Supporting Information

Enantioselective, Catalytic Fluorolactonization Reactions with a Nucleophilic Fluoride Source

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I. General methods

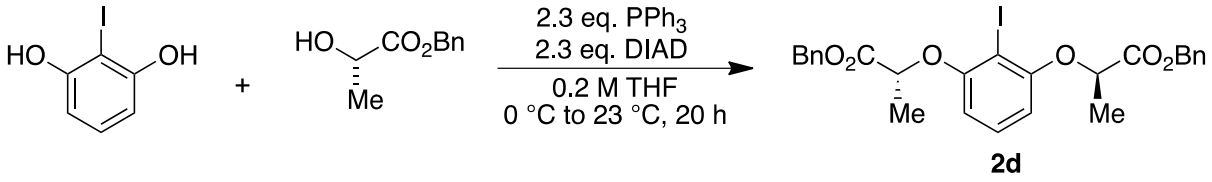
Materials. Commercial reagents were purchased from Sigma-Aldrich, VWR, Alfa Aesar, TCI America, Strem Chemicals Inc., or Frontier Scientific and were used without further purification unless otherwise noted. Solvents were purified via passage through packed columns as described by Pangborn and coworkers[1] (THF, Et_2O, CH_3CN, and CH_2Cl_2: dry neutral alumina; benzene and toluene: dry neutral alumina and Q5 reactant; DMF: activated molecular sieves). All water was deionized prior to use. Triethylamine and pyridine were freshly distilled under an atmosphere of nitrogen from CaH_2.

General Experimental Procedures. Unless noted, all reactions were performed in flame-dried round bottom or modified Schlenk flasks fitted with rubber septa under a positive pressure of argon or nitrogen. Organic solutions were concentrated via rotary evaporation under reduced pressure with a bath temperature of 35–40 °C. Reactions were monitored by analytical thin layer chromatography (TLC) performed using the indicated solvent. Compounds were visualized by exposure to a UV lamp (λ = 254 nm) and/or a solution of basic $KMnO_4$ followed by brief heating using a Varitemp heat gun. Column chromatography was performed using standard methods[2] or on a Teledyne-Isco CombiFlash Rf purification system using EM Science silica gel 60Å (230-400 mesh). For loading, compounds were adsorbed onto non acid-washed Celite under reduced pressure from an acetone solution. Specifically, for a 1 g mixture of crude material the sample is dissolved in reagent grade acetone (25 to 50 mL) and to the flask is added Celite 454 Filter Aid

(5 to 15 g). The mixture is then concentrated under reduced pressure to afford a powder, which is then loaded on top of a silica gel column. The procedure is typically repeated with a small amount of acetone (5 mL) and Celite (2 g) to ensure quantitative transfer. Cryocools are commercially available circulating cooling baths.

Structural analysis. ^{1}H, ^{13}C, and ^{19}F NMR spectra were recorded at 23 °C on a Inova-500 (500 MHz). Chemical shifts (δ) are reported in parts per million (ppm) downfield from tetramethylsilane and referenced to residual protium in the NMR solvent ($CHCl_3$, δ = 7.26) or to added tetramethylsilane (δ = 0.00). Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, quint = quintet, sext = sextet, sept = septet, m = multiplet, b = broad, app = apparent), coupling constant (*J*) in Hertz (Hz), and integration. ^{13}C NMR shifts (δ) are reported in ppm downfield from tetramethylsilane and referenced to carbon resonances in the NMR solvent ($CDCl_3$, δ = 77.0) or to added tetramethylsilane (δ = 0.00). Carbons bearing boron substituents were not observed (quadrupolar relaxation). High resolution mass spectra (HRMS) were performed by Jennifer Wang at the Harvard University Mass Spectrometry Laboratory. Infrared spectra were collected from a thin film on a Bruker Optics Tensor 27 FTIR spectrometer. Absorption maxima (ν_{max}) are reported in wavenumbers (cm^{-1}). High-performance liquid chromatography (HPLC) analysis was performed using an Agilent 1200 series quaternary HPLC system with commercially available ChiralPak and ChiralCel columns. X-ray crystallographic analyses were carried out by Dr. Shao-Liang Zheng at the Harvard University X-Ray facility.

II. Synthesis of catalyst 2d



Aryl iodide 2d. To a 250 mL round bottom flask charged with a stir bar was added 2-iodoresorcinol[3] (4.0 g, 17.0 mmol, 1.0 eq.), benzyl (*S*)-(−)-lactate (6.4 g, 35.7 mmol, 2.1 eq.), and triphenylphosphine (10.3 g, 39.0 mmol, 2.3 eq.). A septum was affixed and the flask was flushed with N_2. THF (85 mL) was then added. The solution was cooled to 0 °C . Diisopropyl azodicarboxylate (DIAD, 7.7 mL, 39.0 mmol, 2.3 eq.) was added dropwise. The solution was warmed to 23 °C and stirred at this temperature for 20 h. After this time, basic alumina (8.0 g) was added to the reaction solution. The suspension was stirred at 23 °C for 10 min. The suspension was filtered and the filtrate was concentrated under reduced pressure. The resulting residue was dry loaded onto celite and purified by column chromatography through a plug of basic alumina followed directly by a column of silica gel (hexanes:Et_2O 100:0 → 80:20) to afford aryl iodide **2d** as a clear, colorless oil (8.6 g, 90% yield).

TLC (hexanes:EtOAc 6:1)
R_f = 0.28, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 7.37-7.29 (m, 10H), 7.03 (t, *J* = 8.5 Hz, 1H), 6.34 (d, *J* = 8.5 Hz, 2H), 5.21 (app dd, *J* = 15.5, 12.5 Hz, 4H), 4.82 (q, *J* = 6.5 Hz, 2H), 1.73 (d, *J* = 6.5 Hz, 6H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 171.4, 158.2, 135.3, 129.5, 128.5, 128.4, 128.2, 107.0, 80.7, 74.2, 66.9, 18.6.

HRMS (method)

Calculated for $C_{26}H_{25}IO_6$ $(M+H)^+$: 561.0769
Found: 561.0782

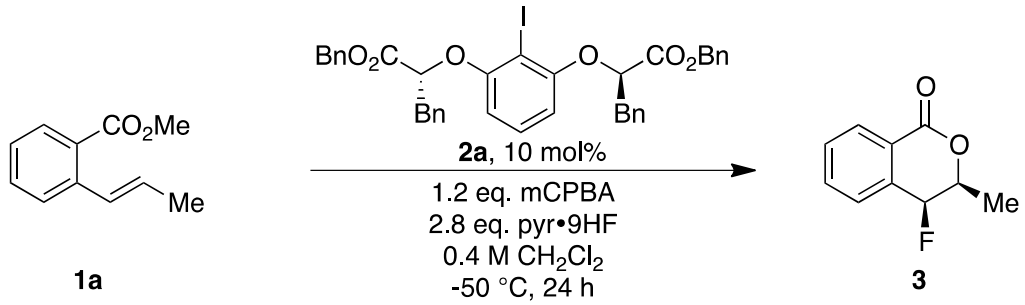
IR (thin film, cm^{-1})

3033, 2989, 2941, 1752, 1587, 1459, 1251, 1131, 1104, 749, 698

$[\alpha]_D^{23}$ -32.4 (*c* = 1.0, $CHCl_3$)

III. Table 1. Optimization of reaction conditions.

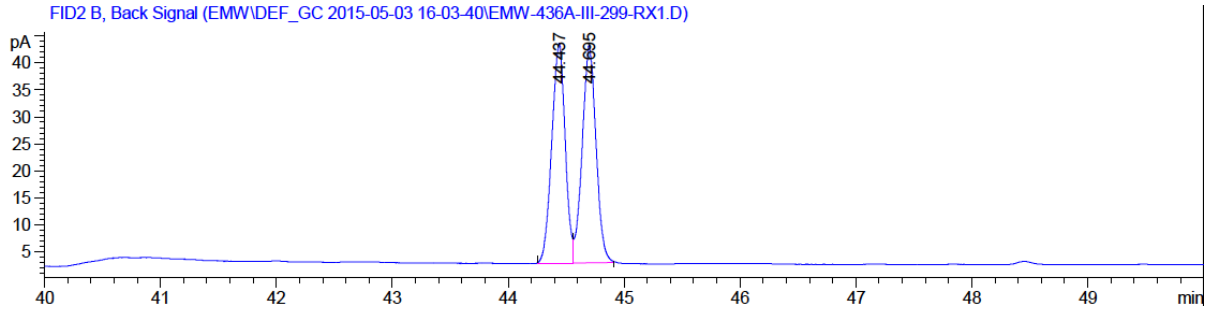
Entry 1:



To a 1.5 mL polyethylene Eppendorf tube charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 26.9 mg, 0.12 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C. To the cooled vial was added aryl iodide catalyst **2a** (7.1 mg, 0.01 mmol, 10 mol%) as a solution in CH_2Cl_2 (0.15 mL) followed by pyr•9HF (70% HF, 0.065 mL, 2.5 mmol HF, 25 eq. HF). The alkene methyl (*E*)-2-(prop-1-en-1-yl)benzoate **1a** (17.6 mg, 0.10 mmol) was added as a solution in CH_2Cl_2 (0.10 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C continuous cooling bath with vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (0.5 g) in CH_2Cl_2 (2.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The crude reaction solution was analyzed by chiral GC.

87% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C, 10 psi); t_R(major) = 44.4 min, t_R(minor) = 44.7 min. 72% GC yield based on a dodecane internal standard.

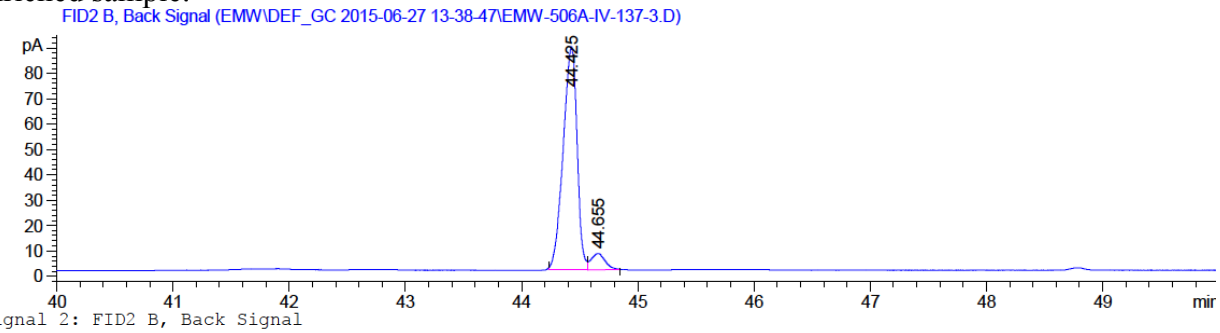
Racemic sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	44.437	BV	0.1274	327.01135	40.66198	49.53568
2	44.695	VB	0.1260	333.14175	40.31749	50.46432
Totals :				660.15311	80.97947	

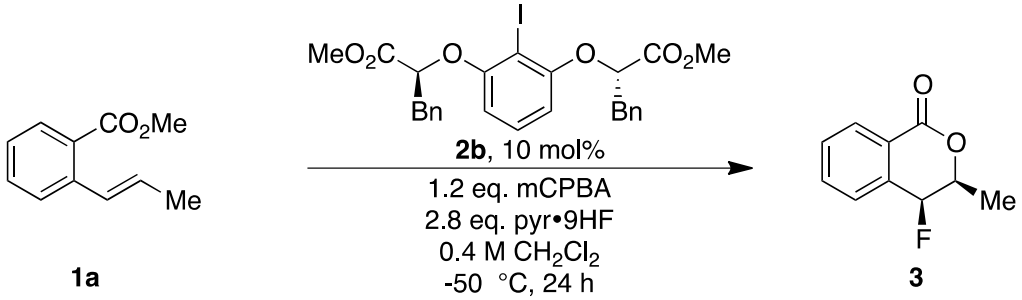
Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	44.425	BV	0.1293	733.40411	87.96513	93.32119
2	44.655	VB	0.1158	52.48823	6.34228	6.67881
Totals :				785.89234	94.30741	

Entry 2:

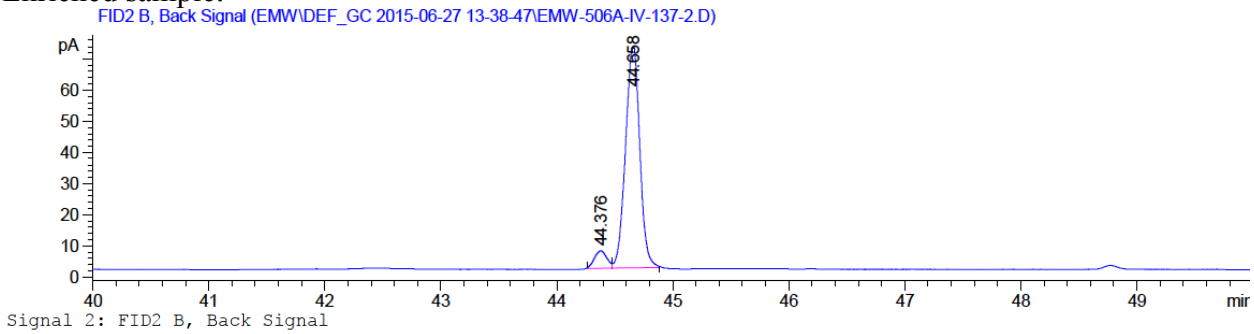


To a 1.5 mL polyethylene Eppendorf tube charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 26.9 mg, 0.12 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C. To the cooled vial was added aryl iodide catalyst **2b** (5.6 mg, 0.01 mmol, 10

mol%) as a solution in CH_2Cl_2 (0.15 mL) followed by pyr•9HF (70% HF, 0.065 mL, 2.5 mmol HF, 25 eq. HF). The alkene methyl (*E*)-2-(prop-1-en-1-yl)benzoate **1a** (17.6 mg, 0.10 mmol) was added as a solution in CH_2Cl_2 (0.10 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C cryocool with vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (0.5 g) in CH_2Cl_2 (2.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The crude reaction solution was analyzed by chiral GC.

-87% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C, 10 psi); t_R(minor) = 44.4 min, t_R(major) = 44.7 min. 50% GC yield based on a dodecane internal standard.

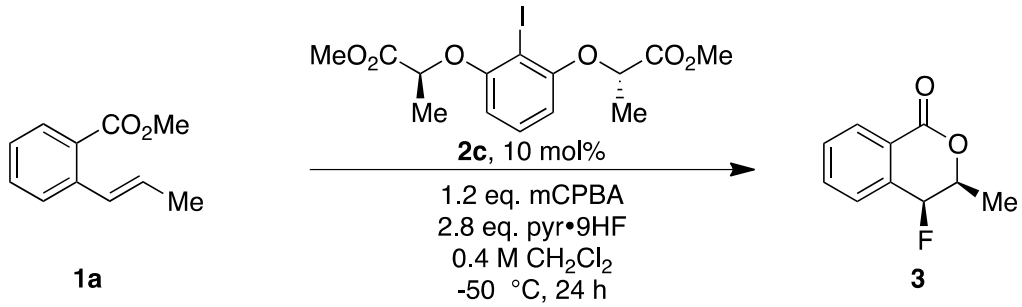
Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	44.376	BV	0.1178	42.70428	5.64929	6.53469
2	44.658	VB	0.1314	610.79736	71.09394	93.46531
Totals :				653.50164	76.74323	

Entry 3:

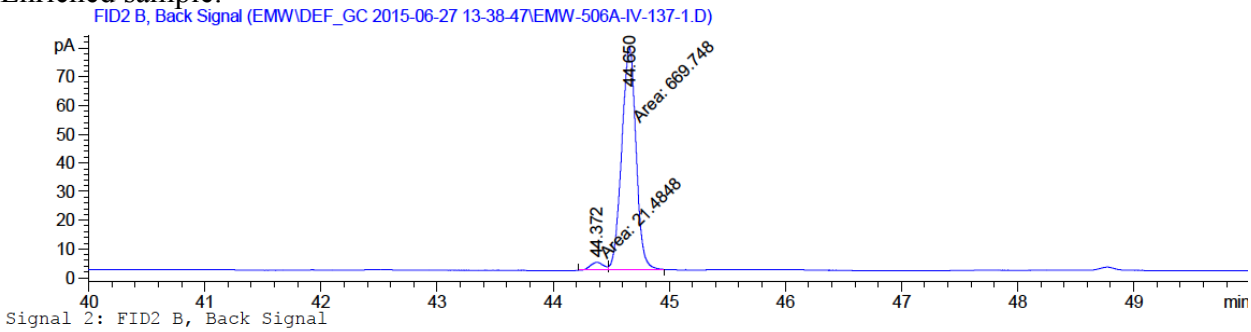


To a 1.5 mL polyethylene Eppendorf tube charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 26.9 mg, 0.12 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C . To the cooled vial was added aryl iodide catalyst **2c** (4.1 mg, 0.01 mmol, 10 mol%) as a solution in CH_2Cl_2 (0.15 mL) followed by pyr•9HF (70% HF, 0.065 mL, 2.5 mmol HF, 25 eq. HF). The alkene methyl (*E*)-2-(prop-1-en-1-yl)benzoate **1a** (17.6 mg, 0.10 mmol) was added as a solution in CH_2Cl_2 (0.10 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C cryocool with vigorous stirring (vigorous stirring of the heterogeneous

mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (0.5 g) in CH_2Cl_2 (2.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The crude reaction solution was analyzed by chiral GC.

-94% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(minor) = 44.4 min, t_R(major) = 44.7 min. 68% GC yield based on a dodecane internal standard.

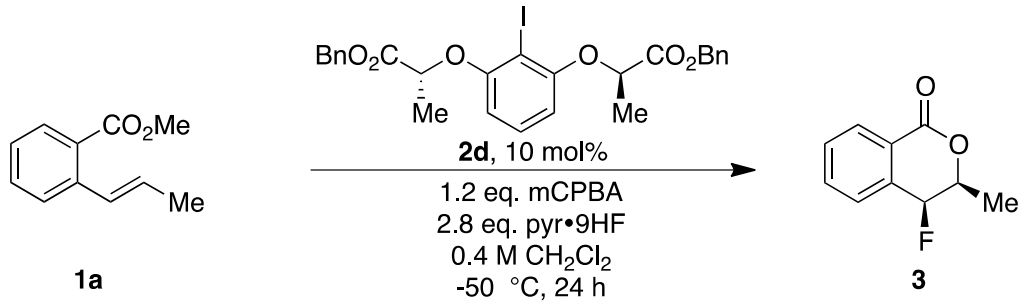
Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	44.372	MM	0.1305	21.48479	2.74408	3.10818
2	44.650	MM	0.1433	669.74823	77.90833	96.89182
Totals :				691.23302	80.65242	

Entry 4:

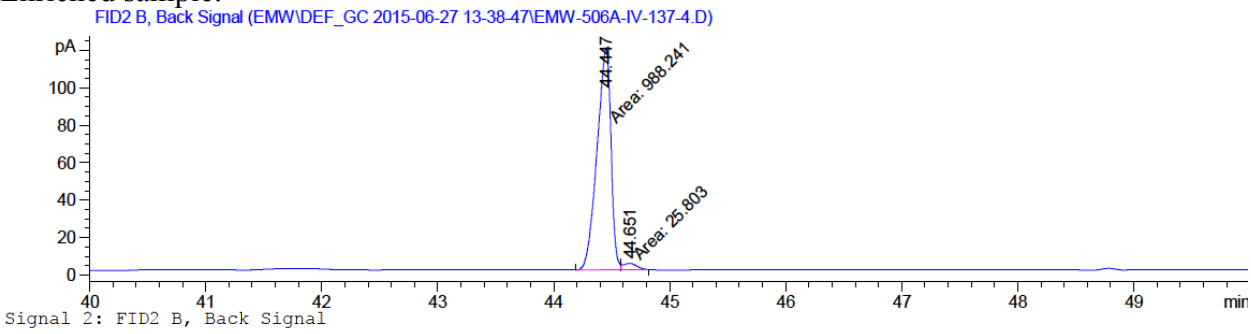


0.1 mmol reaction:
To a 1.5 mL polyethylene Eppendorf tube charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 26.9 mg, 0.12 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C . To the cooled vial was added aryl iodide catalyst **2d** (5.6 mg, 0.01 mmol, 10 mol%) as a solution in CH_2Cl_2 (0.15 mL) followed by pyr•9HF (70% HF, 0.065 mL, 2.5 mmol HF, 25 eq. HF). The alkene methyl (*E*)-2-(prop-1-en-1-yl)benzoate **1a** (17.6 mg, 0.10 mmol) was added as a solution in CH_2Cl_2 (0.10 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C cryocool with vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the

crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (0.5 g) in CH_2Cl_2 (2.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The crude reaction solution was analyzed by chiral GC.

95% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 44.4 min, t_R(minor) = 44.7 min. 86% GC yield based on a dodecane internal standard.

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	44.447	MM	0.1388	988.24091	118.64691	97.45543
2	44.651	MM	0.1300	25.80305	3.30698	2.54457
Totals :				1014.04395	121.95389	

1.0 mmol reaction:

To a 7 mL low-density polyethylene vial with snap cap charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 269 mg, 1.2 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C . To the cooled vial was added aryl iodide catalyst **2d** (56.0 mg, 0.10 mmol, 10 mol%) as a solution in CH_2Cl_2 (1.5 mL) followed by pyr•9HF (70% HF, 0.65 mL, 25 mmol HF, 25 eq. HF). The alkene (*E*)-2-(prop-1-en-1-yl)benzoate **1a** (1.0 mmol) was added as a solution in CH_2Cl_2 (1.0 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C cryocool with vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (2.5 g) in CH_2Cl_2 (5.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The solution was concentrated under reduced pressure. The resulting residue was dry loaded onto celite and purified by column chromatography on silica gel (hexanes:EtOAc 100:0 → 80:20) to afford fluorolactone **3** as a white solid (122 mg, 68% yield).

TLC (hexanes:EtOAc 4:1)

R_f = 0.14, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.19 (d, *J* = 7.5 Hz, 1H), 7.69 (tt, *J* = 7.5, 1.5 Hz, 1H), 7.62 (tdd, *J* = 7.5, 2.0, 1.5 Hz, 1H), 7.52 (m, 1H), 5.32 (dd, *J* = 49.5, 1.5 Hz, 1H), 4.72 (dqd, *J* = 27.3, 6.8, 1.5 Hz, 1H), 1.64 (d, *J* = 6.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 163.8, 134.6 (d, *J* = 17.5 Hz), 134.3 (d, *J* = 3.0 Hz), 131.3 (d, *J* = 3.5 Hz), 130.4 (d, *J* = 3.0 Hz), 128.8 (d, *J* = 3.5 Hz), 124.7 (d, *J* = 2.5 Hz), 85.3 (d, *J* = 181.0 Hz), 75.7 (d, *J* = 22.5 Hz), 16.1 (d, *J* = 5.0 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -183.0 (dd, *J* = 49.5, 28.0 Hz).

HRMS (ESI+)

Calculated for $C_{10}H_9FO_2$ $(M+H)^+$: 181.0659
Found: 181.0660

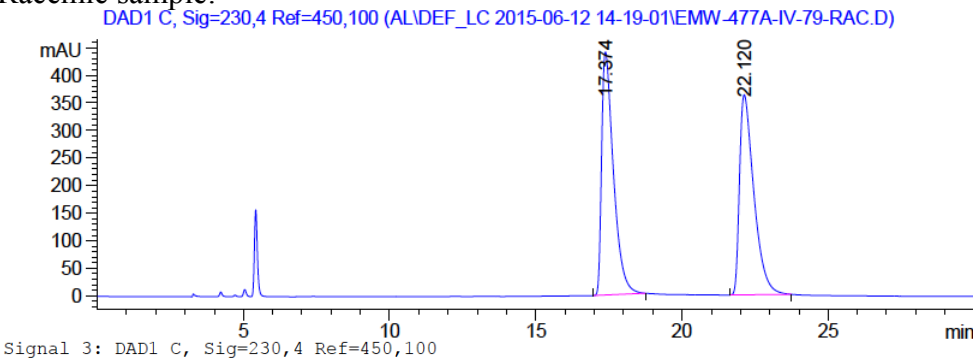
IR (thin film, cm^{-1})

2990, 2943, 1730, 1274, 1239, 1124, 1103, 901, 765, 723, 700, 649

$[\alpha]_D^{23}$ +78.8 (*c* 1.0, $CHCl_3$)

95% *ee*, Chiral HPLC (CHIRALPAK OD-H, 5% isopropanol in hexanes, 1.0 mL/min, λ = 230 nm); t_R(major) = 17.4 min, t_R(minor) = 22.4 min.

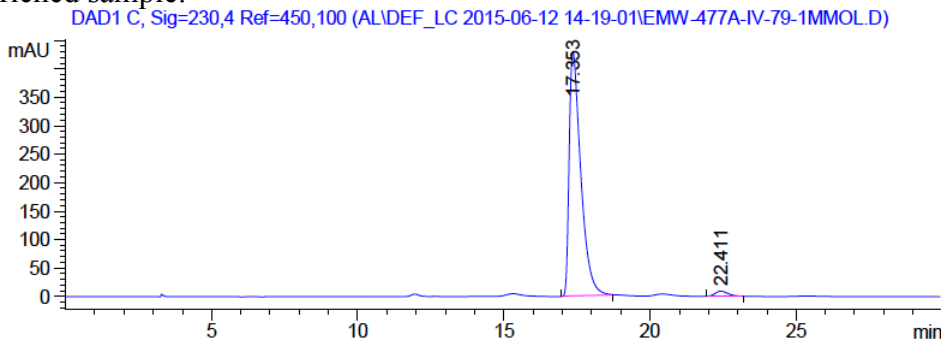
Racemic sample:



Signal 3: DAD1 C, Sig=230,4 Ref=450,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.374	BB	0.4220	1.23833e4	440.47375	49.9442
2	22.120	BB	0.5113	1.24110e4	362.61212	50.0558
Totals :				2.47943e4	803.08588	

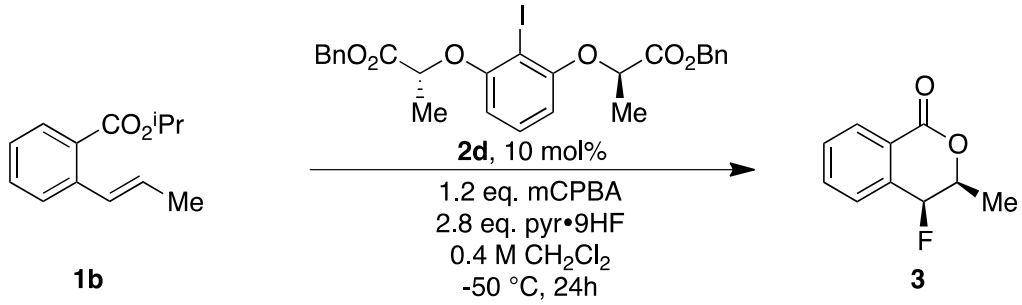
Enriched sample:



Signal 3: DAD1 C, Sig=230,4 Ref=450,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.353	BB	0.4142	1.18424e4	428.77740	97.7392
2	22.411	BB	0.4571	273.92612	8.99970	2.2608
Totals :				1.21164e4	437.77710	

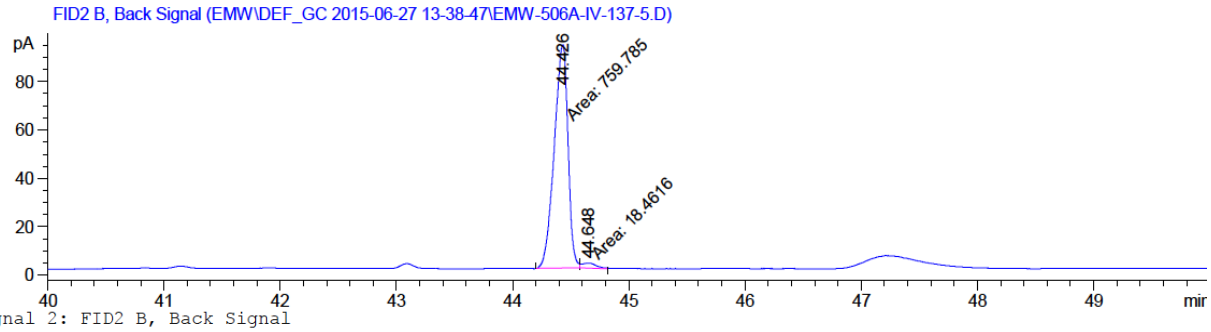
Entry 5:



To a 1.5 mL polyethylene Eppendorf tube charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 26.9 mg, 0.12 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C . To the cooled vial was added aryl iodide catalyst **2d** (5.6 mg, 0.01 mmol, 10 mol%) as a solution in CH_2Cl_2 (0.15 mL) followed by pyr•9HF (70% HF, 0.065 mL, 2.5 mmol HF, 25 eq. HF). The alkene isopropyl (*E*)-2-(prop-1-en-1-yl)benzoate **1b** (20.4 mg, 0.10 mmol) was added as a solution in CH_2Cl_2 (0.10 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C cryocool with vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (0.5 g) in CH_2Cl_2 (2.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The crude reaction solution was analyzed by chiral GC.

95% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 44.4 min, t_R(minor) = 44.6 min. 72% GC yield based on a dodecane internal standard.

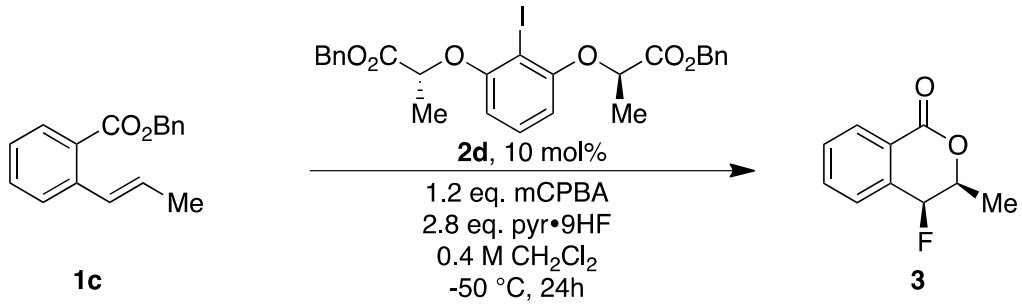
Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	44.426	MM	0.1370	759.78546	92.39988	97.62780
2	44.648	MM	0.1442	18.46158	2.13353	2.37220
Totals :				778.24704	94.53341	

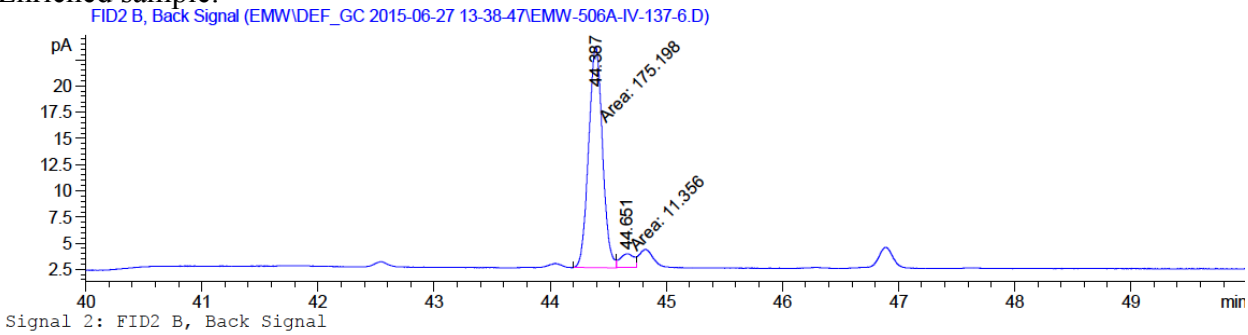
Entry 6:



To a 1.5 mL polyethylene Eppendorf tube charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 26.9 mg, 0.12 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C . To the cooled vial was added aryl iodide catalyst **2d** (5.6 mg, 0.01 mmol, 10 mol%) as a solution in CH_2Cl_2 (0.15 mL) followed by pyr•9HF (70% HF, 0.065 mL, 2.5 mmol HF, 25 eq. HF). The alkene benzyl (*E*)-2-(prop-1-en-1-yl)benzoate **1c** (25.2 mg, 0.10 mmol) was added as a solution in CH_2Cl_2 (0.10 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C cryocool with vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (0.5 g) in CH_2Cl_2 (2.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The crude reaction solution was analyzed by chiral GC.

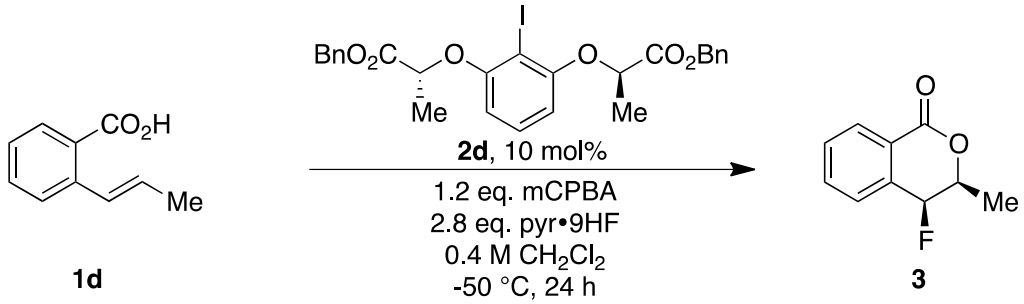
87% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 44.4 min, t_R(minor) = 44.7 min. 42% GC yield based on a dodecane internal standard.

Enriched sample:



Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	44.387	MM	0.1384	175.19818	21.09846	93.91276
2	44.651	MM	0.1402	11.35600	1.35027	6.08724
Totals :				186.55418	22.44873	

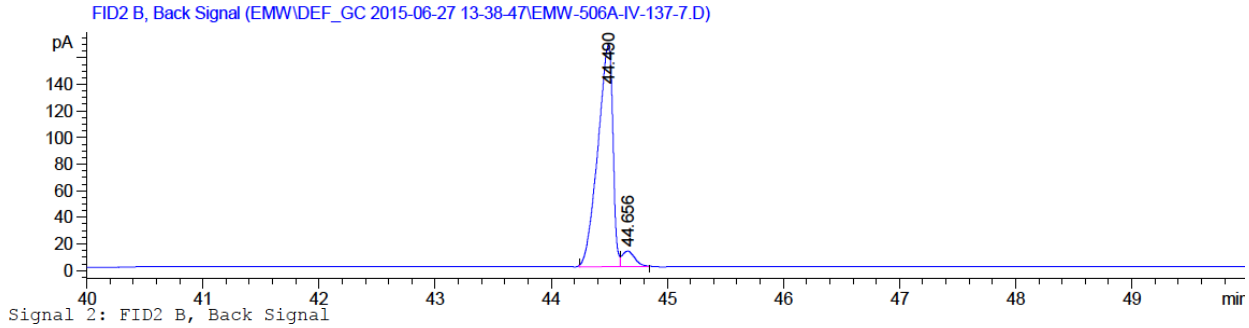
Entry 7:



To a 1.5 mL polyethylene Eppendorf tube charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 26.9 mg, 0.12 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C . To the cooled vial was added aryl iodide catalyst **2d** (5.6 mg, 0.01 mmol, 10 mol%) as a solution in CH_2Cl_2 (0.15 mL) followed by pyr•9HF (70% HF, 0.065 mL, 2.5 mmol HF, 25 eq. HF). The alkene (*E*)-2-(prop-1-en-1-yl)benzoic acid **1d** (16.2 mg, 0.10 mmol) was added as a solution in CH_2Cl_2 (0.10 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C cryocool with vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (0.5 g) in CH_2Cl_2 (2.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The crude reaction solution was analyzed by chiral GC.

89% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 44.5 min, t_R(minor) = 44.7 min. 95% GC yield based on a dodecane internal standard.

Enriched sample:

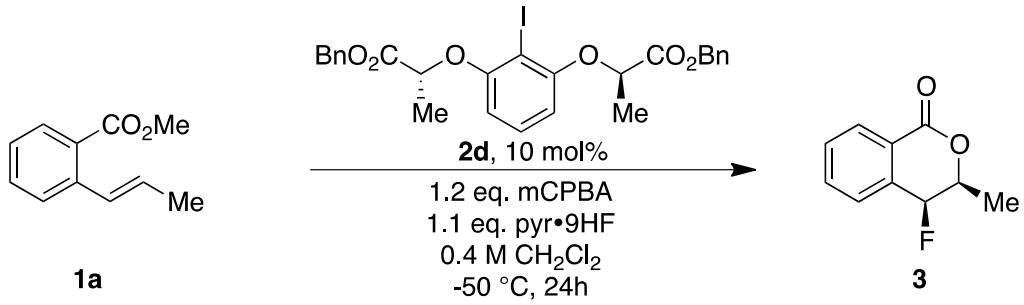


Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	44.490	BV	0.1263	1501.66370	167.30615	94.55768
2	44.656	VB	0.1158	86.42915	11.58797	5.44232
Totals :				1588.09285	178.89412	

See page SI-77 for a 1 mmol scale reaction with isolated yield.

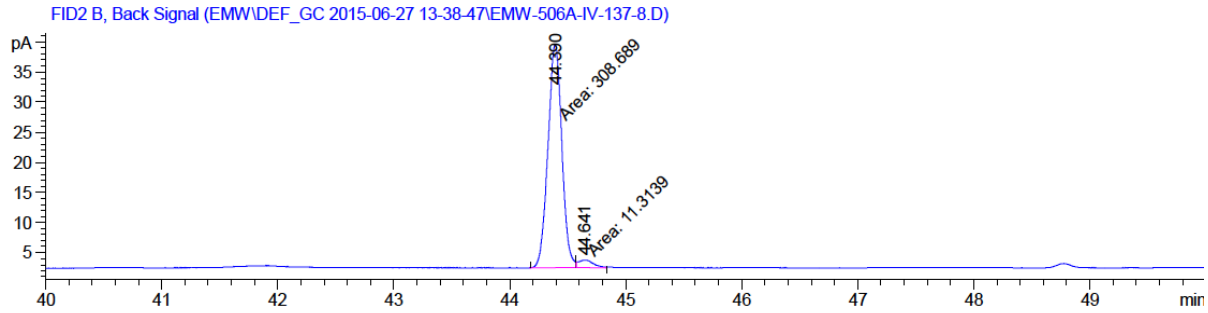
Footnote 15:



To a 1.5 mL polyethylene Eppendorf tube charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 26.9 mg, 0.12 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C . To the cooled vial was added aryl iodide catalyst **2d** (5.6 mg, 0.01 mmol, 10 mol%) as a solution in CH_2Cl_2 (0.15 mL) followed by pyr•9HF (70% HF, 0.026 mL, 1.0 mmol HF, 10 eq. HF). The alkene methyl (*E*)-2-(prop-1-en-1-yl)benzoate **1a** (17.6 mg, 0.10 mmol) was added as a solution in CH_2Cl_2 (0.10 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C cryocool with vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (0.5 g) in CH_2Cl_2 (2.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The crude reaction solution was analyzed by chiral GC.

93% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 44.4 min, t_R(minor) = 44.7 min. 28% GC yield based on a dodecane internal standard.

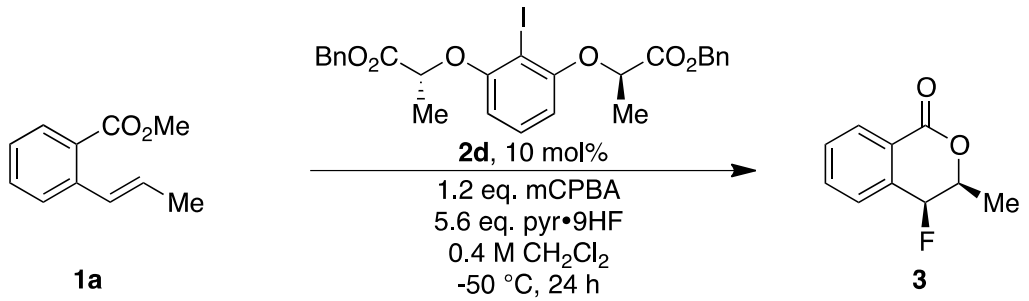
Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	44.390	MM	0.1389	308.68942	37.04516	96.46444
2	44.641	MM	0.1525	11.31391	1.23614	3.53556
Totals :				320.00333	38.28130	

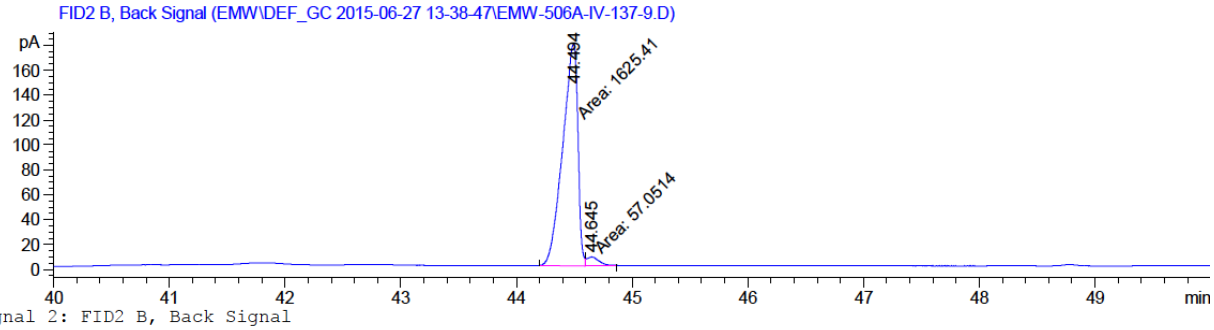
Footnote 15:



To a 1.5 mL polyethylene Eppendorf tube charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 26.9 mg, 0.12 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C . To the cooled vial was added aryl iodide catalyst **2d** (5.6 mg, 0.01 mmol, 10 mol%) as a solution in CH_2Cl_2 (0.15 mL) followed by pyr•9HF (70% HF, 0.13 mL, 5.0 mmol HF, 50 eq. HF). The alkene methyl (*E*)-2-(prop-1-en-1-yl)benzoate **1a** (17.6 mg, 0.10 mmol) was added as a solution in CH_2Cl_2 (0.10 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C cryocool with vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (0.5 g) in CH_2Cl_2 (2.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The crude reaction solution was analyzed by chiral GC.

93% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 44.4 min, t_R(minor) = 44.7 min. 83% GC yield based on a dodecane internal standard.

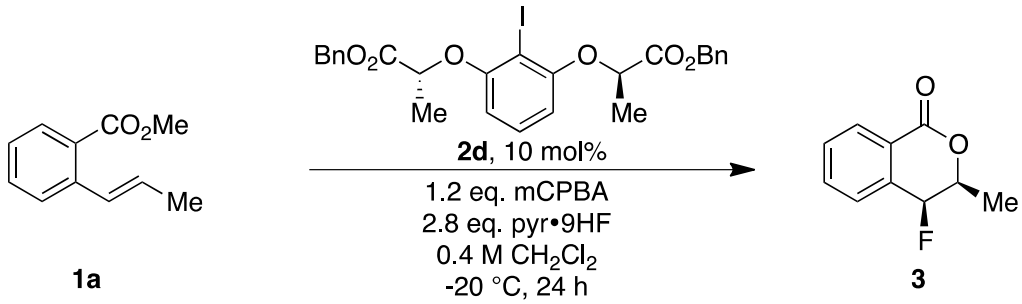
Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	44.494	MM	0.1516	1625.41211	178.68935	96.60906
2	44.645	MM	0.1325	57.05140	7.17632	3.39094
Totals :				1682.46350	185.86566	

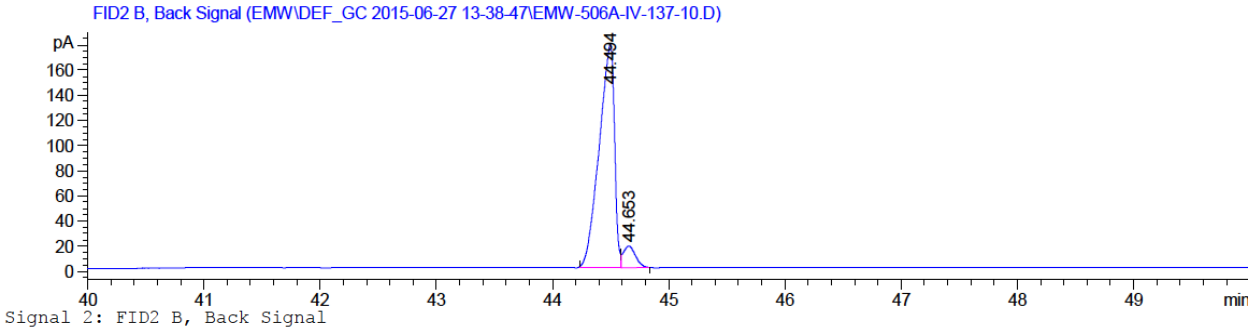
Footnote 15:



To a 1.5 mL polyethylene Eppendorf tube charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 26.9 mg, 0.12 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C . To the cooled vial was added aryl iodide catalyst **2d** (5.6 mg, 0.01 mmol, 10 mol%) as a solution in CH_2Cl_2 (0.15 mL) followed by pyr•9HF (70% HF, 0.065 mL, 2.5 mmol HF, 25 eq. HF). The alkene methyl (*E*)-2-(prop-1-en-1-yl)benzoate **1a** (17.6 mg, 0.10 mmol) was added as a solution in CH_2Cl_2 (0.10 mL, 0.40 M total concentration). The tube was capped and transferred to a -20 °C cryocool with vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -20 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (0.5 g) in CH_2Cl_2 (2.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The crude reaction solution was analyzed by chiral GC.

86% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 44.4 min, t_R(minor) = 44.7 min. 71% GC yield based on a dodecane internal standard.

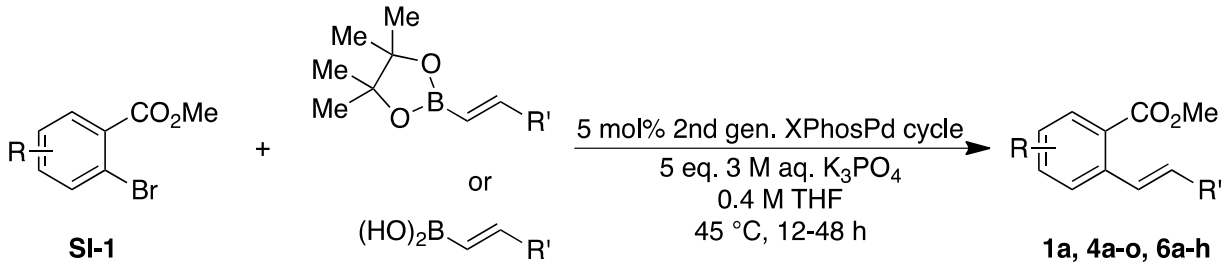
Enriched sample:



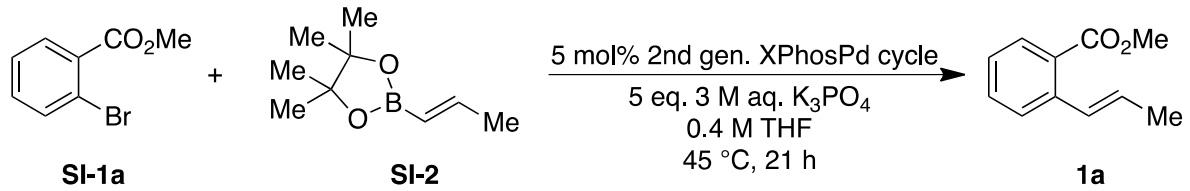
Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	44.494	BV	0.1265	1635.05701	177.76164	92.94569
2	44.653	VB	0.1111	124.09617	17.26008	7.05431
Totals :				1759.15318	195.02173	

IV. Preparation of substrates.

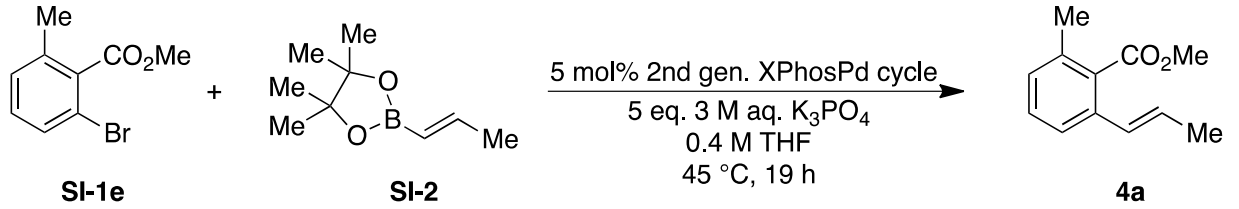


General procedure for the synthesis of substrates 1a, 4a-o, 6a-h.
To a 20 mL glass vial charged with a stir bar, aryl bromide (1 eq.), and pinacol ester or boronic acid (1.1 eq.) was added 2nd generation XPhosPd cycle (5 mol%). The vial was capped with a septum cap and flushed with N_2. THF (0.4 M) and 3 M aqueous K_3PO_4 (5 eq.) were added in order. The solution was stirred at 45 °C for 12-48 h. After this time, the solution was cooled to 23 °C and poured into a separatory funnel. The solution was diluted with brine and Et_2O. After shaking, the layers were separated, and the organic layer was dried over Na_2SO_4, filtered, and concentrated under reduced pressure. The resulting residue was dry loaded onto celite and purified by column chromatography on silica gel (hexanes:EtOAc 100:0 → 90:10) to afford the alkene.



Methyl (*E*)-2-(prop-1-en-1-yl)benzoate 1a. Following the "general procedure for the synthesis of substrate 1a", methyl 2-bromobenzoate **SI-1a** (1.16 g, 5.4 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (1.0 g, 6.0 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (213 mg, 0.27 mmol, 5 mol%) were reacted in THF (13.5 mL, 0.4 M) and 3 M aqueous

K_3PO_4 (9.0 mL, 5 eq.) at 45 °C for 21 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **1a** was isolated as a pale yellow oil (434 mg, 46% yield). Characterization of this compound was consistent with previously reported data.[4]



SI-1e **SI-2** **4a**

methyl (*E*)-2-methyl-6-(prop-1-en-1-yl)benzoate 4a. Following the "general procedure for the synthesis of substrates 4a-o", methyl 2-bromo-6-methylbenzoate **SI-1e** (573 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (462 mg, 2.8 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 19 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4a** was isolated as a pale yellow oil (474 mg, 99% yield).

TLC (hexanes:EtOAc 9:1)

R_f = 0.49, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 7.35 (d, *J* = 7.5 Hz, 1H), 7.25 (t, *J* = 7.0 Hz, 1H), 7.07 (d, *J* = 7.5 Hz, 1H), 6.41 (d, *J* = 16.0 Hz, 1H), 6.21 (dq, *J* = 16.0, 7.0 Hz, 1H), 3.94 (s, 3H), 2.32 (s, 3H), 1.89 (d, *J* = 7.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

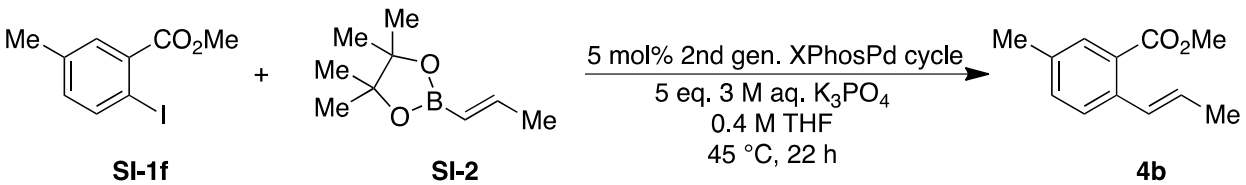
δ 170.4, 135.4, 134.8, 132.2, 129.3, 128.7, 128.4, 127.9, 123.0, 52.0, 19.6, 18.8.

HRMS (ESI+)

Calculated for $C_{12}H_{14}O_2$ $(M+H)^+$:	191.1067
Found:	191.1072

IR (thin film, cm^{-1})

3028, 2950, 1724, 1435, 1265, 1233, 1114, 1069, 958, 767



SI-1f **SI-2** **4b**

methyl (*E*)-5-methyl-2-(prop-1-en-1-yl)benzoate 4b. Following the "general procedure for the synthesis of substrates 4a-o", methyl 2-iodo-5-methylbenzoate **SI-1f** (690 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (462 mg, 2.8 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 22 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4b** was isolated as a pale yellow oil (475 mg, 99% yield).

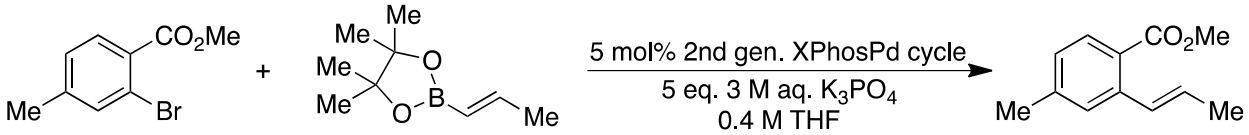
TLC (hexanes:EtOAc 9:1)
R_f = 0.49, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)
δ 7.66 (s, 1H), 7.44 (d, *J* = 8.5 Hz, 1H), 7.25 (d, *J* = 7.5 Hz, 1H), 7.13 (app d, *J* = 16.0 Hz, 1H), 6.13 (dq, *J* = 15.5, 6.5 Hz, 1H), 3.91 (s, 3H), 2.36 (s, 3H), 1.93 (dd, *J* = 6.5, 1.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)
δ 168.2, 136.8, 136.2, 132.8, 130.6, 129.4, 127.9, 127.7, 127.1, 52.0, 20.9, 18.8.

HRMS (ESI+)
Calculated for $C_{12}H_{14}O_2$ $(M+H)^+$: 191.1067
Found: 191.1075

IR (thin film, cm^{-1})
2950, 2915, 2853, 1719, 1433, 1290, 1249, 1198, 1143, 1097, 1074, 965, 838, 776



SI-1g **SI-2** **4c**

methyl (*E*)-4-methyl-2-(prop-1-en-1-yl)benzoate 4c. Following the "general procedure for the synthesis of substrates 4a-o", methyl 2-bromo-4-methylbenzoate **SI-1g** (573 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (462 mg, 2.8 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 22 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4c** was isolated as a pale yellow oil (475 mg, 99% yield).

TLC (hexanes:EtOAc 9:1)
R_f = 0.49, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)
δ 7.78 (d, *J* = 7.5 Hz, 1H), 7.34 (s, 1H), 7.20 (dq, *J* = 16.0, 1.5 Hz, 1H), 7.07 (d, *J* = 8.0 Hz, 1H), 6.15 (dq, *J* = 16.0, 7.0 Hz, 1H), 3.89 (s, 3H), 2.39 (s, 3H), 1.94 (dd, *J* = 6.5, 1.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

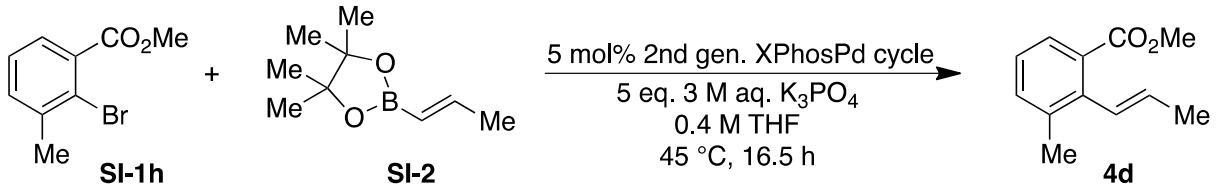
δ 168.0, 142.4, 139.9, 130.5, 129.9, 128.3, 127.9, 127.3, 125.1, 51.8, 21.5, 18.8.

HRMS (ESI+)

Calculated for $C_{12}H_{14}O_2$ $(M+H)^+$:	191.1067
Found:	191.1074

IR (thin film, cm^{-1})

2950, 2913, 2852, 1716, 1607, 1433, 1284, 1243, 1189, 1138, 1098, 1076, 961, 816, 767



methyl (*E*)-3-methyl-2-(prop-1-en-1-yl)benzoate 4d. Following the "general procedure for the synthesis of substrates 4a-o", methyl 2-bromo-3-methylbenzoate **SI-1h** (573 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (462 mg, 2.8 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 16.5 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4d** was isolated as a pale yellow solid (443 mg, 93% yield).

TLC (hexanes:EtOAc 6:1)

R_f = 0.46, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 7.52 (d, *J* = 8.0 Hz, 1H), 7.30 (d, *J* = 7.5 Hz, 1H), 7.17 (t, *J* = 7.5 Hz, 1H), 6.63 (d, *J* = 16.0 Hz, 1H), 5.64 (dq, *J* = 16.0, 6.5 Hz, 1H), 3.85 (s, 3H), 2.34 (s, 3H), 1.90 (dd, *J* = 6.5, 1.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

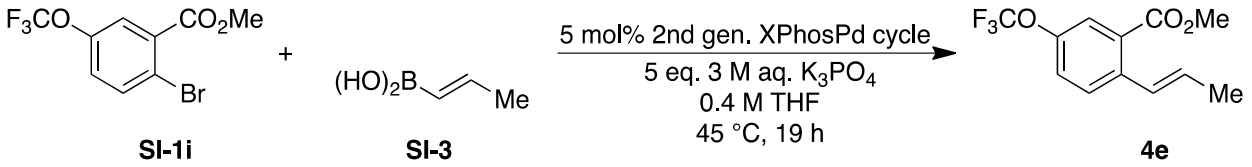
δ 169.8, 138.1, 136.9, 132.9, 131.3, 130.2, 128.3, 126.8, 126.1, 52.0, 20.7, 18.8.

HRMS (ESI+)

Calculated for $C_{12}H_{14}O_2$ $(M+H)^+$:	191.1067
Found:	191.1073

IR (thin film, cm^{-1})

3019, 2949, 2916, 1720, 1434, 1283, 1262, 1208, 1190, 1172, 1132, 1092, 1013, 964, 939, 782, 746



SI-1i **SI-3** **4e**

methyl (*E*)-2-(prop-1-en-1-yl)-5-(trifluoromethoxy)benzoate 4e. Following the "general procedure for the synthesis of substrates 4a-o", methyl 2-bromo-5-(trifluoromethoxy)benzoate **SI-1i** (748 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid **SI-3** (300 mg, 3.5 mmol, 1.4 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 19 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4e** was isolated as a pale yellow oil (545 mg, 84% yield).

TLC (hexanes:EtOAc 4:1)
R_f = 0.30, stained by $KMnO_4$

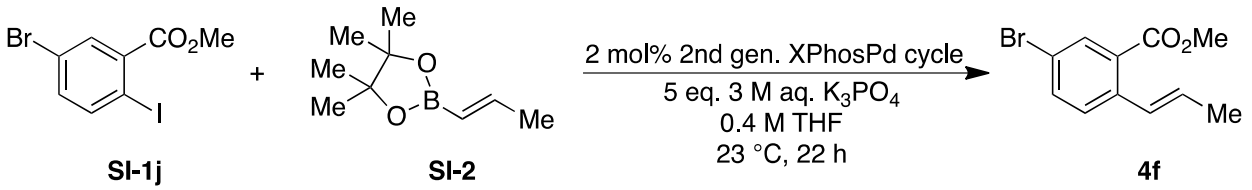
^{1}H-NMR (500 MHz, $CDCl_3$)
δ 7.72 (s, 1H), 7.55 (d, *J* = 8.5 Hz, 1H), 7.31 (d, *J* = 7.5 Hz, 1H), 7.15 (d, *J* = 15.5 Hz, 1H), 6.16 (ddq, 15.5, 7.0, 1.5 Hz, 1H), 3.93 (s, 3H), 1.94 (dt, *J* = 6.5, 2.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)
δ 166.6, 147.4, 138.6, 129.9, 129.1, 128.8, 128.5, 124.5, 122.7, 120.4 (d, *J* = 258 Hz), 52.3 (d, *J* = 3.5 Hz), 18.8.

^{19}F-NMR (470 MHz, $CDCl_3$)
δ -58.0.

HRMS (ESI+)
Calculated for $C_{12}H_{11}F_3O_3$ $(M+H)^+$: 261.0733
Found: 261.0726

IR (thin film, cm^{-1})
2955, 2918, 2855, 1726, 1491, 1437, 1247, 1204, 1157, 1099, 1071, 991, 964, 944, 845, 776



SI-1j **SI-2** **4f**

methyl (*E*)-5-bromo-2-(prop-1-en-1-yl)benzoate 4f. Following the "general procedure for the synthesis of substrates 4a-o", methyl 5-bromo-2-iodobenzoate **SI-1j** (852 mg, 2.5 mmol, 1.0 eq.),

trans-1-propenylboronic acid pinacol ester **SI-2** (420 mg, 2.5 mmol, 1.0 eq.), and 2nd generation XPhosPd cycle (39 mg, 0.05 mmol, 2 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 23 °C for 22 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4f** was isolated as a pale yellow oil (408 mg, 64% yield, 85% purity).

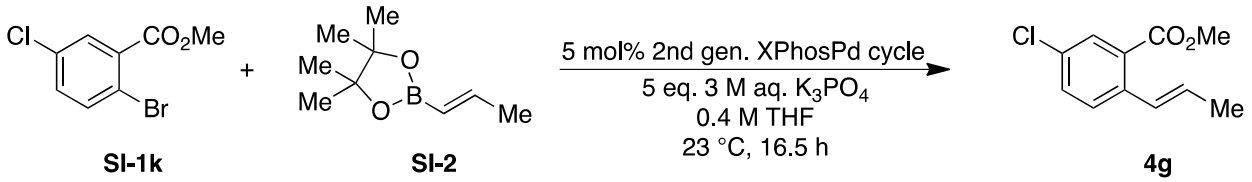
TLC (hexanes:EtOAc 6:1)
R_f = 0.55, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)
δ 7.99 (d, *J* = 2.0 Hz, 1H), 7.55 (dd, *J* = 8.5, 2.5 Hz, 1H), 7.40 (d, *J* = 9.0 Hz, 1H), 7.11 (dd, *J* = 16.0, 1.5 Hz, 1H), 6.17 (dq, *J* = 16.0, 6.5 Hz, 1H), 3.92 (s, 3H), 1.93 (dd, *J* = 7.0, 2.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)
δ 166.7, 142.6, 138.6, 134.8, 133.1, 129.5, 128.7, 128.6, 120.0, 52.3, 18.8.

HRMS (ESI+)
Calculated for $C_{11}H_{11}BrO_2$ $(M+H)^+$: 255.0015
Found: 255.0008

IR (thin film, cm^{-1})
3010, 2949, 2912, 2875, 2850, 1720, 1475, 1434, 1282, 1235, 1204, 1143, 1103, 1074, 964, 839, 774



SI-1k **SI-2** **4g**

methyl (*E*)-5-chloro-2-(prop-1-en-1-yl)benzoate 4g. Following the "general procedure for the synthesis of substrates 4a-o", methyl 2-bromo-5-chlorobenzoate **SI-1k** (624 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (420 mg, 2.8 mmol, 1.0 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 23 °C for 16.5 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4g** was isolated as a pale yellow solid (508 mg, 96% yield).

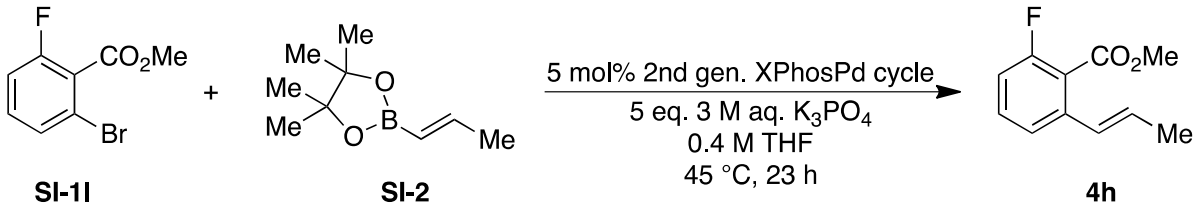
TLC (hexanes:EtOAc 6:1)
R_f = 0.59, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)
δ 7.84 (d, *J* = 2.5 Hz, 1H), 7.47 (d, *J* = 8.5 Hz, 1H), 7.40 (dd, *J* = 8.5, 2.0 Hz, 1H), 7.12 (dd, *J* = 16.0, 2.0 Hz, 1H), 6.16 (dq, *J* = 15.5, 6.5 Hz, 1H), 3.91 (s, 3H), 1.93 (dd, *J* = 6.5, 1.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)
δ 166.8, 138.2, 132.2, 132.0, 130.1, 129.4, 129.1, 128.6, 128.5, 52.3, 18.8.

HRMS (ESI+)
Calculated for $C_{11}H_{11}ClO_2$ $(M+H)^+$: 211.0520
Found: 211.0515

IR (thin film, cm^{-1})
3011, 2913, 2878, 1721, 1476, 1434, 1284, 1232, 1204, 1142, 1112, 1098, 1073, 964, 840, 774, 727



SI-1l **SI-2** **4h**

methyl (*E*)-2-fluoro-6-(prop-1-en-1-yl)benzoate 4h. Following the "general procedure for the synthesis of substrates 4a-o", methyl 2-bromo-6-fluorobenzoate **SI-1l** (583 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (462 mg, 2.8 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 23 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4h** was isolated as a pale yellow oil (367 mg, 76% yield).

TLC (hexanes:EtOAc 6:1)
R_f = 0.62, stained by $KMnO_4$

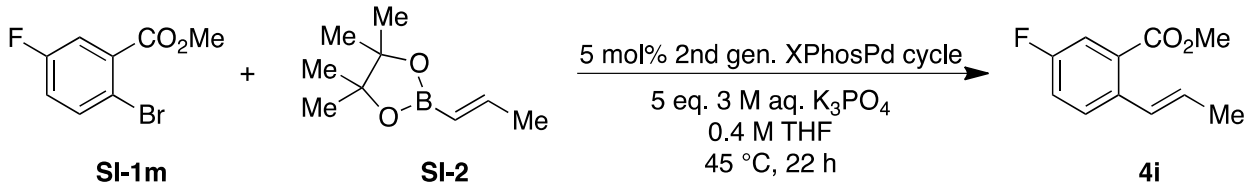
^{1}H-NMR (500 MHz, $CDCl_3$)
δ 7.36-7.26 (m, 2H), 6.99-6.94 (m, 1H), 6.52 (dd, *J* = 15.5, 1.5 Hz, 1H), 6.26 (dq, *J* = 15.5, 6.5 Hz, 1H), 3.96 (s, 3H), 1.90 (dd, *J* = 6.5, 1.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)
δ 166.2, 159.9 (d, *J* = 250.0 Hz), 138.6, 131.2 (d, *J* = 9.0 Hz), 130.3, 127.0 (d, *J* = 2.5 Hz), 121.3 (d, *J* = 3.0 Hz), 119.8 (d, *J* = 16.0 Hz), 113.7 (d, *J* = 22.0 Hz), 52.6, 18.8.

^{19}F-NMR (470 MHz, $CDCl_3$)
δ -115.1 (dd, *J* = 9.5, 5.5 Hz).

HRMS (ESI+)
Calculated for $C_{11}H_{11}FO_2$ $(M+H)^+$: 195.0816
Found: 195.0815

IR (thin film, cm^{-1})
3037, 2953, 2916, 1729, 1611, 1568, 1467, 1431, 1284, 1269, 1240, 1106, 1059, 958, 918, 830, 773, 764, 536



SI-1m **SI-2** **4i**

methyl (*E*)-5-fluoro-2-(prop-1-en-1-yl)benzoate 4i. Following the "general procedure for the synthesis of substrates 4a-o", methyl 2-bromo-5-fluorobenzoate **SI-1m** (583 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (462 mg, 2.8 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 22 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4i** was isolated as a pale yellow oil (480 mg, 99% yield).

TLC (hexanes:EtOAc 9:1)

R_f = 0.49, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 7.53 (dd, *J* = 9.5, 3.0 Hz, 1H), 7.47 (dd, *J* = 8.5, 5.5 Hz, 1H), 7.17-7.06 (m, 2H), 6.07 (dq, *J* = 15.5, 6.5 Hz, 1H), 3.89 (s, 3H), 1.90 (dd, *J* = 7.0, 2.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 166.8 (d, *J* = 2.5 Hz), 161.0 (d, *J* = 249.5 Hz), 136.0 (d, *J* = 4.0 Hz), 129.2 (d, *J* = 8.0 Hz), 129.0 (d, *J* = 7.0 Hz), 128.7, 128.6 (d, *J* = 1.5 Hz), 119.2 (d, *J* = 22.0 Hz), 116.8 (d, *J* = 23.0 Hz), 52.2, 18.7.

^{19}F-NMR (470 MHz, $CDCl_3$)

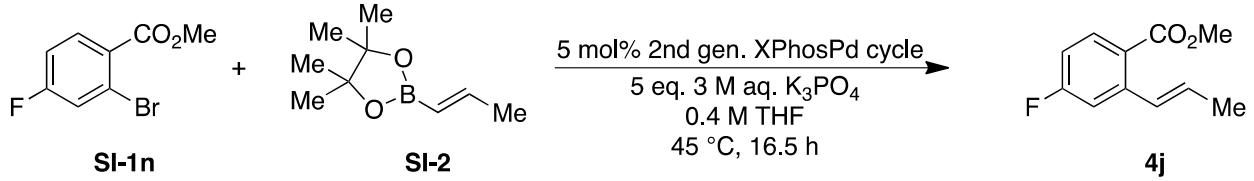
δ -115.6 (m).

HRMS (ESI+)

Calculated for $C_{11}H_{11}FO_2$ $(M+H)^+$: 195.0816
Found: 195.0812

IR (thin film, cm^{-1})

3011, 2953, 2915, 2853, 1723, 1488, 1435, 1290, 1271, 1249, 1207, 1183, 1097, 1064, 982, 964, 887, 841, 775



SI-1n **SI-2** **4j**

methyl (*E*)-4-fluoro-2-(prop-1-en-1-yl)benzoate 4j. Following the "general procedure for the synthesis of substrates 4a-o", methyl 2-bromo-4-fluorobenzoate **SI-1n** (583 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (462 mg, 2.8 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M)

and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 23 °C for 16.5 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4j** was isolated as a pale yellow solid (440 mg, 91% yield).

TLC (hexanes:EtOAc 6:1)
R_f = 0.55, stained by $KMnO_4$

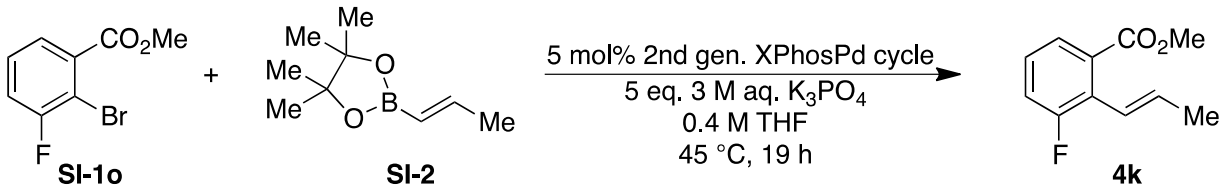
^{1}H-NMR (500 MHz, $CDCl_3$)
δ 7.88 (dd, *J* = 8.5, 6.0 Hz, 1H), 7.23-7.16 (m, 2H), 6.95-6.89 (m, 1H), 6.16 (dq, *J* = 16.0, 6.5 Hz, 1H), 3.88 (s, 3H), 1.92 (dd, *J* = 6.5, 1.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)
δ 167.0, 164.8 (d, *J* = 253.0 Hz), 143.0 (d, *J* = 8.5 Hz), 133.0 (d, *J* = 9.5 Hz), 129.9, 128.9 (d, *J* = 2.5 Hz), 123.9 (d, *J* = 2.0 Hz), 113.7 (d, *J* = 19.0 Hz), 113.5 (d, *J* = 18.5 Hz), 52.0, 18.7.

^{19}F-NMR (470 MHz, $CDCl_3$)
δ -107.6.

HRMS (ESI+)
Calculated for $C_{11}H_{11}FO_2$ $(M+H)^+$: 195.0816
Found: 195.0819

IR (thin film, cm^{-1})
3012, 2953, 2914, 2854, 1719, 1606, 1577, 1434, 1279, 1242, 1219, 1189, 1163, 1115, 1099, 1075, 960, 874, 771



methyl (*E*)-3-fluoro-2-(prop-1-en-1-yl)benzoate 4k. Following the "general procedure for the synthesis of substrates 4a-o", methyl 2-bromo-3-fluorobenzoate **SI-1o** (583 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (462 mg, 2.8 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 19 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4k** was isolated as a pale yellow oil (465 mg, 96% yield).

TLC (hexanes:EtOAc 9:1)
R_f = 0.49, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)
δ 7.57-7.51 (m, 1H), 7.23-7.14 (m, 2H), 6.68 (d, *J* = 16.0 Hz, 1H), 6.25 (ddq, *J* = 15.5, 7.0, 2.0 Hz, 1H), 3.89 (s, 3H), 1.93 (d, *J* = 7.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 167.7 (d, *J* = 4.0 Hz), 160.6 (d, *J* = 247.5 Hz), 133.6 (d, *J* = 10.0 Hz), 131.4 (d, *J* = 4.0 Hz), 127.0 (d, *J* = 9.5 Hz), 126.7 (d, *J* = 14.5 Hz), 125.6 (d, *J* = 4.0 Hz), 122.2, 119.1 (d, *J* = 24.0 Hz), 52.2, 19.5.

^{19}F-NMR (470 MHz, $CDCl_3$)

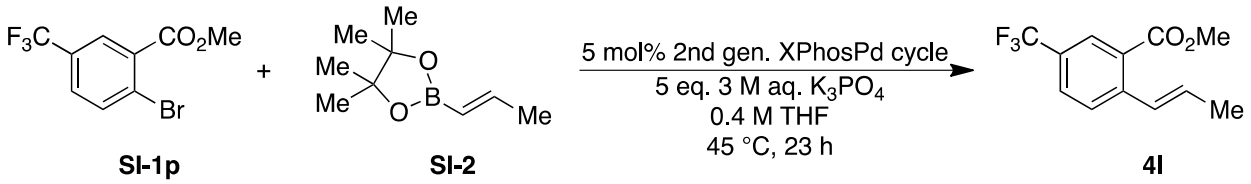
δ -114.2 (t, *J* = 8.0 Hz).

HRMS (ESI+)

Calculated for $C_{11}H_{11}FO_2$ $(M+H)^+$: 195.0816
Found: 195.0821

IR (thin film, cm^{-1})

2953, 2915, 2853, 1721, 1454, 1433, 1287, 1257, 1194, 1174, 1140, 1099, 1001, 965, 900, 773, 753



SI-1p **SI-2** **4l**

methyl (*E*)-2-(prop-1-en-1-yl)-5-(trifluoromethyl)benzoate 4l. Following the "general procedure for the synthesis of substrates 4a-o", methyl 2-bromo-5-(trifluoromethyl)benzoate **SI-1p** (708 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (462 mg, 2.8 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 23 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4l** was isolated as a pale yellow oil (526 mg, 86% yield).

TLC (hexanes:EtOAc 6:1)

R_f = 0.68, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.11 (s, 1H), 7.68-7.61 (m, 2H), 7.20 (d, *J* = 16.0 Hz, 1H), 6.26 (dq, *J* = 16.0, 6.5 Hz, 1H), 3.93 (s, 3H), 1.95 (dd, *J* = 7.0, 1.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 166.7, 143.1, 131.4, 128.6, 128.2, 127.9 (dq, *J* = 102.0, 3.5 Hz) 127.6, 124.8, 122.7, 110.0, 52.3, 18.9.

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -62.7.

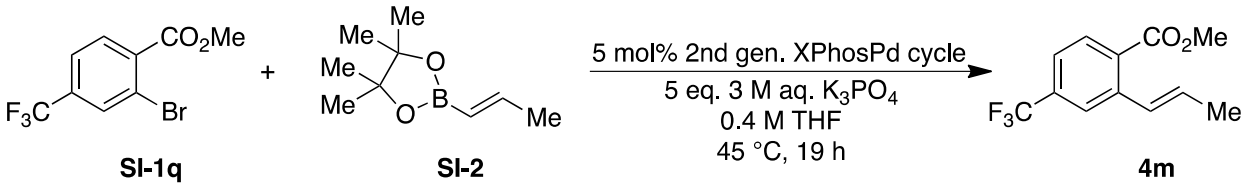
HRMS (ESI+)

Calculated for $C_{12}H_{11}F_3O_2$ $(M+H)^+$: 245.0784

Found: 245.0778

IR (thin film, cm^{-1})

2955, 2917, 1725, 1336, 1273, 1236, 1211, 1168, 1120, 1101, 1084, 1075, 961, 848, 777, 691



methyl (*E*)-2-(prop-1-en-1-yl)-4-(trifluoromethyl)benzoate 4m. Following the "general procedure for the synthesis of substrates 4a-o", methyl 2-bromo-4-(trifluoromethyl)benzoate **SI-1q** (708 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (462 mg, 2.8 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 19 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4m** was isolated as a pale yellow oil (573 mg, 94% yield).

TLC (hexanes:EtOAc 9:1)

R_f = 0.57, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 7.93 (d, *J* = 8.0 Hz, 1H), 7.78 (s, 1H), 7.49 (d, *J* = 8.0 Hz, 1H), 7.15 (dq, *J* = 15.5, 2.0 Hz, 1H), 6.26 (dq, *J* = 15.5, 6.5 Hz, 1H), 3.94 (s, 3H), 1.96 (dd, *J* = 7.0, 2.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 167.0, 140.2, 133.5 (q, *J* = 32.0 Hz), 131.0, 130.8, 130.7, 128.4, 124.7, 123.4 (dq, *J* = 133.0, 4.5 Hz), 122.5, 52.4 (d, *J* = 2.0 Hz), 18.8.

^{19}F-NMR (470 MHz, $CDCl_3$)

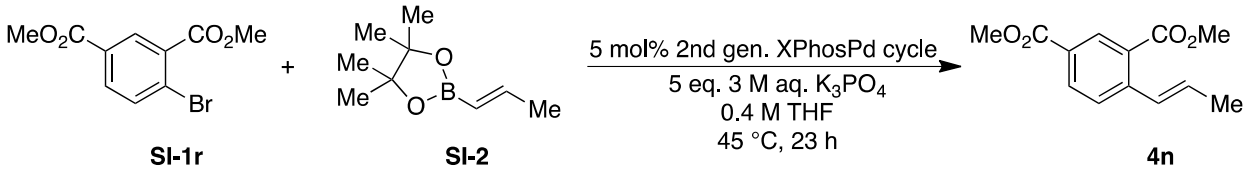
δ -63.3.

HRMS (ESI+)

Calculated for $C_{12}H_{11}F_3O_2$ $(M+H)^+$: 245.0784
Found: 245.0788

IR (thin film, cm^{-1})

2955, 2917, 2856, 1725, 1335, 1312, 1289, 1276, 1245, 1167, 1124, 1089, 961, 894, 846, 776, 754, 707



SI-1r **SI-2** **4n**

dimethyl (*E*)-4-(prop-1-en-1-yl)isophthalate 4n. Following the "general procedure for the synthesis of substrates 4a-o", dimethyl 4-bromoisophthalate **SI-1r** (683 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (462 mg, 2.8 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 23 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4n** was isolated as a pale yellow solid (437 mg, 75% yield).

TLC (hexanes:EtOAc 6:1)

R_f = 0.49, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.50 (d, *J* = 1.5 Hz, 1H), 8.06 (dd, *J* = 8.0, 2.0 Hz, 1H), 7.60 (d, *J* = 8.0 Hz, 1H), 7.21 (dd, *J* = 16.0, 2.0 Hz, 1H), 6.30 (dq, *J* = 15.5, 6.5 Hz, 1H), 3.92 (s, 6H), 1.95 (dd, *J* = 6.5, 1.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

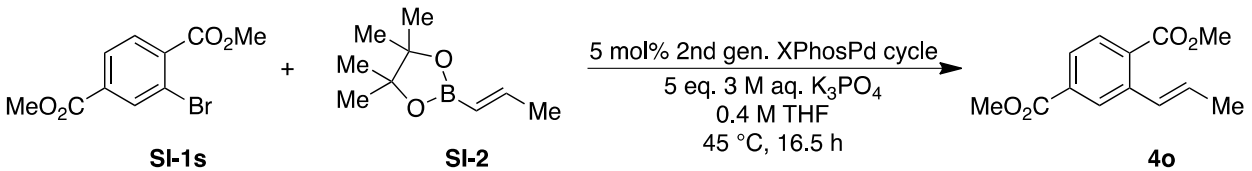
δ 167.2, 166.2, 143.9, 132.5, 131.8, 131.4, 128.9, 128.1, 128.0, 127.1, 52.2, 19.0.

HRMS (ESI+)

Calculated for $C_{13}H_{14}O_4$ $(M+H)^+$:	235.0965
Found:	235.0972

IR (thin film, cm^{-1})

3001, 2952, 2913, 1716, 1607, 1433, 1305, 1262, 1226, 1142, 1116, 1099, 1073, 990, 962, 754



SI-1s **SI-2** **4o**

dimethyl (*E*)-2-(prop-1-en-1-yl)terephthalate 4o. Following the "general procedure for the synthesis of substrates 4a-o", dimethyl 2-bromoterephthalate **SI-1s** (683 mg, 2.5 mmol, 1.0 eq.), *trans*-1-propenylboronic acid pinacol ester **SI-2** (462 mg, 2.8 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.2 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 16.5 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **4o** was isolated as a white solid (586 mg, 99% yield).

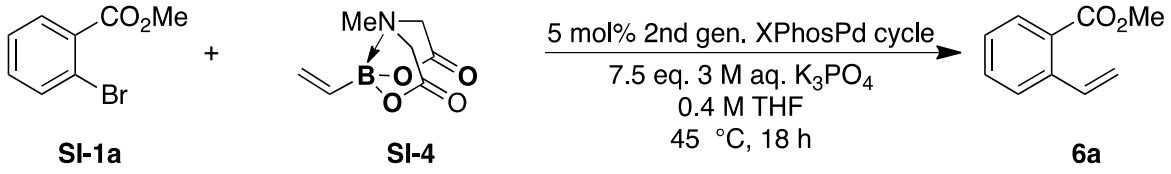
TLC (hexanes:EtOAc 6:1)
R_f = 0.39, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)
δ 8.14 (s, 1H), 7.84-7.79 (m, 2H), 7.07 (d, *J* = 16.5 Hz, 1H), 6.23 (dq, *J* = 16.0, 6.5 Hz, 1H), 3.88 (s, 3H), 3.87 (s, 3H), 1.89 (dd, *J* = 7.0, 1.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)
δ 167.3, 166.2, 139.6, 132.8, 131.6, 130.2, 130.0, 128.6, 128.2, 127.0, 52.3, 52.2, 18.8.

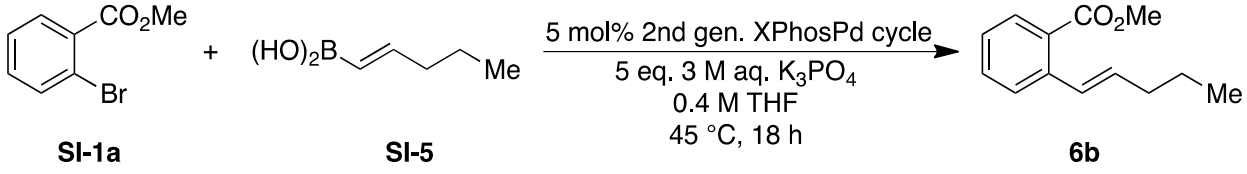
HRMS (ESI+)
Calculated for $C_{13}H_{14}O_4$ $(M+H)^+$: 235.0965
Found: 235.0971

IR (thin film, cm^{-1})
3002, 2952, 2914, 2852, 1717, 1433, 1287, 1237, 1200, 1110, 1073, 962, 747, 730



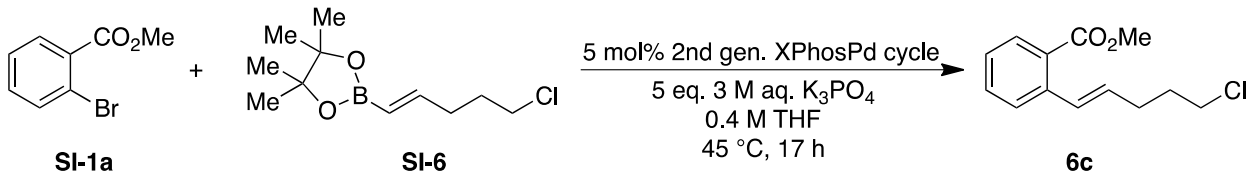
SI-1a **SI-4** **6a**

Methyl 2-vinylbenzoate 6a. Following the "general procedure for the synthesis of substrates 6a-h", methyl 2-bromobenzoate **SI-1a** (968 mg, 4.5 mmol, 1.0 eq.), vinylboronic acid MIDA ester **SI-4** (906 mg, 5.0 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (177 mg, 0.23 mmol, 5 mol%) were reacted in THF (11.0 mL, 0.4 M) and 3 M aqueous K_3PO_4 (11.0 mL, 7.5 eq.) at 45 °C for 18 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **6a** was isolated as a pale yellow oil (569 mg, 78% yield). Characterization of this compound was consistent with previously reported data.[5]



SI-1a **SI-5** **6b**

Methyl (*E*)-2-(pent-1-en-1-yl)benzoate 6b. Following the "general procedure for the synthesis of substrates 6a-h", methyl 2-bromobenzoate **SI-1a** (857 mg, 4.0 mmol, 1.0 eq.), 1-penten-1-ylboronic acid **SI-5** (500 mg, 4.4 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (157 mg, 0.20 mmol, 5 mol%) were reacted in THF (10 mL, 0.4 M) and 3 M aqueous K_3PO_4 (6.6 mL, 5 eq.) at 45 °C for 18 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **6b** was isolated as a pale yellow oil (780 mg, 96% yield). Characterization of this compound was consistent with previously reported data.[6]



Methyl (*E*)-2-(5-chloropent-1-en-1-yl)benzoate 6c. Following the "general procedure for the synthesis of substrates 6a-h", methyl 2-bromobenzoate **SI-1a** (645 mg, 3.0 mmol, 1.0 eq.), *trans*-5-chloro-1-penten-1-ylboronic acid pinacol ester **SI-6** (760 mg, 3.3 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (118 mg, 0.15 mmol, 5 mol%) were reacted in THF (10.0 mL, 0.3 M) and 3 M aqueous K_3PO_4 (5.0 mL, 5 eq.) at 45 °C for 17 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **6c** was isolated as a pale yellow oil (659 mg, 92% yield).

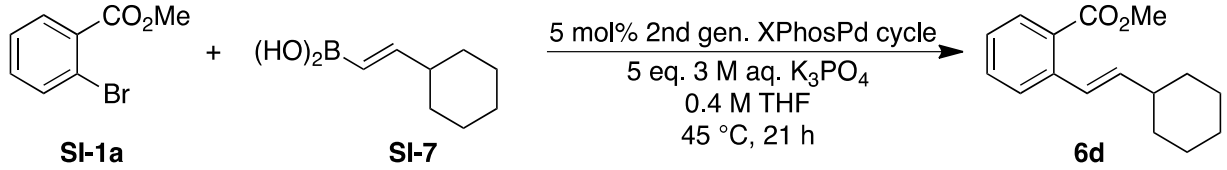
TLC (hexanes:EtOAc 9:1)
R_f = 0.50, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)
δ 7.87 (d, *J* = 8.0 Hz, 1H), 7.53 (d, *J* = 8.0 Hz, 1H), 7.46 (t, *J* = 7.5 Hz, 1H), 7.28 (t, *J* = 7.5 Hz, 1H), 7.20 (d, *J* = 16.0 Hz, 1H), 6.13-6.05 (m, 1H), 3.91 (s, 3H), 3.62 (t, *J* = 7.0 Hz, 2H), 2.43 (q, *J* = 7.0 Hz, 2H), 1.99 (p, *J* = 7.0 Hz, 2H).

^{13}C-NMR (125 MHz, $CDCl_3$)
δ 167.9, 139.3, 132.0, 131.5, 130.3, 130.0, 128.2, 127.3, 126.8, 52.0, 44.3, 32.0, 30.2.

HRMS (ESI+)
Calculated for $C_{13}H_{15}ClO_2$ $(M+H)^+$: 239.0833
Found: 239.0841

IR (thin film, cm^{-1})
3063, 2997, 2951, 2846, 1719, 1481, 1434, 1249, 1159, 1075, 966, 745



Methyl (*E*)-2-(2-cyclohexylvinyl)benzoate 6d. Following the "general procedure for the synthesis of substrates 6a-h", methyl 2-bromobenzoate **SI-1a** (517 mg, 2.4 mmol, 1.0 eq.), (*E*)-(2-cyclohexylvinyl)boronic acid **SI-7** (407 mg, 2.6 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (95 mg, 0.12 mmol, 5 mol%) were reacted in THF (6.0 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 21 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **6d** was isolated as a pale yellow oil (557 mg, 95% yield).

TLC (hexanes:EtOAc 9:1)
R_f = 0.50, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 7.86 (d, *J* = 8.0 Hz, 1H), 7.56 (d, *J* = 8.0 Hz, 1H), 7.45 (t, *J* = 7.5 Hz, 1H), 7.26 (t, *J* = 7.5 Hz, 1H), 7.14 (d, *J* = 16.0 Hz, 1H), 6.11 (dd, *J* = 16.0, 7.0 Hz, 1H), 3.92 (s, 3H), 2.26-2.15 (m, 1H), 1.90-1.83 (m, 2H), 1.83-1.74 (m, 2H), 1.74-1.66 (m, 1H), 1.42-1.29 (m, 2H), 1.28-1.16 (m, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

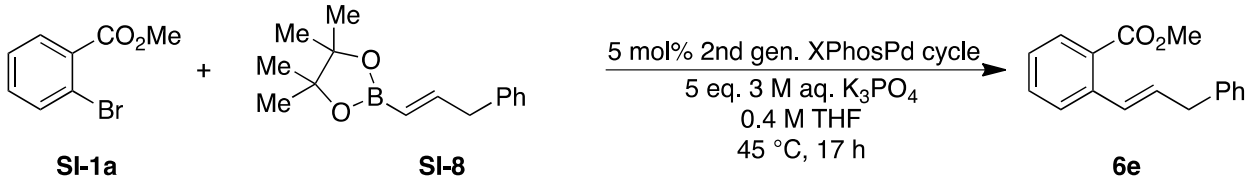
δ 168.1, 139.9, 139.6, 131.9, 130.3, 128.2, 127.1, 126.4, 126.1, 52.0, 41.3, 32.9, 26.2, 26.1.

HRMS (ESI+)

Calculated for $C_{16}H_{20}O_2$ $(M+H)^+$: 245.1536
Found: 245.1541

IR (thin film, cm^{-1})

2923, 2850, 1719, 1448, 1247, 1126, 1075, 966, 903, 725, 649



SI-1a **SI-8** **6e**

Methyl (*E*)-2-(3-phenylprop-1-en-1-yl)benzoate 6e. Following the "general procedure for the synthesis of substrates 6a-h", methyl 2-bromobenzoate **SI-1a** (645 mg, 3.0 mmol, 1.0 eq.), trans-3-phenyl-1-propenylboronic acid pinacol ester **SI-8** (806 mg, 3.3 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (118 mg, 0.15 mmol, 5 mol%) were reacted in THF (10 mL, 0.3 M) and 3 M aqueous K_3PO_4 (5.0 mL, 5 eq.) at 45 °C for 17 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **6e** was isolated as a pale yellow oil (740 mg, 98% yield).

TLC (hexanes:EtOAc 6:1)

R_f = 0.59, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 7.88 (d, *J* = 7.5 Hz, 1H), 7.56 (d, *J* = 7.5 Hz, 1H), 7.45 (t, *J* = 7.0 Hz, 1H), 7.38-7.22 (m, 7H), 6.28 (dt, *J* = 15.5, 6.5 Hz, 1H), 3.91 (s, 3H), 3.62 (d, *J* = 6.5 Hz, 2H).

^{13}C-NMR (125 MHz, $CDCl_3$)

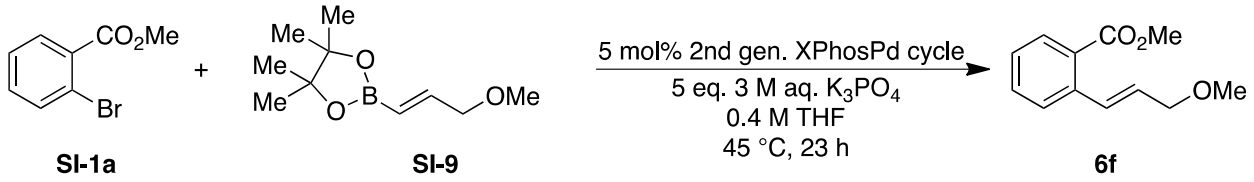
δ 168.1, 140.1, 139.2, 132.0, 131.9, 130.4, 129.9, 128.7, 128.5, 128.3, 127.3, 126.8, 126.2, 52.1, 39.6.

HRMS (ESI+)

Calculated for $C_{17}H_{16}O_2$ $(M+H)^+$: 253.1223
Found: 253.1235

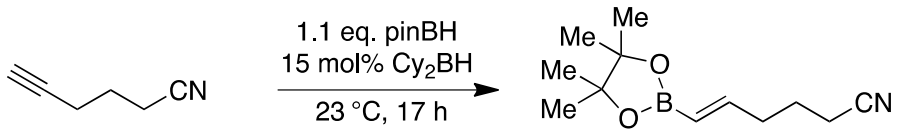
IR (thin film, cm^{-1})

3062, 3027, 2950, 1719, 1433, 1293, 1251, 1130, 1082, 966, 744, 700



SI-1a **SI-9** **6f**

Methyl (*E*)-2-(3-methoxyprop-1-en-1-yl)benzoate 6f. Following the "general procedure for the synthesis of substrates 6a-h", methyl 2-bromobenzoate **SI-1a** (905 mg, 4.2 mmol, 1.0 eq.), trans-3-methoxy-1-propenylboronic acid pinacol ester **SI-9** (1.0 g, 5.0 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (165 mg, 0.21 mmol, 5 mol%) were reacted in THF (10.5 mL, 0.4 M) and 3 M aqueous K_3PO_4 (7.0 mL, 5 eq.) at 45 °C for 23 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **6f** was isolated as a pale yellow oil (860 mg, 99% yield). Characterization of this compound was consistent with previously reported data.[7]



SI-10 **SI-11**

***trans*-5-cyano-1-penten-1-ylboronic acid pinacol ester SI-11.** In a glovebox, to a 7 mL vial charged with a stir bar was added dicyclohexyl borane (160 mg, 0.9 mmol, 15 mol%) and pinacol borane (0.96 mL, 6.6 mmol, 1.1 eq.). The vial was capped, removed from the glovebox and placed under a nitrogen atmosphere. The slurry was cooled to 0 °C in an ice bath. Hex-5-ynenitrile **SI-10** (0.63 mL, 6.0 mmol, 1.0 eq.) was added in one portion. The solution was stirred at 23 °C for 17 h. After this time, celite was added to quench the reaction. The crude reaction was dry loaded onto celite and purified by column chromatography on silica gel (hexanes:EtOAc 100:0 → 80:20) to afford the pinacol ester **SI-11** as a clear, colorless oil (1.0 g, 75% yield).

TLC (hexanes:EtOAc 9:1)

R_f = 0.17, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 6.52 (dt, *J* = 18.0, 6.5 Hz, 1H), 5.49 (dt, *J* = 18.0, 1.5 Hz, 1H), 2.38-2.26 (m, 4H), 1.79 (p, 7.0 Hz, 2H), 1.26 (s, 12H).

^{13}C-NMR (125 MHz, $CDCl_3$)

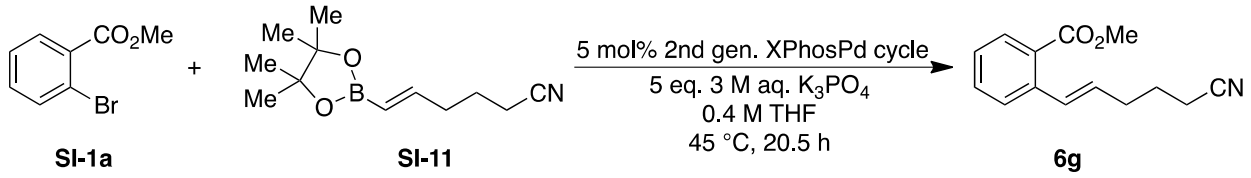
δ 150.9, 119.4, 83.2, 34.2, 24.8, 23.9, 16.5.

HRMS (ESI+)

Calculated for $C_{12}H_{20}BNO_2$ $(M+H)^+$: 222.1662

Found: 222.1666

IR (thin film, cm^{-1})
2978, 2934, 1638, 1364, 1352, 1321, 1142, 969, 849



SI-1a **SI-11** **6g**

methyl (*E*)-2-(5-cyanopent-1-en-1-yl)benzoate 6g. Following the "general procedure for the synthesis of substrates 6a-h", methyl 2-bromobenzoate **SI-1a** (538 mg, 2.5 mmol, 1.0 eq.), *trans*-5-cyano-1-penten-1-ylboronic acid pinacol ester **SI-11** (608 mg, 2.8 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (98 mg, 0.13 mmol, 5 mol%) were reacted in THF (6.3 mL, 0.4 M) and 3 M aqueous K_3PO_4 (4.0 mL, 5 eq.) at 45 °C for 20.5 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **6g** was isolated as a pale yellow oil (544 mg, 95% yield).

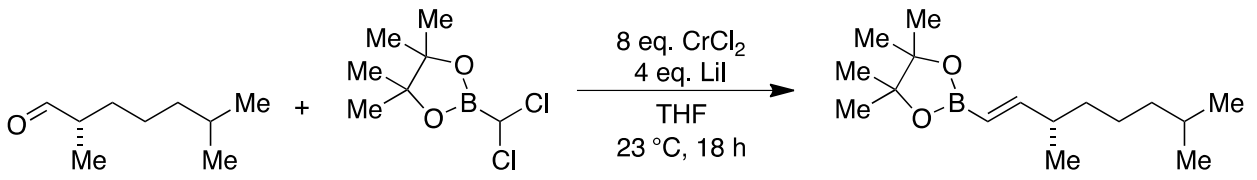
TLC (hexanes:EtOAc 9:1)
R_f = 0.13, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)
δ 7.87 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.51 (d, *J* = 8.0 Hz, 1H), 7.45 (dt, *J* = 7.0, 1.5 Hz, 1H), 7.29 (dt, *J* = 7.5, 1.5 Hz, 1H), 7.20 (d, *J* = 16.0 Hz, 1H), 6.02 (dt, *J* = 16.0, 7.0 Hz, 1H), 3.90 (s, 3H), 2.46-2.38 (m, 4H), 1.88 (p, *J* = 7.0 Hz, 2H).

^{13}C-NMR (125 MHz, $CDCl_3$)
δ 167.8, 139.1, 132.1, 131.0, 130.4, 130.3, 128.1, 127.3, 127.0, 119.7, 52.1, 31.8, 24.9, 16.4.

HRMS (ESI+)
Calculated for $C_{14}H_{15}NO_2$ $(M+H)^+$: 230.1176
Found: 230.1183

IR (thin film, cm^{-1})
3065, 2998, 2950, 1715, 1433, 1293, 1248, 1129, 1074, 965, 746, 706



SI-12 **SI-13** **SI-14**

(*S*,*E*)-2-(3,7-dimethyloct-1-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane SI-14. In a glovebox, to a 100 mL round bottom flask charged with a stir bar was added chromium (II) chloride (3.6 g, 29.6 mmol, 8.0 eq). The round bottom was sealed with a septum, removed from the glovebox, and placed under a nitrogen atmosphere. To the flask was added THF (35 mL),

followed by a solution of aldehyde **SI-12** (526 mg, 3.7 mmol, 1.0 eq) and pinacol ester **SI-13** (1.6 g, 7.4 mmol, 2.0 eq) in THF (10 mL). To the resulting suspension was slowly dropwise added a solution of lithium iodide (2.0 g, 15 mmol, 4.0 eq) in THF (5 mL). The resulting suspension was stirred at 23 °C, under a nitrogen atmosphere, in a reduced light environment (shielded with aluminum foil) for 18 h. After this time, the crude reaction was poured into a separatory funnel containing H_2O (100 mL) and hexanes (75 mL). After shaking, the organic layer was removed and the aqueous layer was extracted with hexanes (2 x 50 mL). The combined organic layers were dried over $MgSO_4$, filtered, and dry loaded onto celite for purification by column chromatography on silica gel (hexanes:EtOAc 100:0 → 90:10) to afford pinacol ester **SI-14** as a clear, colorless oil (603 mg, 61% yield).

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 6.53 (dd, *J* = 18.0, 8.0 Hz, 1H), 5.38 (d, *J* = 18.0 Hz, 1H), 2.25-2.15 (m, 1H), 1.57-1.47 (m, 1H), 1.38-1.23 (m, 4H), 1.28 (s, 12H), 1.20-1.11 (m, 2H), 1.00 (d, *J* = 6.5 Hz, 3H), 0.86 (d, *J* = 6.5 Hz, 6H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 160.2, 83.0, 39.5, 39.0, 36.3, 27.9, 25.0, 24.8, 22.7, 19.5.

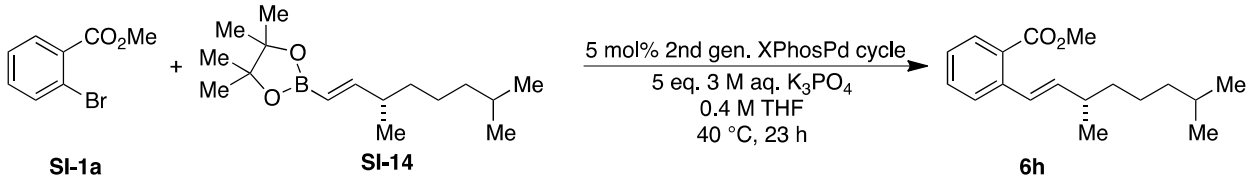
HRMS (ESI+)

Calculated for $C_{16}H_{31}BO_2$ $(M+H)^+$: 267.2493
Found: 267.2501

IR (thin film, cm^{-1})

2977, 2956, 2927, 2869, 1637, 1467, 1397, 1389, 1363, 1318, 1268, 1215, 1165, 1145, 999, 970, 901, 850, 729, 650

$[\alpha]_D^{23}$ +12.8 (*c* 1.0, $CHCl_3$)



methyl (*S*,*E*)-2-(3,7-dimethyloct-1-en-1-yl)benzoate 6h. Following the "general procedure for the synthesis of substrates 6a-h", methyl 2-bromobenzoate **SI-1a** (426 mg, 2.0 mmol, 1.0 eq.), (*S*,*E*)-2-(3,7-dimethyloct-1-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane **SI-14** (580 mg, 2.2 mmol, 1.1 eq.), and 2nd generation XPhosPd cycle (78 mg, 0.10 mmol, 5 mol%) were reacted in THF (5.0 mL, 0.4 M) and 3 M aqueous K_3PO_4 (3.3 mL, 5 eq.) at 40 °C for 23 h. Brine (40 mL) and Et_2O (40 mL) were used in the workup. Alkene **6h** was isolated as a pale yellow oil (525 mg, 96% yield).

TLC (hexanes:EtOAc 4:1)

R_f = 0.73, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 7.86 (d, *J* = 7.5 Hz, 1H), 7.56 (d, *J* = 7.5 Hz, 1H), 7.45 (t, *J* = 6.5 Hz, 1H), 7.27 (t, *J* = 7.0 Hz, 1H), 7.12 (d, *J* = 16.0 Hz, 1H), 6.02 (dd, *J* = 16.0, 8.0 Hz, 1H), 3.91 (s, 3H), 2.42-2.32 (m, 1H), 1.61-1.51 (sept, *J* = 6.5 Hz, 1H), 1.43-1.31 (m, 4H), 1.24-1.16 (m, 2H), 1.11 (d, *J* = 7.0 Hz, 3H), 0.89 (d, *J* = 6.5 Hz, 6H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 168.1, 139.9, 139.8, 131.9, 130.3, 128.2, 127.2, 126.7, 126.4, 51.9, 39.1, 37.4, 37.3, 28.0, 25.1, 22.7, 20.6.

HRMS (ESI+)

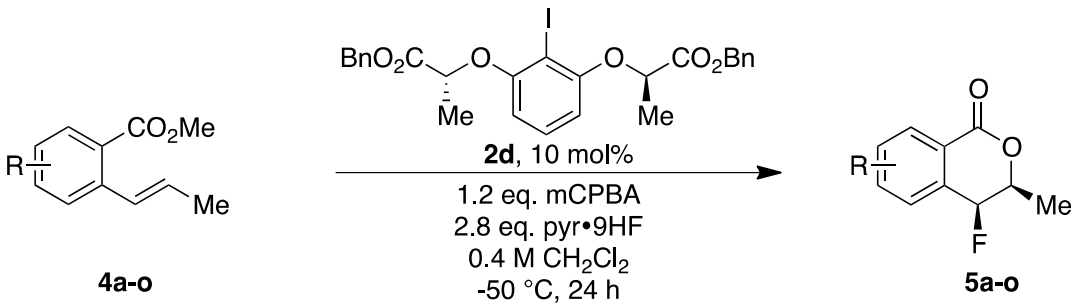
Calculated for $C_{18}H_{26}O_2$ $(M+H)^+$: 275.2006
Found: 275.2006

IR (thin film, cm^{-1})

2952, 2925, 2868, 1722, 1481, 1459, 1433, 1292, 1246, 1206, 1189, 1126, 1076, 967, 749, 707

$[\alpha]_D^{23}$ +24.2 (*c* 1.0, $CHCl_3$)

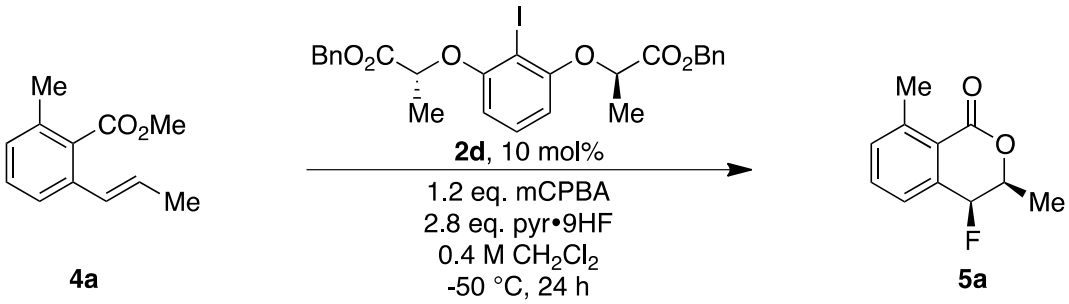
V. Table 2. Fluorolactonization of aryl substituted substrates



General procedure for the synthesis of products 5a-o.

To a 7 mL low-density polyethylene vial with snap cap charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 269 mg, 1.2 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C . To the cooled vial was added aryl iodide catalyst **2d** (56.0 mg, 0.10 mmol HF, 10 mol%) as a solution in CH_2Cl_2 (1.5 mL) followed by pyr•9HF (70% HF, 0.65 mL, 25 mmol HF, 25 eq. HF). The alkene **4a-o** (1.0 mmol) was added as a solution in CH_2Cl_2 (1.0 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C cryocool with

vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (2.5 g) in CH_2Cl_2 (5.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The solution was concentrated under reduced pressure. The resulting residue was dry loaded onto celite and purified by column chromatography on silica gel (hexanes:EtOAc 100:0 → 80:20) to afford fluorolactone **5a-o**.



4-fluoro-3,8-dimethylisochroman-1-one 5a. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5a** was isolated as a white solid (103 mg, 53% yield).

TLC (hexanes:EtOAc 1:1)

R_f = 0.35, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 7.53 (t, *J* = 7.5 Hz, 1H), 7.43 (d, *J* = 7.5 Hz, 1H), 7.34 (d, *J* = 7.0 Hz, 1H), 5.29 (d, *J* = 50.0 Hz, 1H), 4.65 (dq, *J* = 27.0, 6.5 Hz, 1H), 2.73 (s, 3H), 1.61 (d, *J* = 7.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 163.2, 143.4 (d, *J* = 2.5 Hz), 135.8 (d, *J* = 16.5 Hz), 134.6 (d, *J* = 3.5 Hz), 133.2 (d, *J* = 3.0 Hz), 126.7 (d, *J* = 3.5 Hz), 122.9 (d, *J* = 2.5 Hz), 86.5 (d, *J* = 179.5 Hz), 74.9 (d, *J* = 20.5 Hz), 22.2, 16.1 (d, *J* = 4.0 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -184.6 (dd, *J* = 50.0, 27.0 Hz).

HRMS (ESI+)

Calculated for $C_{11}H_{11}FO_2$ $(M+H)^+$: 195.0816
Found: 195.0823

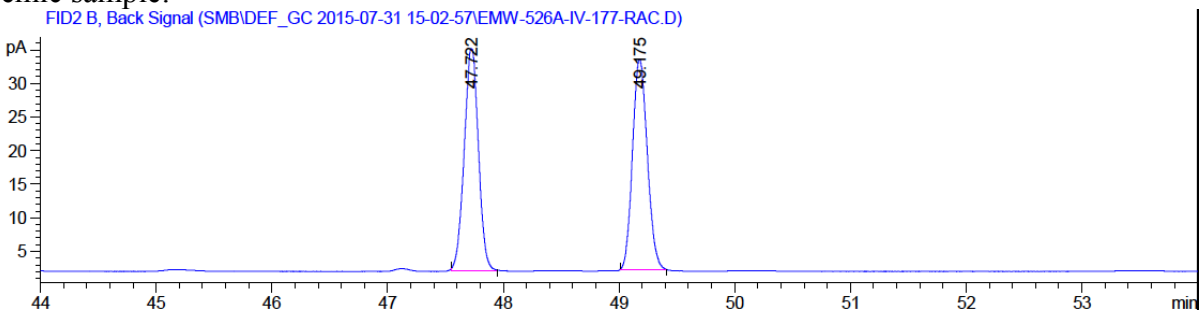
IR (thin film, cm^{-1})

2989, 2941, 1716, 1255, 1241, 1217, 1117, 1070, 964, 937, 899, 811, 788, 703

$[\alpha]_D^{23}$ +123.6 (*c* 1.0, $CHCl_3$)

96% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(minor) = 47.7 min, t_R(major) = 49.2 min.

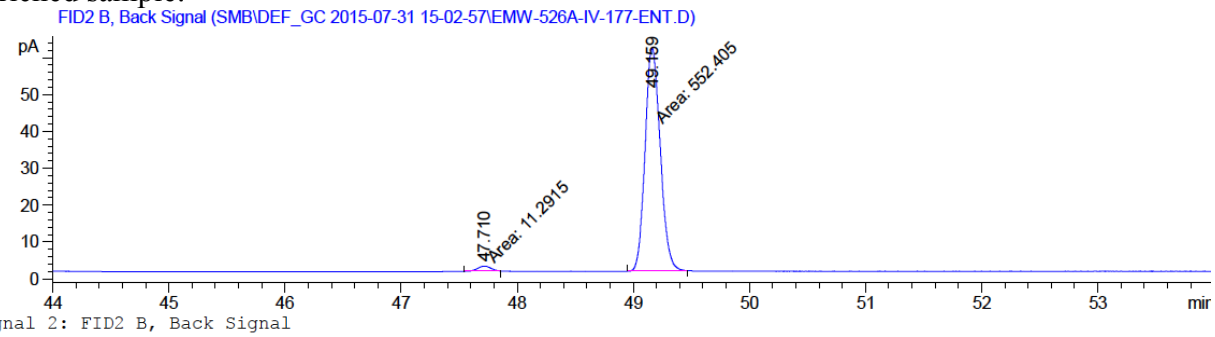
Racemic sample:



Signal 2: FID2 B, Back Signal

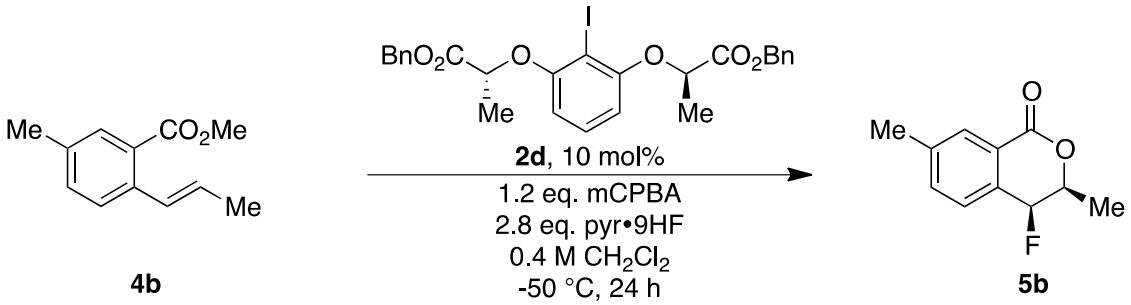
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	47.722	BB	0.1289	280.82138	32.97966	50.08501
2	49.175	BB	0.1385	279.86804	31.37399	49.91499
Totals :				560.68942	64.35366	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	47.710	MM	0.1397	11.29148	1.34719	2.00311
2	49.159	MM	0.1518	552.40509	60.63507	97.99689
Totals :				563.69657	61.98226	



4-fluoro-3,7-dimethylisochroman-1-one 5b. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5b** was isolated as a white solid (97 mg, 50% yield).

TLC (hexanes:EtOAc 3:1)

R_f = 0.36, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.00 (s, 1H), 7.49 (d, *J* = 7.0 Hz, 1H), 7.41 (dd, *J* = 7.0, 3.0 Hz, 1H), 5.29 (dd, *J* = 50.0, 1.5 Hz, 1H), 4.69 (dqd, *J* = 28.0, 6.5, 1.5 Hz, 1H), 2.45 (d, *J* = 3.0 Hz, 3H), 1.63 (d, *J* = 7.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 164.1, 141.7 (d, *J* = 3.5 Hz), 135.0 (d, *J* = 3.0 Hz), 131.9 (d, *J* = 17.5 Hz), 130.7 (d, *J* = 2.5 Hz), 128.8 (d, *J* = 3.5 Hz), 124.5 (d, *J* = 2.5 Hz), 85.3 (d, *J* = 180.5 Hz), 75.8 (d, *J* = 23.0 Hz), 21.3, 16.2 (d, *J* = 5.0 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -182.0 (dd, *J* = 50.0, 28.0 Hz).

HRMS (ESI+)

Calculated for $C_{11}H_{11}FO_2$ $(M+H)^+$: 195.0816
Found: 195.0824

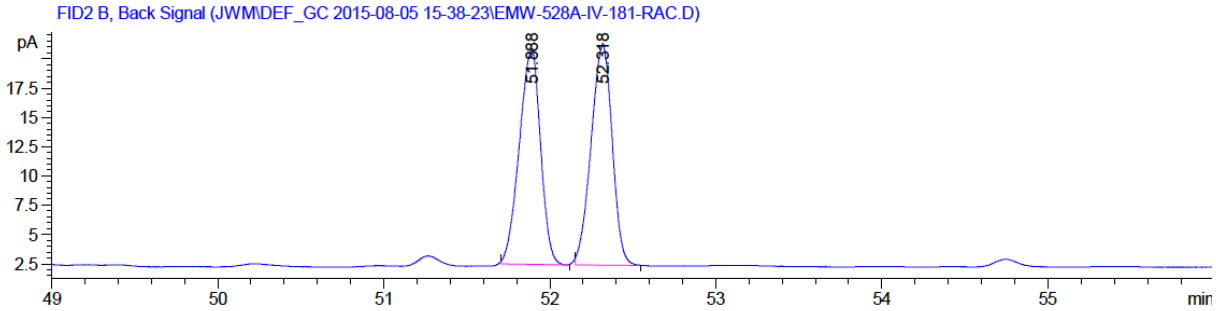
IR (thin film, cm^{-1})

2988, 2941, 1720, 1280, 1238, 1208, 1193, 1153, 1139, 1090, 1037, 946, 891, 843, 787, 589

$[\alpha]_D^{23}$ +67.4 (*c* 1.0, $CHCl_3$)

93% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 52.0 min, t_R(minor) = 52.3 min.

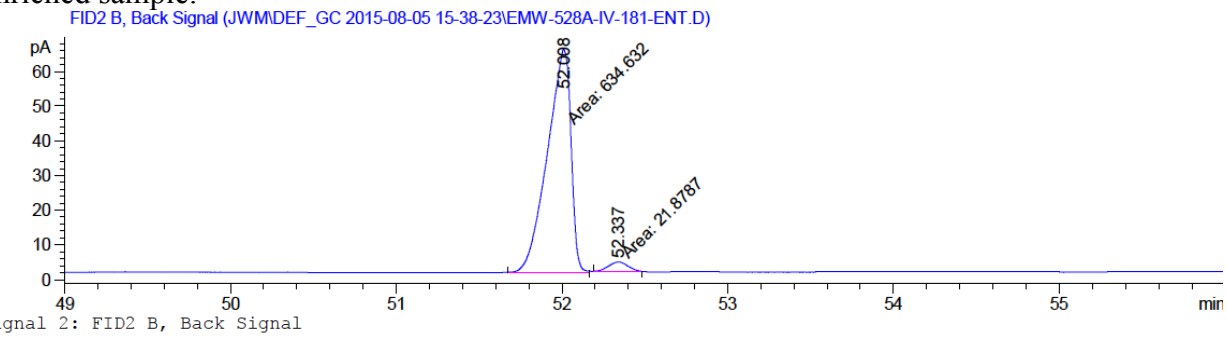
Racemic sample:



Signal 2: FID2 B, Back Signal

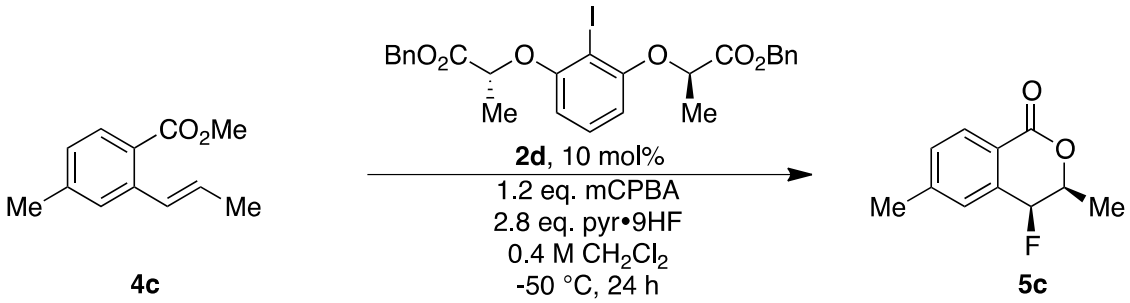
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	51.888	BB	0.1370	163.10365	18.25618	49.47746
2	52.318	BB	0.1356	166.54880	18.89360	50.52254
Totals :				329.65245	37.14977	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	52.008	MM	0.1640	634.63190	64.49779	96.66742
2	52.337	MM	0.1354	21.87875	2.69217	3.33258
Totals :				656.51064	67.18996	



4-fluoro-3,6-dimethylisochroman-1-one 5c. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5c** was isolated as a white solid (124 mg, 64% yield).

TLC (hexanes:EtOAc 3:1)

$R_f = 0.29$, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.05 (d, *J* = 8.0 Hz, 1H), 7.41 (d, *J* = 8.0 Hz, 1H), 7.31 (s, 1H), 5.26 (dd, *J* = 50.0, 1.5 Hz, 1H), 4.69 (dqd, *J* = 27.5, 6.5, 1.5 Hz, 1H), 2.46 (s, 3H), 1.62 (d, *J* = 6.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 164.1, 145.5 (d, *J* = 3.0 Hz), 134.6 (d, *J* = 17.0 Hz), 132.0 (d, *J* = 3.5 Hz), 130.4 (d, *J* = 2.5 Hz), 129.3 (d, *J* = 3.0 Hz), 122.0 (d, *J* = 2.5 Hz), 85.5 (d, *J* = 181.5 Hz), 75.7 (d, *J* = 22.5 Hz), 21.7, 16.1 (d, *J* = 5.0 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -183.1 (dd, *J* = 49.5, 28.0 Hz).

HRMS (ESI+)

Calculated for $C_{11}H_{11}FO_2$ $(M+H)^+$: 195.0816
Found: 195.0825

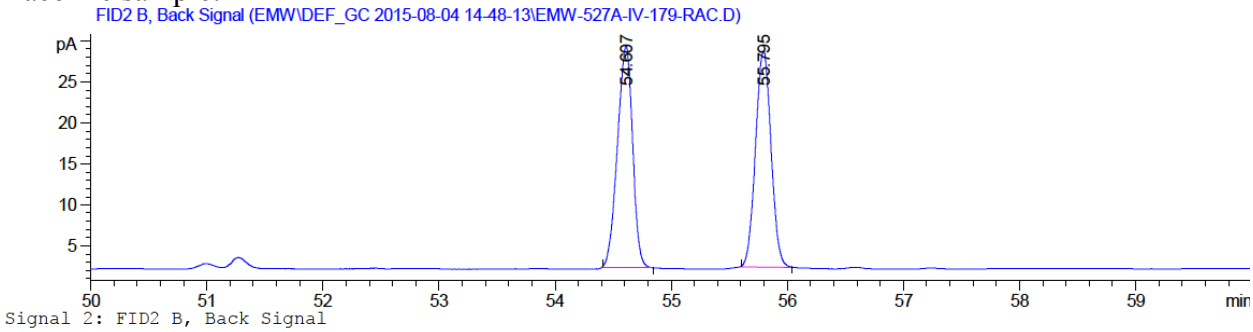
IR (thin film, cm^{-1})

2986, 2943, 1729, 1615, 1274, 1237, 1135, 1094, 1037, 944, 927, 907, 892, 881, 852, 780, 729, 709, 697, 639

$[\alpha]_D^{23}$ +56.0 (*c* 1.0, $CHCl_3$)

94% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 54.6 min, t_R(minor) = 55.8 min.

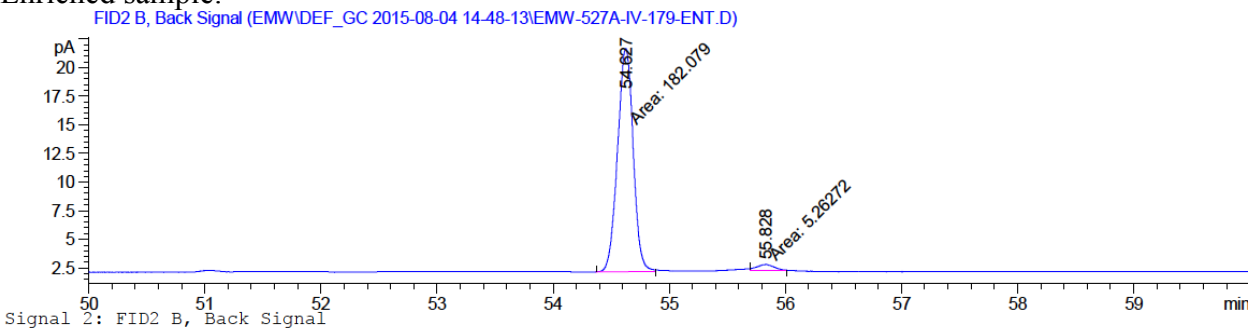
Racemic sample:



Signal 2: FID2 B, Back Signal

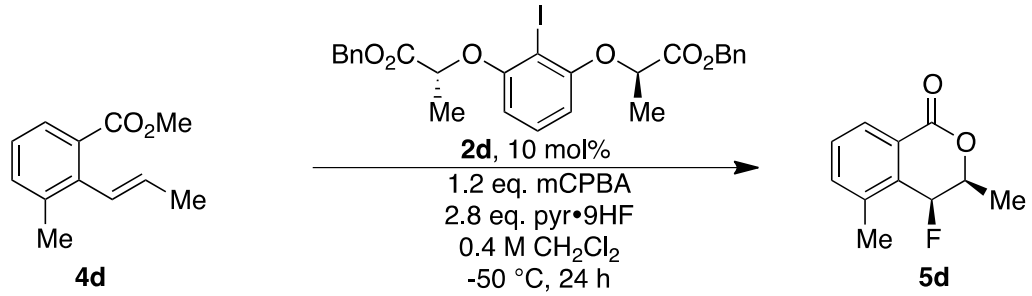
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	54.607	BB	0.1133	245.88181	27.04622	50.14268
2	55.795	BB	0.1247	244.48247	26.24483	49.85732
Totals :				490.36427	53.29106	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	54.627	MM	0.1557	182.07904	19.48489	97.19085
2	55.828	MM	0.1678	5.26272	5.22725e-1	2.80915
Totals :				187.34176	20.00761	



4-fluoro-3,5-dimethylisochroman-1-one 5d. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5d** was isolated as a white solid (101 mg, 52% yield).

TLC (hexanes:EtOAc 3:1)

R_f = 0.27, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.07 (d, *J* = 7.5 Hz, 1H), 7.57-7.48 (m, 2H), 5.49 (dd, *J* = 49.0, 1.5 Hz, 1H), 4.68 (dqd, *J* = 29.5, 7.0, 1.5 Hz, 1H), 2.52 (d, *J* = 1.5 Hz, 3H), 1.69 (d, *J* = 6.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 164.3, 137.3 (d, *J* = 2.5 Hz), 136.0 (d, *J* = 3.0 Hz), 132.9 (d, *J* = 14.5 Hz), 130.7 (d, *J* = 4.0 Hz), 128.3 (d, *J* = 3.0 Hz), 125.0 (d, *J* = 2.5 Hz), 82.3 (d, *J* = 180.0 Hz), 75.3 (d, *J* = 21.5 Hz), 17.9, 16.2 (d, *J* = 5.5 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -190.0 (dd, *J* = 49.5, 29.5 Hz).

HRMS (ESI+)

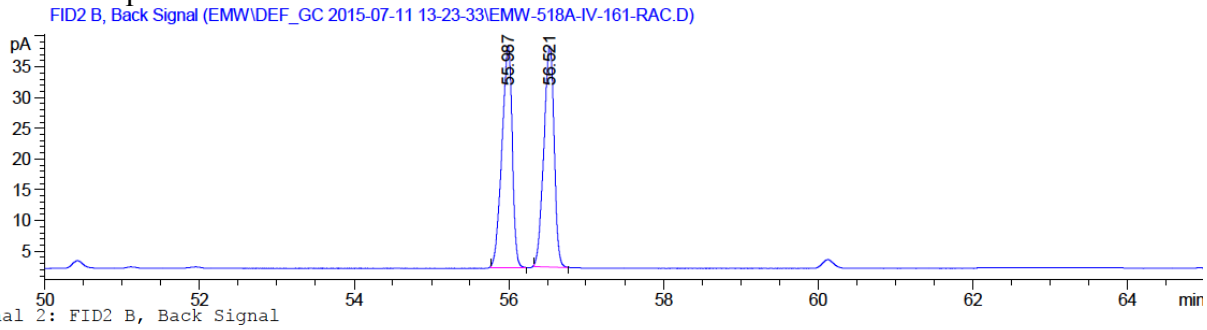
Calculated for $C_{11}H_{11}FO_2$ $(M+H)^+$: 195.0816
Found: 195.0820

IR (thin film, cm^{-1})
2991, 2942, 1717, 1275, 1172, 1160, 1137, 1080, 1038, 985, 949, 763

$[\alpha]_D^{23}$ +48.4 (*c* 1.0, $CHCl_3$)

66% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 56.0 min, t_R(minor) = 56.5 min.

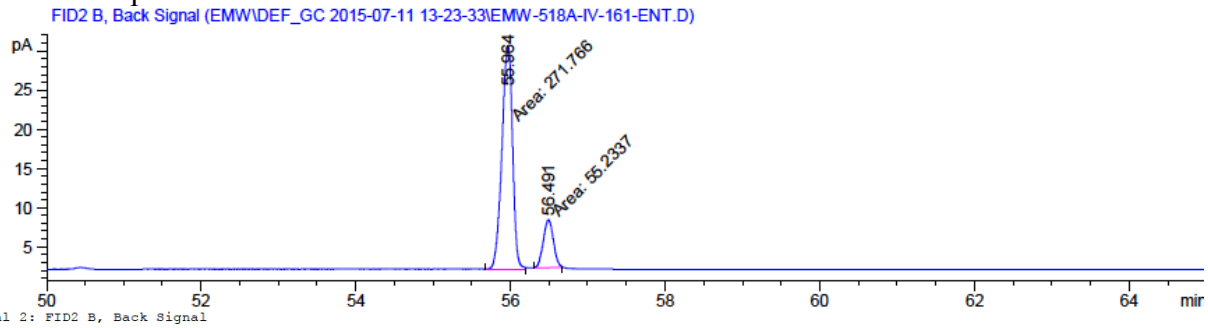
Racemic sample:



Signal 2: FID2 B, Back Signal

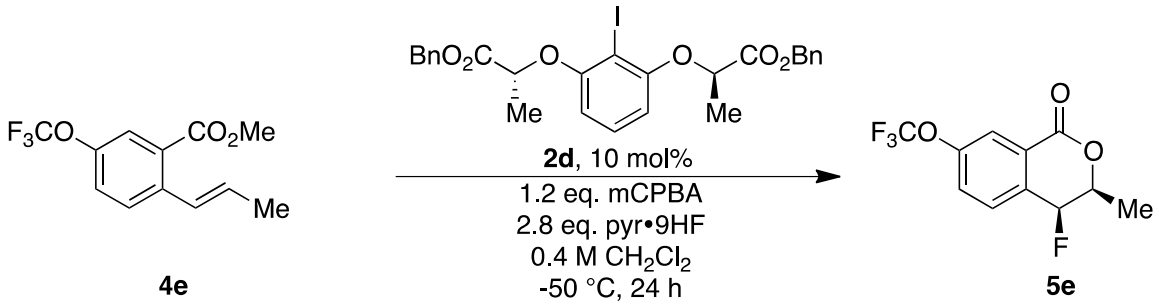
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	55.987	BB	0.1183	333.67615	36.07431	50.08454
2	56.521	BB	0.1194	332.54965	35.85723	49.91546
Totals :				666.22580	71.93154	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	55.964	MM	0.1591	271.76578	28.46391	83.10893
2	56.491	MM	0.1507	55.23372	6.10660	16.89107
Totals :				326.99950	34.57051	



4-fluoro-3-methyl-7-(trifluoromethoxy)isochroman-1-one 5e. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5e** was isolated as a white solid (145 mg, 55% yield).

TLC (hexanes:EtOAc 3:1)

R_f = 0.26, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.02 (s, 1H), 7.62 (d, *J* = 8.5 Hz, 1H), 7.53 (d, *J* = 8.5 Hz, 1H), 5.35 (d, *J* = 49.5 Hz, 1H), 4.74 (dq, *J* = 27.5, 6.5 Hz, 1H), 1.65 (d, *J* = 6.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 162.5, 151.6 (app sextet, *J* = 2.0 Hz), 133.0 (d, *J* = 17.5 Hz), 130.9 (d, *J* = 3.0 Hz), 126.8 (d, *J* = 2.0 Hz), 126.5, 122.1, 120.3 (q, *J* = 258.0 Hz), 84.4 (d, *J* = 182.0 Hz), 76.0 (dd, *J* = 22.0, 3.0 Hz), 16.0 (d, *J* = 5.0 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -58.0, -183.1 (dd, *J* = 49.0, 27.0 Hz).

HRMS (ESI+)

Calculated for $C_{11}H_8F_4O_3$ $(M+H)^+$: 265.0482
Found: 265.0476

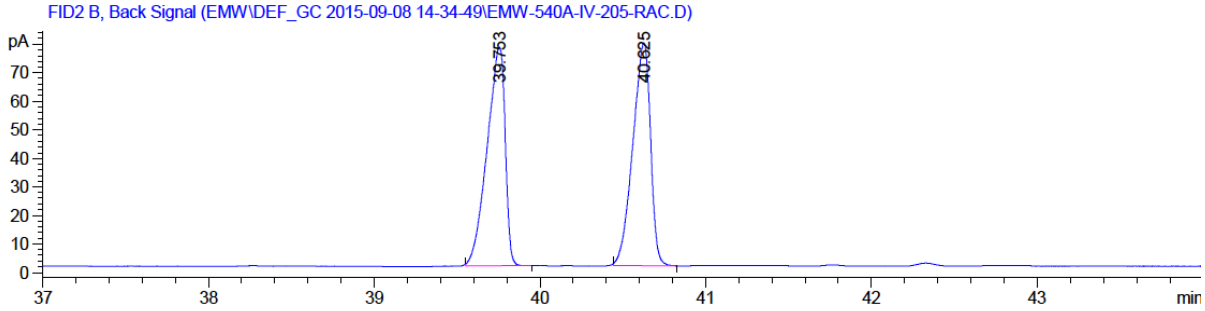
IR (thin film, cm^{-1})

2996, 2945, 1725, 1252, 1204, 1164, 1132, 1106, 1085, 1038, 990, 961, 931, 897, 880, 836, 786, 587

$[\alpha]_D^{23}$ +62.6 (*c* 1.0, $CHCl_3$)

89% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 39.8 min, t_R(minor) = 40.6 min.

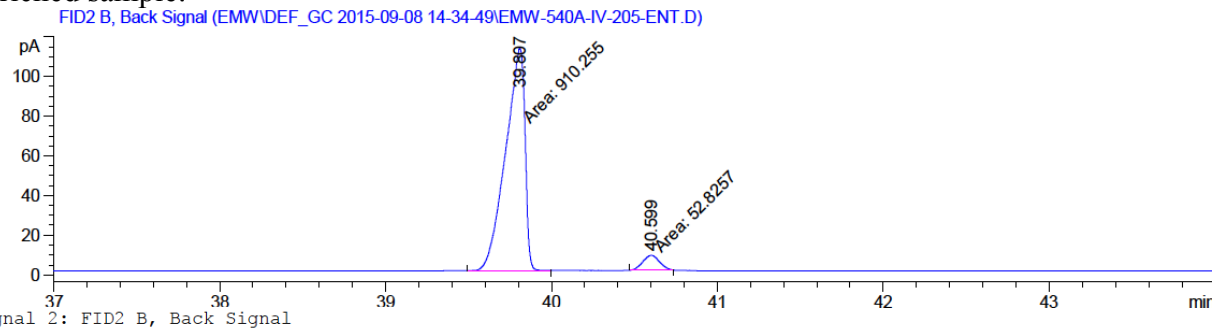
Racemic sample:



Signal 2: FID2 B, Back Signal

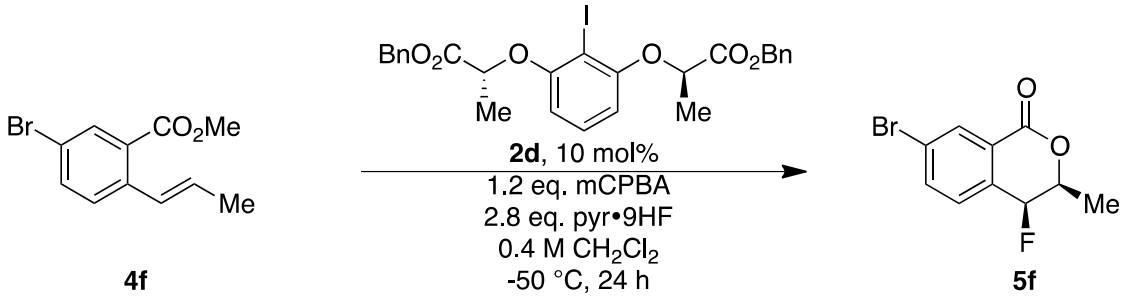
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	39.753	BB	0.1083	578.91248	76.46005	49.94131
2	40.625	BB	0.1091	580.27307	78.09214	50.05869
Totals :				1159.18555	154.55219	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	39.807	MM	0.1348	910.25458	112.52360	94.51492
2	40.599	MM	0.1168	52.82574	7.53536	5.48508
Totals :				963.08031	120.05896	



7-bromo-4-fluoro-3-methylisochroman-1-one 5f. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5f** was isolated as a white solid (124 mg, 48% yield).

TLC (hexanes:EtOAc 3:1)

R_f = 0.34, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.33 (bs, 1H), 7.84-7.81 (m, 1H), 7.42 (dd, *J* = 8.0, 2.5 Hz, 1H), 5.32 (dd, *J* = 49.5, 1.5 Hz, 1H), 4.72 (dqd, *J* = 28.0, 7.0, 1.5 Hz, 1H), 1.65 (dd, *J* = 6.5, 1.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 162.5, 137.3 (d, *J* = 3.0 Hz), 133.4 (d, *J* = 3.0 Hz), 133.3 (d, *J* = 17.5 Hz), 130.4 (d, *J* = 3.0 Hz), 126.3 (d, *J* = 2.0 Hz), 122.5 (d, *J* = 4.5 Hz), 84.7 (d, *J* = 182.0), 75.8 (d, *J* = 22.0 Hz), 16.0 (d, *J* = 4.5 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -183.4 (dd, *J* = 49.5, 27.5 Hz).

HRMS (ESI+)

Calculated for $C_{10}H_8BrFO_2$ $(M+H)^+$: 258.9764
Found: 258.9759

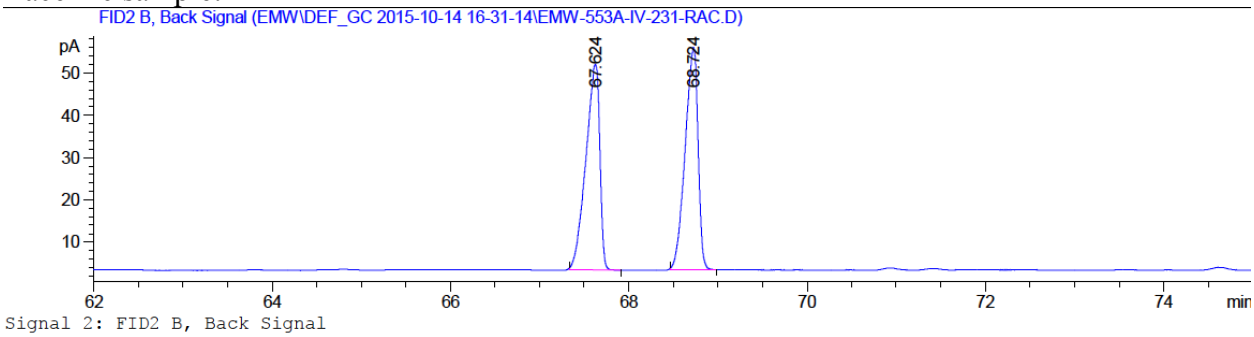
IR (thin film, cm^{-1})

3084, 2990, 2942, 1723, 1418, 1283, 1254, 1228, 1136, 1099, 1072, 1036, 983, 942, 896, 875, 830, 788, 704, 583, 526

$[\alpha]_D^{23}$ +55.0 (*c* 1.0, $CHCl_3$)

86% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 67.5 min, t_R(minor) = 68.6 min.

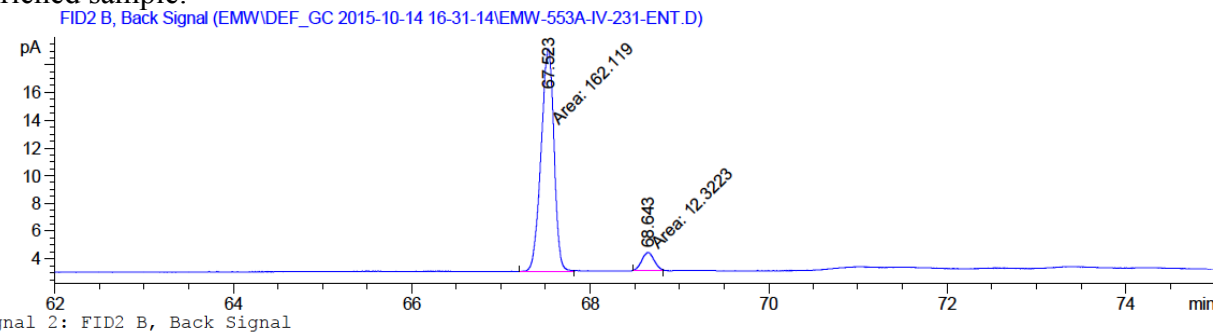
Racemic sample:



Signal 2: FID2 B, Back Signal

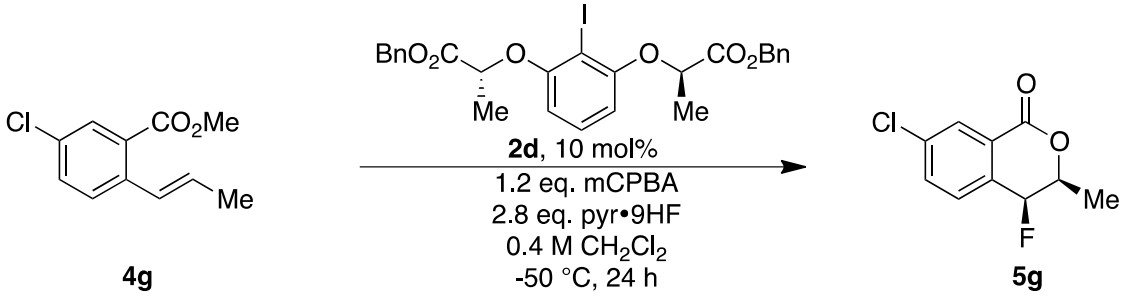
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	67.624	BB	0.1302	525.79370	48.59820	49.91754
2	68.724	BB	0.1222	527.53082	52.43005	50.08246
Totals :				1053.32452	101.02824	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	67.523	MM	0.1681	162.11919	16.07693	92.93612
2	68.643	MM	0.1567	12.32233	1.31044	7.06388
Totals :				174.44152	17.38737	



7-chloro-4-fluoro-3-methylisochroman-1-one 5g. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5g** was isolated as a white solid (128 mg, 60% yield).

TLC (hexanes:EtOAc 3:1)

R_f = 0.26, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.15 (d, *J* = 2.0 Hz, 1H), 7.66 (dq, *J* = 8.5, 1.5 Hz, 1H), 7.49 (dd, *J* = 8.5, 2.5 Hz, 1H), 5.32 (dd, *J* = 49.5, 1.5 Hz, 1H), 4.72 (dqd, *J* = 27.5, 6.5, 1.5 Hz, 1H), 1.64 (dd, *J* = 6.5, 1.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 162.6, 137.6 (d, *J* = 4.5 Hz), 134.4 (d, *J* = 3.0 Hz), 132.9 (d, *J* = 18.5 Hz), 130.3 (d, *J* = 2.5 Hz), 130.3 (d, *J* = 3.5 Hz), 126.3 (d, *J* = 2.0 Hz), 84.6 (d, *J* = 182.5 Hz), 75.9 (d, *J* = 22.0 Hz), 16.0 (d, *J* = 5.0 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -183.2 (dd, J = 49.5, 27.5 Hz).

HRMS (ESI+)

Calculated for $C_{10}H_8ClFO_2$ $(M+H)^+$: 215.0270
Found: 215.0278

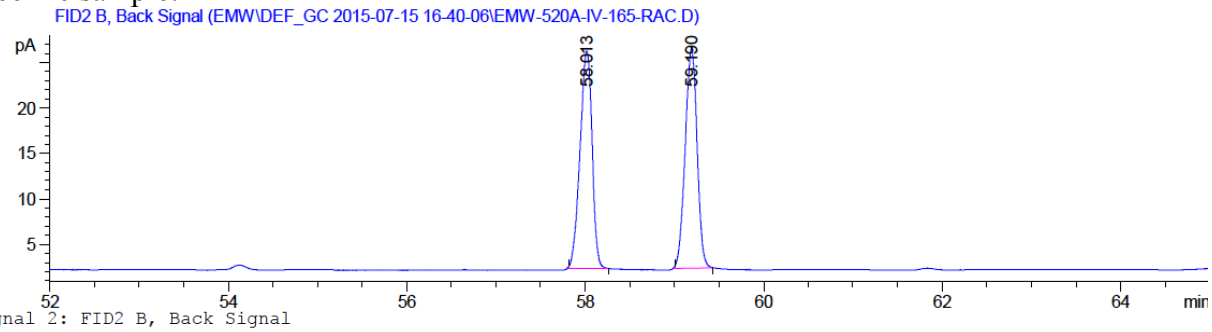
IR (thin film, cm^{-1})

2999, 2943, 1729, 1285, 1256, 1227, 1134, 1077, 939, 907, 895, 878, 826, 782, 729, 705, 665, 584, 529

$[\alpha]_D^{23}$ +69.0 (*c* 1.0, $CHCl_3$)

86% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 58.1 min, t_R(minor) = 59.2 min.

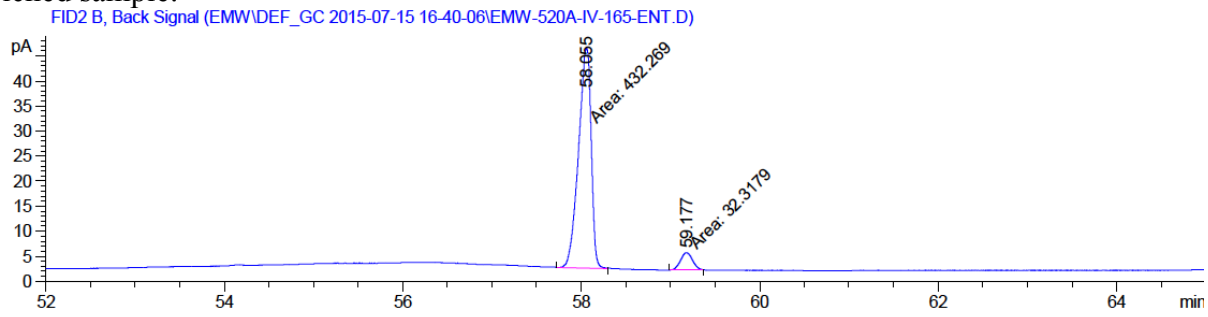
Racemic sample:



Signal 2: FID2 B, Back Signal

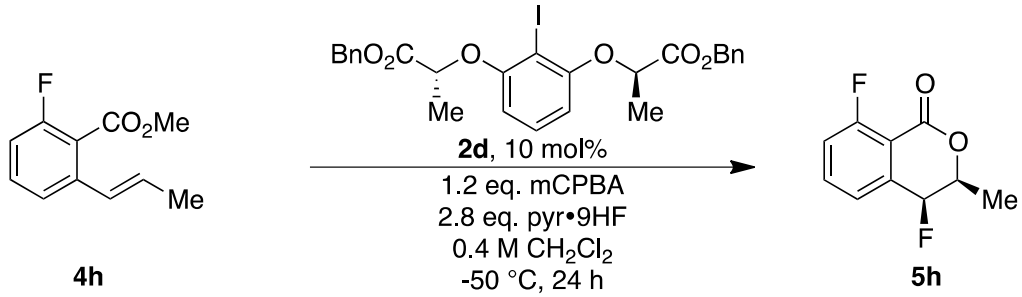
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	58.013	BB	0.1378	224.60539	23.87055	50.01006
2	59.190	BB	0.1420	224.51503	24.34014	49.98994
Totals :				449.12042		48.21069

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	58.055	MM	0.1635	432.26938	44.06221	93.04374
2	59.177	MM	0.1543	32.31788	3.49147	6.95626
Totals :				464.58726	47.55368	



4,8-difluoro-3-methylisochroman-1-one 5h. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5h** was isolated as a white solid (133 mg, 67% yield).

TLC (hexanes:EtOAc 4:1)

R_f = 0.10, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 7.72-7.64 (m, 1H), 7.38-7.27 (m, 2H), 5.34 (dt, *J* = 49.5, 2.0 Hz, 1H), 4.70 (dqd, *J* = 27.5, 7.0, 1.5 Hz, 1H), 1.62 (dd, *J* = 6.5, 1.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 163.7, 160.5 (d, *J* = 270.0, 7.0 Hz), 136.9 (d, *J* = 17.0 Hz), 135.9 (dd, *J* = 10.0, 3.0 Hz), 124.6 (t, *J* = 4.0 Hz), 119.8 (dd, *J* = 21.5, 3.5 Hz), 113.0 (d, *J* = 7.0 Hz), 85.1 (dd, *J* = 183.0, 2.5 Hz), 75.4 (d, *J* = 22.0 Hz), 15.9 (d, *J* = 4.0 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -107.4, -185.1 (dd, *J* = 52.5, 26.5 Hz).

HRMS (ESI+)

Calculated for $C_{10}H_8F_2O_2$ $(M+H)^+$: 199.0565
Found: 199.0571

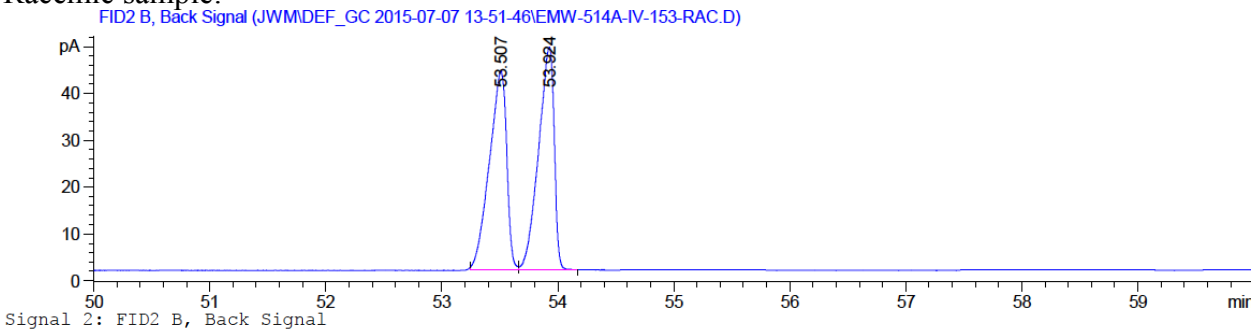
IR (thin film, cm^{-1})

2994, 2944, 1728, 1475, 1251, 1108, 1041, 978, 939, 896, 820, 798, 728, 696, 591

$[\alpha]_D^{23}$ +89.2 (*c* 1.0, $CHCl_3$)

83% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(minor) = 53.4 min, t_R(major) = 53.9 min.

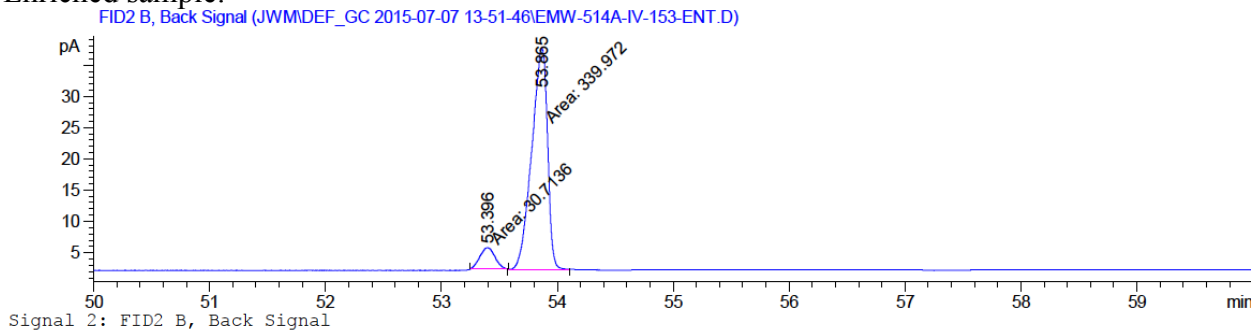
Racemic sample:



Signal 2: FID2 B, Back Signal

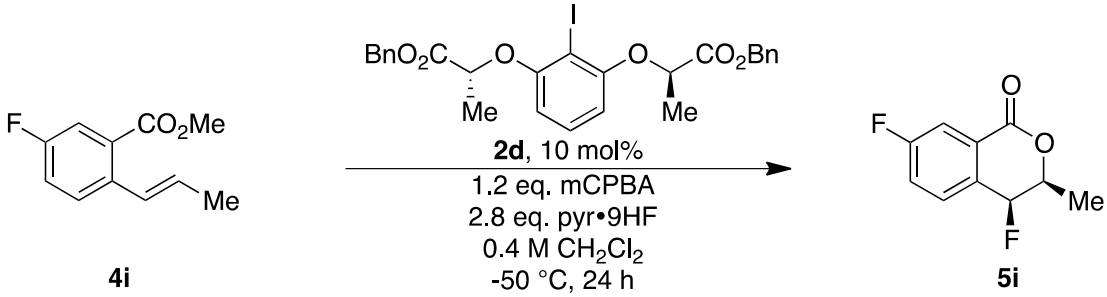
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	53.507	BV	0.1324	439.95749	42.64786	49.69271
2	53.924	VB	0.1279	445.39865	47.46279	50.30729
Totals :				885.35614	90.11065	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	53.396	MM	0.1499	30.71361	3.41581	8.28562
2	53.865	MM	0.1590	339.97186	35.62683	91.71438
Totals :				370.68547	39.04264	



4,7-difluoro-3-methylisochroman-1-one 5i. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5i** was isolated as a white solid (113 mg, 57% yield).

TLC (hexanes:EtOAc 3:1)
R_f = 0.26, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)
δ 7.84 (dd, *J* = 8.5, 2.5 Hz, 1H), 7.55 (ddd, *J* = 8.5, 5.0, 2.5 Hz, 1H), 7.39 (ddd, *J* = 8.5, 2.5, 1.0 Hz, 1H), 5.32 (dd, *J* = 49.5, 1.5 Hz, 1H), 4.72 (dqd, *J* = 28.0, 6.5, 1.5 Hz, 1H), 1.64 (dd, *J* = 7.0, 1.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)
δ 164.0 (dd, *J* = 252.5, 3.5 Hz), 162.8 (dd, *J* = 2.5, 1.0 Hz), 131.2 (dd, *J* = 7.5, 3.0 Hz), 130.8 (dd, *J* = 18.0, 3.0 Hz), 127.0 (dd, *J* = 8.5, 2.0 Hz), 121.7 (dd, *J* = 22.5, 3.0 Hz), 117.1 (dd, *J* = 23.5, 2.5 Hz), 84.5 (dd, *J* = 182.0, 2.5 Hz), 76.1 (dd, *J* = 22.5, 2.0 Hz), 16.1 (d, *J* = 5.0 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)
δ -107.1 (m), -181.8 (ddd, *J* = 49.0, 28.0, 8.0 Hz).

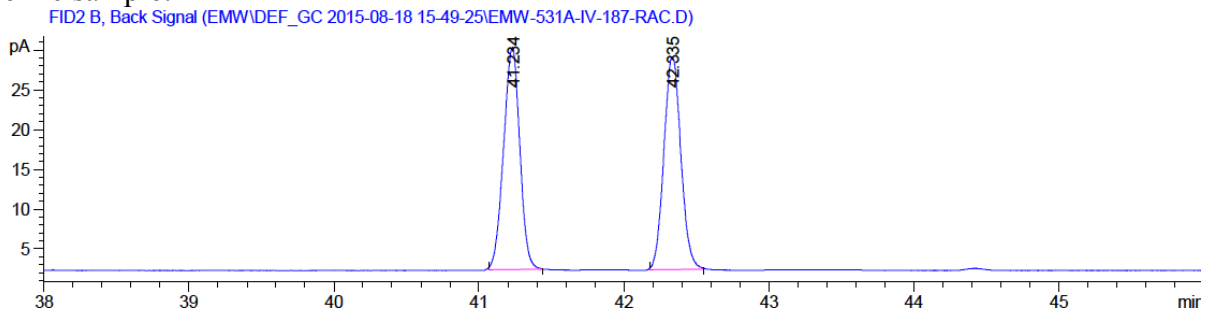
HRMS (ESI+)
Calculated for $C_{10}H_8F_2O_2$ $(M+H)^+$: 199.0565
Found: 199.0561

IR (thin film, cm^{-1})
3075, 3006, 2949, 1721, 1505, 1439, 1296, 1275, 1236, 1217, 1129, 1076, 1033, 944, 901, 893, 850, 830, 787, 694, 591, 534

$[\alpha]_D^{23}$ +80.2 (*c* 1.0, $CHCl_3$)

93% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 41.3 min, t_R(minor) = 42.4 min.

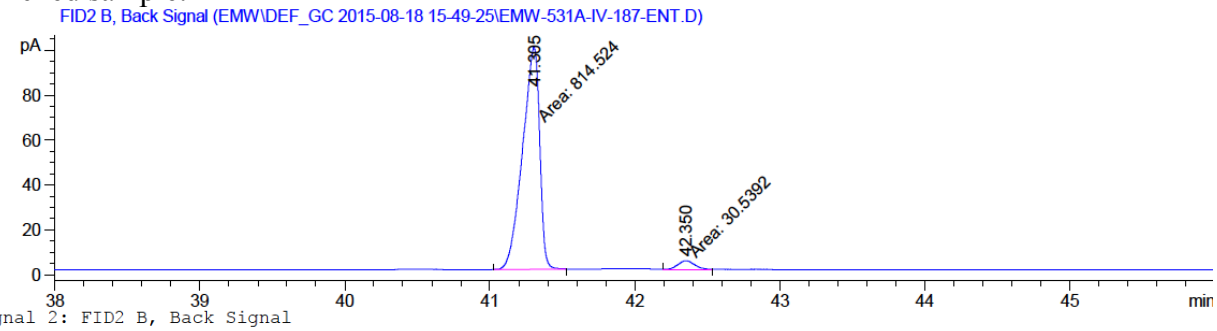
Racemic sample:



Signal 2: FID2 B, Back Signal

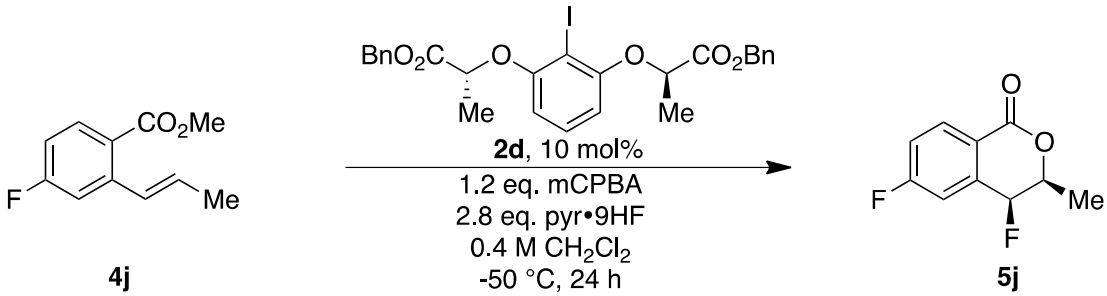
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	41.234	BB	0.1085	217.18713	27.87222	50.00758
2	42.335	BB	0.1140	217.12128	26.71702	49.99242
Totals :				434.30841	54.58924	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	41.305	MM	0.1365	814.52423	99.46216	96.38617
2	42.350	MM	0.1337	30.53919	3.80829	3.61383
Totals :				845.06342	103.27045	



4,6-difluoro-3-methylisochroman-1-one 5j. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5j** was isolated as a white solid (121 mg, 61% yield).

TLC (hexanes:EtOAc 3:1)

R_f = 0.25, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.20 (dd, *J* = 8.5, 5.5 Hz, 1H), 7.29 (tt, *J* = 8.5, 2.5 Hz, 1H), 7.21 (dt, *J* = 8.0, 2.5 Hz, 1H), 5.30 (dd, *J* = 49.5, 1.5 Hz, 1H), 4.72 (dqd, *J* = 27.5, 7.0, 1.5 Hz, 1H), 1.61 (dd, *J* = 7.0, 1.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 165.9 (dd, *J* = 258.0, 3.5 Hz), 162.8, 137.3 (dd, *J* = 17.0, 8.5 Hz), 133.6 (dd, *J* =9.5, 2.5 Hz), 121.0 (t, *J* = 3.0 Hz), 118.7 (dd, *J* = 22.5, 3.5 Hz), 115.6 (dd, *J* = 23.0, 3.5 Hz), 84.9 (d, *J* = 183.0 Hz), 75.6 (d, *J* = 22.0 Hz), 15.9 (d, *J* = 5.0 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -101.9 (m), -184.5 (dd, *J* = 49.5, 27.0 Hz).

HRMS (ESI+)

Calculated for $C_{10}H_8F_2O_2$ $(M+H)^+$: 199.0565
Found: 199.0572

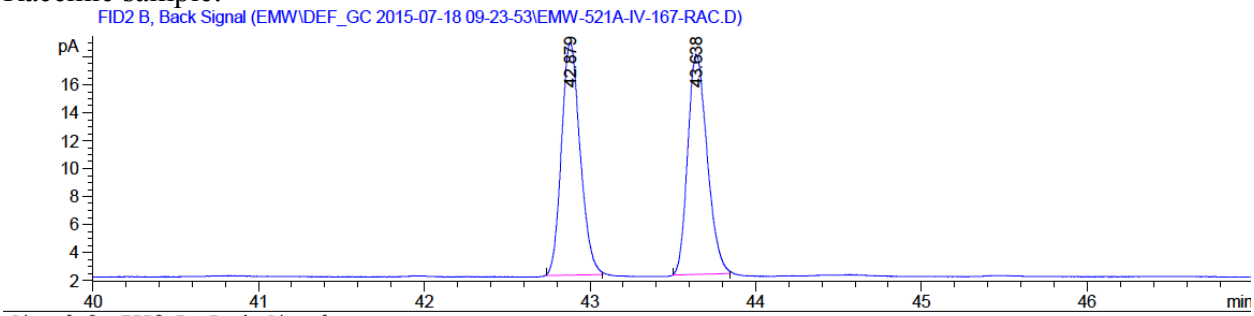
IR (thin film, cm^{-1})

3081, 2991, 2950, 1741, 1613, 1361, 1298, 1267, 1254, 1119, 1100, 953, 871, 694

$[\alpha]_D^{23}$ +57.4 (*c* 1.0, $CHCl_3$)

80% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 42.9 min, t_R(minor) = 43.7 min.

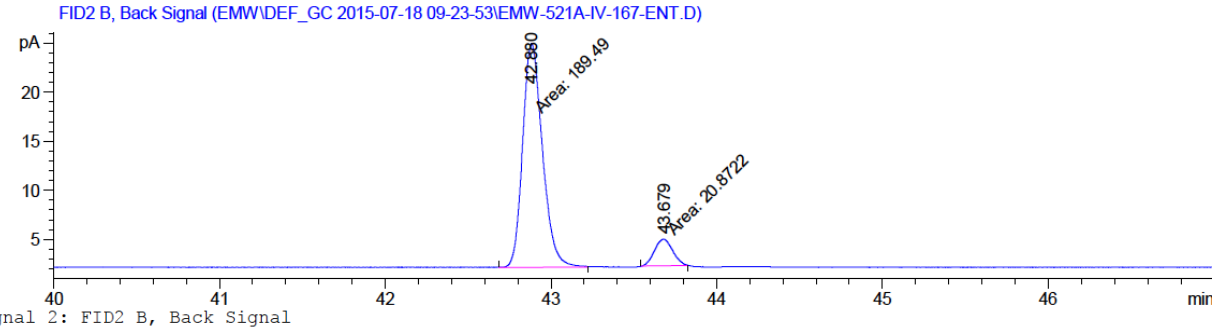
Racemic sample:



Signal 2: FID2 B, Back Signal

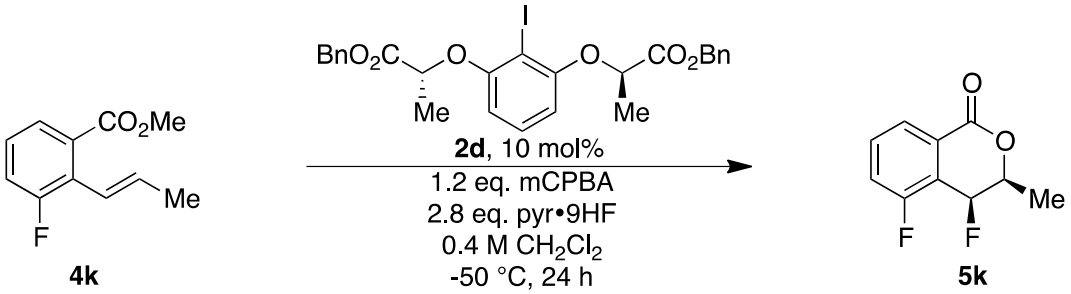
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	42.879	BB	0.1022	130.05312	16.66449	50.22486
2	43.638	BB	0.1082	128.88858	15.75811	49.77514
Totals :				258.94170	32.42260	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	42.880	MM	0.1383	189.49002	22.82919	90.07796
2	43.679	MM	0.1264	20.87223	2.75320	9.92204
Totals :				210.36225	25.58239	



4,5-difluoro-3-methylisochroman-1-one 5k. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5k** was isolated as a white solid (97 mg, 49% yield).

TLC (hexanes:EtOAc 3:1)

R_f = 0.39, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.02 (d, *J* = 7.5 Hz, 1H), 7.66-7.59 (m, 1H), 7.43 (tt, *J* = 8.5, 1.5 Hz, 1H), 5.65 (dd, *J* = 49.0, 1.5 Hz, 1H), 4.70 (dqd, *J* = 29.0, 6.5, 1.5 Hz, 1H), 1.69 (dd, *J* = 7.0, 1.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 162.8 (d, *J* = 4.0 Hz), 159.4 (dd, *J* = 253.0, 2.5 Hz), 132.7 (dd, *J* = 8.0, 4.0 Hz), 126.5 (t, *J* = 2.0 Hz), 126.2 (t, *J* = 3.0 Hz), 122.2 (t, *J* = 18.0 Hz), 121.1 (dd, *J* = 20.0, 3.0 Hz), 78.8 (dt, *J* = 182.0, 3.0 Hz), 76.0 (dd, *J* = 22.0, 2.0 Hz), 16.2 (d, *J* =5.0 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -119.2 (m), -188.7 (dd, *J* = 49.0, 29.0 Hz).

HRMS (ESI+)

Calculated for $C_{10}H_8F_2O_2$ $(M+H)^+$: 199.0565

Found: 199.0561

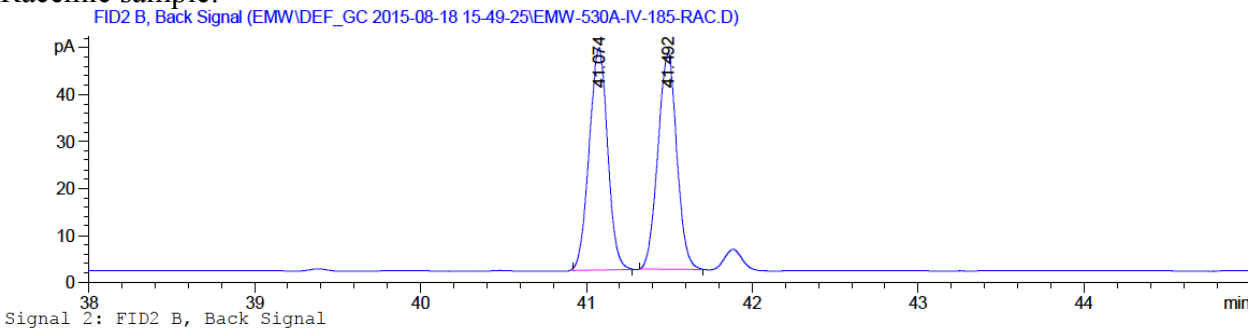
IR (thin film, cm^{-1})

3069, 3000, 2950, 1724, 1477, 1363, 1274, 1251, 1171, 1158, 1134, 1107, 1034, 965, 922, 879, 852, 763

$[\alpha]_D^{23}$ +27.4 (*c* 1.0, $CHCl_3$)

30% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(minor) = 41.1 min, t_R(major) = 41.5 min.

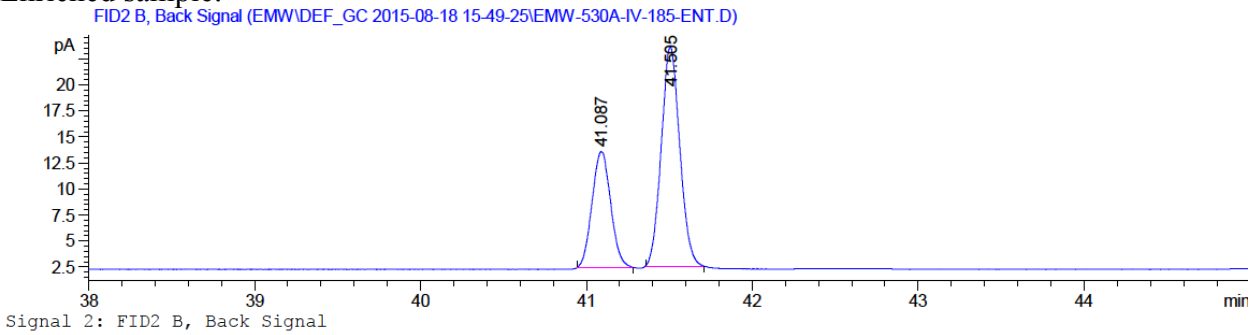
Racemic sample:



Signal 2: FID2 B, Back Signal

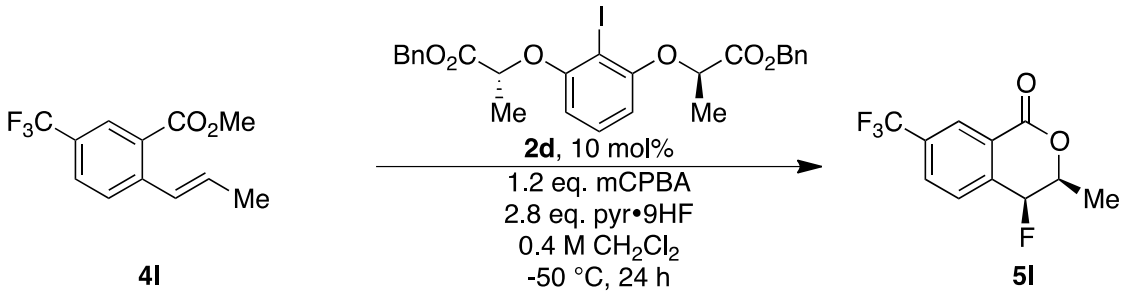
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	41.074	BB	0.1150	365.61722	47.29373	50.05731
2	41.492	BB	0.1239	364.78009	45.92915	49.94269
Totals :				730.39731	93.22288	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	41.087	BB	0.1069	87.69493	11.15483	34.76458
2	41.505	BB	0.1150	164.55875	21.09698	65.23542
Totals :				252.25368	32.25181	



4-fluoro-3-methyl-7-(trifluoromethyl)isochroman-1-one 5l. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5l** was isolated as a white solid (149 mg, 60% yield).

TLC (hexanes:EtOAc 2:1)

R_f = 0.43, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.47 (s, 1H), 7.95 (d, *J* = 8.0 Hz, 1H), 7.69 (dd, *J* = 8.0, 1.5 Hz, 1H), 5.40 (dd, *J* = 49.0, 1.5 Hz, 1H), 4.76 (dqd, *J* = 26.0, 6.5, 2.0 Hz, 1H), 1.66 (dd, *J* = 6.5, 1.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 162.4, 137.8 (d, *J* = 17.0 Hz), 133.7 (dd, *J* = 34.0, 3.5 Hz), 130.8 (m), 129.5 (d, *J* = 3.5 Hz), 127.6 (m), 125.6 (d, *J* = 2.5 Hz), 123.1 (d, *J* = 272.0 Hz), 84.4 (d, *J* = 183.0 Hz), 75.7 (d, *J* = 22.0 Hz), 15.9 (d, *J* = 4.5 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -63.2 (d, *J* = 2.0 Hz), -185.1 (dd, *J* = 48.0, 26.5 Hz).

HRMS (ESI+)

Calculated for $C_{11}H_8F_4O_2$ $(M+H)^+$: 249.0533
Found: 249.0535

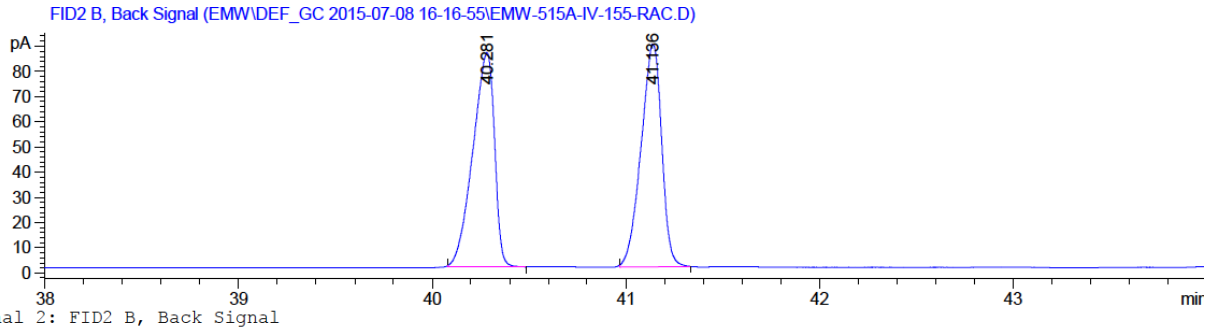
IR (thin film, cm^{-1})

2994, 2917, 2849, 1729, 1331, 1251, 1234, 1172, 1126, 1098, 1069, 1039, 948, 885, 845, 634

$[\alpha]_D^{23}$ +39.4 (*c* 1.0, $CHCl_3$)

73% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 40.2 min, t_R(minor) = 41.1 min.

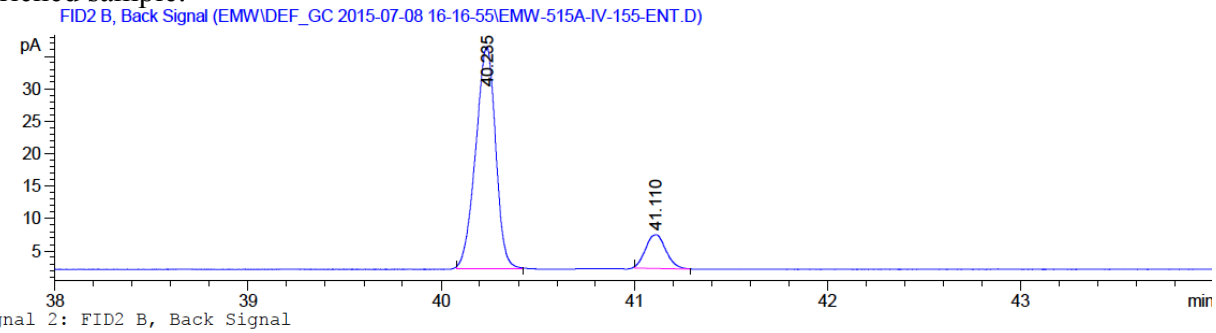
Racemic sample:



Signal 2: FID2 B, Back Signal

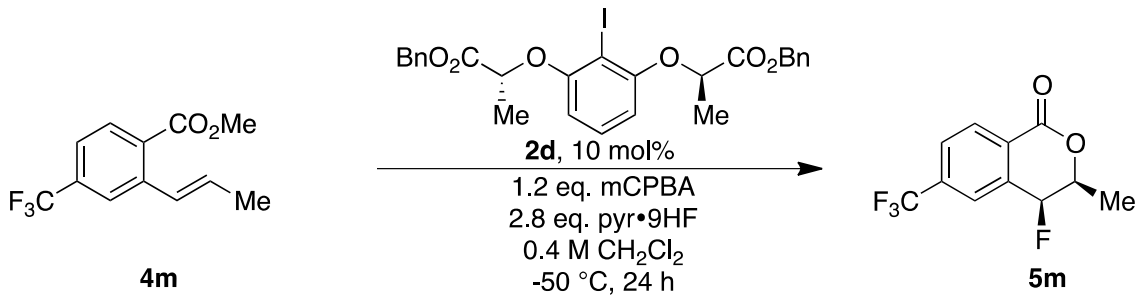
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	40.281	BB	0.1093	663.49445	85.19624	50.34462
2	41.136	BB	0.1065	654.41101	88.27049	49.65538
Totals :				1317.90546	173.46674	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	40.235	BB	0.1037	244.93425	34.14903	86.58817
2	41.110	BB	0.1120	37.93840	5.22228	13.41183
Totals :				282.87265	39.37131	



4-fluoro-3-methyl-6-(trifluoromethyl)isochroman-1-one 5m. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5m** was isolated as a white solid (109 mg, 44% yield).

TLC (hexanes:EtOAc 3:1)

R_f = 0.41, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.33 (d, *J* = 8.0 Hz, 1H), 7.89 (d, *J* = 8.0 Hz, 1H), 7.81 (s, 1H), 5.41 (dd, *J* = 49.0, 1.5 Hz, 1H), 4.77 (dqd, *J* = 27.5, 7.0, 2.0 Hz, 1H), 1.67 (dd, *J* = 7.0, 1.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 162.4, 135.8 (dq, *J* = 33.0, 3.0), 135.3 (d, *J* = 18.0 Hz), 131.2 (d, *J* = 2.0 Hz), 127.8, 127.0 (dp, *J* = 274.0, 3.5 Hz), 124.1, 121.9, 84.7 (d, *J* = 183.0 Hz), 75.8 (dd, *J* = 22.0, 2.5 Hz), 15.9 (d, *J* = 5.0 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -63.3, -184.2 (dd, *J* = 48.5, 26.5 Hz).

HRMS (ESI+)

Calculated for $C_{11}H_8F_4O_2$ $(M+H)^+$: 249.0533
Found: 249.0537

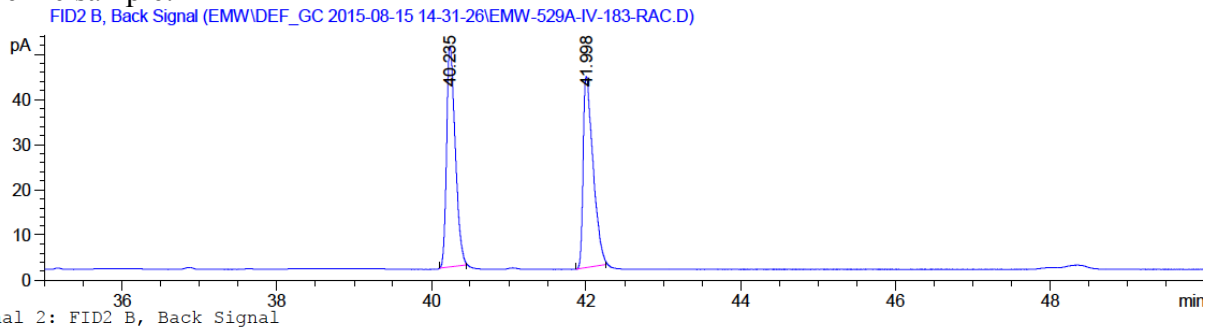
IR (thin film, cm^{-1})

3100, 2994, 1737, 1337, 1322, 1297, 1268, 1197, 1185, 1154, 1129, 1097, 1067, 982, 941, 905, 883, 868, 798, 700

$[\alpha]_D^{23}$ +50.8 (*c* 1.0, $CHCl_3$)

76% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 40.3 min, t_R(minor) = 42.1 min.

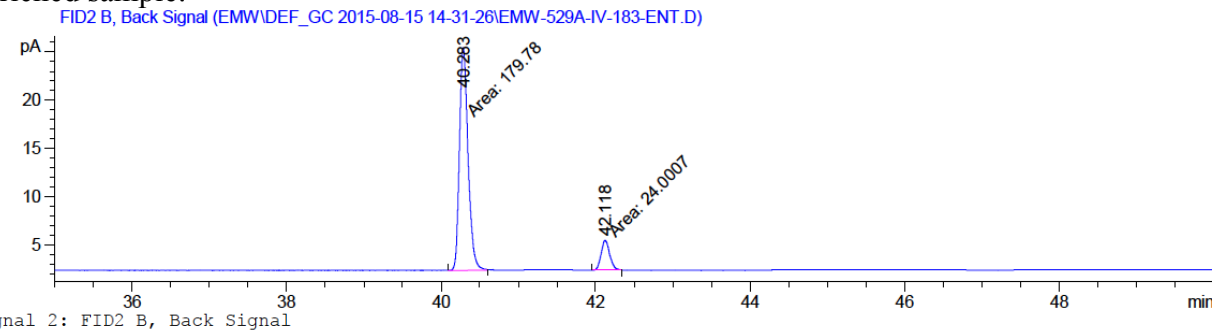
Racemic sample:



Signal 2: FID2 B, Back Signal

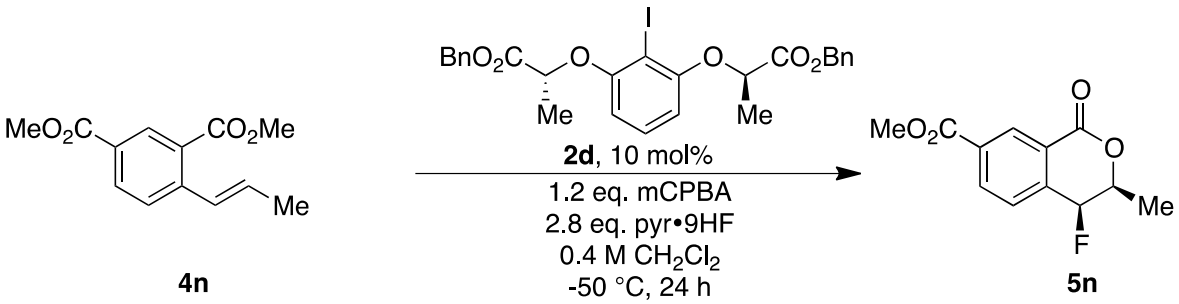
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	40.235	BB	0.1093	380.51321	48.81329	50.21573
2	41.998	BB	0.1255	377.24377	42.36752	49.78427
Totals :				757.75699	91.18081	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	40.283	MM	0.1296	179.78040	23.11809	88.22232
2	42.118	MM	0.1293	24.00069	3.09440	11.77768
Totals :				203.78108	26.21248	



methyl 4-fluoro-3-methyl-1-oxoisochromane-7-carboxylate 5n. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5n** was isolated as a white solid (83 mg, 35% yield).

TLC (hexanes:EtOAc 2:1)

R_f = 0.24, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.81 (s, 1H), 8.34 (dt, *J* = 8.0, 1.5 Hz, 1H), 7.62 (dd, *J* = 8.0, 2.0 Hz, 1H), 5.38 (dd, *J* = 49.0, 1.5 Hz, 1H), 4.75 (dqd, *J* = 27.0, 7.0, 1.5 Hz, 1H), 3.96 (s, 3H), 1.64 (dd, *J* = 6.5, 1.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 165.3, 162.9, 138.3 (d, *J* = 17.5 Hz), 135.0 (d, *J* = 3.0 Hz), 133.2 (d, *J* = 3.5 Hz), 131.7 (d, *J* = 2.5 Hz), 129.0 (d, *J* = 3.5 Hz), 125.1 (d, *J* = 2.0 Hz), 84.8 (d, *J* = 183.0 Hz), 75.6 (d, *J* = 21.5 Hz), 52.7, 15.8.

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -185.2 (dd, *J* = 50.0, 27.0 Hz).

HRMS (ESI+)

Calculated for $C_{12}H_{11}FO_4$ $(M+H)^+$: 239.0714
Found: 239.0725

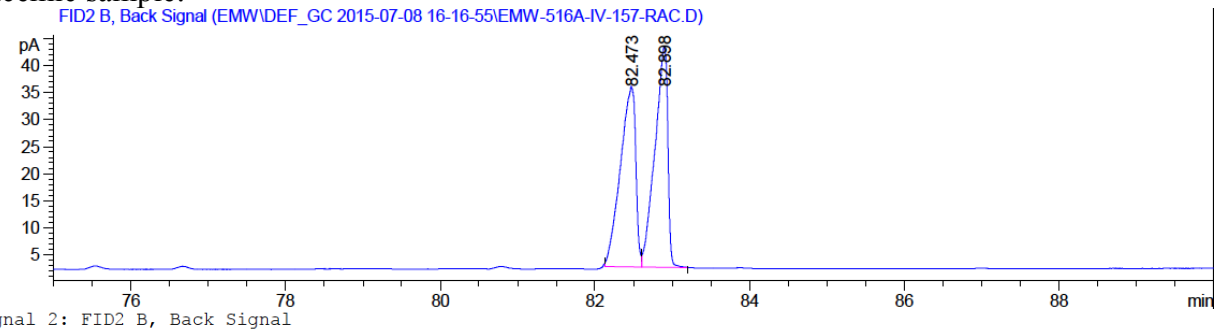
IR (thin film, cm^{-1})

2995, 2954, 1720, 1304, 1234, 1134, 1082, 1037, 989, 969, 944, 897, 770, 761, 731, 698, 584

$[\alpha]_D^{23}$ +64.6 (*c* 1.0, $CHCl_3$)

70% *ee*, Chiral GC (β-Cyclosil, 60 °C to 200 °C , 10 psi); t_R(major) = 82.3 min, t_R(minor) = 82.7 min.

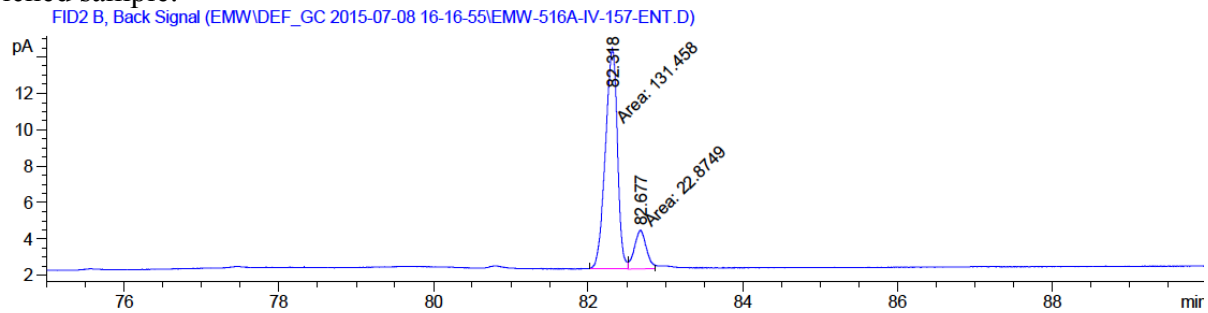
Racemic sample:



Signal 2: FID2 B, Back Signal

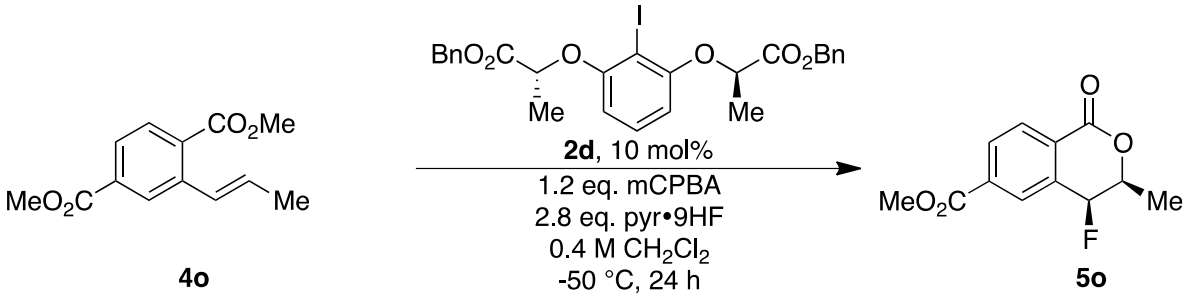
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	82.473	BV	0.1651	460.33545	33.34133	49.29885
2	82.898	VB	0.1427	473.42972	40.76165	50.70115
Totals :				933.76517	74.10299	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	82.318	MM	0.1802	131.45795	12.16079	85.17823
2	82.677	MM	0.1793	22.87485	2.12687	14.82177
Totals :				154.33280	14.28766	



4o **5o**

methyl 4-fluoro-3-methyl-1-oxoisochromane-6-carboxylate 5o. Following the "general procedure for the synthesis of products 5a-o" on a 1 mmol scale, fluorolactone **5o** was isolated as a white solid (121 mg, 51% yield).

TLC (hexanes:EtOAc 1:1)

R_f = 0.14, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.22 (app s, 2H), 8.17-8.15 (m, 1H), 5.36 (dd, *J* = 49.0, 1.5 Hz, 1H), 4.73 (dqd, *J* = 27.5, 6.5, 1.5 Hz, 1H), 3.94 (s, 3H), 1.63 (d, *J* = 7.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 165.3, 162.9, 135.2 (d, *J* = 2.5 Hz), 134.8 (d, *J* = 17.5 Hz), 131.9 (d, *J* = 3.5 Hz), 130.6 (d, *J* = 2.5 Hz), 130.0 (d, *J* = 3.0 Hz), 128.1 (d, *J* = 2.0 Hz), 84.9 (d, *J* = 181.5 Hz), 75.8 (d, *J* = 21.0 Hz), 52.8, 16.0 (d, *J* = 4.5 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -183.7 (dd, *J* = 49.0, 27.5 Hz).

HRMS (ESI+)

Calculated for $C_{12}H_{11}FO_4$ $(M+H)^+$: 239.0714
Found: 239.0720

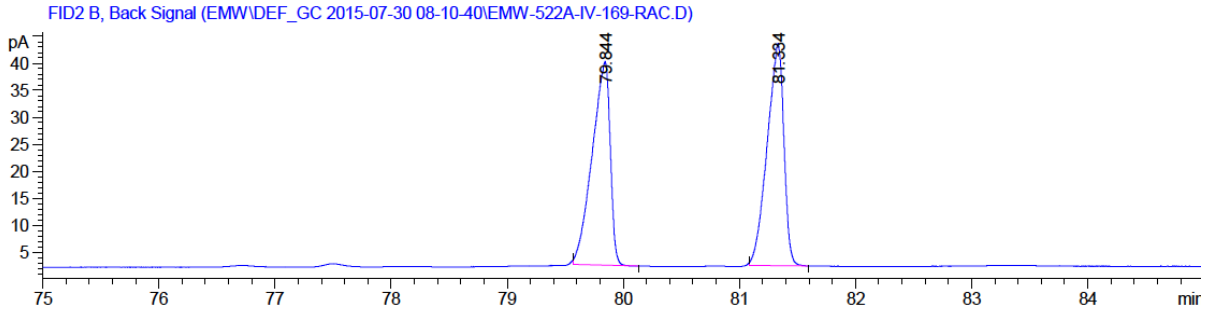
IR (thin film, cm^{-1})

2997, 2956, 1720, 1267, 1232, 1202, 1132, 1113, 1084, 923, 907, 755, 747, 729, 713, 691

$[\alpha]_D^{23}$ +40.0 (*c* 1.0, $CHCl_3$)

58% *ee*, Chiral GC (β-Cyclosil, 60 °C to 200 °C , 10 psi); t_R(major) = 79.8 min, t_R(minor) = 81.3 min.

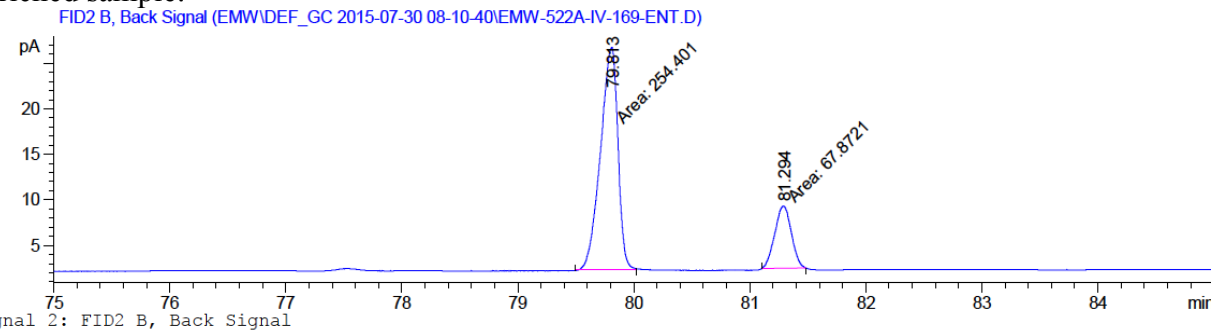
Racemic sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	79.844	BB	0.1443	406.93326	37.71641	49.75588
2	81.334	BB	0.1303	410.92630	41.08205	50.24412
Totals :				817.85956	78.79846	

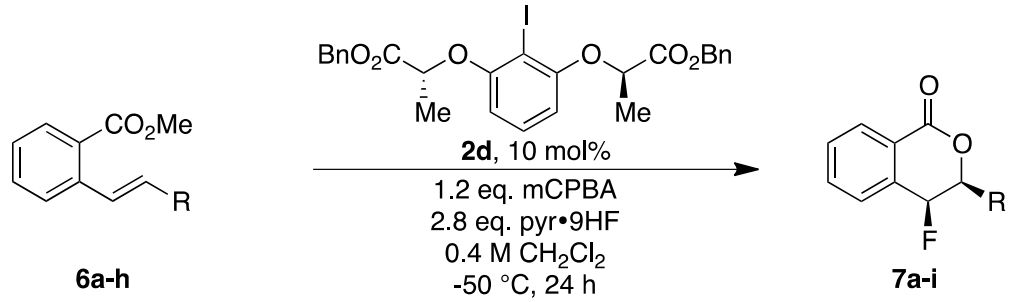
Enriched sample:



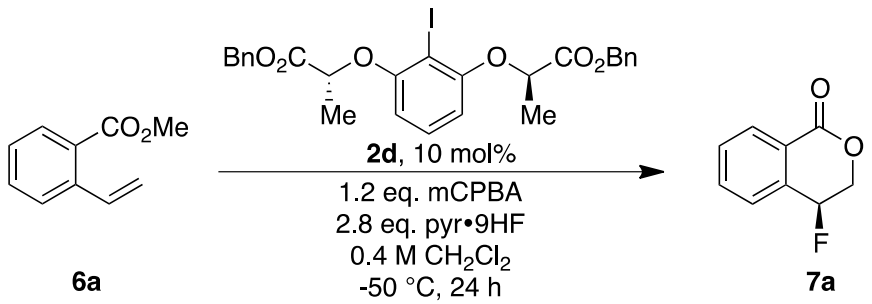
Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	79.813	MM	0.1741	254.40073	24.36075	78.93956
2	81.294	MM	0.1655	67.87207	6.83387	21.06044
Totals :				322.27280	31.19461	

VI. Table 3. Fluorolactonization of alkene substituted substrates



General procedure for the synthesis of products 7a-i.
To a 7 mL low-density polyethylene vial with snap cap charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 269 mg, 1.2 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C . To the cooled vial was added aryl iodide catalyst **2d** (56.0 mg, 0.10 mmol, 10 mol%) as a solution in CH_2Cl_2 (1.5 mL) followed by pyr•9HF (70% HF, 0.65 mL, 25 mmol HF, 25 eq. HF). The alkene **6a-h** (1.0 mmol) was added as a solution in CH_2Cl_2 (1.0 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C cryocool with vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (2.5 g) in CH_2Cl_2 (5.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The solution was concentrated under reduced pressure. The resulting residue was dry loaded onto celite and purified by column chromatography on silica gel (hexanes:EtOAc 100:0 → 80:20) to afford fluorolactone **7a-i**.



4-fluoroisochroman-1-one 7a. Following the "general procedure for the synthesis of products 7a-i" on a 1 mmol scale, fluorolactone **7a** was isolated as a clear colorless oil (81.4 mg, 49% yield).

TLC (hexanes:EtOAc 4:1)
R_f = 0.16, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.21 (d, *J* = 7.5 Hz, 1H), 7.72 (t, *J* =7.5 Hz, 1H), 7.64 (t, *J* = 7.5 Hz, 1H), 7.56 (d, *J* = 7.5 Hz, 1H), 5.59 (ap. dt, *J* = 49.5, 2.5 Hz, 1H), 4.86 (ddd, *J* = 16.1, 13.2 Hz, 3.4 Hz, 1H), 4.64 (ddd, *J* = 33.5, 12.5, 2.5 Hz, 1H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 163.1, 134.5 (d, *J* = 17.5 Hz), 134.4 (d, *J* = 3.0 Hz), 131.2 (d, *J* = 3.5 Hz), 130.5 (d, *J* = 2.0 Hz), 128.1 (d, *J* = 3.5 Hz), 124.8 (d, *J* = 2.0 Hz), 82.9 (d, *J* = 177.5 Hz), 69.7 (d, *J* = 24.5 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -171.5 (ddd, *J* = 49.5, 34.0, 12.0 Hz).

HRMS (ESI+)

Calculated for $C_9H_7FO_2$ $(M+H)^+$: 167.0503
Found: 167.0499

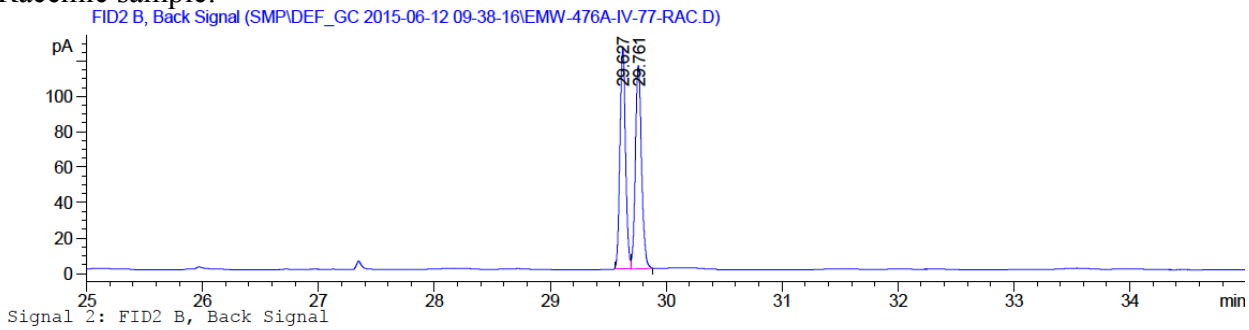
IR (thin film, cm^{-1})

2958, 1721, 1396, 1279, 1241, 1129, 1053, 1028, 961, 865, 767, 751, 716, 696, 606

$[\alpha]_D^{23}$ +40.4 (*c* 1.0, $CHCl_3$)

87% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C , 10 psi); t_R(major) = 29.6 min, t_R(minor) = 29.8 min.

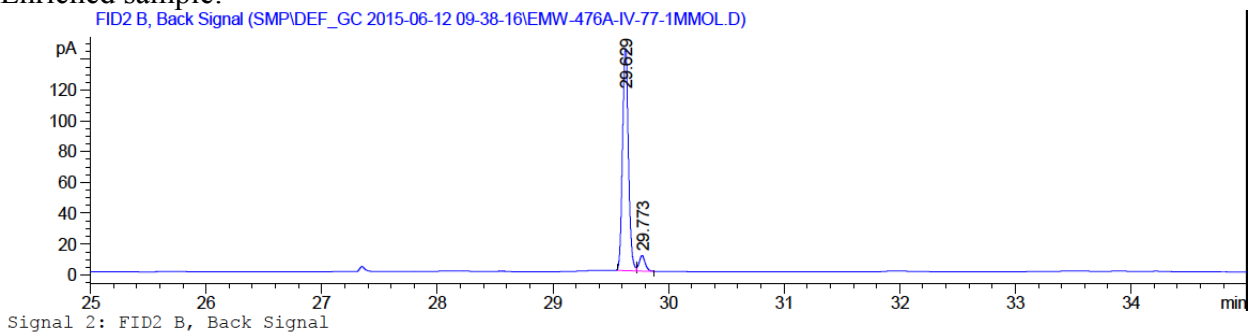
Racemic sample:



Signal 2: FID2 B, Back Signal

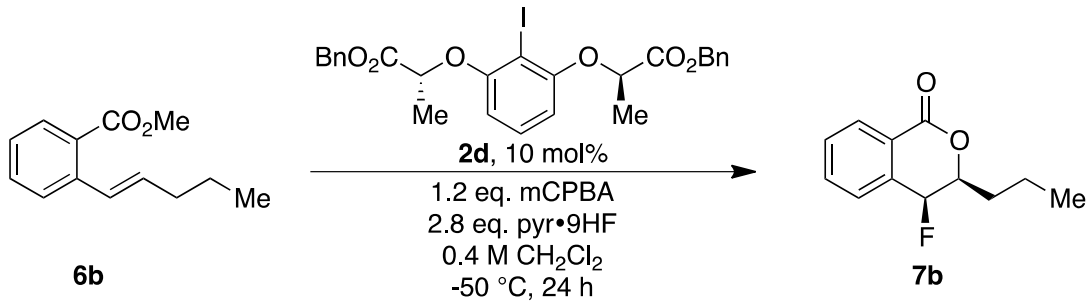
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	29.627	BV	0.0501	419.01712	125.53122	49.60110
2	29.761	VB	0.0569	425.75674	114.73489	50.39890
Totals :				844.77386	240.26611	

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	29.629	BV	0.0555	516.02985	143.78676	93.45555
2	29.773	VB	0.0550	36.13621	9.98415	6.54445
Totals :				552.16605	153.77091	



4-fluoro-3-propylisochroman-1-one 7b. Following the "general procedure for the synthesis of products 7a-i" on a 1 mmol scale, fluorolactone **7b** was isolated as a white solid (129 mg, 62% yield).

TLC (hexanes:EtOAc 4:1)

R_f = 0.26, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.19 (d, *J* = 7.5 Hz, 1H), 7.69 (tt, *J* = 7.5, 1.5 Hz, 1H), 7.62 (tdd, *J* = 7.5, 2.0, 1.5 Hz, 1H), 7.52 (ddd, *J* = 7.5, 2.5, 1.5 Hz, 1H), 5.37 (dd, *J* = 49.5, 1.5 Hz, 1H), 4.53 (dddd, *J* = 29.0, 8.3, 5.5, 1.5 Hz, 1H), 2.13-2.03 (m, 1H), 1.94-1.84 (m, 1H), 1.73-1.52 (m, 2H), 1.02 (t, *J* = 7.5 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 163.9, 134.6 (d, *J* = 17.0 Hz), 134.2 (d, *J* = 3.0 Hz), 131.3 (d, *J* = 3.5 Hz), 130.4 (d, *J* = 3.0 Hz), 128.8 (d, *J* = 3.5 Hz), 125.1 (d, *J* = 2.5 Hz), 84.6 (d, *J* = 180.5 Hz), 79.2 (d, *J* = 22.0 Hz), 32.2 (d, *J* = 3.5 Hz), 18.2, 13.8.

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -182.2 (dd, *J* = 49.5, 28.5 Hz).

HRMS (ESI+)

Calculated for $C_{12}H_{13}FO_2$ $(M+H)^+$:	209.0972
Found:	209.0978

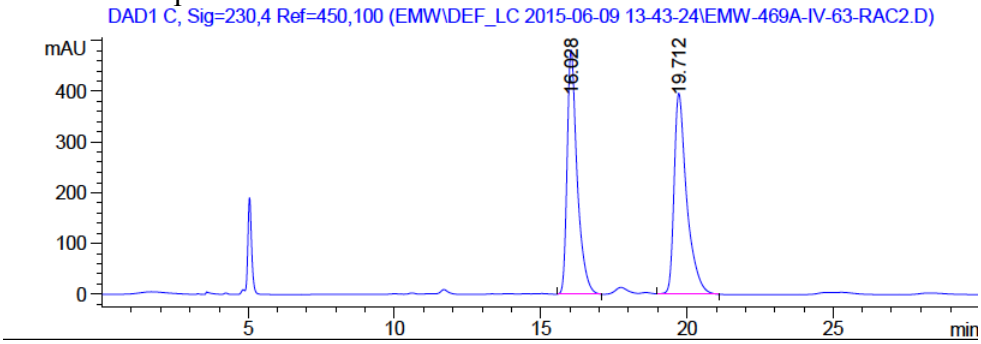
IR (thin film, cm^{-1})

2962, 2875, 1718, 1607, 1463, 1277, 1125, 979, 903, 718, 625

$[\alpha]_D^{23}$ +46.2 (*c* 1.0, $CHCl_3$)

95% *ee*, Chiral HPLC (CHIRALPAK AD-H, 3% isopropanol in hexanes, 1.0 mL/min, λ = 230 nm); t_R(major) = 16.2 min, t_R(minor) = 20.1 min.

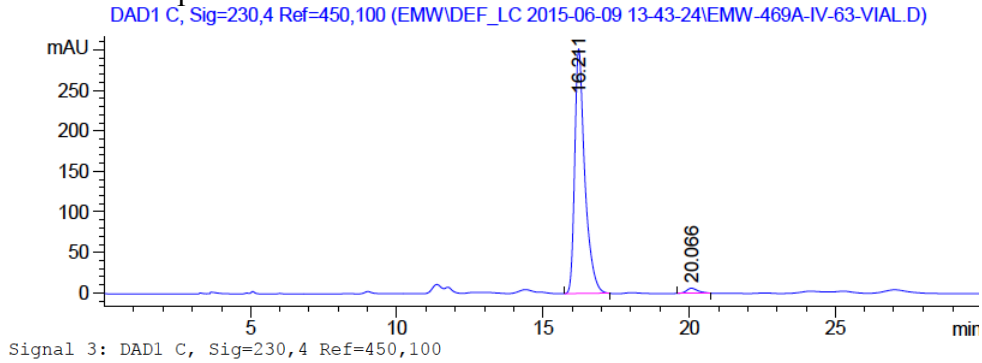
Racemic sample:



Signal 3: DAD1 C, Sig=230,4 Ref=450,100

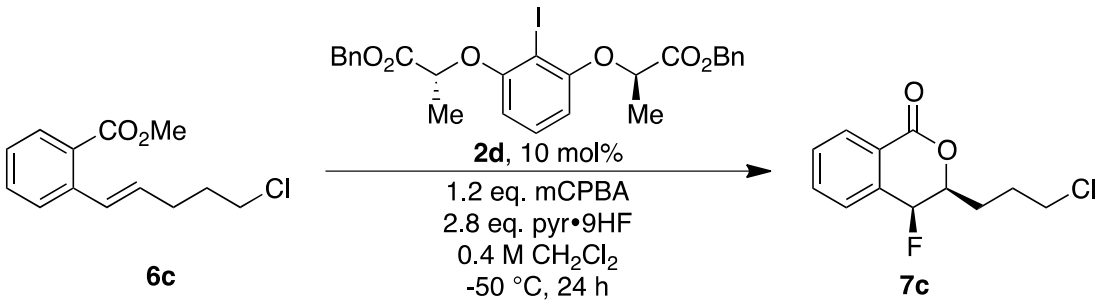
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.028	BB	0.3528	1.14844e4	480.63147	48.9924
2	19.712	VB	0.4443	1.19568e4	395.92218	51.0076
Totals :				2.34412e4	876.55365	

Enriched sample:



Signal 3: DAD1 C, Sig=230,4 Ref=450,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.211	BB	0.3573	7288.53760	302.28888	97.5958
2	20.066	BB	0.4193	179.54802	6.39947	2.4042
Totals :				7468.08562	308.68835	



3-(3-chloropropyl)-4-fluoroisochroman-1-one 7c. Following the "general procedure for the synthesis of products 7a-i" on a 1 mmol scale, fluorolactone **7c** was isolated as a white solid (146 mg, 60% yield).

TLC (hexanes:EtOAc 4:1)

R_f = 0.14, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.20 (d, *J* = 7.5 Hz, 1H), 7.71 (tt, *J* = 7.5, 1.5 Hz, 1H), 7.64 (tt, *J* = 7.5, 1.5 Hz, 1H), 7.53 (d, *J* = 7.5 Hz, 1H), 5.38 (d, *J* = 49.5 Hz, 1H), 4.57 (dddd, *J* = 28.0, 8.5, 4.4, 1.5 Hz, 1H), 3.73-3.60 (m, 2H), 2.30-2.16 (m, 2H), 2.15-1.98 (m, 2H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 163.5, 134.4 (d, *J* = 18.0 Hz), 134.4 (d, *J* = 3.0 Hz), 131.4 (d, *J* = 4.0 Hz), 130.5 (d, *J* = 3.0 Hz), 128.8 (d, *J* = 3.5 Hz), 125.0 (d, *J* = 2.0 Hz), 84.9 (d, *J* = 181.0 Hz), 78.6 (d, *J* = 21.0 Hz), 44.5, 28.0, 27.9 (d, *J* = 4.0 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -181.4 (dd, *J* = 49.5, 28.5 Hz).

HRMS (ESI+)

Calculated for $C_{12}H_{12}ClFO_2$ $(M+H)^+$:243.0583
Found: 243.0588

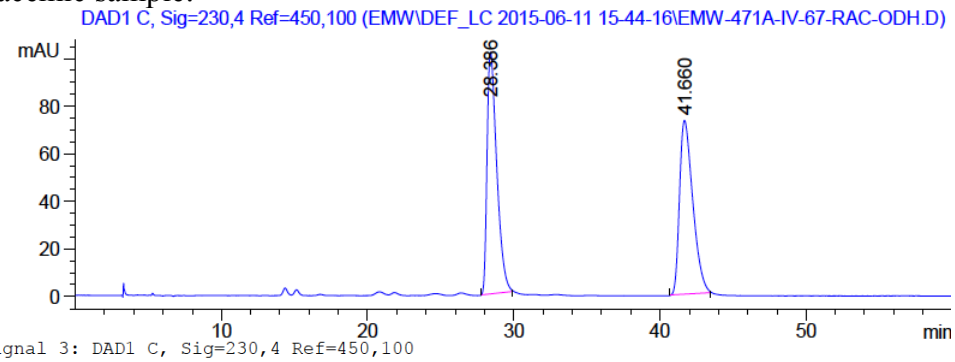
IR (thin film, cm^{-1})

2961, 1732, 1275, 1240, 1124, 1092, 1029, 904, 765, 698

$[\alpha]_D^{23}$ +38.8 (*c* 1.0, $CHCl_3$)

95% *ee*, Chiral HPLC (CHIRALPAK OD-H, 5% isopropanol in hexanes, 1.0 mL/min, λ = 230 nm); t_R(major) = 27.9 min, t_R(minor) = 41.8 min.

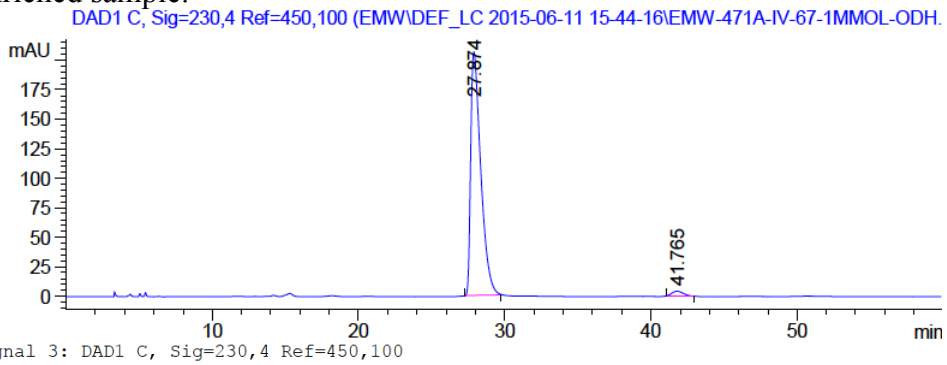
Racemic sample:



Signal 3: DAD1 C, Sig=230,4 Ref=450,100

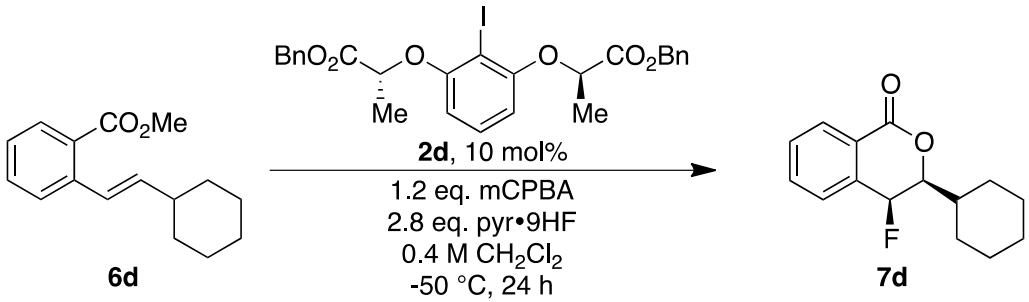
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	28.386	BB	0.7009	4695.12793	101.63579	50.4615
2	41.660	BB	0.9434	4609.24023	73.12428	49.5385
Totals :				9304.36816	174.76006	

Enriched sample:



Signal 3: DAD1 C, Sig=230,4 Ref=450,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	27.874	BB	0.7063	9879.97363	206.47075	97.6746
2	41.765	BB	0.6734	235.22179	4.18713	2.3254
Totals :				1.01152e4	210.65787	



3-cyclohexyl-4-fluoroisochroman-1-one 7d. Following the "general procedure for the synthesis of products 7a-i" on a 1 mmol scale, fluorolactone **7d** was isolated as a white solid (144 mg, 58% yield).

TLC (hexanes:EtOAc 4:1)
R_f = 0.37, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)
δ 8.20 (d, *J* = 7.5 Hz, 1H), 7.70 (tt, *J* = 7.5, 1.5 Hz, 1H), 7.63 (t, *J* = 7.5 Hz, 1H), 7.52 (d, *J* = 7.5 Hz, 1H), 5.53 (d, *J* = 49.5 Hz, 1H), 4.17 (ddd, *J* = 31.0, 9.0, 1.5 Hz, 1H), 2.40-2.30 (m, 1H), 2.19-2.06 (m, 1H), 2.03-1.94 (m, 1H), 1.88-1.78 (m, 2H), 1.78-1.68 (m, 1H), 1.47-1.28 (m, 2H), 1.28-1.05 (m, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)
δ 164.0, 134.5 (d, *J* = 17.0 Hz), 134.2 (d, *J* = 3.0 Hz), 131.3 (d, *J* = 3.5 Hz), 130.4 (d, *J* = 3.0 Hz), 129.0 (d, *J* = 3.5 Hz), 125.4 (d, *J* = 2.0 Hz), 83.7 (d, *J* = 21.5 Hz), 83.0 (d, *J* = 180.5 Hz), 37.9 (d, *J* = 1.5 Hz), 29.4, 28.2, 26.2, 25.7, 25.4.

^{19}F-NMR (470 MHz, $CDCl_3$)
δ -181.9 (dd, *J* = 49.5, 31.0 Hz).

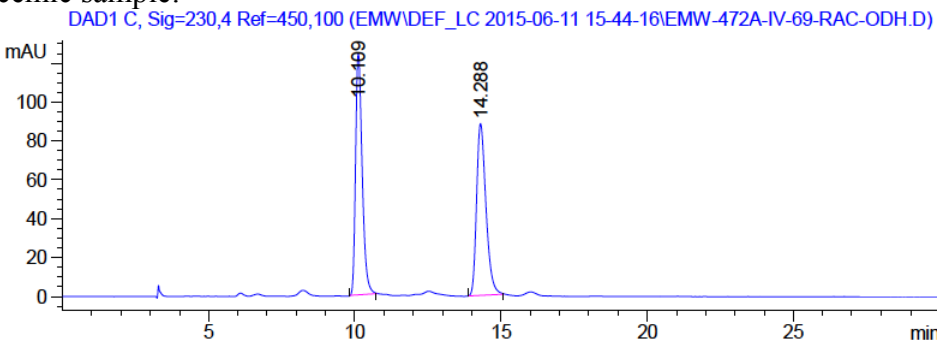
HRMS (ESI+)
Calculated for $C_{15}H_{17}FO_2$ $(M+H)^+$: 249.1285
Found: 249.1297

IR (thin film, cm^{-1})
2927, 2853, 1720, 1278, 1120, 905, 896, 765, 733, 699

$[\alpha]_D^{23}$ +37.2 (*c* 1.0, $CHCl_3$)

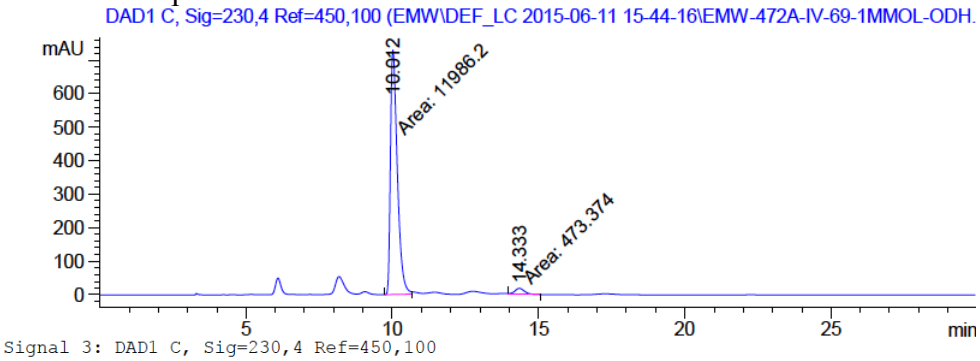
92% *ee*, Chiral HPLC (CHIRALPAK OD-H, 5% isopropanol in hexanes, 1.0 mL/min, λ = 230 nm); t_R(major) = 10.0 min, t_R(minor) = 14.3 min.

Racemic sample:

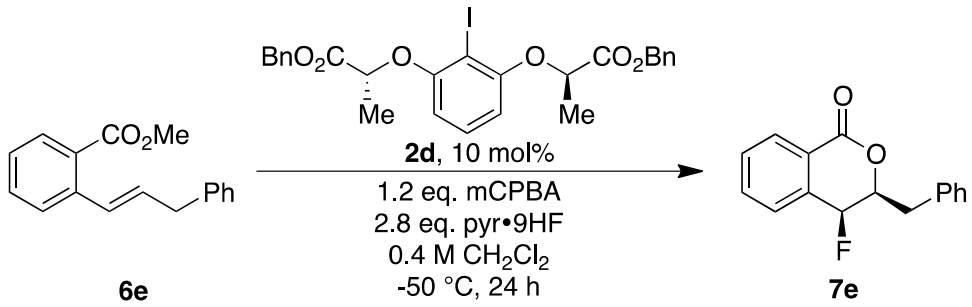


```
Signal 3: DAD1 C, Sig=230,4 Ref=450,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.109 BB    0.2422 1965.89319  124.51721  49.8751
   2  14.288 BB    0.3427 1975.73926   88.42347  50.1249

Totals :                 3941.63245  212.94068
```

Enriched sample:




```
Signal 3: DAD1 C, Sig=230,4 Ref=450,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.012 MM    0.2734 1.19862e4   730.63019  96.2007
   2  14.333 MM    0.4168  473.37363   18.92793   3.7993

Totals :                 1.24595e4   749.55812
```



3-benzyl-4-fluoroisochroman-1-one 7e. Following the "general procedure for the synthesis of products 7a-i" on a 1 mmol scale, fluorolactone **7e** was isolated as a white solid (141 mg, 55% yield).

TLC (hexanes:EtOAc 4:1)

$R_f = 0.34$, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.21 (d, $J = 7.0$ Hz, 1H), 7.71-7.60 (m, 2H), 7.45 (m, 1H), 7.42-7.30 (m, 5H), 5.24 (dd, $J = 49.5$, 1.5 Hz, 1H), 4.71 (dddd, $J = 28.3$, 8.3, 6.8, 1.0 Hz, 1H), 3.40-3.32 (m, 2H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 163.7, 135.3, 134.3 (d, J =3.0 Hz), 134.2, 131.4 (d, J = 3.5 Hz), 130.5 (d, J = 2.5 Hz), 129.7, 129.0 (d, J = 3.0 Hz), 128.9, 127.3, 125.1 (d, J = 2.0 Hz), 83.0 (d, J = 140.5 Hz), 80.3 (d, J = 22.0 Hz), 36.5 (d, J = 3.5 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -182.2 (dd, J = 49.5, 28.5 Hz).

HRMS (ESI+)

Calculated for $C_{16}H_{13}FO_2$ $(M+H)^+$: 257.0972
Found: 257.0981

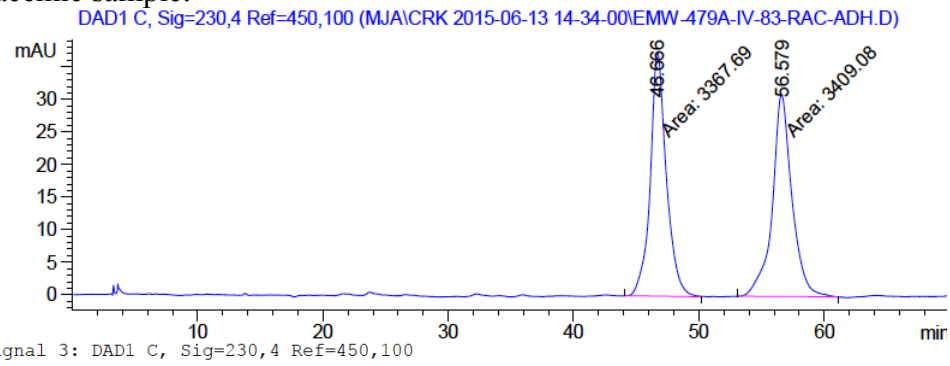
IR (thin film, cm^{-1})

3063, 3030, 2951, 1729, 1267, 1239, 1122, 1089, 999, 898, 762, 735, 717, 696, 584

$[\alpha]_D^{23}$ +22.4 (*c* 1.0, $CHCl_3$)

90% *ee*, Chiral HPLC (CHIRALPAK AD-H, 3% isopropanol in hexanes, 1.0 mL/min, λ = 230 nm); t_R(major) = 45.8 min, t_R(minor) = 56.6 min.

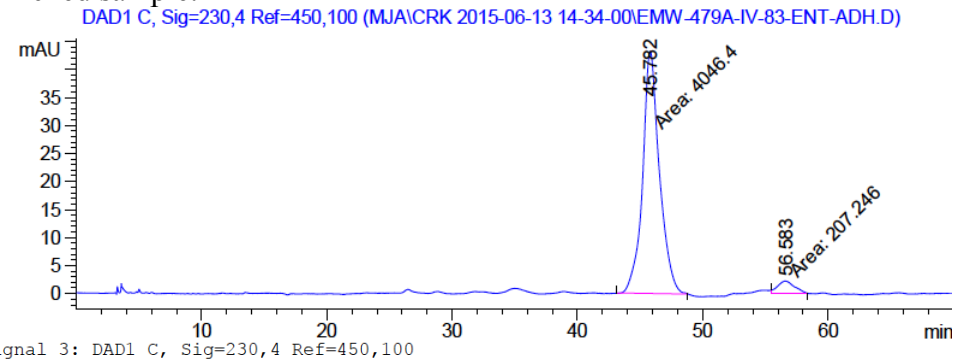
Racemic sample:



Signal 3: DAD1 C, Sig=230,4 Ref=450,100

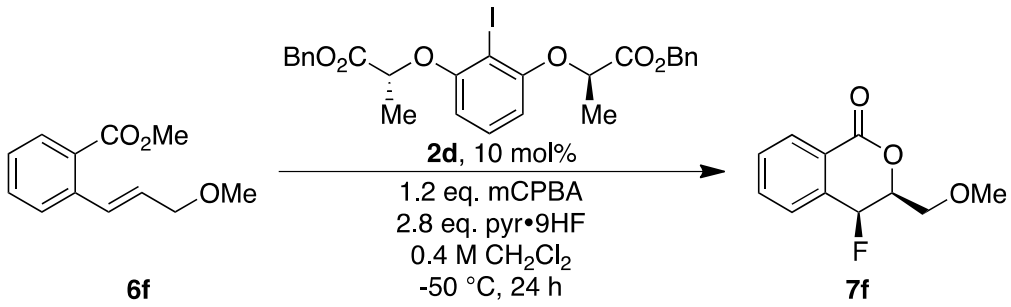
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	46.666	MM	1.4963	3367.69360	37.51128	49.6946
2	56.579	MM	1.8296	3409.08276	31.05462	50.3054
Totals :				6776.77637	68.56590	

Enriched sample:



Signal 3: DAD1 C, Sig=230,4 Ref=450,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	45.782	MM	1.5592	4046.39917	43.25206	95.1278
2	56.583	MM	1.5617	207.24622	2.21174	4.8722
Totals :				4253.64539	45.46380	



4-fluoro-3-(methoxymethyl)isochroman-1-one 7f. Following the "general procedure for the synthesis of products 7a-i" on a 1 mmol scale, fluorolactone **7f** was isolated as a pale yellow solid (120 mg, 57% yield).

TLC (hexanes:EtOAc 4:1)

R_f = 0.16, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.23 (d, *J* = 7.5 Hz, 1H), 7.73 (tt, *J* = 7.5, 1.5 Hz, 1H), 7.67 (tdd, *J* = 7.0, 2.0, 1.5 Hz, 1H), 7.57-7.54 (m, 1H), 5.58 (d, *J* = 49.5 Hz, 1H), 4.71 (dddd, *J* = 29.3, 7.8, 6.4, 1.5 Hz, 1H), 4.00-3.81 (m, 2H), 3.51 (s, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 163.1, 134.5 (d, *J* = 3.0 Hz), 134.1 (d, *J* = 17.0 Hz), 131.5 (d, *J* = 4.5 Hz), 130.5 (d, *J* = 2.5 Hz), 129.0 (d, *J* = 3.5 Hz), 125.1 (d, *J* = 2.0 Hz), 82.7 (d, *J* = 180.0 Hz), 77.5 (d, *J* = 20.0 Hz), 69.4 (d, *J* = 5.0 Hz), 59.6.

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -182.7 (dd, *J* = 49.5, 29.0 Hz).

HRMS (ESI+)

Calculated for $C_{11}H_{11}FO_3$ $(M+H)^+$: 211.0765

Found: 211.0772

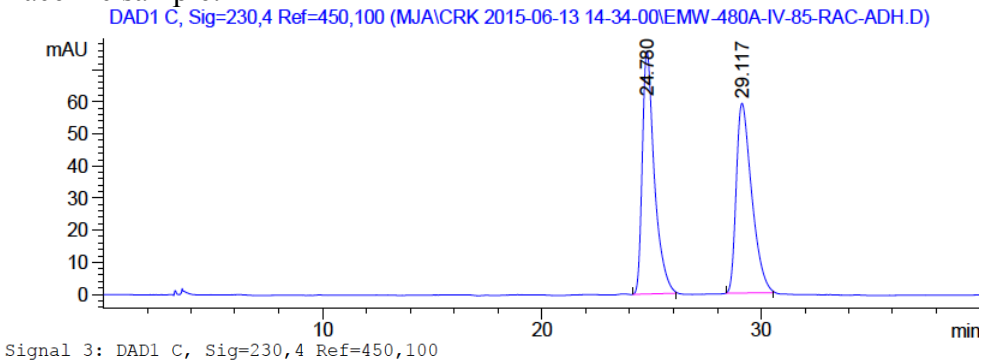
IR (thin film, cm^{-1})

2929, 2820, 1729, 1270, 1236, 1205, 1112, 1090, 1028, 972, 901, 765, 725, 698

$[\alpha]_D^{23}$ +70.6 (*c* 1.0, $CHCl_3$)

91% *ee*, Chiral HPLC (CHIRALPAK AD-H, 3% isopropanol in hexanes, 1.0 mL/min, λ = 230 nm); t_R(minor) = 24.0 min, t_R(major) = 28.2 min.

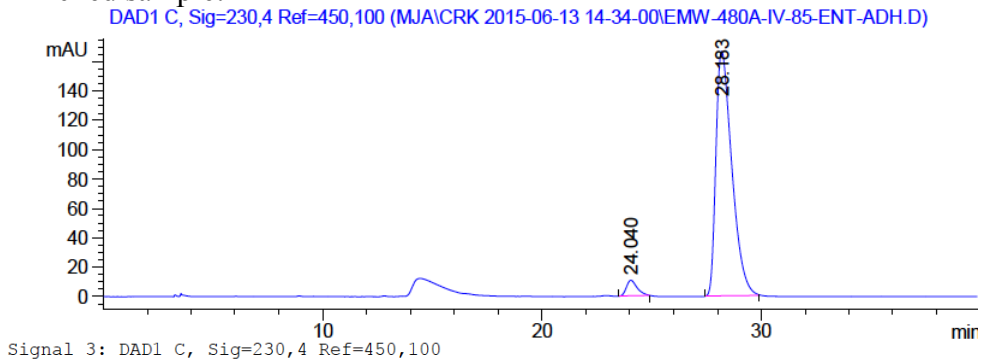
Racemic sample:



Signal 3: DAD1 C, Sig=230,4 Ref=450,100

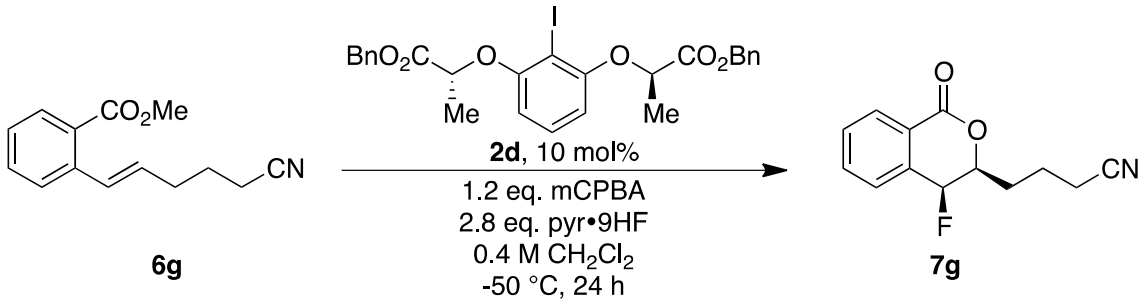
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	24.780	BB	0.5717	2906.56152	75.73632	49.9255
2	29.117	BB	0.7200	2915.23145	59.25201	50.0745
Totals :				5821.79297	134.98833	

Enriched sample:



Signal 3: DAD1 C, Sig=230,4 Ref=450,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	24.040	BB	0.5122	377.89301	10.80137	4.2904
2	28.183	BB	0.7616	8430.06152	166.79672	95.7096
Totals :				8807.95453	177.59809	



4-(4-fluoro-1-oxoisochroman-3-yl)butanenitrile 7g. Following the "general procedure for the synthesis of products 7a-i" on a 1 mmol scale, fluorolactone **7g** was isolated as a white solid (95.6 mg, 41% yield).

TLC (hexanes:EtOAc 4:1)

R_f = 0.10, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 8.21 (d, *J* = 8.0 Hz, 1H), 7.72 (tt, *J* = 7.5, 1.5 Hz, 1H), 7.65 (tq, *J* = 7.0, 1.5 Hz, 1H), 7.54 (d, *J* = 7.0 Hz, 1H), 5.38 (dd, *J* = 50.0, 1.5 Hz, 1H), 4.57 (dddd, *J* = 28.0, 10.0, 3.9, 1.5 Hz, 1H), 2.59-2.41 (m, 2H), 2.36-2.22 (m, 1H), 2.20-2.02 (m, 2H), 2.01-1.88 (m, 1H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 163.3, 134.5 (d, *J* = 3.0 Hz), 134.2 (d, *J* = 17.0 Hz), 131.5 (d, *J* = 3.5 Hz), 130.5 (d, *J* = 3.0 Hz), 128.9 (d, *J* = 3.0 Hz), 124.8 (d, *J* = 2.5 Hz), 119.1, 84.8 (d, *J* = 182.0 Hz), 78.3 (d, *J* = 22.0 Hz), 29.5 (d, *J* = 3.5 Hz), 21.2, 17.0.

^{19}F-NMR (470 MHz, $CDCl_3$)

δ -180.9 (dd, *J* = 50.0, 28.0 Hz).

HRMS (ESI+)

Calculated for $C_{13}H_{12}FNO_2$ $(M+H)^+$: 234.0925
Found: 234.0932

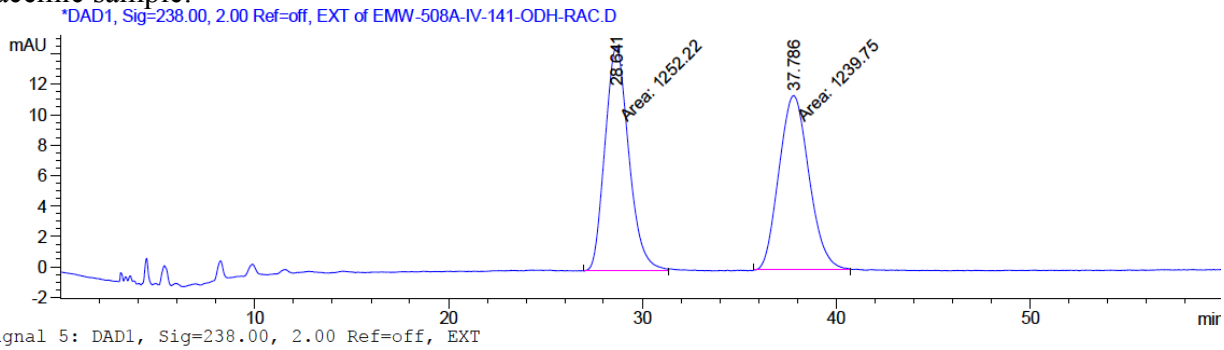
IR (thin film, cm^{-1})

2949, 1728, 1607, 1272, 1241, 1125, 1092, 766, 698

$[\alpha]_D^{23}$ +39.8 (*c* 1.0, $CHCl_3$)

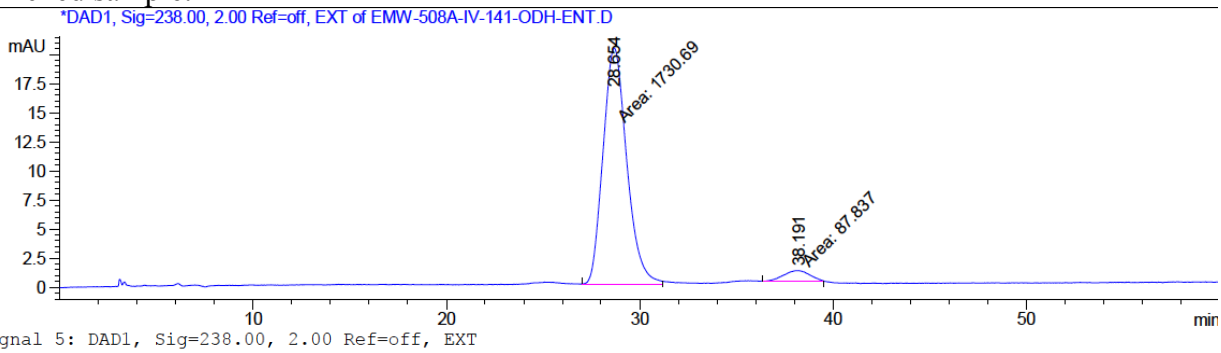
90% *ee*, Chiral HPLC (CHIRALPAK OD-H, 20% isopropanol in hexanes, 1.0 mL/min, λ = 238 nm); t_R(major) = 28.7 min, t_R(minor) = 38.2 min.

Racemic sample:

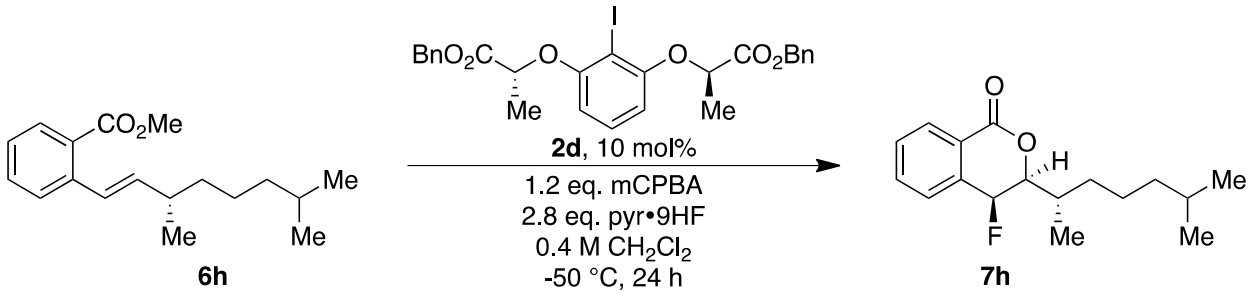



```
Signal 5: DAD1, Sig=238.00, 2.00 Ref=off, EXT
 Signal has been modified after loading from rawdata file!

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  28.641 MM    1.4218 1252.21875   14.67923  50.2501
   2  37.786 MM    1.8016 1239.75171   11.46880  49.7499
```

Enriched sample:




```
Signal 5: DAD1, Sig=238.00, 2.00 Ref=off, EXT
 Signal has been modified after loading from rawdata file!

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  28.654 MM    1.4225 1730.69482   20.27771  95.1699
   2  38.191 MM    1.5794   87.83695 9.26886e-1   4.8301
```



(3*S*,4*S*)-4-fluoro-3-((*S*)-6-methylheptan-2-yl)isochroman-1-one 7h. Following the "general procedure for the synthesis of products 7a-i" on a 0.5 mmol scale, fluorolactone **7h** was isolated as a clear, colorless oil (68.5 mg, 49% yield) as a 6:1 mixture of diastereomers with **7i**.

TLC (hexanes:EtOAc 4:1)
R_f = 0.35, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$) (Major diastereomer)
δ 8.21 (d, *J* = 7.5 Hz, 1H), 7.71 (tt, *J* = 7.5, 1.5 Hz, 1H), 7.64 (tdd, *J* = 7.5, 2.5, 1.5 Hz, 1H), 7.53 (ddd, *J* = 7.5, 2.5, 1.0 Hz, 1H), 5.53 (d, *J* = 49.5 Hz, 1H), 4.19 (ddd, *J* = 31.0, 9.5, 1.5 Hz, 1H), 2.32-2.23 (m, 1H), 1.96-1.88 (m, 1H), 1.61-1.53 (m, 1H), 1.51-1.41 (m, 1H), 1.35-1.20 (m, 4H), 1.15 (d, *J* = 6.0 Hz, 3H), 0.90 (dd, *J* = 6.5, 2.0 Hz, 6H).

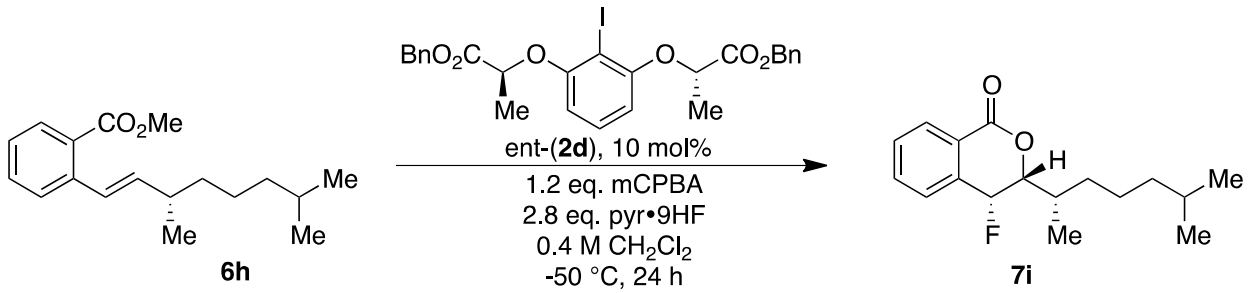
^{13}C-NMR (125 MHz, $CDCl_3$) (Major diastereomer)
δ 164.0, 134.6 (d, *J* = 17.0 Hz), 134.2 (d, *J* = 2.5 Hz), 131.3 (d, *J* = 4.0 Hz), 130.4 (d, *J* = 3.0 Hz), 129.0 (d, *J* = 4.0 Hz), 125.3 (d, *J* = 2.0 Hz), 83.4 (d, *J* = 182.0 Hz), 83.2 (d, *J* = 21.5 Hz), 39.1, 33.8, 32.4, 28.0, 24.0, 22.6 (d, *J* = 35.5 Hz), 14.8.

^{19}F-NMR (470 MHz, $CDCl_3$) (Major diastereomer)
δ -182.5 (dd, *J* = 49.5, 31.0 Hz).

HRMS (ESI+)
Calculated for $C_{17}H_{23}FO_2$ $(M+H)^+$: 279.1755
Found: 279.1768

IR (thin film, cm^{-1})
2952, 2927, 2867, 1720, 1463, 1275, 1242, 1119, 1091, 995, 894, 765, 736, 698

$[\alpha]_D^{23}$ +43.6 (*c* 1.0, $CHCl_3$)



(3*R*,4*R*)-4-fluoro-3-((*S*)-6-methylheptan-2-yl)isochroman-1-one 7i. Following the "general procedure for the synthesis of products 7a-i" on a 0.5 mmol scale, and using ent-(**2d**) as the catalyst, fluorolactone **7i** was isolated as a clear, colorless oil (79.2 mg, 57% yield) as a 6:1 mixture of diastereomers with **7h**.

TLC (hexanes:EtOAc 4:1)
R_f = 0.35, stained by $KMnO_4$

^{1}H-NMR (500 MHz, $CDCl_3$) (Major diastereomer)
δ 8.19 (d, *J* = 7.5 Hz, 1H), 7.69 (tt, *J* = 7.5, 1.5 Hz, 1H), 7.62 (tdd, *J* = 7.5, 2.5, 1.5 Hz, 1H), 7.51 (ddd, *J* = 7.5, 2.5, 1.0 Hz, 1H), 5.54 (d, *J* = 50.0 Hz, 1H), 4.19 (ddd, *J* = 31.0,

8.5, 1.5 Hz, 1H), 2.29-2.20 (m, 1H), 1.71-1.61 (m, 1H), 1.60-1.52 (m, 1H), 1.50-1.39 (m, 1H), 1.39-1.22 (m, 4H), 1.20 (d, J = 6.5 Hz, 3H), 0.89 (dd, J = 6.5, 1.5 Hz, 6H).

^{13}C-NMR (125 MHz, $CDCl_3$) (Major diastereomer)

δ 164.1, 134.7 (d, J = 17.0 Hz), 134.2 (d, J = 3.0 Hz), 131.3 (d, J = 4.0 Hz), 130.4 (d, J = 3.0 Hz), 128.9 (d, J = 4.0 Hz), 125.3 (d, J = 2.0 Hz), 83.6 (d, J = 180.5 Hz), 83.5 (d, J = 22.5 Hz), 39.0, 34.0, 32.3, 27.9, 24.4, 22.6 (d, J = 34.0 Hz), 15.5.

^{19}F-NMR (470 MHz, $CDCl_3$) (Major diastereomer)

δ -181.1 (dd, J = 49.5, 31.5 Hz).

HRMS (ESI+)

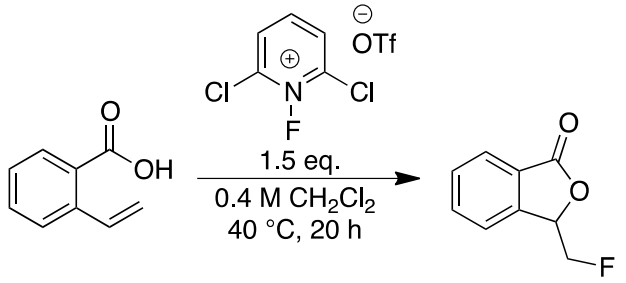
Calculated for $C_{17}H_{23}FO_2$ $(M+H)^+$: 279.1755
Found: 279.1768

IR (thin film, cm^{-1})

2952, 2932, 2868, 1720, 1464, 1347, 1275, 1243, 1120, 1091, 992, 895, 765, 736, 698

$[\alpha]_D^{23}$ -46.0 (*c* 1.0, $CHCl_3$)

VII. Scheme 2. Comparing electrophilic and nucleophilic fluorinating reagents



8 **9**

3-(fluoromethyl)isobenzofuran-1(3*H*)-one 9. To a 7 mL glass vial charged with a Teflon PTFE coated stir bar was added vinylbenzoic acid **8** (150 mg, 1.0 mmol, 1.0 eq.) and 2,6-dichloro-1-fluoropyridinium triflate (474 mg, 1.5 mmol, 1.5 eq.). The reaction vial was capped and placed under a nitrogen atmosphere. The vial was charged with CH_2Cl_2 (2.5 mL) and sealed under nitrogen. The vial was placed in a 40 °C heating block with stirring for 20 h. After this time, the crude reaction was dry loaded onto celite and purified by column chromatography on silica gel (hexanes:EtOAc 100:0 → 60:40) to afford fluorolactone **9** as a clear, colorless oil (107 mg, 65% yield).

^{1}H-NMR (500 MHz, $CDCl_3$)

δ 7.95 (d, J = 7.5 Hz, 1H), 7.73 (t, J = 7.5 Hz, 1H), 7.60 (t, J = 7.0 Hz, 1H), 7.54 (d, J = 7.5 Hz, 1H), 5.66 (dt, J = 18.5, 4.5 Hz, 1H), 4.88-4.64 (m, 2H).

^{13}C-NMR (125 MHz, $CDCl_3$)

δ 169.7, 145.1 (d, J = 4.5 Hz), 134.3, 130.0, 126.5, 126.1, 122.3, 82.4 (d, J = 179.0 Hz), 78.7 (d, J = 20.5 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$)

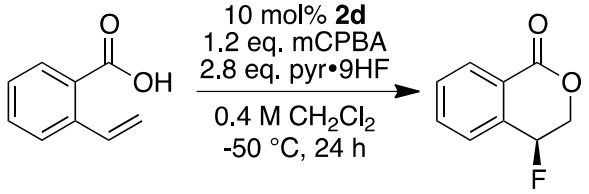
δ -229.0 (dt, J = 46.0, 18.0 Hz).

HRMS (ESI+)

Calculated for $C_9H_7FO_2$ $(M+H)^+$:	167.0503
Found:	167.0503

IR (thin film, cm^{-1})

2958, 1762, 1467, 1349, 1287, 1210, 1079, 1066, 1032, 982, 921, 743, 717, 696, 626

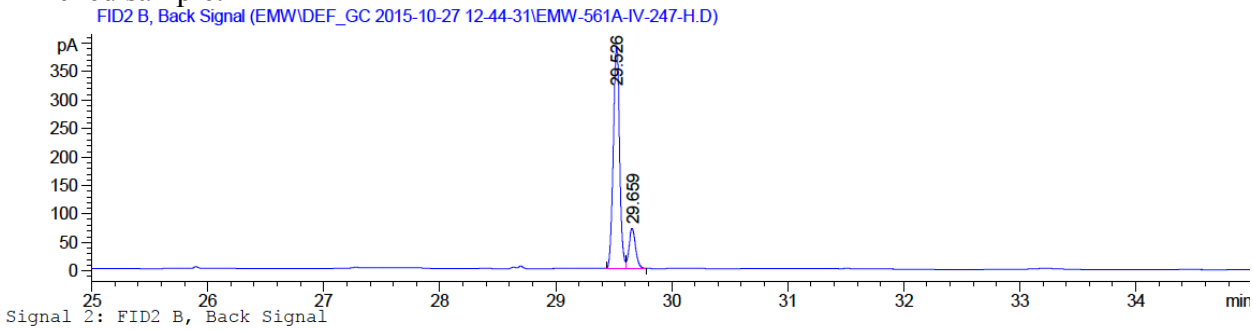


8 **7a**

4-fluoroisochroman-1-one 7a. To a 7 mL low-density polyethylene vial with snap cap charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 269 mg, 1.2 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C. To the cooled vial was added aryl iodide catalyst **2d** (56.0 mg, 0.10 mmol, 10 mol%) as a solution in CH_2Cl_2 (1.5 mL) followed by pyr•9HF (70% HF, 0.65 mL, 25 mmol HF, 25 eq. HF). Vinylbenzoic acid **8** (148.0 mg, 1.0 mmol, 1.0 eq.) was added as a solution in CH_2Cl_2 (1.0 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C cryocool with vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (2.5 g) in CH_2Cl_2 (5.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The solution was concentrated under reduced pressure. The resulting residue was dry loaded onto celite and purified by column chromatography on silica gel (hexanes:EtOAc 100:0 → 80:20) to afford fluorolactone **7a** as a clear, colorless oil (88 mg, 53%).

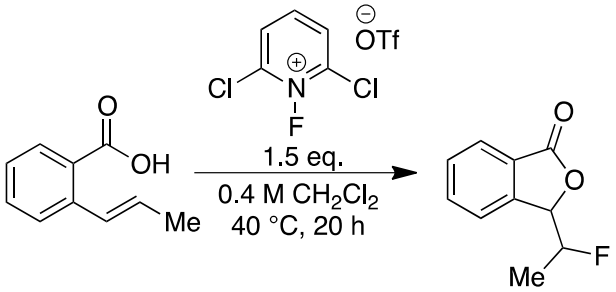
69% *ee*, Chiral GC (β-Cyclosil, 60 °C to 180 °C, 10 psi); t_R(major) = 29.5 min, t_R(minor) = 29.7 min.

Enriched sample:



Signal 2: FID2 B, Back Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	29.526	BV	0.0570	1477.17822	389.60028	84.25733
2	29.659	VB	0.0589	275.99652	69.88795	15.74267
Totals :				1753.17474	459.48823	



1d **10**

3-(1-fluoroethyl)isobenzofuran-1(3*H*)-one 10. To a 1.5 mL glass vial charged with a Teflon PTFE coated stir bar was added (*E*)-2-(prop-1-en-1-yl)benzoic acid **1d** (25 mg, 0.15 mmol, 1.0 eq.) and 2,6-dichloro-1-fluoropyridinium triflate (73 mg, 0.23 mmol, 1.5 eq.). The reaction vial was capped and placed under a nitrogen atmosphere. The vial was charged with CH_2Cl_2 (0.4 mL) and sealed under nitrogen. The vial was placed in a 40 °C heating block with stirring for 20 h. After this time, the crude reaction was dry loaded onto celite and purified by column chromatography on silica gel (hexanes:EtOAc 100:0 → 60:40) to afford fluorolactone **10** as a 1.5:1 mixture of diastereomers as a white solid (25 mg, 93% yield).

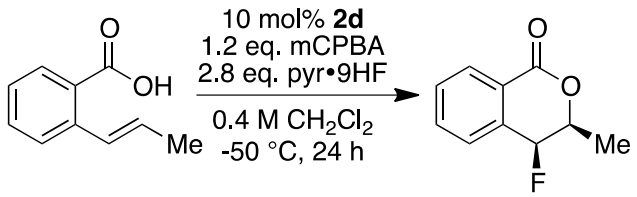
^{1}H-NMR (500 MHz, $CDCl_3$, 1.5:1 mixture of diastereomers, minor diastereomer marked with *)
δ 7.90 (d, *J* = 8.0 Hz, 2H), 7.74-7.66 (m, 2H), 7.60-7.52 (m, 3H), 5.51* (dd, *J* = 16.0, 3.5 Hz, 1H), 5.42 (dd, *J* = 10.0, 6.0 Hz, 1H), 5.17-5.02* (m, 1H), 4.75 (dp, *J* = 47.0, 6.0 Hz, 1H), 1.46 (dd, *J* = 23.5, 6.0 Hz, 3H), 1.37* (dd, *J* = 23.5, 6.0 Hz, 3H).

^{13}C-NMR (125 MHz, $CDCl_3$, mixture of diastereomers)
δ 169.9, 169.8, 150.6, 146.2, 145.6, 140.7, 134.3, 134.2, 129.8, 129.7, 125.9, 125.8, 123.2, 123.1, 89.9 (d, *J* = 173.0 Hz), 88.3 (d, *J* = 173.0 Hz), 81.3 (d, *J* = 28.0 Hz), 80.8 (d, *J* = 25.5 Hz), 16.7 (d, *J* = 22.0 Hz), 15.9 (d, *J* = 22.0 Hz).

^{19}F-NMR (470 MHz, $CDCl_3$, 1.5:1 mixture of diastereomers, minor diastereomer marked with *)
δ -182.8 (m), -188.1* (m)

HRMS (ESI+)
Calculated for $C_{10}H_9FO_2$ $(M+H)^+$: 181.0659
Found: 181.0660

IR (thin film, cm^{-1})
3082, 2991, 2939, 1767, 1566, 1557, 1414, 1284, 1163, 1137, 1057, 984, 791, 743

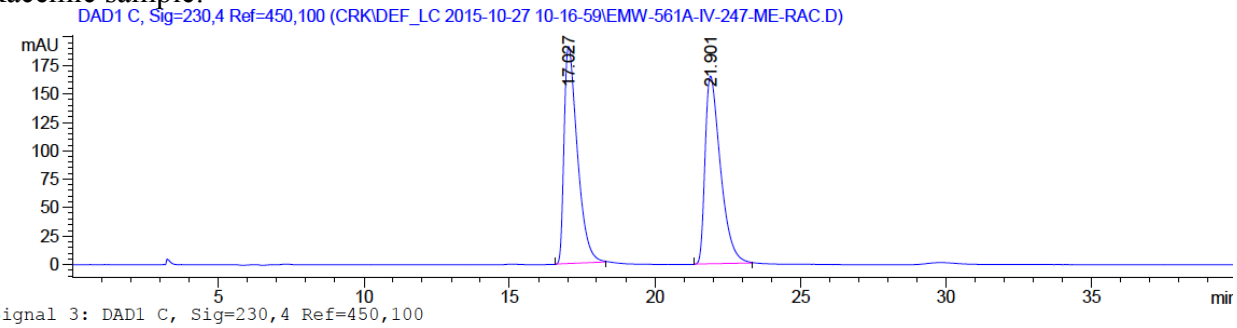


1d **3**

4-fluoro-3-methylisochroman-1-one 3. To a 7 mL low-density polyethylene vial with snap cap charged with a Teflon PTFE coated stir bar was added mCPBA (77%, 269 mg, 1.2 mmol, 1.2 eq.). The reaction vial was cooled in a dry ice/acetone bath to <-60 °C. To the cooled vial was added aryl iodide catalyst **2d** (56.0 mg, 0.10 mmol, 10 mol%) as a solution in CH_2Cl_2 (1.5 mL) followed by pyr•9HF (70% HF, 0.65 mL, 25 mmol HF, 25 eq. HF). (*E*)-2-(prop-1-en-1-yl)benzoic acid **1d** (162.0 mg, 1.0 mmol, 1.0 eq.) was added as a solution in CH_2Cl_2 (1.0 mL, 0.40 M total concentration). The tube was capped and transferred to a -50 °C cryocool with vigorous stirring (vigorous stirring of the heterogeneous mixture is important to ensure reproducible conversion) at -50 °C for 24 h. After this time, the crude reaction suspension was quenched by being added to a cooled (-78 °C) suspension of basic alumina (2.5 g) in CH_2Cl_2 (5.0 mL). The resulting suspension was warmed to 23 °C and stirred at this temperature for 10 min. The suspension was filtered through a plug of basic alumina, eluting with CH_2Cl_2. The solution was concentrated under reduced pressure. The resulting residue was dry loaded onto celite and purified by column chromatography on silica gel (hexanes:EtOAc 100:0 → 80:20) to afford fluorolactone **3** as a white solid (126 mg, 70% yield).

86% *ee*, Chiral HPLC (CHIRALPAK OD-H, 5% isopropanol in hexanes, 1.0 mL/min, λ = 230 nm); t_R(major) = 16.8 min, t_R(minor) = 22.0 min.

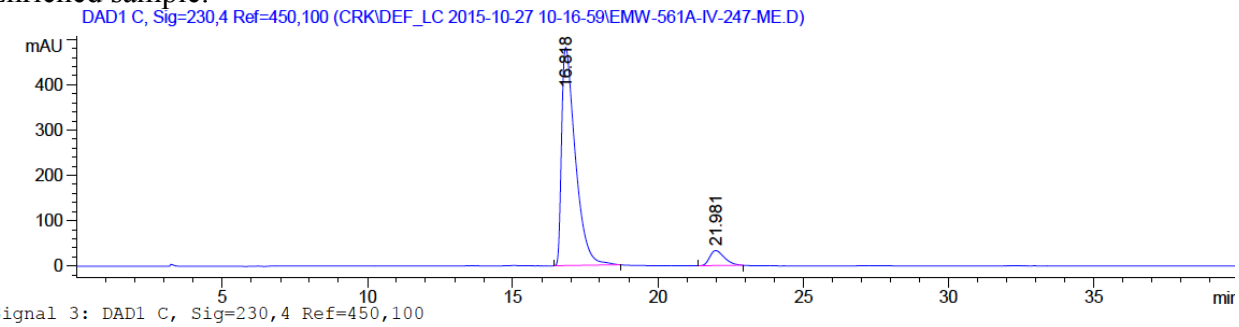
Racemic sample:



Signal 3: DAD1 C, Sig=230,4 Ref=450,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.027	BB	0.4806	6070.55518	191.08333	49.9695
2	21.901	BB	0.5591	6077.95752	165.23271	50.0305
Totals :				1.21485e4	356.31604	

Enriched sample:

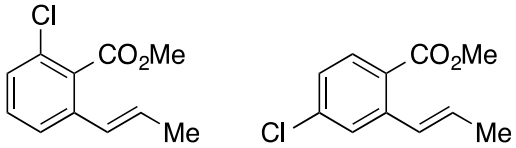


Signal 3: DAD1 C, Sig=230,4 Ref=450,100

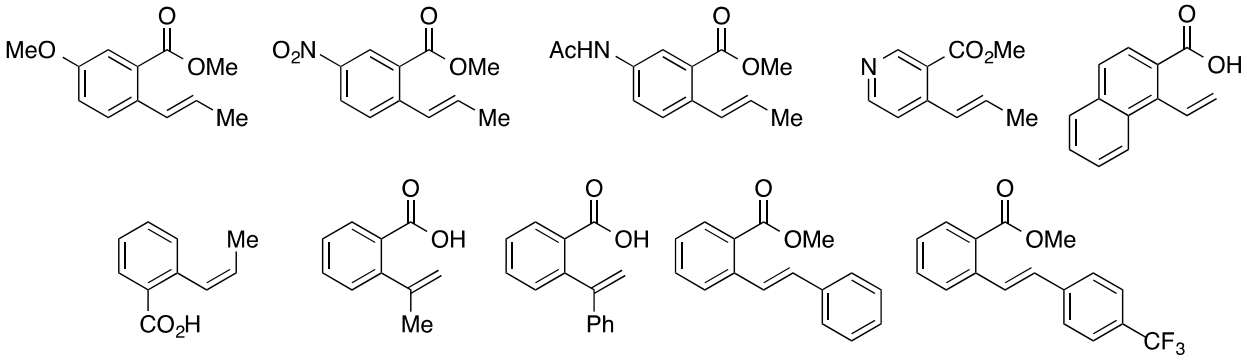
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.818	BB	0.4946	1.58794e4	481.67459	93.0478
2	21.981	BB	0.5369	1186.45020	33.36228	6.9522
Totals :				1.70659e4	515.03687	

VIII. Additional substrates

The following substrates gave the fluorolactones as an inseparable mixture of diastereomers (2:1 syn:anti).



The following substrates provided the fluorolactone product in <10% yield.



IX. X-ray crystallographic data

X-ray quality crystals of **3** were grown by slow diffusion of pentane into a dissolved solution of the fluorolactone in diethyl ether.

X-Ray Crystallography: Data for a crystal mounted on a diffractometer was collected at 100 K. The intensities of the reflections were collected by means of a Bruker APEX II DUO CCD diffractometer ($Cu_{K\alpha}$ radiation, λ=1.54178 Å), and equipped with an Oxford Cryosystems nitrogen flow apparatus. The collection method involved 1.0° scans in ω at -30°, -55°, -80°, 30°, 55°, 80° and 115° in 2θ. Data integration down to 0.84 Å resolution was carried out using SAINT V8.34 C (Bruker diffractometer, 2014) with reflection spot size optimisation. Absorption corrections were made with the program SADABS (Bruker diffractometer, 2014). The structure was solved by the Intrinsic Phasing methods and refined by least-squares methods again F^2 using SHELXT-2014 (Sheldrick, 2015) and SHELXL-2014 (Sheldrick, 2015) with OLEX 2 interface (Dolomanov, et al., 2009). Non-hydrogen atoms were refined anisotropically, and hydrogen atoms were allowed to ride on the respective atoms. Crystal data as well as details of data collection and refinement are summarized in Table S1 and geometric parameters are shown in Table S2. The Ortep plots produced with SHELXL-2014 program, and the other drawings were produced with Accelrys DS Visualizer 2.0 (Accelrys, 2007).

Table S1. Experimental details

Crystal data	
Chemical formula	$C_{10}H_9FO_2$
M_r	180.17
Crystal system, space group	Orthorhombic, $P2_12_12_1$
Temperature (K)	100
a, b, c (Å)	4.4860 (2), 6.8678 (3), 27.2439 (11)
V (Å^3)	839.36 (6)
Z	4
Radiation type	Cu $K\alpha$
μ (mm^{-1})	0.96
Crystal size (mm)	0.20 × 0.04 × 0.02
Data collection	
Diffractometer	Bruker D8 goniometer with CCD area detector diffractometer
Absorption correction	Multi-scan *SADABS*
T_{min}, T_{max}	0.771, 0.864
No. of measured, independent and observed [$I > 2\sigma(I)$] reflections	18807, 1483, 1431

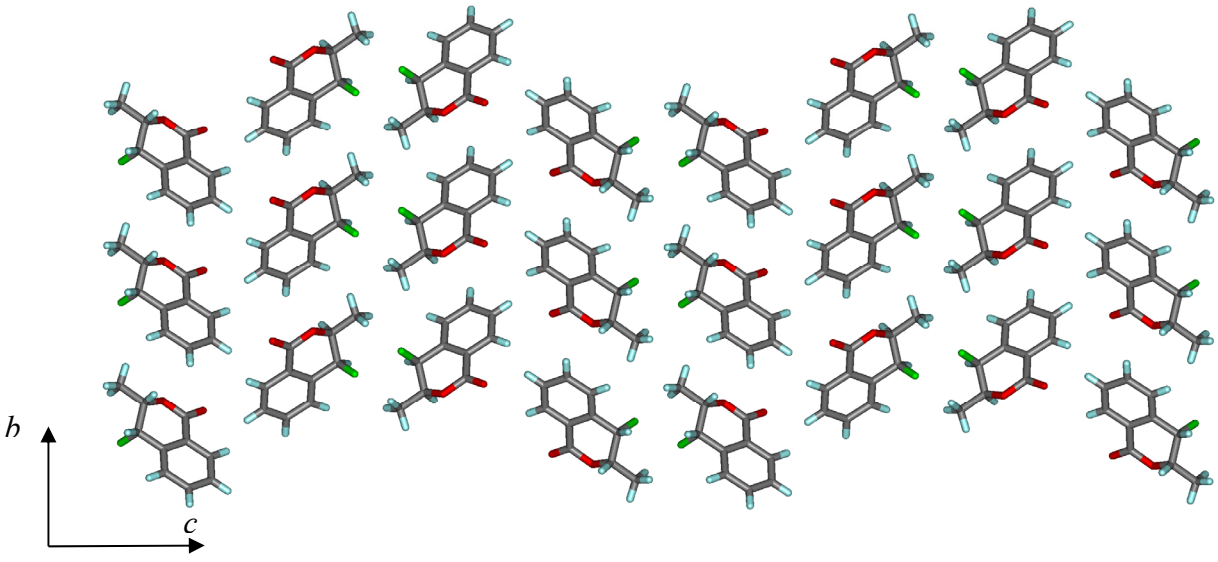
R_{int}	0.038
$(\sin \theta/\lambda)_{max}$ (Å^{-1})	0.595
Refinement	
$R[F^2 > 2\sigma(F^2)]$, $wR(F^2)$, S	0.025, 0.065, 1.08
No. of reflections	1483
No. of parameters	119
H-atom treatment	H-atom parameters constrained
$\Delta\rho_{max}$, $\Delta\rho_{min}$ (e Å^{-3})	0.11, -0.20
Absolute structure	Flack x determined using 532 quotients [(I+)-(I-)]/[(I+)+(I-)] (Parsons, Flack and Wagner, Acta Cryst. B69 (2013) 249-259).
Absolute structure parameter	-0.03 (4)

Computer programs: *APEX2* v2014.3.0 (Bruker-AXS, 2014), *SAINT* 8.34C (Bruker-AXS, 2014), SHELXT-2014 (Sheldrick, 2015), *SHELXL2014* (Sheldrick, 2015), Bruker *SHELXTL* (Sheldrick, 2015).

Table S2. Geometric parameters (Å, º)

C1—O2	1.208 (2)	C6—H6	0.9500
C1—O1	1.360 (2)	C7—C8	1.500 (2)
C1—C2	1.482 (2)	C8—F1	1.419 (2)
C2—C3	1.397 (2)	C8—C9	1.511 (2)
C2—C7	1.398 (2)	C8—H8	1.0000
C3—C4	1.382 (3)	C9—O1	1.4540 (19)
C3—H3	0.9500	C9—C10	1.515 (2)
C4—C5	1.390 (3)	C9—H9	1.0000
C4—H4	0.9500	C10—H10A	0.9800
C5—C6	1.388 (2)	C10—H10B	0.9800
C5—H5	0.9500	C10—H10C	0.9800
C6—C7	1.389 (2)		
O2—C1—O1	117.72 (15)	C2—C7—C8	118.61 (15)
O2—C1—C2	124.39 (15)	F1—C8—C7	108.60 (14)
O1—C1—C2	117.80 (14)	F1—C8—C9	109.36 (13)
C3—C2—C7	120.38 (16)	C7—C8—C9	111.25 (13)
C3—C2—C1	118.77 (15)	F1—C8—H8	109.2
C7—C2—C1	120.82 (15)	C7—C8—H8	109.2
C4—C3—C2	119.45 (16)	C9—C8—H8	109.2
C4—C3—H3	120.3	O1—C9—C8	111.17 (13)
C2—C3—H3	120.3	O1—C9—C10	105.78 (13)
C3—C4—C5	120.46 (16)	C8—C9—C10	114.40 (14)

C3—C4—H4	119.8	O1—C9—H9	108.4
C5—C4—H4	119.8	C8—C9—H9	108.4
C6—C5—C4	120.05 (16)	C10—C9—H9	108.4
C6—C5—H5	120.0	C9—C10—H10A	109.5
C4—C5—H5	120.0	C9—C10—H10B	109.5
C5—C6—C7	120.24 (16)	H10A—C10—H10B	109.5
C5—C6—H6	119.9	C9—C10—H10C	109.5
C7—C6—H6	119.9	H10A—C10—H10C	109.5
C6—C7—C2	119.41 (15)	H10B—C10—H10C	109.5
C6—C7—C8	121.97 (15)	C1—O1—C9	119.52 (13)
O2—C1—C2—C3	8.5 (3)	C1—C2—C7—C8	−0.6 (2)
O1—C1—C2—C3	−174.91 (15)	C6—C7—C8—F1	−87.16 (19)
O2—C1—C2—C7	−169.40 (17)	C2—C7—C8—F1	92.15 (17)
O1—C1—C2—C7	7.2 (2)	C6—C7—C8—C9	152.44 (16)
C7—C2—C3—C4	−0.5 (3)	C2—C7—C8—C9	−28.3 (2)
C1—C2—C3—C4	−178.43 (15)	F1—C8—C9—O1	−69.37 (16)
C2—C3—C4—C5	−0.3 (3)	C7—C8—C9—O1	50.59 (19)
C3—C4—C5—C6	0.9 (3)	F1—C8—C9—C10	50.36 (19)
C4—C5—C6—C7	−0.6 (3)	C7—C8—C9—C10	170.32 (14)
C5—C6—C7—C2	−0.3 (3)	O2—C1—O1—C9	−164.91 (15)
C5—C6—C7—C8	179.03 (16)	C2—C1—O1—C9	18.2 (2)
C3—C2—C7—C6	0.8 (3)	C8—C9—O1—C1	−47.65 (19)
C1—C2—C7—C6	178.68 (15)	C10—C9—O1—C1	−172.38 (14)
C3—C2—C7—C8	−178.49 (15)		



Three-dimensional supramolecular architecture viewed along the *a*-axis direction.

X-ray quality crystals of **7c** were grown by slow evaporation from a saturated solution of the lactone in diethyl ether.

X-Ray Crystallography: Data for a crystal mounted on a diffractometer was collected at 100 K. The intensities of the reflections were collected by means of a Bruker APEX II DUO CCD diffractometer ($Cu_{K\alpha}$ radiation, λ=1.54178 Å), and equipped with an Oxford Cryosystems nitrogen flow apparatus. The collection method involved 1.0° scans in ω at -30°, -55°, -80°, 30°, 55°, 80° and 115° in 2θ. Data integration down to 0.84 Å resolution was carried out using SAINT V8.34 C (Bruker diffractometer, 2014) with reflection spot size optimisation. Absorption corrections were made with the program SADABS (Bruker diffractometer, 2014). The structure was solved by the Intrinsic Phasing methods and refined by least-squares methods again F^2 using SHELXT-2014 (Sheldrick, 2015) and SHELXL-2014 (Sheldrick, 2015) with OLEX 2 interface (Dolomanov, et al., 2009). Non-hydrogen atoms were refined anisotropically, and hydrogen atoms were allowed to ride on the respective atoms. Crystal data as well as details of data collection and refinement are summarized in Table S3 and geometric parameters are shown in Table S4. The Ortep plots produced with SHELXL-2014 program, and the other drawings were produced with Accelrys DS Visualizer 2.0 (Accelrys, 2007).

Table S3. Experimental details

Crystal data	
Chemical formula	$C_{12}H_{12}ClFO_2$
M_r	242.67
Crystal system, space group	Mon°Clinic, *C*2
Temperature (K)	100
a, *b*, *c* (Å)	21.6152 (6), 4.3127 (1), 14.1504 (4)
β (°)	123.3915 (9)
V (Å^3)	1101.35 (5)
Z	4
Radiation type	Cu *K*α
μ (mm^{-1})	3.06
Crystal size (mm)	0.26 × 0.14 × 0.12
Data collection	
Diffractometer	Bruker D8 goniometer with CCD area detector diffractometer
Absorption correction	Multi-scan *SADABS*
T_{min}, T_{max}	0.681, 0.806
No. of measured, independent and	12210, 1747, 1734

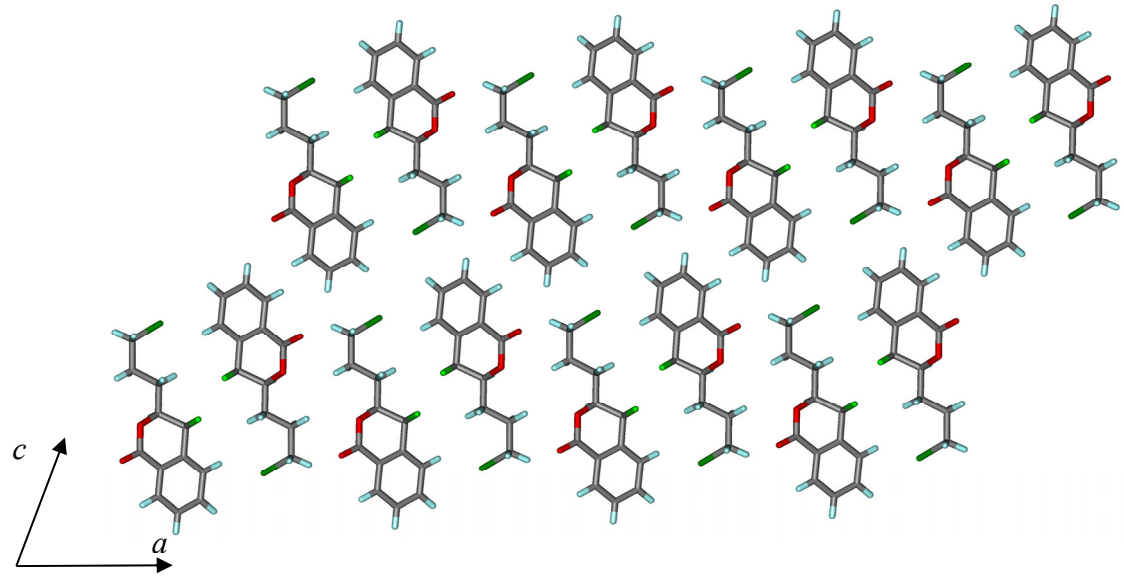
observed [$I > 2\sigma(I)$] reflections	
R_{int}	0.027
$(\sin \theta/\lambda)_{max}$ (Å^{-1})	0.596
Refinement	
$R[F^2 > 2\sigma(F^2)]$, $wR(F^2)$, S	0.022, 0.059, 1.08
No. of reflections	1747
No. of parameters	145
No. of restraints	1
H-atom treatment	H-atom parameters constrained
$\Delta\rho_{max}$, $\Delta\rho_{min}$ (e Å^{-3})	0.17, -0.21
Absolute structure	Flack x determined using 648 quotients [(I+)-(I-)]/[(I+)+(I-)] (Parsons, Flack and Wagner, Acta Cryst. B69 (2013) 249-259).
Flack (x) parameter	-0.004 (12)
Hooft parameter	0.011(6)

Computer programs: *APEX2* v2014.3.0 (Bruker-AXS, 2014), *SAINT* 8.34C (Bruker-AXS, 2014), SHELXT-2014 (Sheldrick, 2015), *SHELXL2014* (Sheldrick, 2015), Bruker *SHELXTL* (Sheldrick, 2015).

Table S4. Geometric parameters (Å, º)

C1—O2	1.209 (3)	C8—C9	1.509 (3)
C1—O1	1.358 (2)	C8—H8	1.0000
C1—C2	1.482 (3)	C9—O1	1.458 (3)
C2—C3	1.394 (3)	C9—C10	1.517 (3)
C2—C7	1.396 (3)	C9—H9	1.0000
C3—C4	1.382 (3)	C10—C11	1.528 (3)
C3—H3	0.9500	C10—H10A	0.9900
C4—C5	1.388 (3)	C10—H10B	0.9900
C4—H4	0.9500	C11—C12	1.516 (3)
C5—C6	1.390 (3)	C11—H11A	0.9900
C5—H5	0.9500	C11—H11B	0.9900
C6—C7	1.385 (3)	C12—Cl1	1.810 (2)
C6—H6	0.9500	C12—H12A	0.9900
C7—C8	1.497 (3)	C12—H12B	0.9900
C8—F1	1.422 (3)		
O2—C1—O1	117.85 (19)	C9—C8—H8	109.6
O2—C1—C2	124.35 (18)	O1—C9—C8	110.67 (17)
O1—C1—C2	117.77 (19)	O1—C9—C10	107.25 (17)
C3—C2—C7	119.7 (2)	C8—C9—C10	113.68 (17)
C3—C2—C1	119.68 (19)	O1—C9—H9	108.4

C7—C2—C1	120.62 (18)	C8—C9—H9	108.4
C4—C3—C2	119.9 (2)	C10—C9—H9	108.4
C4—C3—H3	120.1	C9—C10—C11	112.78 (17)
C2—C3—H3	120.1	C9—C10—H10A	109.0
C3—C4—C5	120.34 (19)	C11—C10—H10A	109.0
C3—C4—H4	119.8	C9—C10—H10B	109.0
C5—C4—H4	119.8	C11—C10—H10B	109.0
C4—C5—C6	120.1 (2)	H10A—C10—H10B	107.8
C4—C5—H5	120.0	C12—C11—C10	113.28 (18)
C6—C5—H5	120.0	C12—C11—H11A	108.9
C7—C6—C5	119.8 (2)	C10—C11—H11A	108.9
C7—C6—H6	120.1	C12—C11—H11B	108.9
C5—C6—H6	120.1	C10—C11—H11B	108.9
C6—C7—C2	120.17 (19)	H11A—C11—H11B	107.7
C6—C7—C8	122.11 (19)	C11—C12—Cl1	111.88 (16)
C2—C7—C8	117.71 (19)	C11—C12—H12A	109.2
F1—C8—C7	108.69 (17)	Cl1—C12—H12A	109.2
F1—C8—C9	108.46 (18)	C11—C12—H12B	109.2
C7—C8—C9	110.93 (17)	Cl1—C12—H12B	109.2
F1—C8—H8	109.6	H12A—C12—H12B	107.9
C7—C8—H8	109.6	C1—O1—C9	120.29 (17)
O2—C1—C2—C3	14.7 (4)	C2—C7—C8—F1	86.3 (2)
O1—C1—C2—C3	−167.4 (2)	C6—C7—C8—C9	147.2 (2)
O2—C1—C2—C7	−163.7 (2)	C2—C7—C8—C9	−32.9 (3)
O1—C1—C2—C7	14.2 (3)	F1—C8—C9—O1	−66.2 (2)
C7—C2—C3—C4	−0.7 (3)	C7—C8—C9—O1	53.1 (2)
C1—C2—C3—C4	−179.1 (2)	F1—C8—C9—C10	54.6 (2)
C2—C3—C4—C5	0.1 (4)	C7—C8—C9—C10	173.92 (19)
C3—C4—C5—C6	0.3 (4)	O1—C9—C10—C11	−71.4 (2)
C4—C5—C6—C7	−0.1 (4)	C8—C9—C10—C11	166.0 (2)
C5—C6—C7—C2	−0.5 (4)	C9—C10—C11—C12	178.7 (2)
C5—C6—C7—C8	179.5 (2)	C10—C11—C12—Cl1	56.7 (3)
C3—C2—C7—C6	0.9 (3)	O2—C1—O1—C9	−172.7 (2)
C1—C2—C7—C6	179.3 (2)	C2—C1—O1—C9	9.2 (3)
C3—C2—C7—C8	−179.0 (2)	C8—C9—O1—C1	−43.0 (3)
C1—C2—C7—C8	−0.7 (3)	C10—C9—O1—C1	−167.49 (17)
C6—C7—C8—F1	−93.7 (2)		



Three-dimensional supramolecular architecture viewed along the *b*-axis direction.

X-ray quality crystals of **7f** were grown by slow evaporation from a saturated solution of the lactone in diethyl ether.

X-Ray Crystallography: Data for a crystal mounted on a diffractometer was collected at 100 K. The intensities of the reflections were collected by means of a Bruker APEX II DUO CCD diffractometer ($Cu_{K\alpha}$ radiation, λ=1.54178 Å), and equipped with an Oxford Cryosystems nitrogen flow apparatus. The collection method involved 1.0° scans in ω at -30°, -55°, -80°, 30°, 55°, 80° and 115° in 2θ. Data integration down to 0.84 Å resolution was carried out using SAINT V8.34 C (Bruker diffractometer, 2014) with reflection spot size optimization. Absorption corrections were made with the program SADABS (Bruker diffractometer, 2014). The structure was solved by the Intrinsic Phasing methods and refined by least-squares methods again F^2 using SHELXT-2014 (Sheldrick, 2015) and SHELXL-2014 (Sheldrick, 2015) with OLEX 2 interface (Dolomanov, et al., 2009). Non-hydrogen atoms were refined anisotropically, and hydrogen atoms were allowed to ride on the respective atoms. Crystal data as well as details of data collection and refinement are summarized in Table S5 and geometric parameters are shown in Table S6. The Ortep plots produced with SHELXL-2014 program, and the other drawings were produced with Accelrys DS Visualizer 2.0 (Accelrys, 2007).

Table S5. Experimental details

Crystal data	
Chemical formula	$C_{11}H_{11}FO_3$
M_r	210.20
Crystal system, space group	Mon°Clinic, $P2_1$
Temperature (K)	100

a, *b*, *c* (Å)	4.5174 (2), 6.8284 (4), 15.9328 (8)
β (°)	92.4936 (17)
V (Å^3)	491.01 (4)
Z	2
Radiation type	Cu *K*α
μ (mm^{-1})	0.98
Crystal size (mm)	0.18 × 0.10 × 0.08
Data collection	
Diffractometer	Bruker D8 goniometer with CCD area detector diffractometer
Absorption correction	Multi-scan *SADABS*
T_{min}, T_{max}	0.765, 0.864
No. of measured, independent and observed [$I > 2\sigma(I)$] reflections	12027, 1628, 1588
R_{int}	0.034
$(\sin \theta/\lambda)_{max}$ (Å^{-1})	0.596
Refinement	
$R[F^2 > 2\sigma(F^2)]$, $wR(F^2)$, S	0.033, 0.086, 1.04
No. of reflections	1628
No. of parameters	138
No. of restraints	1
H-atom treatment	H-atom parameters constrained
$\Delta\rho_{max}$, $\Delta\rho_{min}$ (e Å^{-3})	0.19, -0.15
Absolute structure	Classical Flack method preferred over Parsons because s.u. lower.
Absolute structure parameter	0.0 (2)

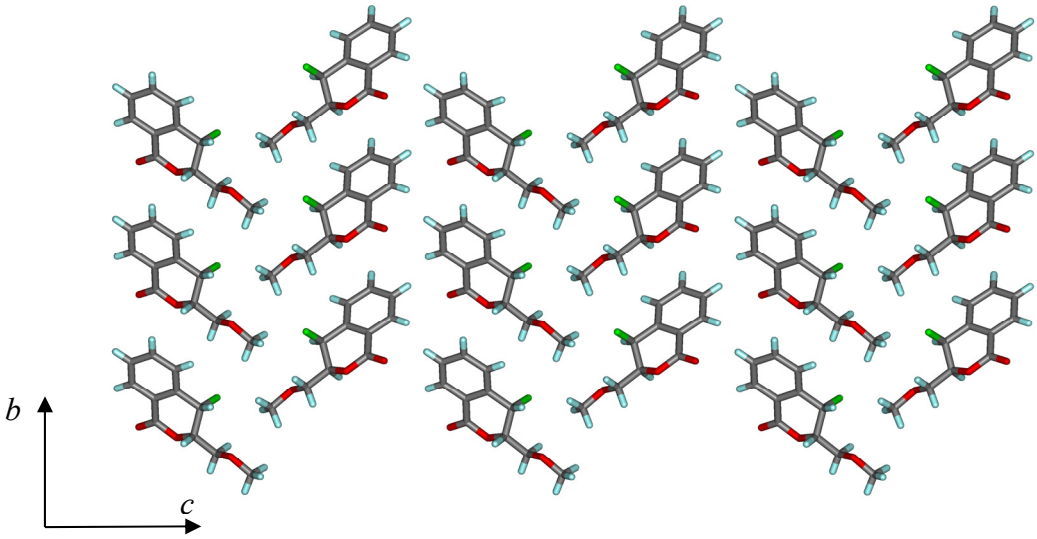
Computer programs: *APEX2* v2014.3.0 (Bruker-AXS, 2014), *SAINT* 8.34C (Bruker-AXS, 2014), SHELXT-2014 (Sheldrick, 2015), *SHELXL2014* (Sheldrick, 2015), Bruker *SHELXTL* (Sheldrick, 2015).

Table S6. Geometric parameters (Å, º)

C1—O2	1.205 (3)	C8—F1	1.419 (3)
C1—O1	1.358 (3)	C8—C9	1.505 (4)
C1—C2	1.481 (3)	C8—H8	1.0000
C2—C3	1.394 (3)	C9—O1	1.449 (3)
C2—C7	1.398 (3)	C9—C10	1.514 (3)
C3—C4	1.389 (4)	C9—H9	1.0000

C3—H3	0.9500	C10—O3	1.413 (3)
C4—C5	1.386 (4)	C10—H10A	0.9900
C4—H4	0.9500	C10—H10B	0.9900
C5—C6	1.387 (4)	C11—O3	1.418 (3)
C5—H5	0.9500	C11—H11A	0.9800
C6—C7	1.392 (4)	C11—H11B	0.9800
C6—H6	0.9500	C11—H11C	0.9800
C7—C8	1.501 (3)		
O2—C1—O1	117.9 (2)	F1—C8—H8	109.4
O2—C1—C2	124.3 (2)	C7—C8—H8	109.4
O1—C1—C2	117.77 (19)	C9—C8—H8	109.4
C3—C2—C7	120.4 (2)	O1—C9—C8	111.31 (19)
C3—C2—C1	118.9 (2)	O1—C9—C10	105.29 (19)
C7—C2—C1	120.7 (2)	C8—C9—C10	115.1 (2)
C4—C3—C2	119.6 (2)	O1—C9—H9	108.3
C4—C3—H3	120.2	C8—C9—H9	108.3
C2—C3—H3	120.2	C10—C9—H9	108.3
C5—C4—C3	120.1 (2)	O3—C10—C9	106.67 (19)
C5—C4—H4	119.9	O3—C10—H10A	110.4
C3—C4—H4	119.9	C9—C10—H10A	110.4
C4—C5—C6	120.5 (2)	O3—C10—H10B	110.4
C4—C5—H5	119.8	C9—C10—H10B	110.4
C6—C5—H5	119.8	H10A—C10—H10B	108.6
C5—C6—C7	120.0 (2)	O3—C11—H11A	109.5
C5—C6—H6	120.0	O3—C11—H11B	109.5
C7—C6—H6	120.0	H11A—C11—H11B	109.5
C6—C7—C2	119.4 (2)	O3—C11—H11C	109.5
C6—C7—C8	122.2 (2)	H11A—C11—H11C	109.5
C2—C7—C8	118.5 (2)	H11B—C11—H11C	109.5
F1—C8—C7	108.66 (19)	C1—O1—C9	118.96 (18)
F1—C8—C9	109.47 (19)	C10—O3—C11	111.86 (19)
C7—C8—C9	110.56 (19)		
O2—C1—C2—C3	9.2 (4)	C6—C7—C8—F1	−88.5 (3)
O1—C1—C2—C3	−173.6 (2)	C2—C7—C8—F1	91.5 (2)
O2—C1—C2—C7	−168.6 (2)	C6—C7—C8—C9	151.3 (2)
O1—C1—C2—C7	8.6 (3)	C2—C7—C8—C9	−28.6 (3)
C7—C2—C3—C4	−0.9 (4)	F1—C8—C9—O1	−67.4 (2)
C1—C2—C3—C4	−178.7 (2)	C7—C8—C9—O1	52.3 (3)
C2—C3—C4—C5	0.2 (4)	F1—C8—C9—C10	52.3 (2)
C3—C4—C5—C6	0.7 (4)	C7—C8—C9—C10	171.96 (19)
C4—C5—C6—C7	−0.9 (4)	O1—C9—C10—O3	−168.78 (19)
C5—C6—C7—C2	0.2 (4)	C8—C9—C10—O3	68.3 (3)
C5—C6—C7—C8	−179.8 (2)	O2—C1—O1—C9	−164.8 (2)
C3—C2—C7—C6	0.7 (4)	C2—C1—O1—C9	17.8 (3)
C1—C2—C7—C6	178.5 (2)	C8—C9—O1—C1	−49.0 (3)
C3—C2—C7—C8	−179.4 (2)	C10—C9—O1—C1	−174.34 (19)

C1—C2—C7—C8	−1.6 (3)	C9—C10—O3—C11	175.7 (2)

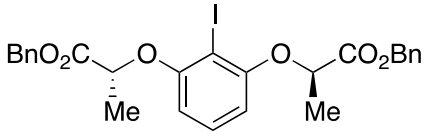


Three-dimensional supramolecular architecture viewed along the *a*-axis direction.

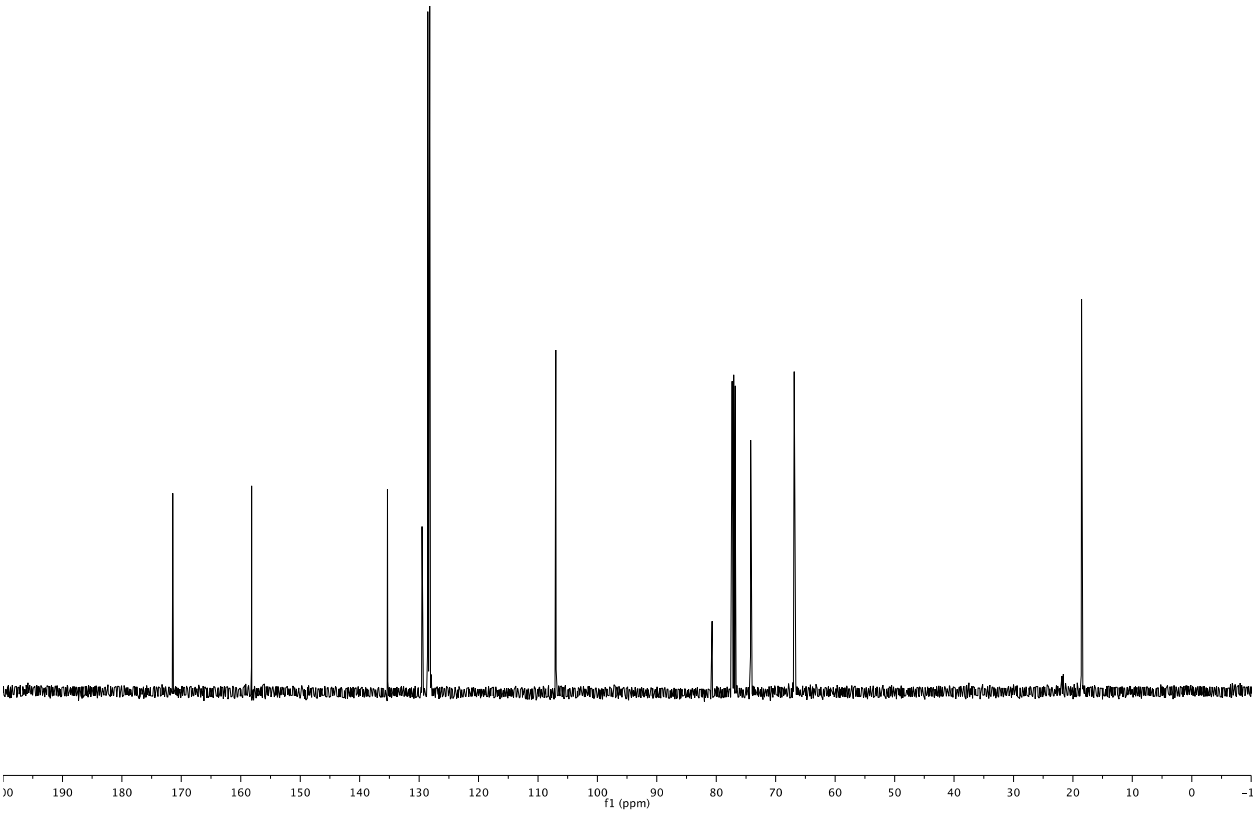
References for X-ray crystallography data:

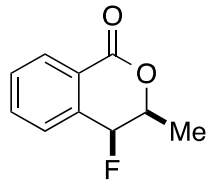
[1] Bruker AXS APEX II, Bruker AXS, Madison, Wisconsin, **2014**.
[2] Accelrys DS Visualizer v2.0.1, Accelrys Software. Inc., **2007**.
[3] G. M. Sheldrick, *Acta Cryst*. **2015**. A**71**, 3-8.
[4] G. M. Sheldrick, *Acta Cryst*. **2015**, C**71**, 3-8.
[5] O. V. Dolomanov, L. J. Bourhis, R. J. Gildea, J. A. K. Howard and H. Puschmann *J. Appl. Cryst.* **2009**, *42*, 339-341.

X. NMR spectra



2d

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O
Me
F

3

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7.0
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1.0
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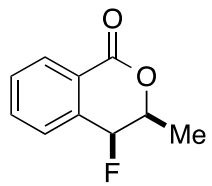
0.0
f1 (ppm)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O
Me
F

3

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10
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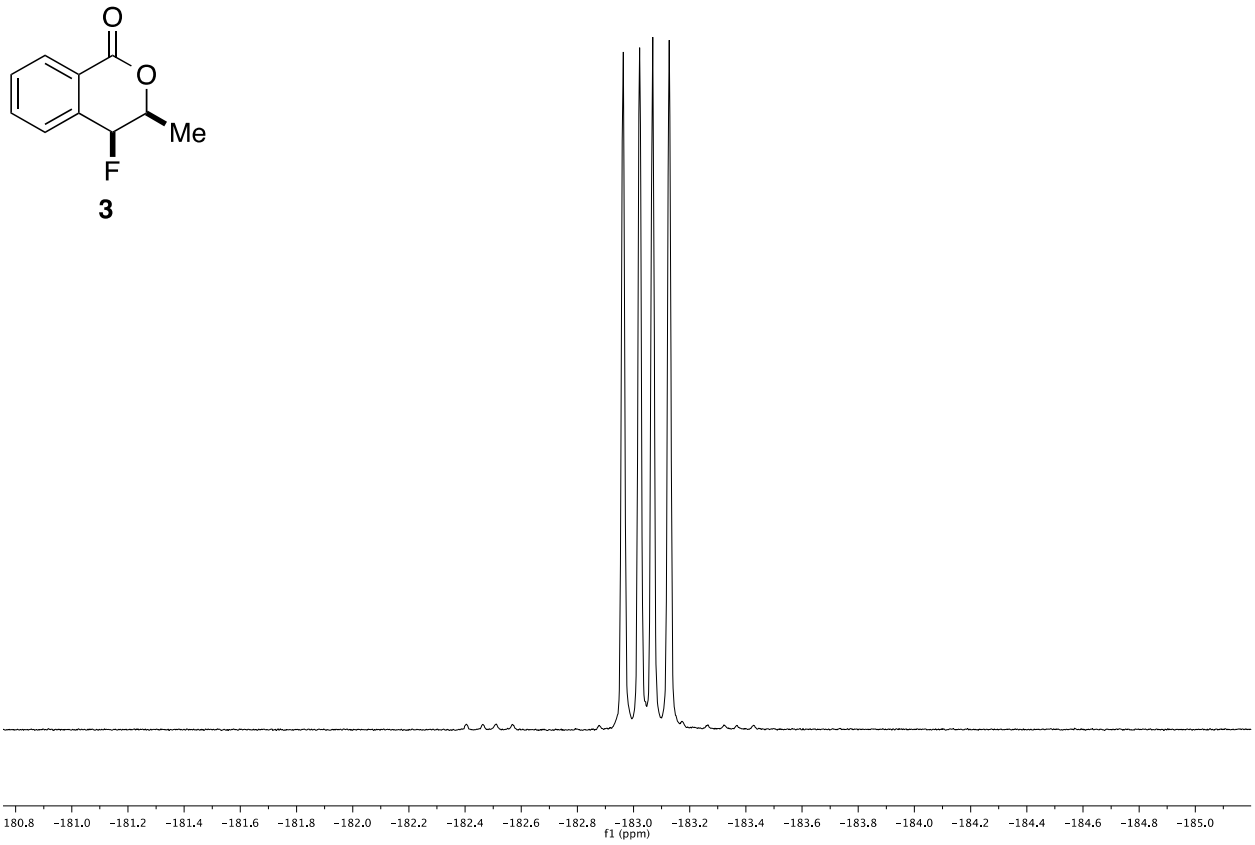
f1 (ppm)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O
Me
F
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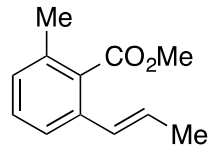
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CO2Me
Me

4a

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5.0
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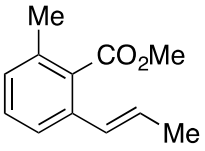
Me
CO2Me
Me

4a

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180
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100
f1 (ppm)
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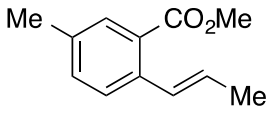
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CO2Me
Me

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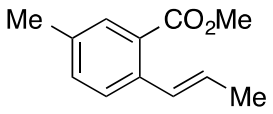
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CO2Me
Me

4b

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60
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30
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10
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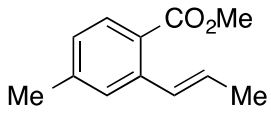
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Me
Me

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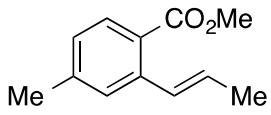
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Me
Me

4c

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180
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120
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100
90
f1 (ppm)
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60
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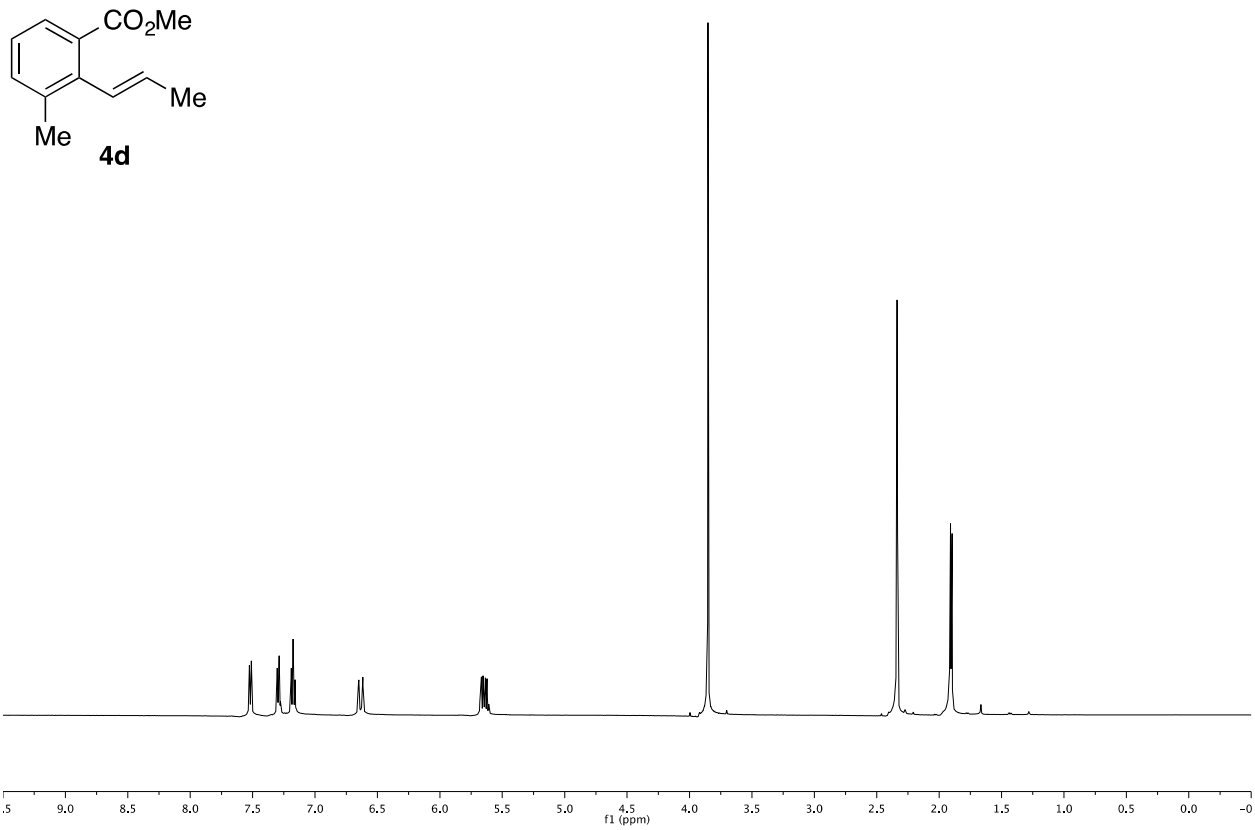
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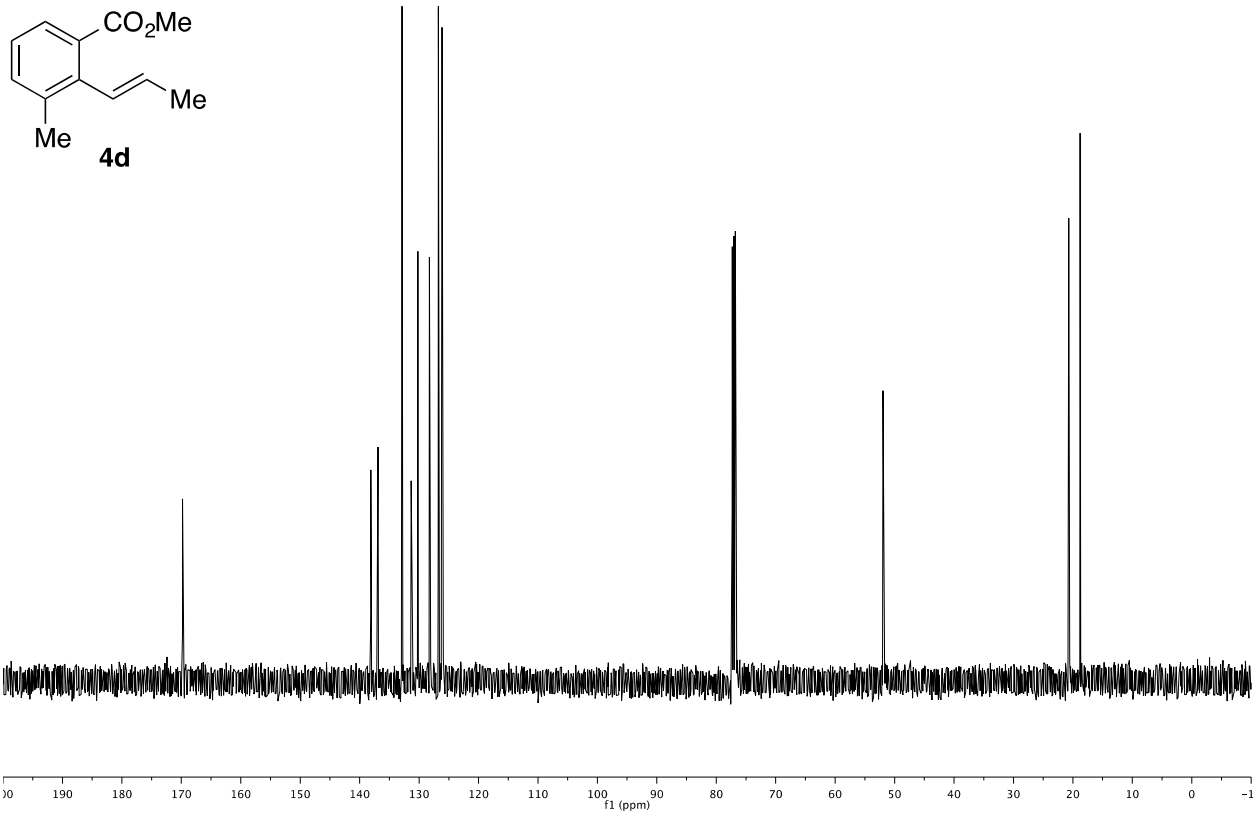
Me
Me
4d
f1 (ppm)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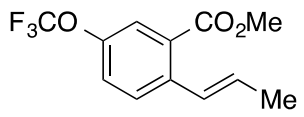
Me
Me
4d
f1 (ppm)



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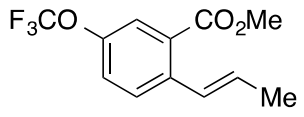

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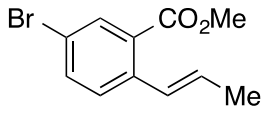
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Me

4f

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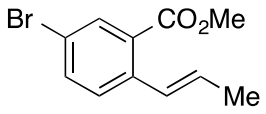
f1 (ppm)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Me

4f

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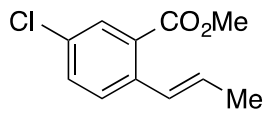
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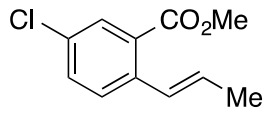
f1 (ppm)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Me

4g

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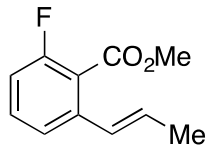
f1 (ppm)



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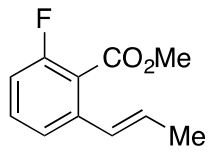

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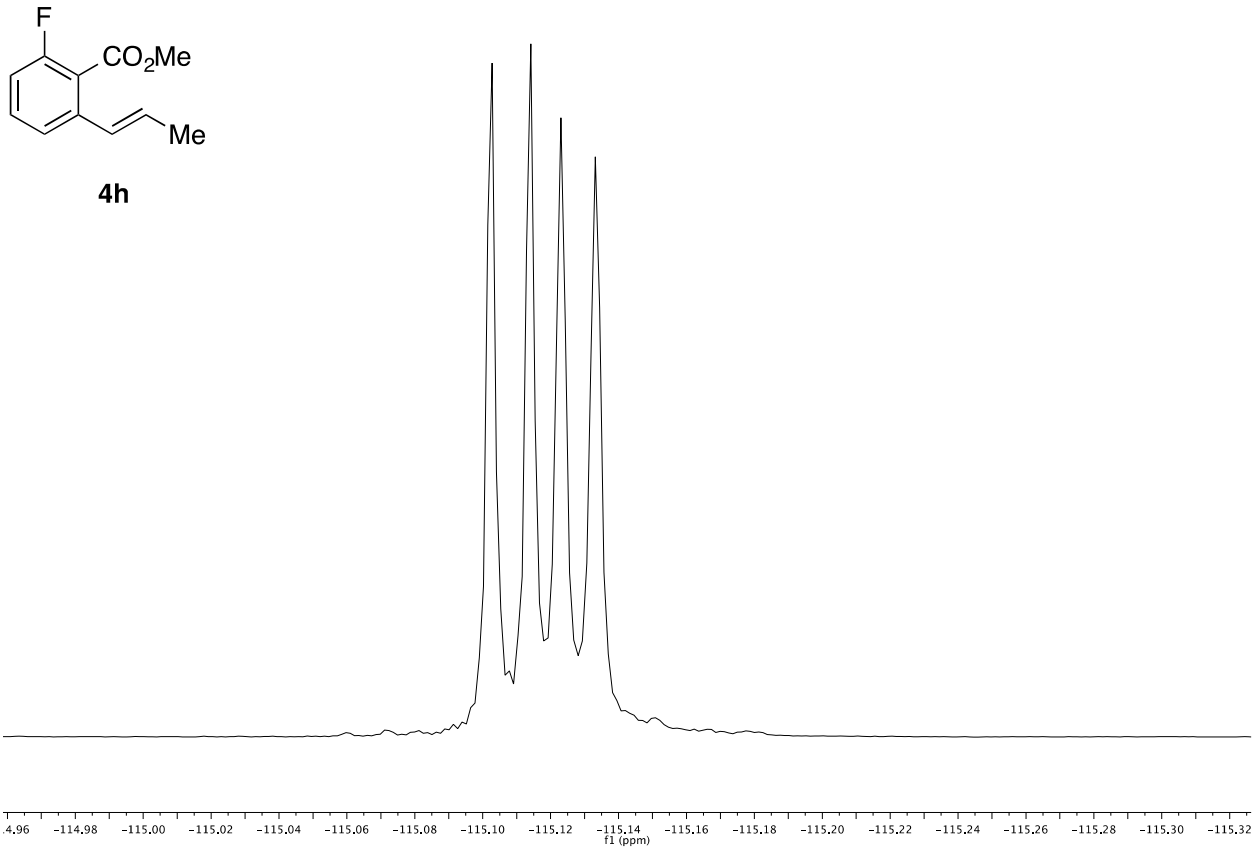
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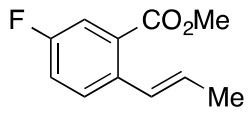
F
CO2Me
Me

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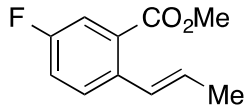
F
CO2Me
Me

4i

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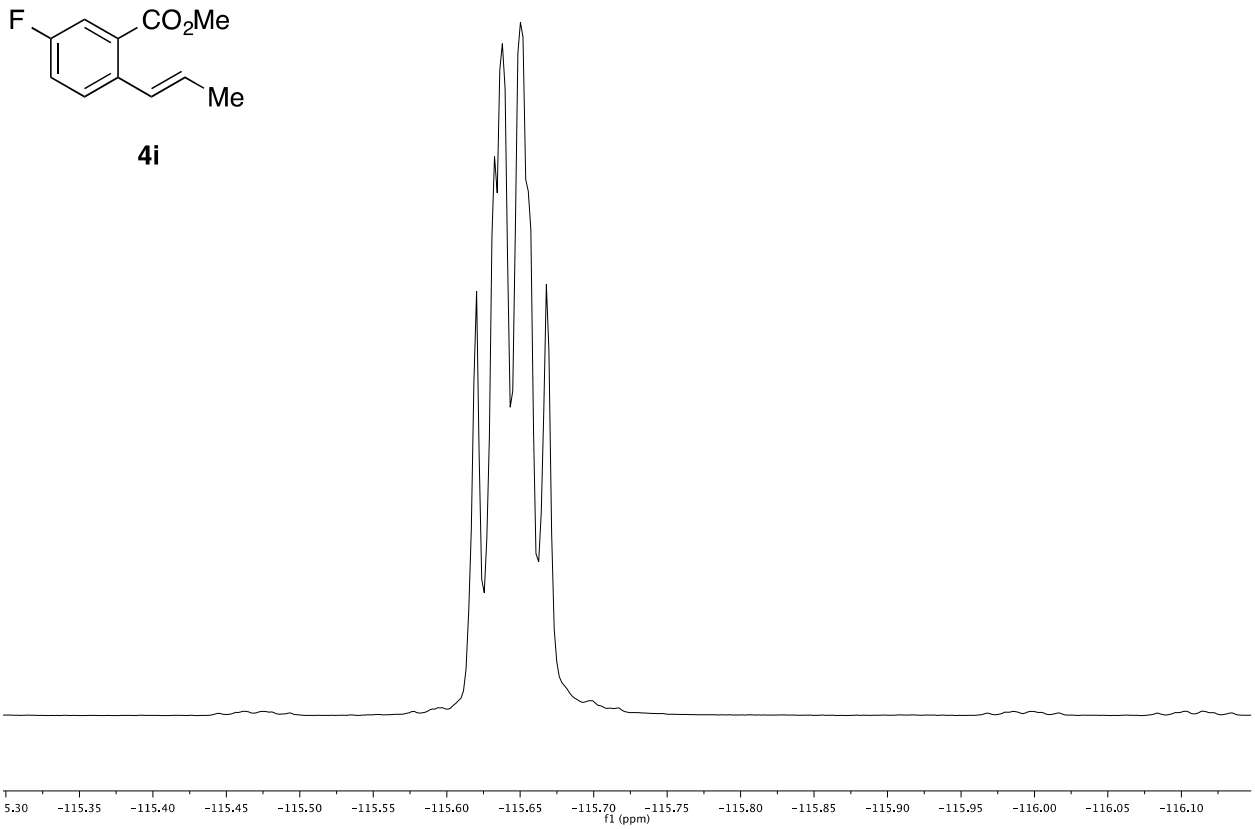
f1 (ppm)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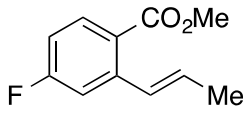

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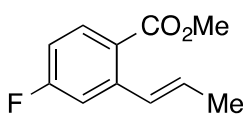

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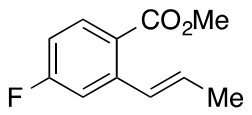
CO2Me
F
Me

4j

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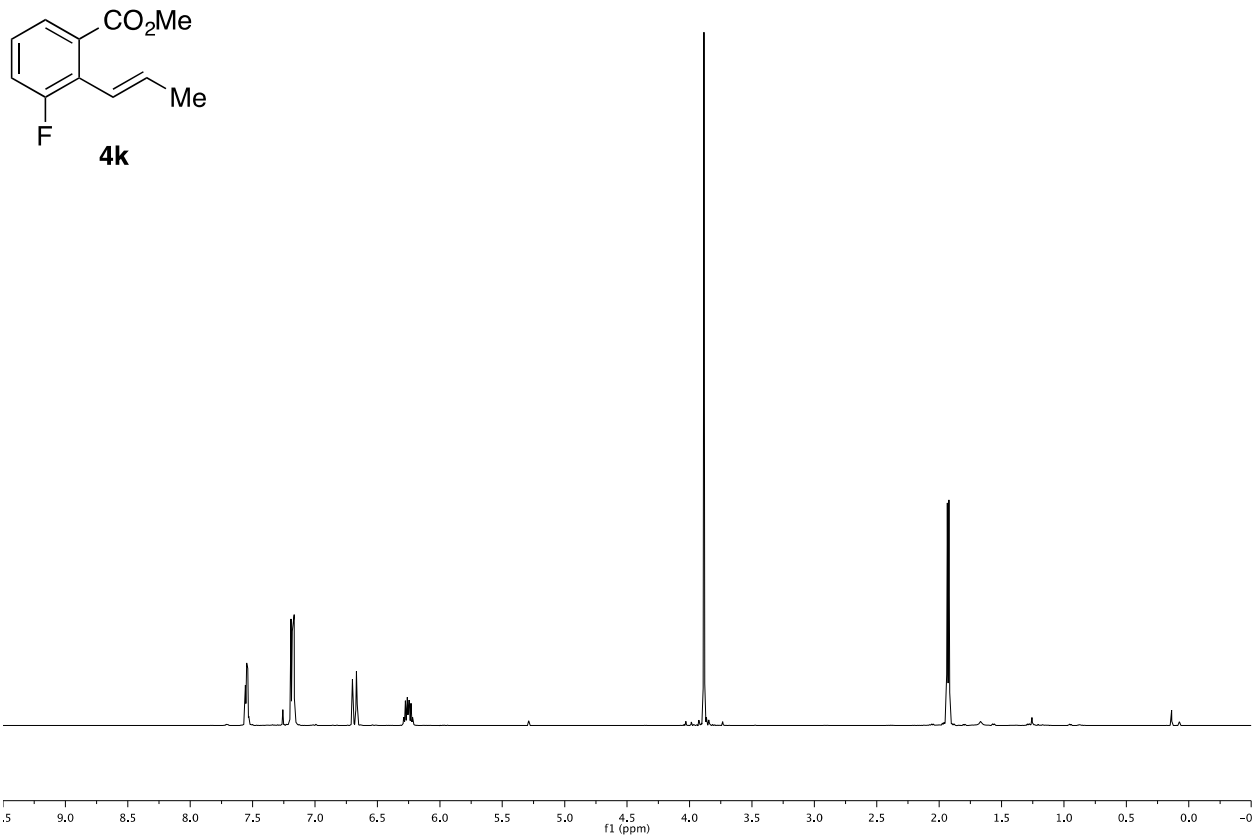
f1 (ppm)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Me
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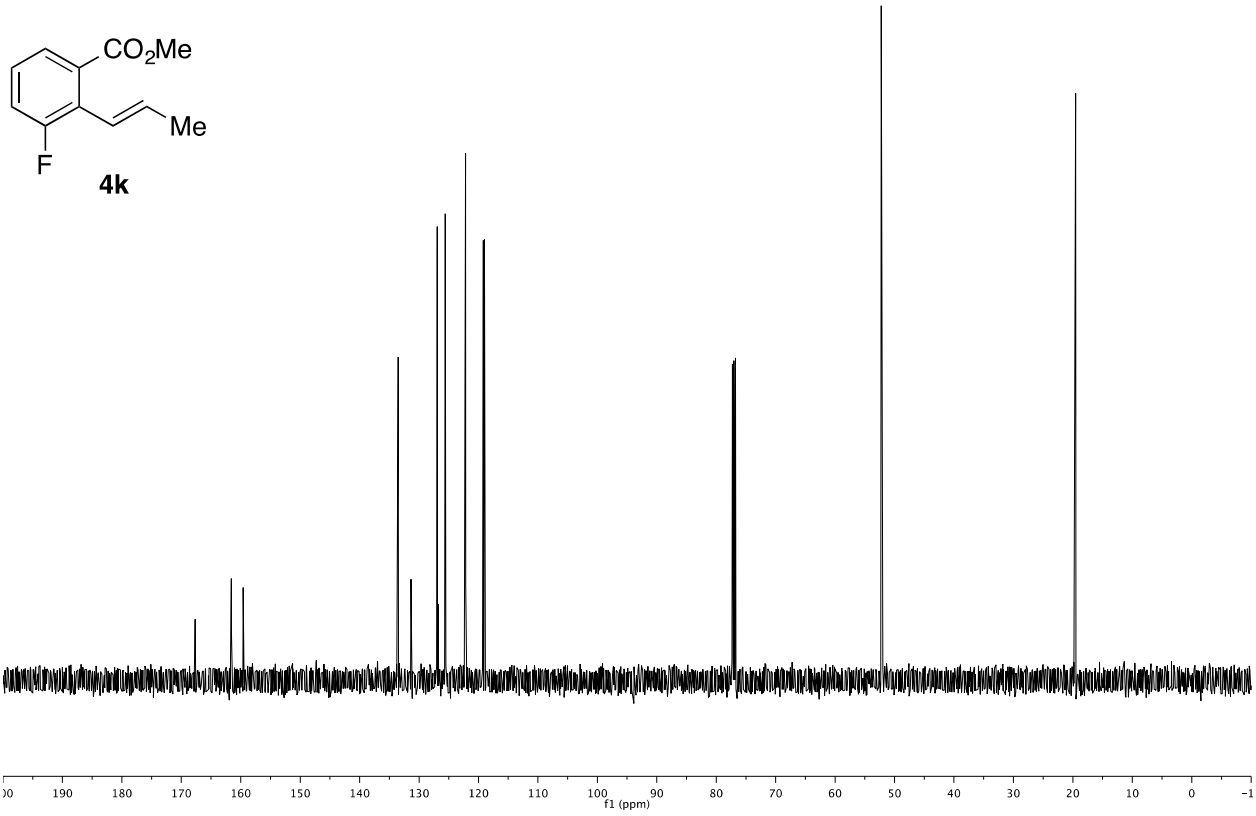
4k
f1 (ppm)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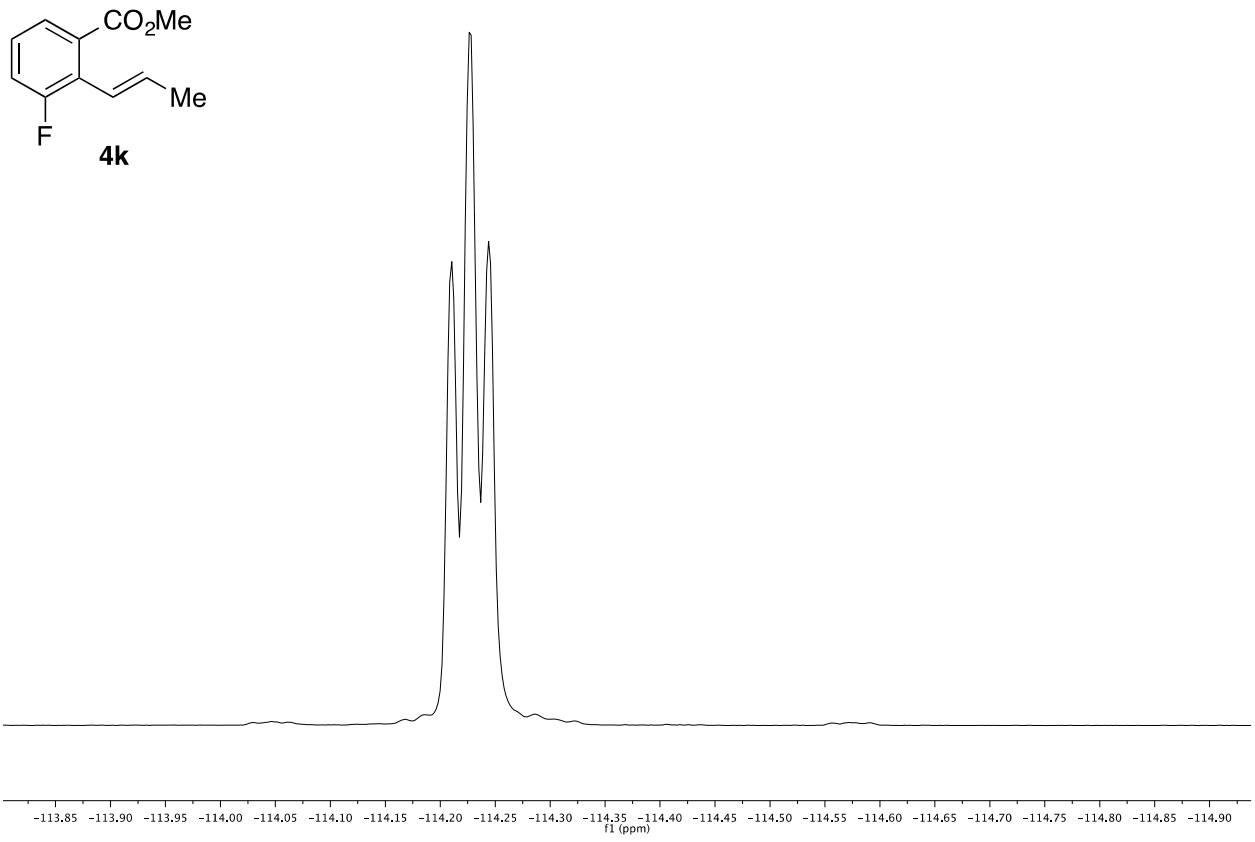
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Me
F
4k
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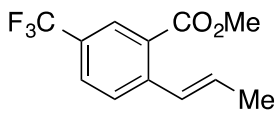
f1 (ppm)



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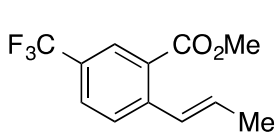
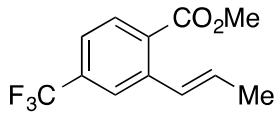
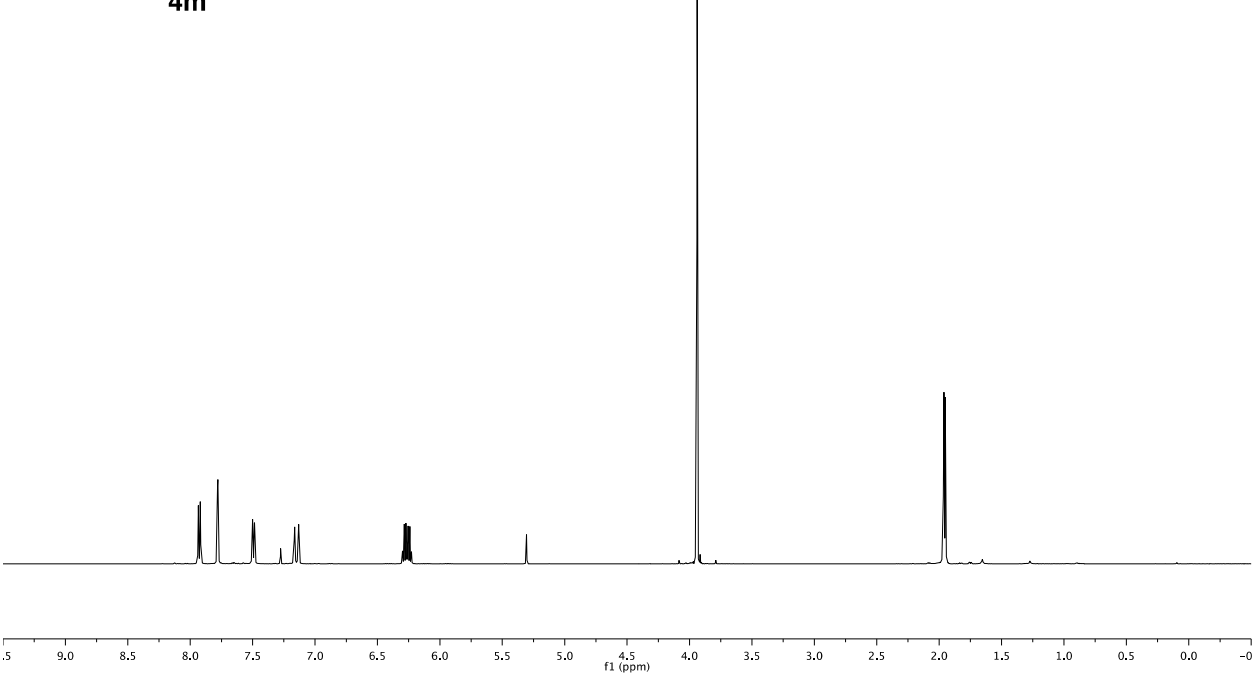
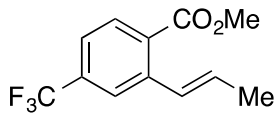


4l


CO2Me
F3C
Me

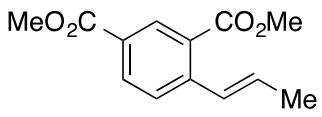
4m


9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


CO2Me
F3C
Me

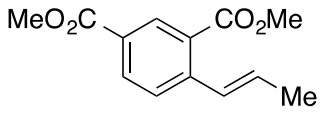
4m

190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


MeO2C
CO2Me
Me

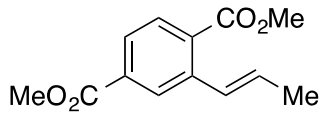
4n

9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


MeO2C
CO2Me
Me

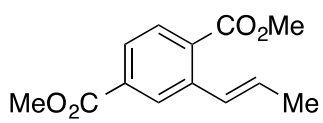
4n

190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


CO2Me
MeO2C
Me

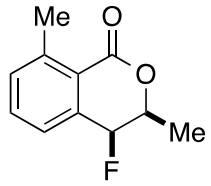
4o

9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


CO2Me
MeO2C
Me

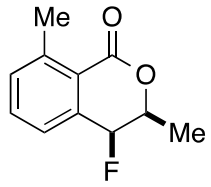
4o

190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


Me
O
O
Me
F

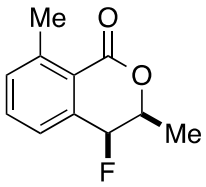
5a

9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


Me
O
O
Me
F

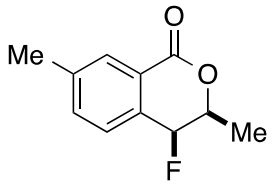
5a

190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


Me
O
O
Me
F

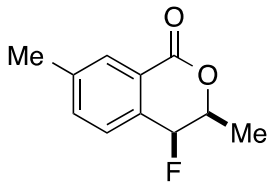
5a

-182.2
-182.6
-183.0
-183.4
-183.8
-184.2
-184.6
-185.0
-185.4
-185.8
-186.2
-186.6
-187.0
-187.4
-187.8
-188.2
f1 (ppm)


O
Me
O
Me
F

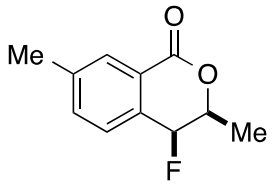
5b

9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


O
Me
O
Me
F

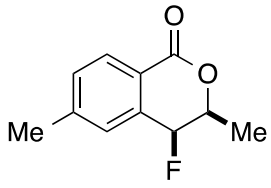
5b

190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


O
Me
O
Me
F

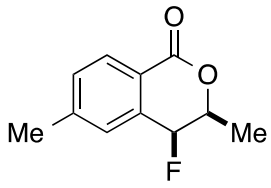
5b

-178.5
-179.0
-179.5
-180.0
-180.5
-181.0
-181.5
-182.0
-182.5
-183.0
-183.5
-184.0
-184.5
-185.0
-185
f1 (ppm)


O
O
Me
Me
F

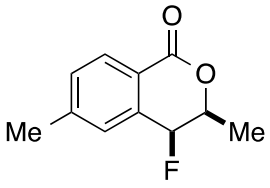
5c

9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


O
O
Me
Me
F

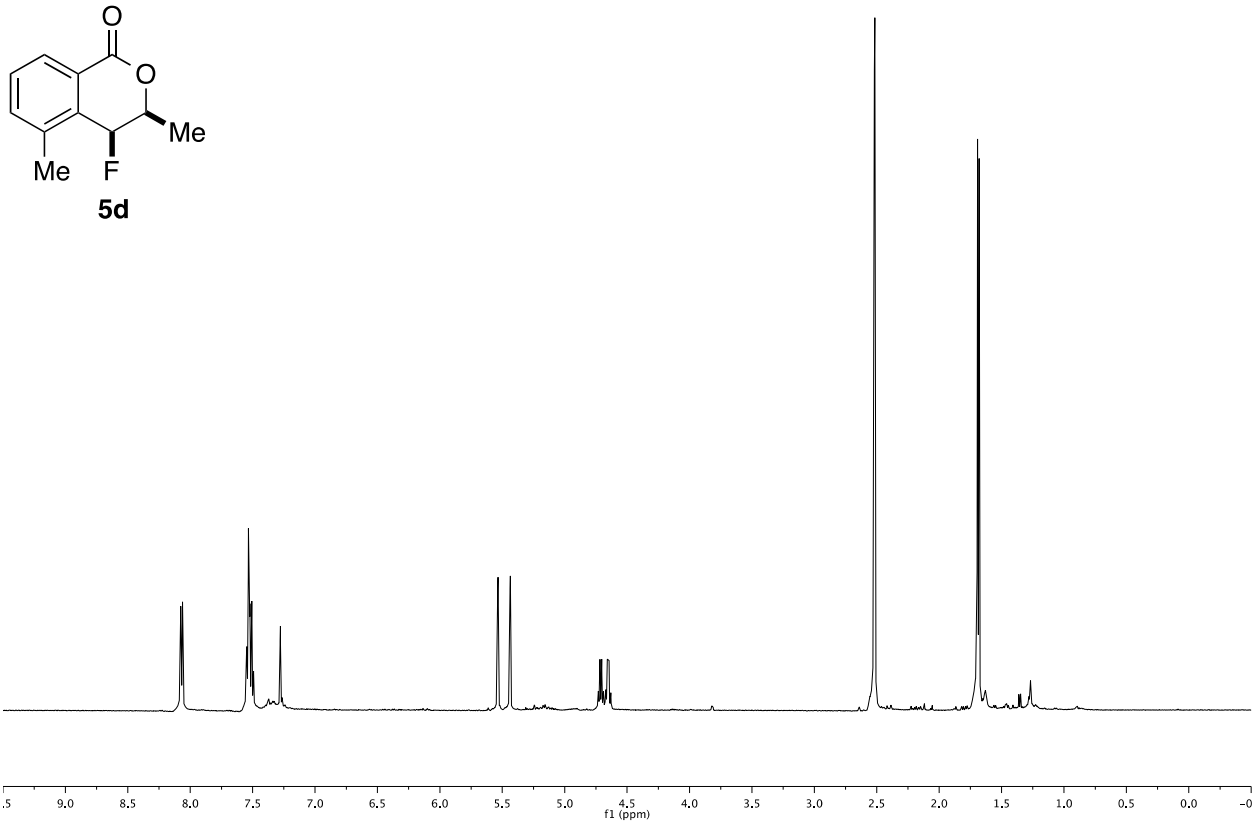
5c

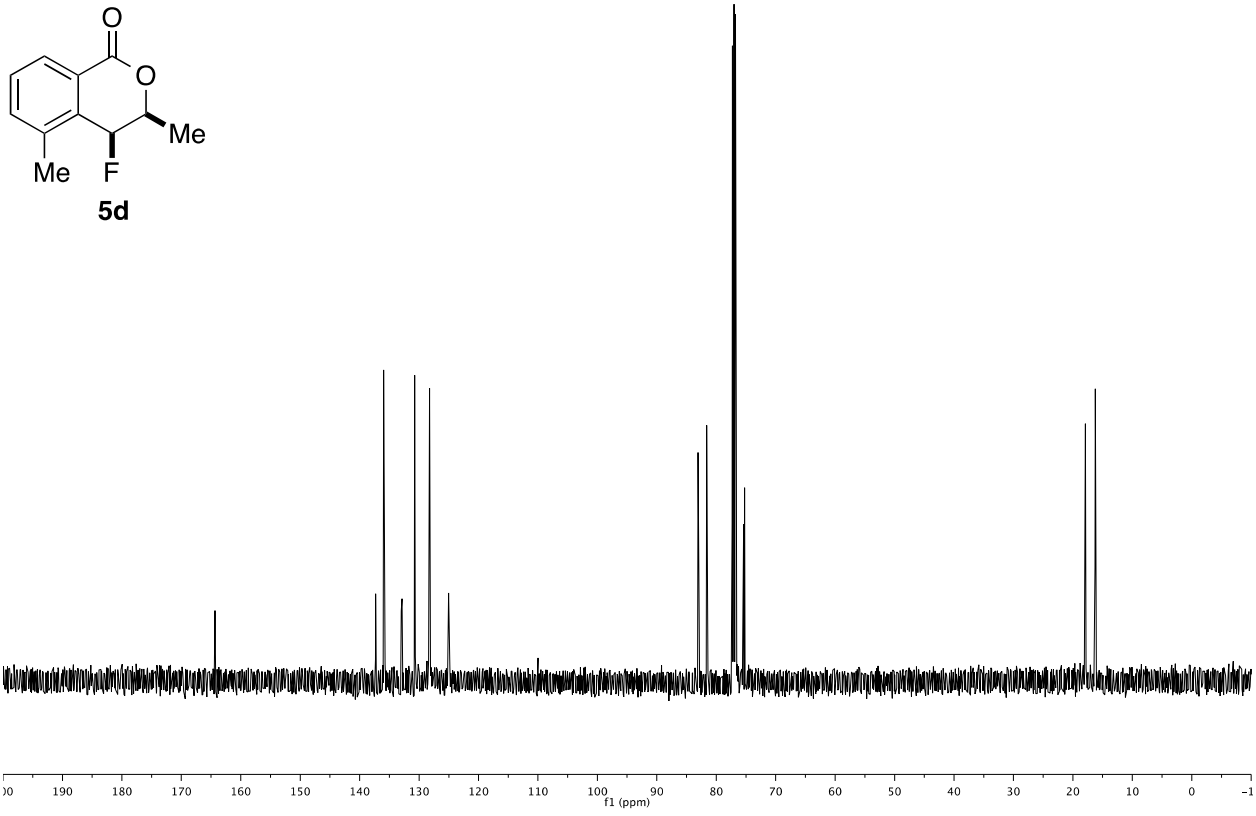
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

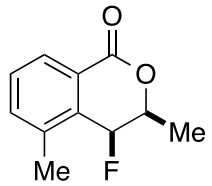

O
O
Me
Me
F

5c

78.5
-179.0
-179.5
-180.0
-180.5
-181.0
-181.5
-182.0
-182.5
-183.0
-183.5
-184.0
-184.5
-185.0
-185.5
-186.0
-186.5
-187.0
-187.5
-188.0
f1 (ppm)

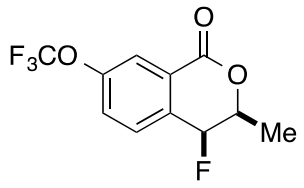

O
O
Me
Me
F
5d
f1 (ppm)


O
O
Me
Me
F
5d
f1 (ppm)


O
O
Me
Me
F

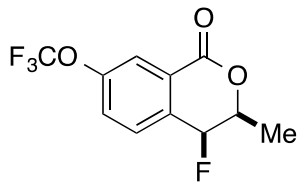
5d

-185.5
-186.0
-186.5
-187.0
-187.5
-188.0
-188.5
-189.0
-189.5
-190.0
-190.5
-191.0
-191.5
-192.0
-192.5
-193.0
-193.5
-194.0
-194.5
f1 (ppm)


O
F3CO
O
Me
F

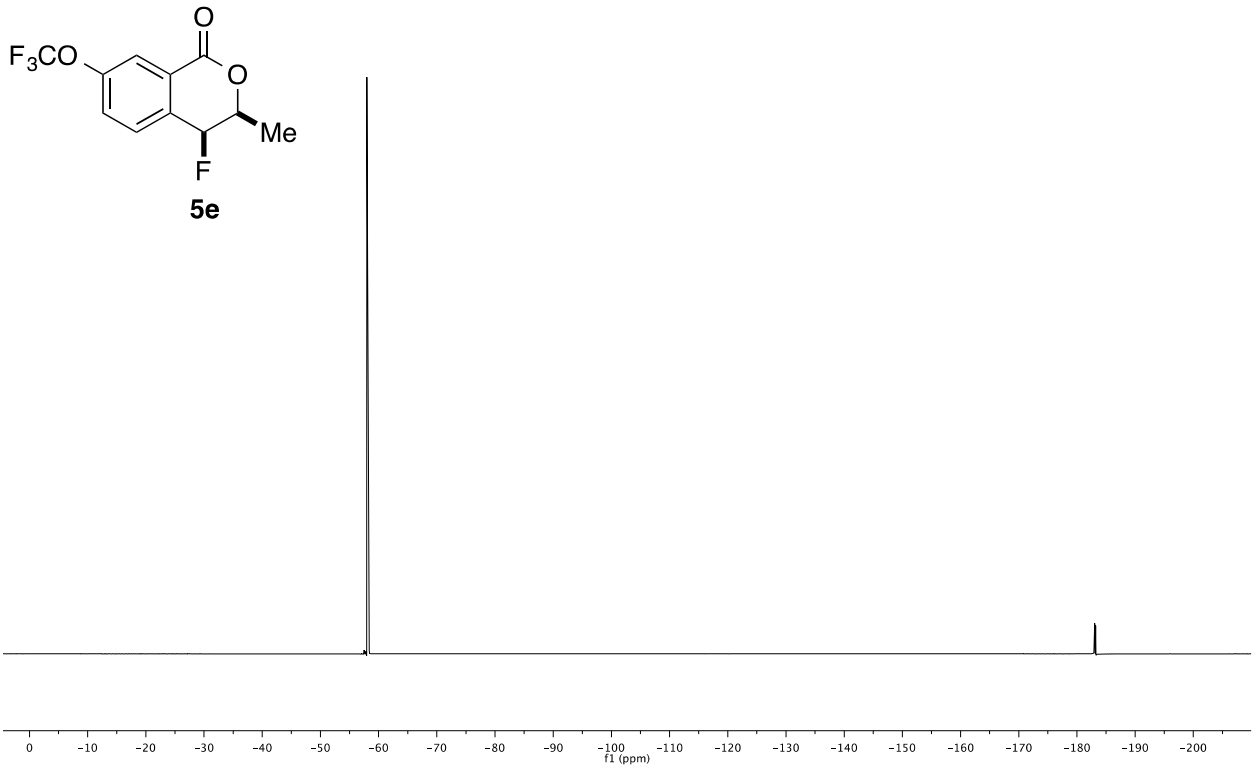
5e

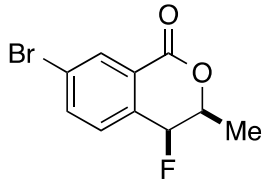
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


O
F3CO
O
Me
F

5e

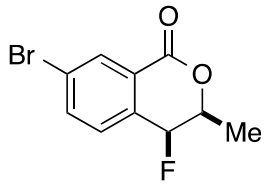
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


O
F3CO
O
Me
F
5e
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
f1 (ppm)


O
Br
O
Me
F

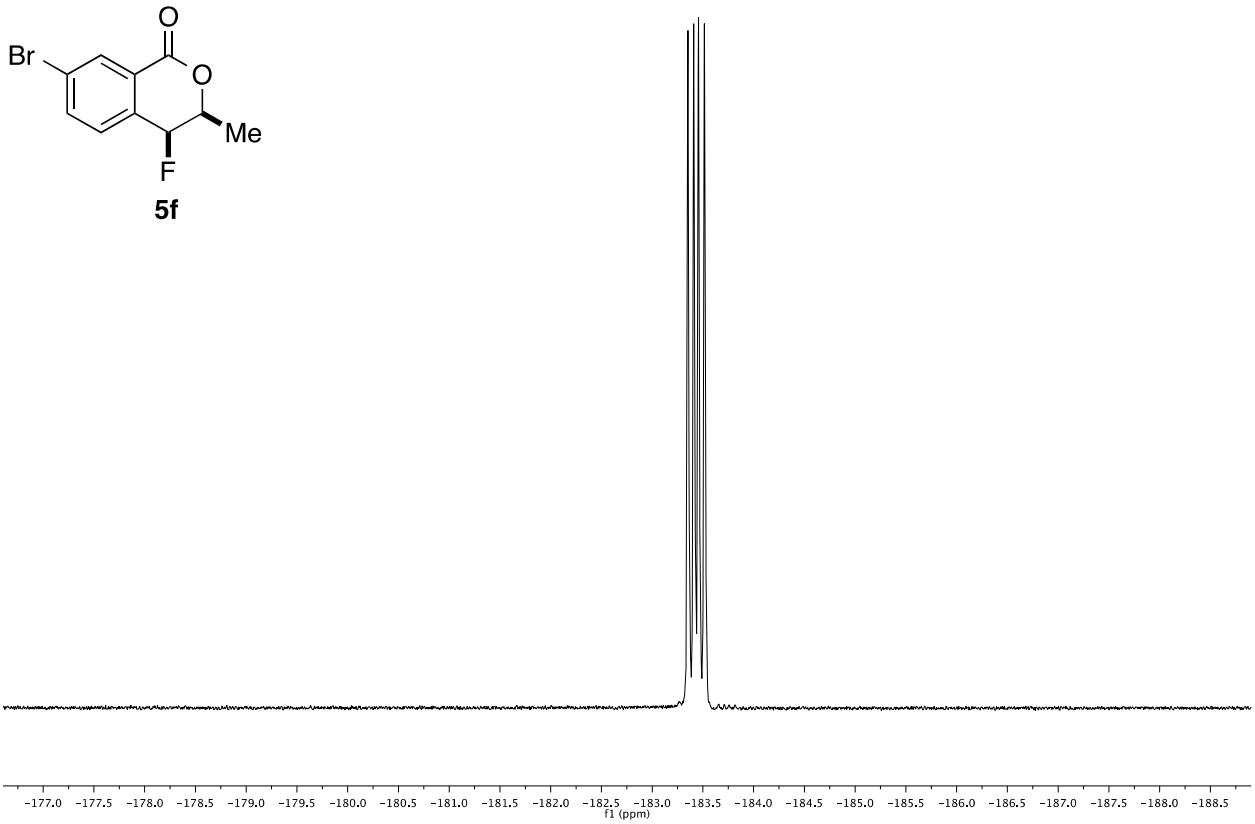
5f

9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

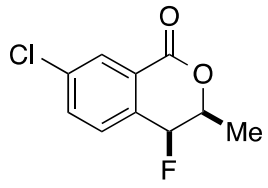

O
Br
O
Me
F

5f

190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

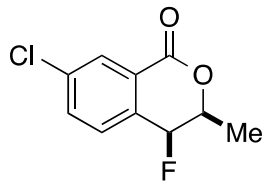

O
Br
O
Me
F
-177.0 -177.5 -178.0 -178.5 -179.0 -179.5 -180.0 -180.5 -181.0 -181.5 -182.0 -182.5 -183.0 -183.5 -184.0 -184.5 -185.0 -185.5 -186.0 -186.5 -187.0 -187.5 -188.0 -188.5
f1 (ppm)

5f


O
Cl
O
Me
F

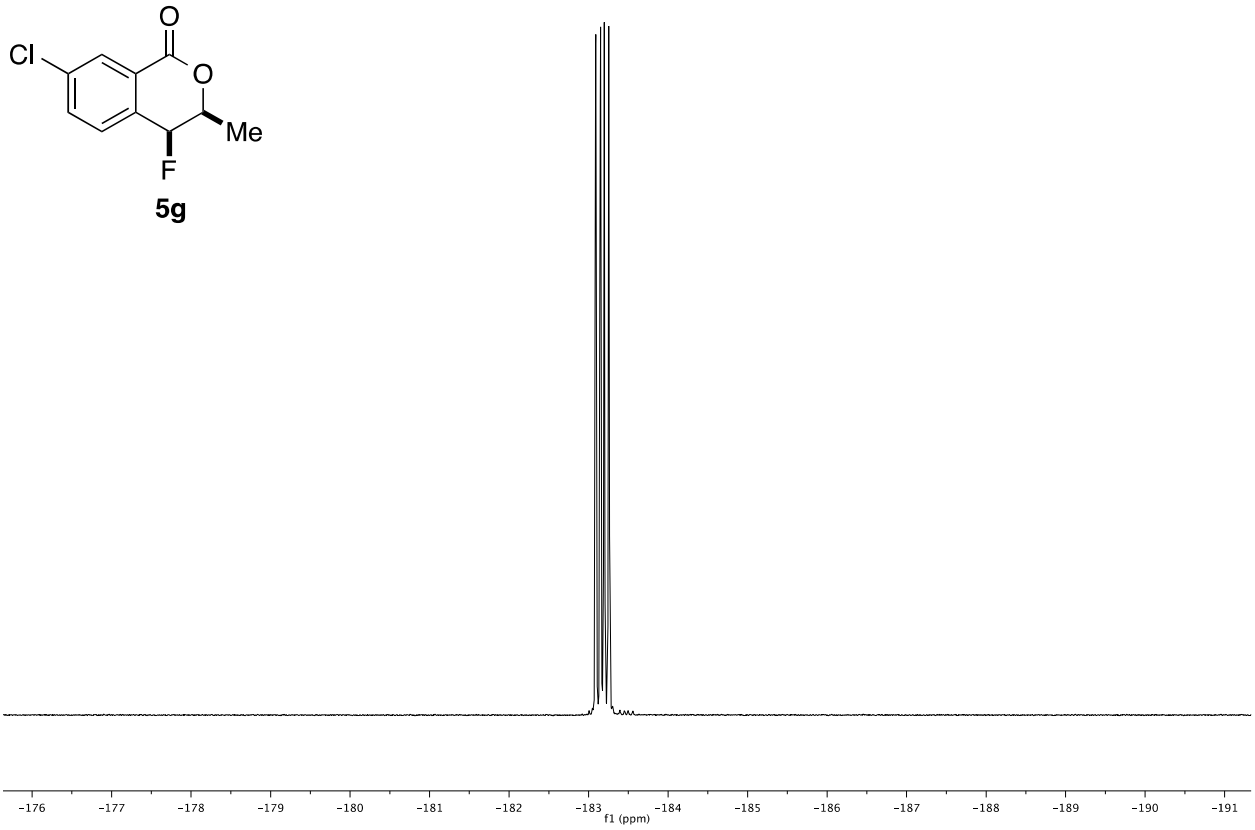
5g

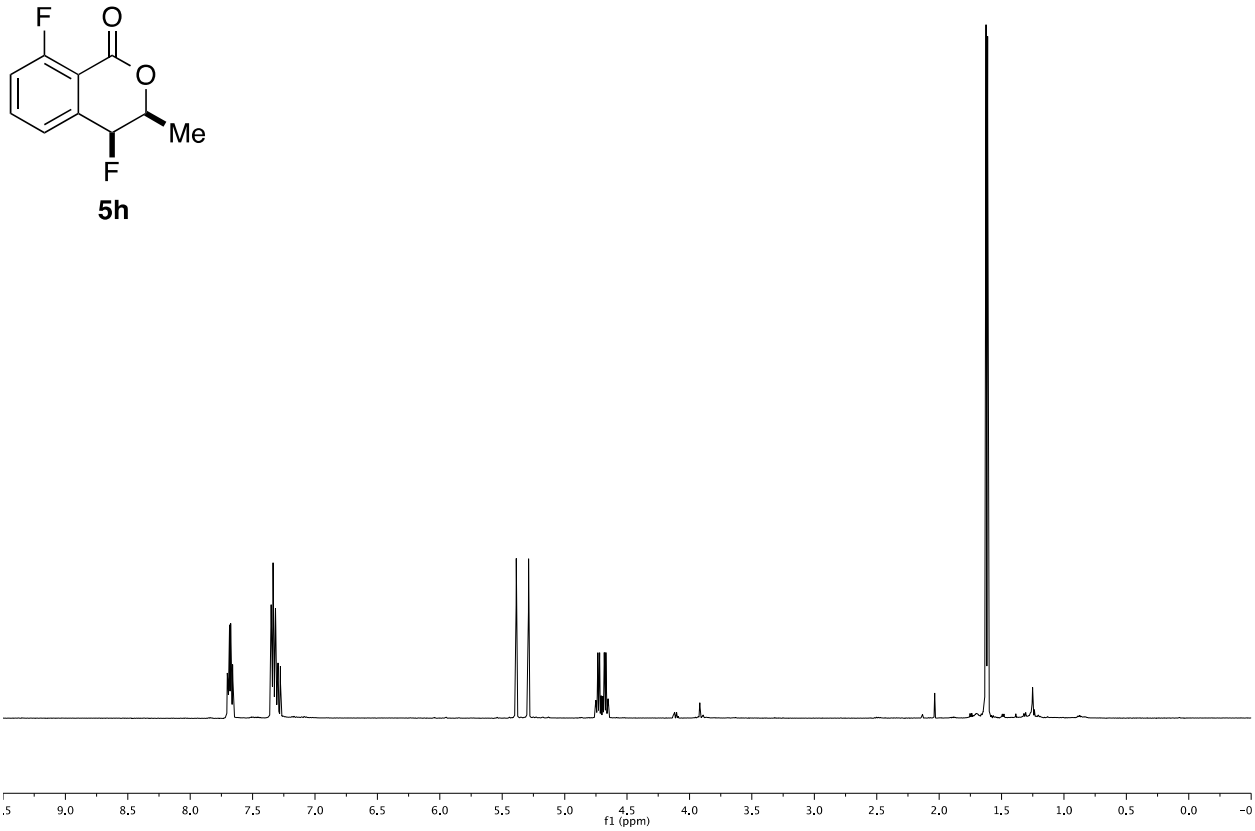
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

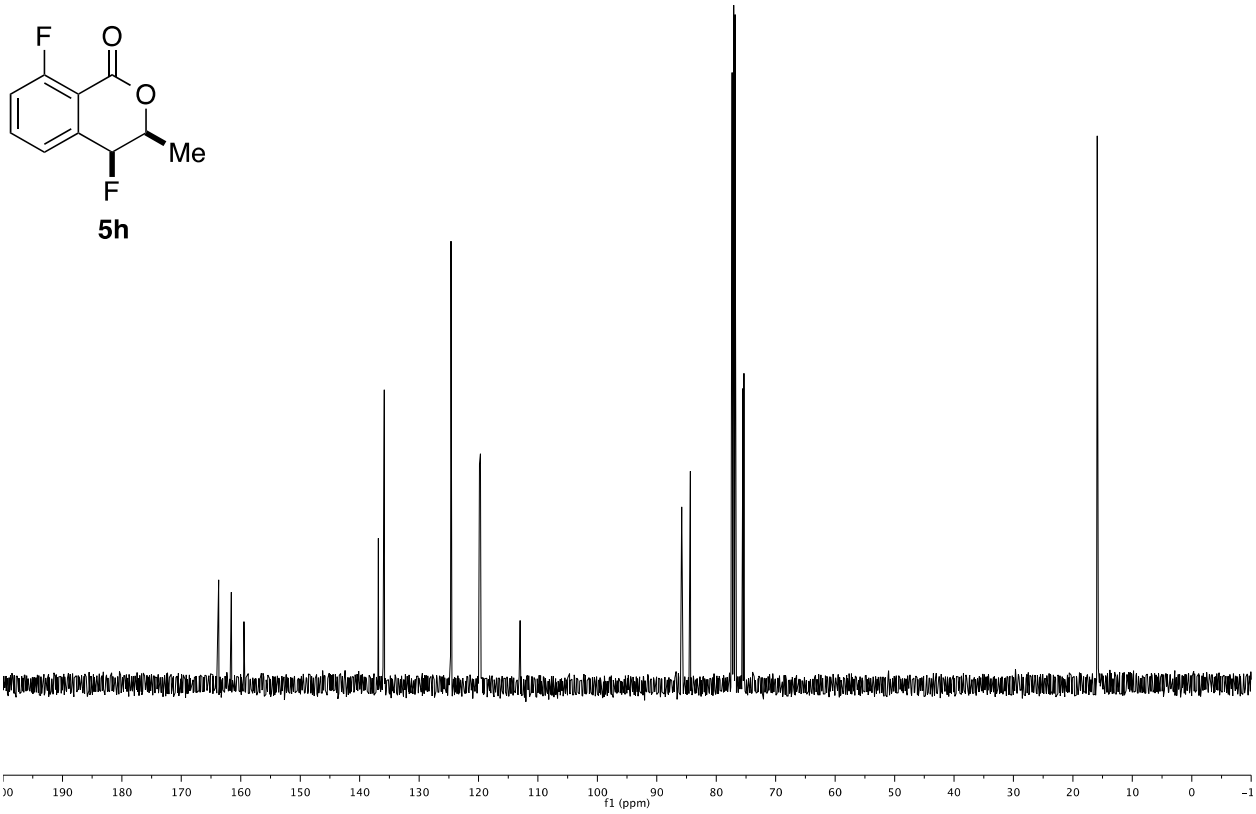

O
Cl
O
Me
F

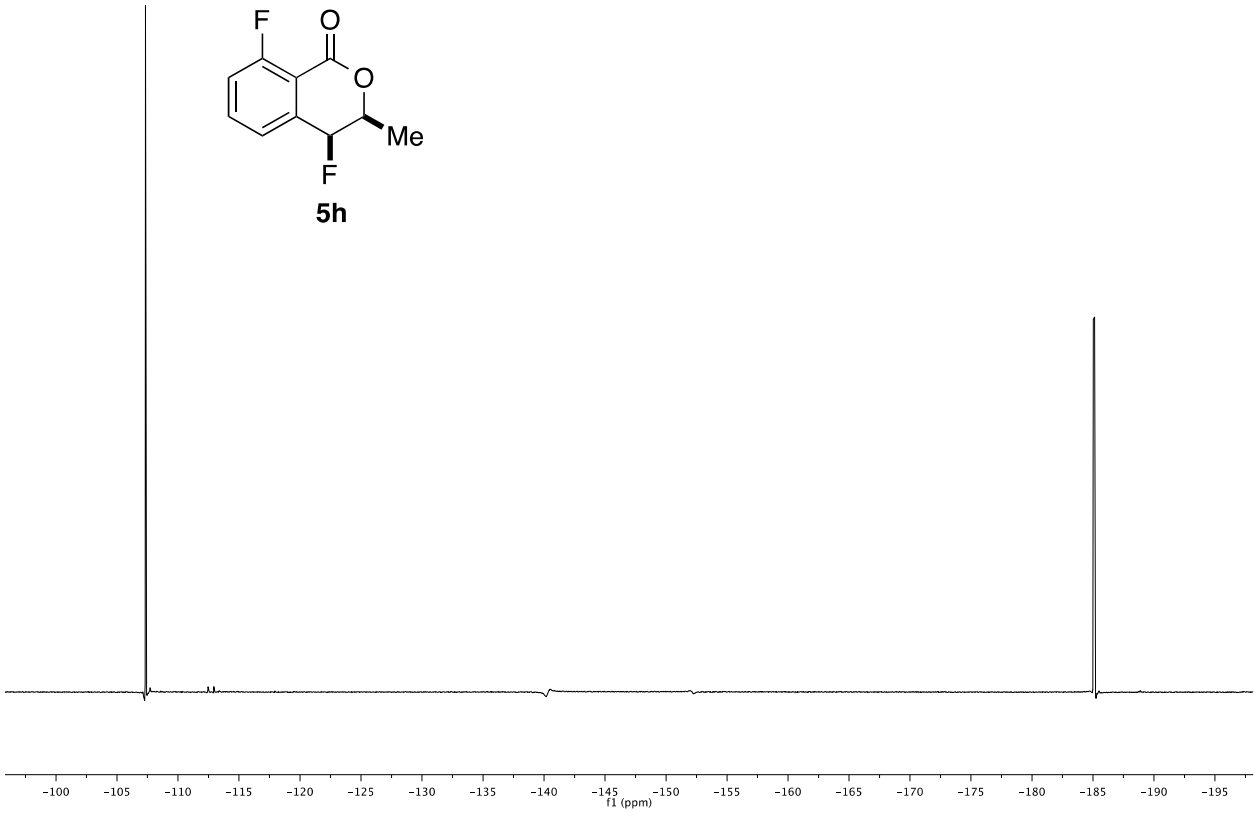
5g

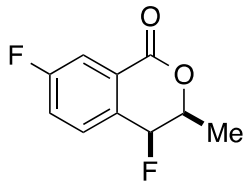
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


O
Cl
O
Me
F
5g
-176
-177
-178
-179
-180
-181
-182
-183
-184
-185
-186
-187
-188
-189
-190
-191
f1 (ppm)

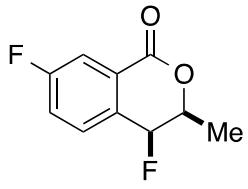

F
O
O
Me
F
5h
f1 (ppm)


F
O
O
Me
F
5h
f1 (ppm)

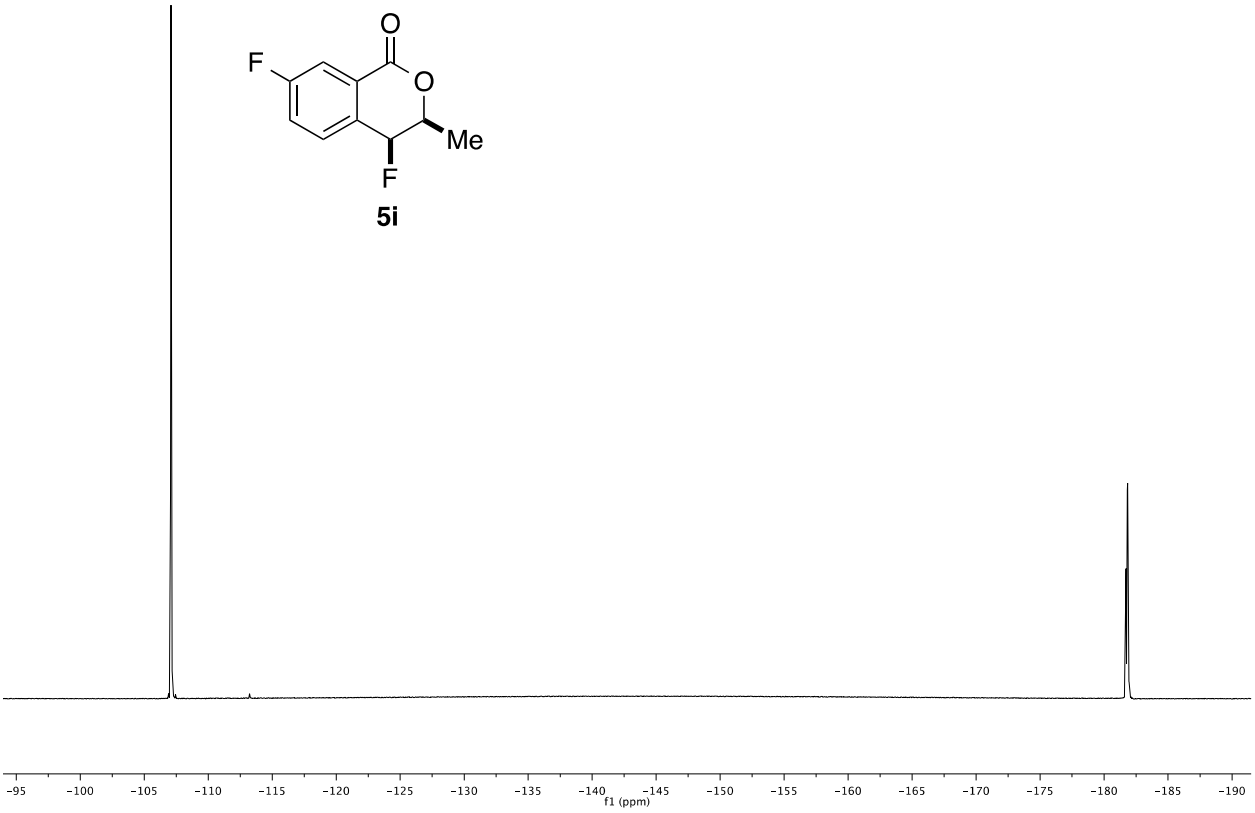

F
O
O
Me
F
5h
-100
-105
-110
-115
-120
-125
-130
-135
-140
-145
-150
-155
-160
-165
-170
-175
-180
-185
-190
-195
f1 (ppm)

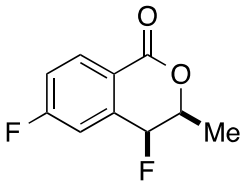


5i

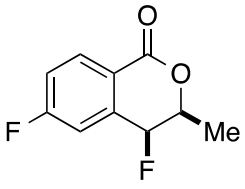


5i

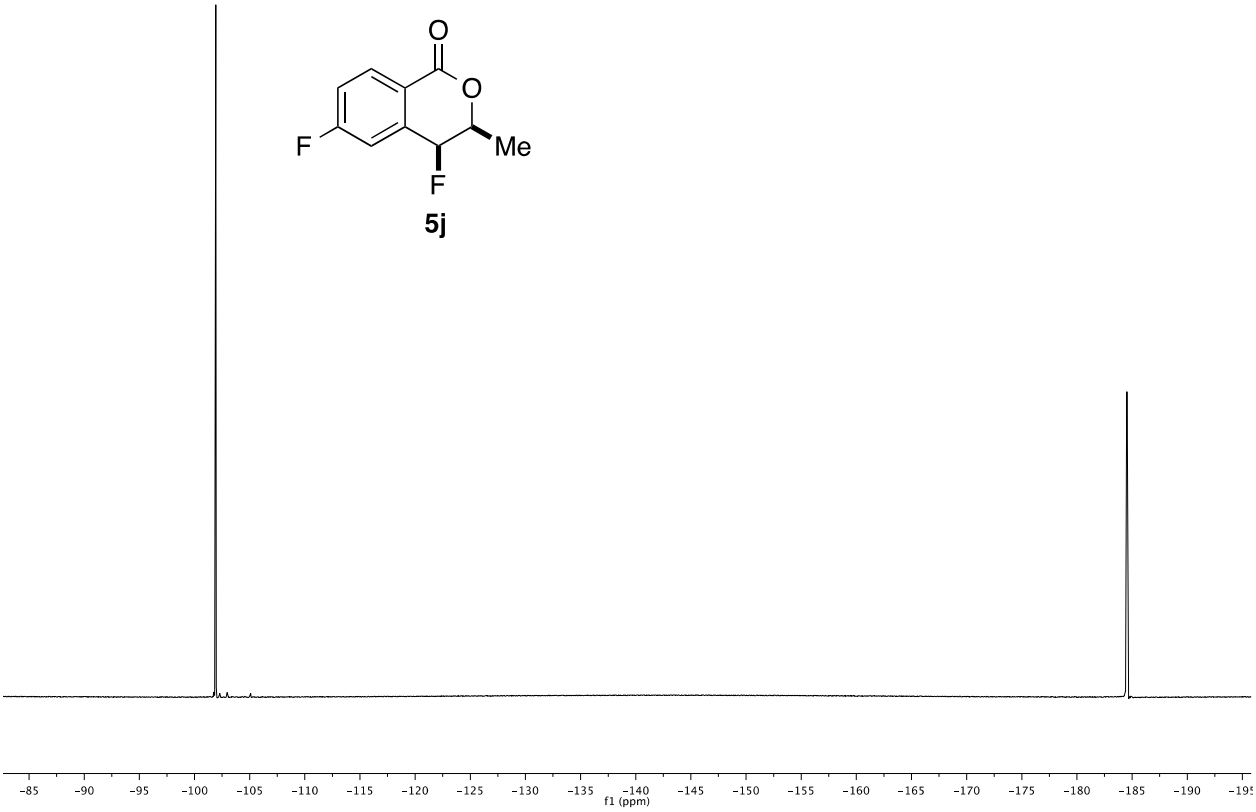

O
F
O
Me
F
5i
-95
-100
-105
-110
-115
-120
-125
-130
-135
-140
-145
-150
-155
-160
-165
-170
-175
-180
-185
-190
f1 (ppm)

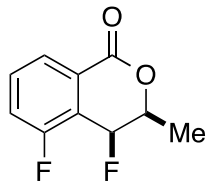


5j



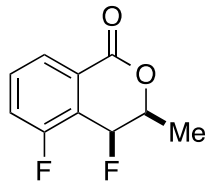
5j


O
O
F
Me
F
5j
-85
-90
-95
-100
-105
-110
-115
-120
-125
-130
-135
-140
-145
-150
-155
-160
-165
-170
-175
-180
-185
-190
f1 (ppm)


O
O
Me
F
F

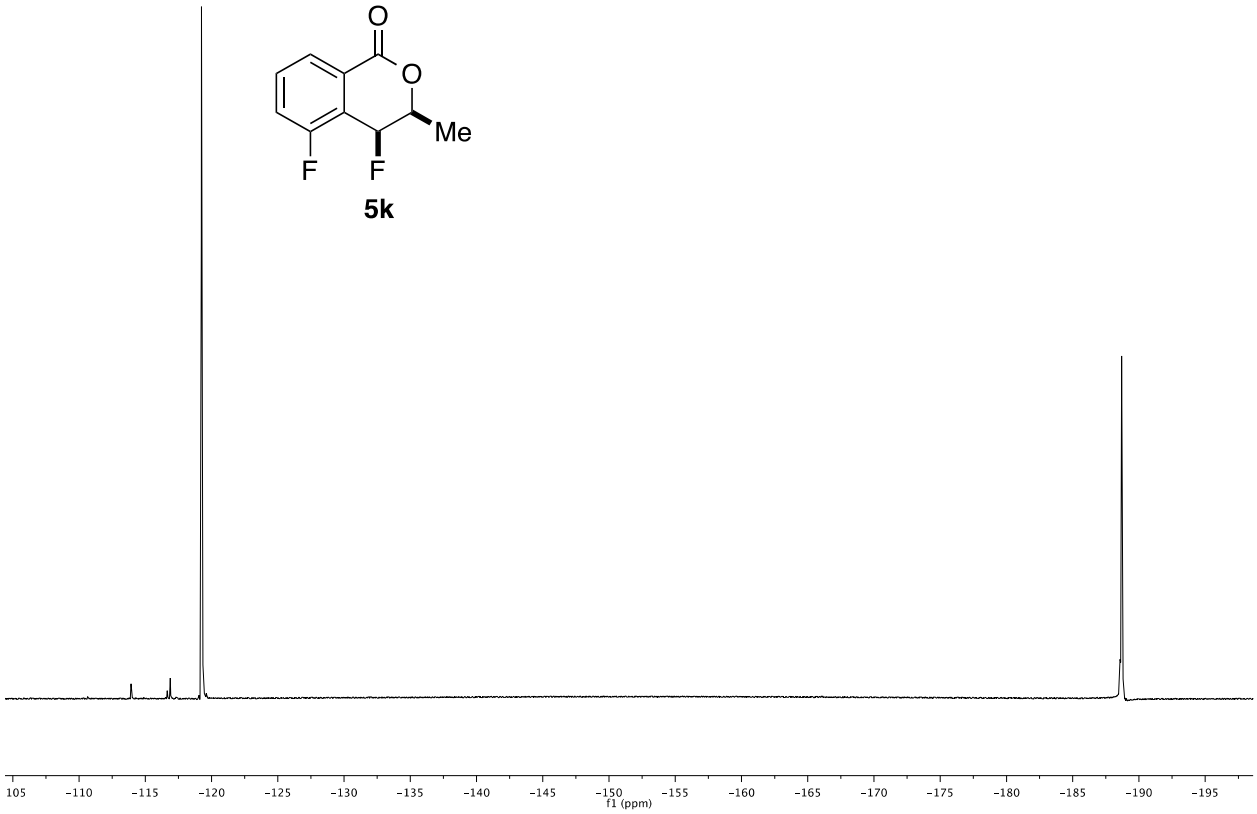
5k

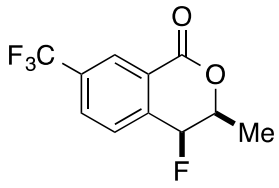
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


O
O
Me
F
F

5k

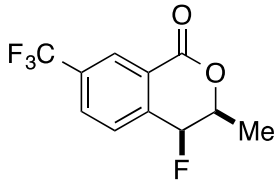
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


O
O
Me
F
F
5k
105
-110
-115
-120
-125
-130
-135
-140
-145
-150
-155
-160
-165
-170
-175
-180
-185
-190
-195
f1 (ppm)


O
F3C
O
Me
F

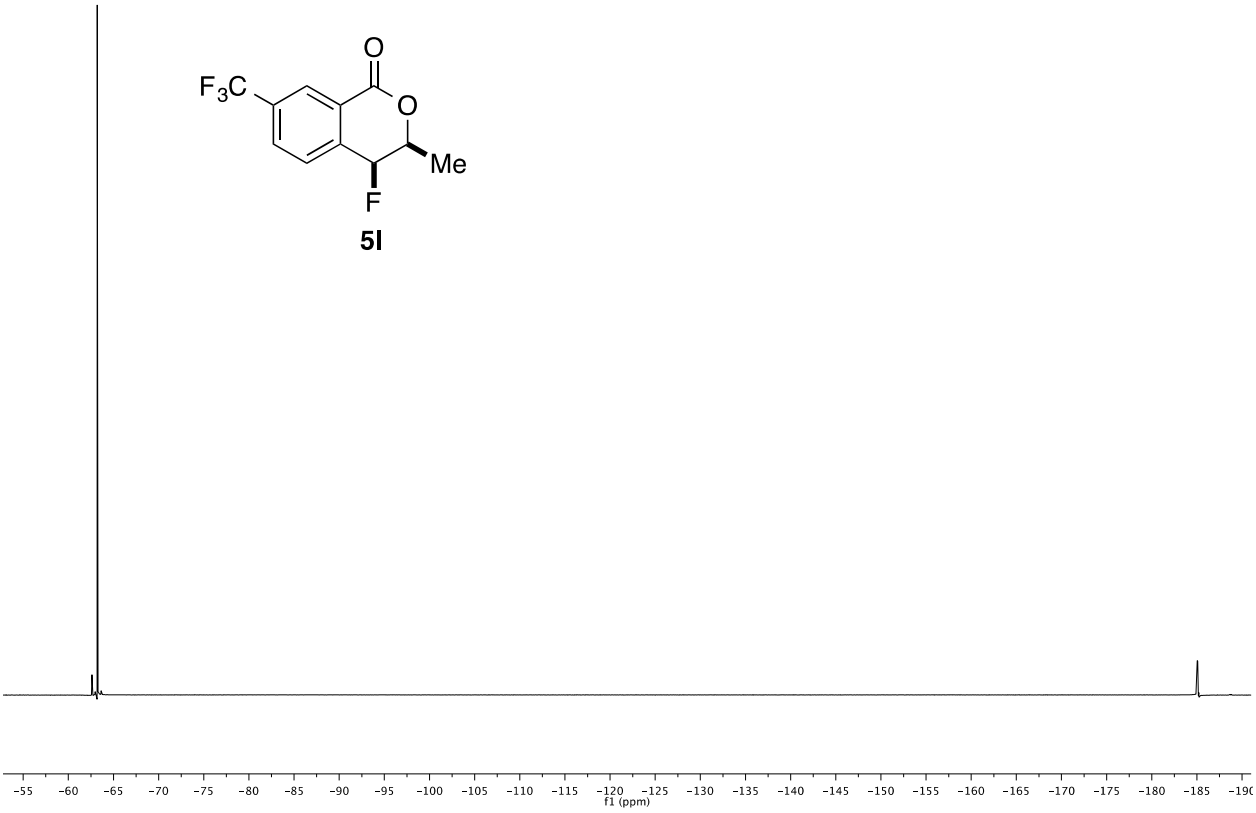
5l

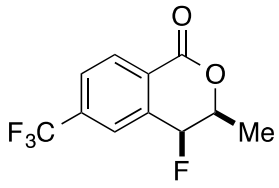
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


O
F3C
O
Me
F

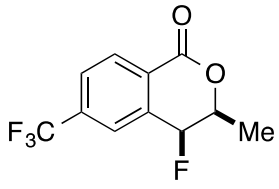
5l

190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

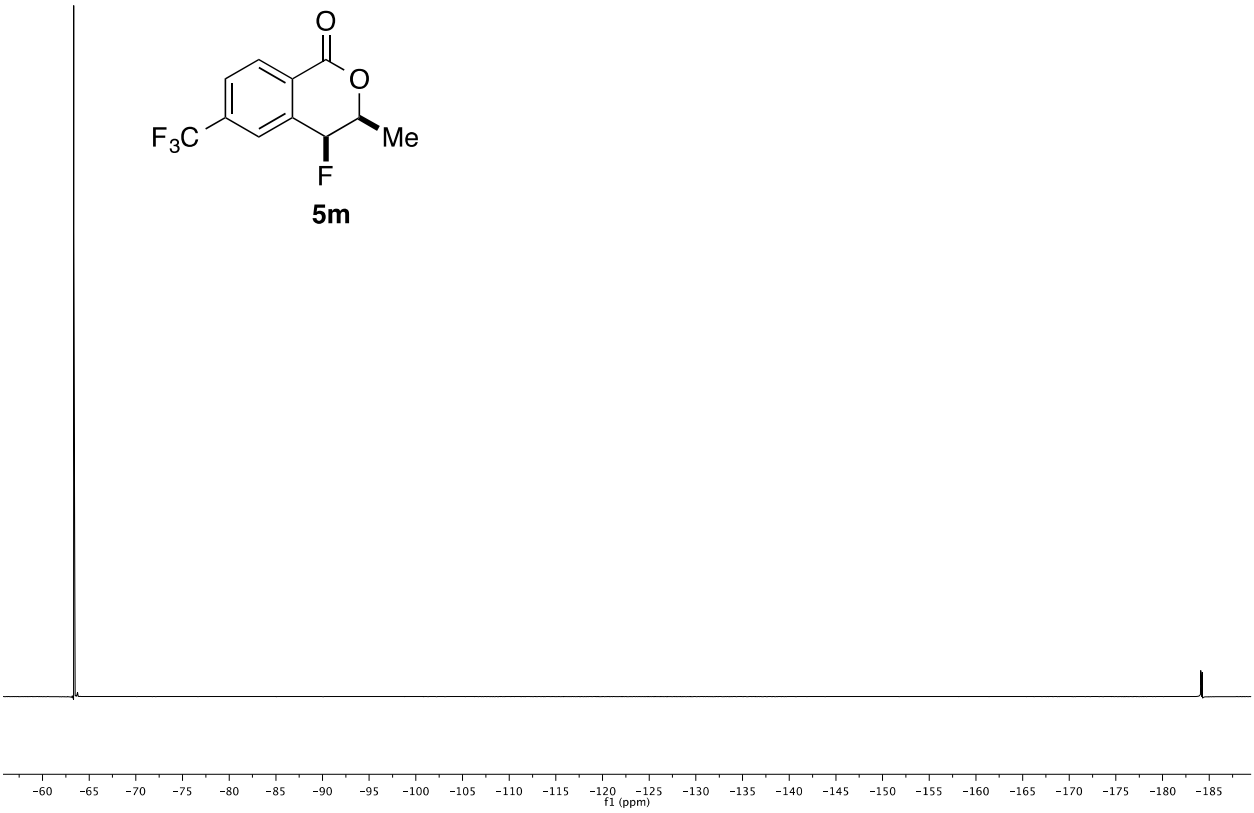

O
F3C
O
Me
F
5l
-55 -60 -65 -70 -75 -80 -85 -90 -95 -100 -105 -110 -115 -120 -125 -130 -135 -140 -145 -150 -155 -160 -165 -170 -175 -180 -185
f1 (ppm)

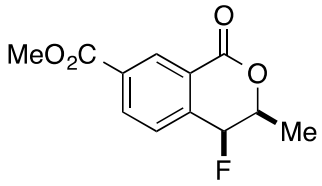


5m



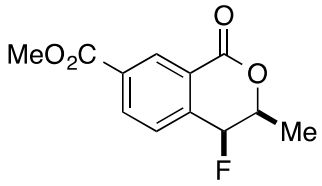
5m


O
O
F3C
Me
F
5m
-60 -65 -70 -75 -80 -85 -90 -95 -100 -105 -110 -115 -120 -125 -130 -135 -140 -145 -150 -155 -160 -165 -170 -175 -180 -185
f1 (ppm)


MeO2C
O
O
Me
F

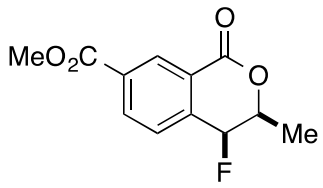
5n

9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


MeO2C
O
O
Me
F

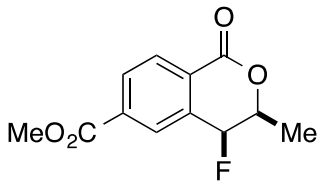
5n

190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

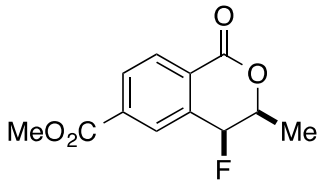

MeO2C
O
O
Me
F

5n

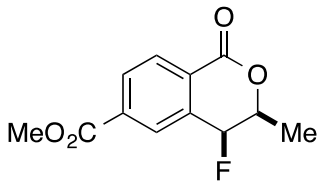
-177
-178
-179
-180
-181
-182
-183
-184
-185
-186
-187
-188
-189
-190
-191
-192
-193
f1 (ppm)



5o



5o


O
O
MeO2C
Me
F

5o

-173
-174
-175
-176
-177
-178
-179
-180
-181
-182
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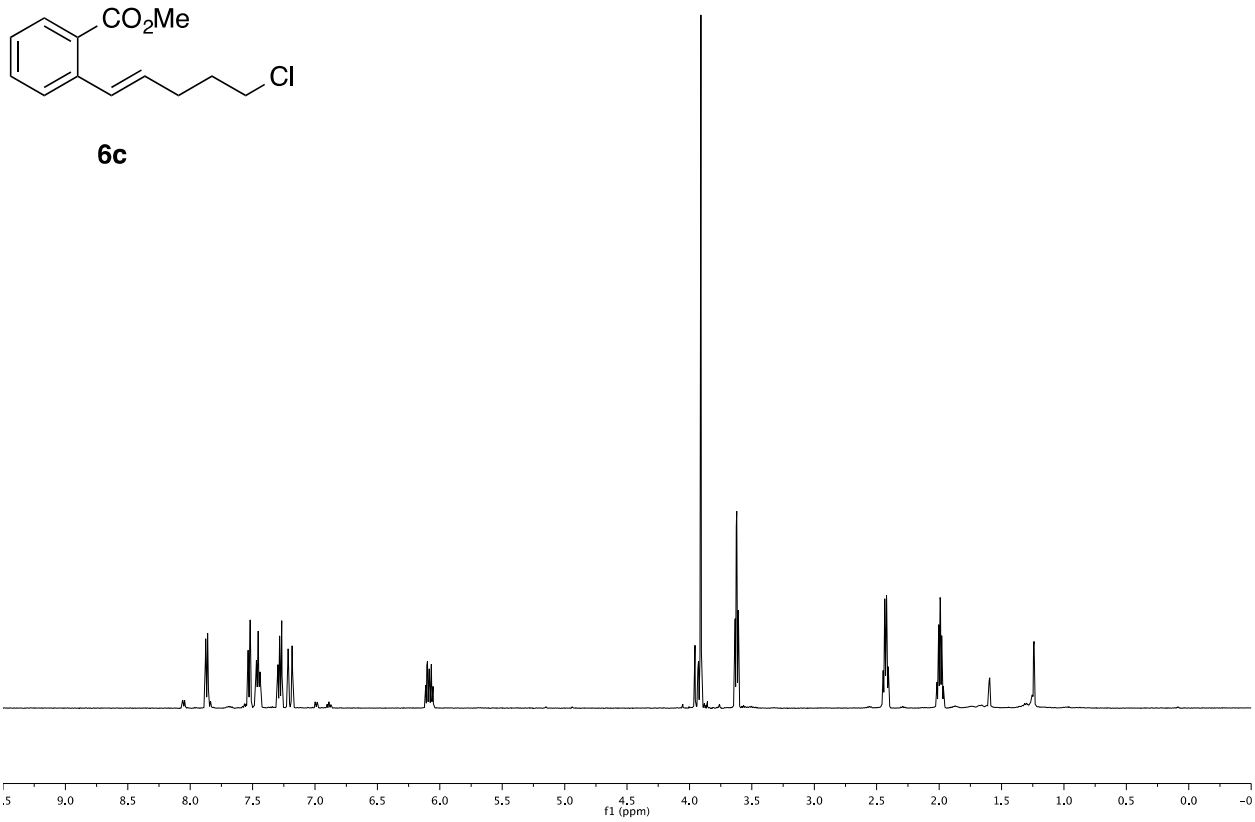
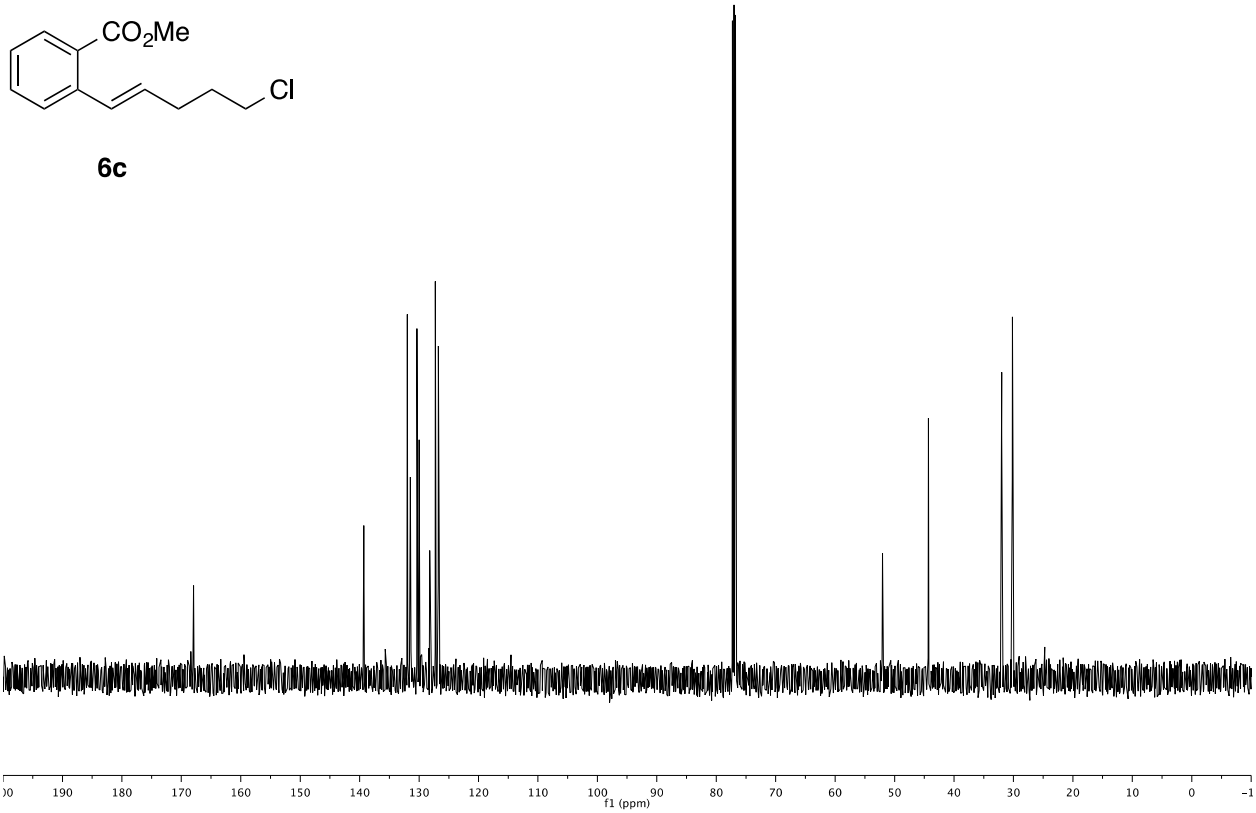
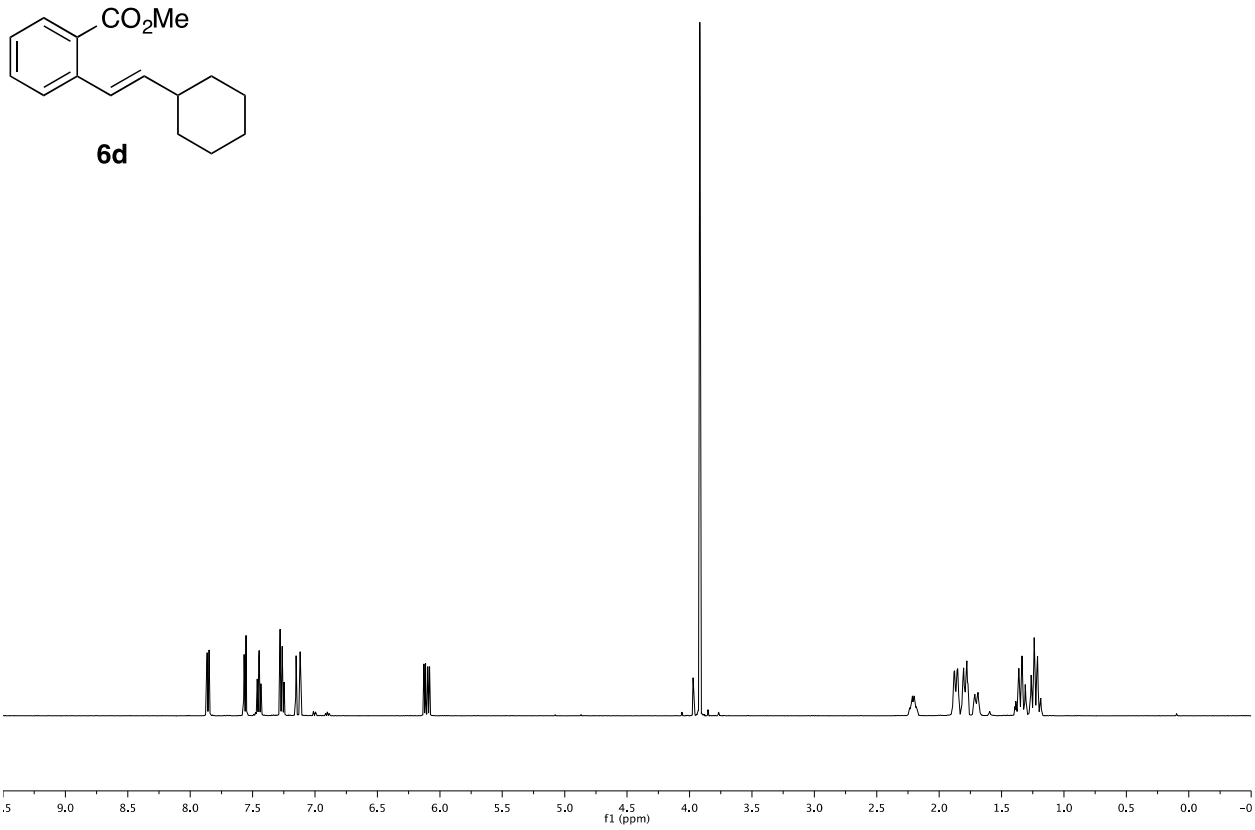
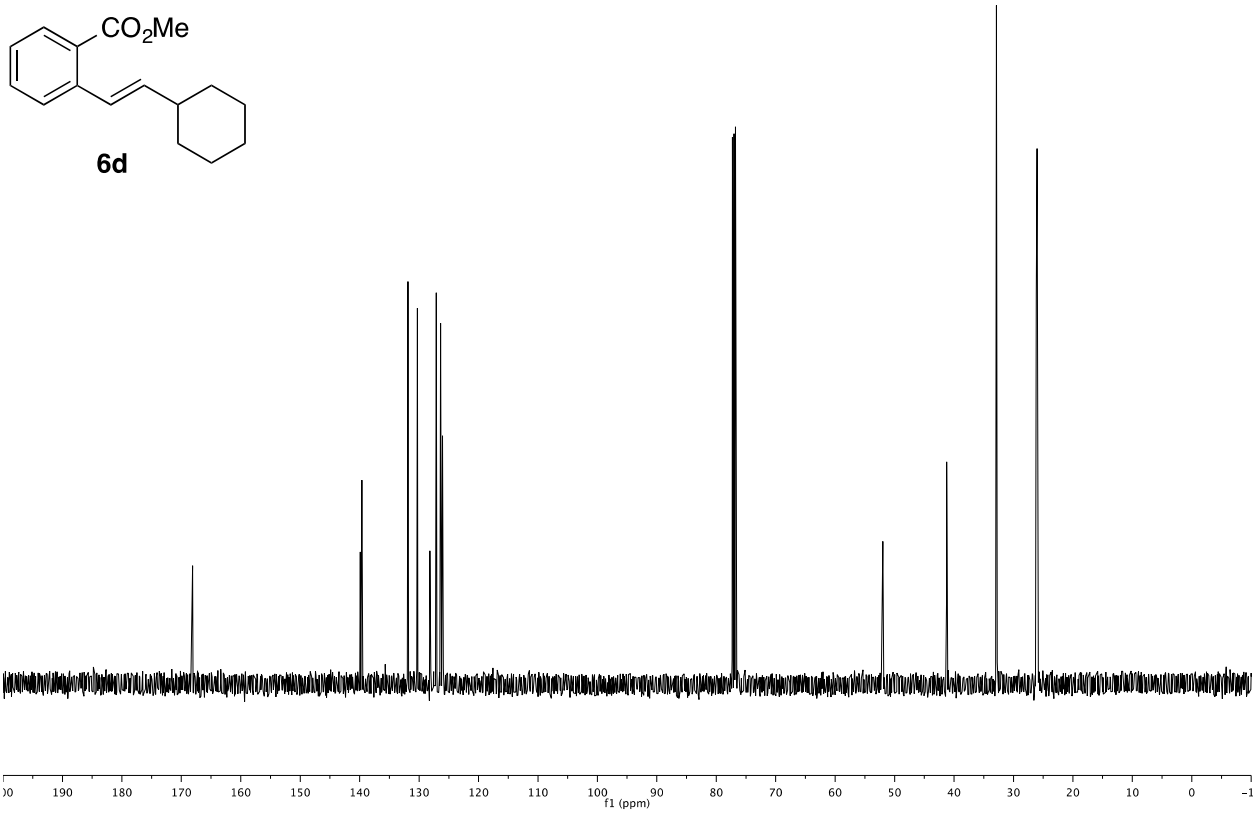
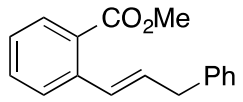
-184
-185
-186
-187
-188
-189
-190
-191
-192
-193
f1 (ppm)


CO2Me
Cl
6c
f1 (ppm)


CO2Me
Cl
6c
f1 (ppm)

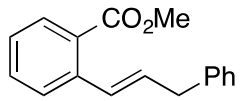

CO2Me
6d
f1 (ppm)


CO2Me
6d
f1 (ppm)


CO2Me
Ph

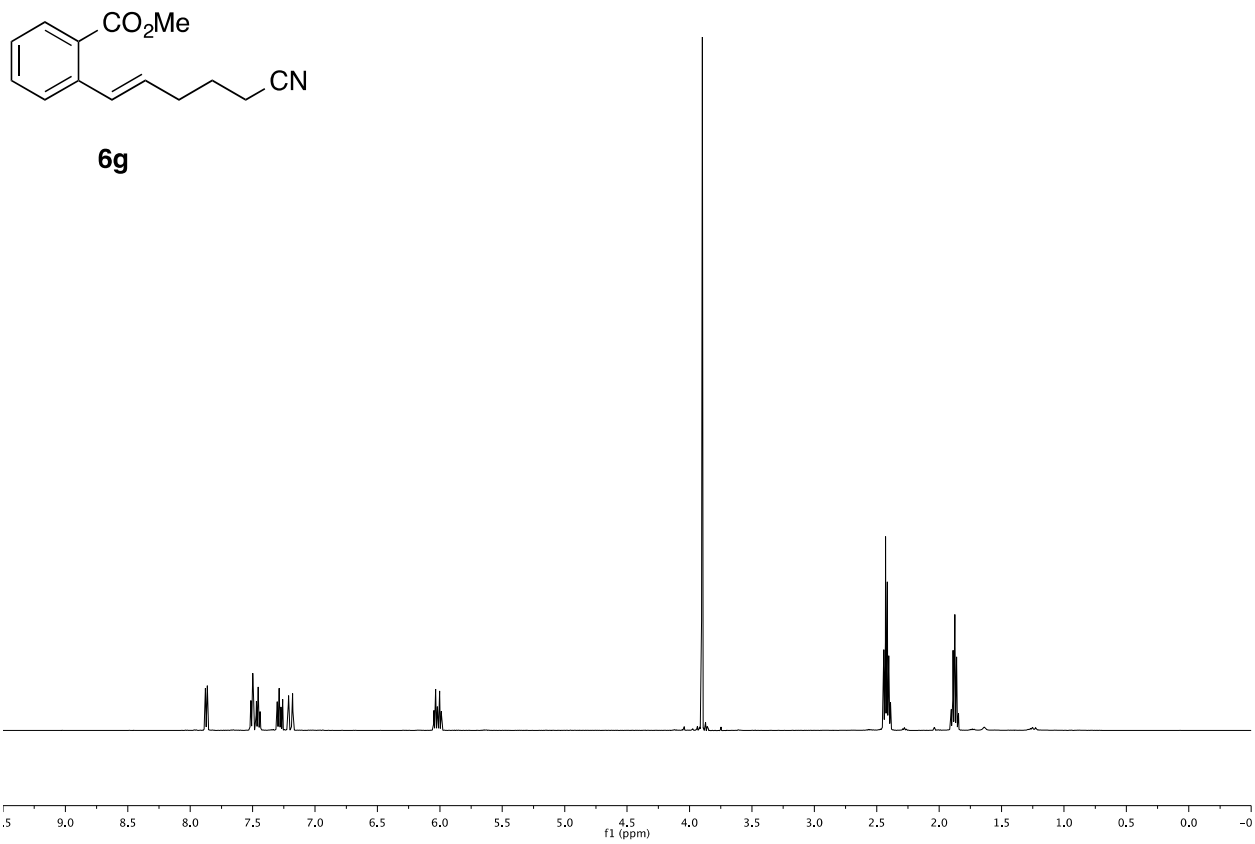
6e

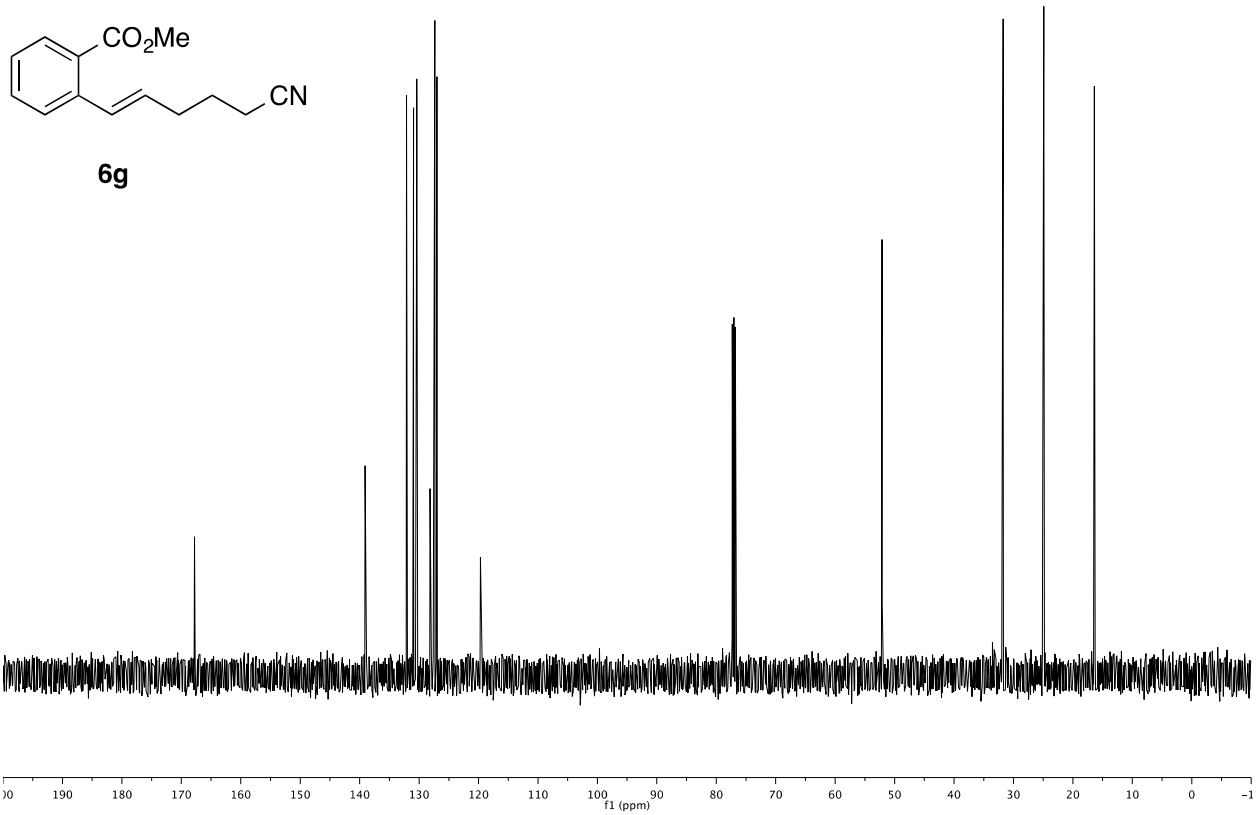
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

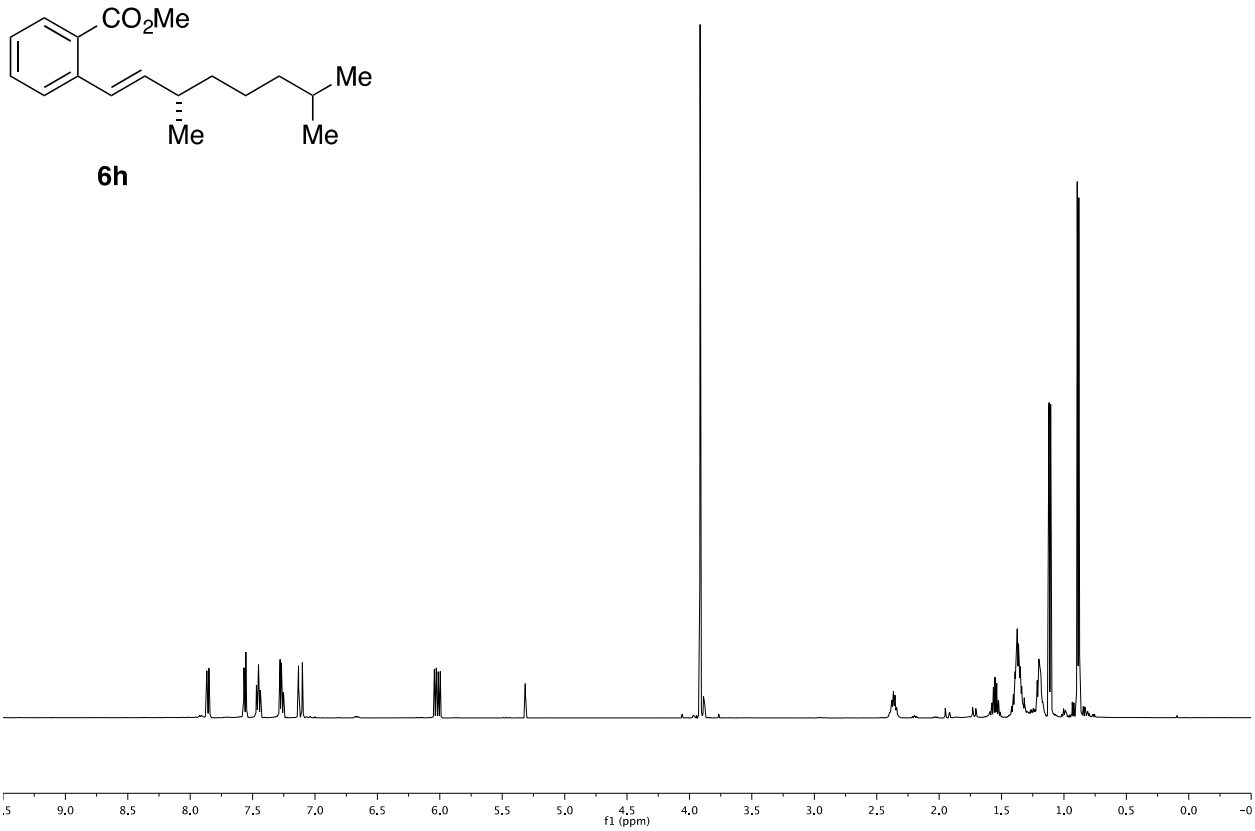

CO2Me
Ph

6e

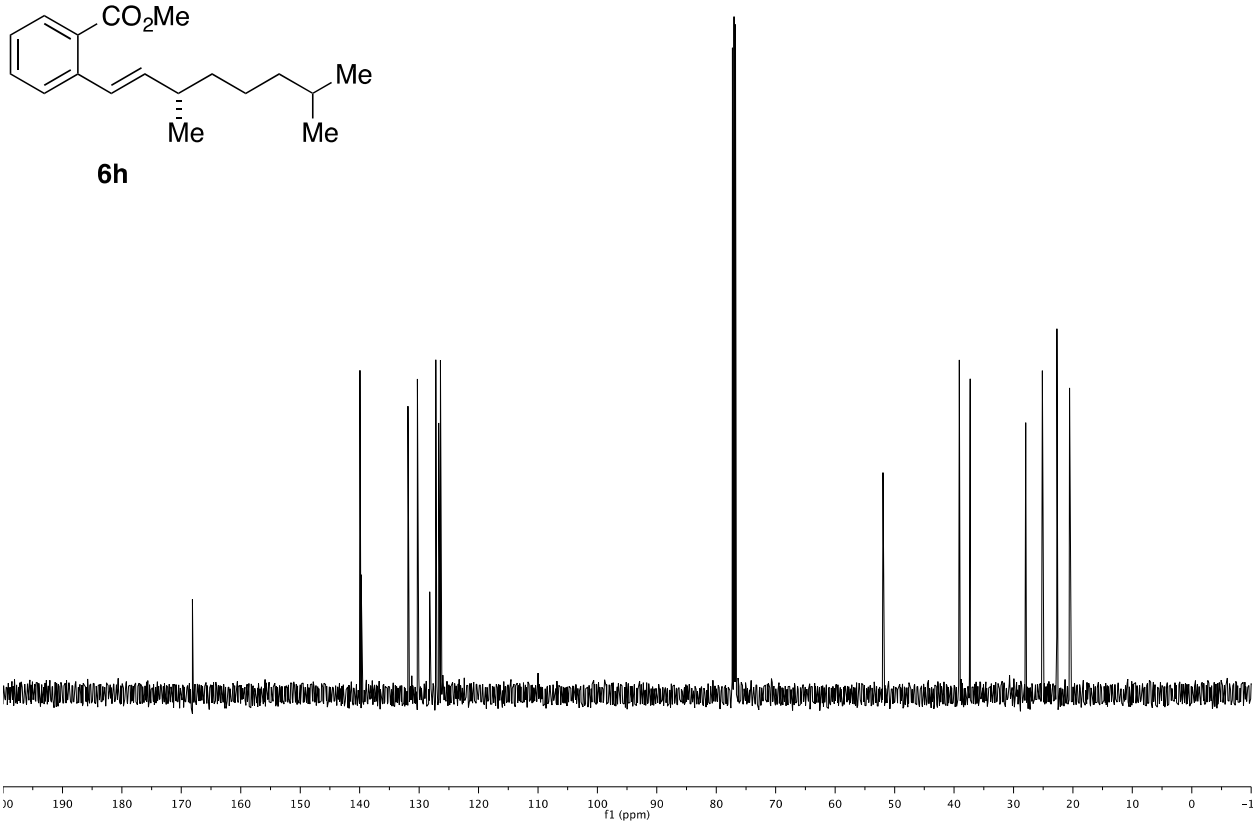
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


CO2Me
CN
6g
f1 (ppm)

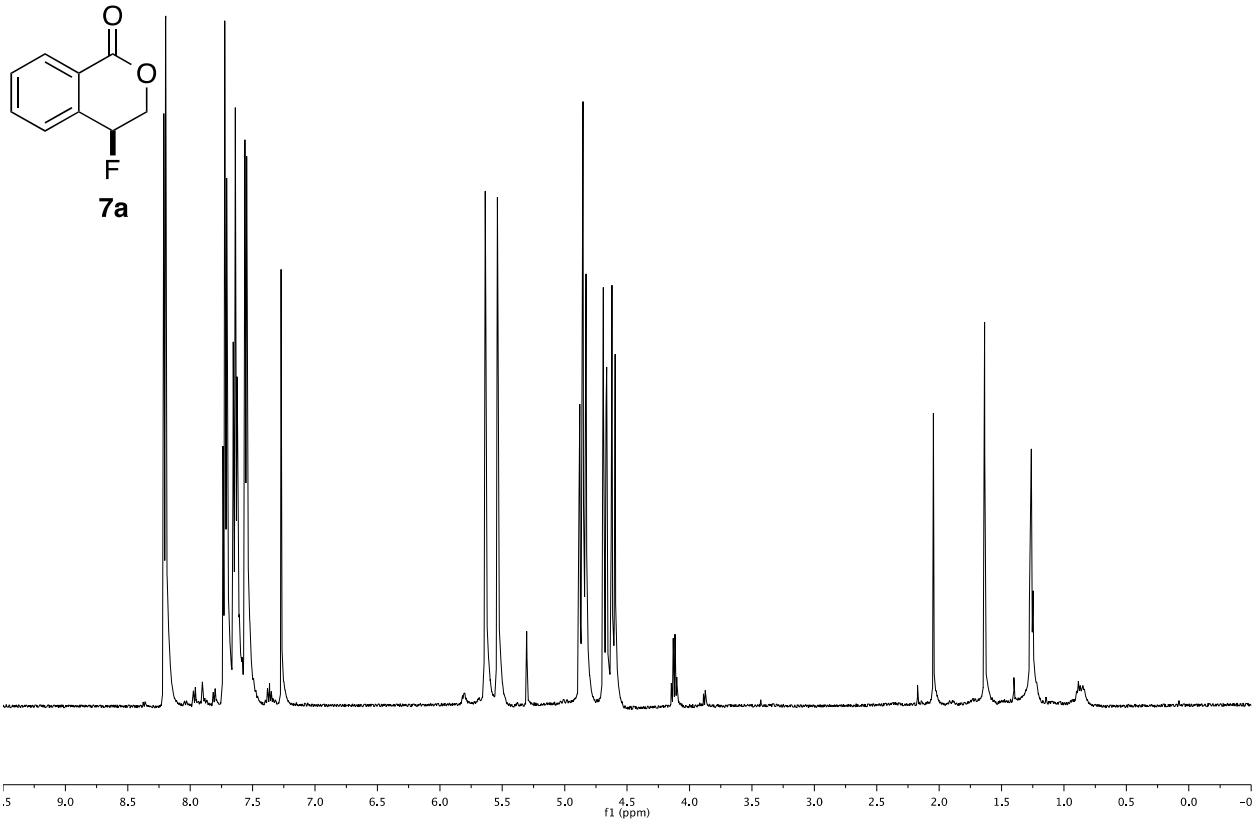

CO2Me
CN
6g
f1 (ppm)

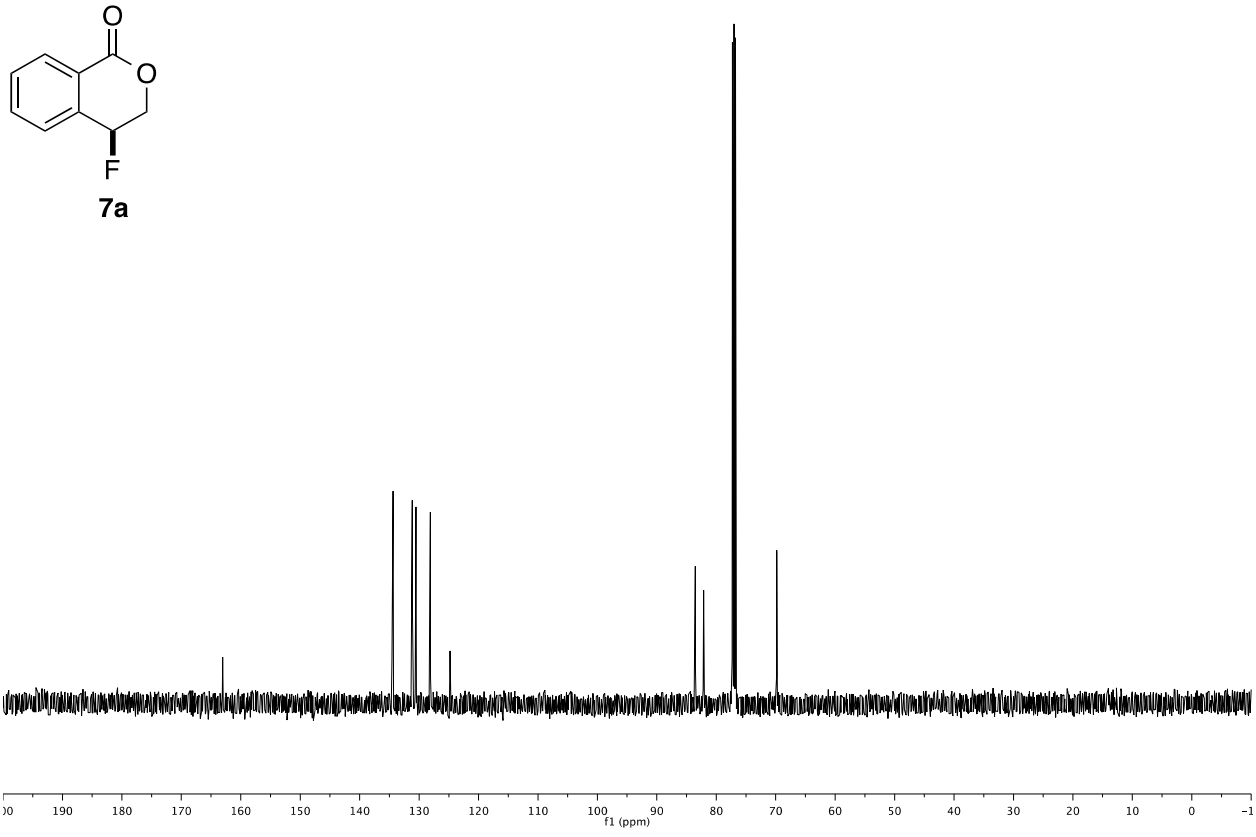


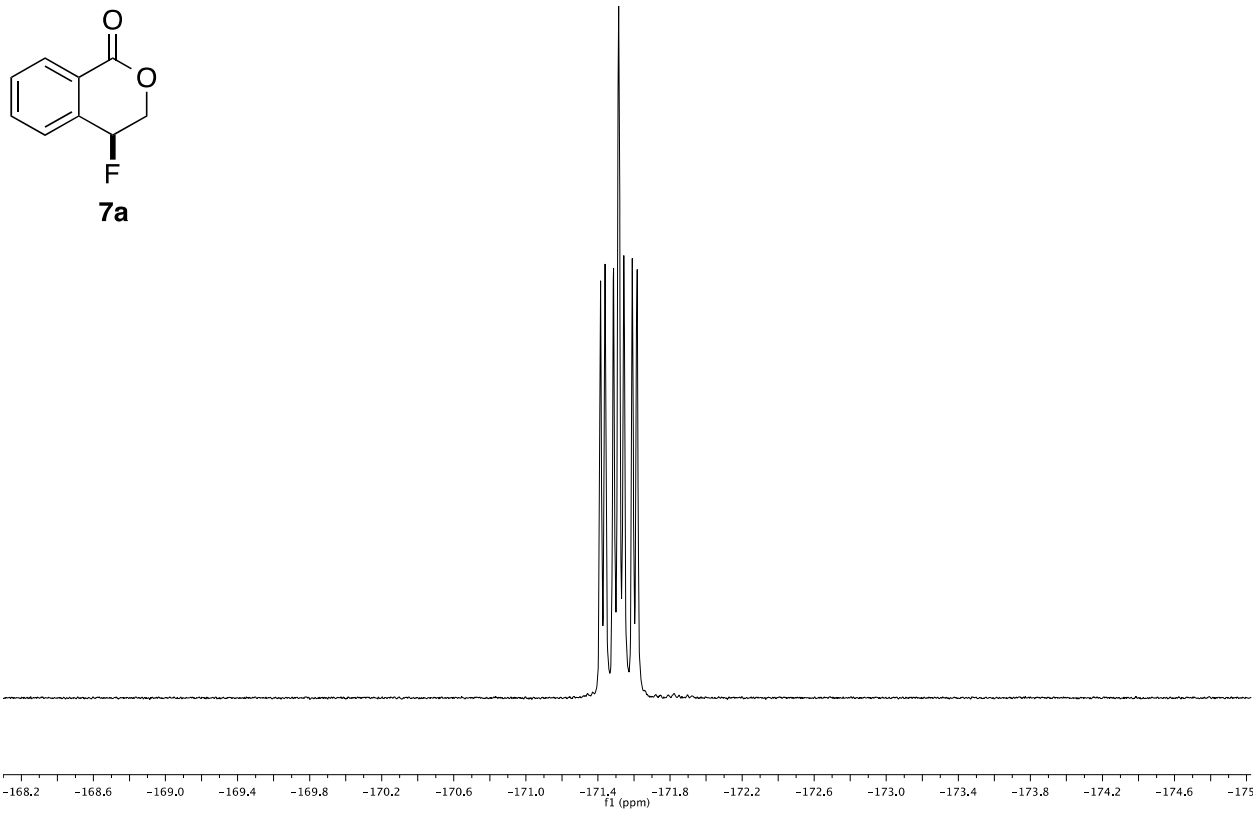
6h

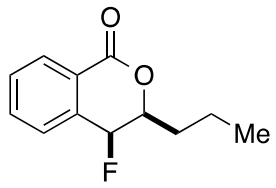


6h


O
O
F
7a
f1 (ppm)

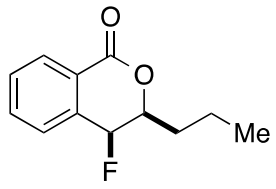

O
O
F
7a
f1 (ppm)


O
O
F
7a
-168.2
-168.6
-169.0
-169.4
-169.8
-170.2
-170.6
-171.0
-171.4
-171.8
-172.2
-172.6
-173.0
-173.4
-173.8
-174.2
-174.6
f1 (ppm)


O
O
Me
F

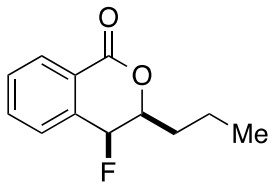
7b

9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


O
O
Me
F

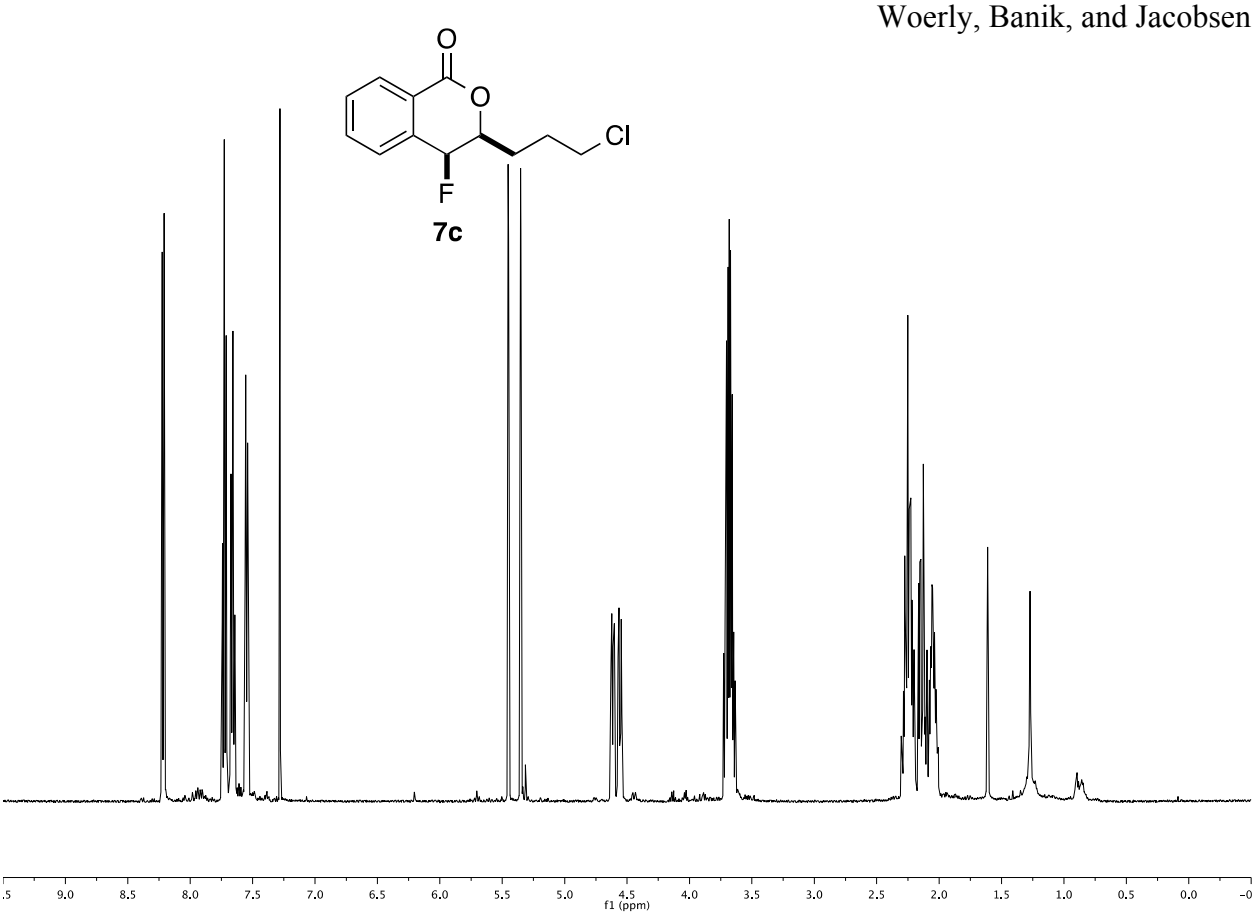
7b

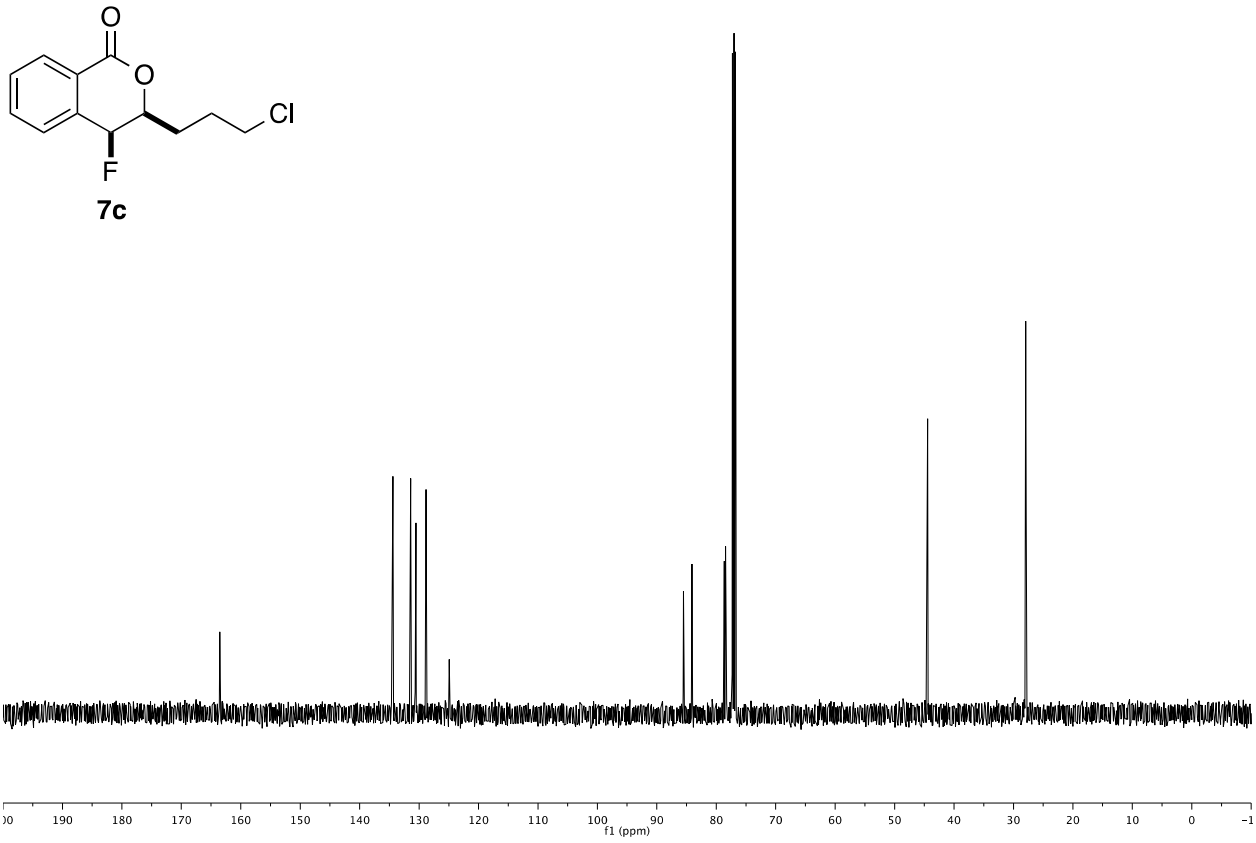
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

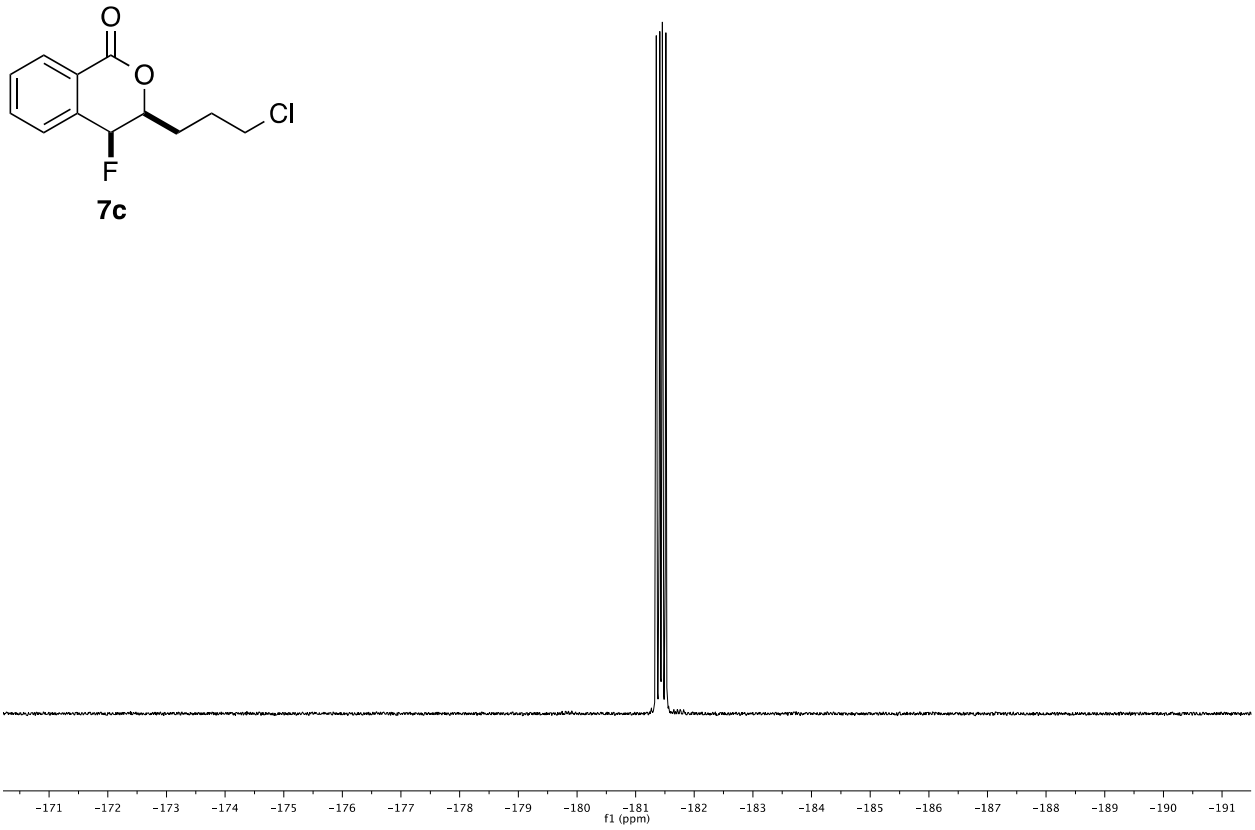

O
O
Me
F

7b

175
-176
-177
-178
-179
-180
-181
-182
-183
f1 (ppm)
-184
-185
-186
-187
-188
-189
-190
-1


O
O
Cl
F
7c
f1 (ppm)


O
O
Cl
F
7c
f1 (ppm)


O
O
Cl
F
7c
-171
-172
-173
-174
-175
-176
-177
-178
-179
-180
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-182
-183
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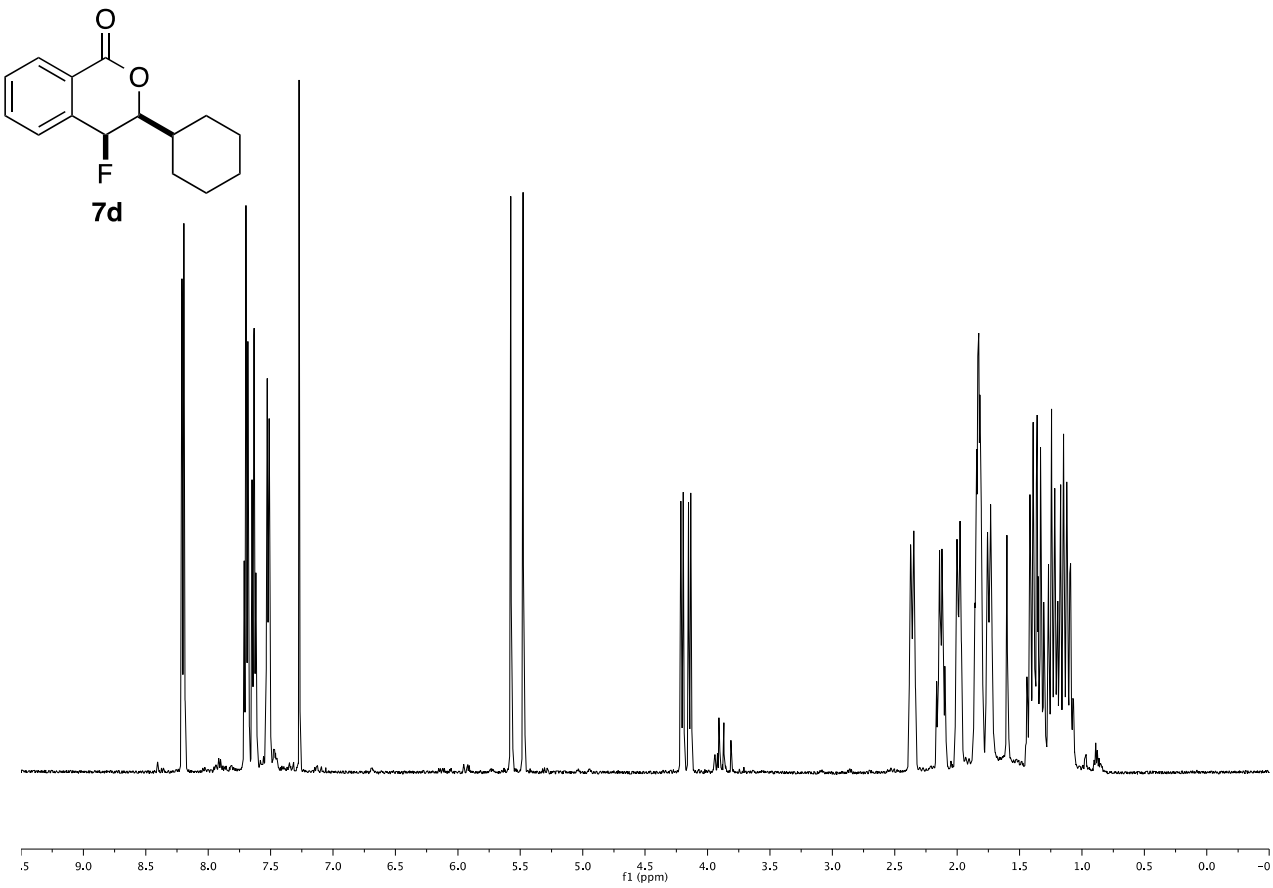
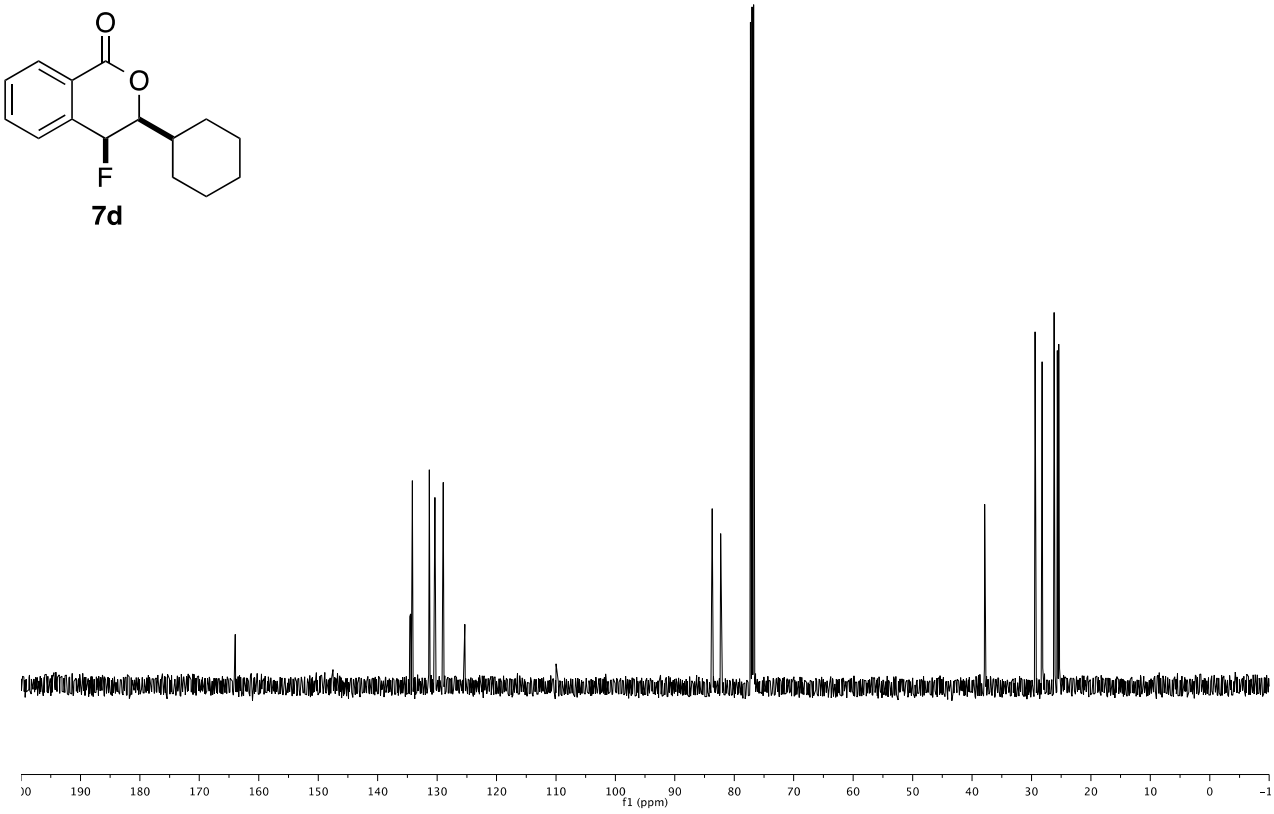
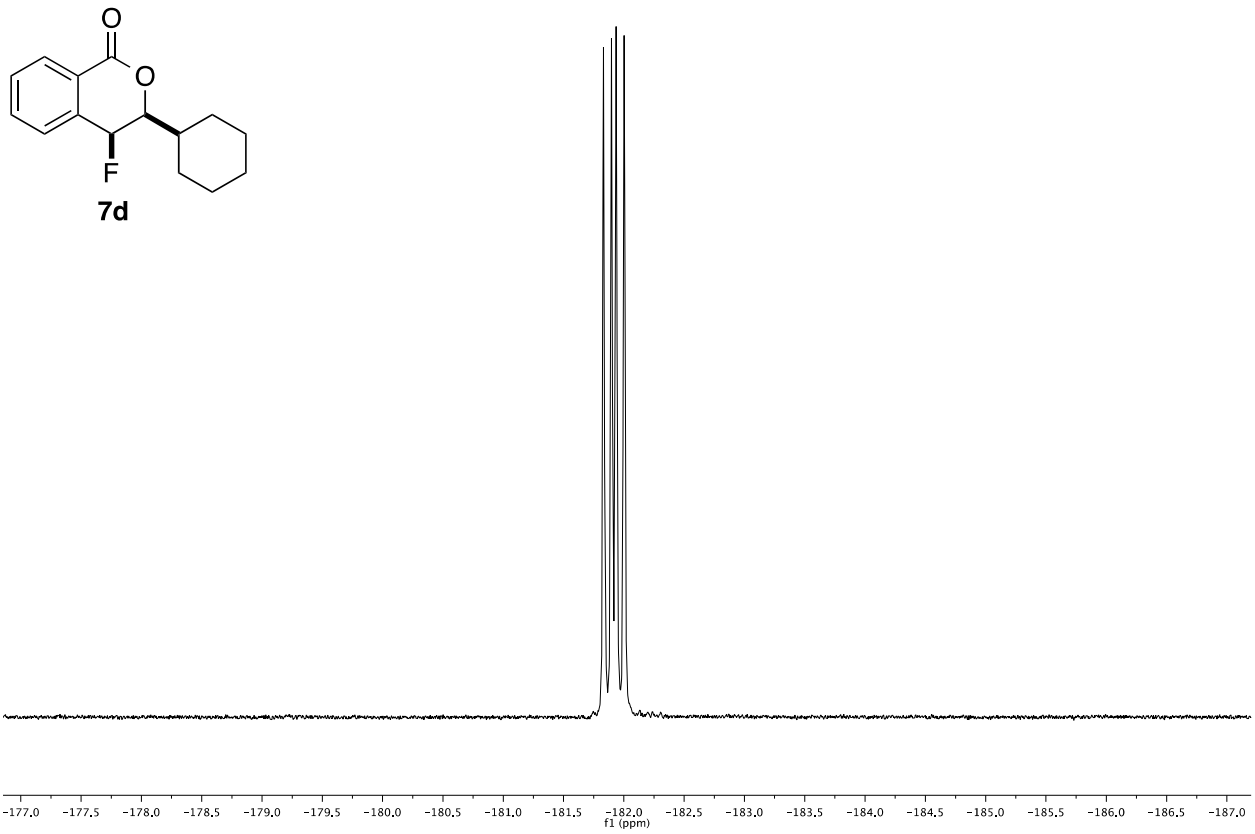
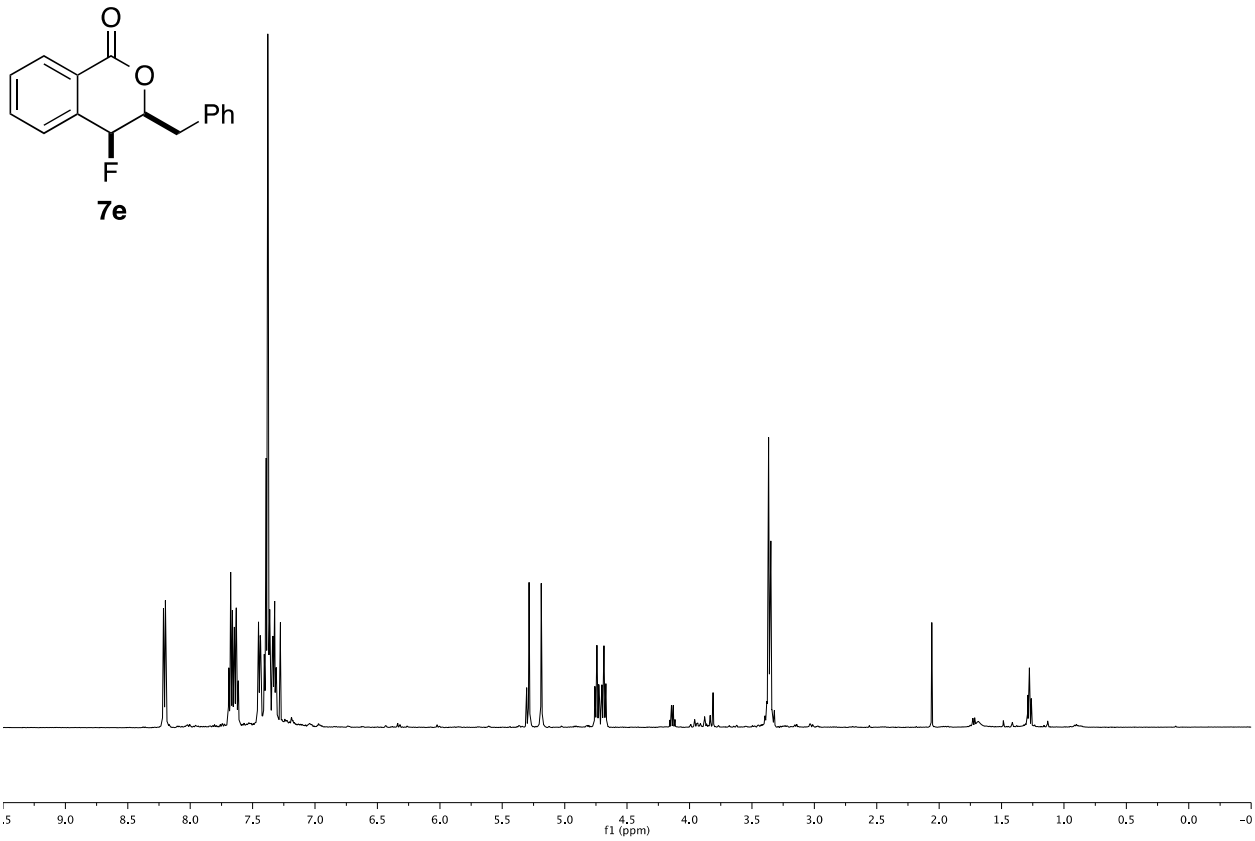
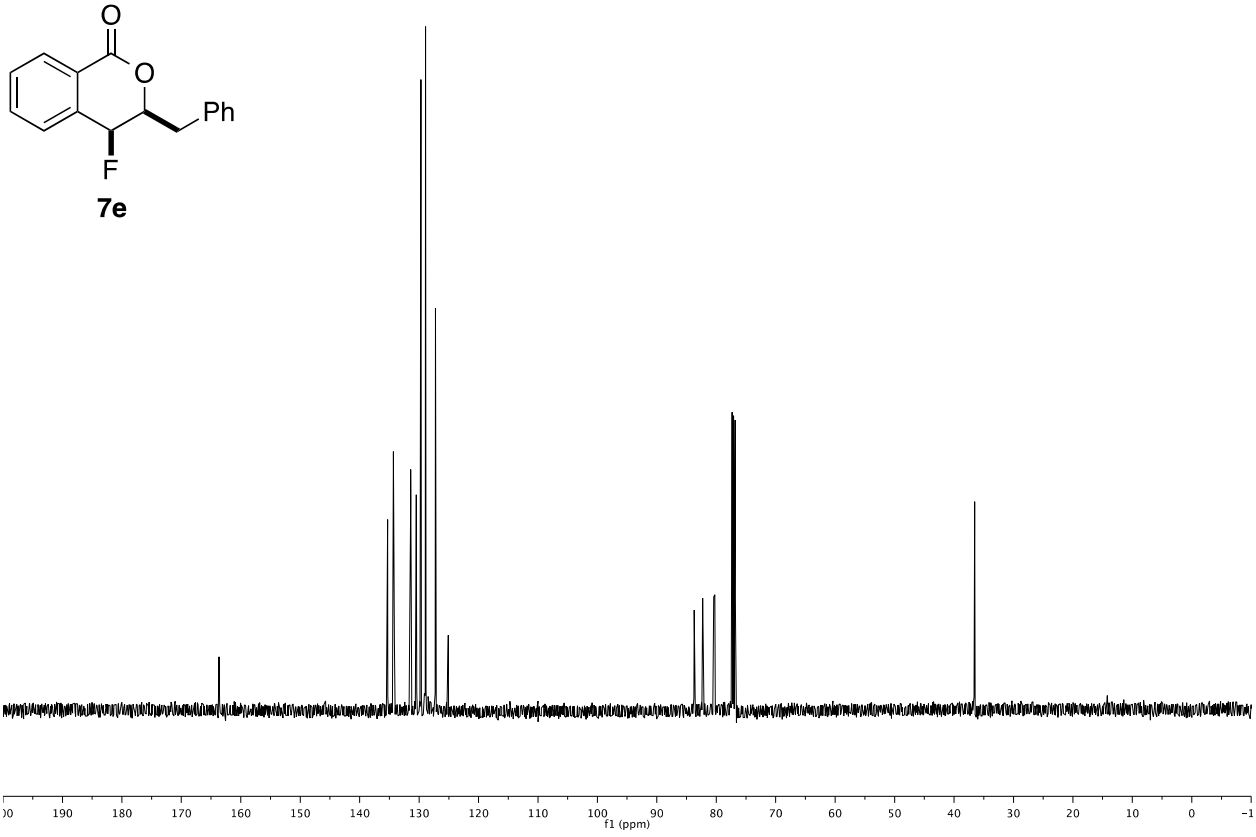
-186
-187
-188
-189
-190
-191
f1 (ppm)

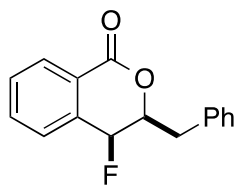

O
O
F
7d
f1 (ppm)


O
O
F
7d
f1 (ppm)


O
O
F
7d
-177.0
-177.5
-178.0
-178.5
-179.0
-179.5
-180.0
-180.5
-181.0
-181.5
-182.0
-182.5
-183.0
-183.5
-184.0
-184.5
-185.0
-185.5
-186.0
-186.5
-187.0
f1 (ppm)

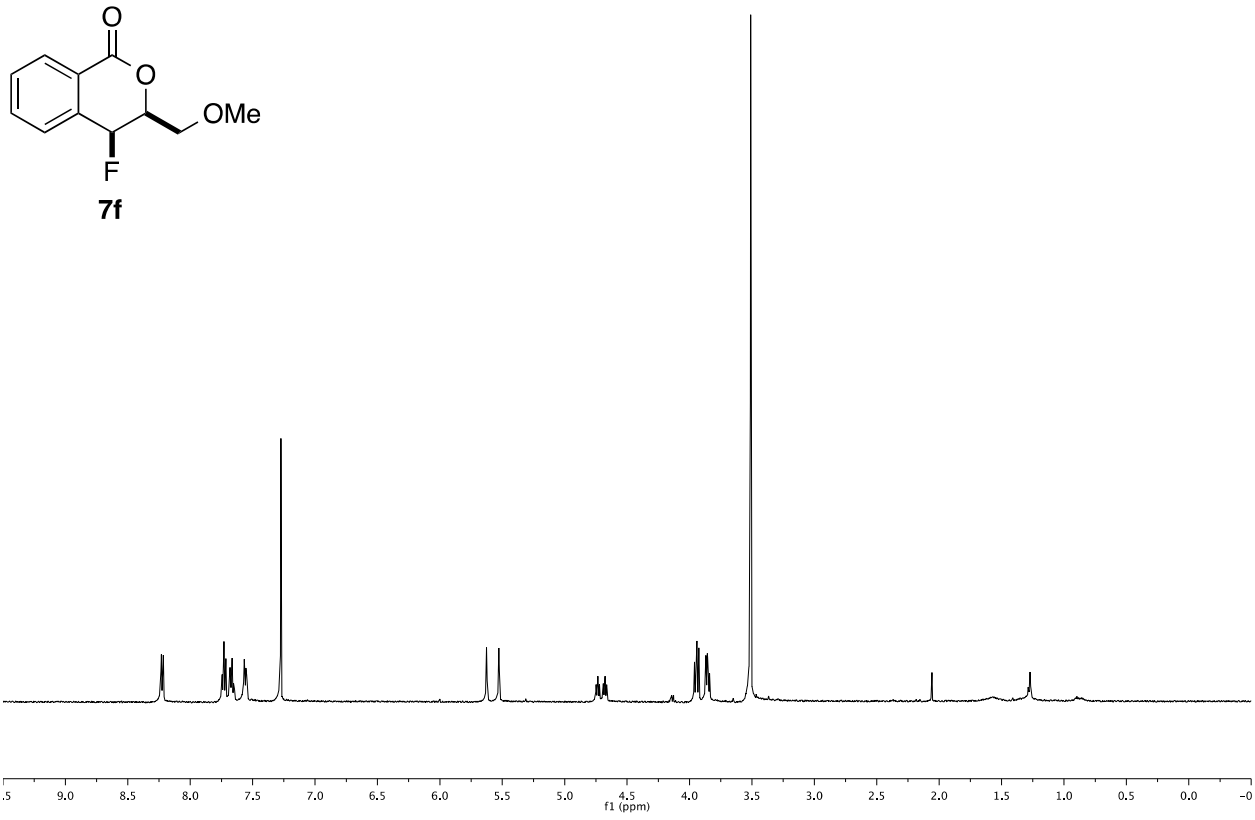

O
O
Ph
F
7e
f1 (ppm)


O
O
Ph
F
7e
f1 (ppm)

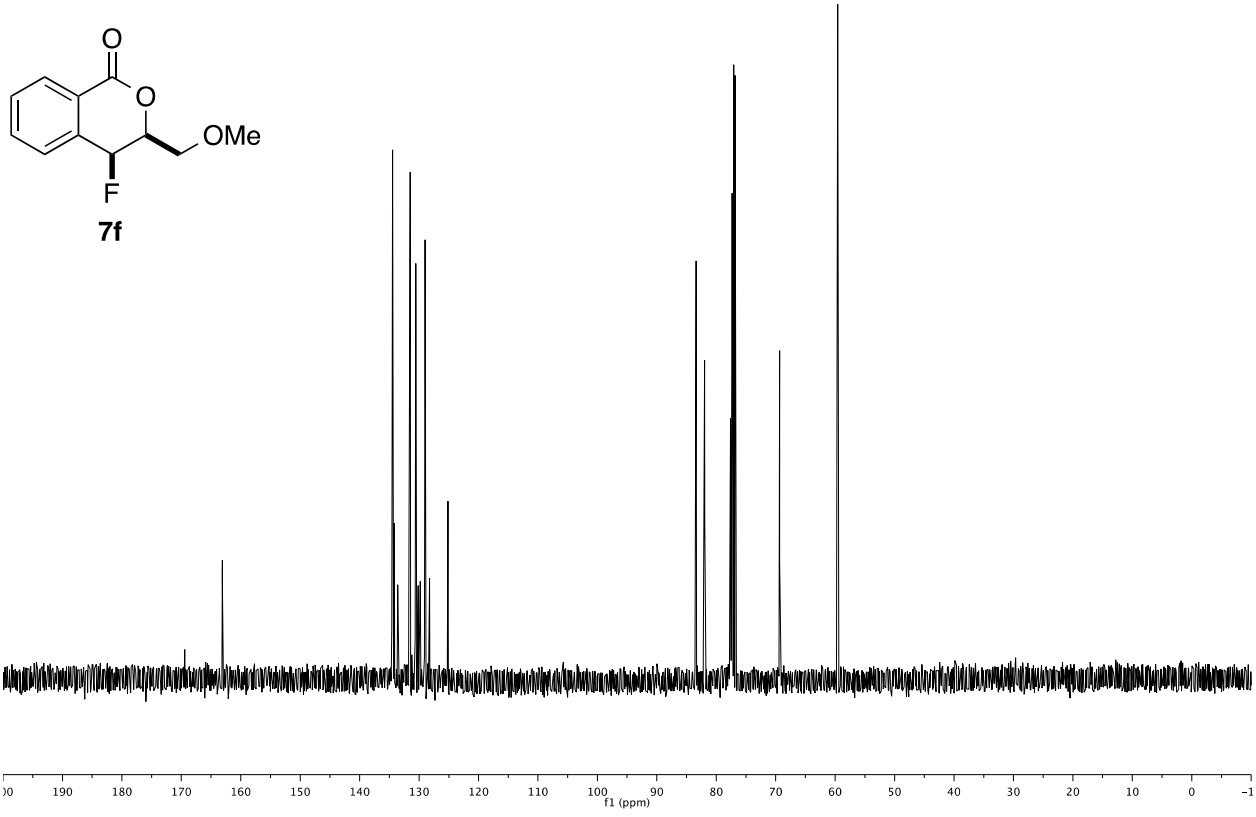

O
O
Ph
F

7e

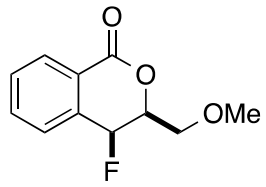
−174
−175
−176
−177
−178
−179
−180
−181
−182
−183
−184
−185
−186
−187
−188
−189
−190
f1 (ppm)



7f

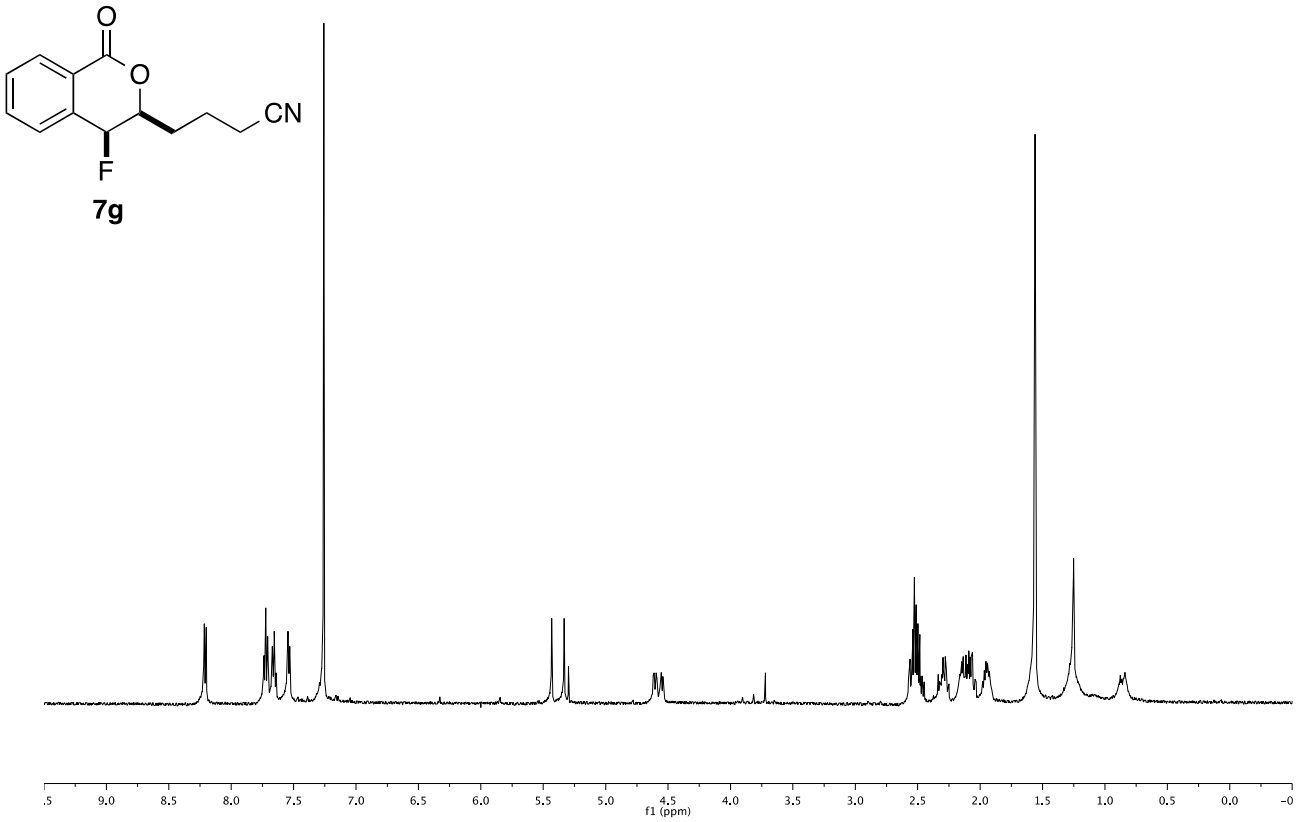


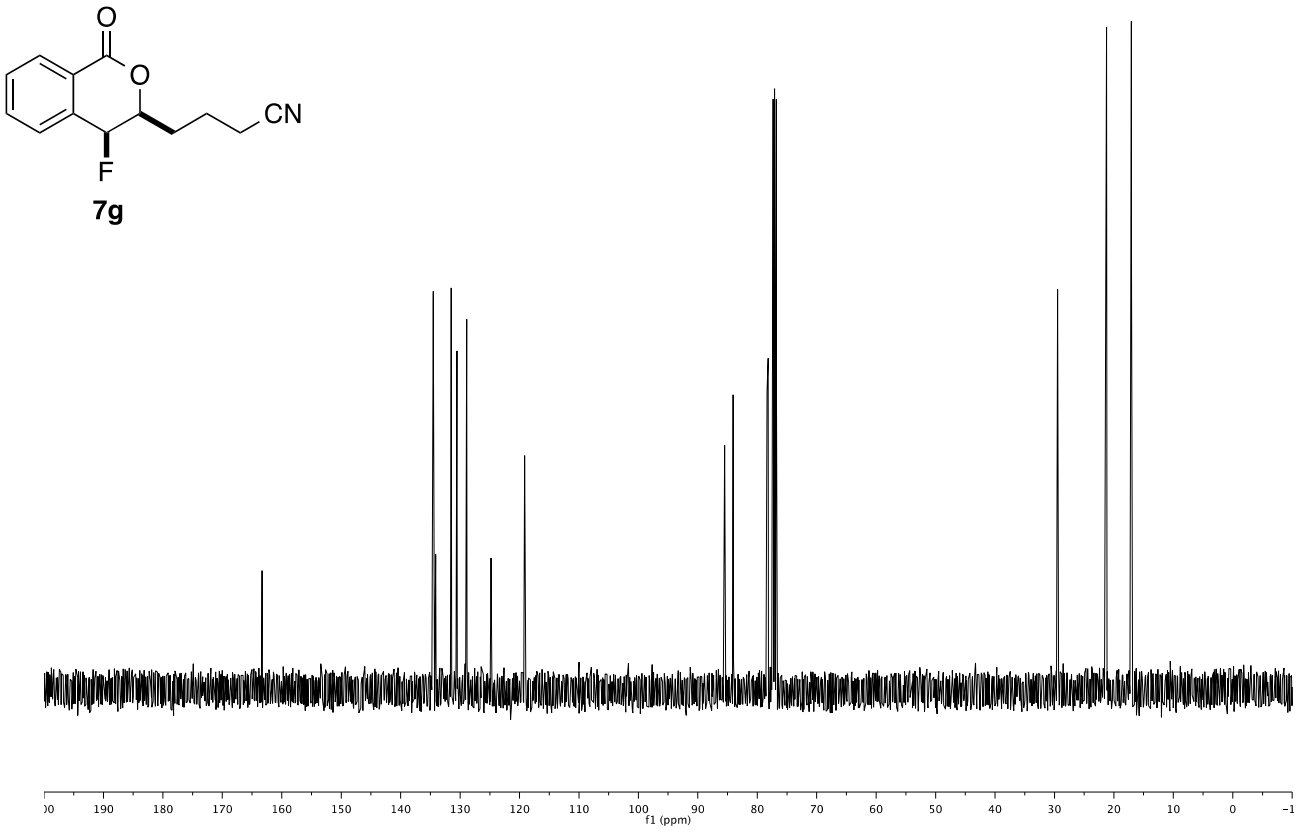
7f

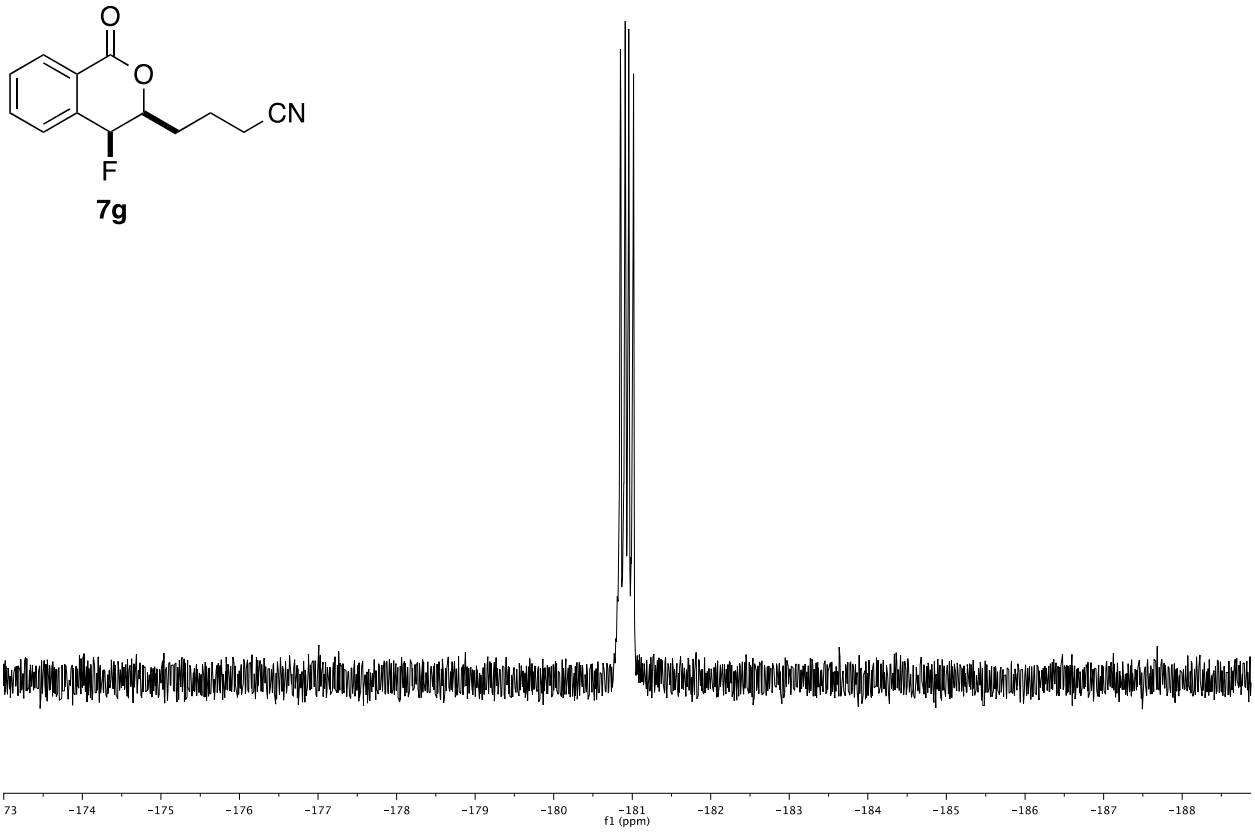

O
O
OMe
F

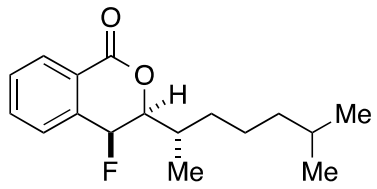
7f

-175
-176
-177
-178
-179
-180
-181
-182
-183
-184
-185
-186
-187
-188
-189
-190
-191
-192
f1 (ppm)


O
O
CN
F
7g
f1 (ppm)

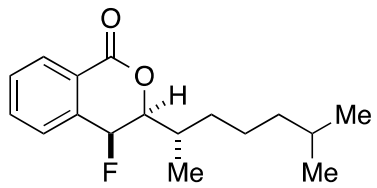

O
O
CN
F
7g
f1 (ppm)


O
O
CN
F
7g
73
-174
-175
-176
-177
-178
-179
-180
-181
f1 (ppm)
-182
-183
-184
-185
-186
-187
-188


O
O
H
Me
F
Me
Me

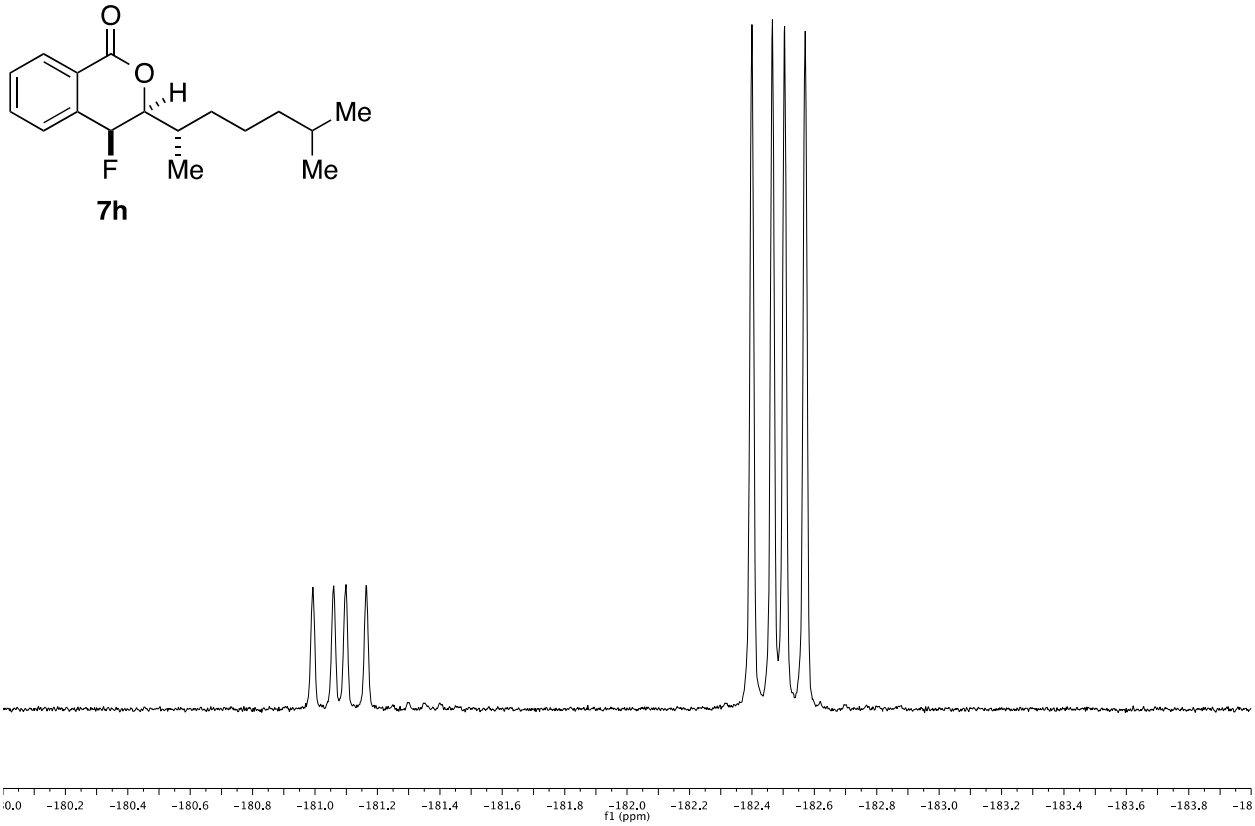
7h

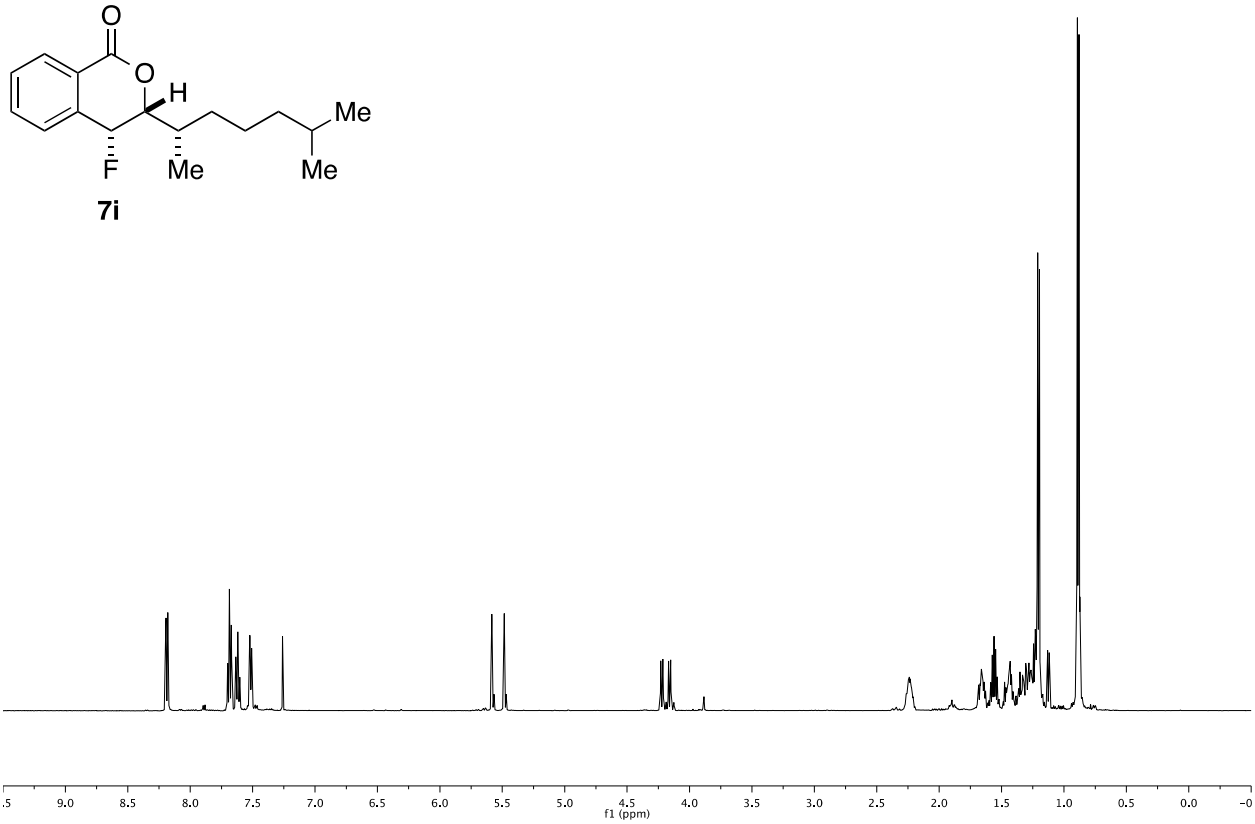
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


O
O
H
Me
F
Me
Me

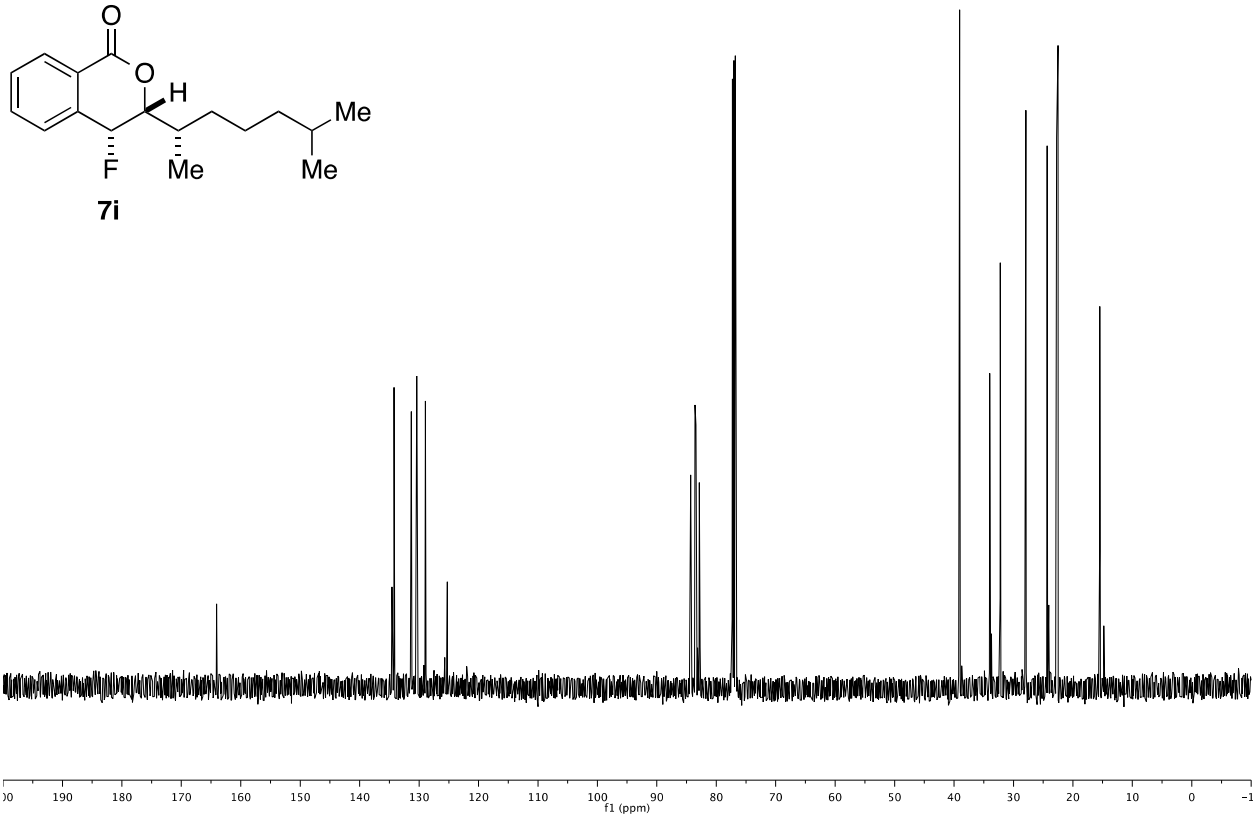
7h

190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

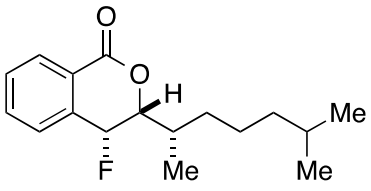

O
O
H
Me
F
Me
Me
7h
-180.0
-180.2
-180.4
-180.6
-180.8
-181.0
-181.2
-181.4
-181.6
-181.8
-182.0
-182.2
-182.4
-182.6
-182.8
-183.0
-183.2
-183.4
-183.6
-183.8
f1 (ppm)



7i

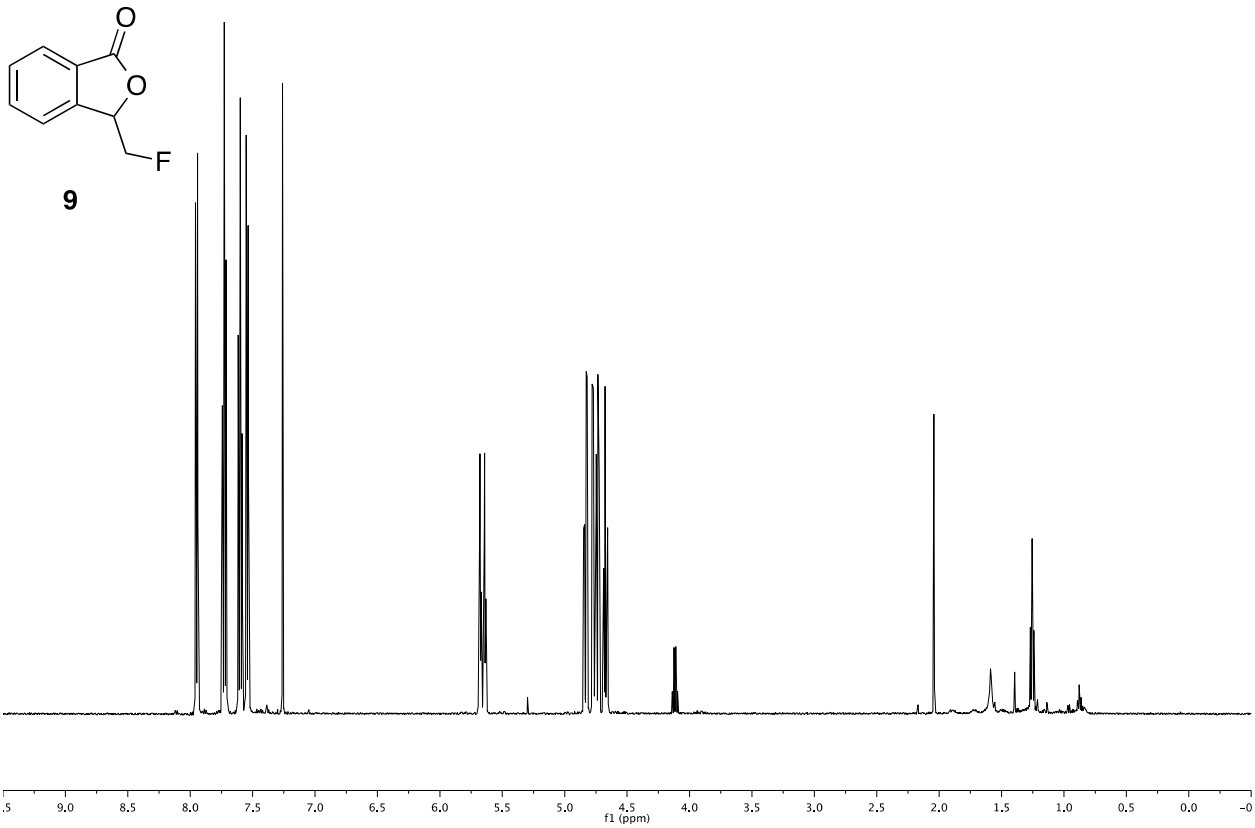


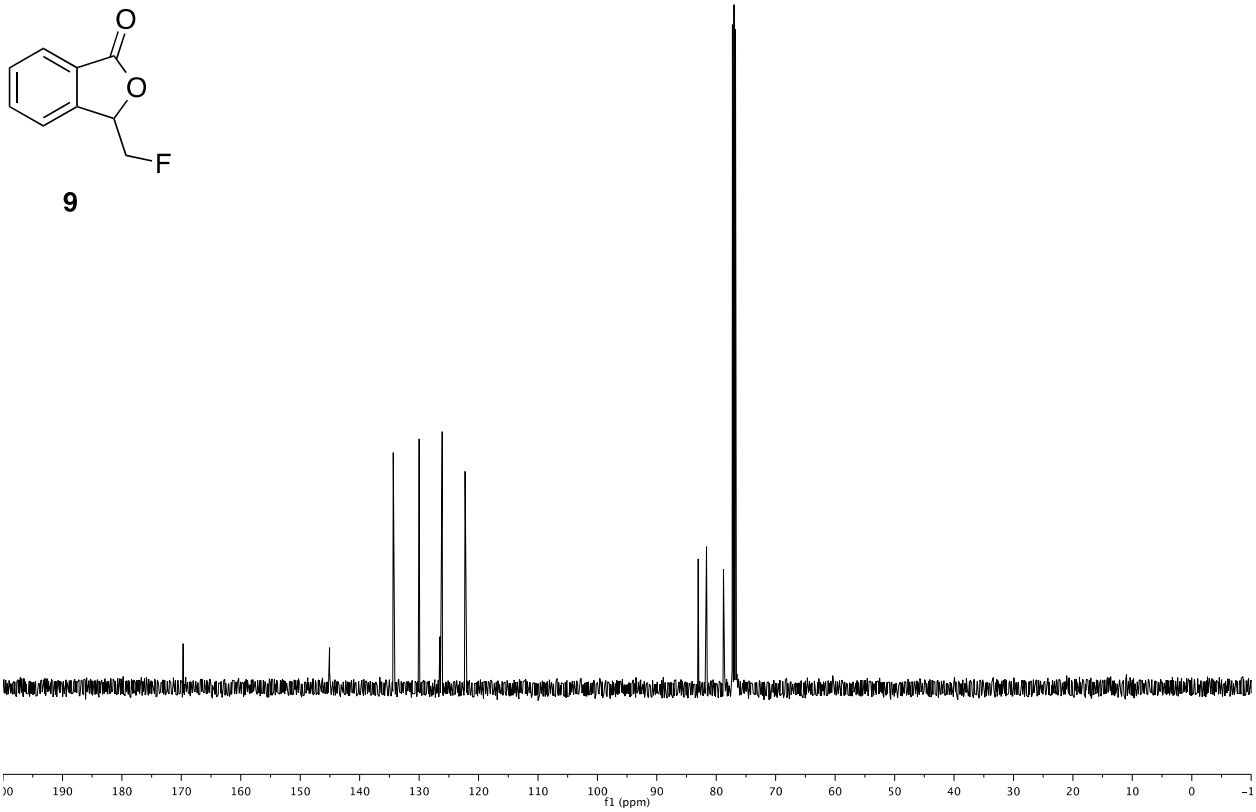
7i

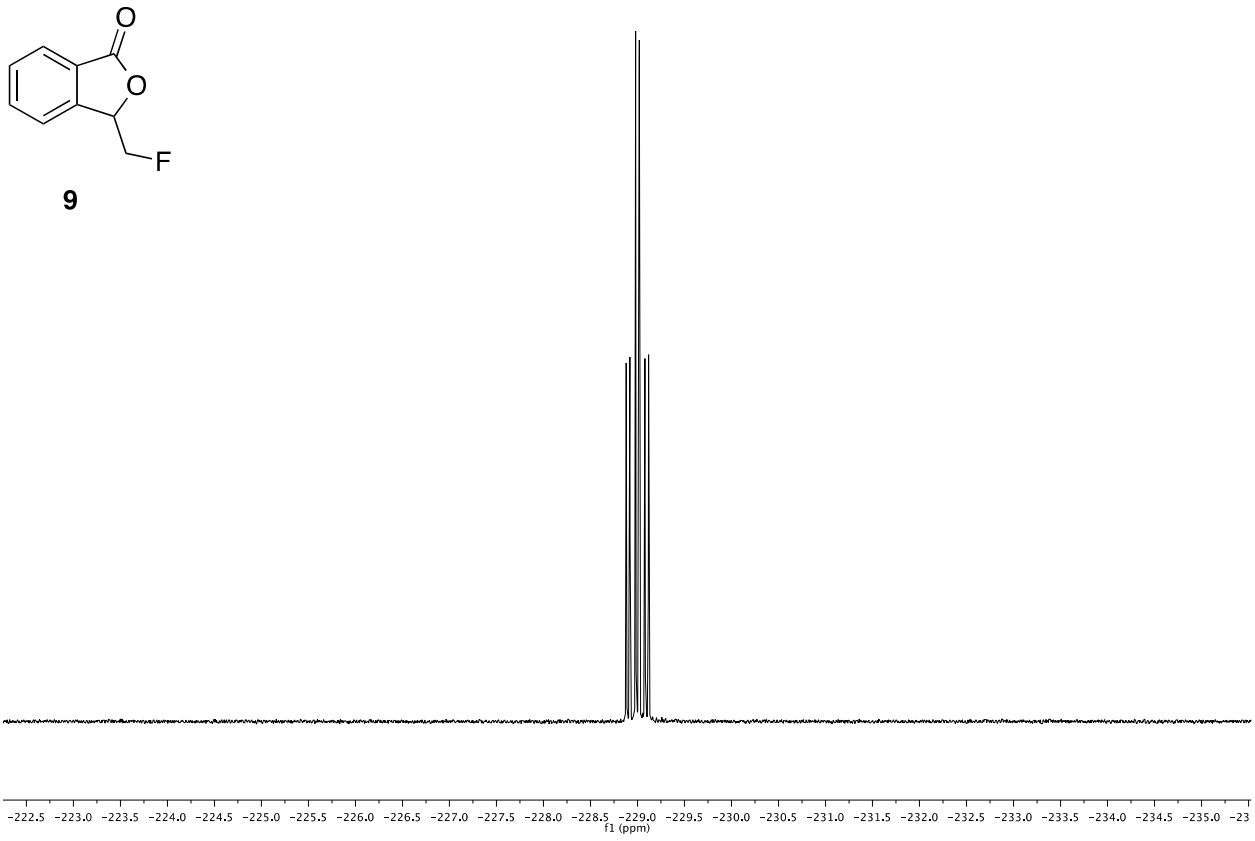

O
O
H
Me
F
Me
Me

7i

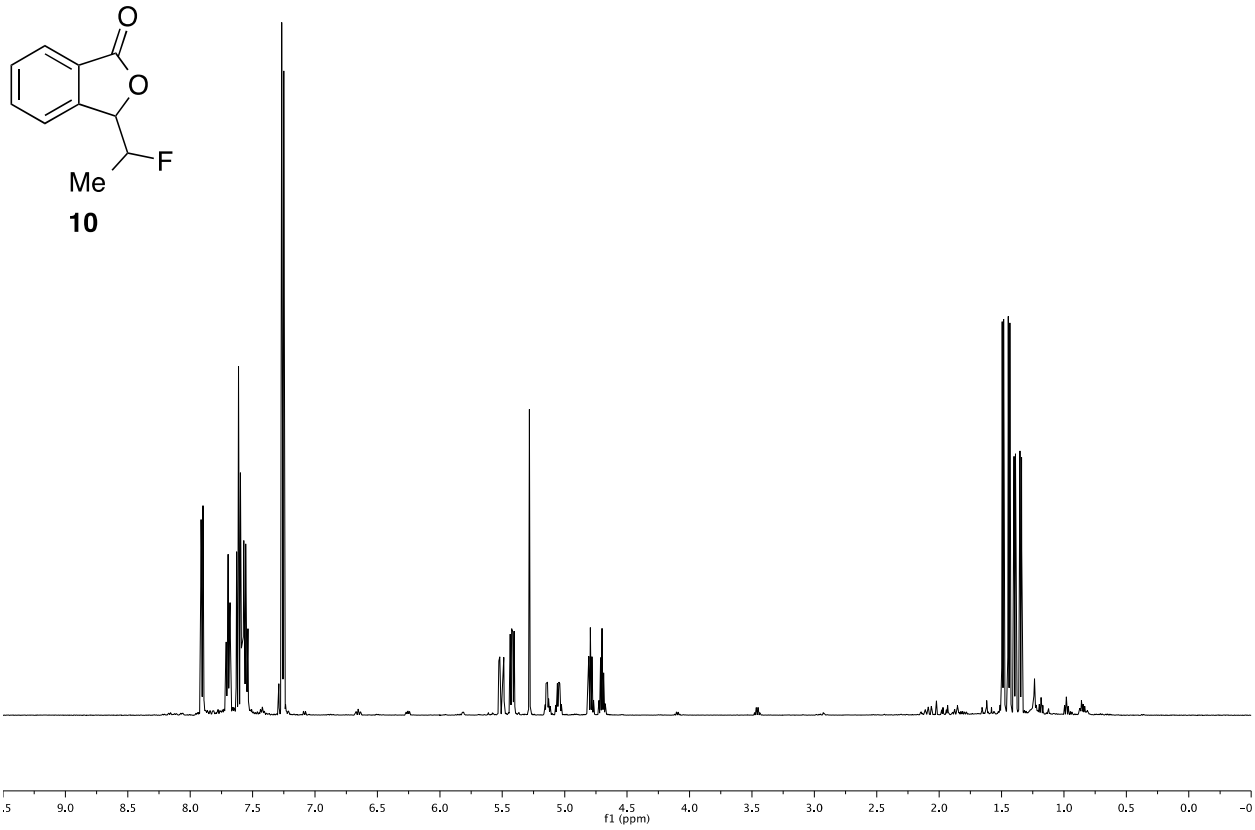
-180.2
-180.4
-180.6
-180.8
-181.0
-181.2
-181.4
-181.6
-181.8
-182.0
f1 (ppm)
-182.2
-182.4
-182.6
-182.8
-183.0
-183.2
-183.4
-183.6
-183.8

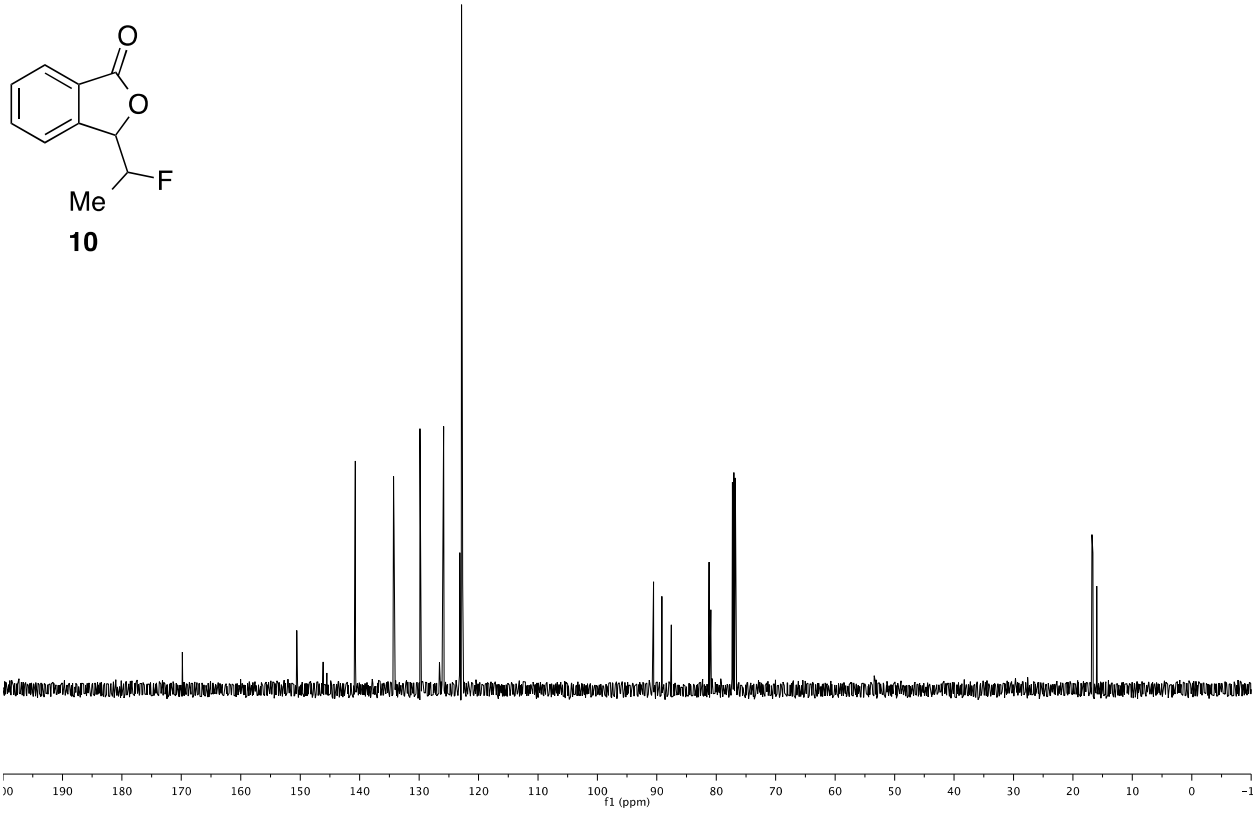

O
O
F
9
f1 (ppm)

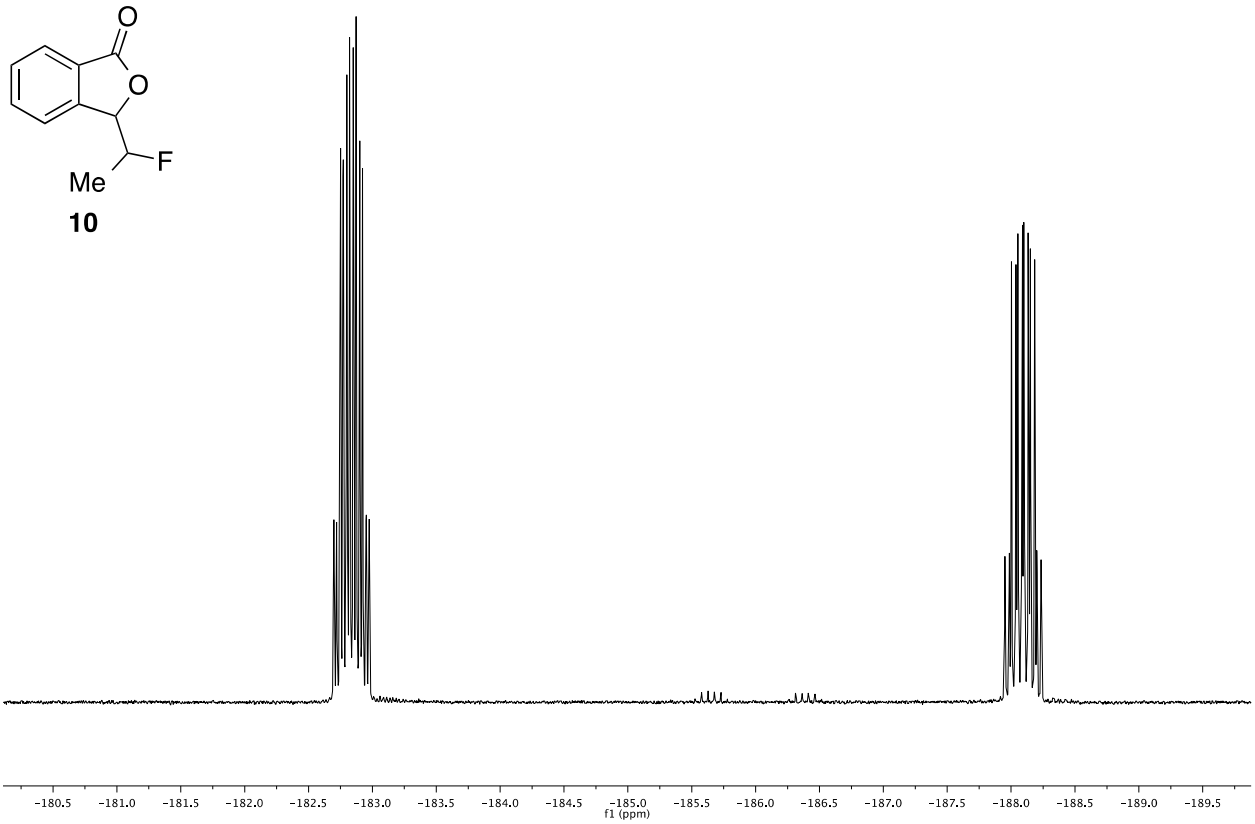

O
O
F
9
f1 (ppm)

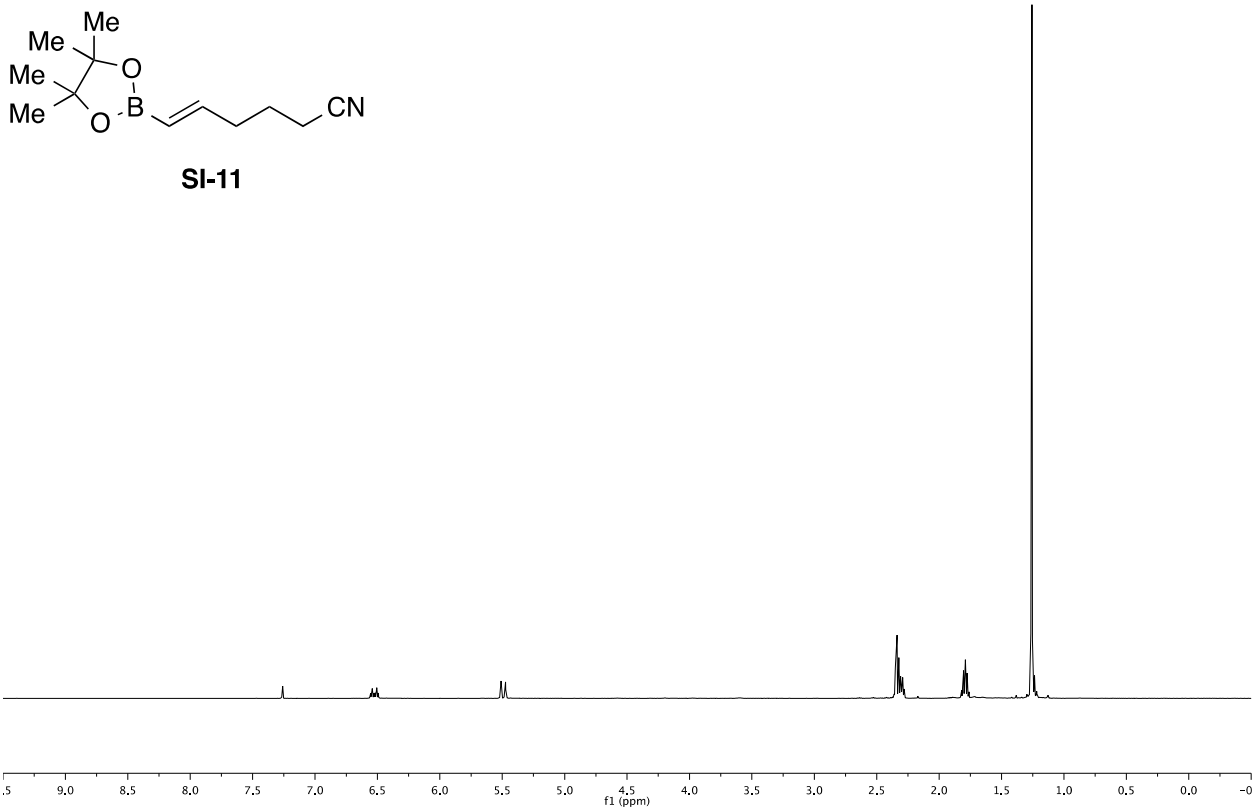

O
O
F
-222.5 -223.0 -223.5 -224.0 -224.5 -225.0 -225.5 -226.0 -226.5 -227.0 -227.5 -228.0 -228.5 -229.0 -229.5 -230.0 -230.5 -231.0 -231.5 -232.0 -232.5 -233.0 -233.5 -234.0 -234.5 -235.0 -23
f1 (ppm)

9

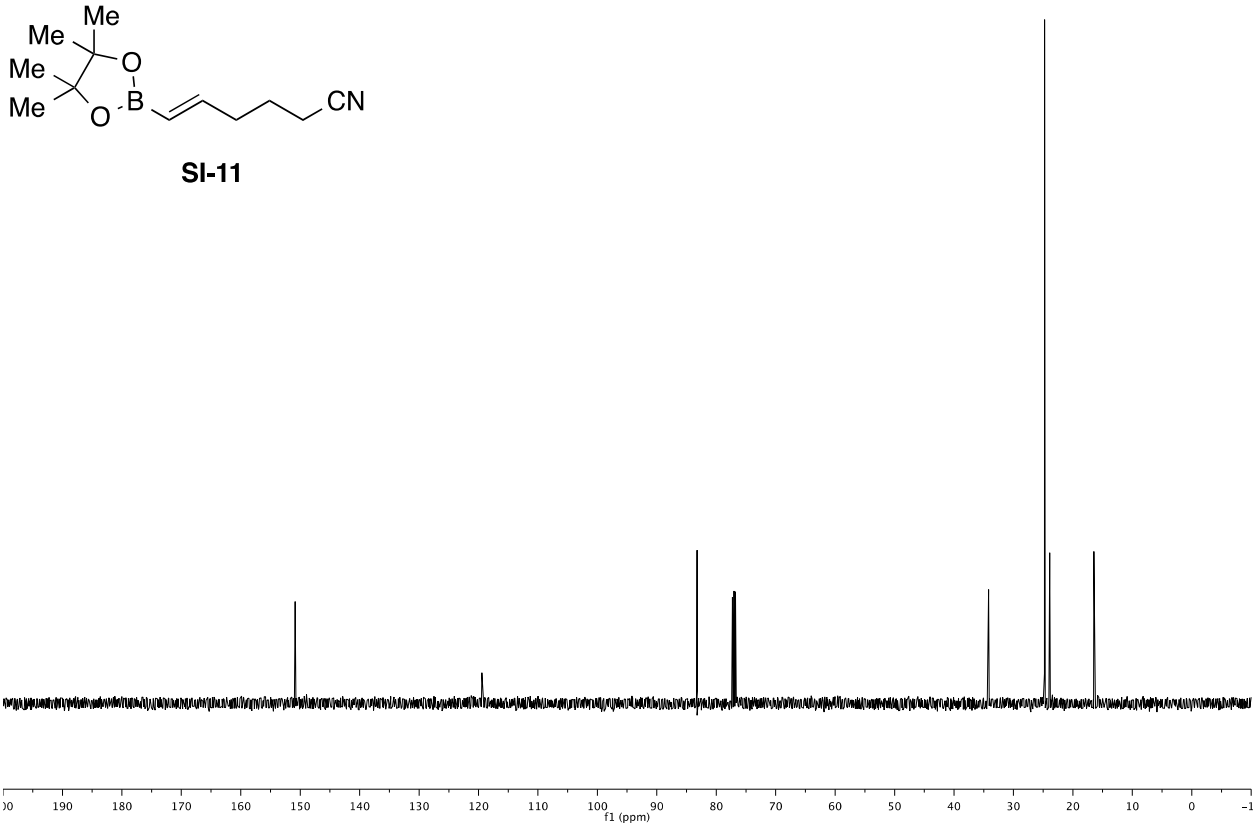

O
O
F
Me
10
f1 (ppm)


O
O
F
Me
10
f1 (ppm)

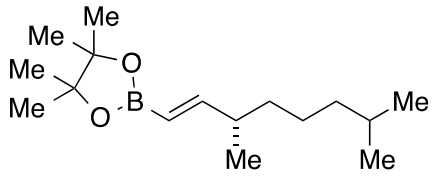

O
O
F
Me
10
-180.5
-181.0
-181.5
-182.0
-182.5
-183.0
-183.5
-184.0
-184.5
-185.0
-185.5
-186.0
-186.5
-187.0
-187.5
-188.0
-188.5
-189.0
-189.5
f1 (ppm)



SI-11

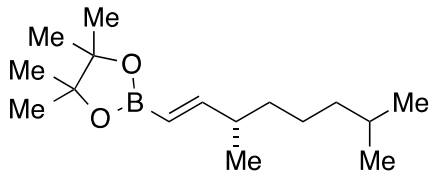


SI-11


Me
Me
Me
Me
O
O
B
Me
Me
Me

SI-14

9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


Me
Me
Me
Me
O
O
B
Me
Me
Me

SI-14

190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

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