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Supporting Information

Polycyclic Indoline-Benzodiazepines through Electrophilic Additions of α-Imino Carbenes to Tröger Bases

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Supporting Information

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1. General remarks

Unless otherwise stated, reagents were purchased from commercial sources and used without further purification. NMR spectra were recorded on 400 or 500 MHz spectrometer at 20 °C. ^{1}H-NMR: chemical shifts are given in ppm relative to Me_4Si with solvent resonances used as internal standards ($CDCl_3$ δ = 7.26 ppm or acetone-d_6 δ = 2.05 ppm). Data were reported as follows: chemical shift (δ) in ppm on the δ scale, multiplicity (s = singulet, d = doublet, t = triplet, dd = doublet of doublets, td = triplet of doublets, sep = septet and m = multiplet), coupling constant (Hz) and integration. ^{13}C-NMR: chemicals shifts were given in ppm relative to Me_4Si with solvent resonances used as internal standards ($CDCl_3$ δ = 77.16 ppm or acetone-d_6 δ = 29.84 and 206.26 ppm). IR spectra were recorded using an ATR sampler and are reported in wave numbers (cm^{-1}). Melting points (Mp) were measured in open capillary tubes and were uncorrected. Electrospray mass spectra (ESI) were obtained by the department of Mass Spectrometry of the University of Geneva. Flash column chromatography was performed with silica gel 40 - 63 µm or alumina (neutral Brockmann I, 50 - 200 µm). Tröger bases **2a-2k** were synthesized starting from their respective anilines [1] and unsymmetrical Tröger bases **2l** and **2m** were preapared according to reported procedures.[2] Ethyl 2-diazo-3-oxopropanoate was synthesized as described in the literature.[3]

2. Optimization of the reaction conditions

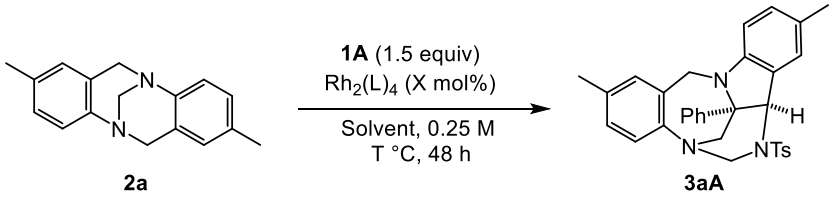
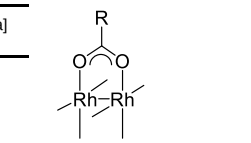
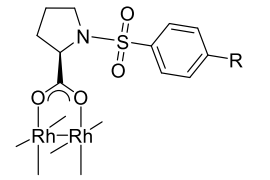
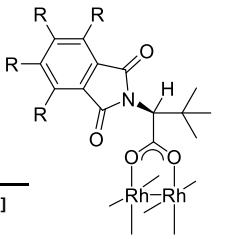


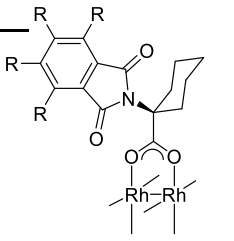
Table S1. Optimization of the reaction conditions.

Entry	Solvent	Catalyst	Cat. Loading	T (°C)	Time (h)	Yield[a]
1	CH_2Cl_2	$Rh_2(oct)_4$	1 mol%	80 °C	48 h	8%
2	CH_2Cl_2	$Rh_2(esp)_4$	1 mol%	80 °C	48 h	16%
3	CH_2Cl_2	Rh_2(*S*-TCPTTL)$_4$	1 mol%	80 °C	48 h	-
4	CH_2Cl_2	$Rh_2(Piv)_4$	1 mol%	80 °C	48 h	14%
5	DCE	$Rh_2(Piv)_4$	1 mol%	80 °C	48 h	24%
6	DCE	$Rh_2(esp)_2$	1 mol%	80 °C	48 h	23%
7	Toluene	Rh_2(*S*-TCPTTL)$_4$	1 mol%	80 °C	48 h	-
8	Toluene	$Rh_2(esp)_2$	1 mol%	80 °C	48 h	14%
9	Toluene	$Rh_2(Piv)_4$	1 mol%	80 °C	48 h	23%
10	$CHCl_3$	$Rh_2(oct)_4$	1 mol%	80 °C	48 h	39%
11	$CHCl_3$	Rh_2(*S*-TCPTTL)$_4$	1 mol%	80 °C	48 h	-
12	$CHCl_3$	$Rh_2(esp)_2$	1 mol%	80 °C	48 h	23%
13	$CHCl_3$	$Rh_2(Piv)_4$	1 mol%	80 °C	48 h	55%
14	**$CHCl_3$**	**$Rh_2(Piv)_4$**	**2 mol%**	**80 °C**	**48 h**	**70%[b]**
15	$CHCl_3$	$Rh_2(Piv)_4$	2 mol%	60 °C	48 h	5%
16	$CHCl_3$	$Rh_2(Piv)_4$	2 mol%	60 °C	7 days	33%
17	$CHCl_3$	$Rh_2(Piv)_4$	2 mol%	100 °C	48 h	27%
18	$CHCl_3$	$Rh_2(OAc)_4$	2 mol%	80 °C	48 h	32%
19	$CHCl_3$	$Rh_2(esp)_2$	2 mol%	80 °C	48 h	30%
20	$CHCl_3$	$Rh_2(oct)_4$	2 mol%	80 °C	48 h	50%
21	$CHCl_3$	Rh_2(*S*-PTTL)$_4$	2 mol%	80 °C	48 h	-
22	$CHCl_3$	Rh_2(*R*-DOSP)$_4$	2 mol%	80 °C	48 h	34%
23	$CHCl_3$	$Rh_2(TFA)_4$	2 mol%	80 °C	48 h	-
24	$CHCl_3$	$Rh_2(TPA)_4$	2 mol%	80 °C	48 h	-
25	$CHCl_3$	$Rh_2(Cap)_4$	2 mol%	80 °C	48 h	<10%
26	$CHCl_3$	$Rh_2(PTCC)_4$	2 mol%	80 °C	48 h	-
27	$CHCl_3$	$Rh_2(TCPTCC)_4$	2 mol%	80 °C	48 h	-









[a] Determined by ^{1}H-NMR spectroscopy using 1,3,5-trimethoxybenzene as reference. [b] Optimized conditions. Isolated yield.

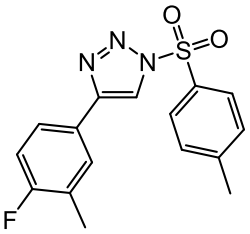
3. General procedure I: synthesis of *N*-sulfonyl-1,2,3-triazoles

Important note: *Sulfonyl azides are potentially explosive materials and must be handled with caution.*
Azide synthesis: Following the reported procedure,[4] to a stirred solution of sulfonyl chloride (1.0 equiv) in water/acetone mixture (1:2, 0.2 M), NaN_3 (1.3 equiv) was slowly added at 0 °C. The resulting solution was stirred at room temperature for 12 h. The residue was suspended in Et_2O, the layers were separated and the aqueous phase was extracted three times with Et_2O. The organic layers were combined, dried over $MgSO_4$, filtered and concentrated under reduced pressure. The desired azide was obtained sufficiently pure to be used without any further purification.

Caution: *Care should be taken to protect the reaction mixture from light at each step of the synthesis of the triazoles.*
Triazole synthesis: Following the reported procedure,[5] 0.05 equiv of copper(I) thiophene-2-carboxylate (CuTC) and 1 equiv of the corresponding sulfonyl azide were diluted in toluene (0.2 M). Then 1.3 equiv of the corresponding alkyne was added and the solution was stirred at room temperature overnight and protected from light. The mixture was diluted with saturated NH_4Cl_{aq} and extracted three times with EtOAc. The combined organic layers were dried over $MgSO_4$ and concentrated under reduced pressure. The crude material was purified by column chromatography or by precipitations to afford the desired product. Products of type **1** were then stored at -20 °C.

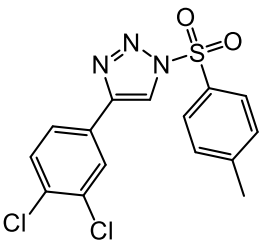
Analysis data for unreported triazoles

4-(4-Fluoro-3-methylphenyl)-1-tosyl-1*H*-1,2,3-triazole (1E):



Following general procedure I, compound **1E** is obtained as a white solid (987 mg, 99% yield) starting from tosyl azide (0.46 mL, 3 mmol) and 4-ethynyl-1-fluoro-2-methylbenzene.
Purification: column chromatography (silica gel, pentane/EtOAc, 8:2)
R_f = 0.54 (Silica gel, pentane/EtOAc, 8:2); **M.p. =** 114-116 °C; **IR** (neat)**:** ṽ 2128, 1593, 1495, 1385, 1339, 1124, 1170, 1120, 1087, 992, 972, 897, 804, 760, 702, 675 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.25 (s, 1H), 8.02 (d, *J* = 8.4 Hz, 2H), 7.72-7.65 (m, 1H), 7.61-7.57 (m, 1H), 7.39 (d, *J* = 8.2 Hz, 2H), 7.05 (t, *J* = 8.9 Hz, 1H), 2.45 (s, 3H), 2.31 (d, *J* = 1.9 Hz, 3H) ppm; **^{13}C NMR (100 MHz, $CDCl_3$):** δ 161.9 (d, J = 247.6 Hz, CF), 147.5 (C), 146.8 (C), 133.2 (C), 130.6 (2xCH), 129.5 (d, *J* = 5.5 Hz, CH), 128.9 (2xCH), 125.9 (d, *J* = 17.9 Hz, C), 125.3 (d, *J* = 8.4 Hz, CH), 124.9 (d, *J* = 3.7 Hz, C), 118.7 (CH), 115.8 (d, *J* = 23.1 Hz, CH), 22.0 (CH_3), 14.7 (d, *J* = 3.5 Hz, CH_3) ppm; **HRMS (ESI):** Calculated for $C_{16}H_{15}FN_3O_2S$ $[M+H]^+$: 332.0864 m/z; Found: 332.0868 m/z.

1-Tosyl-4-(3,4-dichlorophenyl)-1*H*-1,2,3-triazole (1H):



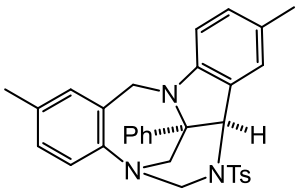
Following general procedure I, compound **1H** is obtained as a yellowish solid (667 mg, 61% yield) starting from tosyl azide (0.46 mL, 3 mmol) and 3,4-dichlorophenylacetylene.
Purification: precipitations with Et_2O
R_f = 0.51 (Silica gel, pentane/EtOAc, 8:2); **M.p. =** 138-140 °C; **IR** (neat) ṽ 1741, 1593, 1455, 1387, 1339, 1196, 1181, 1105, 995, 963, 807, 799, 666 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.32 (s, 1H), 8.03 (d, *J* = 8.3 Hz, 2H), 7.93 (d, *J* = 2.0 Hz, 1H), 7.66 (dd, *J* = 8.3, 2.0 Hz, 1H), 7.51 (d, *J* = 8.4 Hz, 1H), 7.41 (d, *J* = 8.2 Hz, 2H), 2.46 (s, 3H) ppm; **^{13}C NMR (100 MHz, $CDCl_3$):** δ 147.8 (C), 145.3 (C), 133.5 (C), 133.3 (C), 132.9 (C), 131.2 (CH), 130.7 (2xCH), 129.1 (C), 129.0 (2xCH), 128.0 (CH), 125.3 (CH), 119.5 (CH), 22.0 (CH_3) ppm; **HRMS (ESI):** Calculated for $C_{15}H_{12}Cl_2N_3O_2S$ $[M+H]^+$: 368.0022 m/z; Found: 368.0025 m/z.

4. General procedure II: synthesis of compounds 3

In a 2 mL screw-cap vial equipped with a magnetic stirring bar, $Rh_2(Piv)_4$ (2.44 mg, 0.004 mmol, 2 mol%), Tröger's base **2** (0.2 mmol, 1 equiv) and *N*-sulfonyltriazole **1** (0.3 mmol, 1.5 equiv) were dissolved in 0.8 mL of anhydrous $CHCl_3$ (0.25 M). The vial was capped and stirred at 80 °C for 48 h. The solution was concentrated under reduced pressure and the residue was purified by column chromatography.

Analysis data for compounds 3

Compound 3aA:

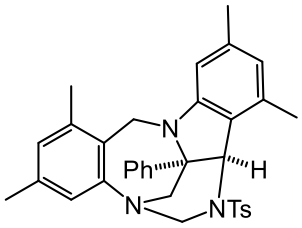


Following general procedure II, compound **3aA** is obtained as a white solid (73 mg, 70% yield) starting from Tröger Base **2a** (50 mg, 0.2 mmol) and triazole **1A**.

Purification: column chromatography (Silica gel, pentane/EtOAc, 9:1)

R_f = 0.67 (pentane/EtOAc, 8:2); **M.p.** = 208-210 °C; **IR** (neat): ṽ 2915, 1615, 1597, 1496, 1400, 1329, 1289, 1247, 1153, 1136, 1087, 1048, 988, 944, 886, 827, 804, 759, 700, 678 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$)**: 7.83 (d, *J* = 8.2 Hz, 2H), 7.38 (d, *J* = 8.0 Hz, 2H), 7.33-7.20 (m, 5H), 6.89 (s, 1H), 6.86-6.80 (m, 2H), 6.54 (d, *J* = 8.0 Hz, 1H), 6.41-6.31 (m, 2H), 5.48 (dd, *J* = 9.7, 1.4 Hz, 1H), 5.44 (s, 1H), 4.67 (d, *J* = 17.5 Hz, 1H), 4.57 (d, *J* = 17.5 Hz, 1H), 3.76 (d, *J* = 15.5 Hz, 1H), 3.70 (d, *J* = 9.6 Hz, 1H), 3.59 (d, *J* = 15.4 Hz, 1H), 2.50 (s, 3H), 2.23 (s, 3H), 2.03 (s, 3H); **^{13}C NMR (100 MHz, $CDCl_3$):** δ 149.0 (C), 146.4 (C), 143.9 (2xC), 138.7 (C), 131.9 (C), 130.9 (CH), 130.8 (CH), 130.1 (2xCH), 129.4 (C) 128.9 (2xCH), 128.5 (2xCH) , 127.8 (C), 127.5 (CH), 127.5 (CH), 126.7 (CH), 125.5 (2xCH), 123.9 (CH), 122.5 (C), 108.2 (CH), 73.7 (C), 66.6 (CH), 62.0 (CH_2), 50.2 (CH_2), 48.7 (CH_2), 21.7 (CH_3), 20.73 (CH_3), 20.65 (CH_3); **HRMS (ESI):** Calculated for $C_{32}H_{32}N_3O_2S$ $[M+H]^+$: 522.2210 m/z; Found: 522.2214 m/z.

Compound 3bA:

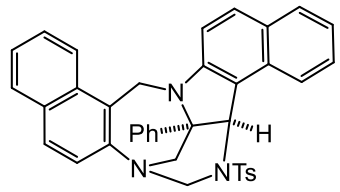


Following general procedure II, compound **3bA** is obtained as a yellow solid (34 mg, 30% yield) starting from Tröger base **2b** (56 mg, 0.2 mol) and triazole **1A**.

Purification: column chromatography (silica gel, pentane/EtOAc, 95:5)

R_f = 0.50 (Silica gel, pentane/EtOAc, 9:1); **M.p. =** 131-133 °C; **IR** (neat)**:** ṽ 2928, 1618, 1511, 1402, 1340, 1266, 1139, 953, 913, 829, 734, 658 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.87 (d, *J* = 8.3 Hz, 2H), 7.37-7.31 (m, 6H), 7.30-7.26 (m, 1H), 6.60 (s, 1H), 6.41 (s, 1H), 6.22 (s, 1H), 6.01 (s, 1H), 5.63 (s, 1H), 5.34-5.30 (m, 1H), 4.86 (d, *J* = 17.7 Hz, 1H), 4.28 (d, *J* = 17.8 Hz, 1H), 3.77 (d, *J* = 11.0 Hz, 1H), 3.73 (d, *J* = 15.5 Hz, 1H), 3.49 (d, *J* = 15.4 Hz, 1H), 2.47 (s, 3H) 2.33 (s, 3H), 2.16 (s, 3H), 2.16 (s, 3H), 2.02 (s, 3H) ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 151.7 (C), 149.1 (C), 143.9 (C), 143.6 (C), 140.5 (C), 138.0 (C), 137.2 (C), 137.0 (C), 136.6 (C), 123.0 (2x CH), 128.9 (2x CH), 127.8 (2x CH), 127.6 (CH), 126.0 (CH), 125.6 (2x CH), 124.6 (C), 123.4 (CH), 121.0 (CH), 117.0 (C), 105.2 (CH), 73.1 (C), 66.1 (CH), 61.5 (CH_2), 49.4 (CH_2), 43.1 (CH_2), 21.9 (CH_3), 21.8 (CH_3), 20.9 (CH_3), 20.4 (CH_3), 18.3 (CH_3) ppm; **HRMS (ESI):** Calculated for $C_{34}H_{36}N_3O_2S$ $[M+H]^+$: 550.2523 m/z; Found: 550.2528 m/z

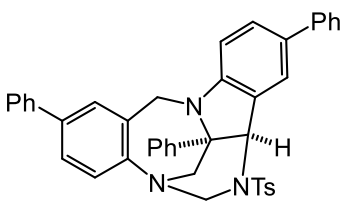
Compound 3cA:



Following general procedure II, compound **3cA** is obtained as an orange solid (76 mg, 64% yield) starting from Tröger base **2c** (64 mg, 0.2 mmol) and triazole **1A**.

Purification: column chromatography (silica gel, pentane/EtOAc, 95:5) **R_f =** 0.46 (Silica gel, pentane/EtOAc, 9:1); **M.p. =** 175-177 °C; **IR** (neat)**:** ṽ 3054, 1623, 1595, 1472, 1340, 1321, 1156, 1113, 1092, 951, 807, 732, 698, 660 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.95 (d, *J* = 8.5 Hz, 1H), 7.90 (d, *J* = 8.3 Hz, 2H), 7.72-7.67 (m, 2H), 7.60-7.52 (m, 2H), 7.49-7.31 (m, 10H), 7.29-7.20 (m, 1H), 7.16-7.09 (m, 1H), 6.74 (d, *J* = 8.7 Hz, 1H), 6.60 (d, *J* = 8.8 Hz, 1H), 6.23 (s, 1H), 5.62 (d, *J* = 18.0 Hz, 1H), 5.40 (dd, *J* = 10.7, 1.2 Hz, 1H), 4.84 (d, *J* = 17.9 Hz, 1H), 4.02 (d, *J* = 15.6 Hz, 1H), 3.91 (dd, *J* = 13.2, 1.2 Hz, 2H), 2.49 (s, 3H) ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 150.2 (C), 147.0 (C), 144.2 (C), 143.5 (C), 137.5 (C), 133.6 (C), 131.9 (CH), 131.5 (C), 130.1 (2x CH), 130.0 (C), 129.1 (2x CH), 128.8 (CH), 128.7 (CH), 128.7 (C), 128.0 (CH), 127.9 (2x CH), 127.9 (CH), 127.2 (CH), 127.0 (CH), 125.6 (2x CH), 123.8 (CH), 123.4 (CH), 122.1 (2x CH), 121.7 (CH), 119.2 (C), 111.1 (C), 110.6 (CH), 74.1 (C), 66.8 (CH), 61.6 (CH_2), 49.6 (CH_2), 43.6 (CH_2), 21.8 (CH_3) ppm; **HRMS (ESI):** Calculated for $C_{38}H_{32}N_3O_2S$ $[M+H]^+$: 594.2210 m/z; Found: 594.2218 m/z.

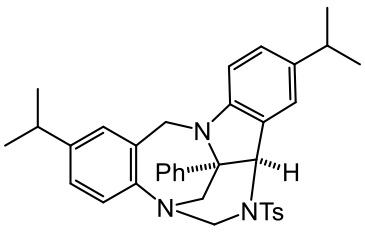
Compound 3dA:



Following general procedure II, compound **3dA** is obtained as an orange solid (97 mg, 75% yield) starting from Tröger base **2d** (75 mg, 0.2 mmol) and triazole **1A**.

Purification: column chromatography (silica gel, toluene/EtOAc, 98:2) **R_f =** 0.39 (Silica gel, pentane/EtOAc, 9:1); **M.p. =** 138-140 °C; **IR** (neat)**:** ṽ 3030, 2928, 1611, 1483, 1339, 1139, 1111, 953, 761, 698 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.95-7.87 (m, 2H), 7.62-7.57 (m, 2H), 7.54-7.41 (m, 9H), 7.40-7.33 (m, 5H), 7.32-7.27 (m, 3H), 7.26-7.24 (m, 1H), 6.78 (d, *J* = 8.2 Hz, 1H), 6.70 (d, *J* = 1.6 Hz, 1H), 6.57 (d, *J* = 8.4 Hz, 1H), 5.71 (dd, *J* = 9.4, 1.2 Hz, 1H), 5.68 (s, 1H), 4.91 (d, *J* = 17.4 Hz, 1H), 4.82 (d, *J* = 17.5 Hz, 1H), 4.03 (d, *J* = 15.6 Hz, 1H), 3.93 (d, *J* = 9.4 Hz, 1H), 3.81 (d, *J* = 15.5 Hz, 1H), 2.51 (s, 3H).ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 150.6 (C), 148.3 (C), 144.1 (C), 143.4 (C), 140.8 (C), 140.5 (C), 138.7 (C), 135.1 (C), 131.8 (C), 130.2 (2x CH), 129.2 (CH), 129.1 (2x CH), 129.0 (CH), 128.9 (2x CH), 128.9 (C), 128.7 (2x CH), 127.8 (CH), 127.3 (2x CH), 127.1 (CH), 126.8 (2x CH), 126.5 (CH), 126.7 (CH), 126.2 (2x CH), 125.6 (2x CH), 124.5 (CH), 124.0 (CH), 123.4 (C), 108.9 (CH), 74.6 (C), 66.5 (CH), 62.1 (CH_2), 50.2 (CH_2), 49.0 (CH_2), 21.8 (CH_3) ppm; **HRMS (ESI):** Calculated for $C_{42}H_{36}N_3O_2S$ $[M+H]^+$: 646.2523 m/z; Found: 646.2523 m/z.

Compound 3eA:

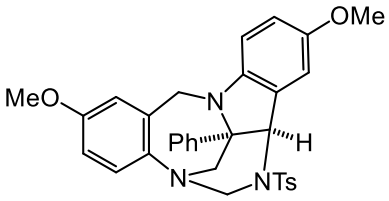


Following general procedure II, compound **3eA** is obtained as a yellow solid (83 mg, 72% yield) starting from Tröger base **2e** (61 mg, 0.2 mmol) and triazole **1A**.

Purification: column chromatography (silica gel, pentane/EtOAc, 95:5)

R_f = 0.64 (Silica gel, pentane/EtOAc, 9:1); **IR** (neat)**:** ṽ 2958, 2869, 1615, 1495, 1340, 1321, 1159, 1109, 1059, 955, 933, 909, 811, 730, 701 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.82 (d, *J* = 8.2 Hz, 2H), 7.44-7.30 (m, 6H), 7.29-7.20 (m, 1H), 6.95 (s, 1H), 6.94-6.89 (m, 1H), 6.86-6.78 (m, 1H), 6.63 (d, *J* = 8.0 Hz, 1H), 6.37 (d, *J* = 8.2 Hz, 1H), 6.26 (s, 1H), 5.50 (d, *J* = 9.6 Hz, 1H), 5.48 (s, 1H), 4.71 (d, *J* = 17.5 Hz, 1H), 4.64 (d, *J* = 17.5 Hz, 1H), 3.88 (d, *J* = 15.5 Hz, 1H), 3.68 (d, *J* = 9.5 Hz, 1H), 3.60 (d, *J* = 15.4 Hz, 1H), 2.81 (sep, *J* = 6.9 Hz, 1H), 2.56 (sep, *J* = 6.9 Hz, 1H), 2.47 (s, 3H), 1.21 (d, *J* = 2.8 Hz, 3H), 1.20 (d, *J* = 2.8 Hz, 3H), 0.99 (d, *J* = 6.9 Hz, 3H), 0.96 (d, *J* = 6.9 Hz, 3H) ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 149.2 (C), 146.8 (C), 143.9 (C), 143.9 (C), 143.2 (C), 139.0 (C), 138.9 (C), 130.1 (2x CH), 129.4 (C), 128.9 (2x CH), 128.5 (CH), 128.2 (CH), 127.5 (CH), 127.3 (2x CH), 125.7 (2x CH), 125.6 (CH), 124.4 (CH), 123.7 (CH), 122.3 (C), 107.9 (CH), 73.8 (C), 66.6 (CH), 61.8 (CH_2), 50.7 (CH_2), 48.7 (CH_2), 33.4 (CH), 33.2 (CH), 24.3 (CH_3), 24.2 (2x CH_3), 23.9 (CH_3), 21.7 (CH_3) ppm; **HRMS (ESI):** Calculated for $C_{36}H_{40}N_3O_2S$ $[M+H]^+$: 578.2836 m/z; Found: 578.2834 m/z.

Compound 3fA:

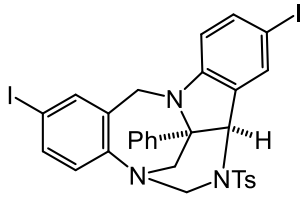


Following general procedure II, compound **3fA** is obtained as a yellow solid (75 mg, 68% yield) starting from Tröger Base **2f** (56 mg, 0.2 mmol) and triazole **1A**.

Purification: column chromatography (Silica gel, pentane/EtOAc, 8:2)

R_f = 0.31 (pentane/EtOAc, 8:2); **M.p.** = 184-186 °C; **IR** (neat): ṽ 1598, 1493, 1336, 1302, 1273, 1235, 1218, 1160, 1137, 1097, 1030, 946, 928, 873, 812, 789, 763, 701 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$)**: 7.85 (d, *J* = 7.9 Hz, 2H), 7.38 (d, *J* = 8.0 Hz, 2H), 7.32-7.31 (m, 5H), 6.68-6.58 (m, 4H), 6.40 (d, *J* = 8.7 Hz, 1H), 6.20 (s, 1H), 5.48-5.46 (m, 2H), 4.69 (d, *J* = 17.5 Hz, 1H), 4.56 (d, *J* = 17.6 Hz, 1H), 3.80 (d, *J* = 15.5 Hz, 1H), 3.74 (s, 3H), 3.66 (d, *J* = 10.0 Hz, 1H), 3.58 (d, *J* = 15.5 Hz, 1H), 3.51 (s, 3H), 2.47 (s, 3H); **^{13}C NMR (126 MHz, $CDCl_3$):** δ 155.3 (C), 152.1 (C), 145.1 (C), 144.0 (C), 143.7 (C), 138.5 (C), 130.9 (C), 130.3 (C), 130.2 (2XCH), 128.9 (2XCH), 127.6 (CH), 127.5 (CH), 126.2 (C), 125.6 (2xCH), 125.3 (CH), 123.0 (C), 117.3 (CH), 113.0 (CH), 112.6 (CH), 111.0 (CH), 109.1 (CH), 77.1 (C) 66.7 (CH), 62.1 (CH_2), 55.9 (CH_3), 55.7 (CH_3), 50.6 (CH_2), 49.0 (CH_2), 21.7 (CH_3); **HRMS (ESI):** Calculated for $C_{32}H_{32}N_3O_4S$ $[M+H]^+$: 554.2108 m/z; Found: 554.2112 m/z.

Compound 3gA:

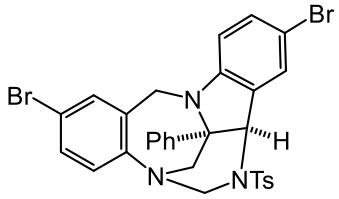


Following general procedure II, compound **3gA** is obtained as a white solid (72 mg, 49% yield) starting from Tröger Base **2g** (94 mg, 0.2 mmol) and triazole **1A**.

Purification: column chromatography (Silica gel, pentane/EtOAc, 9:1)

R_f = 0.75 (pentane/EtOAc, 8:2); **M.p.** = 205-207 °C; **IR** (neat): ṽ 1592, 1476, 1402, 1330, 1284, 1230, 1158, 1092, 1055, 949, 809, 760, 700, 674 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$)**: 7.79-7.77 (m, 2H), 7.42-7.37 (m, 3H), 7.36-7.27 (m, 7H), 6.89 (s, 1H), 6.47 (s, 1H), 6.37 (d, *J* = 8.3 Hz, 1H), 6.23 (d, *J* = 8.4 Hz, 1H), 5.55 (dd, *J* = 9.4, 1.3 Hz, 1H), 5.45 (s, 1H), 4.67 (d, *J* = 17.6 Hz, 1H), 4.51 (d, *J* = 17.6 Hz, 1H), 3.85 (d, *J* = 15.6 Hz, 1H), 3.73 (d, *J* = 9.4 Hz, 1H), 3.61 (d, *J* = 15.5 Hz, 1H), 2.52 (s, 3H); **^{13}C NMR (100 MHz, $CDCl_3$):** δ 150.5 (C), 148.5 (C), 144.5 (C), 142.7 (C), 138.8 (CH), 138.7 (CH), 138.2 (C), 136.9 (CH), 134.8 (CH), 130.4 (2XCH), 130.4 (C), 129.1 (2XCH) 128.0 (CH), 127.2 (2XCH) , 125.4 (CH), 125.41 (CH), 125.3 (2XCH), 110.9 (CH), 85.0 (C), 79.4 (C), 74.5 (C), 65.8 (CH), 62.0 (CH_2), 49.8 (CH_2), 48.1 (CH_2), 21.9 (CH_3); **HRMS (ESI):** Calculated for $C_{30}H_{26}I_2N_3O_2S$ $[M+H]^+$: 745.9830 m/z; Found: 745.9834 m/z.

Compound 3hA:

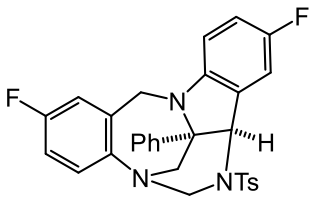


Following general procedure II, compound **3hA** is obtained as a yellow solid (63 mg, 48% yield) starting from Tröger Base **2h** (76 mg, 0.2 mmol) and triazole **1A**.

Purification: column chromatography (Silica gel, pentane/EtOAc, 9:1)

R_f = 0.67 (pentane/EtOAc, 8:2); **M.p.** = 208-210 °C; **IR** (neat): ṽ 1595, 1478, 1407, 1329, 1287, 1155, 1089, 946, 815, 800, 760, 700, 680 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$)**: 7.80 (d, *J* = 8.4 Hz, 2H), 7.40 (d, *J* = 8.2 Hz, 2H), 7.36-7.31 (m, 2H), 7.30-7.27 (m, 3H), 7.21 (d, *J* = 2.4 Hz, 1H), 7.15 (dd, *J* = 8.5, 2.3 Hz, 1H), 7.10 (dd, *J* = 8.5, 2.1 Hz, 1H), 6.48 (d, *J* = 8.4 Hz, 1H), 6.43-6.40 (m, 1H), 6.32 (d, *J* = 8.5 Hz, 1H), 5.54 (dd, *J* = 9.5, 1.4 Hz, 1H), 5.47 (s, 1H), 4.69 (d, *J* = 17.6 Hz, 1H), 4.53 (d, *J* = 17.6 Hz, 1H), 3.82 (d, *J* = 15.5 Hz, 1H), 3.74 (d, *J* = 9.5 Hz, 1H), 3.61 (d, *J* = 15.6 Hz, 1H), 2.51 (s, 3H); **^{13}C NMR (126 MHz, $CDCl_3$):** δ 149.9 (C), 147.7 (C), 144.5 (C), 142.7 (C), 138.1 (C), 133.0 (CH), 132.8 (CH), 130.9 (CH), 130.4 (2XCH) 130.0 (C), 129.1 (2xCH) , 129.0 (CH), 128.0 (CH), 127.3 (2XCH), 125.3 (2XCH), 125.0 (CH), 124.8 (C), 114.6 (C), 110.4 (C), 110.1 (CH), 74.6 (C), 65.9 (CH), 62.0 (CH_2), 49.7 (CH_2), 48.3 (CH_2), 21.8 (CH_3); **HRMS (ESI):** Calculated for $C_{30}H_{25}Br_2N_3O_2S$ $[M+H]^+$: 650.0107 m/z ; Found: 650.0126 m/z.

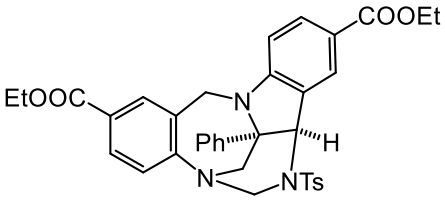
Compound 3iA:



Following general procedure II, compound **3iA** is obtained as a white solid (54 mg, 51% yield) starting from Tröger base **2i** (52 mg, 0.2 mmol) and triazole **1A**.

Purification: column chromatography (silica gel, pentane/EtOAc, 95:5) **R_f =** 0.42 (Silica gel, pentane/EtOAc, 9:1); **M.p. =** 213-215 °C; **IR** (neat)**:** ṽ 2934, 1490, 1340, 1263, 1161, 1136, 962, 871, 813, 763, 702, 657 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.87-7.73 (m, 2H), 7.39 (d, *J* = 8.0 Hz, 2H), 7.35-7.23 (m, 5H), 6.82 (dd, *J* = 8.7, 2.9 Hz, 1H), 6.76 (dd, *J* = 8.6, 2.7 Hz, 1H), 6.75 (dd, *J* = 8.6, 2.7 Hz, 1H), 6.58 (dd, *J* = 8.7, 5.0 Hz, 1H), 6.37 (dd, *J* = 8.7, 4.0 Hz, 1H), 6.33 (dd, *J* = 8.1, 2.5 Hz, 1H), 5.50 - 5.48 (m, 2H), 4.71 (d, *J* = 17.6 Hz, 1H), 4.55 (d, *J* = 17.7 Hz, 1H), 3.81 (d, *J* = 15.6 Hz, 1H), 3.69 (d, *J* = 10.0 Hz, 1H), 3.61 (d, *J* = 15.6 Hz, 1H), 2.50 (s, 3H).ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 158.3 (C, d, *J* = 187.4 Hz), 156.4 (C, d, *J* = 181.3 Hz), 147.1 (C), 144.8 (C, *J* = 2.5 Hz), 144.3 (C), 143.2 (C), 138.2 (C), 130.3 (2x CH), 130.2 (C), 129.0 (2x CH), 127.8 (CH), 127.3 (2x CH), 125.4 (2x CH), 124.9 (CH, *J* = 8.1 Hz), 123.8 (C, *J* = 7.7 Hz), 117.0 (CH, *J* = 23.7 Hz), 116.7 (CH, *J* = 22.1 Hz), 114.6 (CH, *J* = 22.2 Hz), 113.1 (CH, *J* = 24.0 Hz), 108.8 (CH, *J* = 8.0 Hz), 74.5 (C), 66.2 (CH, *J* = 1.4 Hz), 62.1 (CH_2), 50.0 (CH_2), 48.8 (CH_2), 21.8 (CH_3) ppm; **HRMS (ESI):** Calculated for $C_{30}H_{26}F_2N_3O_2S$ $[M+H]^+$: 530.1708 m/z; Found: 530.1706 m/z.

Compound 3jA:

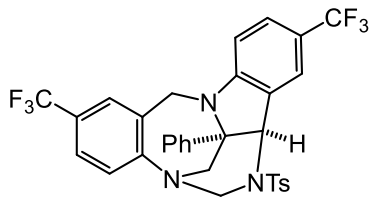


Following general procedure II, compound **3jA** is obtained as a yellow solid (70 mg, 55% yield) starting from Tröger Base **2j** (73 mg, 0.2 mmol) and triazole **1A**.

Purification: column chromatography (Silica gel, pentane/EtOAc, 8:2)

R_f = 0.36 (pentane/EtOAc, 8:2); **M.p.** = 113-115 °C; **IR** (neat): ṽ 1703, 1606 1498, 1366, 1340, 1285, 1256, 1161, 1099, 1020, 953, 761, 656 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$)**: 7.86-7.80 (m, 3H), 7.73 (dd, *J* = 8.5, 1.8, Hz, 1H), 7.70 (dd, *J* = 8.4, 2.0, Hz, 1H), 7.39 (d, *J* = 7.7 Hz, 2H), 7.37-7.28 (m, 6H), 6.53 (d, *J* = 8.3 Hz, 1H), 6.40 (d, *J* = 8.5 Hz, 1H), 5.58 (s, 1H), 5.57 (dd, *J* = 9.8, 1.2 Hz, 1H), 4.78 (d, *J* = 17.5 Hz, 1H), 4.71 (d, *J* = 17.5 Hz, 1H), 4.37-4.30 (m, 2H), 4.26-4.19 (m, 2H), 3.92 (d, *J* = 15.5 Hz, 1H), 3.80 (d, *J* = 9.4 Hz, 1H), 3.75 (d, *J* = 15.6 Hz, 1H), 2.50 (s, 3H), 1.38 (t, *J* = 7.1, 3H), 1.29 (t, *J* = 7.1, 3H); **^{13}C NMR (126 MHz, $CDCl_3$):** δ 166.3 (C), 166.2 (C), 154.8 (C), 152.8 (C), 144.5 (C), 142.3 (C), 137.9 (C), 132.9 (CH), 132.3 (CH), 130.3 (2xCH), 129.6 (CH), 129.2 (2xCH) 128.1 (2xCH), 127.4 (2xCH) , 126.7 (C), 125.4 (2xCH), 123.7 (C), 123.0 (C), 122.0 (CH), 121.4 (C), 108.0 (CH), 75.4 (C), 65.9 (CH), 61.9 (CH_2), 61.0 (CH_2), 60.5 (CH_2), 49.2 (CH_2), 48.5 (CH_2), 21.8 (CH_3), 14.6 (CH_3), 14.5 (CH_3); **HRMS (ESI):** Calculated for $C_{33}H_{34}N_3O_2S$ $[M+H]^+$: 638.2319 m/z; Found: 638.2336 m/z.

Compound 3kA:

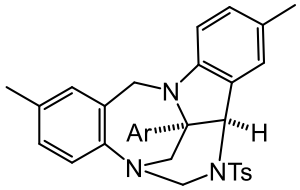


Following general procedure II, compound **3kA** is obtained as a yellow solid (57 mg, 45% yield) starting from Tröger base **2k** (72 mg, 0.2 mmol) and triazole **1A**.

Purification: column chromatography (silica gel, pentane/EtOAc, 95:5)

R_f = 0.47 (Silica gel, pentane/EtOAc, 9:1); **M.p. =** 193-195 °C; **IR** (neat)**:** ṽ 2846, 1598, 1452, 1339, 1261, 1233, 951, 938, 909, 813, 702 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.79 (d, *J* = 8.3 Hz, 2H), 7.44-7.30 (m, 9H), 7.24 (dd, *J* = 8.5, 1.8 Hz, 1H), 6.66 (d, *J* = 8.3 Hz, 1H), 6.45 (s, 1H), 6.43 (d, *J* = 8.5 Hz, 1H), 5.65 (dd, *J* = 9.3, 1.3 Hz, 1H), 5.55 (s, 1H), 4.81 (d, *J* = 17.6 Hz, 1H), 4.70 (d, *J* = 17.6 Hz, 1H), 3.96 (d, *J* = 15.6 Hz, 1H), 3.77 (d, *J* = 9.3 Hz, 1H), 3.73 (d, *J* = 15.6 Hz, 1H), 2.49 (s, 3H).ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 153.4 (C), 151.6 (C), 144.8 (C), 142.2 (C), 138.1 (C), 130.4 (2x CH), 129.3 (2x CH), 128.2 (CH), 128.0 (CH, q, *J* = 3.4 Hz), 127.5 (C), 127.5 (CH, q, *J* = 3.4 Hz), 127.1 (2x CH), 126.0 (CF_3, q, *J* = 233.5 Hz), 125.4 (CH, q, *J* = 3.6 Hz), 125.3 (2x CH), 124.1 (C, q, *J* = 32.9 Hz), 123.5 (CH, q, *J* = 3.6 Hz), 123.1 (C), 123.1 (CH), 121.90 (CF_3, q, *J* = 221.7 Hz), 121.1 (C, q, *J* = 33.0 Hz), 108.1 (CH), 75.2 (C), 65.7 (CH), 62.0 (CH_2), 49.5 (CH_2), 48.5 (CH_2), 21.7 (CH_3) ppm; **HRMS (ESI):** Calculated for $C_{32}H_{26}F_6N_3O_2S$ $[M+H]^+$: 630.1645 m/z; Found: 630.1640 m/z.

Compound 3aB:



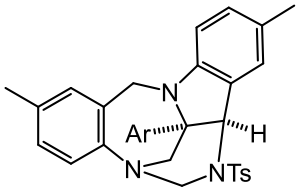
Ar = *p*-$OMeC_6H_4$

Following general procedure II, compound **3aB** is obtained as a yellow solid (37 mg, 34% yield) starting from Tröger base **2a** (50 mg, 0.20 mmol) and triazole **1B**.

Purification: column chromatography (silica gel, pentane/EtOAc, 8:2)

R_f = 0.43 (Silica gel, pentane/EtOAc, 8:2); **M.p. =** 207-209 °C; **IR (neat):** ṽ 1609, 1498, 1401, 1338, 1249, 1157, 954, 811, 659 cm^{-1}; **^{1}H NMR (500 MHz, acetonde-d_6):** δ 7.94-7.85 (m, 2H), 7.59-7.48 (m, 2H), 7.29-7.19 (m, 2H), 7.04-6.97 (m, 1H), 6.94-6.86 (m, 2H), 6.82 (dd, *J* = 8.1, 2.1 Hz, 1H), 6.79 (dd, *J* = 8.2, 1.9 Hz, 1H), 6.57 (d, *J* = 8.0 Hz, 1H), 6.46 (d, *J* = 8.1 Hz, 1H), 6.30 (s, 1H), 5.49 (dd, *J* = 9.6, 1.4 Hz, 1H), 5.39 (s, 1H), 4.75 (d, *J* = 17.6 Hz, 1H), 4.70 (d, *J* = 17.6 Hz, 1H), 3.79 (s, 3H), 3.76-3.60 (m, 3H), 2.52 (s, 3H), 2.19 (s, 3H), 1.99 (s, 3H) ppm; **^{13}C NMR (126 MHz, acetone-d_6):** 159.9 (C), 150.2 (C), 147.5 (C), 144.9 (C), 139.8 (C), 137.1 (C), 131.9 (C), 131.8 (CH), 131.3 (CH), 131.0 (2xCH), 129.8 (C), 128.8 (CH), 128.1 (2xCH), 128.0 (C), 127.4 (2xCH), 127.0 (CH), 124.2 (CH), 123.5 (C), 114.8 (2xCH), 109.5 (CH), 74.2 (C), 67.6 (CH), 62.7 (CH_2), 55.5 (CH_3), 50.5 (CH_2), 49.1 (CH_2), 21.5 (CH_3), 20.57 (CH_3), 20.55 (CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{33}H_{34}N_3O_3S$ $[M+H]^+$: 552.2315 m/z; Found: 552.2333 m/z.

Compound 3aC:



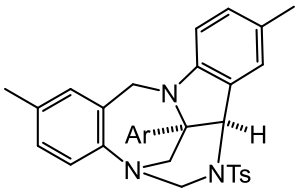
Ar = *m*-$MeOC_6H_4$

Following general procedure II, compound **3aC** is obtained as a yellow solid (60 mg, 54% yield) starting from Tröger base **2a** (50 mg, 0.2 mmol) and triazole **1C**.

Purification: column chromatography (silica gel, pentane/EtOAc, 9:1)

R_f = 0.32 (Silica gel, pentane/EtOAc, 9:1); **IR** (neat)**:** ṽ 2988, 1650, 1418, 1400, 1378, 1294, 1258, 1207, 1132, 1058, 940, 871, 813, 702 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.83 (d, *J* = 8.3 Hz, 2H), 7.38 (d, *J* = 8.0 Hz, 2H), 7.23 (t, *J* = 8 Hz, 1H), 6.97 (d, *J* = 2.0 Hz, 1H), 6.91-6.76 (m, 5H), 6.54 (d, *J* = 8.0 Hz, 1H), 6.36 (d, *J* = 8.1 Hz, 1H), 6.29 (s, 1H), 5.51-5.43 (m, 2H), 4.68 (d, *J* = 17.5 Hz, 1H), 4.58 (d, *J* = 17.5 Hz, 1H), 3.83 (s, 3H), 3.79 (d, *J* = 15.5 Hz, 1H), 3.70 (d, *J* = 9.8 Hz, 1H), 3.60 (d, *J* = 15.5 Hz, 1H), 2.50 (s, 3H), 2.24 (s, 3H), 2.02 (s, 3H) ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 160.1 (C), 149.0 (C), 146.4 (C), 145.7 (C), 143.9 (C), 138.6 (C), 131.8 (C), 130.9 (CH), 130.7 (CH), 130.1 (2x CH), 129.9 (CH), 128.8 (C), 128.4 (CH), 127.7 (C), 127.4 (2x CH), 126.6 (CH), 123.8 (CH), 122.6 (C), 117.8 (CH), 112.5 (CH), 111.7 (CH), 108.3 (CH), 73.8 (C), 66.5 (CH), 62.0 (CH_2), 55.4 (CH_3), 50.2 (CH_2), 48.7 (CH_2), 21.7 (CH_3), 20.7 (CH_3), 20.6 (CH_3) ppm; **HRMS (ESI):** Calculated for $C_{33}H_{34}N_3O_3S$ $[M+H]^+$: 552.2315 m/z; Found: 552.2315 m/z.

Compound 3aD:



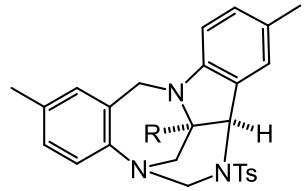
Ar = *p*-MeC_6H_4

Following general procedure II, compound **3aD** is obtained as a white solid (59 mg, 55% yield) starting from Tröger Base **2a** (50 mg, 0.2 mmol) and triazole **1D**.

Purification: column chromatography (Silica gel, pentane/EtOAc, 9:1)

R_f = 0.45 (pentane/EtOAc, 8:2); **M.p.** = 206-208 °C; **IR** (neat): ṽ 1737, 1619, 1594 1343, 1319, 1159, 1115, 964, 948, 930, 877, 810, 795, 703, 664, 654 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$)**: 7.84 (d, *J* = 8.0 Hz, 2H), 7.38 (d, *J* = 8.0 Hz, 2H), 7.15-7.09 (m, 4H), 6.90 (s, 1H), 6.86-6.81 (m, 2H), 6.57 (d, *J* = 7.9 Hz, 1H), 6.38 (s, 1H), 6.36 (d, *J* = 8.1 Hz, 1H), 5.48 (dd, *J* = 9.7, 1.4 Hz, 1H), 5.42 (s, 1H), 4.65 (d, *J* = 17.5 Hz, 1H), 4.57 (d, *J* = 17.6 Hz, 1H), 3.74 (d, *J* = 15.5 Hz, 1H), 3.70 (d, *J* = 9.7 Hz, 1H), 3.57 (d, *J* = 15.5 Hz, 1H), 2.50 (s, 3H), 2.33 (s, 3H) 2.24 (s, 3H), 2.04 (s, 3H); **^{13}C NMR (100 MHz, $CDCl_3$):** δ 149.0 (C), 146.3 (C), 143.9 (C), 140.8 (C), 138.6 (C), 137.2 (C), 132.0 (C), 130.9 (CH), 130.7 (CH) 130.1 (2xCH), 129.5 (2xCH) , 129.0 (C), 128.5 (CH), 127.7 (C), 127.5 (2xCH), 126.8 (CH), 125.4 (2XCH), 124.0 (CH), 122.5 (C), 108.1 (CH), 73.3 (C), 66.7 (CH), 62.0 (CH_2), 50.2 (CH_2), 48.6 (CH_2), 21.7 (CH_3), 21.2 (CH_3), 20.74 (CH_3), 20.66 (CH_3); **HRMS (ESI):** Calculated for $C_{33}H_{34}N_3O_2S$ $[M+H]^+$: 536.2366 m/z; Found: 536.2367 m/z.

Compound 3aE:



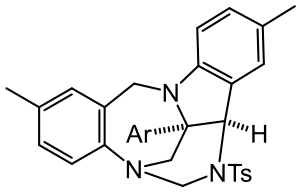
R = 3-F-4-MeC_6H_4

Following general procedure II compound **3aE** is obtained as a yellow solid (71 mg, 64% yield) starting from Tröger base **2a** (50 mg, 0.2 mmol) and triazole **1E**.

Purification: column chromatography (silica gel, pentane/EtOAc, 95:5)

R_f = 0.43 (Silica gel, pentane/EtOAc, 9:1); **IR** (neat)**:** ν̃ 3002, 2850, 1620, 1516, 1397, 1200, 1122, 1079, 972, 963, 809, 732, 698cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.91-7.77 (m, 2H), 7.45-7.34 (m, 2H), 7.14-7.01 (m, 2H), 6.94-6.87 (m, 2H), 6.87-6.79 (m, 2H), 6.54 (d, *J* = 8.0 Hz, 1H), 6.39 (s, 1H), 6.37 (d, *J* = 8.1 Hz, 1H), 5.48 (dd, *J* = 9.7, 1.4 Hz, 1H), 5.41 (s, 1H), 4.64 (d, *J* = 17.5 Hz, 1H), 4.57 (d, *J* = 17.5 Hz, 1H), 3.75-3.66 (m, 2H), 3.56 (d, *J* = 15.5 Hz, 1H), 2.50 (s, 3H), 2.244 (s, 3H), 2.239 (s, 3H), 2.05 (s, 3H).ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 160.7 (C, d, *J* = 244.9 Hz), 148.9 (C), 146.4 (C), 143.9 (C), 139.35 (C, d, *J* = 244.9 Hz), 138.7 (C), 131.8 (C), 130.9 (CH), 130.8 (CH), 130.1 (2xCH), 128.7 (C), 128.6 (CH, d, *J* = 5.1 Hz), 128.5 (CH). 127.9 (C), 127.4 (2x CH), 126.7 (CH), 125.1 (C, d, *J* = 17.3 Hz), 124.5 (CH, d, *J* = 8 Hz), 123.8 (CH), 122.4 (C), 115.2 (CH, d, *J* = 22.2 Hz), 108.3 (CH), 73.3 (C), 66.7 (CH), 62.0 (CH_2), 50.1 (CH_2), 48.7 (CH_2), 21.7 (CH_3), 20.7 (CH_3), 20.6 (CH_3), 14.9 (CH_3, d, *J* = 3.3 Hz) ppm; **HRMS (ESI):** Calculated for $C_{33}H_{33}FN_3O_2S$ $[M+H]^+$: 554.2272 m/z; Found: 554.2276 m/z

Compound 3aF:



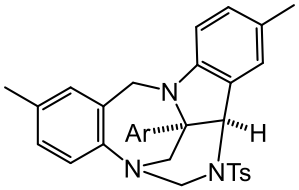
Ar = *p*-$CF_3C_6H_4$

Following general procedure II, compound **3aF** is obtained as a white solid (89 mg, 74% yield) starting from Tröger base **2a** (51 mg, 0.20 mmol) and triazole **1F**.

Purification: column chromatography (silica gel, pentane/EtOAc, 8:2)

R_f = 0.64 (Silica gel, pentane/EtOAc, 8:2); **M.p. =** 195-197 °C; **IR (neat):** ν̃ 1617, 1496, 1355, 1324, 1156, 1112, 1066, 955, 812, 800, 792, 658 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.83 (d, *J* = 8.3 Hz, 2H), 7.56 (d, *J* = 8.2 Hz, 2H), 7.46 (d, *J* = 8.2 Hz, 2H), 7.39 (d, *J* = 8.0 Hz, 2H), 6.90 (d, *J* = 2.0 Hz, 1H), 6.88-6.81 (m, 2H), 6.55 (d, *J* = 8.0 Hz, 1H), 6.39 (d, *J* = 8.1 Hz, 1H), 6.27 (s, 1H), 5.50 (dd, *J* = 9.7, 1.4 Hz, 1H), 5.42 (s, 1H), 4.65 (d, *J* = 17.6 Hz, 1H), 4.60 (d, *J* = 17.6 Hz, 1H), 3.84 (d, *J* = 15.4 Hz, 1H), 3.69 (d, *J* = 9.7 Hz, 1H), 3.61 (d, *J* = 15.4 Hz, 1H), 2.50 (s, 3H), 2.24 (s, 3H), 2.02 (s, 3H) ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 148.8 (C), 147.9 (C), 146.2 (C), 144.1 (C), 138.5 (C), 132.1 (C), 131.0 (CH), 130.9 (CH), 130.2 (2xCH), 129.8 (q, *J* = 32.3 Hz, C), 128.6 (CH), 128.5 (C), 128.2 (C), 127.4 (2xCH), 126.6 (CH), 126.1 (2xCH), 125.9 (q, *J* = 3.7 Hz, 2xCH), 124.2 (q, *J* = 272.0 Hz, CF_3), 123.9 (CH), 122.2 (C), 108.6 (CH), 73.7 (C), 66.4 (CH), 62.0 (CH_2), 50.1 (CH_2), 48.8 (CH_2), 21.7 (CH_3), 20.74 (CH_3), 20.66 (CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{33}H_{31}F_3N_3O_2S$ $[M+H]^+$: 590.2084 m/z; Found: 590.2092 m/z.

Compound 3aG:



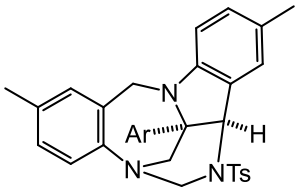
Ar = *p*-BrC_6H_4

Following general procedure II, compound **3aG** is obtained as a yellow solid (99 mg, 83% yield) starting from Tröger Base **2a** (50 mg, 0.2 mmol) and triazole **1G**.

Purification: column chromatography (Silica gel, pentane/EtOAc, 9:1)

R_f = 0.42 (pentane/EtOAc, 8:2); **M.p.** = 208-210 °C; **IR** (neat): ṽ 1618, 1593 1495, 1391, 1321, 1161, 1126, 1110, 1092, 959, 932, 810, 795, 703, 658 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$)**: 7.85 (d, *J* = 8.2 Hz, 2H), 7.44-7.36 (m, 4H), 7.18-7.10 (m, 2H), 6.90 (s, 1H), 6.90-6.83 (m, 2H), 6.61 (d, *J* = 8.0 Hz, 1H), 6.40-6.32 (m, 2H), 5.50 (dd, *J* = 9.8, 1.5 Hz, 1H), 5.36 (s, 1H), 4.69-4.51 (m, 2H), 3.76 (d, *J* = 15.4 Hz, 1H), 3.66 (d, *J* = 9.8 Hz, 1H), 3.57 (d, *J* = 15.4 Hz, 1H), 2.50 (s, 3H), 2.24 (s, 3H), 2.03 (s, 3H); **^{13}C NMR (100 MHz, $CDCl_3$):** δ 148.7 (C), 145.7 (C), 144.1 (C), 142.8 (C), 138.4 (C), 132.4 (C), 132.0 (2XCH), 130.95 (CH), 130.93 (CH), 130.2 (2xCH), 128.71 (C) 128.65 (CH), 128.2 (C), 127.52 (2XCH), 127.46 (2XCH), 126.7 (CH), 124.0 (CH), 122.2 (C), 121.6 (C), 108.4 (CH), 73.1 (C), 66.4 (CH), 62.0 (CH_2), 50.1 (CH_2), 48.6 (CH_2), 21.8 (CH_3), 20.8 (CH_3), 20.7 (CH_3); **HRMS (ESI):** Calculated for $C_{32}H_{31}BrN_3O_2S$ $[M+H]^+$: 600.1315 m/z; Found: 600.1312 m/z.

Compound 3aH:



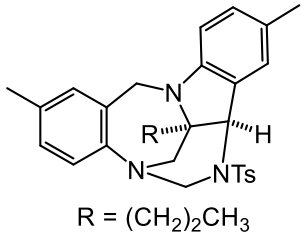
Ar = 3,4-$Cl_2C_6H_3$

Following general procedure II, compound **3aH** is obtained as an orange solid (93 mg, 79% yield) starting from Tröger base **2a** (50 mg, 0.20 mmol) and triazole **1H**.

Purification: column chromatography (silica gel, pentane/EtOAc, 9:1)

R_f = 0.60 (Silica gel, pentane/EtOAc, 8:2); **M.p. =** 196-198 °C; **IR (neat):** ṽ 1615, 1594, 1496, 1468, 1408, 1340, 1290, 1158, 1140, 1093, 964, 809, 662 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.83 (d, *J* = 8.1 Hz, 2H), 7.40 (d, *J* = 8.3 Hz, 2H), 7.38 (d, *J* = 8.6 Hz, 1H), 7.30 (d, *J* = 2.1 Hz, 1H), 7.18 (dd, *J* = 8.4, 2.2 Hz, 1H), 6.89 (s, 1H), 6.85 (d, *J* = 8.3 Hz, 2H), 6.53 (d, *J* = 8.0 Hz, 1H), 6.42-6.34 (m, 2H), 5.49 (d, *J* = 9.7, 1H), 5.37 (s, 1H), 4.66-4.52 (m, 2H), 3.71 (d, *J* = 5.2 Hz, 1H), 3.68 (s, 1H), 3.56 (d, *J* = 15.4 Hz, 1H), 2.50 (s, 3H), 2.23 (s, 3H), 2.04 (s, 3H) ppm; **^{13}C NMR (100 MHz, $CDCl_3$):** δ 148.7 (C), 146.2 (C), 144.3 (C), 144.2 (C), 138.5 (C), 132.7 (C), 132.0 (C), 131.6 (C), 131.01 (CH), 130.98 (CH), 130.9 (CH), 130.3 (2xCH), 128.6 (CH), 128.4 (C), 128.3 (C), 127.6 (CH), 127.3 (2xCH), 126.7 (CH), 125.4 (CH), 123.8 (CH), 122.2 (C), 108.7 (CH), 73.1 (C), 66.4 (CH), 62.0 (CH_2), 49.8 (CH_2), 48.8 (CH_2), 21.8 (CH_3), 20.73 (CH_3), 20.67 (CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{32}H_{30}Cl_2N_3O_2S$ $[M+H]^+$: 590.1430 m/z; Found: 590.1428 m/z.

Compound 3aI:



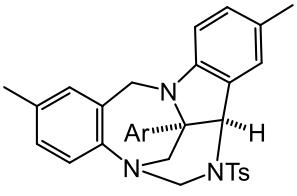
R = $(CH_2)_2CH_3$

Following general procedure II, compound **3aI** is obtained as a white solid (28 mg, 29% yield) starting from Tröger Base **2a** (50 mg, 0.2 mmol) and triazole **1I**.

Purification: column chromatography (Silica gel, pentane/EtOAc, 9:1)

R_f = 0.38 (pentane/EtOAc, 9:1); **M.p.** = 184-186 °C; **IR** (neat): ṽ 1615, 1597 1493, 1397, 1336, 1286, 1162, 1132, 1089, 1062, 963, 809, 718, 657 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$)**: 7.85 (d, *J* = 8.2 Hz, 2H), 7.37 (d, *J* = 7.8 Hz, 2H), 6.83-6.77 (m, 3H), 6.60 (s, 1H), 6.52-6.40 (m, 1H), 6.24 (d, *J* = 8.1 Hz, 1H), 5.33 (dd, *J* = 9.9, 1.4 Hz, 1H), 5.24 (s, 1H), 4.61 (d, *J* = 17.4 Hz, 1H), 4.36 (d, *J* = 17.4 Hz, 1H), 3.63 (d, *J* = 10.0 Hz, 1H), 3.42 (d, *J* = 15.5 Hz, 1H), 2.95 (d, *J* = 15.5 Hz, 1H), 2.47 (s, 3H), 2.20 (s, 3H), 2.07 (s, 3H), 1.45-1.18 (m, 4H), 0.87 (t, *J* = 7.0 Hz, 3H); **^{13}C NMR (100 MHz, $CDCl_3$):** δ 149.6 (C), 146.5 (2xC), 143.8 (C), 138.6 (C), 131.0 (CH), 130.7 (CH), 130.1 (2XCH), 128.7 (C), 128.4 (CH), 127.6 (C) 127.3 (2XCH), 126.5 (CH) , 123.5 (CH), 108.9 (CH), 62.9 (CH), 62.5 (CH_2), 48.94 (CH_2), 48.87 (CH_2), 40.4 (CH_2), 21.7 (CH_3), 20.70 (CH_3), 20.69 (CH_3), 16.1 (CH_2), 14.7 (CH_3); **HRMS (ESI):** Calculated for $C_{29}H_{34}N_3O_2S$ $[M+H]^+$: 488.2366 m/z; Found: 488.2366 m/z.

Compound 3aJ:



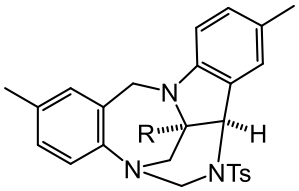
Ar = 6-$OMeC_{10}H_6$

Following general procedure II, compound **3aJ** is obtained as a yellowish solid (50 mg, 41% yield) starting from Tröger base **2a** (51 mg, 0.20 mmol) and triazole **1J**.

Purification: column chromatography (silica gel, pentane/EtOAc, 8:2)

R_f = 0.49 (Silica gel, pentane/EtOAc, 8:2); **M.p. =** 123-125 °C; **IR (neat):** ṽ 1632, 1605, 1497, 1336, 1267, 1208, 1158, 1091, 1031, 954, 907, 852, 808, 727, 663 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.83 (d, *J* = 8.3 Hz, 2H), 7.68 (d, *J* = 8.6 Hz, 1H), 7.64 (d, *J* = 8.9 Hz, 1H), 7.56 (s, 1H), 7.36 (d, *J* = 8.0 Hz, 2H), 7.33 (dd, *J* = 8.6, 2.0 Hz, 1H), 7.17-7.13 (m, 1H), 7.12 (d, *J* = 2.4 Hz, 1H), 6.91 (s, 1H), 6.86 (d, *J* = 8.1 Hz, 2H), 6.56 (d, J = 8.0 Hz, 1H), 6.46 (s, 1H), 6.41 (d, *J* = 8.1 Hz, 1H), 5.57-5.47 (m, 2H), 4.70 (d, *J* = 17.5 Hz, 1H), 4.61 (d, *J* = 17.5 Hz, 1H), 3.93 (s, 3H), 3.82 (d, *J* = 15.5 Hz, 1H), 3.77 (d, *J* = 9.7 Hz, 1H), 3.65 (d, *J* = 15.3 Hz, 1H), 2.51 (s, 3H), 2.24 (s, 3H), 2.06 (d, *J* = 1.7 Hz, 3H) ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 157.9 (C), 149.2 (C), 146.5 (C), 143.8 (C), 138.9 (C), 138.7 (C), 133.9 (C), 131.7 (C), 130.9 (CH), 130.8 (CH), 130.1 (2xCH), 129.7 (CH), 128.8 (C), 128.7 (C), 128.5 (CH), 127.8 (C), 127.8 (CH), 127.4 (2xCH), 126.8 (CH), 124.5 (CH), 123.8 (CH), 123.6 (CH), 122.6 (C), 119.1 (CH), 108.3 (CH), 105.6 (CH), 73.5 (C), 66.6 (CH), 62.1 (CH_2), 55.5 (CH_3), 49.7 (CH_2), 48.7 (CH_2), 21.8 (CH_3), 20.73 (CH_3), 20.67 (CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{37}H_{36}N_3O_3S$ $[M+H]^+$: 602.2472 m/z; Found: 602.2477 m/z.

Compound 3aK:



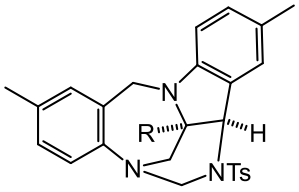
R = Thiophene

Following general procedure II, compound **3aK** is obtained as a white solid (92 mg, 85% yield) starting from Tröger Base **2a** (50 mg, 0.2 mmol) and triazole **1K**.

Purification: column chromatography (Silica gel, pentane/EtOAc, 9:1)

R_f = 0.51 (pentane/EtOAc, 8:2); **M.p.** = 211-213 °C; **IR** (neat): ṽ 1618, 1596 1494, 1396, 1289, 1164, 1157, 1134, 1090, 1058, 980, 957, 809, 776, 705, 661 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$)**: 7.83 (d, *J* = 8.3 Hz, 2H), 7.37 (d, *J* = 8.5 Hz, 2H), 7.29 (dd, *J* = 5.0, 3.0 Hz, 1H), 7.08 (dd, *J* = 3.0, 1.3 Hz, 1H) 6.95 (dd, *J* = 5.0, 1.3 Hz, 1H), 6.89-6.88 (m, 1H), 6.85-6.81 (m, 2H), 6.54 (d, *J* = 8.0 Hz, 1H), 6.41 (s, 1H), 6.34 (d, *J* = 8.1 Hz, 1H), 5.46 (dd, *J* = 9.9, 1.5 Hz, 1H), 5.43 (s, 1H), 4.72 (d, *J* = 17.5 Hz, 1H), 4.52 (d, *J* = 17.5 Hz, 1H), 3.75-3.59 (m, 3H), 2.49 (s, 3H), 2.23 (s, 3H), 2.05 (s, 3H); **^{13}C NMR (100 MHz, $CDCl_3$):** δ 148.9 (C), 146.2 (C), 145.6 (C), 143.9 (C), 138.5 (C), 131.9 (C), 131.0 (CH), 130.8 (CH), 130.1 (2xCH), 128.8 (C) 128.5 (CH), 128.0 (C) , 127.5 (2xCH), 126.9 (CH), 126.7 (CH), 125.8 (CH), 123.8 (CH), 122.6 (C), 120.6 (CH), 108.6 (CH), 71.8 (C), 65.9 (CH), 62.1 (CH_2), 49.7 (CH_2), 48.8 (CH_2), 21.7 (CH_3), 20.7 (CH_3), 20.7 (CH_3); **HRMS (ESI):** Calculated for $C_{30}H_{30}N_3O_2S_2$ $[M+H]^+$: 528.1774 m/z; Found: 528.1774 m/z.

Compound 3aL:



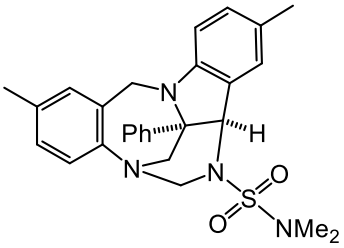
R = COOMe

Following general procedure II, compound **3aL** is obtained as a white solid (82 mg, 81% yield) starting from Tröger base **2a** (51 mg, 0.20 mmol) and triazole **1L**.

Purification: column chromatography (silica gel, pentane/EtOAc, 7:3)

R_f = 0.56 (Silica gel, pentane/EtOAc, 7:3); **M.p. =** 186-188 °C; **IR (neat):** ṽ 1743, 1496, 1346, 1267, 1212, 1163, 1090, 1038, 962, 812, 779, 660, 579 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.88 (d, *J* = 8.4 Hz, 2H), 7.37 (d, *J* = 8.0 Hz, 2H), 6.87-6.77 (m, 4H), 6.43 (d, *J* = 7.9 Hz, 1H), 6.32 (d, *J* = 8.1 Hz, 1H), 6.09 (s, 1H), 5.30 (dd, *J* = 10.4, 1.4 Hz, 1H), 4.86 (d, *J* = 17.6 Hz, 1H), 4.43 (d, *J* = 17.7 Hz, 1H), 3.77-3.69 (m, 5H), 2.88 (d, *J* = 15.7 Hz, 1H), 2.46 (s, 3H), 2.20 (s, 3H), 2.13 (s, 3H) ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 171.8 (C), 148.0 (C), 145.9 (C), 143.9 (C), 137.8 (C), 131.7 (C), 131.1 (CH), 130.9 (CH), 130.0 (2xCH), 129.1 (C), 128.5 (CH), 128.2 (C), 127.4 (2xCH), 126.4 (CH), 123.5 (C), 123.3 (CH), 109.8 (CH), 73.3 (C), 62.4 (CH_2), 60.6 (CH), 52.8 (CH_3), 49.9 (CH_2), 46.6 (CH_2), 21.8 (CH_3), 20.74 (CH_3), 20.66 (CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{28}H_{30}N_3O_4S$ $[M+H]^+$: 504.1952 m/z; Found: 504.1960 m/z.

Compound 3aM:

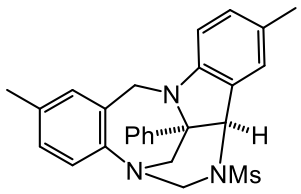


Following general procedure II, compound **3aM** is obtained as an orange solid (53 mg, 56% yield) starting from Tröger base **2a** (50 mg, 0.20 mmol) and triazole **1M** using 100 °C as temperature for the reaction.

Purification: column chromatography (silica gel, pentane/EtOAc, 8:2)

R_f = 0.49 (Silica gel, pentane/EtOAc, 8:2); **M.p. =** 173-175 °C; **IR (neat):** ṽ 1619, 1496, 1338, 1315, 1137, 1096, 953, 925, 793, 721, 703 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.63-7.57 (m, 2H), 7.42-7.34 (m, 2H), 7.29-7.25 (m, 1H), 6.96-6.88 (m, 3H), 6.85 (dd, *J* = 8.0, 2.0 Hz, 1H), 6.57 (d, *J* = 7.9 Hz, 1H), 6.44 (d, *J* = 8.0 Hz, 1H), 5.42 (s, 1H), 5.22 (dd, *J* = 10.2, 1.6 Hz, 1H), 4.73 (d, *J* = 17.5 Hz, 1H), 4.64 (d, *J* = 17.5 Hz, 1H), 4.16 (d, *J* = 15.7 Hz, 1H), 3.71-3.62 (m, 2H), 2.91 (s, 6H), 2.25 (s, 3H), 2.17 (s, 3H) ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** 149.2 (C), 146.8 (C), 143.8 (C), 132.0 (C), 131.0 (CH), 130.8 (CH), 129.3 (C), 129.0 (2xCH), 128.4 (CH), 127.6 (C), 127.5 (CH), 126.6 (CH), 125.8 (2xCH), 124.3 (CH), 122.8 (C), 108.2 (CH), 74.0 (C), 67.4 (CH), 62.6 (CH_2), 50.3 (CH_2), 48.6 (CH_2), 38.4 (2xCH_3), 20.9 (CH_3), 20.8 (CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{27}H_{31}N_4O_2S$ $[M+H]^+$: 475.2162 m/z; Found: 475.2167 m/z.

Compound 3aN:

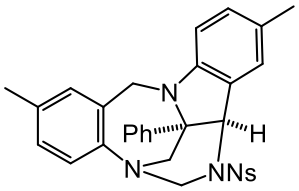


Following general procedure II, compound **3aN** is obtained as a yellow solid (54 mg, 61% yield) starting from Tröger base **2a** (50 mg, 0.20 mmol) and triazole **1N**.

Purification: column chromatography (silica gel, pentane/EtOAc, 8:2)

R_f = 0.29 (Silica gel, pentane/EtOAc, 8:2); **M.p. =** 204-206 °C; **IR (neat):** ṽ 1619, 1497, 1319, 1143, 1099, 949, 928, 910, 801, 702 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.56-7.51 (m, 2H), 7.42-7.34 (m, 2H), 7.31-7.27 (m, 1H), 6.94 (s, 1H), 6.93-6.84 (m, 3H), 6.59 (s, 1H), 6.44 (d, *J* = 8.0 Hz, 1H), 5.53 (s, 1H), 5.31 (dd, *J* = 9.9, 1.5 Hz, 1H), 4.73 (d, *J* = 17.5 Hz, 1H), 4.65 (d, *J* = 17.6 Hz, 1H), 4.03 (d, *J* = 15.6 Hz, 1H), 3.70 (d, *J* = 8.4 Hz, 1H), 3.68 (d, *J* = 2.6 Hz, 1H), 3.16 (s, 3H), 2.25 (s, 3H), 2.17 (s, 3H) ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** 149.1 (C), 146.4 (C), 143.6 (C), 132.2 (C), 131.1 (CH), 130.8 (CH), 129.2 (C), 129.1 (2xCH), 128.5 (CH), 127.9 (C), 127.7 (CH), 126.4 (CH), 125.6 (2xCH), 124.3 (CH), 122.6 (C), 108.3 (CH), 73.7 (C), 66.9 (CH), 61.7 (CH_2), 50.4 (CH_2), 48.6 (CH_2), 42.5 (CH_3), 20.82 (CH_3), 20.78 (CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{26}H_{28}N_3O_2S$ $[M+H]^+$: 446.1897 m/z; Found: 446.1891 m/z.

Compound 3aO:

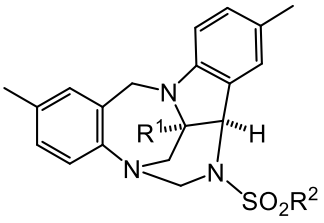


Following general procedure II, compound **3aO** is obtained as a yellow solid (52 mg, 47% yield) starting from Tröger base **2a** (50 mg, 0.2 mmol) and triazole **1O**.

Purification: column chromatography (silica gel, pentane/EtOAc, 9:1)

R_f = 0.60 (Silica gel, pentane/EtOAc, 8:2); **M.p. =** 179-181 °C; **IR** (neat)**:** ν̃ 1621, 1604, 1529, 1496, 1343, 1311, 1166, 1127, 1086, 974, 942, 804, 736, 699 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 8.43-8.38 (m, 2H), 8.12-8.07 (m, 2H), 7.35-7.25 (m, 5H), 6.93-6.89 (m, 1H), 6.89-6.83 (m, 2H), 6.56 (d, *J* = 8.0 Hz, 1H), 6.42 (s, 1H), 6.39 (d, *J* = 8.1 Hz, 1H), 5.49 (s, 1H), 5.43 (dd, *J* = 9.8, 1.5 Hz, 1H), 4.66 (d, *J* = 17.6 Hz, 1H), 4.58 (d, *J* = 17.6 Hz, 1H), 3.79 (d, *J* = 9.9 Hz, 1H), 3.71 (d, *J* = 15.5 Hz, 1H), 3.65 (d, *J* = 15.5 Hz, 1H), 2.24 (s, 3H), 2.03 (s, 3H) ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 150.3 (C), 149.1 (C), 147.2 (C), 145.9 (C), 143.5 (C), 132.3 (C), 131.2 (CH), 131.0 (CH), 129.1 (2xCH), 128.9 (C), 128.60 (CH), 128.56 (2xCH), 128.0 (C), 127.9 (CH), 126.4 (CH), 125.4 (2xCH), 124.7 (2xCH), 124.0 (CH), 121.8 (C), 108.5 (CH), 73.4 (C), 67.3 (CH), 62.3 (CH_2), 50.0 (CH_2), 48.5 (CH_2), 20.75 (CH_3), 20.74 (CH_3) ppm; **HRMS (ESI):** Calculated for $C_{31}H_{29}N_4O_4S$ $[M+H]^+$: 553.1904 m/z; Found: 553.1909 m/z.

Compound 3aP:



R^1 = Phthalimido

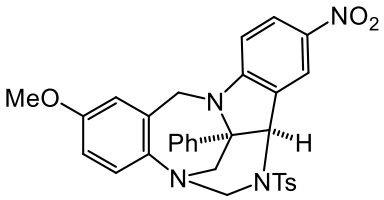
R^2 = *p*-$OMeC_6H_4$

Following general procedure II, compound **3aP** is obtained as a yellow solid (38 mg, 31% yield) starting from Tröger base **2a** (50 mg, 0.20 mmol) and triazole **1P**.

Purification: column chromatography (silica gel, pentane/EtOAc, 8:2)

R_f = 0.44 (Silica gel, pentane/EtOAc, 6:4); **M.p. =** 189-191 °C; **IR (neat):** ν̃ 1776, 1711, 1595, 1497, 1311, 1260, 1148, 1089, 1057, 967, 799, 724 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.85-7.80 (m, 2H), 7.80-7.71 (m, 4H), 6.87-6.83 (m, 2H), 6.83-6.76 (m, 4H), 6.33 (d, *J* = 8.0 Hz, 1H), 6.26 (d, *J* = 8.0 Hz, 1H), 6.13 (s, 1H), 5.44 (d, *J* = 9.7 Hz, 1H), 4.88 (d, *J* = 17.5 Hz, 1H), 4.83 (d, *J* = 16.2 Hz, 1H), 4.34 (d, *J* = 17.5 Hz, 1H), 3.84 (d, *J* = 9.6 Hz, 1H), 3.81 (s, 3H), 3.59 (d, *J* = 15.8 Hz, 1H), 2.19 (s, 3H), 2.15 (s, 3H) ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 168.3 (2xC), 163.2 (C), 148.2 (C), 145.5 (C), 134.5 (2xCH), 132.7 (C), 131.9 (2xC), 131.2 (CH), 130.6 (C), 130.3 (CH), 129.4 (C), 129.3 (2xCH), 128.5 (CH), 126.1 (C), 125.1 (CH), 124.5 (C), 123.4 (2xCH), 121.3 (CH), 114.6 (2xCH), 109.7 (CH), 85.1 (C), 64.0 (CH), 62.5 (CH_2), 55.8 (CH_3), 49.9 (CH_2), 46.1 (CH_2), 20.9 (CH_3), 20.7 (CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{34}H_{31}N_4O_5S$ $[M+H]^+$: 607.2014 m/z; Found: 607.2010 m/z.

Compound 3lA:

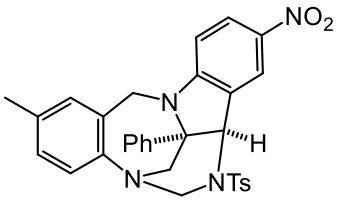


Following general procedure II, compound **3lA** is obtained as an orange-yellow solid (63 mg, 55% yield) starting from Tröger Base **2l** (59 mg, 0.2 mmol) and triazole **1A**.

Purification: column chromatography (Silica gel, pentane/EtOAc, 7:3)

R_f = 0.52 (pentane/EtOAc, 6:4); **M.p.** = 158-160 °C; **IR** (neat): ṽ 1605, 1494, 1448, 1311, 1275, 1156, 1088, 1031, 811, 764, 699, 659 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$)**: 8.00 (dd, *J* = 8.9, 2.3 Hz, 1H), 7.80 (d, *J* = 8.3 Hz, 2H), 7.43-7.36 (m, 4H), 7.34-7.28 (m, 3H), 7.15-7.14 (m, 1H), 6.73 (d, *J* = 8.6 Hz, 1H), 6.70 (d, *J* = 2.8 Hz, 1H), 6.66 (dd, *J* = 8.6, 2.9 Hz, 1H), 6.47 (d, *J* = 8.9, 1H), 5.52 (dd, *J* = 10.1, 1.6 Hz, 1H), 5.45 (s, 1H), 4.78 (d, *J* = 17.4 Hz, 1H), 4.69 (d, *J* = 17.4 Hz, 1H), 4.00 (d, *J* = 15.6 Hz, 1H), 3.76 (s, 3H), 3.61-3.53 (m, 2H), 2.52 (s, 3H); **^{13}C NMR (126 MHz, $CDCl_3$):** δ 156.0 (C), 155.6 (C), 145.0 (C), 141.7 (C), 141.5 (C), 139.8 (C), 137.8 (C), 130.4 (2xCH), 129.5 (C) 129.4 (2xCH), 128.3 (CH) , 128.0 (CH), 127.2 (2XCH), 126.5 (CH), 125.1 (2XCH), 123.4 (C), 123.3 (CH), 115.5 (CH), 113.1 (CH), 106.3 (CH), 75.6 (C), 64.6 (CH), 61.6 (CH_2), 55.7 (CH), 50.2 (CH_2), 48.1 (CH_2), 21.8 (CH_3); **HRMS (ESI):** Calculated for $C_{31}H_{29}N_4O_5S$ $[M+H]^+$: 569.1853 m/z; Found: 569.1860 m/z.

Compound 3mA:



Following general procedure II, compound **3mA** is obtained as an orange-yellow solid (38 mg, 34% yield) starting from Tröger Base **2m** (56 mg, 0.2 mmol) and triazole **1A**.

Purification: column chromatography (Silica gel, pentane/EtOAc, 9:1)

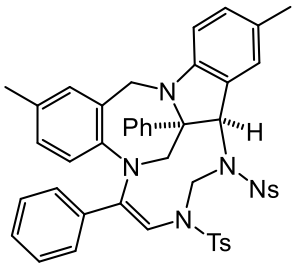
R_f = 0.36 (pentane/EtOAc, 8:2); **M.p.** = 198-200 °C; **IR** (neat): ṽ 1598, 1494, 1445, 1348, 1315, 1271, 1229, 1157, 1100, 1075, 1054, 951, 938, 831, 813, 765, 723, 703, 661 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$)**: 7.99 (dd, *J* = 8.9, 2.3 Hz, 1H), 7.81 (d, *J* = 8.3 Hz, 2H), 7.49-7.34 (m, 4H), 7.35-7.29 (m, 3H), 7.15-7.14 (m, 1H), 6.96-6.87 (m, 2H), 6.65 (dd, *J* = 8.0, 1H), 6.44 (d, *J* = 8.9, 1H), 5.57 (dd, *J* = 10.0, 1.5 Hz, 1H), 5.48 (s, 1H), 4.78 (d, *J* = 17.4 Hz, 1H), 4.67 (d, *J* = 17.3 Hz, 1H), 4.00 (d, *J* = 15.6 Hz, 1H), 3.67-3.56 (m, 2H), 2.52 (s, 3H), 2.26 (s, 3H); **^{13}C NMR (100 MHz, $CDCl_3$):** δ 156.2 (C), 145.9 (C), 145.0 (C), 141.6 (C), 139.8 (C), 137.9 (C), 132.8 (C), 130.6 (CH) 130.5 (2xCH), 129.4 (2XCH), 129.2 (CH), 128.3 (CH), 128.0 (CH), 127.5 (C), 127.2 (2XCH), 125.1 (2XCH), 124.8 (CH), 123.5 (CH), 123.2 (C), 106.6 (CH), 75.7 (C), 64.7 (CH), 61.7 (CH_2), 49.9 (CH_2), 48.2 (CH_2), 21.8 (CH_3), 20.8 (CH_3); **HRMS (ESI):** Calculated for $C_{31}H_{29}N_4O_4S$ $[M+H]^+$: 553.1904 m/z; Found: 553.1907 m/z.

5. General procedure III: synthesis of compounds 4

In a 2 mL screw-cap vial equipped with a magnetic stirring bar, $Rh_2(Piv)_4$ (1.22 mg, 0.002 mmol, 2 mol%), compound **3aO** (0.1 mmol, 1 equiv) and *N*-sulfonyltriazole **1** (0.3 mmol, 3 equiv) were dissolved in 0.4 mL of anhydrous $CHCl_3$ (0.25 M). The vial was capped and stirred at 80 °C for 48 h. The solution was concentrated under reduced pressure and the residue was purified by column chromatography.

Analysis data for compounds 4

Compound 4A:

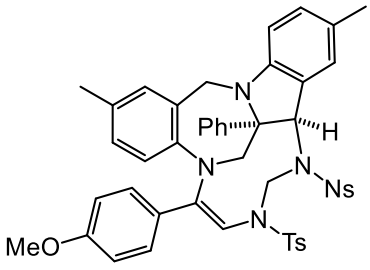


Following general procedure III, compound **4A** is obtained as an orange solid (24 mg, 29% yield) starting from compound **3aO** (55 mg, 0.10 mmol) and triazole **1A**.

Purification: column chromatography (silica gel, pentane/EtOAc, 9:1)

R_f = 0.40 (Silica gel, pentane/EtOAc, 8:2); **M.p. =** 178-180 °C; **IR (neat):** ṽ 1618, 1531, 1499, 1347, 1314, 1240, 1164, 1090, 1009, 939, 809, 764, 665 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.50-8.43 (m, 2H), 8.35-8.27 (m, 2H), 7.36 (d, *J* = 8.4 Hz, 2H), 7.33-7.26 (m, 7H), 7.25-7.16 (m, 3H), 7.08 (d, *J* = 8.0 Hz, 2H), 6.93 (d, *J* = 8.0 Hz, 1H), 6.83 (s, 1H), 6.80 (d, *J* = 2.1 Hz, 1H), 6.50 (d, *J* = 8.1 Hz, 1H), 6.18 (dd, *J* = 8.4, 2.1 Hz, 1H), 6.11 (d, *J* = 8.4 Hz, 1H), 5.33 (s, 1H), 5.28 (s, 1H), 5.00 (d, *J* = 4.0 Hz, 1H), 4.96 (s, 1H), 4.58-4.54 (m, 1H), 4.51 (d, *J* = 2.8 Hz, 1H), 4.12 (d, *J* = 15.5 Hz, 1H), 3.96 (d, *J* = 15.5 Hz, 1H), 2.37 (s, 3H), 2.15 (s, 3H), 1.91 (s, 3H) ppm; **^{13}C NMR (100 MHz, $CDCl_3$):** δ 150.6 (C), 147.7 (C), 144.9 (C), 144.0 (C), 143.9 (C), 143.8 (C), 137.9 (C), 135.6 (C), 131.6 (C), 131.4 (CH), 130.5 (CH), 129.8 (2xCH), 129.8 (2xCH), 129.3 (2xCH), 129.1 (CH), 129.0 (2xCH), 128.2 (CH), 128.0 (CH), 127.7 (C), 126.9 (2xCH), 126.6 (2xCH), 126.6 (C), 125.7 (CH), 125.4 (2xCH), 124.8 (2xCH), 122.5 (C), 120.4 (C), 119.1 (CH), 115.8 (CH), 105.7 (CH), 77.3 (C), 68.6 (CH), 59.6 (CH_2), 56.9 (CH_2), 46.7 (CH_2), 21.7 (CH_3), 20.8 (CH_3), 20.2 (CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{46}H_{42}N_5O_6S_2$ $[M+H]^+$: 824.2556 m/z; Found: 824.2571 m/z.

Compound 4B:

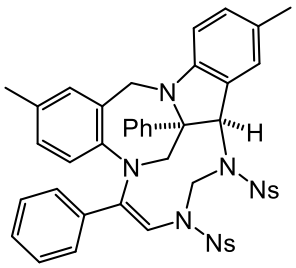


Following general procedure III, compound **4B** is obtained as an orange solid (29 mg, 34% yield) starting from compound **3aO** (55 mg, 0.10 mmol) and triazole **1B**.

Purification: column chromatography (silica gel, pentane/EtOAc, 8:2)

R_f = 0.39 (Silica gel, pentane/EtOAc, 8:2); **M.p. =** 181-183 °C; **IR (neat):** ṽ 1607, 1531, 1500, 1347, 1314, 1291, 1249, 1165, 1090, 1014, 940, 809, 756, 662 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.47 (d, *J* = 8.8 Hz, 2H), 8.30 (d, *J* = 8.8 Hz, 2H), 7.39-7.26 (m, 6H), 7.26-7.20 (m, 1H), 7.11 (d, *J* = 8.7 Hz, 2H), 7.07 (d, *J* = 8.1 Hz, 2H), 6.93 (d, *J* = 8.1 Hz, 1H), 6.84-6.76 (m, 3H), 6.68 (s, 1H), 6.49 (d, *J* = 8.1 Hz, 1H), 6.19 (d, *J* = 8.5 Hz, 1H), 6.13 (d, *J* = 8.4 Hz, 1H), 5.33 (s, 2H), 4.99 (s, 1H), 4.95 (d, *J* = 4.1 Hz, 1H), 4.55 (d, *J* = 3.9 Hz, 1H), 4.51 (s, 1H), 4.08 (d, *J* = 15.5 Hz, 1H), 3.96 (d, *J* = 15.5 Hz, 1H), 3.79 (s, 3H), 2.37 (s, 3H), 2.15 (s, 3H), 1.92 (s, 3H) ppm; **^{13}C NMR (100 MHz, $CDCl_3$):** δ 159.8 (C), 150.6 (C), 147.7 (C), 145.0 (C), 144.1 (C), 143.8 (C), 143.8 (C), 137.9 (C), 131.7 (C), 131.4 (CH), 130.4 (CH), 129.8 (2xCH), 129.7 (2xCH), 129.3 (2xCH), 128.9 (CH), 128.2 (2xCH), 128.00 (C), 127.95 (CH), 127.6 (C), 126.6 (2xCH), 126.5 (C), 125.8 (CH), 125.4 (2xCH), 124.8 (2xCH), 122.5 (C), 120.4 (C), 117.3 (CH), 115.9 (CH), 114.4 (2xCH), 105.6 (CH), 77.3 (C), 68.6 (CH), 59.6 (CH_2), 56.9 (CH_2), 55.5 (CH_3), 46.6 (CH_2), 21.7 (CH_3), 20.8 (CH_3), 20.2 (CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{47}H_{44}N_5O_7S_2$ $[M+H]^+$: 854.2689 m/z; Found: 854.2677 m/z.

Compound 4O:

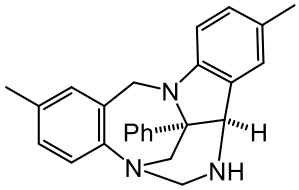


Following general procedure III, compound **4O** is obtained as an orange solid (27 mg, 32% yield) starting from compound **3aO** (55 mg, 0.10 mmol) and triazole **1O**.

Purification: column chromatography (silica gel, pentane/EtOAc, 9:1)

R_f = 0.40 (Silica gel, pentane/EtOAc, 8:2); **M.p. =** 208-210 °C; **IR (neat):** ṽ 1614, 1530, 1500, 1346, 1313, 1167, 1127, 1102, 1015, 942, 912, 853 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 8.53-8.46 (m, 2H), 8.32-8.25 (m, 2H), 8.10-8.03 (m, 2H), 7.61-7.55 (m, 2H), 7.36-7.27 (m, 5H), 7.25-7.19 (m, 5H), 6.96 (d, *J* = 8.0 Hz, 1H), 6.84 (s, 1H), 6.79 (s, 1H), 6.50 (d, *J* = 8.1 Hz, 1H), 6.19-6.12 (m, 2H), 5.22 (s, 1H), 5.20 (s, 1H), 4.99-4.88 (m, 2H), 4.59-4.55 (m, 1H), 4.53 (d, *J* = 6.0 Hz, 1H), 4.04 (d, *J* = 15.6 Hz, 1H), 3.99 (d, *J* = 15.6 Hz, 1H), 2.10 (s, 3H), 1.90 (s, 3H) ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 150.8 (C), 150.0 (C), 147.7 (C), 146.1 (C), 144.5 (C), 144.4 (C), 143.1 (C), 135.2 (C), 134.4 (C), 131.7 (CH), 130.4 (CH), 129.7 (2xCH), 129.4 (2xCH), 129.1 (2xCH), 128.8 (CH), 128.6 (CH), 128.6 (C), 128.1 (CH), 127.7 (2xCH), 127.2 (2xCH), 126.6 (C), 125.8 (CH), 125.4 (2xCH), 125.0 (2xCH), 124.6 (2xCH), 122.9 (C), 120.0 (C), 118.2 (CH), 115.8 (CH), 105.4 (CH), 77.1 (C), 68.7 (CH), 59.8 (CH_2), 56.9 (CH_2), 46.3 (CH_2), 20.8 (CH_3), 19.9 (CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{45}H_{39}N_6O_8S_2$ $[M+H]^+$: 855.2265 m/z; Found: 855.2290 m/z.

6. Synthesis of compound 5

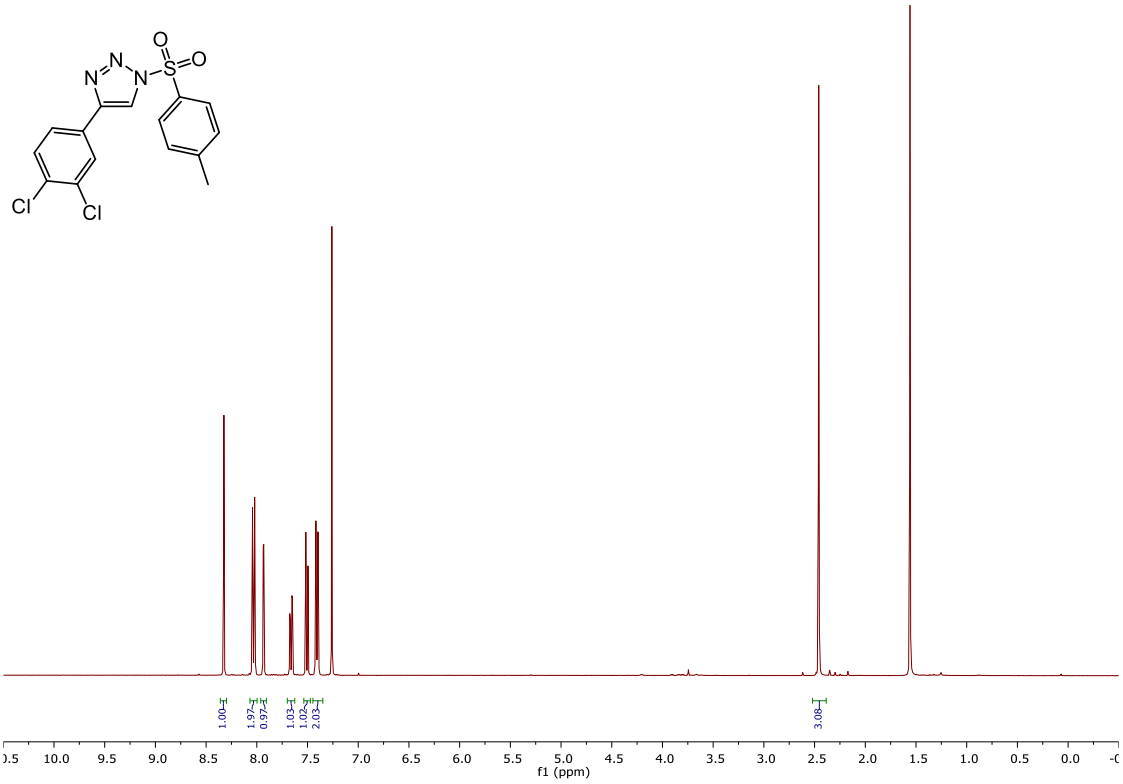


To a stirred solution of compound **3aO** (110 mg, 0.2 mmol, 1 equiv) in a mixture of CH_3CN/DMSO (49:1, 10 mL) were added K_2CO_3 (111 mg, 0.8 mmol, 4 equiv) and PhSH (0.1 mL, 1.0 mmol, 5 equiv). The reaction mixture was stirred at 50 °C for 2 h. After being cooled to 20 °C, solvent was evaporated and the residue was directly purified by column chromatography (silica gel, pentane/EtOAc 7:3) to afford compound **5** as a yellowish solid (54 mg, 74% yield).

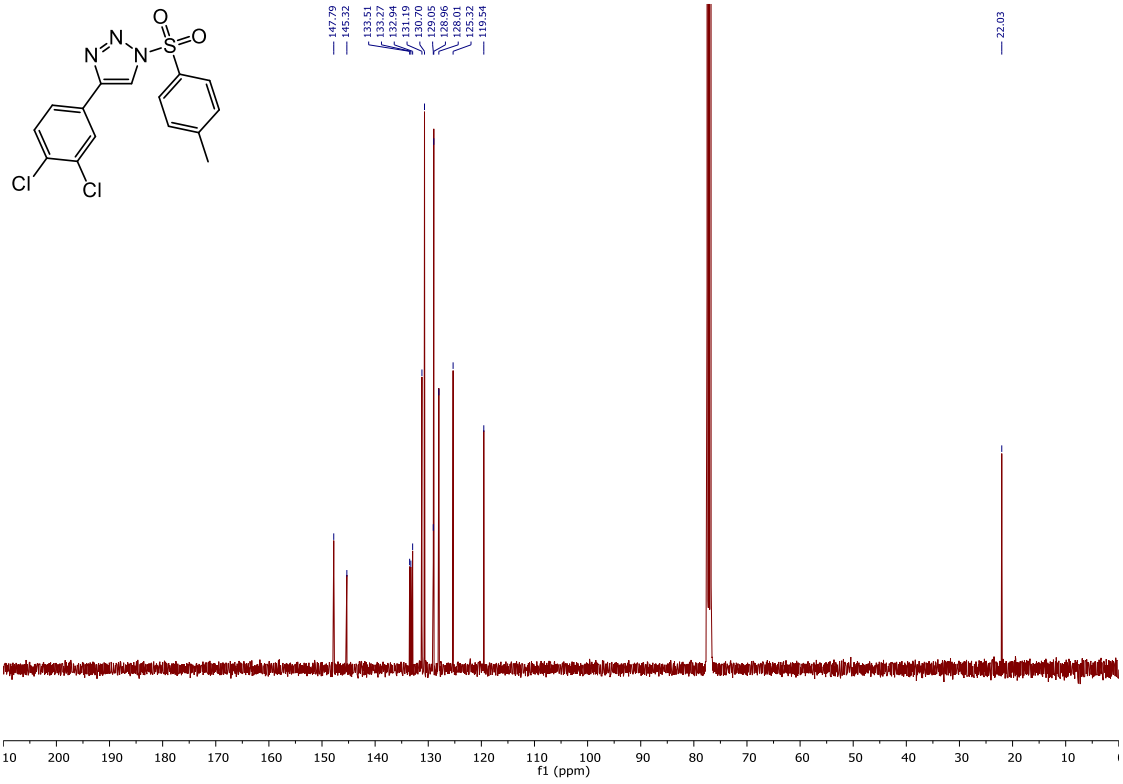
R_f = 0.28 (Silica gel, pentane/EtOAc, 1:1); **M.p. =** 158-160 °C; **IR (neat):** ṽ 2919, 1616, 1494, 1357, 1292, 1244, 1152, 1129, 904, 873, 804, 751, 728, 698 cm^{-1}; **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.53-7.41 (m, 2H), 7.38-7.29 (m, 2H), 7.25-7.20 (m, 1H), 6.98-6.79 (m, 4H), 6.65 (d, *J* = 8.0 Hz, 1H), 6.54 (d, *J* = 8.0 Hz, 1H), 4.91 (d, *J* = 17.3 Hz, 1H), 4.63 (d, *J* = 17.3 Hz, 1H), 4.51 (d, *J* = 11.9 Hz, 1H), 4.40 (s, 1H), 4.02-3.86 (m, 3H), 2.23 (s, 3H), 2.15 (s, 3H) ppm; **^{13}C NMR (100 MHz, $CDCl_3$):** δ 148.9 (C), 146.6 (C), 144.9 (C), 131.1 (C), 131.1 (C), 130.8 (CH), 129.9 (CH), 128.7 (2xCH), 128.7 (CH), 128.6 (C), 127.5 (C), 127.2 (CH), 126.6 (CH), 125.7 (2xCH), 124.4 (CH), 108.6 (CH), 70.4 (C), 65.7 (CH), 65.5 (CH_2), 51.5 (CH_2), 49.2 (CH_2), 20.8 (CH_3), 20.7 (CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{25}H_{26}N_3$ $[M+H]^+$: 368.2123 m/z; Found: 368.2121 m/z.

7. NMR spectra of new compounds

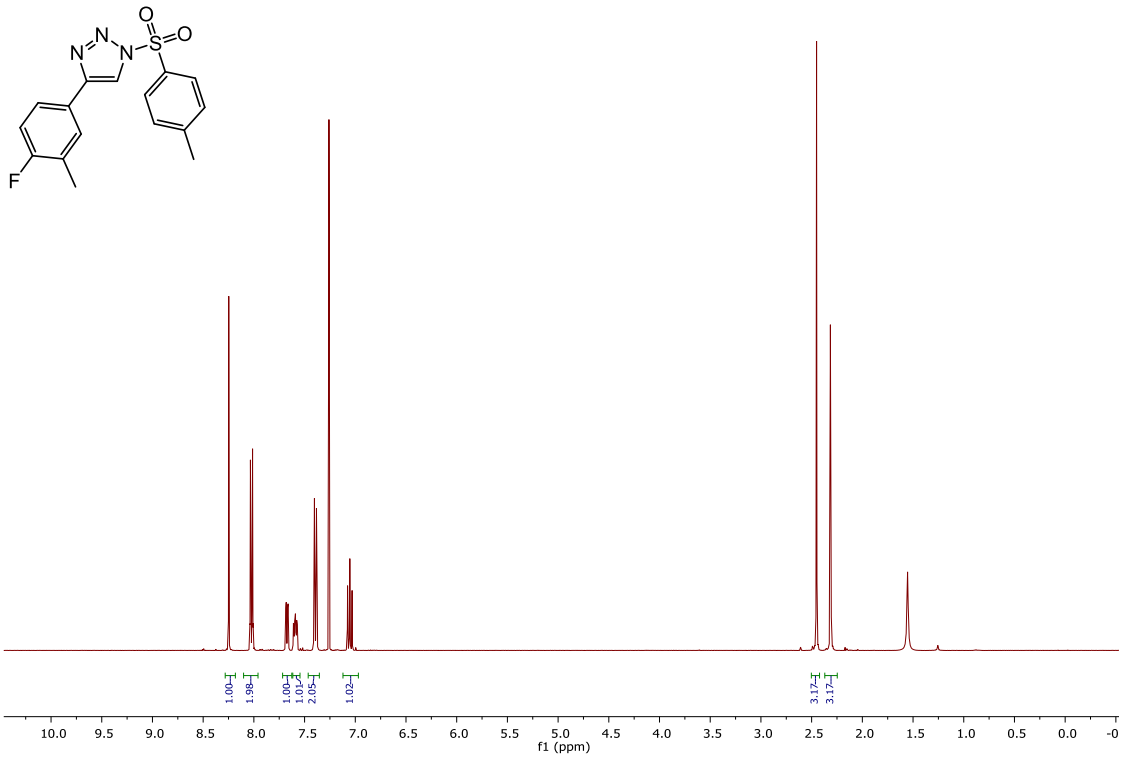
Compound 1E. ^{1}H NMR ($CDCl_3$, 400 MHz)



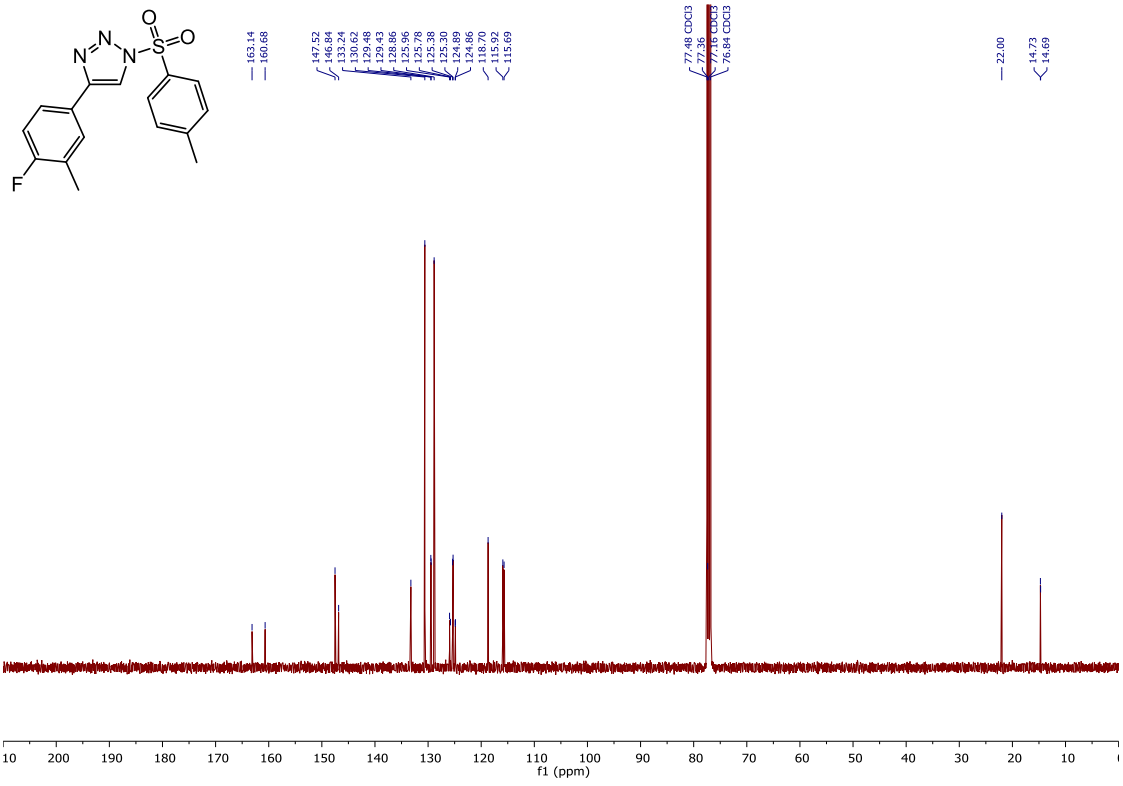
Compound 1E. ^{13}C NMR ($CDCl_3$, 100 MHz)



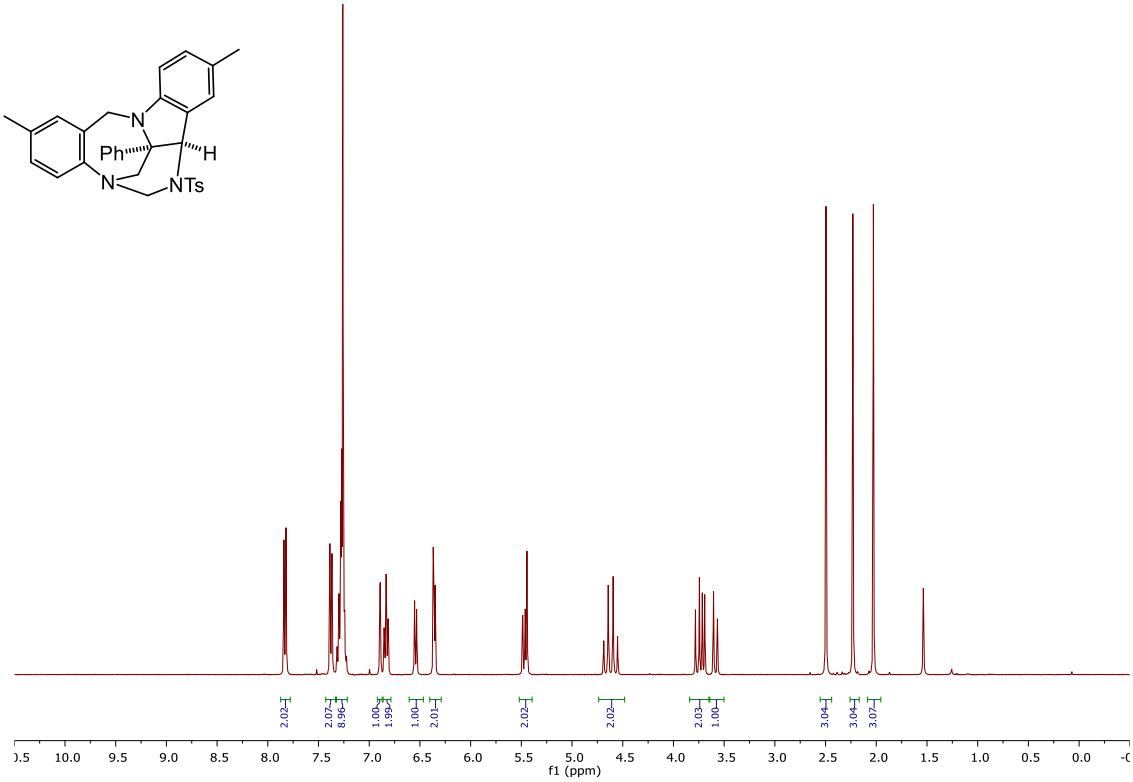
Compound 1H. ^{1}H NMR ($CDCl_3$, 400 MHz)



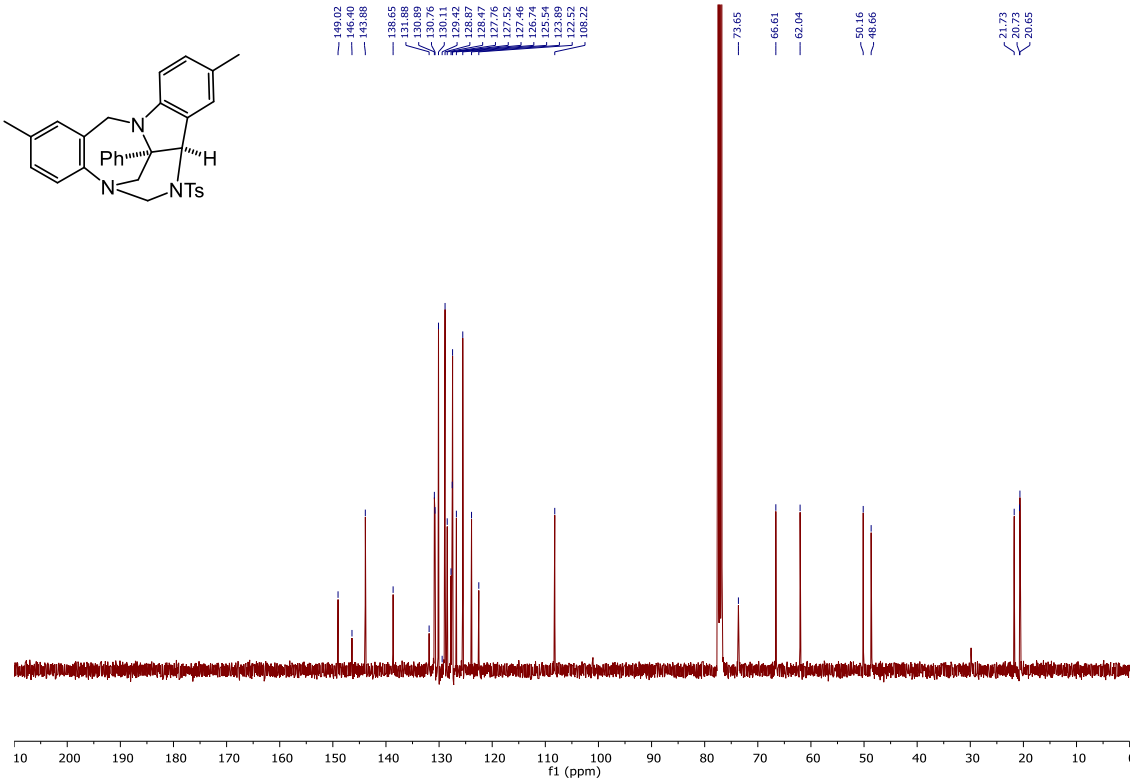
Compound 1H. ^{13}C NMR ($CDCl_3$, 100 MHz)



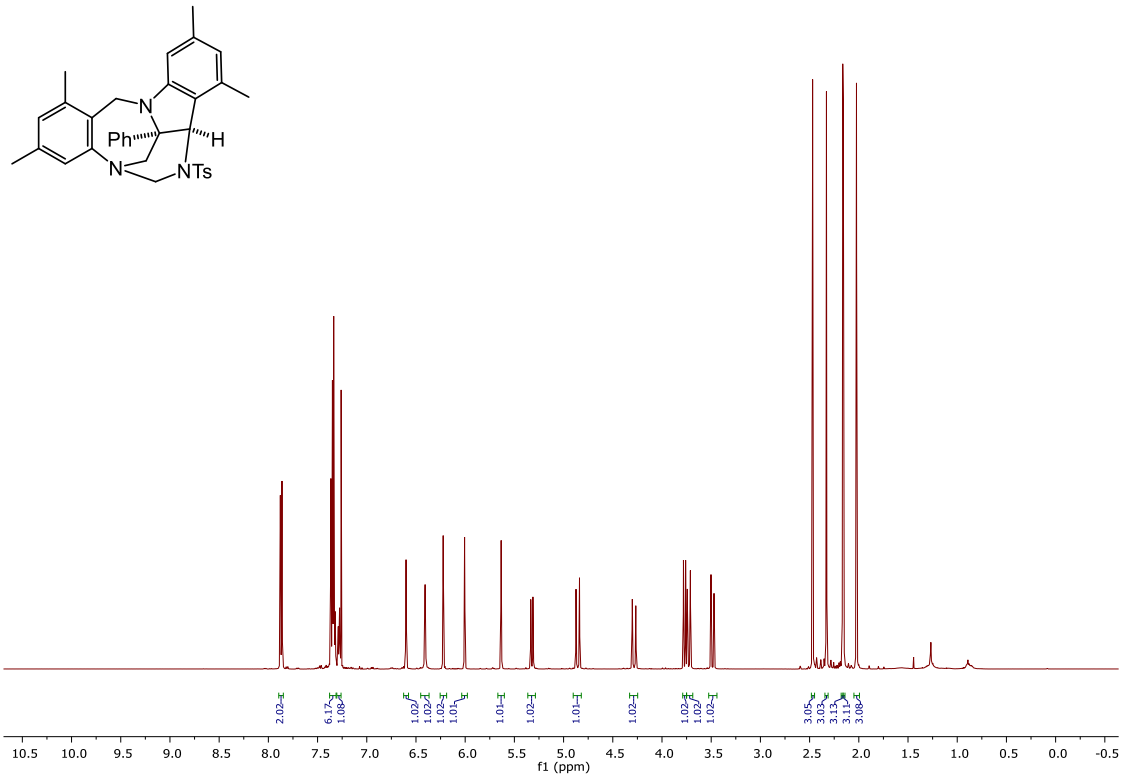
Compound 3aA. ^{1}H NMR ($CDCl_3$, 400 MHz)



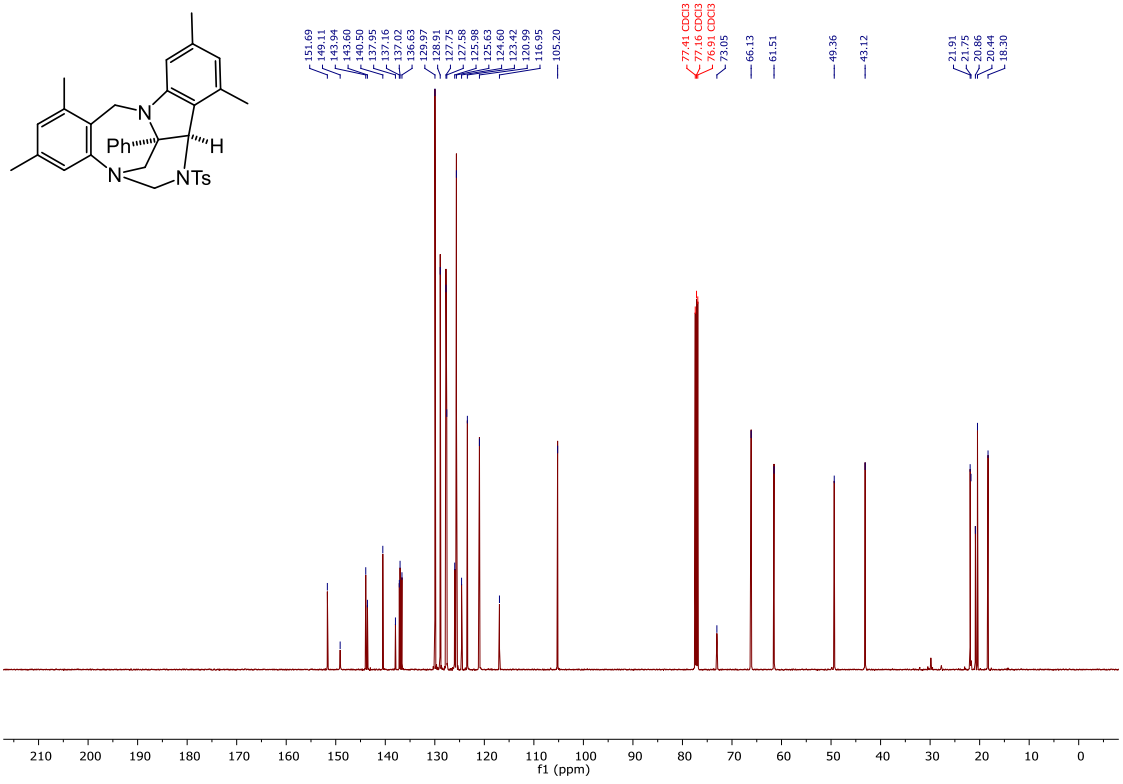
Compound 3aA. ^{13}C NMR ($CDCl_3$, 100 MHz)



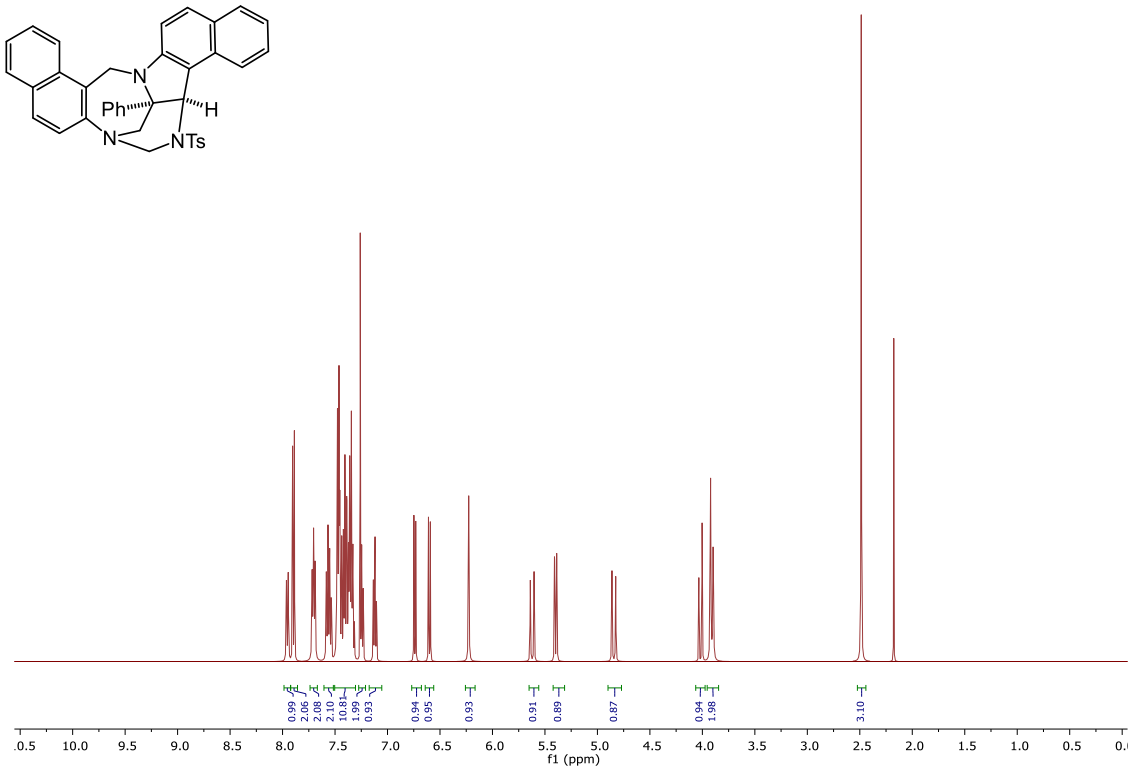
Compound 3bA. ^{1}H NMR ($CDCl_3$, 500 MHz)



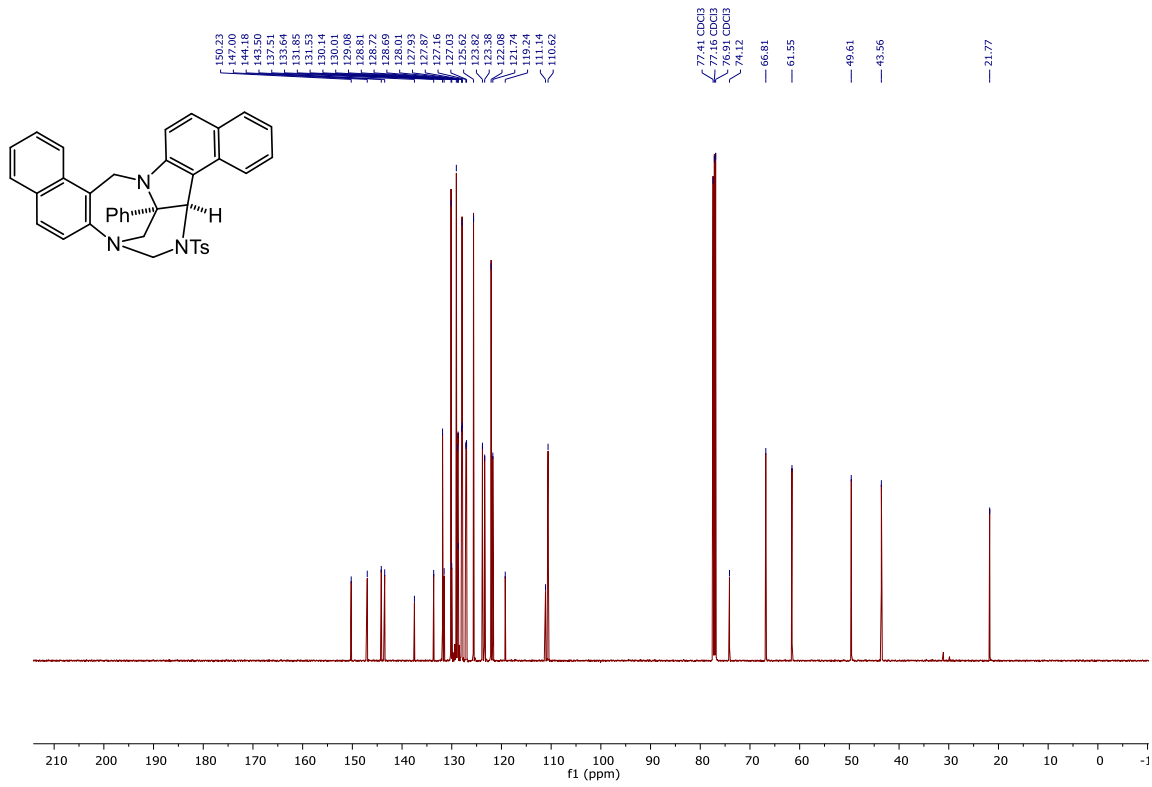
Compound 3bA. ^{13}C NMR ($CDCl_3$, 126 MHz)



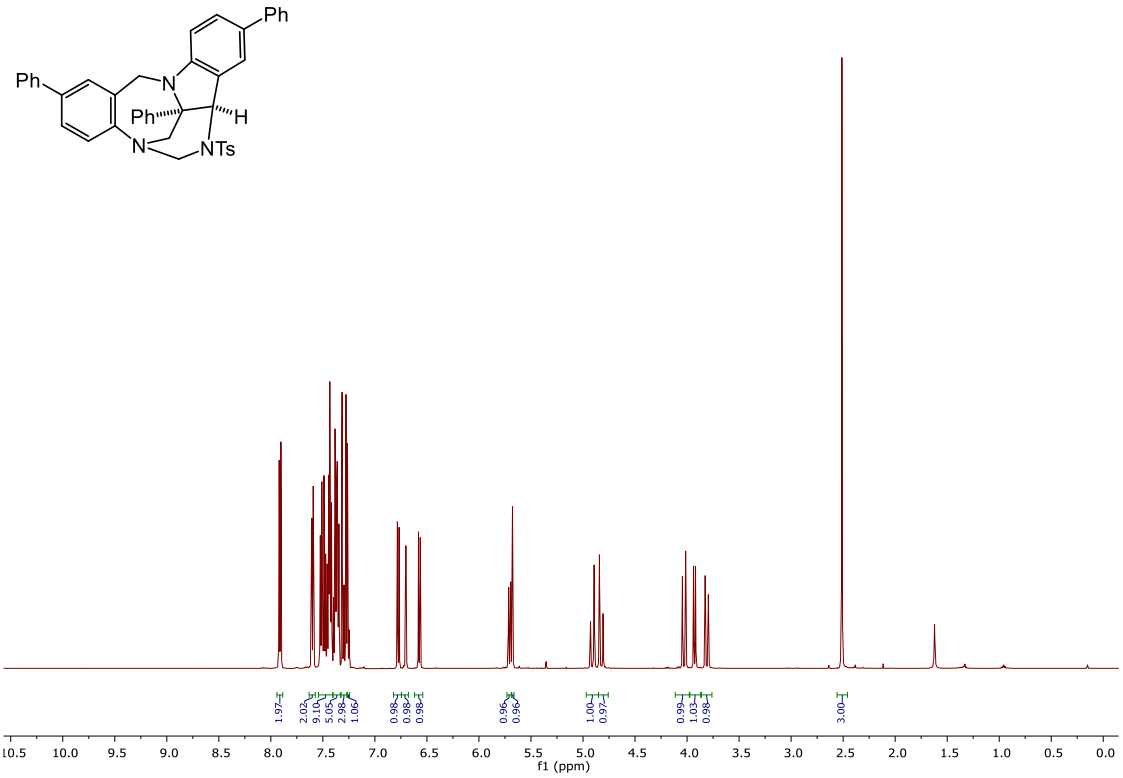
Compound 3cA. ^{1}H NMR ($CDCl_3$, 500 MHz)



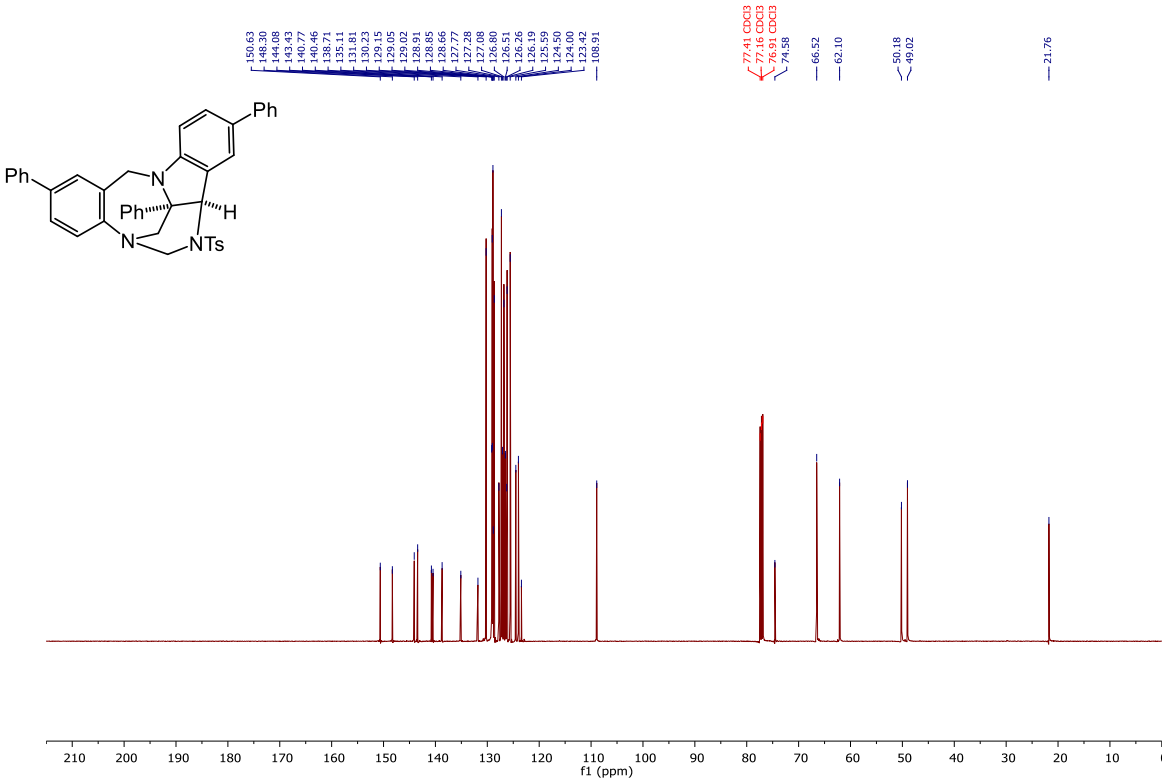
Compound 3cA. ^{13}C NMR ($CDCl_3$, 126 MHz)



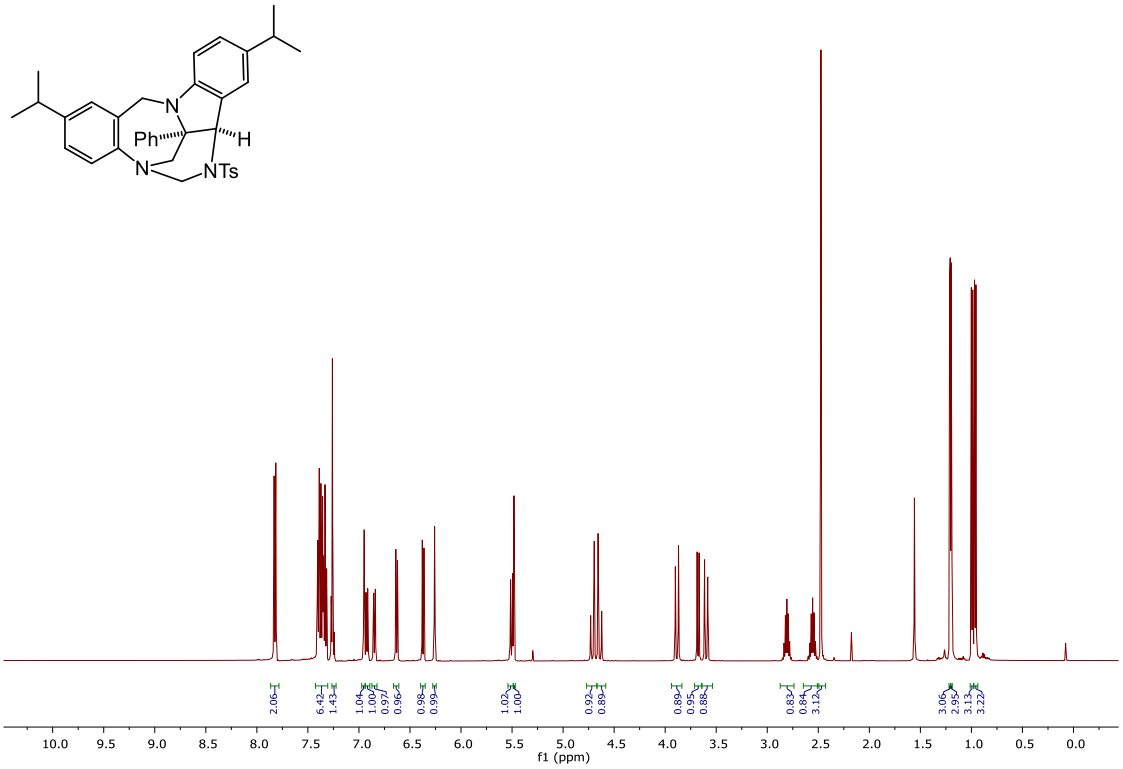
Compound 3dA. ^{1}H NMR ($CDCl_3$, 500 MHz)



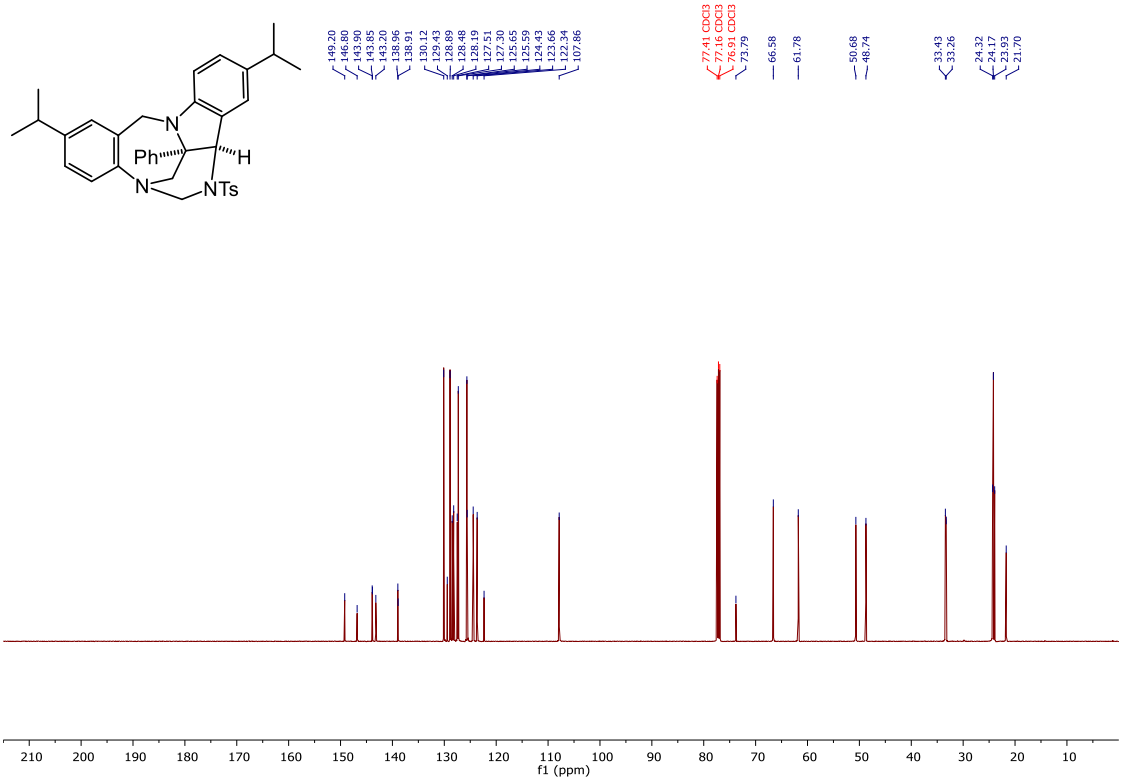
Compound 3dA. ^{13}C NMR ($CDCl_3$, 126 MHz)



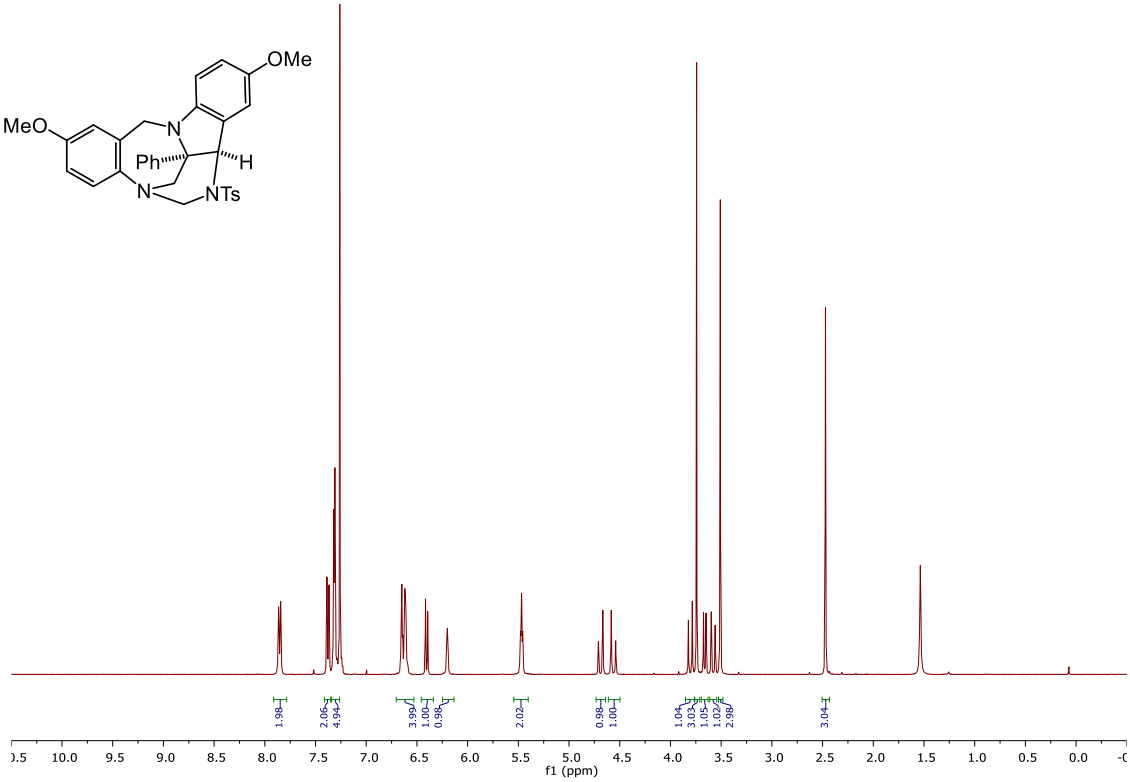
Compound 3eA. ^{1}H NMR ($CDCl_3$, 500 MHz)



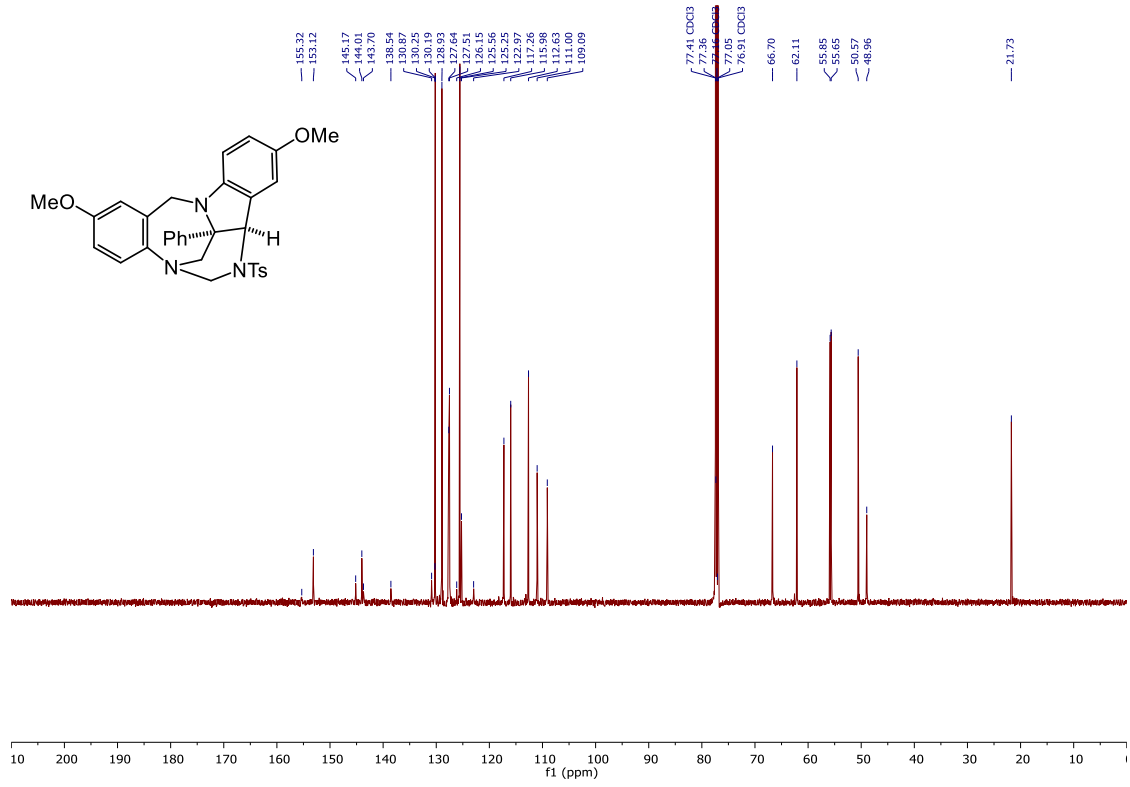
Compound 3eA. ^{13}C NMR ($CDCl_3$, 126 MHz)



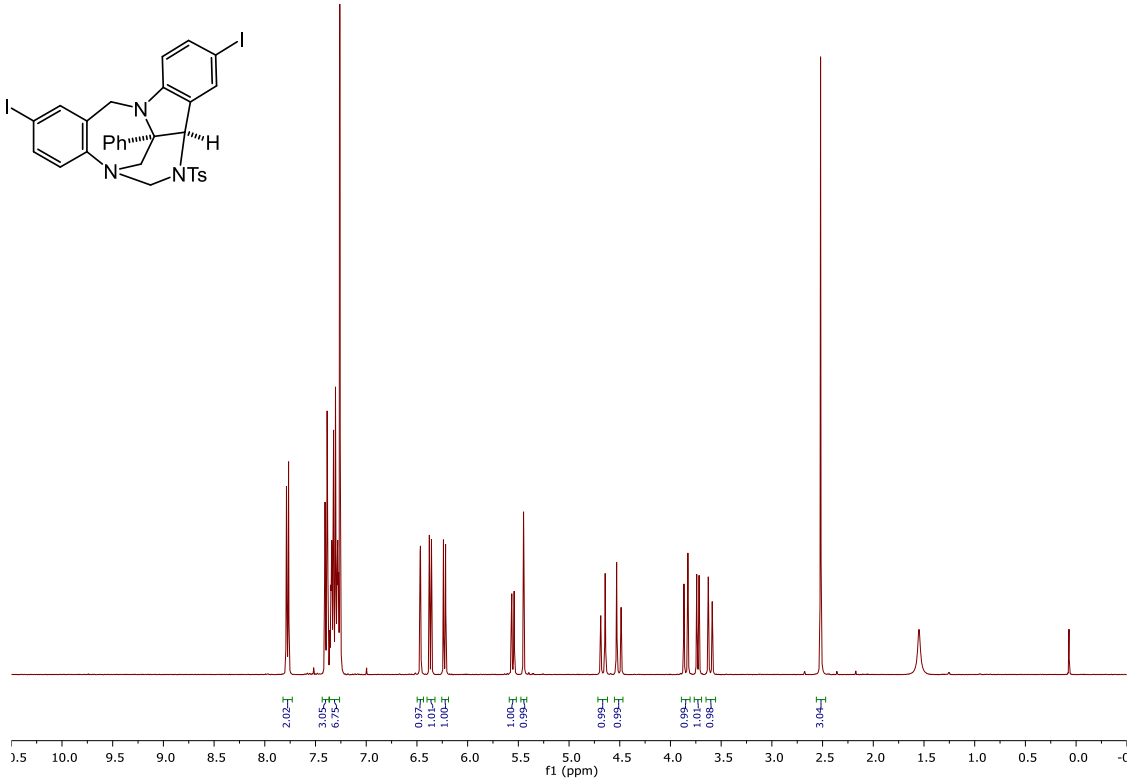
Compound 3fA. ^{1}H NMR ($CDCl_3$, 400 MHz)



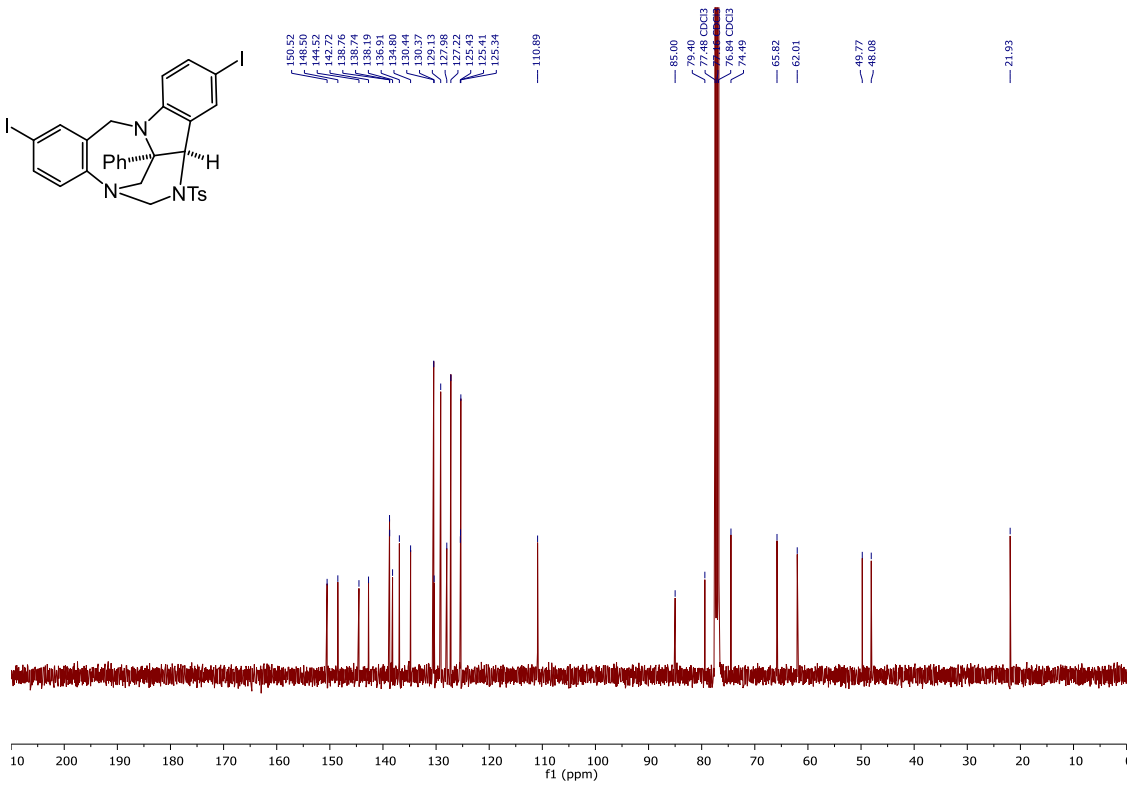
Compound 3fA. ^{13}C NMR ($CDCl_3$, 126 MHz)



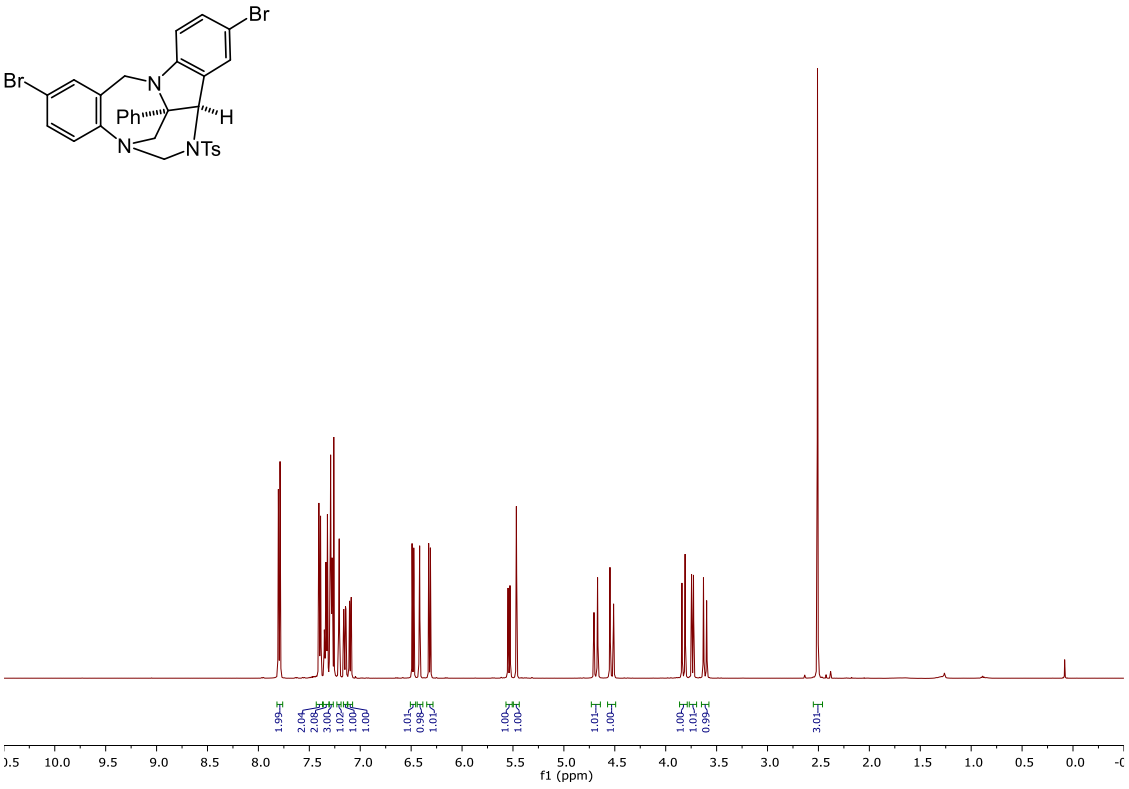
Compound 3gA. ^{1}H NMR ($CDCl_3$, 400 MHz)



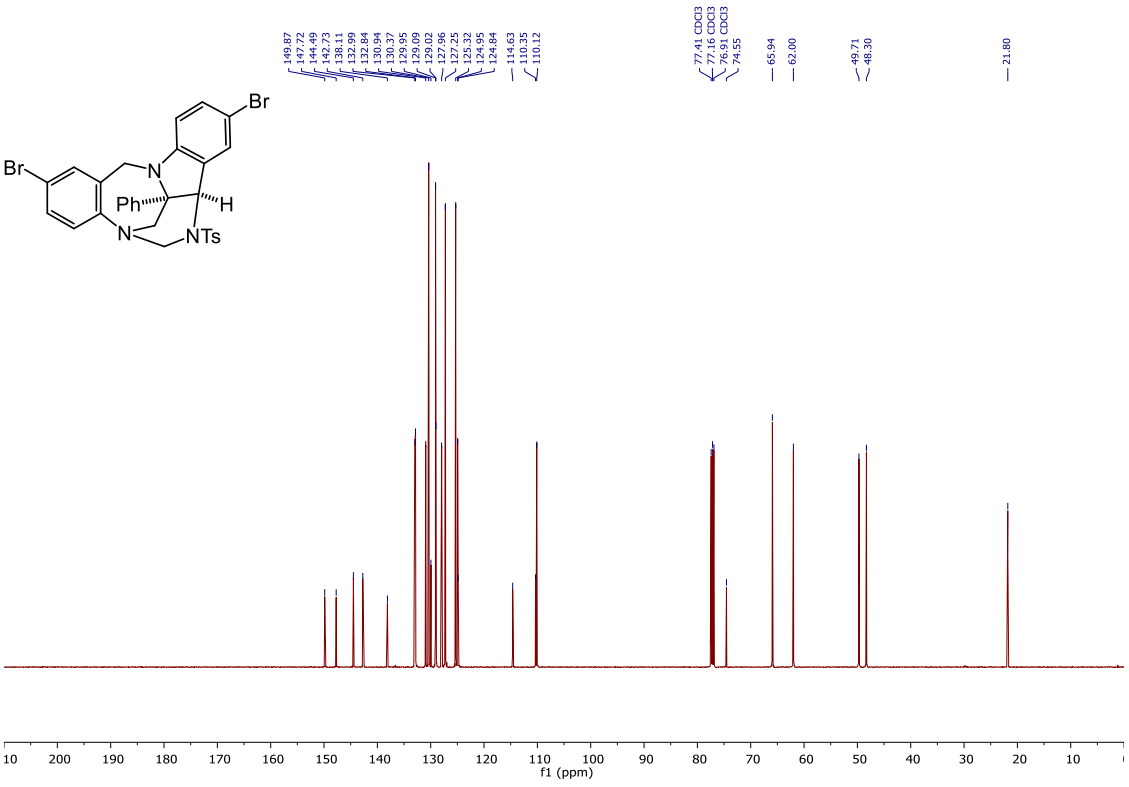
Compound 3gA. ^{13}C NMR ($CDCl_3$, 100 MHz)



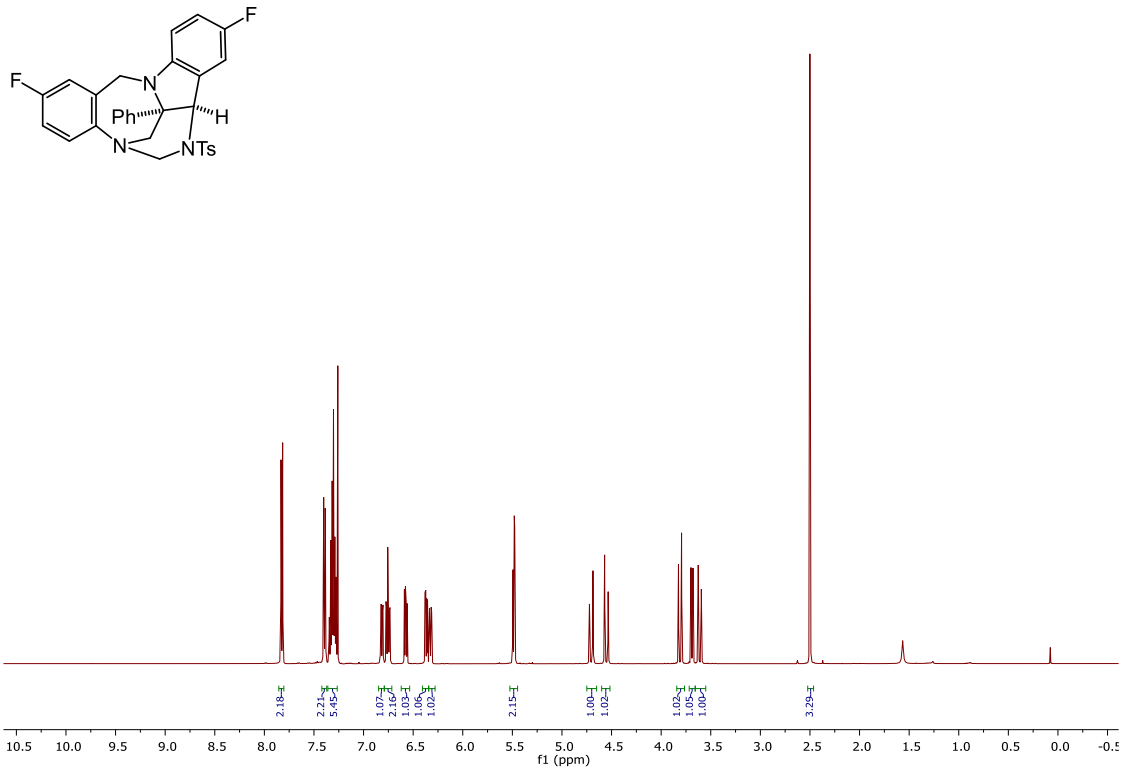
Compound 3hA. ^{1}H NMR ($CDCl_3$, 500 MHz)



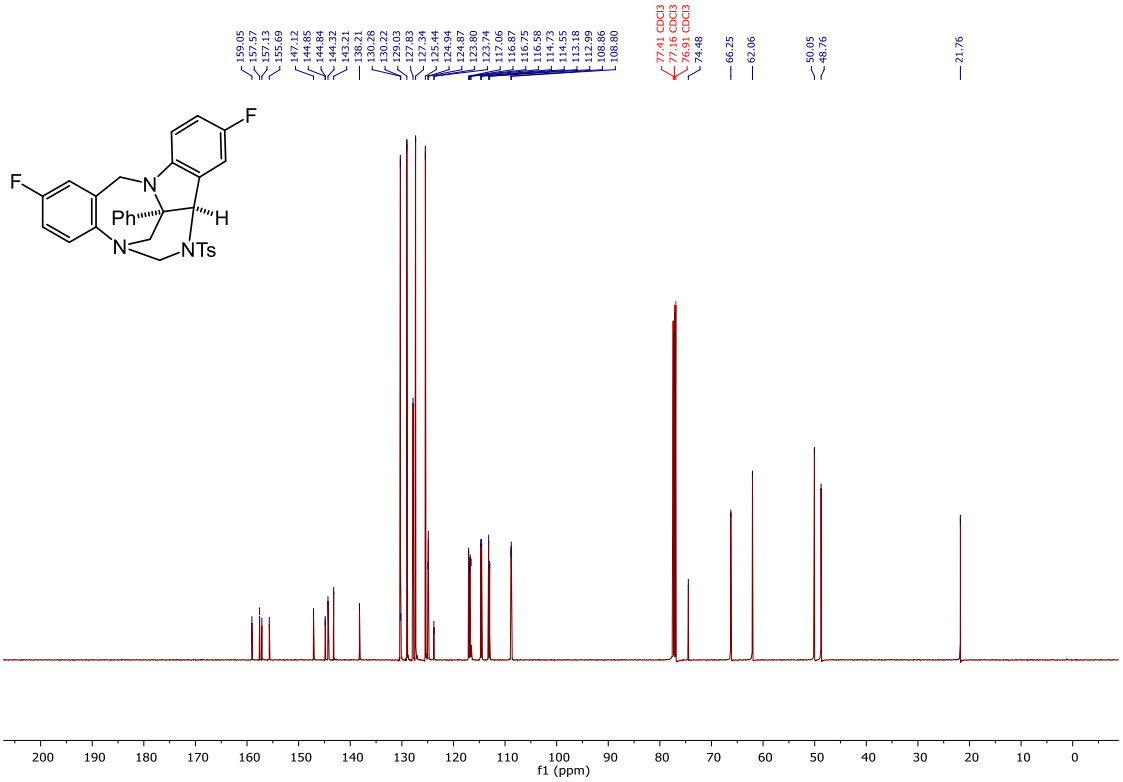
Compound 3hA. ^{13}C NMR ($CDCl_3$, 126 MHz)



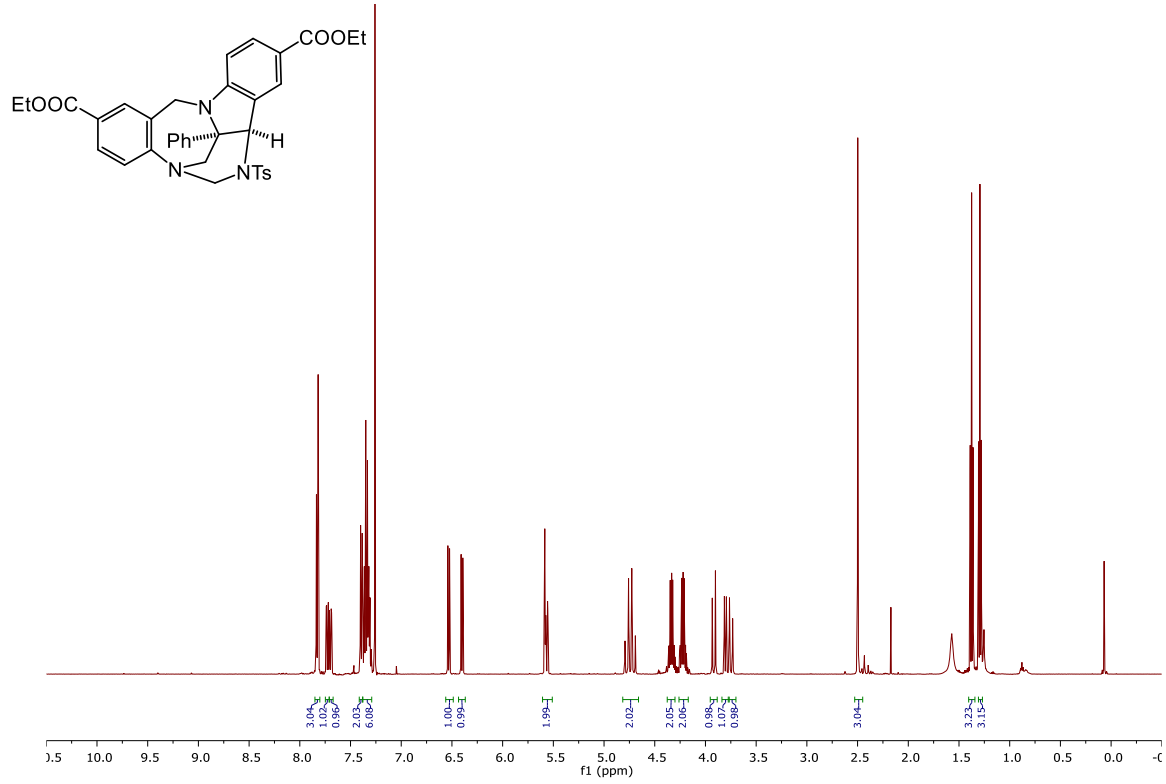
Compound 3iA. ^{1}H NMR ($CDCl_3$, 500 MHz)



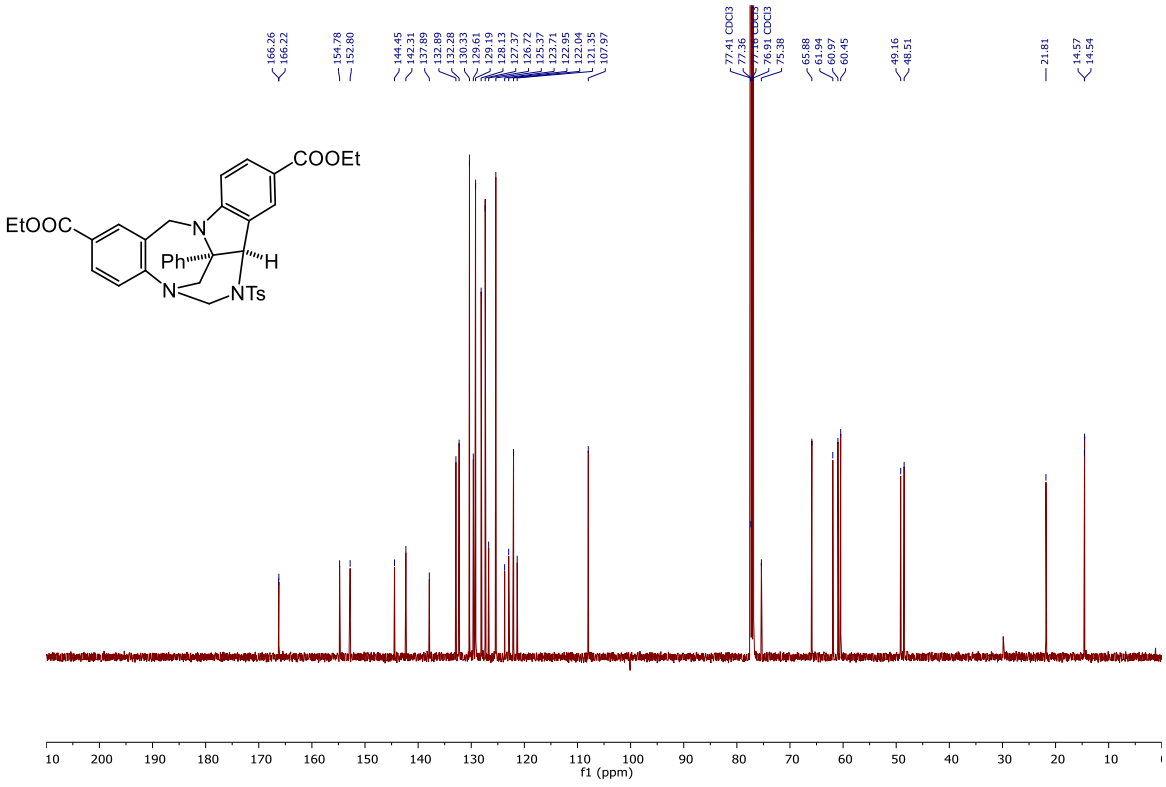
Compound 3iA. ^{13}C NMR ($CDCl_3$, 126 MHz)



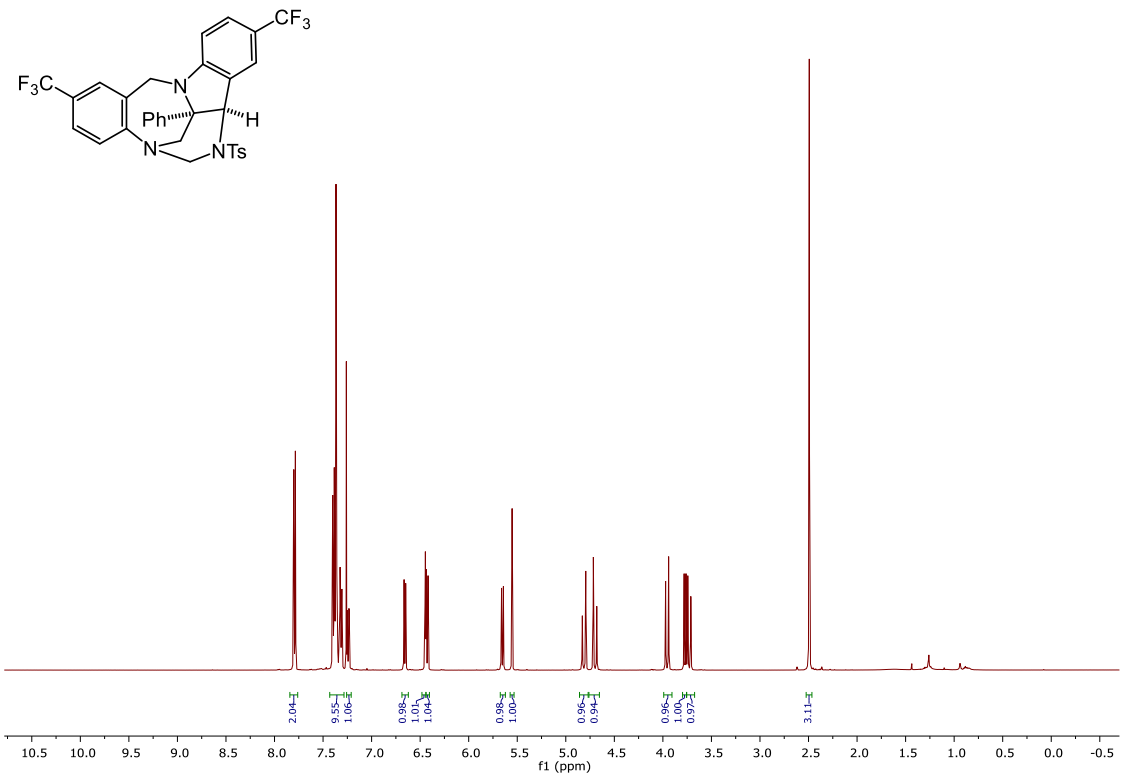
Compound 3jA. ^{1}H NMR ($CDCl_3$, 500 MHz)



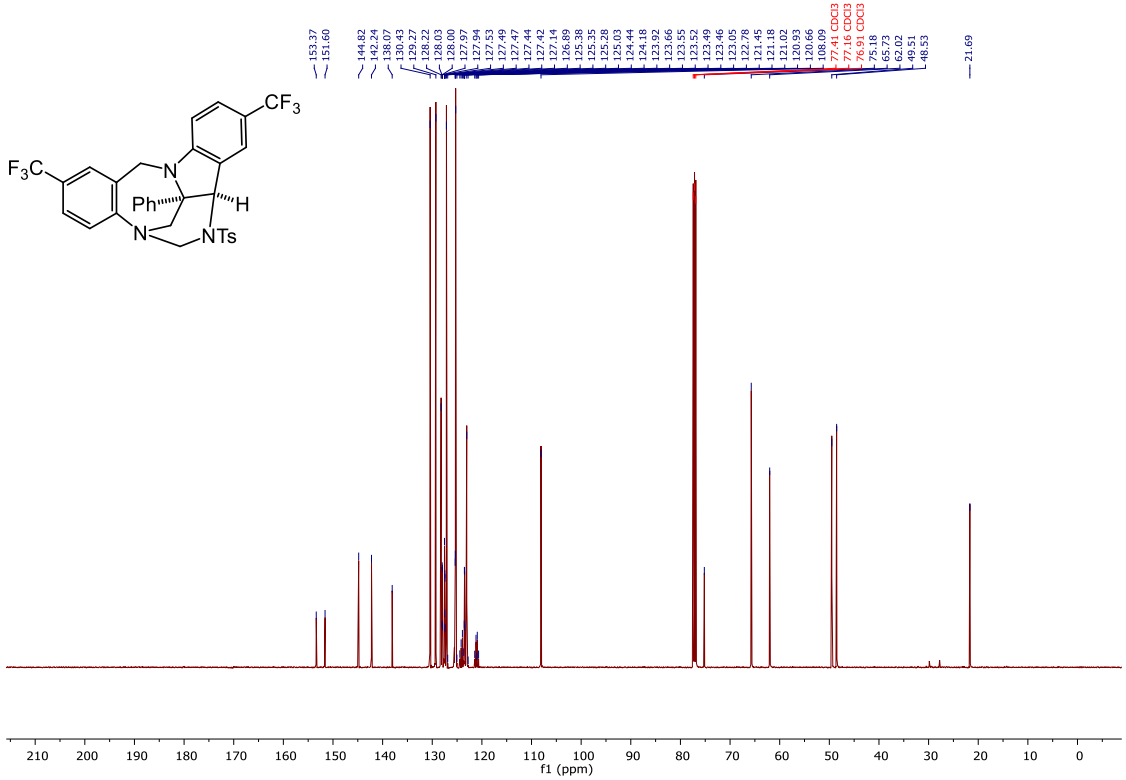
Compound 3jA. ^{13}C NMR ($CDCl_3$, 126 MHz)



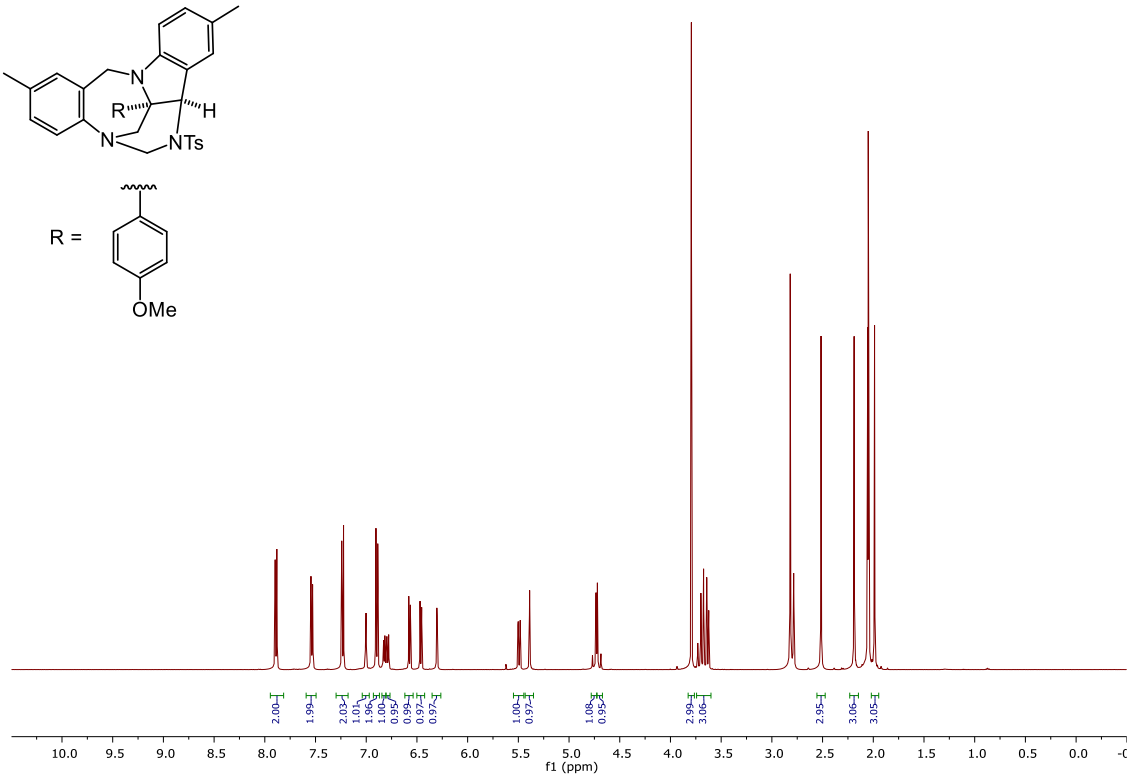
Compound 3kA. ^{1}H NMR ($CDCl_3$, 500 MHz)



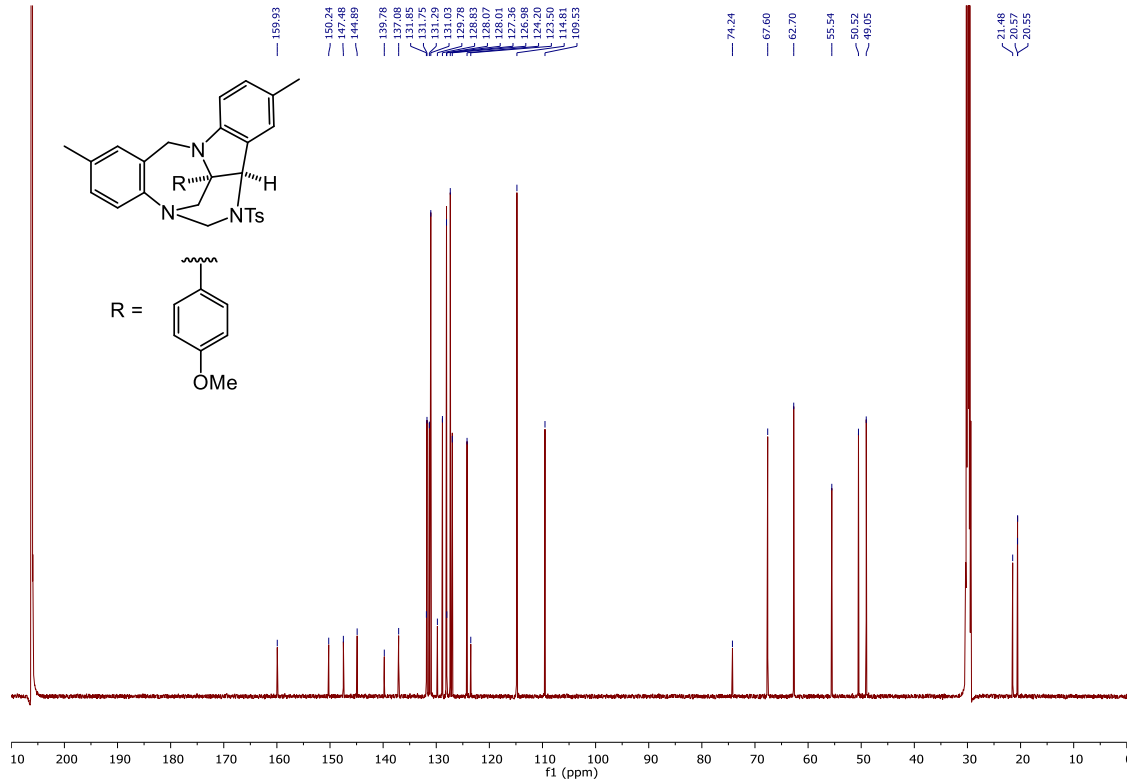
Compound 3kA. ^{13}C NMR ($CDCl_3$, 126 MHz)



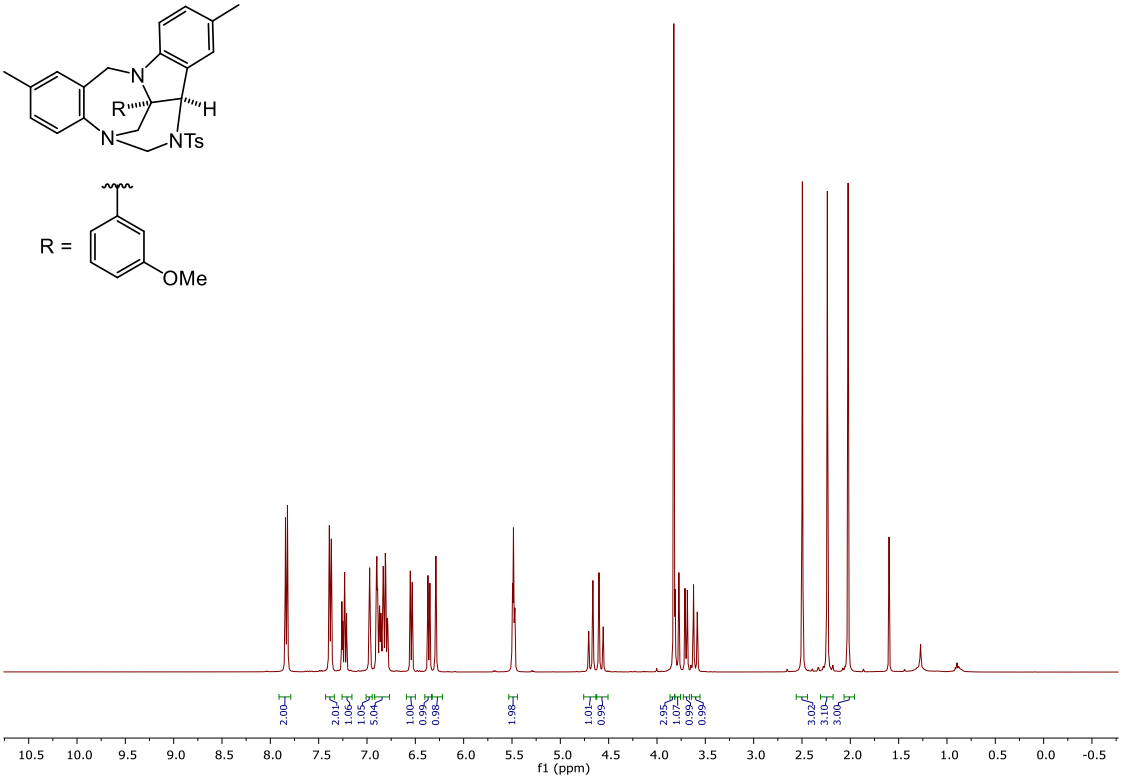
Compound 3aB. ^{1}H NMR (acetone-d_6, 500 MHz)



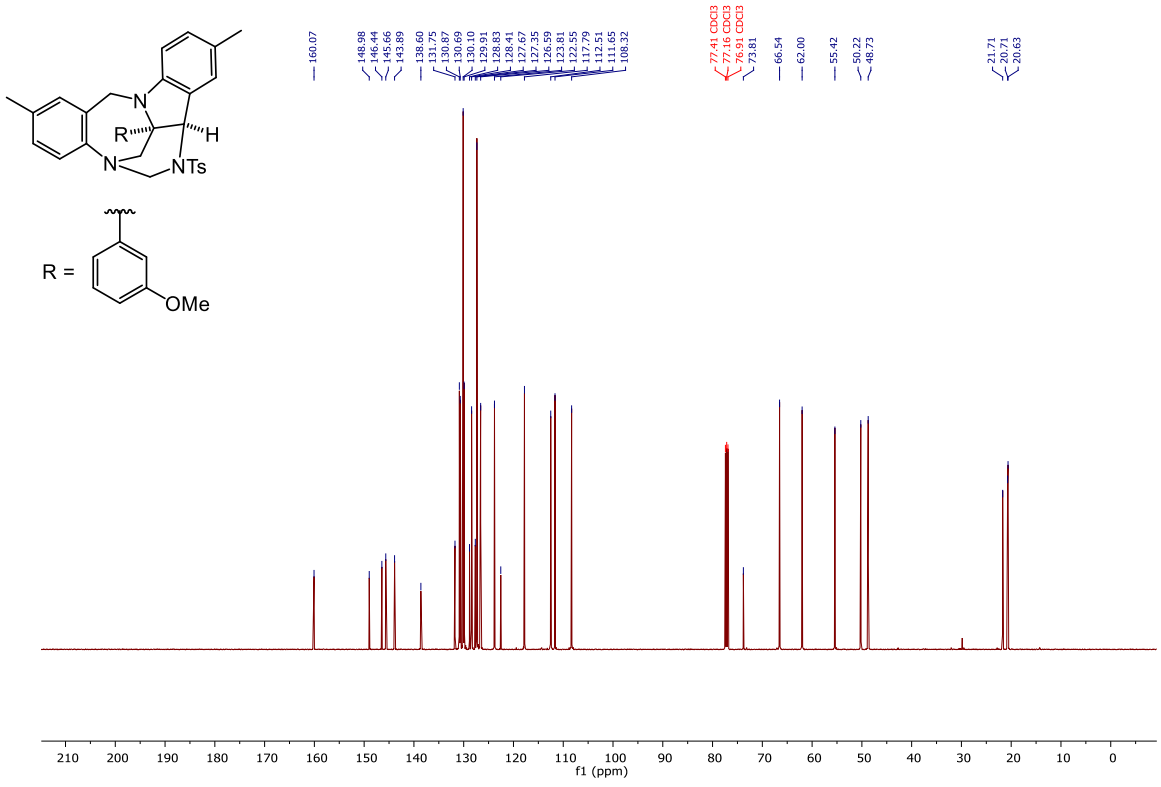
Compound 3aB. ^{13}C NMR (acetone-d_6, 126 MHz)



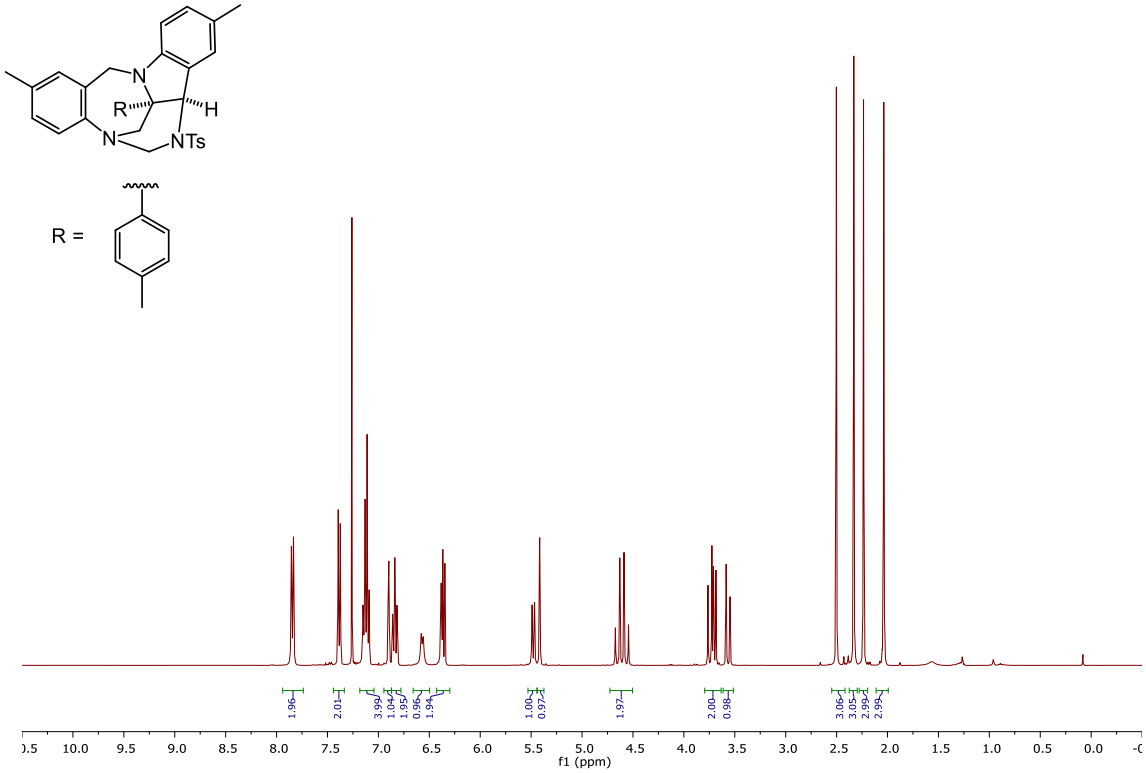
Compound 3aC. ^{1}H NMR ($CDCl_3$, 500 MHz)



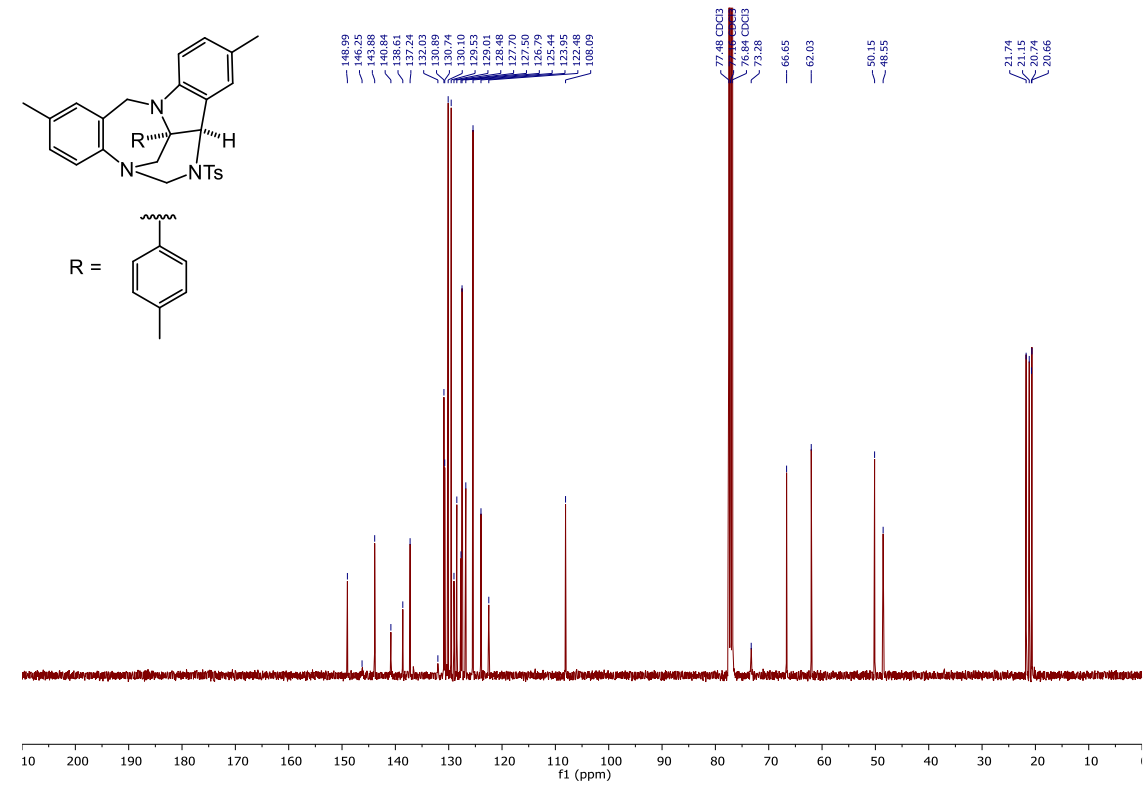
Compound 3aC. ^{13}C NMR ($CDCl_3$, 126 MHz)



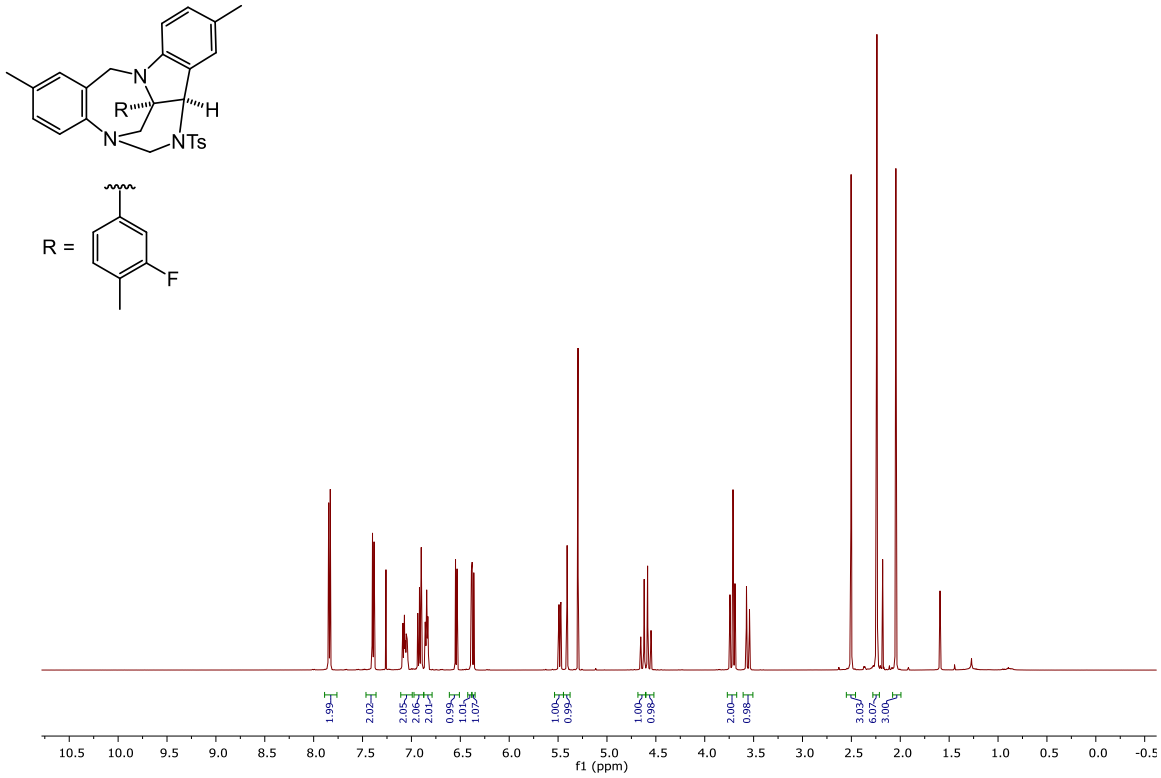
Compound 3aD. ^{1}H NMR ($CDCl_3$, 400 MHz)



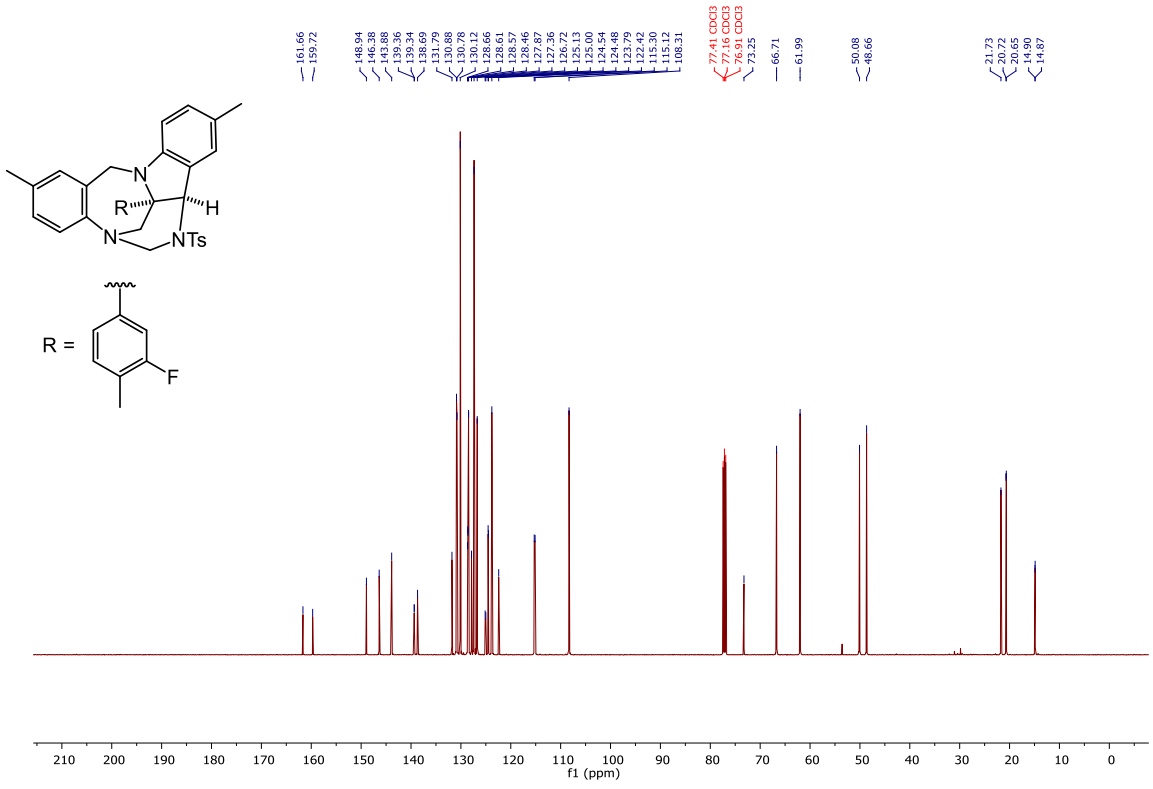
Compound 3aD. ^{13}C NMR ($CDCl_3$, 100 MHz)



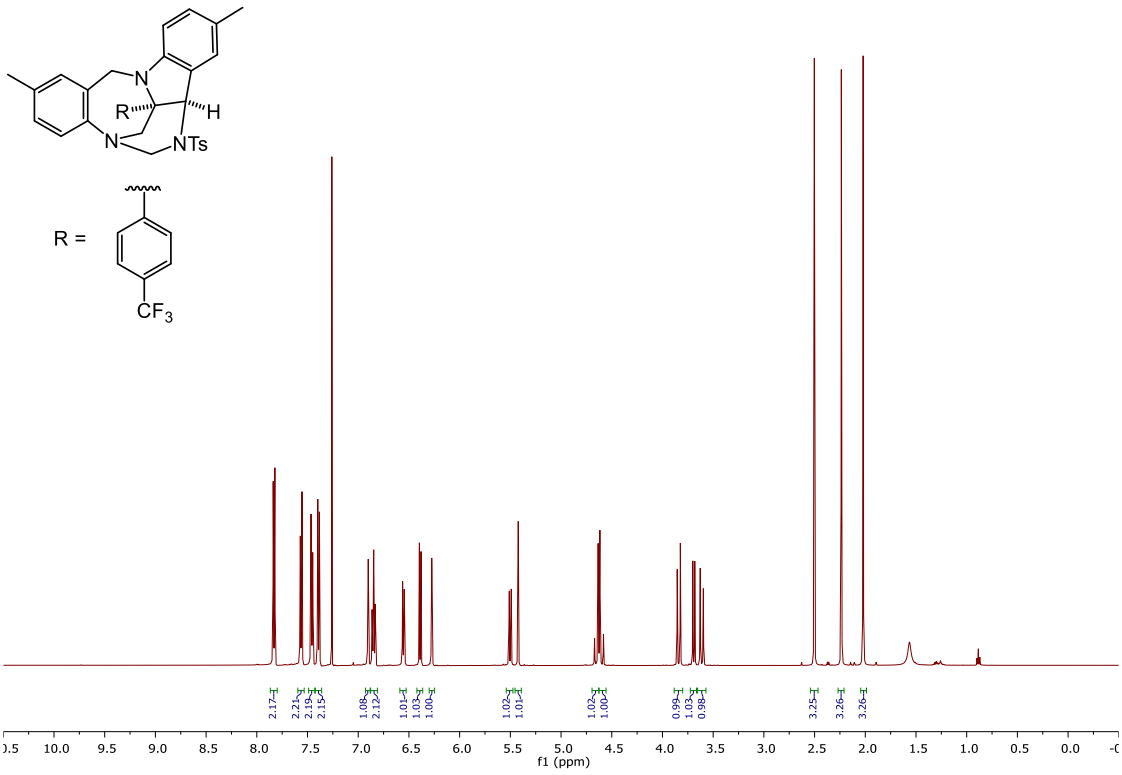
Compound 3aE. ^{1}H NMR ($CDCl_3$, 500 MHz)



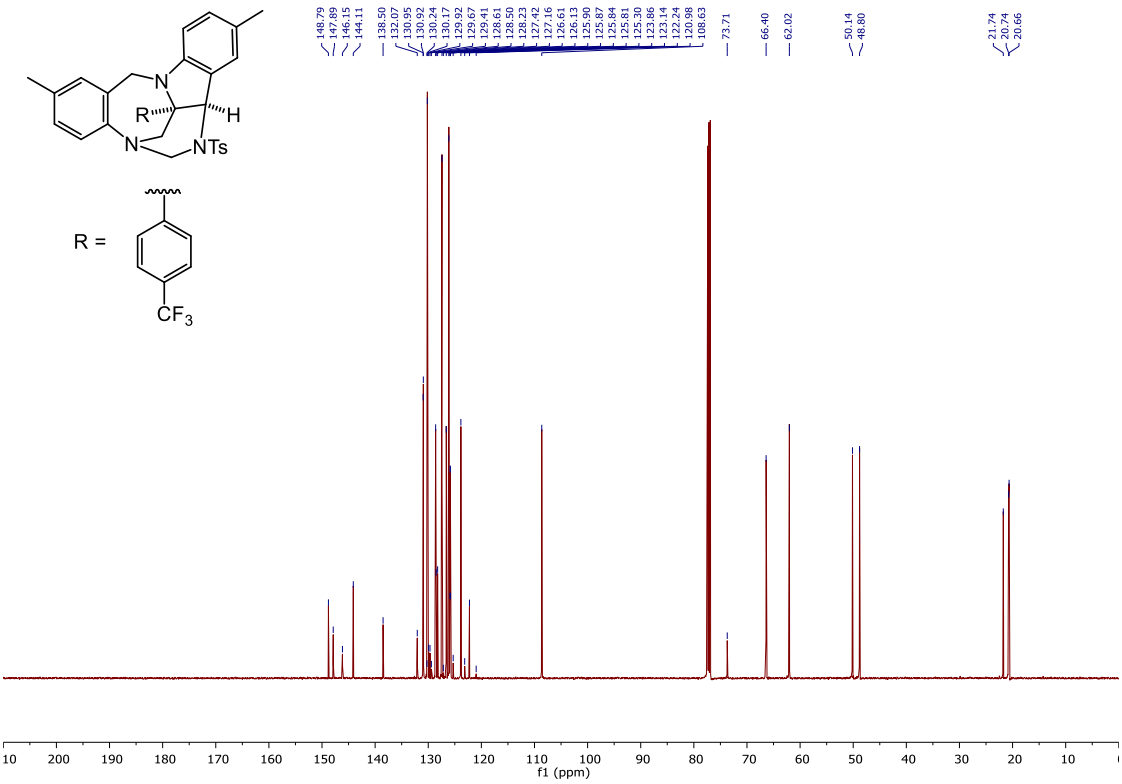
Compound 3aE. ^{13}C NMR ($CDCl_3$, 126 MHz)



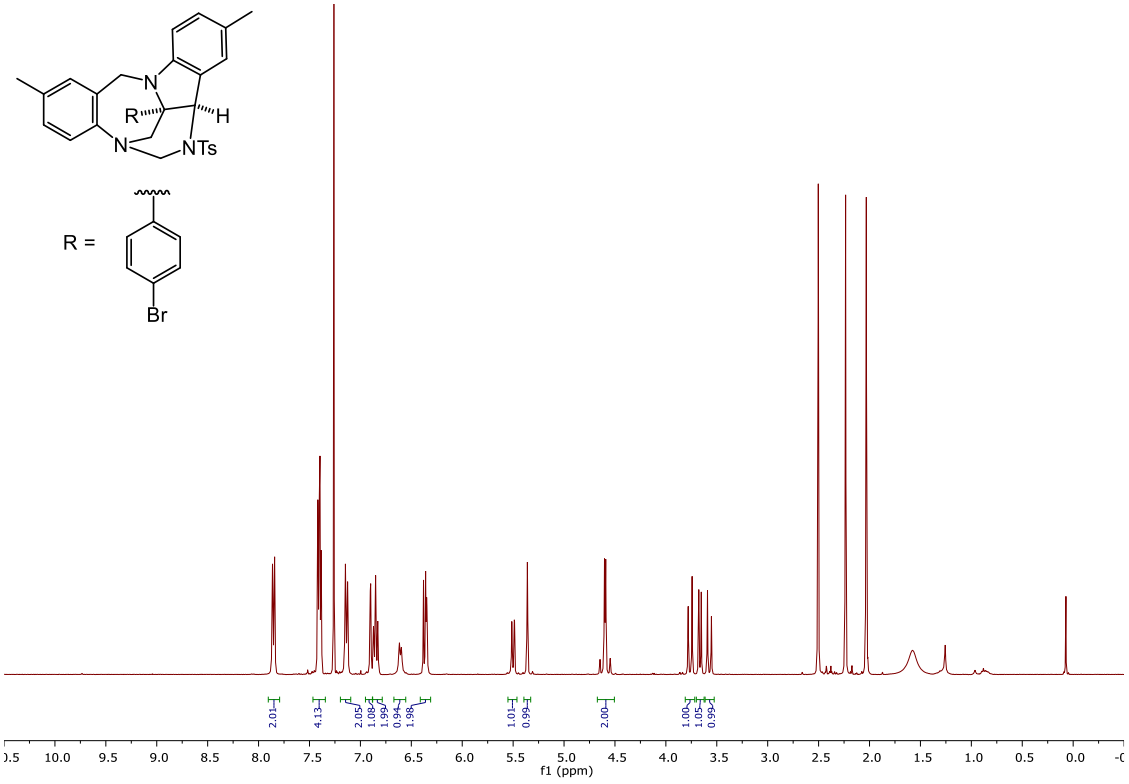
Compound 3aF. ^{1}H NMR ($CDCl_3$, 500 MHz)



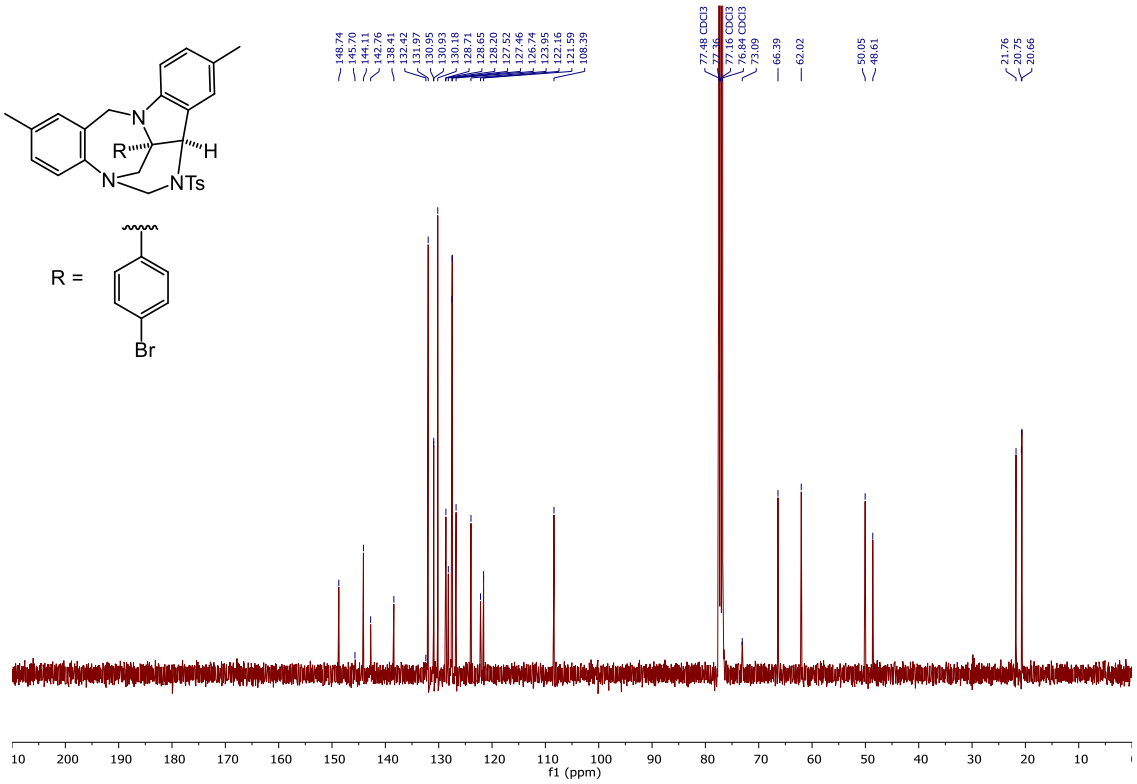
Compound 3aF. ^{13}C NMR ($CDCl_3$, 126 MHz)



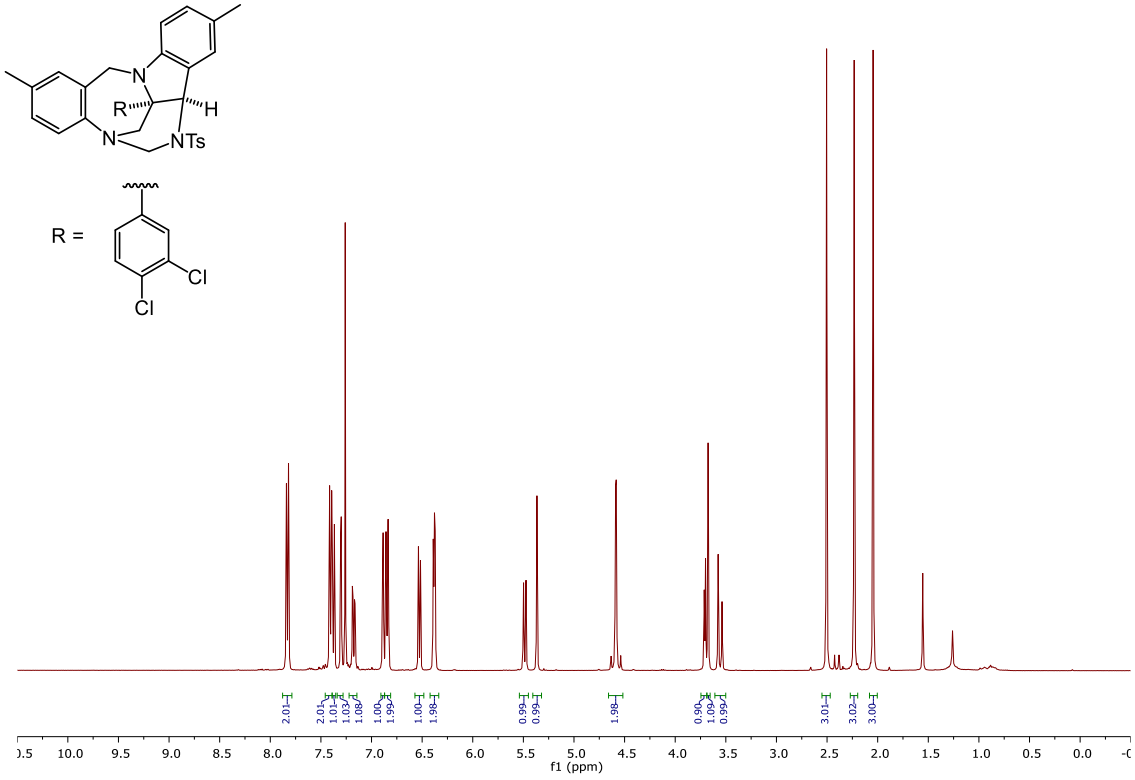
Compound 3aG. ^{1}H NMR ($CDCl_3$, 400 MHz)



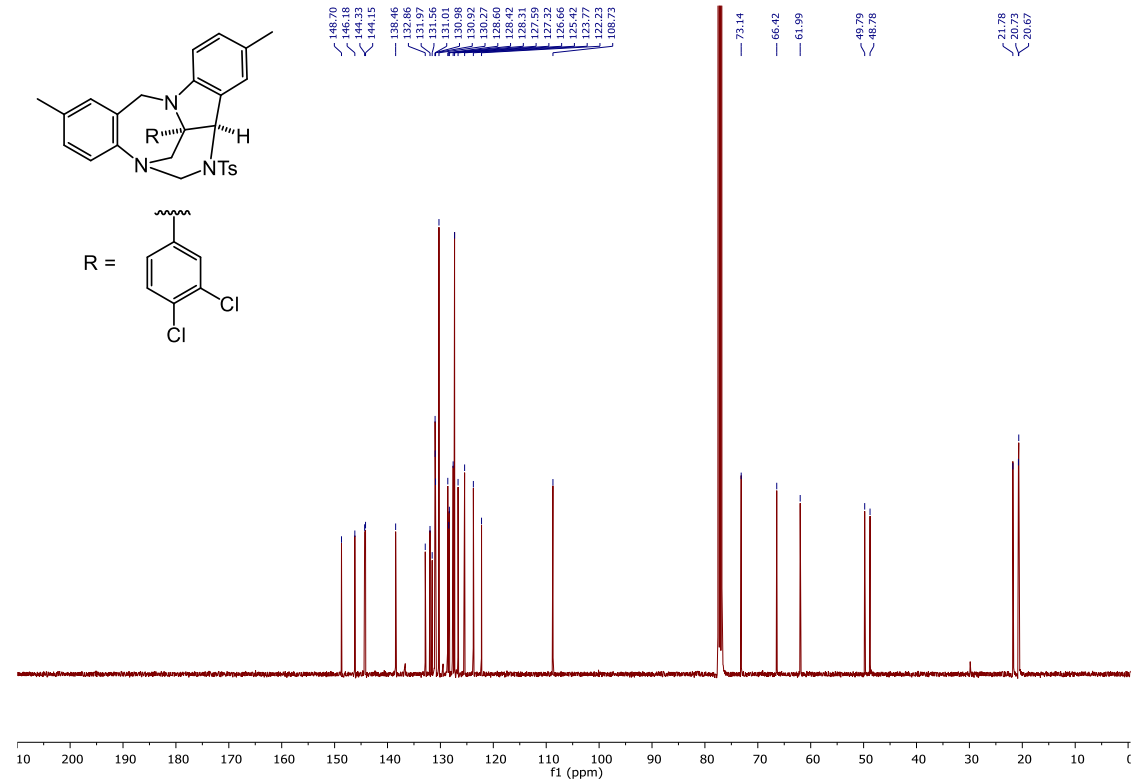
Compound 3aG. ^{13}C NMR ($CDCl_3$, 100 MHz)



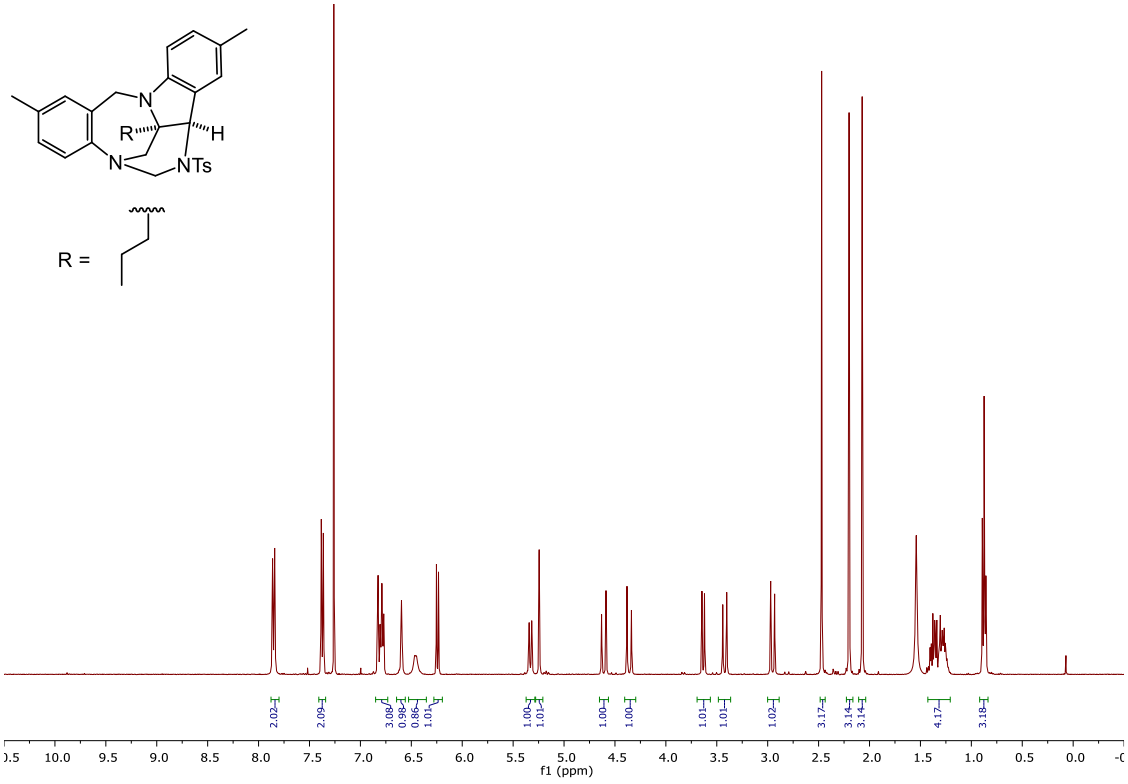
Compound 3aH. ^{1}H NMR ($CDCl_3$, 400 MHz)



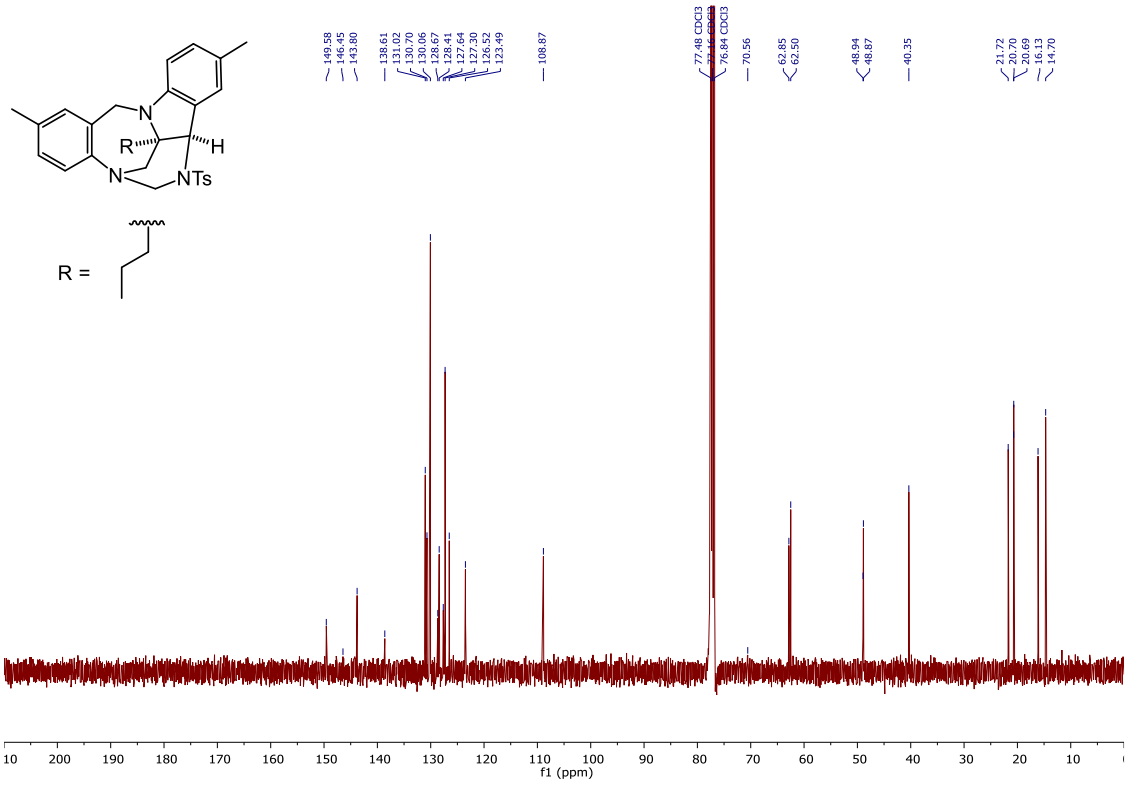
Compound 3aH. ^{13}C NMR ($CDCl_3$, 100 MHz)



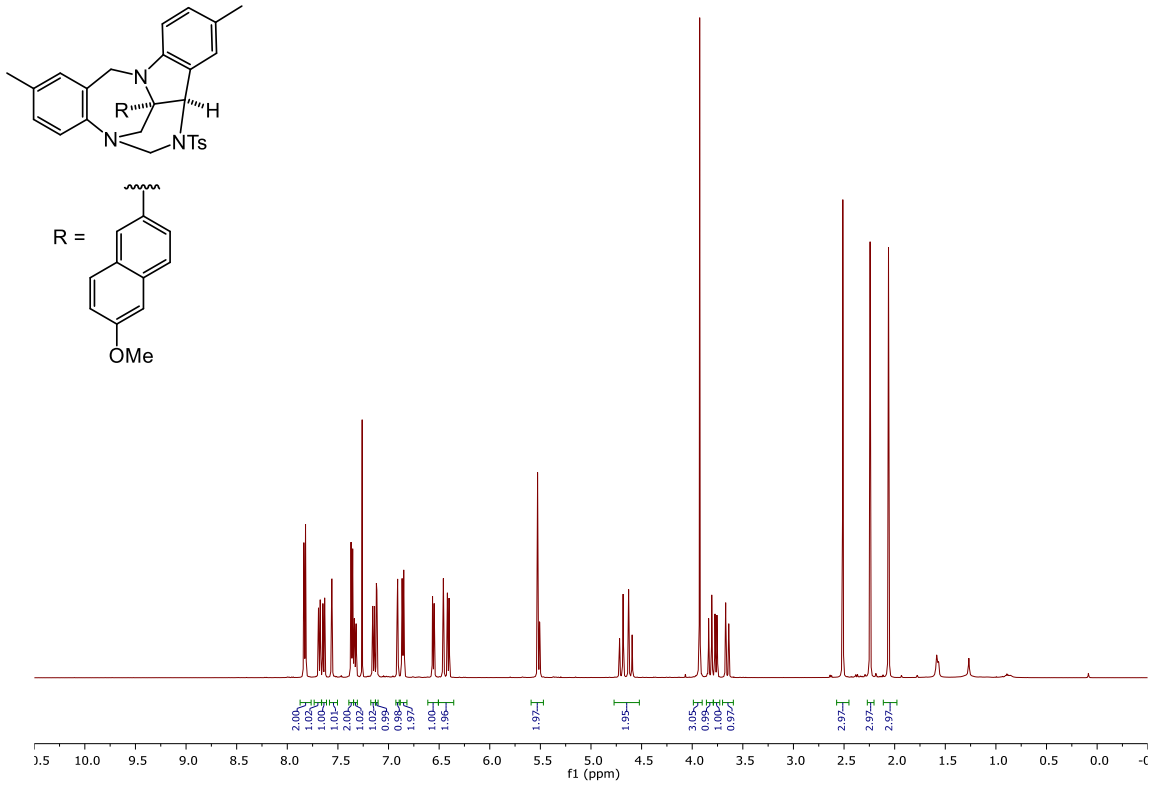
Compound 3al. ^{1}H NMR ($CDCl_3$, 400 MHz)



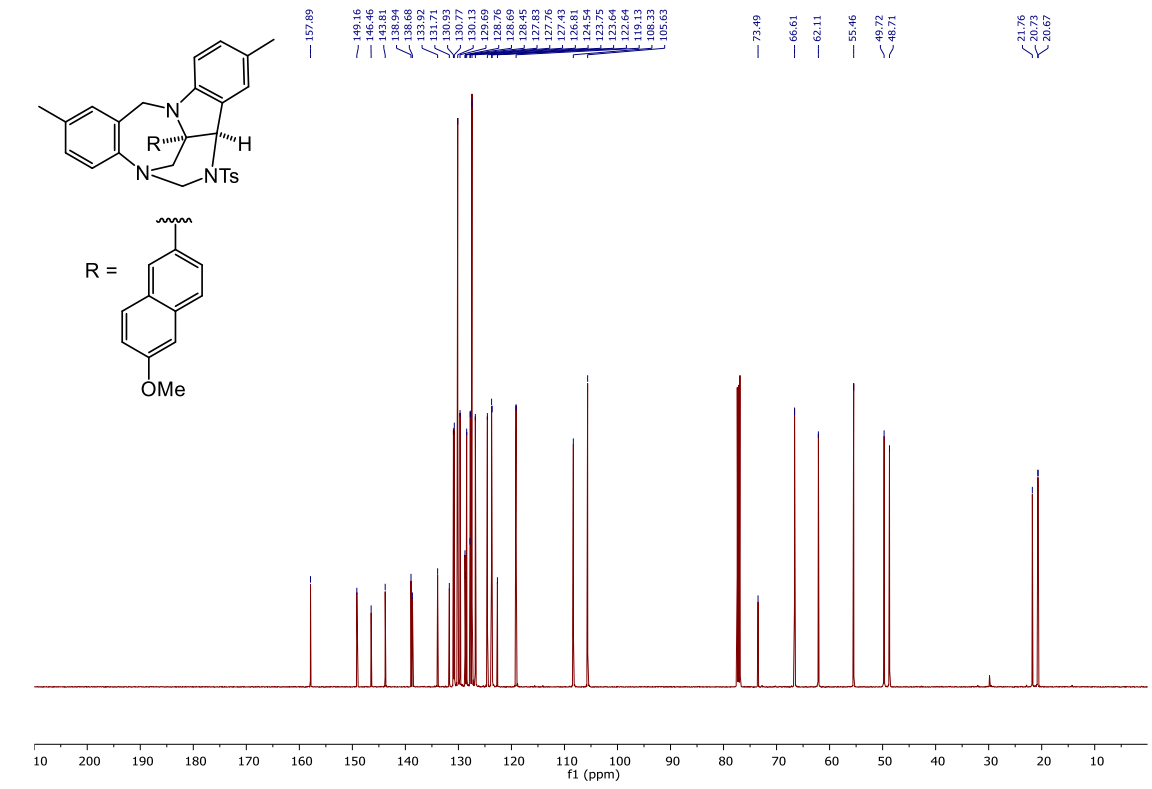
Compound 3al. ^{13}C NMR ($CDCl_3$, 100 MHz)



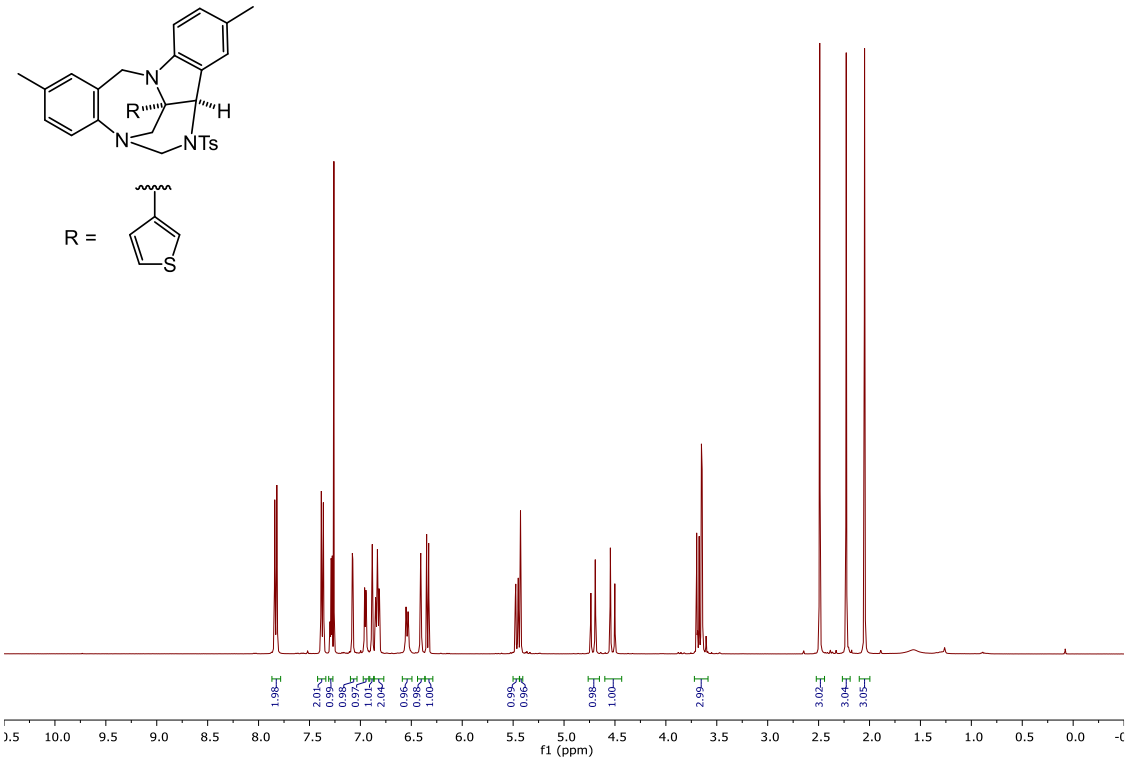
Compound 3aJ. ^{1}H NMR ($CDCl_3$, 500 MHz)



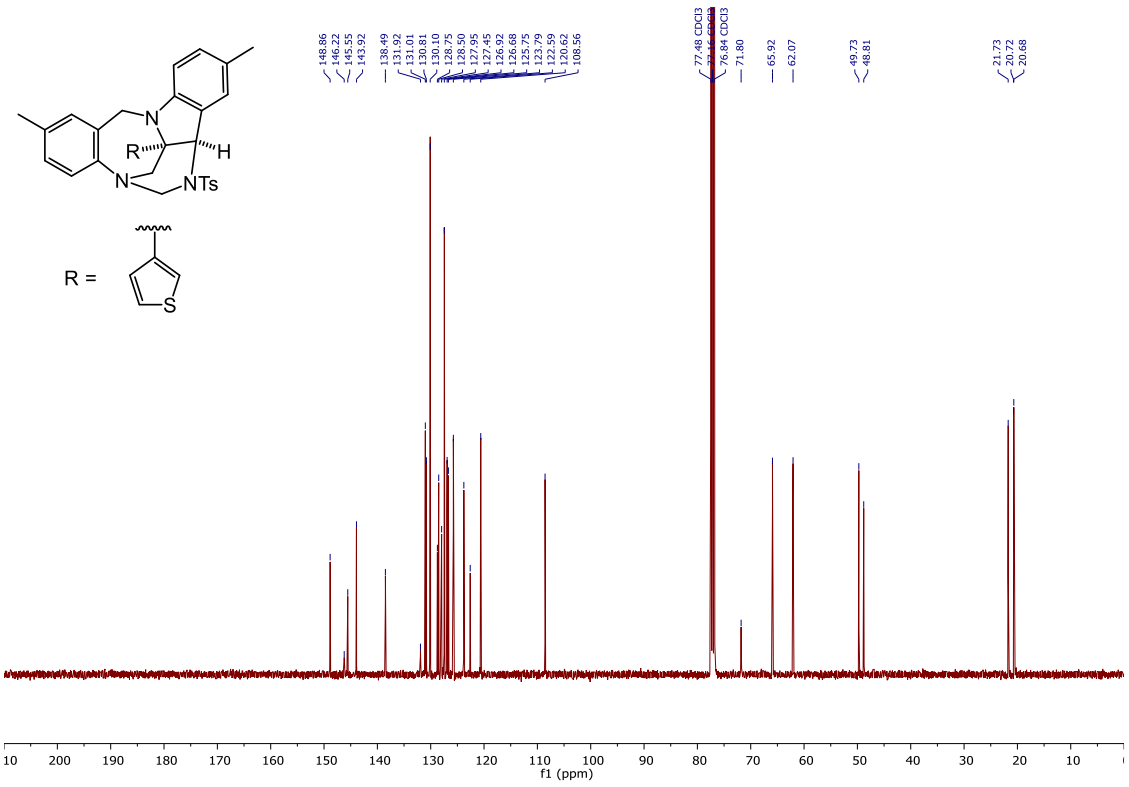
Compound 3aJ. ^{13}C NMR ($CDCl_3$, 126 MHz)



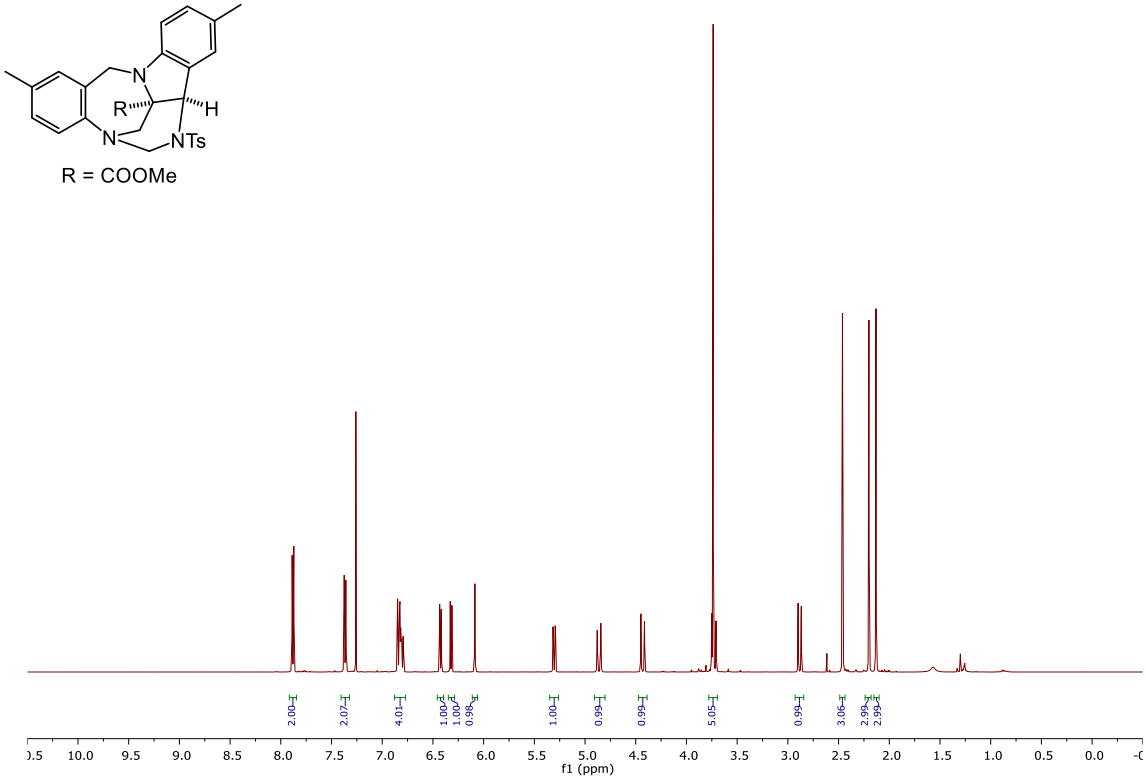
Compound 3aK. ^{1}H NMR ($CDCl_3$, 400 MHz)



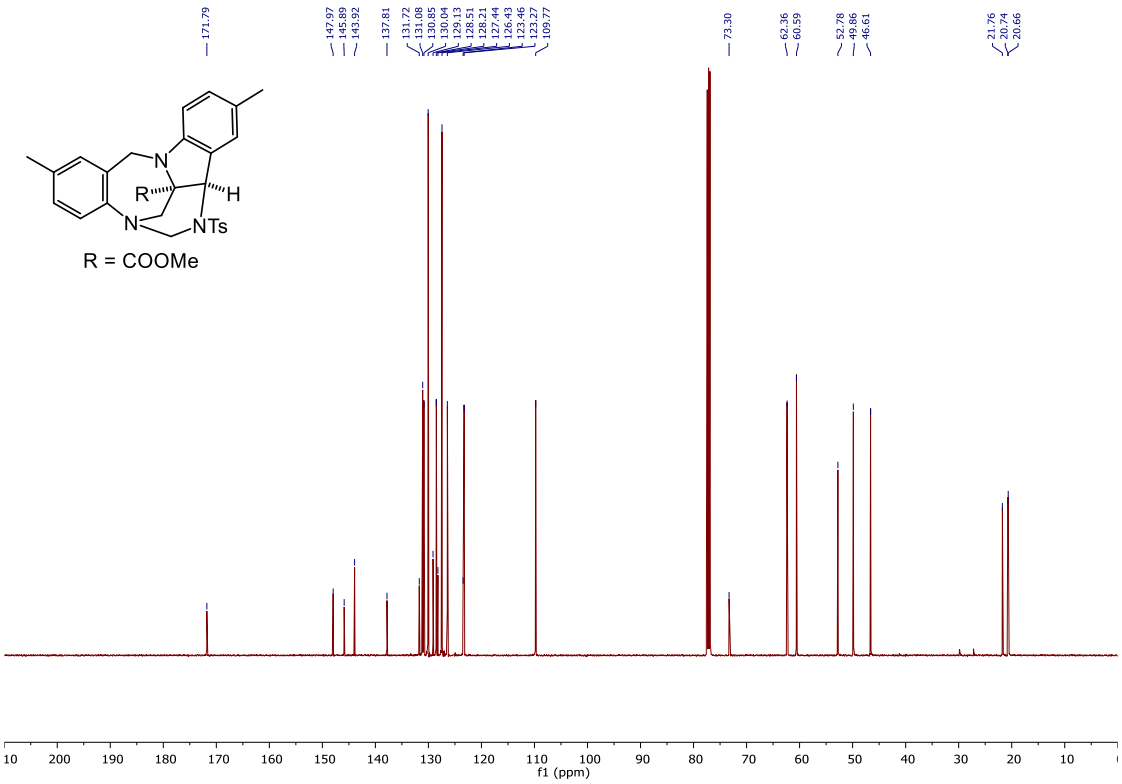
Compound 3aK. ^{13}C NMR ($CDCl_3$, 100 MHz)



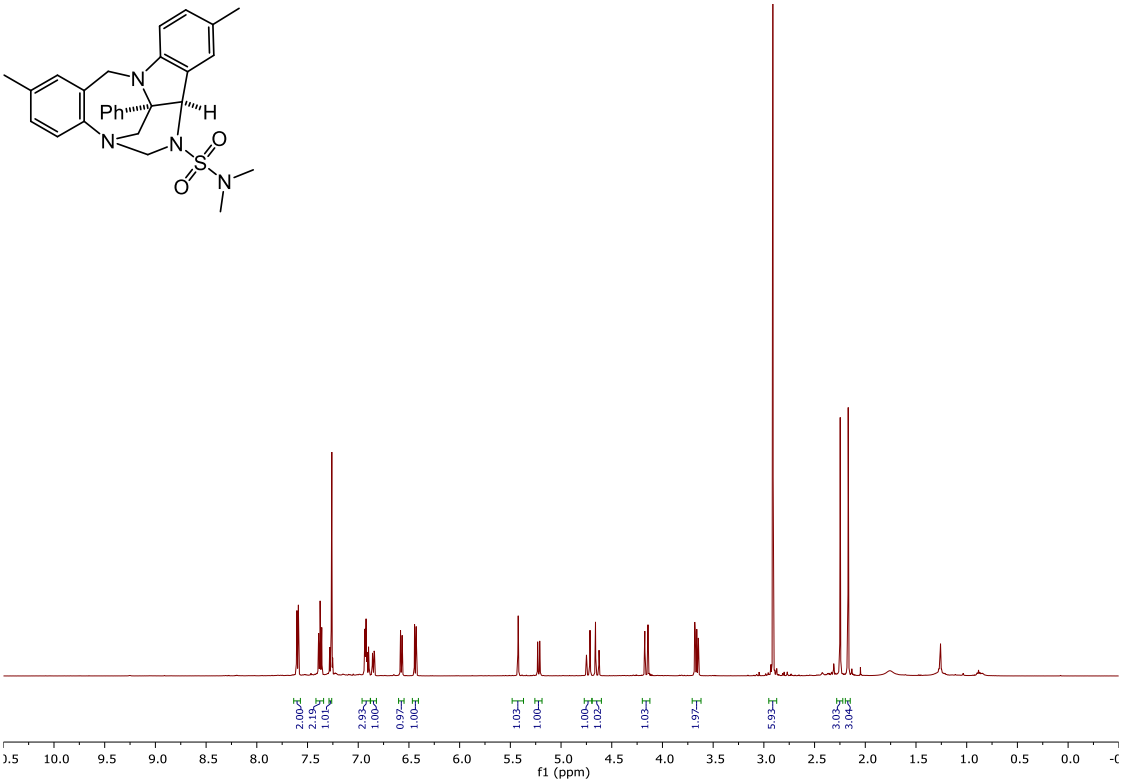
Compound 3aL. ^{1}H NMR ($CDCl_3$, 500 MHz)



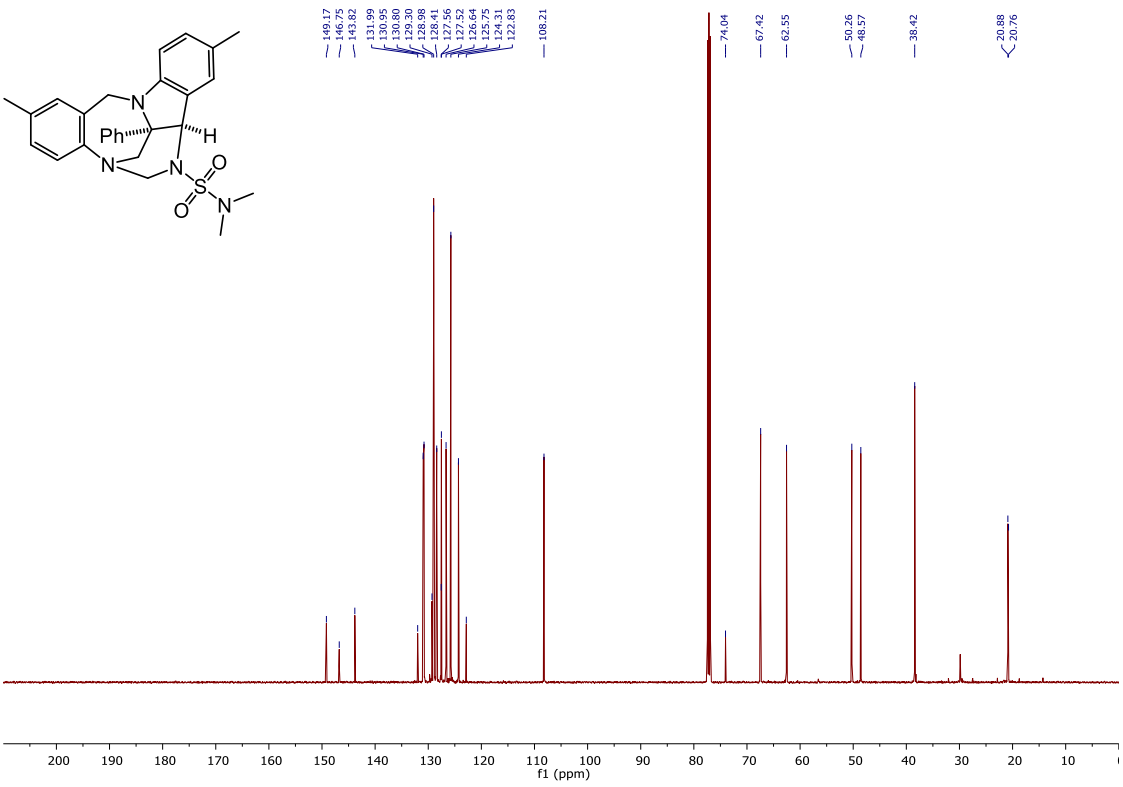
Compound 3aL. ^{13}C NMR ($CDCl_3$, 126 MHz)



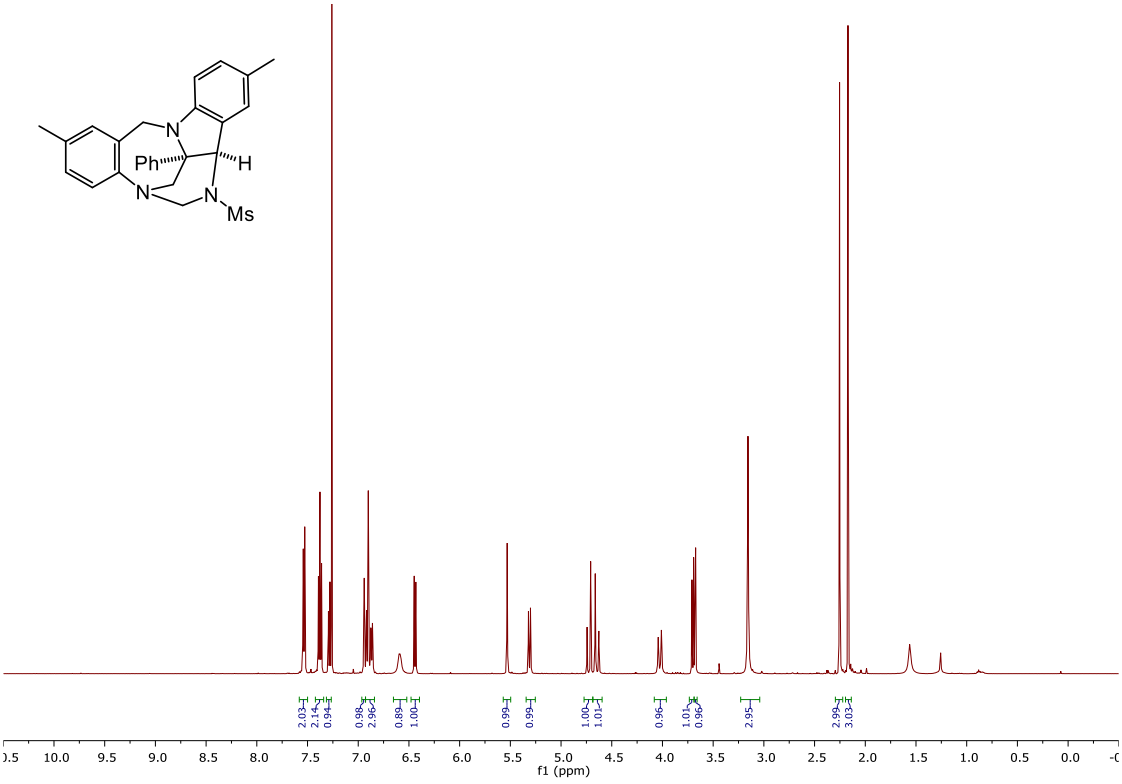
Compound 3aM. ^{1}H NMR ($CDCl_3$, 500 MHz)



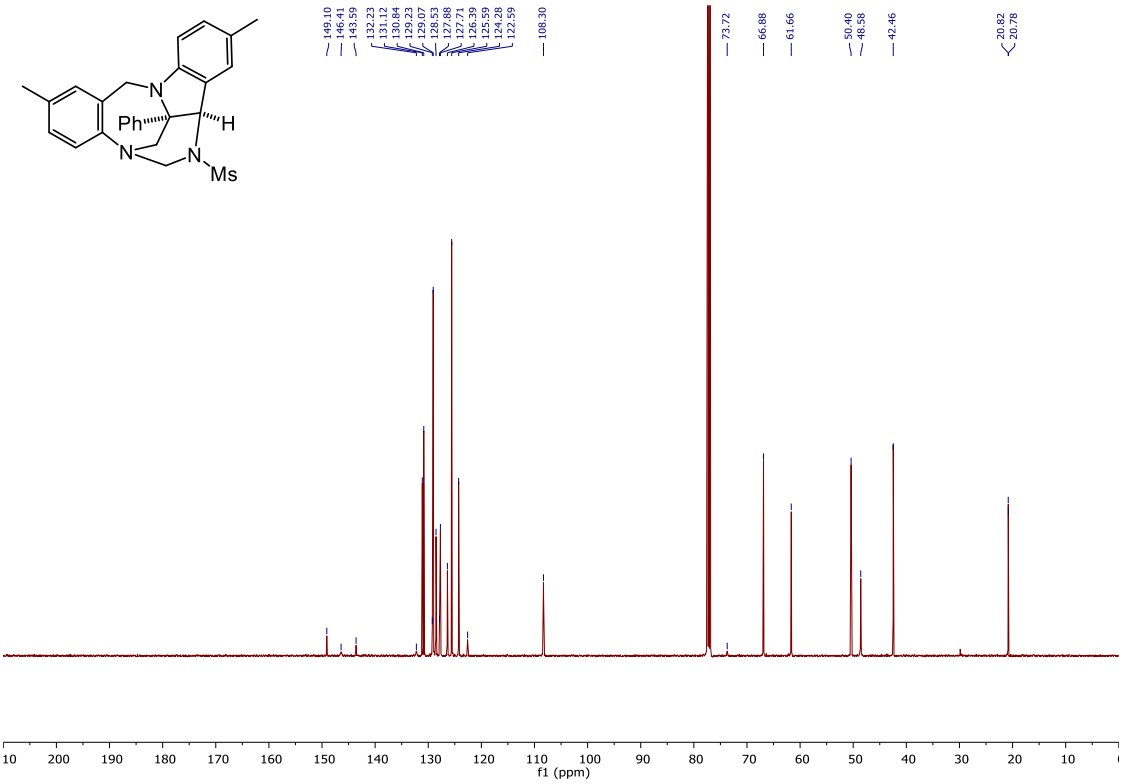
Compound 3aM. ^{13}C NMR ($CDCl_3$, 126 MHz)



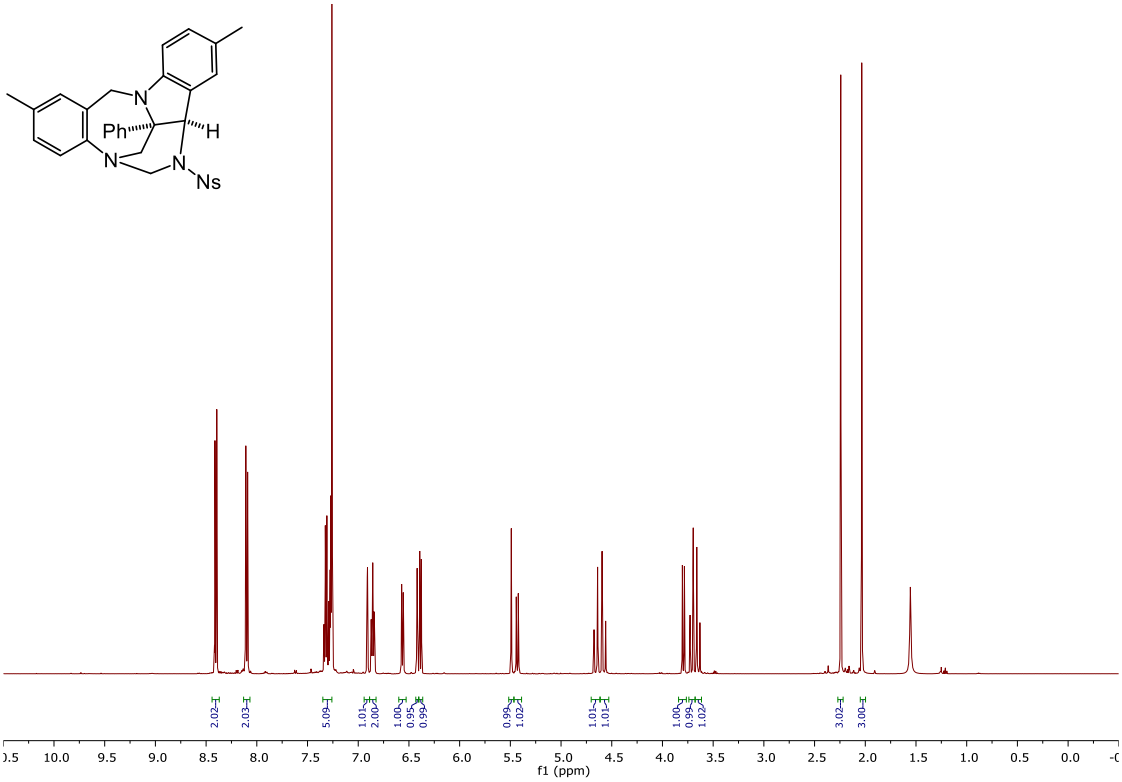
Compound 3aN. ^{1}H NMR ($CDCl_3$, 500 MHz)



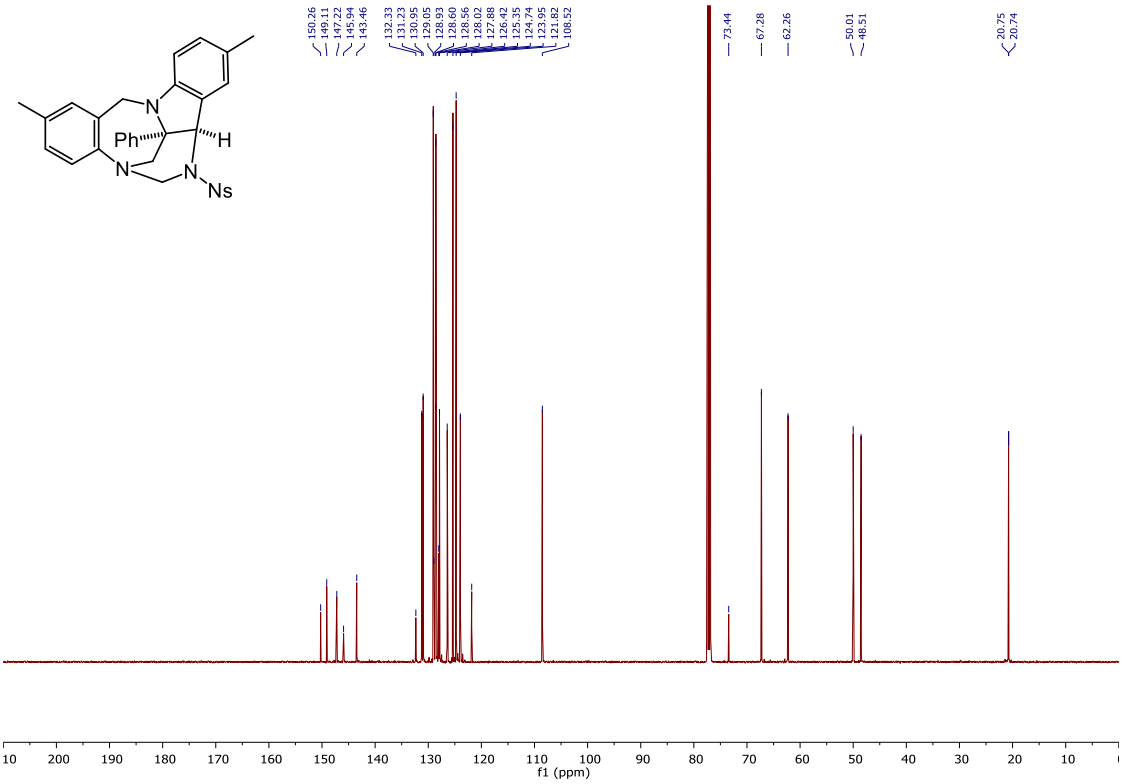
Compound 3aN. ^{13}C NMR ($CDCl_3$, 126 MHz)



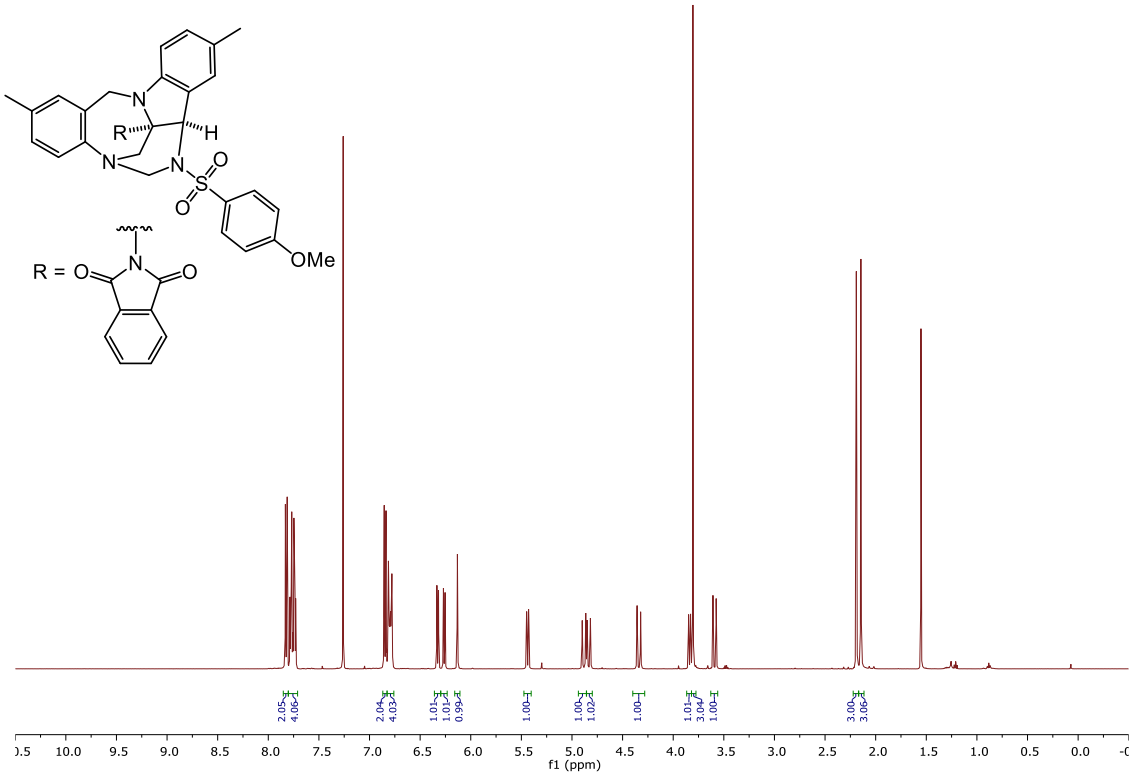
Compound 3aO. ^{1}H NMR ($CDCl_3$, 500 MHz)



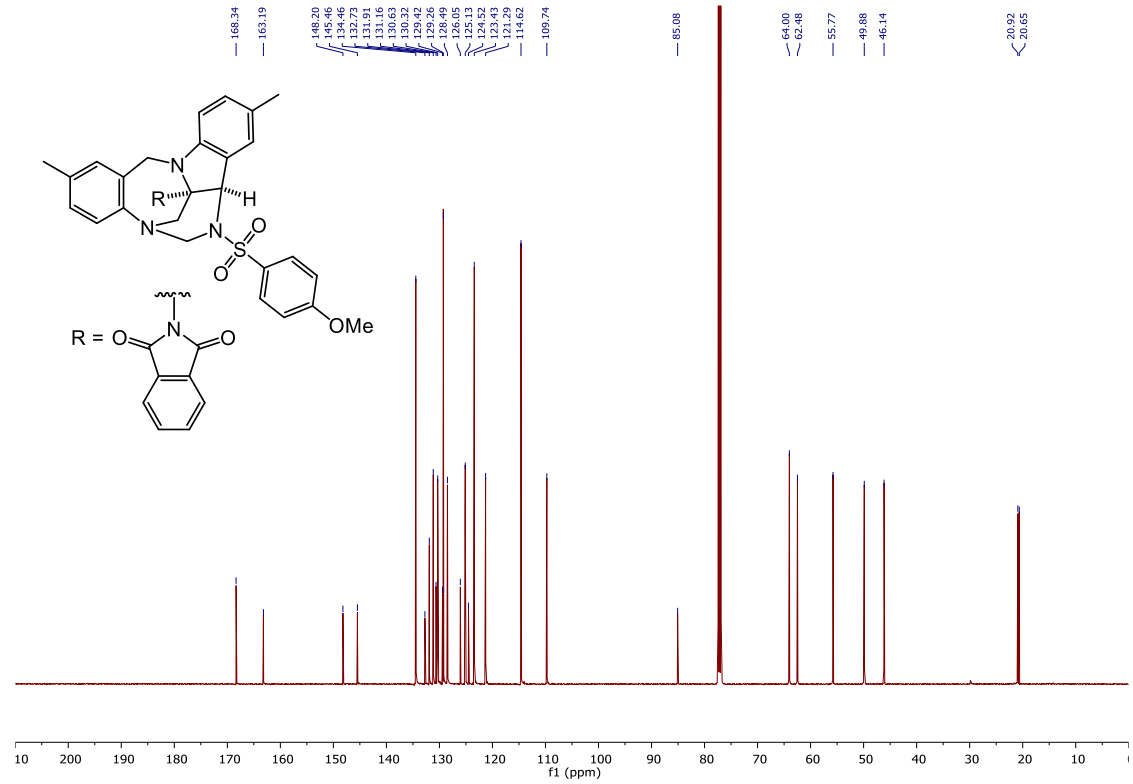
Compound 3aO. ^{13}C NMR ($CDCl_3$, 126 MHz)



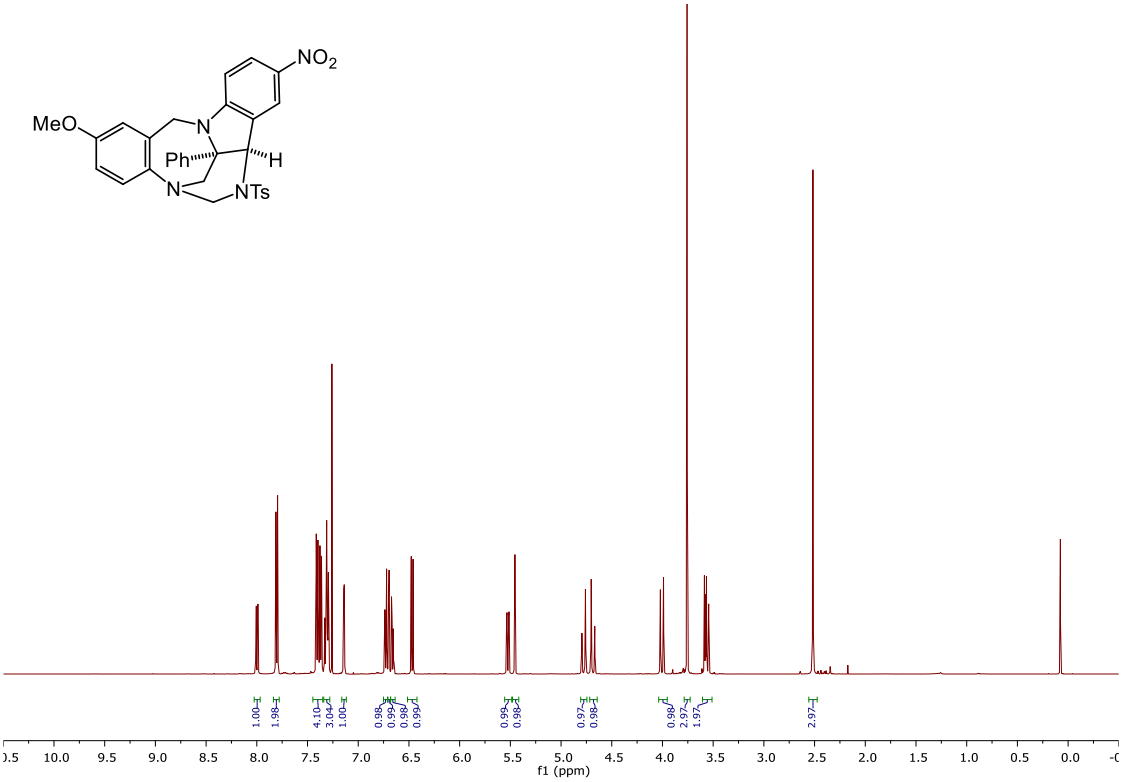
Compound 3aP. ^{1}H NMR ($CDCl_3$, 500 MHz)



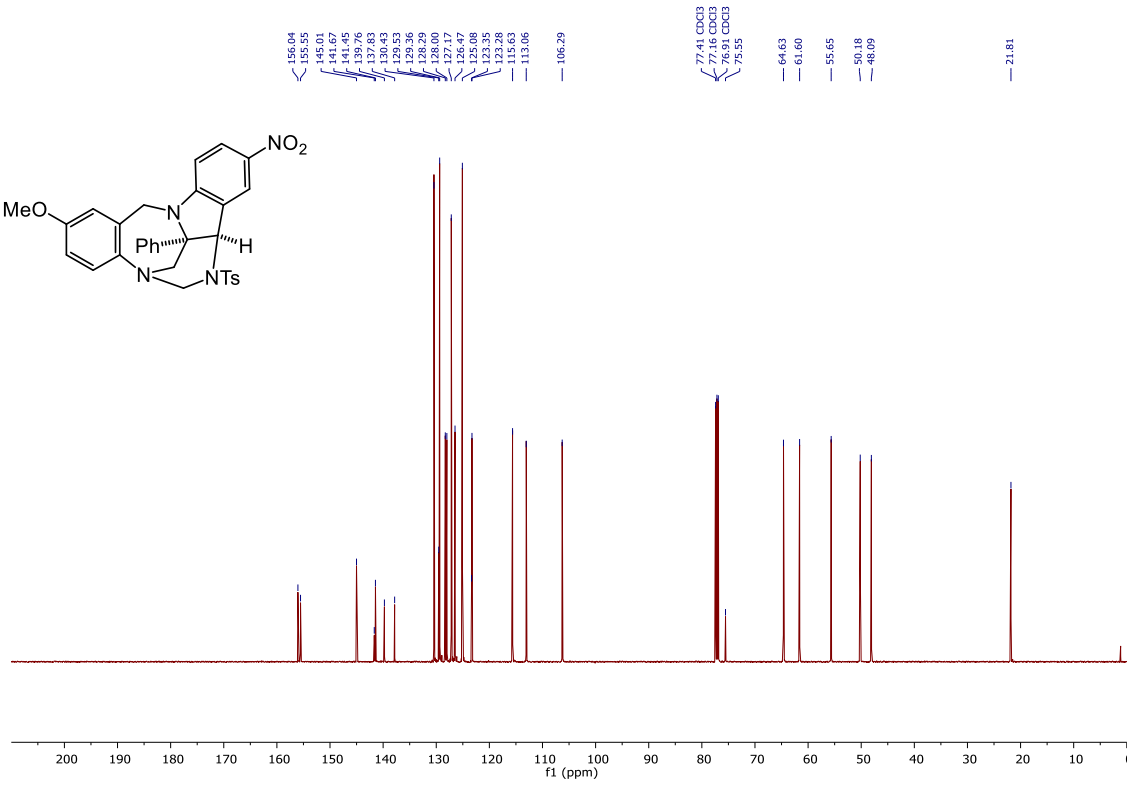
Compound 3aP. ^{13}C NMR ($CDCl_3$, 126 MHz)



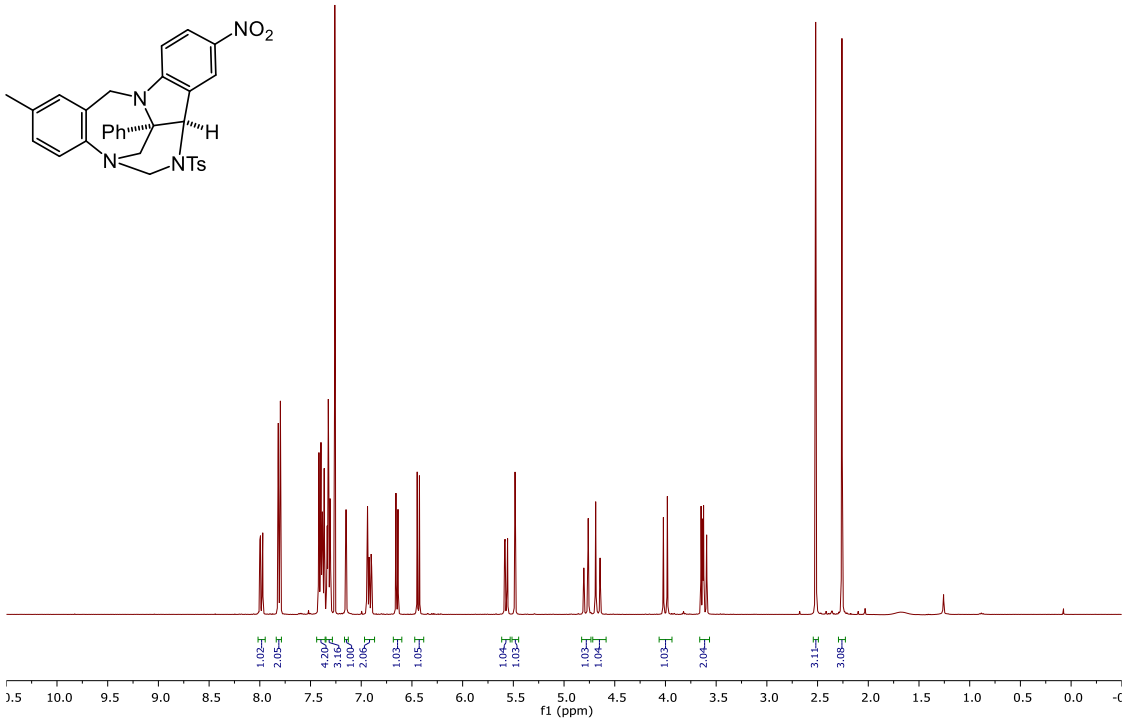
Compound 3lA. ^{1}H NMR ($CDCl_3$, 500 MHz)



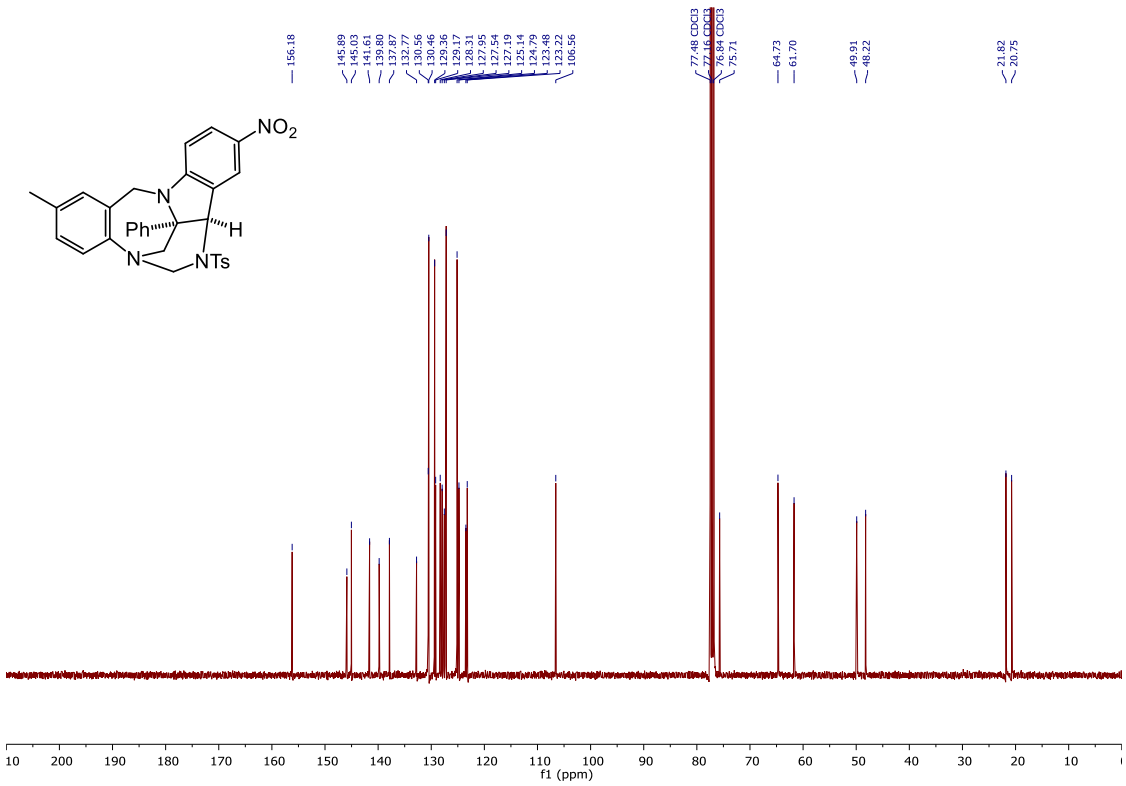
Compound 3lA. ^{13}C NMR ($CDCl_3$, 126 MHz)



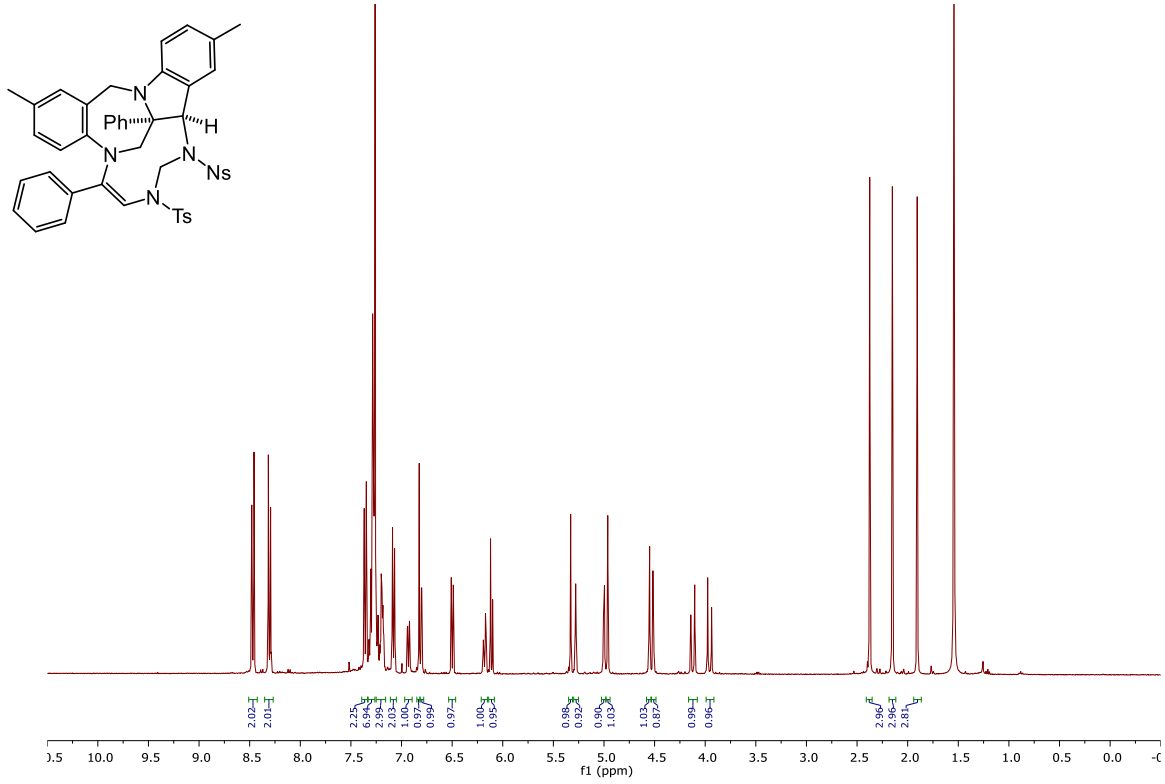
Compound 3mA. ^{1}H NMR ($CDCl_3$, 400 MHz)



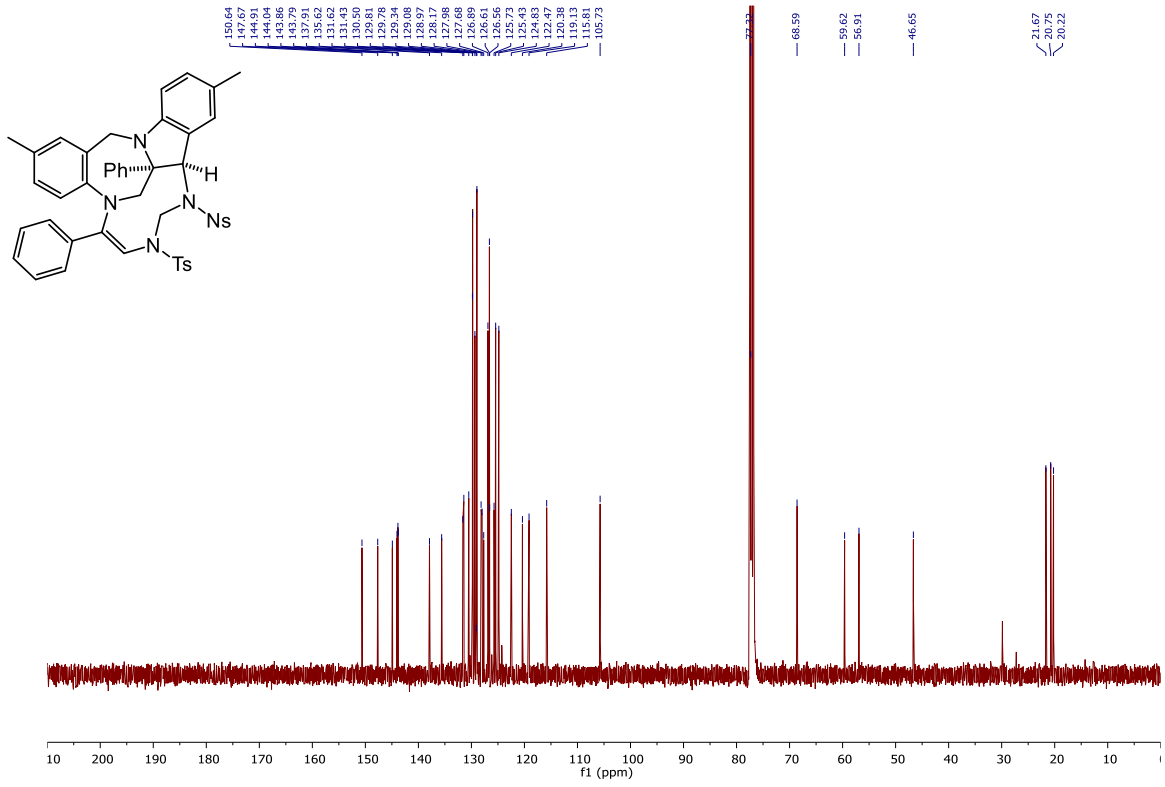
Compound 3mA. ^{13}C NMR ($CDCl_3$, 100 MHz)



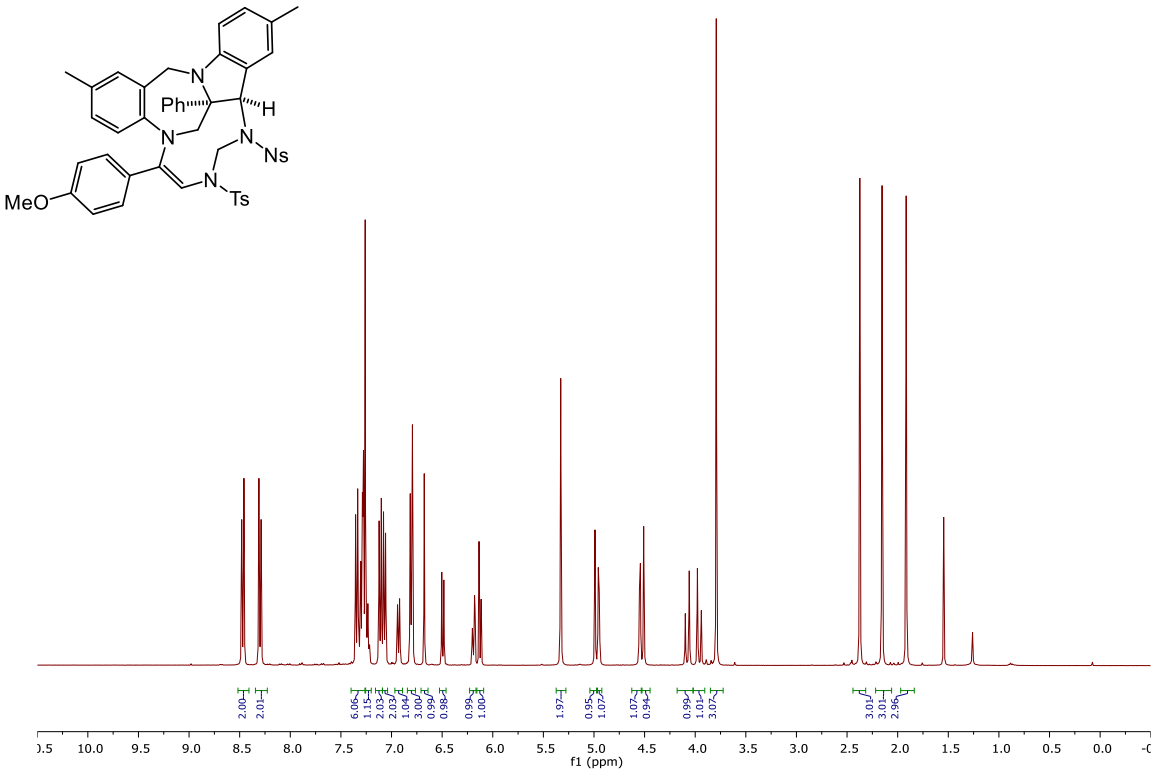
Compound 4A. ^{1}H NMR ($CDCl_3$, 400 MHz)



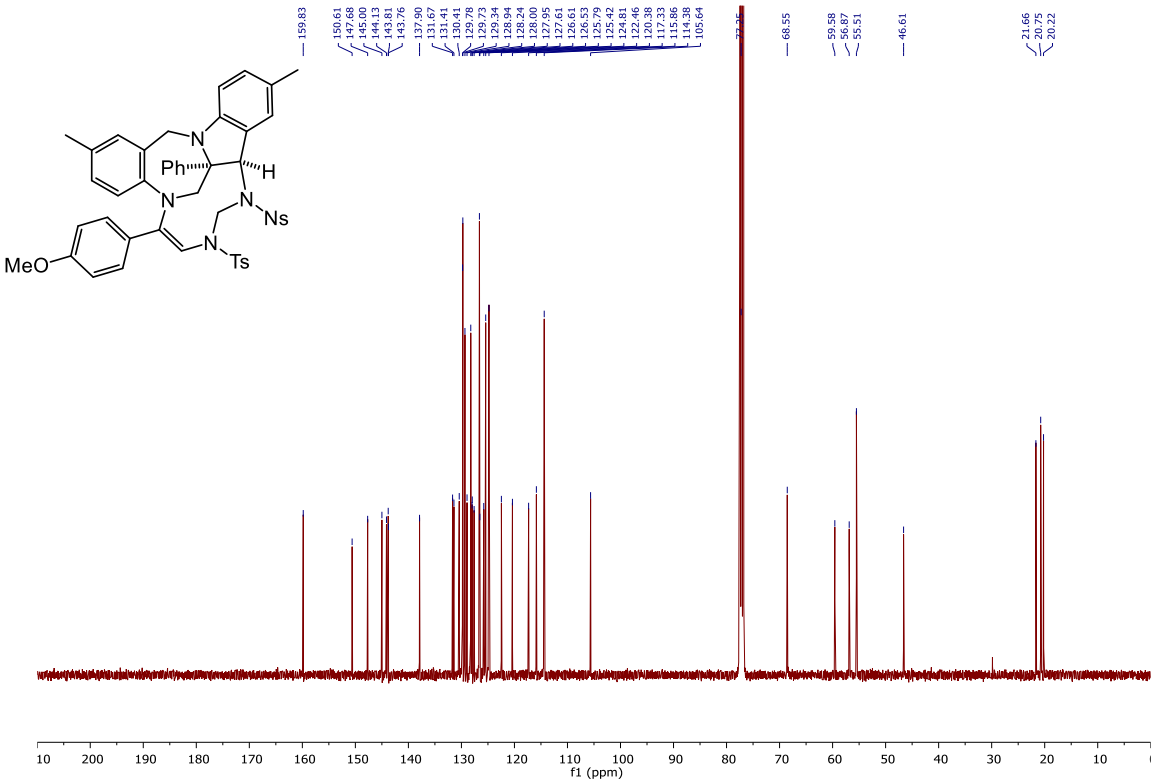
Compound 4A. ^{13}C NMR ($CDCl_3$, 100 MHz)



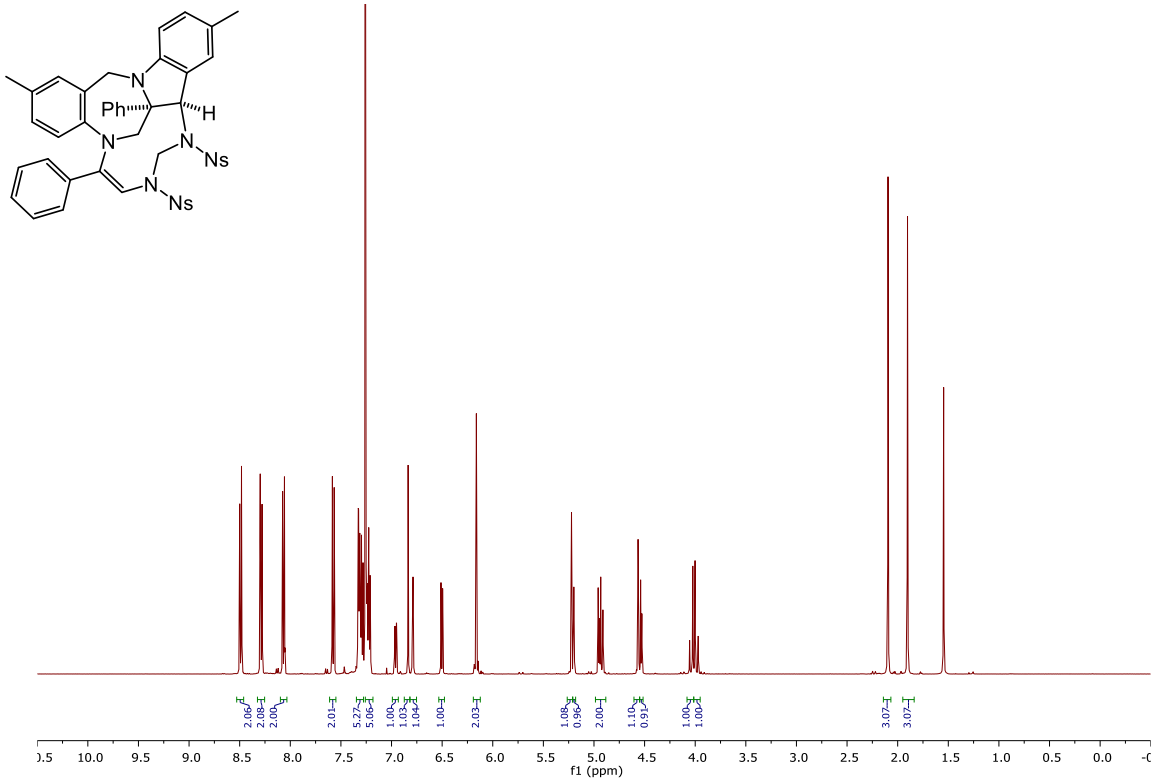
Compound 4B. ^{1}H NMR ($CDCl_3$, 400 MHz)



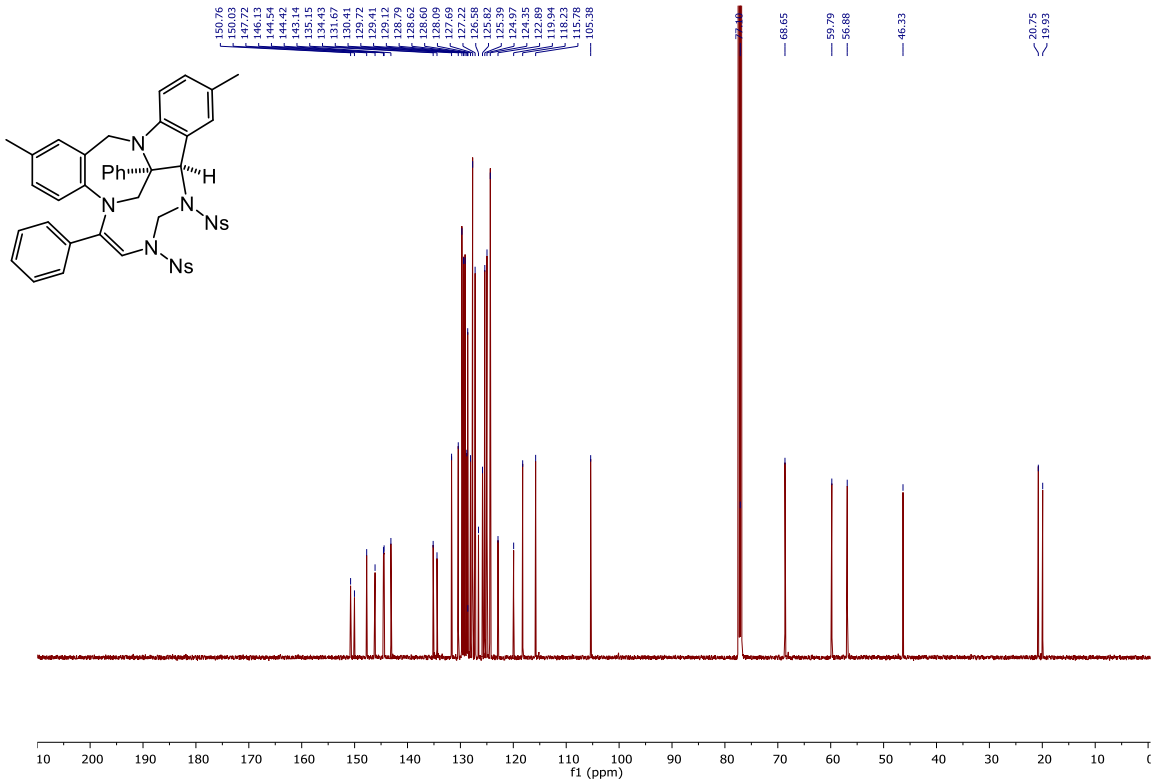
Compound 4B. ^{13}C NMR ($CDCl_3$, 100 MHz)



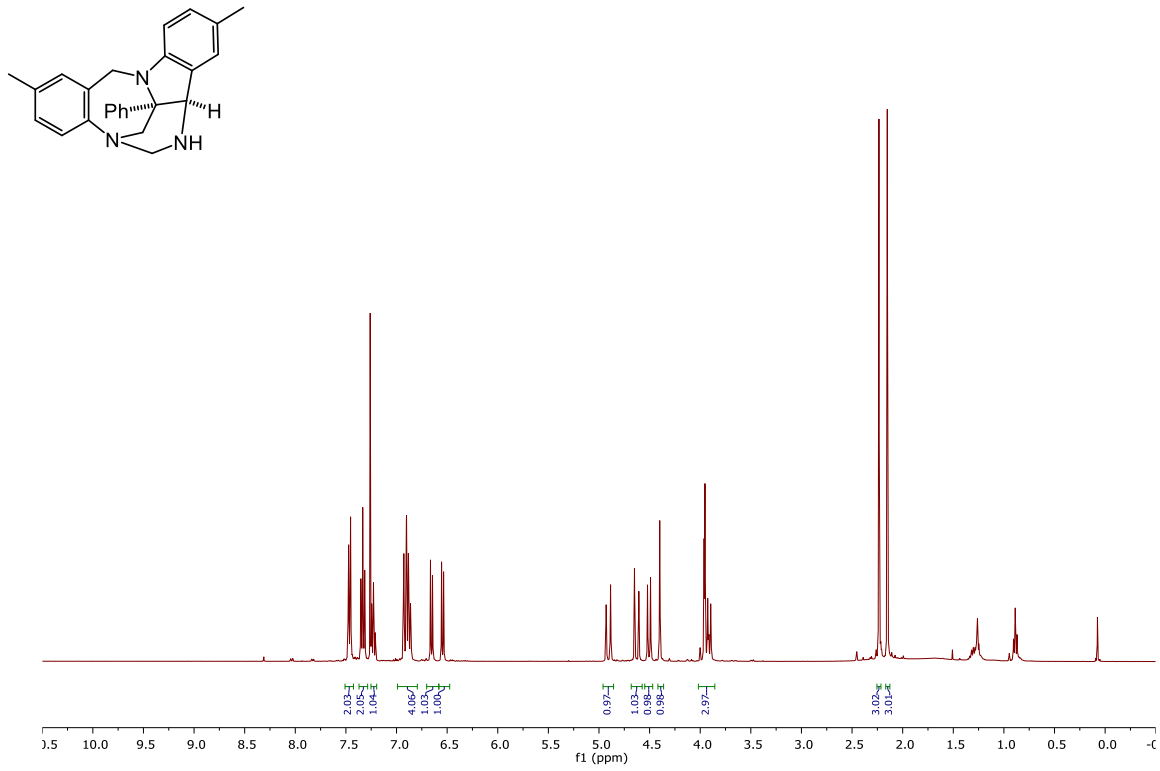
Compound 4O. ^{1}H NMR ($CDCl_3$, 500 MHz)



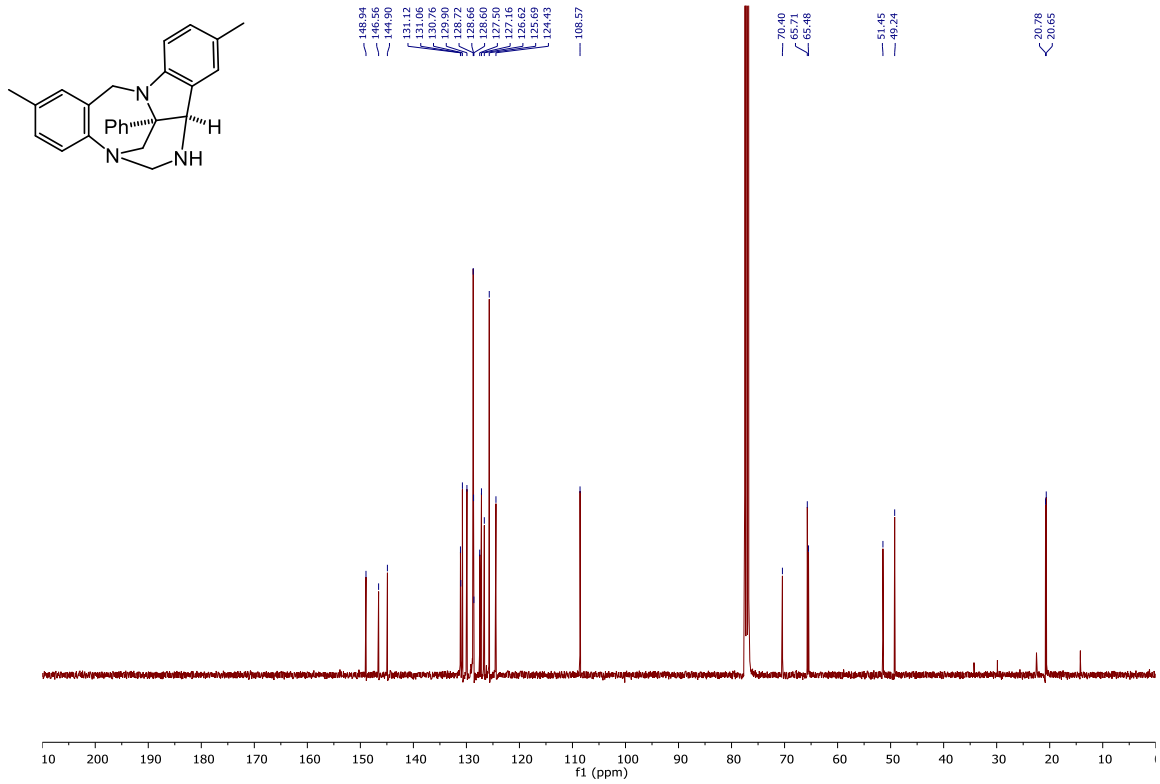
Compound 4O. ^{13}C NMR ($CDCl_3$, 126 MHz)



Compound 5. ^{1}H NMR ($CDCl_3$, 400 MHz)

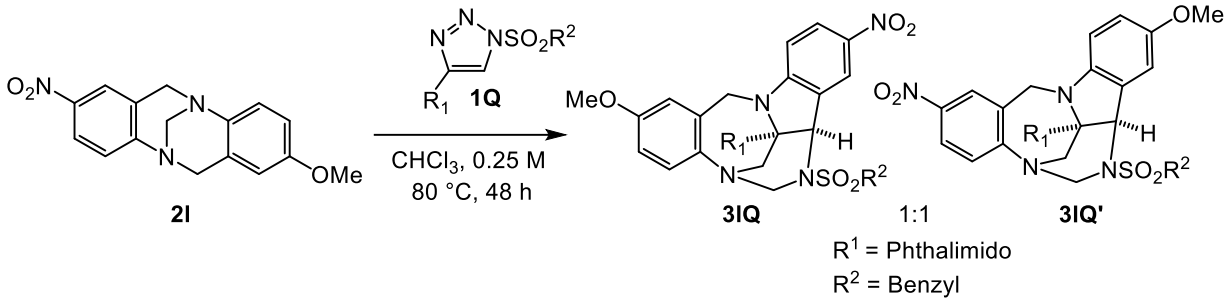


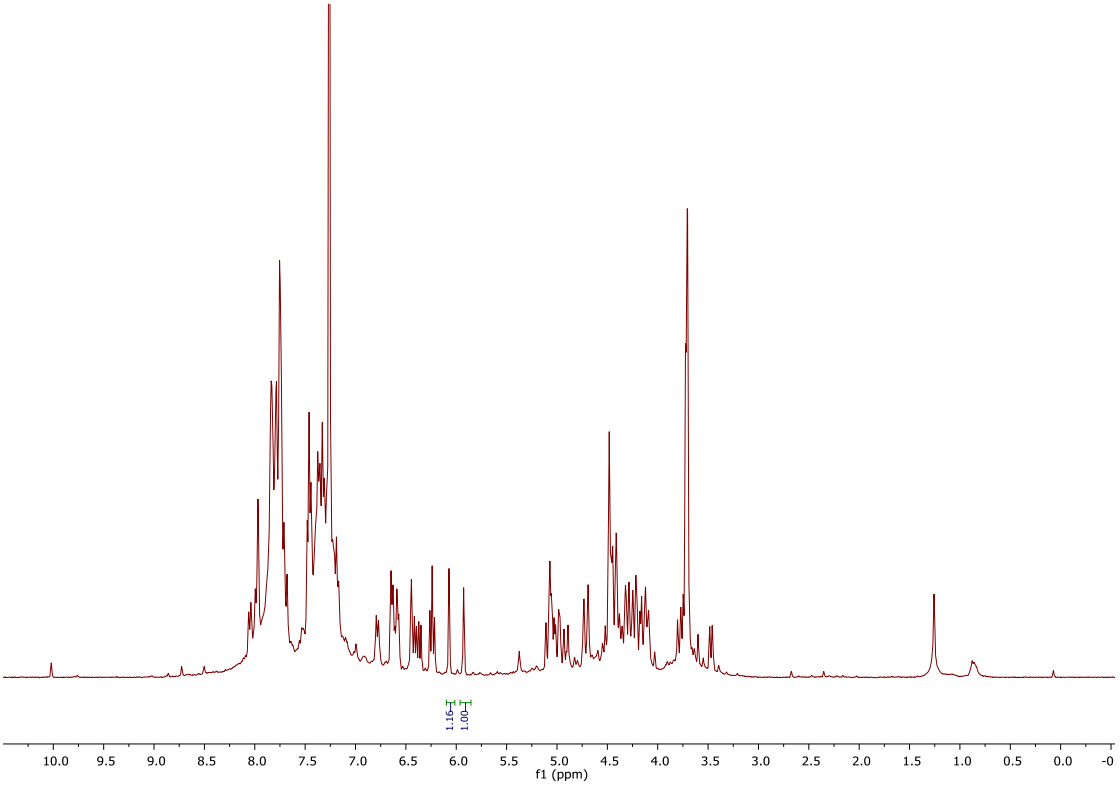
Compound 5. ^{13}C NMR ($CDCl_3$, 100 MHz)



8. Reactivity of 2l and 2m under thermal activation (metal-free) conditions

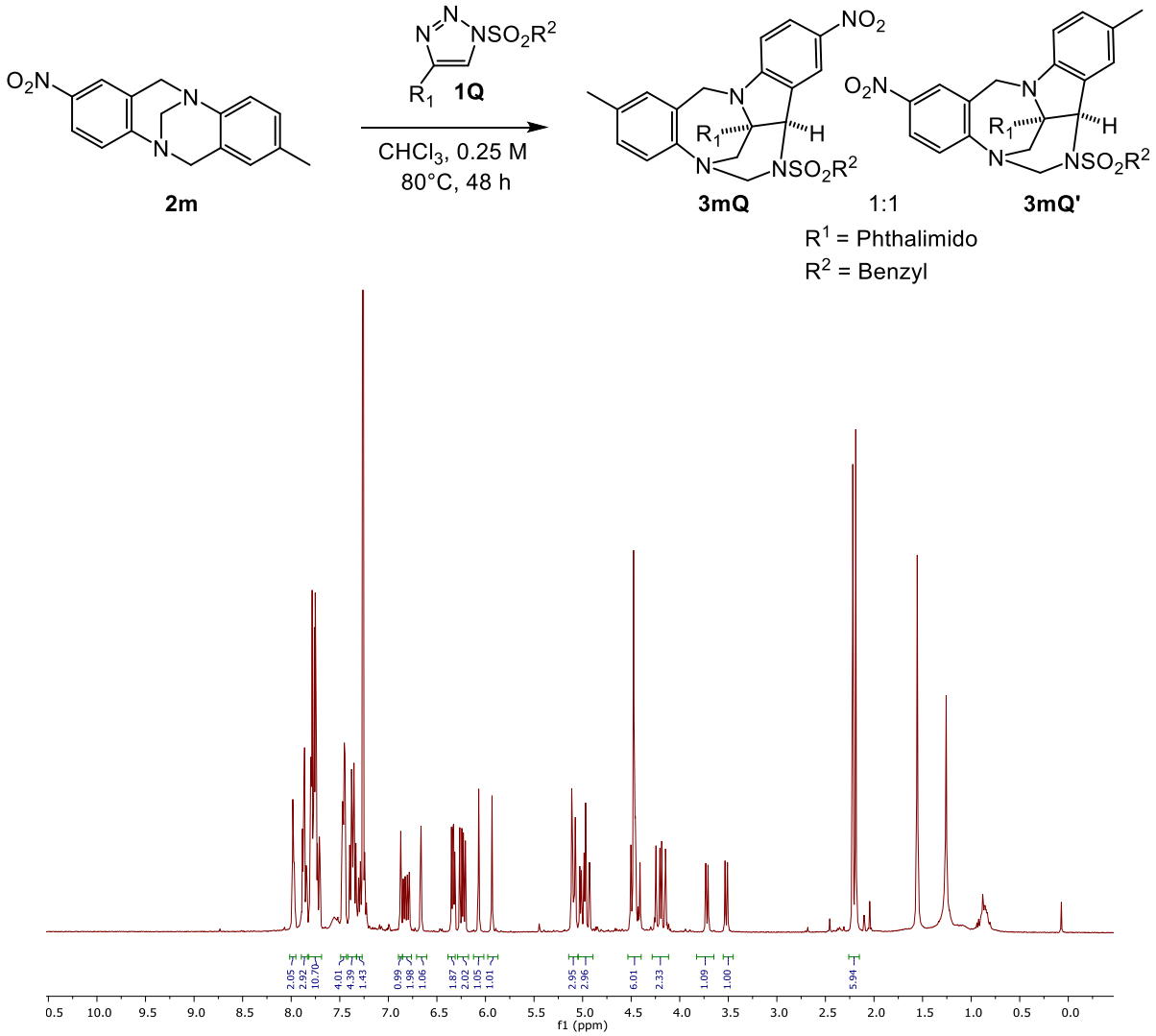
In a 2 mL screw-cap vial equipped with a magnetic stirring bar, Tröger's base **2l** (0.1 mmol, 1 equiv) and *N*-sulfonyltriazole **1Q** (0.15 mmol, 1.5 equiv) were dissolved in 0.4 mL of anhydrous $CHCl_3$ (0.25 M). The vial was capped and stirred at 80 °C for 48 h. The solution was concentrated under reduced pressure and the ^1H NMR of the crude mixture is recorded. As the separation/purification of both regioisomers was difficult by chromatography, the ratio is determined from the crude mixture.





Scheme S1. ^1H NMR of the crude reaction mixture of **1Q** with **2l**: 1:1 ratio of the two regioisomers.

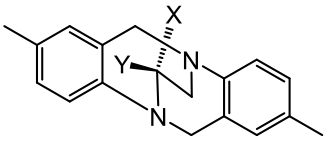
In a 2 mL screw-cap vial equipped with a magnetic stirring bar, Tröger's base **2m** (0.1 mmol, 1 equiv) and *N*-sulfonyltriazole **1Q** (0.15 mmol, 1.5 equiv) were dissolved in 0.4 mL of anhydrous $CHCl_3$ (0.25 M). The vial was capped and stirred at 80 °C for 48 h. The solution was concentrated under reduced pressure and the residue was purified by column chromatography (Pentane/EtOAc 6:4). An inseparable mixture of the two regioisomers is obtained. As the purification was difficult to carry out, the yield is not reported.



Scheme S2. ^{1}H NMR of the isolated mixture from reaction of **1Q** with **2m**.: 1:1 the two regioisomers.

9. Synthesis of compounds 2’ and 3’

Compound 2’:

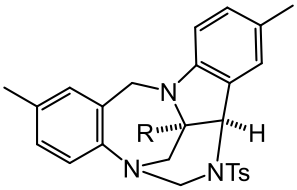


2' : X = CHO, Y = CO_2Et

In a screw cap vial, Tröger base **2a** (125 mg, 0.5 mmol) and CuTc (5 mol%) were dissolved in 1.3 mL of toluene. Then ethyl 2-diazo-3-oxopropanoate (0.75 mmol, 1.5 equiv) was added slowly to the reaction mixture. The resulting solution was stirred at 90°C for 16 h. After being cooled to 20 °C, solvent was evaporated and the residue was directly purified by column chromatography (silica gel, pentane/EtOAc 9:1) to afford compound **2’** as a yellow solid (87 mg, 48% yield).

R_f = 0.63 (Silica gel, pentane/EtOAc, 8:2); **IR (neat):** ṽ 1743, 1720, 1495, 1435, 1218, 1182, 1099, 1070, 1011, 962, 890, 824 cm^{-1};
Major diastereoisomer: **^{1}H NMR (400 MHz, $CDCl_3$):** δ 9.37 (d, *J* = 1.8 Hz, 1H), 7.31 (d, *J* = 8.0 Hz, 1H), 7.00 (d, *J* = 7.9 Hz, 1H), 6.94 (dd, *J* = 8.1, 2.1 Hz, 1H), 6.88 (dd, *J* = 8.1, 2.1 Hz, 1H), 6.71 (s, 1H), 6.58 (s, 1H), 4.77 (d, *J* = 17.9 Hz, 1H), 4.52 (d, *J* = 15.2 Hz, 1H), 4.42 (d, *J* = 18.0 Hz, 1H), 4.31 (d, *J* = 17.7 Hz, 1H), 4.26-4.15 (m, 3H), 3.84 (dt, *J* = 15.2, 1.5 Hz, 1H), 2.18 (s, 3H), 2.17 (s, 3H), 1.27 (t, *J* = 7.1 Hz, 3H) ppm; **^{13}C NMR (100 MHz, $CDCl_3$):** δ 193.9 (C), 167.6 (C), 146.7 (C), 142.3 (C), 136.6 (C), 136.0 (C), 135.0 (C), 133.9 (C), 130.6 (CH), 129.4 (CH), 128.82 (CH), 128.79 (CH), 128.4 (CH), 128.3 (CH), 82.3 (C), 62.4 (CH_2), 59.6 (CH_2), 57.3 (CH_2), 56.2 (CH_2), 21.0 (CH_3), 20.9 (CH_3), 14.2 (CH_3) ppm;
Minor diastereoisomer: **^{1}H NMR (400 MHz, $CDCl_3$):** δ 9.82 (s, 1H), 7.17 (d, *J* = 8.0 Hz, 1H), 7.04 (d, *J* = 8.0 Hz, 1H), 6.90 (td, *J* = 7.8, 2.1 Hz, 2H), 6.68 (s, 1H), 6.62 (s, 1H), 4.70 (d, *J* = 17.5 Hz, 1H), 4.59 (d, *J* = 15.4 Hz, 1H), 4.49 (d, *J* = 17.8 Hz, 1H), 4.42-4.25 (m, 2H), 3.99 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.87 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.65 (dd, *J* = 15.5, 1.4 Hz, 1H), 2.17 (s, 3H), 2.16 (s, 3H), 0.83 (t, *J* = 7.1 Hz, 3H) ppm; **^{13}C NMR (100 MHz, $CDCl_3$):** δ 198.6 (C), 167.2 (C), 146.9 (C), 143.1 (C), 136.5 (C), 135.9 (C), 135.8 (C), 134.8 (C), 130.6 (CH), 128.9 (CH), 128.6 (CH), 128.4 (CH), 128.3 (CH), 128.1 (CH), 82.5 (C), 62.4 (CH_2), 59.7 (CH_2), 57.5 (CH_2), 56.2 (CH_2), 20.94 (CH_3), 20.87 (CH_3), 13.6(CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{29}H_{32}N_3O_4S$ $[M+H]^+$: 518.2108 m/z; Found: 518.2127 m/z.

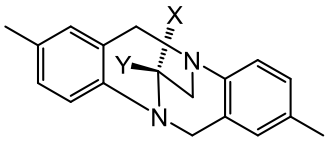
Compound 3’:



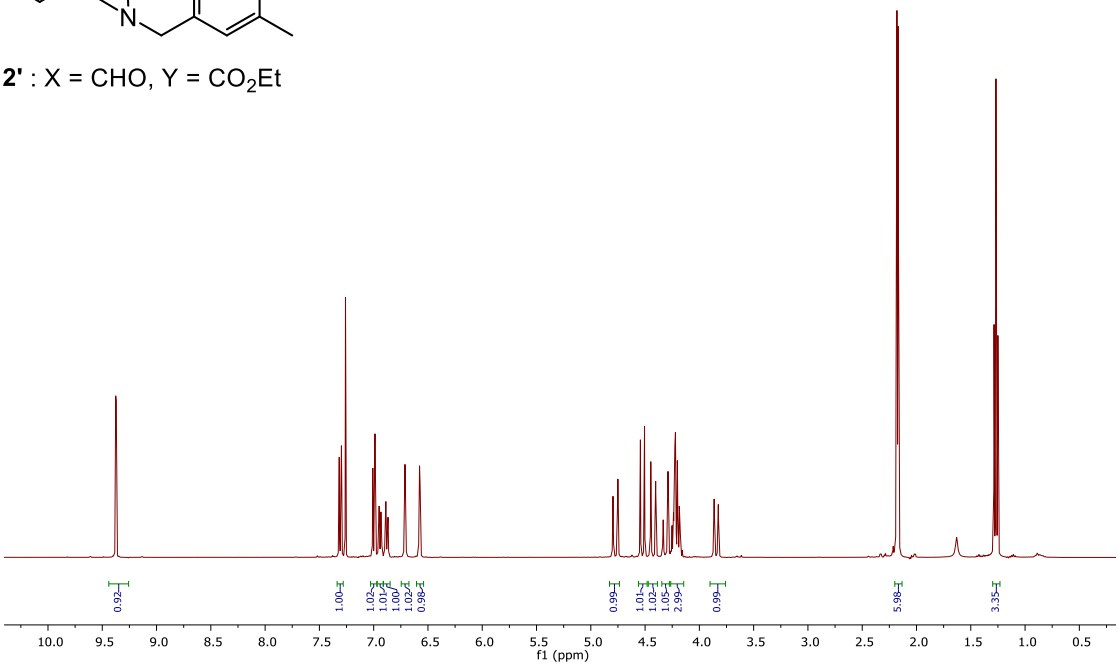
R = COOEt

Following a procedure reported in the literature[6], compound **3’** is obtained as a white solid (10 mg, 32% yield) starting from tosyl amine (10 mg, 0.06 mmol) and Tröger base **2’**(33 mg, 0.18 mmol, 3 equiv). with 10 mol% of antrhanilic acid.
Purification: column chromatography (silica gel, pentane/EtOAc, 8:2)
R_f = 0.33 (Silica gel, pentane/EtOAc, 8:2); **IR (neat):** ṽ 1734, 1615, 1496, 1397, 1348, 1263, 1206, 1162, 1091, 1035, 960, 813, 660 cm^{-1}; **^{1}H NMR (500 MHz, $CDCl_3$):** δ 7.88 (d, *J* = 8.3 Hz, 2H), 7.36 (d, *J* = 7.7 Hz, 2H), 6.88-6.74 (m, 4H), 6.42 (d, *J* = 8.0 Hz, 1H), 6.32 (d, *J* = 8.1 Hz, 1H), 6.11 (s, 1H), 5.30 (dd, *J* = 10.4, 1.3 Hz, 1H), 4.88 (d, *J* = 17.6 Hz, 1H), 4.44 (d, *J* = 17.7 Hz, 1H), 4.19 (m, 2H), 3.79-3.65 (m, 2H), 2.85 (d, *J* = 15.7 Hz, 1H), 2.46 (s, 3H), 2.20 (s, 3H), 2.13 (s, 3H), 1.28 (t, *J* = 7.1 Hz, 3H) ppm; **^{13}C NMR (126 MHz, $CDCl_3$):** δ 171.2 (C), 148.0 (C), 146.0 (C), 143.9 (C), 137.9 (C), 131.7 (C), 131.1 (CH), 130.8 (CH), 130.1 (2xCH), 129.0 (C), 128.5 (CH), 128.3 (C), 127.4 (2xCH), 126.4 (CH), 123.5 (C), 123.3 (CH), 109.7 (CH), 73.3 (C), 62.3 (CH_2), 61.8 (CH_2), 60.4 (CH), 49.9 (CH_2), 46.7 (CH_2), 21.8 (CH_3), 20.8 (CH_3), 20.7 (CH_3), 14.4 (CH_3) ppm; **HR-MS (ESI):** Calculated for $C_{29}H_{32}N_3O_4S$ $[M+H]^+$: 518.2108 m/z; Found: 518.2127 m/z.

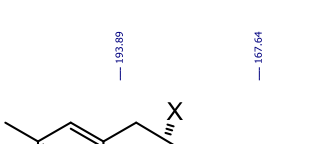
Compound 2'. ^{1}H NMR ($CDCl_3$, 400 MHz) Major diastereoisomer



2' : X = CHO, Y = CO_2Et

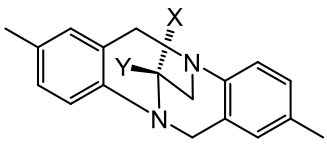


Compound 2'. ^{13}C NMR ($CDCl_3$, 100 MHz) Major diastereoisomer

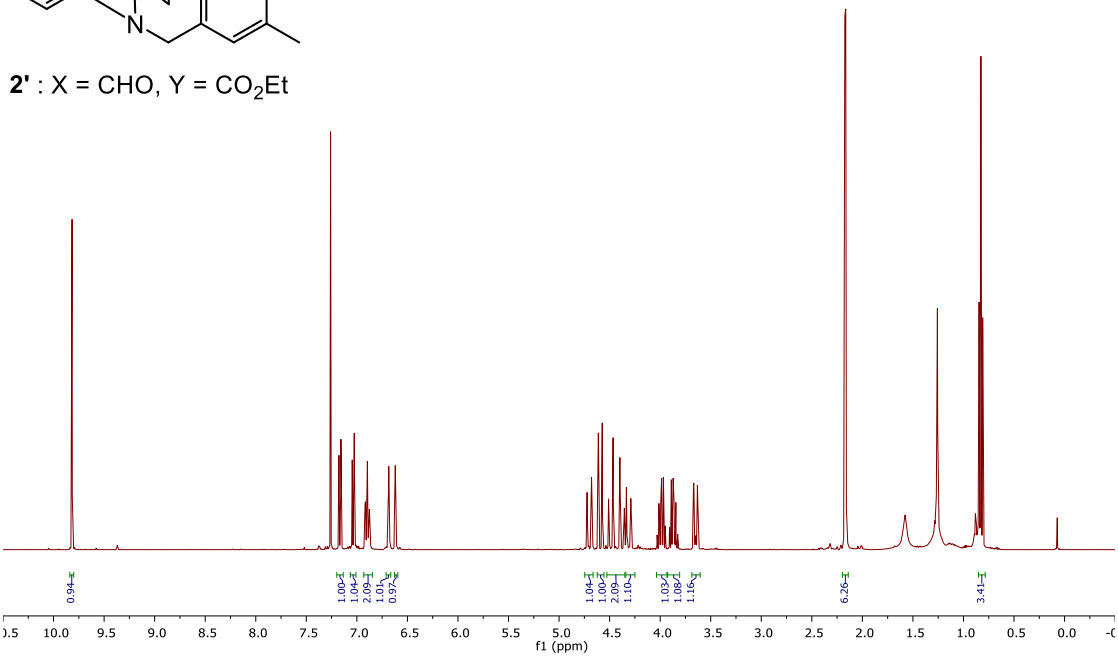


2' : X = CHO, Y = CO_2Et

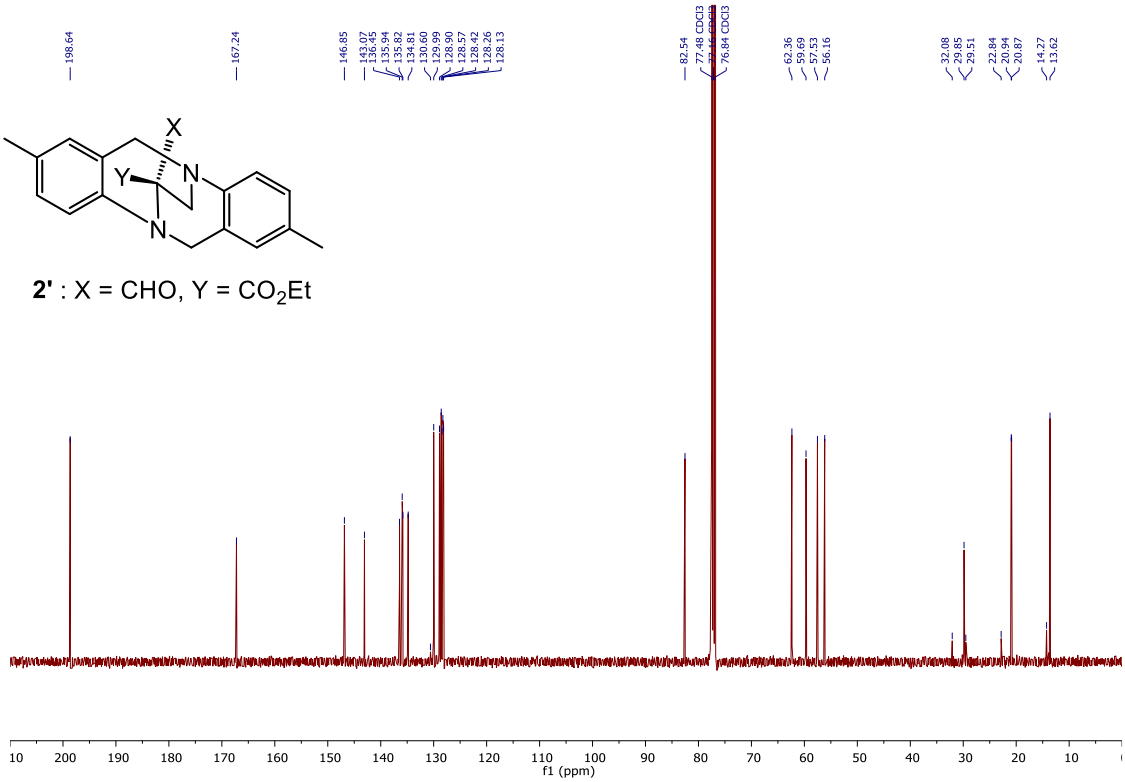
Compound 2'. ^{1}H NMR ($CDCl_3$, 400 MHz) Minor diastereoisomer



2' : X = CHO, Y = CO_2Et

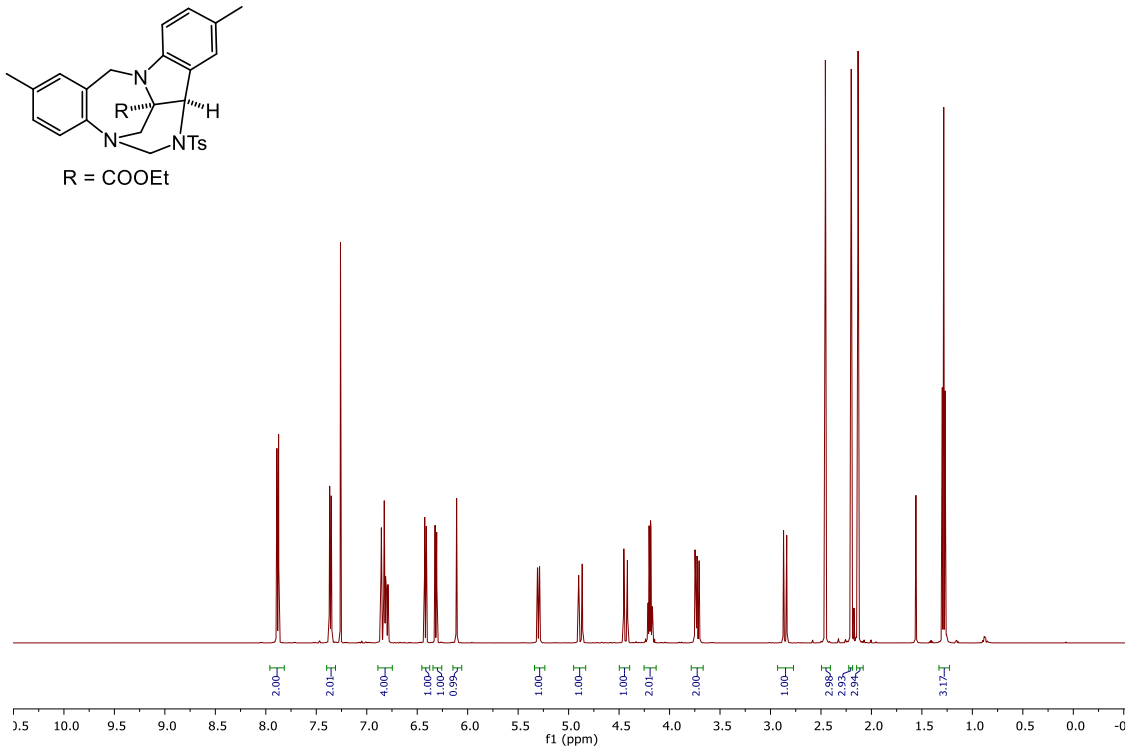


Compound 2'. ^{13}C NMR ($CDCl_3$, 100 MHz) Minor diastereoisomer

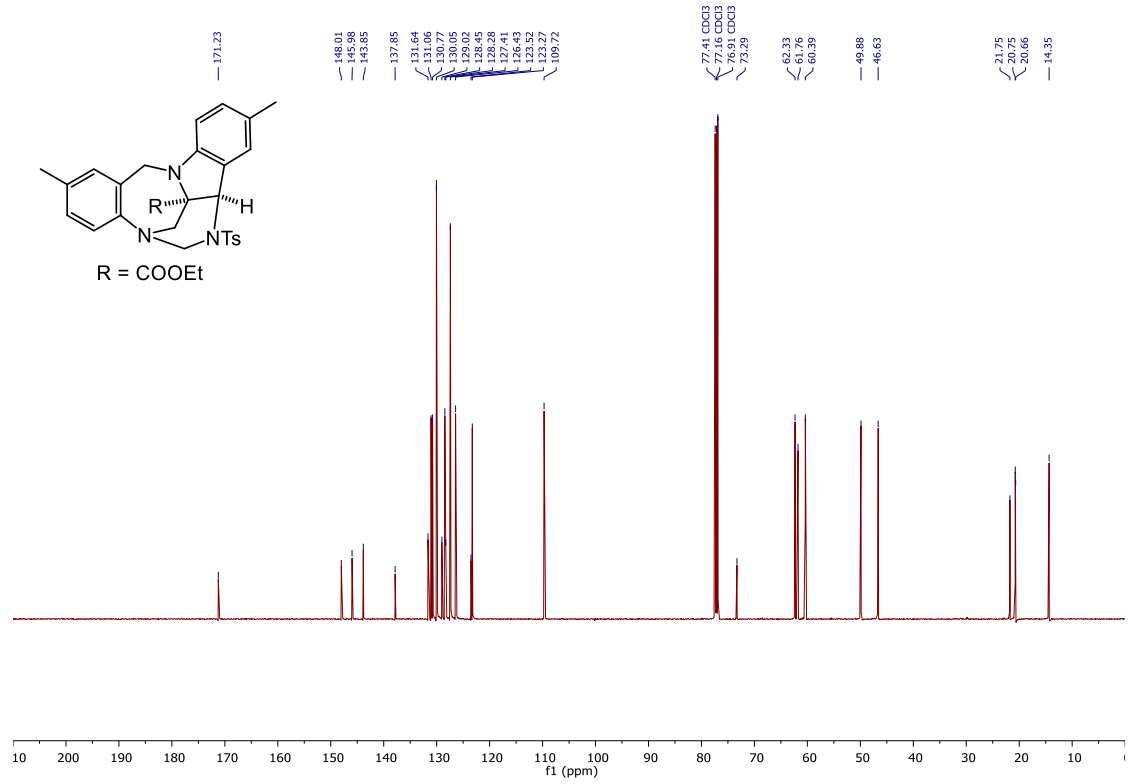


2' : X = CHO, Y = CO_2Et

Compound 3'. ^{1}H NMR ($CDCl_3$, 500 MHz)



Compound 3'. ^{13}C NMR ($CDCl_3$, 126 MHz)



10. Crystallographic data

All data were collected on a Rigaku Supernova diffractometer using Cu Kα radiation. The crystal was mounted on a Mitegen cryoloop and hold at 180K in the cold stream of a cryostream (oxford cryosystems). Structures were solved SIR2004[7], olex2[8] or shelxt[9] and refined in the SHELXL[10] program within the Olex2 Software.

Compound 3aA

Table S2. Crystal data and structure refinement for compound_**3aA.**

CCDC number	**1832810**	
Empirical formula	C32 H31 N3 O2 S	
Formula weight	521.66	
Temperature	180.00(14) K	
Wavelength	1.5418 Å	
Crystal system	Monoclinic	
Space group	P 1 21/n 1	
Unit cell dimensions	a = 11.06311(19) Å	α= 90°
	b = 16.1063(4) Å	β= 93.3032(16)°
	c = 14.3748(3) Å	γ = 90°
Volume	2557.14(9) $Å^3$	
Z	4	
Density (calculated)	1.355 Mg/m^3	
Absorption coefficient	1.407 mm^{-1}	
F(000)	1104	
Crystal size	0.1788 x 0.133 x 0.028 mm^3	
Theta range for data collection	4.126 to 73.342°.	
Index ranges	-13<=h<=13, -17<=k<=19, -17<=l<=16	
Reflections collected	20453	
Independent reflections	5050 [R(int) = 0.0301]	
Completeness to theta = 67.680°	99.8 %	
Absorption correction	Analytical	
Max. and min. transmission	0.962 and 0.835	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	5050 / 0 / 346	
Goodness-of-fit on F^2	1.028	
Final R indices [I>2sigma(I)]	R1 = 0.0379, wR2 = 0.0959	
R indices (all data)	R1 = 0.0497, wR2 = 0.1028	
Extinction coefficient	n/a	
Largest diff. peak and hole	0.222 and -0.348 $e.Å^{-3}$	

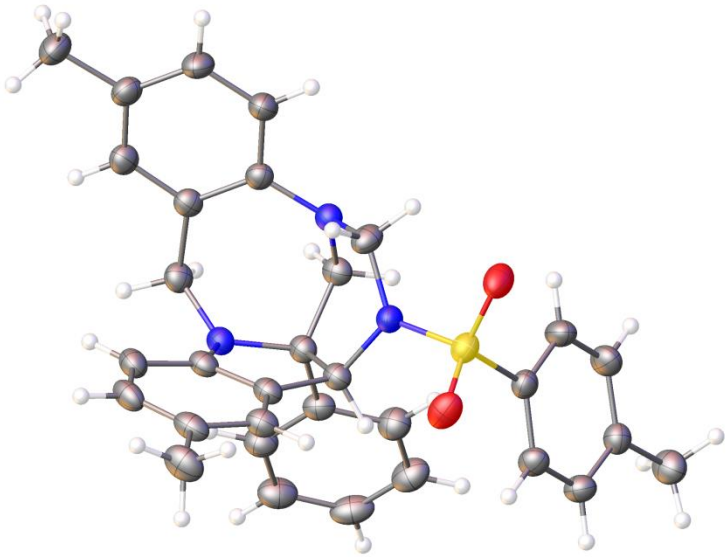


Figure S1. View of the asymmetric unit (displacement ellipsoids are depicted at 50 percent probability level)

Compound 3lA

Table S2. Crystal data and structure refinement for compound_**3lA**..

CCDC number	**1832811**	
Empirical formula	C31 H28 N4 O5 S	
Formula weight	568.63	
Temperature	179.9(2) K	
Wavelength	1.54184 Å	
Crystal system	Monoclinic	
Space group	P 1 21/n 1	
Unit cell dimensions	a = 11.23463(12) Å	α= 90°
	b = 15.96591(15) Å	β= 98.0040(10)°
	c = 14.91002(14) Å	γ = 90°
Volume	2648.37(5) $Å^3$	
Z	4	
Density (calculated)	1.426 Mg/m^3	
Absorption coefficient	1.508 mm^{-1}	
F(000)	1192	
Crystal size	0.3559 x 0.2352 x 0.1567 mm^3	
Theta range for data collection	4.078 to 73.478°.	
Index ranges	-13<=h<=10, -19<=k<=19, -18<=l<=18	
Reflections collected	22701	
Independent reflections	5282 [R(int) = 0.0332]	

Completeness to theta = 67.684°	100.0 %
Absorption correction	Analytical
Max. and min. transmission	0.822 and 0.702
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	5282 / 159 / 443
Goodness-of-fit on F^2	1.043
Final R indices [I>2sigma(I)]	R1 = 0.0362, wR2 = 0.0910
R indices (all data)	R1 = 0.0419, wR2 = 0.0959
Extinction coefficient	n/a
Largest diff. peak and hole	0.246 and -0.421 e.$Å^{-3}$

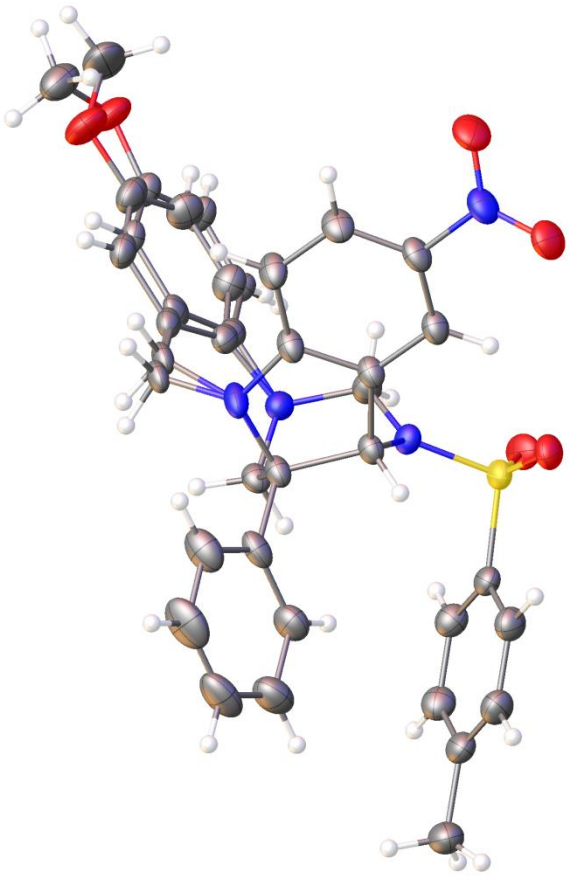


Figure S2. View of the asymmetric unit (displacement ellipsoids are depicted at 50 percent probability level)

COMMENTS: One part of the molecule is disordered and was refined using two components. Restraints were applied on the bond lengths and on the anisotropic displacement parameters Constraints were also applied on some displacement parameters:

SADI O17A C15A O17B C15B

SADI O17A C18A O17B C18B

SADI C15B C14B C15A C14A C16A C15A C16B C15B

SADI C13A C12A C13B C12B C14A C13A C14B C13B C12A C11A C12B C11B C16B C11B C16A C11A

SADI N3 C12A N3 C12B

SADI N9 C10B N9 C10A

SADI C11B C10A C11A C10B

RIGU O17A C14A C15A C12A C10B C18A C16A C13A C11A

RIGU O17B C13B C14B C10A C11B C15B C16B C12B C18B

EADP C10B C10A

EADP C12A C12B

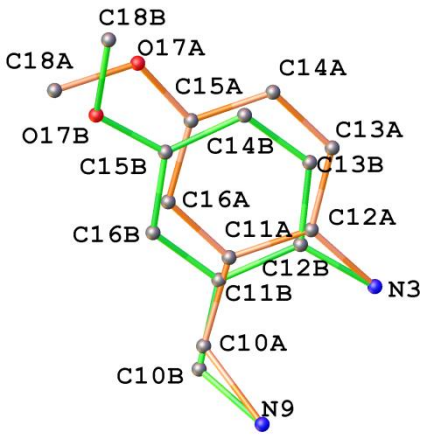


Figure S3. Numbering of the disordered parts A (orange) and B (green)

Compound 4O

Table S2. Crystal data and structure refinement for compound_**4O.**

CCDC number	**1832809**	
Empirical formula	C45 H38 N6 O8 S2	
Formula weight	854.93	
Temperature	180.1(6) K	
Wavelength	1.54184 Å	
Crystal system	Triclinic	
Space group	P-1	
Unit cell dimensions	a = 10.3882(9) Å	α= 83.792(7)°
	b = 11.7539(10) Å	β= 85.494(7)°
	c = 16.4258(13) Å	γ = 78.477(7)°
Volume	1950.3(3) $Å^3$	
Z	2	
Density (calculated)	1.456 Mg/m^3	
Absorption coefficient	1.793 mm^{-1}	

F(000)	892
Crystal size	0.542 x 0.093 x 0.012 mm^3
Theta range for data collection	3.855 to 73.759°.
Index ranges	-12<=h<=10, -14<=k<=12, -20<=l<=20
Reflections collected	12601
Independent reflections	7618 [R(int) = 0.0505]
Completeness to theta = 67.684°	99.6 %
Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	1.00000 and 0.68168
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	7618 / 0 / 552
Goodness-of-fit on F^2	1.047
Final R indices [I>2sigma(I)]	R1 = 0.0663, wR2 = 0.1646
R indices (all data)	R1 = 0.1028, wR2 = 0.1880
Extinction coefficient	n/a
Largest diff. peak and hole	1.152 and -0.459 e.$Å^{-3}$

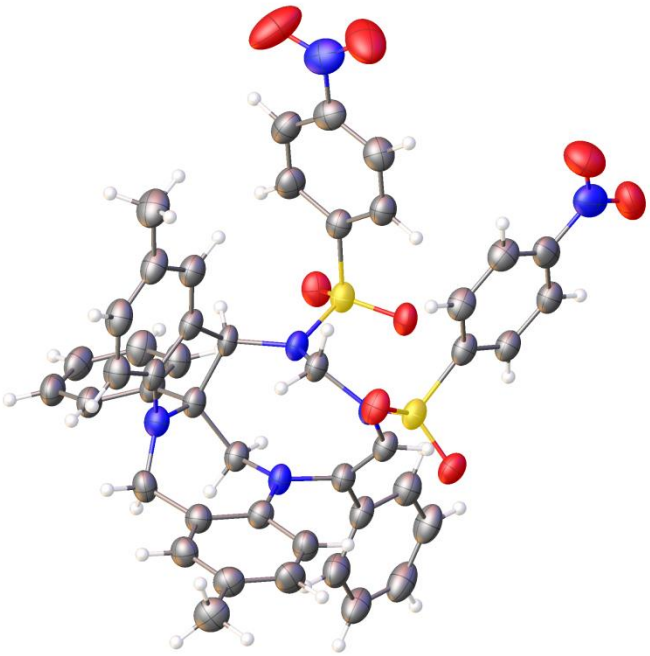


Figure S4. View of the asymmetric unit (displacement ellipsoids are depicted at 50 percent probability level)

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