Supporting Information

Metal Free Regio – and Stereoselective Semireduction of CF_3-Substituted *N*-Allenamides

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Contents

General remarks

All reactions were carried out under an inert atmosphere of argon in dried glassware, unless otherwise noted. Conventional solvents (THF, Et_2O, CH_2Cl_2) are stored on molecular sieves and sampled under argon. Toluene, CH_3CN, acetic acid, were used as received.

NMR Spectra (^1H, ^{13}C, ^{19}F) were performed at 298 K. ^1H (500 MHz or 300 MHz) and ^{13}C (126 MHz) NMR chemical shifts are reported relative to residual protiated solvent. ^{19}F (281 MHz or 471 MHz) NMR chemical shifts are reported without any calibration. Data are presented as follows: chemical shift (ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, hept = heptet, m = multiplet, br = broad), coupling constant *J* (Hz) and integration.

HRMS data were recorded on a microTOF spectrometer equipped with an orthogonal electrospray (ESI) interface.

Thin layer chromatography was performed using Merck TLC silica gel 60 F_{254} aluminum sheets using petroleum ether/EtOAc as eluant and visualized using permanganate stain, ninhydrin stain, vanillin stain and/or UV light. Merck Geduran® 40-63 µm silica gel was used for column chromatography.

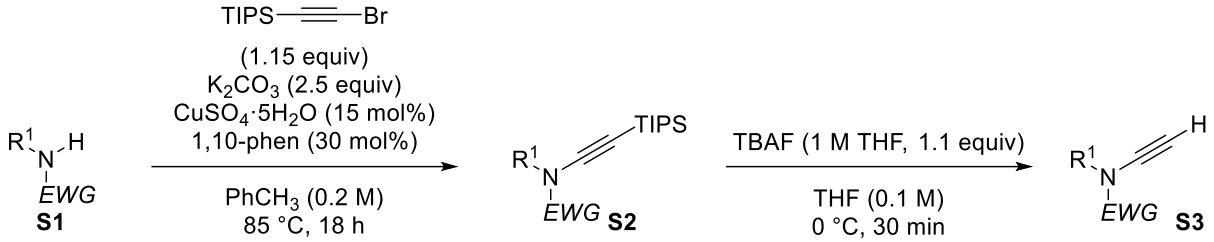
Biotage® Isolera™ One system was used for *flash* chromatography. The wavelength of the UV-detector was calibrated at 254 and 365 nm.

Infrared spectra were reported in frequency of absorption using Alpha Bruker Optics spectrometer.

Melting points were recorded with a SMP3 Stuart Scientific microscope in open capillary tubes and are uncorrected

Experimental procedure

General procedure for preparation of Ynamides[1]



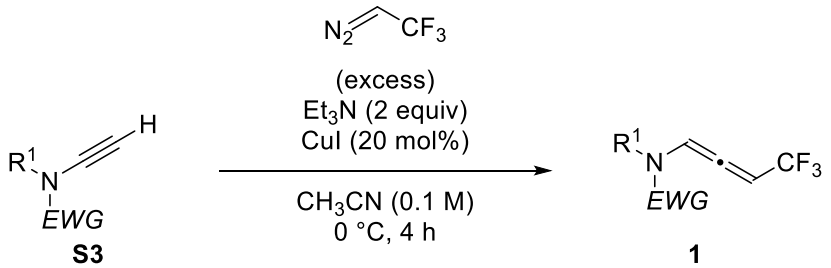
The (2-bromoethynyl)tris(propan-2-yl)silane was synthesized according to the literature.[2]

In a Schlenk tube was introduced $CuSO_4 \cdot 5H_2O$ (0.3 mmol, 15 mol%), 1,10-phenanthroline (0.6 mmol, 30 mol%), K_2CO_3 (5 mmol, 2.5 equiv), the sulfonamide **S1** (2 mmol, 1 equiv), anhydrous toluene (0.2 M) and the bromo-acetylenic (2.3 mmol, 1.15 equiv). The reaction mixture was heated to 85 °C with an oil bath for 18 h and then cooled down to room temperature, filtered on a pad of Celite® and washed profusely with EtOAc. The filtrate was then concentrated under vacuum. The crude material was purified by column chromatography on silica gel using a mixture petroleum ether/EtOAc as eluent to afford the desired product **S2**.

TIPS protected ynamide **S2** (2.8 mmol, 1 equiv) was dissolved in dry THF (30 mL, 0.1 M) and cooled at 0 °C. A TBAF solution (3.1 mmol, 1.1 equiv, 1 M in THF) was added dropwise and the resulting mixture was stirred at 0 °C during 30 min and then hydrolyzed with water. The aqueous layer was extracted with Et_2O (3x). The combined organic layers were washed with a saturated solution of NaCl, dried (Na_2SO_4), filtered and concentrated under vacuum. The crude material was purified by column chromatography on silica gel using a mixture petroleum ether/EtOAc, as eluent or just by washing with *n*-pentane and diethyl ether to afford the desired product **S3**.

General procedure for preparation of *N*-allenamides

Trifluorinated N-allenamides[3] ***1***



[1] (a) Y. Zhang, R. P. Hsung, M. R. Tracey, K. C. M. Kurtz and E. L. Vera, *Org. Lett*., 2004, **6**, 1151–1154. (b) X. Zhang, R. P. Hsung, H. Li, Y. Zhang, W. L. Johnson and R. Figueroa, *Org. Lett*., 2008, **10**, 3477–3479.

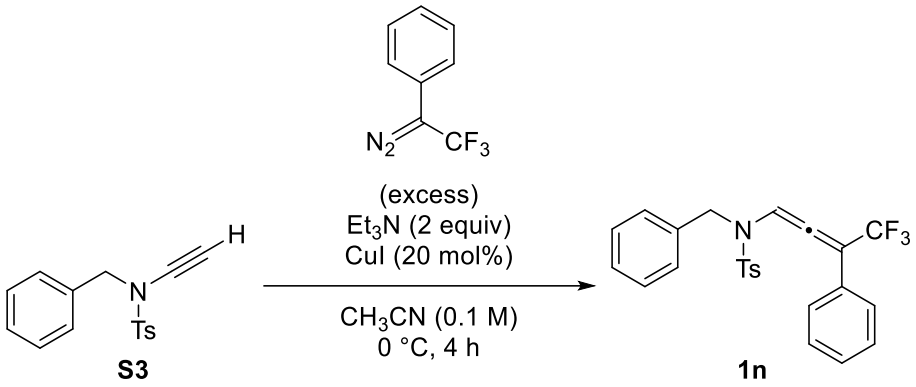
[2] H. Hofmeister, K. Annen, H. Laurent and R. Wiechert, *Angew. Chem. Int. Ed*. 1984, **23**, 727–729.

[3] Y. Zheng, B. Moegle, S. Ghosh, A. Perfetto, D. Luise, I. Ciofini and L. Miesch, *Chem. Eur. J*. 2022, **28**, e202103598.

1,1,1-trifluoro-diazoethane was synthesized according to the previous literature and stored in diethyl ether solution in the presence of Na_2SO_4 at -18 °C for a few weeks.[4]

Ynamide **S3** (0.2 mmol, 1 equiv) was dissolved in dry CH_3CN (0.1 M) in the presence of CuI (0.04 mmol, 20 mol%), and triethylamine (0.4 mmol, 2 equiv). A diethyl ether 1,1,1-trifluoro-diazoethane solution was added dropwise (in excess) and the reaction was stirred for 4 h at 0 °C. The mixture was concentrated under vacuum and the crude material was purified by column chromatography on silica gel using a mixture petroleum ether/EtOAc, as eluent to afford the desired products **1**.

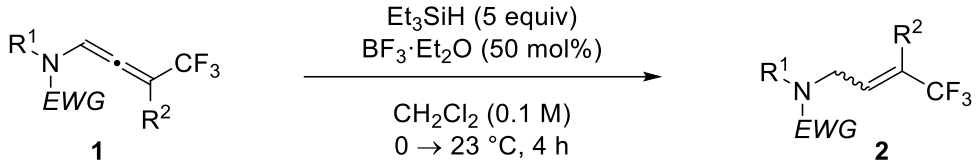
*Disubstitued N-allenamide **1n***



(1-diazo-2,2,2-trifluoroethyl)benzene was synthesized according to the previous literature and directly used.[5]

Benzyl-ynamide **S3** (127 mg, 0.45 mmol, 1 equiv) was dissolved in dry CH_3CN (0.1 M) in the presence of CuI (0.09 mmol, 20 mol%), and triethylamine (0.9 mmol, 2 equiv). A diethyl ether (1-diazo-2,2,2-trifluoroethyl)benzene solution was added dropwise (in excess) and the reaction was stirred for 4 h at 0 °C. The mixture was concentrated under vacuum and the crude material was used without any further purification.

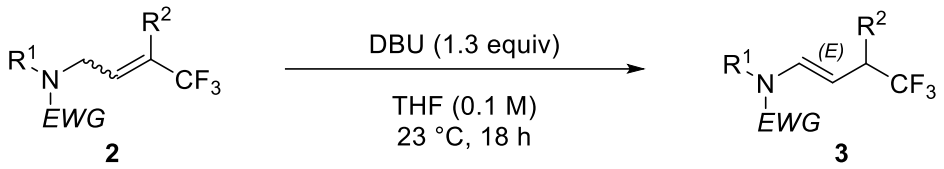
General procedure for the 1,2-semireduction of *N*-allenamides **1**



N-allenamide **1** (0.25 mmol, 1 equiv) was dissolved in dry CH_2Cl_2 (0.1 M) and cooled to 0 °C. Et_3SiH (1.25 mmol, 5 equiv) and $BF_3{\cdot}Et_2O$ (0.13 mmol, 50 mol%) were added dropwise. The reaction mixture was allowed to warm up at 23 °C and stirred for 4 h and then hydrolyzed with water. The organic layer was extracted with CH_2Cl_2 (3x) and Et_2O (1x). The organic layers were washed separately with a saturated solution of NaCl, combined, dried (Na_2SO_4), filtered and concentrated under vacuum. The crude material was purified by column chromatography on silica gel using a mixture petroleum ether/EtOAc, as eluent to afford the desired products **2**.

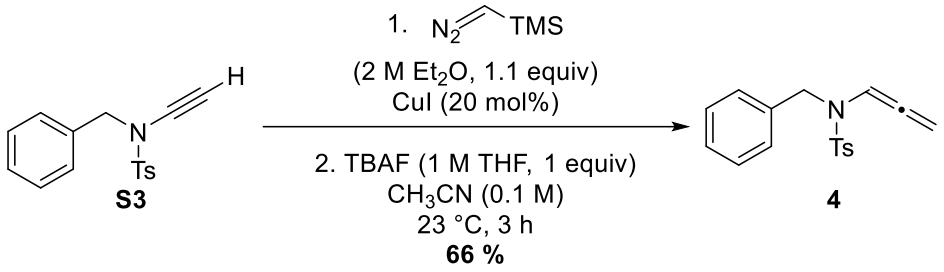
[4] H. Gilman and R. G. Jones, *J. Am. Chem. Soc.*, 1943, **65**, 1458–1460.
[5] X. Huang, M. Garcia-Borràs, K. Miao, S. B. J. Kan, A. Zutshi, K. N. Houk and F. H. Arnold, *ACS Cent. Sci.*, 2019, **5**, 270–276.

General procedure for the isomerization of allylamide **2** to tertiary enamide **3**



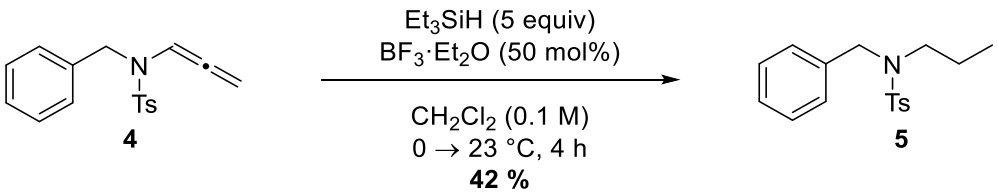
Allylamide **2** (0.1 mmol, 1 equiv) was dissolved in dry THF (0.1 M) and then DBU (0.13 mmol, 1.3 equiv) was added dropwise. The reaction mixture stirred at 23 °C for 18 h and then hydrolyzed with water. The organic layer was extracted with EtOAc (3x). The combined organic layers were washed with a saturated solution of NaCl, dried (Na_2SO_4), filtered and concentrated under vacuum. The crude material was purified by column chromatography on silica gel using a mixture petroleum ether/EtOAc, as eluent to afford the desired products **3**.

Procedure for the preparation of **4**[3]



Benzyl-ynamide **S3** (70 mg, 0.25 mmol, 1 equiv) was dissolved in CH_3CN (0.1 M). CuI (9 mg, 0.05 mmol, 20 mol%) and trimethylsilyldiazomethane (0.13 mL, 0.27 mmol, 1.1 equiv, 2 M Et_2O) was added dropwise and the reaction mixture was stirred at 23 °C for 3 hours. A TBAF solution (0.25 mL, 0.25 mmol, 1 equiv, 1 M in THF) was added dropwise at 0 °C and the resulting mixture was stirred during 30 min and then hydrolyzed with water. The organic layer was extracted with CH_2Cl_2 (3x) and Et_2O (1x). The organic layers were washed separately with a saturated solution of NaCl, combined, dried (Na_2SO_4), filtered and concentrated under vacuum. The crude material was purified by column chromatography on silica gel using a mixture petroleum ether/EtOAc (from 100:0 to 95:5), as eluent to afford the terminal N-allenamide **4** (49 mg, 0.17 mmol, 66 %) as a colorless oil.

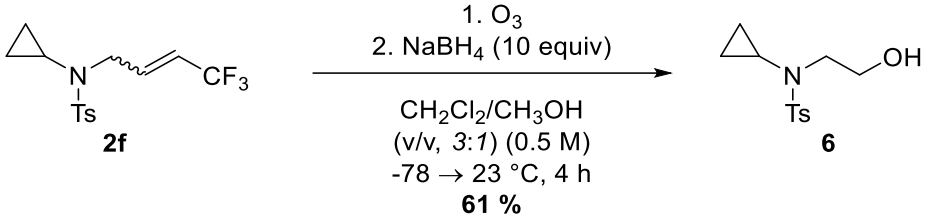
Procedure for the preparation of **5**



4 (75 mg, 0.25 mmol, 1 equiv) was dissolved in dry CH_2Cl_2 (0.1 M) and cooled to 0 °C. Et_3SiH (0.20 mL, 1.25 mmol, 5 equiv) and $BF_3{\cdot}Et_2O$ (0.02 mL, 0.13 mmol, 50 mol%) were added dropwise. The reaction mixture was allowed to warm up at 23 °C and stirred for 4 h and then hydrolyzed with water. The organic layer was extracted with CH_2Cl_2 (3x) and Et_2O (1x). The organic layers were washed separately with a saturated solution of NaCl, combined, dried

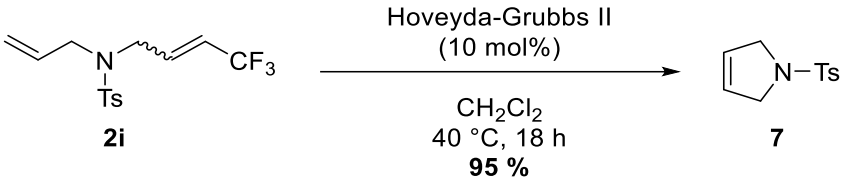
(Na_2SO_4), filtered and concentrated under vacuum. The crude material was purified by column chromatography on silica gel using a mixture petroleum ether/EtOAc (from 100:0 to 60:40), as eluent to afford the desired products **5** (31.8 mg, 0.11 mmol, 42 %) as a colorless oil.

Procedure for the preparation of **6**[6]



2f (51 mg, 0.16 mmol, 1 equiv) was dissolved in a mixture of CH_2Cl_2 (2.4 mL) and CH3OH (0.8 mL) and the solution was cooled to -78 °C (dry-ice/acetone). To this solution was purged O_3 gas for 15 minutes followed by argon gas for additional 15 minutes. The resulting intermediate was quenched with $NaBH_4$ (60 mg, 1.6 mmol, 10 equiv). The reaction mixture was gently warmed to 23 °C for 3.5 hours and then cooled down to 0 °C and hydrolyzed with a saturated aqueous solution of NH_4Cl. The organic layer was extracted with CH_2Cl_2 (3x) and Et_2O (1x). The organic layers were washed separately with a saturated solution of NaCl, combined, dried (Na_2SO_4), filtered and concentrated under vacuum. The crude material was purified by *flash* chromatography on silica gel using a mixture petroleum ether/EtOAc (from 88:12 to 0:100), as eluent to afford **6** (24.9 mg, 0.01 mmol, 61 %) as a white solid .

Procedure for the preparation of **7**

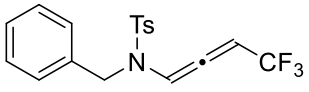


2i (83 mg, 0.26 mmol, 1 equiv) was dissolved in degassed CH_2Cl_2. Hoveyda-Grubbs II (16 mg, 0.02 mmol, 10 mol%) was then added and the reaction mixture was heated to 40 °C for 18 hours. The crude material was purified by *flash* chromatography on silica gel using a mixture petroleum ether/EtOAc (from 95:05 to 60:40), as eluent to afford **7** (55 mg, 0.25 mmol, 95 %) as a white solid .

Characterization data

N-allenamides **1a-v**

Compound 1a *N*-benzyl-4-methyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide[3]



$C_{18}H_{16}F_3NO_2S$
MW: 367.39 g.mol^{-1}
White solid
mp: 88 - 90 °C

[6] M. S. Manna, S. Y. Yoo, M. Sharique, H. Choi, B. Pudasaini, M. Baik and U. K. Tambar, *Angew. Chem. Int. Ed.*, 2023, **62**, e202304848.

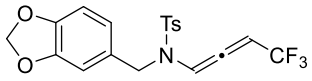
87 % (1.7 g)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 80:20) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.79 – 7.67 (m, 2H), 7.45 – 7.38 (m, 1H), 7.38 – 7.32 (m, 2H), 7.30 – 7.18 (m, 5H), 5.68 (p, *J* = 5.6 Hz, 1H), 4.46 (d, *J* = 15.3 Hz, 1H), 4.12 (d, *J* = 15.3 Hz, 1H), 2.46 (s, 3H) ppm.

This analytical data match with those described in the literature.

Compound 1b *N*-(benzo[d][1,3]dioxol-5-ylmethyl)-4-methyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide[7]



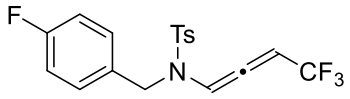
$C_{19}H_{16}F_3NO_4S$
MW: 411.39 g.mol^{-1}
White solid
mp: 110 - 112 °C
75 % (2.3 g)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 80:20) as eluent.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.71 (d, *J* = 8.1 Hz, 2H), 7.41 – 7.37 (m, 1H), 7.35 (d, *J* = 8.1 Hz, 2H), 6.77 (d, *J* = 1.7 Hz, 1H), 6.73 – 6.62 (m, 2H), 5.93 (s, 2H), 5.75 (p, *J* = 5.6 Hz, 1H), 4.34 (d, *J* = 15.0 Hz, 1H), 4.06 (d, *J* = 15.0 Hz, 1H), 2.45 (s, 3H) ppm.

This analytical data match with those described in the literature.

Compound 1c *N*-(4-fluorobenzyl)-4-methyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide



$C_{18}H_{15}F_4NO_2S$
MW: 385.38 g.mol^{-1}
White solid
mp: 99 - 101 °C

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 80:20) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.71 (d, *J* = 8.4 Hz, 2H), 7.43 – 7.38 (m, 1H), 7.36 (d, *J* = 8.1 Hz, 2H), 7.22 (dd, *J* = 8.6, 5.4 Hz, 2H), 6.97 (t, *J* = 8.7 Hz, 2H), 5.71 (p, *J* = 5.6 Hz, 1H), 4.38 (d, *J* = 15.3 Hz, 1H), 4.14 (d, *J* = 15.2 Hz, 1H), 2.46 (s, 3H).

^{19}F NMR (282 MHz, $CDCl_3$): δ -62.77, -114.41.

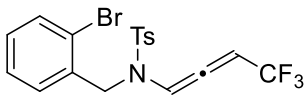
^{13}C NMR (126 MHz, $CDCl_3$): δ 198.9 (q, *J* = 5.9 Hz), 162.5 (d, *J* = 246.8 Hz), 144.8, 135.1, 130.5 (d, *J* = 3.2 Hz), 130.2 (x2), 129.5 (d, *J* = 8.3 Hz), 127.3 (x2), 121.2 (q, *J* = 272.3 Hz), 115.6 (d, *J* = 21.7 Hz), 106.8, 96.5 (q, *J* = 39.4 Hz), 50.4, 21.8.

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{18}H_{15}F_4NaNO_2S$ 408.0652; found 408.0648.

IR (neat): ν = 3045, 1431, 1342, 1124, 944, 814, 543 cm^{-1}.

[7] M. Hourtoule and L. Miesch, *Org. Lett*., 2022, **24**, 3896–3900.

Compound 1d *N*-(2-bromobenzyl)-4-methyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide



$C_{18}H_{15}BrF_3NO_2S$
MW: 442.28 g.mol^{-1}
White solid
mp: 94 - 96 °C

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 80:20) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.75 (dt, *J* = 8.5 Hz, 2.0 Hz, 2H), 7.49 (dd, J = 8.0, 1.5 Hz, 1H), 7.46–7.44 (m, 1H), 7.42–7.41 (m, 1H), 7.39–7.36 (m, 2H), 7.30–7.27 (m, 1H), 7.14–7.10 (m, 1H), 5.69 (p, J = 5.5 Hz, 1H), 4.41 (s, 2H), 2.47 (s, 3H).

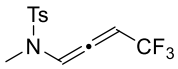
^{19}F NMR (282 MHz, $CDCl_3$): δ -62.72.

^{13}C NMR (126 MHz, $CDCl_3$): δ 198.4 (q, *J* = 5.9 Hz), 144.9, 135.0, 133.5, 132.8, 130.3 (x2), 129.2, 128.1, 127.8, 127.3 (x2), 122.4, 121.0 (q, *J* = 272.5 Hz), 106.7, 96.6 (q, *J* = 39.6 Hz), 50.8, 21.8.

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{18}H_{15}BrF_3NaNO_2S$ 467.9852; found 467.9846.

IR (neat): ν = 3016, 1447, 1352, 1110, 922, 751, 596 cm^{-1}.

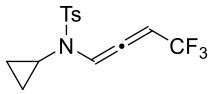
Compound 1e *N*,4-dimethyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide



$C_{12}H_{12}F_3NO_2S$
MW: 291.29 g.mol^{-1}

1e was used without any further purification.

Compound 1f *N*-cyclopropyl-4-methyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide[7]



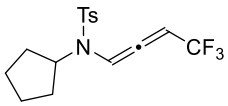
$C_{14}H_{14}F_3NO_2S$
MW: 317.33 g.mol^{-1}
White solid
mp: 53 – 56°C
74 % (760 mg)

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 95:05 to 85:15) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.79 – 7.71 (m, 2H), 7.39 – 7.33 (m, 2H), 7.33 – 7.30 (m, 1H), 5.88 (p, *J* = 5.6 Hz, 1H), 2.45 (s, 3H), 1.73 (tt, *J* = 6.9, 3.6 Hz, 1H), 1.12 – 0.88 (m, 2H), 0.83 – 0.64 (m, 2H).

This analytical data match with those described in the literature.

Compound 1g *N*-cyclopentyl-4-methyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide[7]



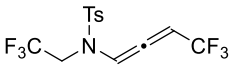
$C_{16}H_{18}F_3NO_2S$
MW: 345.38 g.mol^{-1}
Colorless oil
68 % (563 mg)

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (95:05 to 85:15) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.71 (d, *J* = 8.3 Hz, 2H), 7.44 – 7.28 (m, 3H), 5.85 (p, *J* = 5.7 Hz, 1H), 4.41 (p, *J* = 8.7 Hz, 1H), 2.44 (s, 3H), 1.75 – 1.54 (m, 5H), 1.48 – 1.32 (m, 3H).

This analytical data match with those described in the literature.

Compound 1h 4-methyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)-*N*-(2,2,2-trifluoroethyl)benzenesulfonamide[8]



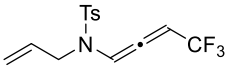
$C_{13}H_{11}F_6NO_2S$
MW: 359.29 g.mol^{-1}
Colorless oil
71 % (78 mg)

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 100:0 to 80:20) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.74 (d, *J* = 8.4 Hz, 2H), 7.53 – 7.33 (m, 3H), 6.07 (p, *J* = 5.5 Hz, 1H), 3.90 (dqd, *J* = 15.6, 8.1, 0.8 Hz, 1H), 3.72 (dq, *J* = 16.1, 8.1 Hz, 1H), 2.49 (s, 3H).

This analytical data match with those described in the literature.

Compound 1i *N*-allyl-4-methyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide[8]



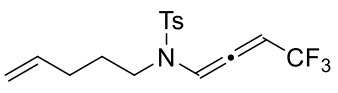
$C_{14}H_{14}F_3NO_2S$
MW: 317.33 g.mol^{-1}
Colorless oil
58 % (169 mg)

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 100:0 to 80:20) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.73 (d, *J* = 8.6 Hz, 2H), 7.48 – 7.40 (m, 1H), 7.36 (dd, *J* = 8.6, 0.8 Hz, 2H), 5.93 (p, *J* = 5.6 Hz, 1H), 5.69 – 5.54 (m, 1H), 5.18 (dt, *J* = 1.4, 0.8 Hz, 1H), 5.16 (dq, *J* = 7.8, 1.4 Hz, 1H), 3.87 (ddtd, *J* = 16.0, 5.5, 1.6, 0.8 Hz, 1H), 3.82 – 3.73 (ddtd, *J* = 16.0, 5.5, 1.6, 0.8 Hz, 1H), 2.47 (s, 3H).

This analytical data match with those described in the literature.

Compound 1j 4-methyl-*N*-(pent-4-en-1-yl)-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide[7]



$C_{16}H_{18}F_3NO_2S$
MW : 345.10 g.mol^{-1}
Colorless oil

[8] M. Hourtoule and L. Miesch, *Org. Lett*., 2023, **25,** 1727–1731.

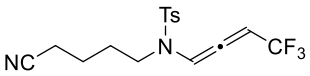
Yield: 90 % (294 mg)

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 5:1 to 4:1) as eluent.

^{1}H NMR (500 MHz, C_6D_6): δ = 7.55 (d, *J* = 8.3 Hz, 2H), 7.33– 7.30 (m, 1H), 6.73 (d, *J* = 8.0 Hz, 2H), 5.65– 5.57 (m, 1H), 5.36 (p, *J* = 5.6 Hz, 1H), 4.97 – 4.89 (m, 2H), 3.02 – 2.87 (m, 2H), 1.96 – 1.76 (m, 5H), 1.58 – 1.39 (m, 2H) ppm.

This analytical data match with those described in the literature.

Compound 1k *N*-(4-cyanobutyl)-4-methyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide[7]



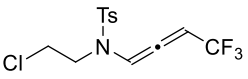
$C_{16}H_{17}F_3N_2O_2S$
MW: 358.38 g.mol^{-1}
Colorless oil
64 % (257 mg)

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 95:05 to 70:30) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$) : δ 7.68 (d, *J* = 8.4 Hz, 2H), 7.47 – 7.38 (m, 1H), 7.35 (d, *J* = 8.4 Hz, 2H), 5.99 (p, *J* = 5.5 Hz, 1H), 3.14 (t, *J* = 6.6 Hz, 2H), 2.45 (s, 3H), 2.39 (tt, *J* = 6.6, 1.4 Hz, 2H), 1.74 – 1.65 (m, 4H) ppm.

This analytical data match with those described in the literature.

Compound 1l *N*-(2-chloroethyl)-4-methyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide[7]



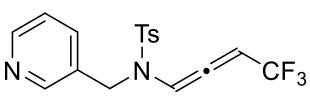
$C_{13}H_{13}ClF_3NO_2S$
MW: 339.76 g.mol^{-1}
White solid
mp: 56 – 57°C
74 % (281 mg)

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 95:05 to 85:15) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$) : δ 7.71 (d, *J* = 8.1 Hz, 1H), 7.42 (dq, *J* = 6.0, 3.0 Hz, 1H), 7.36 (d, *J* = 8.1 Hz, 2H), 6.03 (p, *J* = 5.5 Hz, 1H), 3.58 – 3.51 (m, 2H), 3.45 – 3.38 (m, 2H), 2.45 (s, 3H)

This analytical data match with those described in the literature.

Compound 1m *N*,*N*'-(butane-1,4-diyl)bis(4-methyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide)



$C_{17}H_{15}F_3N_2O_2S$
MW: 368.37 g.mol^{-1}
Orange oil
52 % (244 mg) (*2 steps*)

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 90:10 to 0:100) as eluent.

^{1}H NMR (500 MHz, C_6D_6): δ 8.43 (s, 2H), 7.49 (d, *J* = 8.3 Hz, 2H), 7.42 (d, *J* = 7.8 Hz, 1H), 7.19 – 7.17 (m, 1H), 6.72 (d, *J* = 8.1 Hz, 2H), 6.70 – 6.63 (m, 1H), 5.12 (s, 1H), 3.98 (d, *J* = 15.5 Hz, 1H), 3.74 (d, *J* = 15.4 Hz, 1H), 1.84 (s, 3H).

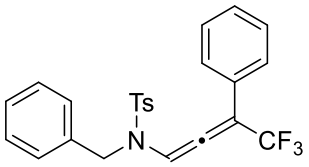
^{19}F NMR (282 MHz, C_6D_6): δ -62.66.

^{13}C NMR (126 MHz, C_6D_6): δ 199.0 (q, *J* = 6.0 Hz), 149.8, 149.8, 144.4, 135.7, 134.9, 130.1 (x2), 128.4, 128.2, 127.4 (x2), 121.7 (q, *J* = 271.7 Hz), 106.9, 96.4 (q, *J* = 41.0 Hz), 48.4, 21.1.

HRMS (ESI-TOF) m/z: $[M+H]^+$ calcd for $C_{17}H_{16}F_3N_2O_2S$ 369.0885; found 369.0879.

IR (neat) : ν = 3043, 2962, 1597, 1451, 1429, 1359, 1267, 1168, 1131, 930, 908, 814, 666, 600, 547 cm^{-1}.

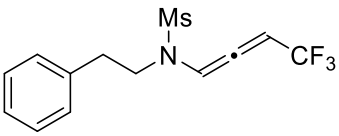
Compound 1n *N*-benzyl-4-methyl-*N*-(4,4,4-trifluoro-3-phenylbuta-1,2-dien-1-yl)benzenesulfonamide



$C_{24}H_{20}F_3NO_2S$
MW: 443.48 $g.mol^{-1}$

1n was used without any further purification.

Compound 1o *N*-phenethyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)methanesulfonamide[9]



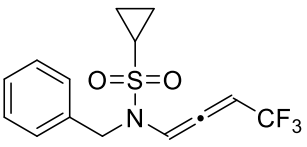
$C_{13}H_{14}F_3NO_2S$
MW: 305.32 $g.mol^{-1}$
White solid
mp: 115 – 118 °C
59 % (477 mg)

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 100:0 to 80:20) as eluent.

^{1}H NMR (300 MHz, C_6D_6): δ = 7.14 – 7.02 (m, 2H), 7.06 – 6.96 (m, 3H), 6.94 (dt, *J* = 6.3, 3.2 Hz, 1H), 5.46 (p, *J* = 5.6 Hz, 1H), 3.26 – 3.03 (m, 2H), 2.64 (dd, *J* = 8.6, 7.1 Hz, 2H), 1.86 (s, 3H).

This analytical data match with those described in the literature.

Compound 1p *N*-benzyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)cyclopropanesulfonamide



$C_{14}H_{14}F_3NO_2S$
MW: 317.33 $g.mol^{-1}$
White solid
mp: 73 – 75 °C

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 80:20) as eluent.

[9] C. Gommenginger, Y. Zheng, D. Maccarone, I. Ciofini and L. Miesch, *Org. Chem. Front.*, 2023, **10**, 4055–4060.

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.30–7.25 (m, 4H), 7.24–7.20 (m, 2H), 5.73 (p, *J* = 5.5 Hz, 1H), 4.64 (d, *J* = 15.5 Hz, 1H), 4.38 (d, *J* = 15.5 Hz, 1H), 2.35–2.30 (m, 1H), 1.22–1.18 (m, 2H), 1.00–0.96 (m, 2H).

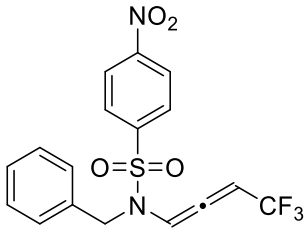
^{19}F NMR (282 MHz, $CDCl_3$): δ 62.61.

^{13}C NMR (126 MHz, $CDCl_3$): δ 198.7 (q, *J* = 5.9 Hz), 135.2, 128.7 (x2), 128.1, 127.7 (x2), 121.3 (q, *J* = 272.2 Hz), 107.2, 96.7 (q, *J* = 39.4 Hz), 51.2, 30.2, 5.7, 5.6.

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{14}H_{14}F_3NaNO_2S$ 340.0590; found 340.0574.

IR (neat) : ν = 3033, 1453, 1347, 1118, 937, 885, 607 cm^{-1}.

Compound 1q *N*-benzyl-4-nitro-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide[7]



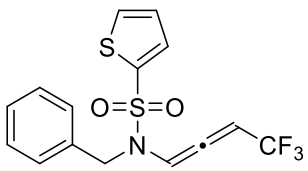
$C_{17}H_{13}F_3N_2O_4S$
MW: 398.36 $g.mol^{-1}$
White solidmp: 92 - 95°C
81 % (163 mg)

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 100:0 to 70:30) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$): δ 8.37 (d, *J* = 8.9 Hz, 1H), 7.97 (d, *J* = 8.9 Hz, 1H), 7.39 (dq, *J* = 6.1, 3.1 Hz, 1H), 7.28 (dt, *J* = 4.6, 2.2 Hz, 3H), 7.24 – 7.18 (m, 2H), 5.79 (p, *J* = 5.5 Hz, 1H), 4.54 (dd, *J* = 15.3, 1.0 Hz, 1H), 4.24 (d, *J* = 15.2 Hz, 1H) ppm.

This analytical data match with those described in the literature.

Compound 1r *N*-benzyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)thiophene-2-sulfonamide



$C_{15}H_{12}F_3NO_2S_2$
MW: 359.38 $g.mol^{-1}$
White solid
mp: 68 – 70 °C

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 100:0 to 80:20) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.67 (dd, *J* = 5.0, 1.5 Hz, 1H), 7.62 (dd, *J* = 4.0, 1.5 Hz, 1H), 7.35–7.32 (m, 1H), 7.31–7.24 (m, 5H), 7.14 (dd, *J* = 5.0, 3.5 Hz, 1H), 5.72 (p, *J* = 6.0 Hz, 1H), 4.53 (d, *J* = 15.0 Hz, 1H), 4.21 (d, *J* = 15.0 Hz, 1H).

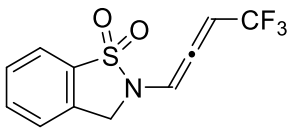
^{19}F NMR (282 MHz, $CDCl_3$): δ -62.63.

^{13}C NMR (126 MHz, $CDCl_3$): δ 199.2 (q, *J* = 6.0 Hz), 138.0, 134.6, 133.3, 133.1, 128.7 (x2), 128.1, 127.9, 127.7 (x2) , 121.2 (q, *J* = 272.2 Hz), 106.4, 96.6 (q, *J* = 39.4 Hz), 51.3.

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{15}H_{12}F_3NaNO_2S_2$ 382.0154; found 382.0150.

IR (neat) : ν = 3106, 3036, 1447, 1357, 1118, 1024, 739, 571 cm^{-1}

Compound 1s 2-(4,4,4-trifluorobuta-1,2-dien-1-yl)-2,3-dihydrobenzo[d]isothiazole 1,1-dioxide[7]



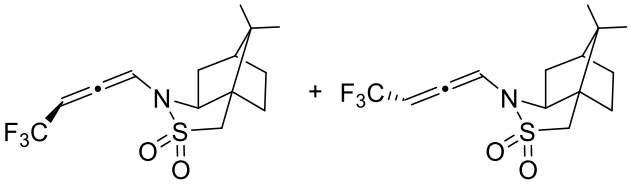
$C_{11}H_8F_3NO_2S$
MW: 275.24 g.mol^{-1}
White solid
mp: 140 – 145 °C
58 % (248 mg)

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 95:05 to 80:20) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$) : δ 7.85 (ddd, *J* = 7.7, 1.3, 0.6 Hz, 1H), 7.69 (td, *J* = 7.7, 1.3 Hz, 1H), 7.63 – 7.55 (m, 1H), 7.47 (dt, *J* = 7.8, 0.9 Hz, 1H), 7.32 (dq, *J* = 5.9, 2.9 Hz, 1H), 6.17 (p, *J* = 5.9 Hz, 1H), 4.46 (d, *J* = 4.8 Hz, 2H) ppm.

This analytical data match with those described in the literature.

Compound 1t 8,8-dimethyl-1-(-4,4,4-trifluorobuta-1,2-dien-1-yl)hexahydro-3H-3a,6-methanobenzo[c]isothiazole 2,2-dioxide[8]



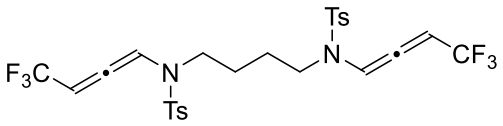
$C_{14}H_{18}F_3NO_2S$
MW: 321.26 g.mol^{-1}
Colorless oil
61 % (96.3 mg)

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 95:05 to 80:20) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$): δ 6.86 – 6.77 (m, 2H), 6.04 – 5.95 (m, 2H), 3.36 – 3.18 (m, 6H), 2.06 – 1.98 (m, 2H), 1.96 – 1.86 (m, 6H), 1.62 (dt, *J* = 13.0, 8.1 Hz, 2H), 1.53 – 1.42 (m, 2H), 1.38 – 1.26 (m, 2H), 1.11 (s, 6H), 0.95 (s, 6H).

This analytical data match with those described in the literature.

Compound 1u *N*,*N*'-(butane-1,4-diyl)bis(4-methyl-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide)



$C_{26}H_{26}F_6N_2O_4S$
MW: 608.61 g.mol^{-1}
White solid
28 % (112 mg)

The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 100:0 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.68 (d, *J* = 8.4 Hz, 4H), 7.43 – 7.30 (m, 6H), 5.94 (p, *J* = 5.5 Hz, 2H), 3.19 – 3.01 (m, 4H), 2.45 (s, 6H), 1.53 – 1.48 (m, 4H).

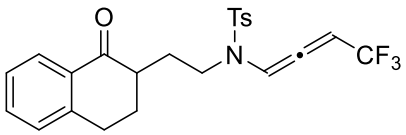
^{19}F NMR (282 MHz, $CDCl_3$): δ -62.18, -62.19.

^{13}C NMR (126 MHz, $CDCl_3$): δ 198.5 (q, *J* = 5.7 Hz) (x2), 144.7 (x2), 135.1, 135.0, 130.2 (x4), 127.3 (x4), 121.4 (q, *J* = 271.8 Hz) (x2), 107.0, 107.0, 96.4 (q, *J* = 39.2 Hz) (x2), 46.5, 46.4, 23.9, 23.8, 21.8 (x2).

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{26}H_{26}F_6NaN_2O_4S$ 631.1000; found 631.1004.

IR (neat): ν = 3048, 2925, 1598, 1434, 1359, 1265, 1168, 1131, 684, 601, 547 cm^{-1}.

Compound 1v 4-methyl-*N*-(2-(1-oxo-1,2,3,4-tetrahydronaphthalen-2-yl)ethyl)-*N*-(4,4,4-trifluorobuta-1,2-dien-1-yl)benzenesulfonamide

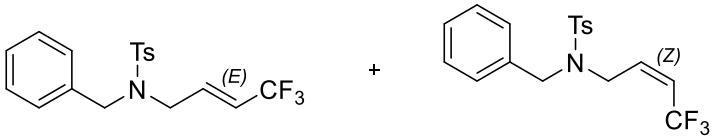


$C_{23}H_{22}F_3NO_2S$
MW: 449.49 g.mol^{-1}

1v was used without any further purification.

Allylamides **2a-v**

Compound 2a *N*-benzyl-4-methyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide



$C_{18}H_{18}F_3NO_2S$
MW: 369.40 g.mol^{-1}
Colorless oil
80 % (73.6 mg)
E/*Z* ratio = *80*:*20*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

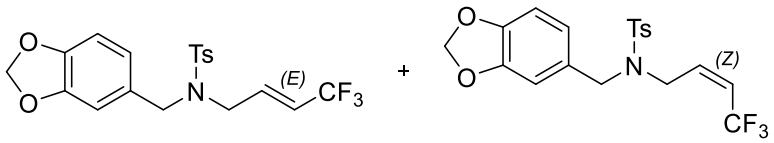
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.73 (d, *J* = 8.3 Hz, 4H, *E* + *Z*), 7.35 (d, *J* = 8.2 Hz, 4H, *E* + *Z*), 7.33 – 7.21 (m, 10H, *E* + *Z*), 6.05 – 5.95 (m, 1H, *Z*), 5.79 (dt, *J* = 12.1, 6.2 Hz, 1H, *E*), 5.51 – 5.40 (m, 2H, *E* + *Z*), 4.38 – 4.24 (m, 4H, *E* + *Z*), 3.96 (dt, *J* = 6.3, 2.3 Hz, 2H, *E*), 3.81 (dt, *J* = 5.9, 1.9 Hz, 2H, *Z*), 2.46 (s, 6H, *E* + *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.0, 138.8 (q, *J* = 5.0 Hz), 136.3, 135.5, 130.1 (x2), 128.8 (x2), 128.7 (x2), 128.3, 127.5 (x2), 122.8 (q, *J* = 271.9 Hz), 119.4 (q, *J* = 34.4 Hz), 52.7, 45.4 (q, *J* = 1.8 Hz), 21.7.

IR (neat): ν = 3068, 2928, 1341, 1223, 1159, 1125, 1094, 721, 656, 549 cm^{-1}.

Compound 2b *N*-(benzo[*d*][1,3]dioxol-5-ylmethyl)-4-methyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide



$C_{19}H_{18}F_3NO_4S$
MW: 413.41 g.mol^{-1}
White solid
mp: 65 – 68 °C
98 % (62 mg)
E/*Z* ratio = *80*:*20*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

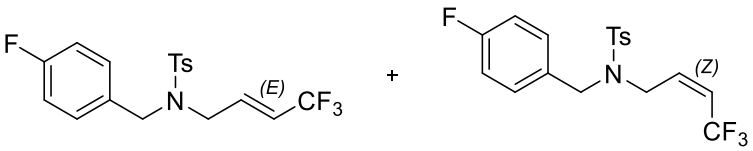
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.72 (d, *J* = 8.3 Hz, 4H, *E* + *Z*), 7.35 (d, J = 7.8 Hz, 4H, *E* + *Z*), 6.87 – 6.59 (m, 6H, *E* + *Z*), 5.95 (s, 5H, *E* + *Z*), 5.81 (dt, J = 12.2, 6.2 Hz, 1H, *E*), 5.56 – 5.42 (m, 2H, *E* + *Z*), 4.24 – 4.15 (m, 4H, *E* + *Z*), 3.95 (dp, J = 6.7, 2.3 Hz, 2H, *E*), 3.80 (dt, J = 6.1, 2.1 Hz, 2H, *Z*), 2.46 (s, 6H, *E* + *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 148.2, 147.7, 144.0, 138.9 (q, *J* = 5.0 Hz), 136.3, 130.1 (x2), 129.2, 127.4 (x2), 122.9 (q, *J* = 271.9 Hz), 122.3, 119.3 (q, *J* = 34.4 Hz), 109.1, 108.3, 101.3, 52.5, 45.2 (q, *J* = 1.7 Hz), 21.7.

IR (neat): ν = 2924, 1504, 1145, 1383, 1241, 1116, 1018, 927, 707, 697, 633, 511 cm^{-1}.

Compound 2c *N*-(4-fluorobenzyl)-4-methyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide



$C_{18}H_{17}F_4NO_2S$
MW: 387.39 $g.mol^{-1}$
Colorless oil
94 % (91.3 mg)
E/*Z* ratio = *95*:*05*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

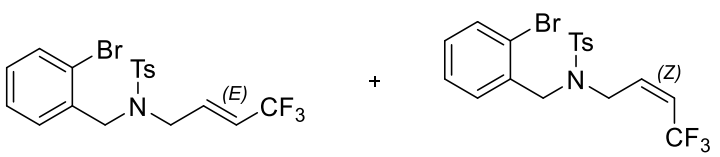
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.65 (d, *J* = 8.4 Hz, 2H, *E*), 7.59 (d, *J* = 8.3 Hz, 2H, *Z*), 7.28 (d, *J* = 8.1 Hz, 2H, *E*), 7.25 (d, *J* = 8.1 Hz, 2H, *Z*), 7.21 – 7.12 (m, 4H, *E* + *Z*), 6.97 – 6.86 (m, 4H, *E* + *Z*), 5.97 – 5.87 (m, 1H, *Z*), 5.70 (dd, *J* = 11.9, 6.3 Hz, 1H, *E*), 5.49 – 5.31 (m, 2H, *E* + *Z*), 4.39 (s, 2H, *Z*), 4.19 (s, 2H, E), 3.88 (dt, *J* = 6.3, 2.2 Hz, 2H, *E*), 3.73 (dt, *J* = 3.9, 2.0 Hz, 2H, *Z*), 2.38 (s, 3H, *E*), 2.36 (s, 3H, *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 162.5 (d, *J* = 246.7 Hz), 143.8, 138.4 (q, *J* = 5.0 Hz), 136.0, 131.1 (d, *J* = 3.2 Hz), 130.2 (d, *J* = 8.3 Hz), 129.9 (x2), 128.5 (d, *J* = 8.1 Hz), 127.1 (x2), 122.5 (q, *J* = 271.9 Hz), 119.4 (q, *J* = 34.4 Hz), 115.5 (d, *J* = 21.6 Hz), 99.0 (q, *J* = 3.7 Hz), 51.7, 45.2 (q, *J* = 1.6 Hz), 21.4.

IR (neat): ν = 2941, 1604, 1510, 1340, 1224, 1159, 1126, 1092, 549 cm^{-1}.

Compound 2d *N*-(2-bromobenzyl)-4-methyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide



$C_{18}H_{17}BrF_3NO_2S$
MW: 448.30 $g.mol^{-1}$
Colorless oil
93 % (61.4 mg)
E/*Z* ratio = *75*:*25*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

Only E-stereoisomer was descried for ^{13}C-NMR.

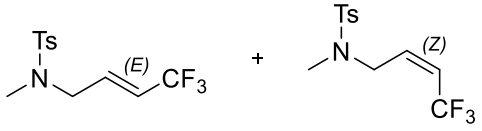
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.74 (d, J = 8.4 Hz, 4H, *E* + *Z*), 7.56 – 7.47 (m, 4H, *E* + *Z*), 7.36 (d, J = 7.8 Hz, 4H, *E* + *Z*), 7.31 (td, J = 7.5, 1.4 Hz, 2H, *E* + *Z*), 7.19 – 7.12 (m, 2H, *E* + *Z*), 6.10

– 5.95 (m, 1H, *Z*), 5.83 (dt, J = 12.2, 6.2 Hz, 1H, *E*), 5.56 – 5.43 (m, 2H, *E* + *Z*), 4.45 (s, 4H, *E* + *Z*), 4.02 (dt, J = 6.3, 2.3 Hz, 2H, *E*), 3.86 (dd, J = 4.1, 2.0 Hz, 2H, *Z*), 2.46 (s, 6H, *E* + *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.0, 138.0 (q, *J* = 5.0 Hz), 136.0, 134.7, 132.9, 130.2, 130.0 (x2), 129.5, 127.8, 127.3 (x2), 123.4, 122.6 (d, *J* = 271.9 Hz), 119.6 (q, *J* = 34.4 Hz), 52.0, 45.8 (d, *J* = 2.1 Hz), 21.6.

IR (neat): ν = 2945, 1598, 1441, 1344, 1161, 1126, 1093, 753, 633, 515 cm^{-1}.

Compound 2e *N*,4-dimethyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide



$C_{12}H_{14}F_3NO_2S$
MW: 293.30 $g.mol^{-1}$
Colorless oil
67 % (67.8 mg)
E/*Z* ratio = *73*:*22*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

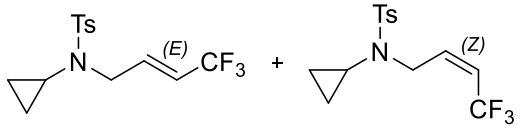
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.70 (d, *J* = 8.3 Hz, 4H, *E* + *Z*), 7.37 (d, *J* = 8.5 Hz, 4H, *E* + *Z*), 6.36 – 6.25 (m, 1H, *Z*), 6.04 (dt, *J* = 11.8, 6.8 Hz, 1H, *E*), 5.91 – 5.73 (m, 2H, *E* + *Z*), 3.92 (dt, *J* = 6.6, 2.0 Hz, 2H, *E*), 3.79 (tt, *J* = 4.3, 2.1 Hz, 2H, *Z*), 2.73 (s, 6H, *E* + *Z*), 2.47 (s, 6H, *E* + *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.0, 138.0 (q, *J* = 5.0 Hz), 134.3, 130.0 (x2), 127.6 (x2), 122.8 (d, *J* = 268.9 Hz), 121.4 (q, *J* = 34.4 Hz), 47.7 (q, *J* = 1.5 Hz), 35.2, 21.7.

IR (neat): ν = 2930, 1674, 1598, 1457, 1413, 1341, 1203, 1162, 1090, 694, 550 cm^{-1}.

Compound 2f *N*-cyclopropyl-4-methyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide



$C_{14}H_{16}F_3NO_2S$
MW: 319.34 $g.mol^{-1}$
Colorless oil
93 % (74.1 mg)
E/*Z* ratio = *90*:*10*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

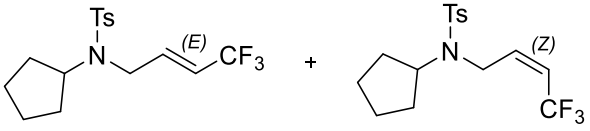
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.74 (d, *J* = 8.3 Hz, 4H, *E* + *Z*), 7.34 (d, *J* = 8.0 Hz, 4H, *E* + *Z*), 6.36 – 6.25 (m, 1H, *Z*), 6.06 (dt, *J* = 11.8, 6.5 Hz, 1H, *E*), 5.86 – 5.73 (m, 1H, *Z*), 5.72 – 5.59 (m, 1H, *E*), 4.06 (dp, *J* = 6.5, 2.1 Hz, 2H, *E*), 3.92 (dp, *J* = 6.1, 2.1 Hz, 2H, *Z*), 2.45 (s, 6H, *E* + *Z*), 2.04 (tt, *J* = 6.9, 3.6 Hz, 2H, *E* + *Z*), 0.87 – 0.81 (m, 4H, *E* + *Z*), 0.74 – 0.67 (m, 4H, *E* + *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.1, 139.1 (q, *J* = 5.1 Hz), 135.0, 129.9 (x2), 127.9 (x2), 123.0 (q, *J* = 271.8 Hz), 119.6 (q, *J* = 34.4 Hz), 48.6 (q, *J* = 1.5 Hz), 31.1, 21.7, 7.7 (x2).

IR (neat): ν = 2966, 2936, 1672, 1566, 1457, 1342, 1174, 1123, 817, 710, 687, 521 cm^{-1}.

Compound 2g *N*-cyclopentyl-4-methyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide



$C_{16}H_{20}F_3NO_2S$
MW: 347.40 g.mol^{-1}
Colorless oil
74 % (37.8 mg)
E/*Z* ratio = *85*:*15*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

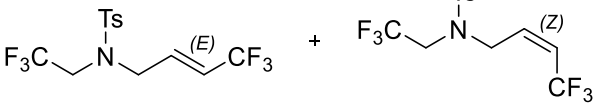
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.69 (d, *J* = 8.3 Hz, 4H, *E* + *Z*), 7.35 – 7.28 (m, 4H; *E* + *Z*), 6.42 – 6.33 (m, 1H, *Z*), 6.19 (dt, *J* = 11.7, 5.7 Hz, 1H, *E*), 5.92 – 5.81 (m, 1H, *Z*), 5.61 (dqt, *J* = 11.3, 8.9, 2.3 Hz, 1H, *E*), 4.30 (p, *J* = 8.8 Hz, 2H, *E* + *Z*), 3.95 (dt, *J* = 5.8, 2.5 Hz, 2H, *E*), 3.83 (dp, *J* = 4.8, 2.4 Hz, 2H, *Z*), 2.43 (s, 6H, *E* + *Z*), 1.78 – 1.65 (m, 4H, *E* + *Z*), 1.63 – 1.55 (m, 4H, *E* + *Z*), 1.53 – 1.42 (m, 4H, *E* + *Z*), 1.36 – 1.22 (m, 4H, *E* + *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 143.6, 142.7 (q, *J* = 4.9 Hz), 137.2, 129.9 (x2), 127.3 (x2), 123.1 (q, *J* = 271.8 Hz), 117.7 (q, *J* = 34.4 Hz), 59.3, 41.2 (q, *J* = 1.6 Hz), 29.2 (x2), 23.6 (x2), 21.8.

IR (neat): ν = 2959, 2874, 1341, 1156, 1092, 659, 547 cm^{-1}.

Compound 2h 4-methyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)-*N*-(2,2,2-trifluoroethyl)benzenesulfonamide



$C_{13}H_{13}F_6NO_2S$
MW: 361.30 g.mol^{-1}
White solid
88 % (75.3 mg)
E/*Z* ratio = *80*:*20*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

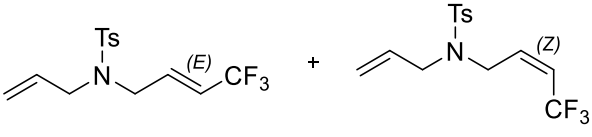
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.72 (d, *J* = 8.4 Hz, 4H, *E* + *Z*), 7.37 – 7.31 (m, 4H, *E* + *Z*), 6.25 – 6.14 (m, 1H, *Z*), 6.02 (dt, *J* = 11.9, 6.5 Hz, 1H, *E*), 5.77 (dqt, *J* = 12.6, 8.6, 2.0 Hz, 2H, *E* + *Z*), 4.10 (dt, *J* = 6.4, 2.0 Hz, 2H, *E*), 3.99 (dt, *J* = 6.3, 2.3 Hz, 2H, *Z*), 3.85 (q, *J* = 8.7 Hz, 4H,*E* + *Z*), 2.45 (s, 6H, *E* + *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.5, 137.3 (d, *J* = 5.3 Hz), 135.6, 129.9 (x2), 127.3 (x2), 123.8 (d, *J* = 280.2 Hz), 122.4 (d, *J* = 272.1 Hz), 121.4 (q, *J* = 34.4 Hz), 48.3 (q, *J* = 35.1 Hz), 46.4, 21.5.

IR (neat): ν = 2952, 1440, 1352, 1273, 1228, 1162, 1129, 1091, 1053 cm^{-1}.

Compound 2i *N*-allyl-4-methyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide



$C_{14}H_{16}F_3NO_2S$
MW: 319.34 g.mol^{-1}
Colorless oil
71 % (121.6 mg)
E/*Z* ratio = *85*:*15*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

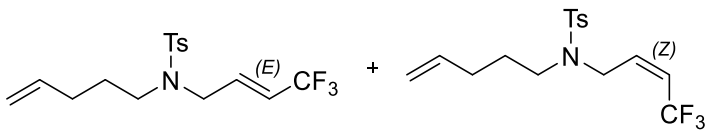
Only E-stereoisomer was described.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.70 (d, *J* = 8.3 Hz, 2H, *E*), 7.32 (d, *J* = 8.1 Hz, 2H, *E*), 5.99 (dt, *J* = 12.4, 6.3 Hz, 1H, *E*), 5.72 – 5.57 (m, 2H, *E*), 5.28 – 4.97 (m, 2H, *E*), 4.01 (dt, *J* = 6.4, 2.2 Hz, 2H, *E*), 3.79 (dt, *J* = 6.3, 1.4 Hz, 2H, *E*), 2.44 (s, 3H, *E*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 143.9, 139.1 (q, *J* = 5.0 Hz), 136.6, 132.2, 130.03 (x2), 127.4 (x2), 122.9 (q, *J* = 271.9 Hz), 119.9 (q, *J* = 34.5 Hz), 119.9, 51.3, 44.7 (q, *J* = 1.7 Hz), 21.7.

IR (neat): ν = 2927, 1645, 1598, 1419, 1348, 1224, 1157, 1122, 1093, 663, 548 cm^{-1}.

Compound 2j 4-methyl-*N*-(pent-4-en-1-yl)-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide



$C_{16}H_{20}F_3NO_2S$
MW: 347.40 $g.mol^{-1}$
Colorless oil
82 % (74.5 mg)
E/*Z* ratio = *95:05*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

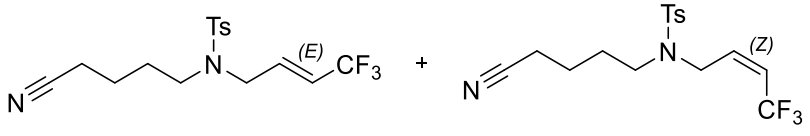
Only E-stereoisomer was described.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.68 (d, *J* = 8.3 Hz, 2H, *E*), 7.32 (d, *J* = 8.0 Hz, 2H, *E*), 6.00 (dt, *J* = 11.8, 6.4 Hz, 1H, *E*), 5.90 – 5.62 (m, 2H, *E*), 5.14 – 4.90 (m, 2H, *E*), 4.01 (dp, *J* = 6.5, 2.2 Hz, 2H, *E*), 3.16 – 3.09 (m, 2H, *E*), 2.44 (s, 3H, *E*), 2.04 (q, *J* = 7.1 Hz, 2H, *E*), 1.67 – 1.58 (m, 2H, *E*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 143.8, 139.5 (q, *J* = 5.0 Hz), 137.4, 136.5, 130.0 (x2), 127.3 (x2), 122.9 (d, *J* = 271.0 Hz), 120.1 (q, *J* = 34.3 Hz), 115.6, 48.5, 45.7 (q, *J* = 1.8 Hz), 30.8, 27.6, 21.7.

IR (neat): ν = 2966, 2924, 2860, 1671, 1642, 1599, 1446, 1415, 1341, 1276, 1221, 1160, 1124, 549 cm^{-1}.

Compound 2k *N*-(4-cyanobutyl)-4-methyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide



$C_{16}H_{19}F_3N_2O_2S$
MW: 360.40 $g.mol^{-1}$
Colorless oil
79 % (79.6 mg)
E/*Z* ratio = *90:10*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

Only E-stereoisomer was descried for ^{13}C-NMR.

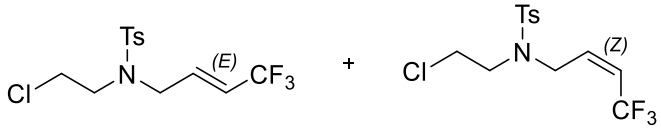
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.68 (d, J = 8.3 Hz, 2H, *E*), 7.62 (d, J = 8.4 Hz, 2H, *Z*), 7.34 (d, J = 7.9 Hz, 4H, *E* + *Z*), 6.24 – 6.14 (m, 1H, *Z*), 5.97 (dt, J = 11.8, 6.6 Hz, 1H, *E*), 5.77 – 5.65

(m, 2H, *E* + *Z*), 4.00 (dp, J = 6.3, 2.1 Hz, 2H, *E*), 3.88 (dt, J = 6.0, 2.1 Hz, 2H, *Z*), 3.17 (t, J = 6.5 Hz, 4H, *E* + *Z*), 2.44 (s, 6H, *E* + *Z*), 2.45 – 2.37 (m, 4H, *E* + *Z*), 1.77 – 1.65 (m, 8H, *E* + *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.1, 138.8 (d, *J* = 4.8 Hz), 136.0, 130.2 (x2), 127.3 (x2), 122.8 (d, *J* = 273.4 Hz), 120.6 (q, *J* = 34.4 Hz), 119.3, 47.8, 45.8 (q, *J* = 1.3 Hz), 27.1, 22.4, 21.7, 16.7.

IR (neat): ν = 2936, 2874, 1671, 1598, 1339, 1159, 1124, 847, 817, 549 cm^{-1}.

Compound 2l *N*-(2-chloroethyl)-4-methyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide



$C_{13}H_{15}ClF_3NO_2S$
MW: 341.77 $g.mol^{-1}$
Colorless oil
88 % (75.3 mg)
E/*Z* ratio = *76:24*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

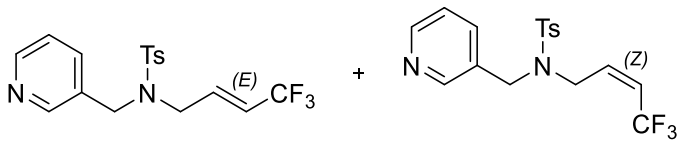
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.71 (d, *J* = 8.3 Hz, 4H, *E* + *Z*), 7.34 (d, J = 7.9 Hz, 4H, *E* + *Z*), 6.32 – 6.14 (m, 1H, *Z*), 6.03 (dt, J = 11.8, 6.6 Hz, 1H, *E*), 5.87 – 5.61 (m, 2H, *E* + *Z*), 4.07 (dt, J = 6.5, 2.1 Hz, 2H, *E*), 3.99 (dt, J = 5.8, 2.1 Hz, 2H, *Z*), 3.76 – 3.56 (m, 4H, *E* + *Z*), 3.50 – 3.39 (m, 4H, *E* + *Z*), 2.45 (s, 6H, *E* + *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.3, 138.6 (q, *J* = 5.2 Hz), 135.9, 130.2 (x2), 127.4 (x2), 124.3 (q, *J* = 283.9 Hz), 120.9 (q, *J* = 34.1 Hz), 50.4, 47.0 (q, *J* = 1.7 Hz), 41.9, 21.7.

IR (neat): ν = 2999, 2943, 1343, 1160, 1126, 1093, 816, 693, 550 cm^{-1}.

Compound 2m 4-methyl-*N*-(pyridin-3-ylmethyl)-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide



$C_{17}H_{17}F_3N_2O_2S$
MW: 370.39 $g.mol^{-1}$
Colorless oil
77 % (93.5 mg)
E/*Z* ratio = *78:22*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

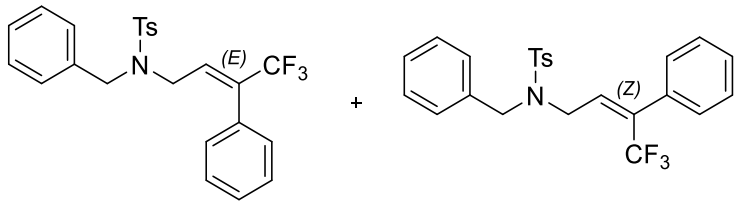
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (500 MHz, $CDCl_3$): δ 8.53 (d, *J* = 51.4 Hz, 4H, *E* + *Z*), 7.73 (d, J = 8.3 Hz, 4H, *E* + *Z*), 7.73 – 7.64 (m, 2H, *E* + *Z*), 7.36 (d, J = 7.9 Hz, 4H, *E* + *Z*), 7.31 (dd, J = 20.4, 7.0 Hz, 2H, *E* + *Z*), 6.10 – 5.93 (m, 1H, *Z*), 5.79 (dt, J = 11.9, 6.4 Hz, 1H, *E*), 5.61 – 5.47 (m, 2H, *E* + *Z*), 4.52 (s, 2H, *Z*), 4.32 (s, 2H, *E*), 3.98 (dt, J = 6.5, 2.2 Hz, 2H, *E*), 3.83 (dt, J = 6.2, 2.0 Hz, 2H, *Z*), 2.46 (s, 6H, *E* + *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 149.8, 144.7, 144.3, 138.2 (q, *J* = 5.0 Hz), 136.4, 136.0, 131.8, 130.3 (x2), 127.4 (x2), 127.1, 122.7 (d, *J* = 272.0 Hz), 120.3 (q, *J* = 34.5 Hz), 50.2, 45.7 (d, *J* = 1.8 Hz), 21.7.

IR (neat): ν = 3035, 2843, 1619, 1428, 1342, 1274, 1223, 1161, 1126, 1092, 815, 771, 697, 516 cm^{-1}.

Compound 2n *N*-benzyl-4-methyl-*N*-(4,4,4-trifluoro-3-phenylbut-2-en-1-yl)benzenesulfonamide



$C_{24}H_{22}F_3NO_2S$
MW: 445.50 $g.mol^{-1}$
Colorless oil
71 % (22.1 mg)
E/*Z* ratio = *78:22*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

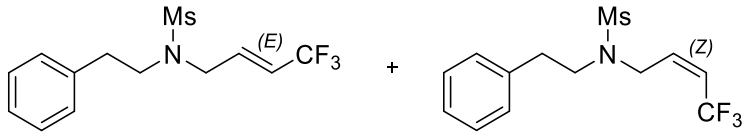
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.76 (d, *J* = 8.3 Hz, 2H, E), 7.67 (d, J = 8.3 Hz, 2H, *Z*), 7.38 – 7.11 (m, 21H, *E* +*Z*), 6.97 (dd, J = 5.7, 3.5 Hz, 3H, *E* + *Z*), 6.13 (tt, J = 6.5, 1.7 Hz, 1H, *Z*), 5.75 (t, J = 6.1 Hz, 1H, *E*), 4.36 (s, 2H, *E*), 4.25 (s, 2H, *Z*), 4.11 (dd, J = 6.0, 2.6 Hz, 2H, *E*), 3.76 – 3.58 (m, 2H, *Z*), 2.45 (s, 3H, *E*), 2.44 (s, 3H, *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 143.9, 137.5 (q, *J* = 2.8 Hz), 136.5, 135.7, 135.4, 130.1 (x2), 129.4 (x2), 128.9 (x2), 128.8 (x2), 128.6, 128.3 (x2), 128.2, 128.0, 127.4 (x2), 123.6 (q, *J* = 275.8 Hz), 52.9, 46.2 (q, *J* = 3.6 Hz), 21.7.

IR (neat): ν = 3064, 3033, 2923, 2863, 1598, 1495, 1455, 1446, 1344, 1289, 1202, 1161, 1099, 734, 699, 549 cm^{-1}.

Compound 2o *N*-phenethyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)methanesulfonamide



$C_{13}H_{16}F_3NO_2S$
MW: 307.33 $g.mol^{-1}$
Colorless oil
71 % (54.6 mg)
E/*Z* ratio = *66:34*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

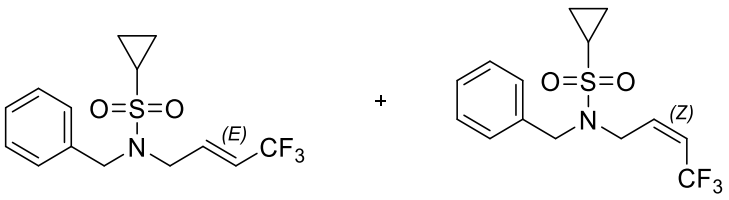
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.34 – 7.29 (m, 6H, *E* + *Z*), 7.26 – 7.18 (m, 4H, *E* + *Z*), 6.40 – 6.23 (m, 1H, *Z*), 6.03 (dt, J = 11.8, 6.7 Hz, 1H, *E*), 5.91 – 5.69 (m, 2H, *E* + *Z*), 4.10 (dt, J = 6.7, 2.0 Hz, 2H, *E*), 3.90 (dt, J = 6.0, 2.1 Hz, 2H, *Z*), 3.47 (dt, J = 7.8, 6.4 Hz, 4H, *E* + *Z*), 2.96 – 2.85 (m, 4H, *E* + *Z*), 2.69 (s, 3H, *Z*), 2.65 (s, 3H, *E*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 138.9 (q, *J* = 5.0 Hz), 138.1, 129.1 (x2), 128.9 (x2), 127.0, 122.9 (q, *J* = 270.6 Hz), 121.0 (q, *J* = 34.3 Hz), 49.8, 45.1 (q, *J* = 1.6 Hz), 39.0, 35.2.

IR (neat): ν = 3065, 3012, 2864, 1330, 1145, 1124, 963, 701, 519 cm^{-1}.

Compound 2p *N*-benzyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)cyclopropanesulfonamide



$C_{14}H_{16}F_3NO_2S$
MW: 319.34 g.mol^{-1}
Colorless oil
89 % (71.4 mg)
E/*Z* ratio = *78:22*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

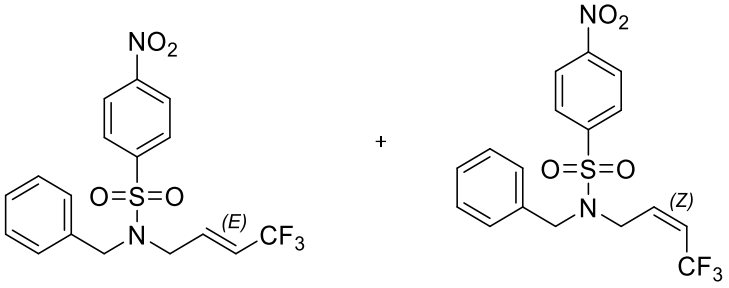
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.42 – 7.28 (m, 10H, *E* + *Z*), 6.37 – 6.21 (m, 1H, *Z*), 6.00 (dt, J = 11.9, 6.3 Hz, 1H, *E*), 5.72 (dddd, J = 15.8, 7.9, 6.2, 4.6 Hz, 1H, *Z*), 5.66 – 5.54 (m, 1H, *E*), 4.43 (s, 4H, *E* + *Z*), 4.11 (dp, J = 6.6, 2.2 Hz, 2H, *E*), 3.90 (dp, J = 6.2, 2.1 Hz, 2H, *Z*), 2.48 – 2.21 (m, 2H, *E* + *Z*), 1.35 – 1.18 (m, 4H, *E* + *Z*), 1.09 – 0.98 (m, 4H, *E* + *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 139.0 (q, *J* = 5.0 Hz), 135.8, 128.9 (x2), 128.7 (x2), 128.3, 122.8 (q, *J* = 271.8 Hz), 120.0 (q, *J* = 34.5 Hz), 52.2, 45.2 (q, *J* = 1.7 Hz), 29.8, 5.5 (x2).

IR (neat): ν = 3065, 2925, 2876, 1335, 1126, 889, 703 cm^{-1}.

Compound 2q *N*-benzyl-4-nitro-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide



$C_{17}H_{15}F_3N_2O_4S$
MW: 400.37 g.mol^{-1}
Colorless oil
74 % (89.7 mg)
E/*Z* ratio = *80:20*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

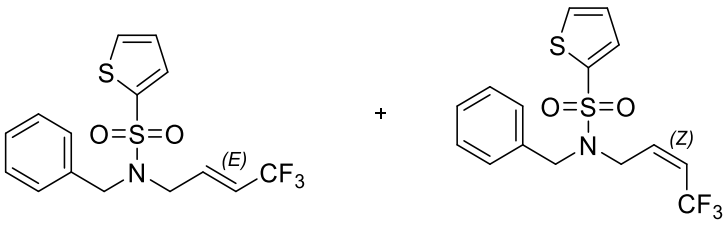
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (500 MHz, $CDCl_3$): δ 8.38 (d, *J* = 8.8 Hz, 4H, *E* + *Z*), 7.99 (d, *J* = 8.8 Hz, 4H, *E* + *Z*), 7.37 – 7.18 (m, 10H, *E* + *Z*), 6.11 – 5.99 (m, 1H, *Z*), 5.78 (dt, J = 11.9, 6.3 Hz, 1H, *E*), 5.64 – 5.48 (m, 2H, *E* + *Z*), 4.39 (s, 4H, *E* + *Z*), 4.04 (dp, J = 6.4, 2.2 Hz, 2H, *E*), 3.89 (dp, J = 6.1, 2.1 Hz, 2H, *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 150.3, 145.4, 137.7 (q, *J* = 5.0 Hz), 134.6, 129.0 (x2), 128.7 (x2), 128.7, 128.5 (x2), 124.7 (x2), 122.7 (q, *J* = 272.0 Hz), 120.3 (q, *J* = 34.5 Hz), 52.7, 45.5 (q, *J* = 1.7 Hz).

IR (neat): ν = 2363, 2340, 1531, 1350, 1162, 1124, 856, 738, 693, 609, 536, 463 cm^{-1}.

Compound 2r *N*-benzyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)thiophene-2-sulfonamide



$C_{15}H_{14}F_3NO_4S_2$
MW: 361.40 g.mol^{-1}
Colorless oil
81 % (64.8 mg)
E/*Z* ratio = *77:23*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

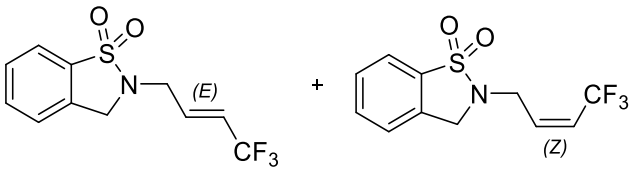
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.75 – 7.60 (m, 4H, *E* + *Z*), 7.39 – 7.29 (m, 10H, *E* + *Z*), 7.18 (dd, J = 5.1, 3.7 Hz, 2H, *E* + *Z*), 6.25 – 6.00 (m, 1H, *Z*), 5.84 (dt, J = 12.3, 6.3 Hz, 1H, *E*), 5.64 – 5.45 (m, 2H, *E* + *Z*), 4.36 (s, 4H, *E* + *Z*), 4.04 (dq, J = 6.4, 2.2 Hz, 2H, *E*), 3.88 (dt, J = 6.1, 2.0 Hz, 2H, *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 139.7, 138.4 (q, *J* = 5.1 Hz), 135.2, 132.5, 132.3, 128.9 (x2), 128.8 (x2), 128.4, 127.8, 122.8 (q, *J* = 271.8 Hz), 119.6 (q, *J* = 34.5 Hz), 53.0, 45.8 (q, *J* = 1.7 Hz).

IR (neat): ν = 3106, 2963, 2874, 1673, 1406, 1349, 1257, 1155, 722, 703, 581 cm^{-1}.

Compound 2s 2-(4,4,4-trifluorobut-2-en-1-yl)-2,3-dihydrobenzo[*d*]isothiazole 1,1-dioxide



$C_{11}H_{10}F_3NO_2S$
MW: 277.26 g.mol^{-1}
White solid
73 % (54.6 mg)
E/*Z* ratio = *90:10*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

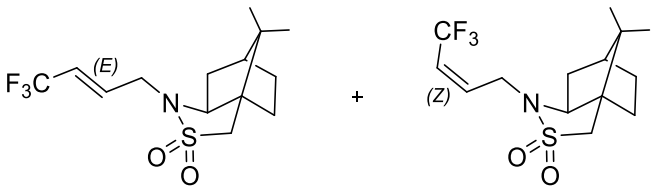
Only E-stereoisomer was descried for ^{13}C-NMR.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.80 (dd, *J* = 18.4, 8.0 Hz, 2H, *E* + *Z*), 7.63 (td, *J* = 7.6, 1.2 Hz, 2H, *E* + *Z*), 7.55 (td, *J* = 7.6, 1.0 Hz, 2H, *E* + *Z*), 7.41 (t, *J* = 0.9 Hz, 2H, *E* + *Z*), 6.56 – 6.48 (m, 1H, *Z*), 6.26 (dt, *J* = 11.8, 7.2 Hz, 1H, *E*), 5.91 (dqt, *J* = 12.0, 8.5, 1.8 Hz, 2H, *E* + *Z*), 4.37 (s, 4H, *E* + *Z*), 4.21 (dp, J = 7.4, 2.0 Hz, 2H, *E*), 4.04 (dt, *J* = 5.9, 2.1 Hz, 2H, *Z*).

^{13}C NMR (126 MHz, $CDCl_3$): δ 136.8 (q, *J* = 5.1 Hz), 134.8, 133.5, 133.1, 129.5, 124.7, 122.8 (d, *J* = 266.2 Hz), 122.6 (q, *J* = 34.4 Hz), 121.7, 50.3, 41.3 (q, *J* = 1.5 Hz).

IR (neat): ν = 2943, 2865, 1675, 1299, 1225, 1175, 1127, 783, 570 cm^{-1}.

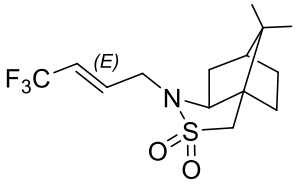
Compound 2t (6S,7aS)-8,8-dimethyl-1-(-4,4,4-trifluorobut-2-en-1-yl)hexahydro-3H-3a,6-methanobenzo[*c*]isothiazole 2,2-dioxide



$C_{14}H_{20}F_3NO_2S$
MW: 323.37 g.mol^{-1}
Colorless oil
67 % (168.9 mg)
E/*Z* ratio = *75:25*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent. Both diastereomers are separable by column chromatography.

- **Compound 2t-*E*** (6S,7aS)-8,8-dimethyl-1-((*E*)-4,4,4-trifluorobut-2-en-1-yl)hexahydro-3H-3a,6-methanobenzo[*c*]isothiazole 2,2-dioxide



^{1}H NMR (500 MHz, $CDCl_3$): δ 6.47 (dddt, *J* = 15.6, 6.5, 4.3, 2.1 Hz, 1H), 6.00 – 5.79 (m, 1H), 3.83 (dtd, *J* = 15.9, 4.1, 2.0 Hz, 1H), 3.53 (ddt, *J* = 15.9, 6.4, 2.0 Hz, 1H), 3.16 (s, 2H), 3.10 (dd, *J* = 8.0, 4.4 Hz, 1H), 2.00 – 1.79 (m, 4H), 1.66 – 1.61 (m, 1H), 1.48 – 1.42 (m, 1H), 1.34 – 1.23 (m, 1H), 1.13 (s, 3H), 0.93 (s, 3H).

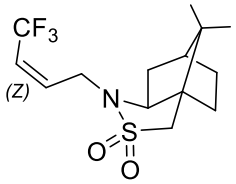
^{19}F NMR (282 MHz, $CDCl_3$): δ -66.42.

^{13}C NMR (126 MHz, $CDCl_3$): δ 135.2 (q, *J* = 6.4 Hz), 122.5 (q, *J* = 269.7 Hz), 122.3 (q, *J* = 34.2 Hz), 67.3, 50.1, 49.5, 47.8, 44.8, 43.7, 35.6, 32.4, 27.0, 20.5, 20.1.

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{14}H_{20}F_3NaNO_2S$ 346.1059; found 346.1053.

IR (neat): ν = 2958, 2883, 1673, 1456, 1308, 1222, 1117, 1063, 542 cm^{-1}.

- **Compound 2t-*Z*** (6S,7aS)-8,8-dimethyl-1-((*Z*)-4,4,4-trifluorobut-2-en-1-yl)hexahydro-3H-3a,6-methanobenzo[*c*]isothiazole 2,2-dioxide



^{1}H NMR (500 MHz, $CDCl_3$): δ 6.26 (dt, *J* = 11.9, 7.0 Hz, 1H), 5.88 – 5.68 (m, 1H), 3.97 (ddt, *J* = 16.6, 6.9, 2.0 Hz, 1H), 3.77 (ddt, *J* = 16.6, 6.9, 2.0 Hz, 1H), 3.15 (s, 2H), 3.15 – 3.10 (m, 1H), 1.99 – 1.93 (m, 1H), 1.93 – 1.81 (m, 3H), 1.65 (dd, *J* = 12.8, 7.9 Hz, 1H), 1.52 – 1.40 (m, 1H), 1.37 – 1.21 (m, 1H), 1.11 (s, 3H), 0.92 (s, 3H).

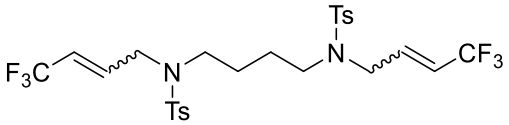
^{19}F NMR (282 MHz, $CDCl_3$): δ -60.07.

^{13}C NMR (126 MHz, $CDCl_3$): δ 137.5 (q, J = 5.1 Hz), 122.9 (q, J = 272.0 Hz), 121.1 (q, J = 34.3 Hz), 66.9, 50.1, 49.5, 47.8, 44.7, 40.1 (q, J = 1.7 Hz), 35.1, 32.3, 22.0, 20.5, 20.1.

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{14}H_{20}F_3NaNO_2S$ 346.1059; found 346.1056.

IR (neat): ν = 2958, 2883, 1719, 1306, 1226, 1130, 1062, 544 cm^{-1}.

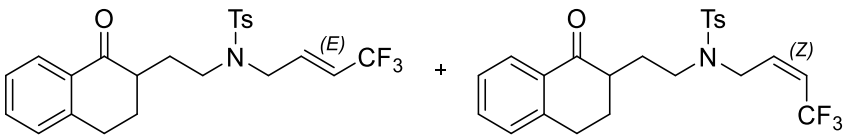
Compound 2u *N*,*N*'-(butane-1,4-diyl)bis(4-methyl-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide)



$C_{26}H_{30}F_6N_2O_4S_2$
MW: 612.65 $g.mol^{-1}$

2u was obtained after short work-up and used without further purification.

Compound 2v 4-methyl-*N*-(2-(1-oxo-1,2,3,4-tetrahydronaphthalen-2-yl)ethyl)-*N*-(4,4,4-trifluorobut-2-en-1-yl)benzenesulfonamide

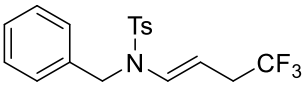


$C_{23}H_{24}F_3NO_3S$
MW: 451.50 g.mol^{-1}

2v was obtained after short work-up and used without further purification.

Enamides **3a-v**

Compound 3a (*E*)-*N*-benzyl-4-methyl-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{18}H_{18}F_3NO_2S$
MW: 369.40 g.mol^{-1}
Colorless oil
87 % (60.7 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 60:40) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.68 (d, *J* = 8.3 Hz, 2H), 7.38 – 7.21 (m, 7H), 6.92 (d, *J* = 14.2 Hz, 1H), 4.54 (dt, *J* = 14.2, 7.5 Hz, 1H), 4.50 (s, 2H), 2.67 (qdd, *J* = 10.4, 7.4, 1.2 Hz, 2H), 2.44 (s, 3H).

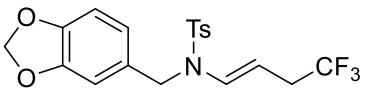
^{19}F NMR (471 MHz, $CDCl_3$): δ -67.40.

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.3, 135.8, 135.0, 132.1, 130.1 (x2), 128.8 (x2), 127.7, 127.1 (2), 127.0 (x2), 126.2 (d, *J* = 276.9 Hz), 99.1 (q, *J* = 3.9 Hz), 49.5, 35.3 (q, *J* = 30.5 Hz), 21.7.

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{18}H_{18}F_3NNaO_2S$ 392.0903; found 392.0895.

IR (neat): ν = 2925, 1852, 1662, 1342, 1255, 1166, 1137, 1068, 697, 550 cm^{-1}.

Compound 3b (*E*)-*N*-(benzo[*d*][1,3]dioxol-5-ylmethyl)-4-methyl-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{19}H_{18}F_3NO_4S$
MW: 413.41 g.mol^{-1}
White solid
mp: 65 – 68 °C
89 % (32.8 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.66 (d, *J* = 8.3 Hz, 2H), 7.32 (d, *J* = 8.0 Hz, 2H), 6.89 (d, *J* = 14.2 Hz, 1H), 6.81 – 6.64 (m, 3H), 5.94 (s, 2H), 4.58 (dt, *J* = 14.1, 7.5 Hz, 1H), 4.39 (s, 2H), 2.69 (qdd, *J* = 10.5, 7.5, 1.2 Hz, 2H), 2.44 (s, 3H).

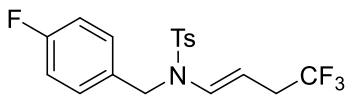
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.35.

^{13}C NMR (126 MHz, $CDCl_3$): δ 148.1, 147.1, 144.2, 135.7, 132.0, 130.0 (x2), 128.7, 127.0 (x2), 125.7 (q, *J* = 275.4 Hz), 120.3, 108.2, 107.5, 101.1, 99.1 (q, *J* = 3.8 Hz), 49.2, 35.2 (q, *J* = 30.5 Hz), 21.6.

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{19}H_{18}F_3NNaO_4S$ 436.0801; found 436.0794.

IR (neat): ν = 2920, 1662, 1491, 1448, 1356, 1245, 1165, 810, 665, 549 cm^{-1}.

Compound 3c (*E*)-*N*-(4-fluorobenzyl)-4-methyl-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{18}H_{17}F_4NO_2S$
MW: 387.39 g.mol^{-1}
White solid
mp: 93 – 95 °C
89 % (73 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:00 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.67 (d, *J* = 8.4 Hz, 2H), 7.32 (d, *J* = 8.0 Hz, 2H), 7.28 – 7.17 (m, 2H), 7.04 – 6.93 (m, 2H), 6.91 (d, *J* = 14.2 Hz, 1H), 4.53 (dd, *J* = 14.6, 7.1 Hz, 1H), 4.46 (s, 2H), 2.69 (qdd, *J* = 10.4, 7.5, 1.2 Hz, 2H), 2.44 (s, 3H).

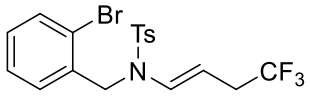
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.40, -114.80.

^{13}C NMR (126 MHz, $CDCl_3$): δ 162.3 (d, *J* = 246.0 Hz), 144.5, 135.7, 132.0, 130.7 (d, *J* = 3.1 Hz), 130.1 (x2), 128.7 (d, *J* = 8.2 Hz) (x2), 127.1 (x2), 125.8 (q, *J* = 276.6 Hz), 115.7 (d, *J* = 21.7 Hz) (x2), 99.2 (q, *J* = 3.7 Hz), 48.8, 35.2 (q, *J* = 30.5 Hz), 21.7.

HRMS (ESI-TOF) m/z: $[M+K]^+$ calcd for $C_{18}H_{17}F_4KNO_2S$ 426.0548; found 426.0541.

IR (neat): ν = 3071, 2929, 1661, 1600, 1509, 1359, 1253, 1129, 1067, 811, 635, 509 cm^{-1}.

Compound 3d (*E*)-*N*-(2-bromobenzyl)-4-methyl-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{18}H_{17}BrF_3NO_2S$
MW: 448.30 g.mol^{-1}
Colorless oil
80 % (44.2 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:5 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.71 (d, *J* = 8.3 Hz, 2H), 7.52 (dd, *J* = 7.9, 1.1 Hz, 1H), 7.35 (d, *J* = 7.9 Hz, 2H), 7.32 – 7.22 (m, 2H), 7.18 – 7.08 (m, 1H), 6.97 (d, *J* = 14.2 Hz, 1H), 4.56 (s, 2H), 4.48 – 4.30 (m, 1H), 2.69 (qdd, *J* = 10.4, 7.5, 1.0 Hz, 2H), 2.45 (s, 3H).

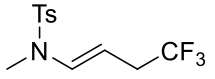
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.36.

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.6, 135.7, 133.6, 132.8, 131.8, 130.3 (x2), 129.2, 128.3, 127.9, 127.1 (x2), 125.8 (d, *J* = 278.6 Hz), 122.3, 98.9 (q, *J* = 3.7 Hz), 49.5, 35.2 (q, *J* = 30.5 Hz), 21.8.

HRMS (ESI-TOF) m/z: $[M+H]^+$ calcd for $C_{18}H_{18}BrF_3NO_2S$ 448.0188; found 448.0187.

IR (neat): ν = 3036, 2960, 1662, 1597, 1442, 1362, 1276, 1255, 1167, 1138, 1046, 665 cm^{-1}.

Compound 3e (*E*)-N,4-dimethyl-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{12}H_{14}F_3NO_2S$
MW: 293.30 g.mol^{-1}
Colorless oil
89 % (53.6 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.62 (d, J = 8.3 Hz, 2H), 7.31 (d, *J* = 8.5 Hz, 2H), 6.98 (d, *J* = 14.1 Hz, 1H), 4.58 (dt, *J* = 14.0, 7.5 Hz, 1H), 2.86 (s, 3H), 2.85 – 2.73 (m, 2H), 2.42 (s, 3H).

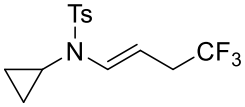
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.34.

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.3, 134.5, 133.8, 130.0 (x2), 127.1 (x2), 126.0 (q, *J* = 276.5 Hz), 97.6 (q, *J* = 3.8 Hz), 35.2 (q, *J* = 30.5 Hz), 32.1, 21.7.

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{12}H_{14}F_3NNaO_2S$ 316.0590; found 316.0581.

IR (neat): ν = 3064, 2931, 1662, 1598, 1356, 1335, 1276, 1248, 1162, 1137, 769, 665, 548 cm^{-1}.

Compound 3f (*E*)-*N*-cyclopropyl-4-methyl-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{14}H_{16}F_3NO_2S$
MW: 319.34 $g.mol^{-1}$
White solid
mp: 66 – 68 °C
92 % (59.7 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.68 (d, *J* = 8.3 Hz, 2H), 7.32 (d, *J* = 7.9 Hz, 2H), 6.87 (d, *J* = 14.1 Hz, 1H), 5.00 (dt, *J* = 14.1, 7.6 Hz, 1H), 2.80 (qdd, *J* = 10.5, 7.6, 1.2 Hz, 2H), 2.43 (d, *J* = 0.8 Hz, 3H), 1.76 (tt, *J* = 6.7, 3.7 Hz, 1H), 1.01 – 0.79 (m, 4H).

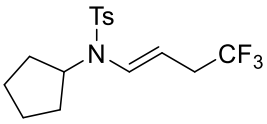
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.27.

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.3, 134.7, 134.2, 129.8 (x2), 127.6 (x2), 126.0 (q, *J* = 276.5 Hz), 100.8 (q, *J* = 3.7 Hz), 35.3 (q, *J* = 30.5 Hz), 27.0, 21.7, 8.2 (x2).

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{14}H_{16}F_3NNaO_2S$ 342.0746; found 342.0746.

IR (neat): ν = 3087, 2931, 1658, 1598, 1365, 1257, 1186, 1125, 664, 601, 551 cm^{-1}.

Compound 3g (*E*)-*N*-cyclopentyl-4-methyl-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{16}H_{20}F_3NO_2S$
MW: 347.40 $g.mol^{-1}$
Colorless oil
79 % (15.9 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.66 (d, *J* = 8.3 Hz, 2H), 7.29 (d, *J* = 7.9 Hz, 2H), 6.37 (d, *J* = 14.4 Hz, 1H), 5.16 (dt, *J* = 14.5, 7.5 Hz, 1H), 4.46 (p, *J* = 8.7 Hz, 1H), 2.80 (qdd, *J* = 10.5, 7.5, 1.2 Hz, 2H), 2.42 (s, 3H), 1.70 – 1.59 (m, 6H), 1.54 – 1.40 (m, 2H).

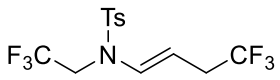
^{19}F NMR (282 MHz, $CDCl_3$): δ -66.99.

^{13}C NMR (126 MHz, $CDCl_3$): δ 143.8, 136.8, 129.7 (x2), 129.1, 127.1 (x2), 123.6 (q, *J* = 279.2 Hz), 105.4 (q, *J* = 3.5 Hz), 58.6, 35.9 (q, *J* = 30.4 Hz), 27.5 (x2), 24.4 (x2), 21.6.

HRMS (ESI-TOF) m/z: $[M+K]^+$ calcd for $C_{16}H_{20}F_3KNO_2S$ 386.0798; found 386.0801.

IR (neat): ν = 2960, 1875, 1660, 1340, 1273, 1252, 1160, 1137, 1091, 1064, 666, 548 cm^{-1}.

Compound 3h (*E*)-4-methyl-*N*-(4,4,4-trifluorobut-1-en-1-yl)-*N*-(2,2,2-trifluoroethyl)benzenesulfonamide



$C_{13}H_{13}F_6NO_2S$
MW: 361.30 $g.mol^{-1}$
White solid
mp: 60 – 62 °C
90 % (67.4 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.67 (d, *J* = 8.4 Hz, 2H), 7.34 (d, *J* = 8.0 Hz, 2H), 6.75 (d, *J* = 14.2 Hz, 1H), 4.94 (dt, *J* = 14.6, 7.4 Hz, 1H), 4.01 (q, *J* = 8.3 Hz, 2H), 2.80 (qdd, *J* = 10.3, 7.5, 1.1 Hz, 2H), 2.44 (s, 3H).

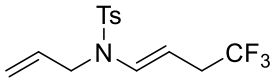
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.15, -68.53.

^{13}C NMR (126 MHz, $CDCl_3$): δ 145.1, 135.2, 132.0, 130.2 (x2), 127.3 (x2), 125.7 (q, *J* = 278.1 Hz), 123.7 (q, *J* = 281.1 Hz), 101.1 (m), 47.1 (q, *J* = 36.2 Hz), 35.2 (q, *J* = 30.7 Hz), 21.7.

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{13}H_{13}F_6NNaO_2S$ 384.0463; found 384.0462.

IR (neat): ν = 2937, 1667, 1599, 1364, 1332, 1271, 1257, 1164, 1069, 1010, 666, 547 cm^{-1}.

Compound 3i (*E*)-*N*-allyl-4-methyl-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{14}H_{16}F_3NO_2S$
MW: 319.34 $g.mol^{-1}$
Colorless oil
86 % (51.4 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.66 (d, *J* = 8.3 Hz, 2H), 7.31 (d, *J* = 8.3 Hz, 2H), 6.88 (d, *J* = 14.2 Hz, 1H), 5.60 (ddt, *J* = 17.2, 10.5, 5.3 Hz, 1H), 5.20 – 5.14 (m, 1H), 5.14 (t, *J* = 1.3 Hz, 1H), 4.67 (dt, *J* = 14.5, 7.4 Hz, 1H), 3.99 (dt, *J* = 5.3, 1.7 Hz, 2H), 2.77 (qdd, *J* = 10.5, 7.5, 1.2 Hz, 2H), 2.43 (s, 3H).

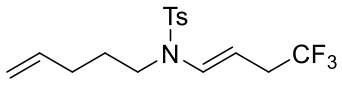
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.37.

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.3, 136.1, 131.9, 131.2, 130.0 (x2), 127.1 (x2), 126.0 (q, *J* = 276.5 Hz), 118.2, 98.2 (q, *J* = 3.8 Hz), 48.2, 35.3 (q, *J* = 30.5 Hz), 21.7.

HRMS (ESI-TOF) m/z: $[M+K]^+$ calcd for $C_{14}H_{16}F_3KNO_2S$ 359.0485; found 358.0476.

IR (neat): ν = 3070, 2929, 2874, 1662, 1598, 1357, 1274, 1254, 1164, 1133, 1089, 1067, 889, 814, 665, 593, 547 cm^{-1}.

Compound 3j (*E*)-4-methyl-*N*-(pent-4-en-1-yl)-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{16}H_{20}F_3NO_2S$
MW: 347.40 $g.mol^{-1}$
Colorless oil
88 % (61.8 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.63 (d, *J* = 8.3 Hz, 2H), 7.30 (d, *J* = 7.9 Hz, 2H), 6.85 (d, *J* = 14.3 Hz, 1H), 5.76 (ddt, *J* = 16.9, 10.2, 6.6 Hz, 1H), 5.09 – 4.92 (m, 2H), 3.35 – 3.22 (m, 2H), 2.80 (qdd, *J* = 10.4, 7.5, 1.2 Hz, 2H), 2.42 (s, 3H), 2.15 – 1.93 (m, 2H), 1.74 – 1.58 (m, 2H), 1.29 – 1.22 (m, 1H).

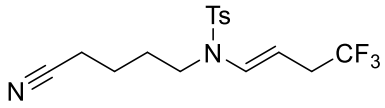
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.33.

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.1, 137.3, 136.0, 132.1, 130.0 (x2), 127.0 (x2), 126.0 (q, *J* = 276.6 Hz), 115.8, 97.4 (q, *J* = 3.8 Hz), 45.0, 35.4 (q, *J* = 30.5 Hz), 30.9, 25.9, 21.7.

HRMS (ESI-TOF) m/z: $[M+K]^+$ calcd for $C_{16}H_{20}F_3KNO_2S$ 386.0790; found 386.0790.

IR (neat): ν = 3081, 2828, 2857, 1661, 1358, 1341, 1307, 1276, 1186, 1138, 1091, 7071, 951, 911, 814, 665, 596, 560 cm^{-1}.

Compound 3k (*E*)-*N*-(4-cyanobutyl)-4-methyl-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{16}H_{19}F_3N_2O_2S$
MW: 360.40 $g.mol^{-1}$
Colorless oil
82 % (57.4 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.62 (d, *J* = 8.4 Hz, 2H), 7.31 (d, *J* = 8.0 Hz, 2H), 6.83 (d, *J* = 14.3 Hz, 1H), 4.67 (dt, *J* = 14.6, 7.5 Hz, 1H), 3.38 – 3.28 (m, 2H), 2.81 (qdd, *J* = 10.4, 7.5, 1.2 Hz, 2H), 2.43 (s, 5H), 1.77 – 1.69 (m, 4H).

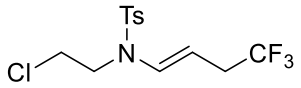
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.25.

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.3, 135.4, 131.8, 130.0 (x2), 126.9 (x2), 125.4 (q, *J* = 274.4 Hz), 119.2, 98.4 (q, *J* = 3.7 Hz), 44.2, 35.2 (q, *J* = 30.5 Hz), 25.3, 22.3, 21.6, 16.7.

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{16}H_{19}F_3N_2NaO_2S$ 383.1012; found 383.1008.

IR (neat): ν = 3060, 2944, 2876, 1661, 1598, 1340, 1255, 1162, 1099, 1063, 665, 597, 549 cm^{-1}.

Compound 3l (*E*)-*N*-(2-chloroethyl)-4-methyl-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{13}H_{15}ClF_3NO_2S$
MW: 341.77 g.mol^{-1}
Colorless oil
76 % (52.2 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.66 (d, *J* = 8.4 Hz, 2H), 7.33 (d, *J* = 8.5 Hz, 2H), 6.84 (d, *J* = 14.3 Hz, 1H), 4.74 (dt, *J* = 14.2, 7.4 Hz, 1H), 3.59 (s, 4H), 2.81 (qdd, *J* = 10.4, 7.5, 1.2 Hz, 2H), 2.44 (s, 3H).

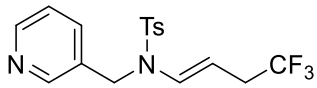
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.21.

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.7, 135.4, 131.9, 130.2 (x2), 127.1 (x2), 125.8 (q, *J* = 276.5 Hz), 97.7 (q, *J* = 3.8 Hz), 46.7, 39.2, 35.2 (q, *J* = 30.6 Hz), 21.7.

HRMS (ESI-TOF) m/z: $[M+H]^+$ calcd for $C_{13}H_{16}ClF_3NO_2S$ 342.0537; found 342.0529.

IR (neat): ν = 3057, 2971n 1662, 1598, 1365, 1339, 1276n 1255, 1187, 1139, 1074, 905, 664, 549 cm^{-1}.

Compound 3m (*E*)-4-methyl-*N*-(pyridin-3-ylmethyl)-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{17}H_{17}F_3N_2O_2S$
MW: 370.39 g.mol^{-1}
Colorless oil
87 % (61.2 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$): δ 8.50 (d, *J* = 20.9 Hz, 2H), 7.67 (d, *J* = 8.4 Hz, 2H), 7.64 (d, *J* = 7.9 Hz, 1H), 7.33 (d, *J* = 8.0 Hz, 2H), 7.28 – 7.22 (m, 1H), 6.92 (d, *J* = 14.3 Hz, 1H), 4.58 – 4.43 (m, 3H), 2.69 (qdd, *J* = 10.4, 7.5, 1.1 Hz, 2H), 2.44 (s, 3H).

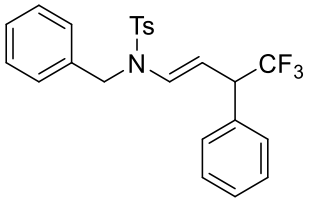
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.36.

^{13}C NMR (126 MHz, $CDCl_3$): δ 149.3, 148.6, 144.7, 135.5, 135.5, 134.8, 131.8, 130.2 (x2), 123.8, 127.1 (x2), 125.7 (q, *J* = 276.6 Hz), 99.4 (q, *J* = 3.7 Hz), 47.0, 35.2 (q, *J* = 30.6 Hz), 21.7.

HRMS (ESI-TOF) m/z: $[M+H]^+$ calcd for $C_{17}H_{18}F_3N_2O_2S$ 371.1036; found 371.1031.

IR (neat): ν = 3079, 2930, 1661, 1429, 1363, 1275, 1255, 1166, 1138, 1071, 666 cm^{-1}.

Compound 3n (*E*)-*N*-benzyl-4-methyl-*N*-(4,4,4-trifluoro-3-phenylbut-1-en-1-yl)benzenesulfonamide



$C_{24}H_{22}F_3NO_2S$
MW: 445.50 g.mol^{-1}
Colorless oil
86 % (10.4 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:00 to 60:40) as eluent.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.64 (d, *J* = 8.3 Hz, 2H), 7.29 – 7.20 (m, 10H), 7.03 – 6.96 (m, 2H), 6.90 (d, *J* = 14.2 Hz, 1H), 4.92 (dd, *J* = 14.2, 8.8 Hz, 1H), 4.64 (d, *J* = 15.9 Hz, 1H), 4.46 (d, *J* = 15.9 Hz, 1H), 3.86 (p, *J* = 9.1 Hz, 1H), 2.44 (s, 3H).

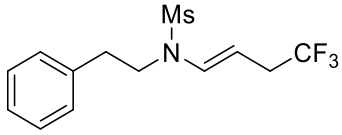
^{19}F NMR (282 MHz, $CDCl_3$): δ -69.97.

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.3, 135.8, 135.0, 134.9, 131.1, 130.1 (x2), 129.4, 128.8 (x2), 128.8 (x2), 128.7 (x2), 128.2 (d, *J* = 65.5 Hz), 127.1 (x2), 127.1 (x2), 123.7 (q, *J* = 270.7 Hz), 105.4 (d, *J* = 2.9 Hz), 51.1 (q, *J* = 28.1 Hz), 49.6, 21.7.

HRMS (ESI-TOF) m/z: $[M+K]^+$ calcd for $C_{24}H_{22}F_3KNO_2S$ 484.0955; found 484.0941.

IR (neat): ν = 3090, 2957, 2872, 2357, 1659, 1520, 1455, 1363, 1250, 1165, 1107, 948, 738, 701, 666, 572 cm^{-1}.

Compound 3o (*E*)-*N*-phenethyl-*N*-(4,4,4-trifluorobut-1-en-1-yl)methanesulfonamide



$C_{13}H_{16}F_3NO_2S$
MW: 307.33 g.mol^{-1}
White solid
mp: 88 – 90 °C
69 % (32.2 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.37 – 7.20 (m, 5H), 6.69 (d, *J* = 14.0 Hz, 1H), 4.84 (dt, *J* = 14.3, 7.4 Hz, 1H), 3.83 – 3.67 (m, 2H), 2.99 – 2.93 (m, 2H), 2.84 (qdd, *J* = 10.4, 7.5, 1.2 Hz, 2H), 2.72 (s, 3H).

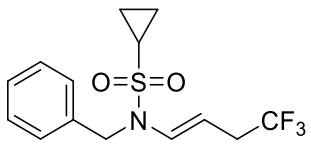
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.25.

^{13}C NMR (126 MHz, $CDCl_3$): δ 138.0, 131.3, 129.0 (x2), 129.0 (x2), 127.1, 126.0 (d, *J* = 274.4 Hz), 97.3 (q, *J* = 3.8 Hz), 47.3, 39.6, 35.4 (q, *J* = 30.6 Hz), 33.6.

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{13}H_{16}F_3NNaO_2S$ 330.0746; found 330.0744.

IR (neat): ν = 3089, 3062, 3005, 2936, 1664, 1331, 1254, 1132, 1087, 967, 738, 700, 519 cm^{-1}.

Compound 3p (*E*)-*N*-benzyl-N-(4,4,4-trifluorobut-1-en-1-yl)cyclopropanesulfonamide



$C_{14}H_{16}F_3NO_2S$
MW: 319.34 g.mol^{-1}
Colorless oil
79 % (55.5 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.42 – 7.19 (m, 5H), 6.80 (d, *J* = 14.2 Hz, 1H), 4.76 (s, 2H), 4.64 (dt, *J* = 14.3, 7.5 Hz, 1H), 2.70 (qdd, *J* = 10.5, 7.5, 1.1 Hz, 2H), 2.37 (tt, *J* = 8.0, 4.9 Hz, 1H), 1.31 – 1.14 (m, 2H), 1.11 – 0.91 (m, 2H).

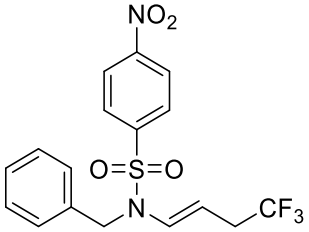
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.39.

^{13}C NMR (126 MHz, $CDCl_3$): δ 135.4, 132.3, 128.8 (x2), 127.8, 126.9 (x2), 125.9 (q, *J* = 276.5 Hz), 97.8 (q, *J* = 3.8 Hz), 49.7, 35.2 (q, *J* = 30.5 Hz), 30.6, 5.7 (x2).

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{14}H_{16}F_3NaNO_2S$ 342.0746; found 342.0744.

IR (neat): ν = 3065, 2931, 1662, 1340, 1275, 1253, 1127, 1066, 946, 882, 696, 602, 541 cm^{-1}.

Compound 3q (*E*)-*N*-benzyl-4-nitro-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{17}H_{15}F_3N_2O_4S$
MW: 400.37 $g.mol^{-1}$
Colorless oil
75 % (59.6 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 8.35 (d, *J* = 9.1 Hz, 2H), 7.94 (d, *J* = 9.1 Hz, 2H), 7.50 – 7.17 (m, 5H), 6.90 (d, *J* = 14.3 Hz, 1H), 4.73 (dt, *J* = 14.2, 7.5 Hz, 1H), 4.60 (s, 2H), 2.72 (qdd, *J* = 10.4, 7.5, 1.2 Hz, 2H).

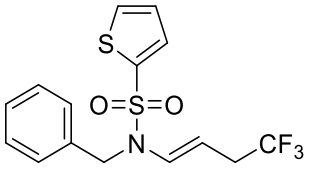
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.26.

^{13}C NMR (126 MHz, $CDCl_3$): δ 150.5, 144.3, 134.1, 131.3, 128.9 (x2), 128.3 (x2), 128.1, 127.1 (x2), 125.6 (q, *J* = 280.2 Hz), 124.7 (x2), 101.4 (q, *J* = 3.8 Hz), 49.8, 35.2 (q, *J* = 30.6 Hz).

HRMS (ESI-TOF) m/z: $[M+H]^+$ calcd for $C_{17}H_{16}F_3N_2O_4S$ 401.0777; found 401.0777.

IR (neat): ν = 3107, 1663, 1532, 1350, 1254, 1170, 1137, 1090, 1068, 950, 855, 737, 684, 618, 545, 463 cm^{-1}.

Compound 3r (*E*)-*N*-benzyl-*N*-(4,4,4-trifluorobut-1-en-1-yl)thiophene-2-sulfonamide



$C_{15}H_{14}F_3NO_2S_2$
MW: 361.40 $g.mol^{-1}$
Colorless oil
85 % (51.2 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.64 (dd, *J* = 5.0, 1.4 Hz, 1H), 7.58 (dd, *J* = 3.8, 1.3 Hz, 1H), 7.35 – 7.23 (m, 5H), 7.11 (dd, *J* = 5.0, 3.8 Hz, 1H), 6.88 (d, *J* = 14.2 Hz, 1H), 4.65 (dt, *J* = 14.4, 7.5 Hz, 1H), 4.58 (s, 2H), 2.70 (qdd, *J* = 10.4, 7.5, 1.0 Hz, 2H).

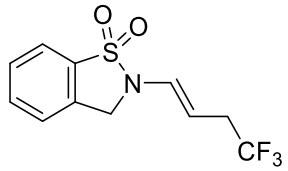
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.31.

^{13}C NMR (126 MHz, $CDCl_3$): δ 139.0, 134.8, 132.8, 132.6, 131.6, 128.9 (x2), 127.9, 127.7, 127.0 (x2), 125.6 (q, *J* = 277.0 Hz), 100.6 (q, *J* = 3.8 Hz), 49.8, 35.3 (q, *J* = 30.6 Hz).

HRMS (ESI-TOF) m/z: $[M+K]^+$ calcd for $C_{15}H_{14}F_3KNO_2S_2$ 400.0050; found 400.0039.

IR (neat): ν = 3165, 3068, 1663, 1367, 1344, 1276, 1255, 1164, 1138, 1070, 697, 607, 576 cm^{-1}.

Compound 3s (*E*)-2-(4,4,4-trifluorobut-1-en-1-yl)-2,3-dihydrobenzo[d]isothiazole 1,1-dioxide



$C_{11}H_{10}F_3NO_2S$
MW: 277.26 $g.mol^{-1}$
White solid
mp: 120 – 123 °C
92 % (41.5 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.89 – 7.80 (m, 1H), 7.73 – 7.62 (m, 1H), 7.64 – 7.53 (m, 1H), 7.52 – 7.43 (m, 1H), 6.80 (d, *J* = 14.0 Hz, 1H), 4.90 (dt, *J* = 13.9, 7.4 Hz, 1H), 4.61 (s, 2H), 2.90 (qdd, *J* = 10.5, 7.4, 1.2 Hz, 2H).

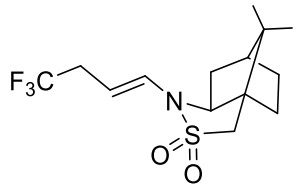
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.14.

^{13}C NMR (126 MHz, $CDCl_3$): δ 134.3, 133.6, 132.0, 129.7, 127.2, 125.9 (d, *J* = 296.4 Hz), 124.8, 121.8, 98.2 (q, *J* = 3.9 Hz), 47.6, 35.4 (q, *J* = 30.7 Hz).

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{11}H_{10}F_3NNaO_2S$ 300.0277; found 300.0275.

IR (neat): ν = 2928, 2868, 1668, 1307, 1282, 1214, 1172, 1162, 1128, 1065 cm^{-1}.

Compound 3t (6*S*,7a*S*)-8,8-dimethyl-1-((*E*)-4,4,4-trifluorobut-1-en-1-yl)hexahydro-3H-3a,6-methanobenzo[*c*]isothiazole 2,2-dioxide



$C_{14}H_{20}F_3NO_2S$
MW: 323.37 $g.mol^{-1}$
White solid
mp: 103 – 106 °C
83 % (45.6 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 6.32 (d, *J* = 14.1 Hz, 1H), 4.81 (ddd, *J* = 14.5, 8.0, 6.9 Hz, 1H), 3.41 (dd, *J* = 7.8, 4.8 Hz, 1H), 3.25 (d, *J* = 3.3 Hz, 2H), 2.95 – 2.69 (m, 2H), 2.15 – 2.01 (m, 1H), 1.96 – 1.89 (m, 3H), 1.87 – 1.76 (m, 1H), 1.54 – 1.44 (m, 1H), 1.39 – 1.31 (m, 1H), 1.08 (s, 3H), 0.95 (s, 3H).

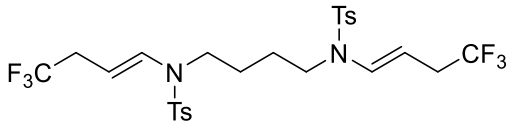
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.14.

^{13}C NMR (126 MHz, $CDCl_3$): δ 126.7, 125.9 (q, *J* = 276.5 Hz), 102.2 (q, *J* = 3.7 Hz), 63.9, 50.4, 49.8, 48.1, 44.6, 36.0, 35.6 (q, *J* = 30.6 Hz), 32.2, 27.0, 20.3, 20.1.

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{14}H_{20}F_3NNaO_2S$ 346.1059; found 346.1054.

IR (neat): ν = 2959, 2884, 1664, 1321, 1253, 1136, 1068 cm^{-1}.

Compound 3u 4-methyl-*N*-(4-((4-methyl-*N*-((*E*)-4,4,4-trifluorobut-1-en-1-yl)phenyl)sulfonamido)butyl)-*N*-((*E*)-4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{26}H_{30}F_6N_2O_4S_2$
MW: 612.65 g.mol^{-1}
Colorless oil
61 % (44.7 mg) (*two steps)*

*This compound was obtained through a sequential two steps procedure from **1u**.*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ 7.63 (d, *J* = 8.3 Hz, 4H), 7.31 (d, *J* = 8.5 Hz, 4H), 6.80 (d, *J* = 14.3 Hz, 2H), 4.66 (dt, *J* = 14.6, 7.5 Hz, 2H), 3.35 – 3.24 (m, 4H), 2.80 (qdd, *J* = 10.4, 7.4, 1.1 Hz, 4H), 2.43 (s, 6H), 1.66 – 1.57 (m, 4H).

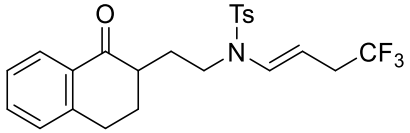
^{19}F NMR (282 MHz, $CDCl_3$): δ -67.27.

^{13}C NMR (126 MHz, $CDCl_3$): δ 144.3 (x2), 135.7 (x2), 132.0 (x2), 130.1 (x4), 127.0 (x4), 126.0 (q, *J* = 276.5 Hz) (x2), 98.4 (q, *J* = 3.7 Hz) (x2), 44.7 (x2), 35.3 (q, *J* = 30.5 Hz) (x2), 23.5 (x2), 21.7 (x2).

HRMS (ESI-TOF) m/z: $[M+H]^+$ calcd for $C_{26}H_{31}F_6N_2O_4S_2$ 613.1624; found 613.1626.

IR (neat): ν = 3089, 2931, 2882, 1661, 1339, 1253, 1163, 1063, 890, 846, 814, 664, 595, 548 cm^{-1}.

Compound 3v (*E*)-4-methyl-*N*-(2-(1-oxo-1,2,3,4-tetrahydronaphthalen-2-yl)ethyl)-*N*-(4,4,4-trifluorobut-1-en-1-yl)benzenesulfonamide



$C_{23}H_{24}F_3NO_3S$
MW: 451.50 g.mol^{-1}
Colorless oil
68 % (30 mg) (*two steps*)

*This compound was obtained through a sequential two steps procedure from **1v**.*

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.99 (dd, *J* = 7.8, 1.5 Hz, 1H), 7.64 (d, *J* = 8.3 Hz, 2H), 7.46 (td, *J* = 7.5, 1.5 Hz, 1H), 7.36 – 7.26 (m, 3H), 7.23 (d, *J* = 7.6 Hz, 1H), 6.86 (d, *J* = 14.3 Hz, 1H), 4.96 (dt, *J* = 14.7, 7.5 Hz, 1H), 3.59 – 3.50 (m, 1H), 3.51 – 3.41 (m, 1H), 3.14 – 2.94 (m, 2H), 2.89 – 2.76 (m, 2H), 2.62 – 2.51 (m, 1H), 2.41 (s, 3H), 2.32 – 2.16 (m, 2H), 1.97 – 1.85 (m, 1H), 1.77 – 1.65 (m, 1H).

^{19}F NMR (282 MHz, $CDCl_3$): δ -67.20.

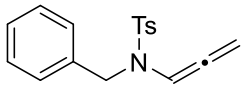
^{13}C NMR (126 MHz, $CDCl_3$): δ 120.0, 144.2, 144.0, 135.9, 133.5, 132.6, 132.0, 130.0 (x2), 128.9, 128.9 (d, *J* = 265.6 Hz), 127.5, 127.0 (x2), 126.8, 98.2 (q, *J* = 4.0 Hz), 45.4, 43.9, 35.4 (d, *J* = 30.3 Hz), 29.7, 29.3, 27.8, 21.7.

HRMS (ESI-TOF) m/z: $[M+K]^+$ calcd for $C_{23}H_{24}F_3KNO_3S$ 490.1061; found 490.1050.

IR (neat): ν = 3072, 2930, 1681, 2661, 1600, 1342, 1276, 1255, 1186, 1136 cm^{-1}.

Terminal *N*-allenamide **4**

Compound 4 *N*-benzyl-4-methyl-*N*-(propa-1,2-dien-1-yl)benzenesulfonamide[Erreur ! Signet non défini.]



$C_{17}H_{17}NO_2S$
MW: 299.39 g.mol^{-1}
Colorless oil
66 %

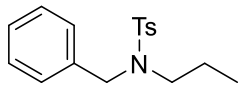
The product was obtained by column chromatography on silica gel using Petroleum ether / EtOAc (from 100:0 to 95:05) as eluent.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.68 (d, J = 8.3 Hz, 2H), 7.30 – 7.20 (m, 7H), 6.79 (t, J = 6.2 Hz, 1H), 5.10 (d, J = 6.2 Hz, 2H), 4.26 (s, 2H), 2.41 (s, 3H).

This analytical data match with those described in the literature.

Various syntheses **5-7**

Compound 5 *N*-benzyl-4-methyl-*N*-propylbenzenesulfonamide



$C_{17}H_{21}NO_2S$
MW: 303.42 g.mol^{-1}
Colorless oil
42 % (31.8 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 100:0 to 80:20) as eluent.

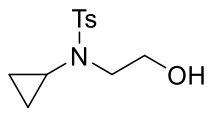
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.73 (d, *J* = 8.3 Hz, 2H), 7.34 – 7.25 (m, 7H), 4.32 (s, 2H), 3.08 – 3.01 (m, 2H), 2.44 (s, 3H), 1.34 (dq, *J* = 14.9, 7.4 Hz, 2H), 0.70 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$): δ 143.3, 137.3, 136.8, 129.8 (x2), 128.6 (x2), 128.4 (x2), 127.8, 127.3 (x2), 52.0, 50.0, 21.7, 21.5, 11.3.

HRMS (ESI-TOF) m/z: $[M+K]^+$ calcd for $C_{17}H_{21}KNO_2S$ 342.0925; found 342.0921.

IR (neat): ν = 3063, 3030, 2967, 2934, 2875, 1598, 1495, 1455, 1338, 1157, 1091, 1034, 940, 815, 736, 655, 549 cm^{-1}.

Compound 6 *N*-cyclopropyl-*N*-(2-hydroxyethyl)-4-methylbenzenesulfonamide



$C_{12}H_{17}NO_3S$
MW: 255.33 g.mol^{-1}
White solid
61 % (24.9 mg)

The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 88:12 to 0:100) as eluent.

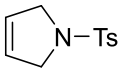
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.76 (d, *J* = 8.3 Hz, 2H), 7.34 (d, *J* = 8.0 Hz, 2H), 3.80 (q, *J* = 5.6 Hz, 2H), 3.31 (t, *J* = 5.5 Hz, 2H), 2.44 (s, 3H), 2.18 – 2.05 (m, 2H), 0.95 – 0.85 (m, 2H), 0.76 – 0.64 (m, 2H).

^{13}C NMR (126 MHz, $CDCl_3$): δ 143.9, 134.8, 129.8 (x2), 127.9 (x2), 61.3, 53.7, 32.0, 21.7, 7.7 (x2).

HRMS (ESI-TOF) m/z: $[M+Na]^+$ calcd for $C_{12}H_{17}NNaO_3S$ 278.0821; found 278.0814.

IR (neat): ν = 3537, 3022, 2927, 1891, 1597, 1454, 1334, 1304, 1155, 1108, 1034, 866, 816, 691, 579, 548 cm^{-1}.

Compound 7 1-tosyl-2,5-dihydro-1H-pyrrole[10]



$C_{11}H_{13}NO_2S$
MW: 223.29 $g.mol^{-1}$
White solid
95 % (55 mg)

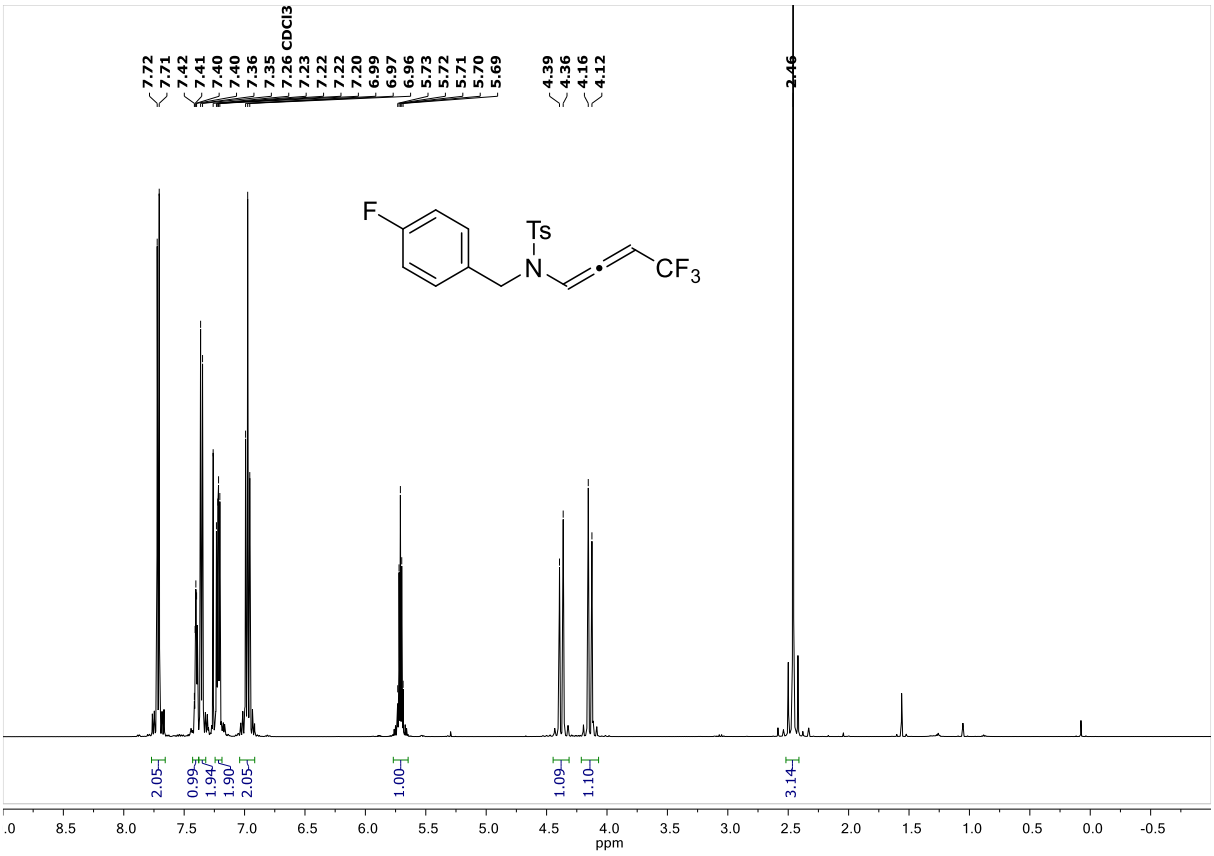
The product was obtained by column chromatography on silica gel using petroleum ether/EtOAc (from 95:05 to 60:40) as eluent.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.72 (d, *J* = 8.2 Hz, 2H), 7.32 (d, *J* = 8.0 Hz, 2H), 5.65 (s, 2H), 4.12 (s, 4H), 2.42 (s, 3H).

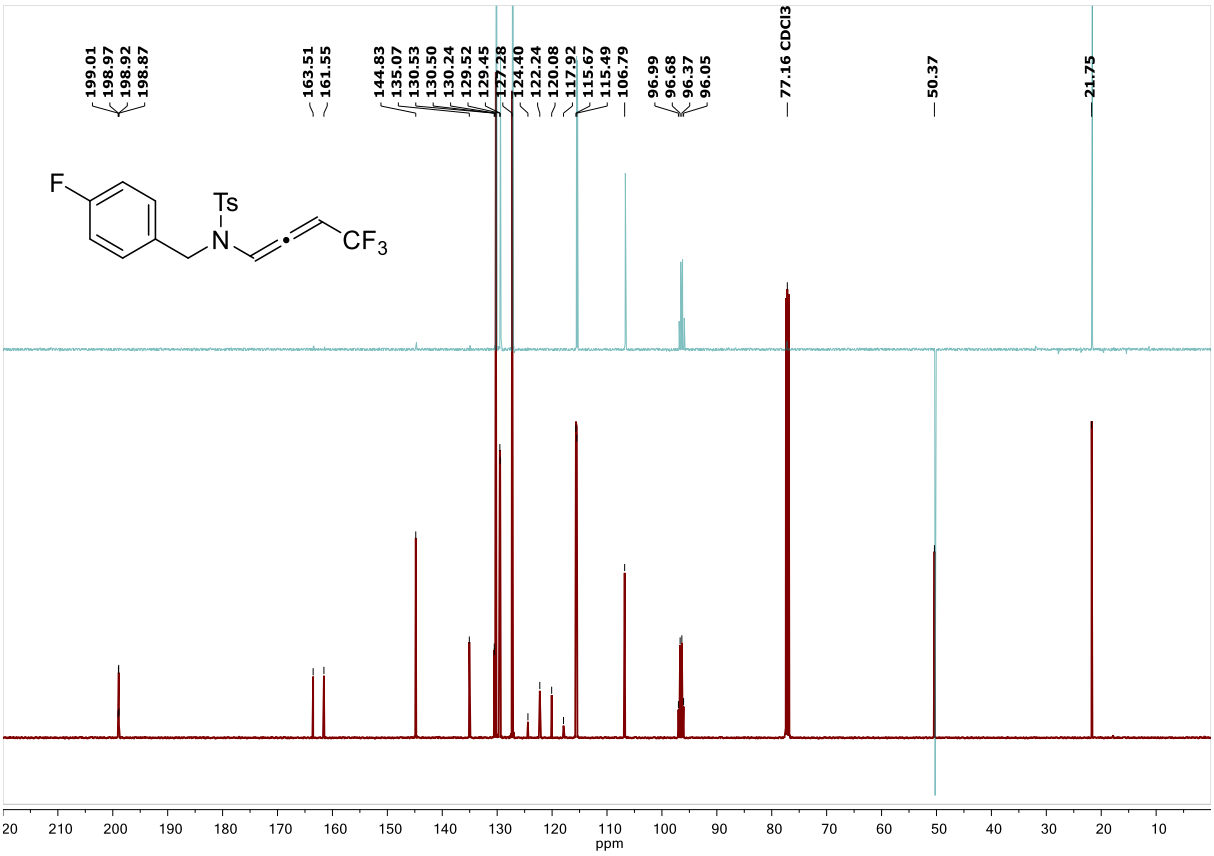
This analytical data match with those described in the literature.

NMR Spectra

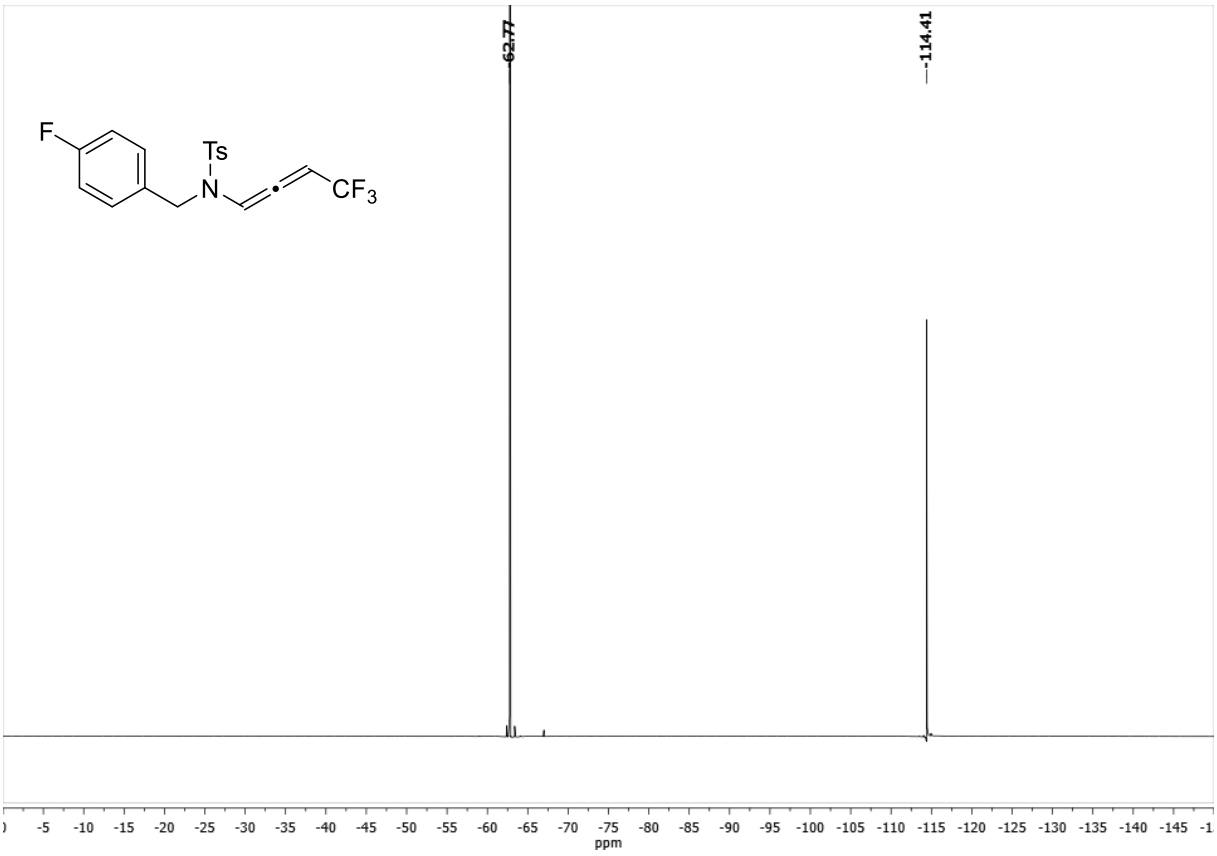
[10] C. A. Urbina-Blanco, X. Bantreil, J. Wappel, T. E. Schmid, A. M. Z. Slawin, C. Slugovc and C. S. J. Cazin, *Organometallics*, 2013, **32**, 6240–6247.



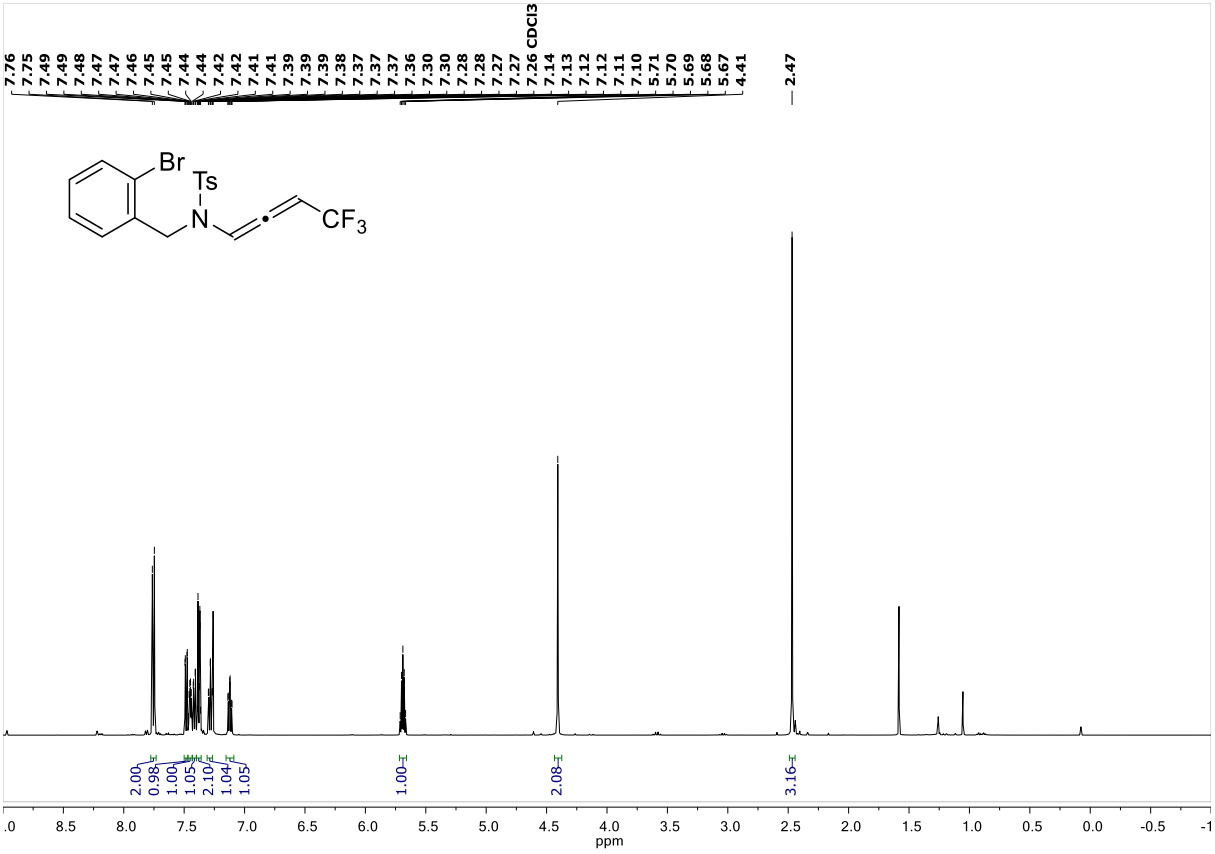
^{1}H NMR ($CDCl_3$, 500 MHz) of **1c**



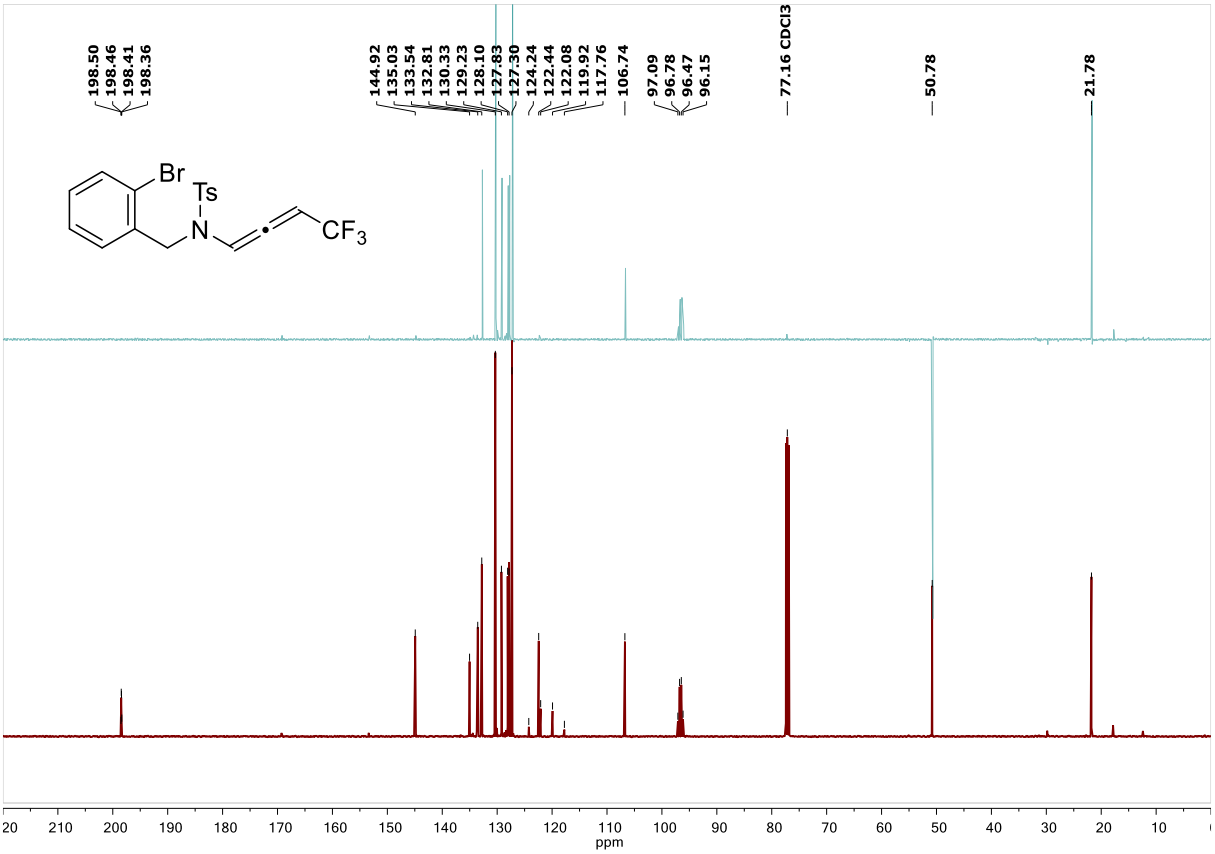
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **1c**



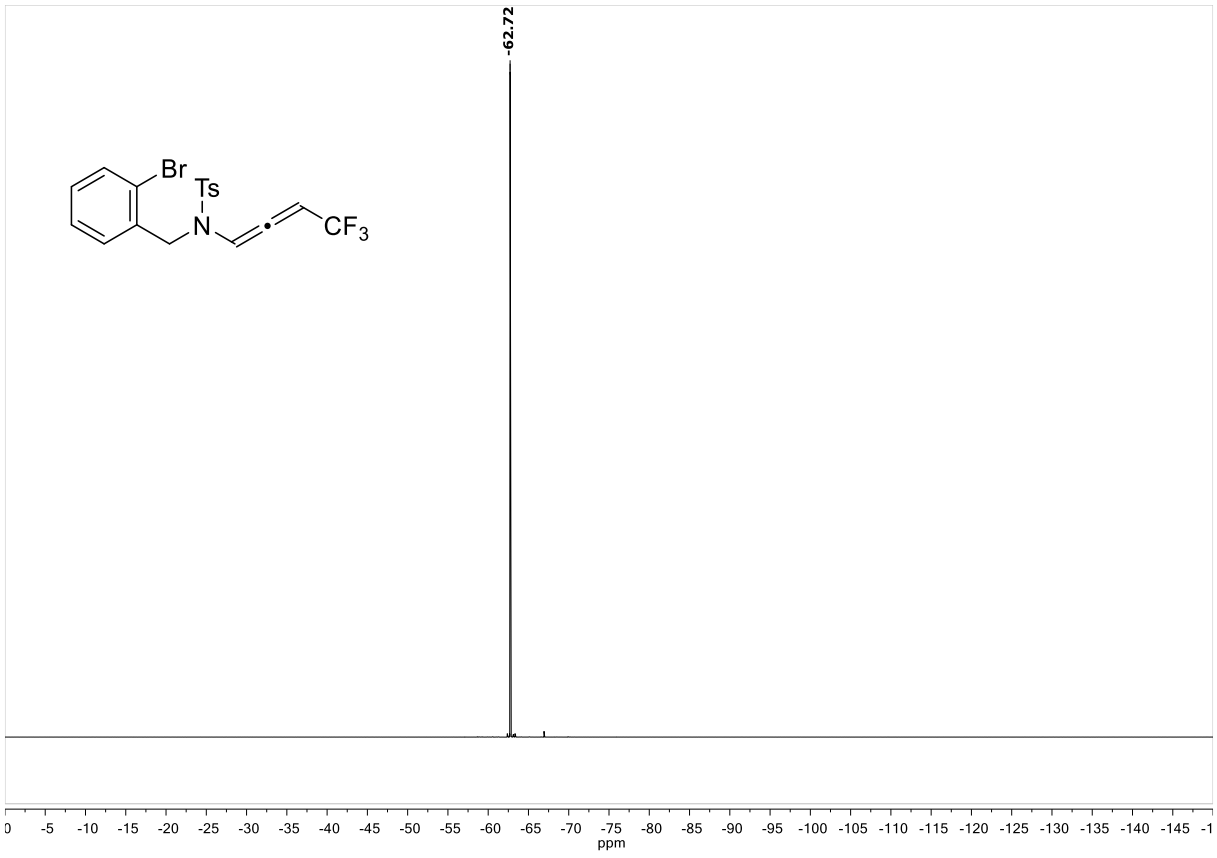
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **1c**



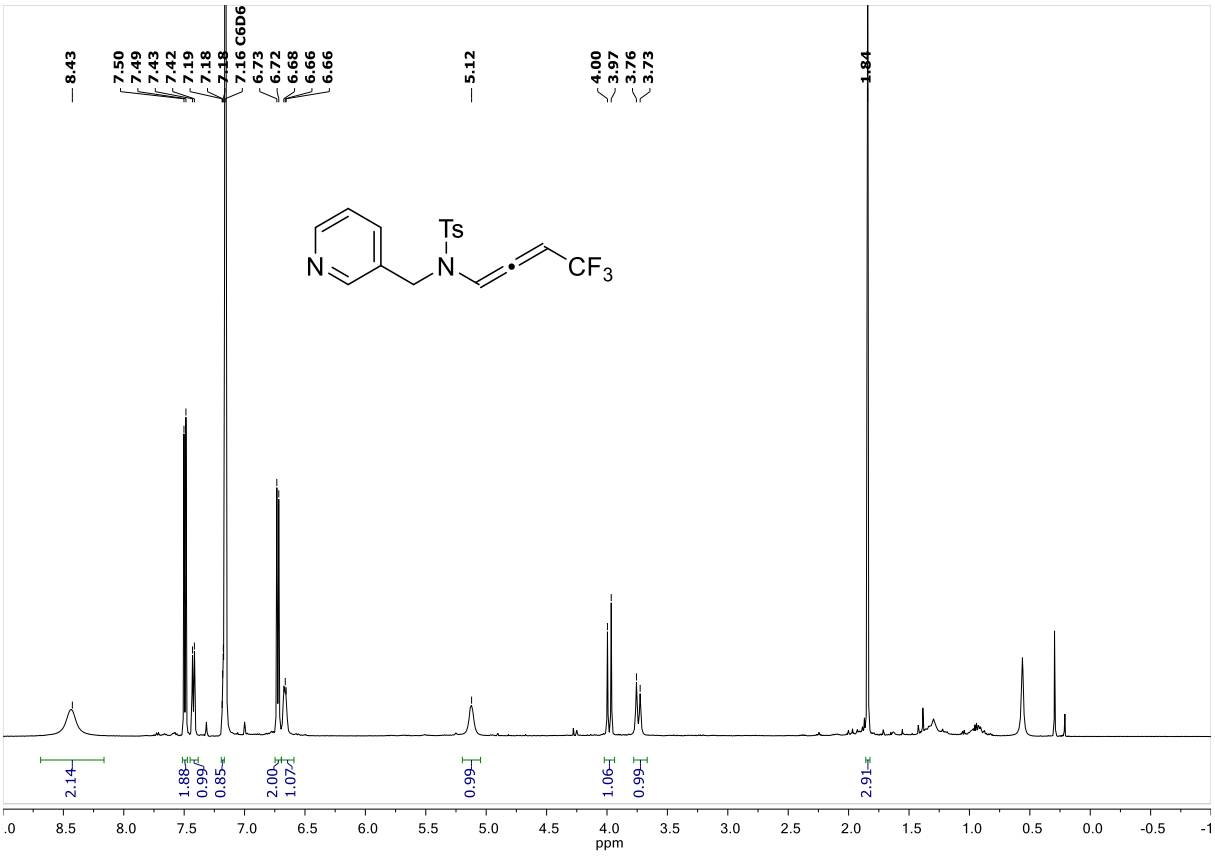
^{1}H NMR ($CDCl_3$, 500 MHz) of **1d**



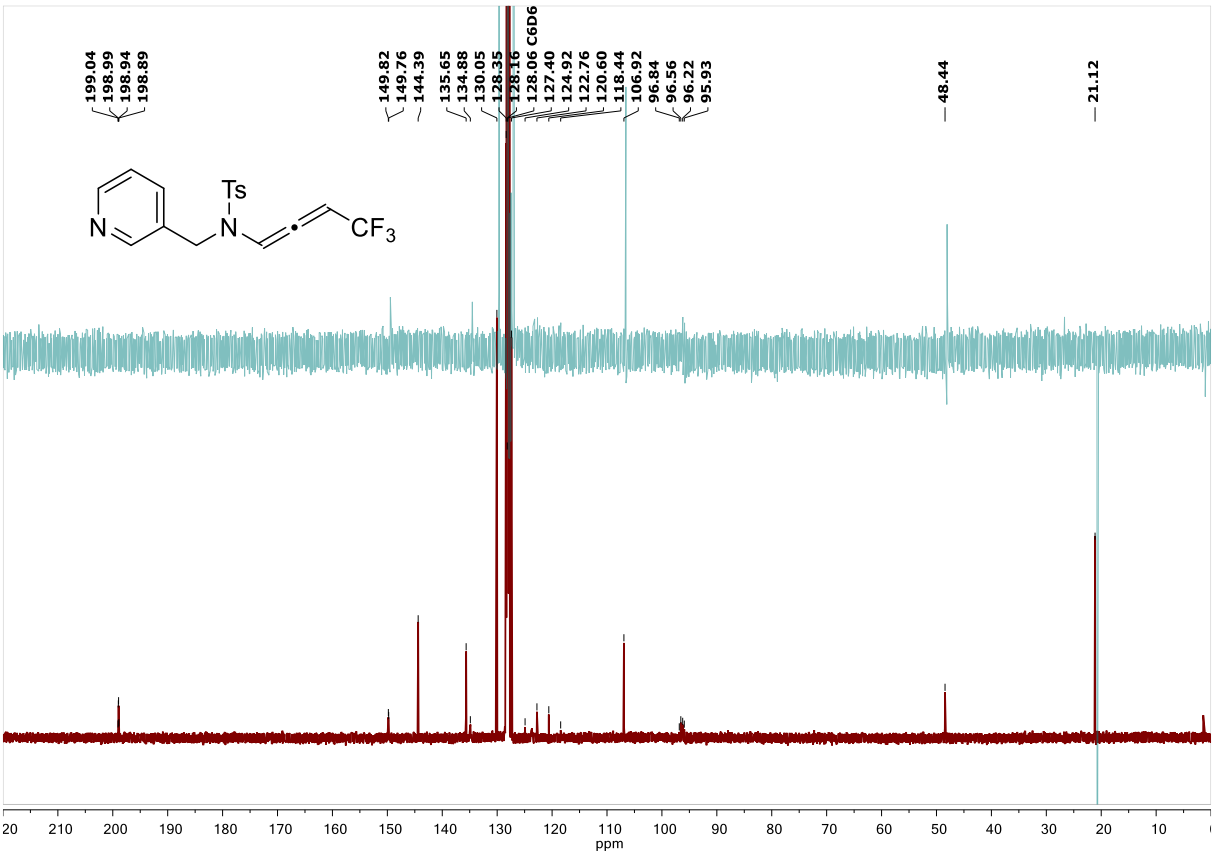
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **1d**



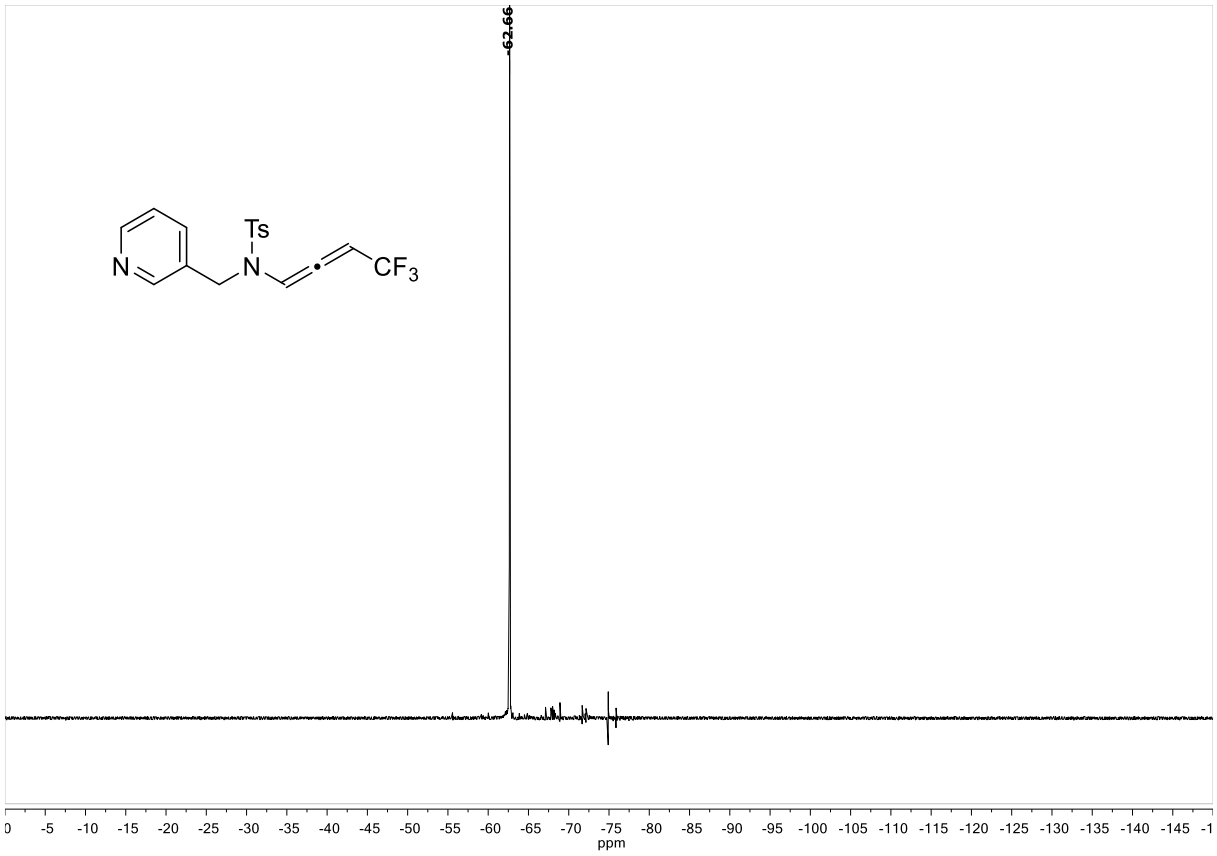
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **1d**



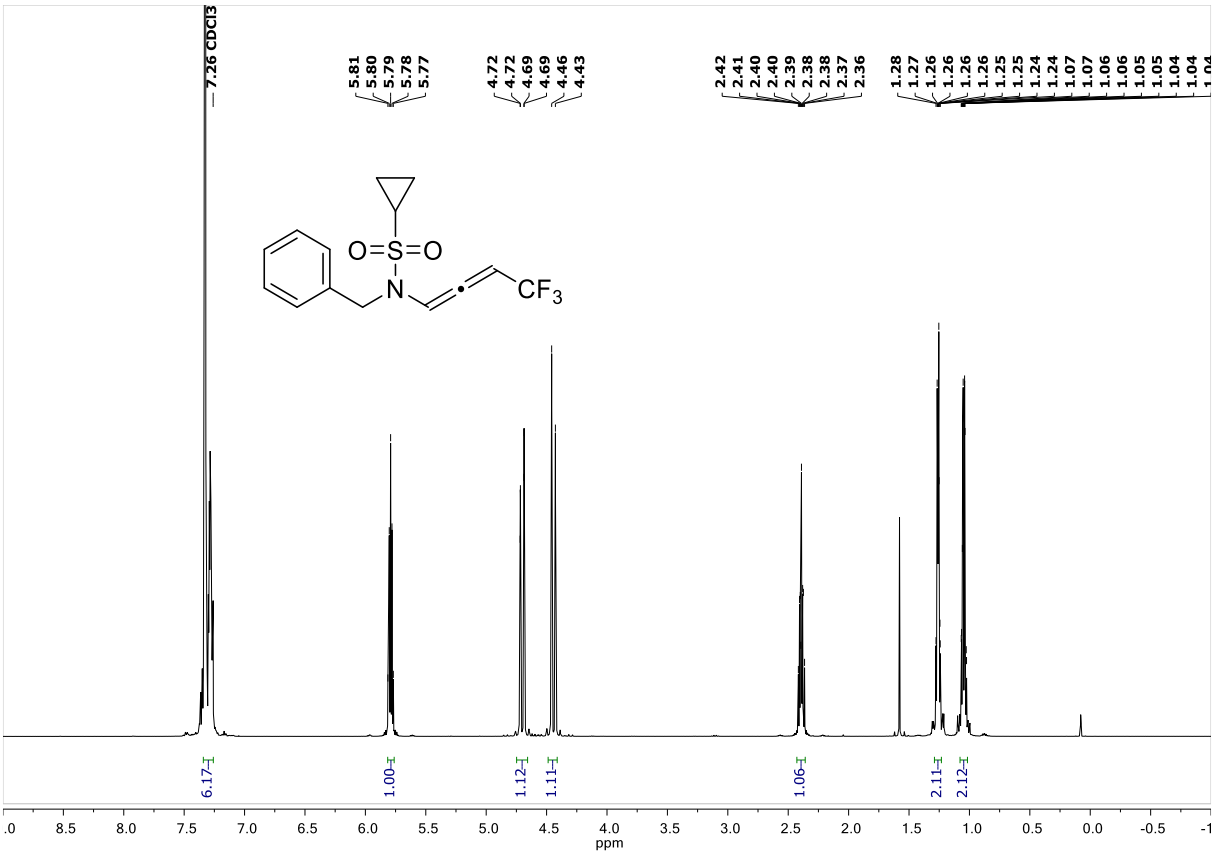
^{1}H NMR (C_6D_6, 500 MHz) of **1m**



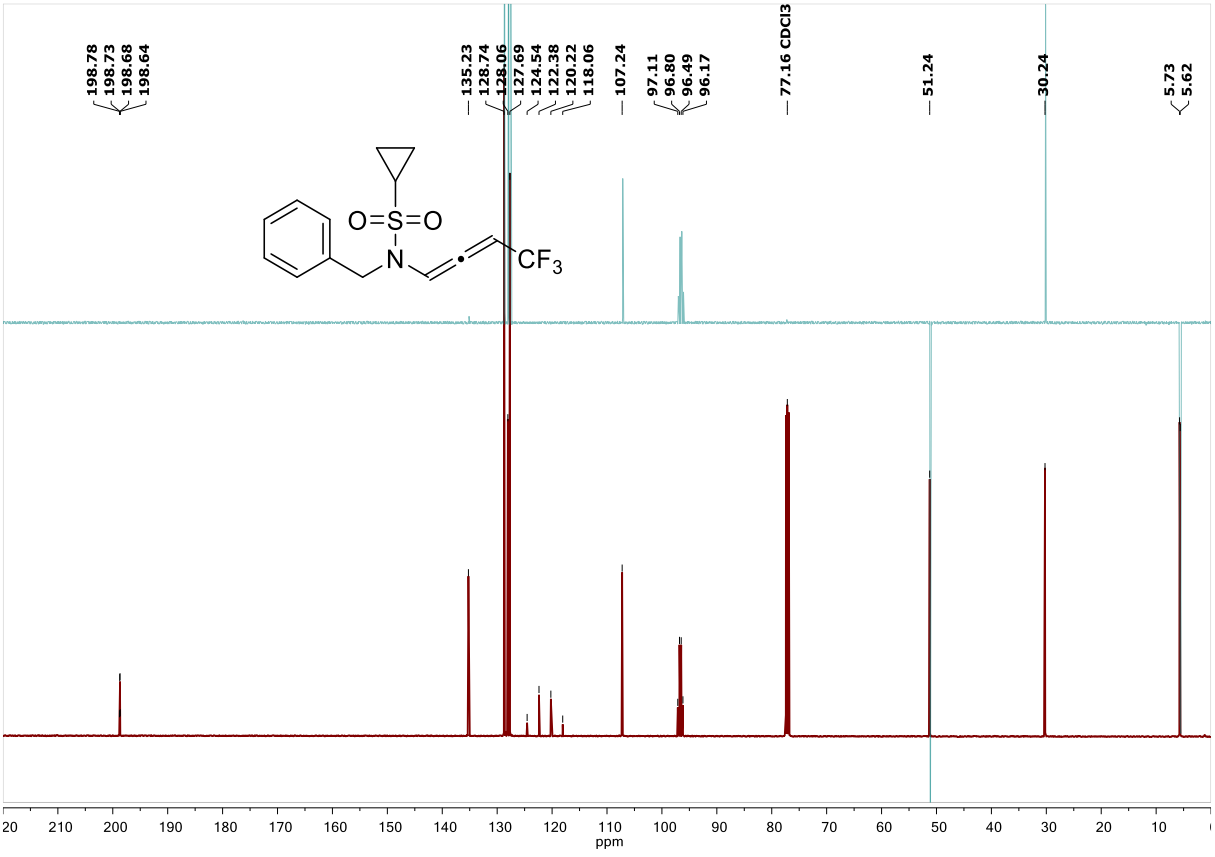
^{13}C{^{1}H} NMR (C_6D_6, 126 MHz) of **1m**



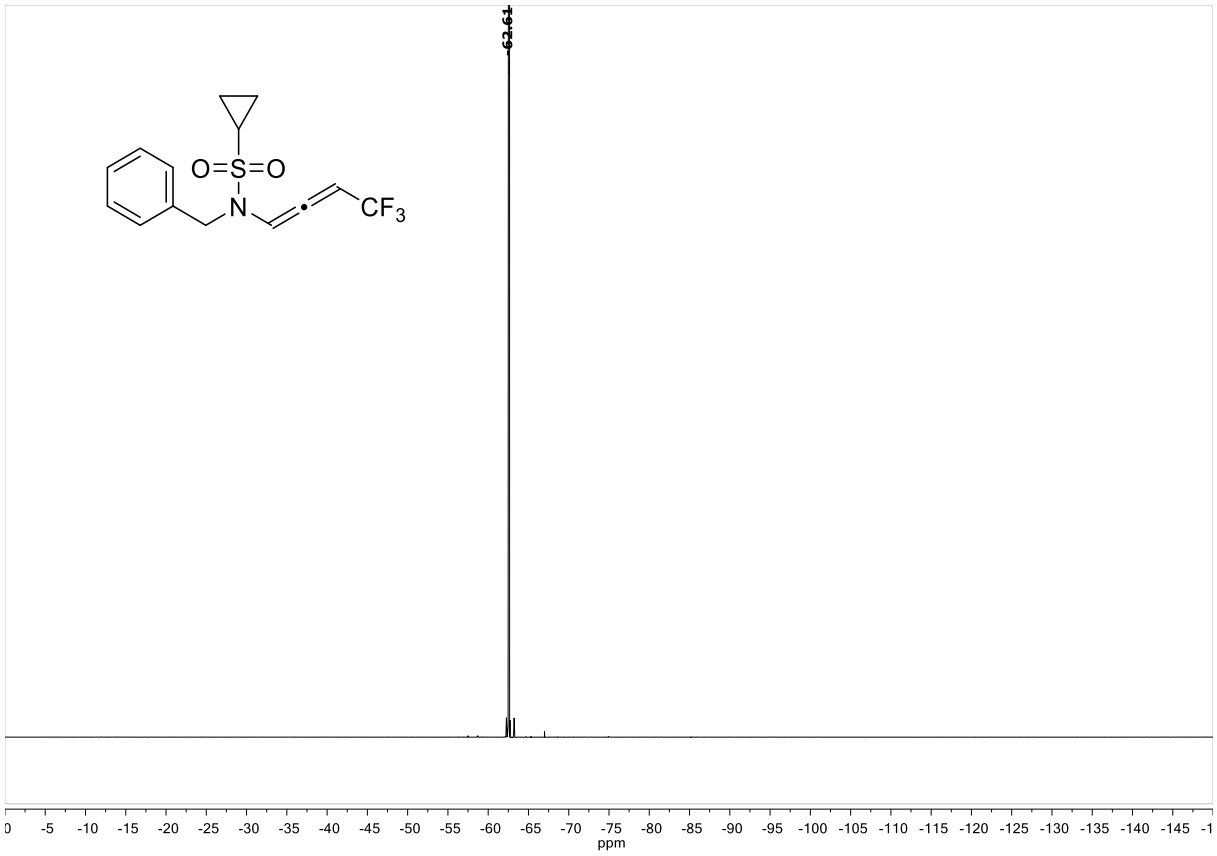
$^{19}F\{^{1}H\}$ NMR (C_6D_6, 282 MHz) of **1m**



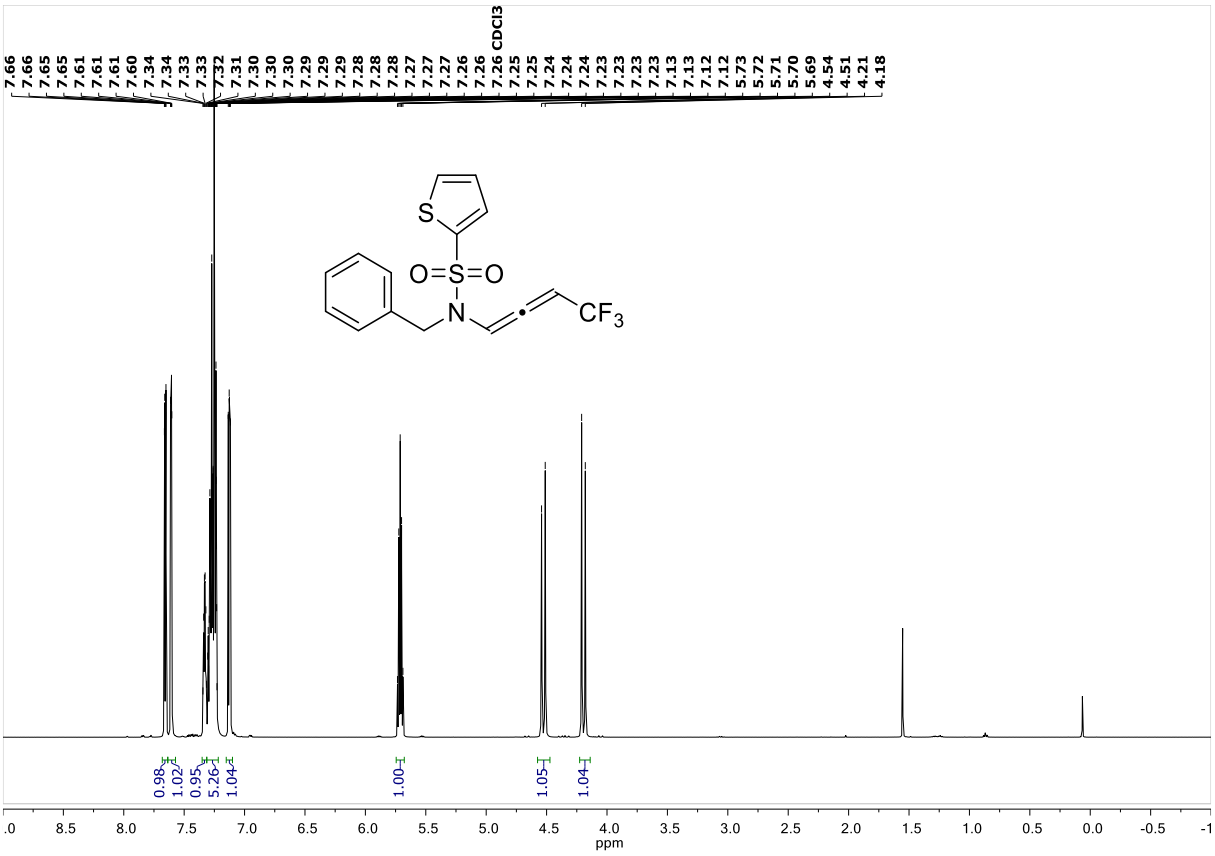
^{1}H NMR ($CDCl_3$, 500 MHz) of **1p**



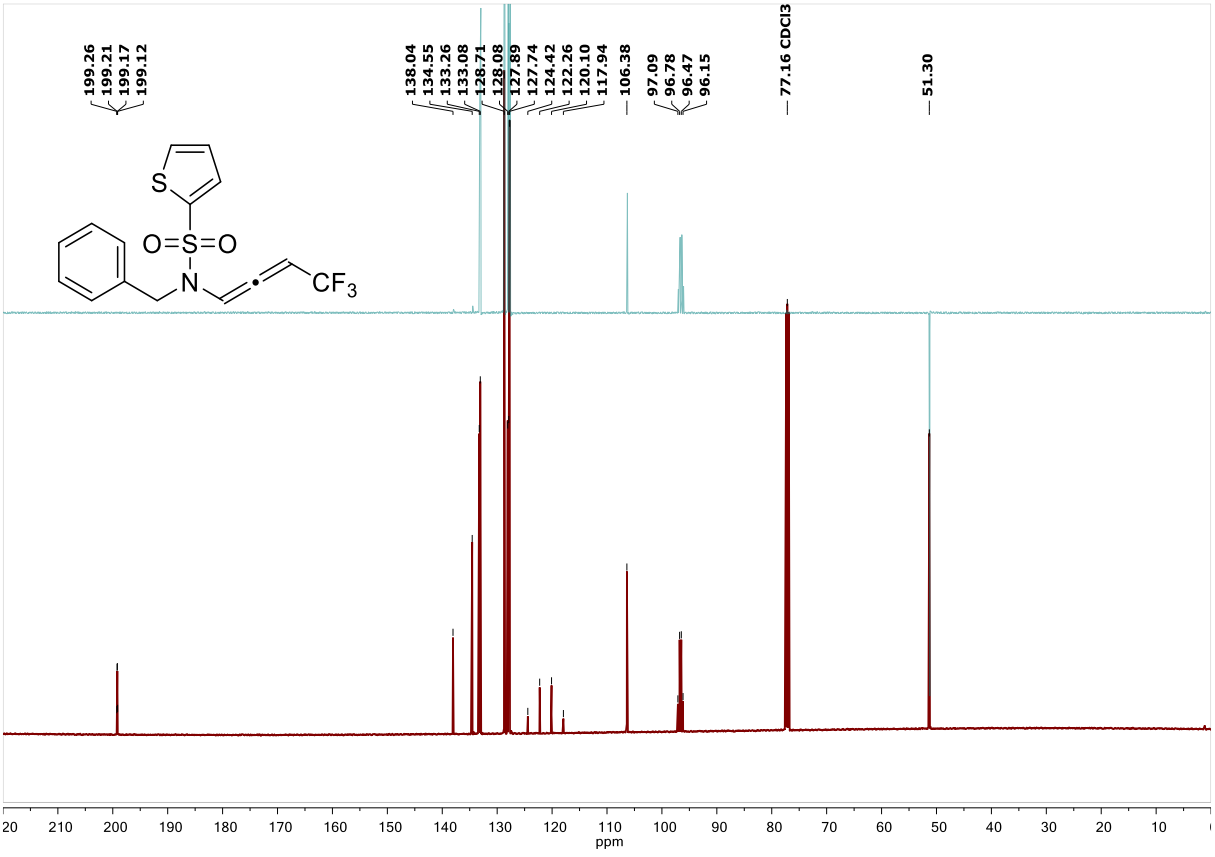
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **1p**



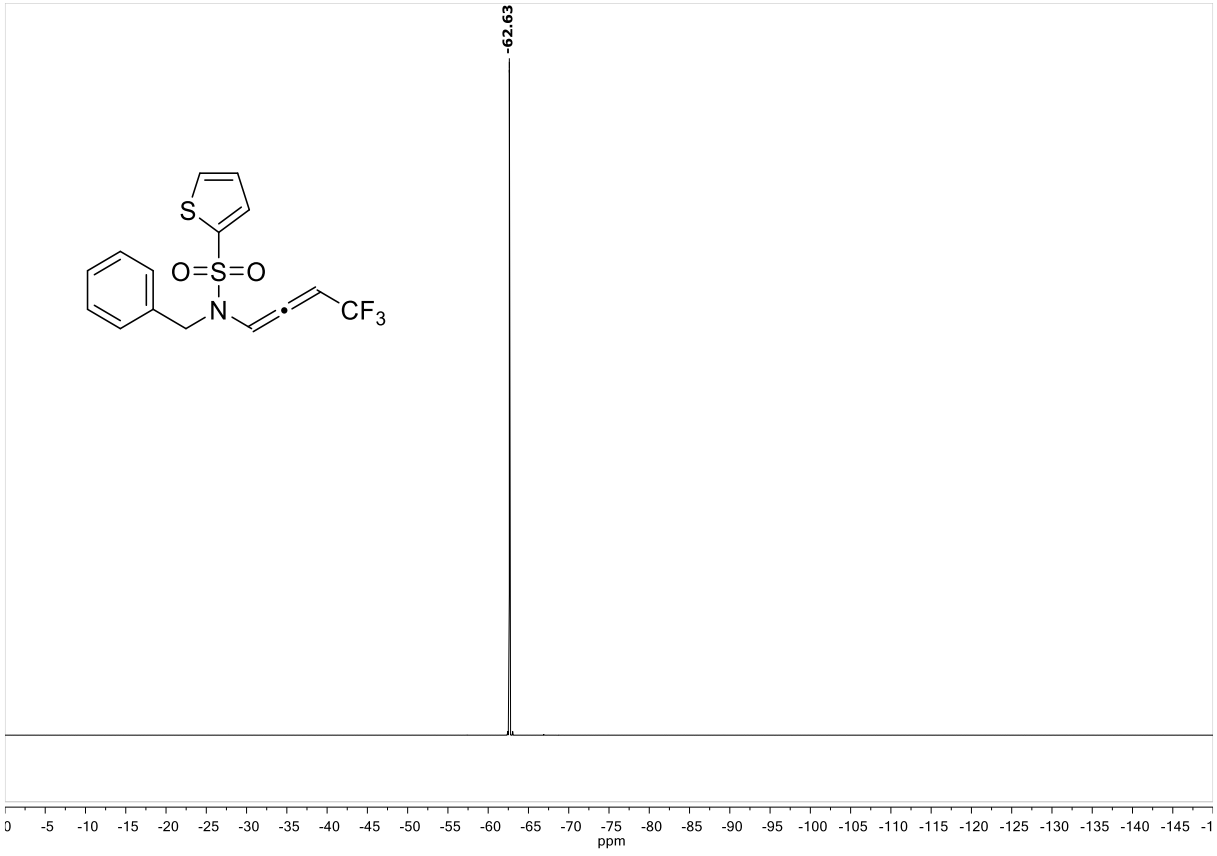
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **1p**



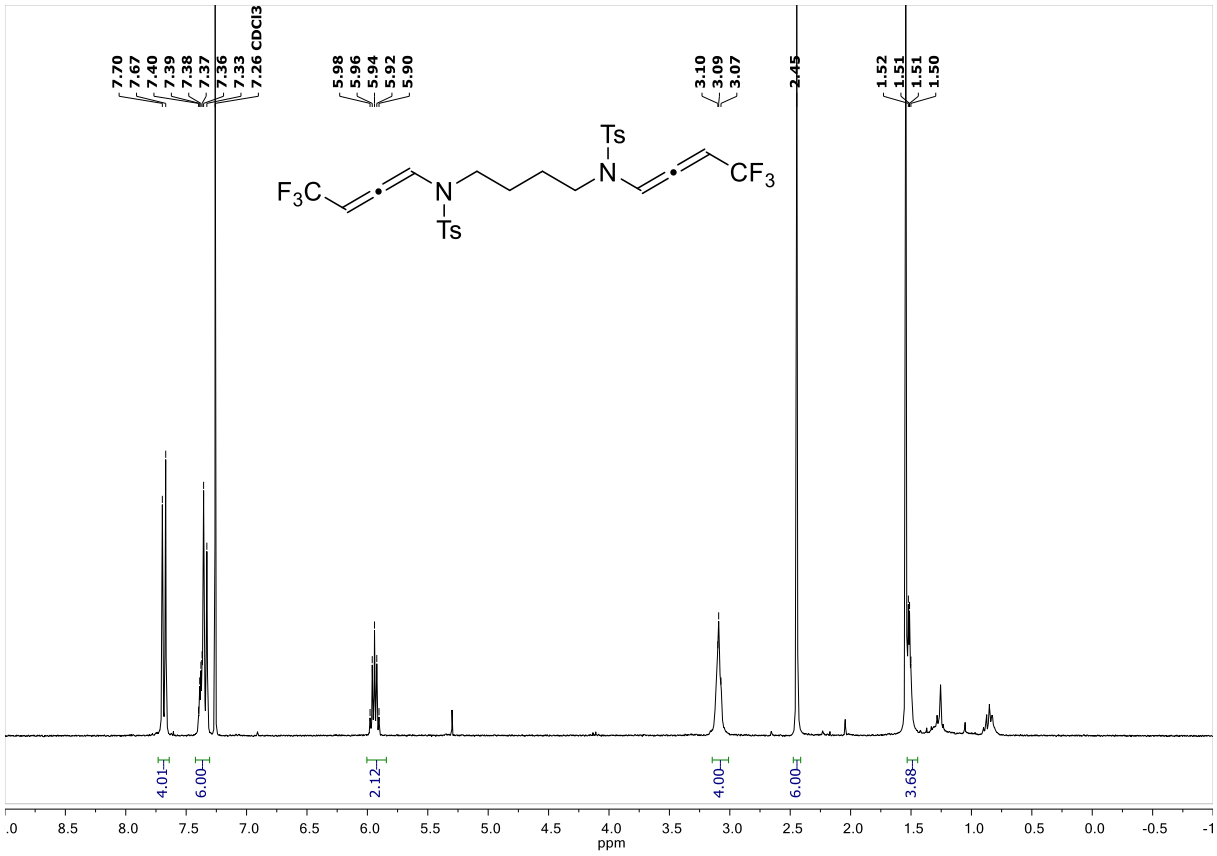
^{1}H NMR ($CDCl_3$, 500 MHz) of **1r**



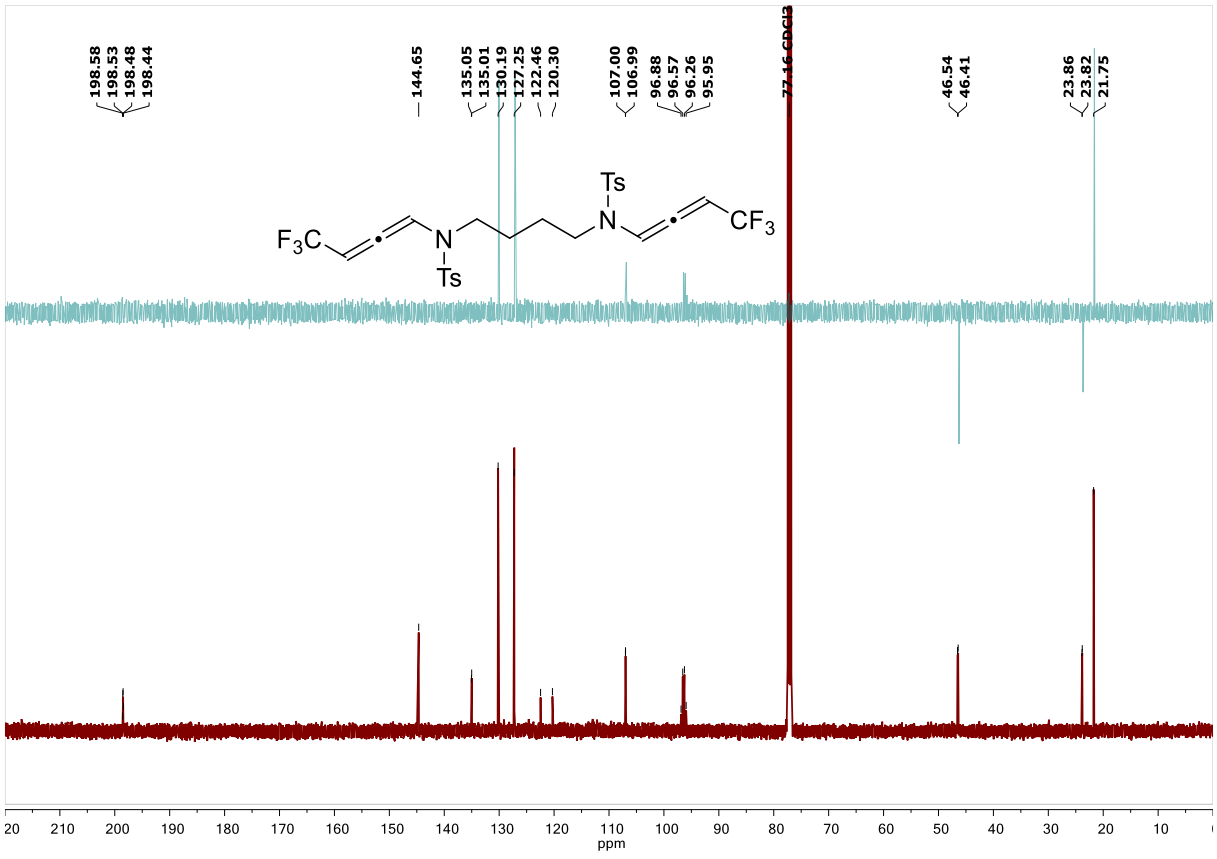
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **1r**



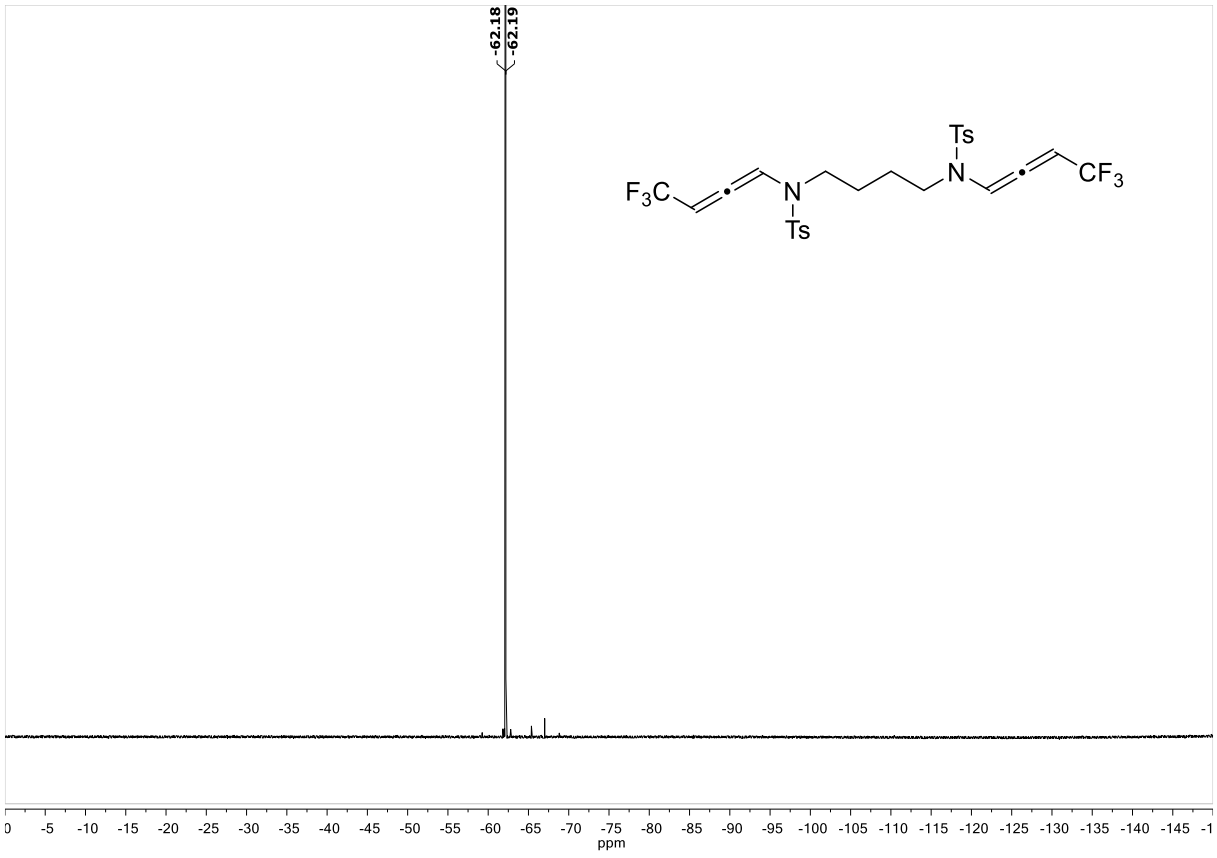
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 471 MHz) of **1r**



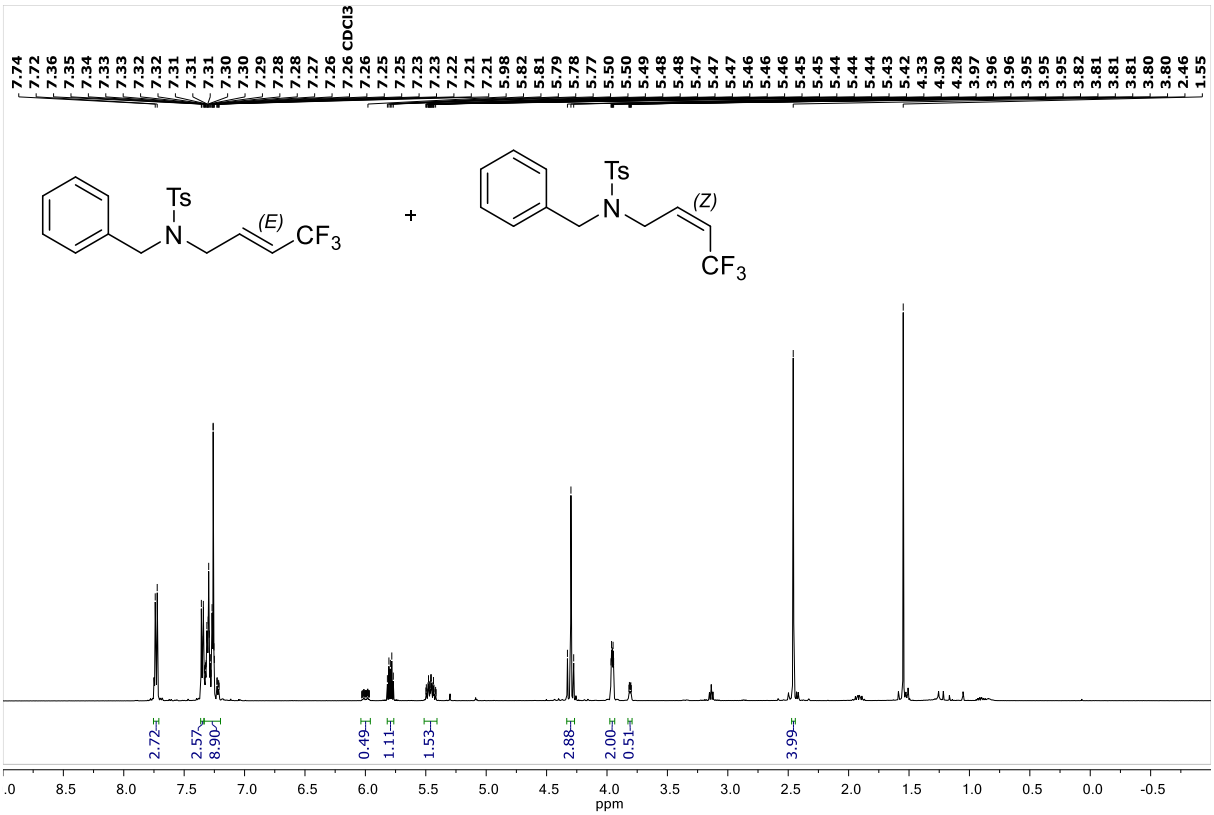
^{1}H NMR ($CDCl_3$, 300 MHz) of **1u**



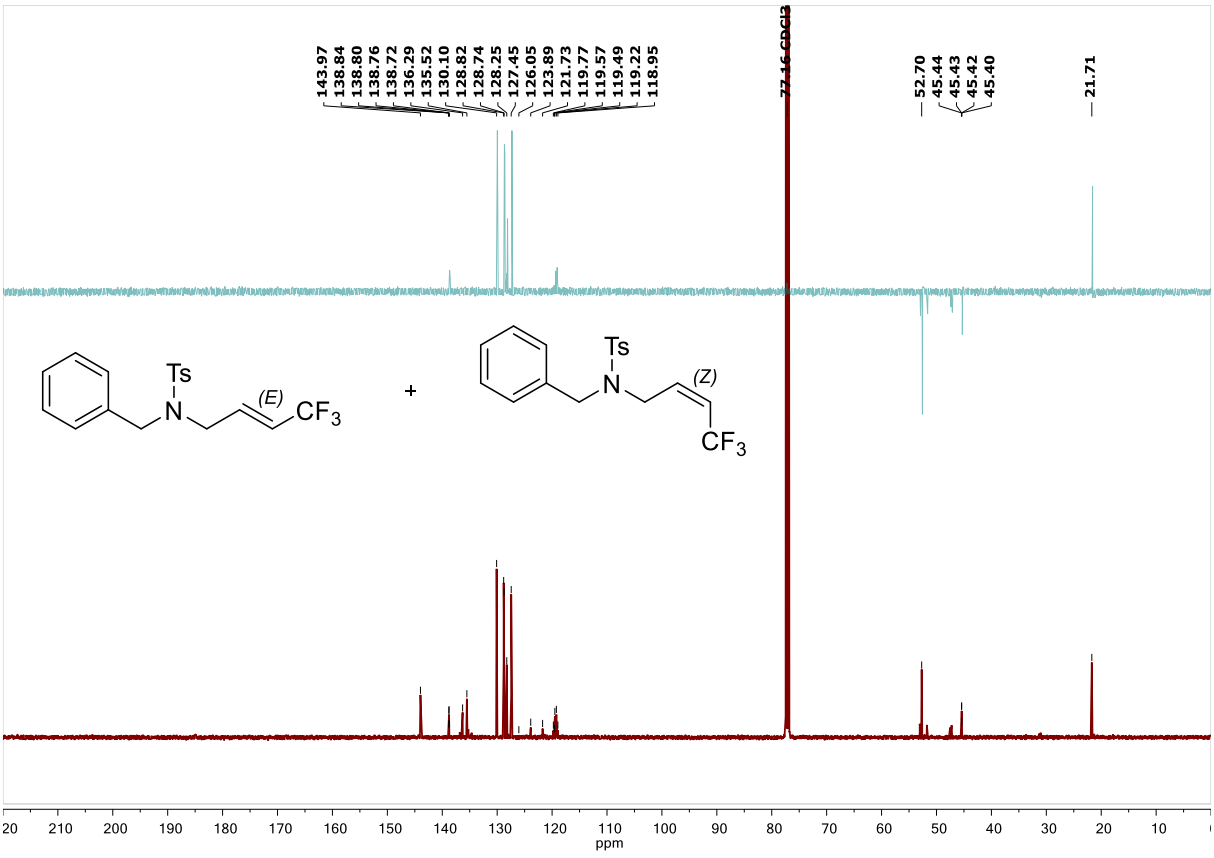
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **1u**



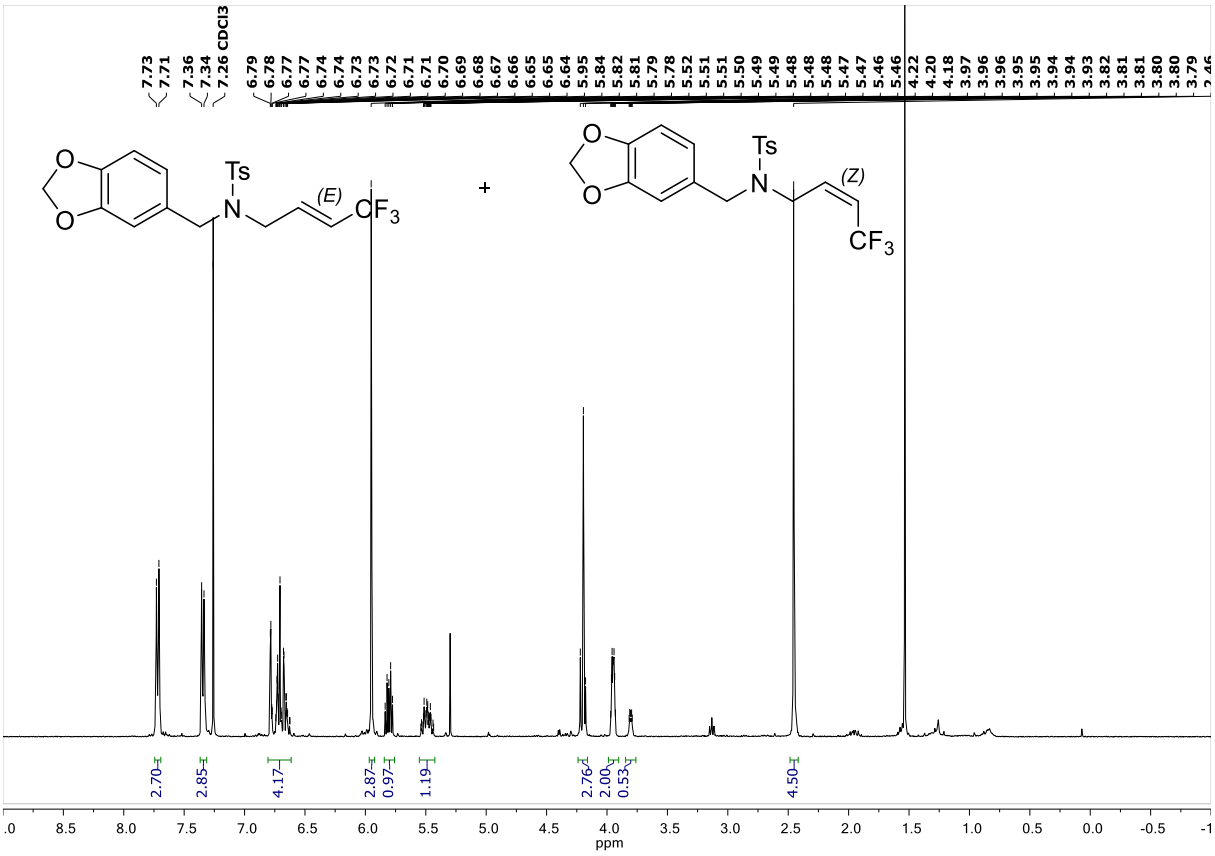
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **1u**



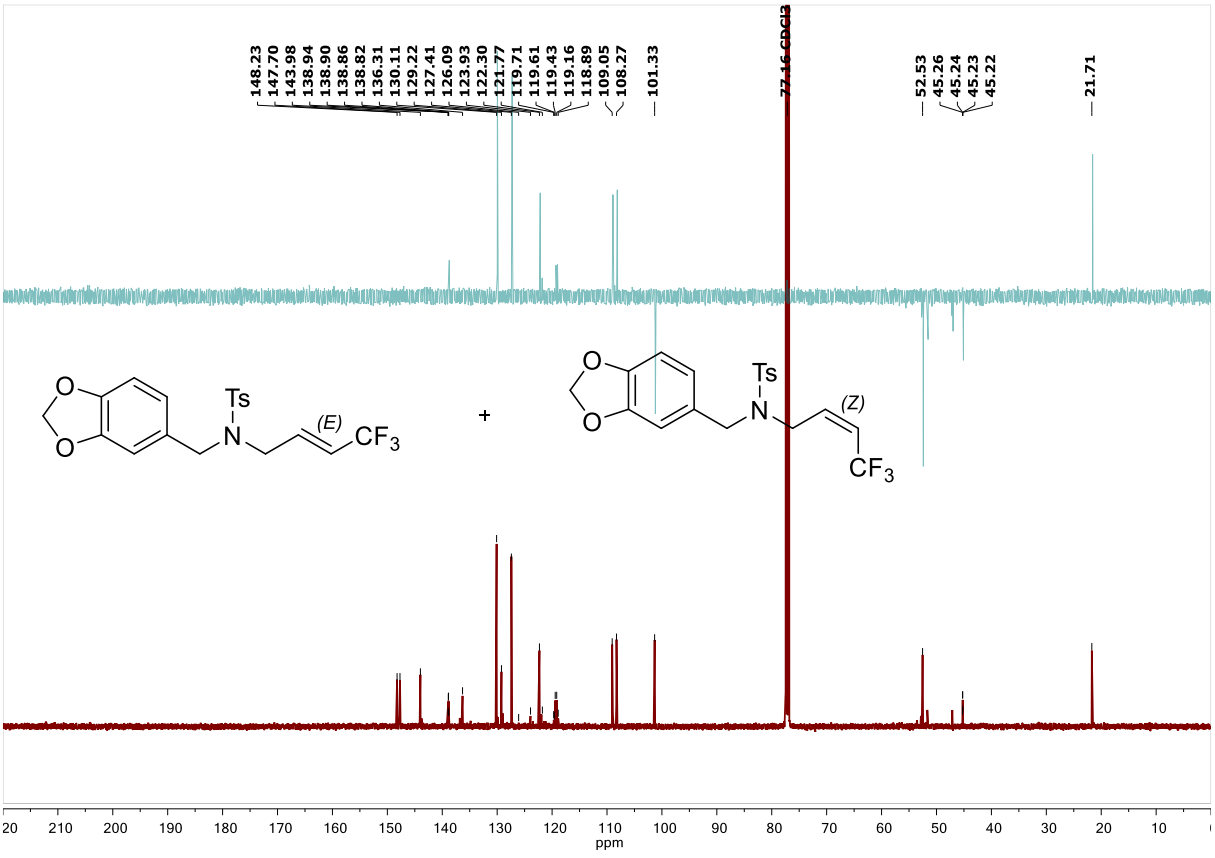
^{1}H NMR ($CDCl_3$, 500 MHz) of **2a**



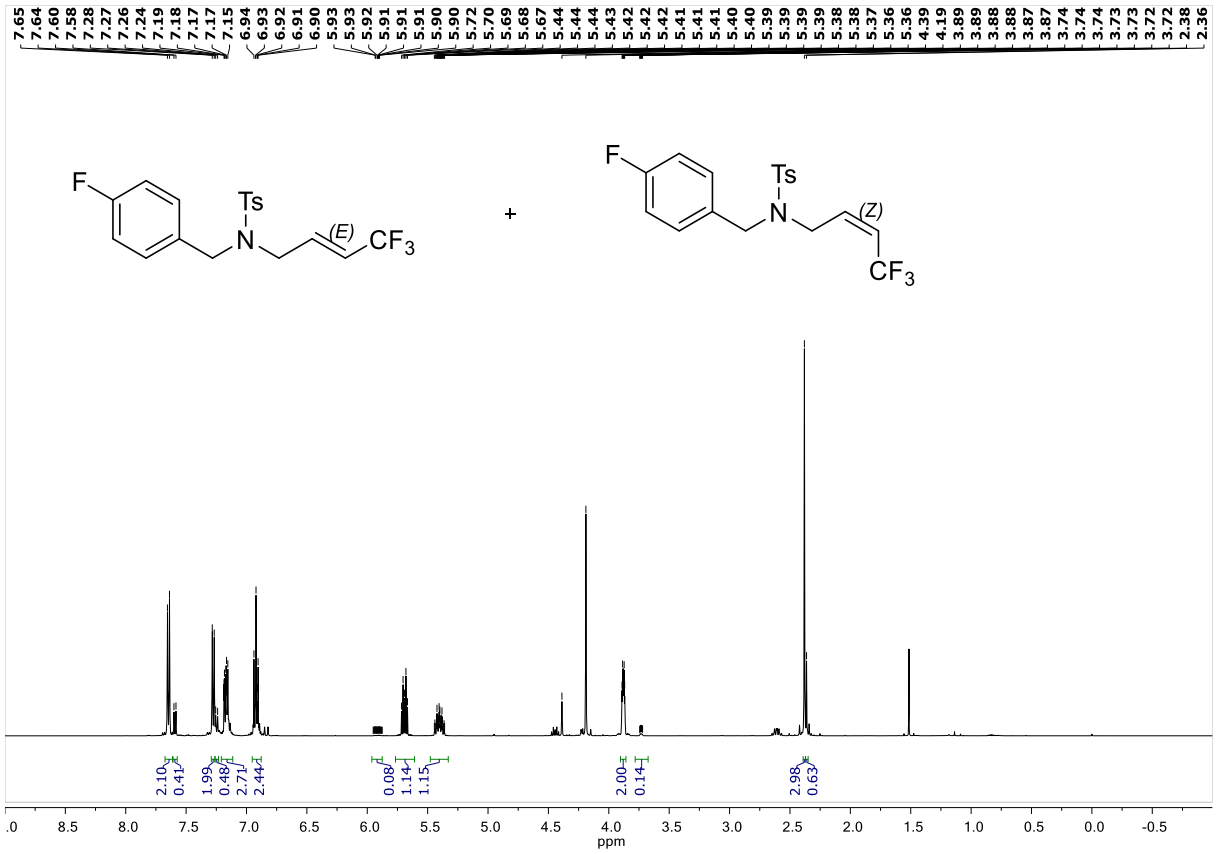
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2a**



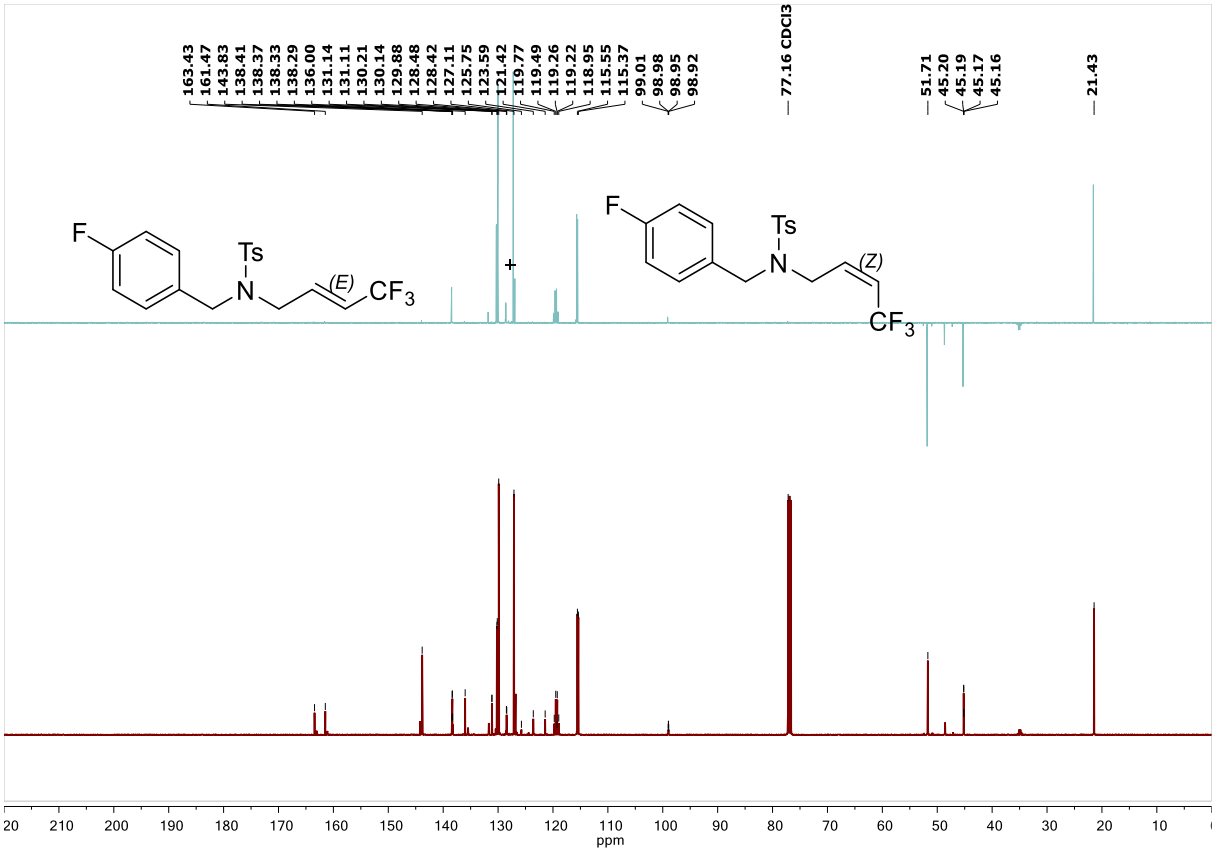
^{1}H NMR ($CDCl_3$, 300 MHz) of **2b**



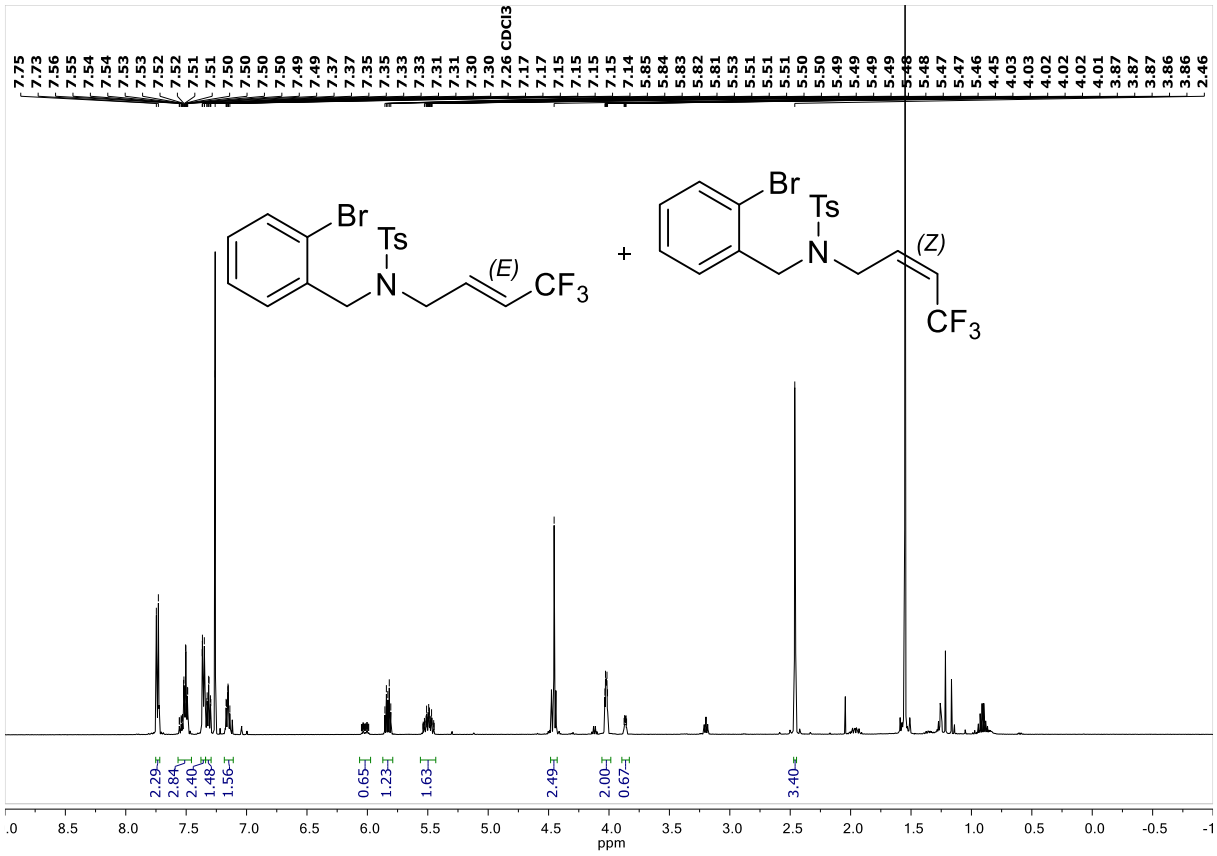
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2b**



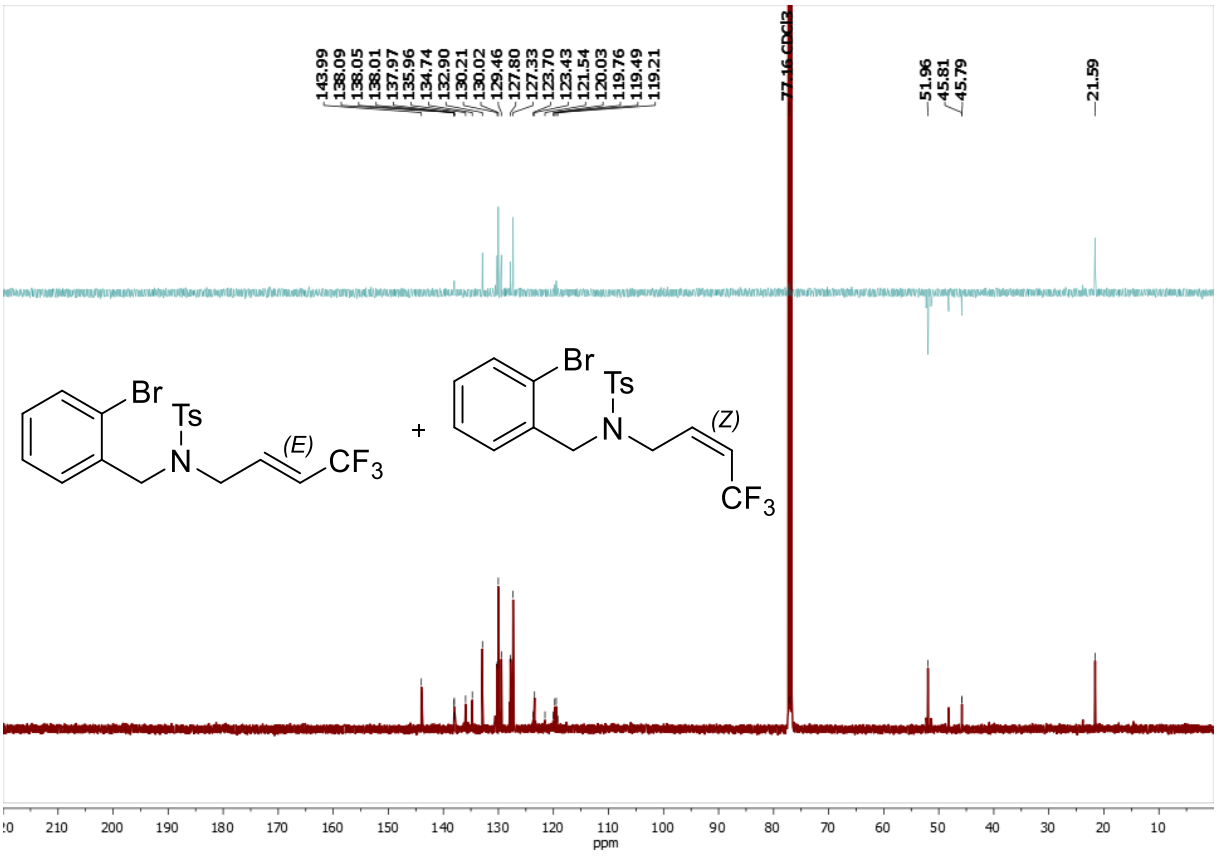
^{1}H NMR ($CDCl_3$, 500 MHz) of **2c**



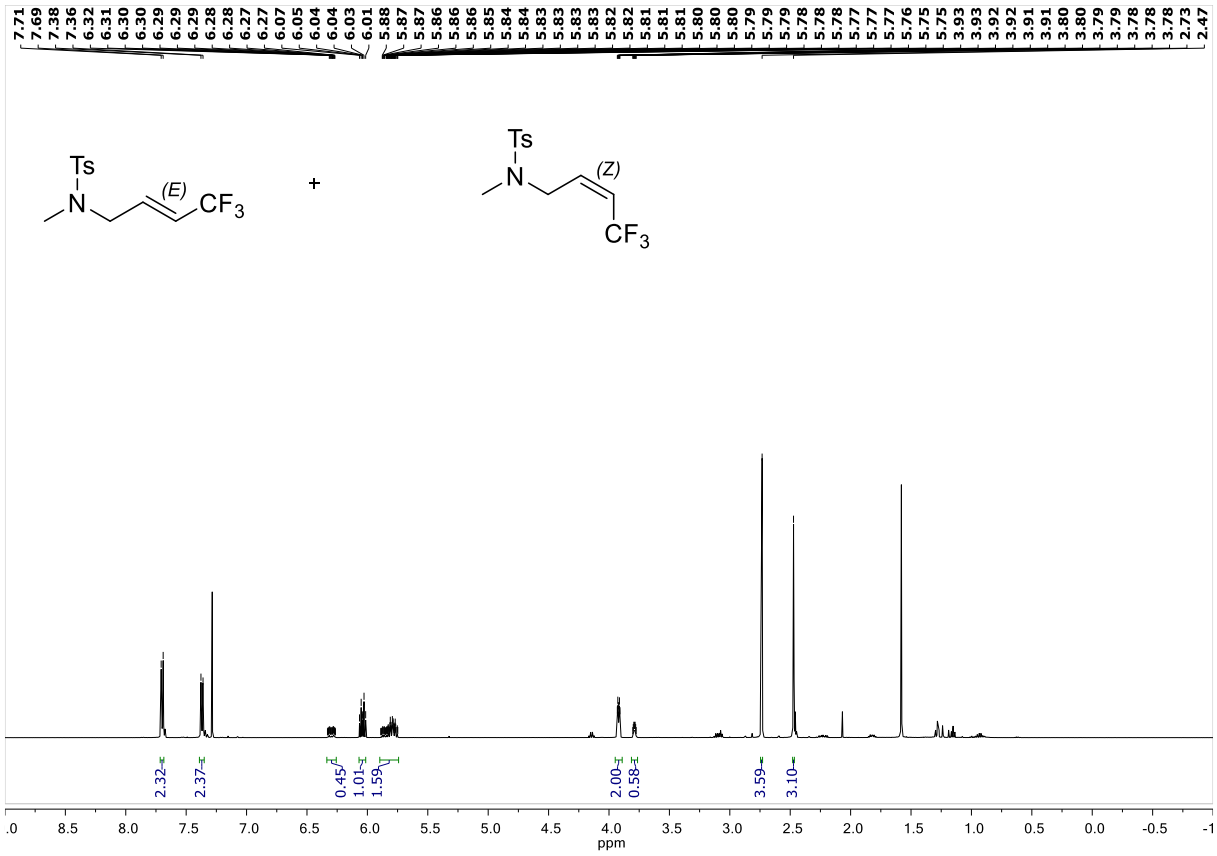
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2c**



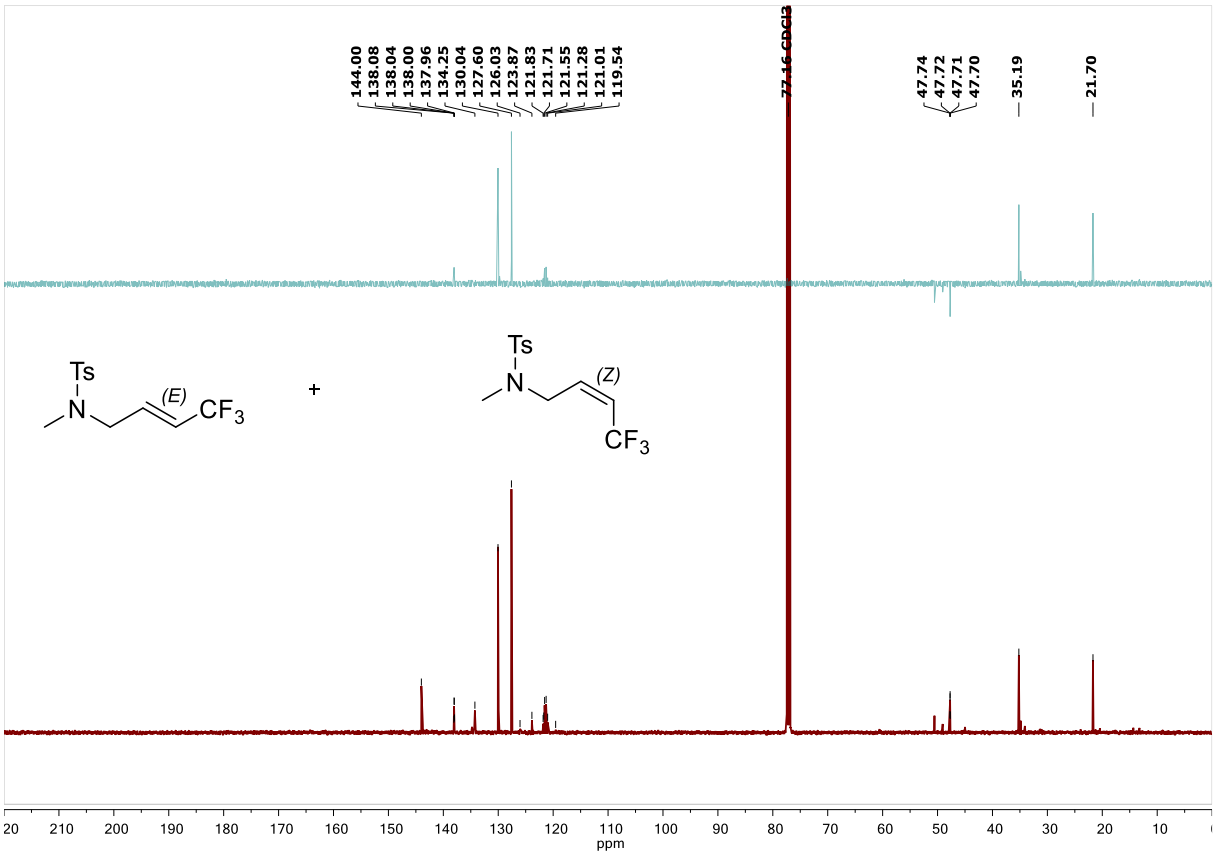
^{1}H NMR ($CDCl_3$, 500 MHz) of **2d**



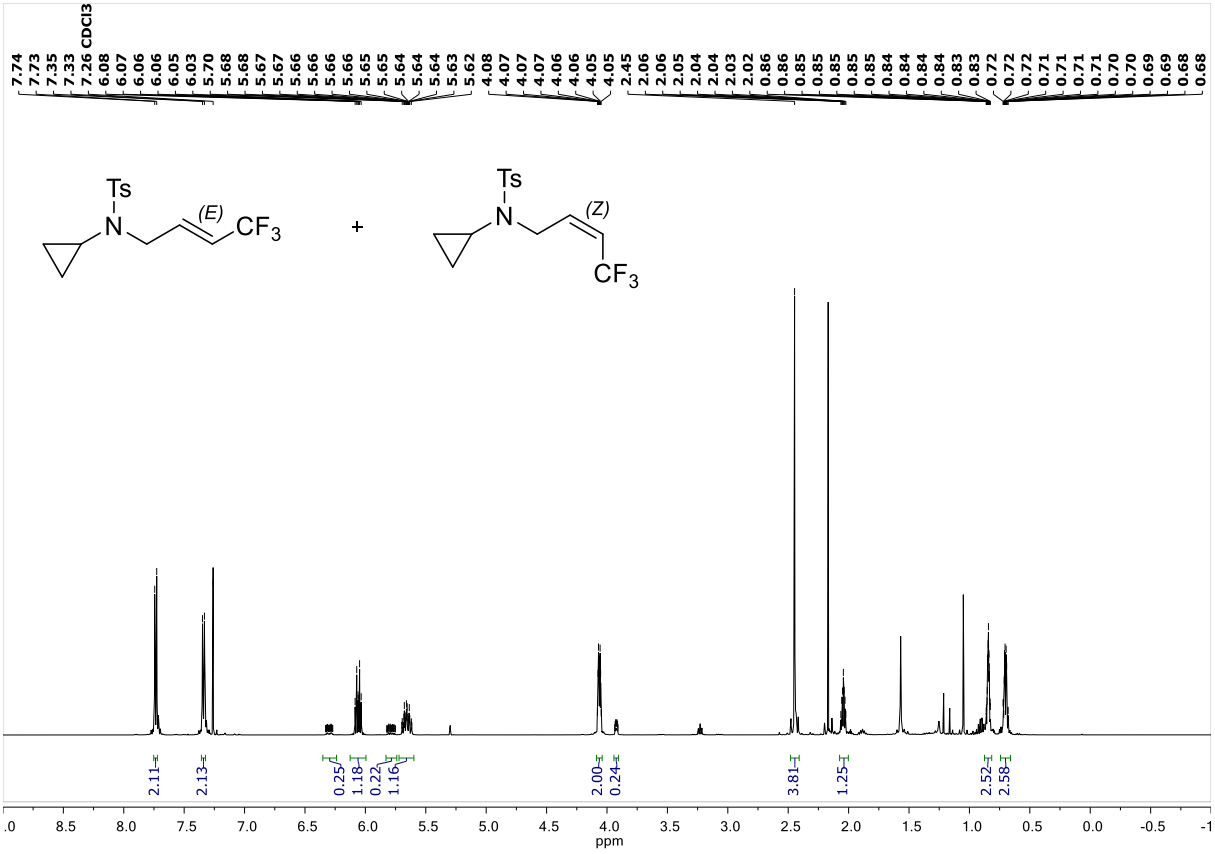
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2d**



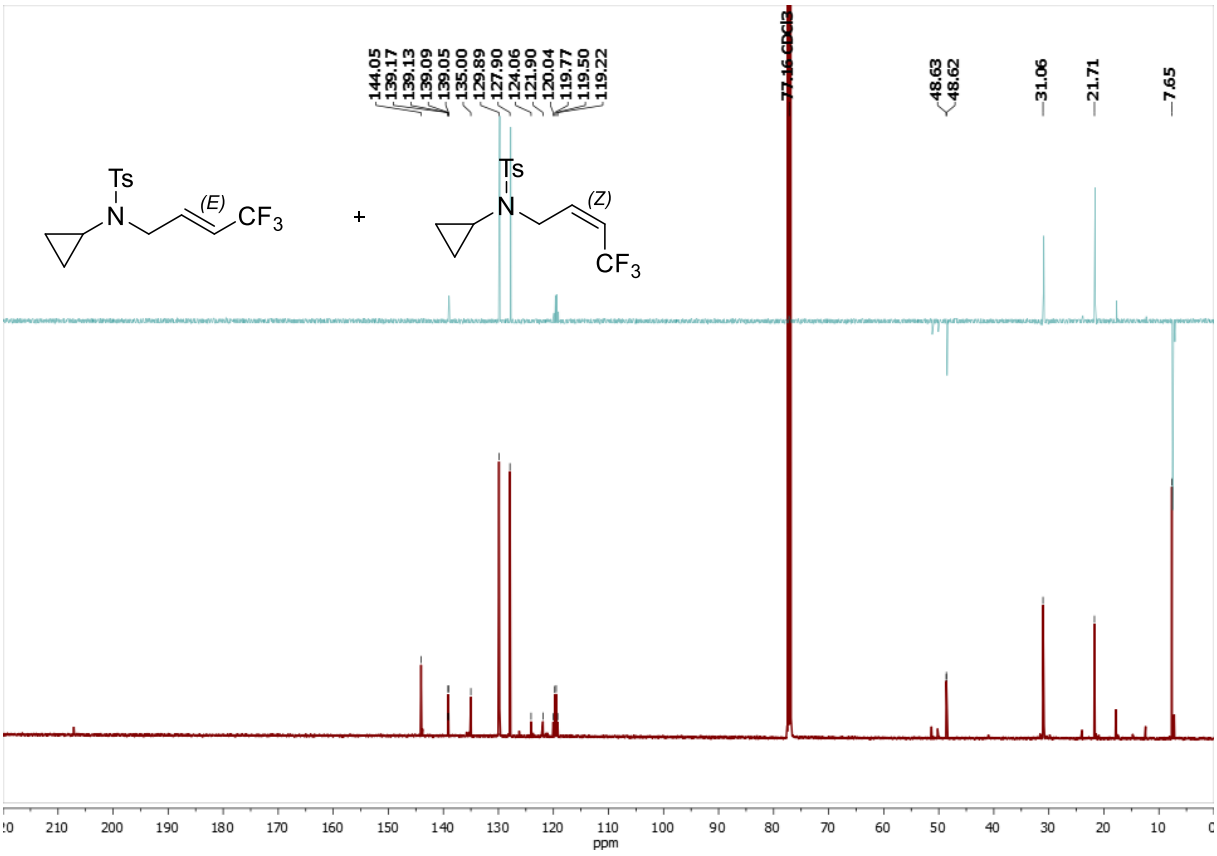
^{1}H NMR ($CDCl_3$, 500 MHz) of **2e**



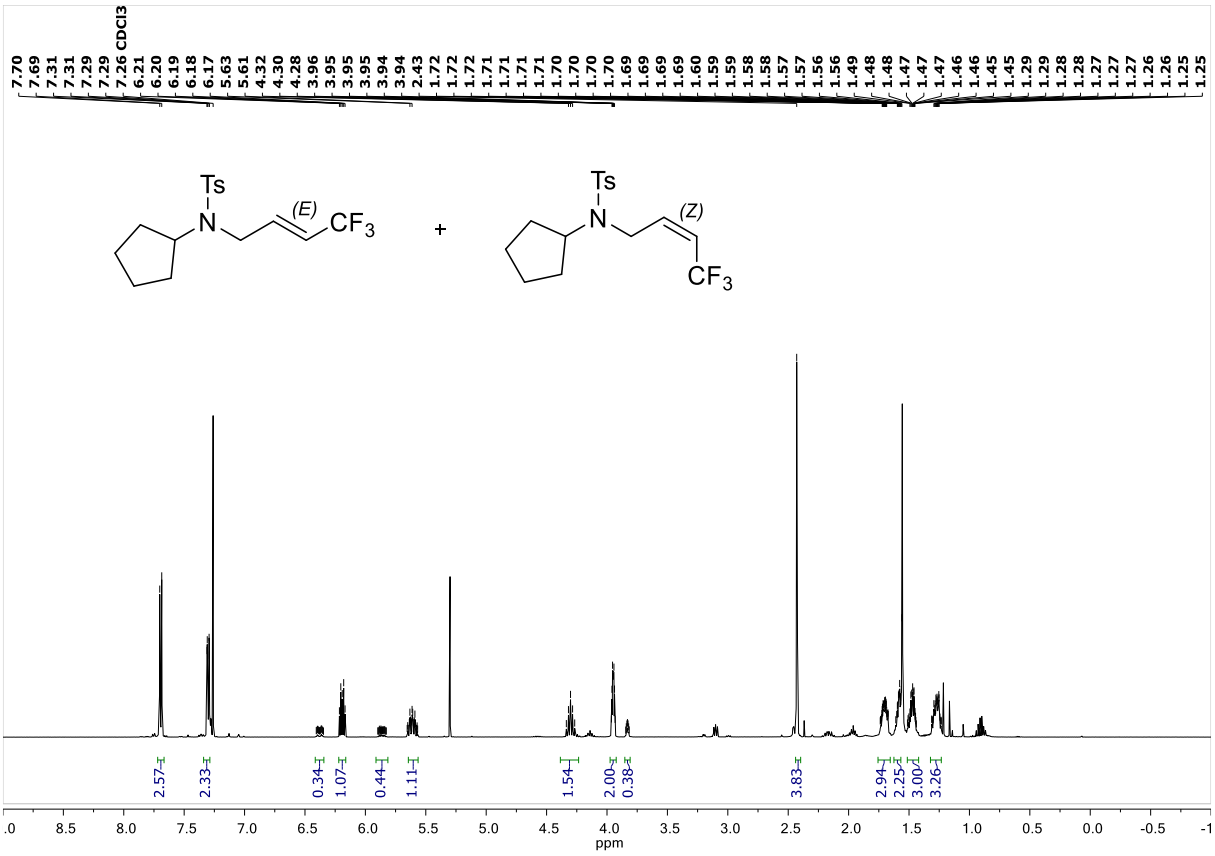
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2e**



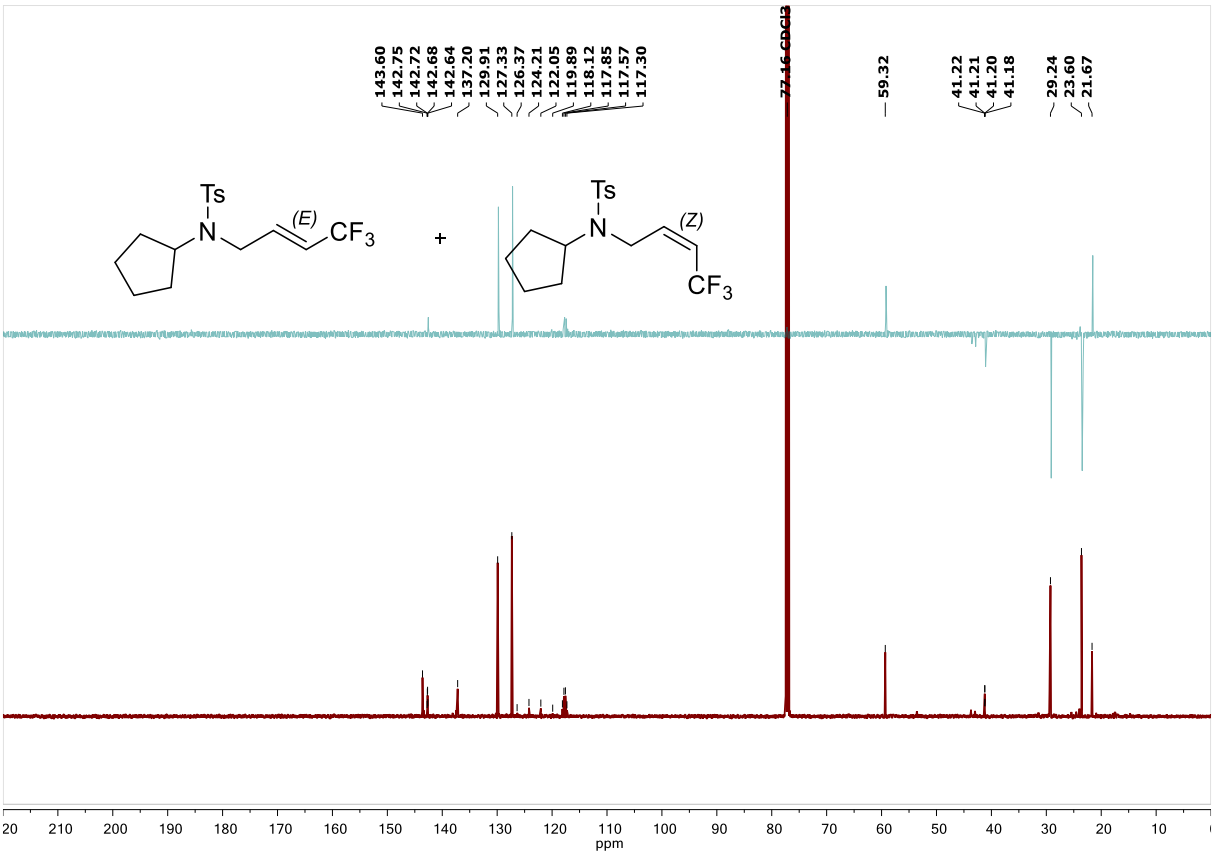
^{1}H NMR ($CDCl_3$, 500 MHz) of **2f**



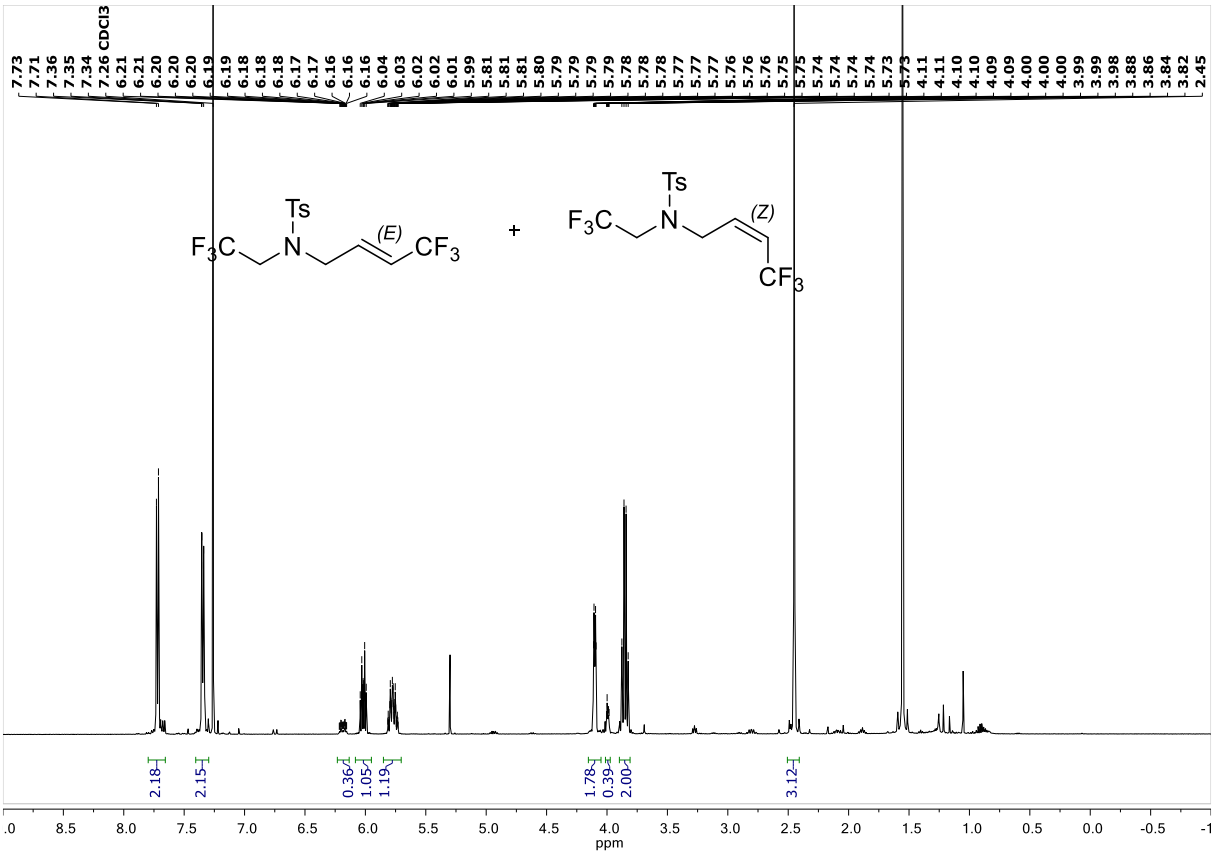
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2f**



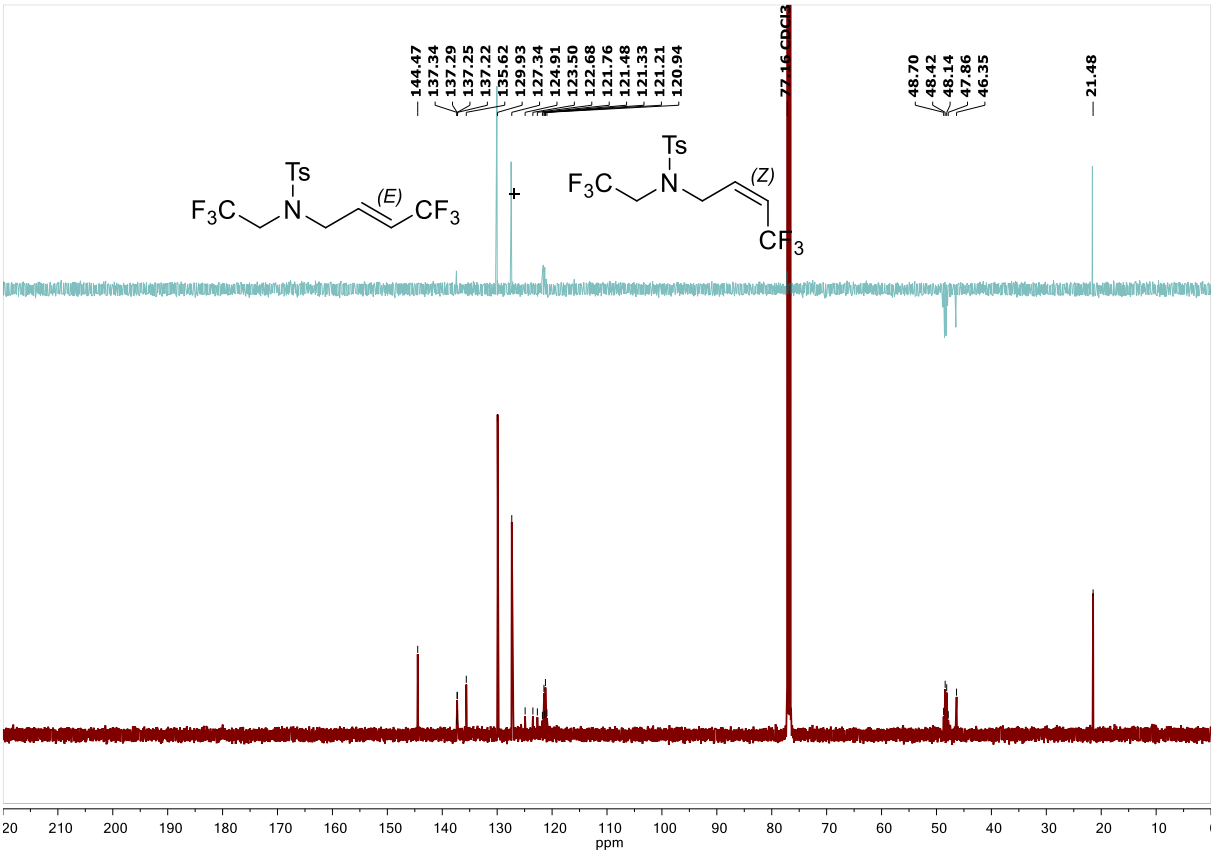
^{1}H NMR ($CDCl_3$, 500 MHz) of **2g**



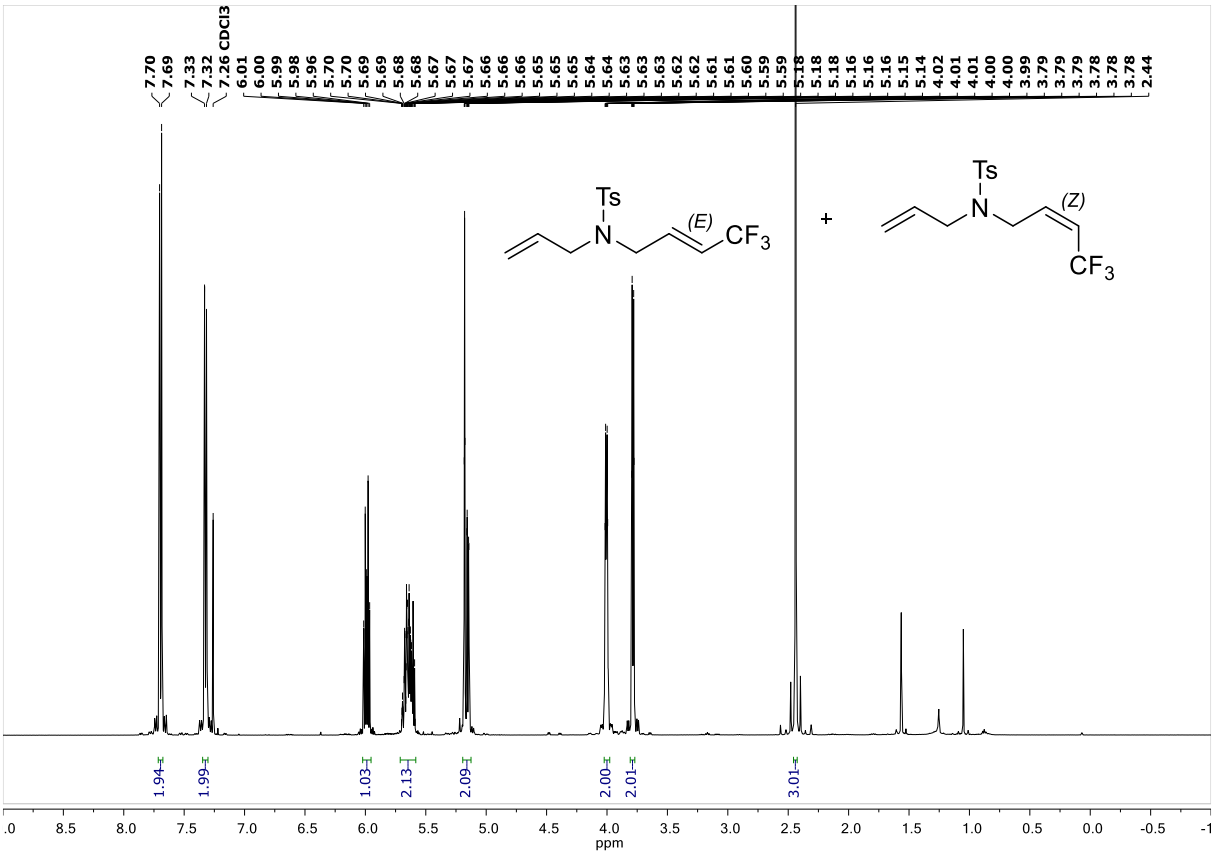
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2g**



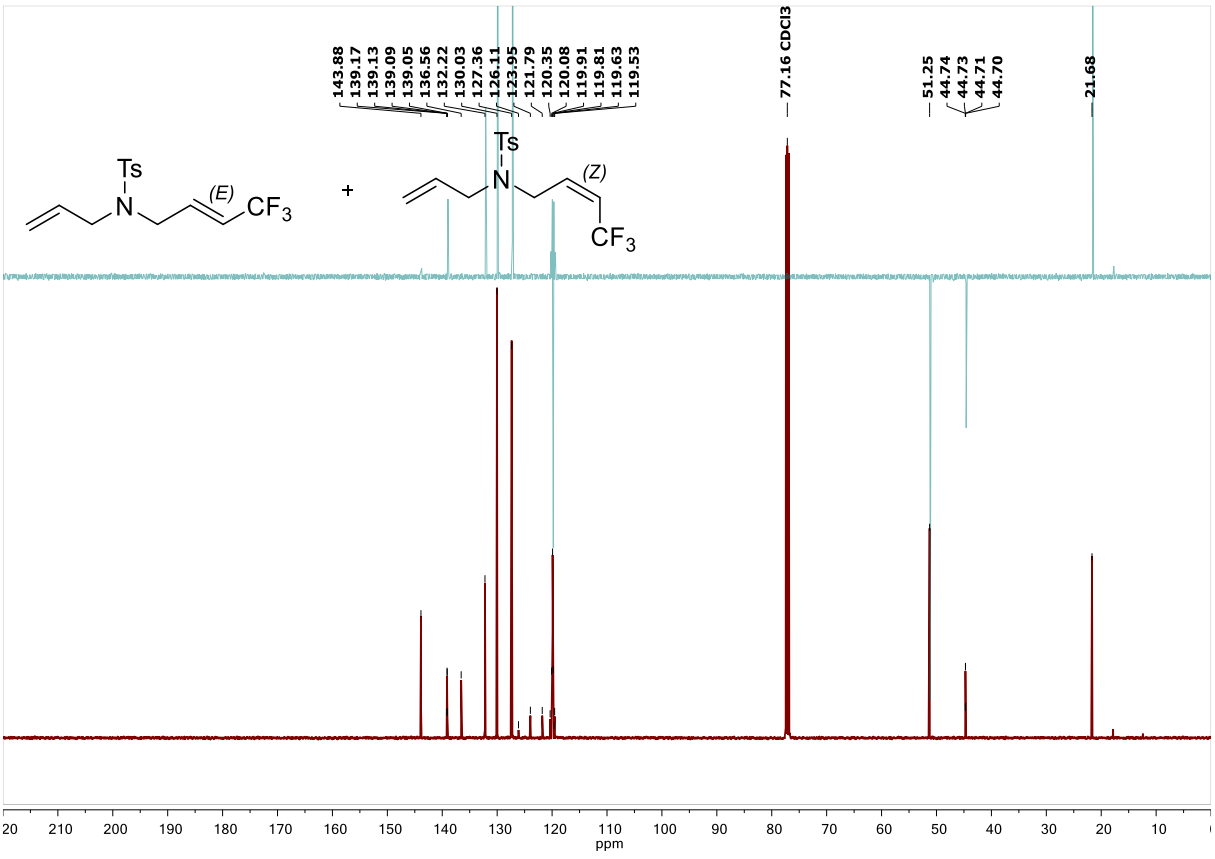
^{1}H NMR ($CDCl_3$, 500 MHz) of **2h**



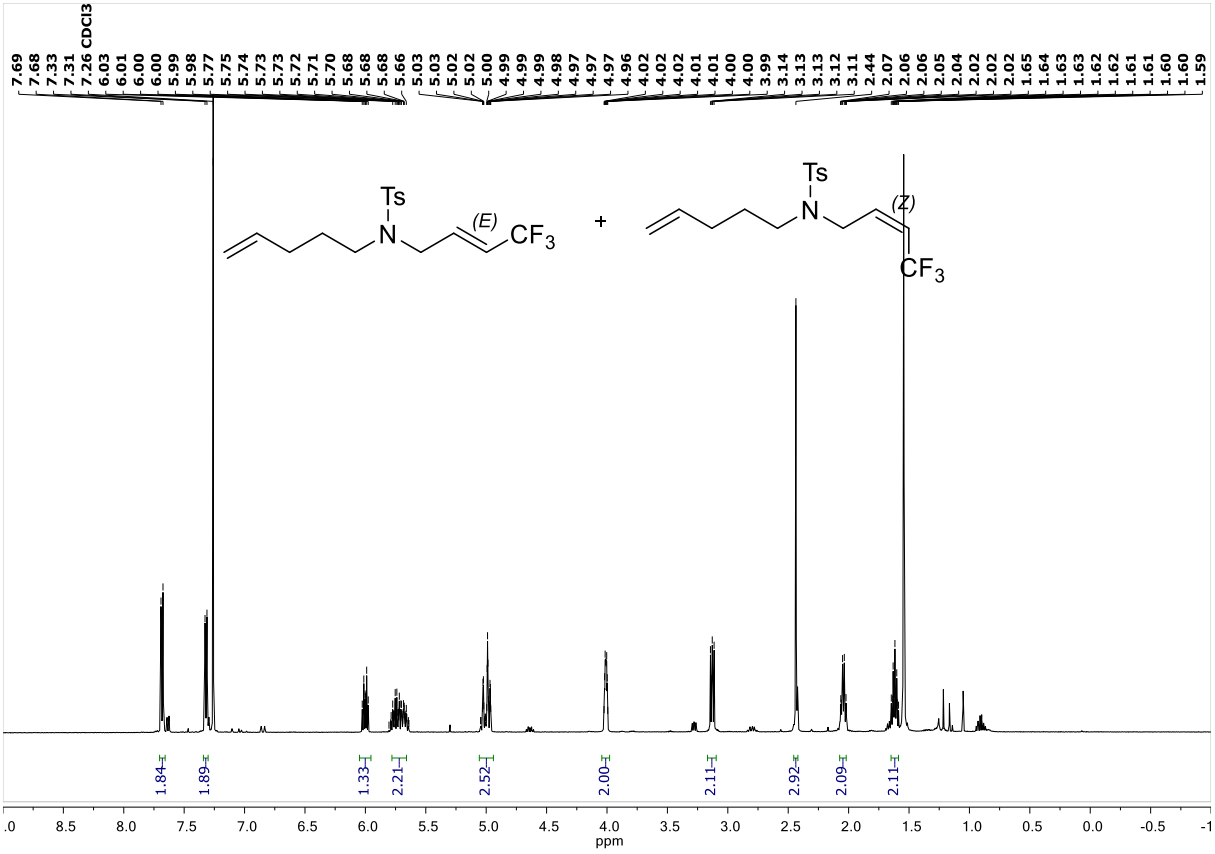
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2h**



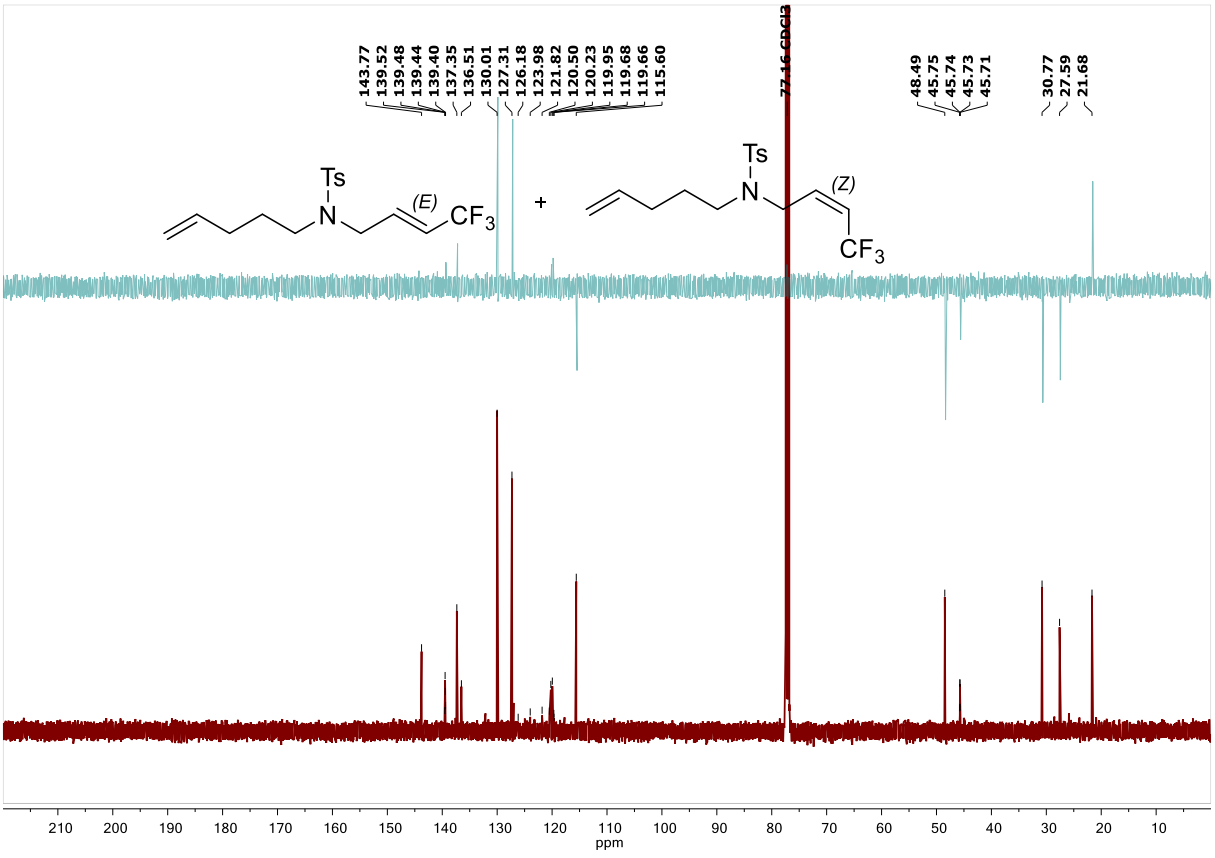
^{1}H NMR ($CDCl_3$, 500 MHz) of **2i**



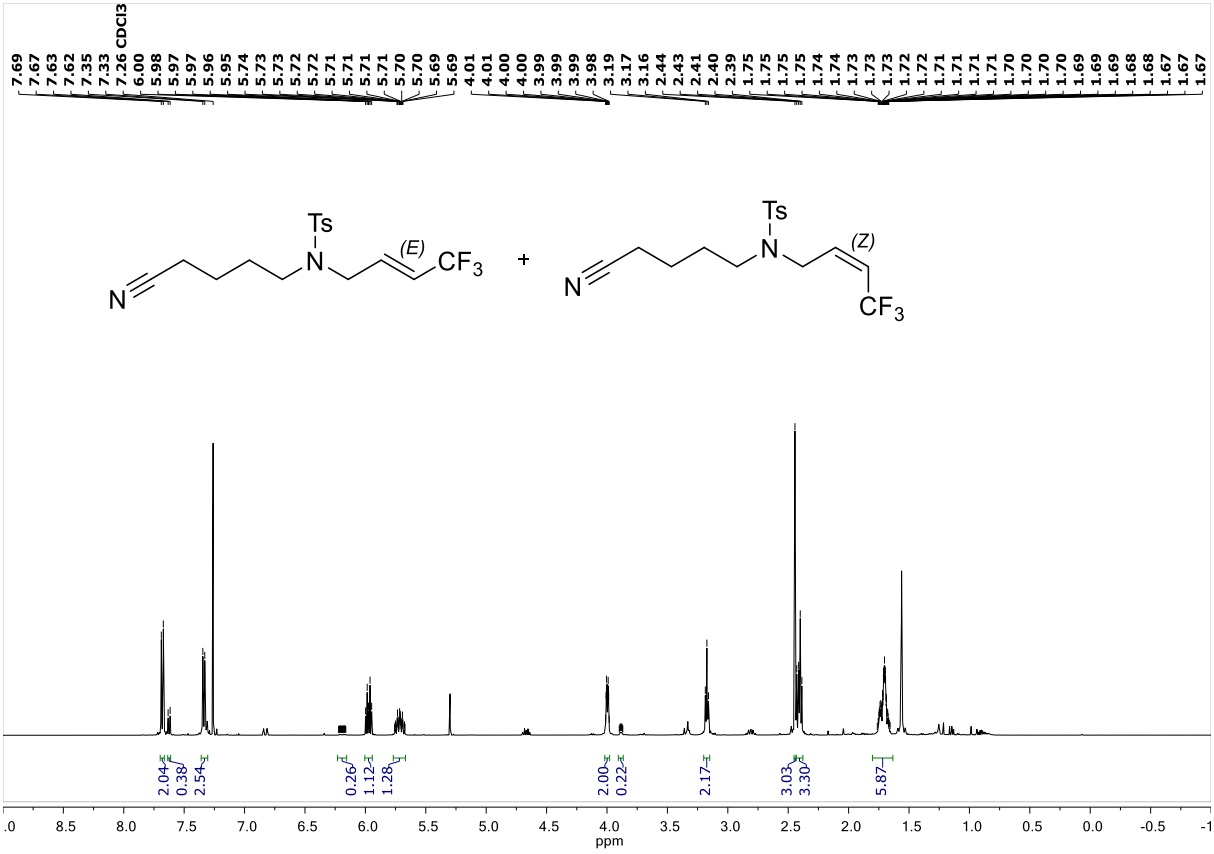
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2i**



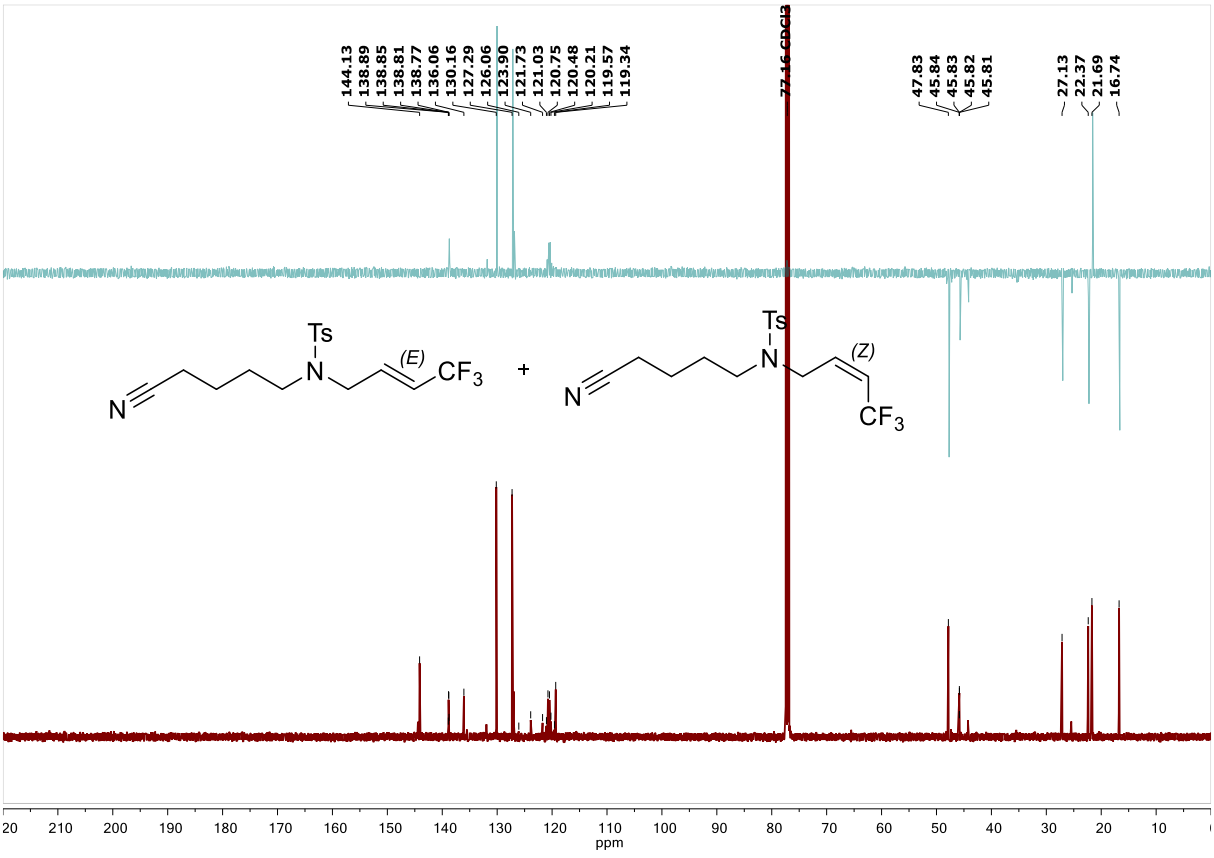
^{1}H NMR ($CDCl_3$, 500 MHz) of **2j**



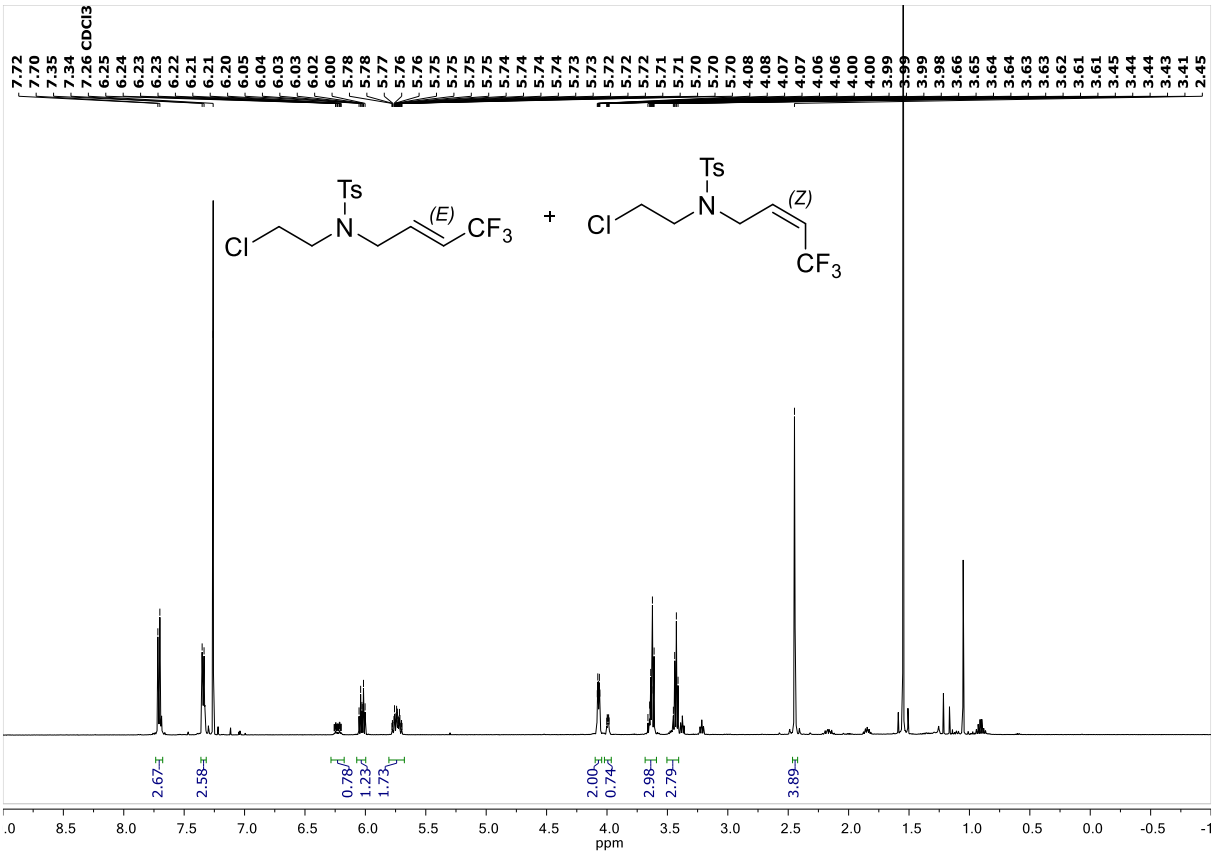
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2j**



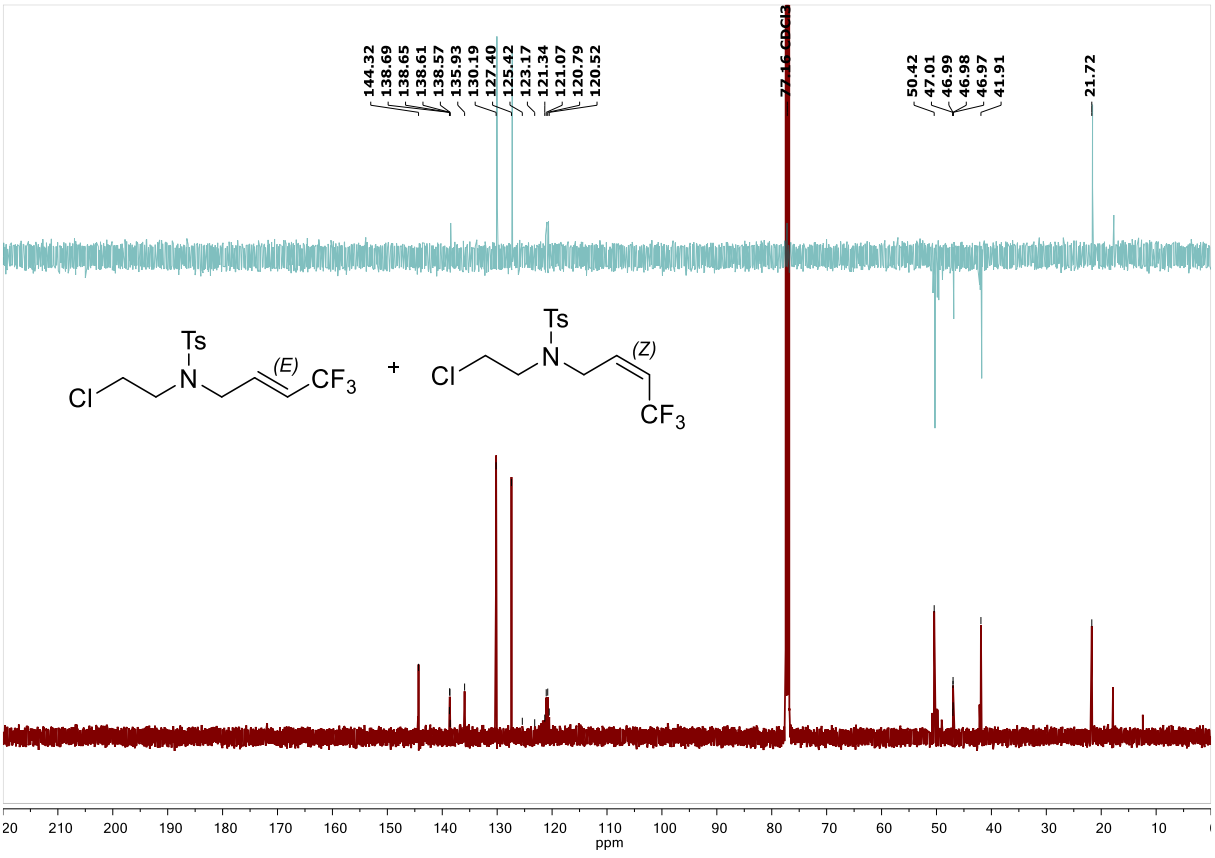
^{1}H NMR ($CDCl_3$, 500 MHz) of **2k**



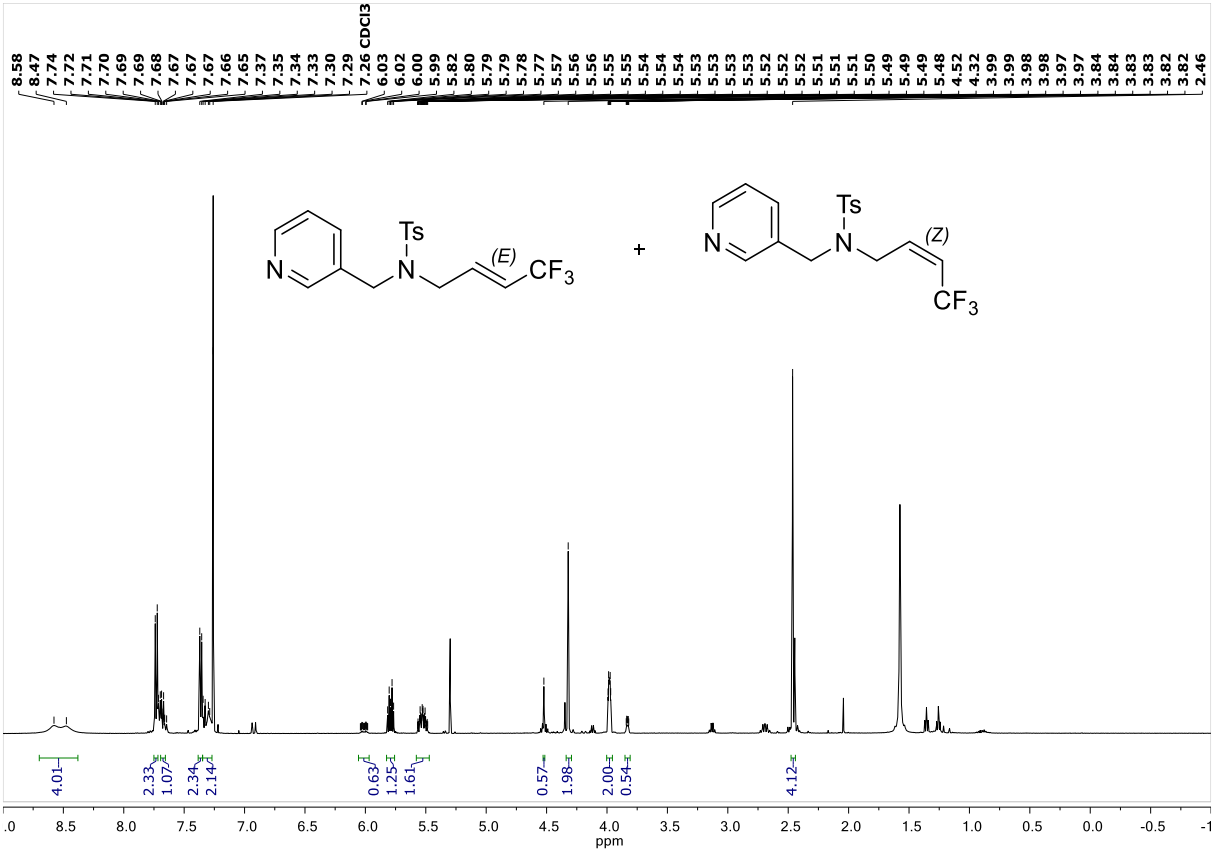
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2k**



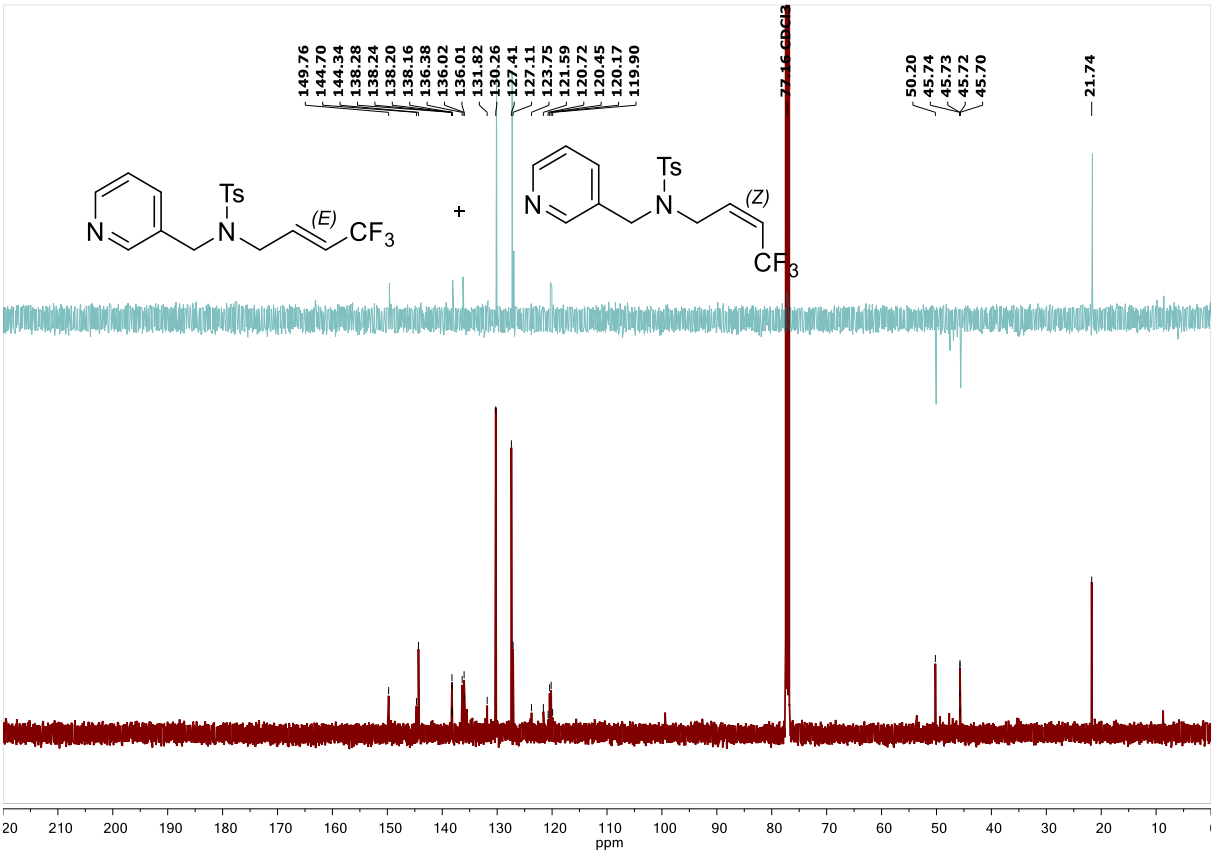
^{1}H NMR ($CDCl_3$, 500 MHz) of **2l**



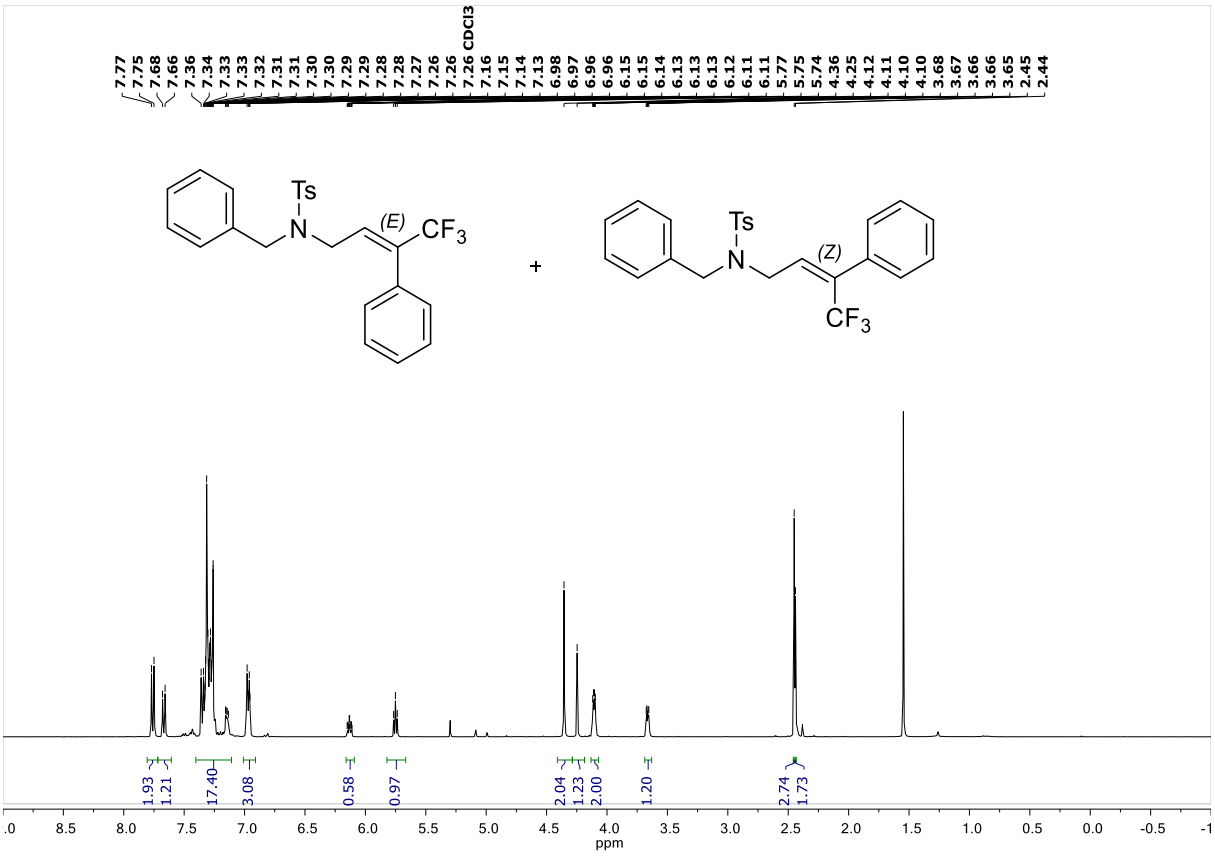
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2l**



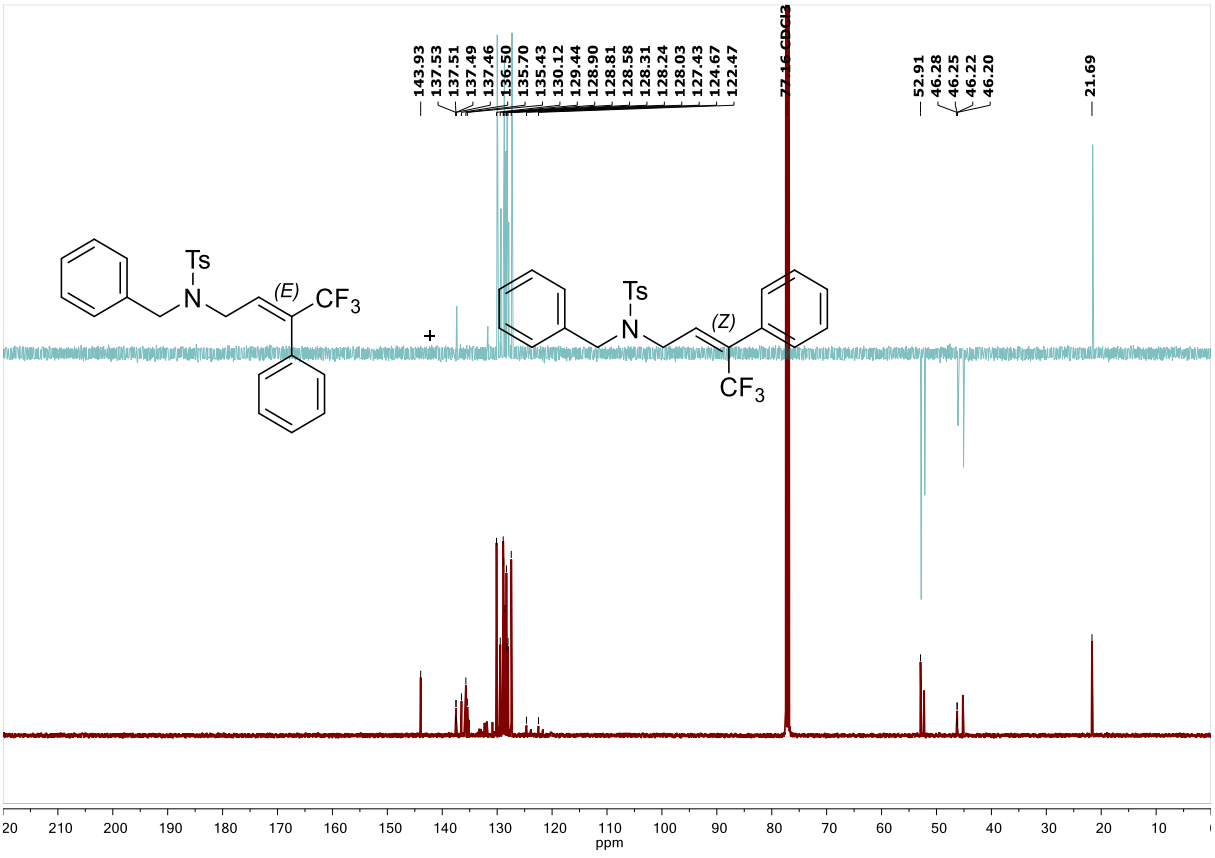
^{1}H NMR ($CDCl_3$, 500 MHz) of **2m**



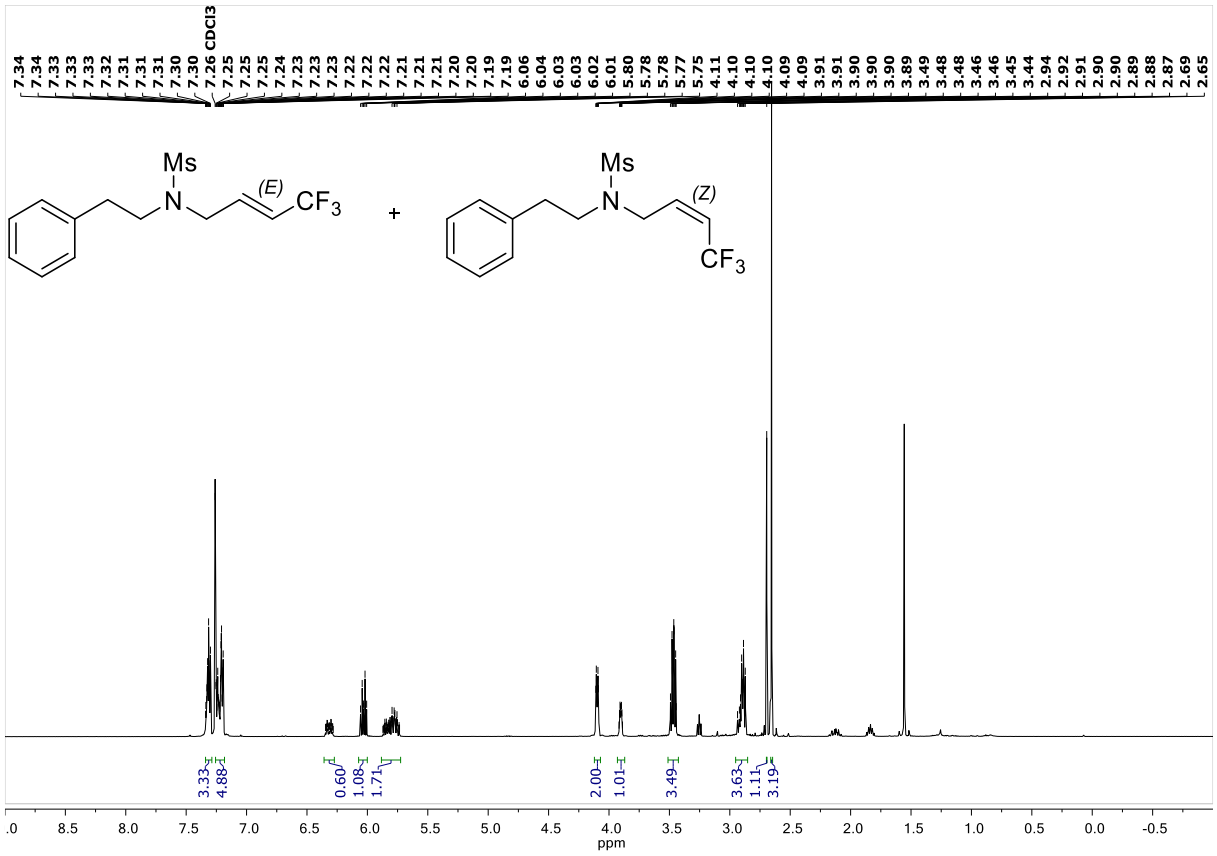
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2m**



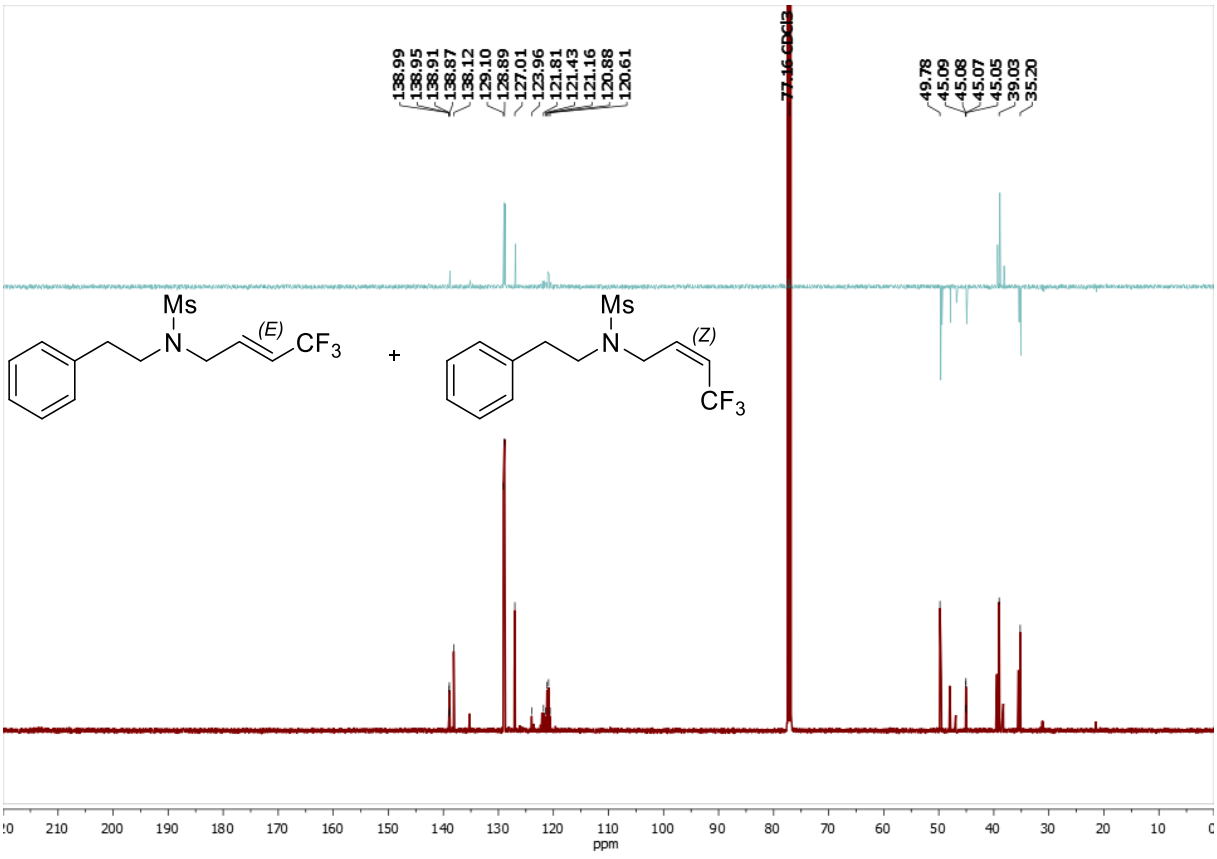
^{1}H NMR ($CDCl_3$, 400 MHz) of **2n**



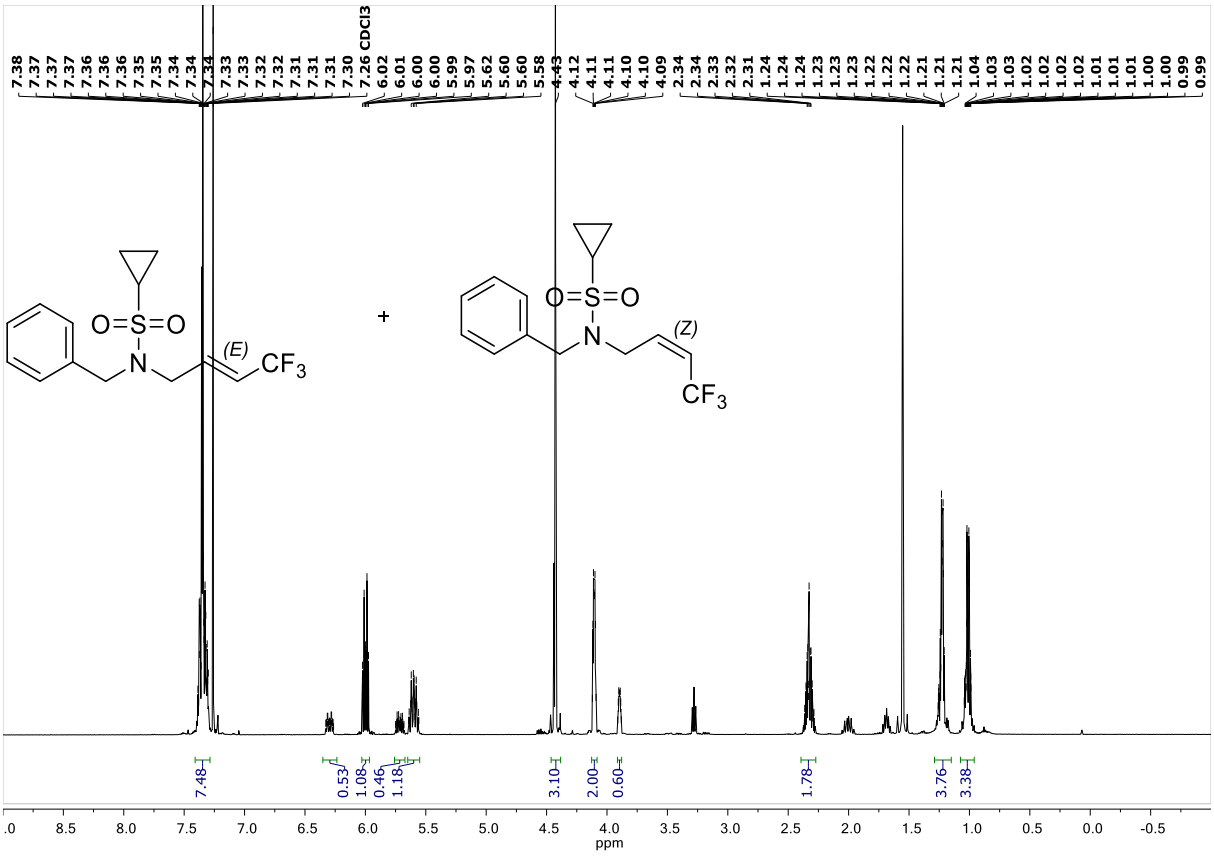
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2n**



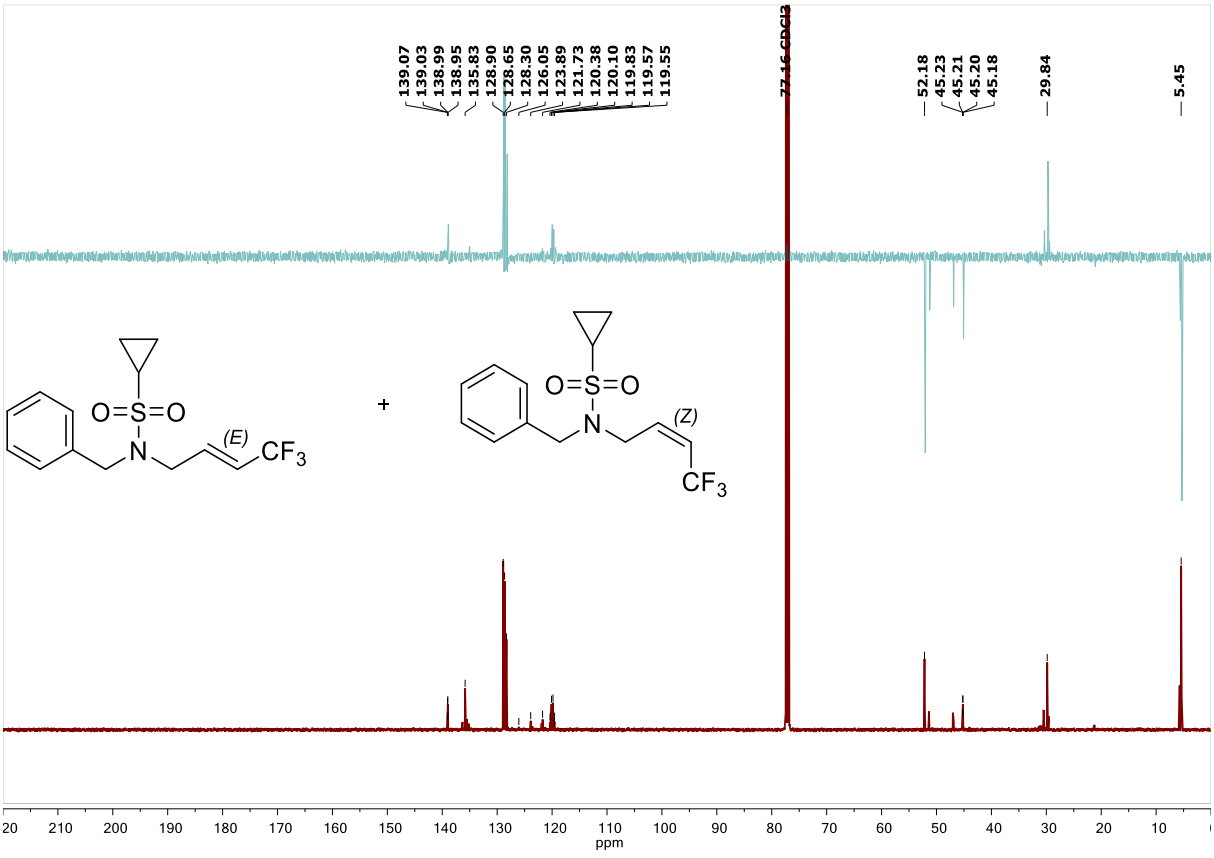
^{1}H NMR ($CDCl_3$, 500 MHz) of **2o**



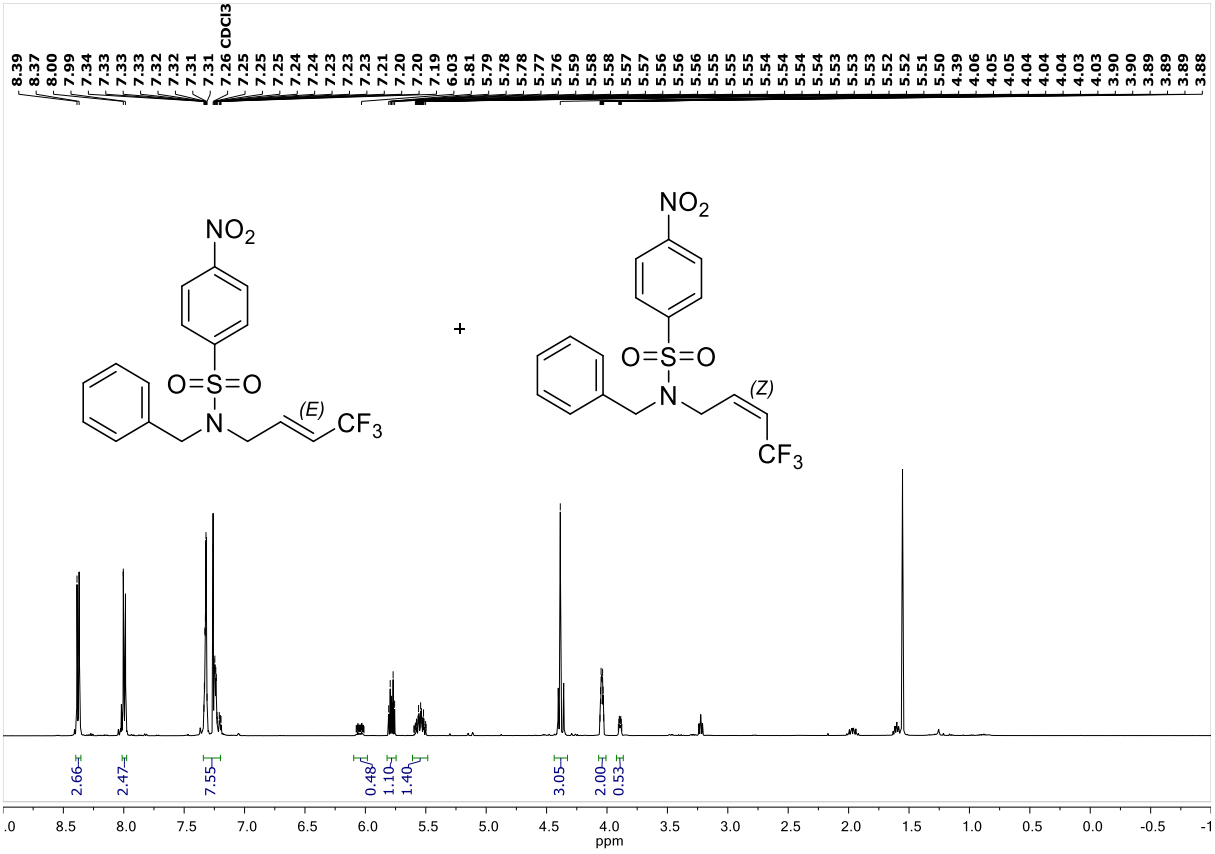
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2o**



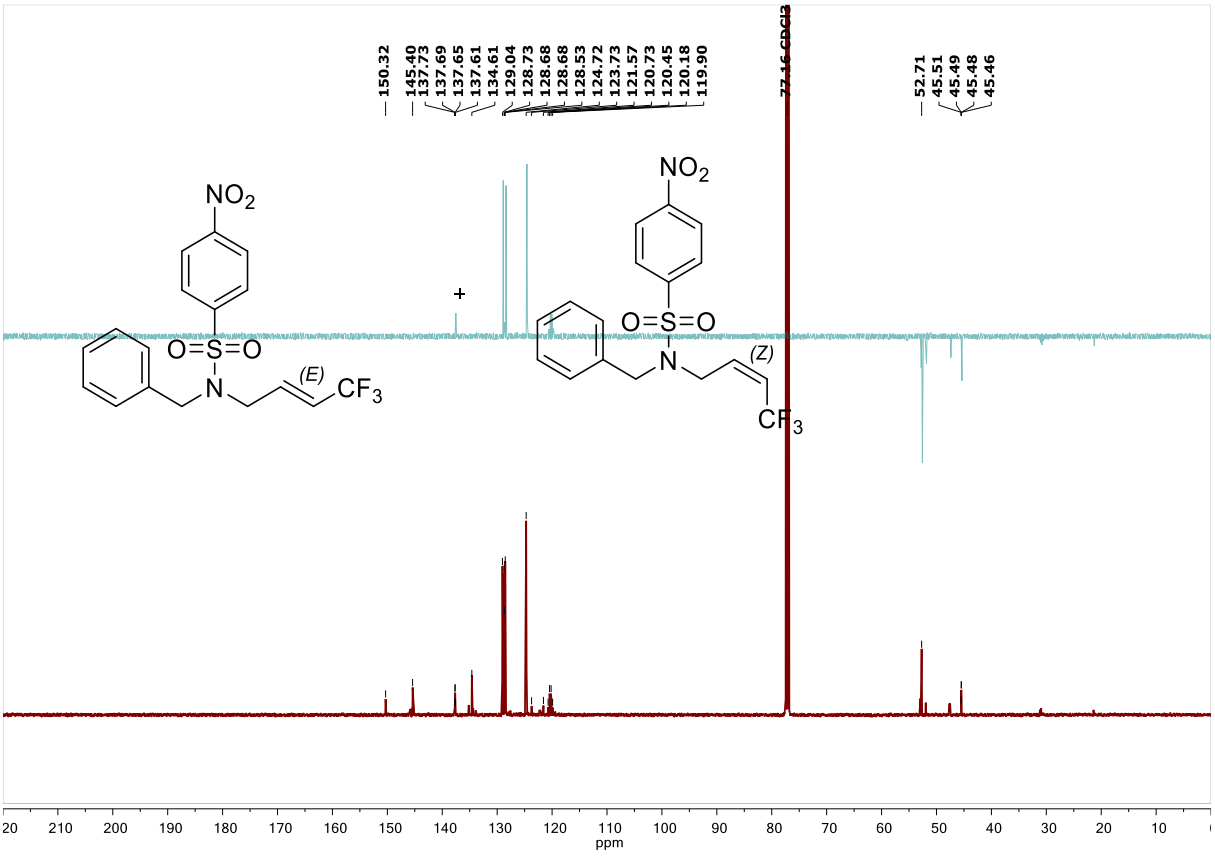
^{1}H NMR ($CDCl_3$, 500 MHz) of **2p**



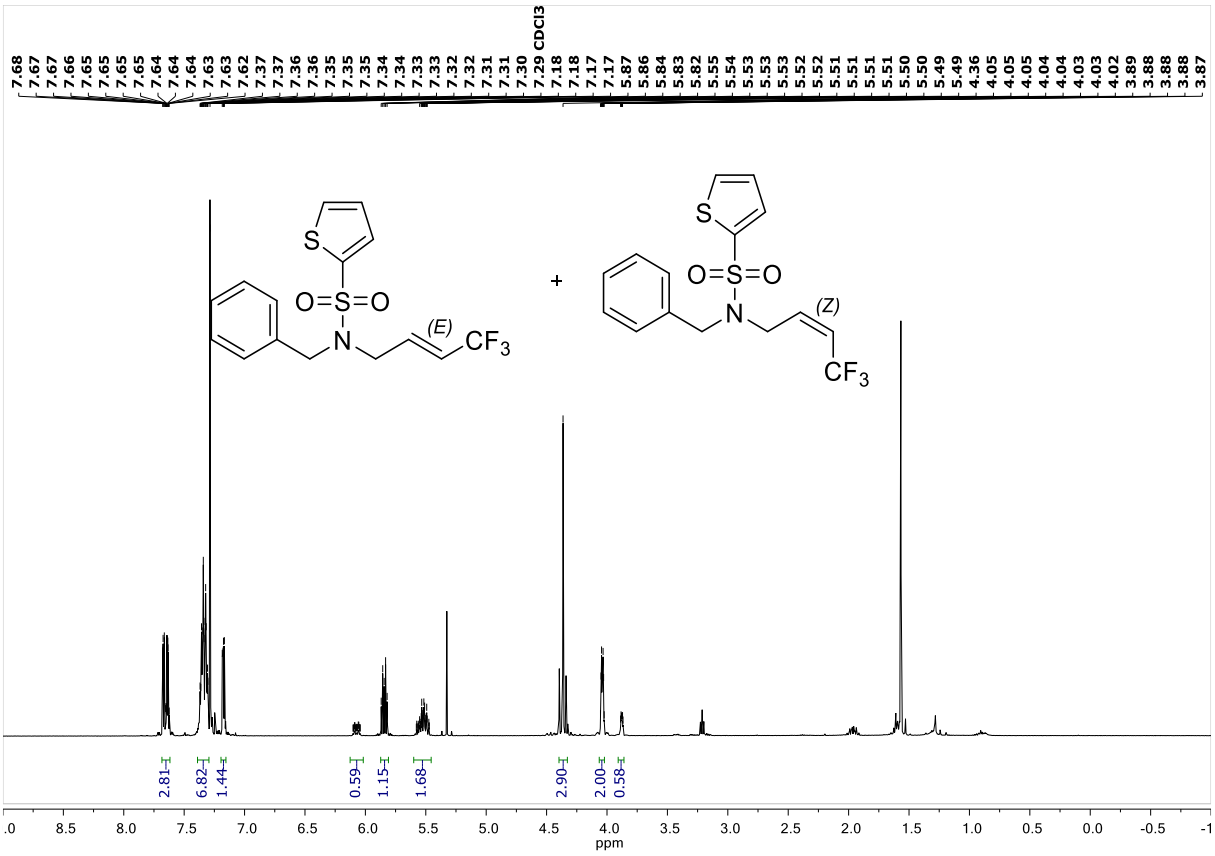
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2p**



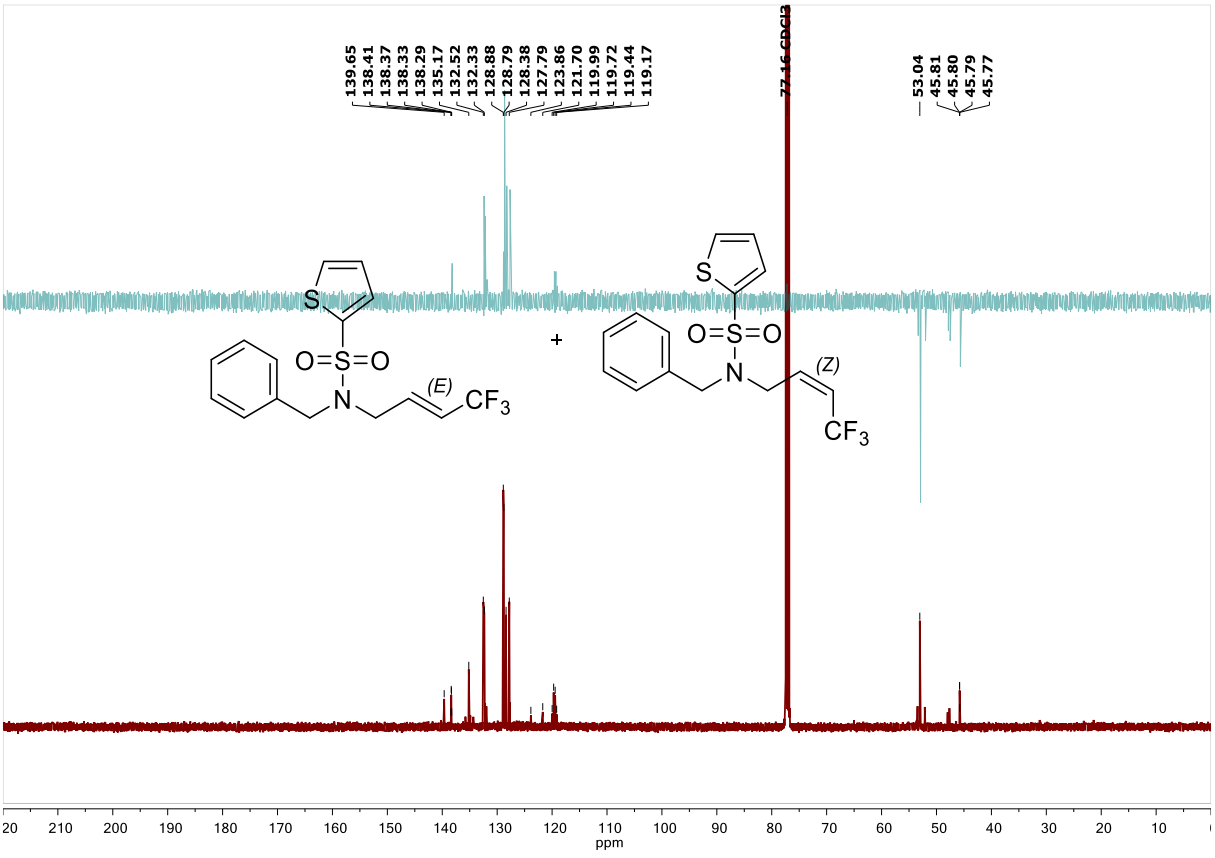
^{1}H NMR ($CDCl_3$, 500 MHz) of **2q**



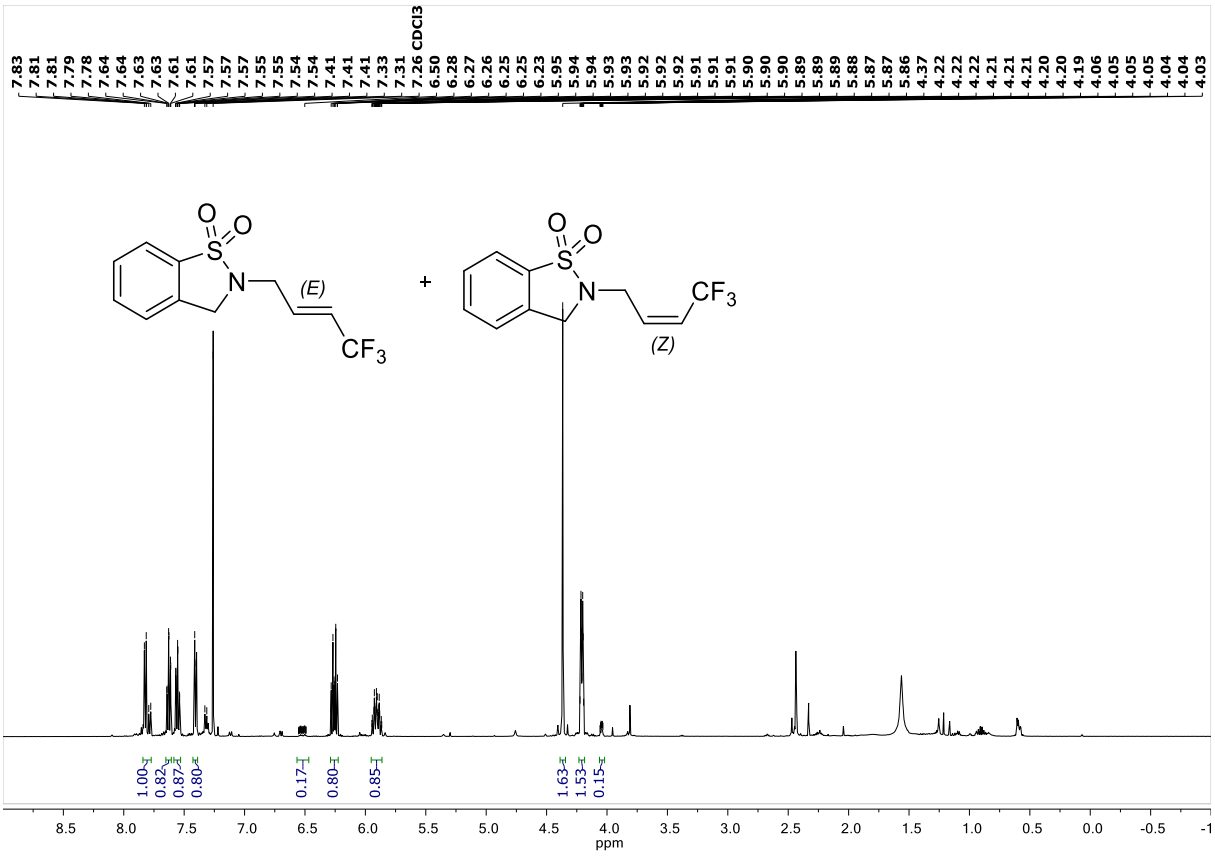
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2q**



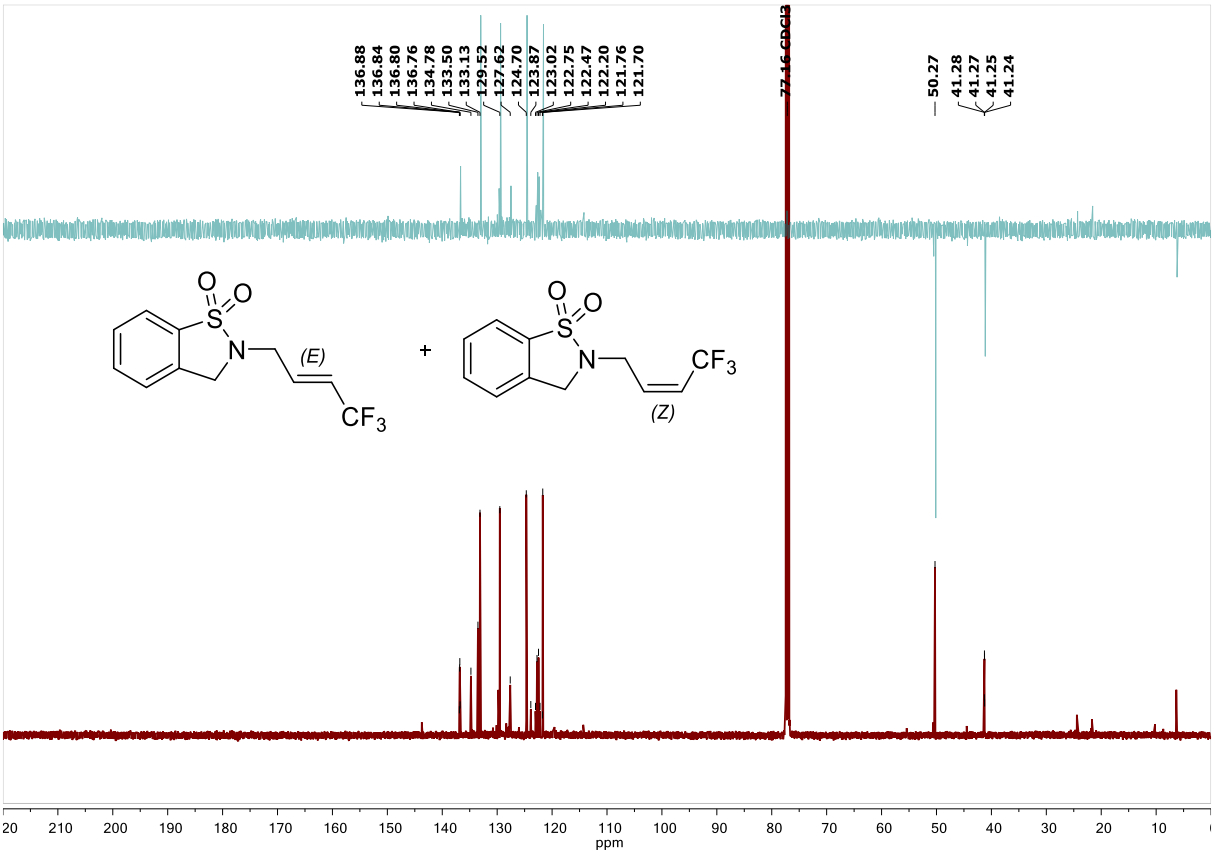
^{1}H NMR ($CDCl_3$, 500 MHz) of **2r**



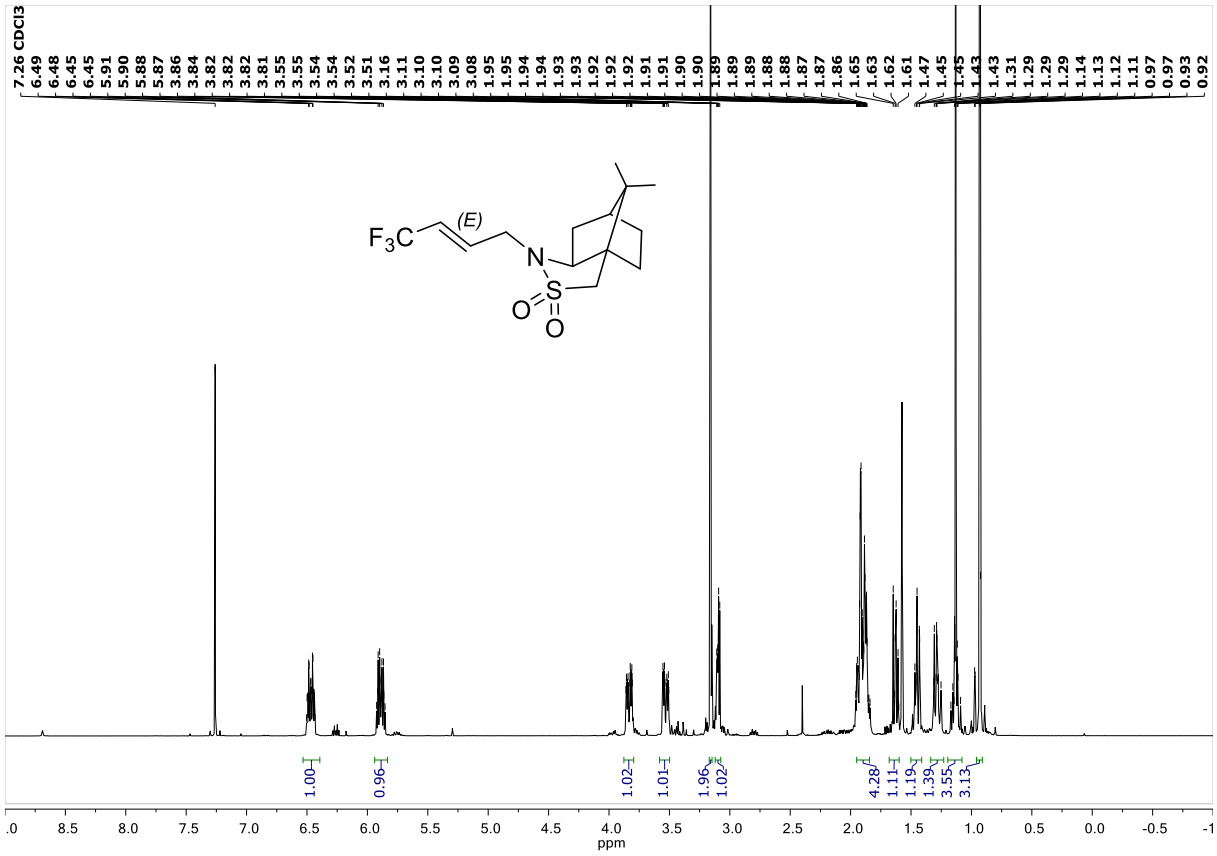
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2r**



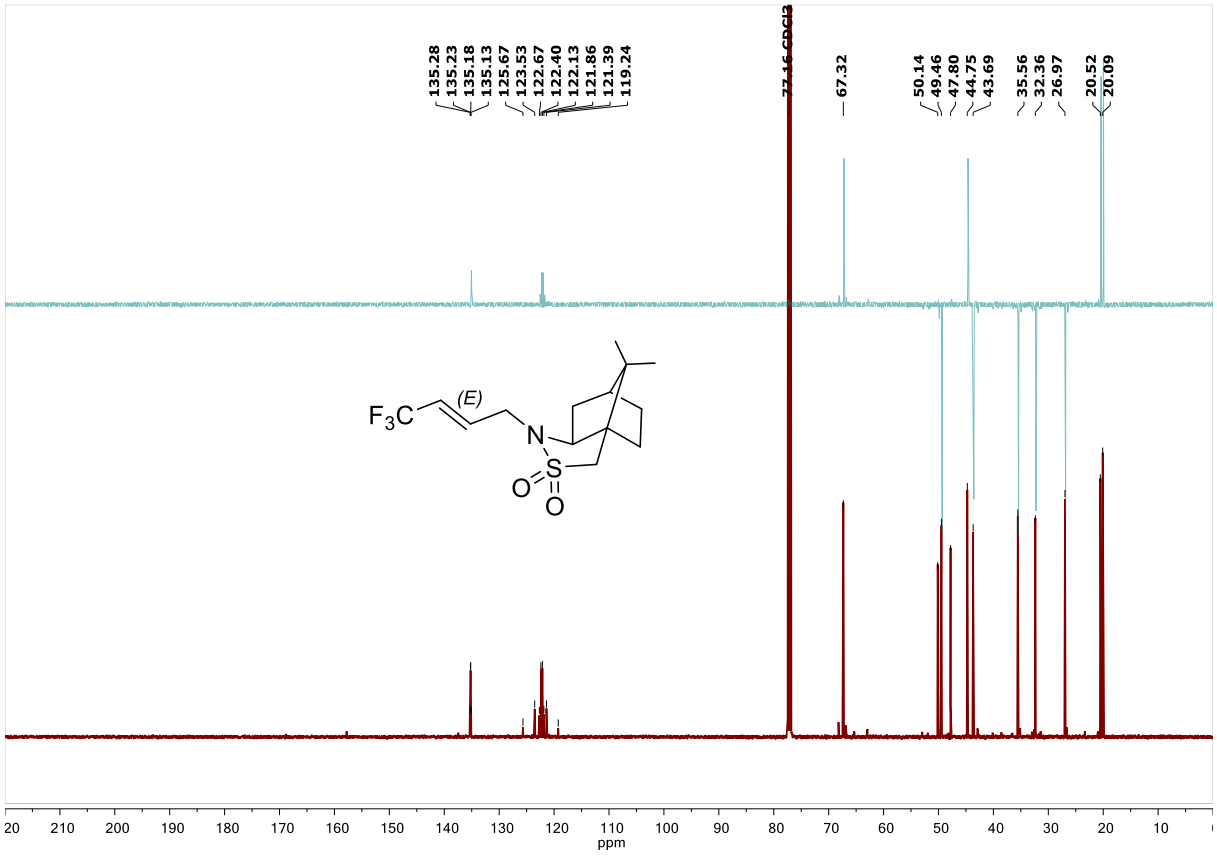
^{1}H NMR ($CDCl_3$, 500 MHz) of **2s**



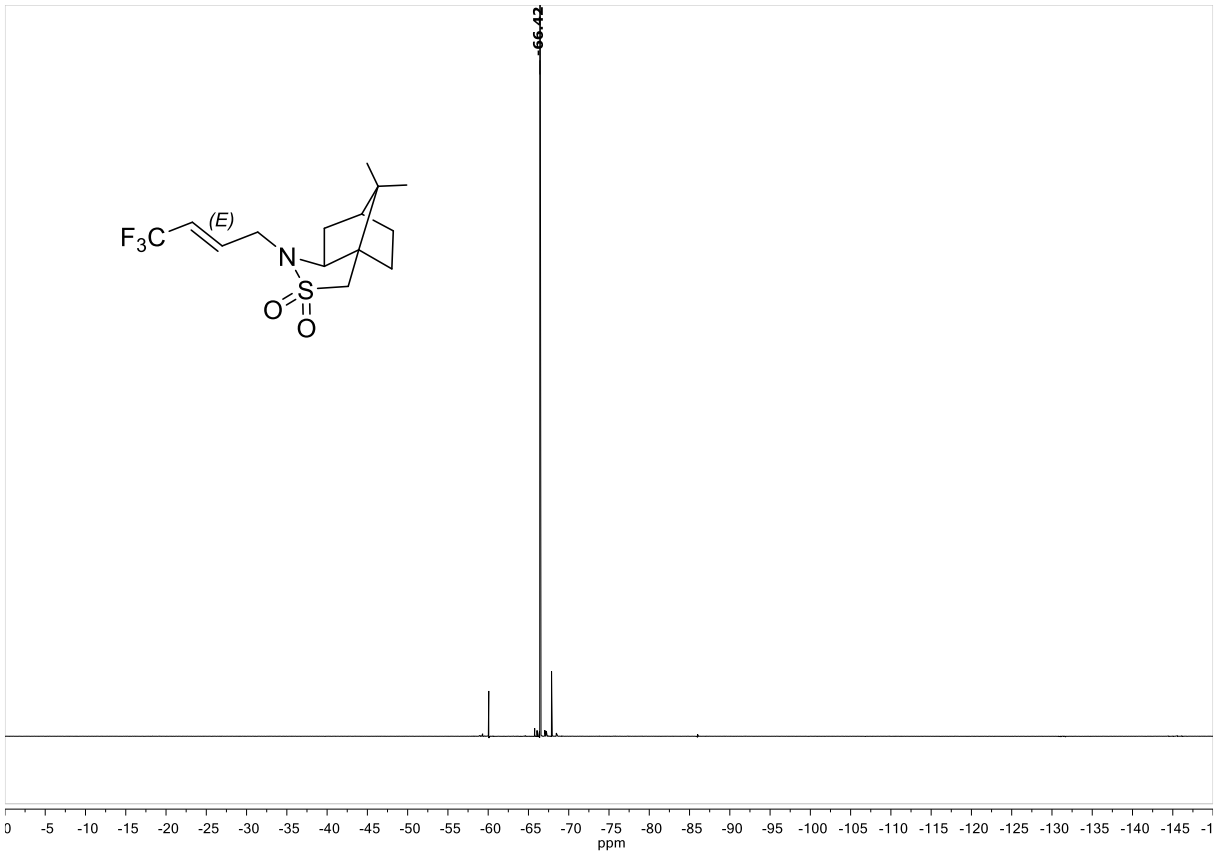
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2s**



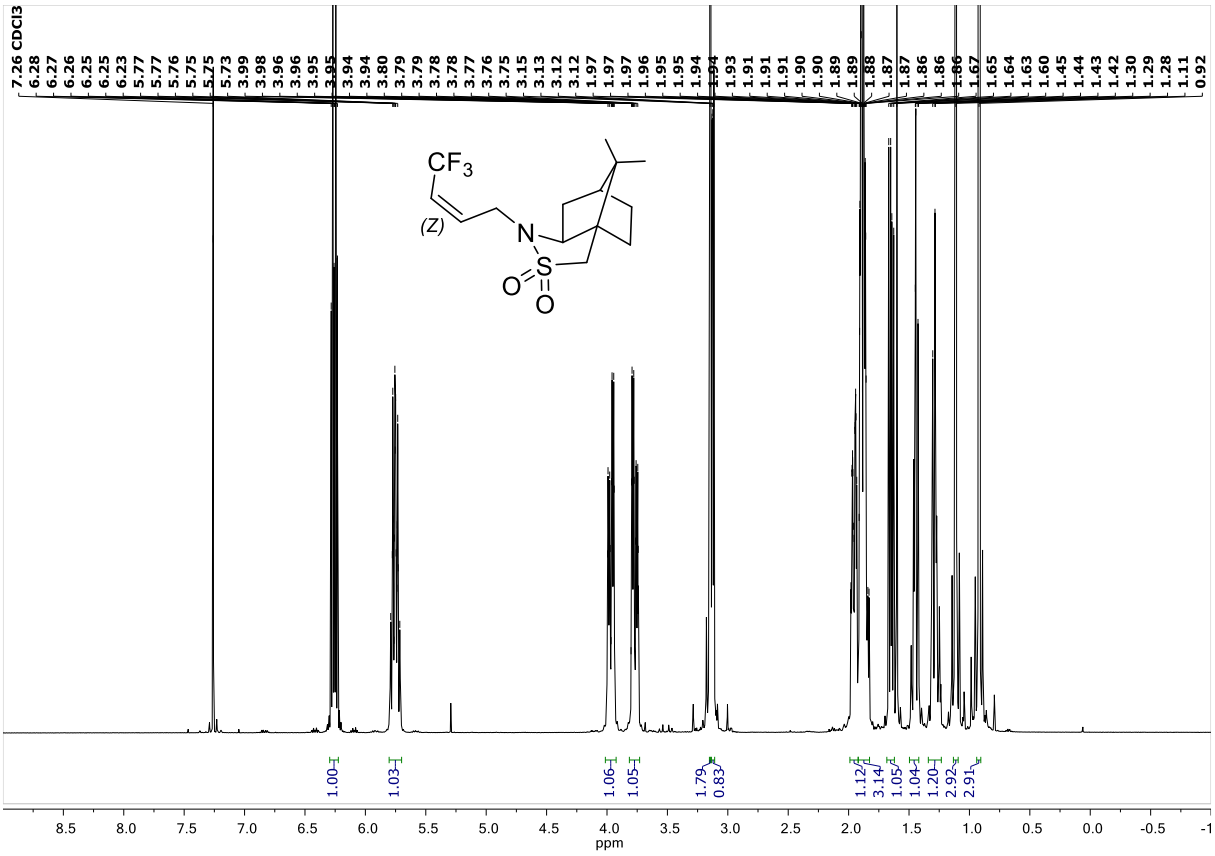
^{1}H NMR ($CDCl_3$, 500 MHz) of **2t-*E***



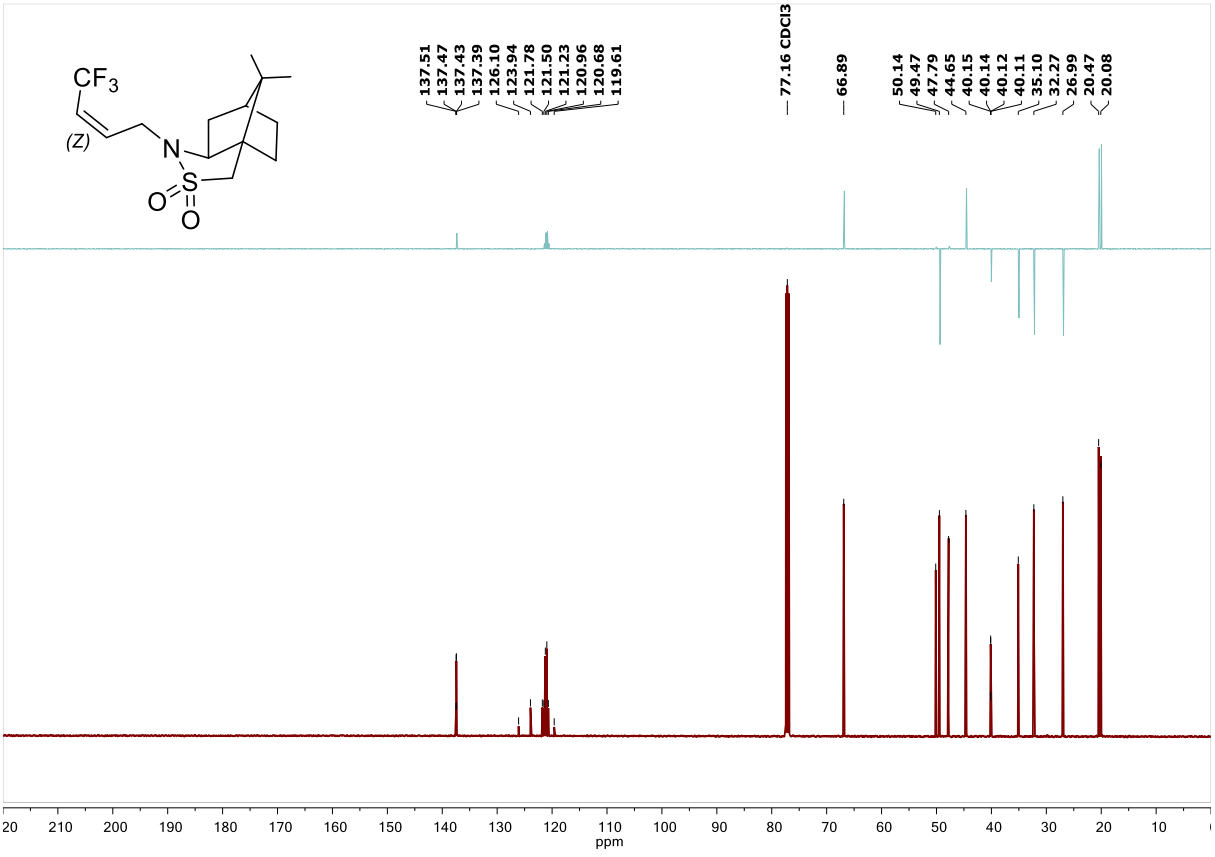
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2t-*E***



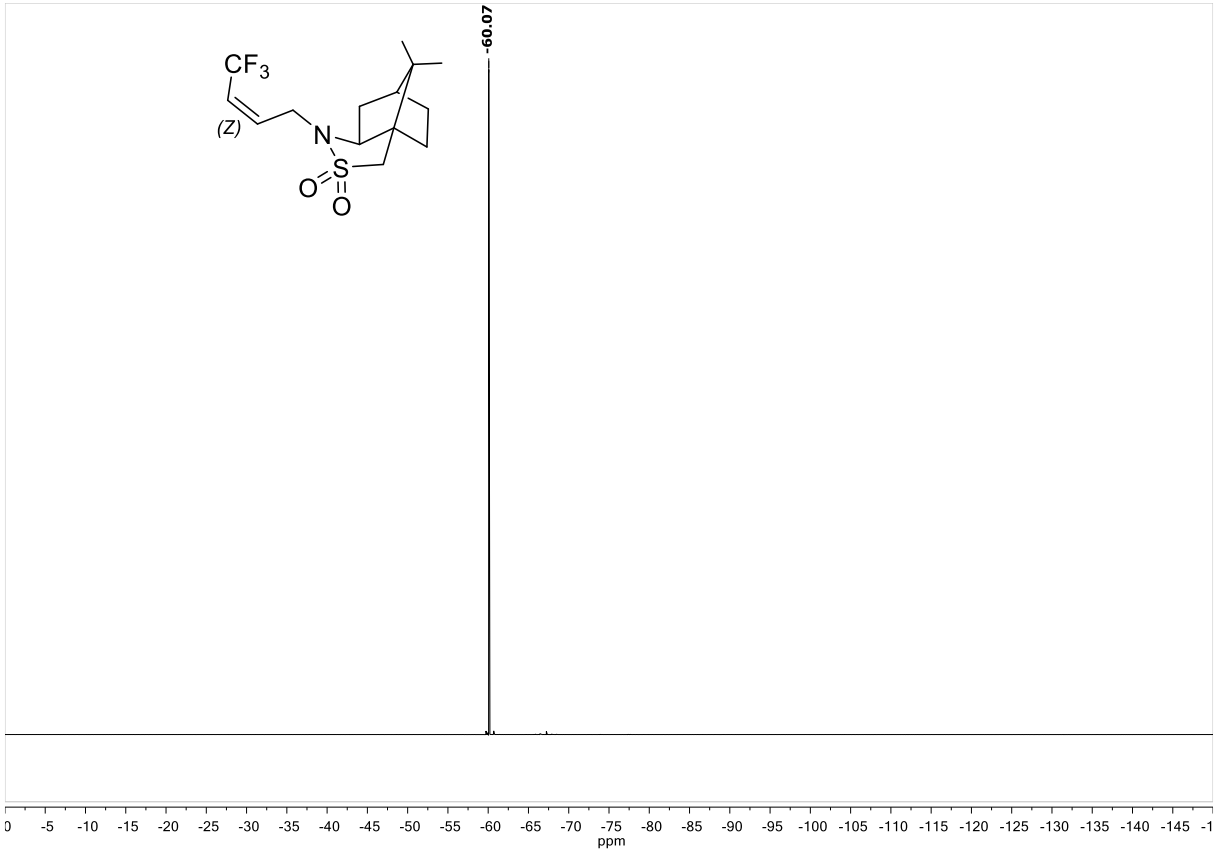
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **2t-*E***



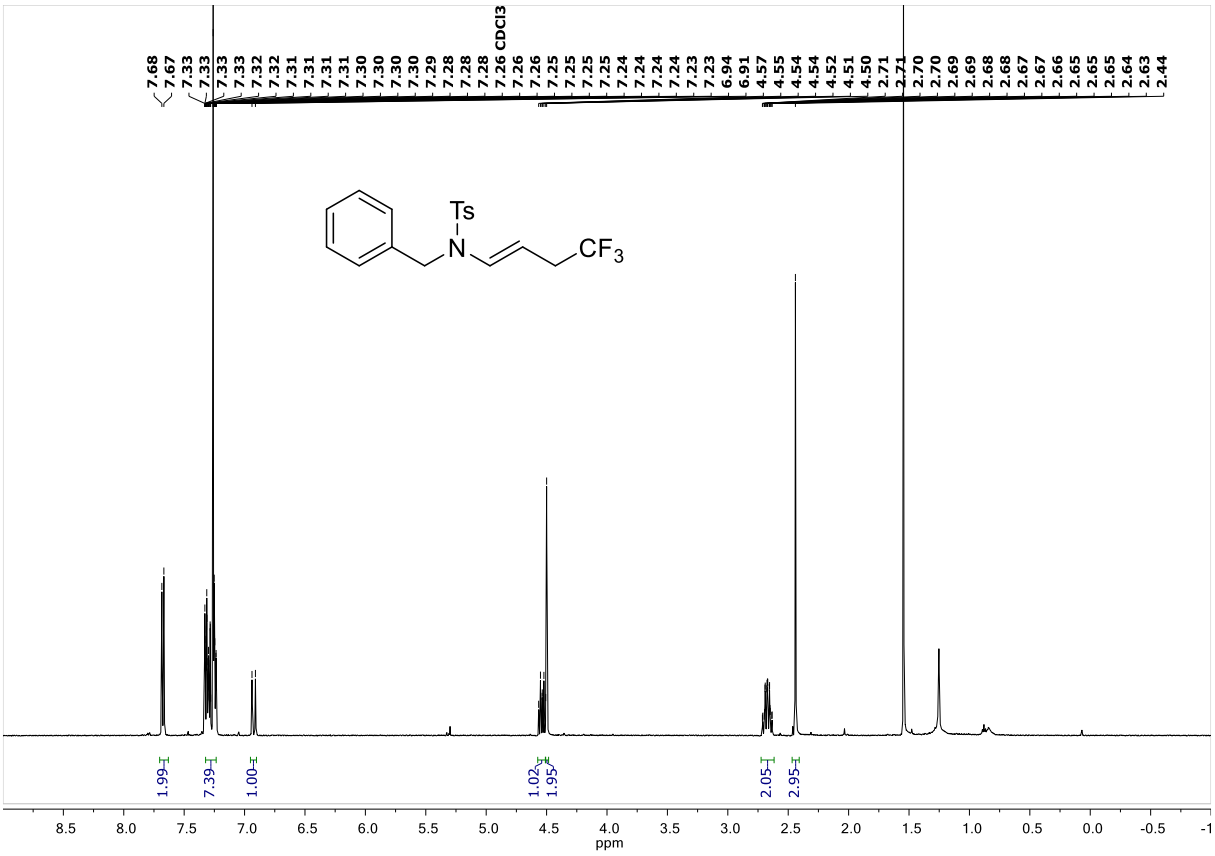
^{1}H NMR ($CDCl_3$, 500 MHz) of **2t-*Z***



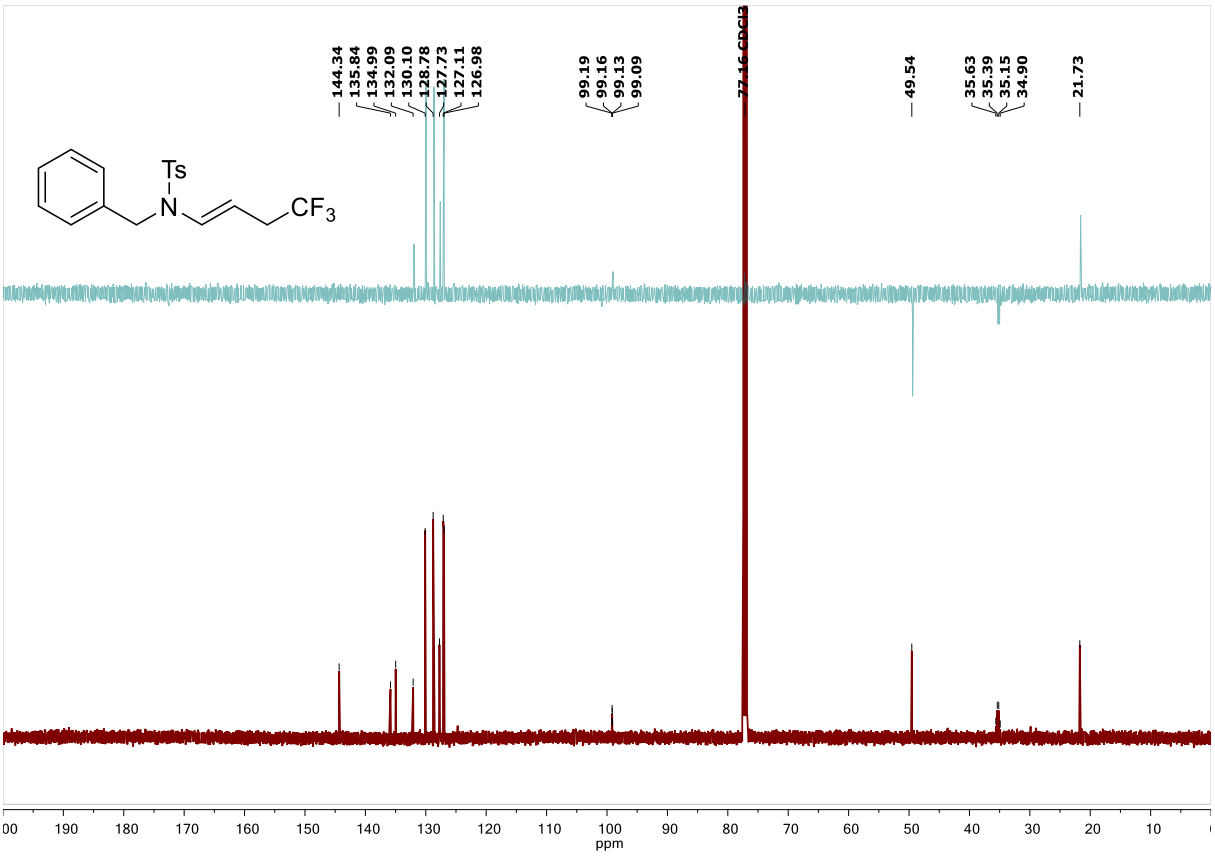
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **2t-*Z***



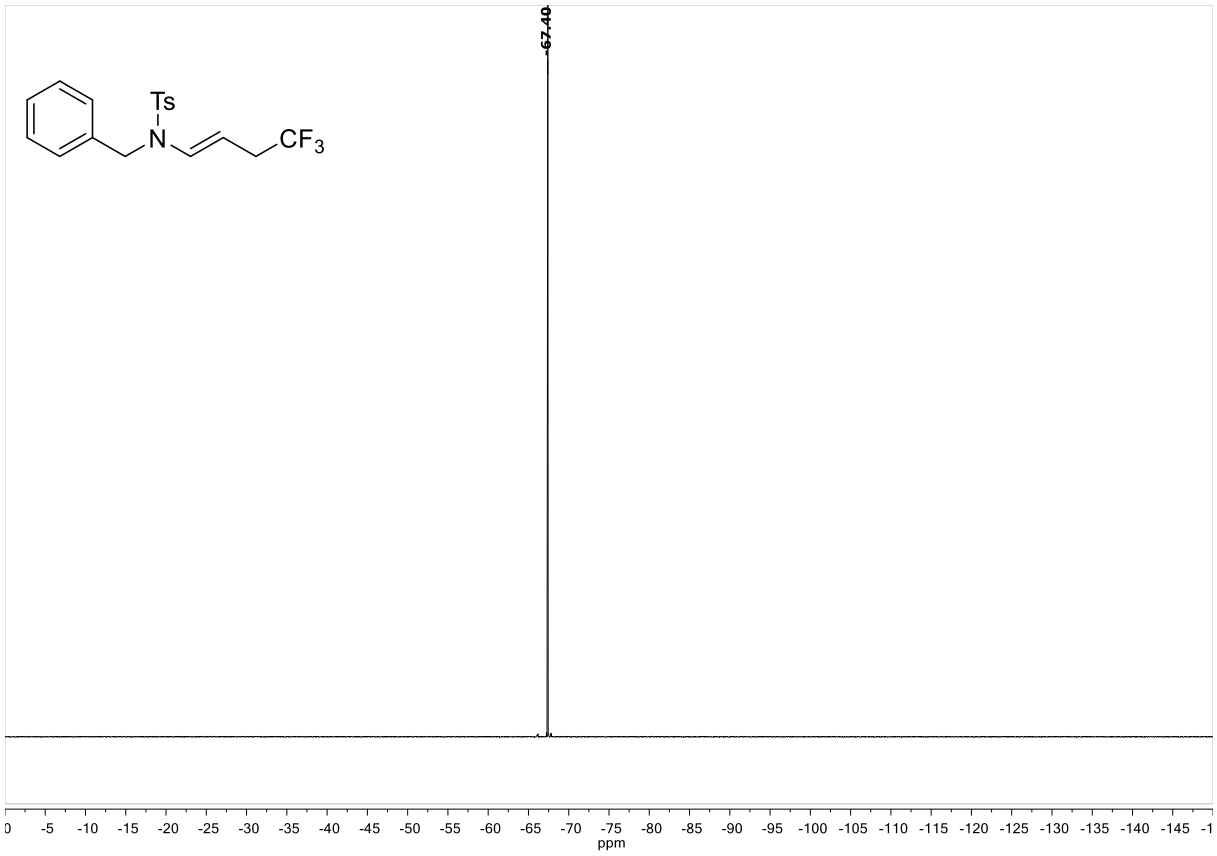
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **2t-*Z***



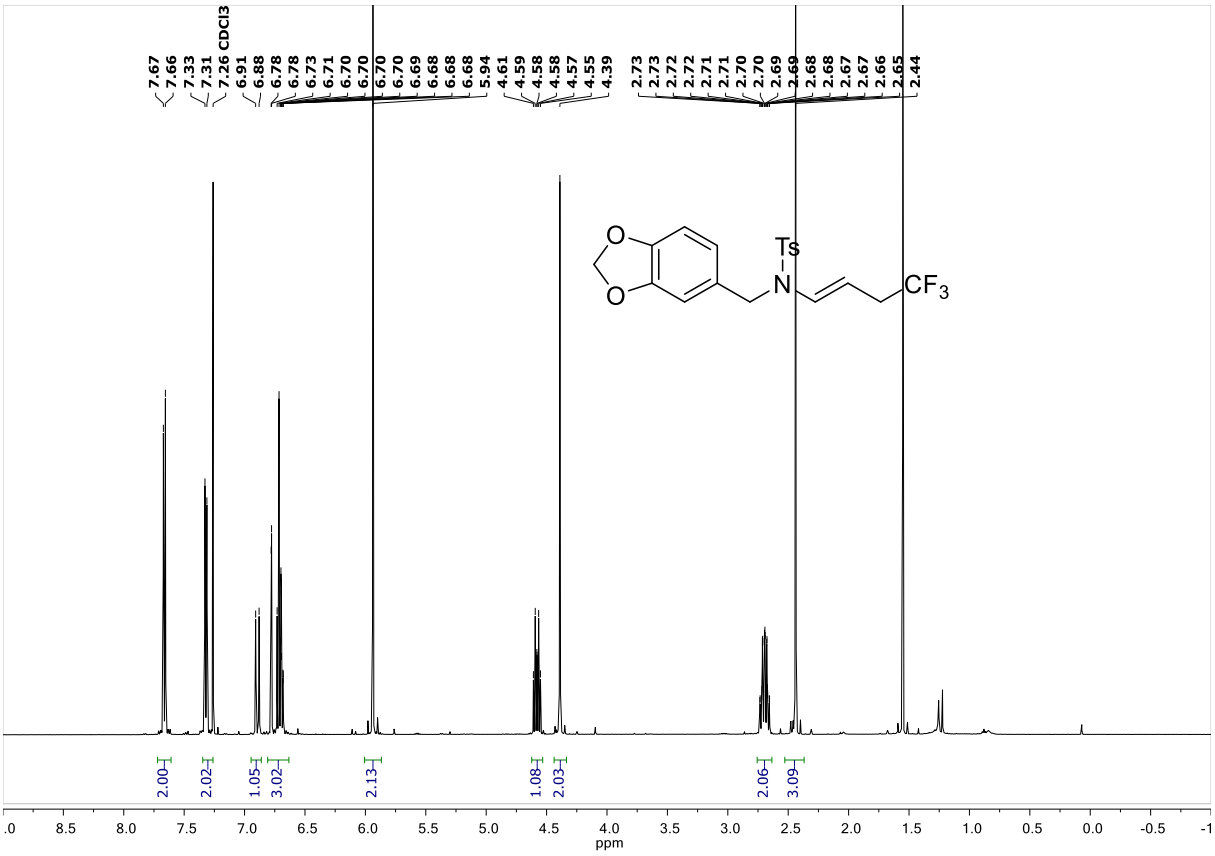
^{1}H NMR ($CDCl_3$, 500 MHz) of **3a**



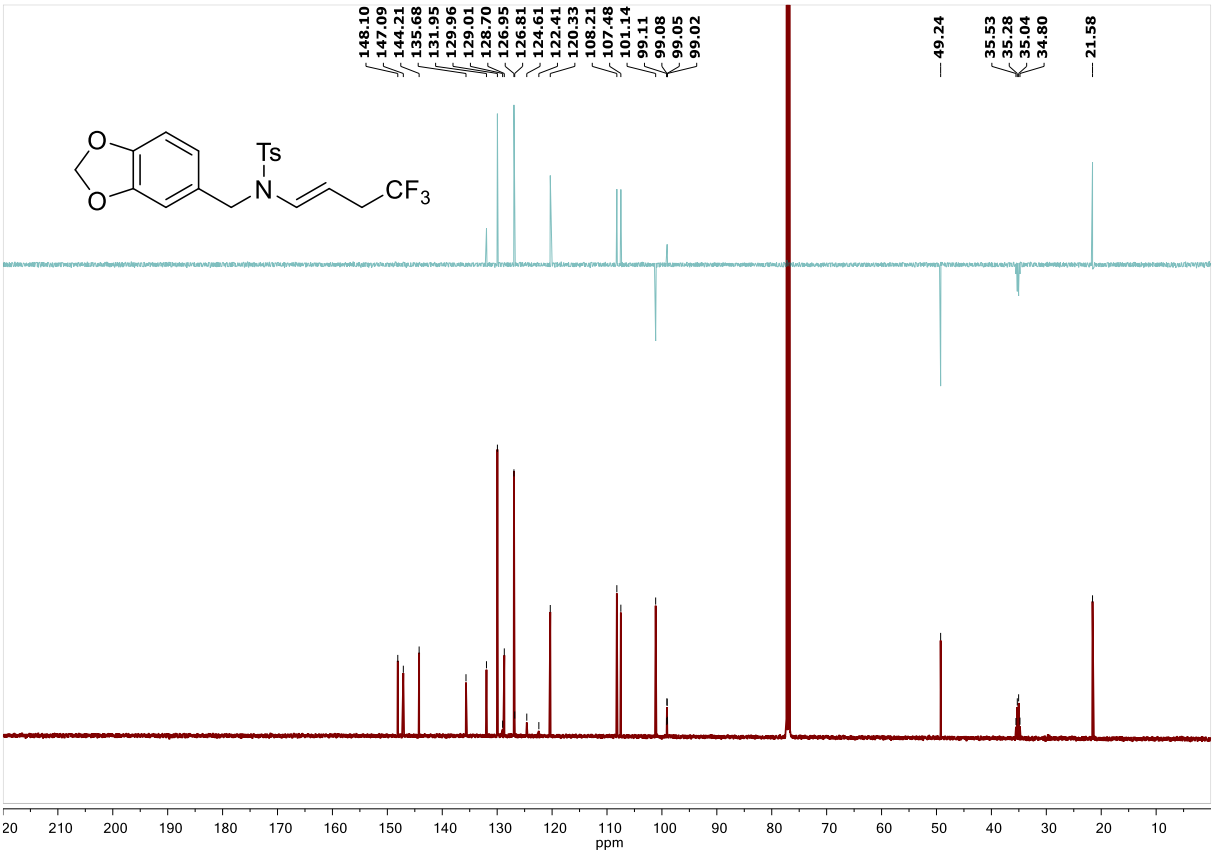
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3a**



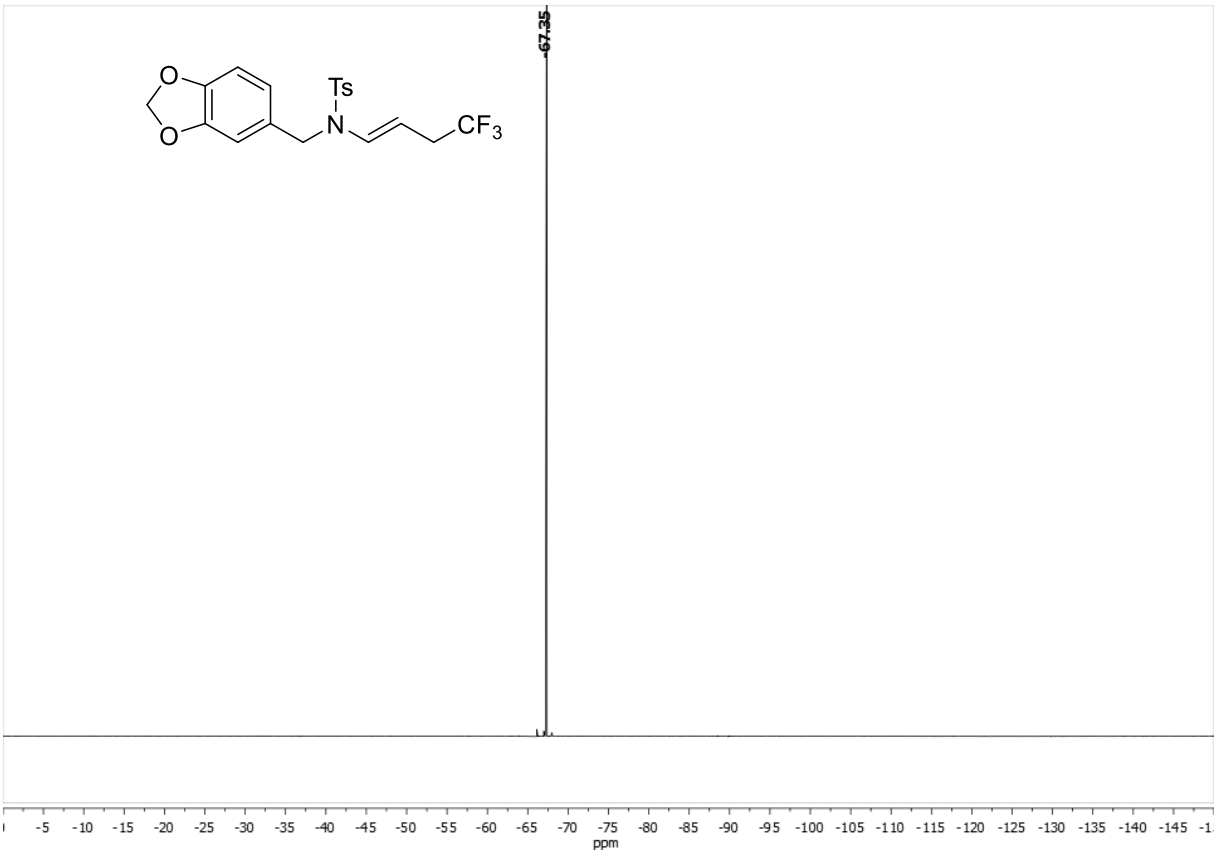
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 471 MHz) of **3a**



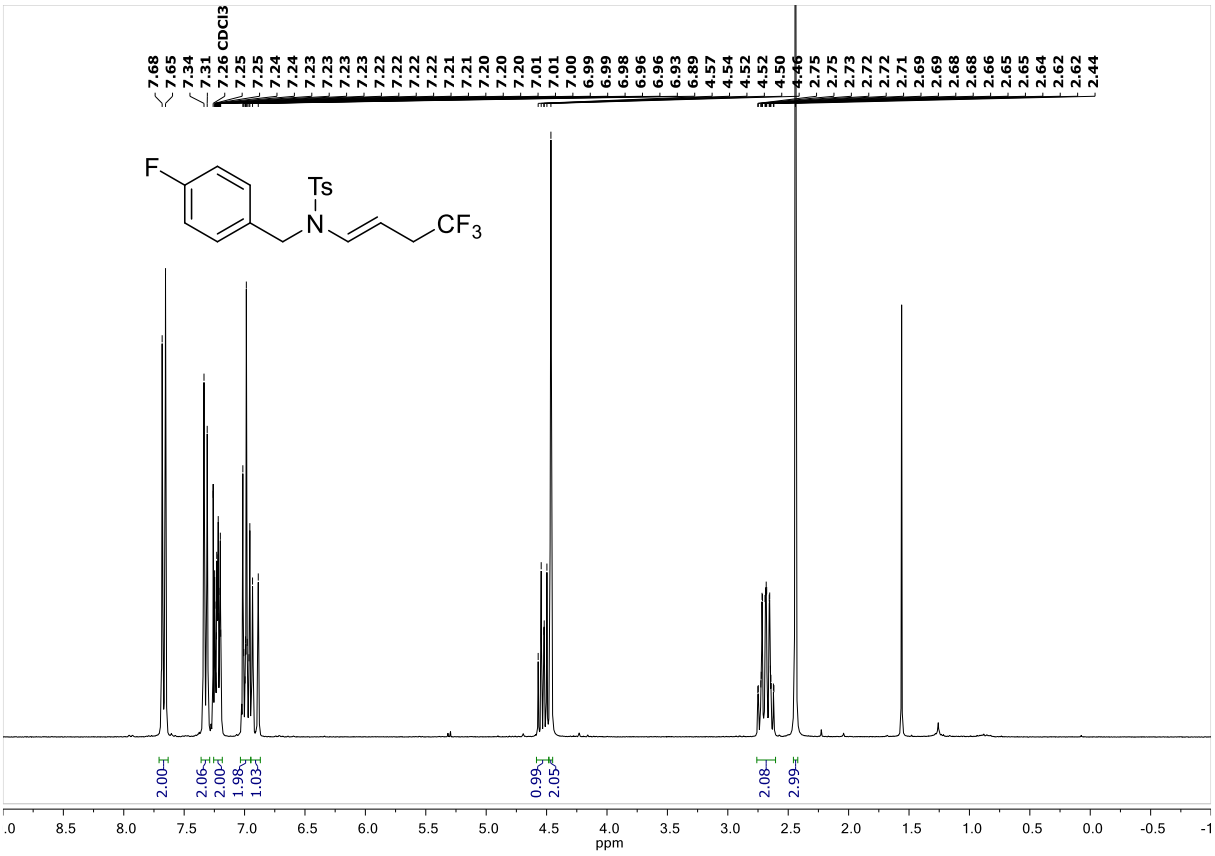
^{1}H NMR ($CDCl_3$, 500 MHz) of **3b**



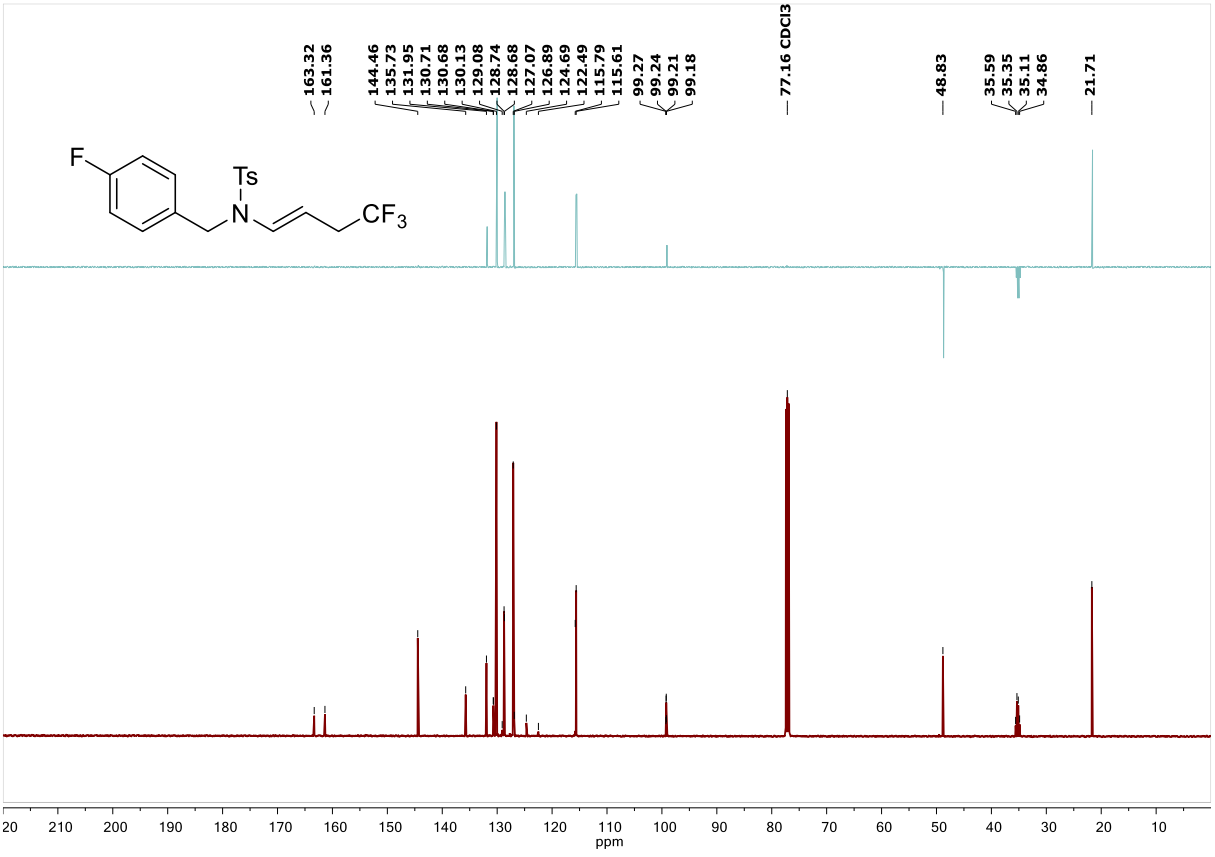
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3b**



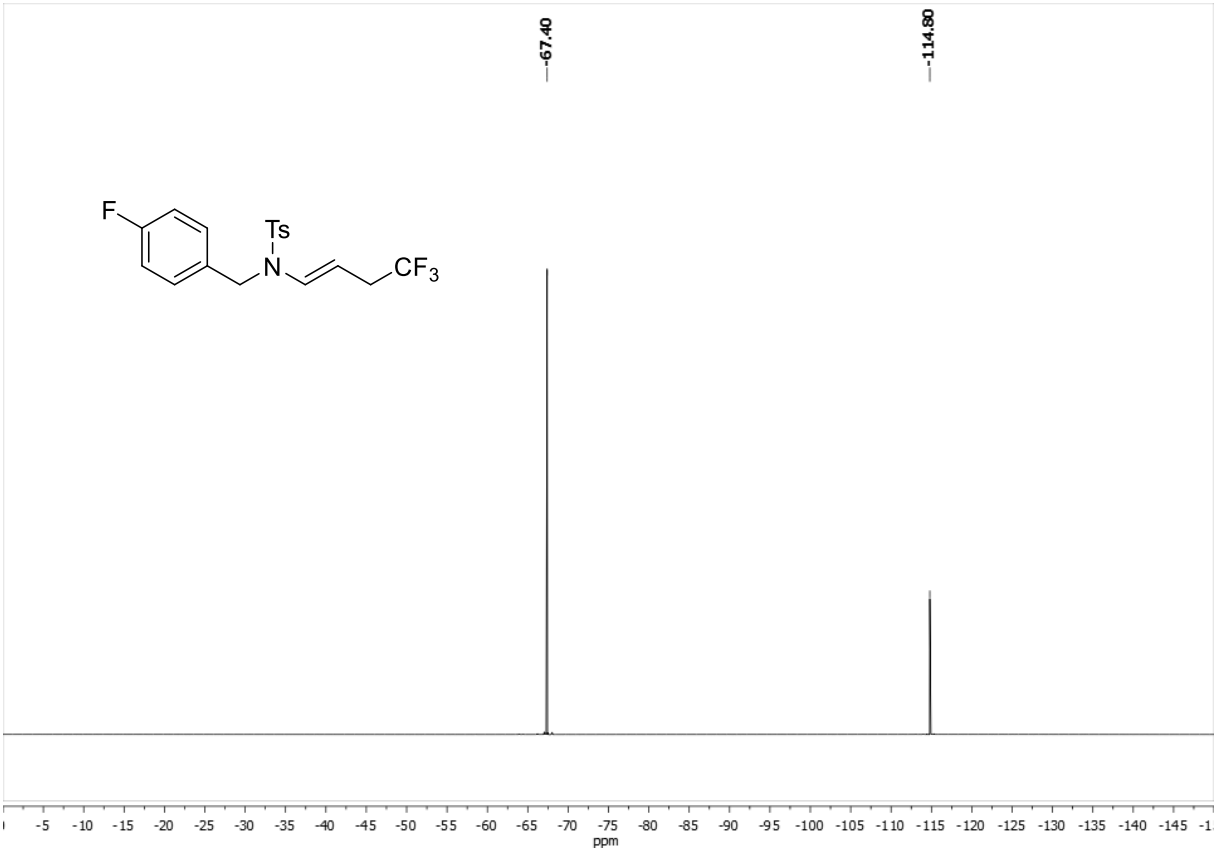
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3b**



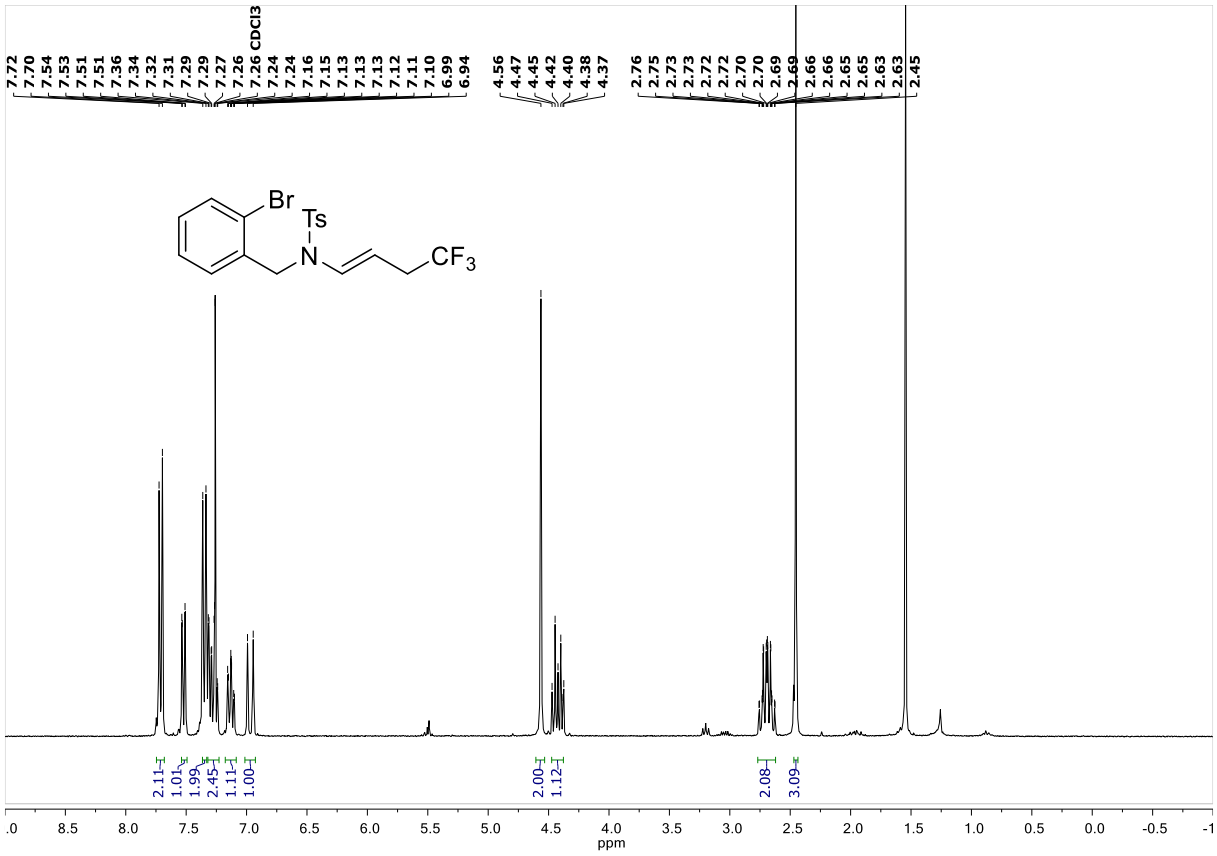
^{1}H NMR ($CDCl_3$, 300 MHz) of **3c**



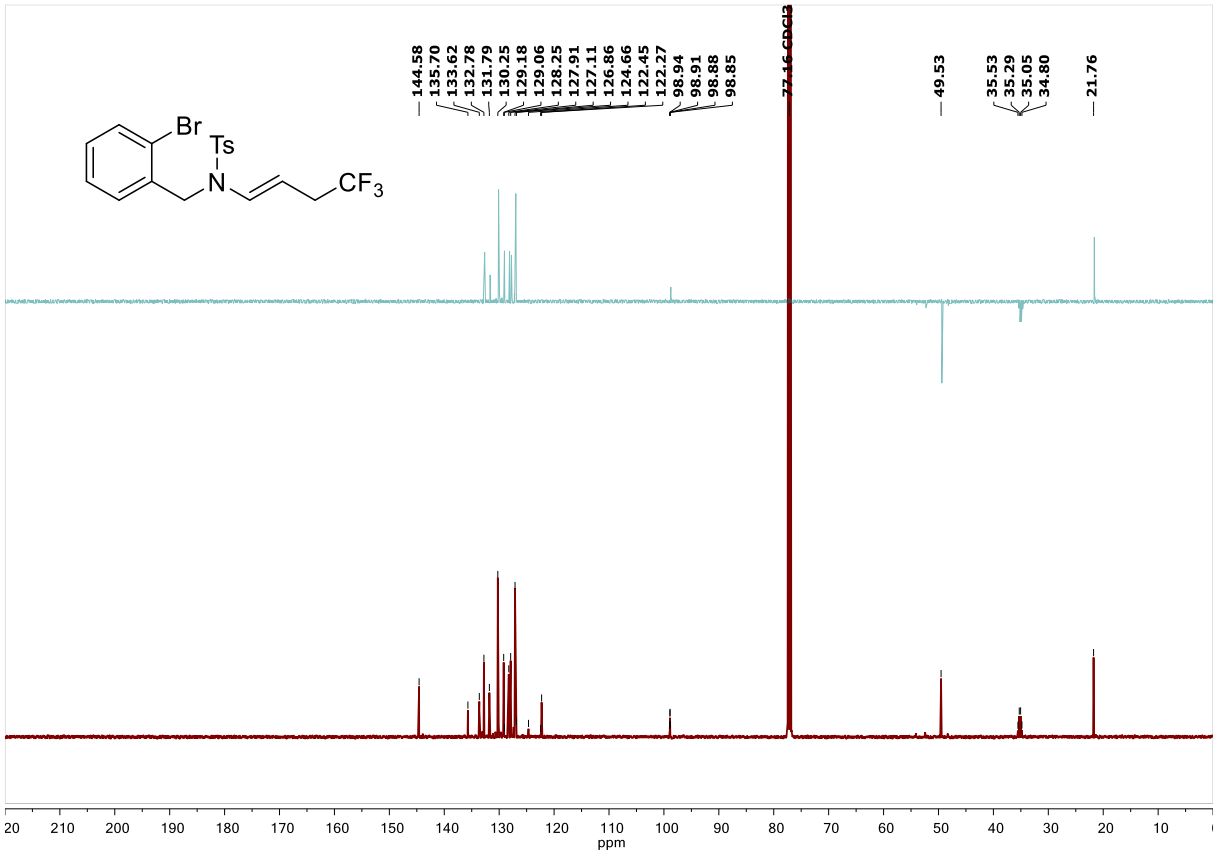
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3c**



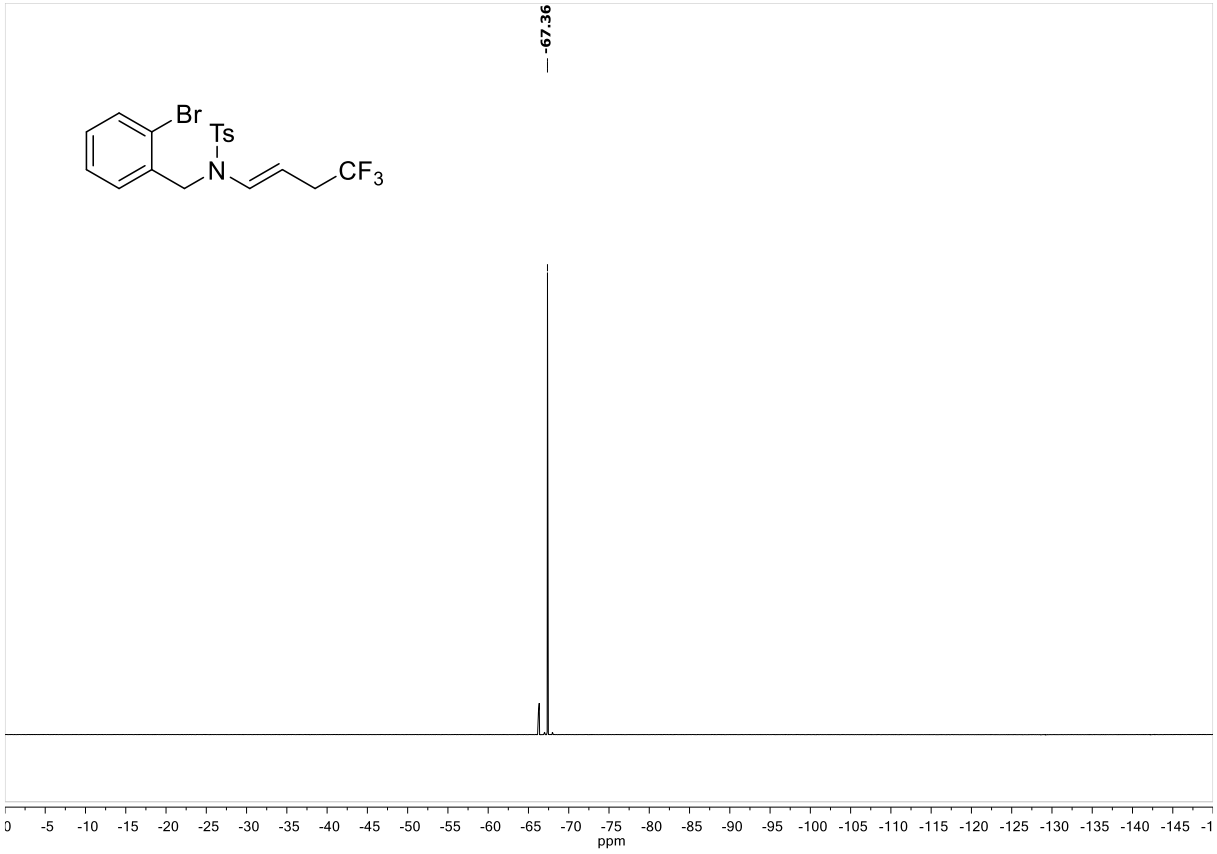
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3c**



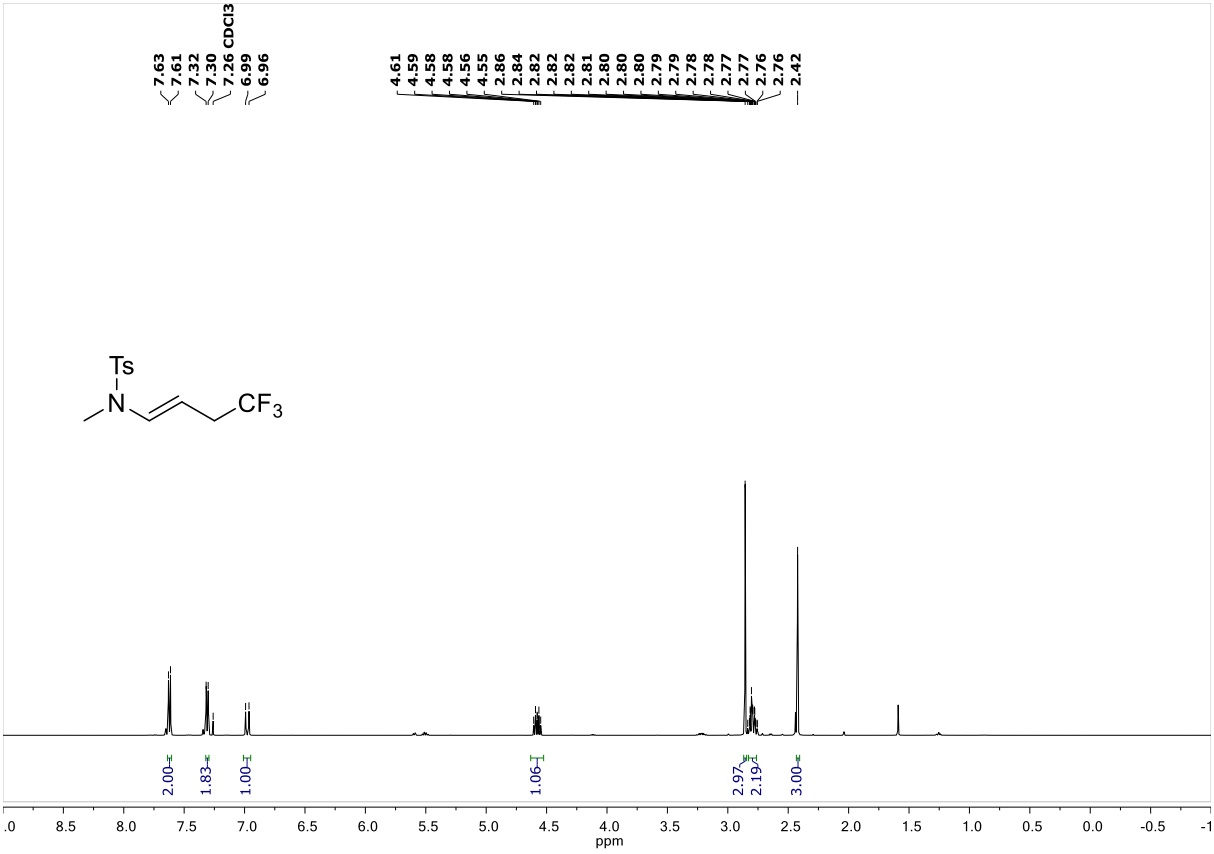
^{1}H NMR ($CDCl_3$, 300 MHz) of **3d**



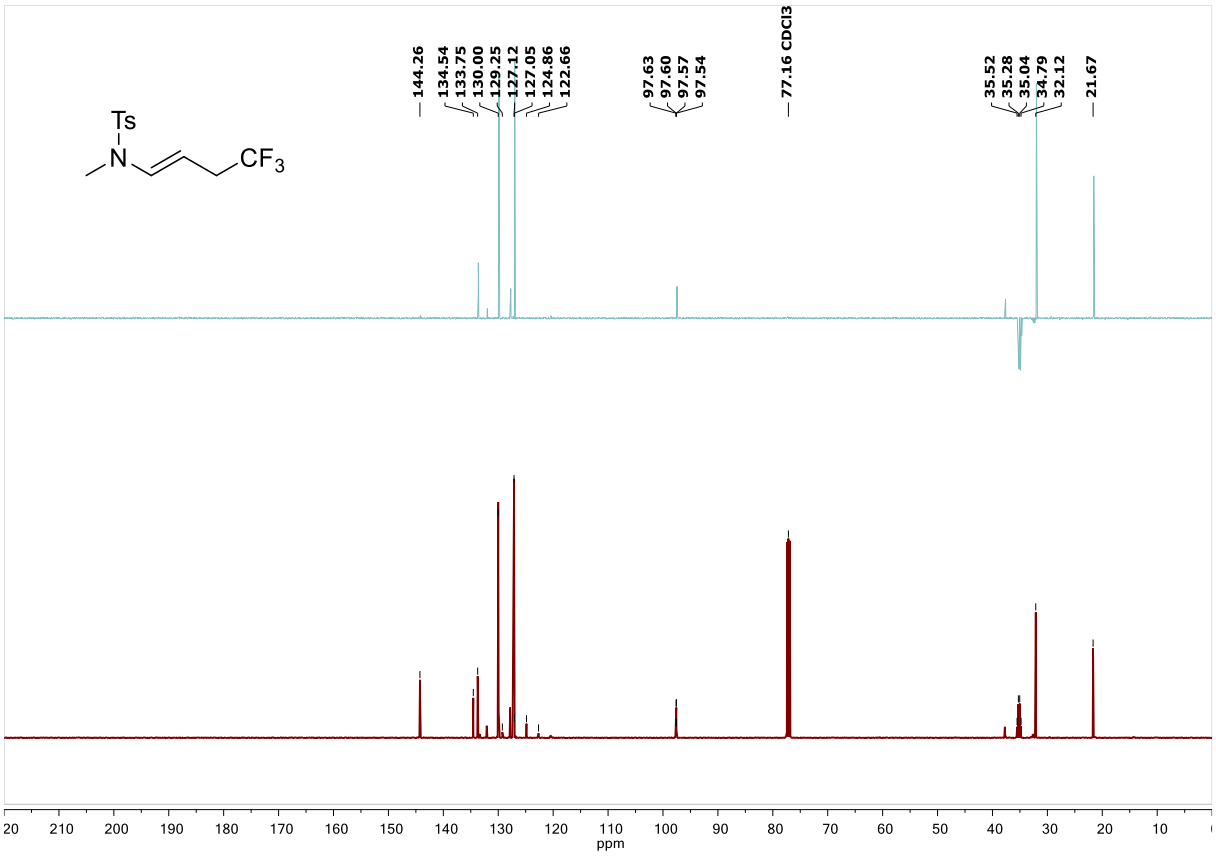
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3d**



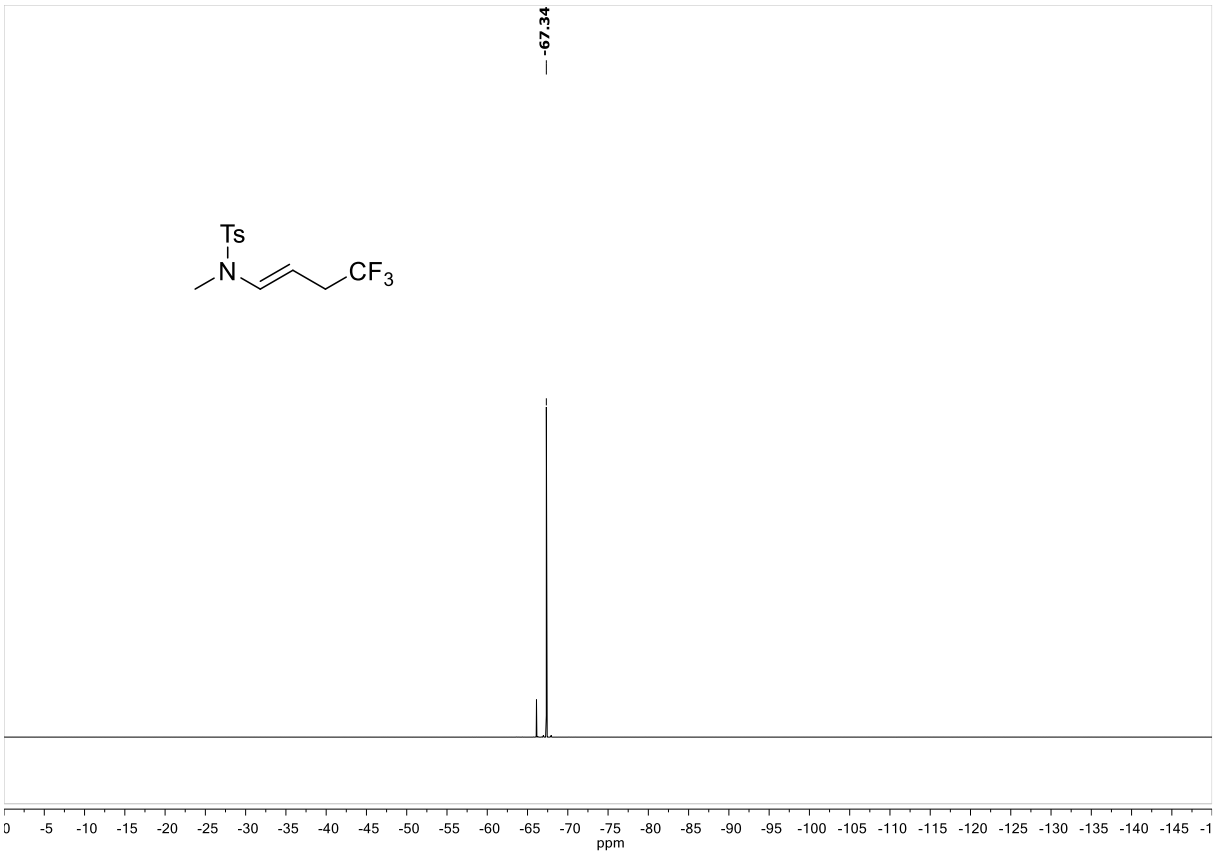
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3d**



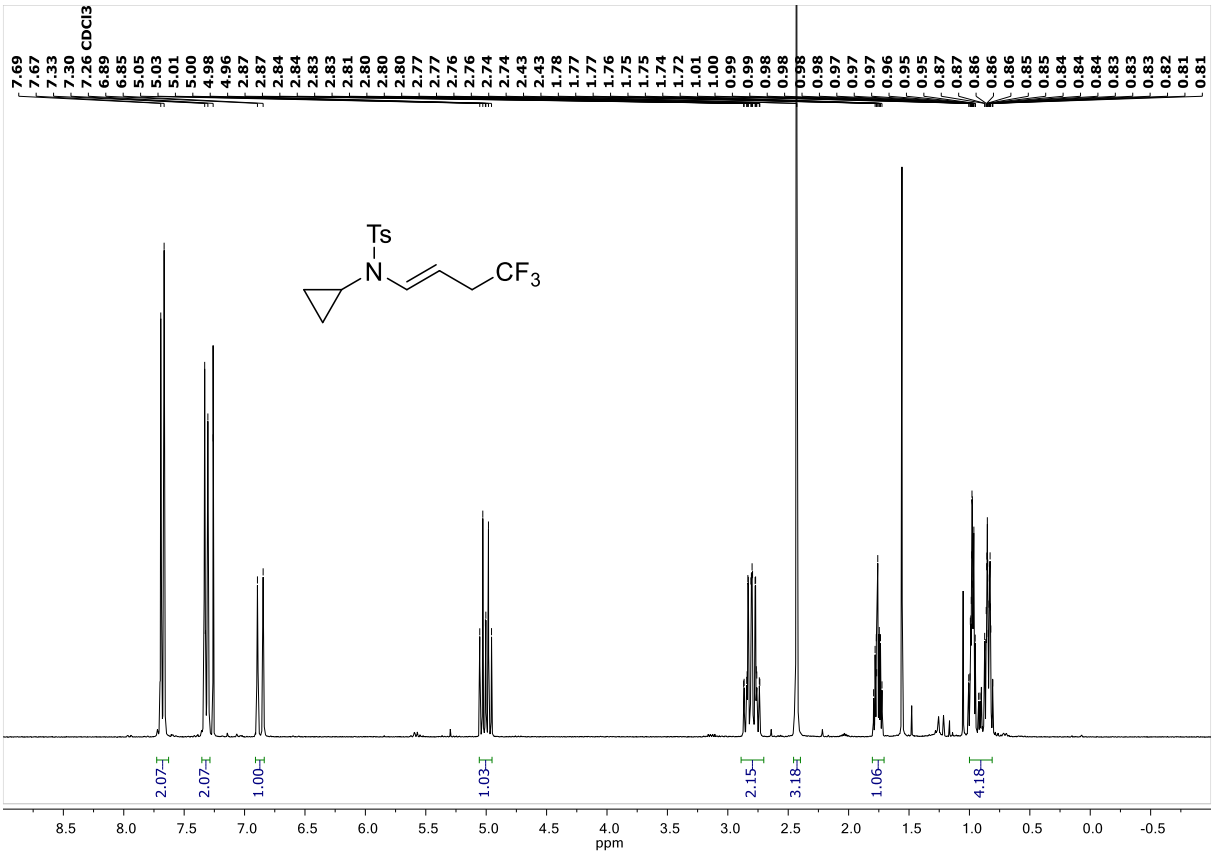
^{1}H NMR ($CDCl_3$, 500 MHz) of **3e**



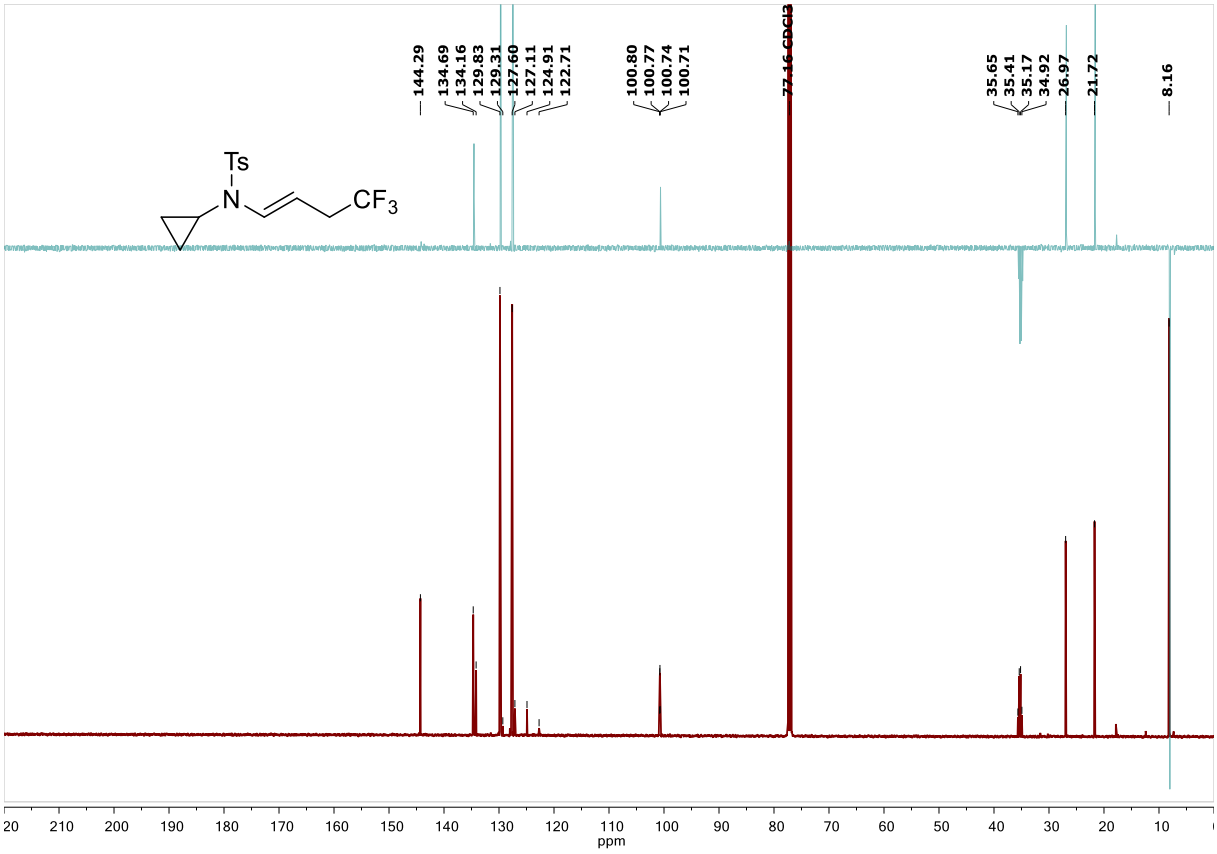
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3e**



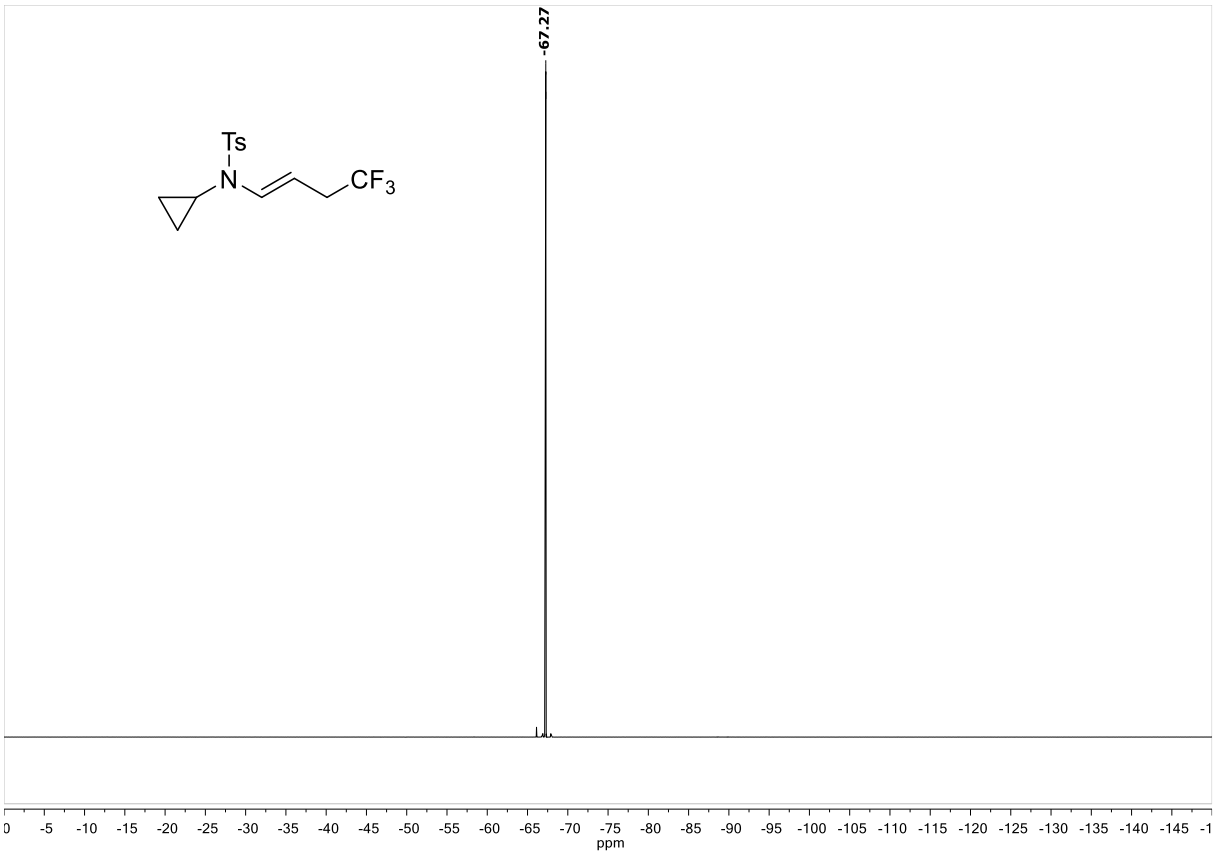
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3e**



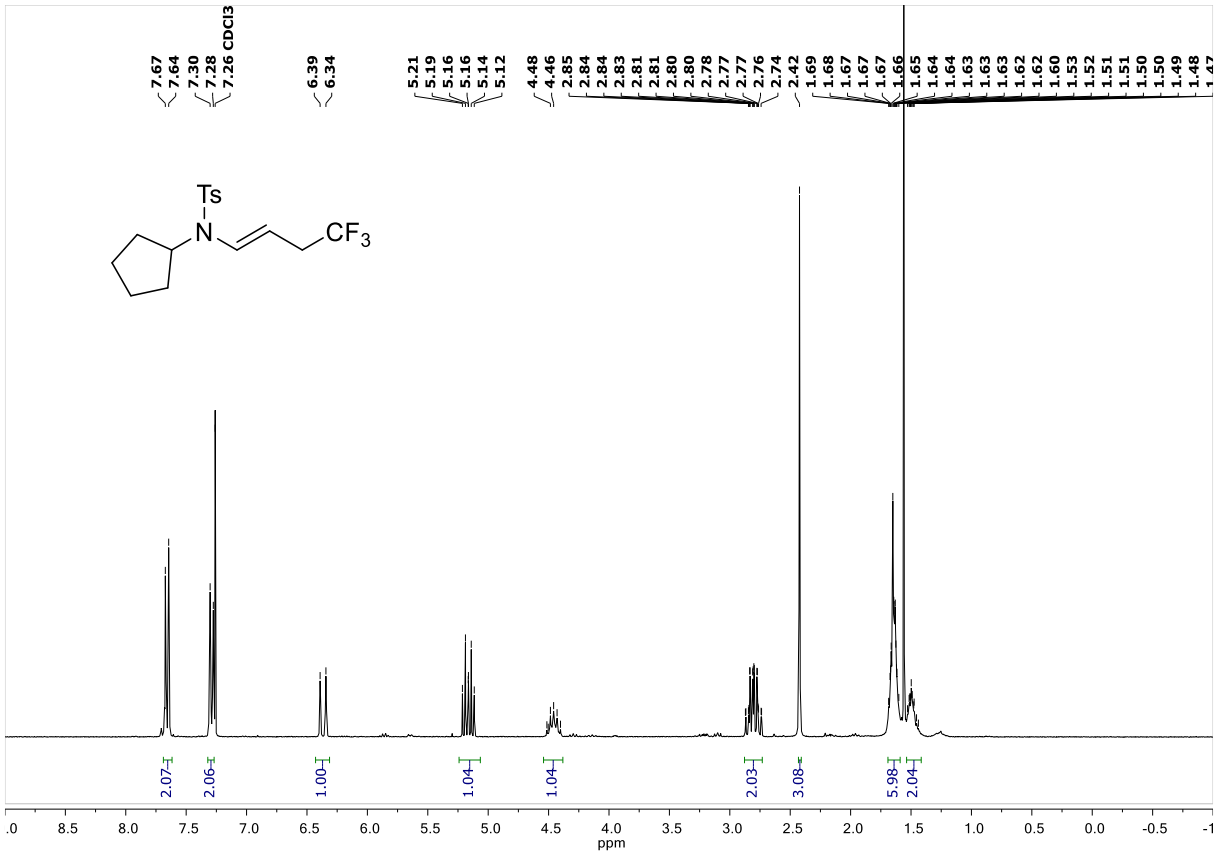
^{1}H NMR ($CDCl_3$, 300 MHz) of **3f**



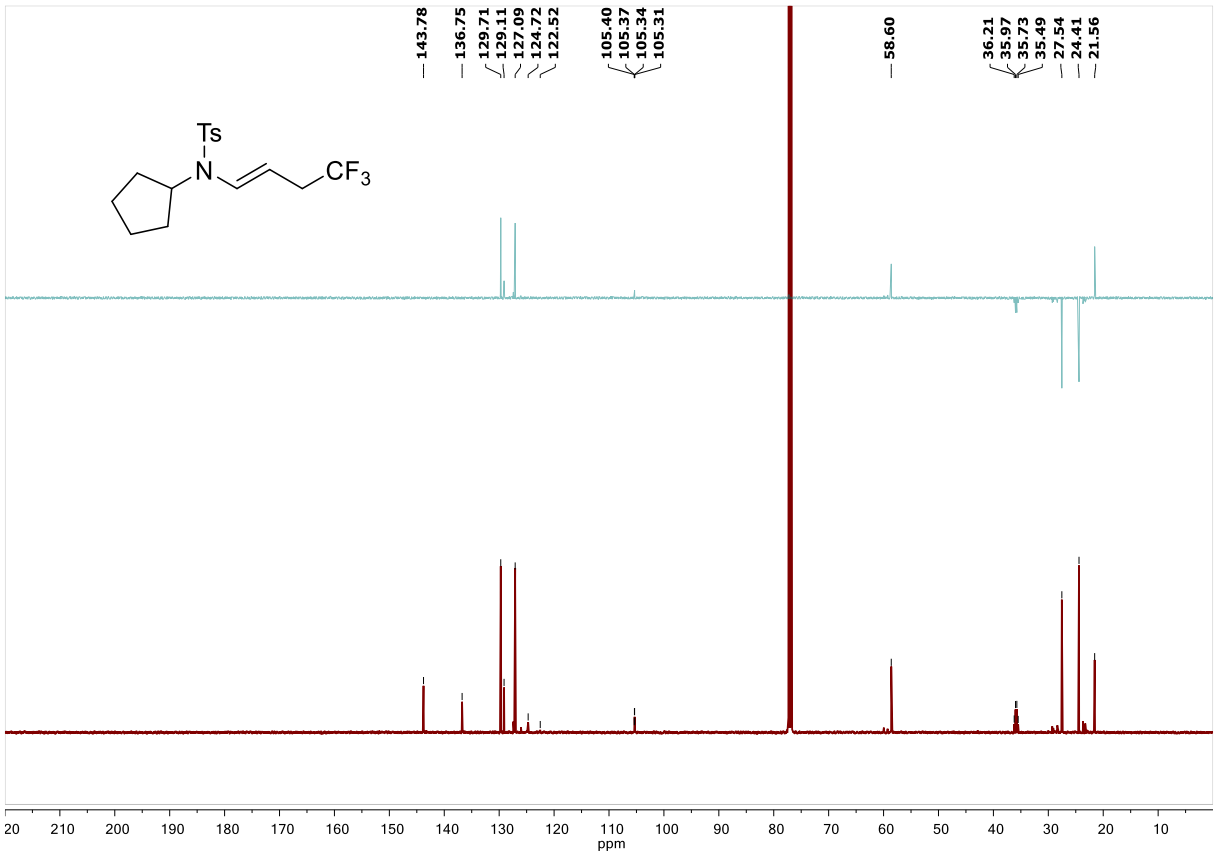
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3f**



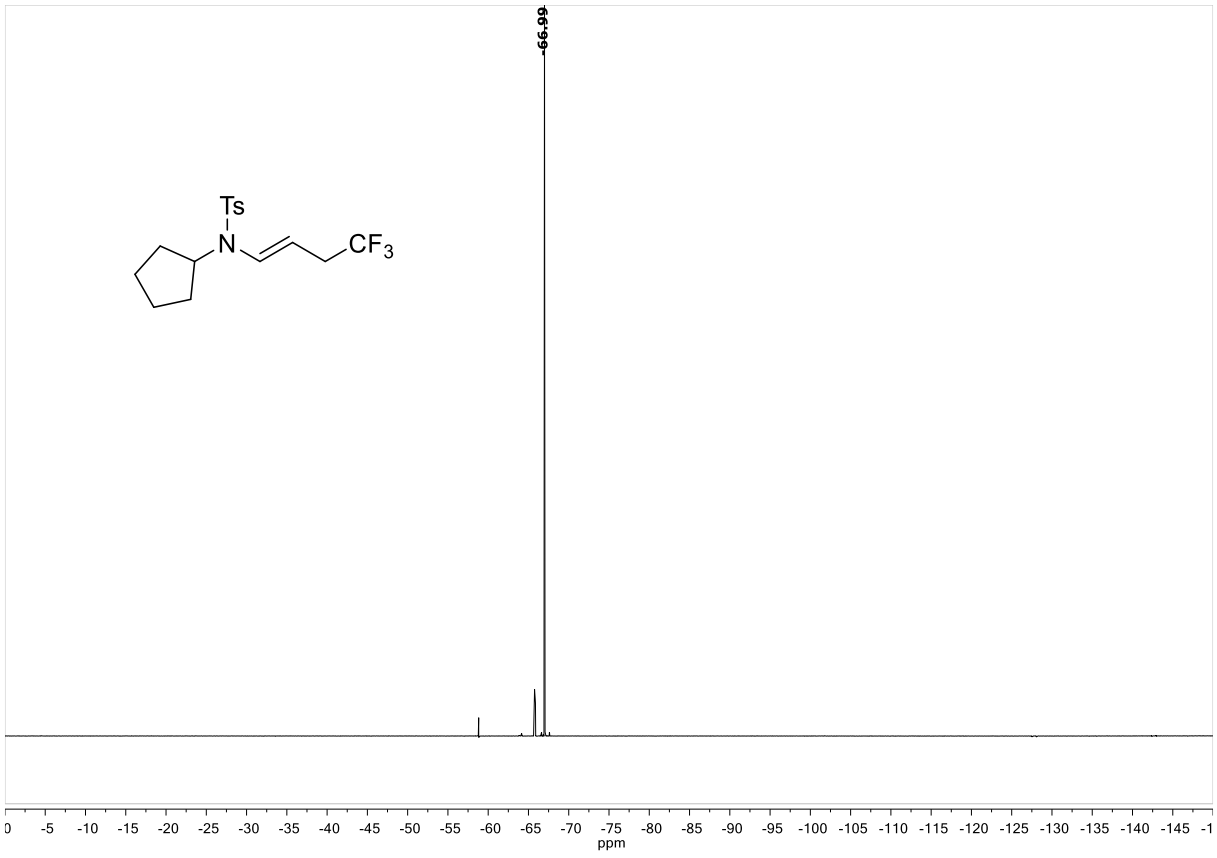
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3f**



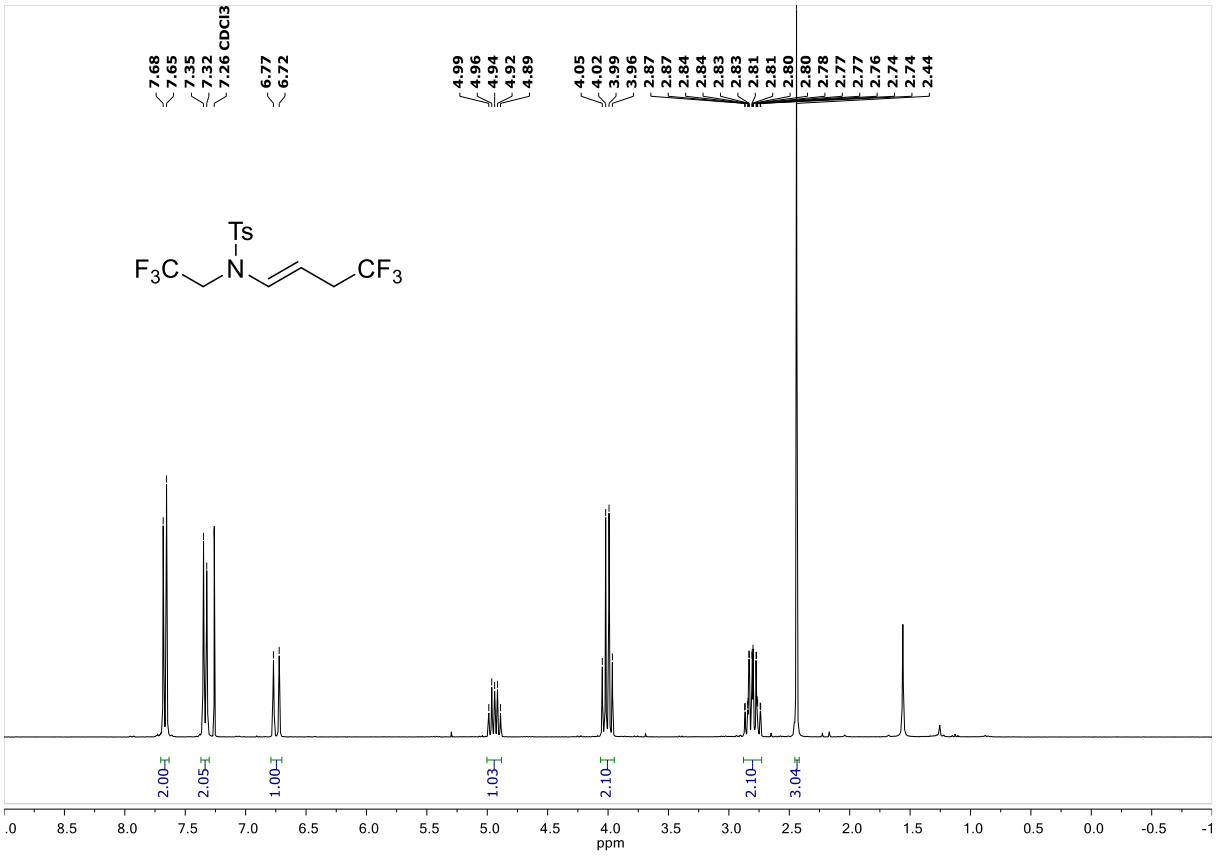
^{1}H NMR ($CDCl_3$, 300 MHz) of **3g**



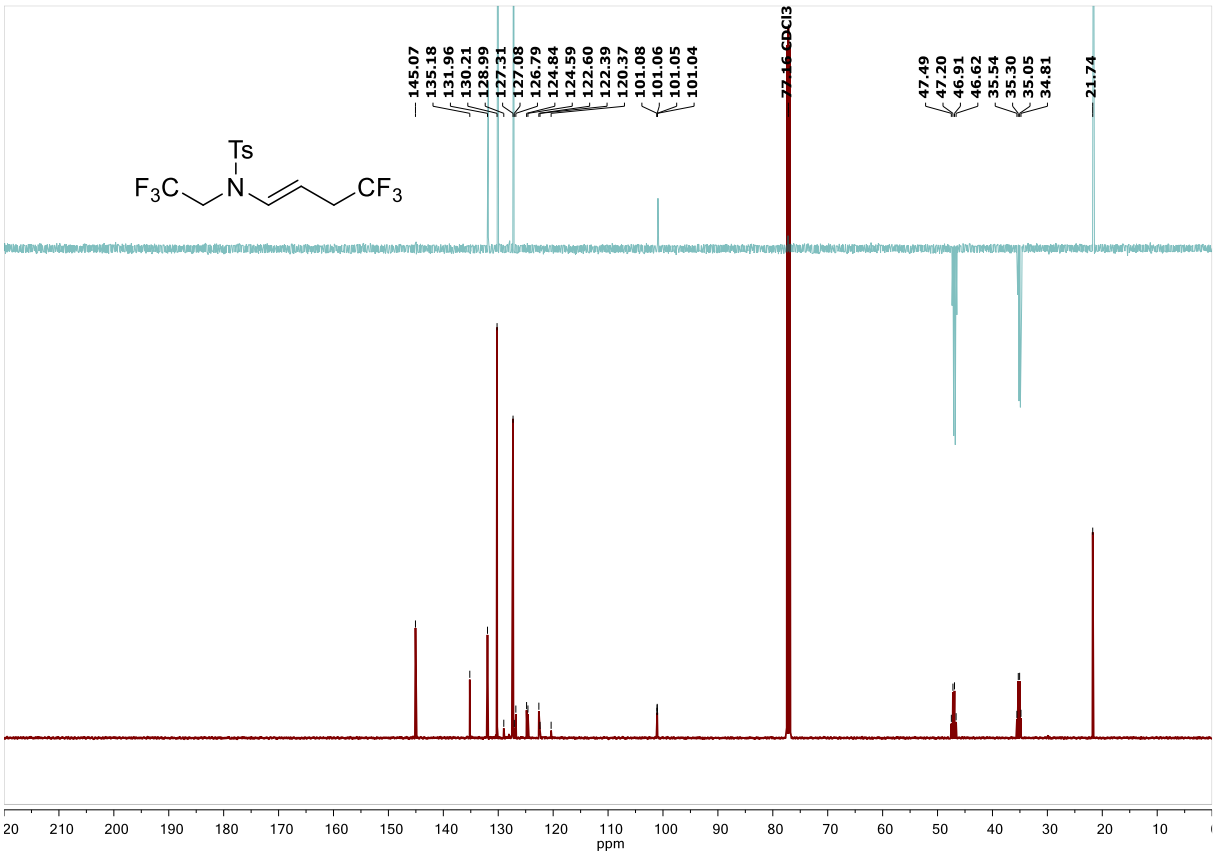
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3g**



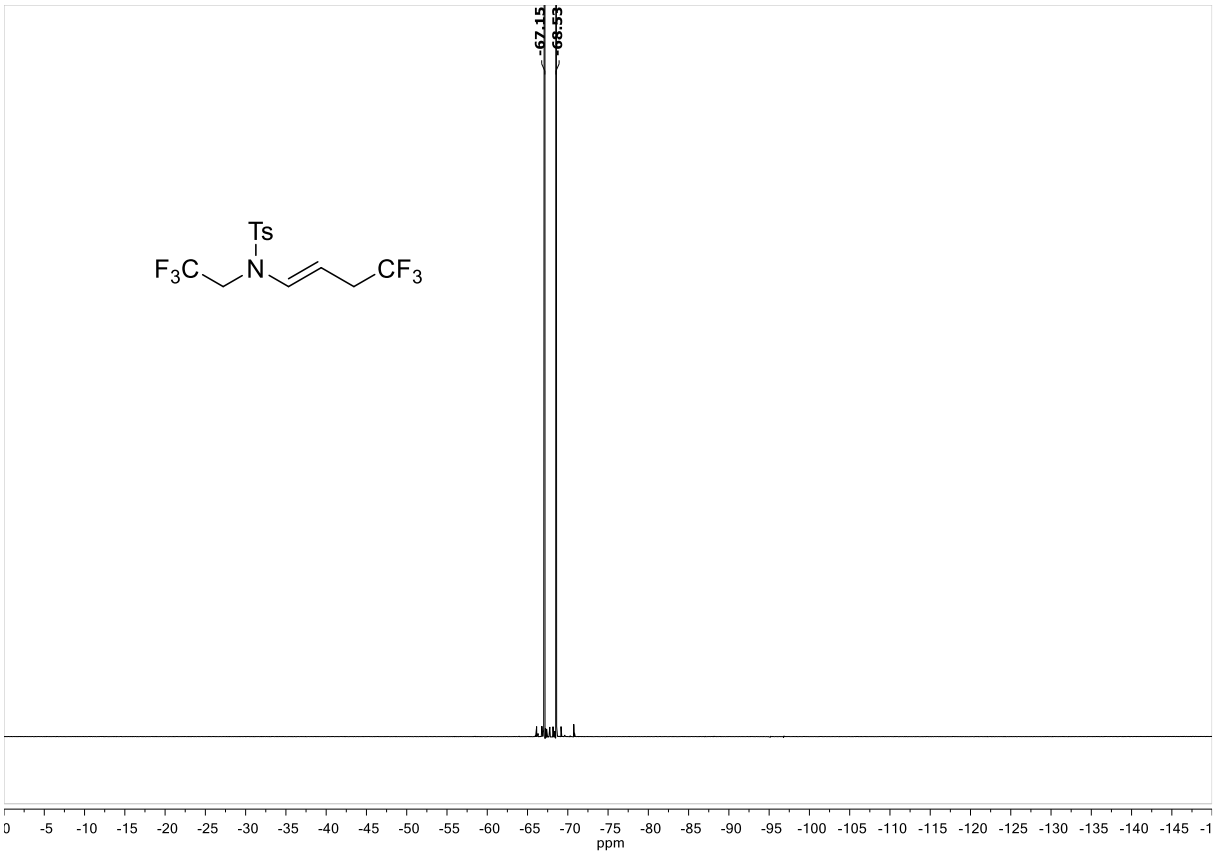
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3g**



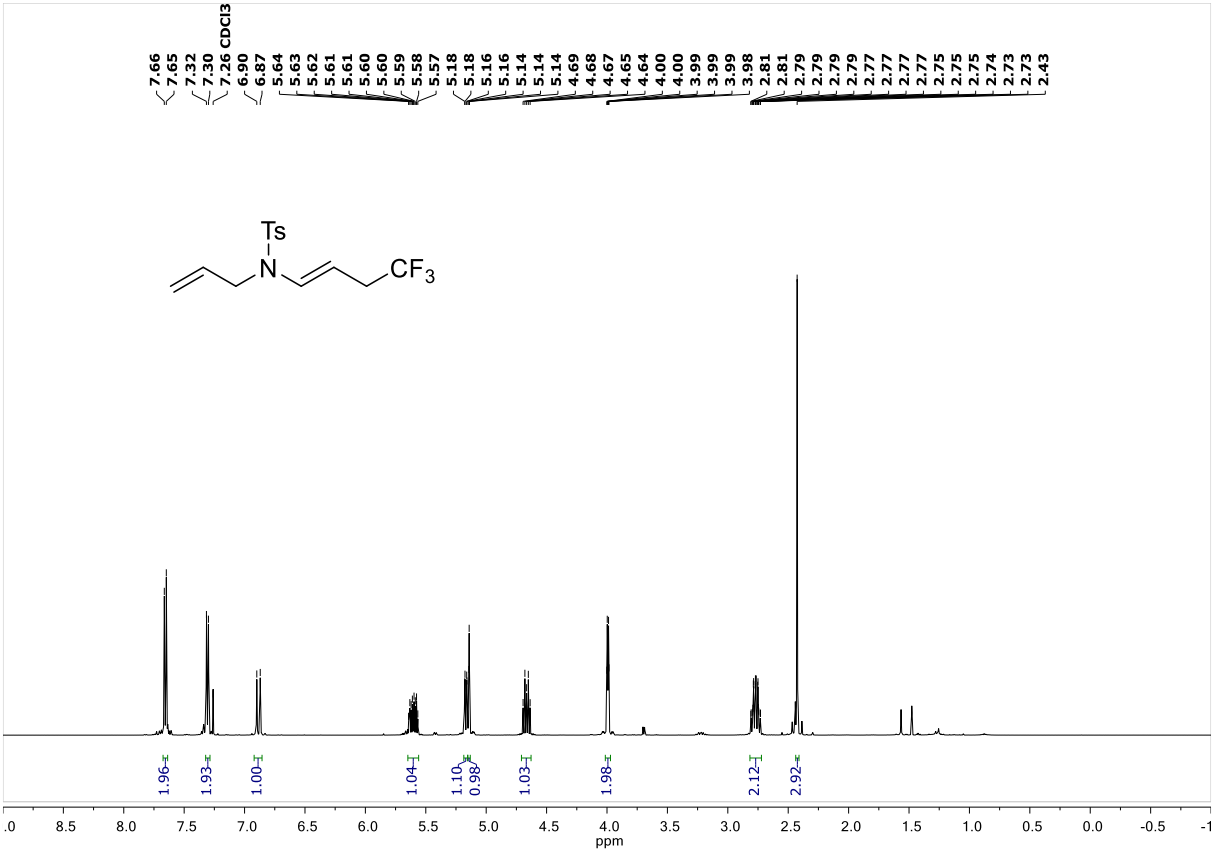
^{1}H NMR ($CDCl_3$, 300 MHz) of **3h**



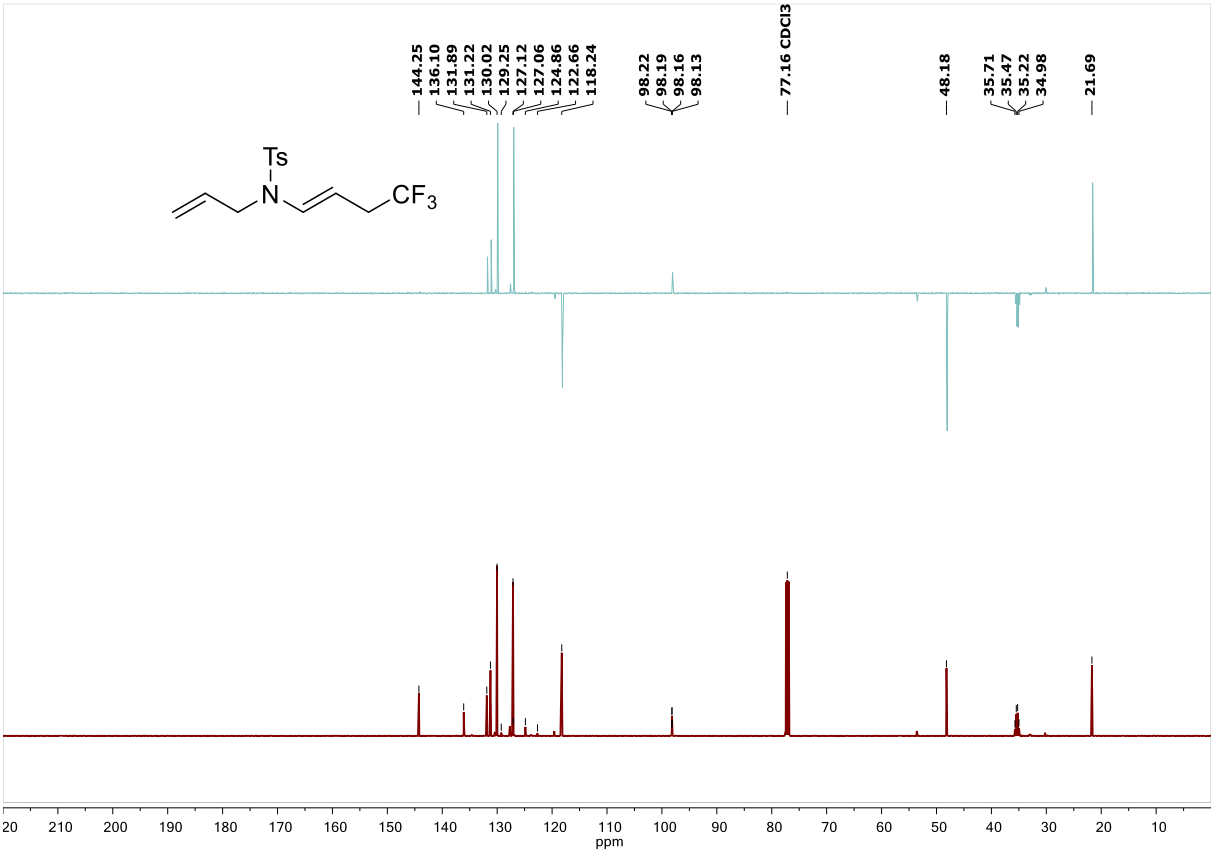
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3h**



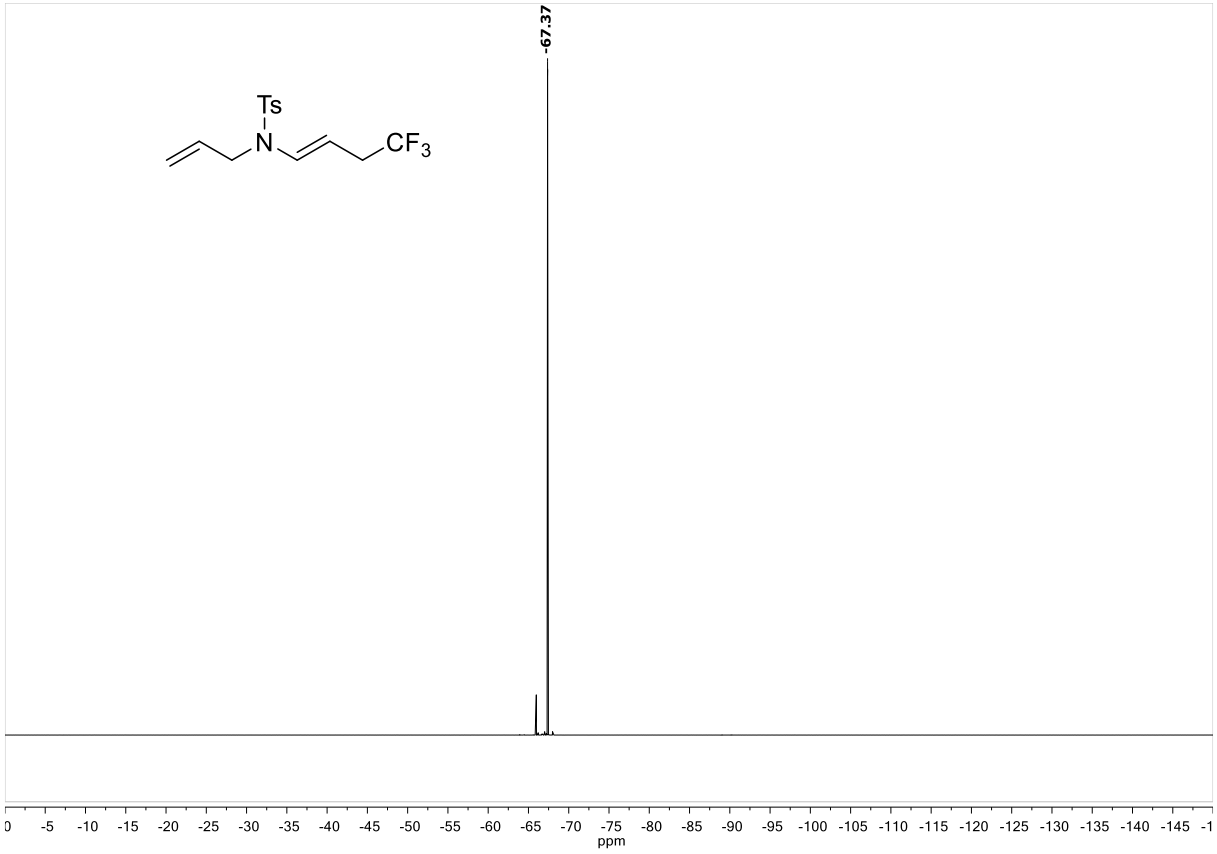
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3h**



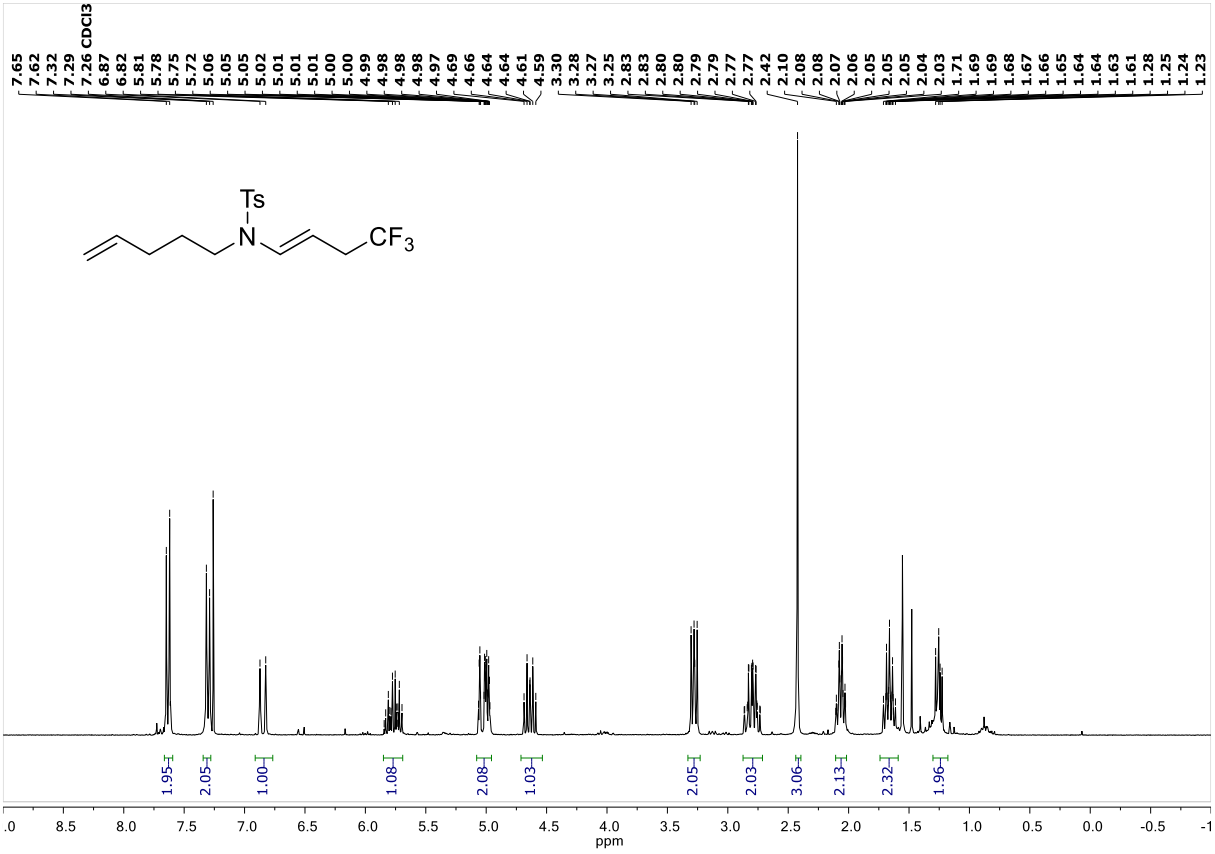
^{1}H NMR ($CDCl_3$, 500 MHz) of **3i**



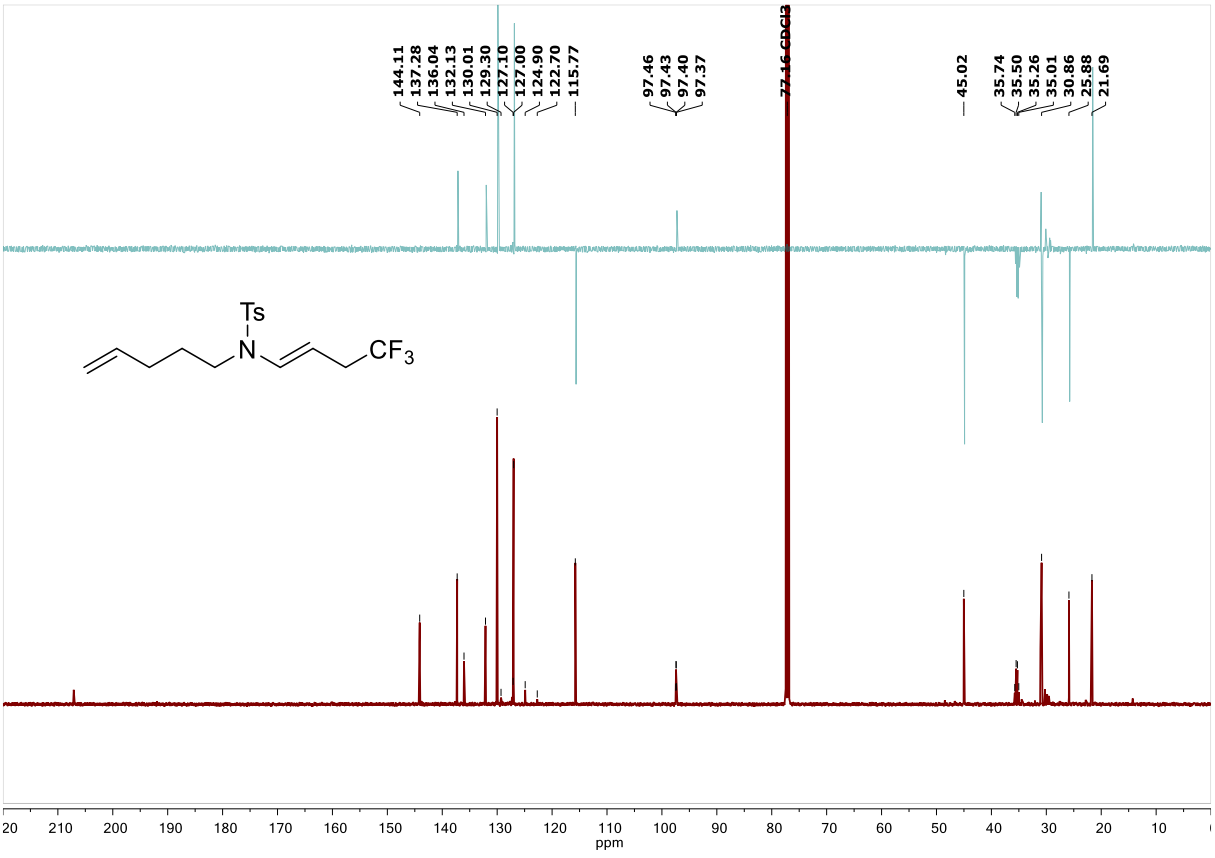
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3i**



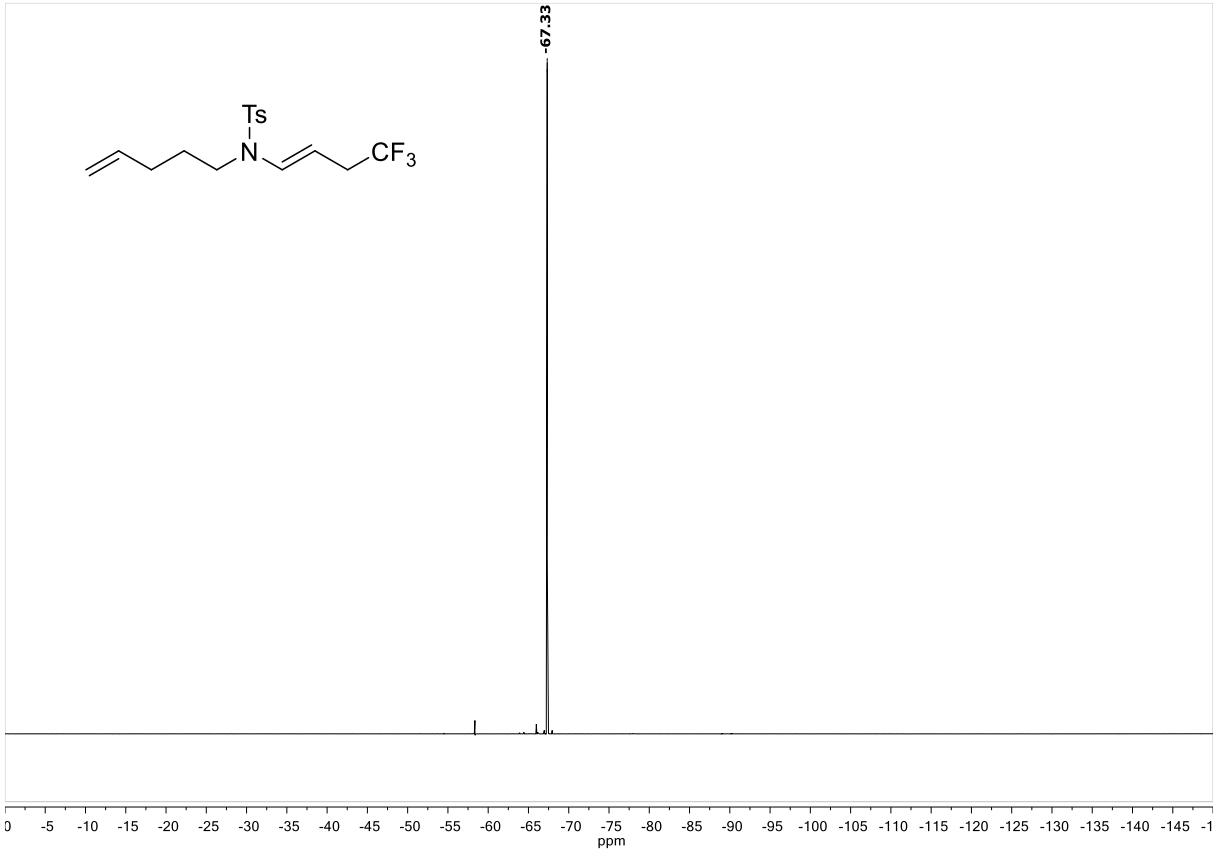
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3i**



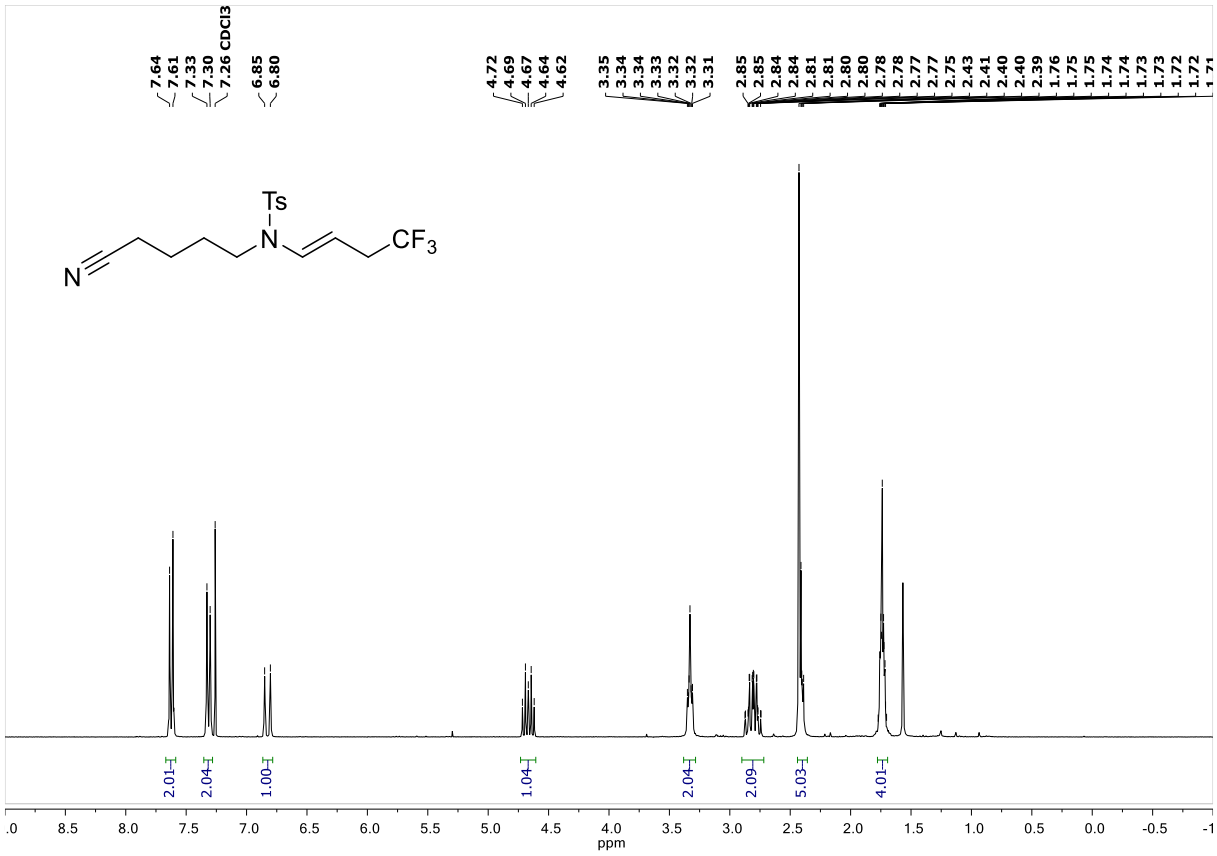
^{1}H NMR ($CDCl_3$, 300 MHz) of **3j**



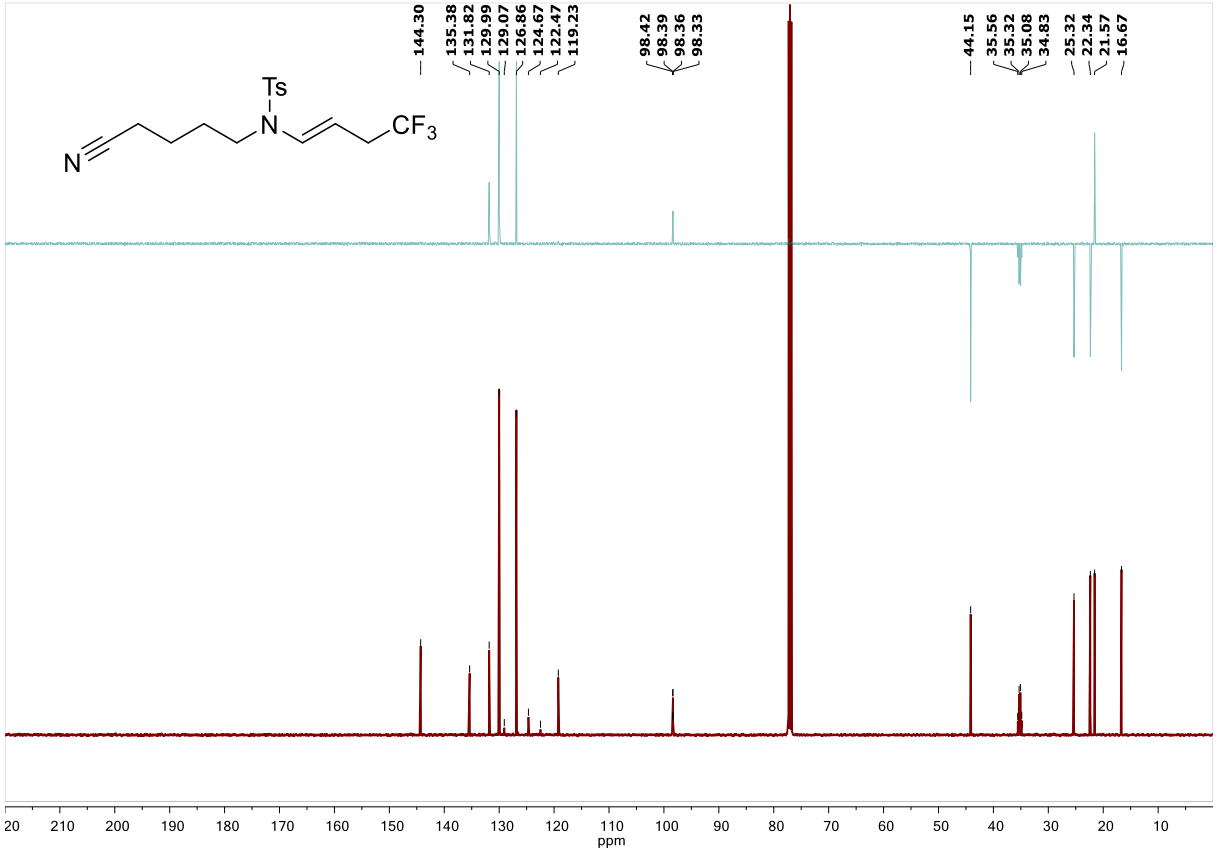
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3j**



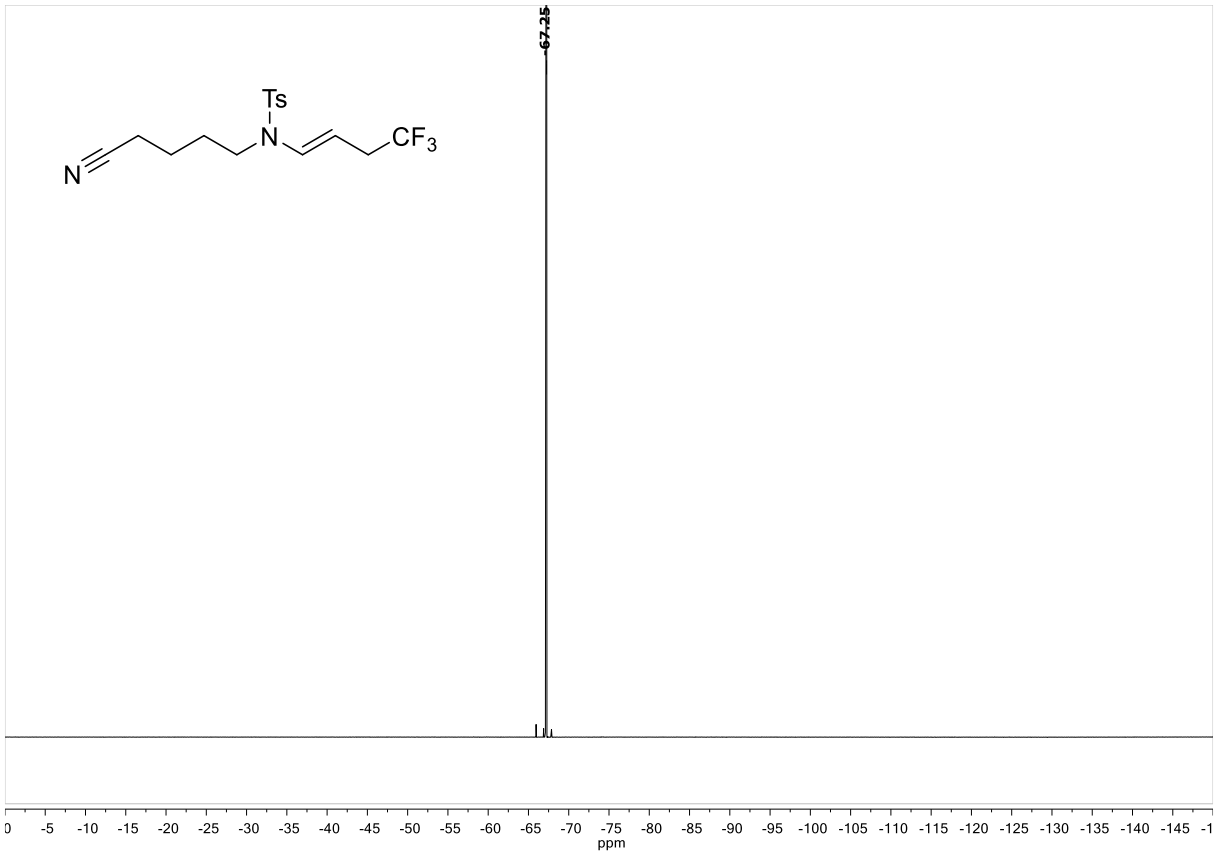
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3j**



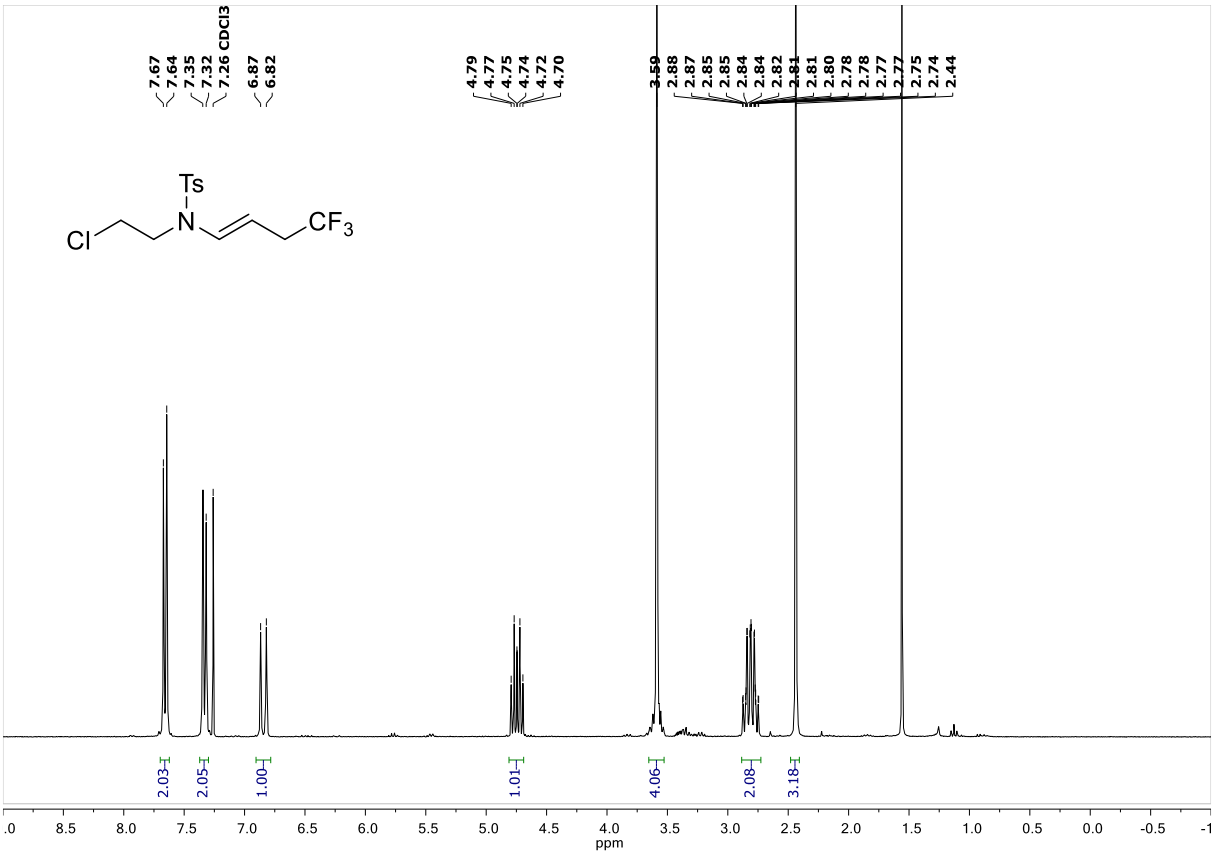
^{1}H NMR ($CDCl_3$, 300 MHz) of **3k**



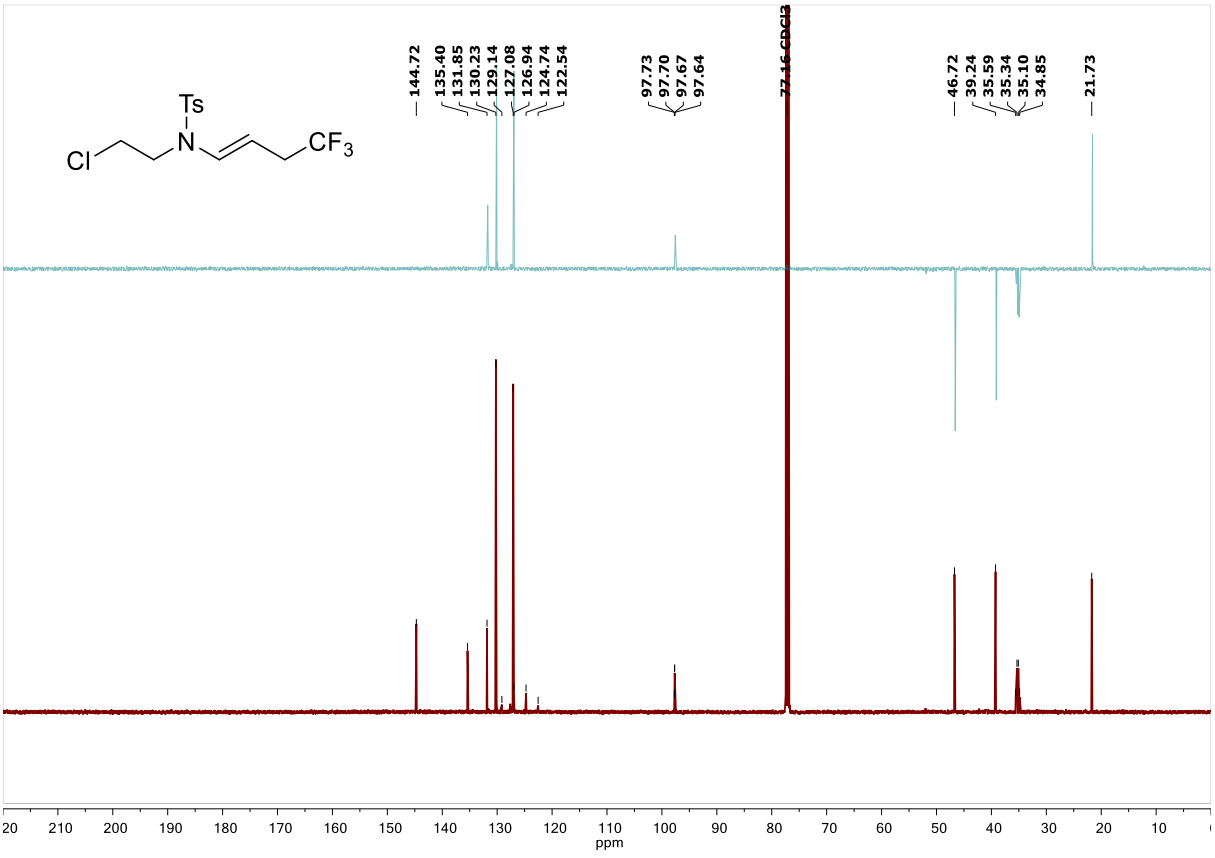
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3k**



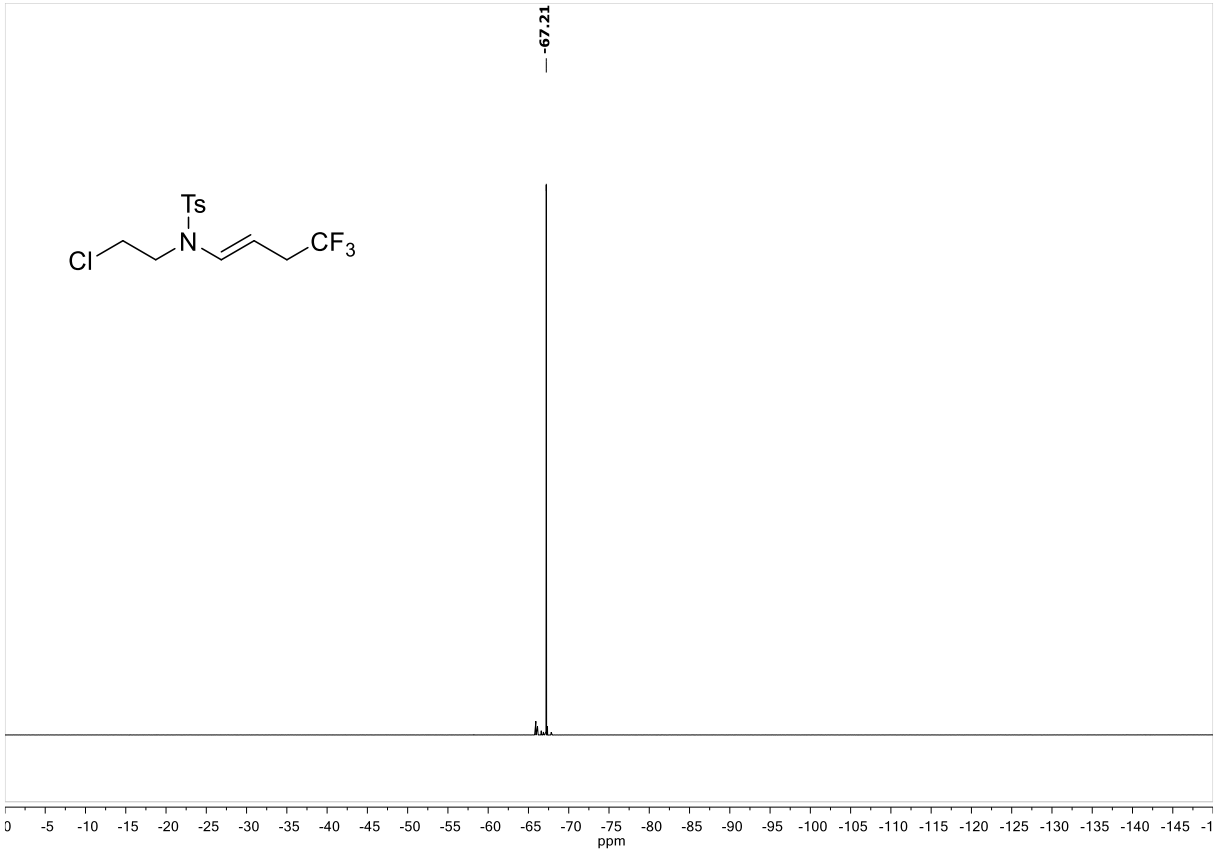
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3k**



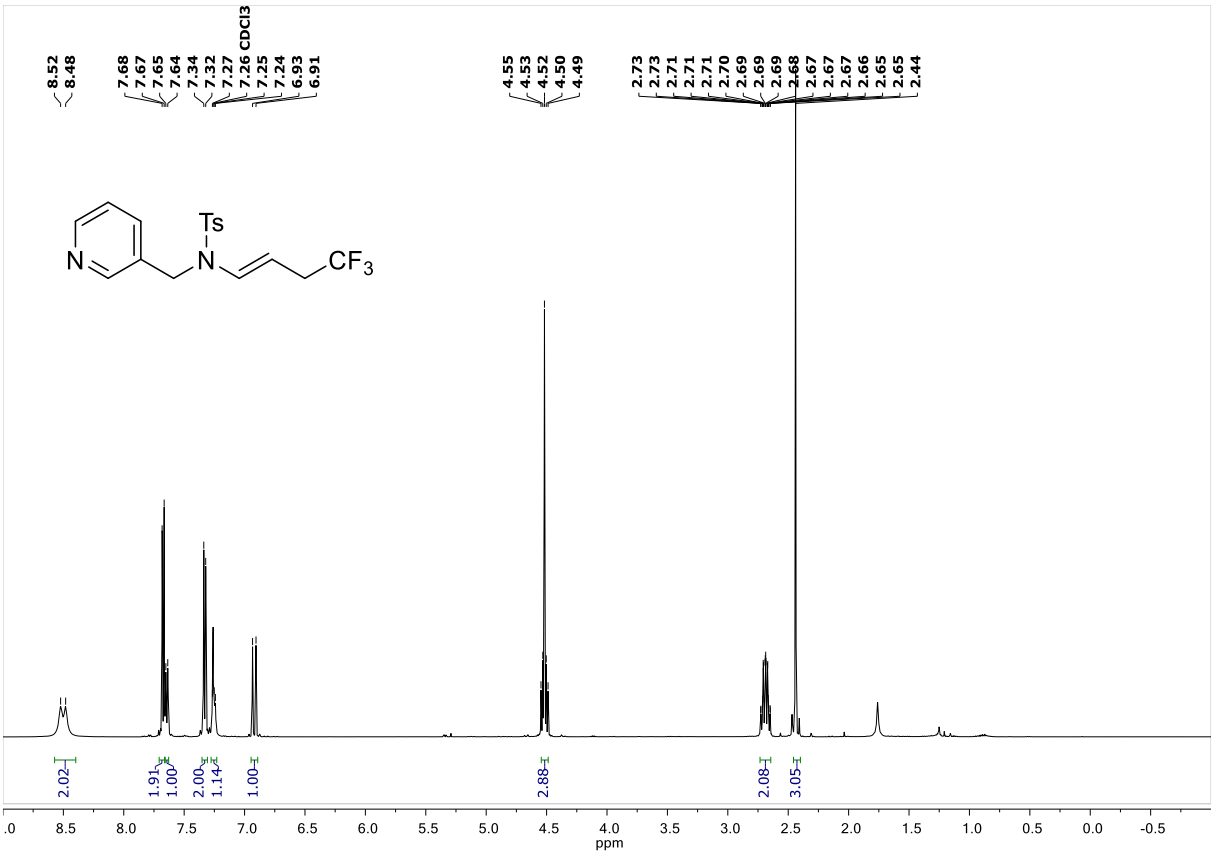
^{1}H NMR ($CDCl_3$, 300 MHz) of **3l**



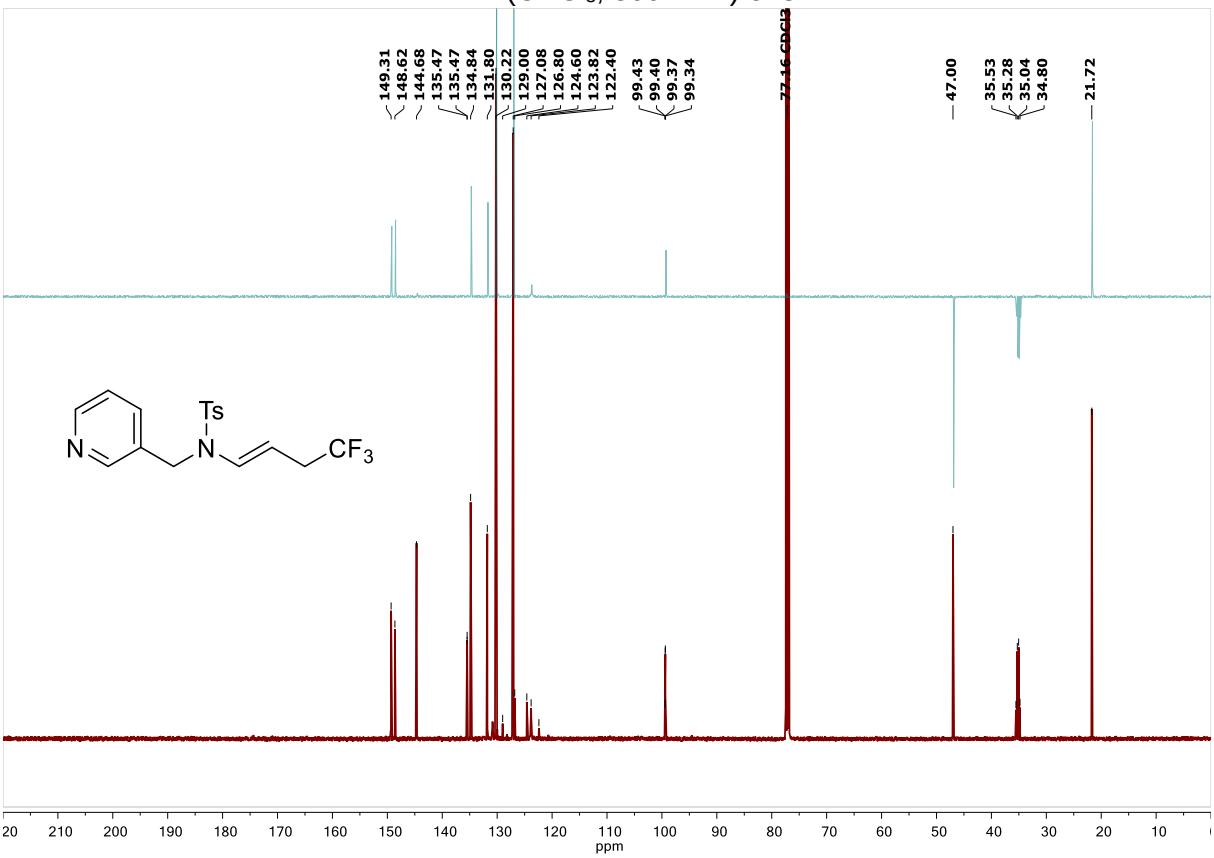
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3l**



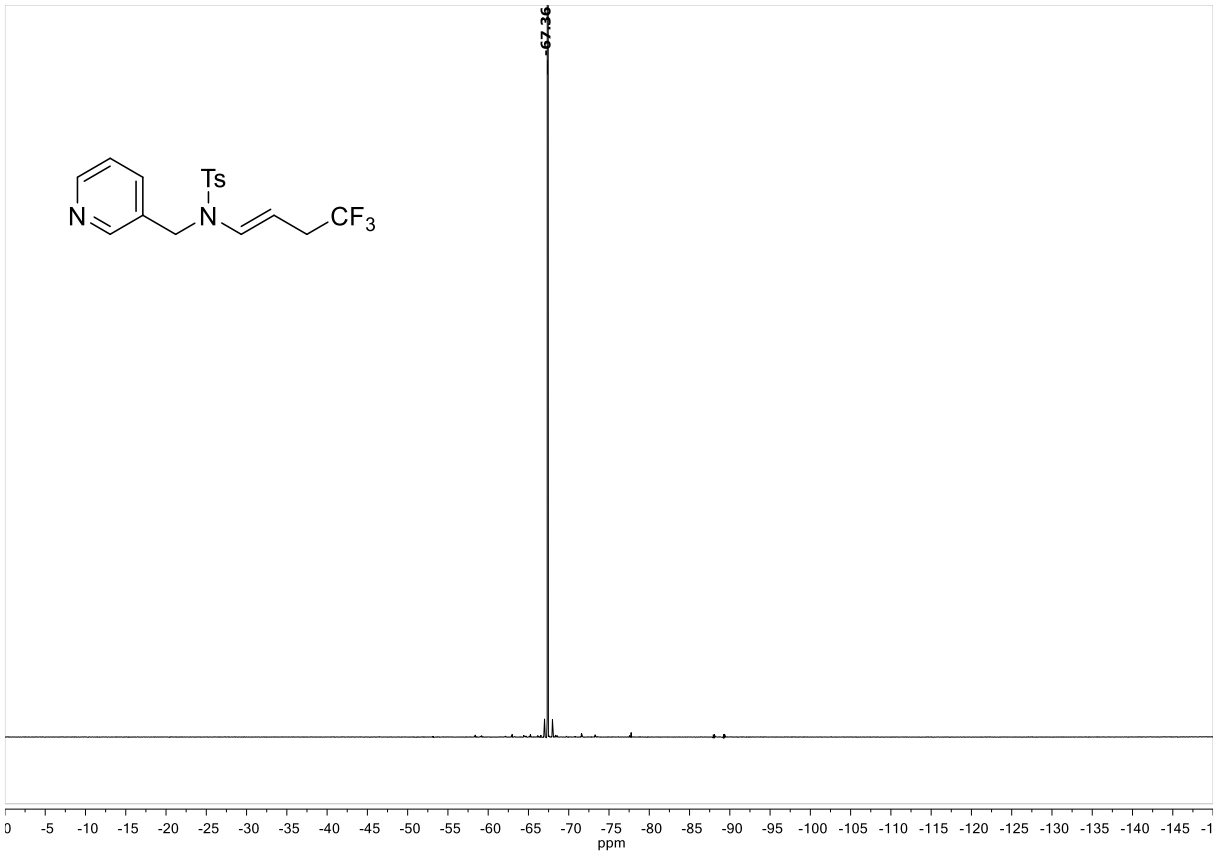
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3l**



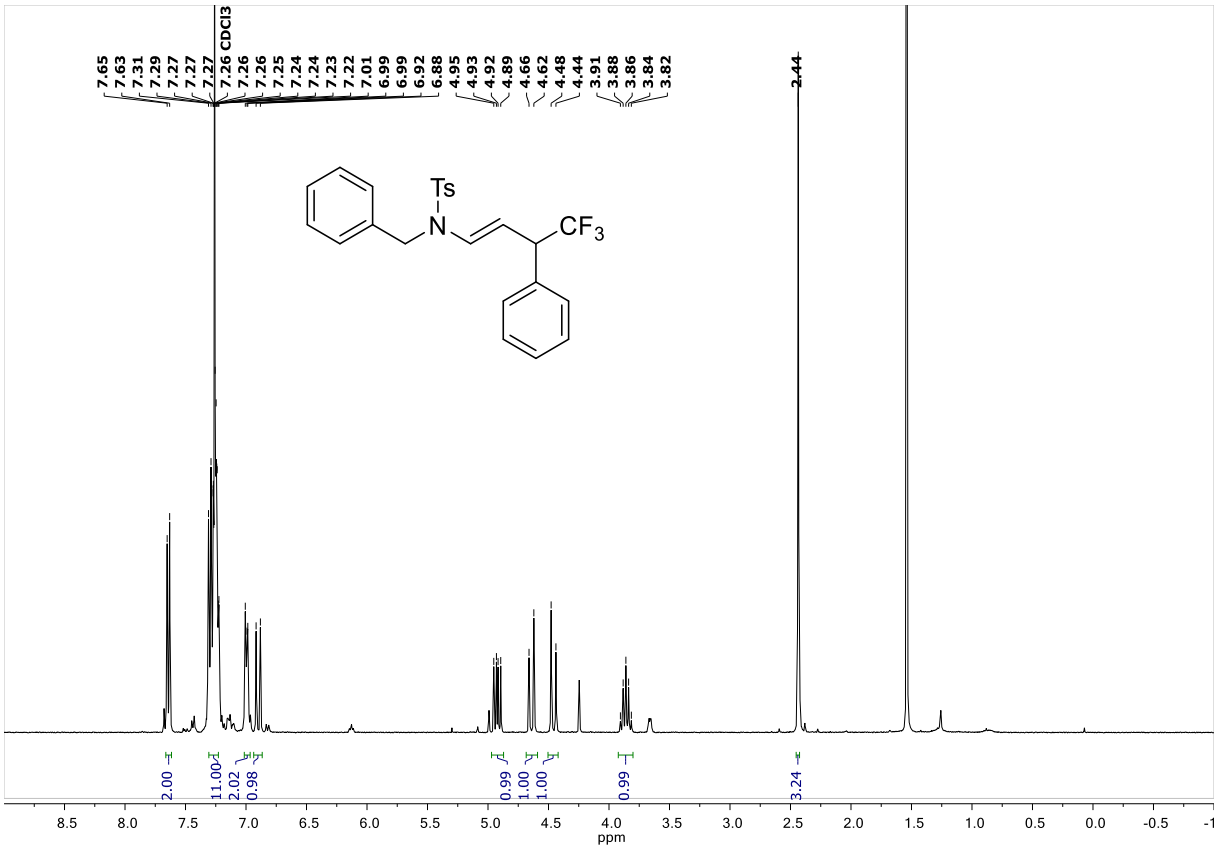
^{1}H NMR ($CDCl_3$, 500 MHz) of **3m**



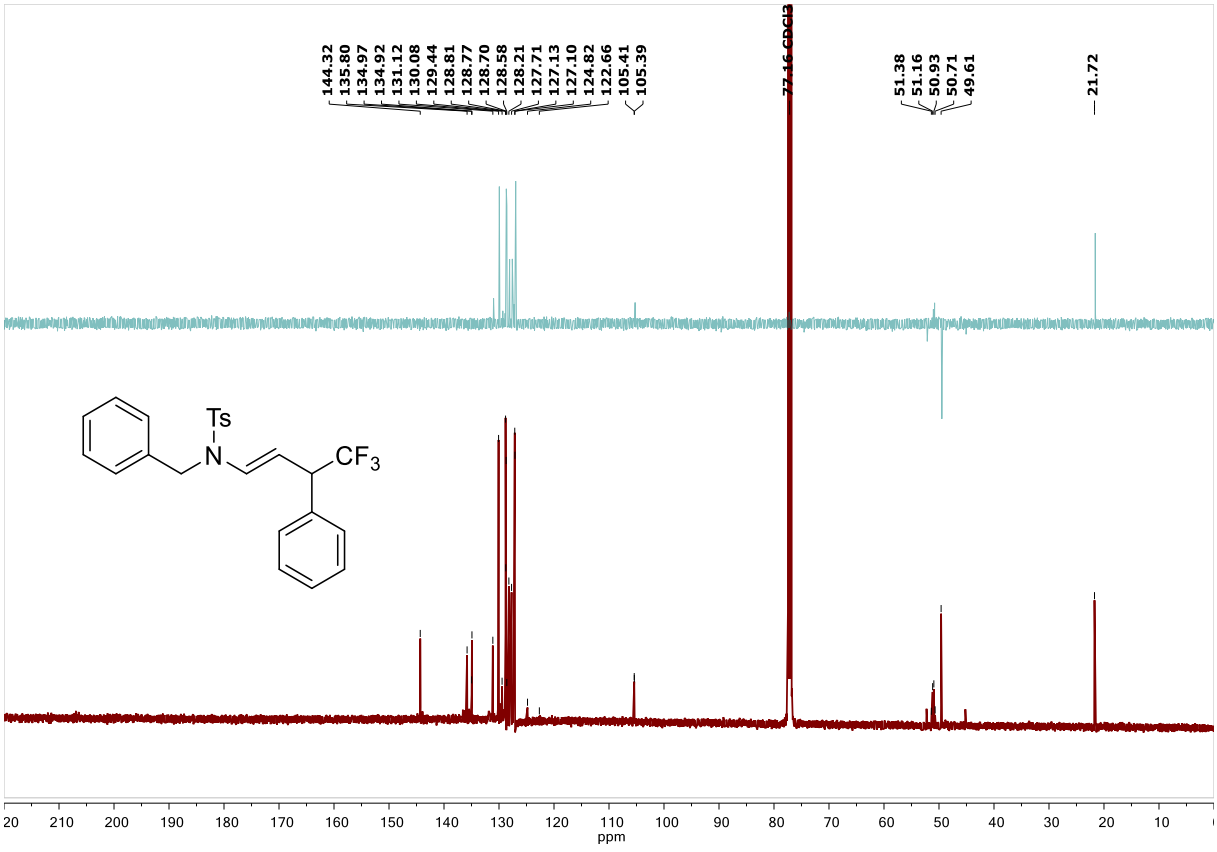
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3m**



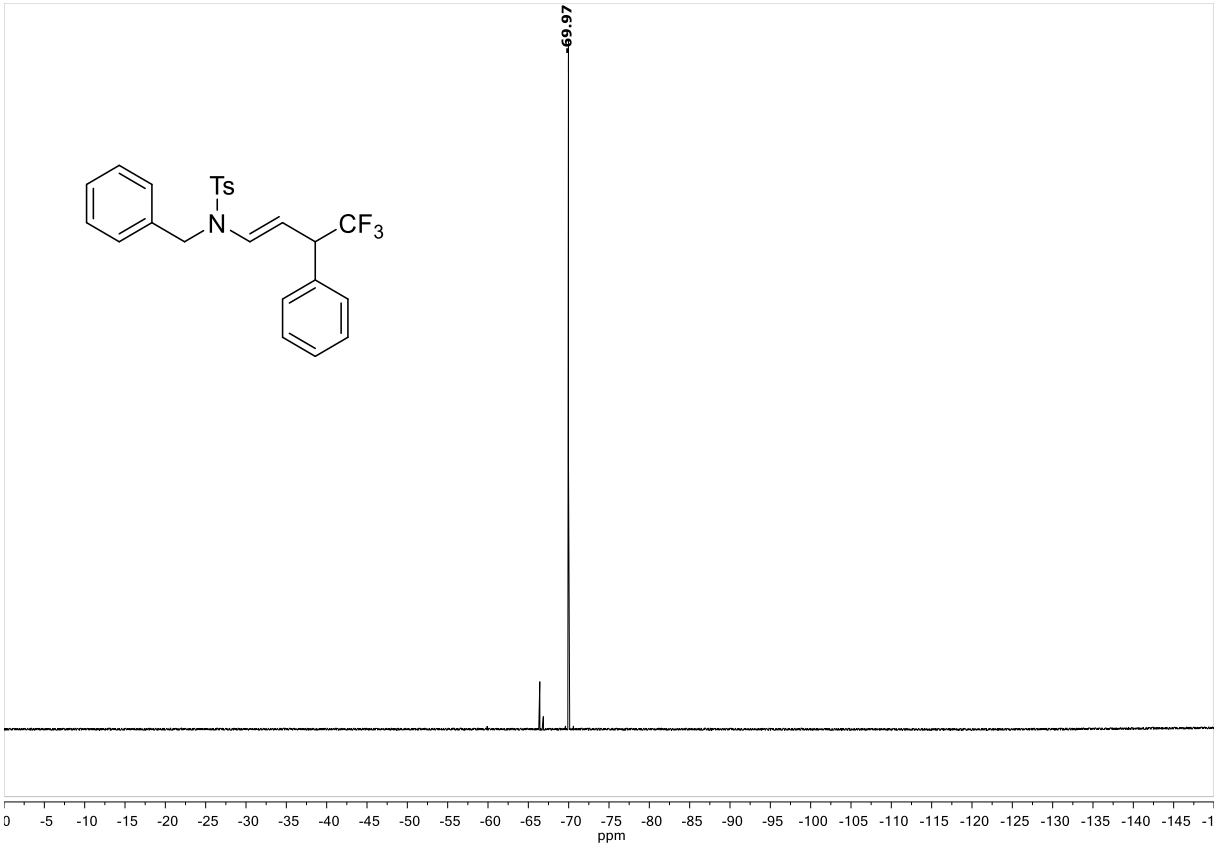
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3m**



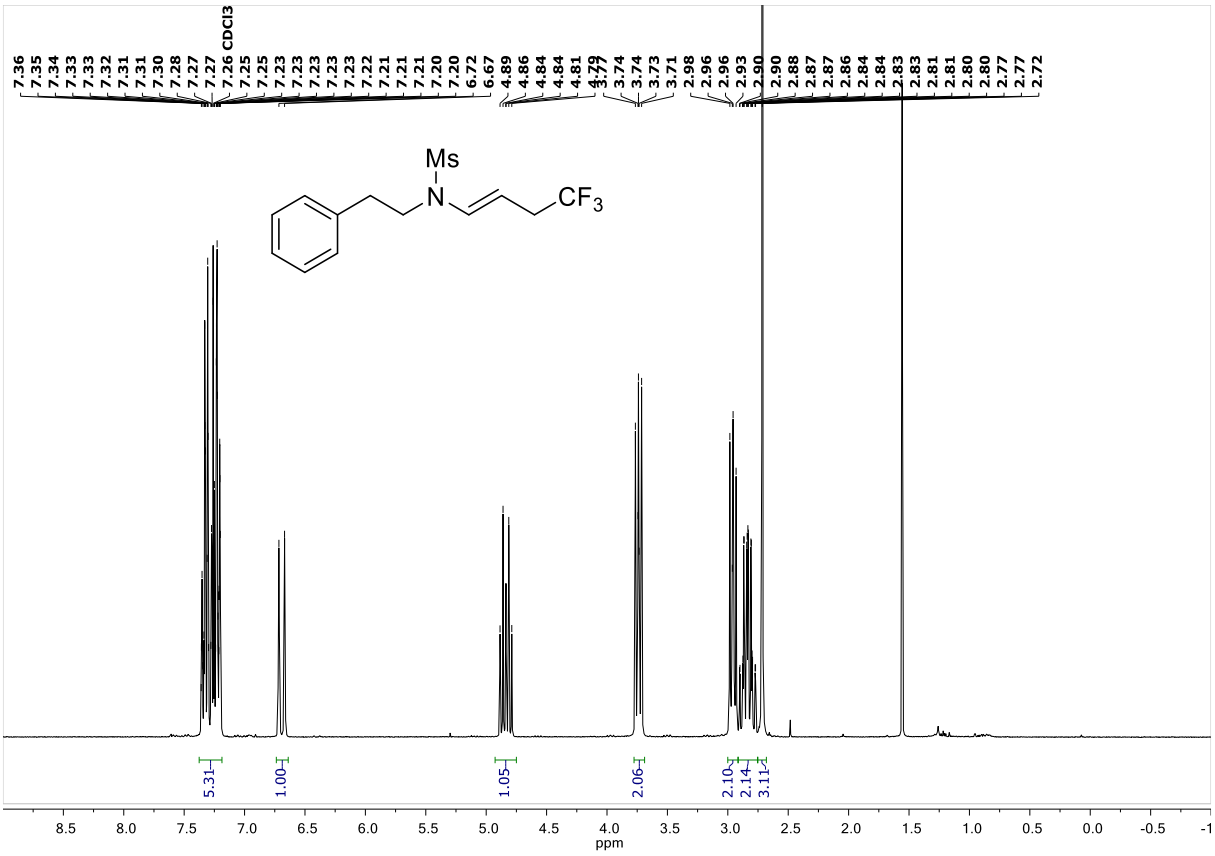
^{1}H NMR ($CDCl_3$, 400 MHz) of **3n**



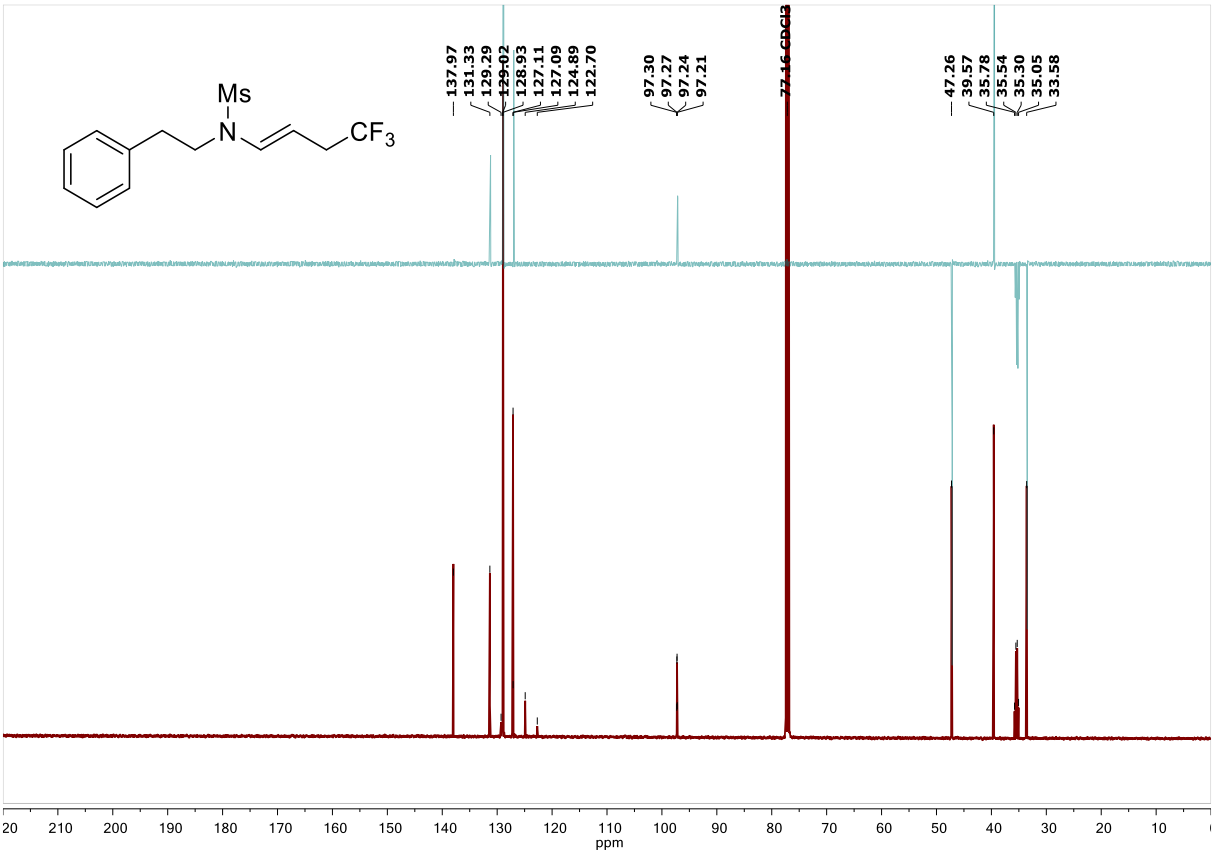
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3n**



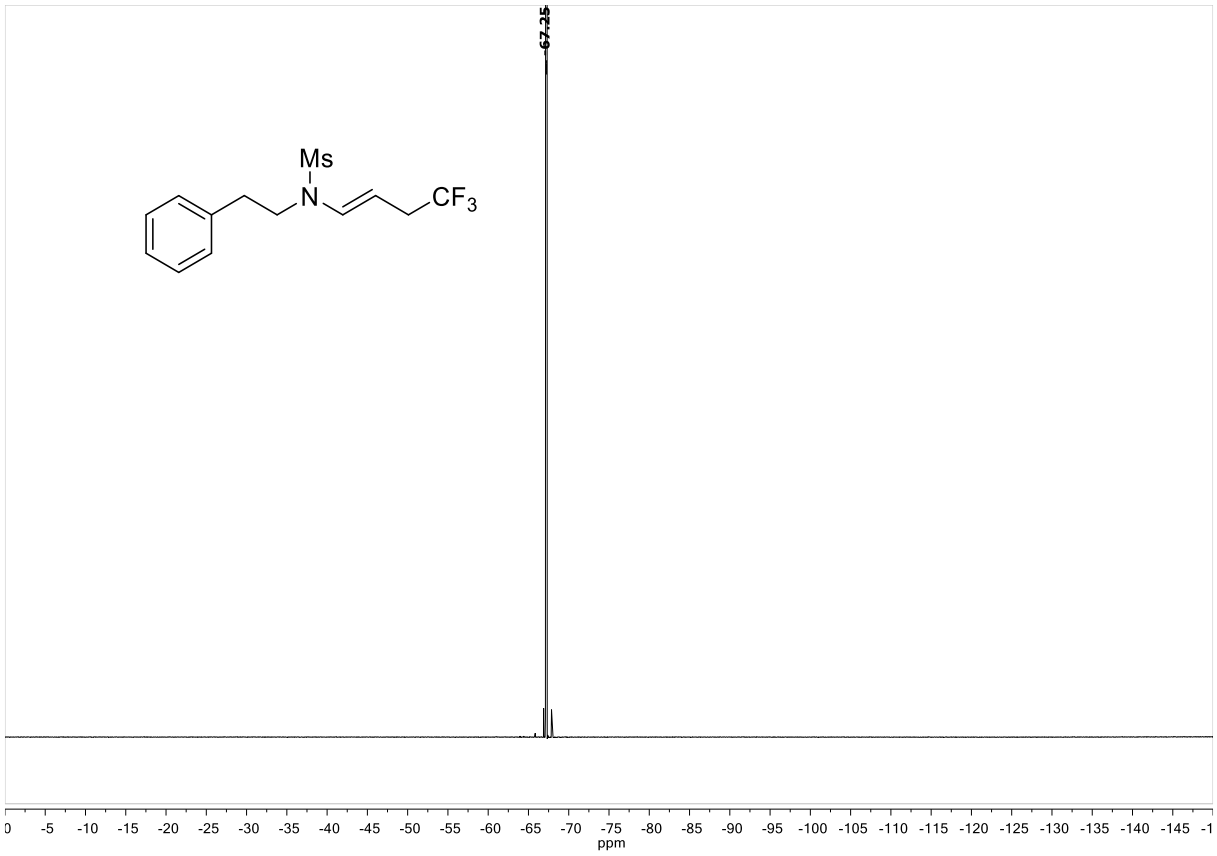
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3n**



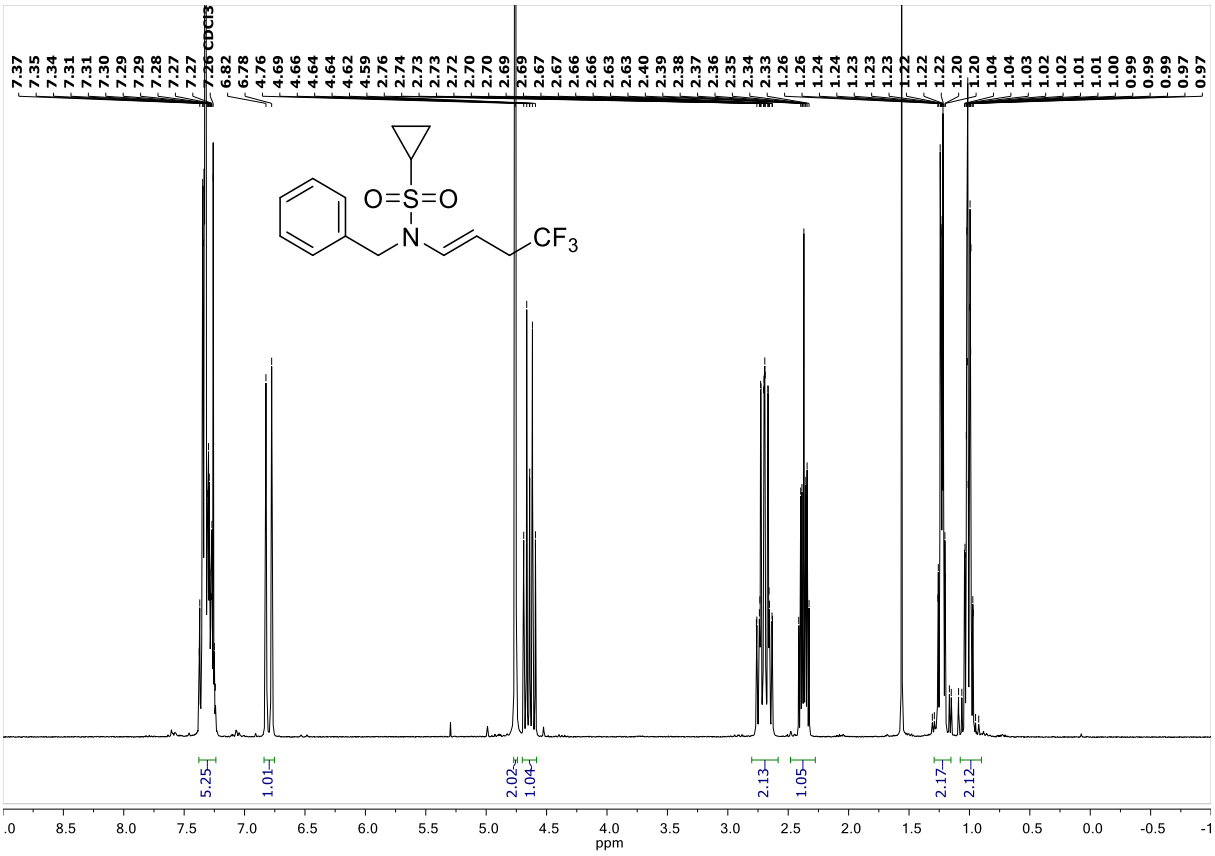
^{1}H NMR ($CDCl_3$, 300 MHz) of **3o**



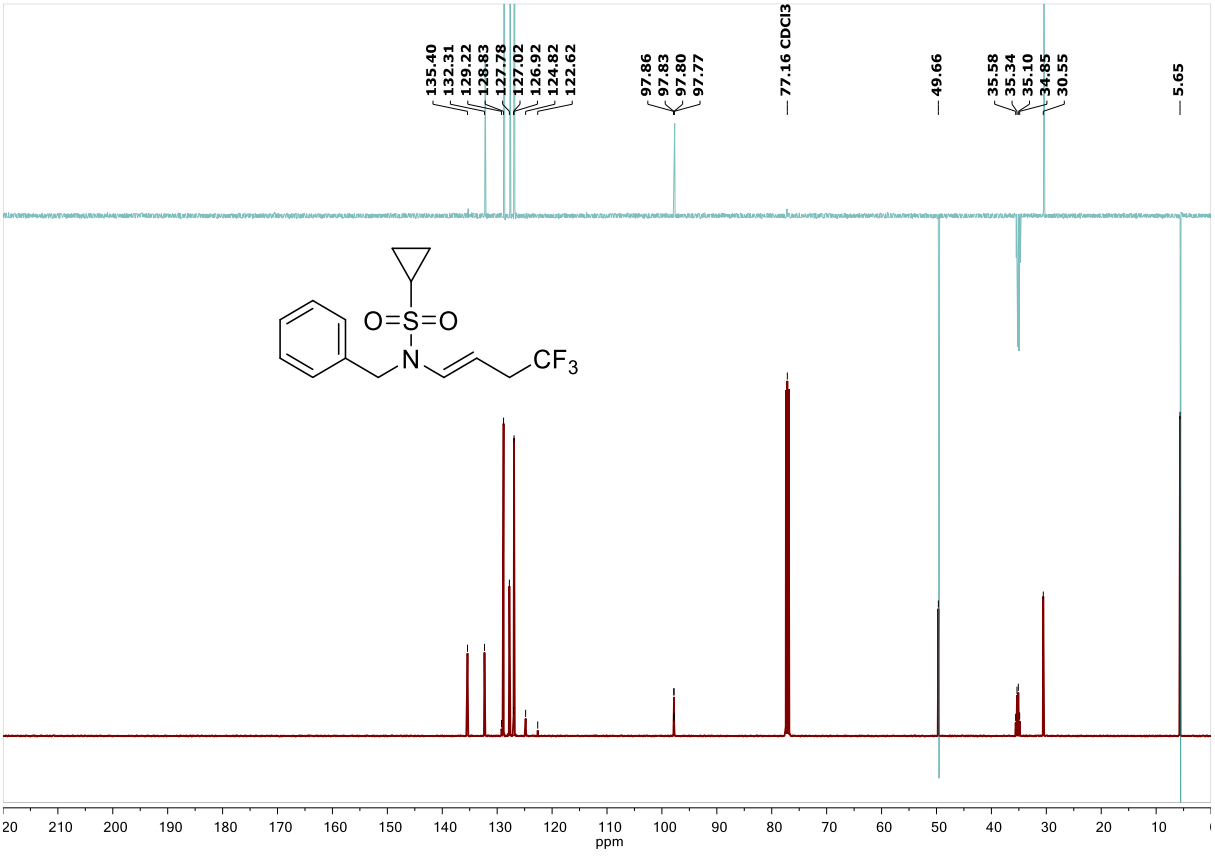
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3o**



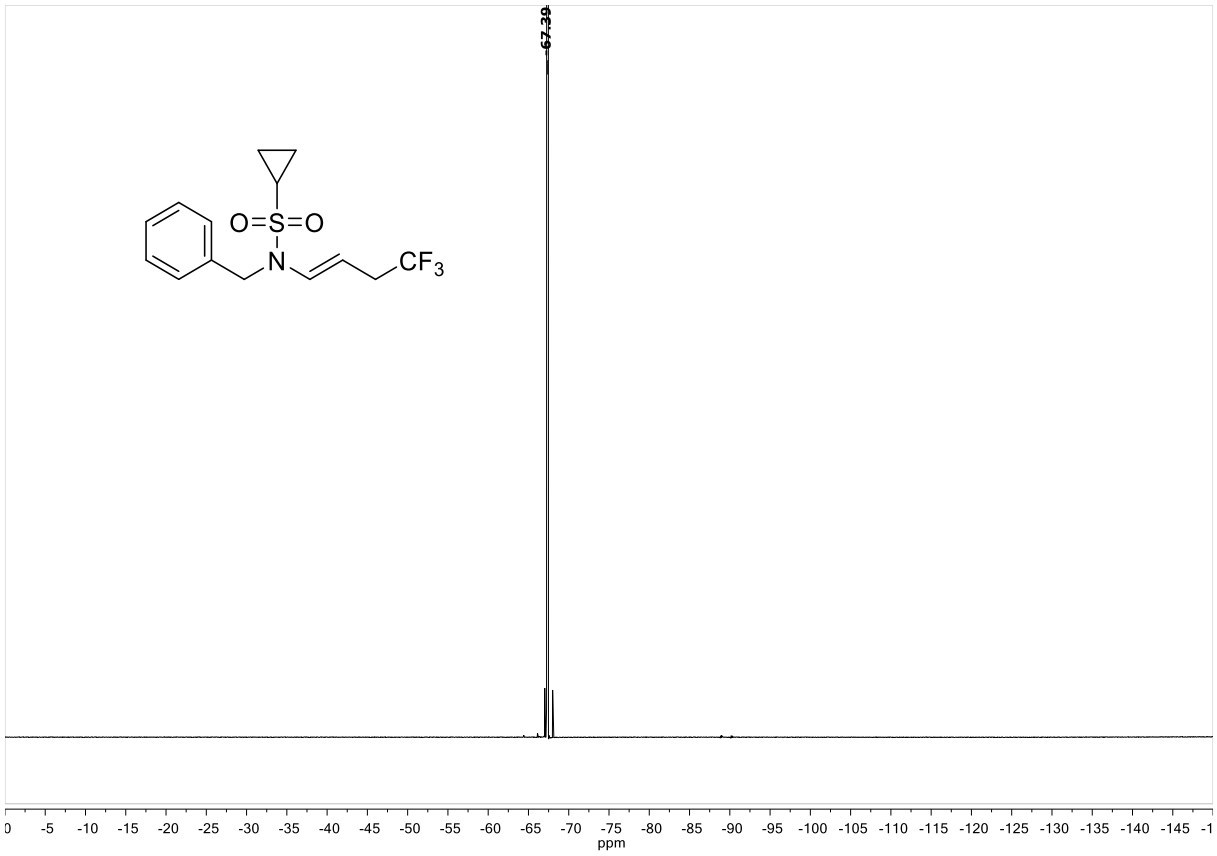
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3o**



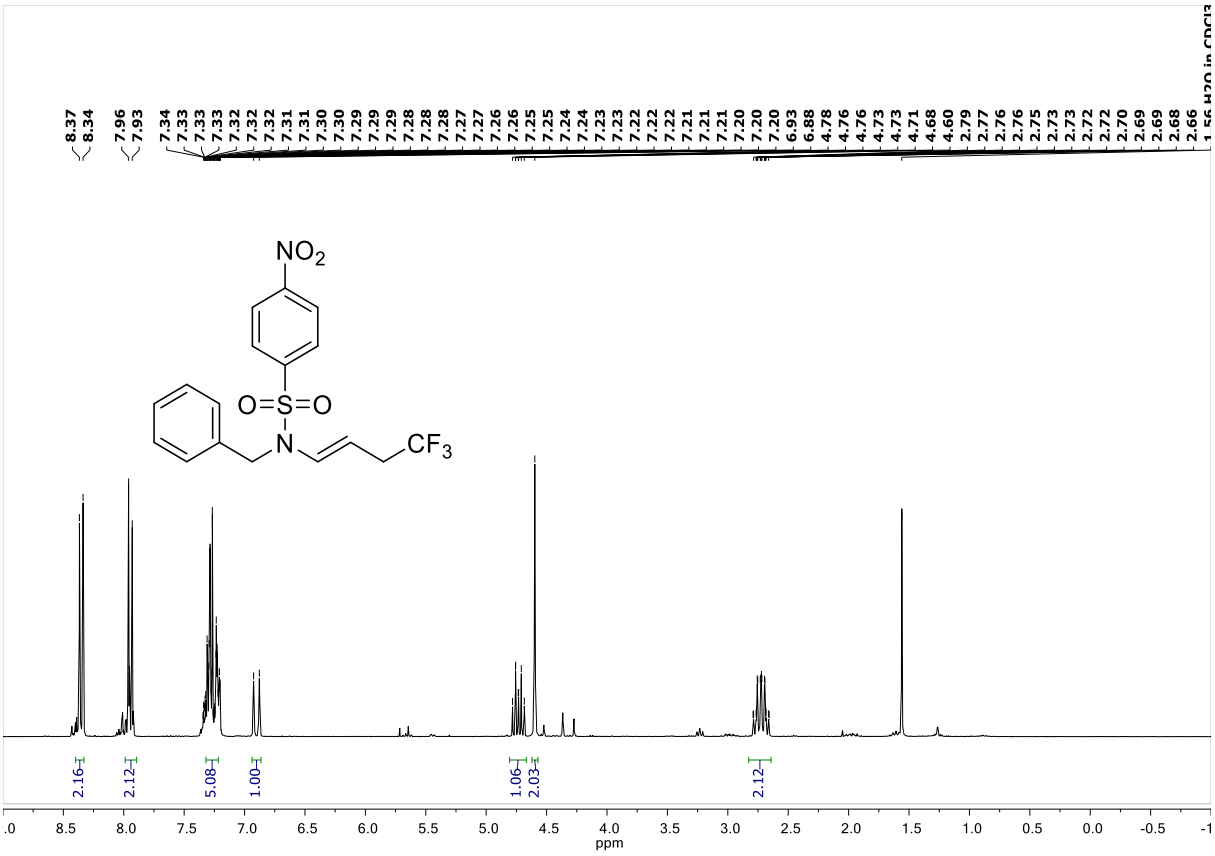
^{1}H NMR ($CDCl_3$, 300 MHz) of **3p**



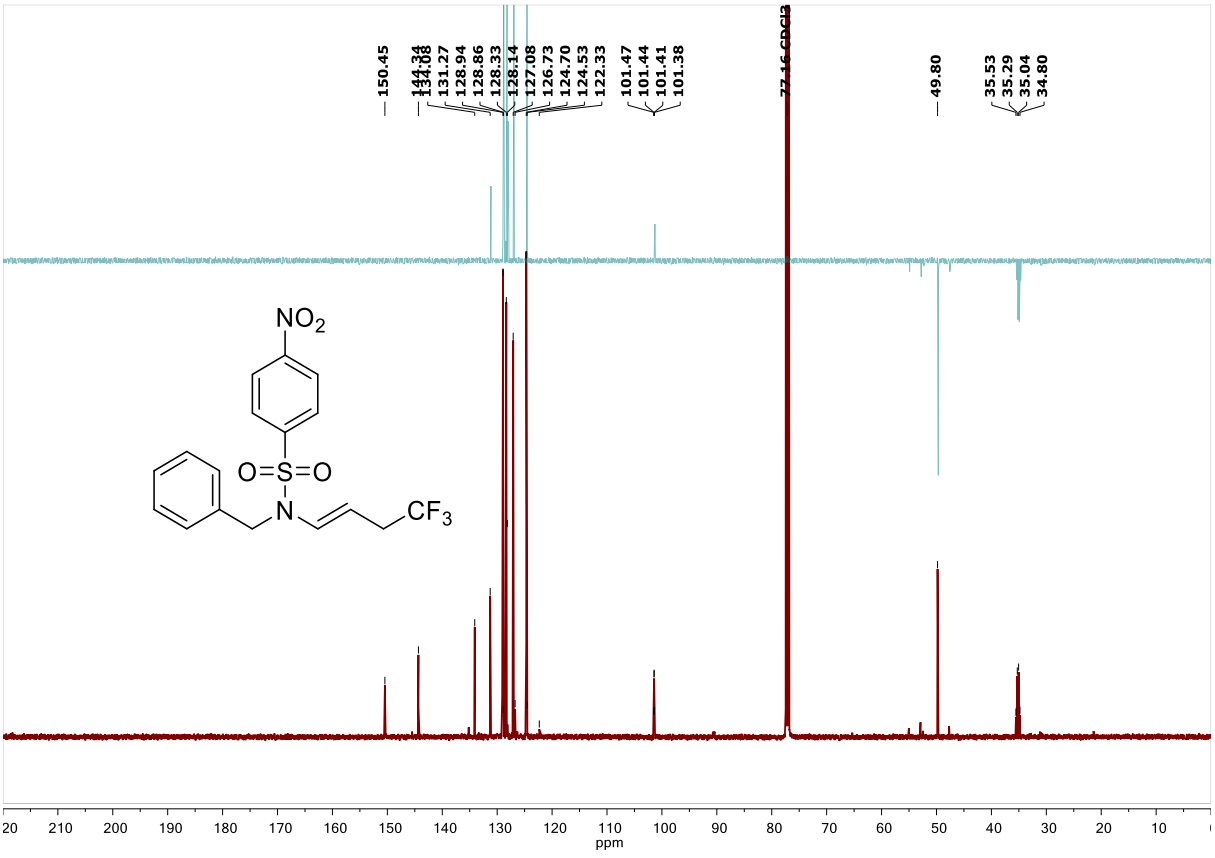
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3p**



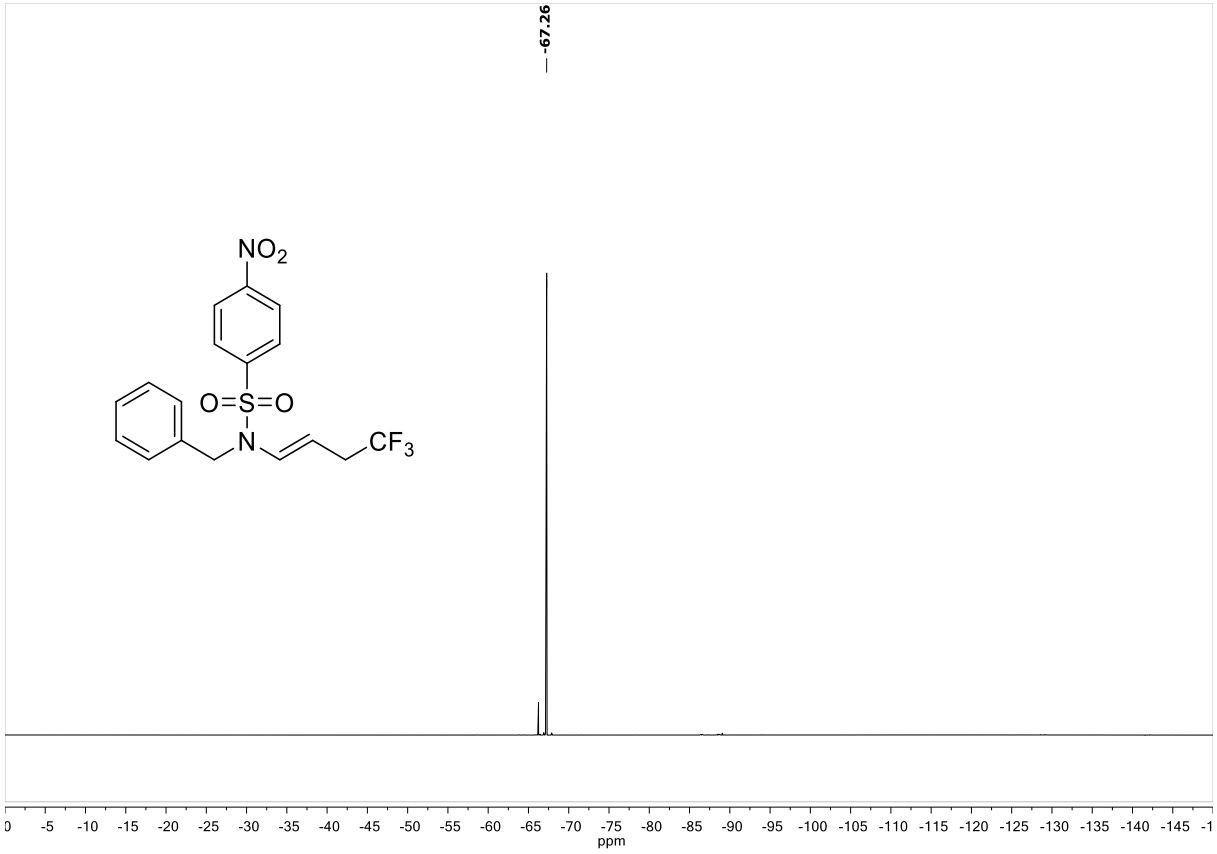
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3p**



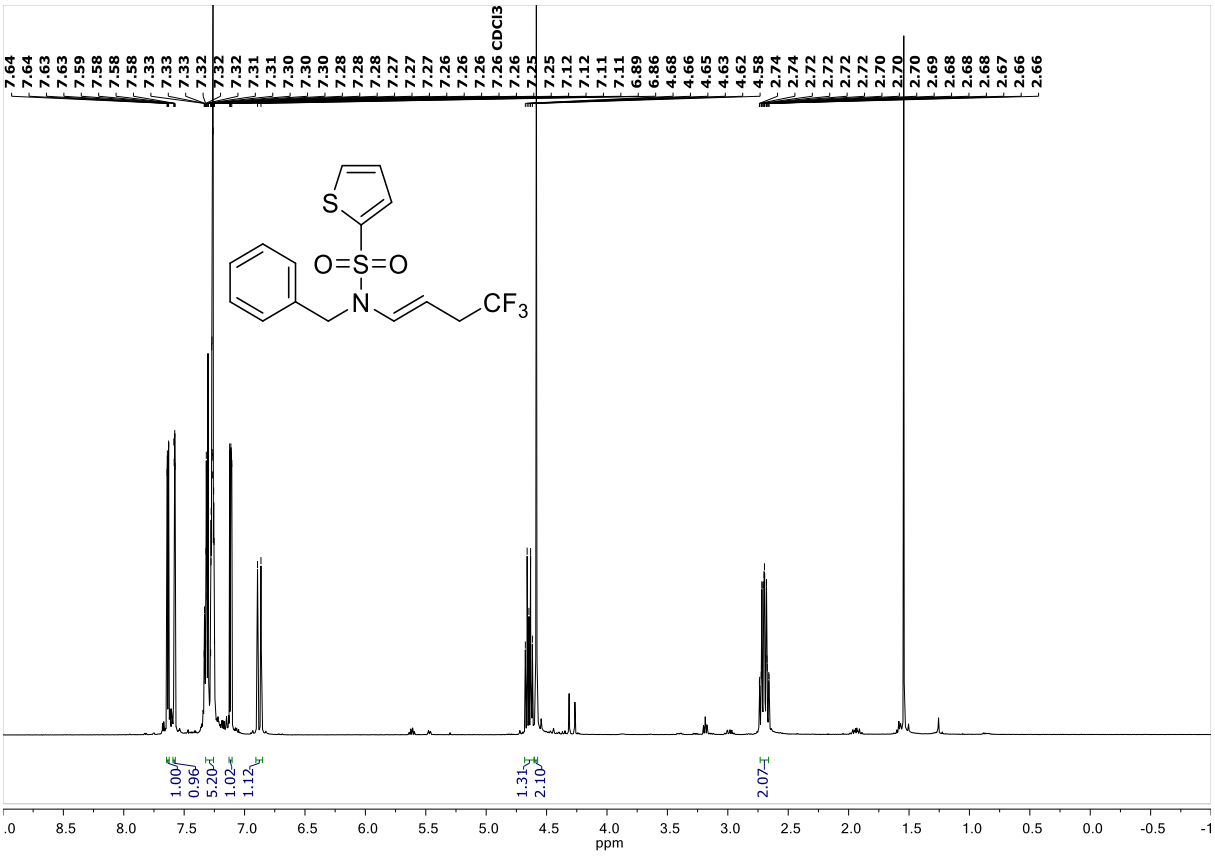
^{1}H NMR ($CDCl_3$, 300 MHz) of **3q**



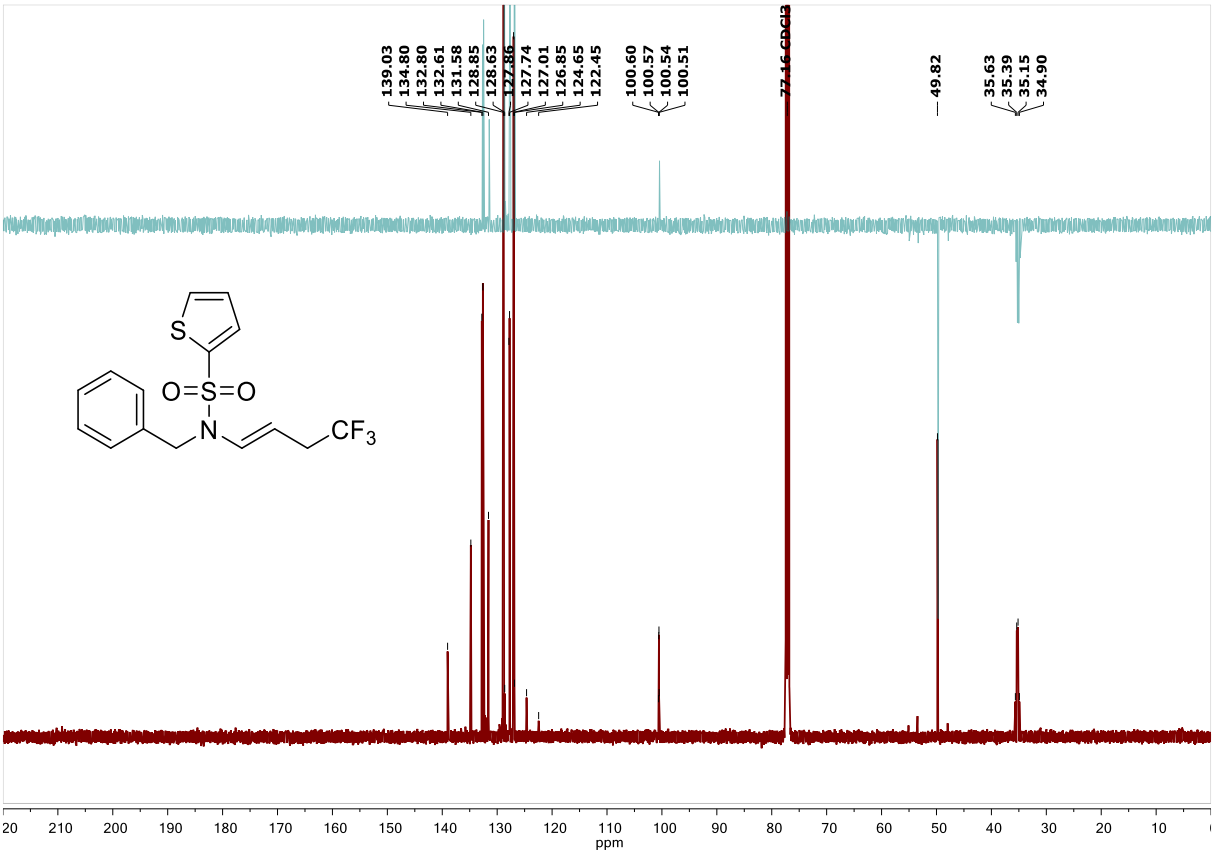
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3q**



$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3q**

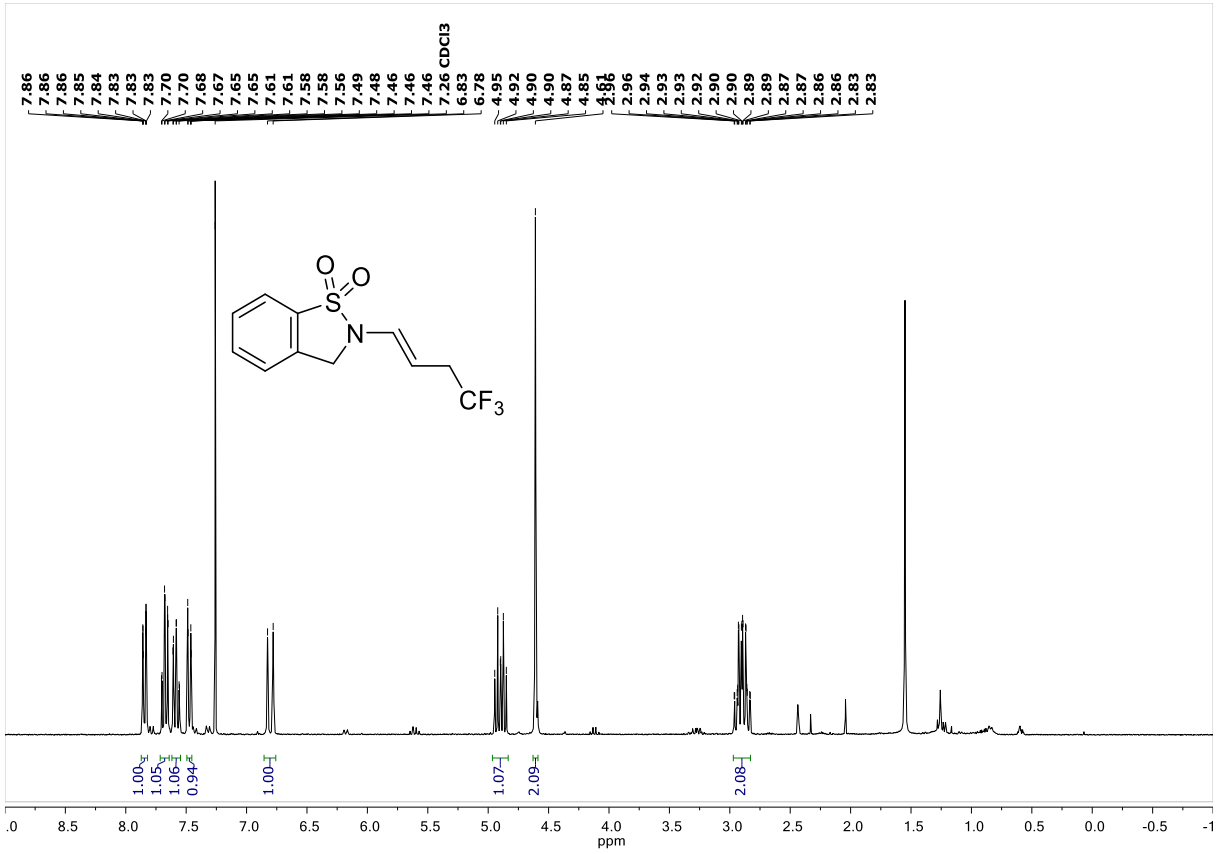


^{1}H NMR ($CDCl_3$, 500 MHz) of **3r**

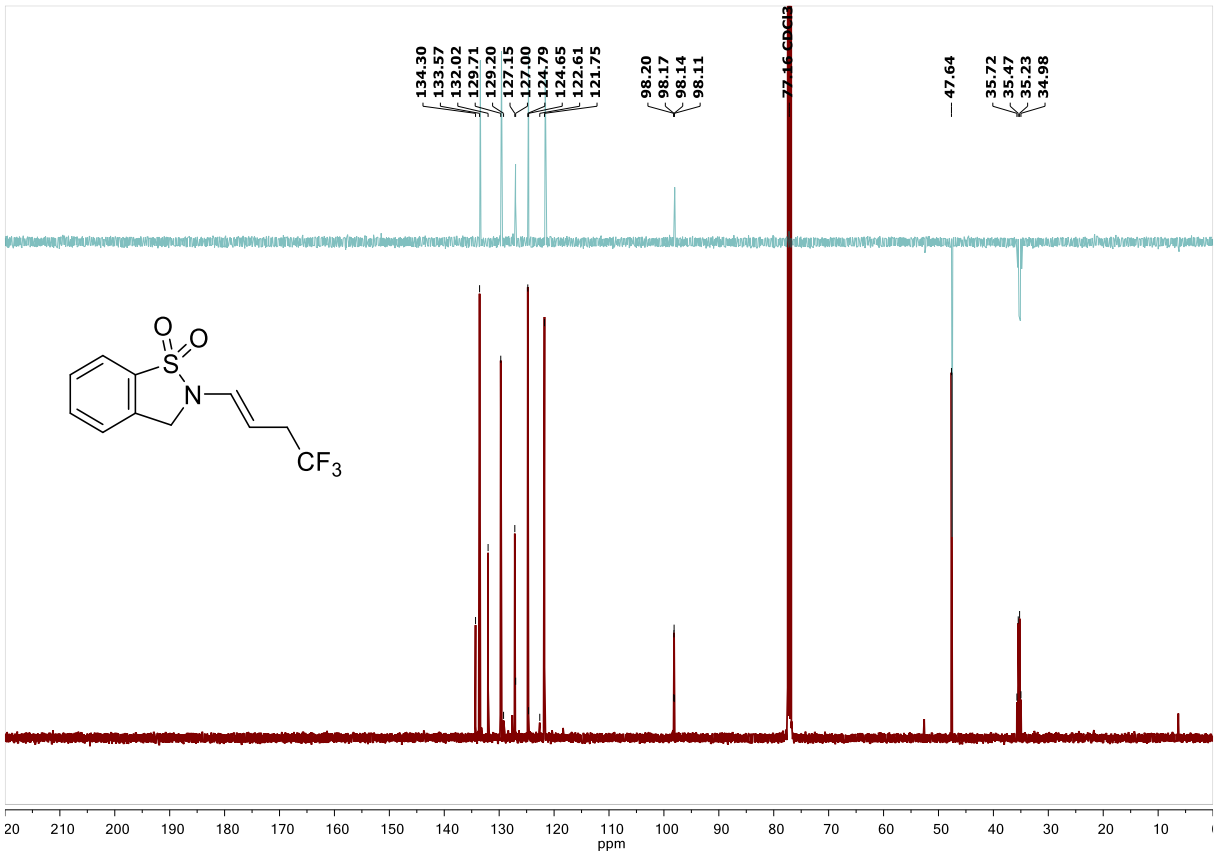


^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3r**

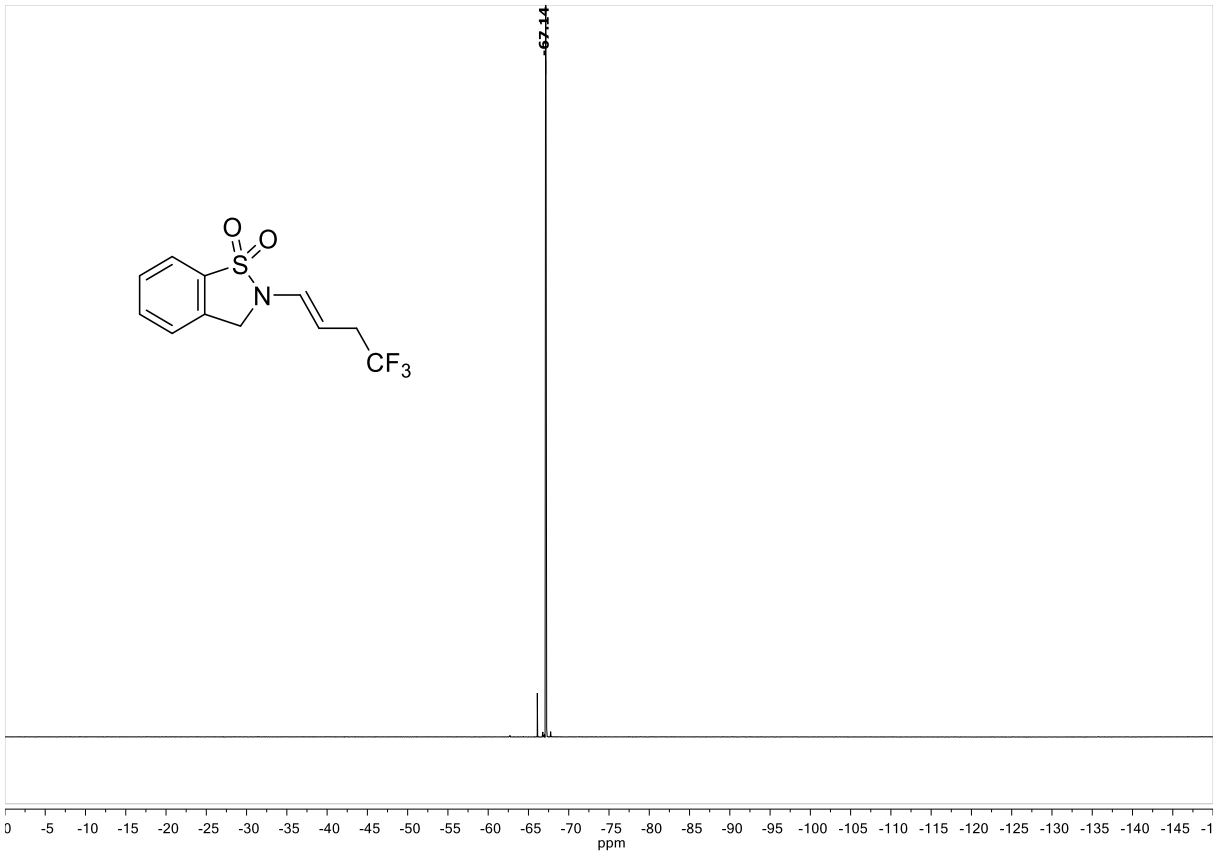
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3r**



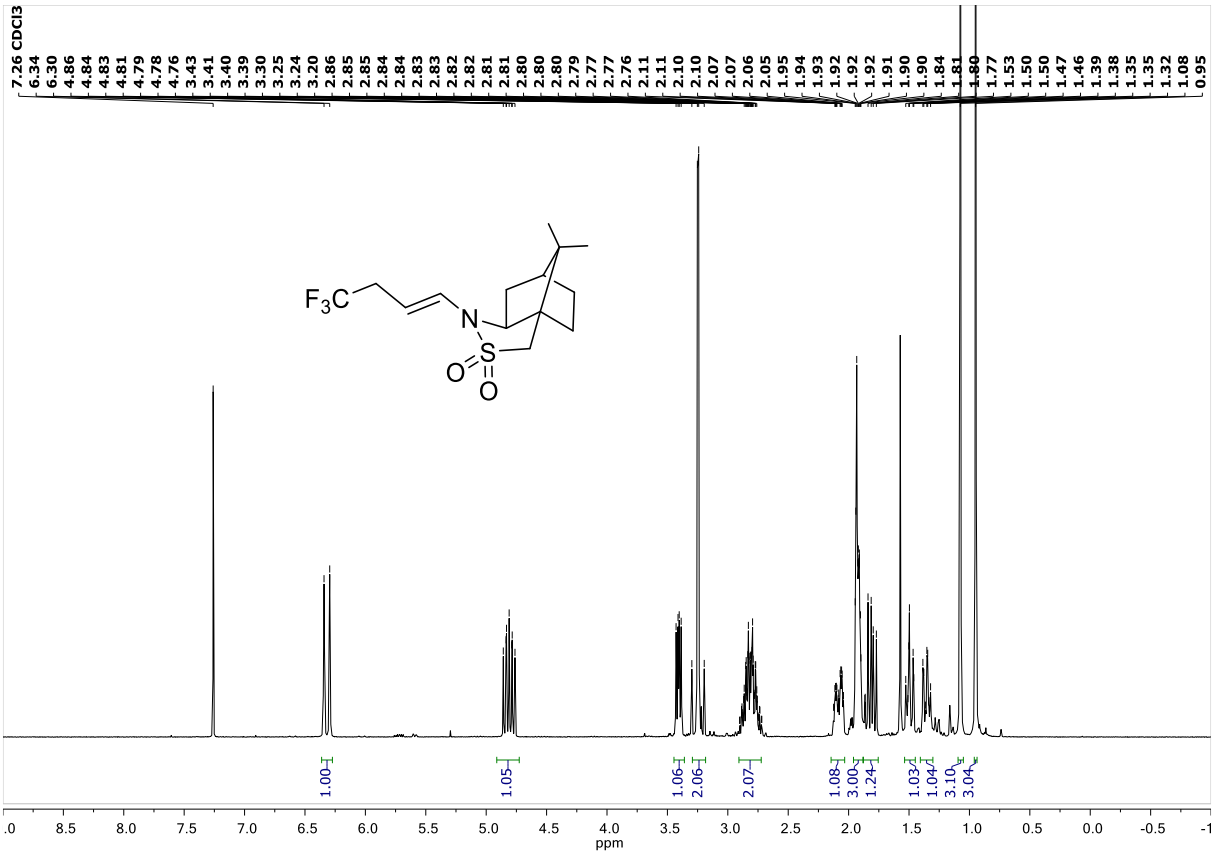
^{1}H NMR ($CDCl_3$, 300 MHz) of **3s**



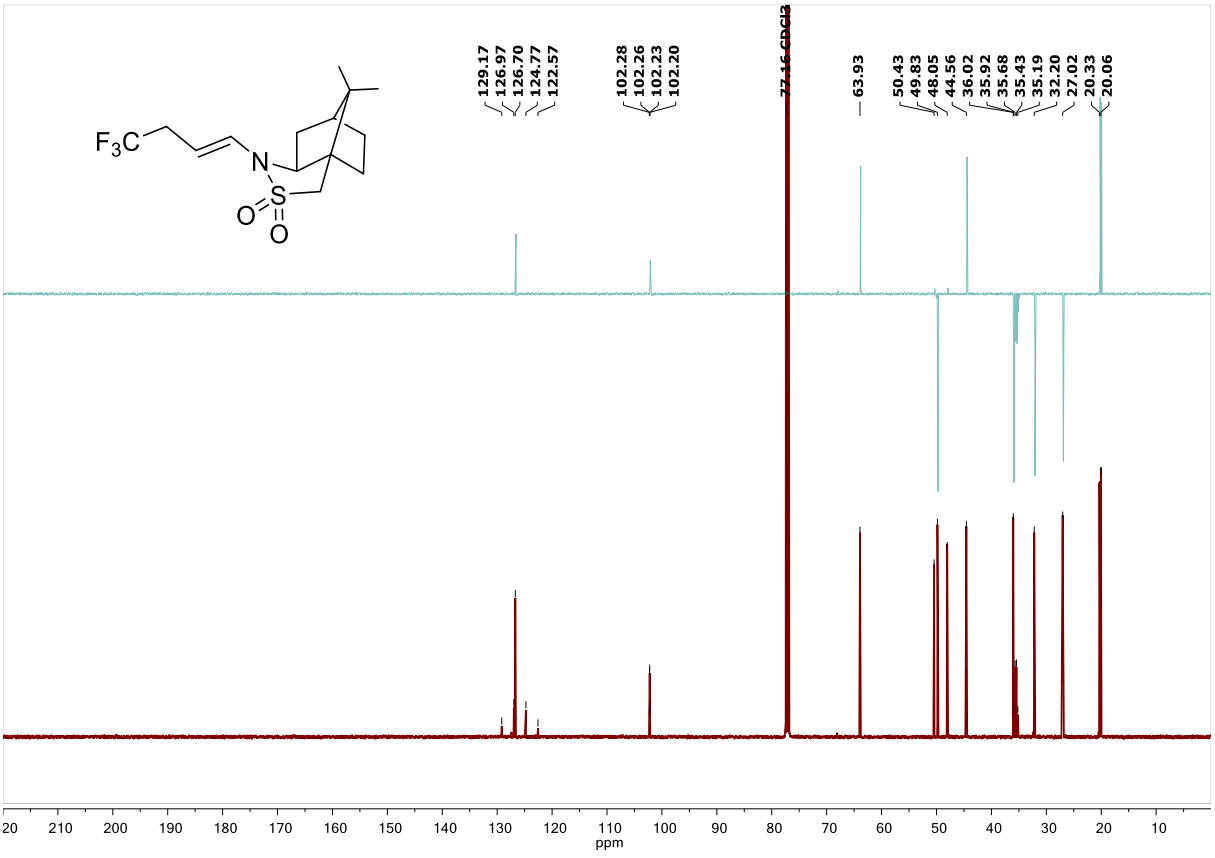
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3s**



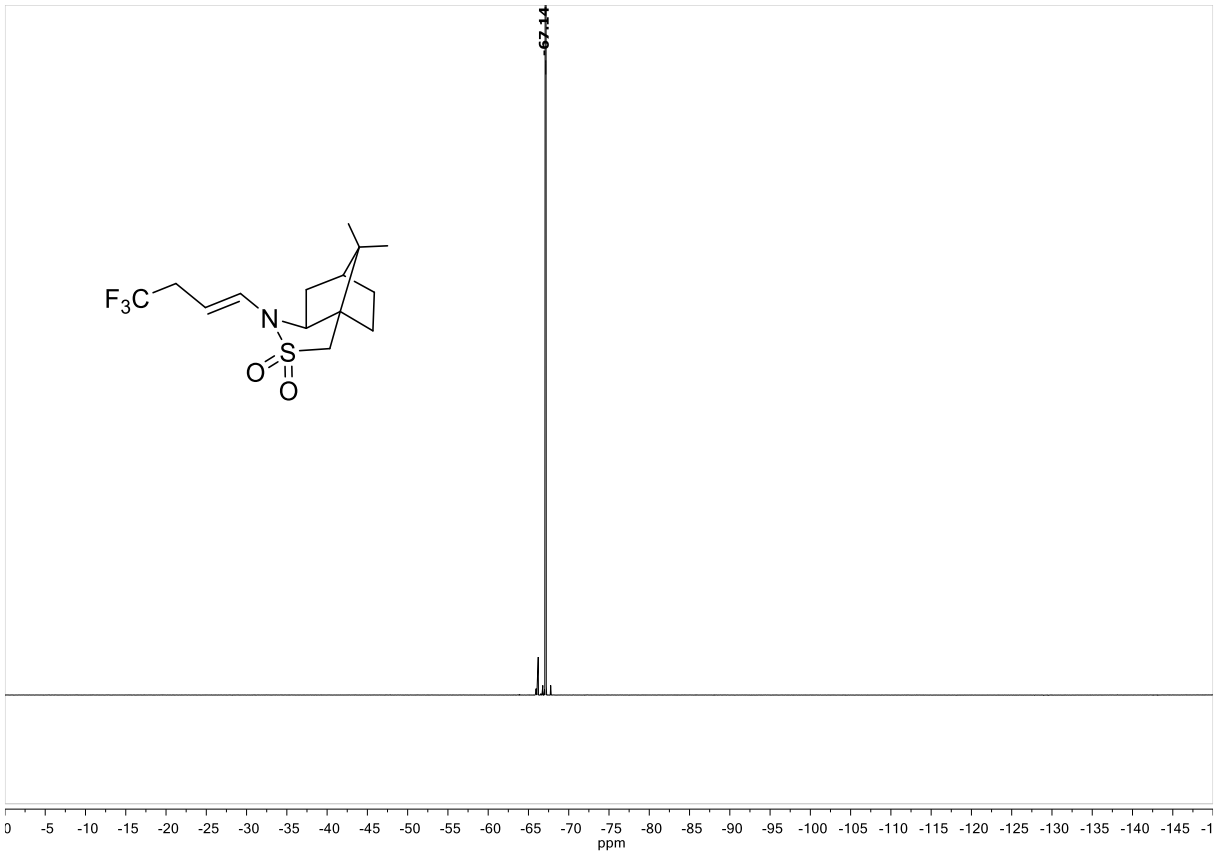
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3s**



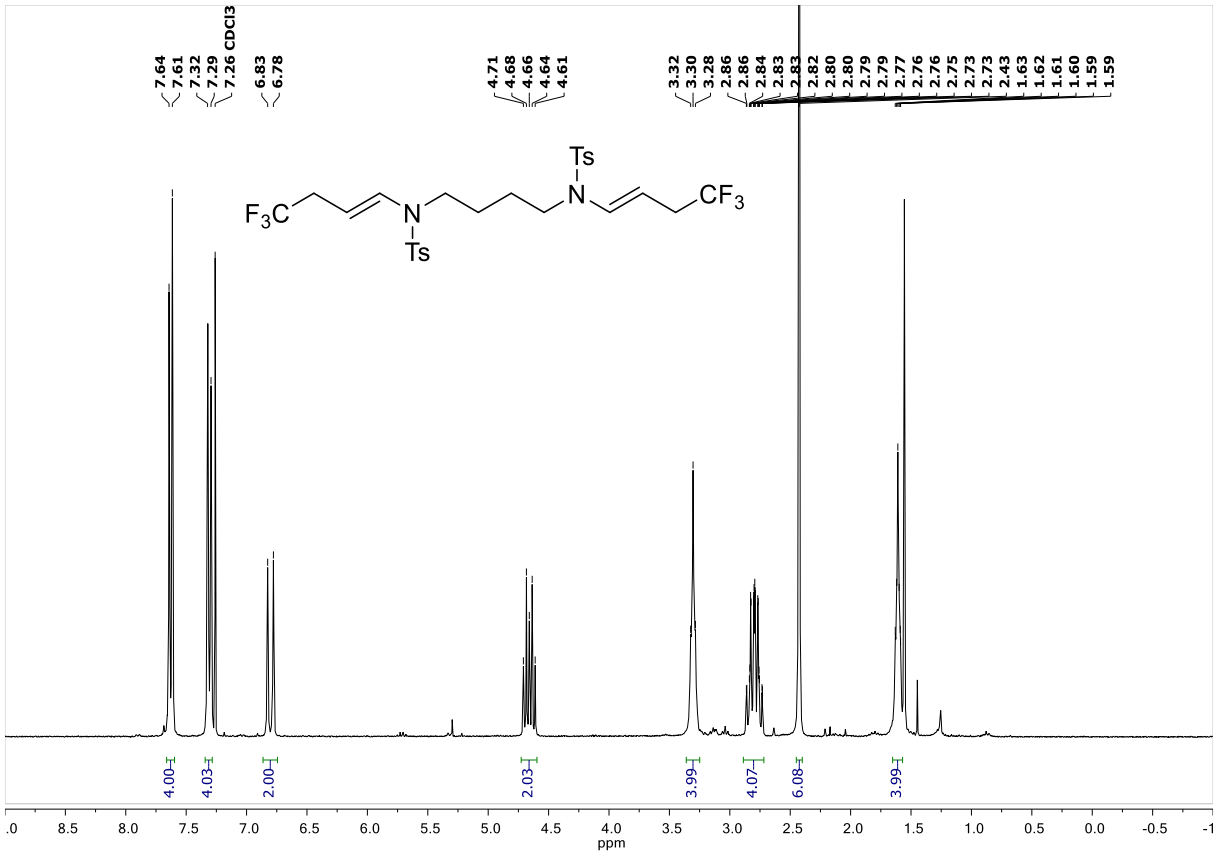
^{1}H NMR ($CDCl_3$, 300 MHz) of **3t**



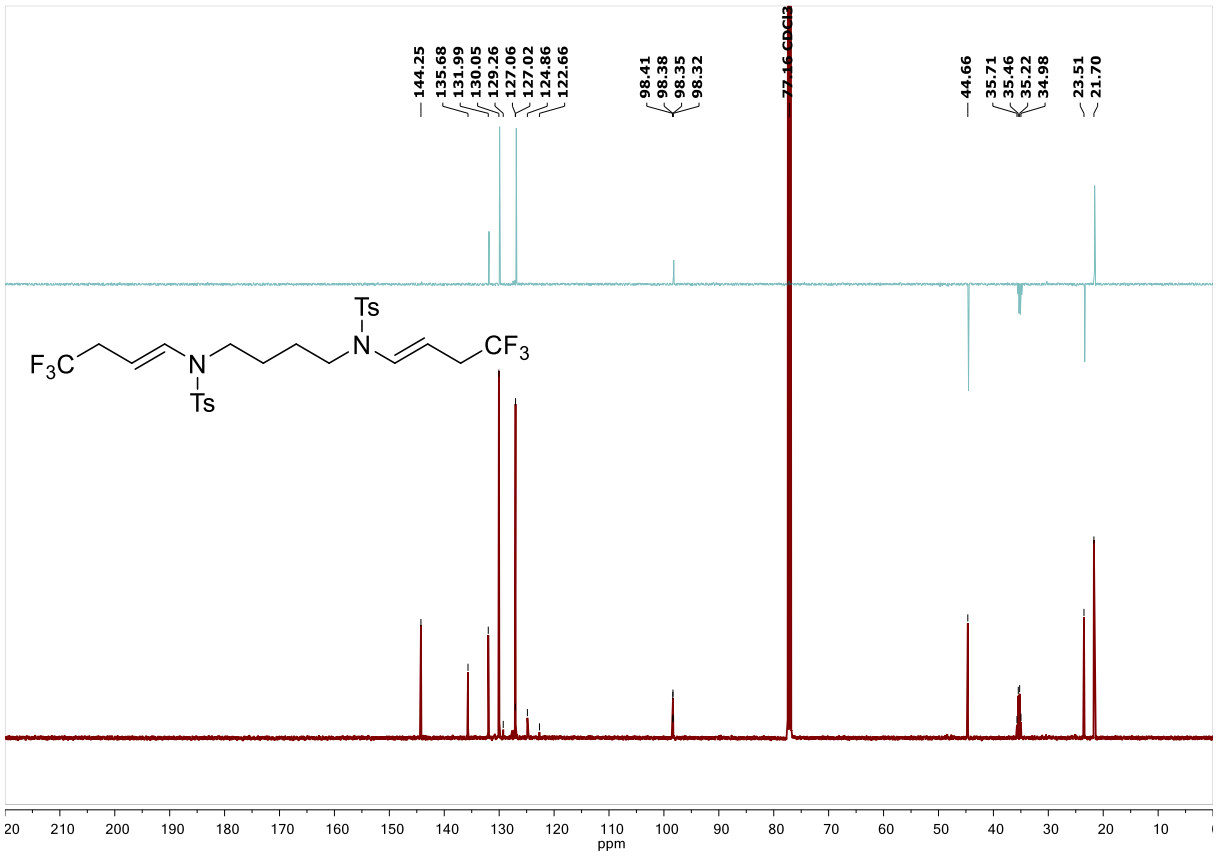
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3t**



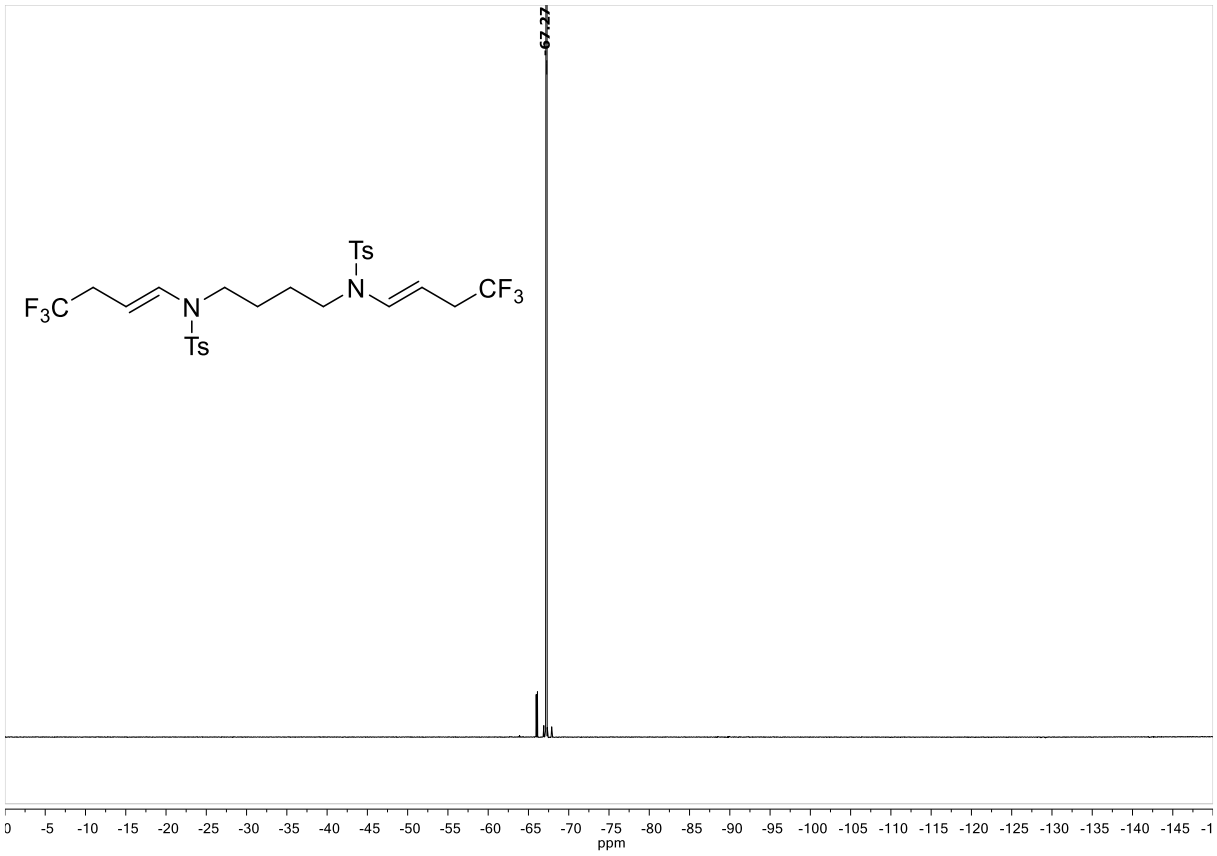
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3t**



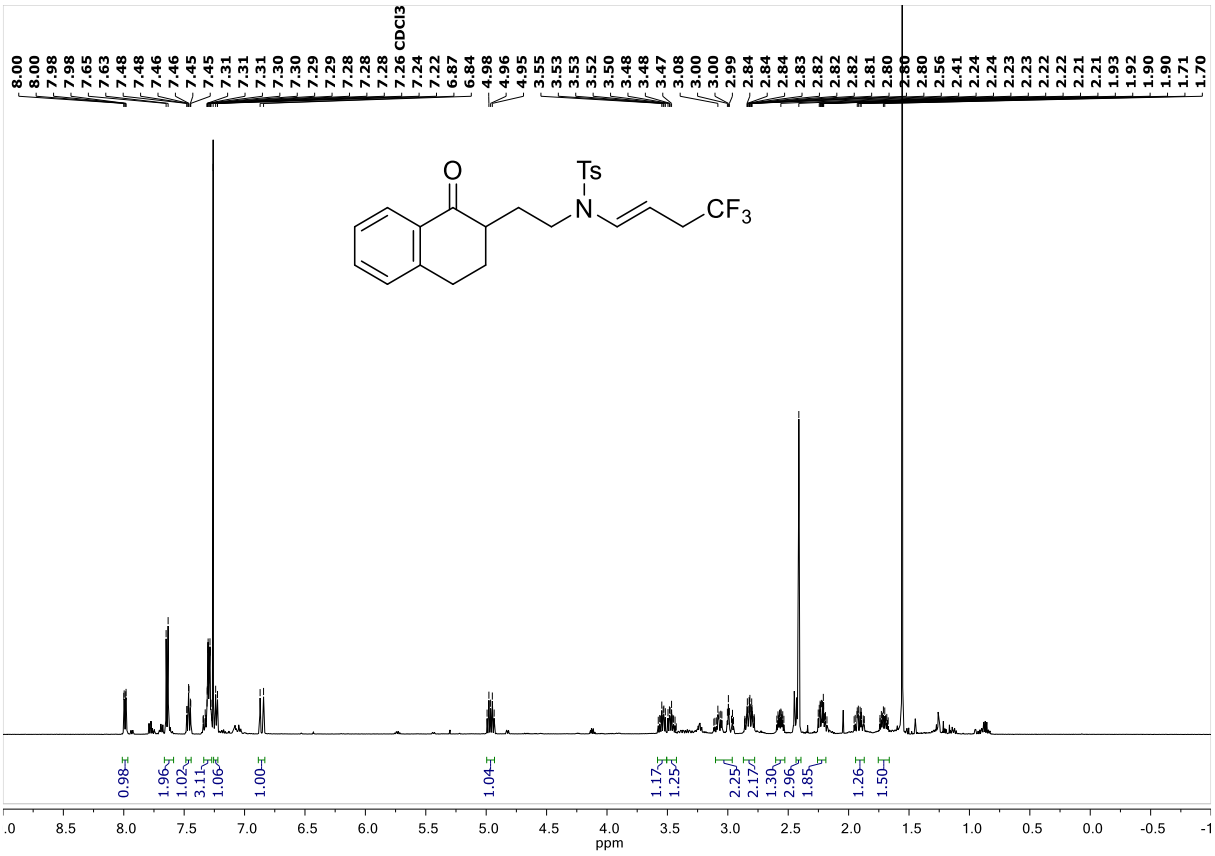
^{1}H NMR ($CDCl_3$, 300 MHz) of **3u**



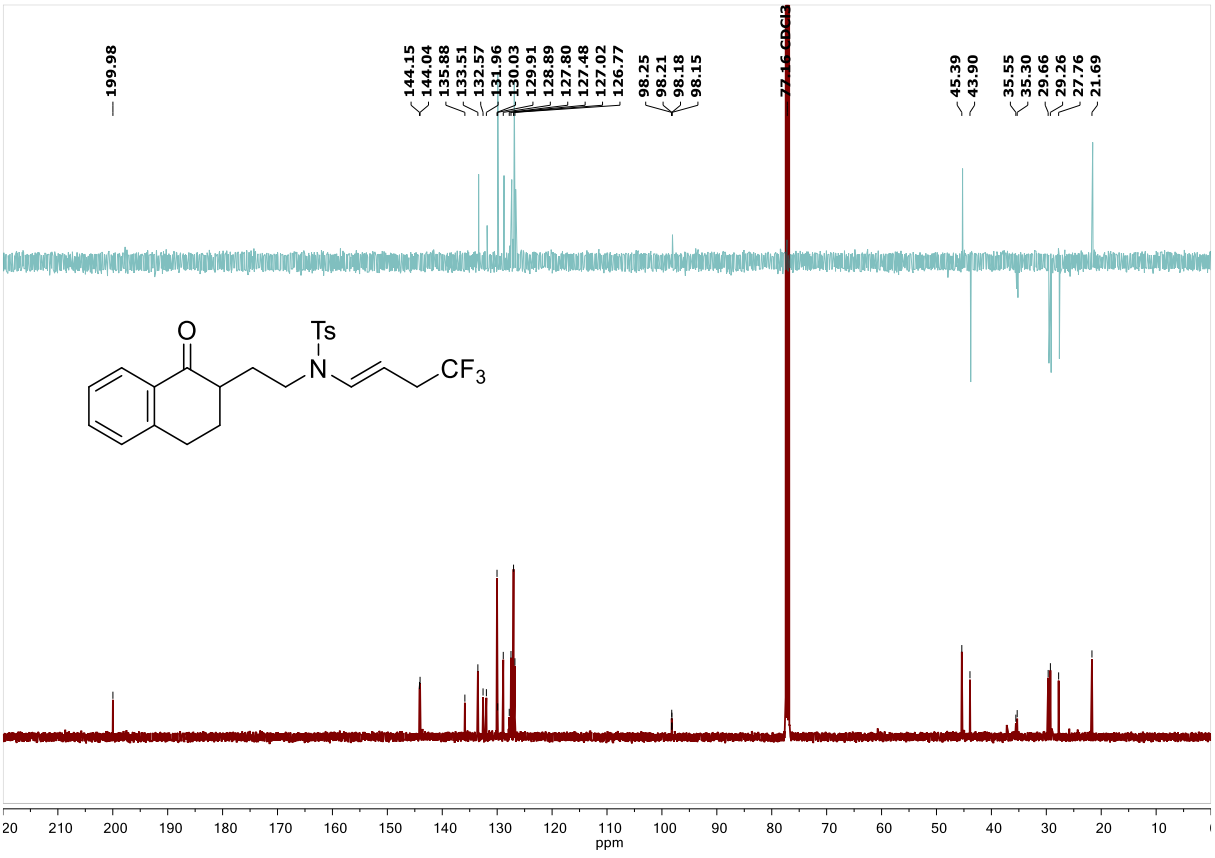
^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3u**



$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3u**

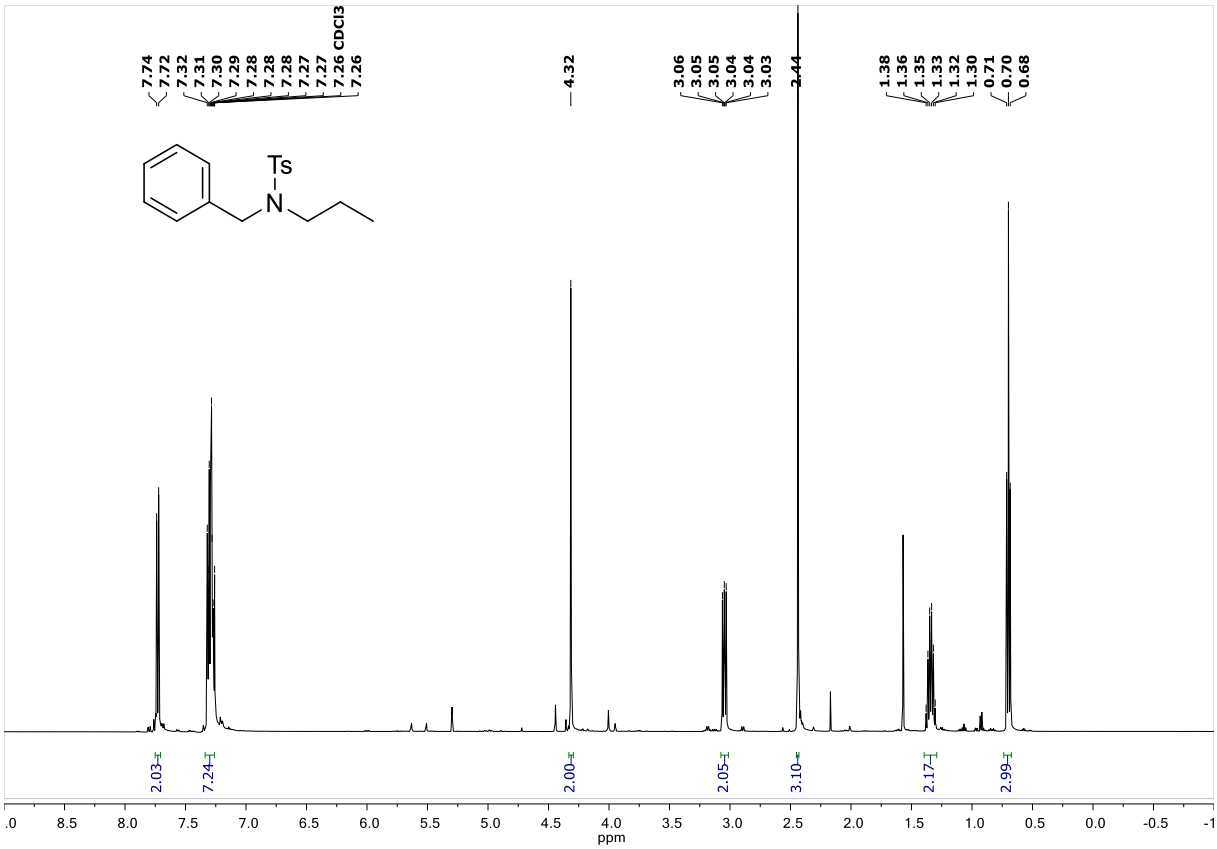


^{1}H NMR ($CDCl_3$, 500 MHz) of **3v**

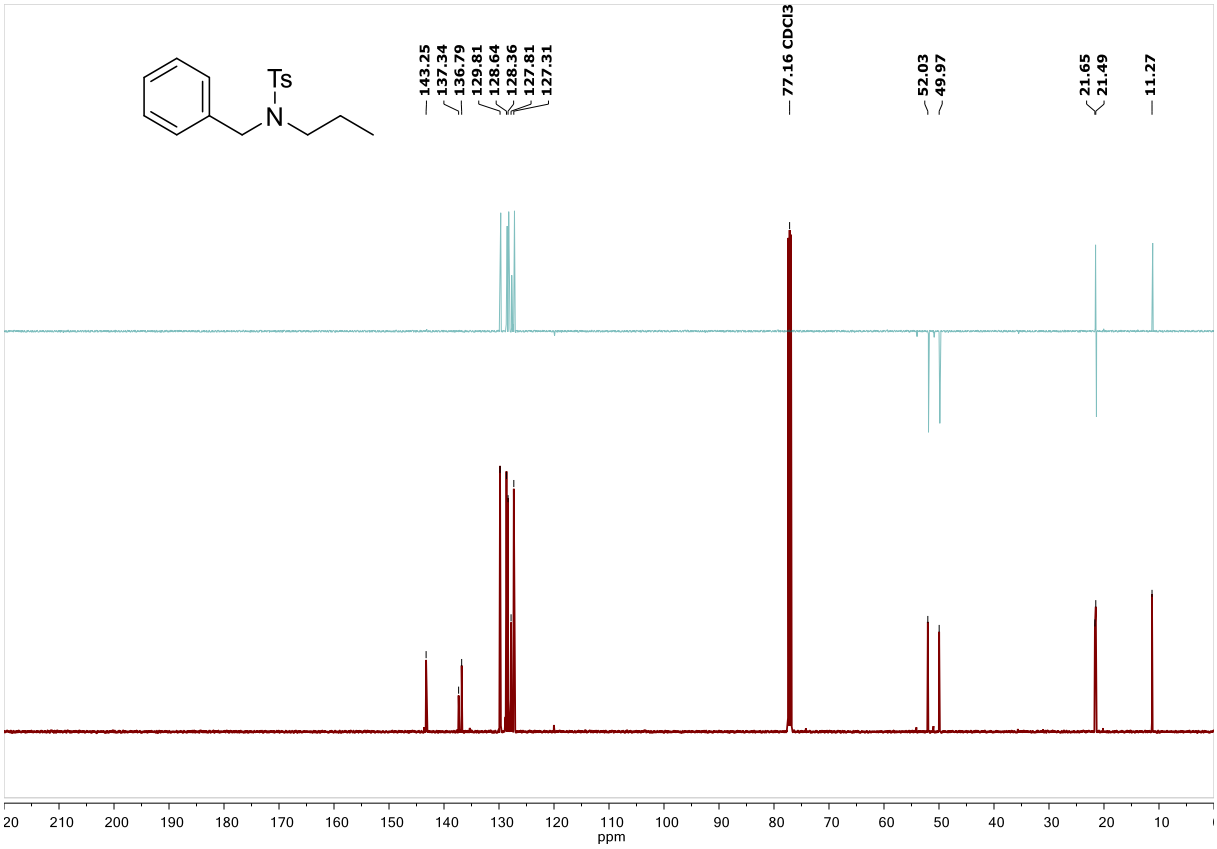


^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **3v**

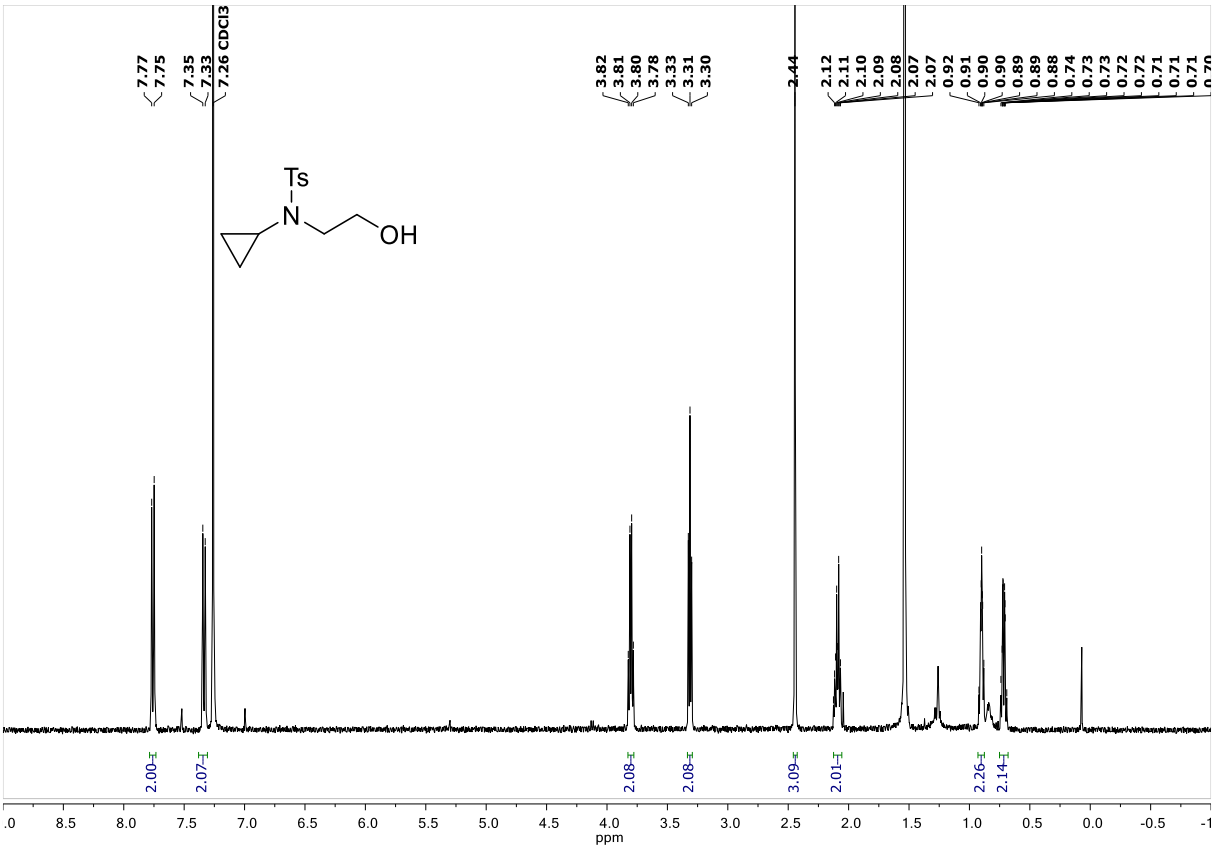
$^{19}F\{^{1}H\}$ NMR ($CDCl_3$, 282 MHz) of **3v**



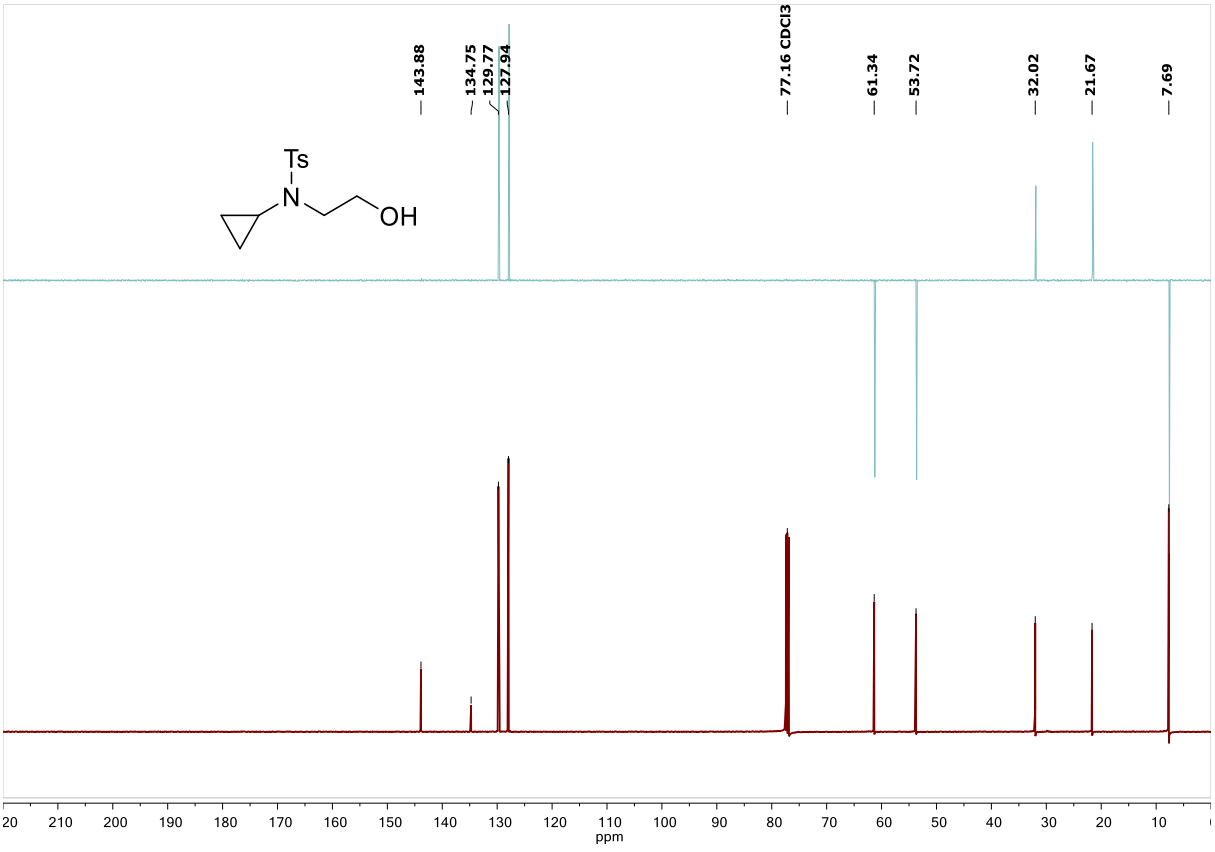
^{1}H NMR ($CDCl_3$, 500 MHz) of **5**



^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **5**



^{1}H NMR ($CDCl_3$, 400 MHz) of **6**



^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz) of **6**

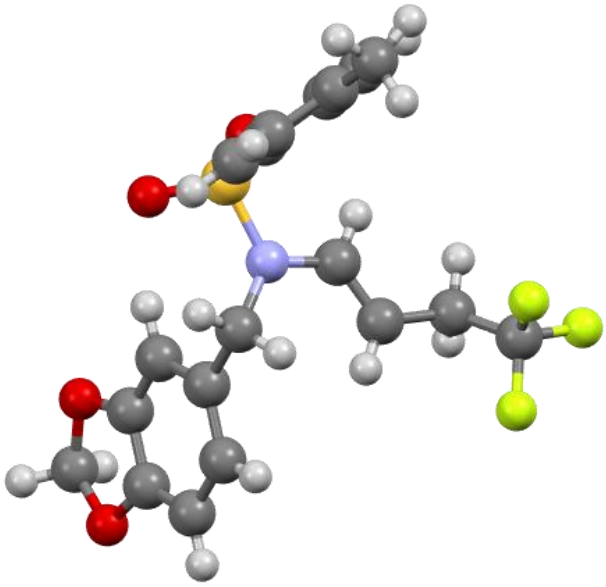
X-Ray Crystallography data

CCDC 2301994 (**3b**) contains the supplementary crystallographic data for this paper. These data can be obtained free of charge from the Cambridge crystallographic Data Centre.

Compound 4a was dissolved in a 0.5 mL dichloromethane, and *n*-hexane 2 mL were added. The sample was maintained at 4 °C for several days. Crystals were obtained through diffusion.

The X-ray diffraction data were collected at and 173 K on a Bruker SMART CCD diffractometer with MoKα radiation (λ = 0.71073 Å). The diffraction data were corrected for absorption using the SADABS program. The structures were solved using SHELXS977 and refined by full matrix leastsquares on F2 using SHELXL-2014 in the anisotropic approximation for all non-hydrogen atoms. The hydrogen atoms were introduced at calculated positions and not refined (riding model).[11]

Crystallography date of 3b:



Structure of **3b** (CCDC 2301994): ellipsoid contour probability 50 %

[11] (a) Bruker. SADABS. Bruker AXS Inc.: Madison, Wisconsin, USA 2001. (b) M. Sheldrick, *Acta Crystallogr. Sect. A Found. Crystallogr*. 2008, **64**, 112–122. (c) G. M. Sheldrick, *Acta Crystallogr. Sect. C. Struct. Chem*. 2015, **71**, 3-8.

Crystal structure Report for **3b** (CCDC 2301994)

Table 1. Crystal data and structure refinement for elmcg_b.

Identification code	elmcg230419
Empirical formula	C19 H18 F3 N O4 S
Formula weight	413.40
Temperature	120(2) K
Wavelength	0.71073 A
Crystal system, space group	Monoclinic, P 21/c
Unit cell dimensions	a = 9.9278(3) A alpha = 90 deg. b = 16.1864(4) A beta = 110.3770(10) deg. c = 12.2047(3) A gamma = 90 deg.
Volume	1838.51(9) A^3
Z, Calculated density	4, 1.494 Mg/m^3
Absorption coefficient	0.232 mm^-1
F(000)	856
Crystal size	0.200 x 0.160 x 0.150 mm
Theta range for data collection	2.180 to 27.913 deg.
Limiting indices	-13<=h<=13, -21<=k<=19, -16<=l<=14

Reflections collected / unique 29538 / 4381 [R(int) = 0.0245]

Completeness to theta = 25.242 99.9 %

Absorption correction Semi-empirical from equivalents

Max. and min. transmission 0.7456 and 0.6812

Refinement method Full-matrix least-squares on F^2

Data / restraints / parameters 4381 / 0 / 254

Goodness-of-fit on F^2 1.012

Final R indices [I>2sigma(I)] R1 = 0.0379, wR2 = 0.1034

R indices (all data) R1 = 0.0414, wR2 = 0.1070

Extinction coefficient n/a

Largest diff. peak and hole 0.728 and -0.668 e.A^-3

Table 2. Atomic coordinates (x 10^4) and equivalent isotropic displacement parameters (A^2 x 10^3) for elmcg_b.
U(eq) is defined as one third of the trace of the orthogonalized Uij tensor.

	x	y	z	U(eq)
N(1)	4519(1)	8077(1)	5912(1)	20(1)
S(1)	3965(1)	8971(1)	6252(1)	19(1)
O(1)	3821(1)	8855(1)	7371(1)	25(1)
O(2)	4926(1)	9586(1)	6105(1)	26(1)
C(1)	2252(1)	9145(1)	5209(1)	19(1)
C(2)	1060(2)	8865(1)	5450(1)	23(1)
C(3)	-294(2)	8938(1)	4601(1)	25(1)
C(4)	-477(2)	9291(1)	3521(1)	25(1)
C(5)	735(2)	9589(1)	3309(1)	26(1)
C(6)	2099(2)	9519(1)	4140(1)	23(1)
C(7)	-1958(2)	9357(1)	2612(2)	37(1)
C(8)	5254(1)	8039(1)	5055(1)	21(1)
C(9)	6821(1)	7789(1)	5614(1)	19(1)
C(10)	7424(2)	7214(1)	5075(1)	22(1)
C(11)	8884(2)	6992(1)	5553(1)	24(1)
C(12)	9670(1)	7362(1)	6590(1)	21(1)
O(3)	11122(1)	7280(1)	7225(1)	26(1)
C(13)	11349(2)	7740(1)	8281(1)	29(1)
O(4)	10111(1)	8247(1)	8109(1)	30(1)
C(14)	9074(2)	7935(1)	7127(1)	21(1)
C(15)	7660(2)	8168(1)	6669(1)	21(1)
C(16)	4050(2)	7350(1)	6300(1)	21(1)

C(17)	4329(2)	6580(1)	6069(1)	25(1)
C(18)	3804(2)	5871(1)	6607(2)	32(1)
C(19)	2879(2)	5282(1)	5755(2)	32(1)
F(1)	1707(1)	5636(1)	4997(1)	64(1)
F(2)	2413(1)	4661(1)	6263(1)	41(1)
F(3)	3589(2)	4913(1)	5127(1)	59(1)

Table 3. Selected bond lengths [A] and angles [deg] for elmcg_b.

Symmetry transformations used to generate equivalent atoms:

Table 4. Bond lengths [A] and angles [deg] for elmcg_b.

N(1)-C(16)	1.4064(18)
N(1)-C(8)	1.4701(18)
N(1)-S(1)	1.6529(12)
S(1)-O(2)	1.4323(11)
S(1)-O(1)	1.4339(11)
S(1)-C(1)	1.7559(14)
C(1)-C(2)	1.3910(19)
C(1)-C(6)	1.398(2)
C(2)-C(3)	1.387(2)
C(3)-C(4)	1.388(2)
C(4)-C(5)	1.401(2)
C(4)-C(7)	1.506(2)
C(5)-C(6)	1.386(2)
C(8)-C(9)	1.5197(18)
C(9)-C(10)	1.3888(19)
C(9)-C(15)	1.4078(19)
C(10)-C(11)	1.408(2)
C(11)-C(12)	1.372(2)
C(12)-C(14)	1.383(2)
C(12)-O(3)	1.3850(17)
O(3)-C(13)	1.436(2)
C(13)-O(4)	1.4310(19)
O(4)-C(14)	1.3752(17)
C(14)-C(15)	1.3710(19)
C(16)-C(17)	1.328(2)
C(17)-C(18)	1.503(2)
C(18)-C(19)	1.473(2)
C(19)-F(1)	1.337(2)
C(19)-F(2)	1.3445(19)

C(19)-F(3)	1.348(2)

C(16)-N(1)-C(8)	120.67(12)
C(16)-N(1)-S(1)	118.00(10)
C(8)-N(1)-S(1)	120.39(10)
O(2)-S(1)-O(1)	120.11(7)
O(2)-S(1)-N(1)	106.40(6)
O(1)-S(1)-N(1)	106.05(6)
O(2)-S(1)-C(1)	108.52(7)
O(1)-S(1)-C(1)	108.61(7)
N(1)-S(1)-C(1)	106.34(6)
C(2)-C(1)-C(6)	121.00(13)
C(2)-C(1)-S(1)	118.35(11)
C(6)-C(1)-S(1)	120.58(11)
C(3)-C(2)-C(1)	119.21(14)
C(2)-C(3)-C(4)	121.13(14)
C(3)-C(4)-C(5)	118.67(13)
C(3)-C(4)-C(7)	119.99(15)
C(5)-C(4)-C(7)	121.33(15)
C(6)-C(5)-C(4)	121.33(14)
C(5)-C(6)-C(1)	118.62(13)
N(1)-C(8)-C(9)	112.06(11)
C(10)-C(9)-C(15)	120.66(13)
C(10)-C(9)-C(8)	120.55(13)
C(15)-C(9)-C(8)	118.76(12)
C(9)-C(10)-C(11)	121.76(13)
C(12)-C(11)-C(10)	116.32(13)
C(11)-C(12)-C(14)	122.04(13)
C(11)-C(12)-O(3)	128.44(14)
C(14)-C(12)-O(3)	109.43(13)
C(12)-O(3)-C(13)	105.06(11)
O(4)-C(13)-O(3)	107.94(12)

C(14)-O(4)-C(13)	105.13(12)
C(15)-C(14)-O(4)	127.14(14)
C(15)-C(14)-C(12)	122.55(13)
O(4)-C(14)-C(12)	110.22(12)
C(14)-C(15)-C(9)	116.65(13)
C(17)-C(16)-N(1)	126.48(13)
C(16)-C(17)-C(18)	119.58(14)
C(19)-C(18)-C(17)	114.34(14)
F(1)-C(19)-F(2)	106.47(14)
F(1)-C(19)-F(3)	107.37(16)
F(2)-C(19)-F(3)	105.21(14)
F(1)-C(19)-C(18)	112.89(15)
F(2)-C(19)-C(18)	112.87(14)
F(3)-C(19)-C(18)	111.53(15)

Symmetry transformations used to generate equivalent atoms:

Table 5. Anisotropic displacement parameters (A^2 x 10^3) for elmcg_b.

The anisotropic displacement factor exponent takes the form:

-2 pi^2 [h^2 a*^2 U11 + ... + 2 h k a* b* U12]

	U11	U22	U33	U23	U13	U12
N(1)	15(1)	19(1)	27(1)	1(1)	9(1)	1(1)
S(1)	14(1)	18(1)	23(1)	-2(1)	5(1)	-2(1)
O(1)	23(1)	28(1)	23(1)	-2(1)	7(1)	1(1)
O(2)	19(1)	23(1)	36(1)	-2(1)	7(1)	-7(1)
C(1)	16(1)	16(1)	23(1)	-1(1)	6(1)	-1(1)
C(2)	19(1)	21(1)	28(1)	2(1)	9(1)	0(1)
C(3)	16(1)	21(1)	36(1)	-2(1)	7(1)	-1(1)
C(4)	20(1)	22(1)	28(1)	-7(1)	2(1)	5(1)
C(5)	28(1)	28(1)	23(1)	1(1)	8(1)	6(1)
C(6)	22(1)	22(1)	25(1)	1(1)	11(1)	1(1)
C(7)	24(1)	40(1)	35(1)	-9(1)	-3(1)	9(1)
C(8)	16(1)	26(1)	21(1)	1(1)	6(1)	0(1)
C(9)	15(1)	20(1)	22(1)	1(1)	7(1)	-1(1)
C(10)	20(1)	22(1)	25(1)	-4(1)	9(1)	-3(1)
C(11)	22(1)	21(1)	34(1)	-2(1)	14(1)	1(1)
C(12)	14(1)	21(1)	30(1)	6(1)	9(1)	1(1)
O(3)	15(1)	29(1)	34(1)	6(1)	7(1)	2(1)
C(13)	18(1)	37(1)	28(1)	9(1)	4(1)	1(1)
O(4)	17(1)	40(1)	27(1)	-5(1)	0(1)	1(1)
C(14)	17(1)	25(1)	21(1)	1(1)	6(1)	-3(1)
C(15)	17(1)	24(1)	23(1)	-3(1)	8(1)	0(1)
C(16)	18(1)	22(1)	23(1)	1(1)	7(1)	-2(1)
C(17)	23(1)	23(1)	28(1)	2(1)	8(1)	0(1)

C(18)	39(1)	23(1)	33(1)	3(1)	11(1)	-4(1)
C(19)	36(1)	28(1)	32(1)	2(1)	10(1)	-6(1)
F(1)	38(1)	54(1)	73(1)	24(1)	-14(1)	-10(1)
F(2)	49(1)	29(1)	44(1)	3(1)	14(1)	-14(1)
F(3)	86(1)	44(1)	61(1)	-22(1)	44(1)	-17(1)

Table 6. Hydrogen coordinates (x 10^4) and isotropic displacement parameters (A^2 x 10^3) for elmcg_b.

	x	y	z	U(eq)
H(2)	1172	8627	6188	27
H(3)	-1109	8744	4760	30
H(5)	618	9845	2581	32
H(6)	2914	9721	3986	27
H(7A)	-2058	8954	1989	55
H(7B)	-2102	9915	2282	55
H(7C)	-2678	9244	2974	55
H(8A)	5200	8587	4682	25
H(8B)	4755	7636	4436	25
H(10)	6835	6965	4366	27
H(11)	9302	6607	5178	29
H(13A)	11485	7358	8944	34
H(13B)	12218	8089	8458	34
H(15)	7265	8566	7045	26
H(16)	3476	7417	6775	25
H(17)	4858	6479	5566	30
H(18A)	4646	5570	7138	39
H(18B)	3262	6096	7085	39

Table 7. Selected torsion angles [deg] for elmcg_b.

Symmetry transformations used to generate equivalent atoms:

Table 8. Torsion angles [deg] for elmcg_b.

C(16)-N(1)-S(1)-O(2)	161.56(10)
C(8)-N(1)-S(1)-O(2)	-29.42(12)
C(16)-N(1)-S(1)-O(1)	32.60(12)
C(8)-N(1)-S(1)-O(1)	-158.38(10)
C(16)-N(1)-S(1)-C(1)	-82.89(11)
C(8)-N(1)-S(1)-C(1)	86.13(11)
O(2)-S(1)-C(1)-C(2)	-154.78(11)
O(1)-S(1)-C(1)-C(2)	-22.63(13)
N(1)-S(1)-C(1)-C(2)	91.12(12)
O(2)-S(1)-C(1)-C(6)	28.30(14)
O(1)-S(1)-C(1)-C(6)	160.45(11)
N(1)-S(1)-C(1)-C(6)	-85.80(12)
C(6)-C(1)-C(2)-C(3)	1.9(2)
S(1)-C(1)-C(2)-C(3)	-175.00(11)
C(1)-C(2)-C(3)-C(4)	-0.5(2)
C(2)-C(3)-C(4)-C(5)	-1.2(2)
C(2)-C(3)-C(4)-C(7)	179.57(14)
C(3)-C(4)-C(5)-C(6)	1.6(2)
C(7)-C(4)-C(5)-C(6)	-179.18(14)
C(4)-C(5)-C(6)-C(1)	-0.3(2)
C(2)-C(1)-C(6)-C(5)	-1.5(2)
S(1)-C(1)-C(6)-C(5)	175.33(11)
C(16)-N(1)-C(8)-C(9)	-78.52(16)
S(1)-N(1)-C(8)-C(9)	112.76(12)
N(1)-C(8)-C(9)-C(10)	136.17(14)
N(1)-C(8)-C(9)-C(15)	-45.73(17)
C(15)-C(9)-C(10)-C(11)	-0.3(2)
C(8)-C(9)-C(10)-C(11)	177.79(13)
C(9)-C(10)-C(11)-C(12)	1.2(2)

C(10)-C(11)-C(12)-C(14)	-1.4(2)
C(10)-C(11)-C(12)-O(3)	-177.51(13)
C(11)-C(12)-O(3)-C(13)	-174.94(15)
C(14)-C(12)-O(3)-C(13)	8.54(15)
C(12)-O(3)-C(13)-O(4)	-14.37(15)
O(3)-C(13)-O(4)-C(14)	14.73(15)
C(13)-O(4)-C(14)-C(15)	173.86(15)
C(13)-O(4)-C(14)-C(12)	-9.54(16)
C(11)-C(12)-C(14)-C(15)	0.6(2)
O(3)-C(12)-C(14)-C(15)	177.40(13)
C(11)-C(12)-C(14)-O(4)	-176.16(13)
O(3)-C(12)-C(14)-O(4)	0.62(16)
O(4)-C(14)-C(15)-C(9)	176.59(13)
C(12)-C(14)-C(15)-C(9)	0.4(2)
C(10)-C(9)-C(15)-C(14)	-0.5(2)
C(8)-C(9)-C(15)-C(14)	-178.63(13)
C(8)-N(1)-C(16)-C(17)	7.8(2)
S(1)-N(1)-C(16)-C(17)	176.77(12)
N(1)-C(16)-C(17)-C(18)	176.88(14)
C(16)-C(17)-C(18)-C(19)	122.82(17)
C(17)-C(18)-C(19)-F(1)	-58.5(2)
C(17)-C(18)-C(19)-F(2)	-179.27(14)
C(17)-C(18)-C(19)-F(3)	62.5(2)

Symmetry transformations used to generate equivalent atoms:

Table 9. Hydrogen bonds for elmcg_b [A and deg.].

D-H...A	d(D-H)	d(H...A)	d(D...A)	<(DHA)