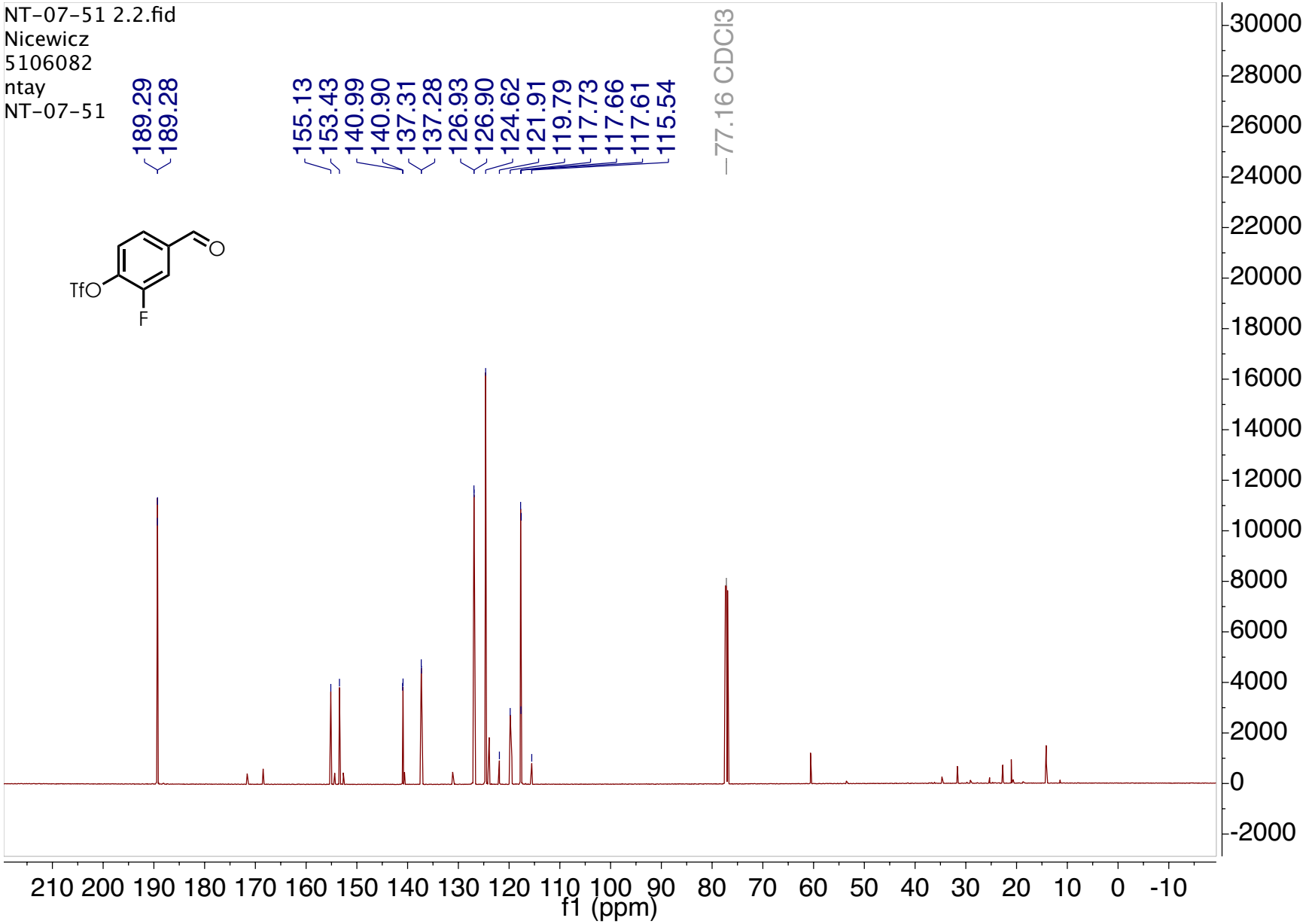

NT-07-65-mecn.1.fid
F19 CD3CN {C:\data\ntay} nmrsu 55
-76.76
-116.98
-116.99
-117.00
-117.01
-117.02
-117.03
-117.04
-117.05
-164.38 C6F6
COOH
NH3
F
O
O
CF3
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

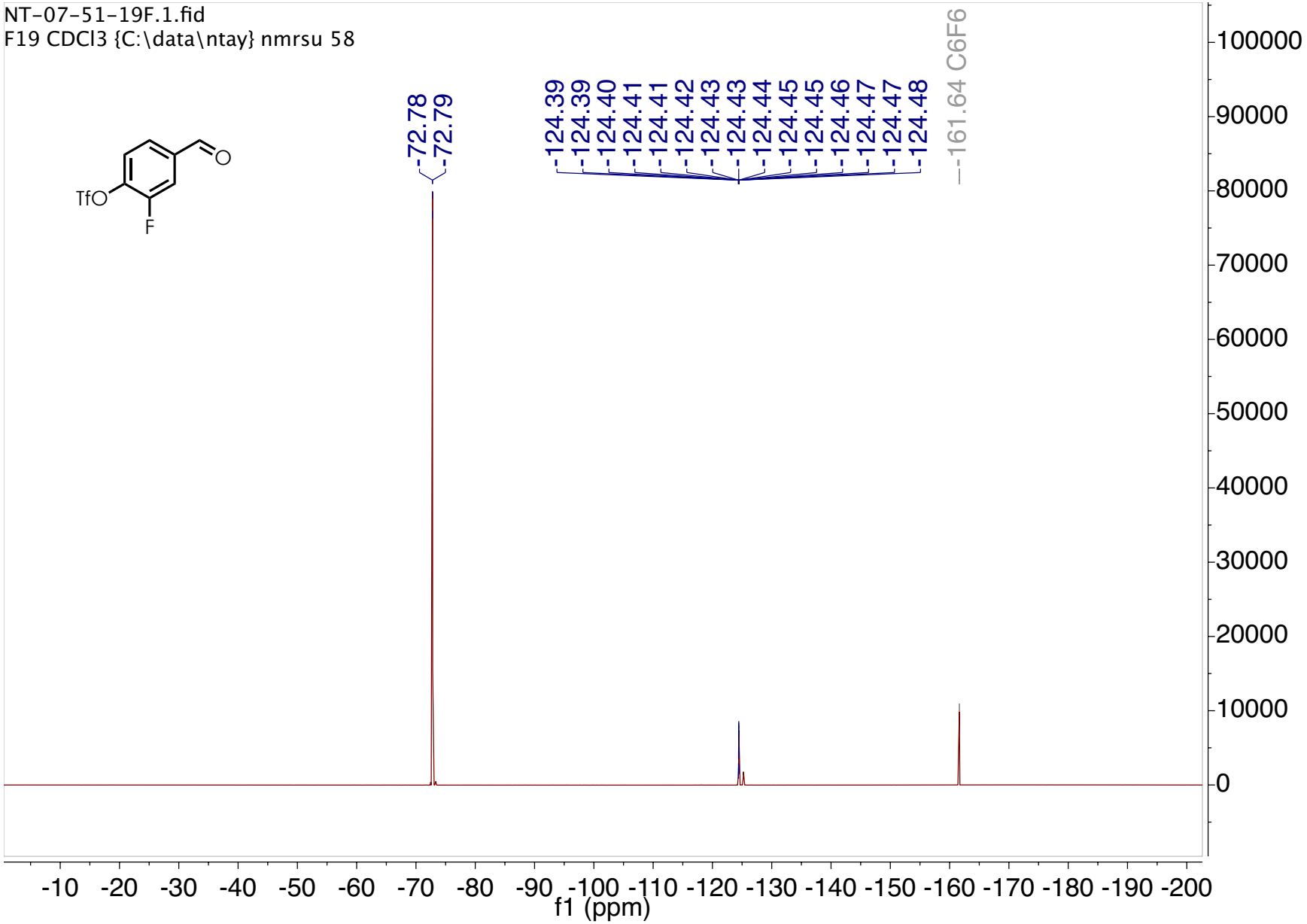

NT-07-65-meod-1H.1.fid
Nicewicz
5106082
ntav
NT-07-65-meod
7.64
7.64
7.63
7.63
7.63
7.62
7.62
7.62
7.61
7.61
7.60
7.39
7.39
7.39
7.38
7.37
7.19
7.19
7.18
7.18
7.18
7.17
7.17
7.17
7.16
4.92 H2O
4.28
4.27
4.27
4.26
3.37
3.36
3.35
3.34
3.31 MeOD
3.21
3.19
3.18
3.17
COOH
NH3
F
O
O
CF3
1.96
2.28
2.00
2.03
f1 (ppm)

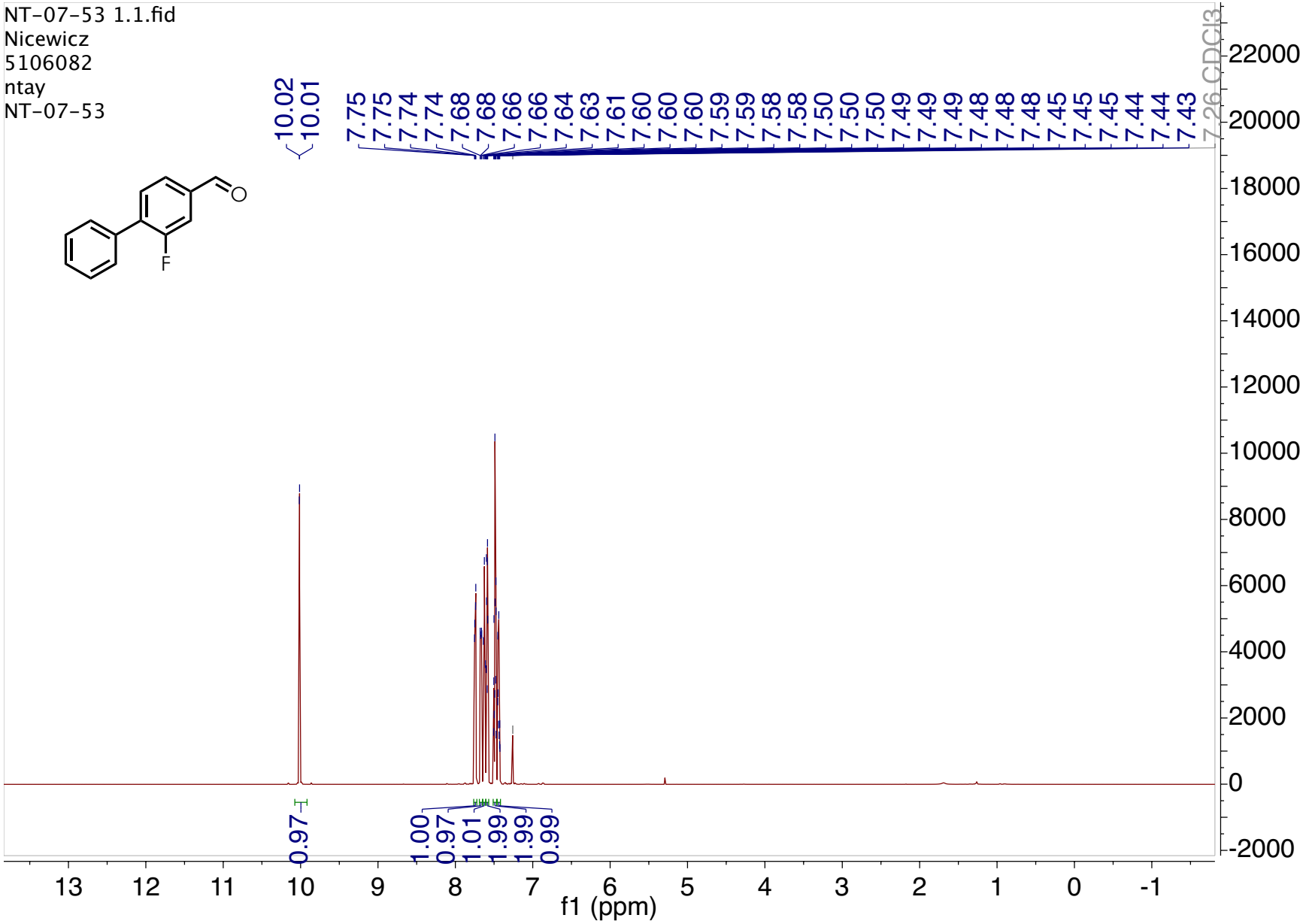

NT-07-65-meod.2.fid
Nicewicz
5106082
ntay
NT-07-65-meod
171.35
164.81
163.19
141.01
138.15
138.13
134.74
131.05
129.78
129.73
128.60
116.69
116.55
55.17
49.00 MeOD
37.01
COOH
NH3
F
O
O
CF3
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
210
190
170
150
130
110
90
70
50
30
10
-10
f1 (ppm)

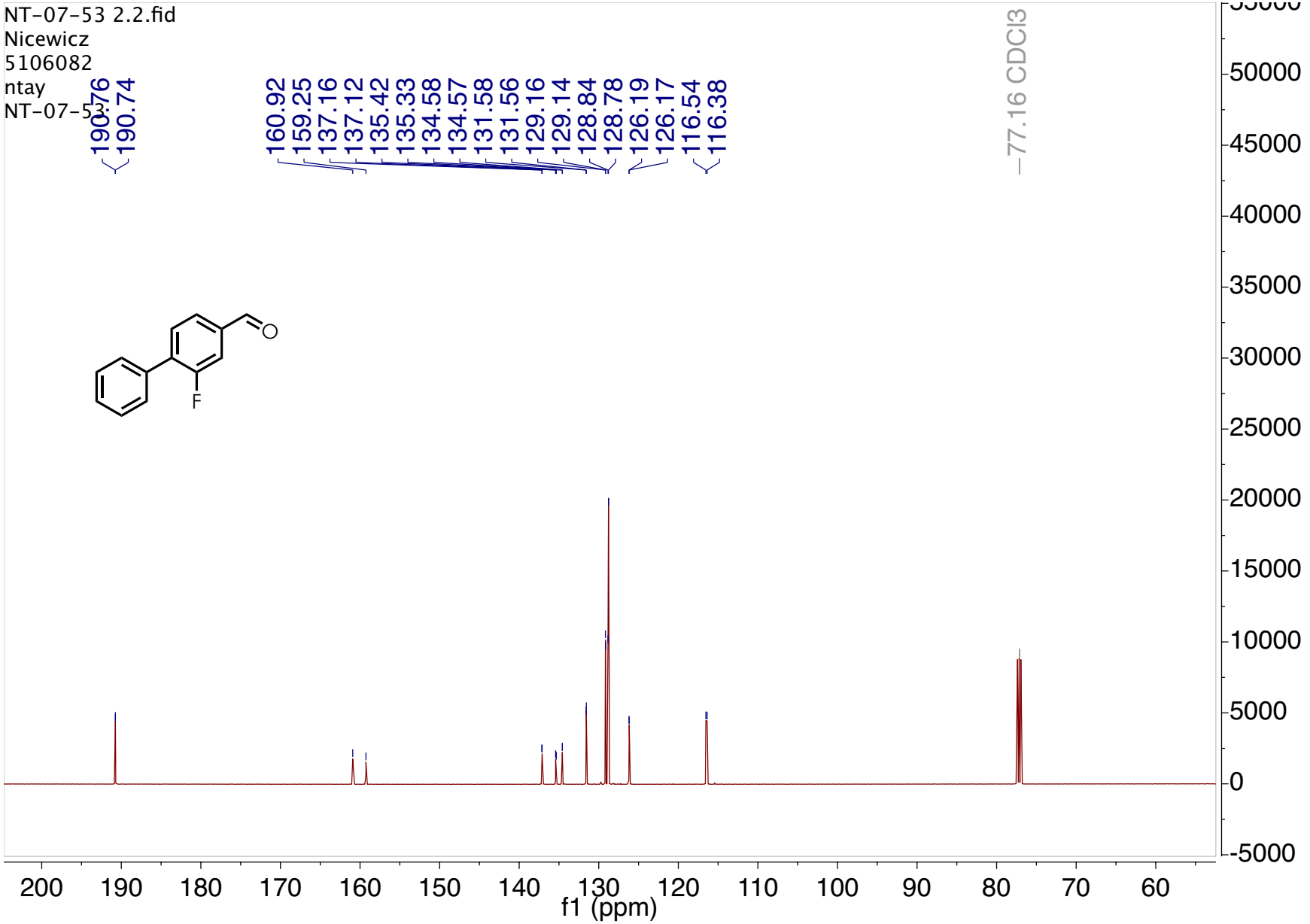

NT-07-65-meod 2.1.fid
F19 MeOD {C:\data\ntay} nmrsu 43
-77.09
-117.75
-117.77
-117.78
-117.79
-117.80
-117.82
-117.83
-165.37 C6F6
COOH
NH3
F
O
O
CF3
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

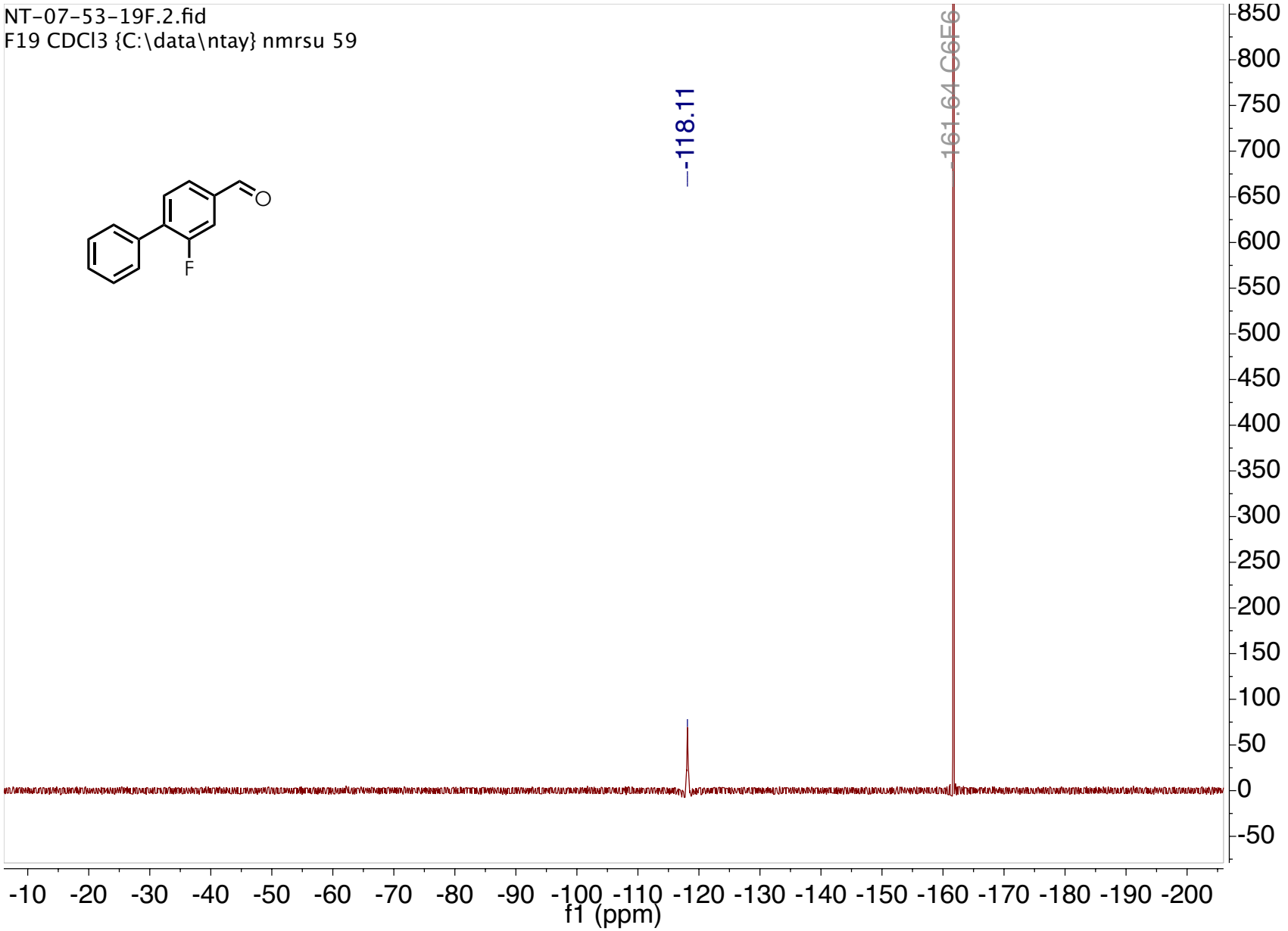

NT-07-51 1.1.fid
Nicewicz
5106082
ntay
NT-07-51
9.98
9.98
7.79
7.78
7.78
7.78
7.78
7.77
7.77
7.77
7.76
7.55
7.54
7.54
7.53
7.26 CDCl3
TfO
F
O
1.00
2.03
1.00
f1 (ppm)

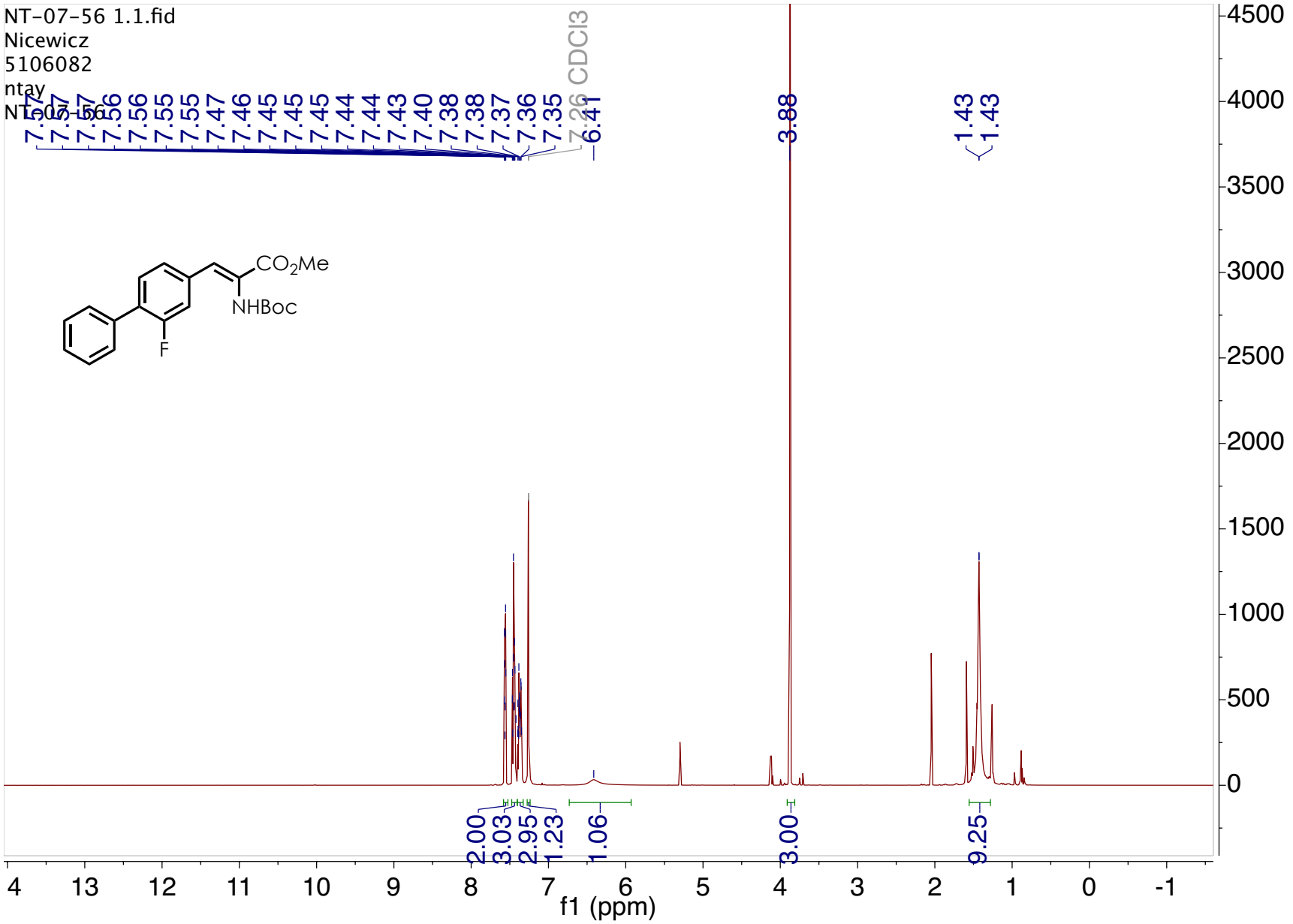

NT-07-51 2.2.fid
Nicewicz
5106082
ntay
NT-07-51
189.29
189.28
155.13
153.43
140.99
140.90
137.31
137.28
126.93
126.90
124.62
121.91
119.79
117.73
117.66
117.61
115.54
77.16 CDCl3
TfO
F
O
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

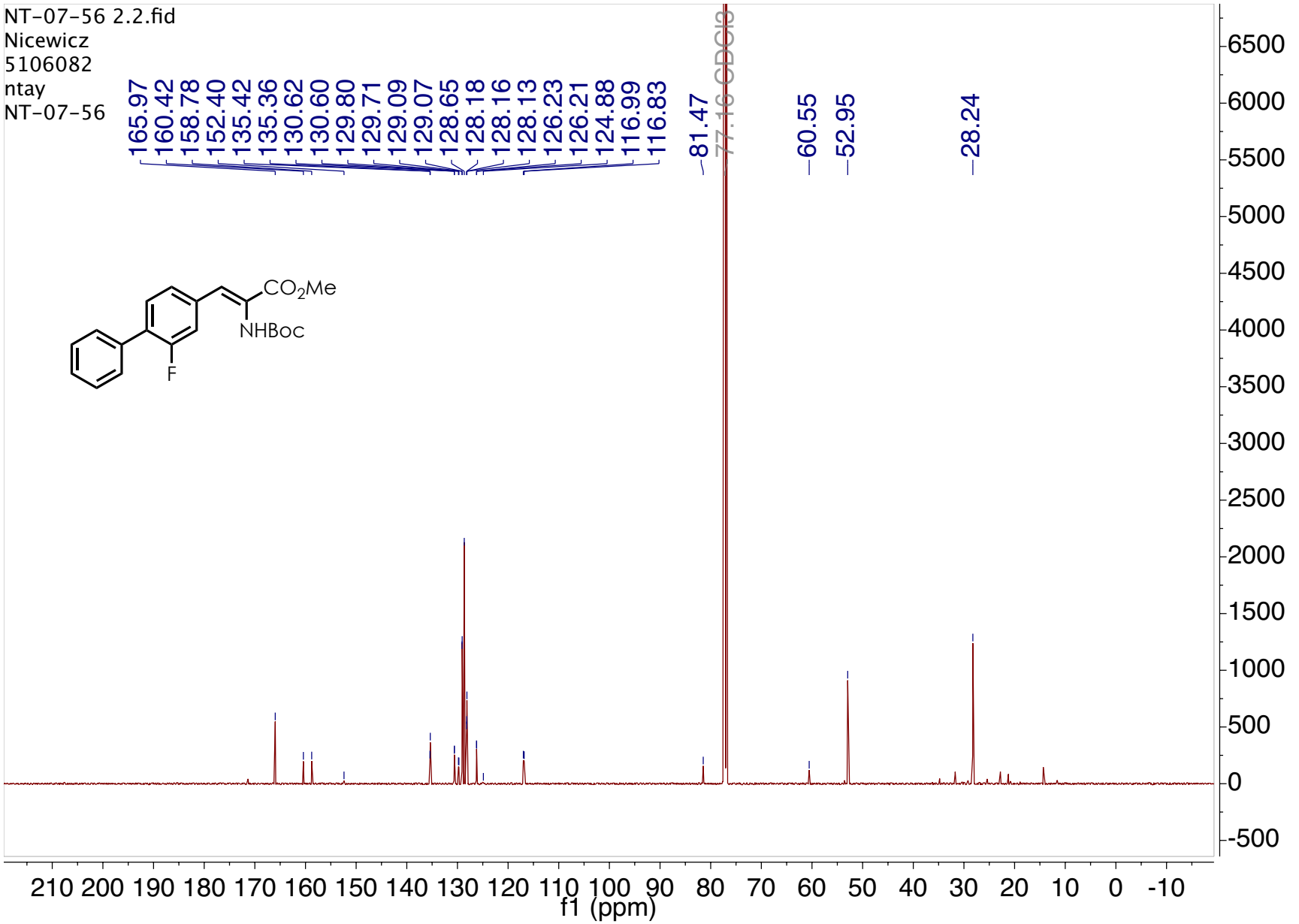

NT-07-51-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 58
TfO
F
O
-72.78
-72.79
-124.39
-124.39
-124.40
-124.41
-124.41
-124.42
-124.43
-124.43
-124.44
-124.45
-124.45
-124.46
-124.47
-124.47
-124.48
-161.64 C6F6
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
-10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)

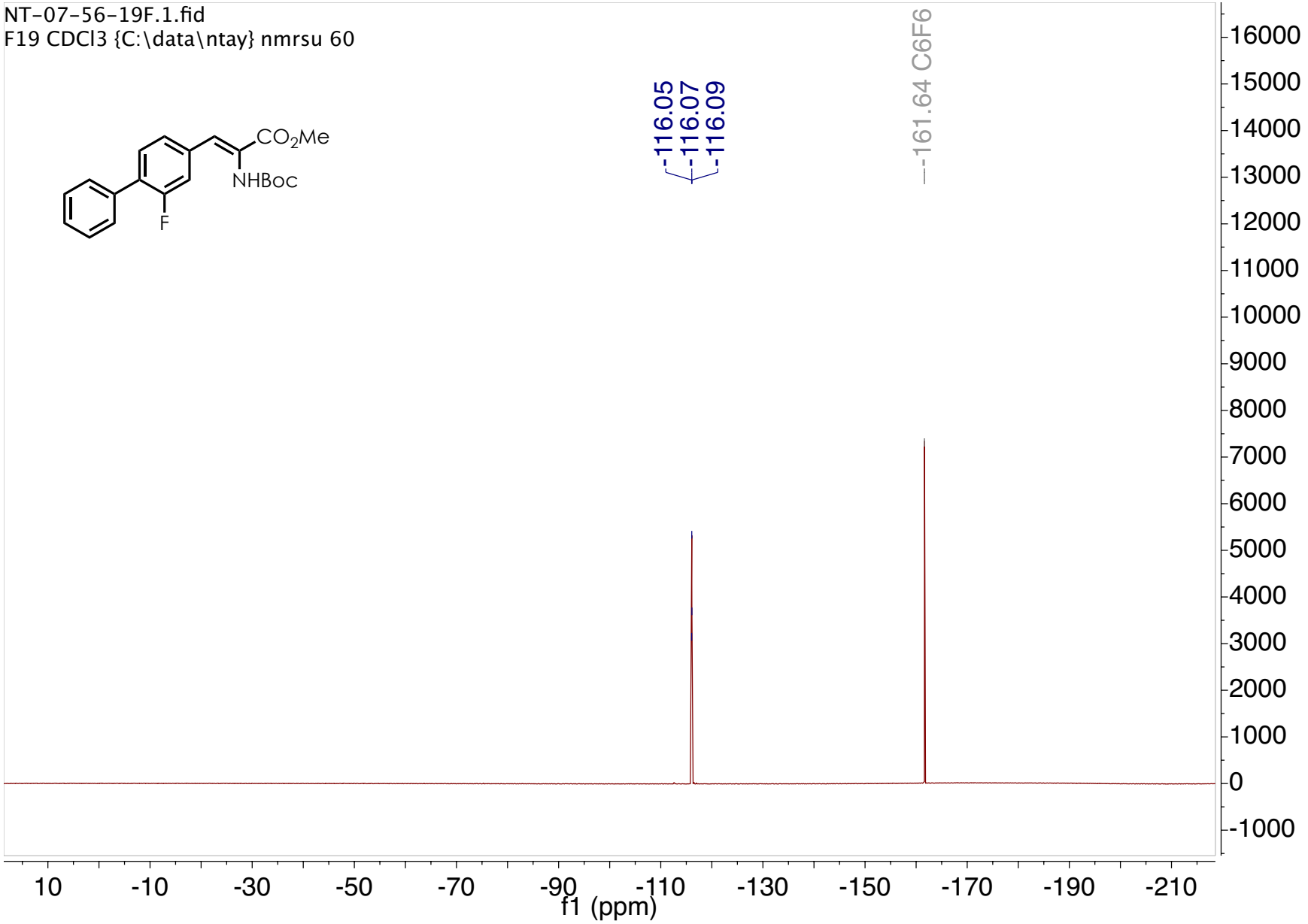

NT-07-53 1.1.fid
Nicewicz
5106082
ntay
NT-07-53
10.02
10.01
7.75
7.75
7.74
7.74
7.68
7.68
7.66
7.66
7.64
7.63
7.61
7.60
7.60
7.60
7.59
7.59
7.58
7.58
7.50
7.50
7.50
7.49
7.49
7.49
7.48
7.48
7.48
7.45
7.45
7.45
7.44
7.44
7.43
7.26 CDCl3
F
O
0.97
1.00
0.97
1.01
1.99
1.99
0.99
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
f1 (ppm)

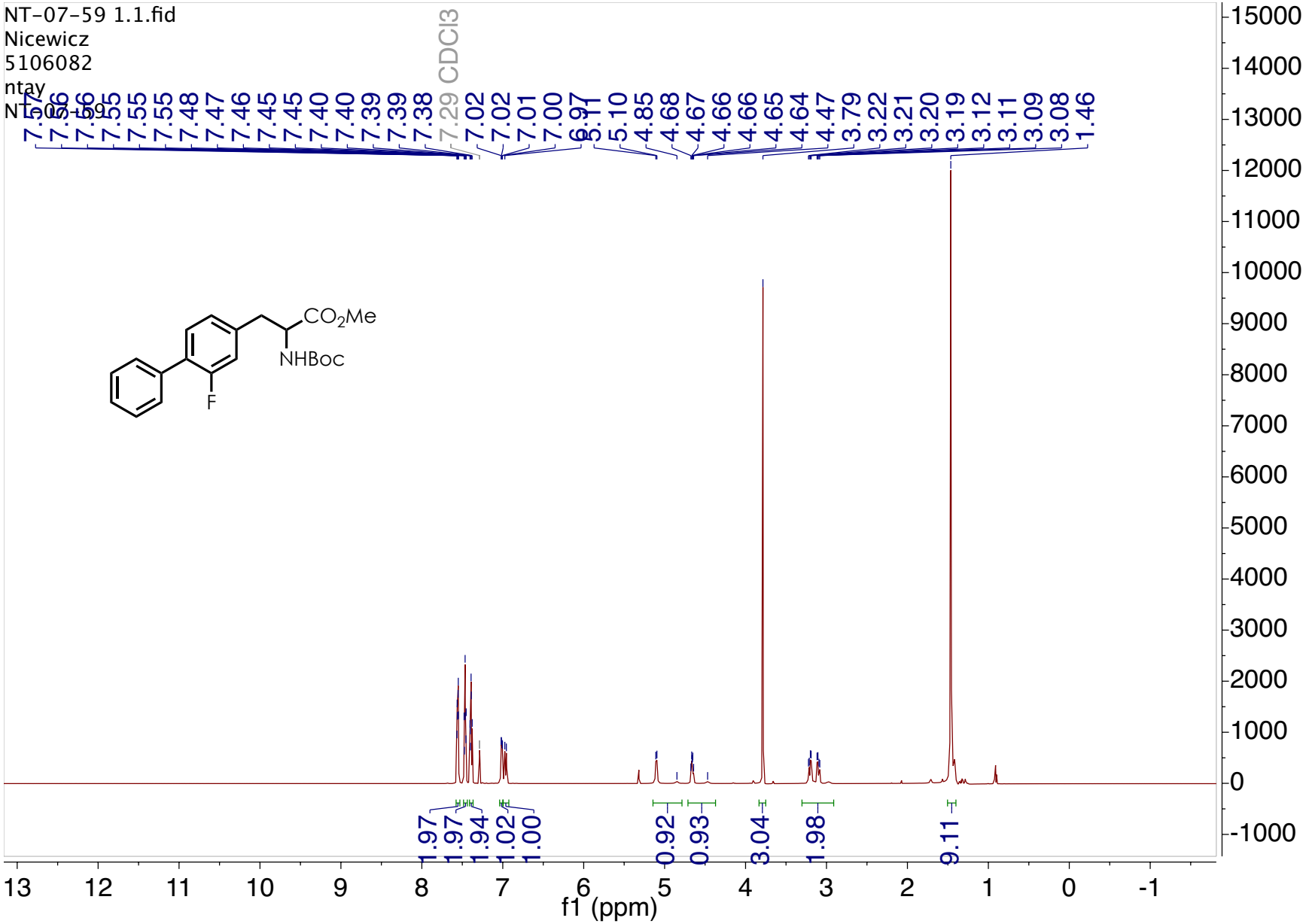

NT-07-53 2.2.fid
Nicewicz
5106082
ntay
NT-07-53
190.76
190.74
160.92
159.25
137.16
137.12
135.42
135.33
134.58
134.57
131.58
131.56
129.16
129.14
128.84
128.78
126.19
126.17
116.54
116.38
77.16 CDCl3
O
F
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
f1 (ppm)

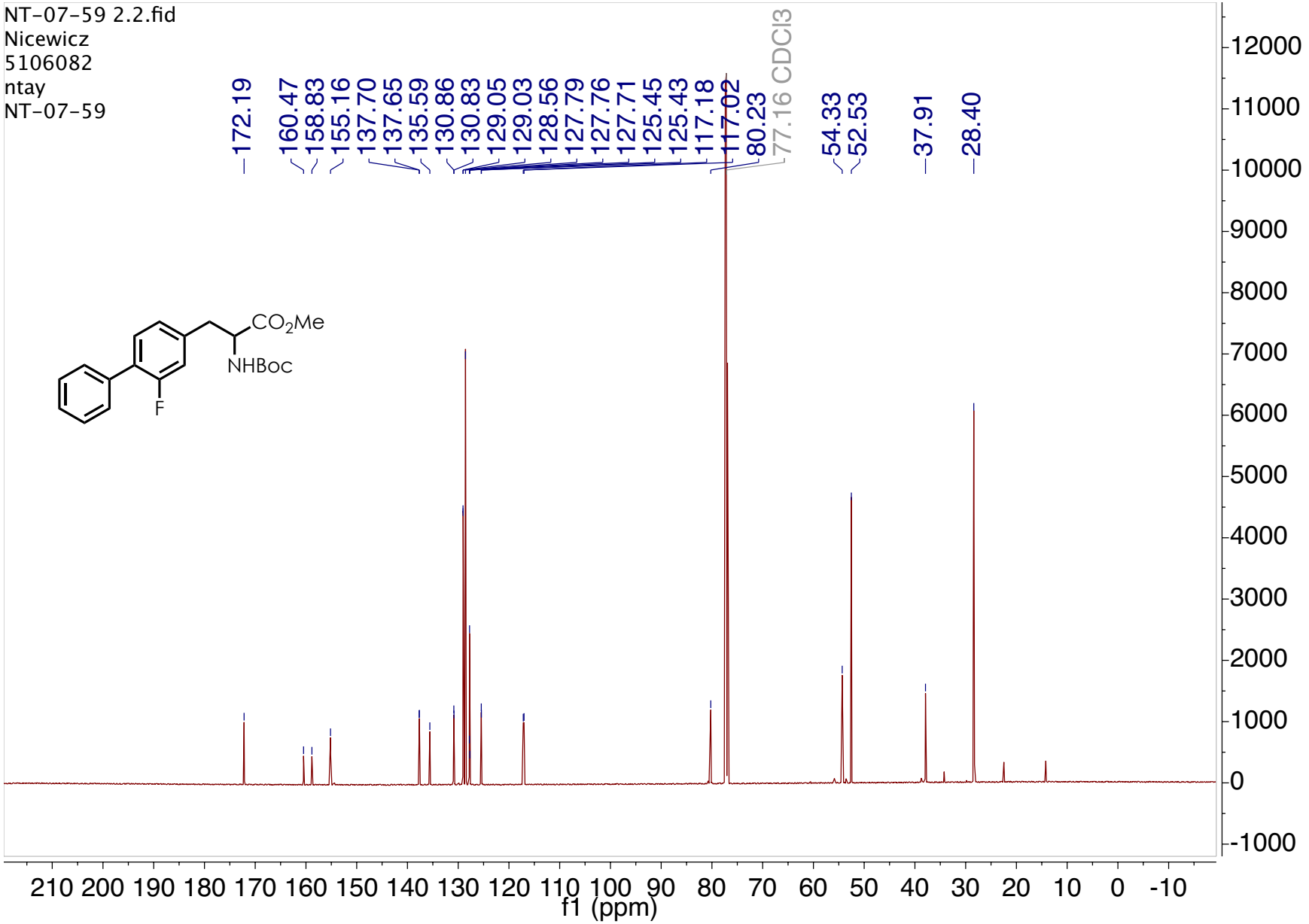

NT-07-53-19F.2.fid
F19 CDCl3 {C:\data\ntay} nmrsu 59
-118.11
-161.64 C6F6
O
F
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
-50
-10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)

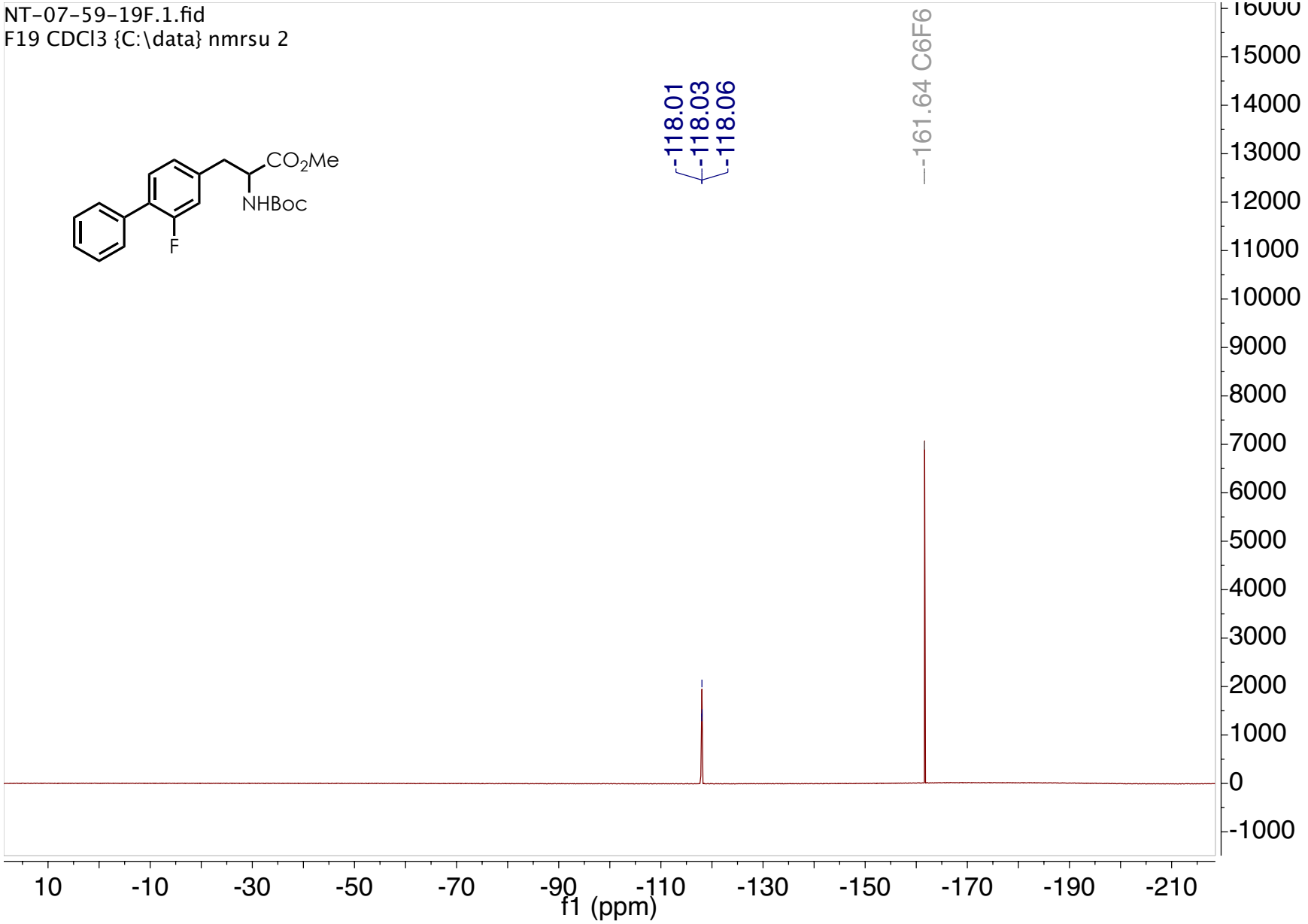

NT-07-56 1.1.fid
Nicewicz
5106082
ntay
NT-07-56
7.57
7.57
7.56
7.56
7.55
7.55
7.47
7.46
7.45
7.45
7.45
7.44
7.44
7.43
7.40
7.38
7.38
7.37
7.36
7.35
7.26 CDCl3
6.41
3.88
1.43
1.43
CO2Me
NHBoc
F
2.00
3.03
2.95
1.23
1.06
3.00
9.25
4500
4000
3500
3000
2500
2000
1500
1000
500
0
4 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1
f1 (ppm)

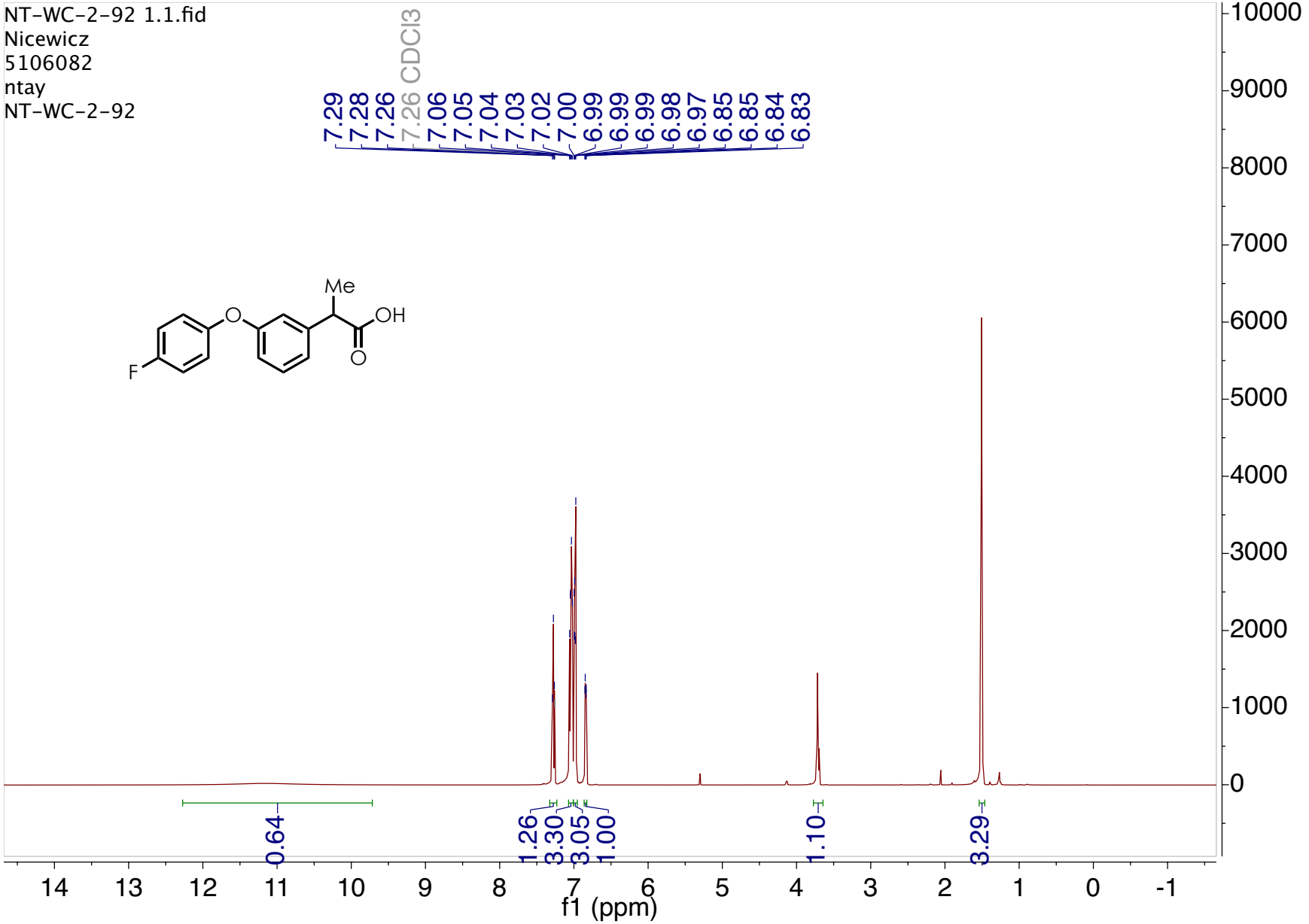

NT-07-56 2.2.fid
Nicewicz
5106082
ntay
NT-07-56
165.97
160.42
158.78
152.40
135.42
135.36
130.62
130.60
129.80
129.71
129.09
129.07
128.65
128.18
128.16
128.13
126.23
126.21
124.88
116.99
116.83
81.47
77.16 CDCl3
60.55
52.95
28.24
CO2Me
NHBoc
F
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

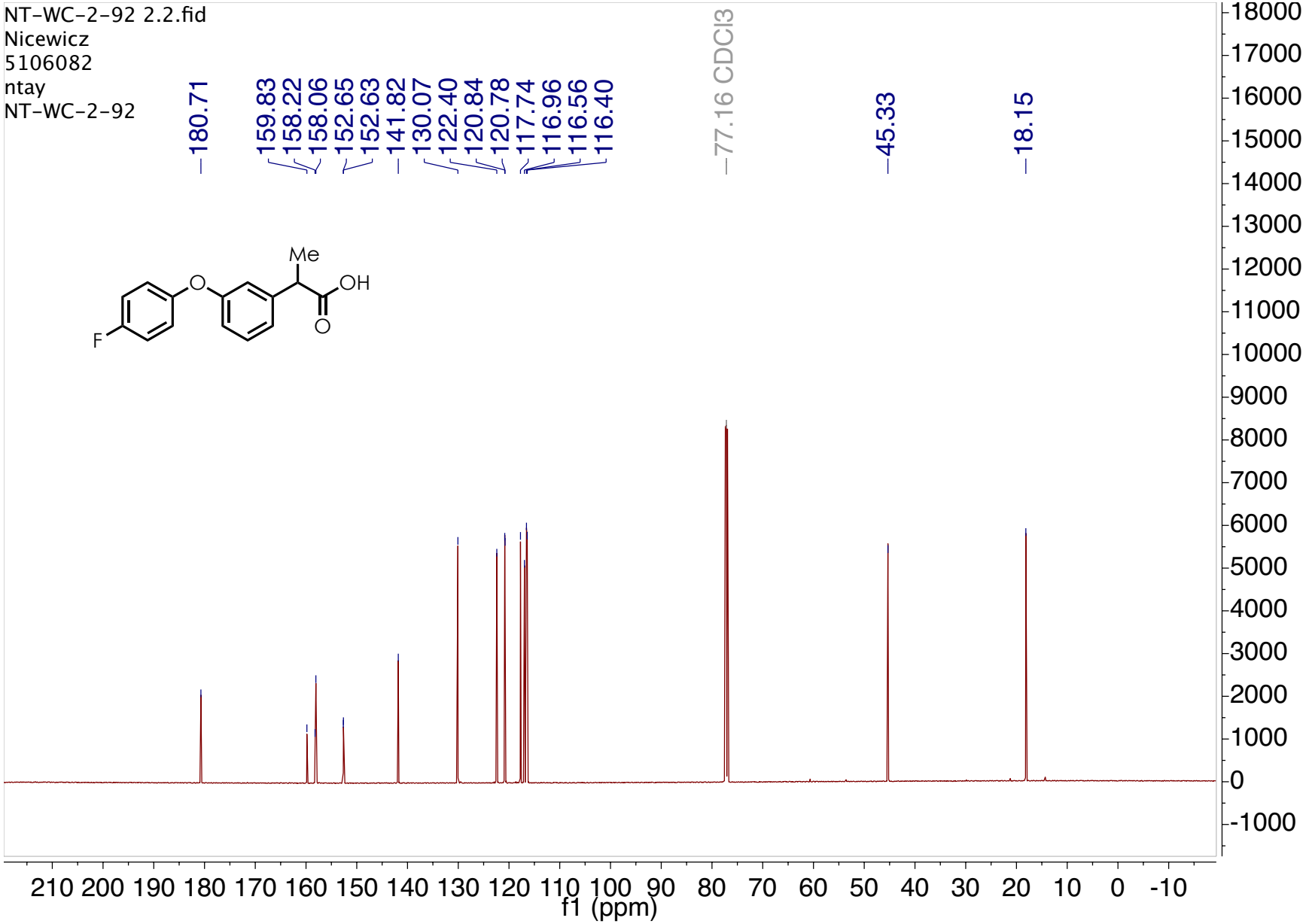

NT-07-56-19F.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 60
CO2Me
NHBoc
F
-116.05
-116.07
-116.09
-161.64 C6F6
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

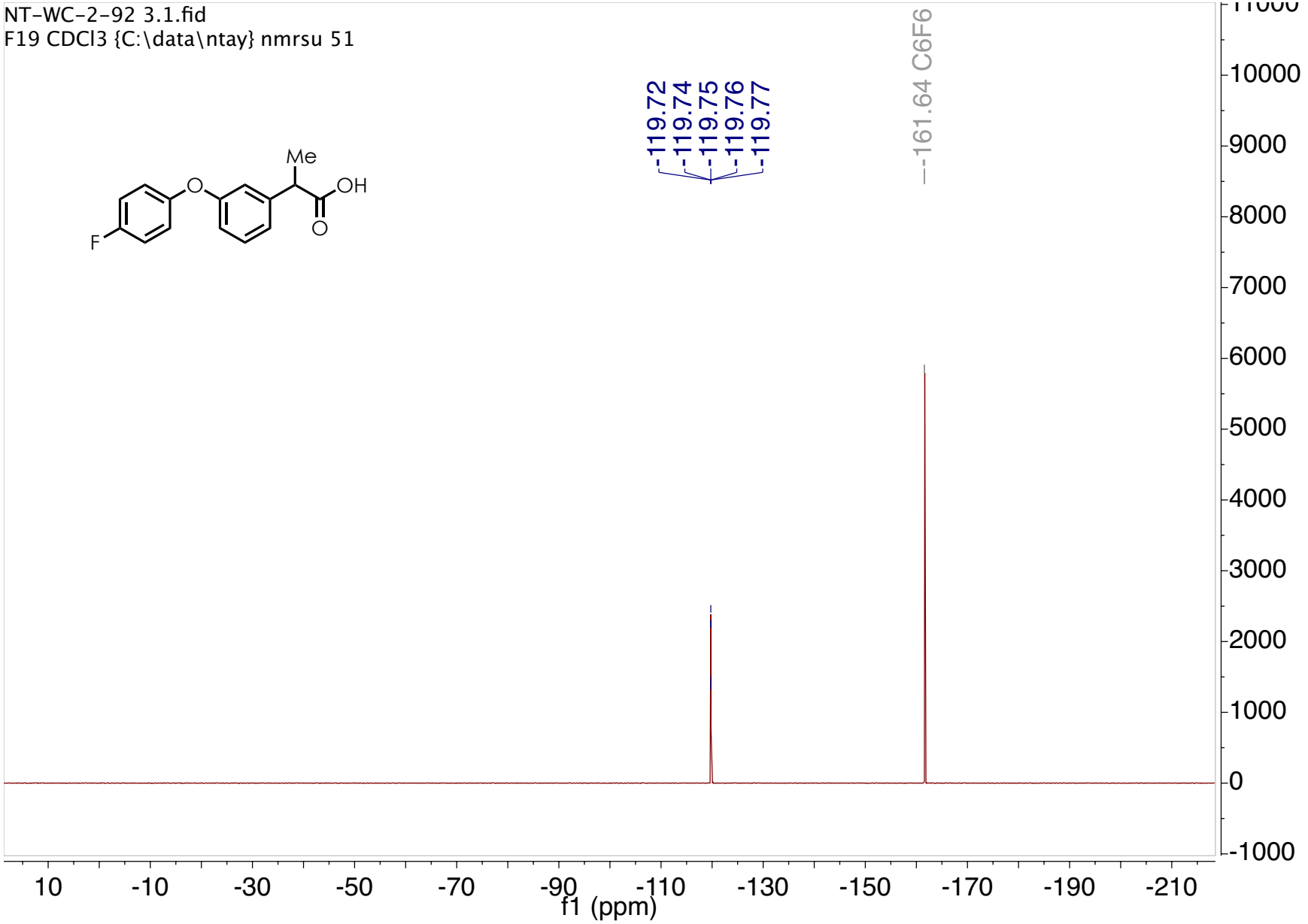

NT-07-59 1.1.fid
Nicewicz
5106082
ntay
NT-07-59
CDCl3
7.56 7.56 7.55 7.55 7.55 7.48 7.47 7.46 7.45 7.45 7.40 7.40 7.39 7.39 7.38 7.29 7.02 7.02 7.01 7.00 6.97 5.11 5.10 4.85 4.68 4.67 4.66 4.66 4.65 4.64 4.47 3.79 3.22 3.21 3.20 3.19 3.12 3.11 3.09 3.08 1.46
CO2Me
NHBoc
F
1.97 1.97 1.94 1.02 1.00 0.92 0.93 3.04 1.98 9.11
f1 (ppm)


NT-07-59 2.2.fid
Nicewicz
5106082
ntay
NT-07-59
172.19
160.47
158.83
155.16
137.70
137.65
135.59
130.86
130.83
129.05
129.03
128.56
127.79
127.76
127.71
125.45
125.43
117.18
117.02
80.23
77.16 CDCl3
54.33
52.53
37.91
28.40
CO2Me
NHBoc
F
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


NT-07-59-19F.1.fid
F19 CDCl3 {C:\data} nmrsu 2
CO2Me
NHBoc
F
-118.01
-118.03
-118.06
-161.64 C6F6
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)


NT-WC-2-92 1.1.fid
Nicewicz
5106082
ntay
NT-WC-2-92
7.29
7.28
7.26
7.26 CDCl3
7.06
7.05
7.04
7.03
7.02
7.00
6.99
6.99
6.99
6.98
6.97
6.85
6.85
6.84
6.83
Me
O
OH
O
F
0.64
1.26
3.30
3.05
1.00
1.10
3.29
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
f1 (ppm)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0


NT-WC-2-92 2.2.fid
Nicewicz
5106082
ntay
NT-WC-2-92
180.71
159.83
158.22
158.06
152.65
152.63
141.82
130.07
122.40
120.84
120.78
117.74
116.96
116.56
116.40
77.16 CDCl3
45.33
18.15
Me
OH
O
O
F
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


NT-WC-2-92 3.1.fid
F19 CDCl3 {C:\data\ntay} nmrsu 51
-119.72
-119.74
-119.75
-119.76
-119.77
-161.64 C6F6
Me
O
OH
O
F
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
f1 (ppm)

9. Movie Captions

Movie S1: *In vivo* composite PET/CT scans of a MCF-7 xenograft mouse model injected with radiotracer 39. PET radiotracer 39 is predominantly localized in the MCF-7 tumor, pancreas and bladder (cf. Figures 3 and S95).

Movie S2: *In vivo* composite PET/CT scans of a MCF-7 xenograft mouse model injected with radiotracer 41. PET radiotracer 41 is predominantly localized in the heart, liver and bladder, with minimal uptake in the MCF-7 tumor (cf. Figures 3 and S95).

Movie S3: *In vivo* composite PET/CT scans of a U-87 MG xenograft mouse model injected with radiotracer 39. PET radiotracer 39 is predominantly localized in the U-87 MG tumor, pancreas and bladder (cf. Figure S95).

10. References and Notes

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