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Para-Selective Dearomatization of Phenols by I(I)/I(III) Catalysis-Based Fluorination

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I. General Information

Commercially available reagents were purchased in reagent grade quality from *Sigma Aldrich*, *Merck*, *Alfa Aesar*, *TCI Europe*, *Fluorochem*, *BLD Pharm, Thermo Fisher Scientific* or *abcr* and were used directly without purification unless stated otherwise. Solvents used for extractions or chromatographic purification were bought as technical grade quality and distilled on a rotary evaporator prior to use. Dry solvents were taken from a Grubbs-type purification system with columns packed with molecular sieves and aluminium oxide. Reactions with dry solvent were run under an argon atmosphere using standard *Schlenk* techniques. Column chromatography was performed using silica gel as stationary phase (40-63 *µ*m; VWR Chemicals). Thin layer chromatography was performed on aluminium foil coated with silica gel and fluorescent indicator F_{254}. Visualization was performed with UV light (254 nm), with $KMnO_4$ or CAM solutions. Column chromatography was performed using silica gel (40-63 µm, *VWR Chemicals*). Concentration under reduced pressure was performed on a rotary evaporator at 40 °C and ~10mbar. NMR spectra were measured by the NMR service in the Organisch-Chemisches Institut, Westfälische Wilhelms-Universität Münster on a *Bruker Avance II 400*, an *Agilent DD2 500* or an *Agilent DD2 600* spectrometer. The chemical shifts are referenced to the residual solvent peak as the internal standard (7.26 ppm for $CDCl_3$, 2.50 for DMSO-d_6 for ^{1}H-NMR, 77.16 ppm for $CDCl_3$, 39.52 for DMSO-d_6 for ^{13}C-NMR). The multiplicities are abbreviated as follows: s (singlet), d (doublet), t (triplet), q (quartet), p (pentet), h (hept), m (multiplet) and br (broad) or combinations of the mentioned. Mass spectrometry was performed by the MS staff of the Organisch-Chemisches Institut, Westfälische Wilhelms-Universität Münster on a *Triplequad TSQ 7000* (Thermo-Finnigan-MAT, EI), a *Triplequad Quattro Micro GC* (Waters-Micromass, EI), a *Trace 1310*/*ISQ 7000 Single Quad* (Thermo Fisher Scientific, EI), a *Trace 1310/GC Exactive Orbitrap* (Thermo Fisher Scientific, EI), a *MicroTof* (Bruker Daltronics, ESI) and a *LTQ Orbitrap LTQ XL* (Thermo Fisher Scientific, ESI). Melting points were measured on a *Büchi B-540* melting point apparatus using open glass capillaries and are uncorrected. IR-spectra were recorded on a *Jasco FT/IR-4600*. The absorption bands are reported in wave numbers ũ (cm^{-1}) and the intensities are reported as w (weak), m (medium), s (strong). Specific optical rotations were measured on a *Jasco P2000* polarimeter in specified solvents. Enantiomeric rations were determined on an *Agilent 1260 Infinity II* HPLC system using a diod array detector. Following chiral columns were used: *Daicel AD-H,*

AS-H, OD-H (all 5 μm, 4.6 mmx250 mm) and a *ReproSil Chiral-NR* (8 μm, 4.6 mmx250 mm). Mobile phases were specified mixtures of *n*-hexane and isopropanol.

Photoreactions were performed utilizing a 365 nm UVA LED (emission spectrum see Figure S1)

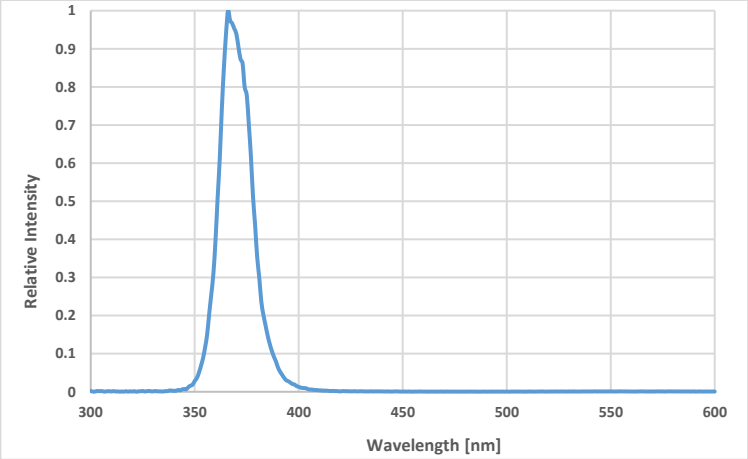


Figure S1: Emission spectrum of the utilized UVA-LED (365 nm).

Preparation of Amine:HF mixtures

Amine:HF mixtures were used as premixed stock solutions from commercially available $NEt_3 \cdot 3HF$ and pyr:HF 1:9.23 (Olah's reagent).

A mixture of amine:HF 1:3 was obtained by using 0.50 mL of $NEt_3 \cdot 3HF$.

A mixture of amine:HF 1:3.5 was obtained by mixing 0.44 mL of $NEt_3 \cdot 3HF$ and 0.06 mL of Olah's reagent.

A mixture of amine:HF 1:4 was obtained by mixing 0.39 mL of $NEt_3 \cdot 3HF$ and 0.11 mL of Olah's reagent.

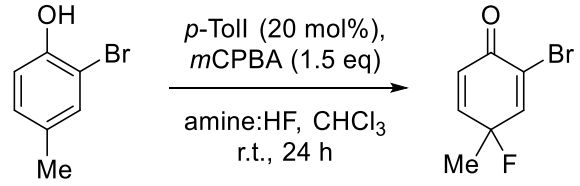
A mixture of amine:HF 1:4.5 was obtained by mixing 0.34 mL of $NEt_3 \cdot 3HF$ and 0.16 mL of Olah's reagent.

A mixture of amine:HF 1:7 was obtained by mixing 0.14 mL of $NEt_3 \cdot 3HF$ and 0.36 mL of Olah's reagent.

II. Optimization

Racemic optimization of the amine:HF ratio

A Teflon® screw cap vial was charged with a 1 cm stirring bar, 2-bromo-4-methylphenol (37.4 mg, 0.2 mmol, 1.0 eq.), *p*-TolI (8.7 mg, 0.04 mmol, 0.2 eq.), $CHCl_3$ (0.5 mL) and a specified amine:HF mixture (0.5 mL). *m*CPBA (≤77% purity, 74 mg, 0.3 mmol, 1.5 eq.) was added to the mixture and the reaction was stirred for 24 h. After completion, the reaction mixture was poured into a saturated solution of $NaHCO_3$ and the aqueous layer was extracted with CH_2Cl_2 (3x). The combined organic layers were dried over MgSO4, filtered and the solvent was removed under reduced pressure. The crude mixture was subjected to ^{19}F-NMR analysis using ethyl fluoroacetate (0.2 mmol) as an internal standard to determine the yield.



Amine:HF 1:3.0: 11%
Amine:HF 1:3.5: 59%
Amine:HF 1:4.0: 66%
Amine:HF 1:4.5: 44%
Amine:HF 1:7.0: >5%

The reaction performed best with amine:HF ratio 1:4.0 and was used for the remainder of the study. This protocol with the amine:HF ratio 1:4.0 was used to obtain racemic samples of the products for HPLC analysis.

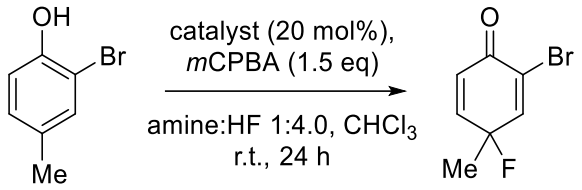
Optimization of catalyst structure

A Teflon® screw cap vial was charged with a 1 cm stirring bar, 2-bromo-4-methylphenol (37.4 mg, 0.2 mmol, 1.0 eq.), catalyst (0.04 mmol, 0.2 eq.), $CHCl_3$ (0.5 mL) and amine:HF 1:4.0 (0.5 mL). *m*CPBA (≤77% purity, 74 mg, 0.3 mmol, 1.5 eq.) was added to the mixture and the reaction was stirred for 24 h. After completion, the reaction mixture was poured into a saturated solution of $NaHCO_3$ and the aqueous layer was extracted with CH_2Cl_2 (3x). The combined organic layers were dried over MgSO4, filtered and the solvent was removed under reduced pressure. The crude mixture was subjected to ^{19}F-NMR analysis using ethyl fluoroacetate (0.2 mmol) as an internal standard to determine the yield. A part of the cruder mixture was filtered through a silica plug and the solvent was removed. The residue was analyzed by

chiral HPLC (AS-H, eluent: hexanes: *i*PrOH 95:5, flowrate: 1 mL/min, Detection: λ = 230 nm) to determine the enantiomeric ratio.

ΔΔG for Schemes 2, 3 and 4 was determined using following equation:

$$\Delta\Delta G = 1.987 \frac{\text{cal}}{K \cdot mol} \cdot 293\ K * \ln(e.r.)$$



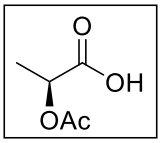
entry	catalyst	yield	*e.r.*	ΔΔG
1	**10**	10%	43:57	0.16
2	**11**	37%	45:55	0.12
3	**12**	60%	36:64	0.33
4	**13**	67%	41:59	0.21
5	**14**	65%	39:61	0.26
6	**15**	67%	40:60	0.24
7	**16**	64%	45:55	0.12
8	**17**	58%	32:68	0.44
9	**18**	60%	33:67	0.41
10	**19**	52%	37:63	0.31
11	**20**	59%	33:67	0.41
12	**21**	50%	41:59	0.21
13	**22**	62%	28:72	0.55
14	**23**	64%	32:68	0.44
15	**24**	64%	33:67	0.41
16	**25**	48%	29:71	0.52
17	**26**	56%	27:73	0.58
18	**27**	55%	32:68	0.44

III. Catalyst Synthesis

General Procedure A:

According to a modified procedure, (2*R*,2'*R*)-2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))dipropionic acid (**S5**) (1.0 eq.) was suspended in dry CH_2Cl_2 (0.1 M). Oxalyl chloride (3.5 eq.) and DMF (few drops) were added. The mixture was stirred for 2 h at room temperature and then concentrated under reduced pressure. The residue was dissolved in CH_2Cl_2 (0.05 M) and cooled to 0 °C. The corresponding alcohol (2.5 eq.) and pyridine (2.5 eq.) were added sequentially at that temperature. The reaction mixture was warmed to room temperature and stirred for an indicated amount of time. The reaction was diluted with CH_2Cl_2 and 1 M aq. HCl was added. The layers were separated and the aqueous phase extracted with CH_2Cl_2 (2x). The combined organic layers were dried over $MgSO_4$, filtered and the solvent was removed under reduced pressure. The crude mixture was purified by column chromatography (specified combination of solvents).

(*S*)-2-acetoxypropanoic acid (S1)



According to a modified procedure,[1] L-lactic acid (9.5 g, 105 mmol, 1.0 eq.) was dissolved in acetic acid (10 mL). At 0 °C acetyl chloride (22.5 mL, 315 mmol, 3.0 eq.) was added dropwise. After stirring for 24 h at room temperature the reaction mixture was concentrated under reduced pressure. The residue was purified by distillation under reduced pressure to afford (*S*)-2-acetoxypropanoic acid (**S1**) as a colourless oil (8.2 g, 62 mmol, 66% [based on 90% purity of starting material]).

Boiling point 68°C at 0.2 mbar.

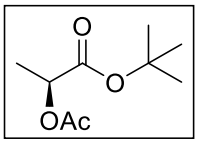
^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 10.64 (s, 1H), 5.10 (q, *J* = 7.1 Hz, 1H), 2.13 (s, 3H), 1.52 (d, *J* = 7.1 Hz, 3H).

HRMS (ESI) *m/z* $[M-H]^-$, calcd. for $C_5H_7O_4^-$: 131,0344, found: 131.03505.

$[\boldsymbol{\alpha}]_{\mathbf{D}}^{\mathbf{23}}$ = -6.3° (*c* = 1.00, $CHCl_3$).

Analytical data in agreement with literature.[1]

tert-butyl (*S*)-2-acetoxypropanoate (S2)



To a solution of (*S*)-2-acetoxypropanoic acid (**S1**) (7.9 g, 60 mmol, 1.0 eq.) in CH_2Cl_2 (180 mL) were added 4-(dimethylamino)pyridine (2.4 g, 20 mmol, 0.3 eq.) and *t*BuOH (9.8 g, 132 mmol, 2.2 eq.). At 0 °C Dicyclohexylmethanediimine (18.5 g, 90 mmol, 1.5 eq.) was added in portions. After stirring 18 h at room temperature the reaction mixture was filtered and the solvent was removed. The residue was purified by distillation under reduced pressure to afford *tert*-butyl (*S*)-2-acetoxypropanoate (**S2**) as a colourless oil (8.8 g, 47 mmol, 78%).

Boiling point 28°C at 0.2 mbar.

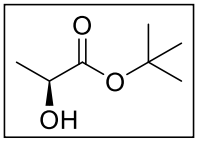
^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 4.93 (q, *J* = 7.1 Hz, 1H), 2.11 (s, 3H), 1.46 (s, 9H), 1.44 (d, *J* = 7.1 Hz, 3H).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_9H_{16}O_4Na^+$: 211.0941, found: 211.0940.

$[\alpha]_D^{23}$ = -21.6° (*c* = 1.00, $CHCl_3$).

Analytical data in agreement with literature.[1]

tert-butyl (_S_)-2-hydroxypropanoate (S3)



According to a modified procedure,[1] K_2CO_3 (19 g, 138 mmol, 3.0 eq.) was dissolved in H_2O/MeOH (2:1, 75 mL). *tert*-butyl (*S*)-2-acetoxypropanoate (**S3**) (8.7 g, 46 mmol, 1.0 eq.) was added at 0 °C and the mixture was stirred at that temperature for 3 h. After diluting with H_2O the mixture was extracted with DCM (3x). The combined organic layers were dried over $MgSO_4$ and the solvent was evaporated at room temperature under a stream of air to afford *tert*-butyl (*S*)-2-hydroxypropanoate (**S3**) as white crystals (5.6 g, 38 mmol, 84%).

R_f (*n*-pentane:EtOAc 10:1) =

M.p. 39.0-39.6 °C

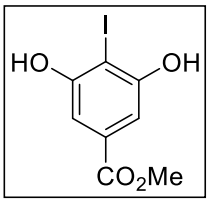
^{1}H NMR (400 MHz, $CDCl_3$, 299 K) *δ* [ppm] = 4.12 (q, *J* = 6.9 Hz, 1H), 1.47 (s, 11H), 1.36 (d, *J* = 6.9 Hz, 3H).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_7H_{14}O_3Na^+$: 169.0835, found: 169.0835.

$[\alpha]_D^{23}$ = -2.0° (*c* = 1.00, $CHCl_3$).

Analytical data in agreement with literature.[1]

Methyl 3,5-dihydroxy-4-iodobenzoate (S4)



According to a modified procedure,[2] to a solution of methyl 3,5-dihydroxybenzoate (2.5 g, 15 mmol, 1.0 eq.) in methanol was added dropwise a solution of *N*-iodosuccinimide (3.8 g, 17 mmol, 1.1 eq.) at 0 °C. The solution was stirred at room temperature for 16 h. A saturated solution of $Na_2S_2O_3$ was added and the aqueous layer was extracted with EtOAc (3x). The combined organic layers were washed with brine, dried over $MgSO_4$, filtered and concentrated under reduced pressure. Column chromatography purification (*n*-pentane with 50 % EtOAc) afforded **35** as an off-white solid (4.3 g, 15 mmol, 97%).

R_f (*n*-pentane with 50 % EtOAc) = 0.50.

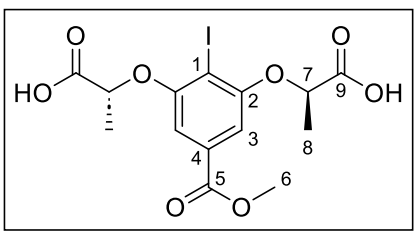
M.p. 204-205 °C with decomposition.

^{1}H NMR (400 MHz, DMSO-d_6, 299 K) *δ* [ppm] = 10.53 (broad s, 1H), 6.93 (s, 2H), 3.80 (s, 3H).

HRMS (ESI) *m/z* $[M-H]^-$, calcd. for $C_8H_6O_4I^-$: 292.9316, found: 292.9310.

Analytical data in agreement with the literature.[3]

(2_R_,2'_R_)-2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))dipropionic acid (S5)



To a solution of methyl 3,5-dihydroxy-4-iodobenzoate (**S4**) (6.7 g, 23 mmol, 1.0 eq.) in dry THF (150 mL) was added *tert*-butyl (*S*)-2-hydroxypropanoate (**S3)** (7.4 g, 50 mmol, 2.2 eq.) and PPh_3 (14.9 g, 56 mmol, 2.5 eq.). At 0 °C DIAD (10 mL, 52 mmol, 2.3 eq.) was added dropwise. After stirring for 14 h at room temperature the solvent was

removed under reduced pressure. To the residue was added Et_2O:*n*-pentane (1:1) and the participate was filtered off and washed with *n*-pentane. The filtrate was concentrated under reduced pressure and dissolved in CH_2Cl_2 (100 mL). At 0 °C TFA (17.5 mL, 227 mmol, 10 eq.) was added. After stirring for 3 h at room temperature the solvent was removed under reduced pressure. The residue was dissolved in sat. aq. $NaHCO_3$ and washed with CH_2Cl_2. The aq. layer was acidified with 1 M HCl and extracted with CH_2Cl_2 (3x). The combined organic layers were dried over $MgSO_4$ and the solvent was removed under reduced pressure to afford (**S5**) as a white solid (7.4 g, 17 mmol, 75%).

M.p. 147.2.0-151.0 °C

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.57 (s, 2H, H-C3), 5.49 (q, *J* = 6.8 Hz, 2H, H-C7), 4.40 (s, 3H, H-C6), 2.20 (d, *J* = 6.8 Hz, 6H, H-C8).

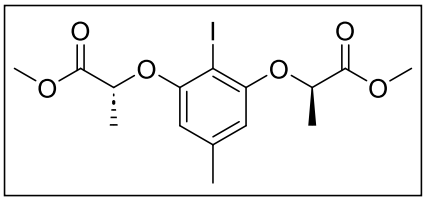
^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 211.3 (C9), 205.0 (C5), 197.4 (C2), 171.2 (C4), 145.6 (C3), 124.7 (C1), 112.7 (C7), 91.4 (C6), 57.0 (C8).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 2942 (w),2535 (w),1714 (s),1575 (m),1416 (s),1372 (w),1318 (m),1249 (s),1227 (s),1133 (s),1105 (s),1075 (m),1005 (m),892 (w),862 (m),839 (m),760 (m),647 (m),573 (w).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_{14}H_{15}O_8INa^+$: 460.9704, found: 460.9709.

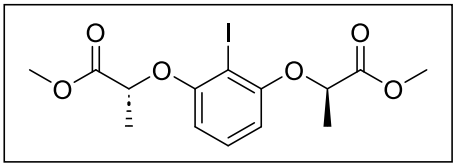
$[\boldsymbol{\alpha}]_{\mathbf{D}}^{\mathbf{25}}$ = 0.7° (*c* = 1.00, MeOH).

dimethyl 2,2'-((2-iodo-5-methyl-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (10)



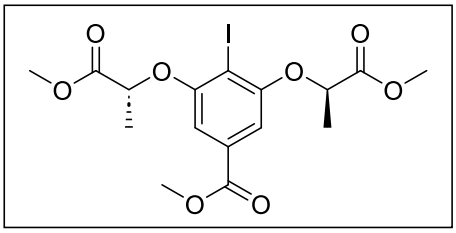
The catalyst was prepared in a previous study from this group.[4]

dimethyl 2,2'-((2-iodo-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (11)



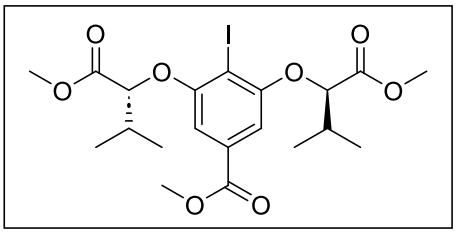
The catalyst was prepared in a previous study from this group. [4]

dimethyl 2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (12)



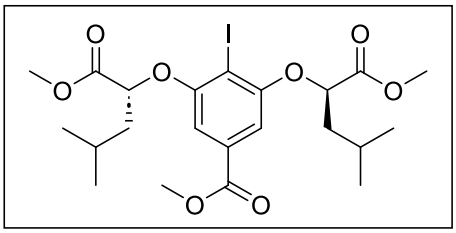
The catalyst was prepared in a previous study from this group. [4]

dimethyl 2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-bis(3-methylbutanoate) (13)



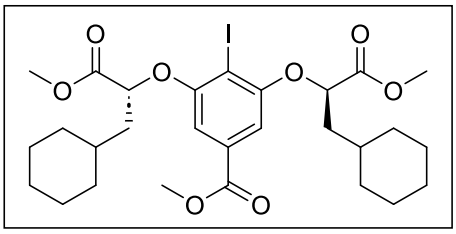
The catalyst was prepared in a previous study from this group.[5]

dimethyl 2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-bis(4-methylpentanoate) (14)



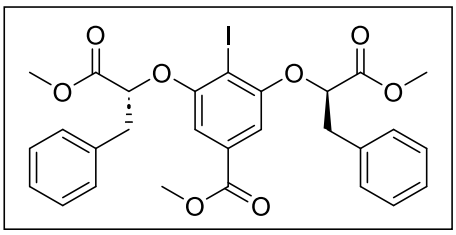
The catalyst was prepared in a previous study from this group.[4]

dimethyl 2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-bis(3-cyclohexylpropanoate) (15)



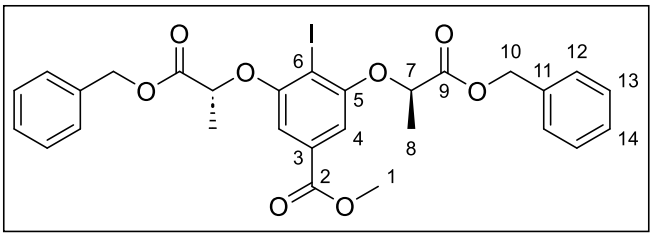
The catalyst was prepared in a previous study from this group.[4]

dimethyl 2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-bis(3-phenylpropanoate) (16)



The catalyst was prepared in a previous study from this group.[4]

Dibenzyl 2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (17)



According to a modified procedure,[6] to a solution of methyl 3,5-dihydroxy-4-iodobenzoate (**S4**) (1.5 g, 5.0 mmol, 1.0 eq.), benzyl-(*S*)-lactate (1.7 mL, 11 mmol, 2.1 eq.) and PPh_3 (3.5 g, 14 mmol, 2.7 eq.) in dry THF (50 ml, DIAD (2.3 ml, 4.6 mmol, 2.3 eq.) was added dropwise at 0°C. The mixture was stirred for 16 h and the solvent was removed under reduced pressure. The crude residue was purified by column chromatography purification (cyclohexane: EtOAc = 6:1) to afford **14** as a white solid (2.3 g, 3.8 mmol, 76%).

R_f (*n*-pentane with 15% EtOAc) = 0.19.

M.p. 55-56 °C

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.36 – 7.27 (m, 10H, H12-14), 7.0 (s, 2H, H4), 5.19 (dd, *J* = 21.0, 12.3 Hz, 4H, H10), 4.92 (q, *J* = 6.8 Hz, 2H, H7), 3.82 (s, 3H, H1), 1.73 (d, *J* = 6.8 Hz, 6H, H8).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 171.0 (C9), 165.9 (C2), 158.1 (C5), 135.2 (C11), 131.7 (C3), 128.5 (C13), 128.4 (C14), 128.2 (C12), 107.1 (C4), 87.1 (C6), 74.0 (C7), 67.1 (C10), 52.4 (C1), 18.4 (C8).

IR (ATR) $\bar{\nu}$ [cm^{-1}] = 1742 (s), 1716 (m), 1679 (w), 1575 (m), 1455 (w), 1420 (m), 1387 (w), 1373 (w), 1334 (m), 1308 (m), 1239 (m), 1195 (m), 1132 (s), 1106 (s), 1078 (m), 1032 (w), 1012 (m), 953 (m), 906 (m), 888 (w), 867 (m), 849 (w), 774 (m), 748 (m), 710 (m), 696 (s), 658 (m).

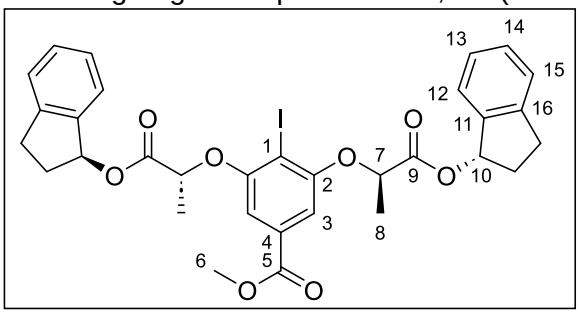
HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{28}H_{27}O_8INa^+$: 641.0643, found: 641.0645.

$[\alpha]_D^{25}$ = 2.3 (*c* = 1.00, $CHCl_3$).

Analytical data in agreement with the literature.[6]

bis(2,3-dihydro-1H-inden-1-yl)2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (18)

According to general procedure A, **S5** (220 mg, 0.5 mmol, 1.0 eq.), oxalyl chloride (0.15 mL, 1.8 mmol, 3.5 eq.), (*S*)-indanol (168 mg, 1.3 mmol, 2.5 eq.) and pyridine (0.1 mL, 1.3 mmol, 2.5 eq.) were converted to (**15**) in 16 h. Column chromatography (*n*-pentane with 15% EtOAc) afforded a white solid (188 mg, 0.28 mmol, 56%).



R_f (*n*-pentane with 20% EtOAc) = 0.52.

M.p. 115-116 °C

^{1}H NMR (599 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.57 – 7.51 (m, 2H), 7.47 – 7.38 (m, 6H), 7.31 – 7.22 (m, 4H), 7.10 (s, 2H, H-C3), 6.85 (s, 2H, H-C10), 4.97 (q, *J* = 6.7 Hz, 2H, H-C7), 3.80 (s, 3H, H-C6), 1.79 (d, *J* = 6.8 Hz, 6H, H-C8).

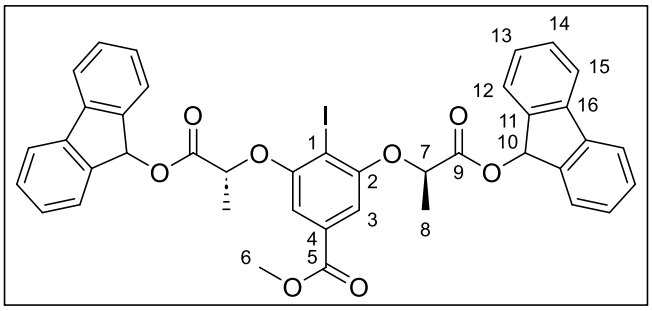
^{13}C NMR (151 MHz, $CDCl_3$, 299 K) δ [ppm] = 172.2 (C9), 166.0 (C5), 158.3 (C2), 141.3 (dd, *J* = 31.7, 6.3 Hz), 131.8 (C4), 129.8, 128.1 (d, *J* = 10.5 Hz), 126.2, 125.7, 120.2 (d, *J* = 8.5 Hz), 107.2 (C3), 87.2 (C1), 76.1 (C10), 74.1 (C7), 52.5 (C6), 18.6 (C8).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 2946 (w), 1736 (s), 1713 (s), 1575 (m), 1480 (w), 1416 (s), 1384 (w), 1327 (s), 1308 (m), 1235 (s), 1194 (s), 1133 (s), 1107 (s), 1075 (s), 1008 (s), 933 (s), 891 (s), 863 (m), 847 (m), 749 (s), 705 (m), 681 (m), 651 (s), 594 (m).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{32}H_{31}O_8INa^+$: 693.0956, found: 693.0954.

$[\alpha]_D^{23}$ = -27.6° (*c* = 1.00, $CHCl_3$).

di(9H-fluoren-9-yl)2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (19)



According to general procedure A, **S5** (220 mg, 0.5 mmol, 1.0 eq.), oxalyl chloride (0.15 mL, 1.8 mmol, 3.5 eq.), 9*H*-fluoren-9-ol (228 mg, 1.3 mmol, 2.5 eq.) and pyridine (0.1 mL, 1.3 mmol, 2.5 eq.) were converted to (**15**) in 1 h. Recrystallisation of the crude mixture afforded a white solid (197 mg, 0.26 mmol, 52%).

R_f (*n*-pentane with 20% EtOAc) = 0.43.

M.p. 212-213 °C

^{1}H NMR (599 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.57 – 7.51 (m, 2H), 7.47 – 7.38 (m, 6H), 7.31 – 7.22 (m, 4H), 7.10 (s, 2H, H-C3), 6.85 (s, 2H, H-C10), 4.97 (q, *J* = 6.7 Hz, 2H, H-C7), 3.80 (s, 3H, H-C6), 1.79 (d, *J* = 6.8 Hz, 6H, H-C8).

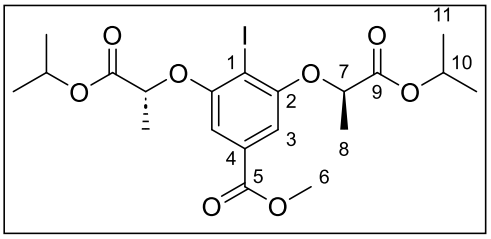
^{13}C NMR (151 MHz, $CDCl_3$, 299 K) δ [ppm] = 172.2 (C9), 166.0 (C5), 158.3 (C2), 141.3 (dd, *J* = 31.7, 6.3 Hz), 131.8 (C4), 129.8, 128.1 (d, *J* = 10.5 Hz), 126.2, 125.7, 120.2 (d, *J* = 8.5 Hz), 107.2 (C3), 87.2 (C1), 76.1 (C10), 74.1 (C7), 52.5 (C6), 18.6 (C8).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 1745 (m), 1716 (m), 1575 (m), 1452 (m), 1417 (m), 1381 (w), 1340 (m), 1303 (m), 1235 (s), 1189 (s), 1131 (s), 1106 (s), 1007 (m), 961 (m), 924 (m), 861 (m), 762 (s), 739 (s), 704 (s), 648 (m), 622 (m), 602 (s).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{40}H_{31}O_8INa^+$: 789.0956, found: 789.0957.

$[\alpha]_D^{23}$ = 12.1° (*c* = 1.00, $CHCl_3$).

diisopropyl 2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2R,2'R)-dipropionate (20)



According to general procedure A, **S5** (220 mg, 0.5 mmol, 1.0 eq.), oxalyl chloride (0.15 mL, 1.8 mmol, 3.5 eq.), isopropanol (0.19 mL, 2.5 mmol, 5.0 eq.) and pyridine (0.1 mL, 1.3 mmol, 2.5 eq.) were converted to (**17**) in 4 h. Column chromatography (*n*-pentane with 10% EtOAc) afforded a colourless oil (177 mg, 0.34 mmol, 68%).

R_f (*n*-pentane with 20% EtOAc) = 0.55.

^{1}H NMR (599 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.01 (s, 2H, H-C3), 5.08 (hept, *J* = 6.3 Hz, 2H, C-H10), 4.79 (q, *J* = 6.8 Hz, 2H, H-C7), 3.86 (s, 3H, H-C6), 1.69 (d, *J* = 6.7 Hz, 6H, H-C8), 1.28 (d, *J* = 6.3 Hz, 6H, H-C11^a), 1.20 (d, *J* = 6.3 Hz, 6H, H-C11^b).

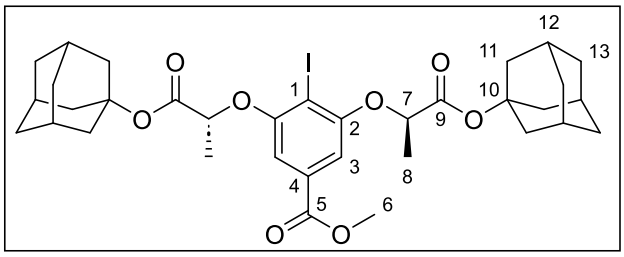
^{13}C NMR (151 MHz, $CDCl_3$, 299 K) δ [ppm] = 170.9 (C9), 166.2 (C5), 158.4 (C2), 131.6 (C4), 107.3 (C3), 87.3 (C1), 74.4 (C10), 69.2 (C10), 52.5 (C6), 21.8 (C11^a), 21.7 (C11^b), 18.5 (C8).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 2982 (w), 1749 (m), 1727 (s), 1577 (w), 1419 (m), 1377 (w), 1324 (w), 1279 (w), 1245 (s), 1207 (m), 1140 (s), 1102 (s), 1013 (w), 766 (w).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_{20}H_{27}O_8INa^+$: 545.0643, found: 545.0645.

$[\alpha]_D^{23}$ = 2.2° (*c* = 1.00, $CHCl_3$).

di((1*R*,3S,5*R*,7*R*)-adamantan-2-yl)2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (21)



According to general procedure A, **S5** (657 mg, 1.5 mmol, 1.0 eq.), oxalyl chloride (0.45 mL, 5.3 mmol, 3.5 eq.), 1-adamantol (1.1 g, 7.5 mmol, 5.0 eq.) and pyridine (0.3 mL, 3.8 mmol, 2.5 eq.) were converted to (**18**) in 16 h. Column chromatography (*n*-pentane with 7.5% EtOAc) afforded white solid (211 mg, 0.3 mmol, 20%).

R$_f$ (*n*-pentane with 10% EtOAc) = 0.40.

M.p. 70.4-71.6 °C

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.03 (s, 2H, H-C3), 4.71 (q, *J* = 6.8 Hz, 2H, H-C7), 3.89 (s, 3H, H-C6), 2.15 (m, 6H, H-C12), 2.09 (m, 12H, H-C11), 1.67 (d, *J* = 6.9 Hz, 6H, H-C8), 1.64 (m, 12H, H-C13)

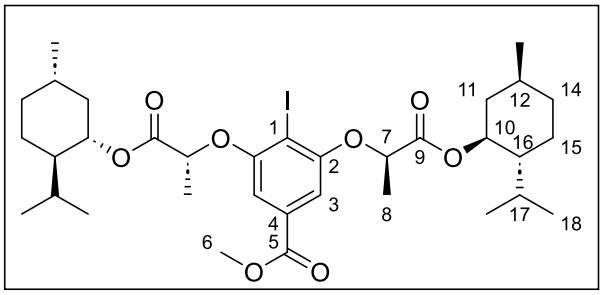
^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 170.2 (C9), 166.3 (C5), 158.4 (C2), 131.4 (C4), 107.1 (C3), 87.0 (C1), 82.4 (C10), 74.5 (C7), 52.4 (C6), 41.3 (C11), 36.2 (C13), 31.0 (C12), 18.5 (C8).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 2908 (w), 1746 (w), 1723 (m), 1577 (w), 1417 (w), 1315 (w), 1272 (w), 1238 (m), 1197 (m), 1133 (s), 1103 (s), 1049 (s), 1012 (m), 965 (w), 860 (w), 765 (w).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_{34}H_{43}O_8INa^+$: 729.1895, found: 729.1887.

$[\alpha]_D^{23}$ = 1.6° (*c* = 1.00, $CHCl_3$).

bis((1*S*,2*R*,5*S*)-2-isopropyl-5-methylcyclohexyl) 2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (22)



According to general procedure A, **S5** (220 mg, 0.5 mmol, 1.0 eq.), oxalyl chloride (0.15 mL, 1.8 mmol, 3.5 eq.), D-menthol (391 mg, 2.5 mmol, 5.0 eq.) and pyridine (0.1 mL, 1.3 mmol, 2.5 eq.) were converted to (**19**) in 15 h. Column chromatography (cyclohexane with 2.5% EtOAc) afforded a white solid (182 mg, 0.25 mmol, 51%).

R$_f$ (cyclohexane with 5% EtOAc) = 0.43.

M.p. 108-109 °C.

^{1}H NMR (599 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.02 (s, 2H, H-C3), 4.86 (q, *J* = 6.8 Hz, 2H, H-C7), 4.74 (td, *J* = 10.9, 4.4 Hz, 2H, H-C10), 3.86 (s, 3H, H-C6), 1.93 (pd, *J* = 7.0, 2.7 Hz, 2H, H-C17), 1.92 – 1.85 (m, 2H, H-C11^a), 1.70 (d, *J* = 6.8 Hz, 6H, H-C8), 1.69-1.64 (m, 4H, H-C14^a/15^a), 1.45 (dddd, *J* = 12.1, 8.8, 5.9, 3.2 Hz, 2H, H-C12), 1.44 – 1.34 (m, 2H, H-C16), 1.03 (td, *J* = 12.7, 9.2 Hz, 2H, H-C15^b), 0.90 (d, *J* = 7.0 Hz, 6H, H-C18^a), 0.87 (d, *J* = 6.6 Hz, 6H, H-C13), 0.86 – 0.81 (m, 4H, H-C11^b/H14^b), 0.72 (d, *J* = 7.0 Hz, 6H, H-C18^b).

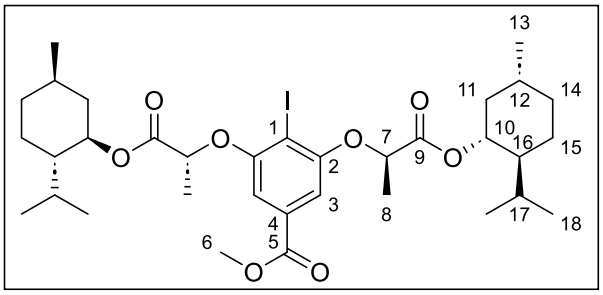
^{13}C NMR (151 MHz, $CDCl_3$, 299 K) δ [ppm] = 170.9 (C9), 166.1 (C5), 158.3 (C2), 131.6 (C4), 107.3 (C3), 87.6 (C1), 75.6 (C10), 74.2 (C7), 52.5 (C6), 46.9 (C16), 40.6 (C11), 34.3 (C14), 31.5 (C12), 26.4 (C17), 23.5 (C15), 22.1 (C13), 20.9 (C18^a), 18.6 (C8), 16.3 (C18^b).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 2953 (w), 1744 (m), 1717 (m), 1575 (m), 1436 (w), 1418 (m), 1325 (m), 1231 (s), 1196 (s), 1134 (s), 1108 (s), 1075 (m), 1037 (w), 1022 (m), 1006 (m), 983 (m), 971 (m), 962 (m), 917 (w), 855 (w), 766 (m).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{34}H_{51}O_8INa^+$: 737.2521, found: 737.2521.

$[\alpha]_D^{25}$ = 51.7 (*c* = 1.00, $CHCl_3$).

bis((1*R*,2*S*,5*R*)-2-isopropyl-5-methylcyclohexyl) 2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (23)



According to general procedure A, **S5** (220 mg, 0.5 mmol, 1.0 eq.), oxalyl chloride (0.15 mL, 1.8 mmol, 3.5 eq.), L-menthol (391 mg, 2.5 mmol, 5.0 eq.) and pyridine (0.1 mL, 1.3 mmol, 2.5 eq.) were converted to (**20**) in 15 h. Column chromatography (*n*-pentane with 2.5% EtOAc) afforded a colourless wax (191 mg, 0.27 mmol, 53%).

R_f (*n*-pentane with 5% EtOAc) = 0.42.

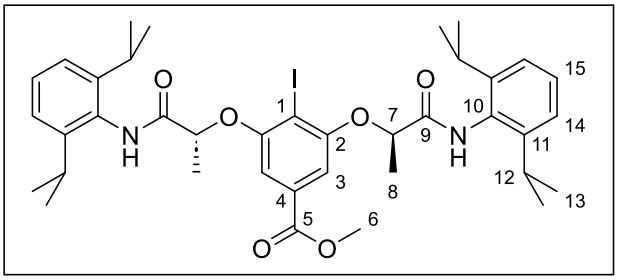
^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.00 (s, 2H, H-C3), 4.84 (q, *J* = 6.7 Hz, 2H, H-C7), 4.67 (td, *J* = 10.9, 4.4 Hz, 2H, H-C10), 3.85 (s, 3H, H-C6), 2.03 – 1.94 (m, 2H, H-C17), 1.71 (d, *J* = 6.8 Hz, 6H, H-C8), 1.65 (ddq, *J* = 16.2, 13.1, 3.2 Hz, 4H, H-C14^a/15^a), 1.46 (qt, *J* = 7.0, 3.8 Hz, 2H, H12), 1.41 – 1.30 (m, 2H, H16), 1.05 (td, *J* = 12.1, 10.9 Hz, 2H, H-C15^b), 0.99 (qd, *J* = 13.0, 3.3 Hz, 2H), 0.89 (d, *J* = 6.5 Hz, 6H, H-C18^a), 0.88 – 0.81 (m, 4H, H-C11^b/14^b), 0.75 (d, *J* = 7.0 Hz, 6H, H-C13), 0.58 (d, *J* = 7.0 Hz, 6H, H-C18^b).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 171.2 (C9), 166.0 (C5), 158.4 (C2), 131.7 (C4), 106.7 (C3), 86.6 (C1), 75.8 (C10), 74.3 (C7), 52.5 (C6), 46.9 (C16), 40.6 (C11), 34.3 (C14), 31.5 (C12), 25.9 (C17), 23.1 (C15), 22.1 (C13), 20.9 (C18^a), 18.6 (C8), 15.8 (C18^b).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{34}H_{51}O_8INa^+$: 737.2521, found: 737.2537.

$[\alpha]_D^{23}$ = -15.2° (*c* = 1.00, $CHCl_3$).

methyl 3,5-bis(((R)-1-((2,6-diisopropylphenyl)amino)-1-oxopropan-2-yl)oxy)-4-iodobenzoate (24)



According to general procedure A, **S5** (438 mg, 1.0 mmol, 1.0 eq.), oxalyl chloride (0.3 mL, 3.5 mmol, 3.5 eq.), 2,6-diisopropylaniline (0.94 mL, 5.0 mmol, 5.0 eq.) without additional base were converted to (**21**) in 14 h. Column chromatography (*n*-pentane with 20% EtOAc) afforded a white solid (447 mg, 0.59 mmol, 59%).

R_f (*n*-pentane with 20% EtOAc) = 0.19.

M.p. 208-210 °C

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.91 (s, 2H, H-N), 7.36 (s, 2H, H-C3), 7.31 (t, *J* = 7.8 Hz, 2H, H-C15), 7.19 (d, *J* = 7.7 Hz, 4H, H-C14), 5.15 (q, *J* = 6.6 Hz, 2H, H-C7), 3.96 (s, 3H, H-C6), 2.98 (s, 4H, H-C12), 1.82 (d, *J* = 6.7 Hz, 6H, H-C6), 1.20 (d, *J* = 6.9 Hz, 12H, H-C13^a), 1.12 (s, 12H, H-C13^b).

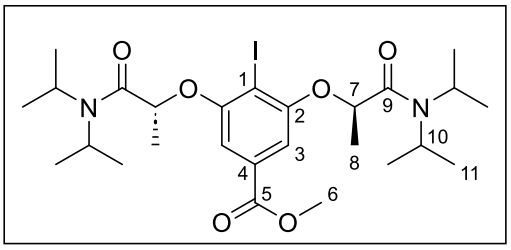
^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 170.2 (C9), 165.6 (C5), 157.2 (C2), 146.3 (C11), 133.1 (C4), 130.1 (C10), 128.8 (C15), 123.7 (C14), 107.8 (C3), 86.9 (C1), 76.5 (C7), 52.9 (C6), 28.9 (C12), 23.78 (C13^b), 23.67 (C13^a), 18.7 (C8).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 2962 (w), 1717 (s), 1692 (m), 1673 (s), 1568 (w), 1490 (s), 1441 (m), 1411 (s), 1382 (w), 1305 (m), 1240 (s), 1212 (s), 1109 (s), 1002 (s), 932 (w), 883 (w), 801 (m), 765 (w), 706 (w), 653 (w), 598 (m), 583 (m).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{38}H_{49}N_2O_6INa^+$: 779.2528, found: 779.2510.

$[\alpha]_D^{23}$ = -8.3° (*c* = 1.00, $CHCl_3$).

methyl 3,5-bis(((R)-1-(diisopropylamino)-1-oxopropan-2-yl)oxy)-4-iodobenzoate(25)



According to general procedure A, **S5** (220 mg, 0.5 mmol, 1.0 eq.), oxalyl chloride (0.15 mL, 1.8 mmol, 3.5 eq.), diisopropylamine (0.42 mL, 6.0 mmol, 6.0 eq.) without additional base were converted to (**22**) in 14 h. Column chromatography (*n*-pentane with 20% EtOAc) afforded a white solid (213 mg, 0.35 mmol, 70%).

R_f (*n*-pentane with 30% EtOAc) = 0.24.

M.p. 192-195 °C

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.05 (s, 2H, H-C3), 4.94 (q, *J* = 6.7 Hz, 2H, H-C7), 4.27 (hept, *J* = 6.6 Hz, 2H, H-C10^a), 3.84 (s, 3H, H-C6), 3.37 (hept, *J* = 6.8 Hz, 2H, H-C10^b), 1.66 (d, *J* = 6.8 Hz, 6H, H-C8), 1.41 (d, *J* = 6.8 Hz, 6H, H-C11^a), 1.36 (d, *J* = 6.8 Hz, 6H, H-C11^b), 1.29 (d, *J* = 6.6 Hz, 6H, H-C11^c), 1.08 (d, *J* = 6.5 Hz, 6H, H-C11^d).

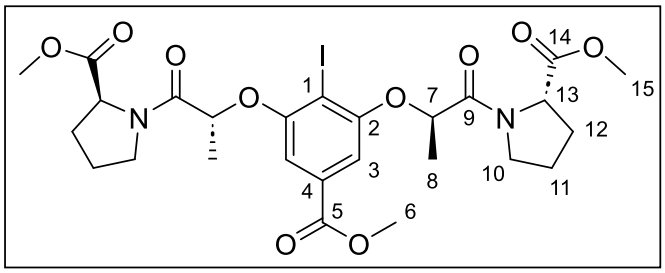
^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 168.9 (C9), 166.4 (C5), 158.1 (C2), 131.7 (C, 106.6 (C3), 75.6 (C7), 52.4 (C6), 48.1 (C10^a), 46.6 (C10^b), 21.0 (C11^c), 20.8 (C11^d), 20.5 (C11^a), 20.2 (C11^b), 18.0 (C8).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 1723 (m), 1649 (m), 1577 (w), 1437 (m), 1419 (m), 1374 (w), 1340 (m), 1281 (w), 1241 (m), 1146 (m), 1101 (m), 1039 (w), 1014 (m), 751 (m), 662 (w).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_{26}H_{41}N_2O_6INa^+$: 627.1902, found: 627.1885.

$[\alpha]_D^{23}$ = -32.5° (*c* = 0.58, $CHCl_3$).

dimethyl ((2*R*,2'*R*)-2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))bis(propanoyl))(*S*)-di-*L*-prolinate (26)



According to a modified procedure,[7] to a suspension of **S5** (1.1 g, 2.6 mmol, 1.0 eq.) in CH_2Cl_2 (15 mL), were added oxalyl chloride (0.78 mL, 9.1 mmol, 3.5 eq.) and DMF (3 drops) sequentially. After stirring for 2 h, the mixture was concentrated under reduced pressure and the residue was dissolved in CH_2Cl_2 (30 mL). At 0 °C, L-prolin-methylester -hydrochlorid (1.1 g, 6.5 mmol, 2.5 eq.) and triethylamine (1.7 mL, 12.5 mmol, 5.0 eq.) were added sequentially. The mixture was stirred at room temperature for 16 h. The reaction was diluted with CH_2Cl_2 and 1 M aq. HCl was added. The layers were separated and the aqueous phase extracted with CH_2Cl_2 (2x). The combined organic layers were dried over $MgSO_4$, filtered and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 90% EtOAc) afforded **23** as a white solid (1.54 g, 2.3 mmol, 90%).

R_f (EtOAc) = 0.43.

M.p. 105-107 °C

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.11 (s, 2H, H-C3), 4.93 (q, *J* = 6.7 Hz, 2H, H-C7), 4.49 (dd, *J* = 8.1, 3.4 Hz, 2H, H-C13), 3.95 – 3.88 (m, 2H, H10^a), 3.88 (s, 3H, H-C6), 3.69 (s, 6H, H-C15), 3.55 – 3.48 (m, 2H, H-C10^b), 2.11 – 2.01 (m, 4H, H-C11^a/12^b), 1.98 – 1.88 (m, 4H, H-C11^b/12^b), 1.71 (d, *J* = 6.8 Hz, 6H, H-C8).

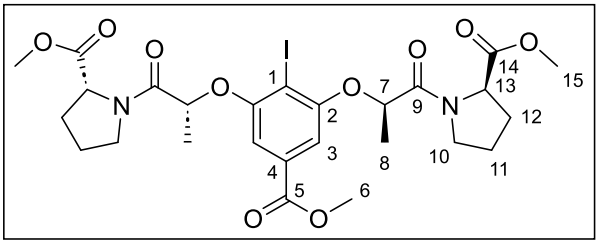
^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 172.4 (C13), 169.3 (C9), 166.3 (C5), 157.8 (C2), 132.6 (C4), 106.8 (C3), 85.6 (C1), 76.0 (C7), 59.7 (C13), 52.7 (C6), 52.3 (C15), 47.1 (C10), 28.4 (C12), 25.3 (C11), 17.4 (C8).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 1743 (w), 1720 (s), 1658 (s), 1573 (w), 1416 (s), 1339 (s), 1301 (w), 1244 (s), 1213 (s), 1181 (s), 1138 (s), 1102 (s), 1011 (s), 763 (s), 653 (w).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_{26}H_{33}N_2O_{10}INa^+$: 683.1072, found: 683.1086.

$[\alpha]_D^{23}$ = -43.1° (*c* = 1.00, $CHCl_3$).

dimethyl ((2R,2'R)-2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))bis(propanoyl))(R)-di-D-prolinate (27)



According to a modified procedure,[7] to a suspension of **S5** (438 mg, 1.0 mmol, 1.0 eq.) in CH_2Cl_2 (6 mL), were added oxalyl chloride (0.3 mL, 3.5 mmol, 3.5 eq.) and DMF (2 drops) sequentially. After stirring for 2 h, the mixture was concentrated under reduced pressure and the residue was dissolved in CH_2Cl_2 (12 mL). At 0 °C, D-prolin-methylester -hydrochlorid (414 mg, 2.5 mmol, 2.5 eq.) and triethylamine (0.34 mL, 2.5 mL, 5.0 eq.) were added sequentially. The mixture was stirred at room temperature for 15 h. The reaction was diluted with CH_2Cl_2 and 1 M aq. HCl was added. The layers were separated and the aqueous phase extracted with CH_2Cl_2 (2x). The combined organic layers were dried over $MgSO_4$, filtered and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 90% EtOAc) afforded **24** as a white solid (543 mg, 0.82 mmol, 82%).

R_f (EtOAc) = 0.43.

M.p. 192-194 °C

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.07 (s, 2H, H-C3), 4.97 (q, J = 6.7 Hz, 2H, H-C7), 4.54 (dd, J = 8.5, 5.0 Hz, 2H, H-C13), 3.88 (s, 3H, H-C6), 3.80 (dt, J = 10.5, 6.7 Hz, 2H, H-C10^a), 3.66 (s, 6H, H-C15), 3.55 (dt, J = 10.4, 6.8 Hz, 2H, H-C10^b), 2.27 – 2.11 (m, 2H, H-C12^a), 2.08 – 1.95 (m, 4H, H-C11), 1.93 – 1.85 (m, 2H, H-C12^b), 1.68 (d, J = 6.7 Hz, 6H, H-C8).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 172.4 (C14), 169.2 (C9), 166.3 (C5), 157.9 (C2), 132.2 (C4), 107.1 (C3), 86.1 (C1) 75.1 (C7), 59.7 (C13), 52.6 (C6), 52.3 (C15), 47.1 (C10), 28.6 (C12), 25.5 (C11), 17.3 (C8).

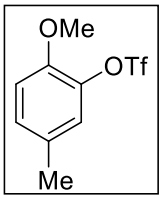
IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 1721 (s), 1654 (s), 1573 (m), 1417 (s), 1360 (m), 1337 (m), 1233 (s), 1173 (s), 1142 (s), 1104 (s), 1013 (s), 940 (w), 855 (w), 767 (s), 743 (m), 650 (w).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{26}H_{33}N_2O_{10}INa^+$: 683.1072, found: 683.1072.

$[\alpha]_D^{23}$ = -4.4° (*c* = 1.00, $CHCl_3$).

IV. Synthesis of Starting Materials

2-methoxy-5-methylphenyl trifluoromethanesulfonate (S6)



According to a modified procedure,[8] to a solution of 2-methoxy-5-methyl phenol (0.69 g, 5.0 mmol, 1.0 eq.) and NEt_3 (2.1 ml, 15 mmol, 3.0 eq.) in dry CH_2Cl_2 (12 ml) was added Tf_2O (0.9 ml, 5.5 mmol, 1.1. eq.) dropwise at -78 °C. The solution was stirred at that temperature for 2 h and additionally for 16 h at room temperature. The reaction was quenched by the addition of H_2O and the aqueous layer was extracted with CH_2Cl_2 (3x). The combined organic layers were dried over MgSO4, filtered and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 5% EtOAc) afforded 2-methoxy-5-methylphenyl trifluoromethanesulfonate (**S6**) as a yellow oil (1.3 g, 4.7 mmol, 94%).

R_f (n-pentane with 5% EtOAc) = 0.60.

^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.11 (ddd, J = 8.4, 2.1, 0.9 Hz, 1H), 7.02 (d, *J* = 2.1 Hz, 1H), 6.92 (d, J = 8.4 Hz, 1H), 3.88 (s, 3H), 2.31 (s, 3H).

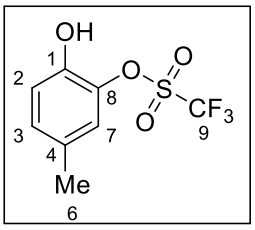
^{19}F NMR (282 MHz, $CDCl_3$, 299 K) δ [ppm] = -74.0 (s, 3F).

^{19}F{^{1}H} NMR (282 MHz, $CDCl_3$, 299 K) δ [ppm] = -74.0 (s, 3F).

GC-MS (EI) *m/z* $[M]^+$, calcd. for C9H9F3O4S+: 270.0, found: 270.1.

Analytical data in agreement with literature.[8]

2-hydroxy-5-methylphenyl trifluoromethanesulfonate (8d)



2-methoxy-5-methylphenyl trifluoromethanesulfonate (**S1**), (713 mg, 2.8 mmol, 1.0 eq.), was dissolved in dry CH_2Cl_2 (28 mL). At 0 °C, BBr_3 (1.0 M in CH_2Cl_2, 3.1 mL, 3.1 mmol, 1.1 eq.) was added dropwise. The reaction mixture was stirred for 24 h at room temperature and quenched with H_2O. The layers were separated and the aqueous layer was extracted with CH_2Cl_2 (2x). The combined organic layers were dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 5% EtOAc) purification afforded 2-hydroxy-5-methylphenyl trifluoromethanesulfonate **(5d)** as a yellow oil (294 mg, 1.1 mmol, 42%).

R_f (*n*-pentane with 10% EtOAc) = 0.36.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.11 – 7.04 (m, 1H, H-C3), 7.05 (s, 1H, H-C7), 6.96 – 6.91 (m, 1H, H-C2), 5.12 (s, 1H, HO-C1), 2.32 (s, 3H, H-C6).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 144.8 (C1), 137.1 (C8), 131.8 (C4), 129.9 (C3), 122.6 (C7), 118.6 (q, J = 320.5 Hz, C9), 118.0 (C5), 20.4 (C6).

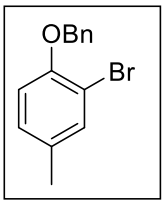
^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.4 (s, F9, F-C9).

^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.4 (s, F9, F-C9).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 3523 (m), 1521 (m), 1403 (m), 1339 (w), 1296 (m), 1271 (w), 1253 (w), 1222 (s), 1215 (s), 1197 (m), 1145 (m), 1132 (m), 1078 (m), 1007 (w), 946 (s), 880 (w), 845 (s), 812 (m), 783 (m), 765 (w), 729 (w), 704 (w).

HRMS (ESI) *m/z* $[M-H]^-$, calcd. for $C_8H_6O_4SF_3$: 254.9944, found: 254.9943.

1-(benzyloxy)-2-bromo-4-methylbenzene (S7)



To a solution of 2-bromo-4-methylphenol (5.0 g, 27 mmol, 1.0 eq.) in acetone (27 mL) was added benzylbromide (3.9 mL, 32 mmol, 1.2 eq.) and K_2CO_3 (7.4 g, 53 mmol, 2.0 eq.). The mixture was refluxed for 16 h. After cooling to room temperature, the mixture was acidified with 1M HCl and extracted with CH_2Cl_2 (3x). The combined organic layers were dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 2% EtOAc) purification afforded 1-(benzyloxy)-2-bromo-4-methylbenzene (**S7**) as a white solid (7.1 g, 26 mmol, 96%).

R_f (n-pentane with 5% EtOAc) = 0.77

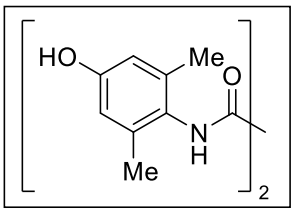
M.p.: 45.7-46.7 °C

^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.53 – 7.43 (m, 2H), 7.43 – 7.36 (m, 3H), 7.34 – 7.29 (m, 1H), 7.02 (ddd, *J* = 8.3, 2.2, 0.8 Hz, 1H), 6.83 (d, *J* = 8.3 Hz, 1H), 5.13 (s, 2H), 2.27 (s, 2H).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{14}H_{13}OBrNa$: 299.0042, found: 299.0042.

Analytical data in agreement with literature.[9]

***N*^{1},*N*^{2}-bis(4-hydroxy-2,6-dimethylphenyl)oxalamide (S8)**



According to a modified procedure,[10] to a solution of 4-amino-3,5-dimethylphenol (1.3 g, 10 mmol, 2.0 eq.) in THF (15 mL) was added NEt_3 (1.5 mL, 10.5 mmol, 2.1 eq.). The mixture was cooled to 0 °C and oxalylchloride (0.45 mL, 5 mmol, 1.0 eq.) was added dropwise. The solution was warmed to room temperature and stirred for 2h. The solvent was removed under reduced pressure and the residue was suspended in H_2O. The slurry was filtered and the residue was washed with Et_2O and dried in *vacuo* to afford *N*^{1},*N*^{2}-bis(4-hydroxy-2,6-dimethylphenyl)oxalamide (**S3**) as a brown solid (236 g, 3.6 mmol, 72%).

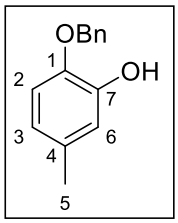
M.p.: decomposition above 250 °C.

^{1}H NMR (400 MHz, DMSO-d6, 299 K) δ [ppm] = 9.95 (s, 2H), 9.25 (s, 2H), 6.49 (s, 4H), 2.06 (s, 12H).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{18}H_{20}N_2O_4Na$ 351.1315, found: 351.1315.

Analytical data in agreement with literature.[10]

2-(benzyloxy)-5-methylphenol (S9)



According to a modified procedure,[10] a flask was charged with 1-(benzyloxy)-2-bromo-4-methylbenzene (**S7**) (5.5 g, 20 mmol, 1.0 eq.), $Cu(acac)_2$ (52 mg, 0.2 mmol, 1 mol%), *N*^{1},*N*^{2}-bis(4-hydroxy-2,6-dimethylphenyl)oxalamide (**S8**) (66 mg, 0.2 mmol, 1 mol%), $LiOH \cdot H_2O$ (1.8 g, 42 mmol, 2.1 eq.), DMSO (16 mL) and H_2O (4 mL) under argon. The mixture was stirred at 80 °C for 24 h. After cooling to room temperature, the mixture was acidified with 1M HCl and Extracted with EtOAc (3x). The combined organic layers were washed with brine, dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography

(*n*-pentane with 5% EtOAc) purification afforded 2-(benzyloxy)-5-methylphenol (**S9**) as a colourless oil (1.9 g, 8.8 mmol, 44%).

R_f (*n*-pentane with 10% EtOAc) = 0.59

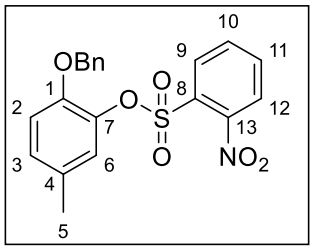
^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.46 – 7.33 (m, 5H, H-Bn), 6.82 (d, *J* = 8.2 Hz, 1H, H-C2), 6.78 (dt, *J* = 2.1, 0.7 Hz, 1H, H-C6), 6.63 (ddt, *J* = 8.1, 2.2, 0.7 Hz, 1H, H-C3), 5.59 (s, 1H, HO-C7), 5.08 (s, 2H, H-Bn), 2.27 (s, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 145.8 (C7), 143.8 (C1), 136.8 (C-Bn), 131.8 (C4), 128.8 (C-Bn), 128.5 (C-Bn), 127.9 (C-Bn), 120.4 (C3), 115.7 (C6), 112.4 (C2), 71.5 (C-Bn), 21.0 (C5).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 1591 (w), 1506 (s), 1453 (m), 1381 (w), 1335 (w), 1273 (s), 1228 (s), 1190 (s), 1148 (m), 1125 (s), 1001 (m), 943 (m), 854 (w), 790 (s), 763 (m), 735 (m), 694 (s), 584 (m).

HRMS (ESI) *m/z* $[M-H]^-$, calcd. for $C_{14}H_{13}O_2$: 213.0921, found: 213.0920

2-(benzyloxy)-5-methylphenyl 2-nitrobenzenesulfonate (S10)



To a solution of 2-(benzyloxy)-5-methylphenol (**S9**) (429 mg, 2.0 mmol, 1.0 eq.) in dry CH_2Cl_2 (10 mL) were added NEt_3 (0.33 ml, 2.4 mmol, 1.2 eq.) and 2-nitro-benzolsulfonylchlorid (487 mg, 2.2 mmol, 1.1 eq.) sequentially at 0 °C. The mixture was warmed to room temperature and stirred for 14 h. The reaction was quenched by the addition of 1N HCl and extracted with CH_2Cl_2 (3x). The combined organic layers were dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 20% EtOAc) purification afforded 2-(benzyloxy)-5-methylphenyl 2-nitrobenzenesulfonate (**S10**) as a yellow solid (715 mg, 1.8 mmol, 90%).

R_f (*n*-pentane with 30% EtOAc) = 0.46

M.p.: 104.3-105.3 °C

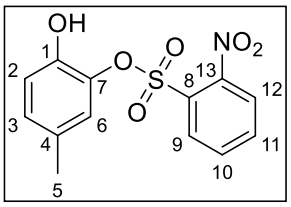
^{1}H NMR (599 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.92 (dd, *J* = 7.9, 1.3 Hz, 1H, H-C9), 7.61 – 7.47 (m, 2H, H-C11/12), 7.42 (ddd, *J* = 7.9, 7.3, 1.5 Hz, 1H, H-C10), 7.34 – 7.28 (m, 3H, H-Bn), 7.23 – 7.16 (m, 2H, H-Bn), 7.09 (dd, *J* = 2.1, 0.7 Hz, 1H, H-C6), 7.02 (ddd, *J* = 8.3, 2.2, 0.9 Hz, 1H, H-C3), 6.84 (d, *J* = 8.3 Hz, 1H, H-C2), 4.80 (s, 2H, H-Bn), 2.28 (s, 3H, H-C5).

^{13}C NMR (151 MHz, $CDCl_3$, 299 K) δ [ppm] = 148.5 (C1), 148.3 (C13), 138.4 (C7), 136.1 (C-Bn), 134.6 (C11/12), 131.7 (C10), 131.4 (C9), 131.3 (C8), 130.2 (C4), 129.0 (C3), 128.5 (C-Bn), 128.1 (C-Bn), 127.6 (C-Bn), 125.3 (C6), 124.7 (C11/12), 114.3 (C2), 70.9 (C-Bn), 20.5 (C5).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 1542 (m), 1506 (w), 1359 (m), 1290 (w), 1259 (w), 1184 (m), 1128 (w), 1090 (m), 1056 (w), 999 (w), 936 (w), 876 (w), 852 (m), 806 (s), 773 (m), 737 (s), 697 (s), 658 (m), 633 (m), 572 (s), 558 (m).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{20}H_{17}NO_6SNa$: 422.0669, found: 422.0668

2-hydroxy-5-methylphenyl 2-nitrobenzenesulfonate (8e)



To a solution of 2-(benzyloxy)-5-methylphenyl 2-nitrobenzenesulfonate (**S10**) (399 mg, 1.0 mmol, 1.0 eq.) in dry CH_2Cl_2 (5 mL) was added BBr_3 (1.0 M in CH_2Cl_2, 1.0 mL, 1.0 mmol, 1.0 eq.) dropwise at 0 °C. After 5 minutes the reaction was quenched by the addition of H_2O. The mixture was extracted with CH_2Cl_2 (3x). The combined organic layers were dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 30% EtOAc) purification afforded 2-hydroxy-5-methylphenyl 2-nitrobenzenesulfonate (**5e**) as a yellow solid (280 mg, 0.91 mmol, 91%).

R_f (*n*-pentane with 30% EtOAc) = 0.25.

M.p.: 113.0-114.0 °C

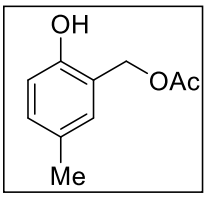
^{1}H NMR (599 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.87 (dt, *J* = 8.0, 0.8 Hz, 1H), 7.85 (d, *J* = 1.1 Hz, 1H), 7.84 (d, *J* = 1.0 Hz, 1H), 7.70 – 7.62 (m, 1H), 7.20 (dd, *J* = 2.1, 0.8 Hz, 1H, H-C2), 6.96 (ddt, *J* = 8.3, 2.1, 0.6 Hz, 1H, H-C3), 6.76 (d, *J* = 8.3 Hz, 1H, H-C6), 6.36 (s, 1H, OH-C1), 2.29 (s, 3H, H-C5).

^{13}C NMR (151 MHz, $CDCl_3$, 299 K) δ [ppm] = 148.8 (C13), 145.9 (C1), 136.0, 136.0 (C7), 132.8, 132.4, 130.8 (C4), 129.7, 128.0 (C8), 125.3, 123.8, 117.5, 20.6 (C5).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 1737 (w), 1590 (w), 1542 (s), 1507 (m), 1470 (w), 1454 (w), 1371 (s), 1359 (s), 1290 (m), 1259 (m), 1214 (w), 1183 (s), 1151 (m), 1128 (m), 1090 (m), 1057 (w), 999 (m), 936 (m), 876 (w), 852 (m), 805 (s), 788 (m), 773 (s), 737 (s), 701 (s), 658 (s), 632 (m), 573 (s).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{13}H_{11}NO_6SNa$: 332.0199, found: 332.0198.

2-hydroxy-5-methylbenzyl acetate (8f)



According to a literature procedure,[11] to a solution of 2-hydroxy-5-methylbenzaldehyde (544 mg, 4.0 mmol, 1.0 eq.) in Et_2O (30 mL) was added K_2CO_3 (600 mg, 4.4 mmol, 1.1 eq.) and Ac_2O (1 mL, 9.9 mmol, 2.5 eq.). The reaction mixture was stirred overnight and quenched with 1M HCl. The layers were separated and the organic layer was washed with brine, dried over $MgSO_4$ and concentrated under reduced pressure. The residue was dissolved in dry THF (20 mL) and BH_3·DMS (2M in THF, 2 mL, 4.0 mmol, 1.0 eq.) was added. The mixture was stirred for 2 h and quenched with H_2O and concentrated under reduced pressure. Column chromatography (*n*-pentane with 10% EtOAc) afforded 2-hydroxy-5-methylbenzyl acetate (**5f**) as white solid (608 mg, 3.4 mmol, 85%).

R_f (*n*-pentane with 30% EtOAc) = 0.57.

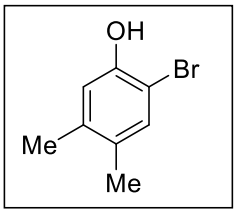
M.p.: 39.9-40.9 °C

^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.53 (s, 1H), 7.11 – 7.05 (m, 2H), 6.84 (d, *J* = 8.0 Hz, 1H), 5.09 (s, 2H), 2.27 (s, 3H), 2.10 (s, 3H).

HRMS (ESI) *m/z* $[M-H]^-$, calcd. for $C_{10}H_{12}O_3Na$: 203.0679, found: 203.0677.

Analytical data in agreement with literature.[11]

2-bromo-4,5-dimethylphenol (S11)



To a solution of 3,4-dimethylphenol (611 mg, 5 mmol, 1.0 eq.) in MeOH (5 mL) was added *p*TsOH·H_2O (86 mg, 0.5 mmol, 0.1 eq.). At 0°C, a solution of *N*-bromosuccinimide (890 mg, 5 mmol, 1.0 eq.) in MeOH (25 mL) was added dropwise. The solution was stirred for 10 h at room temperature. The solvent was removed under reduced pressure. The residue was filtered through a silica plug (*n*-pentane with 10% EtOAc) and recrystalized from *n*-pentane to afford 2-bromo-4,5-dimethylphenol (**S11**) as a white solid (267 mg, 1.3 mmol, 27%).

R_f (*n*-pentane with 10% EtOAc) = 0.48.

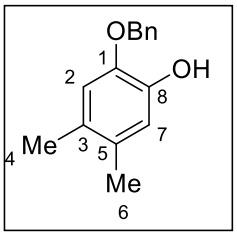
M.p.: 86.1-87.1 °C

^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.20 (s, 1H), 6.82 (s, 1H), 5.23 (s, 1H), 2.18 (s, 3H), 2.17 (s, 3H).

HRMS (ESI) *m/z* $[M-H]^-$, calcd. for C_8H_8BrO: 198.9764, found: 198.9763.

Analytical data in agreement with literature.[12]

2-(benzyloxy)-4,5-dimethylphenol (S12)



To a solution of 2-bromo-4,5-dimethylphenol (**S11**) (1.4 g, 7 mmol, 1.0 eq.) in acetone (20 mL) was added benzyl bromide (1.0 mL, 8.4 mmol, 1.2 eq.) and K_2CO_3 (1.9 g, 14 mmol, 2.0 eq.). The mixture was refluxed for 20 h. After cooling to room temperature, the mixture was acidified with 1M HCl and extracted with CH_2Cl_2 (3x). The combined organic layers were dried over $MgSO_4$ and the solvent was removed under reduced pressure. According to a modified procedure,[10] to the crude material was added $Cu(acac)_2$ (36 mg, 0.14 mmol, 2 mol%), N^1,N^2-bis(4-hydroxy-2,6-dimethylphenyl)oxalamide (**S8**) (46 mg, 0.14 mmol, 2 mol%), LiOH·H_2O (617 g, 14.7 mmol, 2.1 eq.), DMSO (5.6 mL) and H_2O (1.4 mL) under argon. The mixture was stirred at 80 °C for 24 h. After cooling to room temperature, the mixture was acidified with 1M HCl and Extracted with EtOAc (3x). The combined organic layers were washed with brine, dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 5% EtOAc) purification afforded 2-(benzyloxy)-4,5-dimethylphenol (**S12**) as a white solid (901 mg, 4.0 mmol, 56%).

R_f (*n*-pentane with 10% EtOAc) = 0.56.

M.p.: 55.7-56.7 °C

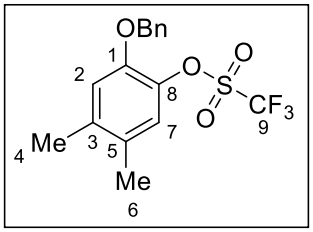
^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.45 – 7.34 (m, 5H, H-Bn), 6.75 (s, 1H, H-C7), 6.74 (s, 1H, H-C2), 5.41 (s, 1H, HO-C1), 5.07 (s, 2H, H-Bn), 2.18 (s, 3H, H-C4), 2.17 (s, 3H, H-C6).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 143.7 (C8), 143.7 (C1), 136.9 (C-Bn), 129.8 (C5), 128.8 (C-Bn), 128.4 (C-Bn), 127.9 (C-Bn), 127.8 (C3), 116.3 (C7), 114.3 (C2), 71.6 (C-Bn), 19.5 (C4), 19.2 (C6).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 2958 (w), 1873 (w), 1597 (w), 1508 (s), 1452 (m), 1384 (w), 1340 (w), 1276 (s), 1227 (s), 1172 (s), 1092 (s), 1017 (s), 903 (w), 862 (m), 840 (s), 824 (w), 800 (m), 739 (s), 694 (s), 631 (m), 574 (m).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_{15}H_{16}O_2Na^+$: 251.1043, found: 251.10423.

2-(benzyloxy)-4,5-dimethylphenyl trifluoromethanesulfonate (S13)



To a solution of 2-(benzyloxy)-4,5-dimethylphenol (**S12**) (684 mg, 3.0 mmol, 1.0 eq.) and pyridine (0.29 ml, 3.6 mmol, 1.2 eq.) in dry CH_2Cl_2 (10 ml) was added Tf_2O (0.6 ml, 3.3 mmol, 1.1. eq.) dropwise at 0 °C. The solution was warmed to room temperature and stirred for 16 h. The reaction was quenched by the addition of H_2O and the aqueous layer was extracted with CH_2Cl_2 (3x). The combined organic layers were dried over MgSO4, filtered and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 5% EtOAc) afforded 2-(benzyloxy)-4,5-dimethylphenyl trifluoromethanesulfonate (**S13**) as white solid (885 g, 2.5 mmol, 82%).

R$_f$ (*n*-pentane) = 0.68.

M.p.: 52.9-53.9 °C

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.49 – 7.43 (m, 2H, H-Bn), 7.43 – 7.36 (m, 2H, H-Bn), 7.36 – 7.30 (m, 1H, H-Bn), 6.99 (s, 1H, H-C2), 6.86 (s, 1H, H-C7), 5.13 (s, 2H, H-Bn), 2.23 (s, 3H, C6), 2.20 (s, 3H, C4).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 148.2 (C1), 137.9 (C3), 136.8 (C8), 136.2 (C-Bn), 129.8, 128.7 (C-Bn), 128.2 (C-Bn), 127.4 (C-Bn), 123.2 (C2), 118.9 (q, *J* = 320.4 Hz, C9), 116.2 (C7), 71.3 (C-Bn), 20.1 (C6), 19.1 (C4).

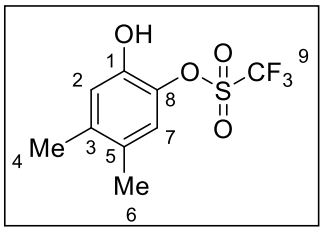
^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.9 (F-C9).

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.9 (s. F-C9).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 1617 (w), 1510 (m), 1450 (w), 1419 (s), 1307 (m), 1245 (m), 1203 (s), 1159 (m), 1136 (s), 1070 (s), 1020 (m), 884 (s), 865 (s), 850 (m), 829 (m), 798 (m), 765 (w), 736 (s), 694 (m), 678 (m), 633 (s), 612 (m), 600 (s).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_{16}H_{15}O_4SF_3Na^+$: 383.0535, found: 383.0543.

2-hydroxy-4,5-dimethylphenyl trifluoromethanesulfonate (8g)



To a solution of 2-(benzyloxy)-4,5-dimethylphenyl trifluoromethanesulfonate (**S13**) (541 mg, 1.5 mmol, 1.0 eq) in CH_2Cl_2 (15 mL) was added BBr_3 (1.0 M in CH_2Cl_2, 1.7 mL, 1.7 mmol, 1.1 eq.) added dropwise at 0 °C.The mixture was warmed to room temperature. After stirring for 2 h at room temperature the reaction was quenched by the addition of 1M HCl and extracted with CH_2Cl_2 (3x). The combined organic layers were dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 10% EtOAc) purification afforded 2-hydroxy-4,5-dimethylphenyl trifluoromethanesulfonate (**8g**) as a white solid (345 mg, 1.3 mmol, 85%).

R_f (*n*-pentane with 10% EtOAc) = 0.44.

M.p.: 63.7-64.7 °C

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 6.98 (s, 1H, H-C7), 6.82 (s, 1H, H-C2), 5.00 (s, 1H, HO-C1), 2.21 (s, 3H, H-C4), 2.20 (s, 3H, H-C6).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 144.6 (C1), 138.3 (C3), 134.9 (C8), 130.2 (C5), 122.8 (C7), 119.3 (C2), 118.7 (q, J = 320.5 Hz, C9), 19.5 (C4), 18.9 (C6).

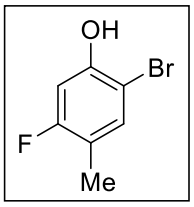
^{19}F NMR (376 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.38 (s. F-C9).

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.38 (s. F-C9).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 1617 (w), 1510 (m), 1450 (w), 1419 (s), 1307 (m), 1245 (m), 1203 (s), 1159 (m), 1136 (s), 1070 (s), 1020 (m), 884 (s), 865 (s), 850 (m), 829 (m), 798 (m), 765 (w), 736 (s), 694 (m), 678 (m), 633 (s), 612 (m), 600 (s).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_9H_9O_4SF_3Na^+$: 293.0066, found: 293.0066.

2-bromo-5-fluoro-4-methylphenol (8h)



According to a modified literature procedure,[13] to a solution of 3-fluoro-4-methylphenol (1.2 g, 10 mmol, 1.0 eq.) in CH_2Cl_2 (5 mL) was added Br_2 (0.51 mL, 10 mmol, 1.0 eq.) at -15 °C and stirred for 30 min at that temperature.. The reaction was quenched by the addition of sat. aq. Na_2SO_3 solution. The layers were separated and the aqueous layers was extracted with CH_2Cl_2 (2x). The combined organic layers were dried over $MgSO_4$ and the solvent was removed under reduced pressure to afford 2-bromo-5-fluoro-4-methylphenol (**8h**) as a colourless oil (1.9 g, 9.5 mmol, 95%).

R_f (*n*-pentane with 10% EtOAc) = 0.53.

^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.26 (dd, *J* = 7.8, 0.9 Hz, 1H), 6.72 (d, *J* = 10.4 Hz, 1H), 5.40 (d, *J* = 1.4 Hz, 1H), 2.18 (dd, *J* = 2.1, 0.8 Hz, 3H).

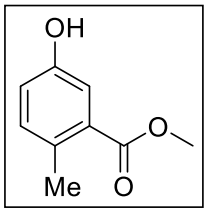
^{19}F NMR (282 MHz, $CDCl_3$, 299 K) δ [ppm] = -115.5 (s.).

^{19}F{^{1}H} NMR (282 MHz, $CDCl_3$, 299 K) δ [ppm] = -115.5 (s.).

HRMS (ESI) *m/z* $[M-H]^-$, calcd. for $C_7H_5OBrF^-$: 202.9513, found: 202.9511.

Analytical data in agreement with literature.[13]

methyl 5-hydroxy-2-methylbenzoate (8q)



To a solution of 5-hydroxy-2-methylbenzoic acid (1.0 g, 6.6 mmol, 1.0 eq.) in MeOH (15 mL) was added H_2SO_4 (5 drops). The mixture was refluxed for 24 h and neutralized with sat. aq. $NaHCO_3$ solution. The mixture was extracted with CH_2Cl_2 (3x). The combined organic layers were dried over $MgSO_4$ and the solvent was removed under reduced pressure to afford methyl 5-hydroxy-2-methylbenzoate (**8q**) as a white solid (1.0 g, 6.3 mmol, 96%).

R_f (*n*-pentane with 10% EtOAc) = 0.28.

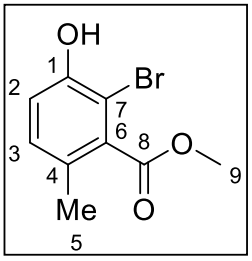
M.p.: 79.2-80.2 °C

^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.42 (d, J = 2.8 Hz, 1H), 7.11 (d, J = 8.2 Hz, 1H), 6.91 (dd, J = 8.3, 2.9 Hz, 1H), 5.17 (s, 1H), 3.89 (s, 3H), 2.50 (s, 3H).

HRMS (ESI) *m/z* $[M-H]^-$, calcd. for $C_9H_9O_3$: 165.0557, found: 165.0555.

Analytical data in agreement with literature.[14]

methyl 2-bromo-3-hydroxy-6-methylbenzoate (8i)



To a solution of methyl 5-hydroxy-2-methylbenzoate (**8q**) (1.0 g, 6.0 mmol, 1.0 eq.) and *p*TsOH·H_2O (114 mg, 0.6 mmol, 0.1 eq.) in MeOH (50 mL) was added *N*-bromosuccinimide (1.0 g, 6.3 mmol, 1.05 eq.) at 0 °C. The reaction mixture was stirred for 15 h at room temperature. The solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 10% EtOAc) afforded methyl 2-bromo-3-hydroxy-6-methylbenzoate (**8i**) as a colorless oil (1.3 g, 5.2 mmol, 87%).

R_f (*n*-pentane with 20% EtOAc) = 0.43.

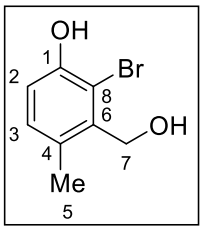
^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.06 (dt, J = 8.4, 0.5 Hz, 1H, H-C3), 6.96 (d, J = 8.4 Hz, 1H, H-C2), 5.56 (s, 1H, HO-C1), 3.95 (s, 3H, H-C9), 2.26 (s, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 168.2 (C8), 150.5 (C1), 135.9 (C6), 130.8 (C3), 128.5 (C7), 116.9 (C2), 107.4 (C4), 52.7 (C9), 19.0 (C5).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 1705 (s), 1478 (m), 1439 (m), 1299 (s), 1262 (s), 1222 (s), 1148 (m), 1099 (s), 1007 (m), 983 (m), 842 (w), 815 (m), 724 (m), 622 (w).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_9H_9O_3BrNa^+$: 266.9627, found: 266.9627.

2-bromo-3-(hydroxymethyl)-4-methylphenol (S14)



To a suspension of $LiAlH_4$ (239 mg, 6.3 mmol, 1.5 eq.) in dry THF (20 mL) was added 2-bromo-3-hydroxy-6-methylbenzoate (**8i**) (1.0 g, 4.2 mmol, 1.0 eq.) in dry THF (5 mL) at 0 °C. After stirring for 20 h at room temperature the reaction was quenched with EtOAc. A saturated solution of Rochelle salt was added and stirred for 2 h. The mixture was extracted with EtOAc (3x). The combined organic layers were washed with brine, dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 20% EtOAc) purification afforded 2-bromo-3-(hydroxymethyl)-4-methylphenol (**S14**) as a white solid (467 mg, 2.2 mmol, 54%).

R_f (*n*-pentane with 20% EtOAc) = 0.23.

M.p.: 152.1-153.1 °C

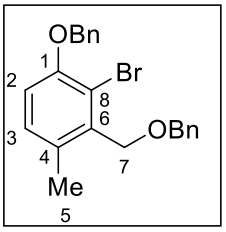
^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.06 (dd, J = 8.3, 0.8 Hz, 1H, H-C3), 6.91 (d, J = 8.3 Hz, 1H, H-C2), 5.51 (s, 1H, HO-C1), 4.84 (d, J = 5.1 Hz, 2H, H-C7), 2.42 (d, J = 0.7 Hz, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 150.8 (C1), 137.6 (C6), 130.9 (C3), 130.9 (C4) 115.7 (C2), 113.8 (C8), 62.8 (C7), 19.3 (C5).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 1882 (w), 1564 (w), 1459 (w), 1387 (w), 1345 (w), 1286 (m), 1240 (m), 1188 (w), 1172 (m), 1126 (w), 1038 (w), 1002 (w), 965 (s), 818 (m), 752 (m), 647 (w), 572 (w).

HRMS (ESI) *m/z* $[M+H]^+$, calcd. for $C_8H_8O_2Br^+$: 214.9702, found: 214.9712.

1-(benzyloxy)-3-((benzyloxy)methyl)-2-bromo-4-methylbenzene (S15)



According to a modified procedure,[13] 2-bromo-3-(hydroxymethyl)-4-methylphenol (**S14**) (434 mg, 2.0 mmol, 1.0 eq.) and benzylbromide (0.57 mL, 4.8 mmol, 2.4 eq.) were dissolved in DMF (6 mL). NaH (60 wt% in mineral oil, 192 mg, 4.8 mmol, 2.4 eq.) was added in portions. The reaction mixture was stirred for 3 h at 60 °C. After cooling to room temperature, the reaction was quenched with sat. aq. $NaHCO_3$ and extracted with EtOAc (3x). The combined organic layers were washed with brine, dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 5% EtOAc) purification afforded 1-(benzyloxy)-3-((benzyloxy)methyl)-2-bromo-4-methylbenzene (**S15**) as a white solid (514 mg, 1.3 mmol, 65%).

R_f (*n*-pentane with 5% EtOAc) = 0.54.

M.p.: 38.4-39.4 °C

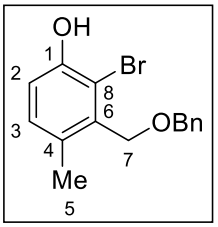
^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.51 – 7.48 (m, 2H, H-Bn), 7.43 – 7.28 (m, 8H, H-Bn), 7.05 (dd, *J* = 8.3, 0.8 Hz, 1H, H-C3), 6.82 (d, *J* = 8.3 Hz, 1H, H-C2), 5.14 (s, 2H, H-Bn), 4.81 (s, 2H, H-C7), 4.63 (s, 2H, H-Bn), 2.38 (s, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 153.5 (C1), 138.5 (C-Bn), 136.9 (C-Bn), 136.8 (C6), 132.5 (C4), 129.8 (C3), 128.7 (C-Bn), 128.5 (C-Bn), 128.1 (C-Bn), 128.0 (C-Bn), 127.8 (C-Bn), 127.1 (C-Bn), 117.1 (C8), 113.8 (C2), 72.8 (C-Bn), 71.3 (C-Bn), 69.7 (C7), 19.4 (C5).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 2878 (w), 1603 (w), 1563 (w), 1496 (w), 1477 (m), 1448 (s), 1418 (w), 1379 (w), 1349 (m), 1309 (w), 1294 (s), 1271 (s), 1207 (w), 1178 (w), 1135 (w), 1086 (s), 1065 (s), 1027 (m), 985 (s), 903 (w), 795 (s), 768 (m), 728 (s), 691 (s), 628 (m).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{22}H_{21}O_2BrNa^+$: 419.0617, found: 419.0619.

3-((benzyloxy)methyl)-2-bromo-4-methylphenol (8j)



According to a modified procedure,[15] 1-(benzyloxy)-3-((benzyloxy)methyl)-2-bromo-4-methylbenzene (**S15**) (397 mg, 1.0 mmol, 1.0 eq.) and pentamethylbenzene (445 mg, 3.0 mmol, 3.0 eq.) were dissolved in CH_2Cl_2 and cooled to -78 °C. BCl_3 (1.0 M in CH_2Cl_2, 2.0 mmol, 2.0 eq.) was added and the mixture was stirred for 20 min. The reaction mixture was quenched at -78 °C by the addition of $CHCl_3$/MeOH (10:1, 11 mL) and slowly warmed to room temperature. The solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 10% EtOAc) purification afforded 3-((benzyloxy)methyl)-2-bromo-4-methylphenol (**8j**) as a white solid (246 mg, 0.8 mmol, 80%).

R_f (*n*-pentane with 5% EtOAc) = 0.29.

M.p.: 71.2-72.2 °C.

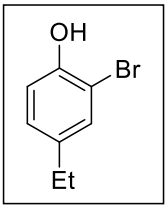
^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.42 – 7.30 (m, 4H, H-Bn), 7.34 – 7.27 (m, 1H, H-Bn), 7.04 (d, *J* = 8.3 Hz, 1H, H-C3), 6.91 (d, *J* = 8.2 Hz, 1H, H-C2), 5.55 (s, 2H), 4.70 (s, 2H, H-C7), 4.61 (s, 2H, H-Bn), 2.36 (s, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 150.6 (C1), 138.2 (C-Bn), 135.3 (C4), 131.7 (C6), 130.6 (C3), 128.5 (C-Bn), 128.1 (C-Bn), 127.9 (C-Bn), 115.6 (C2), 114.7 (C8), 72.8 (C-Bn), 69.6 (C7), 19.3 (C5).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 1739 (w), 1569 (w), 1493 (w), 1454 (w), 1364 (w), 1327 (w), 1297 (s), 1221 (w), 1175 (w), 1135 (w), 1049 (s), 1020 (m), 997 (s), 961 (w), 928 (m), 910 (m), 812 (s), 767 (m), 746 (s), 699 (s), 664 (m), 604 (s).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{15}H_{15}O_2BrNa^+$: 329.0148, found: 329.0148.

2-bromo-4-ethylphenol (8k)



To a solution of 4-ethylphenol (1.2 g, 10 mmol, 1.0 eq.) in MeOH (10 mL) was added *p*TsOH·H_2O (19 mg, 1 mmol, 0.1 eq.). At 0°C, a solution of *N*-bromosuccinimide (1.8 g, 10 mmol, 1.0 eq.) in MeOH (100 mL) was added dropwise. The solution was stirred for 10 h at room temperature. The solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 5% EtOAc) purification afforded 2-bromo-4-ethylphenol (**8k**) as a pale yellow oil (2.0 g, 10 mmol, quant.).

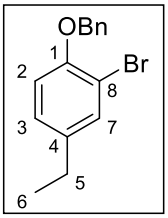
R_f (*n*-pentane with 5% EtOAc) = 0.41.

^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.29 (d, *J* = 2.0 Hz, 1H), 7.10 – 7.00 (m, 1H), 6.93 (d, *J* = 8.3 Hz, 1H), 5.35 (s, 1H), 2.57 (q, *J* = 7.5 Hz, 2H), 1.20 (t, *J* = 7.6 Hz, 3H).

HRMS (ESI) *m/z* $[M-H]^-$, calcd. for $C_8H_8OBr^-$: 198.9753, found: 198.9767.

Analytical data in agreement with literature.[16]

1-(benzyloxy)-2-bromo-4-ethylbenzene (S16)



To a solution of 2-bromo-4-ethylphenol (**8k**) in DMF (25 mL) was added benzyl bromide (1.6 mL, 13 mmol, 1.3 eq.) and K_2CO_3 (2.7 g, 20 mmol, 2.0 eq.). The mixture was stirred at 90 °C for 11 h. The reaction mixture was diluted with H_2O and extracted with EtOAc. The organic layer was washed with brine (2x), dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 5% EtOAc) purification afforded 1-(benzyloxy)-2-bromo-4-ethylbenzene (**S16**) as a colorless oil (2.6 g, 9.1 mmol, 91%).

R_f (*n*-pentane with 10% EtOAc) = 0.76.

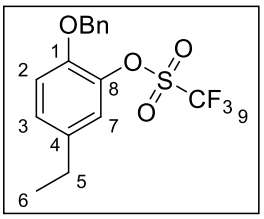
^{1}H NMR (600 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.49 (ddd, *J* = 7.7, 1.3, 0.7 Hz, 2H, H-Bn), 7.42 (d, *J* = 2.2 Hz, 1H, H-C7), 7.41 – 7.38 (m, 2H, H-Bn), 7.36 – 7.31 (m, 1H, H-Bn), 7.05 (ddd, *J* = 8.3, 2.1, 0.6 Hz, 1H, H-C3), 6.86 (d, *J* = 8.3 Hz, 1H, H-C2), 5.14 (s, 2H, H-Bn), 2.58 (q, *J* = 7.6 Hz, 2H, H-C5), 1.22 (t, *J* = 7.6 Hz, 3H, H-C6).

^{13}C NMR (151 MHz, $CDCl_3$, 299 K) δ [ppm] = 153.2 (C1), 138.5 (C4), 136.9 (C-Bn), 132.8 (C7), 128.7 (C-Bn), 128.0 (C-Bn), 127.8 (C3), 127.2 (C-Bn), 114.2 (C2), 112.5 (C8), 71.1 (C-Bn), 27.8 (C5), 15.7 (C6).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 2963 (w), 2871 (w), 1722 (w), 1604 (m), 1493 (s), 1453 (m), 1404 (w), 1380 (m), 1278 (s), 1251 (s), 1154 (m), 1046 (s), 1021 (m), 907 (w), 877 (m), 808 (m), 762 (m), 733 (s), 693 (s), 586 (m).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{15}H_{15}BrNaO^+$: 313.0204, found: 313.0199.

2-(benzyloxy)-5-ethylphenyl trifluoromethanesulfonate (S17)



According to a modified procedure,[10] a flask was charged with 1-(benzyloxy)-2-bromo-4-ethylbenzene (**S16**) (2.2 g, 8.0 mmol, 1.0 eq.), $Cu(acac)_2$ (42 mg, 0.16 mmol, 2 mol%), N^1,N^2-bis(4-hydroxy-2,6-dimethylphenyl)oxalamide (**S3**) (53 mg, 0.16 mmol, 2 mol%), $LiOH \cdot H_2O$ (428 mg, 14.7 mmol, 2.2 eq.), DMSO (6.4 mL) and H_2O (1.6 mL) under argon. The mixture was stirred at 80 °C for 24 h. After cooling to room temperature, the mixture was acidified with 1M HCl and extracted with EtOAc (3x). The combined organic layers were washed with brine, dried over $MgSO_4$ and the solvent was removed under reduced pressure. The crude material was filtered through a silica plug (*n*-pentane with 10% EtOAc). After concentration, the crude material was dissolved in dry CH_2Cl_2 (80 mL) and NEt_3 (1.3 mL, 9.6 mmol, 1.2 eq.) was added. The solution was cooled to 0 °C and Tf_2O (1.6 mL, 9.6 mmol, 1.2 eq.) was added dropwise. After stirring for 14 h at room temperature the reaction was quenched by addition of 1M HCl. The layers were separated and the aqueous layer was extracted with CH_2Cl_2 (2x). The combined organic layers were dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 5% EtOAc) purification afforded 2-(benzyloxy)-5-ethylphenyl trifluoromethanesulfonate (**S17**) as a pale-yellow oil (756 mg, 2.8 mmol, 35%).

R_f (*n*-pentane with 10% EtOAc) = 0.71.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.46 (ddd, *J* = 7.8, 1.6, 0.9 Hz, 2H, H-Bn), 7.43 – 7.37 (m, 2H, H-Bn), 7.36 – 7.32 (m, 1H, H-Bn), 7.10 (ddt, *J* = 8.4, 2.1, 0.7 Hz, 1H, H-C3), 7.07 (d, *J* = 2.0 Hz, 1H, H-C7), 6.98 (d, *J* = 8.5 Hz, 1H, H-C2), 5.16 (s, 2H, H-Bn), 2.62 2.62 (qt, *J* = 7.5, 0.7 Hz, 2H, H-C5), 1.22 (t, *J* = 7.6 Hz, 3H, H-C6).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 148.5 (C1), 139.0 (C8), 137.8 (C4), 136.1 (C-Bn), 128.7 (C-Bn), 128.4 (C3), 128.3 (C-Bn), 127.4 (C-Bn), 121.9 (C7), 118.9 (q, *J* = 320.5 Hz, C9), 114.7 (C2), 71.3 (C-Bn), 27.9 (C5), 15.5 (C6).

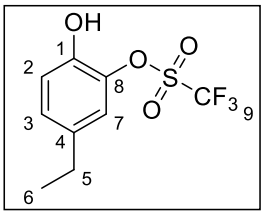
^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.9 (s, F-C9).

^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.9 (s, F-C9).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 2372 (w), 1872 (w), 1622 (w), 1511 (s), 1455 (m), 1419 (s), 1287 (m), 1265 (m), 1247 (s), 1201 (s), 1138 (s), 1092 (s), 986 (m), 928 (s), 877 (m), 822 (s), 784 (m), 734 (s), 694 (s), 650 (m), 600 (s).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{16}H_{15}F_3O_4SNa^+$: 383.0541, found: 383.0537.

5-ethyl-2-hydroxyphenyl trifluoromethanesulfonate (8l)



To a solution of 2-(benzyloxy)-5-ethylphenyl trifluoromethanesulfonate (**S12**) (540 mg, 2.0 mmol, 1.0 eq.) in MeOH (10 mL) was added Pd/C (200 mg) under argon. The reaction vessel was evacuated and backfilled with H_2 (3x). After stirring for 13 h under H_2 atmosphere (balloon), the reaction vessel was evacuated and backfilled with argon (3x). The suspension was filtered through Celite® and washed with MeOH. The solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 20% EtOAc) purification afforded 5-ethyl-2-hydroxyphenyl trifluoromethanesulfonate (**5l**) as a brown oil (230 mg, 0.9 mmol, 43%).

R_f (*n*-pentane with 10% EtOAc) = 0.38.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.09 – 7.04 (m, 2H, H-C3/7), 6.95 (d, J = 8.2 Hz, 1H, H-C2), 5.29 (s, 1H, HO-C1), 2.61 (q, J = 7.5 Hz, 2H, H-C5), 1.22 (t, J = 7.6 Hz, 3H. H-C6).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 145.2 (C1), 138.3 (C4), 137.4 (C8), 128.8 (C2/3), 121.6 (C2/3), 118.8 (q, J = 320.7 Hz, C9), 118.2 (C2), 28.0 (C5), 15.5 (C6).

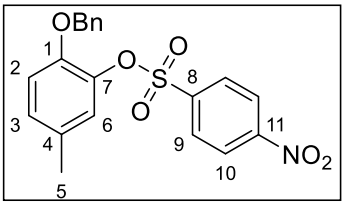
^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.42 (s, F-C9).

^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.42 (s, F-C9).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 1628 (w), 1517 (m), 1415 (s), 1295 (m), 1203 (s), 1134 (s), 1083 (s), 984 (m), 929 (s), 876 (m), 831 (s), 778 (m), 760 (m), 697 (m), 648 (m), 602 (s).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_9H_9O_4SF_3Na^+$: 293.0066, found: 293.0068.

2-(benzyloxy)-5-methylphenyl 4-nitrobenzenesulfonate (S18)



To a solution of 2-(benzyloxy)-5-methylphenol (**S9**) (406 mg, 1.9 mmol, 1.0 eq.) in dry CH_2Cl_2 (10 mL) were added NEt_3 (0.39 ml, 2.8 mmol, 1.5 eq.) and 4-nitro-benzolsulfonylchlorid (505 mg, 2.3 mmol, 1.2 eq.) sequentially at 0 °C. The mixture was warmed to room temperature and stirred for 14 h. The reaction was quenched by the addition of 1N HCl and extracted with CH_2Cl_2 (3x). The combined organic layers were dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 10% EtOAc) purification afforded 2-(benzyloxy)-5-methylphenyl 4-nitrobenzenesulfonate (**S18**) as a yellow solid (697 mg, 1.8 mmol, 92%).

R_f (*n*-pentane with 10% EtOAc) = 0.41.

M.p.: 117-119 °C.

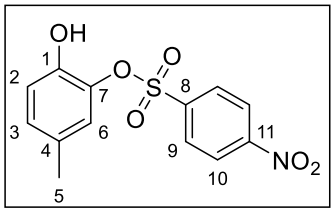
^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 8.00 – 7.93 (m, 2H, H-C10), 7.95 – 7.87 (m, 2H, H-C9), 7.41 – 7.30 (m, 3H, H-Bn), 7.19 – 7.17 (m, 2H, H-Bn), 7.17 – 7.16 (m, 1H, H-C6), 7.05 (ddd, J = 8.3, 2.2, 0.8 Hz, 1H, H-C3), 6.84 (d, J = 8.4 Hz, 1H, H-C2), 4.73 (s, 2H, H-Bn), 2.34 (d, J = 0.7 Hz, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 150.6 (C11), 148.3 (C1), 142.1 (C8), 137.9 (C7), 135.9 (C-Bn), 131.5 (C4), 129.8 (C9), 129.1 (C3), 128.7 (C-Bn), 128.6 (C-Bn), 127.8 (C6), 125.4 (C-Bn), 123.8 (C10), 114.0 (C2), 70.9 (C-Bn), 20.6 (C5).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 1738 (w), 1590 (w), 1542 (s), 1507 (m), 1470 (w), 1454 (w), 1371 (s), 1359 (s), 1290 (m), 1259 (m), 1214 (w), 1183 (s), 1151 (w), 1128 (m), 1090 (m), 1057 (w), 999 (m), 936 (m), 876 (w), 852 (m), 805 (s), 788 (m), 773 (s), 737 (s), 702 (s), 658 (s), 632 (m), 573 (s).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_{20}H_{17}NO_6SNa^+$: 422.0669, found: 422.0672.

2-hydroxy-5-methylphenyl 4-nitrobenzenesulfonate (8m)



To a solution of 2-(benzyloxy)-5-methylphenol (**S18**) (399 mg, 1.0 mmol, 1.0 eq.) in dry CH_2Cl_2 (5 mL) was added BBr_3 (1.0 M in CH_2Cl_2, 1.0 mL, 1.0 mmol, 1.0 eq.) dropwise at 0 °C. After 4 h the reaction was quenched by the addition of H_2O. The mixture was extracted with CH_2Cl_2 (3x). The combined organic layers were dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 20% EtOAc) purification afforded 2-hydroxy-5-methylphenyl 2-nitrobenzenesulfonate (**8m**) as a white solid (280 mg, 0.71 mmol, 71%).

R$_f$ (*n*-pentane with 10% EtOAc) = 0.15.

M.p.: 124-126 °C.

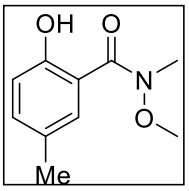
^{1}H NMR (599 MHz, $CDCl_3$, 299 K) δ [ppm] = 8.4 – 8.3 (m, 2H), 8.1 – 8.1 (m, 2H), 7.0 – 6.9 (m, 1H, H-C3), 6.8 (d, *J* = 8.3 Hz, 1H, H-C2), 6.8 (dt, *J* = 2.1, 0.7 Hz, 1H, H-C6), 5.4 (d, *J* = 1.0 Hz, 1H, OH-C1), 2.2 (s, 3H, H-C5).

^{13}C NMR (151 MHz, $CDCl_3$, 299 K) δ [ppm] = 151.3 (C11), 145.6 (C1), 140.6 (C8), 136.5 (C7), 131.5 (C4), 130.2 (C10), 129.7 (C3), 124.5 (C9), 123.5 (C6), 118.3 (C2), 20.5 (C5).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 1609 (w), 1541 (m), 1515 (m), 1346 (m), 1289 (m), 1239 (w), 1183 (m), 1083 (m), 942 (m), 853 (w), 816 (s), 775 (m), 739 (m), 699 (m), 676 (w), 645 (w), 601 (s), 580 (m).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_{13}H_{11}NO_6SNa^+$: 332.0199, found: 332.0199.

2-hydroxy-*N*-methoxy-*N*,5-dimethylbenzamide (8n)



According to a literature procedure,[13] to a solution of 2-hydroxy-5-methylbenzoic acid (761 mg, 5.0 mmol, 1.0 eq.) in dry DMF (15 mL) were added *N,O*-dimethylhydroxylamine hydrochloride (975 mg, 10 mmol, 2.0 eq.), EDC·HCl (1.44 g, 7.5 mmol, 1.5 eq.), HOBt (918 mg, 6 mmol, 1.2 eq.) and NEt_3 (1.4 mmol, 10 mmol, 2.0 eq.) at 0 °C. After stirring for 2 days at room temperature, the mixture was quenched with H_2O and extracted with CH_2Cl_2 (3x). The combined organic layers were dried over $MgSO_4$ and concentrated under reduced pressure. Column chromatography (*n*-pentane with 20% EtOAc afforded 2-hydroxy-N-methoxy-N,5-dimethylbenzamide (**8n**) as a colourless oil (543 mg, 2.8 mmol, 56%).

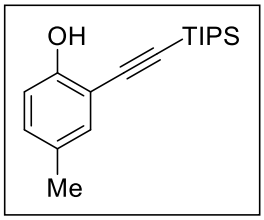
R$_f$ (*n*-pentane with 30%) = 0.53.

^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 10.77 (s, 1H), 7.71 (dt, *J* = 2.3, 0.7 Hz, 1H), 7.18 (ddd, *J* = 8.4, 2.2, 0.7 Hz, 1H), 6.88 (d, *J* = 8.4 Hz, 1H), 3.65 (s, 3H), 3.39 (s, 3H), 2.27 (s, 3H).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_{10}H_{13}NO_3Na^+$: 218.0788, found: 218.0786.

Analytical data in agreement with literature.[13]

4-methyl-2-((triisopropylsilyl)ethynyl)phenol (8o)



According to a modified procedure,[17] a Schlenk tube was charged with 2-iodo-4-methylphenol (1.1 g, 4.7 mmol, 1.0 eq.), (triisopropylsilyl)-acetylene (1.3 mL, 5.6 mmol, 1.2 eq.), $PdCl_2(PPh_3)_2$ (70 mg, 0.1 mmol, 2 mol%), diisopropylethylamine (1.6 mL, 9.4 mmol, 2.0 eq.) and dry toluene (15 mL). The reaction mixture was stirred 10 min before adding CuI (76 mg, 0.4 mmol, 8 mol%) and stirring additional 15 h at room temperature. The reaction was quenched by adding 1 M HCl and extracted with EtOAc (3x). The combined organic layers were washed with brine, dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 5% EtOAc) purification afforded 4-methyl-2-((triisopropylsilyl)ethynyl)phenol (**8o**) as a colorless oil (549 mg, 1.9 mmol, 40%).

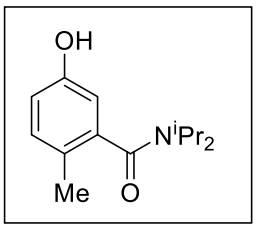
R_f (*n*-pentane with 5% EtOAc) = 0.77

^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.17 (d, J = 2.2 Hz, 1H), 7.05 (dd, J = 8.3, 2.2 Hz, 1H), 6.84 (d, J = 8.3 Hz, 1H), 5.71 (s, 1H), 2.25 (s, 3H), 1.13 (d, J = 2.9 Hz, 21H).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{18}H_{28}OSiNa^+$: 311.1802, found: 311.1803.

Analytical data in agreement with literature.[18]

5-hydroxy-2-methyl-*N,N*-dipropylbenzamide (8p)



According to a modified procedure,[19] to a suspension of 5-hydroxy-2-methylbenzoic acid (761 mg, 5.0 mmol, 1.0 eq.) in H_2O (5 mL) was added NaOH (400 mg, 10 mmol, 2.0 eq.). After cooling the solution to 0 °C, acetic acid anhydride (1.1 mL, 11.5 mmol, 2.3 mmol) was added. The mixture was stirred for 13 h at room temperature and extracted with EtOAc (3x). The combined organic layers were washed with brine, dried over $MgSO_4$ and the solvent was removed under reduced pressure. The residue was dissolved in dry CH_2Cl_2 (100 mL) and oxalylchloride (0.51 mL, 6.0 mmol, 1.2 eq.) and DMF (4 drops) were added. After stirring for 4 h, diisopropylamine (4.9 mL, 35 mmol, 7.0 eq.) was added at 0 °C. The mixture was stirred for 1 h at room temperature and concentrated under reduced pressure. To the residue was added MeOH (25 mL) and sat. aq. $NaHCO_3$ (25 mL). The suspension was stirred for 4 h. The mixture was acidified with 1 M HCl and extracted with EtOAc (3x). The combined organic layers were washed with brine, dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (EtOAc) purification afforded 5-hydroxy-2-methyl-*N,N*-dipropylbenzamide (**8p**) as a white solid (1.0 g, 3.6 mmol, 72%).

R_f (*n*-pentane with 30% EtOAc) = 0.25.

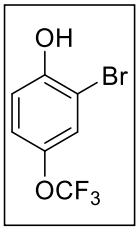
M.p.: 213.2-214-2 °C.

^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 8.07 (s, 1H), 6.90 (d, J = 8.3 Hz, 1H), 6.55 (dd, J = 8.3, 2.6 Hz, 1H), 6.44 (d, J = 2.6 Hz, 1H), 3.74 (p, J = 6.7 Hz, 1H), 3.52 (p, J = 6.8 Hz, 1H), 2.16 (s, 3H), 1.57 (dd, J = 6.8, 1.1 Hz, 6H), 1.12 (d, J = 6.7 Hz, 3H), 1.06 (d, J = 6.6 Hz, 3H).

HRMS (ESI) *m/z* $[M-H]^-$, calcd. for $C_{14}H_{20}NO_2^-$: 234.1500, found: 234.1497.

Analytical data in agreement with literature.[19]

2-bromo-4-(trifluoromethoxy)phenol (8r)



4-(trifluoromethoxy)phenol (1.3 mL, 10 mmol, 1.0 eq.) was dissolved in CH_2Cl_2 (60 mL) and Br_2 (0.51 mL, 10 mmol, 1.0 eq.) was added dropwise. The mixture was stirred for 2 days at room temperature and quenched by the addition of sat. aq. $Na_2S_2O_3$. The layers were separated and the aqueous layer was extracted with CH_2Cl_2 (2x). The combined organic layers were dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 5% EtOAc) afforded 2-bromo-4-(trifluoromethoxy)phenol (**8r**) as a yellow oil (1.7 g, 6.5 mmol, 65%).

R_f (*n*-pentane with 5% EtOAc) = 0.23

^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.37 (dd, *J* = 2.7, 0.8 Hz, 1H), 7.12 (ddq, *J* = 9.1, 2.7, 0.8 Hz, 1H), 7.03 (d, *J* = 9.0 Hz, 1H), 5.55 (s, 1H).

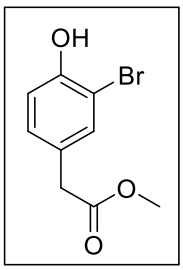
^{19}F NMR (282 MHz, $CDCl_3$, 299 K) δ [ppm] = -58.59 (s.).

^{19}F{^{1}H} NMR (282 MHz, $CDCl_3$, 299 K) δ [ppm] = -58.59 (s.).

HRMS (ESI) *m/z* $[M-H]^-$, calcd. for $C_7H_3O_2BrF_3^-$: 254.9274, found: 254.9270.

Analytical data in agreement with literature.[20]

Methyl 2-(3-bromo-4-hydroxyphenyl)acetate (S19)



To a solution of 2-(4-hydroxyphenyl)acetic acid (1.5 g, 10 mmol, 1.0 eq.) and *p*-TsOH·H_2O (0.19 g, 1.0 mmol, 0.10 eq.) in MeOH (5 ml) was added *N*-bromosuccinimide (1.8 g, 10 mmol, 1.0 eq.) in MeOH (60 ml) dropwise at 0 °C. The mixture was stirred for 14 h at room temperature and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 15% EtOAc) purification afforded methyl 2-(3-bromo-4-hydroxyphenyl)acetate (**S19**) as colorless oil (1.9 g, 7.8 mmol, 78%).

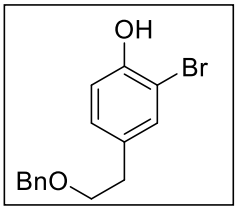
R_f (*n*-pentane with 15% EtOAc) = 0.20

^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.39 (d, *J* = 2.1 Hz, 1H), 7.12 (dd, *J* = 8.3, 2.1 Hz, 1H), 6.96 (d, *J* = 8.3 Hz, 1H), 5.56 (s, 1H), 3.70 (s, 3H), 3.53 (s, 2H).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_9H_9O_3BrNa^+$: 266.9627, found: 266.9625.

Analytical data in agreement with the literature.[21]

4-(2-(benzyloxy)ethyl)-2-bromophenol (8s)



To a suspension of $LiAlH_4$ (0.19 g, 5.1 mmol, 1.2 eq.) in dry THF (60 ml) was added methyl 2-(3-bromo-4-hydroxyphenyl)acetate (1.1 g, 4.3 mmol, 1.0 eq.) in dry THF (60 ml) dropwise at 0 °C. The mixture was stirred for 20 h at room temperature and cooled to 0 °C. The reaction mixture was quenched with aqueous Rochelle salt, extracted with EtOAc (3x), dried over $MgSO_4$, filtered and the solvent was removed under reduced pressure to afford 2-bromo-4-(2-hydroxyethyl)phenol as a white solid in 80% yield. According to a modified procedure,[13] to a solution of this material (0.76 g, 3.5 mmol, 1.0 eq.) in dry DMF (11 ml) were added NaH (60% in mineral oil, 0.33 g, 8.4 mmol, 2.4 eq.) and BnBr (0.99 ml, 8.4 mmol,

2.4 eq.) at 0 °C. The mixture was stirrred for 4 h at 60 °C and cooled to 0 °C. The reaction mixture was acidified with 1 M HCl, extracted with CH_2Cl_2 (3x), washed with 1 M HCl, water, saturated $NaHCO_3$, and brine, dried over $MgSO_4$, filterered and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 5% EtOAc) purification afforded 1-(benzyloxy)-4-(2-(benzyloxy)ethyl)-2-bromobenzene as colorless oil in 72% yield. To a solution of this material (1.0 g, 2.5 mmol, 1.0 eq.) and pentamethylbenzene (1.1 g, 7.6 mmol, 3.0 eq.) in dry CH_2Cl_2 (50 ml) was added BCl_3 (1.0 M in CH_2Cl_2, 5.0 mmol, 2.0 eq.) at –78 °C. After stirring for 30 min at the same temperature, the reaction was quenched with $CHCl_3$-MeOH (10:1) co-solvent (25 ml) at the same temperature, and gradually warmed up to room temperature. The solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 10% EtOAc) purification afforded 4-(2-(benzyloxy)ethyl)-2-bromophenol (**8s**) as colorless oil (610 mg, 2.0 mmol, 79%).

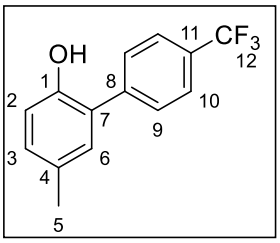
R_f (*n*-pentane with 10% EtOAc) = 0.16

^{1}H NMR (400 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.38 – 7.27 (m, 6H), 7.07 (dd, *J* = 8.3, 2.1 Hz, 1H), 6.93 (d, *J* = 8.3 Hz, 1H), 5.38 (s, 1H), 4.52 (s, 2H), 3.64 (t, *J* = 6.9 Hz, 2H), 2.83 (t, *J* = 6.9 Hz, 2H).

HRMS (ESI) *m/z* $[M-H]^-$, calcd. for $C_{15}H_{14}O_2Br^-$: 305.01827, found: 305.01790.

Analytical data in agreement with the literature.[13]

5-methyl-4'-(trifluoromethyl)-[1,1'-biphenyl]-2-ol (8t)



According to a modified literature procedure,[4] THF (12 mL) and K_2CO_3 (2 M aq., 8 mL, 4.0 eq.) were added to a pressure tube. The solution was degassed, followed by the addition of (4-(trifluoromethyl)phenyl)boronic acid (911 mg, 4.8 mmol, 1.2 eq.), bis(triphenylphosphine)palladium(II) dichloride (84 mg, 0.12 mmol, 0.03 eq.) and 2-bromo-4-methylphenol (748 mg, 4.0 mmol, 1.0 eq.). The pressure tube solution was sealed and heated to 80 °C for 16 h. After cooling to room temperature, the mixture was acidified with 1M HCl and extracted with Et_2O (3x). The combined organic layers were washed with brine, dried over $MgSO_4$ and the solvent was removed under reduced pressure. Column chromatography (*n*-pentane with 5-10% EtOAc) purification afforded 5-methyl-4'-(trifluoromethyl)-[1,1'-biphenyl]-2-ol (**8t**) as a white solid (478 mg, 1.9 mmol, 47%).

R_f (*n*-pentane with 10% EtOAc) = 0.47.

M.p.: 50-52 °C.

^{1}H NMR (599 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.75 – 7.71 (m, 2H, H-C10), 7.68 – 7.58 (m, 2H, H-C9), 7.11 – 7.08 (m, 1H, H-C3), 7.08 (d, *J* = 2.2 Hz, 1H, H-C6), 6.86 (d, *J* = 8.1 Hz, 1H, H-C2), 4.87 (s, 1H, HO-C1), 2.34 (s, 3H, H-C5).

^{13}C NMR (151 MHz, $CDCl_3$, 299 K) δ [ppm] = 150.2 (C1), 141.5 (q, *J* = 1.4 Hz, C8), 131.0 (C6), 130.7 (C4), 130.4 (C3), 129.8 (q, *J* = 32.3 Hz, C11) 129.7 (C10), 126.8 (C7), 125.9 (q, *J* = 3.8 Hz, C10), 124.3 (d, *J* = 272.0 Hz, C12), 116.2 (C2), 20.6 (C5).

^{19}F NMR (564 MHz, $CDCl_3$, 299 K) δ [ppm] = -62.6 (s, 3F, F-C12).

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$, 299 K) δ [ppm] = -62.6 (s, 3F, F-C12).

IR (ATR) $\tilde{u}$ [cm^{-1}] = 1618 (w), 1495 (m), 1396 (w), 1317 (s), 1267 (m), 1201 (m), 1153 (s), 1109 (s), 1063 (s), 1014 (m), 883 (w), 839 (m), 810 (m), 783 (m), 766 (m), 706 (m), 650 (w), 606 (m).
HRMS (ESI) *m/z* [M-H]$^-$, calcd. for $C_{14}H_{10}OF_3^-$: 251.0678, found: 251.0685.

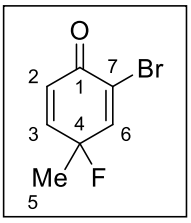
V. Synthesis of 4-fluoro-2,5-cyclohexadien-1-ones

General procedure B for the asymmetric dearomatisation of phenol

For the asymmetric reaction, commercially available *m*CPBA was purified to >95% by NMR using literature procedures.[22]

A Teflon® screw cap vial was charged with a 1 cm stirring bar the corresponding phenol (0.2 mmol, 1.0 eq.), catalyst **23** (26.4 mg, 0.04 mmol, 0.2 eq.), MTBE (0.35 mL) and amine:HF 1:4.0 (0.65 mL). The vial was put into a cooling bath (-6 °C to -4 °C) and stirred at 500 rpm. After 10 minutes, *m*CPBA (138.0 mg, 0.8 mmol, 4.0 eq.) was added and the reaction mixture was stirred for 48 h. After completion, the reaction mixture was poured into a saturated solution of $NaHCO_3$ and the aqueous layer was extracted with CH_2Cl_2 (3x). The combined organic layers were dried over MgSO4, filtered and the solvent was removed under reduced pressure. The crude residue was purified by column chromatography (SiO_2, specified combination of solvents).

2-bromo-4-fluoro-4-methylcyclohexa-2,5-dien-1-one (9a)



According to general procedure B, 2-bromo-4-methylphenol (37.4 mg, 0.2 mmol, 1.0 eq.) was converted into 2-bromo-4-fluoro-4-methylcyclohexa-2,5-dien-1-one (**9a**). Column chromatography (*n*-pentane with 5% Et_2O) afforded a white solid (19.7 mg, 0.09 mmol, 48%; ^{19}F-NMR yield 61%).

R_f (*n*-pentane with 10% EtOAc) = 0.41.

M.p.: 52-54 °C.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.34 (dd, *J* = 6.2 , 2.9 Hz, 1H, H-C6), 6.92 (ddd, *J* = 10.1, 5.8, 2.9 Hz, 1H, H-C3), 6.32 (dd, *J* = 10.1, 0.6, 1H, H-C2), 1.66 (d, *J* = 21.1 Hz, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 177.4 (d, *J* = 5.2 Hz, C1), 146.8 (d, *J* = 22.7 Hz, C6), 146.7 (d, *J* = 21.5 Hz, C3), 127.1 (d, *J* = 7.8 Hz, C2), 125.2 (d, *J* = 11.0 Hz, C7), 88.3 (d, *J* = 166.6 Hz, C4), 25.5 (d, *J* = 27.1 Hz, C5).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -144.1 (qt, *J* = 21.2, 5.9 Hz, 1F, F-C4).

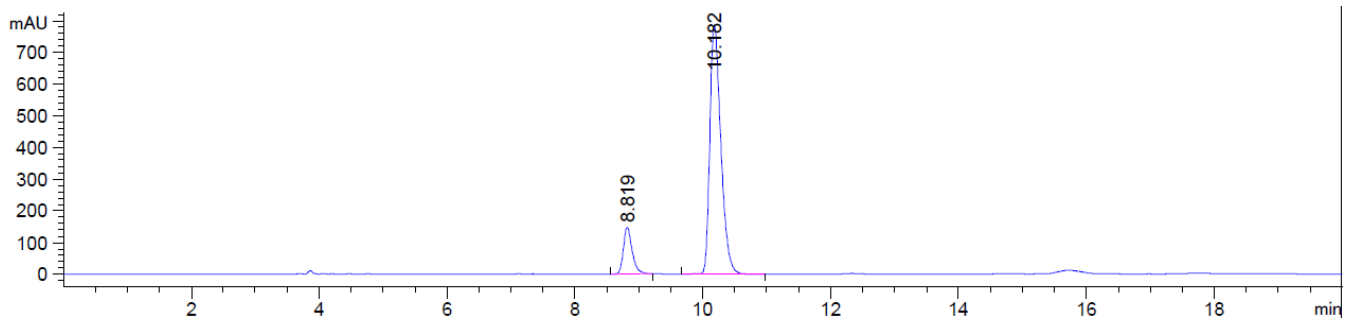
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -144.1 (s, 1F, F-C4).

IR (ATR) $\bar{\nu}$ [cm^{-1}] = 2923 (w), 1677 (m), 1640 (w), 1607 (w), 1379 (w), 1371 (w), 1333 (m), 1292 (m), 1225 (w), 1147 (w), 1109 (w), 1062 (m), 989 (m), 973 (m), 901 (s), 822 (m), 803 (m), 747 (m), 714 (m).

GC-MS (EI) *m/z* [M-CH_3]$^+$, calcd. for $C_6H_3OBrF^+$: 188.9346, found:188.9346.

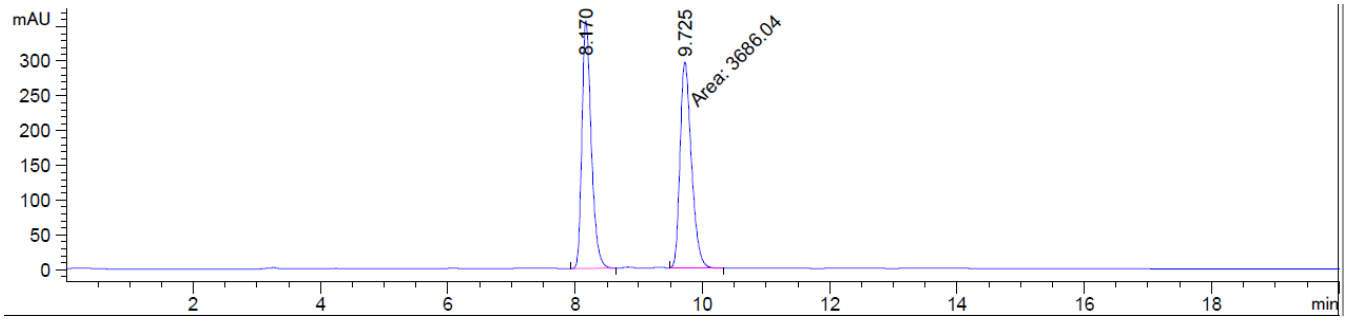
$[\boldsymbol{\alpha}]_{\mathbf{D}}^{\mathbf{22}}$ = -12.3° (*c* = 1.00, CH_2Cl_2).

***e.r.*:** 87:13 Column: AS-H, eluent: hexanes: *i*PrOH 95:5, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 8.8 min; t_R (major) = 10.2 min.



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

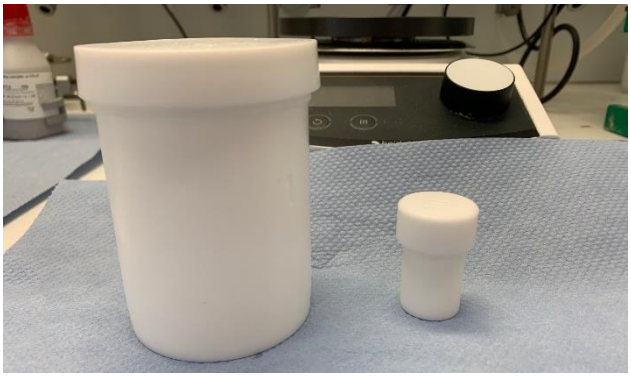
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.819	BB	0.1460	1415.88220	147.46538	13.1251
2	10.182	BB	0.1810	9371.71484	786.40039	86.8749
Totals :				1.07876e4	933.86577	



Signal 3: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.170	BB	0.1546	3628.06934	356.89075	49.6037
2	9.725	MM	0.2072	3686.04126	296.55350	50.3963
Totals :				7314.11060	653.44424	

According to general procedure B, 2-bromo-4-methylphenol (374.0 mg, 2 mmol, 1.0 eq.) was converted into 2-bromo-4-fluoro-4-methylcyclohexa-2,5-dien-1-one (**9a**). Column chromatography (*n*-pentane with 5% Et_2O) afforded a yellow oil (210.4 mg, 1.026 mmol, 51%; ^{19}F-NMR yield 61%).

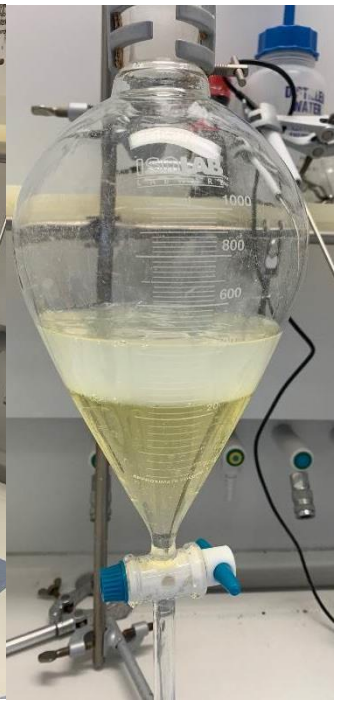


Comparison of Teflon® vials for scale up and for usual 0.2 mmol scale.

Set up for addition of HF to starting material and catalyst.

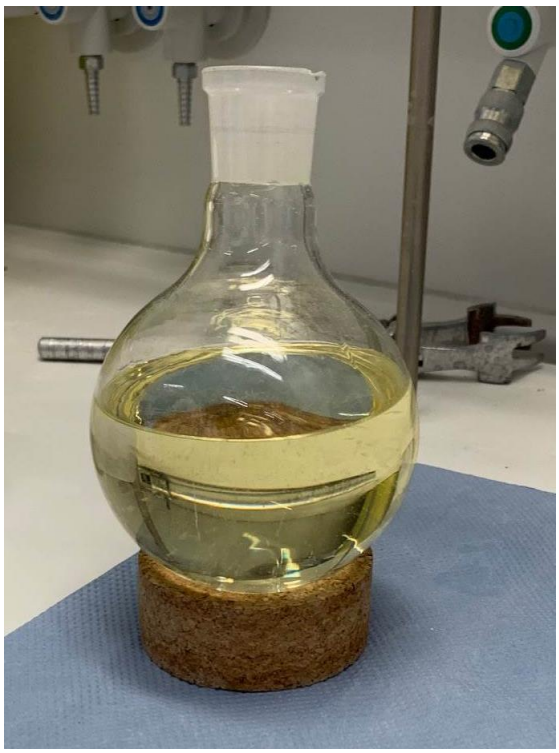
264 mg of catalyst that was synthesised in 6 steps.

6.5 mL of HF solution added.



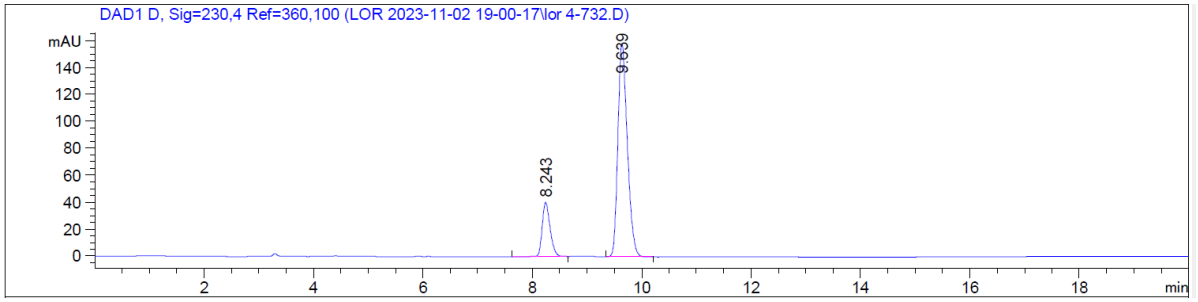
After 48 h the yellow solution was poured into sat. aq. $NaHCO_3$ solution in order to quench it. For this scale more than 200 mL of quenching solution had to be used.

The extraction was done in a 1L separation funnel.



After extraction the crude material was more than 400 mL of liquid that was concentrated *in vacuo.*

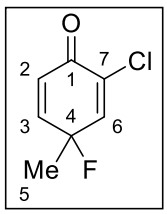
***e.r.*:** 83:17 Column: AS-H, eluent: hexanes: *i*PrOH 95:5, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 8.2 min; t_R (major) = 9.6 min.



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.243	BB	0.1504	401.23578	40.20928	17.4285
2	9.639	BB	0.1840	1900.94104	158.45845	82.5715
Totals :				2302.17682	198.66773	

2-chloro-4-fluoro-4-methylcyclohexa-2,5-dien-1-one (9b)



According to general procedure B, 2-chloro-4-methylphenol (28.5 mg, 0.2 mmol, 1.0 eq.) was converted into 2-chloro-4-fluoro-4-methylcyclohexa-2,5-dien-1-one (**9b**). Column chromatography (*n*-pentane with 7.5% Et_2O) afforded a white solid (16.2 mg, 0.10 mmol, 50%; ^{19}F-NMR yield 60%).

R_f (*n*-pentane with 10% EtOAc) = 0.47.

M.p.: 35-37 °C.

^{1}H NMR (600 MHz, $CDCl_3$, k299 K) δ [ppm] = 7.06 (dd, *J* = 6.3, 2.9 Hz, 1H, H-C6), 6.92 (ddd, *J* = 10.1, 5.7, 2.9 Hz, 1H, H-C3), 6.30 (dd, *J* = 10.1, 0.7 Hz, 1H, H-C2), 1.68 (d, *J* = 21.2 Hz, 3H, H-C5).

^{13}C NMR (151 MHz, $CDCl_3$, 299 K) δ [ppm] = 177.7 (d, *J* = 5.3 Hz, C1), 146.9 (d, *J* = 21.4 Hz, C3), 142.5 (d, *J* = 22.8 Hz, C6), 133.4 (d, *J* = 11.2 Hz, C7), 127.7 (d, *J* = 7.8 Hz, C2), 88.0 (d, *J* = 165.6 Hz, C4), 25.8 (d, *J* = 27.2 Hz, C5).

^{19}F NMR (564 MHz, $CDCl_3$, 299 K) δ [ppm] = -144.3 (qt, *J* = 21.0, 6.0 Hz, 1F, F-C4).

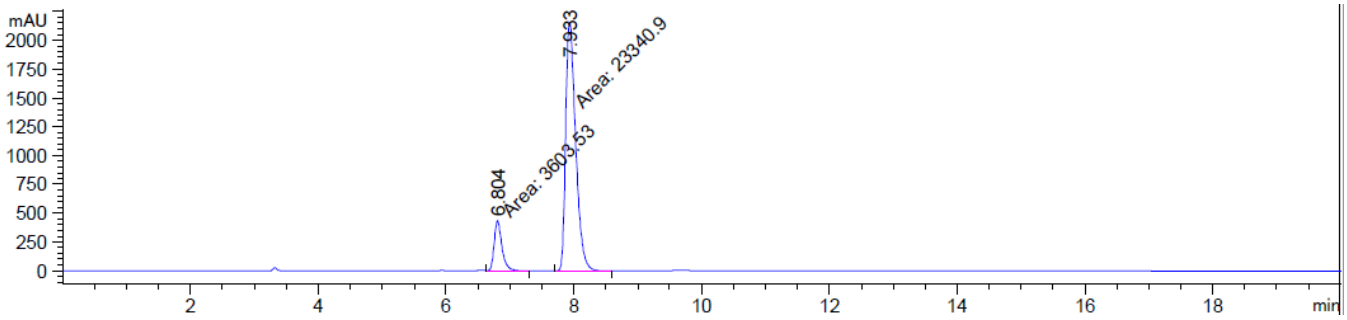
^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$, 299 K) δ [ppm] = -144.3 (s, 1F, F-C4).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 1682 (s), 1649 (w), 1612 (w), 1385 (w), 1372 (w), 1334 (w), 1299 (w), 1148 (w), 1115 (w), 1065 (s), 998 (m), 898 (m), 819 (s), 757 (m), 716 (w).

GC-MS (EI) *m/z* $[M]^+$, calcd. for $C_7H_6OClF^+$: 160.0086, found: 160.0085.

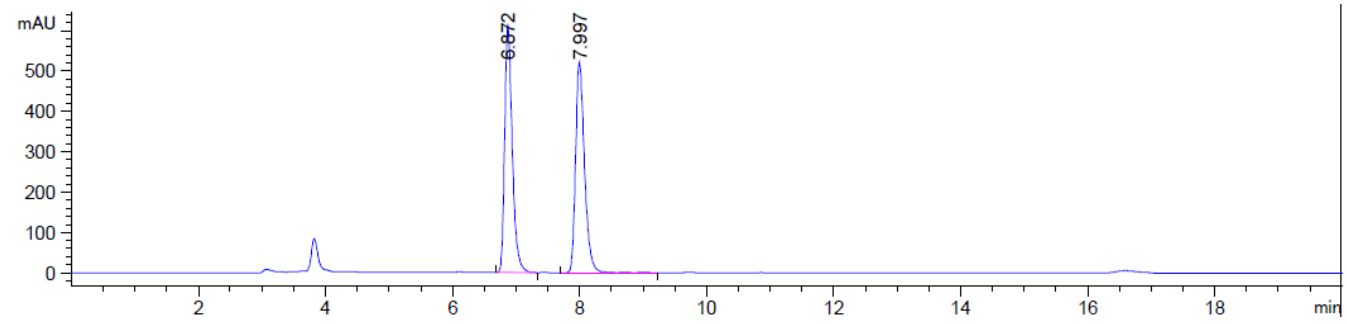
$[\alpha]_D^{22}$ = -16.0° (*c* = 0.78, CH_2Cl_2).

***e.r.*:** 87:13 Column: AS-H, eluent: hexanes: *i*PrOH 90:10, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 6.8 min; t_R (major) = 7.9 min.



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

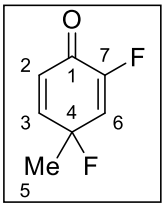
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.804	MM	0.1388	3603.52686	432.66858	13.3739
2	7.933	MM	0.1804	2.33409e4	2155.96362	86.6261
Totals :				2.69445e4	2588.63220	



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.872	BB	0.1264	5075.73096	613.98163	49.9589
2	7.997	BV R	0.1476	5084.07520	521.11511	50.0411
Totals :				1.01598e4	1135.09674	

2,4-difluoro-4-methylcyclohexa-2,5-dien-1-one (9c)



According to general procedure B, 2-fluoro-4-methylphenol (25.2 mg, 0.2 mmol, 1.0 eq.) was converted into 2,4-difluoro-4-methylcyclohexa-2,5-dien-1-one (**9c**). Column chromatography (*n*-pentane with 5% Et_2O) afforded a yellow oil (8.7 mg, 0.06 mmol, 30%; ^{19}F-NMR yield 42%).

R_f (*n*-pentane with 10% Et_2O) = 0.28.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 6.91 (dddd, *J* = 10.2, 5.6, 2.8, 0.6 Hz, 1H, H-C3), 6.43 (ddd, *J* = 11.4, 6.0, 2.8 Hz, 1H, H-C6), 6.23 (ddd, *J* = 10.0, 6.7, 0.7 Hz, 1H, H-C2), 1.70 (dd, *J* = 21.1, 1.2 Hz, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 177.7 (dd, *J* = 22.8, 5.6 Hz, C1), 153.0 (dd, *J* = 271.0, 11.8 Hz, C7), 147.4 (dd, *J* = 21.2, 2.6 Hz,C3), 127.4 (dd, *J* = 7.7, 3.5 Hz, C2), 122.5 (dd, *J* = 23.4,13.1 Hz, C6), 88.8 (dd, *J* = 164.9 Hz, 10.6 Hz, C4), 26.3 (dd, *J* = 27.3, 2.2 Hz, C5).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -128.2 – -128.4 (m, 1F, F-C7), -144.73 (qtd, *J* = 21.1, 5.8, 3.8 Hz, 1F, F-C4).

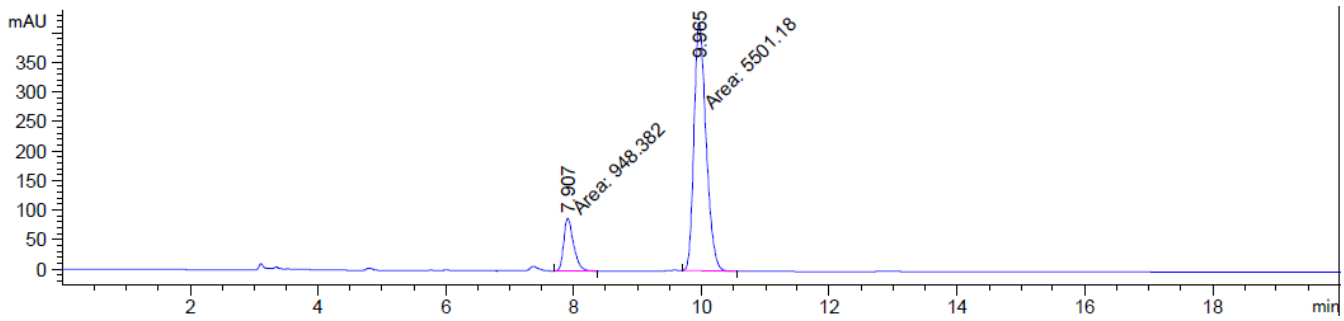
^{19}F{^{1}H} NMR (377 MHz, $CDCl_3$, 299 K) δ [ppm] = -128.9 (d, *J* = 3.8 Hz, 1F, F-C7), -144.80 (d, *J* = 3.8 Hz, 1F, F-C4).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 2924 (w), 1695 (m), 1673 (m), 1360 (w), 1178 (w), 1129 (w), 1089 (m), 1068 (s), 898 (w), 867 (w), 832 (w), 774 (w), 666 (w).

GC-MS (EI) *m/z* $[M\text{-}CH_3]^+$, calcd. for $C_6H_3OF_2^+$:129.0147, found: 129.0147.

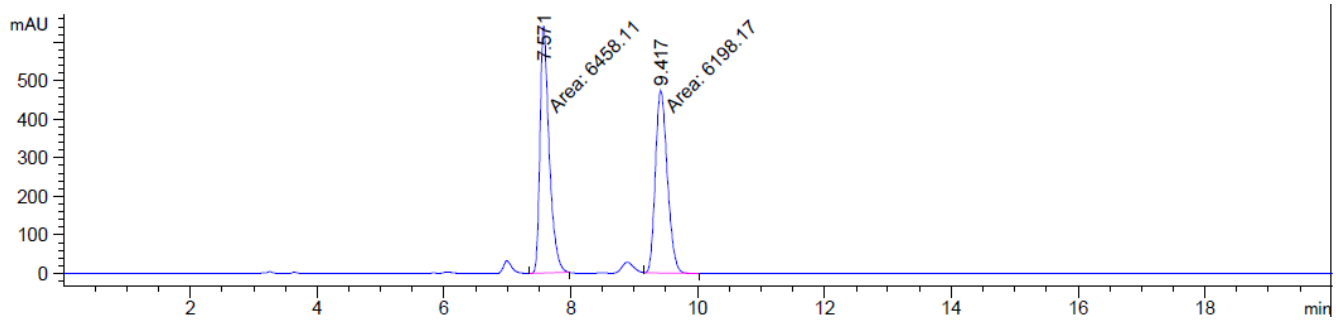
$[\alpha]_D^{22}$ = -0.8° (*c* = 0.26, CH_2Cl_2).

***e.r.*:** 85:15 Column: AS-H, eluent: hexanes: *i*PrOH 90:10, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 7.9 min; t_R (major) = 10.0 min.



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

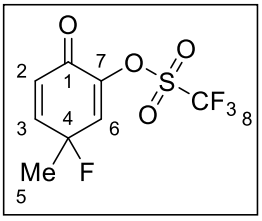
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.907	MM	0.1769	948.38202	89.34927	14.7046
2	9.965	MM	0.2186	5501.18457	419.50528	85.2954
Totals :				6449.56659	508.85455	



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.571	MM	0.1681	6458.11279	640.13696	51.0269
2	9.417	MM	0.2185	6198.16553	472.86646	48.9731
Totals :				1.26563e4	1113.00342	

3-fluoro-3-methyl-6-oxocyclohexa-1,4-dien-1-yl trifluoromethanesulfonate (9d)



According to general procedure B, 2-hydroxy-5-methylphenyl trifluoromethanesulfonate (**8d**) (51.2 mg, 0.2 mmol, 1.0 eq.) was converted into 3-fluoro-3-methyl-6-oxocyclohexa-1,4-dien-1-yl trifluoromethanesulfonate (**9d**). Column chromatography (*n*-pentane with 10% Et_2O) afforded a pale yellow oil (19.3 mg, 0.07 mmol, 35%; ^{19}F-NMR yield 41%).

R_f (*n*-pentane with 10% Et_2O) = 0.23.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 6.97 (ddd, *J* = 10.2 Hz, 5.8, 2.8 Hz, 1H, H-C3), 6.85 (dd, *J* = 5.8, 2.8 Hz, 1H, H-C6), 6.31 (dd, *J* = 10.1, 0.6 Hz, 1H, H-C2), 1.75 (d, *J* = 21.2 Hz, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 176.2 (d, *J* = 5.2 Hz, C1), 147.3 (d, *J* = 21.5 Hz, C3), 143.6 (d, *J* = 11.4 Hz, C7), 134.9 (d, *J* = 24.1 Hz, C6), 127.1 (d, *J* = 7.8 Hz, C2), 118.7 (q, *J* = 320.5 Hz, C8), 88.3 (d, *J* = 168.0 Hz, C4), 25.9 (d, *J* = 26.9 Hz, C5).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.5 (s, 3F, F-C8), -146.1 (qt, *J* = 21.2, 5.8 Hz, 1F, F-C4).

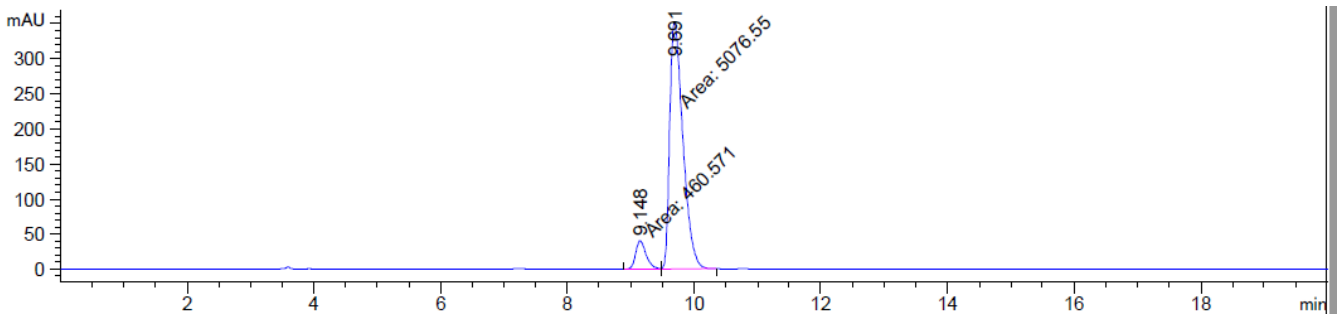
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.5 (s, 3F, F-C8), -146.1 (s, 1F, F-C4).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 1695 (m), 1666 (m), 1426 (m), 1353 (w), 1249 (m), 1205 (s), 1136 (s), 1055 (s), 903 (m), 836 (m), 796 (s), 773 (m), 757 (m), 723 (w), 671 (m).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_8H_6O_4SF_4Na^+$: 296.9815, found: 296.9813.

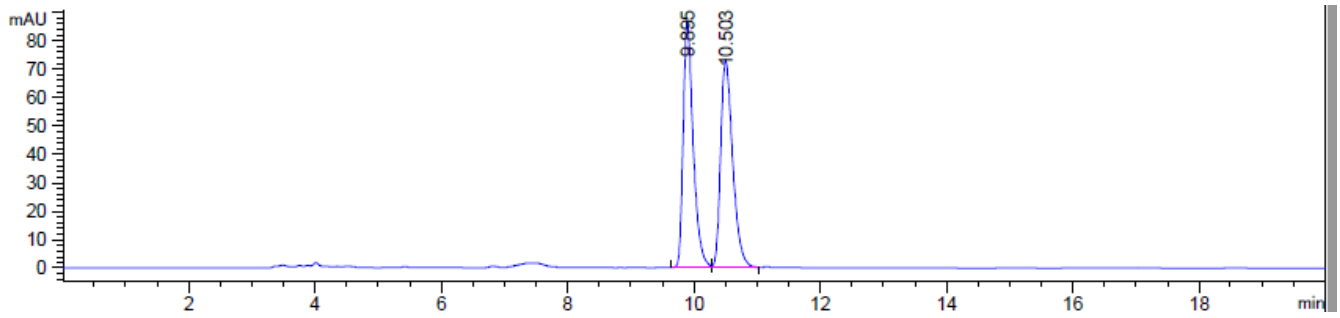
$[\alpha]_D^{22}$ = -9.3° (*c* = 0.78, CH_2Cl_2).

***e.r.*:** 92:8 Column: AS-H, eluent: hexanes: *i*PrOH 99:1, flowrate: 1 mL/min, Detection: λ = 254 nm with t_R(minor) = 9.1 min; t_R (major) = 9.7 min.



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

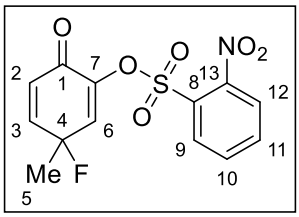
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.148	MF T	0.1905	460.57080	40.29620	8.3179
2	9.691	FM T	0.2404	5076.55029	351.90817	91.6821
Totals :				5537.12109	392.20438	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.895	BV	0.1662	949.65247	86.39259	49.6304
2	10.503	VB	0.2020	963.79681	72.99860	50.3696
Totals :				1913.44928	159.39118	

3-fluoro-3-methyl-6-oxocyclohexa-1,4-dien-1-yl 2-nitrobenzenesulfonate (9e)



According to general procedure B, 2-hydroxy-5-methylphenyl 2-nitrobenzenesulfonate (**8e**) (61.8 mg, 0.2 mmol, 1.0 eq.) was converted into 3-fluoro-3-methyl-6-oxocyclohexa-1,4-dien-1-yl 2-nitrobenzenesulfonate (**9e**). Column chromatography (*n*-pentane with 30% EtOAc) afforded a off white solid (29.0 mg, 0.09 mmol, 44%; ^{19}F-NMR yield 54%).

R_f (*n*-pentane with 20% EtOAc) = 0.16.

M.p.: 63-65 °C.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 8.22 (ddd, *J* = 7.6, 1.2, 0.6 Hz, 1H), 7.90 – 7.77 (m, 3H), 6.92 (ddd, *J* = 10.0, 5.8, 2.8 Hz, 1H, H-C3), 6.87 (dd, *J* = 6.0, 2.9 Hz, 1H, H-C6), 6.17 (d, *J* = 10.1 Hz, 1H, H-C2), 1.75 (d, *J* = 21.3 Hz, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 177.6 (d, *J* = 5.0 Hz, C1), 148.4 (C13), 147.2 (d, *J* = 21.5 Hz, C3), 143.1 (d, *J* = 11.4 Hz, C7), 135.9 (d, *J* = 23.8 Hz, C6), 135.5 (C11), 132.5 (C10), 132.0 (C9), 129.8 (C8), 127.3 (d, *J* = 8.0 Hz, C2), 124.9 (C8), 88.6 (d, *J* = 166.7 Hz, C4), 25.9 (d, *J* = 26.8 Hz, C5).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -145.7 (qt, *J* = 21.3, 5.9 Hz, F-C4).

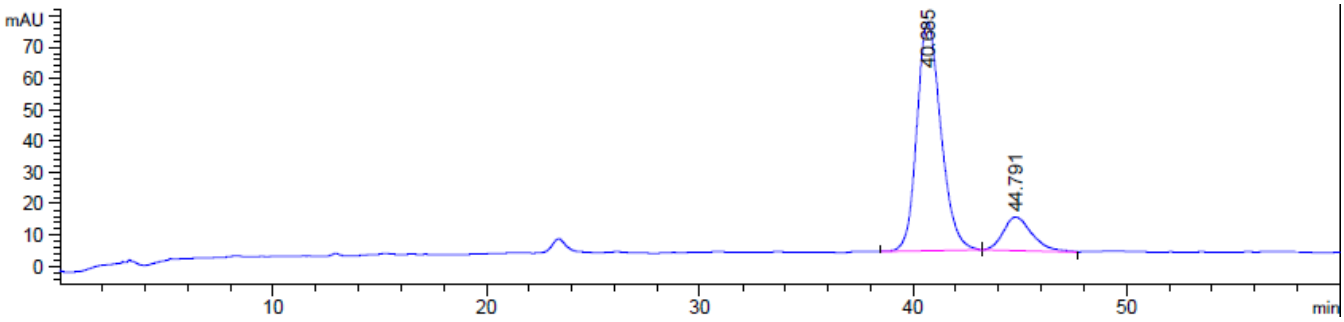
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -145.7 (s, F-C4).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 1692 (m), 1660 (w), 1545 (s), 1389 (m), 1195 (s), 1159 (w), 1127 (w), 1065 (s), 896 (m), 852 (w), 838 (w), 779 (s), 738 (w), 672 (m), 585 (m).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{13}H_{10}NO_6SFNa^+$: 221.0584, found: 221.0580.

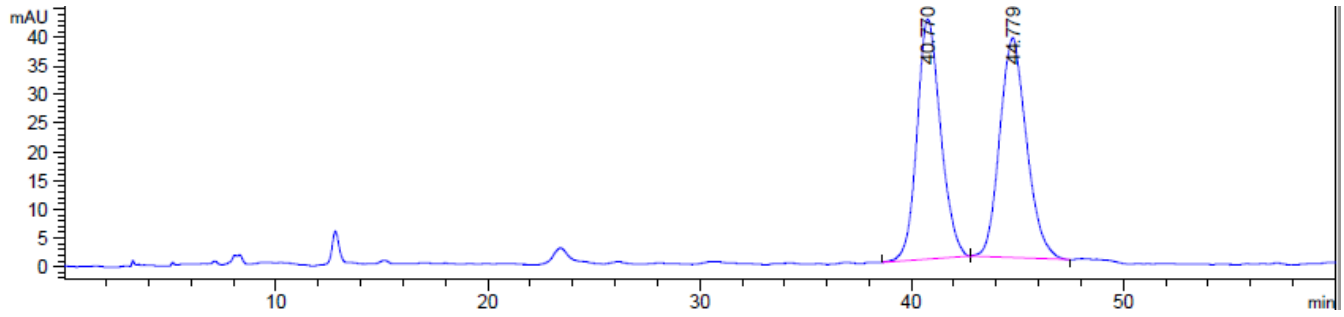
$[\alpha]_D^{22}$ = 1.5° (*c* = 1.00, CH_2Cl_2).

***e.r.*:** 85:15 Column: Chiral-NR, eluent: hexanes: *i*PrOH 85:15, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 44.8 min; t_R (major) = 40.7 min.



Signal 3: DAD1 D, Sig=230,4 Ref=off

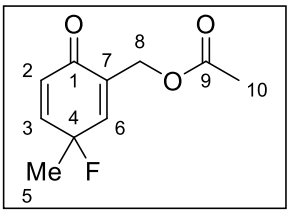
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	40.685	BB	1.1878	5710.34131	73.06293	85.0758
2	44.791	BB	1.2283	1001.72021	10.69951	14.9242
Totals :				6712.06152	83.76245	



Signal 3: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	40.770	BB	1.0977	3240.27295	41.83004	48.9979
2	44.779	BB	1.1706	3372.81372	38.33154	51.0021
Totals :				6613.08667	80.16158	

(3-fluoro-3-methyl-6-oxocyclohexa-1,4-dien-1-yl)methyl acetate (9f)



According to general procedure B, 2-hydroxy-5-methylbenzyl acetate (**8f**) (36.0 mg, 0.2 mmol, 1.0 eq.) was converted into (3-fluoro-3-methyl-6-oxocyclohexa-1,4-dien-1-yl)methyl acetate (**9f**). Column chromatography (*n*-pentane with 10% EtOAc) afforded a colourless oil (19.6 mg, 0.10 mmol, 49%; ^{19}F-NMR yield 49%).

R_f (*n*-pentane with 10% EtOAc) = 0.19.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 6.91 (ddd, *J* = 10.0, 6.0, 3.1 Hz, 1H, H-C3), 6.84 (ddt, *J* = 6.3, 3.1, 1.6 Hz, 1H, H-C6), 6.21 (dd, *J* = 10.1, 0.7 Hz, 1H, H-C2), 4.86 (td, *J* = 3.7, 1.6 Hz, 2H, H-C8), 2.12 (s, 3H, H-C10), 1.64 (d, *J* = 21.3 Hz, 3H, H-C10).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 183.6 (d, *J* = 5.3 Hz, C1), 170.4 (C9), 146.9 (d, *J* = 21.5 Hz, C3), 142.7 (d, *J* = 22.2 Hz, C6), 133.8 (d, *J* = 8.1 Hz, C7), 128.4 (d, *J* = 7.6 Hz, C2), 87.0 (d, *J* = 162.6 Hz, C4), 60.3 (C8), 25.9 (d, *J* = 27.1 Hz, C5), 21.0 (C10).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -145.93 – -146.12 (m, F-C4).

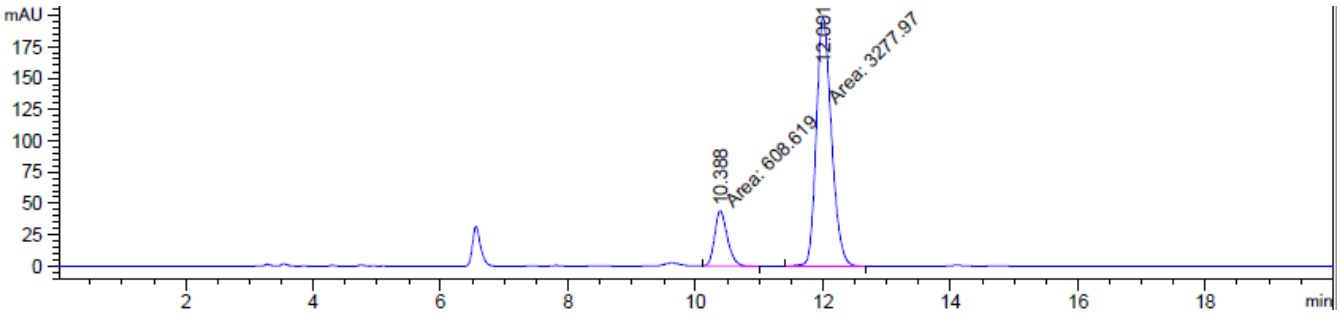
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -146.03 (s, F-C4).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 1705 (s), 1478 (m), 1439 (m), 1299 (s), 1262 (s), 1222 (s), 1148 (m), 1099 (s), 1007 (m), 983 (m), 842 (w), 815 (m), 724 (m), 622 (w).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{10}H_{11}O_3FNa^+$: 221.0584, found: 221.0580.

$[\alpha]_D^{22}$ = -0.9° (*c* = 1.00, CH_2Cl_2).

***e.r.*:** 84:16 Column: AS-H, eluent: hexanes: *i*PrOH 90:10, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 10.4 min; t_R (major) = 12.0 min.

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Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.388 MM    0.2304  608.61926   44.02916  15.6595
   2  12.001 MM    0.2755 3277.96704  198.31821  84.3405

Totals :                  3886.58630  242.34737
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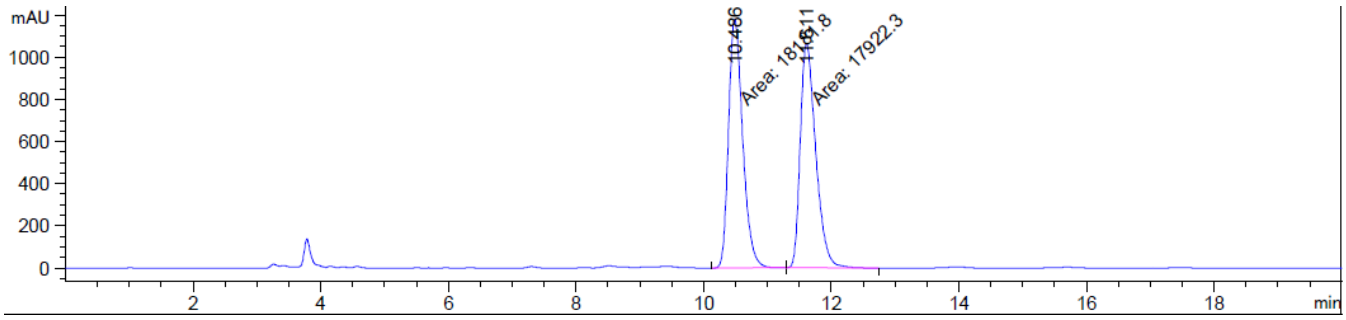
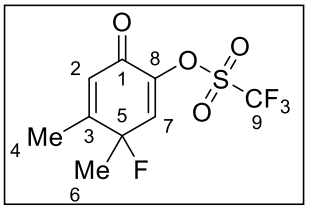


Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.486	MM	0.2565	1.81818e4	1181.55408	50.3594
2	11.611	MM	0.2809	1.79223e4	1063.46985	49.6406
Totals :				3.61041e4	2245.02393	

3-fluoro-3,4-dimethyl-6-oxocyclohexa-1,4-dien-1-yl trifluoromethanesulfonate (9g)



According to general procedure B, 2-hydroxy-4,5-dimethylphenyl trifluoromethanesulfonate (**8g**) (54.0 mg, 0.2 mmol, 1.0 eq.) was converted into 3-fluoro-3,4-dimethyl-6-oxocyclohexa-1,4-dien-1-yl trifluoromethanesulfonate (**9g**). Column chromatography (*n*-pentane with 7.5% EtOAc) afforded a pale yellow wax (28.1 mg, 0.10 mmol, 49%; ^{19}F-NMR yield 68%).

R$_f$ (*n*-pentane with 10% EtOAc) = 0.33.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 6.87 (d, *J* = 6.7 Hz, 1H, H-C7), 6.15 (p, *J* = 1.5 Hz, 1H, H-C2), 2.15 (d, *J* = 1.5 Hz, 3H, H-C4), 1.73 (d, *J* = 21.0 Hz, 3H, H-C6).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 176.4 (d, *J* = 4.1 Hz, C1), 158.7 (d, *J* = 20.3 Hz, C3), 143.4 (d, *J* = 11.6 Hz, C8), 135.3 (d, *J* = 25.5 Hz, C7), 125.0 (d, *J* = 5.0 Hz, C2), 118.7 (q, *J* = 320.5 Hz, C9), 90.1 (d, *J* = 171.5 Hz, C5), 25.5 (d, *J* = 26.8 Hz, C6), 17.6 (d, *J* = 2.4 Hz, C4).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.5 (s, 3F, F-C9), -150.7 (qdd, *J* = 20.9, 6.6, 1.7 Hz, 1F, F-C5).

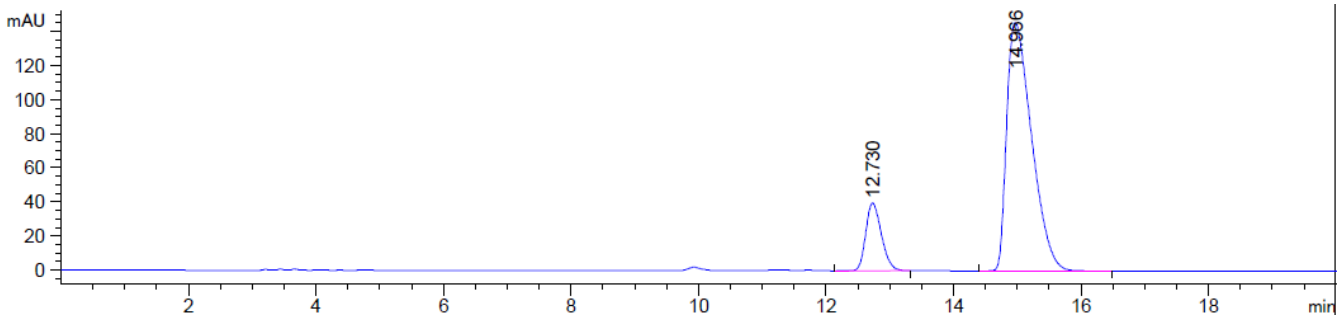
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.5 (s, 3F, F-C9), -150.6 (s, 1F, F-C5).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 2924 (s), 2853 (m), 1692 (m), 1670 (m), 1630 (w), 1428 (s), 1377 (w), 1209 (s), 1138 (s), 1064 (s), 1034 (m), 900 (m), 848 (s).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_9H_8O_4SF_4Na^+$: 310.9972, found: 310.9971.

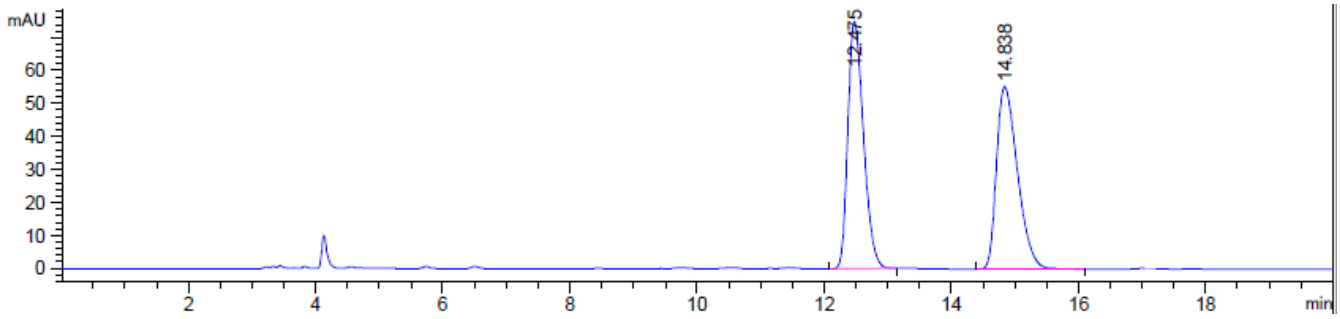
$[\alpha]_D^{22}$ = -10.5° (*c* = 1.00, CH_2Cl_2).

***e.r.*:** 85:15 Column: AS-H, eluent: hexanes: *i*PrOH 99:1, flowrate: 1 mL/min, Detection: λ = 254 nm with t_R(minor) = 12.7 min; t_R (major) = 15.0 min.



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

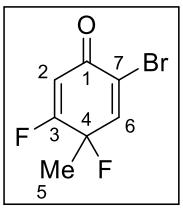
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.730	BB	0.2672	677.31421	39.66388	14.6386
2	14.966	BB	0.4262	3949.59497	145.71782	85.3614
Totals :				4626.90918	185.38170	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.475	BB	0.2653	1279.56201	74.90920	50.2480
2	14.838	BB	0.3576	1266.93347	55.22687	49.7520
Totals :				2546.49548	130.13607	

2-bromo-4,5-difluoro-4-methylcyclohexa-2,5-dien-1-one (9h)



According to general procedure B, 2-bromo-5-fluoro-4-methylphenol (**8h**) (41.0 mg, 0.2 mmol, 1.0 eq.) was converted into 2-bromo-4,5-difluoro-4-methylcyclohexa-2,5-dien-1-one (**9h**). Column chromatography (*n*-pentane with 2% Et_2O) afforded a pale yellow oil (17.4 mg, 0.08 mmol, 39%; ^{19}F-NMR yield 55%).

R_f (*n*-pentane with 10% EtOAc) = 0.56.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.21 (dd, *J* = 9.5, 6.5 Hz, 1H, H-C6), 6.07 (dd, *J* = 11.8, 0.8 Hz, 1H, H-C2), 1.83 – 1.74 (m, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 178.6 (C1), 171.4 (dd, *J* = 295.0, 17.3 Hz, C3), 142.1 (dd, *J* = 20.8, 3.7 Hz, C6), 125.4 (d, *J* = 9.7 Hz, C7), 108.1 (dd, *J* = 11.7, 3.6 Hz, C2), 86.8 (dd, *J* = 174.1, 25.6 Hz, C4), 22.4 (d, *J* = 27.6 Hz, C5).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -99.2 (ddd, J = 31.3, 11.7, 9.4 Hz, 1F, F-C3), -152.0 (dqd, J = 31.5, 21.0, 6.4 Hz, 1, F-C4).

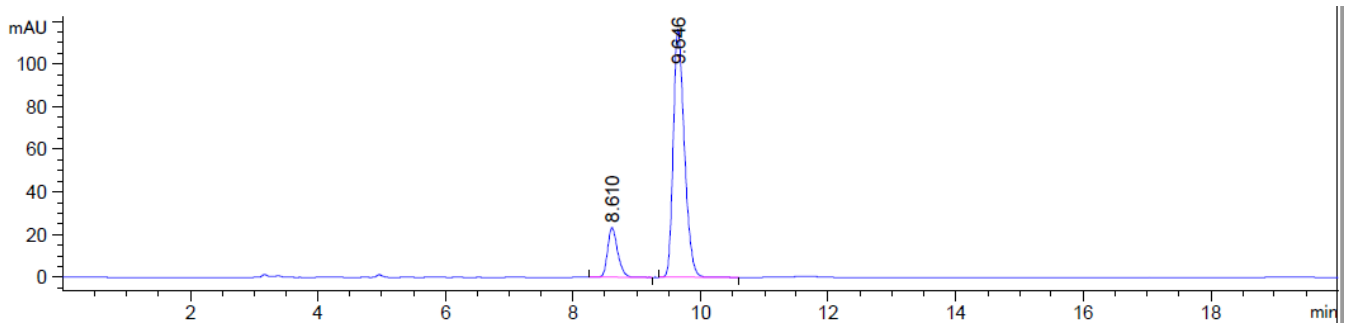
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -99.2 (d, J = 31.3 Hz, 1F, F-C3), -152.0 (d, J = 31.3 Hz, 1F, F-C4).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 1687 (s), 1619 (m), 1445 (w), 1378 (w), 1358 (m), 1331 (m), 1242 (m), 1176 (s), 1136 (s), 1077 (s), 984 (w), 949 (w), 909 (m), 881 (m), 758 (m), 684 (w).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_7H_5OBrF_2Na^+$: 244.9384, found: 244.9384.

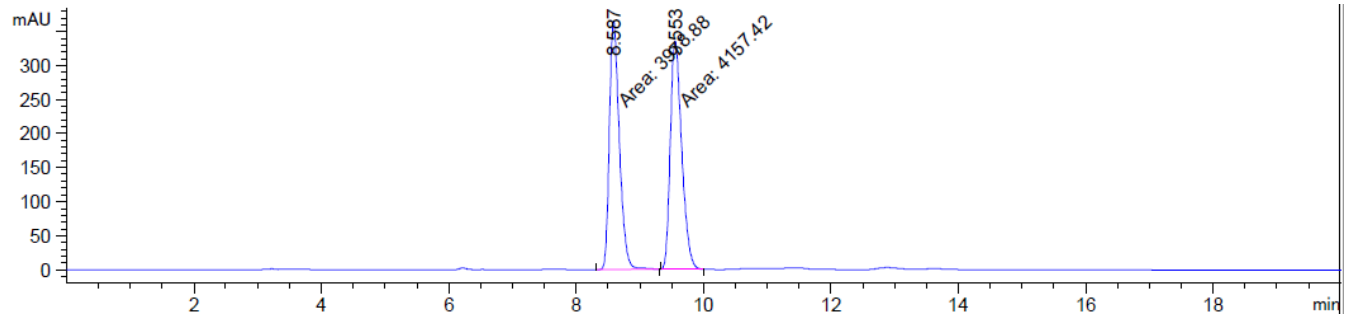
$[\alpha]_D^{22}$ = -9.4° (c = 0.58, CH_2Cl_2).

***e.r.*:** 85:15 Column: AS-H, eluent: hexanes: *i*PrOH 99:1, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 8.6 min; t_R (major) = 9.6 min.



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

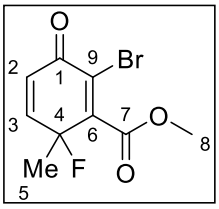
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.610	BB	0.1648	252.65109	23.24200	15.2325
2	9.646	BB	0.1852	1405.98206	116.20316	84.7675
Totals :				1658.63315	139.44515	



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.587	MM	0.1812	3978.88306	365.90512	48.9028
2	9.553	MM	0.2068	4157.41992	335.01450	51.0972
Totals :				8136.30298	700.91962	

methyl 2-bromo-6-fluoro-6-methyl-3-oxocyclohexa-1,4-diene-1-carboxylate(9i)



According to general procedure B, methyl 2-bromo-3-hydroxy-6-methylbenzoate (**8i**) (49.0 mg, 0.2 mmol, 1.0 eq.) was converted into methyl 2-bromo-6-fluoro-6-methyl-3-oxocyclohexa-1,4-diene-1-carboxylate (**9i**). Column chromatography (*n*-pentane with 12% Et_2O) afforded a colourless oil (17.6 mg, 0.07 mmol, 33%; ^{19}F-NMR yield 36%). **R_f** (*n*-pentane with 12% Et_2O) = 0.22.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 6.95 (dd, *J* = 10.1, 6.7 Hz, 1H, H-C3), 6.35 (dd, *J* = 10.1, 0.5 Hz, 1H, H-C2), 3.95 (s, 3H, H-C8), 1.84 (d, *J* = 21.1 Hz, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 177.0 (C1), 164.1 (C7), 148.8 (d, *J* = 23.7 Hz, C6), 147.0 (d, *J* = 22.5 Hz, C3), 126.1 (d, *J* = 7.9 Hz, C2), 124.2 (d, *J* = 8.8 Hz, C9), 89.0 (d, *J* = 172.0 Hz, C4), 53.3 (C8), 25.6 (d, *J* = 27.2 Hz, C5).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -146.5 (qd, *J* = 21.1, 6.7 Hz, F-C4).

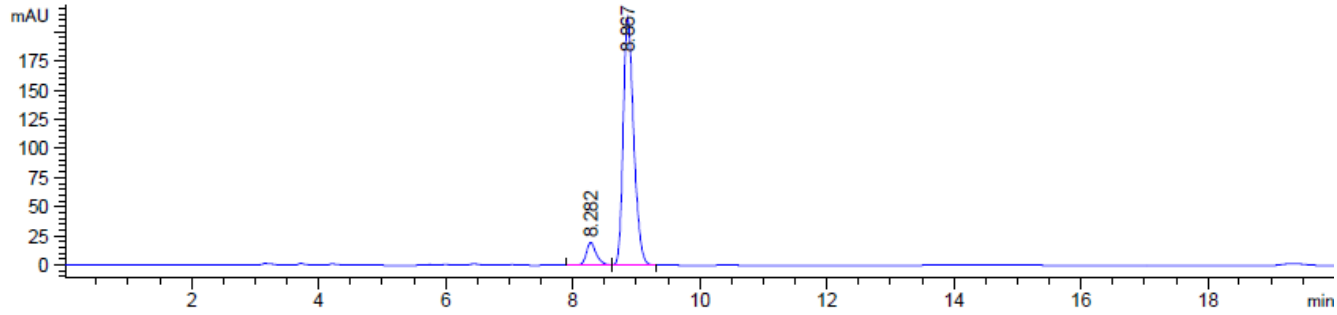
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -146.5 (s, F-C4).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 1736 (s), 1683 (s), 1435 (w), 1383 (w), 1310 (s), 1281 (w), 1233 (s), 1164 (w), 1117 (w), 1057 (s), 973 (m), 928 (w), 893 (w), 826 (m), 813 (m), 787 (w), 709 (w).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_9H_8O_3BrFNa^+$: 284.9533, found: 284.9533.

$[\alpha]_D^{22}$ = -1.7° (*c* = 1.00, CH_2Cl_2).

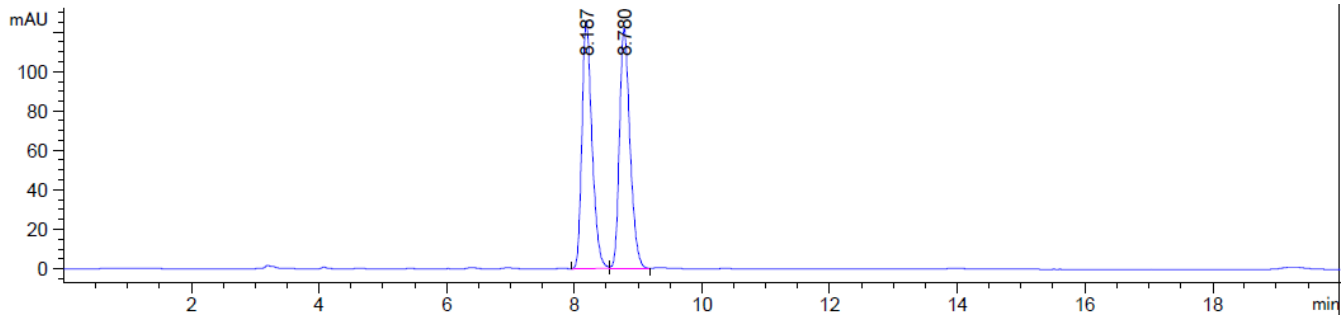
***e.r.*:** 92:8 Column: AS-H, eluent: hexanes: *i*PrOH 90:10, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 8.3 min; t_R (major) = 8.9 min.




```
Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   8.282 BV    0.1622  207.48083   19.18285   7.8726
   2   8.867 VB    0.1735 2428.00049  212.21140  92.1274

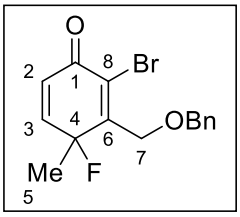
Totals :                  2635.48132  231.39425
```



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.187	BV	0.1655	1374.91443	125.77152	49.6332
2	8.780	VB	0.1733	1395.23755	122.13408	50.3668
Totals :				2770.15198	247.90560	

3-((benzyloxy)methyl)-2-bromo-4-fluoro-4-methylcyclohexa-2,5-dien-1-one (9j)



According to general procedure B, 3-((benzyloxy)methyl)-2-bromo-4-methylphenol (**8j**) (61.4 mg, 0.2 mmol, 1.0 eq.) was converted into methyl 2-bromo-6-fluoro-6-methyl-3-oxocyclohexa-1,4-diene-1-carboxylate (**9i**). Column chromatography (*n*-pentane with 14% Et_2O) afforded a pale yellow oil (35.0 mg, 0.11 mmol, 54%; ^{19}F-NMR yield 69%).

R_f (*n*-pentane with 10% EtOAc) = 0.41.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.42 – 7.35 (m, 4H, H-Bn), 7.37 – 7.28 (m, 1H, H-Bn), 6.93 (dd, *J* = 10.0, 6.9 Hz, 1H, H-C3), 6.32 (dd, *J* = 10.0, 0.6 Hz, 1H, H-C2), 4.65 (d, *J* = 2.5 Hz, 2H, C-Bn), 4.50 (d, *J* = 0.7 Hz, 1H, C7), 1.74 (d, *J* = 21.0 Hz, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 177.7 (d, *J* = 4.7 Hz, C1), 152.2 (d, *J* = 19.9 Hz, C6), 147.4 (d, *J* = 22.9 Hz, C3), 137.3 (C-Bn), 128.7 (d, *J* = 8.3 Hz, C8), 128.4 (C-Bn), 128.02 (C-Bn), 127.9 (C-Bn), 126.0 (d, *J* = 8.1 Hz, C2), 90.0 (d, *J* = 170.2 Hz, C4), 73.7 (C-Bn), 68.21 (d, *J* = 2.3 Hz, C7), 25.0 (d, *J* = 26.8 Hz, C5).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -148.2 (qd, *J* = 21.1, 6.9 Hz, F-C4).

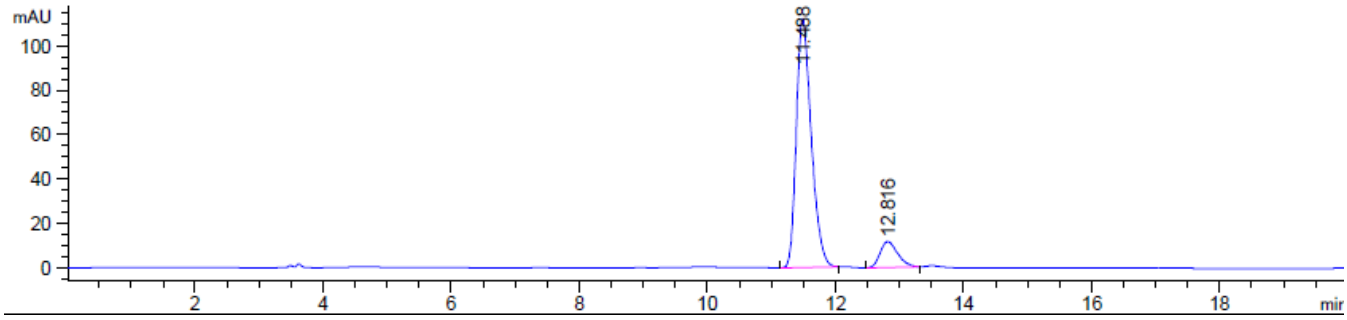
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -148.2 (F-C4).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 2866 (w), 1678 (s), 1649 (w), 1608 (w), 1454 (w), 1361 (w), 1307 (w), 1278 (m), 1165 (m), 1139 (m), 1062 (s), 1029 (w), 969 (w), 900 (m), 827 (m), 740 (m), 699 (m).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{15}H_{14}O_2BrFNa^+$: 347.0053, found: 347.0052.

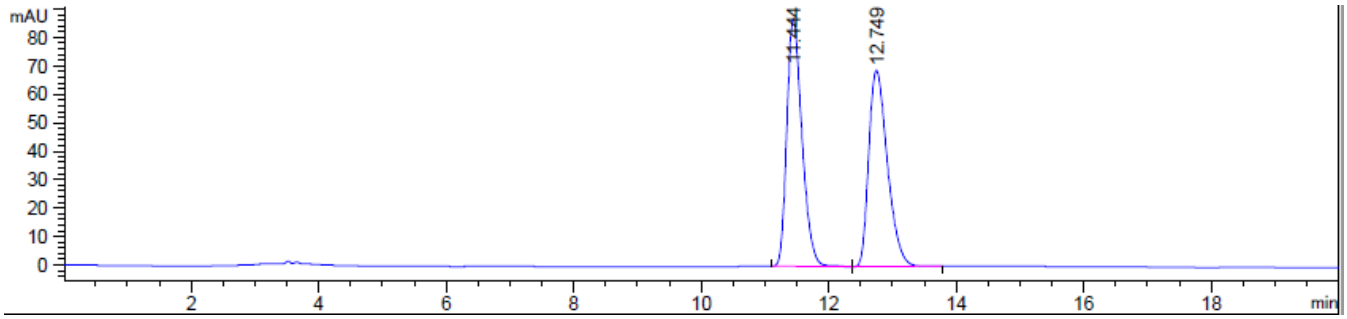
$[\alpha]_D^{22}$ = -17.6° (*c* = 1.00, CH_2Cl_2).

***e.r.*:** 89:11 Column: AS-H, eluent: hexanes: *i*PrOH 95:5, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 12.8 min; t_R (major) = 11.5 min.



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

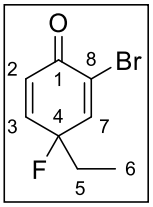
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.488	BB	0.2466	1811.24219	112.03117	89.1361
2	12.816	BB	0.2927	220.75394	11.66870	10.8639
Totals :				2031.99612	123.69987	



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.444	BB	0.2532	1441.76050	87.05649	50.6604
2	12.749	BB	0.3151	1404.17126	69.08314	49.3396
Totals :				2845.93176	156.13963	

2-bromo-4-ethyl-4-fluorocyclohexa-2,5-dien-1-one (9k)



According to general procedure B, 2-bromo-4-ethylphenol (**8k**) (40.3 mg, 0.2 mmol, 1.0 eq.) was converted into methyl 2-bromo-4-ethyl-4-fluorocyclohexa-2,5-dien-1-one (**9k**). Column chromatography (*n*-pentane with 10% Et_2O) afforded a colourless oil (19.2 mg, 0.09 mmol, 45%; ^{19}F-NMR yield 55%).

R_f (*n*-pentane with 10% EtOAc) = 0.47.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.30 (dd, *J* = 6.4, 2.9 Hz, 1H, H-C7), 6.88 (ddd, *J* = 10.1, 6.0, 2.9 Hz, 1H, H-C3), 6.37 (dd, *J* = 10.1, 0.6 Hz, 1H, H-C2), 1.95 (dqd, *J* = 15.1, 7.6, 2.5 Hz, 2H, H-C5), 0.96 (t, *J* = 7.6 Hz, 3H, H-C6).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 177.8 (d, *J* = 5.5 Hz, C1), 146.2 (d, *J* = 22.9 Hz, C7), 146.0 (d, *J* = 21.6 Hz, C3), 128.3 (d, *J* = 8.1 Hz, C2), 125.8 (d, *J* = 11.5 Hz, C8), 91.5 (d, *J* = 167.9 Hz, C4), 31.8 (d, *J* = 26.0 Hz, C5), 7.7 (d, *J* = 6.6 Hz, C6).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -149.2 (tt, *J* = 15.4, 6.2 Hz, F-C4).

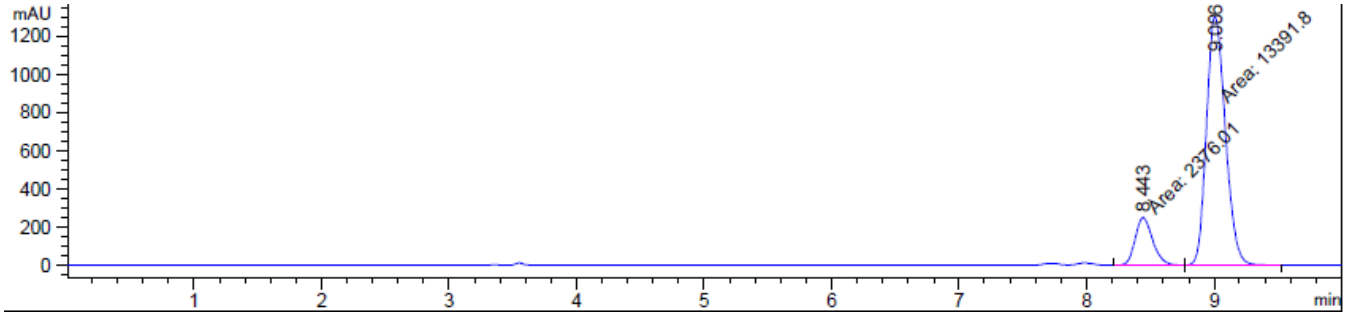
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -149.2 (s, F-C4)

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 1677 (s), 1643 (m), 1608 (m), 1460 (m), 1381 (w), 1329 (s), 1254 (w), 1134 (w), 1111 (m), 1074 (m), 1058 (m), 1002 (m), 966 (s), 934 (s), 879 (m), 824 (s), 798 (m), 736 (s), 603 (m), 554 (m).

HRMS (ESI) *m/z* $[M-Br]^+$, calcd. for $C_8H_8OF^+$: 139.0554, found: 139.0552.

$[\alpha]_D^{22}$ = -19.4° (*c* = 1.00, CH_2Cl_2).

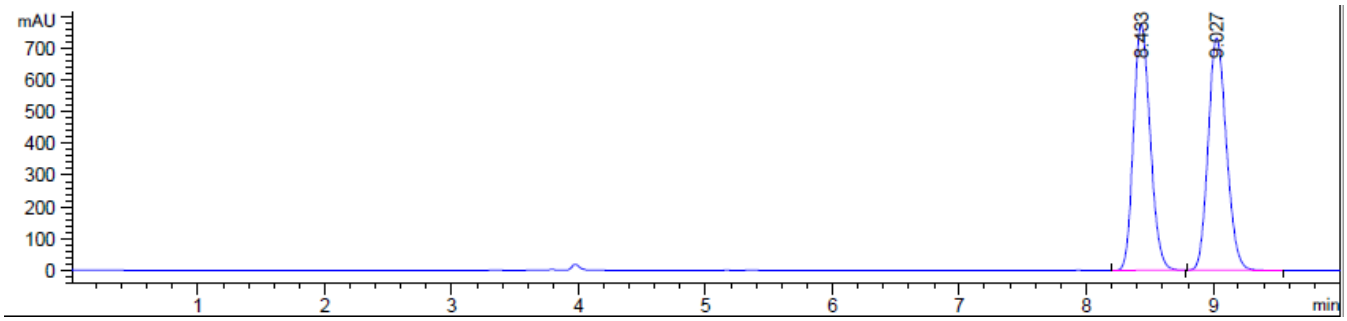
***e.r.*:** 85:15 Column: OD-H, eluent: hexanes: *i*PrOH 99:1, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 8.4 min; t_R (major) = 9.0 min.



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.443	MM	0.1591	2376.00757	248.95940	15.0687
2	9.006	MF	0.1712	1.33918e4	1303.66479	84.9313

Totals : 1.57678e4 1552.62419

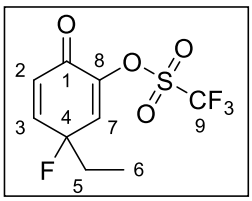


Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.433	BB	0.1426	7125.30518	779.52765	49.2731
2	9.027	BB	0.1566	7335.54297	733.94482	50.7269

Totals : 1.44608e4 1513.47247

3-ethyl-3-fluoro-6-oxocyclohexa-1,4-dien-1-yl trifluoromethanesulfonate (9l)



According to general procedure B, 5-ethyl-2-hydroxyphenyl trifluoromethanesulfonate (**8l**) (54.0 mg, 0.2 mmol, 1.0 eq.) was converted into 3-ethyl-3-fluoro-6-oxocyclohexa-1,4-dien-1-yl trifluoromethanesulfonate (**9l**) in 72 h. Column chromatography (*n*-pentane with 5% Et_2O) afforded a colourless oil (20.4 mg, 0.07 mmol, 35%; ^{19}F-NMR yield 39%).

R_f (*n*-pentane with 10% EtOAc) = 0.37.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 6.93 (ddd, *J* = 10.2, 6.1, 2.8 Hz, 1H, H-C3), 6.81 (dd, *J* = 6.1, 2.8 Hz, 1H, H-C7), 6.37 (d, *J* = 10.2 Hz, 1H, H-C2), 2.04 (dp, *J* = 15.2, 7.7 Hz, 2H, H-C5), 0.96 (t, *J* = 7.6 Hz, 3H, H-C6).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 176.3 (d, *J* = 5.1 Hz, C1), 146.5 (d, *J* = 21.7 Hz, C3), 143.9 (d, *J* = 11.8 Hz, C8), 134.0 (d, *J* = 24.2 Hz, C7), 128.1 (d, *J* = 8.1 Hz, C2), 118.6 (q, *J* = 320.5 Hz, C9), 91.4 (d, *J* = 169.4 Hz, C4), 32.0 (d, *J* = 25.8 Hz, C5), 7.4 (d, *J* = 6.8 Hz, C6).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.4 (s, 3F, F-C9), -150.6 (tt, *J* = 14.9, 6.1 Hz, 1F, F-C4).

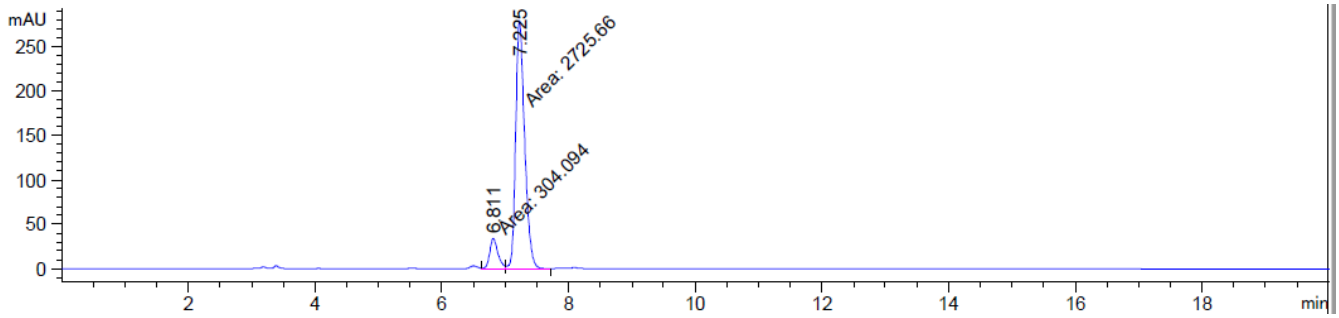
^{19}F{^{1}H} NMR (377 MHz, $CDCl_3$, 299 K) δ [ppm] = -73.40 (s, 3F, F-C9), -150.55 (s, 1F, F-C4).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 1694 (m), 1664 (m), 1518 (w), 1425 (s), 1209 (s), 1139 (s), 1076 (m), 996 (m), 950 (m), 911 (m), 836 (m), 798 (m), 755 (w), 612 (m).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_9H_8O_4SF_4Na^+$: 310.9972, found: 310.9971

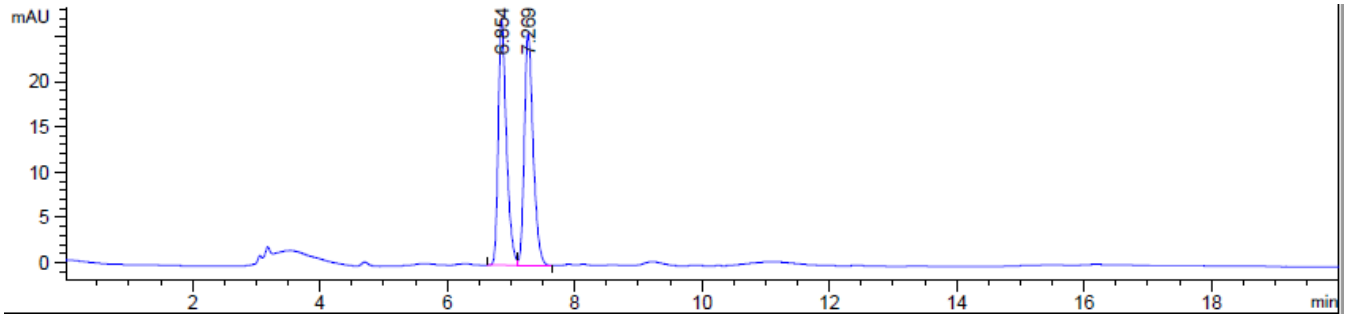
$[\alpha]_D^{22}$ = -24.8° (*c* = 0.48, CH_2Cl_2).

***e.r.*:** 90:10 Column: AS-H, eluent: hexanes: *i*PrOH 99:1, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 6.8 min; t_R (major) = 7.2 min.



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

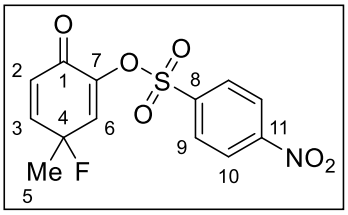
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.811	MF	0.1492	304.09433	33.96703	10.0369
2	7.225	FM	0.1630	2725.65698	278.73950	89.9631
Totals :				3029.75131	312.70654	



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.854	BV	0.1338	241.54495	27.13688	49.5608
2	7.269	VB	0.1460	245.82611	25.60931	50.4392
Totals :				487.37106	52.74619	

3-fluoro-3-methyl-6-oxocyclohexa-1,4-dien-1-yl 4-nitrobenzenesulfonate (9m)



According to general procedure B, 2-hydroxy-5-methylphenyl 4-nitrobenzenesulfonate (**8m**) (61.8 mg, 0.2 mmol, 1.0 eq.) was converted into 3-fluoro-3-methyl-6-oxocyclohexa-1,4-dien-1-yl 4-nitrobenzenesulfonate (**9m**). Column chromatography (*n*-pentane with 30% EtOAc) afforded a white solid (25.1 mg, 0.08 mmol, 38%; ^{19}F-NMR yield 44%).

R_f (*n*-pentane with 20% EtOAc) = 0.32.

M.p.: 102-104 °C.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) *δ* [ppm] = 8.45 – 8.37 (m, 2H, H-C10), 8.26 – 8.17 (m, 2H, H-C9), 6.96 – 6.88 (m, 1H, H-C3), 6.91 (d, *J* = 5.8 Hz, 1H, H-C6), 6.15 (dt, *J* = 9.4, 0.6 Hz, 1H, H-C2), 1.73 (d, *J* = 21.2 Hz, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) *δ* [ppm] = 177.5 (d, *J* = 5.2 Hz, C1), 151.3 (C11), 147.2 (d, *J* = 21.5 Hz, C3), 142.5 (d, *J* = 11.2 Hz, C7), 141.5 (C8), 136.1 (d, *J* = 23.4 Hz, C6), 130.1 (C9), 127.3 (d, *J* = 7.8 Hz, C2), 124.4 (C10), 88.3 (d, *J* = 166.7 Hz, C4), 26.0 (d, *J* = 27.1 Hz, C5).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) *δ* [ppm] = 145.5 – -145.7 (m, F-C4).

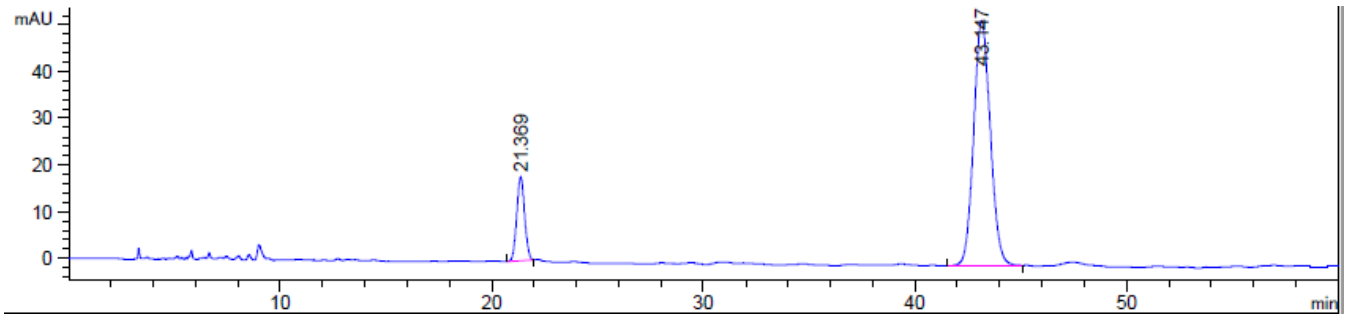
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) *δ* [ppm] = -145.6 (s, F-C4).

IR (ATR) *ũ* [cm^{-1}] = 1691 (m), 1659 (w), 1535 (s), 1406 (w), 1387 (w), 1351 (m), 1313 (w), 1193 (s), 1159 (w), 1065 (s), 894 (w), 857 (w), 774 (m), 736 (w), 610 (w).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_{13}H_{10}NO_6SFNa^+$: 350.0105, found: 350.0106.

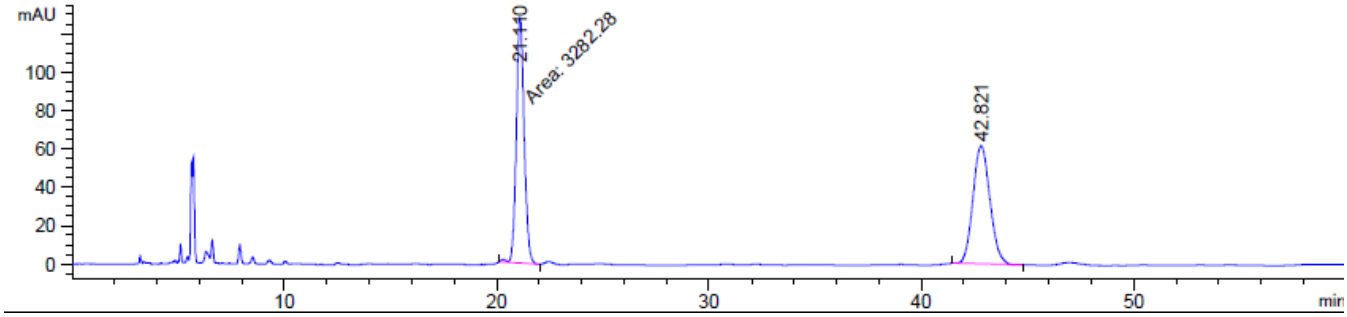
$[\alpha]_D^{22}$ = -9.9° (*c* = 1.00, CH_2Cl_2).

***e.r.*:** 86:14 Column: AD-H, eluent: hexanes: *i*PrOH 80:20, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 21.4 min; t_R (major) = 43.1 min.



Signal 3: DAD1 D, Sig=230,4 Ref=off

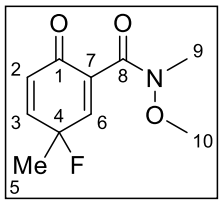
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	21.369	BB	0.4071	463.57288	17.84395	13.9092
2	43.147	BB	0.8206	2869.28101	52.41898	86.0908
Totals :				3332.85388	70.26293	



Signal 3: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	21.110	MM	0.4269	3282.28149	128.15031	48.8787
2	42.821	BB	0.8263	3432.88135	61.58852	51.1213
Totals :				6715.16284	189.73883	

3-fluoro-N-methoxy-*N*,3-dimethyl-6-oxocyclohexa-1,4-diene-1-carboxamide (9n)



According to general procedure B, 2-hydroxy-N-methoxy-*N*,5-dimethylbenzamide (**8n**) (39.0 mg, 0.2 mmol, 1.0 eq.) was converted into 3-fluoro-N-methoxy-N,3-dimethyl-6-oxocyclohexa-1,4-diene-1-carboxamide (**9n**). Column chromatography (CH_2Cl_2 with 10% EtOAc) afforded a colourless oil (16.1 mg, 0.08 mmol, 38%; ^{19}F-NMR yield 52%).

R_f (*n*-pentane with 40% EtOAc) = 0.19.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 6.97 – 6.93 (m, 1H, H-C6), 6.91 (ddd, *J* = 10.2, 6.0, 3.1 Hz, 1H, H-C3), 6.23 (dd, *J* = 10.1, 0.7 Hz, 1H, H-C2), 3.56 (s, 3H, H-C10), 3.28 (s, 3H, H-C9), 1.67 (d, *J* = 21.3 Hz, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 180.9 (d, *J* = 5.4 Hz, C1), 165.9 (C8), 146.6 (d, *J* = 21.5 Hz, C3), 143.0 (d, *J* = 22.3 Hz, C6), 136.7 (C7), 128.2 (d, *J* = 7.7 Hz, C2), 86.4 (d, *J* = 164.0 Hz, C4), 61.4 (C10), 32.1 (C9), 25.8 (d, *J* = 27.0 Hz, C5).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -145.7 (q, J = 21.8 Hz, F-C4).

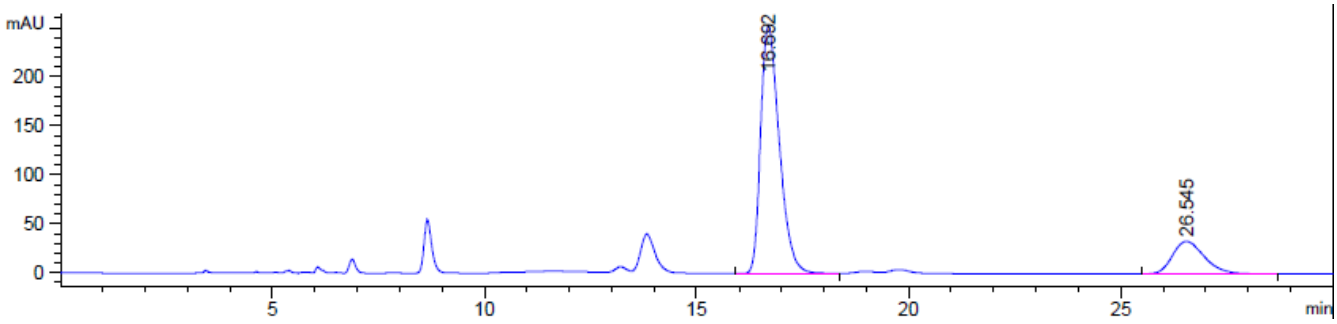
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -145.7 (s, F-C4).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 1684 (s), 1649 (s), 1423 (m), 1389 (m), 1354 (m), 1301 (w), 1241 (w), 1134 (w), 1066 (s), 1037 (w), 978 (w), 903 (m), 840 (m), 780 (w).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{10}H_{12}NO_3FNa^+$: 236.0693, found: 236.0691.

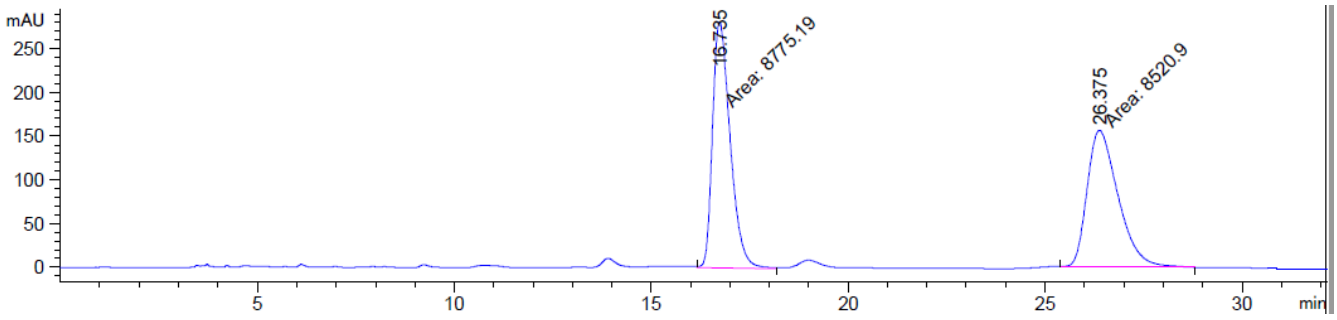
$[\alpha]_D^{22}$ = -2.6° (c = 1.00, CH_2Cl_2).

***e.r.*:** 82:18 Column: AS-H, eluent: hexanes: *i*PrOH 80:20, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 16.7 min; t_R (major) = 26.5 min.



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

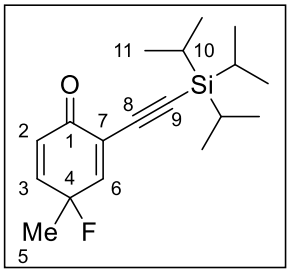
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.692	BB	0.4703	7707.58496	252.37013	81.6751
2	26.545	BB	0.8044	1729.29443	33.05463	18.3249
Totals :				9436.87939	285.42476	



Signal 3: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.735	MM	0.5193	8775.19043	281.62076	50.7351
2	26.375	MM	0.9089	8520.89941	156.24986	49.2649
Totals :				1.72961e4	437.87062	

4-fluoro-4-methyl-2-((triisopropylsilyl)ethynyl)cyclohexa-2,5-dien-1-one (9o)



According to general procedure B, 4-methyl-2-((triisopropylsilyl)ethynyl)phenol (**8o**) (57.7 mg, 0.2 mmol, 1.0 eq.) was converted into 4-fluoro-4-methyl-2-((triisopropylsilyl)ethynyl)cyclohexa-2,5-dien-1-one (**9o**). Column chromatography (*n*-pentane with 5% Et_2O) afforded a colourless oil (33.8 mg, 0.11 mmol, 55%; ^{19}F-NMR yield 58%).

R_f (*n*-pentane with 10% EtOAc) = 0.64.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.08 (dd, *J* = 7.1, 3.2 Hz, 1H, H-C6), 6.86 (ddd, *J* = 10.2, 6.0, 3.2 Hz, 1H, H-C3), 6.20 (dd, *J* = 10.2, 0.7 Hz, 1H, H-C2), 1.65 (d, *J* = 21.0 Hz, 3H, H-C5), 1.12 (s, 18H, H-C11), 1.11 (s, 3H, H-C10).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 181.1 (d, *J* = 5.3 Hz, C1), 148.3 (d, *J* = 21.4 Hz, C6), 146.0 (d, *J* = 21.5 Hz, C3), 128.3 (d, *J* = 8.1 Hz, C2), 124.5 (d, *J* = 9.5 Hz, C7), 99.3 (d, *J* = 2.3 Hz, C8), 98.6 (d, *J* = 1.8 Hz, C9), 86.7 (d, *J* = 162.6 Hz, C4), 26.0 (d, *J* = 27.5 Hz, C5), 18.7 (C11), 11.3 (C10).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -143.7 – -144.0 (m, F-C4).

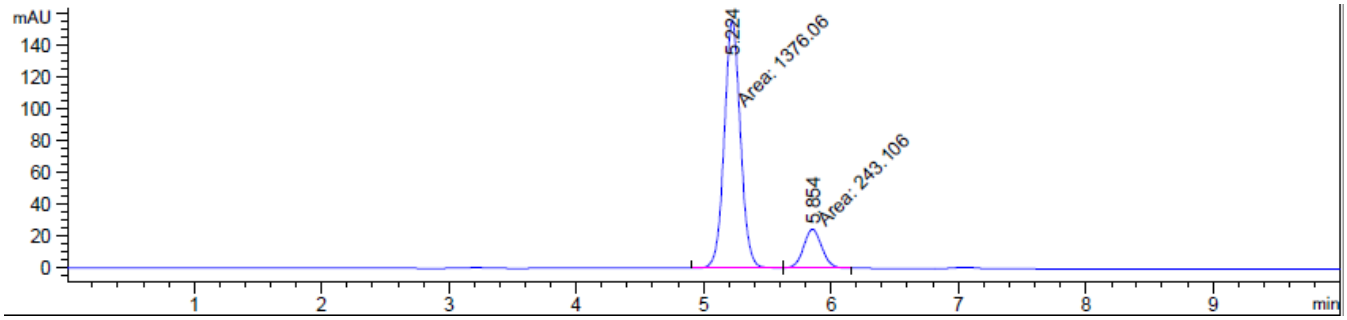
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -143.8 (F-C4).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 2942 (s), 2866 (s), 1682 (m), 1644 (w), 1464 (w), 1345 (w), 1301 (w), 1130 (w), 1065 (s), 997 (w), 883 (m), 833 (w), 772 (w), 705 (m), 677 (m), 618 (w).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{18}H_{27}OFSiNa^+$: 329.1707, found: 329.1705.

$[\alpha]_D^{22}$ = -8.8° (*c* = 0.81, CH_2Cl_2).

***e.r.*:** 85:15 Column: Chiral-NR, eluent: hexanes: *i*PrOH 95:5, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 5.9 min; t_R (major) = 5.2 min.

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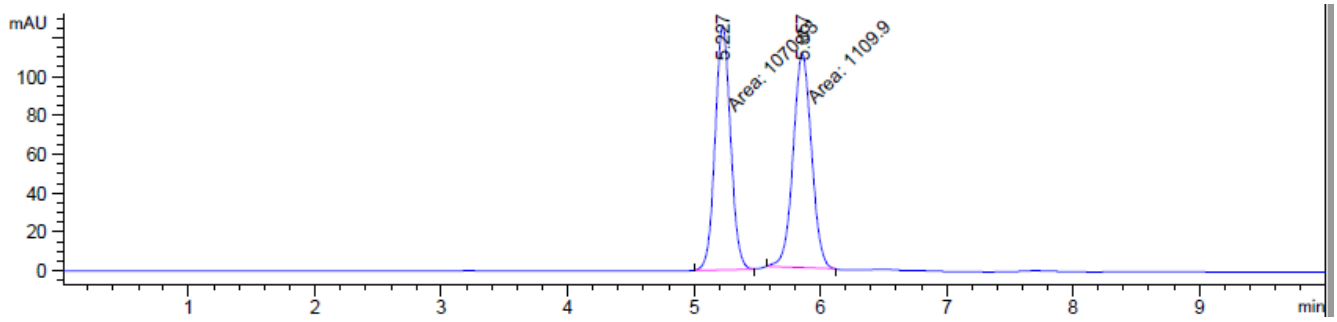
Signal 3: DAD1 D, Sig=230,4 Ref=off

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   5.224 MF    0.1467 1376.05872  156.36855  84.9857
   2   5.854 FM    0.1658  243.10564   24.43237  15.0143

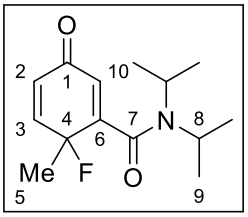
Totals :                  1619.16435  180.80092
```



Signal 3: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.227	MM	0.1417	1070.53064	125.92064	49.0973
2	5.857	MM	0.1680	1109.89563	110.13874	50.9027
Totals :				2180.42627	236.05938	

6-fluoro-*N,N*-diisopropyl-6-methyl-3-oxocyclohexa-1,4-diene-1-carboxamide (9p)



According to general procedure B, 5-hydroxy-2-methyl-*N,N*-dipropylbenzamide (**8p**) (56.0mg, 0.2 mmol, 1.0 eq.) was converted into 6-fluoro-*N,N*-diisopropyl-6-methyl-3-oxocyclohexa-1,4-diene-1-carboxamide (**9p**). Column chromatography (*n*-pentane with 10% EtOAc) afforded a white solid (12.4 mg, 0.05 mmol, 25%; ^{19}F-NMR yield 29%).

R_f (*n*-pentane with 20% EtOAc) = 0.41.

M.p.: 87-89 °C.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 6.89 (dd, *J* = 10.2, 6.6 Hz, 1H, H-C3), 6.20 (ddd, *J* = 10.2, 1.9, 0.8 Hz, 1H, H-C2), 6.03 (d, *J* = 1.8 Hz, 1H, H-C10), 3.94 (hept, *J* = 6.7 Hz, 1H, H-C8^a), 3.47 (hept, *J* = 6.8 Hz, 1H, H-C8^b), 1.82 (d, *J* = 22.1 Hz, 3H, H-C5), 1.48 (d, *J* = 6.7 Hz, 6H, H-C9^a), 1.17 (d, *J* = 6.6 Hz, 3H, H-C9^b), 1.12 (d, *J* = 6.7 Hz, 3H, H-C9^c).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 184.7 (d, *J* = 4.8 Hz, C1), 164.8 (C7), 153.9 (C6),147.0 (d, *J* = 22.7 Hz, C3), 127.9 (d, *J* = 7.9 Hz, C2), 124.2 (d, *J* = 6.4 Hz, C10), 51.2 (C8^a), 46.2 (C8^b), 26.2 (d, *J* = 27.4 Hz, C5z), 20.6 (C9^a), 20.5 (C9^b), 20.4 (C9^c), 20.4 (C9^d).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -148.3 (s, F-C4).

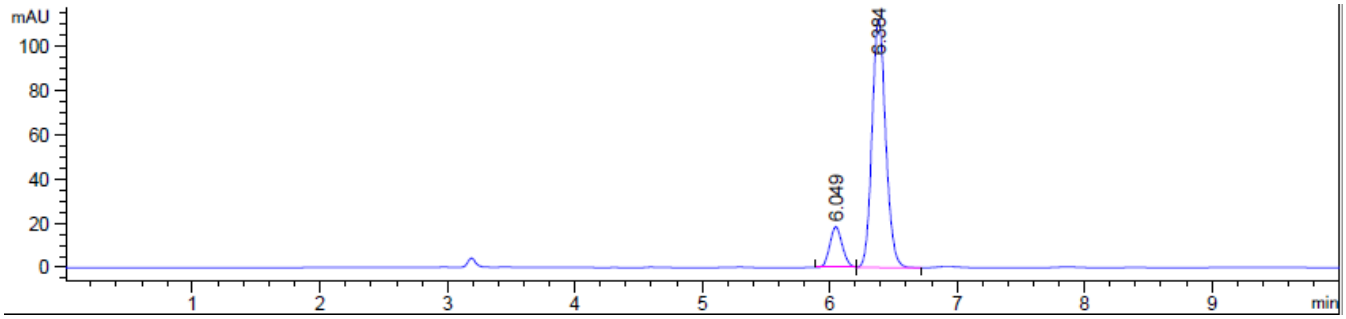
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -148.3 (s, F-C4).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 1671 (m), 1628 (s), 1448 (m), 1370 (w), 1355 (m), 1331 (m), 1288 (s), 1213 (w), 1161 (w), 1122 (w), 1058 (s), 1026 (m), 923 (w), 906 (s), 814 (w), 796 (w), 695 (w), 605 (w).

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_{14}H_{20}NO_2FNa^+$: 276.1370, found: 276.1366.

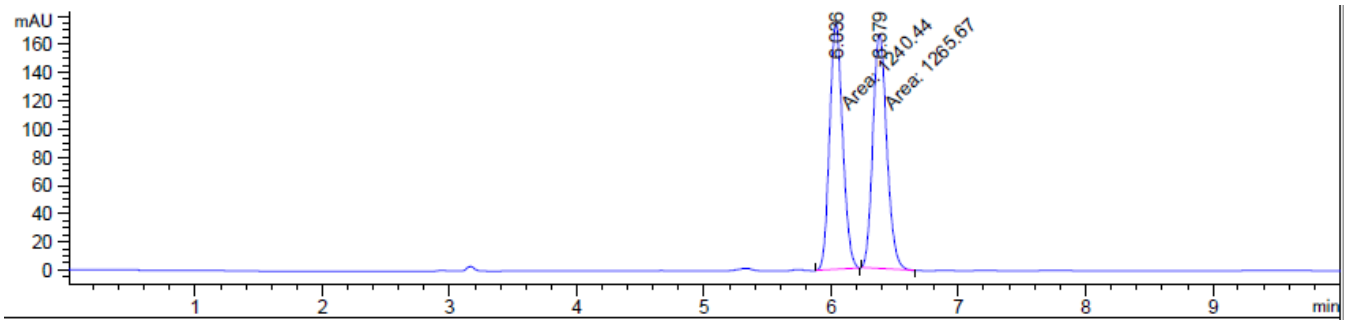
$[\alpha]_D^{25}$ = -16.9° (*c* = 0.79, CH_2Cl_2).

***e.r.*:** 87:13 Column: AD-H, eluent: hexanes: *i*PrOH 85:15, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 6.0 min; t_R (major) = 6.4 min.



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

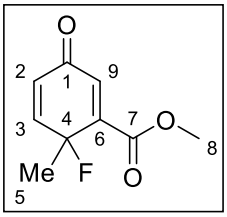
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.049	BV	0.1063	126.92457	18.43998	13.1759
2	6.384	VB	0.1149	836.38092	112.32372	86.8241
Totals :				963.30549	130.76369	



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.036	MM	0.1185	1240.43823	174.50323	49.4965
2	6.379	MM	0.1266	1265.67432	166.57678	50.5035
Totals :				2506.11255	341.08002	

methyl 6-fluoro-6-methyl-3-oxocyclohexa-1,4-diene-1-carboxylate (9q)



According to general procedure B, methyl 5-hydroxy-2-methylbenzoate (**8q**) (33.2mg, 0.2 mmol, 1.0 eq.) was converted into methyl 6-fluoro-6-methyl-3-oxocyclohexa-1,4-diene-1-carboxylate (**9q**). Column chromatography (*n*-pentane with 5% EtOAc) afforded a yellow oil (8.6 mg, 0.05 mmol, 23%; ^{19}F-NMR yield 33%).

R_f (*n*-pentane with 10% EtOAc) = 0.28.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 6.94 (dd, *J* = 10.2, 7.6 Hz, 2H, H-C3), 6.93 (d, *J* = 1.8 Hz, 1H, H-C9), 6.25 (ddd, *J* = 10.2, 2.0, 1.0 Hz, 1H, H-C2), 3.89 (s, 3H, H-C8), 1.90 (d, *J* = 20.6 Hz, 3H, H-C5)

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 185.2 (d, J = 4.3 Hz, C1), 164.1 (C7), 148.9 (d, J = 22.9 Hz, C3), 144.9 (d, J = 20.1 Hz, C6), 133.7 (d, J = 4.8 Hz, C9), 127.3 (d, J = 7.4 Hz, C2)), 87.1 (d, J = 170.1 Hz, C4), 52.9 (C8), 25.4 (d, J = 27.1 Hz, C5).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -151.5 (dtd, *J* = 21.7, 20.1, 7.6 Hz, F-C4).

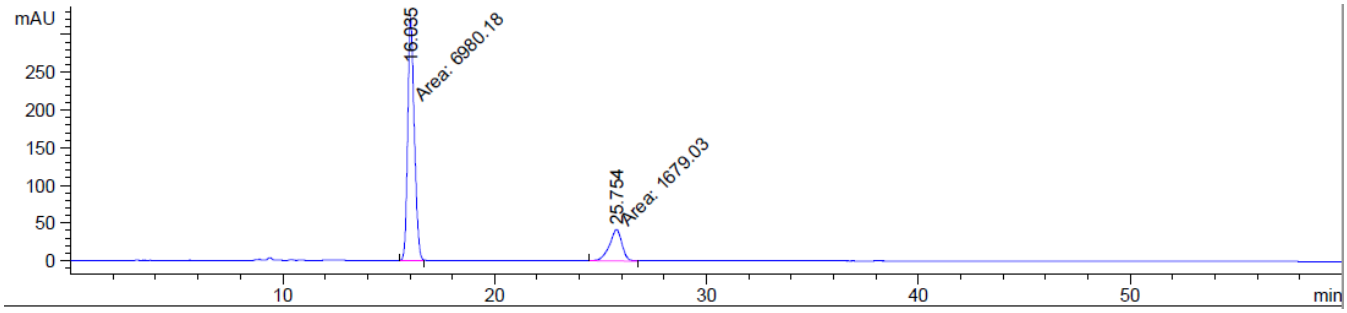
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -151.46 (s, F-C4).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 2923 (w), 2360 (w), 2342 (w), 1731 (m), 1677 (s), 1639 (w), 1437 (w), 1360 (w), 1238 (s), 1162 (w), 1074 (m), 1057 (m), 914 (w), 821 (w), 731 (w).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_9H_9O_3FNa^+$: 207.0428, found: 207.0429.

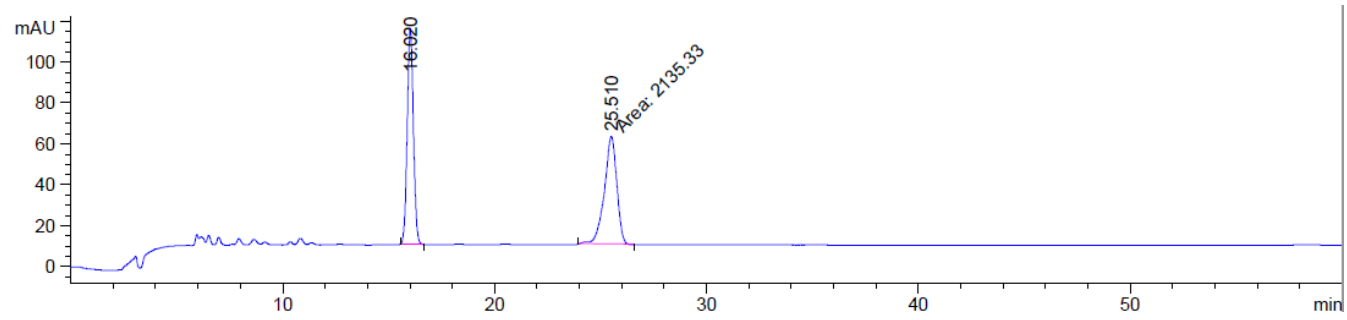
$[\alpha]_D^{22}$ = -3.5° (*c* = 0.68, CH_2Cl_2).

***e.r.*:** 81:19 Column: AS-H, eluent: hexanes: *i*PrOH 90:10, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 25.8 min; t_R (major) = 16.0 min.



Signal 3: DAD1 D, Sig=230,16 Ref=360,100

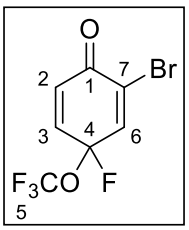
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.035	MM	0.3627	6980.17725	320.71039	80.6098
2	25.754	MM	0.6770	1679.03479	41.33318	19.3902
Totals :				8659.21204	362.04356	



Signal 3: DAD1 D, Sig=230,16 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.020	BB	0.3131	2152.92700	105.93082	50.2051
2	25.510	MM	0.6748	2135.33276	52.73866	49.7949
Totals :				4288.25977	158.66948	

2-bromo-4-fluoro-4-(trifluoromethoxy)cyclohexa-2,5-dien-1-one (9r)



According to general procedure B, 2-bromo-4-(trifluoromethoxy)phenol (**8r**) (51.4 mg, 0.2 mmol, 1.0 eq.) was converted into methyl 2-bromo-4-fluoro-4-(trifluoromethoxy)cyclohexa-2,5-dien-1-one (**9r**). Column chromatography (*n*-pentane with 10% Et_2O) afforded an off white solid (35.1 mg, 0.13 mmol, 64%; ^{19}F-NMR yield 82%).

R_f (*n*-pentane with 10% EtOAc) = 0.71.

M.p.: 45-47 °C.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.35 (ddq, *J* = 5.4, 3.2, 1.1 Hz, 1H, H-C6), 7.03 – 6.88 (m, 1H, H-C3), 6.51 (d, *J* = 10.3 Hz, 1H, H-C2).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 176.2 (d, *J* = 4.6 Hz, C1), 137.7 (dd, *J* = 29.3, 1.4 Hz, C6), 137.5 (dd, *J* = 28.2, 1.5 Hz, C3), 129.7 (d, *J* = 8.6 Hz, C2), 128.9 (d, *J* = 11.2 Hz, C7), 120.3 (q, *J* = 263.9 Hz, C5), 103.3 (d, *J* = 225.1 Hz, C4).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -52.81 (d, J = 8.9 Hz, 3F, F-C5), -104.67 (qt, J = 9.2, 5.1 Hz, 1F, F-C4).

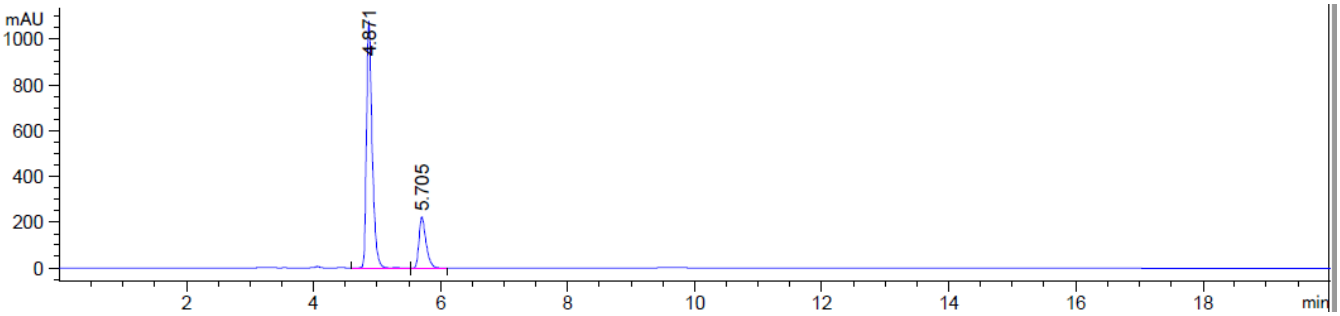
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -52.80 (d, J = 9.0 Hz, 3F, F-C5), -104.64 (q, J = 9.0 Hz, 1F, F-C4).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 2925 (s), 2854 (m), 1695 (w), 1463 (w), 1379 (w), 1251 (s), 1115 (w), 1026 (m), 963 (m), 903 (m).

HRMS (ESI) *m/z* [M-H]$^-$, calcd. for $C_7H_2O_2BrF_4^-$: 272.9180, found: 272.9186.

$[\alpha]_D^{22}$ = -5.5° (*c* = 1.00, CH_2Cl_2).

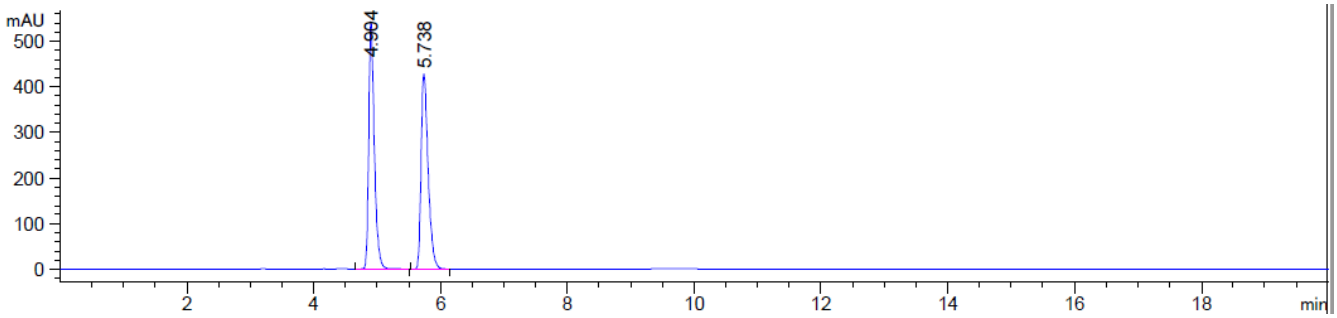
***e.r.*:** 81:19 Column: AS-H, eluent: hexanes: *i*PrOH 99:1, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 5.7 min; t_R (major) = 4.9 min.




```
Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   4.871 VV R  0.0946 6743.70557 1082.34961  79.8396
   2   5.705 BB    0.1147 1702.85840  223.90089  20.1604

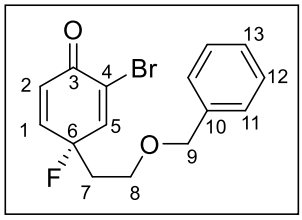
Totals :                 8446.56396 1306.25050
```



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.904	BB	0.0919	3338.85986	541.66095	50.3254
2	5.738	BB	0.1155	3295.68701	429.39359	49.6746
Totals :				6634.54688	971.05453	

4-(2-(benzyloxy)ethyl)-2-bromo-4-fluorocyclohexa-2,5-dien-1-one (9s)



According to general procedure B, 4-(2-(benzyloxy)ethyl)-2-bromophenol (**8s**) (61.4 mg, 0.2 mmol, 1.0 eq.) was converted into methyl 2-bromo-4-fluoro-4-(trifluoromethoxy)cyclohexa-2,5-dien-1-one (**9s**). Column chromatography (*n*-pentane with 5% EtOAc) afforded a yellow oil (31.3 mg, 0.10 mmol, 48%; ^{19}F-NMR yield 53%).

R$_f$ (*n*-pentane with 5% EtOAc) = 0.25.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.40 (dd, *J* = 6.5, 2.9 Hz, 1H, H-C5), 7.37 – 7.33 (m, 2H, H-C12), 7.32 – 7.27 (m, 3H, H-C11, H-C13), 6.95 (ddd, *J* = 10.1, 6.1, 2.9 Hz, 1H, H-C1), 6.33 (dd, *J* = 10.1, 0.7 Hz, 1H, H-C2), 4.46 (s, 2H, H-C9), 3.65 – 3.56 (m, 2H, H-C8), 2.30 – 2.13 (m, 2H, H-C7).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 177.9 (d, *J* = 5.7 Hz, 1C, C3), 146.4 (d, *J* = 22.8 Hz, C5), 146.1 (d, *J* = 21.3 Hz, C1), 137.6 (C10), 128.6 (12C), 128.0 (C13), 127.8 (C11), 127.6 (d, *J* = 8.1 Hz, C2), 125.3 (d, *J* = 11.9 Hz, C4), 89.9 (d, *J* = 167.9 Hz, C6), 73.4 (C9), 64.3 (d, *J* = 6.7 Hz, C8), 39.2 (d, *J* = 26.0 Hz, C7).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -149.3 (tt, *J* = 16.8, 6.3 Hz, 1F, F-C6).

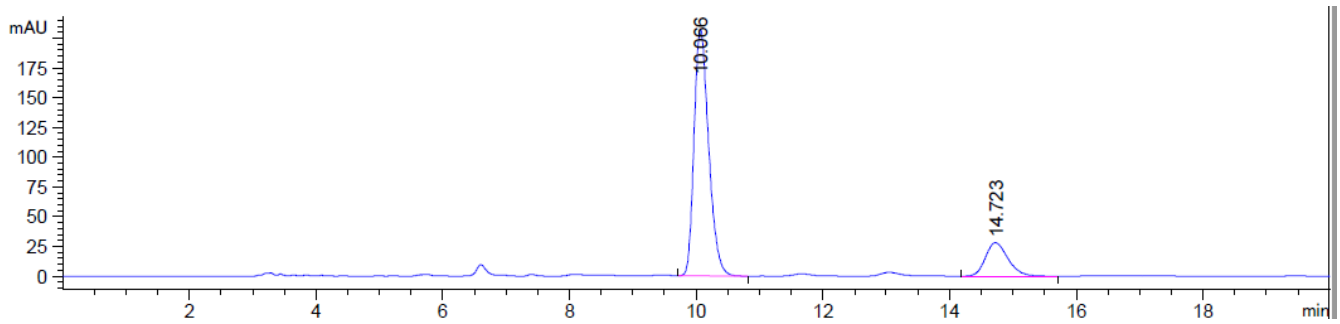
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -149.3 (s, 1F, F-C6)

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 2929 (s), 2854 (m), 1678 (s), 1643 (w), 1608 (w), 1455 (w), 1364 (w), 1333 (w), 1105 (m), 935 (w), 820 (w), 737 (m), 698 (m), 607 (w)

HRMS (ESI) *m/z* [M+Na]$^+$, calcd. for $C_{15}H_{14}O_2BrFNa^+$: 347.00534, found: 347.00524.

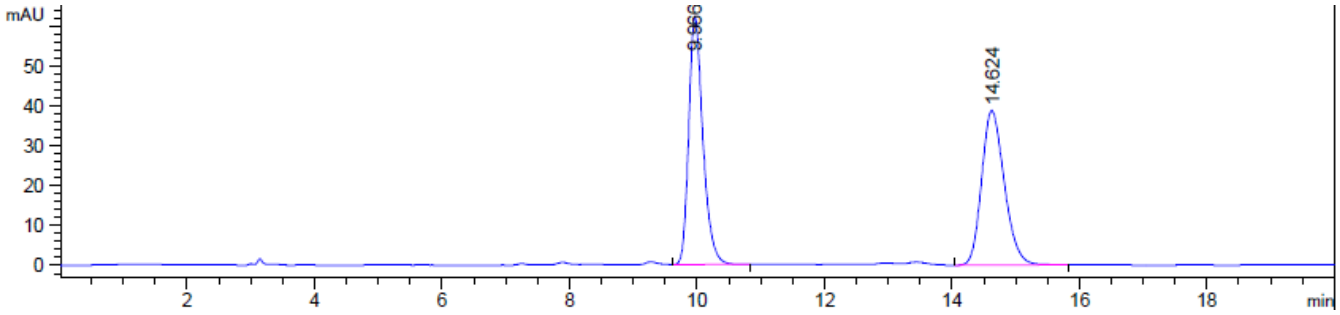
$[\alpha]_D^{22}$ = -10.5° (*c* = 1.00, CH_2Cl_2).

***e.r.*:** 83:17 Column: AS-H, eluent: hexanes: *i*PrOH 90:10, flowrate: 1 mL/min, Detection: λ = 230 nm with t_R(minor) = 14.7 min; t_R (major) = 10.1 min.



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

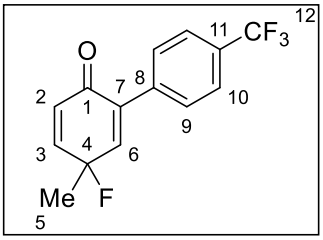
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.066	BB	0.2463	3305.19043	207.02701	82.7065
2	14.723	BB	0.3813	691.09784	28.06524	17.2935
Totals :				3996.28827	235.09225	



Signal 3: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.966	BB	0.2344	962.29193	62.21727	50.1094
2	14.624	BB	0.3826	958.08826	38.73430	49.8906
Totals :				1920.38019	100.95156	

5-fluoro-5-methyl-4'-(trifluoromethyl)-[1,1'-biphenyl]-2(5H)-one (9t)



According to general procedure B, 5-methyl-4'-(trifluoromethyl)-[1,1'-biphenyl]-2-ol (**8t**) (50.4 mg, 0.2 mmol, 1.0 eq.) was converted into 5-fluoro-5-methyl-4'-(trifluoromethyl)-[1,1'-biphenyl]-2(5H)-one (**9t**). Column chromatography (*n*-pentane with 7.5% EtOAc) afforded a pale-yellow solid (29.2 mg, 0.11 mmol, 54%; ^{19}F-NMR yield 62%).

R_f (*n*-pentane with 10% EtOAc) = 0.37.

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] = 7.69 – 7.63 (m, 2H, H-C10), 7.56 – 7.51 (m, 2H, H-C9), 7.02 – 6.96 (m, 2H, H-C3/6), 6.36 – 6.32 (m, 1H, H-C2), 1.74 (d, *J* = 21.1 Hz, 3H, H-C5).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] = 183.3 (d, *J* = 5.5 Hz, C1), 146.1 (d, *J* = 21.4 Hz, C6), 144.5 (d, *J* = 21.9 Hz, C3), 138.0 (d, *J* = 2.7 Hz, C8), 137.8 (d, *J* = 8.4 Hz, C7), 130.8 (q, *J* = 32.5 Hz, C11), 129.7 (q, *J* = 1.8 Hz, C9),129.0 (d, *J* = 7.8 Hz, C2), 125.3 (q, *J* = 3.8 Hz, C10), 124.2 (q, J = 272.1 Hz, C12), 87.1 (d, *J* = 162.4 Hz, C4), 26.1 (d, *J* = 27.3 Hz, C5).

^{19}F NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -62.7 (s, 3F, F-C12), -144.2 (qt, J = 21.2, 6.4 Hz, 1F, F-C4).

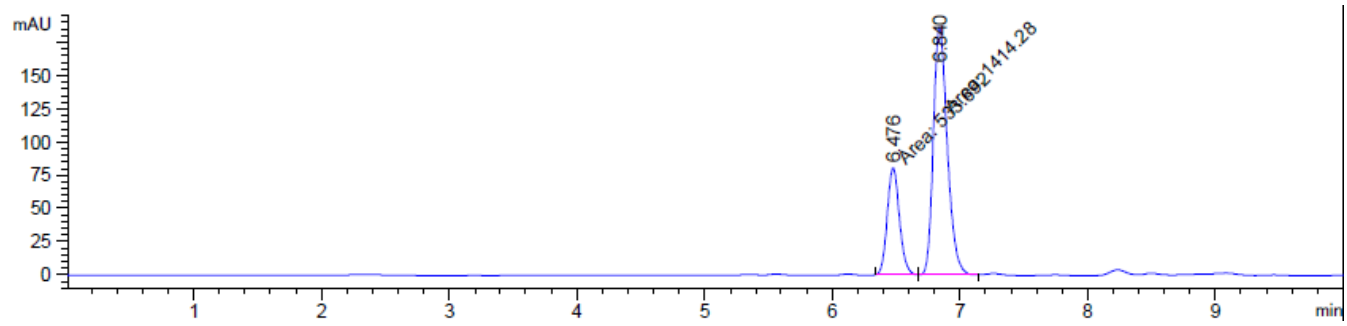
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K) δ [ppm] = -62.7 (s, 3F, F-C12), -144.2 (s, 1F, F-C4).

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 2360 (m), 2341 (w), 1710 (w), 1678 (s), 1645 (m), 1615 (w), 1412 (w), 1352 (w), 1325 (s), 1166 (s), 1124 (s), 1066 (s), 1020 (m), 903 (m), 851 (s), 763 (w), 687 (w), 613 (w), 600 (w).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_{14}H_{10}OF_4Na^+$: 293.0560, found: 293.0559.

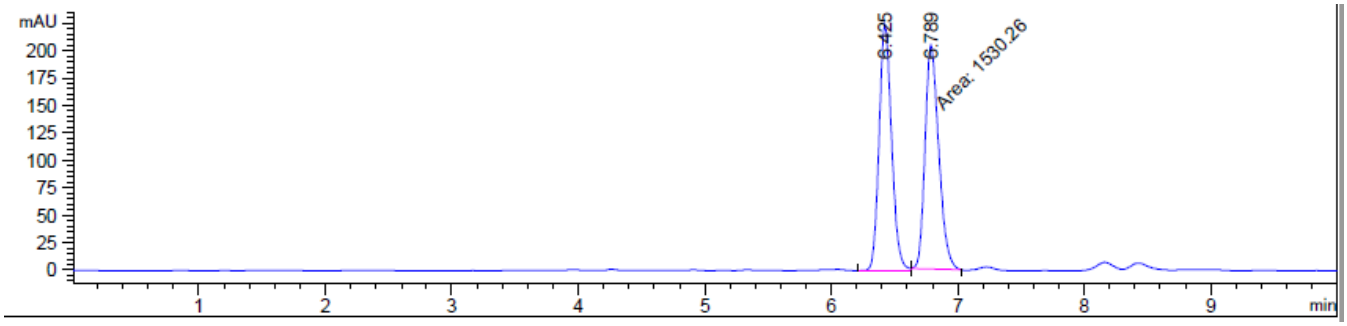
$[\alpha]_D^{25}$ = -8.2° (c = 1.00, $CHCl_3$).

***e.r.*:** 73:27 Column: AD-H, eluent: hexanes: *i*PrOH 95:5, flowrate: 1 mL/min, Detection: λ = 280 nm with t_R(minor) = 6.5 min; t_R (major) = 6.8 min.



Signal 4: DAD1 E, Sig=280,4 Ref=off

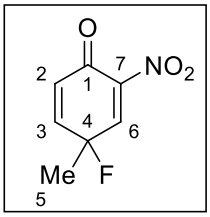
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.476	MM	0.1104	533.69171	80.53395	27.3974
2	6.840	MM	0.1262	1414.27576	186.82649	72.6026
Totals :				1947.96747	267.36044	



Signal 4: DAD1 E, Sig=280,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.425	BV	0.1059	1539.98547	224.95999	50.1583
2	6.789	MM	0.1249	1530.26245	204.13293	49.8417
Totals :				3070.24792	429.09293	

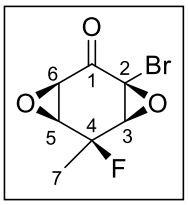
4-fluoro-4-methyl-2-nitrocyclohexa-2,5-dien-1-one (9u)



According to general procedure B, 4-methyl-2-nitrophenol (30.6 mg, 0.2 mmol, 1.0 eq.) was converted into 4-fluoro-4-methyl-2-nitrocyclohexa-2,5-dien-1-one (**9u**). Analysis of the crude NMR showed no product formation (^{19}F-NMR yield <5%).

VI. Derivatization of 4-fluoro-2,5-cyclohexadien-1-ones

1-bromo-6-fluoro-6-methyl-4,8-dioxatricyclo[5.1.0.0^{3,5}]octan-2-one (28)



According to a modified procedure,[23] to a solution of 2-bromo-4-fluoro-4-methylcyclohexa-2,5-dien-1-one (0.10 g, 0.5 mmol, 1.0 eq.) in MeOH (7.2 mL) at room temperature was added a mixture of 5% NaOH•MeOH (95 µL) and 30% H_2O_2 (285 µL). The reaction mixture was stirred for 23 hours, then diluted with H_2O (5 mL) and CH_2Cl_2 (5 mL). The phases were separated and the aqueous phase extracted with CH_2Cl_2 (3x10 mL). The combined organic layers were dried over $MgSO_4$ and concentrated *in vacuo*. The product was purified by column chromatography (40% EtOAc in pentane) and yielded the product as colourless solid (69 mg, 0.29 mmol) in 58% yield.

m.p.: 143.7-147.1 °C

R_f (*n*-pentane with 50% EtOAc) = 0.43

^{1}H NMR (599 MHz, $CDCl_3$, 299 K) δ [ppm] = 3.92 (dd, *J* = 3.6, 1.0 Hz, 1H, H-C6), 3.69 (t, *J* = 4.0 Hz, 1H, H-C5), 3.66 (td, *J* = 3.8, 1.3 Hz, 1H, H-C3), 1.70 (d, *J* = 21.0 Hz, 3H, H-C7).

^{13}C NMR (151 MHz, $CDCl_3$, 299 K) δ [ppm] = 189.2 (C1), 88.1 (d, *J* = 181.5 Hz, C4), 67.9 (d, *J* = 26.1 Hz, C6), 66.5 (d, *J* = 8.4 Hz, C2), 60.9 (d, *J* = 26.2 Hz, C5), 53.4 (d, *J* = 6.1 Hz, C3), 21.9 (d, *J* = 24.5 Hz, C7).

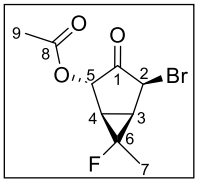
^{19}F NMR (564 MHz, $CDCl_3$, 299 K) δ [ppm] = -159.2 (qdt, *J* = 21.1, 3.9, 1.2 Hz, F-C4).

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$, 299 K) δ [ppm] = -159.2 (s, F-C4).

IR (ATR) $\tilde{\nu}$ [cm^{-1}] = 1838 (w), 173 (s), 1694 (w), 1442 (w), 1427 (w), 1387 (w), 1321 (m), 1286 (w), 1252 (m), 1151 (m), 1135 (m), 1092 (s), 1034 (m), 964 (m), 944 (s), 922 (s), 896 (s), 849 (s), 821 (s), 803 (s), 743 (s), 627 (m), 583 (s).

HRMS (ESI) *m/z* [M+MeOH+Na]$^+$, calcd. for $C_8H_{10}BrFO_4Na^+$: 290.96387, found: 290.96387.

4-bromo-6-fluoro-6-methyl-3-oxobicyclo[3.1.0]hexan-2-yl acetate (29)



According to a modified procedure,[24] glacial acetic acid (5 mL) was degassed by bubbling argon through for 15 min. Racemic 2-bromo-4-fluoro-4-methylcyclohexa-2,5-dien-1-one (42 mg, 0.2 mmol, 1.0 eq.) was added and the bubbling was continued until complete dissolution. The reaction mixture was irradiated at 365 nm at room temperature for 24 hours. The solvent was evaporated and the brown residue dissolved in CH_2Cl_2 (5 mL)

and neutralized with sat. aq. $NaHCO_3$ (5 mL). The aqueous phase was extracted with CH_2Cl_2 (3 x 5 mL) and the combined organic phases dried over $MgSO_4$ and concentrated in vacuo. Column chromatography (10-20% EtOAc in *n*-pentane) afforded the product as colourless oil (16 mg, 0.060 mmol, 30%).

R_f (*n*-pentane with 15% EtOAc) = 0.18

^{1}H NMR (500 MHz, $CDCl_3$, 299 K) δ [ppm] 5.18 (dt, *J* = 6.4, 1.4 Hz, 1H, H-C2), 4.69 (s, 1H, H-C5), 2.13 (ddd, *J* = 7.9, 6.3, 3.3 Hz, 1H, H-C3), 2.11 (s, 3H, H-C9), 1.84 (dd, *J* = 7.8, 2.8 Hz, 1H, H-C4), 1.69 (d, *J* = 20.0 Hz, 3H, H-C7).

^{13}C NMR (126 MHz, $CDCl_3$, 299 K) δ [ppm] 202.8 (d, *J* = 1.4 Hz, C1), 169.9 (C8), 81.6 (d, *J* = 227.0 Hz, C6), 70.1 (d, *J* = 11.0 Hz, C5), 45.8 (d, *J* = 7.4 Hz, C2), 29.4 (d, *J* = 10.7 Hz, C4), 29.0 (d, *J* = 10.1 Hz, C3), 20.6 (C9), 20.5 (d, *J* = 22.7 Hz, C7).

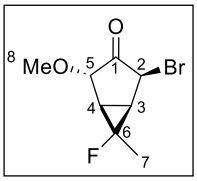
^{19}F NMR (564 MHz, $CDCl_3$, 299 K) δ [ppm] = -195.45 – -195.62 (m, F-C6).

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$, 299 K) δ [ppm] = -195.5 (s, F-C6)

IR (ATR) $\tilde{\upsilon}$ [cm^{-1}] = 2927 (w), 1766 (s), 1742 (s), 1462 (w), 1426 (w), 1371 (s), 1295 (w), 1217 (s), 1133 (m), 1110 (m), 1088 (w), 1026 (s), 986 (w), 947 (s), 914 (m), 869 (m), 815 (w), 766 (m), 719 (m), 684 (w), 650 (w), 616 (m).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_9H_{10}BrFO_3Na^+$: 286.9690, found: 286.9688.

2-bromo-6-fluoro-4-methoxy-6-methylbicyclo[3.1.0]hexan-3-one (30)



According to a modified procedure,[24] racemic 2-bromo-4-fluoro-4-methylcyclohexa-2,5-dien-1-one (63 mg, 0.3 mmol, 1.0 eq.) was dissolved in MeOH (6 mL). The reaction mixture was degassed by bubbling argon through it for 15 min. The capped flask was irradiated at 365 nm for 24 hours at room temperature. The solvent was evaporated and the residue dissolved in H_2O (5 mL) and CH_2Cl_2 (5 mL). The aqueous phase was extracted with CH_2Cl_2 (3x 5 mL). The combined organic phases were dried over $MgSO_4$ and concentrated *in vacuo*. The pure product was obtained as colourless crystals (20 mg, 0.084 mmol, 28%) after column chromatography (8% EtOAc in *n*-pentane).

m.p.: 79.5 – 81.4 °C

R_f (*n*-pentane with 10% EtOAc) = 0.27

^{1}H NMR (599 MHz, $CDCl_3$, 299 K) δ [ppm] = 5.14 (dt, *J* = 5.9, 1.3 Hz, 1H, H-C2), 3.50 (s, 1H, H-C5), 3.48 (s, 3H, H-C8), 2.06 (ddd, *J* = 7.9, 5.9, 2.6 Hz, 1H, H-C3), 1.81 (ddt, *J* = 7.9, 3.0, 0.5 Hz, 1H, H-C4), 1.67 (d, *J* = 20.0 Hz, 3H, H-C7).

^{13}C NMR (151 MHz, $CDCl_3$, 299 K) δ [ppm] = 201.8 (d, *J* = 1.8 Hz, C1), 82.0 (d, *J* = 226.2 Hz, C6), 77.0 (C5), 58.4 (C8), 47.1 (d, *J* = 7.2 Hz, C2), 30.4 (d, *J* = 10.9 Hz, C4), 29.1 (d, *J* = 10.4 Hz, C3), 20.5 (d, *J* = 22.5 Hz, C7).

^{19}F NMR (564 MHz, $CDCl_3$, 299 K) δ [ppm] = -194.41 (dddd, *J* = 22.6, 20.1, 17.5, 2.5 Hz, F-C6).

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$, 299 K) δ [ppm] = -194.41 (s, F-C6).

IR (ATR) $\tilde{u}$ [cm^{-1}] = 2946 (w), 2838 (w), 2384 (w), 2360 (w), 1768 (s), 1756 (s), 1638 (w), 1466 (m), 1427 (s), 1385 (w), 1339 (m), 1271 (m), 1249 (m), 1234 (m), 1191 (m), 1158 (m), 1129 (s), 1114 (m), 1095 (s), 1064 (s), 1038 (s), 984 (m), 945 (s), 866 (s), 812 (m), 774 (s), 721 (s), 681 (s), 672 (s), 617 (s).

HRMS (ESI) *m/z* $[M+Na]^+$, calcd. for $C_8H_{10}BrFO_2Na^+$: 258.9740, found: 258.9739.

VII. X-Ray Data

X-Ray diffraction: Data sets for compounds **6m**, **23**, **28** and **30** were collected with a Bruker D8 Venture Photon III Diffractometer. Programs used: data collection: *APEX4* Version 2021.4-0 [25] (Bruker AXS Inc., **2021**); cell refinement: *SAINT* Version 8.40B (Bruker AXS Inc., **2021**); data reduction: *SAINT* Version 8.40B (Bruker AXS Inc., **2021**); absorption correction, *SADABS* Version 2016/2 (Bruker AXS Inc., **2021**); structure solution *SHELXT*-Version 2018-3 [26] (Sheldrick, G. M. *Acta Cryst.,* **2015**, *A71*, 3-8); structure refinement *SHELXL*- Version 2018-3 [27] (Sheldrick, G. M. *Acta Cryst.,* **2015**, *C71* (1), 3-8) and graphics, *XP* [28] (Version 5.1, Bruker AXS Inc., Madison, Wisconsin, USA, **1998**). *R*-values are given for observed reflections, and *w*R^2 values are given for all reflections.

Exceptions and special features: For compound **23** one badly disordered half heptane molecule was found in the asymmetrical unit and could not be satisfactorily refined. The program SQUEEZE (Spek, A.L. (**2015**). Acta Cryst. C71, 9-18) was therefore used to remove mathematically the effect of the solvent. The quoted formula and derived parameters are not included the squeezed solvent molecule. Moreover, different parts of the molecule were found disordered over two positions in the asymmetric unit. Several restraints (SADI, SAME, ISOR and SIMU) were used in order to improve refinement stability.

X-ray crystal structure analysis of 6m (gil10483): A colorless, prism-like specimen of $C_{13}H_{10}FNO_6S$, approximate dimensions 0.112 mm x 0.204 mm x 0.242 mm, was used for the X-ray crystallographic analysis. The X-ray intensity data were measured on a single crystal diffractometer Bruker D8 Venture Photon III system equipped with a micro focus tube Cu ImS (CuKα, λ = 1.54178 Å) and a MX mirror monochromator. A total of 1812 frames were collected. The total exposure time was 20.18 hours. The frames were integrated with the Bruker SAINT software package using a wide-frame algorithm. The integration of the data using a monoclinic unit cell yielded a total of 9796 reflections to a maximum θ angle of 66.65° (0.84 Å resolution), of which 2343 were independent (average redundancy 4.181, completeness = 97.9%, R_{int} = 3.67%, R_{sig} = 3.07%) and 2317 (98.89%) were greater than $2\sigma(F^2)$. The final cell constants of $\underline{a}$ = 6.78220(10) Å, $\underline{b}$ = 15.6869(3) Å, $\underline{c}$ = 6.85770(10) Å, β = 108.4430(10)°, volume = 692.13(2) $Å^3$, are based upon the refinement of the XYZ-centroids of 9970 reflections above 20 σ(I) with 5.633° < 2θ < 133.3°. Data were corrected for absorption effects using the Multi-Scan method (SADABS). The ratio of minimum to maximum apparent transmission was 0.831. The calculated minimum and maximum transmission coefficients (based on crystal size) are 0.5830 and 0.7670. The structure was solved and refined using the Bruker SHELXTL Software Package, using the space

group *P*21, with Z = 2 for the formula unit, $C_{13}H_{10}FNO_6S$. The final anisotropic full-matrix least-squares refinement on F^2 with 200 variables converged at R1 = 2.64%, for the observed data and wR2 = 6.72% for all data. The goodness-of-fit was 1.067. The largest peak in the final difference electron density synthesis was 0.152 $e^-/Å^3$ and the largest hole was -0.183 $e^-/Å^3$ with an RMS deviation of 0.036 $e^-/Å^3$. On the basis of the final model, the calculated density was 1.570 g/cm^3 and F(000), 336 e^-. Flack parameter was refined: 0.01(1). CCDC Nr.: 2288990.

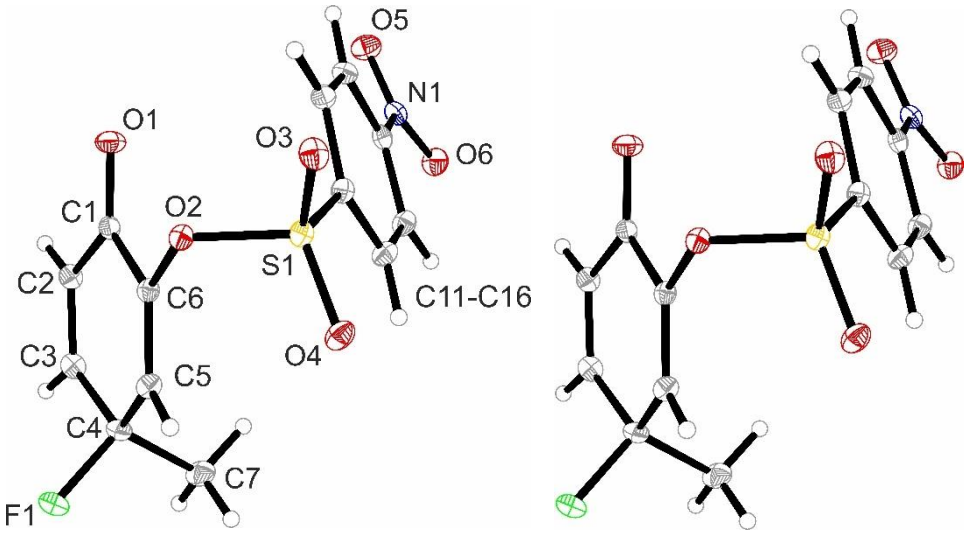


Figure S1: Crystal structure of compound **6m**.
Thermal ellipsoids are set at 30% probability.

X-ray crystal structure analysis of 23 (gil10466): A colorless, prism-like specimen of $C_{26}H_{33}IN_2O_{10}$, approximate dimensions 0.065 mm x 0.074 mm x 0.144 mm, was used for the X-ray crystallographic analysis. The X-ray intensity data were measured on a single crystal diffractometer Bruker D8 Venture Photon III system equipped with a micro focus tube Cu ImS (CuKα, λ = 1.54178 Å) and a MX mirror monochromator. A total of 2040 frames were collected. The total exposure time was 20.91 hours. The frames were integrated with the Bruker SAINT software package using a wide-frame algorithm. The integration of the data using an orthorhombic unit cell yielded a total of 28879 reflections to a maximum θ angle of 66.78° (0.84 Å resolution), of which 5552 were independent (average redundancy 5.202, completeness = 99.4%, R_{int} = 4.31%, R_{sig} = 4.14%) and 5308 (95.61%) were greater than $2\sigma(F^2)$. The final cell constants of a = 7.00380(10) Å, b = 15.9234(2) Å, c = 28.8087(4) Å, volume = 3212.87(8) $Å^3$, are based upon the refinement of the XYZ-centroids of 9826 reflections above 20 σ(I) with 6.342° < 2θ < 133.3°. Data were corrected for absorption effects using the Multi-Scan method (SADABS). The ratio of minimum to maximum apparent transmission was 0.802. The calculated minimum and maximum transmission coefficients (based on crystal size) are 0.3820 and 0.6150. The structure was solved and refined using the Bruker SHELXTL Software Package, using the space group $P2_12_12_1$, with Z = 4 for the formula unit, $C_{26}H_{33}IN_2O_{10}$. The final anisotropic full-matrix least-squares refinement on F^2 with 500 variables converged at R1 = 2.85%, for the observed data and wR2 = 7.21% for all data. The

goodness-of-fit was 1.064. The largest peak in the final difference electron density synthesis was 1.593 $e^-/Å^3$ and the largest hole was -0.298 $e^-/Å^3$ with an RMS deviation of 0.071 $e^-/Å^3$. On the basis of the final model, the calculated density was 1.365 g/cm^3 and F(000), 1344 e^-. Flack parameter was refined: 0.056(3). CCDC Nr.: 2288991.

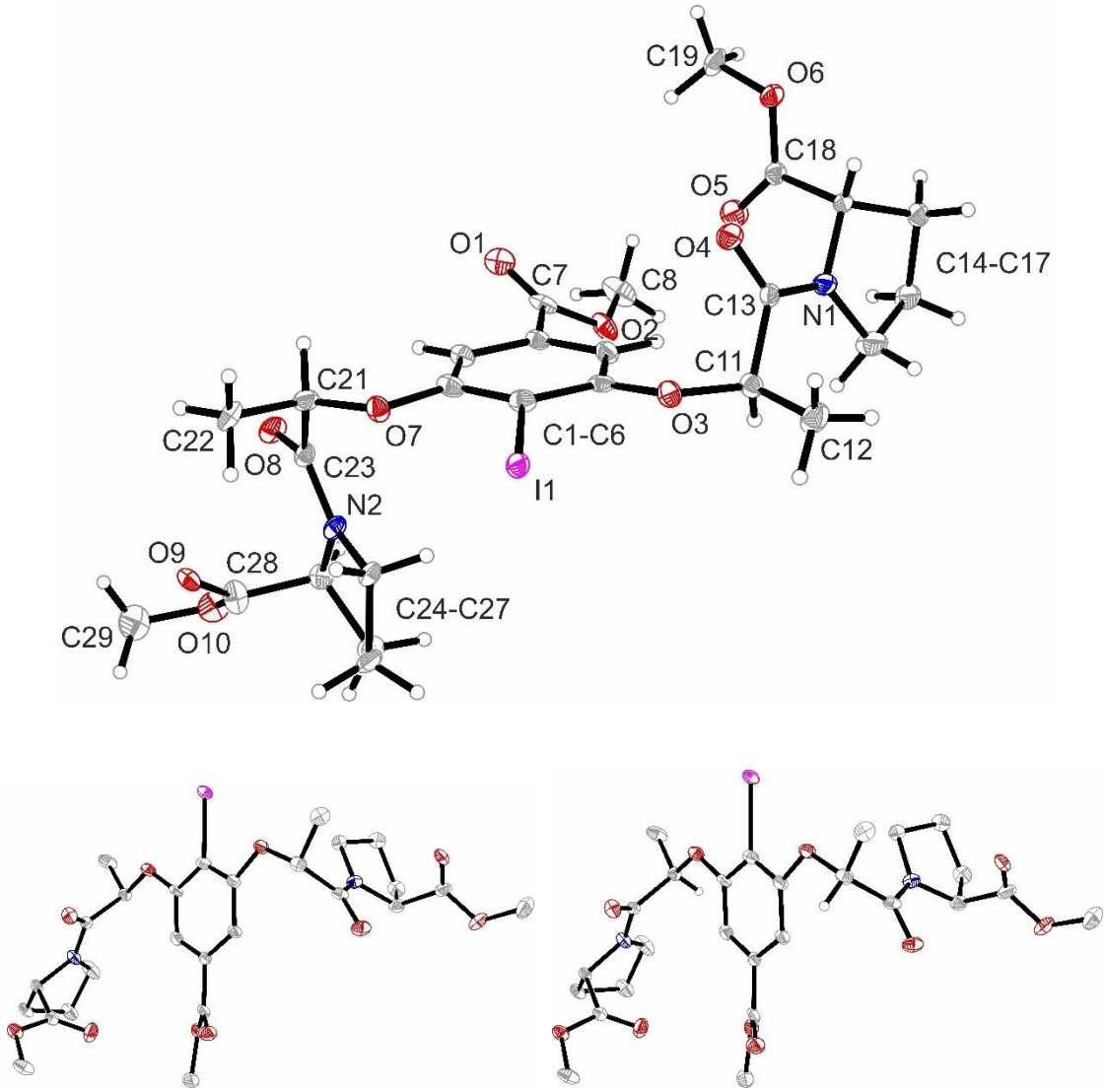


Figure S2: Crystal structure of compound **23**.
Thermal ellipsoids are set at 30% probability.

X-ray crystal structure analysis of 28 (gil10471): A colorless, prism-like specimen of $C_7H_6BrFO_3$, approximate dimensions 0.047 mm x 0.107 mm x 0.111 mm, was used for the X-ray crystallographic analysis. The X-ray intensity data were measured on a single crystal diffractometer Bruker D8 Venture Photon III system equipped with a micro focus tube Cu ImS (CuKα, λ = 1.54178 Å) and a MX mirror monochromator. A total of 2044 frames were collected. The total exposure time was 16.61 hours. The frames were integrated with the Bruker SAINT software package using a wide-frame algorithm. The integration of the data using an orthorhombic unit cell yielded a total of 12498 reflections to a maximum

θ angle of 66.60° (0.84 Å resolution), of which 1359 were independent (average redundancy 9.196, completeness = 98.1%, R_{int} = 3.09%, R_{sig} = 1.57%) and 1356 (99.78%) were greater than 2σ(F^2). The final cell constants of a = 6.4447(2) Å, b = 9.8276(3) Å, c = 12.3314(4) Å, volume = 781.02(4) Å^3, are based upon the refinement of the XYZ-centroids of 9969 reflections above 20 σ(I) with 11.51° < 2θ < 133.1°. Data were corrected for absorption effects using the multi-scan method (SADABS). The ratio of minimum to maximum apparent transmission was 0.807. The calculated minimum and maximum transmission coefficients (based on crystal size) are 0.5070 and 0.7320. The structure was solved and refined using the Bruker SHELXTL Software Package, using the space group $P2_12_12_1$, with Z = 4 for the formula unit, $C_7H_6BrFO_3$. The final anisotropic full-matrix least-squares refinement on F^2 with 111 variables converged at R1 = 1.38%, for the observed data and wR2 = 3.52% for all data. The goodness-of-fit was 1.084. The largest peak in the final difference electron density synthesis was 0.222 e^-/Å^3 and the largest hole was -0.238 e^-/Å^3 with an RMS deviation of 0.045 e^-/Å^3. On the basis of the final model, the calculated density was 2.016 g/cm^3 and F(000), 464 e^-. Flack parameter was refined to: 0.19(2). CCDC Nr.: 2288992.

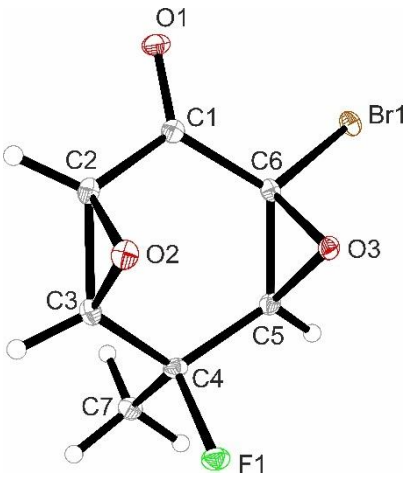


Figure S3: Crystal structure of compound **28**.
Thermal ellipsoids are set at 30% probability.

X-ray crystal structure analysis of 30 (gil10452): A colorless, prism-like specimen of $C_8H_{10}BrFO_2$, approximate dimensions 0.064 mm x 0.076 mm x 0.342 mm, was used for the X-ray crystallographic analysis. The X-ray intensity data were measured on a single crystal diffractometer Bruker D8 Venture Photon III system equipped with a micro focus tube Cu ImS (CuKα, λ = 1.54178 Å) and a MX mirror monochromator. A total of 1712 frames were collected. The total exposure time was 18.52 hours. The frames were integrated with the Bruker SAINT software package using a wide-frame algorithm. The integration of the data using a monoclinic unit cell yielded a total of 12842 reflections to a maximum θ angle of 66.91° (0.84 Å resolution), of which 1569 were independent (average redundancy 8.185, completeness = 98.2%, R_{int} = 5.72%, R_{sig} = 3.02%) and 1421 (90.57%) were greater than 2σ(F^2). The final cell constants of a = 8.6997(4) Å, b = 15.8634(8) Å, c = 6.6702(4) Å, β = 102.677(2)°, volume

= 898.09(8) Å^3, are based upon the refinement of the XYZ-centroids of 8485 reflections above 20 σ(I) with 10.42° < 2θ < 133.0°. Data were corrected for absorption effects using the multi-scan method (SADABS). The ratio of minimum to maximum apparent transmission was 0.707. The calculated minimum and maximum transmission coefficients (based on crystal size) are 0.2310 and 0.6970. The structure was solved and refined using the Bruker SHELXTL Software Package, using the space group $P2_1/c$, with Z = 4 for the formula unit, $C_8H_{10}BrFO_2$. The final anisotropic full-matrix least-squares refinement on F^2 with 111 variables converged at R1 = 3.10%, for the observed data and wR2 = 7.14% for all data. The goodness-of-fit was 1.042. The largest peak in the final difference electron density synthesis was 0.332 e$^-$/Å^3 and the largest hole was -0.373 e$^-$/Å^3 with an RMS deviation of 0.081 e$^-$/Å^3. On the basis of the final model, the calculated density was 1.753 g/cm^3 and F(000), 472 e$^-$. CCDC Nr.: 2288993.

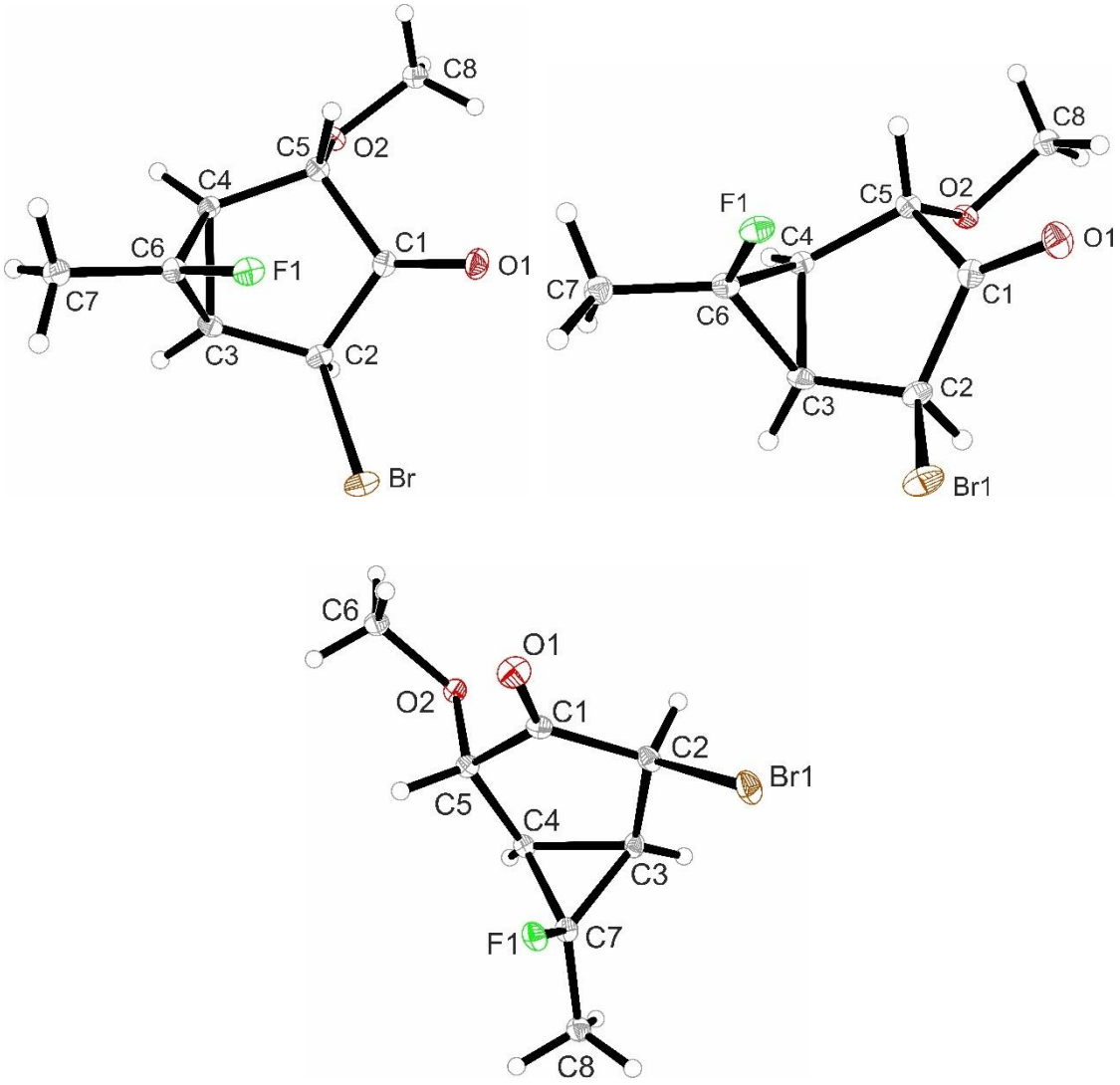
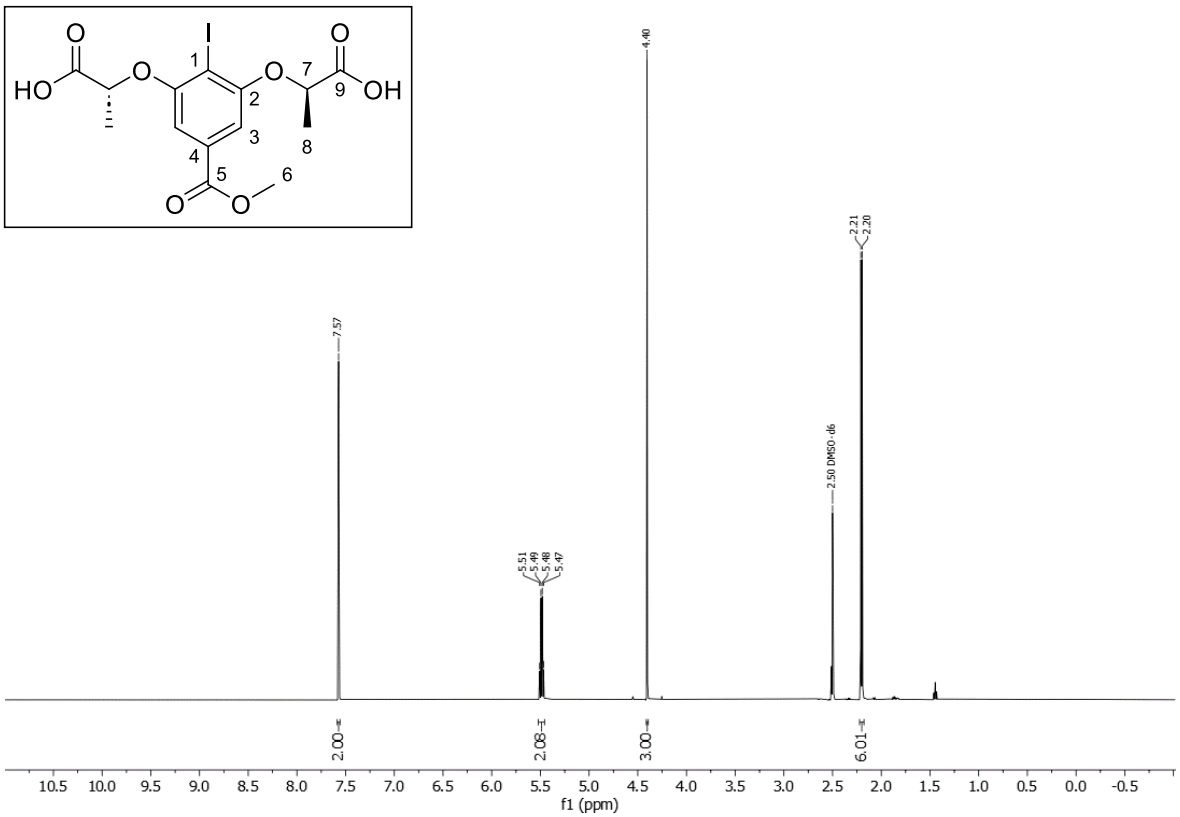


Figure S4: Crystal structure of compound **30**.
Thermal ellipsoids are set at 30% probability.

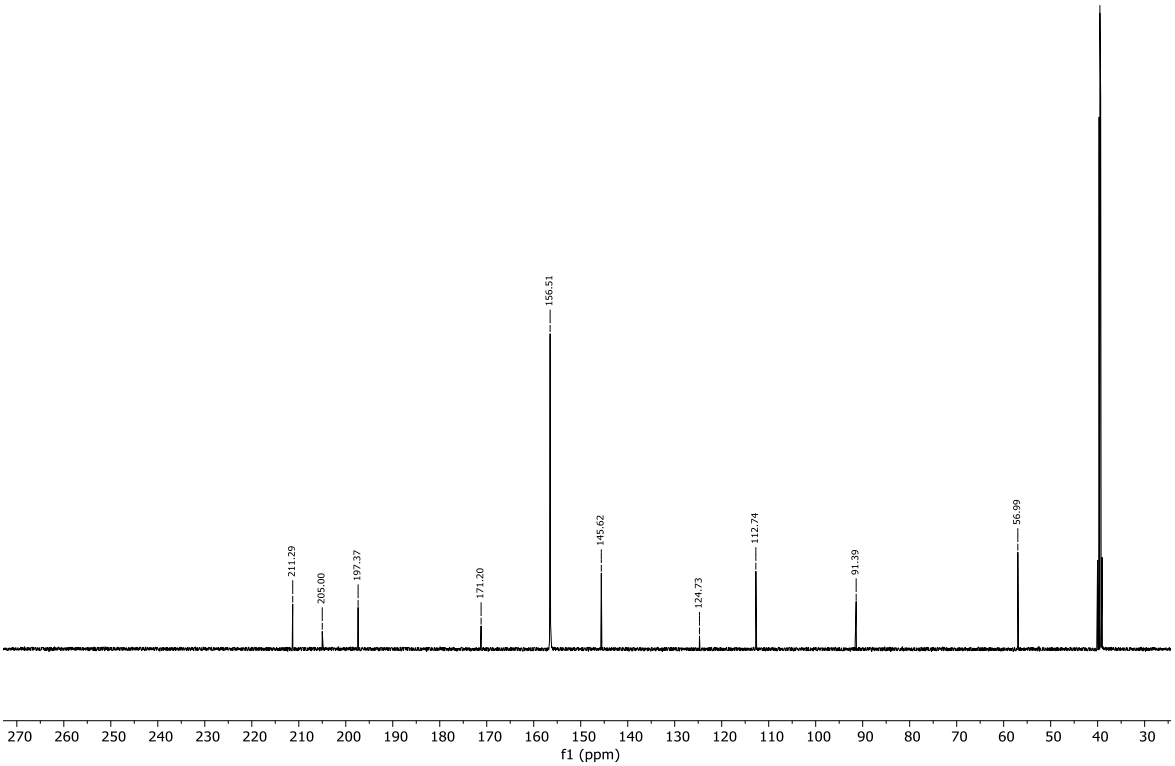
VIII. NMR data of unreported compounds

(2*R*,2'*R*)-2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))dipropionic acid (S5)

^{1}H NMR (500MHz, DMSO-d6, 299 K)

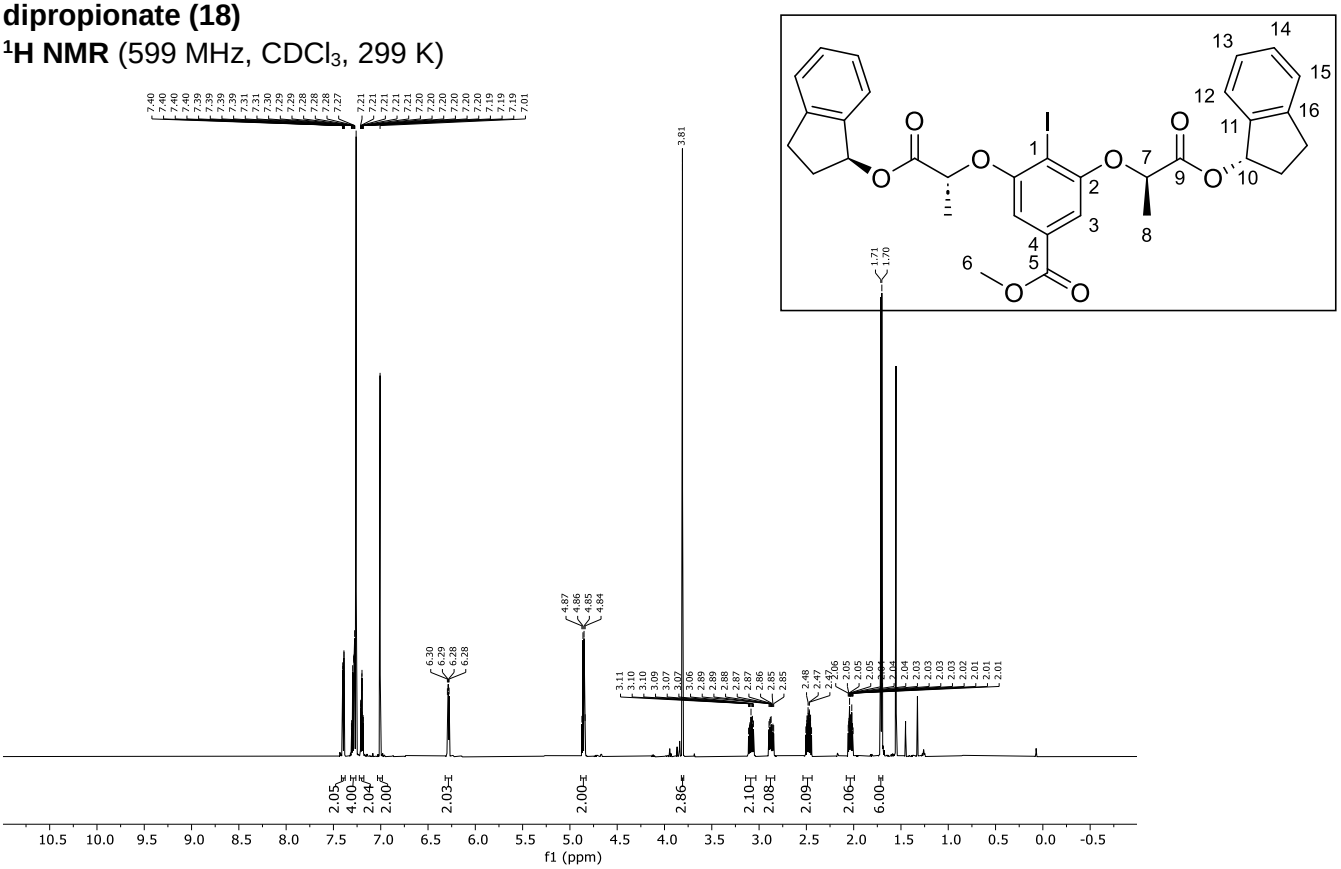


^{13}C NMR (126 MHz, DMSO-d6, 299 K)

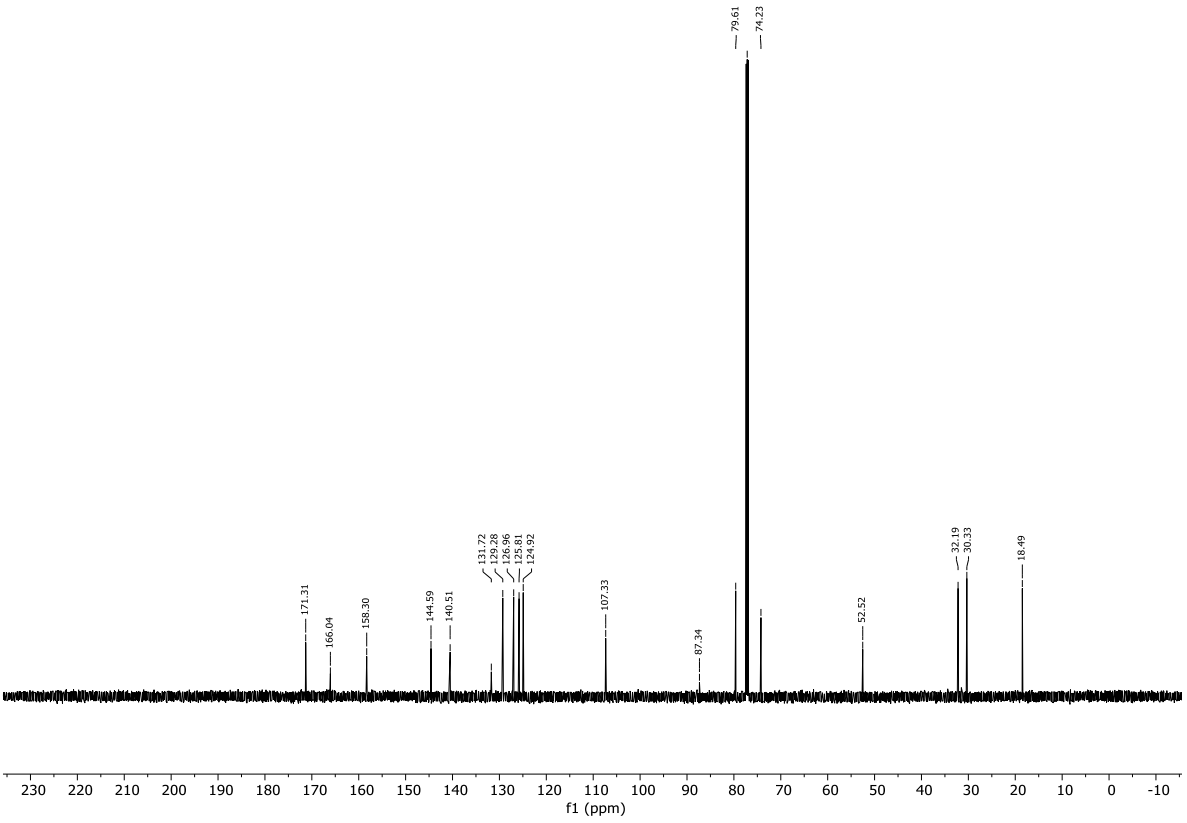


bis(2,3-dihydro-1H-inden-1-yl)2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (18)

^{1}H NMR (599 MHz, $CDCl_3$, 299 K)

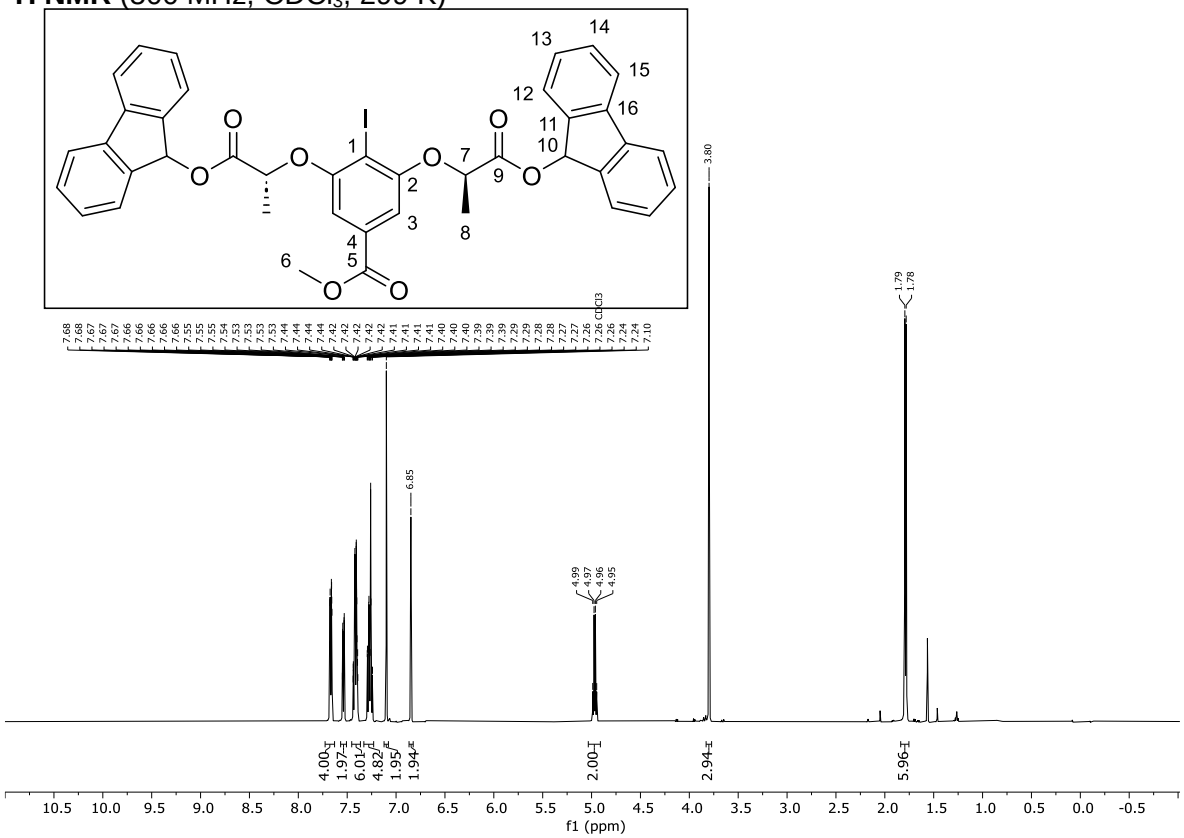


^{13}C NMR (151 MHz, $CDCl_3$, 299 K)

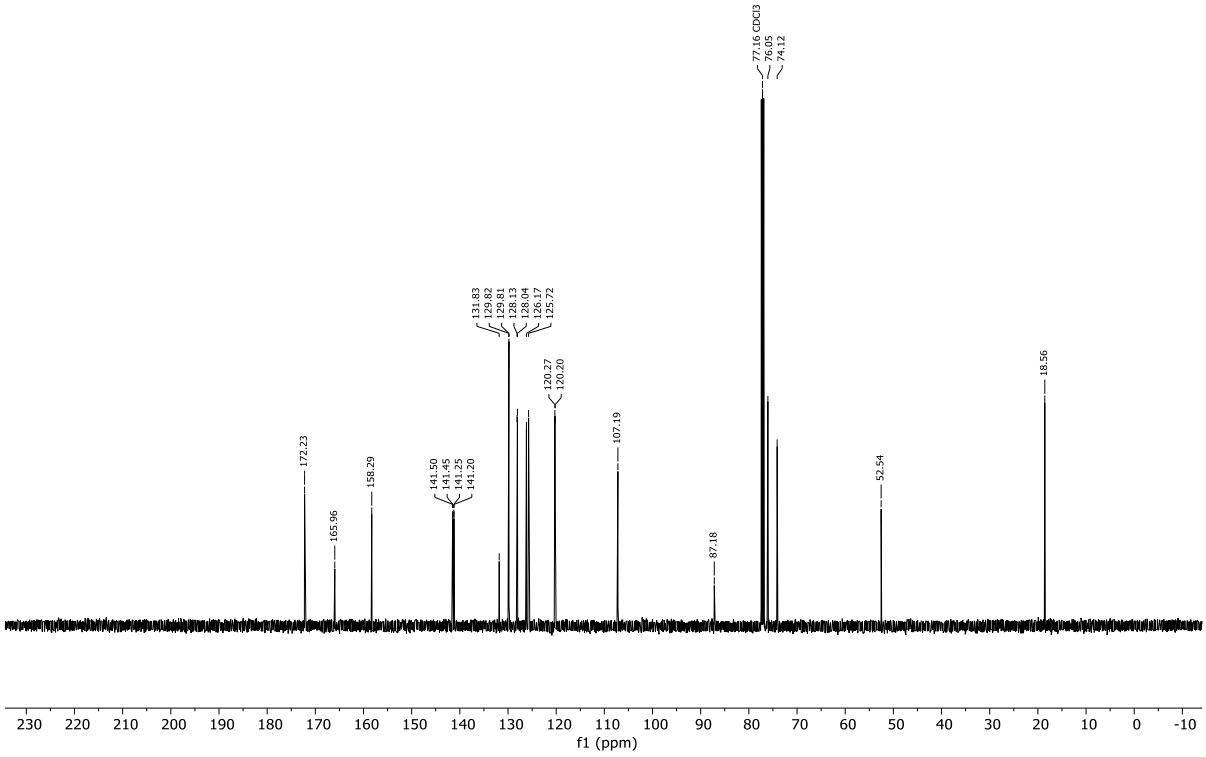


di(9H-fluoren-9-yl)2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (16)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

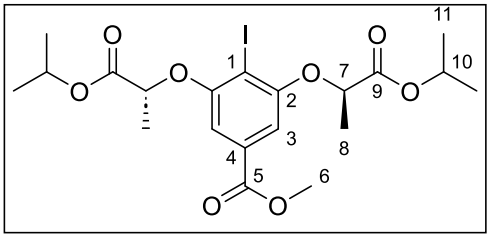


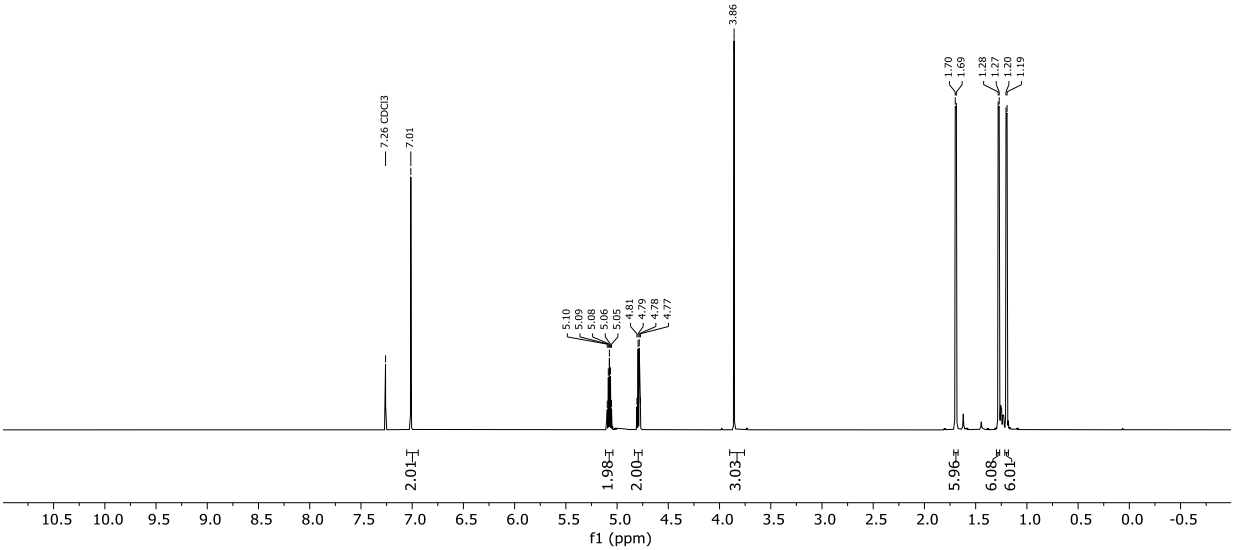
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



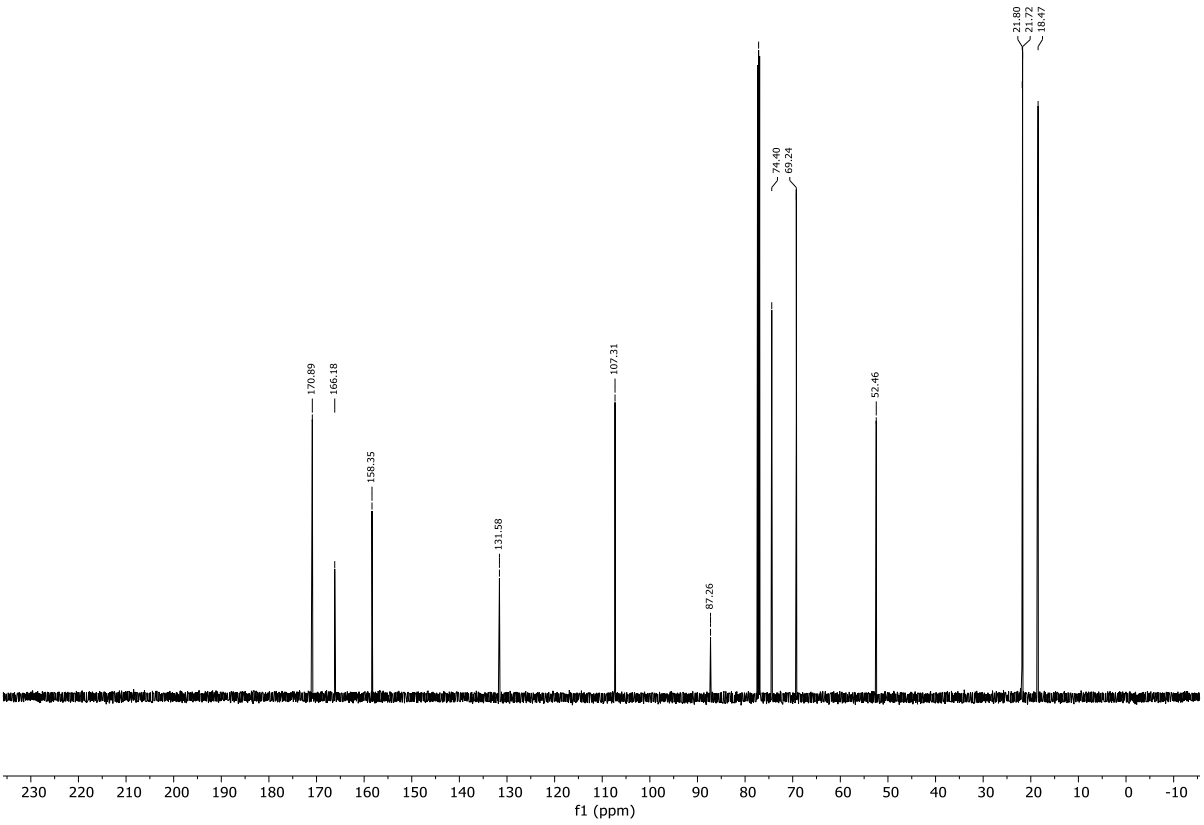
diisopropyl 2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2R,2'R)-dipropionate (20)

^{1}H NMR (599 MHz, $CDCl_3$, 299 K)



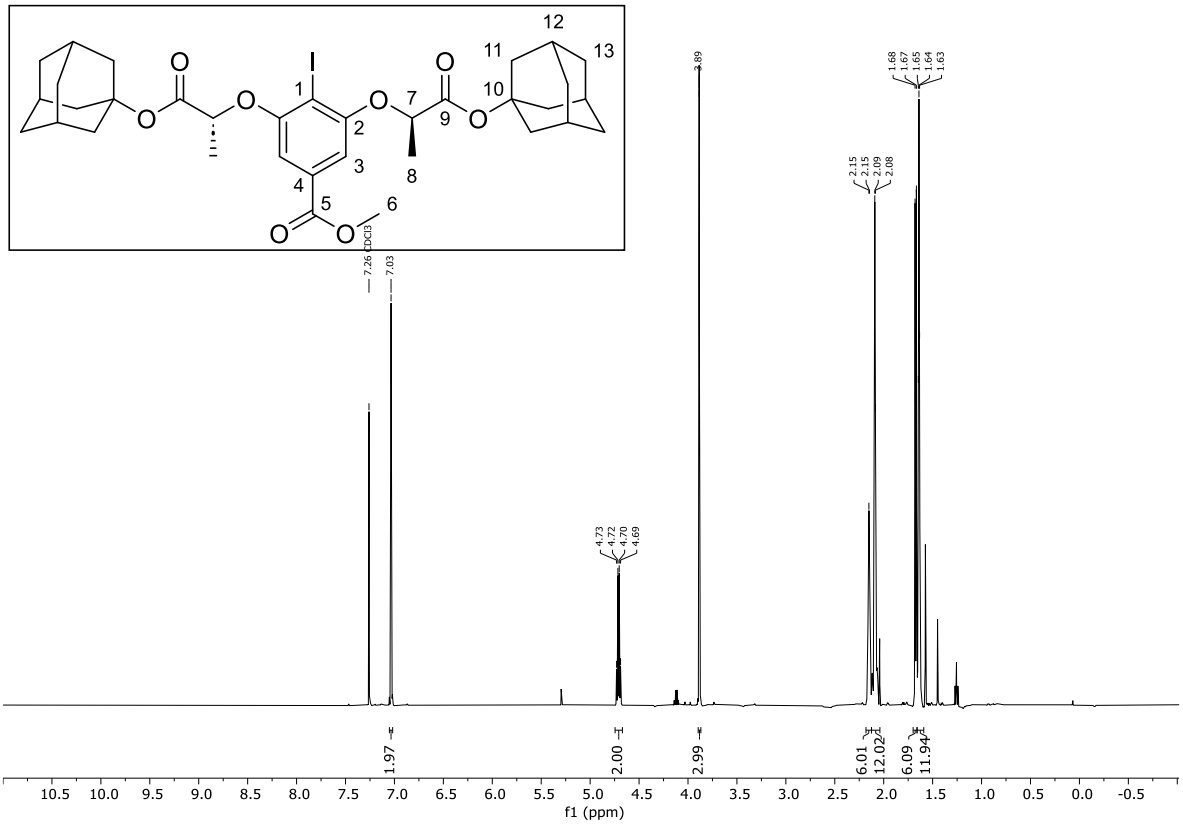


^{13}C NMR (151 MHz, $CDCl_3$, 299 K)

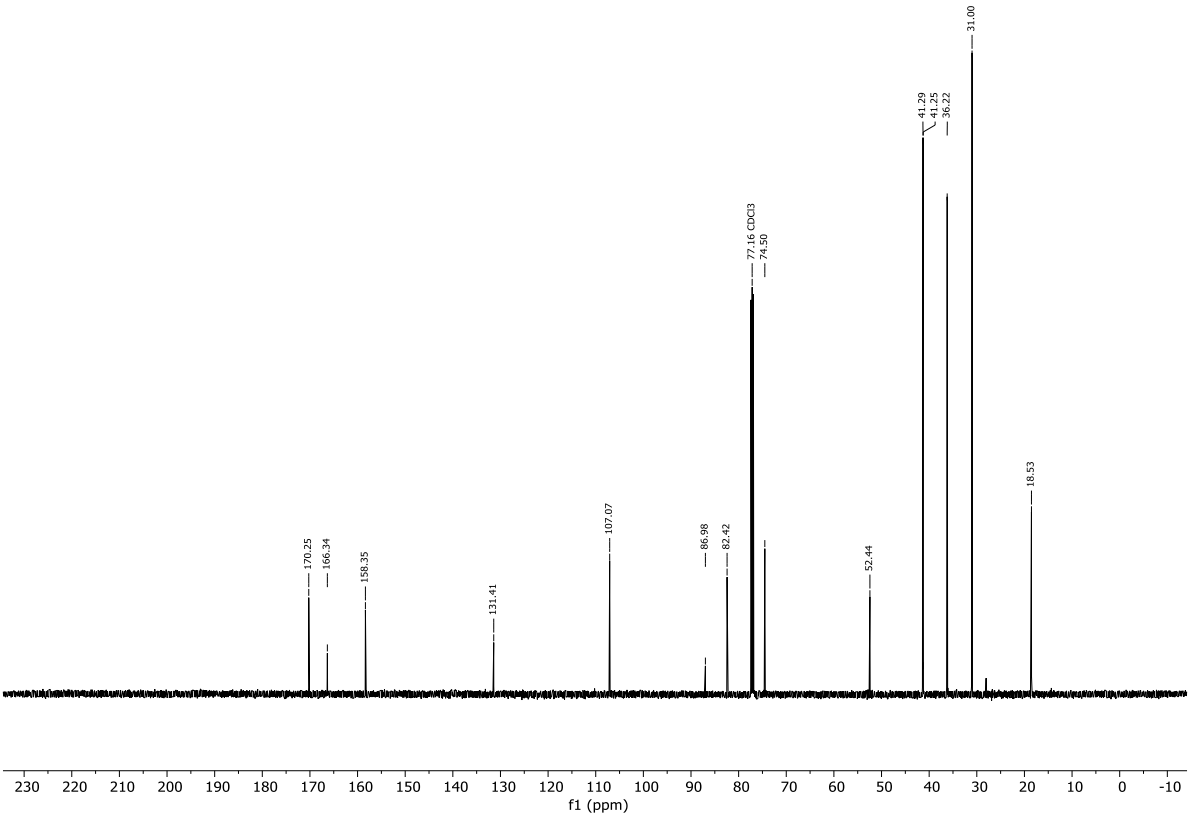


di((1*R*,3S,5*R*,7*R*)-adamantan-2-yl)2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (21)

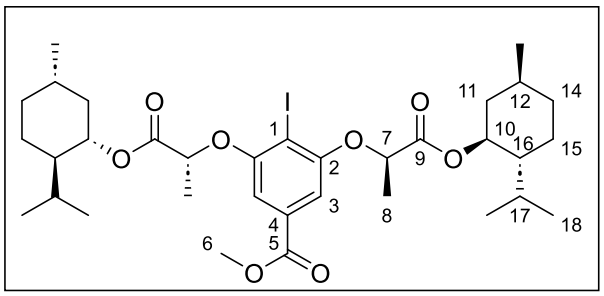
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



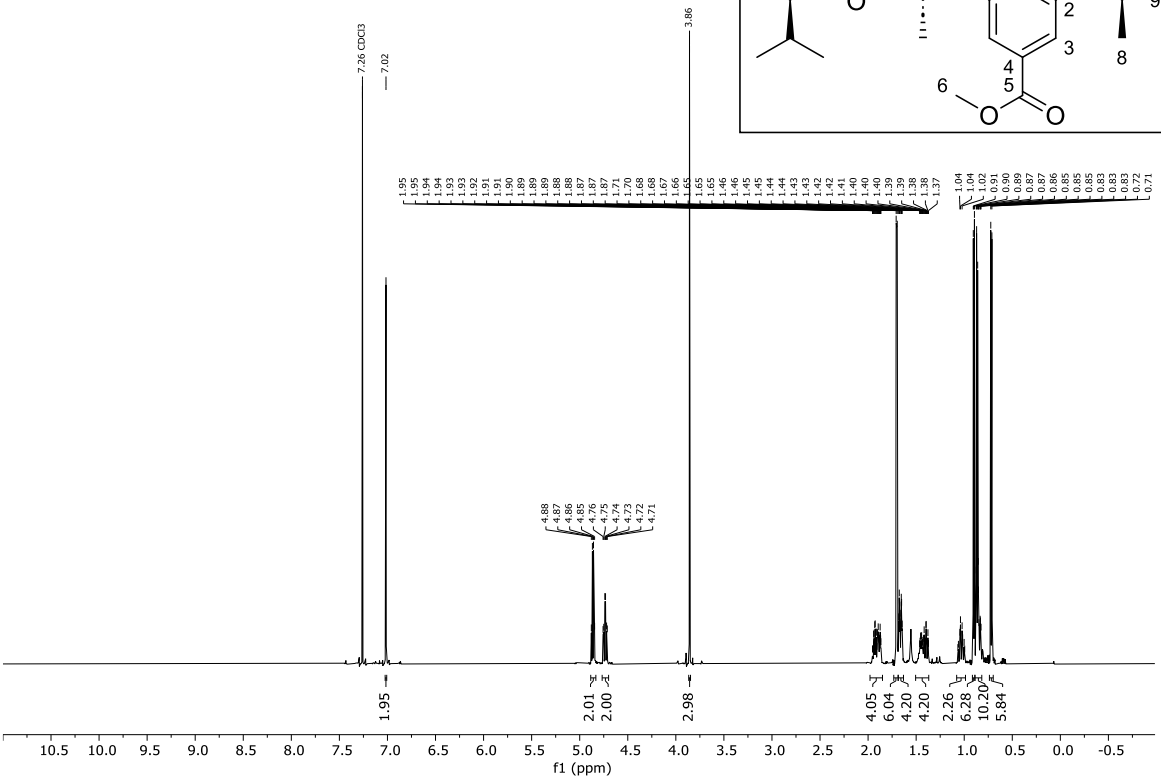
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



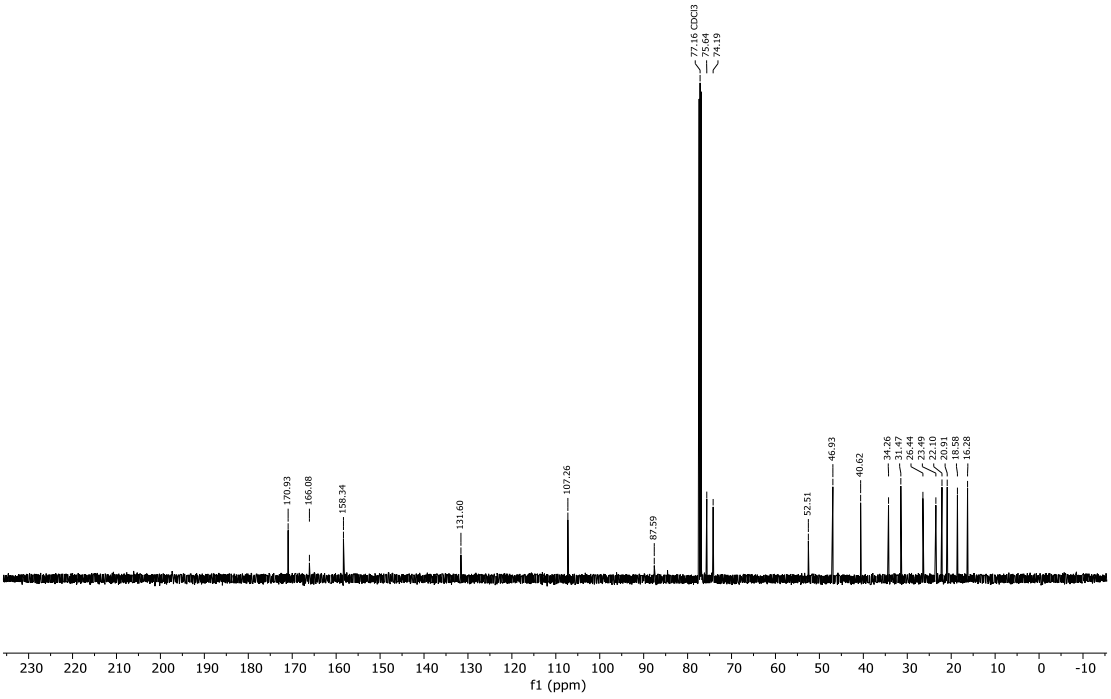
bis((1*S*,2*R*,5*S*)-2-isopropyl-5-methylcyclohexyl) 2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (22)



^{1}H NMR (599 MHz, $CDCl_3$, 299 K)

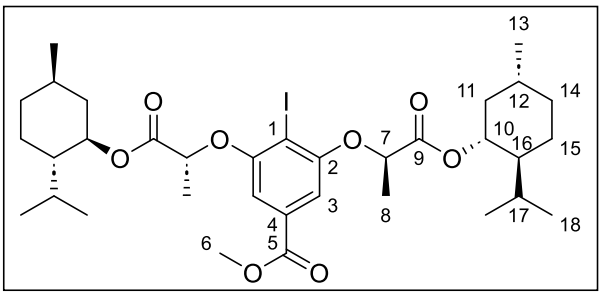


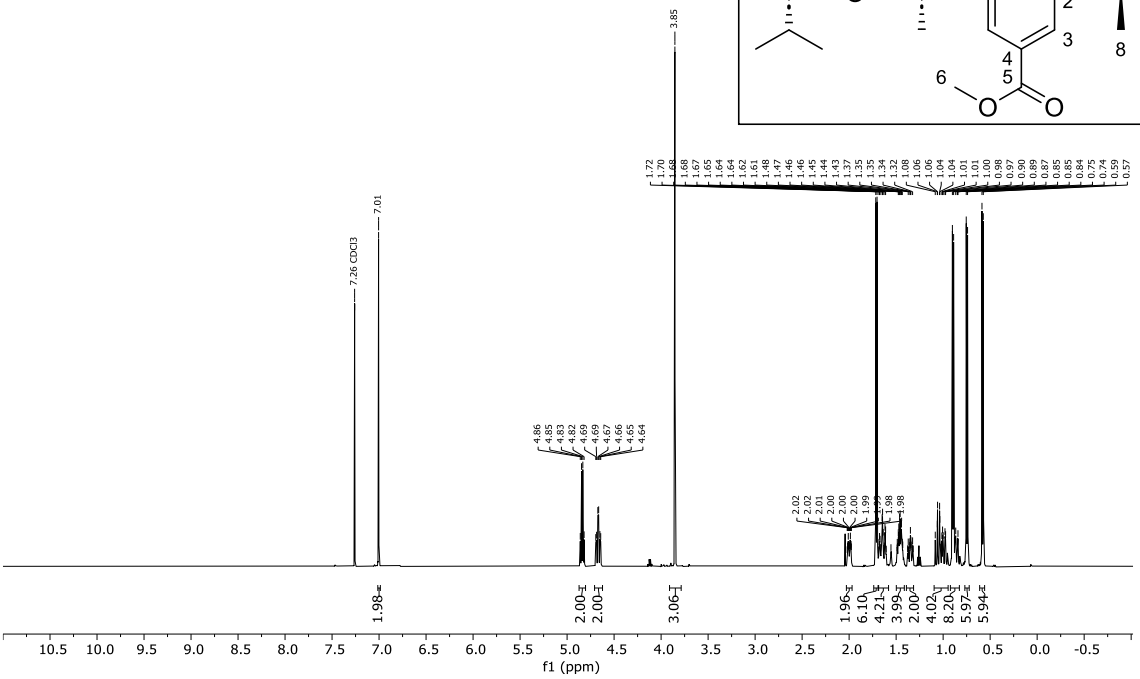
^{13}C NMR (151 MHz, $CDCl_3$, 299 K)



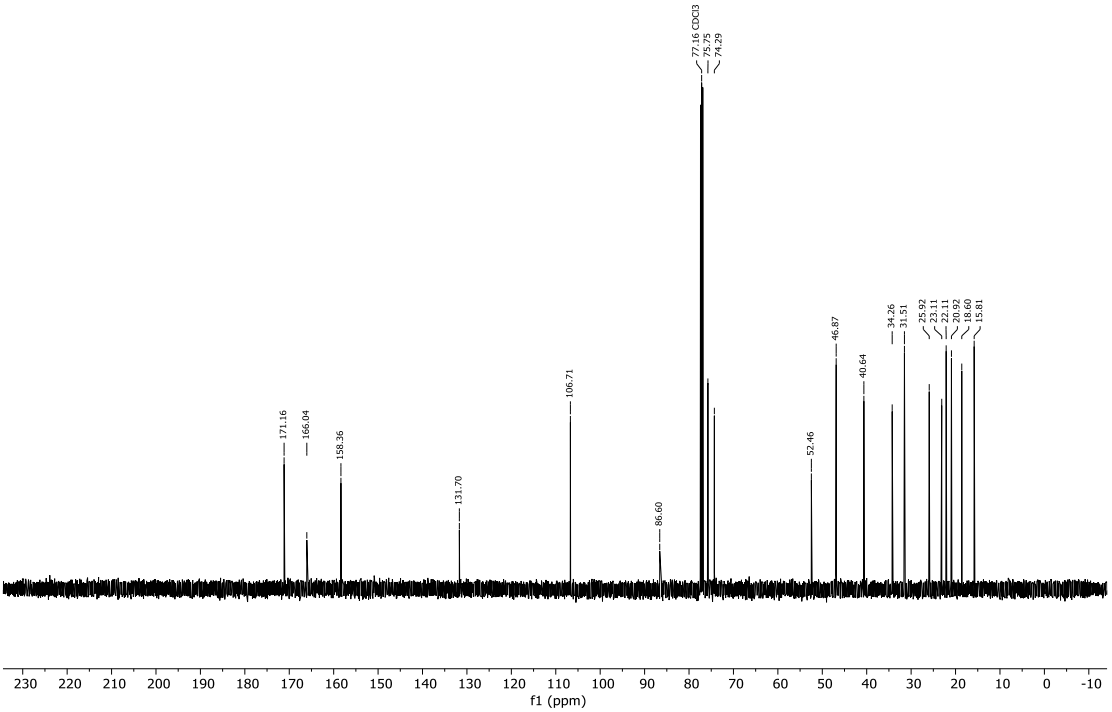
bis((1*R*,2*S*,5*R*)-2-isopropyl-5-methylcyclohexyl) 2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))(2*R*,2'*R*)-dipropionate (23)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)





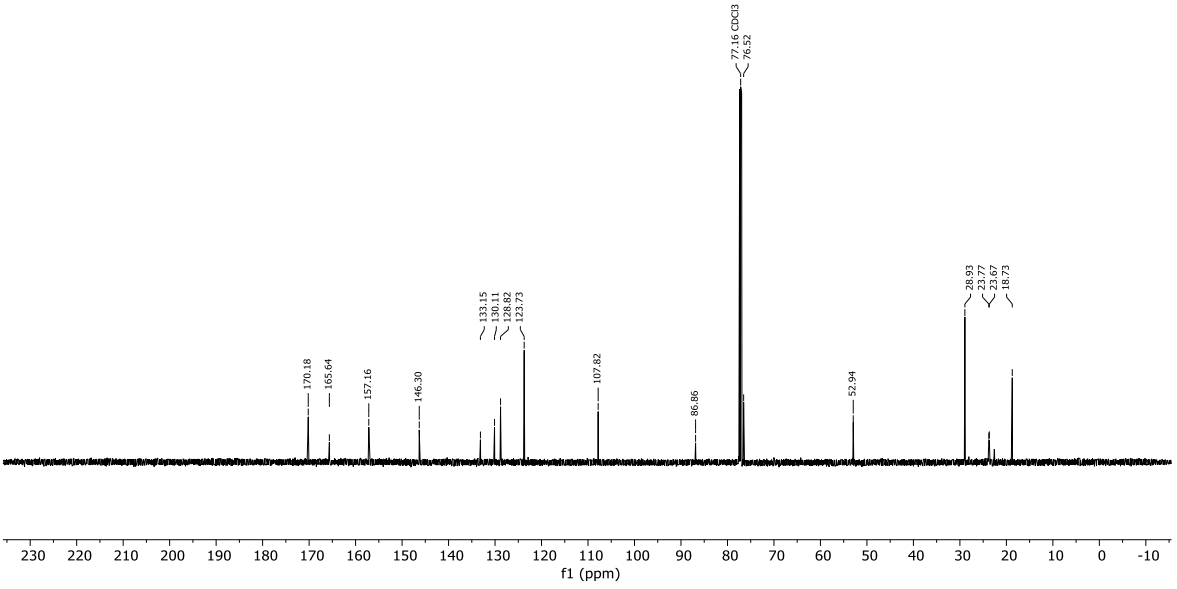
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



methyl 3,5-bis(((R)-1-((2,6-diisopropylphenyl)amino)-1-oxopropan-2-yl)oxy)-4-iodobenzoate (24)

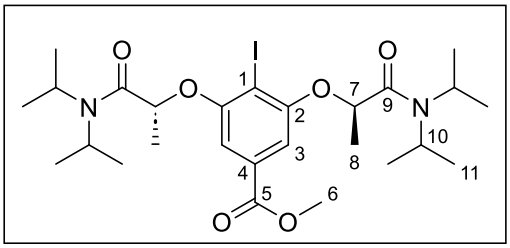
^{1}H NMR (599 MHz, $CDCl_3$, 299 K)

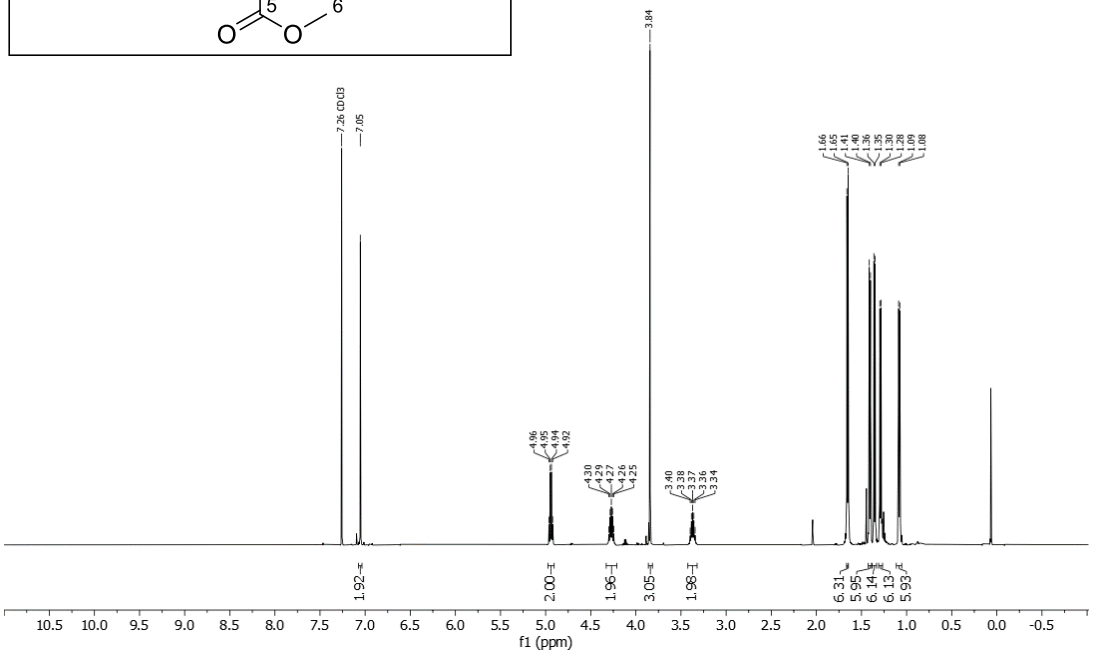
^{13}C NMR (151 MHz, $CDCl_3$, 299 K)



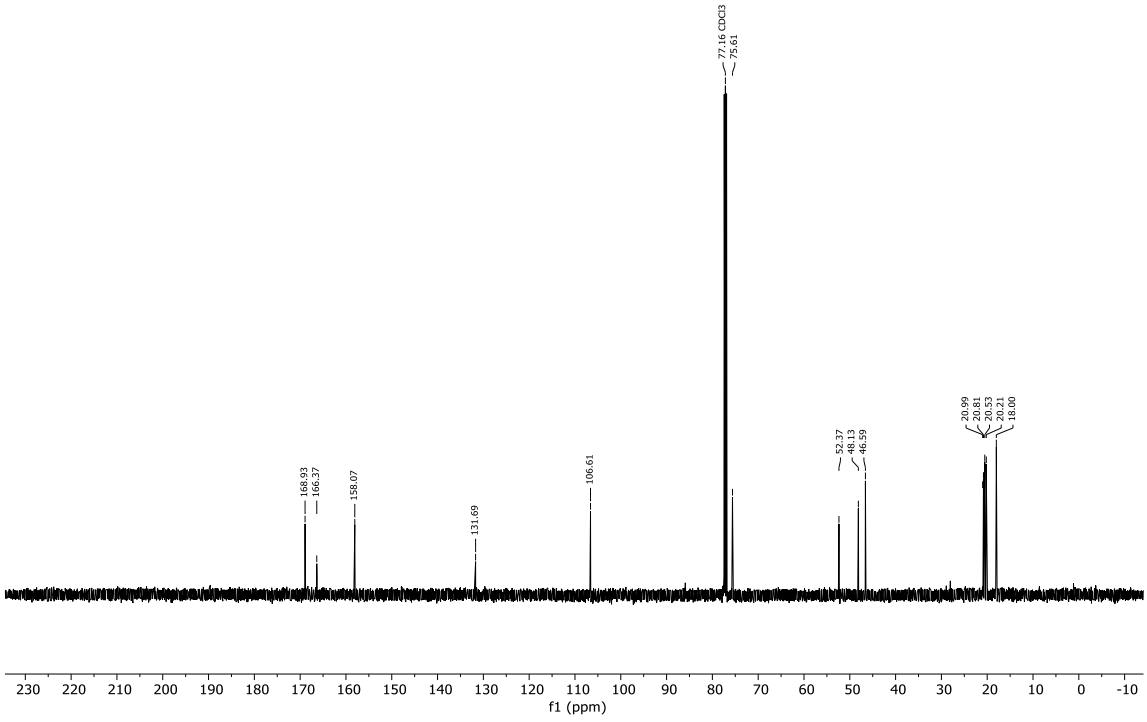
methyl 3,5-bis(((R)-1-(diisopropylamino)-1-oxopropan-2-yl)oxy)-4-iodobenzoate(25)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



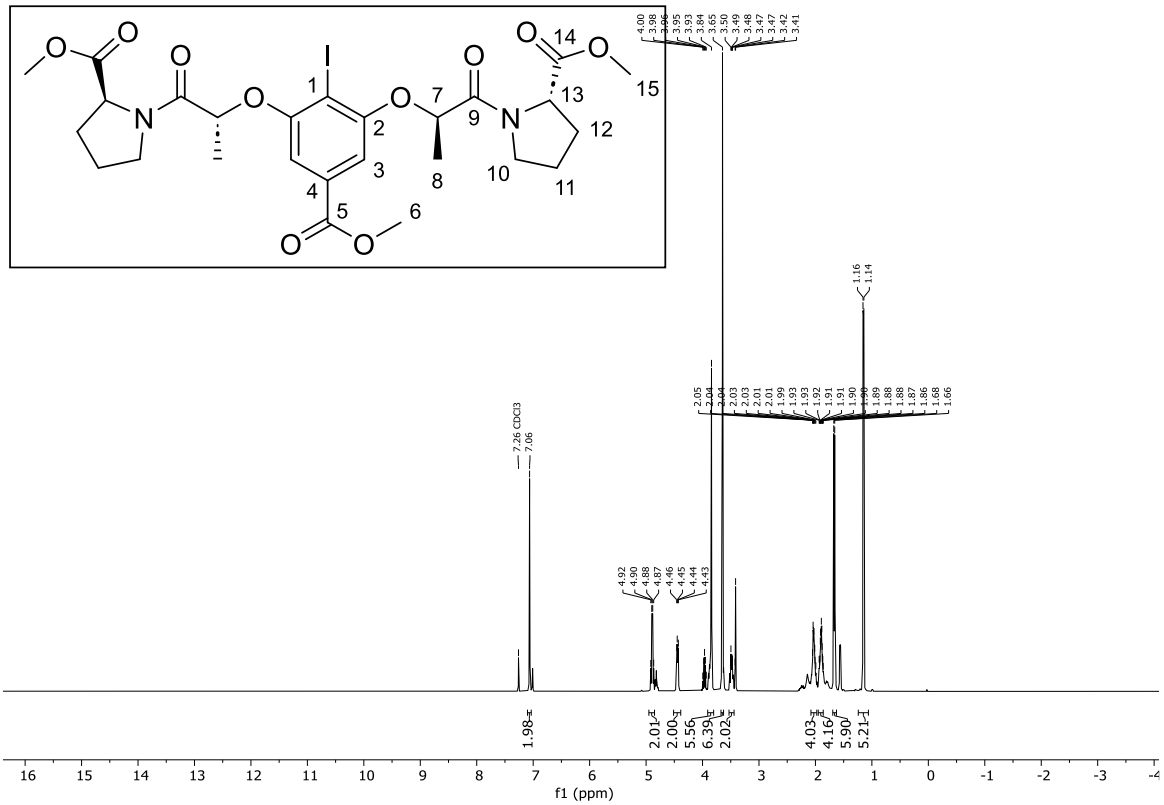


^{13}C NMR (126 MHz, $CDCl_3$, 299 K)

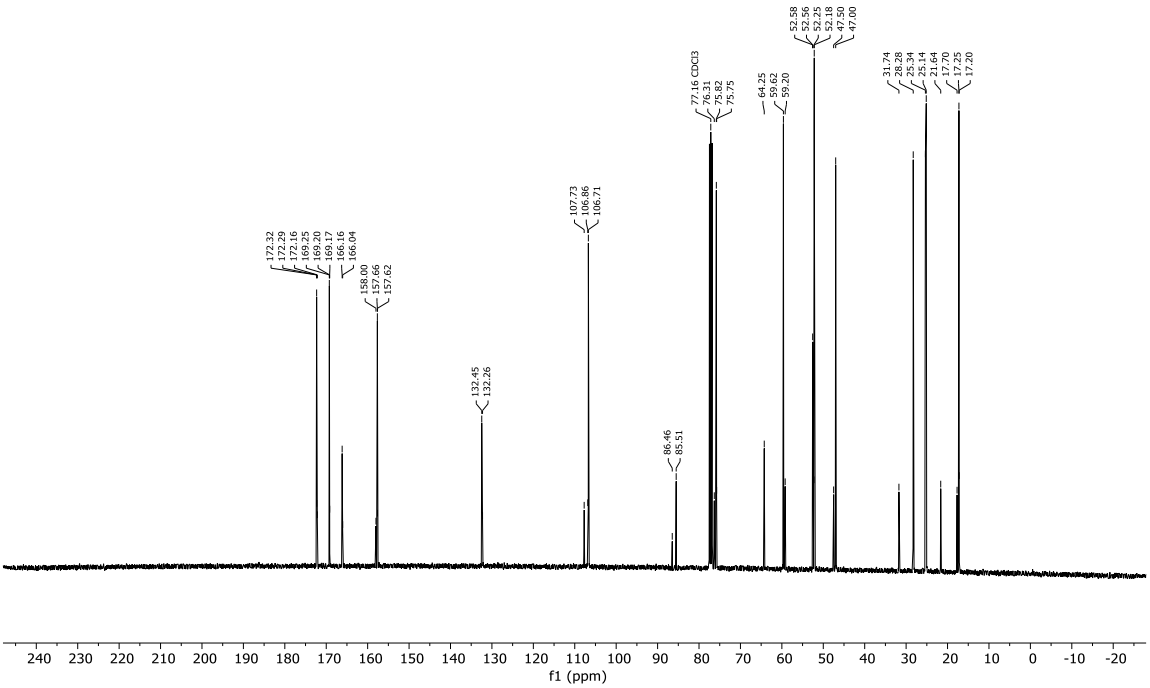


dimethyl ((2*R*,2'*R*)-2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))bis(propanoyl))(*S*)-di-*L*-prolinate (26)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

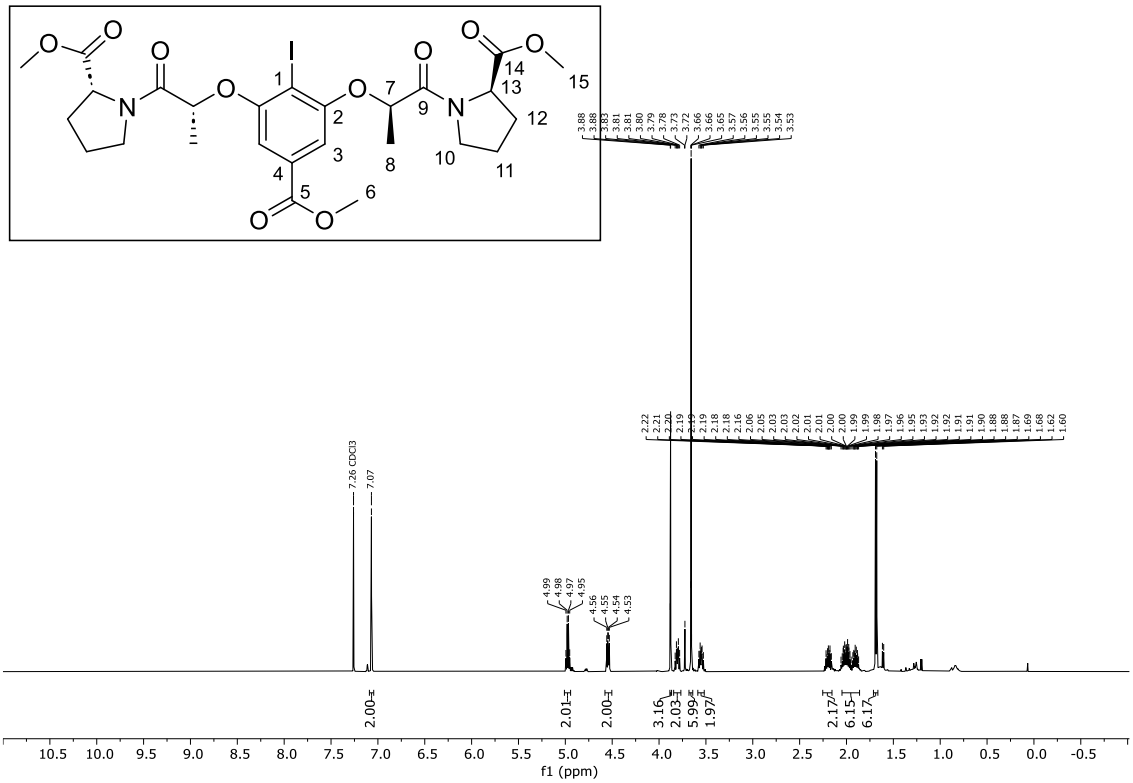


^{13}C NMR (126 MHz, $CDCl_3$, 299 K)

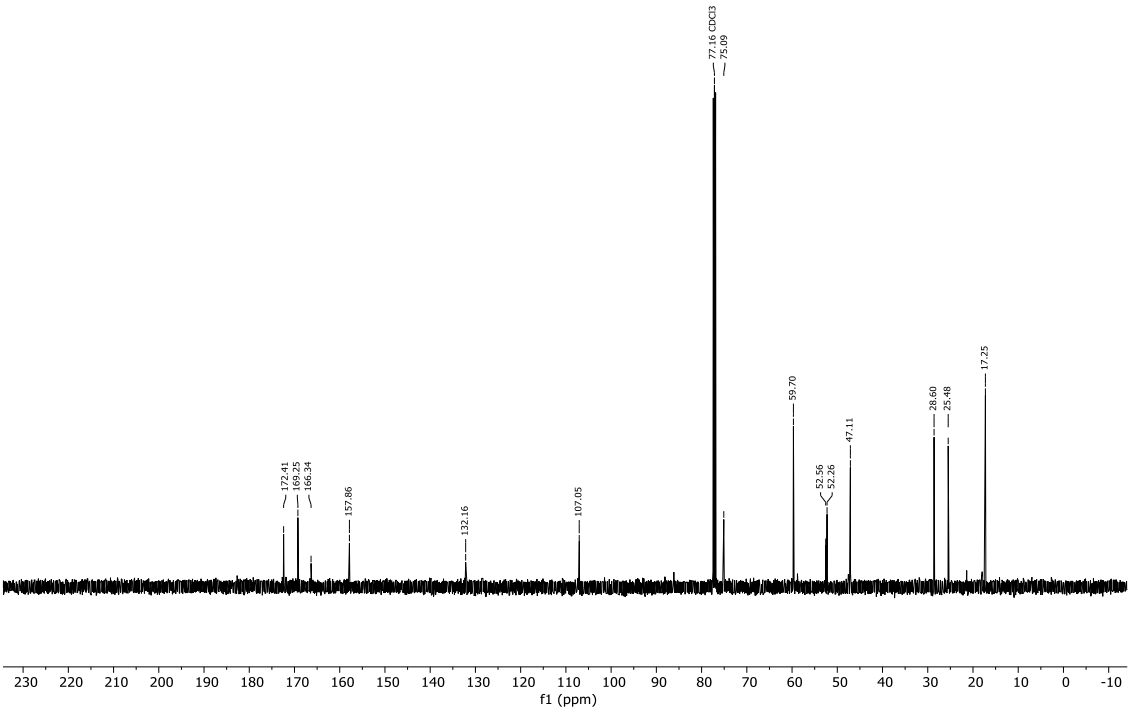


dimethyl ((2R,2'R)-2,2'-((2-iodo-5-(methoxycarbonyl)-1,3-phenylene)bis(oxy))bis(propanoyl))(R)-di-D-prolinate (27)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

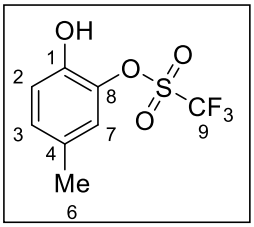


^{13}C NMR (126 MHz, $CDCl_3$, 299 K)

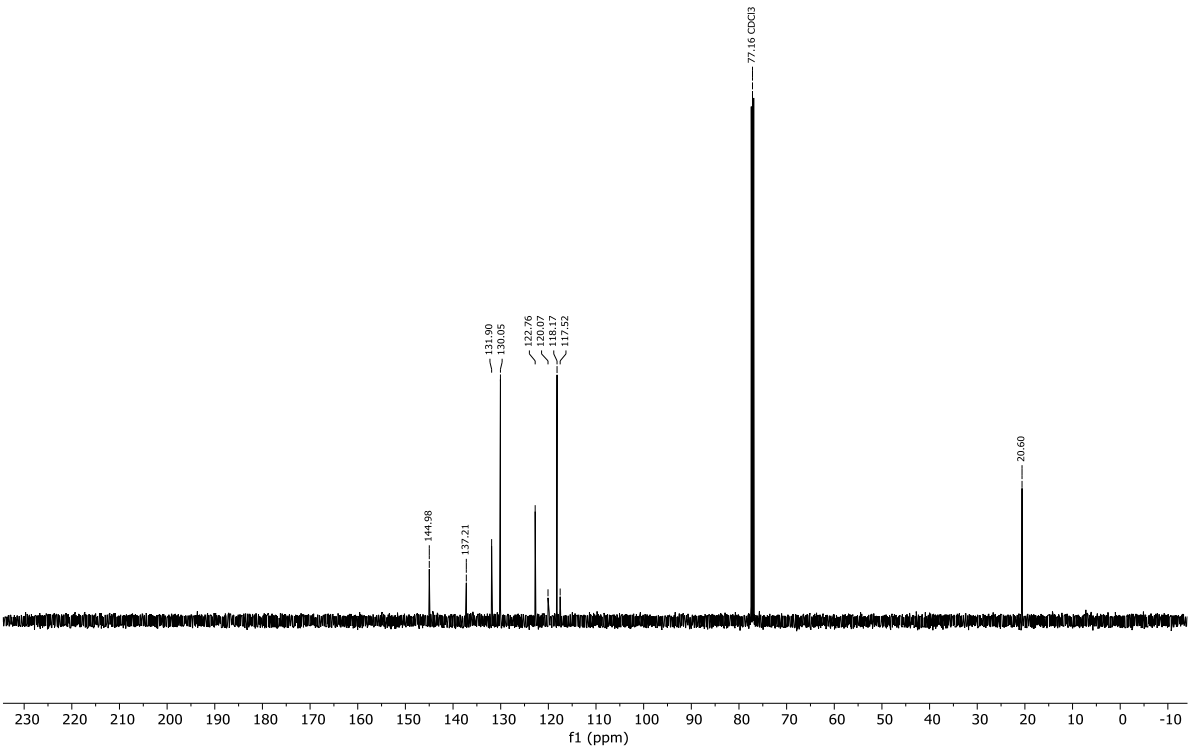


2-hydroxy-5-methylphenyl trifluoromethanesulfonate (8d)

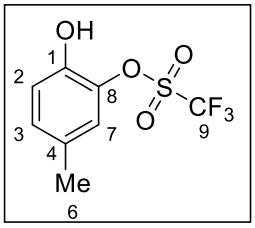
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



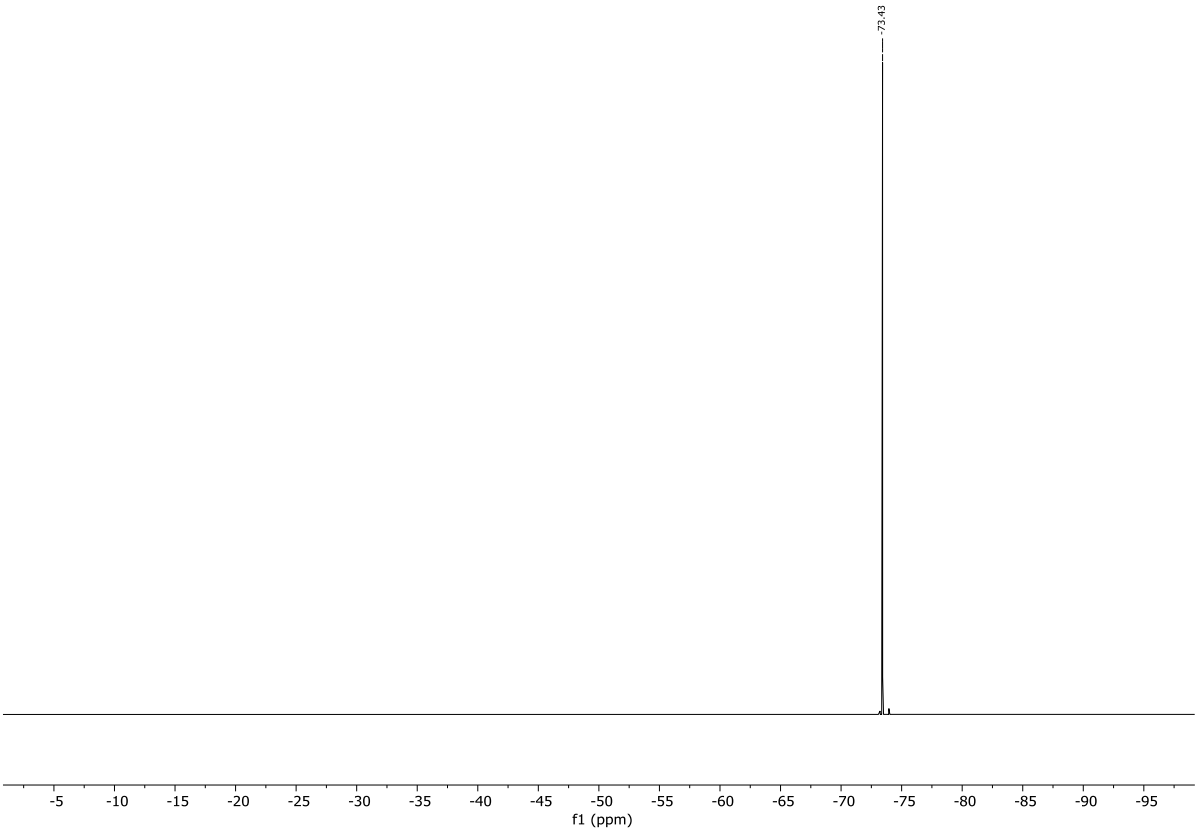
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

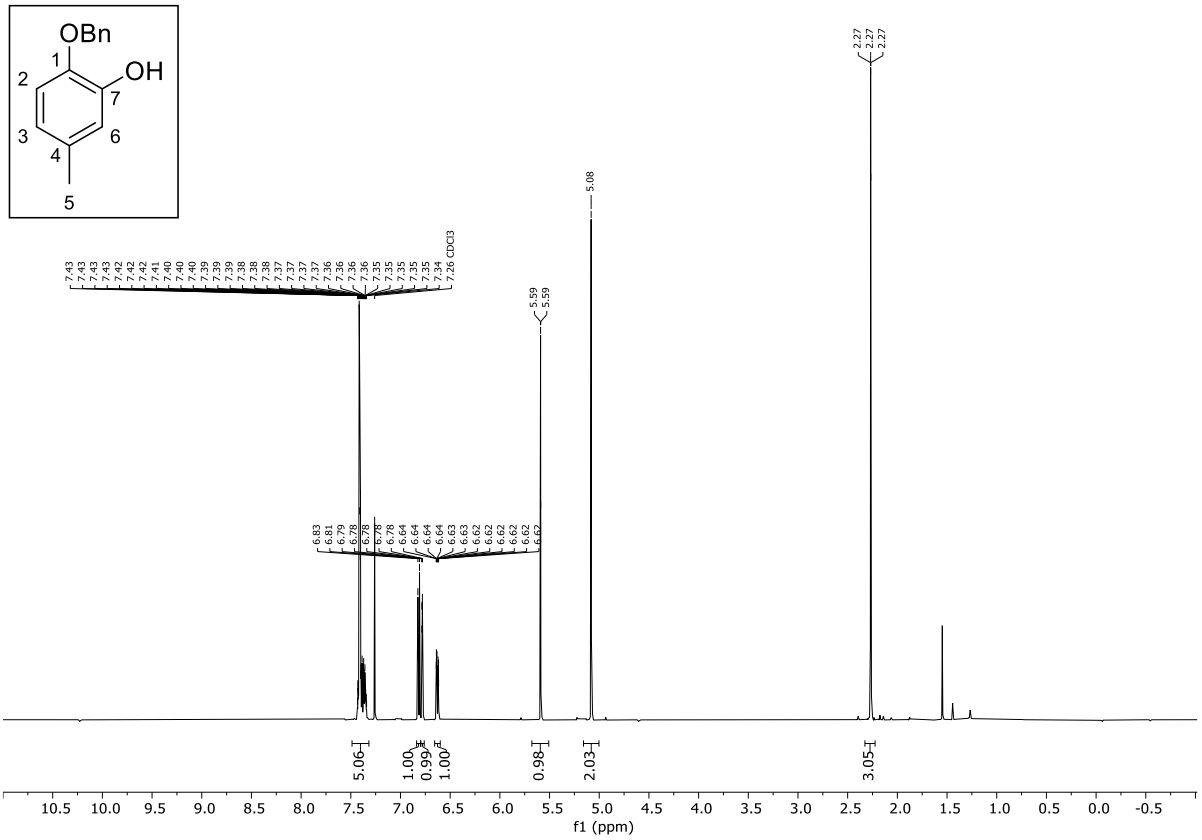


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

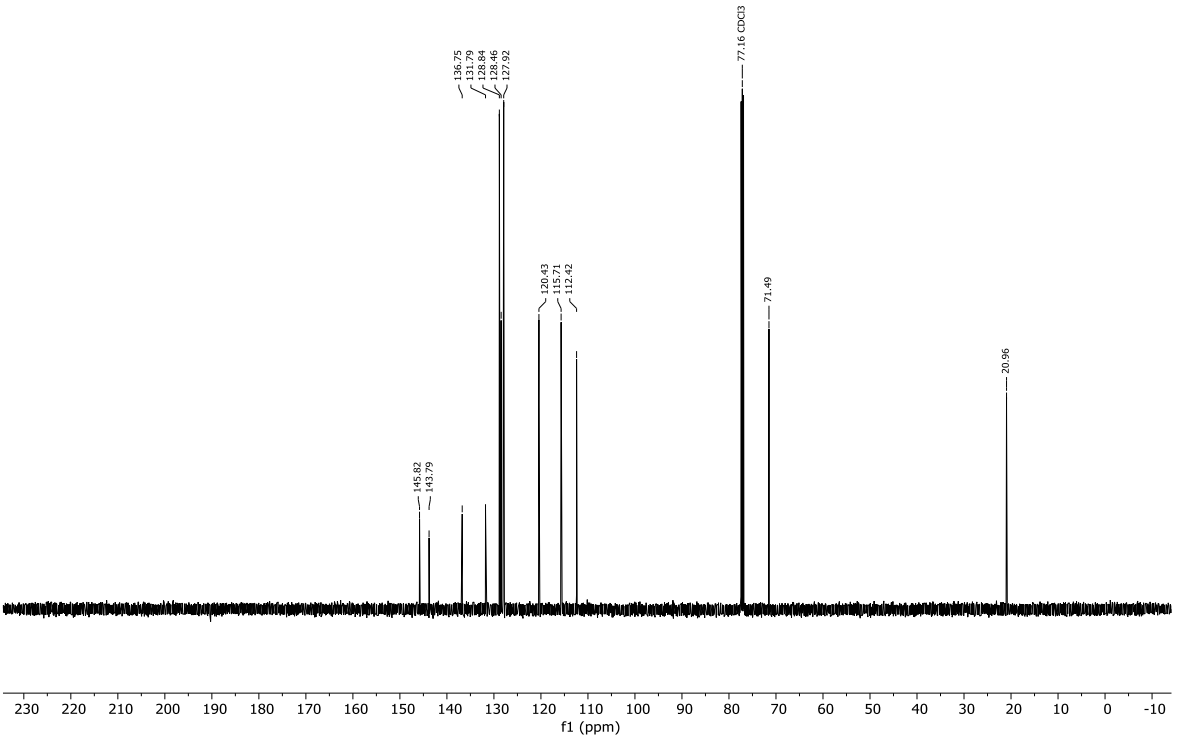


2-(benzyloxy)-5-methylphenol (S9)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

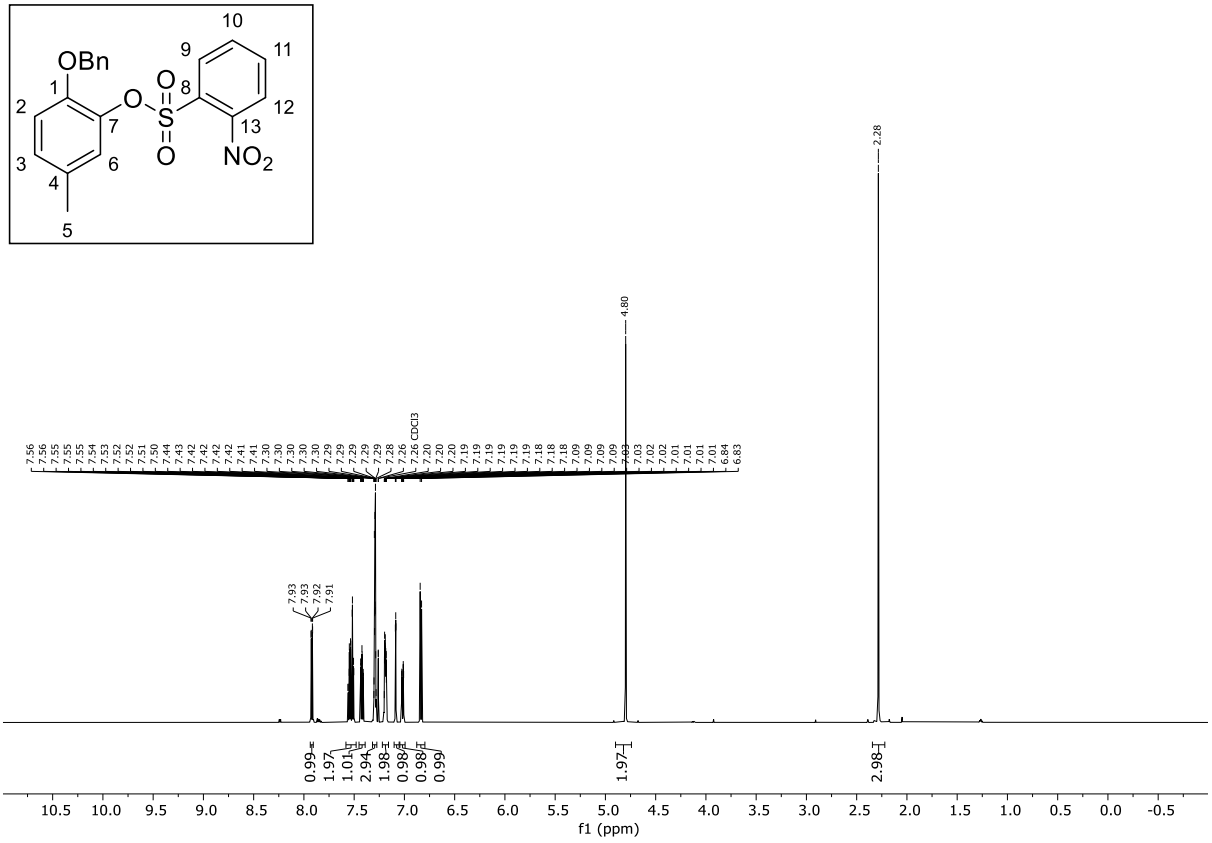


^{13}C NMR (126 MHz, $CDCl_3$, 299 K)

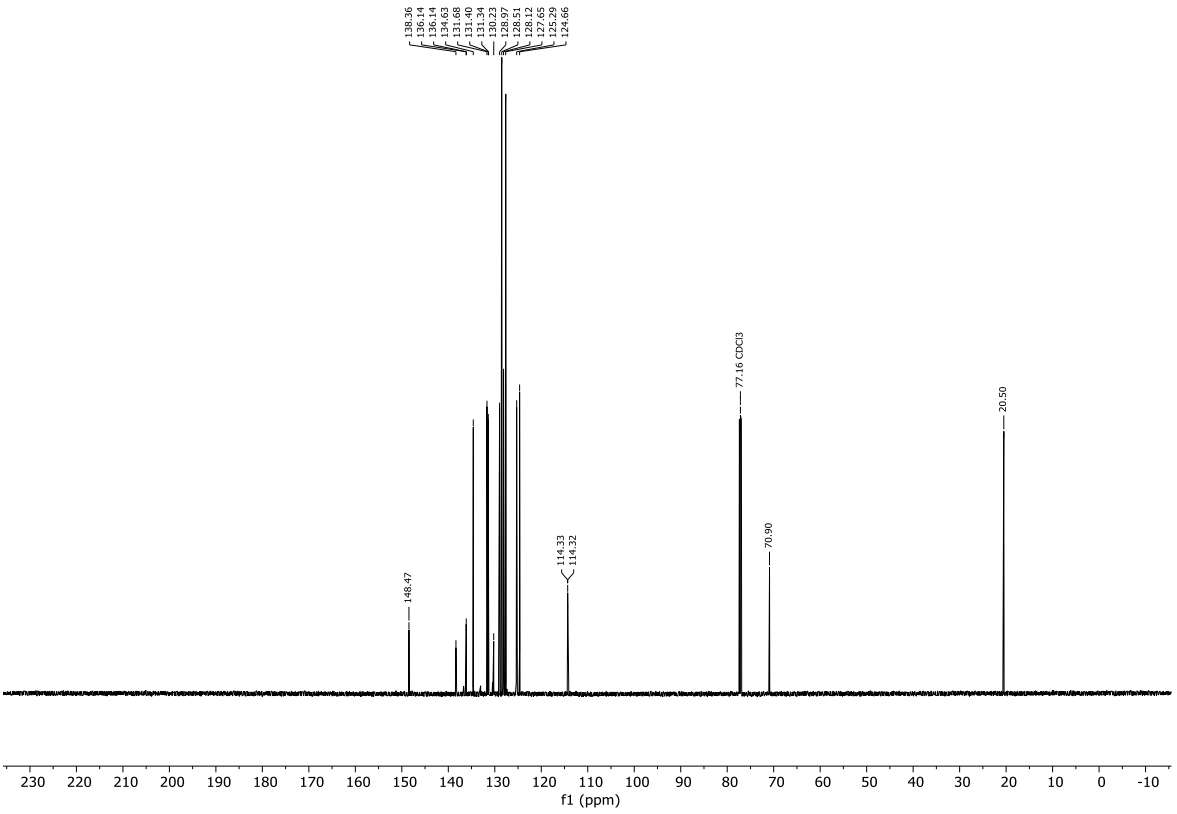


2-(benzyloxy)-5-methylphenyl 2-nitrobenzenesulfonate (S10)

^{1}H NMR (599 MHz, $CDCl_3$, 299 K)

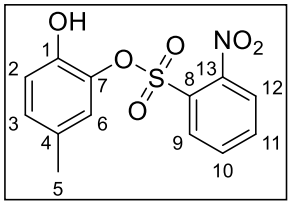


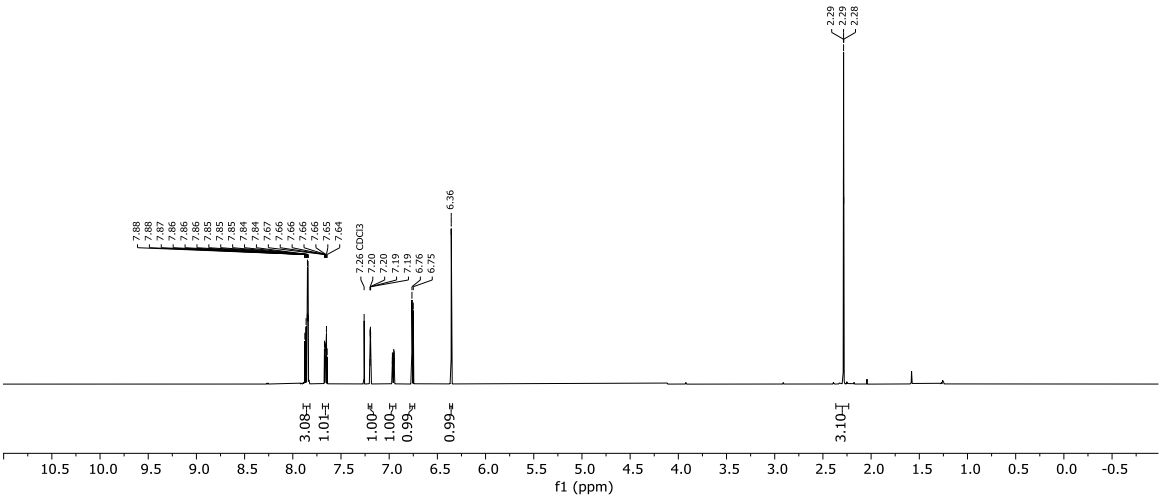
^{13}C NMR (151 MHz, $CDCl_3$, 299 K)



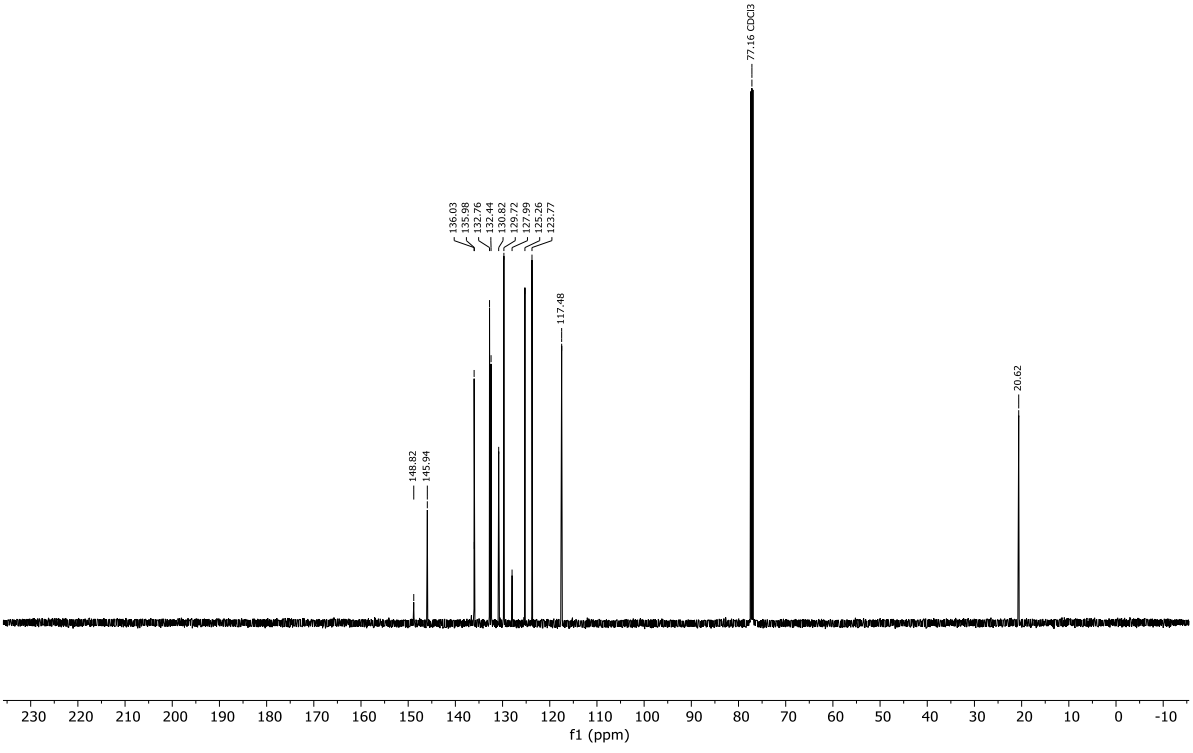
2-hydroxy-5-methylphenyl 2-nitrobenzenesulfonate (8e)

^{1}H NMR (599 MHz, $CDCl_3$, 299 K)



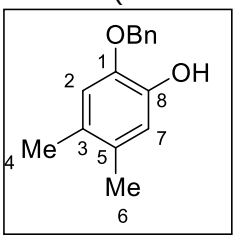


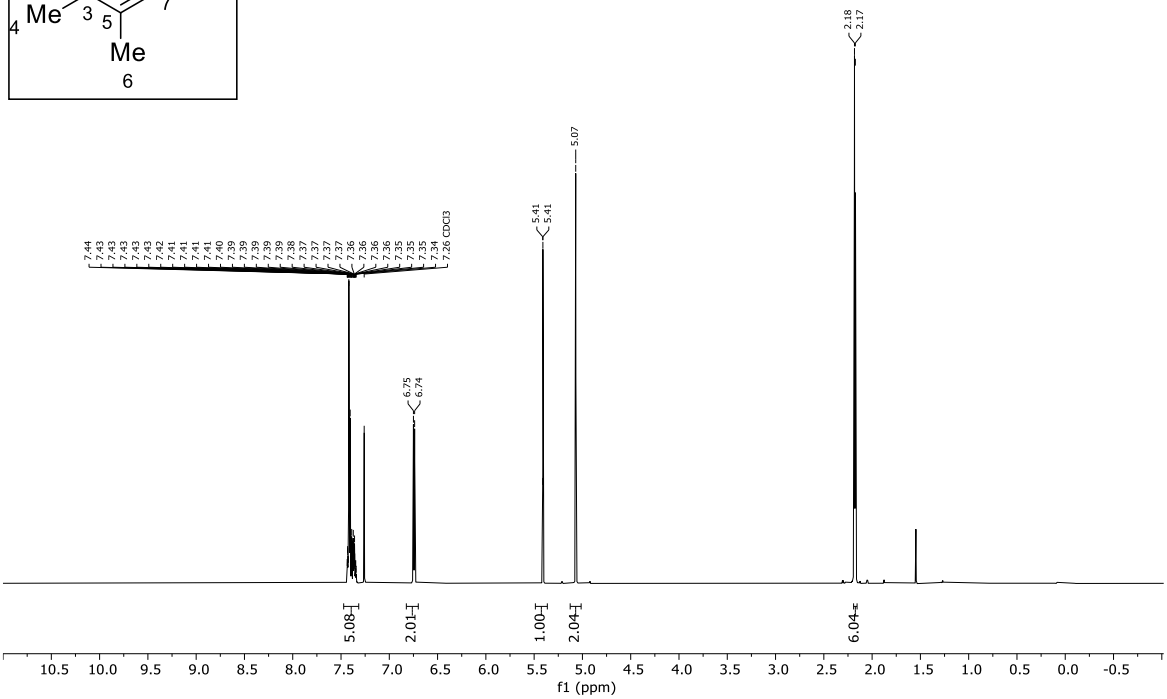
^{13}C NMR (151 MHz, $CDCl_3$, 299 K)



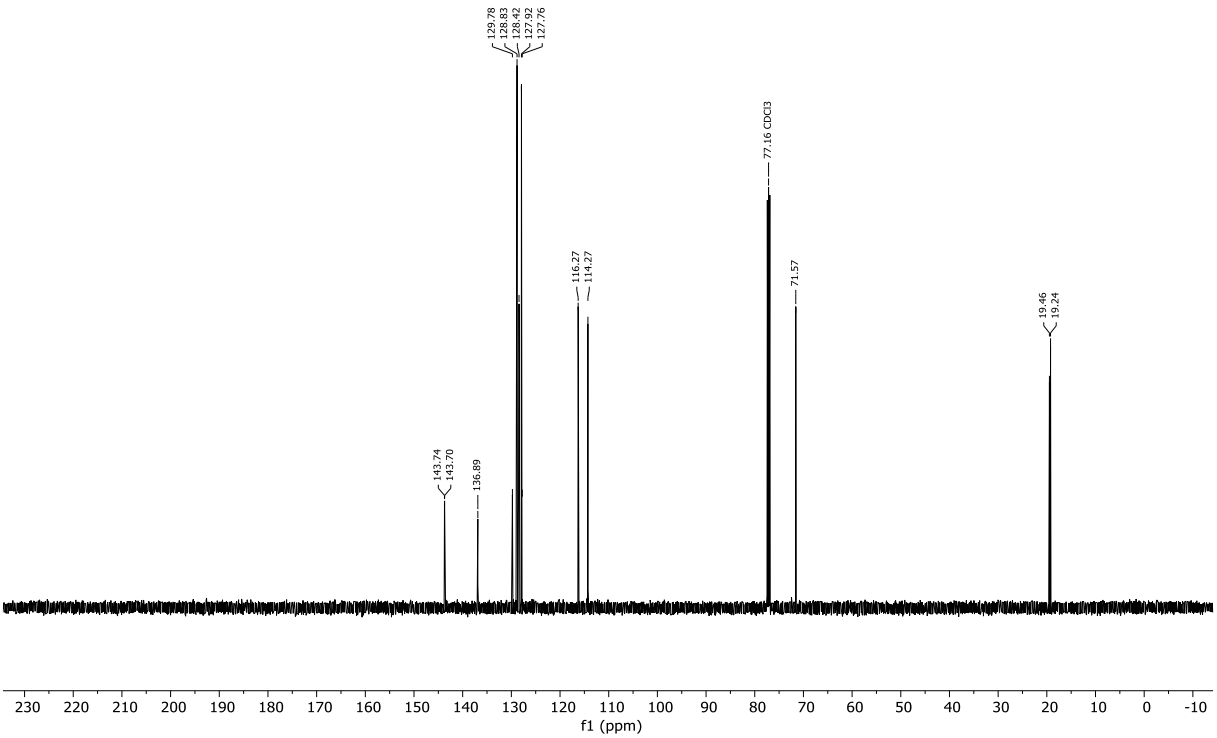
2-(benzyloxy)-4,5-dimethylphenol (S12)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



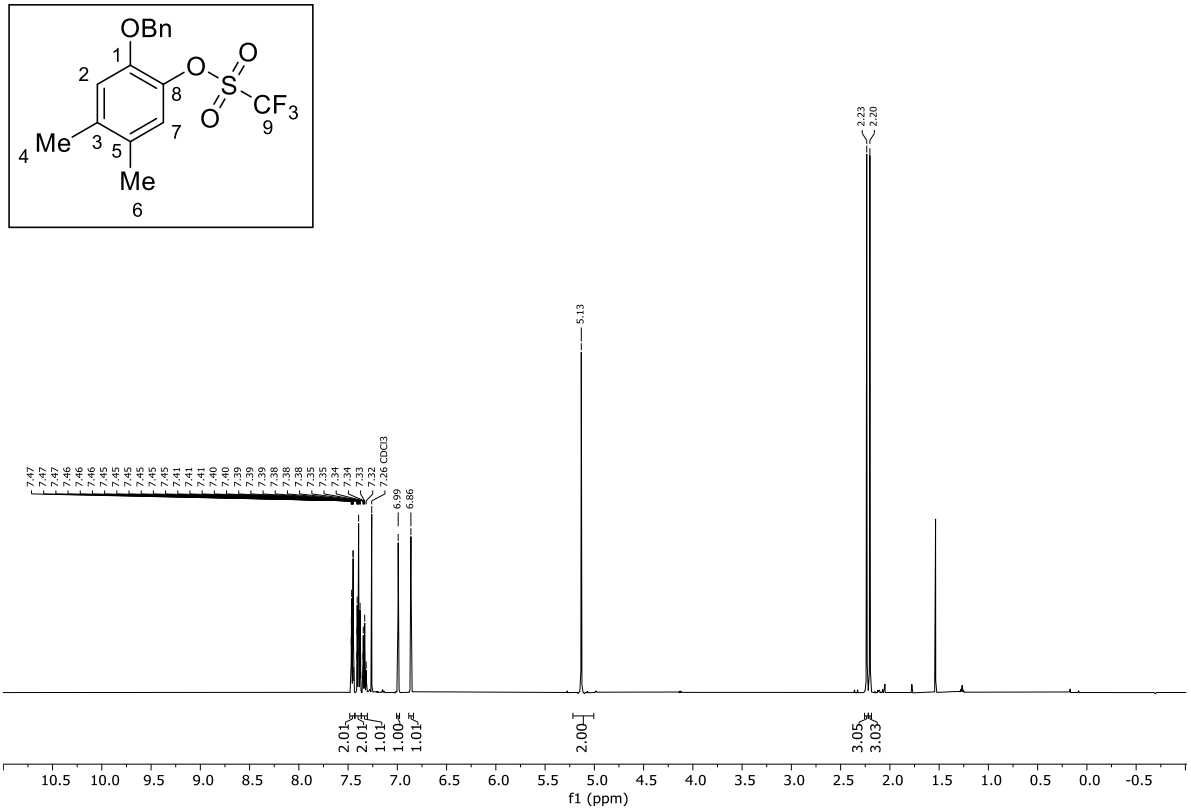


^{13}C NMR (126 MHz, $CDCl_3$, 299 K)

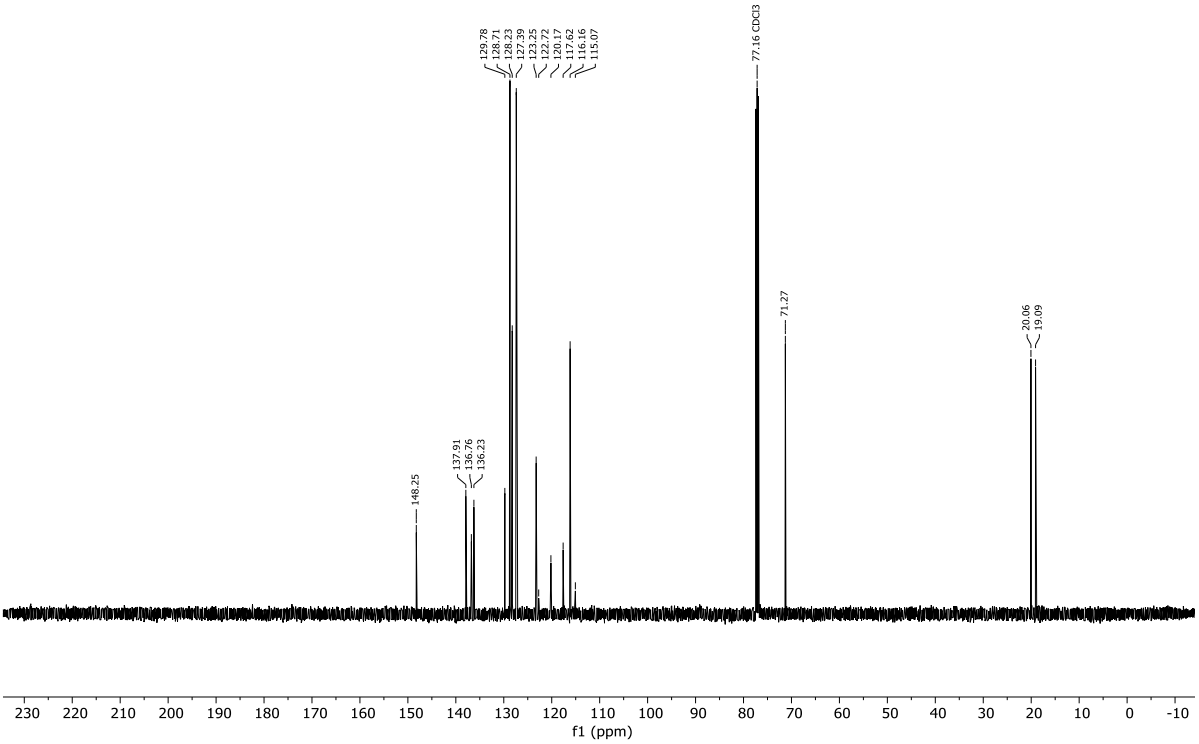


2-(benzyloxy)-4,5-dimethylphenyl trifluoromethanesulfonate (S13)

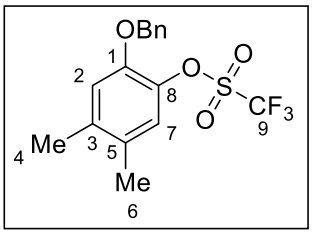
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



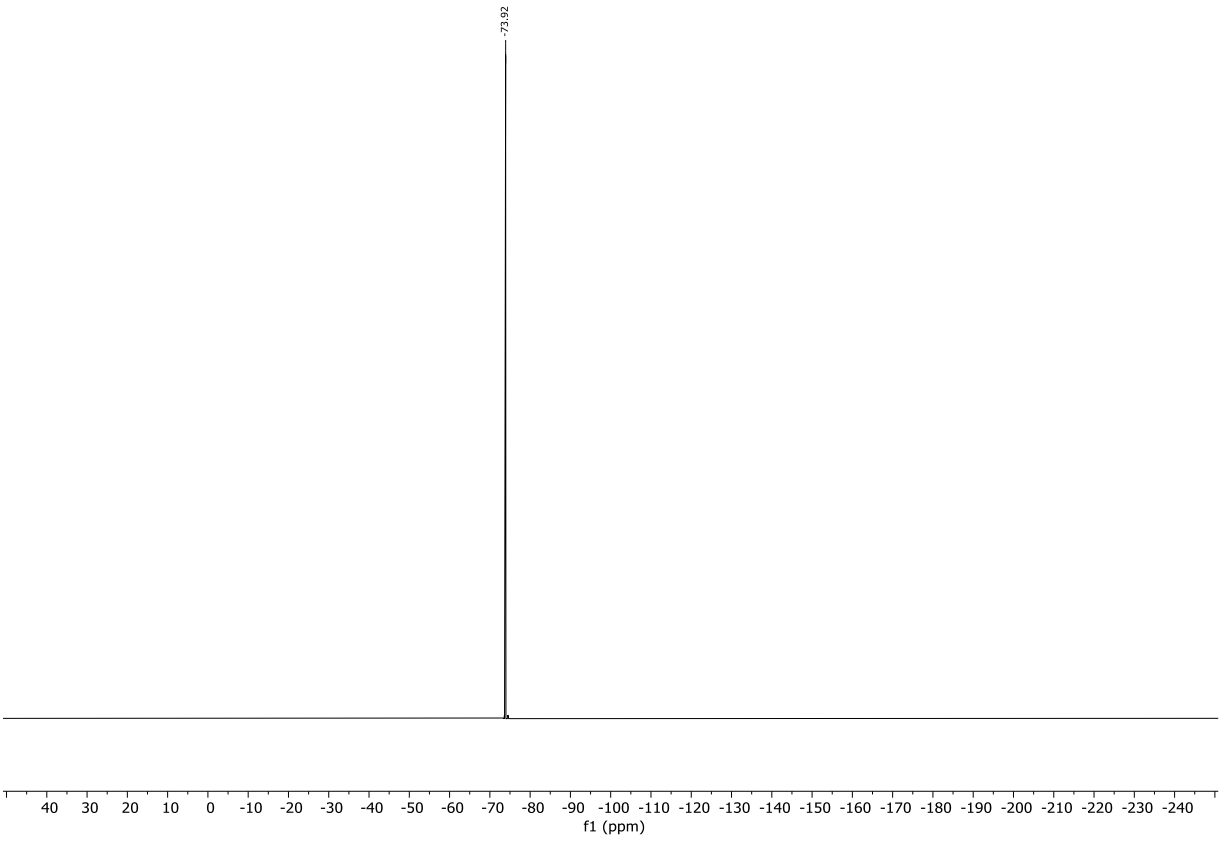
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

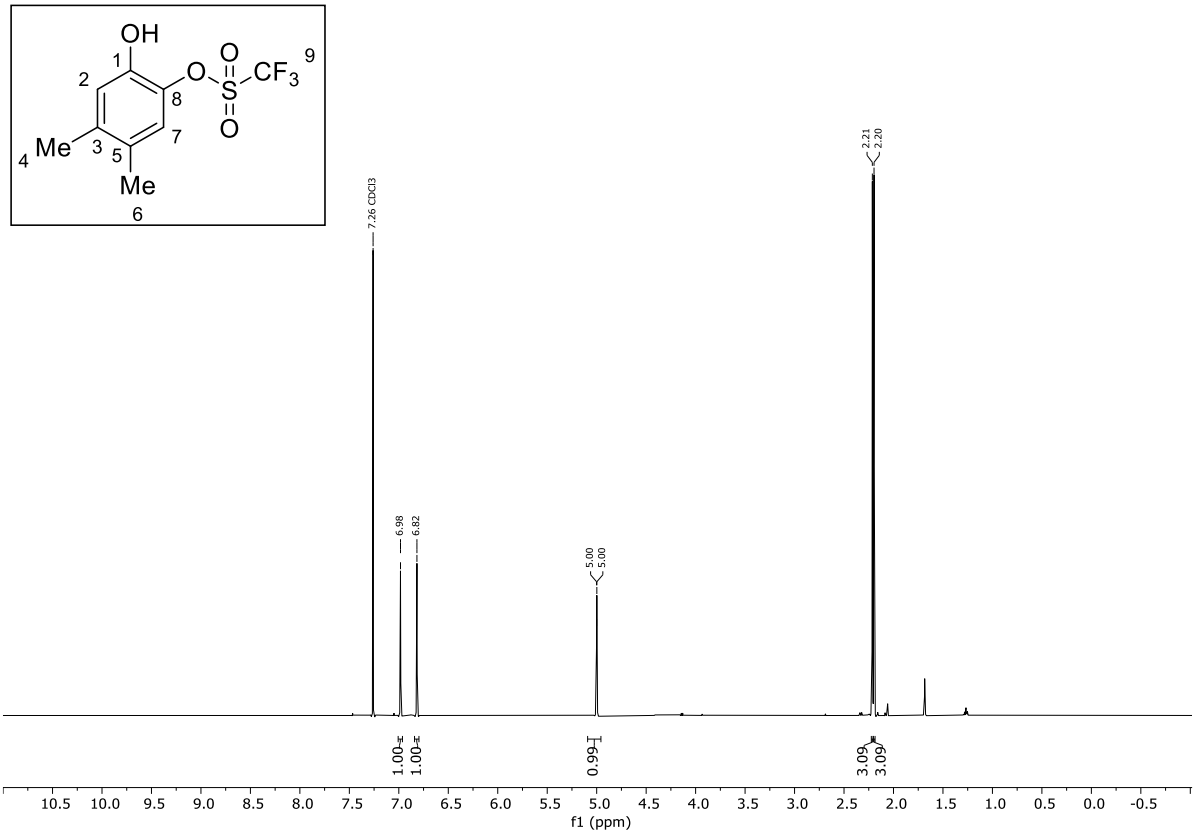


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

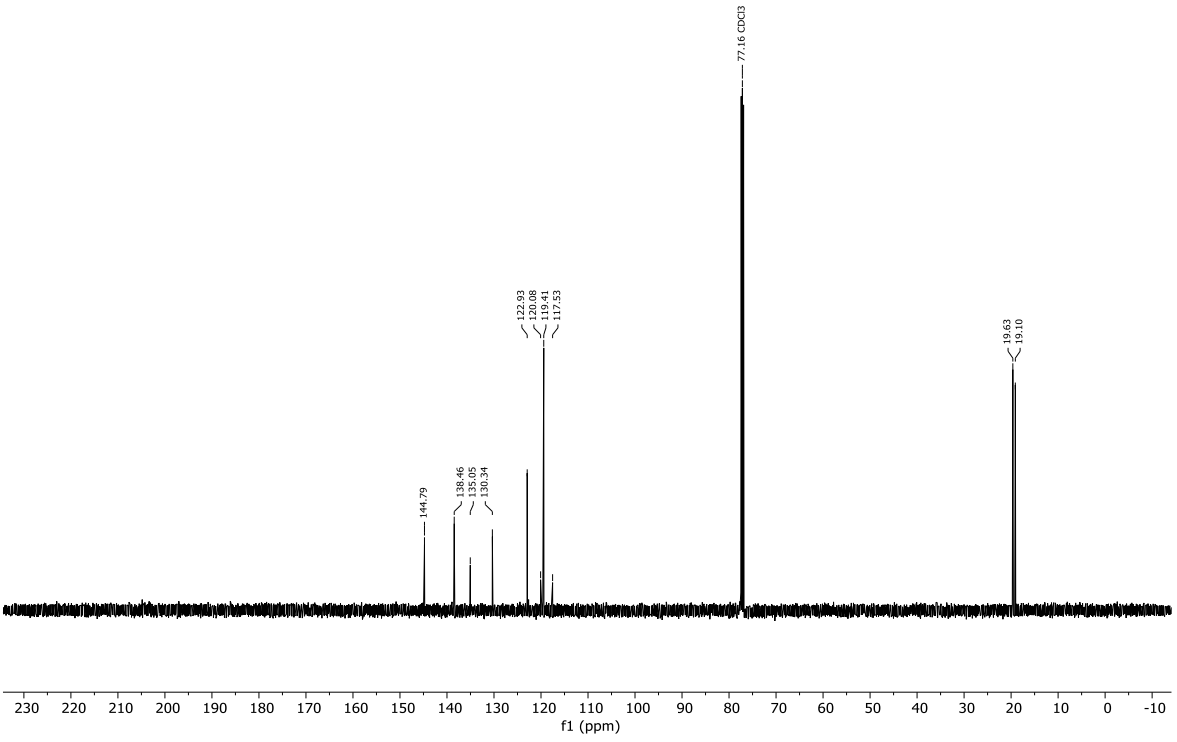


2-hydroxy-4,5-dimethylphenyl trifluoromethanesulfonate (8g)

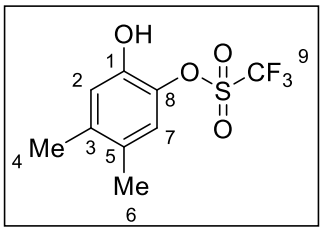
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



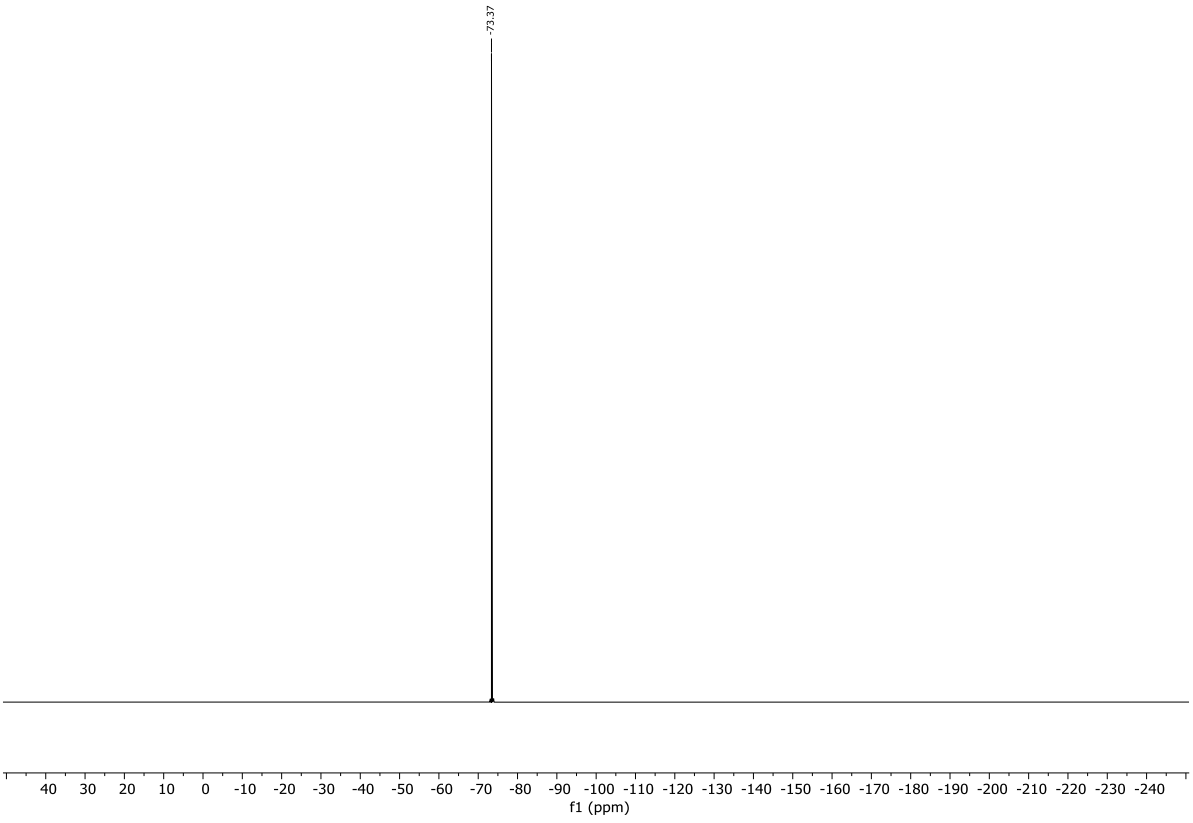
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

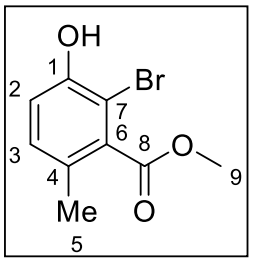


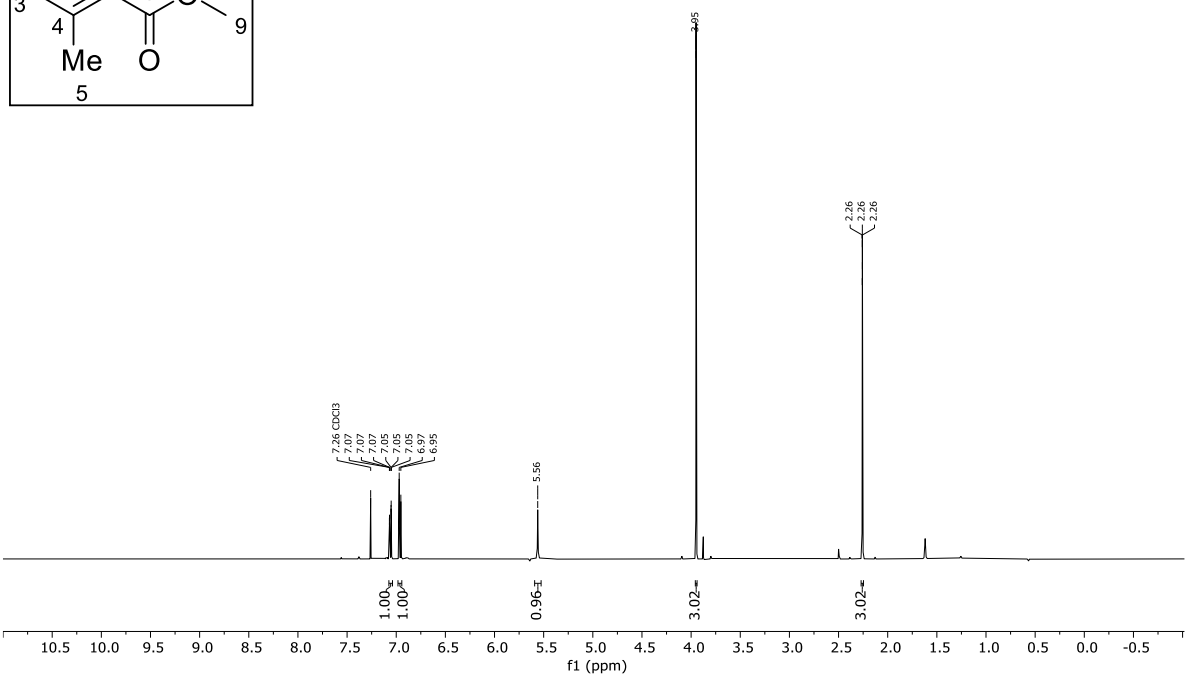
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)



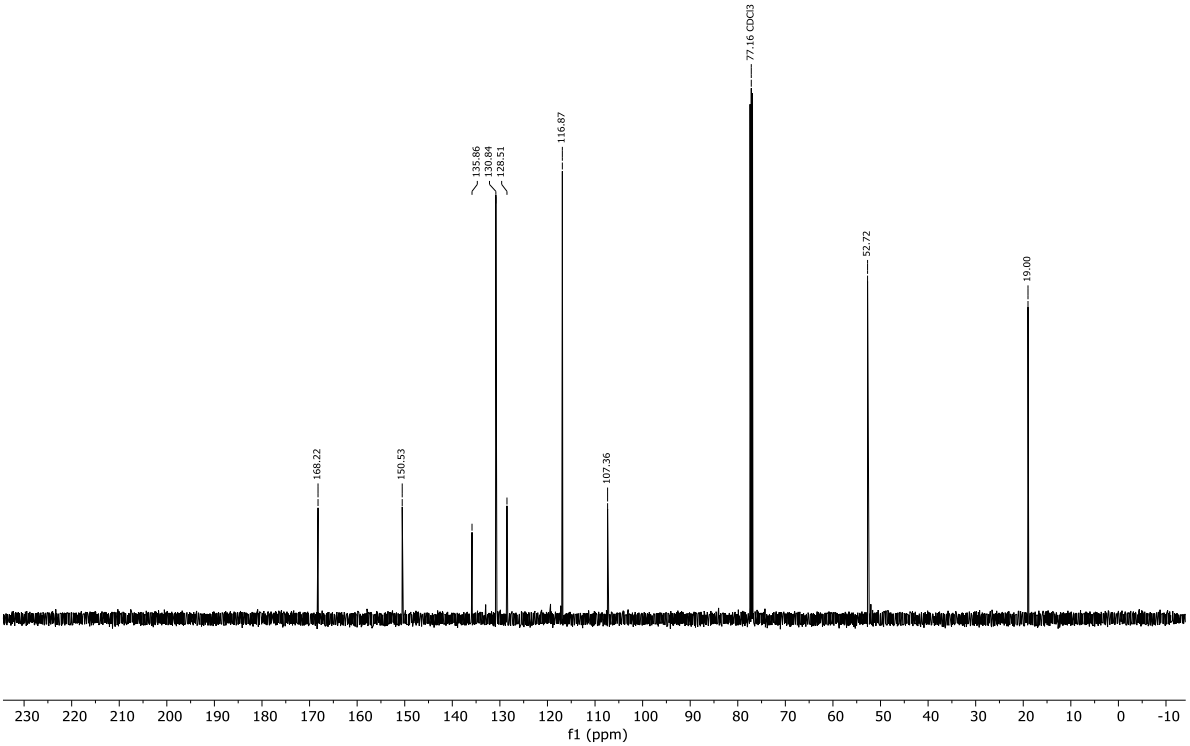
methyl 2-bromo-3-hydroxy-6-methylbenzoate (8i)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



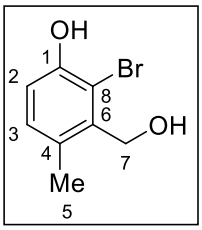


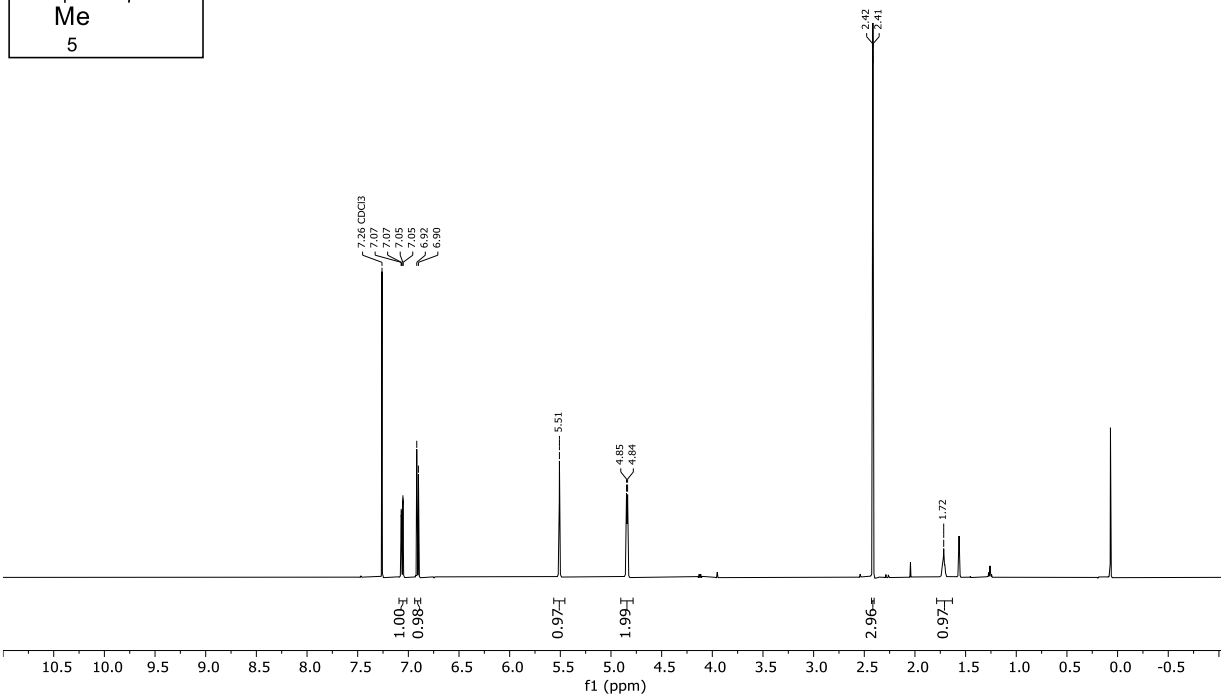
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



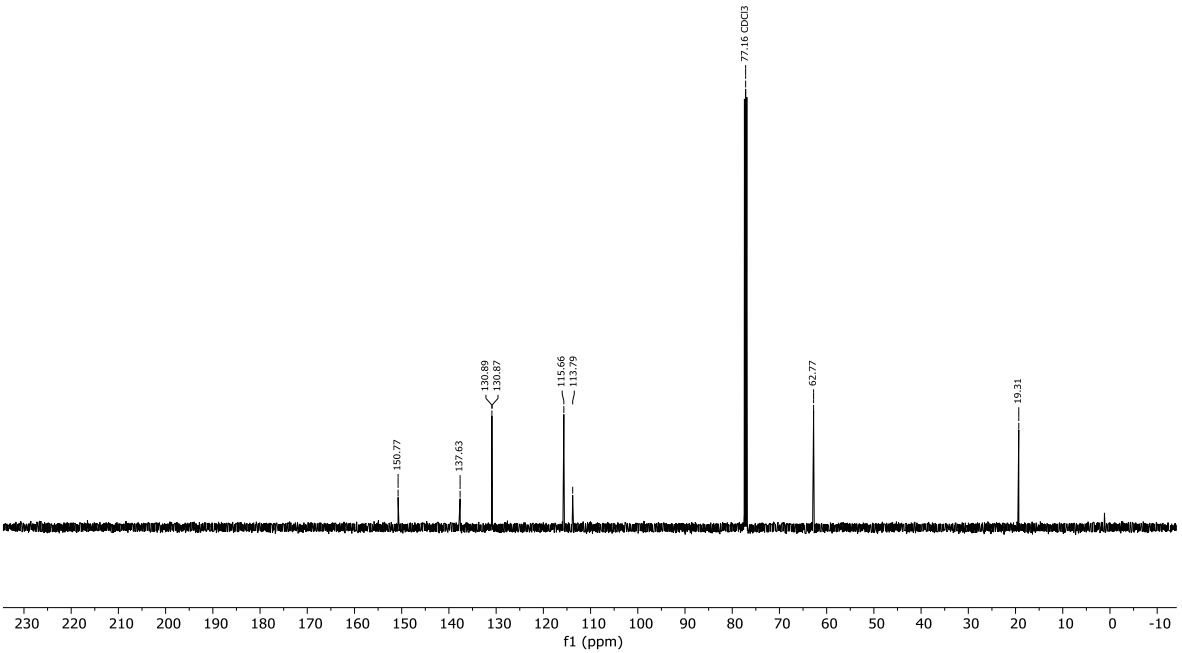
2-bromo-3-(hydroxymethyl)-4-methylphenol (S14)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



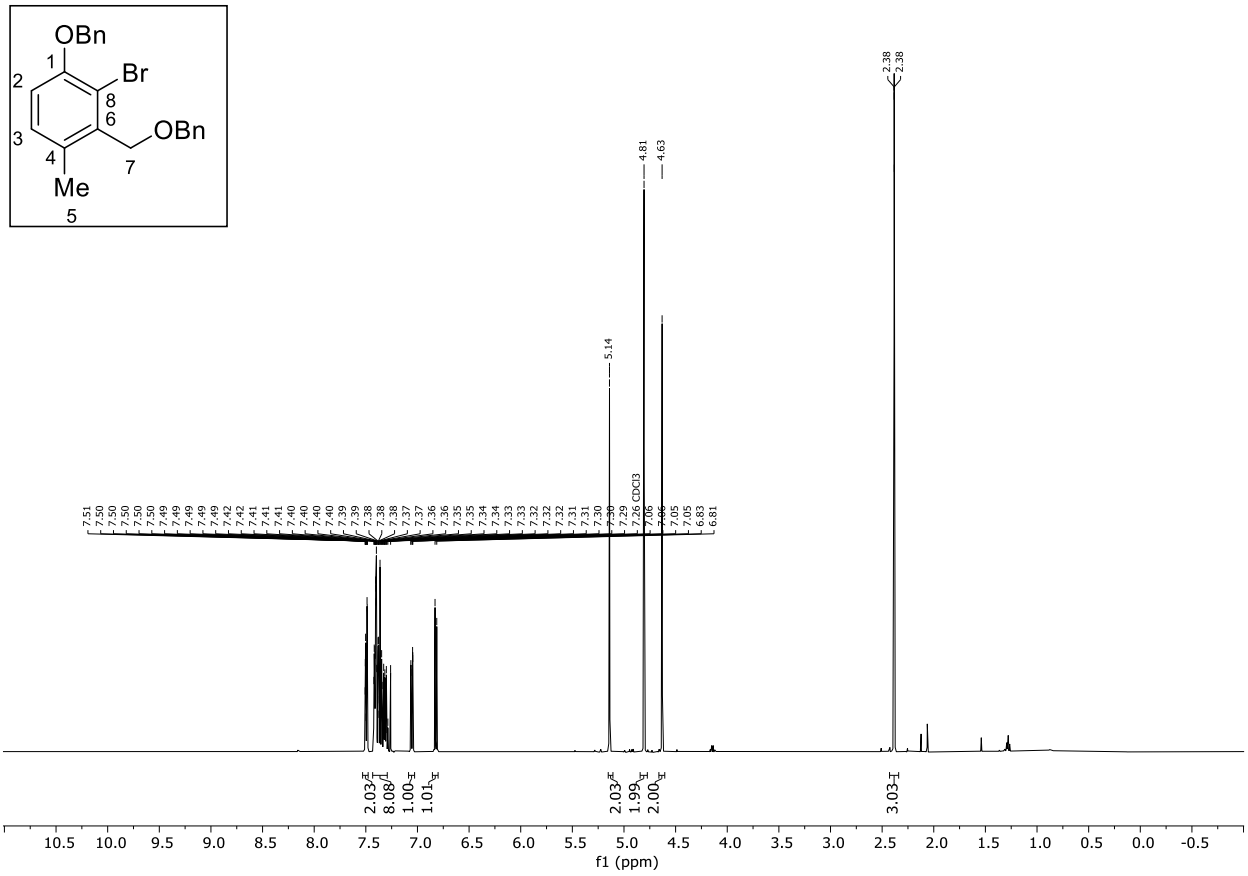


^{13}C NMR (126 MHz, $CDCl_3$, 299 K)

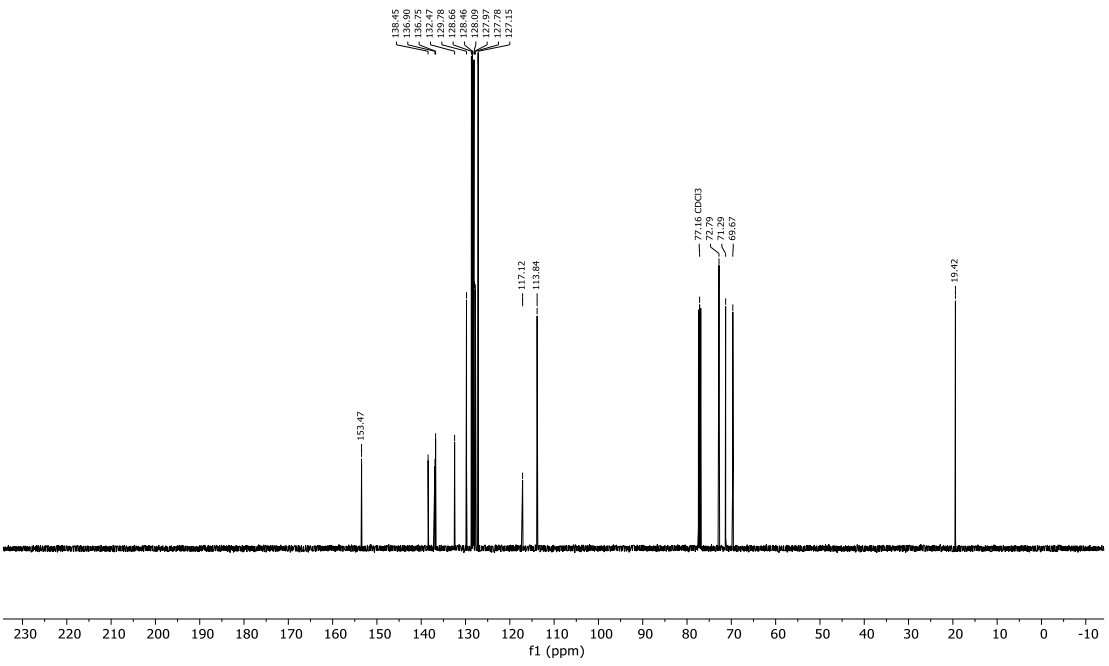


1-(benzyloxy)-3-((benzyloxy)methyl)-2-bromo-4-methylbenzene (S15)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

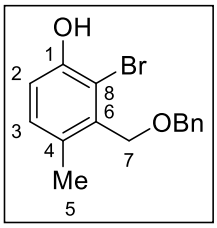


^{13}C NMR (126 MHz, $CDCl_3$, 299 K)

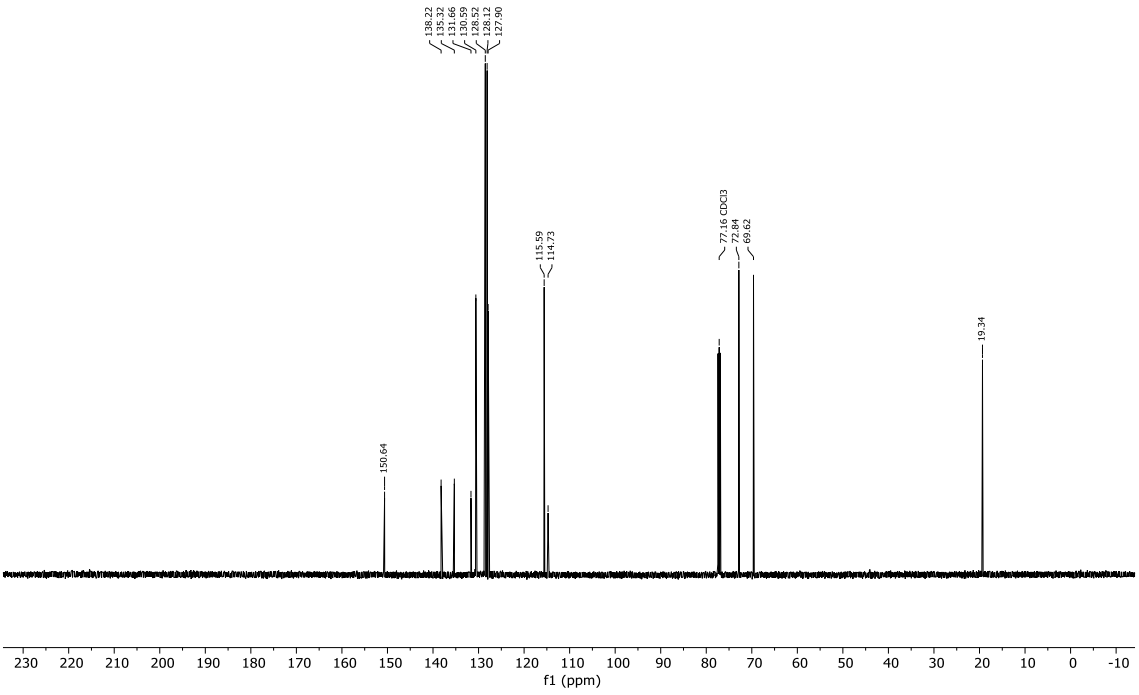


3-((benzyloxy)methyl)-2-bromo-4-methylphenol (8j)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

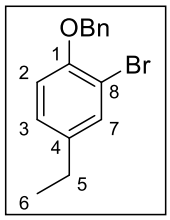


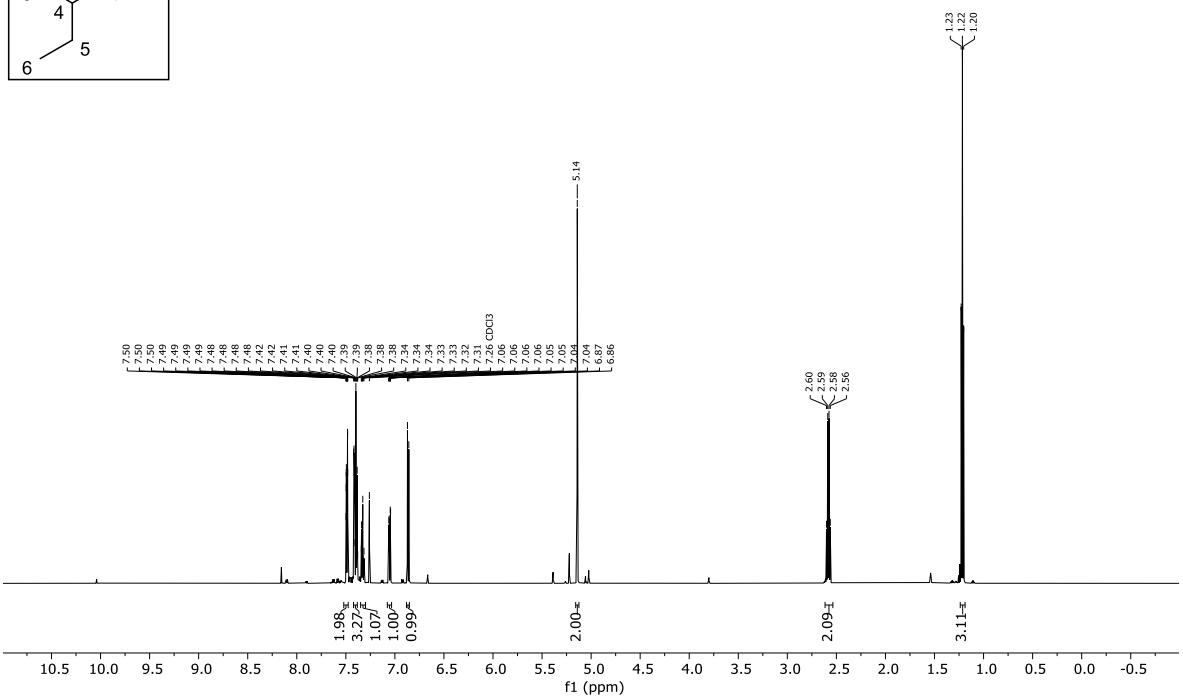
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



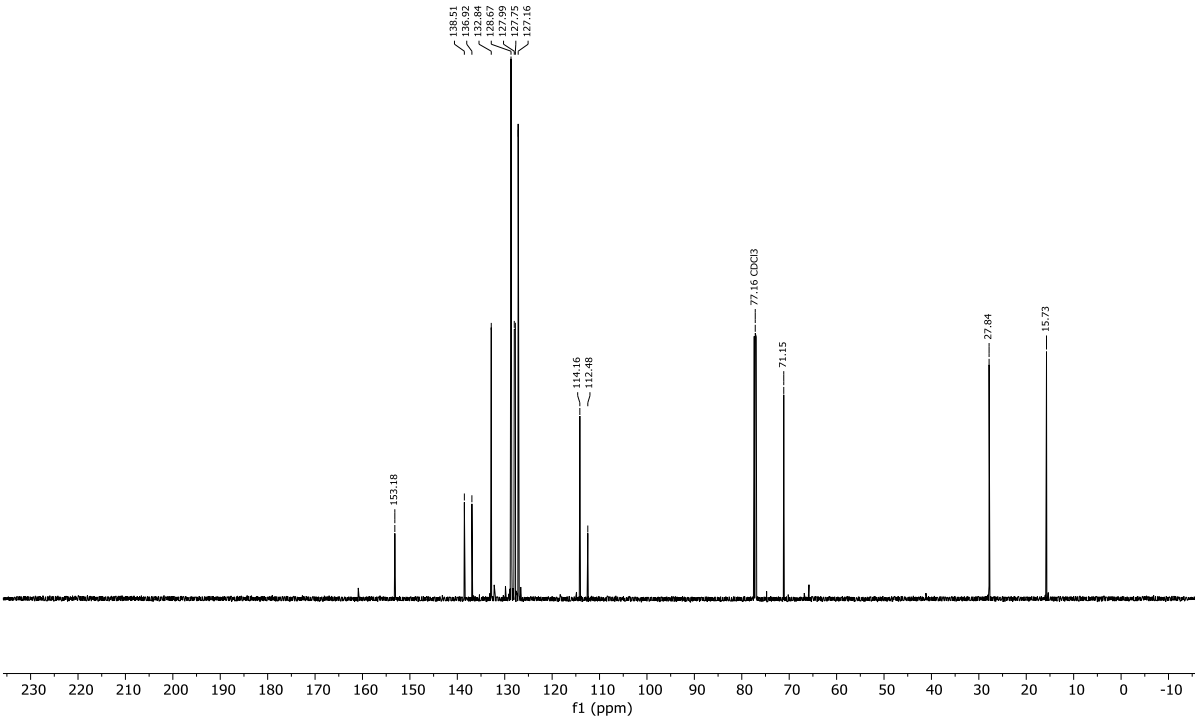
1-(benzyloxy)-2-bromo-4-ethylbenzene (S16)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



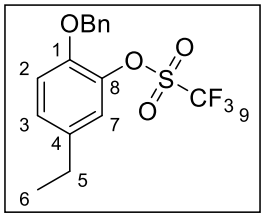


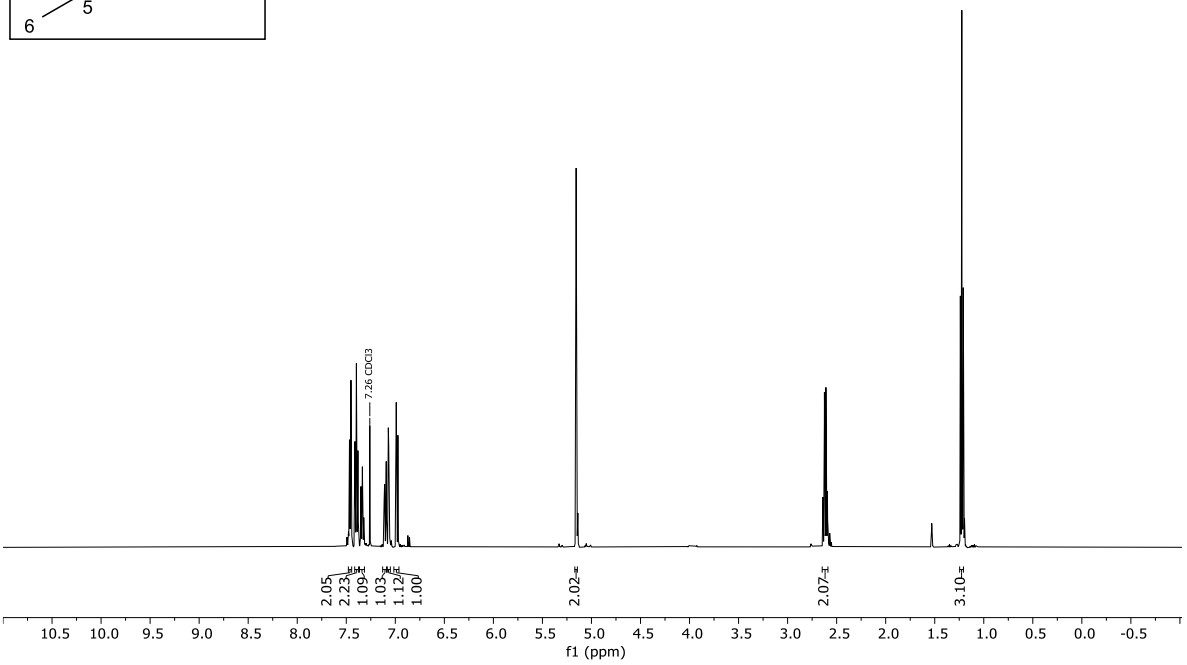
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



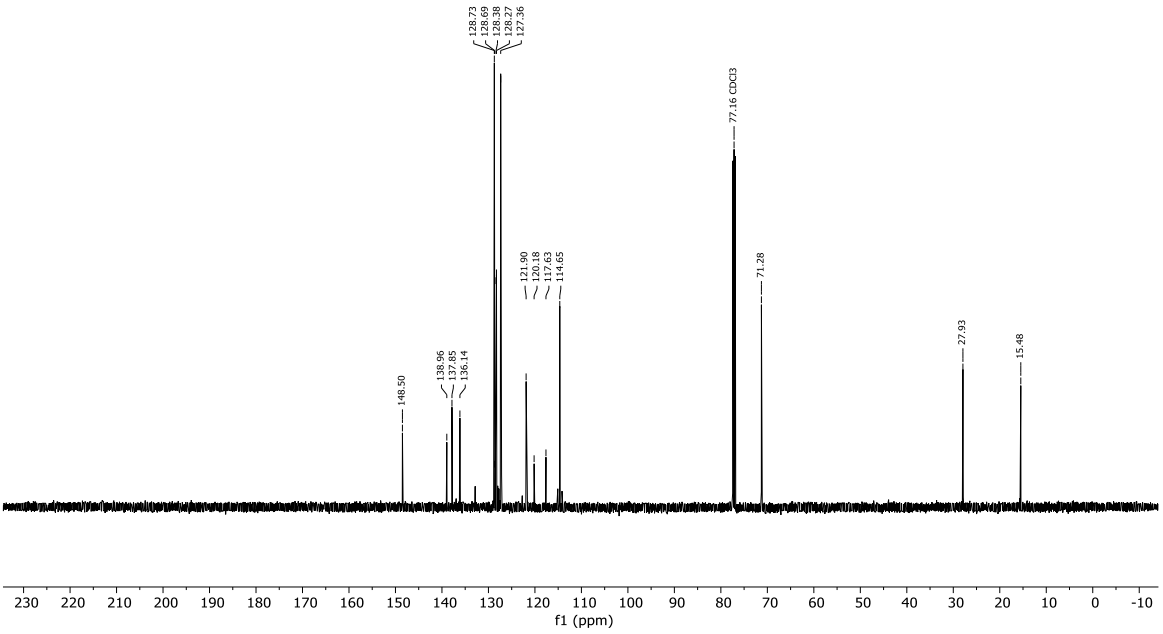
2-(benzyloxy)-5-ethylphenyl trifluoromethanesulfonate (S17)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

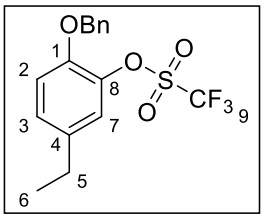




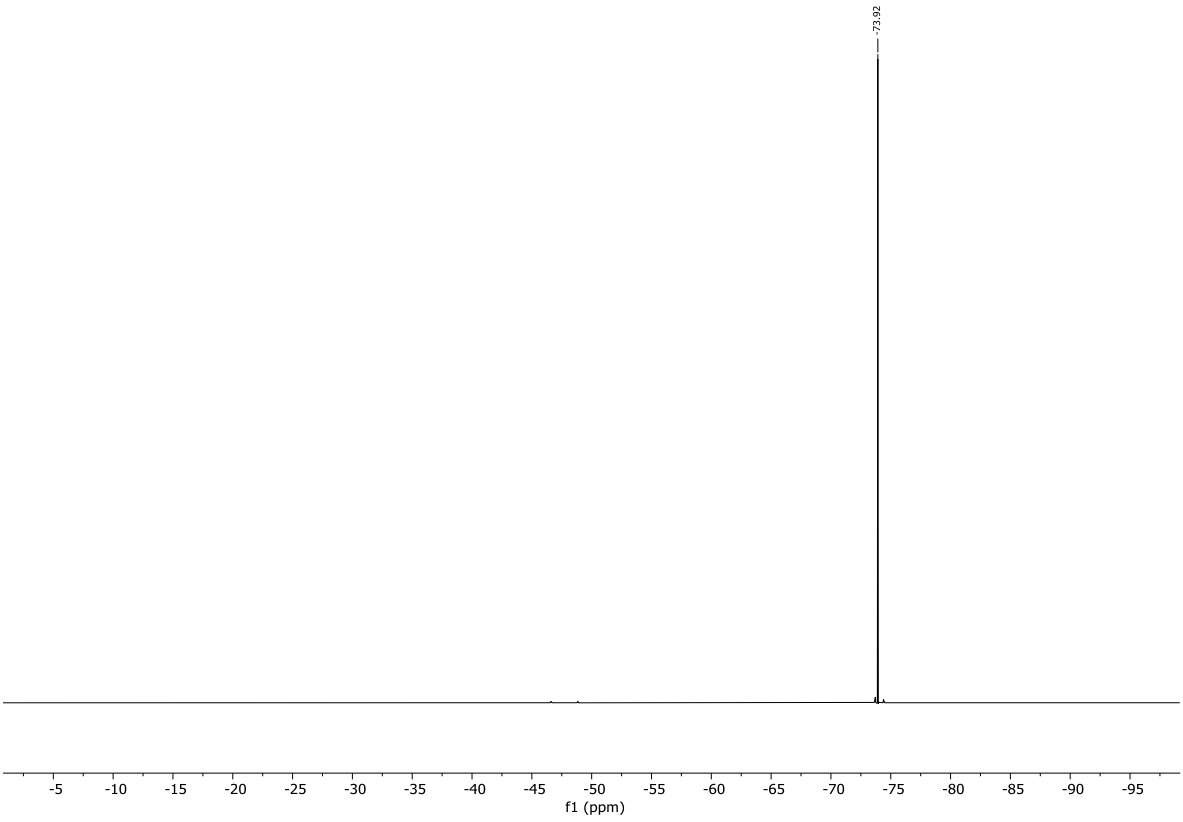
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

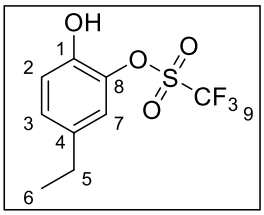


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

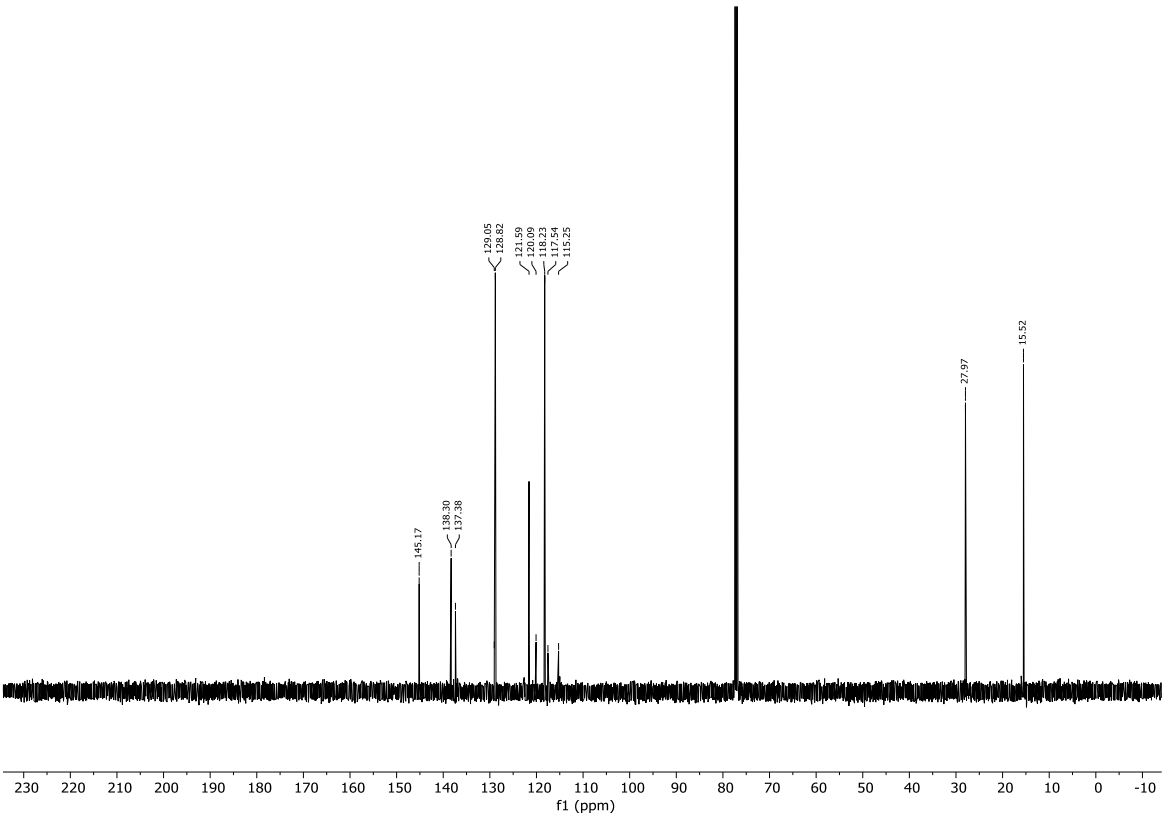


5-ethyl-2-hydroxyphenyl trifluoromethanesulfonate (8l)

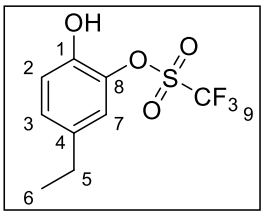
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

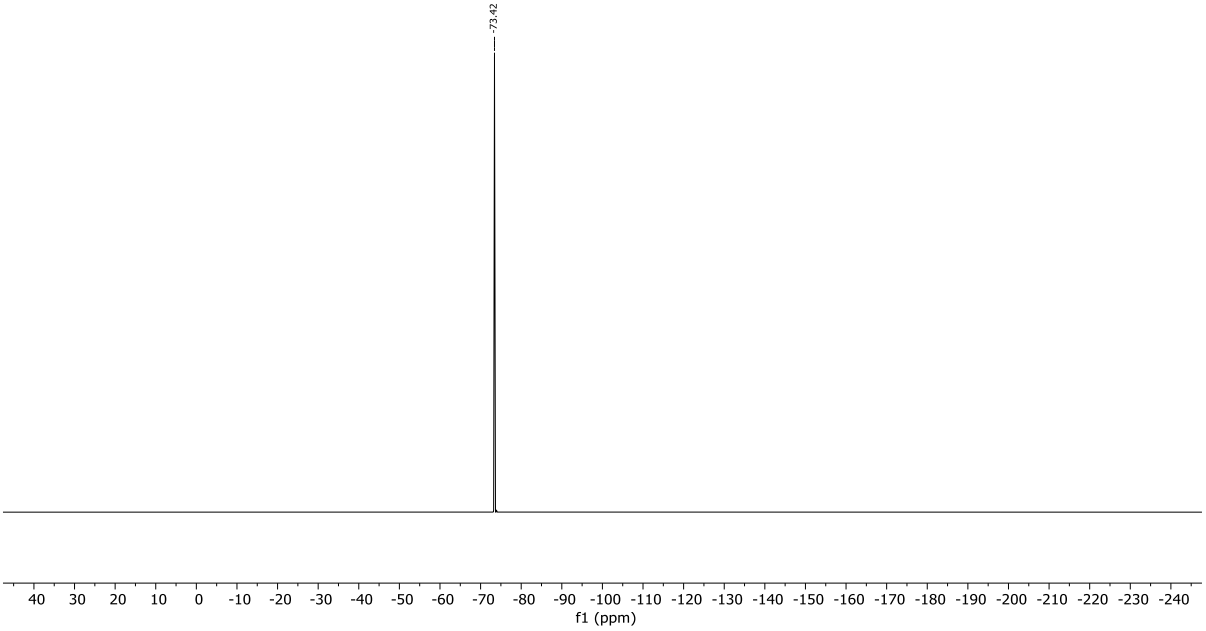


^{13}C NMR (126 MHz, $CDCl_3$, 299 K)

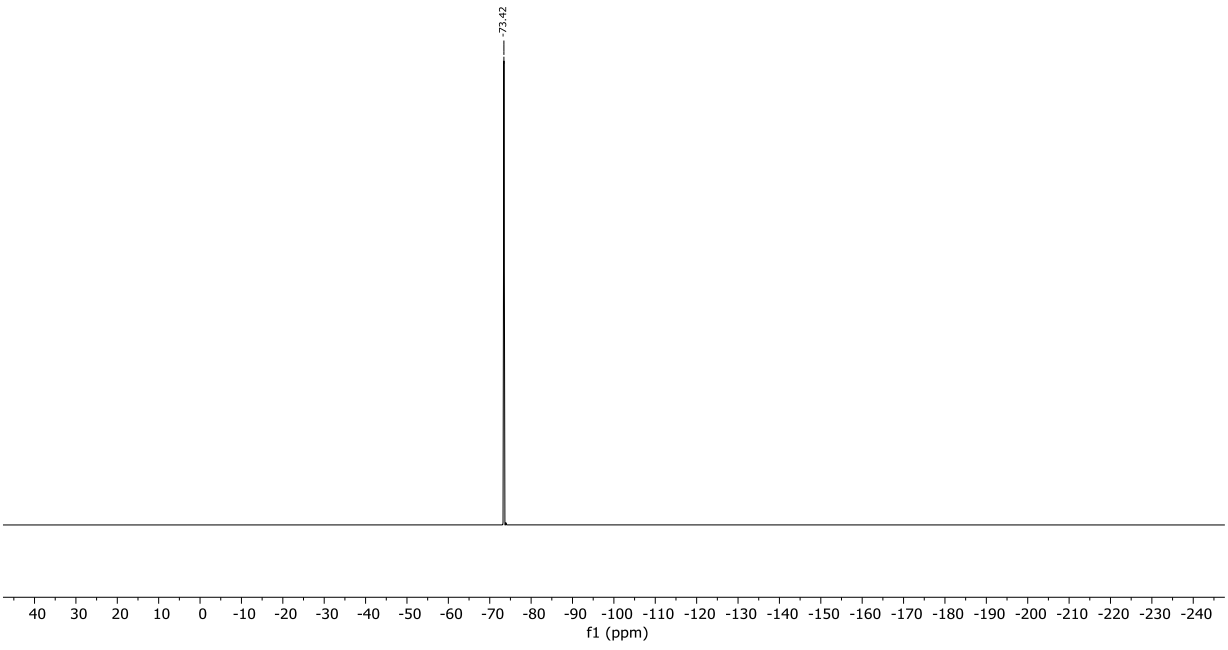


^{19}F NMR (470 MHz, $CDCl_3$, 299 K)



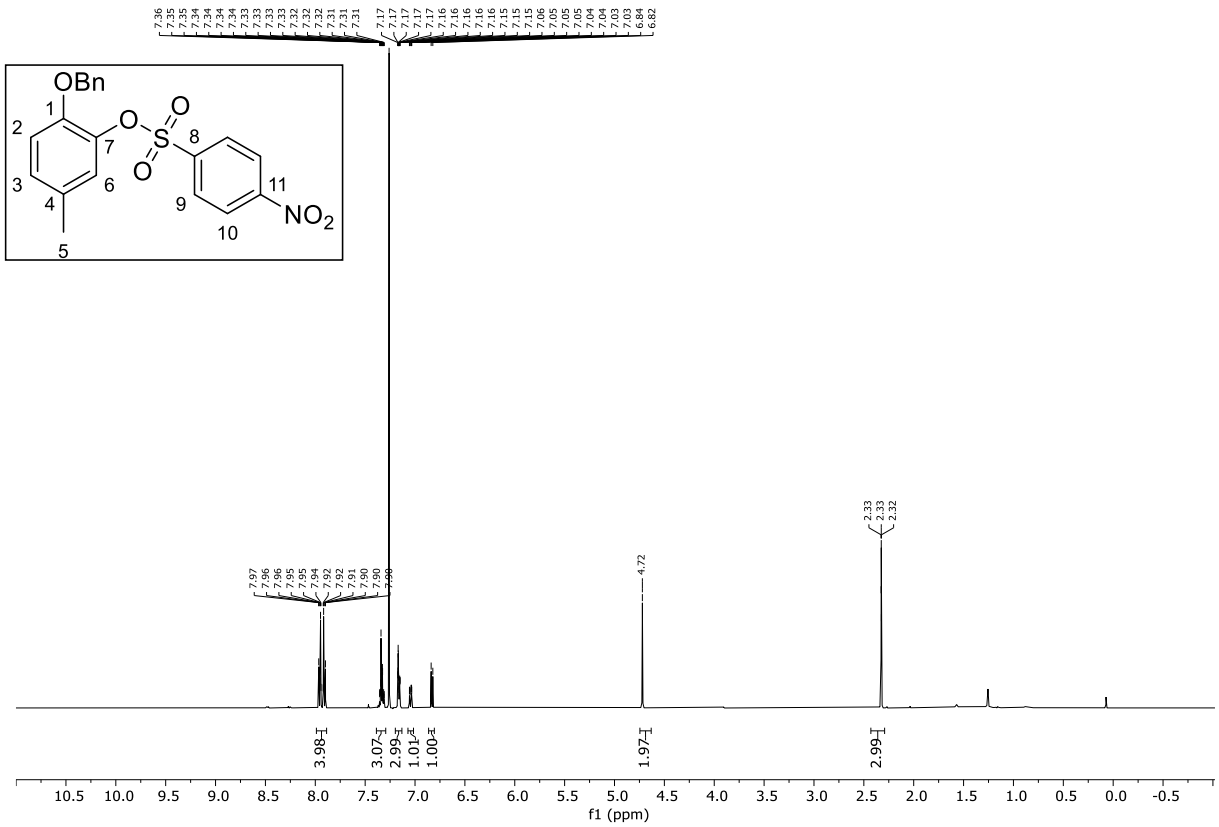


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

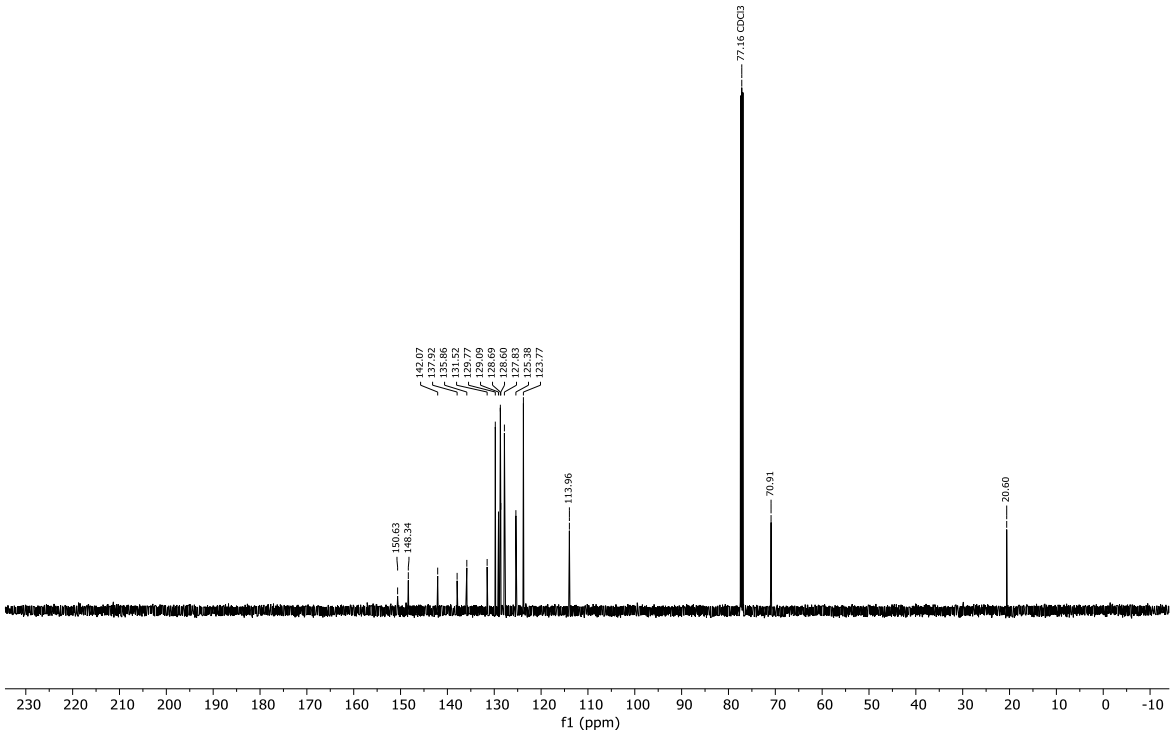


2-(benzyloxy)-5-methylphenyl 4-nitrobenzenesulfonate (S18)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

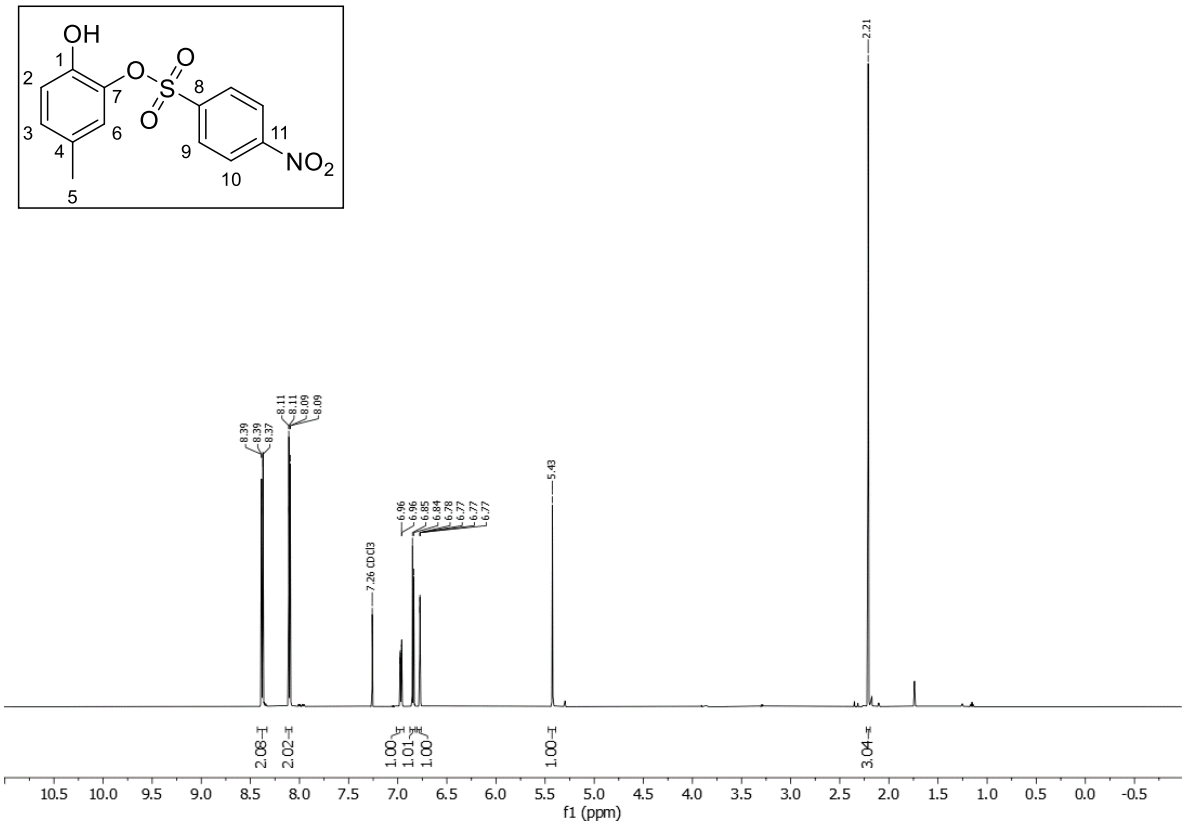


^{13}C NMR (126 MHz, $CDCl_3$, 299 K)

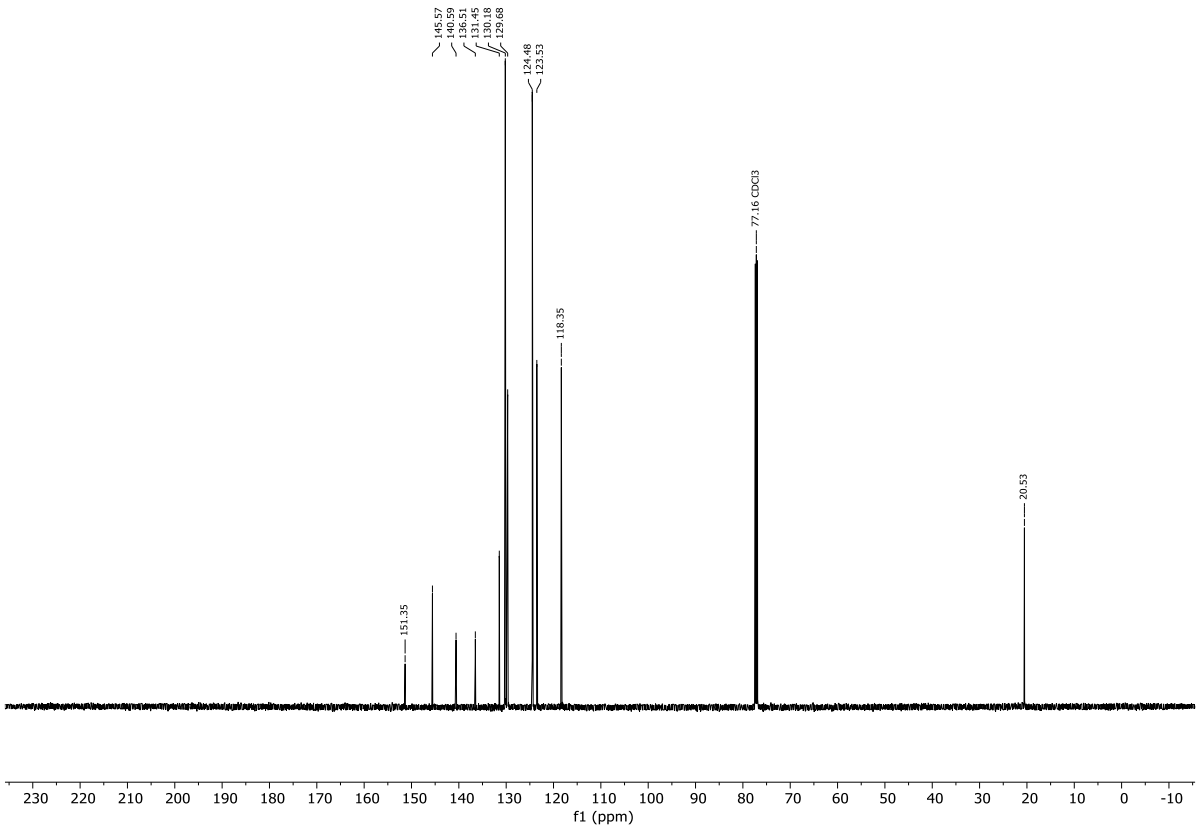


2-hydroxy-5-methylphenyl 4-nitrobenzenesulfonate (8m)

^{1}H NMR (599 MHz, $CDCl_3$, 299 K)

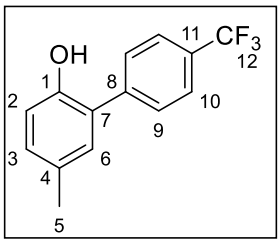


^{13}C NMR (151 MHz, $CDCl_3$, 299 K)

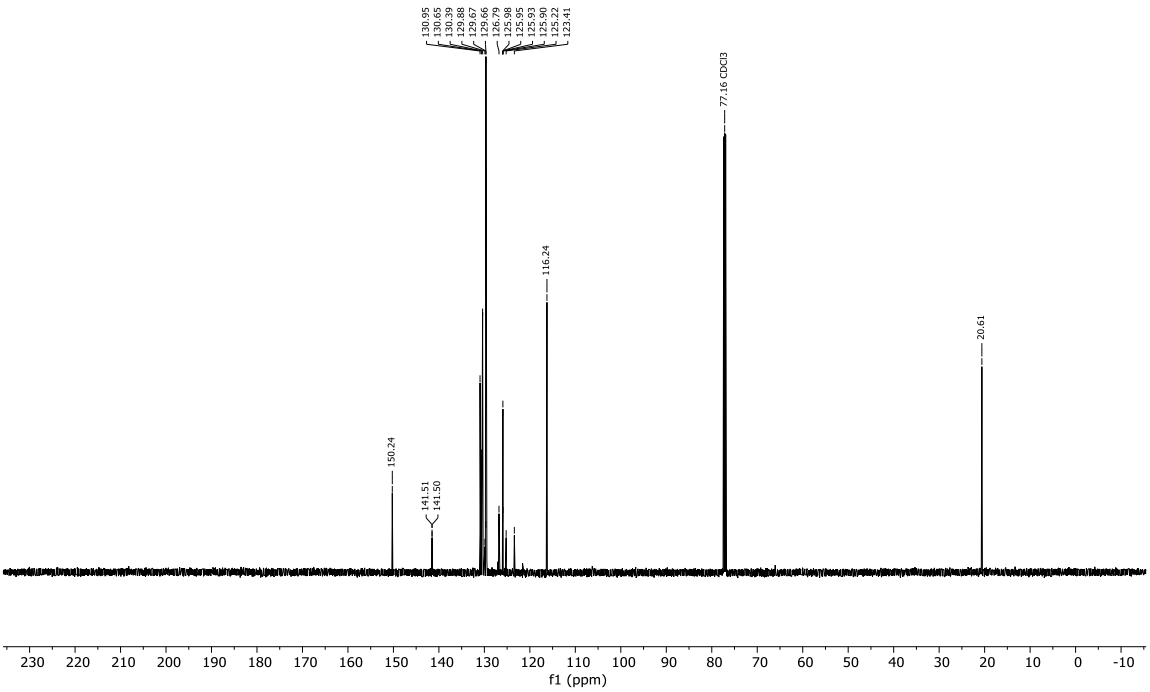


5-methyl-4'-(trifluoromethyl)-[1,1'-biphenyl]-2-ol (8t)

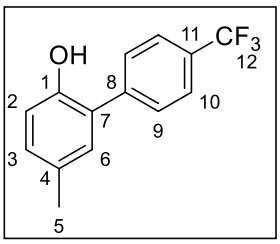
^{1}H NMR (599 MHz, $CDCl_3$, 299 K)



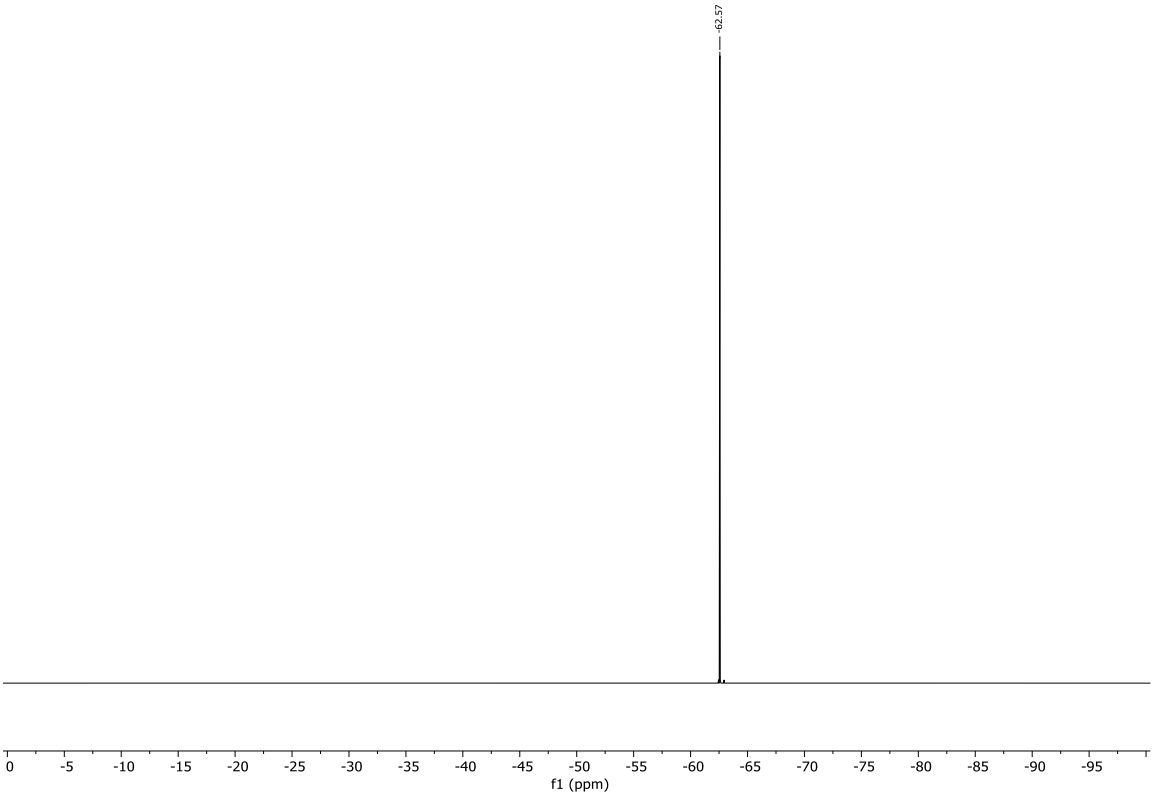
^{13}C NMR (151 MHz, $CDCl_3$, 299 K)



^{19}F NMR (564 MHz, $CDCl_3$, 299 K)

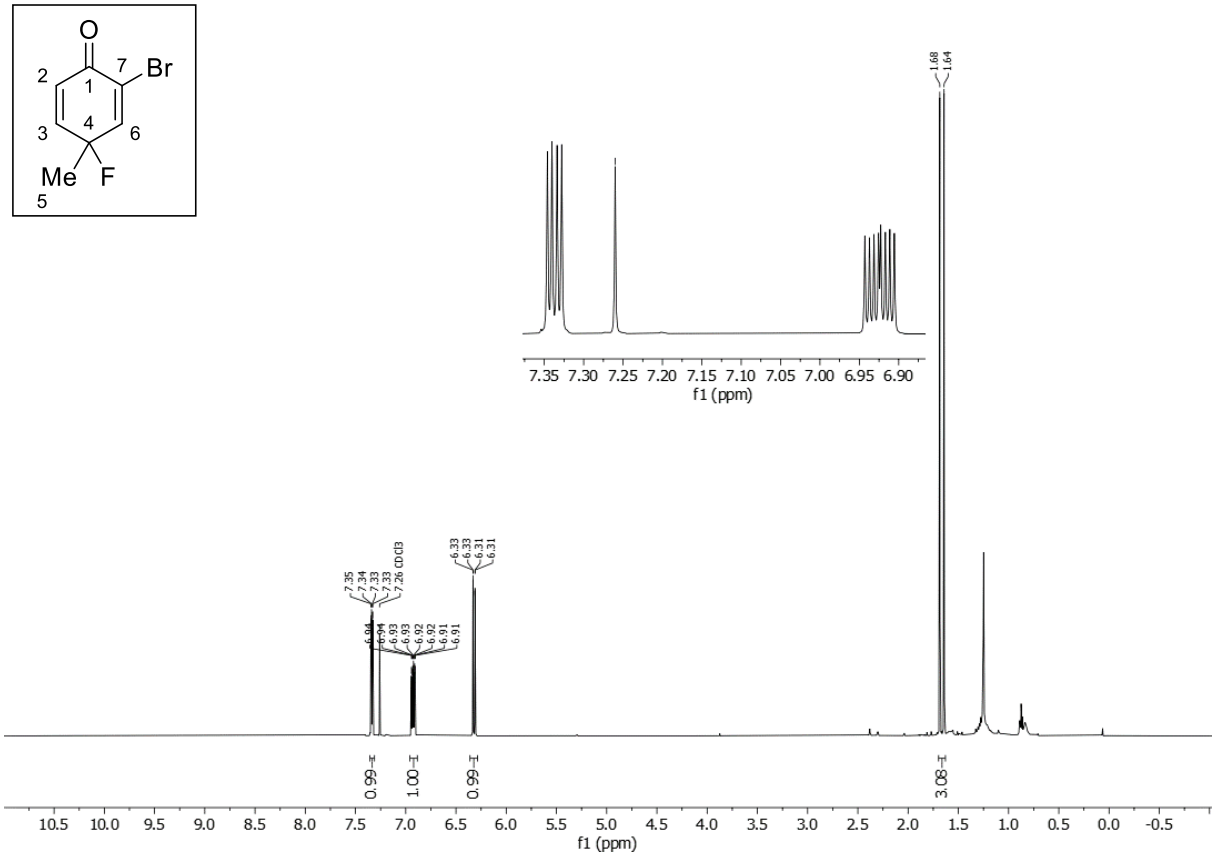


^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$, 299 K)

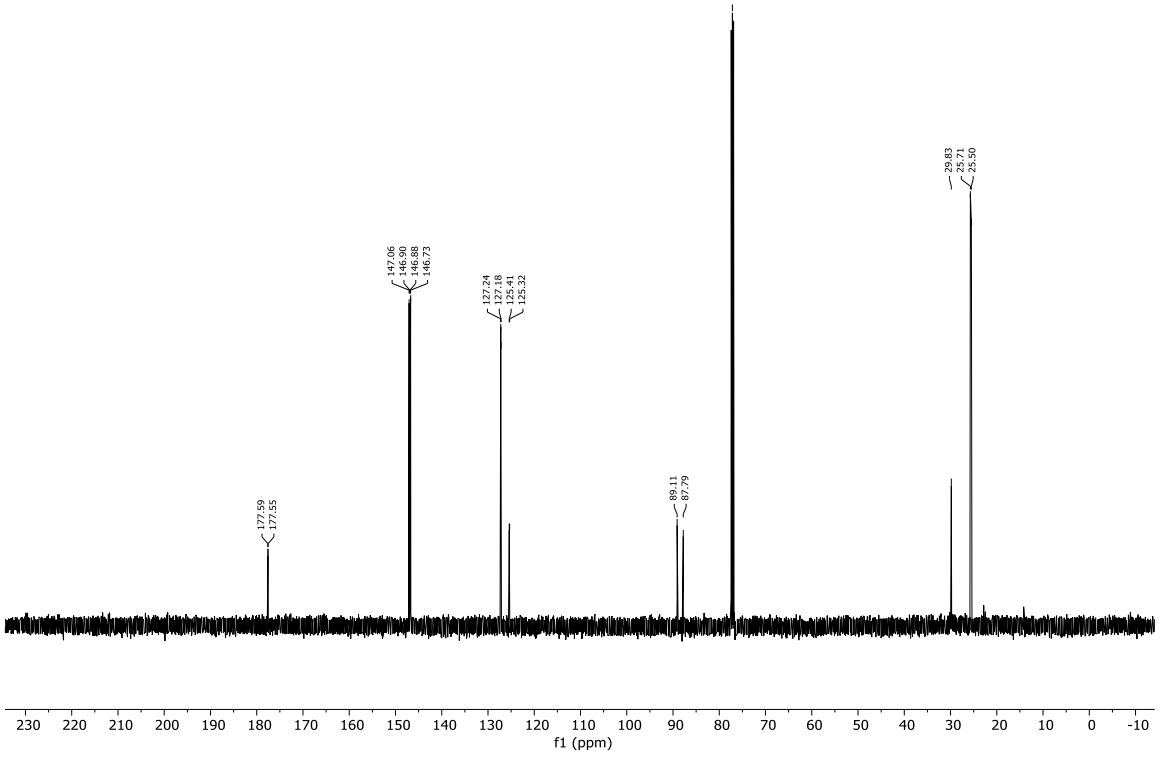


2-bromo-4-fluoro-4-methylcyclohexa-2,5-dien-1-one (9a)

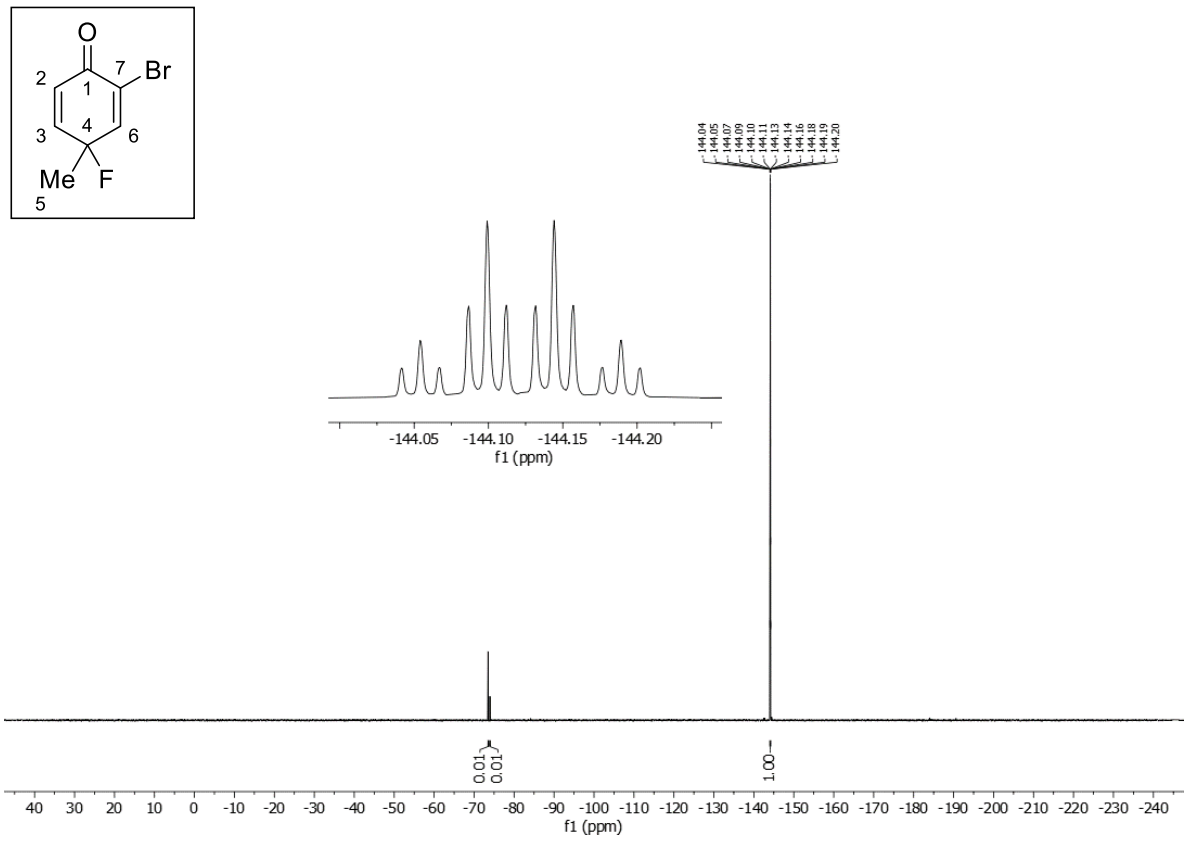
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



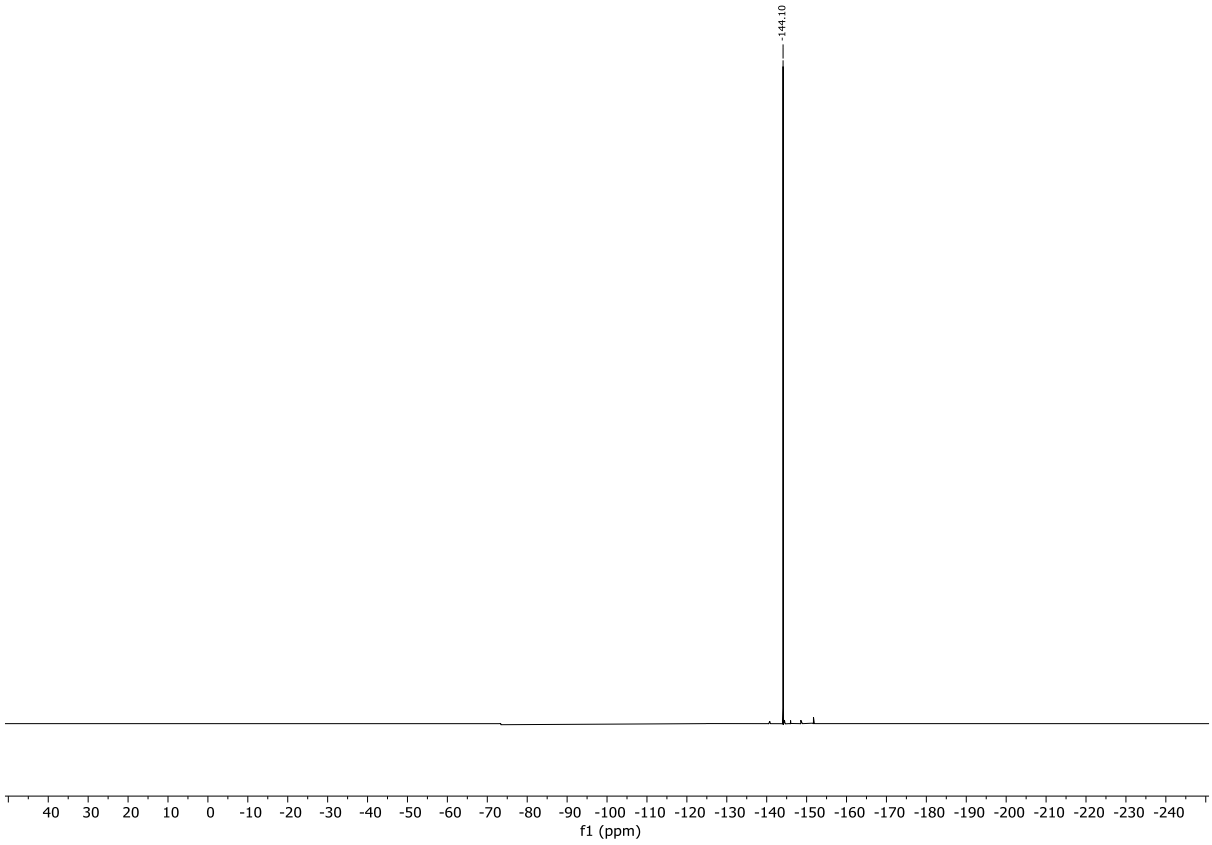
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

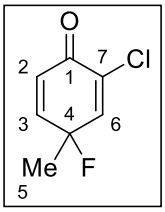


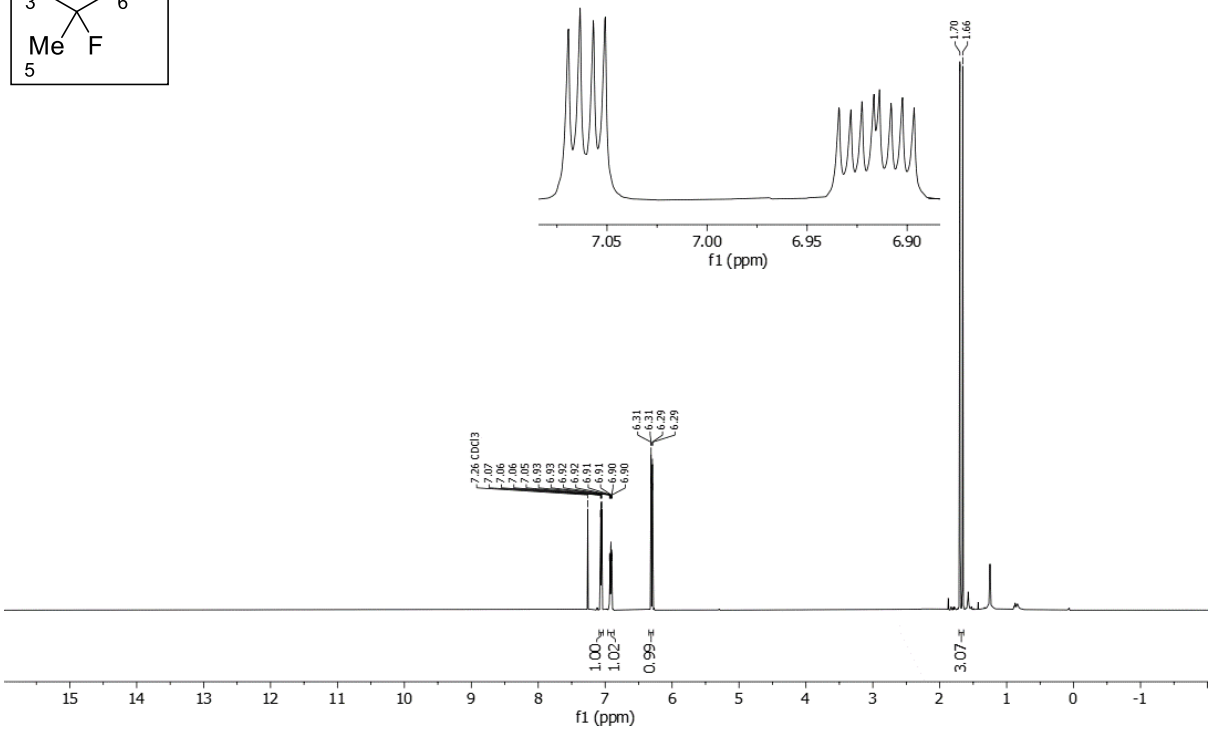
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)



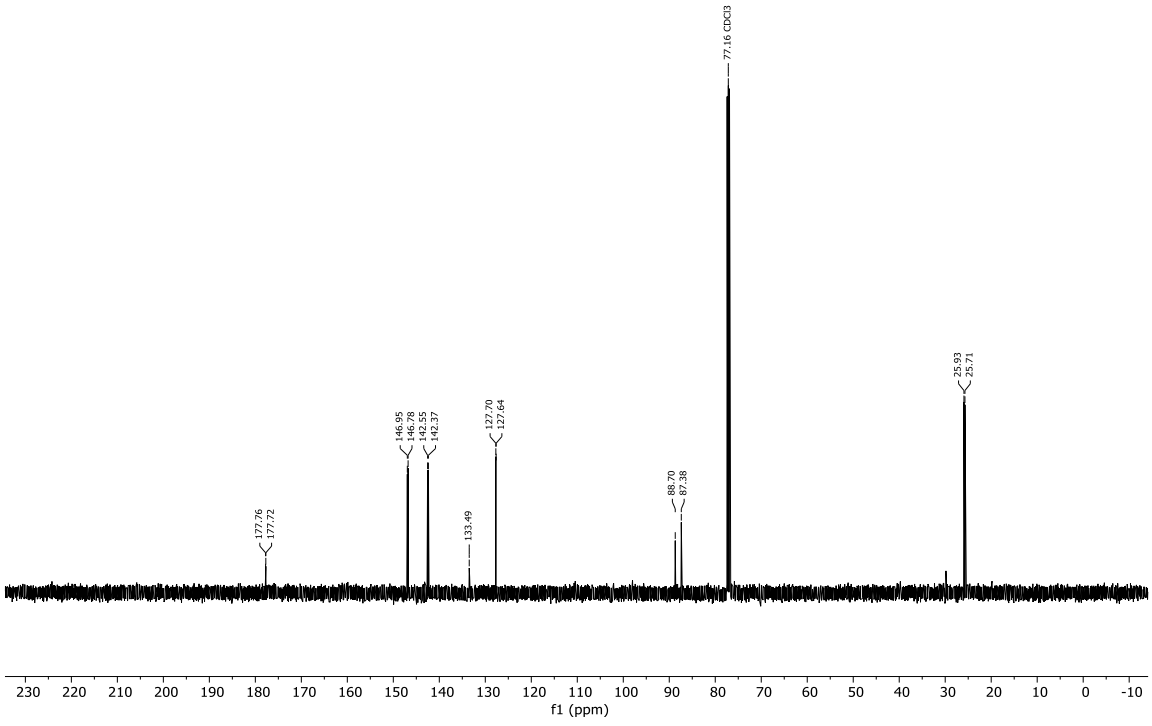
2-chloro-4-fluoro-4-methylcyclohexa-2,5-dien-1-one (9b)

^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

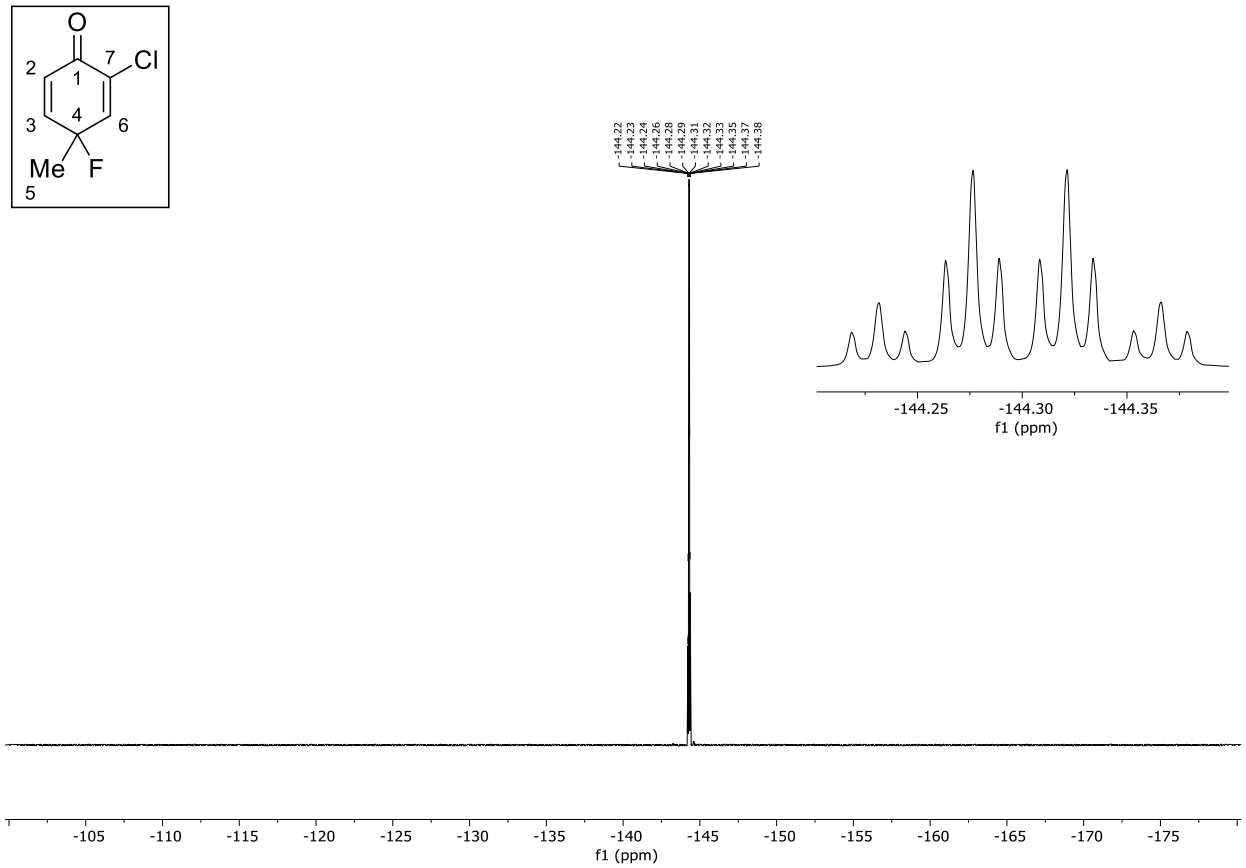




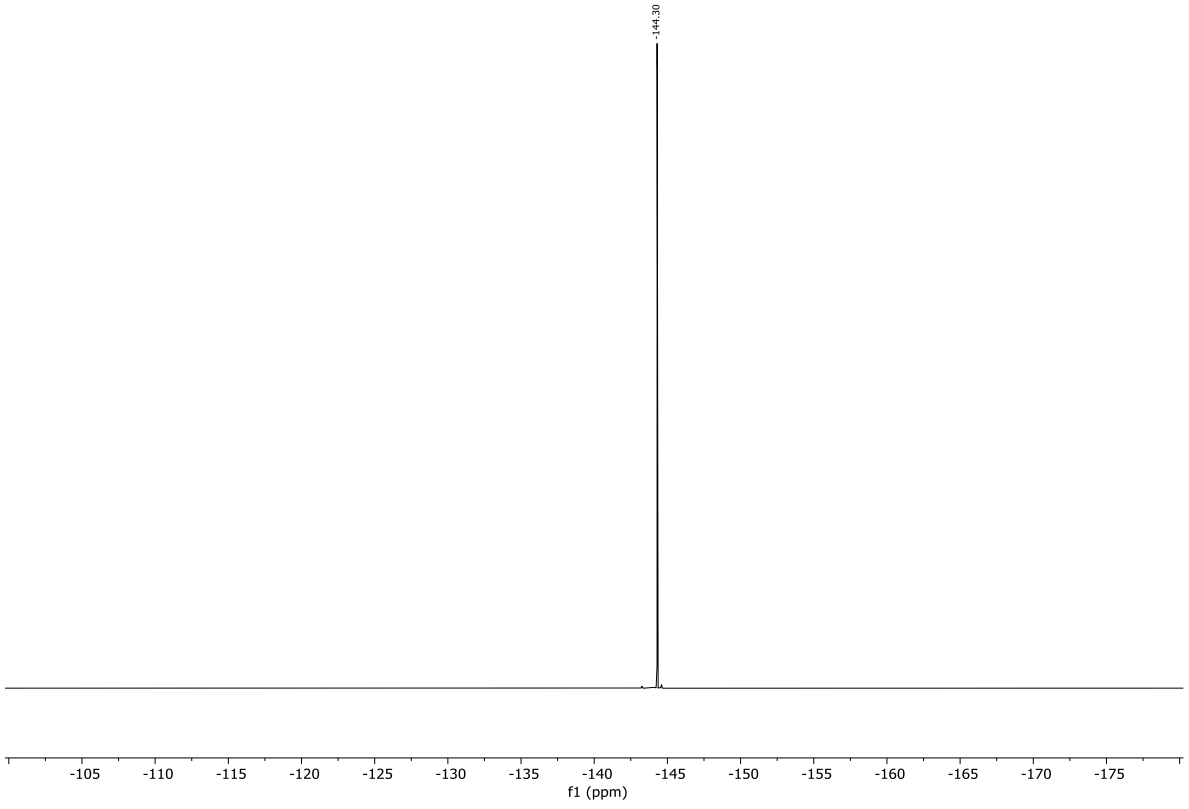
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

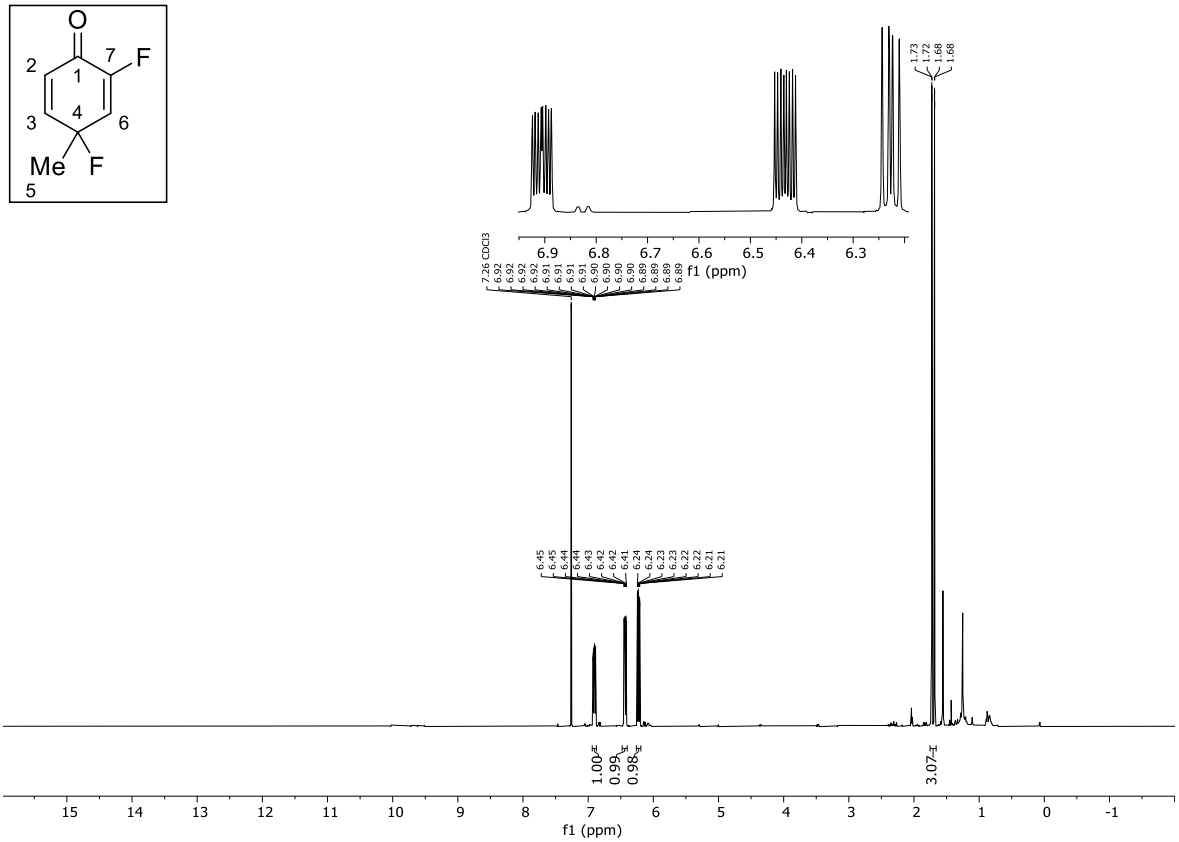


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

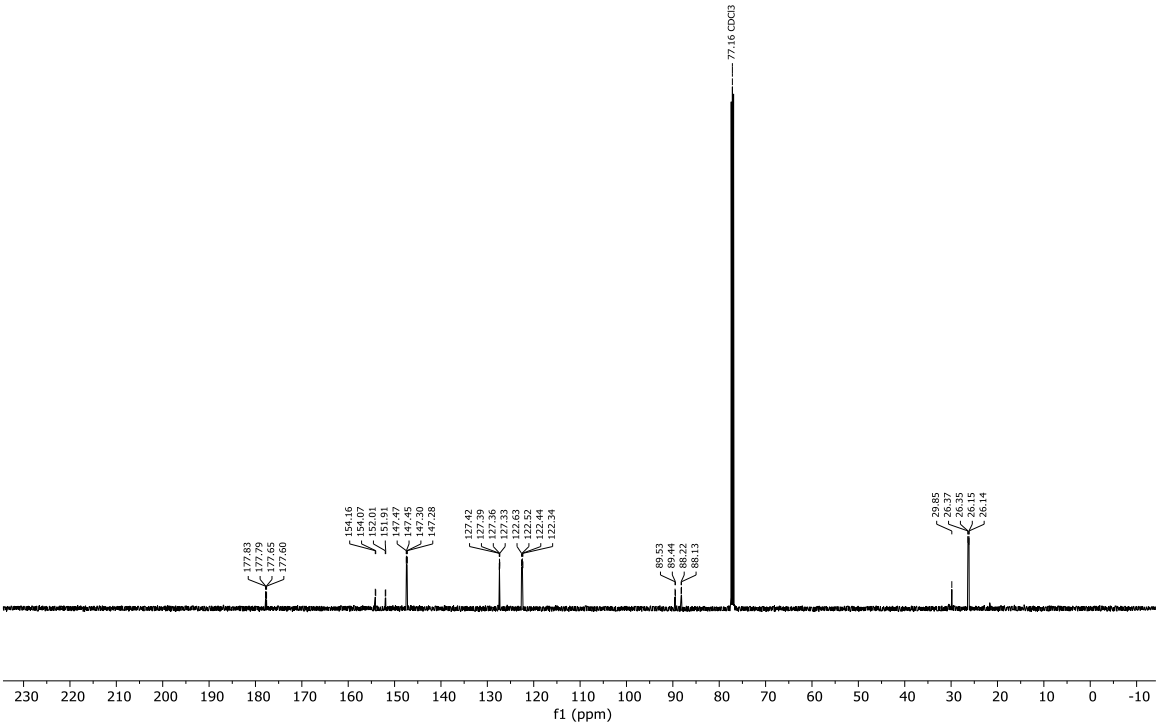


2,4-difluoro-4-methylcyclohexa-2,5-dien-1-one (9c)

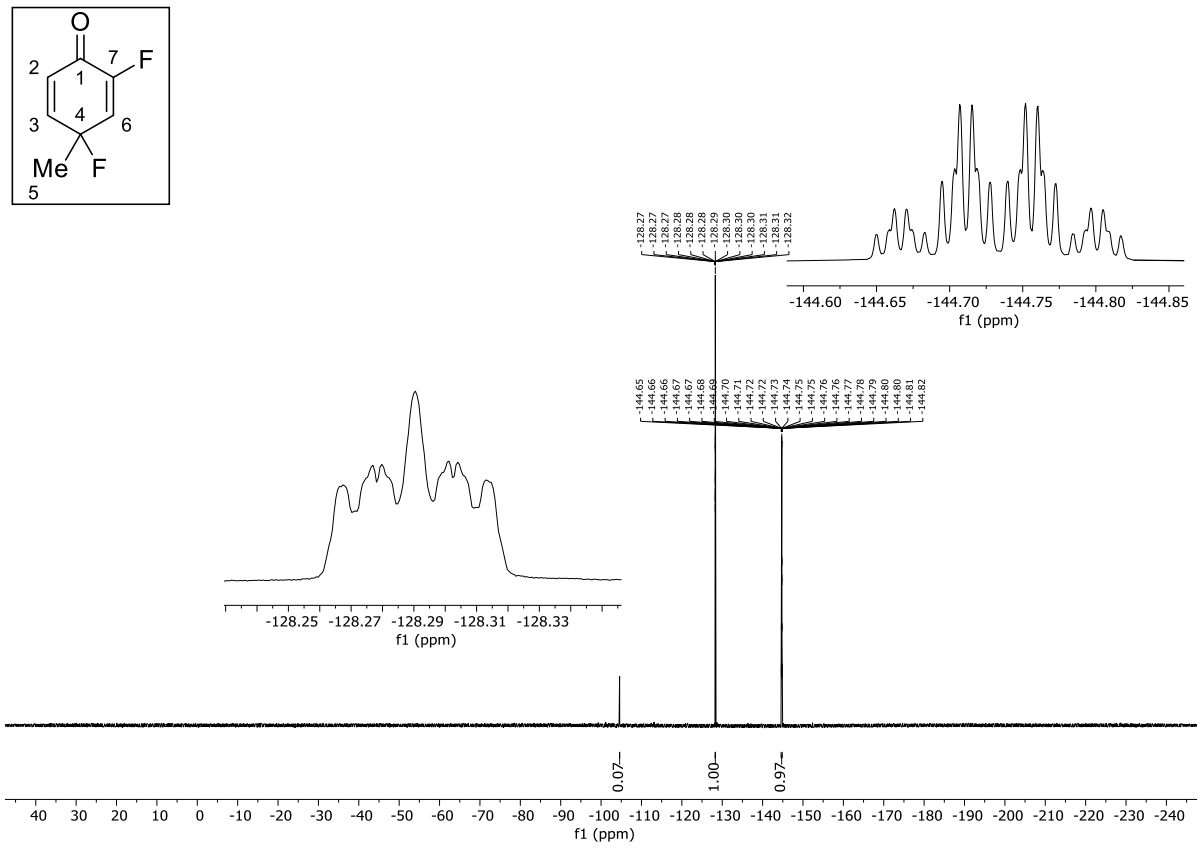
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



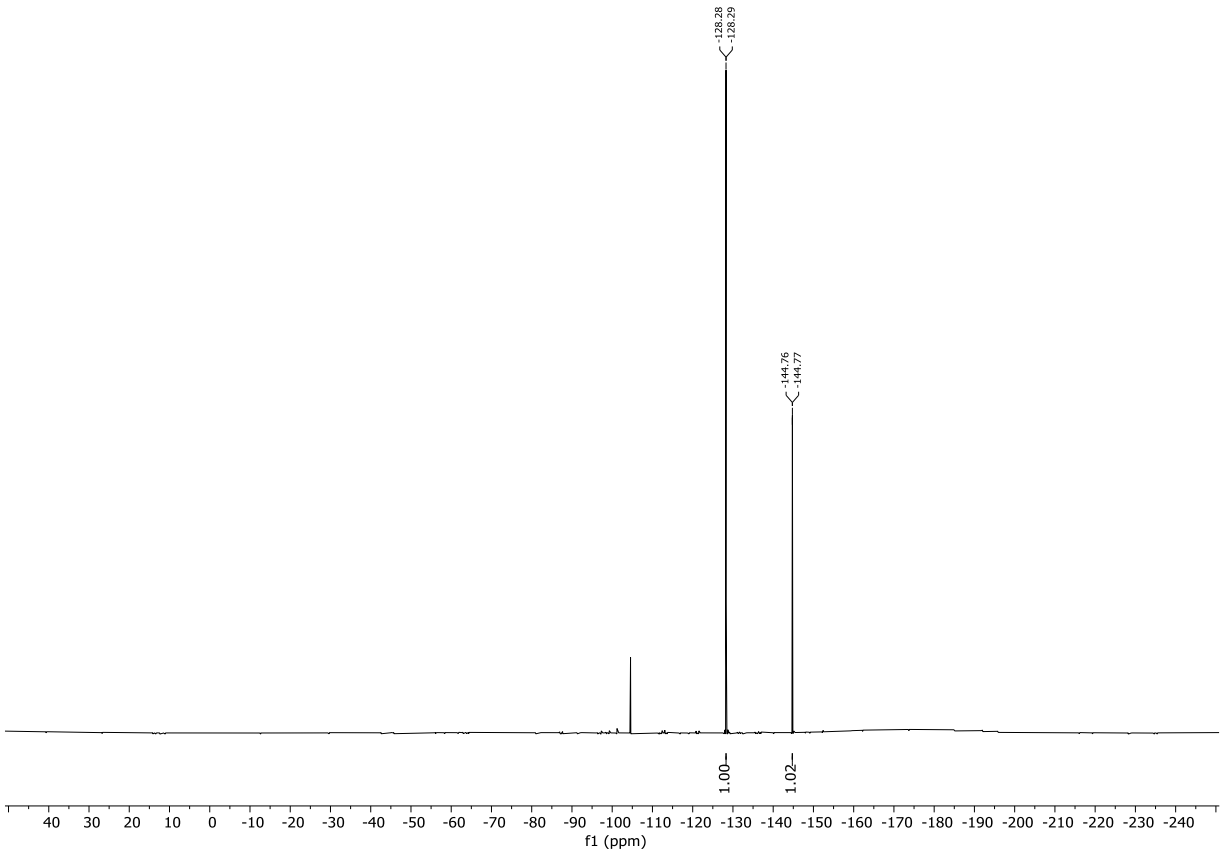
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

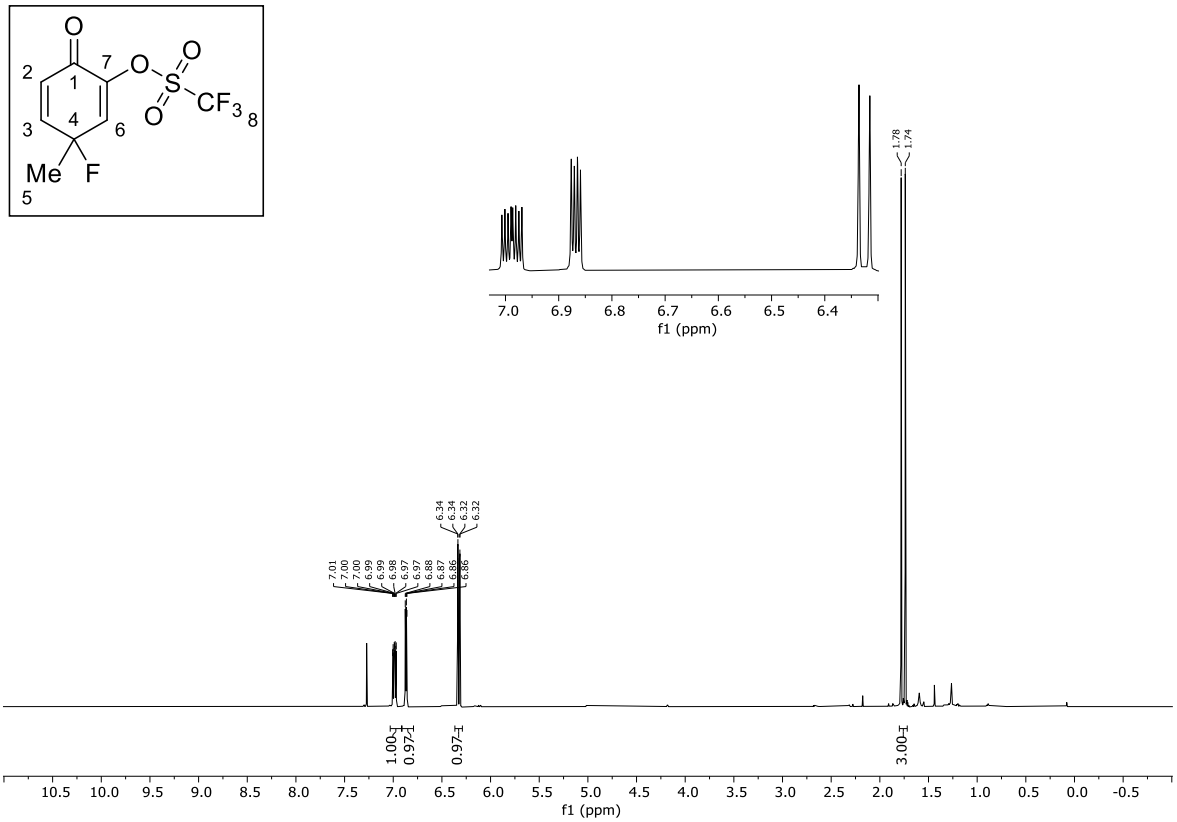


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

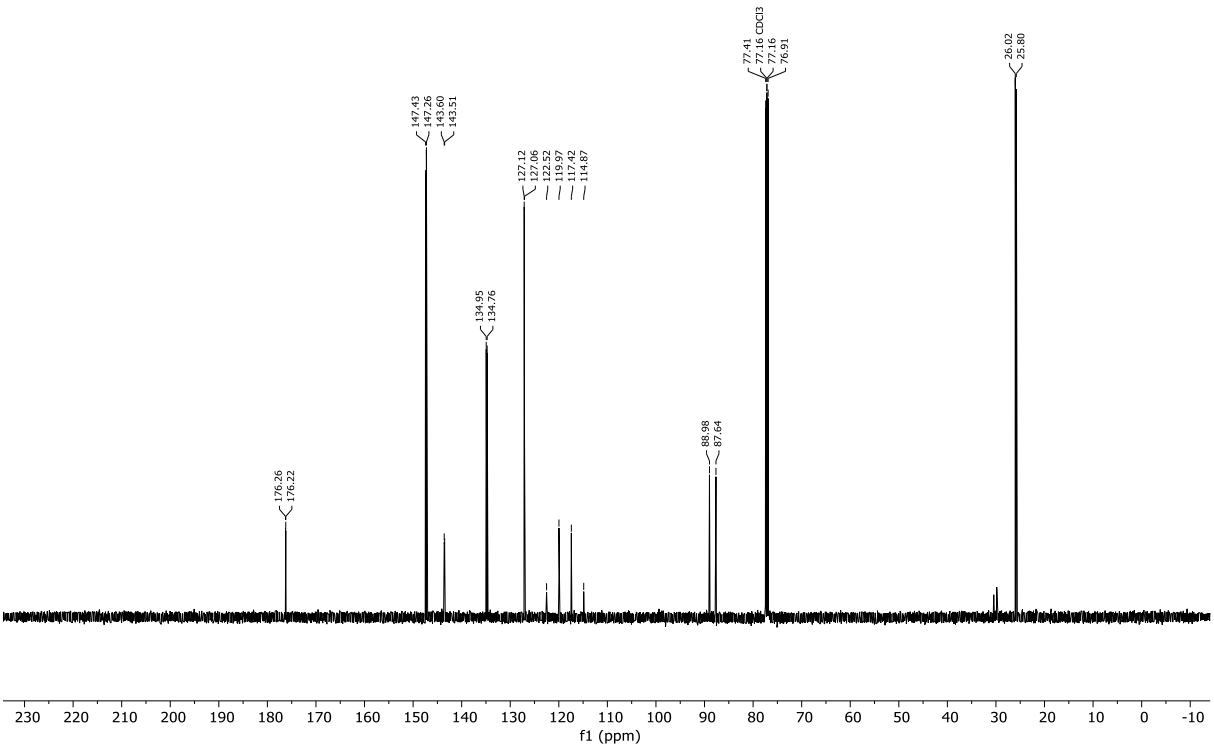


3-fluoro-3-methyl-6-oxocyclohexa-1,4-dien-1-yl trifluoromethanesulfonate (9d)

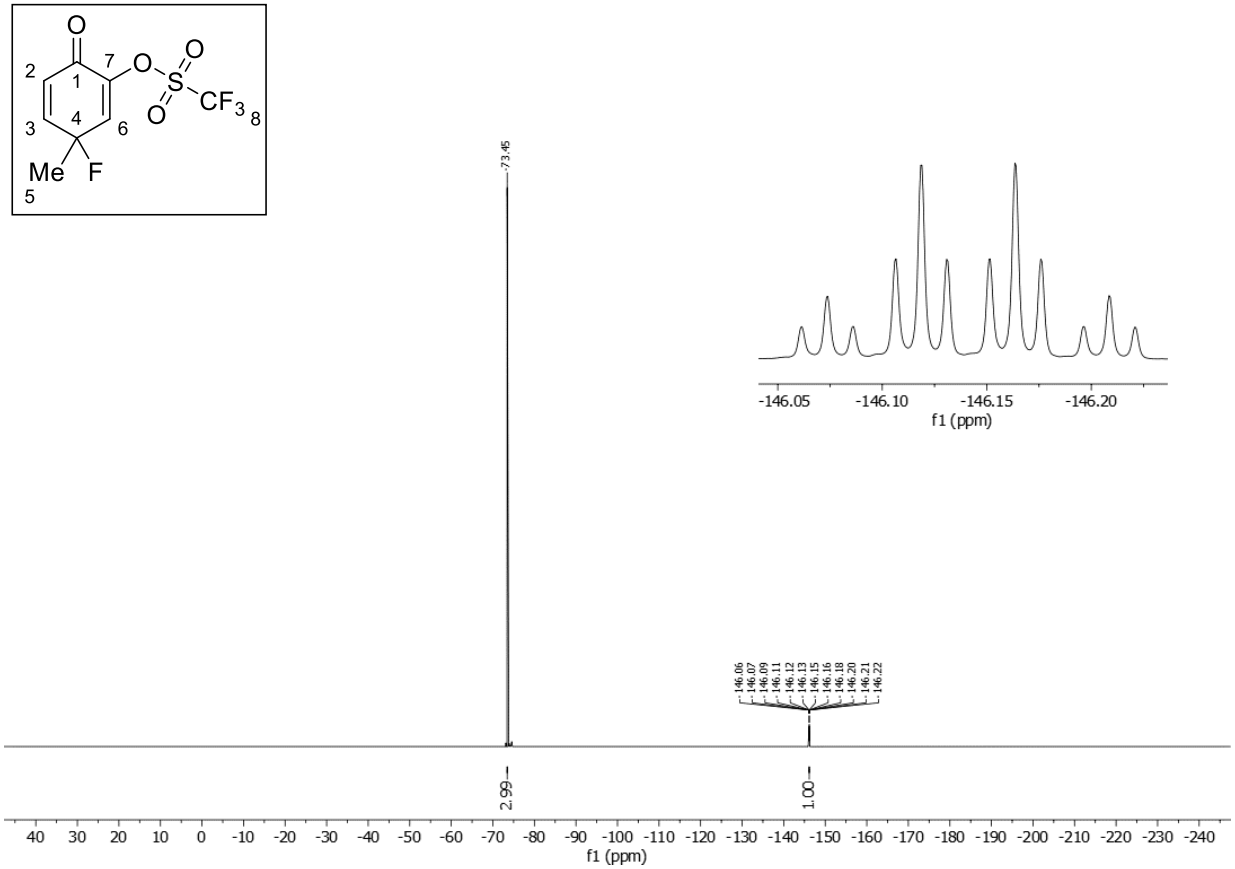
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



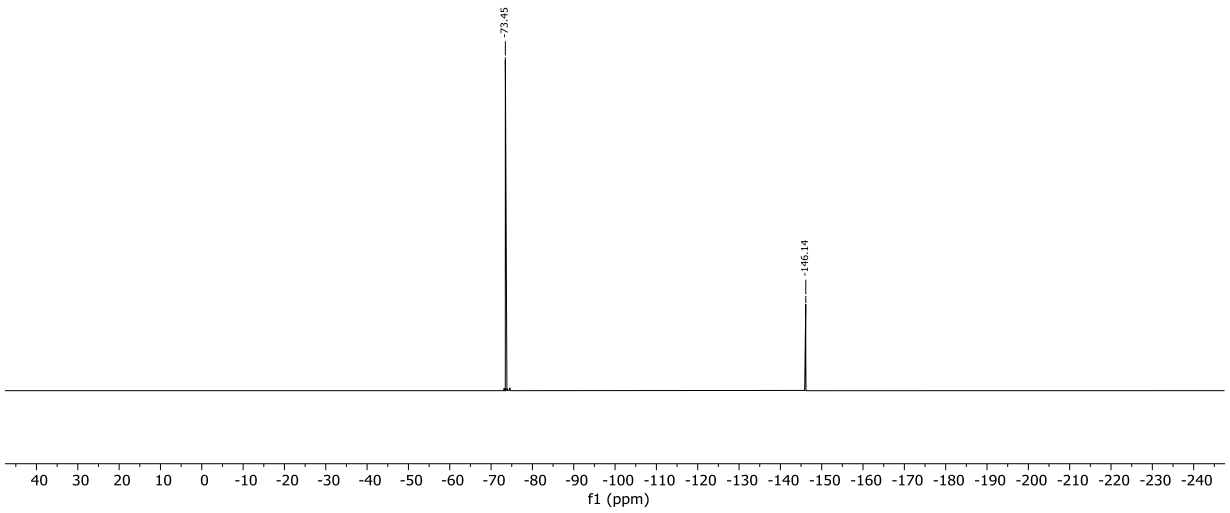
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

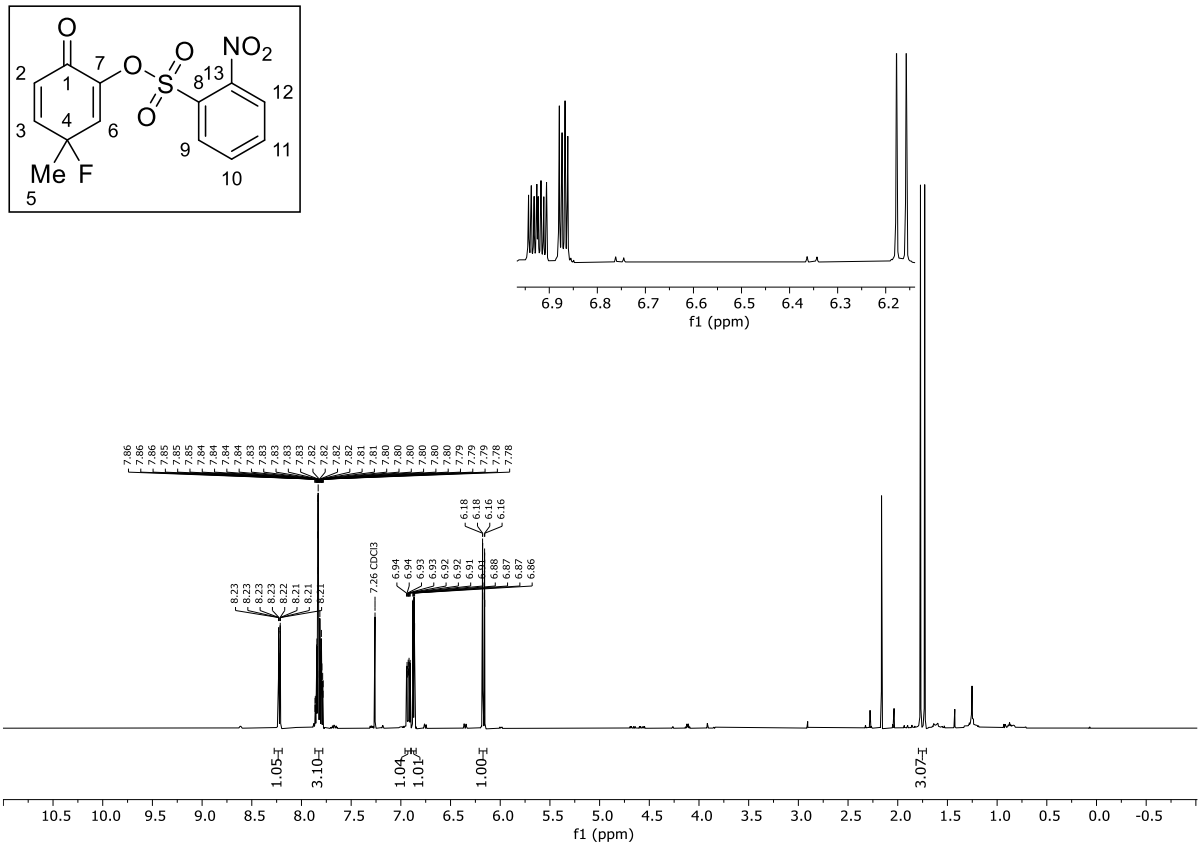


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

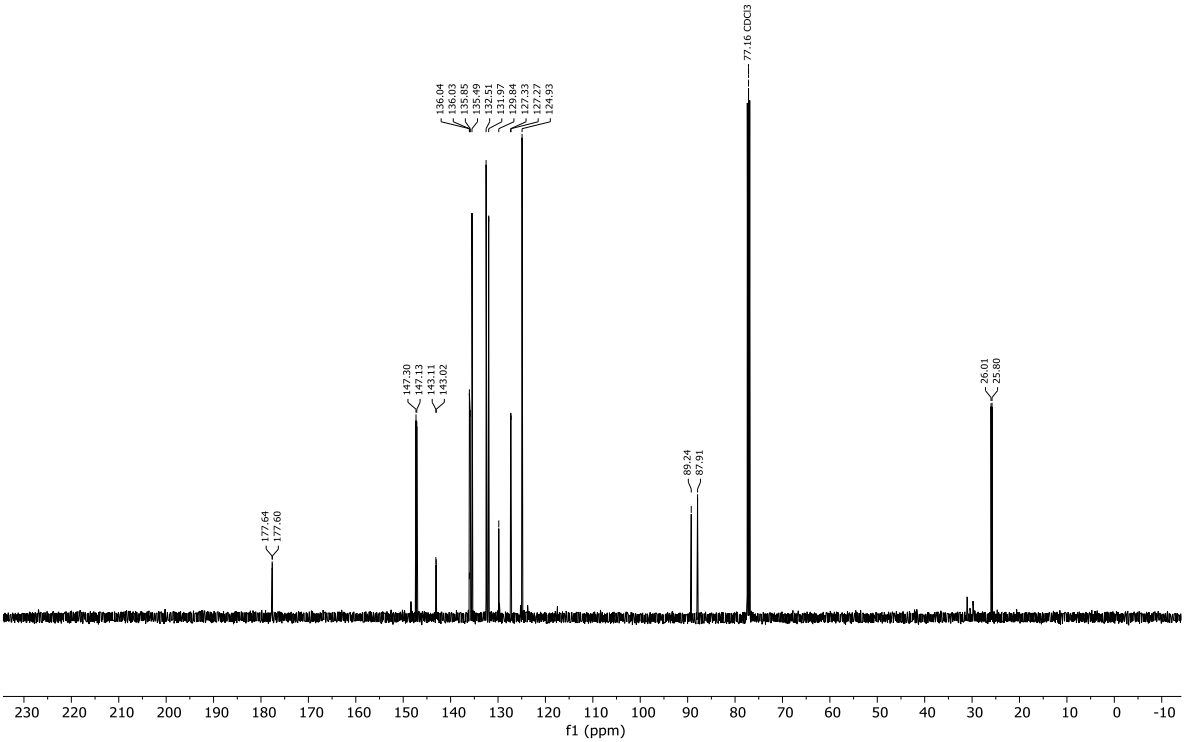


3-fluoro-3-methyl-6-oxocyclohexa-1,4-dien-1-yl 2-nitrobenzenesulfonate (9e)

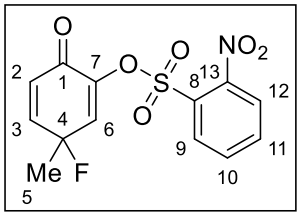
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



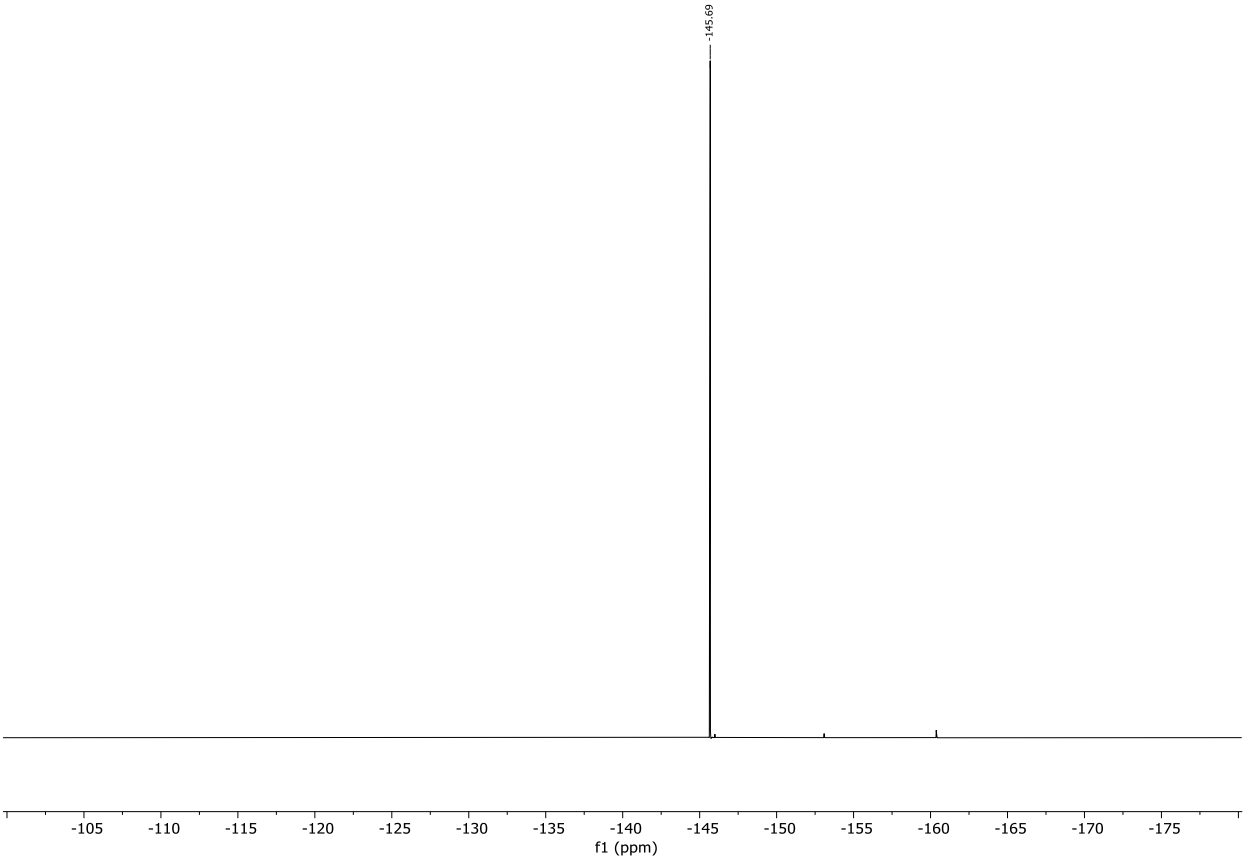
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

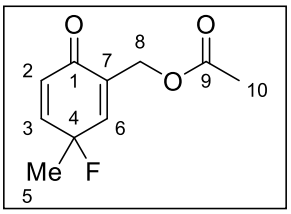


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

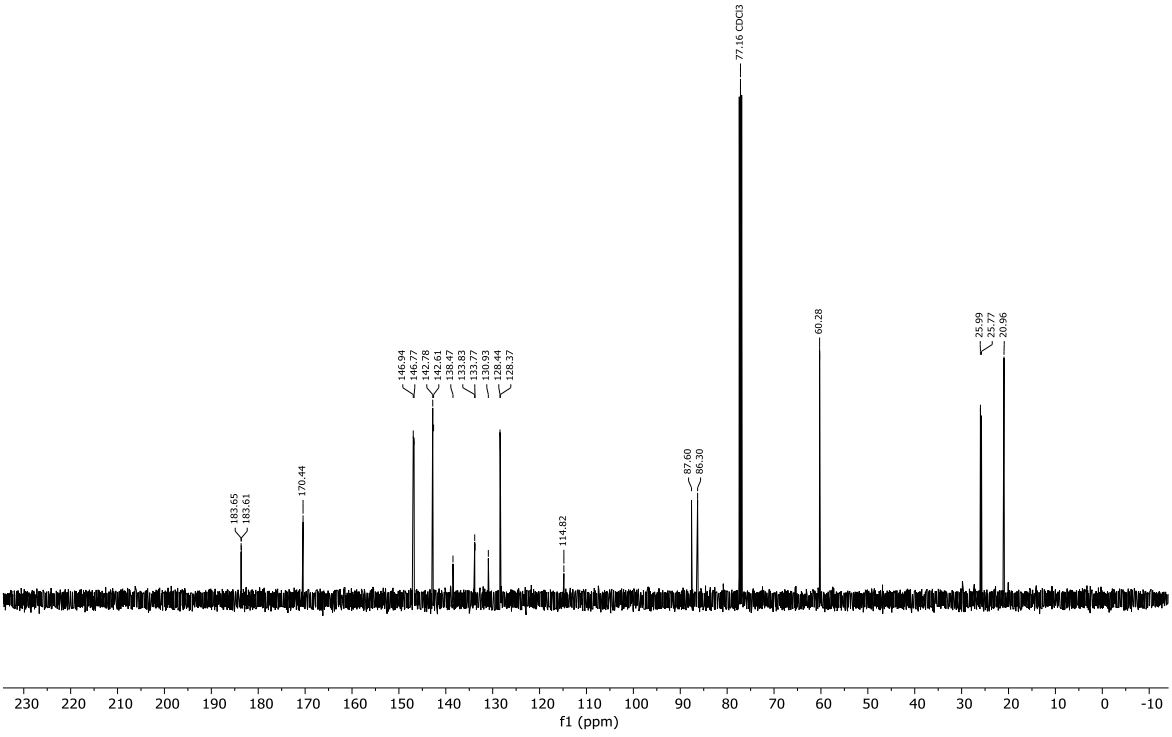


(3-fluoro-3-methyl-6-oxocyclohexa-1,4-dien-1-yl)methyl acetate (9f)

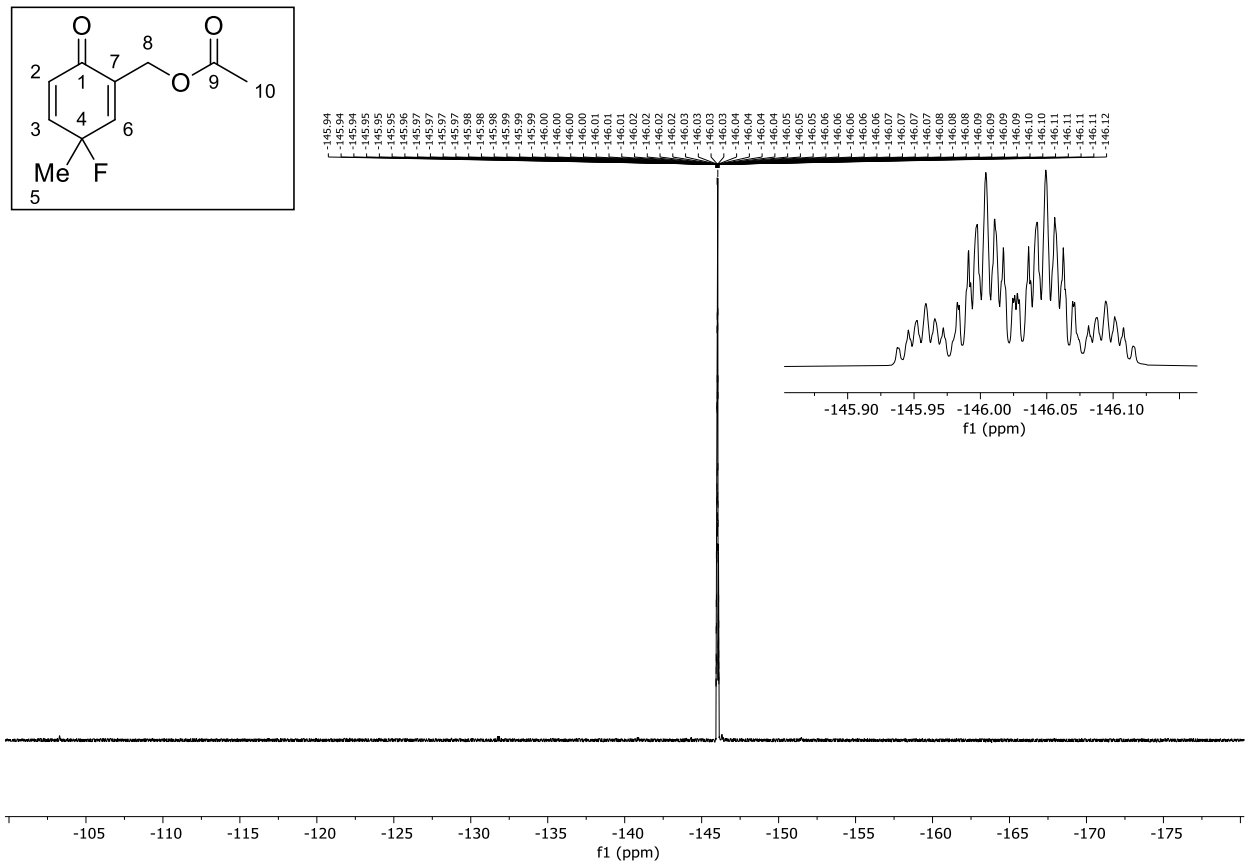
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



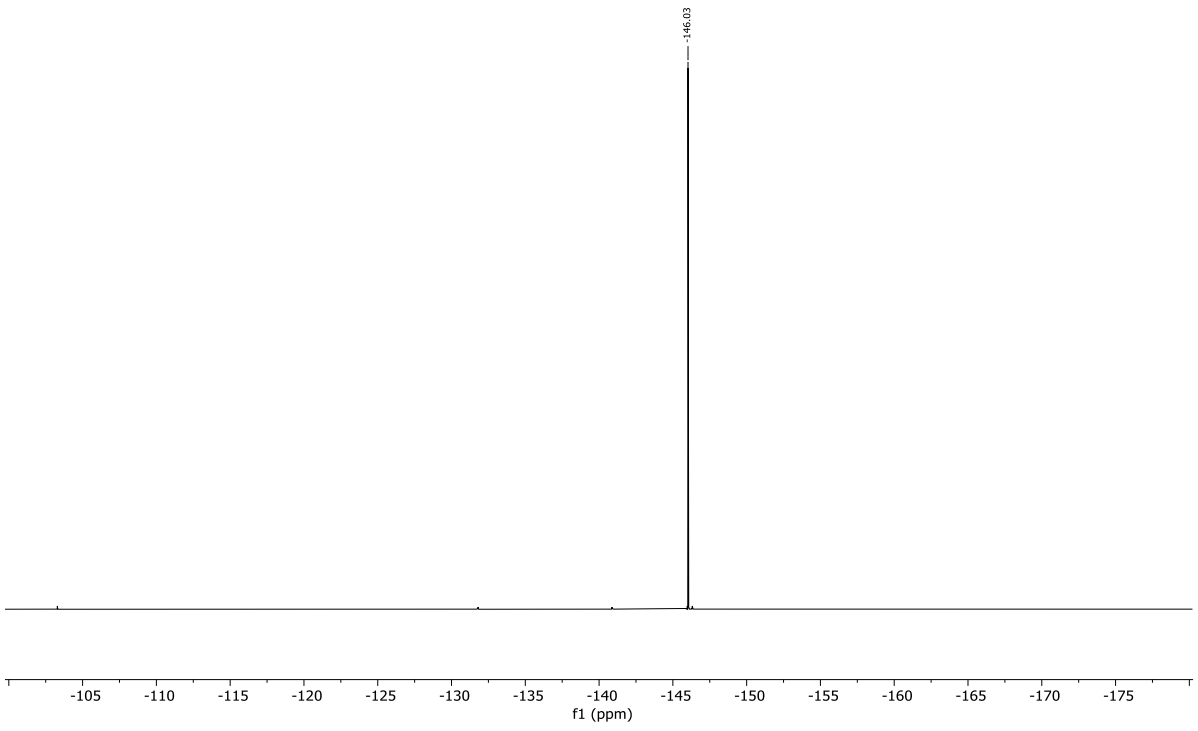
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

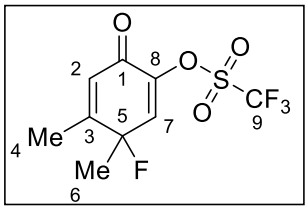


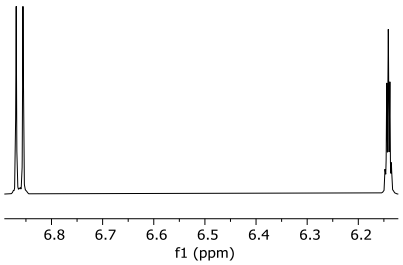
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

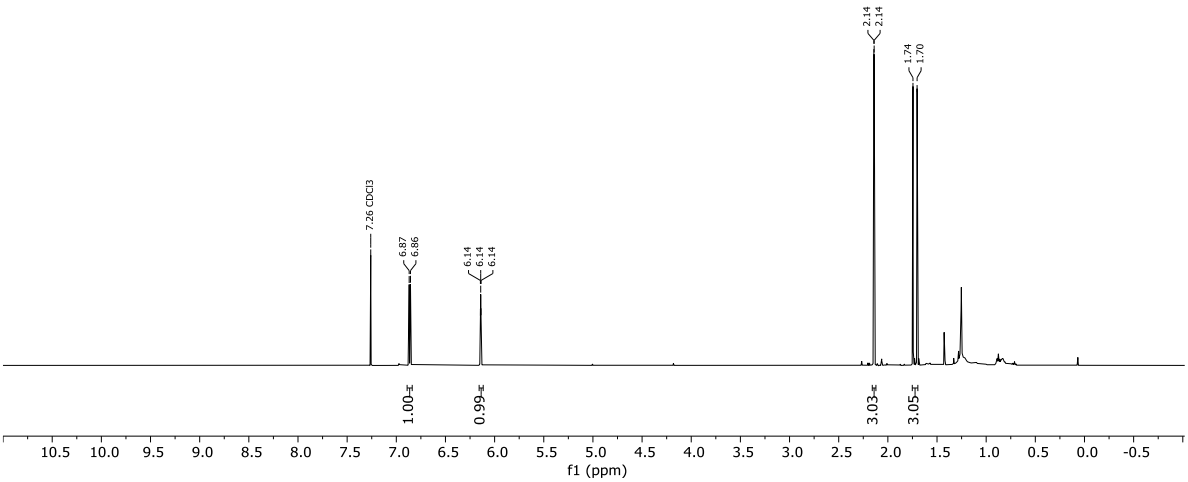


3-fluoro-3,4-dimethyl-6-oxocyclohexa-1,4-dien-1-yl trifluoromethanesulfonate (9g)

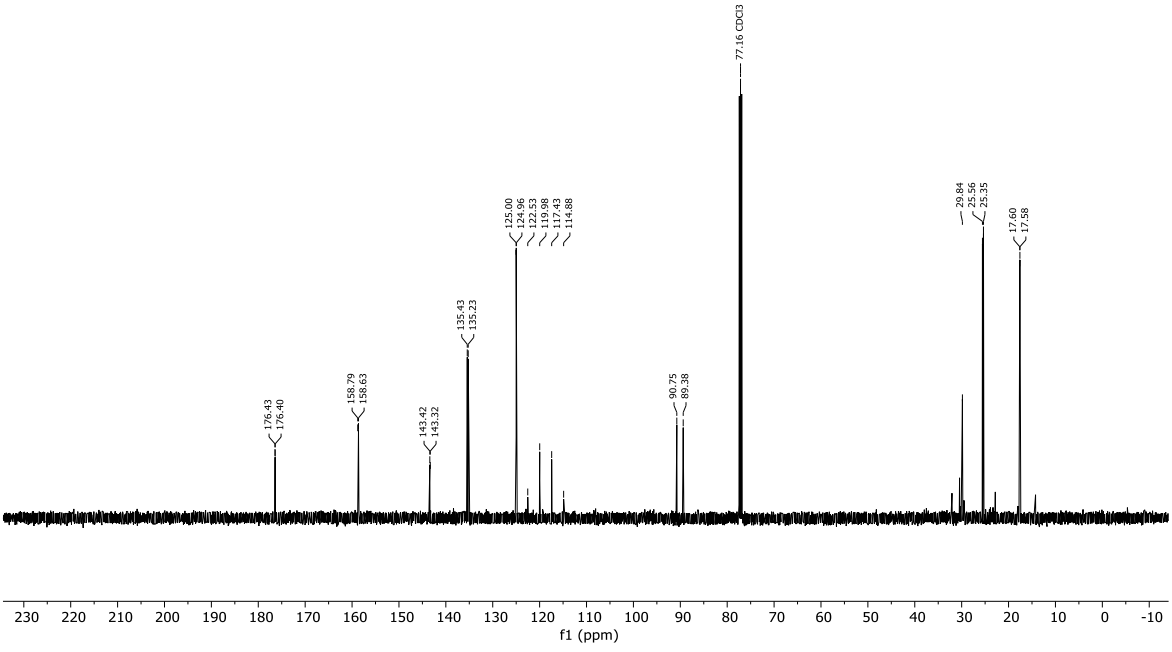
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



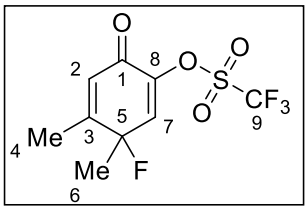




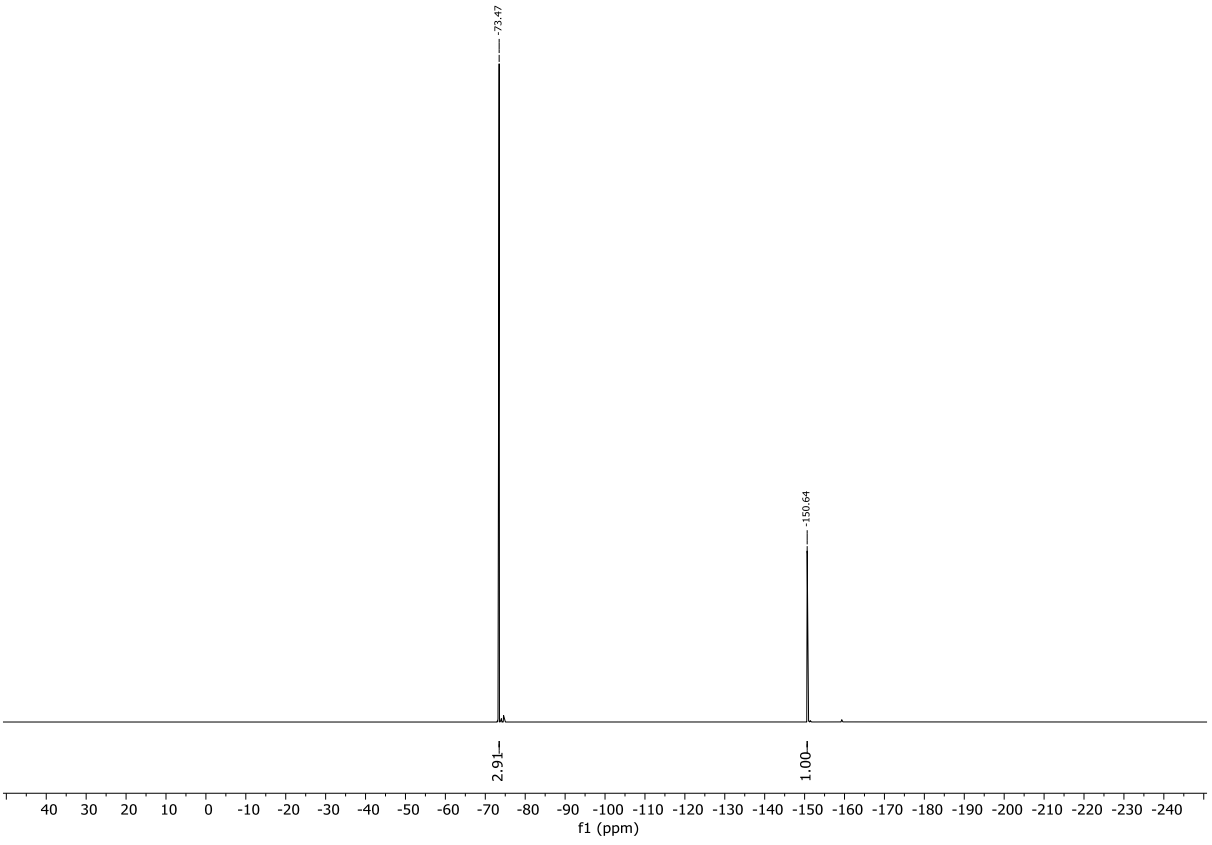
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

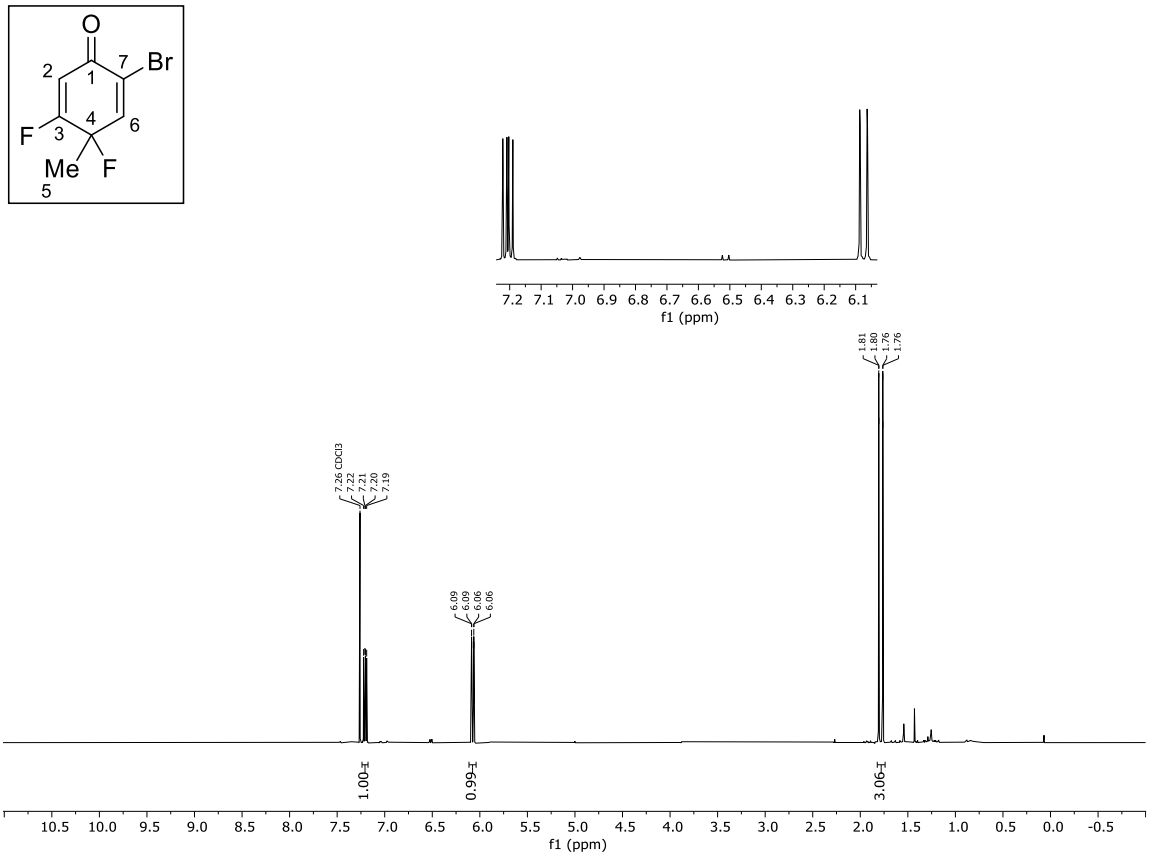


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

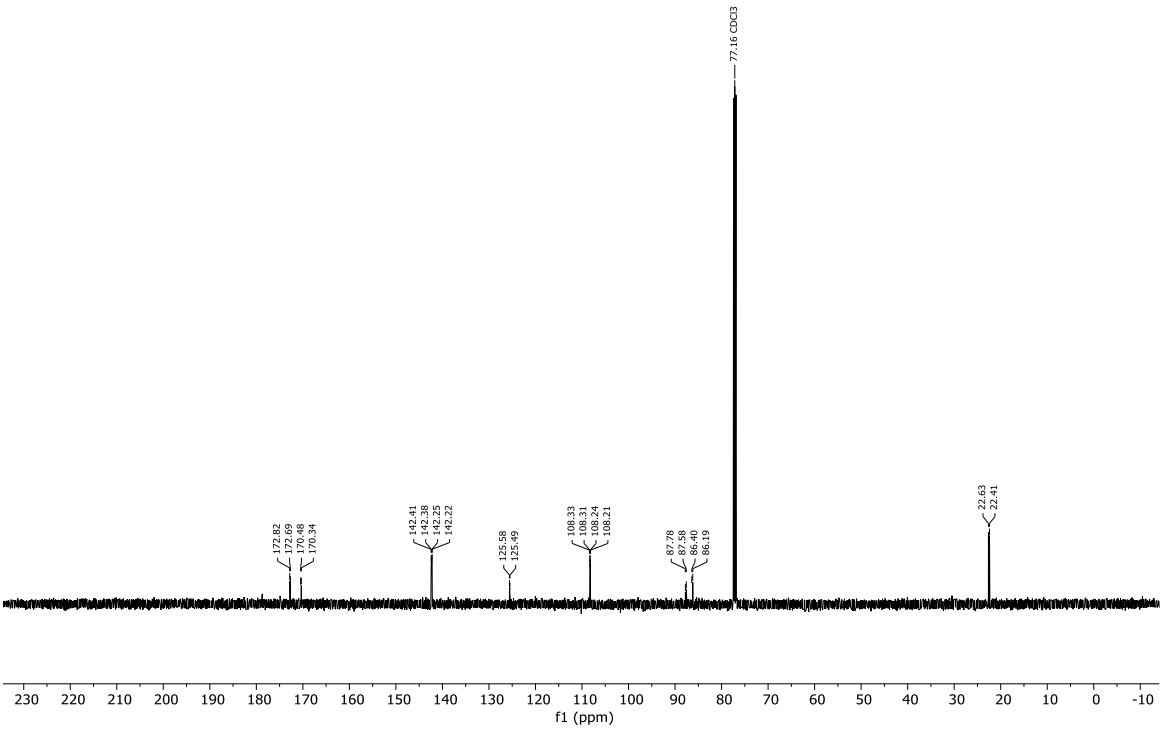


2-bromo-4,5-difluoro-4-methylcyclohexa-2,5-dien-1-one (9h)

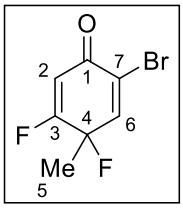
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



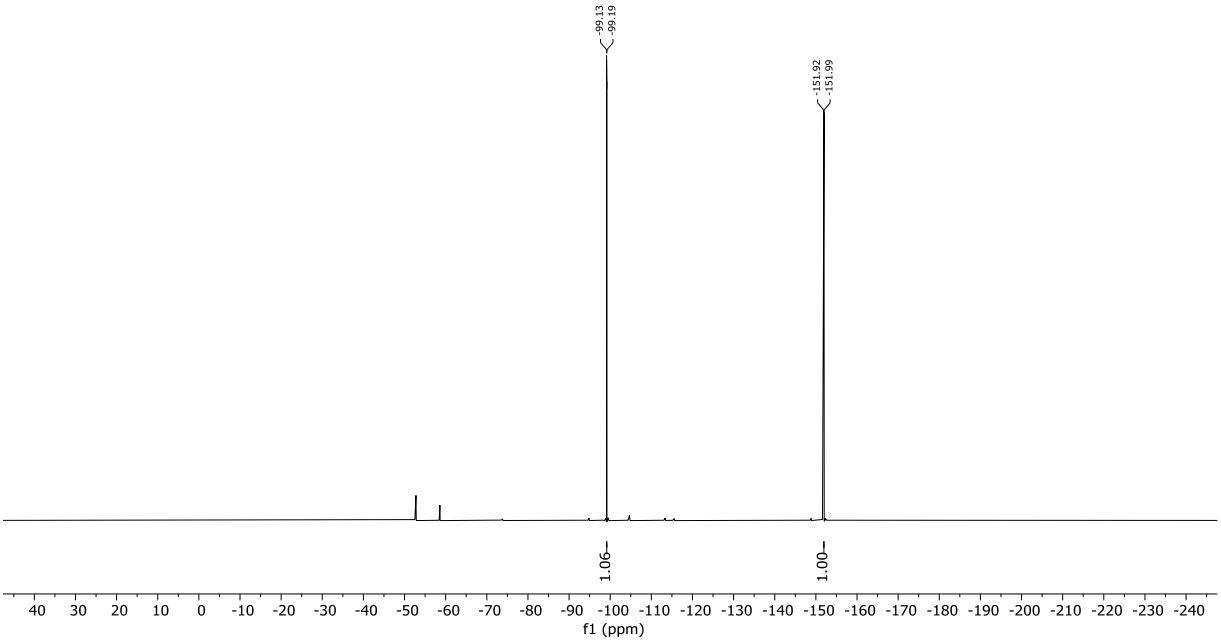
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

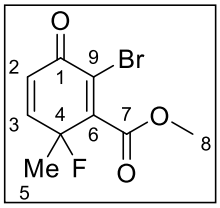


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

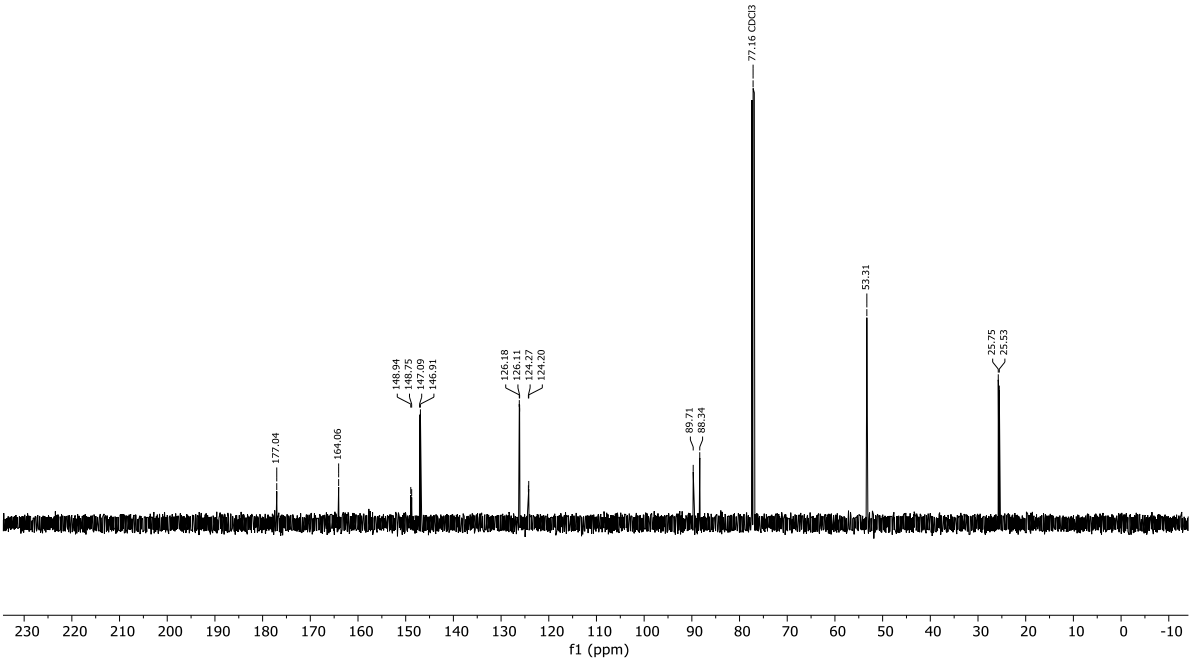


methyl 2-bromo-6-fluoro-6-methyl-3-oxocyclohexa-1,4-diene-1-carboxylate(9i)

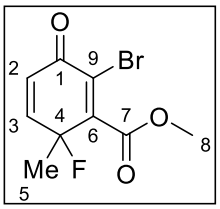
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

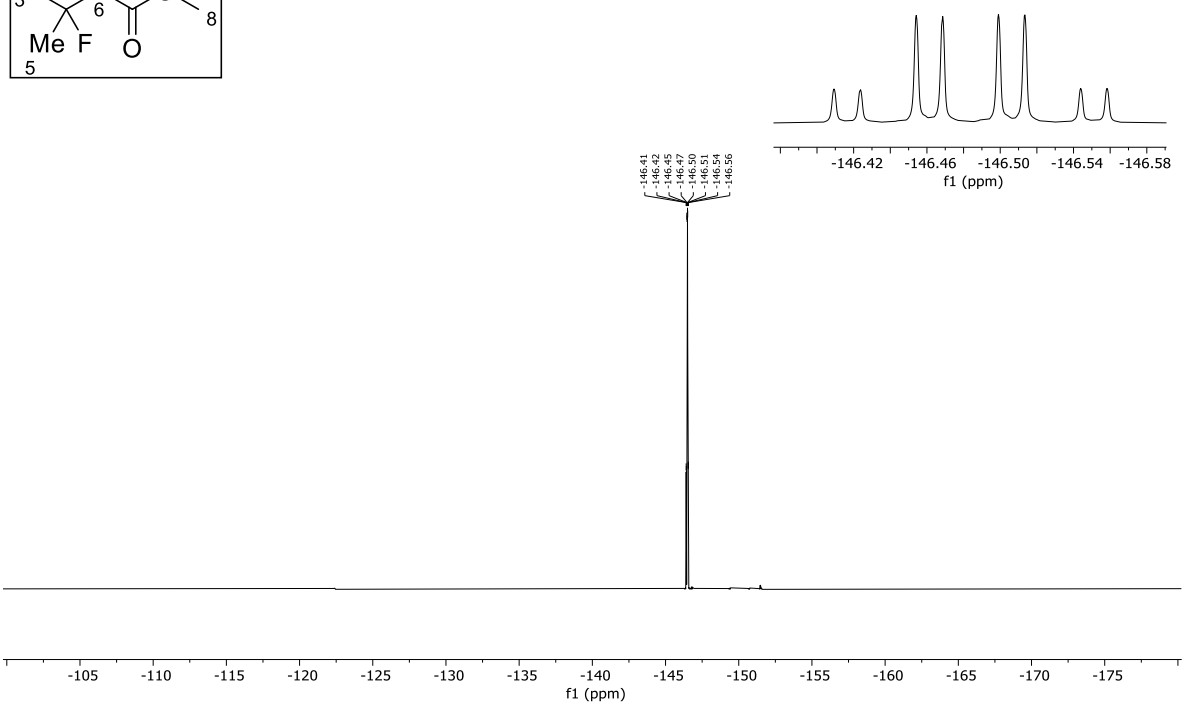


^{13}C NMR (126 MHz, $CDCl_3$, 299 K)

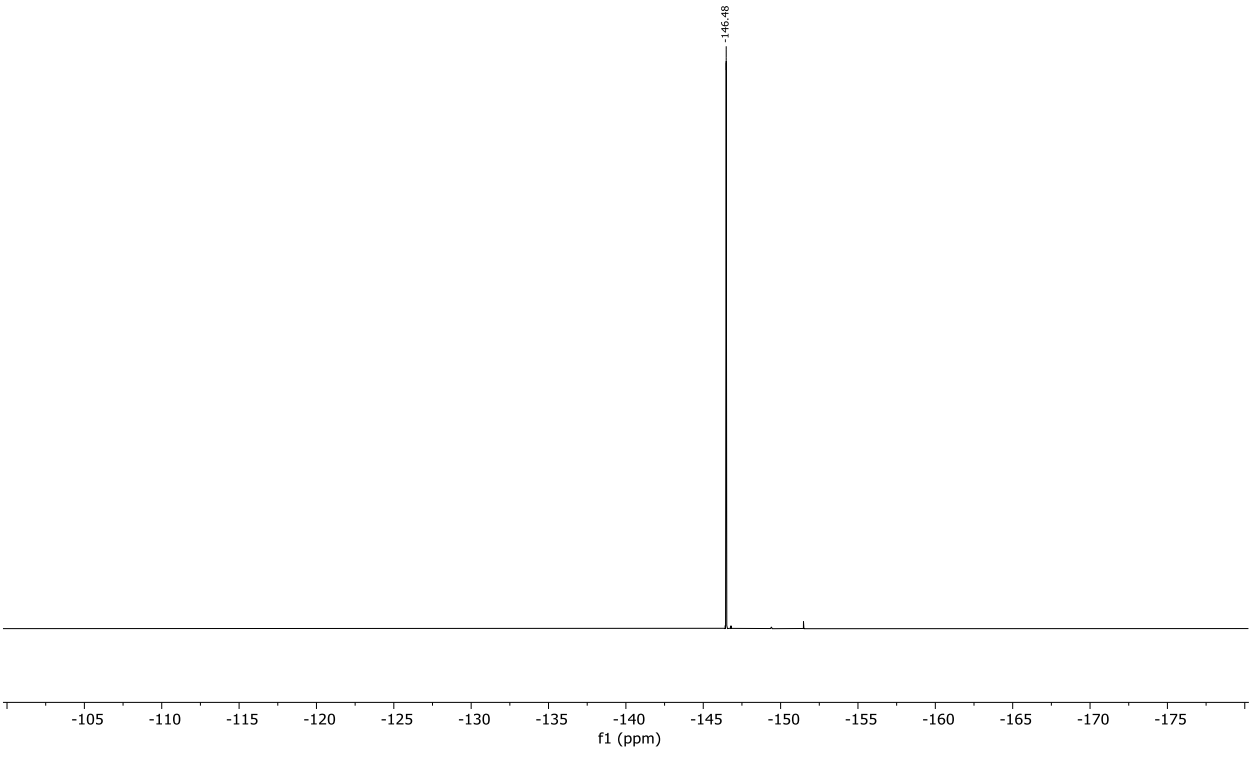


^{19}F NMR (470 MHz, $CDCl_3$, 299 K)



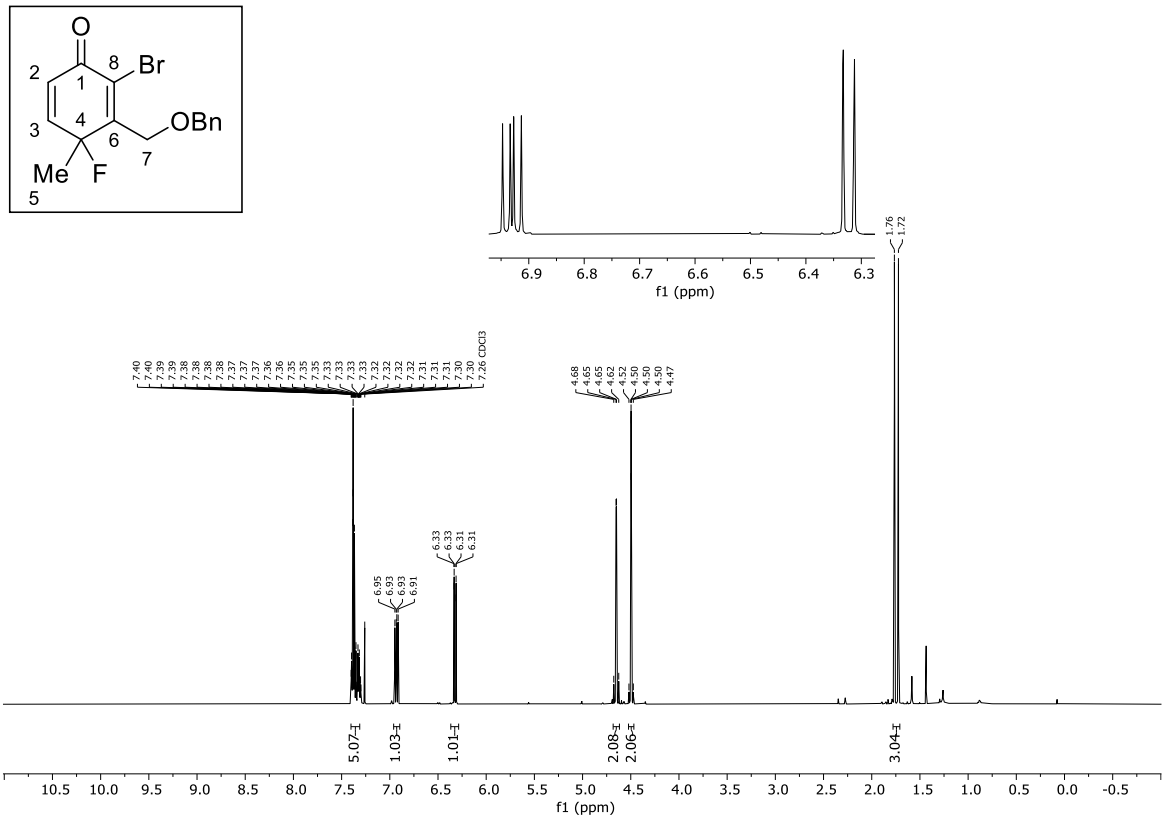


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

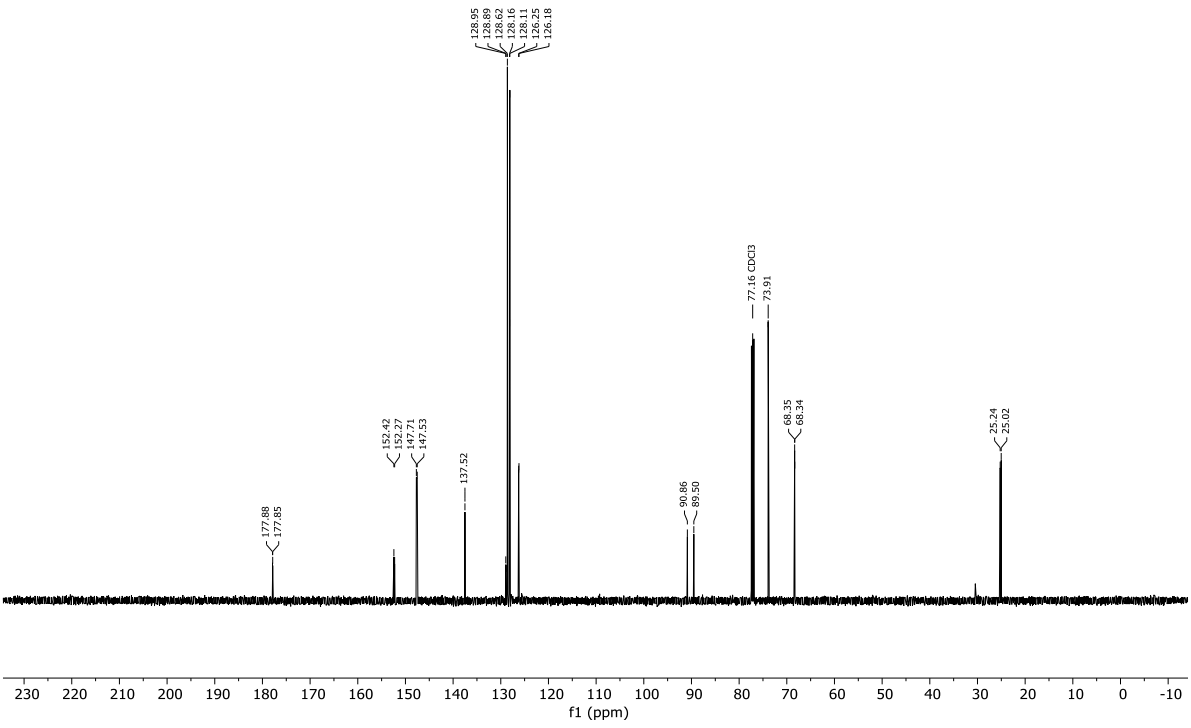


3-((benzyloxy)methyl)-2-bromo-4-fluoro-4-methylcyclohexa-2,5-dien-1-one (9j)

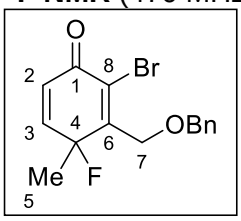
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

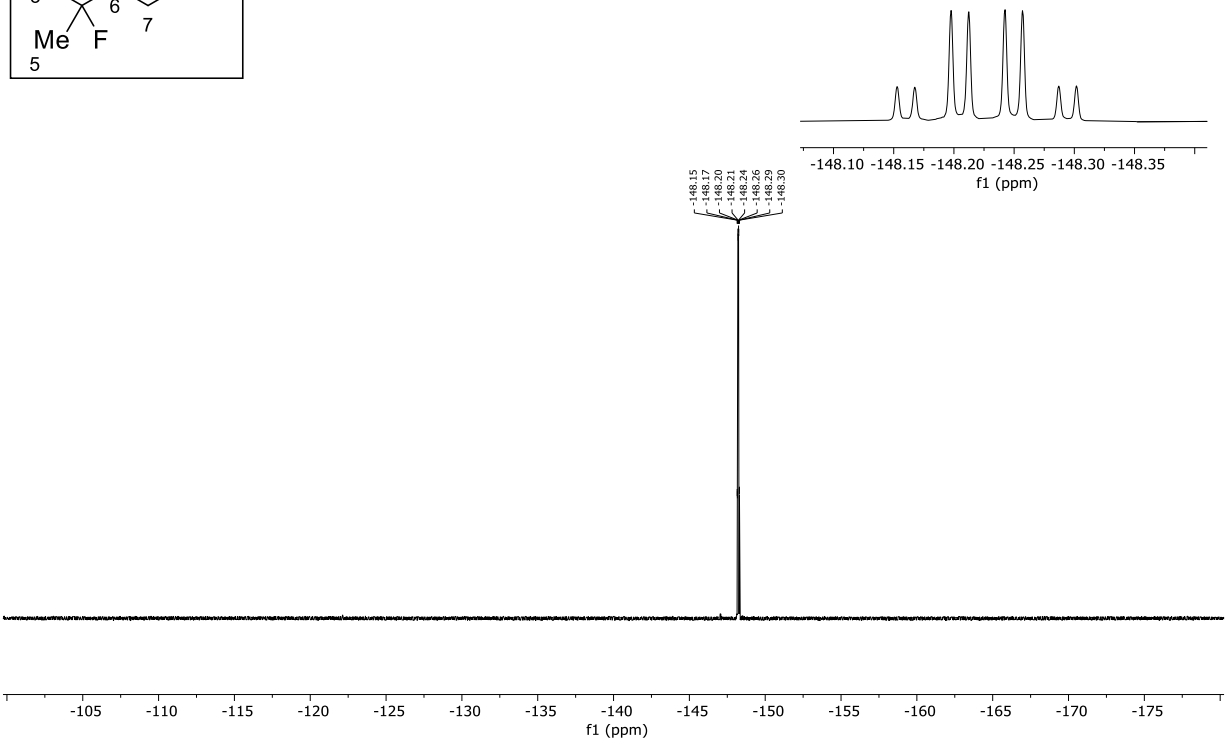


^{13}C NMR (126 MHz, $CDCl_3$, 299 K)

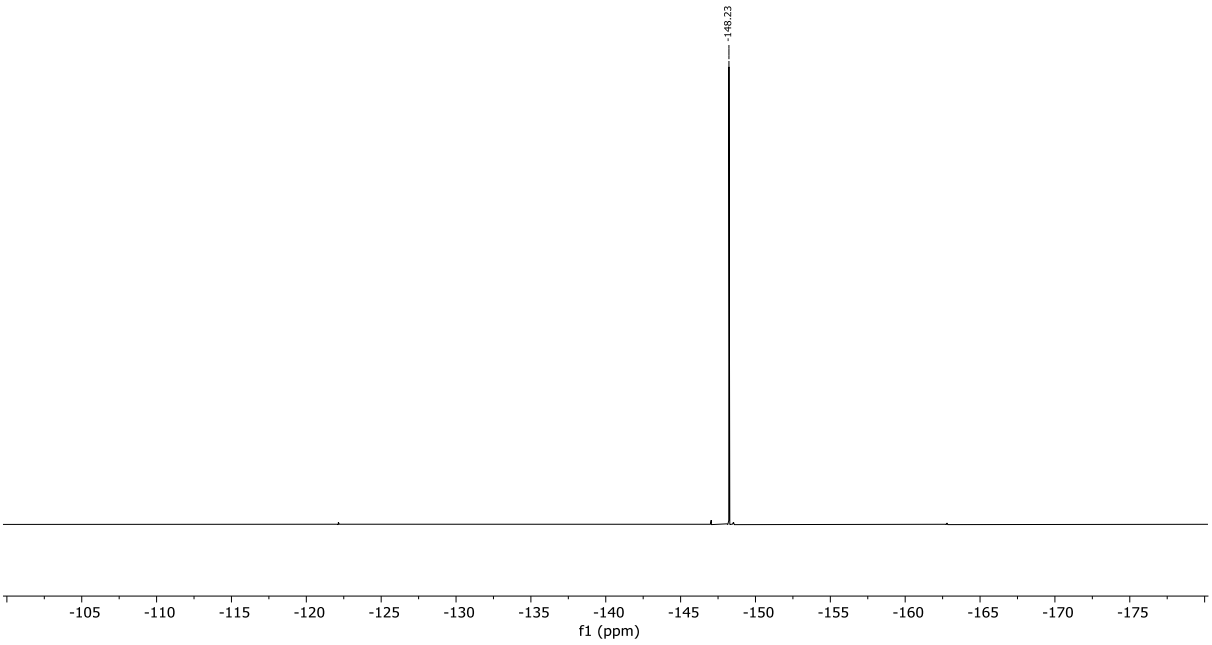


^{19}F NMR (470 MHz, $CDCl_3$, 299 K)



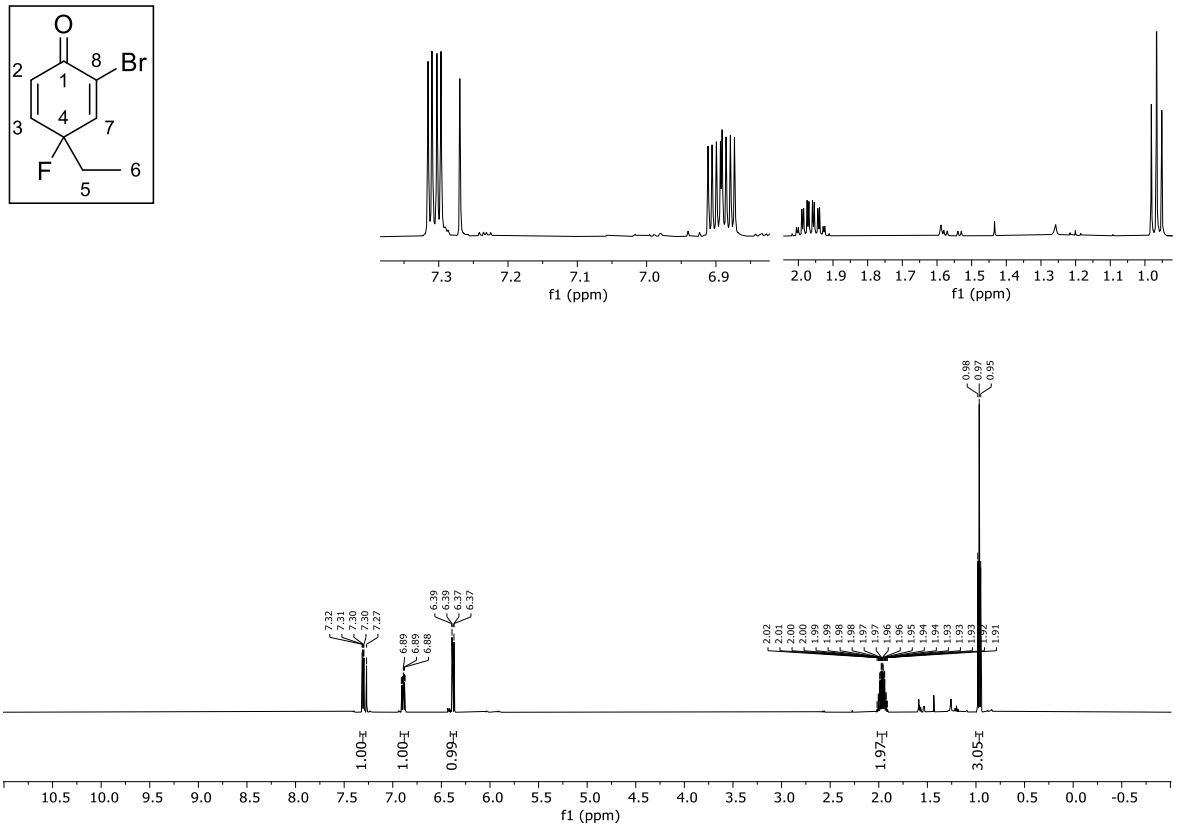


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

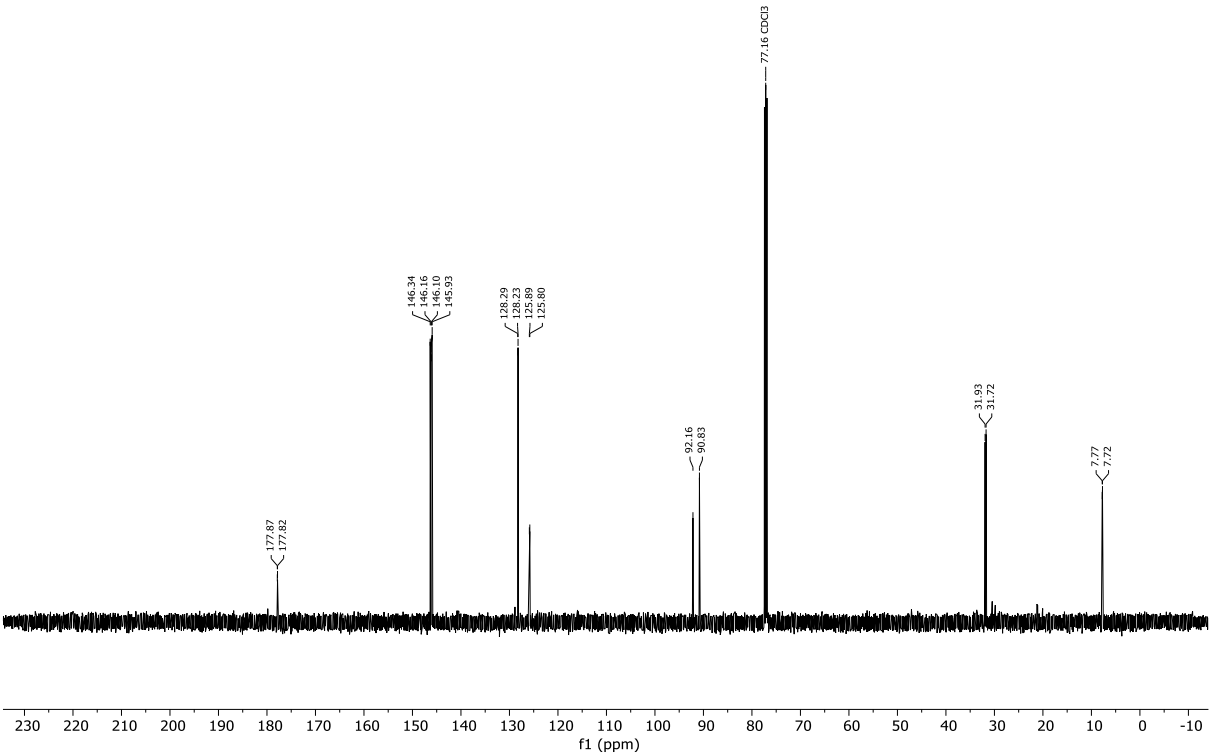


2-bromo-4-ethyl-4-fluorocyclohexa-2,5-dien-1-one (9k)

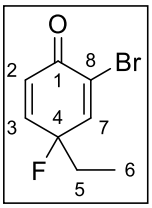
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

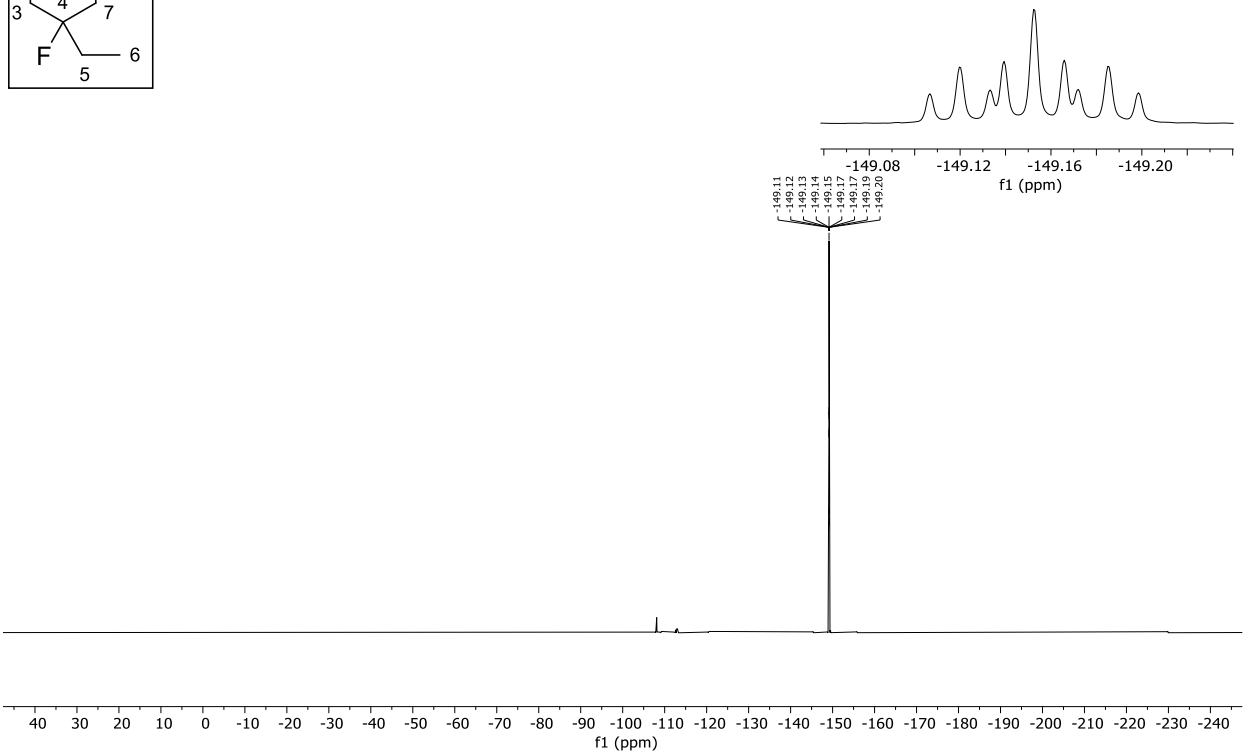


^{13}C NMR (126 MHz, $CDCl_3$, 299 K)

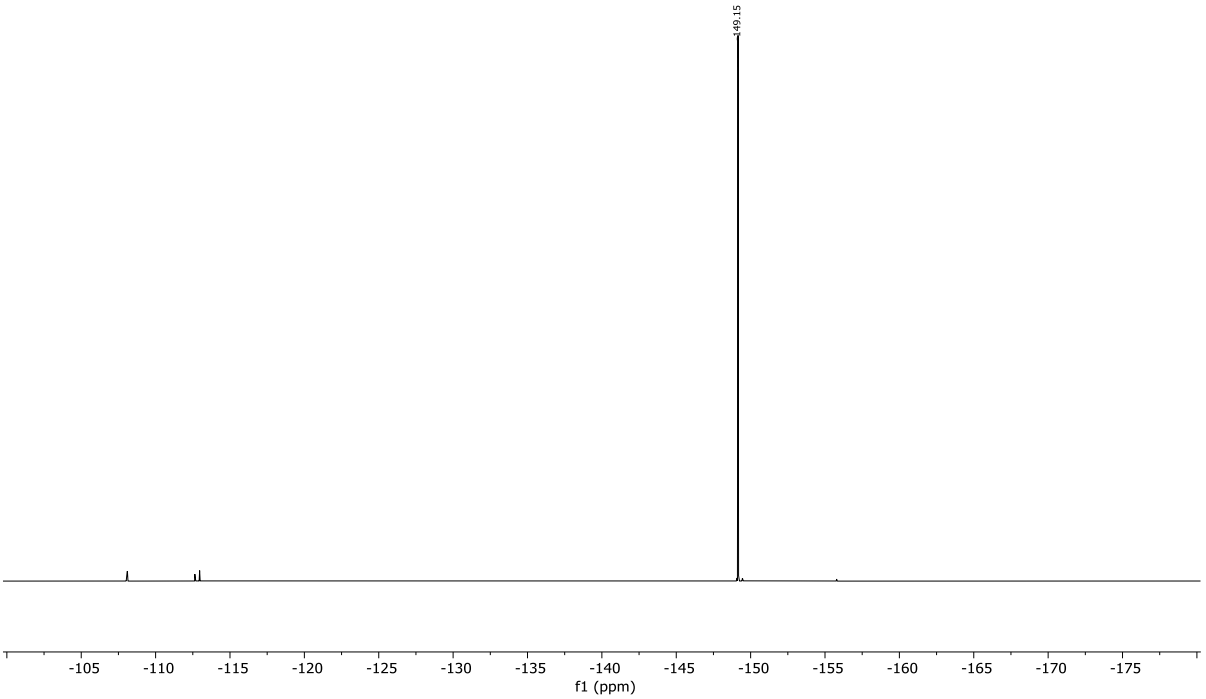


^{19}F NMR (470 MHz, $CDCl_3$, 299 K)



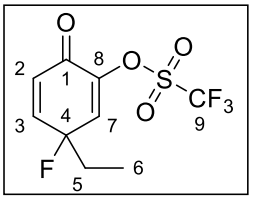


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

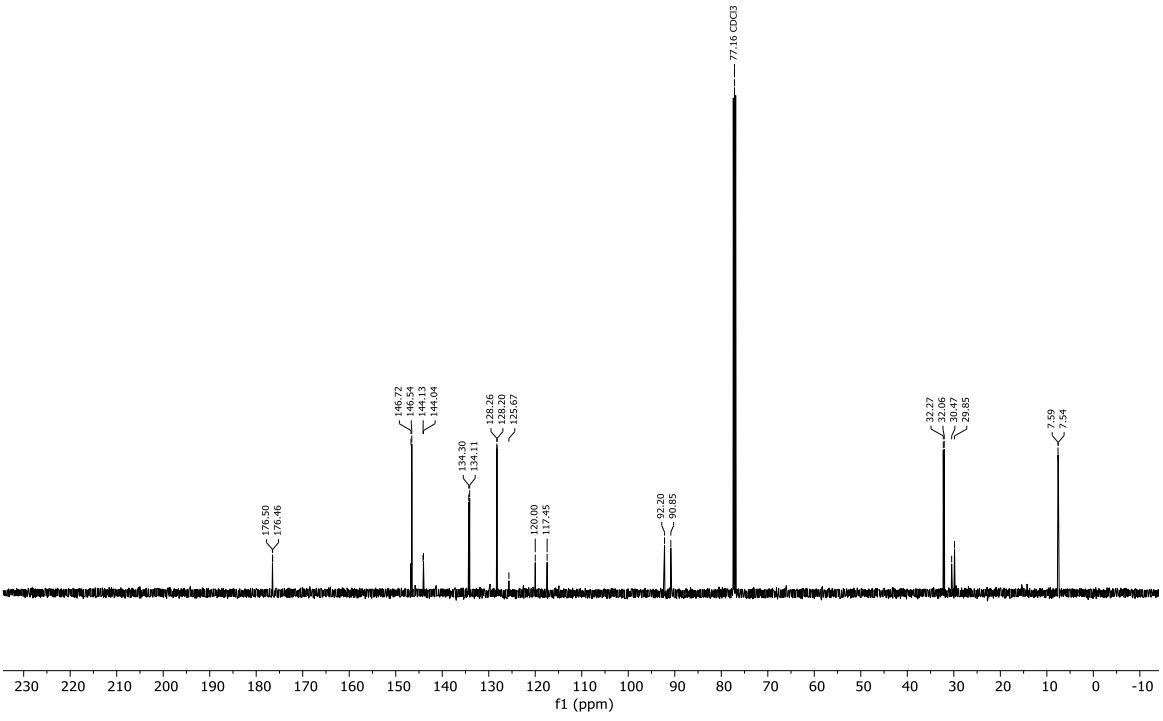


3-ethyl-3-fluoro-6-oxocyclohexa-1,4-dien-1-yl trifluoromethanesulfonate (9l)

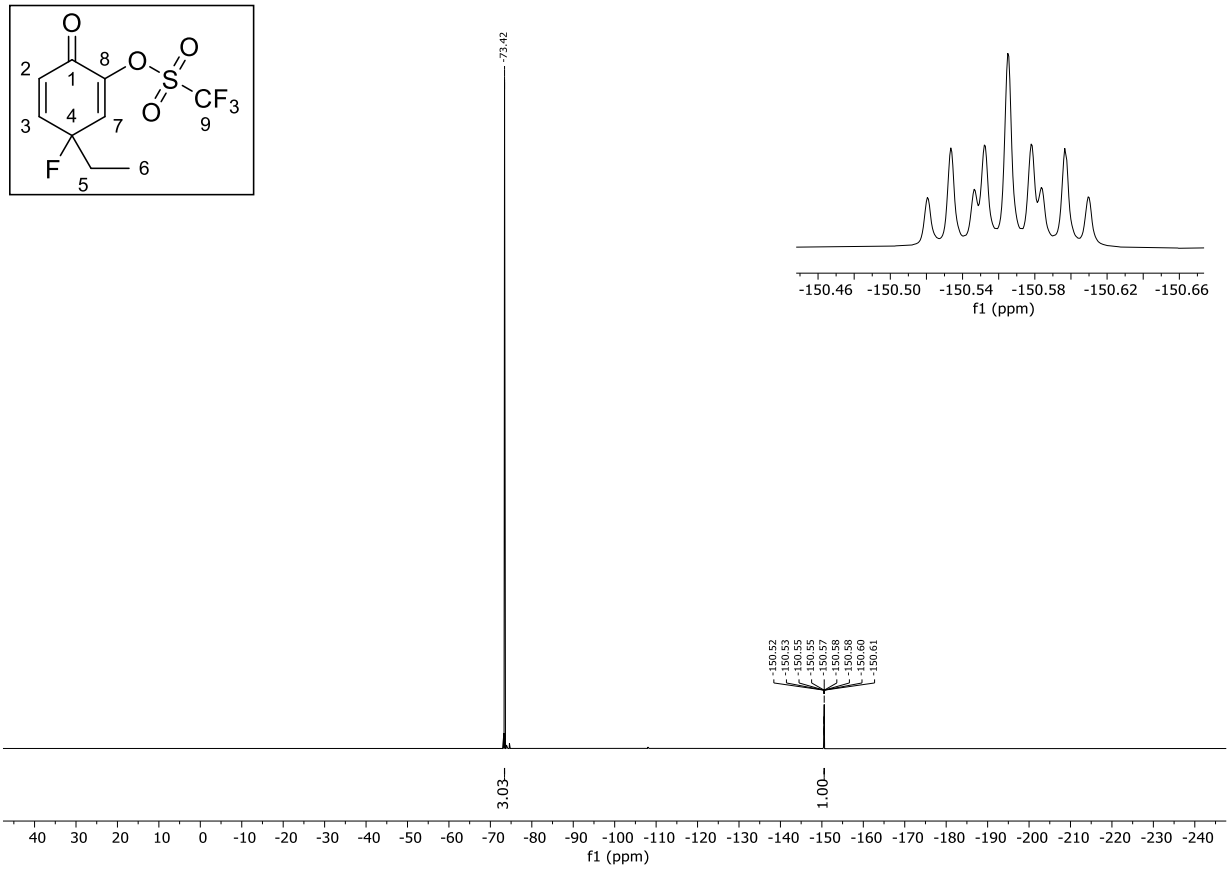
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



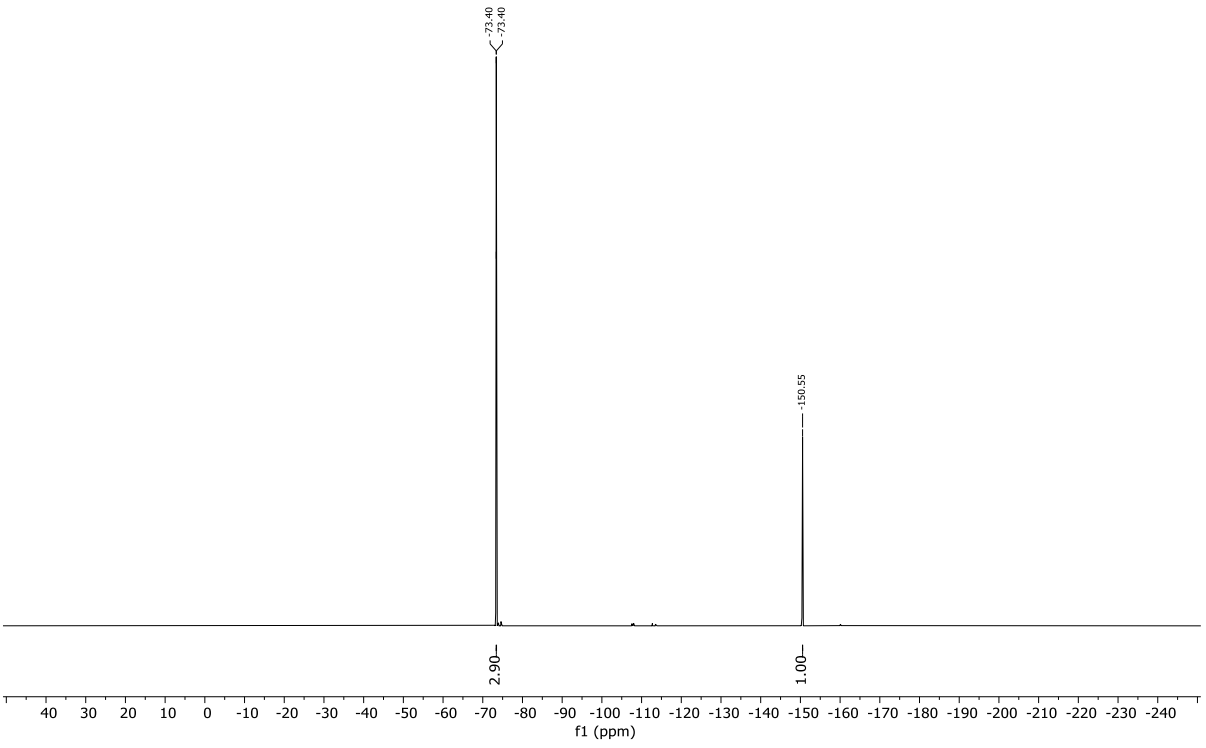
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

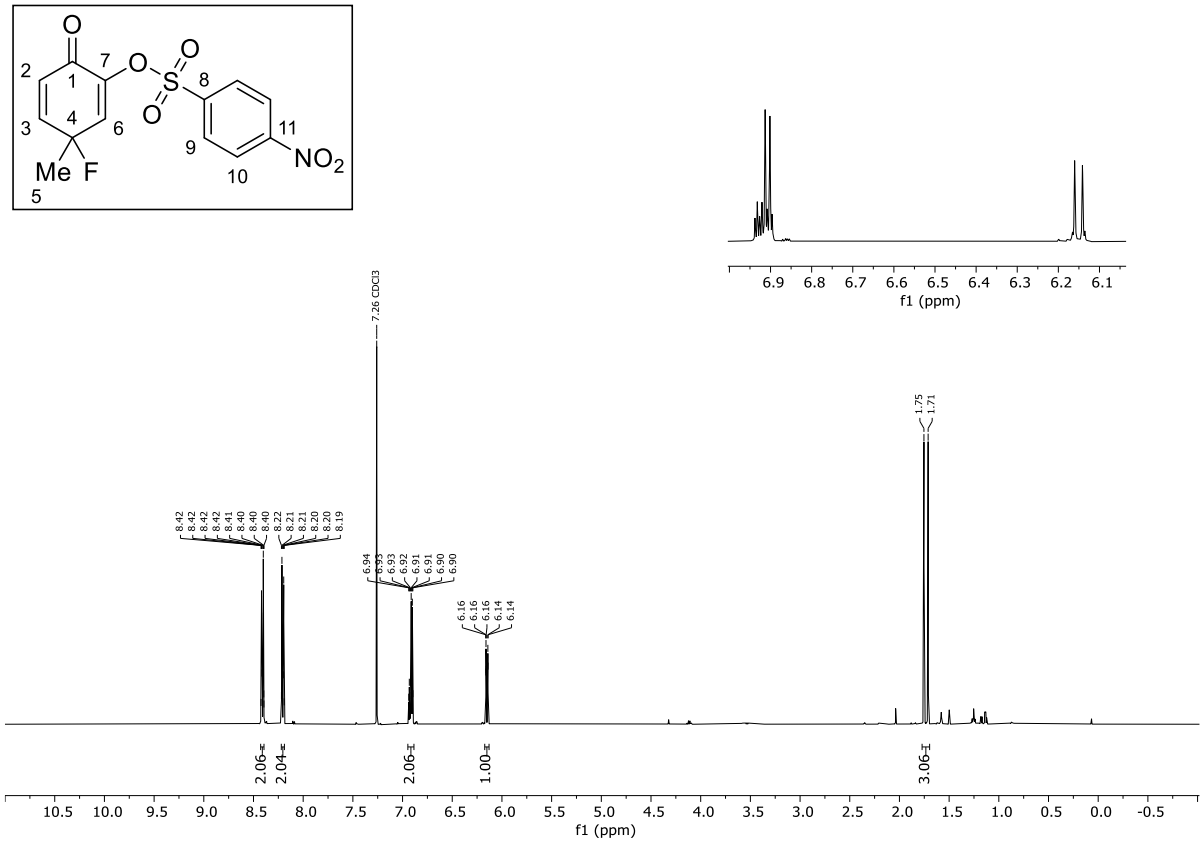


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

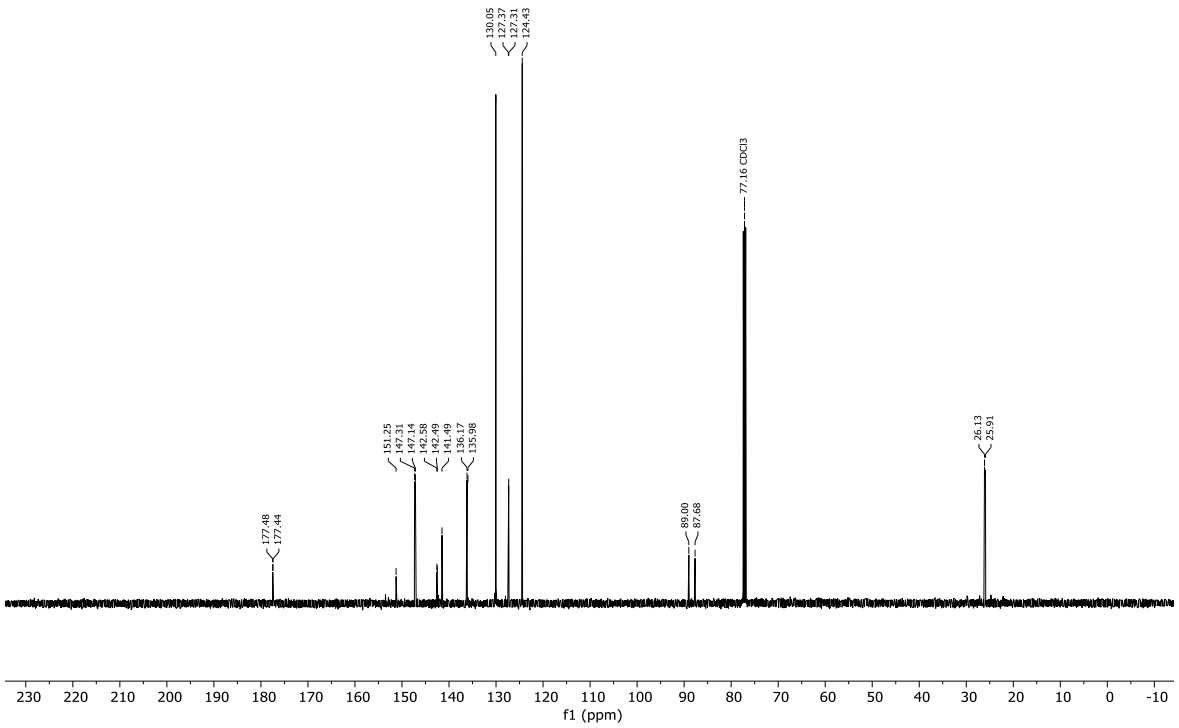


3-fluoro-3-methyl-6-oxocyclohexa-1,4-dien-1-yl 4-nitrobenzenesulfonate (9m)

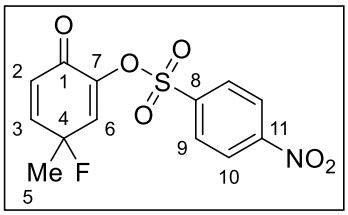
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

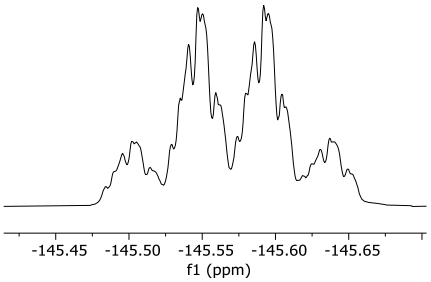


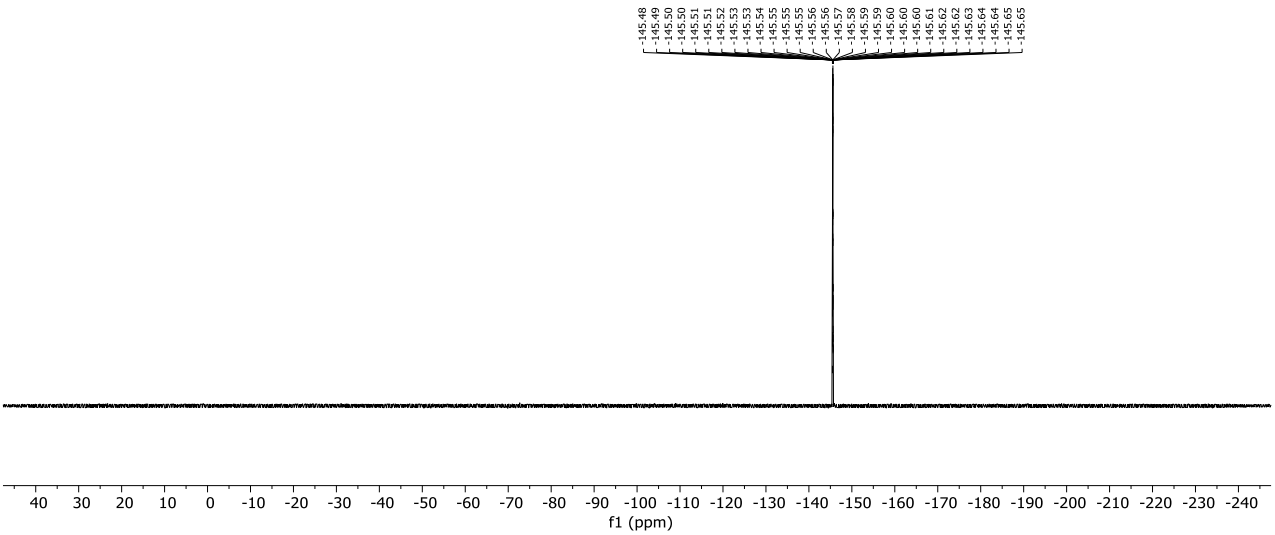
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



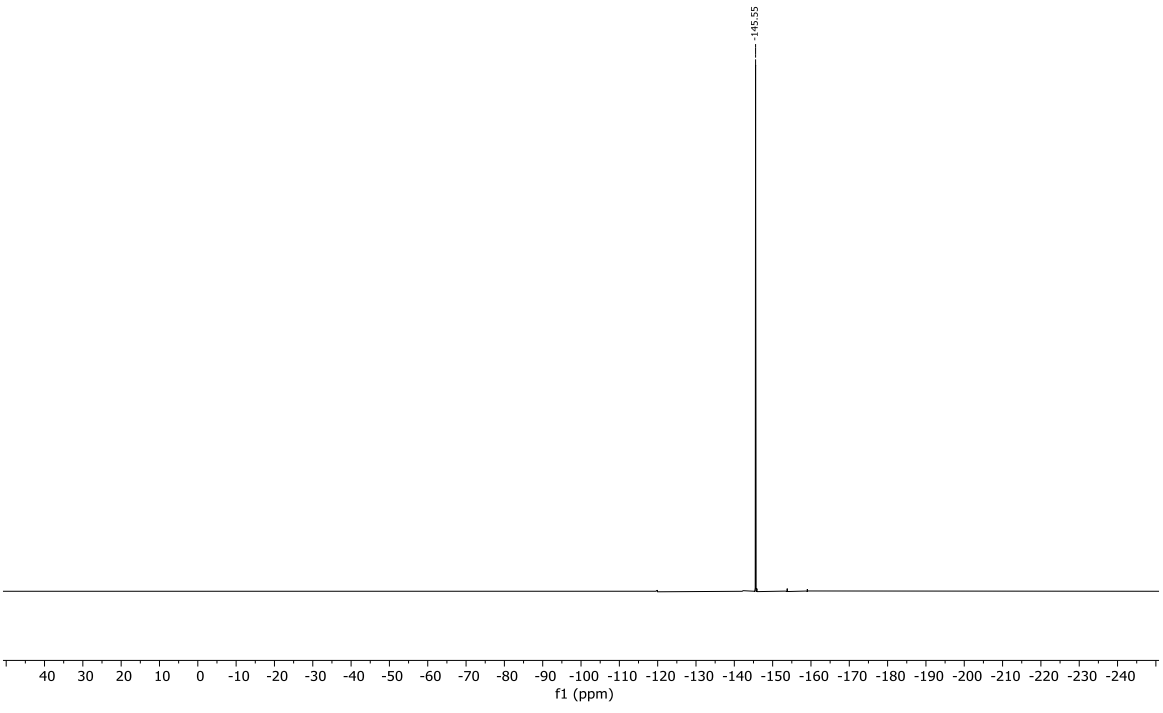
^{19}F NMR (470 MHz, $CDCl_3$, 299 K)





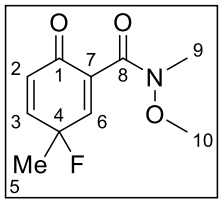


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

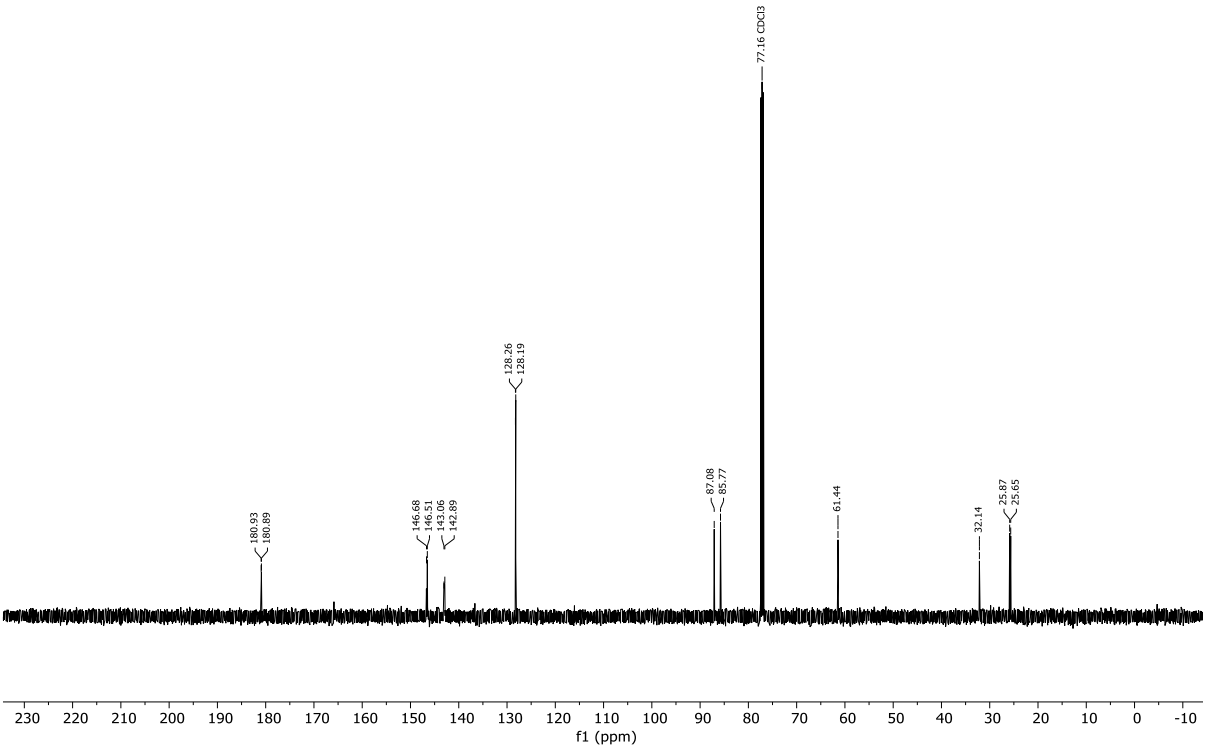


3-fluoro-N-methoxy-*N*,3-dimethyl-6-oxocyclohexa-1,4-diene-1-carboxamide (9n)

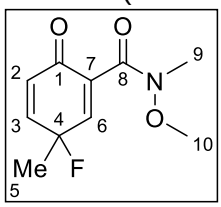
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



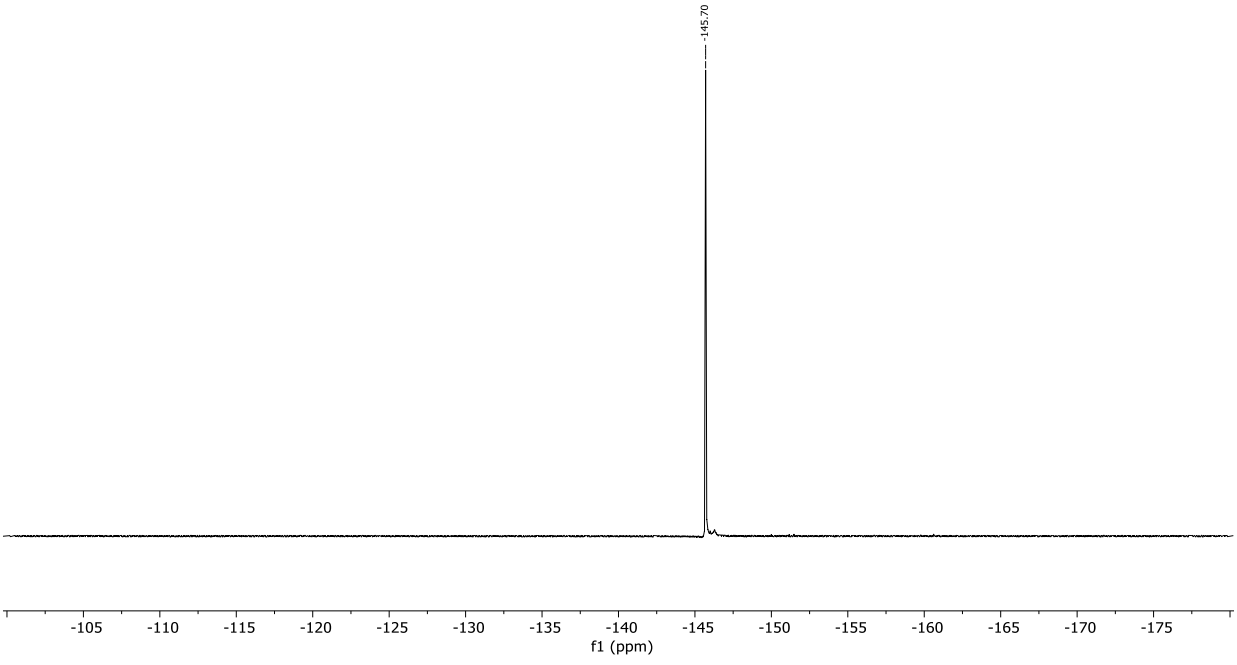
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

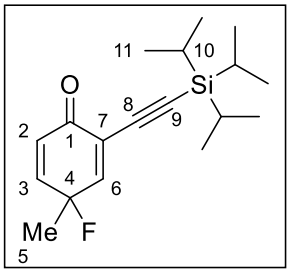


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

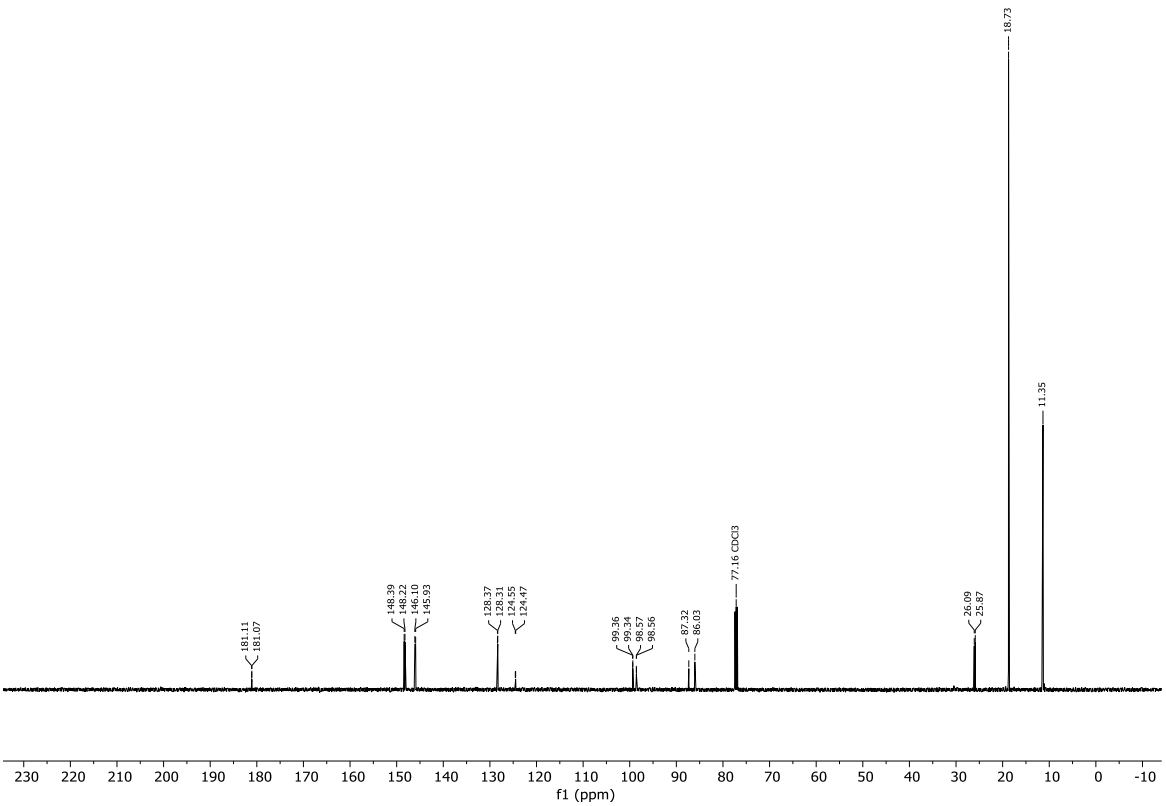


4-fluoro-4-methyl-2-((triisopropylsilyl)ethynyl)cyclohexa-2,5-dien-1-one (9o)

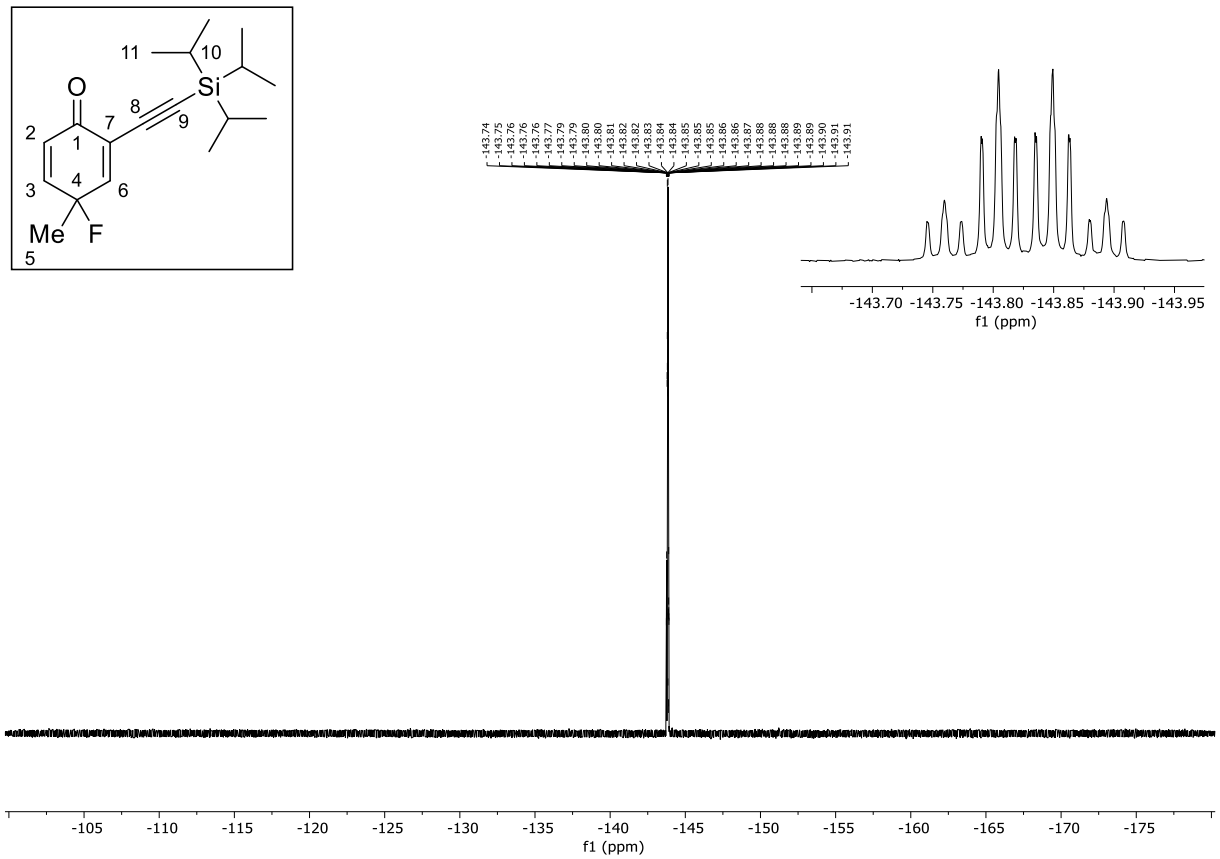
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



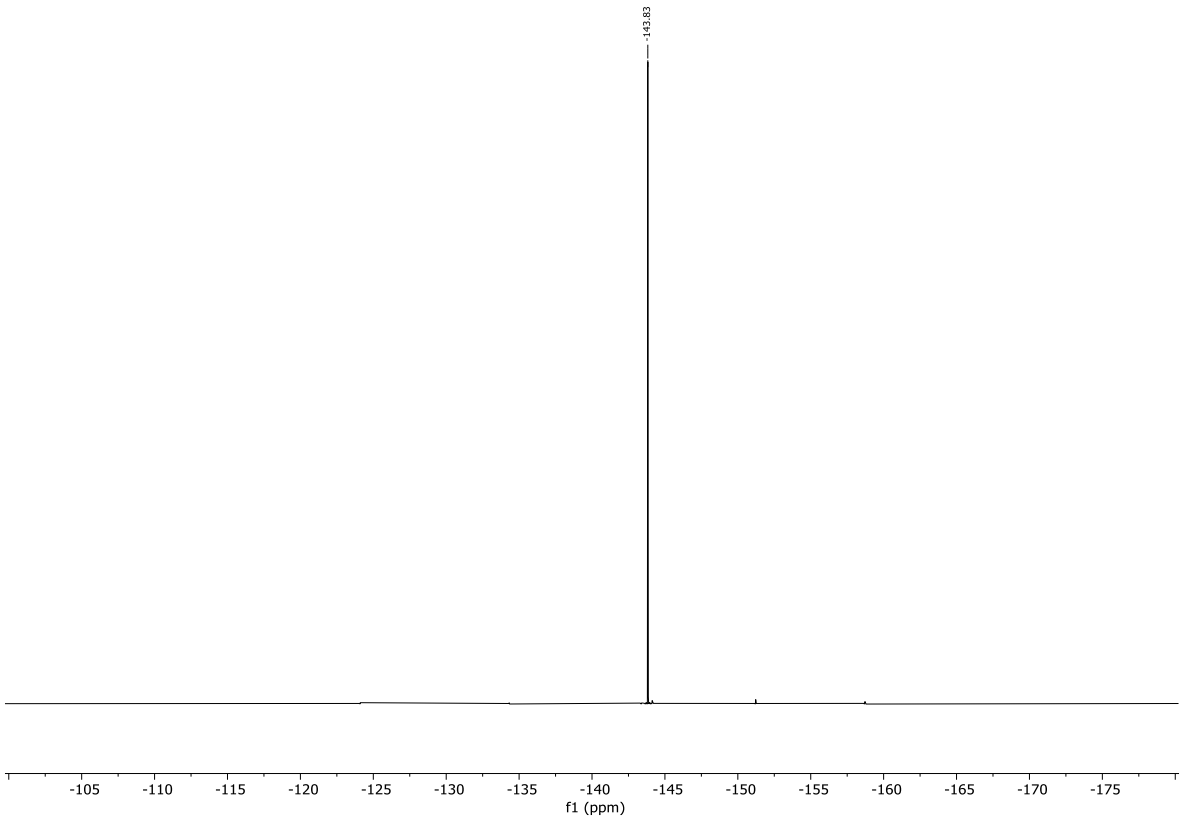
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

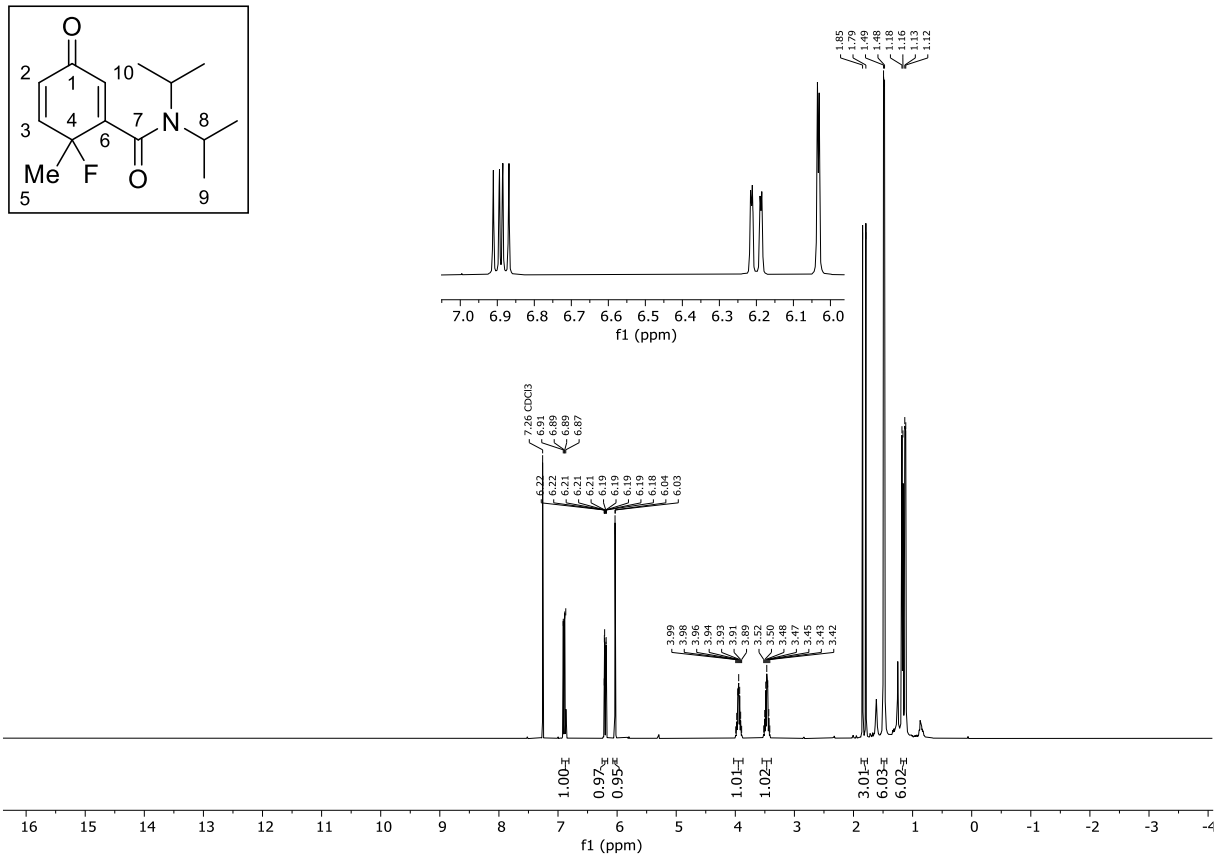


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

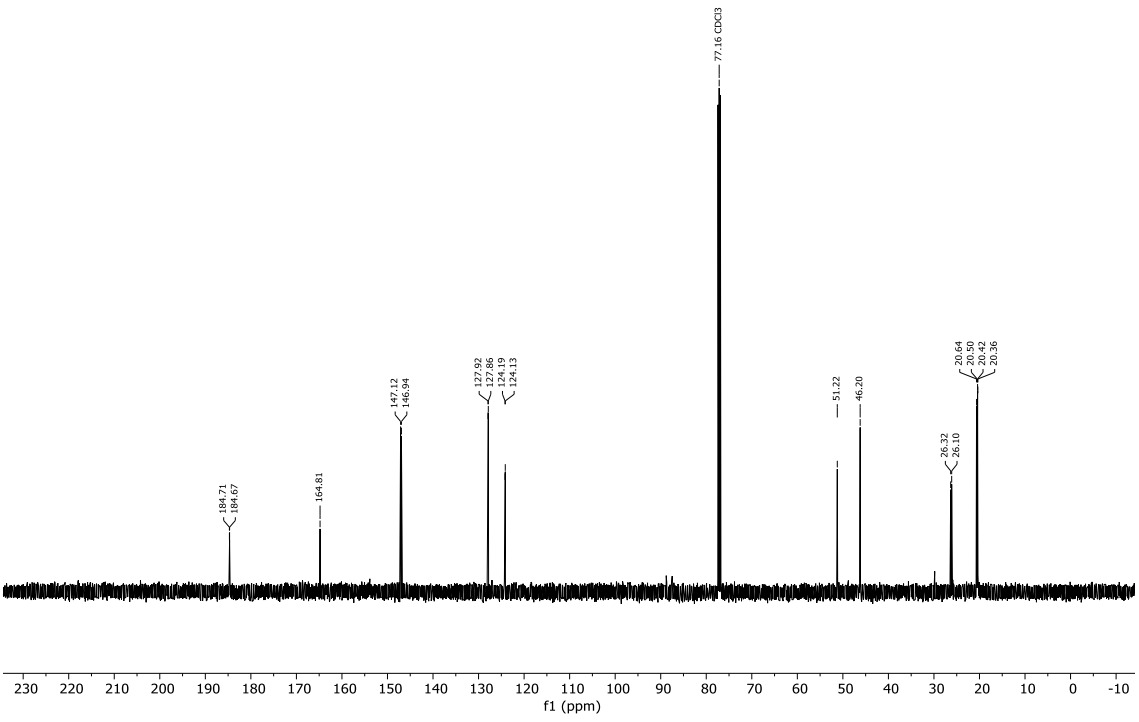


6-fluoro-*N,N*-diisopropyl-6-methyl-3-oxocyclohexa-1,4-diene-1-carboxamide (9p)

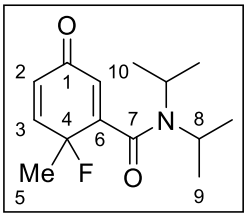
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

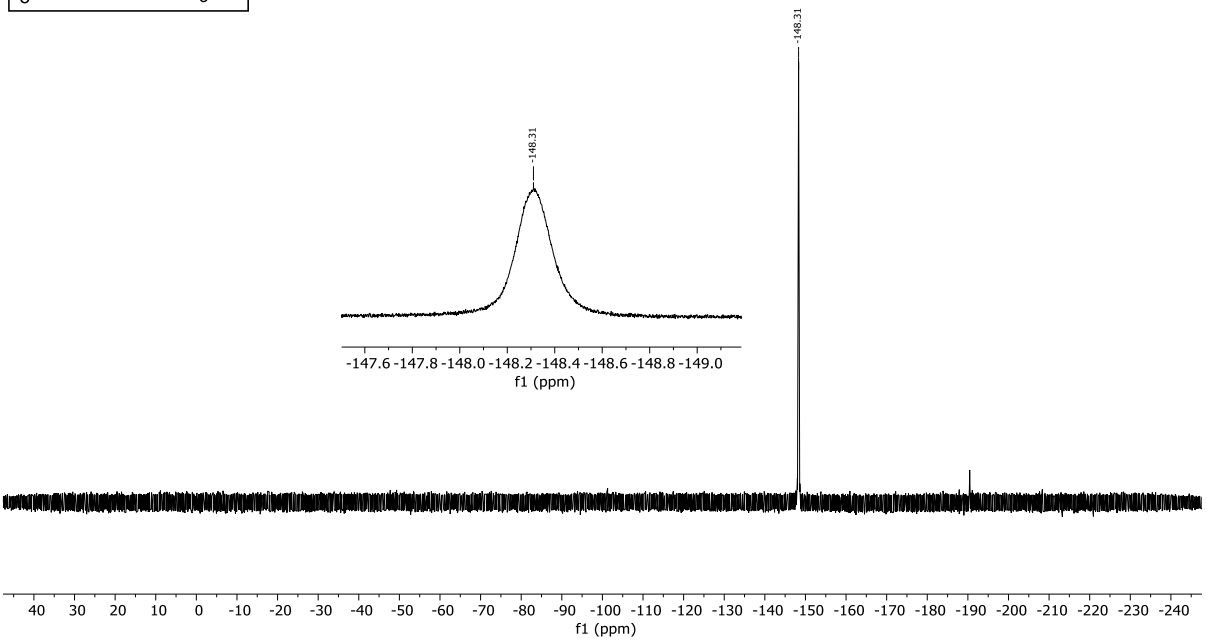


^{13}C NMR (126 MHz, $CDCl_3$, 299 K)

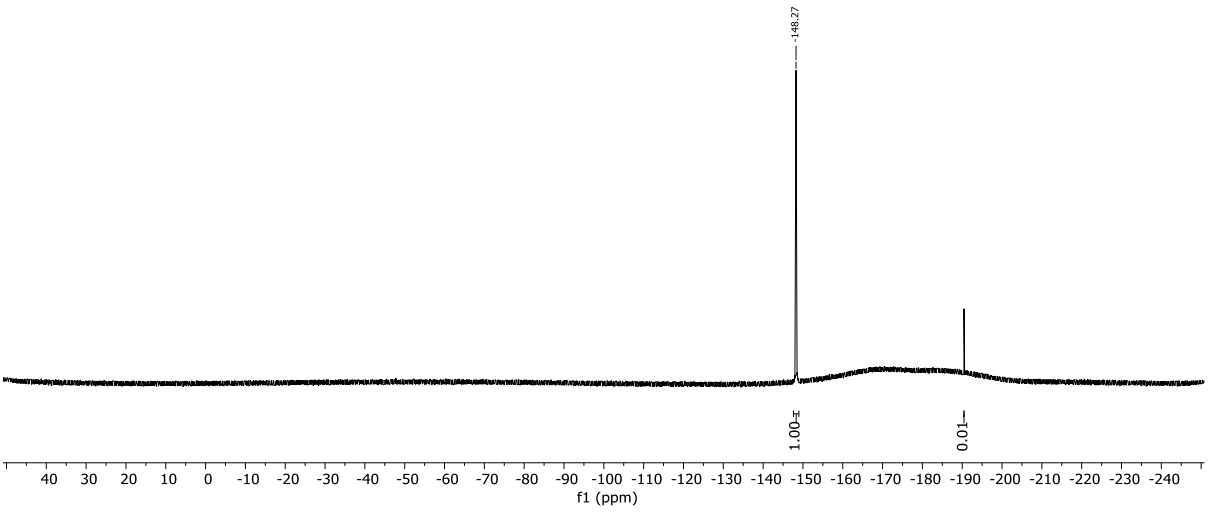


^{19}F NMR (470 MHz, $CDCl_3$, 299 K)



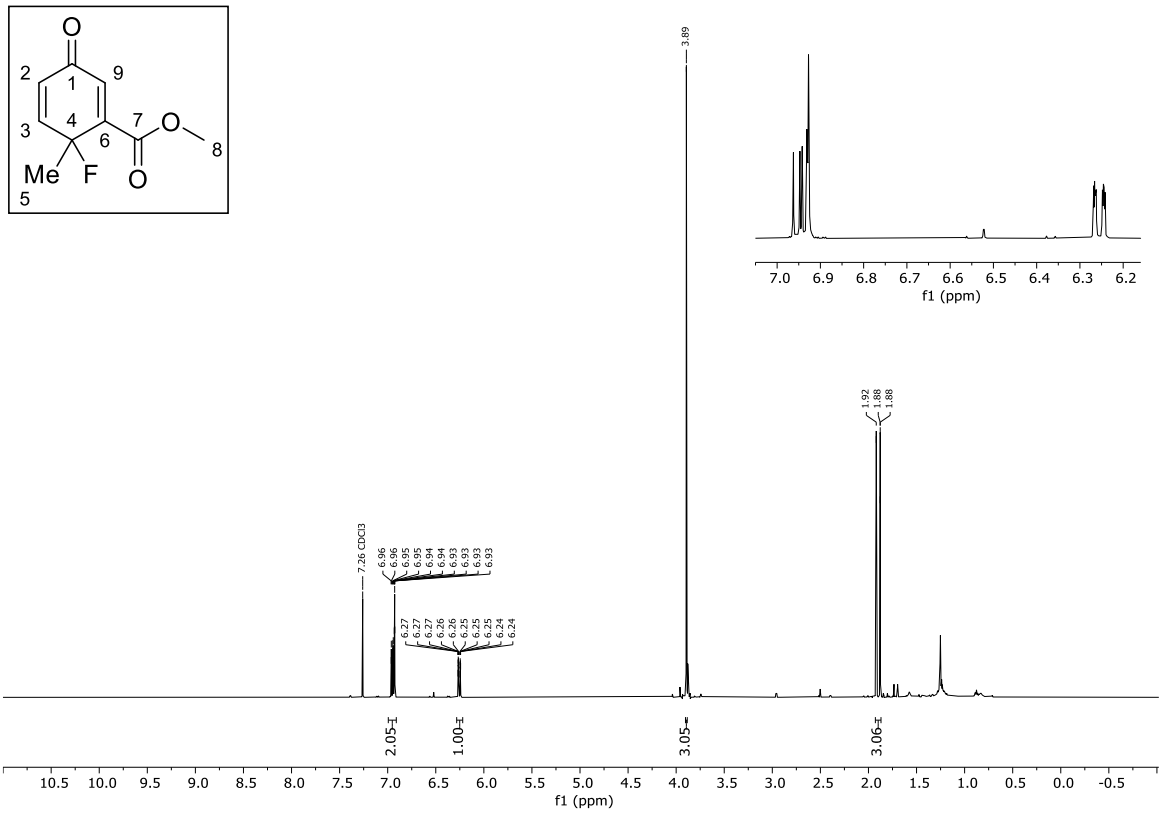


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

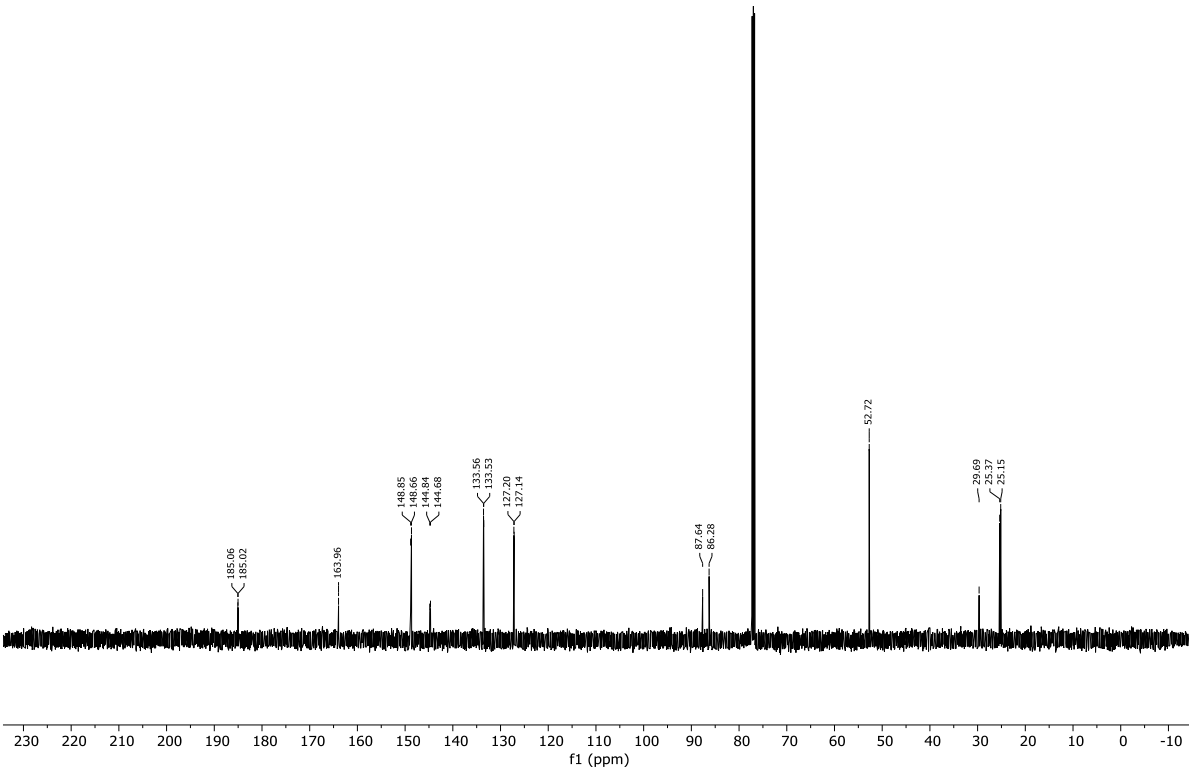


methyl 6-fluoro-6-methyl-3-oxocyclohexa-1,4-diene-1-carboxylate (9q)

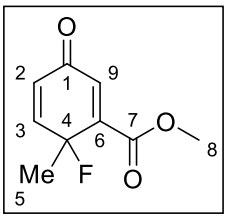
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)

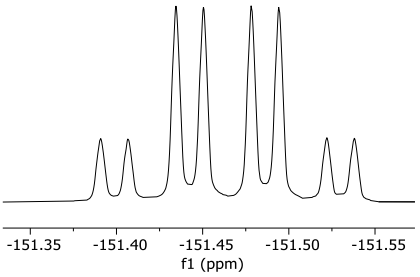


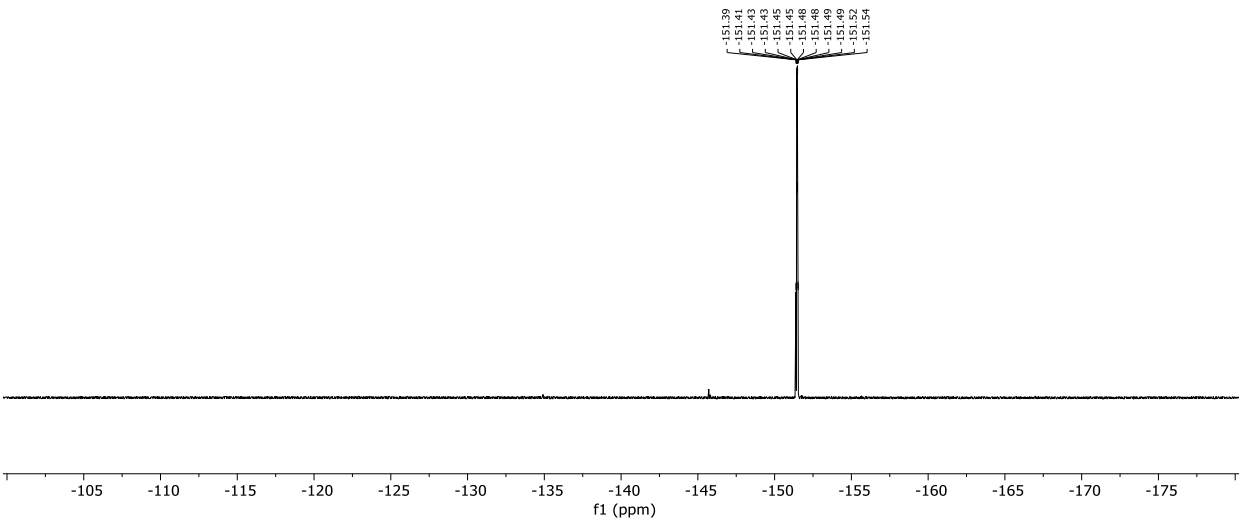
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



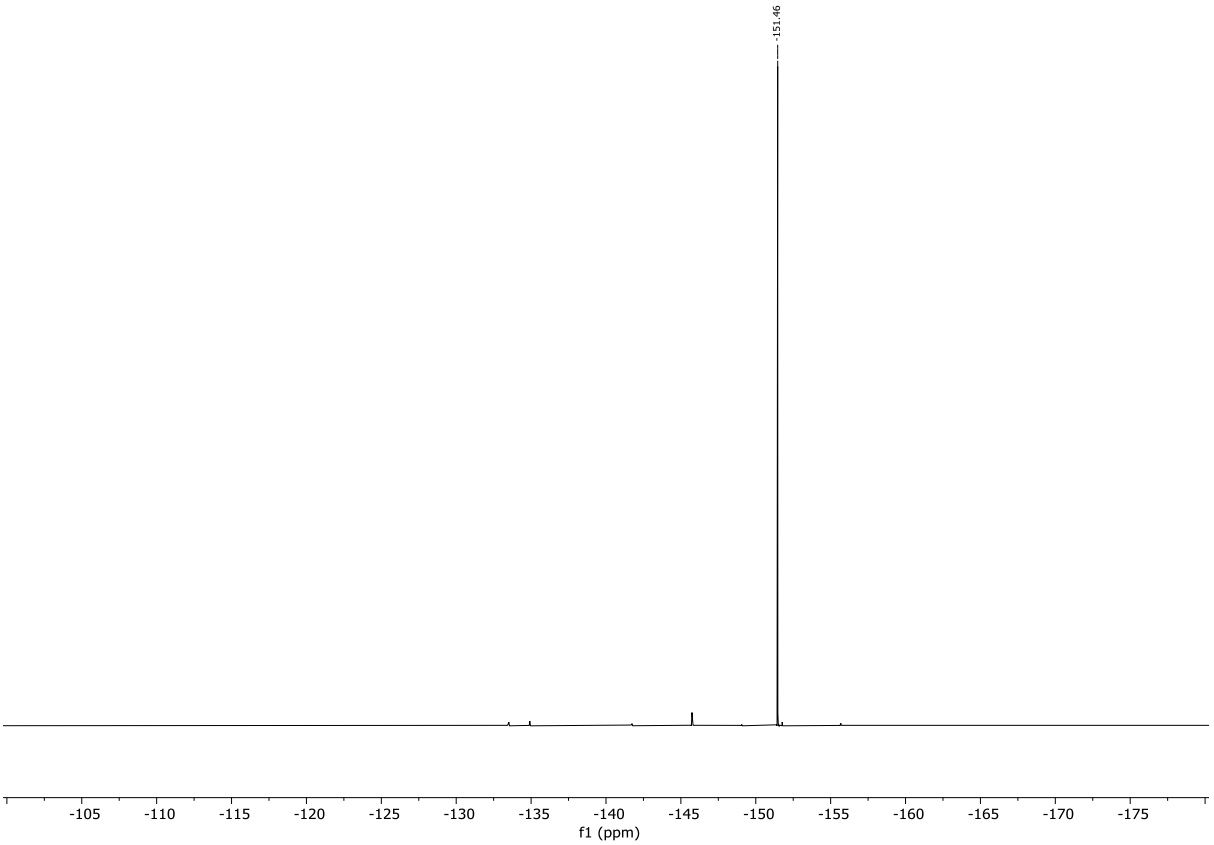
^{19}F NMR (470 MHz, $CDCl_3$, 299 K)





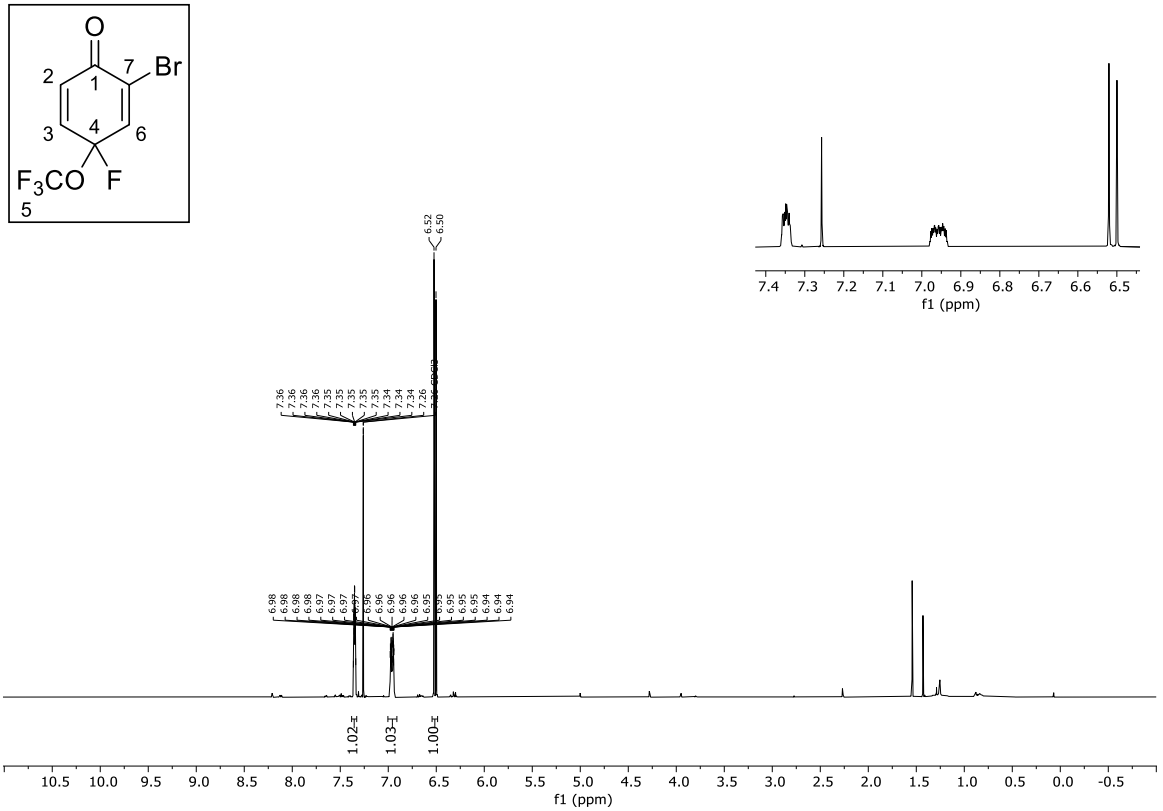


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

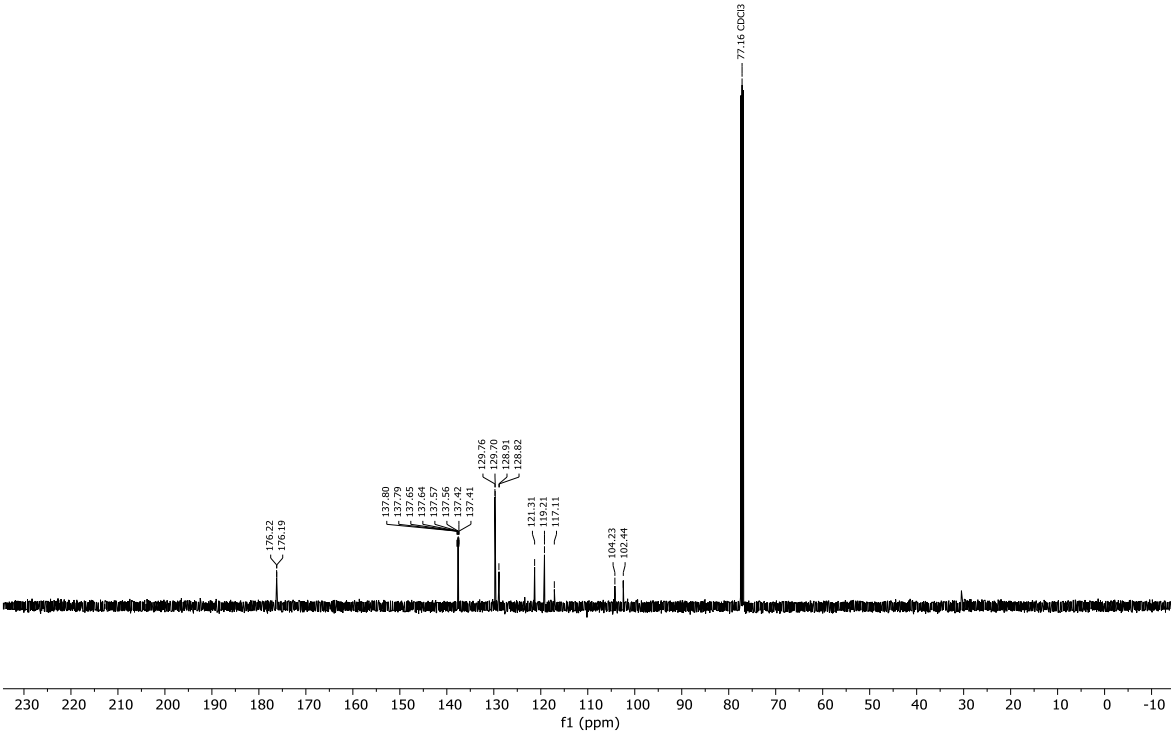


2-bromo-4-fluoro-4-(trifluoromethoxy)cyclohexa-2,5-dien-1-one (9r)

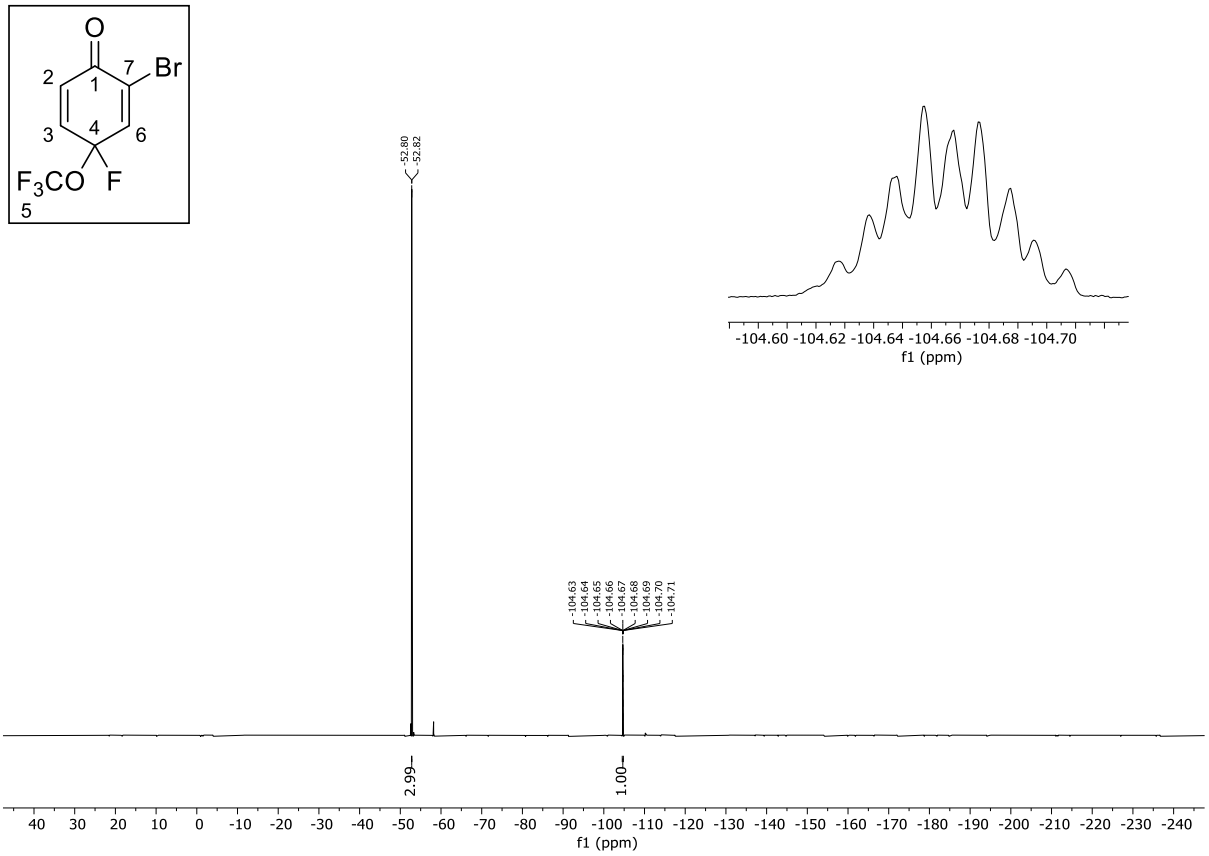
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



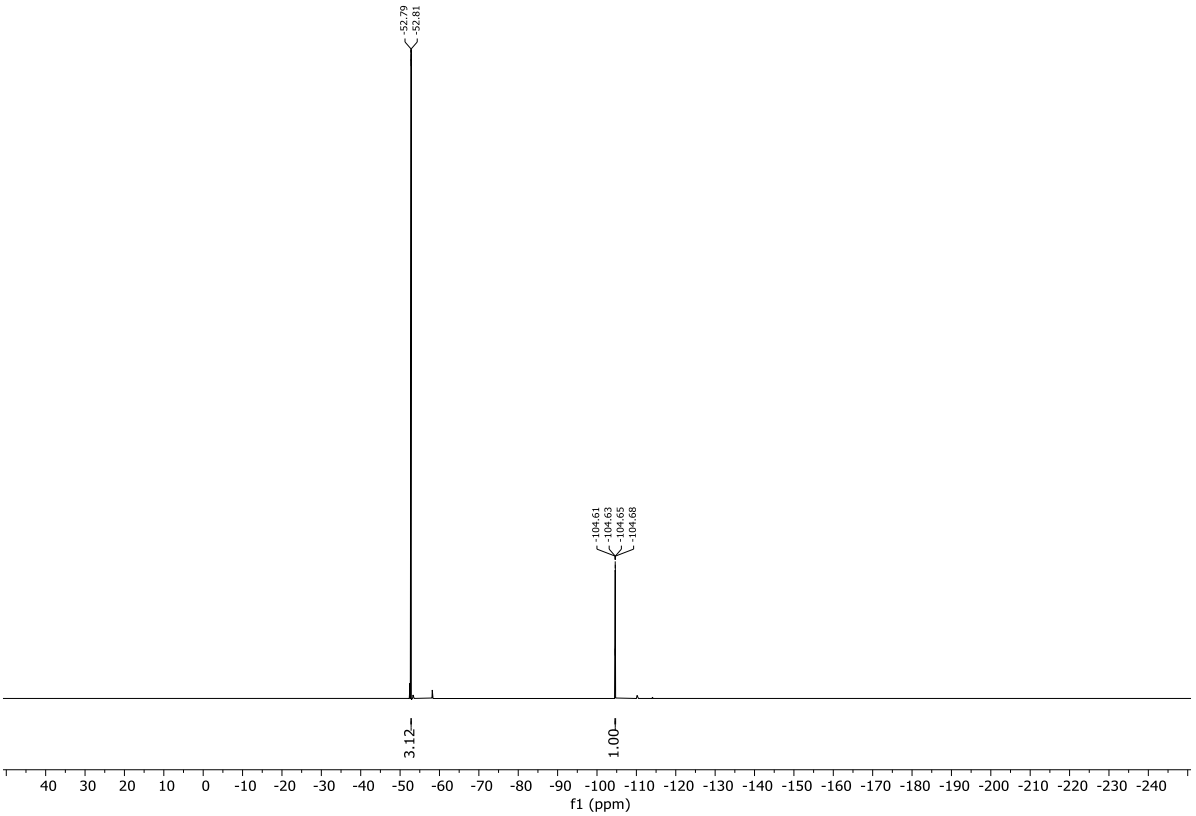
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

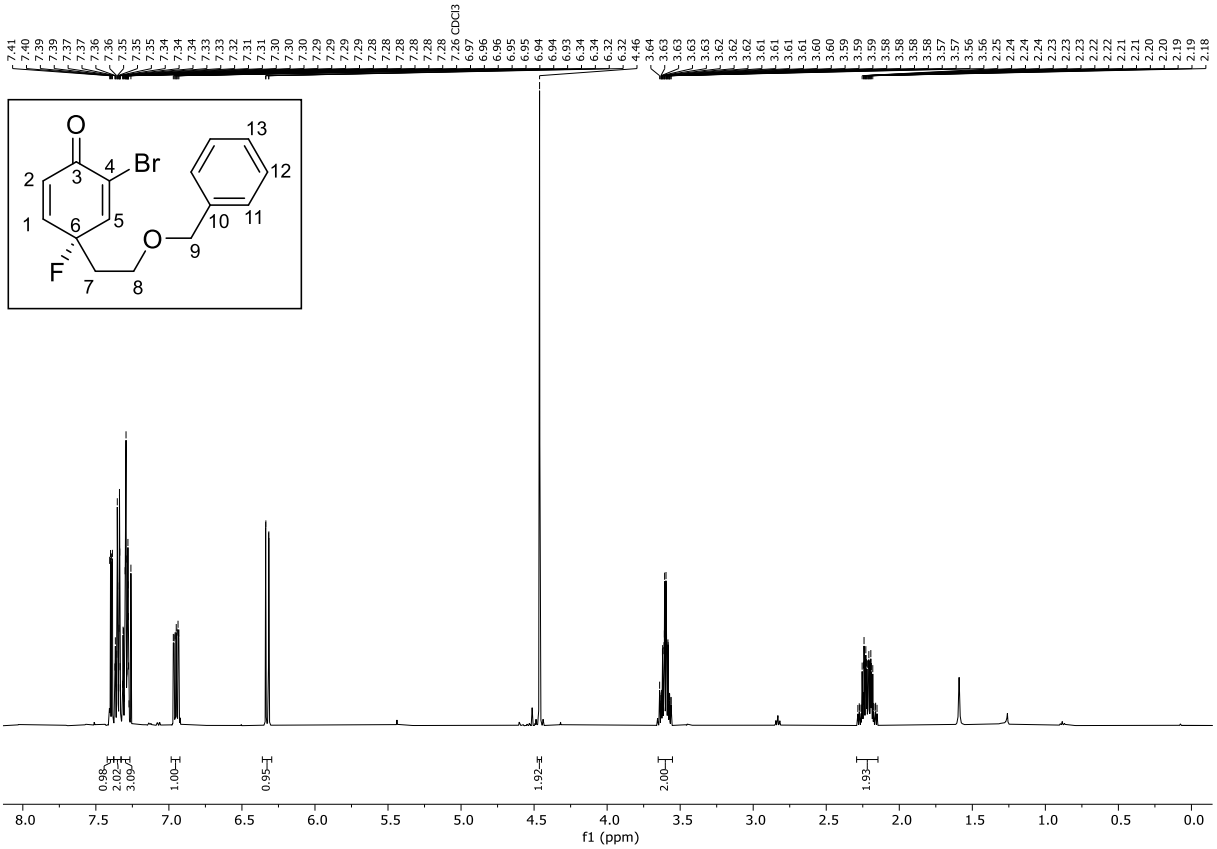


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

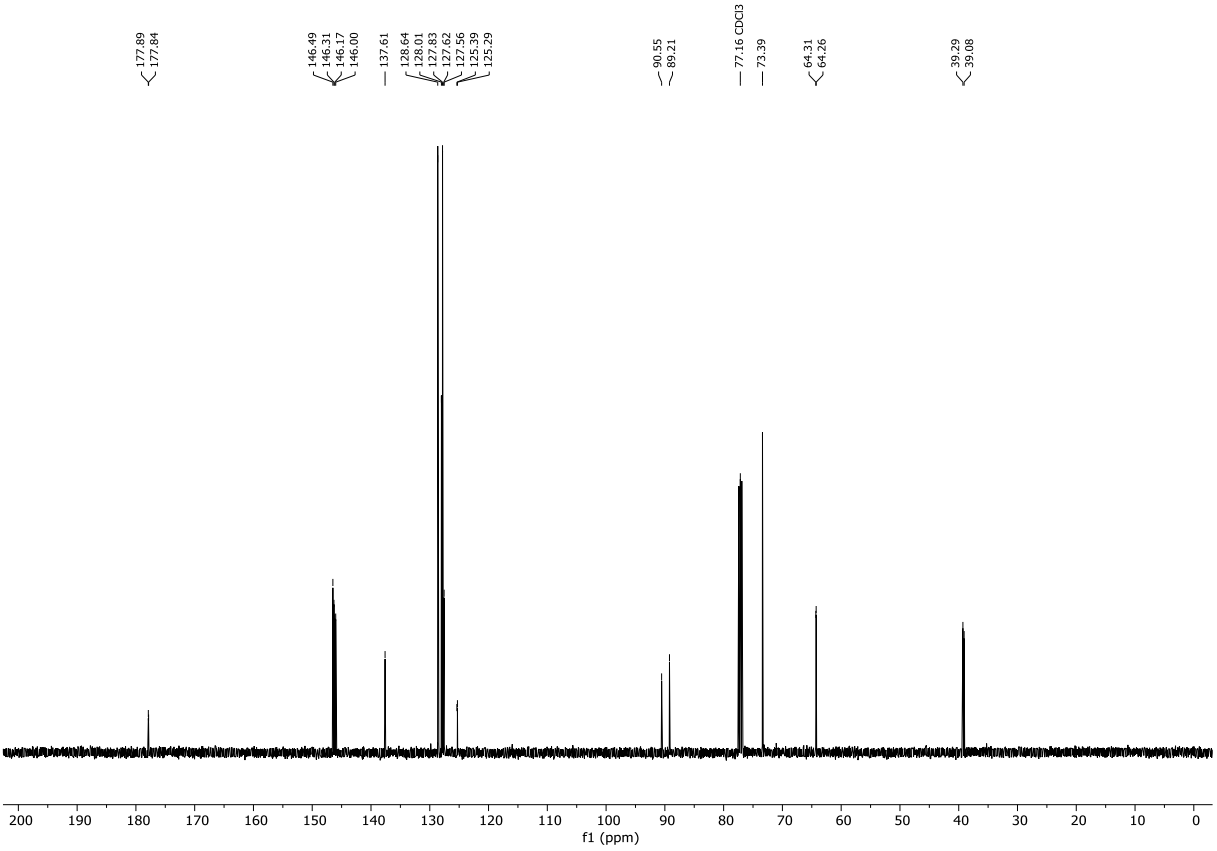


4-(2-(benzyloxy)ethyl)-2-bromo-4-fluorocyclohexa-2,5-dien-1-one (9s)

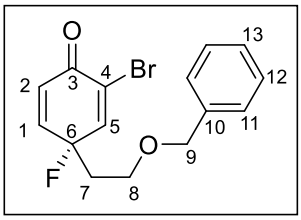
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



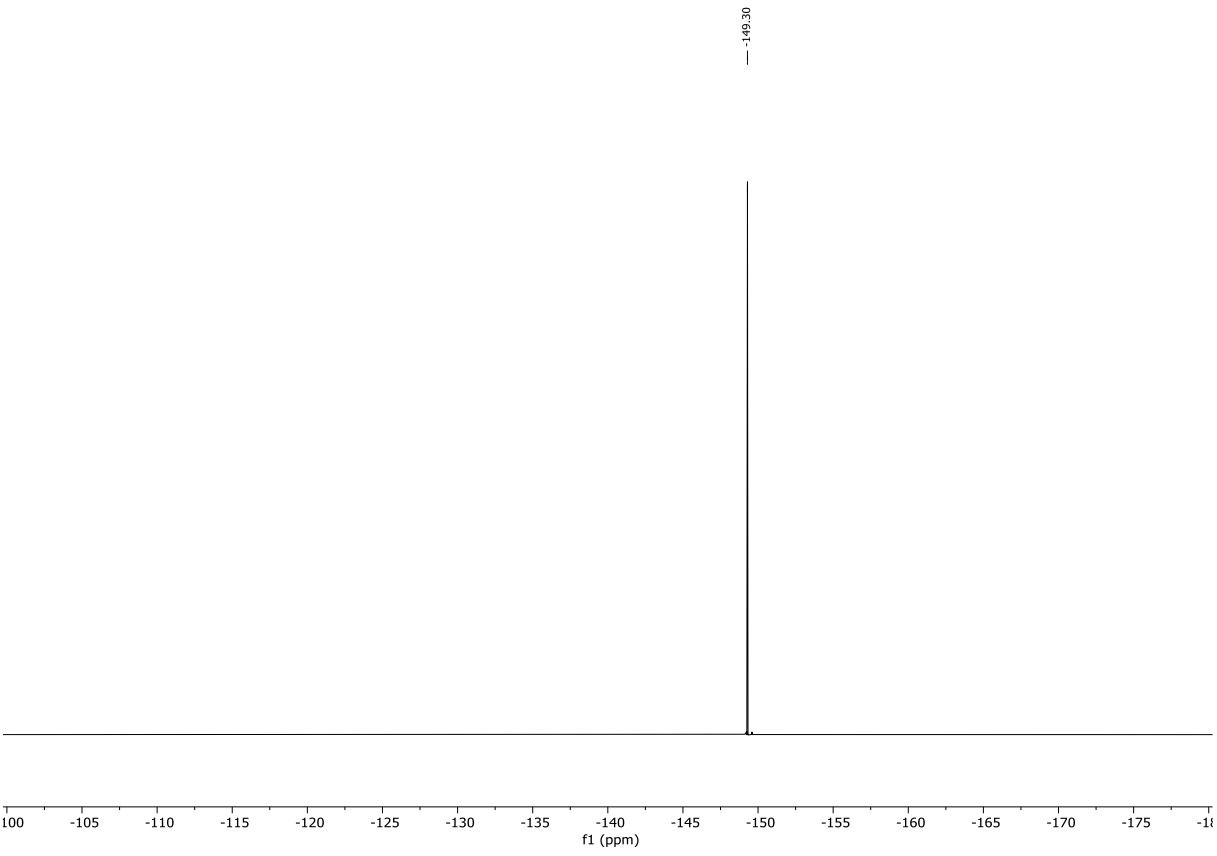
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

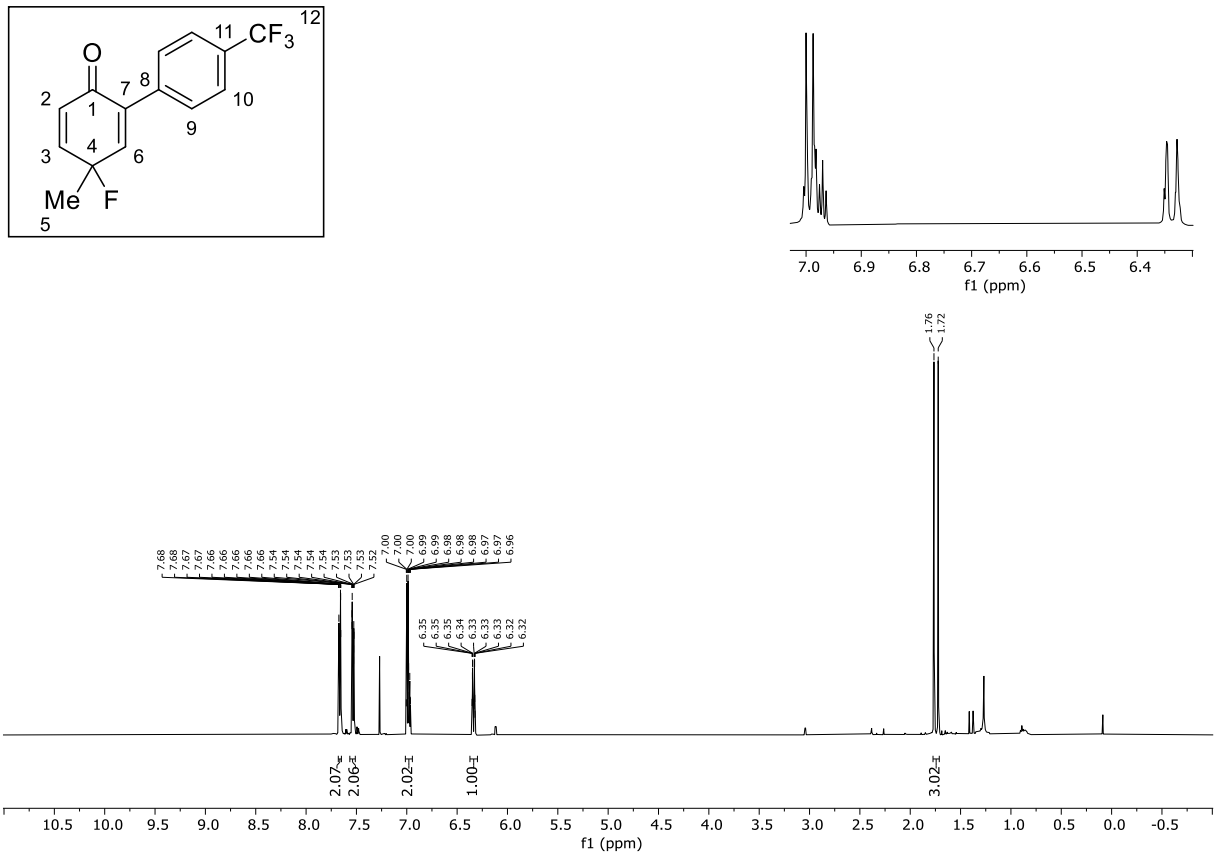


^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)

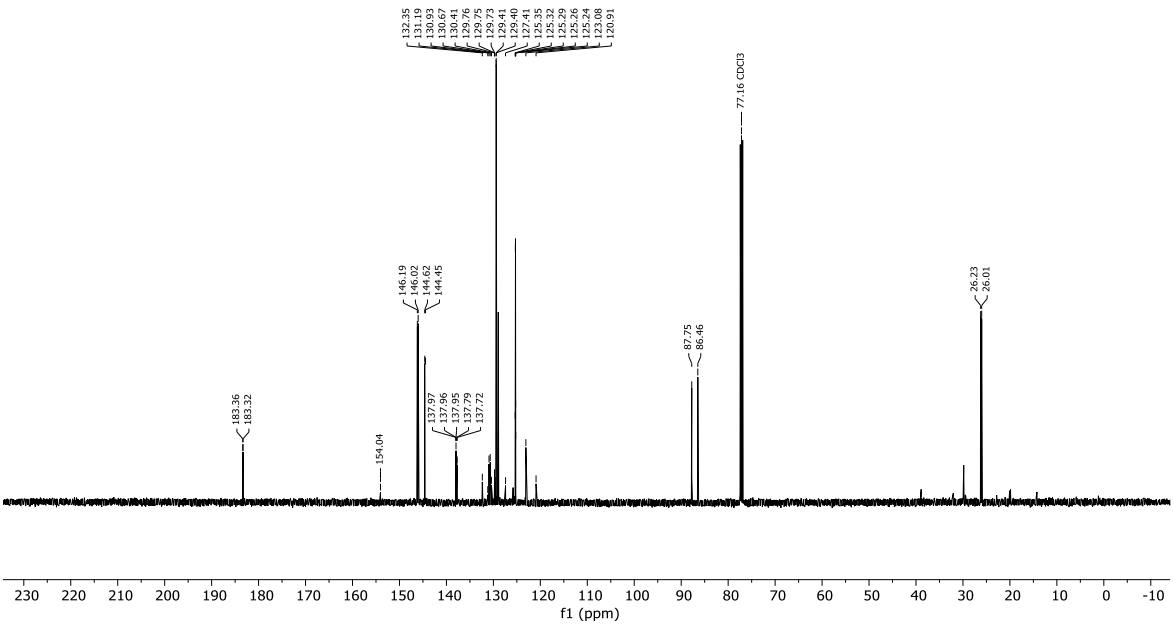


5-fluoro-5-methyl-4'-(trifluoromethyl)-[1,1'-biphenyl]-2(5H)-one (9t)

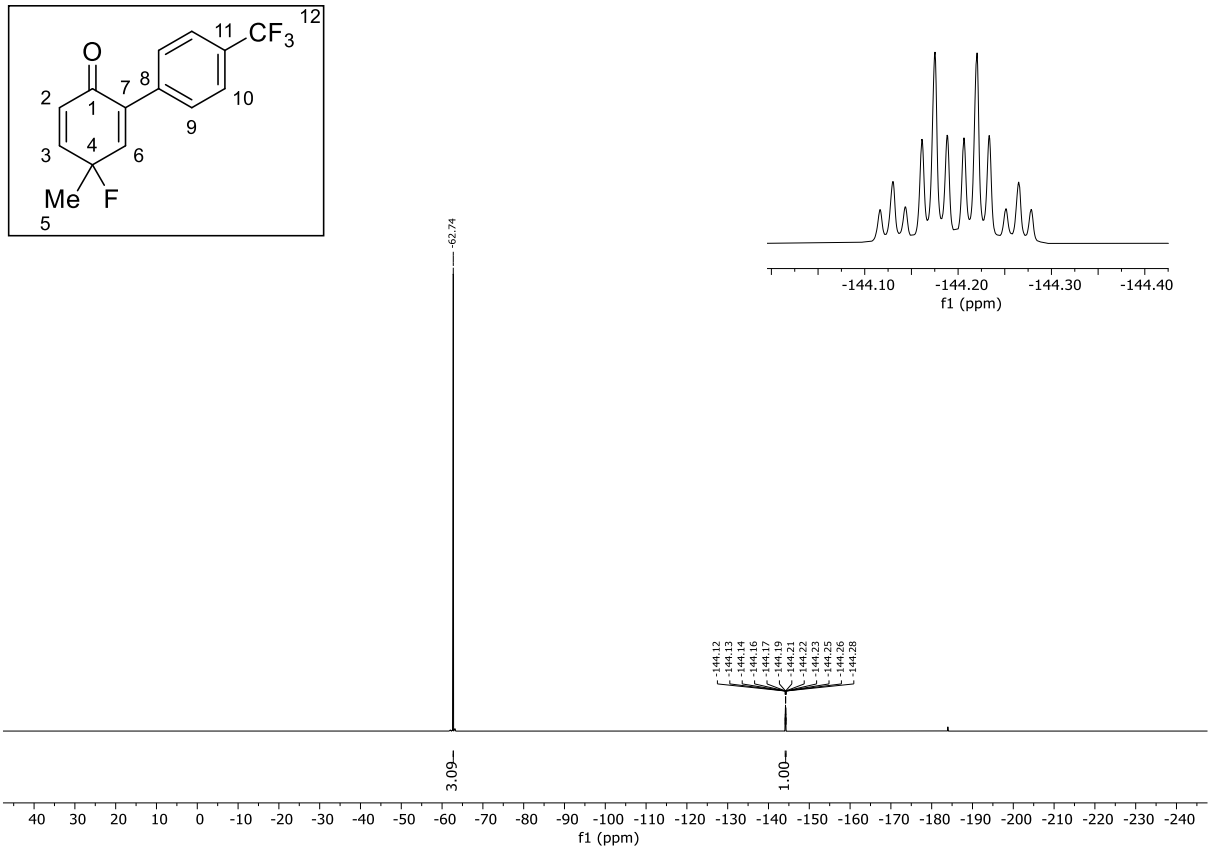
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



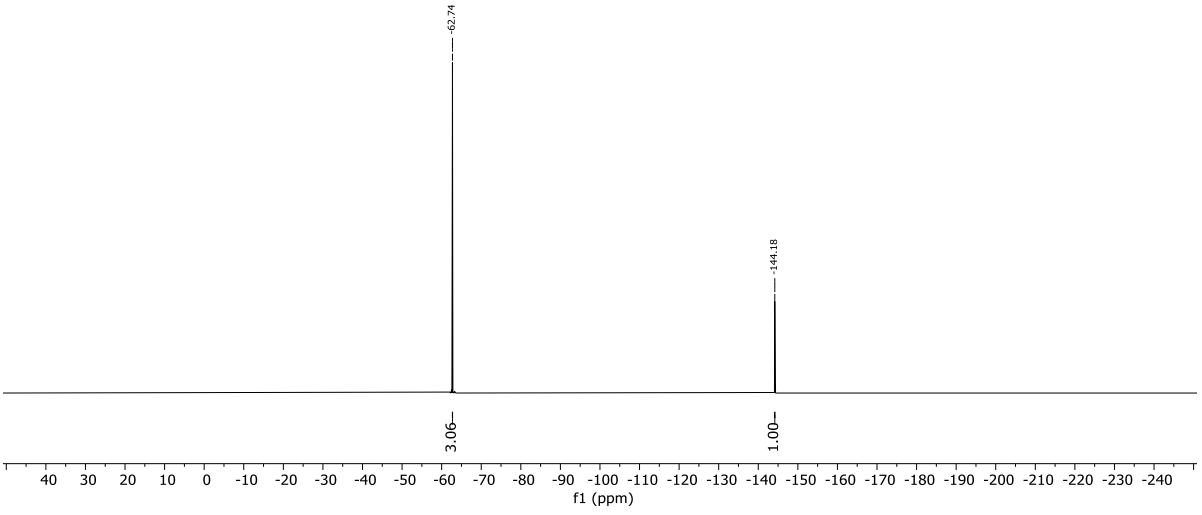
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)

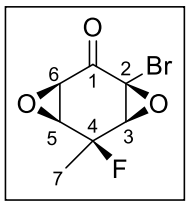


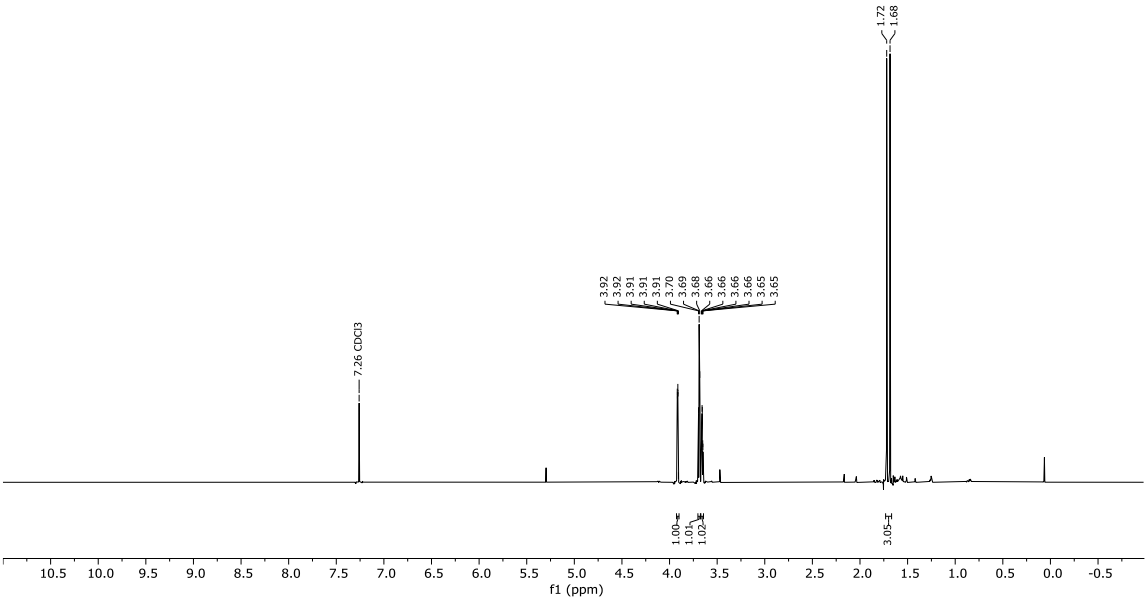
^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)



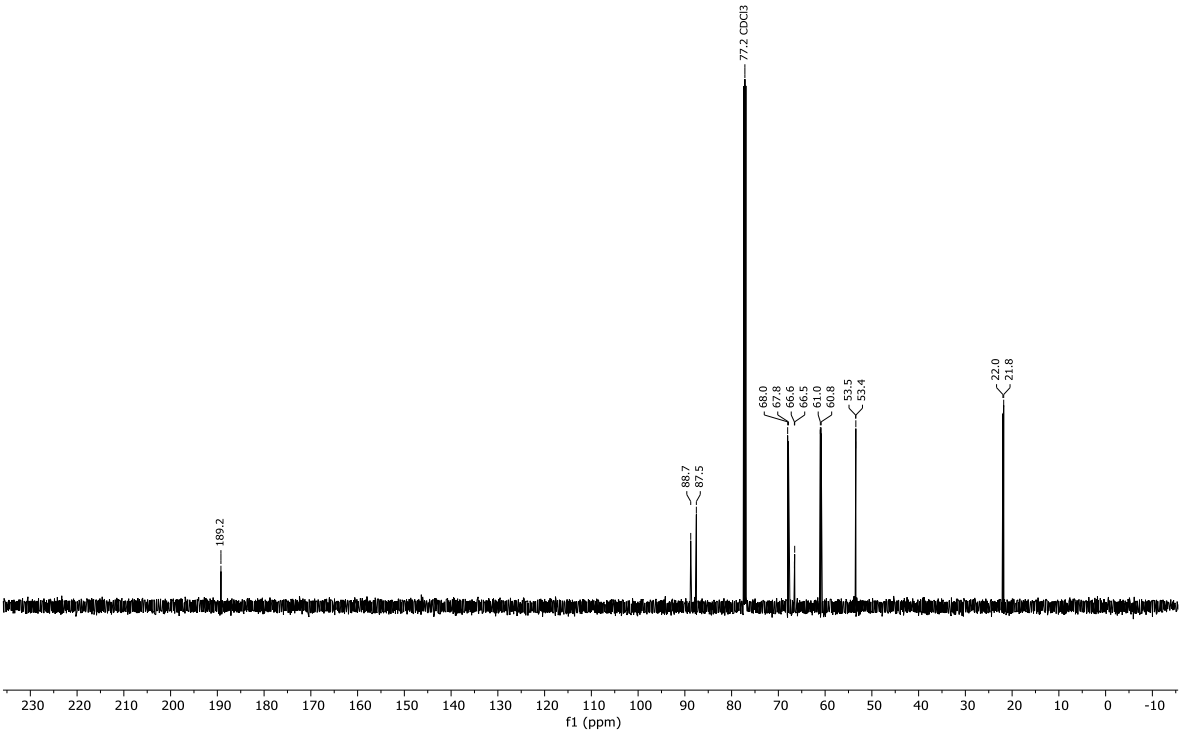
1-bromo-6-fluoro-6-methyl-4,8-dioxatricyclo[5.1.0.0^{3,5}]octan-2-one (28)

^{1}H NMR (599 MHz, $CDCl_3$, 299 K)

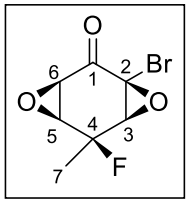


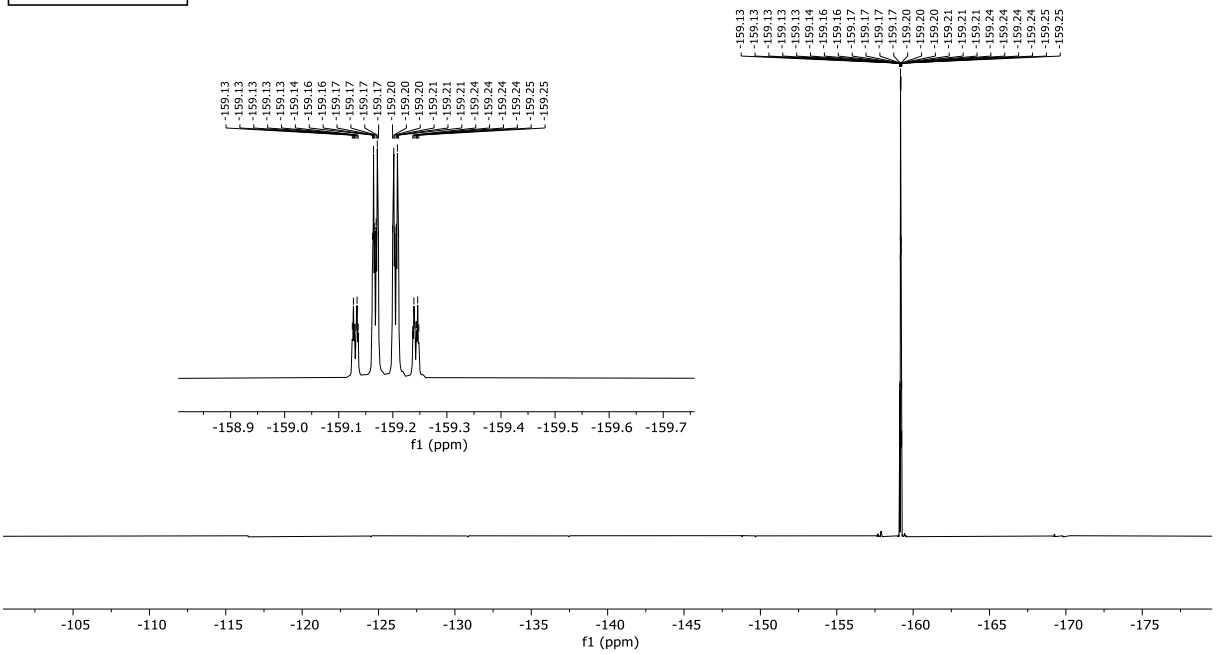


^{13}C NMR (151 MHz, $CDCl_3$, 299 K)

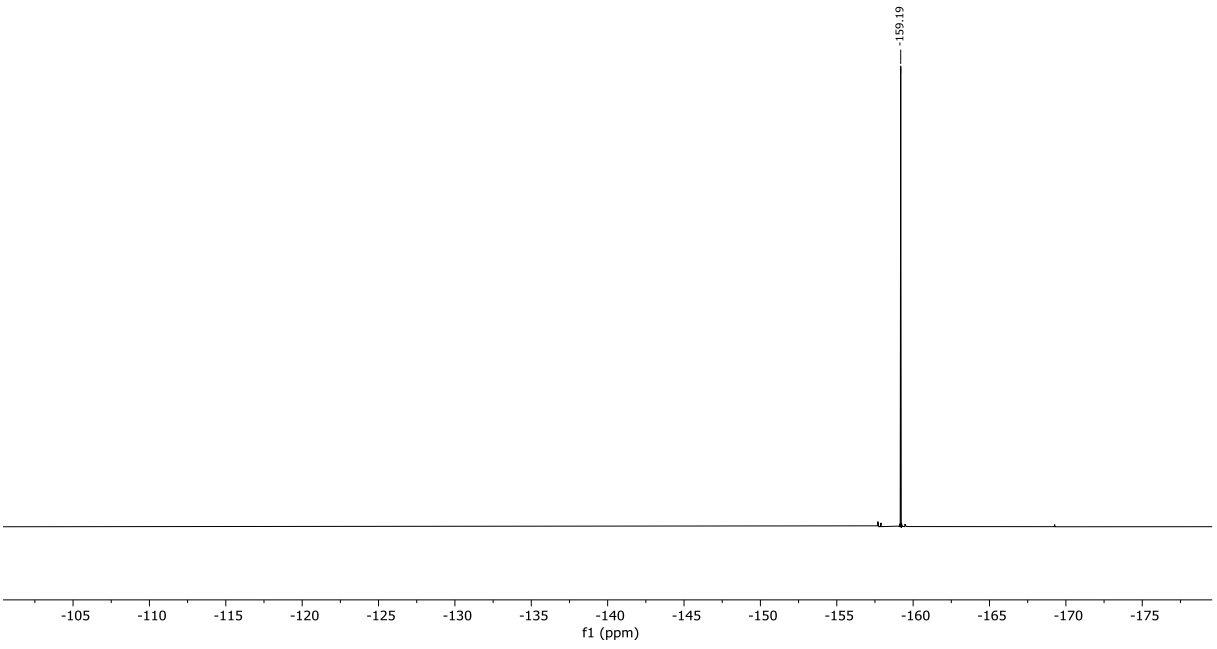


^{19}F NMR (564 MHz, $CDCl_3$, 299 K)



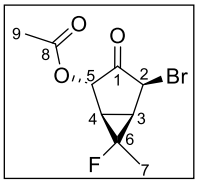


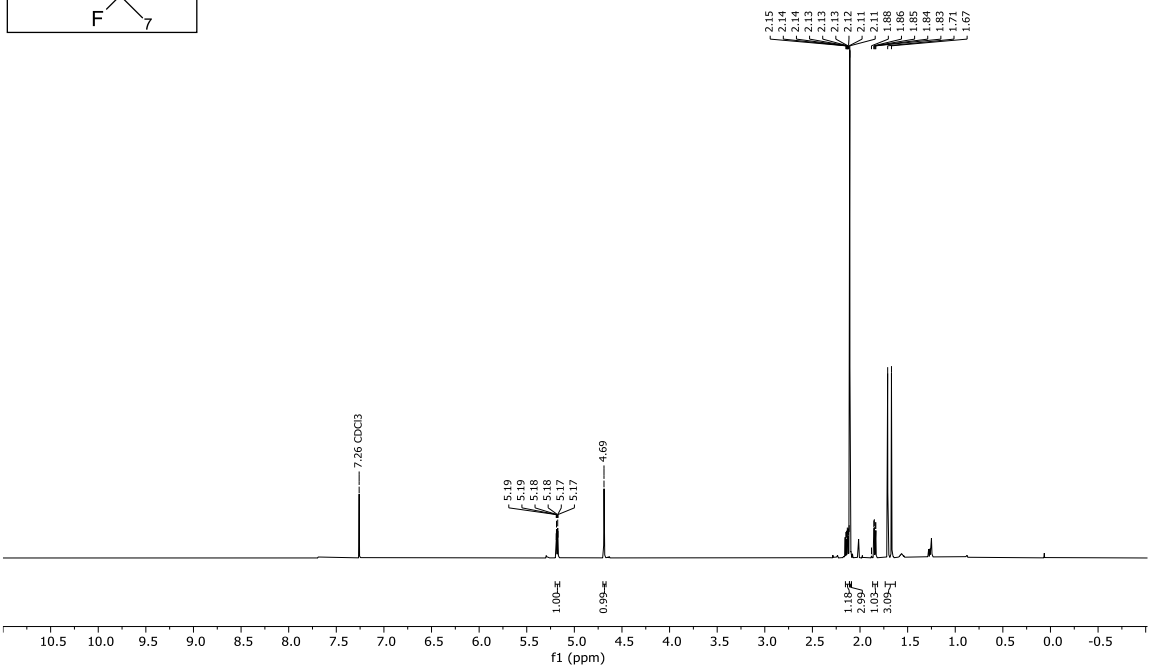
^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$, 299 K)



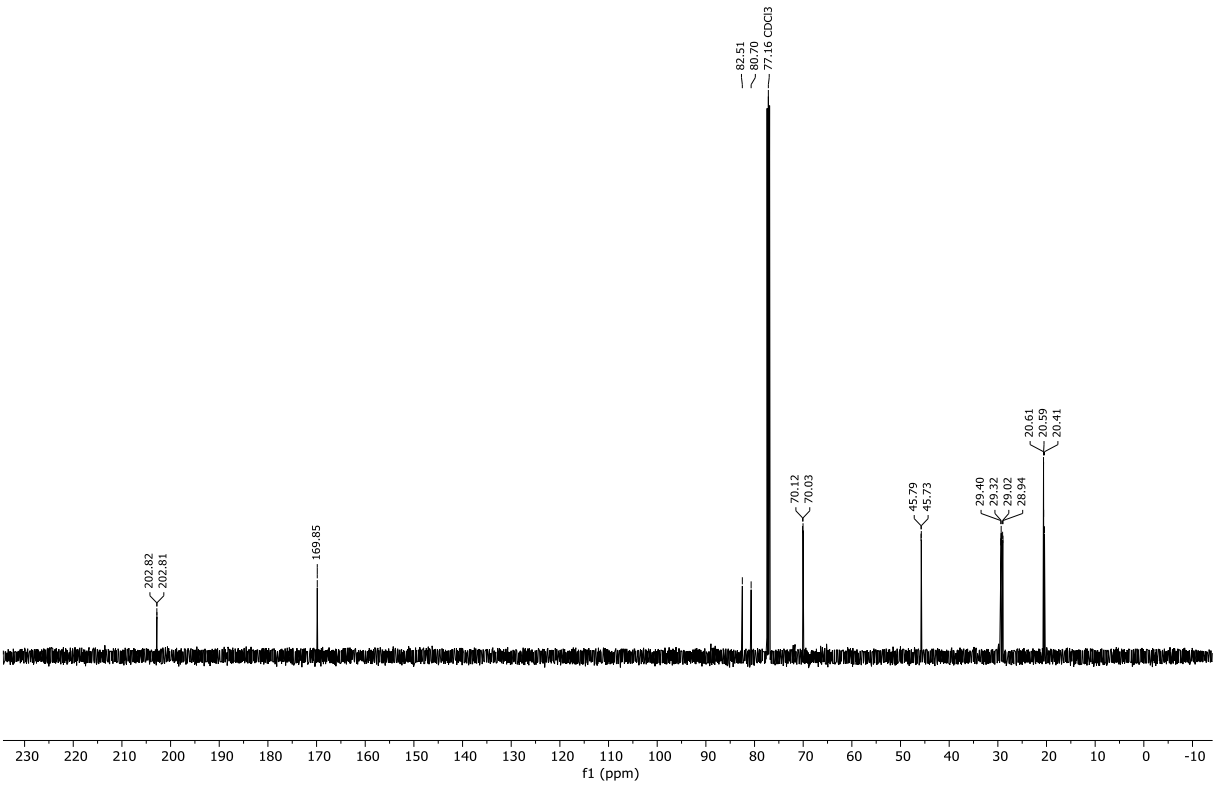
4-bromo-6-fluoro-6-methyl-3-oxobicyclo[3.1.0]hexan-2-yl acetate (29)

^{1}H NMR (599 MHz, $CDCl_3$, 299 K)

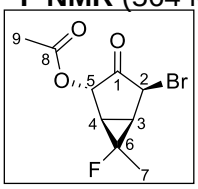


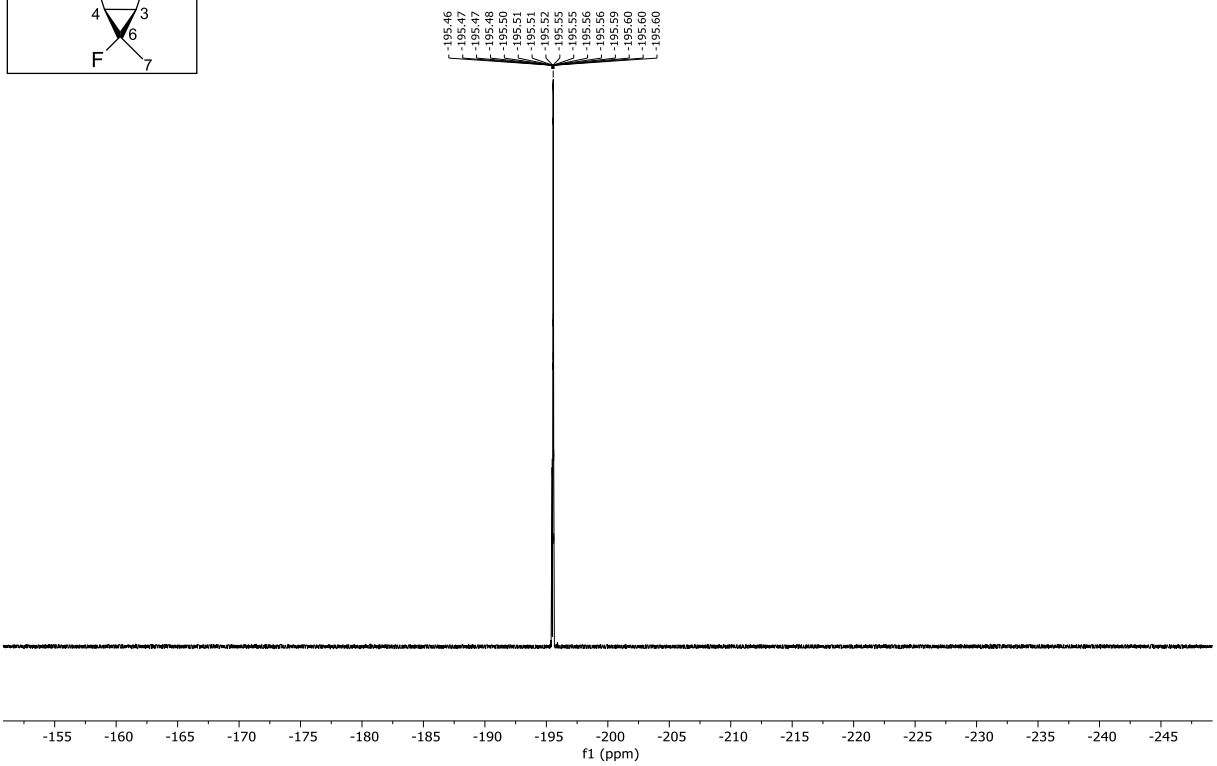


^{13}C NMR (151 MHz, $CDCl_3$, 299 K)

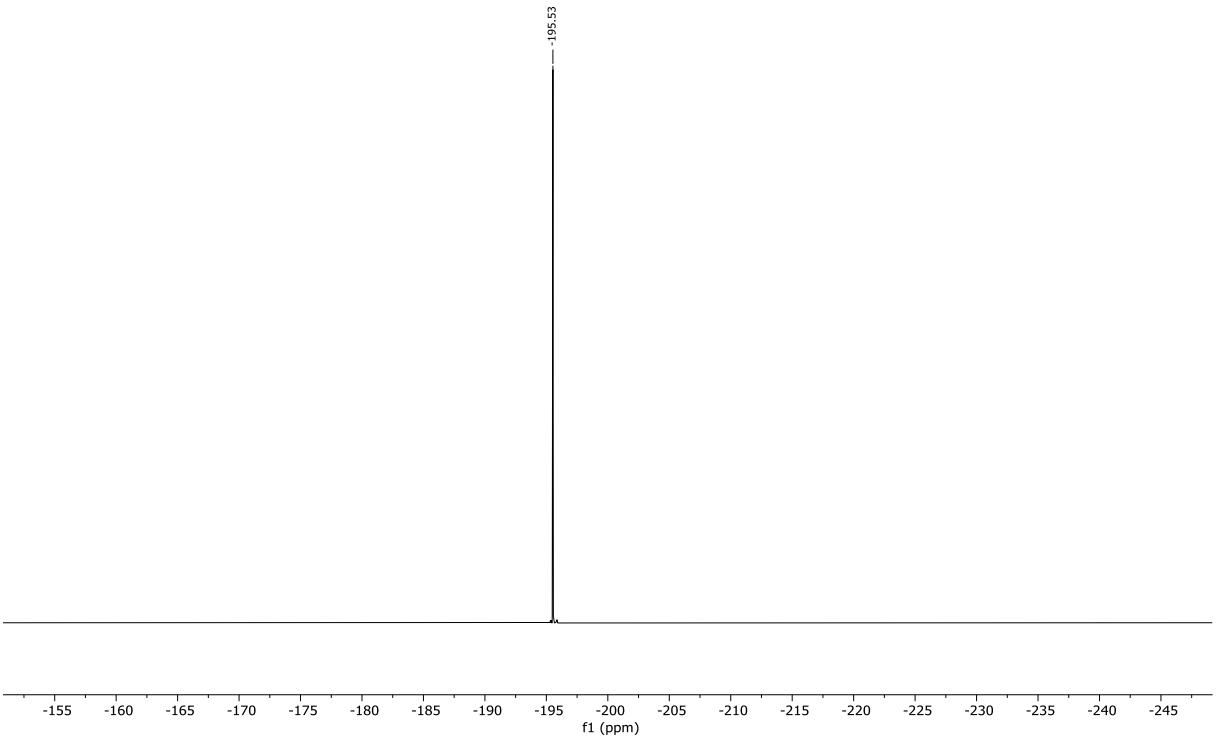


^{19}F NMR (564 MHz, $CDCl_3$, 299 K)



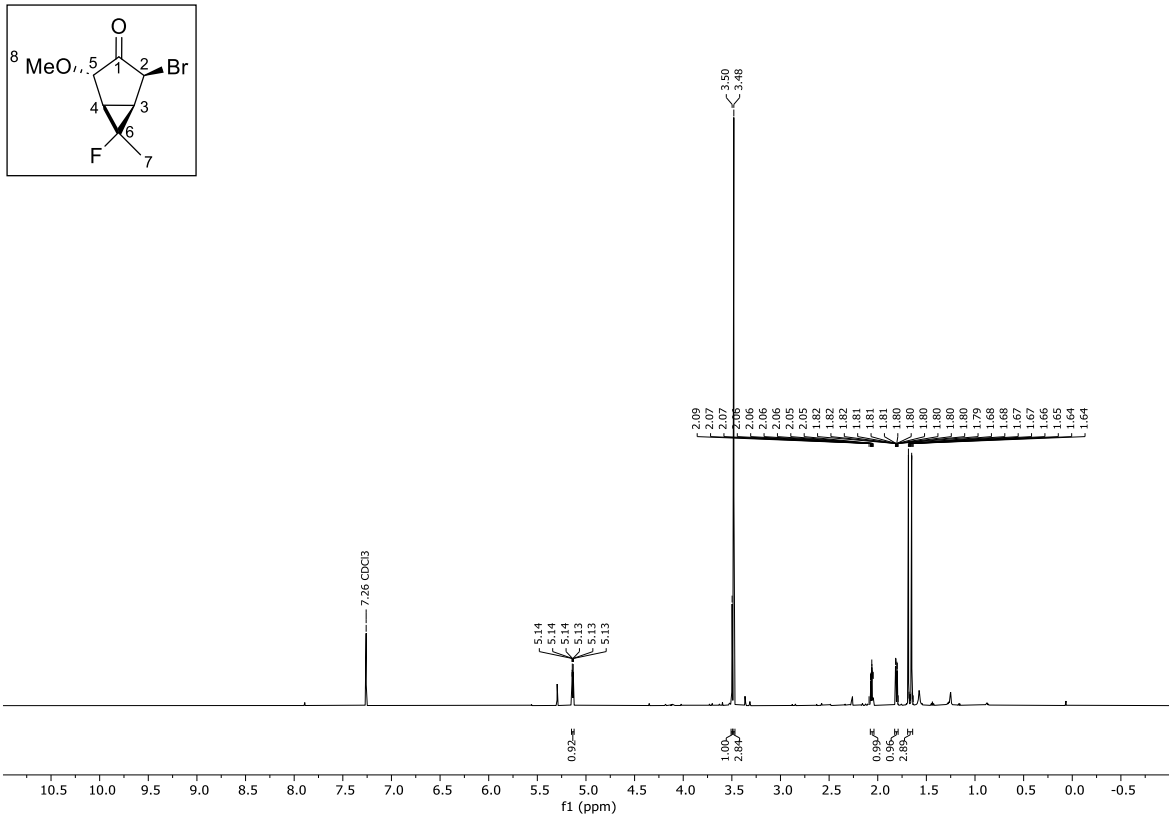


^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$, 299 K)

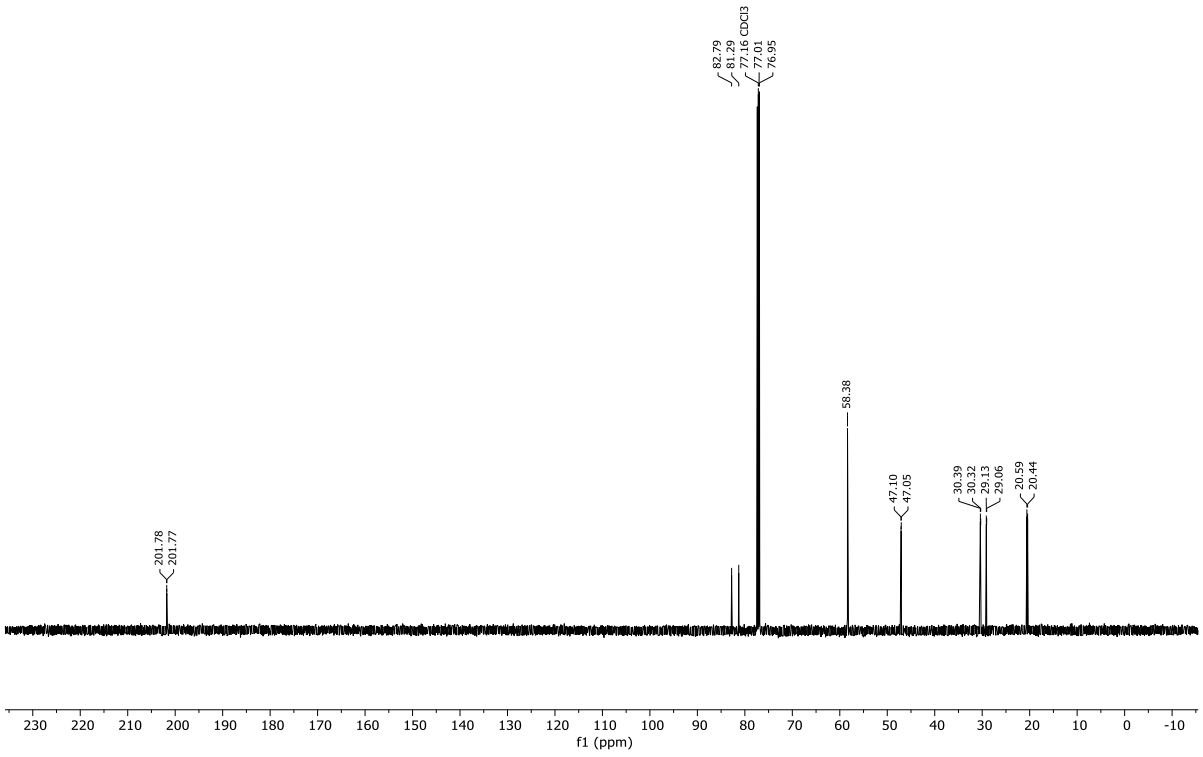


2-bromo-6-fluoro-4-methoxy-6-methylbicyclo[3.1.0]hexan-3-one (30)

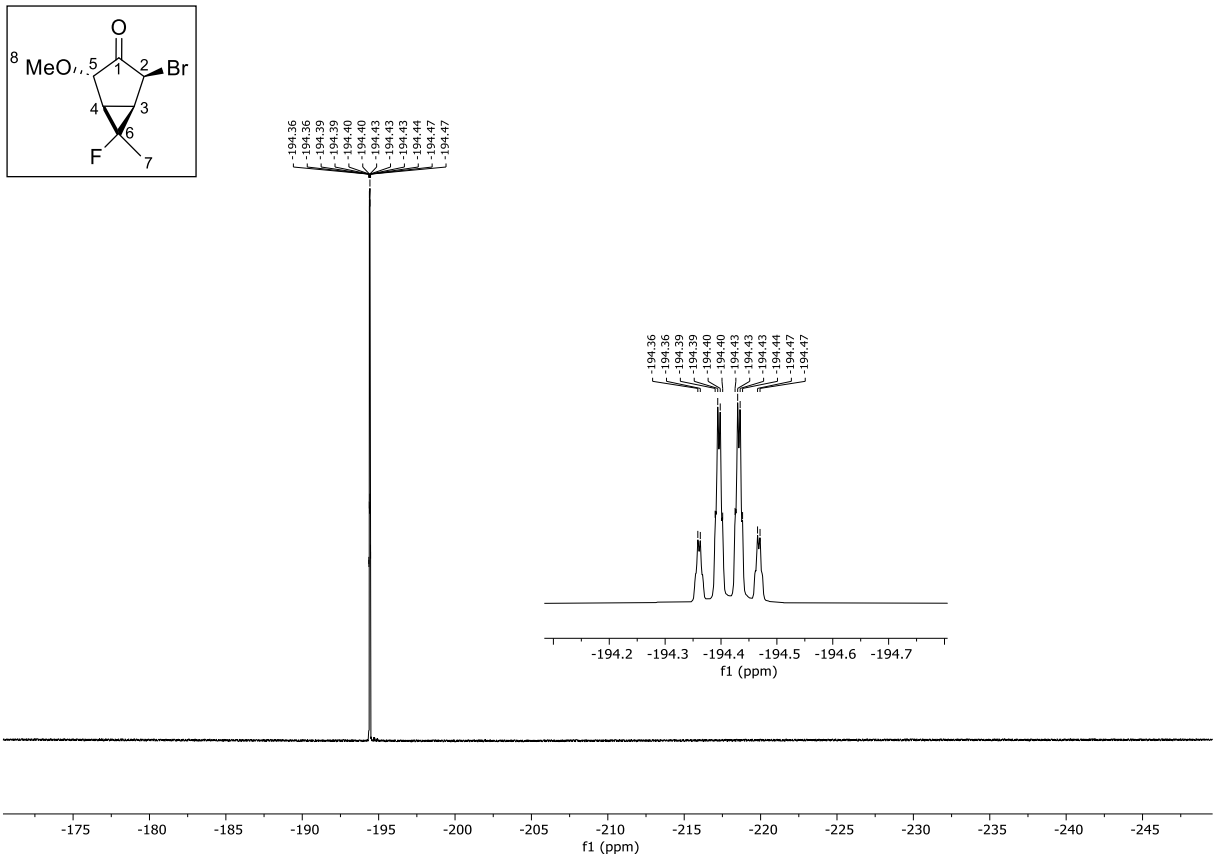
^{1}H NMR (500 MHz, $CDCl_3$, 299 K)



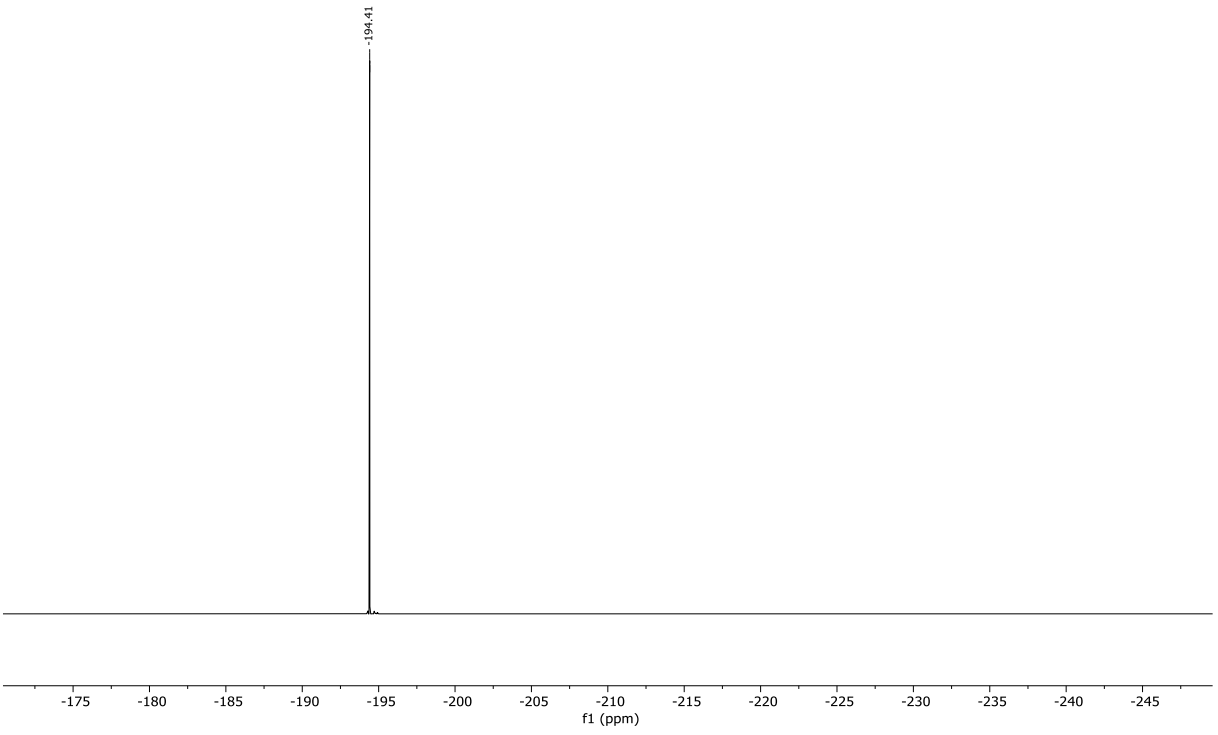
^{13}C NMR (126 MHz, $CDCl_3$, 299 K)



^{19}F NMR (470 MHz, $CDCl_3$, 299 K)



^{19}F{^{1}H} NMR (470 MHz, $CDCl_3$, 299 K)



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