Supporting Information

Stereoselective Monofluoromethylation of *N*-*tert*-Butylsulfinyl Ketimines Using Pregenerated Fluoro(phenylsulfonyl)methyl Anion

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General Remarks:

The *N-tert*-butylsulfinyl ketimines[1] were prepared from the corresponding ketones according to the known condensation procedure in one step. Fluoromethyl phenyl sulfone **1**[2] was prepared according to the known procedures. Unless otherwise mentioned, all chemicals were purchased from commercial sources. THF was freshly distilled over sodium. Silica gel (300-400 mesh) was used for column chromatography, and in most cases petroleum ether/ethyl acetate combination was used as the eluent.

All the melting points were uncorrected. ^{1}H, ^{13}C and ^{19}F NMR spectra were recorded on 400 MHz or 300 MHz NMR spectrometer. ^{1}H NMR chemical shifts were determined relative to internal $(CH_3)_4Si$ (TMS) at δ 0.0 or to the signal of a residual protonated solvent: $CDCl_3$ δ 7.26. ^{13}C NMR chemical shifts were determined relative to internal TMS at δ 0.0. ^{19}F NMR chemical shifts were determined relative to $CFCl_3$ at δ 0.0. Chemical shifts are reported in ppm. Mass spectra were obtained on a mass spectrometer. High-resolution mass data were recorded on a high-resolution mass spectrometer in the EI, ESI or MALDI mode.

Typical procedure for stereoselective nucleophilic monofluoromethylation of *N-tert*-butylsulfinyl ketimines using fluoromethyl phenyl sulfone:

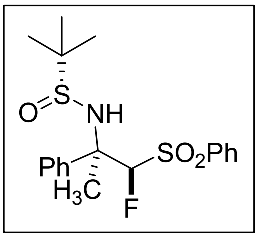
Condition A (*n*BuLi as a base): Under N_2 atmosphere, *n*-butyllithium in hexane (1.3 mmol) was added dropwise into the THF (8 mL) solution of fluoromethyl phenyl sulfone (209 mg, 1.2 mmol) at –78 °C, and after 30 min at that temperature, *N-tert*-butylsulfinyl ketimine (1.0 mmol) in 2mL THF was added slowly into the solution. The reaction mixture was then stirred vigorously at –78 °C for 1 h , followed by adding a saturated NaCl water solution (10 mL). The solution mixture was extracted with Et_2O (10 mL×3), and the combined organic phase was dried over $MgSO_4$. After the removal of volatile solvents under vacuum, the crude product was further purified by silica gel column chromatography to give product **4’** and **4”**.

Condition B (KHMDS as a base): Under N_2 atmosphere, KHMDS in toluene (1.1 mmol) was added dropwise into the THF (4 mL) solution of fluoromethyl phenyl sulfone (174 mg, 1.0 mmol) at –78 °C, and after 30 min at that temperature, *N-tert*-butylsulfinyl ketimine (0.5 mmol) in 1 mL of THF was added slowly into the solution. The reaction mixture was then stirred vigorously at –78 °C for 2 h , followed by adding a saturated NaCl water solution (10 mL). The solution mixture was extracted with Et_2O (10 mL×3), and the combined organic phase was dried over $MgSO_4$. After the removal of volatile solvents under vacuum, the crude product was further purified by silica gel column chromatography to give product **4’** and **4”**.

Sulfinamide 4a’+4a”:

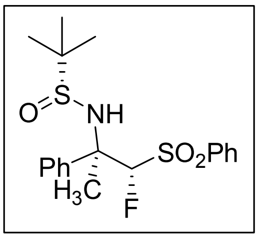
Using the typical procedure as condition A, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4a’** (198 mg) and **4a”** (158 mg) respectively, overall yield 90%.

Using the typical procedure as condition B, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4a’** (97mg) and **4a”** (30 mg) respectively, overall yield 64%.



4a’

White solid. mp 161−163 °C. $[\alpha]_D^{25}$ = −72.06 (c = 0.98, $CHCl_3$); ^{1}H NMR: δ 7.81 (d, J = 7.5 Hz, 2H), 7.62 (t, J = 7.5 Hz, 1H), 7.53−7.58 (m, 2H), 7.49 (t, J = 7.8 Hz, 2H), 7.31−7.37 (m, 3H), 5.81 (d, J = 45.0 Hz, 1H), 5.73 (brs, 1H), 1.97 (d, J = 2.4 Hz, 3H), 1.41 (s, 9H); ^{19}F NMR: δ −174.4 (d, J = 44.9 Hz, 1F); ^{13}C NMR: δ 139.7, 137.4, 134.3, 129.2, 129.0, 128.4, 128.3, 126.56, 126.52, 105.4 (d, J = 236.6 Hz), 62.4 (d, J = 16.7 Hz), 56.7, 25.4 (d, J = 4.8 Hz), 23.1; IR (KBr): 3293□2982□1497, 1447, 1329, 1164, 1050, 569 cm^{-1}; Anal. Calcd. for $C_{19}H_{24}FNO_3S_2$: C, 57.41; H, 6.09; N, 3.52; Found C, 57.46; H, 6.10; N, 3.55; MS (ESI, *m/z*) 398.1 (M^++1).



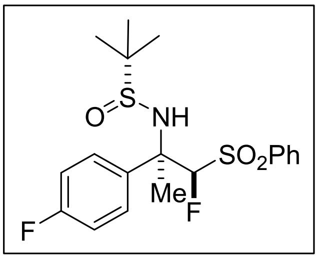
4a”

White solid. mp 155 −156 °C. $[\alpha]_D^{25}$ = −85.68 (c = 0.94, $CHCl_3$); ^{1}H NMR: δ 7.94 (d, J = 7.8 Hz, 2H), 7.71 (t, J = 7.5 Hz, 1H), 7.58 (t, J = 7.8 Hz, 2H), 7.46−7.51 (m, 2H), 7.33−7.41 (m, 3H), 5.35 (brs, 1H), 5.18 (d, J = 44.1 Hz, 1H), 2.15 (s, 3H), 1.30 (s, 9H); ^{19}F NMR: δ −178.2 (d, J = 45.7 Hz, 1F); ^{13}C NMR: δ 138.9, 137.2, 134.9, 129.5, 129.1, 128.7, 128.6, 127.8, 104.4 (d, J = 228.2 Hz), 63.5 (d, J = 21.9 Hz), 56.8, 22.9, 22.8; IR (KBr): 3271, 2938, 1585, 1475, 1450, 1327, 1150, 1057, 797, 686, 601 cm^{-1}; Anal. Calcd. for $C_{19}H_{24}FNO_3S_2$: C, 57.41; H, 6.09; N, 3.52; Found C, 57.42; H, 6.24; N, 3.32; MS (ESI, *m/z*) 398.1 (M^++1).

Sulfinamide 4b'+4b":

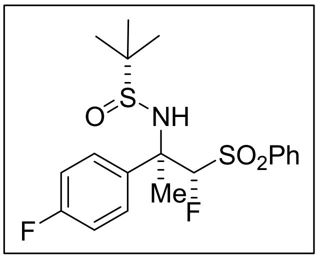
Using the typical procedure as condition A, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4b'** (185 mg) and **4b"** (151 mg) respectively, overall yield 81%.

Using the typical procedure as condition B, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4b'** (83 mg) and **4b"** (52 mg) respectively, overall yield 65%.



4b'

White solid. mp 178 −180°C. $[\alpha]_D^{25}$ = −70.96 (c = 0.98, $CHCl_3$); ^{1}H NMR: δ 7.81 (d, J = 7.5 Hz, 2H), 7.65 (t, J = 7.2 Hz, 1H), 7.48−7.56 (m, 4H), 7.02 (t, J = 8.7 Hz, 2H), 5.80 (d, J = 45.9 Hz, 1H), 5.71 (brs, 1H), 1.95 (d, J = 2.7 Hz, 3H), 1.41 (s, 9H); ^{19}F NMR: δ −114.4 − −114.3 (m, 1F), − 174.7 (d, J = 46.0 Hz, 1F); ^{13}C NMR: δ 162.6 (d, J = 248.2 Hz), 137.4, 135.7, 134.4, 129.3, 128.9, 128.4 (dd, J = 8.4, 3.0 Hz), 115.1 (d, J = 21.4 Hz), 105.3 (d, J = 237.1 Hz), 62.2 (d, J = 16.7 Hz), 56.7, 25.6 (d, J = 5.1 Hz), 23.0; IR (KBr): 3286, 2987, 1602, 1510, 1451, 1408, 1329, 1168, 1054, 836, 689, 620, 554 cm^{-1} Anal. Calcd. for $C_{19}H_{23}F_2NO_3S_2$: C, 54.92; H, 5.58; N, 3.37; Found C, 54.97; H, 5.72; N, 3.22; MS (ESI, *m/z*) 416.0 (M^++1).



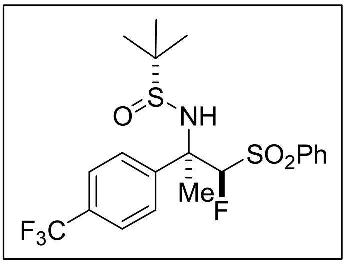
4b"

White solid. mp 162 −163°C. $[\alpha]_D^{25}$ = −82.86 (c = 1.03, $CHCl_3$); ^{1}H NMR: δ 7.94 (d, J = 8.1 Hz, 2H), 7.72 (t, J = 7.2 Hz, 1H), 7.59 (t, J = 7.8 Hz, 2H), 7.43−7.49 (m, 2H), 7.06 (t, J = 8.4 Hz, 2H), 5.33 (brs, 1H), 5.13 (d, J = 44.7 Hz, 1H), 2.14 (s, 3H), 1.29 (s, 9H); ^{19}F NMR: δ −113.3 − −113.2 (m, 1F), −178.7 (d, J = 44.3 Hz, 1F); ^{13}C NMR: δ 162.7 (d, J = 249.1 Hz), 137.2, 134.9, 134.7, 129.7 (d, J = 8.4 Hz), 129.5, 129.1, 115.5 (d, J = 22.1 Hz), 104.3 (d, J = 229.4 Hz), 63.1 (d, J = 22.0 Hz), 56.8, 22.9, 22.8; IR (KBr): 3276, 2956, 1739, 1604, 1513, 1450, 1325, 1311, 1148, 1056, 848, 729, 686, 595, 545 cm^{-1}. Anal. Calcd. for $C_{19}H_{23}F_2NO_3S_2$: C, 54.92; H, 5.58; N, 3.37; Found C, 54.99; H, 5.54; N, 3.13; MS (ESI, *m/z*) 416.0 (M^++1).

Sulfinamide 4c'+4c":

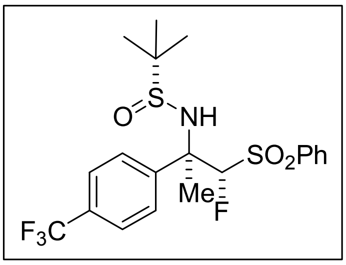
Using the typical procedure as condition A, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4c'** (218 mg) and **4c"** (182 mg) respectively, overall yield 86%.

Using the typical procedure as condition B, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4c'** (46 mg) and **4c"** (94 mg) respectively, overall yield 60%.



4c'

White solid. mp 142 −144°C. $[\alpha]_D^{25}$ = −53.63 (c = 0.98, $CHCl_3$); ^{1}H NMR: δ 7.78 (d, J = 7.2 Hz, 2H), 7.54−7.70 (m, 5H), 7.49 (t, J = 7.5 Hz, 2H), 5.89 (d, J = 45.6 Hz, 1H), 5.81 (brs, 1H), 1.96 (d, J = 3.3 Hz, 3H), 1.42 (s, 9H); ^{19}F NMR: δ −63.1 (s, 3F), −174.6 (d, J = 47.1 Hz, 1F); ^{13}C NMR: δ 144.1, 137.1, 134.6, 130.4 (q, J = 31.3 Hz), 129.3, 128.9, 126.95, 126.91, 125.2 (q, J = 4.9 Hz), 105.3 (d, J = 237.3 Hz), 62.4 (d, J = 16.7 Hz), 56.8, 25.5 (d, J = 5.3 Hz), 23.0; IR (KBr): 3287, 2974, 1622, 1450, 1328, 1164, 1121, 1054, 847, 687, 601, 519 cm^{-1} Anal. Calcd. for $C_{20}H_{23}F_4NO_3S_2$: C, 51.60; H, 4.98; N, 3.01; Found C, 51.70; H, 5.02; N, 2.83; MS (ESI, *m/z*) 466.0 (M^++1).



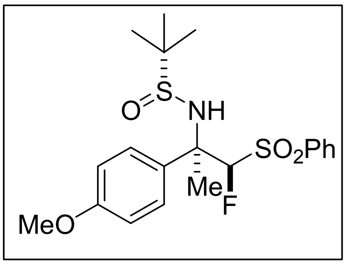
4c”

White solid. mp 180 −182°C. $[\alpha]_D^{25}$ = −71.17 (c = 0.93, $CHCl_3$); ^{1}H NMR: δ 7.93 (d, J = 8.1 Hz, 2H), 7.72 (t, J = 7.5 Hz, 1H), 7.55−7.64 (m, 6H), 5.39 (brs, 1H), 5.16 (d, J = 44.7 Hz, 1H), 2.18 (s, 3H), 1.31 (s, 9H); ^{19}F NMR: δ −63.2 (s, 3F), −178.8 (d, J = 44.6 Hz, 1F); ^{13}C NMR: δ 143.1, 136.9, 135.1, 130.8 (d, J = 33.5Hz), 129.5, 129.2, 128.3, 125.5 (d, J = 4.6 Hz), 122.0, 104.0 (d, J = 229.9 Hz), 63.4 (d, J = 22.0 Hz), 57.1, 22.9, 22.8; IR (KBr): 3292, 2945, 1620, 1417, 1328, 1152, 1134, 1056, 850, 613, 572, 536 cm^{-1} Anal. Calcd. for $C_{20}H_{23}F_4NO_3S_2$: C, 51.60; H, 4.98; N, 3.01; Found C, 51.44; H, 4.97; N, 2.80; MS (ESI, *m/z*) 466.1 (M^++1).

Sulfinamide 4d’+4d”:

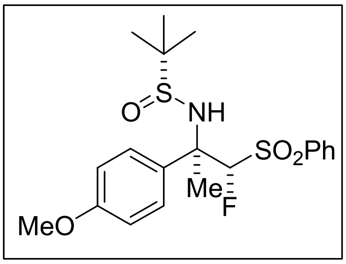
Using the typical procedure as condition A, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4d’** (188mg) and **4d”** (175mg) respectively, overall yield 85%.

Using the typical procedure as condition B, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4d’** (96 mg) and **4d”** (38 mg), respectively; overall yield 62%.



4d'

White solid. mp 100 −102^{o}C. $[\alpha]_D^{25}$ = −54.44 (c = 1.05, $CHCl_3$); ^{1}H NMR: δ 7.81 (d, J = 7.5 Hz, 2H), 7.63 (t, J = 7.5 Hz, 1H), 7.42−7.53 (m, 4H), 6.85 (d, J = 9.0 Hz, 2H), 5.74 (d, J = 45.3 Hz, 1H), 5.63 (brs, 1H), 3.81 (s, 3H), 1.96 (d, J = 2.4 Hz, 3H), 1.39 (s, 9H); ^{19}F NMR: δ −175.0 (d, J = 44.0 Hz, 1F); ^{13}C NMR: δ 159.5, 137.5, 134.3, 131.6, 129.2, 129.0, 127.8 (d, J = 2.3 Hz), 113.6, 105.6 (d, J = 235.4 Hz), 62.2 (d, J = 16.4 Hz), 56.6, 55.2, 25.3 (d, J = 3.1 Hz), 23.1; IR (KBr): 3452, 3286, 2977, 1614, 1516, 1323, 1256, 1186, 1141, 1055, 834, 689, 564, 515 cm^{-1}□Anal. Calcd. for $C_{20}H_{26}FNO_4S_2$: C, 56.18; H, 6.13; N, 3.28; Found C, 56.07; H, 6.22; N, 2.97; MS (ESI, *m/z*) 428.1 (M^++1).



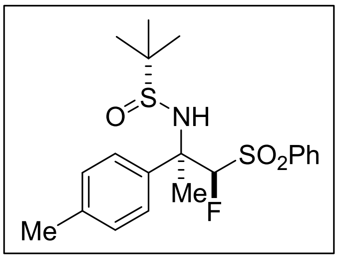
4d"

White solid. mp 171 −172^{o}C. $[\alpha]_D^{26}$ = −82.73 (c = 0.95, $CHCl_3$); ^{1}H NMR: δ 7.94 (d, J = 8.1 Hz, 2H), 7.71 (t, J = 7.2 Hz, 1H), 7.58 (t, J = 7.2 Hz, 2H), 7.38 (d, J = 9.0 Hz, 2H), 6.88 (d, J = 9.0 Hz, 2H), 5.29 (brs, 1H), 5.13 (d, J = 44.7 Hz, 1H), 3.80 (s, 3H), 2.12 (s, 3H), 1.29 (s, 9H); ^{19}F NMR: δ −178.5 (d, J = 43.7 Hz, 1F); ^{13}C NMR: δ 159.7, 137.3, 134.8, 130.7, 129.4, 129.1, 113.9, 104.5 (d, J = 228.5 Hz), 63.1 (d, J = 21.7 Hz), 56.7, 55.3, 22.9, 22.8; IR (KBr): 3295, 2953, 1612, 1517, 1309, 1259, 1151, 1058, 842, 728, 597 cm^{-1}□Anal. Calcd. for $C_{20}H_{26}FNO_4S_2$: C, 56.18; H, 6.13; N, 3.28; Found C, 56.16; H, 6.09; N, 3.10; MS (ESI, *m/z*) 428.2 (M^++1).

Sulfinamide 4e'+4e":

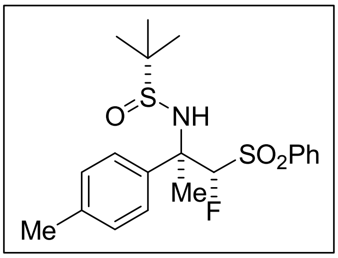
Using the typical procedure as condition A, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4e'** (218 mg) and **4e"** (163 mg) respectively, overall yield 93%.

Using the typical procedure as condition B, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4e'** (85mg) and **4e"** (55mg) respectively, overall yield 68%.



4e'

White solid. mp 145 −147 °C. $[\alpha]_D^{26}$ = −58.86 (c = 0.91, $CHCl_3$); ^{1}H NMR: δ 7.80 (d, J = 7.8 Hz, 2H), 7.62 (t, J = 7.5 Hz, 1H), 7.48 (t, J = 7.8 Hz, 2H), 7.42 (d, J = 7.5 Hz, 2H), 6.85 (d, J = 8.1 Hz, 2H), 5.77 (d, J = 45.3 Hz, 1H), 5.66 (brs, 1H), 2.34 (s, 3H), 1.96 (d, J = 2.7 Hz, 3H), 1.39 (s, 9H); ^{19}F NMR: δ −175.0 (d, J = 47.1 Hz, 1F); ^{13}C NMR: δ 138.1, 137.5, 136.7, 134.2, 129.2, 129.0, 128.9, 126.4 (d, J = 3.2 Hz), 105.6 (d, J = 236.9 Hz), 62.3 (d, J = 17.9 Hz), 56.7, 25.3 (d, J = 4.9 Hz), 23.1, 21.1; IR (KBr): 3456, 3291, 2978, 1517, 1450, 1324, 1163, 1140, 1056, 818, 688, 532 cm^{-1}□Anal. Calcd. for $C_{20}H_{26}FNO_3S_2$: C, 58.37; H, 6.37; N, 3.40; Found C, 58.40; H, 6.57; N, 3.20; MS (ESI, *m/z*) 412.1 (M^++1).



4e"

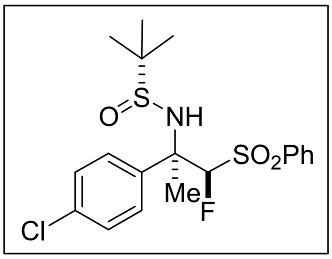
White solid. mp 175 −176 °C. $[\alpha]_D^{26}$ = −82.79 (c = 0.99, $CHCl_3$); ^{1}H NMR: δ 7.93 (d, J = 8.1 Hz, 2H), 7.70 (t, J = 7.2 Hz, 1H), 7.57 (t, J = 7.5 Hz, 2H), 7.36 (d, J = 8.1 Hz, 2H), 6.88 (d, J = 8.4 Hz, 2H), 5.32 (brs, 1H), 5.16 (d, J = 44.7 Hz, 1H), 2.34 (s, 3H), 2.12 (s, 3H), 1.29 (s, 9H); ^{19}F NMR: δ

−178.5 (d, J = 46.3 Hz, 1F); ^{13}C NMR: δ 138.7, 137.3, 135.9 (d, J = 2.6 Hz), 134.8, 129.4, 129.3, 129.1, 127.7, 104.5 (d, J = 228.7 Hz), 63.3 (d, J = 22.3 Hz), 56.8, 22.9, 22.8, 21.1; IR (KBr): 3290, 2945, 1449, 1310, 1150, 1056, 827, 729, 595 cm^{-1} Anal. Calcd. for $C_{20}H_{26}FNO_3S_2$: C, 58.37; H, 6.37; N, 3.40; Found C, 58.47; H, 6.36; N, 3.19; MS (ESI, *m/z*) 412.1 (M^++1).

Sulfinamide 4f'+4f":

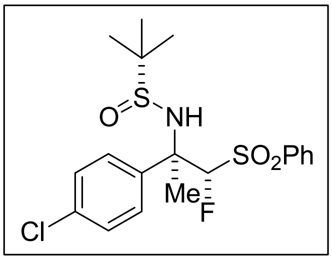
Using the typical procedure as condition A, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4f'** (180 mg) and **4f"** (152 mg), respectively; overall yield 77%.

Using the typical procedure as condition B, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4f'** (58 mg) and **4f"** (90 mg), respectively; overall yield 69%.



4f'

White solid. mp 163 −164 °C. $[\alpha]_D^{23}$ = −41.14 (c = 1.02, $CHCl_3$); ^{1}H NMR: δ 7.80 (d, J = 7.8 Hz, 2H), 7.65 (t, J = 7.5 Hz, 1H), 7.46−7.55 (m, 4H), 7.26-7.31 (m, 2H), 5.82 (d, J = 45.3 Hz, 1H), 5.72 (brs, 1H), 1.94 (d, J = 2.4 Hz, 3H), 1.41 (s, 9H); ^{19}F NMR: δ −174.6 (d, J = 45.5 Hz, 1F); ^{13}C NMR: δ 138.5, 137.2, 134.4, 134.3, 129.3, 128.9, 128.4, 127.97, 127.91, 105.3 (d, J = 236.5 Hz), 62.2 (d, J = 17.9 Hz), 56.7, 25.4 (d, J = 4.8 Hz), 23.1; IR (KBr): 3285, 2985, 1496, 1451, 1404, 1326, 1164, 1054, 1014, 830, 687, 616, 528 cm^{-1} Anal. Calcd. for $C_{19}H_{23}ClFNO_3S_2$: C, 52.83; H, 5.37; N, 3.24; Found C, 52.83; H, 5.42; N, 3.08; MS (ESI, *m/z*) 432.1 (M^++1).



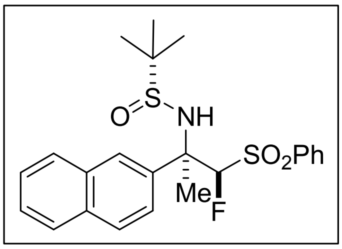
4f”

White solid. mp 167 −168 °C. $[\alpha]_D^{24}$ = −79.14 (c = 1.01, $CHCl_3$); ^{1}H NMR: δ 7.94 (d, J = 7.8 Hz, 2H), 7.74 (t, J = 7.2 Hz, 1H), 7.59 (t, J = 8.1 Hz, 2H), 7.42 (d, J = 9.0 Hz, 2H), 7.34 (d, J = 9.0 Hz, 2H), 5.33 (brs, 1H), 5.12 (d, J = 44.7 Hz, 1H), 2.13 (s, 3H), 1.29 (s, 9H); ^{19}F NMR: δ −178.3 (d, J = 46.0 Hz, 1F); ^{13}C NMR: δ 137.5, 137.1, 134.9, 134.8, 129.5, 129.2, 129.1, 128.8, 104.1 (d, J = 229.3 Hz), 63.2 (d, J = 22.3 Hz), 56.9, 22.9, 22.8; IR (KBr): 3310, 3276, 2939, 1498, 1449, 1328, 1151, 1057, 1013, 840, 722, 580, 536 cm^{-1}□Anal. Calcd. for $C_{19}H_{23}ClFNO_3S_2$: C, 52.83; H, 5.37; N, 3.24; Found C, 52.80; H, 5.42; N, 3.13; MS (ESI, *m/z*) 432.1 (M^++1).

Sulfinamide 4g’+4g”:

Using the typical procedure as condition A, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4g’** (170 mg) and **4g”** (148 mg) respectively, overall yield 72%.

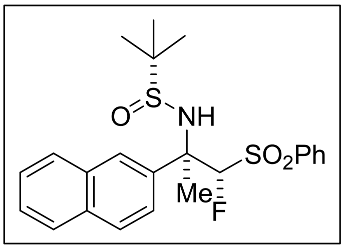
Using the typical procedure as condition B, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4g’** (51 mg) and **4g”** (101 mg) respectively, overall yield 68%.



4g’

White solid. mp 156 −157 °C. $[\alpha]_D^{26}$ = −34.82 (c = 0.99, $CHCl_3$); ^{1}H NMR: δ 7.98 (s, 1H), 7.71−7.84 (m, 5H), 7.45−7.64 (m, 4H), 7.36(t, J = 7.5 Hz, 2H), 5.87 (d, J = 45.6 Hz, 1H), 5.78 (brs, 1H), 2.07 (d, J = 2.7 Hz, 3H), 1.45 (s, 9H); ^{19}F NMR: δ −174.7 (d, J = 44.6 Hz, 1F); ^{13}C NMR: δ

137.2, 137.1, 134.3, 133.0, 132.8, 129.1, 129.0, 128.6, 127.8, 127.5, 126.6, 126.3, 125.9, 124.5, 105.8 (d, *J* = 237.1 Hz), 62.7 (d, *J* = 16.6 Hz), 56.8, 25.4 (d, *J* = 2.6 Hz), 23.1; IR (KBr): 3291, 3063, 1448, 1330, 1161, 1069, 754, 687, 595, 534 cm^{-1}□Anal. Calcd. for $C_{23}H_{26}FNO_3S_2$: C, 61.72; H, 5.86; N, 3.13; Found C, 61.69; H, 6.05; N, 2.96; MS (ESI, *m/z*) 448.1 (M^++1).



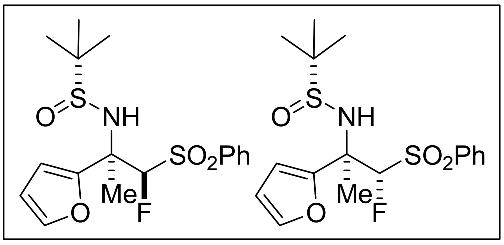
4g"

White solid. mp 170 −171 °C. $[\alpha]_D^{26}$ = −116.64 (c = 1.09, $CHCl_3$); ^{1}H NMR: δ 7.93−7.97 (m, 3H), 7.79−7.86 (m, 3H), 7.69 (t, *J* = 7.8 Hz, 1H), 7.49-7.60 (m, 5H), 5.41 (brs, 1H), 5.30 (d, *J* = 45.0 Hz, 1H), 2.28 (s, 3H), 1.30 (s, 9H); ^{19}F NMR: δ −178.2 (d, *J* = 44.3 Hz, 1F); ^{13}C NMR: δ 137.2□ 136.0□134.9□ 133.0□ 132.9□ 129.5□ 129.1□ 128.6□ 128.4□ 128.2□ 127.5□ 127.1□ 126.6□ 124.5□ 104.1 (d, *J* = 230.9 Hz), 63.7 (d, *J* = 22.5 Hz), 56.9, 22.9, 22.8; IR (KBr): 3293, 2942, 1450, 1320, 1189, 1150, 1056, 823, 755, 684, 593, 543 cm^{-1}□Anal. Calcd. for $C_{23}H_{26}FNO_3S_2$: C, 61.72; H, 5.86; N, 3.13; Found C, 61.80; H, 5.96; N, 2.97; MS (ESI, *m/z*) 448.1 (M^++1).

Sulfinamide 4h'+4h":

Using the typical procedure as condition A, the crude product was purified by silica gel column chromatography to afford a mixture of two diastereoisomers **4h'** and **4h"** in the ratio 1:1 (determined by ^{19}F NMR of the crude reaction mixture), overall yield 81%.

Using the typical procedure as condition B, the crude product was purified by silica gel column chromatography to afford a mixture of two diastereoisomers **4h'** and **4h"** in the ratio 4:1 (determined by ^{19}F NMR of the crude reaction mixture), overall yield 77%.



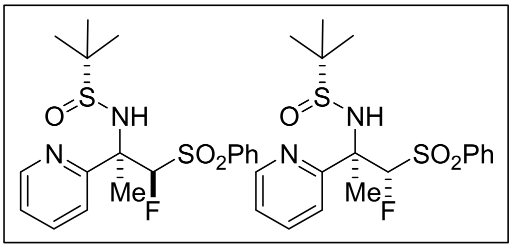
4h' + 4h"

^{1}H NMR: δ 7.88−7.97 (m, 2H), 7.52−7.76 (m, 3H), 7.43−7.46 (m, 0.4H), 7.39−7.41 (m, 0.6H), 6.55 (d, J = 3.6 Hz, 0.6H), 6.47 (d, J = 3.6 Hz, 0.4H), 6.40−6.43 (m, 0.4H), 6.36−6.39 (m, 0.6H), 5.62 (d, J = 45.6 Hz, 0.4H), 5.43 (d, J = 44.7 Hz, 0.6H), 5.15 (brs, 0.4H), 5.01 (brs, 0.6H), 2.06 (s, 1.8H), 1.98 (d, J = 2.4 Hz, 1.2H), 1.29 (s, 3.6H), 1.26 (s, 5.4H); ^{19}F NMR: δ −178.2 (d, J = 45.7 Hz, 0.6F)−179.3 (d, J = 45.1 Hz, 0.4F); IR (KBr): 3295, 2959, 1585, 1449, 1327, 1162, 1063, 1021, 726, 574, 537 cm^{-1}; MS (ESI, *m/z*) 388.0 (M$^+$+1); HRMS analysis (MALDI) *m/z*: Calcd. For $C_{17}H_{22}NO_4FS_2Na$ (M$^+$+Na): 410.0857; Found 410.0866.

Sulfinamide 4i'+4i":

Using the typical procedure as condition A, the crude product was purified by silica gel column chromatography to afford a mixture of two diastereoisomers **4i'** and **4i"** in the ratio 1.3:1 (determined by ^{19}F NMR of the crude reaction mixture), overall yield 81%.

Using the typical procedure as condition B, the crude product was purified by silica gel column chromatography to afford a mixture of two diastereoisomers **4i'** and **4i"** in the ratio 1.2:1 (determined by ^{19}F NMR of the crude reaction mixture), overall yield 74%.



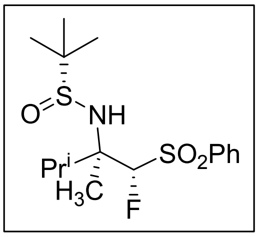
4i' + 4i"

^{1}H NMR: δ 8.62 (d, J = 4.8 Hz, 0.56H), 8.58 (d, J = 4.5 Hz, 0.44H), 7.47−7.92 (m, 7H), 7.24−7.34 (m, 1H), 5.88 (d, J = 45.0 Hz, 0.44H), 5.81 (d, J = 45.9 Hz, 0.56H), 5.64 (brs, 0.44H), 5.62 (brs, 0.56H), 2.11 (d, J = 1.2 Hz,, 1.32H), 1.98 (d, J = 2.1 Hz, 1.68H), 1.30 (s, 3.96H), 1.26 (s, 5.04H); ^{19}F NMR: δ −179.0 (d, J = 44.6 Hz, 0.56F)−180.8 (d, J = 45.1 Hz, 0.44F); IR (KBr): 3469, 3290, 2960, 1589, 1469, 1449, 1330, 1155, 1067, 751, 720, 688, 564, 537 cm^{-1}; MS (ESI, *m/z*) 399.1 (M$^+$+1); HRMS analysis (MALDI) *m/z*: Calcd. For $C_{18}H_{23}N_2O_3FS_2Na$ (M$^+$+Na): 421.1024; Found 421.1026.

Sulfinamide 4j'+4j":

Using the typical procedure as condition A, the crude product was purified by silica gel column chromatography to afford only a diastereoisomer **4j**" (the other diastereoisomer **4j'** was mixed with unreacted fluoromethyl phenyl sulfone **1**, the ratio of **4j'** and **4j"** 1:1.6), overall yield (determined by ^{19}F NMR of the crude reaction mixture) 81%.

Using the typical procedure as condition B, the crude product was purified by silica gel column chromatography to afford only a diastereoisomer **4j**" (the other diastereoisomer **4j'** was mixed with unreacted fluoromethyl phenyl sulfone **1**, the ratio of **4j'** and **4j"** is 1:1.6), overall yield 73% (determined by ^{19}F NMR of the crude reaction mixture).



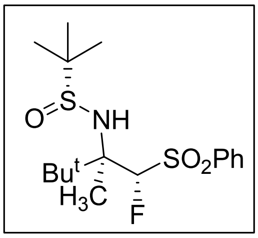
4j"

White solid. mp 125 −126°C. $[\alpha]_D^{24}$ = −89.71 (c = 0.90, $CHCl_3$); ^{1}H NMR: δ 7.97 (d, J = 7.5 Hz, 2H), 7.69 (t, J = 7.2 Hz, 1H), 7.58 (t, J = 7.5 Hz, 2H), 5.19 (d, J = 45.6 Hz, 1H), 4.47 (brs, 1H), 2.52-2.62 (m, 1H), 1.64 (s, 3H), 1.26 (s, 9H), 1.11 (dd, J = 6.9, 2.4 Hz, 3H), 1.04 (d, J = 6.0 Hz, 3H); ^{19}F NMR: δ −175.7 (d, J = 43.7 Hz, 1F); ^{13}C NMR: δ 137.3, 134.6, 129.3, 105.4 (d, J = 226.9 Hz), 63.0 (d, J = 16.4 Hz), 56.5, 34.8, 22.8, 20.4 (d, J = 3.8 Hz), 17.9, 17.7 (d, J = 5.7 Hz); IR (KBr): 3307, 2946, 1451, 1319, 1273, 1150, 1073, 897, 838, 687, 593, 557 cm^{-1} Anal. Calcd. for $C_{16}H_{26}FNO_3S_2$: C, 52.87; H, 7.21; N, 3.85; Found C, 52.88; H, 7.28; N, 3.68; MS (ESI, *m/z*) 364.1 (M^++1).

Sulfinamide 4k'+4k":

Using the typical procedure as condition A, the crude product was purified by silica gel column chromatography to afford only a diastereoisomer **4k**" (the other diastereoisomer **4k'** was mixed with unreacted fluoromethyl phenyl sulfone **1**, the ratio of **4k'** and **4k"** 1:1.8), overall yield 77% (determined by ^{19}F NMR of the crude reaction mixture).

Using the typical procedure as condition B, the crude product was purified by silica gel column chromatography to afford only a diastereoisomer **4k''** (the other diastereoisomer **4k'** was mixed with unreacted fluoromethyl phenyl sulfone **1**, the ratio of **4k'** and **4k''** is 1:2.9), overall yield 47% (determined by ^{19}F NMR of the crude reaction mixture).



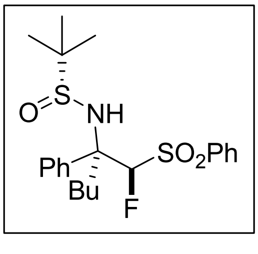
4k''

White solid. mp 142 −143 °C. $[\alpha]_D^{24}$ = −117.72 (c = 1.03, $CHCl_3$); ^{1}H NMR: δ 8.00 (d, J = 7.5 Hz, 2H), 7.68 (t, J = 7.8 Hz, 1H), 7.57 (t, J = 7.5 Hz, 2H), 5.26 (d, J = 43.8 Hz, 1H), 4.76 (brs, 1H), 1.65 (d, J = 2.7 Hz, 3H), 1.28 (s, 9H), 1.16 (s, 9H); ^{19}F NMR: δ −173.4 (d, J = 57.9 Hz, 1F); ^{13}C NMR: δ 137.8, 134.5, 129.4, 129.3, 104.9 (d, J = 225.7 Hz), 67.3 (d, J = 16.6 Hz), 56.8, 39.2, 26.5, 23.0, 17.5 (d, J = 6.9 Hz); IR (KBr): 3317, 2955, 1585, 1450, 1324, 1273, 1162, 1084, 1071, 903, 688, 589 cm^{-1};Anal. Calcd. for $C_{17}H_{28}FNO_3S_2$: C, 54.08; H, 7.48; N, 3.71; Found C, 54.07; H, 7.54; N, 3.51; MS (ESI, *m/z*) 378.1 (M^++1).

Sulfinamide 4l'+4l'':

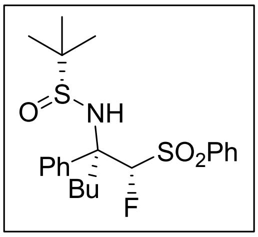
Using the typical procedure as condition A, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4l'** (127 mg) and **4l''** (263 mg), respectively; overall yield 88%.

Using the typical procedure as condition B, the crude product was purified by silica gel column chromatography to afford two diastereoisomers **4l'** (42 mg) and **4l''** (154 mg), respectively; overall yield 67%.



4l'

White solid. mp 170 −172°C. $[\alpha]_D^{24}$ = −60.81 (c = 1.05, $CHCl_3$); ^1H NMR: δ 7.87 (d, J = 7.5 Hz, 2H), 7.64 (t, J = 7.2 Hz, 1H), 7.36−7.56 (m, 7H), 5.45 (d, J = 45.9 Hz, 1H), 5.44 (brs, 1H), 2.55−2.67 (m, 1H), 2.17−2.29 (m, 1H), 1.38 (s, 9H), 1.19−1.32 (m, 3H), 0.87−1.02(m, 1H), 0.81 (t, J = 6.6 Hz, 3H); ^{19}F NMR: δ −172.2 (d, J = 47.1 Hz, 1F); ^{13}C NMR: δ137.0, 136.8, 134.5, 129.5, 129.2, 128.6, 128.4, 126.9, 104.5 (d, J = 236.0 Hz), 65.9 (d, J = 19.8 Hz), 57.3, 35.5, 24.8, 23.2, 22.6, 13.8; IR (KBr): 3298, 2958, 1467, 1448, 1324, 1256, 1158, 1071, 779, 687, 572, 541 cm^{-1}; Anal. Calcd. for $C_{22}H_{30}FNO_3S_2$: C, 60.11; H, 6.88; N, 3.19; Found C, 60.28; H, 6.85; N, 3.10; MS (ESI, *m/z*) 440.1 (M^++1).

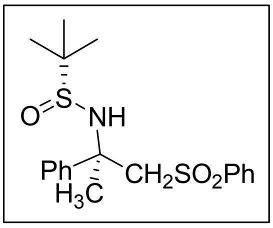


4l"

White solid. mp 162−164°C. $[\alpha]_D^{24}$ = −50.56 (c = 0.99, $CHCl_3$); ^1H NMR: δ 7.79 (d, J = 7.5 Hz, 2H), 7.60 (t, J = 7.5 Hz, 1H), 7.43−7.51 (m, 4H), 7.30−7.38 (m, 3H), 6.07 (d, J = 45.6 Hz, 1H), 5.81 (brs, 1H), 2.29−2.39 (m, 2H), 1.45 (s, 9H), 1.12−1.30 (m, 3H), 0.77 (t, J = 6.9 Hz, 3H), 0.58−0.72 (m, 1H); ^{19}F NMR: δ −175.8 (d, J = 46.9 Hz, 1F); ^{13}C NMR: δ 137.8, 134.1, 129.2, 128.9, 128.2, 128.1 126.53, 126.50, 105.3 (d, J = 235.6 Hz), 64.9 (d, J = 18.6 Hz), 57.0, 34.2 (d, J = 1.9 Hz), 23.8, 23.1, 22.4, 13.9; IR (KBr): 3287, 2870, 1447, 1332, 1164, 1055, 871, 757, 702, 577, 527 cm^{-1}; Anal. Calcd. for $C_{22}H_{30}FNO_3S_2$: C, 60.11; H, 6.88; N, 3.19; Found C, 60.00; H, 6.81; N, 3.10; MS (ESI, *m/z*) 440.1 (M^++1).

Addition of Lithiated Methyl Sulfones to 2a:

Under N_2 atmosphere, *n*-Butyllithium in hexane (1.3 mmol) was added dropwise into the THF (8 mL) solution of methyl phenyl sulfone (188 mg, 1.2 mmol) at -78 °C, and after 30 min at that temperature, *N-tert*-butanesulfinyl ketimine **2a** (224mg, 1.0 mmol) in 2 mL of THF was added slowly into the solution. The reaction mixture was then stirred vigorously at –78 °C for 3.5 h , followed by adding a saturated NaCl water solution (10 mL) at this temperature. The solution mixture was extracted with Et_2O (10 mL×3), and the combined organic phase was dried over $MgSO_4$. After the removal of volatile solvents under vacuum, the crude product was further purified by silica gel column chromatography to give product **7** in 58% yield (222 mg).



7

White solid. mp 104 −105°C. $[\alpha]_D^{23}$ = −61.83 (c = 0.95, $CHCl_3$); ^{1}H NMR: *δ* 7.79 (d, *J* = 7.2 Hz, 2H), 7.58 (t, *J* = 7.2 Hz, 1H), 7.38−7.50 (m, 4H), 7.24−7.32 (m, 3H), 5.92 (s, 1H), 3.89 (d, *J* = 14.7 Hz, 1H), 3.78 (d, *J* = 14.7 Hz, 1H), 1.91 (s, 3H), 1.37 (s, 9H); ^{13}C NMR: *δ* 142.8, 140.9, 133.6, 129.2, 128.4, 127.8, 127.6, 126.0, 66.9, 60.2, 56.4, 28.7, 23.1; IR (KBr): 3284, 2971, 2497, 1495, 1448, 1309, 1147, 1057, 773, 680, 611 cm^{-1}□Anal. Calcd. for $C_{19}H_{25}NO_3S_2$: C, 60.13; H, 6.64; N, 3.69; Found C, 60.00; H, 6.55; N, 3.43; MS (ESI, *m/z*) 380.2 (M^++1).

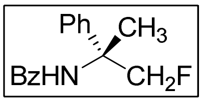
Procedure for magnesium-mediated reductive desulfonylation and deprotection of the *tert*-butylsulfinyl group and benzoylation of 4a:

Into a 50-mL Schlenk flask containing **4a** (210 mg, 0.52 mmol) in 5 mL DMF at room temperature was added 3 mL of HOAc/NaOAc (1:1) buffer solution (8 mol/L). Magnesium turnings (183 mg, 7.5 mmol) were added in portions. The reaction mixture was stirred at room temperature for 8 h followed by adding 10 mL of water. The solution mixture was extracted with Et_2O (20 mL x 3), and the combined organic phase was washed with saturated $NaHCO_3$ solution and brine, then dried over $MgSO_4$ and the solvent was removed to give the intermediate product without further purification.

The intermediate product was dissolved in 5 mL of anhydrous methanol. Then 0.5 mL of HCl/Dioxane (4N) was added. The reaction mixture was stirred at room temperature for 30 min and was then concentrated to near dryness. Diethyl ether wad added to precipitate out the amine hydrochloride.

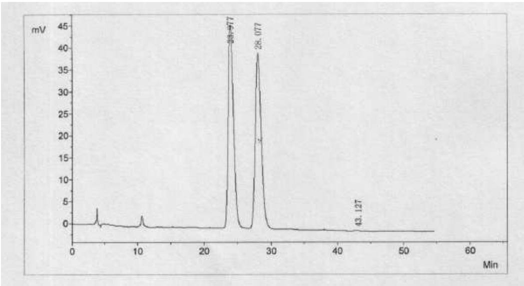
Under N_2 atmosphere, a flask containing the amine hydrochloride without further purification

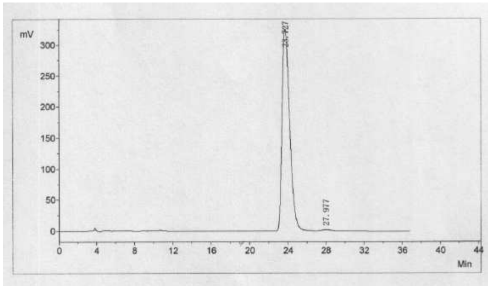
PhCOCl (1.5 mmol), Et_3N (1.5 mmol) and K_2CO_3 (0.5 mmol) in 5 mL of dioxane was stirred at 60 ^{o}C for 5 h. Then removal of the solvents under reduced pressure and flash chromatography afforded **10** (96 mg) as a white solid in total 72% yield.



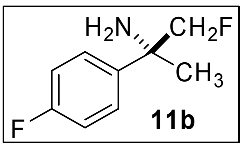
10

HPLC: CHIRAIPAK OD hexane/2-propanol= 95:5; 0.7mL/min; UV 214 nm; (R)-, r_t= 23.9 min, (S)-, r_t = 28.0 min (98.7% ee);

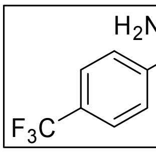




White solid. mp 141−142°C. $[\alpha]_D^{23}$ = 21.08 (c = 0.97, $CHCl_3$); ^{1}H NMR: δ 7.80 (d, J = 7.5 Hz, 2H), 7.25−7.55 (m, 8H), 6.61 (brs, 1H), 4.84 (dd, J = 25.2, 9.0Hz, 1H), 4.69 (dd, J = 24.6, 9.0 Hz, 1H), 1.90 (d, J = 2.1 Hz, 3H); ^{19}F NMR: δ −221.9 (t, J = 48.0 Hz, 1F); ^{13}C NMR: δ 166.9, 141.4, 134.9, 131.7, 128.7, 128.6, 127.7, 127.0, 125.5, 87.6 (d, J = 179.9 Hz), 59.3, 22.6 (d, J = 4.0 Hz); IR (KBr): 3255, 3062, 1638, 1540, 1494, 1317, 1035, 1022, 699, 607 cm^{-1} Anal. Calcd. for $C_{16}H_{16}FNO$: C, 74.69; H, 6.27; N, 5.44; Found C, 74.58; H, 6.12; N, 5.24; MS (ESI, *m/z*) 258.4 (M^++1).

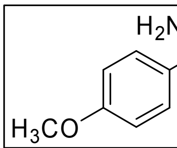


^{1}H NMR: δ 7.49 (dd, J = 9.0, 5.1 Hz, 2H), 7.04 (t, J = 8.7 Hz, 2H), 4.36 (d, J = 48.0 Hz, 2H), 1.67 (s, 2H), 1.50 (d, J = 1.8 Hz, 3H); ^{19}F NMR: δ −116.0 to −116.2 (m, 1F), −220.1 (t, J = 52.7 Hz, 1F); ^{13}C NMR: δ 136.1, 127.4 (d, J = 1.6 Hz), 127.3, 115.1 (d, J = 20.9 Hz), 91.0 (d, J = 177.3 Hz), 55.1, 26.6 (d, J = 3.6 Hz); IR (KBr): 2929, 1602, 1512, 1233, 1165, 1012, 836, 572 cm^{-1}; MS (EI, *m/z*, %) 42 (39.14), 138 (M−CH_2F, 100.00); HRMS analysis (EI) *m/z*: Calcd. For $C_9H_{11}NF_2$ (M^+): 171.0860; Found 171.0855.



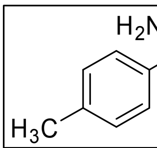
11c

^{1}H NMR: δ 7.66 (d, J = 8.4 Hz, 2H), 7.62 (d, J = 9.0 Hz, 2H), 4.49 (dd, J = 15.3, 9.0 Hz, 1H), 4.33 (dd, J = 15.0, 9.0 Hz, 1H), 1.67 (s, 2H), 1.51 (d, J = 2.4 Hz, 3H); ^{19}F NMR: δ − 62.6 (s, 3F), − 220.7 (t, J = 42.0 Hz, 1F); ^{13}C NMR: δ 148.6, 129.3 (q, J = 95.8 Hz), 126.1, 125.3 (q, J = 3.8 Hz), 90.7 (d, J = 178.4 Hz), 55.4 (d, J = 17.6 Hz), 26.5 (d, J = 2.6 Hz); IR (KBr): 3379, 2979, 1620, 1412, 1330, 1168, 1118, 1016, 842, 617 cm^{-1}; MS (EI, *m/z*, %) 42 (30.94), 188 (M−CH_2F, 100.00); HRMS analysis (EI) *m/z*: Calcd. For $C_{10}H_{11}NF_4$ (M^+): 221.0828; Found 221.0828.



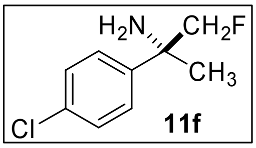
11d

^{1}H NMR: δ 7.43 (d, J = 9.3 Hz, 2H), 7.11 (d, J = 8.7 Hz, 2H), 4.34 (d, J = 47.7 Hz, 2H), 3.80 (s, 3H), 1.70 (s, 2H), 1.50 (d, J = 1.8 Hz, 3H); ^{19}F NMR: δ − 219.9 (t, J = 45.4 Hz, 1F); ^{13}C NMR: δ 158.6, 136.4 (d, J = 4.3 Hz), 126.7, 113.7, 91.2 (d, J = 177.0 Hz), 55.2, 54.9 (d, J = 17.8 Hz), 26.5 (d, J = 4.2 Hz); IR (KBr): 2970, 1611, 1514, 1251, 1182, 1034, 831, 410 cm^{-1}; MS (EI, *m/z*, %) 42 (18.09), 150 (M−CH_2F, 100.00); HRMS analysis (EI) *m/z*: Calcd. For $C_{10}H_{14}NOF$ (M^+): 183.1059; Found 183.1060.



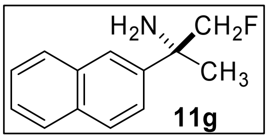
11e

^{1}H NMR: δ 7.32 (d, J = 8.4 Hz, 2H), 7.11 (d, J = 8.4 Hz, 2H), 4.30 (d, J = 48.0 Hz, 2H), 2.27 (s, 2H), 1.61 (s, 3H), 1.43 (d, J = 1.5 Hz, 3H); ^{19}F NMR: δ − 220.5 (t, J = 52.2 Hz, 1F); ^{13}C NMR: δ 141.4, 136.8, 129.1, 125.4, 91.2 (d, J = 177.2 Hz), 55.1 (d, J = 17.8 Hz), 26.5 (d, J = 3.7 Hz), 20.9; IR (KBr): 3378, 2972, 1514, 1010, 817, 424, 404 cm^{-1}; MS (EI, *m/z*, %) 42 (27.99), 134 (M−CH_2F, 100.00); HRMS analysis (EI) *m/z*: Calcd. For $C_{10}H_{14}NF$ (M^+): 167.1110; Found 167.1104.



11f

^{1}H NMR: δ 7.46 (d, J = 8.4 Hz, 2H), 7.33 (d, J = 9.0 Hz, 2H), 4.44 (dd, J = 10.8, 8.4 Hz, 1H), 4.28 (dd, J =11.1, 9.3 Hz, 1H), 1.78 (s, 2H), 1.49 (d, J = 1.8 Hz, 3H); ^{19}F NMR: δ − 220.2 (t, J = 51.3 Hz, 1F); ^{13}C NMR: δ 142.9, 133.0, 128.5, 127.1, 90.8 (d, J = 178.4 Hz), 55.1 (d, J = 18.4 Hz), 26.5 (d, J = 3.8 Hz); IR (KBr): 2975, 1594, 1494, 1096, 1013, 829, 579, 410 cm^{-1}; MS (EI, *m/z*, %) 42 (39.00), 154 (M−CH_2F, 100.00), 156 (32.20); HRMS analysis (EI) *m/z*: Calcd. For $C_9H_{11}NFCl$ (M^+): 187.0564; Found 187.0561.



11g

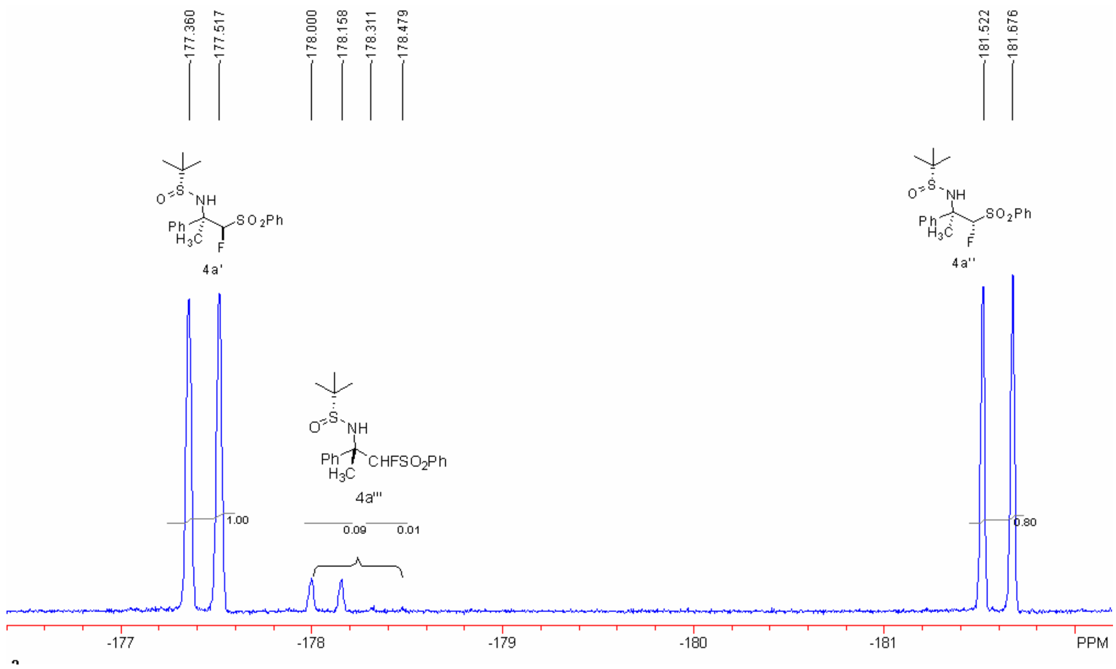
^{1}H NMR: δ 7.96 −7.99 (m, 1H), 7.79 −7.88 (m, 3H), 7.62 (dd, J = 8.7, 1.8 Hz, 1H), 7.44 −7.52 (m, 2H), 4.49 (d, J = 47.4 Hz, 2H), 1.84 (s, 2H), 1.60 (d, J = 2.1 Hz, 3H); ^{19}F NMR: δ − 220.6 (t, J = 52.7 Hz, 1F); ^{13}C NMR: δ 133.2, 132.4, 128.2, 128.1, 127.4, 126.2, 126.0, 124.3, 123.9, 91.0 (d, J = 177.5 Hz), 55.5 (d, J = 17.9 Hz), 26.5 (d, J = 3.6 Hz); IR (KBr): 3059, 2971, 1601, 1506, 1276, 1011, 819, 749, 479, 405 cm^{-1}; MS (EI, *m/z*, %) 129 (26.43), 170 (M−CH_2F, 100.00); HRMS analysis (EI) *m/z*: Calcd. For $C_{13}H_{14}NF$ (M^+): 203.1110; Found 203.1114.

References:

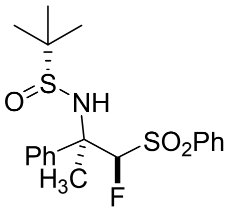
1. Liu, G.; Cogan, D.A.; Owens, T.D.; Tang, T.P.; Ellman, J.A. *J. Org. Chem.* **1999**, *64*, 1278.

2. *Encyclopedia of Reagents for Organic Synthesis, Vol. 4,* pp 2558-2561, Paquette, L. A., et.al Eds; John Wiley & Sons: Chichester, 2002.

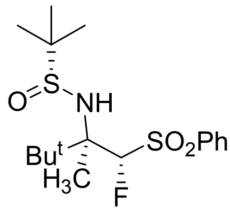
Example of determination of facial selectivity ratio of 4 (the organic phase of the reaction mixture after saturated NaCl water solution was added) by ^{19}F NMR:



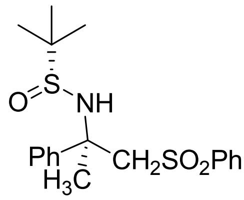
Determination of the absolute configuration of 4a', 4k'' and 7 by X-ray analysis



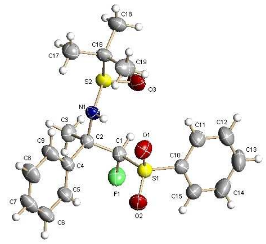
4a'

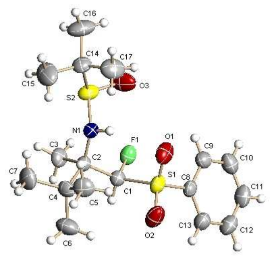


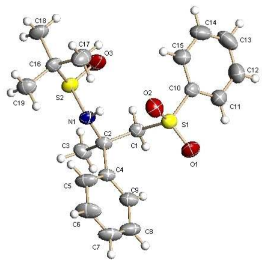
4k'



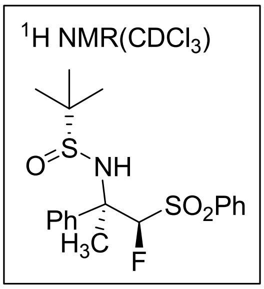
7





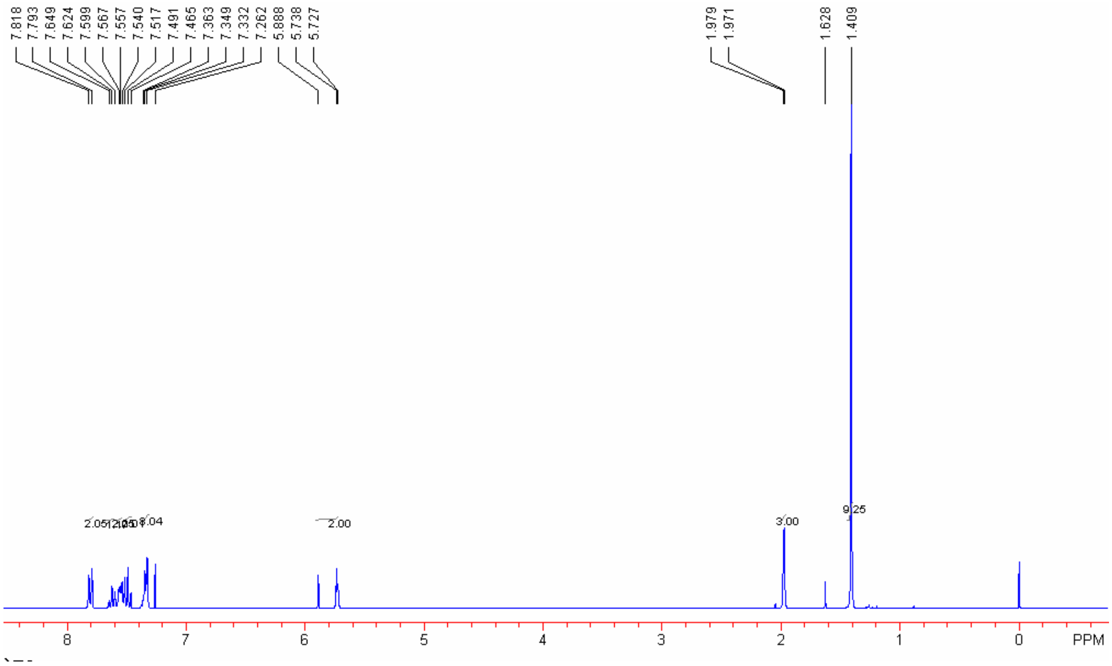


NMR spectra for all isolated products

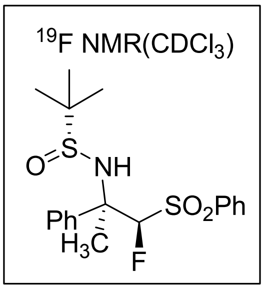


^{1}H NMR(CDCl$_3$)
O
S
NH
Ph
H$_3$C
SO$_2$Ph
F

4a'

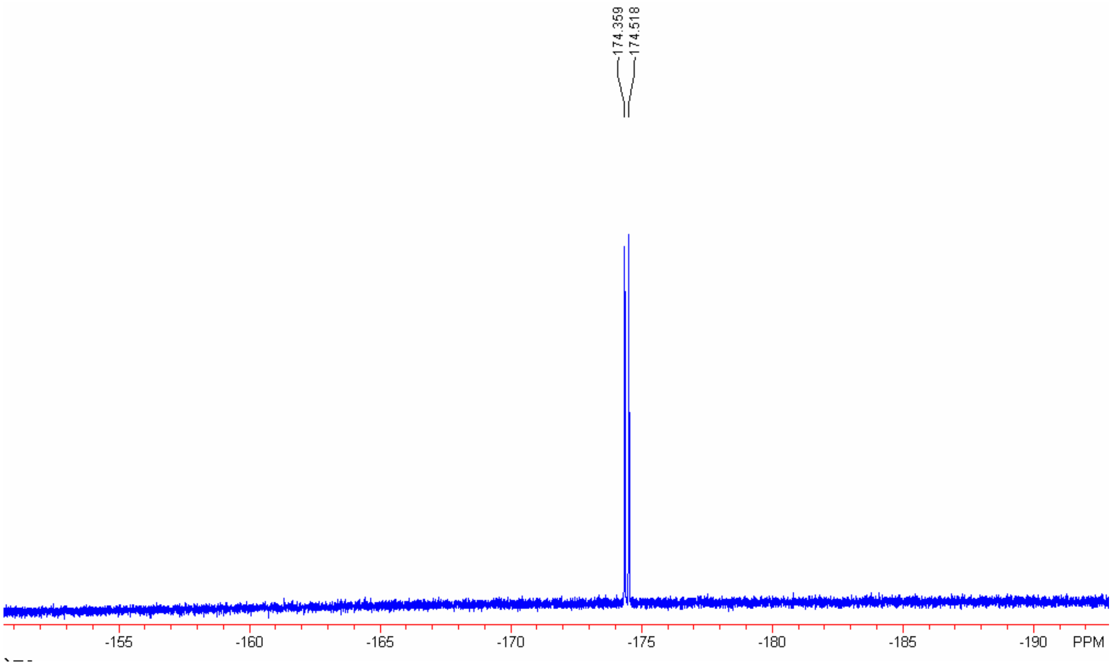


7.818
7.793
7.649
7.624
7.599
7.567
7.557
7.540
7.517
7.491
7.465
7.363
7.349
7.332
7.262
5.888
5.738
5.727
1.979
1.971
1.628
1.409
2.00
3.00
9.25
8.04
8
7
6
5
4
3
2
1
0
PPM

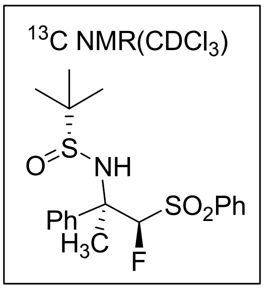


19F NMR(CDCl3)
O
S
NH
Ph
H3C
SO2Ph
F

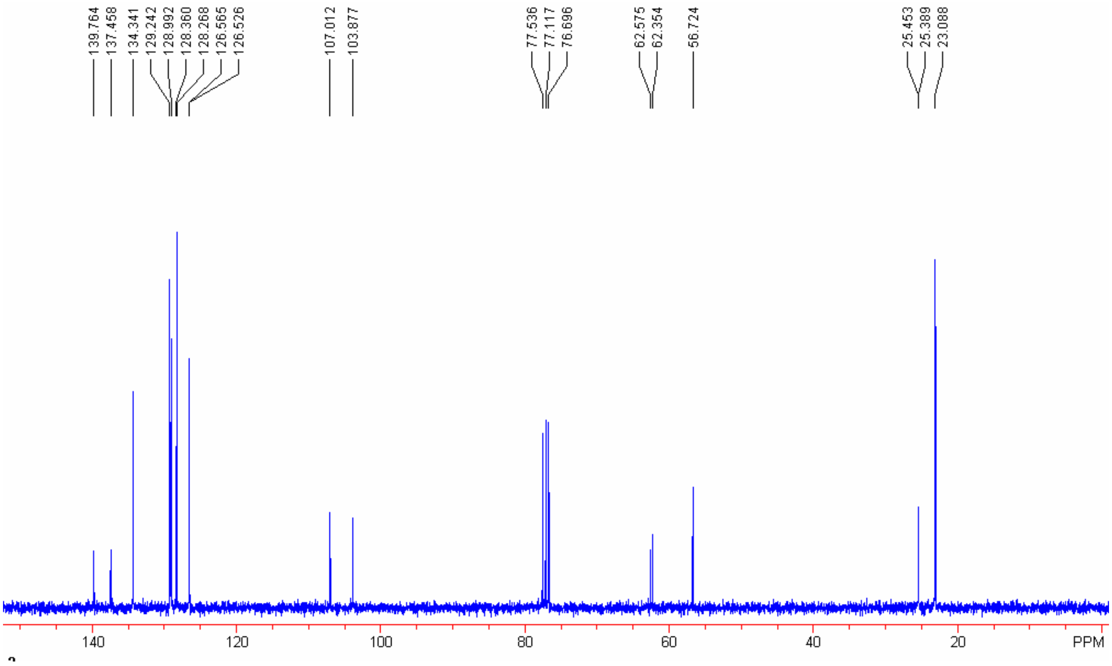
4a'

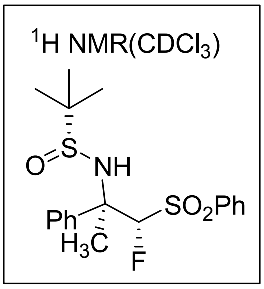


174.359
174.518
-155
-160
-165
-170
-175
-180
-185
-190
PPM


^{13}C NMR(CDCl$_3$)
O
S
NH
Ph
H$_3$C
SO$_2$Ph
F

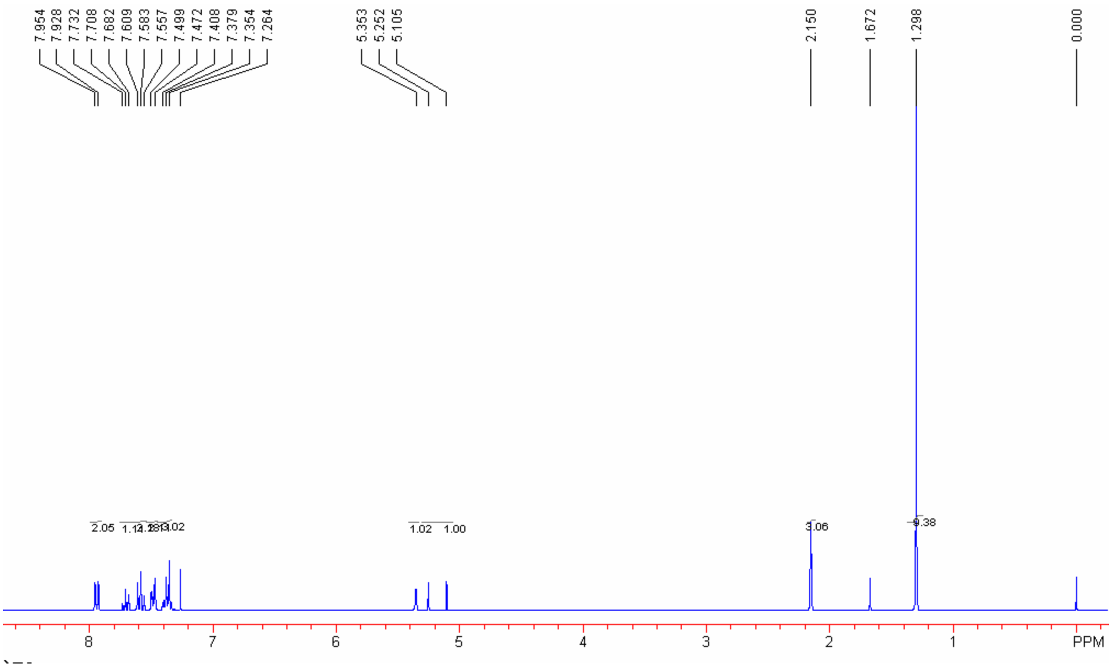
4a'


139.764
137.458
134.341
129.242
128.992
128.360
128.268
126.565
126.526
107.012
103.877
77.536
77.117
76.696
62.575
62.354
56.724
25.453
25.389
23.088
140
120
100
80
60
40
20
PPM

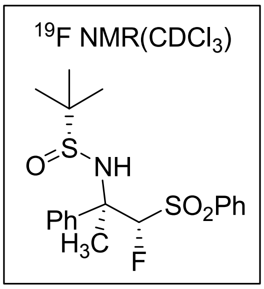


^{1}H NMR(CDCl$_3$)
O
S
NH
Ph
H$_3$C
SO$_2$Ph
F

4a"

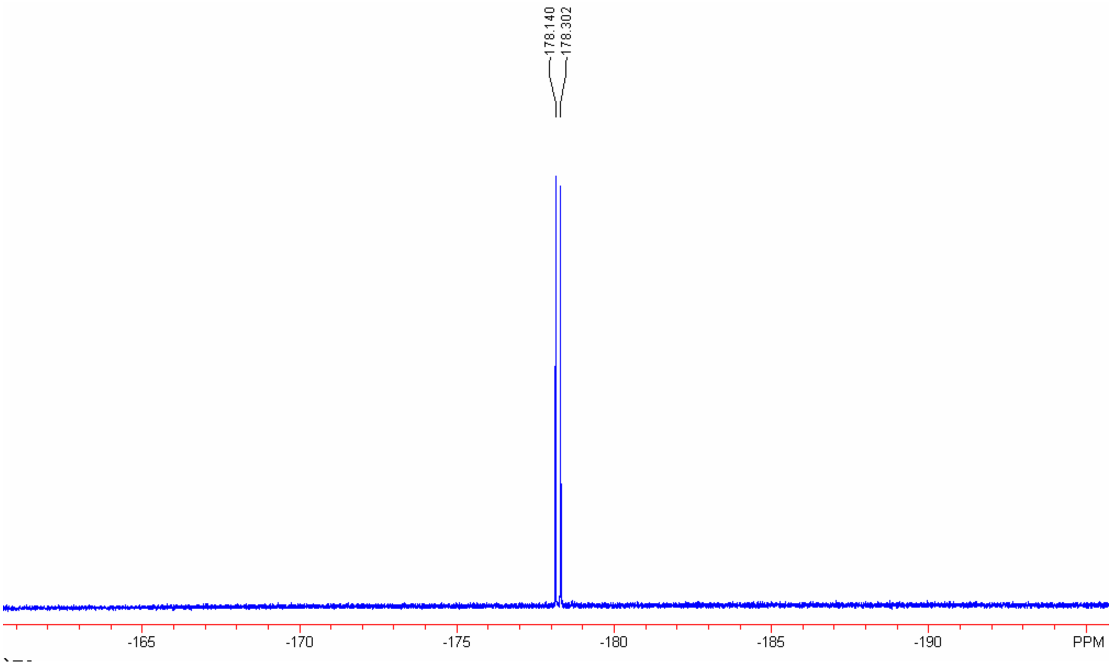


7.954
7.928
7.732
7.708
7.682
7.609
7.583
7.557
7.499
7.472
7.408
7.379
7.354
7.264
5.353
5.252
5.105
2.150
1.672
1.298
0.000
2.05
1.02
1.00
3.06
9.38
8
7
6
5
4
3
2
1
PPM

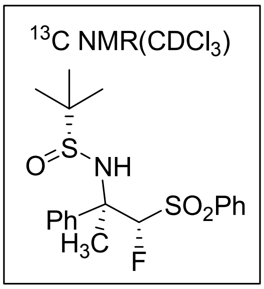


19F NMR(CDCl3)
O
S
NH
Ph
H3C
SO2Ph
F

4a"

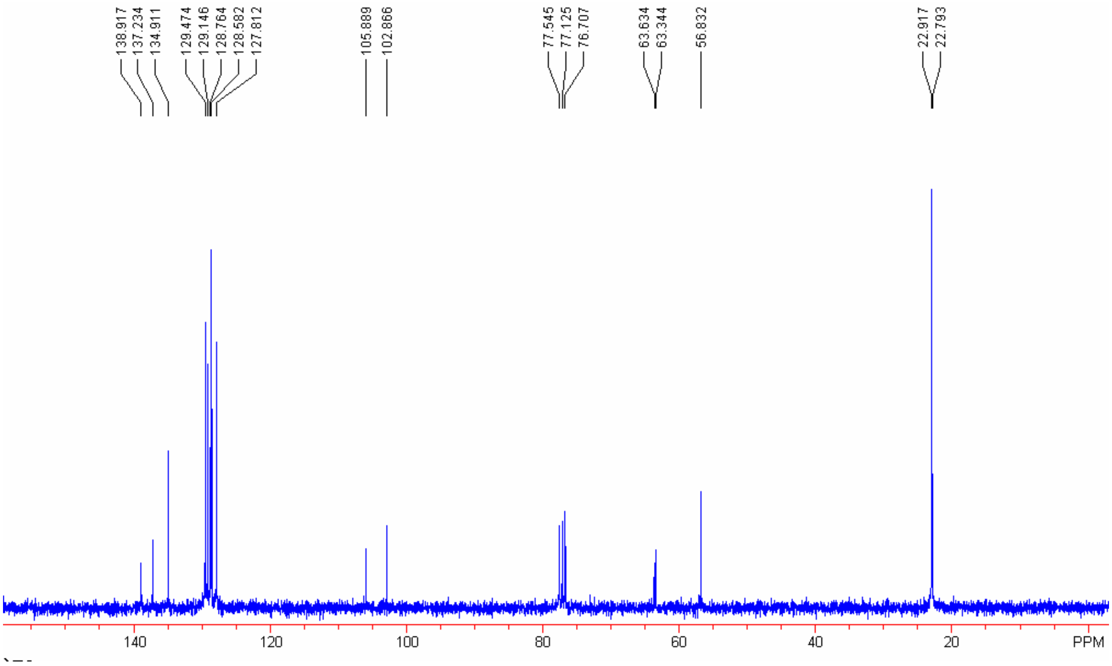


178.140
178.302
-165
-170
-175
-180
-185
-190
PPM

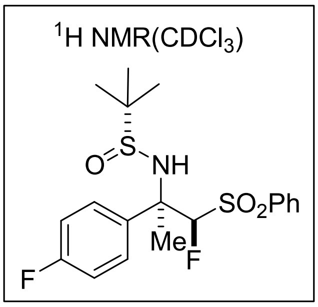


^{13}C NMR(CDCl$_3$)
O
S
NH
Ph
H$_3$C
SO$_2$Ph
F

4a"

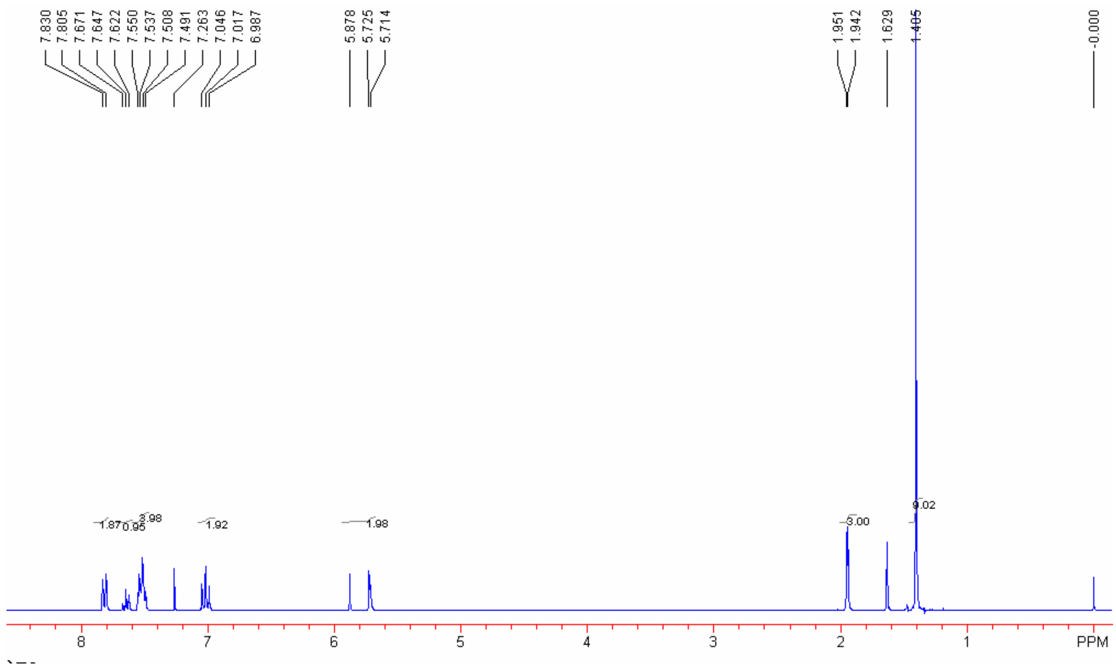


138.917
137.234
134.911
129.474
129.146
128.764
128.582
127.812
105.889
102.866
77.545
77.125
76.707
63.634
63.344
56.832
22.917
22.793
140
120
100
80
60
40
20
PPM

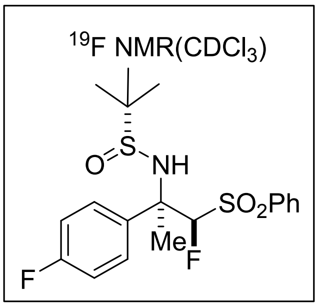


^{1}H NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
F

4b'

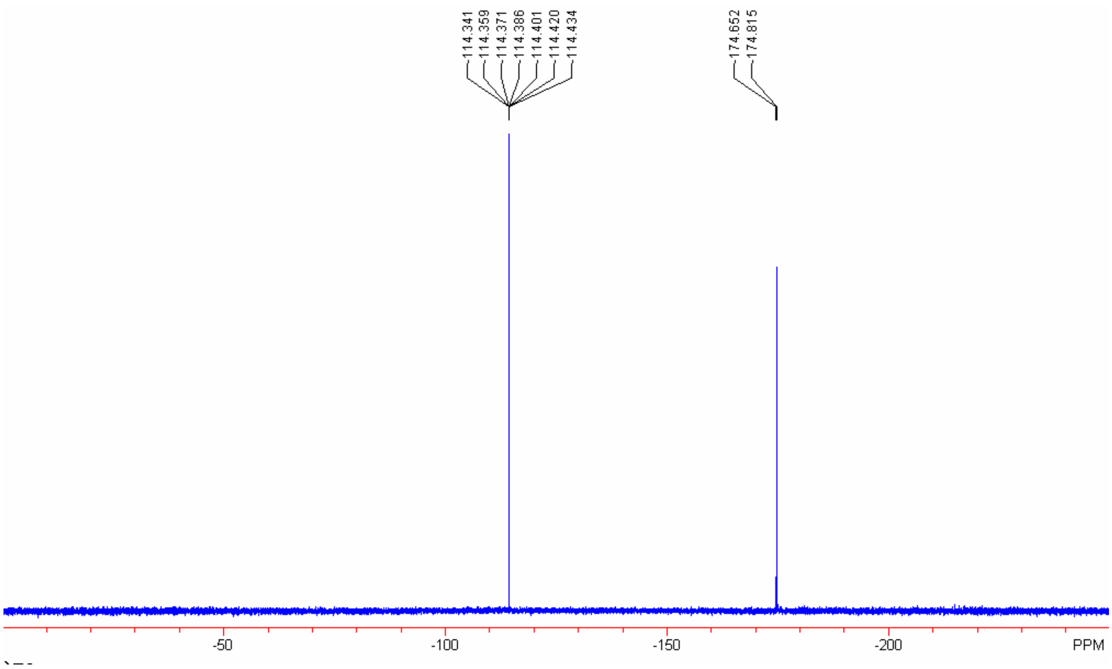


7.830
7.805
7.671
7.647
7.622
7.550
7.537
7.508
7.491
7.263
7.046
7.017
6.987
5.878
5.725
5.714
1.951
1.942
1.629
1.405
-0.000
1.87
0.95
3.98
1.92
1.98
3.00
9.02
8
7
6
5
4
3
2
1
PPM

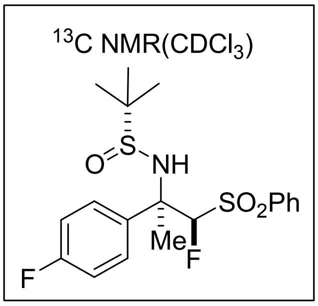


^{19}F NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
F

4b'

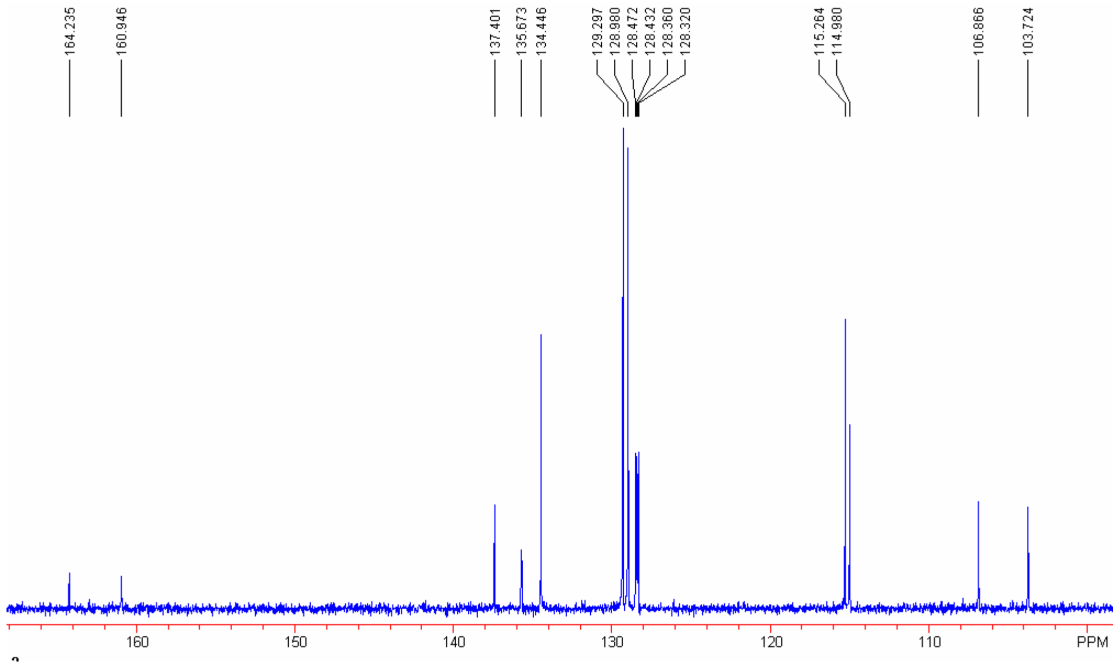


114.341
114.359
114.371
114.386
114.401
114.420
114.434
174.652
174.815
-50
-100
-150
-200
PPM

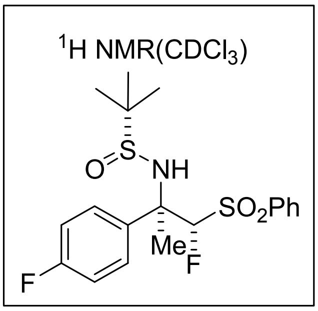


^{13}C NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
F

4b'

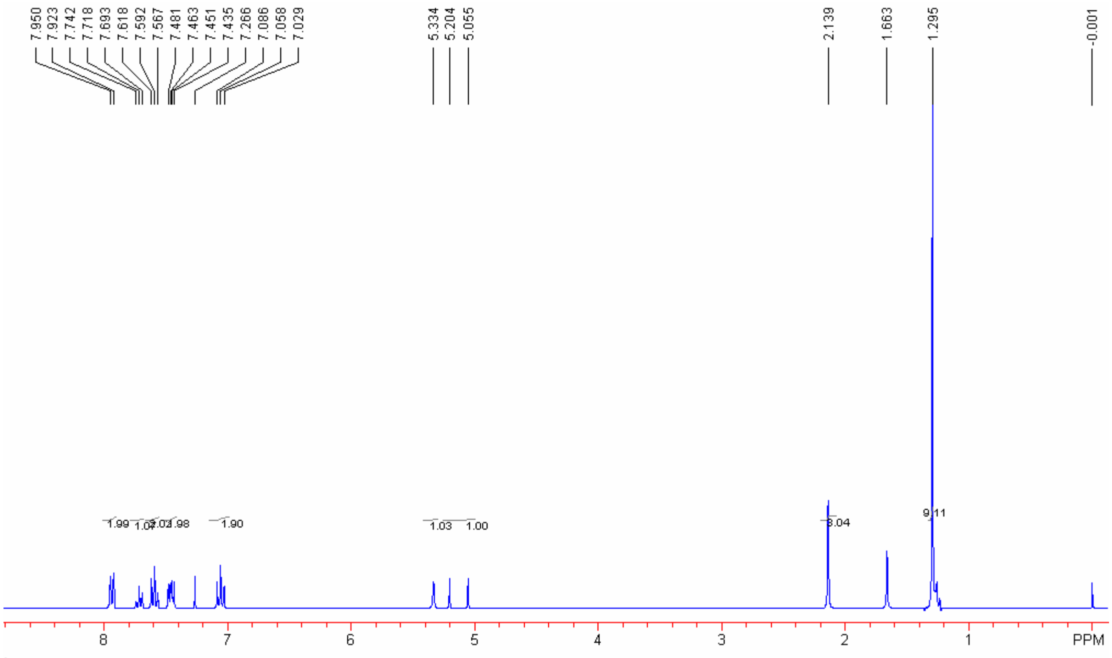


164.235
160.946
137.401
135.673
134.446
129.297
128.980
128.472
128.432
128.360
128.320
115.264
114.980
106.866
103.724
160
150
140
130
120
110
PPM

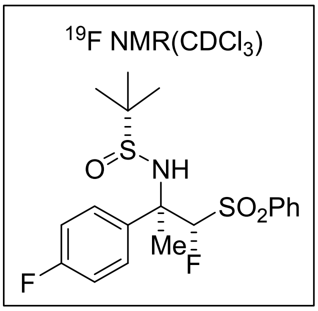


^{1}H NMR(CDCl$_3$)

4b''

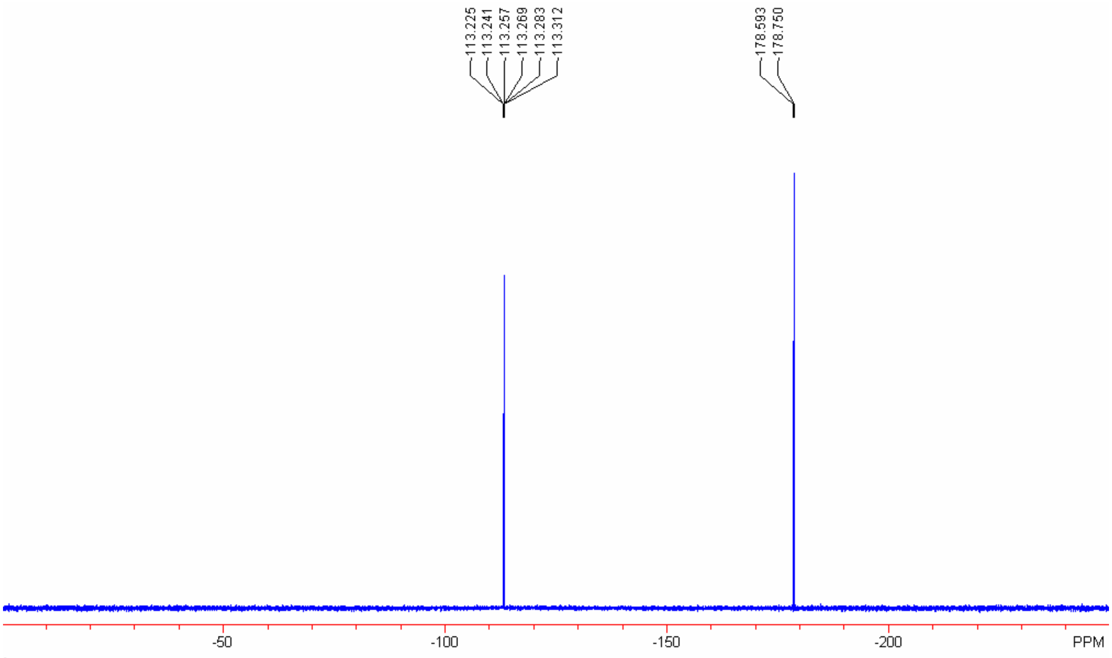


7.950
7.923
7.742
7.718
7.693
7.618
7.592
7.567
7.481
7.463
7.451
7.435
7.266
7.086
7.058
7.029
5.334
5.204
5.055
2.139
1.663
1.295
-0.001
1.99
1.07
2.02
2.98
1.90
1.03
1.00
3.04
9.11
8
7
6
5
4
3
2
1
PPM

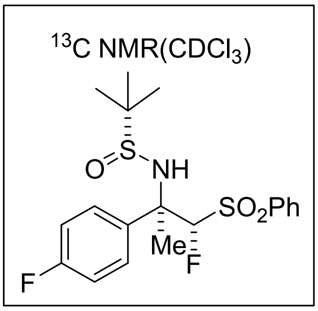


^{19}F NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
F

4b''

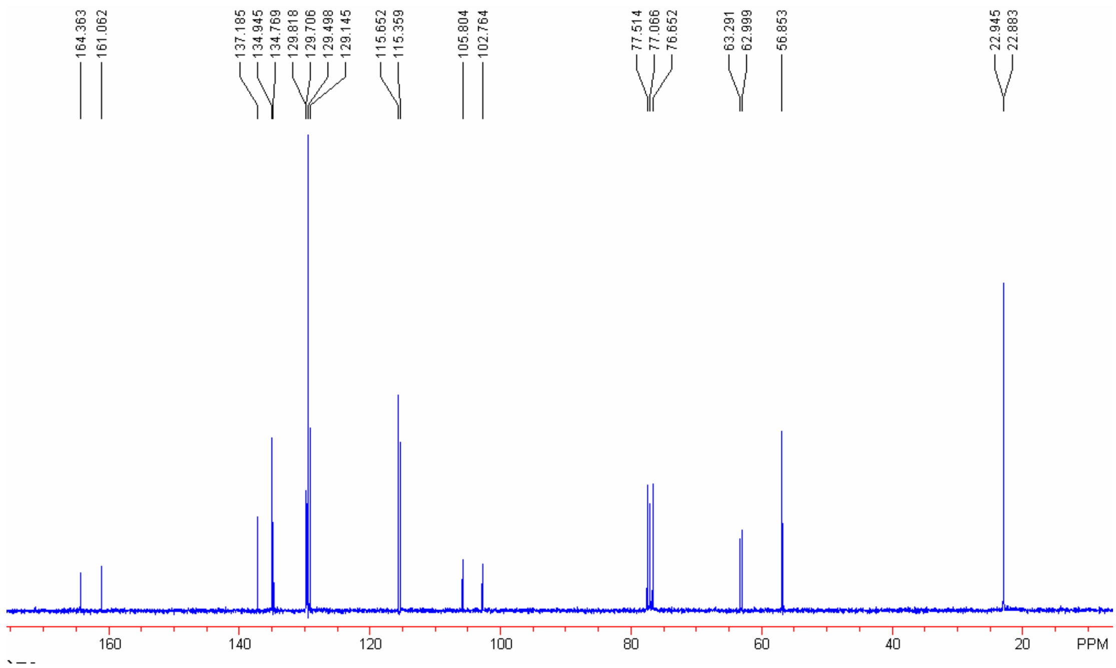


113.225
113.241
113.257
113.269
113.283
113.312
178.593
178.750
-50
-100
-150
-200
PPM

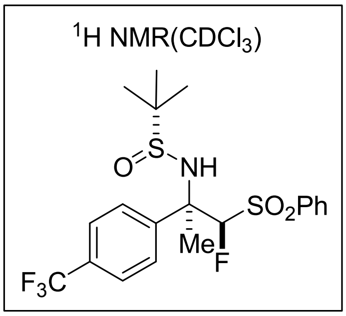


^{13}C NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
F

4b''

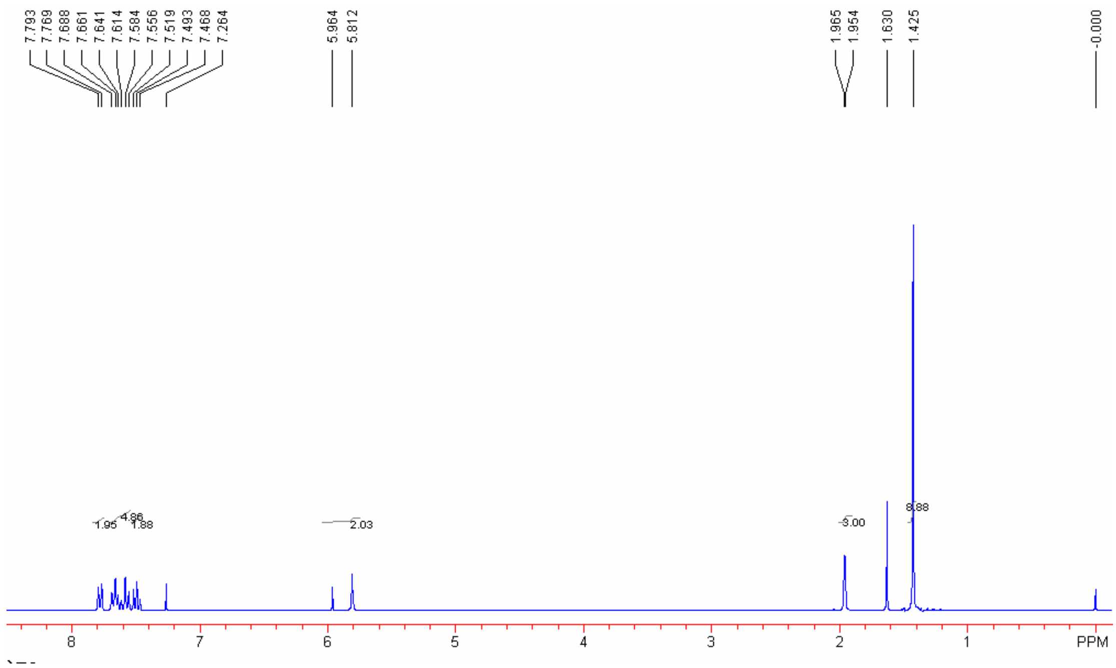


164.363
161.062
137.185
134.945
134.769
129.818
129.706
129.498
129.145
115.652
115.359
105.804
102.764
77.514
77.066
76.652
63.291
62.999
56.853
22.945
22.883
160
140
120
100
80
60
40
20
PPM

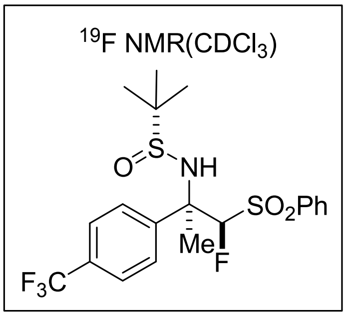


^{1}H NMR($CDCl_3$)
NH
SO$_2$Ph
Me
F
F$_3$C

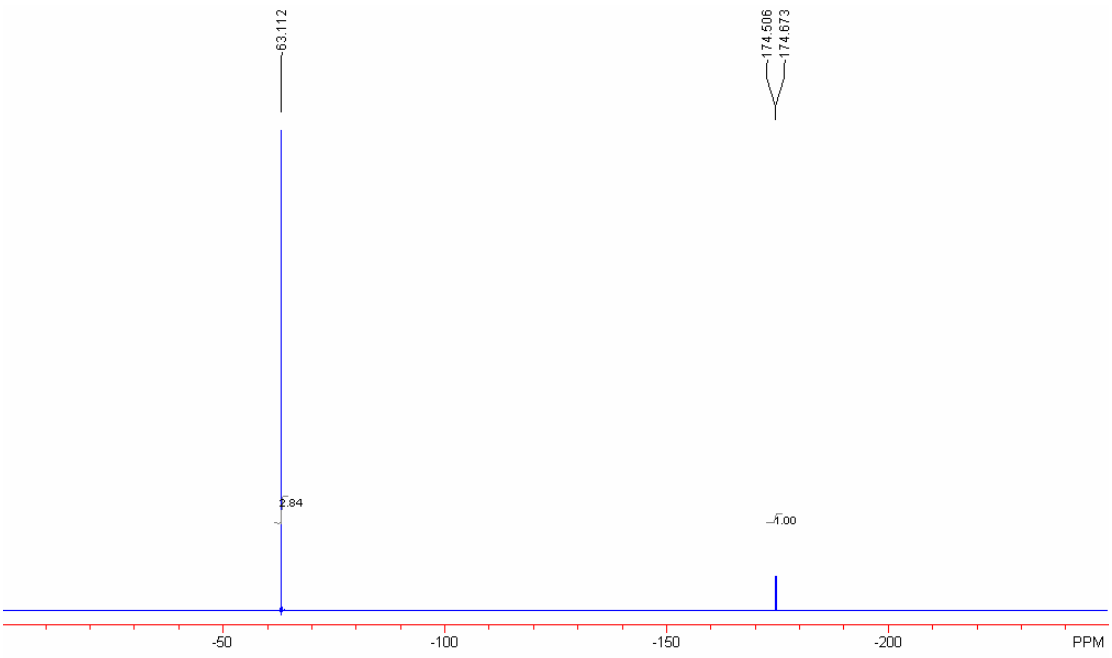
4c'

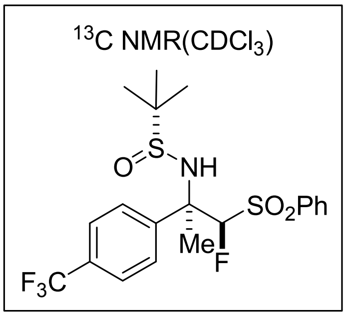


7.793
7.769
7.688
7.661
7.641
7.614
7.584
7.556
7.519
7.493
7.468
7.264
5.964
5.812
1.965
1.954
1.630
1.425
-0.000
1.95
4.86
1.88
2.03
3.00
8.88
8
7
6
5
4
3
2
1
PPM


19F NMR(CDCl3)
O
S
NH
SO2Ph
Me
F
F3C

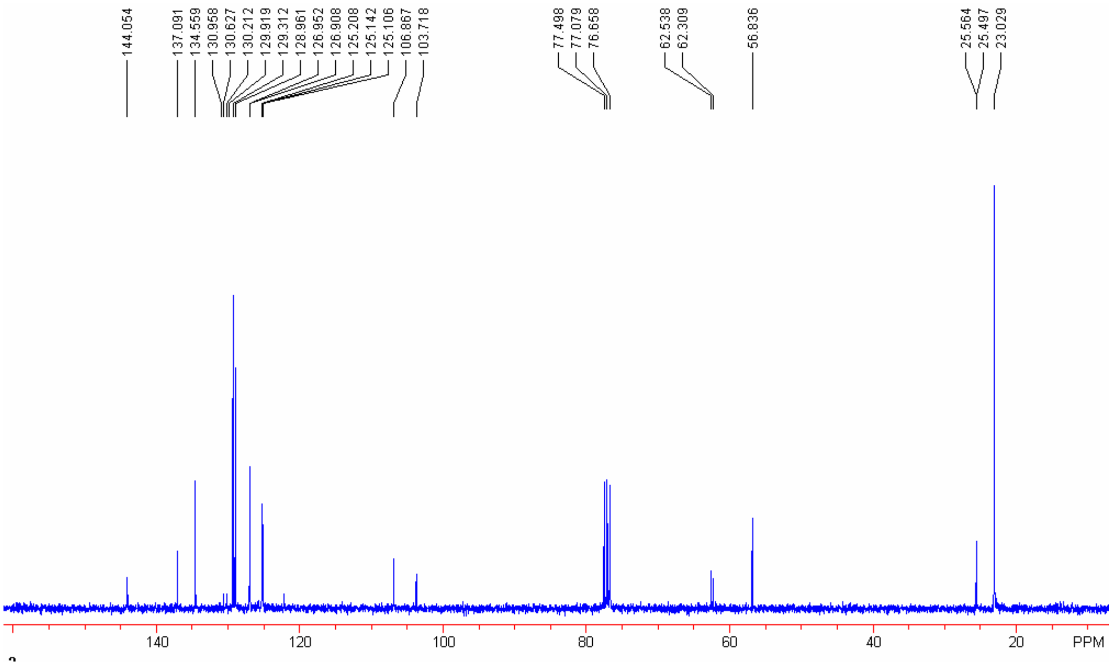
4c’


63.112
174.506
174.673
2.84
1.00
-50
-100
-150
-200
PPM

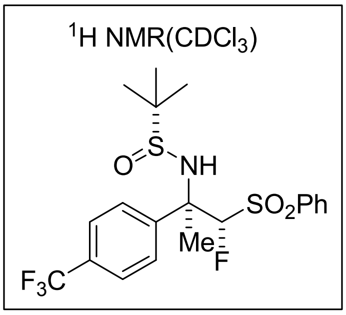


^{13}C NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
F$_3$C

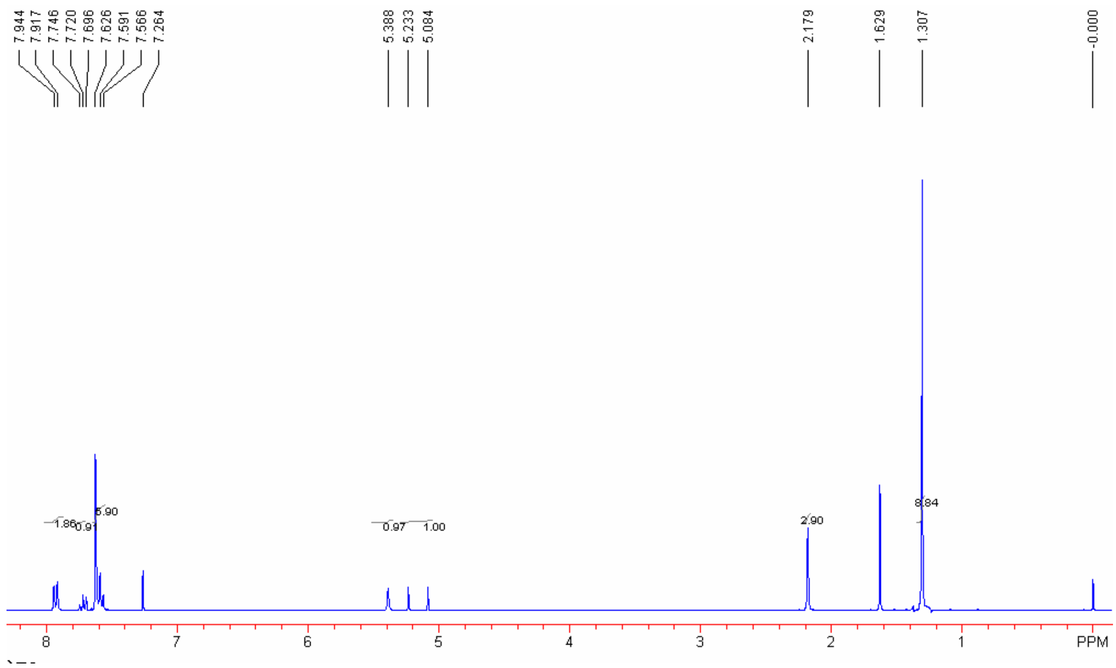
4c’

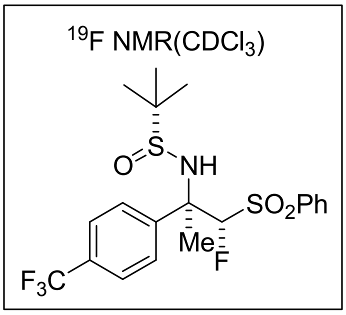


144.054
137.091
134.559
130.958
130.627
130.212
129.919
129.312
128.961
126.952
126.908
125.208
125.142
125.106
106.867
103.718
77.498
77.079
76.658
62.538
62.309
56.836
25.564
25.497
23.029
140
120
100
80
60
40
20
PPM

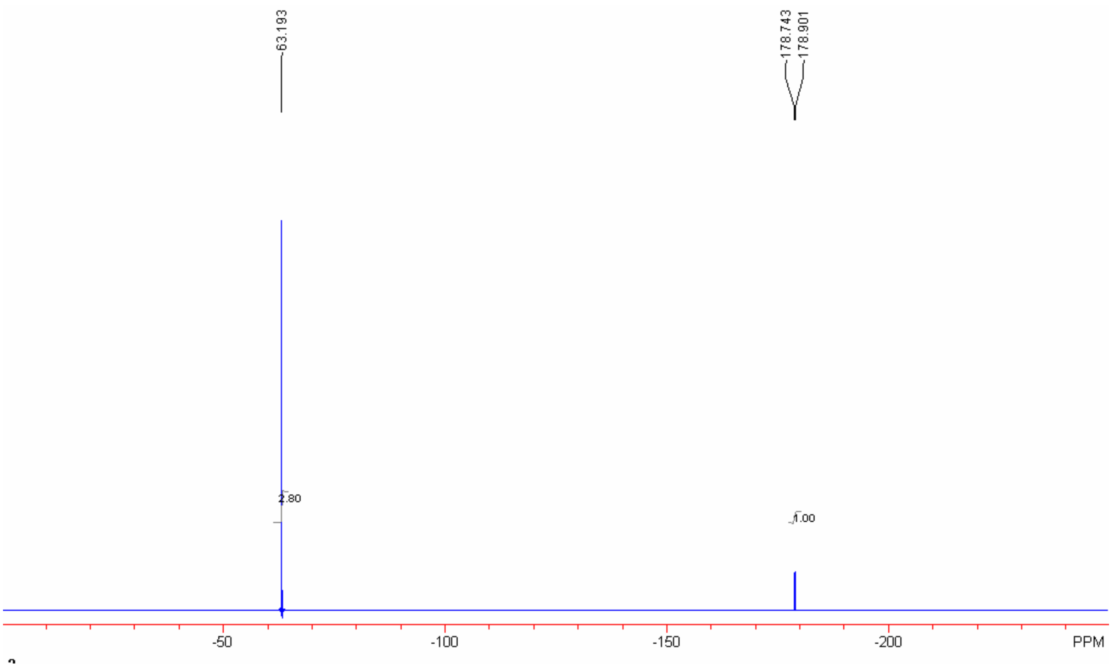

^1H NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
F$_3$C

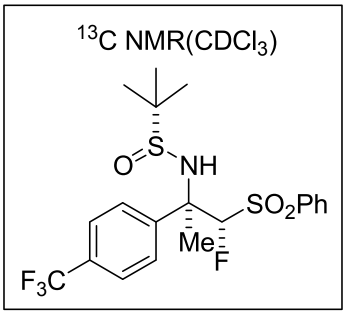
4c''


7.944
7.917
7.746
7.720
7.696
7.626
7.591
7.566
7.264
5.388
5.233
5.084
2.179
1.629
1.307
-0.000
1.86
0.91
5.90
0.97
1.00
2.90
8.84
8
7
6
5
4
3
2
1
PPM


^{19}F NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
F$_3$C

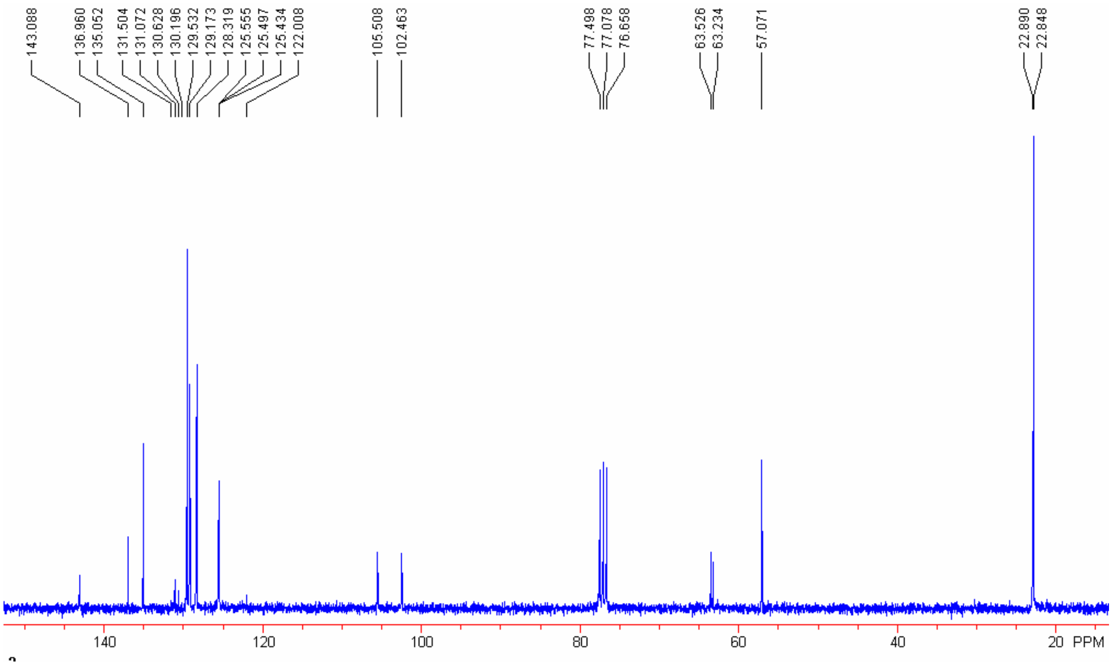
4c”


63.193
178.743
178.901
2.80
1.00
-50
-100
-150
-200
PPM

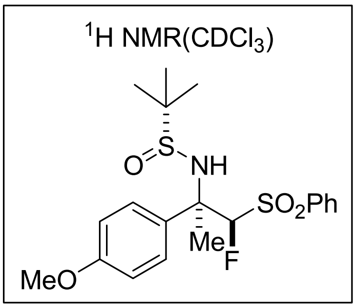


13C NMR(CDCl3)
NH
SO2Ph
Me
F
F3C

4c''

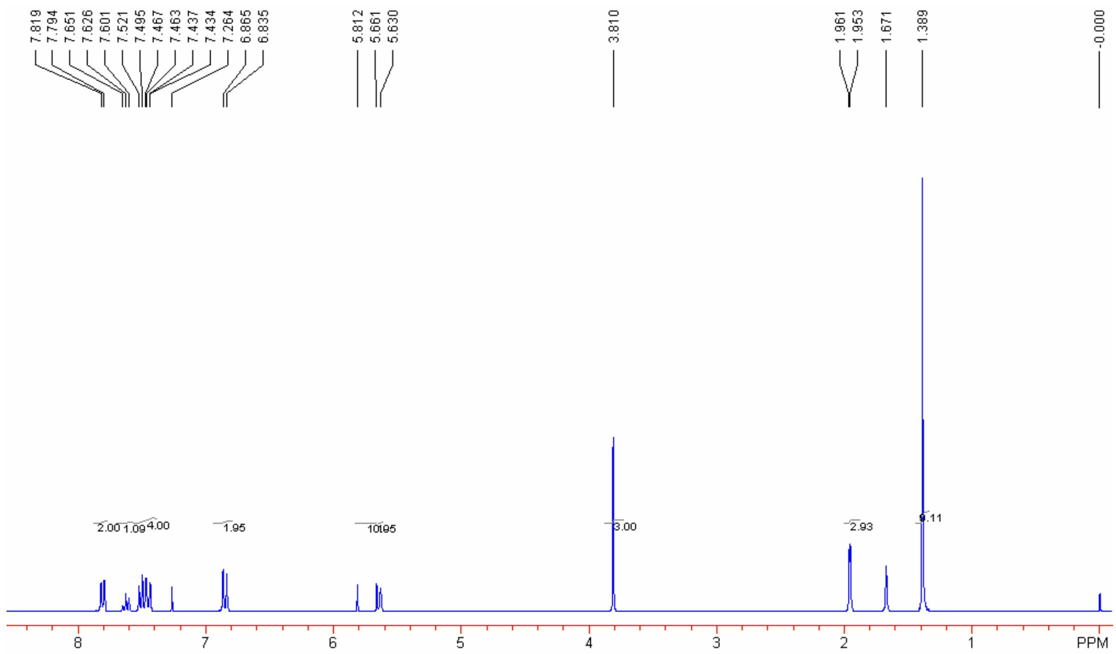


143.088
136.960
135.052
131.504
131.072
130.628
130.196
129.532
129.173
128.319
125.555
125.497
125.434
122.008
105.508
102.463
77.498
77.078
76.658
63.526
63.234
57.071
22.890
22.848
140
120
100
80
60
40
20 PPM

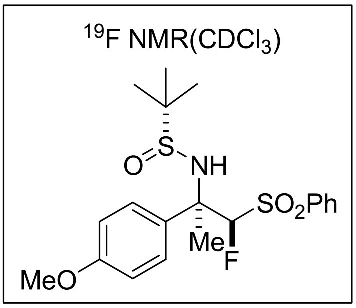


^{1}H NMR(CDCl$_3$)
NH
SO$_2$Ph
Me
F
MeO

4d'

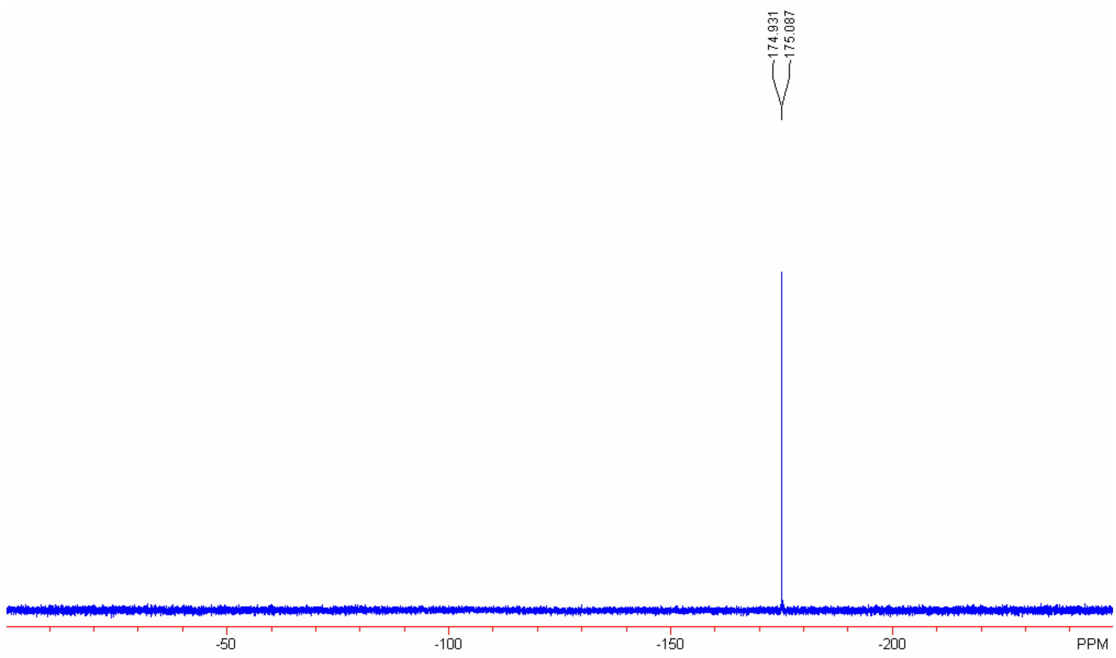


7.819
7.794
7.651
7.626
7.601
7.521
7.495
7.467
7.463
7.437
7.434
7.264
6.865
6.835
5.812
5.661
5.630
3.810
1.961
1.953
1.671
1.389
-0.000
2.00
1.09
4.00
1.95
3.00
2.93
9.11
8
7
6
5
4
3
2
1
PPM

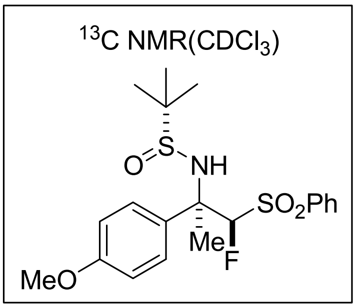


19F NMR(CDCl3)
O
S
NH
SO2Ph
Me
F
MeO

4d’

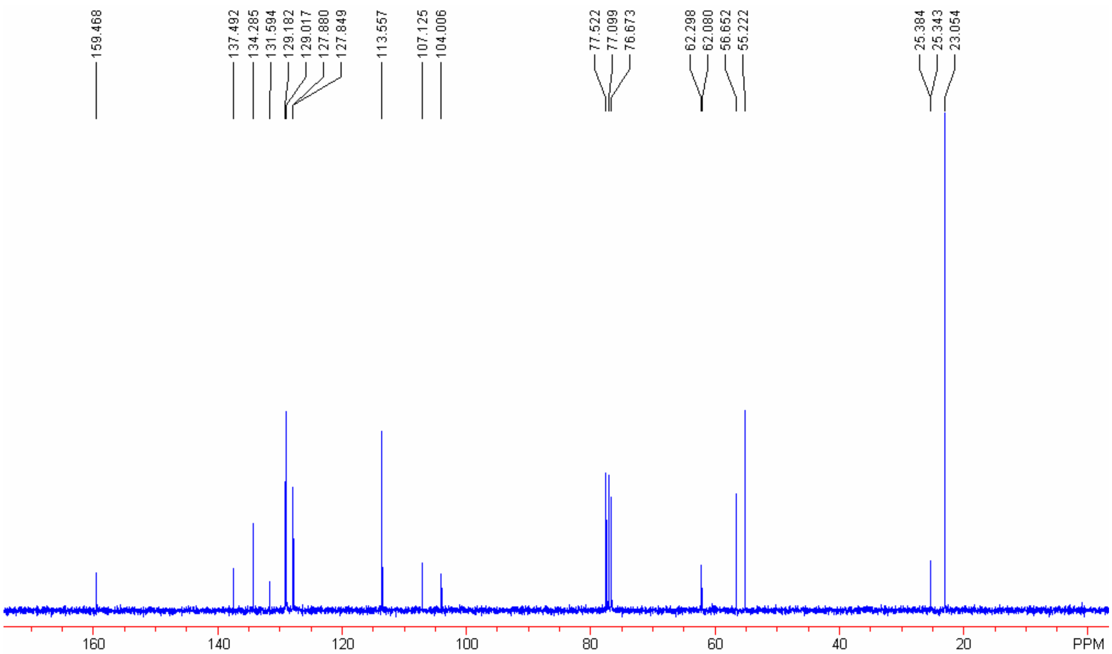


174.931
175.087
-50
-100
-150
-200
PPM

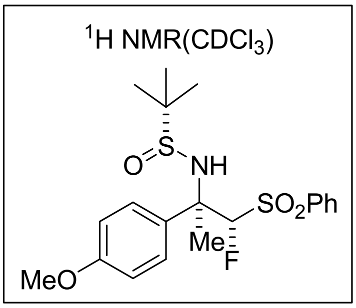


^{13}C NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
MeO

4d'

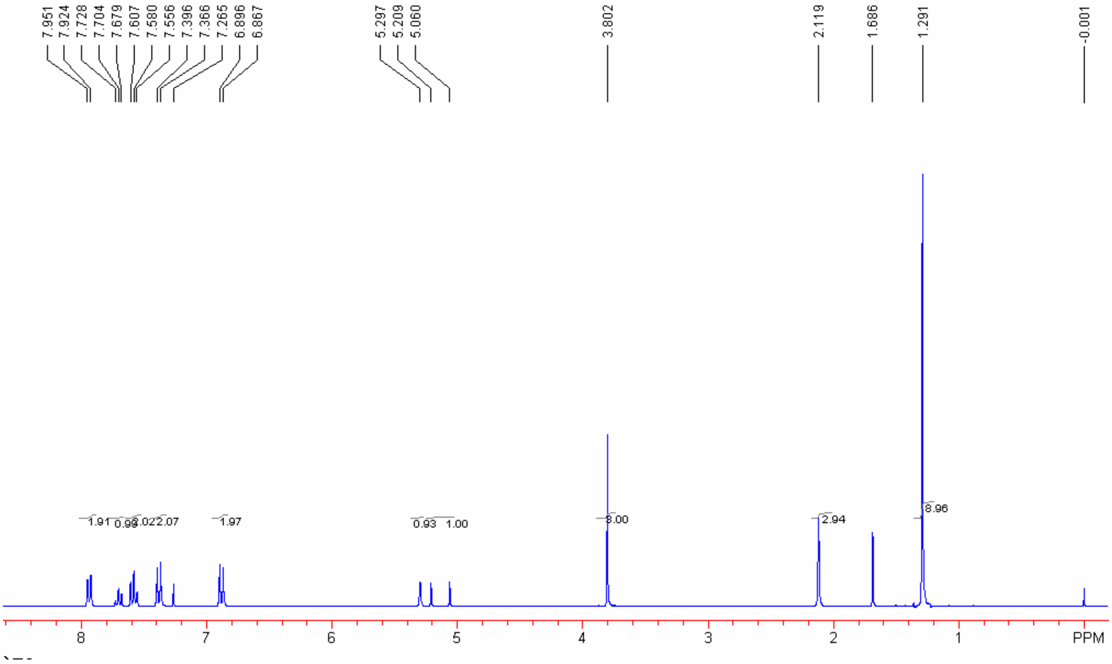


159.468
137.492
134.285
131.594
129.182
129.017
127.880
127.849
113.557
107.125
104.006
77.522
77.099
76.673
62.298
62.080
56.652
55.222
25.384
25.343
23.054
160
140
120
100
80
60
40
20
PPM

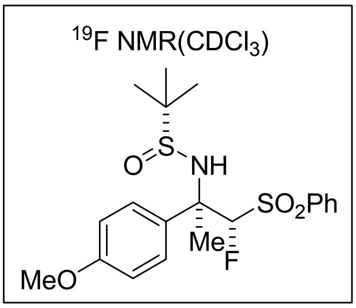


^{1}H NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
MeO

4d”

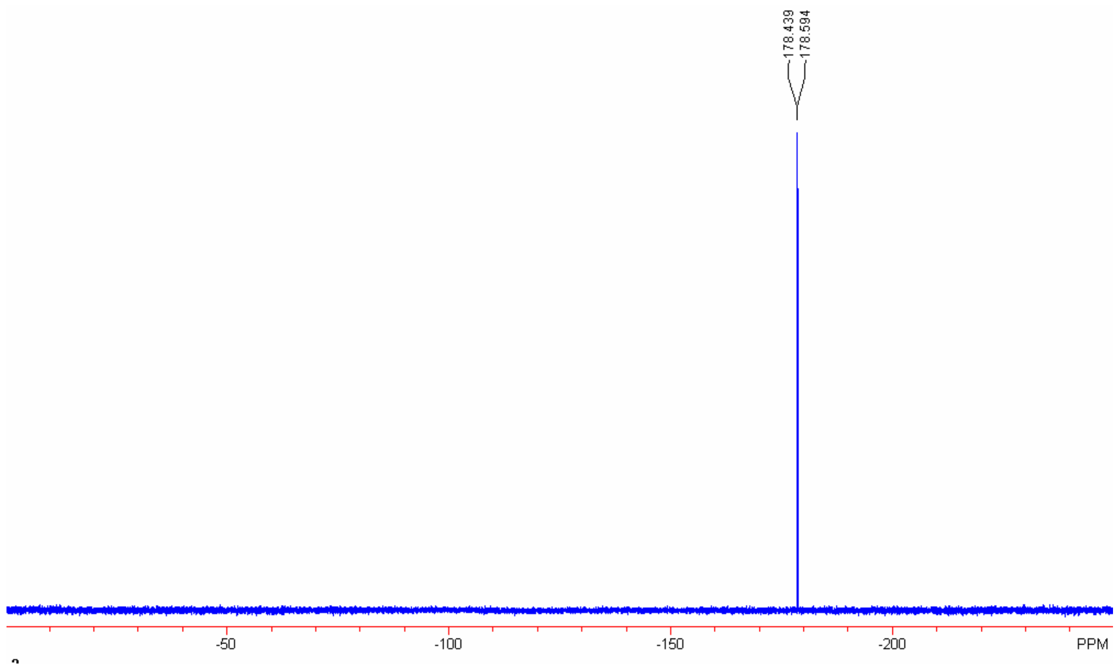


7.951
7.924
7.728
7.704
7.679
7.607
7.580
7.556
7.396
7.366
7.265
6.896
6.867
5.297
5.209
5.060
3.802
2.119
1.686
1.291
-0.001
1.91
0.98
2.02
2.07
1.97
0.93
1.00
3.00
2.94
8.96
8
7
6
5
4
3
2
1
PPM

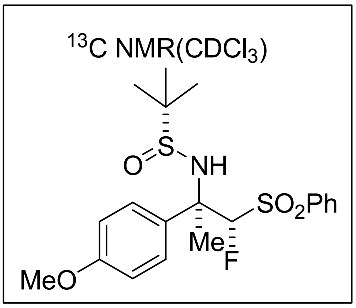


19F NMR(CDCl3)
O
S
NH
SO2Ph
Me
F
MeO

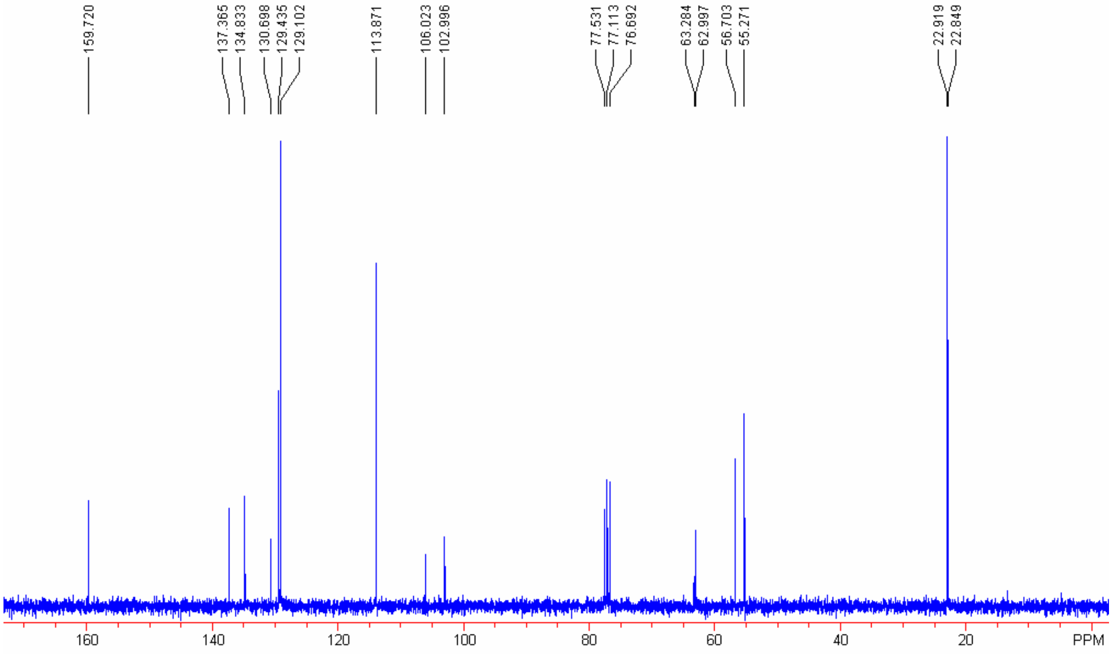
4d''

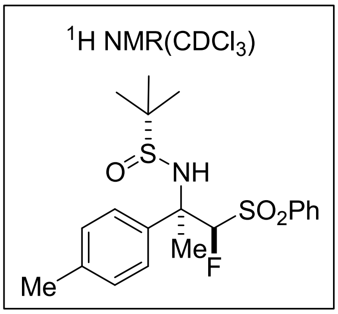


178.439
178.594
-50
-100
-150
-200
PPM

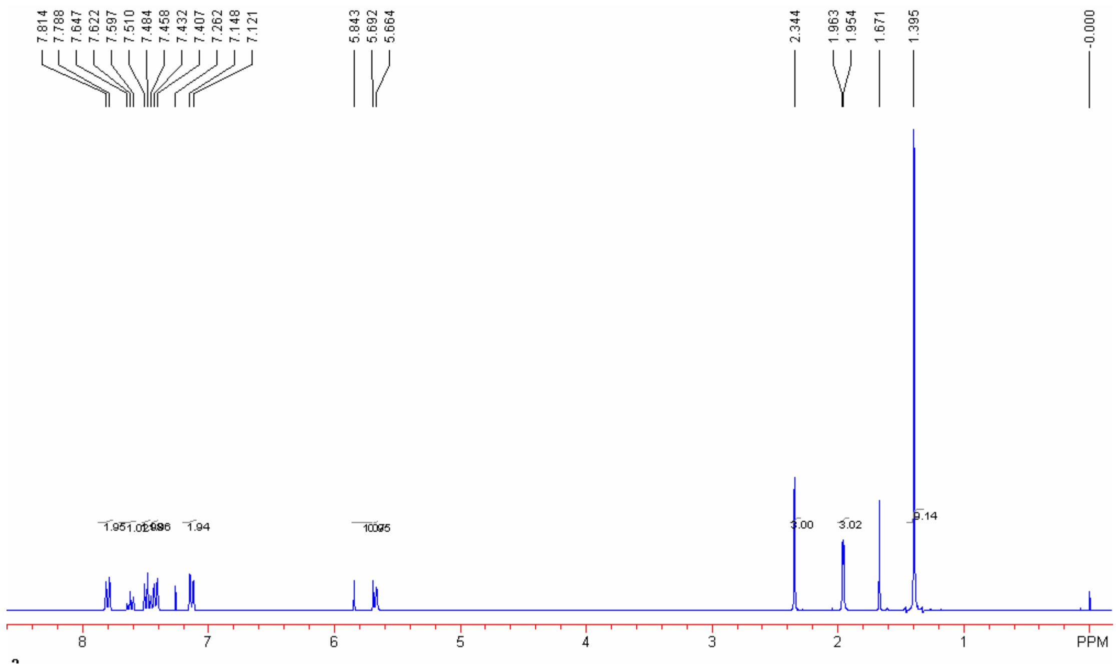

^{13}C NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
MeO

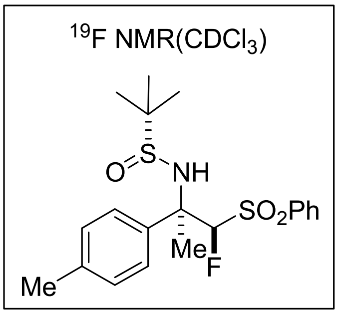
4d”


159.720
137.365
134.833
130.698
129.435
129.102
113.871
106.023
102.996
77.531
77.113
76.692
63.284
62.997
56.703
55.271
22.919
22.849
160
140
120
100
80
60
40
20
PPM


1H NMR(CDCl3)
O
S
NH
SO2Ph
Me
F
Me

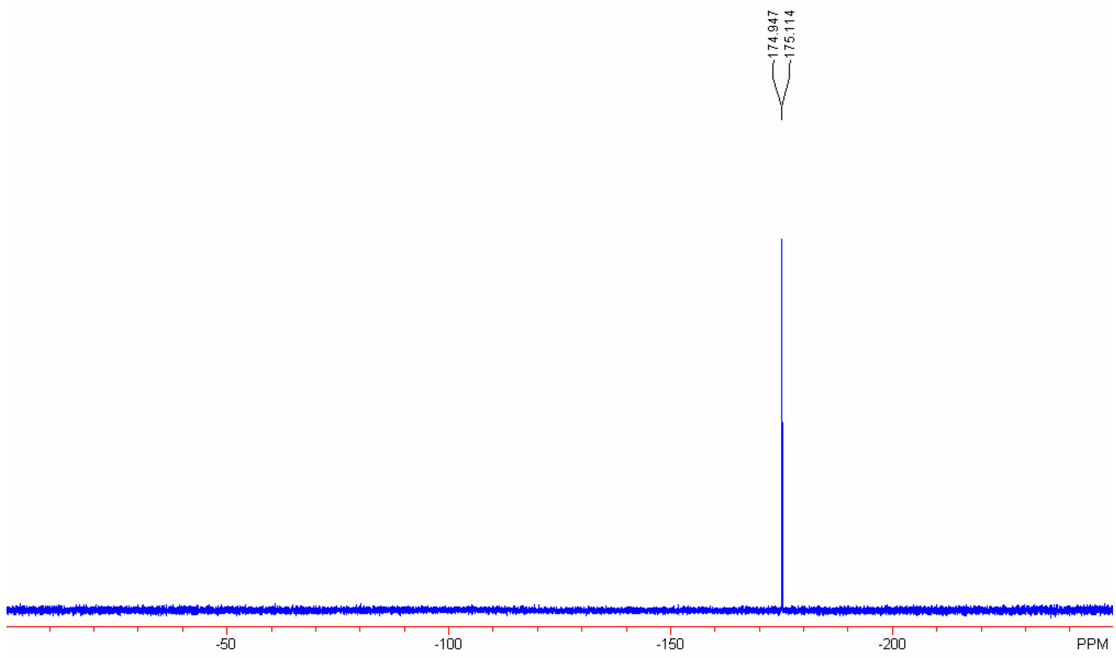
4e'


7.814
7.788
7.647
7.622
7.597
7.510
7.484
7.458
7.432
7.407
7.262
7.148
7.121
5.843
5.692
5.664
2.344
1.963
1.954
1.671
1.395
-0.000
1.94
3.00
3.02
9.14
8
7
6
5
4
3
2
1
PPM

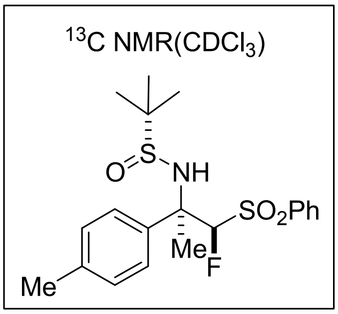


^{19}F NMR($CDCl_3$)
O
S
NH
SO2Ph
Me
F
Me

4e'

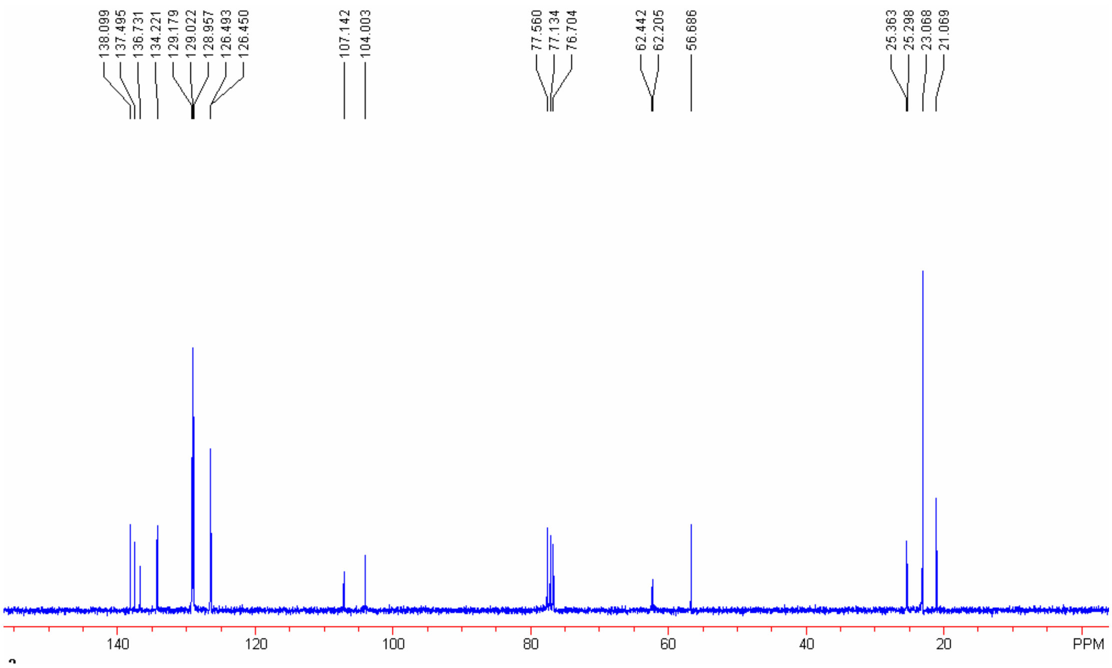


-174.947
-175.114
-50
-100
-150
-200
PPM

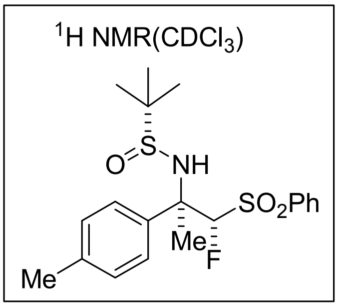


^{13}C NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
Me

4e'

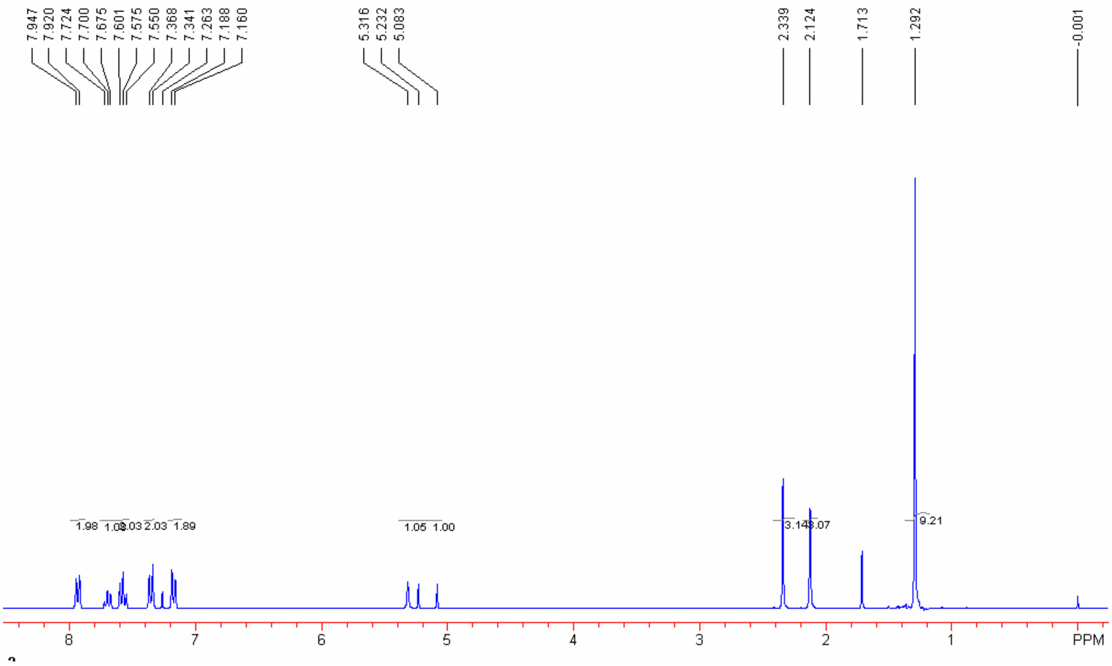


138.099
137.495
136.731
134.221
129.179
129.022
128.957
126.493
126.450
107.142
104.003
77.560
77.134
76.704
62.442
62.205
56.686
25.363
25.298
23.068
21.069
140
120
100
80
60
40
20
PPM

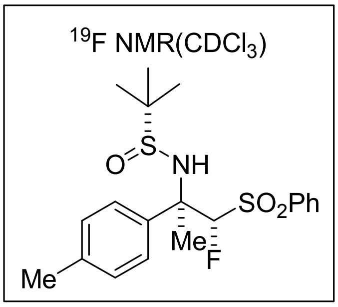


^{1}H NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
Me

4e''

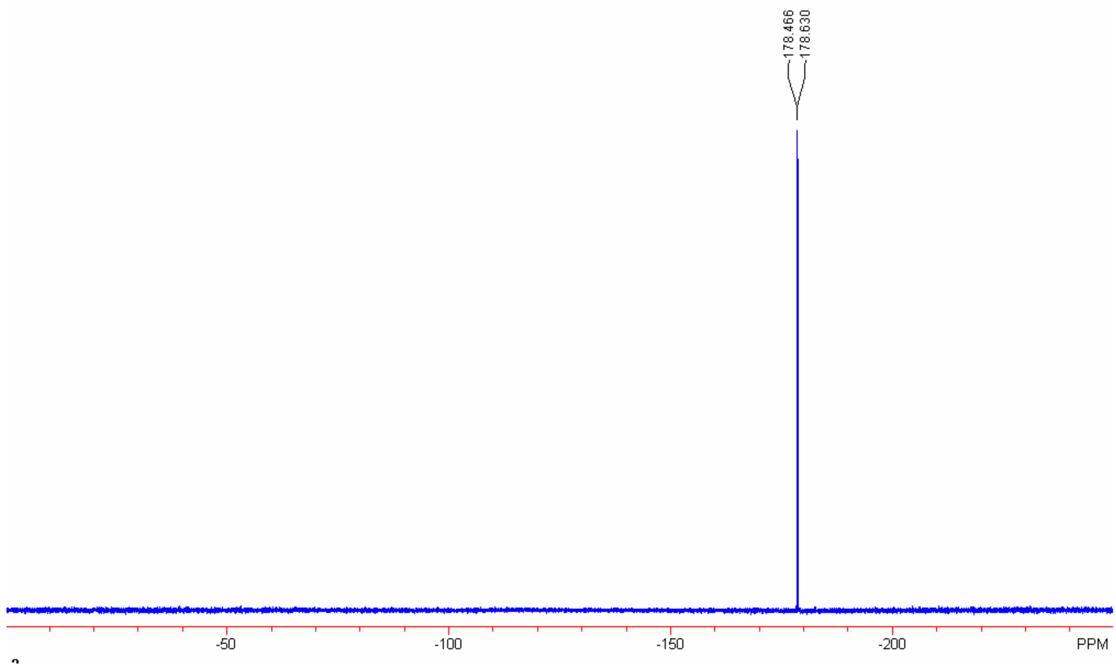


7.947
7.920
7.724
7.700
7.675
7.601
7.575
7.550
7.368
7.341
7.263
7.188
7.160
5.316
5.232
5.083
2.339
2.124
1.713
1.292
-0.001
1.98
2.03
2.03
1.89
1.05
1.00
9.21
8
7
6
5
4
3
2
1
PPM

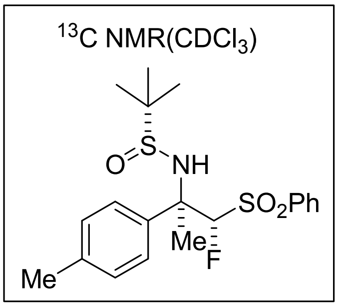


19F NMR(CDCl3)
O
S
NH
SO2Ph
Me
F
Me

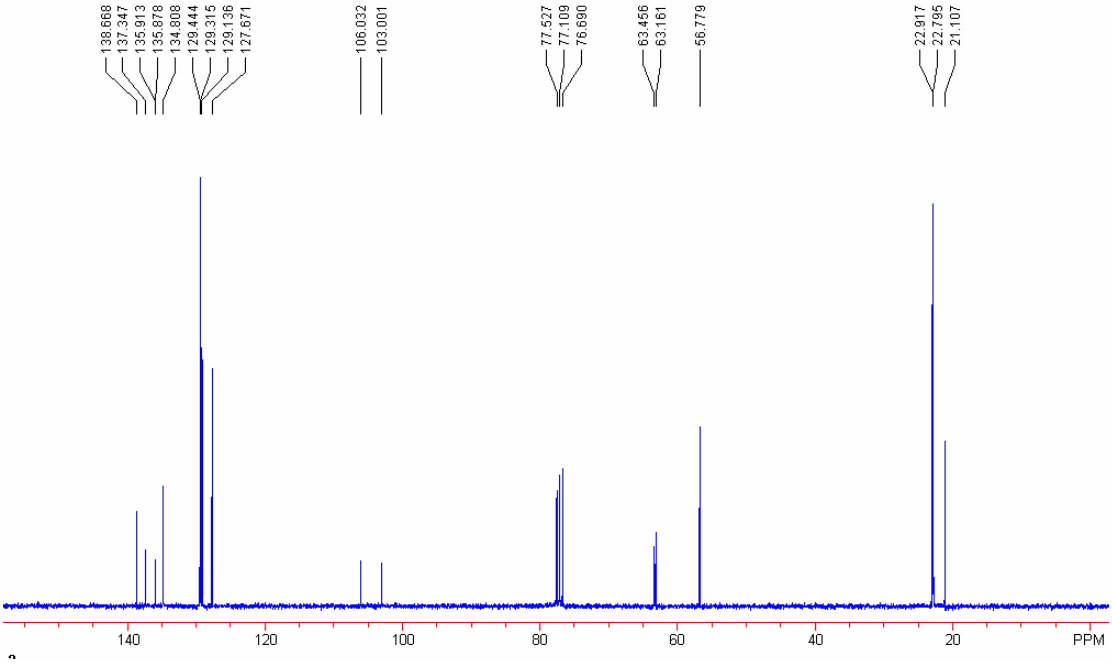
4e"

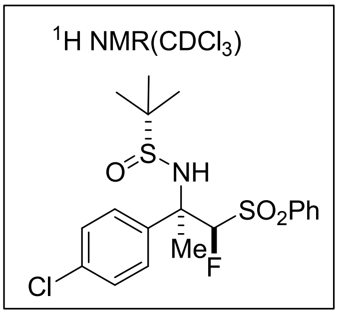


178.466
178.630
-50
-100
-150
-200
PPM


13C NMR(CDCl3)
O=S
NH
SO2Ph
Me
F
Me

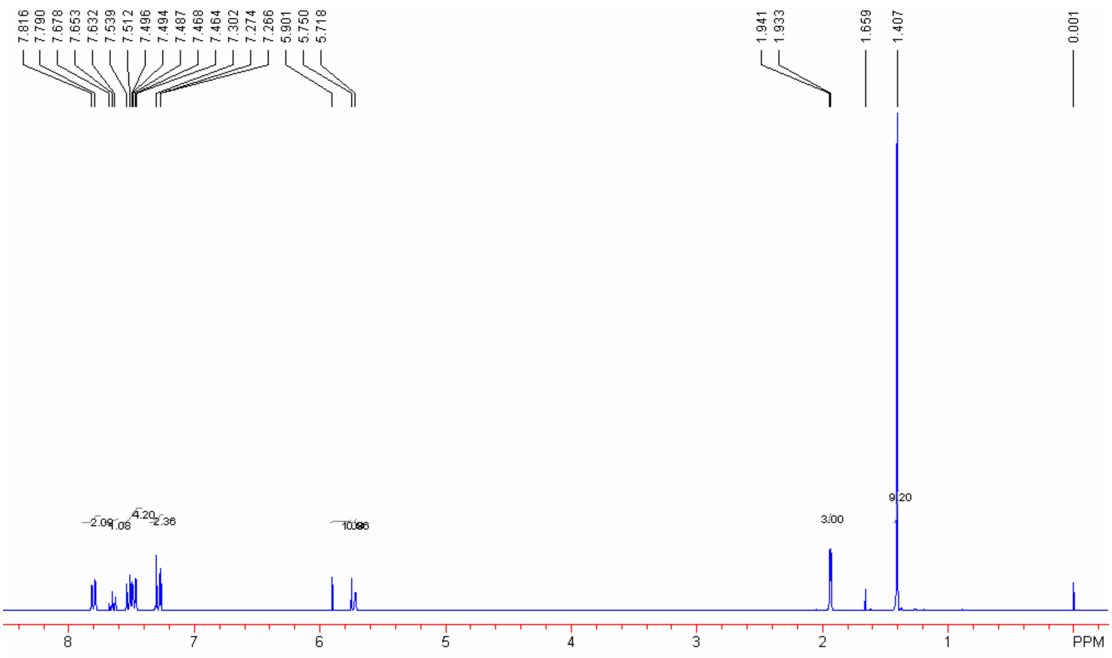
4e”


138.668
137.347
135.913
135.878
134.808
129.444
129.315
129.136
127.671
106.032
103.001
77.527
77.109
76.690
63.456
63.161
56.779
22.917
22.795
21.107
140
120
100
80
60
40
20
PPM

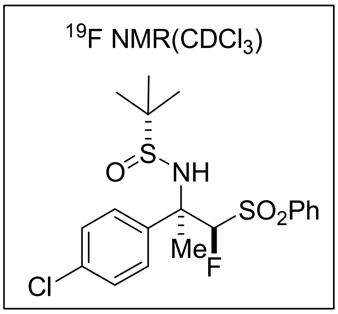


^1H NMR($CDCl_3$)
NH
O
S
SO_2Ph
Me
F
Cl

4f'

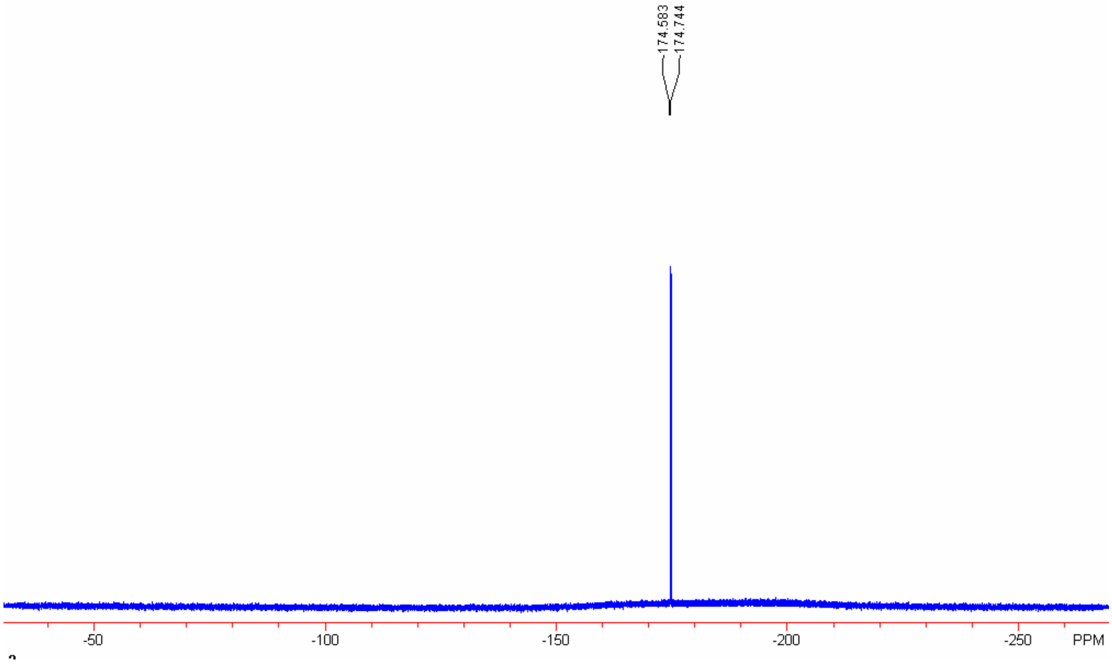


7.816
7.790
7.678
7.653
7.632
7.539
7.512
7.496
7.494
7.487
7.468
7.464
7.302
7.274
7.266
5.901
5.750
5.718
1.941
1.933
1.659
1.407
0.001
2.09
1.08
4.20
2.36
3.00
9.20
8
7
6
5
4
3
2
1
PPM

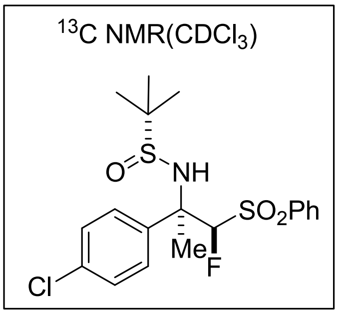


^{19}F NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
Cl

4f’

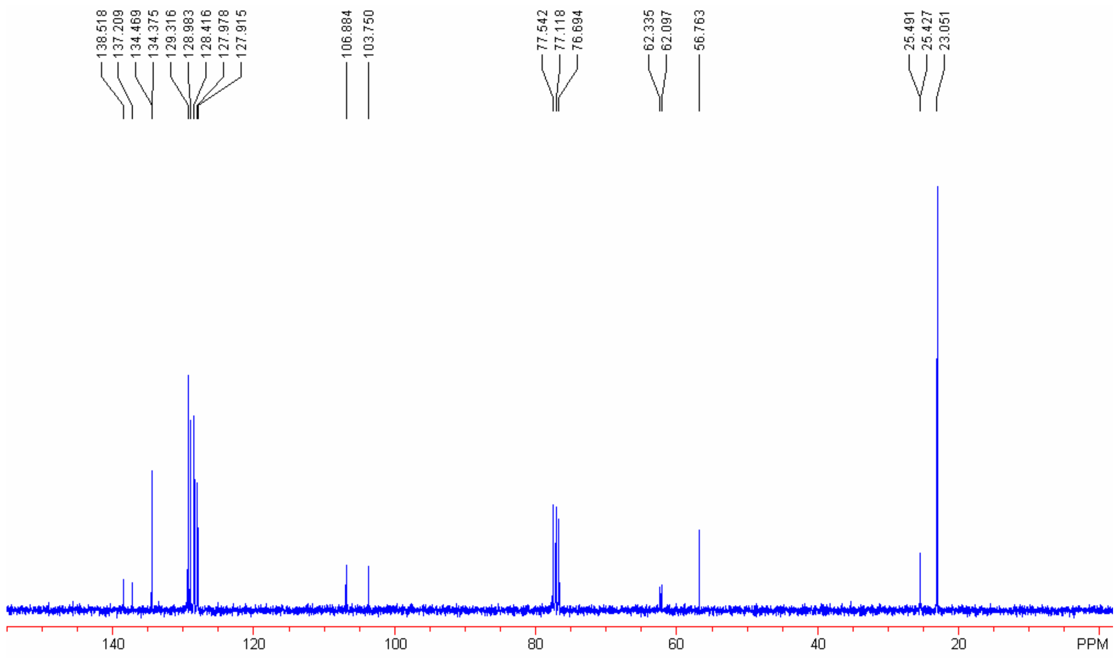


174.583
174.744
-50
-100
-150
-200
-250
PPM

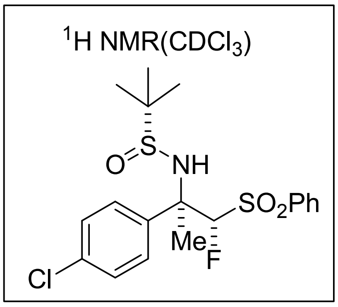


^{13}C NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
Cl

4f'

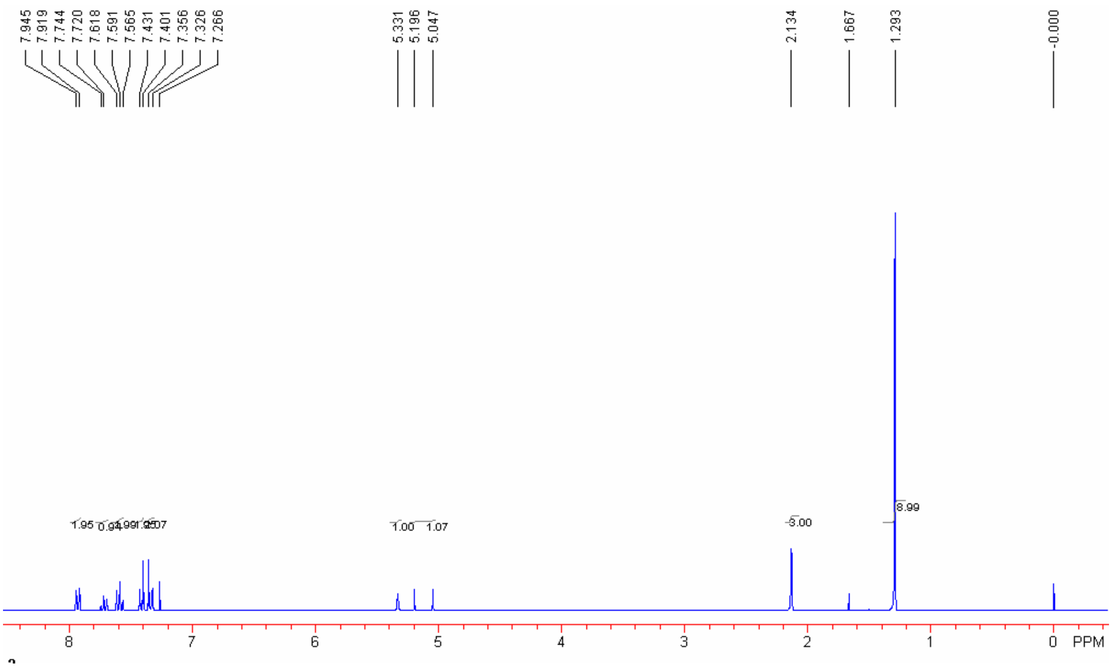


138.518
137.209
134.469
134.375
129.316
128.983
128.416
127.978
127.915
106.884
103.750
77.542
77.118
76.694
62.335
62.097
56.763
25.491
25.427
23.051
140
120
100
80
60
40
20
PPM



1H NMR(CDCl3)
O
S
NH
SO2Ph
Me
F
Cl

4f''



7.945
7.919
7.744
7.720
7.618
7.591
7.565
7.431
7.401
7.356
7.326
7.266
5.331
5.196
5.047
2.134
1.667
1.293
-0.000
1.95
0.94
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1.07
3.00
8.99
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4
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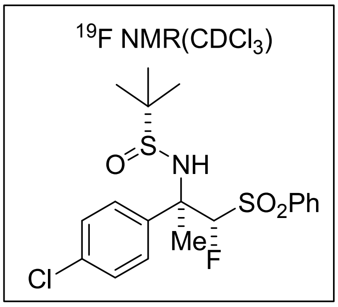
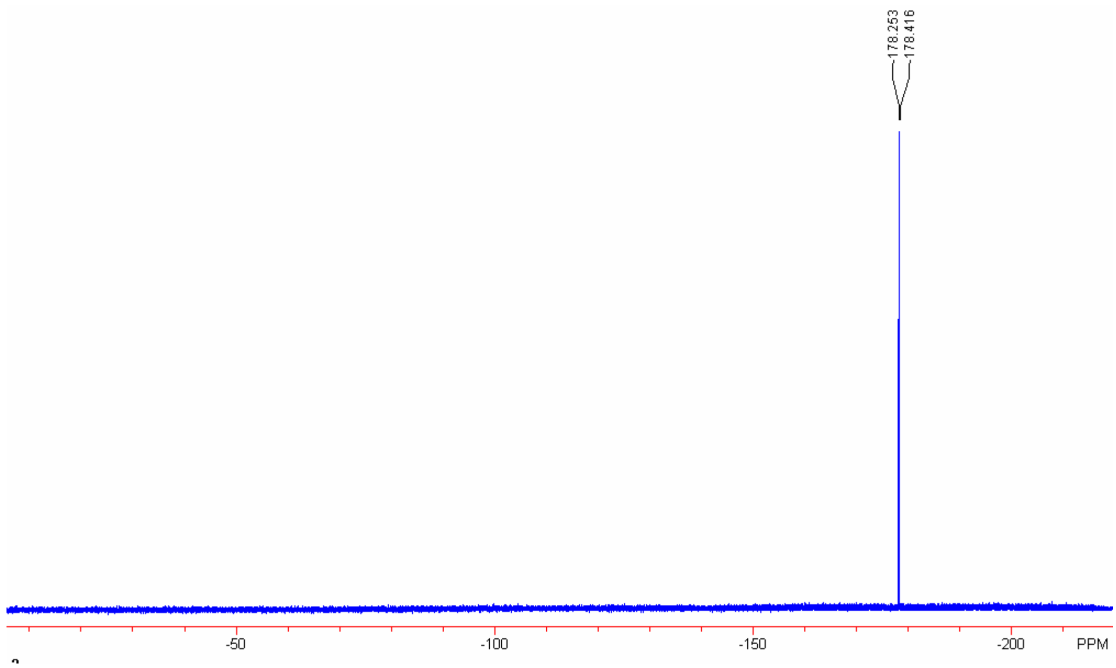
0
PPM

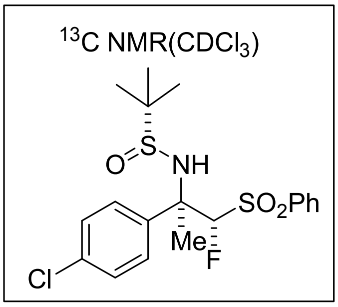


^{19}F NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F
Cl

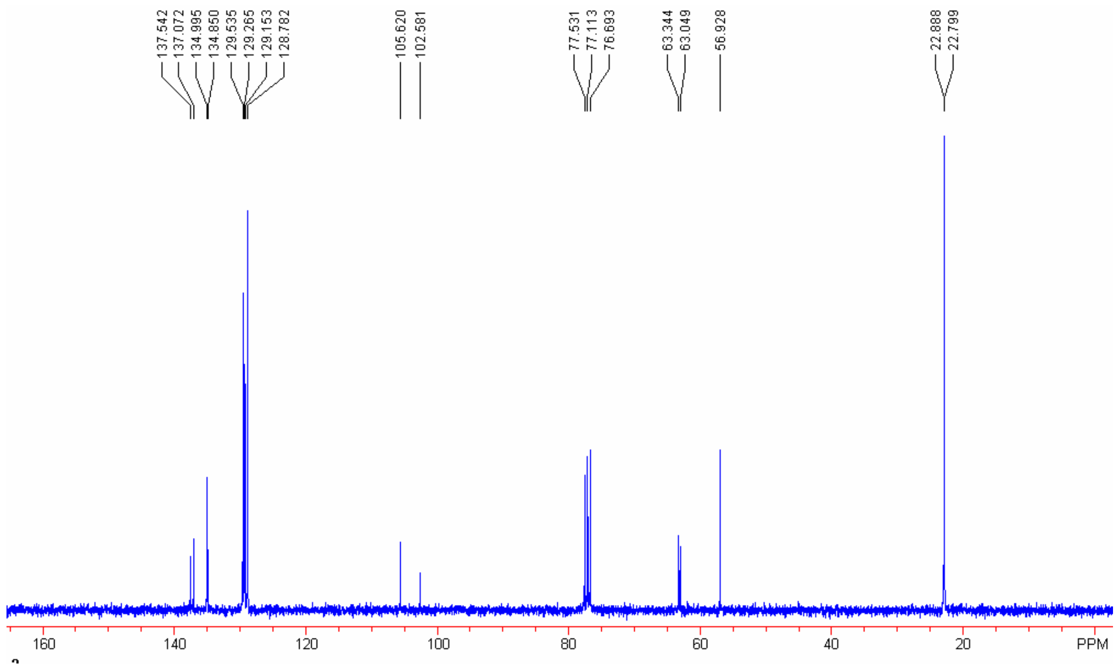
4f''

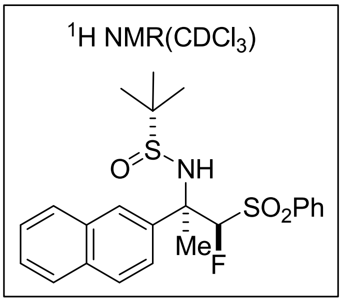


178.253
178.416
-50
-100
-150
-200
PPM

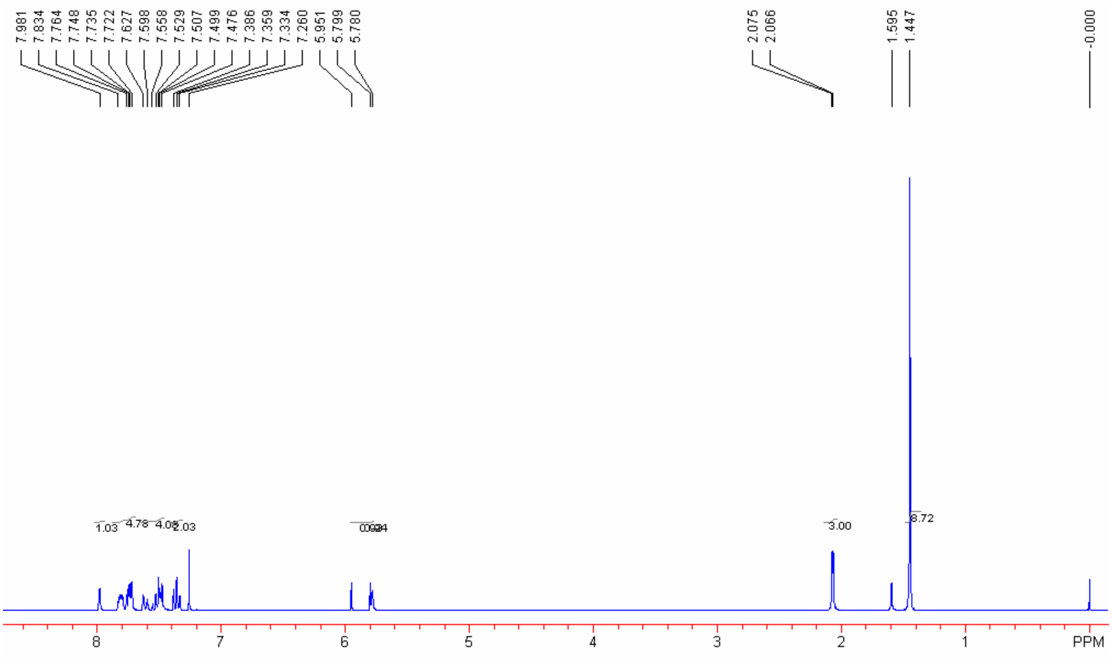

13C NMR(CDCl3)
O
S
NH
SO2Ph
Me
F
Cl

4f''


137.542
137.072
134.995
134.850
129.535
129.265
129.153
128.782
105.620
102.581
77.531
77.113
76.693
63.344
63.049
56.928
22.888
22.799
160
140
120
100
80
60
40
20
PPM


1H NMR(CDCl3)
NH
SO2Ph
Me
F

4g'


7.981
7.834
7.764
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7.558
7.529
7.507
7.499
7.476
7.386
7.359
7.334
7.260
5.951
5.799
5.780
2.075
2.066
1.595
1.447
-0.000
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3.00
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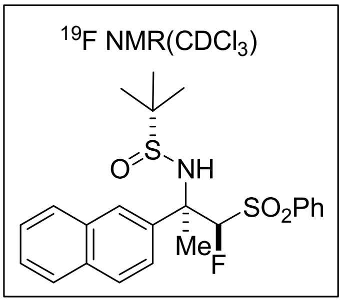
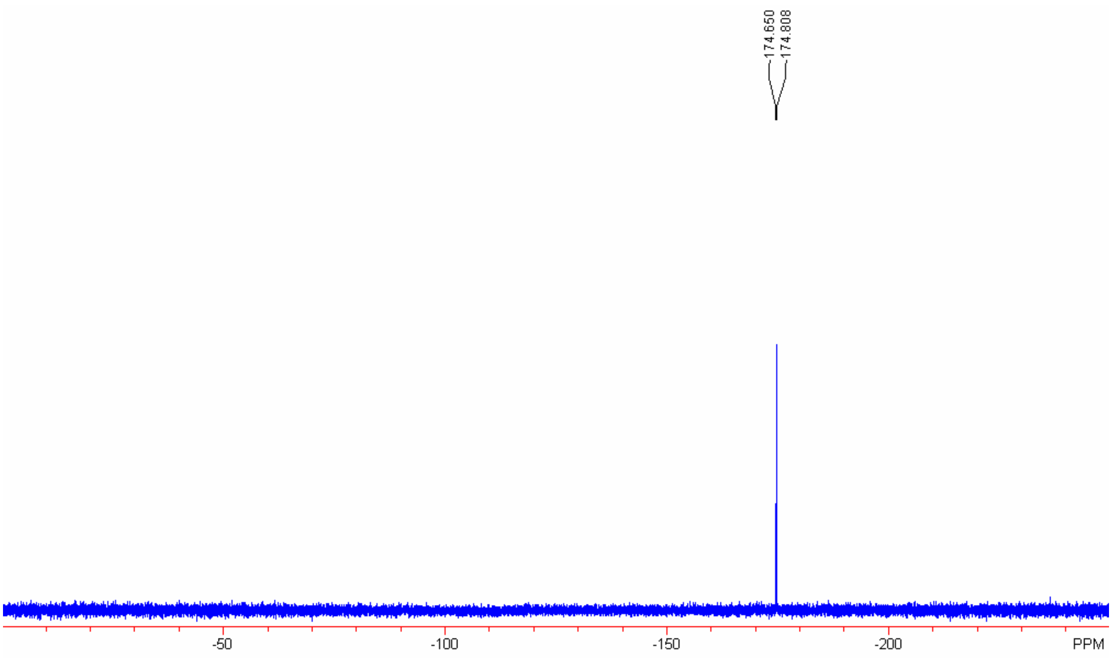
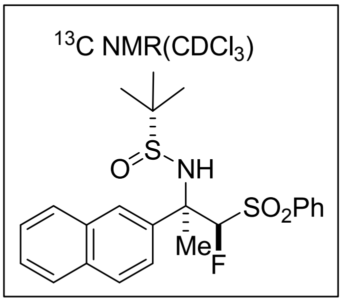
1
PPM



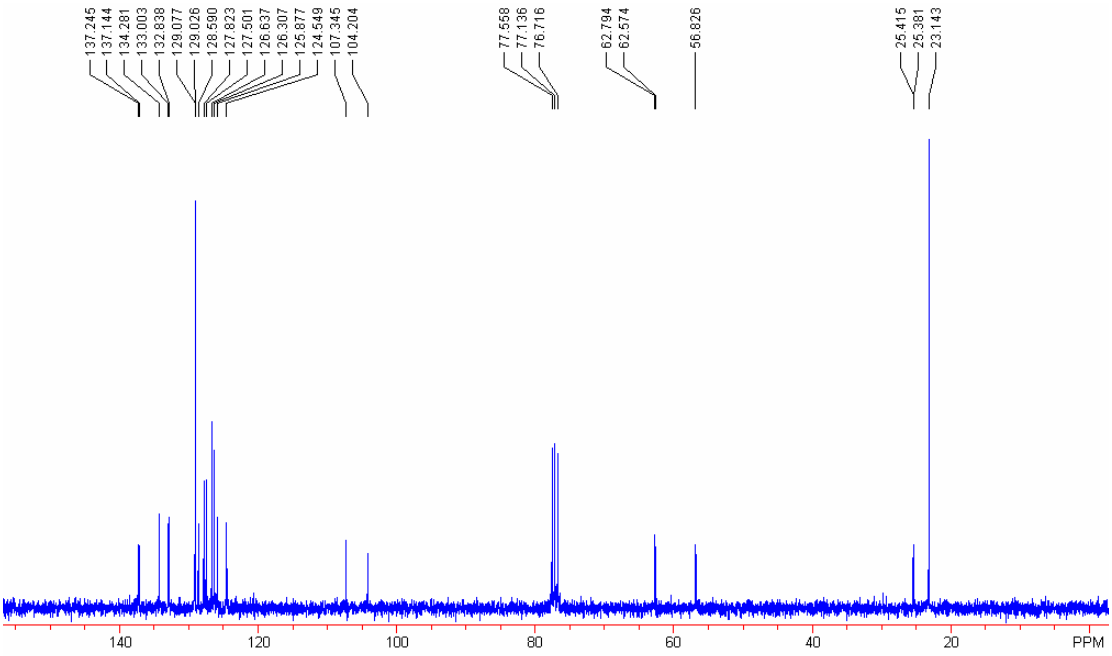
4g’



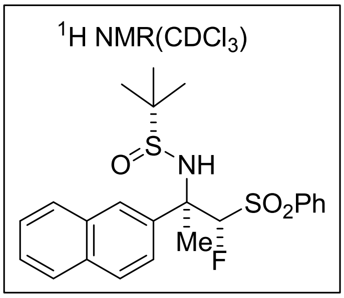


^{13}C NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F

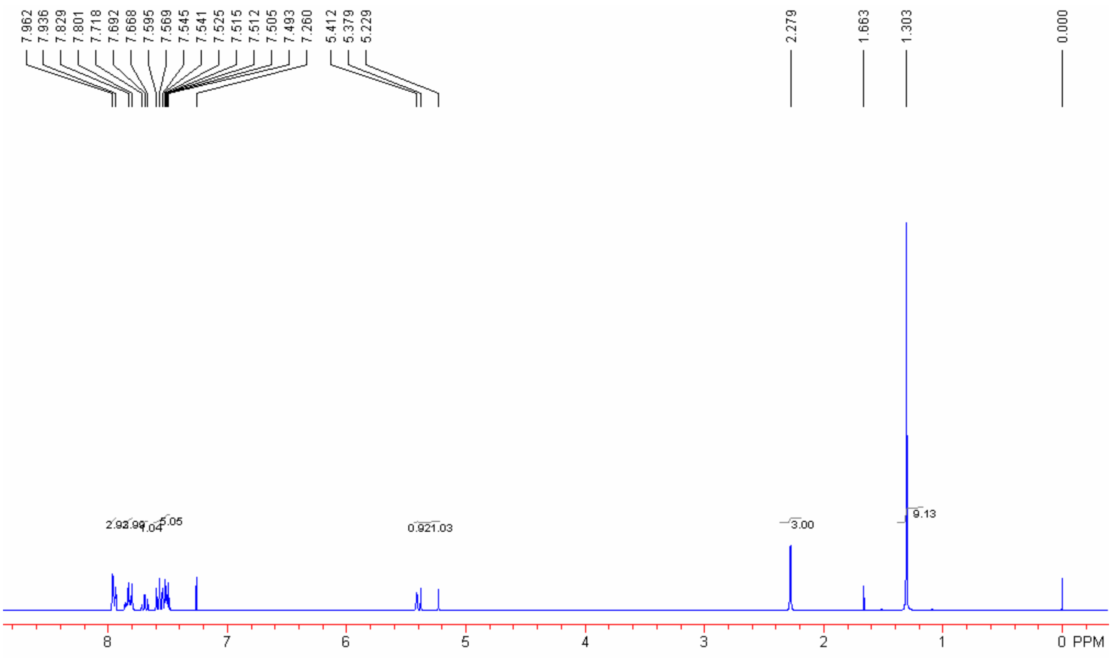
4g’

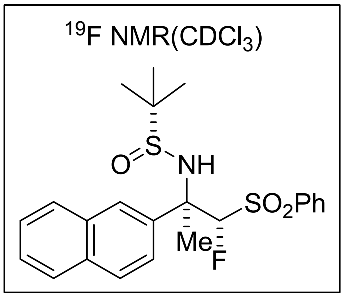


137.245
137.144
134.281
133.003
132.838
129.077
129.026
128.590
127.823
127.501
126.637
126.307
125.877
124.549
107.345
104.204
77.558
77.136
76.716
62.794
62.574
56.826
25.415
25.381
23.143
140
120
100
80
60
40
20
PPM



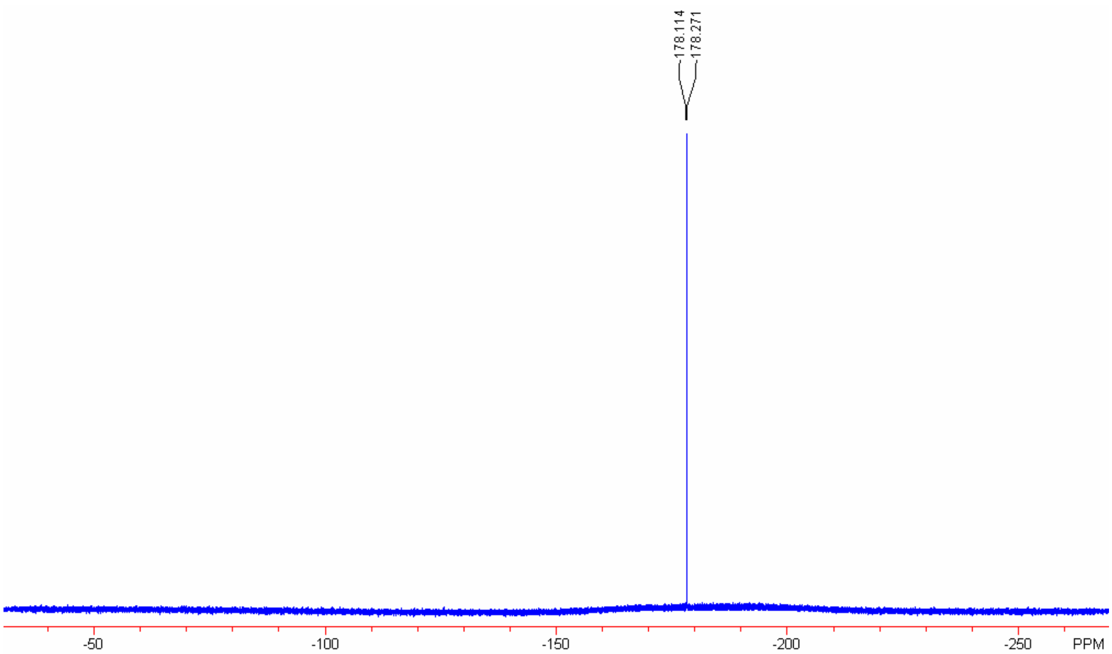
4g''


7.962
7.936
7.829
7.801
7.718
7.692
7.668
7.595
7.569
7.545
7.541
7.525
7.515
7.512
7.505
7.493
7.260
5.412
5.379
5.229
2.279
1.663
1.303
0.000
2.93
2.99
1.04
5.05
0.92
1.03
3.00
9.13
8
7
6
5
4
3
2
1
0 PPM

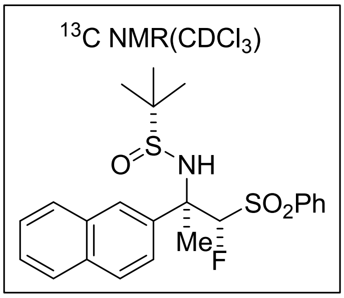


19F NMR(CDCl3)
NH
SO2Ph
Me
F

4g”

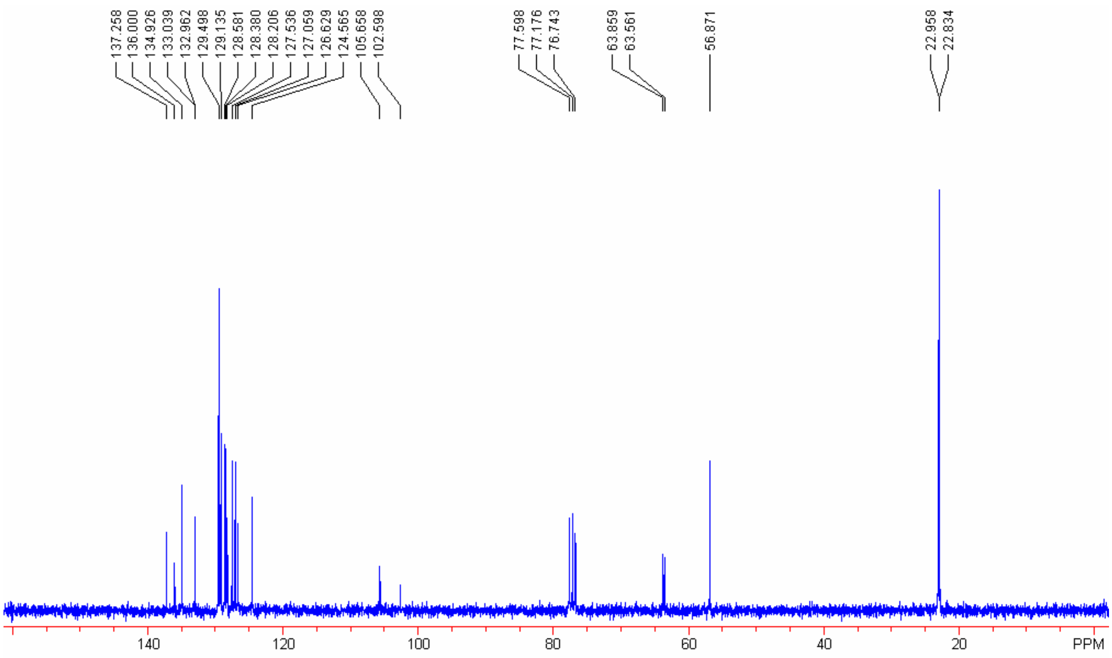


178.114
178.271
-50
-100
-150
-200
-250
PPM

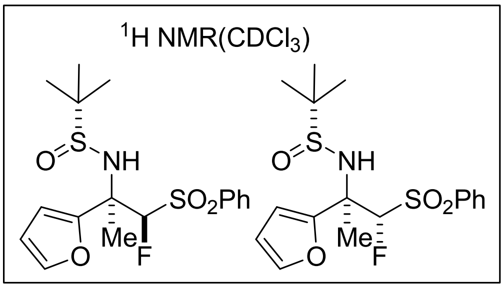


^{13}C NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Me
F

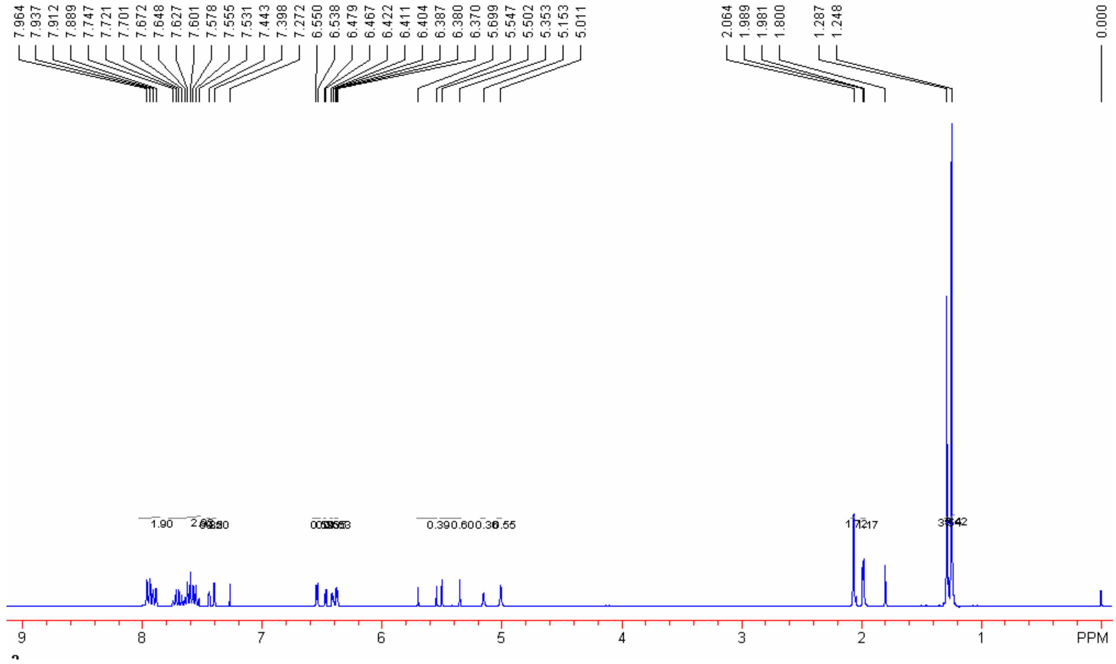
4g''

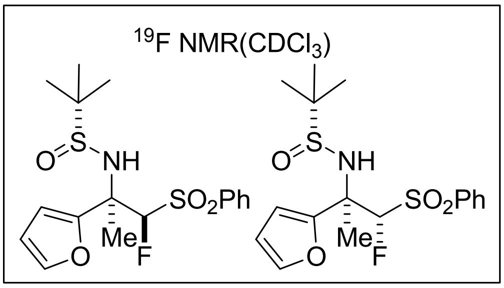


137.258
136.000
134.926
133.039
132.962
129.498
129.135
128.581
128.380
128.206
127.536
127.059
126.629
124.565
105.658
102.598
77.598
77.176
76.743
63.859
63.561
56.871
22.958
22.834
140
120
100
80
60
40
20
PPM

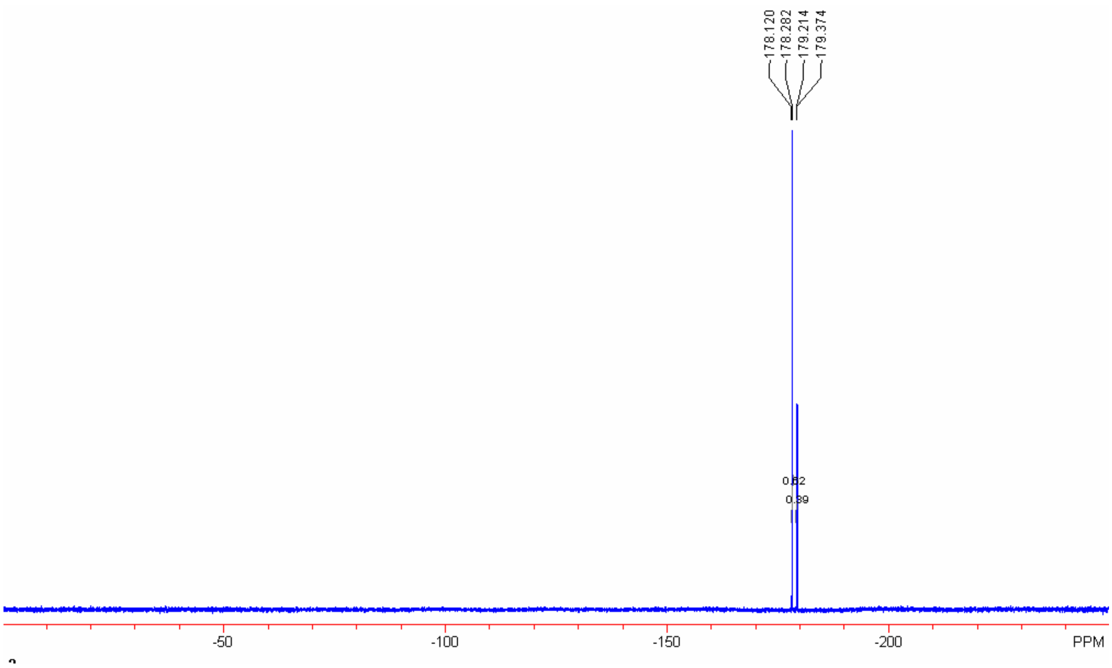


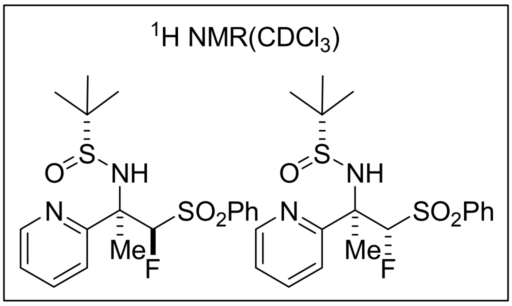
4h'+4h''



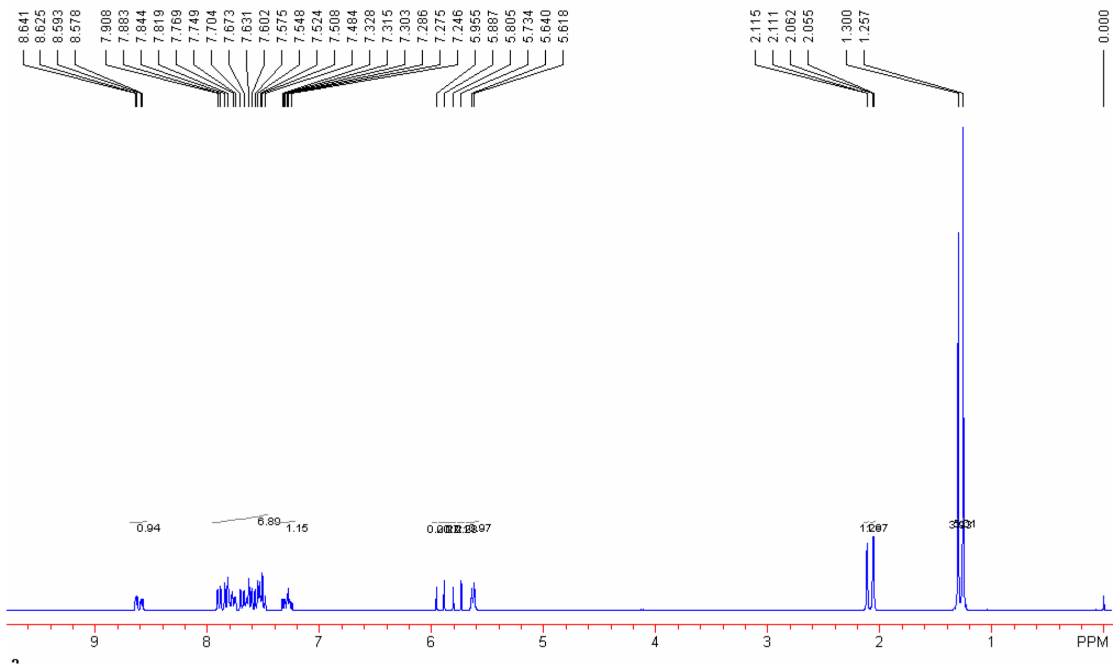

^{19}F NMR(CDCl$_3$)
NH
SO$_2$Ph
Me
F
O
S

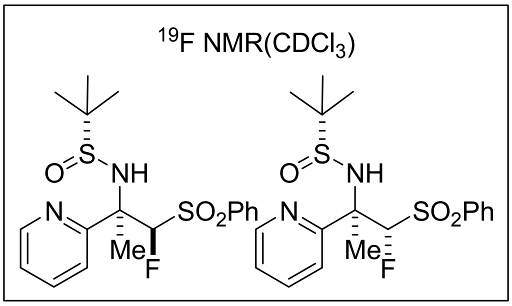
4h'+4h''


178.120
178.282
179.214
179.374
-50
-100
-150
-200
PPM

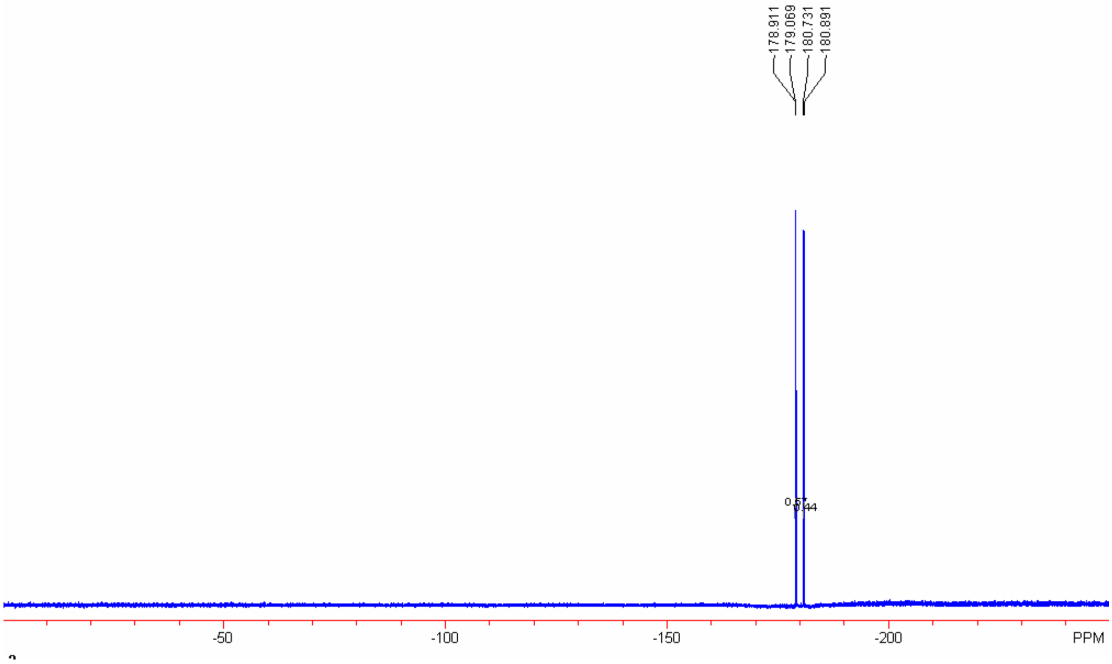


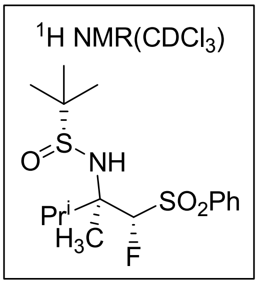
4i'+4i''



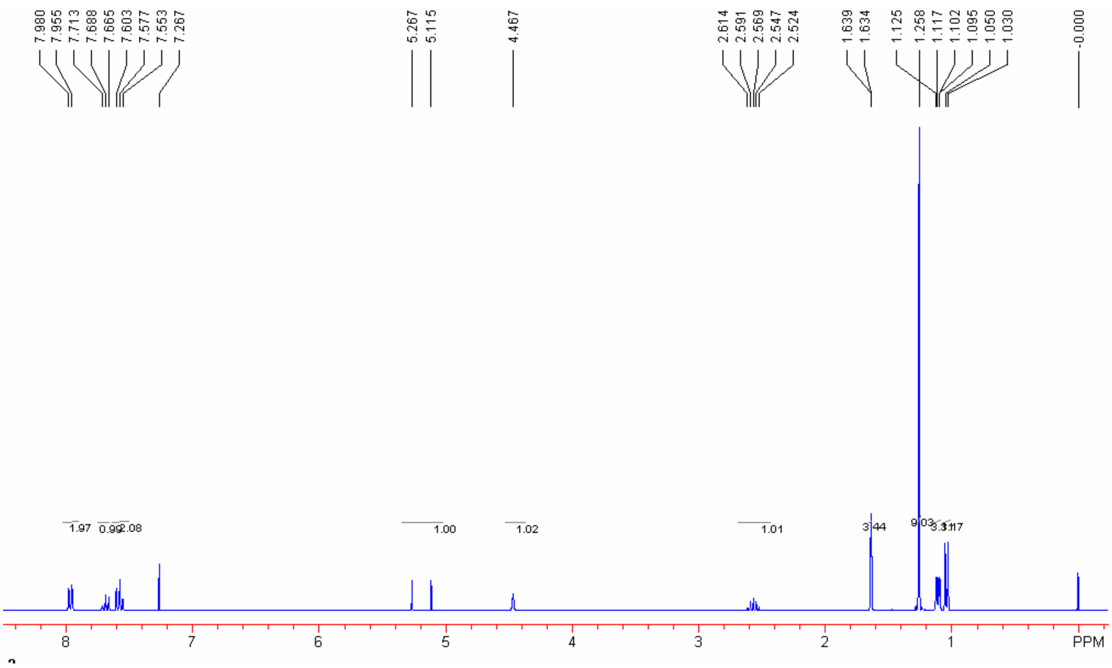

19F NMR(CDCl3)
NH
SO2Ph
N
Me
F
O
S

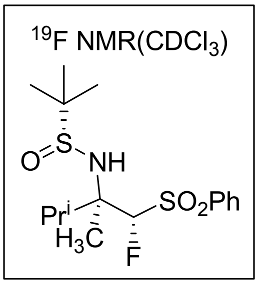
4i'+4i"


178.911
179.069
180.731
180.891
0.57
0.44
-50
-100
-150
-200
PPM

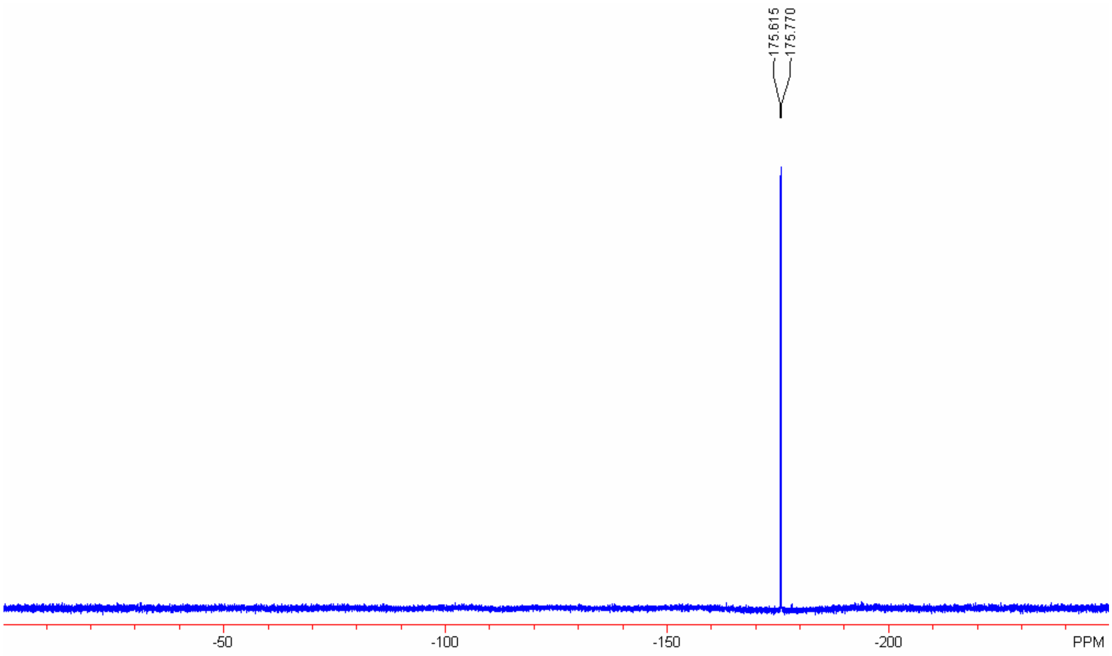

^{1}H NMR(CDCl$_3$)
O
S
NH
SO$_2$Ph
Pr^i
H$_3$C
F

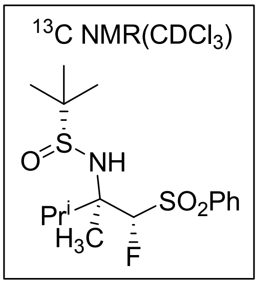
4j''


7.980
7.955
7.713
7.688
7.665
7.603
7.577
7.553
7.267
5.267
5.115
4.467
2.614
2.591
2.569
2.547
2.524
1.639
1.634
1.125
1.258
1.117
1.102
1.095
1.050
1.030
-0.000
1.97
0.99
2.08
1.00
1.02
1.01
3.44
9.03
3.31
1.17
8
7
6
5
4
3
2
1
PPM


19F NMR(CDCl3)
O
S
NH
Pr^i
H3C
SO2Ph
F

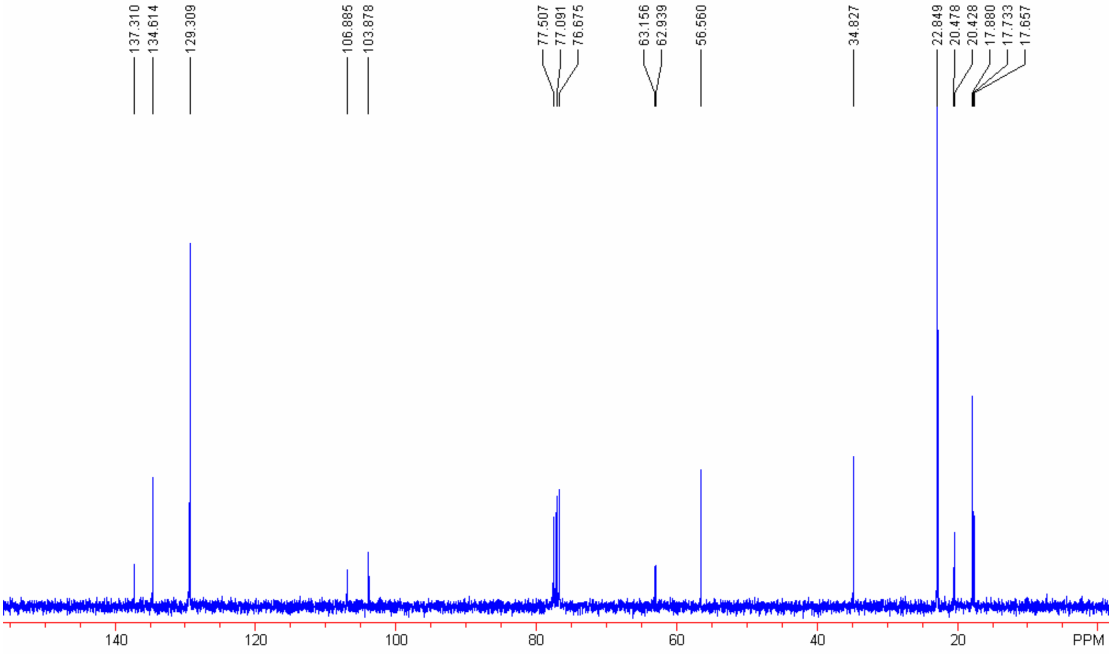
4j"


175.615
175.770
-50
-100
-150
-200
PPM

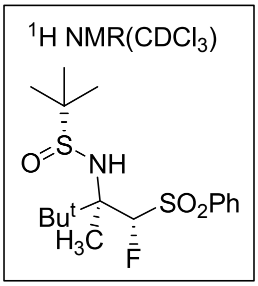


^{13}C NMR(CDCl$_3$)
NH
SO$_2$Ph
Pr^i
H$_3$C
F

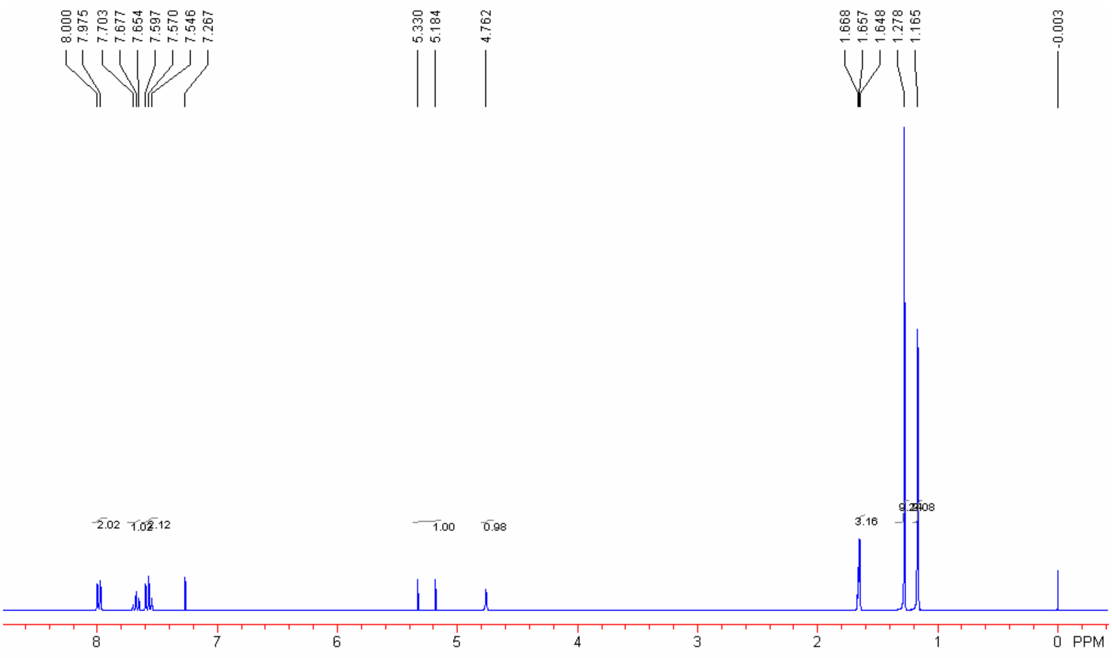
4j''

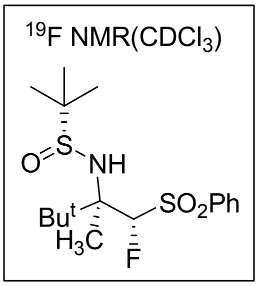


137.310
134.614
129.309
106.885
103.878
77.507
77.091
76.675
63.156
62.939
56.560
34.827
22.849
20.478
20.428
17.880
17.733
17.657
140
120
100
80
60
40
20
PPM



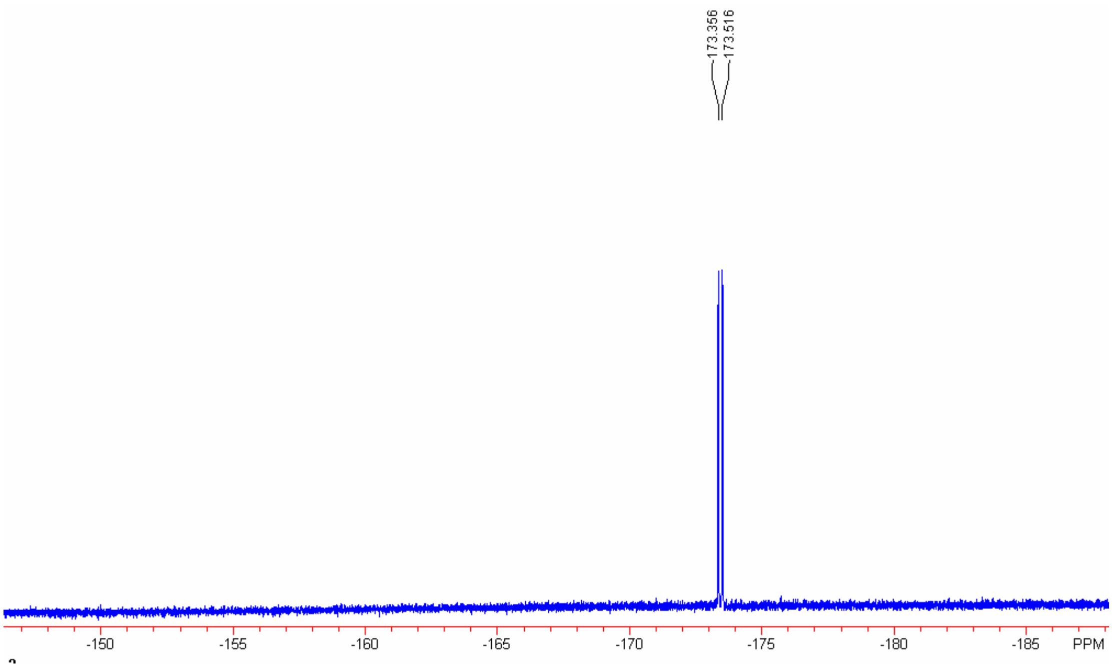
4k"



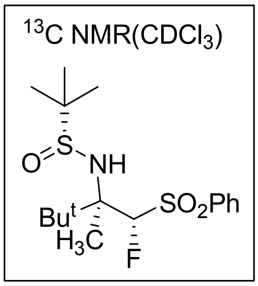


19F NMR(CDCl3)
O
S
NH
Bu
t
H3C
SO2Ph
F

4k"

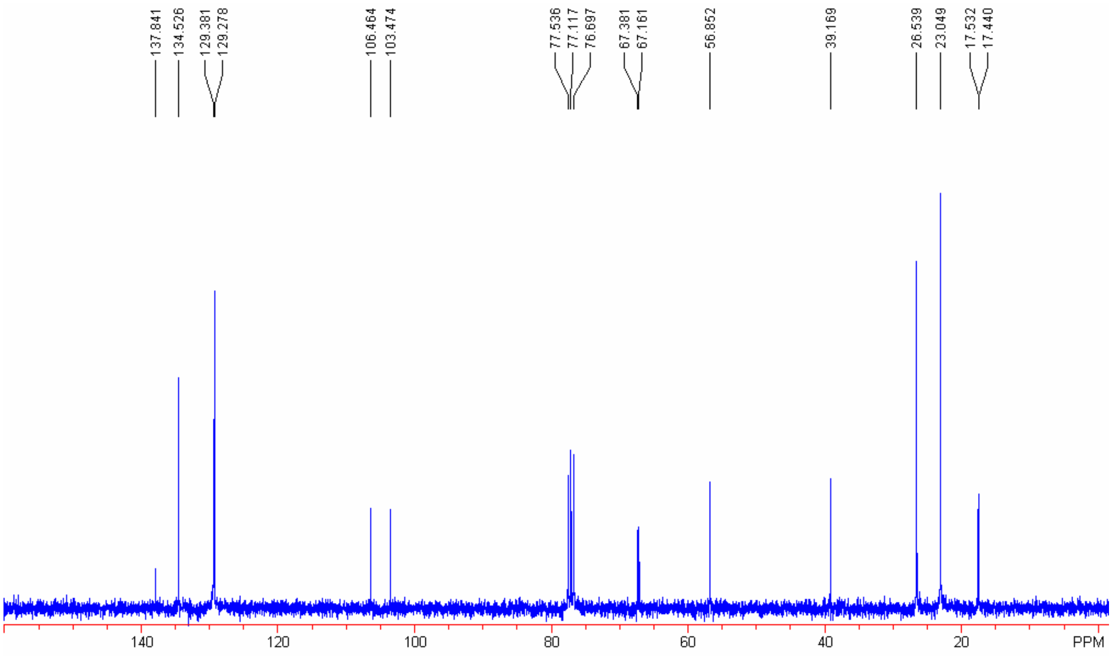


173.356
173.516
-150
-155
-160
-165
-170
-175
-180
-185
PPM

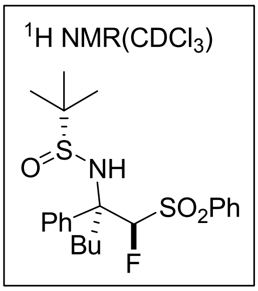


13C NMR(CDCl3)
O
S
NH
Bu^t
H3C
SO2Ph
F

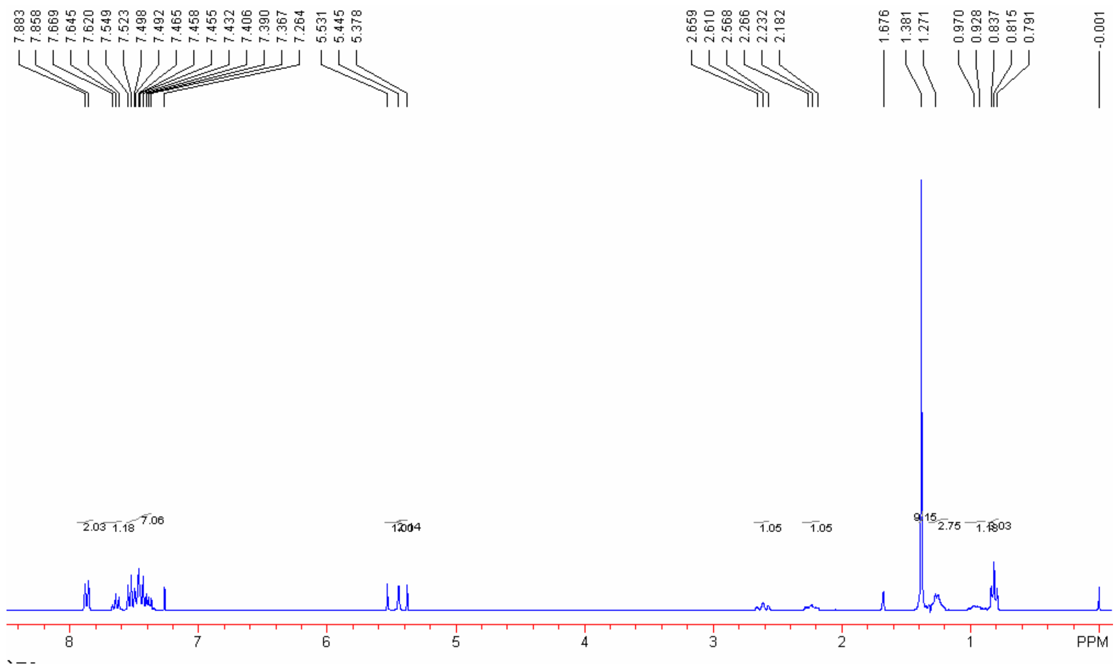
4k”

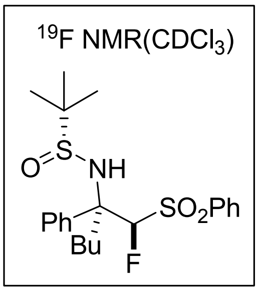


137.841
134.526
129.381
129.278
106.464
103.474
77.536
77.117
76.697
67.381
67.161
56.852
39.169
26.539
23.049
17.532
17.440
140
120
100
80
60
40
20
PPM



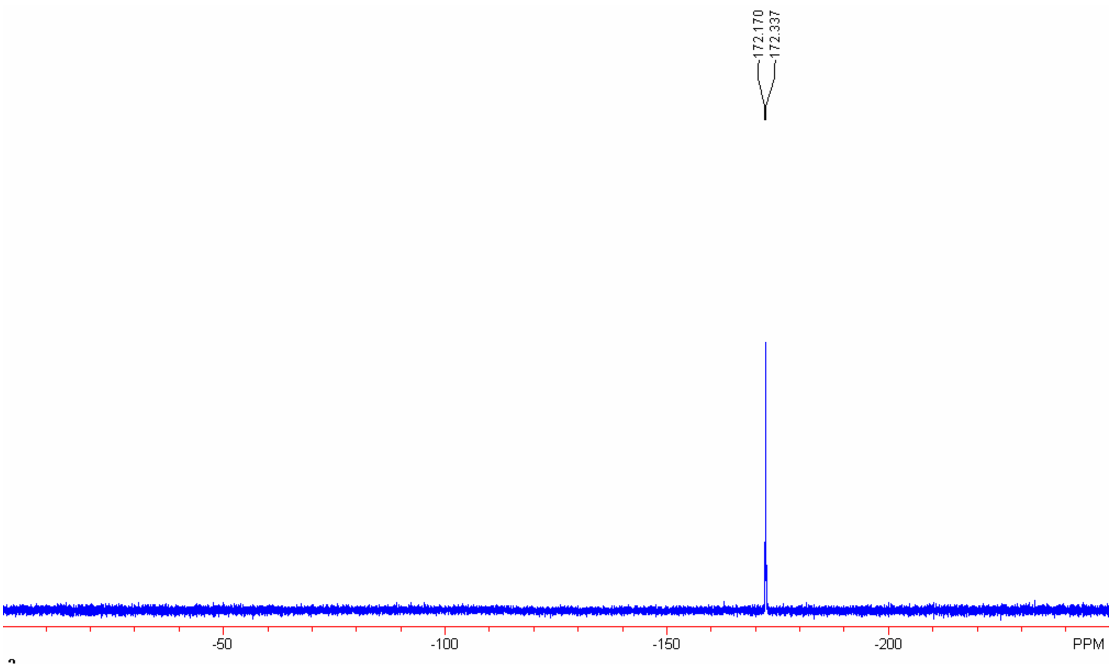
4l'



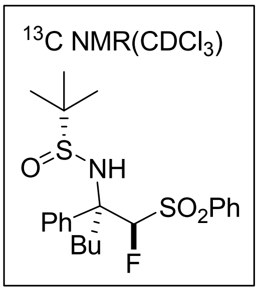


19F NMR(CDCl3)
O
S
NH
Ph
Bu
SO2Ph
F

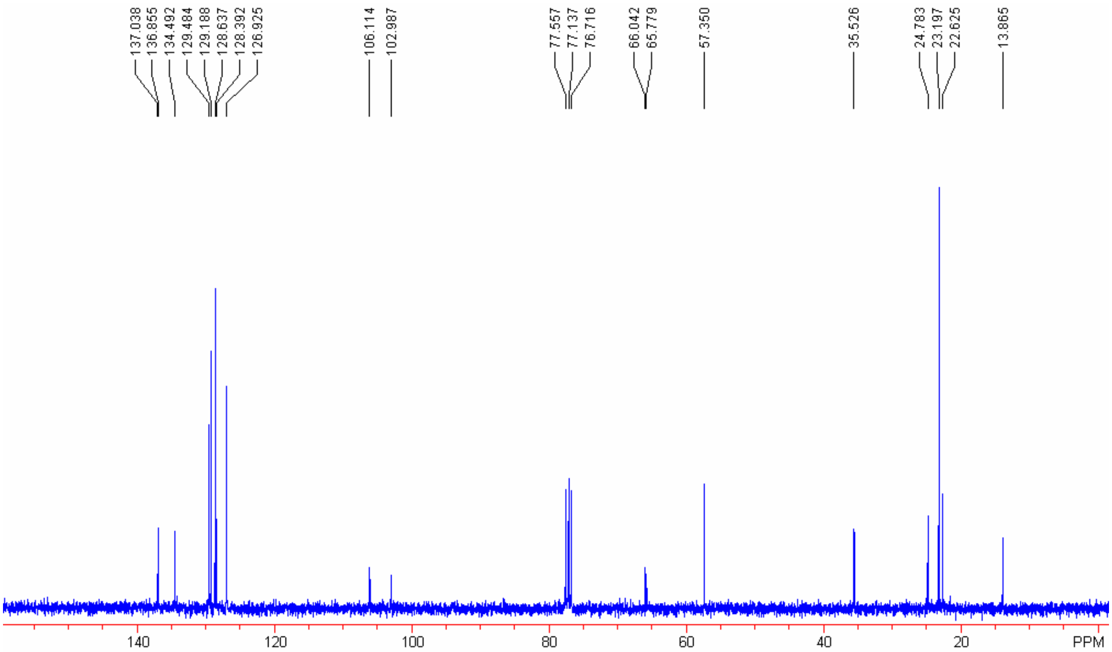
4l’

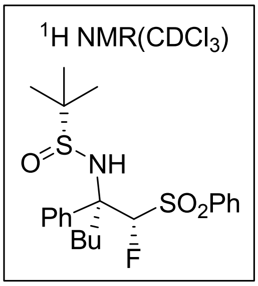


172.170
172.337
-50
-100
-150
-200
PPM

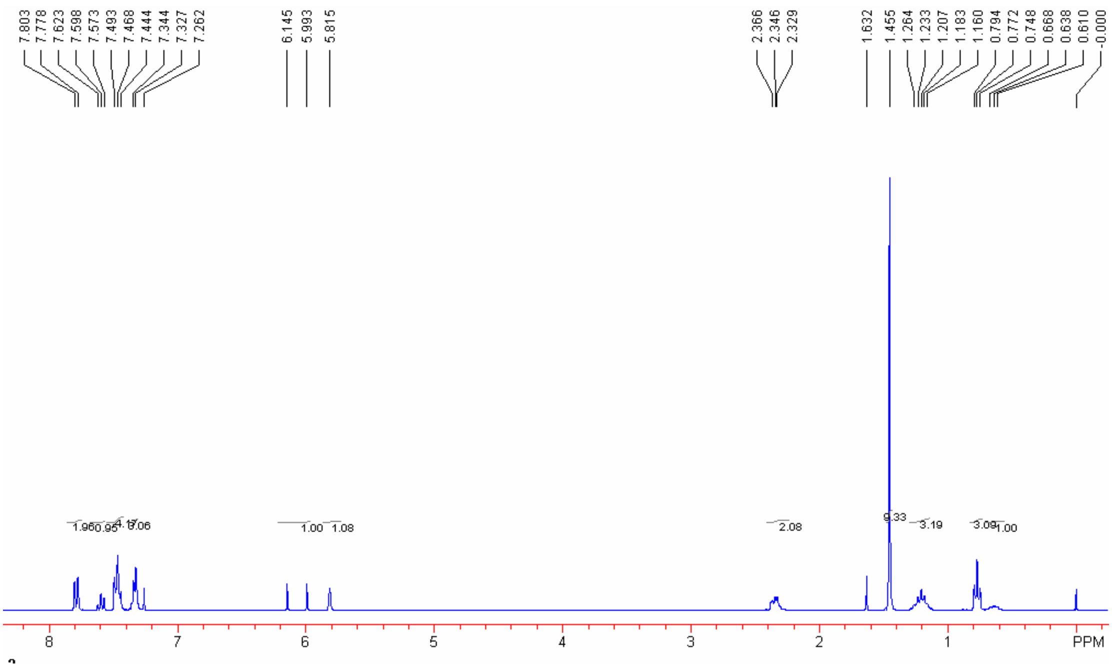

^{13}C NMR(CDCl$_3$)
O
S
NH
Ph
Bu
SO$_2$Ph
F

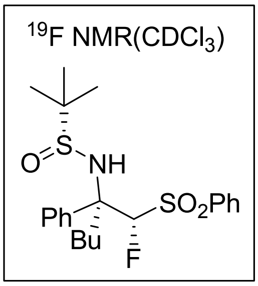
4l’


137.038
136.855
134.492
129.484
129.188
128.637
128.392
126.925
106.114
102.987
77.557
77.137
76.716
66.042
65.779
57.350
35.526
24.783
23.197
22.625
13.865
140
120
100
80
60
40
20
PPM



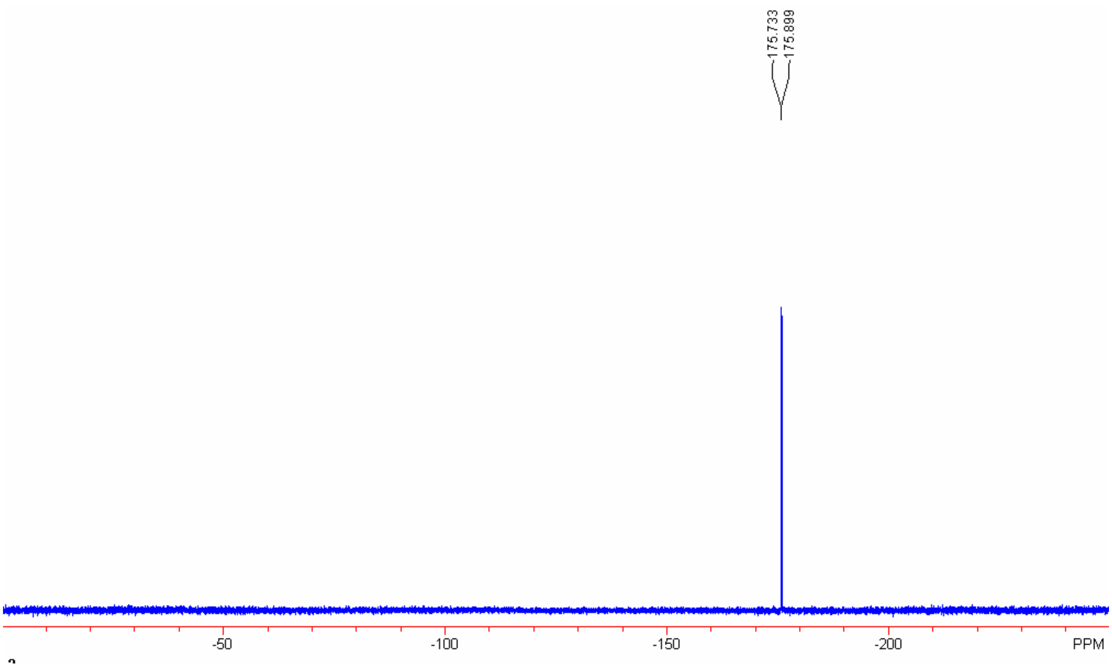
4l''



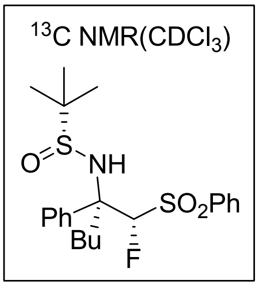


19F NMR(CDCl3)
O=S
NH
Ph
Bu
SO2Ph
F

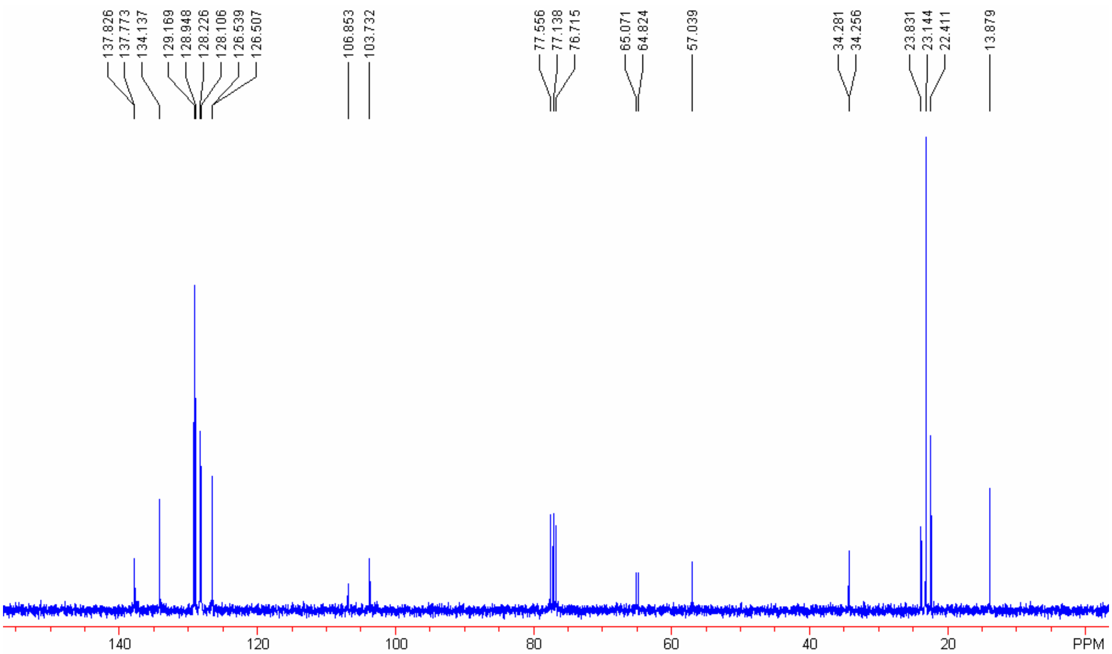
4l”

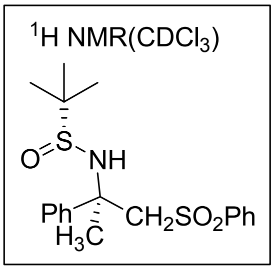


175.733
175.899
-50
-100
-150
-200
PPM

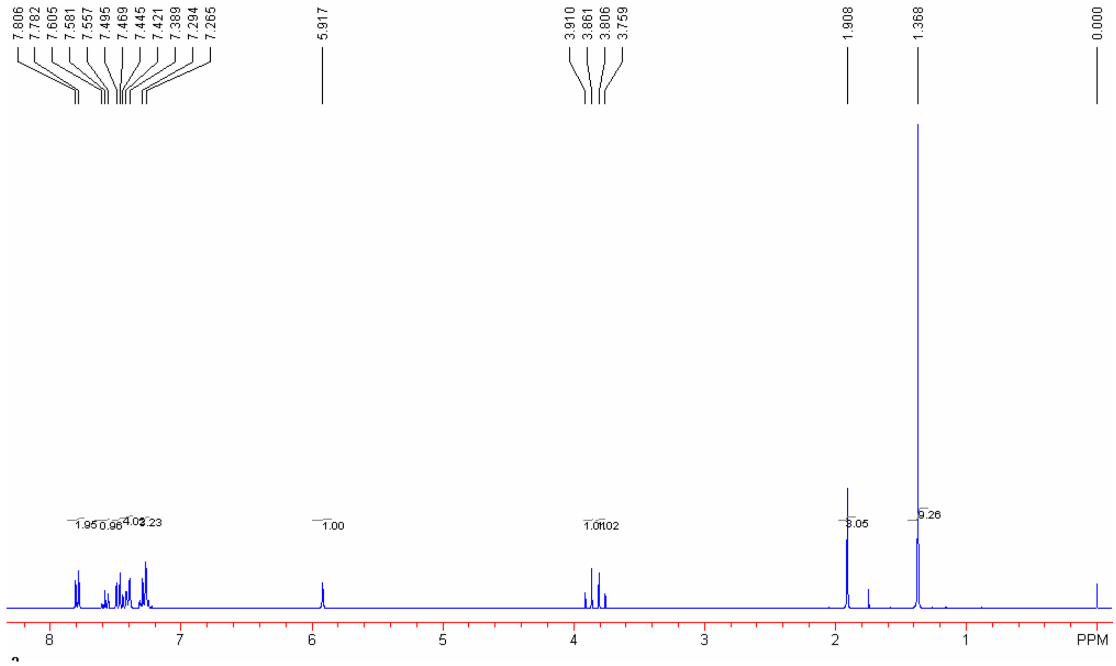

13C NMR(CDCl3)
O
S
NH
Ph
Bu
SO2Ph
F

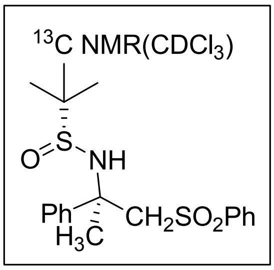
4l”


137.826
137.773
134.137
129.169
128.948
128.226
128.106
126.539
126.507
106.853
103.732
77.556
77.138
76.715
65.071
64.824
57.039
34.281
34.256
23.831
23.144
22.411
13.879
140
120
100
80
60
40
20
PPM



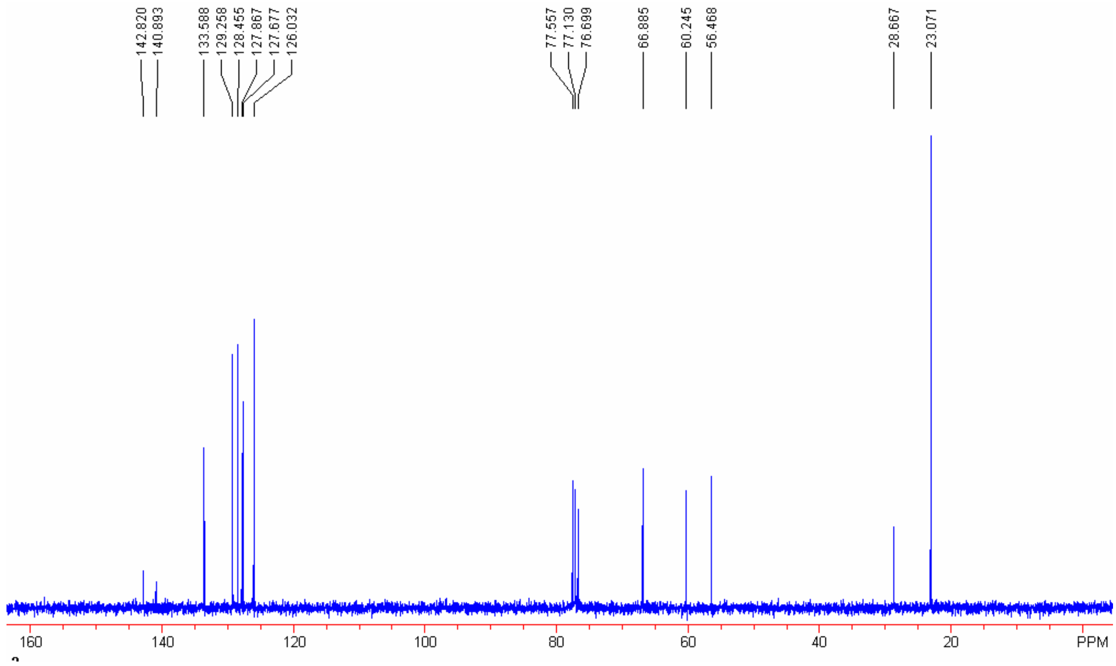
7



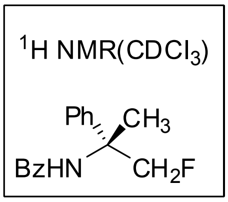


^{13}C NMR(CDCl$_3$)
O
S
NH
Ph
H$_3$C
CH$_2$SO$_2$Ph

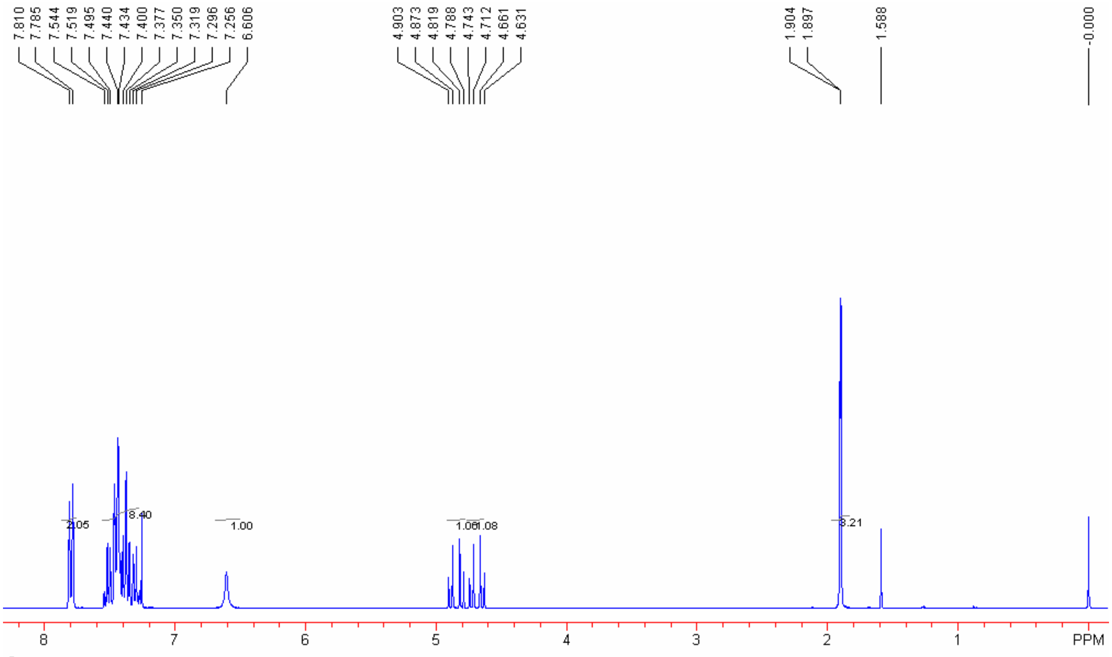
7

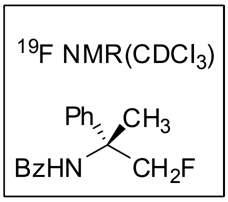


142.820
140.893
133.588
129.258
128.455
127.867
127.677
126.032
77.557
77.130
76.699
66.885
60.245
56.468
28.667
23.071
160
140
120
100
80
60
40
20
PPM

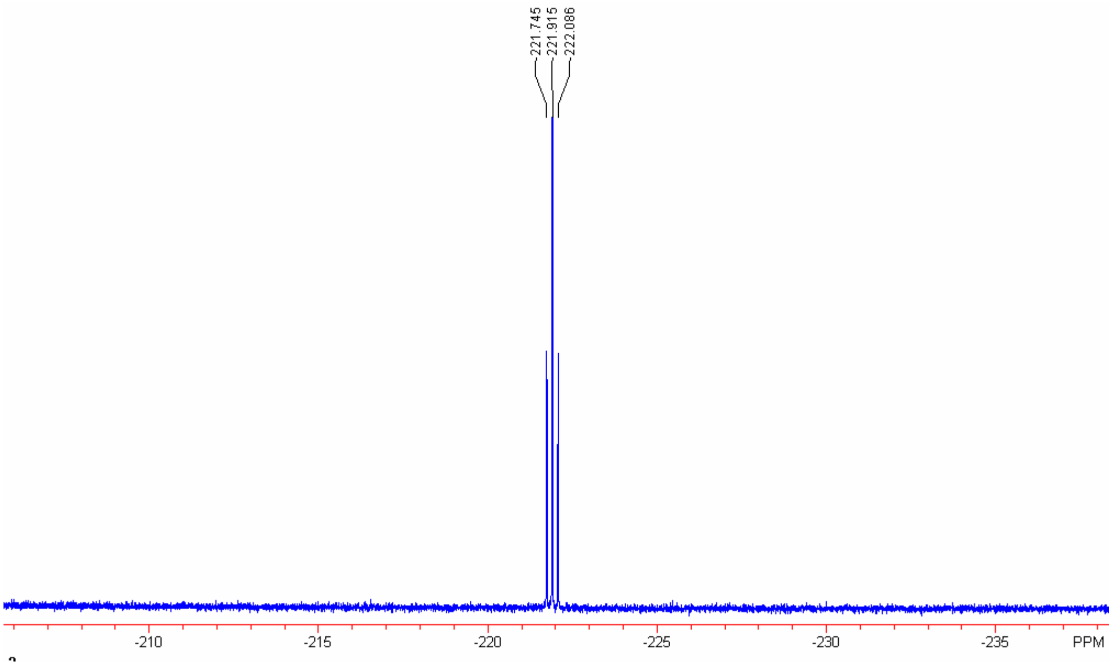


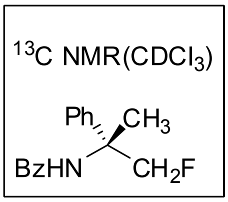
10




19F NMR(CDCl3)
Ph
CH3
BzHN
CH2F

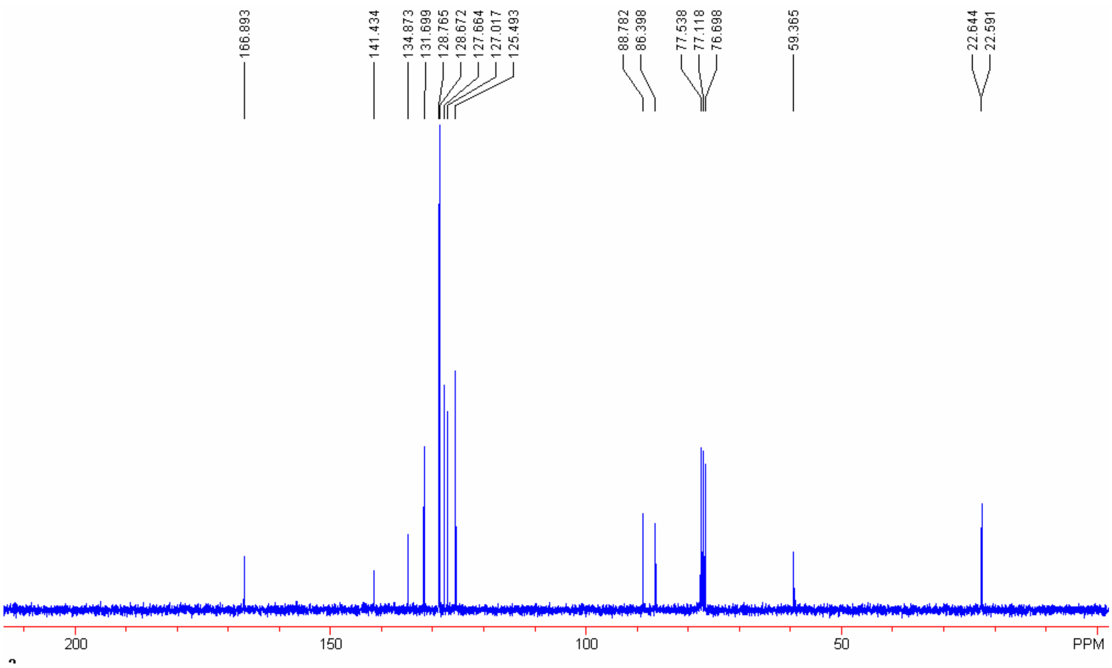
10


221.745
221.915
222.086
-210
-215
-220
-225
-230
-235
PPM

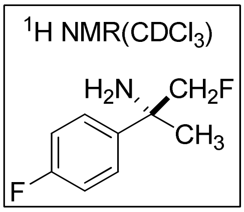


^{13}C NMR(CDCl$_3$)
Ph
CH3
BzHN
CH2F

10

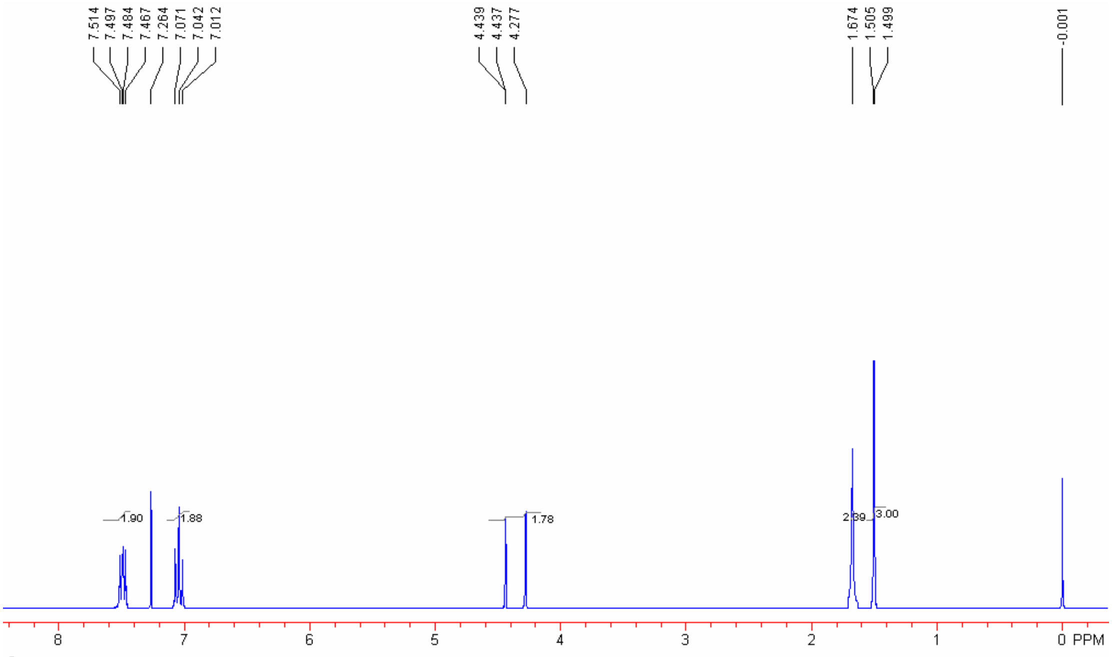


166.893
141.434
134.873
131.699
128.765
128.672
127.664
127.017
125.493
88.782
86.398
77.538
77.118
76.698
59.365
22.644
22.591
200
150
100
50
PPM

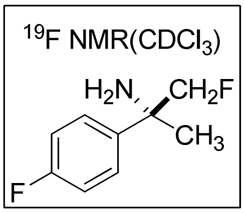


^{1}H NMR(CDCl$_3$)
H$_2$N
CH$_2$F
CH$_3$
F

11b

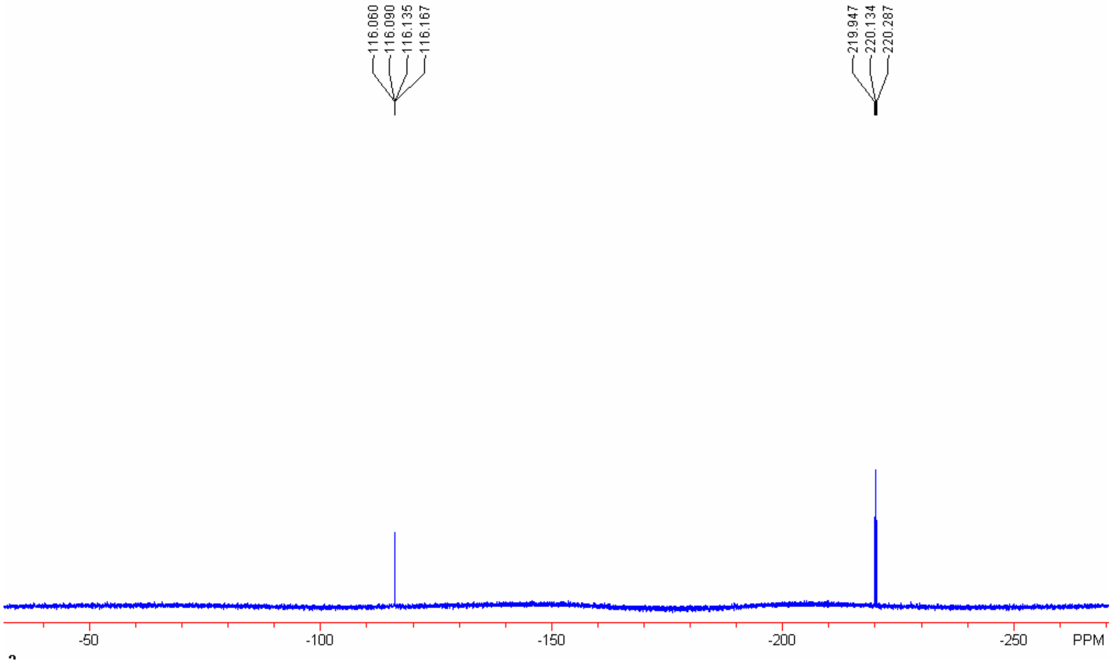


7.514
7.497
7.484
7.467
7.264
7.071
7.042
7.012
4.439
4.437
4.277
1.674
1.505
1.499
-0.001
1.90
1.88
1.78
2.99
3.00
8
7
6
5
4
3
2
1
0 PPM

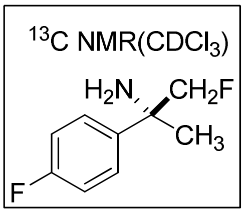


19F NMR(CDCl3)
H2N
CH2F
CH3
F

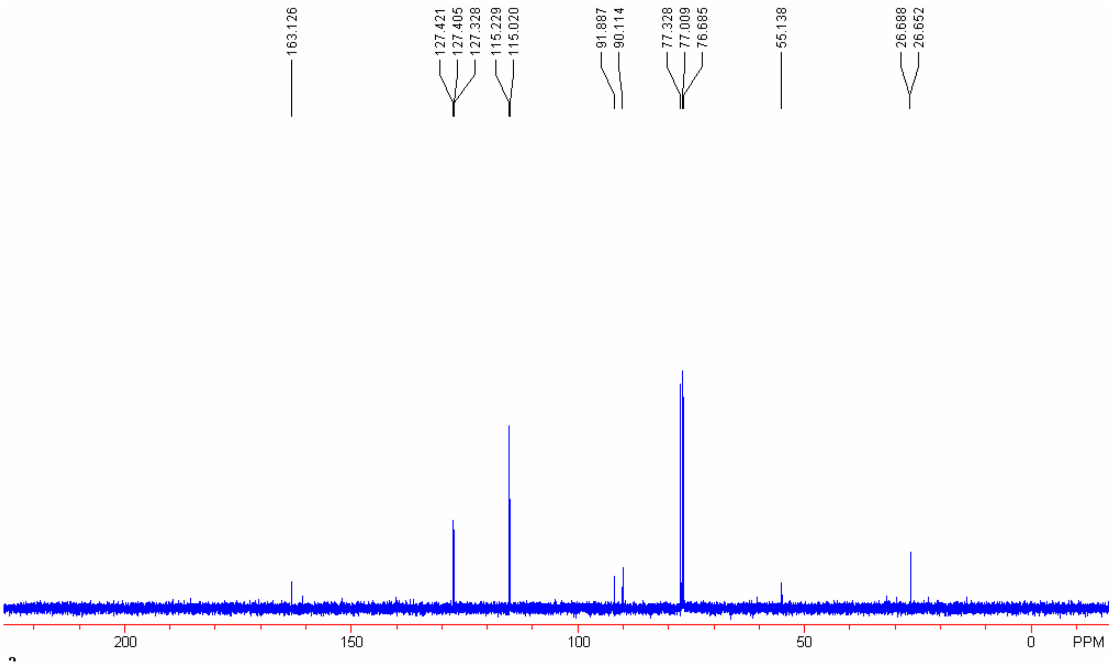
11b

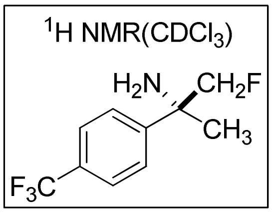


116.060
116.090
116.135
116.167
219.947
220.134
220.287
-50
-100
-150
-200
-250
PPM

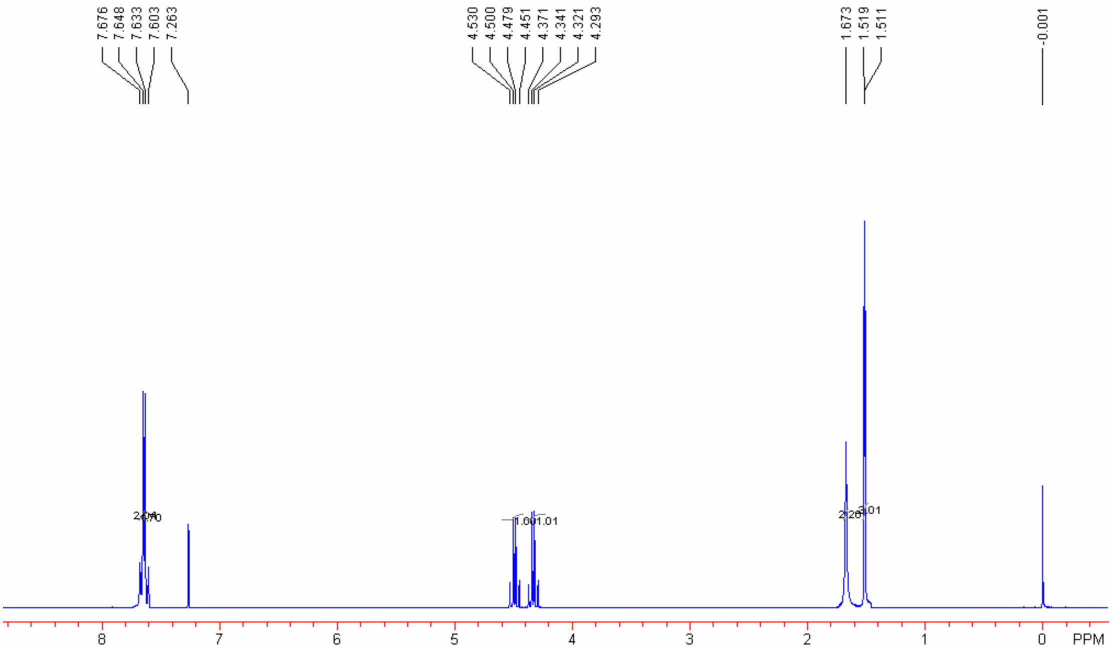

13C NMR(CDCl3)
H2N
CH2F
CH3
F

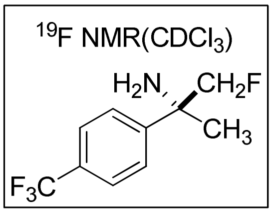
11b


163.126
127.421
127.405
127.328
115.229
115.020
91.887
90.114
77.328
77.009
76.685
55.138
26.688
26.652
200
150
100
50
0
PPM

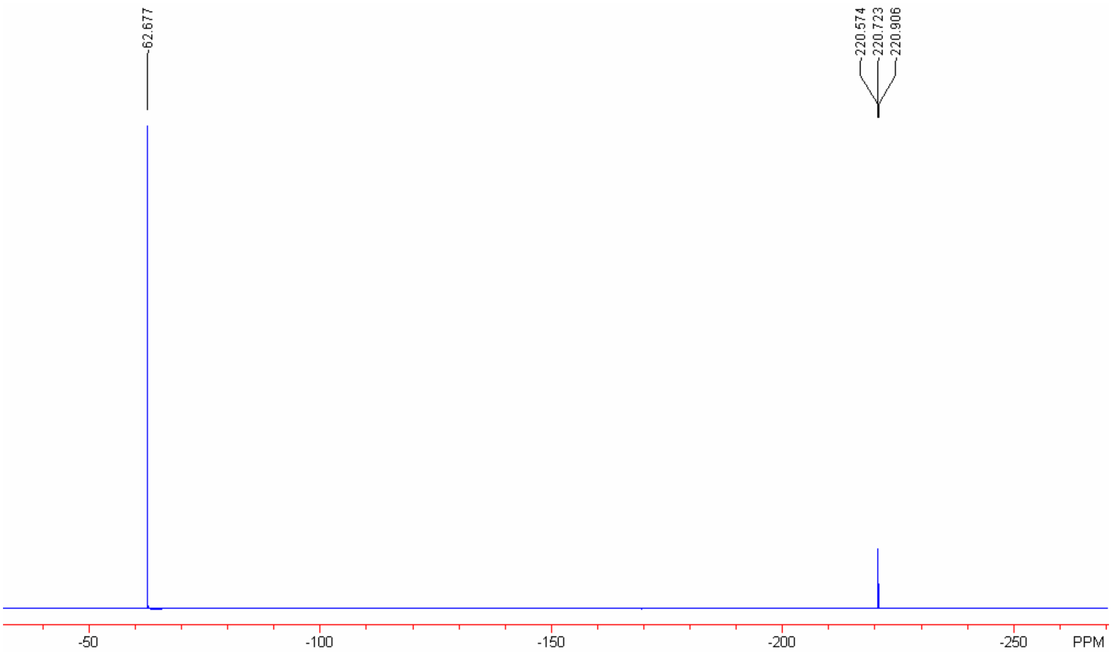

1H NMR(CDCl3)
H2N
CH2F
CH3
F3C

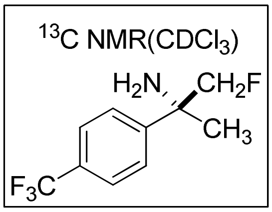
11c


7.676
7.648
7.633
7.603
7.263
4.530
4.500
4.479
4.451
4.371
4.341
4.321
4.293
1.673
1.519
1.511
-0.001
8
7
6
5
4
3
2
1
0
PPM

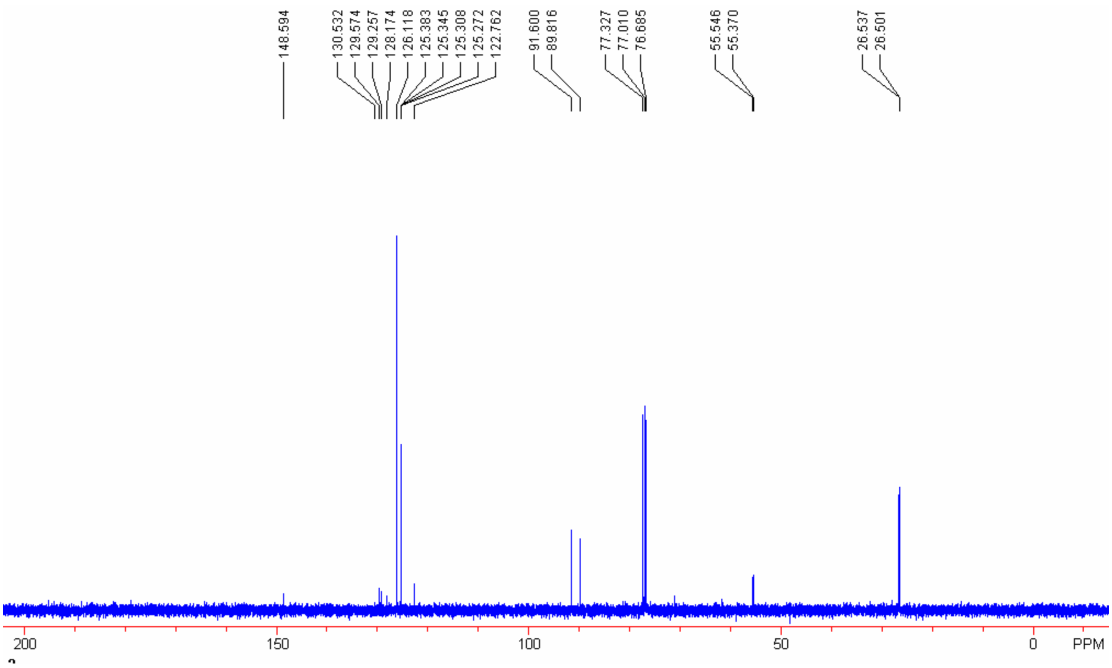

19F NMR(CDCl3)
H2N
CH2F
CH3
F3C

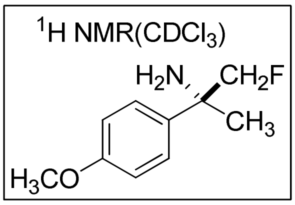
11c


62.677
220.574
220.723
220.906
-50
-100
-150
-200
-250
PPM


^{13}C NMR(CDCl$_3$)
H$_2$N
CH$_2$F
CH$_3$
F$_3$C

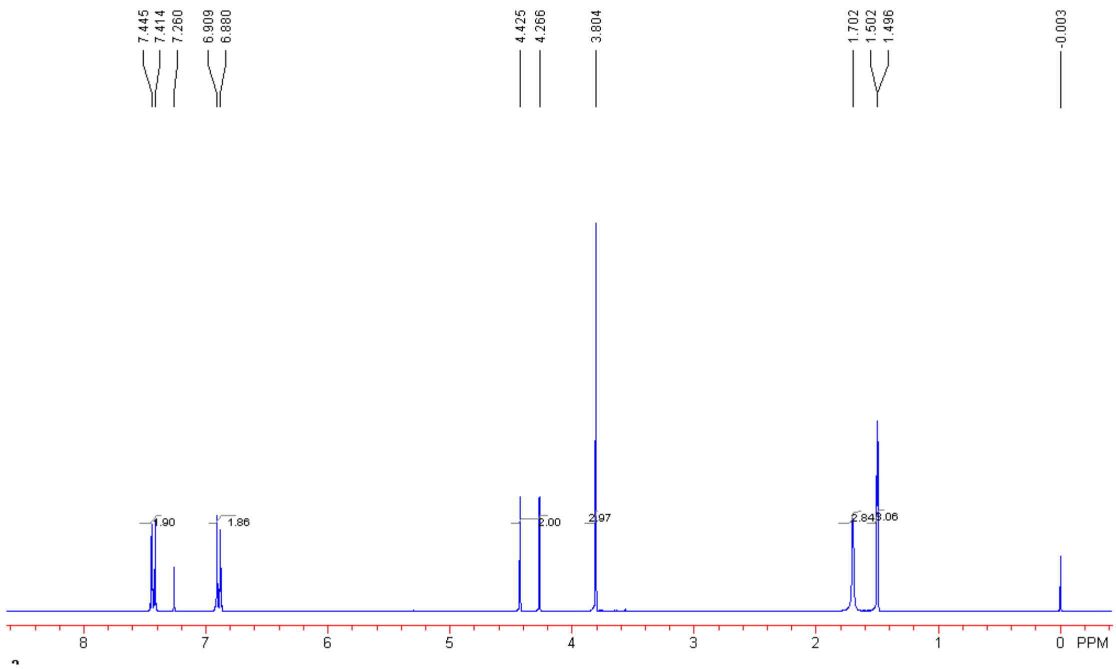
11c


148.594
130.532
129.574
129.257
128.174
126.118
125.383
125.345
125.308
125.272
122.762
91.600
89.816
77.327
77.010
76.685
55.546
55.370
26.537
26.501
200
150
100
50
0
PPM

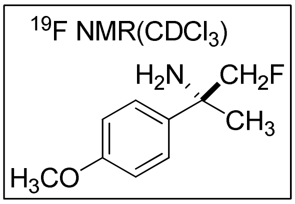


1H NMR(CDCl3)
H2N
CH2F
CH3
H3CO

11d

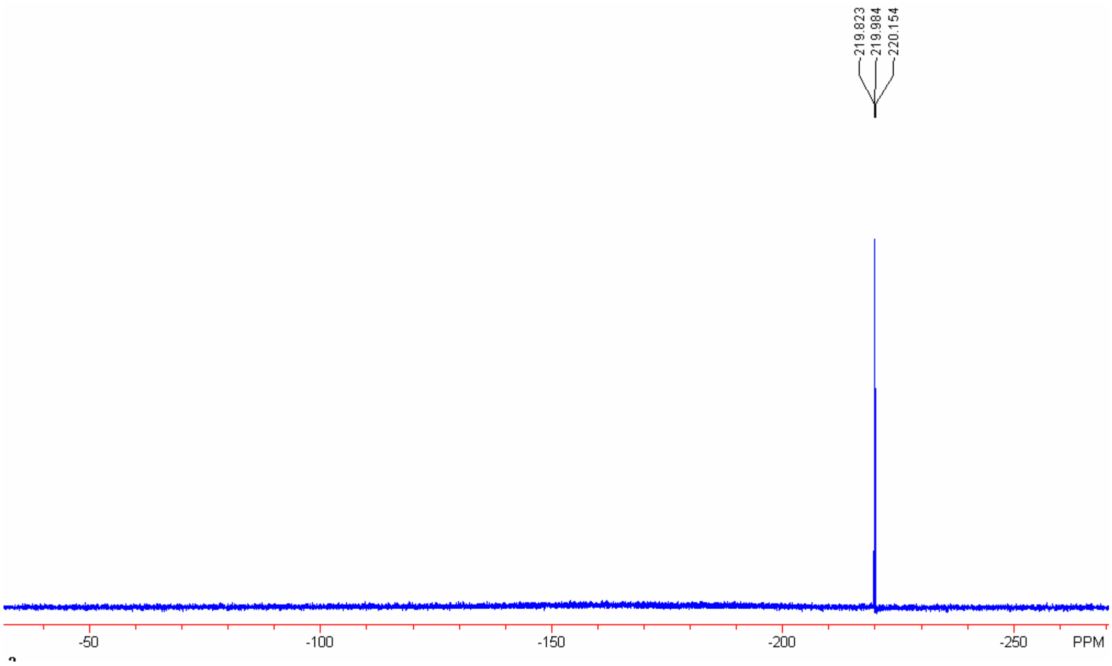


7.445
7.414
7.260
6.909
6.880
4.425
4.266
3.804
1.702
1.502
1.496
-0.003
1.90
1.86
2.00
2.97
2.84
3.06
8
7
6
5
4
3
2
1
0
PPM

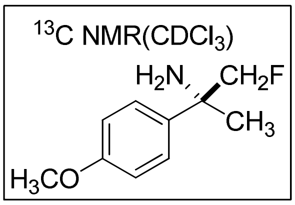


19F NMR(CDCl3)
H2N
CH2F
CH3
H3CO

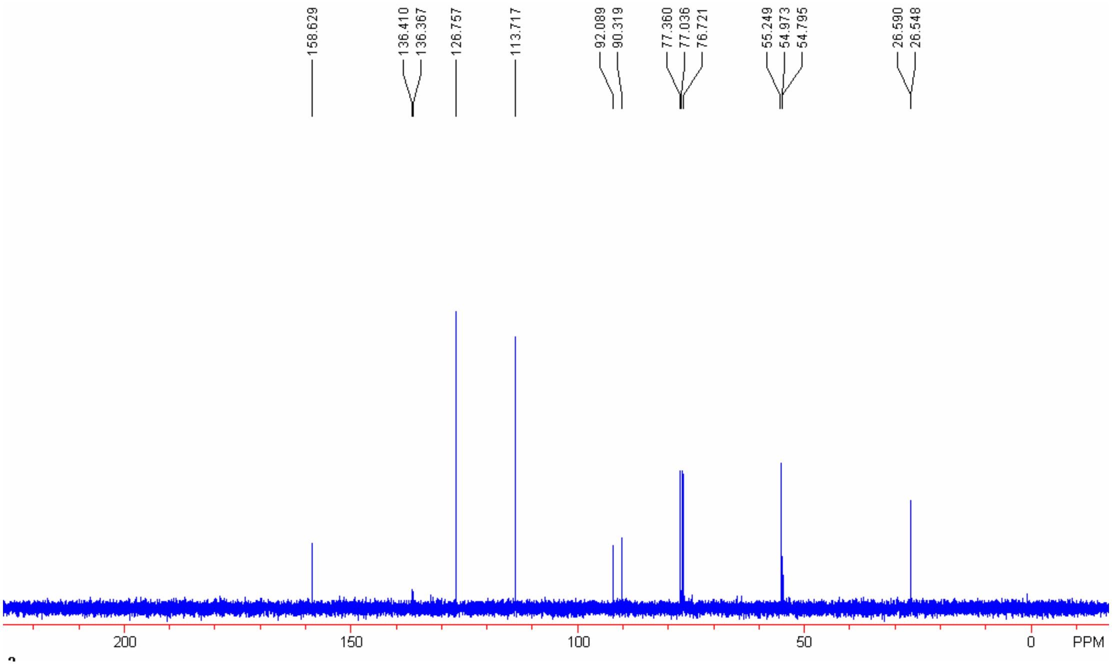
11d

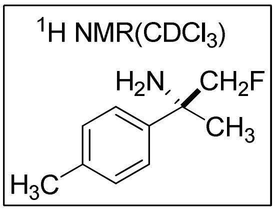


219.823
219.984
220.154
-50
-100
-150
-200
-250
PPM

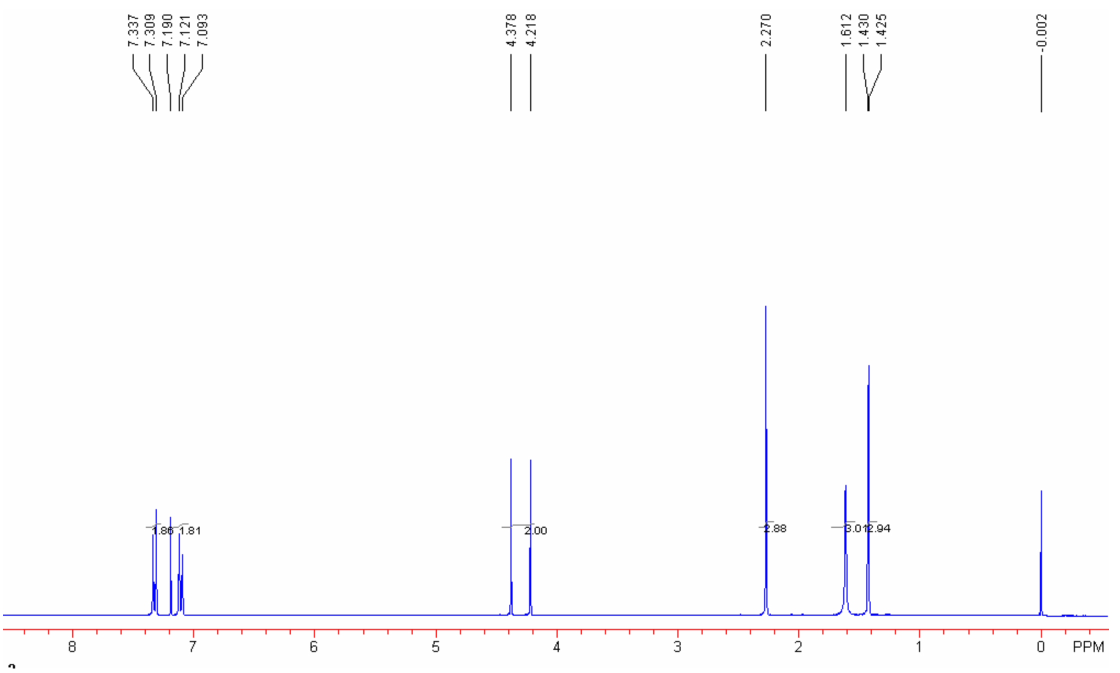

13C NMR(CDCl3)
H2N
CH2F
CH3
H3CO

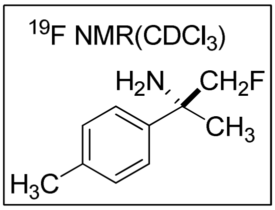
11d


158.629
136.410
136.367
126.757
113.717
92.089
90.319
77.360
77.036
76.721
55.249
54.973
54.795
26.590
26.548
200
150
100
50
0
PPM


^{1}H NMR(CDCl$_3$)
H$_2$N
CH$_2$F
CH$_3$
H$_3$C

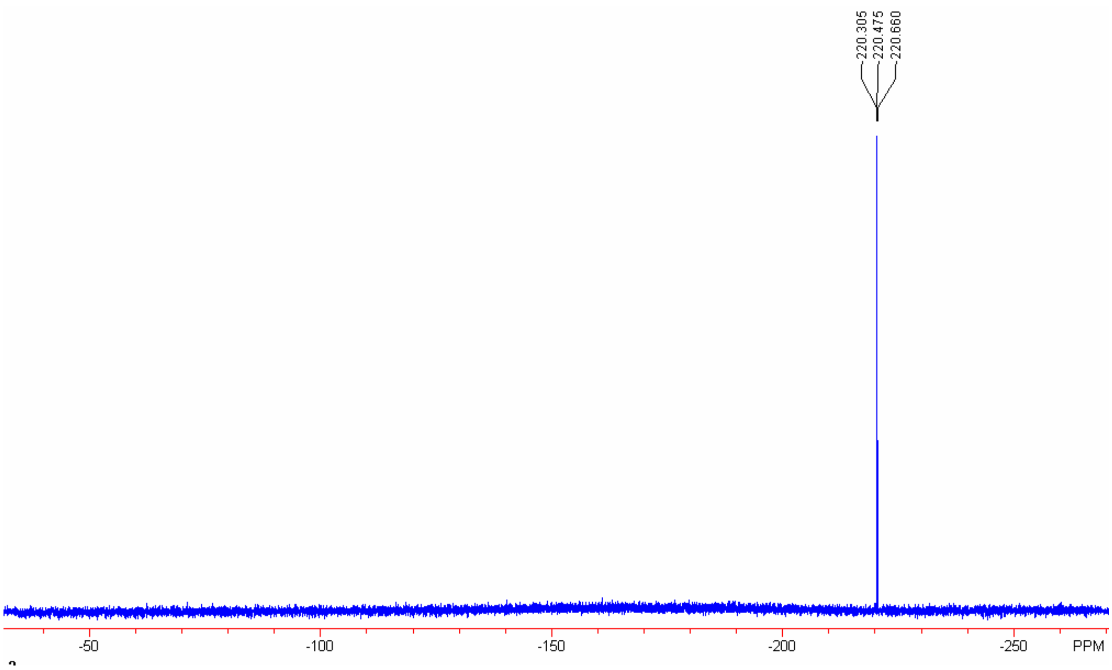
11e


7.337
7.309
7.190
7.121
7.093
4.378
4.218
2.270
1.612
1.430
1.425
-0.002
1.86
1.81
2.00
2.88
3.01
2.94
8
7
6
5
4
3
2
1
0
PPM

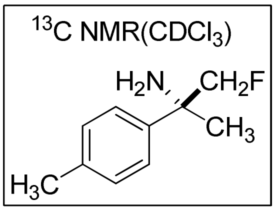


19F NMR(CDCl3)
H2N
CH2F
CH3
H3C

11e

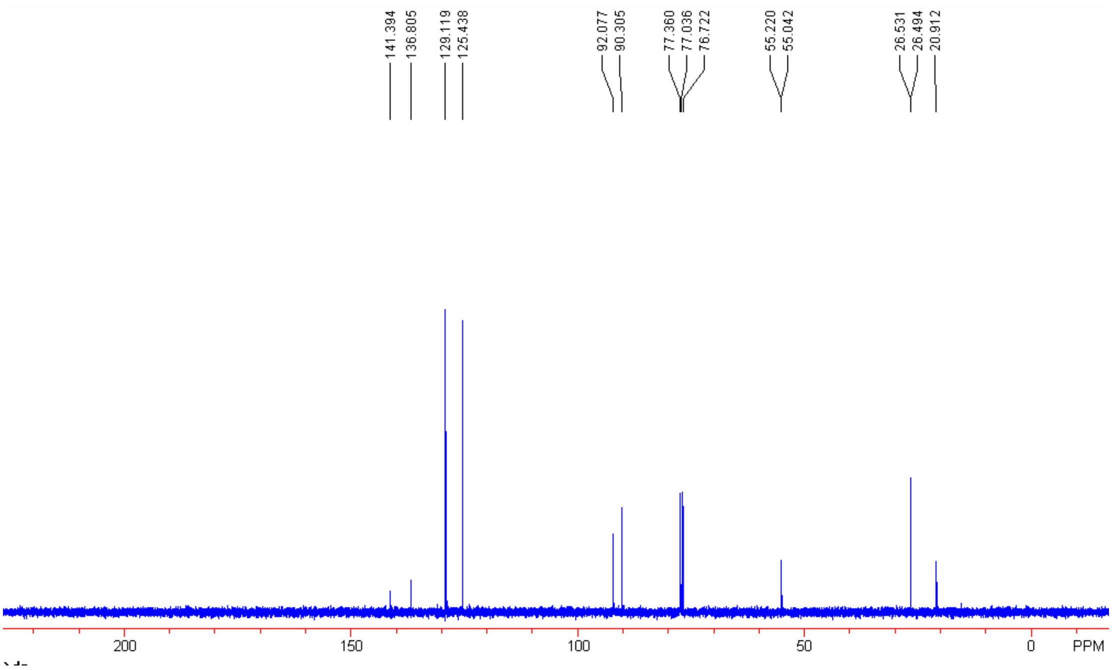


220.305
220.475
220.660
-50
-100
-150
-200
-250
PPM

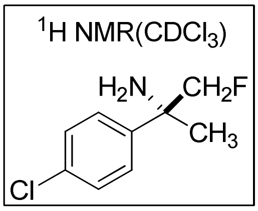


13C NMR(CDCl3)
H2N
CH2F
CH3
H3C

11e

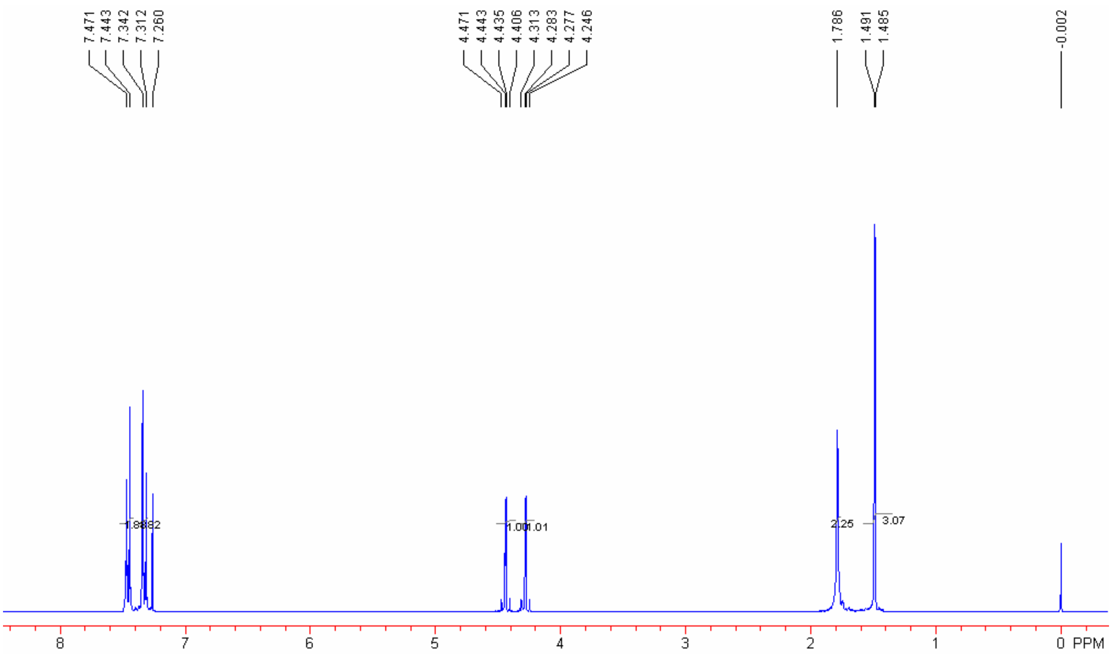


141.394
136.805
129.119
125.438
92.077
90.305
77.360
77.036
76.722
55.220
55.042
26.531
26.494
20.912
200
150
100
50
0
PPM

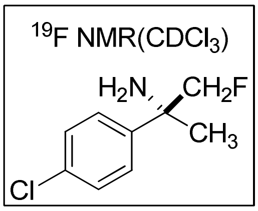


^{1}H NMR(CDCl$_3$)
H$_2$N
CH$_2$F
CH$_3$
Cl

11f

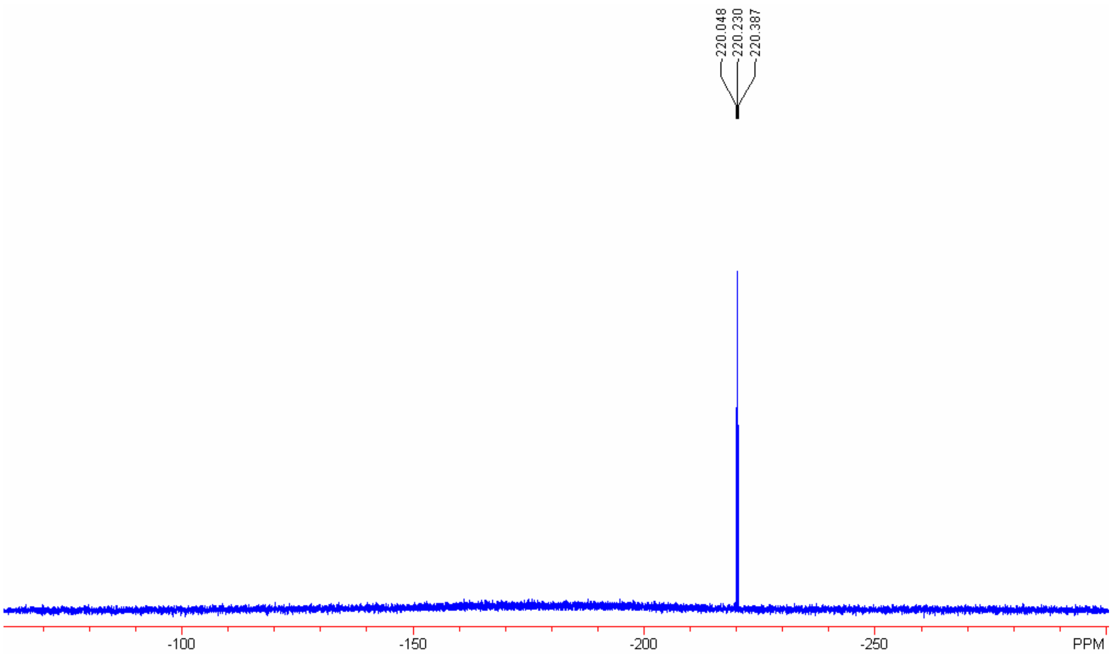


7.471
7.443
7.342
7.312
7.260
4.471
4.443
4.435
4.406
4.313
4.283
4.277
4.246
1.786
1.491
1.485
-0.002
2.25
3.07
1.01
8
7
6
5
4
3
2
1
0 PPM

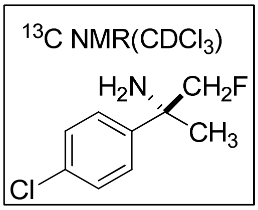


^{19}F NMR(CDCl$_3$)
H$_2$N
CH$_2$F
CH$_3$
Cl

11f

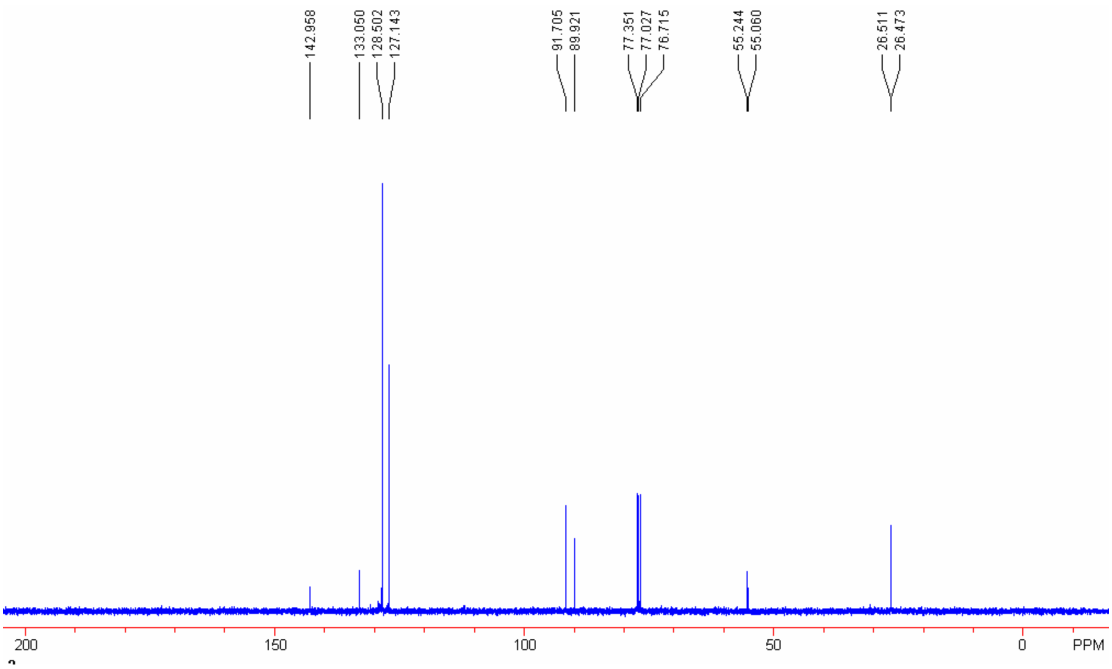


220.048
220.230
220.387
-100
-150
-200
-250
PPM

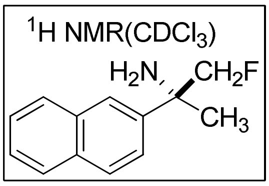


^{13}C NMR(CDCl$_3$)
H$_2$N
CH$_2$F
CH$_3$
Cl

11f

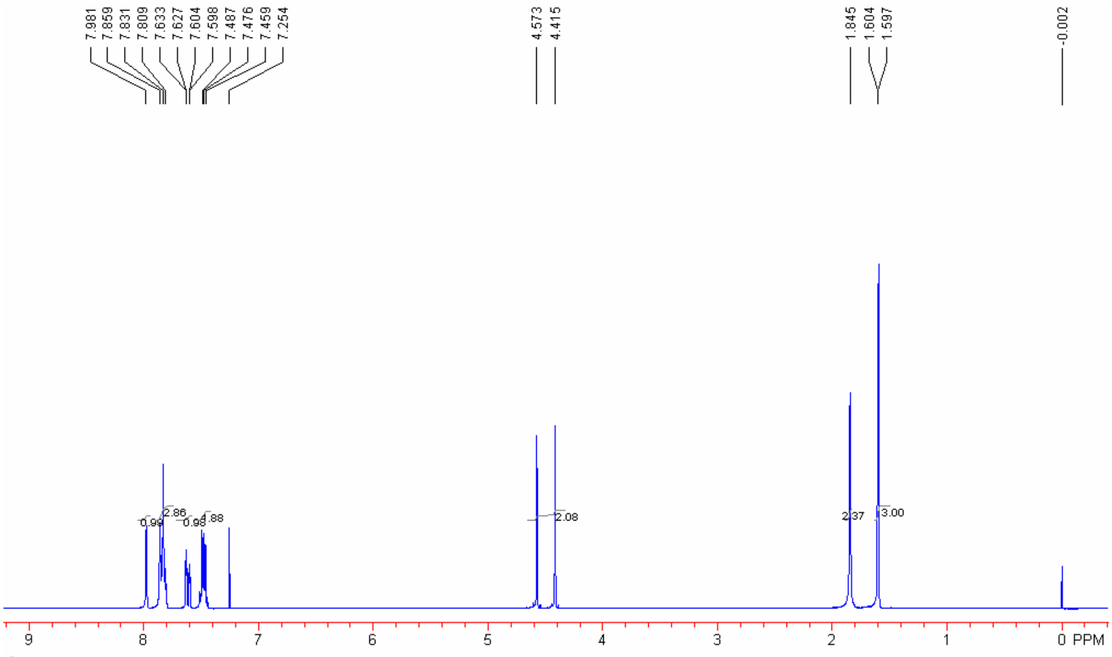


142.958
133.050
128.502
127.143
91.705
89.921
77.351
77.027
76.715
55.244
55.060
26.511
26.473
200
150
100
50
0
PPM

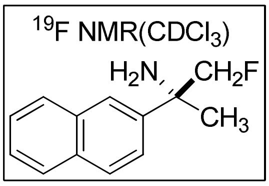


^{1}H NMR(CDCl$_3$)
H$_2$N
CH$_2$F
CH$_3$

11g

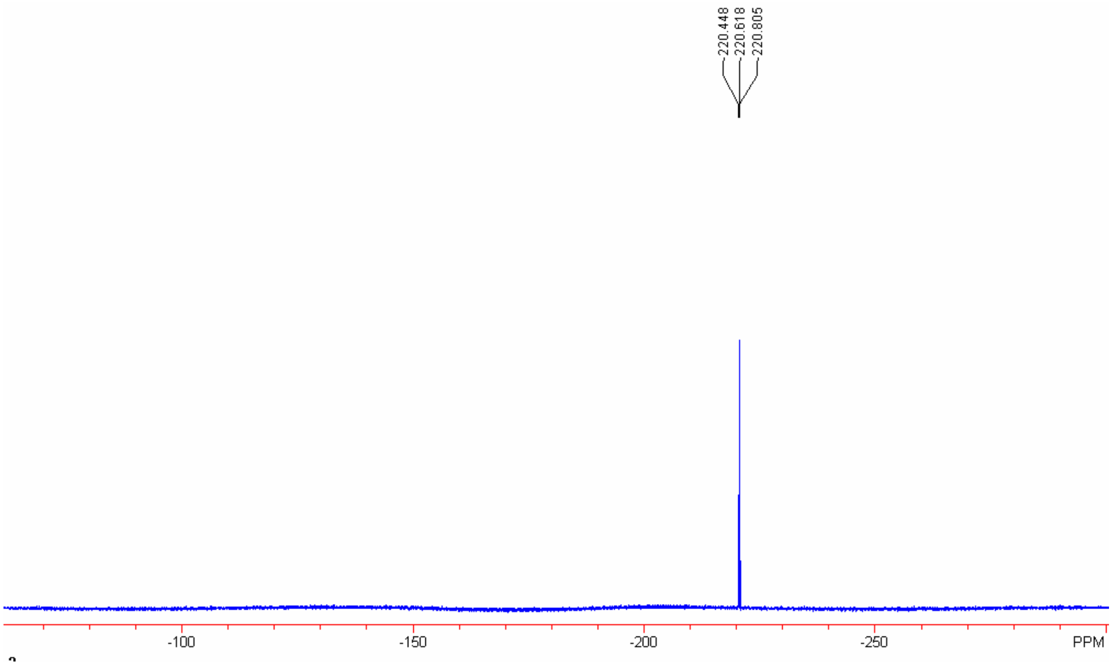


7.981
7.859
7.831
7.809
7.633
7.627
7.604
7.598
7.487
7.476
7.459
7.254
4.573
4.415
1.845
1.604
1.597
-0.002
0.99
2.86
0.98
1.88
2.08
2.37
3.00
9
8
7
6
5
4
3
2
1
0 PPM

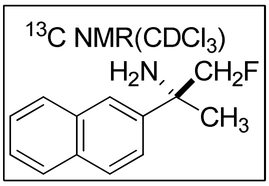


^{19}F NMR(CDCl3)
H2N
CH2F
CH3

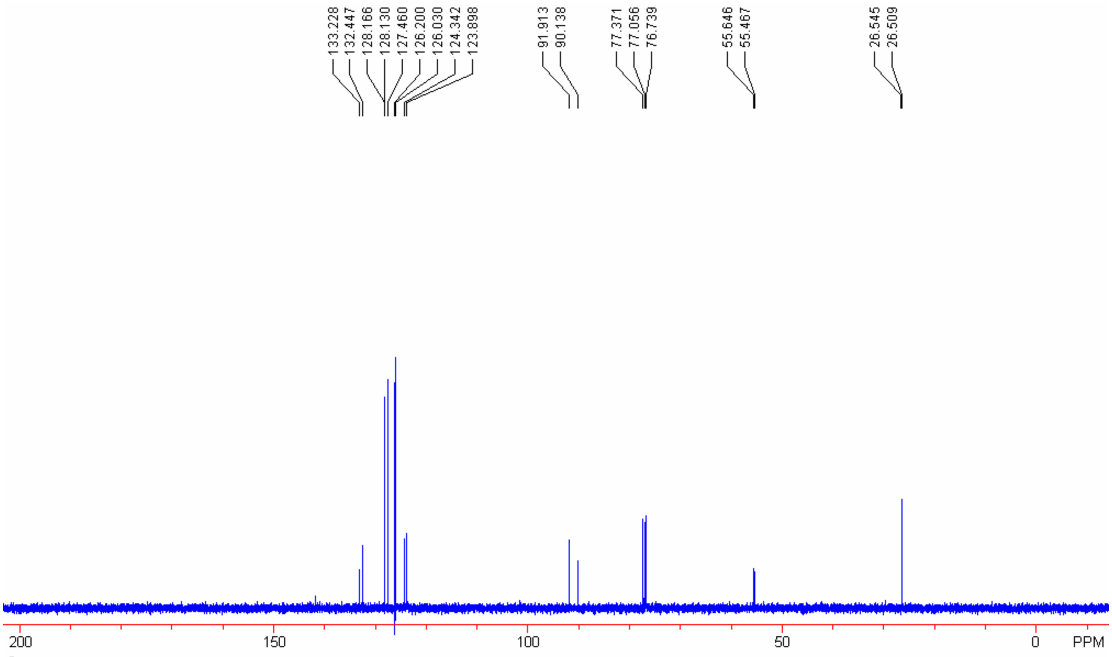
11g



220.448
220.618
220.805
-100
-150
-200
-250
PPM


13C NMR(CDCl3)
H2N
CH2F
CH3

11g


133.228
132.447
128.166
128.130
127.460
126.200
126.030
124.342
123.898
91.913
90.138
77.371
77.056
76.739
55.646
55.467
26.545
26.509
200
150
100
50
0
PPM