1,3-γ-Silyl-Elimination in Electron-Deficient Cationic Systems

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Supporting Information: Kinetic Substrate Synthesis and Data

Key to Abbreviated Terms:

$CDCl_3$ - Deuterated chloroform
Cy - Cyclohexyl
DCM - Dichloromethane
DME - Dimethoxyethane
Et_2O - Diethyl ether
EtOAc - Ethyl acetate
Hex - Hexanes
HFIP - Hexafluoroisopropanol
HMDS - Hexamethyldisilane
HMPA - Hexamethylphosphoramide
HOAc/NaOAc - Acetic acid/sodium acetate
MeLi – Methyllithium
MsCl - Methanesulfonyl chloride
Ms_2O - Methanesulfonic anhydride
n-Bu - *n*-Butyl
OHFB - 2,2,3,3,4,4,4-heptafluorobutanoate
OPf - 2,3,4,5,6-Pentafluorobenzenesulfonate
OTf - Trifluoromethylsulfonate
OTs - *p*-Toluenesulfonate
Ph - Phenyl
TBAF - Tetrabutylammonium fluoride
^{t}Bu - *tert*-Butyl
Tf_2O – Trifluoromethanesulfonic anhydride
TFE- 2,2,2-Trifluoroethanol
TFE-d_6 - Deuterated 2,2,2-trifluoroethanol
THF - Tetrahydrofuran
TLC - Thin layer chromatography
TCE- 1,1,2 trichloroethane
TMS, Me_3Si - Trimethylsilyl
TMS-CF_3 - Trimethyl(trifluoromethyl)silane
TsCl - *p*-Toluenesulfonyl chloride
TsOH - *p*-Toluenesulfonic acid
Ts_2O - *p*-Toluenesulfonic anhydride
97T - 97% w/w TFE, 3% H_2O

General Considerations:

General:

All chemical transformations requiring inert atmospheric conditions or vacuum distillation utilized Schlenk line techniques with a 3,4, or 5-port dual-manifold or in a glove box. Nitrogen or argon was used to provide such an atmosphere. NMR Spectra (^{1}H, ^{2}H, ^{13}C, ^{19}F) were collected at 298K on either a Brüker Avance Ultra Shield 300 MHz NMR, Brüker DRX-400 400 MHz NMR, or Brüker Avance 500 MHz NMR. ^{1}H-NMR Spectra obtained in $CDCl_3$ were referenced to residual non-deuterated chloroform (7.26 ppm) or TCE (5.76 ppm) in deuterated TFE or deuterated HFIP. ^{13}C-NMR Spectra obtained in $CDCl_3$ were referenced to chloroform (77.3 ppm). ^{19}F-NMR Spectra were referenced to fluorobenzene (–115.3 ppm) [1] or hexafluorobenzene (-164.9 ppm)[2]. ^{2}H NMR Spectra obtained in $CDCl_3$ were referenced to chloroform (7.26 ppm). Reactions were monitored by GC-MS using a HP 5890 Series II Gas Chromatograph attached to a 5972 Mass Spectrometer or an Agilent Technologies 7820A Gas Chromatograph attached to a 5975 Mass Spectrometer, by ^{1}H NMR, and/or by TLC on silica gel plates. High-resolution mass spectra were obtained using a JEOL AccuTOF-DART SVP 100 in positive direct analysis in real time (DART) ionization method, using PEG as the internal standard. TLC analysis was performed using hexanes/ethyl acetate as the eluent and visualized using permanganate stain, *p*-anisaldehyde stain, Seebach's Stain, and/or UV light. Flash chromatography was performed on either hand packed glass columns with Dynamic Adsorbants Inc. Flash Silica Gel (60 Å porosity,

[1] Furuya, T.; Kaiser, H. M.; Ritter, T. *Angew. Chem., Int. Ed.*, **2008**, *47*, 5993.
[2] Ravikumar, I.; Saha, S.; Ghosh, P. *Chem. Commun*. **2011**, *47*, 4721.

32-63 μm). Automated Flash Chromotography was performed using either Biotage SNAP KP-SIL columns or Silicycle SiliaSep Flash Cartridges (60Å porosity, 40-63 μm).

Chemicals:

All chemicals purchased for syntheses are listed and purified as in the supporting information detailing substrate synthesis and solvolytic studies. Diethyl phthalate used for ethanol purification was purchased from Sigma-Aldrich. Conductivity grade water was obtained from a Siemens PURELAB Option ELGA DV-25 Deionizer system.

Ethanol

Conductivity grade ethanol was purified using Tilley's[3] modification of Murr[4] Approximately 6 L of commercial absolute ethanol was dried for 2 days with 2 lbs. of Drierite. Roughly 1 L of this ethanol was then filtered away from the Drierite into a 2 L round-bottomed flask and, under nitrogen, 12.0 g (0.52 mol) of sodium metal was added in small portions while stirring, such that gas evolution was not too rapid.

After the sodium had completely dissolved, the solution was poured into a 12 L round-bottomed flask, and the remaining 5 L of ethanol was filtered into the flask, away from the Drierite. Diethyl phthalate (40 mL, 36 g, 0.16 mol) was added. A 100 cm X 2 cm vacuum-jacketed distillation column packed with ¼" glass helices was attached to flask, followed by a total condensation, variable take-off type head[4,5] under nitrogen. The reflux ratio for the column was controlled by means of a ground-glass plug on the end of a long glass rod, the other end of which contained a bar magnet encased in glass. The plug was periodically lifted by a solenoid controlled by a Model No. 5 Repeat Cycle Timer (G.C. Wilson and Co, Huntington, WV) to control the take-off rate.

Under nitrogen, the flask was heated to reflux and allowed to equilibrate overnight. Approximately 200 mL of ethanol were then distilled off at a reflux ratio of 100:1 to ensure removal of any acetaldehyde. The take-off head was then connected to a conductance cell by means of glass tubing with ground-glass ball-joints and the distillate was allowed to flow into the cell and into a waste beaker. The cell was disconnected periodically, capped off, and the resistance of the ethanol was checked until it had reached a maximum value. A 5 L solvent reservoir was then connected to the still *via* glass tubing with ground-glass ball joints and the solvent was collected at a 4:1 reflux ratio. The specific conductivity of the ethanol obtained in this way is between 1 and 2 X 10^{-8} mho.

2,2,2-Trifluoroethanol

[3] Tilley, L. J. PhD Thesis, Indiana University, Bloomington, IN (1996)
[4] Murr, B. L., Jr, PhD Thesis, Indiana University, Bloomington, IN (1961)
[5] Glasebrook, A. L.; Williams, F.E. In *Technique of Organic Chemistry*; Weissberger, A., Ed.; Interscience: New York, 1951, Vol. 4, pg. 252.

Conductivity grade 2,2,2-trifluoroethanol was purified using Tilley's[6] modification of the procedure initially described by Shiner, *et. al.*[7] Trifluoroethanol[8] (2-3 L) and water (1 L) were placed in a 5 L round bottomed flask and enough K_2CO_3 was added to bring the mixture to a pH of 8-9. The flask was attached to a distillation column and take-off head as described for ethanol. The TFE was heated to reflux and allowed to equilibrate overnight.[9] The material boiling between 73.5-74.5 °C was collected in a 1 L receiver at a reflux ratio of approximately 20:1. This receiver was periodically emptied into a 3 L round-bottomed flask with a glass stopper.

The distillate was then percolated into a 5 L round-bottomed flask through a 50 cm high X 3 cm diameter column containing 4Å molecular sieves. The flask was then attached to a distillation column and take-off head as described above, heated to reflux, and allowed to equilibrate. As described for ethanol, the TFE was taken off at a reflux ratio of 20:1 into a conductance cell and resistance was measured until maximum resistance was reached. A 5 L solvent reservoir was then connected and the solvent was collected at a 20:1 reflux ratio. The specific conductivity of the TFE obtained in the way is between 2 and 5 X 10^{-9} mho.

Solvent Mixtures for Kinetics

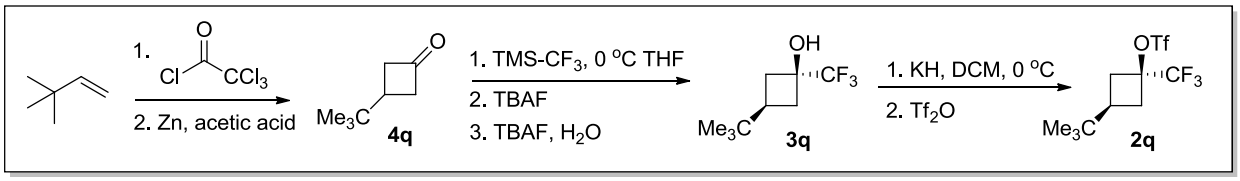
TFE solutions7 are reported as weight percents, and were prepared by directly weighing appropriate amounts of purified TFE and conductivity water into a 500 mL Erlenmeyer flask containing a stir bar. The flask was capped with a ground glass cap, and the mixture was stirred vigorously for 20 minutes. Ethanol solutions are reported as volume percents, but were prepared by weight using densities and buoyancy corrections as described by Murr.[10]

[6] Tilley, L. J. PhD Thesis, Indiana University, Bloomington, IN (1996)
[7] Shiner, V. J.; Dowd, W.; Fisher, R. D.; Hartshorn, S. R.; Kessick, M. A.; Milakofsky, L.; Rapp, M. W. *J. Am. Chem. Soc.* **1969**, *91*, 4838
[8] Newly purchased TFE or TFE recovered from kinetic reaction mixtures may be purified in this fashion.
[9] Although it can be used, nitrogen is not necessary for this distillation – rather, a drying tube with $CaCl_2$ may be attached to the nitrogen inlet.
[10] Murr, B. L., Jr, PhD Thesis, Indiana University, Bloomington, IN (1961).

Synthesis of Kinetic Substrates

(Trifluoromethyl)-3-(trimethylsilyl)cyclobutyl 4-methylbenzenesulfonate was prepared according to our previously published protocol.[11]

Preparation of 3-(*tert*-butyl)-1-(trifluoromethyl)cyclobutyl trifluoromethanesulfonate (2q)



3-(*tert*-butyl)cyclobutanone[12] (4q)

A 1-neck 2 L round bottom flask equipped with a stir bar was charged with Zn-Cu[13] (50.5 g, 0.392 mol, 0.784 equiv) and dry ether (675 mL) followed by 3,3-dimethylbut-1-ene (42.1 g, 0.50 mol, 1 equiv). The solution was allowed to stir and an addition funnel equipped with a N_2 inlet needle and rubber septum was attached. The contents of the flask were placed under a nitrogen atmosphere. To the funnel was added DME (325 mL) followed by trichloroacetyl chloride (104.49 g, 0.575 mol, 1.15 equiv) and the solution briefly stirred with a stir rod and added dropwise over six hours. Afterwards, the reaction was allowed to stir for overnight while being monitored by GC/MS. The reaction was incomplete and additional Zn-Cu (33.5 g, 0.260 mol, 0.52 equiv) was added to the reaction flask and allowed to stir for 24 hours. After this time, the reaction was deemed complete by GC/MS and the reaction flask was placed in an ice bath. Once cool, 150 mL of deionized water was added dropwise *via* the addition funnel over two hours. During this time, additional Zn-Cu (66.5 g, 0.516 mol, 1.03 equiv) was added every 5 minutes and left to stir for 72 hours as it warmed to room temperature. Analysis by GC/MS showed the reaction to be complete at this time.

The stirring was turned off and the mixture allowed to settle whereupon it was carefully decanted through a pad of Celite®. The remaining Zn-Cu was washed with ether and decanted through the pad of Celite®. This washing process was repeated twice. Finally, pentane (300 mL) was placed in the flask to wash the remaining Zn-Cu and the contents of the flask poured through the pad of Celite®. The filtrate was transferred to a separatory funnel and washed with brine (3 X 200 mL). The combined brine layers were then extracted with pentane (200 mL) and combined with the organic solution. The combined solution was then washed with saturated sodium bicarbonate (3 x 200 mL). The organic layer then dried over sodium sulfate and the solvent removed *via* rotary evaporation to give the crude product. Further purification was accomplished by vacuum

[11] Kelly, C. B.; Colthart, A. M.; Constant, B.D.; Corning, S.R.; Dubois, L. N.E.; Genovese, J. T.; Radziewicz, J. L.; Sletten, E. M.; Whitaker, K. R.; Tilley, J. J. *Org. Lett.* **2011**, *13*, 1646.
[12] Trost, B. M.; Xie, J. *J. Am. Chem. Soc.*, **2008**, *130*, 6231.
[13] Prepared according to our previously published protocol, see Ref 11.

distillation (b.p. 68-70 ^{o}C @ 20 mmHg) to give the pure **4q** (28.15 g, 47%) as a clear, colorless oil.

^{1}H NMR (500 MHz, $CDCl_3$) δ ppm 0.91 (s, 9 H) 2.27 (quin, *J* = 8.20 Hz, 1 H) 2.83 (qd, *J* = 13.20, 9.10 Hz, 4 H **^{13}C NMR** (125 MHz, $CDCl_3$) δ ppm 26.61 (CH_3) 31.64 (C) 34.94 (CH) 47.92 (CH_2) 208.14 (C) **GC-MS** (EI) 126 ($[M]^+$, 2%), 99 (22%), 83 (32%), 70 (21%), 69 (100%), 57 (13%), 55 (18%), 41 (45%).

(1s,3s)-3-(*tert*-butyl)-1-(trifluoromethyl)cyclobutanol "*cis*" **(3q)**

The following is a modification of the procedure outline by Kelly et al.[14] To a 100 mL round bottom flask equipped with a stir bar was added **4q** (3.38 g, 0.0268 mol, 1 equiv), THF (45 mL), and (trifluoromethyl)trimethylsilane (4.95 g, 0.035 mol, 1.3 equiv). The flask was sealed with a rubber septum and placed under a N_2 atmosphere *via* an inlet needle. The reaction mixture was cooled to 0 ^{o}C in an ice-water bath and stirred. After approximately 10 minutes, TBAF (1 M in THF, 0.27 mL, 0. 268 mmol, 0.01 equiv) was added dropwise *via* a syringe.[15] After 10 minutes, the ice-bath was removed and the solution was allowed to stir for approximately 6 hour at room temperature. To cleave the silyl ether formed by the reaction, the reaction mixture was cooled to 0 ^{o}C in an ice bath. After 10 minutes, H_2O (2.7 mL, 0.150 mol, 5.6 equiv) was added *via* a syringe. TBAF (1 M in THF, 2.68 mL, 0.00268 mol, 0.1 equiv) was then added. After 10 minutes the ice bath was removed and the reaction mixture was allowed to stir at room temperature. When the cleavage was judged complete[16], the contents of the flask were transferred to a separatory funnel. Brine (≈100 mL) and Et_2O (≈150 mL) were added and the layers were partitioned. The aqueous layer was back-extracted (3 X ≈50 mL each) with Et_2O. The combined ether layers were dried with Na_2SO_4. The solvent was removed *in vacuo* and then purified by sublimation (50-70 ^{o}C (oil bath temp.) @ 5 mmHg) to give **3q** (2.805 g, 53%) as a flaky white crystalline solid.

^{1}H NMR (500 MHz, $CDCl_3$) δ ppm 0.84 (s, 9 H) 1.90 - 1.98 (m, 3 H) 2.39 (s, 2 H) 2.46 (s, 1 H) **^{13}C NMR** (125 MHz, $CDCl_3$) δ ppm 26.24 (CH_3) 31.31 (CH) 31.99 (C) 35.99 (CH_2) 69.84 (q, $J_{C\text{-}C\text{-}F}$ = 31.90 Hz, C) 126.45 (q, $J_{C\text{-}F}$ = 285.20 Hz, CF_3) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -87.97 **GC-MS** (EI) 196 ($[M]^+$, 1%), 163 (34%), 84 (51%), 70 (10%), 69 (100%), 59 (17%), 57 (29%), 55 (15%), 41 (43%). **HRMS** (DART) calcd for $C_8H_{15}F_3OSi$ $[M - OH]^+$: 179.1048, found: 179.1035.

[14] Kelly, C. B.; Colthart, A. M.; Constant, B.D.; Corning, S.R.; Dubois, L. N.E.; Genovese, J. T.; Radziewicz, J. L.; Sletten, E. M.; Whitaker, K. R.; Tilley, J. J. *Org. Lett.* **2011**, *13*, 1646.

[15] Note that on small scales (< 15 mmol) the TBAF could be added relatively fast. However, upon scale-up the addition of TBAF is quite exothermic. Hence, it is recommended that the TBAF be added as slow as possible and/or cooling the reaction mixture to a temperature lower than that of 0 ^{o}C.

[16] It is recommended that this cleavage step be monitored by some form of spectroscopy (e.g. GC/MS or NMR). Some of the silyl ethers were very slow to cleave and required another addition of TBAF and H_2O.

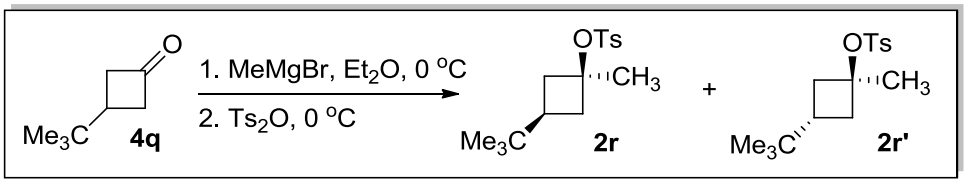
(1s,3s)-3-(*tert*-butyl)-1-(trifluoromethyl)cyclobutyl trifluoromethanesulfonate "*cis*" **(2q)**

Tosylates and triflates were synthesized according to a modified procedure outlined by Kelly et al.[17] In a glove box under argon, a suspension of KH in mineral oil was washed multiple times with pentane and allowed to dry. A flame-dried 100 mL 3-necked, round-bottomed flask equipped with a stir bar, nitrogen inlet adapter, and two septa, was placed in the glove box. The now dry KH (0.209 g, 0.0052 mol, 2 equiv) was placed in the flask and sealed with the septa and inlet adapter and removed from the glove box. The flask was then placed under a nitrogen atmosphere *via* the nitrogen inlet adapter. DCM (26 mL, 0.1 M) was added to the flask *via* syringe. The reaction mixture was cooled to 0 ^{o}C in an ice-water bath for approximately 10 minutes while stirring. To this chilled mixture was added a solution of **3q** (0.50 g, 2.6 mmol) dissolved in DCM (2.6 mL, 1 M) *via* syringe. Gas evolution and foaming was observed, consistent with deprotonation of the trifluoromethyl alcohol. After five minutes, the ice bath was removed and the reaction mixture allowed to stir at room temperature for one hour. The mixture was then placed back in the ice-water bath and allowed to cool to 0 ^{o}C for ten minutes. Tf_2O (1.10 g, 3.9 mmol, 1.5 equiv) was added dropwise *via* a syringe to the flask over five minutes. Ten minutes after complete addition, the flask was removed from the ice bath and allowed to stir at room temperature for one hour, at which time it became thicker and an off-white precipitate was observed to form.

At this point, 30 mL of pentane was syringed into the reaction mixture. Deionized water (15 mL) was then added very slowly to the reaction mixture, to ensure that gas evolution was not too rapid. **CAUTION!** *It is important that water be added slowly so as not to generate too much heat and avoid the possibility of fire.* The reaction mixture was left to stir until the solution became clear, indicating the quench was complete. The contents of the reaction flask were then transferred into a separatory funnel and the aqueous layer removed. The organic layer containing the triflated product was dried with Na_2SO_4. The solvent was then removed *via* rotary evaporation in a 30 ^{o}C water bath and then placed under a high vacuum to remove residual solvent to give the desired product (0.498 g, 60%) as a clear colorless oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.87 (s, 9 H) 2.07 (quin, J = 9.10 Hz, 1 H) 2.54 - 2.67 (m, 4 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 26.00 (CH_3) 31.45 (CH) 32.02 (C) 37.81 (CH_2) 85.46 (q, $J_{C\text{-}C\text{-}F}$ = 34.80 Hz, C) 118.52 (q, $J_{C\text{-}F}$ = 319.60 Hz, CF_3) 123.72 (q, $J_{C\text{-}F}$ = 281.90 Hz, CF_3) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -84.86 (s, 3 F) -78.44 (s, 3 F).

[17] Kelly, C. B.; Colthart, A. M.; Constant, B.D.; Corning, S.R.; Dubois, L. N.E.; Genovese, J. T.; Radziewicz, J. L.; Sletten, E. M.; Whitaker, K. R.; Tilley, J. J. *Org. Lett.* **2011**, *13*, 1646.

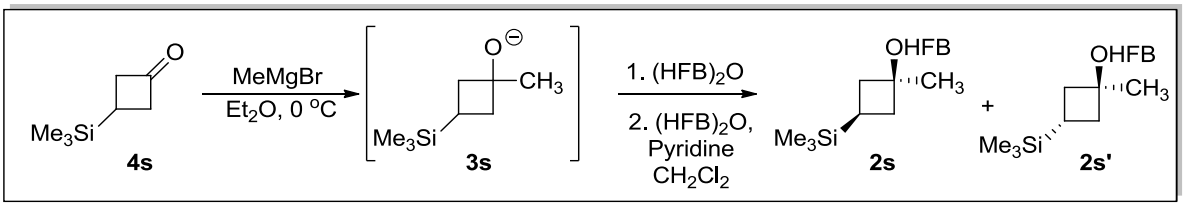


(1*S*,3*S*) & (1*R*,1*R*)-3-(*tert*-butyl)-1-methylcyclobutyl 4-methylbenzenesulfonate, "*cis*" **2r** A 500 mL round-bottomed flask was setup with a septa, stopper, and nitrogen inlet over ice. The temperature was allowed to drop down to 0 °C. The system was flushed with nitrogen for five minutes. A thermometer was added to the flask to track the temperature, and dry ether (60 mL) was added to the flask. The temperature was allowed to drop back down to 0 °C. Following the temperature drop, methyllithium (6 mL, 1.6 M, 0.0096 mol, 1.2 equiv) was added *via* syringe, followed by 1.00 g of the **4q** (0.0079 mol, 0.12 M, 1.0 equiv), and the mixture stirred for 15 minutes. While stirring, Ts_2O (4.00 g, 0.012 mol, 1.6 equiv) was obtained from the glove box and placed in a vial then added to the reaction flask against a positive flow of nitrogen using a powder funnel, and the temperature was kept as close to 0 °C as possible. The reaction was then placed in a warm water bath to quickly bring the temperature up to room temperature and the reaction was allowed to stir for 3 hours.

Pentane (150 ml) was then added followed by 10 mL of water slowly dropwise, and the mixture was stirred vigorously until the both layers were clear, with some unreacted Ts_2O remaining in the mixture. At this point, the flask was opened to the air and the mixture was filtered through a fritted filter funnel to remove the excess and unreacted Ts_2O. After the aqueous layer was removed, the pentane solution was dried with Na_2SO_4 and K_2CO_3. This solution was filtered into a round bottomed flask and the solvent was stripped *in vacuo* by rotary evaporation. The crude product was dissolved in 25 mL of pentane, and filtered through filter-paper into a new round bottom to remove more Ts_2O. Following the filtration, the solvent was stripped *in vacuo* by rotary evaporation. This process was repeated twice. The product was placed under high vacuum for five minutes to remove any remaining solvent. The product was re-dissolved in 5 ml of pentane (in a vial) and was pipetted through a Pasteur pipette with a Kim-wipe inside of it into a new vial. The vial was placed in the freezer for two hours, whereupon white crystals were seen to form in the bottom. The product was collected by vacuum filtration while under an atmosphere of nitrogen and allowed to dry for 15 minutes, affording the pure tosylate as a white crystalline solid (1.01 g, 43%).[18]

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.76 (s, 9 H) 1.64 (s, 3 H) 2.04 (t, *J* = 9.00 Hz, 2 H) 2.26 (t, *J* = 11.10 Hz, 2 H) 2.42 (s, 3 H) 7.30 (d, *J* = 7.91 Hz, 2 H) 7.77 (d, *J* = 8.10 Hz, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 21.67 (CH_3) 25.89 (CH_3) 26.54 (CH_3) 31.12 (C) 37.31 (CH_2) 38.49 (CH) 84.30 (C) 127.30 (CH) 129.74 (CH) 137.06 (C) 144.09 (C).

[18] The material is extremely sensitive to thermal decomposition and should be kept in the freezer at all times. If left out, it will spontaneously decompose into a brown oil. For characterization, a small amount (100 mg or so) may be separately dried *in vacuo* for no more than 20 minutes in order to remove traces of solvent.



(1*S*,3*S*) & (1*R*,1*R*)-1-methyl-3-(trimethylsilyl)cyclobutyl 2,2,3,3,4,4,4-heptafluorobutanoate ("*cis*" & "*trans*") **2s & 2s′**[19] (1.32 g, 53%). To a three-neck 100 mL round-bottom flask equipped with a nitrogen inlet, a rubber septum, a glass stopper, and a stir bar was added dry Et_2O (15 mL). The flask was placed under an N_2 atmosphere and cooled to 0 °C for 10 minutes *via* an ice-bath. At this time, a solution of methylmagnesium bromide (2.78 mL, 3.0 M in Et_2O, 9.2 mmol, 1.3 equiv) was added syringe-wise to the flask. Upon complete addition of the Grignard reagent, the ketone **4s** (1.00 g, 7.0 mmol, 1 equiv) was added dropwise to the flask. After stirring at for five minutes at 0 °C, the ice bath was removed and the solution was allowed to stir for 15 minutes at room temperature. After this time, the flask was cooled to 0 °C for five minute *via* an ice-bath. Following this, heptafluorobutyric anhydride (4.02g, 2.40 mL, 9.9 mmol, 1.4 equiv) was added to the flask dropwise *via* a syringe dropwise. The reaction was allowed to stir at 0 °C for five minutes. After this, the ice-bath was removed and the reaction mixture was allowed to stir at room temperature overnight, monitoring by GC/MS.

The next day the reaction mixture was quenched with 5 mL of saturated aqueous Na_2CO_3. Pentane (50 mL) was added to the flask and the aqueous layer was removed by pipetting. The pentane solution was dried with Na_2SO_4 and the solvent was stripped *in vacuo* by rotary evaporation. Unfortunately, ^{1}H NMR and GC/MS of the crude material revealed that some of the intermediate alcohol (**3s**, protonated form) remained and hence a second step was required. The crude product was then dissolved in 5 mL of CH_2Cl_2 in a vial equipped with a stir bar. Pyridine (0.556 g, 7.0 mmol, 1 equiv) was added to the vial, capped and brought into a glovebox. Heptafluorobutyric anhydride (2.89 g, 1.73 mL, 7.0 mmol, 1 equiv) was added dropwise and intermittently stirred. The reaction was allowed to stir for ten minutes. After confirming complete consumption of the remaining alcohol by GC/MS, the reaction mixture was quenched with 5 mL of saturated aq. $NaHCO_3$ and transferred to a separatory funnel with pentane (50 mL). The aqueous layer was removed and the organic layer was washed with 10 mL of saturated aq. $NaHCO_3$. The pentane solution was dried with Na_2SO_4 and the solvent was stripped *in vacuo* by rotary evaporation. High vacuum removal of the residual solvent gave **2s** as a clear, pale yellow oil.[20] The following data is for the 55:45 mixture of **2s** ("*cis*") to **2s′** ("*trans*") isomers:

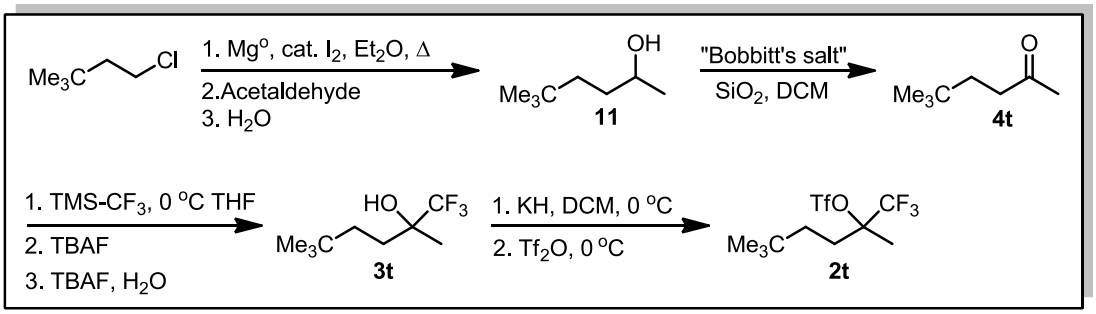
***Cis* Isomer (2s)** **^{1}H NMR** (300 MHz, $CDCl_3$) δ ppm -0.03 (s,9 H) 1.23 - 1.39 (m, 1 H) 1.67 (s, 3 H) 2.16 - 2.31 (m, 4 H) **^{13}C NMR** (75 MHz, $CDCl_3$) δ ppm -4.83 (CH_3) 12.47 (CH_3) 20.98 (CH) 35.45 (CH_2) 83.91 (C) 106.24 (tt, $J_{C\text{-}F}$ = 265.90, $J_{C\text{-}C\text{-}F}$ = 31.60 Hz, CF_2) 107.22 (tq, $J_{C\text{-}F}$ = 267.60, $J_{C\text{-}C\text{-}F}$ = 38.70 Hz, CF_2) 116.49 (qt, $J_{C\text{-}F}$ = 287.90, $J_{C\text{-}C\text{-}F}$ = 33.80 Hz, CF_3) 155.60 (t, $J_{C\text{-}C\text{-}F}$ =28.50 Hz, C) **^{19}F NMR** (282 MHz, $CDCl_3$) δ ppm -130.00 (d, *J* = 26.80 Hz, 2 F) -122.53

[19] For our kinetic studies we utilized compound prepared by a similar protocol using MeLi rather than MeMgBr. While the *Cis:Trans* ratio was somewhat better (roughly 80:20) the purification was much more difficult because the material still contained small amounts of unreacted alcohol (this did not affect rate-constant determination).
[20] Should further purification be required, this compound can be distilled (b.p. 85-87 °C @ 15 mmHg).

(dq, *J* = 52.19, 8.72 Hz, 2 F) -83.79 (t, *J* = 8.25 Hz, 3 F) **GC-MS** (EI) 339 ([M − CH_3]$^+$, 10%), 169 (82%), 157 (45%), 147 (14%), 130 (13%), 85 (10%), 73 (100%).

***Trans* Isomer (2s′)** **^{1}H NMR** (300 MHz, $CDCl_3$) δ ppm -0.01 (s, 9 H) 1.55 (s, 3 H) 1.72 - 1.91 (m, 1 H) 2.14 (s, 2 H) 2.56 (tdd, *J*=11.80, 11.80, 2.80, 0.90 Hz, 2 H) **^{13}C NMR** (75 MHz, $CDCl_3$) δ ppm -4.49 (CH_3) 12.33 (CH_3) 23.07 (CH) 33.88 (CH_2) 88.07 (C) 107.25 (tq, $J_{C\text{-}F}$ = 267.60, $J_{C\text{-}C\text{-}F}$ = 38.00 Hz, CF_2) 106.31 (tt, $J_{C\text{-}F}$ = 265.90, $J_{C\text{-}C\text{-}F}$ = 33.00 Hz, CF_2) 116.51 (qt, $J_{C\text{-}F}$ = 287.60, $J_{C\text{-}C\text{-}F}$ = 33.50 Hz, CF_3) 156.04 (t, $J_{C\text{-}C\text{-}F}$ = 29.40 Hz, C) **^{19}F NMR** (282 MHz, $CDCl_3$) δ ppm -130.00 (d, *J* = 26.80 Hz, 2 F) -122.53 (dq, *J* = 52.19, 8.72 Hz, 2 F) -83.79 (t, *J* = 8.25 Hz, 3 F) **GC-MS** (EI) 339 ([M − CH_3]$^+$, 10%), 169 (82%), 157 (45%), 147 (14%), 130 (13%), 85 (10%), 73 (100%).

Preparation of 1,1,1-trifluoro-2,5,5-trimethylhexan-2-yl trifluoromethanesulfonate (2t)



5,5-dimethylhexan-2-ol (11)

This procedure is a modification of the protocol outlined by Cook and Whitmore.[21] To a 100 mL round bottom flask was equipped with a stir bar was added ground magnesium turnings (1.73 g, 0.071 g, 1.42 equiv) and sealed with a septum. The flask was flame dried under vacuum and backfilled with nitrogen. Dry diethyl ether (28 mL, 1.76 M) and 1-chloro-3,3-dimethylbutane (8.57 g, 0.071 mol, 1.42 equiv) was added to the flask and cooled to 0 °C using an ice bath. At this time, acetaldehyde was freshly distilled using catalytic *p*-toluenesulfonic acid. This freshly distilled acetaldehyde (2.20 g, 0.050 mol, 1 equiv) was diluted with dry diethyl ether (14 mL) and added drop-wise to the reaction flask (**Caution!** *Reacts violently!*). The solution was then allowed to warm to room temperature and left to stir for 30 minutes. The reaction was quenched using saturated ammonium chloride (3 mL). This solution was transferred to a separatory funnel and diluted with deionized water and extracted with pentane (3 x 75 mL). The combined organic layers were then washed with deionized water and brine (50 mL each). The organic layer was dried over Na_2SO_4 and the solvent removed *via* rotary evaporation (30 °C water bath at 100 mmHg) to give the crude product. Further purification was accomplished by vacuum distillation (b.p. 77-79 °C @ 13 mmHg) giving the pure product (4.97 g, 76%) as a clear colorless oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.83 (s, 9 H) 1.09 (m, 1 H) 1.13 (d, *J* = 6.18 Hz, 3 H) 1.20 -

[21] Whitmore, F. C.; Whitmore , H. E.; Cook N. C. *J. Am. Chem. Soc.*, **1950**, *72*, 51.

1.44 (m, 3 H) 2.15 (s, 1 H) 3.66 (d, J = 6.06 Hz, 1 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 23.60 (CH_3) 29.54 (CH_3) 30.22 (C) 34.53 (CH_2) 40.16 (CH_2) 68.95 (CH) **GC-MS** (EI) 115 ($[M\text{-}CH_3]^+$, 9%), 97 (66%), 73 (13%), 69 (20%), 57 (100%), 55 (70%), 46 (45%), 43 (28%), 41 (45%), 39 (19%) **HRMS** (DART) calcd for $C_8H_{17}O$ $[M]^+$: 129.1279, found: 129.1272.

5,5-dimethylhexan-2-one (4t)[22]

This procedure is a modification of the one outlined by Bobbitt.[23] To a 500 mL round bottom flask equipped with a stir bar, gas inlet and septum was added 4-acetamido-2,2,6,6-tetramethyl-1-oxopiperidin-1-ium tetrafluoroborate, "Bobbitt's Salt" (7.02 g, 0.0234 mol, 1.05 equiv), silica gel (2.9 g, 1 mass equiv to the substrate) and DCM (220 mL, 0.1 M). The flask was sealed with a stopper, placed under nitrogen. **11** (2.9 g, 0.022 mol, 1 equiv) was added *via* syringe while stirring. The reaction mixture was allowed to react for 48 h and monitored by GC/MS. Upon complete oxidation, the reaction mixture was filtered through a pad of silica gel on a fritted funnel, eluting with Et_2O. The filtrate was transferred to a flask and the solvent was removed *in vacuo* by rotary evaporation[24] giving the pure ketone (1.50 g, 52%) as a clear colorless oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.82 (s, 9 H) 1.41 (apparent triplet, J = 8.10 Hz, 2 H) 2.08 (s, 3 H) 2.32 (apparent triplet, J = 8.50 Hz, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 29.25 (CH_3) 29.96 (C) 30.04 (CH_3) 37.54 (CH_2) 39.60 (CH_2) 209.54 (C) **GC-MS** (EI) 128 ($[M]^+$, 3%), 113 ($[M\text{-}CH_3]^+$, 20%), 95 (25%), 72 (21%), 57 (61%), 55 (18%), 43 (100%), 41 (35%), 39 (18%) **HRMS** (DART) calcd for $C_8H_{16}O$ $[M + M]^+$: 257.2481, found: 257.2473.

1,1,1-trifluoro-2,5,5-trimethylhexan-2-ol (3t) (1.63 g, 70%) was prepared using a similar procedure to the protocol used to prepare **3q**, using **4t** (1.50 g, 0.0117 mol) and further purified by vacuum distillation (b.p. 54-56 ^{o}C @ 4 mmHg) to give the alcohol as a viscous light yellow oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.90 (s, 9 H) 1.28 (td, J = 12.40, 5.09 Hz, 1 H) 1.34 (td, J = 12.70, 4.60 Hz, 1 H) 1.32 (s, 3 H) 1.58 (td, J = 13.20, 4.97 Hz, 1 H) 1.65 (td, J = 13.20, 4.24 Hz, 1 H) 2.20 (s, 1 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 20.15 (CH_3) 29.41 (CH_3) 30.16 (C) 30.33 (CH_2) 36.29 (CH_2) 74.09 (q, $J_{C\text{-}C\text{-}F}$ = 28.00 Hz, C) 126.97 (q, $J_{C\text{-}F}$ = 285.70 Hz, CF_3) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -86.12 **GC-MS** (EI) 183 ($M - CH_3]^+$, 17%), 165 (58%), 129 (13%), 87 (13%), 69 (17%), 57 (100%), 434 (50%), 41 (45%) **HRMS** (DART) calcd for $C_9H_{16}F_3O$ $[M - OH]^+$: 181.1205, found: 181.1213.

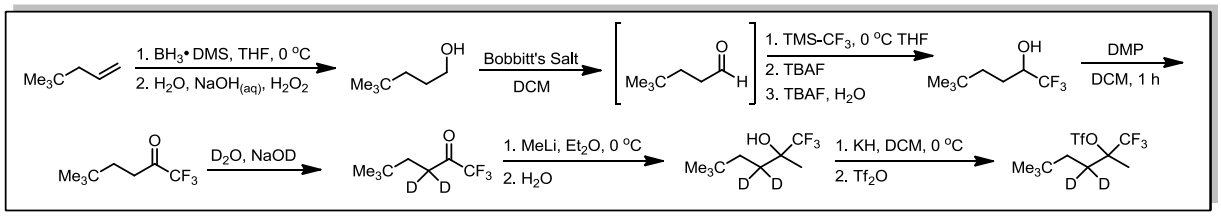
1,1,1-trifluoro-2,5,5-trimethylhexan-2-yl trifluoromethanesulfonate (2t) (0.64 g, 77%), was prepared according similarly to the representative tosylation procedure (see Synthesis SI or **2q**) using **3t** (0.50 g, 2.5 mmol) with the following modifications: Tf_2O (1.067 g, 3.8 3mol, 1.5

[22] Mello, R.; Martínez-Ferrer, J.; Alcalde-Aragonés, A.; Varea, T.; Acerete, R.; Gonzalez-Núñez, M. E.; Asensio, G. *J. Org. Chem.*, **2011**, *76*, 10129.
[23] Bobbitt, J. M. *J. Org. Chem.* **1998**, *63*, 9367.
[24] Because of the inherent volatility of this compound, it is recommended that the vacuum for rotary evaporation be no lower than 100 mmHg.

equiv) was used in place of Ts_2O and the reaction left to stir for 1 hour at 0 °C before quenching with deionized water. The resulting triflate was obtained as a light yellow liquid and used directly in the next step.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.93 (s, 9 H) 1.32 - 1.48 (m, 2 H) 1.87 (s, 3 H) 1.98 (td, *J* = 13.00, 5.80 Hz, 1 H) 2.10 (td, *J* = 13.00, 5.64 Hz, 1 H **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 18.87 (CH_3) 29.21 (CH_2) 30.27 (CH_3) 31.07 (C) 36.42 (CH_2) 96.40 (q, $J_{C\text{-}C\text{-}F}$ = 30.80 Hz, C) 118.37 (q, $J_{C\text{-}F}$ = 319.10 Hz, CF_3) 123.63 (q, $J_{C\text{-}F}$ = 284.60 Hz, CF_3) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -82.92 (s, 3 F) -78.71 (s, 3 F).

Preparation of 1,1,1-trifluoro-2,5,5-trimethylhexan-2-yl trifluoromethanesulfonate-3,3-d_2 (2t′)



4,4-dimethylpentan-1-ol (12) (10.77 g, 91%) was prepared using a similar oxidation procedure to the protocol used to prepare **9** (see Synthesis SI) from 4,4-dimethylpent-1-ene (10.0 g, 0.102 mol, 1 equiv) and further purified by vacuum distillation (b.p. 110-114 °C, 200 mmHg) to give **12** as a clear, colorless oil.

^{1}H NMR ($CDCl_3$, 400 MHz, ppm) δ ppm 0.85 (s, 9 H) 1.14 - 1.21 (m, 2 H) 1.45 - 1.55 (m, 2 H) 2.27 (s, 1 H) 3.56 (t, *J* = 6.76 Hz, 2 H) **^{13}C NMR** ($CDCl_3$, 100 MHz, ppm) δ ppm 28.22 (CH_2) 29.57 (CH_3) 30.28 (C) 40.19 (CH_2) 63.89 (CH_2) **GC-MS** (EI) 116 ($[M]^+$, 1%), 101 ($[M\text{-}CH_3]^+$, 4%), 83 (66%), 57 (100%), 55 (70%), 41 (51%), 39 (17%).

4,4-dimethylpentanal (13) was prepared using a similar oxidation procedure to the protocol used to prepare **9** (see Synthesis SI) from **12** (10.0 g, 0.086 mol, 1 equiv). The aldehyde[25] was obtained as a solution in THF[26] and used directly in the next step without further purification.

^{1}H NMR ($CDCl_3$, 400 MHz, ppm) δ ppm 0.87 (s, 9 H) 1.49 (t, *J* = 8.00 Hz, 2 H) 2.36 (td, *J* = 8.11, 1.71 Hz, 2 H) 9.74 (t, *J* = 1.90 Hz, 1 H) **^{13}C NMR** ($CDCl_3$, 100 MHz, ppm) δ ppm 29.32 (CH_3) 35.75 (CH_2) 40.06 (CH_2) 203.16 (C) **GC-MS** (EI) 99 ($[M\text{-}CH_3]^+$, 3%), 96 (7%), 81 (73%), 57 (100%), 55 (26%), 43 (37%), 41 (48%), 39 (21%).

[25] Because of the inherent volatility of this compound, it is recommended that the vacuum for rotary evaporation be no lower than 100 mmHg.
[26] Because DCM was found to be incompatible with the subsequent trifluoromethylation step, we performed a solvent swap by gradually removing the DCM by rotary evaporation and replacing it with THF in portions.

1,1,1-trifluoro-5,5-dimethylhexan-2-ol (14) (5.24 g, 66%), was prepared using a similar trifluoromethylation procedure to the protocol used to prepare **3q** from **13** (4.91 g, 0.043 mol, 1 equiv) and further purified by vacuum distillation (b.p. 74-76 ^{o}C @ 15 mmHg) to give **14** as a clear, colorless oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.91 (s, 9 H) 1.17 - 1.27 (m, 1 H) 1.52 (s, 2 H) 1.63 - 1.71 (m, 1 H) 2.64 (s, 1 H) 3.77 - 3.88 (m, 1 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 25.32 (q, $J_{C\text{-}C\text{-}F}$ = 1.47 Hz, CH_2) 29.43 (CH_3) 30.33 (CH_2) 39.48 (CH_2) 71.63 (q, $J_{C\text{-}C\text{-}F}$ = 30.80 Hz, CH) 125.56 (q, $J_{C\text{-}F}$ = 281.70 Hz, CF_3) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -82.94 (d, J = 6.81 Hz) **GC-MS** (EI) 169 ($[M\text{-}CH_3]^+$, 30%), 151 (32%), 131 (29%), 111 (18%), 87 (12%), 79 (11%), 69 (15%), 57 (100%), 55 (27%), 51 (12%).

1,1,1-trifluoro-5,5-dimethylhexan-2-one (15)

To a 500 mL round bottom flask was added a stir bar, DCM (135 mL, 0.2 M), and **15** (5.00 g, 0.026 mol, 1 equiv). The flask was placed in an ice bath and allowed to cool to 0 ^{o}C for 10 minutes. At this time, Dess-Martin periodinane (12.66 g, 0.029 mol, 1.1 equiv) was added slowly. The reaction was allowed to warm to room temperature and stir for 1 hour. The mixture was then diluted with 150 mL of pentane, creating a thick, white mixture. 150 mL of a 50:50 v/v of a saturated $Na_2S_2O_3$ solution and $NaHCO_3$ solution was then added to the white mixture and allowed to stir for 15 minutes during which the solution became clear again. The solution was transferred to a separatory funnel and extracted with diethyl ether (3 x 75 mL). The organic layers were combined and washed with saturated $Na_2S_2O_3$ (75 mL) followed by saturated $NaHCO_3$ (75 mL) and then with brine (75 mL). The organic layer was dried over Na_2SO_4 and the solvent removed *via* distillation at atmospheric pressure to give the crude ketone. The crude product was purified by vacuum distillation (b.p. 83-85 °C @ 200 mmHg) giving the pure product as a clear, colorless oil (2.52 g, 60%).

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.91 (s, 9 H) 1.57 (apparent triplet, J = 7.80 Hz, 2 H) 2.67 (apparent triplet, J = 8.10 Hz, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 29.19 (CH_3) 29.44 (C) 32.52 (CH_2) 36.13 (CH_2) 115.98 (q, $J_{C\text{-}F}$ = 292.20 Hz, CF_3) 192.34 (q, $J_{C\text{-}C\text{-}F}$ = 34.70, C) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -82.17 **GC-MS** (EI) 167 ($[M\text{-}CH_3]^+$, 29%), 129 (17%), 113 (47%), 109 (13%), 69 (52%), 57 (100%), 55 (70%), 53 (12%).

1,1,1-trifluoro-5,5-dimethylhexan-2-one-3,3-d_2 (15′)

To a 100 mL round bottom flask was added a stir bar, D_2O (14 mL, 1.0 M), and **15** (2.60 g, 0.014 mol, 1 equiv). While stirring, 0.5 mL of a 30% w/w solution of sodium deuteroxide was added to the reaction flask. This solution was allowed to stir for 24 hours and the progress of the exchange monitored by ^{1}H NMR. Once complete, the solution was transferred to a separatory funnel and extracted with pentane (3 x 50 mL).[27] The combined organic layers were dried over sodium

[27] We specifically avoid washes with deionized H_2O to minimize any reversal of exchange. Alternatively, the ether solution could be washed with D_2O if so desired.

sulfate. The deuterated ketone[28] was obtained as a clear, colorless oil (1.61 g, 61%) with trace amounts of pentane and used directly in the next step without further purification.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.91 (s, 9 H) 1.56 (s, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 29.19 (CH_3) 30.16 (C) 31.91 (spt, $J_{C\text{-}D}$ = 19.60 Hz, CD_2) 36.06 (CH_2) 115.99 (q, $J_{C\text{-}F}$ = 292.20 Hz, CF_3) 192.36 (q, $J_{C\text{-}C\text{-}F}$ = 35.20 Hz, C) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -82.21 **^{2}H NMR** (61 MHz, $CDCl_3$) δ ppm 2.58 - 2.71 (m, 1 D) **GC-MS** (EI) 169 ($[M\text{-}CH_3]^+$, 29%), 151 (77%), 131 (10%), 115 (43%), 69 (27%), 57 (100%), 55 (54%), 41 (41%)

1,1,1-trifluoro-2,5,5-trimethylhexan-2-ol-3,3-d$_2$ (3t′)

To a flame dried 50 mL round bottom flask equipped with a stir bar was added dry Et_2O (12 mL). The flask was cooled to 0 °C using an ice bath for 10 minutes. After this time, methyllithium (1.6 M, 6.11 mL, 9.8 mmol, 1.2 equiv) was added to the flask *via* syringe. To this solution was added **15′** (1.50 g, 8 mmol, 1 equiv) dropwise and left to stir for five minutes at 0 °C. After this time, the flask was brought to room temperature and left to stir for 15 minutes. The flask was then cooled to 0 °C using an ice bath and the reaction was quenched by added deionized water (3.5 mL) dropwise. The flask was brought to room temperature and the reaction stirred for five minutes, generating a white precipitate which then dissolved over time. The aqueous layer was removed from the flask *via* pipette and the organic layer stirred with $MgSO_4$. The solution was then filtered and the solvent removed *via* rotary evaporation (30 °C water bath at 100 mmHg) to give the crude product. Further purification was accomplished by vacuum distillation (b.p. 63-65 °C @ 8 mmHg) giving the pure product (1.17 g, 72%) as a clear colorless oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.90 (s, 9 H) 1.30 (q, *J* = 14.80 Hz, 2 H) 1.32 (s, 3 H) 2.08 (s, 1 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 20.15 (CH_3) 29.43 (CH_3) 30.16 (C) 31.69 (quin, $J_{C\text{-}D}$ = 5.10 Hz, CD_2) 36.10 (CH_2) 73.96 (q, $J_{C\text{-}C\text{-}F}$ = 27.30 Hz, C) 126.96 (q, $J_{C\text{-}F}$ = 286.70 Hz, CF_3) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -85.96 **^{2}H NMR** (61 MHz, $CDCl_3$) δ ppm 1.45 - 1.75 (m, 255 D) **GC-MS** (EI) 185 ($[M\text{-}CH_3]^+$, 16%), 167 (53%), 131 (10%), 88 (10%), 69 (5%), 57 (100%), 43 (35%), 41 (27%)

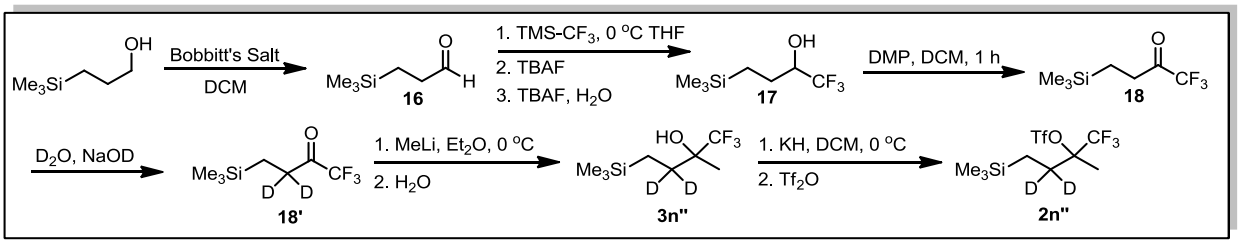
1,1,1-trifluoro-2,5,5-trimethylhexan-2-yl trifluoromethanesulfonate-3,3-d$_2$ (2t′) (0.64 g, 77%), was prepared from **3t′** (0.50 g, 2.5 mmol) according to representative tosylation procedure (see Synthesis SI or **2q**) with the following modifications: Tf_2O (1.06 g, 3.7 mmol, 1.5 equiv) was used. The resulting triflate was obtained as a clear, brown oil and used without further purification.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.92 (s, 9 H) 1.39 (apparent quartet, *J* = 9.30 Hz, 2 H) 1.86 (s, 3 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 18.75 (CH_3) 29.15 (CH_3) 30.45 (spt, $J_{C\text{-}D}$ = 19.60 Hz, CD_2) 30.22 (C) 36.26 (CH_3) 96.31 (q, $J_{C\text{-}C\text{-}F}$ = 30.40 Hz, C) 118.39 (q, $J_{C\text{-}F}$ = 319.80 Hz,

[28] Because of the inherent volatility of this compound, it is recommended that the vacuum for rotary evaporation be no lower than 100 mmHg.

CF_3) 123.67 (q, $J_{C\text{-}F}$ = 284.60 Hz, CF_3) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -82.71 (s, 3 F) -78.56 (s, 3 F) **^{2}H NMR** (61 MHz, $CDCl_3$) δ ppm 2.04 (d, *J* = 7.57 Hz, 2 D).

Preparation of 1,1,1-trifluoro-2-methyl-4-(trimethylsilyl)butan-2-yl trifluoromethanesulfonate-3,3-d$_2$ (2n′)[29]



3-(trimethylsilyl)propanal (16)[30] (5.80 g, 65%) was prepared using a similar oxidation procedure to the protocol used to prepare **9** (see Synthesis SI) from 3-(trimethylsilyl)-1-propanol (9.00 g, 0.068 mol, 1 equiv). The pure aldehyde[31] was obtained as a clear, colorless oil.

^{1}H NMR ($CDCl_3$, 400 MHz, ppm) δ ppm 0.01 (s, 9 H) 0.76 (apparent triplet, *J* = 8.40 Hz, 2 H) 2.37 (td, *J* = 8.39, 1.85 Hz, 2 H) 9.75 (t, *J* = 1.80 Hz, 1 H) **^{13}C NMR** ($CDCl_3$, 100 MHz, ppm) δ ppm -1.62 (CH_3) 8.53 (CH_2) 38.70 (CH_2) 203.41 (C) **GC-MS** (EI) 130 ($[M]^+$, 1%), 115 (100%), 85 (37%), 75 (15%), 73 (70%), 59 (46%), 45 (22%), 43 (23%).

1,1,1-trifluoro-4-(trimethylsilyl)butan-2-ol (17) (6.58 g, 78%), was prepared using a similar trifluoromethylation procedure to the protocol used to prepare **3q** from **16** (5.50 g, 0.042 mol, 1 equiv) and further purified by vacuum distillation (b.p. 80-82 °C @ 18 mmHg) to give **17** as a clear, colorless oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.02 (s, 9 H) 0.49 (td, *J* = 13.80, 4.67 Hz, 1 H) 0.81 (td, *J* = 13.70, 4.23 Hz, 1 H) 1.49 - 1.61 (m, 1 H) 1.73 (tt, *J* = 13.80, 4.00 Hz, 1 H) 2.21 - 2.31 (m, 1 H) 3.77 - 3.87 (m, 1 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm -1.67 (CH_3) 11.84 (CH_2) 24.60 (CH_2) 73.04 (q, $J_{C\text{-}C\text{-}F}$ = 30.10 Hz, CH) 125.49 (q, $J_{C\text{-}F}$ = 282.80 Hz, CF_3) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -82.63 (d, *J* = 6.81 Hz) **GC-MS** (EI) 185 ($[M\text{-}CH_3]^+$, 4%), 91 (17%), 73 (100%), 69 (9%), 61 (23%), 45 (32.0%), 43 (28%), 29 (20%) **HRMS** (DART) calcd for $C_7H_{15}F_3OSi$ $[M - CH_3]^+$: 185.0609, found: 185.0646.

1,1,1-trifluoro-4-(trimethylsilyl)butan-2-one (18) (3.01 g, 51%), was prepared using a similar oxidation procedure to the protocol used to prepare **15**, from **17** (6.00 g, 0.030 mol, 1 equiv) and further purified by vacuum distillation (b.p. 59-62 °C @ 60 mmHg) to give **18** as a clear, colorless oil.

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[29] For the preparation of the non-deuterated form of this compound, see Synthesis SI

[30] Shiner, V. J.; Ensinger, M. W.; Rutkowske, R. D. *J. Am. Chem. Soc.*, **1987** , *109*, 804

[31] Because of the inherent volatility of this compound, it is recommended that the vacuum for rotary evaporation be no lower than 100 mmHg.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.03 (s, 9 H) 0.84 (t, *J* = 8.20 Hz, 2 H) 2.68 (t, *J* = 8.00 Hz, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm -1.74 (CH_3) 9.01 (CH_2) 31.66 (CH_2) 116.15 (q, $J_{C\text{-}F}$ = 292.50 Hz, CF_3) 192.87 (q, $J_{C\text{-}C\text{-}F}$ = 33.90 Hz, C) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -81.75 **GC-MS** (EI) 183 ($[M\text{-}CH_3]^+$, 15%), 143 (12%), 105 (12%), 97 (5%), 73 (100%), 69 (26%), 59 (64%), 43 (48%), 28 (16%)

1,1,1-trifluoro-4-(trimethylsilyl)butan-2-one-3,3-*d*$_2$ (18′) (1.61 g, 53%), was prepared using a similar deuteration procedure to the protocol used to prepare **15′**, from **18** (3.0 g, 0.015 mol, 1 equiv) and further purified by vacuum distillation (b.p. 59-62 °C @ 60 mmHg) to give **18′** as a clear, colorless oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.02 (s, 9 H) 0.82 (s, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm -1.77 (CH_3) 8.92 (CH_2) 31.01 (quin, $J_{C\text{-}D}$ = 19.80 Hz, 2 CD_2) 116.16 (q, $J_{C\text{-}F}$ = 292.00 Hz, CF_3) 192.96 (q, $J_{C\text{-}C\text{-}F}$ = 34.10 Hz, C) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -81.75 **^{2}H NMR** (61 MHz, $CDCl_3$) 1.49 - 1.72 (m, 2 D) **GC-MS** (EI) 183 ($[M\text{-}CH_3]^+$, 15%), 143 (12%), 105 (12%), 97 (5%), 73 (100%), 69 (26%), 59 (64%), 43 (48%), 28 (16%)

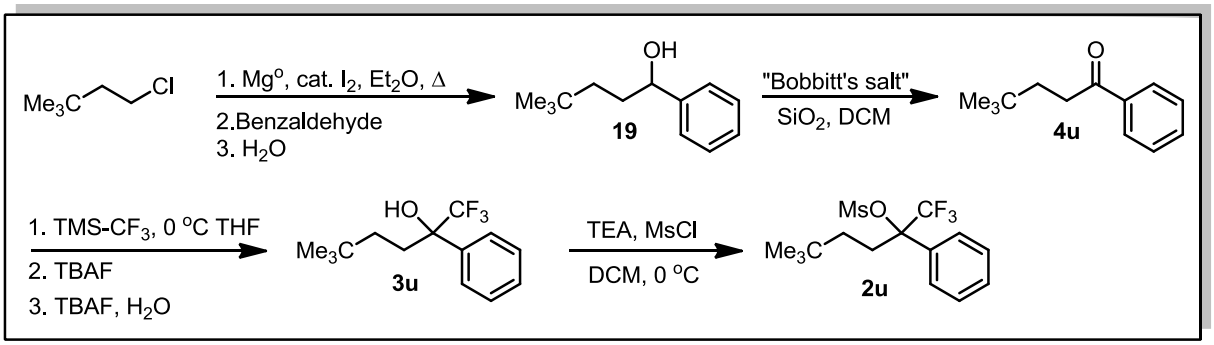
1,1,1-trifluoro-2-methyl-4-(trimethylsilyl)butan-2-ol-3,3-*d*$_2$ (3n″) (1.20 g, 69%), was prepared using a similar methylation procedure to the protocol used to prepare **3t′**, from **18'** (1.60 g, 8 mmol, 1 equiv) and further purified by vacuum distillation (b.p. 47-48 °C @ 3 mmHg) to give **3n″** as a clear, colorless oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.01 (s, 9 H) 0.50 (d, *J* = 14.01 Hz, 1 H) 0.60 (d, *J* = 14.01 Hz, 1 H) 1.31 (s, 3 H) 2.04 (s, 1 H) **^{2}H NMR** (61 Mz, $CDCl_3$) δ ppm 1.63 (d, *J* = 5.25 Hz, 2 D) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm -1.79 (CH_3) 8.55 (CH_2) 19.69 (CH_3) 29.02 (quin, $J_{C\text{-}D}$ = 19.80 Hz, CD_2) 74.38 (q, $J_{C\text{-}C\text{-}F}$ = 27.90 Hz, C) 127.05 (q, $J_{C\text{-}F}$ = 285.40 Hz, CF_3) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -85.28 **GC-MS** (EI) 201 (M^+-CH_3, 2%), 107 (10%), 94 (39%), 73 (100%), 69 (3%), 57 (24%), 43 (56%), 29 (10%) **FTIR** (cm-1, salt plates) 3396 (broad, OH), 2956 (sharp), 2525 (broad, C-D), 1253, 1314, 1151, 861, 831 **HRMS** (DART) calcd for $C_8H_{15}D_2F_3OSi$ $[M - CH_3]^+$: 201.0891, found: 201.0935.

1,1,1-trifluoro-2-methyl-4-(trimethylsilyl)butan-2-yl trifluoromethanesulfonate-3,3-*d*$_2$ (2n″) (0.951 g, 55%), was prepared from **3n″** (1.04 g, 4.8 mmol) according to representative tosylation procedure (see Synthesis SI or **2q**) with the following modifications: Tf_2O (2.03 g, 7.2 mmol, 1.5 equiv) was used. The resulting triflate was obtained as a clear, colorless oil and used without further purification.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.04 (s, 9 H) 0.61 - 0.72 (m, 2 H) 1.85 (s, 3 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm -2.03 (CH_3) 9.35 (CH_3) 18.25 (CH_2) 30.03 (quin, $J_{C\text{-}D}$ = 19.30 Hz, CD_2) 97.10 (q, $J_{C\text{-}C\text{-}F}$ = 29.70 Hz, C) 118.42 (q, $J_{C\text{-}F}$ = 318.90 Hz, CF_3) 123.75 (q, $J_{C\text{-}F}$ = 283.90).

Preparation of 1,1,1-trifluoro-5,5-dimethyl-2-phenylhexan-2-yl methanesulfonate (2u)



4,4-dimethyl-1-phenylpentan-1-ol (19)[32]

To a 100 mL round bottom flask was added a stir bar and ground magnesium turnings (1.11 g, 0.046 g, 1.4 equiv) and sealed with a septum. The flask was flame dried under vacuum and backfilled with nitrogen. 1-chloro-3,3-dimethylbutane (5.50 g, 0.046 mol, 1.4 equiv) was added directly to the magnesium turnings. The flask was equipped with a reflux condenser with nitrogen inlet and the solution heated to reflux for 12 hours. The solution was then cooled to 0 °C and the reflux condenser removed and replaced with a septum with nitrogen inlet needle. At this time, benzaldehyde (3.456 g, 0.033 mol, 1 equiv) was added to the reaction flask and allowed to warm to room temperature and left to stir for 30 minutes. The reaction was quenched using saturated ammonium chloride (3 mL). This solution was transferred to a separatory funnel and diluted with deionized water, 2 M HCl (150 mL) and extracted with pentane (3 x 75 mL). The organic layer was dried over Na_2SO_4 and the solvent removed *via* rotary evaporation to give the crude product. Further purification was accomplished by vacuum distillation (b.p. 76-78 °C @ 0.1 mmHg) giving the pure alcohol (3.726 g, 42%) as a clear colorless oil which solidified upon standing into a white solid.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.88 (s, 9 H) 1.10 (td, *J* = 12.80, 4.57 Hz, 1 H) 1.39 (td, *J* = 12.70, 4.77 Hz, 1 H) 1.65 - 1.84 (m, 2 H) 2.18 (s, 1 H) 4.59 (dd, *J* = 7.18, 6.11 Hz, 1 H) 7.29 (d, *J* = 5.79 Hz, 1 H) 7.33 - 7.39 (m, 4 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 29.58 (CH_3) 30.33 (C) 34.46 (CH_2) 40.23 (CH_2) 75.72 (CH) 126.21 (CH) 127.74 (CH) 128.68 (CH) 145.20 (C) **GC-MS** (EI) 192 ($[M]^+$, 4%), 117 (11%), 108 (100%), 79 (28%), 77 (15%), 57 (10%).

4,4-dimethyl-1-phenylpentan-1-one[33] **(4u)** (3.28 g, 95%) was prepared from **19** (3.50 g, 0.018 mol) using a similar oxidation procedure utilized for **9** (See Synthesis SI) and was used without further purification.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.96 (s, 9 H) 1.64 (t, *J* = 8.20 Hz, 2 H) 2.93 (t, *J* = 8.30 Hz, 2 H) 7.45 (t, *J* = 7.60 Hz, 2 H) 7.51 - 7.58 (m, 1 H) 7.96 (d, *J* = 7.30 Hz, 2 H) **^{13}C NMR** (100

[32] Yang, J.; Liu, X.; Chen, H.-Y.; Zong, Z.-H.; Feng, T.-T.; Sun, K.; Meng, D.-L. *Adv. Synth. Catal.*, **2012** , *354*, 328
[33] Hooper, Joel F.; Weller, Andrew S.; Willis, Michael C.; Young, Rowan D. *Chem. Eur. J.*, **2013**, *19*, 3125

MHz, $CDCl_3$) δ ppm 29.47 (CH_3) 30.45 (C) 34.55 (CH_2) 38.38 (CH_2) 128.32 (CH) 128.80 (CH) 133.09 (CH) 137.35 (C) 201.25 (C) **GC-MS** (EI) 190 ($[M]^+$, 7%), 133 (24%), 105 (100%), 77 (36%), 51 (8%).

1,1,1-trifluoro-5,5-dimethyl-2-phenylhexan-2-ol (3u) (3.42 g, 71%) was prepared from **4u** (3.50 g, 0.018 mol) using a similar trifluoromethylation procedure utilized to prepare **3q**. Further purification was accomplished by vacuum distillation (b.p. 75-78 ^oC @ 0.1 mmHg) to give the CF_3 alcohol as a clear, colorless oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.89 (s, 9 H) 0.93 (td, *J* = 13.00, 4.14 Hz, 1 H) 1.28 (td, *J* = 13.10, 4.43 Hz, 1 H) 2.03 (td, *J* = 13.70, 4.38 Hz, 1 H) 2.24 (td, *J* = 13.60, 4.14 Hz, 1 H) 2.44 (s, 1 H) 7.35 - 7.46 (m, 3 H) 7.57 (d, *J* = 7.64 Hz, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 29.41 (CH_3) 30.12 (C) 30.30 (CH_2) 35.95 (CH_2) 77.80 (q, $J_{C\text{-}C\text{-}F}$ = 27.50 Hz, C) 126.09 (q, $J_{C\text{-}F}$ = 285.40 Hz, CF_3) 126.66 (CH) 128.59 (CH) 128.62 (CH) 136.69 (C) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -83.12 **GC-MS** (EI) 260 ($[M]^+$, 1%), 227 (20%), 191 (100%), 175 (38%), 105 (46%), 77 (18%), 69 (6%), 57 (33%), 41 (13%). **HRMS** (DART) calcd for $C_{14}H_{19}F_3O$ [M – CF_3]$^+$: 191.1436, found: 191.1466.

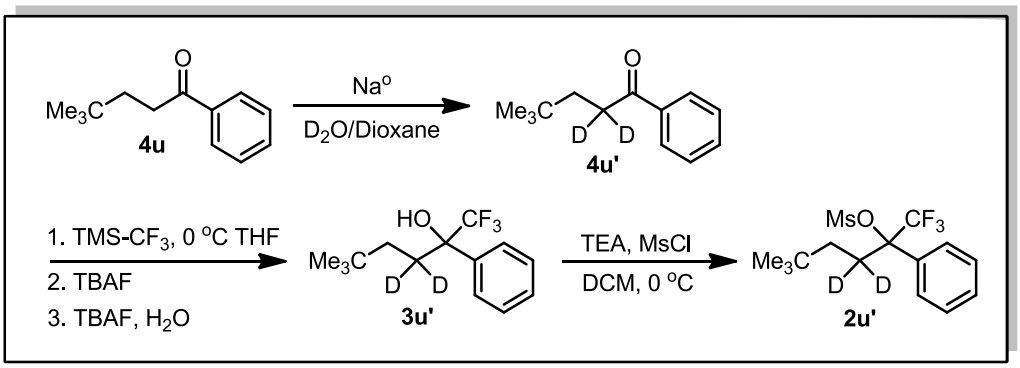
1,1,1-trifluoro-5,5-dimethyl-2-phenylhexan-2-yl methanesulfonate (2u)

The following is a modification of the procedure outlined by Crossland *et al*.[34] and Gassman *et al*.[35] To a flame dried 50 mL round bottom flask containing a stir bar was added pentane (20 mL, 0.2 M), **3u** (1.0 g, 3.8 mmol, 1 equiv), and triethylamine (0.583 g, 5.7 mmol, 1.5 equiv) under nitrogen. The reaction flask was placed in an ice bath and allowed to cool to 0 ^oC for 10 minutes. After this time, MsCl (0.484 g, 4.2 mmol, 1.1 equiv) was added dropwise to the flask. The reaction was allowed to stir for 15 minutes at 0 ^oC and then warmed to room temperature for 30 minutes. The progress of the reaction was monitored by ^{1}H NMR and deemed incomplete at this time. The reaction was then cooled to 0 ^oC again and another portion of triethylamine (0.292 g, 2.85 mmol, 0.75 equiv) was added followed by MsCl (0.242 g, 2.1 mmol, 0.55 equiv) dropwise. The reaction was allowed to stir for 15 minutes at 0 ^oC and then warmed to room temperature for 30 minutes. This process *was repeated again*, and the reaction deemed complete at this time by ^{1}H NMR.[36] The reaction mixture was diluted with pentane (10 mL) and quenched with deionized water (5 mL). The solution was then transferred to a separatory funnel and the aqueous layer extracted with pentane (3 x 20 mL). The combined organic layers were then washed with water (10 mL), saturated sodium bicarbonate (10 mL), and brine (10 mL). The organic layer was dried with Na_2SO_4 and the solvent removed *via* rotary evaporation in a 28 ^oC water bath and then placed under a high vacuum to remove residual solvent to give the desired product (1.24 g, 96%) as a light yellow oil.

[34] Crossland, R. K.; Servis, K. L. *J. Org. Chem*., **1970**, *35*, 3195
[35] Nelson, D. W.; O'Reilly, N. J. Speier, J.; Gassman, P. G. *J. Org. Chem.* **1994**, *59*, 8157
[36] It was necessary to perform this process three times as the active mesylating reagent would decompose faster than the reaction with the trifluoromethyl carbinol would react. We did notice increased conversion after each addition.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.92 (s, 9 H) 1.16 (td, *J* = 12.70, 4.23 Hz, 1 H) 1.50 (td, *J* = 13.10, 4.38 Hz, 1 H) 2.39 (td, *J* = 14.00, 3.31 Hz, 1 H) 2.97 (td, *J* = 13.80, 4.14 Hz, 1 H) 3.14 (s, 3 H) 7.40 - 7.48 (m, 3 H) 7.52 - 7.59 (m, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 27.87 (CH_2) 29.26 (CH_3) 30.25 (C) 36.46 (CH_2) 40.87 (CH_3) 92.67 (q, $J_{C\text{-}C\text{-}F}$ = 29.30 Hz, C) 123.98 (q, $J_{C\text{-}F}$ = 286.10 Hz, CF_3) 126.92 (CH) 128.68 (CH) 129.65 (CH) 133.92 (C) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -77.94.

Preparation of 1,1,1-trifluoro-5,5-dimethyl-2-phenylhexan-2-yl methanesulfonate-2,2-d_2 (2u′)



4,4-dimethyl-1-phenylpentan-1-one-2,2-d_2 (4u′)[37]

This procedure is a modification of the protocol outlined by Zimmerman.[38] To a 250 mL round bottom flask containing D_2O (55 mL) cooled to 0 °C with an ice bath, was added sodium metal (2.80 g , 0.122 mol. 4.64 equiv) carefully in small portions. Dioxane (75 mL) and **4u**[39] (5.0 g, 0.026 mol, 1 equiv) were then added to the reaction flask and allowed to stir at room temperature under nitrogen. The reaction was monitored by ^{1}H NMR and found to be complete after 24 hours. The solution was transferred to a separatory funnel and extracted with pentane (3 x 75 mL). The organic layer was then washed with deionized water (100 mL), and brine (100 mL). The organic layer was dried over Na_2SO_4 and the solvent removed *via* rotary evaporation. Trace solvent removed under high vacuum to afford the deuterated ketone (4.60 g, 91%) as a light yellow oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.96 (s, 9 H) 1.62 (s, 2 H) 7.45 (t, *J* = 7.70 Hz, 2 H) 7.54 (tt, *J* = 7.40, 1.90 Hz, 1 H) 7.95 (d, *J* = 7.08 Hz, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 29.44 (CH_3) 30.43 (C) 33.88 (quin, $J_{C\text{-}D}$ = 19.10 Hz, CD_2) 38.32 (CH_2) 128.31 (CH) 128.78 (CH) 133.07 (CH) 137.29 (C) 201.35 (C) **^{2}H NMR** (61 MHz, $CDCl_3$) 2.92 (s, 2 D) **GC-MS** (EI) 192 ($[M]^+$, 8%), 135 (15%), 105 (100%), 77 (31%), 57 (7%) **HRMS** (DART) calcd for $C_{13}H_{16}D_2O$ $[M+H]^+$, calc. 193.1561, obs. 193.1588

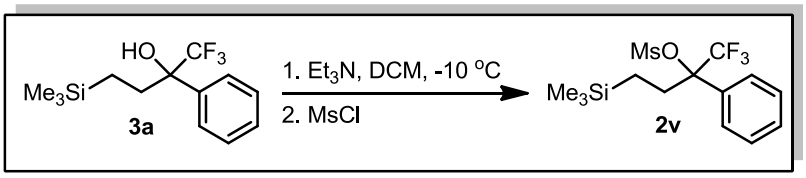
[37] McWilliam, D. C.; Balasubramanian, T. R.; Kuivila, H. G. *J. Am. Chem. Soc.*, **1978**, *100*, 6407
[38] Zimmerman, H. E.; Nuss, J. M. *J. Org. Chem.*, **1986**, *51*, 4604
[39] Prepared in the synthesis of **2u**

1,1,1-trifluoro-5,5-dimethyl-2-phenylhexan-2-ol-2,2-d_2 (3u′) (3.41 g, 79%), was prepared from **4u′** (2.50 g, 0.013 mol, 1 equiv) using a similar protocol to that outlined for **3q**. Further purification was accomplished by vacuum distillation (b.p. 58-60 °C @ 0.1 mmHg) to give **3u′** as a clear, colorless oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.88 (s, 9 H) 1.46 (s, 2 H) 2.37 (s, 1 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 29.43 (CH_3) 30.13 (C) 35.78 (CH_2) 77.69 (q, $J_{C\text{-}C\text{-}F}$ = 27.70 Hz, C) 126.08 (q, $J_{C\text{-}F}$ = 285.70 Hz, CF_3) 126.64 (CH) 128.59 (CH) 128.63 (CH) 136.65 (C) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -86.16 **^{2}H NMR** (61 MHz, $CDCl_3$) 2.08 (d, J = 13.53 Hz, 2 D) **GC-MS** (EI) 262 ($[M]^+$, 1%), 229 (19%), 193 (100%), 175 (41%), 105 (44%), 77 (15%), 69 (5%), 57 (43%), 41 (10%) **HRMS** (DART) calcd for $C_{14}H_{17}D_2F_3O$ $[M - OH]^+$: 245.1486, found: 245.1461.

1,1,1-trifluoro-5,5-dimethyl-2-phenylhexan-2-yl methanesulfonate-2,2-d_2 (2u′) (1.22 g, 94%) was prepared from **3u′** (1.0 g, 3.8 mmol) in a similar manner to **2u**. The pure mesylate was obtained as a light yellow oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.92 (s, 9 H) 1.15 (d, J = 13.33 Hz, 1 H) 1.48 (d, J = 13.33 Hz, 1 H) 3.14 (s, 3 H) 7.39 - 7.48 (m, 3 H) 7.55 (d, J = 6.71 Hz, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm 27.29 (quin, $J_{C\text{-}D}$ = 18.50 Hz, CD_2) 29.28 (CH_3) 30.25 (C) 36.31 (CH_2) 40.88 (CH_3) 92.57 (q, $J_{C\text{-}C\text{-}F}$ = 29.20 Hz, C) 123.99 (q, $J_{C\text{-}F}$ = 286.50 Hz, CF_3) 126.92 (CH) 128.70 (CH) 129.67 (CH) 133.89 (C) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -77.97.

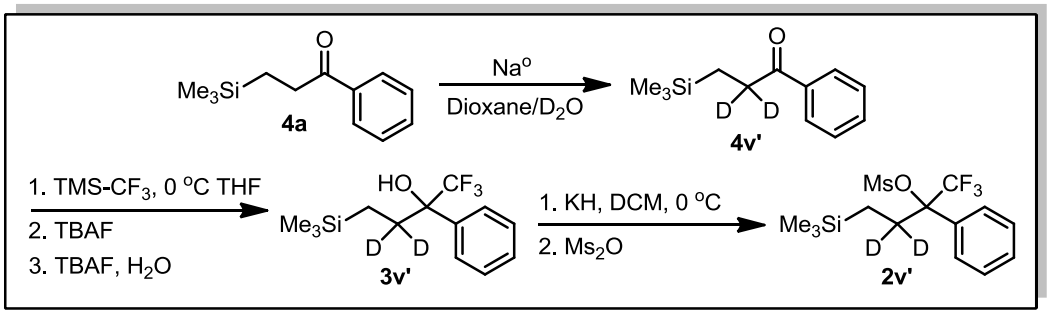


1,1,1-trifluoro-2-phenyl-4-(trimethylsilyl)butan-2-yl methanesulfonate (2v) (0.641 g, 97%) was prepared from **3a**[40] (0.50 g, 1.8 mmol, 1 equiv) in a similar manner to **2u**. These mesylate was obtained as a light yellow oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.02 (s, 9 H) 0.38 (td, J = 14.00, 3.99 Hz, 1 H) 0.72 (td, J = 14.00, 3.94 Hz, 1 H) 2.31 (td, J = 14.50, 3.70 Hz, 1 H) 2.93 (td, J = 14.00, 3.89 Hz, 1 H) 3.18 (s, 3 H) 7.41 - 7.47 (m, 3 H) 7.48 - 7.53 (m, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm -1.91 (CH_3) 9.62 (CH_2) 27.26 (CH_2) 40.85 (CH_3) 93.66 (q, $J_{C\text{-}C\text{-}F}$ = 28.30 Hz, C) 124.03 (q, $J_{C\text{-}F}$ = 285.70 Hz, CF_3) 126.97 (CH) 128.68 (CH) 129.56 (CH) 133.81 (C) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm –77.93.

[40] See Synthesis SI for the preparation of this compound

Preparation of 1,1,1-trifluoro-2-phenyl-4-(trimethylsilyl)butan-2-yl methanesulfonate-3,3-d_2 (2v′)



1-phenyl-3-(trimethylsilyl)propan-1-one-2,2-*d*$_2$ (4v′) (0.662 g, 70%) was prepared from **4a**[41] (0.94 g, 0.00455 mol, 1 equiv) in a similar manner to **4u′**. The pure ketone was obtained as a clear, colorless oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.05 (s, 9 H) 0.90 (s, 2 H) 7.41 - 7.48 (m, 2 H) 7.53 (d, *J* = 7.38 Hz, 1 H) 7.95 (d, *J* = 7.23 Hz, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm -1.50 (CH_3) 11.28 (CH_2) 32.75 (quin, $J_{C\text{-}D}$ = 19.30 Hz, CD_2) 128.33 (CH) 128.79 (CH) 132.93 (CH) 137.34 (C) 201.42 (C) **^{2}H NMR** (61 MHz, $CDCl_3$) δ ppm 2.88 - 2.98 (m, 2 D) **GC-MS** (EI) 208 ($[M]^+$, 19%), 207 (91%), 193 (67%), 178 (16%), 135 (13%), 119 (72%), 105 (34%), 77 (33%), 73 (100%), 45 (12%). **HRMS** (DART) calcd for $C_{12}H_{16}D_2OSi$ $[M + H]^+$: 209.1331, found: 209.1334

1,1,1-trifluoro-2-phenyl-4-(trimethylsilyl)butan-2-ol-3,3-*d*$_2$ (3v′) (2.70 g, 79%), was prepared from **4v′** (2.50 g, 0.013 mol, 1 equiv) in a similar manner to **3q**. Further purification was accomplished by vacuum distillation (b.p. 58-60 °C @ 0.1 mmHg) to give **3v′** as a clear, colorless oil.

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.00 (s, 9 H) 0.12 (d, *J* = 14.23 Hz, 1 H) 0.50 (d, *J* = 13.99 Hz, 1 H) 2.41 (s, 1 H) 7.35 – 7.39 (m, 1 H) 7.40 - 7.44 (m, 2 H) 7.53 (d, *J* = 7.69 Hz, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm -1.71 (CH_3) 8.18 (CH_2) 29.10 (quin, $J_{C\text{-}D}$ = 19.70 Hz, CD_2) 78.22 (q, $J_{C\text{-}C\text{-}F}$ = 26.90 Hz, C) 126.13 (q, $J_{C\text{-}F}$ = 286.10 Hz, CF_3) 126.79 (CH) 128.60 (CH) 136.78 (C) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm –82.65 **^{2}H NMR** (61 MHz, $CDCl_3$) δ ppm 2.05 (d, *J* = 14.40 Hz, 2 D) **GC-MS** (EI) 263 ($[M\text{-}CH_3]^+$, 1%), 188 (7%), 156 (57%), 149 (10%), 119 (14%), 105 (17%), 103 (24%), 77 (17%), 73 (100%), 69 (2%), 45 (8%) **HRMS** (DART) calcd for $C_{13}H_{17}D_2F_3OSi$ $[M – HCF_3]^+$: 208.1252, found: 208.1259.

1,1,1-trifluoro-2-phenyl-4-(trimethylsilyl)butan-2-yl methanesulfonate-3,3-d_2 (2v′) (0.616 g, 96%) was prepared from **3v′** (0.501 g, 1.8 mmol) in a similar manner to **2u**. The pure mesylate was obtained as a pale yellow oil.

[41] See Synthesis SI for the preparation of this compound

^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 0.02 (s, 9 H) 0.37 (d, *J* = 14.16 Hz, 1 H) 0.71 (d, *J* = 14.21 Hz, 1 H) 3.18 (s, 3 H) 7.41 - 7.46 (m, 3 H) 7.48 - 7.53 (m, 2 H) **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm -1.80 (CH_3) 9.51 (CH_2) 26.79 (quin, $J_{C\text{-}D}$ = 20.20 Hz, CD_2) 40.99 (CH_3) 93.73 (q, $J_{C\text{-}C\text{-}F}$ = 28.80 Hz, C) 124.09 (q, $J_{C\text{-}F}$ = 286.50 Hz, CF_3) 127.03 (CH) 128.76 (CH) 129.64 (CH) 133.84 (C) **^{19}F NMR** (377 MHz, $CDCl_3$) δ ppm -77.85.

Representative Procedure for Kinetic Studies

All rate constants for this work were determined conductometrically at 25 $\pm$ 0.001^{o}C using the bipolar pulsed conductance technique, as described by Shiner and Tilley.[42, 43]

Hardware:

The constant-temperature oil-bath employed for kinetic measurements was designed by Murr[44], with later modifications as described by Tilley.[42] The Bipolar Pulsed Conductance Instrument as originally described by Caserta[45] with modifications of Tilley[42] was built by Indiana University Chemistry Department Electronic Instrumentation Services Group. Two types of conductance cells were employed for measurements – unstirred and stirred cells. Construction and design of these cells has been described by Tilley.[42]

Software:

Raw data was acquired and converted to resistance-time values using software written by Tilley[42] and analyzed using a non-linear, doubly weighted least-squares program.[43]

Representative Procedures

Stirred cells were necessary for reactions with short half-lives; either stirred or unstirred cells could be used for reactions with half-lives of more than several hours.

When stirred cells were required, the cell was filled with an appropriate solvent (generally 40 mL), leads were connected, and the cell placed in the constant-temperature bath, and pre-equilibrated for ten minutes. The appropriate mass of substrate to yield approximately 1 X 10^{-3} M solution was determined. Solid substrates were weighed on glassine paper and added directly to the stirred cell, using a small amount of solvent from the cell and a pipette to rinse residual solid off the paper into the cell. Liquid substrates were weighed by withdrawing a volume into a tared syringe until the appropriate weight was reached. The tip of the syringe was then placed just below the liquid level in the cell and the substrate was directly injected while stirring; and the syringe was plunged up and down several times to ensure complete addition.

In the case of unstirred cells, a solution of substrate was prepared by weighing an appropriate mass of material in to a volumetric flask (generally 25 or 100 mL) so as to yield a 1.0 X 10^{-3} M solution of substrate. The flask was then filled to the mark with appropriate solvent and mixed. The cells were then rinsed with a small amount of this solution. The rinse was then discarded, and the cell then completely filled with solution and clamped into the oil bath and leads were connected.

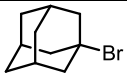
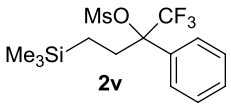
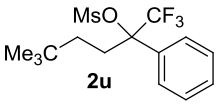
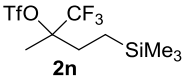
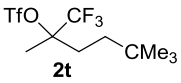
The resistance measurements were continually measured by the BIPCON until a specified (solvent-dependent) trigger resistance value was reached, whereupon data collection began. Generally, data points (approximately 400) were collected over the span of two half-lives; for

[42] Tilley, L. J. PhD Thesis, Indiana University, Bloomington, IN (1996)
[43] Tilley, L. J.; Shiner, V. J. *J. Phys. Org. Chem.* **1999**, *12*, 564.
[44] Murr, B. L., Jr, PhD Thesis, Indiana University, Bloomington, IN (1961)
[45] K. J. Caserta, F. J. Holler, S. R. Crouch and C. G. Enke, *Anal. Chem.* **1978**, *50*, 1534.

very fast reactions fewer data points (approximately 50-100) were collected. The data was then treated as mentioned above to obtain first-order rate constants.

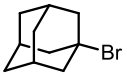
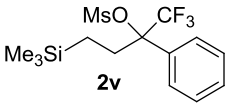
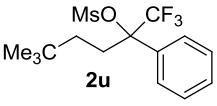
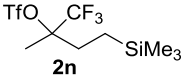
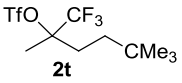
Raber-Harris Plots and Conductometric Data

Table S1: Rate Data Obtained from Conductometric Studies[a, b]

Compound	90E	80E	70E	60E	97T	70T
 see Ref 46	2.455×10^{-8}	5.129×10^{-7}	1.549×10^{-6}	7.244×10^{-6}	9.550×10^{-5}	1.778×10^{-4}
 **2v**	-	9.480×10^{-6}	2.970×10^{-5}	8.680×10^{-5}	9.615×10^{-3}	8.310×10^{-3}
 **2u**	-	4.060×10^{-6}	1.260×10^{-5}	3.590×10^{-5}	2.495×10^{-3}	2.480×10^{-3}
 **2n**	1.533×10^{-4}	3.356×10^{-4}	5.943×10^{-4}	7.100×10^{-4}	2.885×10^{-3}	-
 **2t**	6.578×10^{-5}	1.235×10^{-4}	1.974×10^{-4}	3.178×10^{-4}	1.387×10^{-5}	-

[a] E = aqueous ethanol; T = aqueous trifluoroethanol. Ethanol runs are volume percent, trifluoroethanol runs are weight percent.
[b] Values are the average of multiple runs.

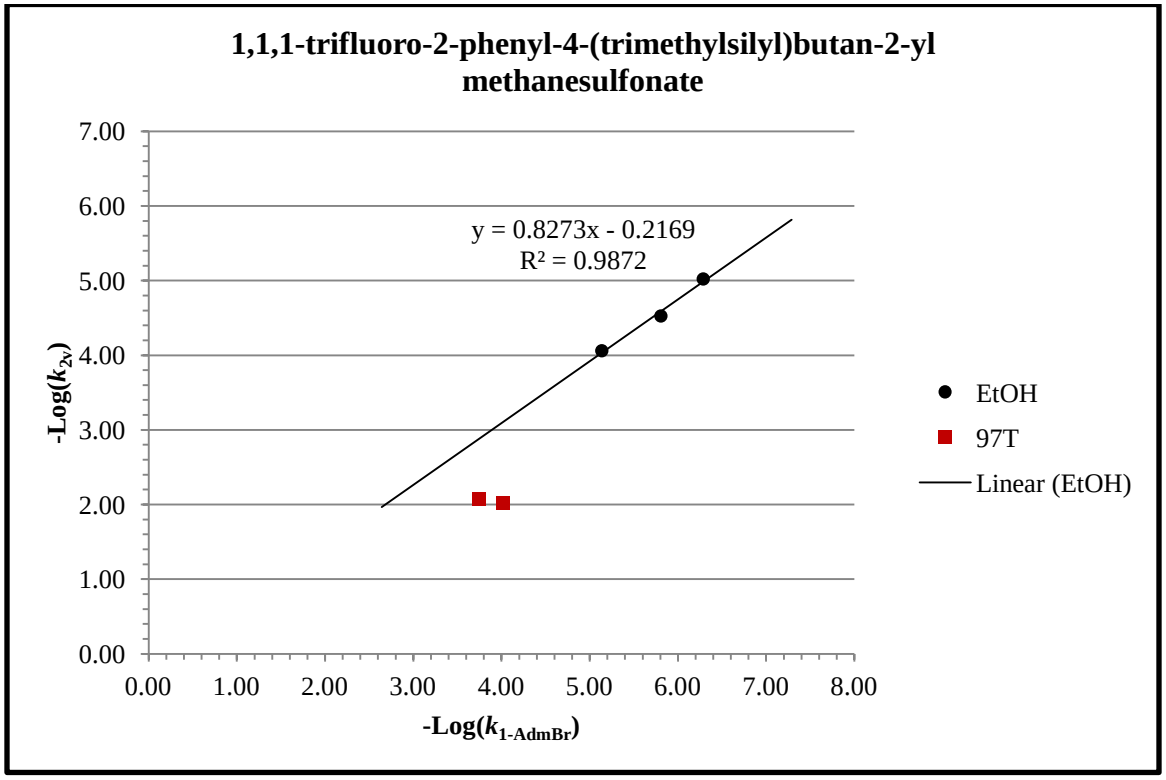
Table S2: Solvolysis Rates (-log *k*) of Conductometric Data[a, b]

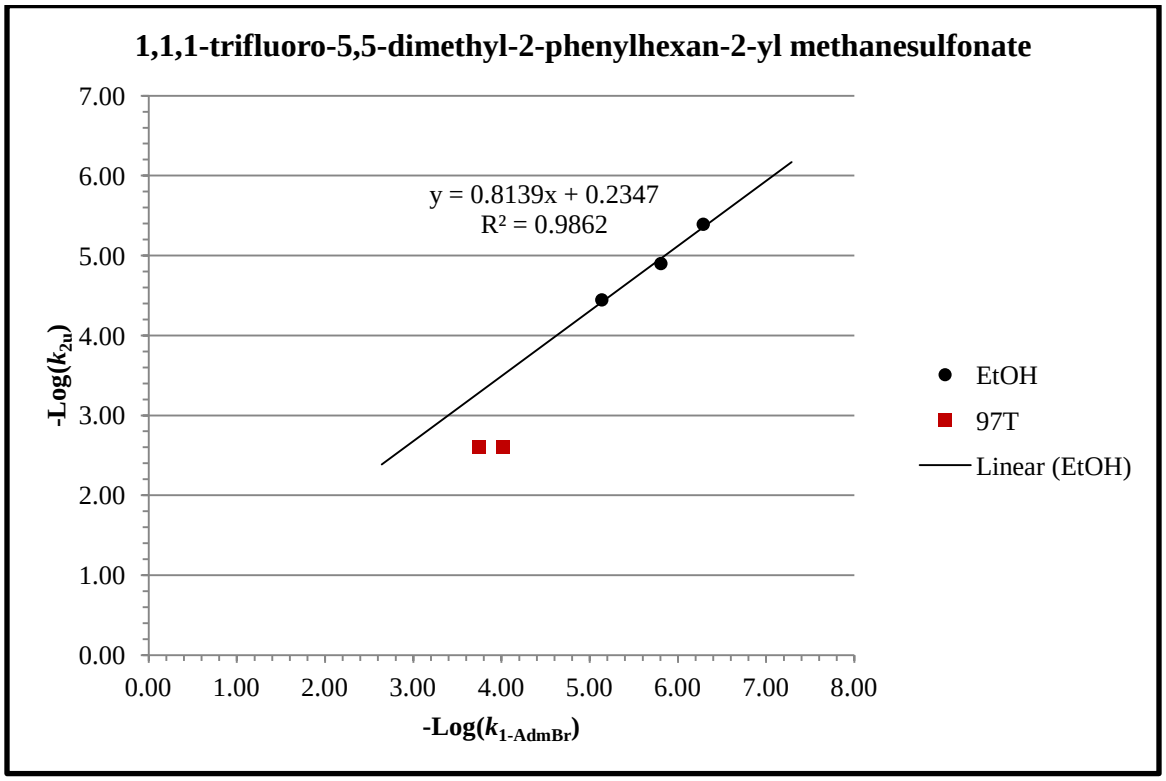
Compound	90E	80E	70E	60E	97T	70T
 see Ref 46	7.61	6.29	5.81	5.14	4.02	3.75
 **2v**	-	5.02	4.53	4.06	2.02	2.08
 **2u**	-	5.39	4.90	4.44	2.60	2.61
 **2n**	3.81	3.47	3.23	3.15	2.54	-
 **2t**	4.18	3.91	3.70	3.50	4.86	-

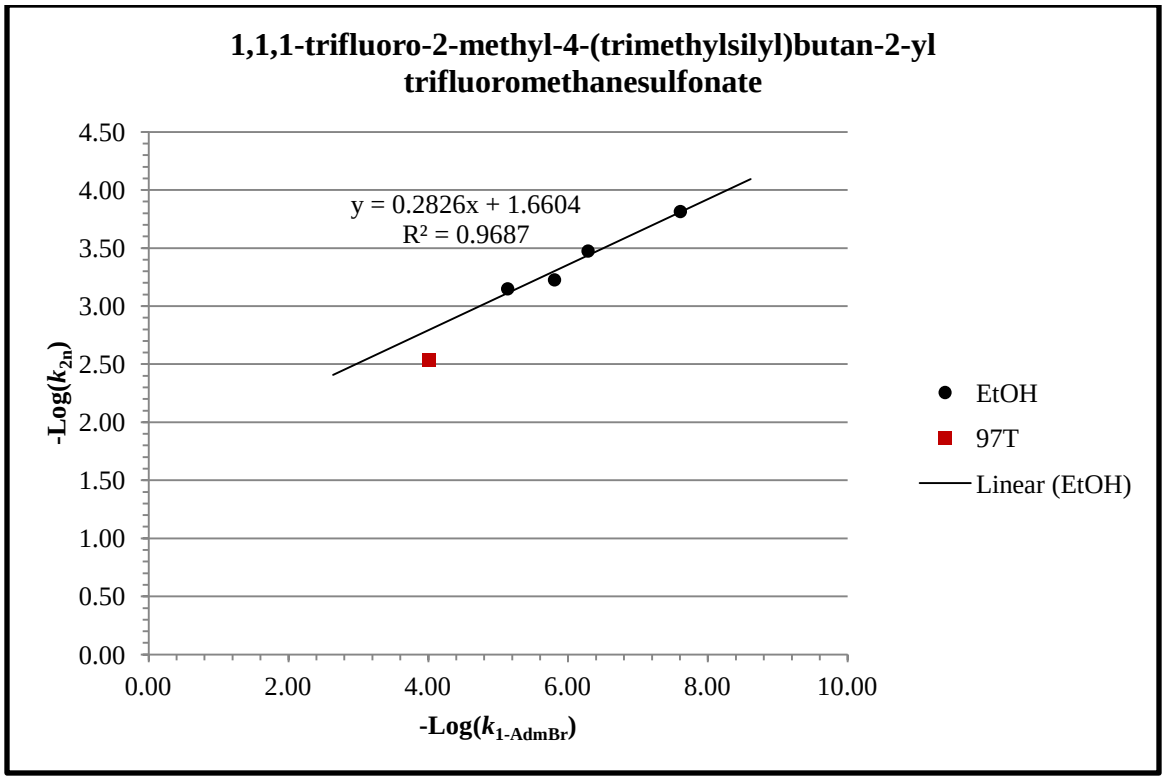
[a] E = aqueous ethanol; T = aqueous trifluoroethanol. Ethanol runs are volume percent, trifluoroethanol runs are weight percent. [b] Values are the average of multiple runs

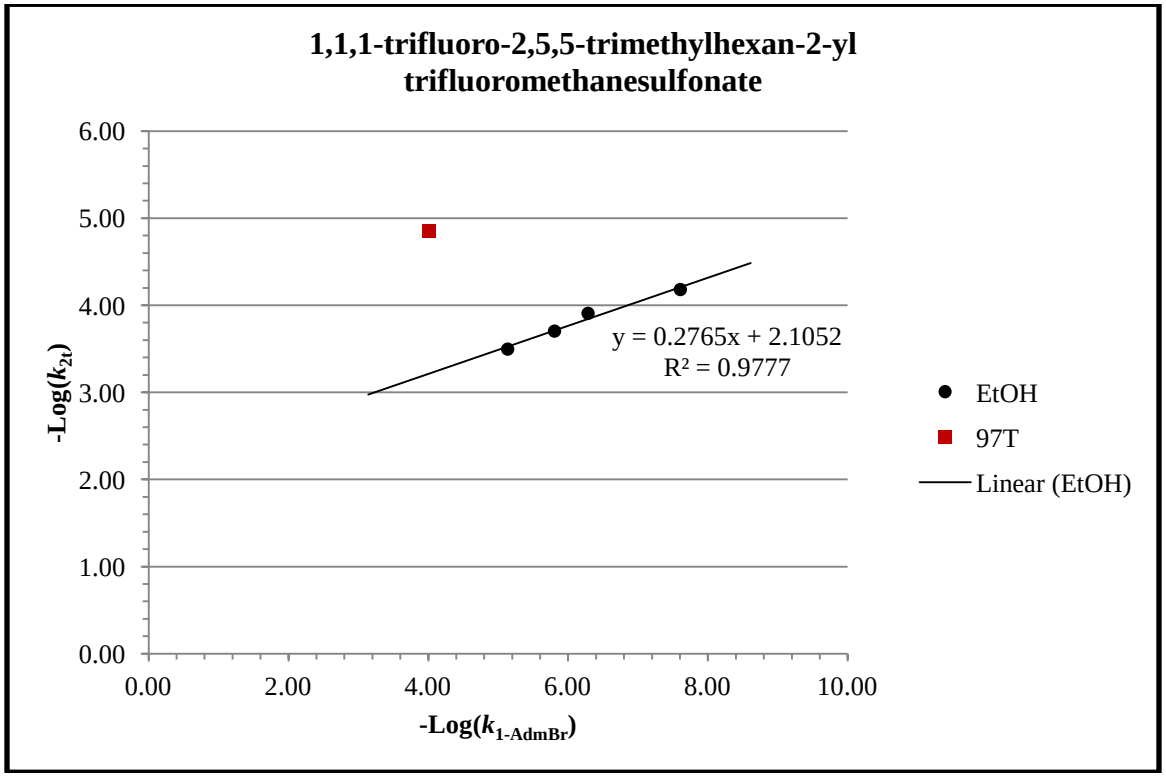
[46] Raber, D. J.; Neal, W. C.; Dukes, M. D.; Harris, J. M.; Mount, D. L *J. Am. Chem. Soc.* **1978**, *100*, 8137

Raber-Harris Plots

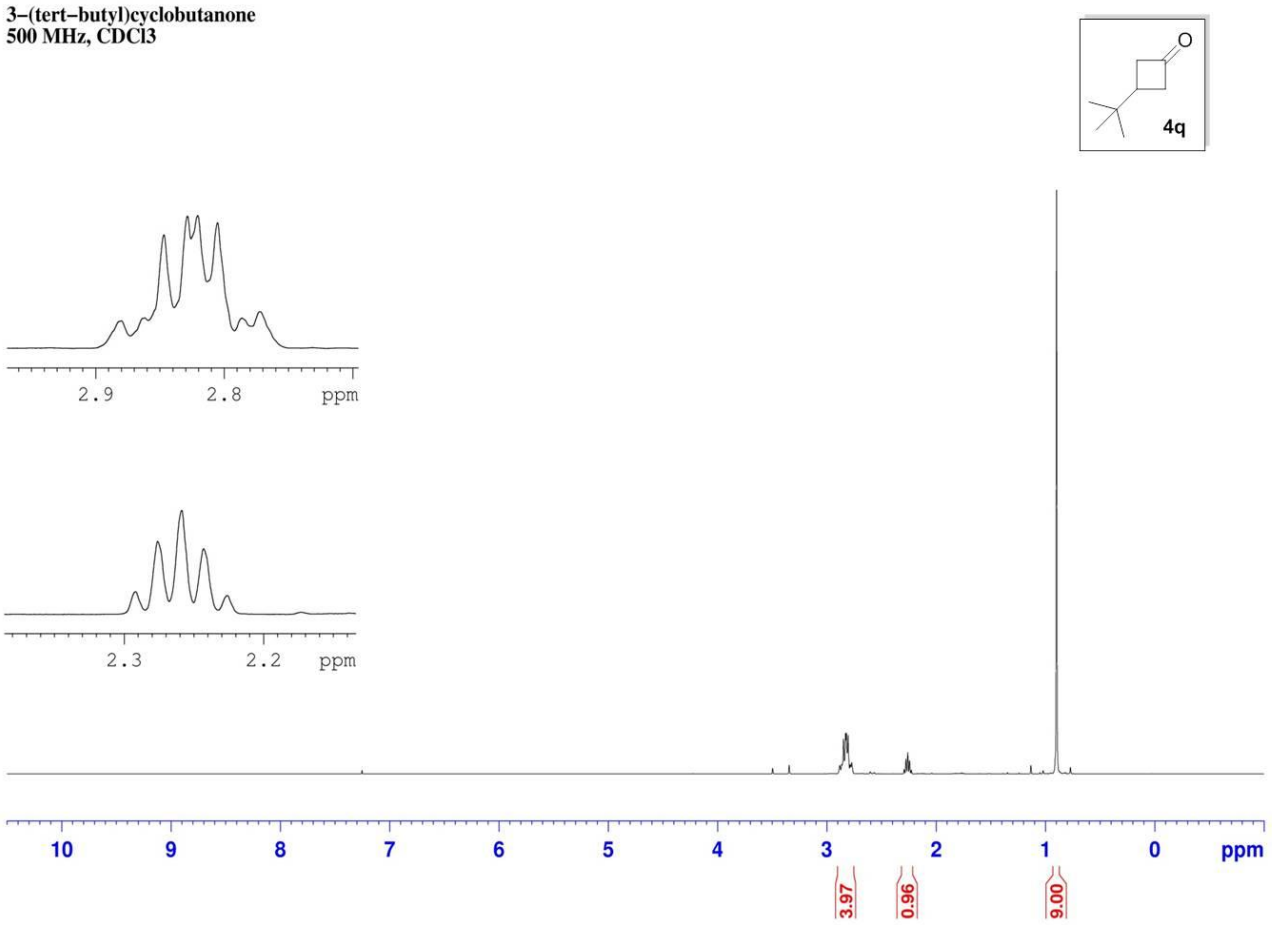




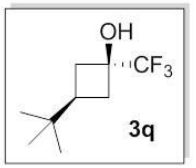

1,1,1-trifluoro-2-methyl-4-(trimethylsilyl)butan-2-yl trifluoromethanesulfonate
y = 0.2826x + 1.6604
R² = 0.9687
-Log(k2n)
-Log(k1-AdmBr)
EtOH
97T
Linear (EtOH)

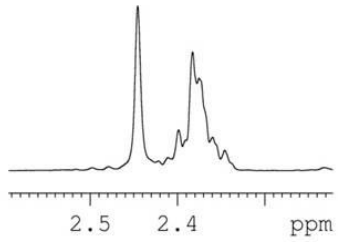

1,1,1-trifluoro-2,5,5-trimethylhexan-2-yl trifluoromethanesulfonate
y = 0.2765x + 2.1052
R² = 0.9777
-Log(k2t)
-Log(k1-AdmBr)
EtOH
97T
Linear (EtOH)

^{1}H NMR Spectra of Synthesized Compounds

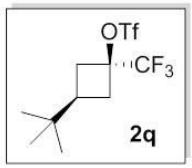


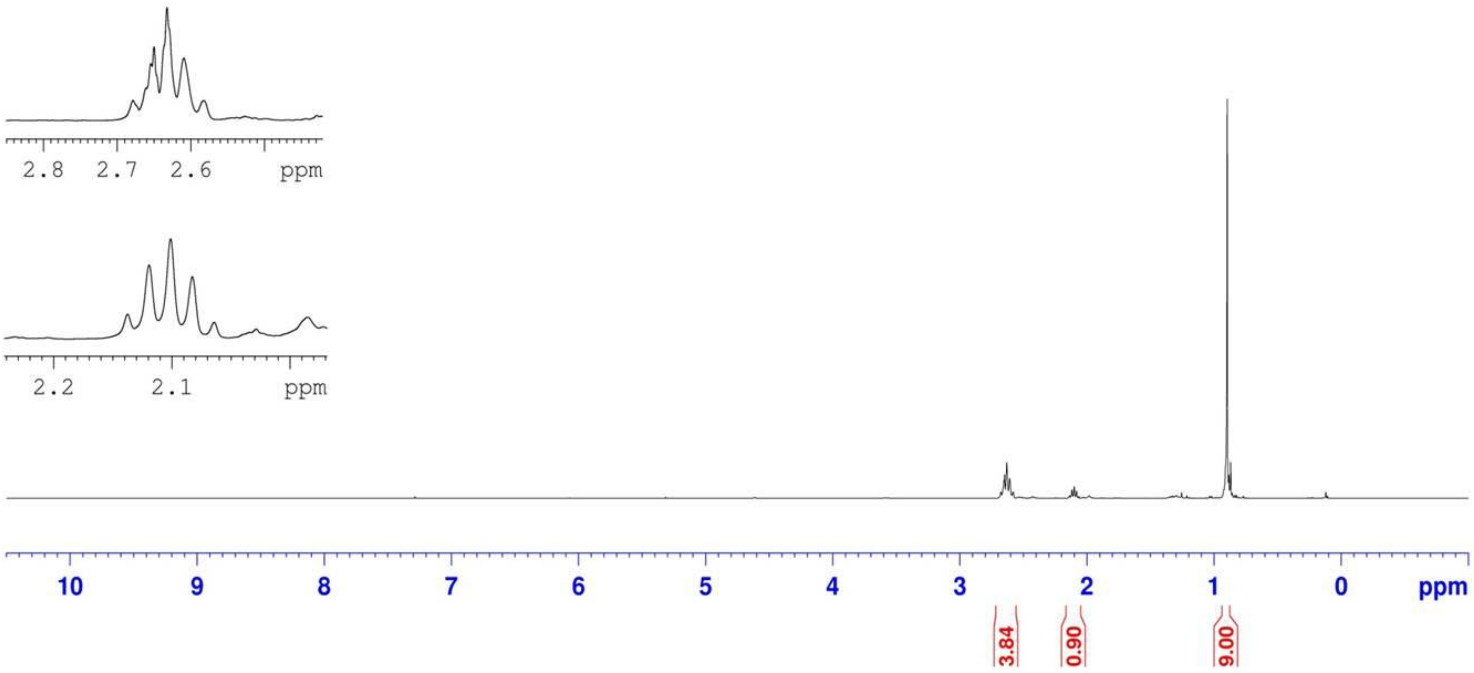
(1s,3s)−3−(tert−butyl)−1−(trifluoromethyl)cyclobutanol "cis"
400 MHz, CDCl3



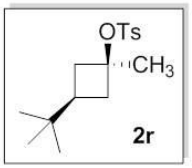


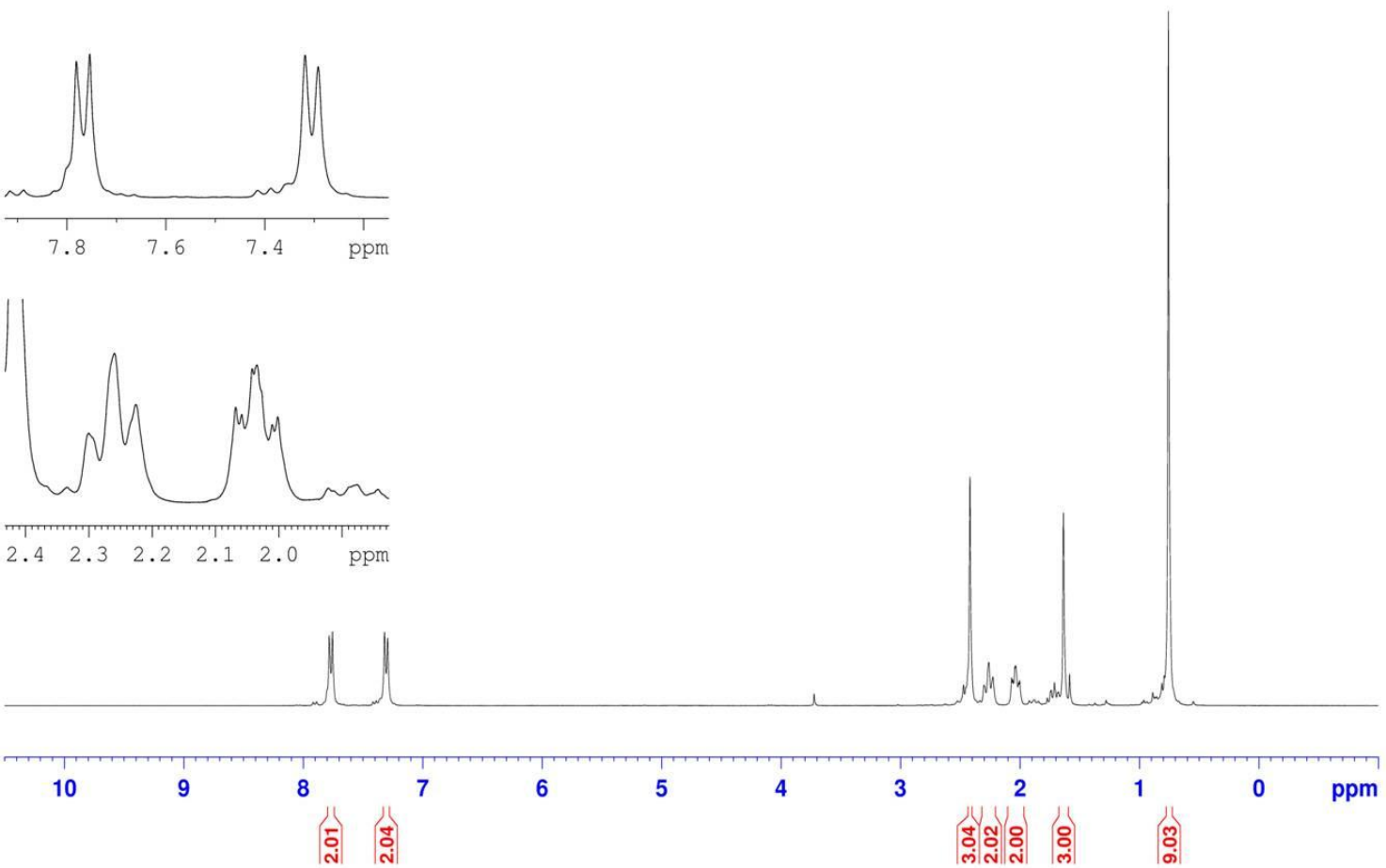
(1s,3s)−3−(tert−butyl)−1−(trifluoromethyl)cyclobutyl trifluoromethanesulfonate "cis"
400 MHz, CDCl3



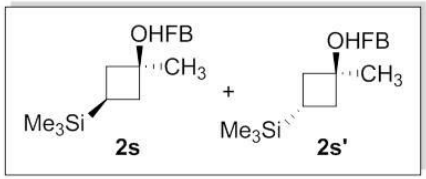


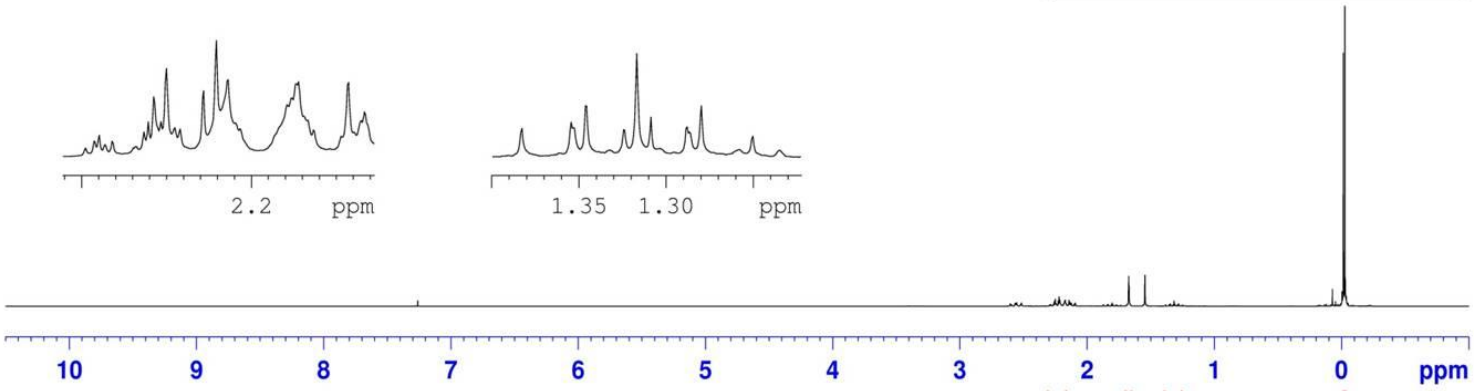
(1s,3s)−3−(tert−butyl)−1−methylcyclobutyl 4−methylbenzenesulfonate "cis"
400 MHz, CDCl3



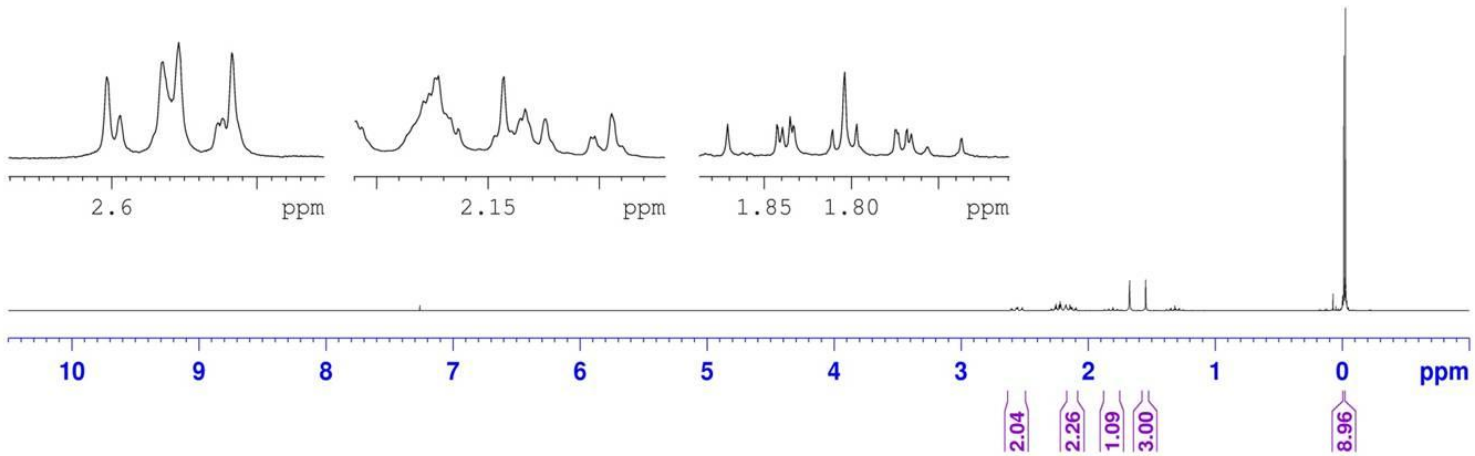


Cis 1–methyl–3–(trimethylsilyl)cyclobutyl 2,2,3,3,4,4,4–heptafluorobutanoate
300 MHz, CDCl3

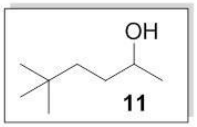


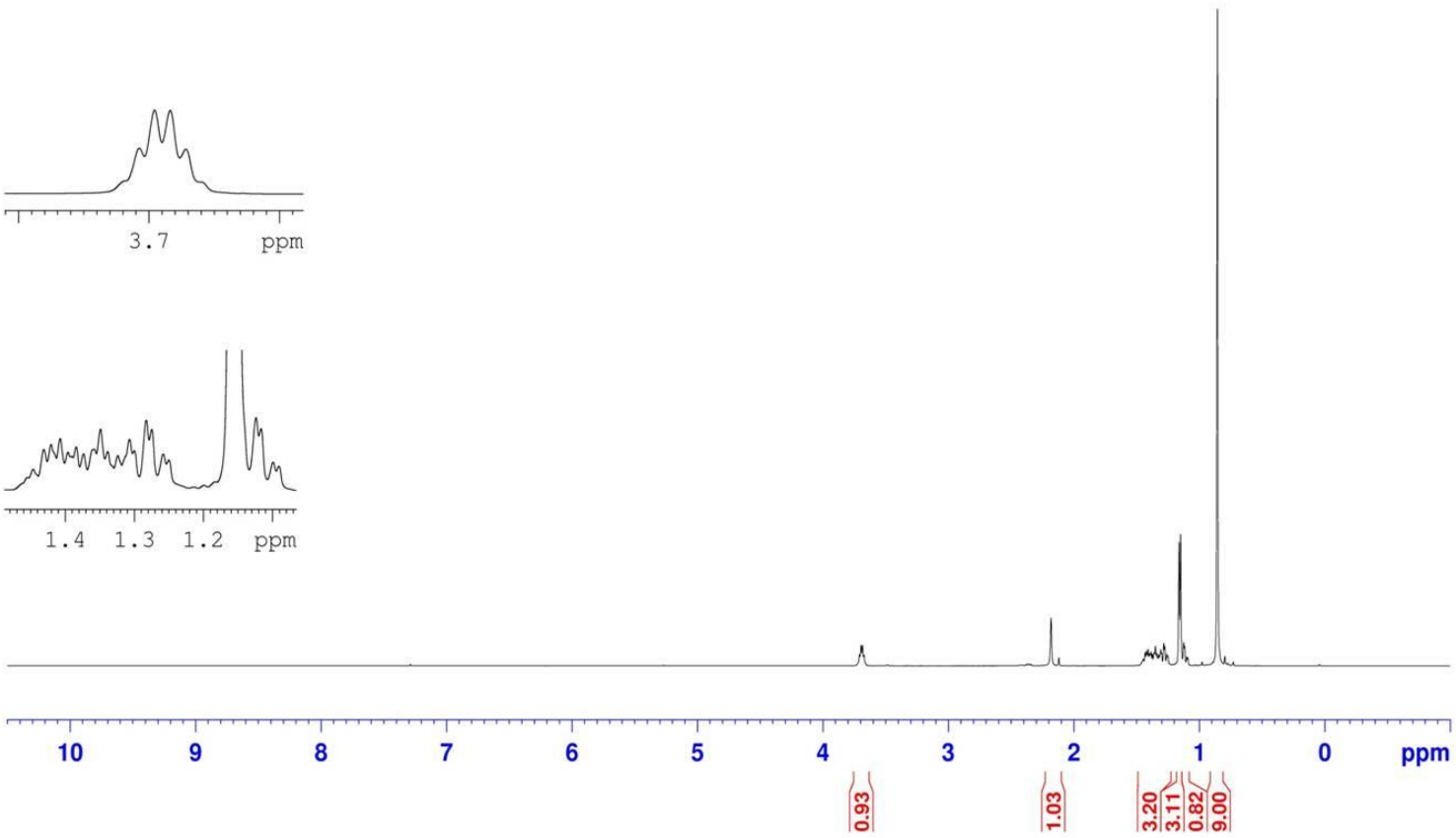


Trans 1–methyl–3–(trimethylsilyl)cyclobutyl 2,2,3,3,4,4,4–heptafluorobutanoate
300 MHz, CDCl3

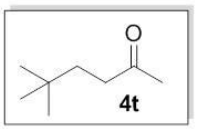


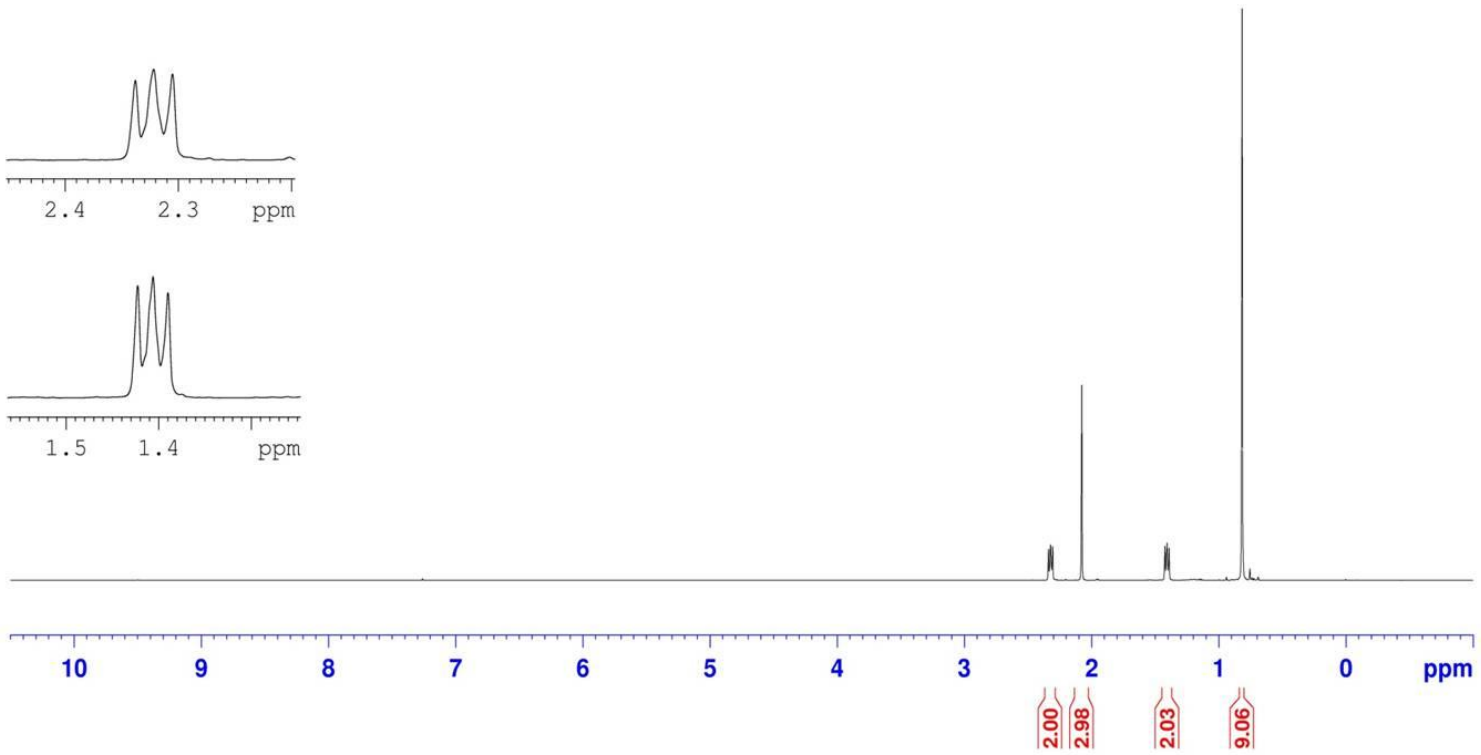
5,5–dimethylhexan–2–ol
500 MHz, CDCl3



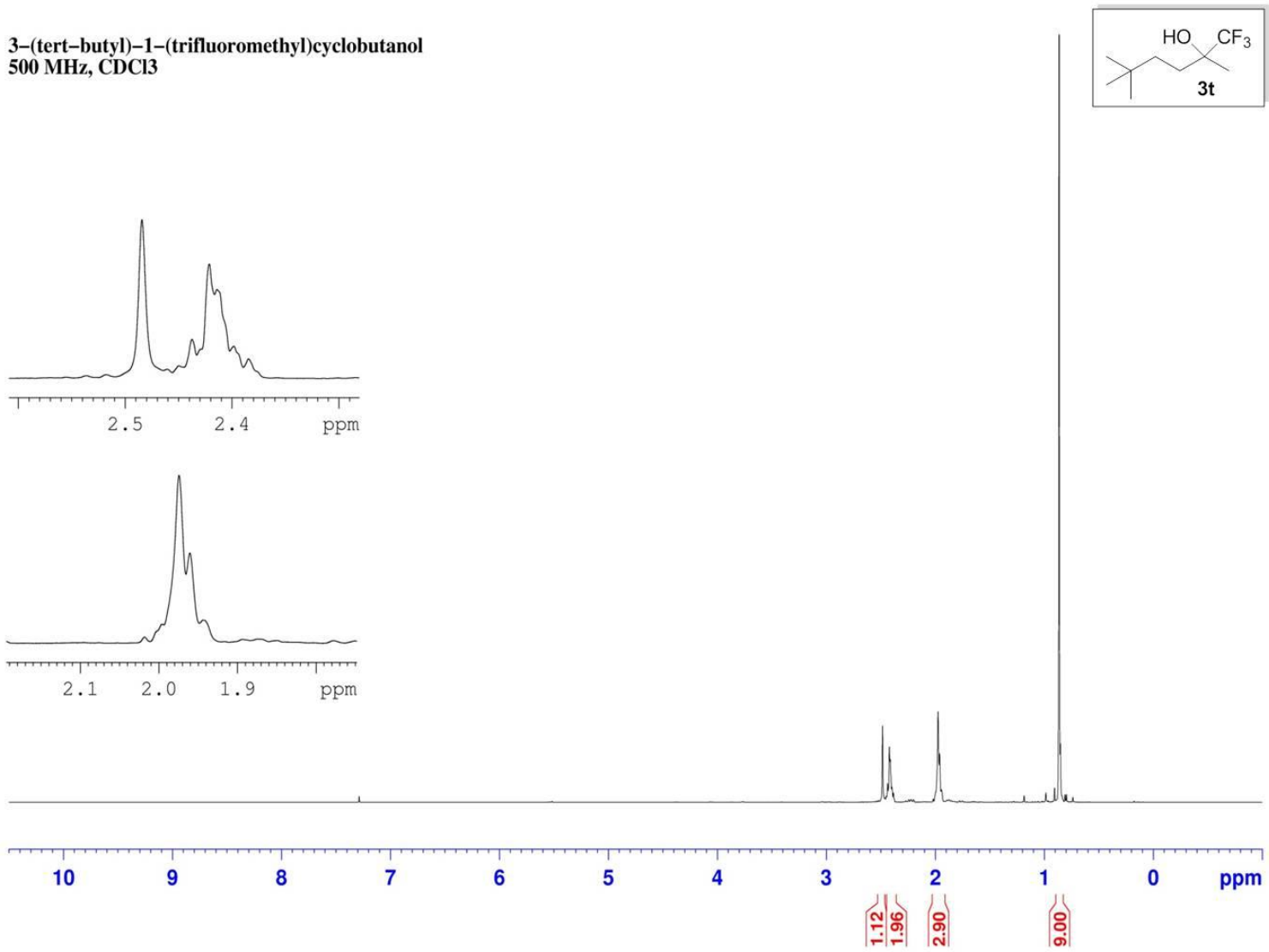


5,5–dimethylhexan–2–one
500 MHz, CDCl3

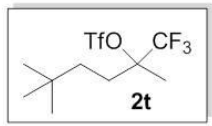


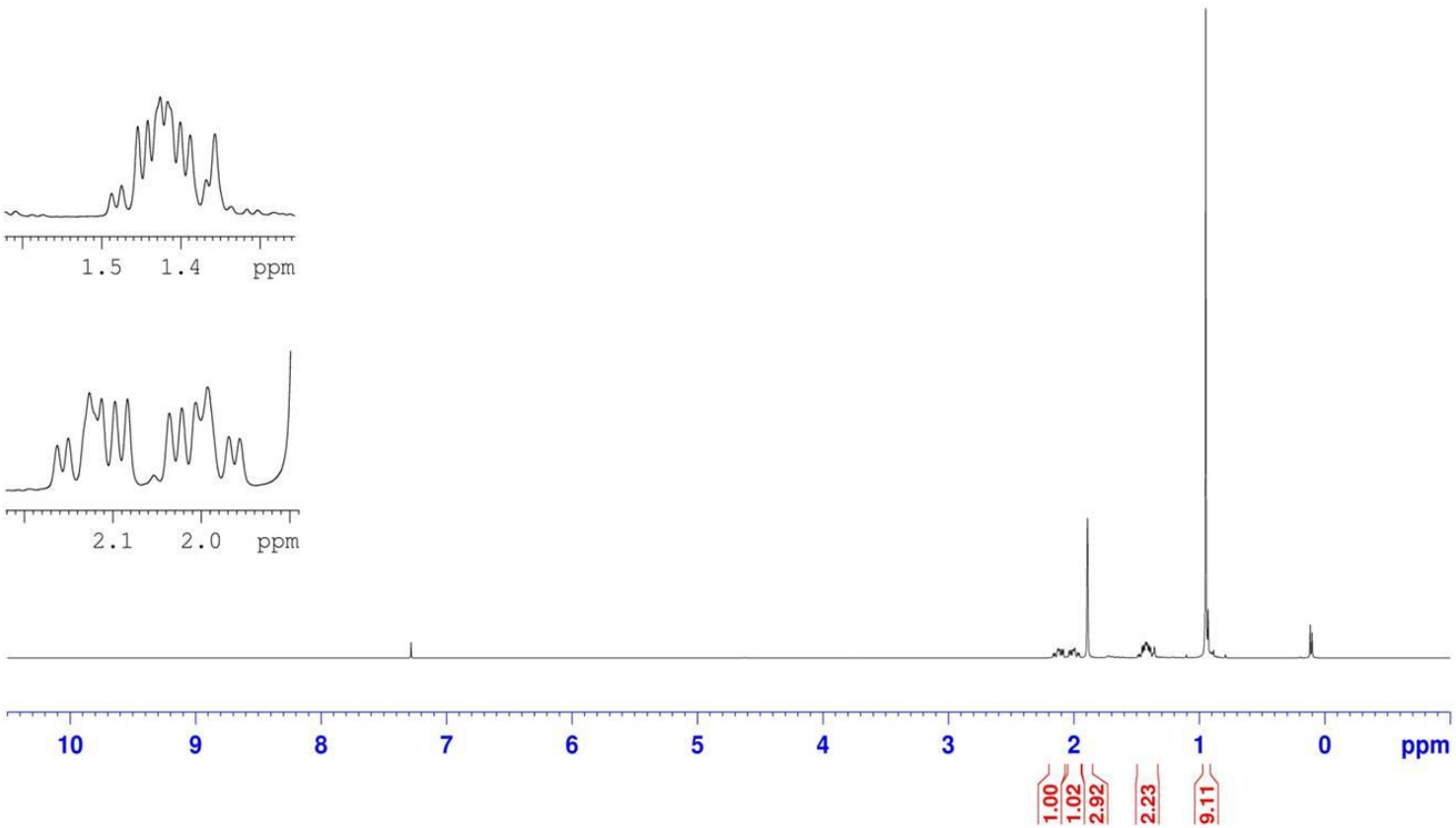


3–(tert–butyl)–1–(trifluoromethyl)cyclobutanol
500 MHz, CDCl3

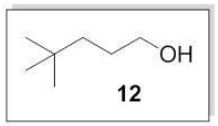


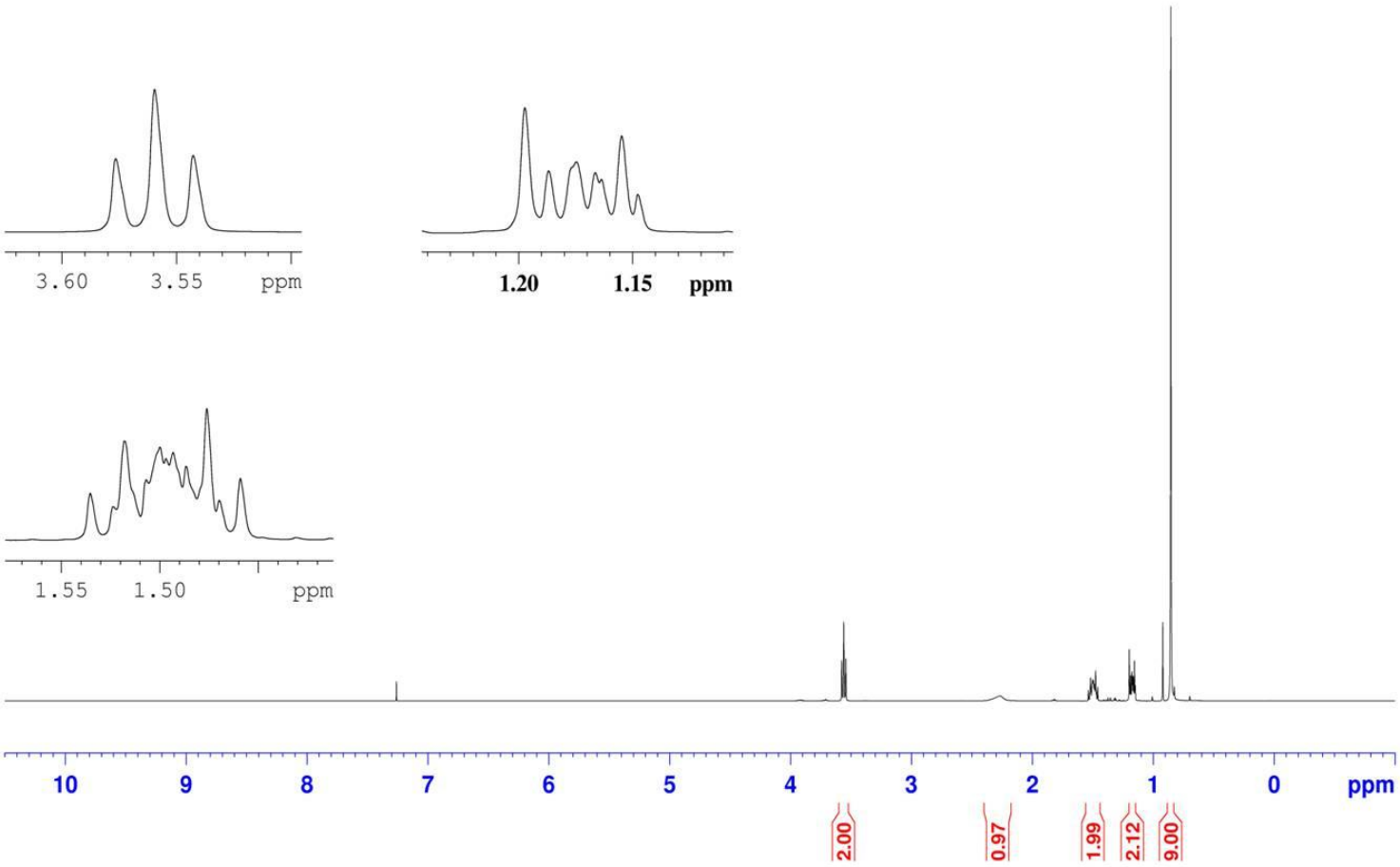
1,1,1−trifluoro−2,5,5−trimethylhexan−2−yl trifluoromethanesulfonate
400 MHz, CDCl3



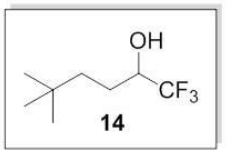


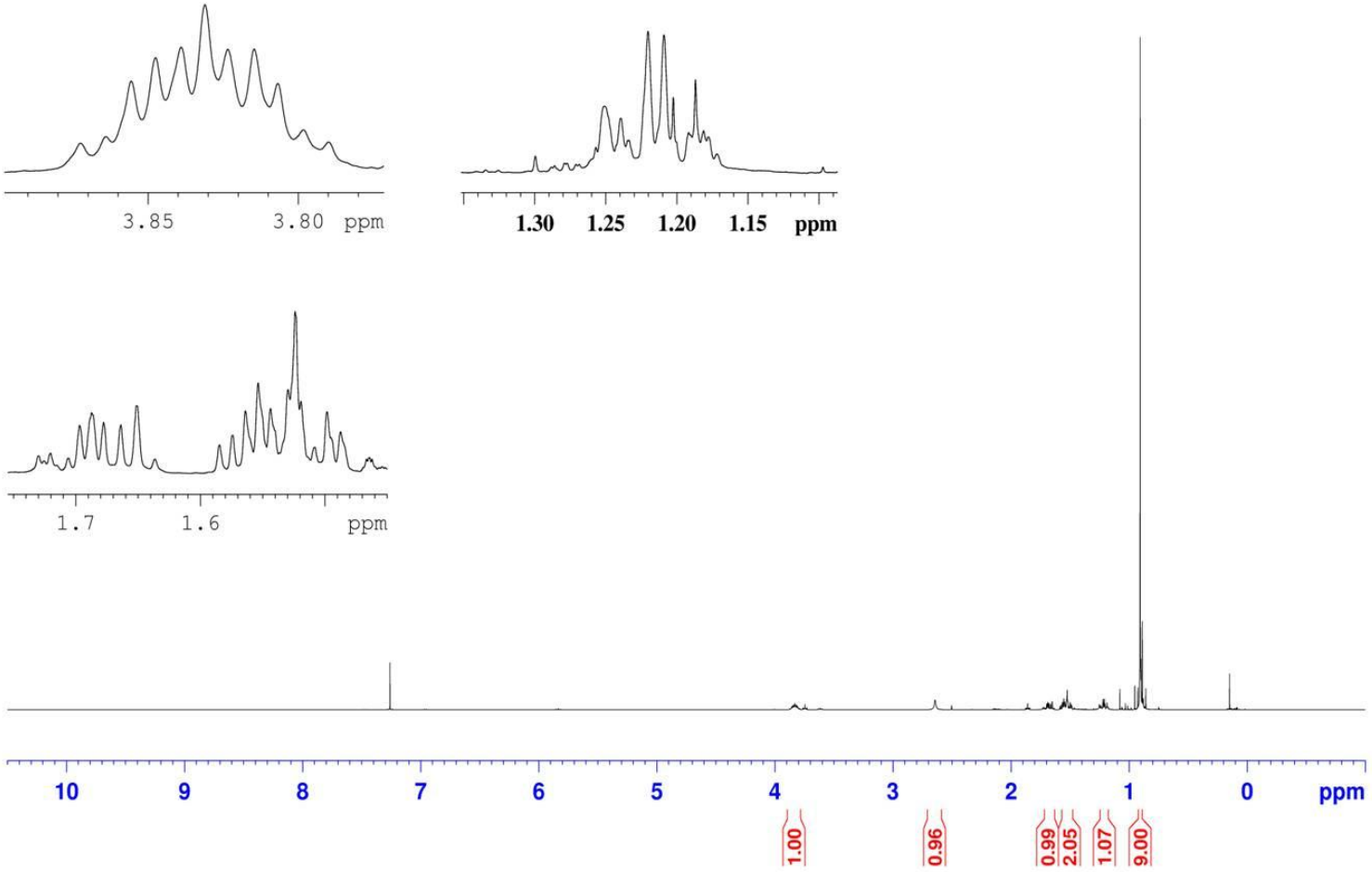
4,4–dimethylpentan–1–ol
400 MHz, CDCl3



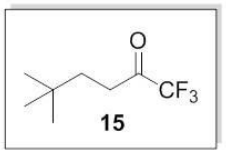


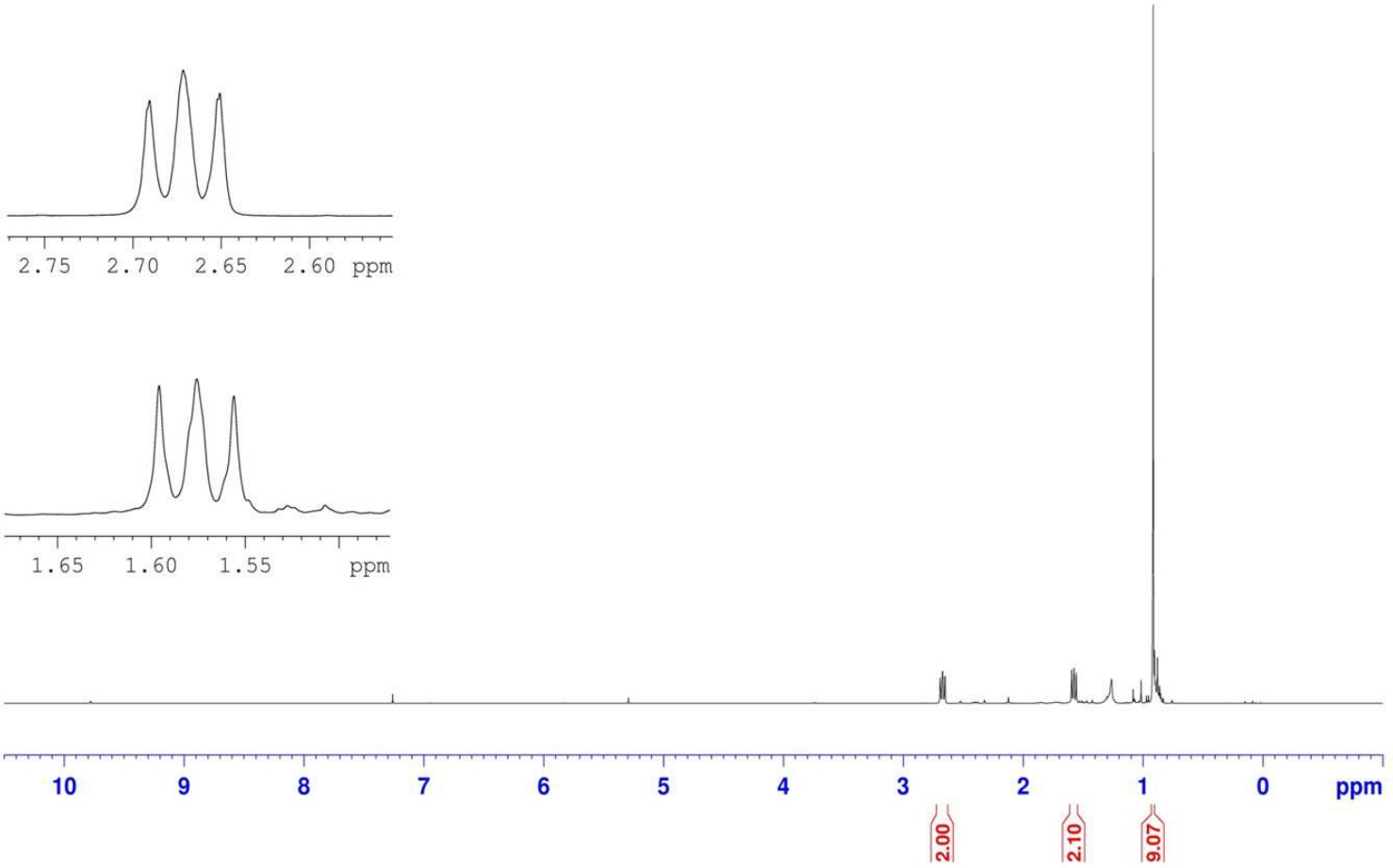
1,1,1–trifluoro–5,5–dimethylhexan–2–ol
400 MHz, CDCl3



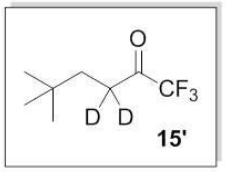


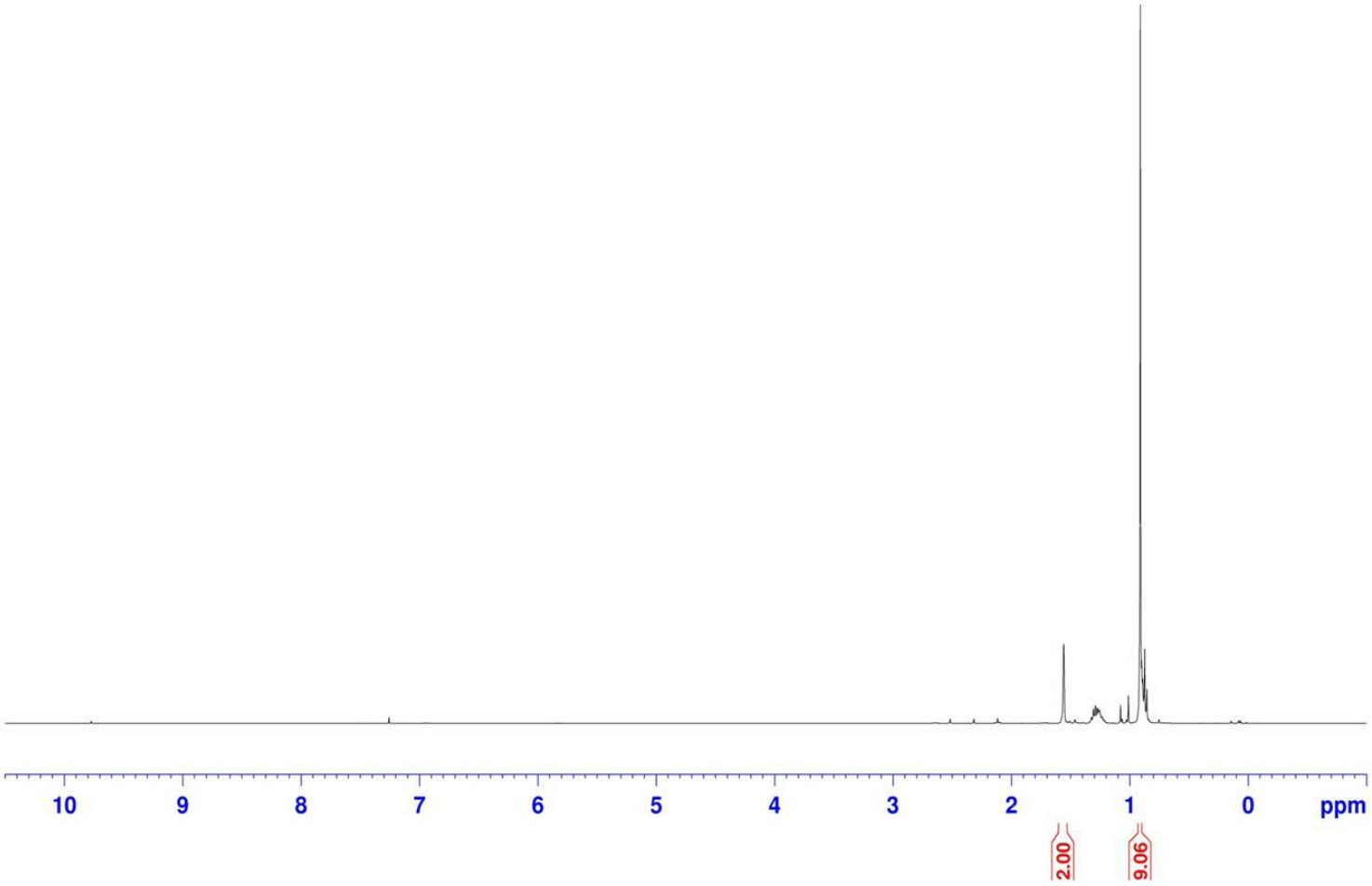
1,1,1–trifluoro–5,5–dimethylhexan–2–one
400 MHz, CDCl3



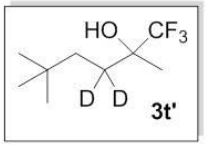


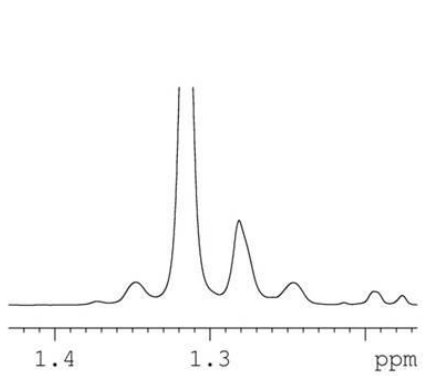
1,1,1–trifluoro–5,5–dimethylhexan–2–one–3,3–
400 MHz, CDCl3



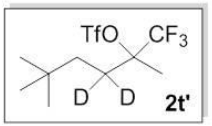


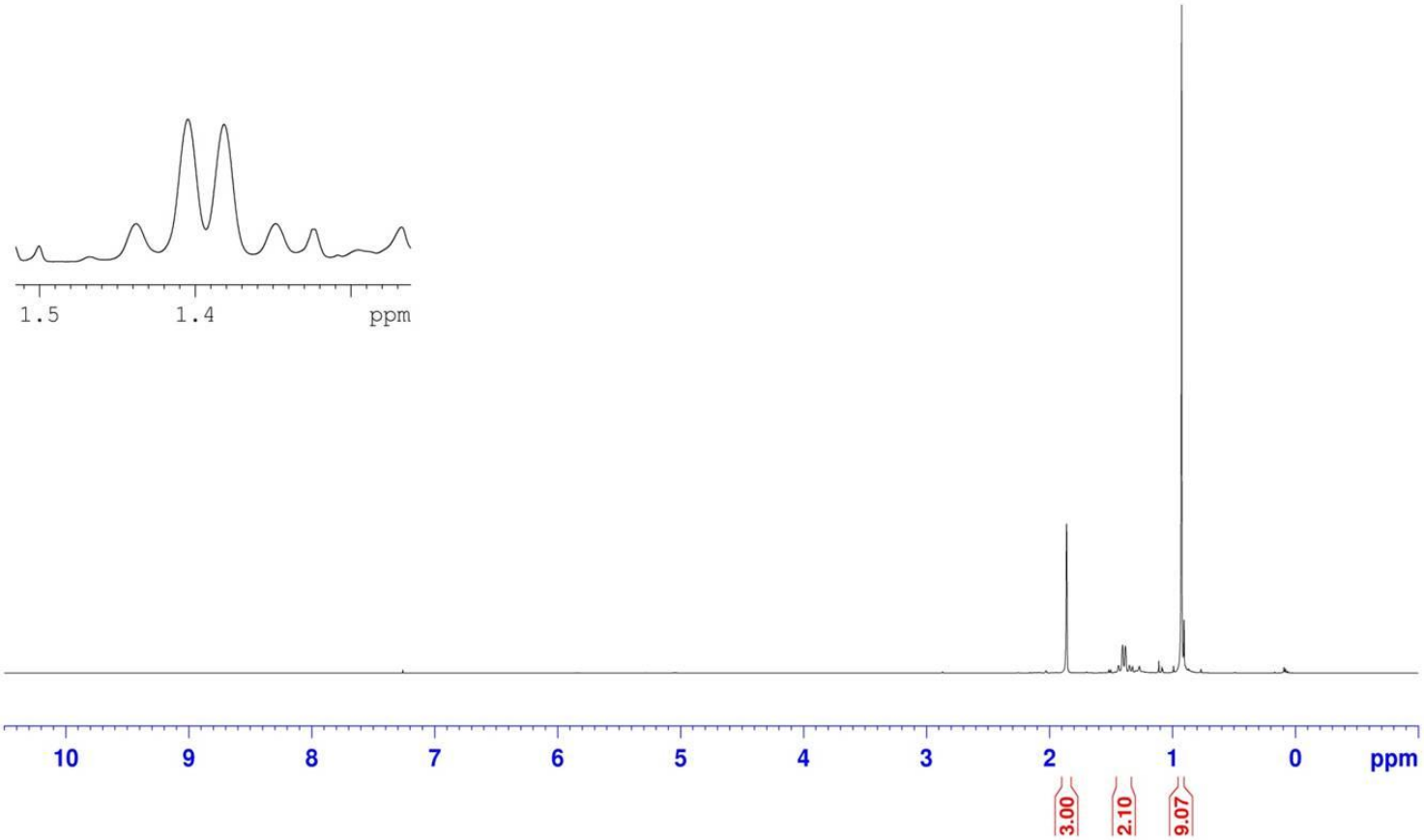
1,1,1–trifluoro–2,5,5–trimethylhexan–2–ol–3,3–d2
400 MHz, CDCl3



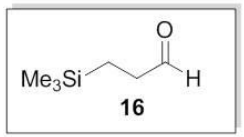


1,1,1–trifluoro–2,5,5–trimethylhexan–2–yl trifluoromethanesulfonate–3,3–d2
400 MHz, CDCl3

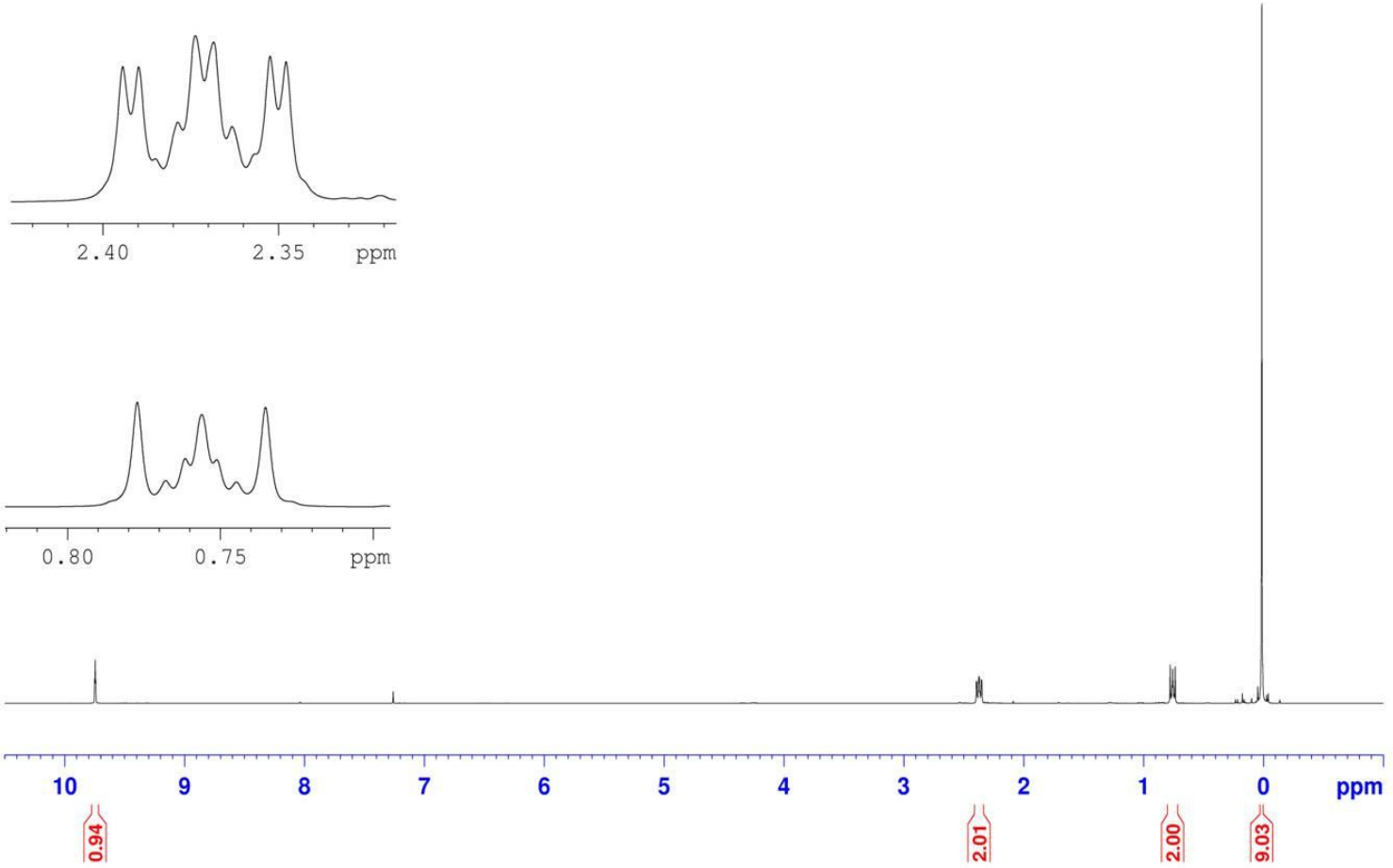




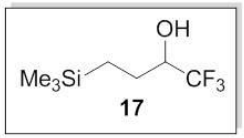
3–(trimethylsilyl)propanal
400 MHz, CDCl3

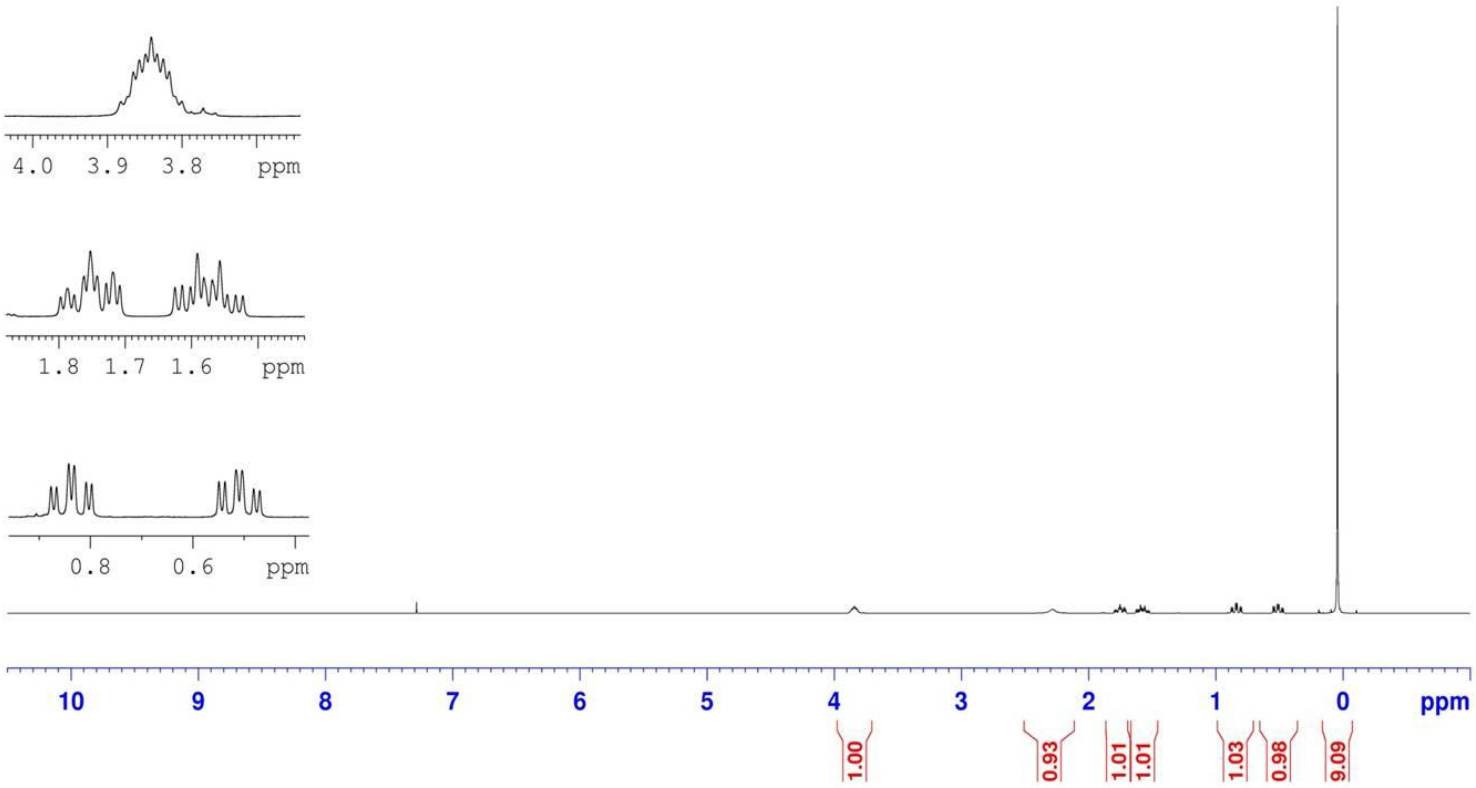


16

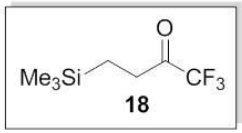


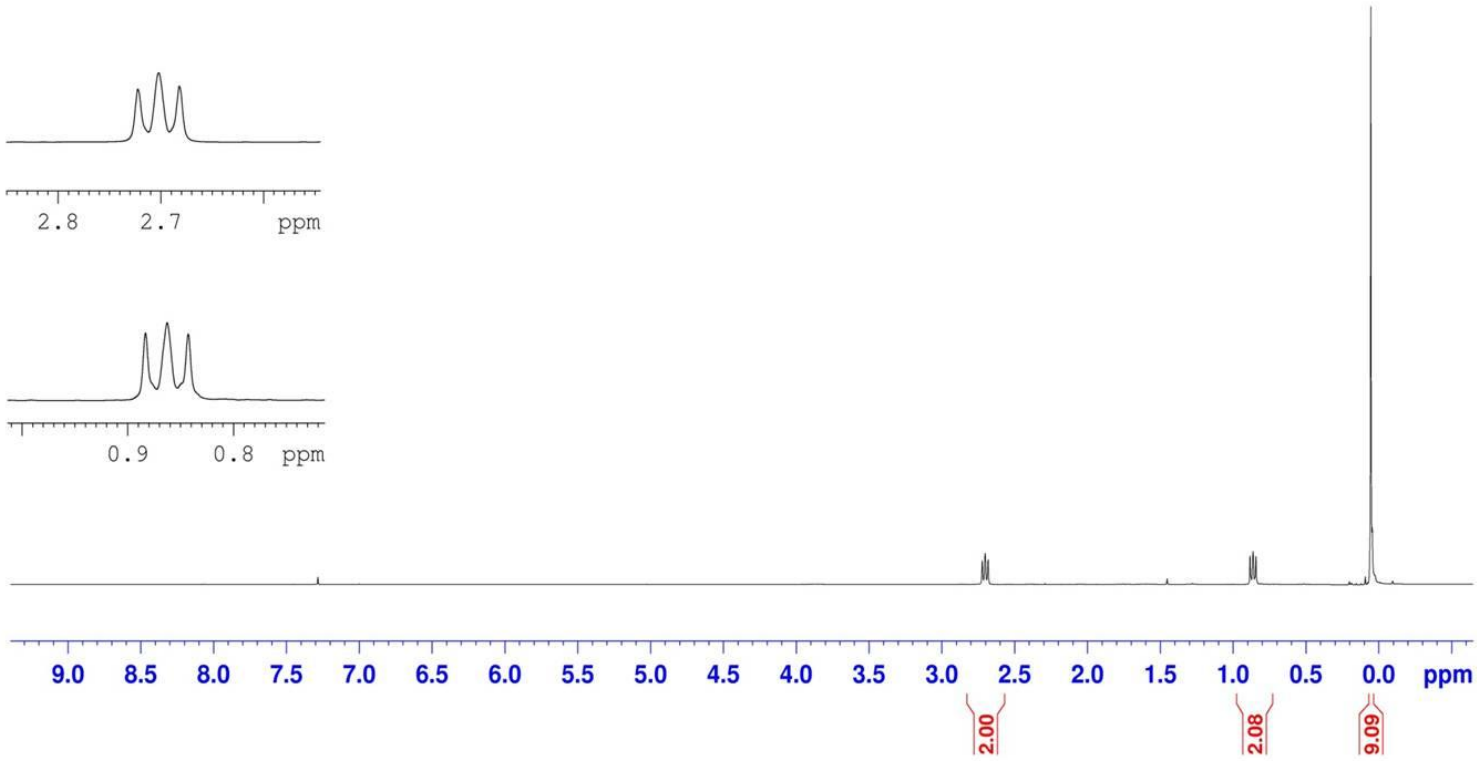
1,1,1–trifluoro–4–(trimethylsilyl)butan–2–ol
400 MHz, CDCl3



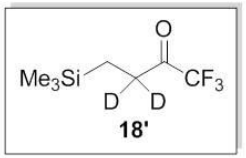


1,1,1–trifluoro–4–(trimethylsilyl)butan–2–one
400 MHz, CDCl3

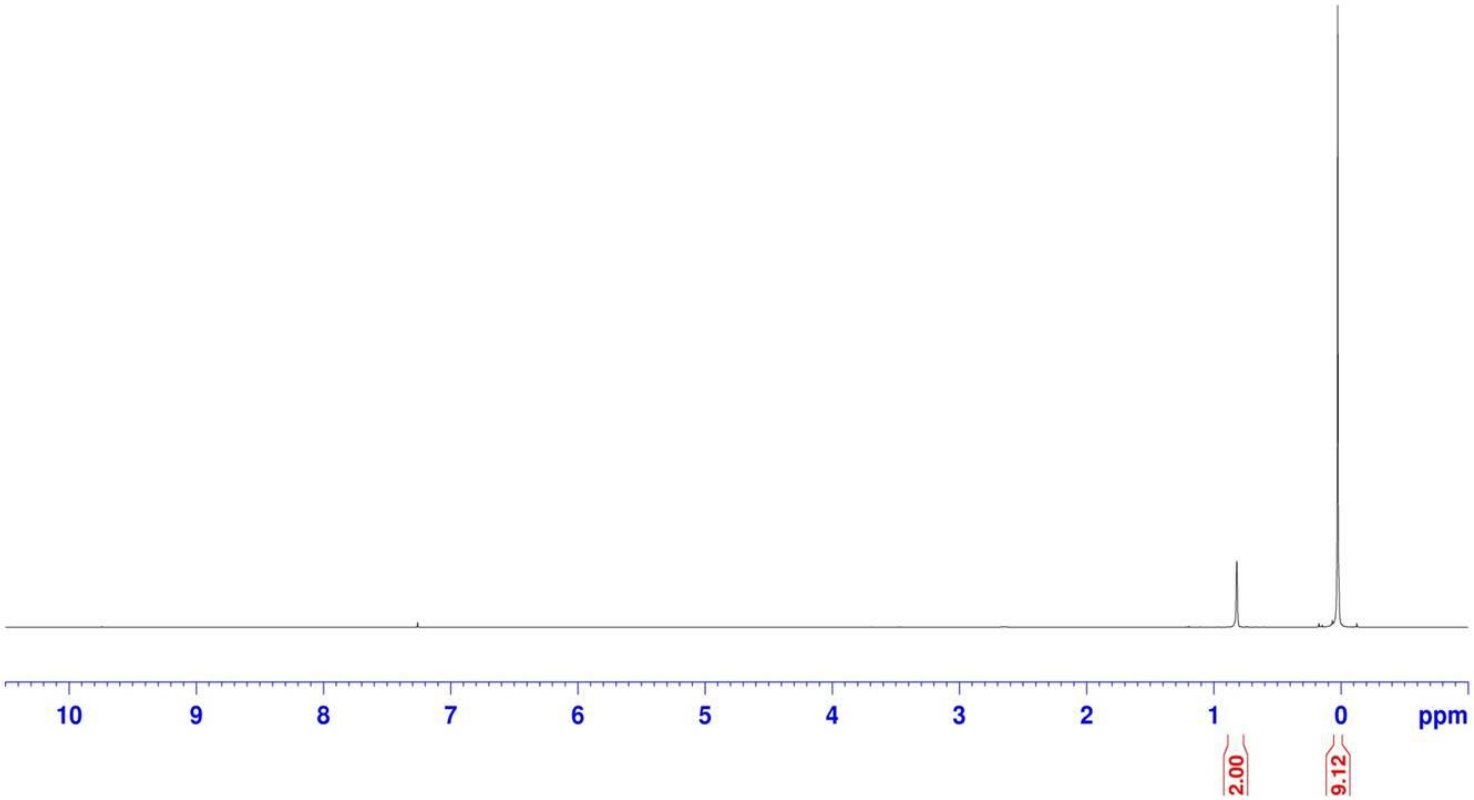




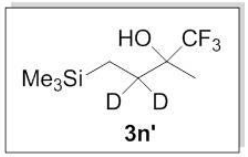
1,1,1–trifluoro–4–(trimethylsilyl)butan–2–one–3.3–d2
400 MHz, CDCl3



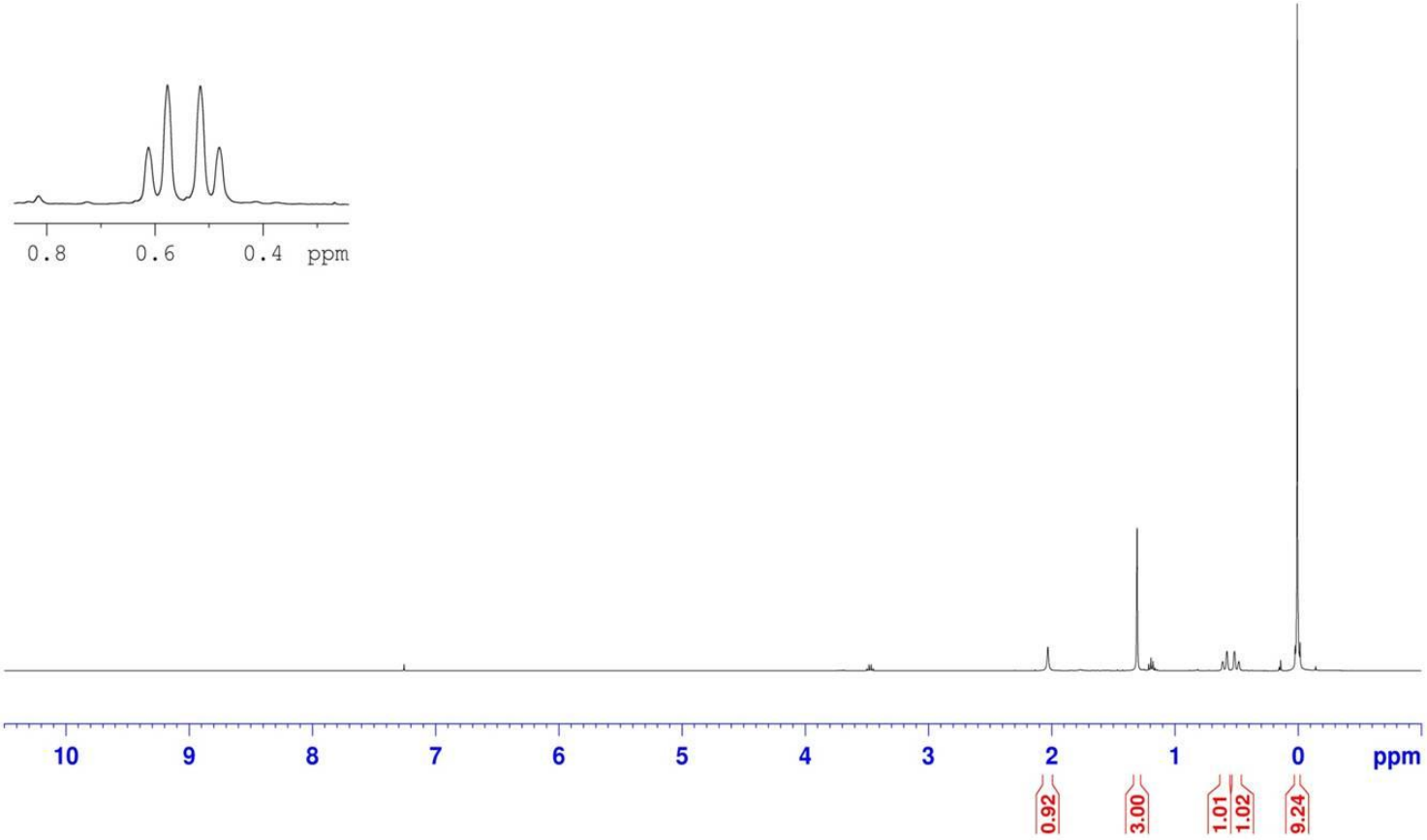
18'



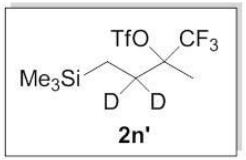
1,1,1–trifluoro–2–methyl–4–(trimethylsilyl)butan–2–ol–3,3–d2
400 MHz, CDCl3



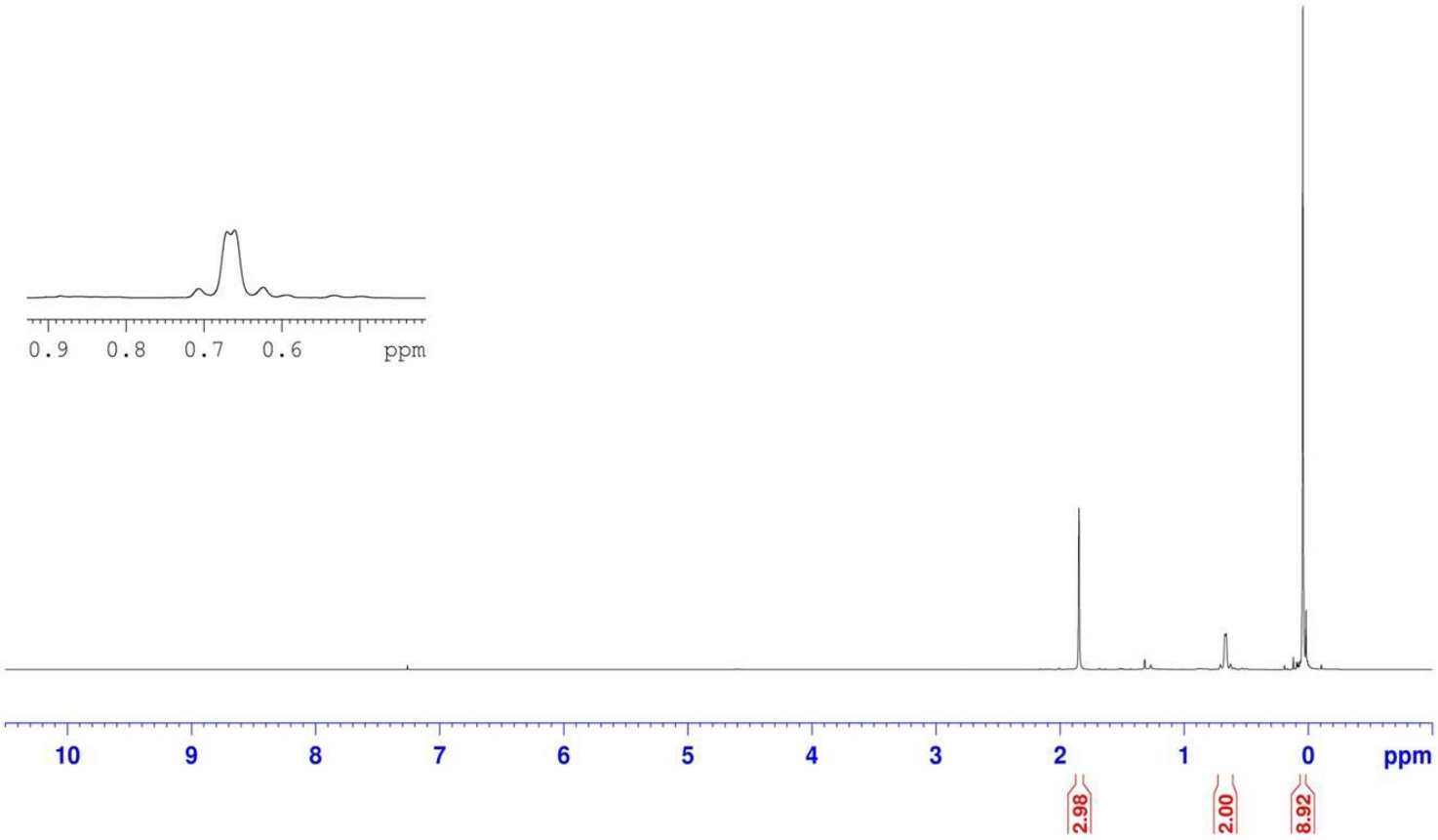
3n'



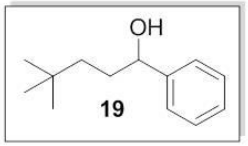
1,1,1–trifluoro–2–methyl–4–(trimethylsilyl)butan–2–yl trifluoromethanesulfonate–2,2–d2
400 MHz, CDCl3

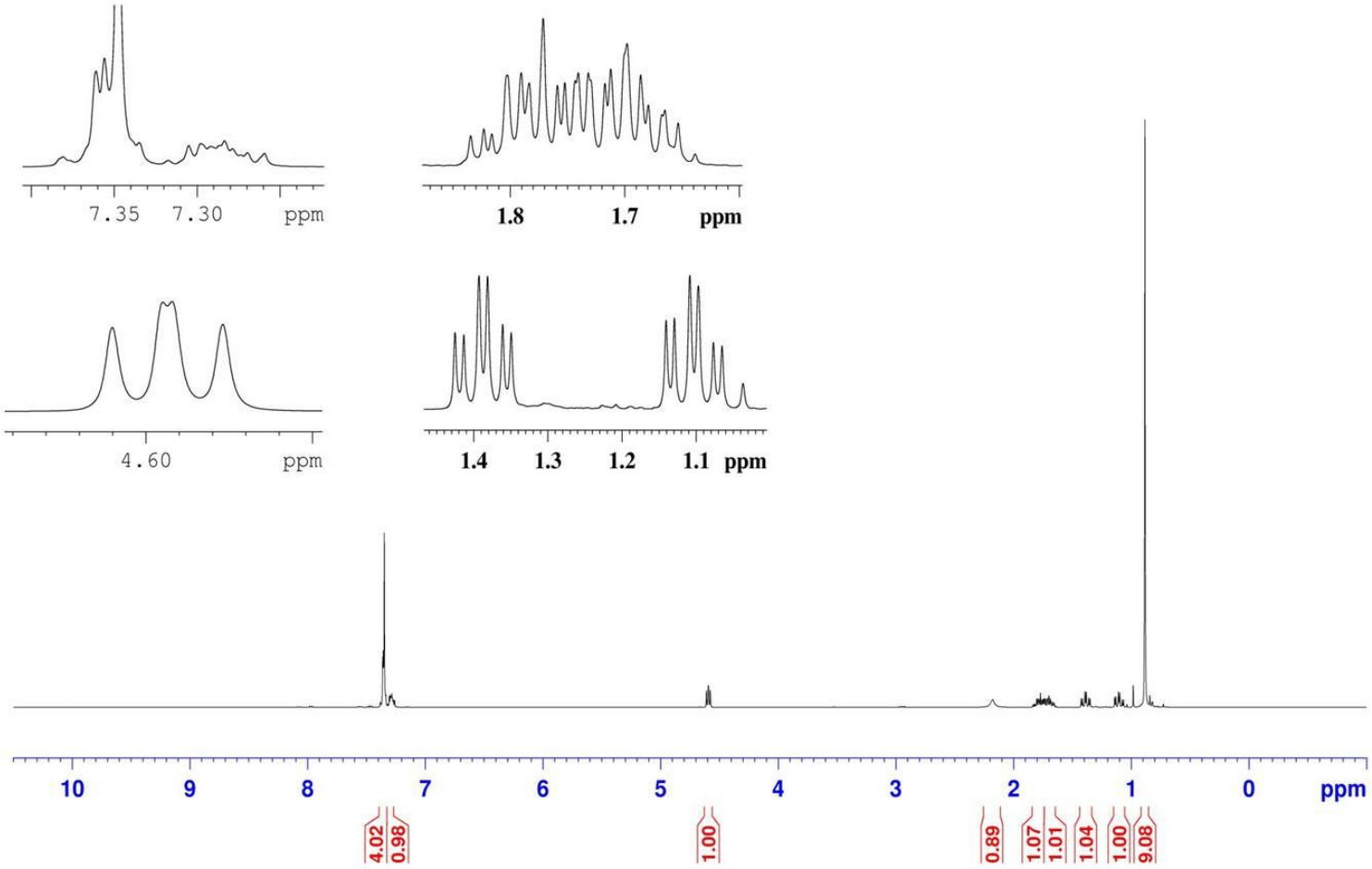


2n'

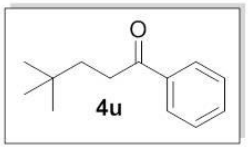


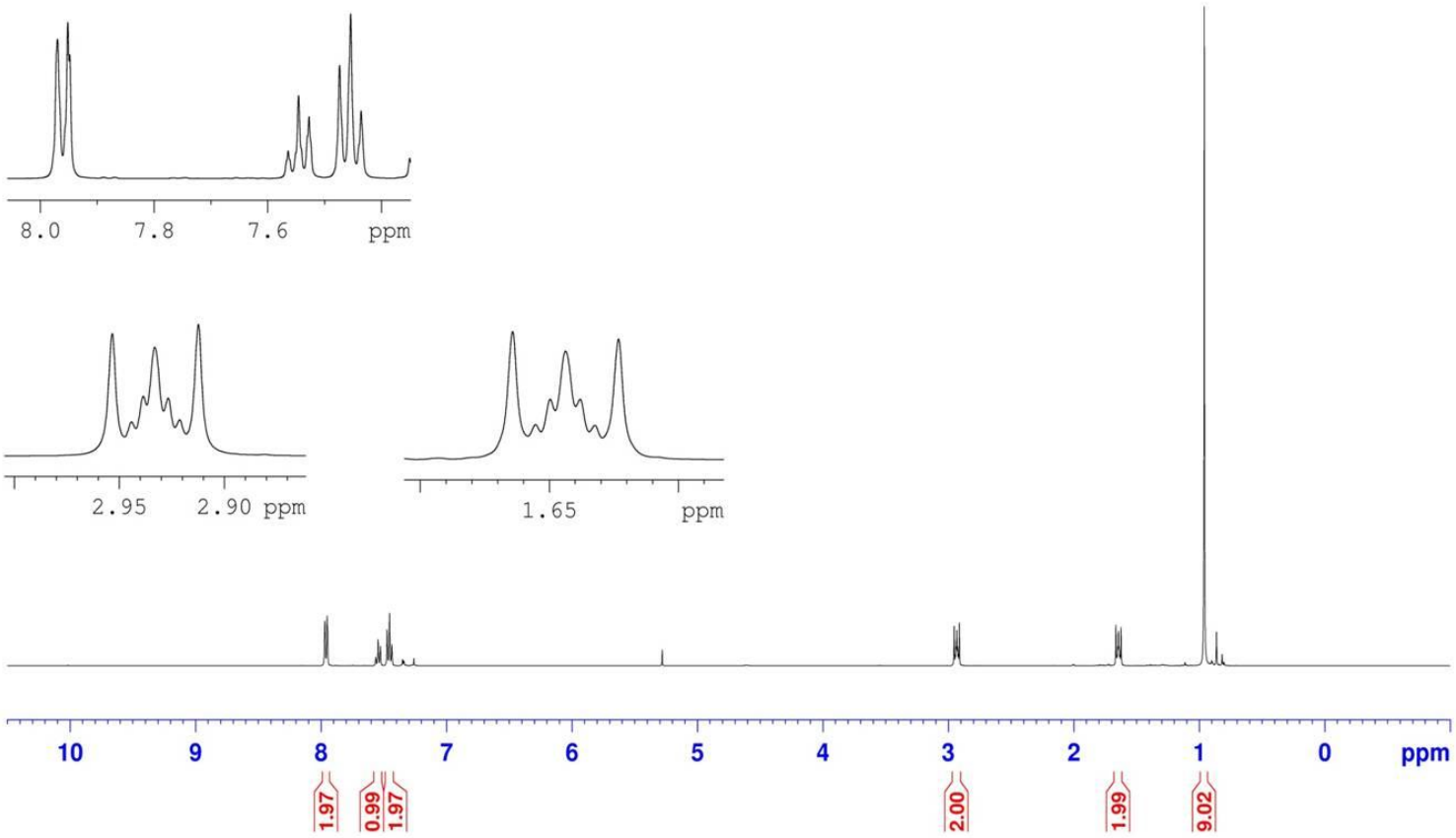
4,4–dimethyl–1–phenylpentan–1–ol
400 MHz, CDCl3



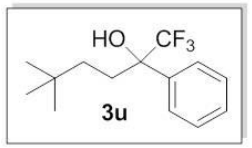


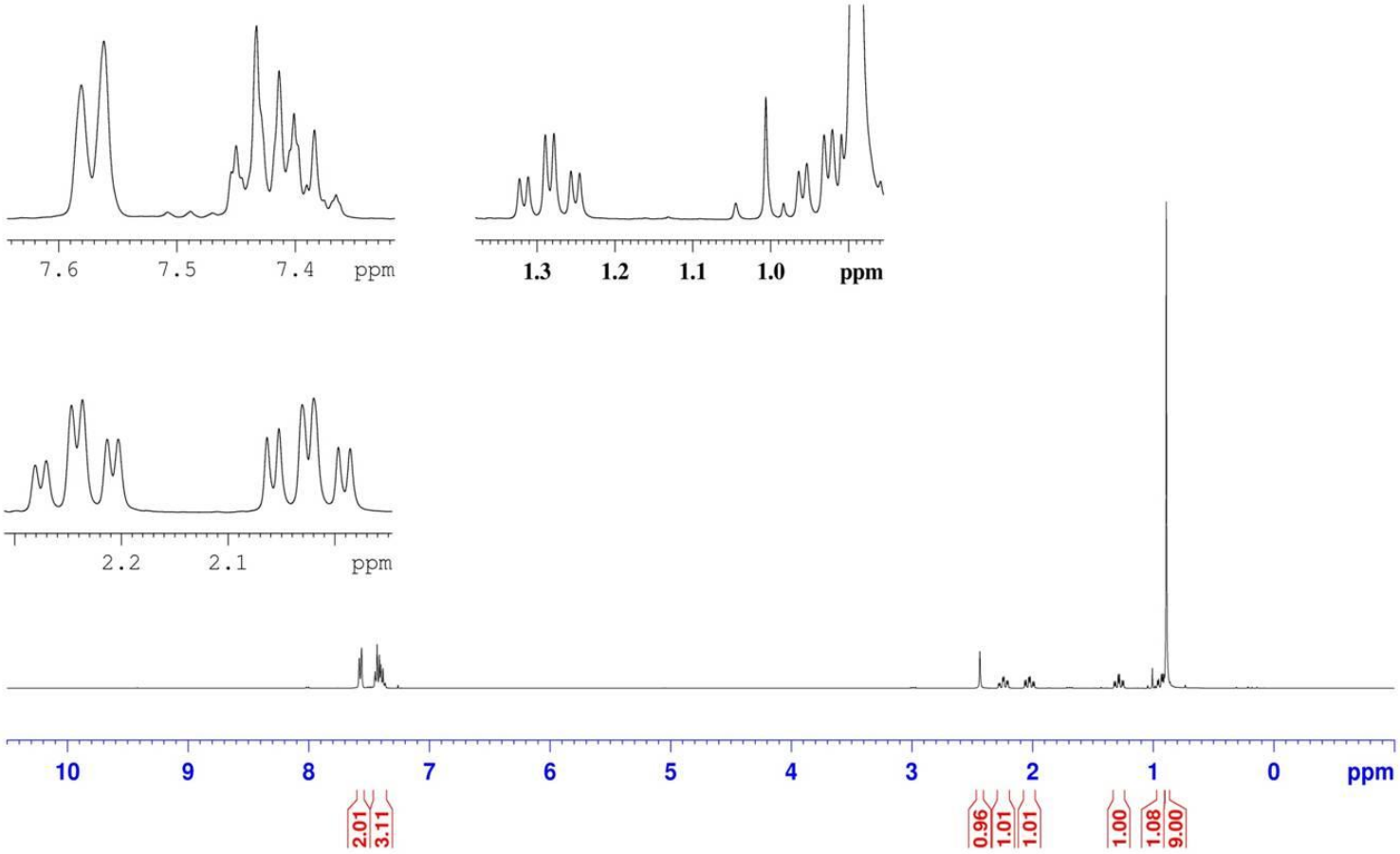
4,4–dimethyl–1–phenylpentan–1–one
400 MHz, CDCl3



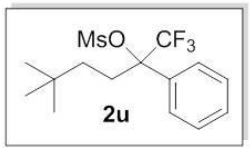


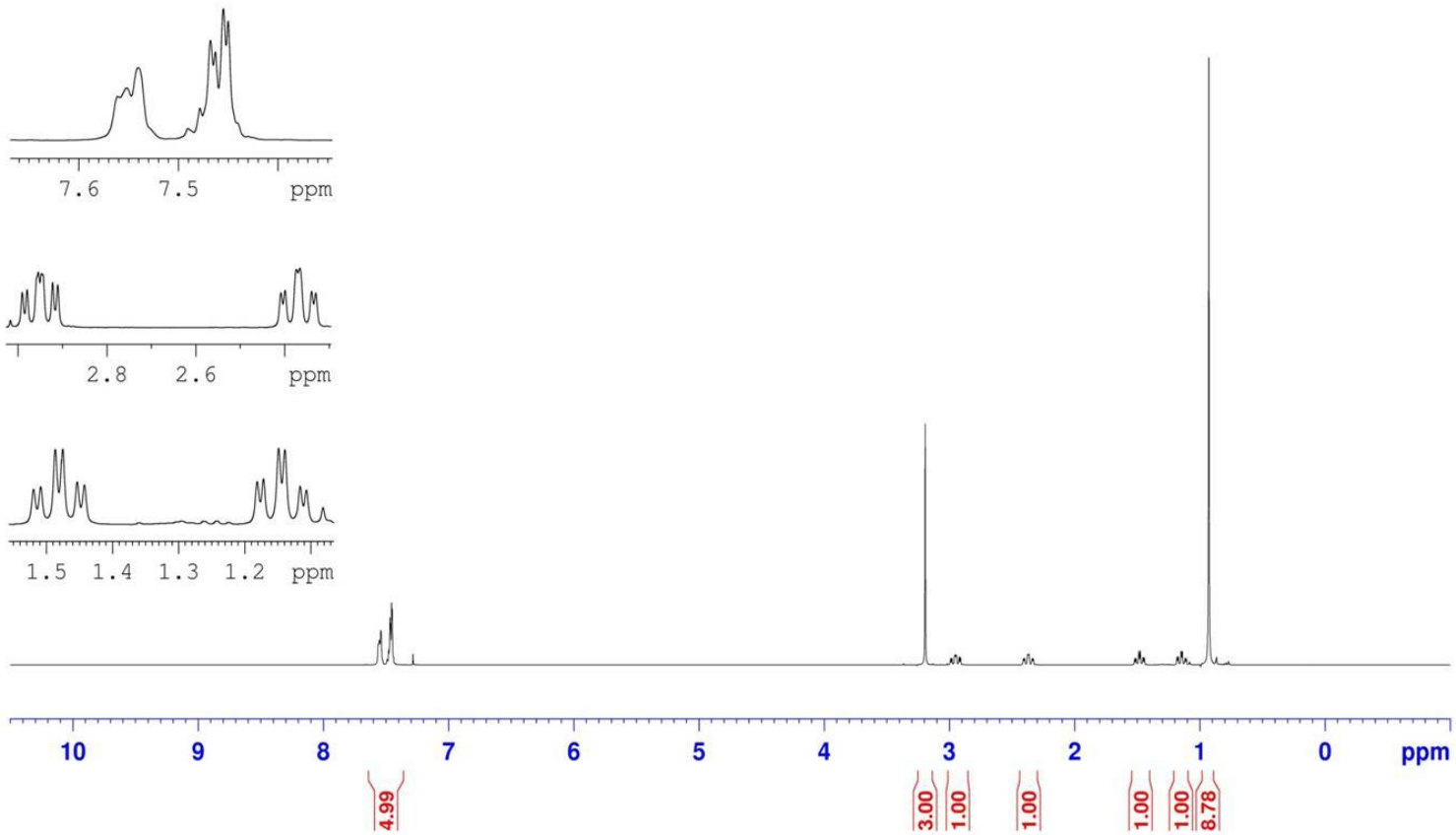
1,1,1–trifluoro–5,5–dimethyl–2–phenylhexan–2–ol
400 MHz, CDCl3



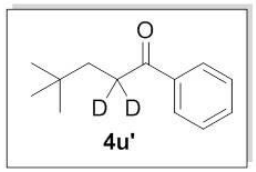


1,1,1–trifluoro–5,5–dimethyl–2–phenylhexan–2–yl methanesulfonate
400 MHz, CDCl3

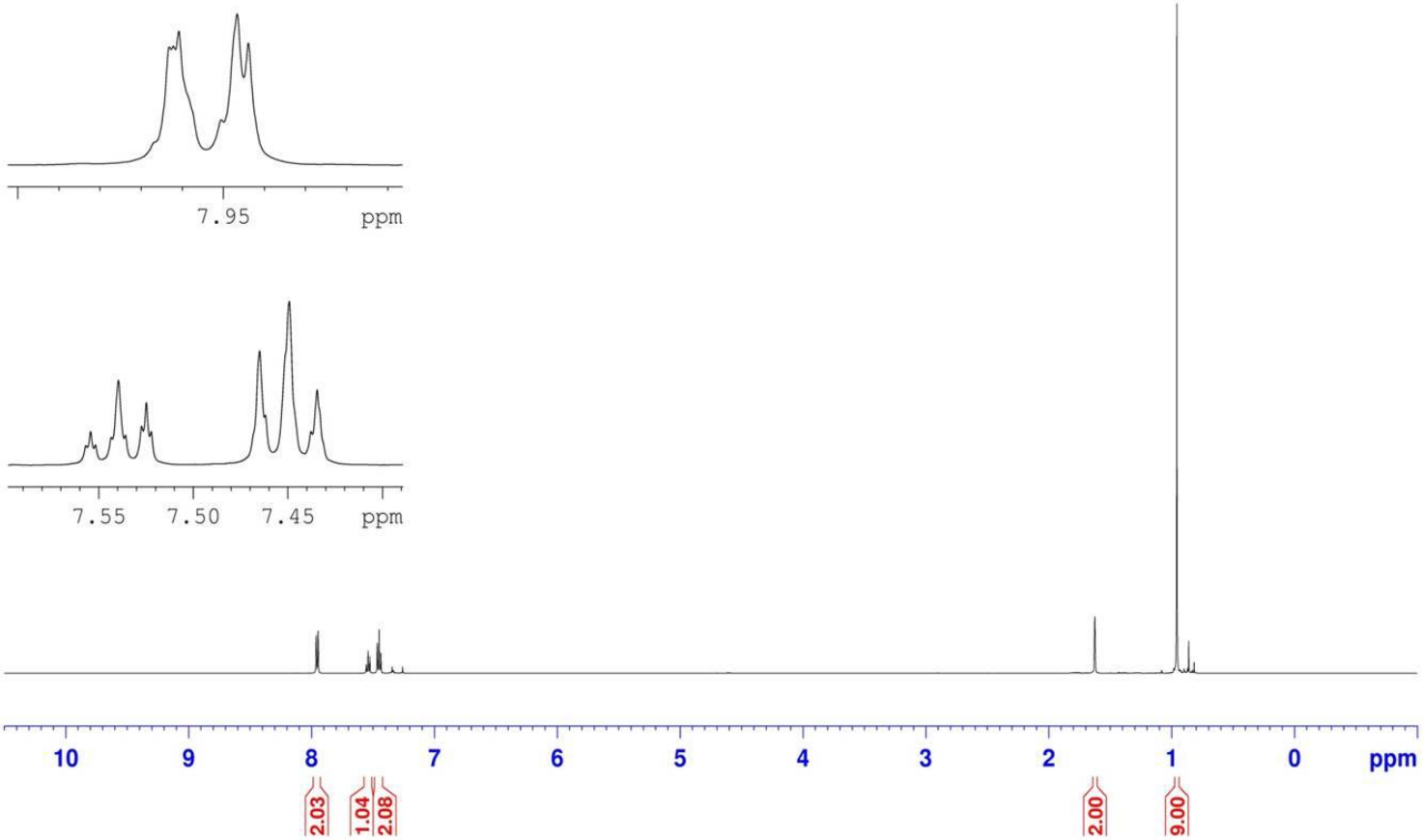




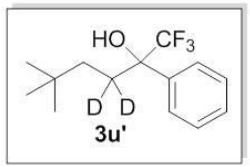
4,4–dimethyl–1–phenylpentan–1–one–2,2–d2
400 MHz, CDCl3

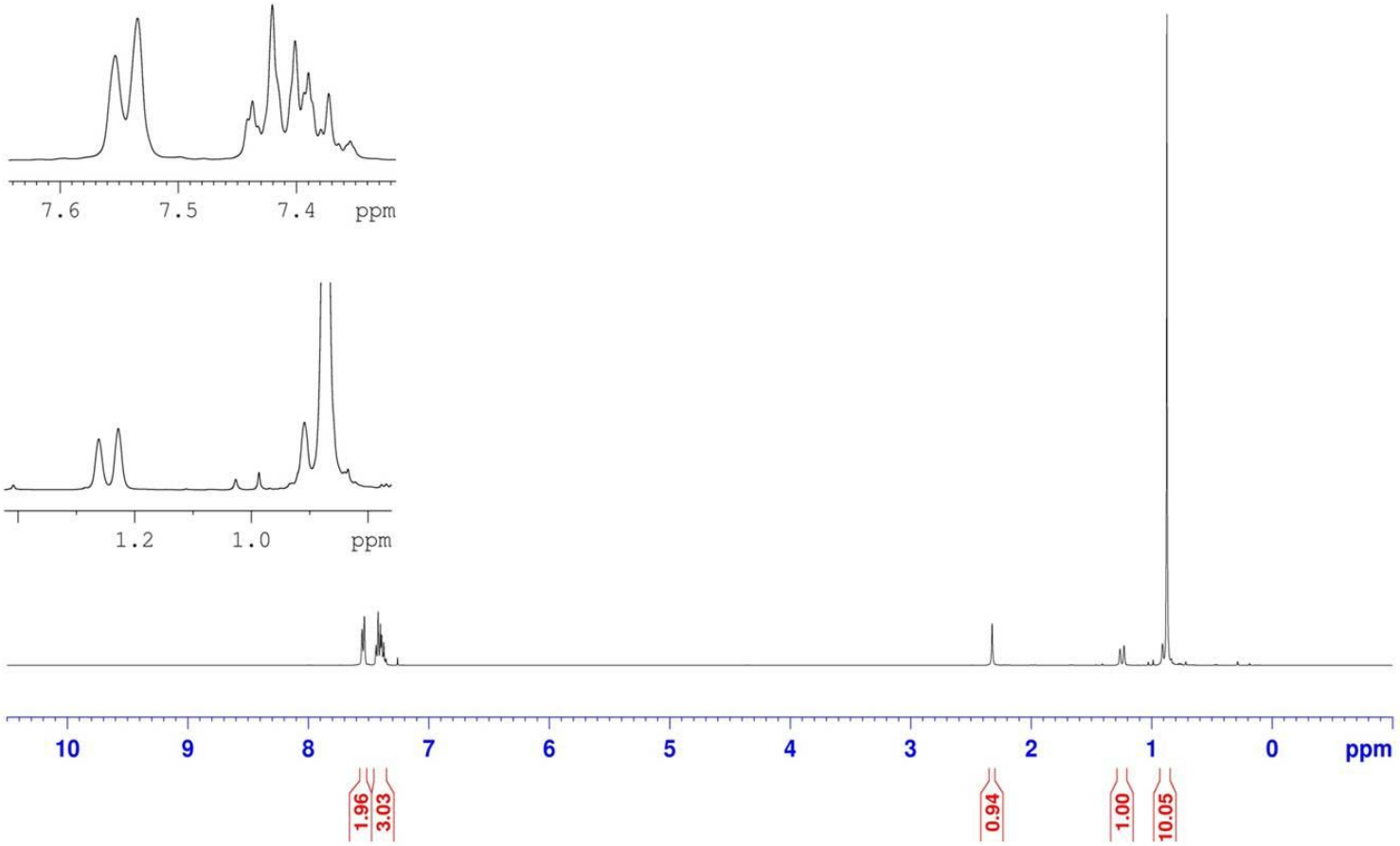


4u'

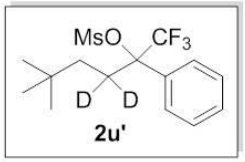


1,1,1−trifluoro−5,5−dimethyl−2−phenylhexan−2−ol−2,2−d2
400 MHz, CDCl3

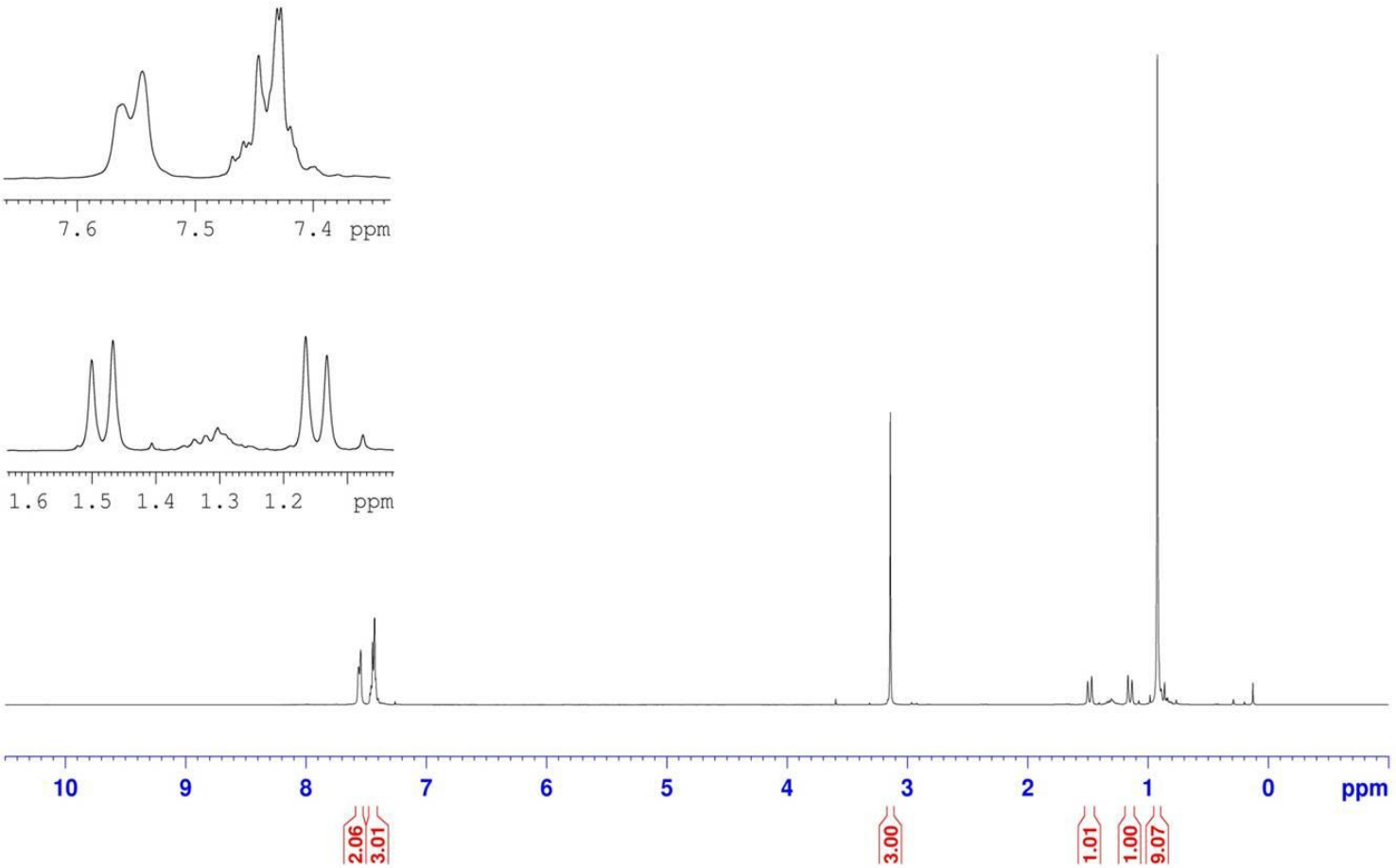




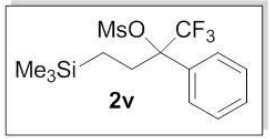
1,1,1−trifluoro−5,5−dimethyl−2−phenylhexan−2−yl methanesulfonate−2,2−d2
400 MHz, CDCl3

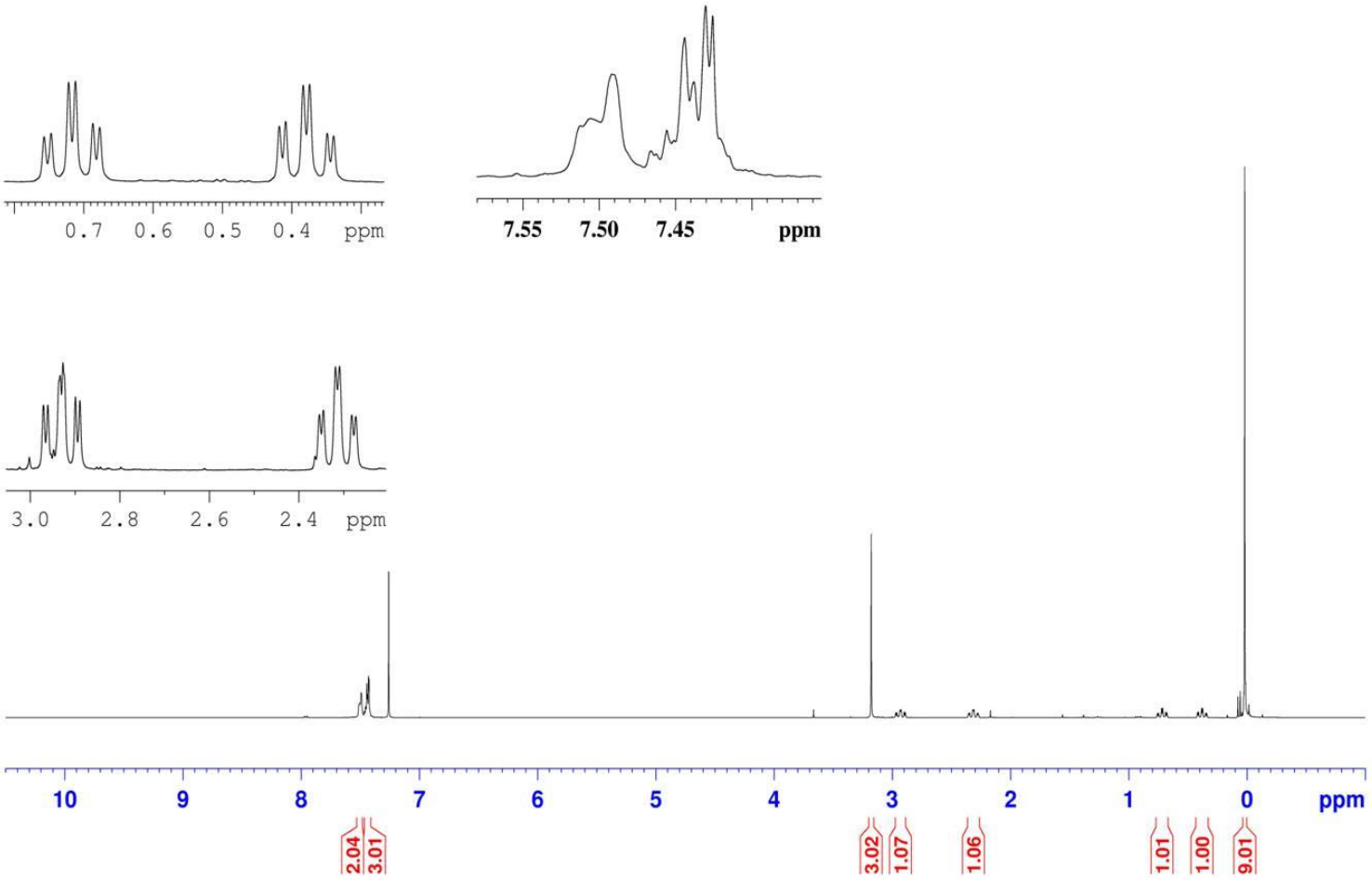


2u'

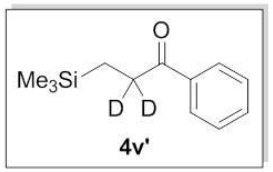


1,1,1–trifluoro–2–phenyl–4–(trimethylsilyl)butan–2–yl methanesulfonate
400 MHz, CDCl3

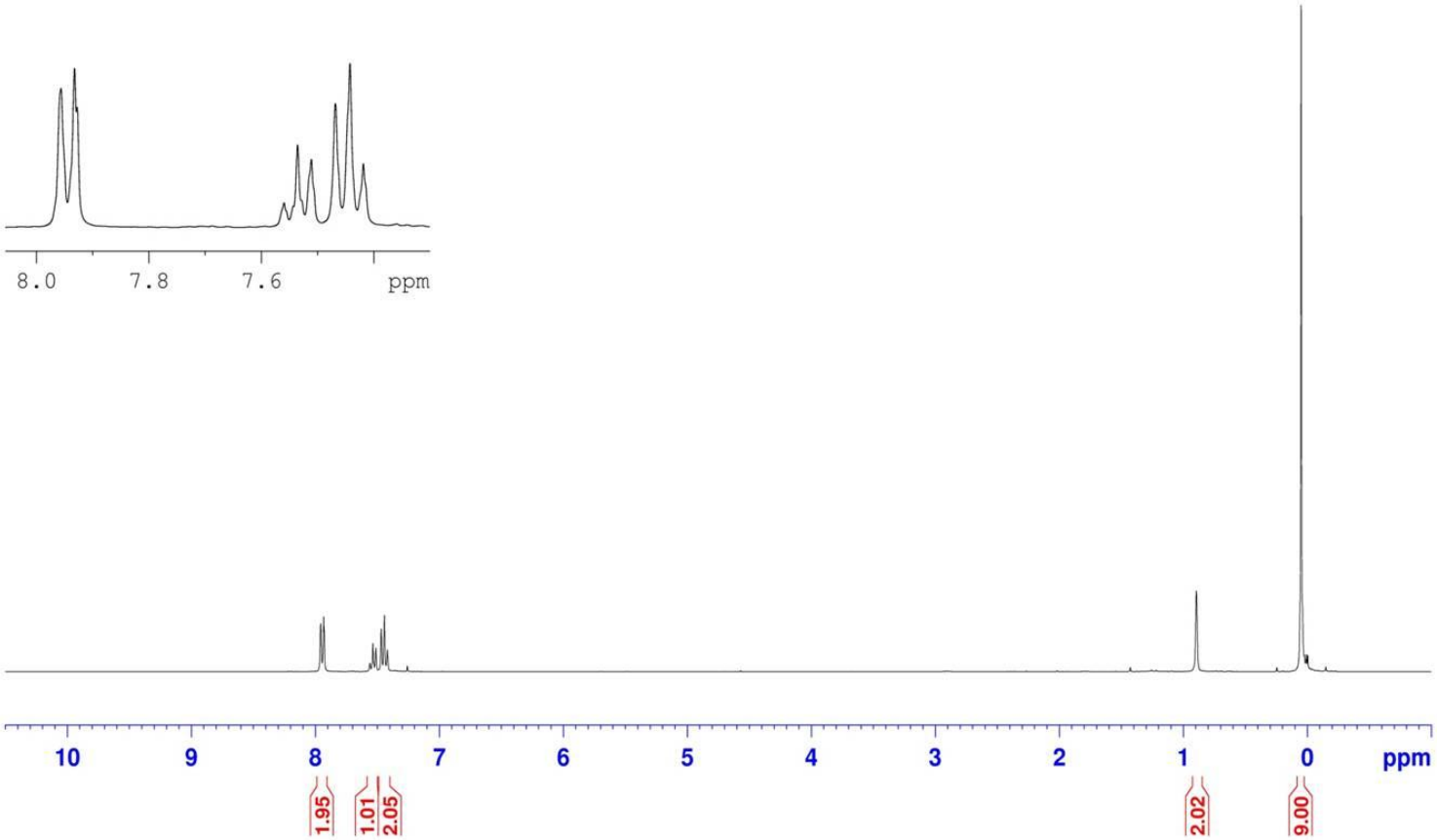




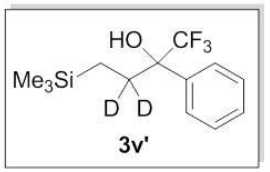
1–phenyl–3–(trimethylsilyl)propan–1–one–2,2–d2
400 MHz, CDCl3



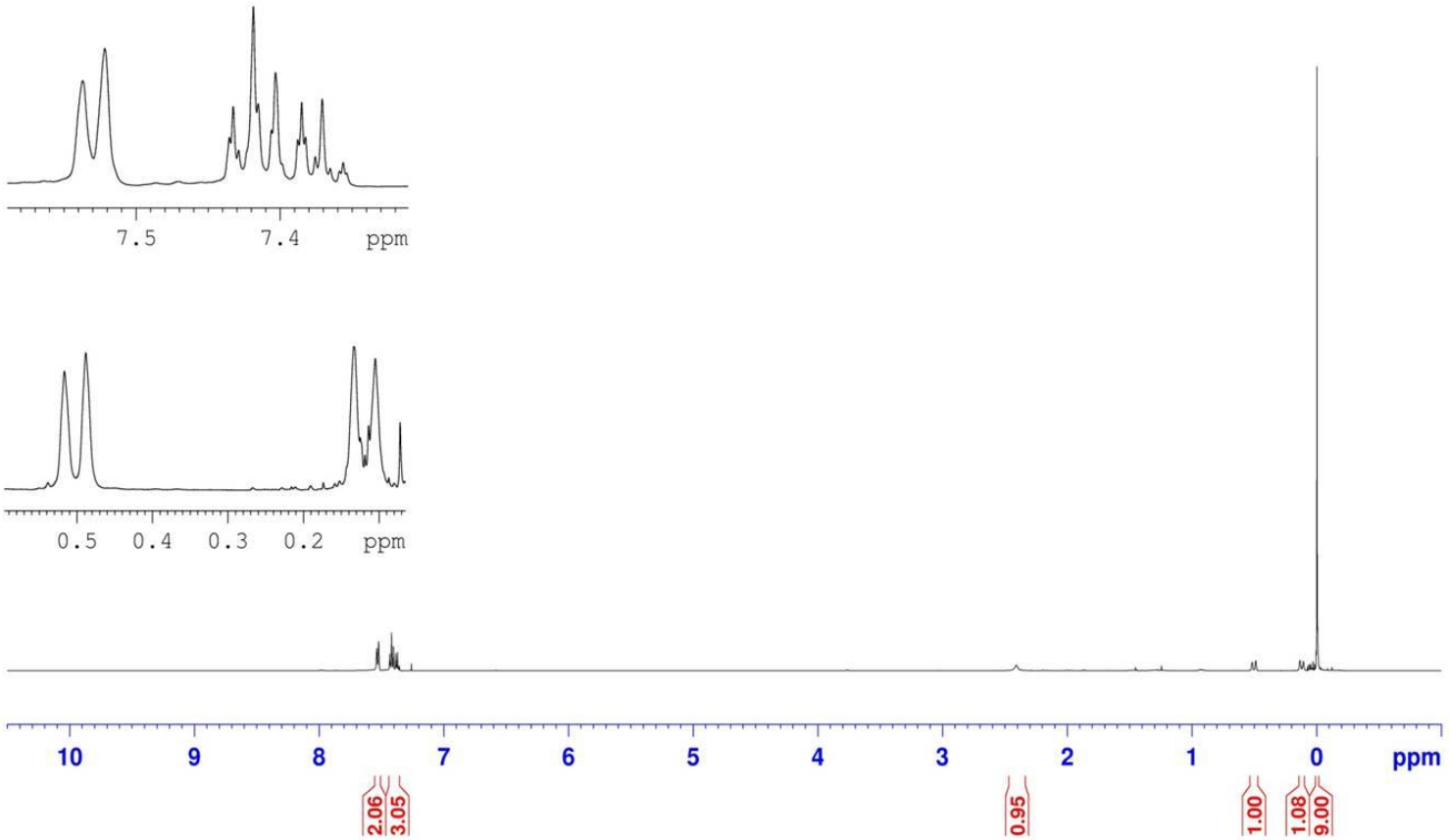
4v'



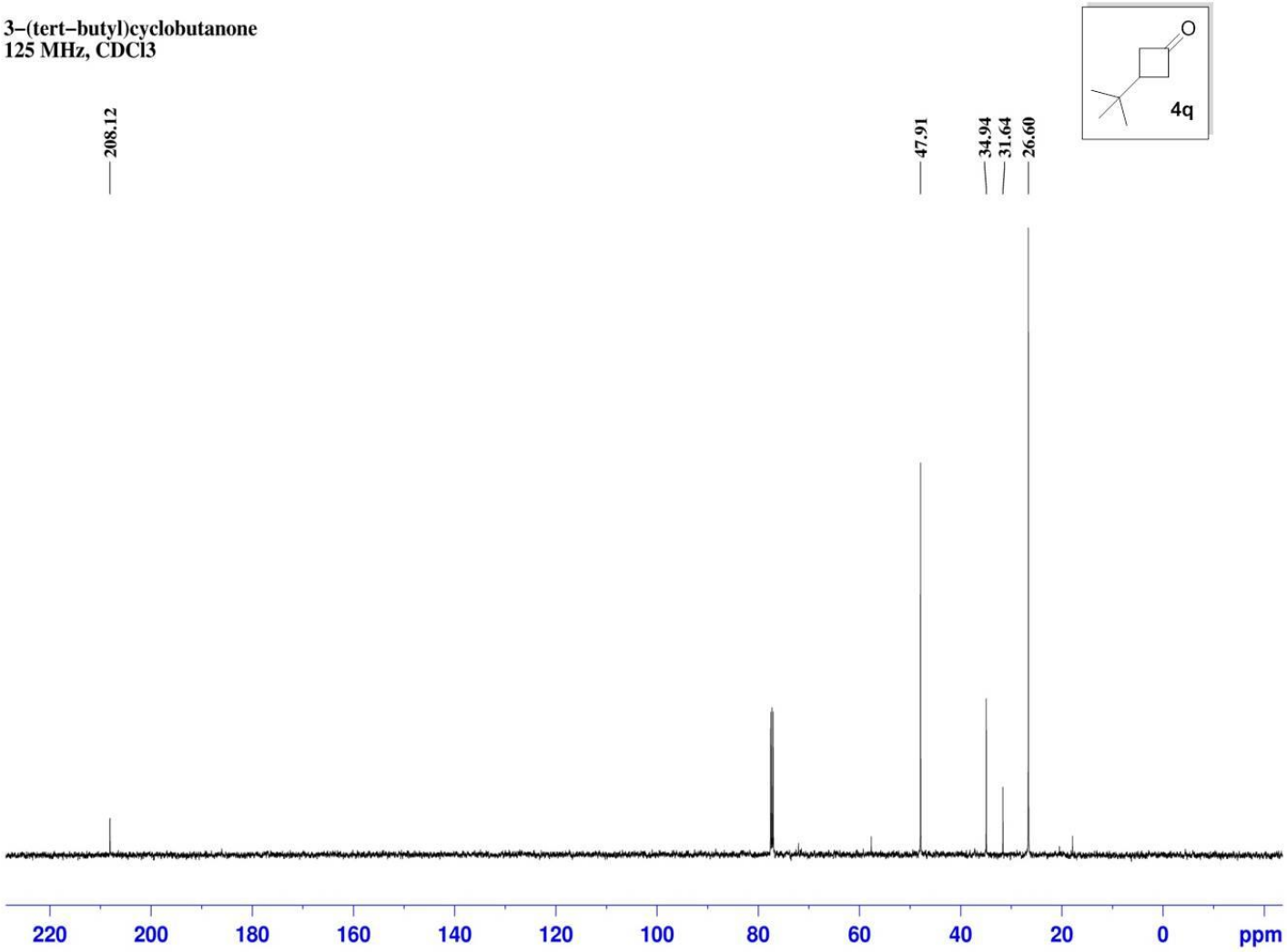
1,1,1−trifluoro−2−phenyl−4−(trimethylsilyl)butan−2−ol−3,3−d2
400 MHz, CDCl3



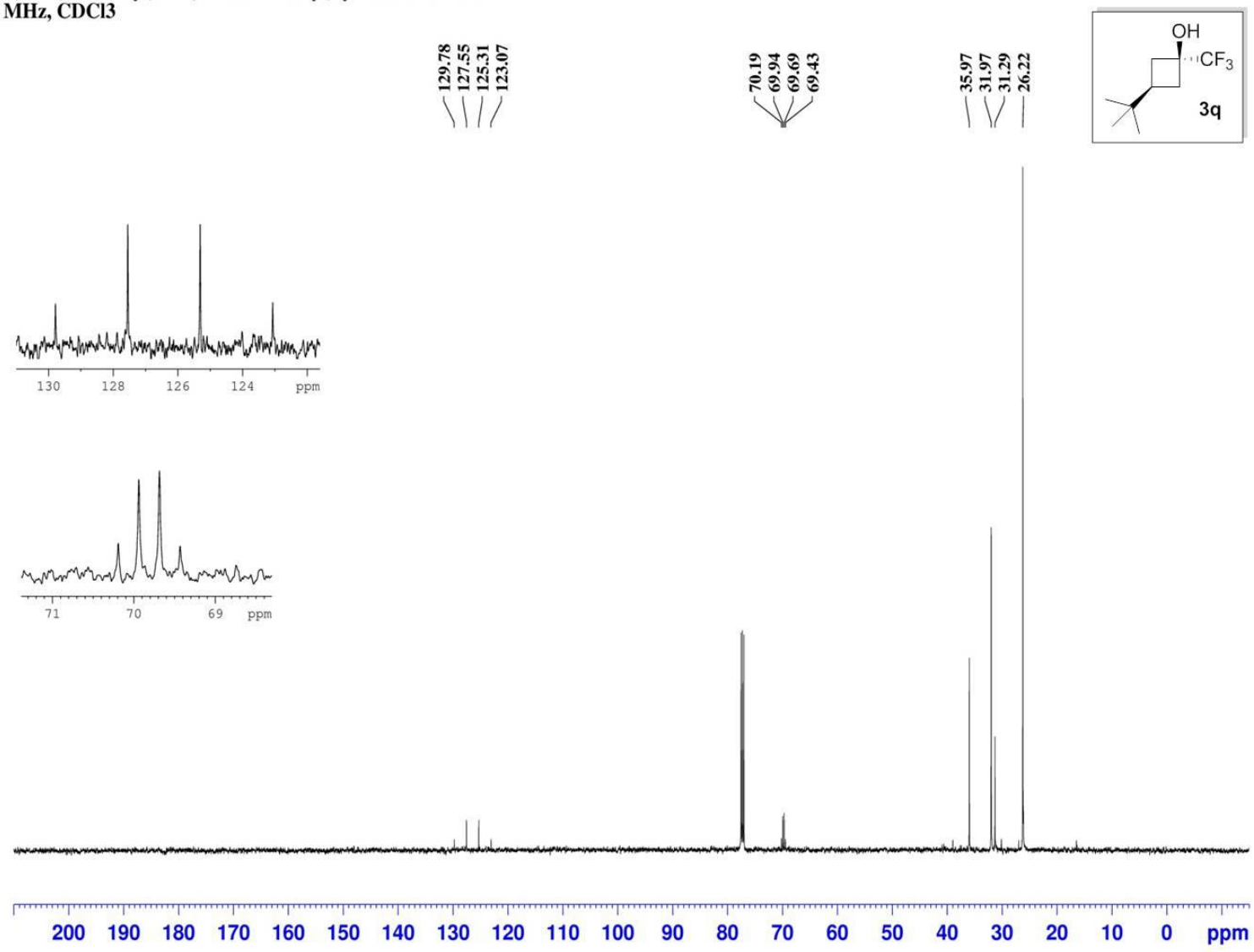
3v'



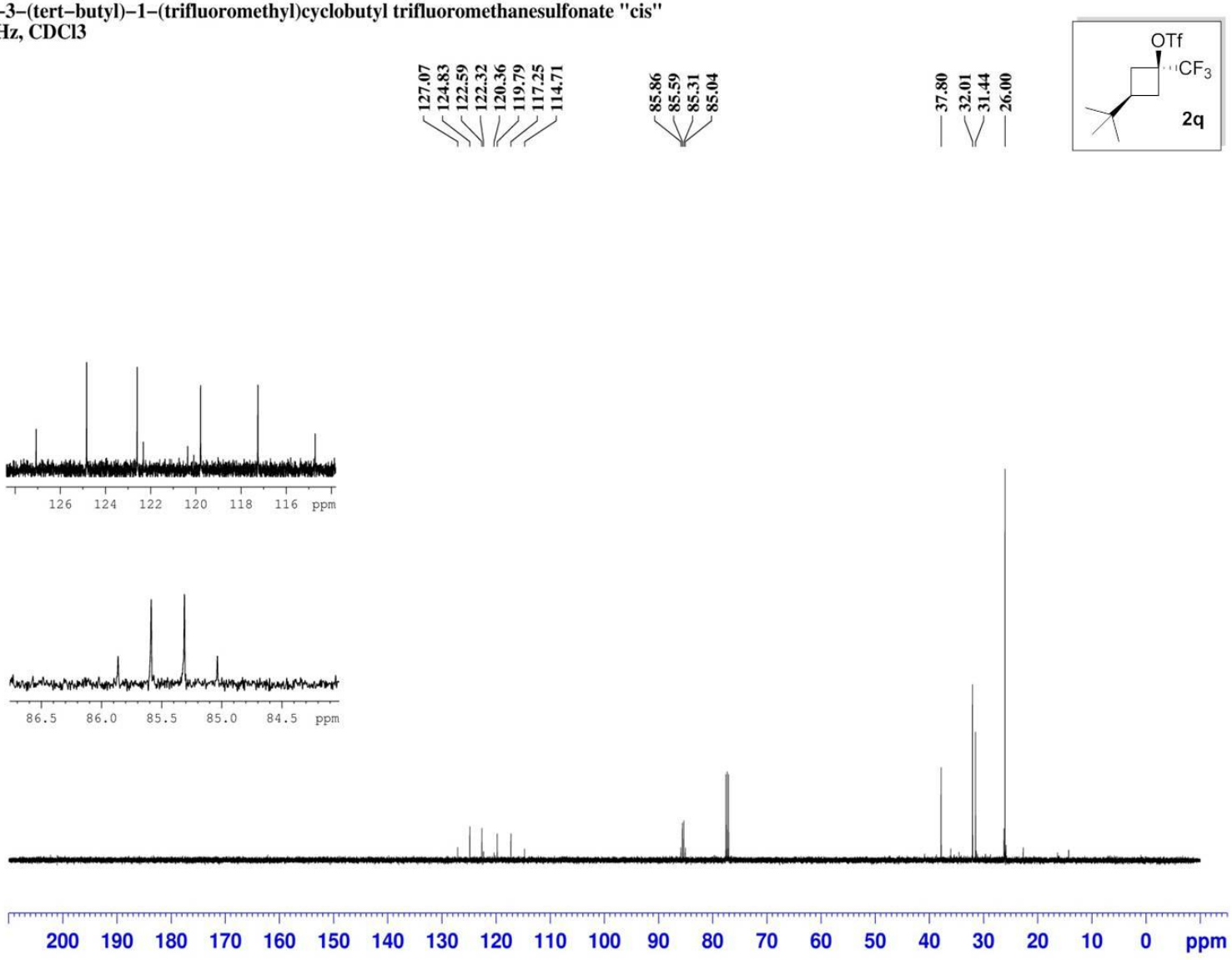
^{13}C NMR Spectra of Synthesized Compounds



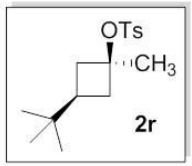
(1s,3s)−3−(tert−butyl)−1−(trifluoromethyl)cyclobutanol "cis"
100 MHz, CDCl3

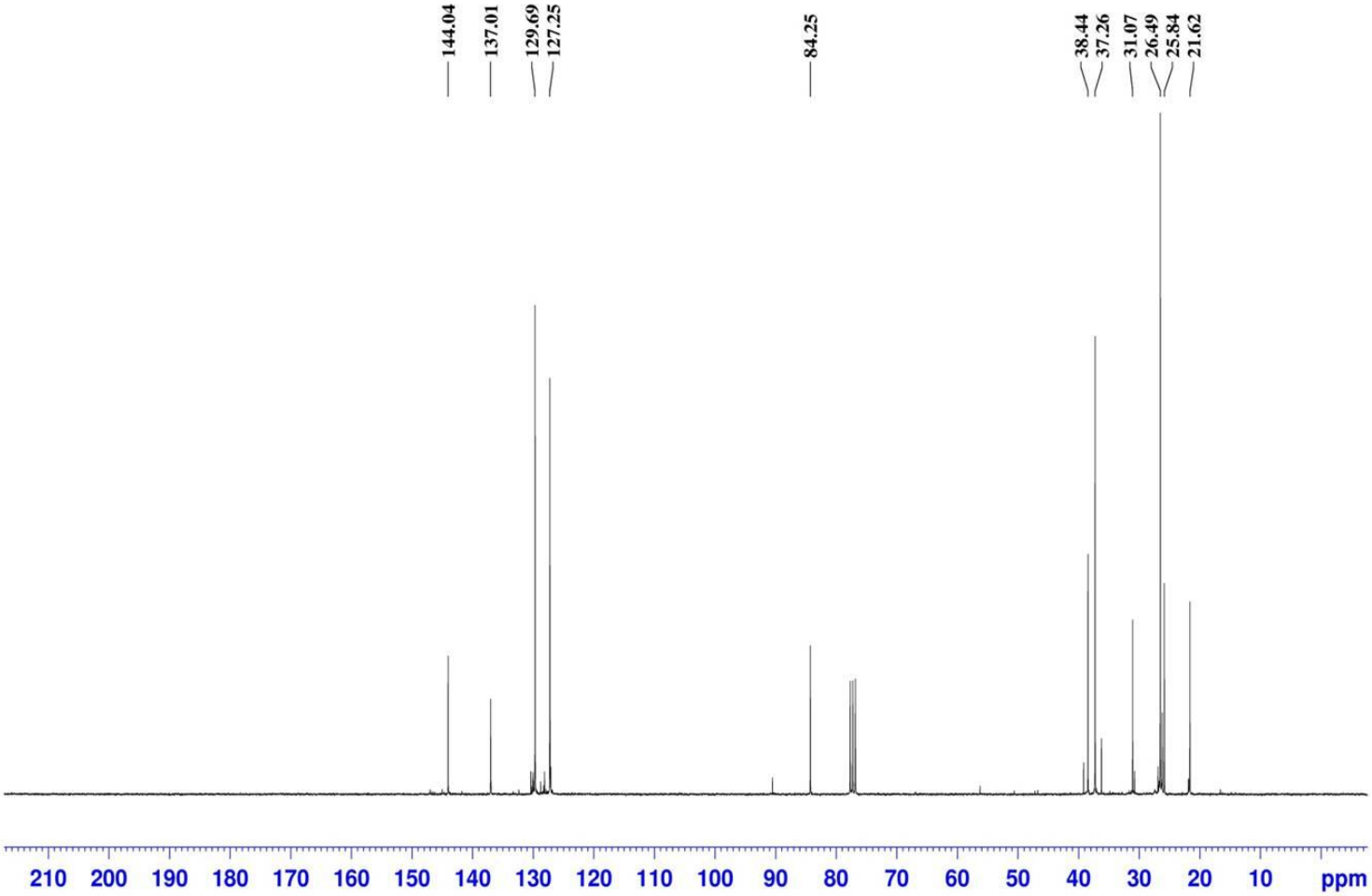


(1s,3s)−3−(tert−butyl)−1−(trifluoromethyl)cyclobutyl trifluoromethanesulfonate "cis"
100 MHz, CDCl3

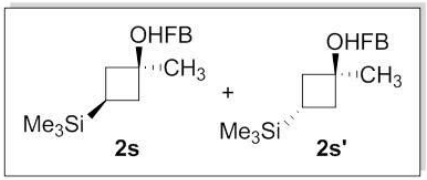


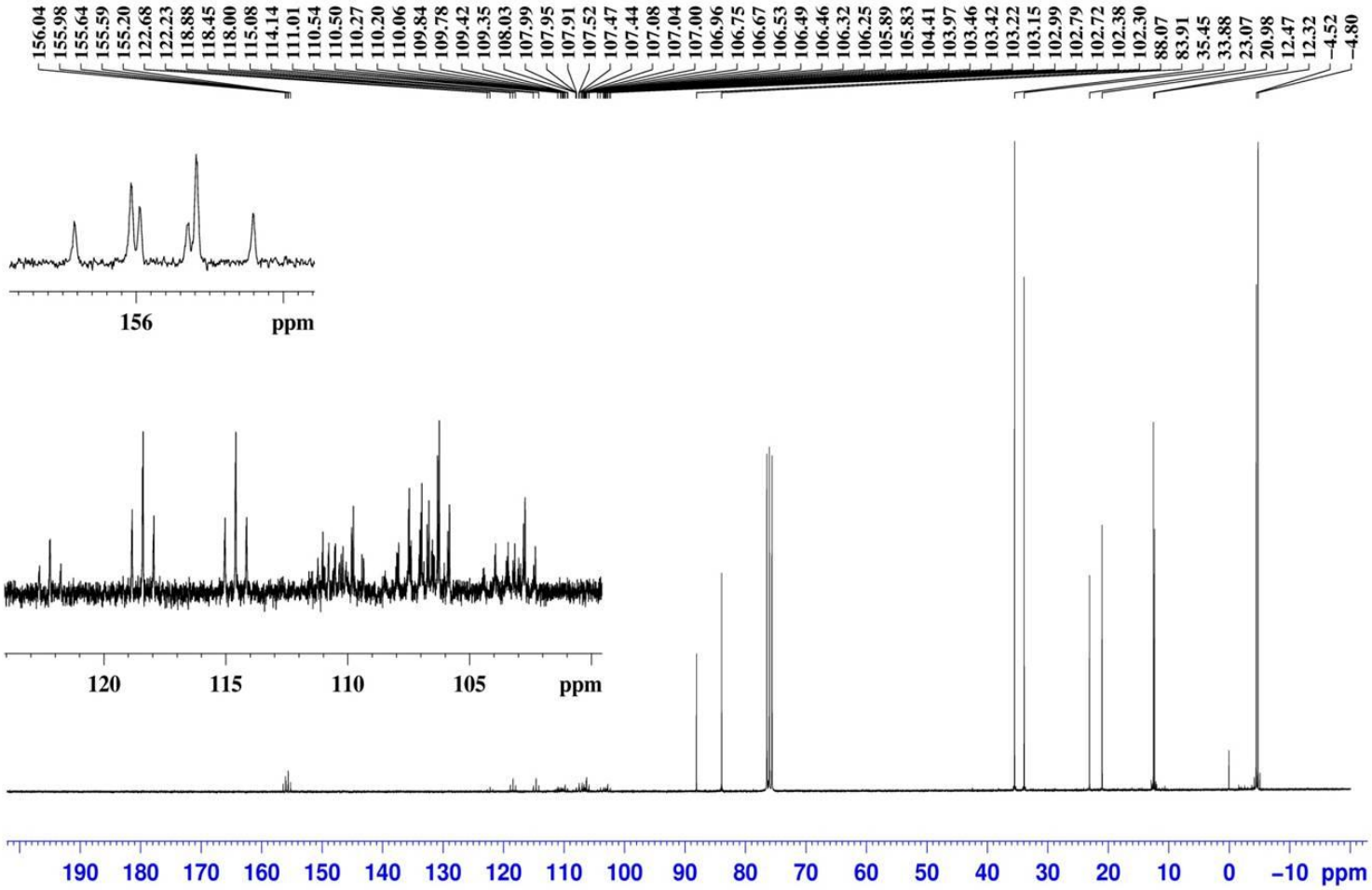
(1s,3s)−3−(tert−butyl)−1−methylcyclobutyl 4−methylbenzenesulfonate "cis"
400 MHz, CDCl3

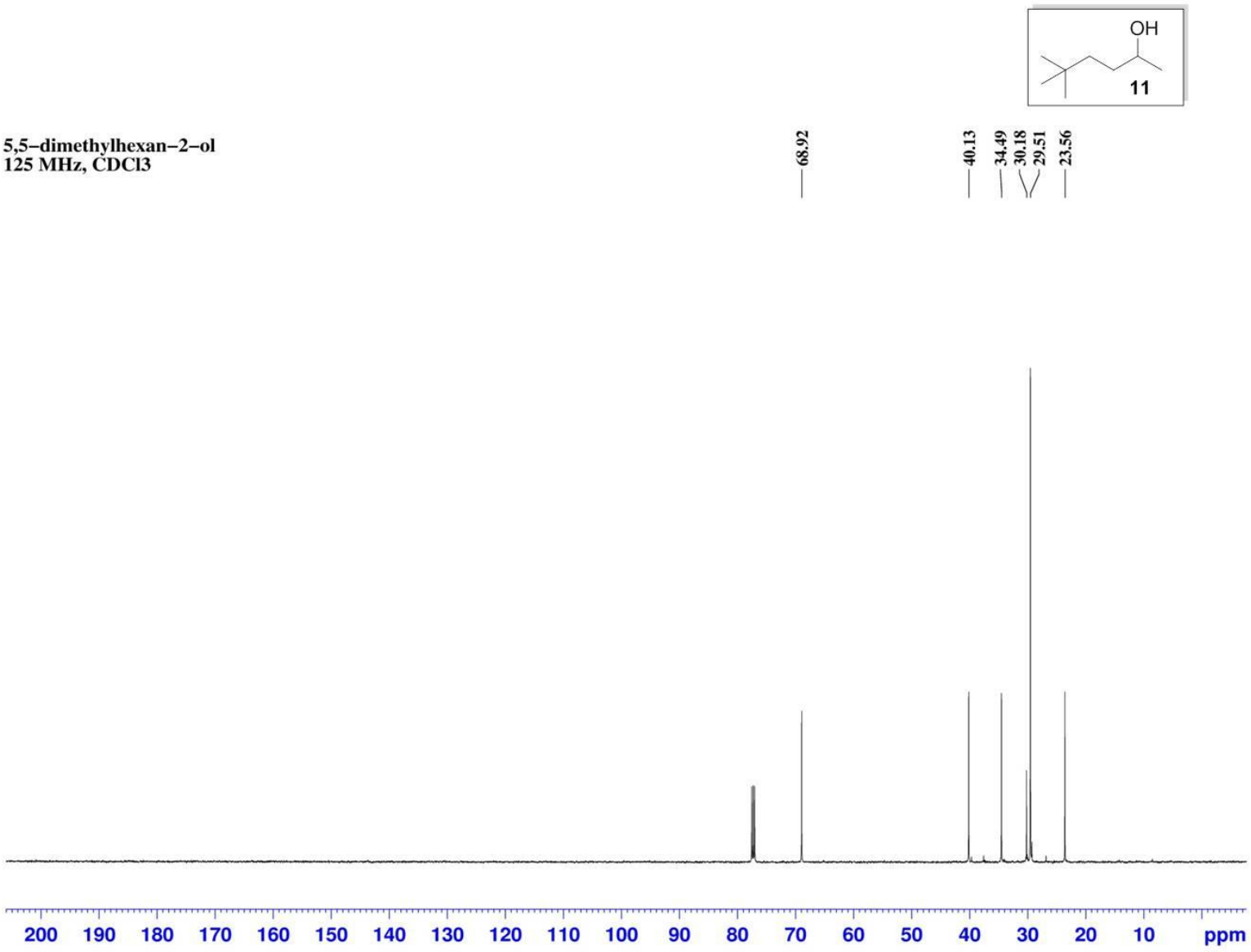


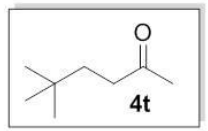


(1s,3s) & (1r,3r)−1−methyl−3−(trimethylsilyl)cyclobutyl 2,2,3,3,4,4,4−heptafluorobutanoate ("cis" & "trans")
100 MHz, CDCl3





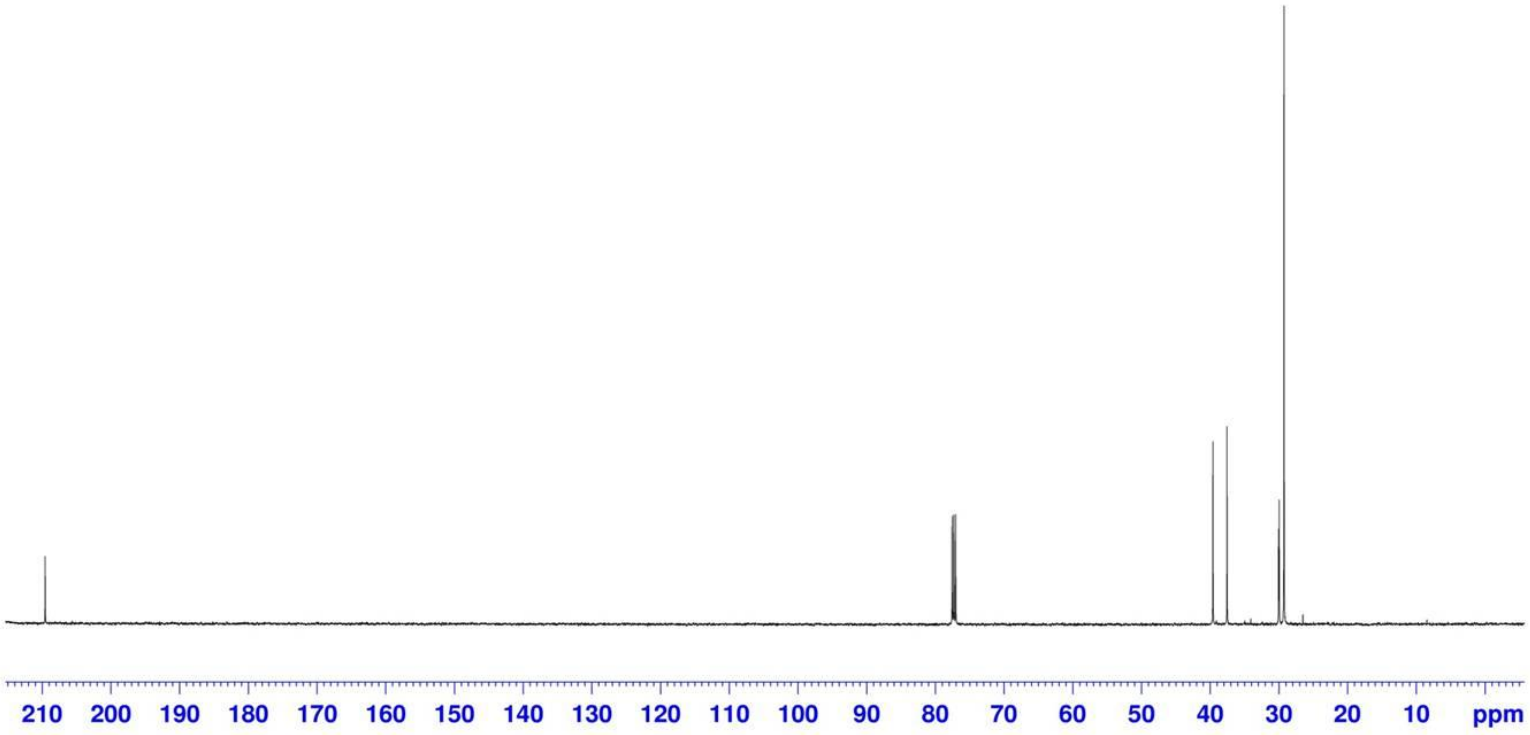

OH
11
5,5–dimethylhexan–2–ol
125 MHz, CDCl3
68.92
40.13
34.49
30.18
29.51
23.56
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

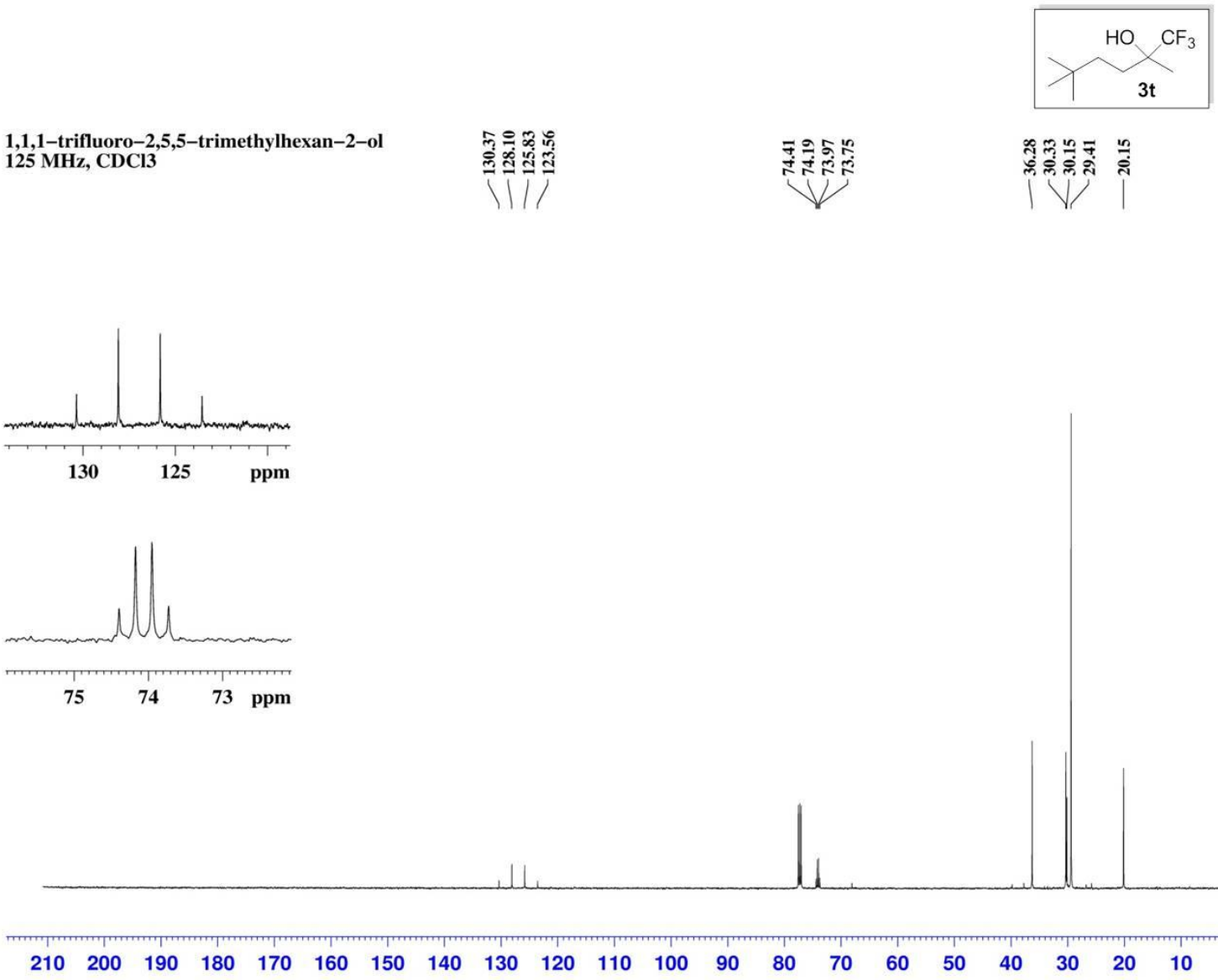


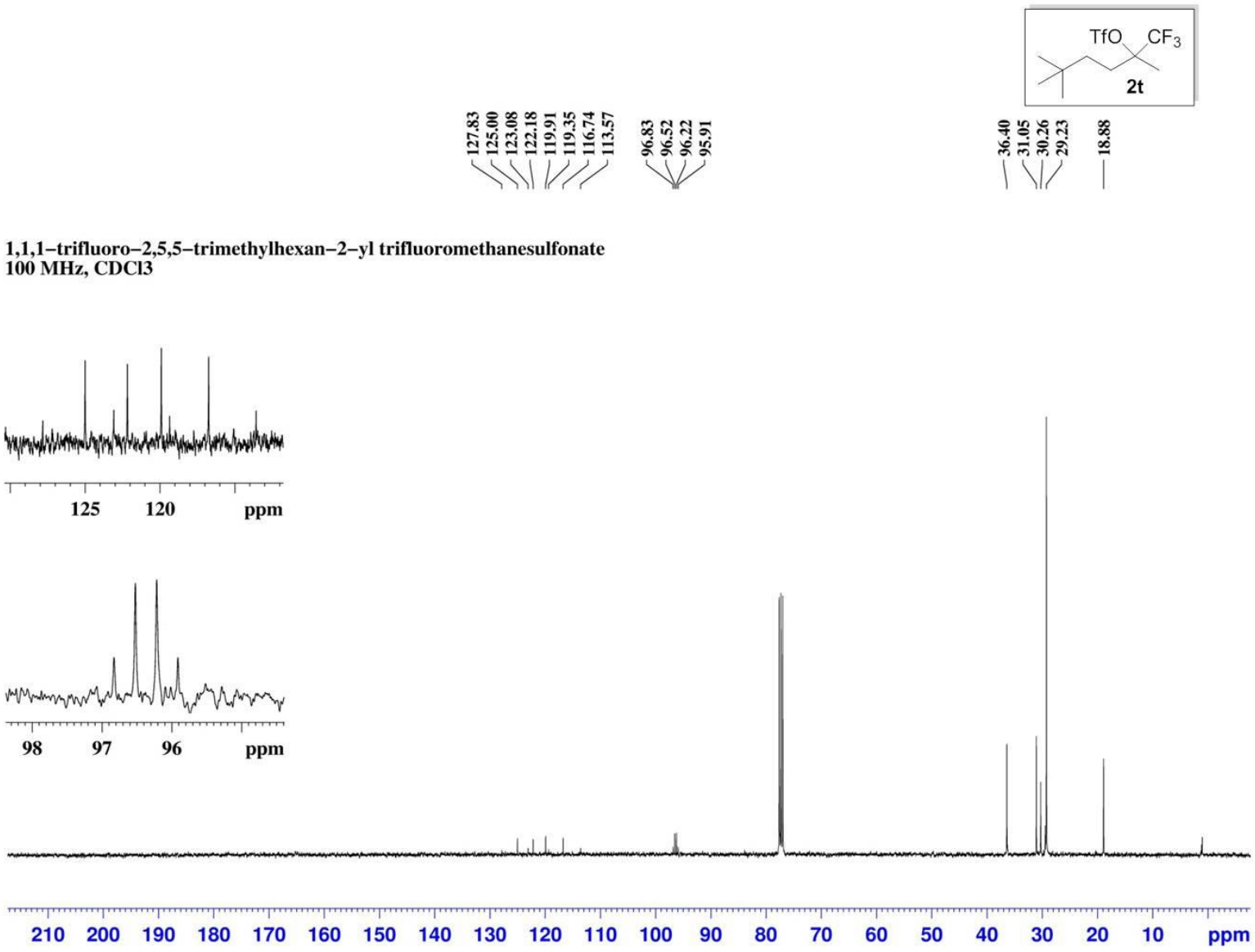
209.53

39.59
37.54
30.03
29.95
29.25

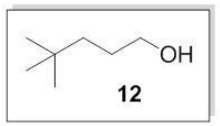
5,5–dimethylhexan–2–one
125 MHz, CDCl3

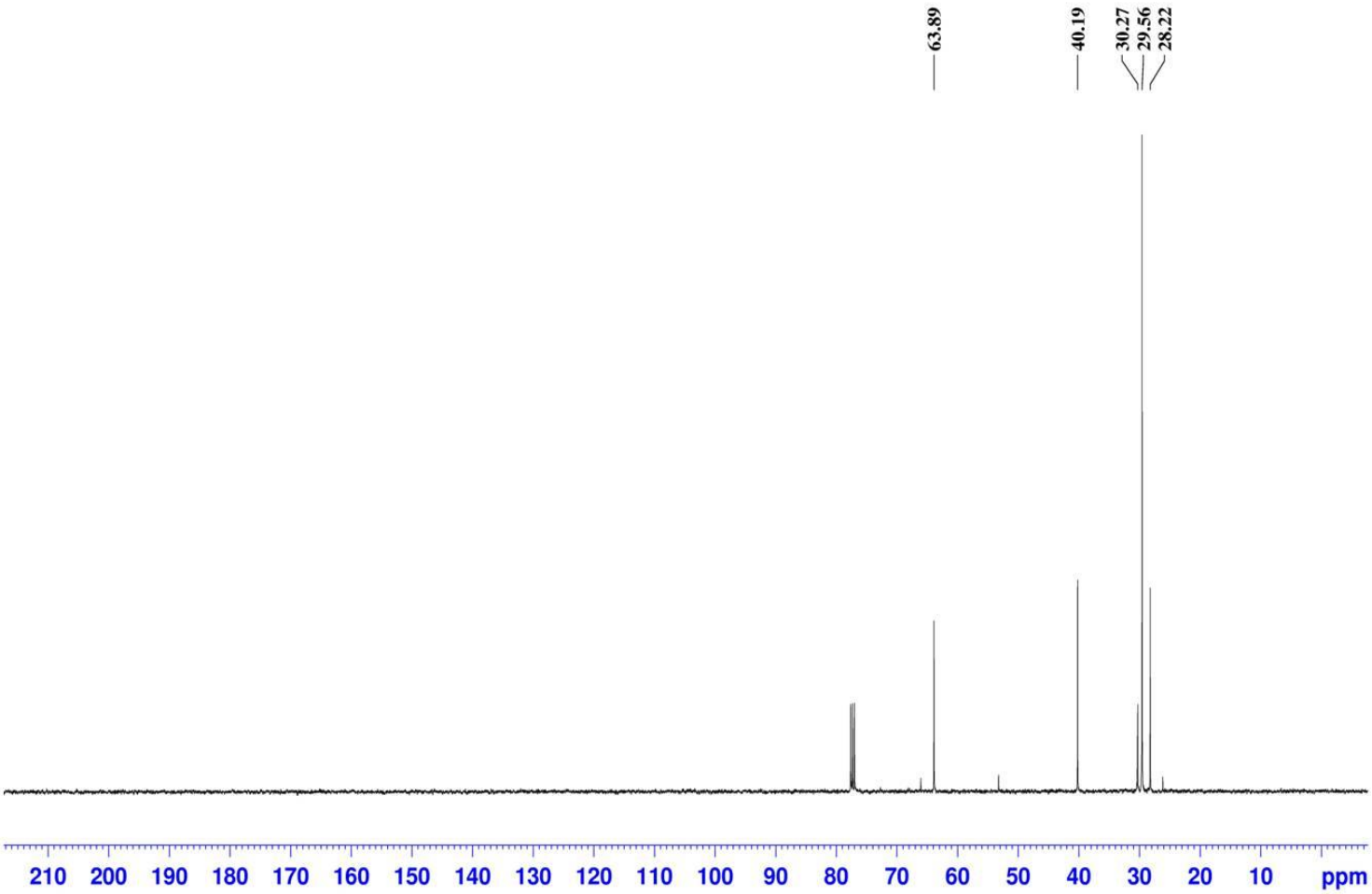


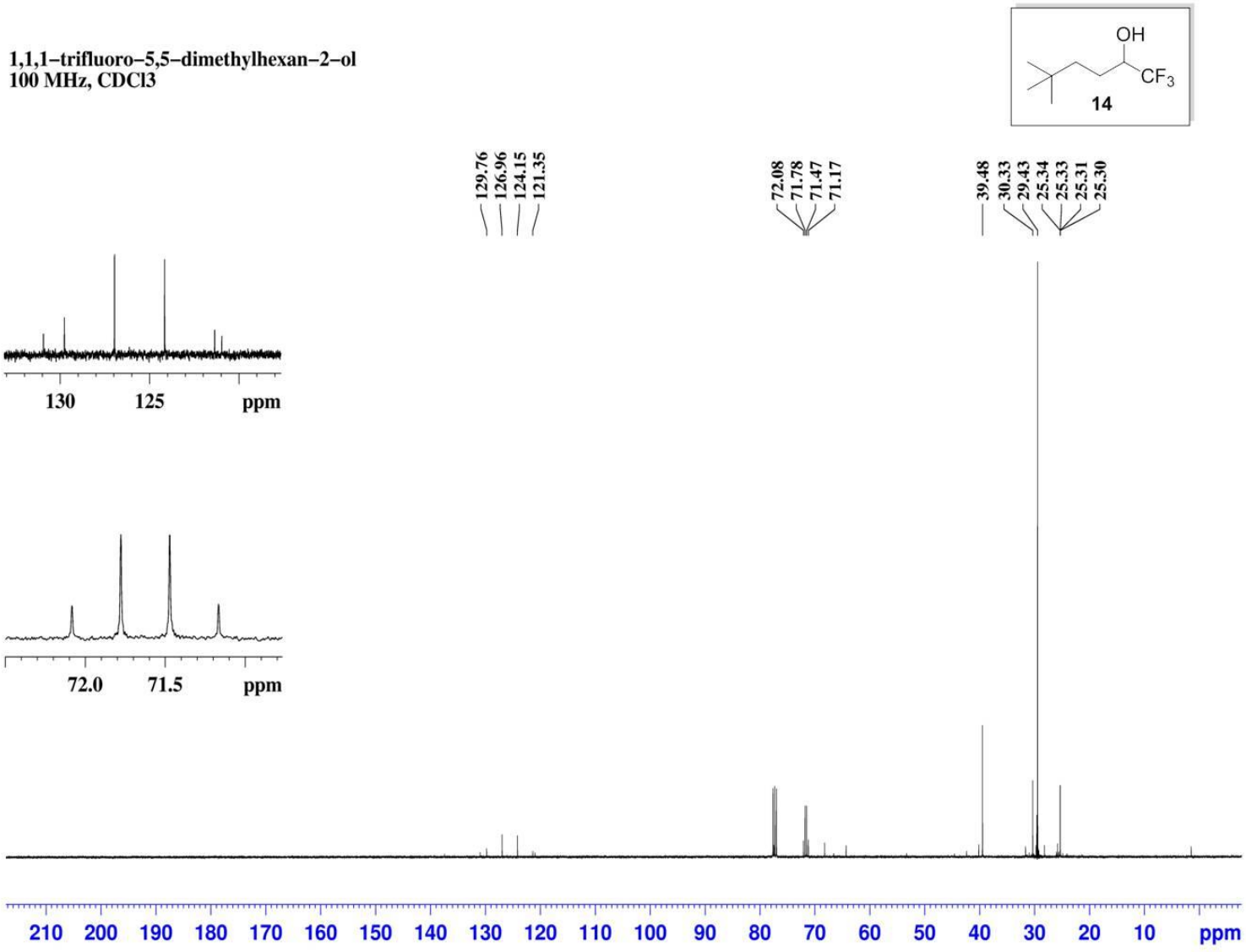

HO
CF3
3t
1,1,1−trifluoro−2,5,5−trimethylhexan−2−ol
125 MHz, CDCl3
130.37
128.10
125.83
123.56
74.41
74.19
73.97
73.75
36.28
30.33
30.15
29.41
20.15
130
125
ppm
75
74
73
ppm
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

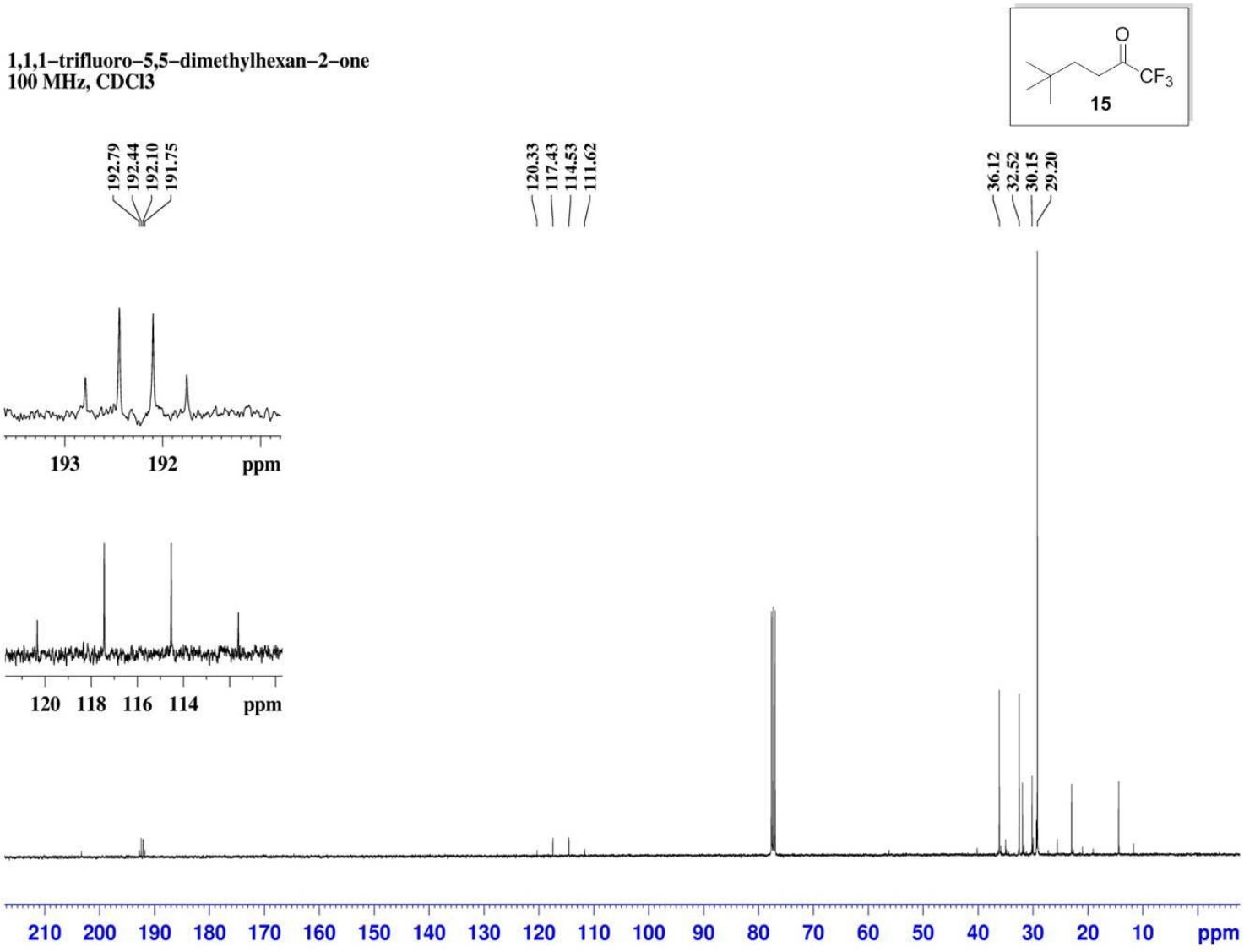

TfO
CF3
2t
127.83
125.00
123.08
122.18
119.91
119.35
116.74
113.57
96.83
96.52
96.22
95.91
36.40
31.05
30.26
29.23
18.88
1,1,1−trifluoro−2,5,5−trimethylhexan−2−yl trifluoromethanesulfonate
100 MHz, CDCl3
125
120
ppm
98
97
96
ppm
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

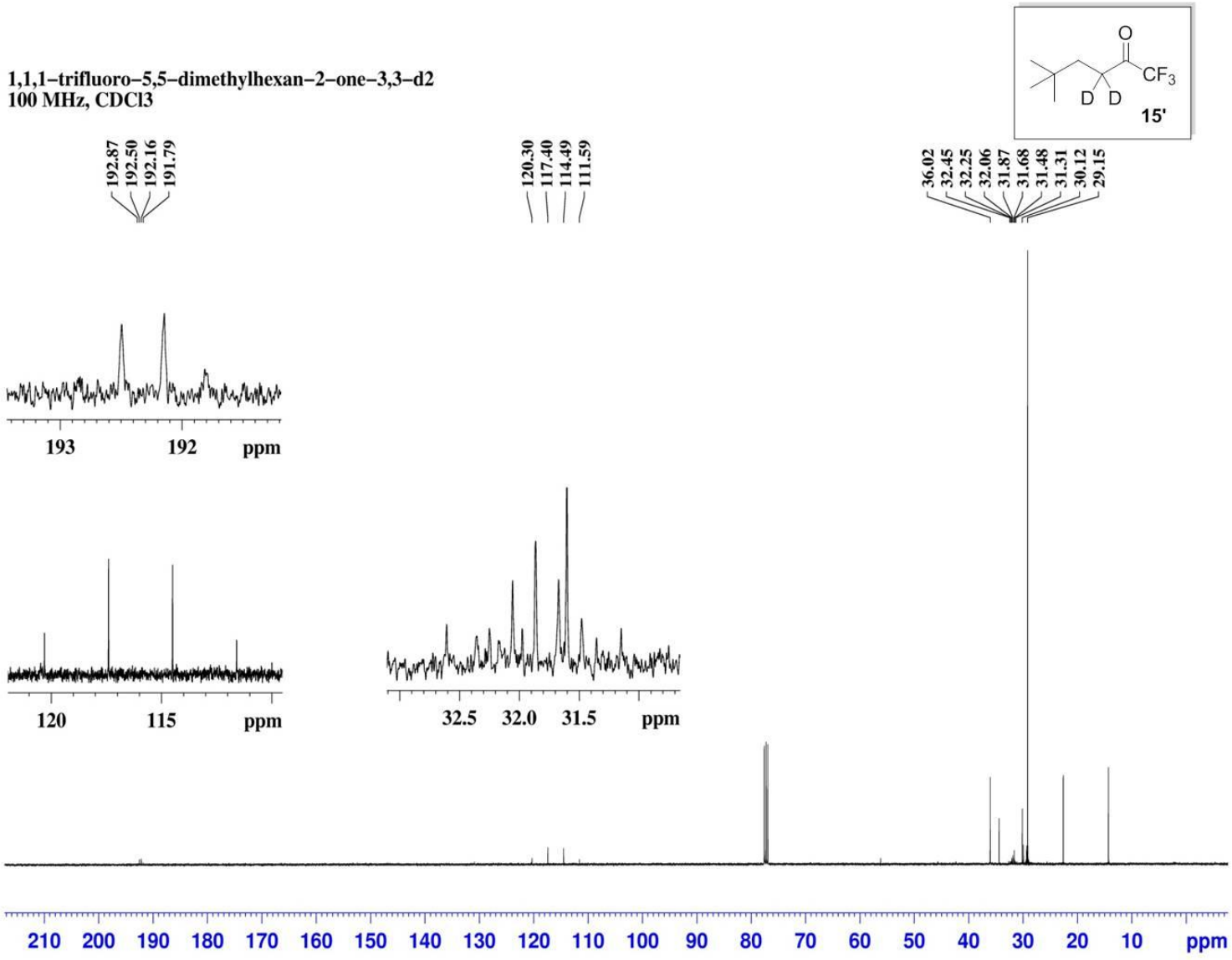
4,4–dimethylpentan–1–ol
100 MHz, CDCl3

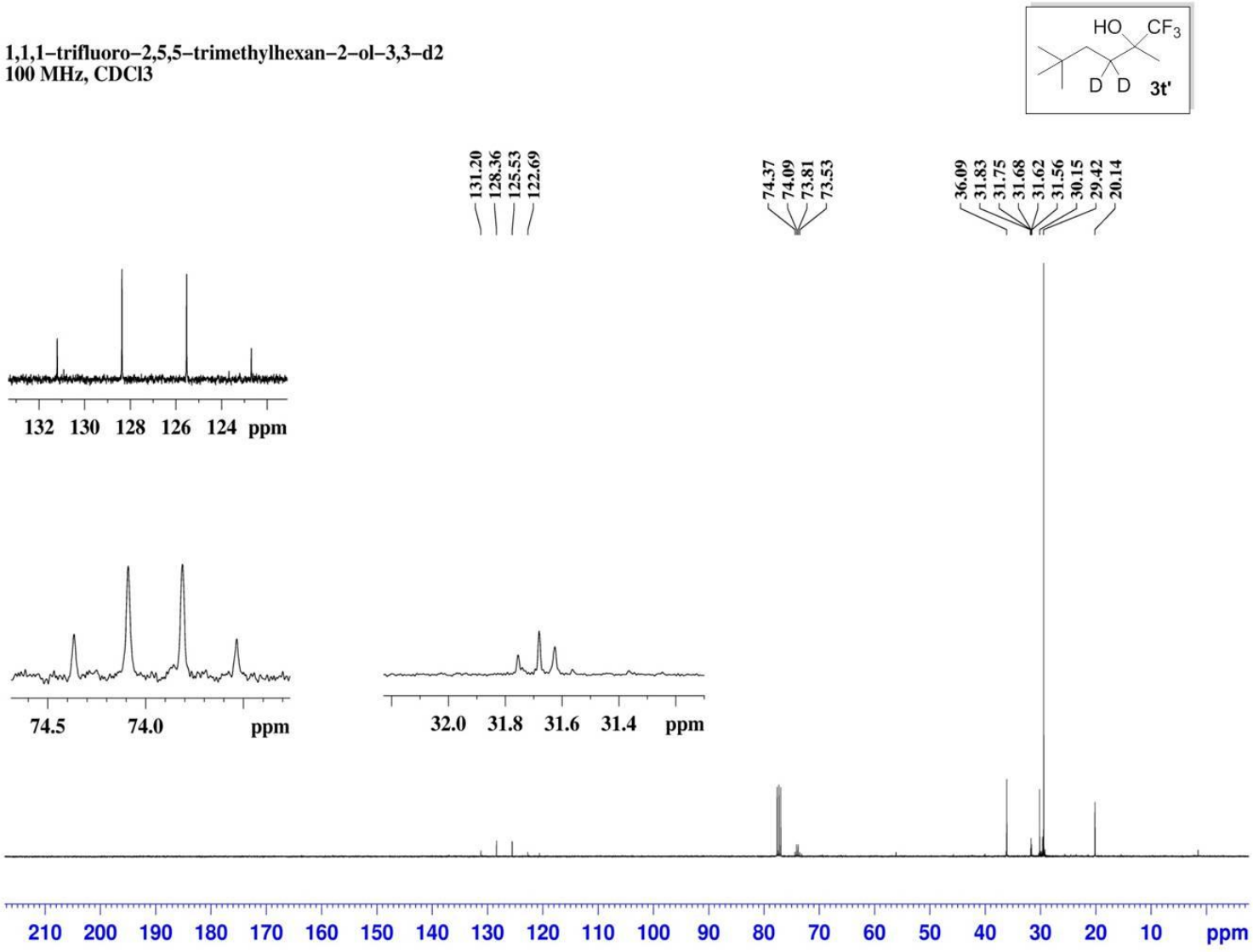




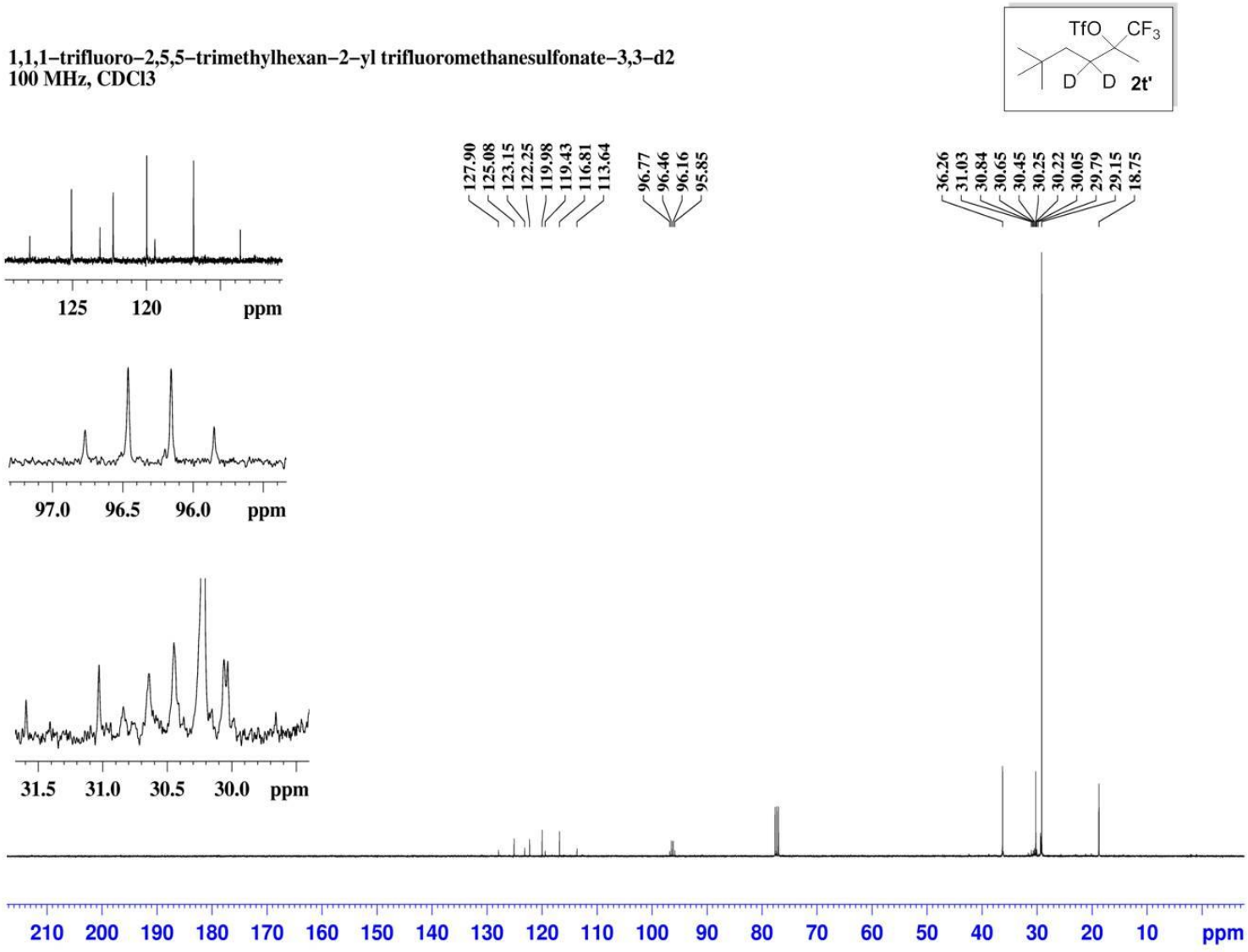

1,1,1–trifluoro–5,5–dimethylhexan–2–ol
100 MHz, CDCl3
OH
CF3
14
129.76
126.96
124.15
121.35
72.08
71.78
71.47
71.17
39.48
30.33
29.43
25.34
25.33
25.31
25.30
130
125
ppm
72.0
71.5
ppm
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


1,1,1–trifluoro–5,5–dimethylhexan–2–one
100 MHz, CDCl3
O
CF3
15
192.79
192.44
192.10
191.75
120.33
117.43
114.53
111.62
36.12
32.52
30.15
29.20
193
192
ppm
120
118
116
114
ppm
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

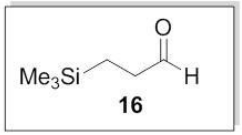

1,1,1−trifluoro−5,5−dimethylhexan−2−one−3,3−d2
100 MHz, CDCl3
O
CF3
D D
15'
192.87
192.50
192.16
191.79
120.30
117.40
114.49
111.59
36.02
32.45
32.25
32.06
31.87
31.68
31.48
31.31
30.12
29.15
193
192
ppm
120
115
ppm
32.5
32.0
31.5
ppm
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


1,1,1–trifluoro–2,5,5–trimethylhexan–2–ol–3,3–d2
100 MHz, CDCl3
HO
CF3
D D
3t'
131.20
128.36
125.53
122.69
74.37
74.09
73.81
73.53
36.09
31.83
31.75
31.68
31.62
31.56
30.15
29.42
20.14
132 130 128 126 124 ppm
74.5 74.0 ppm
32.0 31.8 31.6 31.4 ppm
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

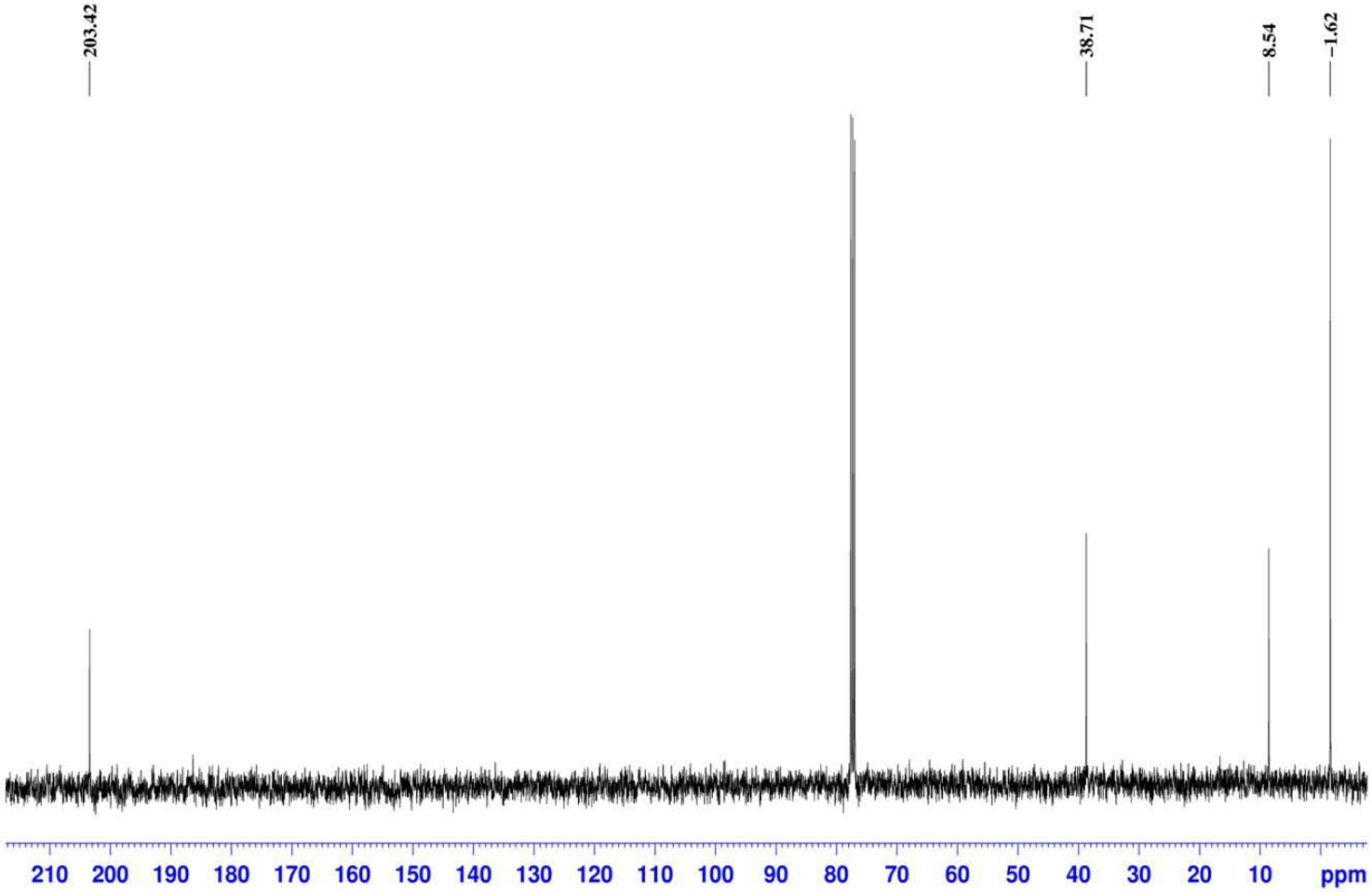
1,1,1–trifluoro–2,5,5–trimethylhexan–2–yl trifluoromethanesulfonate–3,3–d2
100 MHz, CDCl3

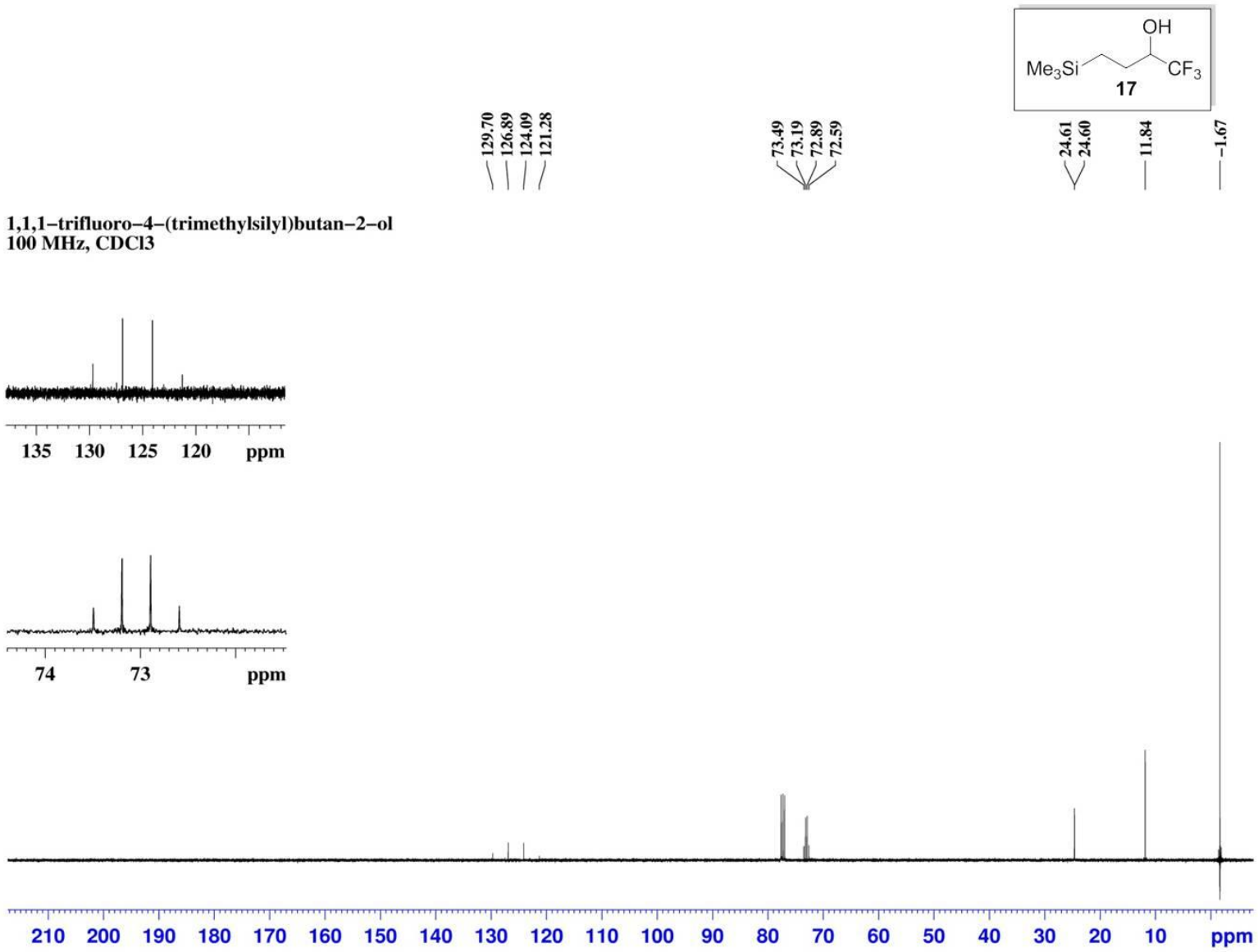


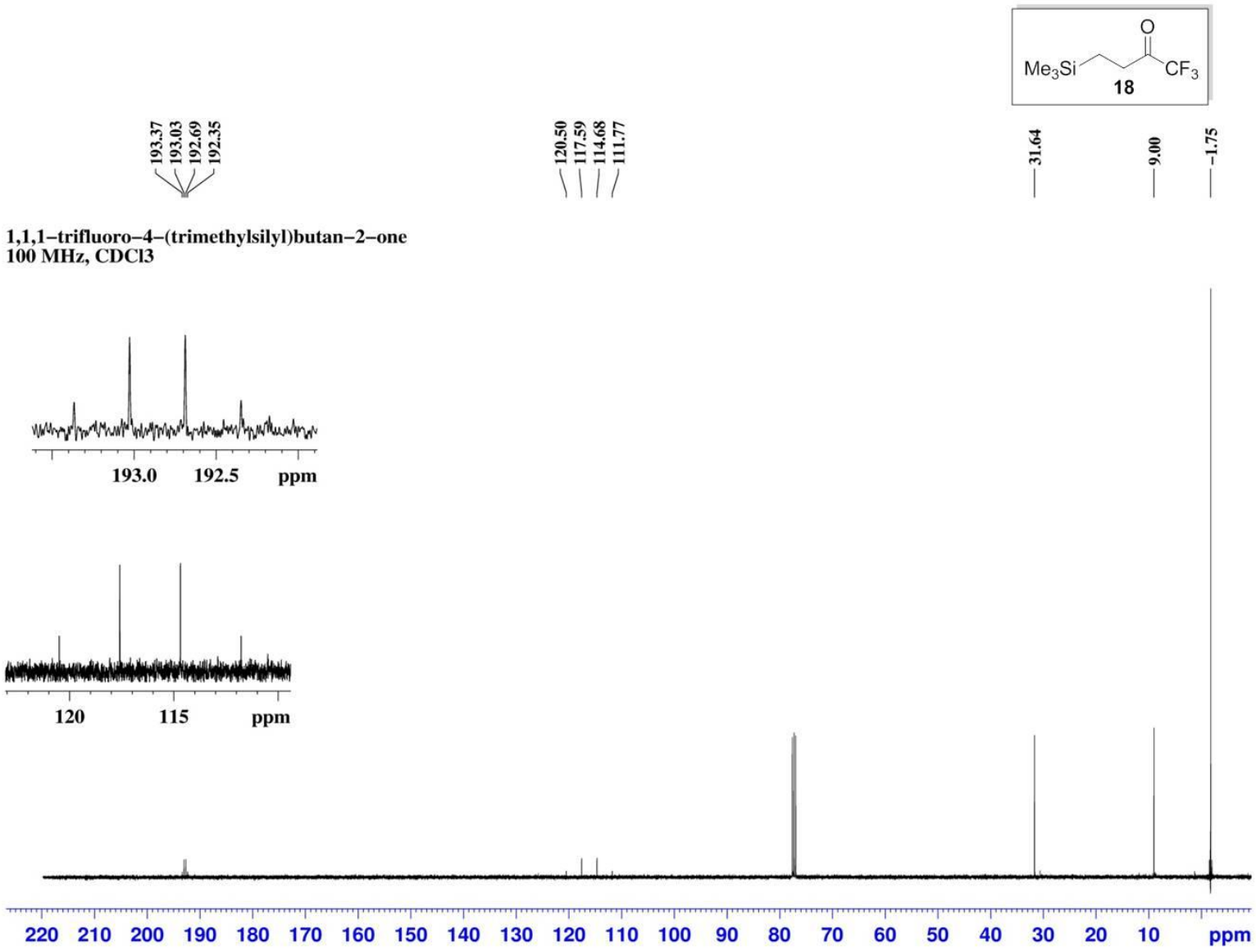
3–(trimethylsilyl)propanal
100 MHz, CDCl3



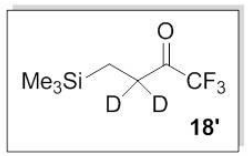
16

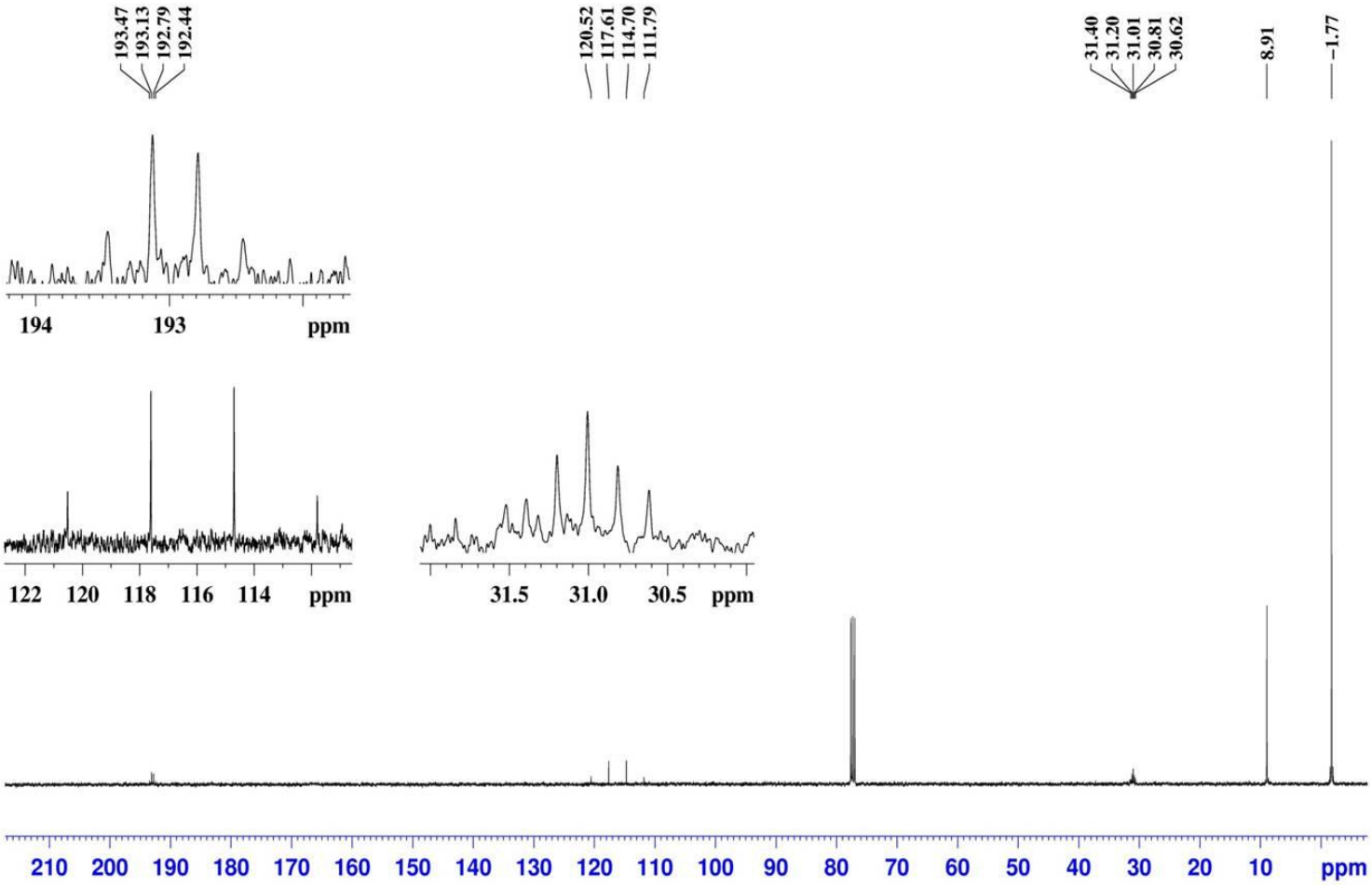



OH
Me3Si
CF3
17
129.70
126.89
124.09
121.28
73.49
73.19
72.89
72.59
24.61
24.60
11.84
-1.67
1,1,1−trifluoro−4−(trimethylsilyl)butan−2−ol
100 MHz, CDCl3
135 130 125 120 ppm
74 73 ppm
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

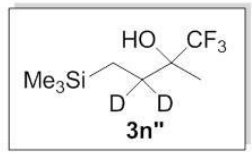

193.37
193.03
192.69
192.35
120.50
117.59
114.68
111.77
31.64
9.00
-1.75
Me3Si
CF3
O
18
1,1,1-trifluoro-4-(trimethylsilyl)butan-2-one
100 MHz, CDCl3
193.0
192.5
ppm
120
115
ppm
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

1,1,1–trifluoro–4–(trimethylsilyl)butan–2–one–3,3–d2
100 MHz, CDCl3

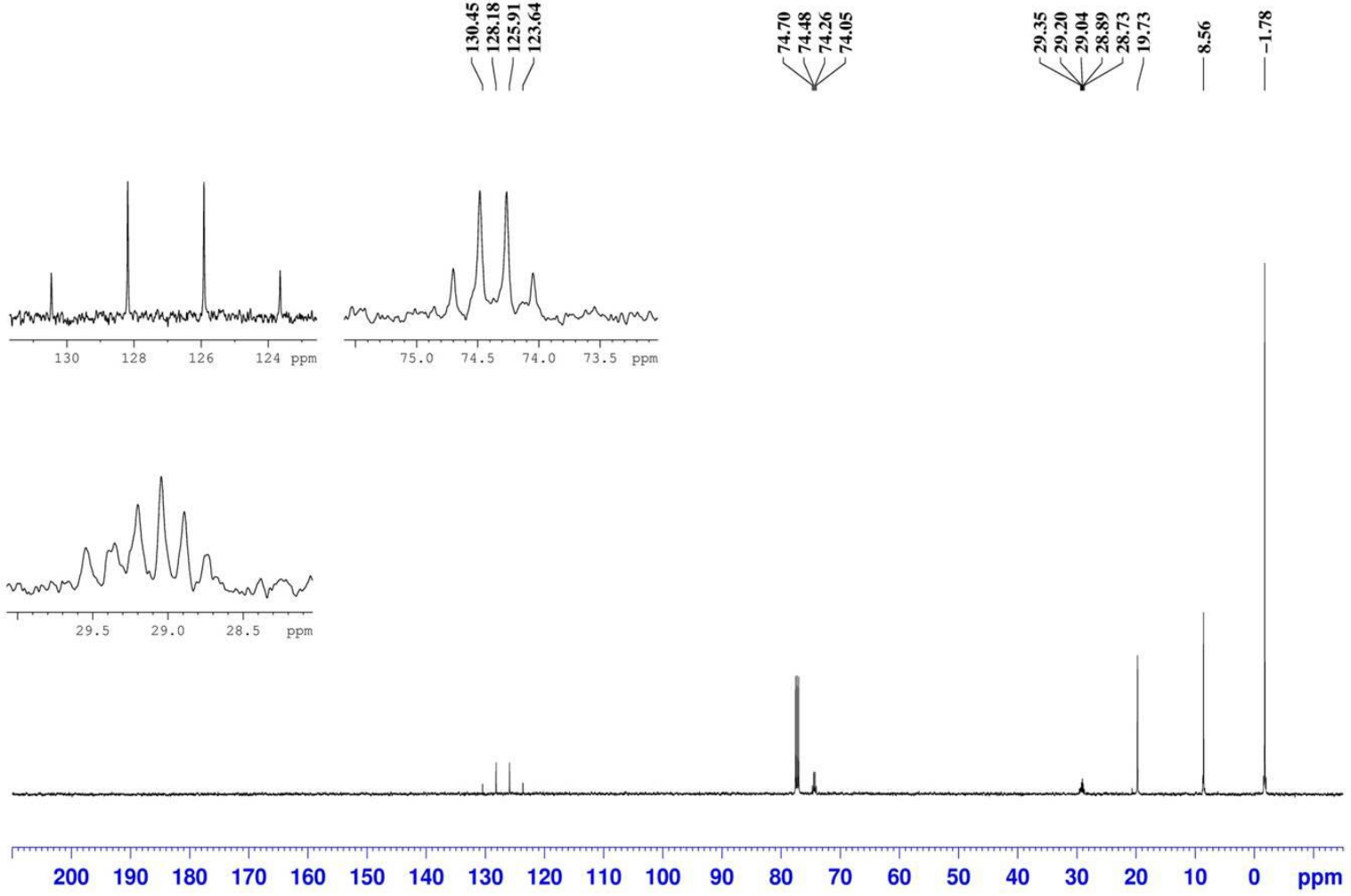




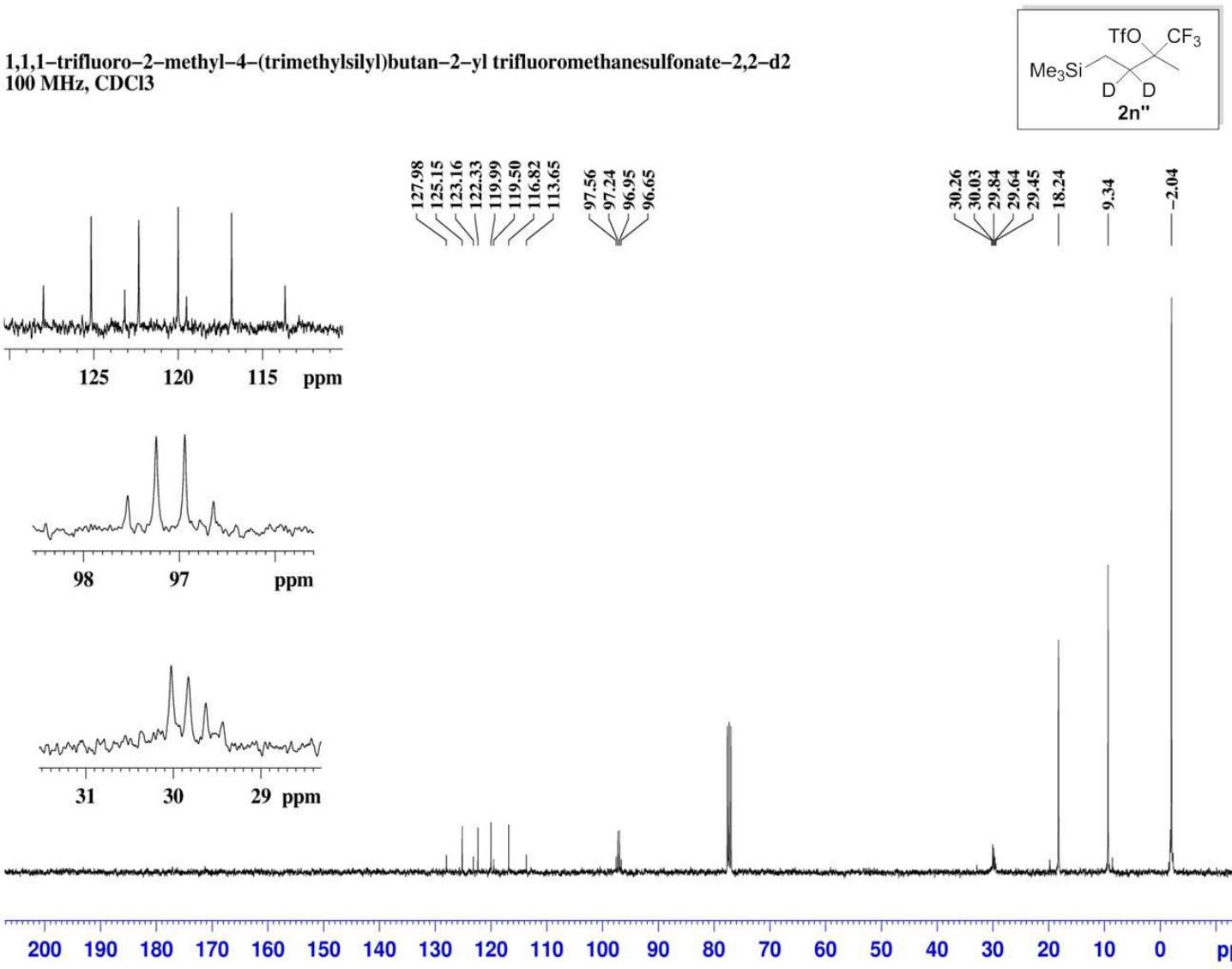
1,1,1–trifluoro–2–methyl–4–(trimethylsilyl)butan–2–ol–3,3–d2
100 MHz, CDCl3



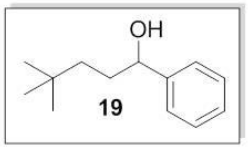
3n"

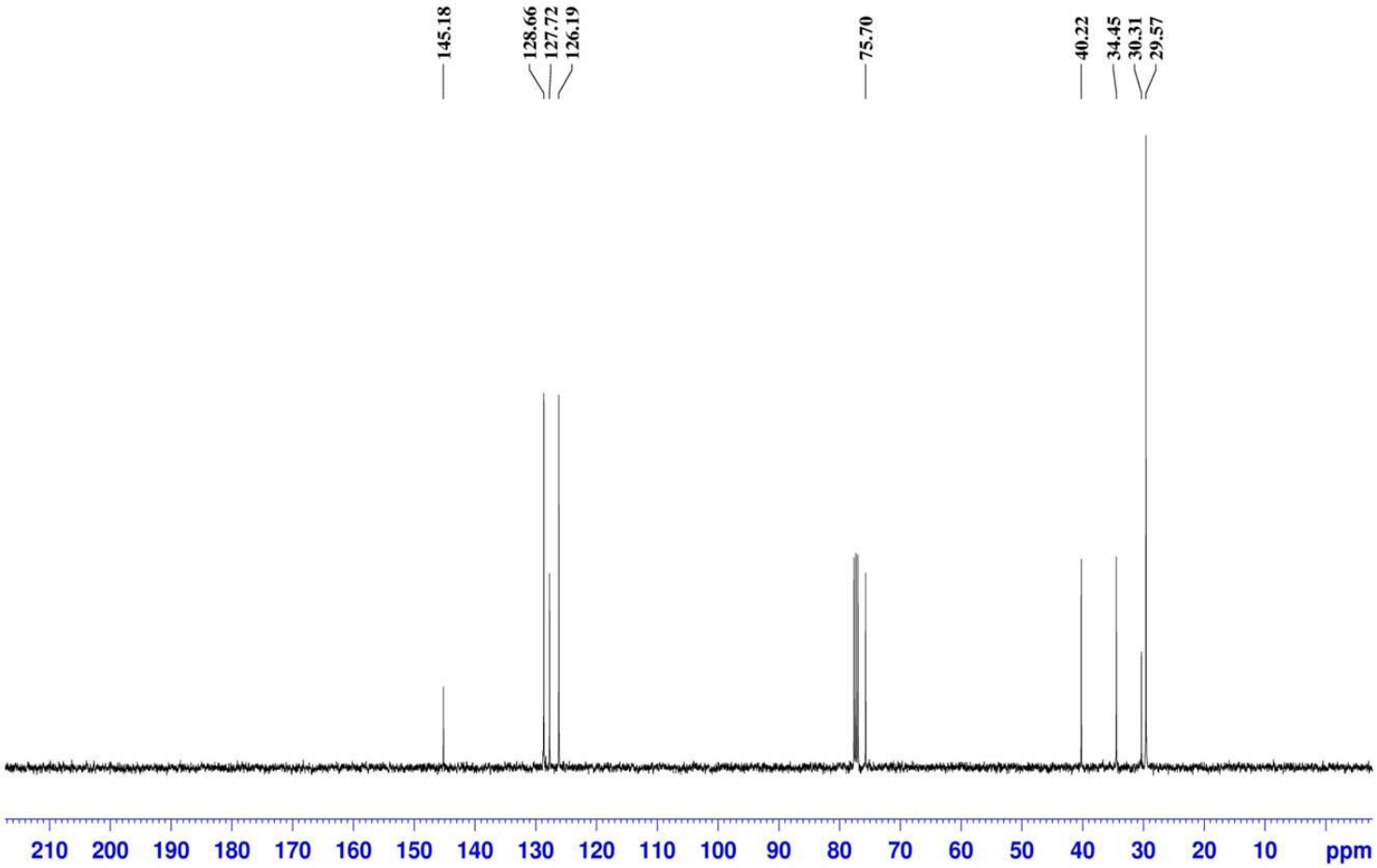


1,1,1–trifluoro–2–methyl–4–(trimethylsilyl)butan–2–yl trifluoromethanesulfonate–2,2–d2
100 MHz, CDCl3

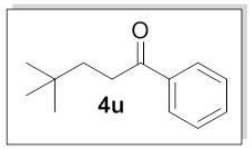


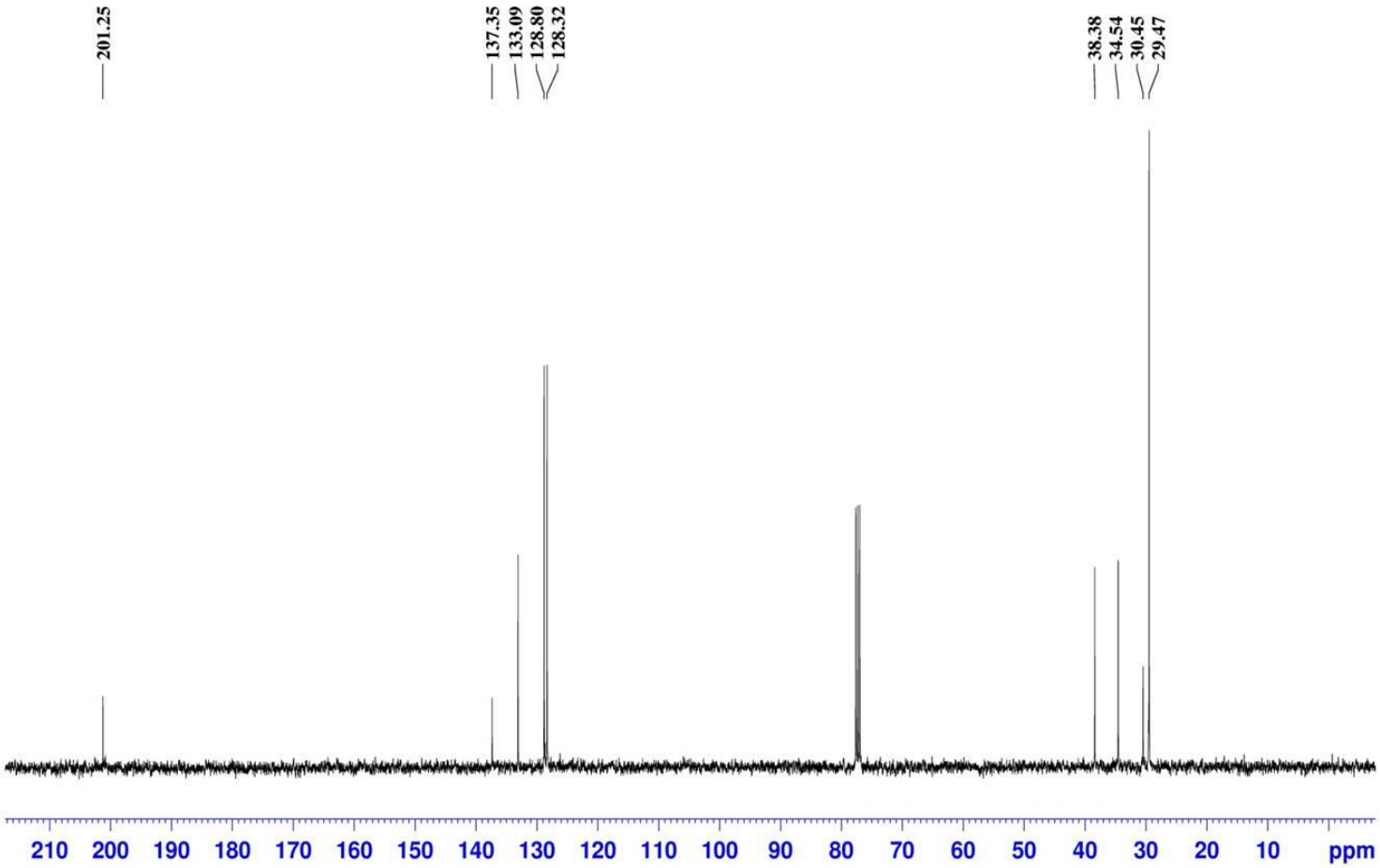
4,4–dimethyl–1–phenylpentan–1–ol
100 MHz, CDCl3

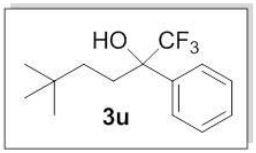




4,4–dimethyl–1–phenylpentan–1–one
100 MHz, CDCl3

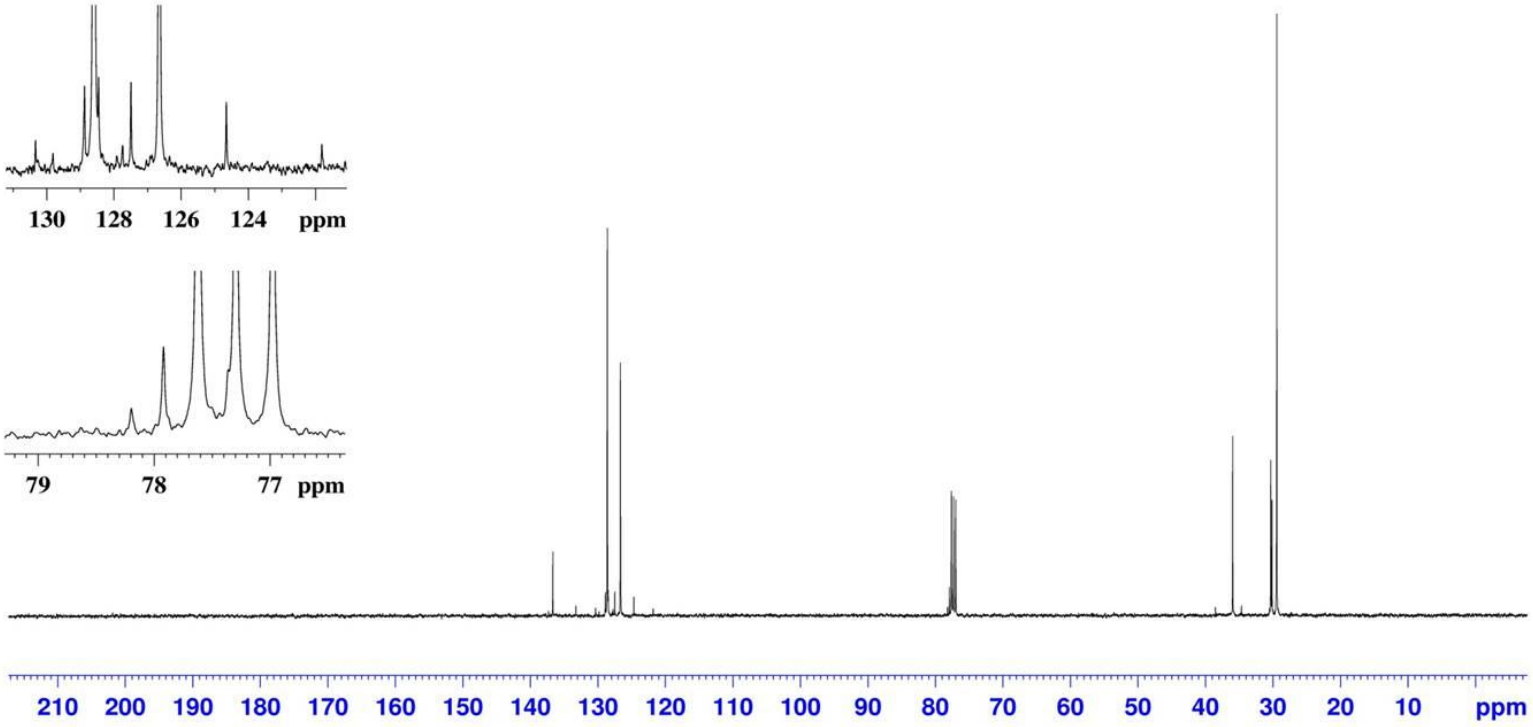


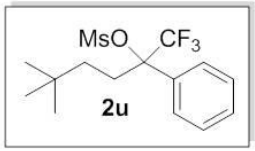




136.67
128.62
128.58
126.65
78.20
77.92
77.66
77.38
35.95
30.30
30.13
29.42

1,1,1−trifluoro−5,5−dimethyl−2−phenylhexan−2−ol
100 MHz, CDCl3



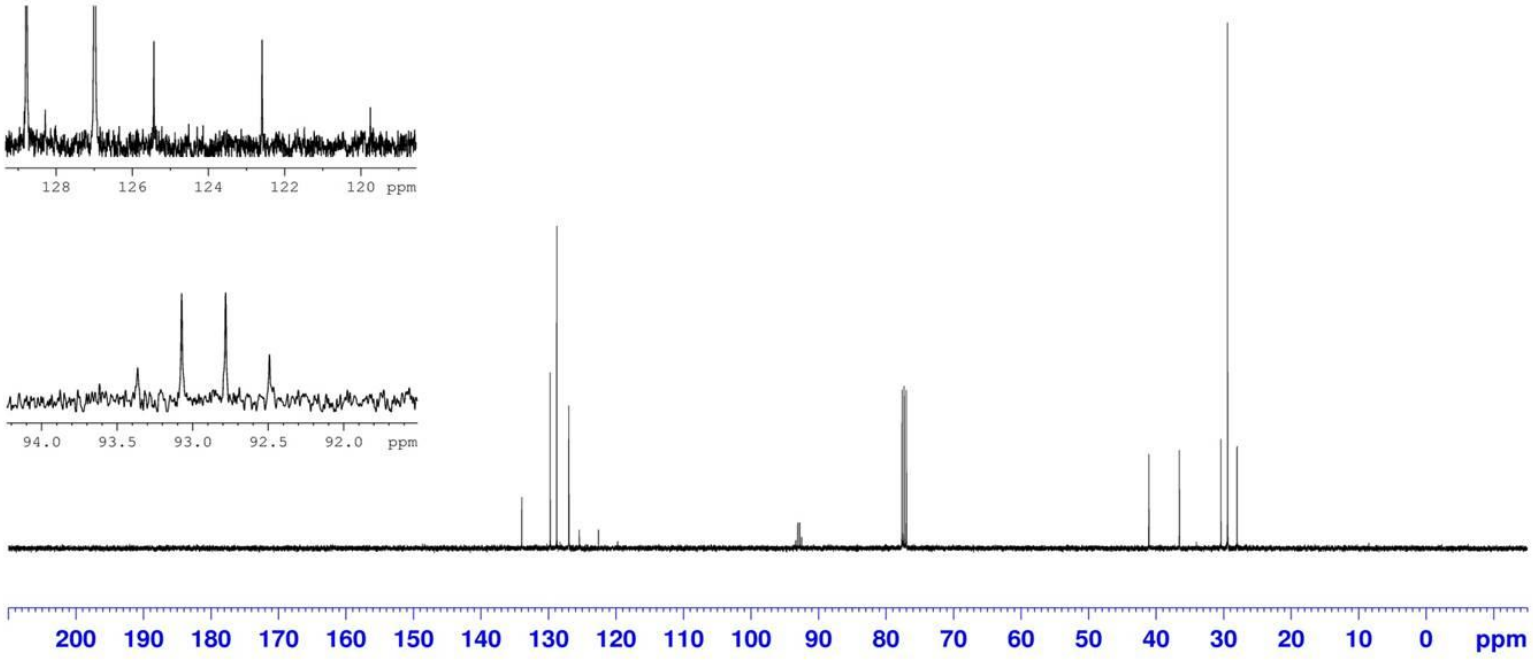


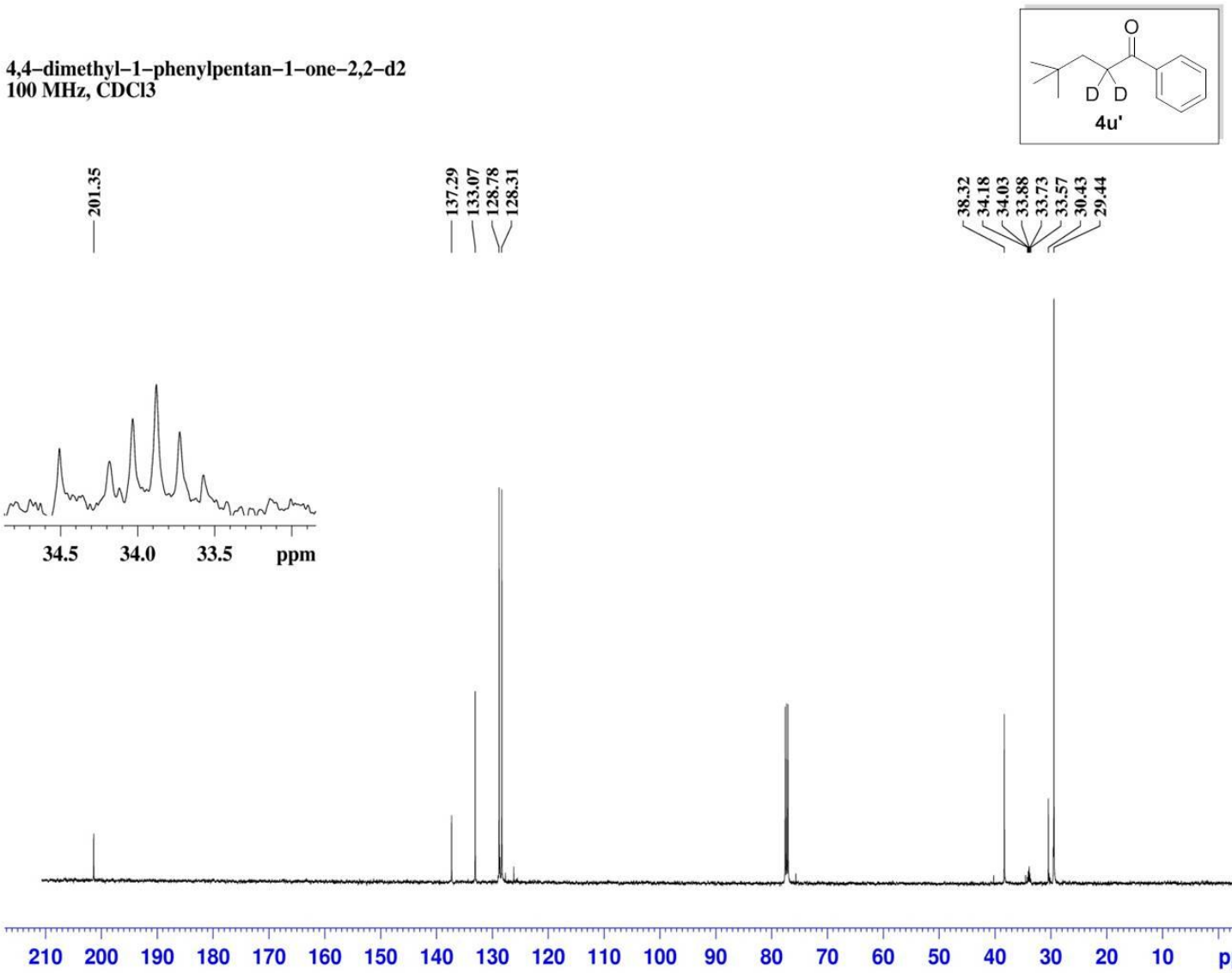
133.95
129.74
128.77
128.28
126.99
126.98
125.43
122.59
119.74

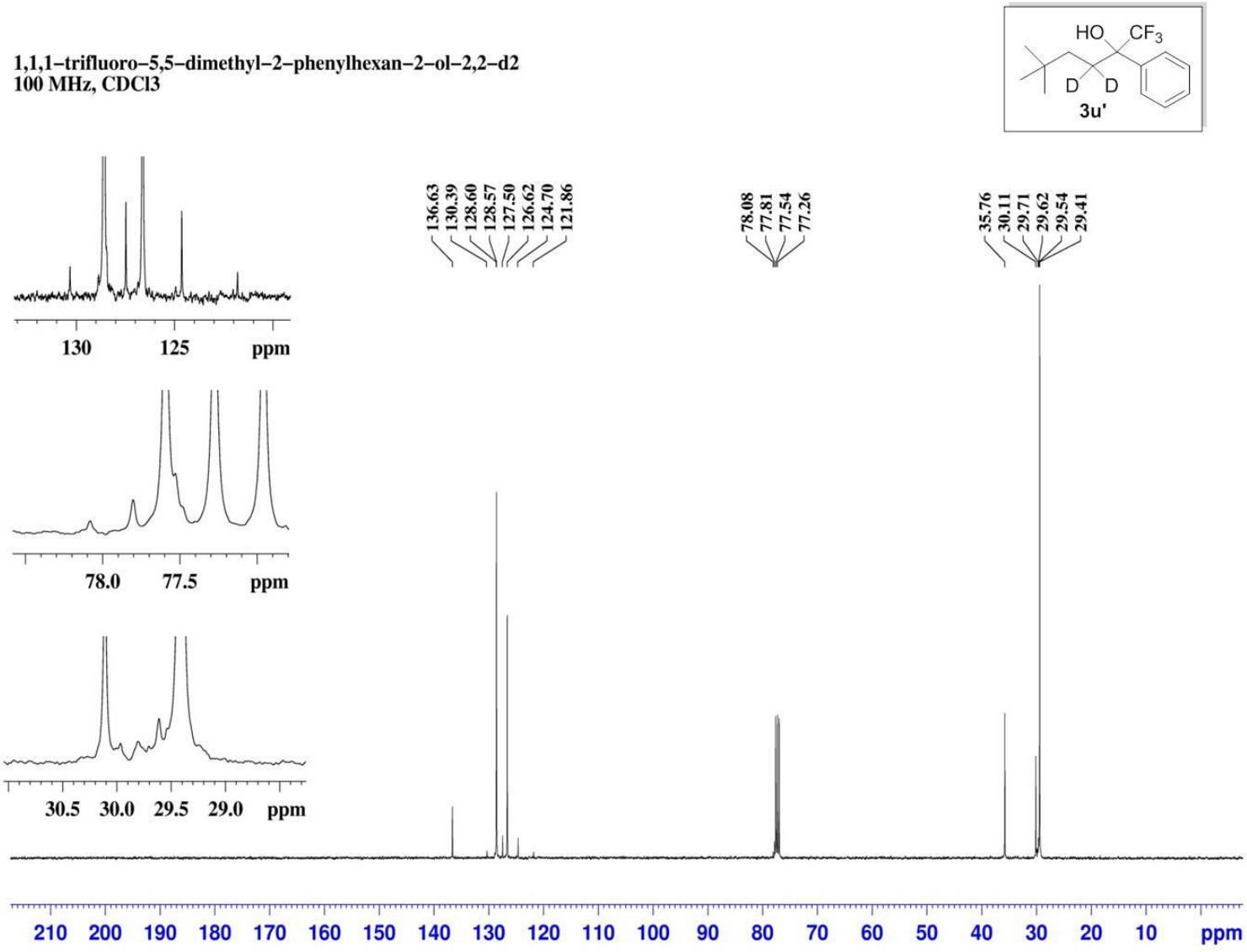
93.36
93.07
92.78
92.49

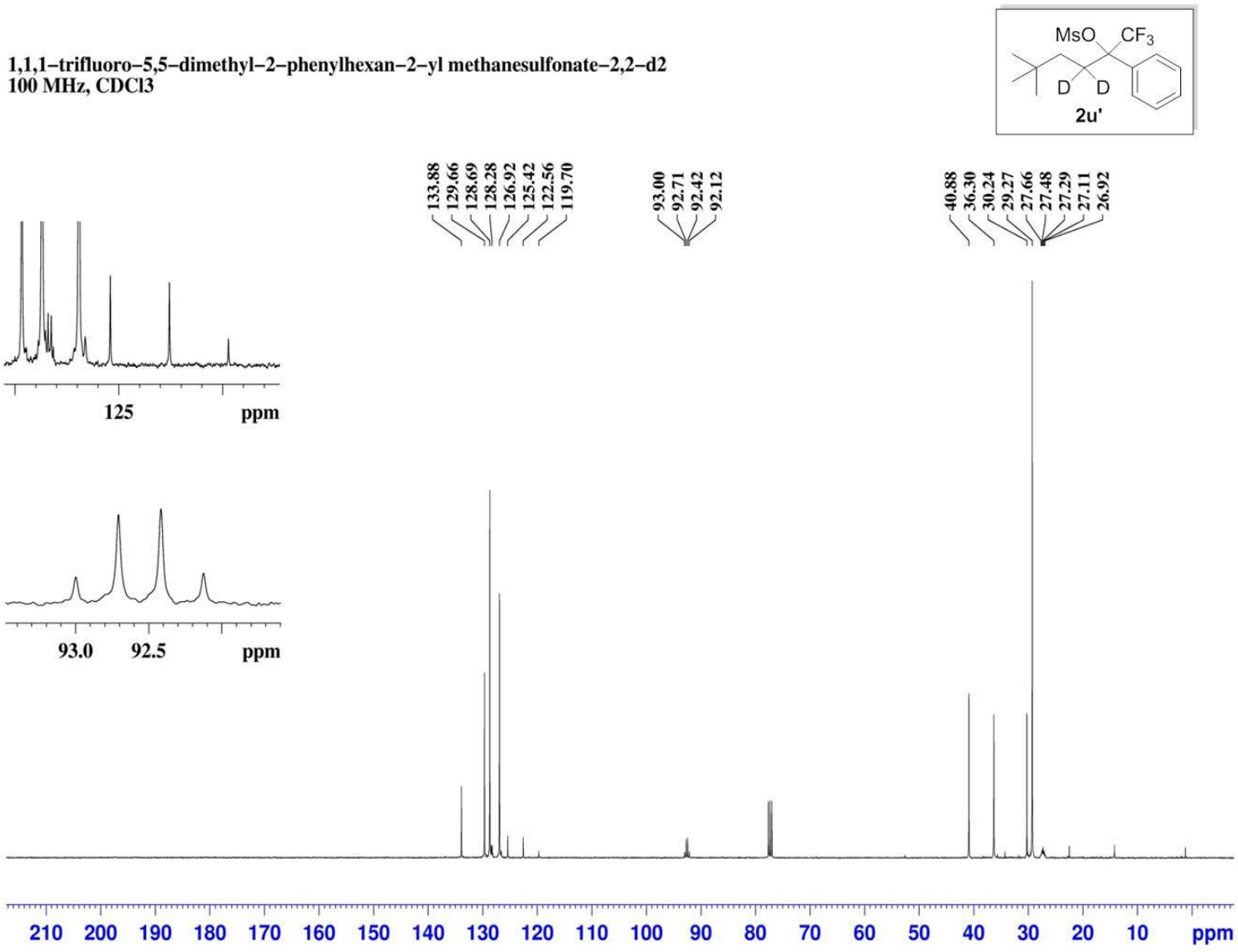
41.06
36.53
30.38
29.39
27.99

1,1,1–trifluoro–5,5–dimethyl–2–phenylhexan–2–yl methanesulfonate
100 MHz, CDCl3

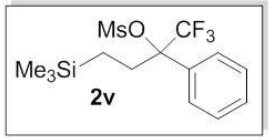


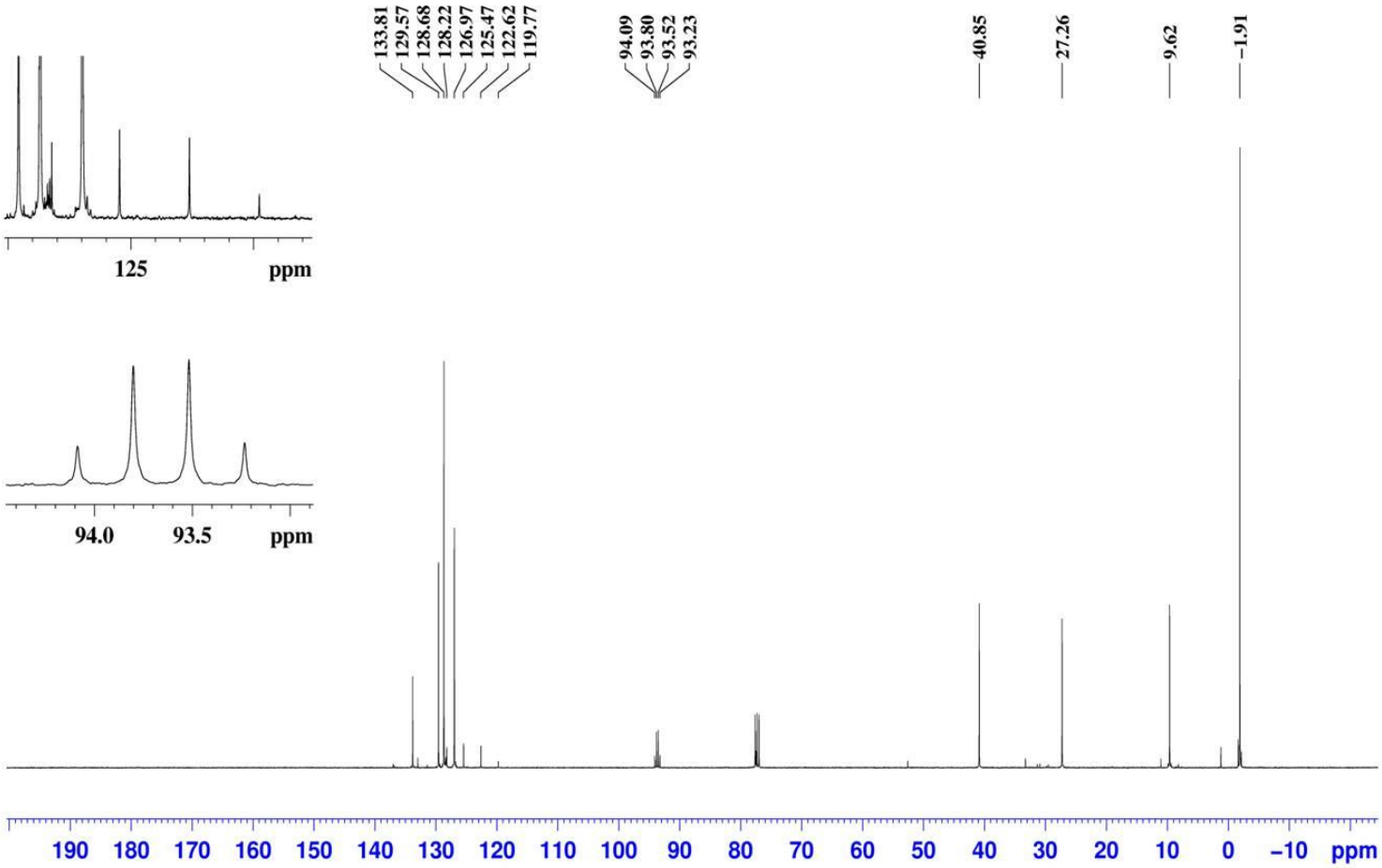

4,4–dimethyl–1–phenylpentan–1–one–2,2–d2
100 MHz, CDCl3
O
D D
4u'
201.35
137.29
133.07
128.78
128.31
38.32
34.18
34.03
33.88
33.73
33.57
30.43
29.44
34.5
34.0
33.5
ppm
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


1,1,1–trifluoro–5,5–dimethyl–2–phenylhexan–2–ol–2,2–d2
100 MHz, CDCl3
HO
CF3
D
D
3u'
136.63
130.39
128.60
128.57
127.50
126.62
124.70
121.86
78.08
77.81
77.54
77.26
35.76
30.11
29.71
29.62
29.54
29.41
130
125
ppm
78.0
77.5
ppm
30.5
30.0
29.5
29.0
ppm
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

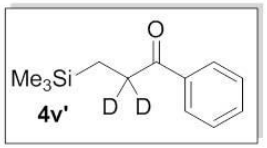

1,1,1–trifluoro–5,5–dimethyl–2–phenylhexan–2–yl methanesulfonate–2,2–d2
100 MHz, CDCl3
MsO
CF3
D
D
2u'
133.88
129.66
128.69
128.28
126.92
125.42
122.56
119.70
93.00
92.71
92.42
92.12
40.88
36.30
30.24
29.27
27.66
27.48
27.29
27.11
26.92
125
ppm
93.0
92.5
ppm
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

1,1,1–trifluoro–2–phenyl–4–(trimethylsilyl)butan–2–yl methanesulfonate
100 MHz, CDCl3

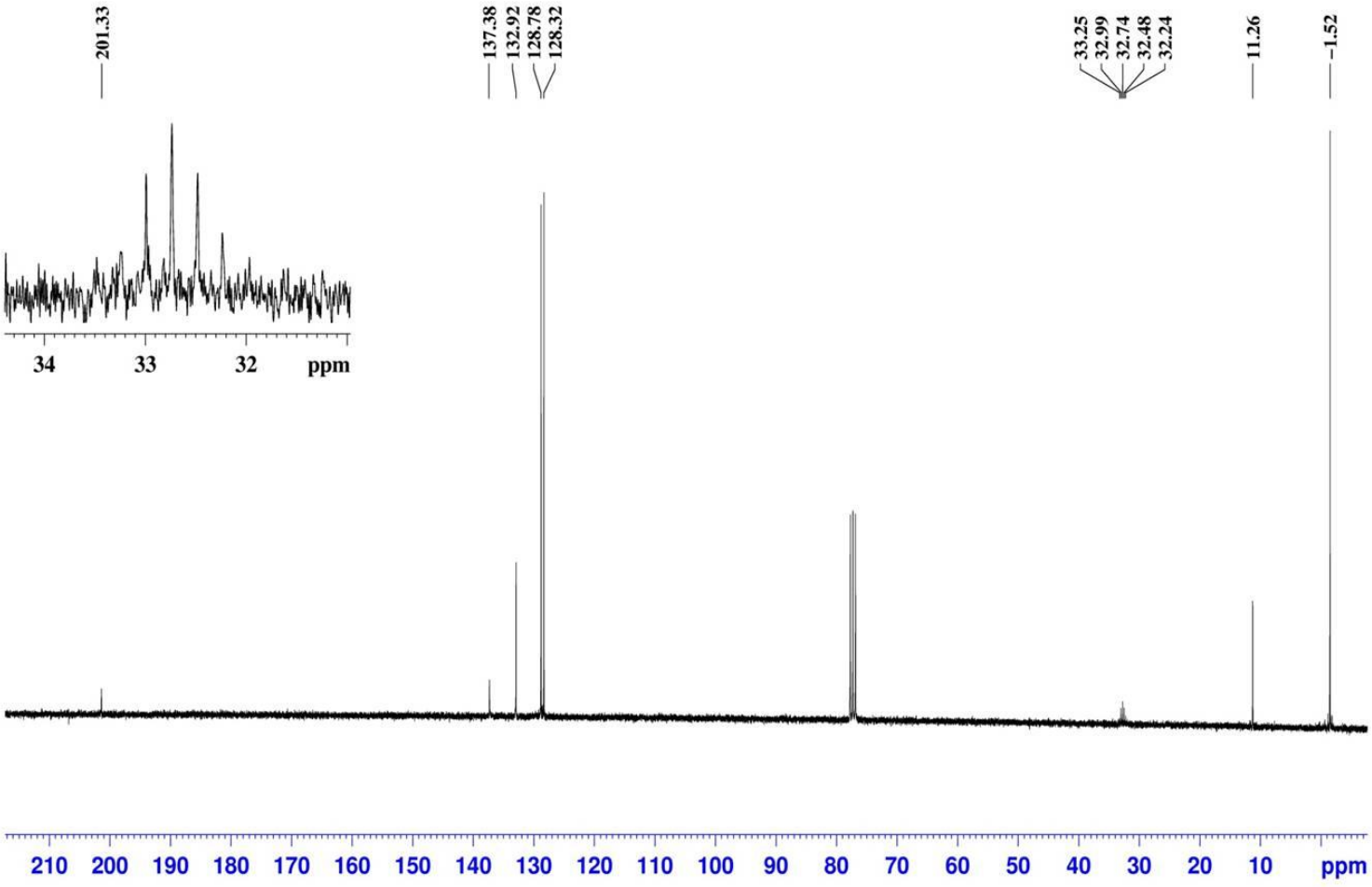


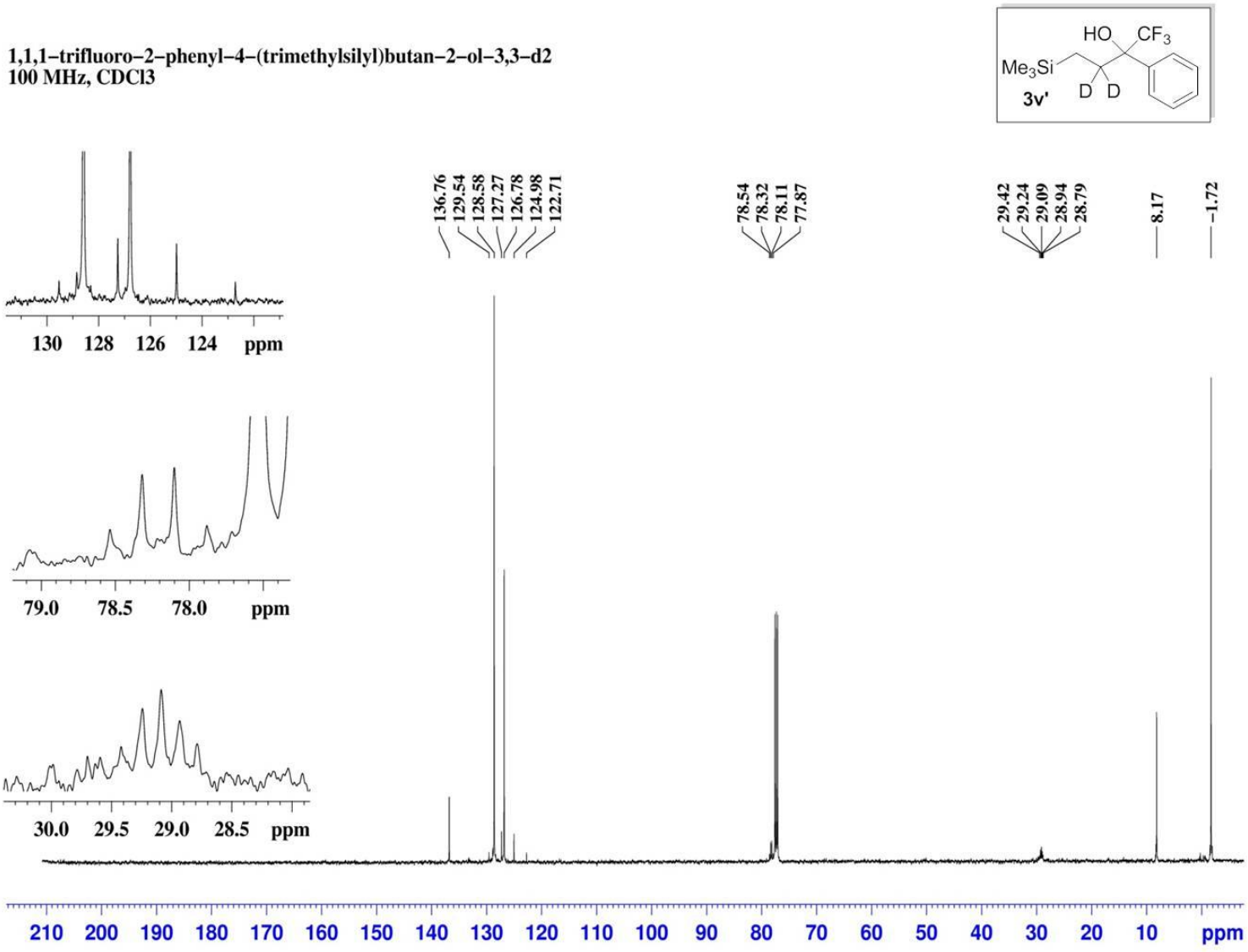


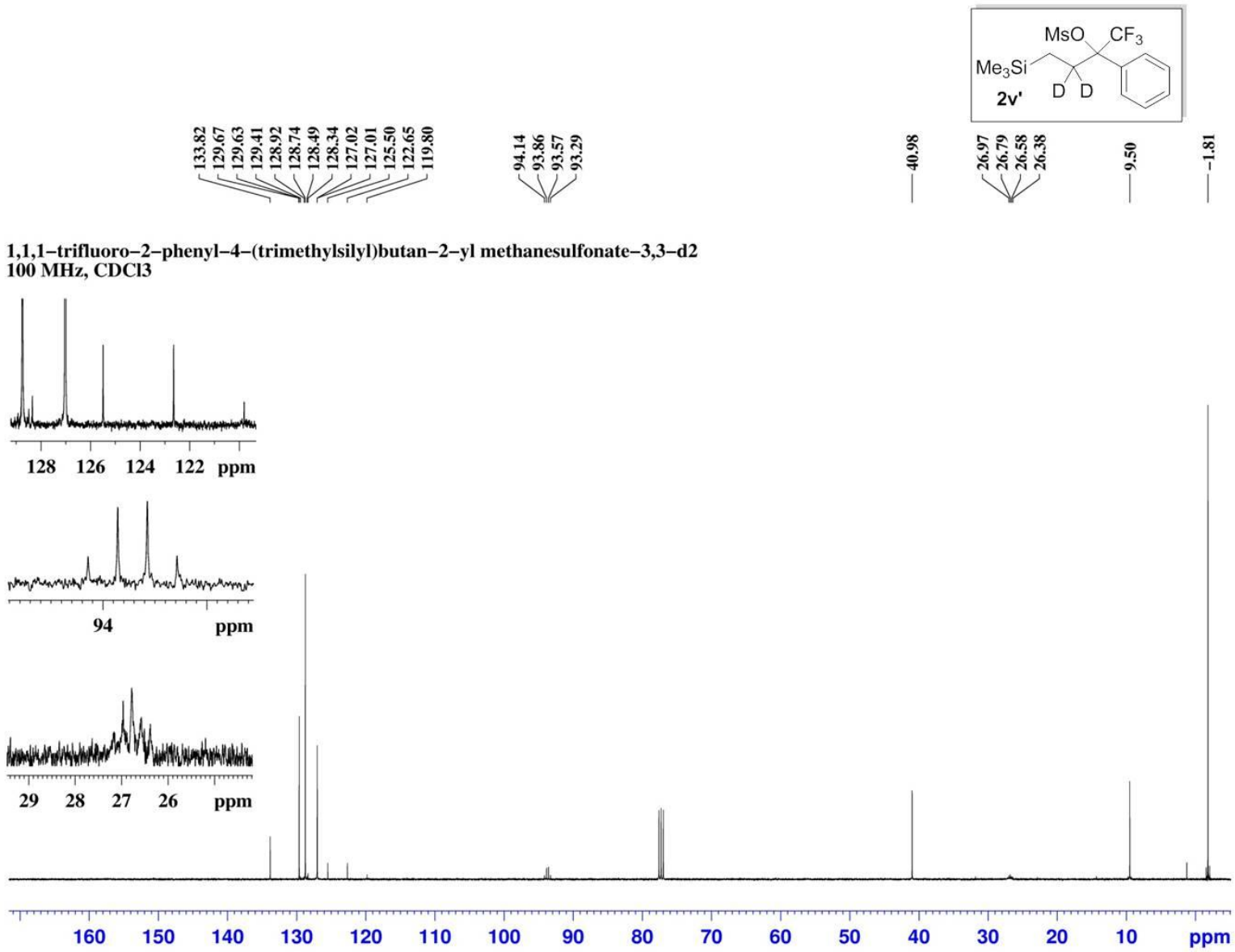
1–phenyl–3–(trimethylsilyl)propan–1–one–2,2–d2
100 MHz, CDCl3



4v'

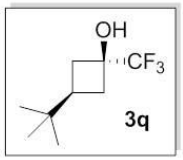


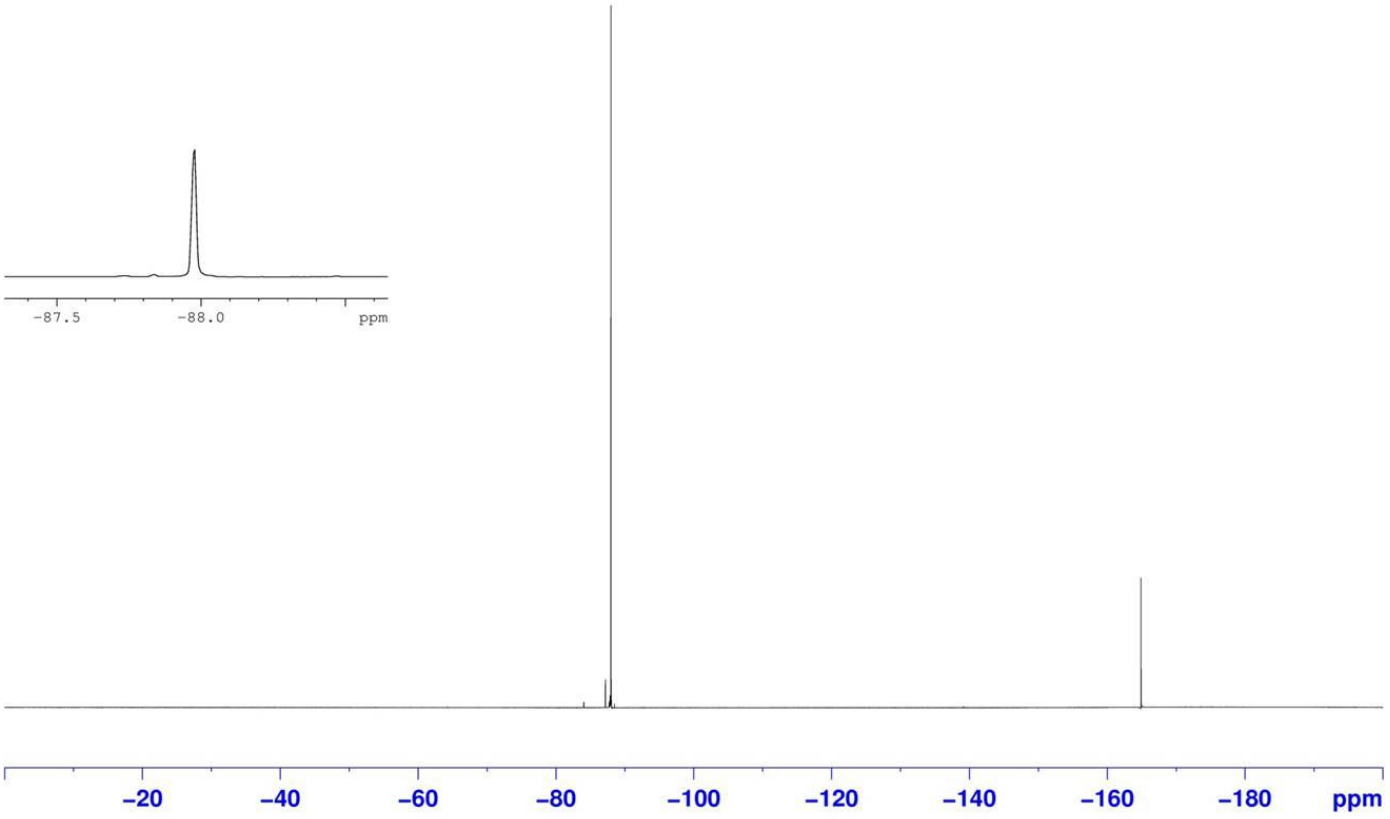

1,1,1−trifluoro−2−phenyl−4−(trimethylsilyl)butan−2−ol−3,3−d2
100 MHz, CDCl3
HO
CF3
Me3Si
D D
3v'
136.76
129.54
128.58
127.27
126.78
124.98
122.71
78.54
78.32
78.11
77.87
29.42
29.24
29.09
28.94
28.79
8.17
−1.72
130 128 126 124 ppm
79.0 78.5 78.0 ppm
30.0 29.5 29.0 28.5 ppm
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


MsO
CF3
Me3Si
D D
2v'
133.82
129.67
129.63
129.41
128.92
128.74
128.49
128.34
127.02
127.01
125.50
122.65
119.80
94.14
93.86
93.57
93.29
40.98
26.97
26.79
26.58
26.38
9.50
-1.81
1,1,1-trifluoro-2-phenyl-4-(trimethylsilyl)butan-2-yl methanesulfonate-3,3-d2
100 MHz, CDCl3
128 126 124 122 ppm
94 ppm
29 28 27 26 ppm
160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

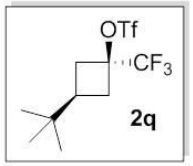
^{19}F NMR Spectra of Synthesized Compounds

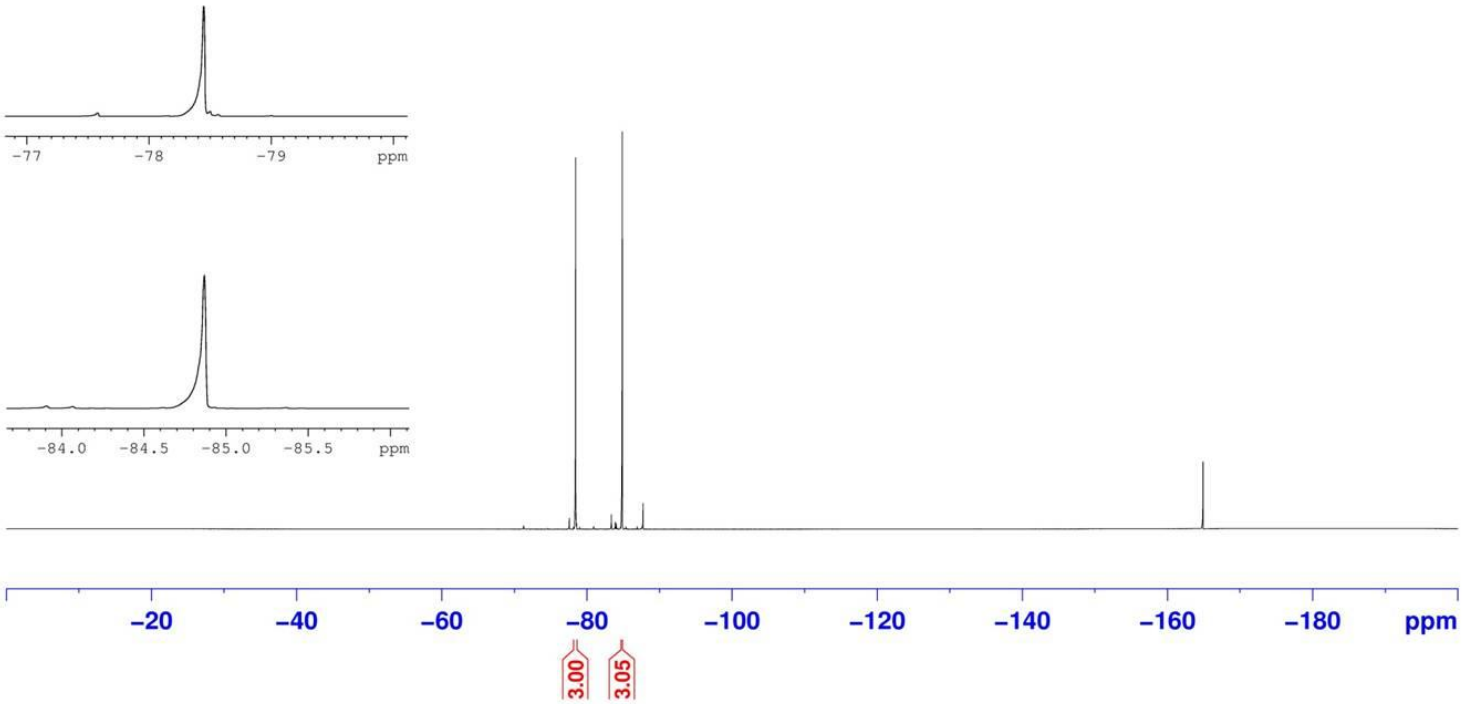
(1s,3s)−3−(tert−butyl)−1−(trifluoromethyl)cyclobutanol "cis"
377 MHz, CDCl3



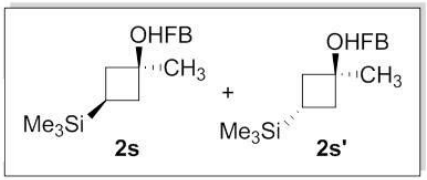


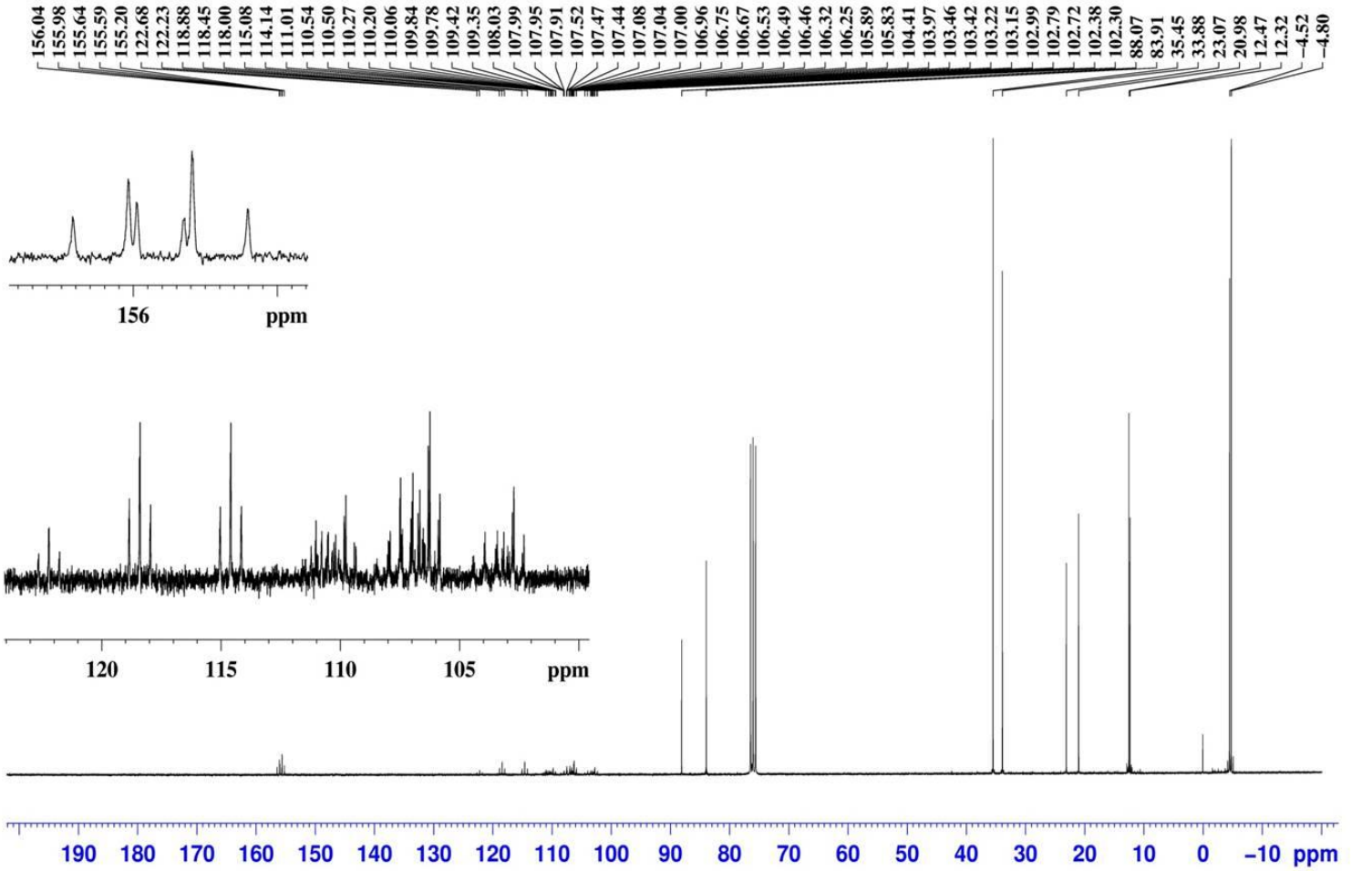
(1s,3s)−3−(tert−butyl)−1−(trifluoromethyl)cyclobutyl trifluoromethanesulfonate "cis"
377 MHz, CDCl3

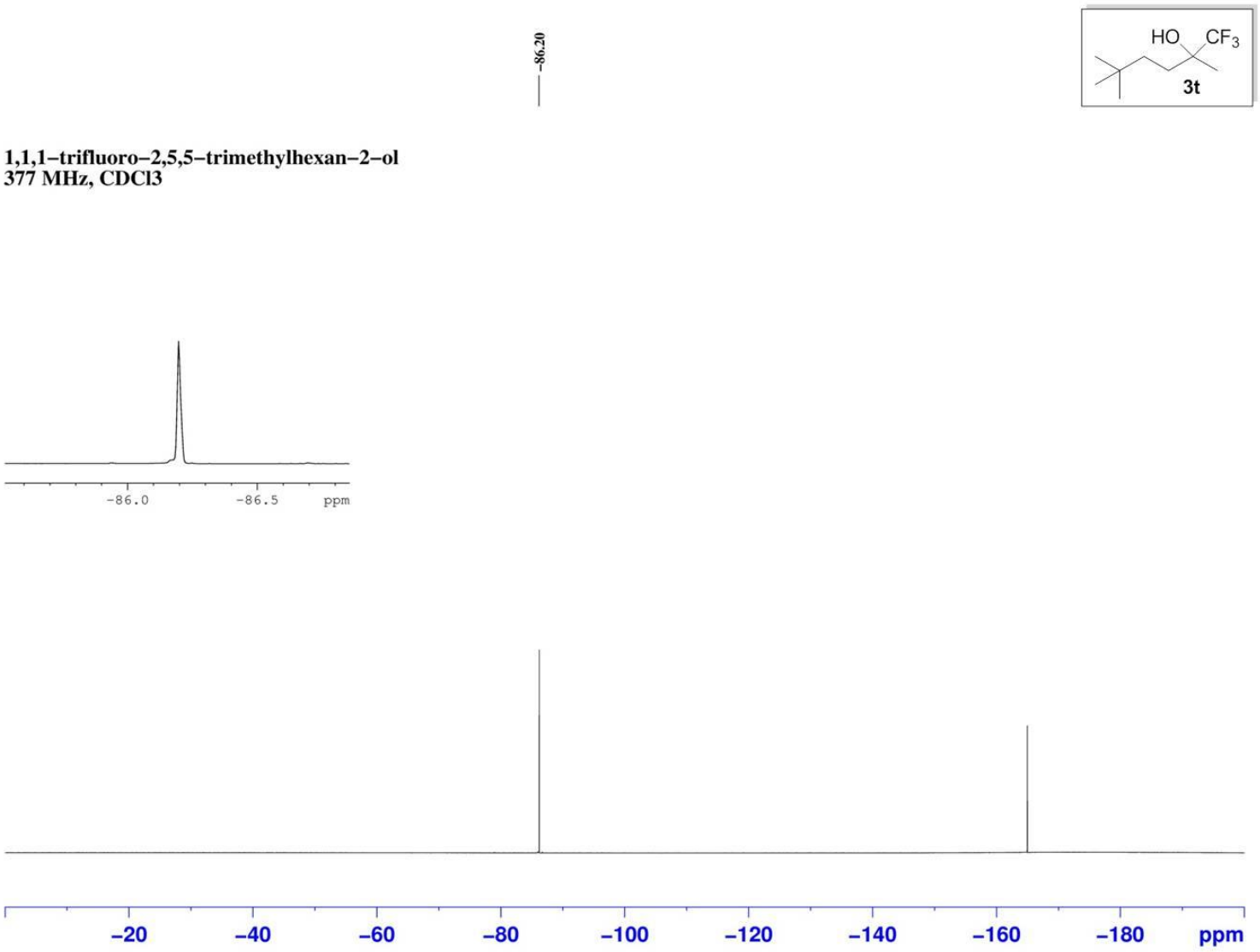


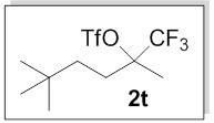


(1s,3s) & (1r,3r)–1–methyl–3–(trimethylsilyl)cyclobutyl 2,2,3,3,4,4,4–heptafluorobutanoate ("cis" & "trans")
282 MHz, CDCl3

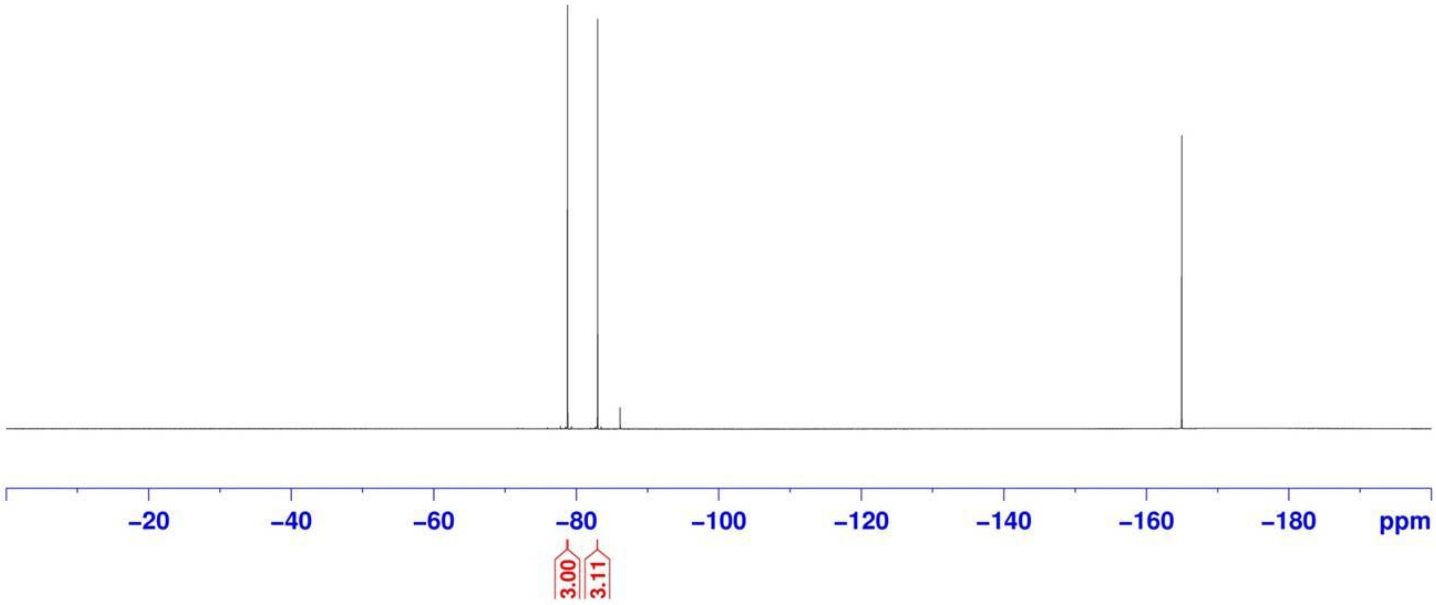




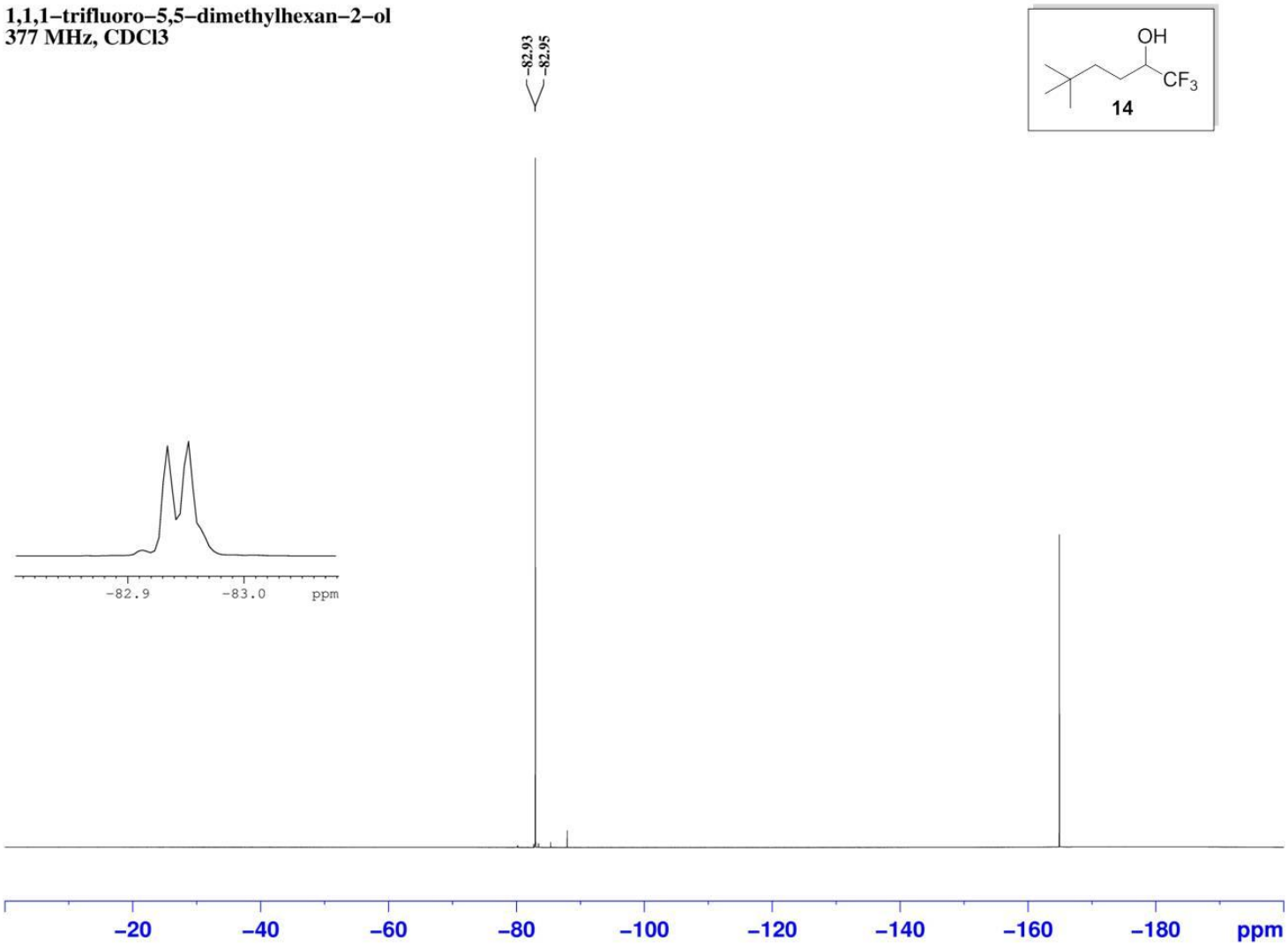

-86.20
HO
CF3
3t
1,1,1−trifluoro−2,5,5−trimethylhexan−2−ol
377 MHz, CDCl3
-86.0
-86.5
ppm
−20
−40
−60
−80
−100
−120
−140
−160
−180
ppm



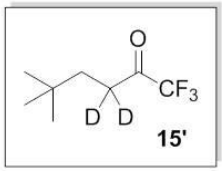
1,1,1−trifluoro−2,5,5−trimethylhexan−2−yl trifluoromethanesulfonate
377 MHz, CDCl3

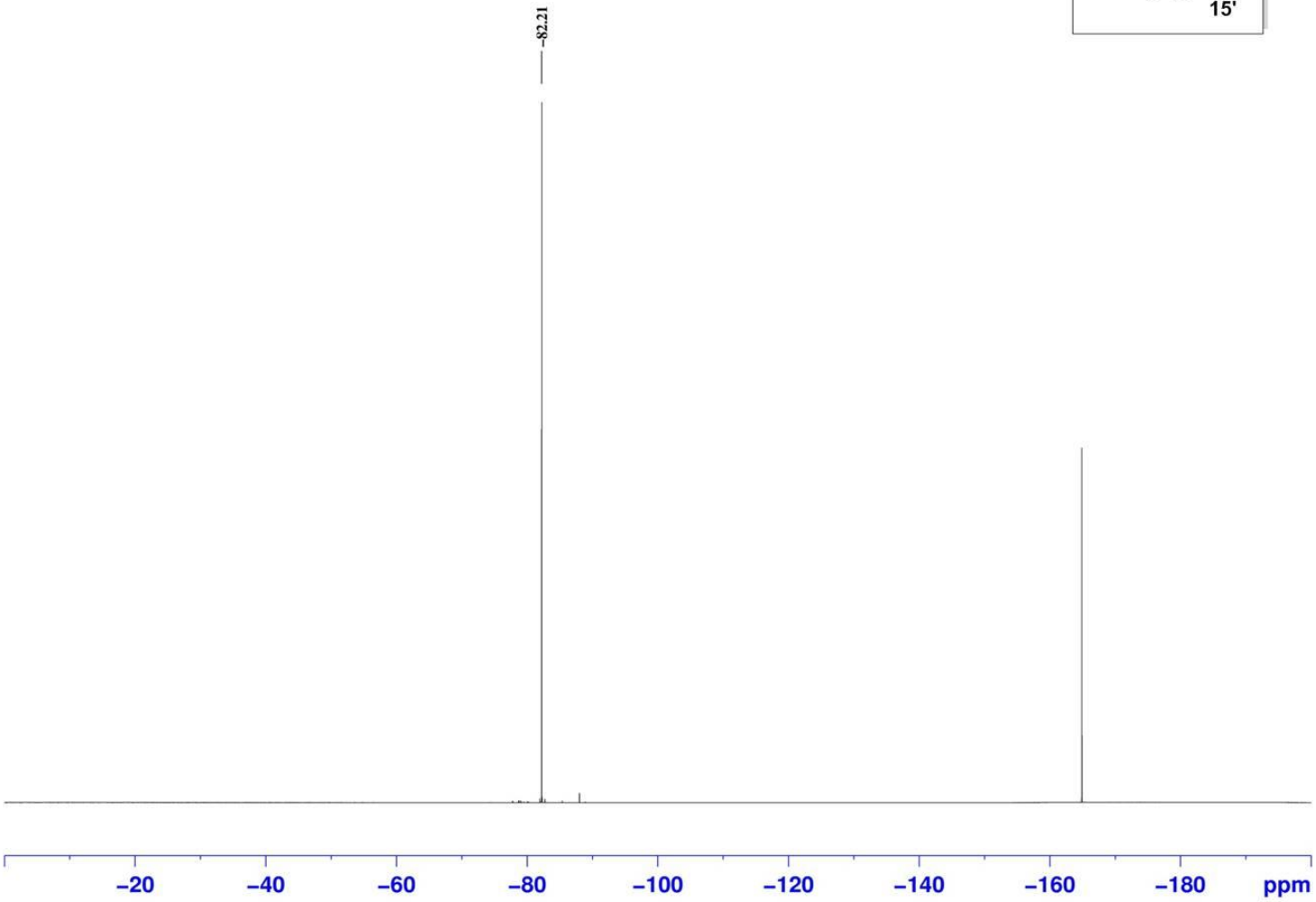


1,1,1–trifluoro–5,5–dimethylhexan–2–ol
377 MHz, CDCl3

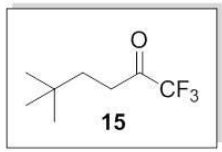


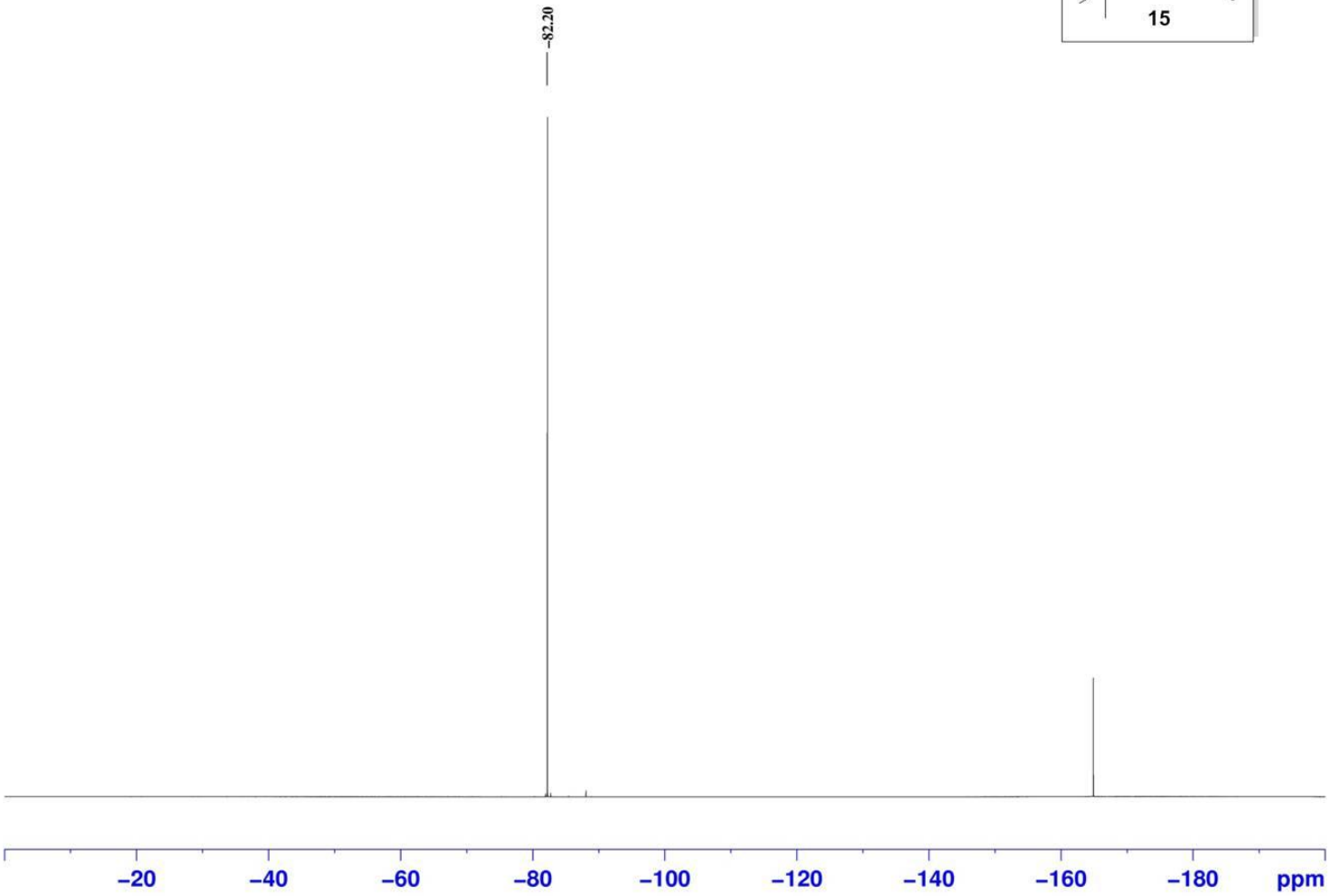
1,1,1–trifluoro–5,5–dimethylhexan–2–one–3,3–d2
377 MHz, CDCl3



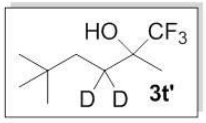


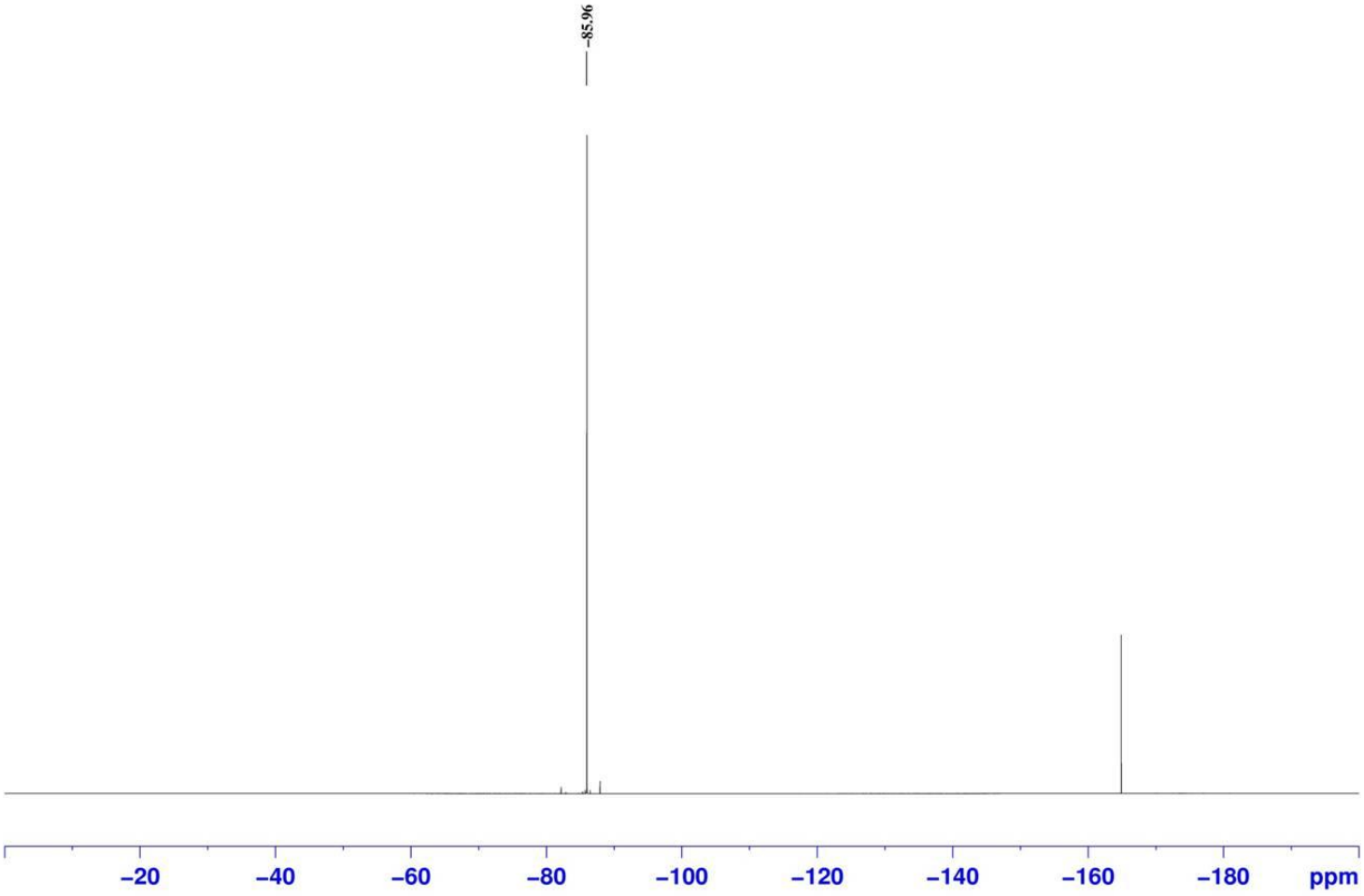
1,1,1–trifluoro–5,5–dimethylhexan–2–one
377 MHz, CDCl3



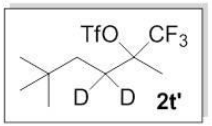


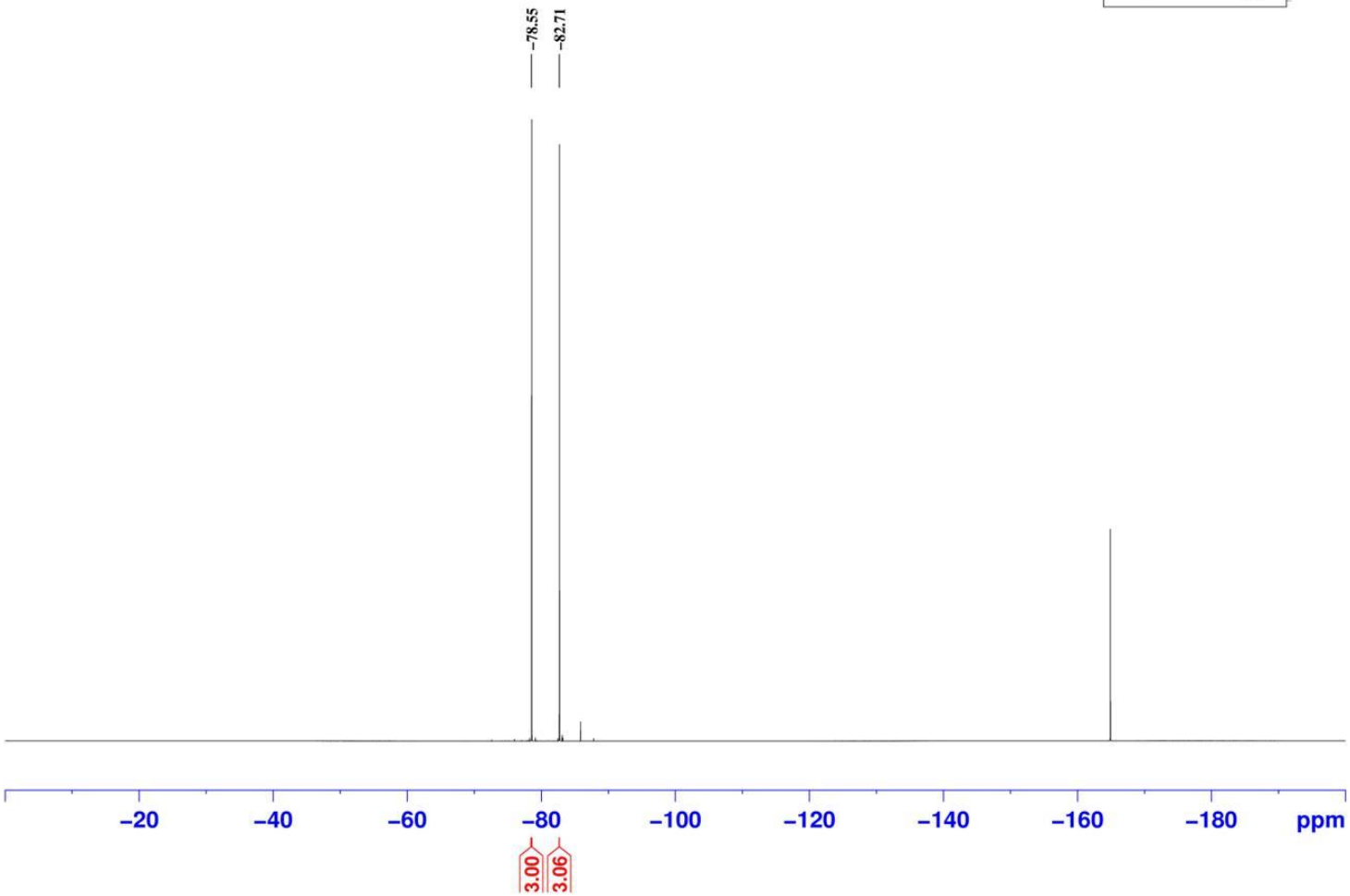
1,1,1−trifluoro−2,5,5−trimethylhexan−2−ol−3,3−d2
377 MHz, CDCl3



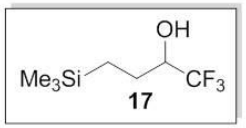


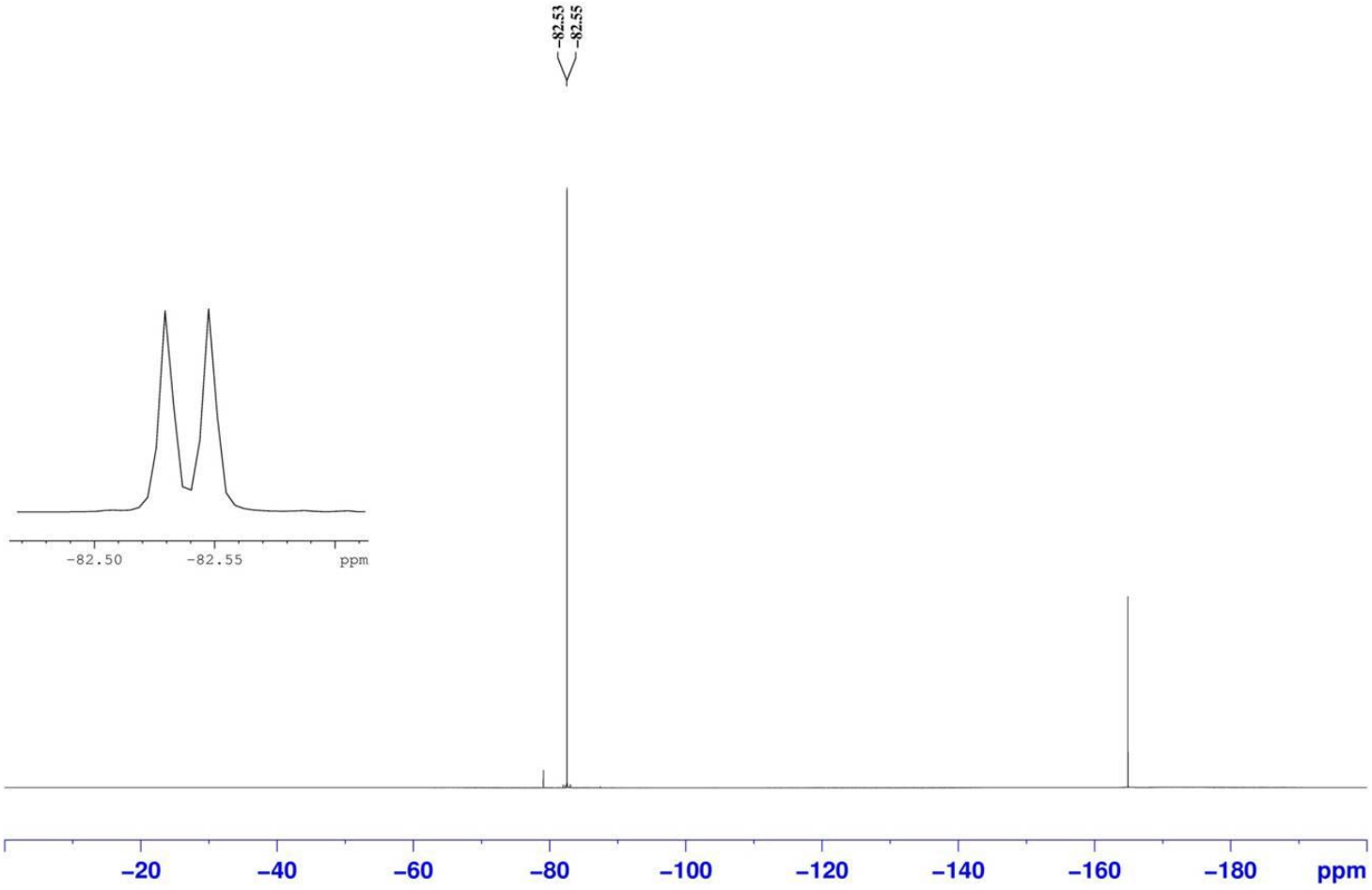
1,1,1−trifluoro−2,5,5−trimethylhexan−2−yl trifluoromethanesulfonate−3,3−d2
377 MHz, CDCl3



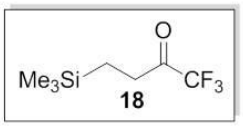


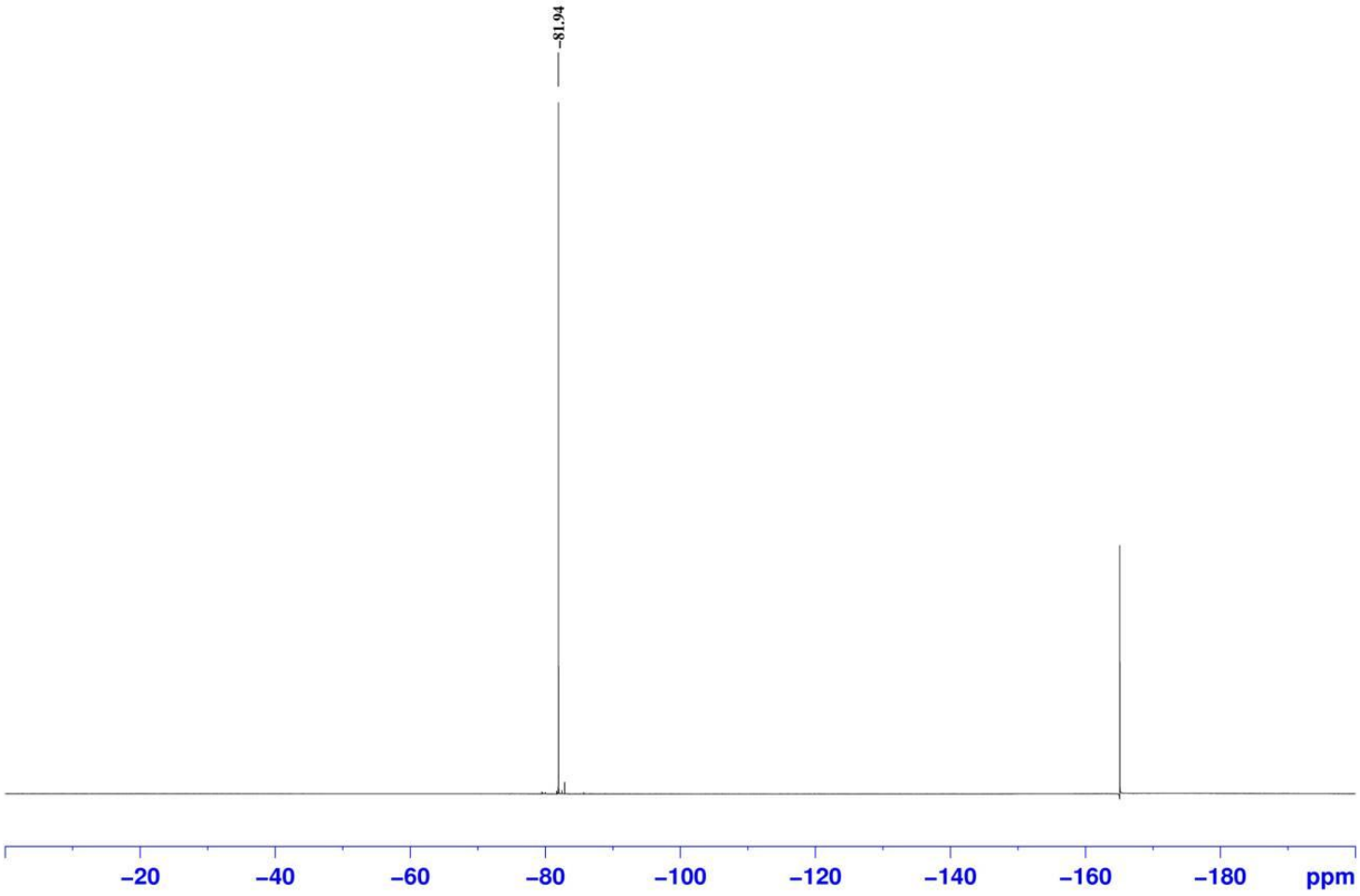
1,1,1−trifluoro−4−(trimethylsilyl)butan−2−ol
377 MHz, CDCl3



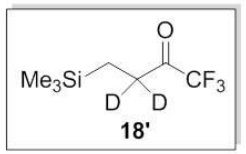


1,1,1−trifluoro−4−(trimethylsilyl)butan−2−one
377 MHz, CDCl3

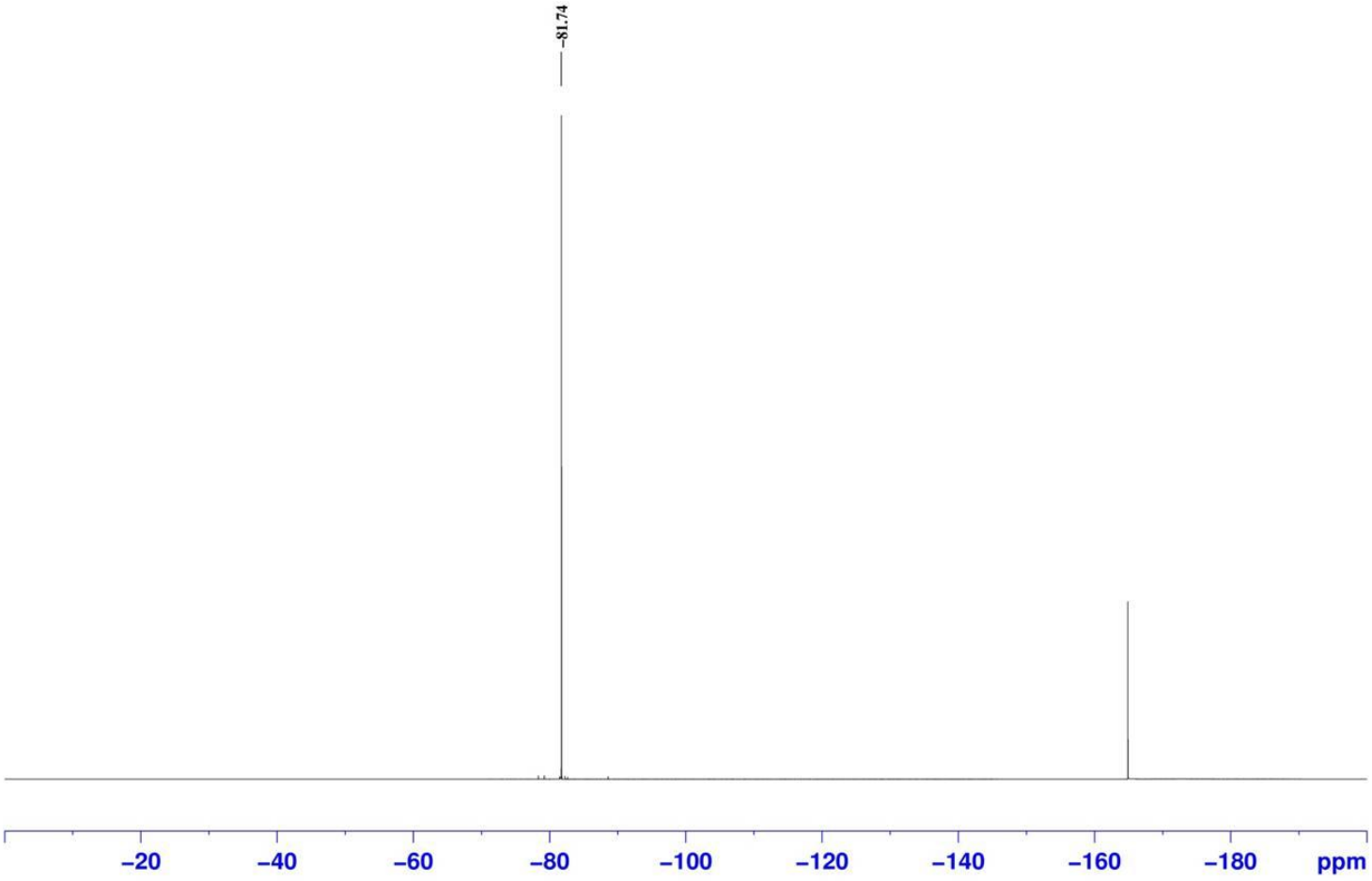




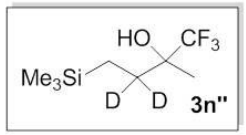
1,1,1−trifluoro−4−(trimethylsilyl)butan−2−one−3,3−d2
377 MHz, CDCl3

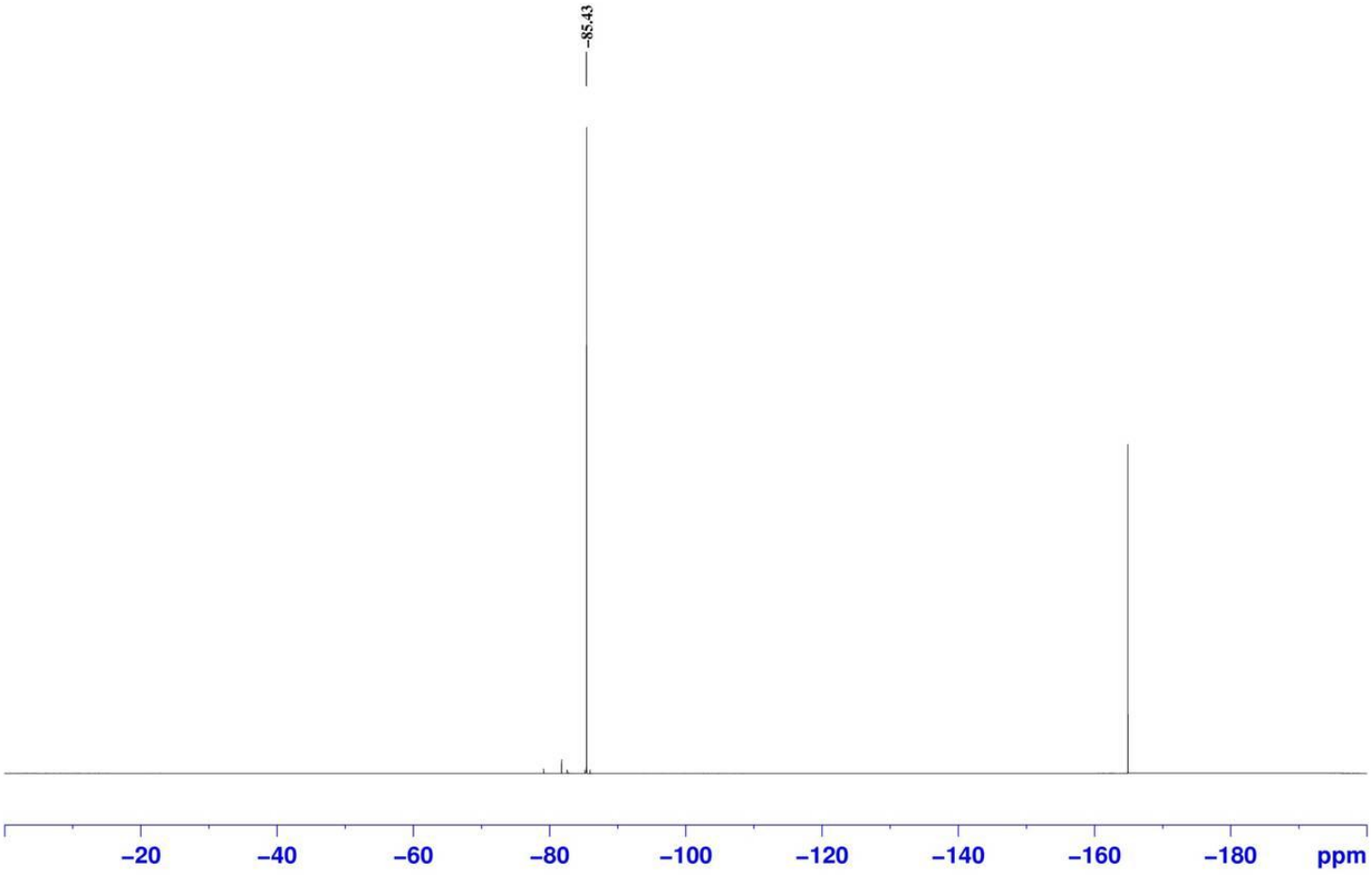


18'

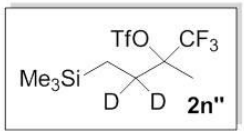


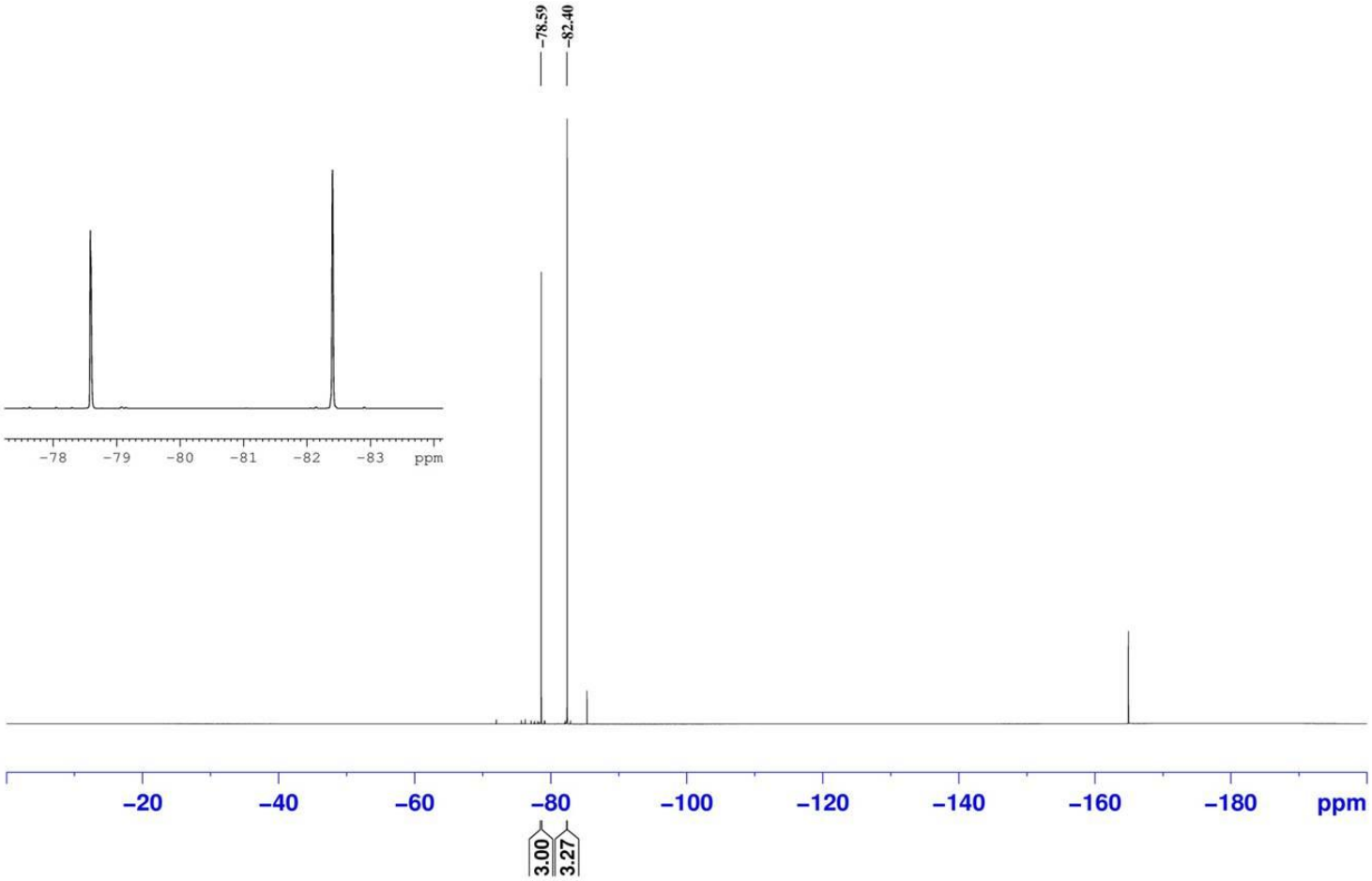
1,1,1−trifluoro−2−methyl−4−(trimethylsilyl)butan−2−ol−3,3−d2
377 MHz, CDCl3

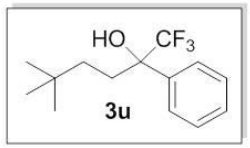




1,1,1−trifluoro−2−methyl−4−(trimethylsilyl)butan−2−yl trifluoromethanesulfonate−2,2−d2
377 MHz, CDCl3

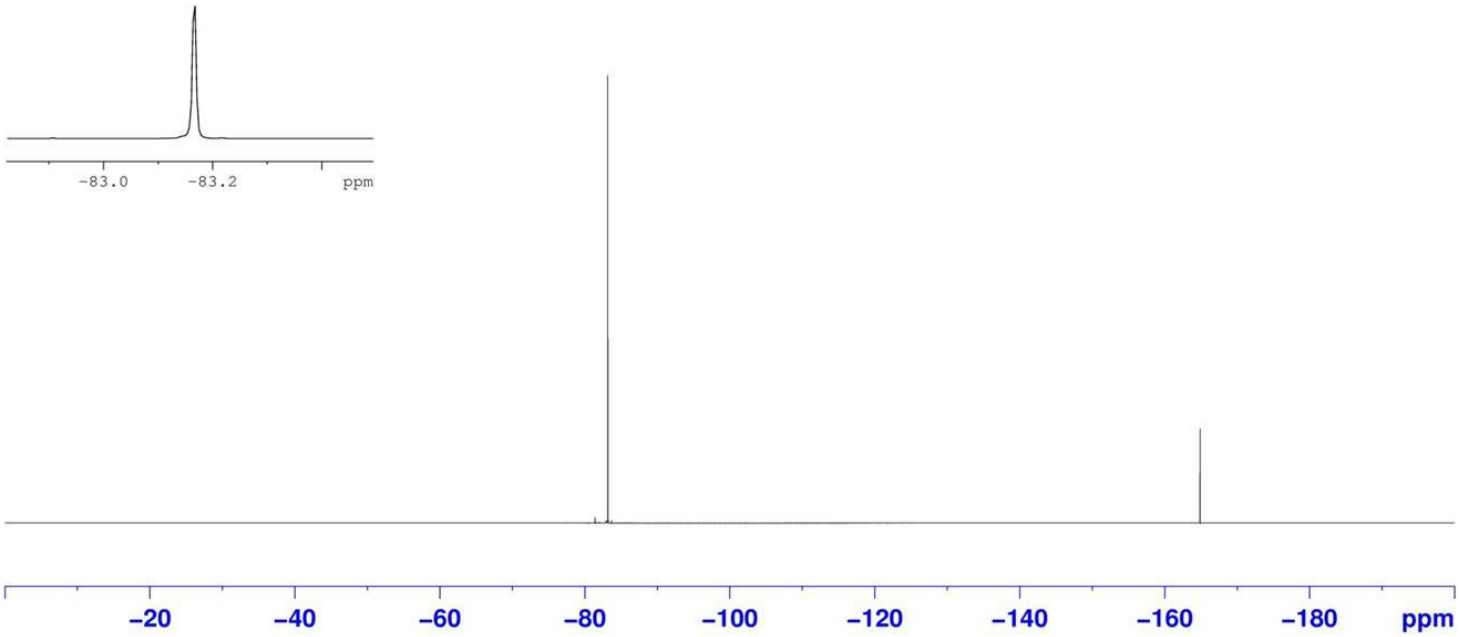




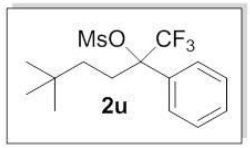


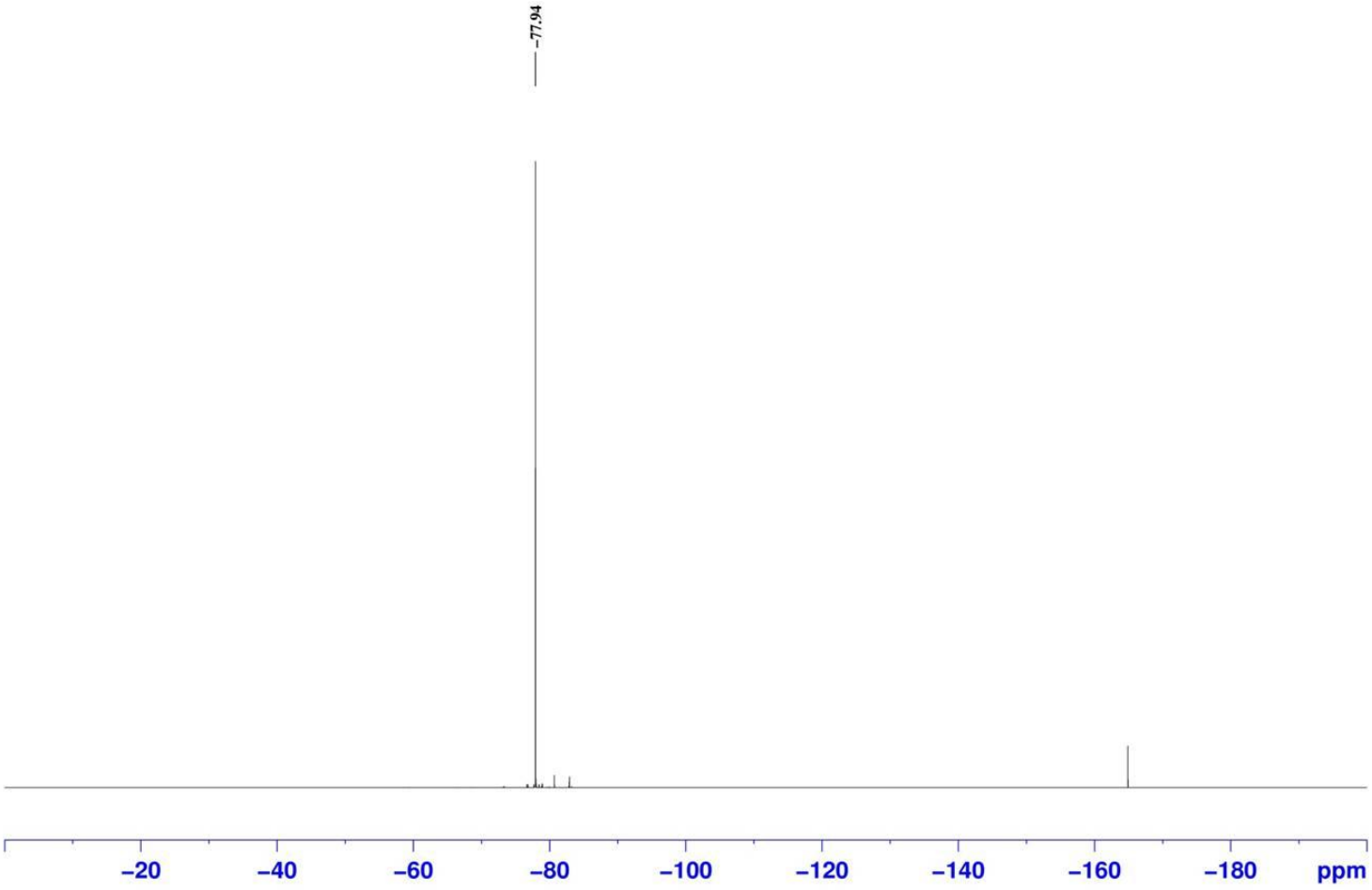
-83.17

1,1,1–trifluoro–5,5–dimethyl–2–phenylhexan–2–ol
377 MHz, CDCl3

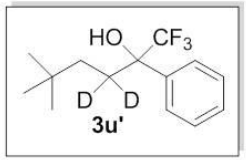


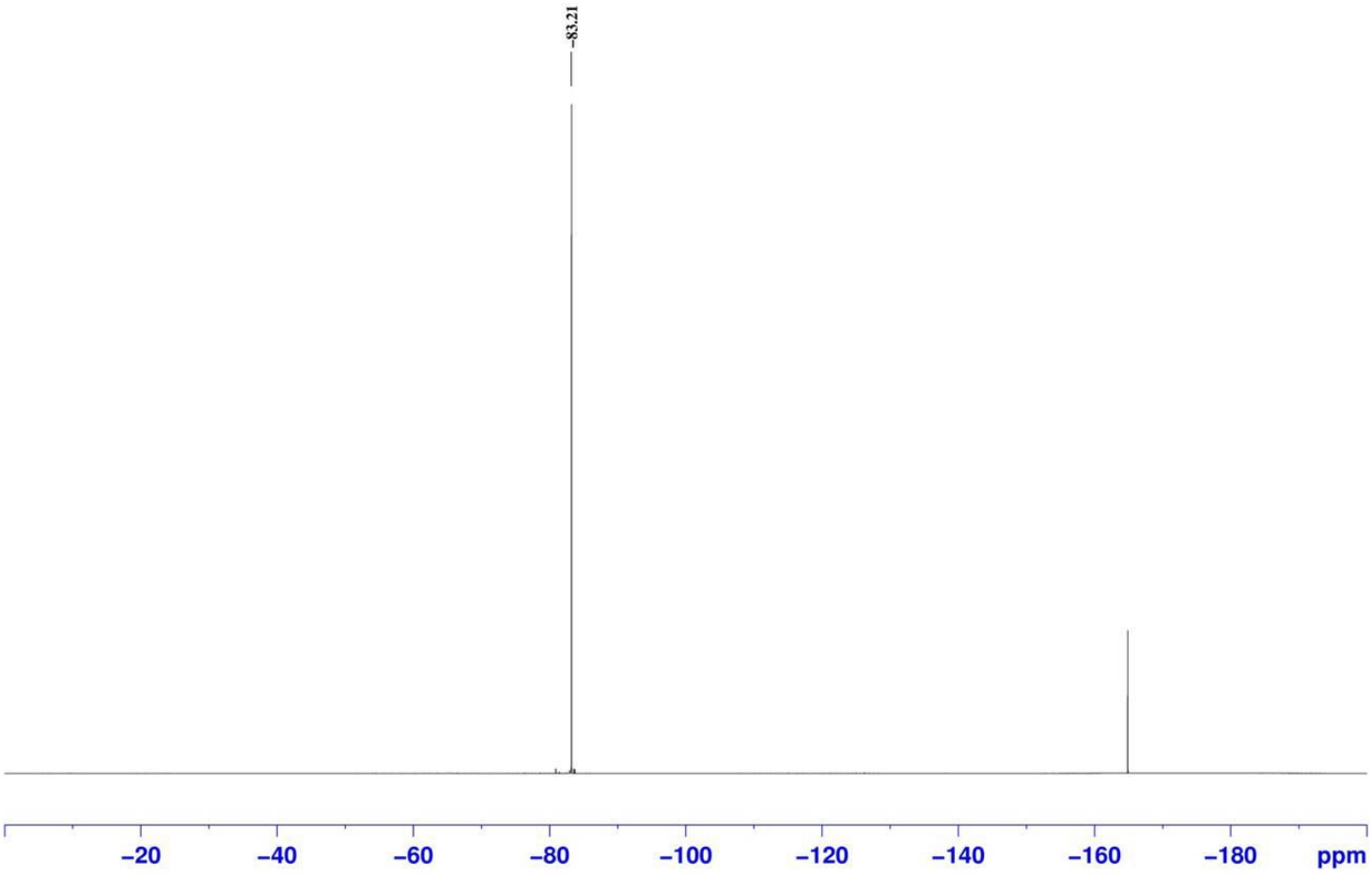
1,1,1−trifluoro−5,5−dimethyl−2−phenylhexan−2−yl methanesulfonate
377 MHz, CDCl3

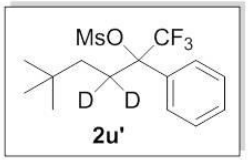




1,1,1−trifluoro−5,5−dimethyl−2−phenylhexan−2−ol−2,2−d2
377 MHz, CDCl3



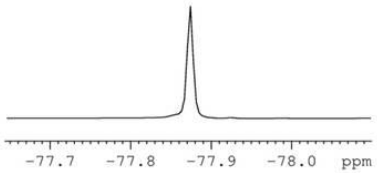




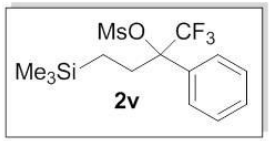
2u'

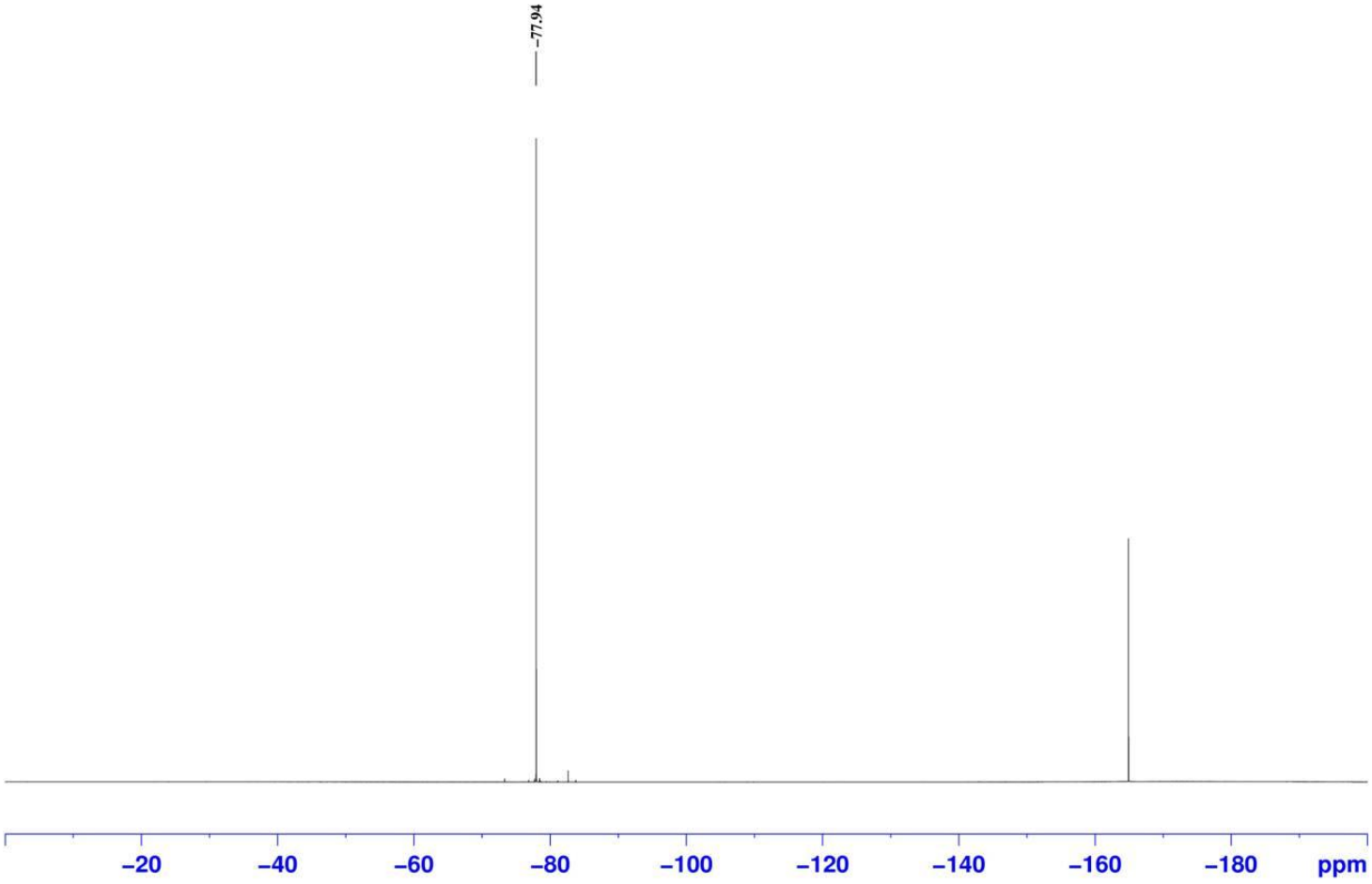
−77.87

1,1,1−trifluoro−5,5−dimethyl−2−phenylhexan−2−yl methanesulfonate−3,3−d2
377 MHz, CDCl3

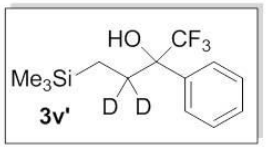


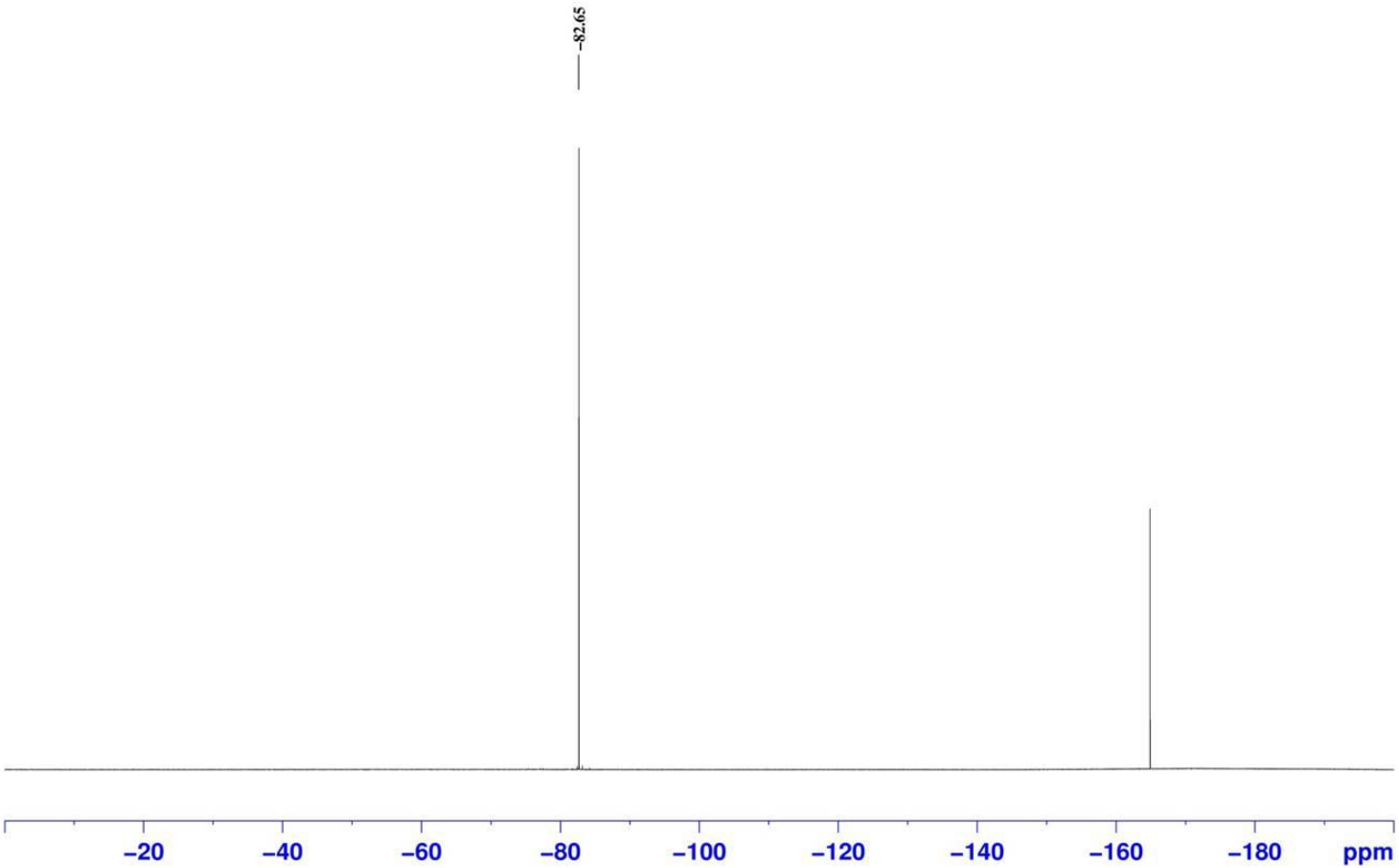
1,1,1–trifluoro–2–phenyl–4–(trimethylsilyl)butan–2–yl methanesulfonate
377 MHz, CDCl3



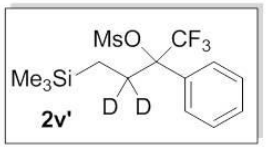


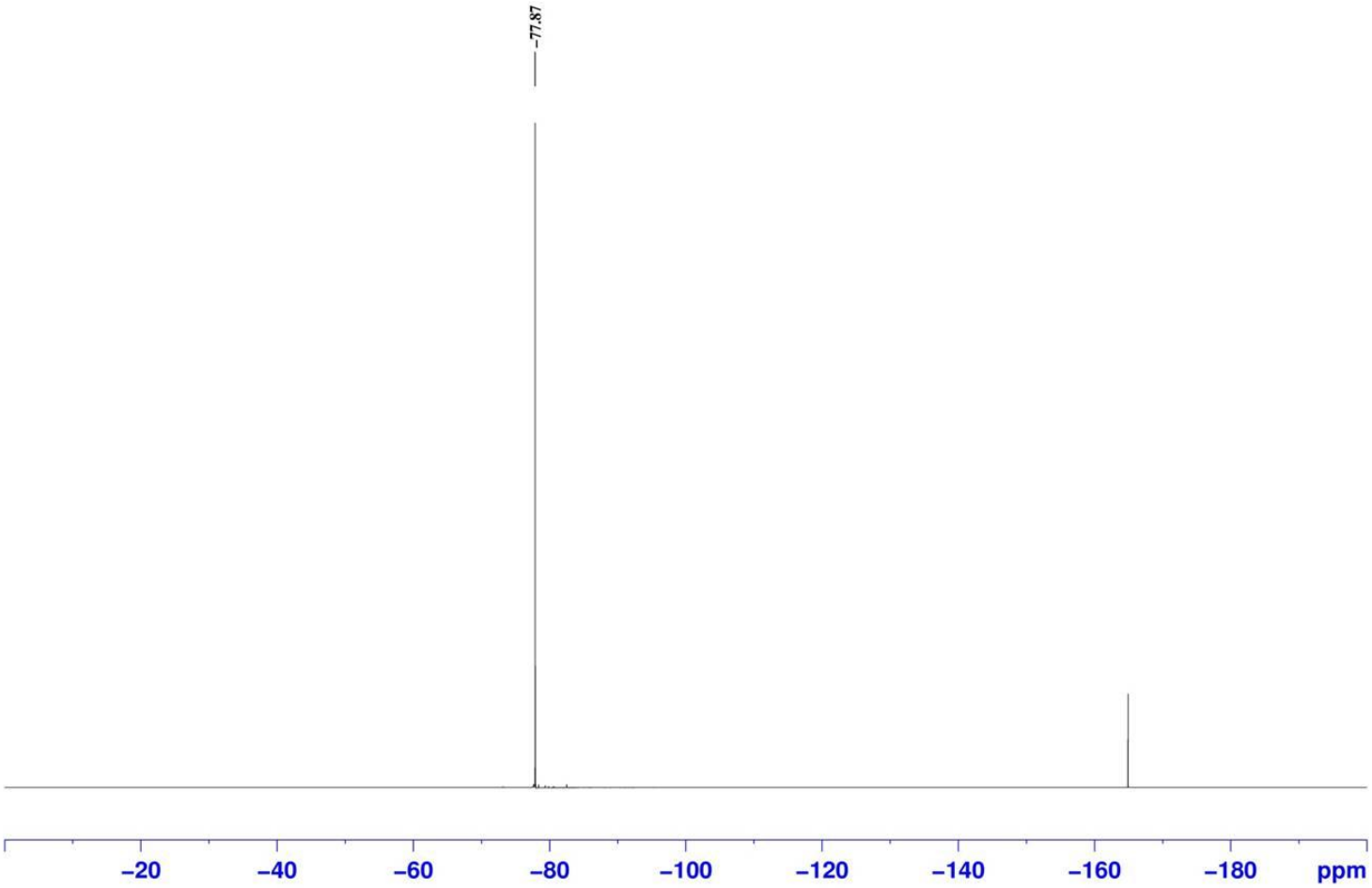
1,1,1−trifluoro−2−phenyl−4−(trimethylsilyl)butan−2−ol−3,3−d2
377 MHz, CDCl3



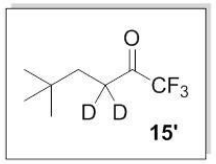


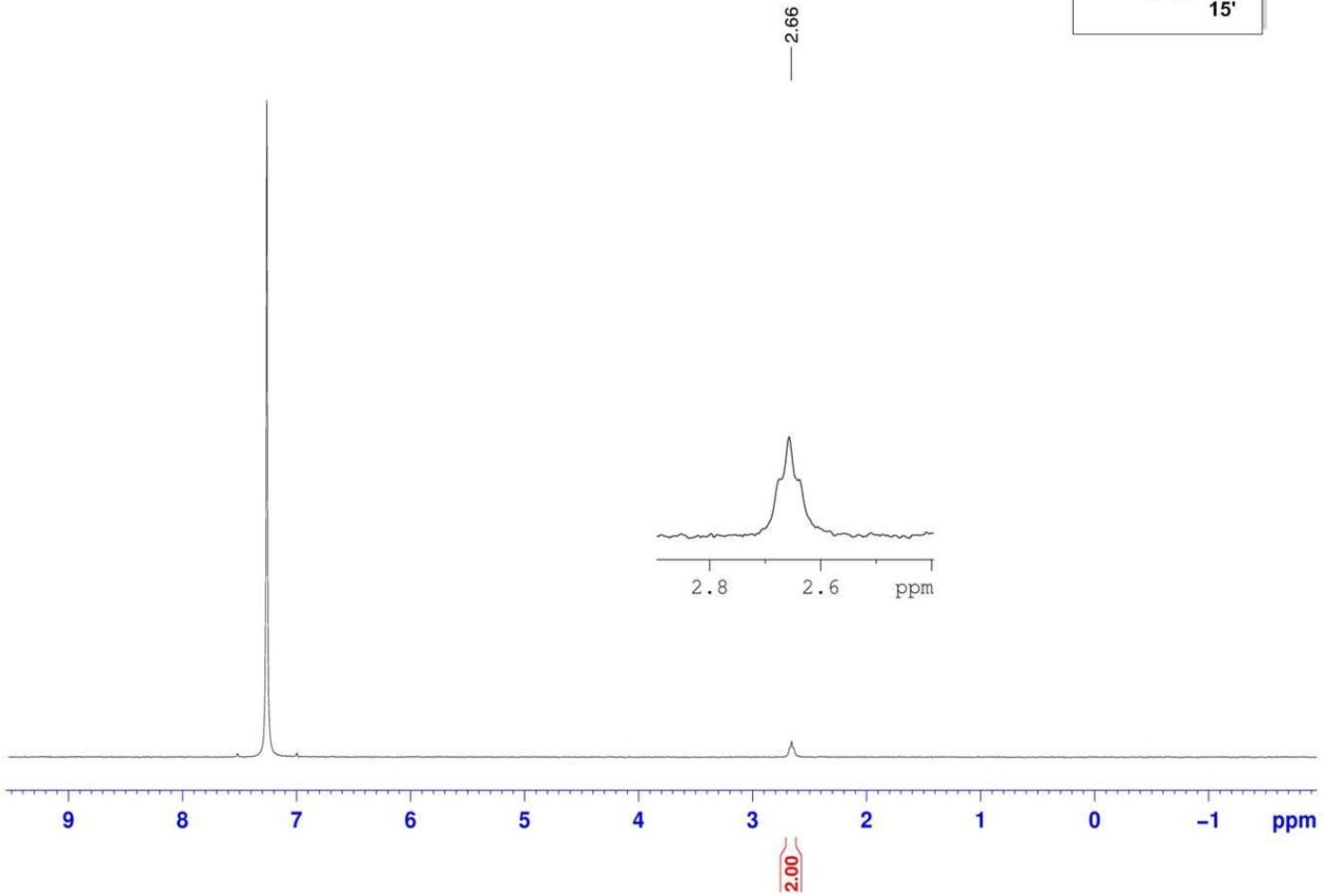
1,1,1−trifluoro−2−phenyl−4−(trimethylsilyl)butan−2−yl methanesulfonate−3,3−d2
377 MHz, CDCl3



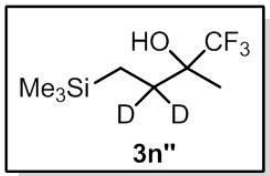


1,1,1–trifluoro–5,5–dimethylhexan–2–one–3,3–d2
61 MHz, CDCl3





1,1,1–trifluoro–2–methyl–4–(trimethylsilyl)butan–2–ol–3,3–d2
77 MHz, CDCl3



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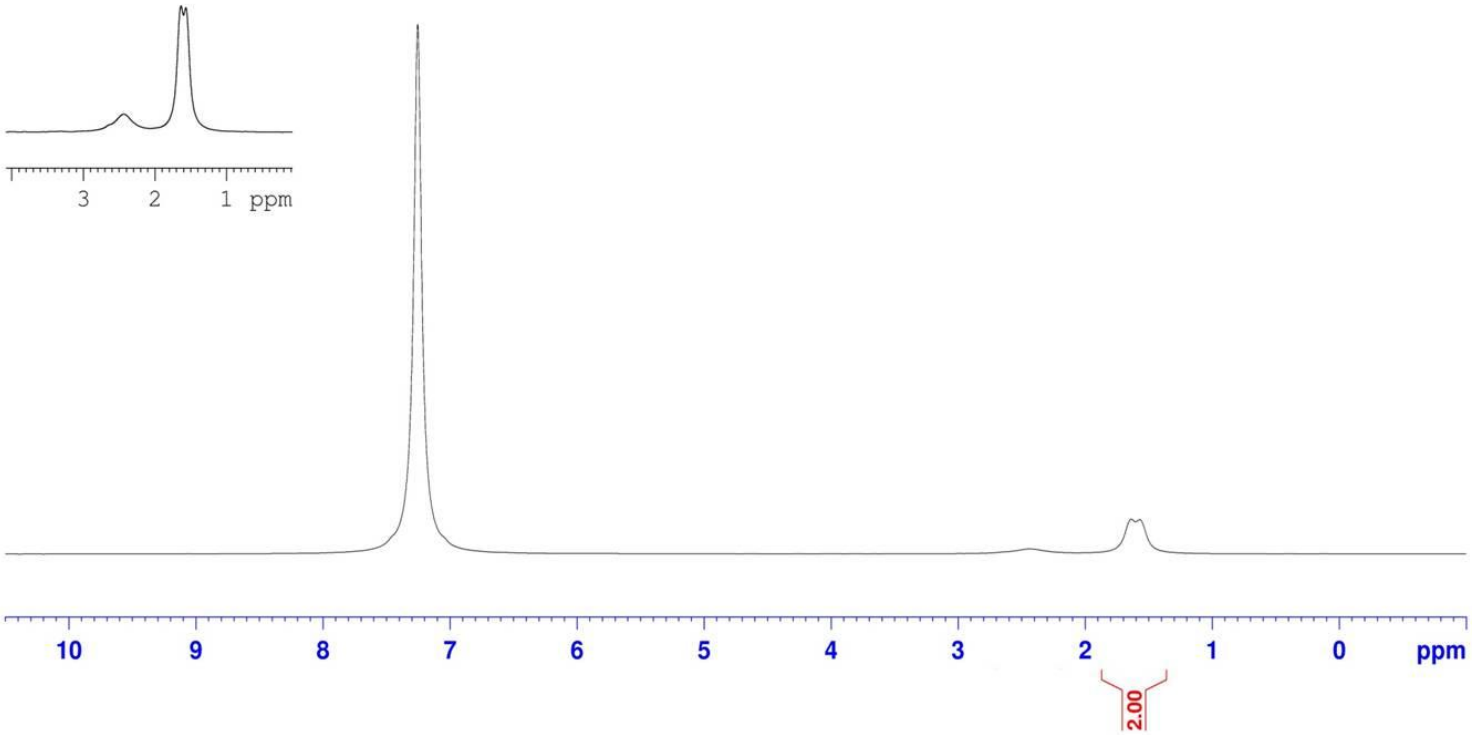
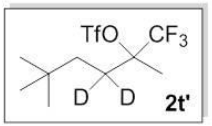
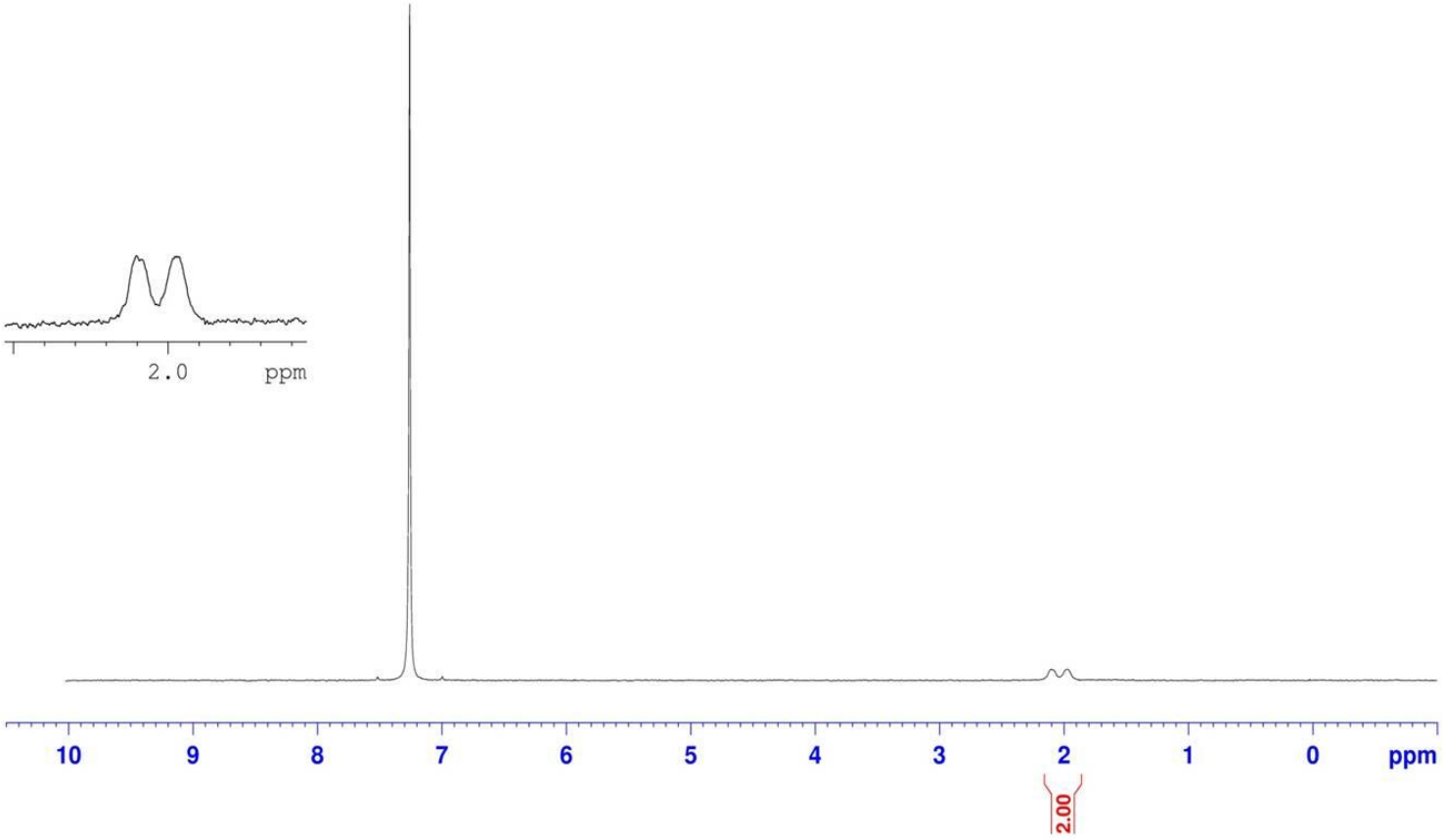
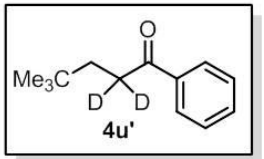


1,1,1–trifluoro–2,5,5–trimethylhexan–2–yl trifluoromethanesulfonate–3,3–d2
61 MHz, CDCl3

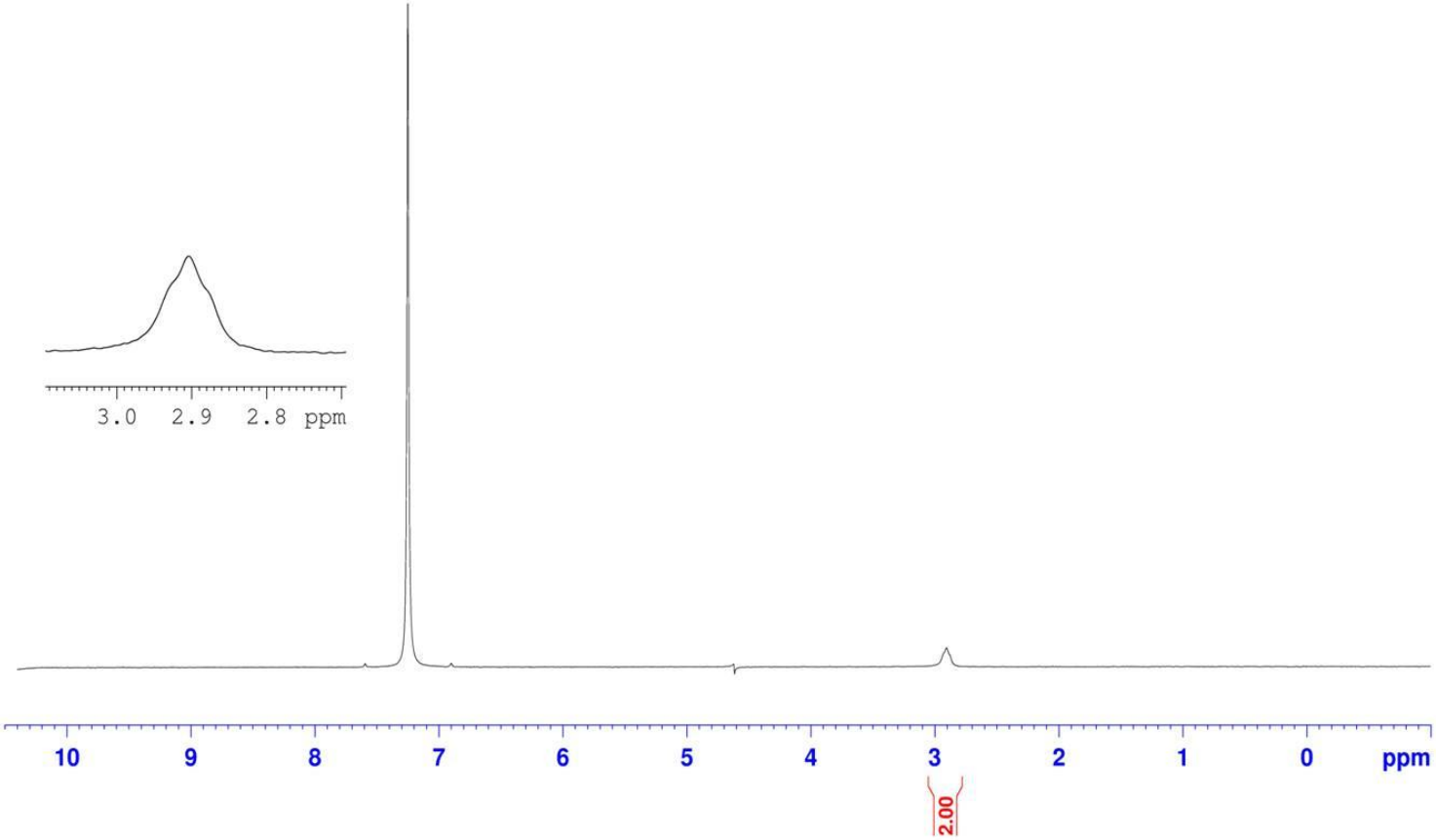




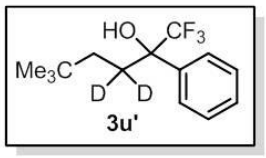
4,4–dimethyl–1–phenylpentan–1–one–3,3–d2
61 MHz, CDCl3



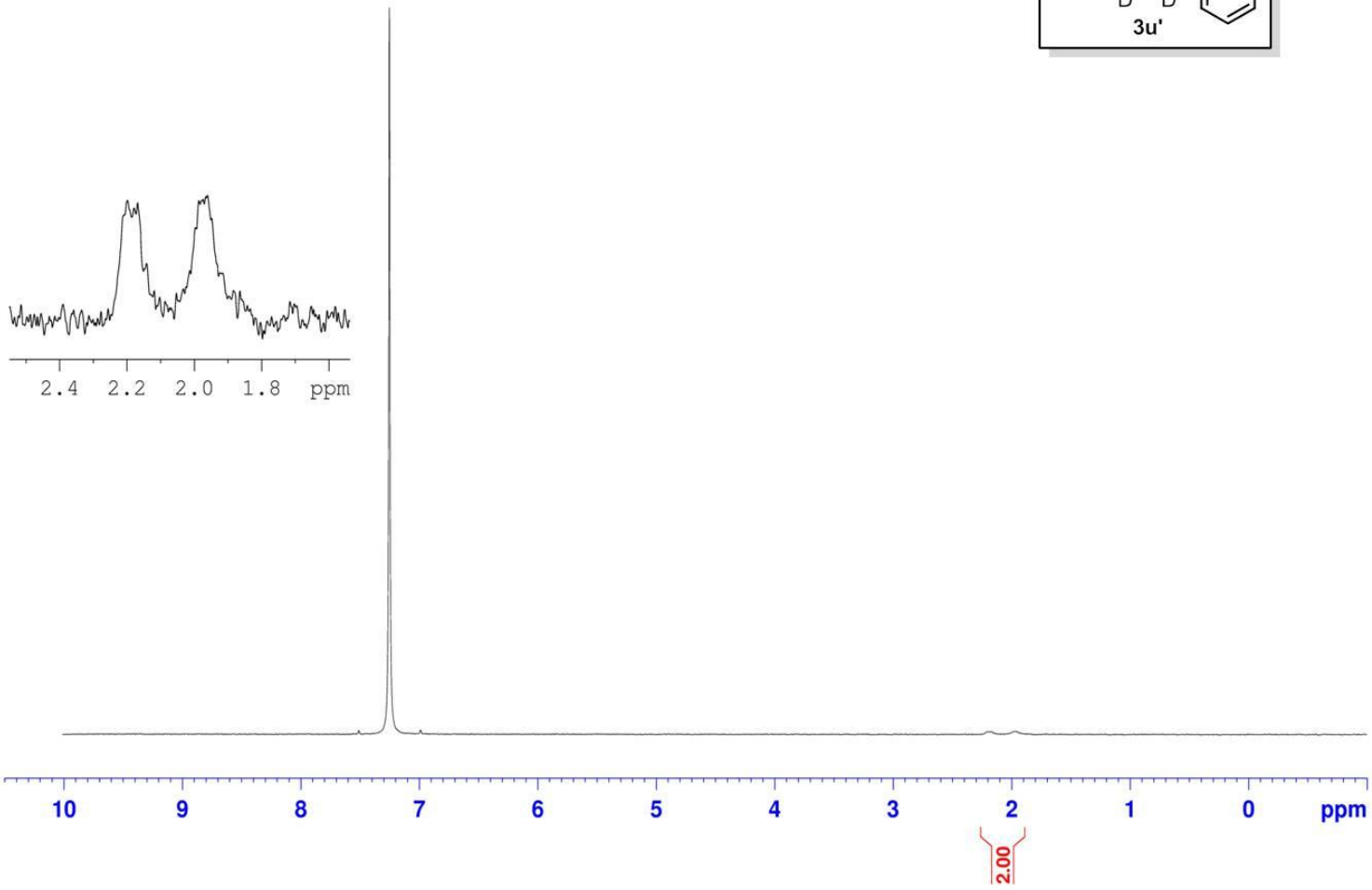
4u'



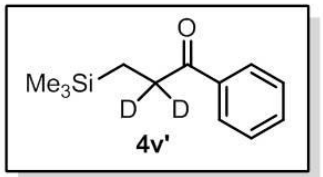
1,1,1−trifluoro−5,5−dimethyl−2−phenylhexan−2−ol−3,3−d2
61 MHz, CDCl3



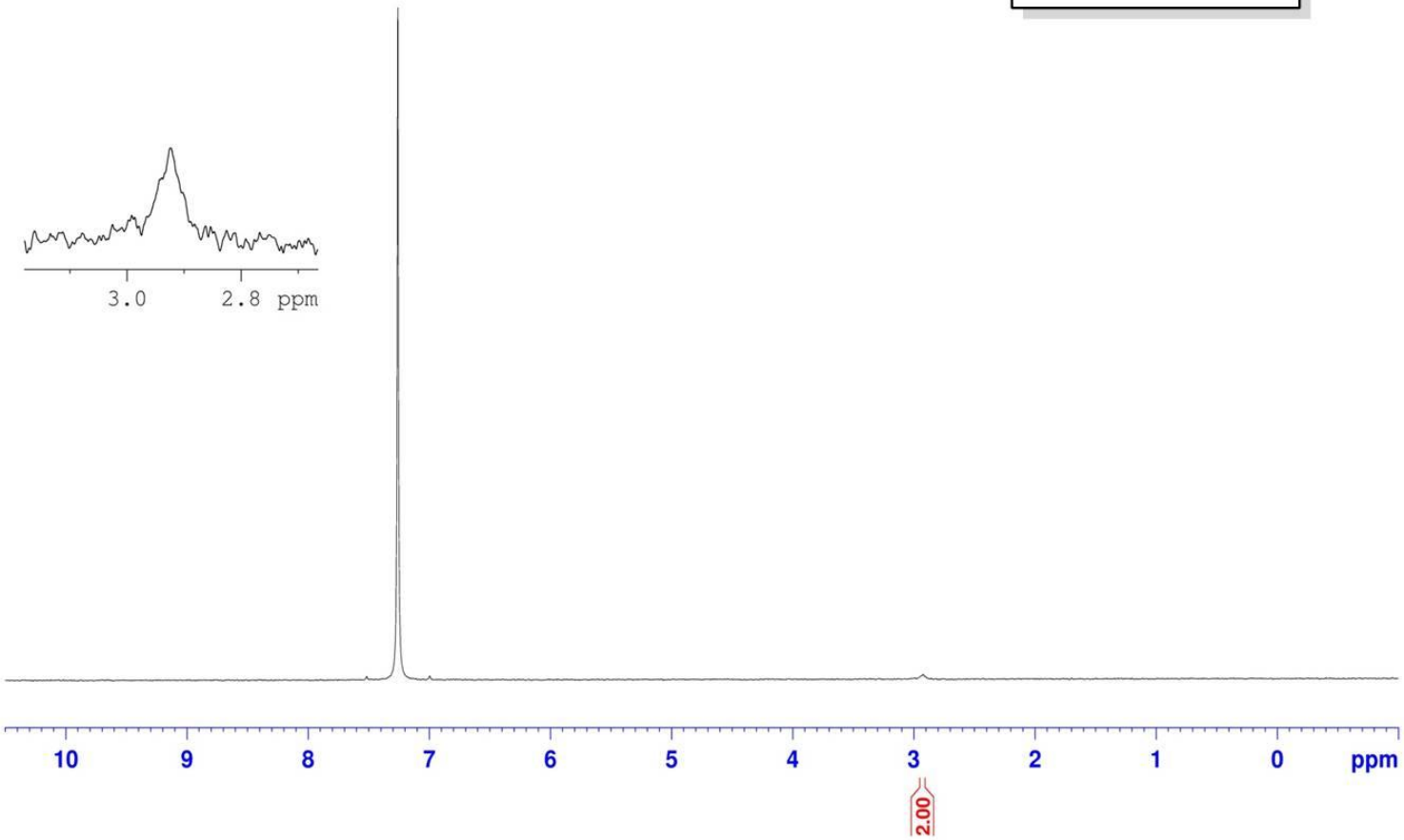
3u'



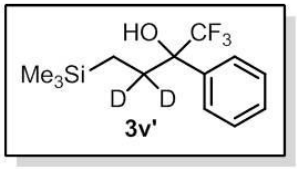
1–phenyl–3–(trimethylsilyl)propan–1–one–2,2–d2
61 MHz, CDCl3



4v'



1,1,1−trifluoro−2−phenyl−4−(trimethylsilyl)butan−2−ol−3,3−d2
61 MHz, CDCl3



3v'