Supporting Information for Experiments

Cu/Chiral Phosphoric Acid-Catalyzed Asymmetric Three-Component Radical-Initiated 1,2-Dicarbofunctionalization of Alkenes

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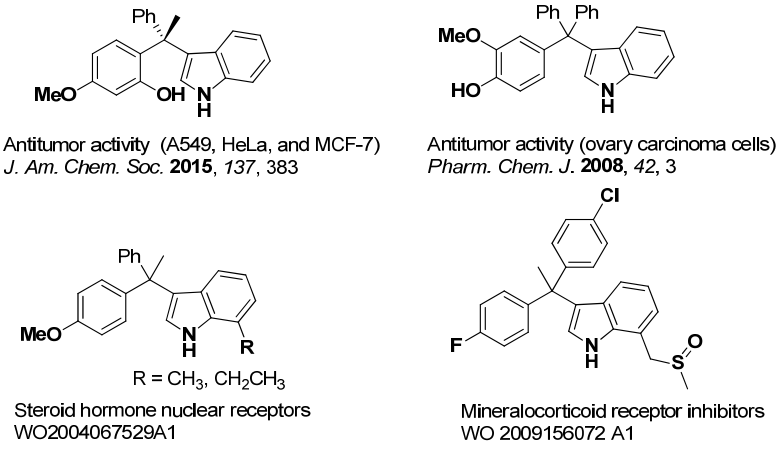


Figure S1. Representative biologically active indole-containing triarylmethanes bearing a quaternary carbon center

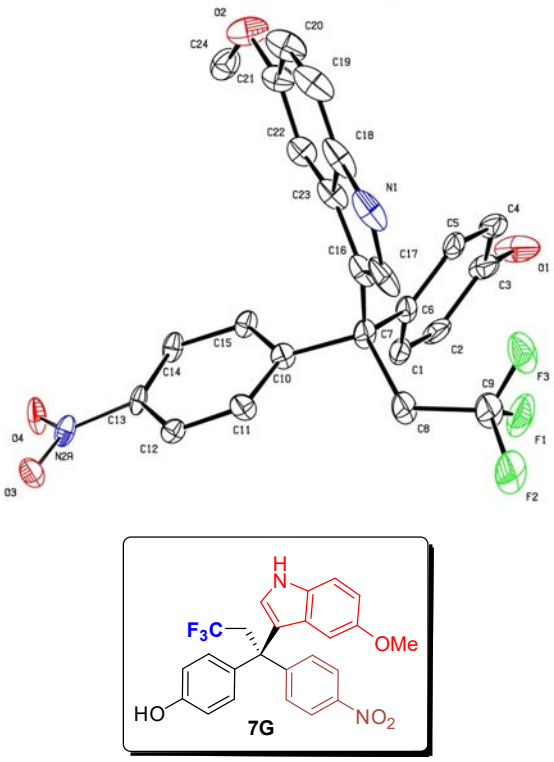
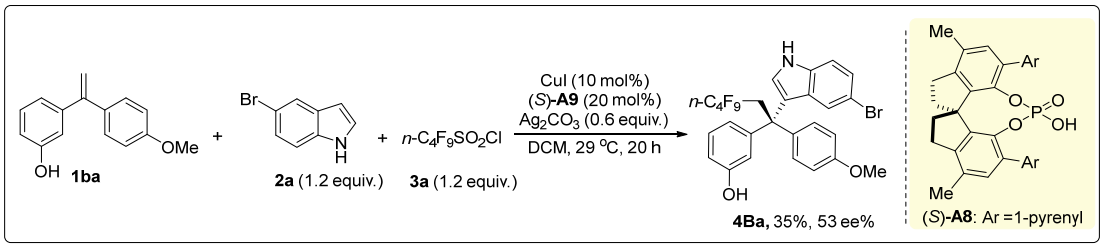


Figure S2. X-ray of chiral compound **7G**

Scheme S1. Asymmetric Intermolecular Three-Component Radical-Initiated Dicarbofunctionalization of *meta*-Phenol Substrate 1ba

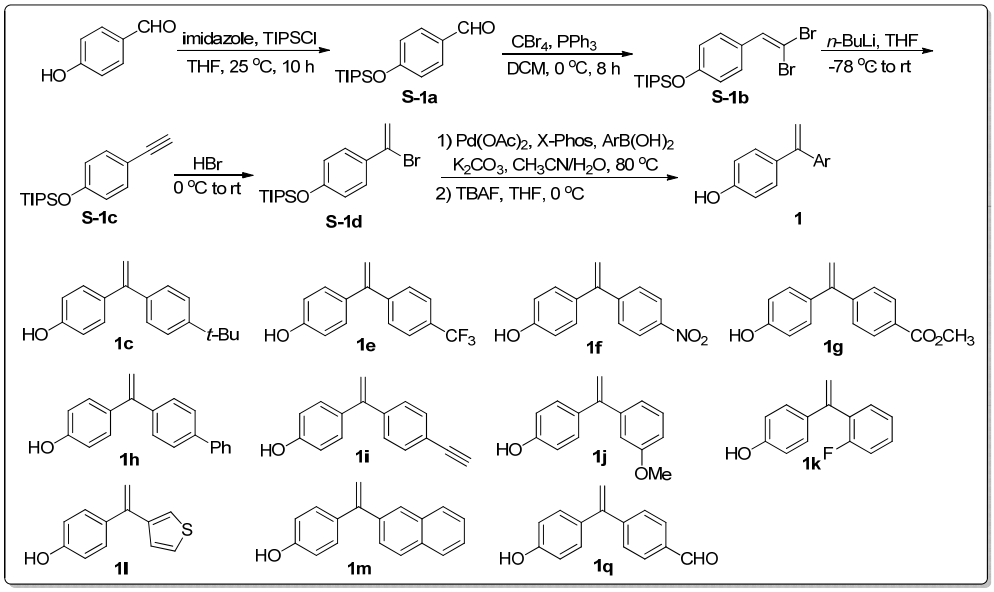


General information

Most of reactions were carried out under argon atmosphere using Schlenk techniques. Reagents were purchased at the highest commercial quality and used without further purification, unless otherwise stated. CuI was purchased from Sigma-Aldrich. Chiral phosphoric acid (**CPA**) was purchased from Daicel Chiral Technologies (China). Analytical thin layer chromatography (TLC) was performed on precoated silica gel 60 GF254 plates. Flash column chromatography was performed using Tsingdao silica gel (60, particle size 0.040-0.063 mm). Visualization on TLC was achieved by use of UV light (254 nm) or iodine. NMR spectra were recorded on Bruker DRX-500 and DPX 400 spectrometer at 400 or 500 MHz for ^{1}H NMR, 101 or 126 MHz for ^{13}C NMR and 376 MHz for ^{19}F NMR in $CDCl_3$, or CD_3OD with tetramethylsilane (TMS) as internal standard. The chemical shifts are expressed in ppm and coupling constants are given in Hz. Data for ^{1}H NMR are recorded as follows: chemical shift (ppm), multiplicity (s, singlet; d, doublet; t, triplet; q, quarter; p, pentet, m, multiplet; br, broad), coupling constant (Hz), integration. Data for ^{13}C NMR are reported in terms of chemical shift (δ, ppm). Mass spectrometric data were obtained using Bruker Apex IV RTMS. Enantiomeric excess (ee) was determined using Agilent high-performance liquid chromatography (HPLC) with a Hatachi detector (λ = 254 or 214 nm). Column conditions are reported in the experimental section below. Absolute configuration of a product was determined by X-ray analysis.

General procedure for the synthesis of substrates:

General synthesis of substrates 1a-1m and 1q



Under argon atmosphere, TIPSCl (250 mmol) was added dropwise to a solution of *p*-hydroxybenzaldehyde (200 mmol) and imidazole (500 mmol) in THF (250 mL). Then the reaction was stirred at 30 °C for 10 h. After complete conversion (monitored by TLC), the reaction mixture was extracted with EtOAc. The combined organic layers were concentrated *in vacuo*. The residue was purified by column chromatography on silica gel (petroleum ether /EtOAc = 80/1) to get **S-1a** (186 mmol, 93%).

Under argon atmosphere, CBr_4 (216 mmol) and PPh_3 (360 mmol) were added to a solution of **S-1a** (180 mmol) in DCM (250 mL) sequentially. Then the reaction was stirred at 0 °C for 6 h. After complete conversion (monitored by TLC), the reaction mixture was concentrated *in vacuo*. Then the solid was washed with petroleum ether .The filtrate were concentrated *in vacuo*. The residue was purified by column chromatography on silica gel (petroleum ether) to get **S-1b** (165 mmol, 91.7%).

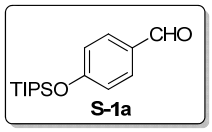
n-BuLi (160 mmol, 2.4M in THF) was slowly added to a stirred solution of **S-1b** (80 mmol) in anhydrous THF (13.0 mL) at -78 °C, the reaction mixture was stirred at -78 °C for an additional 4 h. Then the reaction was gradually raised to room temperature for another 4 h. After complete conversion (monitored by TLC), the reaction mixture was extracted with EtOAc. The combined organic layers were concentrated *in vacuo*. The residue was purified by column chromatography on silica gel (petroleum ether) to give **S-1c** (78 mmol, 96%).

Under argon atmosphere, hydrobromic acid was slowly added to **S-1c** (12 mmol) in acetic acid (13 mmol) at 0 °C, the reaction mixture was stirred for 30 min at 0 °C. Then the reaction was quenched by water, and the reaction mixture was extracted with EtOAc. The combined organic layers were concentrated *in vacuo*. The residue was

purified by column chromatography on silica gel (petroleum ether) to get **S-1d** (8 mmol, 67%).

$Pd(OAc)_2$ (0.08 mmol) was added to a solution of **S-1d** (2.0 mmol), $ArB(OH)_2$ (3.0 mmol), K_2CO_3 (6.0 mmol) and 2-dicyclohexylphosphino-2′,4′,6′-triisopropylbiphenyl (X-Phos, 0.16 mmol) in CH_3CN/H_2O (6.0 mL/3.0 mL). The flask and its contents were put under reduced pressure and then backfilled with argon three times. The reaction mixture was stirred at 80 °C for 24 h under argon atmosphere. After completion, the reaction mixture was cooled to room temperature and extracted with EtOAc, and the combined organic layers were brined, dried over Na_2SO_4 and concentrated *in vacuo*. The residue was dissolved in THF again, *t*-$Bu_4N^+F^-$ (TBAF, 2.0 mmol) was added to the solution of crude product in THF. After complete conversion (monitored by TLC), the reaction mixture was extracted with EtOAc, and the combined organic layers were brined and concentrated *in vacuo,* and the residue was purified by column chromatography on silicagel to give **1** (1.2-1.6 mmol, 60%-80%).

Note：*The 1,1-diarylethylenes were unstable at -20-30°C, and easily converted to other products, so the1,1-diarylethylenes should be used in the next reaction ASAP.*

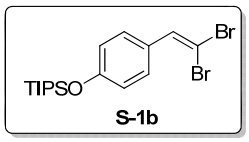


S-1a

4-((triisopropylsilyl)oxy)benzaldehyde (S-1a)

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.87 (s, 1H), 7.78 (d, *J* = 8.6 Hz, 2H), 6.97 (d, *J* = 8.6 Hz, 2H), 1.33-1.24 (m, 3H), 1.10 (d, *J* = 7.4 Hz, 18H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 190.9, 161.9, 132.0, 130.2, 120.3, 17.9, 12.7.

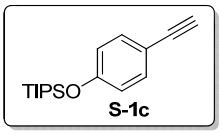


S-1b

(4-(2,2-dibromovinyl)phenoxy)triisopropylsilane (S-1b)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45 (d, *J* = 8.0 Hz, 2H), 7.39 (s, 1H), 6.86 (d, *J*= 7.9 Hz, 2H), 1.35-1.20 (m, 3H), 1.10 (t, *J* = 6.0 Hz, 18H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 156.5, 136.4, 129.9, 128.1, 119.8, 87.0, 17.9, 12.7.

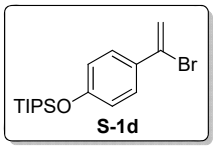


S-1c

(4-ethynylphenoxy)triisopropylsilane (S-1c)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36 (d, *J* = 8.6 Hz, 2H), 6.81 (d, *J* = 8.6 Hz, 2H), 2.97 (s, 1H), 1.24 (m, 3H), 1.09 (d, *J* = 7.4 Hz, 18H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 156.8, 133.6, 120.0, 114.6, 83.8, 75.8, 17.9, 12.7.

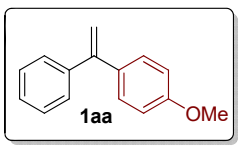


S-1d

(4-(1-bromovinyl)phenoxy)triisopropylsilane (S-1d)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47 (d, *J* = 8.7 Hz, 2H), 6.83 (d, *J* = 8.7 Hz, 2H), 6.01 (d, *J* = 2.0 Hz, 1H), 5.66 (d, *J*= 2.0 Hz, 1H), 1.34-1.17 (m, 3H), 1.10 (d, *J* = 7.3 Hz, 18H).

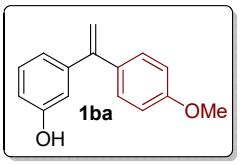
^{13}C NMR (101 MHz, $CDCl_3$) δ 157.1, 131.3, 130.9, 128.6, 119.5, 115.8, 17.9, 12.7.



1aa

1-methoxy-4-(1-phenylvinyl)benzene (1aa)

1aa was synthesized according to the procedures.[1]

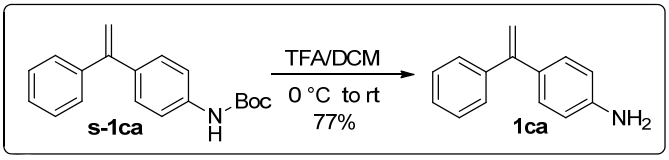


3-(1-(4-methoxyphenyl)vinyl)phenol (1ba)

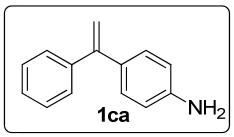
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32 (d, *J* = 8.7 Hz, 2H), 7.24 (t, *J* = 7.7 Hz, 1H), 6.97 (d, *J* = 7.7 Hz, 1H), 6.91 (d, *J* = 8.7 Hz, 2H), 6.84 (d, *J* = 7.8 Hz, 2H), 5.71 (s, 1H), 5.41 (d, *J* = 11.8 Hz, 2H), 3.86 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.2, 155.4, 149.1, 143.5, 134.0, 129.5, 129.4, 121.0, 115.3, 114.7, 113.6, 113.3, 55.4.

General synthesis of substrate 1ca



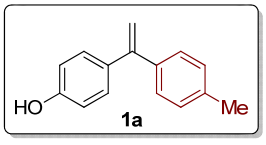
According to the procedures with minor revision,[2] compound **s-1ca** (295 mg, 1.0 mmol) was dissolved in DCM and then cooled to 0 °C. Trifluoroacetic acid was added dropwise, after stirred at rt for 1h, the mixture was concentrated. To the remaining sticky liquid was added 10 mL DCM and washed with saturated aqueous Na_2CO_3, brine and dried over anhydrous Na_2SO_4. After removal of solvent, the residue was purified by flash chromatography on silica gel (petroleum ether/EA = 2:1) to give product **1ca** (150 mg, 77%).



4-(1-phenylvinyl)aniline (1ca)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.51 – 7.31 (m, 4H), 7.18 (d, *J* = 8.5 Hz, 2H), 6.67 (d, *J* = 8.5 Hz, 2H), 5.39 (d, *J* = 1.4 Hz, 1H), 5.30 (d, *J* = 1.4 Hz, 1H), 3.74 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 149.7, 146.1, 142.1, 131.7, 129.2, 128.4, 128.0, 127.5, 114.6, 111.8.

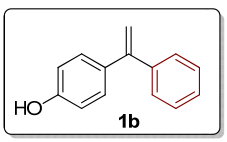


4-(1-(*p*-tolyl)vinyl)phenol (1a)

1a was synthesized according to the procedures.[3]

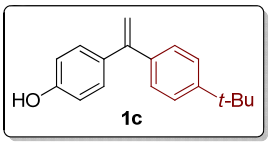
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36-7.25 (m, 4H), 7.20 (d, *J* = 7.9 Hz, 2H), 6.91-6.83 (m, 2H), 5.39 (dd, *J* = 5.3, 1.3 Hz, 2H), 2.43 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 155.6, 149.4, 139.0, 137.5, 134.2, 129.7, 128.9, 128.3, 115.1, 112.3.



4-(1-phenylvinyl)phenol (1b)

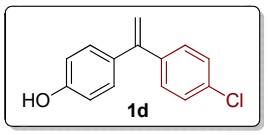
1aa was synthesized according to the procedures.[3]



4-(1-(4-(*tert*-butyl)phenyl)vinyl)phenol (1c)

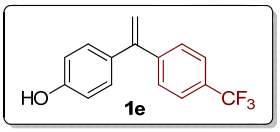
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 (d, *J* = 8.1 Hz, 2H), 7.38 (d, *J* = 7.8 Hz, 2H), 7.33 (d, *J* = 8.0 Hz, 2H), 6.88 (d, *J* = 8.0 Hz, 2H), 5.99 (s, 1H), 5.44 (d, *J* = 5.7 Hz, 2H), 1.43 (s, 10H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 155.2, 150.8, 149.3, 138.8, 134.5, 129.8, 128.0, 125.2, 115.1, 112.6, 34.7, 31.5.



4-(1-(4-chlorophenyl)vinyl)phenol (1d)

1d was synthesized according to the procedures.[1]

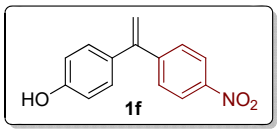


4-(1-(4-(trifluoromethyl)phenyl)vinyl)phenol (1e)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 8.0 Hz, 2H), 7.50 (d, *J* = 8.0 Hz, 2H), 7.26 (d, *J* = 8.2 Hz, 2H), 6.91 (d, *J* = 8.2 Hz, 2H), 5.54 (s, 1H), 5.46 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 155.6, 148.4, 145.4, 133.4, 129.7, 128.7, 125.2 (q, *J* = 3.7 Hz), 124.3 (*J* = 270.0 Hz), 115.4, 114.6.

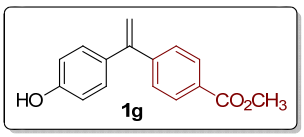
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.3 (s, 3F).



4-(1-(4-nitrophenyl)vinyl)phenol (1f)

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 (d, *J* = 8.8 Hz, 2H), 7.49 (d, *J* = 8.8 Hz, 2H), 7.17 (d, *J* = 8.6 Hz, 2H), 6.83 (d, *J* = 8.6 Hz, 2H), 5.55 (s, 1H), 5.47 (s, 1H).

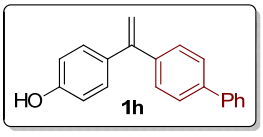
^{13}C NMR (101 MHz, $CDCl_3$) δ 155.9, 148.5, 147.8, 147.3, 132.8, 129.6, 129.1, 123.6, 115.9, 115.4.



methyl 4-(1-(4-hydroxyphenyl)vinyl)benzoate (1g)

^{1}H NMR (400 MHz, DMSO) δ 9.61 (d, *J* = 3.7 Hz, 1H), 7.94 (t, *J* = 8.0 Hz, 2H), 7.42 (t, *J* = 8.9 Hz, 2H), 7.09 (t, *J* = 7.3 Hz, 2H), 6.75 (d, *J* = 6.7 Hz, 2H), 5.43 (dd, *J* = 27.7, 9.6 Hz, 2H), 3.85 (d, *J* = 8.7 Hz, 3H).

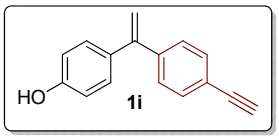
^{13}C NMR (101 MHz, DMSO) δ 166.5, 158.0, 148.6, 146.6, 131.2, 129.7, 129.5, 129.2, 128.7, 115.7, 114.7, 52.6.



4-(1-([1,1'-biphenyl]-4-yl)vinyl)phenol (1h)

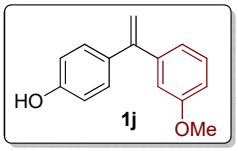
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (d, *J* = 7.5 Hz, 2H), 7.57 (d, *J* = 8.2 Hz, 2H), 7.47-7.32 (m, 5H), 7.23 (t, *J* = 7.8 Hz, 1H), 6.96 (d, *J* = 7.7 Hz, 1H), 6.82 (dd, *J* = 11.4, 2.1 Hz, 2H), 5.49 (d, *J* = 13.4 Hz, 2H), 4.89 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 155.4, 149.2, 143.2, 140.7, 140.6, 140.2, 129.5, 128.8 (d, *J* = 13.1 Hz), 127.4, 127.0 (d, *J* = 14.6 Hz), 121.0, 115.3, 114.7, 114.5.

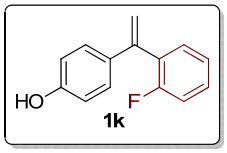


4-(1-(4-ethynylphenyl)vinyl)phenol (1i)

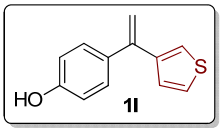
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.51 (d, *J* = 8.0 Hz, 2H), 7.34 (d, *J* = 7.9 Hz, 2H), 7.24 (d, *J* = 8.3 Hz, 2H), 6.87 (d, *J* = 8.3 Hz, 2H), 6.56 (s, 1H), 5.43 (d, *J* = 13.2 Hz, 2H), 3.18 (s, 1H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 155.5, 148.8, 142.3, 133.7, 132.0, 129.7, 128.3, 121.3, 115.3, 113.9, 83.8, 77.9.



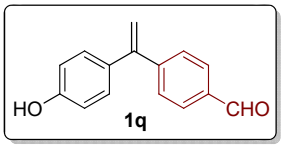
4-(1-(3-methoxyphenyl)vinyl)phenol (1j)
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34-7.21 (m, 3H), 6.96 (d, *J* = 7.7 Hz, 1H), 6.93-6.86 (m, 2H), 6.82 (t, *J* = 5.7 Hz, 2H), 5.41 (s, 1H), 5.38 (s, 1H), 5.06 (s, 1H), 3.82 (s, 3H).



4-(1-(2-fluorophenyl)vinyl)phenol (1k)
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35-7.27 (m, 2H), 7.24-7.18 (m, 2H), 7.14 (td, *J* = 7.6, 1.2 Hz, 1H), 7.07 (ddd, *J* = 10.5, 8.1, 0.9 Hz, 1H), 6.84-6.77 (m, 2H), 6.10 (s, 1H), 5.67 (d, *J* = 1.1 Hz, 1H), 5.31 (t, *J* = 0.9 Hz, 1H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 160.14 (d, *J* = 248.1 Hz), 155.6, 143.6, 133.2, 131.6 (d, *J* = 3.7 Hz), 129.57 (d, *J* = 14.4 Hz), 129.33 (d, *J* = 8.2 Hz), 128.2, 124.0 (d, *J* = 3.6 Hz), 115.76 (d, *J* = 22.3 Hz), 115.3, 115.2.
^{19}F NMR (375 MHz, $CDCl_3$) δ -113.4 (s).

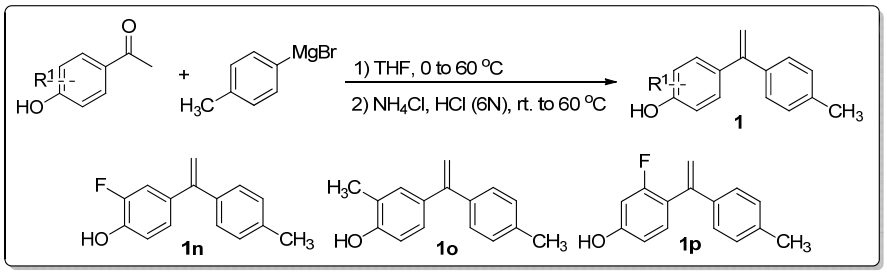


4-(1-(thiophen-3-yl)vinyl)phenol (1l)
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35-7.28 (m, 3H), 7.22-7.14 (m, 2H), 6.85 (d, *J* = 8.7 Hz, 2H), 5.46 (d, *J* = 1.0 Hz, 1H), 5.39 (s, 1H), 5.30 (d, *J* = 1.1 Hz, 1H).
^{13}C NMR (100 MHz, $CDCl_3$) δ 155.4, 143.9, 142.8, 134.1, 129.5, 127.4, 125.4, 123.2, 115.0, 112.3.

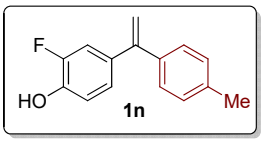


4-(1-(4-hydroxyphenyl)vinyl)benzaldehyde (1q)
1q was obtained by the same procedure for the compound **1c**
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.02 (s, 1H), 7.86 (d, *J* = 8.2 Hz, 2H), 7.52 (d, *J* = 8.2 Hz, 2H), 7.18 (d, *J* = 8.6 Hz, 2H), 6.86 (d, *J* = 8.4 Hz, 2H), 5.51 (s, 1H), 5.45 (s, 1H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 192.1, 155.8, 148.6, 148.1, 135.6, 133.1, 129.7, 129.6, 128.9, 115.3, 115.1.

General synthesis of substrates 1n-1p



1n-1p were synthesized according to the procedures previously reported.[3]

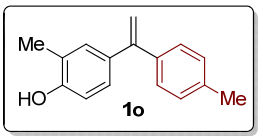


2-fluoro-4-(1-(*p*-tolyl)vinyl)phenol (1n)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.21 (d, *J* = 8.0 Hz, 2H), 7.14 (d, *J* = 7.6 Hz, 2H), 7.07 (dd, *J* = 11.6, 2.0 Hz, 1H), 7.03 (ddd, *J* = 11.6, 2.4, 1.0 Hz, 1H), 6.94 (t, *J* = 8.8 Hz, 1H), 5.35 (s, 1H), 5.30 (brs, 1H), 2.37 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 150.6 (d, *J* = 237.0 Hz), 138.25, 137.69, 148.5 (d, *J* = 1.8 Hz), 143.1 (d, *J* = 14.5 Hz), 134.9 (d, *J* = 6.0 Hz), 128.90, 128.15, 124.6 (d, *J* = 3.2 Hz), 116.7 (d, *J* = 2.1 Hz), 115.3 (d, *J* = 18.6 Hz), 113.16, 21.14.

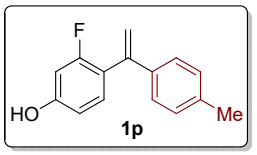
^{19}F NMR (376 MHz, $CDCl_3$) δ -141.2 (s, 1F).



2-methyl-4-(1-(*p*-tolyl)vinyl)phenol (1o)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 (s, 2H), 7.20 (s, 3H), 7.11 (s, 1H), 6.77 (d, *J* = 8.2 Hz, 1H), 5.38 (d, *J* = 2.9 Hz, 2H), 5.13 (s, 1H), 2.43 (s, 3H), 2.29 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 153.6, 149.5, 139.1, 137.5, 134.4, 131.0, 128.9, 128.3, 127.2, 123.4, 114.6, 112.3, 21.2, 15.9.



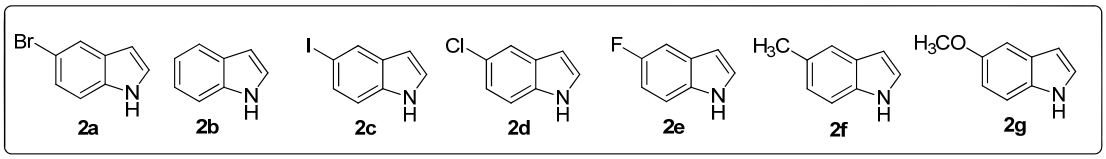
3-fluoro-4-(1-(*p*-tolyl)vinyl)phenol (1p)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.24 (d, *J* = 8.1 Hz, 2H), 7.15 (t, *J* = 7.9 Hz, 3H), 6.68-6.56 (m, 2H), 5.66 (s, 1H), 5.34 (s, 1H), 5.17 (s, 1H), 2.37 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 160.7 (d, *J* = 248.9 Hz), 156.4 (d, *J* = 11.4 Hz), 143.7, 138.1, 137.6, 132.1 (d, *J* = 5.5 Hz), 129.0, 126.8, 122.0 (d, *J* = 14.5 Hz), 115.6 (d, *J* = 2.2 Hz), 111.0 (d, *J* = 3.1 Hz), 103.4 (d, *J* = 25.8 Hz), 21.2.

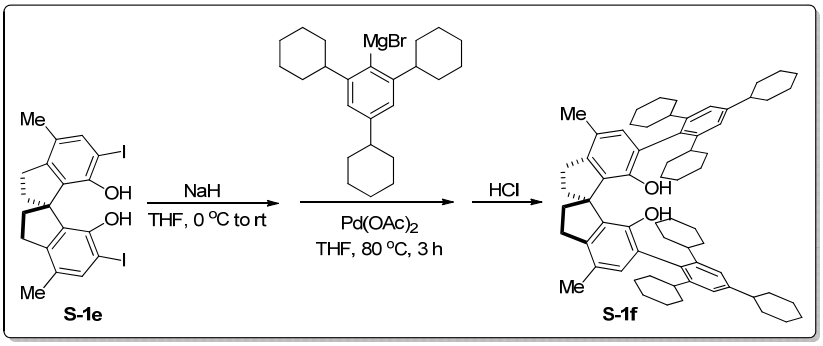
^{19}F NMR (376 MHz, $CDCl_3$) δ -111.0 (s, 1F).

Substituted indoles were used in the Cu/CPA-catalyzed asymmetric three-component radical-initiated 1,2-dicarbofunctionalization of alkenes



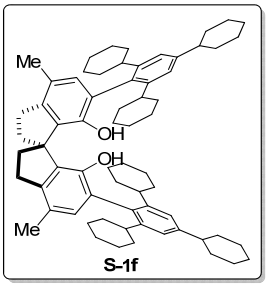
Synthesis of the catalyst (*S*)-A5

(*S*)-6,6'-bis(2,4,6-tricyclohexylphenyl)- 4,4'-dimethyl- 2,2',3,3'-tetrahydro-1,1' -spirobi[indene]-7,7'-diol (S-1f)



(2,4,6-Tricyclohexylphenyl)magnesium bromide. Mg (320 mg, 13 mmol), (2-bromobenzene-1,3,5-triyl)tricyclohexane (4.02 g, 10 mmol) and anhydrous THF (30.0 mL) were added to an oven-dried resealable Schlenk tube (100 mL) under argon atmosphere, then one bean of I_2 was added. The reaction mixture was heated to reflux, and then Me_3SiCl (150 μL) and 1,2-dibromoethane (150 μL) were added. The resultant solution was heated at 80 °C for 2 h, until only trace amounts of magnesium metal remained unreacted. The resulting Grignard solution was used directly in the next step.

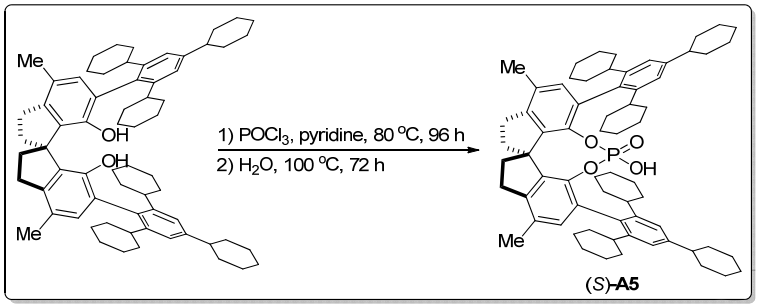
(*S*)-6,6'-diiodo-4,4'-dimethyl-2,2',3,3'-tetrahydro-1,1'-spirobi[indene]-7,7'-diol S-1e (1.33g, 2.5 mmol) and anhydrous THF (5 mL) were added into an oven-dried resealable Schlenk tube (100 ml) under argon atmosphere. The resulting solution was placed in an ice bath, and NaH (380 mg) was slowly added under argon atmosphere. Then the resulting mixture was warmed up to room temperature and stirred for 15 minutes. $Pd(OAc)_2$ (100 mg, 0.44 mmol) was added, followed by the Grignard reagent prepared before, and the reaction mixture was heated to 80 °C for 24 h. Upon cooling to room temperature, H_2O was carefully added to quench the residual Grignard reagent and sodium hydride. HCl (2 M, 20 mL) and EtOAc (30 mL) were added and the mixture stirred for 5 minutes, then the resulting mixture was filtered through a pad of celite. The resulting phases were separated, and the aqueous phase was extracted with EtOAc (3 times). The combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, filtered and concentrated *in vacuo*. The resulting residue was purified by flash column chromatography (silica gel, eluent: *n*-hexane/ethyl acetate = 100/0-25/1) to give the **S-1f** (1.54g, 1.67 mmol, 67%) as a white solid.



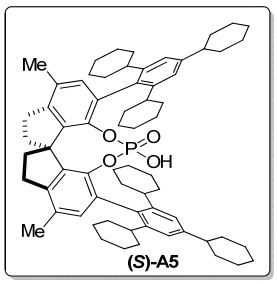
(*S*)-6,6'-Bis(2,4,6-tricyclohexylphenyl)- 4,4'-dimethyl -2,2',3,3'-tetrahydro-1,1'-spirobi[indene]-7,7'-diol (S-1f)

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.98 (s, 2H), 6.95 (s, 2H), 6.65 (s, 2H), 4.11 (d, *J* = 1.6 Hz, 2H), 2.97 (dd, *J* = 9.5, 3.7 Hz, 4H), 2.49 (t, *J* = 9.5 Hz, 2H), 2.40-2.31 (m, 2H), 2.30-2.17 (m, 10H),

2.11 (t, J = 11.7 Hz, 2H), 1.87 (s, 8H), 1.82-1.58 (m, 14H), 1.51-0.82 (m, 38H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 147.9, 147.4, 147.3, 147.1, 142.6, 132.1, 131.0, 130.2, 124.5, 124.3, 122.1, 121.9, 59.2, 44.9, 41.3, 40.8, 37.3, 35.0, 34.7, 34.6, 34.42, 34.38, 34.1, 29.8, 27.1, 27.0, 27.0, 26.7, 26.3, 26.13, 26.08, 18.5.
HRMS (ESI) m/z calcd. for $C_{67}H_{88}NaO_2$ $[M+Na]^+$ 947.66765, found 947.66833.



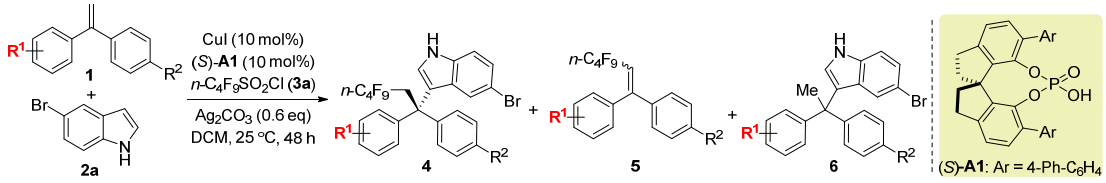
Chiral Phosphoric Acid (*S*)-A5. S-1f (925 mg, 1 mmol) was suspended in 15 mL of pyridine and treated with 1 mL of freshly distilled $POCl_3$. The resulting solution was stirred at 100 °C for 6 days. After cooling to room temperature, H_2O (3 mL) was added carefully and the resulting mixture was heated to 100 °C for 2 days. The reaction mixture was acidified with HCl (2N) and extracted with EtOAc for three times. The combined organic layers were washed with 2N HCl for two times, dried over anhydrous Na_2SO_4, filtered and concentrated *in vacuo*. The resulting residue was purified by flash column chromatography (silica gel, eluted with *n*-hexane /DCM=10/1 then *n*-hexane/ EtOAc=4/1) to give the product as a slight yellow solid in 56% yield (552 mg, 0.56 mmol) and 200 mg of substrate was recovered.



(*S*)-A5
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.00 (d, J = 1.3 Hz, 2H), 6.94 (d, J = 1.3 Hz, 2H), 6.87 (s, 2H), 3.07-2.96 (m, 2H), 2.90 (dd, J = 16.1, 8.0 Hz, 2H), 2.77 (s, 9H), 2.54-2.41 (m, 4H), 2.39-2.22 (m, 10H), 2.14 (dd, J = 19.5, 10.8 Hz, 2H), 2.01-1.81 (m, 12H), 1.74 (t, J = 14.3 Hz, 7H), 1.62 (t, J = 11.3 Hz, 8H), 1.53-0.87 (m, 32H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 147.1, 146.7, 146.4, 142.8, 142.8, 141.4, 141.3, 138.9, 138.9, 132.9, 132.7, 131.2, 131.1, 130.2, 122.5, 121.5, 60.7, 44.7, 41.7, 41.5, 38.1, 37.6, 35.5, 34.50, 34.48, 33.4, 33.0, 28.8, 27.6, 27.5, 27.0, 26.8, 26.6, 26.4, 26.2, 18.4.
^{31}P NMR (162 MHz, $CDCl_3$) δ -9.51(s, 1P).
HRMS (ESI) m/z calcd. for $C_{67}H_{88}PO_4$ $[M+H]^+$ 987.64147, found 987.64404.

General procedure for initial exploration and screening of reaction conditions

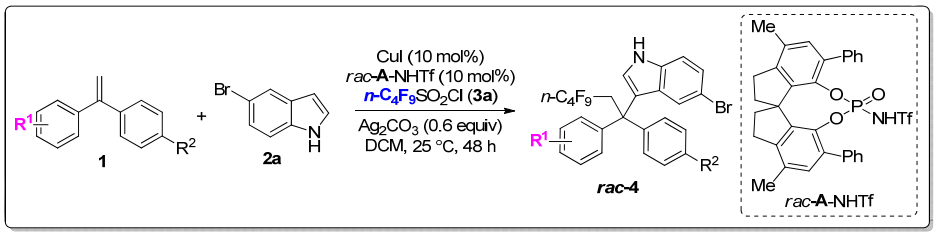
Table 1. Initial Exploration of Reaction Conditions[a]



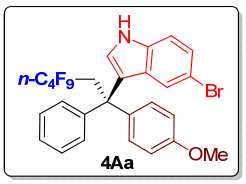
Entry	1	R^1	R^2	4	y (%)[b]	ee (%)[c]	5	y (%)	6	y (%)
1	**1aa**	4-H	OMe	**4Aa**	20	7	**5Aa**	53	**6Aa**	24
2	**1ba**	3-OH	OMe	**4Ba**	54	43	**5Ba**	44	**6Ba**	0
3	**1a**	4-OH	Me	**4A**	10	68	**5Ca**	44	**6Ca**	43
4	**1ca**	4-NH_2	H	**4Ca**	0	--	**5Da**	68	**6Da**	0

[a]Reaction conditions: **1** (0.1 mmol), **2a** (0.12 mmol), *n*-$C_4F_9SO_2Cl$ (0.12 mmol), CuI (10 mol%), Ag_2CO_3 (0.06 mmol), CPA (10 mol%), DCM (1.0 mL) under argon. [b] Isolated yield. [c]Ee value on HPLC.

Under argon atmosphere, an oven-dried resealable Schlenk tube equipped with a magnetic stir bar was charged with 1,1-diarylalkene substrate **1** (0.1 mmol, 1.0 equiv.), 5-bromo-1*H*-indole (0.12 mmol, 1.2 equiv.), CuI (1.9 mg, 0.01 mmol, 10 mol%), chiral phosphoric acid ((*S*)-**A1** (6.18 mg, 0.01 mmol, 10 mol%), *n*-$C_4F_9SO_2Cl$ (**3a**) (38.2 mg, 0.12 mmol, 1.2 equiv.), Ag_2CO_3 (16.56 mg, 0.06 mmol, 0.6 equiv.), and anhydrous DCM (1.0 mL) at 25 °C, then the sealed tube was stirred at 25 °C for 48 h. Upon completion (monitored by TLC), the reaction mixture was directly purified by a silica gel chromatography [eluent: *n*-hexane/ethyl acetate = 20/0-2/1, using *n*-hexane (100%) to remove the solvent (DCM) at first] to afford the desired product **4**, **5** and **6**.
Note: Since the reaction is sensitive to water and air, Schlenk tube and the reagents must be dried prior to use.



The racemate was prepared following the same procedure described above using CuI (3.0 mg, 0.015 mmol, 15 mol%) and *rac*-**A**-NHTf (6.3 mg, 0.01 mmol, 10 mol%) as catalyst at 0 °C in anhydrous DCM (1.0 mL) for 48 h. Upon completion (monitored by TLC), the solvent was removed *in vacuo*, and the residue was purified by a silica gel column chromatography (eluent: *n*-hexane/ethyl acetate = 20/0-2/1) to give the desired product.
Note: Since the reaction is sensitive to water and air, Schlenk tube and the reagents must be dried prior to use.



(*R*)-5-bromo-3-(3,3,4,4,5,5,6,6,6-nonafluoro-1-(4-methoxyphenyl)-1-phenylhexyl)-1*H*-indole (4Aa)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100:0 to 3:1) to afford desired product **4Aa** (12.5 mg, 20 %) as sticky light yellow oil.

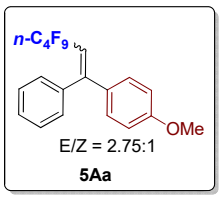
HPLC analysis: Chiralcel IA (hexane/*i*-PrOH = 85/15, flow rate 0.5 mL/min, λ = 254 nm), t_R (minor) = 14.66 min, t_R (major) = 15.89 min.

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.18 (s, 1H), 7.40 (d, *J* = 7.6 Hz, 2H), 7.33-7.27 (m, 4H), 7.27-7.20 (m, 3H), 7.07 (d, *J* = 1.5 Hz, 2H), 6.86-6.79 (m, 2H), 3.81 (s, 3H), 3.53 (t, *J* = 18.6 Hz, 2H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 158.0, 145.0, 136.5, 135.4, 129.4, 128.2, 128.1, 128.0, 126.5, 125.5, 124.9, 124.2, 120.4, 113.3, 112.7, 112.7, 117.8-106.1 (m), 55.2, 49.1, 39.1 (t, *J* = 19.5 Hz).

^{19}F NMR (376 MHz, $CDCl_3$) δ -80.5 ~ -81.4 (m, 3F), -108.6 (t, *J* = 12.1 Hz, 2F), -124.2 (d, *J* = 5.8 Hz, 2F), -125.2 ~ -126.0 (m, 2F).

HRMS (ESI) m/z calcd. for $C_{27}H_{18}NOBrF_9$ $[M-H]^-$ 622.04335, found 622.04303.



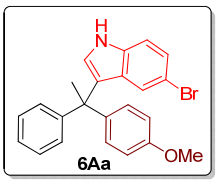
(*E*/*Z*)-1-methoxy-4-(3,3,4,4,5,5,6,6,6-nonafluoro-1-phenylhex-1-en-1-yl)benzene (5Aa)

The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100:0 to 10:1) to afford desired product **5Aa** (22.7 mg, 53 %) as sticky colorless oil.

^{1}H NMR (500 MHz, $CDCl_3$, observed as a mixture of *Z* and *E*-isomers) δ 7.49-7.32 (m, 3H, *E*+*Z*), 7.27-7.24 (m, 2H, *E*+*Z*), 7.20 (t, *J* = 7.5 Hz, 2H, *E*+*Z*), 6.94 (d, *J* = 8.7 Hz, 2H, *Z*), 6.88 (d, *J* = 8.8 Hz, 2H, *E*), 6.05 (t, *J* = 14.8 Hz, 1H, *E*+*Z*), 3.87 (s, 3H, *Z*), 3.84 (s, 3H, *E*).

^{13}C NMR (126 MHz, $CDCl_3$, observed as a mixture of *Z* and *E*-isomers) δ 160.8 (*E*), 159.8 (*Z*), 154.4 (*Z*), 153.8 (*E*), 153.7, 153.7, 141.4, 137.7, 133.0, 130.6, 129.8, 129.5, 129.4, 129.04, 129.02, 128.4, 128.23, 128.15, 127.8, 118.9-105.8 (m), 113.8, 113.3, 110.5 (t, *J* = 21.1 Hz), 55.4 (*E*), 55.2 (*Z*).

^{19}F NMR (376 MHz, $CDCl_3$, observed as a mixture of *Z* and *E*-isomers) δ -81.0 ~ -81.1 (m, 3F, *E*+*Z*), -103.0 ~ -103.3 (m, 2F, *E*), -103.3 ~ -103.4 (m, 2F, *Z*), -123.8 ~ -124.1 (m, 2F, *E*+*Z*), -125.5 ~ -125.8 (m, 2F, *E*+*Z*).

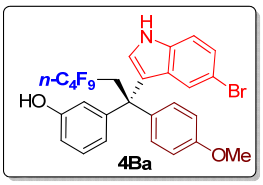


5-bromo-3-(1-(4-methoxyphenyl)-1-phenylethyl)-1H-indole (6Aa)

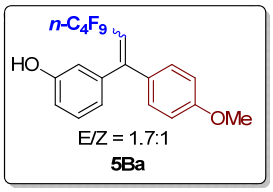
The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100:0 to 3:1) to afford desired product **6Aa** (9.7 mg, 24 %) as a light yellow solid.

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.98 (s, 1H), 7.35-7.20 (m, 8H), 7.14 (d, *J* = 8.8 Hz, 2H), 6.83 (d, *J* = 8.8 Hz, 2H), 6.47 (d, *J* = 2.3 Hz, 1H), 3.82 (s, 3H), 2.24 (s, 3H).

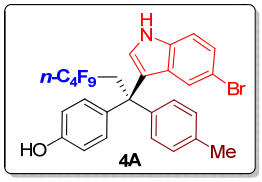
^{13}C NMR (126 MHz, $CDCl_3$) δ 157.7, 148.4, 140.3, 135.8, 129.3, 128.2, 127.9, 126.0, 125.6, 124.9, 124.7, 124.4, 113.2, 112.6, 112.5, 55.2, 47.3, 29.4.
HRMS (ESI) m/z calcd. for $C_{23}H_{19}NOBr$ $[M-H]^-$ 404.06555, found 404.06516.



(*R*)-3-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(4-methoxyphenyl)hexyl)phenol (4Ba)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100:0 to 3:1) to afford desired product **4Ba** (34.5 mg, 54 %) as sticky light yellow oil.
HPLC analysis: Chiralcel IA (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.4 mL/min, λ = 240 nm), t_R (minor) = 16.43 min, t_R (major) = 19.00 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.18 (s, 1H), 7.34-7.26 (m, 2H), 7.22 (s, 2H), 7.16 (t, *J* = 8.0 Hz, 1H), 7.10 (s, 1H), 7.04 (d, *J* = 1.6 Hz, 1H), 6.98 (d, *J* = 7.9 Hz, 1H), 6.86 (d, *J* = 1.9 Hz, 1H), 6.82 (d, *J* = 8.9 Hz, 2H), 6.69 (dd, *J* = 8.0, 2.2 Hz, 1H), 5.20 (s, 1H), 3.80 (s, 3H), 3.50 (t, *J* = 18.6 Hz, 2H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 158.0, 155.2, 147.2, 136.2, 135.4, 129.4, 129.2, 128.2, 125.6, 124.9, 124.2, 120.8, 120.3, 120.0, 119.4-106.8 (m) 115.4, 113.6, 112.7, 112.6, 55.2, 49.0, 39.0 (t, *J* = 19.4 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.7 Hz, 3F), -108.7 (t, *J* = 13.8 Hz, 2F), -123.9 ~ -124.5 (m, 2F), -125.5 ~ -125.9 (m, 2F).
HRMS (ESI) m/z calcd. for $C_{27}H_{18}F_9BrNO_2$ $[M-H]^-$ 638.03827, found 638.03754.



(*E*/*Z*)-3-(3,3,4,4,5,5,6,6,6-nonafluoro-1-(4-methoxyphenyl)hex-1-en-1-yl)phenol (5Ba)
The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100:0 to 10:1) to afford desired product **5Ba** (19.5 mg, 44 %) as sticky colorless oil.
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.36-7.09 (m, 3H, *E*+*Z*), 6.98-6.77 (m, 4H, *E*+*Z*), 6.70 (d, *J* = 10.2 Hz, 1H, *E*+*Z*), 6.02 (td, *J* = 14.7, 8.3 Hz, 1H, *E*+*Z*), 5.14 (s, 1H, *E*+*Z*), 3.85 (d, *J* = 15.4 Hz, 3H, *E*+*Z*).
^{13}C NMR (126 MHz, $CDCl_3$, observed as a mixture of *Z* and *E*-isomers) δ 160.8 (*E*), 159.8 (*Z*), 155.6 (*Z*), 155.1 (*E*), 153.90 (*Z*), 153.2 (*E*), 143.0, 139.2 (*E*), 132.7, 130.6, 129.7, 129.6, 129.3, 129.2, 121.7, 120.6, 116.8, 116.4, 116.0, 115.3, 115.2, 113.9, 113.3, 112.4 (t, *J* = 20.7 Hz), 110.5 (t, *J* = 21.2 Hz), 55.4 (*E*), 55.3 (*Z*).
^{19}F NMR (376 MHz, $CDCl_3$, observed as a mixture of *Z* and *E*-isomers) δ -80.5 ~ -81.3 (m, 3F, *E*+*Z*), -103.46 (t, *J* = 11.1 Hz, 2F, *E*+*Z*), -123.7 ~ -124.3 (m, 2F, *E*+*Z*), -125.4 ~ -125.8 (m, 2F, *E*+*Z*).
HRMS (ESI) m/z calcd. for $C_{19}H_{12}F_9O_2$ $[M-H]^-$ 443.06991, found 443.06921.



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(*p*-tolyl)hexyl)phenol (4A)
The reaction was conducted on a 0.1 mmol scale according to

the above general procedure. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100:0 to 3:1) to afford desired product **4A** (6.2 mg, 10 %) as sticky light yellow oil.

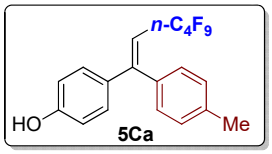
HPLC analysis: Chiralcel IA (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.5 mL/min, λ = 240 nm), t_R (major) = 10.57 min, t_R (minor) = 11.72 min.

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.13 (s, 1H), 7.26-7.20 (m, 6H), 7.07 (d, *J* = 7.5 Hz, 3H), 7.04 (d, *J* = 2.4 Hz, 1H), 6.79-6.71 (m, 2H), 4.90 (br s, 1H), 3.57-3.37 (m, 2H), 2.30 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 154.0, 142.0, 136.9, 136.1, 135.4, 129.6, 128.8, 128.2, 127.9, 125.4, 124.8, 124.2, 120.6, 114.8, 112.7, 112.6, 119.9-105.6 (m), 48.8, 39.2 (t, *J* = 19.6 Hz), 20.9.

^{19}F NMR (376 MHz, $CDCl_3$) δ -80.7 ~ -81.4 (m, 3F), -108.4 ~ -109.0 (m, 2F), -124.2 (d, *J* = 8.2 Hz, 2F), -125.1 ~ -126.2 (m, 2F).

HRMS (ESI) m/z calcd. for $C_{27}H_{18}ONBrF_9$ $[M-H]^-$ 622.0434, found 622.0455.



(*E*)-4-(3,3,4,4,5,5,6,6,6-nonafluoro-1-(4-methoxyphenyl)hex-1-en-1-yl)phenol (5Ca)

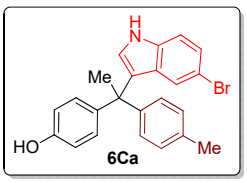
The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100:0 to 10:1) to afford desired product **5Ca** (18.8 mg, 44 %) as sticky colorless oil.

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.20 (d, *J* = 7.8 Hz, 2H), 7.14 (dd, *J* = 12.5, 8.2 Hz, 4H), 6.80 (d, *J* = 8.6 Hz, 2H), 5.99 (t, *J* = 14.8 Hz, 1H), 5.22 (s, 1H), 2.42 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 156.8, 153.9, 138.2, 134.7, 133.7, 129.7, 129.0, 128.5, 115.3, 119.0-106.5 (m), 110.4 (t, *J* = 21.0 Hz), 21.3.

^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (s, 3F), -103.1 (s, 2F), -123.9 (s, 2F), -125.6 (s, 2F).

HRMS (ESI) m/z calcd. for $C_{19}H_{12}OF_9$ $[M-H]^-$ 427.07499, found 427.07535.



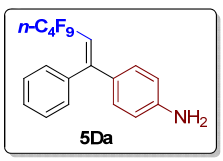
4-(1-(5-bromo-1*H*-indol-3-yl)-1-(*p*-tolyl)ethyl)phenol (6Ca)

The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100:0 to 3:1) to afford desired product **6Ca** (17.4 mg, 43 %) as a light yellow solid.

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.93 (s, 1H), 7.24 (s, 1H), 7.20 (d, *J* = 1.0 Hz, 2H), 7.09-7.04 (m, 5H), 7.03 (d, *J* = 2.1 Hz, 1H), 6.74-6.67 (m, 2H), 6.43 (d, *J* = 2.5 Hz, 1H), 4.83 (s, 1H), 2.31 (s, 3H), 2.16 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 153.6, 145.4, 140.7, 135.8, 135.5, 129.5, 128.7, 128.1, 125.7, 124.8, 124.6, 124.4, 114.7, 112.6, 112.4, 46.9, 29.5, 21.0.

HRMS (ESI) m/z calcd. for $C_{23}H_{19}ONBr$ $[M-H]^-$ 404.0656, found 404.0667.



(*E*)-4-(3,3,4,4,5,5,6,6,6-nonafluoro-1-phenylhex-1-en-1-yl)aniline (5Da)

The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100:0 to 10:1) to afford desired product **5Da** (28.0 mg, 68 %) as light yellow oil. *Note: **5Da** is unstable at rt*

under air atmosphere, easily converted to other products.

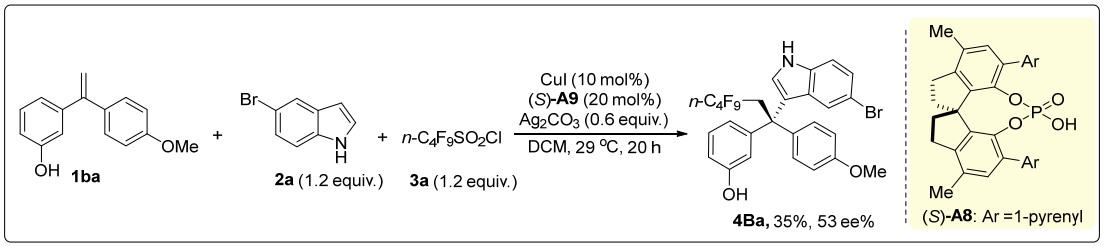
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.41-7.34 (m, 3H), 7.22 (dd, *J* = 6.4, 2.9 Hz, 2H), 7.04 (d, *J* = 8.6 Hz, 2H), 6.63-6.55 (m, 2H), 5.97 (t, *J* = 15.0 Hz, 1H), 3.80 (br s, 2H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 153.9, 147.9, 137.9, 130.5, 129.3, 129.1, 128.0, 127.7, 114.5, 125.3-110.8 (m), 108.9 (t, *J* = 21.0 Hz).

^{19}F NMR (376 MHz, $CDCl_3$) δ -79.4 ~ -83.5 (m, 3F), -102.2 ~ -103.0 (m, 2F), -123.3 ~ -124.4 (m, 2F), -125.3 ~ -126.0 (m, 2F).

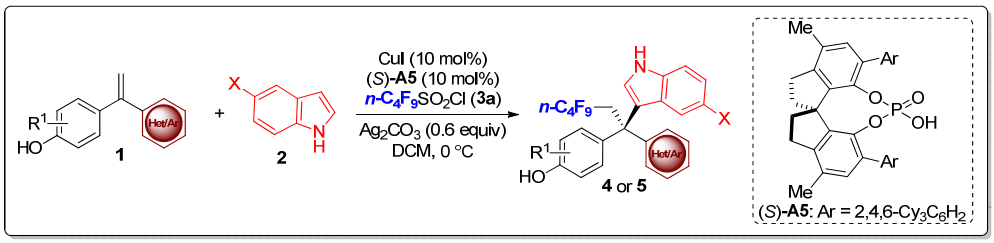
HRMS (ESI) m/z calcd. for $C_{18}H_{13}NF_9$ $[M+H]^-$ 414.08988, found 414.08859.

Scheme S1. Asymmetric Intermolecular Three-Component Radical-Initiated Dicarbofunctionalization of *meta*-Phenol Substrate 1ba



The reaction was conducted on a 0.025 mmol scale according to the above general procedure in the presence of (*S*)-**A8**. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100:0 to 3:1) to afford desired product **4Ba** (5.6 mg, 35 %, 53% ee).

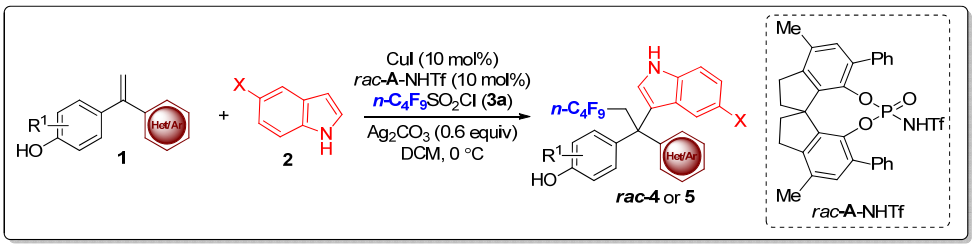
General procedure A: Cu/CPA-catalyzed asymmetric three-component radical -initiated perfluoroalkylarylation or difluoroacetylarylation of 1,1-diarylalkene



Under argon, an oven-dried resealable Schlenk tube equipped with a magnetic stir bar was charged with 1,1-diarylalkene substrate **1** (0.1 mmol, 1.0 equiv.), substituted indole (0.12 mmol, 1.2 equiv.), CuI (1.9 mg, 0.01 mmol, 10 mol%), chiral phosphoric acid ((*S*)-**A5** (9.86 mg, 0.01 mmol, 10 mol%), *n*-$C_4F_9SO_2Cl$ (**3a**, 38.2 mg, 0.12 mmol, 1.2 equiv.), Ag_2CO_3 (16.56 mg, 0.06 mmol, 0.6 equiv.), and anhydrous DCM (1.0 mL) at 0 °C, then the sealed tube was stirred at 0 °C for 40-96 h. Upon completion (monitored by TLC), the reaction mixture was directly purified by a silica gel chromatography [eluent: *n*-hexane/ethyl acetate = 20/0-2/1, using *n*-hexane (100%) to remove the solvent (DCM) at first] to afford the desired product **4**.

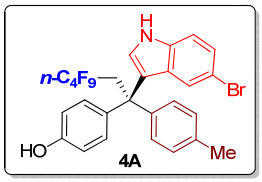
The difluoroacetyl-containing product **5A** was prepared following the same procedure described above conducting on 0.025 mmol scale with 1,1-diarylalkene substrate **1** (5.25 mg, 0.025 mmol, 1.0 equiv.), $MeO_2CCF_2SO_2Cl$ (**3b**, 6.4 mg, 0.03 mmol, 1.2 equiv.), Ag_2CO_3 (3.5 mg, 0.025 mmol, 0.5 equiv.), (*R*)-3,3′-(3,5-$(Ph)_2C_6H_3)_2$-8*H* -BINOL-derived CPA (2.0 mg, 0.0025 mmol, 10 mol%) at –30 °C for 72 h.

Note: Since the reaction is sensitive to water and air, Schlenk tube and the reagents must be dried prior to use.



The racemate was prepared following the same procedure described above using CuI (3.0 mg, 0.015 mmol, 15 mol%) and *rac*-**A**-NHTf (6.3 mg, 0.01 mmol, 10 mol%) as catalyst at 0 °C in anhydrous DCM (1.0 mL) for 48-96 h. Upon completion (monitored by TLC), the solvent was removed *in vacuo*, and the residue was purified by a silica gel column chromatography (eluent: *n*-hexane/ethyl acetate = 20/0-2/1) to give the desired product.

Note: Since the reaction is sensitive to water and air, Schlenk tube and the reagents must be dried prior to use.



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(*p*-tolyl)hexyl)phenol (4A)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4A** (51.1 mg, 82 %) as sticky light yellow oil.

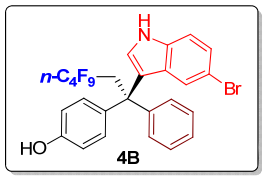
HPLC analysis: Chiralcel IA (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.5 mL/min, λ = 240 nm), t_R (minor) = 10.39 min, t_R (major) = 11.52 min.

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.13 (s, 1H), 7.26-7.20 (m, 6H), 7.07 (d, *J* = 7.5 Hz, 3H), 7.04 (d, *J* = 2.4 Hz, 1H), 6.79-6.71 (m, 2H), 4.90 (br s, 1H), 3.57-3.37 (m, 2H), 2.30 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 154.0, 142.0, 136.9, 136.1, 135.4, 129.6, 128.8, 128.2, 127.9, 125.4, 124.8, 124.2, 120.6, 114.8, 112.7, 112.6, 119.9-105.6 (m), 48.8, 39.2 (t, *J* = 19.6 Hz), 20.9.

^{19}F NMR (376 MHz, $CDCl_3$) δ -80.7 ~ -81.4 (m, 3F), -108.4 ~ -109.0 (m, 2F), -124.2 (d, *J* = 8.2 Hz, 2F), -125.1 ~ -126.2 (m, 2F).

HRMS (ESI) m/z calcd. for $C_{27}H_{18}ONBrF_9$ $[M-H]^-$ 622.0434, found 622.0455.



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-phenylhexyl)phenol (4B)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4B** (41.2 mg, 66 %) as sticky light yellow oil.

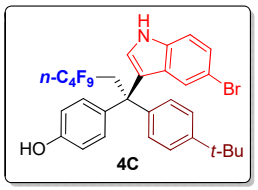
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 230 nm), t_R (minor) = 17.21 min, t_R (major) = 21.59 min.

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.18 (s, 1H), 7.40 (d, *J* = 7.8 Hz, 2H), 7.35-7.18 (m, 7H), 7.07 (s, 2H), 6.81-6.71 (m, 2H), 5.01 (br s, 1H), 3.62-3.42 (m, 2H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 154.0, 144.9, 136.7, 135.4, 129.6, 128.2, 128.1, 128.0, 126.6, 125.4, 124.9, 124.2, 120.4, 114.8, 112.72, 112.66, 120.8-108.9 (m), 49.1, 39.2 (t, *J* = 19.5 Hz).

^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.7 Hz, 3F), -108.6 (s, 2F), -124.2 (d, *J* = 4.3 Hz, 2F), -125.0 ~ -126.3 (m, 2F).

HRMS (ESI) m/z calcd. for $C_{26}H_{16}ONBrF_9$ $[M-H]^-$ 608.0277, found 608.0290.

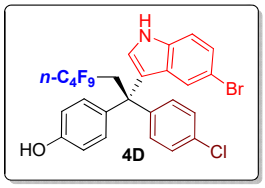


(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-1-(4-(*tert*-butyl)phenyl)-3,3,4,4,5,5,6,6,6-nonafluorohexyl)phenol (4C)

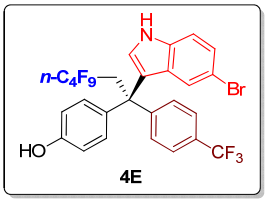
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4C** (56.5 mg, 85 %) as sticky light yellow oil.

HPLC analysis: Chiralcel IA (*n*-hexane/*i*-PrOH = 90/10, flow rate 0.2 mL/min, λ = 240 nm), t_R (minor) = 34.07 min, t_R (major) = 35.93 min.

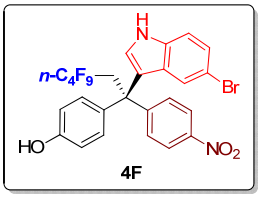
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.12 (s, 1H), 7.35-7.24 (m, 6H), 7.21 (q, *J* = 8.6 Hz, 2H), 7.05 (d, *J* = 11.6 Hz, 2H), 6.75 (d, *J* = 8.6 Hz, 2H), 3.69-3.37 (m, 2H), 1.32 (s, 9H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 154.0, 149.3, 142.2, 136.9, 135.4, 129.7, 128.3, 127.5, 125.6, 125.0, 124.7, 124.3, 120.5, 114.8, 112.7, 112.6, 120.8-106.5 (m), 48.7, 39.1 (t, *J* = 19.4 Hz) 34.4, 31.3.
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.6 Hz, 3F), -107.5 ~ -109.9 (m, 2F), -123.8 ~ -124.7 (m, 2F), -125.6 (t, *J* = 11.6 Hz, 2F).
HRMS (ESI) m/z calcd. for $C_{30}H_{24}ONBrF_9$ $[M-H]^-$ 664.0903, found 664.0918.



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-1-(4-chlorophenyl)-3,3,4,4,5,5,6,6,6-nonafluorohexyl)phenol (4D)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4D** (36.1 mg, 56 %) as sticky light yellow oil.
HPLC analysis: Chiralcel IA (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 230 nm), t_R (minor) = 19.09 min, t_R (major) = 22.02 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.20 (s, 1H), 7.33 (d, *J* = 8.6 Hz, 2H), 7.30-7.24 (m, 4H), 7.22 (d, *J* = 8.7 Hz, 2H), 7.12-7.01 (m, 2H), 6.76 (d, *J* = 8.7 Hz, 2H), 4.96 (s, 1H), 3.48 (t, *J* = 18.4 Hz, 2H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 154.2, 143.2, 136.4, 135.4, 132.4, 129.6, 129.5, 128.2, 127.9, 125.3, 125.1, 124.0, 120.0, 115.0, 112.8, 120.2-107.8 (m), 48.8, 39.2 (t, *J* = 19.5 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.6 Hz, 3F), -108.5 (t, *J* = 12.5 Hz, 2F), -124.2 (s, 2F), -125.6 ~ -125.7 (m, 2F).
HRMS (ESI) m/z calcd. for $C_{26}H_{15}ONBrF_9$ $[M-H]^-$ 643.9867, found 643.9871.



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(4-(trifluoromethyl)phenyl)hexyl)phenol (4E)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4E** (54.8 mg, 56 %) as sticky light yellow oil.
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 234 nm), t_R (minor) = 14.54 min, t_R (major) = 18.63 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.26 (s, 1H), 7.67-7.48 (m, 4H), 7.33-7.17 (m, 4H), 7.07 (s, 2H), 6.79 (d, *J* = 8.7 Hz, 2H), 5.14 (s, 1H), 3.68-3.38 (m, 2H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 154.3, 148.8, 136.0, 135.4, 129.5, 128.8 (q, *J* = 32.6 Hz), 128.4, 127.8, 125.5, 125.2, 125.1 (q, *J* = 3.6 Hz), 124.1 (q, *J* = 272.7 Hz), 123.9, 119.6, 115.1, 112.92 (d, *J* = 1.8 Hz), 120.8-106.4 (m), 49.2, 39.0 (t, *J* = 19.5 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.5 (s, 3F), -81.0 (t, *J* = 9.7 Hz, 3F), -107.9 ~ -109.3 (m, 2F), -124.2 (d, *J* = 5.4 Hz, 2F), -125.7 (t, *J* = 12.2 Hz, 2F).
HRMS (ESI) m/z calcd. for $C_{27}H_{15}ONBrF_{12}$ $[M-H]^-$ 676.0151, found 676.0156.



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(4-nitrophenyl)hexyl)phenol (4F)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4F** (62.8 mg, 95 %) as a yellow solid.

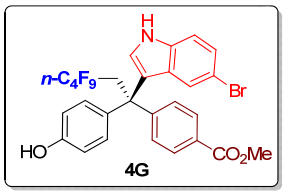
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.5 mL/min, λ = 230 nm), t_R (minor) = 15.21 min, t_R (major) = 22.34 min.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.28 (s, 1H), 8.16 (d, *J* = 8.9 Hz, 2H), 7.61 (d, *J* = 8.8 Hz, 2H), 7.30-7.22 (m, 4H), 7.09 (s, 1H), 7.03 (s, 1H), 6.79 (d, *J* = 8.7 Hz, 2H), 4.99 (br s, 1H), 3.55 (t, *J* = 18.3 Hz, 2H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 154.6, 152.1, 146.3, 135.5, 135.3, 129.5, 129.1, 127.6, 125.4, 125.4, 123.7, 123.4, 119.1, 115.3, 113.1, 120.7-106.0 (m), 49.4, 39.1 (t, *J* = 19.5 Hz).

^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.1 Hz, 3F), -108.4 (s, 2F), -124.2 (s, 2F), -125.6 (t, *J* = 12.9 Hz, 2F).

HRMS (ESI) m/z calcd. for $C_{26}H_{15}O_3N_2BrF_9$ $[M-H]^-$ 653.0128, found 653.0139.



(*S*)-methyl 4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(4-hydroxyphenyl)hexyl)benzoate (4G)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4G** (46.0 mg, 69 %) as sticky light yellow oil.

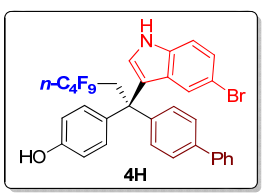
HPLC analysis: Chiralcel IA (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 230 nm), t_R (minor) = 23.38 min, t_R (major) = 29.49 min.

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.24 (s, 1H), 7.94 (d, *J* = 8.6 Hz, 2H), 7.47 (d, *J* = 8.5 Hz, 2H), 7.25-7.20 (m, 4H), 7.08-6.99 (m, 2H), 6.75 (d, *J* = 8.8 Hz, 2H), 5.17 (s, 1H), 3.89 (s, 3H), 3.60-3.40 (m, 2H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 166.9, 154.3, 150.0, 135.9, 135.4, 129.6, 129.4, 128.3, 128.1, 127.9, 125.5, 125.1, 123.9, 119.6, 115.1, 112.9, 120.6-106.4 (m), 52.2, 49.3, 38.95 (t, *J* = 19.3 Hz).

^{19}F NMR (376 MHz, $CDCl_3$) δ -81.03 (t, *J* = 9.5 Hz, 3F), -107.80 ~ -109.33 (m, 2F), -124.20 (s, 2F), -125.13 ~ -126.30 (m, 2F).

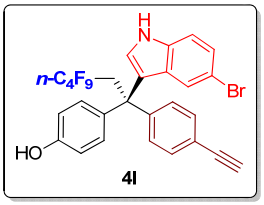
HRMS (ESI) m/z calcd. for $C_{28}H_{18}O_3NBrF_9$ $[M-H]^-$ 666.0332, found 666.0345.



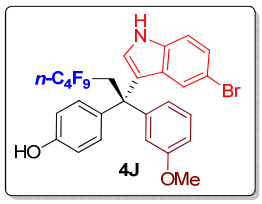
(*S*)-4-(1-([1,1'-biphenyl]-4-yl)-1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluorohexyl)phenol (4H)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4H** (39.7 mg, 58 %) as sticky light yellow oil.

HPLC analysis: Chiralcel OD3 (hexane/*i*-PrOH = 87/13, flow rate 0.3 mL/min, λ = 230 nm), t_R (major) = 25.23 min, t_R (minor) = 28.12 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.16 (s, 1H), 7.58 (d, *J* = 7.7 Hz, 2H), 7.51 (d, *J* = 8.4 Hz, 2H), 7.42 (dd, *J* = 15.2, 7.9 Hz, 4H), 7.32 (t, *J* = 7.4 Hz, 1H), 7.24 (dt, *J* = 11.6, 8.6 Hz, 4H), 7.11 (s, 1H), 7.08 (d, *J* = 1.3 Hz, 1H), 6.76 (d, *J* = 8.7 Hz, 2H), 4.92 (br s, 1H), 3.63-3.42 (m, 2H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 154.1, 144.0, 140.4, 139.1, 136.7, 135.4, 129.7, 128.8, 128.4, 128.1, 127.3, 127.0, 126.7, 125.5, 124.9, 124.2, 120.3, 114.9, 112.8, 120.8-106.3 (m), 48.9, 39.1 (t, *J* = 19.4 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -80.99 (t, *J* = 9.6 Hz, 3F), -108.58 (s, 2F), -123.76 ~ -124.57 (m, 2F), -125.31 ~ -126.13 (m, 2F).
HRMS (ESI) m/z calcd. for $C_{32}H_{20}ONBrF_9$ $[M-H]^-$ 684.0590, found 684.0602.

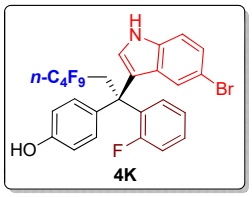


(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-1-(4-ethynylphenyl)-3,3,4,4,5,5,6,6,6-nonafluorohexyl)phenol (4I)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4I** (39.9 mg, 63 %) as sticky light yellow oil.
HPLC analysis: Chiralcel IA (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 230 nm), t_R (minor) = 19.77 min, t_R (major) = 22.39 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.21 (s, 1H), 7.43 (d, *J* = 8.4 Hz, 2H), 7.37 (d, *J* = 8.4 Hz, 2H), 7.23 (d, *J* = 8.6 Hz, 4H), 7.08 (s, 1H), 7.05 (d, *J* = 2.0 Hz, 1H), 6.76 (d, *J* = 8.7 Hz, 2H), 3.50 (t, *J* = 18.7 Hz, 2H), 3.08 (s, 1H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 154.2, 145.6, 136.2, 135.4, 131.9, 129.6, 128.1, 128.0, 125.4, 125.0, 124.0, 120.3, 119.8, 115.0, 112.9, 112.8, 120.8-106.5 (m), 83.4, 77.5, 49.1, 39.0 (t, *J* = 19.4 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.6 Hz, 3F), -108.6 (d, *J* = 8.3 Hz, 2F), -124.2 (s, 2F), -125.7 (t, *J* = 13.4 Hz, 2F).
HRMS (ESI) m/z calcd. for $C_{28}H_{16}ONBrF_9$ $[M-H]^-$ 632.0277, found 632.0288.

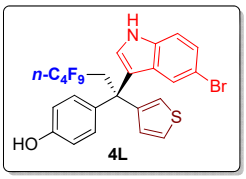


(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(3-methoxyphenyl)hexyl)phenol (4J)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4J** (47.9 mg, 75 %) as sticky light yellow oil.
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 230 nm), t_R (minor) = 18.32 min, t_R (major) = 20.30 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.16 (s, 1H), 7.34-7.14 (m, 5H), 7.11 (s, 1H), 7.06 (s, 1H), 7.03-6.90 (m, 2H), 6.76 (t, *J* = 8.9 Hz, 3H), 3.74 (s, 3H), 3.59-3.42 (m, 2H).

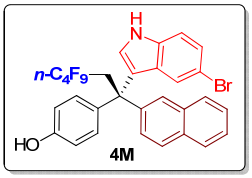
^{13}C NMR (126 MHz, $CDCl_3$) δ 159.2, 154.1, 146.9, 136.5, 135.4, 129.6, 129.0, 128.2, 125.6, 124.9, 124.21, 120.5, 120.11, 114.8, 114.75, 112.7, 112.7, 111.2, 119.9-106.4 (m), 55.2, 49.1, 39.01 (t, *J* = 19.4 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.03 (s, 3F), -108.63 (s, 2F), -124.21 (s, 2F), -125.63 (s, 2F).
HRMS (ESI) m/z calcd. for $C_{27}H_{18}O_2NBrF_9$ $[M-H]^-$ 638.03827, found 638.03784.



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(2-fluorophenyl)hexyl)phenol (4K)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4K** (50.1 mg, 80 %) as sticky light yellow oil.
HPLC analysis: Chiralcel IA (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 230 nm), t_R (minor) = 17.89 min, t_R (major) = 21.70 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.18 (s, 1H), 7.38-7.30 (m, 1H), 7.27-7.15 (m, 6H), 7.13-6.99 (m, 3H), 6.80-6.69 (m, 2H), 4.78 (br s, 1H), 3.72-3.53 (m, 2H).
^{13}C NMR (126 MHz, $CDCl_3$) δ161.6 (d, *J* = 248.3 Hz), 154.0, 135.9, 135.3, 131.4 (d, *J* = 3.8 Hz), 129.6 (d, *J* = 8.9 Hz), 129.3 (d, *J* = 11.2 Hz), 129.1, 128.1, 125.0, 124.2 (d, *J* = 5.3 Hz), 124.0, 123.8 (d, *J* = 3.0 Hz), 120.0, 116.4, 116.2, 114.8, 112.73, 112.70, 120.8-106.5 (m), 48.0, 38.8 (td, *J* = 19.4, 4.7 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.5 Hz, 3F), -104.0 (s, 1F), -107.5 ~ -110.7 (m, 2F), -124.3 (d, *J* = 7.5 Hz, 2F), -125.6 (dt, *J* = 27.7, 14.6 Hz, 2F).
HRMS (ESI) m/z calcd. for $C_{26}H_{15}ONBrF_{10}$ $[M-H]^-$ 626.0183, found 626.0192.



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(thiophen-2-yl)hexyl)phenol (4L)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4L** (58.3 mg, 95 %) as sticky light yellow oil.
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 230 nm), t_R (minor) = 18.63 min, t_R (major) = 24.27 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.14 (s, 1H), 7.25-7.18 (m, 5H), 7.07 (d, *J* = 8.2 Hz, 2H), 7.02 (s, 1H), 6.95 (d, *J* = 5.0 Hz, 1H), 6.74 (d, *J* = 8.6 Hz, 2H), 5.00 (br s, 1H), 3.60-3.25 (m, 2H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 154.2, 146.4, 136.4, 135.4, 129.3, 128.6, 127.9, 125.2, 125.0, 124.9, 124.0, 121.7, 120.5, 114.9, 112.7, 120.6-106.6 (m), 46.8, 39.8 (t, *J* = 19.8 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.5 Hz, 3F), -106.9 ~ -110.6 (m, 2F), -124.3 (d, *J* = 7.6 Hz, 2F), -125.7 (s, 2F).
HRMS (ESI) m/z calcd. for $C_{24}H_{14}ONBrF_9S$ $[M-H]^-$ 613.9841, found 613.9846.



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(naphthalen-2-yl)hexyl)phenol (4M)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4M** (62.0 mg, 94 %) as sticky light yellow oil.

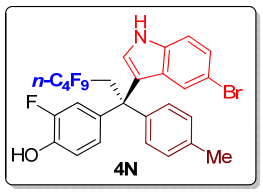
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.4 mL/min, λ = 230 nm), t_R (minor) = 15.90 min, t_R (major) = 24.35 min.

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.18 (s, 1H), 7.90 (s, 1H), 7.80 (s, 2H), 7.74 (d, *J* = 8.7 Hz, 1H), 7.49 (d, *J* = 6.6 Hz, 3H), 7.30 (dd, *J* = 9.5, 5.0 Hz, 2H), 7.25 (d, *J* = 8.8 Hz, 2H), 7.18 (s, 1H), 7.06 (s, 1H), 6.76 (d, *J* = 8.4 Hz, 2H), 3.76-3.55 (m, 2H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 154.1, 142.3, 136.7, 135.4, 133.0, 132.0, 129.8, 128.4, 128.2, 127.6, 127.4, 127.1, 126.2, 125.9, 125.8, 124.9, 124.2, 120.0, 115.0, 112.8, 112.8, 120.5-106.5 (m), 49.3, 39.0 (t, *J* = 19.5 Hz).

^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.6 Hz, 3F), -107.4 ~ -109.7 (m, 2F), -124.1 (d, *J* = 9.2 Hz, 2F), -125.6 (dd, *J* = 23.1, 11.0 Hz, 2F).

HRMS (ESI) m/z calcd. for $C_{30}H_{18}ONBrF_9$ $[M-H]^-$ 658.0434, found 658.0441.



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(*p*-tolyl)hexyl)-2-fluorophenol (4N)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4N** (62.2 mg, 97 %) as sticky light yellow oil.

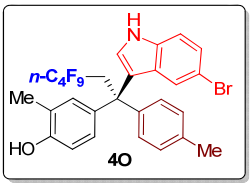
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 240 nm), t_R (minor) = 15.46 min, t_R (major) = 18.98 min.

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.17 (s, 1H), 7.33-7.19 (m, 4H), 7.16-7.01 (m, 6H), 6.90 (t, *J* = 8.8 Hz, 1H), 5.27 (s, 1H), 3.47 (t, *J* = 18.2 Hz, 2H), 2.31 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 150.4 (d, *J* = 236.9 Hz), 142.0 (d, *J* = 14.3 Hz), 141.4, 137.8 (d, *J* = 4.8 Hz), 136.4, 135.4, 128.9, 128.0, 127.8, 125.5, 125.0, 124.5 (d, *J* = 2.6 Hz), 124.0, 119.9, 116.6 (d, *J* = 1.8 Hz), 115.9 (d, *J* = 19.8 Hz), 112.81, 112.77, 120.8-106.5 (m), 48.8, 39.1 (t, *J* = 19.4 Hz), 20.9.

^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 8.5 Hz, 3F), -108.6 (d, *J* = 14.6 Hz, 2F), -124.2 (s, 2F), -125.6 (t, *J* = 13.0 Hz, 2F), -138.6 ~ -141.1 (m, 1F).

HRMS (ESI) m/z calcd. for $C_{27}H_{17}ONBrF_{10}$ $[M-H]^-$ 640.0339, found 640.0350.

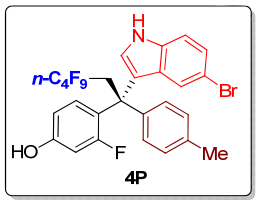


(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(*p*-tolyl)hexyl)-2-methylphenol (4O)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4O** (44.6 mg, 70 %) as sticky light yellow oil.

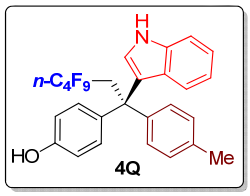
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 230 nm), t_R (minor) = 15.72 min, t_R (major) = 18.65 min.

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.11 (s, 1H), 7.27-7.22 (m, 2H), 7.20 (s, 2H), 7.12-6.99 (m, 6H), 6.63 (d, *J* = 8.4 Hz, 1H), 4.80 (s, 1H), 3.58-3.38 (m, 2H), 2.30 (s, 3H), 2.16 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 152.2, 142.1, 137.0, 136.0, 135.4, 130.8, 128.7, 128.3, 127.9, 126.9, 125.6, 124.8, 124.3, 123.1, 120.5, 114.3, 112.7, 112.6, 120.7-106.6 (m), 48.7, 39.0 (t, *J* = 19.6 Hz), 20.9, 16.1.
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.7 Hz, 3F), -108.7 (t, *J* = 13.0 Hz, 2F), -124.2 (d, *J* = 4.8 Hz, 2F), -125.2 ~ -126.4 (m, 2F).
HRMS (ESI) m/z calcd. for $C_{28}H_{20}ONBrF_9$ $[M-H]^-$ 636.0590, found 636.0605.



4P

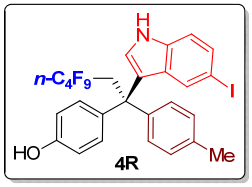
(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(*p*-tolyl)hexyl)-3-fluorophenol (4P)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4P** (57.1 mg, 89 %) as sticky light yellow oil.
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.4 mL/min, λ = 240 nm), t_R (minor) = 11.83 min, t_R (major) = 22.86 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.14 (s, 1H), 7.22-7.12 (m, 5H), 7.06-7.05 (m, 3H), 7.00 (t, *J* = 8.9 Hz, 1H), 6.60 (dd, *J* = 13.1, 2.5 Hz, 1H), 6.46 (dd, *J* = 8.7, 2.5 Hz, 1H), 3.73-3.57 (m, 1H), 3.57-3.38 (m, 1H), 2.28 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ162.0 (d, *J* = 248.6 Hz), 156.5 (d, *J* = 12.1 Hz), 141.1, 136.2, 135.3, 132.3 (d, *J* = 5.9 Hz), 128.7, 128.1, 127.4, 124.9, 124.1, 123.9 (d, *J* = 5.9 Hz), 121.1 (d, *J* = 12.0 Hz), 120.3, 112.7, 110.6 (d, *J* = 2.4 Hz), 104.1, 103.9, 120.7-106.5 (m), 47.6, 38.6 (t, *J* = 19.4 Hz). 20.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.2 Hz, 3F), -101.8 (s, 1F), -109.4 (dd, *J* = 1000.5, 275.3 Hz, 2F), -124.3 (d, *J* = 6.4 Hz, 2F), -125.3 ~ -126.1 (m, 2F).
HRMS (ESI) m/z calcd. for $C_{27}H_{17}ONBrF_{10}$ $[M-H]^-$ 640.0339, found 640.0347.



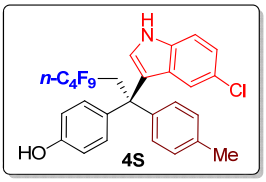
4Q

(*S*)-4-(3,3,4,4,5,5,6,6,6-nonafluoro-1-(1*H*-indol-3-yl)-1-(*p*-tolyl)hexyl)phenol (4Q)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4Q** (51.8 mg, 95 %) as sticky light yellow oil.
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 90/10, flow rate 0.2 mL/min, λ = 230 nm), t_R (major) = 40.11 min, t_R (minor) = 42.34 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.02 (s, 1H), 7.36-7.31 (m, 3H), 7.29 (d, *J* = 8.7 Hz, 2H), 7.17-7.13 (m, 1H), 7.09 (d, *J* = 8.2 Hz, 2H), 7.03 (d, *J* = 8.1 Hz, 1H), 7.00 (d, *J* = 2.3 Hz, 1H), 6.97-6.90 (m, 1H), 6.74-6.65 (m, 2H), 3.56 (t, *J* = 18.6 Hz, 2H), 2.32 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 153.8, 142.4, 137.3, 136.8, 135.9, 129.8, 128.7, 128.1, 126.4, 124.1, 122.0, 121.8, 121.1, 119.2, 114.7, 111.3, 120.9-106.5 (m), 49.0, 39.2 (t, *J* = 19.4 Hz), 20.9.

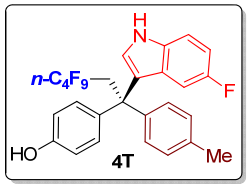
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.8 Hz, 3F), -108.5 (t, *J* = 12.9 Hz, 2F), -123.6 ~ -124.7 (m, 2F), -125.0 ~ -126.1 (m, 2F).
HRMS (ESI) m/z calcd. for $C_{27}H_{19}ONF_9$ $[M-H]^-$ 544.1328, found 544.1334.



(*S*)-4-(3,3,4,4,5,5,6,6,6-nonafluoro-1-(5-iodo-1*H*-indol-3-yl)-1-(*p*-tolyl)hexyl)phenol (4R)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4R** (63.8 mg, 95 %) as sticky light yellow oil.
HPLC analysis: Chiralcel IA (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.25 mL/min, λ = 230 nm), t_R (minor) = 21.62 min, t_R (major) = 24.75 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.12 (s, 1H), 7.37 (dd, *J* = 8.5, 1.4 Hz, 1H), 7.30-7.17 (m, 5H), 7.12 (d, *J* = 8.5 Hz, 1H), 7.07 (d, *J* = 8.2 Hz, 2H), 6.99 (d, *J* = 2.1 Hz, 1H), 6.73 (d, *J* = 8.7 Hz, 2H), 3.58-3.35 (m, 2H), 2.31 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 153.9, 142.0, 136.9, 136.1, 135.8, 130.5, 130.3, 129.6, 129.0, 128.7, 127.9, 124.9, 120.3, 114.8, 113.2, 120.5-106.2 (m), 83.0, 48.8, 39.2 (t, *J* = 19.4 Hz), 20.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.7 Hz, 3F), -108.6 (d, *J* = 10.5 Hz, 2F), -124.2 (dd, *J* = 12.0, 7.3 Hz, 2F), -125.2 ~ -126.1 (m, 2F).
HRMS (ESI) m/z calcd. for $C_{27}H_{18}ONIF_9$ $[M-H]^-$ 670.0295, found 670.0314.

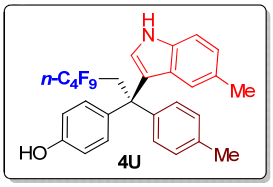


(*S*)-4-(1-(5-chloro-1*H*-indol-3-yl)-3,3,4,4,5,5,6,6,6-nonafluoro-1-(*p*-tolyl)hexyl)phenol (4S)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4S** (53.3 mg, 92 %) as sticky light yellow oil.
HPLC analysis: Chiralcel IA (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.25 mL/min, λ = 240 nm), t_R (minor) = 20.94 min, t_R (major) = 23.26 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.15 (s, 1H), 7.29-7.25 (m, 5H), 7.16-7.04 (m, 4H), 6.94 (s, 1H), 6.75 (d, *J* = 8.6 Hz, 2H), 5.00 (s, 1H), 3.64-3.36 (m, 2H), 2.33 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 154.0, 142.0, 136.9, 136.1, 135.1, 129.6, 128.8, 127.9, 127.5, 125.5, 124.9, 122.3, 121.2, 120.6, 114.8, 112.2, 120.6-106.6 (m), 48.8, 39.1 (t, *J* = 19.5 Hz), 20.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.8 Hz, 3F), -108.6 (d, *J* = 14.6 Hz, 2F), -124.2 (d, *J* = 3.2 Hz, 2F), -125.3 ~ -126.2 (m, 2F).
HRMS (ESI) m/z calcd. for $C_{27}H_{18}ONClF_9$ $[M-H]^-$ 578.0939, found 578.0948.

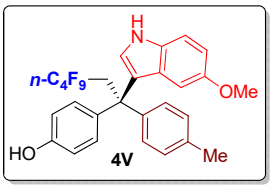


(*S*)-4-(3,3,4,4,5,5,6,6,6-nonafluoro-1-(5-fluoro-1*H*-indol-3-yl)-1-(*p*-tolyl)hexyl)phenol (4T)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate =

100/0 to 2/1) to afford desired product **4T** (36.1 mg, 56 %) as sticky light yellow oil.
HPLC analysis: Chiralcel IA (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.2 mL/min, λ = 230 nm), t_R (minor) = 26.49 min, t_R (major) = 28.80 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.09 (s, 1H), 7.33-7.18 (m, 6H), 7.12-7.02 (m, 3H), 6.87 (td, *J* = 8.9, 1.9 Hz, 1H), 6.72 (d, *J* = 8.6 Hz, 2H), 6.60 (dd, *J* = 10.2, 1.2 Hz, 1H), 4.95 (br s, 1H), 3.48 (t, *J* = 18.6 Hz, 2H), 2.30 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ157.1 (d, *J* = 234.0 Hz), 153.9, 142.0, 136.9, 136.0, 133.3, 129.6, 128.7, 127.9, 126.8 (d, *J* = 10.0 Hz), 125.8, 121.1 (d, *J* = 4.6 Hz), 114.8, 111.8 (d, *J* = 9.8 Hz), 110.3 (d, *J* = 26.5 Hz), 106.8 (d, *J* = 24.3 Hz), 120.8-106.4 (m), 48.8, 39.1 (t, *J* = 19.5 Hz), 20.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -80.4 ~ -81.4 (m, 3F), -108.4 ~ -108.9 (m, 2F), -123.9 ~ -124.1 (m, 1F), -124.3 (s, 2F), -125.5 ~ -126.0 (m, 2F).
HRMS (ESI) m/z calcd. for $C_{27}H_{18}ONBrF_{10}$ $[M-H]^-$ 562.1234, found 562.1248.

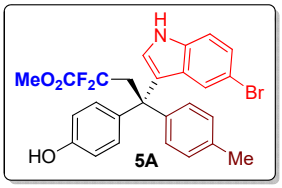


(*S*)-4-(3,3,4,4,5,5,6,6,6-nonafluoro-1-(5-methyl-1*H*-indol-3-yl)-1-(*p*-tolyl)hexyl)phenol (4U)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4U** (53.7 mg, 96 %) as sticky light yellow oil.
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 214 nm), t_R (minor) = 17.74 min, t_R (major) = 21.31 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.97 (s, 1H), 7.30-7.23 (m, 5H), 7.07 (d, *J* = 7.9 Hz, 2H), 6.97-6.94 (m, 2H), 6.77 (s, 1H), 6.71 (d, *J* = 8.3 Hz, 2H), 4.95 (s, 1H), 3.63-3.40 (m, 2H), 2.31 (s, 3H), 2.28 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 153.8, 142.4, 137.4, 135.8, 135.2, 129.9, 128.6, 128.3, 128.1, 126.6, 124.3, 123.5, 121.6, 120.5, 114.6, 110.9, 120.7-106.5 (m), 49.1, 39.1 (t, *J* = 19.4 Hz), 21.7, 20.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.4 Hz, 3F), -108.3 (s, 2F), -124.2 (s, 2F), -125.0 ~ -126.1 (m, 2F).
HRMS (ESI) m/z calcd. for $C_{28}H_{21}ONF_9$ $[M-H]^-$ 558.1485, found 558.1490.



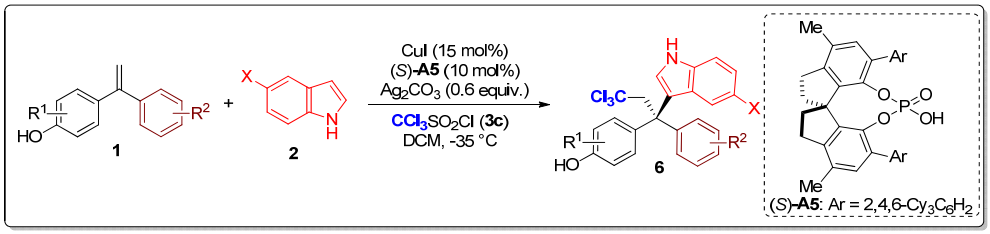
(*S*)-4-(3,3,4,4,5,5,6,6,6-nonafluoro-1-(5-methoxy-1*H*-indol-3-yl)-1-(*p*-tolyl)hexyl)phenol (4V)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4V** (54.6 mg, 56 %) as sticky light yellow oil.
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 214 nm), t_R (minor) = 18.25 min, t_R (major) = 23.57 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.98 (s, 1H), 7.34-7.24 (m, 4H), 7.22 (d, *J* = 8.8 Hz, 1H), 7.06 (d, *J* = 8.2 Hz, 2H), 7.01 (d, *J* = 2.3 Hz, 1H), 6.79 (dd, *J* = 8.8, 2.4 Hz, 1H), 6.70 (d, *J* = 8.7 Hz, 2H), 6.37 (d, *J* = 2.0 Hz, 1H), 5.05 (s, 1H), 3.58 (s, 3H), 3.54-3.42 (m, 2H), 2.29 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 153.9, 153.2, 142.2, 137.0, 135.9, 132.0, 129.8, 128.6, 128.1, 126.9, 124.8, 120.7, 114.6, 111.8, 111.7, 104.4, 120.6-106.6 (m), 55.7, 48.9, 39.3 (t, *J* = 19.4 Hz), 20.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -81.0 (t, *J* = 9.5 Hz, 3F), -108.3 (s, 2F), -124.3 (s, 2F), -125.1 ~ -126.2 (m, 2F).
HRMS (ESI) m/z calcd. for $C_{28}H_{21}O_2NF_9$ $[M-H]^-$ 574.1434, found 574.1441.



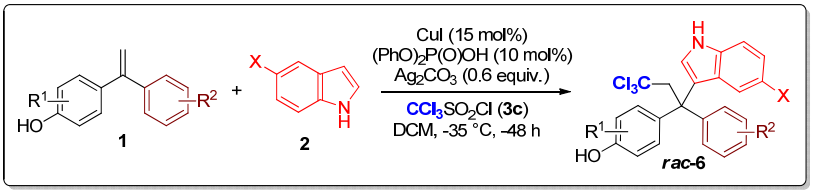
(*R*)-methyl 4-(5-bromo-1*H*-indol-3-yl)-2,2-difluoro-4-(4-hydroxy-phenyl)-4-(*p*-tolyl)butanoate (5A)
The reaction was conducted on a 0.025 mmol scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **5A** (5.4 mg, 42 %) as a sticky light yellow solid.
HPLC analysis: Chiralcel IC (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.2 mL/min, λ = 240 nm), t_R (major) = 35.06 min, t_R (minor) = 38.24 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.34 (s, 1H), 7.31-7.28 (m, 4H), 7.21 (s, 2H), 7.10-7.03 (m, 3H), 7.01 (d, *J* = 2.4 Hz, 1H), 6.72 (d, *J* = 8.7 Hz, 2H), 4.88 (s, 1H), 3.76 (t, *J* = 14.7 Hz, 2H), 2.99 (s, 3H), 2.31 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 163.1 (t, *J* = 33.4 Hz), 153.7, 142.8, 137.9, 135.8, 135.2, 129.2, 128.8, 128.0, 127.7, 127.5, 124.6, 124.4, 119.2, 115.6 (d, *J* = 251.3 Hz), 114.8, 112.8, 112.5, 52.5, 48.2, 42.9 (t, *J* = 22.7 Hz), 20.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -97.6 ~ -99.4 (m, 2F).
HRMS (ESI) m/z calcd. for $C_{26}H_{21}O_3NBrF_2$ $[M-H]^-$ 514.06469, found 514.06525.

General procedure B: Cu/CPA-catalyzed asymmetric three-component radical-initiated trichloromethylarylation of 1,1-diarylalkene



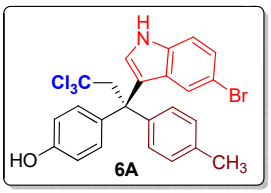
Under argon atmosphere, an oven-dried resealable Schlenk tube equipped with a magnetic stir bar was charged with 1,1-diarylalkene substrate **1** (0.1 mmol, 1.0 equiv.), substituted indole (0.12 mmol, 1.2 equiv.), CuI (3.0 mg, 0.015 mmol, 15 mol%), chiral phosphoric acid ((*S*)-**A5** (9.86 mg, 0.01 mmol, 10 mol%), CCl_3SO_2Cl (**3c**, 26.2 mg, 0.12 mmol, 1.2 equiv.), Ag_2CO_3 (16.56 mg, 0.06 mmol, 0.6 equiv.), and anhydrous DCM (1.0 mL) at 0 °C, then the sealed tube was stirred at -35 °C for 60-72 h. Upon completion (monitored by TLC), the reaction mixture was directly purified by a silica gel chromatography [eluent: *n*-hexane/ethyl acetate = 100/0 to 2/1, using petroleum ether (100%) to remove the solvent (DCM) at first] to afford the desired product **6**.

*Note: the trichloromethyl-containing products **6A–6D** was unstable at 2-30*°C*, easy to convert to other products, especially when dissolved in halogen-containing solvents, such as DCM, $CHCl_3$ etc, and slightly more stable in alcoholic solvents, such as n-hexane, ethyl acetate, alcohol isopropanol etc. So **6A–6D** should be characterized by NMR, HPLC or HRMS ASAP. Meanwhile, the reaction is sensitive to water and air, Schlenk tube and the reagents must be dried prior to use.*



The racemate was prepared following the same procedure described above using CuI (3.0 mg, 0.015 mmol, 15 mol%) and diphenyl phosphate (2.5 mg, 0.01 mmol, 10 mol%) as catalyst at -35 °C in anhydrous DCM (1.0 mL) for 48 h. Upon completion (monitored by TLC), the solvent was removed *in vacuo*, and the residue was purified by a silica gel column chromatography (eluent: *n*-hexane/ethyl acetate = 100/0 to 2/1) to give the desired product.

Note: Since the reaction is sensitive to water and air, Schlenk tube and the reagents must be dried prior to use.



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,3-trichloro-1-(*p*-tolyl) propyl)phenol (6A)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure B. The product was purified by

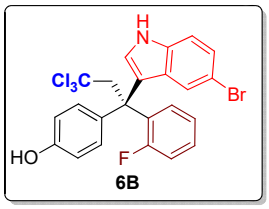
silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **6A** (44.9 mg, 86 %) as sticky light yellow oil.

HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.5 mL/min, λ = 230 nm), t_R (minor) = 16.08 min, t_R (major) = 24.65 min.

^{1}H NMR (400 MHz, MeOD) δ 7.46 (d, *J* = 8.4 Hz, 2H), 7.42-7.36 (m, 2H), 7.33 (s, 1H), 7.24 (d, *J* = 8.6 Hz, 1H), 7.12-7.02 (m, 4H), 6.88 (d, *J* = 1.6 Hz, 1H), 6.72-6.68 (m, 2H), 4.32 (s, 2H), 2.25 (s, 3H).

^{13}C NMR (101 MHz, MeOD) δ 155.2, 142.9, 136.1, 135.7, 135.3, 129.4, 128.9, 128.1, 127.7, 127.4, 123.8, 123.4, 117.3, 114.2, 112.6, 111.2, 98.2, 58.8, 51.7, 19.5.

HRMS (ESI) m/z calcd. for $C_{24}H_{18}ON^{81}BrCl_3$ $[M-H]^-$ 521.96224, found 521.96173.



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,3-trichloro-1-(2-fluoro phenyl)propyl)phenol (6B)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure B. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **6B** (43.1 mg, 82 %) as sticky light yellow oil.

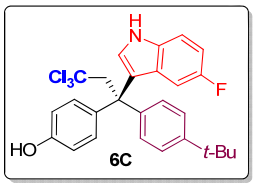
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.5 mL/min, λ = 254 nm), t_R (minor) = 20.34 min, t_R (major) = 27.49 min.

^{1}H NMR (400 MHz, MeOD) δ 7.65 (td, *J* = 8.2, 1.6 Hz, 1H), 7.42 (s, 1H), 7.32 (d, *J* = 8.0 Hz, 2H), 7.30-7.21 (m, 2H), 7.13-7.04 (m, 2H), 6.99 (dd, *J* = 13.1, 8.1 Hz, 1H), 6.93 (d, *J* = 1.6 Hz, 1H), 6.73-6.66 (m, 2H), 4.52 (d, *J* = 15.8 Hz, 1H), 4.37 (d, *J* = 15.7 Hz, 1H).

^{13}C NMR (101 MHz, MeOD) δ 161.5 (d, *J* = 247.5 Hz), 155.4, 135.7, 135.0, 131.5 (d, *J* = 4.0 Hz), 130.2 (d, *J* = 9.9 Hz), 128.9, 128.8, 128.2, 126.5, 123.5 (d, *J* = 3.4 Hz), 123.1 (d, *J* = 3.1 Hz), 116.9, 116.2, 116.0, 114.1, 112.7, 111.2, 98.0, 58.9 (d, *J* = 7.0 Hz), 51.1 (d, *J* = 2.3 Hz).

^{19}F NMR (376 MHz, MeOD) δ -104.5 (s, 1F).

HRMS (ESI) m/z calcd. for $C_{23}H_{15}ON^{81}BrCl_3F$ $[M-H]^-$ 525.93716, found 525.93707.



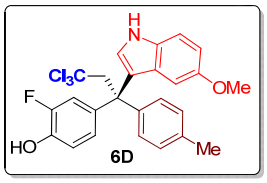
(*S*)-4-(1-(4-(*tert*-butyl)phenyl)-3,3,3-trichloro-1-(5-fluoro-1*H*-indol-3-yl)propyl)phenol (6C)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure B. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **6C** (34.2 mg, 68 %) as sticky light yellow oil.

HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.5 mL/min, λ = 230 nm), t_R (minor) = 15.58 min, t_R (major) = 18.58 min.

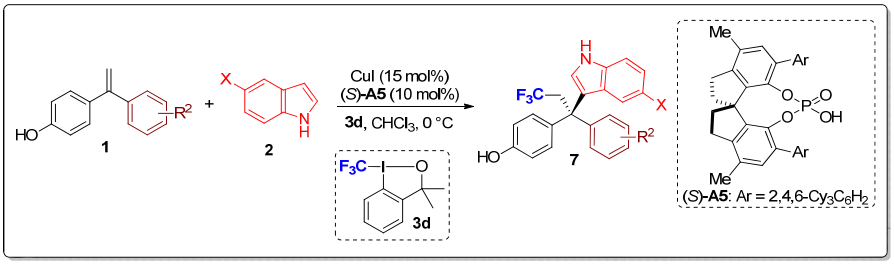
^{1}H NMR (400 MHz, MeOD) δ 7.48 (s, 1H), 7.45 (s, 1H), 7.35 (s, 1H), 7.33 (s, 1H), 7.30 (s, 1H), 7.23-7.18 (m, 3H), 6.70 (td, *J* = 9.0, 2.4 Hz, 1H), 6.65-6.63 (m, 1H), 6.62 (s, 1H), 6.29 (dd, *J* = 10.9, 2.4 Hz, 1H), 4.34-4.18 (m, 2H), 1.21 (s, 9H).

^{13}C NMR (101 MHz, MeOD) δ 156.7 (d, *J* = 231.5 Hz), 155.2, 148.5, 143.1, 136.1, 133.6, 129.5, 127.8, 127.4, 124.4, 117.6 (d, *J* = 4.7 Hz), 114.1, 111.6 (d, *J* = 9.8 Hz), 108.7 (d, *J* = 26.5 Hz), 106.0 (d, *J* = 24.5 Hz), 98.2, 58.6, 51.6, 33.7, 30.4.
^{19}F NMR (376 MHz, MeOD) δ -127.2 (s, 1F).
HRMS (ESI) m/z calcd. for $C_{27}H_{24}ONCl_3F$ $[M-H]^-$ 502.09130, found 502.09097.



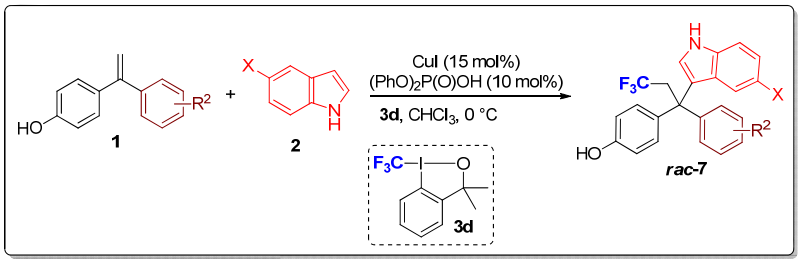
(*S*)-2-fluoro-4-(3,3,3-trichloro-1-(5-methoxy-1*H*-indol-3-yl)-1-(*p*-tolyl)propyl)phenol (6D)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure B. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **6D** (41.7 mg, 85 %) as sticky light yellow oil.
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.6 mL/min, λ = 230 nm), t_R (minor) = 15.81 min, t_R (major) = 19.96 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.12 (s, 1H), 7.47 (d, *J* = 8.4 Hz, 2H), 7.34 (dd, *J* = 12.9, 2.3 Hz, 1H), 7.29 (dd, *J* = 8.0, 2.3 Hz, 1H), 7.24 (t, *J* = 5.3 Hz, 2H), 7.10 (t, *J* = 6.8 Hz, 2H), 6.90 (t, *J* = 8.9 Hz, 1H), 6.81 (dd, *J* = 8.8, 2.4 Hz, 1H), 6.27 (d, *J* = 2.3 Hz, 1H), 4.30 (s, 2H), 3.59 (s, 3H), 2.31 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 153.2, 150.4 (d, *J* = 236.5 Hz), 142.2, 141.7 (d, *J* = 14.4 Hz), 138.3 (d, *J* = 4.8 Hz), 135.9, 131.8, 128.8, 127.9, 127.5, 126.6, 124.6 (d, *J* = 3.0 Hz), 117.5, 116.0 (d, *J* = 19.8 Hz), 116.0, 111.8, 111.6, 104.3, 97.9, 58.6, 55.7, 51.9, 20.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -139.8 (s, 1F).
HRMS (ESI) m/z calcd. for $C_{25}H_{22}O_2NCl_3F$ $[M+H]^+$ 492.06947, found 492.06964.

General procedure C: Cu/CPA-catalyzed asymmetric three-component radical-initiated trifluoromethylarylation of 1,1-diarylalkene



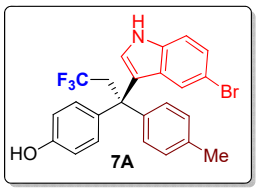
Under argon, an oven-dried resealable Schlenk tube equipped with a magnetic stir bar was charged with 1,1-diarylalkene substrate **1** (0.1 mmol, 1.0 equiv.), substituted indole (0.12 mmol, 1.2 equiv.), CuI (3.0 mg, 0.015 mmol, 15 mol%), chiral phosphoric acid ((*S*)-**A5** (9.86 mg, 0.01 mmol, 10 mol%), **3d** (39.6 mg, 0.12 mmol, 1.2 equiv.), and anhydrous $CHCl_3$ (1.0 mL) at 0 °C, then the sealed tube was stirred at 0 °C for 40-72 h. Upon completion (monitored by TLC), the reaction mixture was directly purified by a silica gel chromatography [eluent: *n*-hexane/ethyl acetate = 100/0 to 2/1, using *n*-hexane (100%) to remove the solvent (DCM) at first] to afford the desired product **7**.

Note: Since the reaction is sensitive to water and air, Schlenk tube and the reagents must be dried prior to use.



The racemate was prepared following the same procedure described above using CuI (3.0 mg, 0.015 mmol, 15 mol%) and diphenyl phosphate (2.5 mg, 0.01 mmol, 10 mol%) as catalyst at -35 °C in anhydrous DCM (1.0 mL) for 48 h. Upon completion (monitored by TLC), the solvent was removed *in vacuo*, and the residue was purified by a silica gel column chromatography (eluent: petroleum ether/EtOAc = 20/0-2/1) to give the desired product.

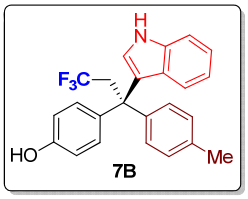
Note: Since the reaction is sensitive to water and air, Schlenk tube and the reagents must be dried prior to use.



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3,3-trifluoro-1-(*p*-tolyl)propyl)phenol (7A)

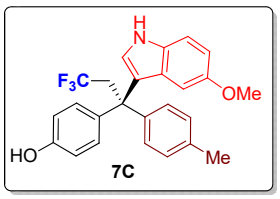
The reaction was conducted on a 0.1 mmol scale according to the above general procedure C. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **7A** (35.3 mg, 75 %) as sticky light yellow oil.

HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.5 mL/min, λ = 240 nm), t_R (major) = 31.92 min, t_R (minor) = 35.09 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.12 (s, 1H), 7.33-7.17 (m, 6H), 7.15-7.04 (m, 3H), 7.00 (s, 1H), 6.73 (d, *J* = 8.2 Hz, 2H), 4.91 (br s, 1H), 3.68-3.43 (m, 2H), 2.32 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 153.9, 141.8, 136.9, 136.1, 135.4, 129.6, 128.8, 128.1, 127.9, 125.9 (q, *J* = 280.0 Hz), 125.5, 124.8, 124.2, 120.4, 114.8, 112.7, 112.6, 48.7, 43.7 (q, *J* = 26.3 Hz), 20.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -56.5 (t, *J* = 10.6 Hz, 3F).
HRMS (ESI) m/z calcd. for $C_{24}H_{18}ONBrF_3$ $[M-H]^-$ 472.05293, found 472.05203.



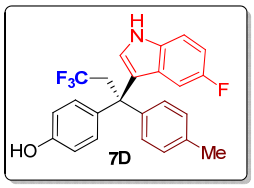
7B

(*S*)-4-(3,3,3-trifluoro-1-(1*H*-indol-3-yl)-1-(*p*-tolyl)propyl)phenol (7B)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure C. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **7B** (37.9 mg, 96 %) as sticky light yellow oil.
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.5 mL/min, λ = 230 nm), t_R (minor) = 22.02 min, t_R (major) = 25.13 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.03 (s, 1H), 7.41-7.19 (m, 5H), 7.19-7.00 (m, 4H), 6.99-6.86 (m, 2H), 6.69 (d, *J* = 7.7 Hz, 2H), 3.77 (br s, 1H), 3.60 (d, *J* = 10.2 Hz, 2H), 2.31 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 153.8, 142.2, 137.2, 136.8, 135.9, 129.8, 128.6, 128.1, 126.3, 126.1 (q, *J* = 280.0 Hz), 124.2, 121.9, 121.8, 120.8, 119.2, 114.7, 111.3, 48.8, 44.0, 43.7 (q, *J* = 26.0 Hz), 20.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -56.4 (s, 3F).
HRMS (ESI) m/z calcd. for $C_{24}H_{19}ONF_3$ $[M-H]^-$ 394.14242, found 394.14157.



7C

(*S*)-4-(3,3,3-trifluoro-1-(5-methoxy-1*H*-indol-3-yl)-1-(*p*-tolyl)propyl)phenol (7C)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure C. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **7C** (40.0 mg, 94 %) as sticky light yellow oil.
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.5 mL/min, λ = 240 nm), t_R (major) = 31.92 min, t_R (minor) = 35.09 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.99 (s, 1H), 7.36-7.21 (m, 6H), 7.09 (d, *J* = 8.1 Hz, 2H), 7.01 (d, *J* = 2.2 Hz, 1H), 6.81 (dd, *J* = 8.8, 2.2 Hz, 1H), 6.72 (d, *J* = 8.7 Hz, 2H), 6.39 (d, *J* = 1.9 Hz, 1H), 3.65-3.51 (m, 5H), 2.32 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 153.9, 153.2, 142.1, 137.0, 135.8, 132.0, 129.8, 128.6, 128.1, 126.9, 126.1 (q, *J* = 280.0 Hz), 124.9, 120.5, 114.7, 111.8, 111.6, 104.3, 55.7, 48.8, 43.8 (q, *J* = 26.1 Hz), 20.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -56.4 (s, 3F).
HRMS (ESI) m/z calcd. for $C_{25}H_{21}O_2NF_3$ $[M-H]^-$ 424.15299, found 424.15247.



(*S*)-4-(3,3,3-trifluoro-1-(5-fluoro-1*H*-indol-3-yl)-1-(*p*-tolyl)propyl)phenol (7D)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure C. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **7D** (35.9 mg, 87 %) as sticky light yellow oil.

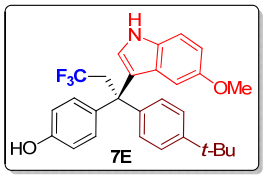
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.5 mL/min, λ = 230 nm), t_R (minor) = 19.47 min, t_R (major) = 24.01 min.

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.08 (s, 1H), 7.34-7.18 (m, 5H), 7.15-7.02 (m, 3H), 6.89 (t, *J* = 8.8 Hz, 1H), 6.74 (d, *J* = 8.1 Hz, 2H), 6.62 (d, *J* = 10.3 Hz, 1H), 4.77 (s, 1H), 3.55 (q, *J* = 10.5 Hz, 2H), 2.32 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 157.1 (d, *J* = 234.0 Hz), 153.9, 141.8, 136.9, 136.0, 133.3, 129.6, 128.7, 127.9, 126.8 (d, *J* = 10.0 Hz), 125.9 (q, *J* = 279.5 Hz), 125.88, 120.9 (d, *J* = 4.5 Hz), 114.8, 111.8 (d, *J* = 9.8 Hz), 110.3 (d, *J* = 26.4 Hz), 106.8 (d, *J* = 24.3 Hz), 48.6, 43.6 (q, *J* = 26.3 Hz), 20.9.

^{19}F NMR (376 MHz, $CDCl_3$) δ -56.6 (s, 3F), -124.0 (s, 1F).

HRMS (ESI) m/z calcd. for $C_{24}H_{18}ONF_4$ $[M-H]^-$ 412.13190, found 412.13217.



(*S*)-4-(1-(4-(*tert*-butyl)phenyl)-3,3,3-trifluoro-1-(5-methoxy-1*H*-indol-3-yl)propyl)phenol (7E)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure C. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **7E** (40.1 mg, 86 %) as sticky light yellow oil.

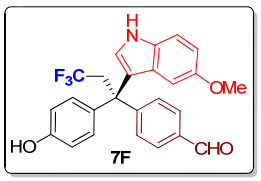
HPLC analysis: Chiralcel OD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.5 mL/min, λ = 230 nm), t_R (major) = 14.57 min, t_R (minor) = 18.80 min.

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.97 (s, 1H), 7.38-7.18 (m, 7H), 7.00 (s, 1H), 6.79 (d, *J* = 8.6 Hz, 1H), 6.72 (d, *J* = 8.4 Hz, 2H), 6.33 (s, 1H), 3.56 (s, 5H), 1.29 (s, 9H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 153.8, 153.2, 148.9, 142.2, 136.9, 131.9, 129.8, 127.7, 126.9, 126.1 (q, *J* = 280.2 Hz), 125.0, 124.8, 120.6, 114.6, 111.7, 104.2, 55.7, 48.6, 43.7 (q, *J* = 26.1 Hz), 34.3, 31.3.

^{19}F NMR (376 MHz, $CDCl_3$) δ -56.3 (s, 3F).

HRMS (ESI) m/z calcd. for $C_{28}H_{29}O_2NF_3$ $[M+H]^+$ 468.2150, found 468.2151.

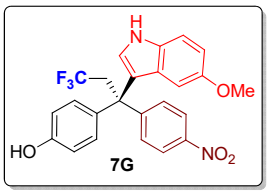


(*S*)-4-(3,3,3-trifluoro-1-(4-hydroxyphenyl)-1-(5-methoxy-1*H*-indol-3-yl)propyl)benzaldehyde (7F)

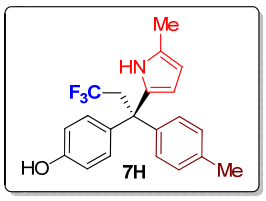
The reaction was conducted on a 0.1 mmol scale according to the above general procedure C. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **7F** (26.7 mg, 61 %) as sticky light yellow oil.

HPLC analysis: Chiralcel IC (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 254 nm), t_R (minor) = 30.32 min, t_R (major) = 33.10 min.

^{1}H NMR (500 MHz, $CDCl_3$) δ 9.93 (s, 1H), 8.15 (s, 1H), 7.76 (d, *J* = 7.9 Hz, 2H), 7.59 (d, *J* = 7.9 Hz, 2H), 7.23 (dd, *J* = 16.5, 7.7 Hz, 3H), 6.99 (s, 1H), 6.80 (d, *J* = 8.8 Hz, 1H), 6.72 (d, *J* = 8.2 Hz, 2H), 6.32 (s, 1H), 5.29 (s, 1H), 3.64-3.49 (m, 5H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 192.3, 154.4, 153.3, 152.0, 135.5, 134.4, 132.0, 129.7, 129.5, 128.9, 126.5, 125.8 (q, *J* = 279.5 Hz), 125.0, 119.2, 115.0, 112.0, 111.7, 104.1, 55.8, 49.5, 43.5 (q, *J* = 26.6 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -56.5 (s, 3F).
HRMS (ESI) m/z calcd. for $C_{25}H_{19}O_3NF_3$ $[M+H]^+$ 438.13115, found 438.13126.

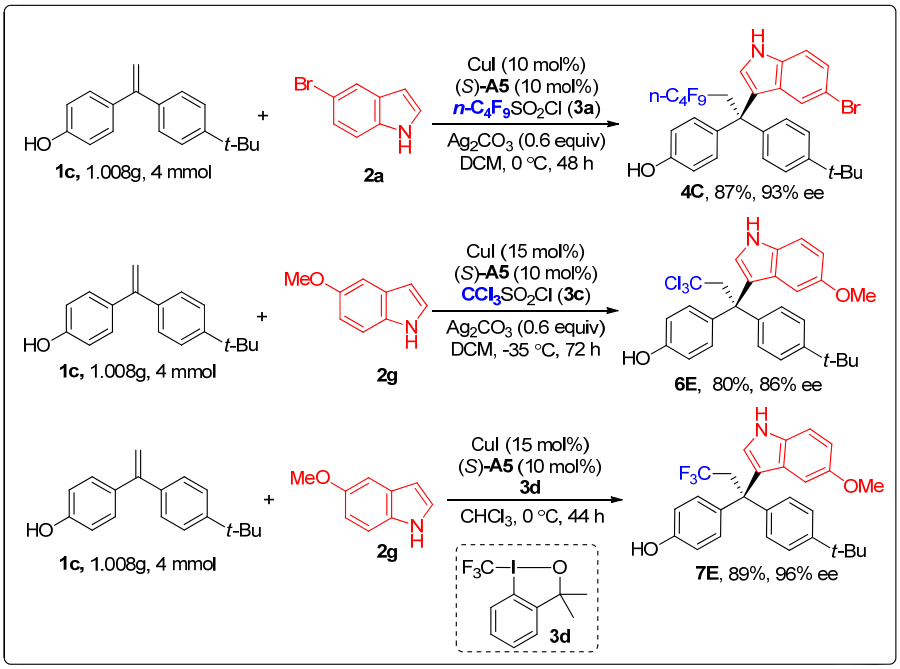


(*S*)-4-(3,3,3-trifluoro-1-(5-methoxy-1*H*-indol-3-yl)-1-(4-nitrophenyl)propyl)phenol (7G)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure C. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **7G** (27.7 mg, 61 %) as a sticky light yellow solid.
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 80/20, flow rate 0.7 mL/min, λ = 214 nm), t_R (minor) = 24.54 min, t_R (major) = 29.43 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.20 (s, 1H), 8.11 (d, *J* = 8.5 Hz, 2H), 7.60 (d, *J* = 8.5 Hz, 2H), 7.27 (d, *J* = 8.5 Hz, 1H), 7.21 (d, *J* = 8.2 Hz, 2H), 7.02 (s, 1H), 6.83 (d, *J* = 8.7 Hz, 1H), 6.74 (d, *J* = 8.2 Hz, 2H), 6.32 (s, 1H), 5.45 (br s, 1H), 3.67-3.52 (m, 5H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 154.6, 153.4, 152.3, 146.2, 135.1, 132.1, 129.7, 129.2, 126.3, 125.7 (q, *J* = 280.0 Hz), 124.9, 123.2, 118.9, 115.1, 112.2, 111.8, 104.0, 55.8, 49.4 (d, *J* = 1.4 Hz), 43.6 (q, *J* = 26.6 Hz).
^{19}F NMR (376 MHz, $CDCl_3$) δ -56.5 (s, 3F).
HRMS (ESI) m/z calcd. for $C_{24}H_{18}O_4N_2F_3$ $[M+H]^+$ 455.12241, found 455.12161.



(*S*)-4-(3,3,3-trifluoro-1-(5-methyl-1*H*-pyrrol-2-yl)-1-(*p*-tolyl)propyl)phenol (7H)
The reaction was conducted on a 0.1 mmol scale according to the above general procedure C. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **7A** (28.0 mg, 78 %) as sticky light yellow oil.
HPLC analysis: Chiralcel OD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.3 mL/min, λ = 230 nm), t_R (major) = 18.70 min, t_R (minor) = 20.94 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.36 (s, 1H), 7.13 (s, 4H), 6.97 (d, *J* = 8.5 Hz, 2H), 6.77 (d, *J* = 9.0 Hz, 2H), 5.94 (t, *J* = 3.0 Hz, 1H), 5.82-5.79 (m, 1H), 5.10 (br s, 1H), 3.40 (q, *J* = 10.5 Hz, 2H), 2.36 (s, 3H), 2.17 (s, 3H).
^{13}C NMR (125 MHz, $CDCl_3$) δ 154.3, 141.6, 136.5, 136.4, 133.9, 129.9, 128.9, 128.2, 127.8, 126.3 (q, *J* = 277.3 Hz), 114.8, 107.6, 105.3, 49.29, 44.2 (q, *J* = 26.5 Hz), 20.9, 13.1.
^{19}F NMR (376 MHz, $CDCl_3$) δ -56.1 (s, 3F).
HRMS (ESI) m/z calcd. for $C_{21}H_{21}F_3NO$ $[M+H]^+$ 360.1570, found 360.1565.

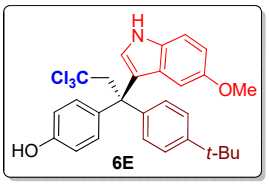
Gram-scale reaction with diverse radical precursors



Synthesis of **4C**:

The reaction was conducted on a 4.0 mmol (1.008 g) scale according to the above general procedure A. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **4C** (2.314 g, 87 %) as sticky light yellow oil.

Synthesis of **6E**:



(*S*)-4-(1-(4-(*tert*-butyl)phenyl)-3,3,3-trichloro-1-(5-methoxy-1H-indol-3-yl)propyl)phenol (6E)

The reaction was conducted on a 4.0 mmol (1.008 g) scale according to the above general procedure B. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **6E** (1.648 mg, 80 %) as sticky light yellow oil.

*Note: the pure **6E** is unstable at 25-35°C, easy to convert to dichloroolefin-containing product or other products, especially when dissolved in halogen-containing solvents under air, such as DCM, $CHCl_3$ etc. **6E** gradually converted to dichloroolefin-containing product or other products in other solvents, such as n-hexane, ethyl acetate, alcohol isopropanol etc at 25-30°C under air atmosphere. So **6E** should be characterized by NMR, HPLC or HRMS ASAP.*

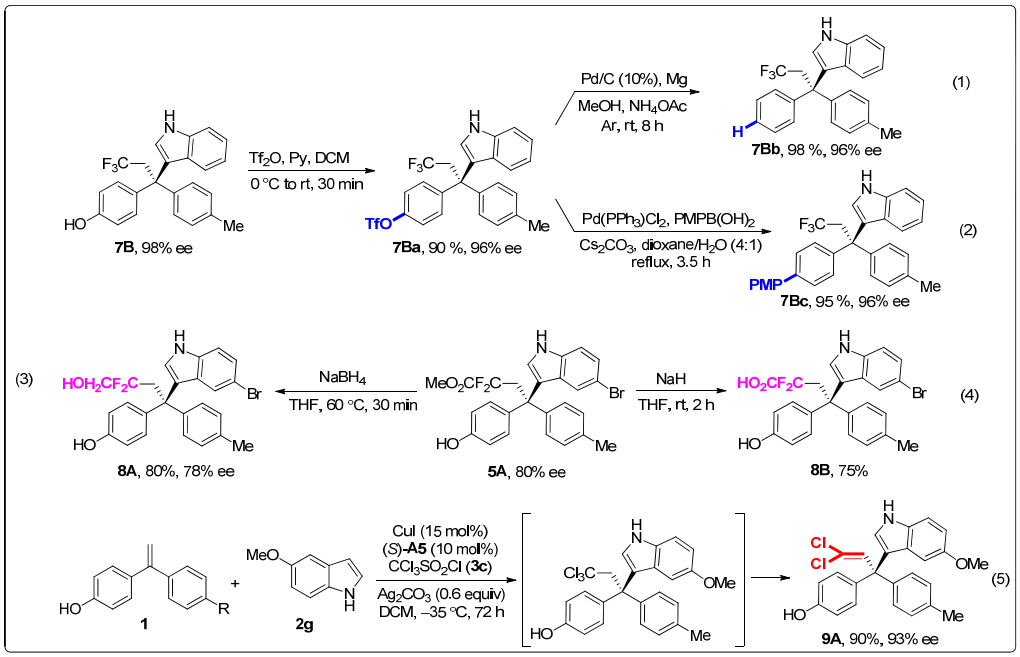
*As the pure **6E** is unstable at 20-35°C, amounts of EtOAc is observed in NMRs.*

HPLC analysis: Chiralcel IA (*n*-hexane/*i*-PrOH = 90/10, flow rate 0.4 mL/min, λ = 260 nm), t_R (major) = 33.72 min, t_R (minor) = 37.56 min.

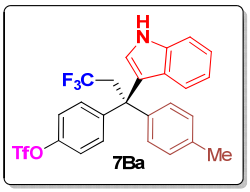
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (s, 1H), 7.49 (d, *J* = 8.2 Hz, 4H), 7.24 (dd, *J* = 18.6, 8.3 Hz, 4H), 6.78 (d, *J* = 8.7 Hz, 1H), 6.72 (d, *J* = 8.1 Hz, 2H), 6.21 (s, 1H), 4.42-4.24 (m, 2H), 3.54 (s, 3H), 1.28 (s, 9H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 153.8, 153.1, 148.7, 142.9, 137.2, 131.7, 129.8, 127.8, 127.5, 126.7, 124.8, 118.0, 114.7, 111.7, 104.2, 98.2, 58.7, 55.5, 51.7, 34.3, 31.3.
HRMS (ESI) m/z calcd. for $C_{28}H_{29}O_2NCl_3$ $[M+H]^+$516.12584, found 516.12630.

Synthesis of **7E**: The reaction was conducted on a 4.0 mmol (1.008 g) scale according to the above general procedure C. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired product **7E** (1.663 g, 89 %) as sticky light yellow oil.

Procedure for synthetic application:



Synthesis of **7Ba**: **7Ba** was synthesized according to the procedures previously reported.[4]



(*S*)-4-(3,3,3-trifluoro-1-(1*H*-indol-3-yl)-1-(*p*-tolyl)propyl)phenyl trifluoromethanesulfonate (7Ba)

HPLC analysis: Chiralcel OD-H (*n*-hexane/*i*-PrOH = 90/10, flow rate 0.8 mL/min, λ = 254 nm), t_R (minor) = 10.93 min, t_R (major) = 18.24 min.

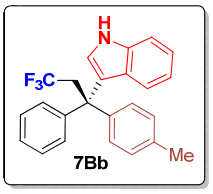
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.09 (s, 1H), 7.48 (d, *J* = 8.9 Hz, 2H), 7.34 (d, *J* = 8.2 Hz, 1H), 7.28-7.21 (m, 2H), 7.14 (t, *J* = 8.0 Hz, 3H), 7.07 (d, *J* = 8.1 Hz, 2H), 6.98-6.87 (m, 3H), 3.59 (q, *J* = 10.5 Hz, 2H), 2.30 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 147.9, 145.4, 141.0, 136.9, 136.5, 130.5, 128.9, 128.1, 126.0, 125.8 (q, *J* = 280.0 Hz), 124.2, 122.1, 121.6, 120.6, 118.7 (q, *J* = 321.3 Hz), 119.9, 119.5, 111.5, 49.3 (d, *J* = 1.5 Hz), 43.7 (q, *J* = 26.6 Hz), 20.9.

^{19}F NMR (376 MHz, $CDCl_3$) δ -56.4 (s, 3F), -72.9 (s, 3F).

HRMS (ESI) m/z calcd. for $C_{25}H_{18}O_3NF_6S$ $[M-H]^-$ 526.09171, found 526.09045.

Synthesis of **7Bb**: **7Bb** was synthesized according to the procedures previously reported.[5]



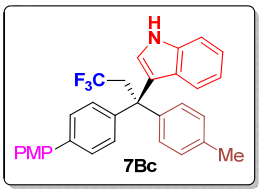
(*S*)-3-(3,3,3-trifluoro-1-phenyl-1-(*p*-tolyl)propyl)-1*H*-indole (7Bb)

HPLC analysis: Chiralcel OD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.6 mL/min, λ = 254 nm), t_R (minor) = 9.98 min, t_R (major) = 10.57 min.

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.03 (s, 1H), 7.40 (d, *J* = 7.7 Hz, 2H), 7.33 (d, *J* = 8.2 Hz, 1H), 7.31-7.21 (m, 4H), 7.18 (t, *J* = 7.2 Hz, 1H), 7.12 (t, *J* = 7.6 Hz, 1H), 7.06 (d, *J* = 8.1 Hz, 2H), 7.01-6.94 (m, 2H), 6.89 (t, *J* = 7.5 Hz, 1H), 3.62 (q, *J* = 10.7 Hz, 2H), 2.29 (s, 3H).

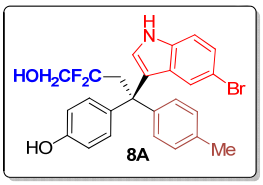
^{13}C NMR (126 MHz, $CDCl_3$) δ 145.0, 141.9, 136.8, 135.9, 128.7, 128.3, 128.2, 127.9, 126.40, 126.35, 126.0 (q, *J* = 279.9 Hz), 124.4, 121.9, 121.8, 120.5, 119.2, 111.3, 49.5 (d, *J* = 1.6 Hz), 43.5 (q, *J* = 26.3 Hz), 20.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -56.5 (s, 3F).
HRMS (ESI) m/z calcd. for $C_{24}H_{19}NF_6$ $[M-H]^-$ 378.14751, found 378.14661.

Synthesis of **7Bc**: **7Bc** was synthesized according to the procedures previously reported.[6]



(*S*)-3-(3,3,3-trifluoro-1-(4'-methoxy-[1,1'-biphenyl]-4-yl)-1-(*p*-tolyl)propyl)-1*H*-indole (7Bc)
HPLC analysis: Chiralcel AZ3 (*n*-hexane/*i*-PrOH = 90/10, flow rate 0.4 mL/min, λ = 254 nm), t_R (minor) = 19.31 min, t_R (major) = 21.19 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.05 (s, 1H), 7.50 (t, *J* = 5.7 Hz, 2H), 7.43 (s, 4H), 7.32 (dd, *J* = 10.6, 8.3 Hz, 3H), 7.13 (t, *J* = 7.6 Hz, 1H), 7.07 (d, *J* = 8.2 Hz, 2H), 7.01 (dd, *J* = 14.0, 5.3 Hz, 2H), 6.97-6.87 (m, 3H), 3.82 (s, 3H), 3.64 (q, *J* = 10.7 Hz, 2H), 2.30 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 159.0, 143.5, 141.9, 138.4, 136.8, 135.9, 133.1, 128.7, 128.6, 128.2, 127.9, 126.4, 126.03 (q, *J* = 277.3 Hz), 126.01, 124.5, 121.9, 121.8, 120.3, 119.2, 114.1, 111.3, 55.3, 49.2 (d, *J* = 1.6 Hz), 43.4 (q, *J* = 26.3 Hz), 20.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -56.5 (s, 3F).
HRMS (ESI) m/z calcd. for $C_{31}H_{25}ONF_3$ $[M-H]^-$ 484.18937, found 484.18845.

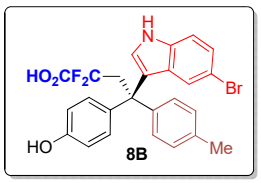
Synthesis of **8A**: **8A** was synthesized according to the procedures previously reported.[7]



(*S*)-4-(1-(5-bromo-1*H*-indol-3-yl)-3,3-difluoro-4-hydroxy-1-(*p*-tolyl)butyl)phenol (8A)
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 75/25, flow rate 0.6 mL/min, λ = 254 nm), t_R (minor) = 17.43 min, t_R (major) = 23.25 min.
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.11 (s, 1H), 7.35-7.29 (m, 4H), 7.26-7.18 (m, 2H), 7.15 (d, *J* = 5.2 Hz, 2H), 7.08 (d, *J* = 8.1 Hz, 2H), 6.74 (d, *J* = 8.6 Hz, 2H), 4.74 (s, 1H), 3.41 (td, *J* = 16.4, 3.9 Hz, 2H), 3.11 (t, *J* = 13.3 Hz, 2H), 2.32 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 152.7, 141.6, 136.8, 134.8, 134.3, 128.8, 127.6, 127.2, 127.1, 124.4, 123.7, 123.3, 120.5, 113.6, 111.7, 111.5, 64.0 (t, *J* = 31.9 Hz), 48.1, 41.5 (t, *J* = 22.7 Hz), 28.7, 19.9.
^{19}F NMR (376 MHz, $CDCl_3$) δ -97.1 (s, 2F).
HRMS (ESI) m/z calcd. for $C_{25}H_{21}O_2NBrF_2$ $[M-H]^-$ 484.07292, found 484.07196.

Synthesis of **8B**: **8B** was synthesized according to the procedures previously reported with minor revision.[7] NaH (8.0 mg, 60% in mineral oil, 0.2 mmol) was added to a stirred solution of **5A** (51.5 mg, 0.1 mmol) in dry THF (2.0 mL) in an oven-dried Schlenk tube at rt. After stirring at rt for additional 2 h, the reaction mixture was quenched with saturated NH_4Cl solution and stirred for 15 min. The mixture was extracted three times with ethyl acetate, dried over Na_2SO_4, and concentrated *in vacuo*.

The crude product was purified by flash column chromatography on silica gel (eluent: EtOAc/MeOH = 100/1 to 20/1) to give **8B** (37.4 mg, 75%).



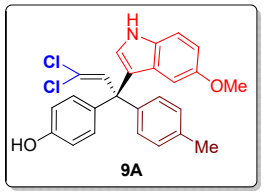
(*S*)-4-(5-bromo-1*H*-indol-3-yl)-2,2-difluoro-4-(4-hydroxyphenyl)-4-(*p*-tolyl)butanoic acid (8B)

^{1}H NMR (500 MHz, MeOD) δ 7.28 (d, *J* = 8.1 Hz, 2H), 7.22 (dd, *J* = 8.6, 4.1 Hz, 3H), 7.16 (s, 1H), 7.07 (d, *J* = 8.6 Hz, 1H), 7.02 (d, *J* = 8.0 Hz, 2H), 6.97 (d, *J* = 1.6 Hz, 1H), 6.66 (d, *J* = 8.7 Hz, 2H), 3.53 (t, *J* = 17.6 Hz, 2H), 3.37 (s, 1H), 2.28 (s, 3H).

^{13}C NMR (126 MHz, MeOD) δ 171.4, 154.9, 143.5, 137.0, 135.8, 134.9, 129.8, 128.5, 128.4, 127.7, 126.0, 123.8, 123.0, 121.1, 113.7, 112.4, 110.9, 49.1, 48.5, 44.0 (t, *J* = 22.4 Hz), 19.6.

^{19}F NMR (376 MHz, MeOD) δ -96.6 (s, 2F).

HRMS (ESI) m/z calcd. for $C_{25}H_{19}O_3NBrF_2$ $[M-H]^-$ 498.05219, found 498.05182.



(*S*)-4-(3,3-dichloro-1-(5-methoxy-1*H*-indol-3-yl)-1-(*p*-tolyl)allyl)phenol (9A)

The reaction was conducted on a 0.1 mmol scale according to the above general procedure B. The product was purified by silica gel flash column chromatography (*n*-hexane/ethyl acetate = 100/0 to 2/1) to afford desired trichloromethyl-product, which gradually converted to dichloroolefin-containing product **9A** (39.3 mg, 90 %) as sticky black oil when concentrated at 40°C *in vacuo*.

*Note: the pure **9A** is unstable at 25-35°C, easy to convert to other products, especially when dissolved in halogen-containing solvents under air, such as DCM, $CHCl_3$ etc. So **9A** should be characterized by NMR, HPLC or HRMS ASAP.*

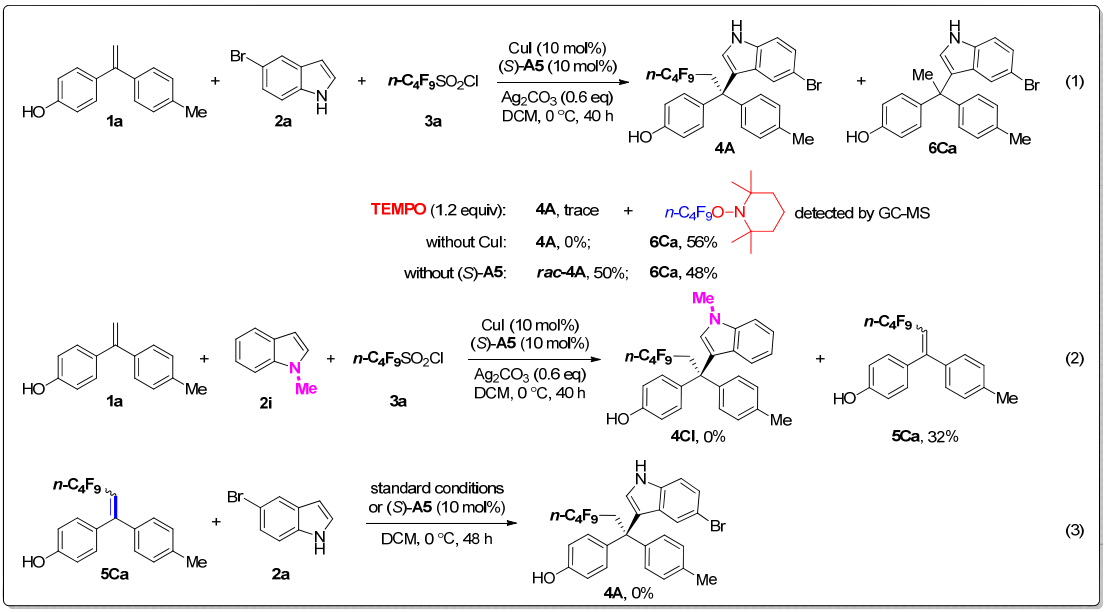
HPLC analysis: Chiralcel AD3 (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.6 mL/min, λ = 230 nm), t_R (minor) = 17.17 min, t_R (major) = 23.97 min.

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.93 (s, 1H), 7.23 (d, *J* = 8.8 Hz, 1H), 7.12-7.06 (m, 7H), 7.00 (s, 1H), 6.81 (dd, *J* = 8.8, 2.3 Hz, 1H), 6.73 (d, *J* = 8.6 Hz, 2H), 6.66 (d, *J* = 1.9 Hz, 1H), 6.43 (d, *J* = 2.2 Hz, 1H), 3.61 (s, 3H), 2.32 (s, 3H).

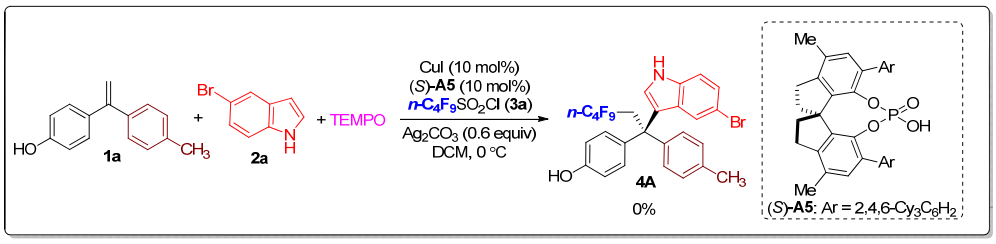
^{13}C NMR (126 MHz, $CDCl_3$) δ 154.1, 153.5, 141.5, 136.7, 136.6, 136.1, 132.2, 130.6, 129.1, 128.7, 126.8, 126.0, 123.0, 121.2, 114.8, 112.0, 111.8, 103.4, 55.8, 54.9, 21.0.

HRMS (ESI) m/z calcd. for $C_{25}H_{22}O_2NCl_2$ $[M+H]^+$ 438.10221, found 438.10245.

Mechanistic study

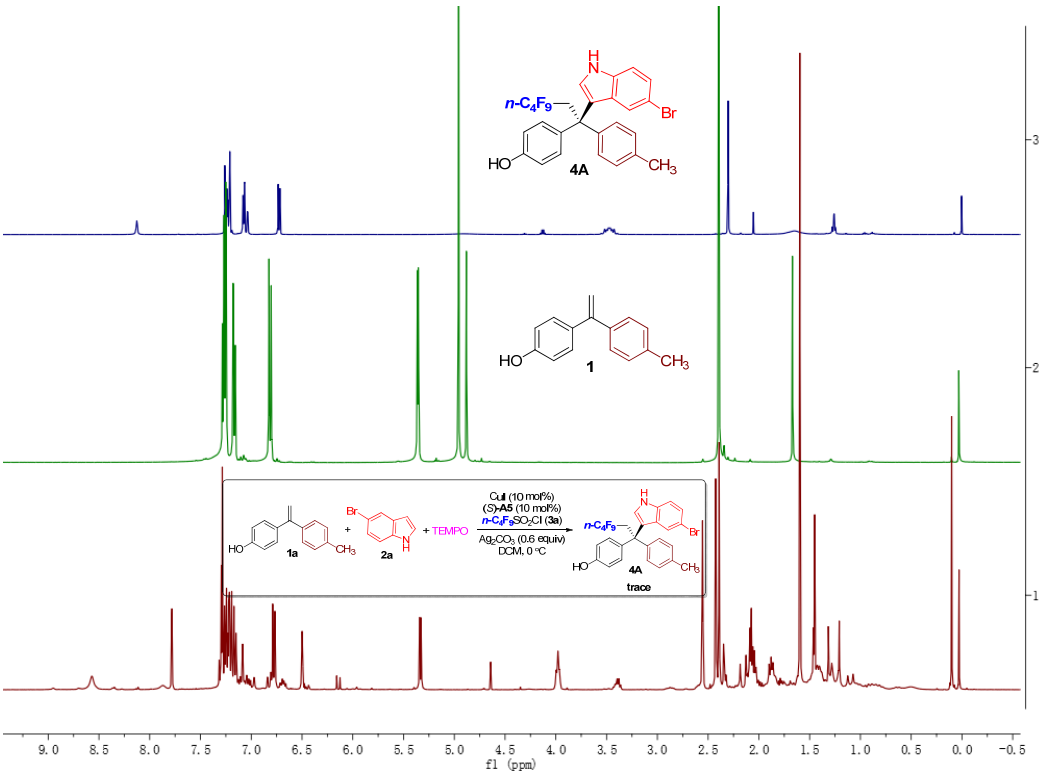


a) Trapping with TEMPO

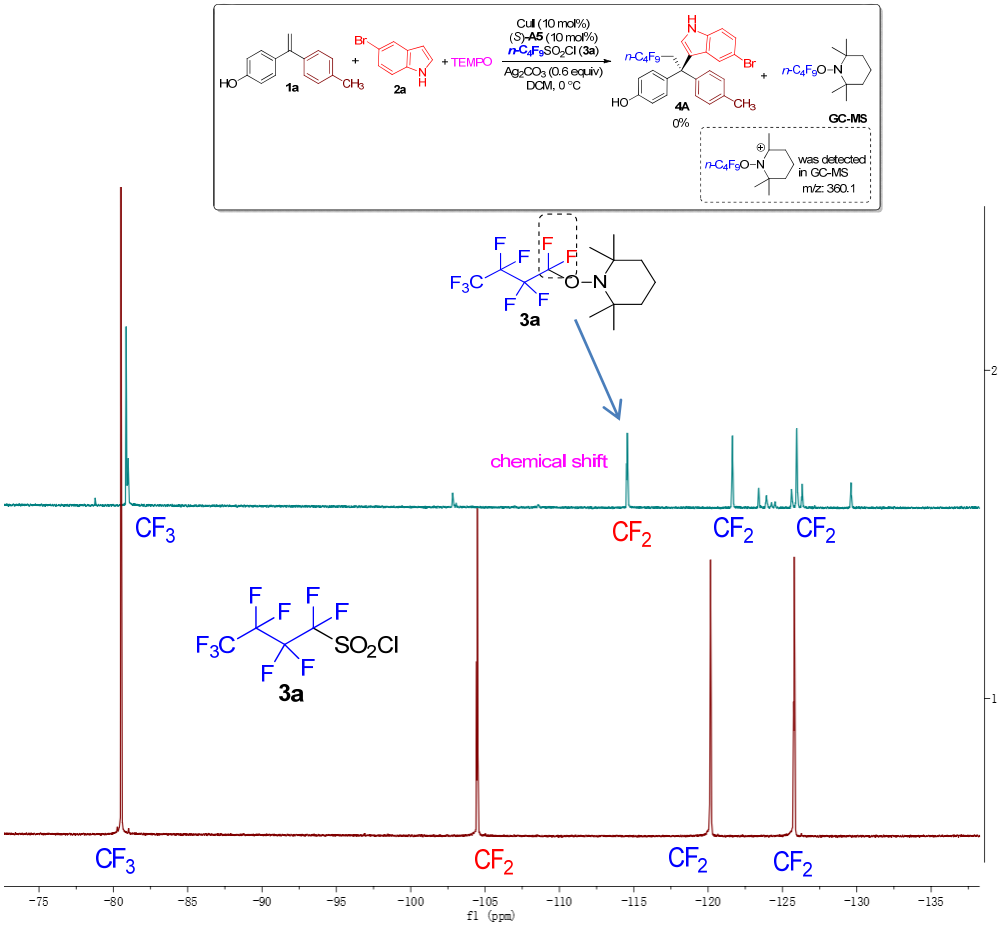


Under argon atmosphere, an oven-dried resealable Schlenk tube equipped with a magnetic stir bar was charged with 1,1-diarylalkene **1a** (0.05 mmol, 1.0 equiv.), 5-bromo-1*H*-indole (0.06 mmol, 1.2 equiv.), CuI (1.0 mg, 0.005 mmol, 10 mol%), chiral phosphoric acid ((*S*)-**A5** (5 mg, 0.005 mmol, 10 mol%), *n*-$C_4F_9SO_2Cl$ (**3a**, 19.1 mg, 0.06 mmol, 1.2 equiv.), 2,2,6,6-tetramethyl-1-piperidinyloxy (TEMPO, 9.4 mg, 0.06 mmol, 1.2 equiv), Ag_2CO_3 (8.3 mg, 0.03 mmol, 0.6 equiv.), and anhydrous DCM (0.5 mL) at 0 °C, then the sealed tube was stirred at 0 °C for 40 h. Conversion was based on ^{1}H NMR/^{19}F NMR/GC-MS analysis of the crude product.

Note: Since the reaction is sensitive to water and air, Schlenk tube and the reagents must be dried prior to use.

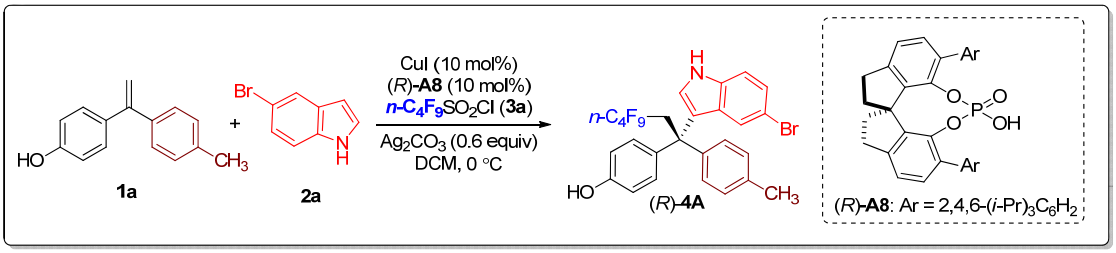


^{1}H NMR



^{19}F NMR

b) Linear effect experiments



These reactions were conducted according to the general procedure A. The product was separated by preparative TLC. Chiral HPLC analysis gave linear effect data. The ee of (*R*)-**4A** was determined by HPLC analysis: Chiralcel IA (*n*-hexane/*i*-PrOH = 85/15, flow rate 0.5 mL/min, λ = 240 nm), t_R (major) = ~10.57 min, t_R (minor) = ~11.72 min.

Supplementary references:

(1) Liu, C.; Meng, G.; Szostak, M. *J. Org. Chem.* **2016**, *81*, 12023.

(2) Shen, H.; Ma, H.; Liu, P.; Huang, W.; Han, L.; Li, C.; Li, Y. *Macromol. Rapid. Commun.* **2017**, *38*.

(3) Wang, Z.; Wong, Y. F.; Sun, J. *Angew. Chem., Int. Ed.* **2015**, *54*, 13711.

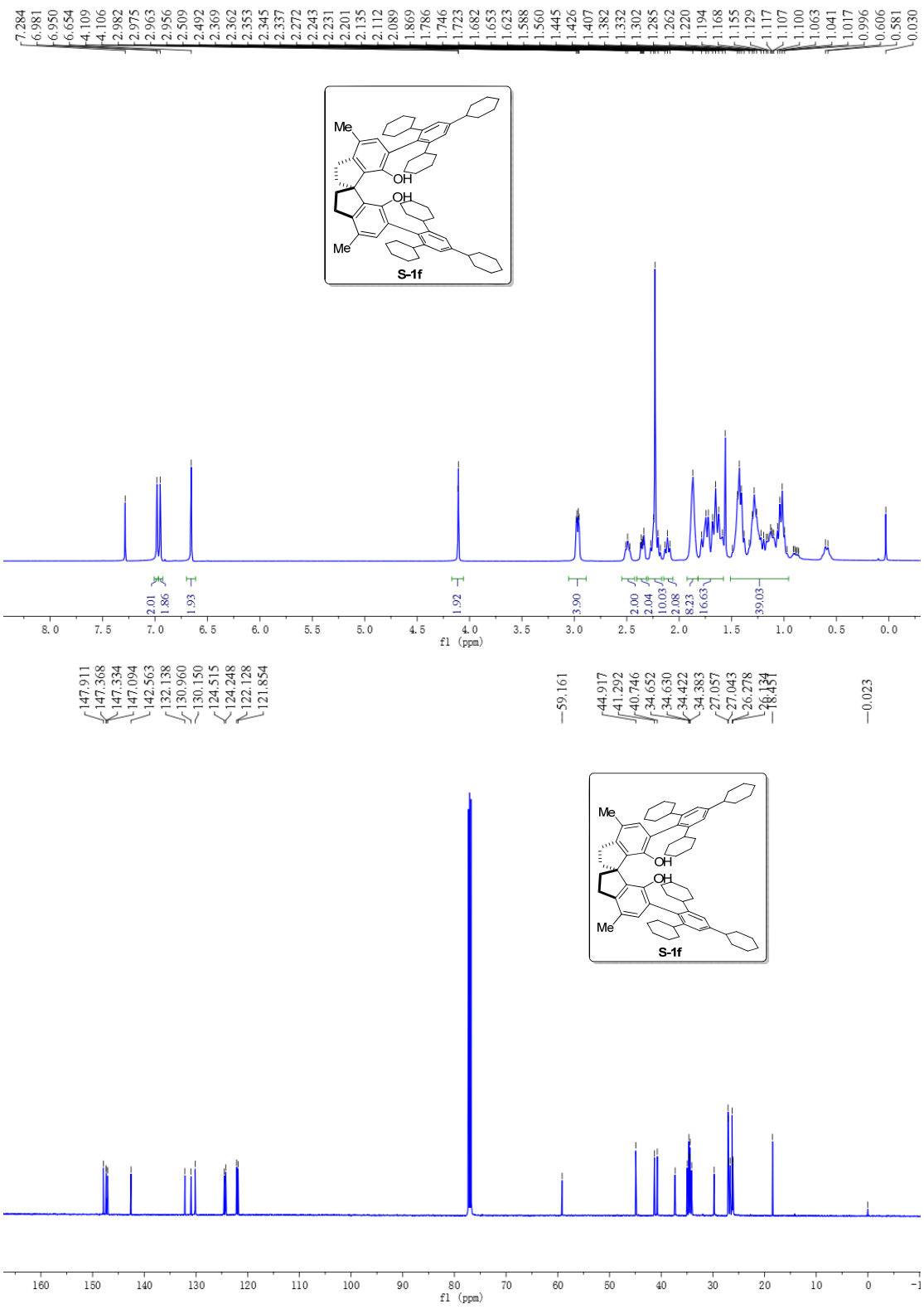
(4) Wang, Z.; Ai, F.; Wang, Z.; Zhao, W.; Zhu, G.; Lin, Z.; Sun, J. *J. Am. Chem. Soc.* **2015**, *137*, 383.

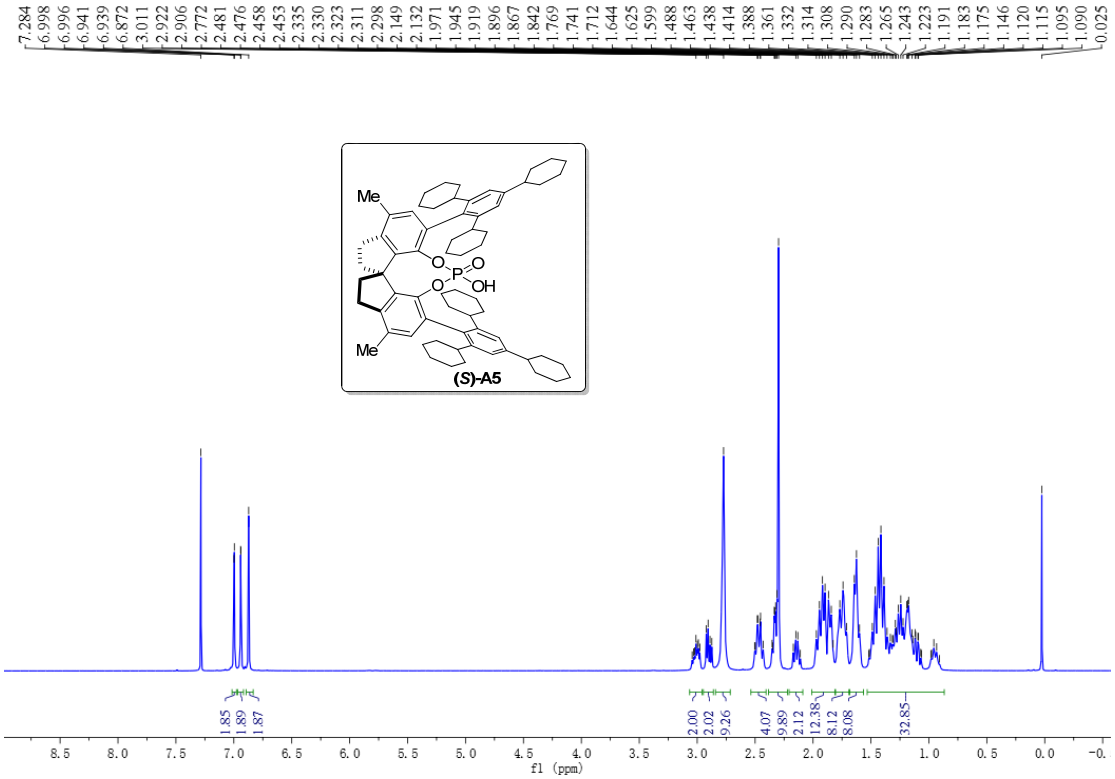
(5) Jiang, F.; Zhang, Y.-C.; Sun, S.-B.; Zhou, L.-J.; Shi, F. *Adv. Synth. Catal.* **2015**, *357*, 1283.

(6) Nambu, H.; Hirota, W.; Fukumoto, M.; Tamura, T.; Yakura, T. *Chem. Eur. .J.* **2017**, *23*, 16799.

(7) Lin, J.-S.; Wang, F.-L.; Dong, X.-Y.; He, W.-W.; Yuan, Y.; Chen, S.; Liu, X.-Y. *Nat. Commun.* **2017**, *8*, 14841.

NMR spectra

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2.458
2.453
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1.945
1.919
1.896
1.867
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1.741
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1.388
1.361
1.332
1.314
1.308
1.290
1.283
1.265
1.243
1.223
1.191
1.183
1.175
1.146
1.120
1.115
1.095
1.090
0.025
Me
O
P
O
O
OH
Me
(S)-A5
1.85
1.89
1.87
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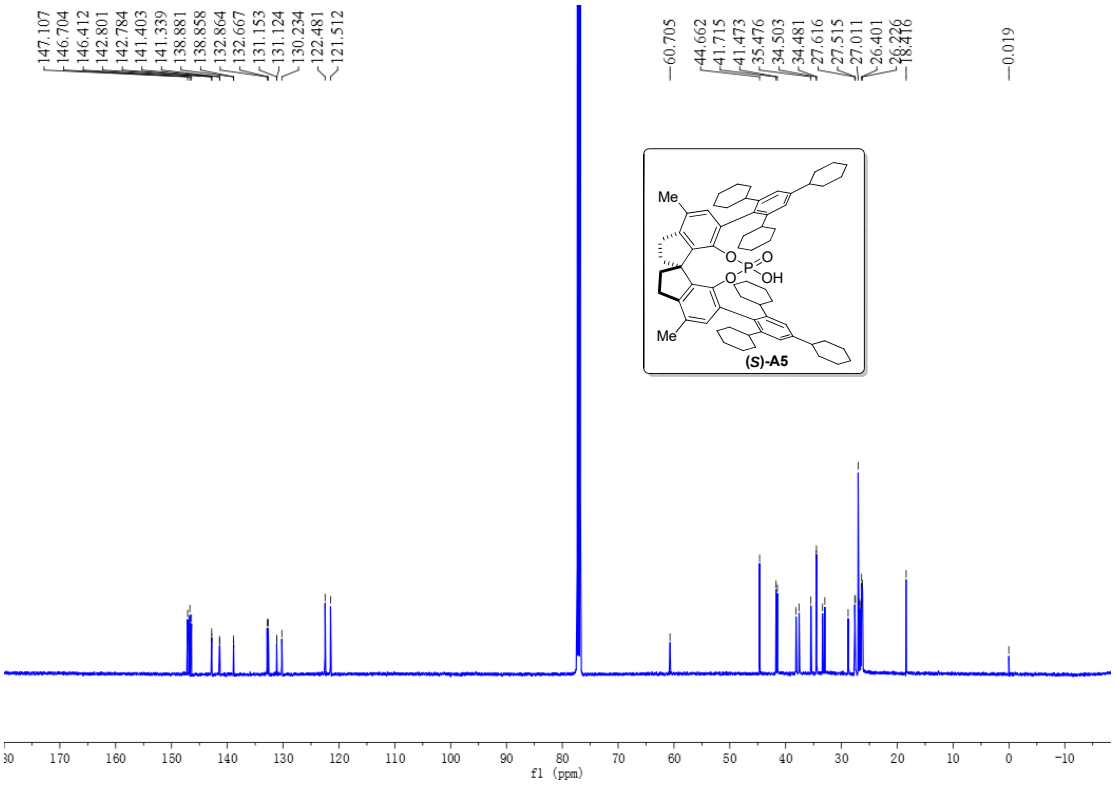
4.07
9.89
2.12
12.38
8.12
8.08
32.85
f1 (ppm)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122.481
121.512
60.705
44.662
41.715
41.473
35.476
34.503
34.481
27.616
27.515
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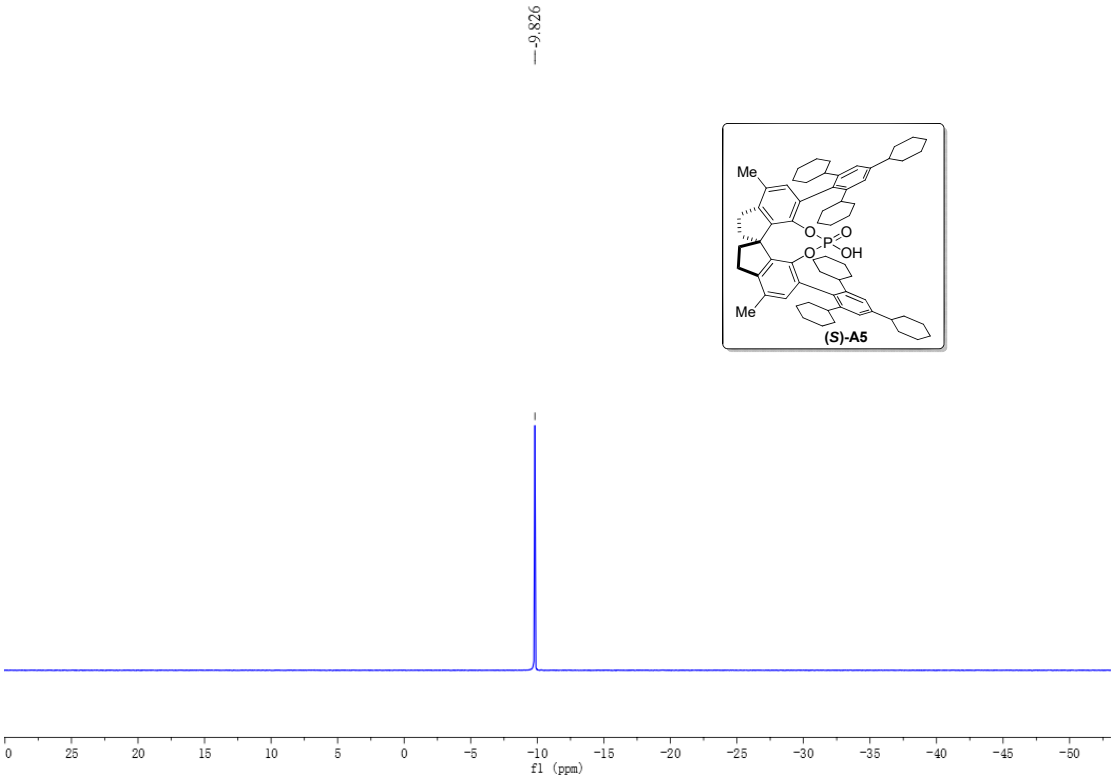
O
O
OH
Me
(S)-A5
f1 (ppm)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OH
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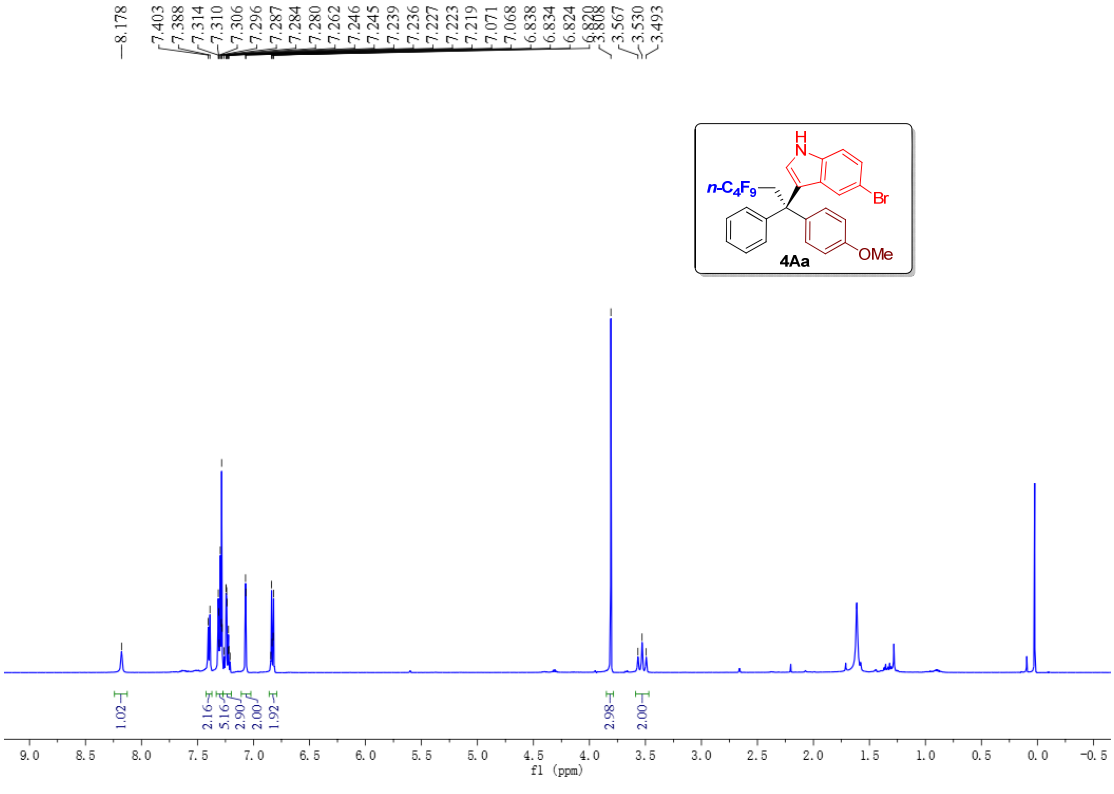
f1 (ppm)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7.245
7.239
7.236
7.227
7.223
7.219
7.071
7.068
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6.834
6.824
6.820
3.868
3.567
3.530
3.493
H
N
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5.16
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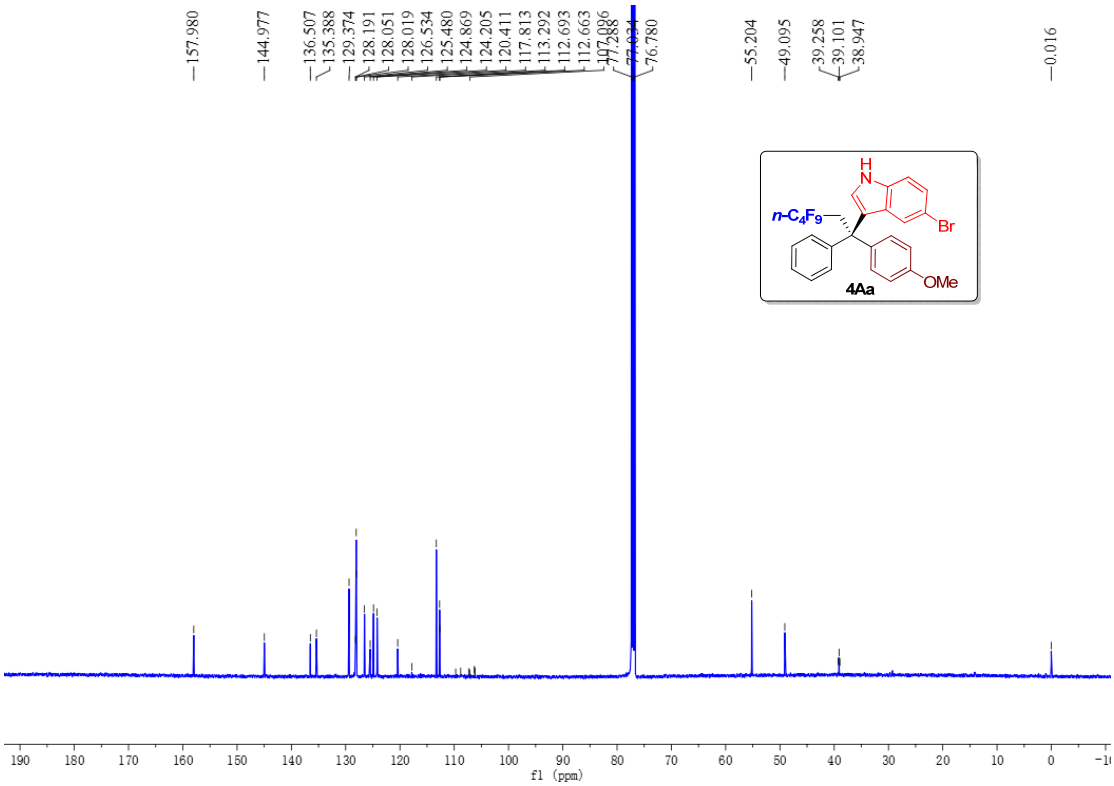
2.98
2.00
f1 (ppm)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128.051
128.019
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117.813
113.292
112.693
112.663
107.096
77.288
77.034
76.780
55.204
49.095
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39.101
38.947
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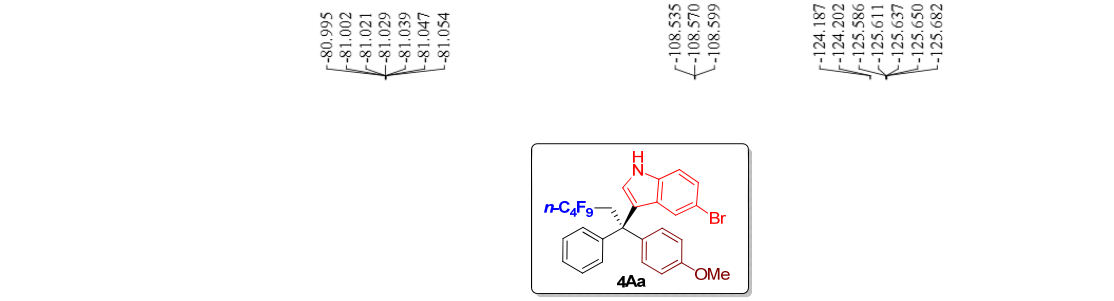
N
n-C4F9
Br
OMe
4Aa
f1 (ppm)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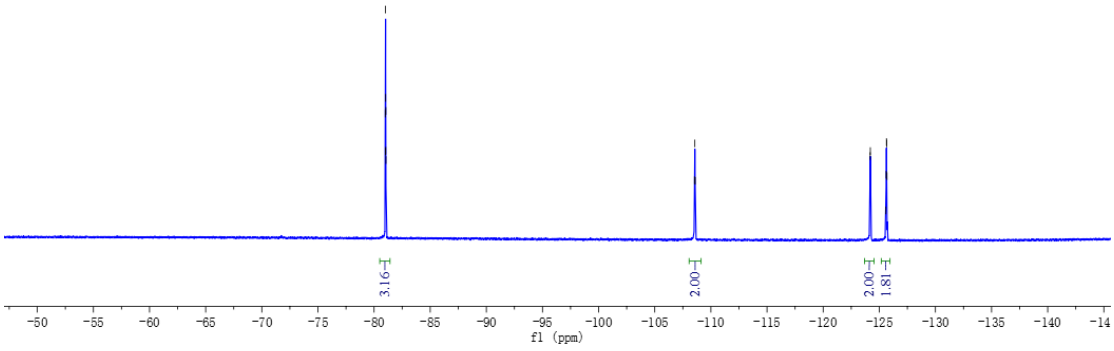
-125.637
-125.650
-125.682

H
N
n-C4F9
Br
OMe
4Aa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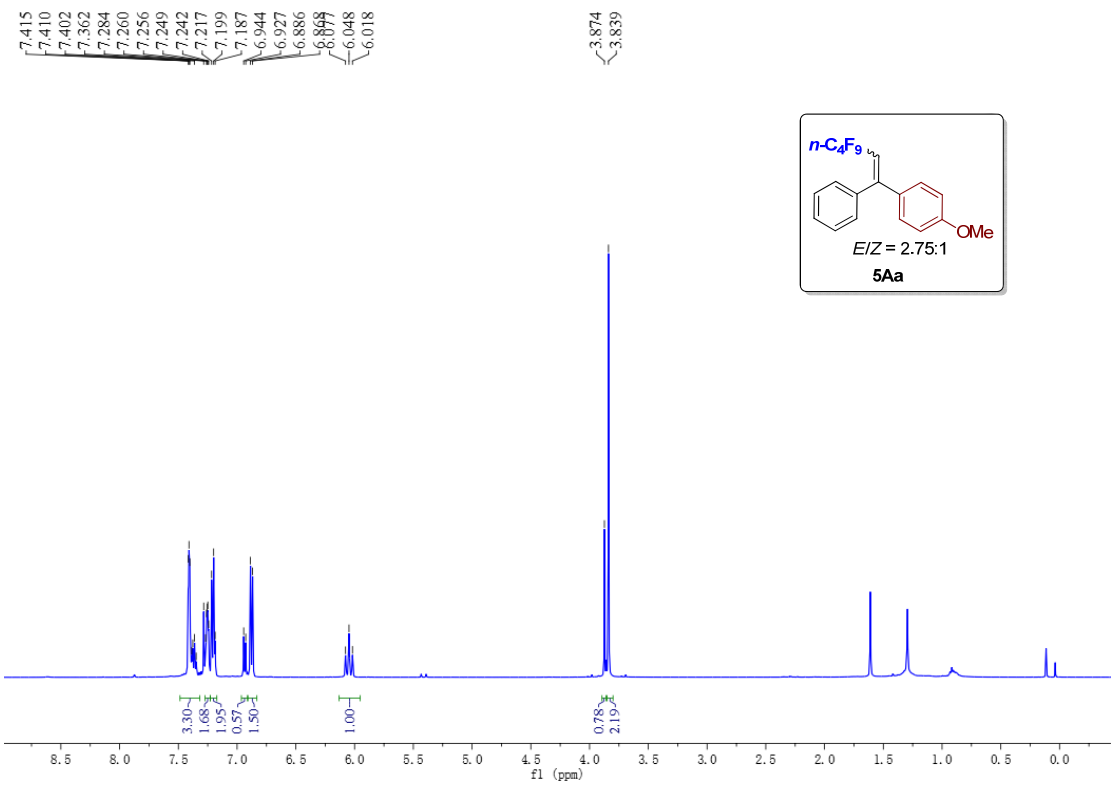
f1 (ppm)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7.249
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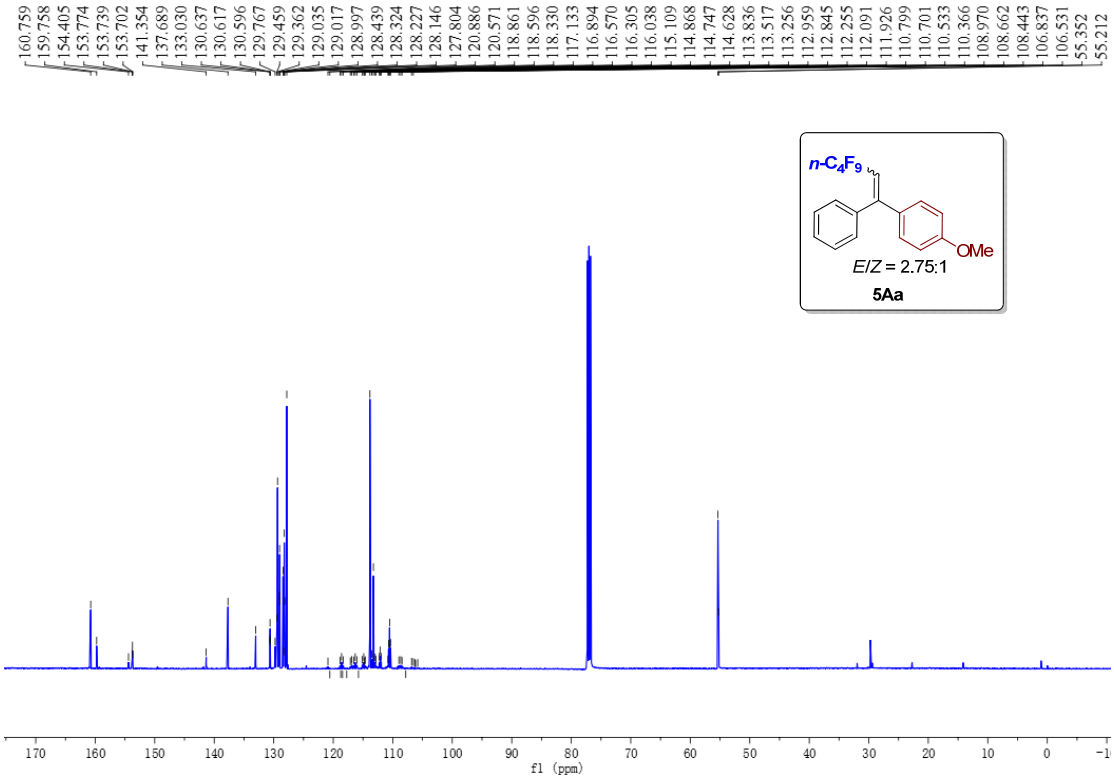
7.217
7.199
7.187
6.944
6.927
6.886
6.048
6.018
3.874
3.839
n-C4F9
OMe
E/Z = 2.75:1
5Aa
3.30
1.68
1.95
0.57
1.50
1.00
0.78
2.19
f1 (ppm)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137.689
133.030
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130.617
130.596
129.767
129.459
129.362
129.035
129.017
128.997
128.439
128.324
128.227
128.146
127.804
120.886
120.571
118.861
118.596
118.330
117.133
116.894
116.570
116.305
116.038
115.109
114.868
114.747
114.628
113.836
113.517
113.256
112.959
112.845
112.255
112.091
111.926
110.799
110.701
110.533
110.366
108.970
108.662
108.443
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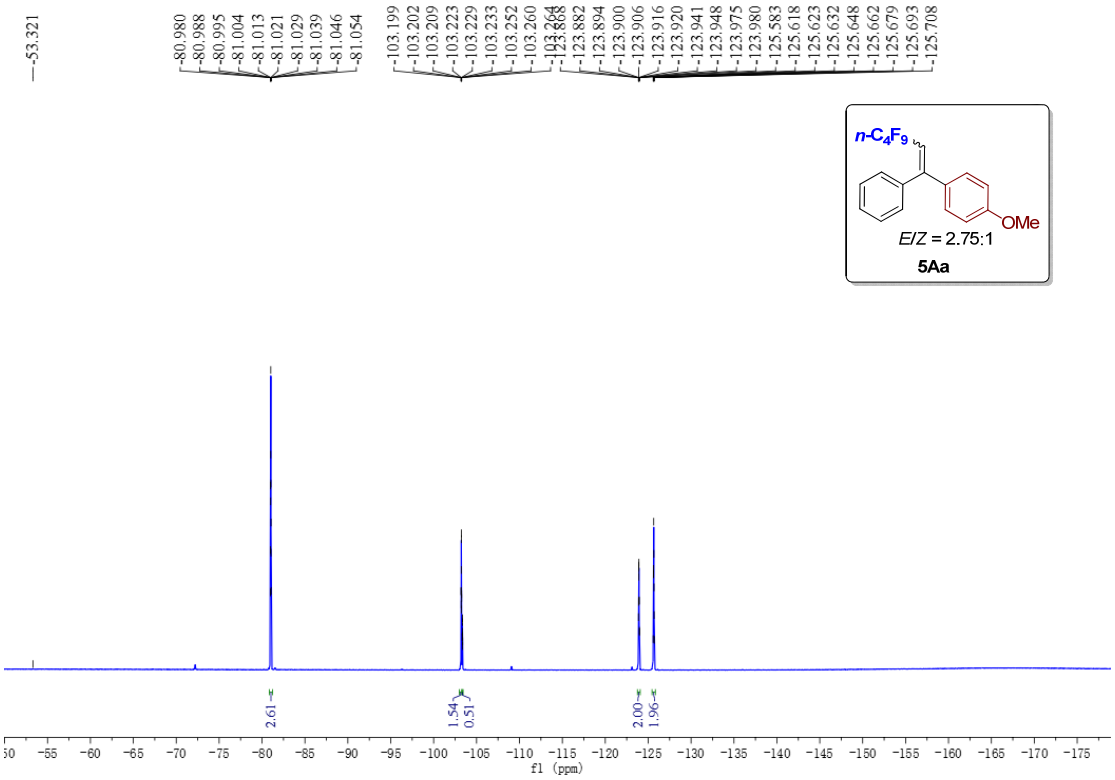
106.531
55.352
55.212
n-C4F9
OMe
E/Z = 2.75:1
5Aa
f1 (ppm)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-103.199
-103.202
-103.209
-103.223
-103.229
-103.233
-103.252
-103.260
-123.882
-123.894
-123.900
-123.906
-123.916
-123.920
-123.941
-123.948
-123.975
-123.980
-125.583
-125.618
-125.623
-125.632
-125.648
-125.662
-125.679
-125.693
-125.708
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OMe
E/Z = 2.75:1
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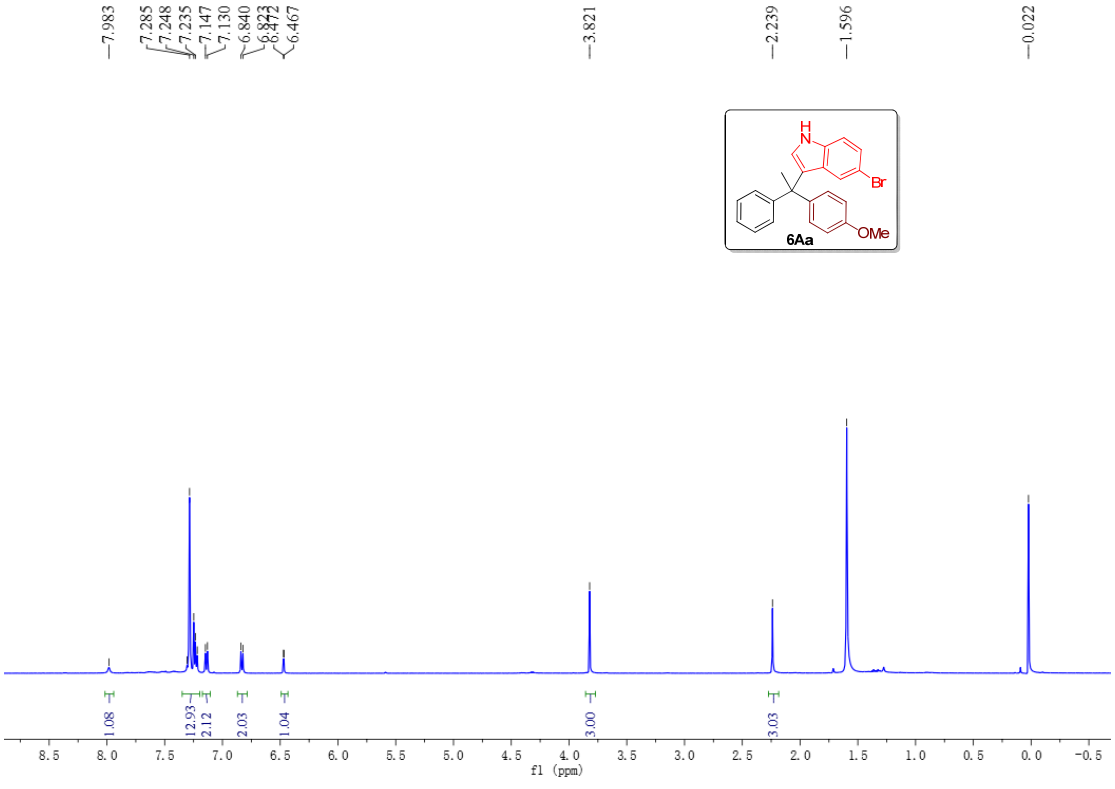
2.61
1.54
0.51
2.00
1.96
f1 (ppm)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7.248
7.235
7.147
7.130
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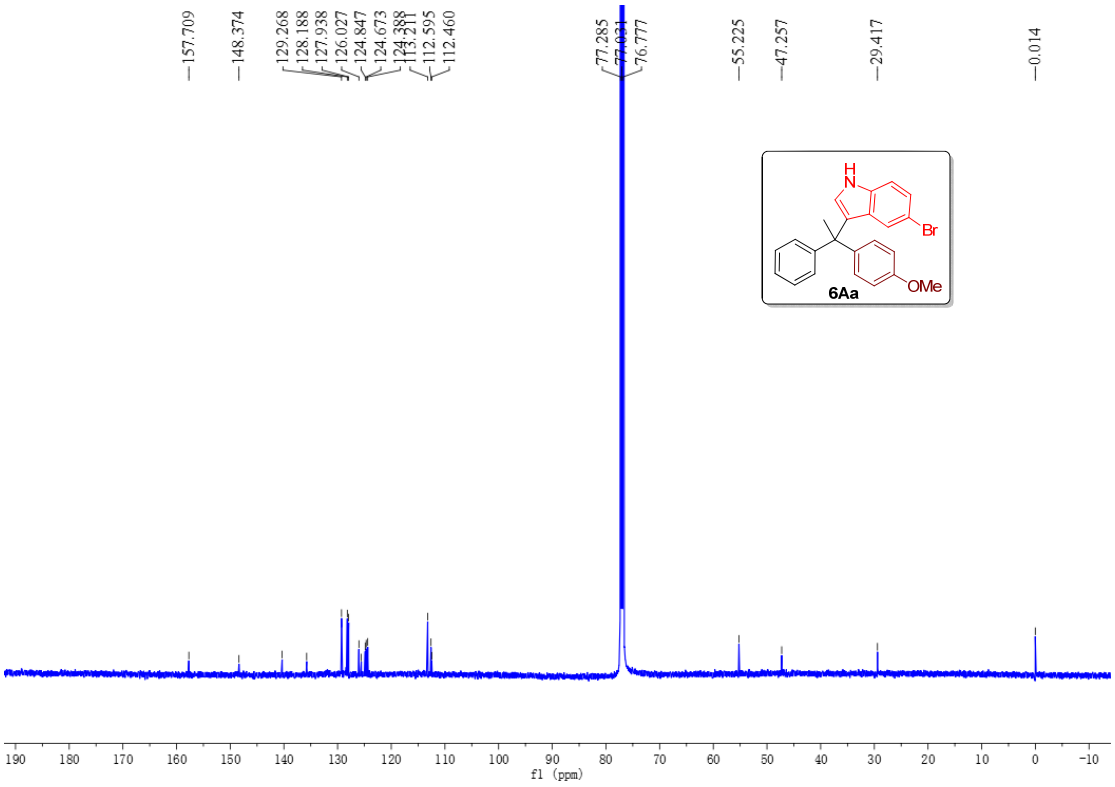
6.823
6.472
6.467
3.821
2.239
1.596
0.022
H
N
Br
OMe
6Aa
1.08
12.93
2.12
2.03
1.04
3.00
3.03
f1 (ppm)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126.027
124.847
124.673
124.388
113.211
112.595
112.460
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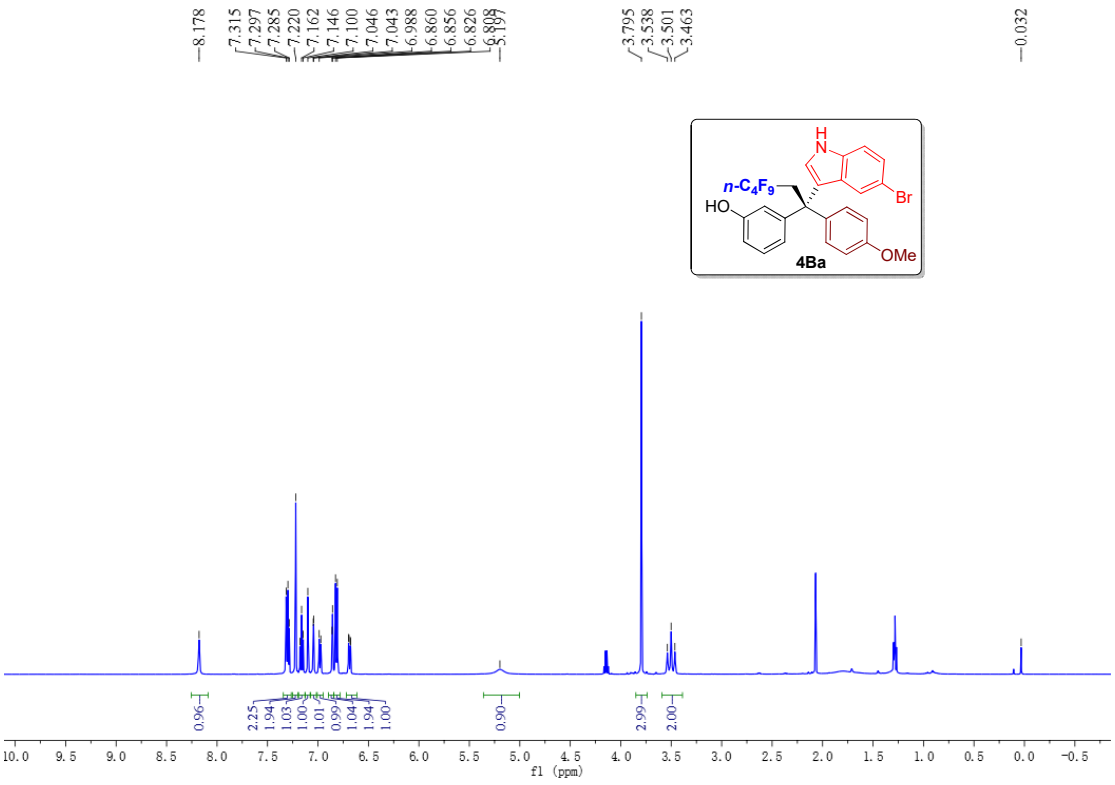
77.031
76.777
55.225
47.257
29.417
0.014
H
N
Br
OMe
6Aa
f1 (ppm)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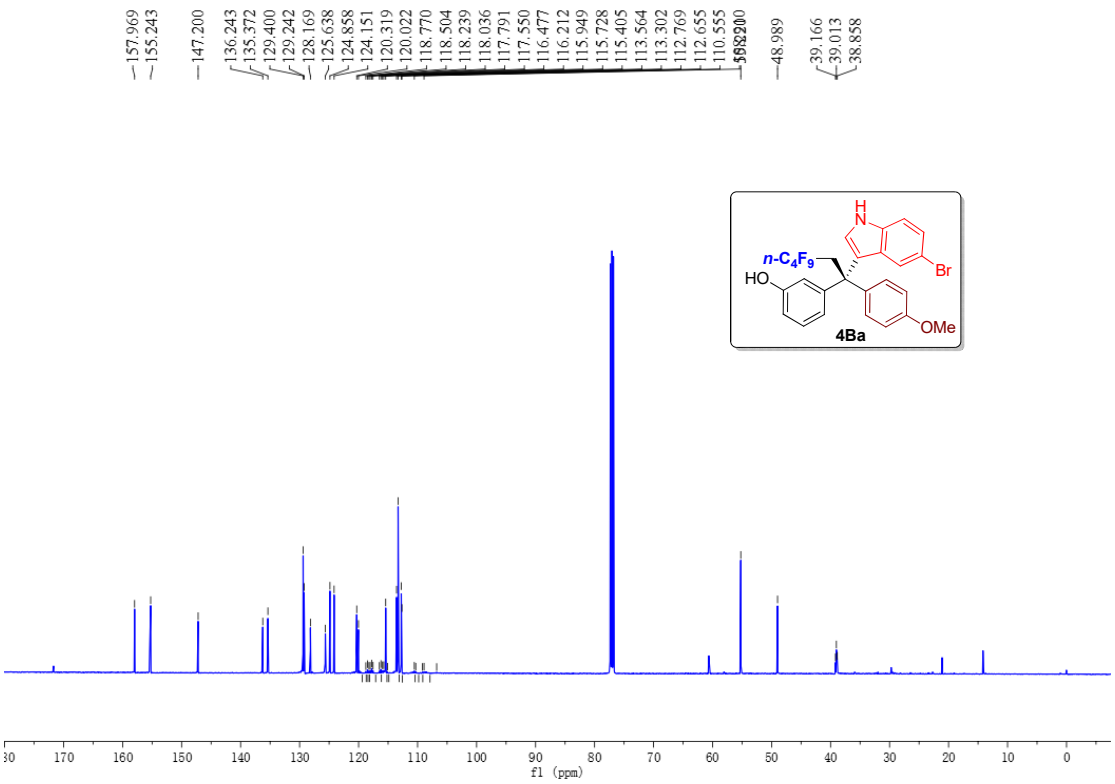
7.297
7.285
7.220
7.162
7.146
7.100
7.046
7.043
6.988
6.860
6.856
6.826
6.808
5.197
3.795
3.538
3.501
3.463
0.032
H
N
n-C4F9
HO
Br
OMe
4Ba
0.96
2.25
1.94
1.03
1.00
1.01
0.99
1.04
1.94
1.00
0.90
2.99
2.00
f1 (ppm)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128.169
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124.858
124.151
120.319
120.022
118.770
118.504
118.239
118.036
117.791
117.550
116.477
116.212
115.949
115.728
115.405
113.564
113.302
112.769
112.655
110.555
48.989
39.166
39.013
38.858
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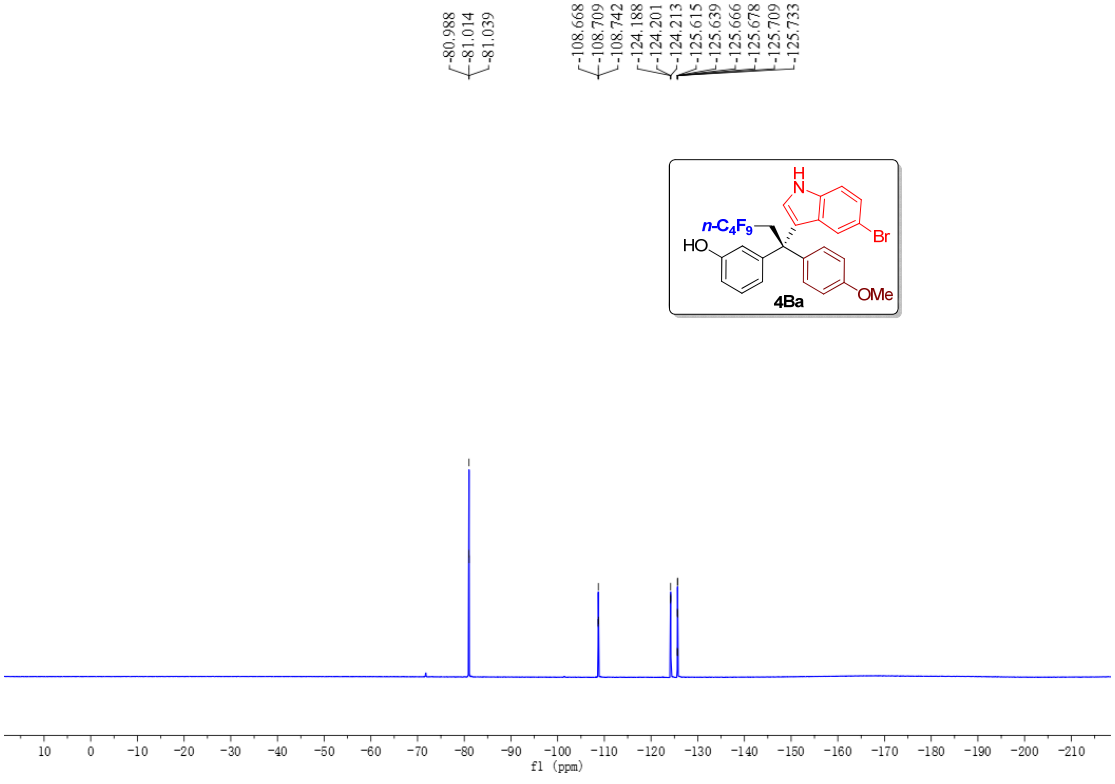
HO
Br
OMe
4Ba
f1 (ppm)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81.039
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108.709
108.742
124.188
124.201
124.213
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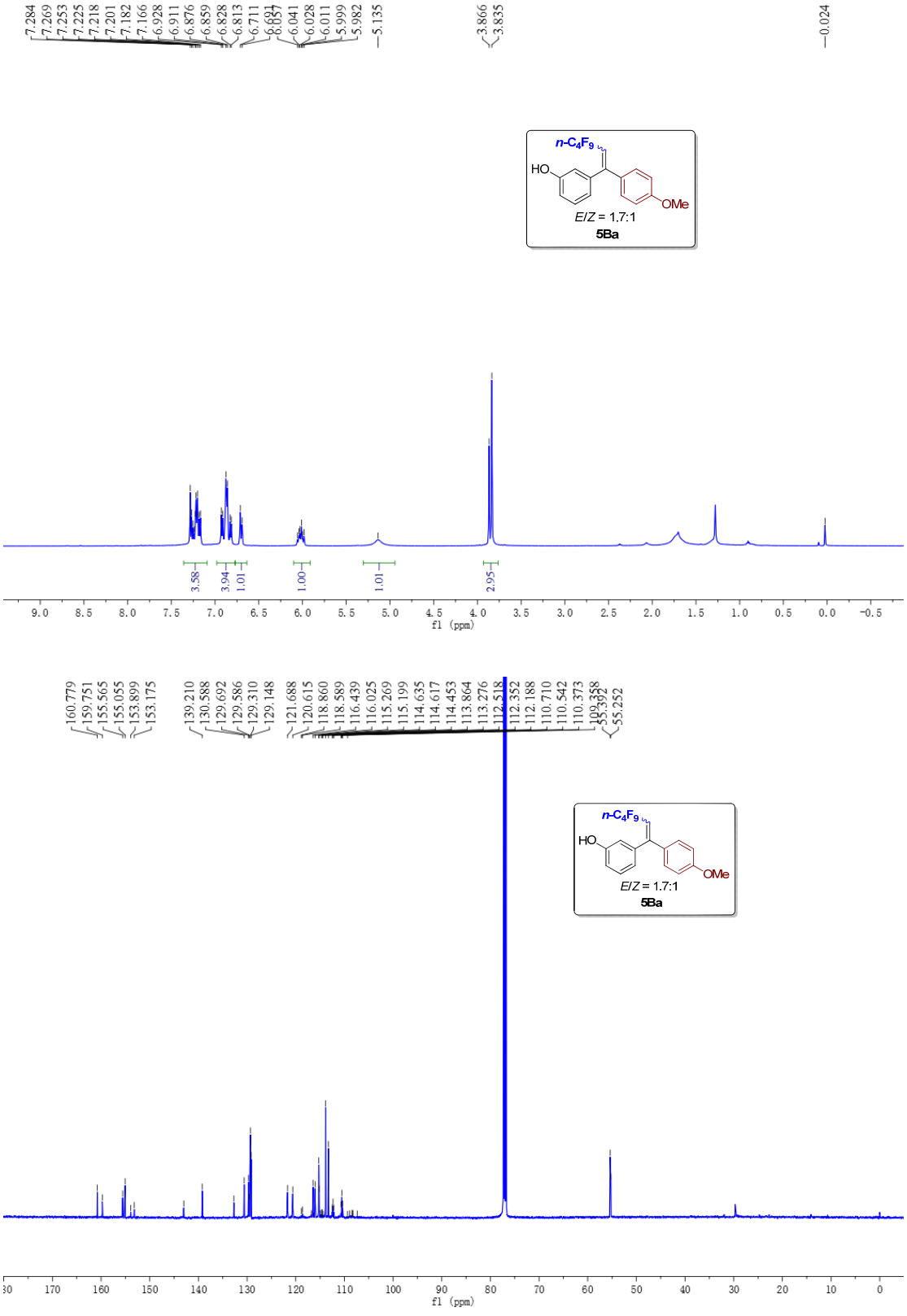
125.639
125.666
125.678
125.709
125.733
n-C4F9
HO
Br
OMe
4Ba
f1 (ppm)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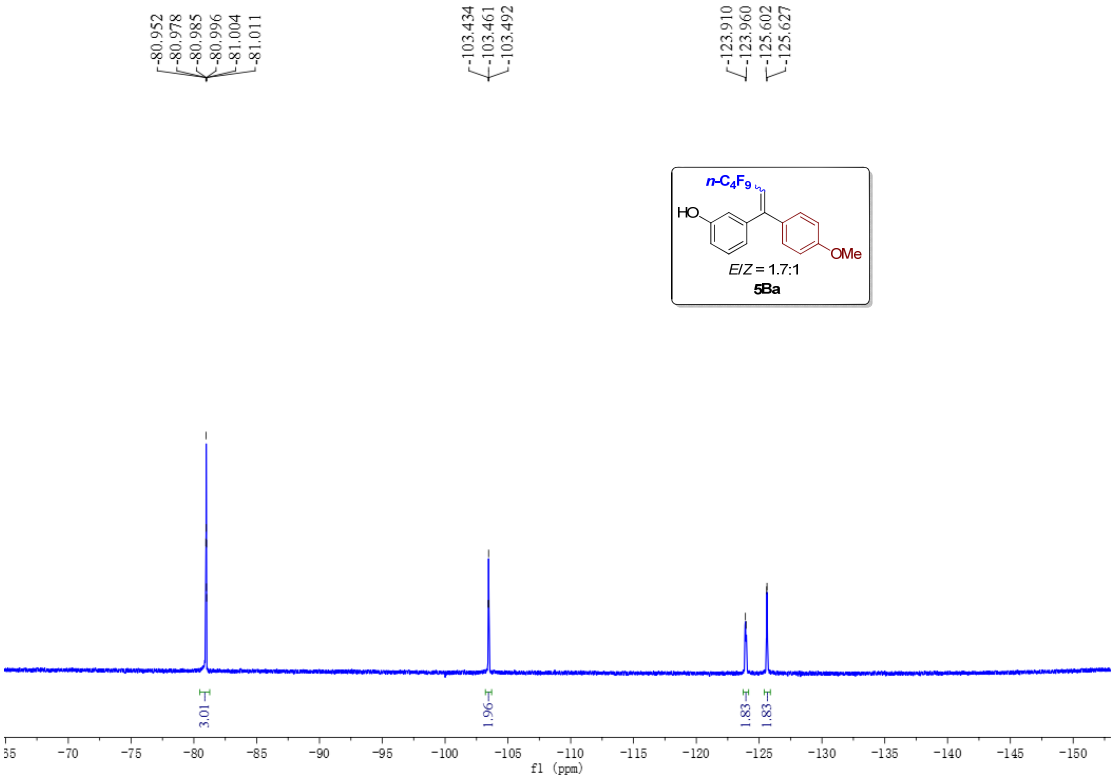
7.253
7.225
7.218
7.201
7.182
7.166
6.928
6.911
6.876
6.859
6.828
6.813
6.711
6.691
6.057
6.041
6.028
6.011
5.999
5.982
5.135
3.866
3.835
0.024
n-C4F9
HO
OMe
E/Z = 1.7:1
5Ba
3.58
3.94
1.01
1.00
1.01
2.95
f1 (ppm)
160.779
159.751
155.565
155.055
153.899
153.175
139.210
130.588
129.692
129.586
129.310
129.148
121.688
120.615
118.860
118.589
116.439
116.025
115.269
115.199
114.635
114.617
114.453
113.864
113.276
112.518
112.352
112.188
110.710
110.542
110.373
109.358
55.392
55.252
n-C4F9
HO
OMe
E/Z = 1.7:1
5Ba
f1 (ppm)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-81.011
-103.434
-103.461
-103.492
-123.910
-123.960
-125.602
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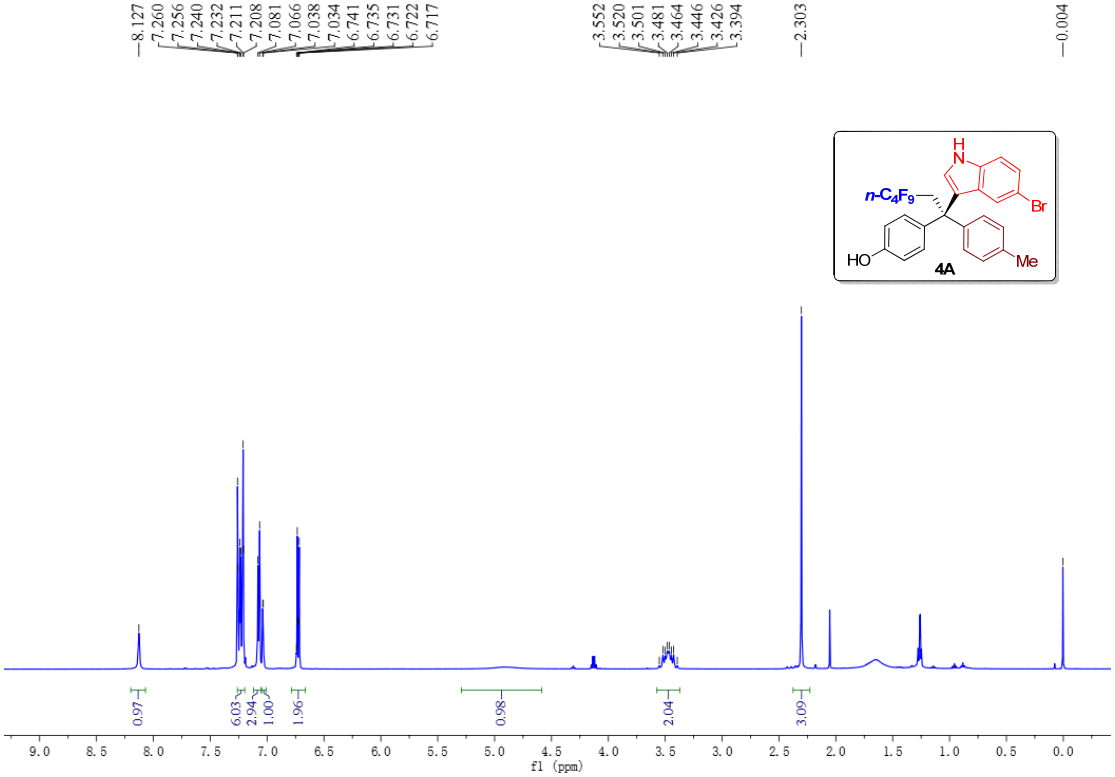
n-C4F9
HO
OMe
E/Z = 1.7:1
5Ba
3.01
1.96
1.83
1.83
f1 (ppm)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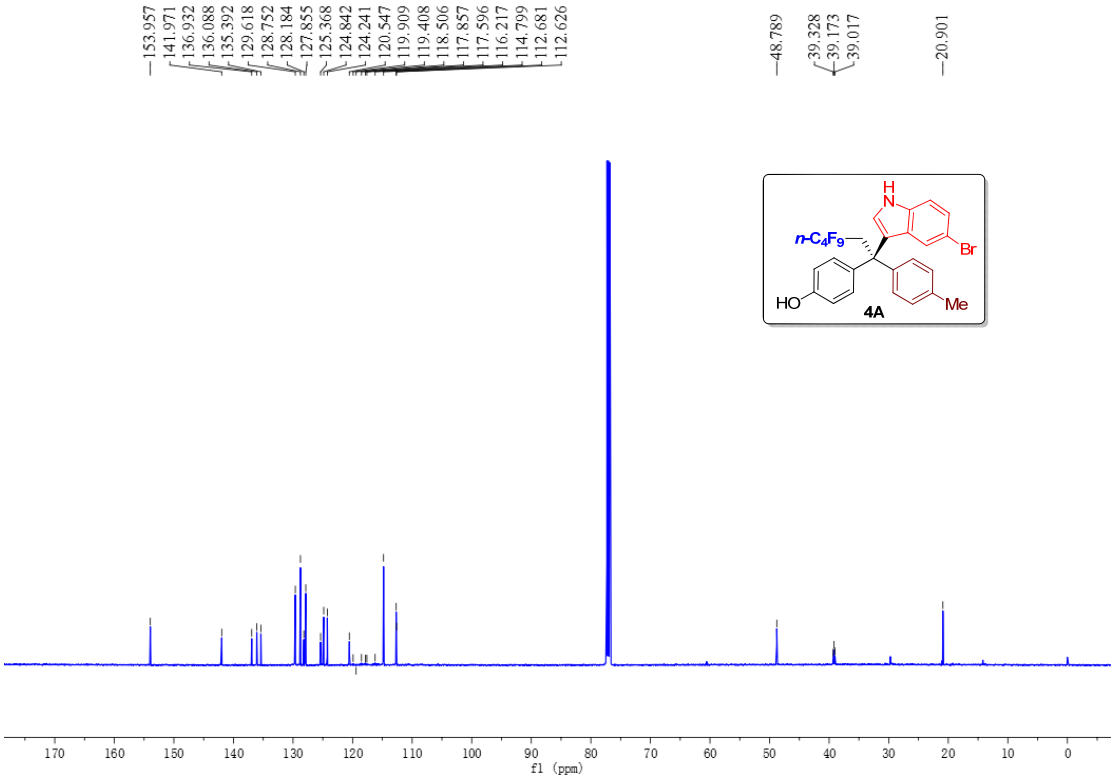
7.240
7.232
7.211
7.208
7.081
7.066
7.038
7.034
6.741
6.735
6.731
6.722
6.717
3.552
3.520
3.501
3.481
3.464
3.446
3.426
3.394
2.303
0.004
H
N
n-C4F9
Br
HO
Me
4A
0.97
6.03
2.94
1.00
1.96
0.98
2.04
3.09
f1 (ppm)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136.088
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128.752
128.184
127.855
125.368
124.842
124.241
120.547
119.909
119.408
118.506
117.857
117.596
116.217
114.799
112.681
112.626
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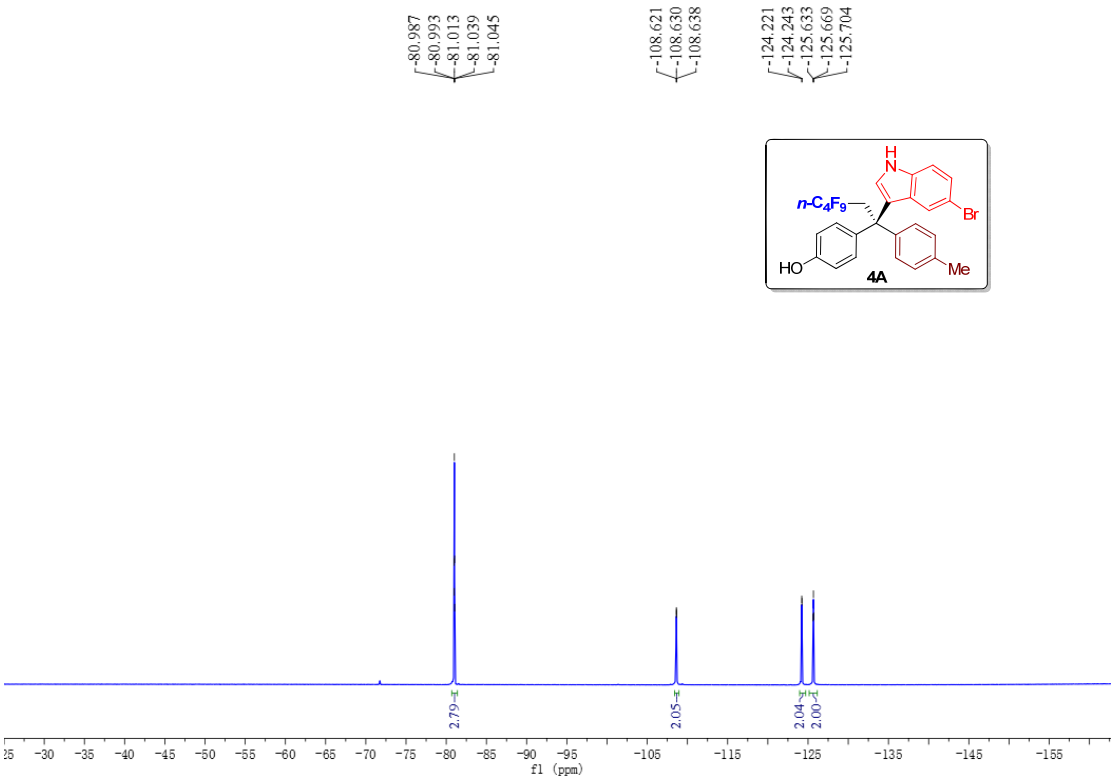
39.173
39.017
20.901
H
N
n-C4F9
Br
HO
Me
4A
f1 (ppm)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-108.630
-108.638
-124.221
-124.243
-125.633
-125.669
-125.704
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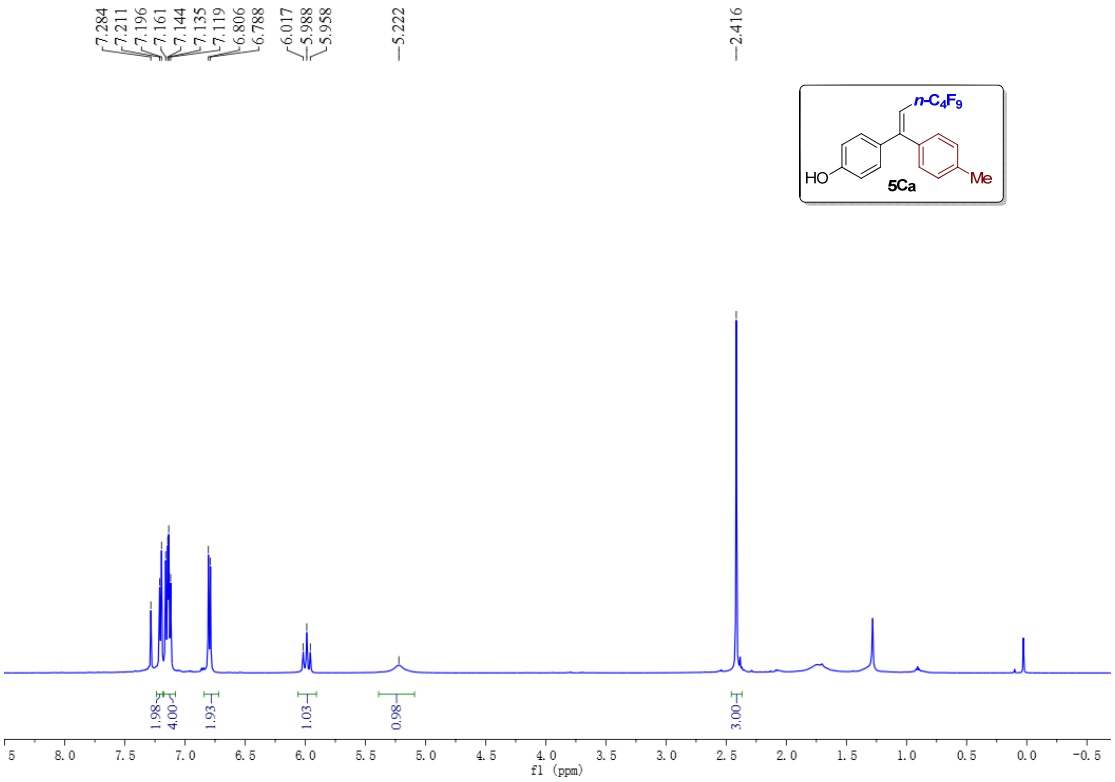
N
n-C4F9
Br
HO
Me
4A
2.79
2.05
2.04
2.00
f1 (ppm)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7.196
7.161
7.144
7.135
7.119
6.806
6.788
6.017
5.988
5.958
5.222
2.416
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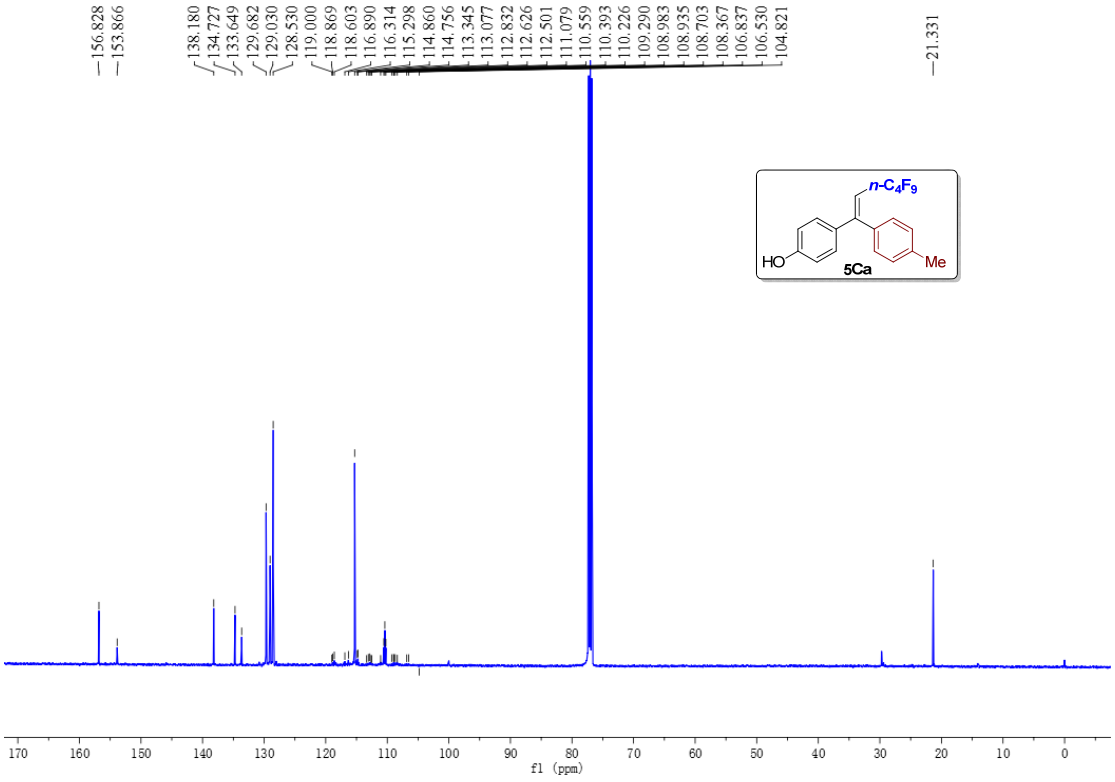
HO
Me
5Ca
1.98
4.00
1.93
1.03
0.98
3.00
f1 (ppm)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118.603
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116.314
115.298
114.860
114.756
113.345
113.077
112.832
112.626
112.501
111.079
110.559
110.393
110.226
109.290
108.983
108.935
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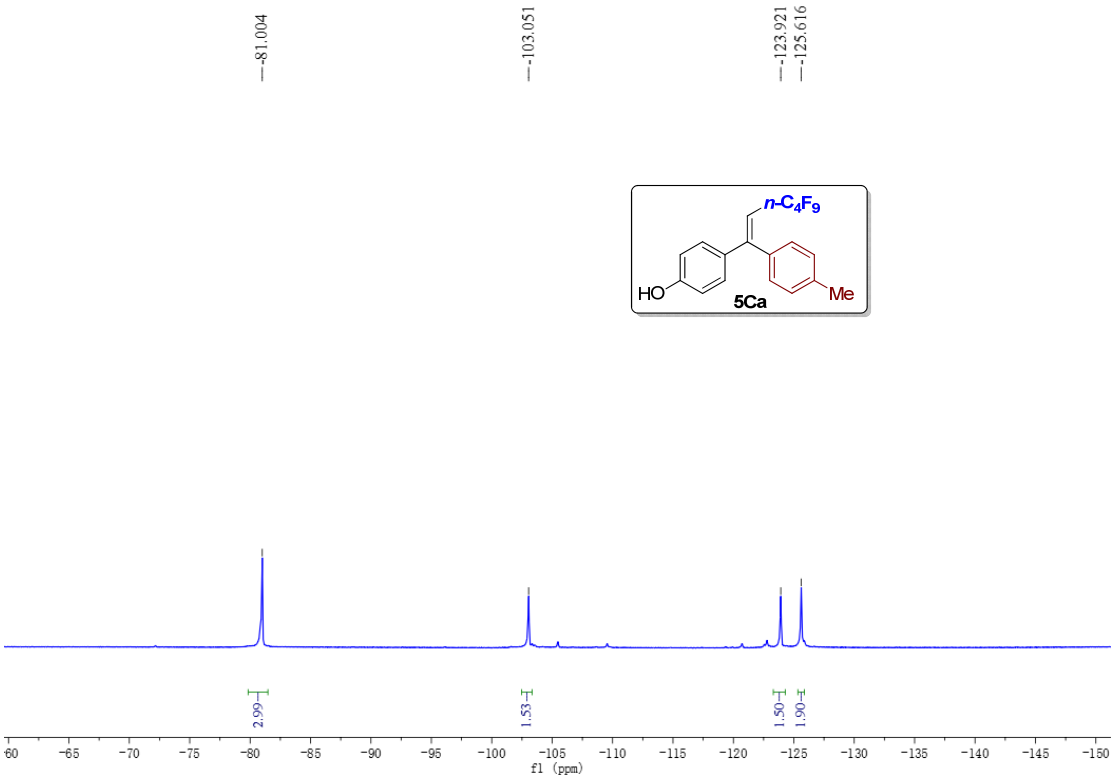
106.837
106.530
104.821
21.331
n-C4F9
HO
Me
5Ca
f1 (ppm)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-123.921
-125.616
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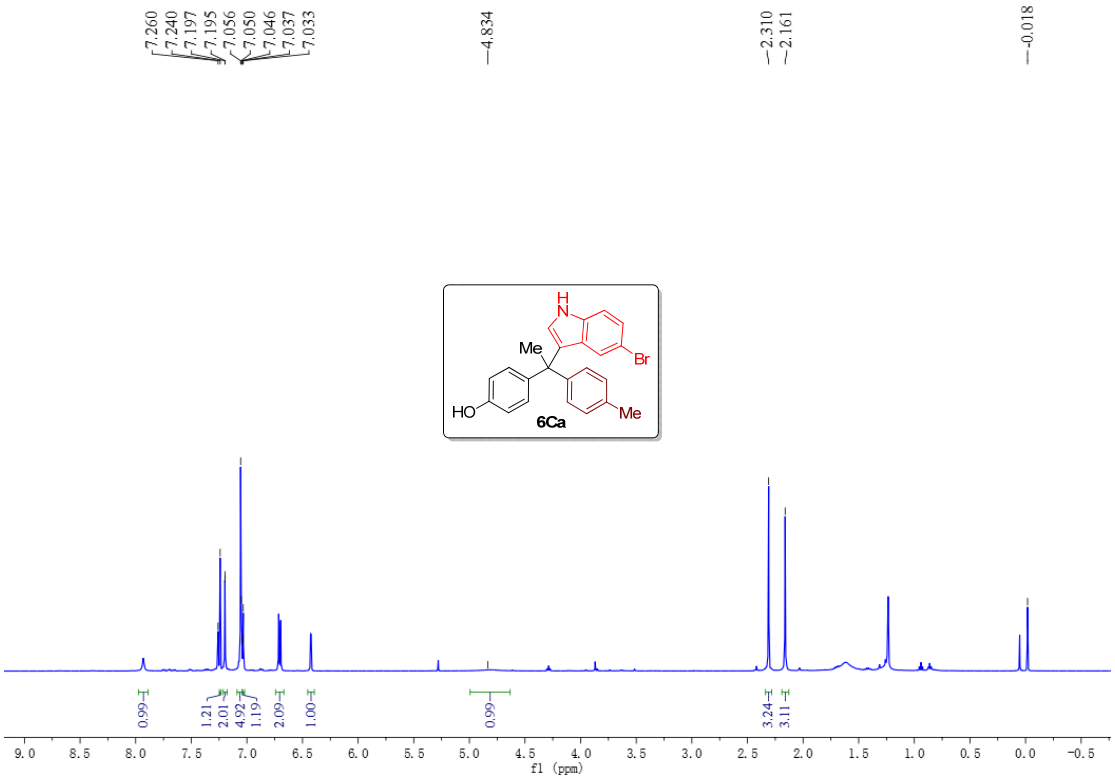
HO
Me
5Ca
2.99
1.53
1.50
1.90
60 -65 -70 -75 -80 -85 -90 -95 -100 -105 -110 -115 -120 -125 -130 -135 -140 -145 -150
f1 (ppm)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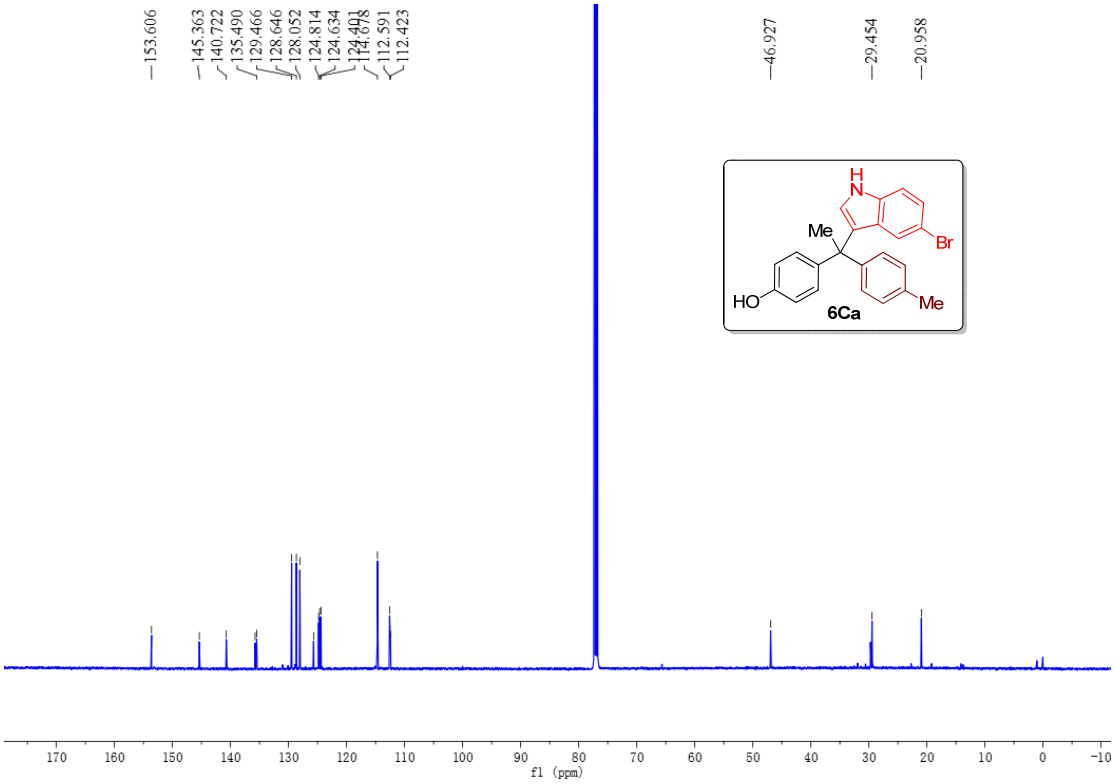
7.197
7.195
7.056
7.050
7.046
7.037
7.033
4.834
2.310
2.161
-0.018
H
N
Me
Br
HO
Me
6Ca
0.99
1.21
2.01
4.92
1.19
2.09
1.00
0.99
3.24
3.11
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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128.646
128.052
124.814
124.634
114.088
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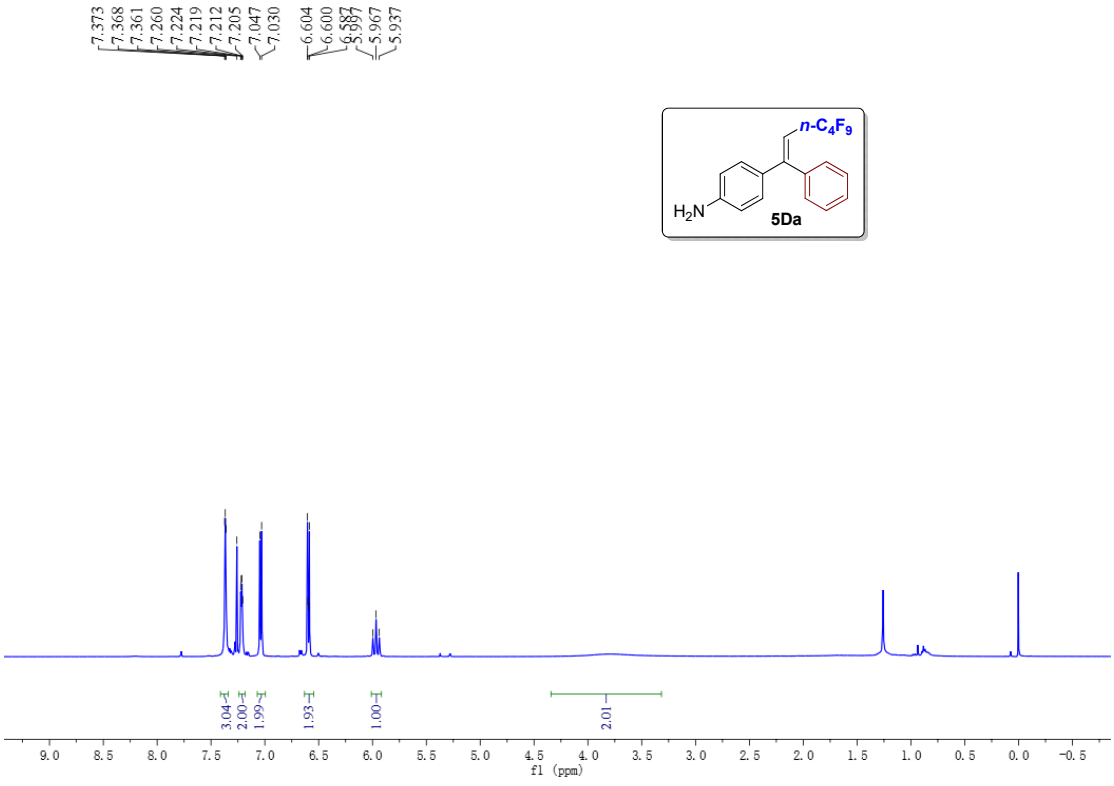
112.423
46.927
29.454
20.958
H
N
Me
Br
HO
Me
6Ca
f1 (ppm)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7.224
7.219
7.212
7.205
7.047
7.030
6.604
6.600
5.967
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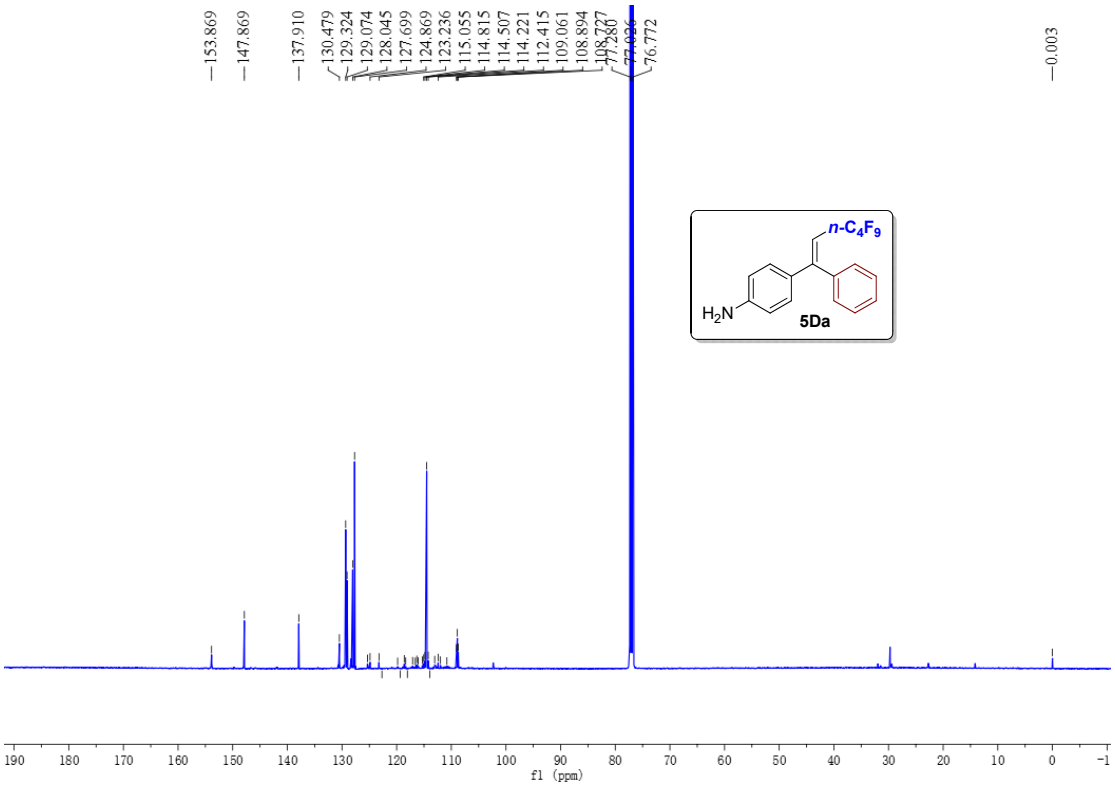
H2N
5Da
3.04
2.00
1.99
1.93
1.00
2.01
f1 (ppm)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114.815
114.507
114.221
112.415
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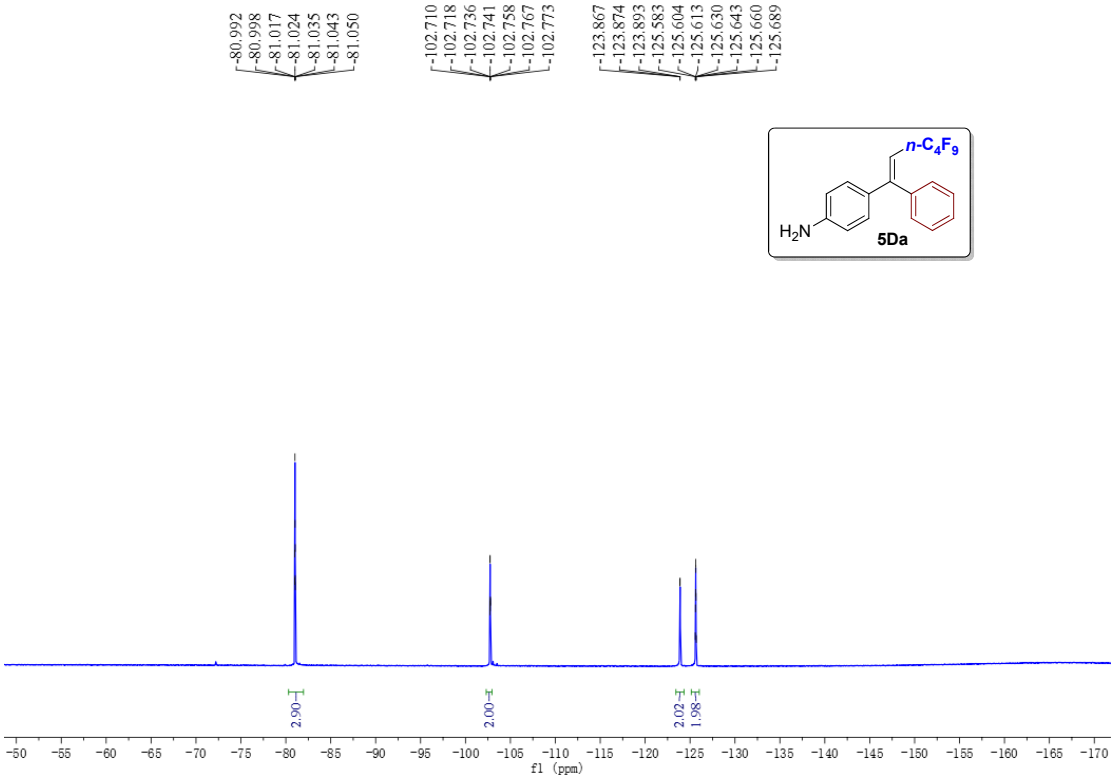
108.727
77.280
77.036
76.772
0.003
n-C4F9
H2N
5Da
f1 (ppm)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-102.758
-102.767
-102.773
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-123.893
-125.583
-125.604
-125.613
-125.630
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-125.689
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H2N
5Da
2.90
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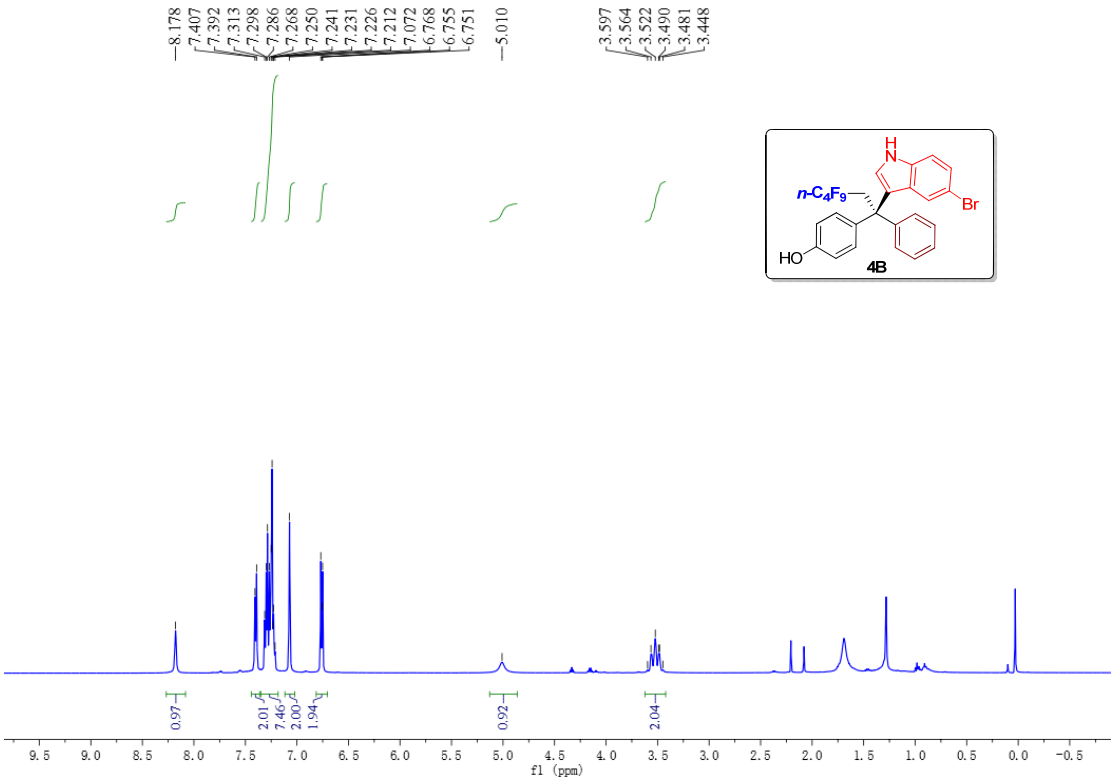
2.02
1.98
f1 (ppm)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7.286
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7.241
7.231
7.226
7.212
7.072
6.768
6.755
6.751
5.010
3.597
3.564
3.522
3.490
3.481
3.448
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Br
HO
4B
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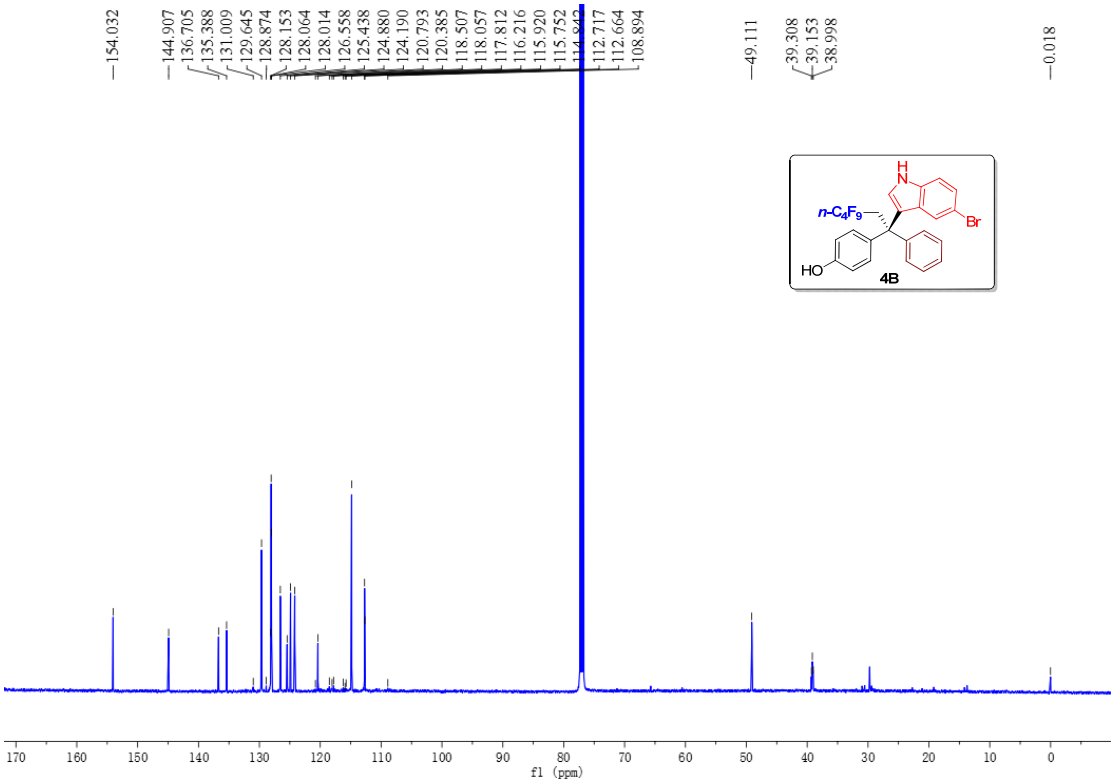
2.04
f1 (ppm)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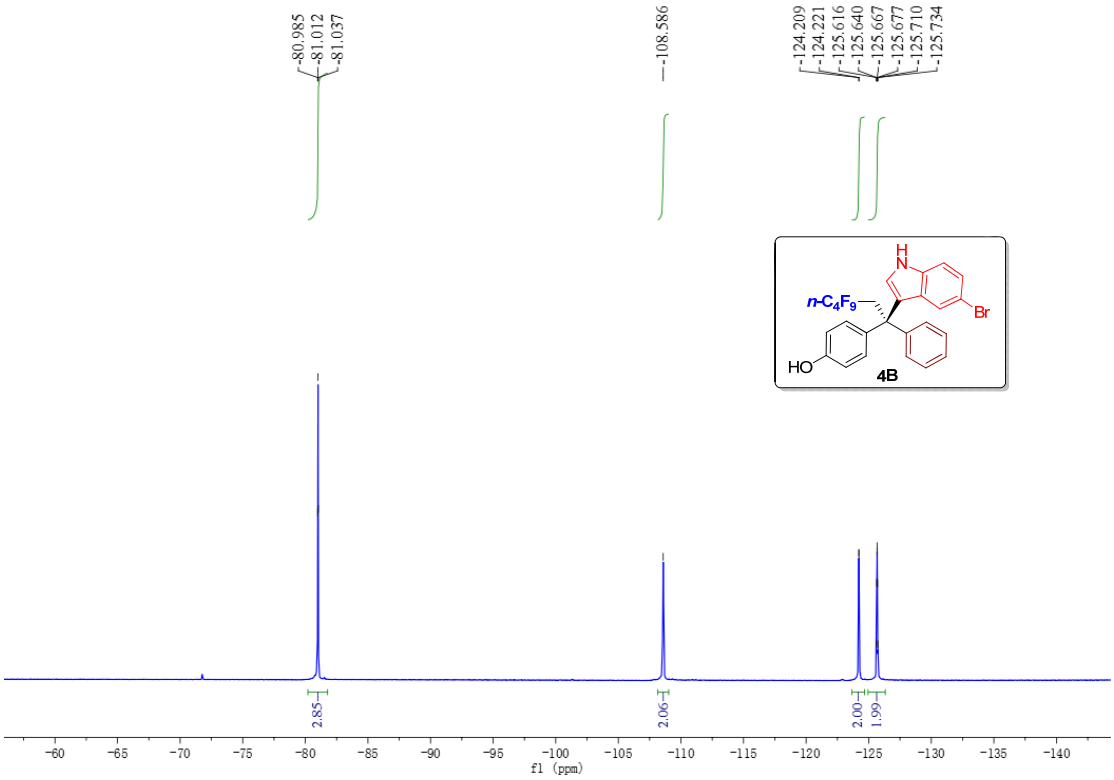
128.014
126.558
125.438
124.880
124.190
120.793
120.385
118.507
118.057
117.812
116.216
115.920
115.752
114.842
112.717
112.664
108.894
49.111
39.308
39.153
38.998
0.018
n-C4F9
Br
HO
4B
f1 (ppm)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-125.616
-125.640
-125.667
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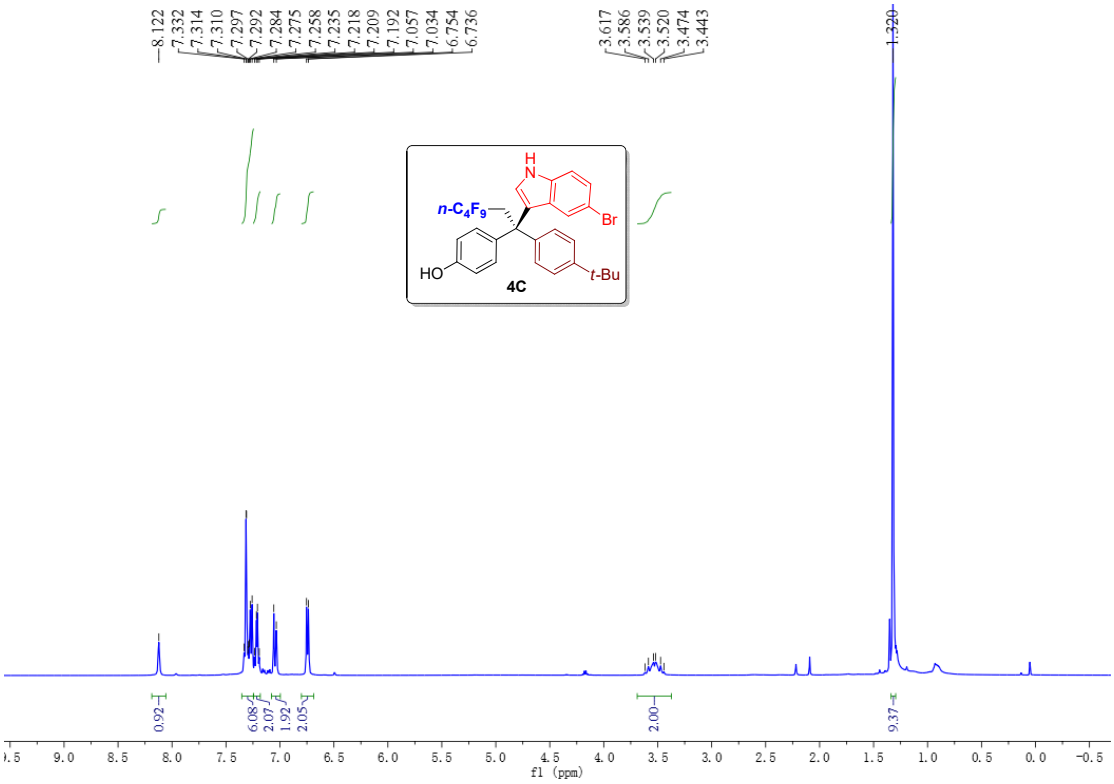
-125.734
n-C4F9
Br
HO
4B
2.85
2.06
2.00
1.99
f1 (ppm)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7.332
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7.292
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7.275
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7.235
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7.209
7.192
7.057
7.034
6.754
6.736
3.617
3.586
3.539
3.520
3.474
3.443
1.320
n-C4F9
Br
HO
t-Bu
4C
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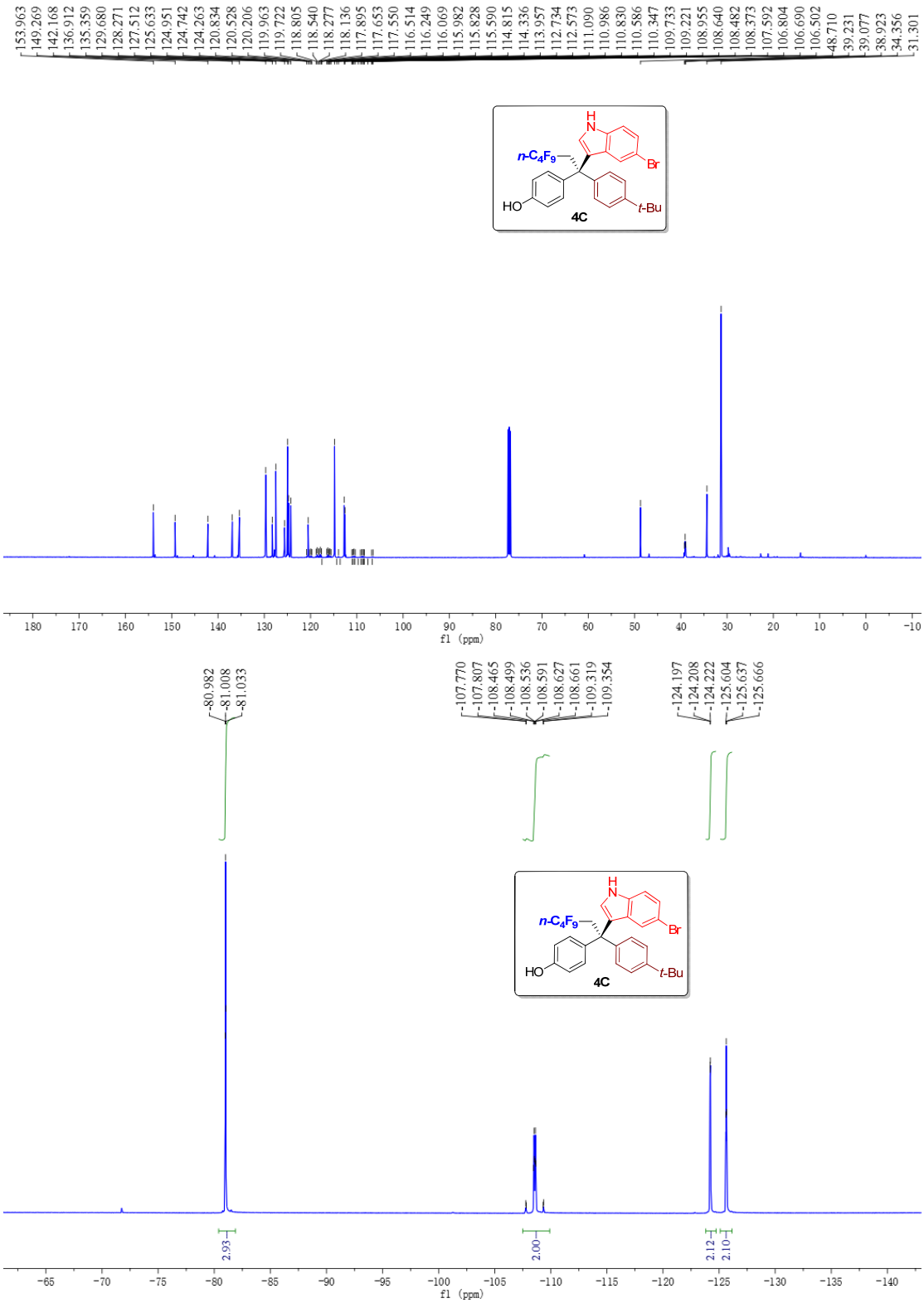
1.92
2.05
2.00
9.37
f1 (ppm)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127.512
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124.951
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120.834
120.528
120.206
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119.722
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118.136
117.895
117.653
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106.690
106.502
48.710
39.231
39.077
38.923
34.356
31.301
n-C4F9
Br
HO
t-Bu
4C
f1 (ppm)
-80.982
-81.008
-81.033
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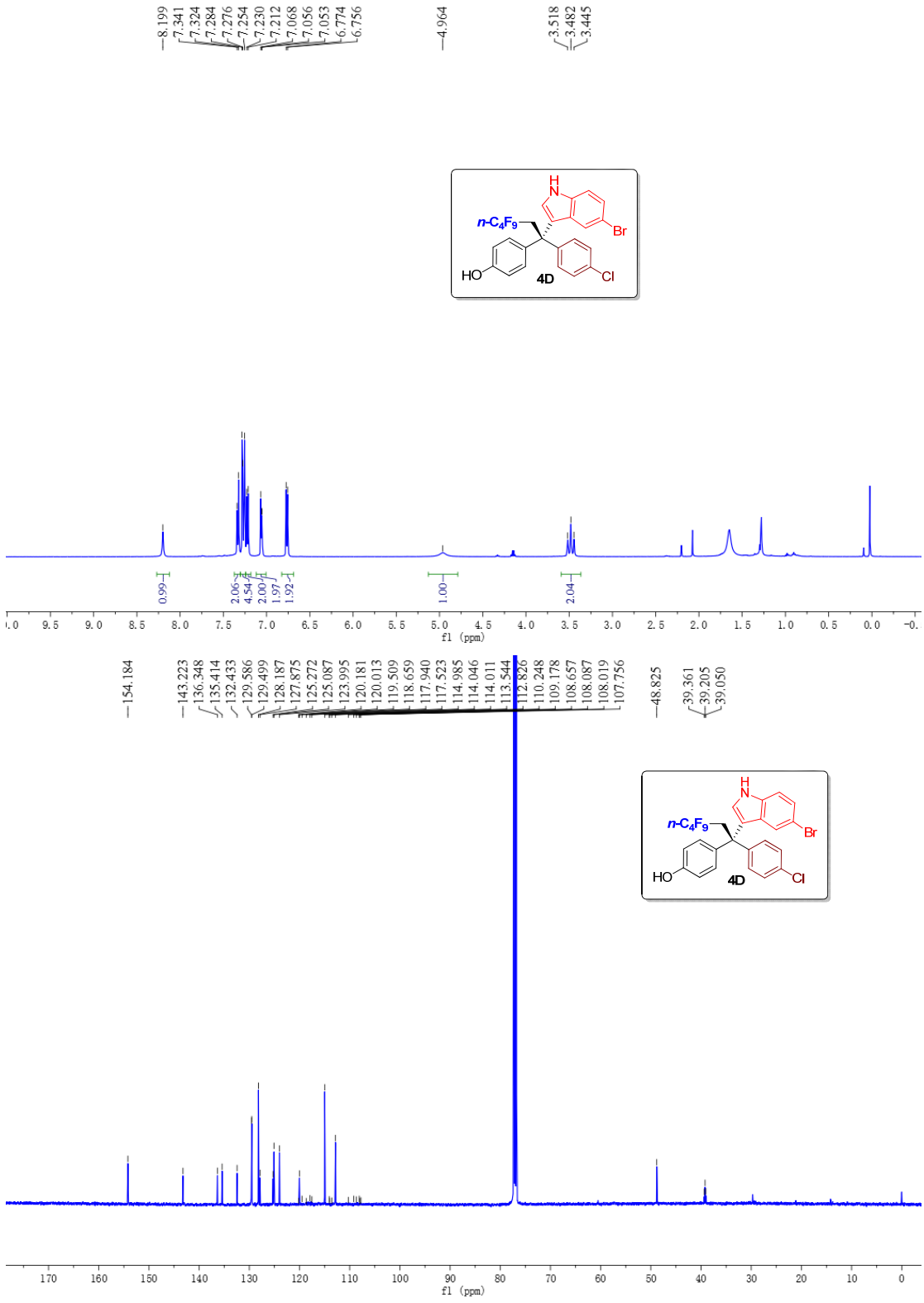
-108.465
-108.499
-108.536
-108.591
-108.627
-108.661
-109.319
-109.354
-124.197
-124.208
-124.222
-125.604
-125.637
-125.666
2.93
2.00
2.12
2.10
f1 (ppm)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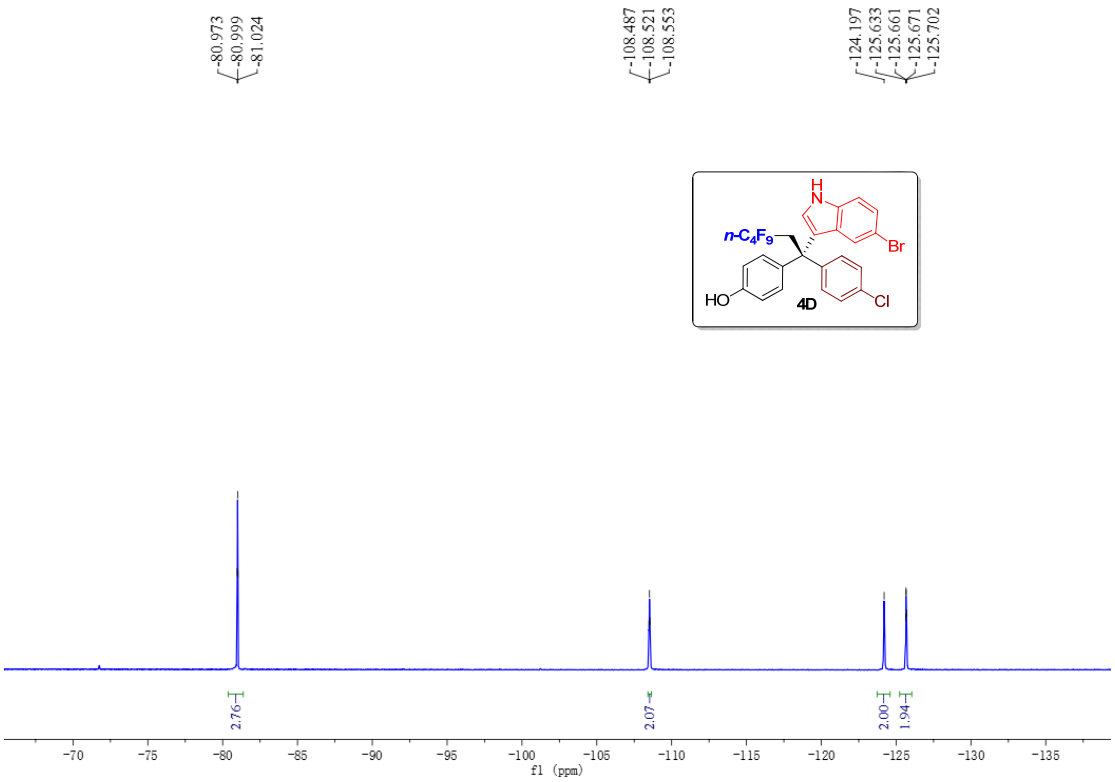
7.324
7.284
7.276
7.254
7.230
7.212
7.068
7.056
7.053
6.774
6.756
4.964
3.518
3.482
3.445
n-C4F9
Br
HO
Cl
4D
0.99
2.06
4.54
2.00
1.97
1.92
1.00
2.04
f1 (ppm)
154.184
143.223
136.348
135.414
132.433
129.586
129.499
128.187
127.875
125.272
125.087
123.995
120.181
120.013
119.509
118.659
117.940
117.523
114.985
114.046
114.011
113.544
112.826
110.248
109.178
108.657
108.087
108.019
107.756
48.825
39.361
39.205
39.050
n-C4F9
Br
HO
4D
Cl
f1 (ppm)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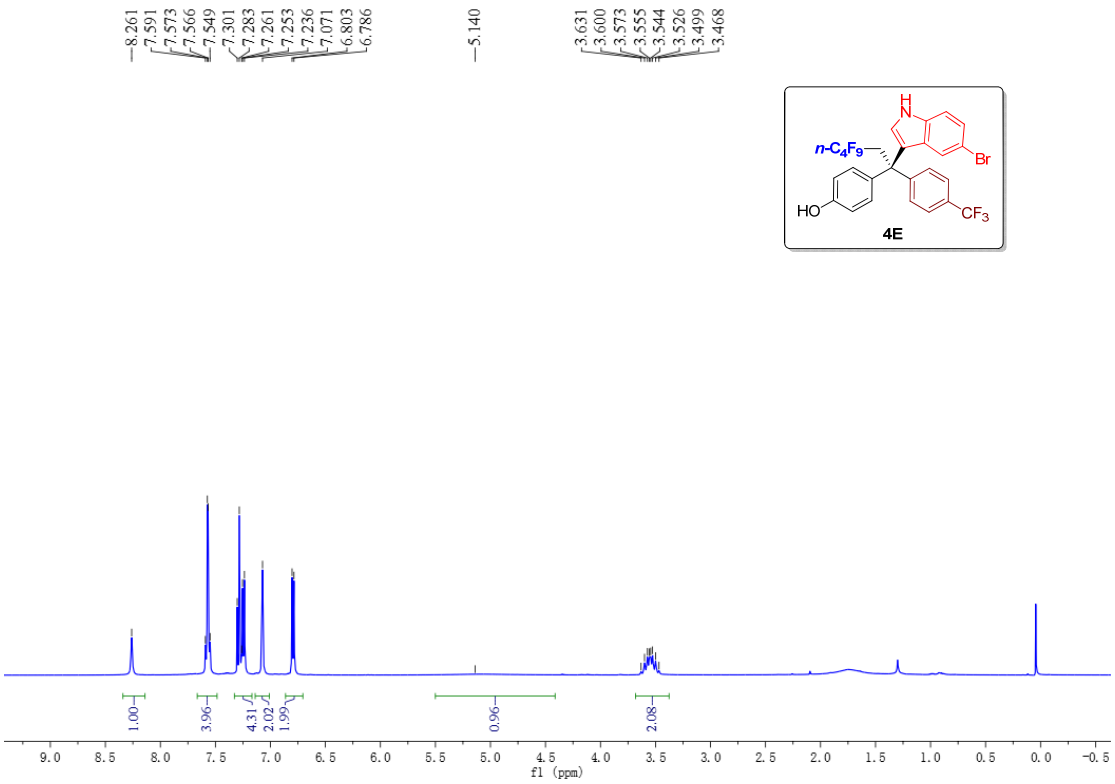
-108.521
-108.553
-124.197
-125.633
-125.661
-125.671
-125.702
H
N
n-C4F9
Br
HO
Cl
4D
2.76
2.07
2.00
1.94
-70
-75
-80
-85
-90
-95
-100
-105
-110
-115
-120
-125
-130
-135
f1 (ppm)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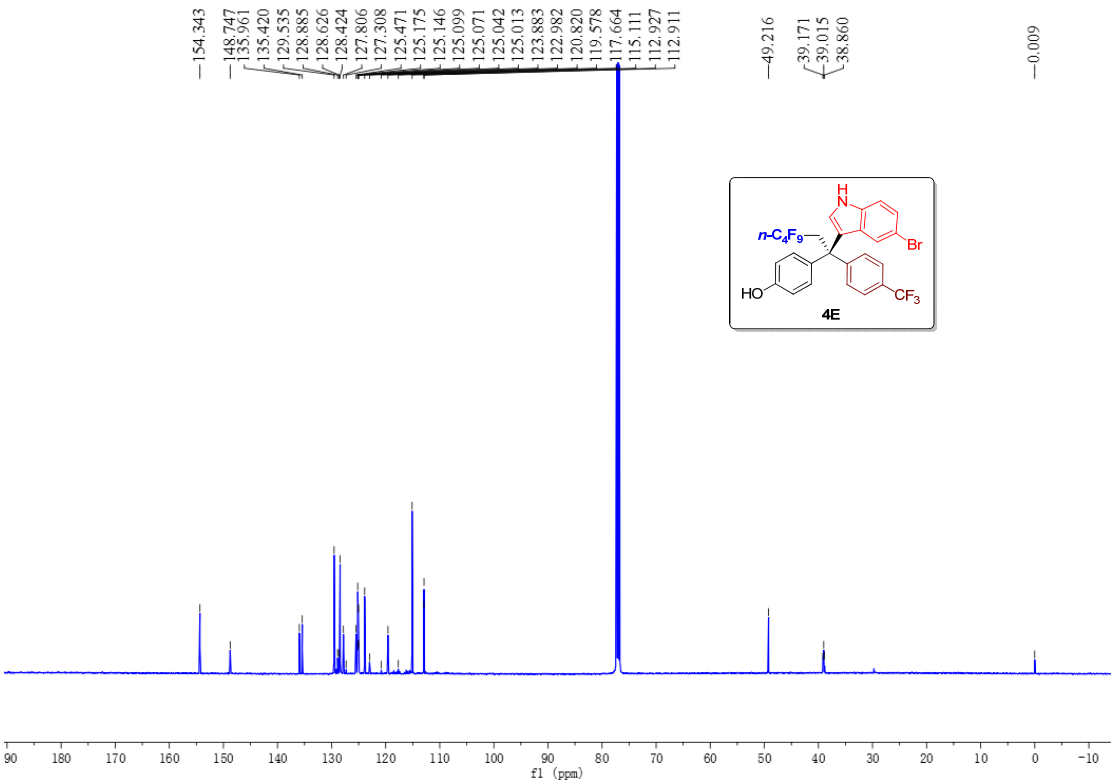
7.236
7.071
6.803
6.786
5.140
3.631
3.600
3.573
3.555
3.544
3.526
3.499
3.468
H
N
n-C4F9
Br
HO
CF3
4E
1.00
3.96
4.31
2.02
1.99
0.96
2.08
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)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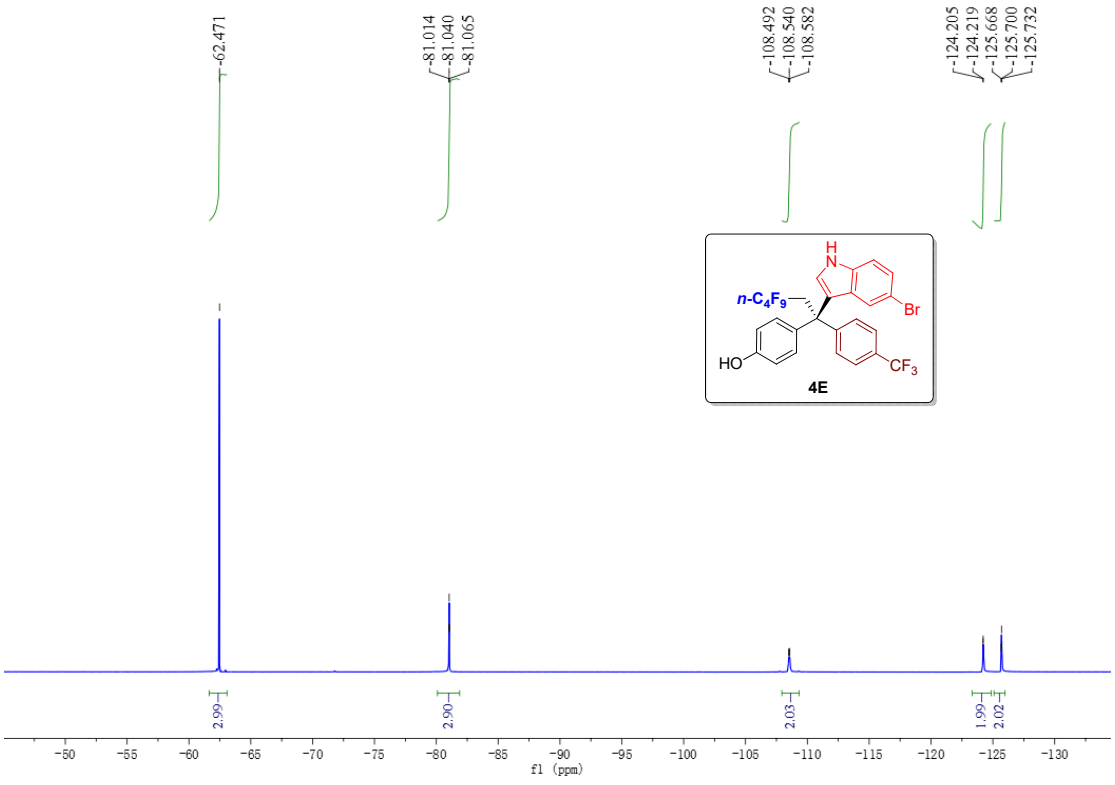
148.747
135.961
135.420
129.535
128.885
128.626
128.424
127.806
127.308
125.471
125.175
125.146
125.099
125.071
125.042
125.013
123.883
122.982
120.820
119.578
117.664
115.111
112.927
112.911
49.216
39.171
39.015
38.860
0.009
H
N
n-C4F9
Br
HO
CF3
4E
f1 (ppm)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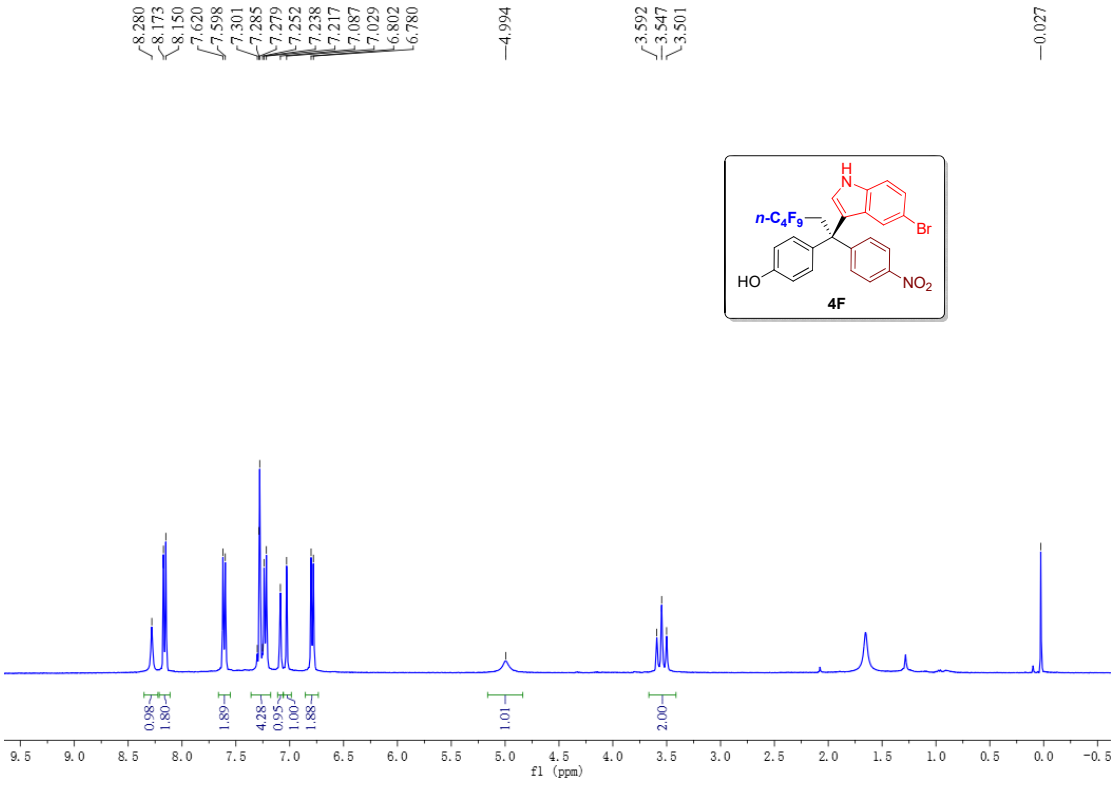
-81.040
-81.065
-108.492
-108.540
-108.582
-124.205
-124.219
-125.668
-125.700
-125.732
H
N
n-C4F9
Br
HO
CF3
4E
2.99
2.90
2.03
1.99
2.02
f1 (ppm)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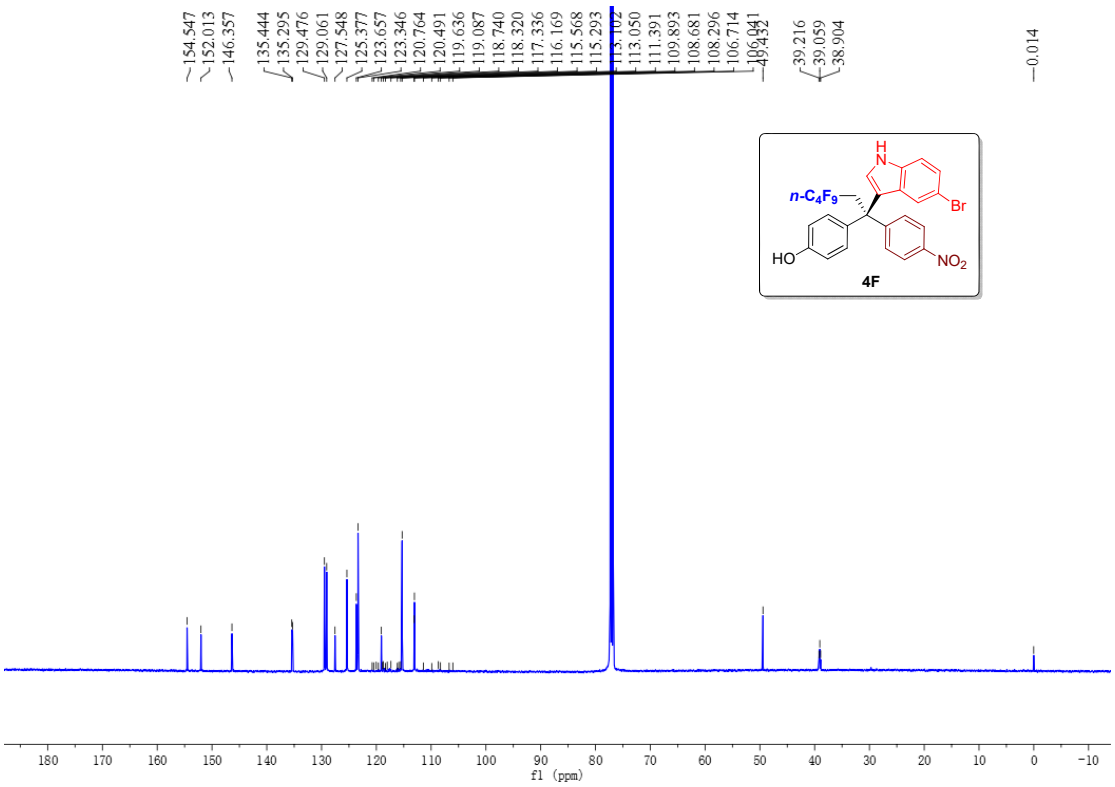
8.173
8.150
7.620
7.598
7.301
7.285
7.279
7.252
7.238
7.217
7.087
7.029
6.802
6.780
4.994
3.592
3.547
3.501
0.027
4F
0.98
1.80
1.89
4.28
0.95
1.00
1.88
1.01
2.00
f1 (ppm)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127.548
125.377
123.657
123.346
120.764
120.491
119.636
119.087
118.740
118.320
117.336
116.169
115.568
115.293
113.102
113.050
111.391
109.893
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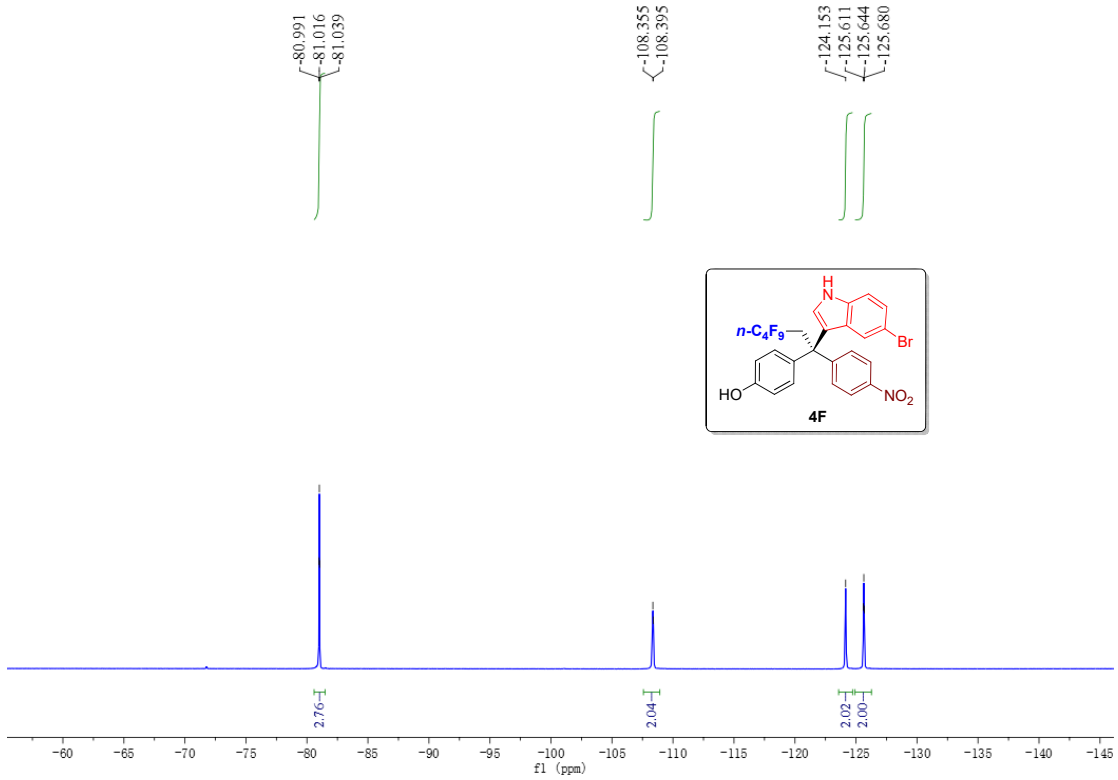
108.296
106.714
106.041
49.432
39.216
39.059
38.904
0.014
4F
f1 (ppm)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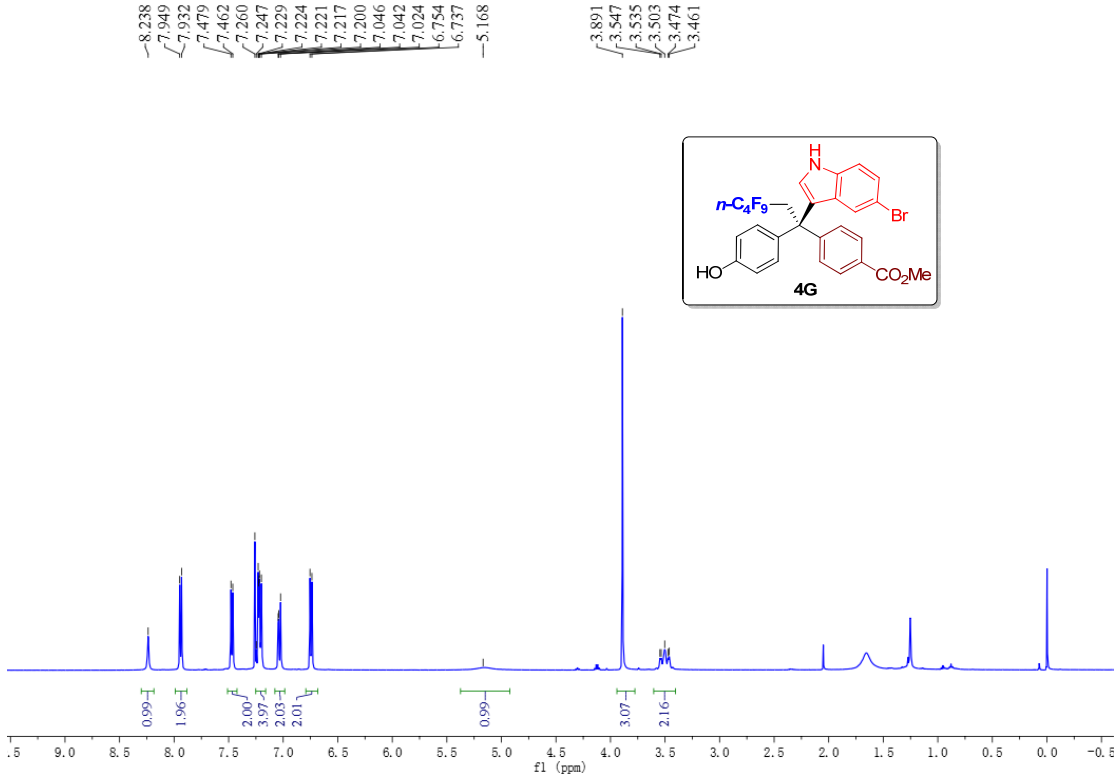
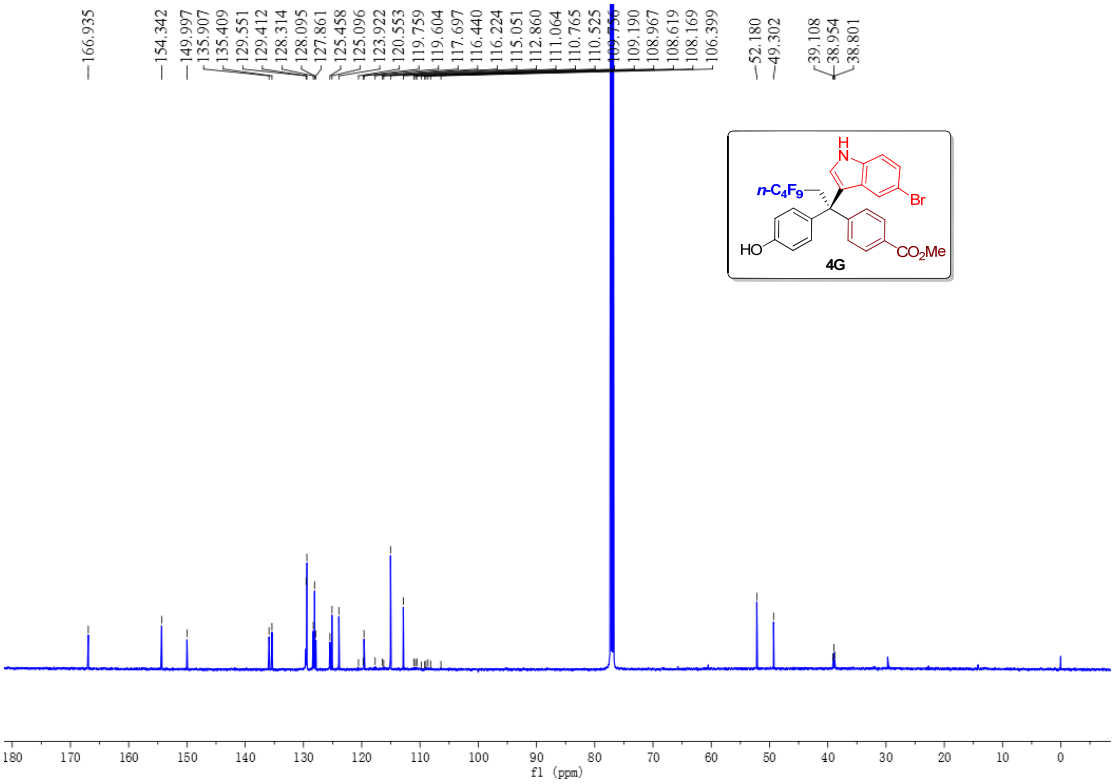
-81.039
-108.355
-108.395
-124.153
-125.611
-125.644
-125.680
n-C4F9
Br
HO
NO2
4F
2.76
2.04
2.02
2.00
f1 (ppm)


8.238
7.949
7.932
7.479
7.462
7.260
7.247
7.229
7.224
7.221
7.217
7.200
7.046
7.042
7.024
6.754
6.737
5.168
3.891
3.547
3.535
3.503
3.474
3.461
n-C4F9
Br
HO
CO2Me
4G
0.99
1.96
2.00
3.97
2.03
2.01
0.99
3.07
2.16
f1 (ppm)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149.997
135.907
135.409
129.551
129.412
128.314
128.095
127.861
125.458
125.096
123.922
120.553
119.759
119.604
117.697
116.440
116.224
115.051
112.860
111.064
110.765
110.525
109.190
108.967
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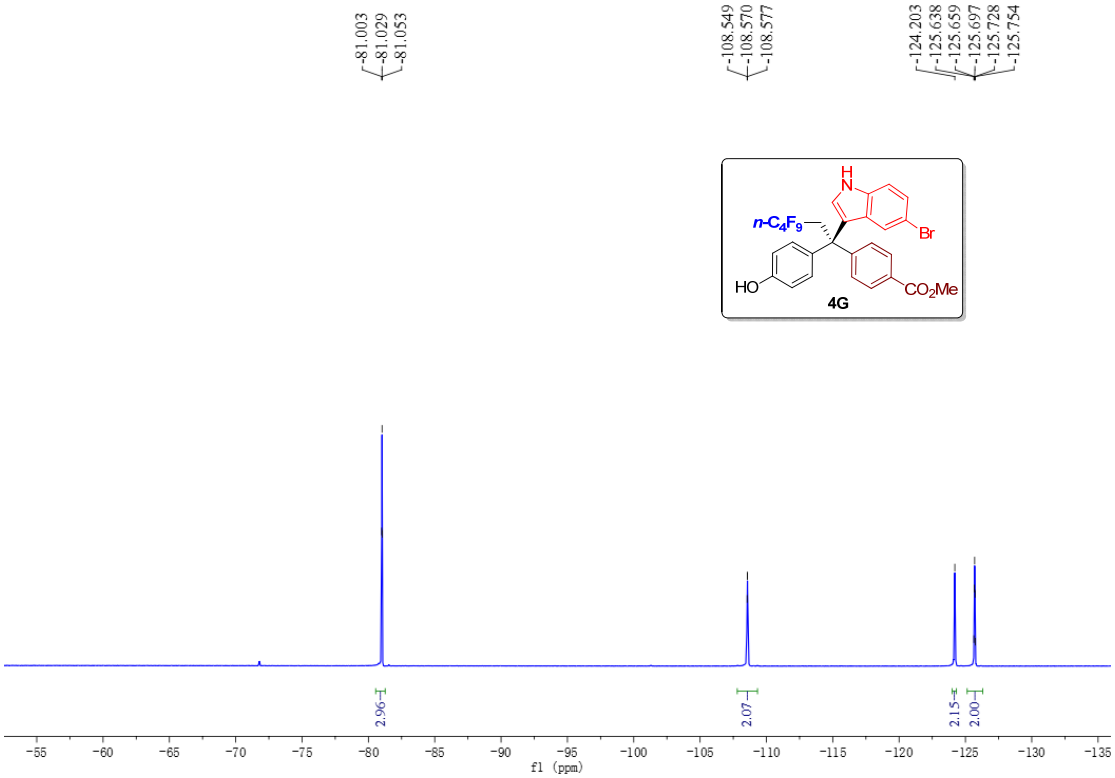
108.169
106.399
52.180
49.302
39.108
38.954
38.801
f1 (ppm)
4G


81.003
81.029
81.053
108.549
108.570
108.577
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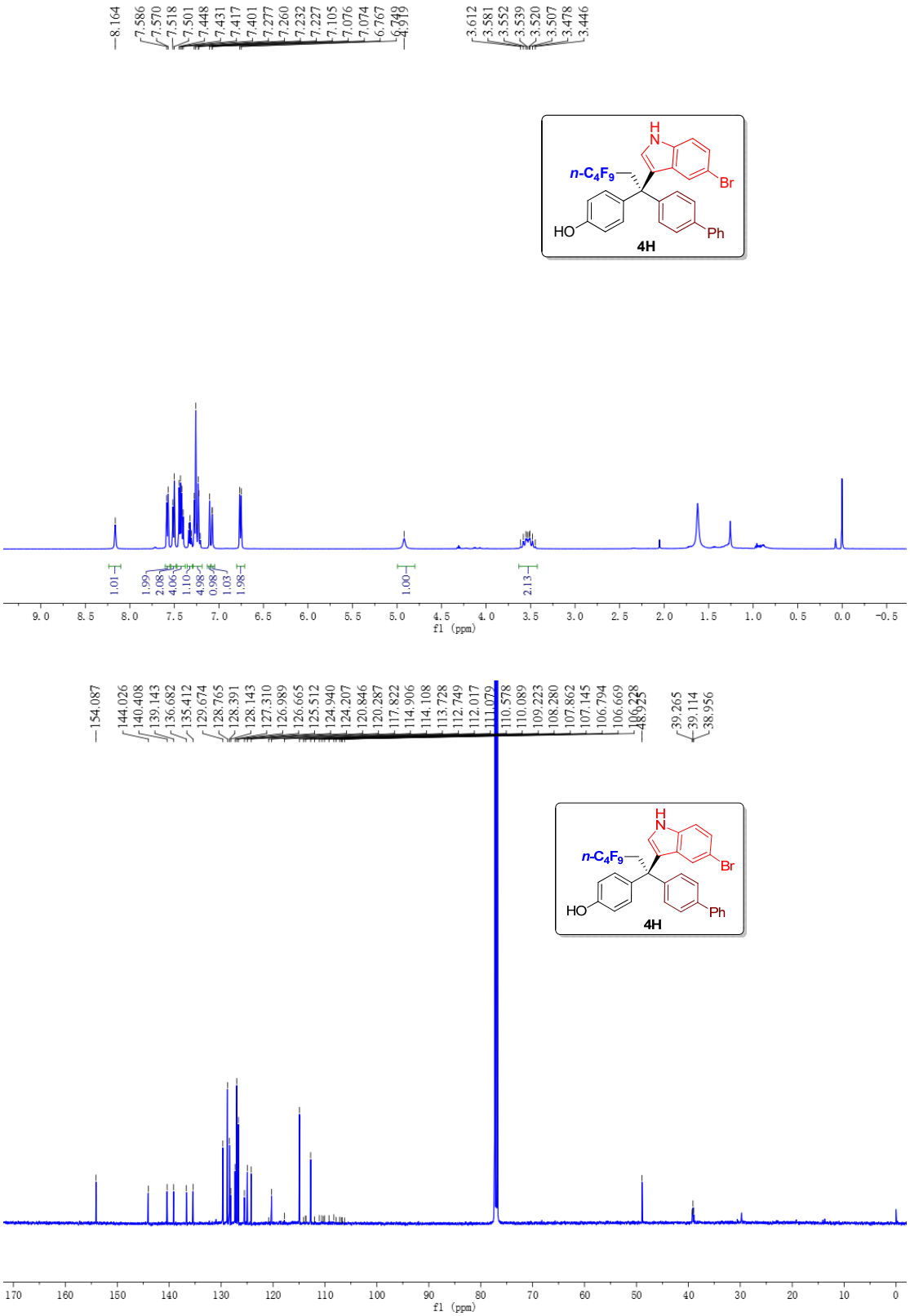
125.638
125.659
125.697
125.728
125.754
2.96
2.07
2.15
2.00
f1 (ppm)
4G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7.518
7.501
7.448
7.431
7.417
7.401
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7.260
7.232
7.227
7.105
7.076
7.074
6.767
6.749
4.919
3.612
3.581
3.552
3.539
3.520
3.507
3.478
3.446
n-C4F9
Br
HO
Ph
4H
1.01
1.99
2.08
4.06
1.10
4.98
0.98
1.03
1.98
1.00
2.13
f1 (ppm)
154.087
144.026
140.408
139.143
136.682
135.412
129.674
128.765
128.391
128.143
127.310
126.989
126.665
125.512
124.940
124.207
120.846
120.287
117.822
114.906
114.108
113.728
112.749
112.017
111.079
110.578
110.089
109.223
108.280
107.862
107.145
106.794
106.669
48.925
39.265
39.114
38.956
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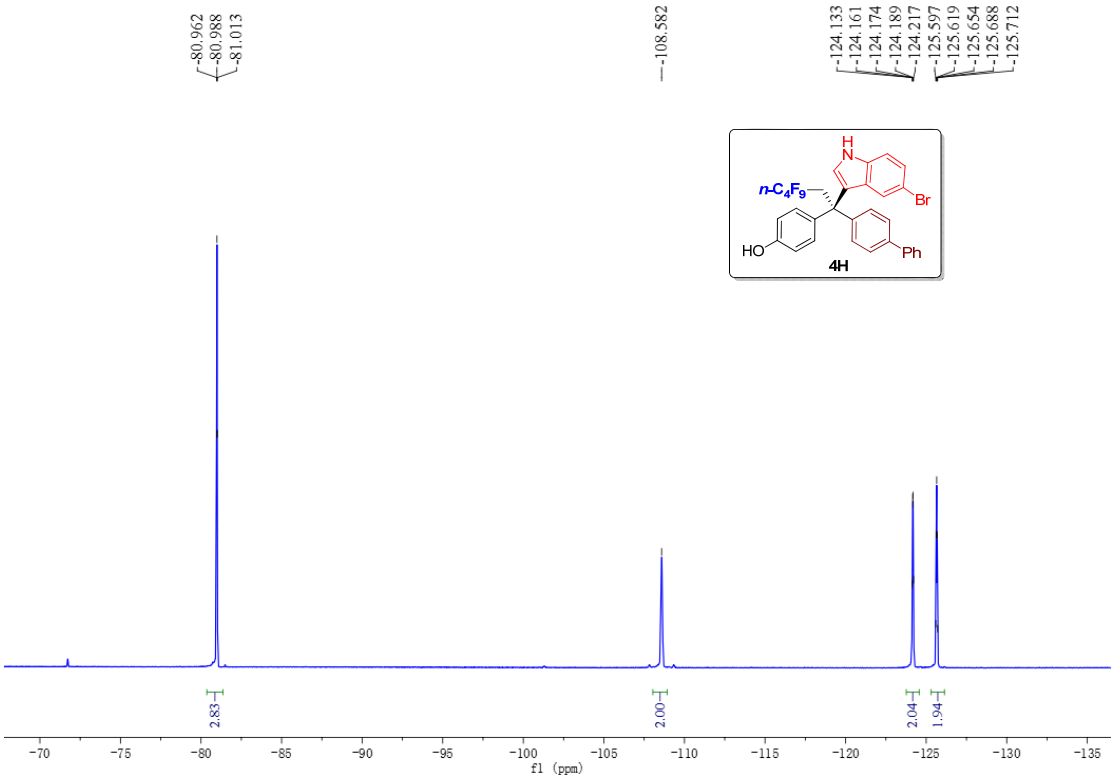
Br
HO
Ph
4H
f1 (ppm)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-124.189
-124.217
-125.597
-125.619
-125.654
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n-C4F9
Br
HO
Ph
4H
2.83
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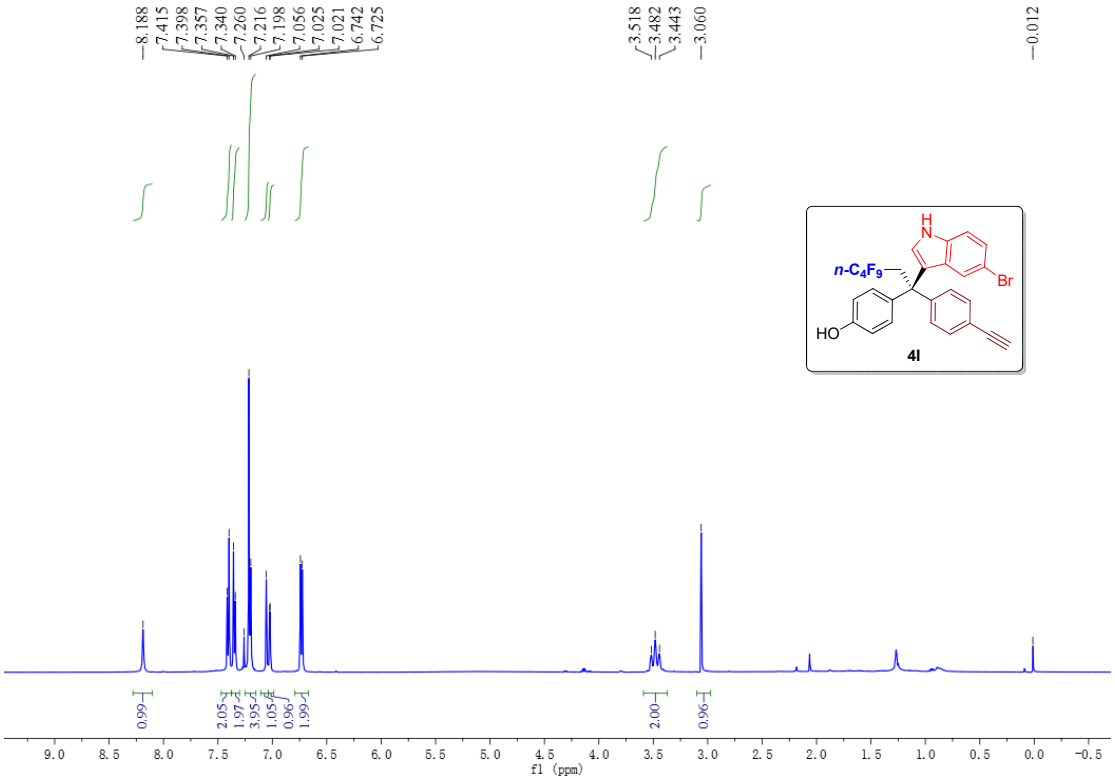
1.94
f1 (ppm)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7.025
7.021
6.742
6.725
3.518
3.482
3.443
3.060
-0.012
n-C4F9
Br
HO
4I
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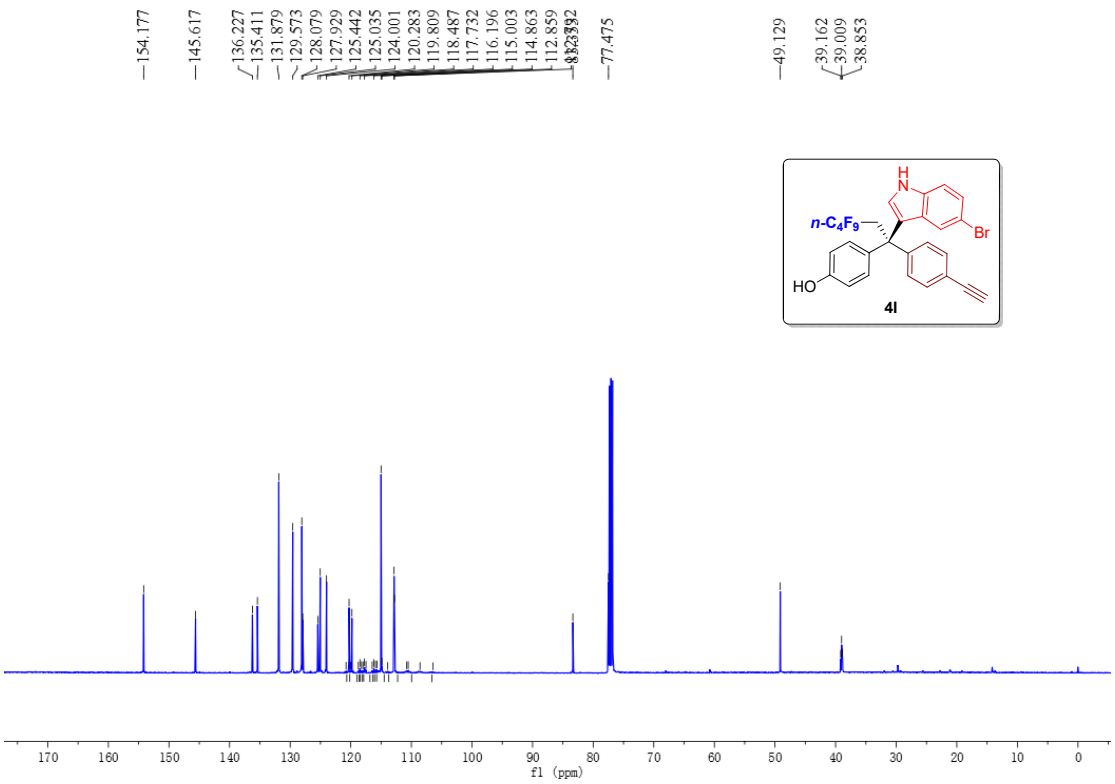
2.05
1.97
3.95
1.05
0.96
1.99
2.00
0.96
f1 (ppm)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128.079
127.929
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125.035
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120.283
119.809
118.487
117.732
116.196
115.003
114.863
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38.853
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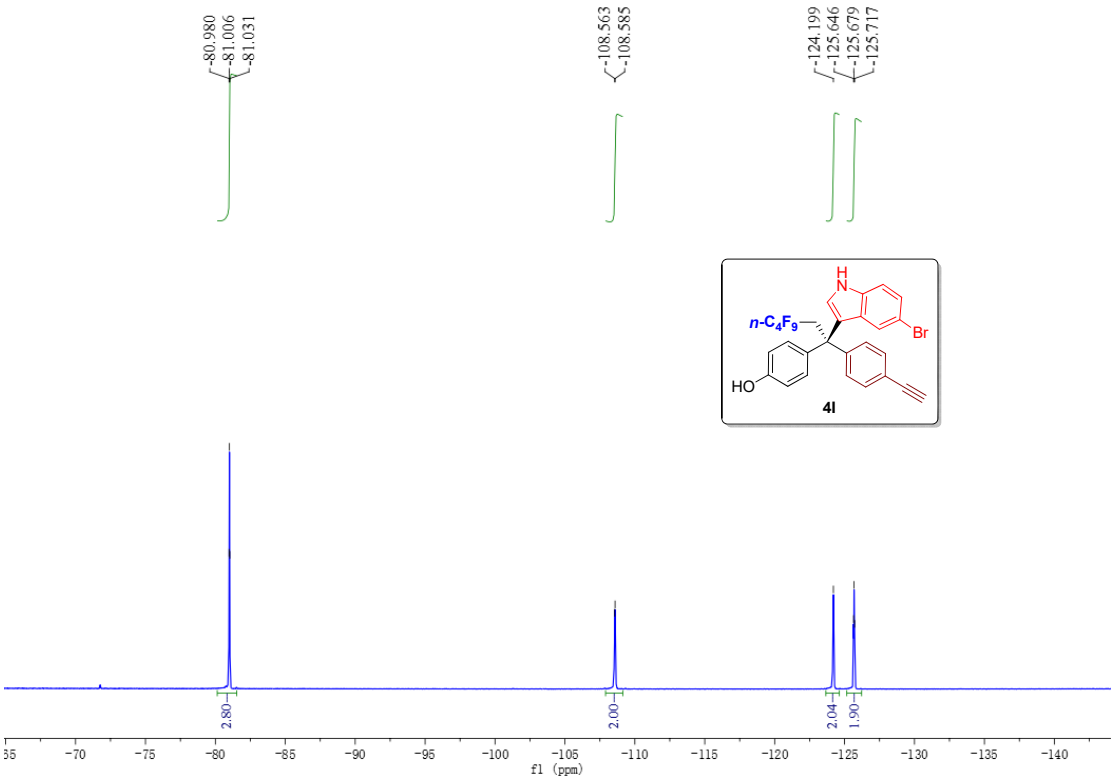
Br
HO
H
N
4l
f1 (ppm)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-125.646
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Br
HO
H
N
4l
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2.00
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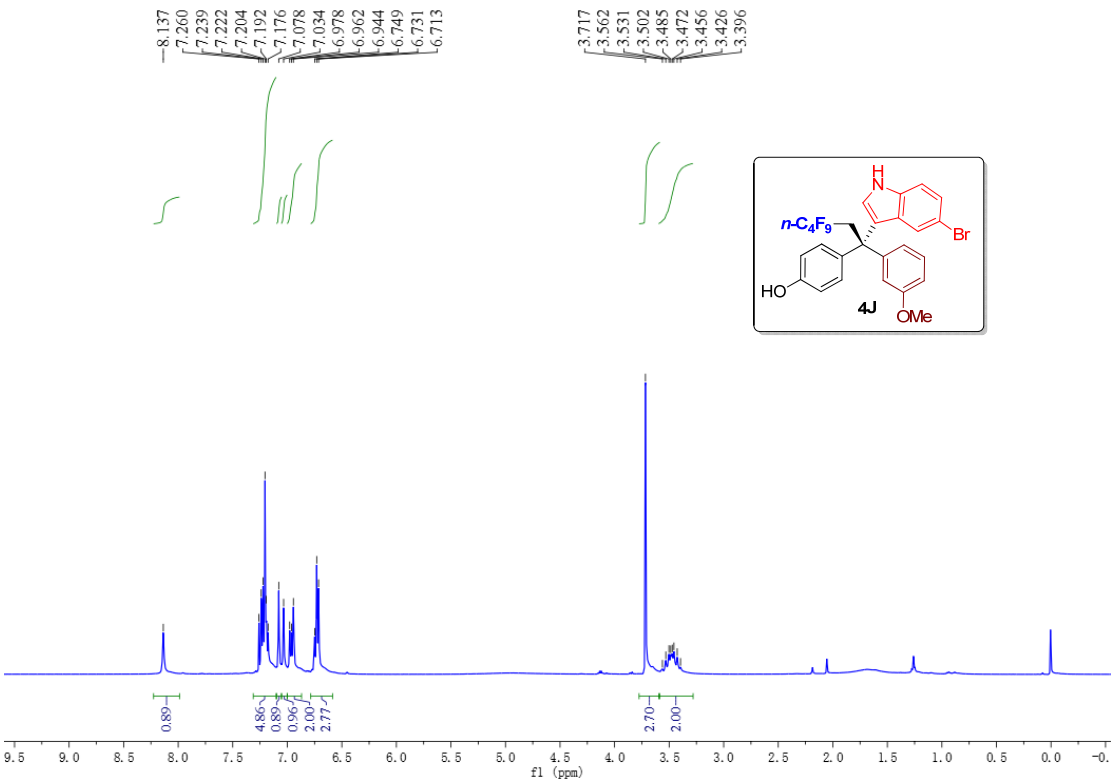
f1 (ppm)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7.204
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6.944
6.749
6.731
6.713
3.717
3.562
3.531
3.502
3.485
3.472
3.456
3.426
3.396
n-C4F9
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HO
4J
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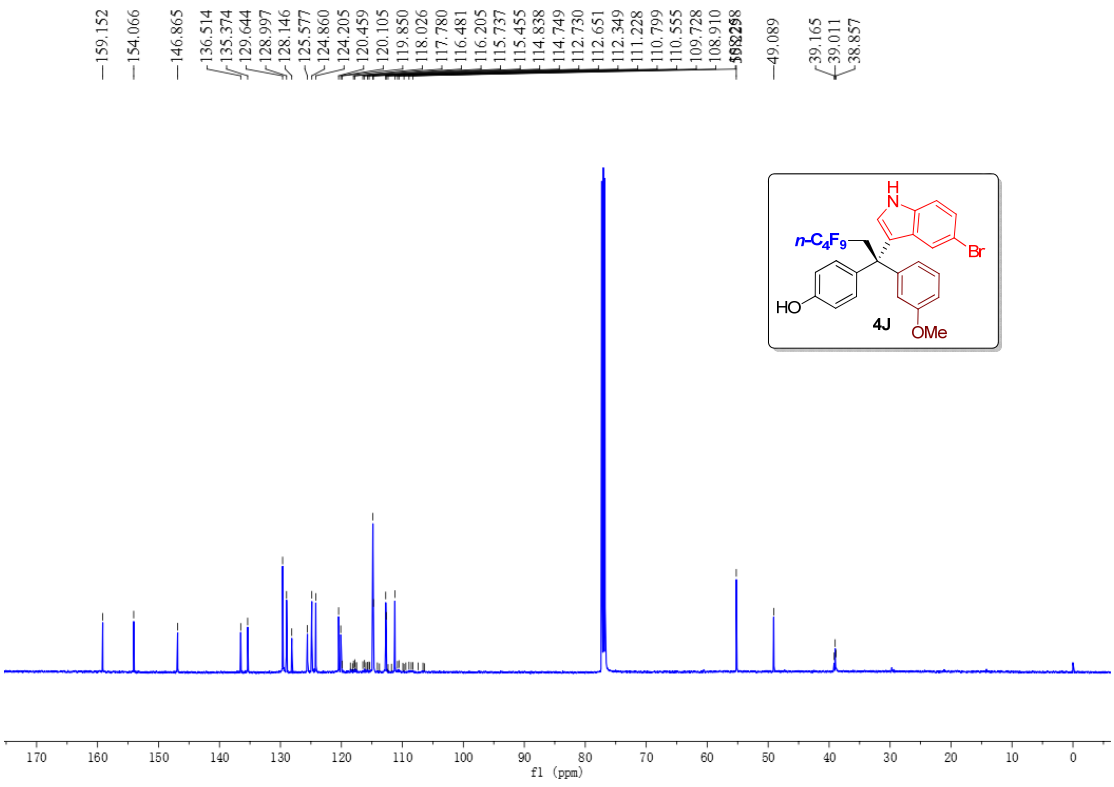
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120.105
119.850
118.026
117.780
116.481
116.205
115.737
115.455
114.838
114.749
112.730
112.651
112.349
111.228
110.799
110.555
109.728
108.910
49.089
39.165
39.011
38.857
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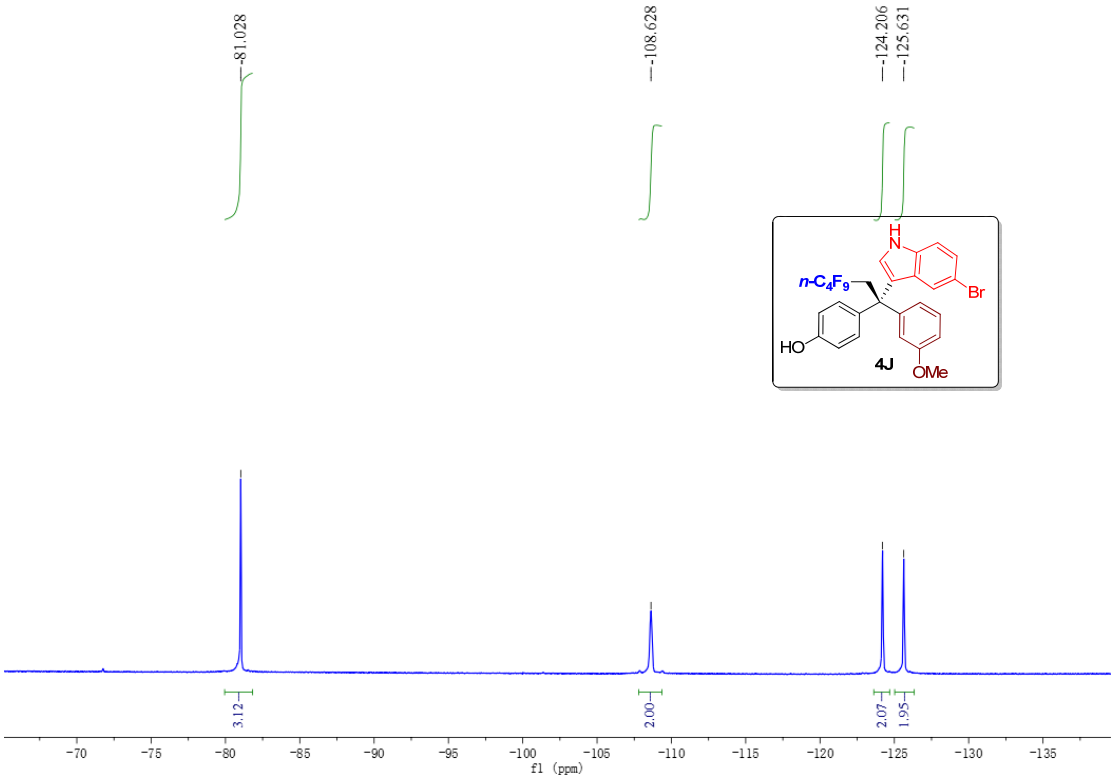
Br
HO
4J
OMe
f1 (ppm)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HO
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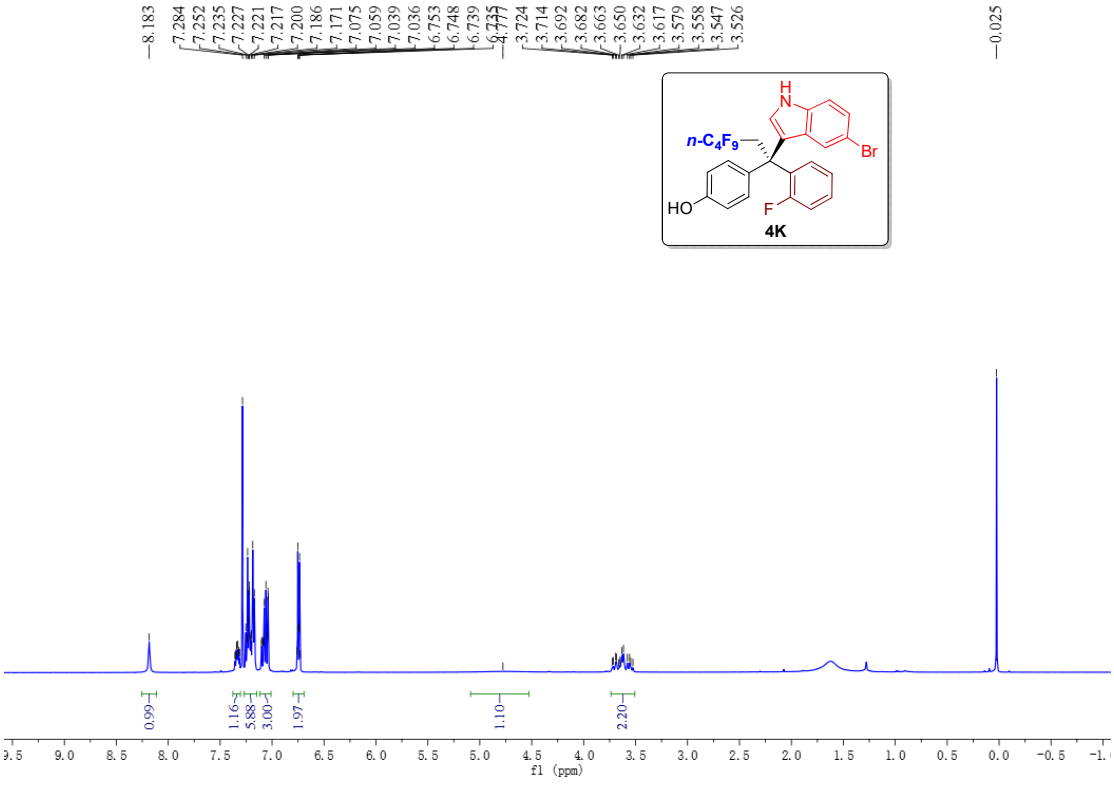
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7.200
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7.171
7.075
7.059
7.039
7.036
6.753
6.748
6.739
3.724
3.714
3.692
3.682
3.663
3.650
3.632
3.617
3.579
3.558
3.547
3.526
0.025
n-C4F9
Br
HO
F
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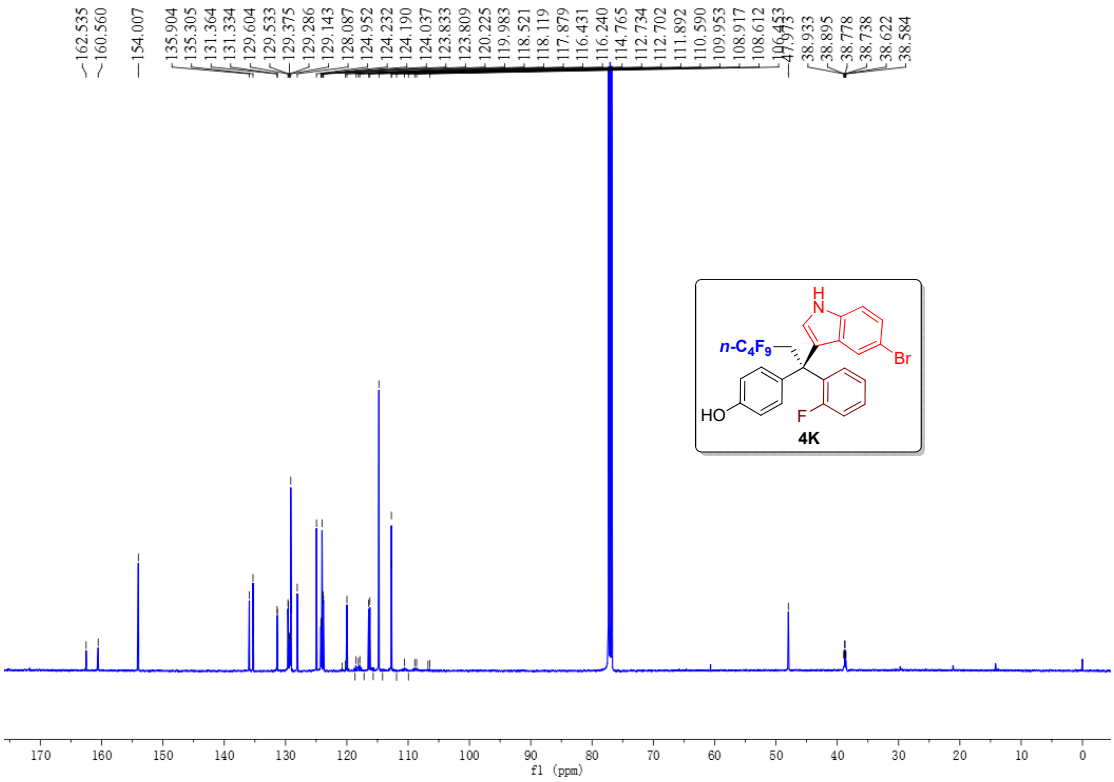
2.20
f1 (ppm)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124.952
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124.037
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123.809
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116.431
116.240
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112.734
112.702
111.892
110.590
109.953
108.917
108.612
47.973
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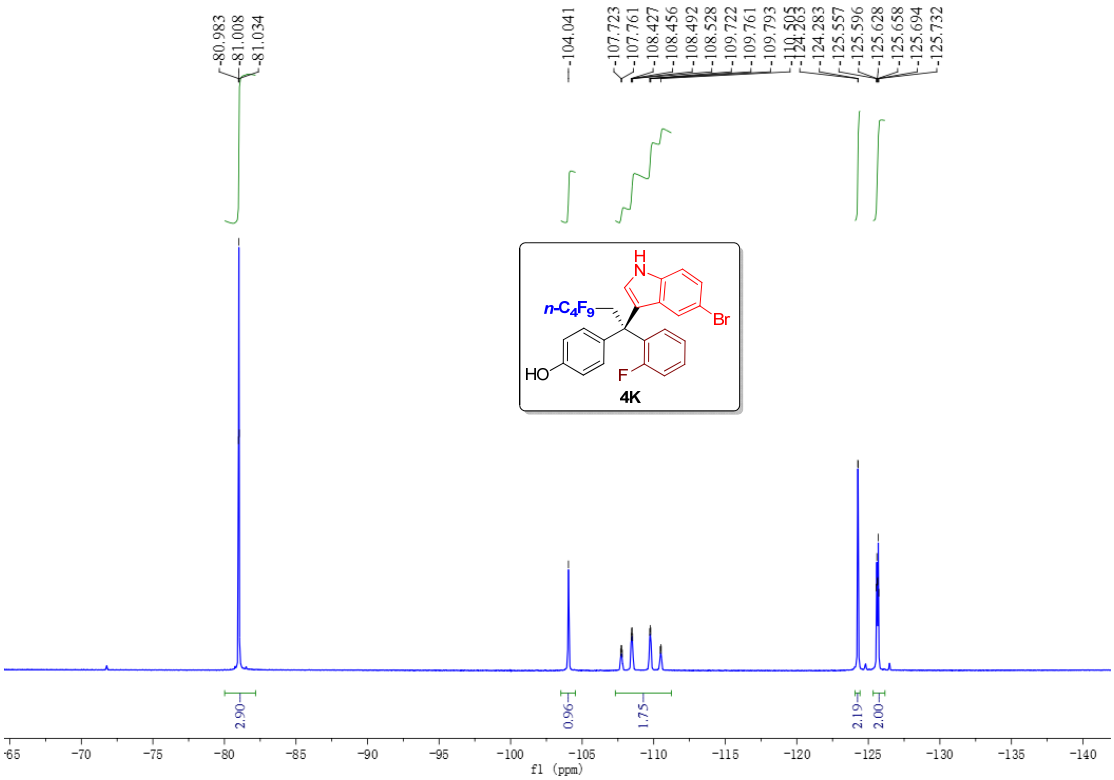
Br
HO
F
4K
f1 (ppm)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-109.761
-109.793
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-125.557
-125.596
-125.628
-125.658
-125.694
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Br
HO
F
4K
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1.75
2.19
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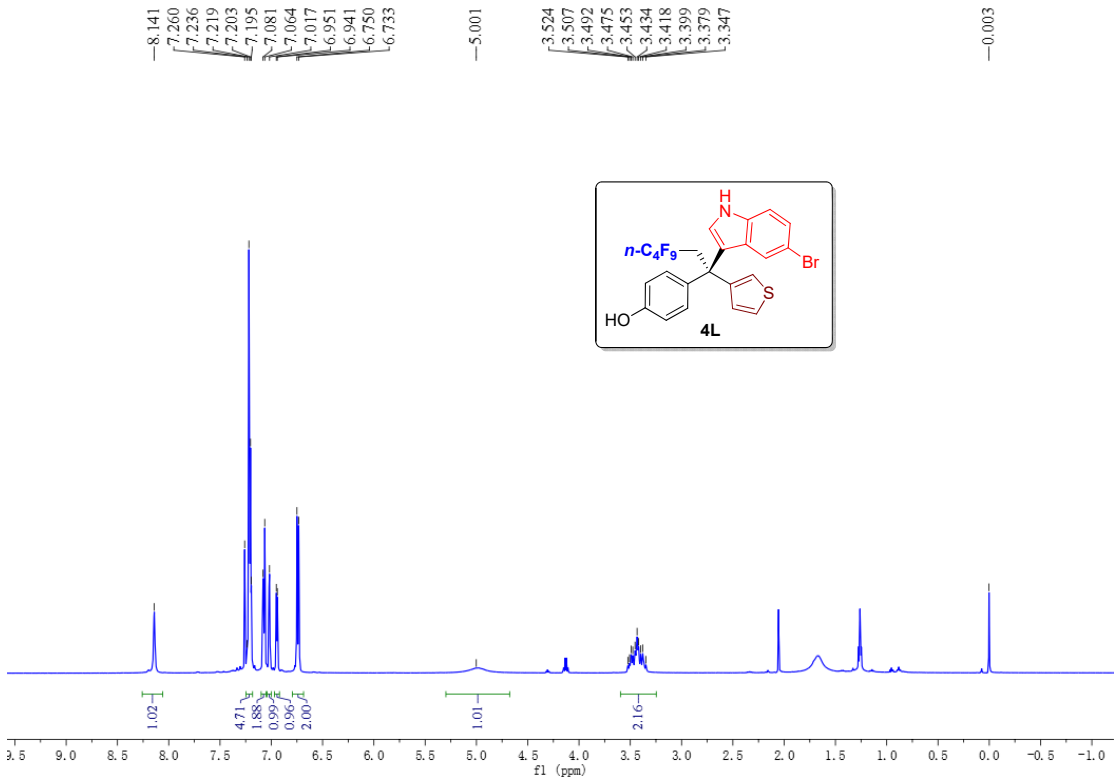
f1 (ppm)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7.236
7.219
7.203
7.195
7.081
7.064
7.017
6.951
6.941
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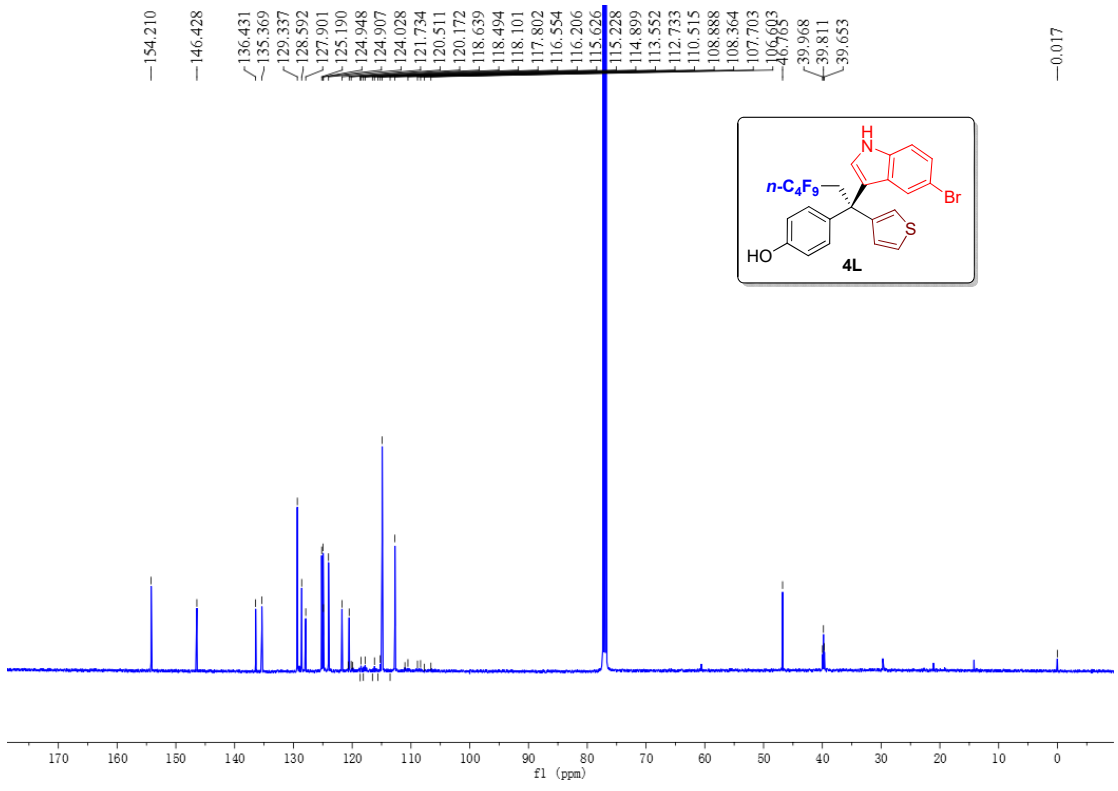
6.733
5.001
3.524
3.507
3.492
3.475
3.453
3.434
3.418
3.399
3.379
3.347
0.003
n-C4F9
Br
S
HO
4L
1.02
4.71
1.88
0.99
0.96
2.00
1.01
2.16
f1 (ppm)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125.190
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121.734
120.511
120.172
118.639
118.494
118.101
117.802
116.554
116.206
115.626
115.228
114.899
113.552
112.733
110.515
108.888
108.364
107.703
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39.811
39.653
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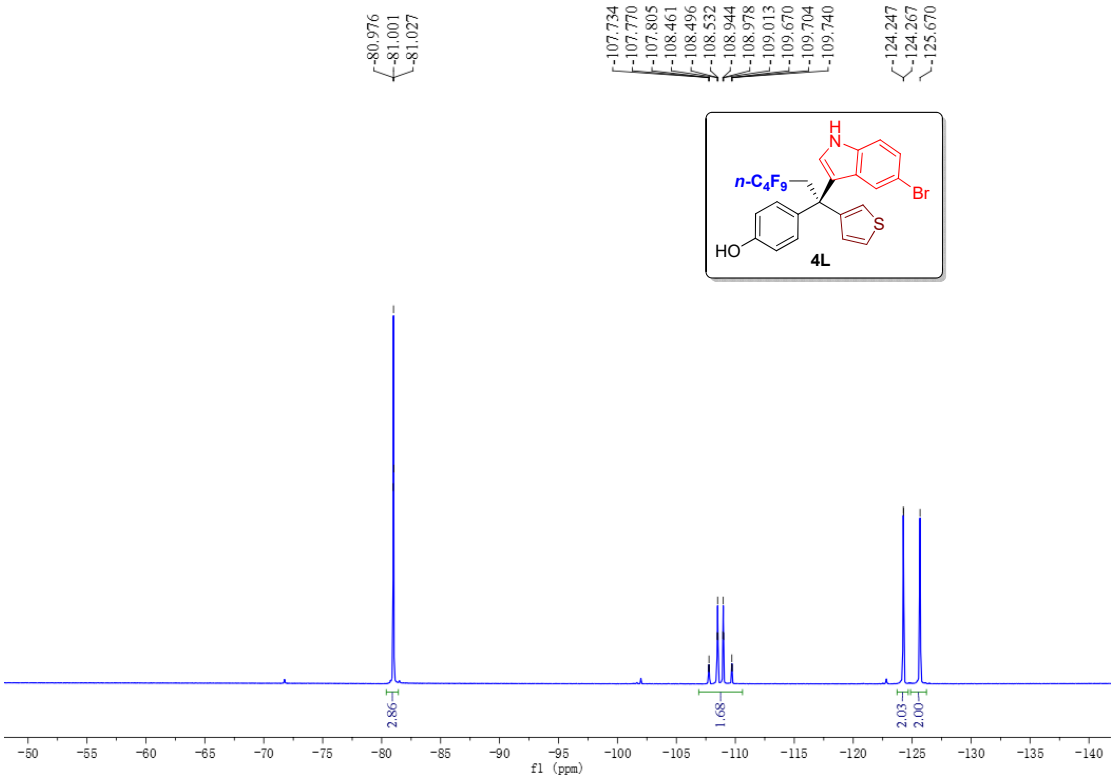
n-C4F9
Br
S
HO
4L
f1 (ppm)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-109.704
-109.740
-124.247
-124.267
-125.670
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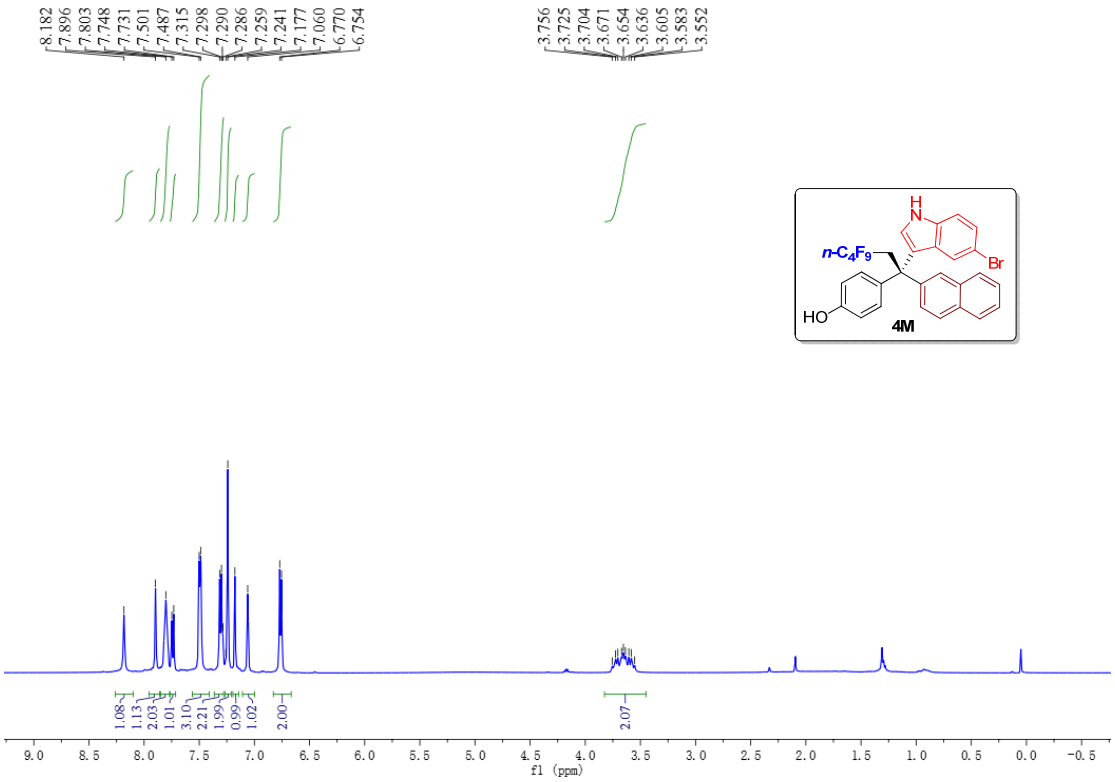
Br
HO
S
H
N
4L
2.86
1.68
2.03
2.00
f1 (ppm)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7.748
7.731
7.501
7.487
7.315
7.298
7.290
7.286
7.259
7.241
7.177
7.060
6.770
6.754
3.756
3.725
3.704
3.671
3.654
3.636
3.605
3.583
3.552
n-C4F9
Br
HO
H
N
4M
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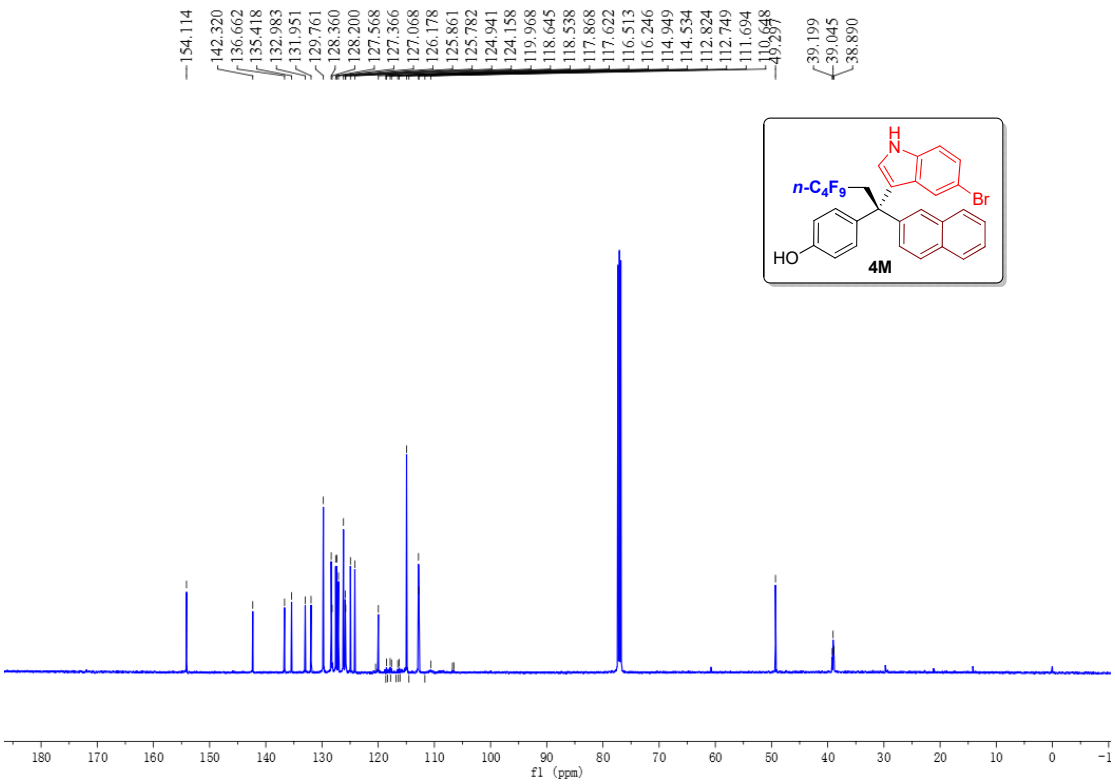
1.01
3.10
2.21
1.99
0.99
1.02
2.00
2.07
f1 (ppm)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126.178
125.861
125.782
124.941
124.158
119.968
118.645
118.538
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117.622
116.513
116.246
114.949
114.534
112.824
112.749
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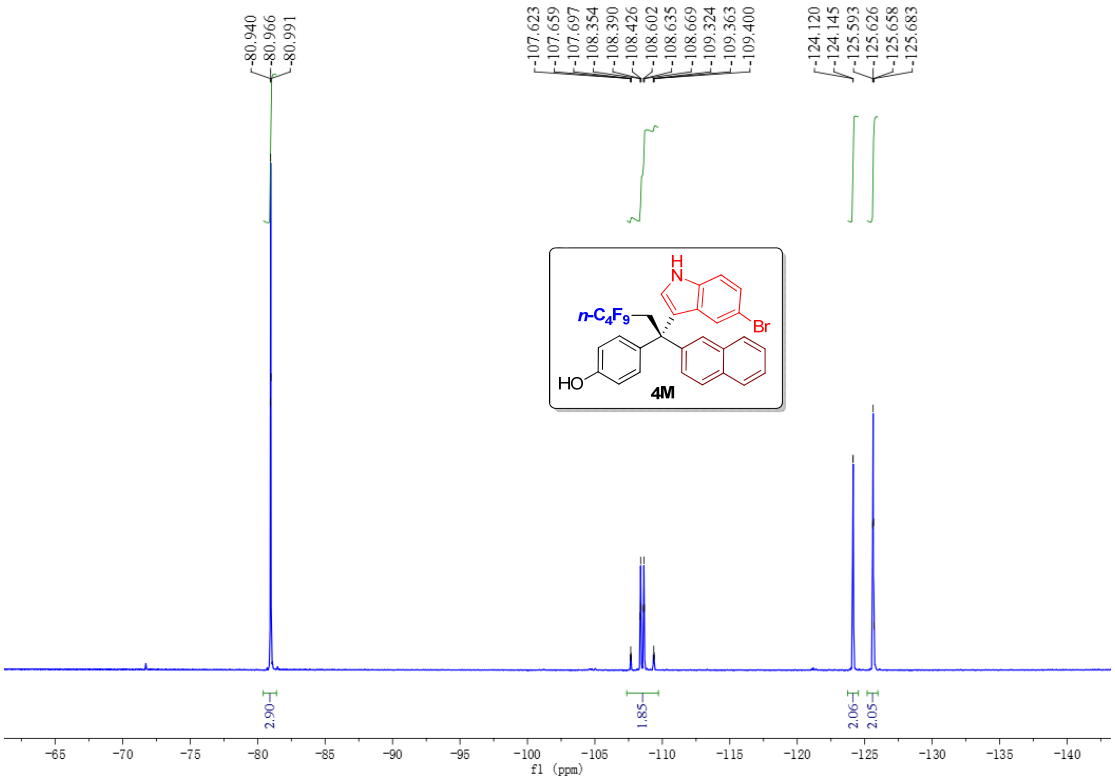
38.890
H
N
n-C4F9
Br
HO
4M
f1 (ppm)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-109.363
-109.400
-124.120
-124.145
-125.593
-125.626
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N
n-C4F9
Br
HO
4M
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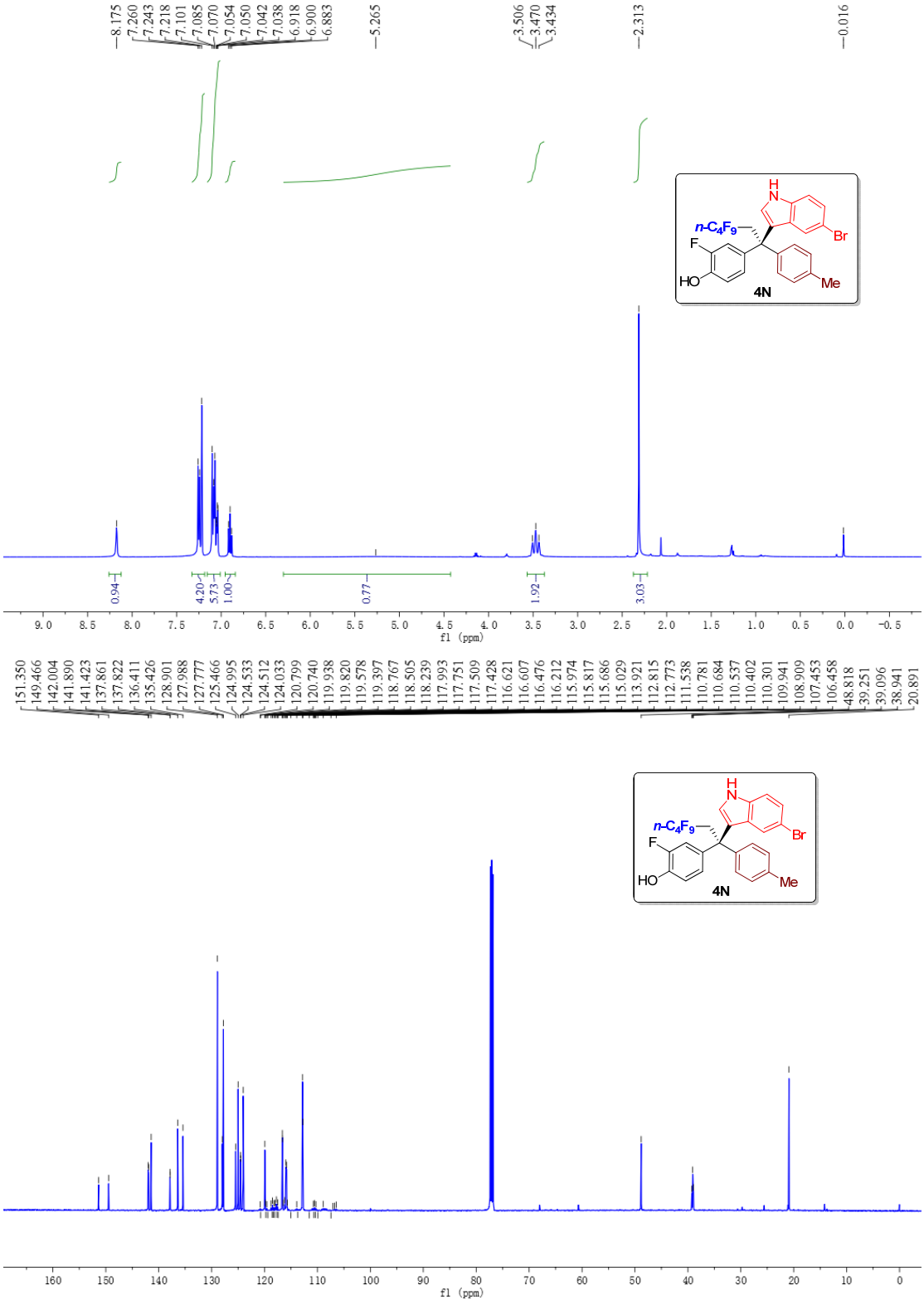
2.05
f1 (ppm)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7.218
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7.070
7.054
7.050
7.042
7.038
6.918
6.900
6.883
5.265
3.506
3.470
3.434
2.313
0.016
4N
0.94
4.20
5.73
1.00
0.77
1.92
3.03
f1 (ppm)
151.350
149.466
142.004
141.890
141.423
137.861
137.822
136.411
135.426
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127.988
127.777
125.466
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124.533
124.512
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116.476
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110.684
110.537
110.402
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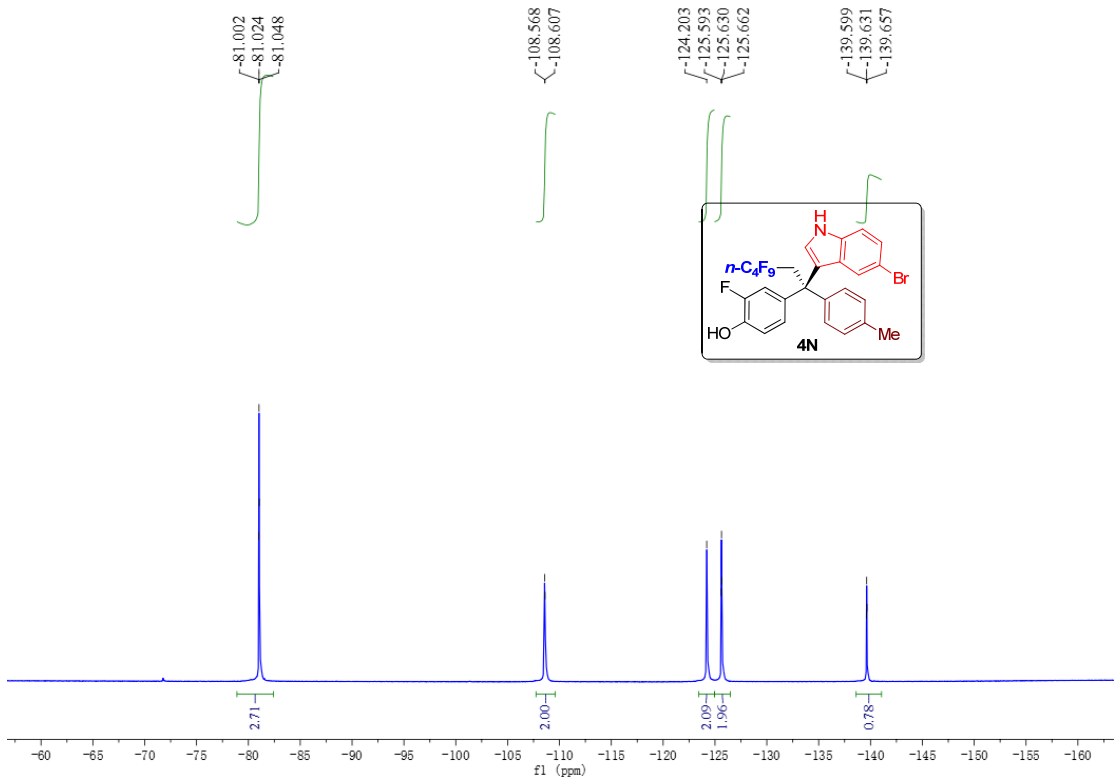
39.096
38.941
20.891
4N
f1 (ppm)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2.00
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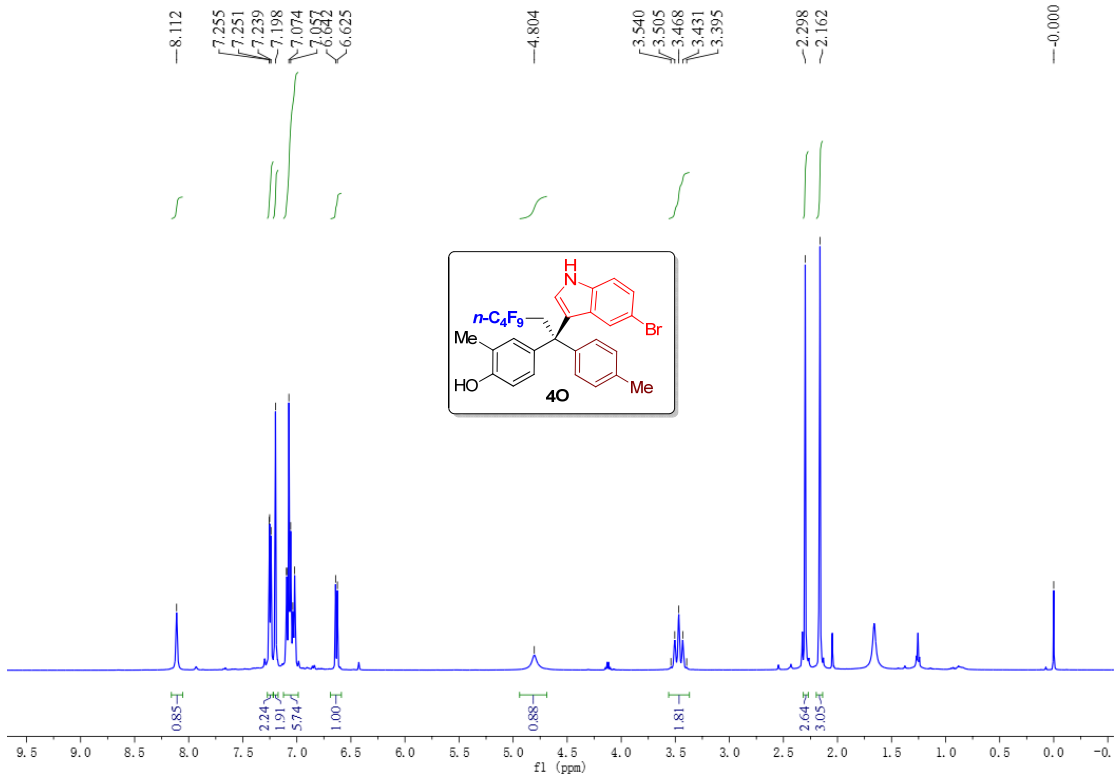
f1 (ppm)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7.251
7.239
7.198
7.074
7.057
7.042
6.625
4.804
3.540
3.505
3.468
3.431
3.395
2.298
2.162
0.000
4O
0.85
2.24
1.91
5.74
1.00
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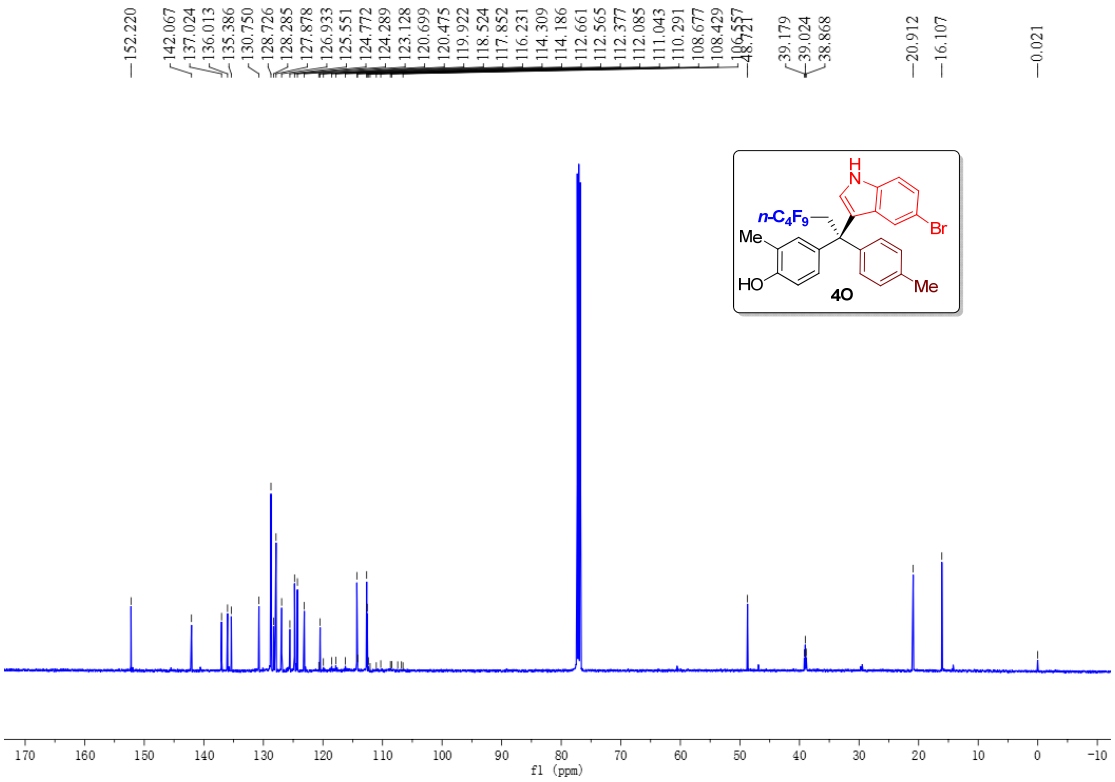
1.81
2.64
3.05
f1 (ppm)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124.289
123.128
120.699
120.475
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117.852
116.231
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114.186
112.661
112.565
112.377
112.085
111.043
110.291
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108.429
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48.721
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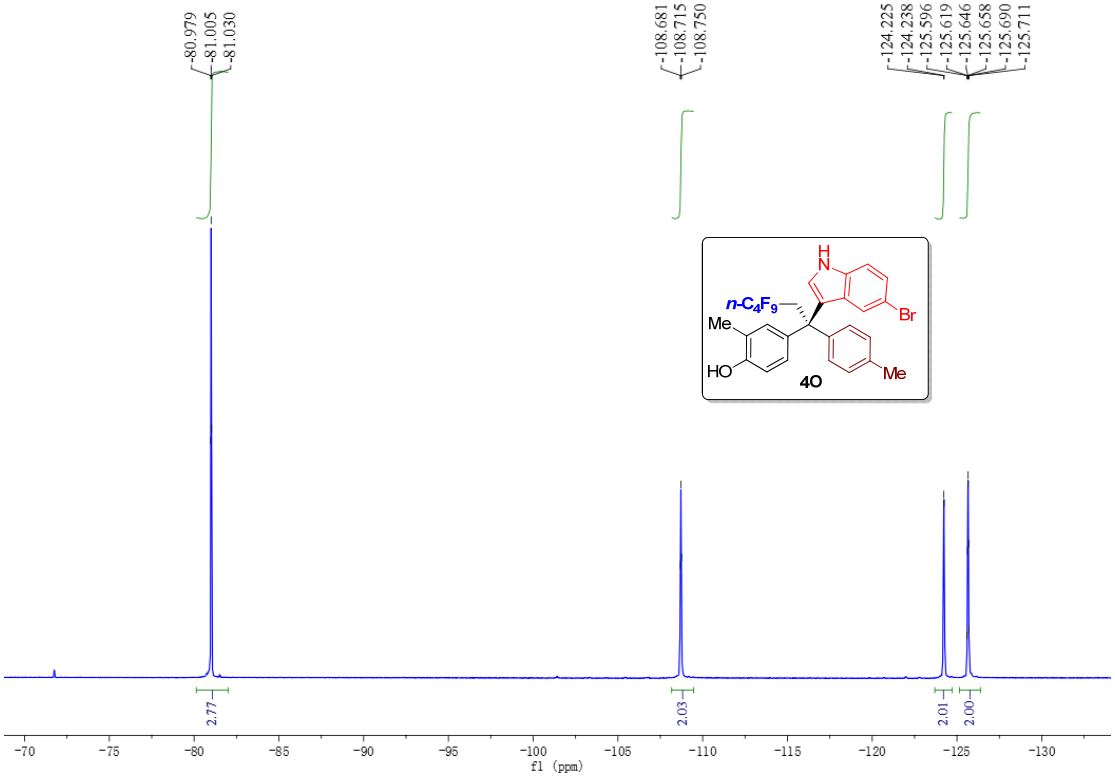
Me
HO
Br
Me
4O
f1 (ppm)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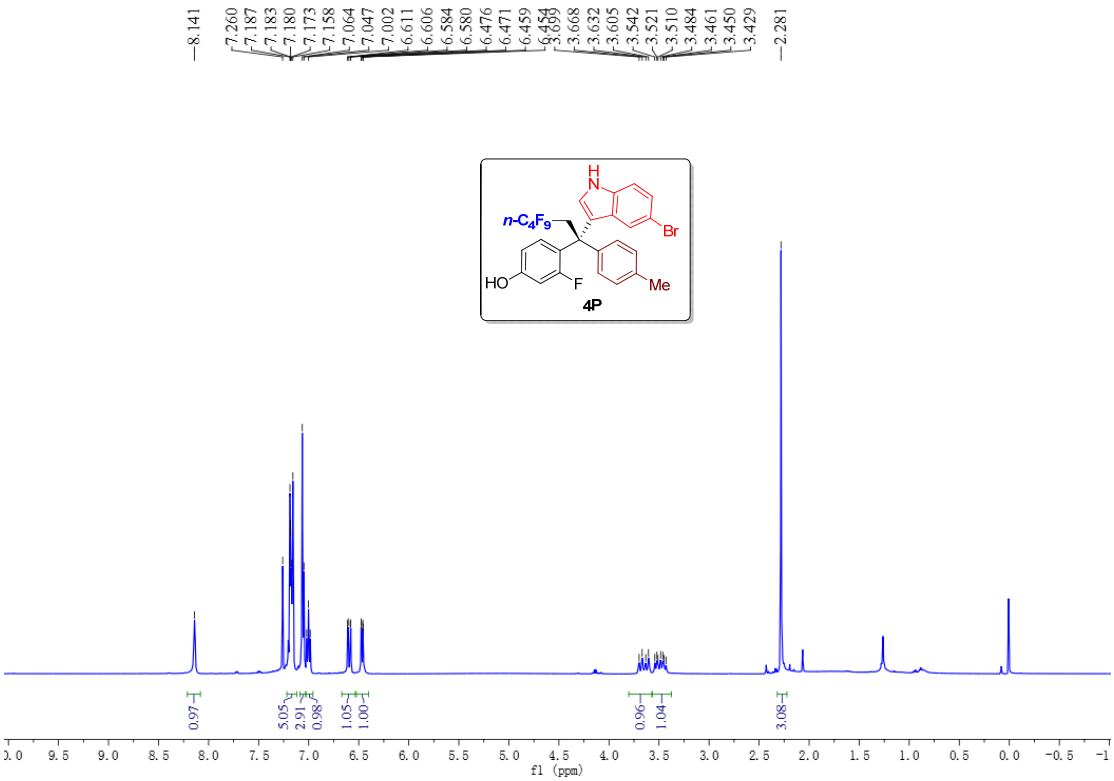
n-C4F9
Me
HO
Br
Me
4O
2.77
2.03
2.01
2.00
f1 (ppm)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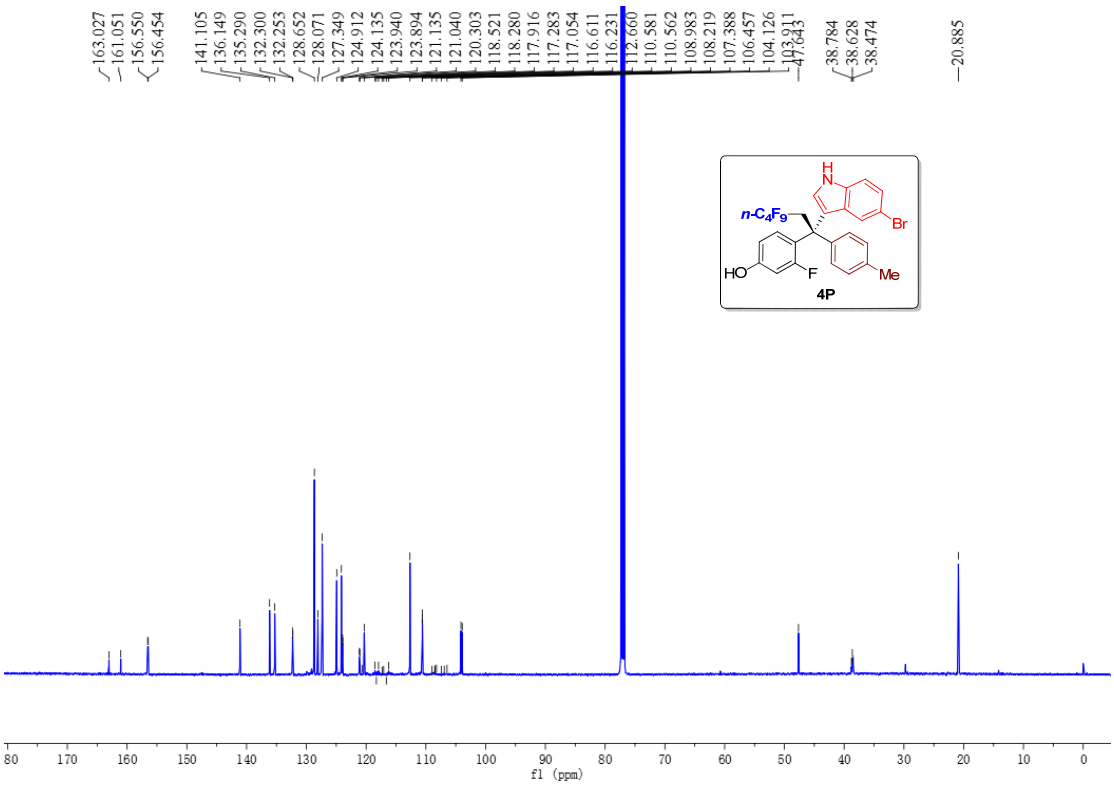
7.183
7.180
7.173
7.158
7.064
7.047
7.002
6.611
6.606
6.584
6.580
6.476
6.471
6.459
6.454
3.699
3.668
3.632
3.605
3.542
3.521
3.510
3.484
3.461
3.450
3.429
2.281
n-C4F9
Br
HO
F
Me
4P
0.97
5.05
2.91
0.98
1.05
1.00
0.96
1.04
3.08
f1 (ppm)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135.290
132.300
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128.071
127.349
124.912
124.135
123.940
123.894
121.135
121.040
120.303
118.521
118.280
117.916
117.283
117.054
116.611
116.231
112.660
110.581
110.562
108.983
108.219
107.388
106.457
104.126
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47.043
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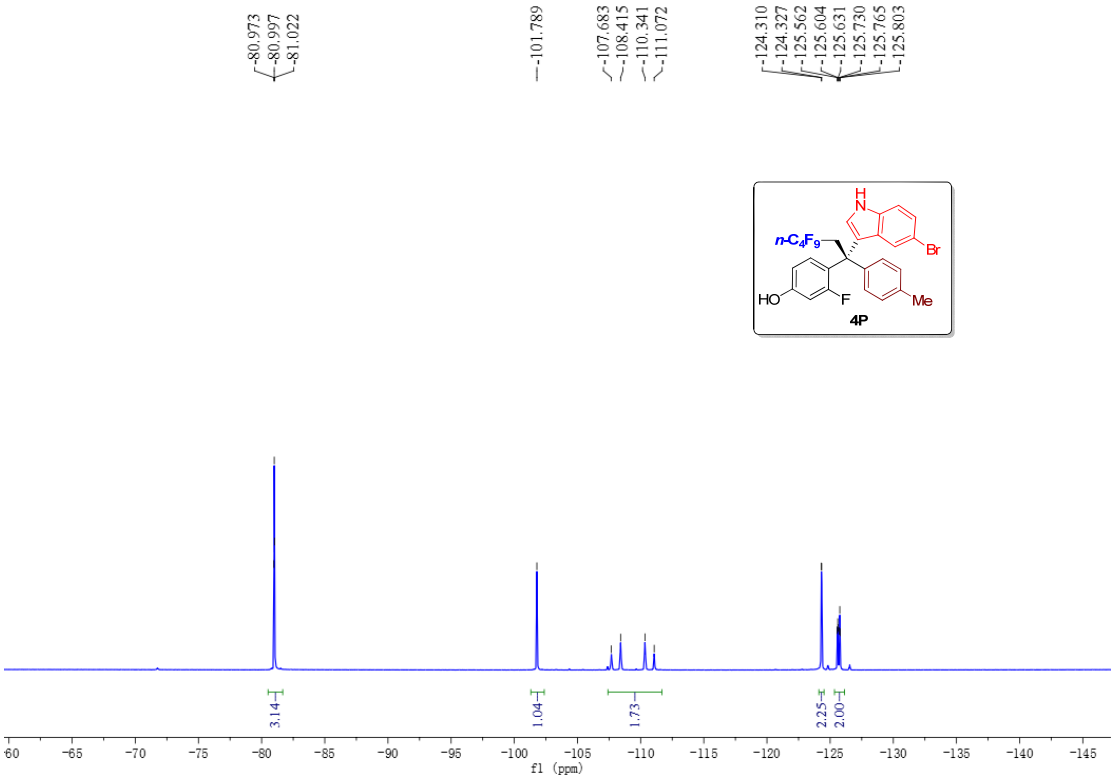
n-C4F9
Br
HO
F
Me
4P
f1 (ppm)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-124.327
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-125.604
-125.631
-125.730
-125.765
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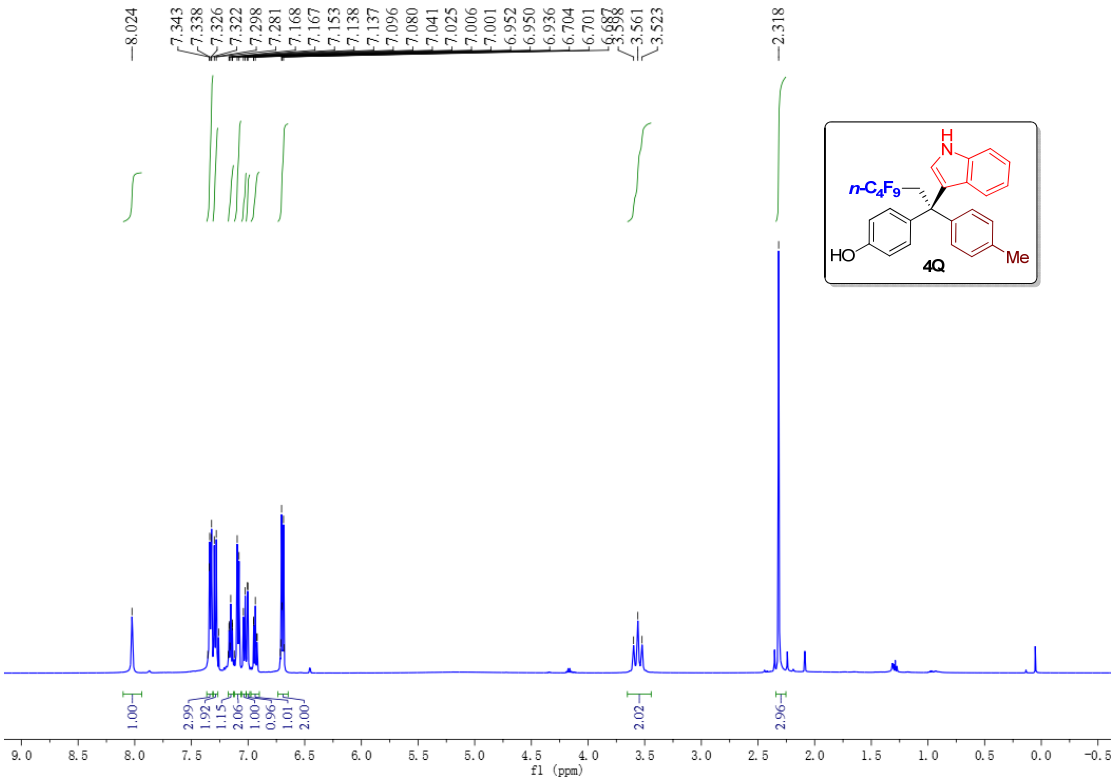
n-C4F9
Br
HO
F
Me
4P
3.14
1.04
1.73
2.25
2.00
f1 (ppm)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7.298
7.281
7.168
7.167
7.153
7.138
7.137
7.096
7.080
7.041
7.025
7.006
7.001
6.952
6.950
6.936
6.704
6.701
3.561
3.523
2.318
n-C4F9
HO
Me
4Q
1.00
2.99
1.92
1.15
2.06
1.00
0.96
1.01
2.00
2.02
2.96
f1 (ppm)


153.819
142.357
137.300
136.824
135.921
129.816
128.647
128.102
126.405
124.124
121.999
121.820
121.073
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113.988
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110.643
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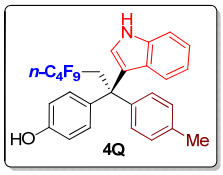
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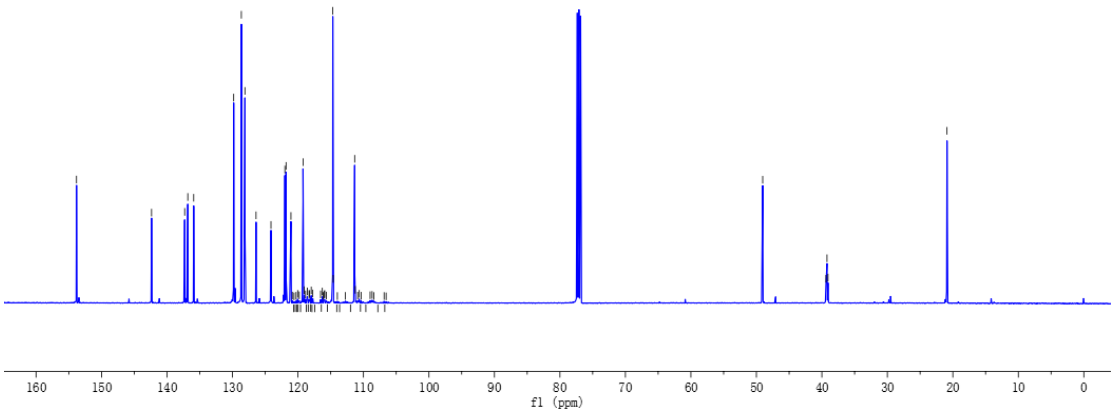
HO
Me
4Q


160
150
140
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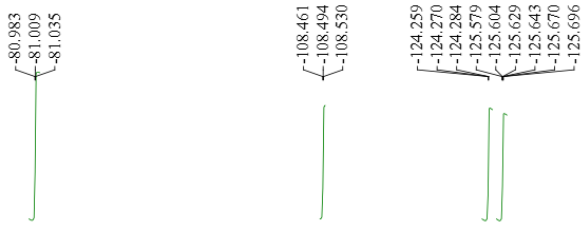
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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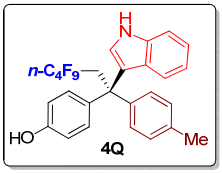
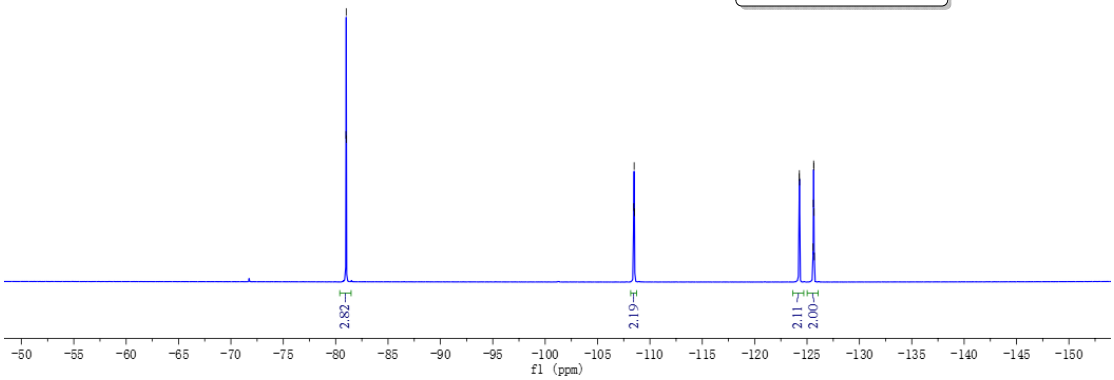
-125.696


n-C4F9
HO
Me
4Q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2.11
2.00
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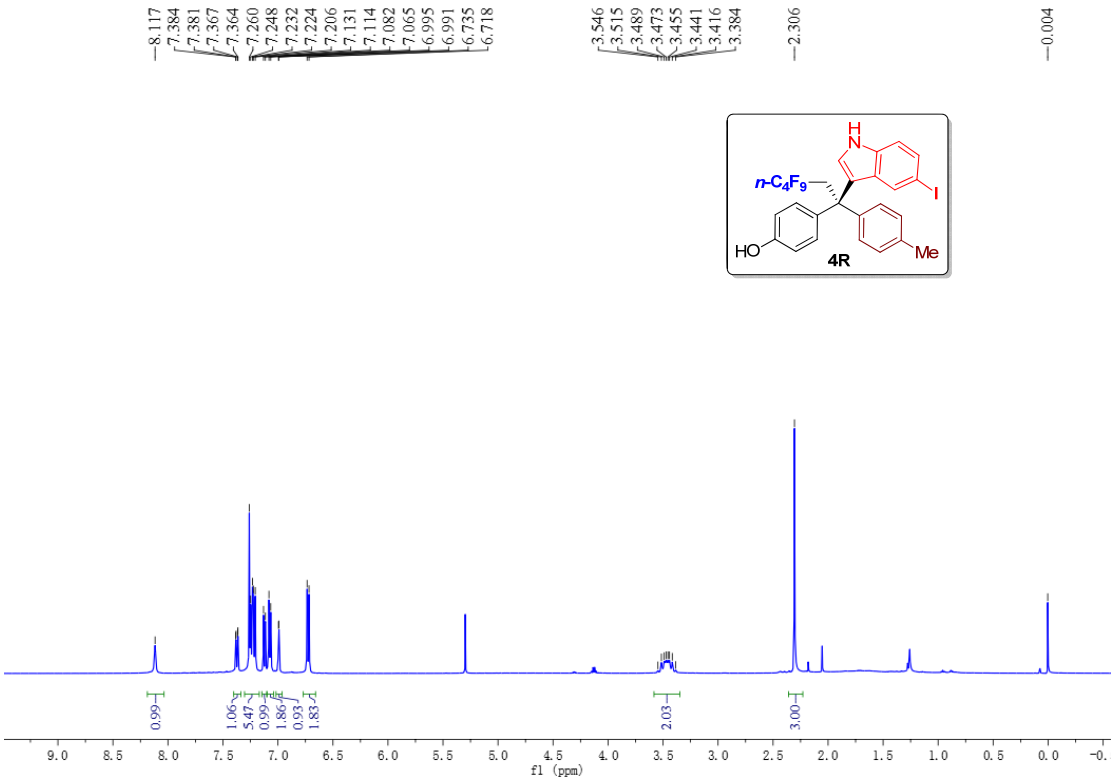
-55
-60
-65
-70
-75
-80
-85
-90
-95
-100
-105
-110
-115
-120
-125
-130
-135
-140
-145
-150
f1 (ppm)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7.232
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7.082
7.065
6.995
6.991
6.735
6.718
3.546
3.515
3.489
3.473
3.455
3.441
3.416
3.384
2.306
0.004
n-C4F9
I
HO
Me
4R
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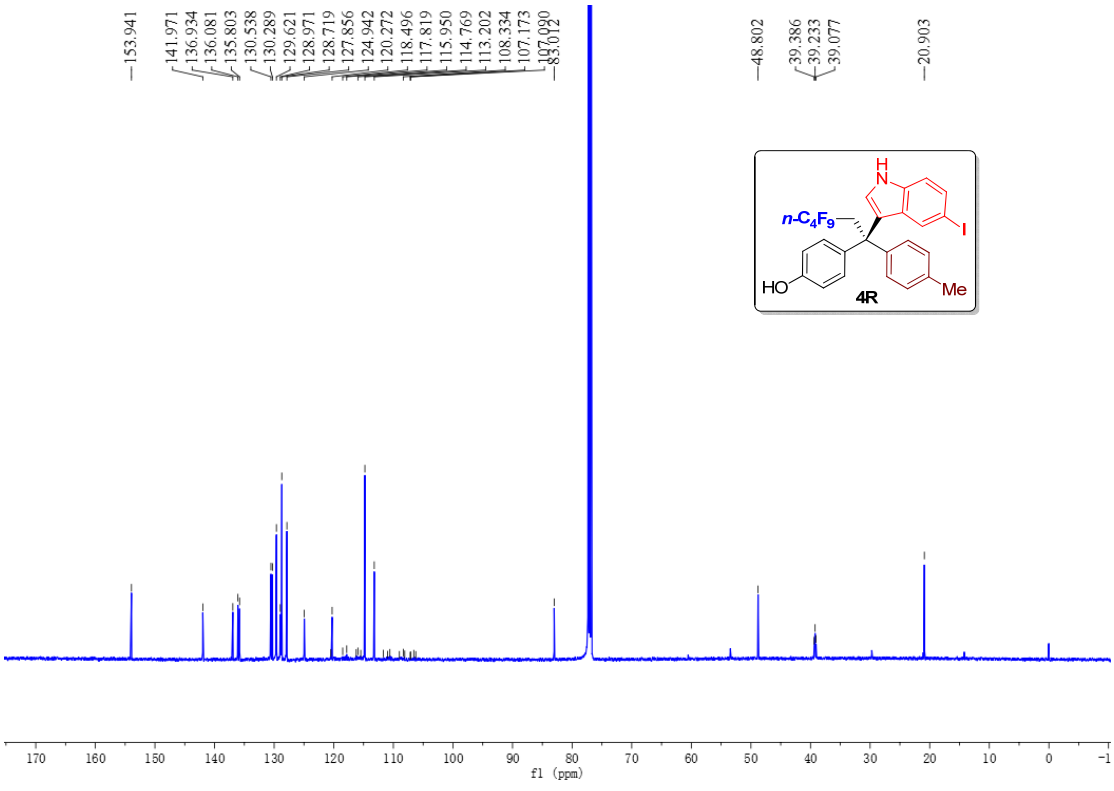
0.93
1.83
2.03
3.00
f1 (ppm)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115.950
114.769
113.202
108.334
107.173
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39.386
39.233
39.077
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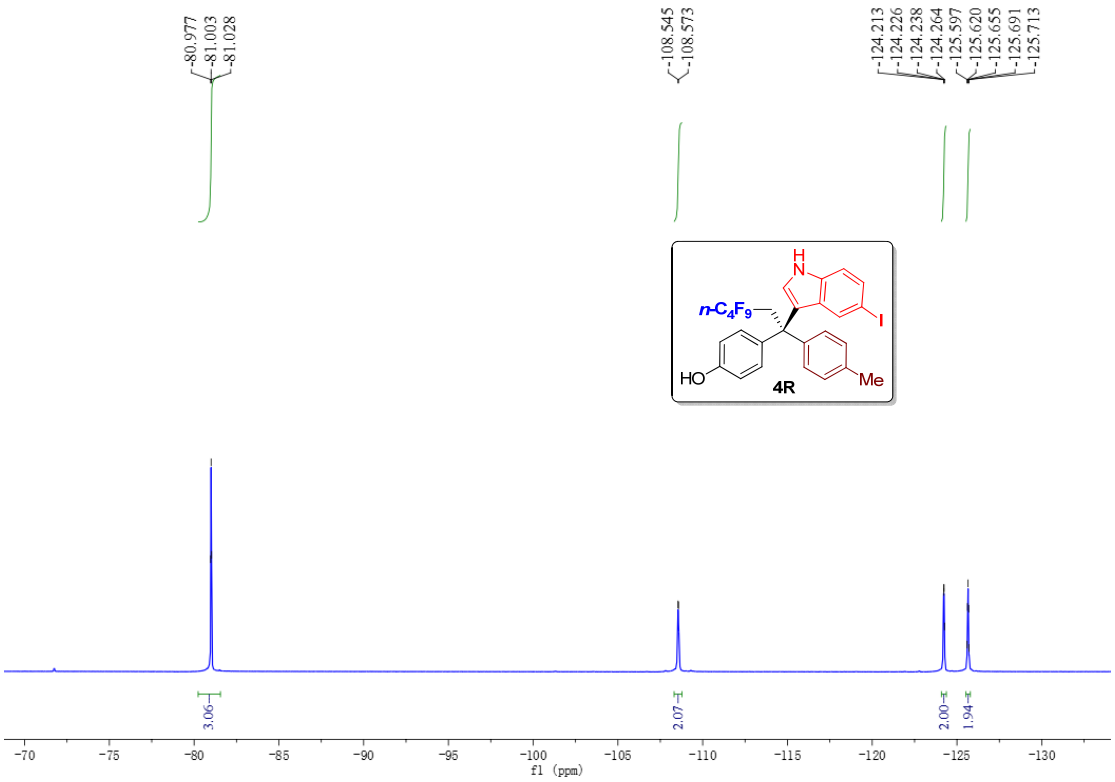
I
HO
Me
4R
f1 (ppm)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-125.620
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HO
Me
4R
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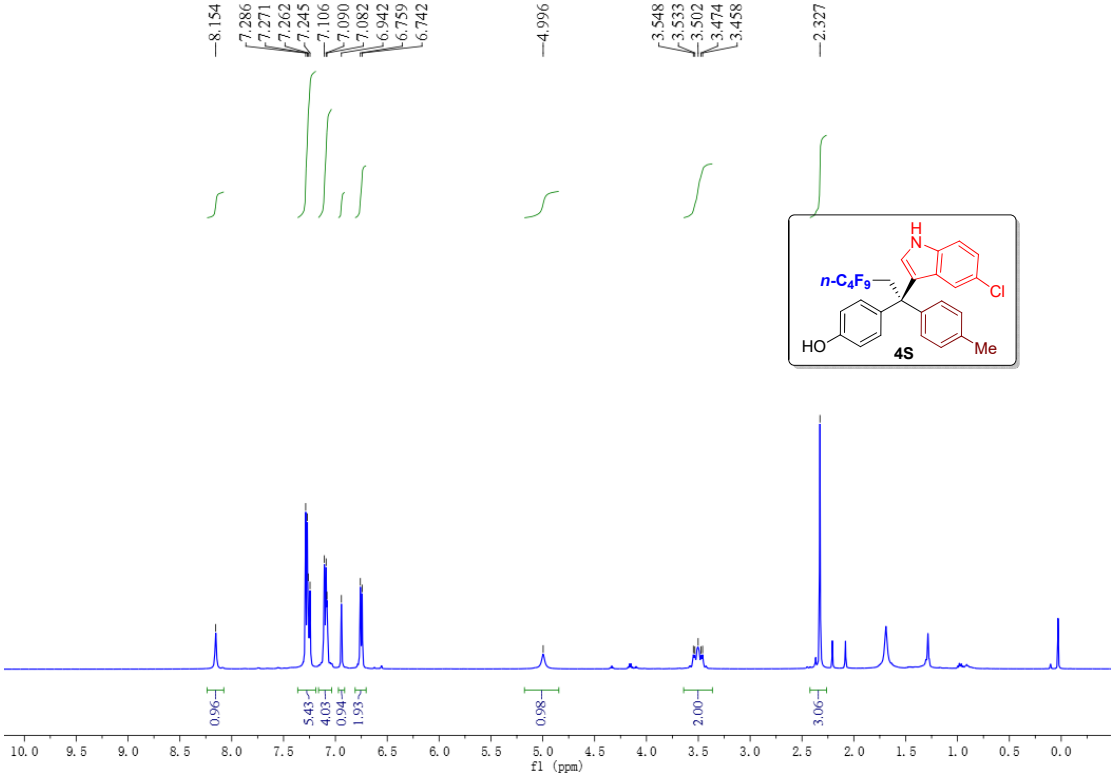
2.07
2.00
1.94
f1 (ppm)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7.082
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6.742
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3.533
3.502
3.474
3.458
2.327
n-C4F9
HO
Cl
Me
4S
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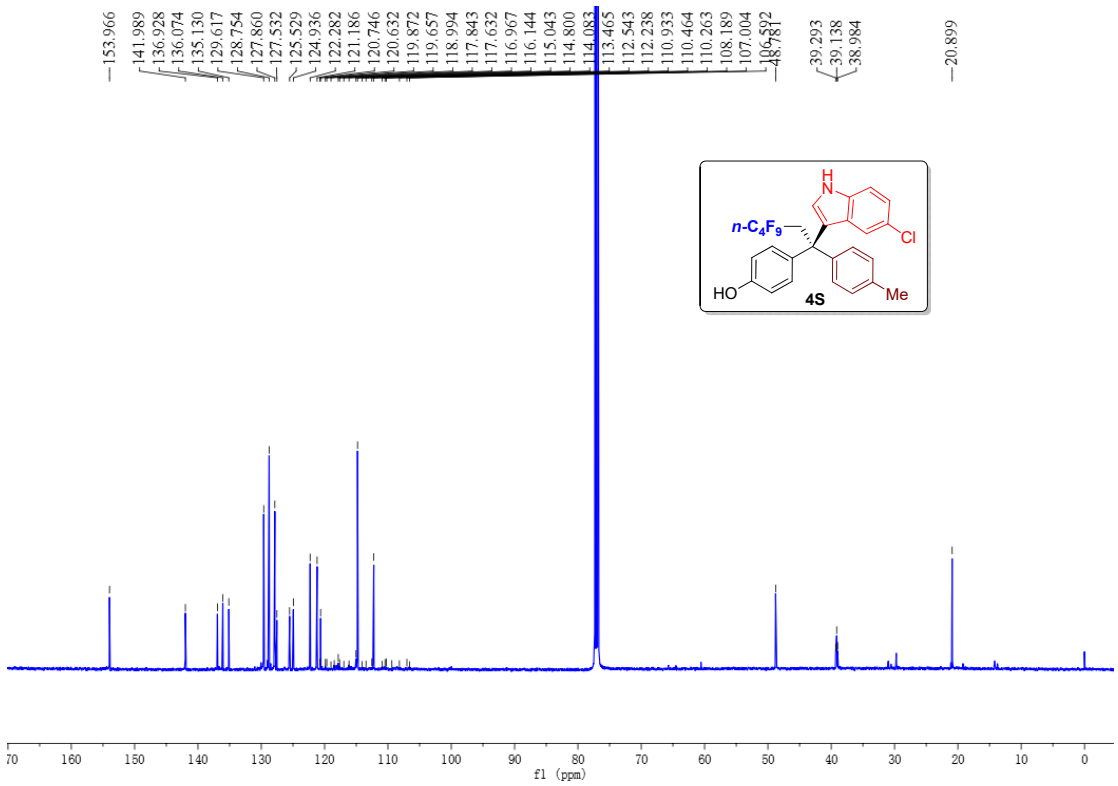
3.06
f1 (ppm)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110.263
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106.502
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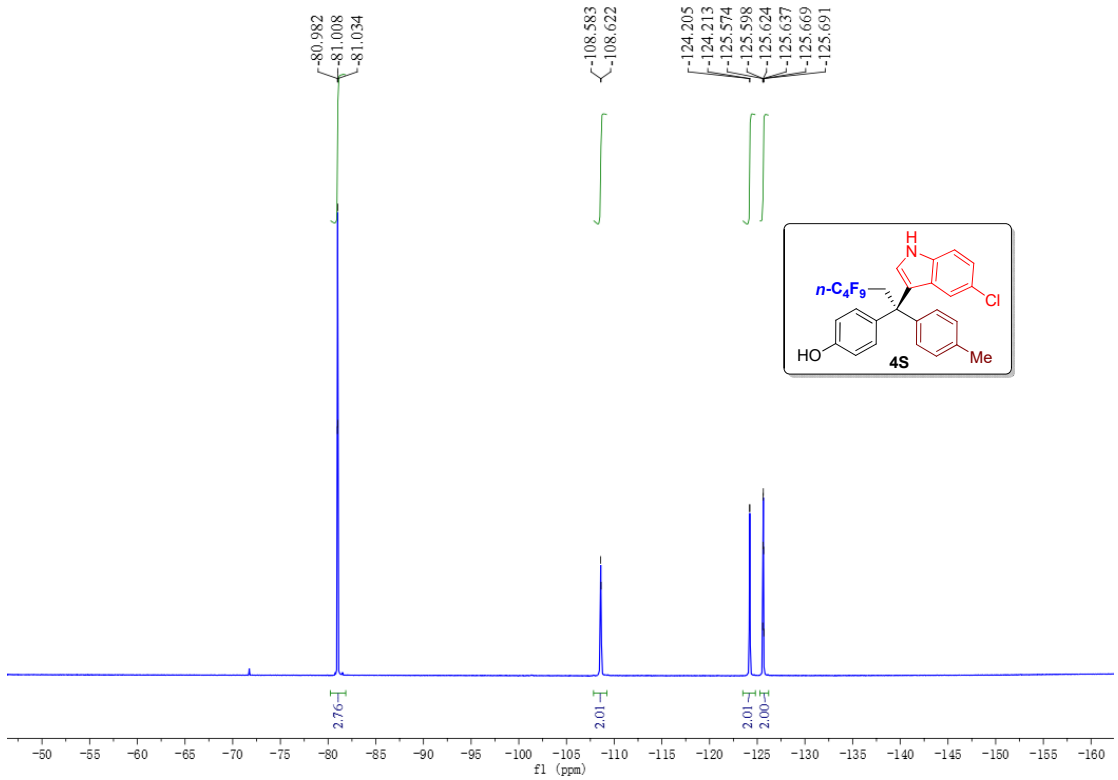
N
n-C4F9
Cl
HO
Me
4S
f1 (ppm)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-125.637
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N
n-C4F9
Cl
HO
Me
4S
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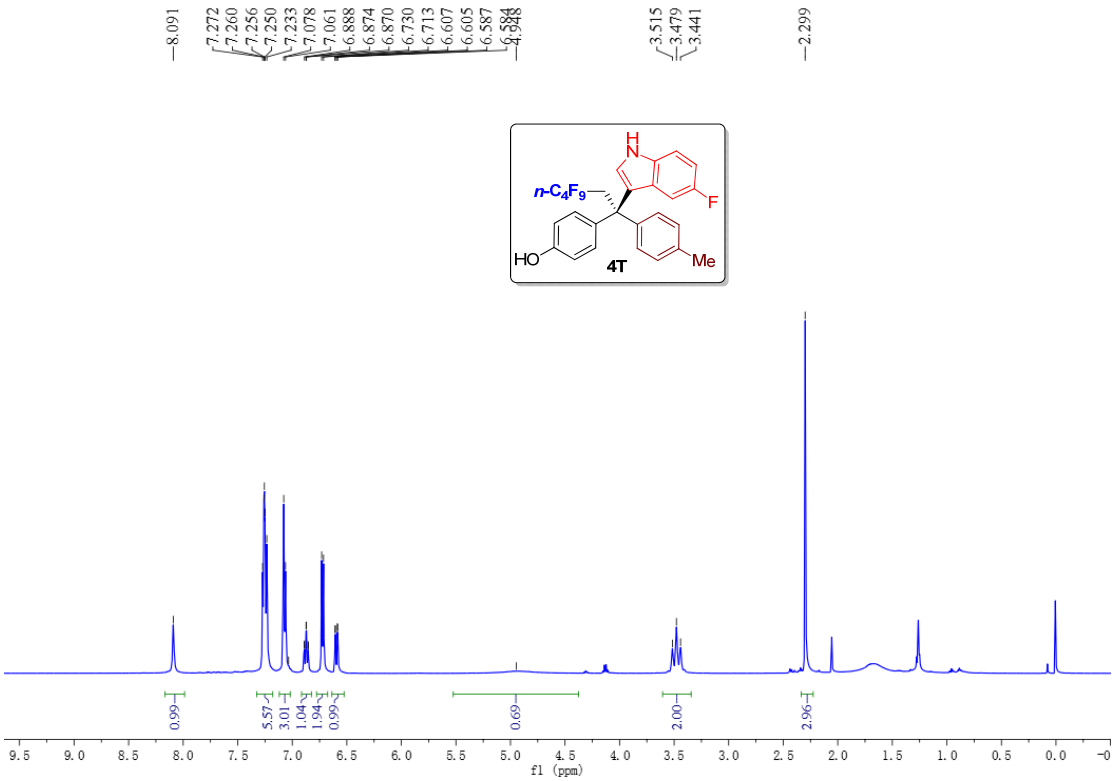
2.01
2.00
f1 (ppm)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6.607
6.605
6.587
6.584
4.948
3.515
3.479
3.441
2.299
n-C4F9
F
HO
Me
4T
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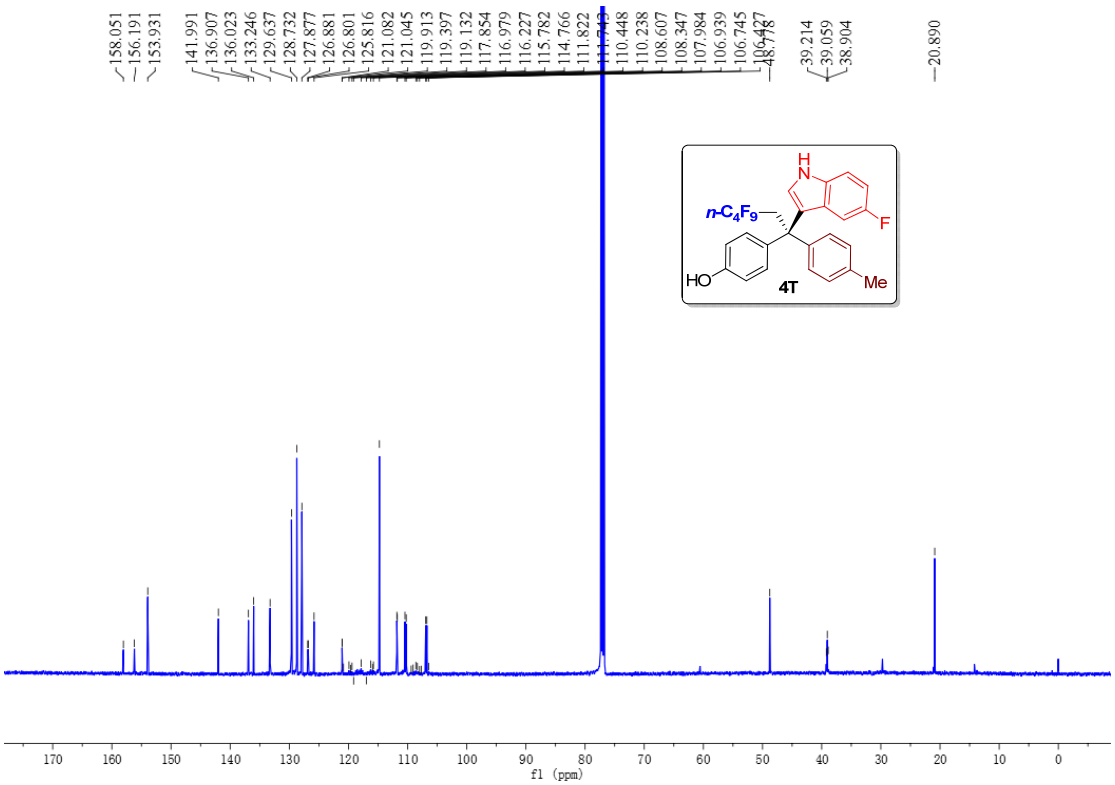
1.04
1.94
0.99
0.69
2.00
2.96
f1 (ppm)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108.347
107.984
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39.059
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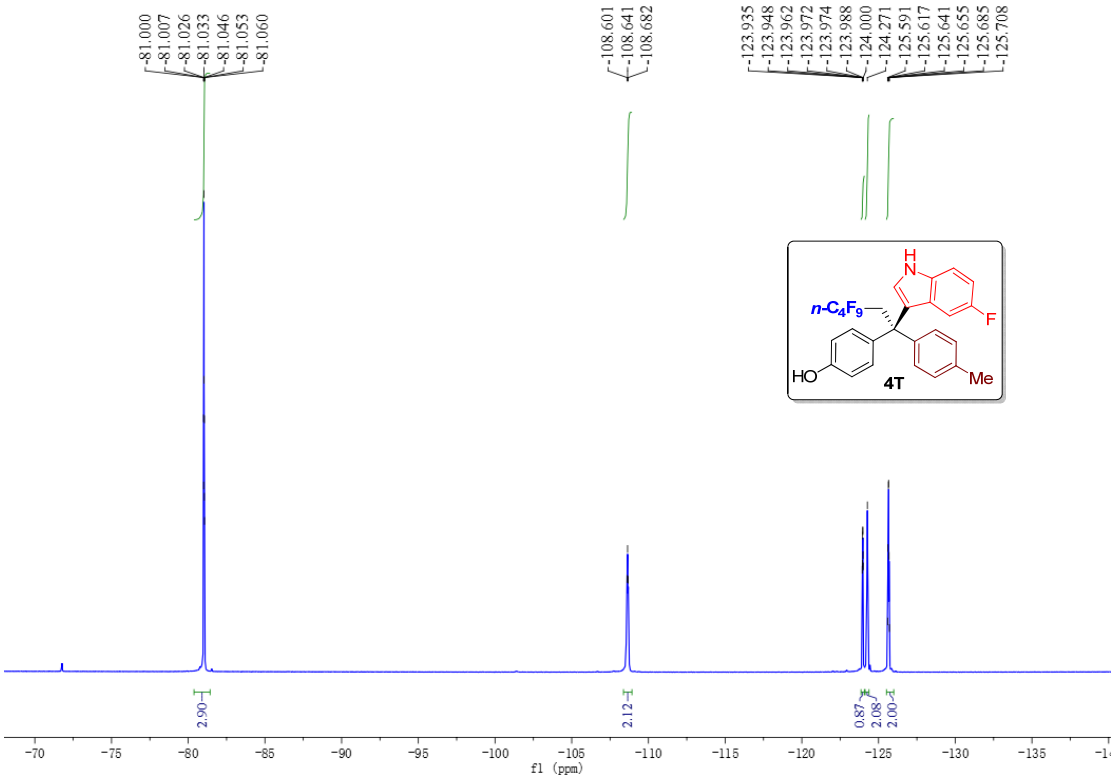
F
HO
Me
4T
f1 (ppm)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-125.617
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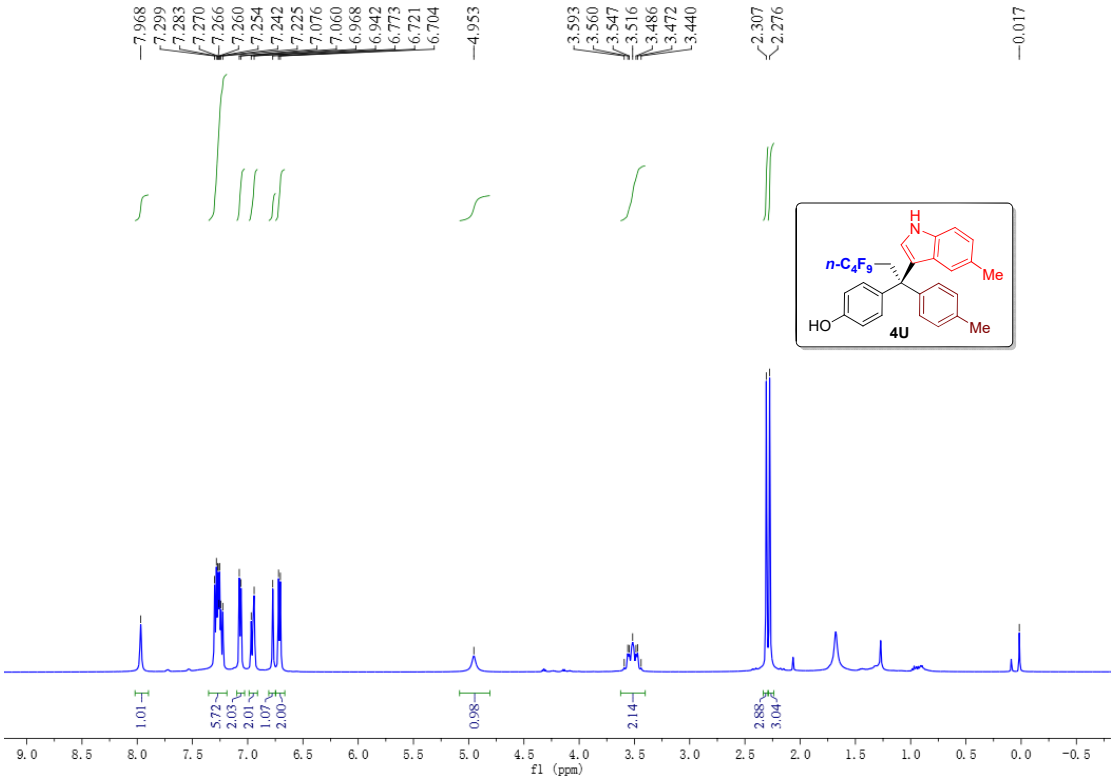
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7.076
7.060
6.968
6.942
6.773
6.721
6.704
4.953
3.593
3.560
3.547
3.516
3.486
3.472
3.440
2.307
2.276
0.017
n-C4F9
Me
HO
Me
4U
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2.01
1.07
2.00
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2.14
2.88
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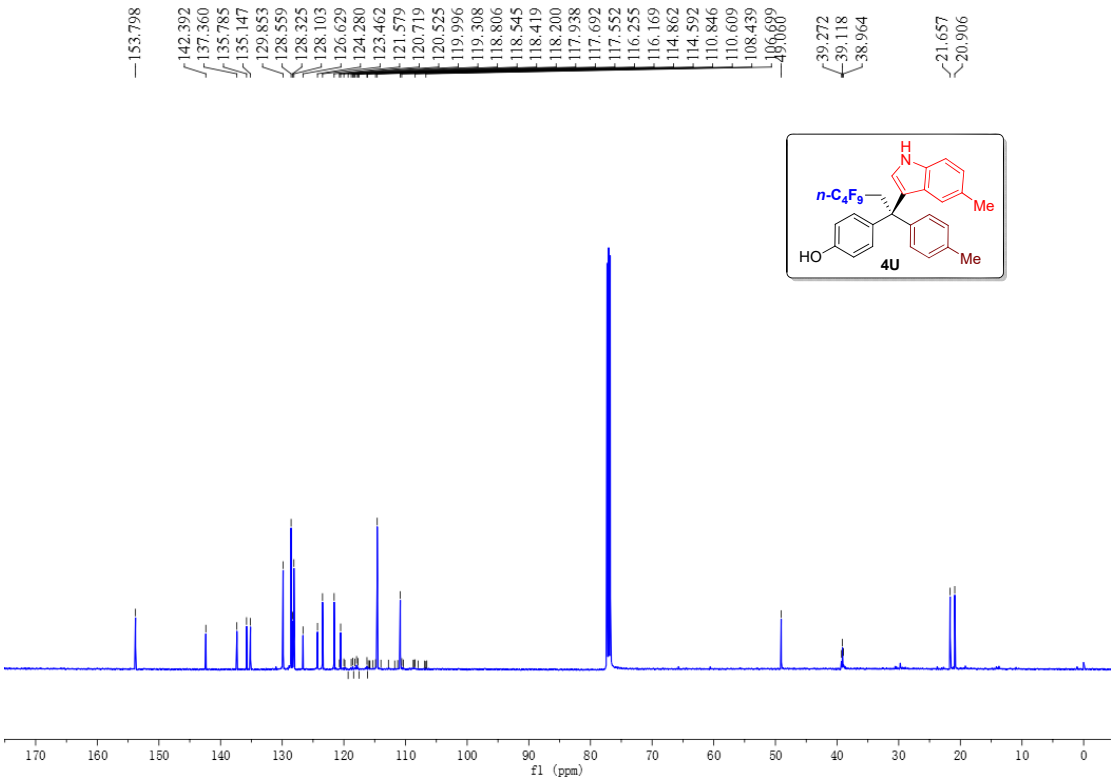
f1 (ppm)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120.719
120.525
119.996
119.308
118.806
118.545
118.419
118.200
117.938
117.692
117.552
116.255
116.169
114.862
114.592
110.846
110.609
108.439
106.689
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39.118
38.964
21.657
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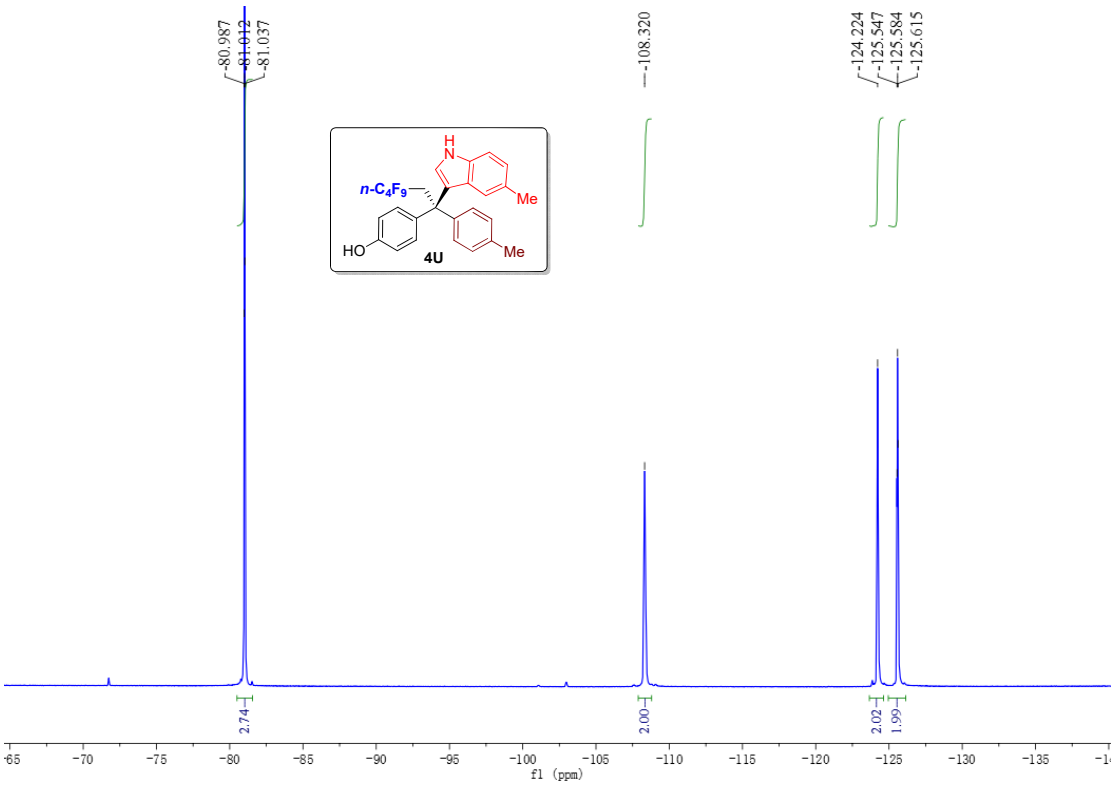
Me
HO
Me
4U
f1 (ppm)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HO
Me
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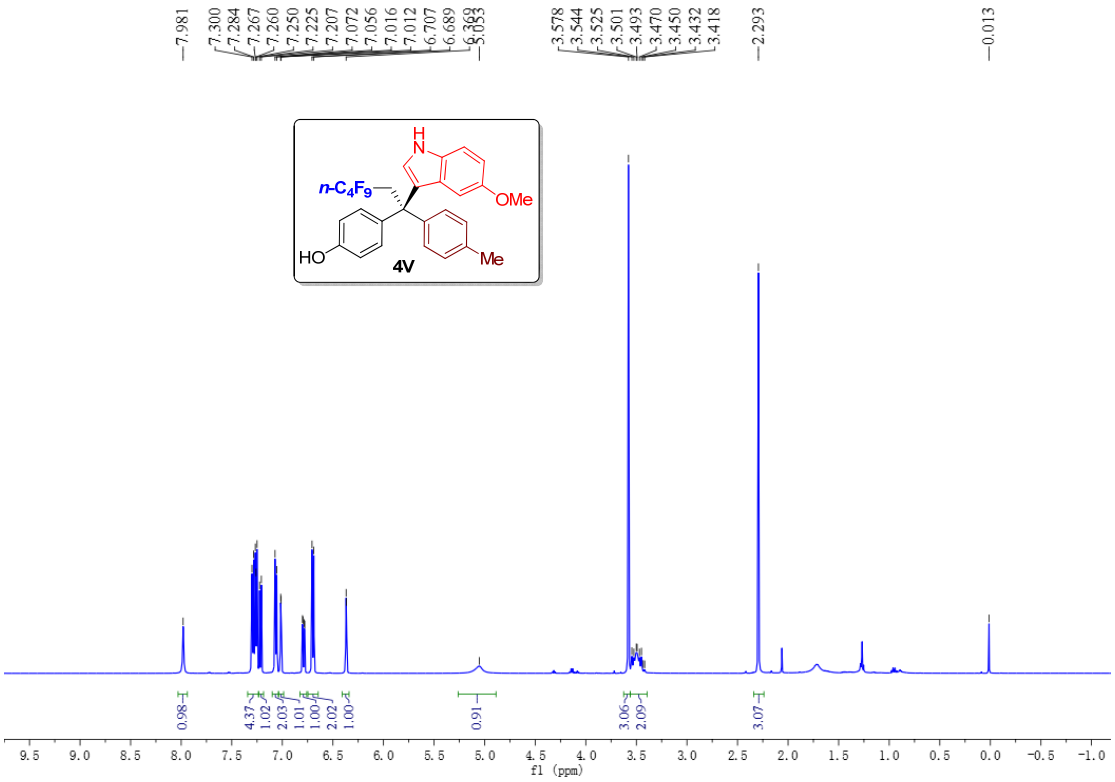
1.99
f1 (ppm)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7.267
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7.250
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7.207
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7.056
7.016
7.012
6.707
6.689
6.369
6.353
3.578
3.544
3.525
3.501
3.493
3.470
3.450
3.432
3.418
2.293
0.013
n-C4F9
OMe
HO
Me
4V
0.98
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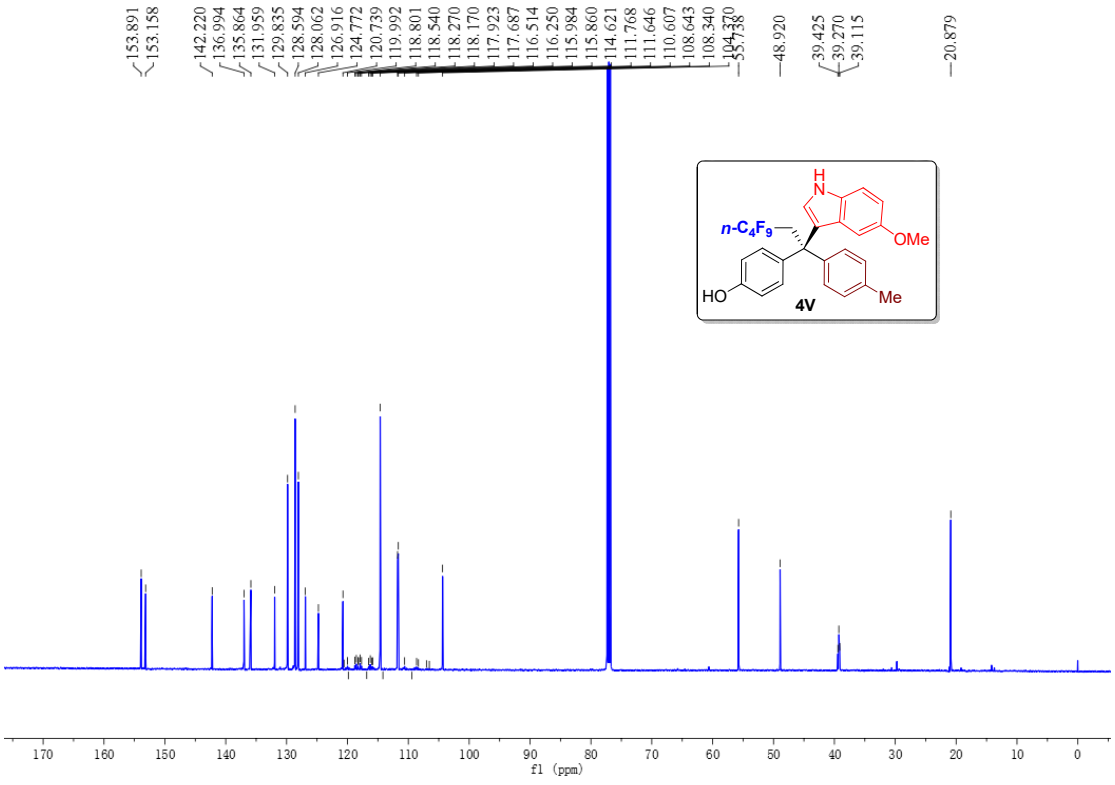
1.01
1.00
2.02
1.00
0.91
3.06
2.09
3.07
f1 (ppm)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118.540
118.270
118.170
117.923
117.687
116.514
116.250
115.984
115.860
114.621
111.768
111.646
110.607
108.643
108.340
104.370
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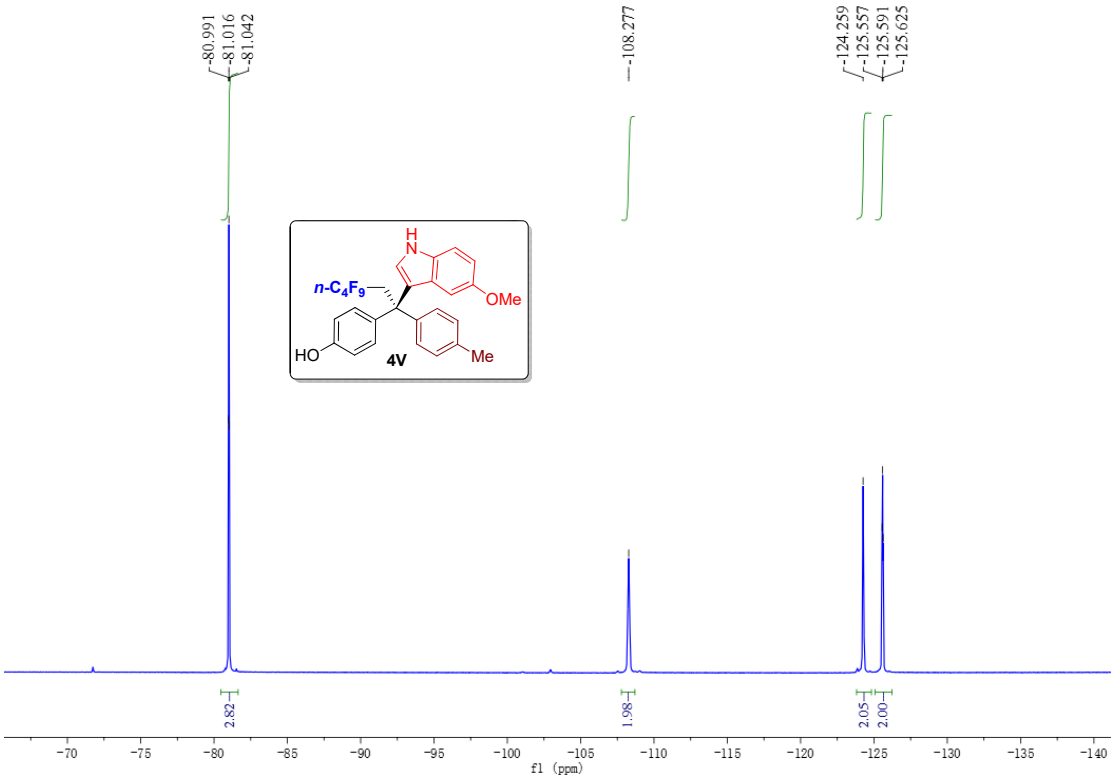
OMe
HO
Me
4V
f1 (ppm)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-81.042
-108.277
-124.259
-125.557
-125.591
-125.625
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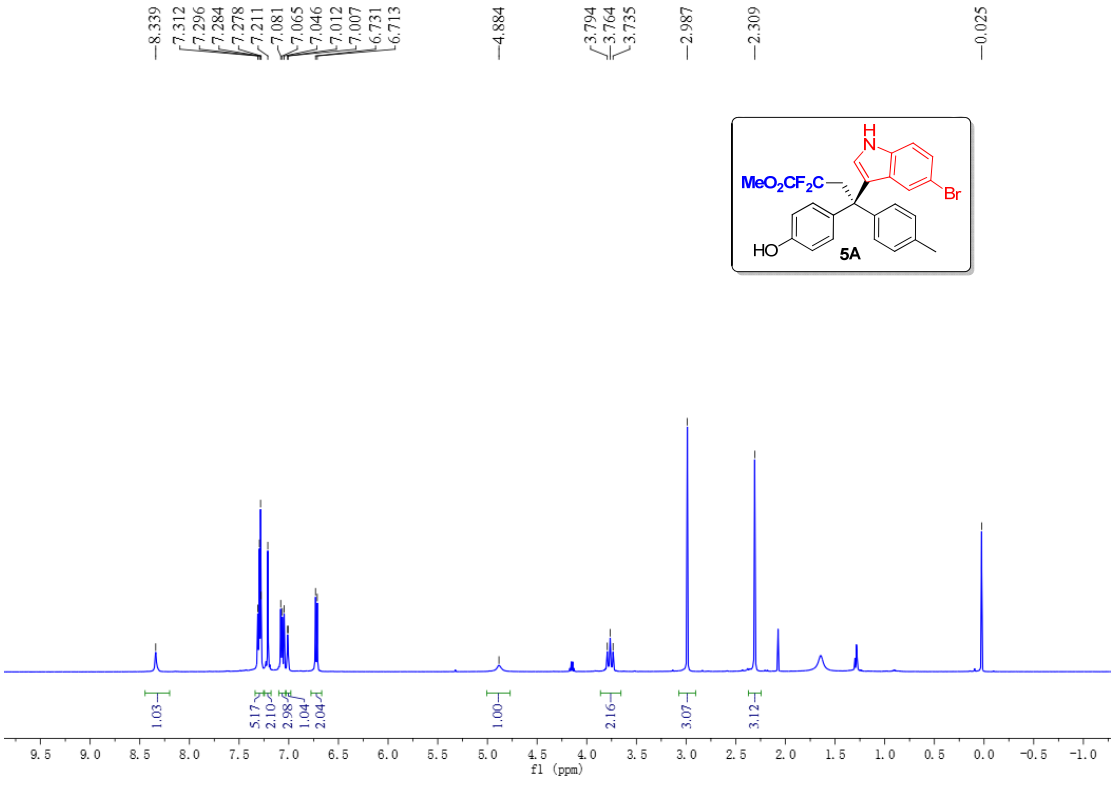
OMe
HO
Me
4V
2.82
1.98
2.05
2.00
f1 (ppm)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7.278
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7.065
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7.012
7.007
6.731
6.713
4.884
3.794
3.764
3.735
2.987
2.309
0.025
MeO2CF2C
Br
HO
5A
1.03
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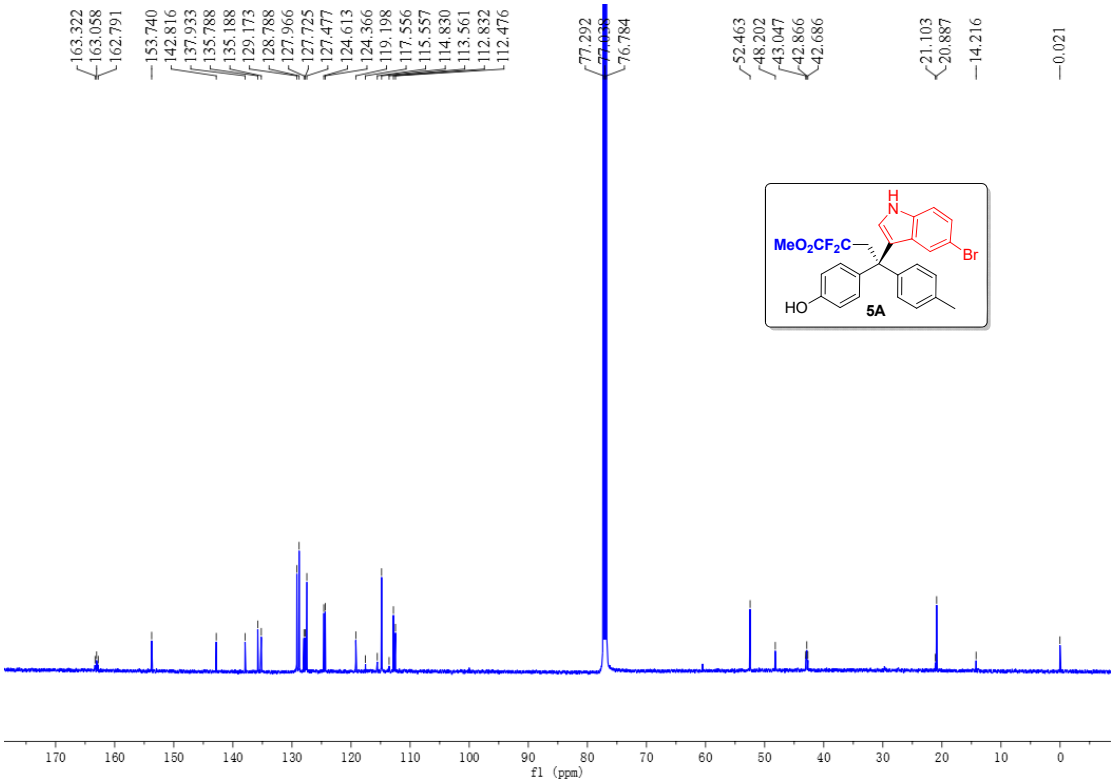
2.10
2.98
1.04
2.04
1.00
2.16
3.07
3.12
f1 (ppm)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135.188
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127.725
127.477
124.613
124.366
119.198
117.556
115.557
114.830
113.561
112.832
112.476
77.292
77.038
76.784
52.463
48.202
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42.686
21.103
20.887
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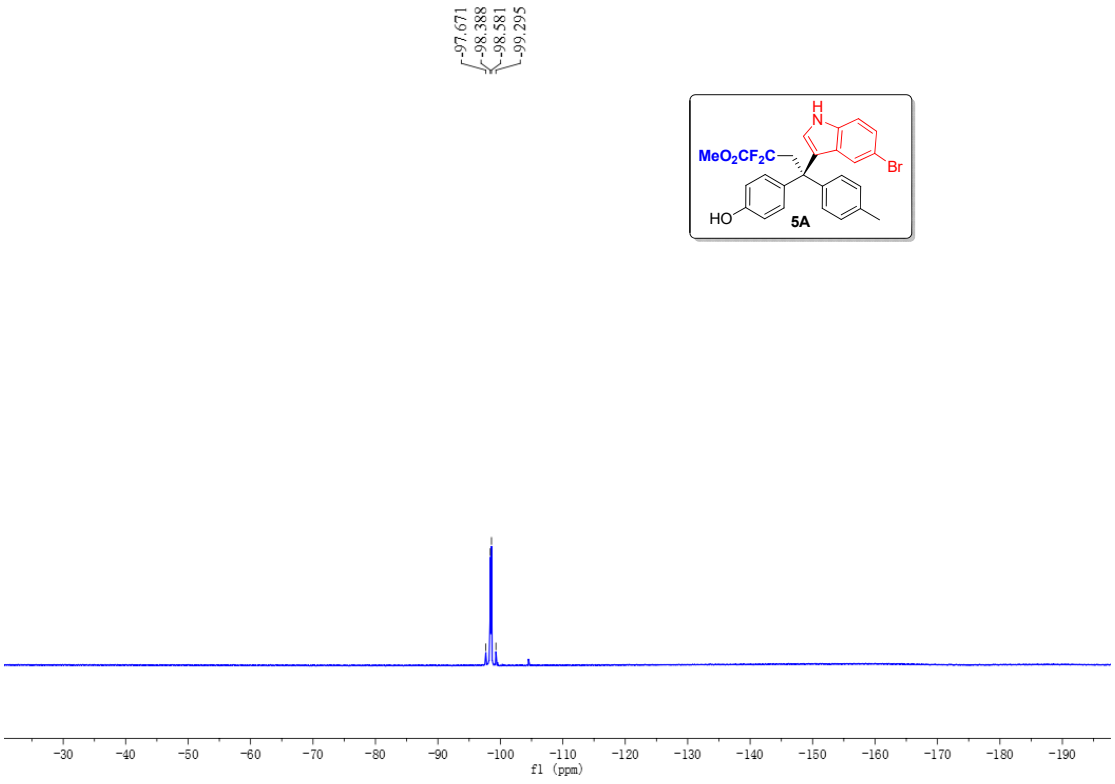
MeO2CF2C
Br
HO
5A
f1 (ppm)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-98.581
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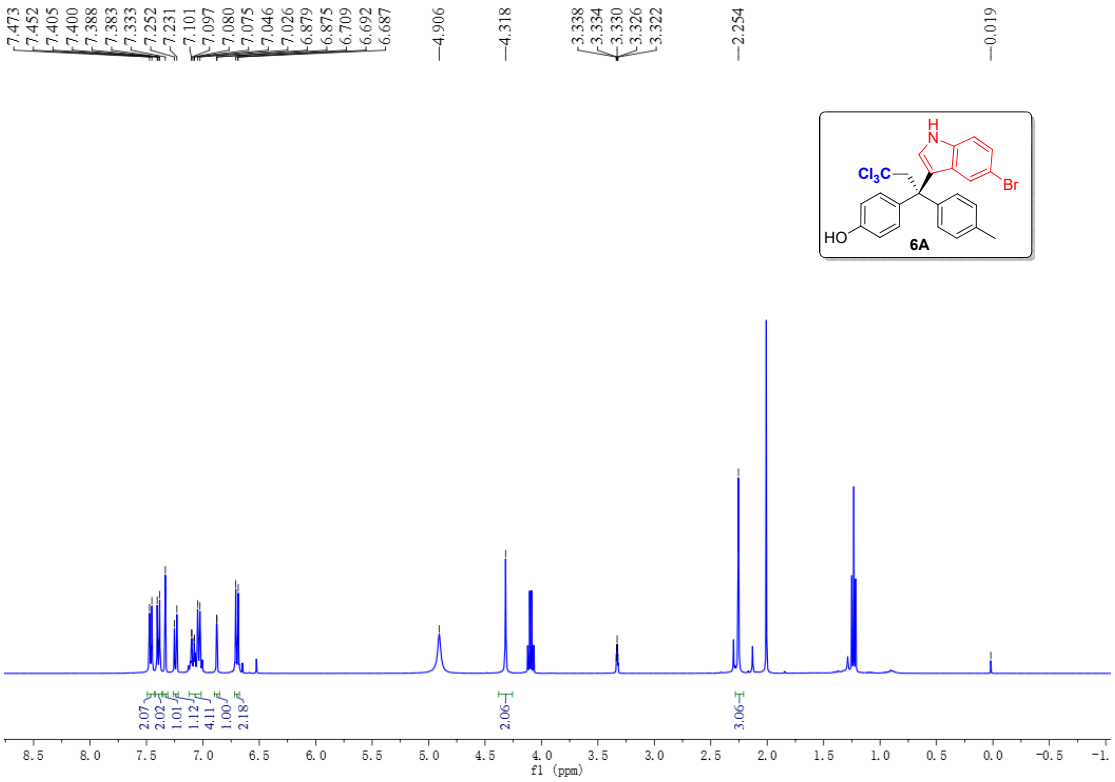
MeO2CF2C
Br
HO
5A
f1 (ppm)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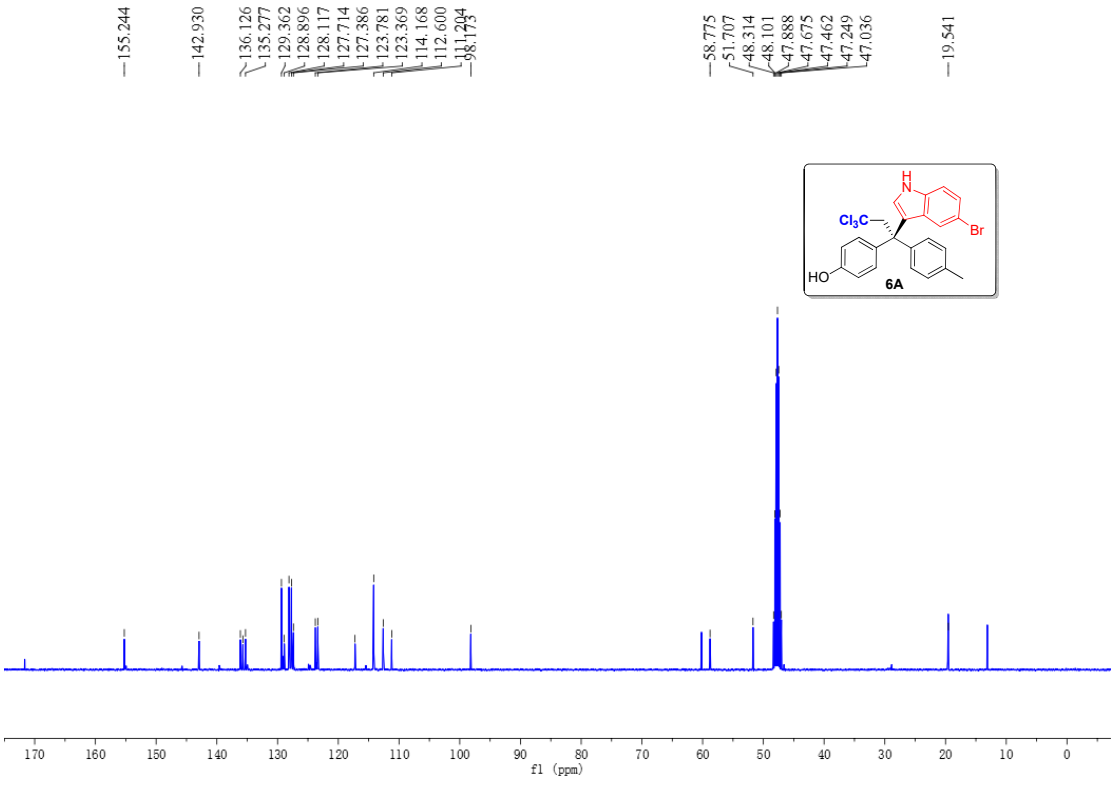
7.400
7.388
7.383
7.333
7.252
7.231
7.101
7.097
7.080
7.075
7.046
7.026
6.879
6.875
6.709
6.692
6.687
4.906
4.318
3.338
3.334
3.330
3.326
3.322
2.254
0.019
Cl3C
Br
HO
6A
2.07
2.02
1.01
1.12
4.11
1.00
2.18
2.06
3.06
f1 (ppm)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128.117
127.714
127.386
123.781
123.369
114.168
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111.204
98.173
58.775
51.707
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48.101
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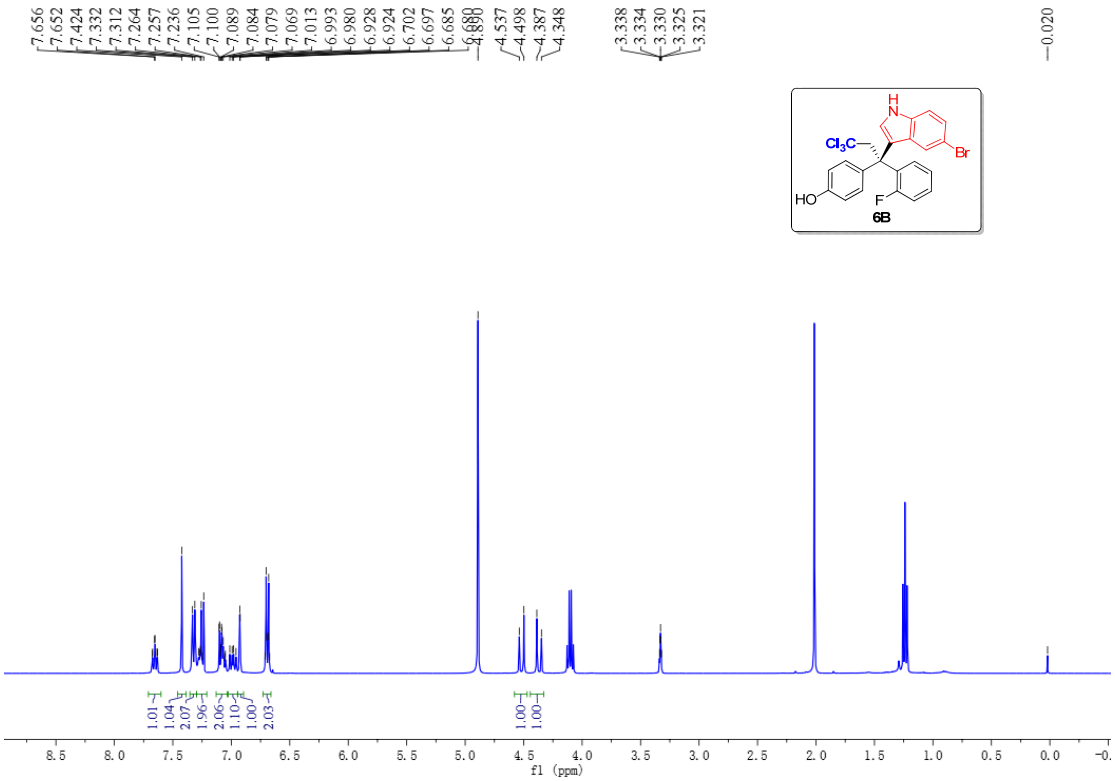
47.675
47.462
47.249
47.036
19.541
Cl3C
Br
HO
6A
f1 (ppm)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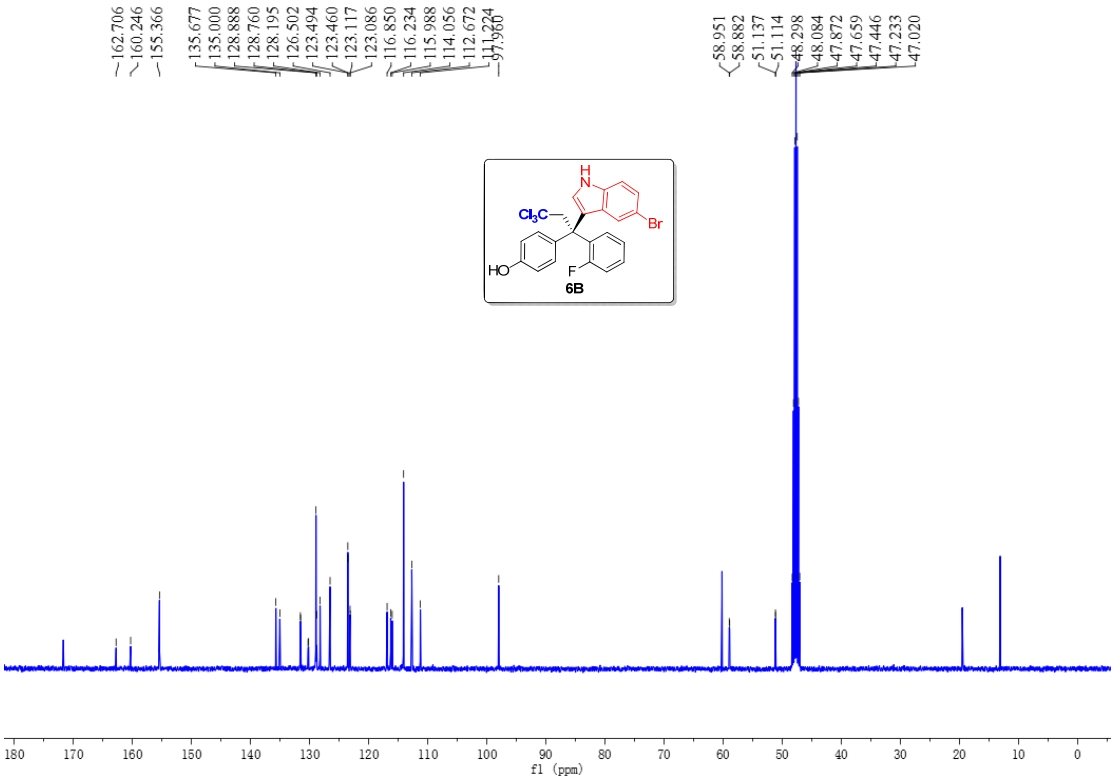
7.652
7.424
7.332
7.312
7.264
7.257
7.236
7.105
7.100
7.089
7.084
7.079
7.069
7.013
6.993
6.980
6.928
6.924
6.702
6.697
6.685
4.537
4.498
4.387
4.348
3.338
3.334
3.330
3.325
3.321
0.020
6B
1.01
1.04
2.07
1.96
2.06
1.10
1.00
2.03
1.00
1.00
f1 (ppm)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128.888
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128.195
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123.460
123.117
123.086
116.850
116.234
115.988
114.056
112.672
111.224
97.960
58.951
58.882
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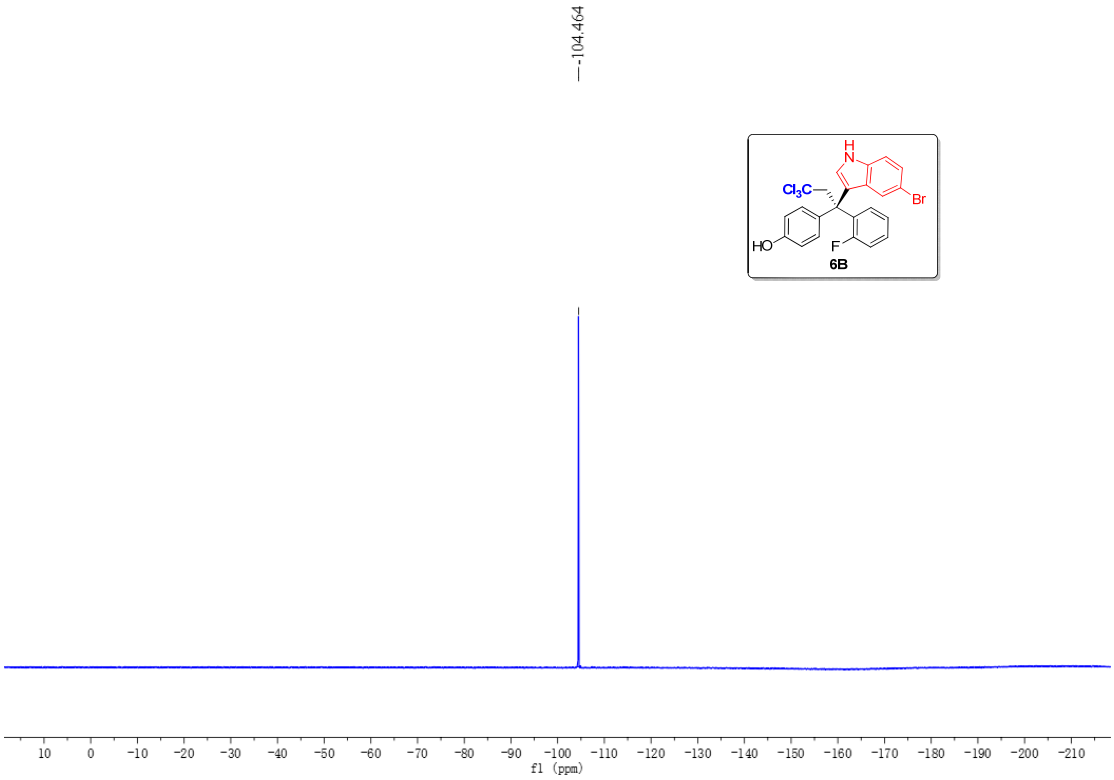
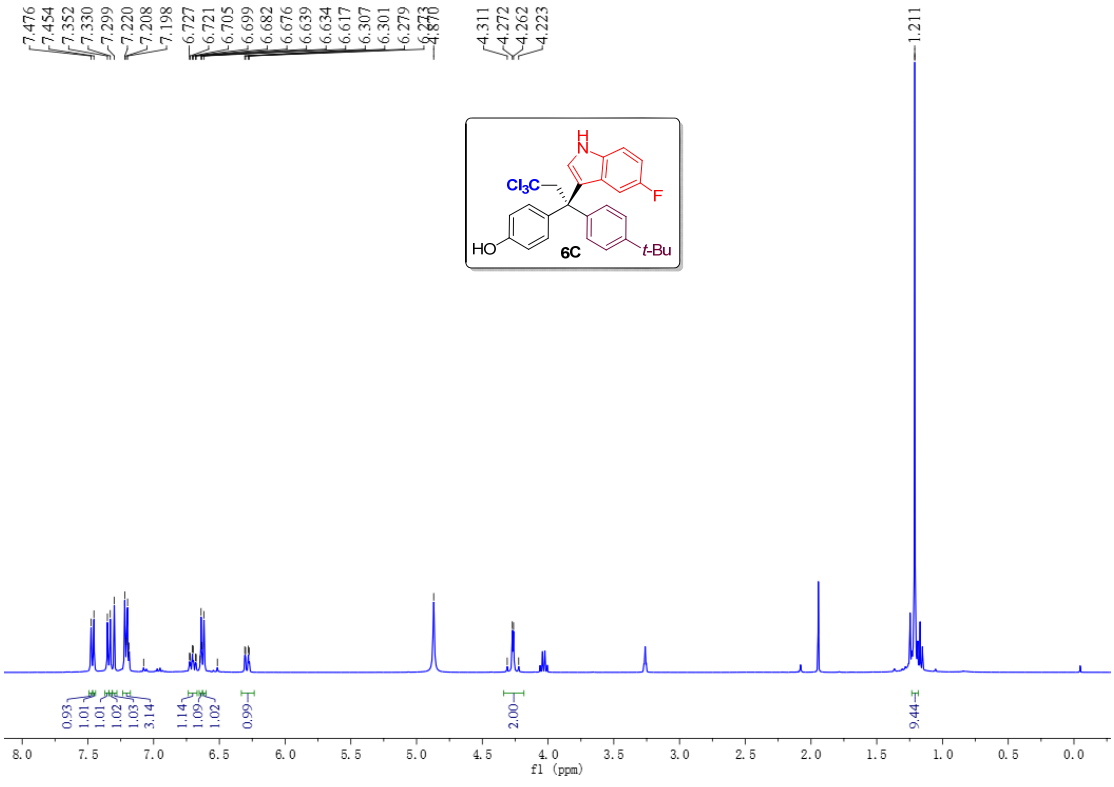
51.114
48.298
48.084
47.872
47.659
47.446
47.233
47.020
6B
f1 (ppm)


-104.464
6B
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)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7.454
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7.208
7.198
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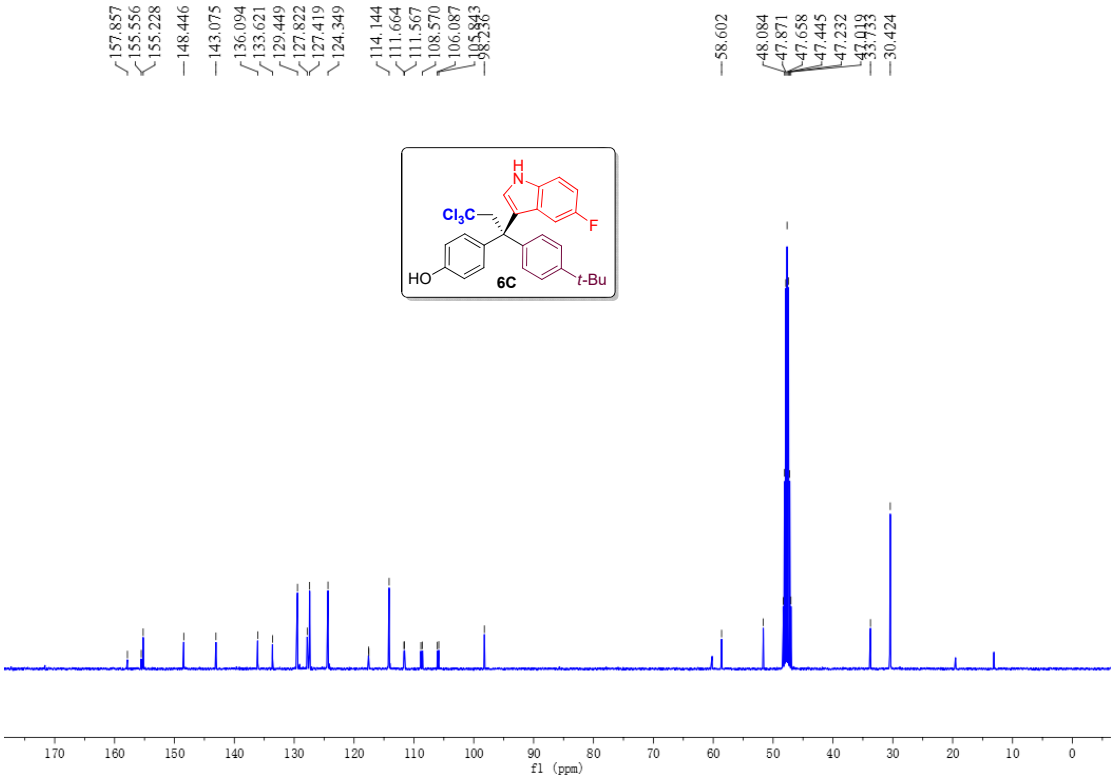
6.721
6.705
6.699
6.682
6.676
6.639
6.634
6.617
6.307
6.301
6.279
4.311
4.272
4.262
4.223
1.211
6C
0.93
1.01
1.01
1.02
1.03
3.14
1.14
1.09
1.02
0.99
2.00
9.44
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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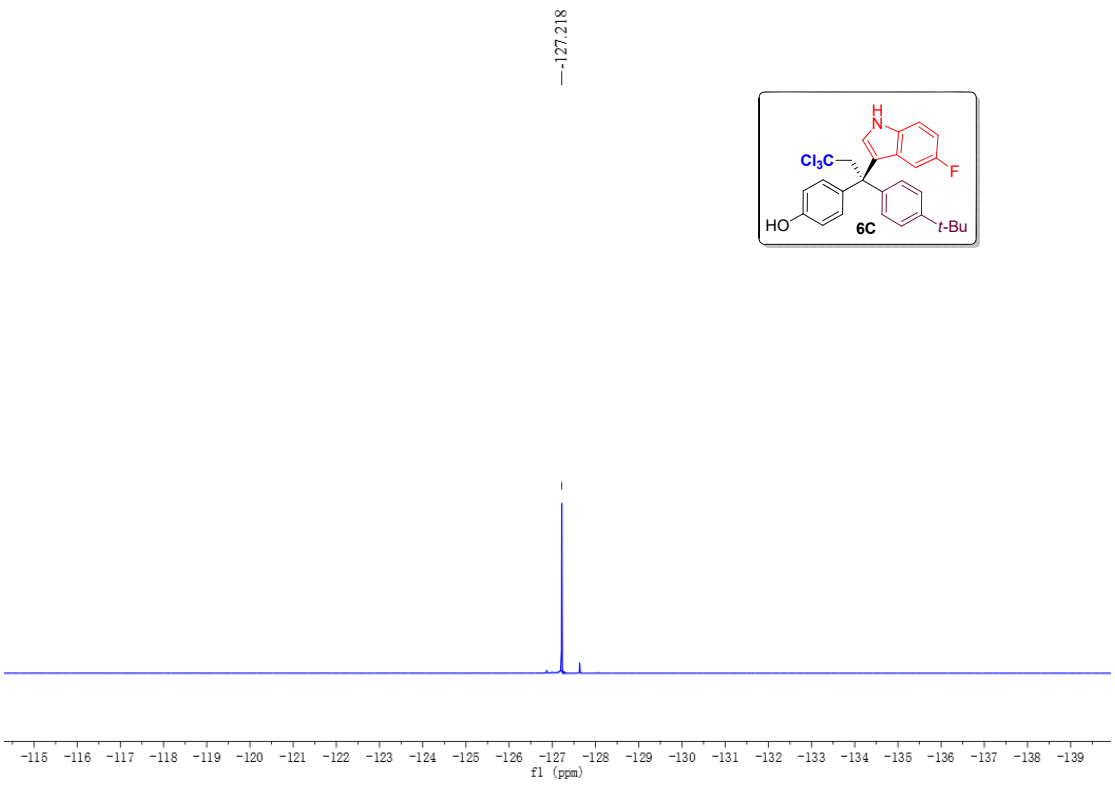
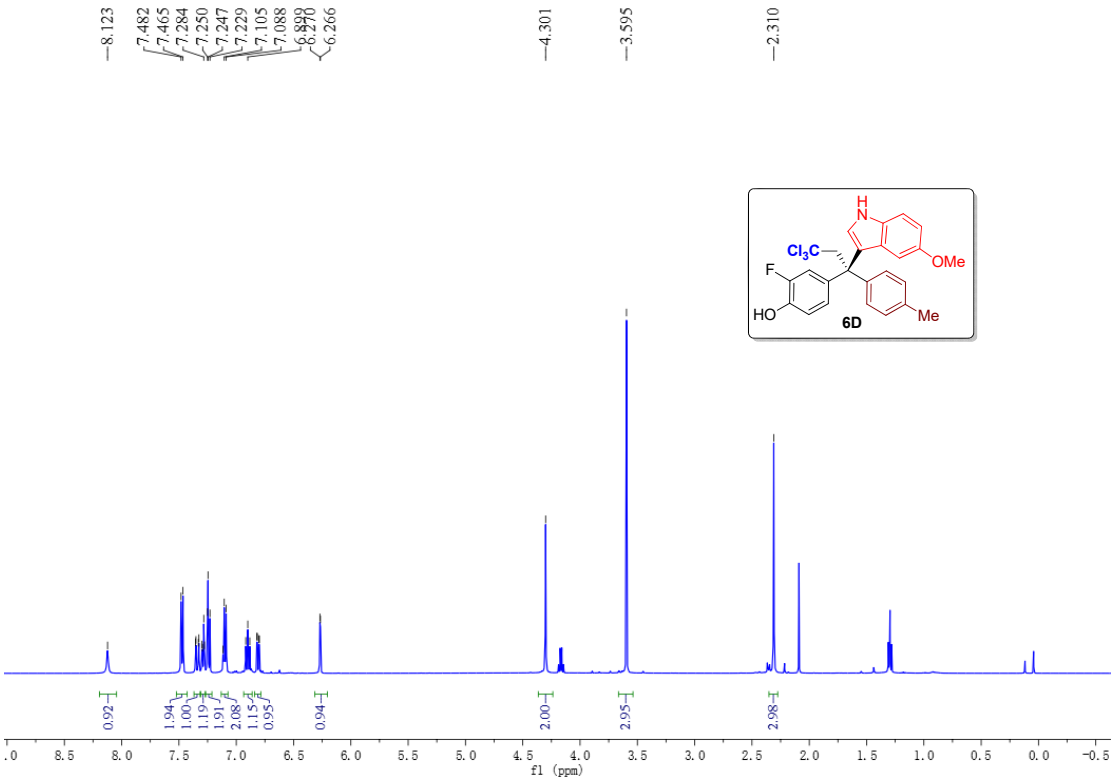
114.144
111.664
111.567
108.570
106.087
105.843
98.236
58.602
48.084
47.871
47.658
47.445
47.232
43.013
33.733
30.424
Cl3C
F
HO
6C
t-Bu
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-127.218
Cl3C
F
HO
6C
t-Bu
-115 -116 -117 -118 -119 -120 -121 -122 -123 -124 -125 -126 -127 -128 -129 -130 -131 -132 -133 -134 -135 -136 -137 -138 -139
f1 (ppm)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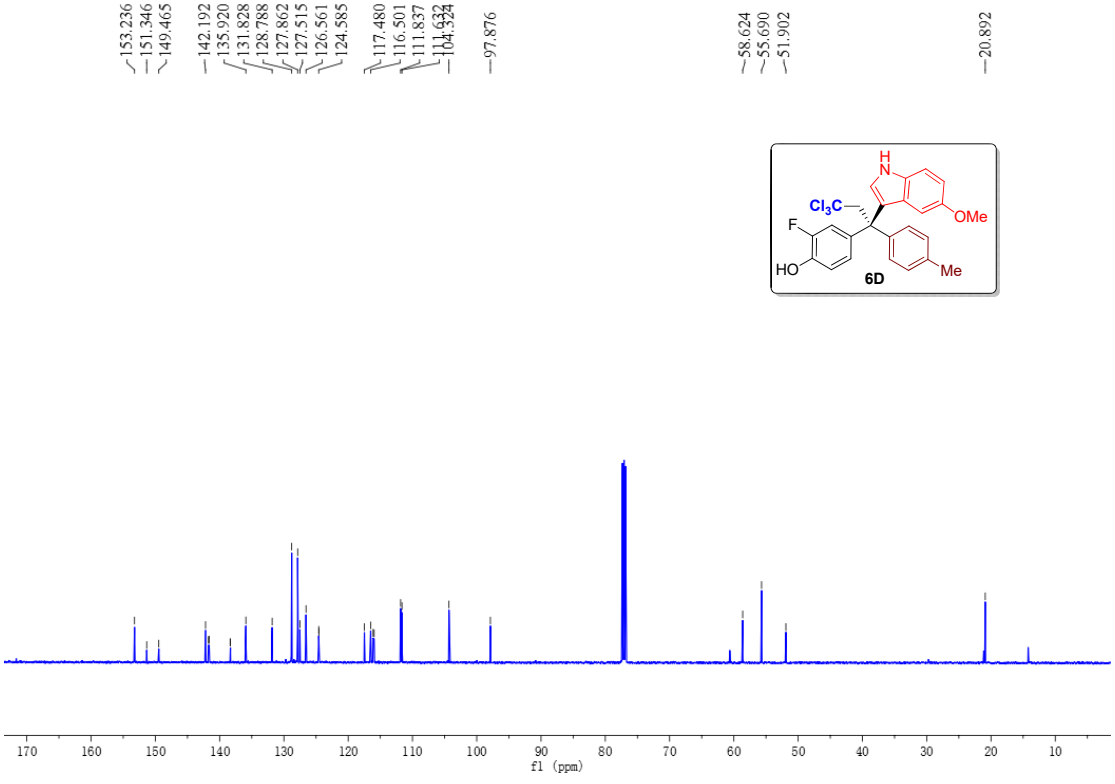
7.229
7.105
7.088
6.270
6.266
4.301
3.595
2.310
6D
0.92
1.94
1.00
1.19
1.91
2.08
1.15
0.95
0.94
2.00
2.95
2.98
f1 (ppm)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127.862
127.515
126.561
124.585
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111.632
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97.876
58.624
55.690
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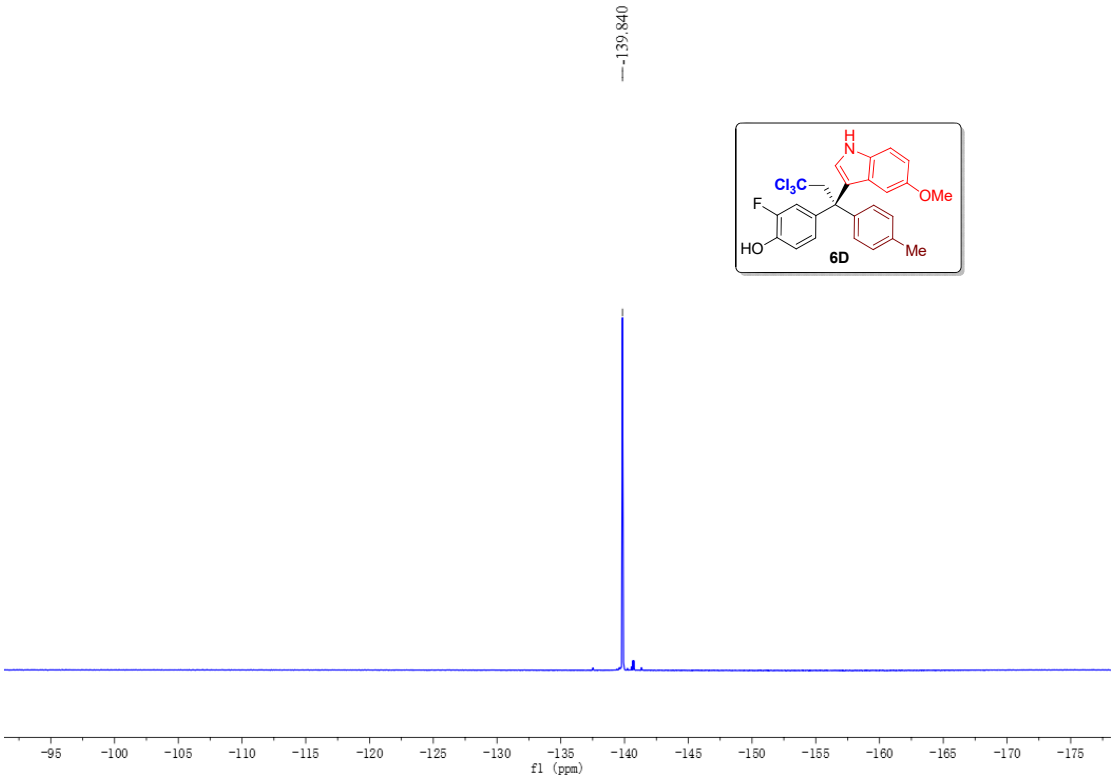
20.892
6D
f1 (ppm)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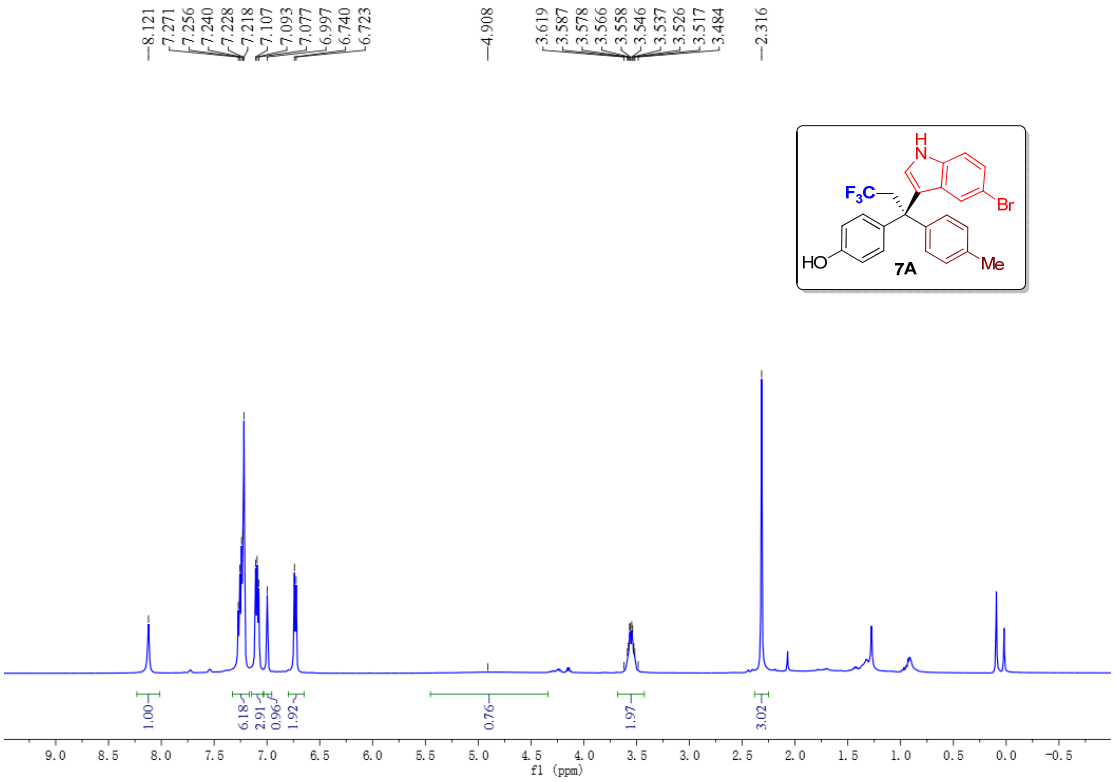
H
N
Cl3C
F
HO
OMe
Me
6D
-95 -100 -105 -110 -115 -120 -125 -130 -135 -140 -145 -150 -155 -160 -165 -170 -175
f1 (ppm)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7.077
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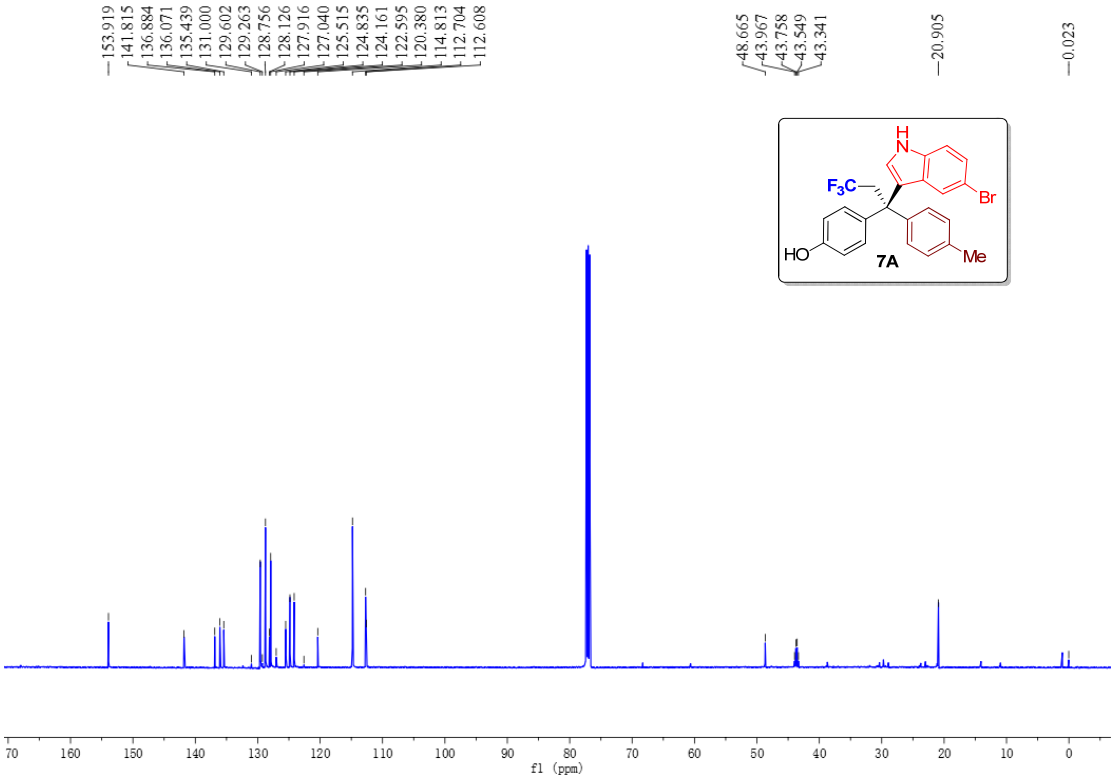
6.723
4.908
3.619
3.587
3.578
3.566
3.558
3.546
3.537
3.526
3.517
3.484
2.316
H
N
F3C
Br
HO
Me
7A
1.00
6.18
2.91
0.96
1.92
0.76
1.97
3.02
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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125.515
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124.161
122.595
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112.704
112.608
48.665
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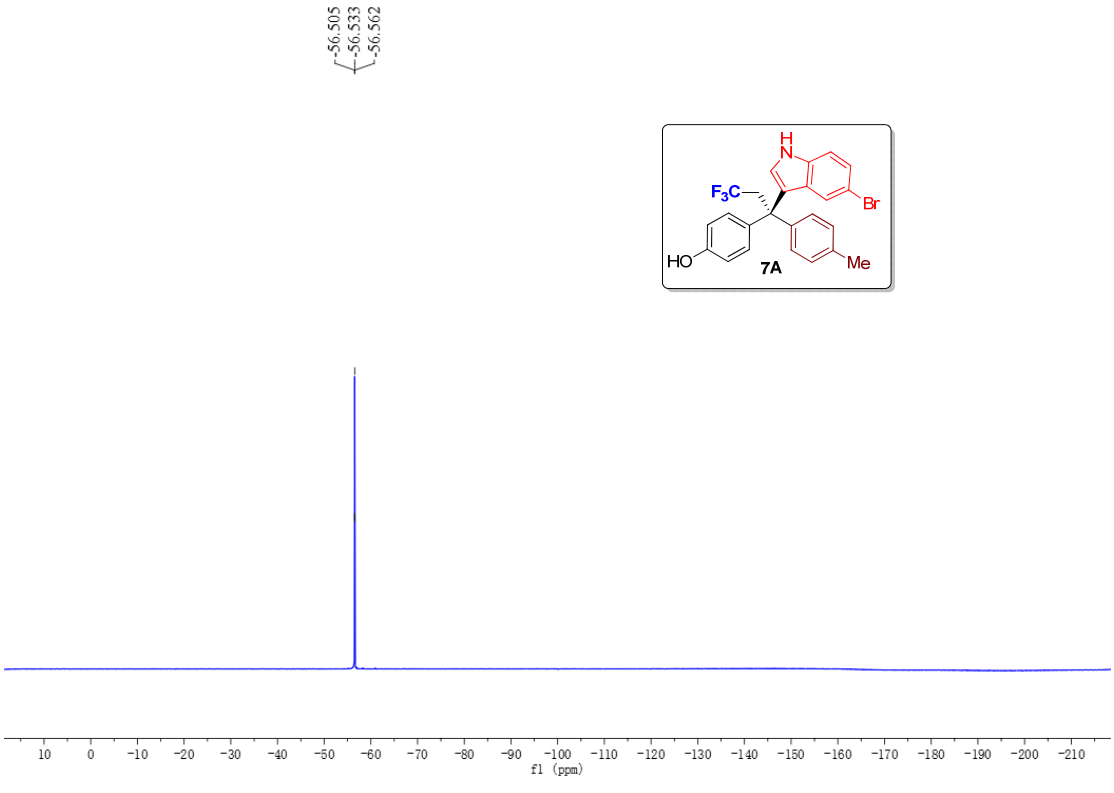
43.341
20.905
0.023
H
N
F3C
Br
HO
Me
7A
f1 (ppm)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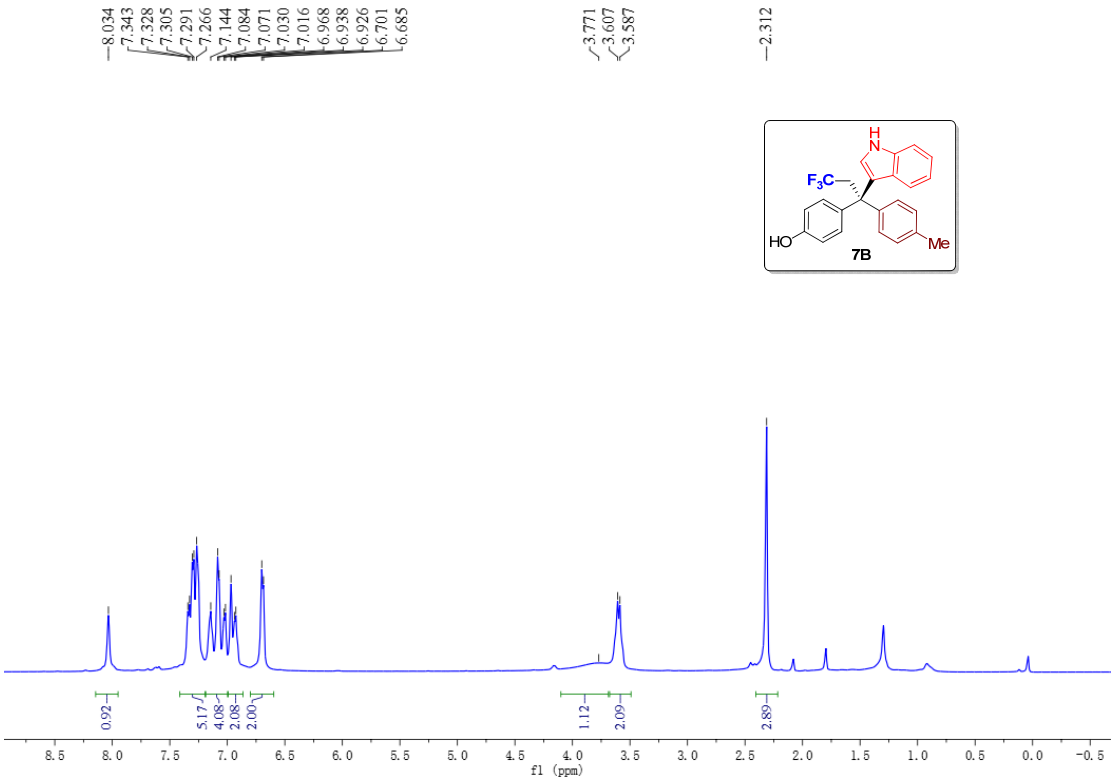
N
F3C
Br
HO
Me
7A
f1 (ppm)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6.926
6.701
6.685
3.771
3.607
3.587
2.312
H
N
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HO
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2.00
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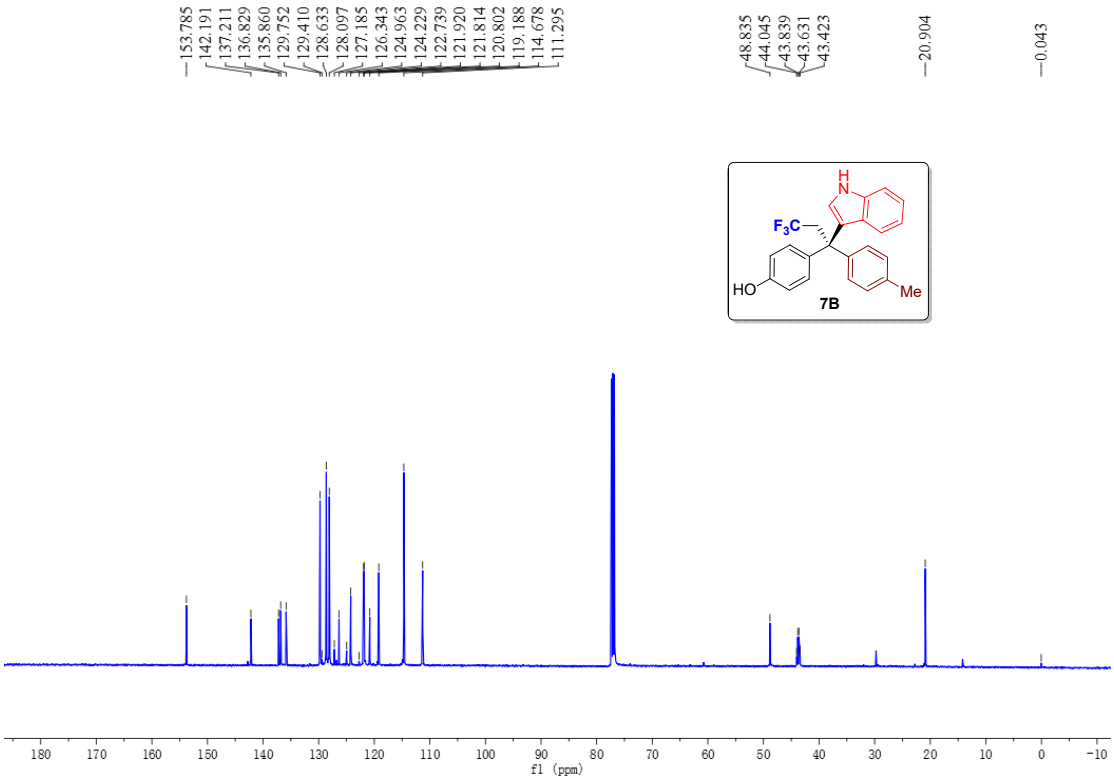
2.09
2.89
f1 (ppm)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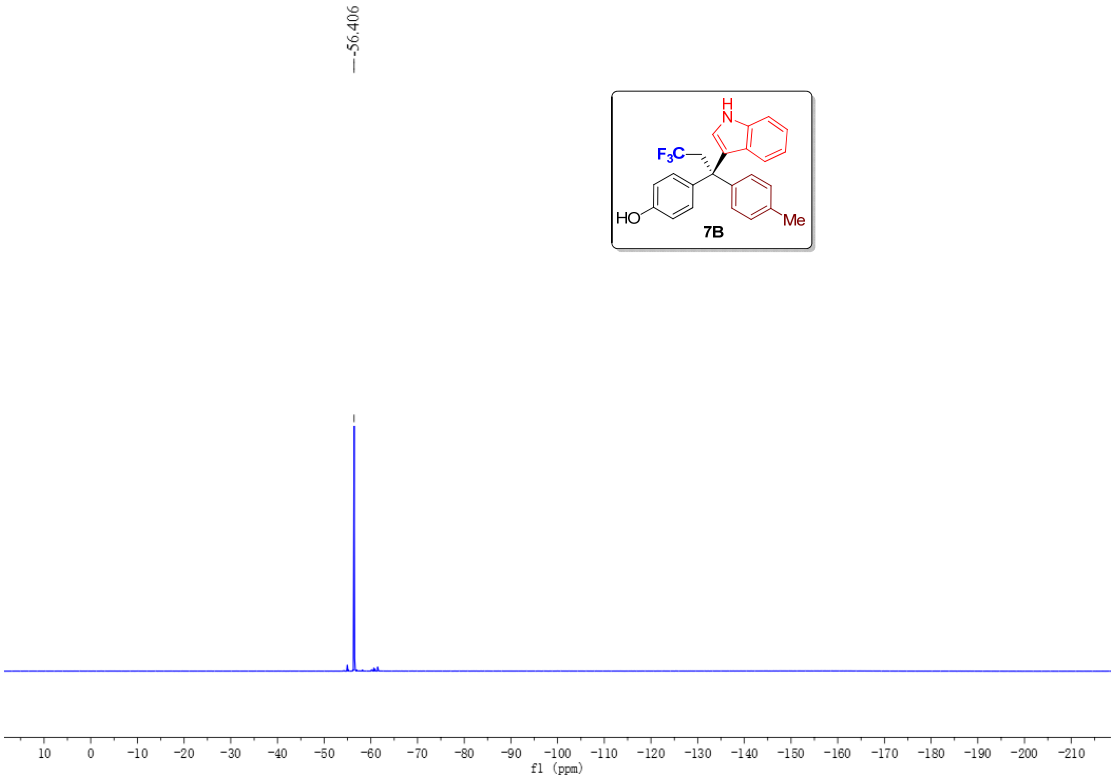
124.963
124.229
122.739
121.920
121.814
120.802
119.188
114.678
111.295
48.835
44.045
43.839
43.631
43.423
20.904
0.043
H
N
F3C
HO
Me
7B
f1 (ppm)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F3C
HO
Me
7B
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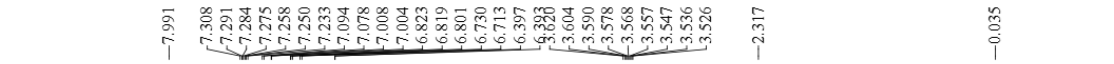
f1 (ppm)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7.308
7.291
7.284
7.275
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7.078
7.008
7.004
6.823
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6.801
6.730
6.713
6.397
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3.568
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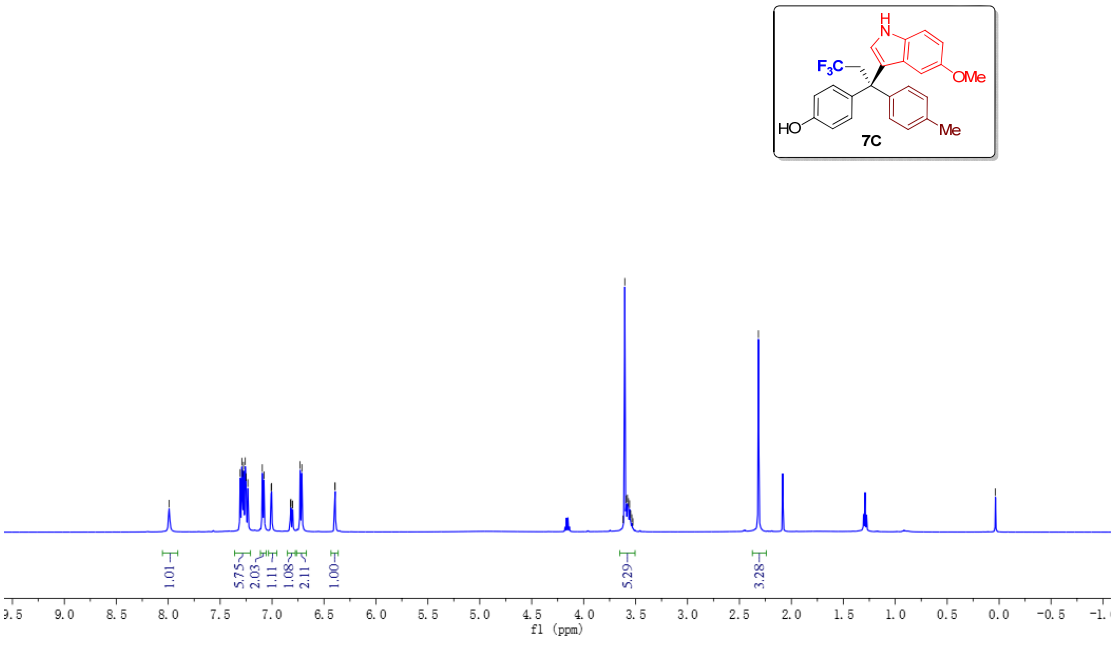
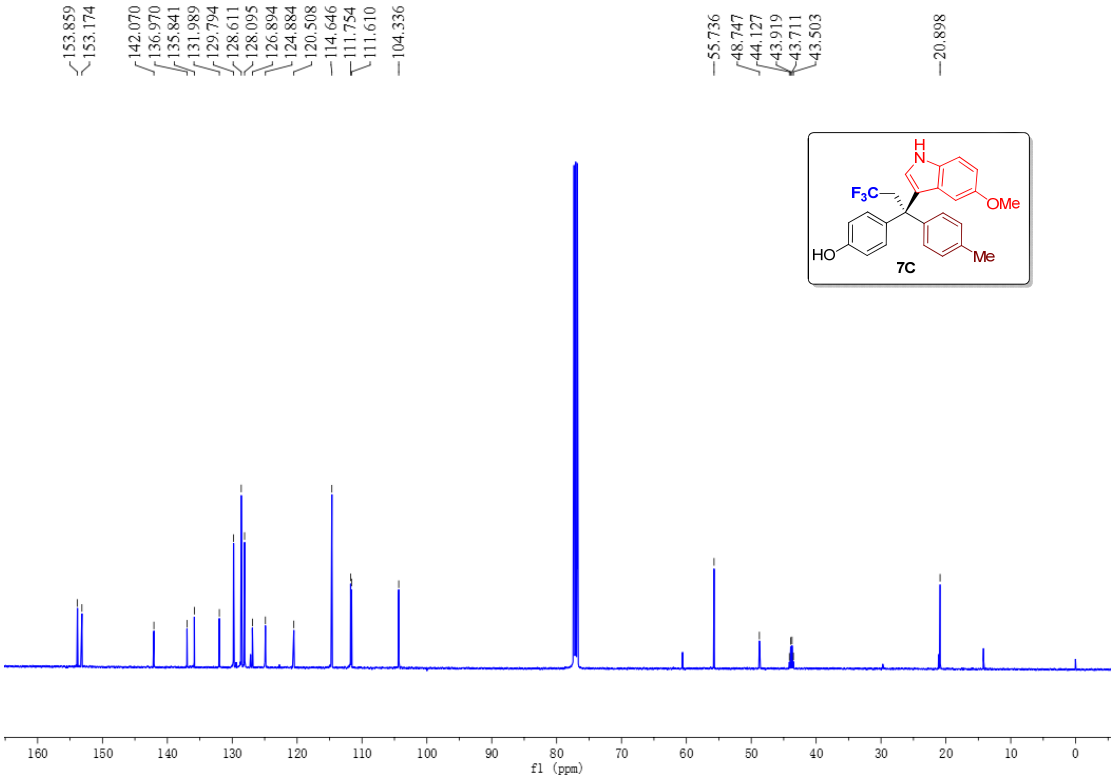
0.035


F3C
OMe
HO
Me
7C
1.01
5.75
2.03
1.11
1.08
2.11
1.00
5.29
3.28
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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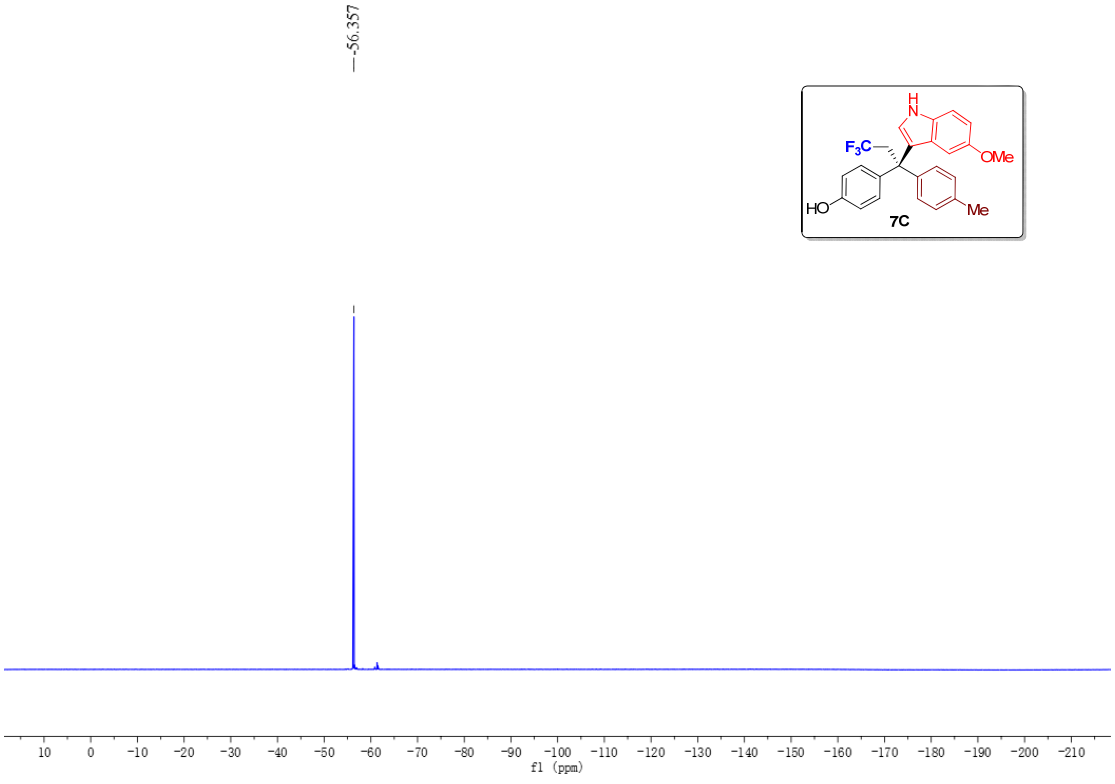
120.508
114.646
111.754
111.610
104.336
55.736
48.747
44.127
43.919
43.711
43.503
20.898
H
N
F3C
OMe
HO
Me
7C
160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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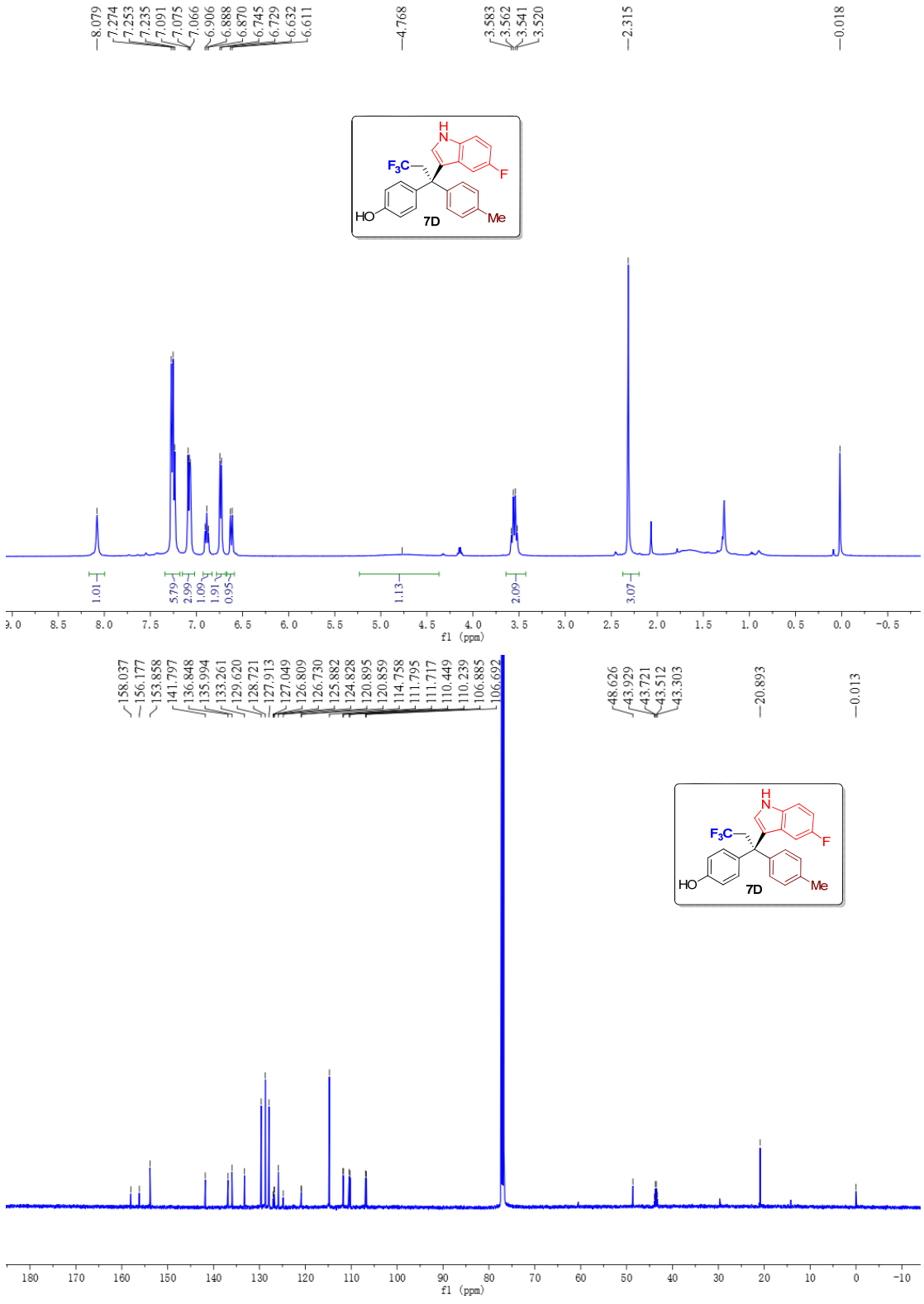
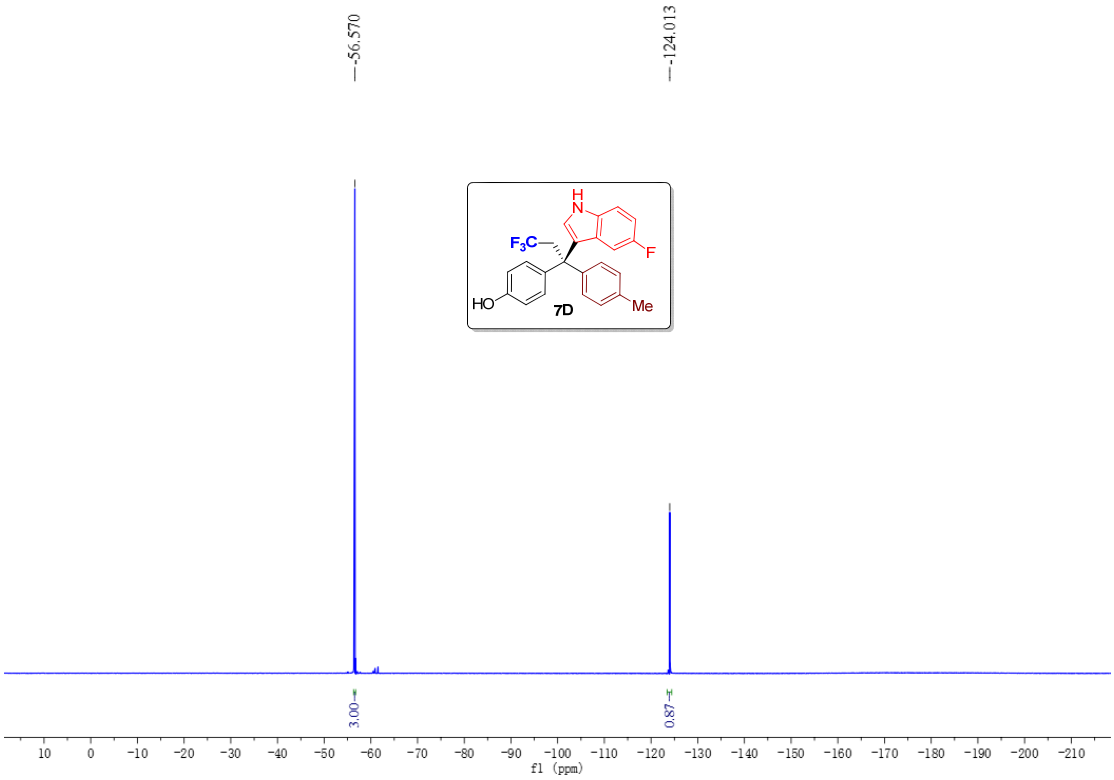
H
N
F3C
OMe
HO
Me
7C
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)


8.079
7.274
7.253
7.235
7.091
7.075
7.066
6.906
6.888
6.870
6.745
6.729
6.632
6.611
4.768
3.583
3.562
3.541
3.520
2.315
0.018
7D
1.01
5.79
2.99
1.09
1.91
0.95
1.13
2.09
3.07
f1 (ppm)
158.037
156.177
153.858
141.797
136.848
135.994
133.261
129.620
128.721
127.913
127.049
126.809
126.730
125.882
124.828
120.895
120.859
114.758
111.795
111.717
110.449
110.239
106.885
106.692
48.626
43.929
43.721
43.512
43.303
20.893
0.013
7D
f1 (ppm)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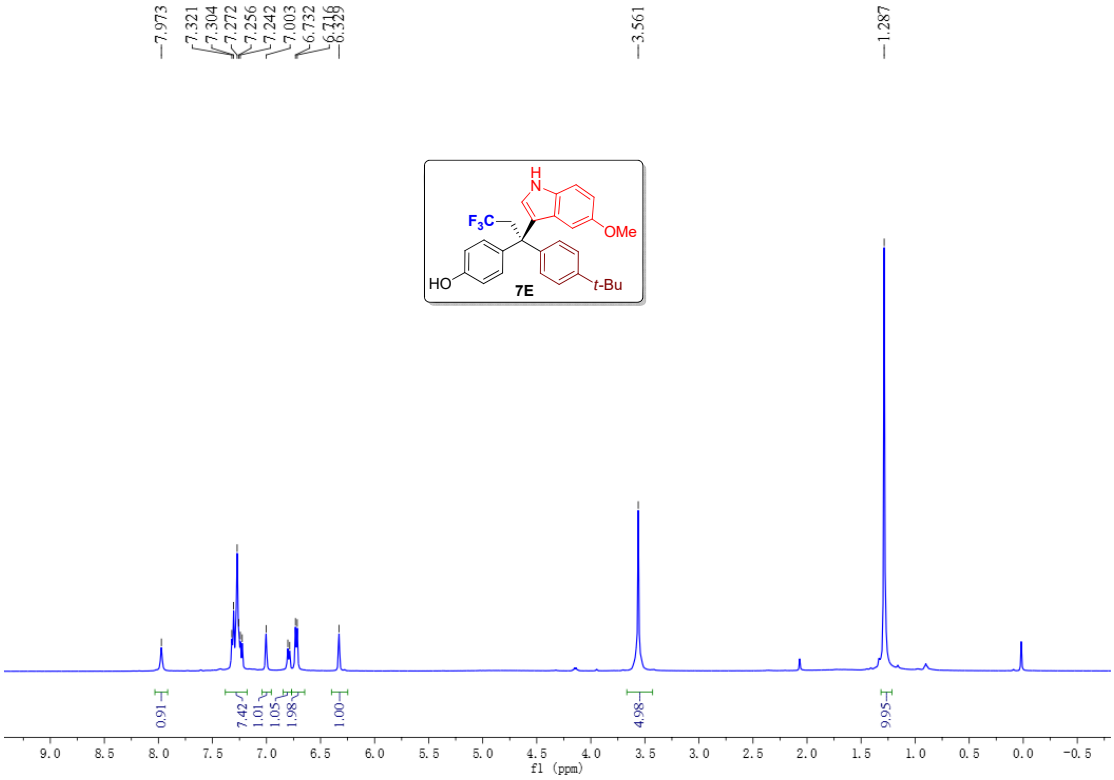
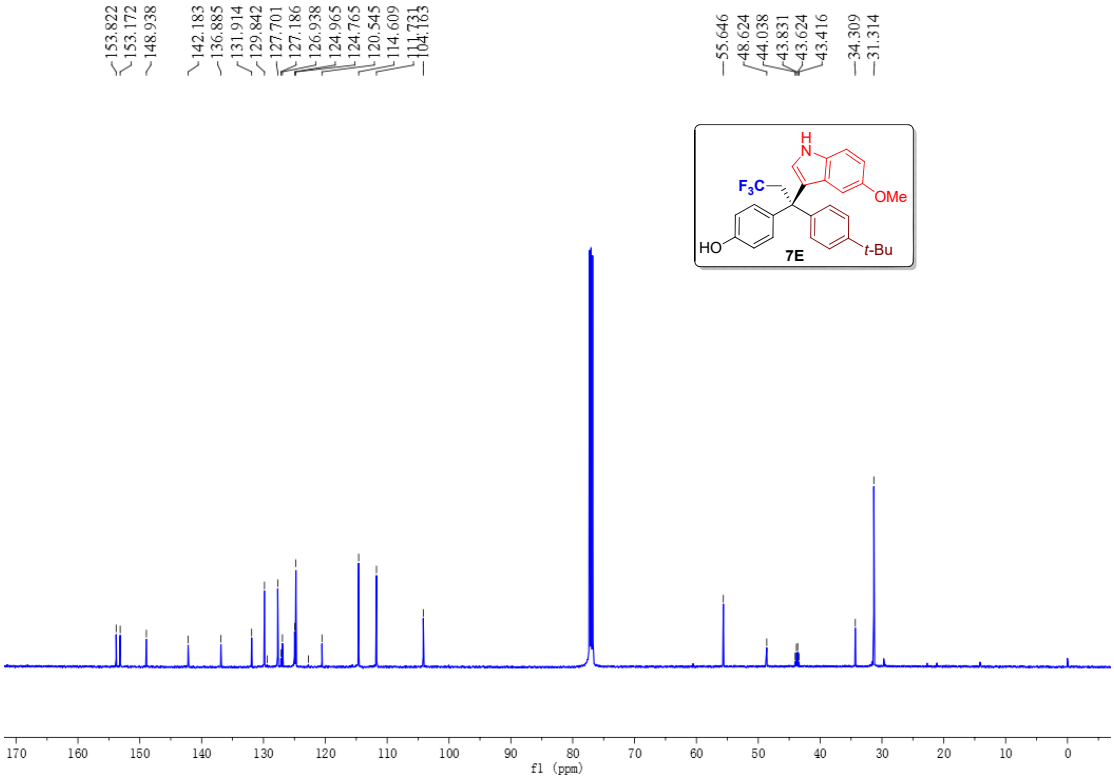
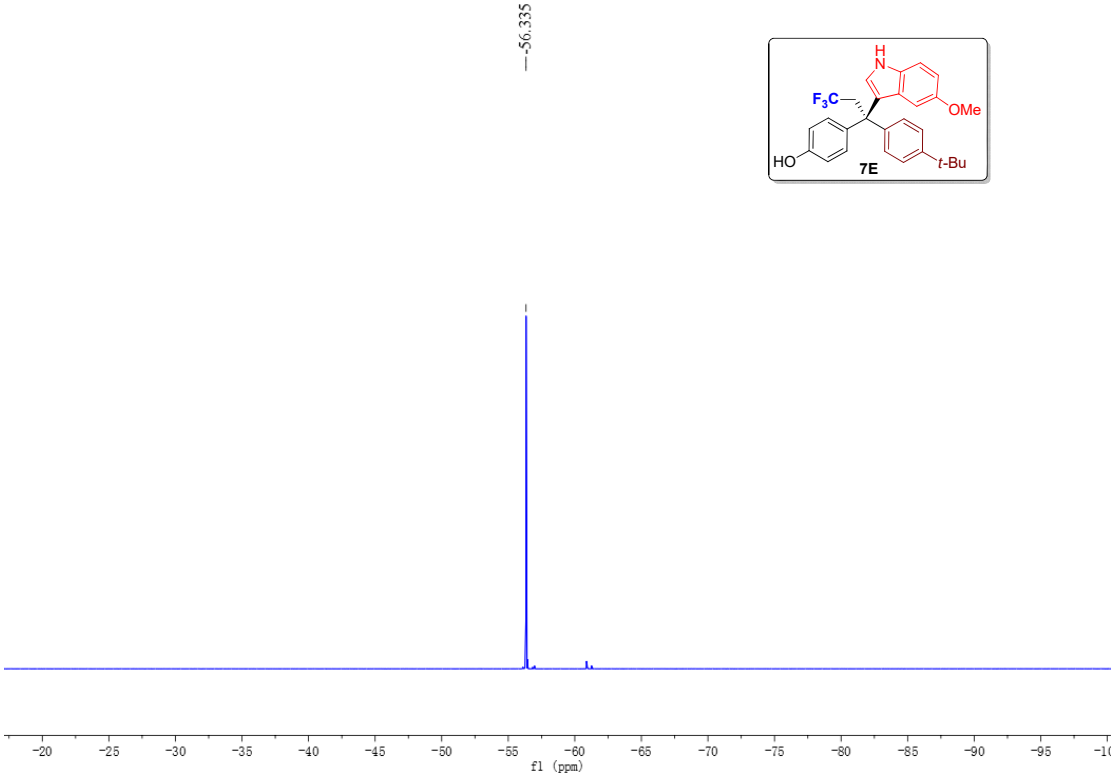
-124.013
7D
3.00
0.87
f1 (ppm)


7.973
7.321
7.304
7.272
7.256
7.242
7.003
6.732
6.326
6.309
3.561
1.287
7E
0.91
7.42
1.01
1.05
1.98
1.00
4.98
9.95
f1 (ppm)


153.822
153.172
148.938
142.183
136.885
131.914
129.842
127.701
127.186
126.938
124.965
124.765
120.545
114.609
111.731
104.183
55.646
48.624
44.038
43.831
43.624
43.416
34.309
31.314
H
N
F3C
OMe
HO
7E
t-Bu
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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N
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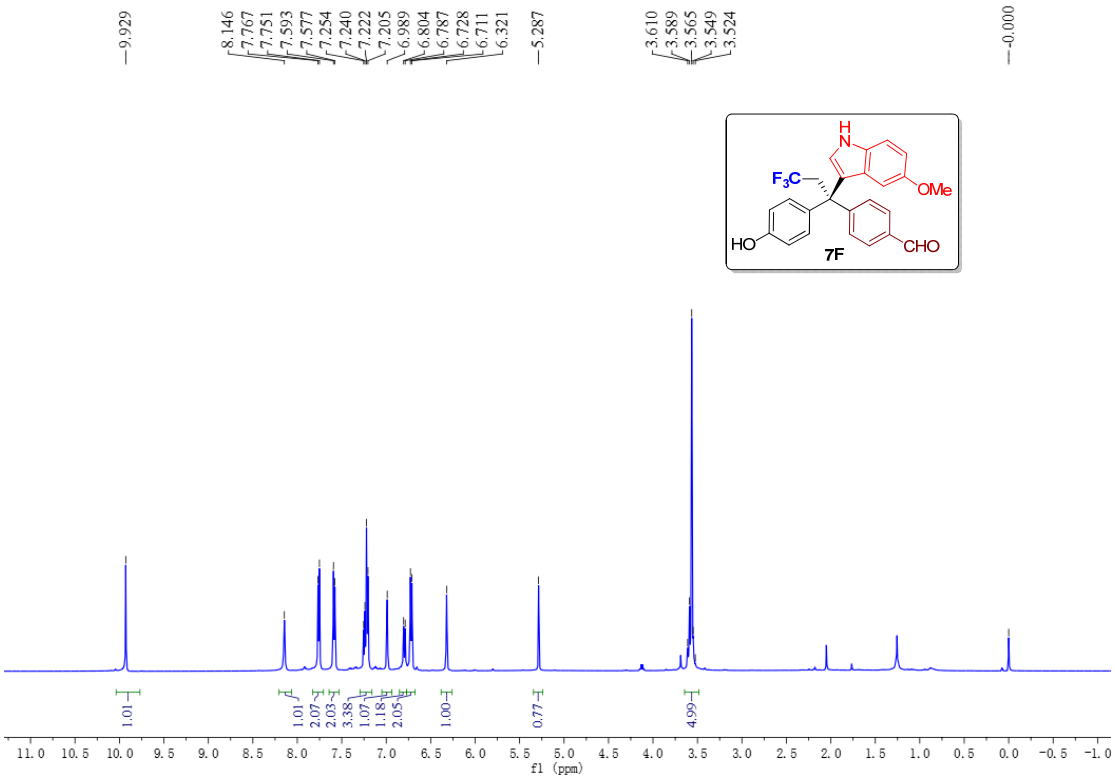
OMe
HO
7E
t-Bu
-20 -25 -30 -35 -40 -45 -50 -55 -60 -65 -70 -75 -80 -85 -90 -95
f1 (ppm)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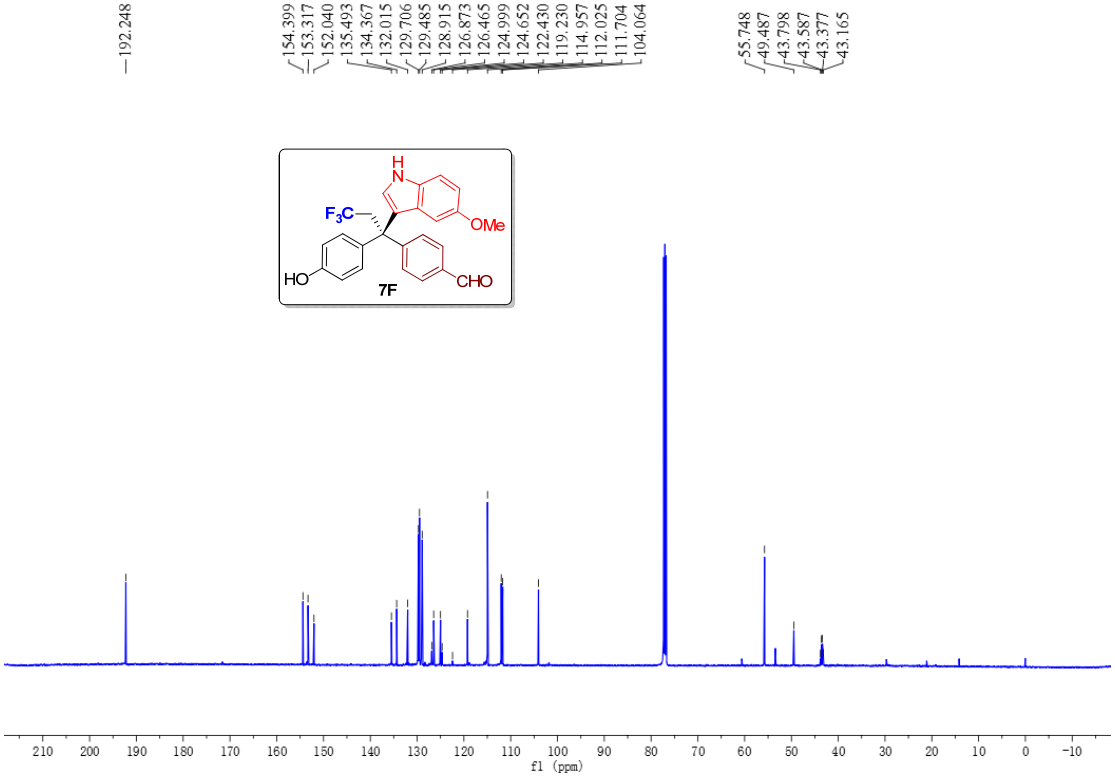
8.146
7.767
7.751
7.593
7.577
7.254
7.240
7.222
7.205
6.989
6.804
6.787
6.728
6.711
6.321
5.287
3.610
3.589
3.565
3.549
3.524
0.000
H
N
F3C
OMe
HO
CHO
7F
1.01
1.01
2.07
2.03
3.38
1.07
1.18
2.05
1.00
0.77
4.99
f1 (ppm)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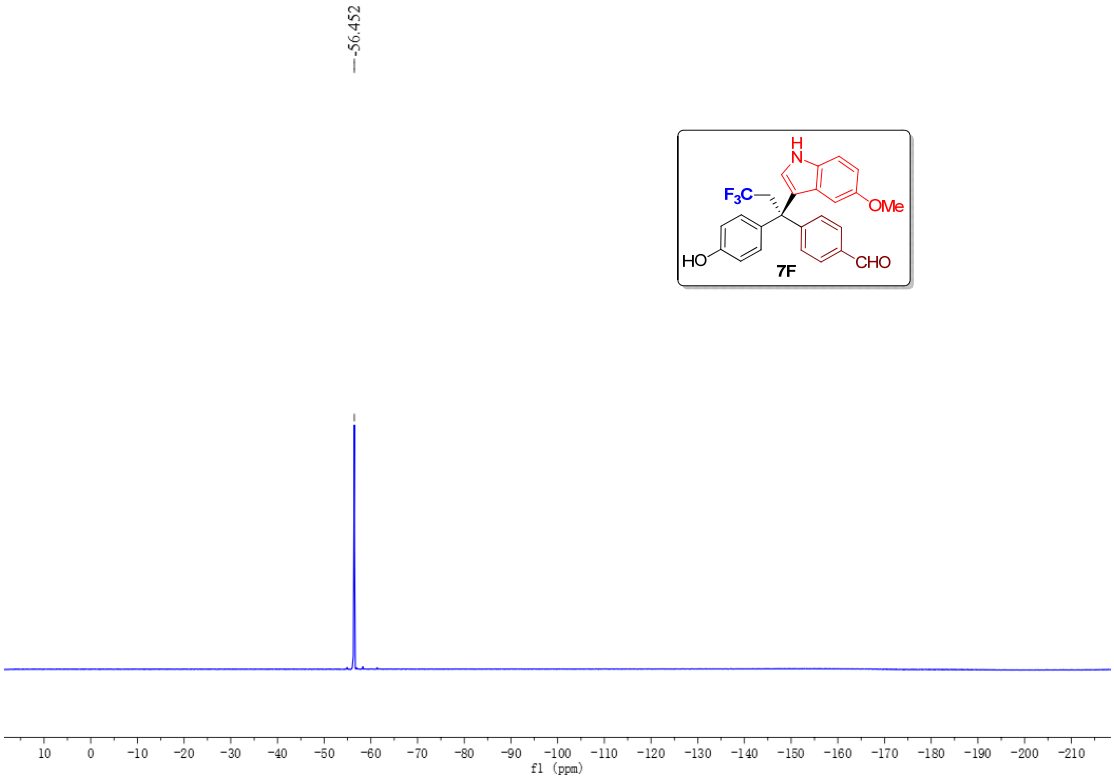
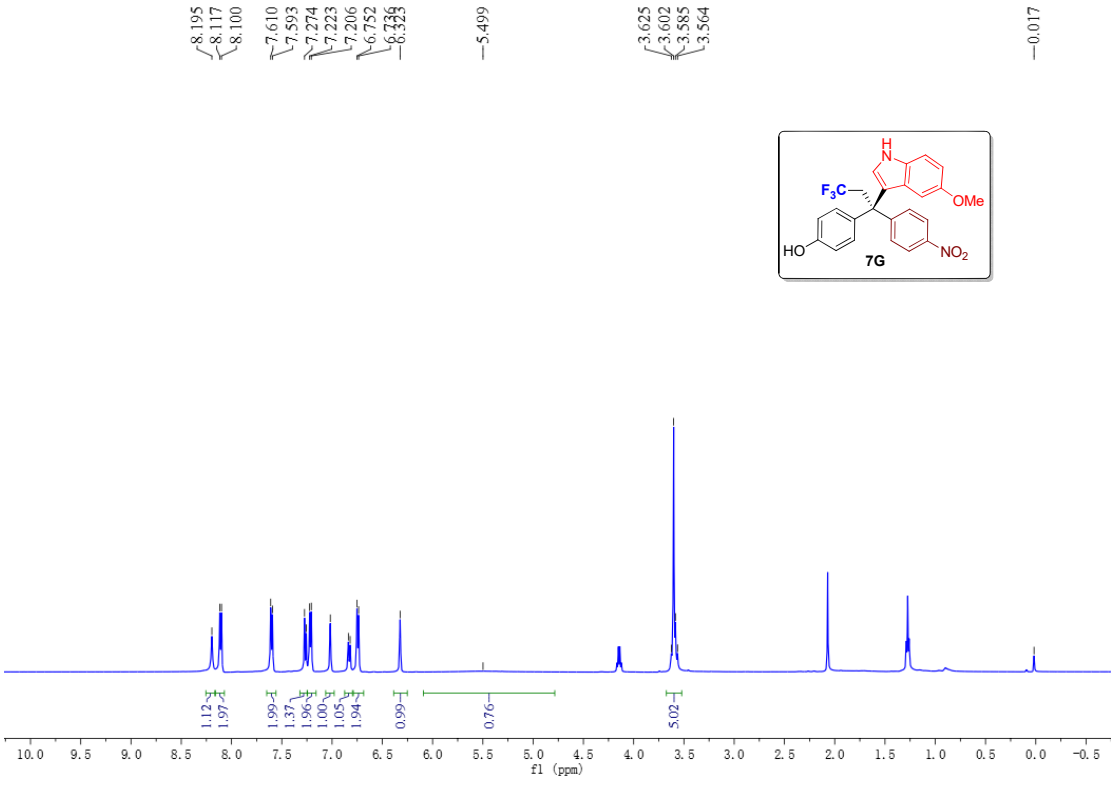
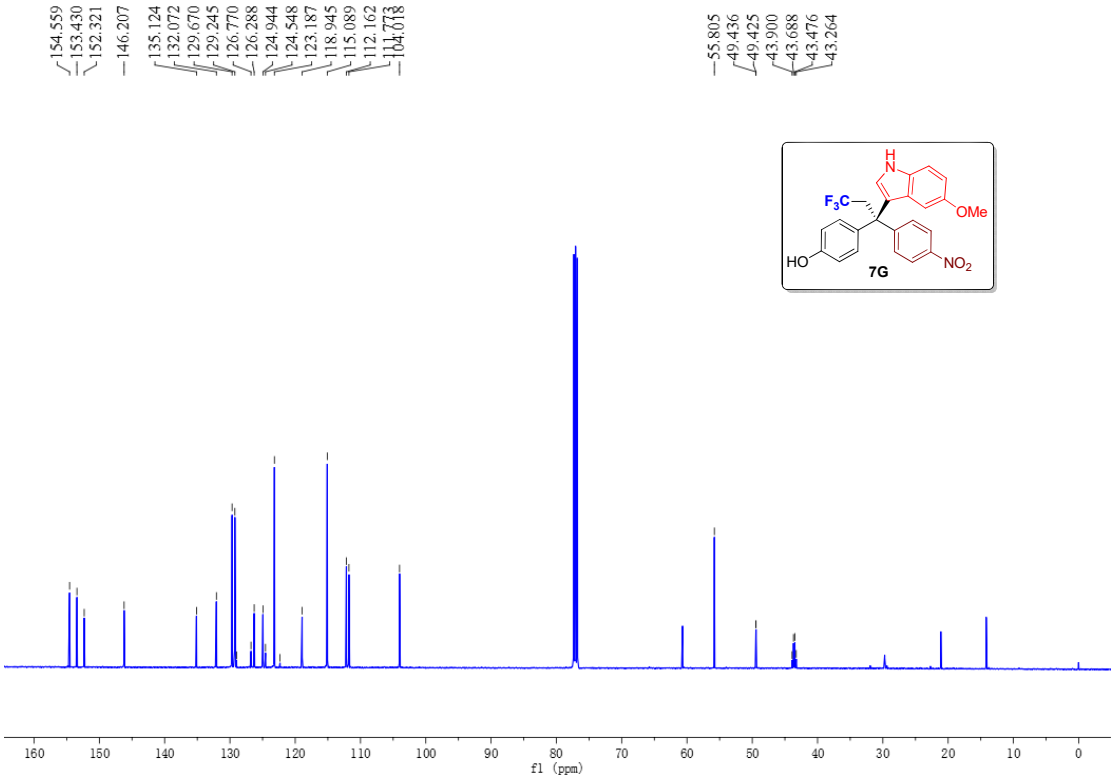
153.317
152.040
135.493
134.367
132.015
129.706
129.485
128.915
126.873
126.465
124.999
124.652
122.430
119.230
114.957
112.025
111.704
104.064
55.748
49.487
43.798
43.587
43.377
43.165
H
N
F3C
OMe
HO
CHO
7F
f1 (ppm)


-56.452
H
N
F3C
OMe
HO
CHO
7F
f1 (ppm)


8.195
8.117
8.100
7.610
7.593
7.274
7.223
7.206
6.752
6.736
6.323
5.499
3.625
3.602
3.585
3.564
0.017
H
N
F3C
OMe
HO
NO2
7G
1.12
1.97
1.99
1.37
1.96
1.00
1.05
1.94
0.99
0.76
5.02
f1 (ppm)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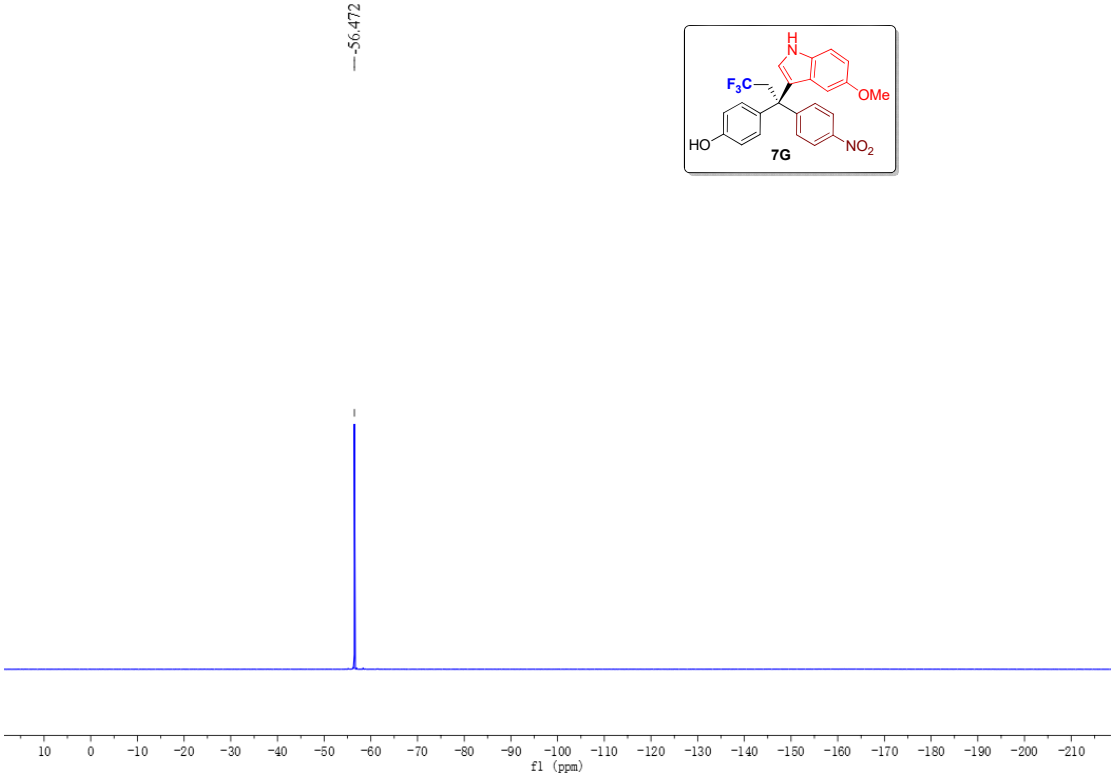
153.430
152.321
146.207
135.124
132.072
129.670
129.245
126.770
126.288
124.944
124.548
123.187
118.945
115.089
112.162
111.773
104.018
55.805
49.436
49.425
43.900
43.688
43.476
43.264
H
N
F3C
OMe
HO
NO2
7G
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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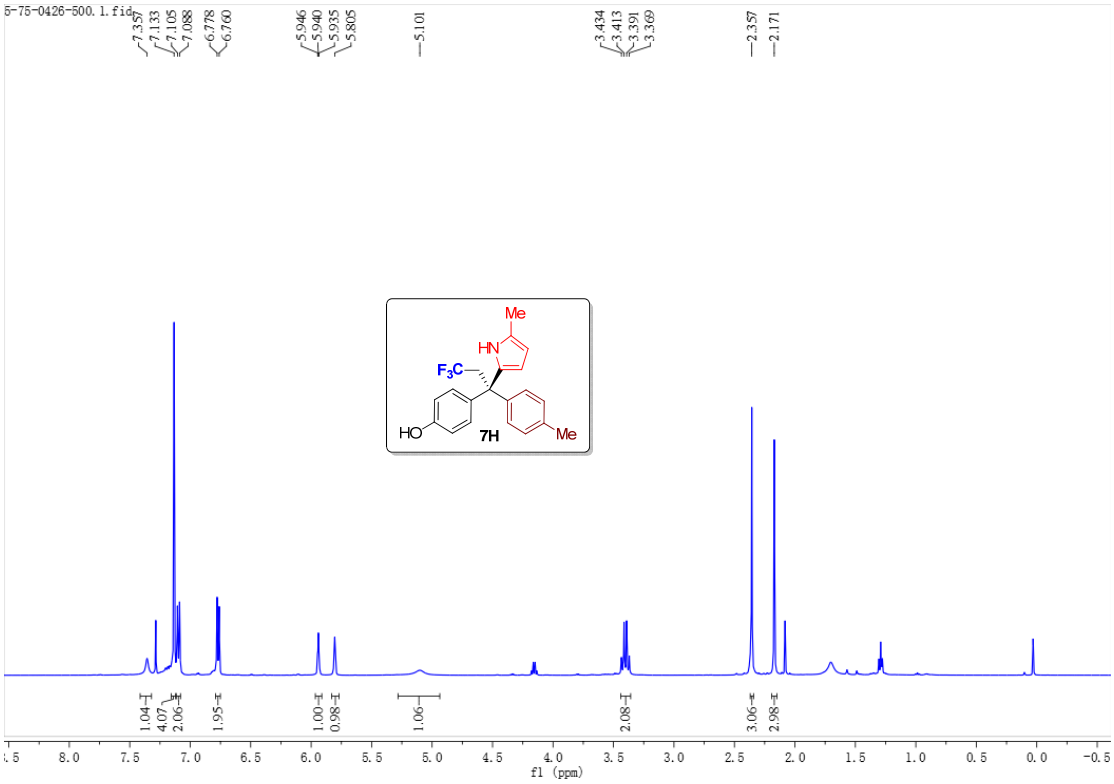
H
N
F3C
OMe
HO
NO2
7G
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)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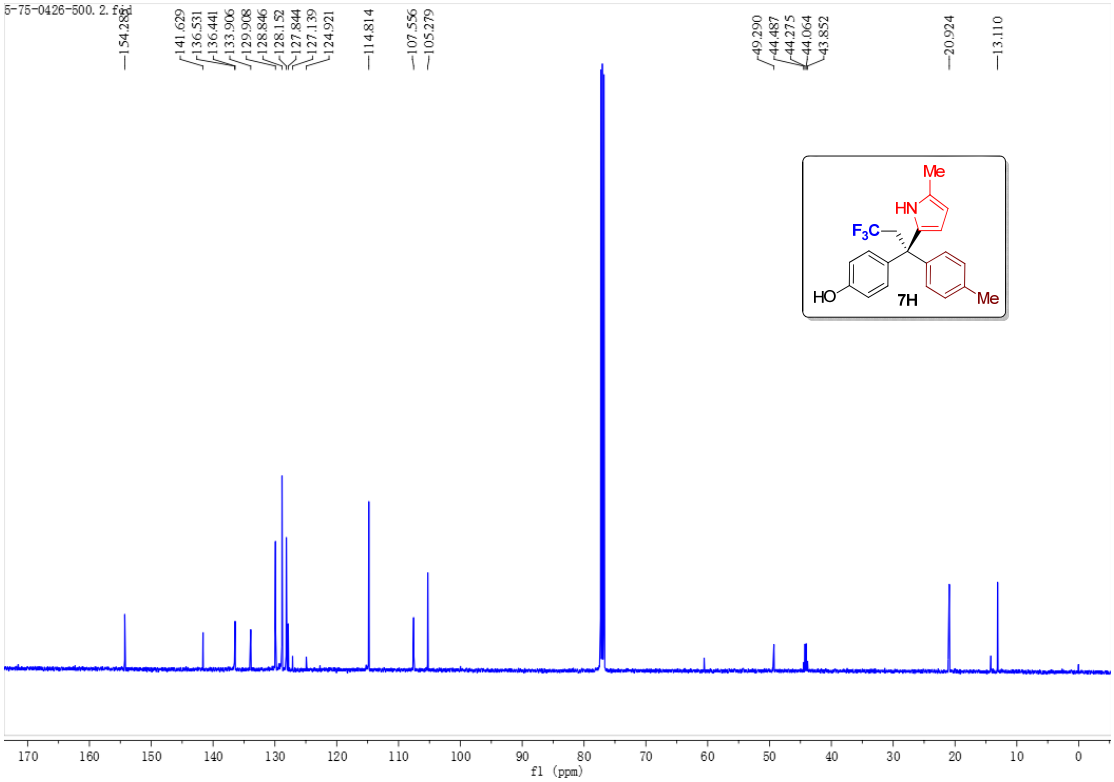
7.133
7.105
7.088
6.778
6.760
5.946
5.940
5.935
5.805
5.101
3.434
3.413
3.391
3.369
2.357
2.171
Me
HN
F3C
HO
7H
Me
1.04
4.07
2.06
1.95
1.00
0.98
1.06
2.08
3.06
2.98
f1 (ppm)


5-75-0426-500.2.fid
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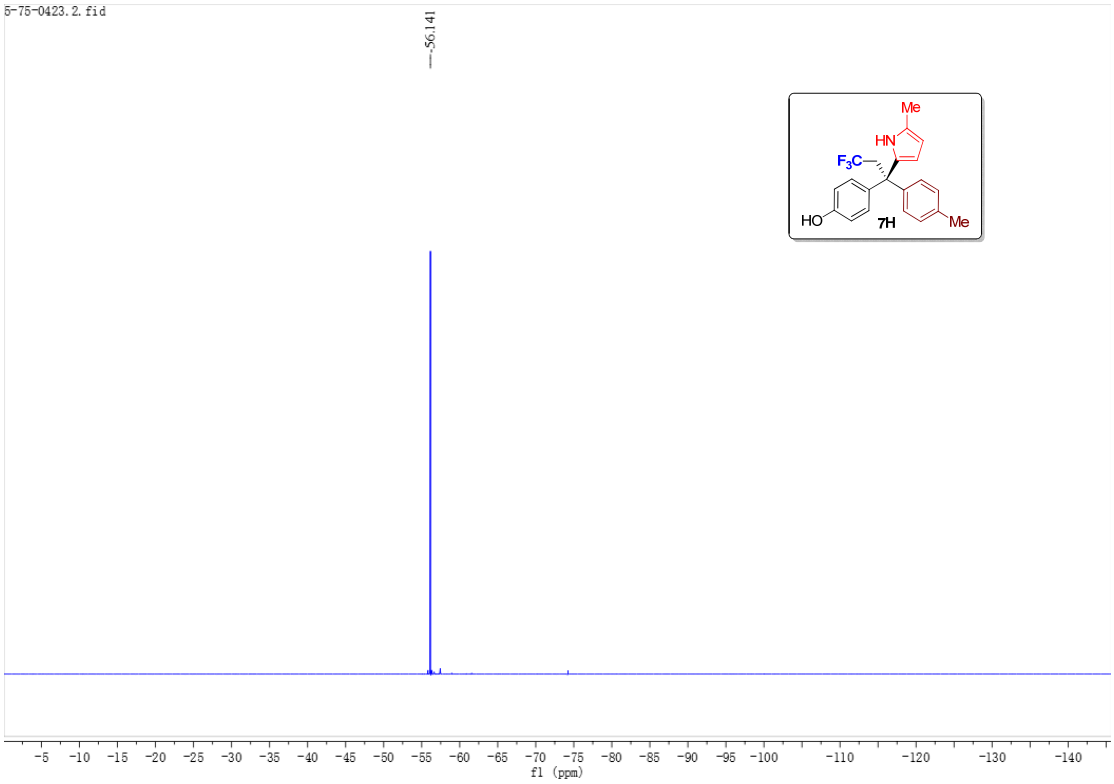
141.629
136.531
136.441
133.906
129.908
128.846
128.152
127.844
127.139
124.921
114.814
107.556
105.279
49.290
44.487
44.275
44.064
43.852
20.924
13.110
Me
HN
F3C
HO
7H
Me
f1 (ppm)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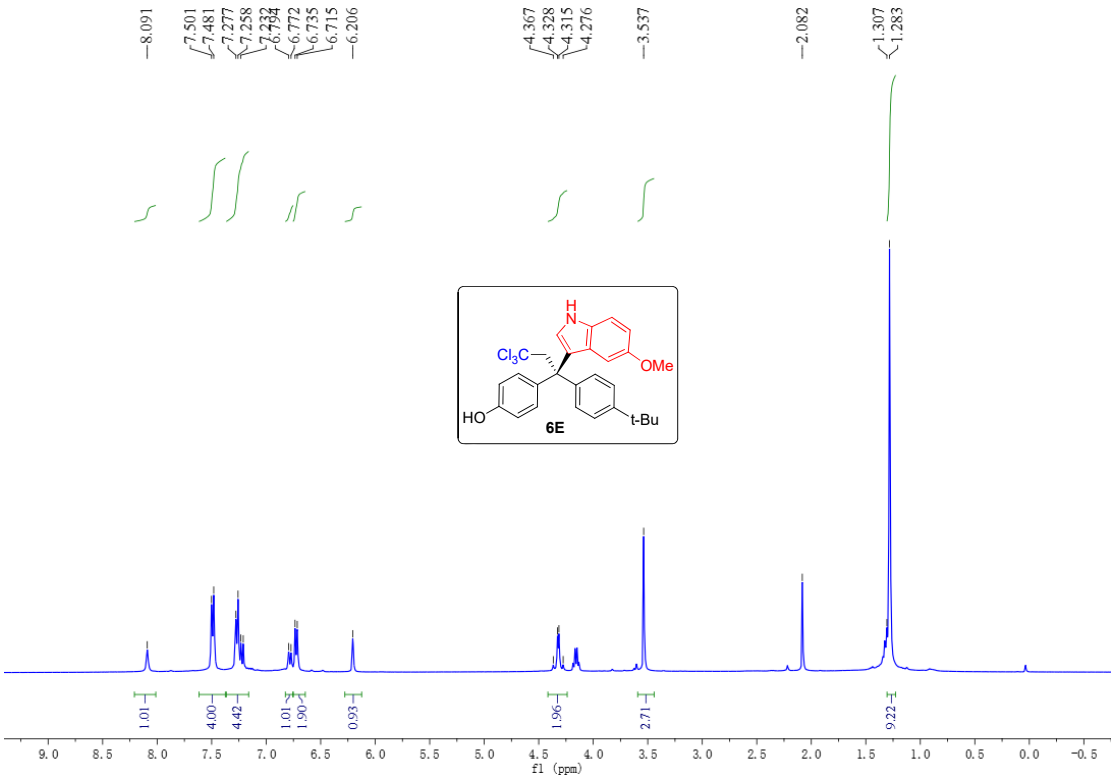
-56.141
Me
HN
F3C
HO
7H
Me
f1 (ppm)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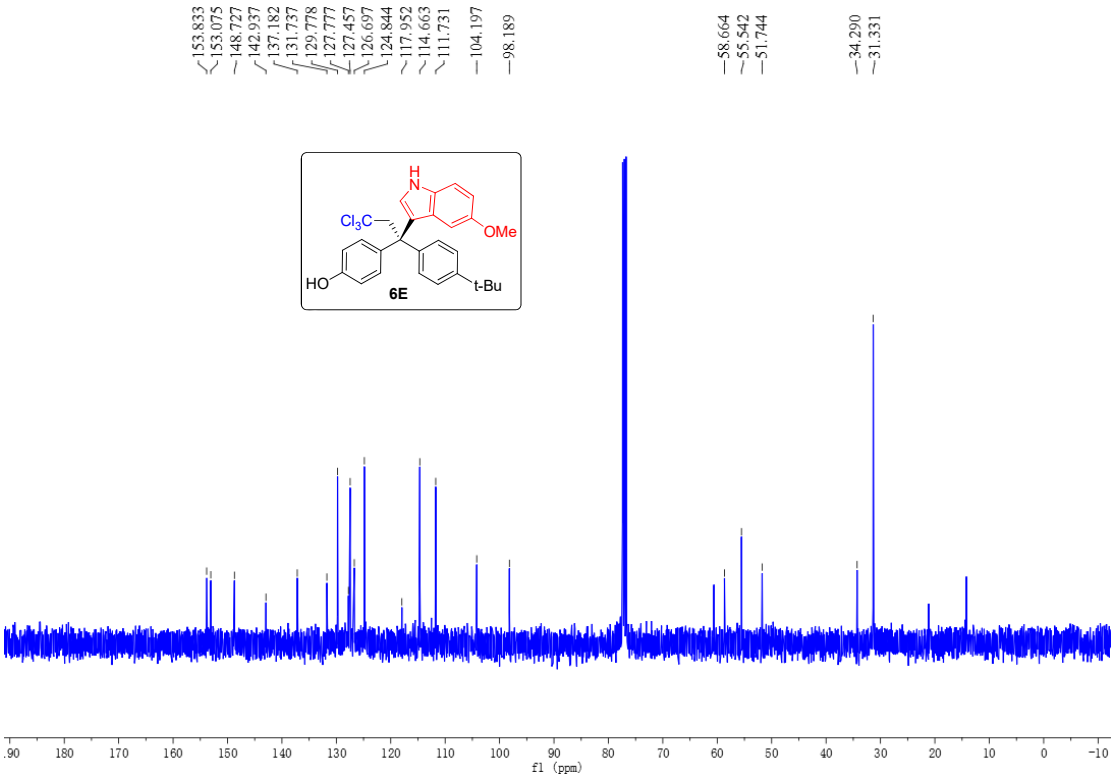
7.501
7.481
7.277
7.258
6.772
6.735
6.715
6.206
4.367
4.328
4.315
4.276
3.537
2.082
1.307
1.283
H
N
Cl3C
OMe
HO
t-Bu
6E
1.01
4.00
4.42
1.01
1.90
0.93
1.96
2.71
9.22
f1 (ppm)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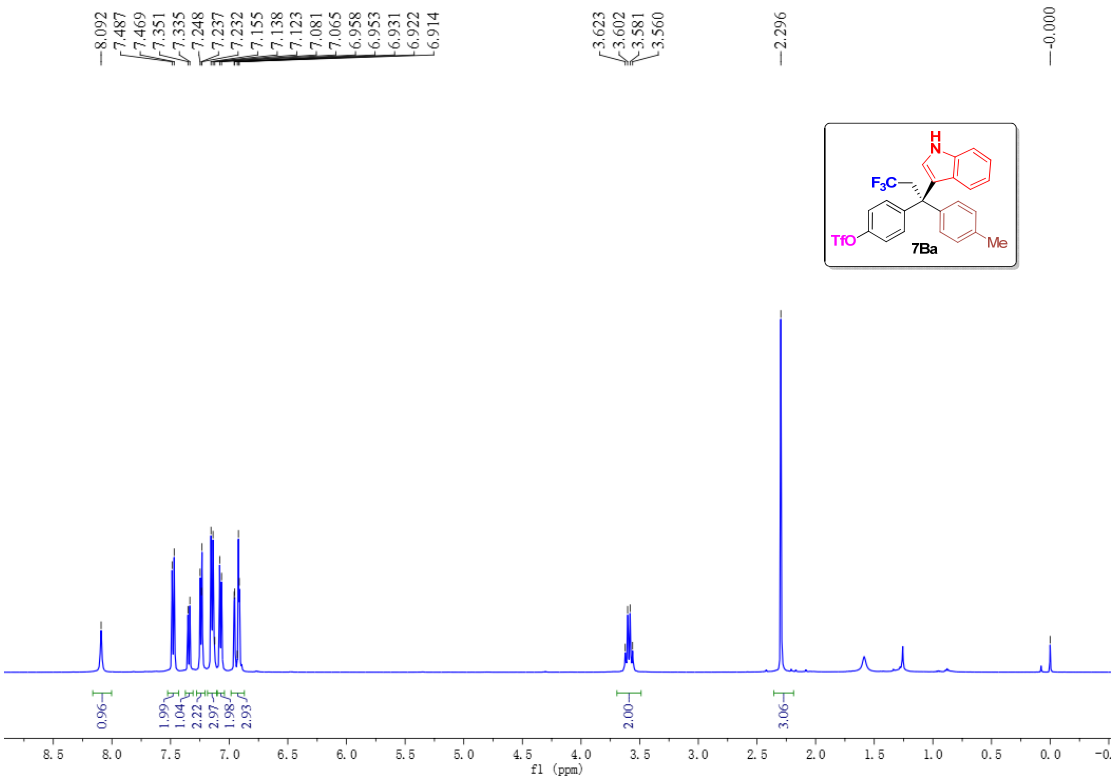
153.075
148.727
142.937
137.182
131.737
129.778
127.777
127.457
126.697
124.844
117.952
114.663
111.731
104.197
98.189
58.664
55.542
51.744
34.290
31.331
H
N
Cl3C
OMe
HO
t-Bu
6E
f1 (ppm)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7.469
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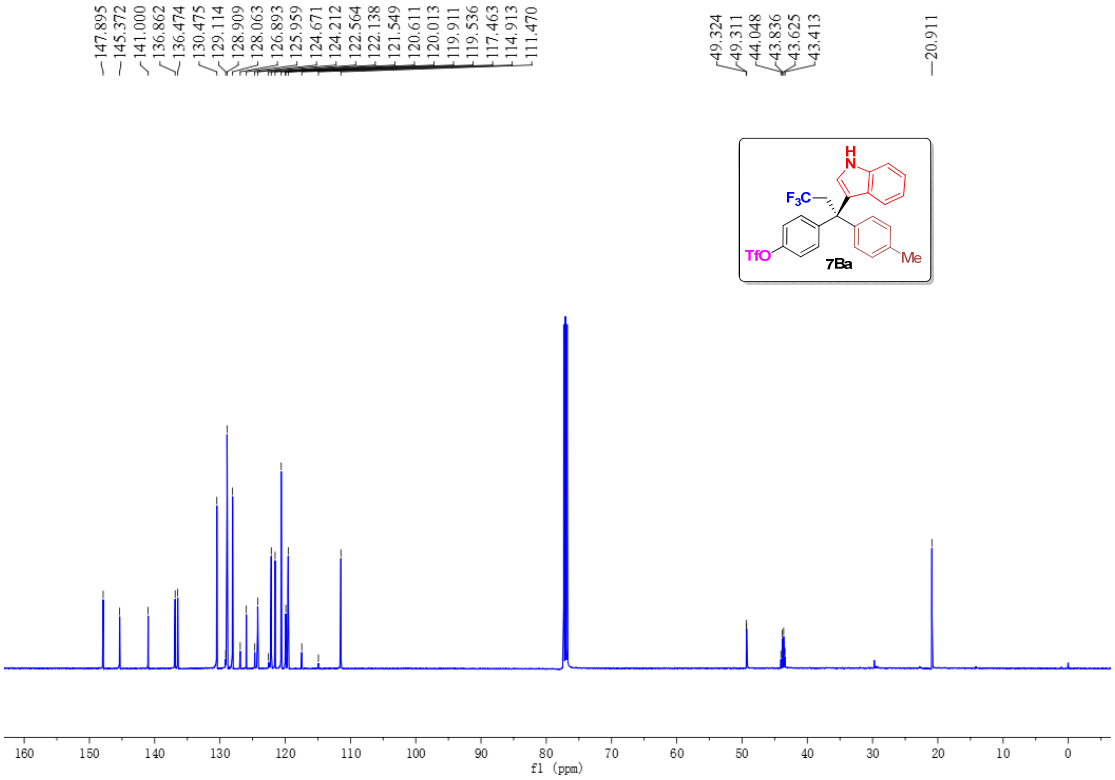
7.335
7.248
7.237
7.232
7.155
7.138
7.123
7.081
7.065
6.958
6.953
6.931
6.922
6.914
3.623
3.602
3.581
3.560
2.296
-0.000
H
N
F3C
TfO
Me
7Ba
0.96
1.99
1.04
2.22
2.97
1.98
2.93
2.00
3.06
f1 (ppm)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141.000
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136.474
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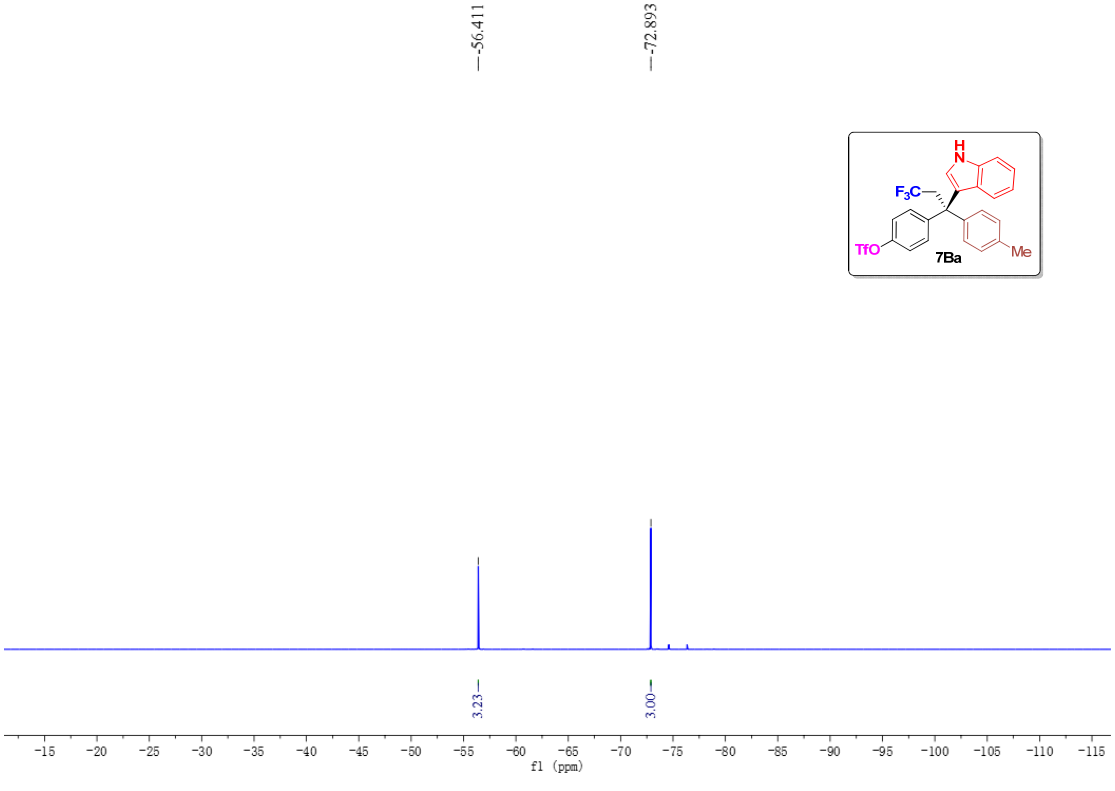
129.114
128.909
128.063
126.893
125.959
124.671
124.212
122.564
122.138
121.549
120.611
120.013
119.911
119.536
117.463
114.913
111.470
49.324
49.311
44.048
43.836
43.625
43.413
20.911
H
N
F3C
TfO
Me
7Ba
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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-72.893
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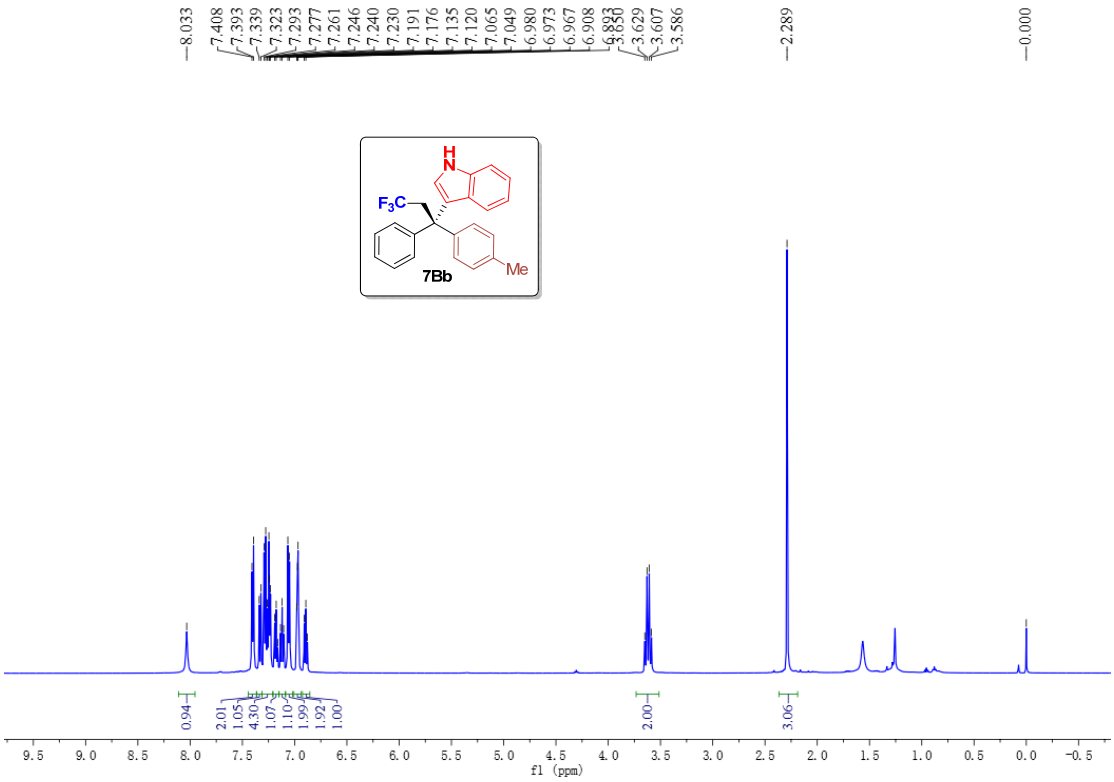
N
F3C
TfO
Me
7Ba
3.23
3.00
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
-85
-90
-95
-100
-105
-110
-115
f1 (ppm)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7.339
7.323
7.293
7.277
7.261
7.246
7.240
7.230
7.191
7.176
7.135
7.120
7.065
7.049
6.980
6.973
6.967
6.908
6.883
3.650
3.629
3.607
3.586
2.289
0.000
F3C
H
N
Me
7Bb
0.94
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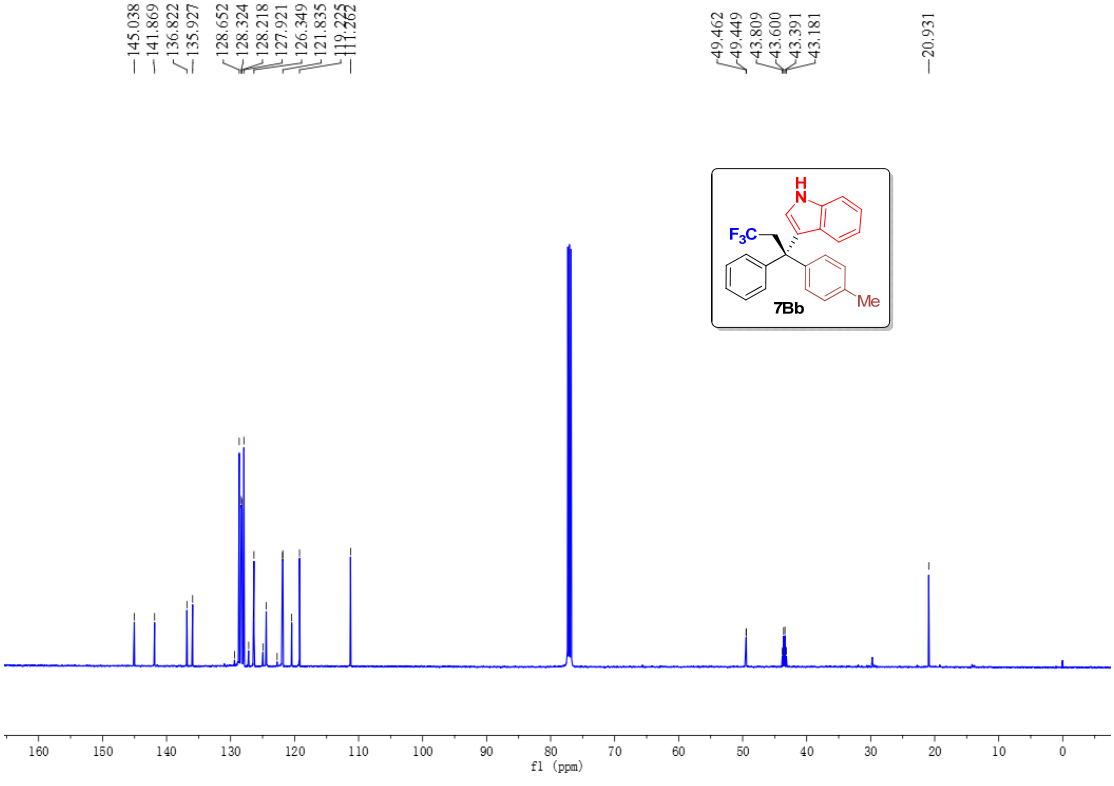
1.05
4.30
1.07
1.10
1.99
1.92
1.00
2.00
3.06
f1 (ppm)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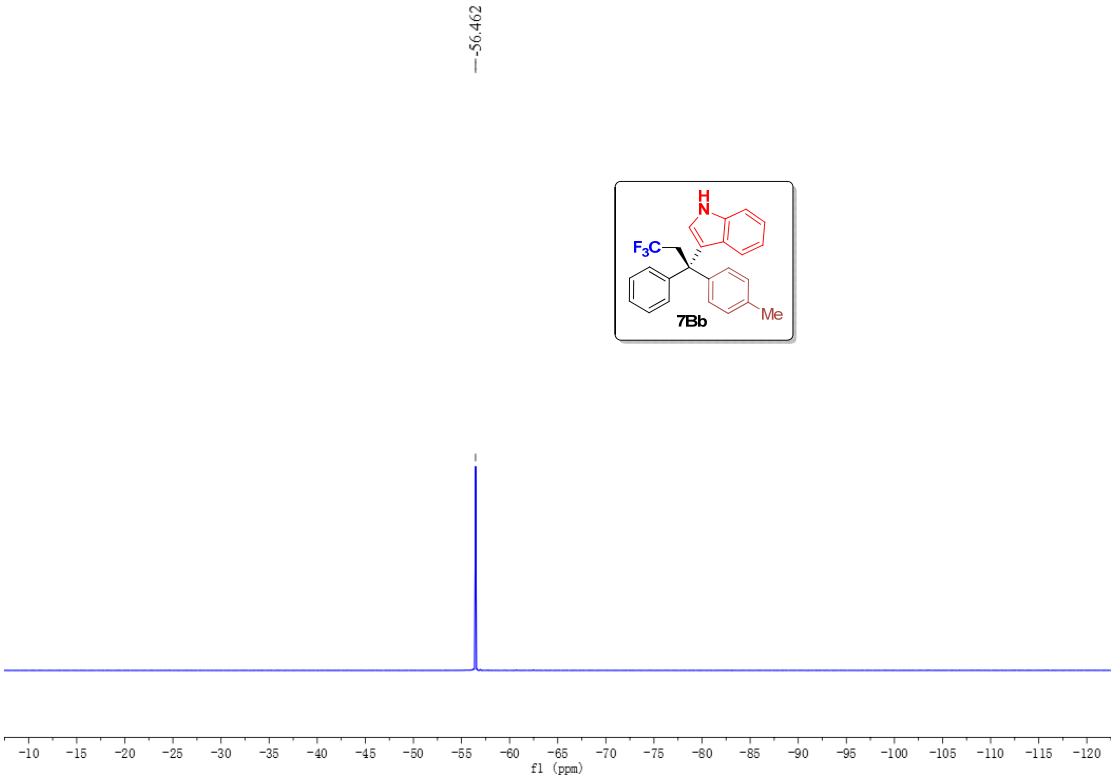
136.822
135.927
128.652
128.324
128.218
127.921
126.349
121.835
111.262
49.462
49.449
43.809
43.600
43.391
43.181
20.931
F3C
H
N
Me
7Bb
f1 (ppm)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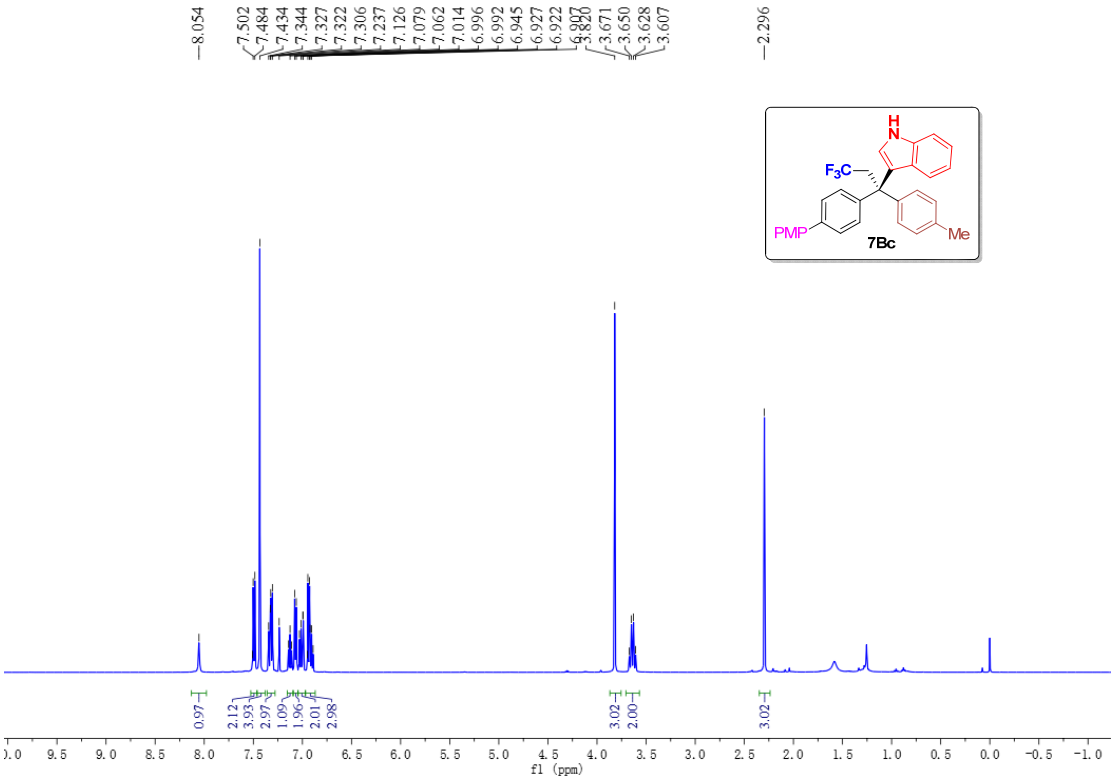
f1 (ppm)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7.344
7.327
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7.306
7.237
7.126
7.079
7.062
7.014
6.996
6.992
6.945
6.927
6.922
6.907
3.820
3.671
3.650
3.628
3.607
2.296
7Bc
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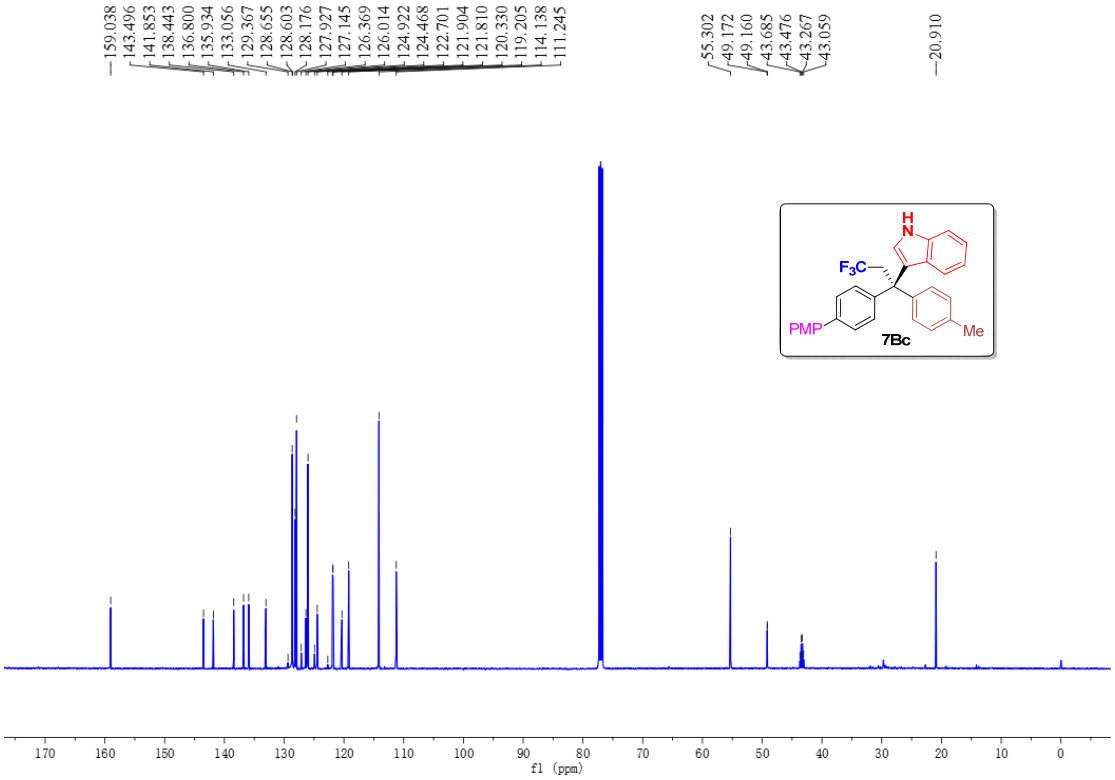
2.12
3.93
2.97
1.09
1.96
2.01
2.98
3.02
2.00
3.02
f1 (ppm)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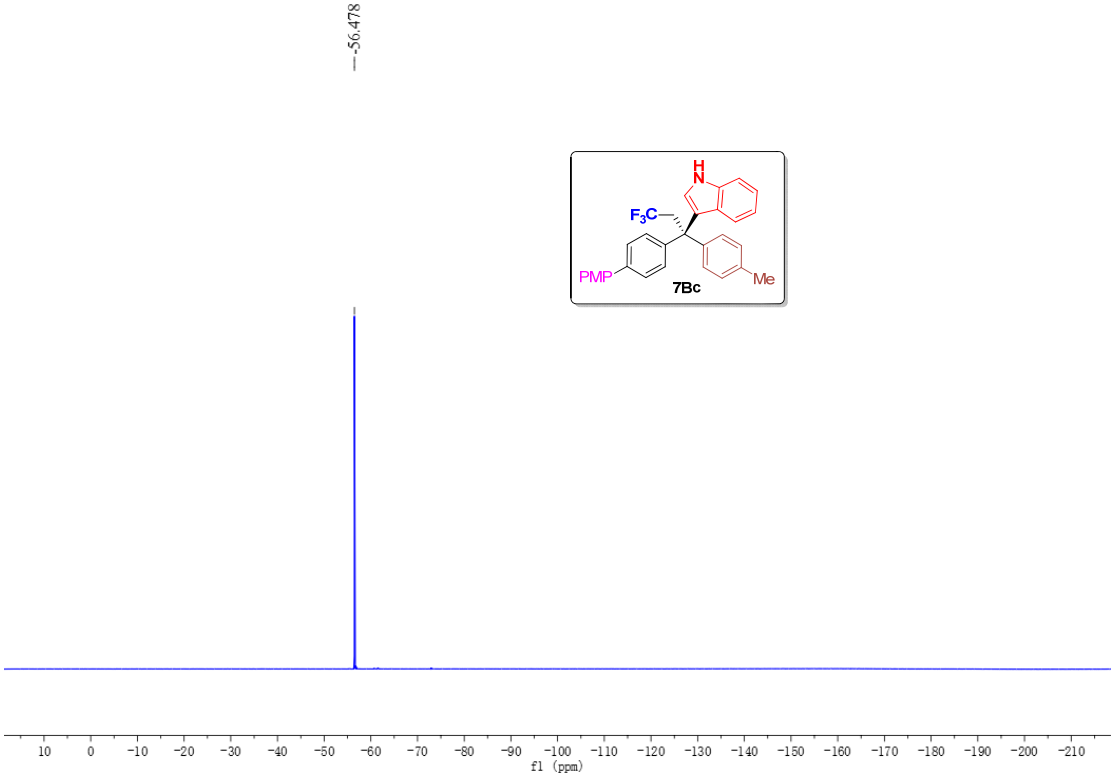
127.145
126.369
126.014
124.922
124.468
122.701
121.904
121.810
120.330
119.205
114.138
111.245
55.302
49.172
49.160
43.685
43.476
43.267
43.059
20.910
H
N
F3C
PMP
Me
7Bc
f1 (ppm)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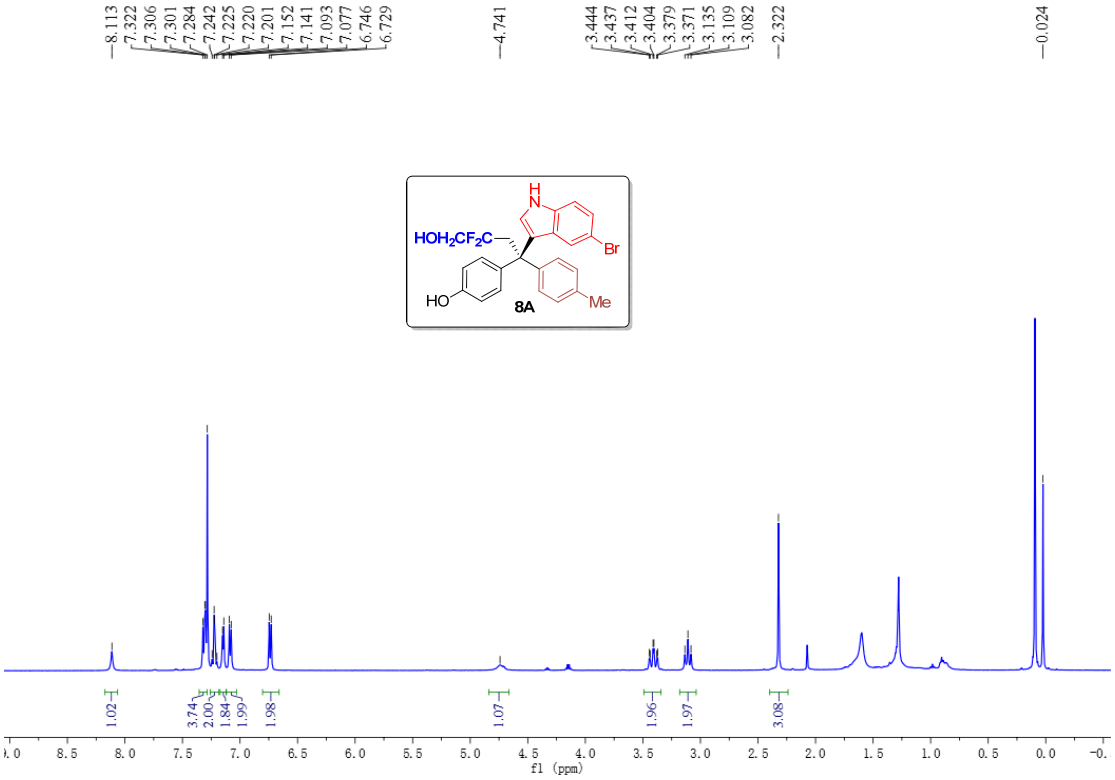
7Bc
f1 (ppm)


8.113
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7.306
7.301
7.284
7.242
7.225
7.220
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7.152
7.141
7.093
7.077
6.746
6.729
4.741
3.444
3.437
3.412
3.404
3.379
3.371
3.135
3.109
3.082
2.322
0.024
HOH2CF2C
Br
HO
Me
8A
1.02
3.74
2.00
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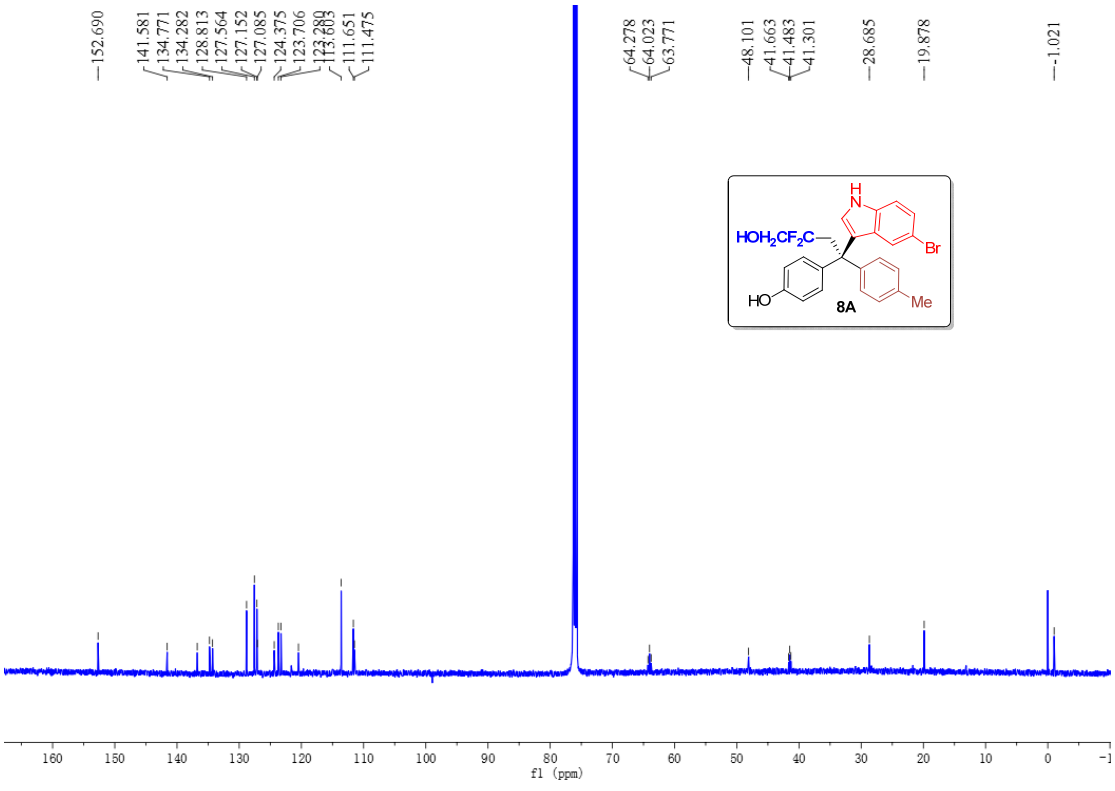
1.99
1.98
1.07
1.96
1.97
3.08
f1 (ppm)


152.690
141.581
134.771
134.282
128.813
127.564
127.152
127.085
124.375
123.706
123.280
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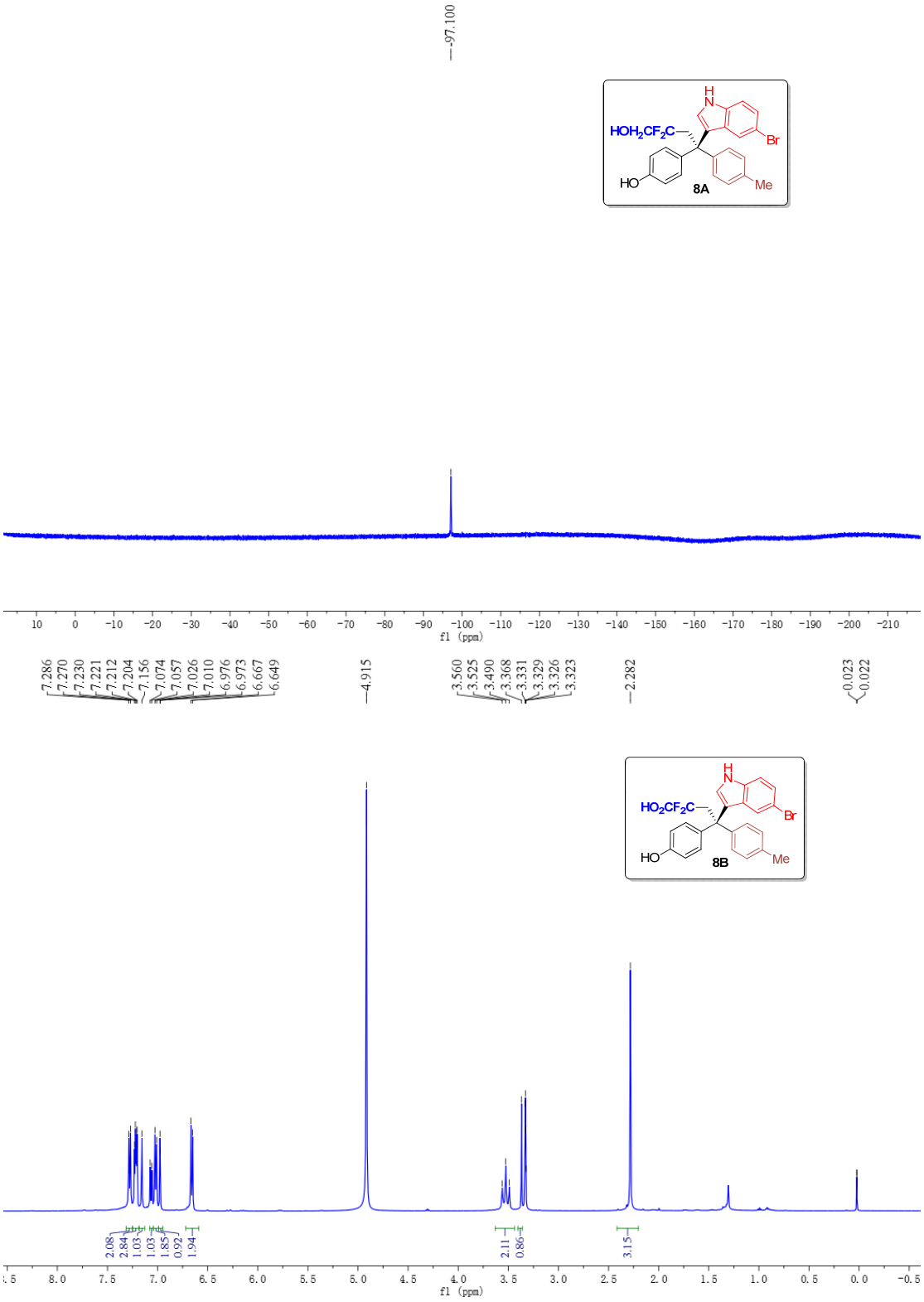
111.651
111.475
64.278
64.023
63.771
48.101
41.663
41.483
41.301
28.685
19.878
1.021
HOH2CF2C
Br
HO
Me
8A
f1 (ppm)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HOH2CF2C
Br
HO
Me
8A
f1 (ppm)
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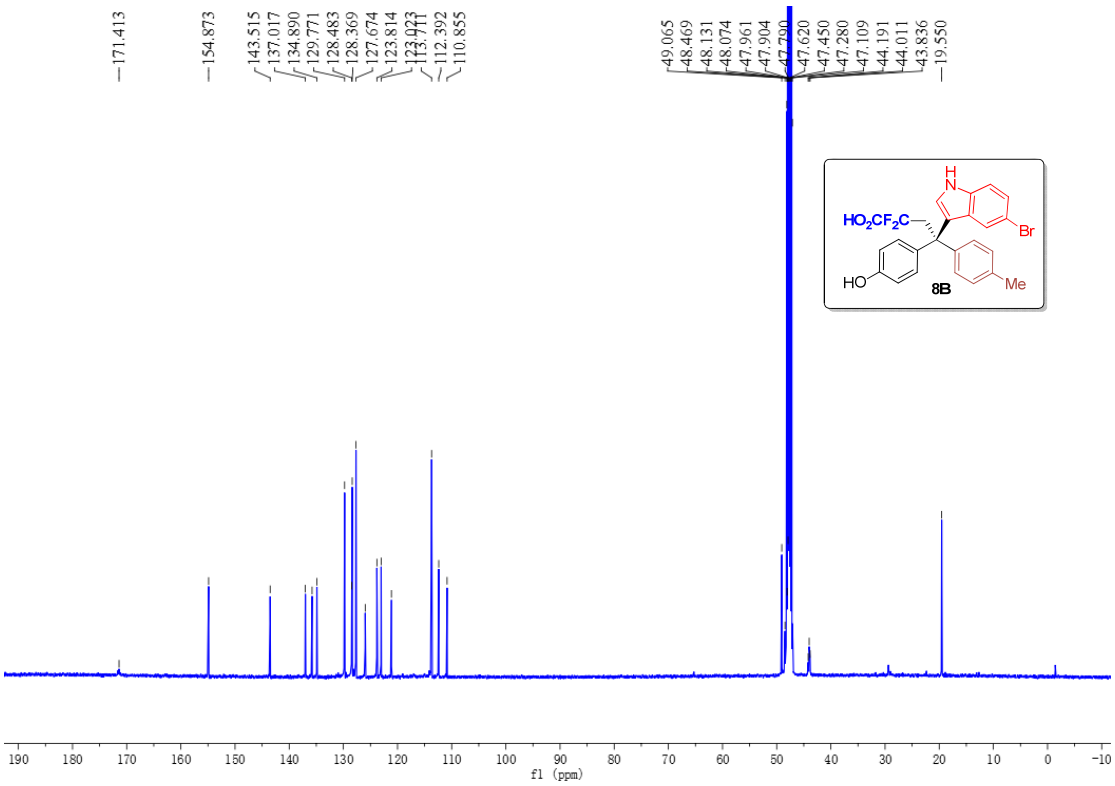
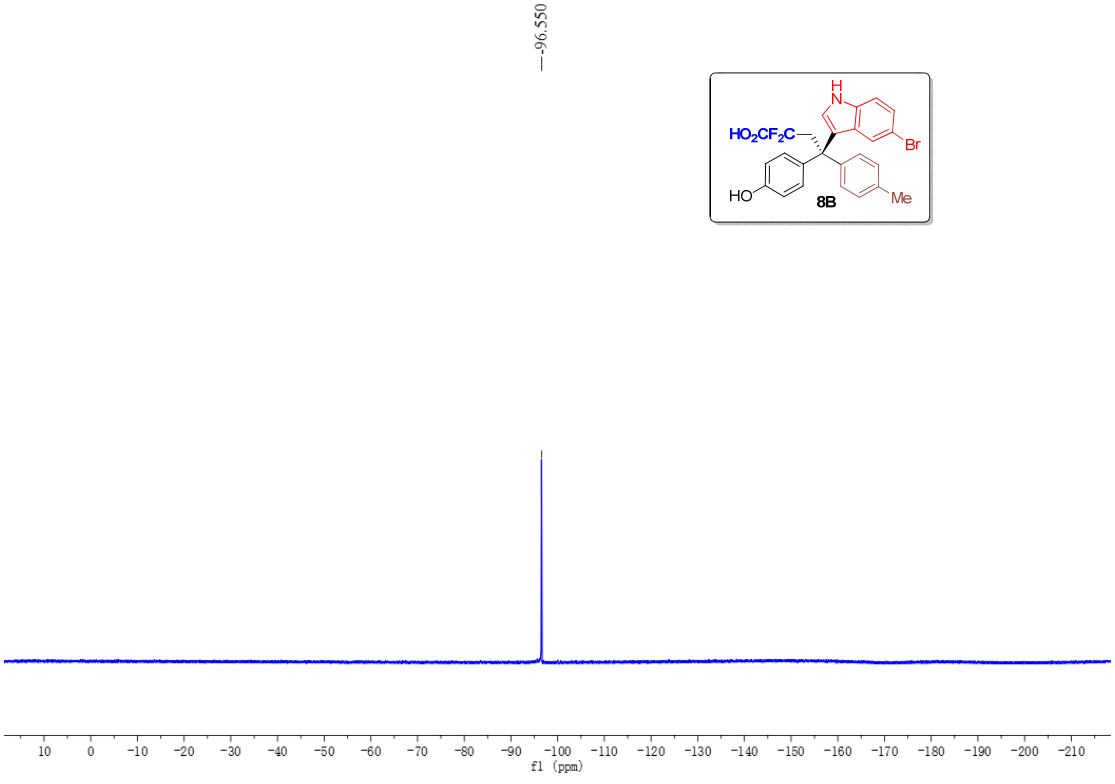
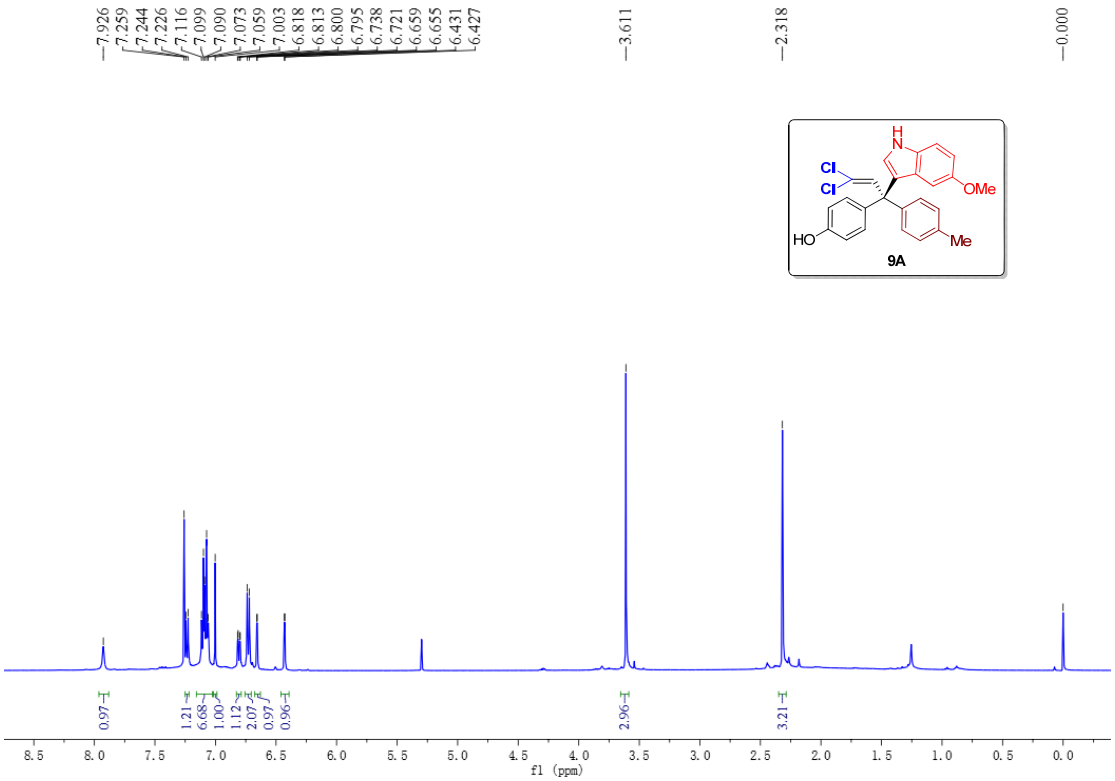
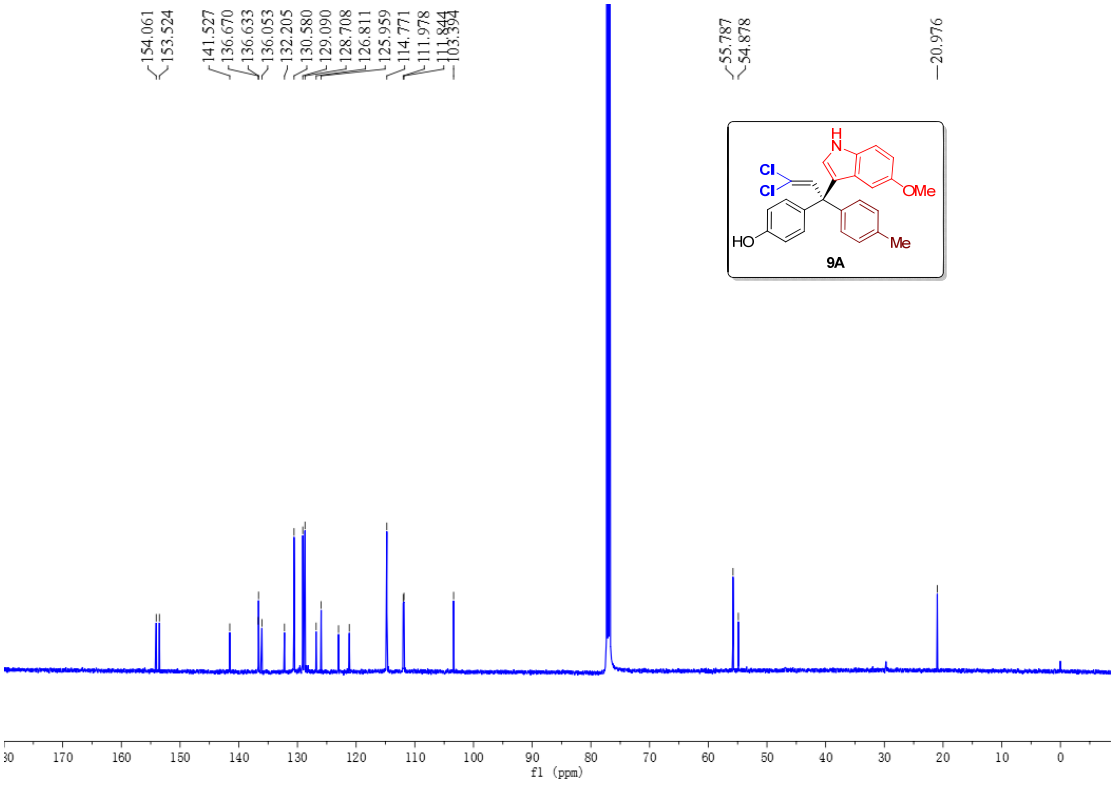
7.270
7.230
7.221
7.212
7.204
7.156
7.074
7.057
7.026
7.010
6.976
6.973
6.667
6.649
4.915
3.560
3.525
3.490
3.368
3.331
3.329
3.326
3.323
2.282
0.023
0.022
HO2CF2C
Br
HO
Me
8B
2.08
2.84
1.03
1.03
1.85
0.92
1.94
2.11
0.86
3.15
f1 (ppm)

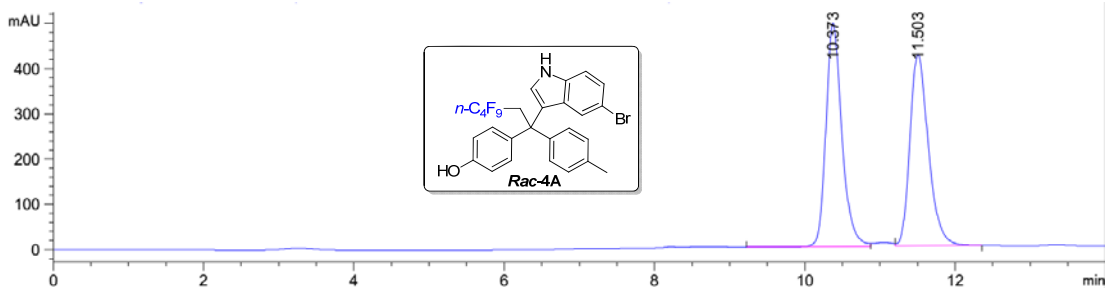

171.413
154.873
143.515
137.017
134.890
129.771
128.483
128.369
127.674
123.814
112.392
110.855
49.065
48.469
48.131
48.074
47.961
47.904
47.620
47.450
47.280
47.109
44.191
44.011
43.836
19.550
HO2CF2C
Br
HO
Me
8B
f1 (ppm)


-96.550
HO2CF2C
Br
HO
Me
8B
f1 (ppm)


7.926
7.259
7.244
7.226
7.116
7.099
7.090
7.073
7.059
7.003
6.818
6.813
6.800
6.795
6.738
6.721
6.659
6.655
6.431
6.427
3.611
2.318
0.000
Cl
Cl
OMe
HO
Me
9A
0.97
1.21
6.68
1.00
1.12
2.07
0.97
0.96
2.96
3.21
f1 (ppm)

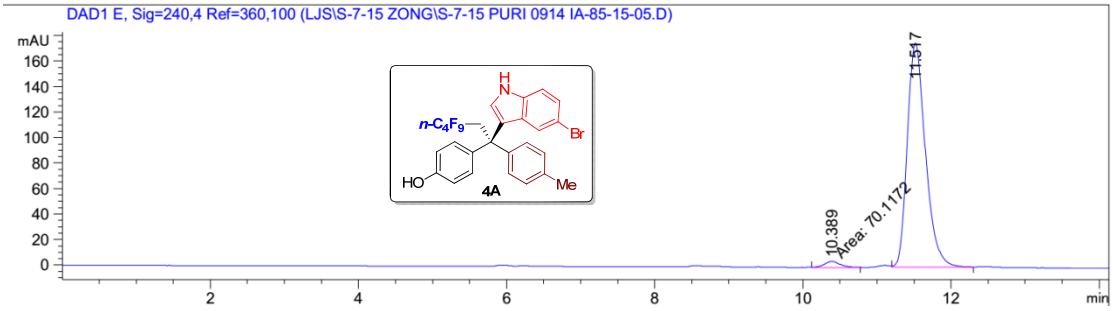

154.061
153.524
141.527
136.670
136.633
136.053
132.205
130.580
129.090
128.708
126.811
125.959
114.771
111.978
111.844
103.394
55.787
54.878
20.976
Cl
Cl
OMe
HO
Me
9A
f1 (ppm)

HPLC spectra



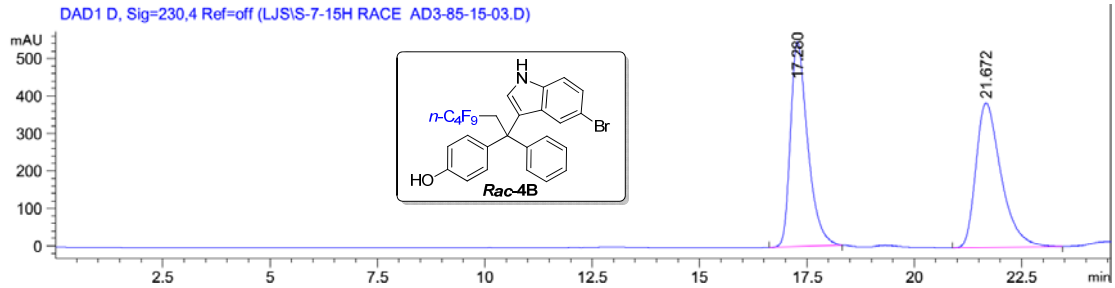
Signal 5: DAD1 E, Sig=240,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.373	BV	0.2215	7246.45947	492.84589	50.0920
2	11.503	VB	0.2612	7219.85547	422.80692	49.9080
Totals :				1.44663e4	915.65280	



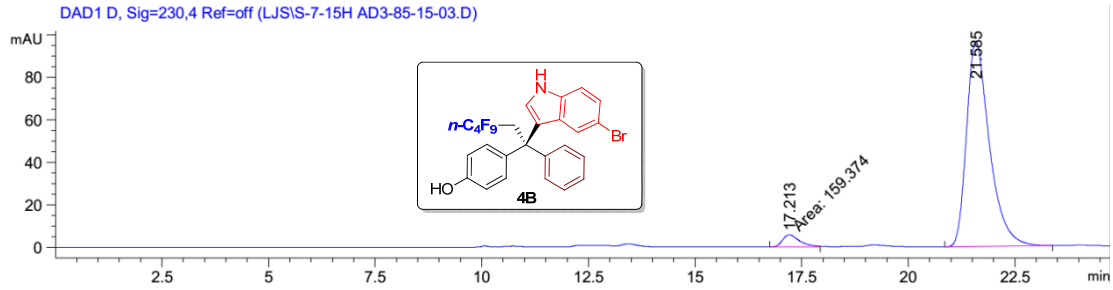
Signal 5: DAD1 E, Sig=240,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.389	FM	0.2491	70.11725	4.69105	2.2891
2	11.517	VB	0.2625	2992.93237	175.86555	97.7109
Totals :				3063.04962	180.55660	



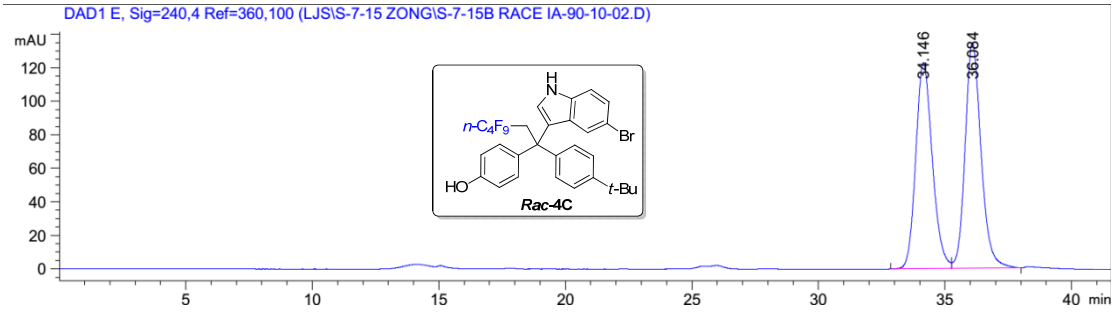
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.280	BB	0.4176	1.52739e4	547.25378	49.3563
2	21.672	BB	0.6186	1.56723e4	385.25958	50.6437
Totals :				3.09463e4	932.51337	



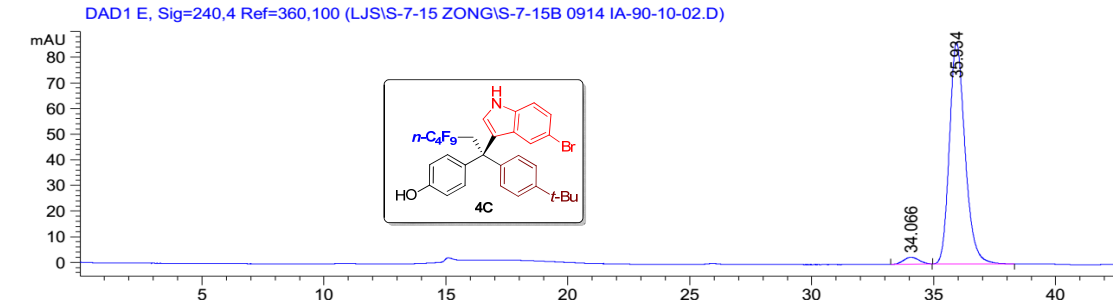
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.213	MF	0.4647	159.37355	5.71635	4.2212
2	21.585	BB	0.5597	3616.16211	96.82339	95.7788
Totals :				3775.53566	102.53974	



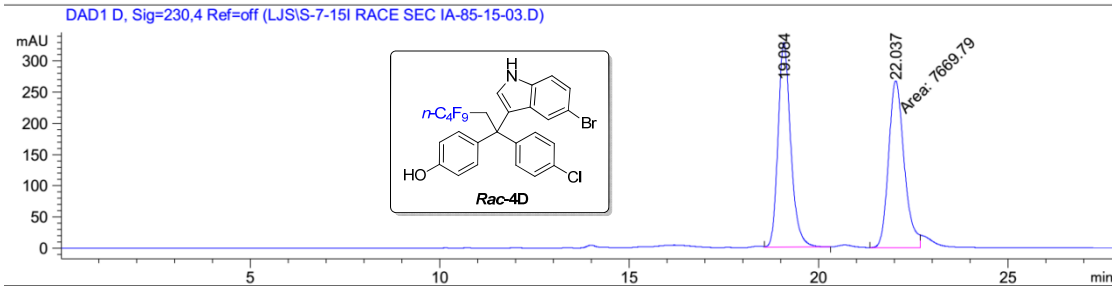
Signal 5: DAD1 E, Sig=240,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	34.146	BV	0.7007	5596.82813	123.02785	48.6717
2	36.084	VB	0.6677	5902.32471	134.56389	51.3283
Totals :				1.14992e4	257.59174	



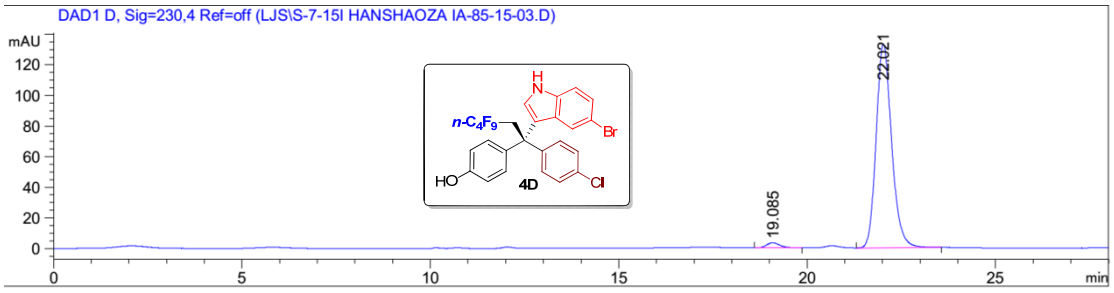
Signal 5: DAD1 E, Sig=240,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	34.066	BB	0.5648	118.31023	2.70209	2.9847
2	35.934	BB	0.6813	3845.59131	86.39652	97.0153
Totals :				3963.90154	89.09861	



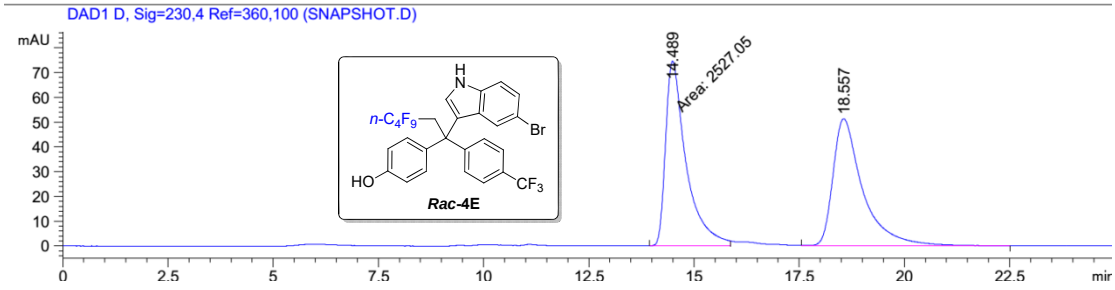
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.084	VB	0.3582	7664.07861	328.44595	49.9814
2	22.037	MF	0.4779	7669.79102	267.47556	50.0186
Totals :				1.53339e4	595.92151	



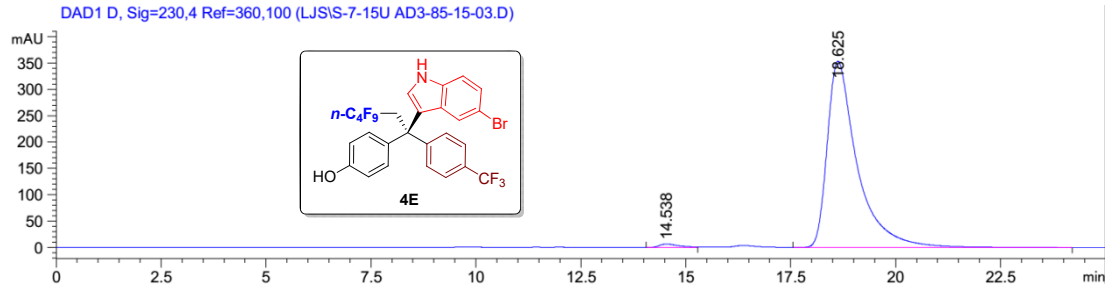
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.085	BB	0.3730	83.45928	3.39248	2.1507
2	22.021	BB	0.4347	3797.17871	133.17070	97.8493
Totals :				3880.63799	136.56318	



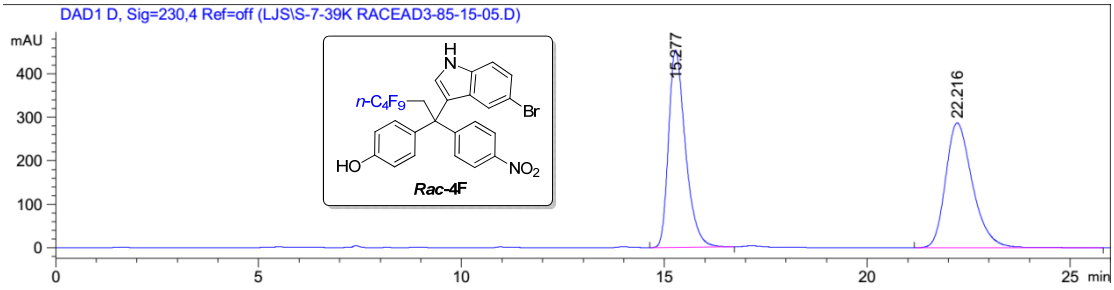
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.489	MF	0.5650	2527.04639	74.53927	49.9710
2	18.557	VB	0.7233	2529.98291	51.30322	50.0290
Totals :				5057.02930	125.84249	



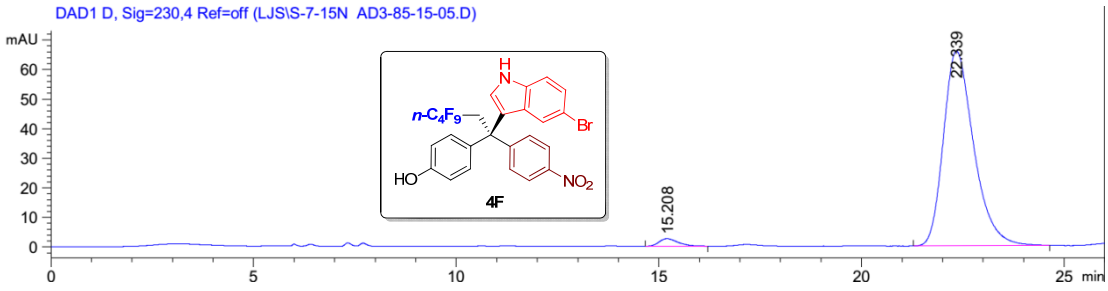
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.538	BV	0.4782	214.35159	6.61148	1.2050
2	18.625	BB	0.7291	1.75746e4	352.85519	98.7950
Totals :				1.77889e4	359.46668	



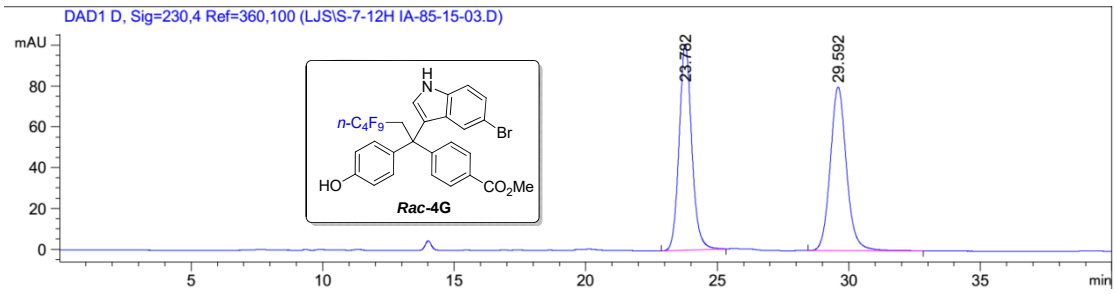
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.277	BB	0.4375	1.31420e4	454.22736	49.8587
2	22.216	BB	0.7068	1.32165e4	287.25797	50.1413
Totals :				2.63585e4	741.48532	



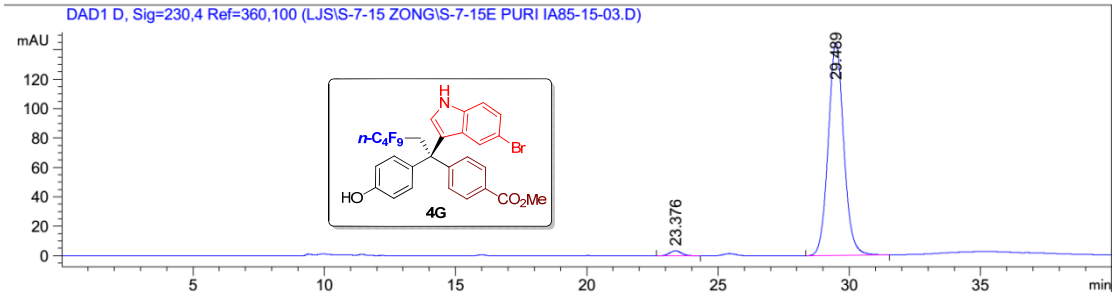
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.208	BB	0.4010	82.91225	2.55231	2.3645
2	22.339	BB	0.7863	3423.65332	65.87541	97.6355
Totals :				3506.56557	68.42772	



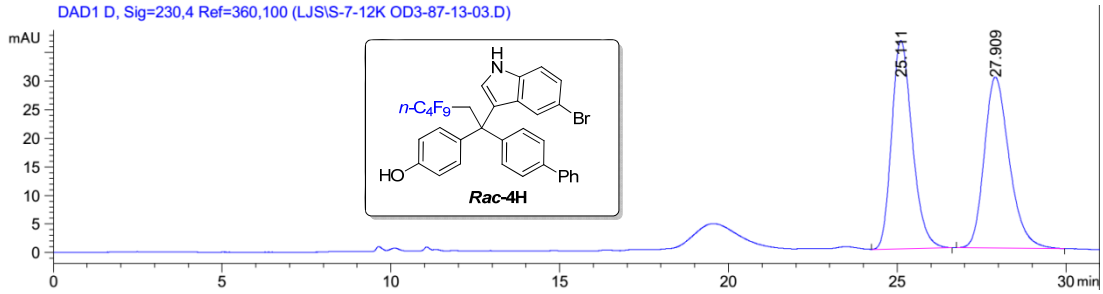
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	23.782	BB	0.5066	3360.12354	100.89011	49.4070
2	29.592	BB	0.6564	3440.77710	80.22123	50.5930
Totals :				6800.90063	181.11134	



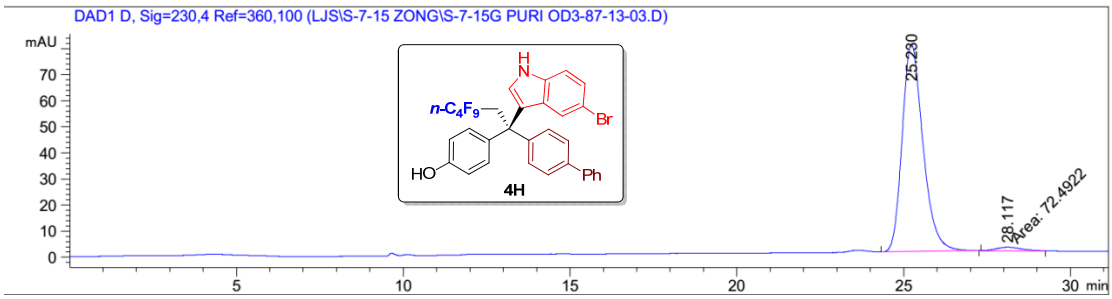
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	23.376	BB	0.4628	112.02116	3.50561	1.8482
2	29.489	BB	0.6278	5948.92188	144.64386	98.1518
Totals :				6060.94303	148.14947	



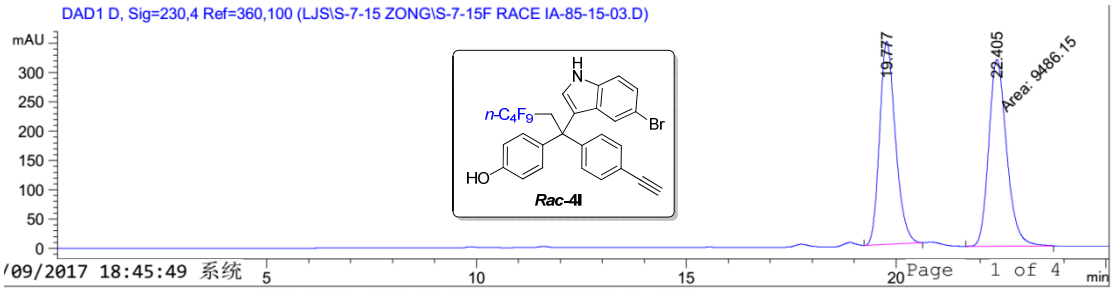
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	25.111	BB	0.6511	1547.42676	36.46709	50.0593
2	27.909	BB	0.7841	1543.76282	29.91044	49.9407
Totals :				3091.18958	66.37753	



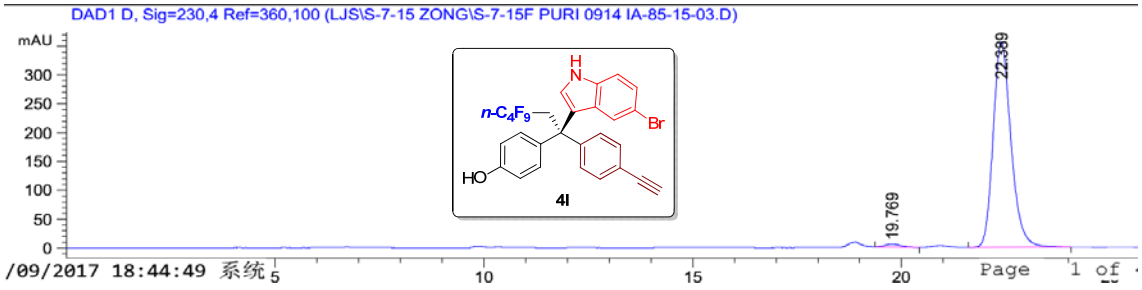
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	25.230	BB	0.6617	3442.90210	79.43047	97.9379
2	28.117	MM	0.8817	72.49220	1.37031	2.0621
Totals :				3515.39429	80.80078	



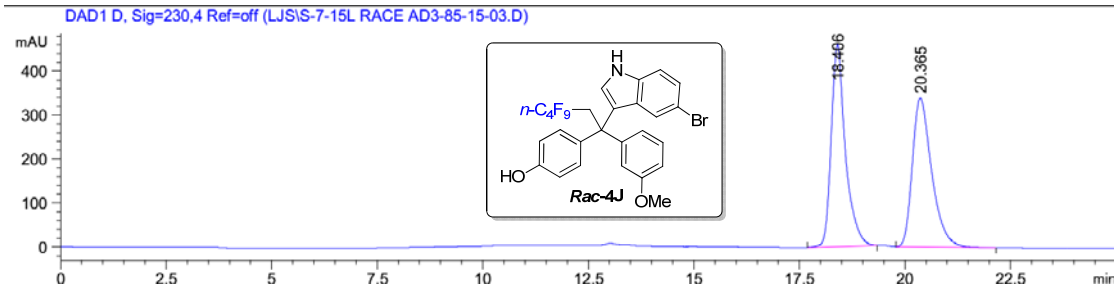
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.777	BB	0.3998	9086.50781	346.69034	48.9241
2	22.405	MF	0.4956	9486.15137	319.01028	51.0759
Totals :				1.85727e4	665.70062	



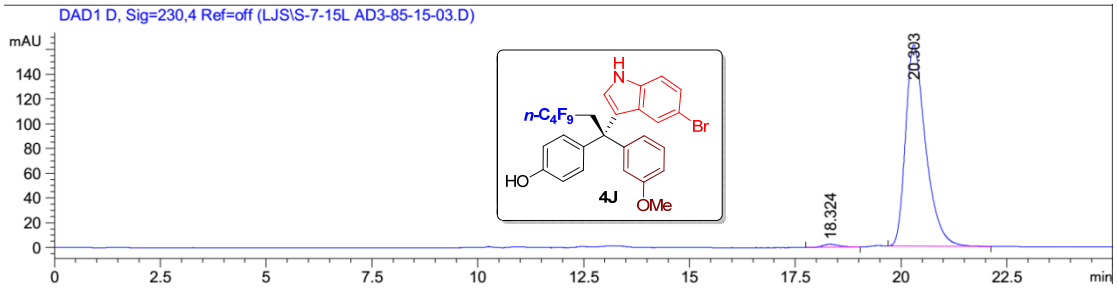
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.769	BB	0.3714	135.88611	5.55388	1.2714
2	22.389	BB	0.4518	1.05522e4	355.99057	98.7286
Totals :				1.06881e4	361.54445	



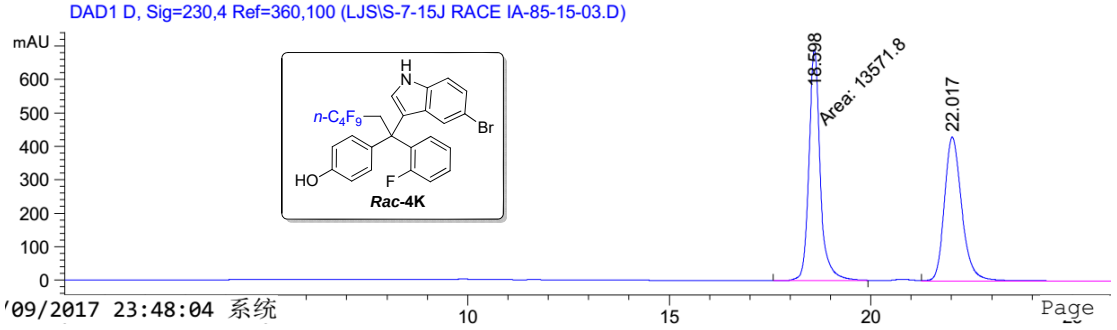
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	18.406	BB	0.3419	1.07138e4	459.63275	49.8999
2	20.365	BB	0.4724	1.07568e4	338.78400	50.1001
Totals :				2.14706e4	798.41675	



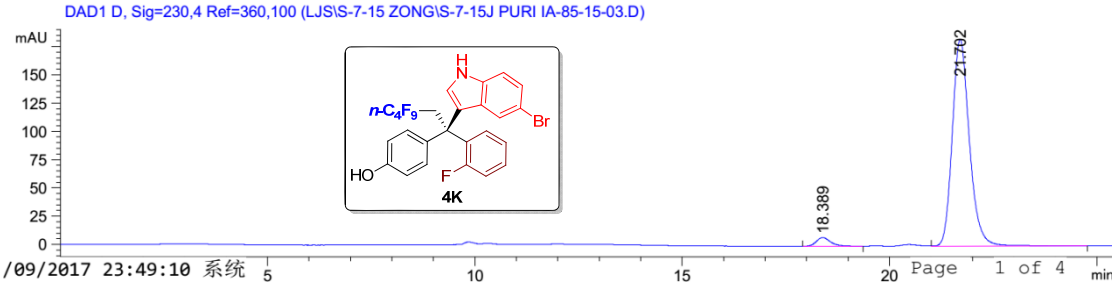
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	18.324	BB	0.3318	68.52231	2.51536	1.2598
2	20.303	BB	0.4994	5370.48193	162.57887	98.7402
Totals :				5439.00424	165.09423	



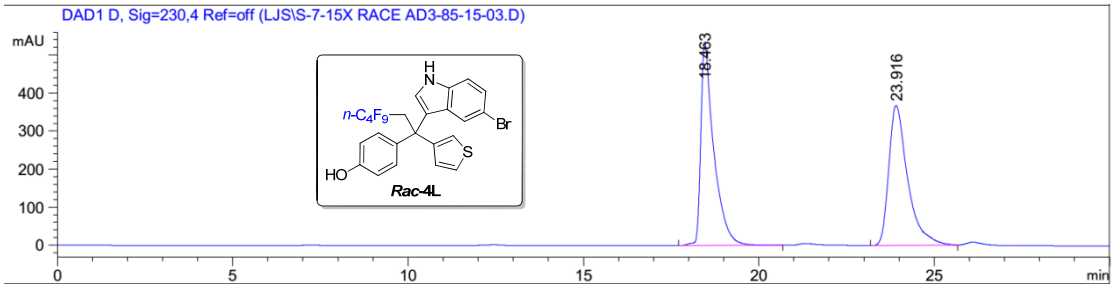
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	18.598	MF	0.3270	1.35718e4	691.72754	51.1049
2	22.017	VB	0.4634	1.29850e4	431.15488	48.8951
Totals :				2.65568e4	1122.88242	



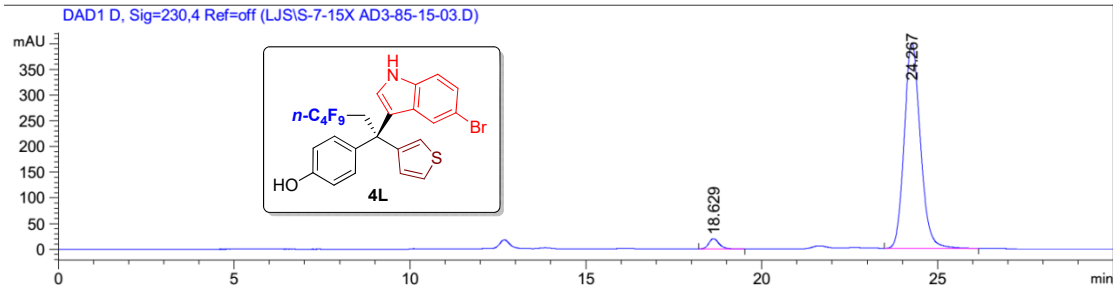
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	18.389	BB	0.3672	183.75833	7.67755	3.3843
2	21.702	VB	0.4427	5245.96289	182.85039	96.6157



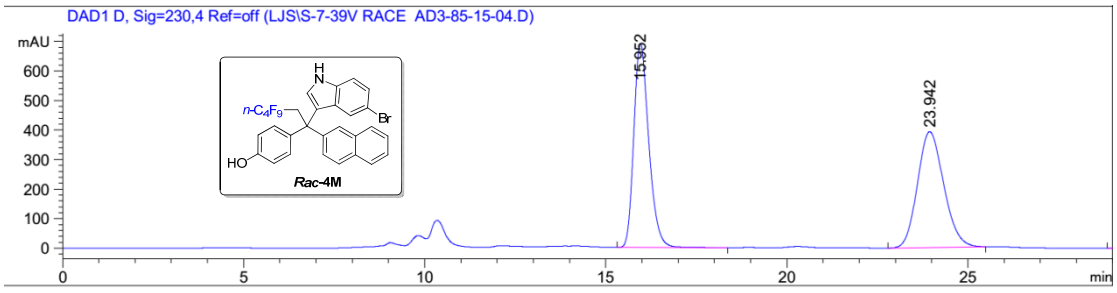
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	18.463	BB	0.3637	1.37237e4	534.14832	49.9226
2	23.916	BB	0.5544	1.37663e4	368.06750	50.0774
Totals :				2.74900e4	902.21582	



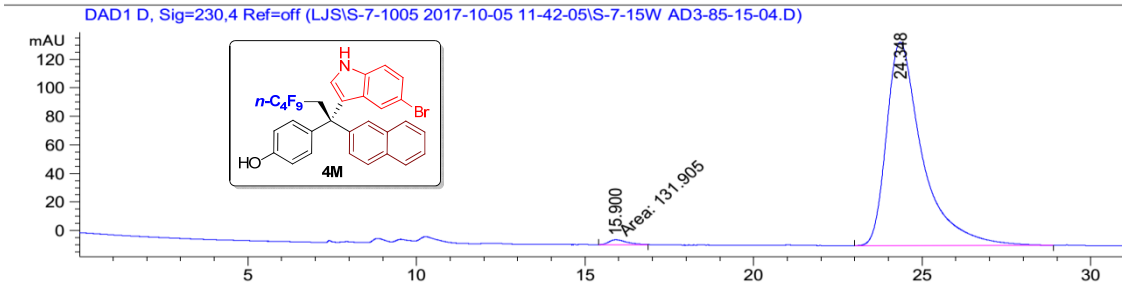
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	18.629	BB	0.3044	410.17618	20.24386	3.1200
2	24.267	BB	0.4894	1.27364e4	400.13480	96.8800
Totals :				1.31465e4	420.37866	



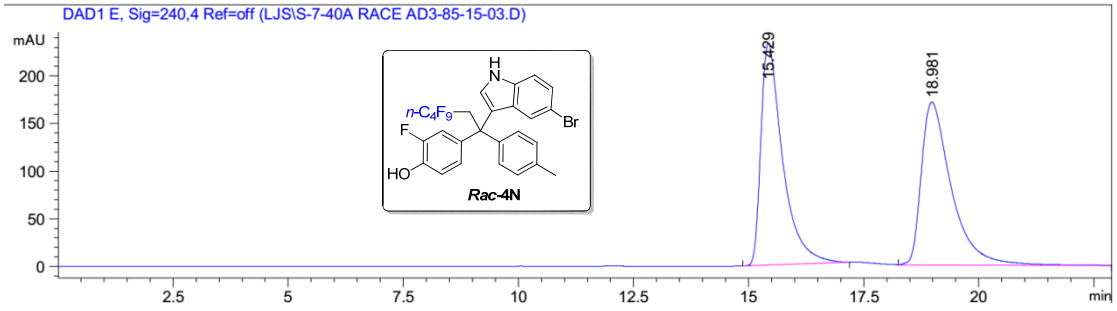
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.952	BB	0.4359	1.97555e4	690.20972	49.5364
2	23.942	BB	0.7809	1.97096e4	391.82425	49.4215



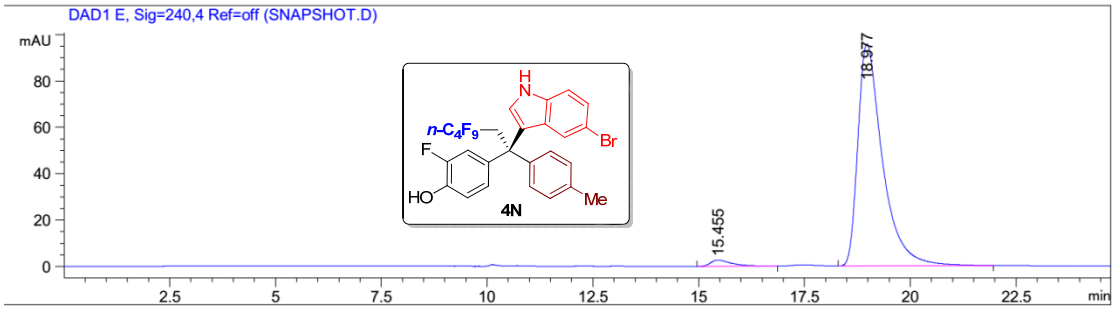
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.900	MF	0.6296	131.90491	3.49204	1.2382
2	24.348	BB	1.0652	1.05207e4	142.53197	98.7618
Totals :				1.06526e4	146.02400	



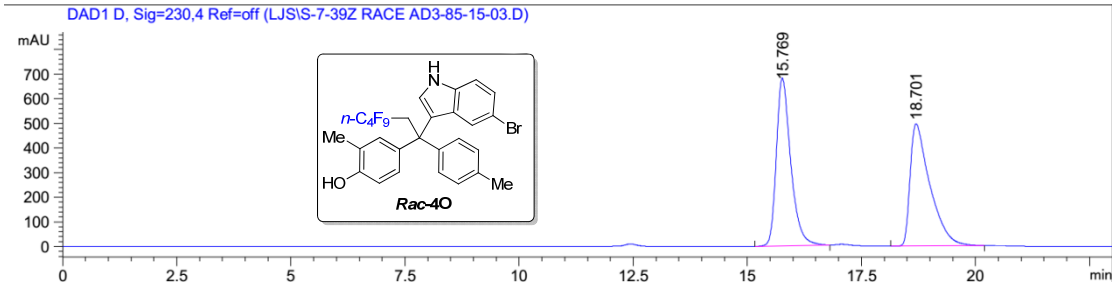
Signal 5: DAD1 E, Sig=240,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.429	BB	0.4867	7648.23877	233.14557	49.6957
2	18.981	BBA	0.6808	7741.89209	170.80876	50.3043
Totals :				1.53901e4	403.95433	



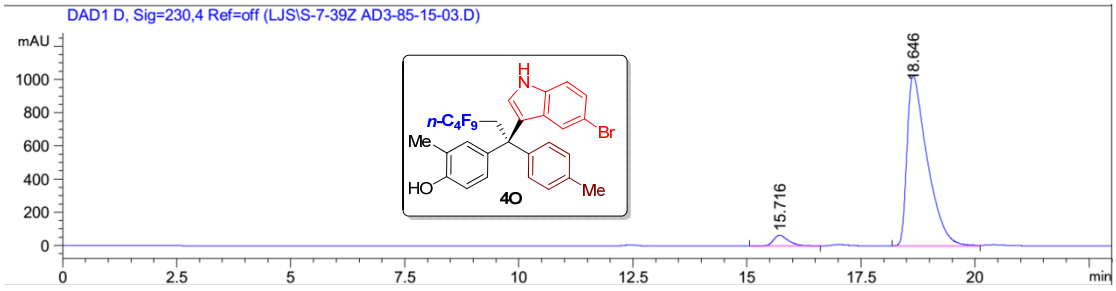
Signal 5: DAD1 E, Sig=240,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.455	BB	0.4869	94.32697	2.69160	2.3754
2	18.977	BB	0.5979	3876.68555	95.85226	97.6246
Totals :				3971.01252	98.54386	



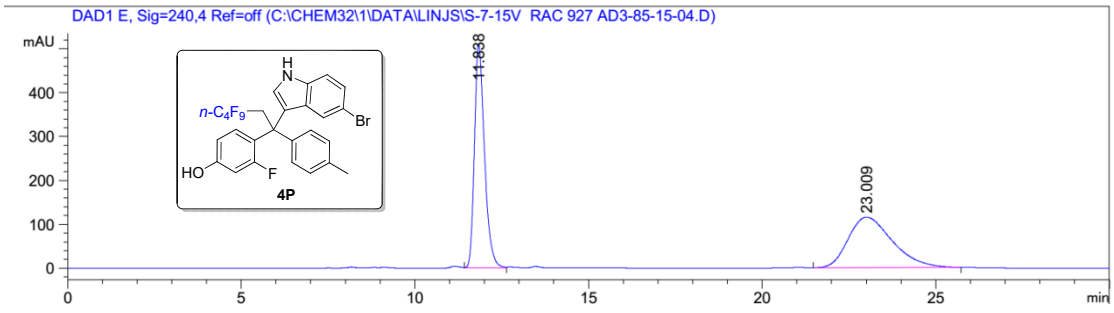
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.769	BB	0.3275	1.49377e4	682.06580	49.9873
2	18.701	BB	0.4334	1.49453e4	496.23874	50.0127
Totals :				2.98830e4	1178.30453	



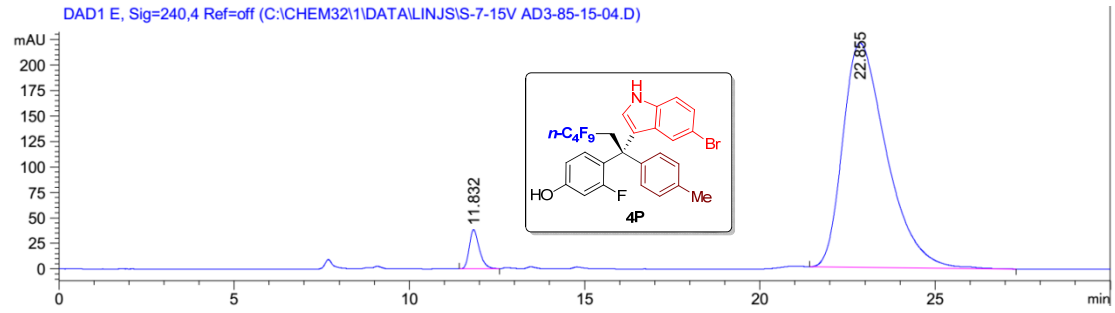
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.716	BB	0.3379	1452.88623	64.22540	4.4038
2	18.646	BV	0.4489	3.15386e4	1025.15613	95.5962
Totals :				3.29915e4	1089.38152	



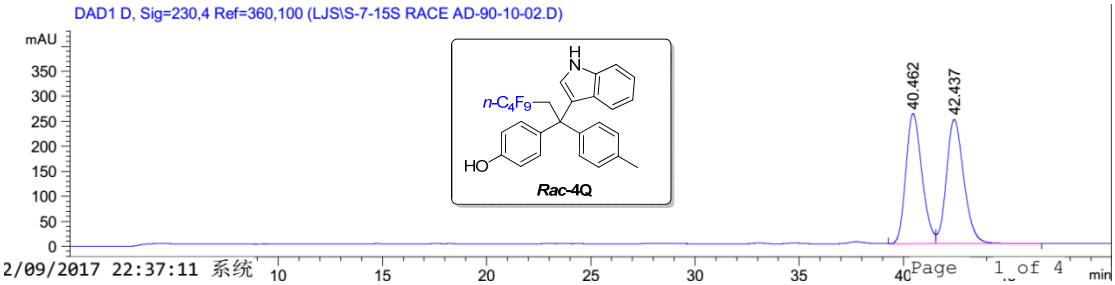
Signal 5: DAD1 E, Sig=240,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.838	VV	0.3070	1.02654e4	509.54871	50.3561
2	23.009	BB	1.3146	1.01202e4	115.00603	49.6439
Totals :				2.03856e4	624.55473	



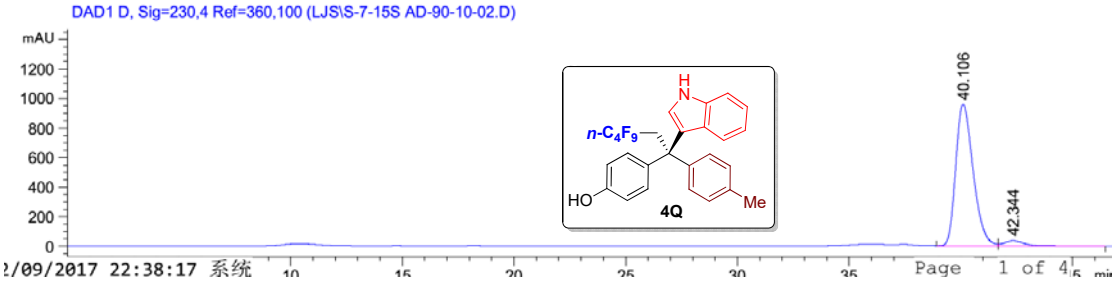
Signal 5: DAD1 E, Sig=240,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.832	BB	0.3009	761.17328	38.45509	3.8369
2	22.855	BB	1.3210	1.90771e4	220.13712	96.1631
Totals :				1.98382e4	258.59221	



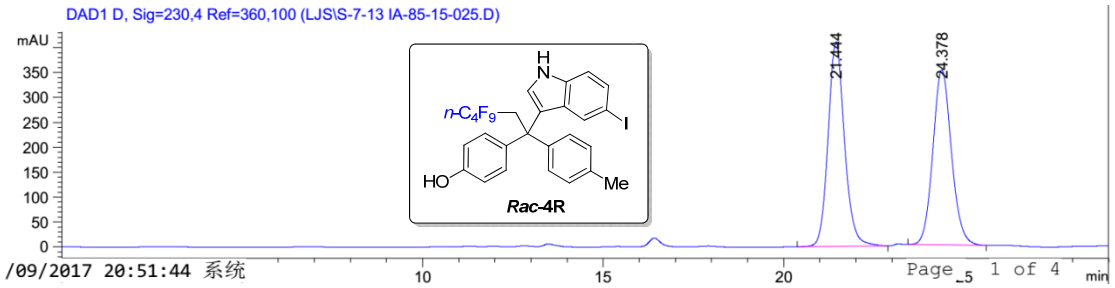
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	40.462	VV	0.8229	1.39878e4	260.30338	49.2004
2	42.437	VB	0.9016	1.44424e4	248.68167	50.7996
Totals :				2.84302e4	508.98505	



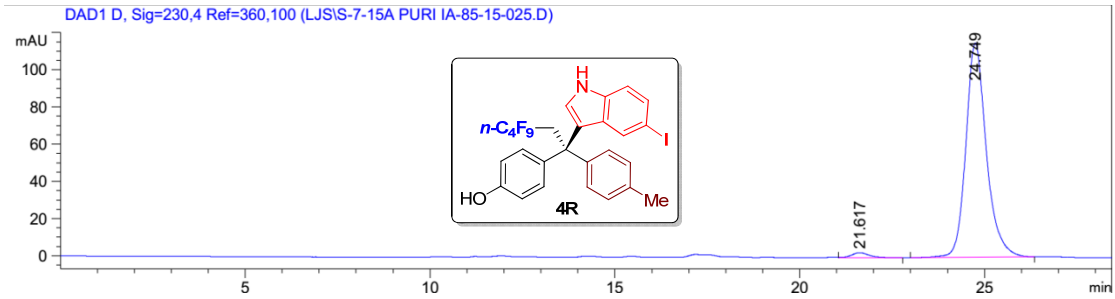
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	40.106	BV	0.8366	5.21314e4	961.45404	95.8135
2	42.344	VB	0.9217	2277.82471	37.02875	4.1865
Totals :				5.44092e4	998.48279	



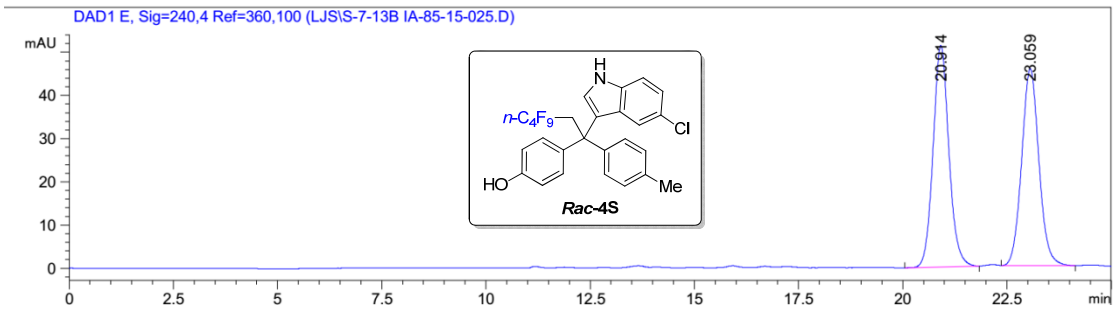
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	21.444	BB	0.4805	1.29709e4	410.66199	50.8663
2	24.378	BB	0.5400	1.25291e4	351.36792	49.1337



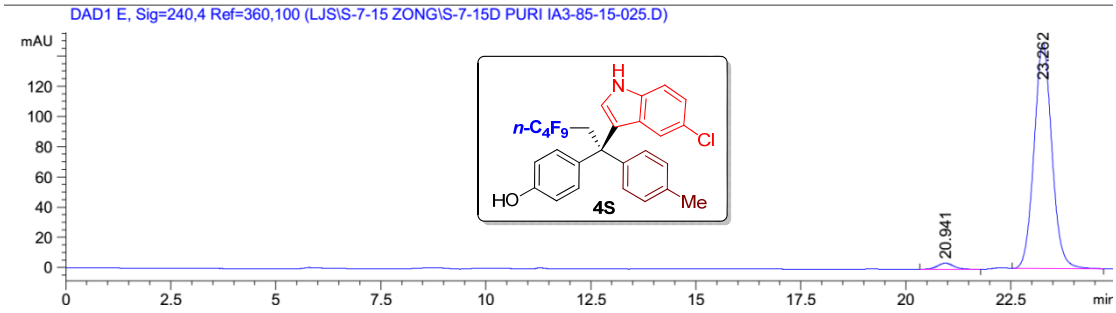
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	21.617	BB	0.4657	84.20930	2.64308	1.8584
2	24.749	BB	0.5779	4447.09570	115.30930	98.1416
Totals :				4531.30500	117.95237	



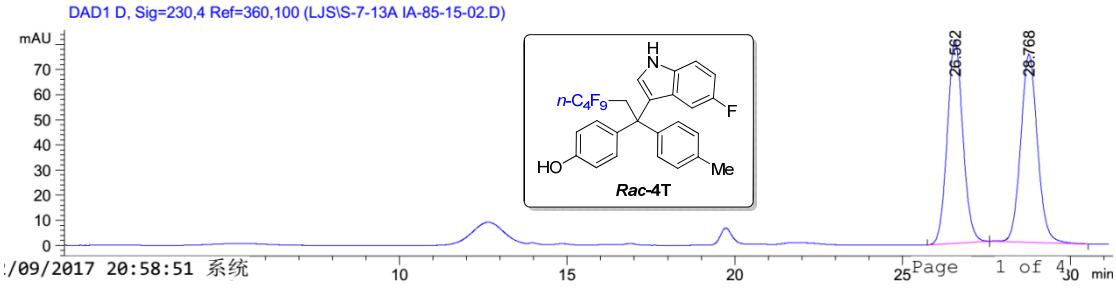
Signal 5: DAD1 E, Sig=240,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.914	BB	0.4012	1350.16565	51.27951	50.7372
2	23.059	BB	0.4436	1310.92859	45.57672	49.2628
Totals :				2661.09424	96.85624	



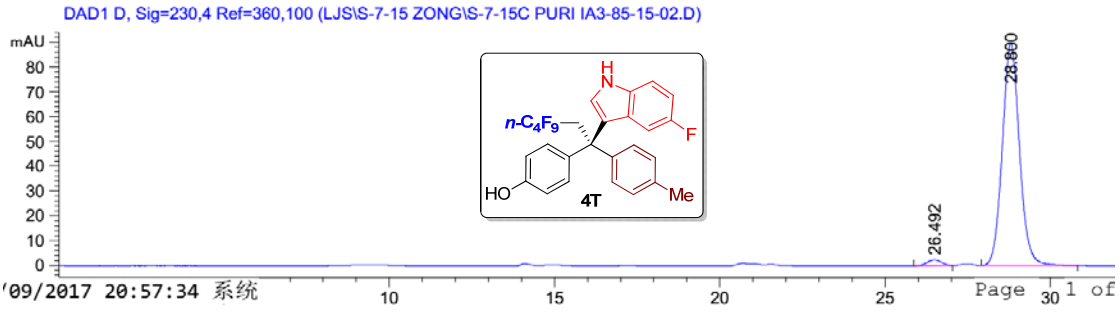
Signal 5: DAD1 E, Sig=240,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.941	BB	0.3994	107.62167	4.05843	2.3931
2	23.262	BB	0.4539	4389.48975	148.90154	97.6069
Totals :				4497.11141	152.95997	



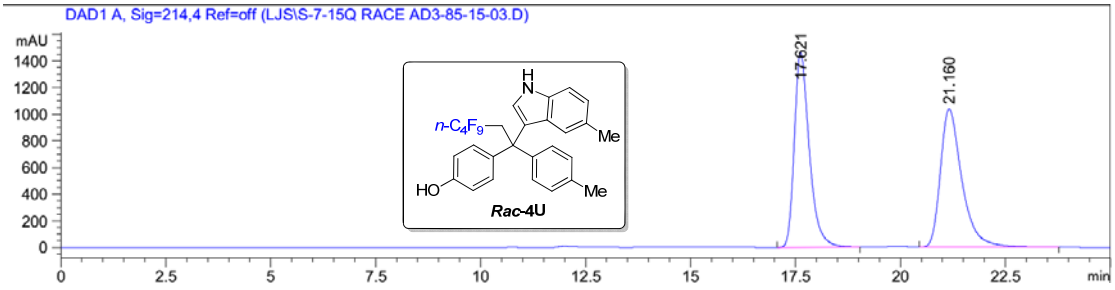
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.562	BB	0.4890	2603.41553	80.98534	50.0724
2	28.768	BB	0.5309	2595.88818	74.78911	49.9276
Totals :				5199.30371	155.77445	



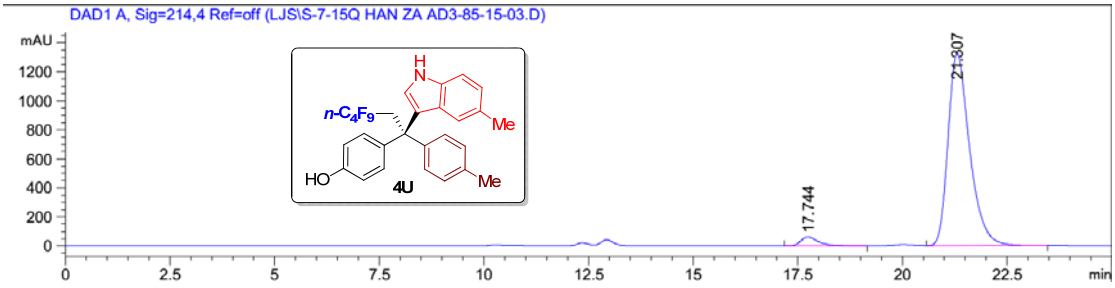
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.492	BB	0.4548	68.53264	2.31890	2.0831
2	28.800	BB	0.5479	3221.36694	89.51254	97.9169
Totals :				3289.89958	91.83144	



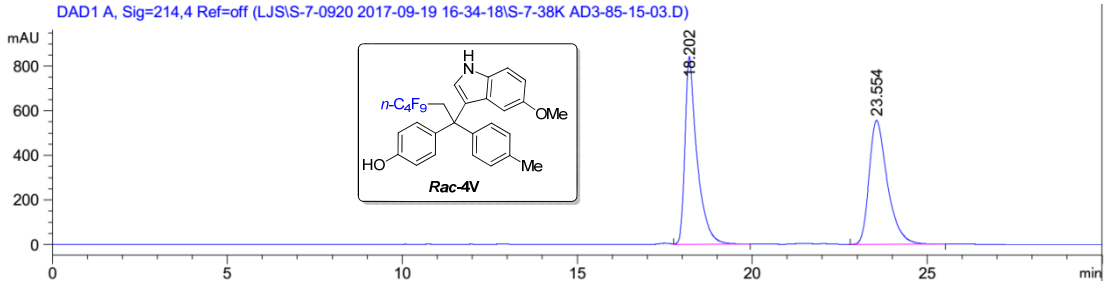
Signal 1: DAD1 A, Sig=214,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.621	BB	0.3772	3.61918e4	1460.08032	49.4910
2	21.160	BB	0.5395	3.69362e4	1037.11914	50.5090
Totals :				7.31280e4	2497.19946	



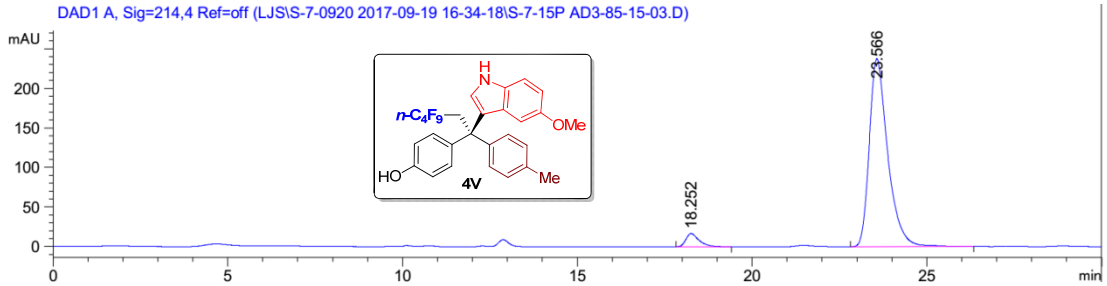
Signal 1: DAD1 A, Sig=214,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.744	BB	0.4295	1830.67908	63.65922	3.7085
2	21.307	VB	0.5443	4.75336e4	1325.84290	96.2915
Totals :				4.93643e4	1389.50211	



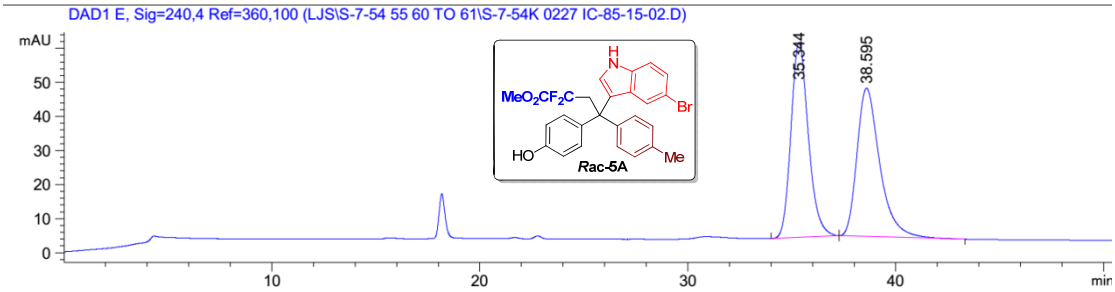
Signal 1: DAD1 A, Sig=214,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	18.202	VB	0.3417	2.02037e4	842.61206	49.9611
2	23.554	BB	0.5483	2.02352e4	556.42401	50.0389
Totals :				4.04390e4	1399.03607	



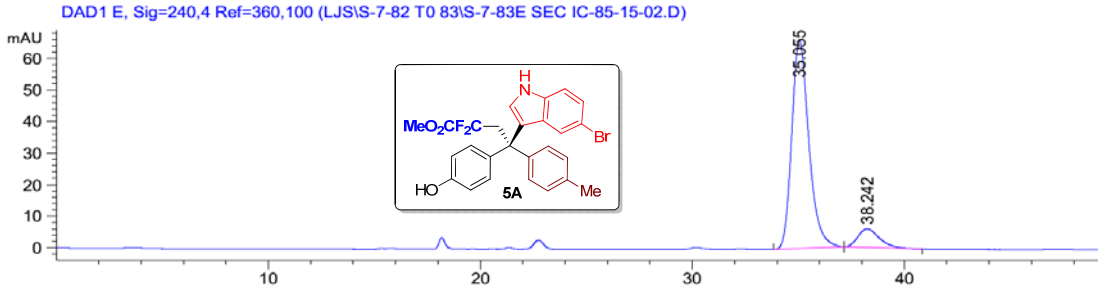
Signal 1: DAD1 A, Sig=214,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	18.252	BB	0.3795	435.32199	16.73618	4.7451
2	23.566	BB	0.5530	8738.79980	237.67667	95.2549
Totals :				9174.12180	254.41285	



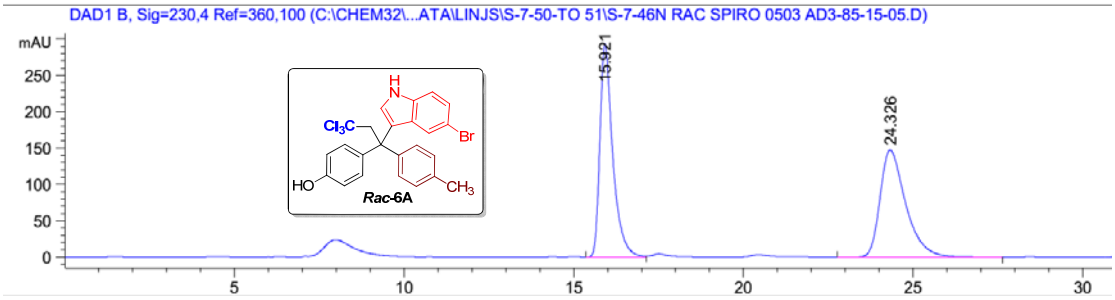
Signal 5: DAD1 E, Sig=240,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	35.344	BB	0.9047	3327.18237	57.19556	50.0377
2	38.595	BB	1.1540	3322.17212	43.54681	49.9623
Totals :				6649.35449	100.74237	



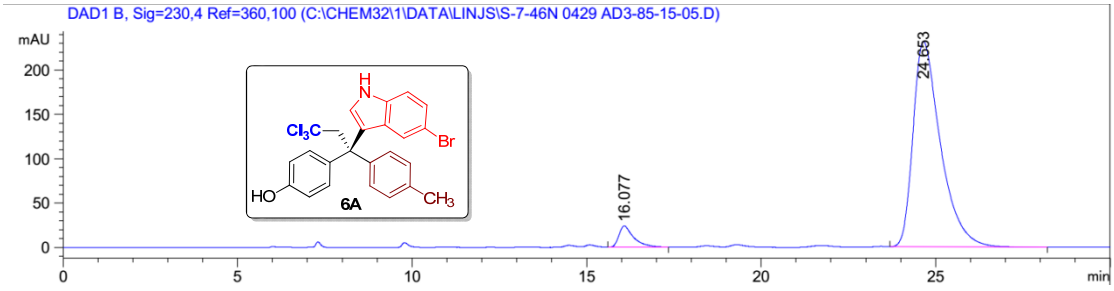
Signal 5: DAD1 E, Sig=240,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	35.055	BB	0.8554	3694.17871	65.95687	89.9074
2	38.242	BB	0.8876	414.69037	5.91754	10.0926
Totals :				4108.86908	71.87441	



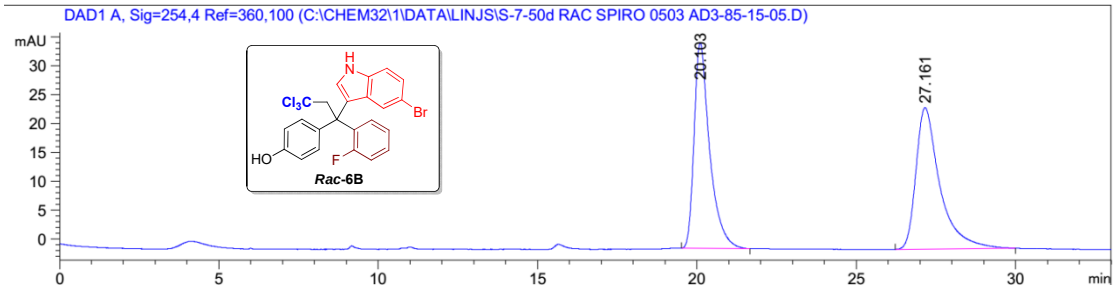
Signal 2: DAD1 B, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.921	BV	0.3902	7700.43848	293.35715	49.9334
2	24.326	BB	0.7873	7720.99365	147.35886	50.0666
Totals :				1.54214e4	440.71600	



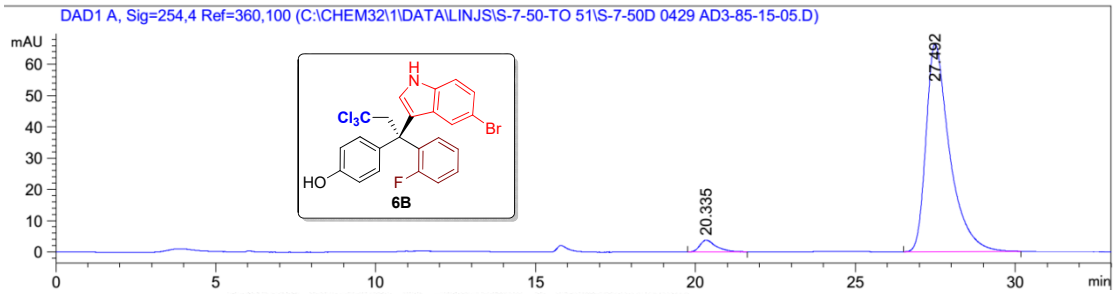
Signal 2: DAD1 B, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.077	BB	0.4187	704.44830	24.12592	5.2633
2	24.653	BB	0.8187	1.26796e4	231.59270	94.7367
Totals :				1.33841e4	255.71862	



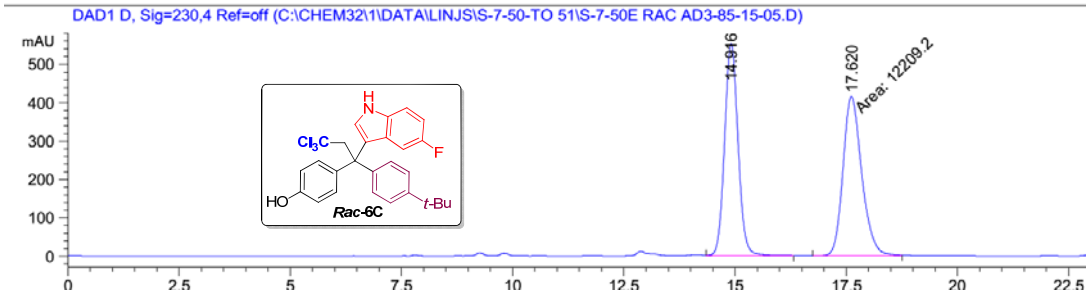
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.103	BB	0.4956	1206.43506	35.57877	48.5165
2	27.161	BB	0.7366	1280.21387	24.46266	51.4835
Totals :				2486.64893	60.04143	



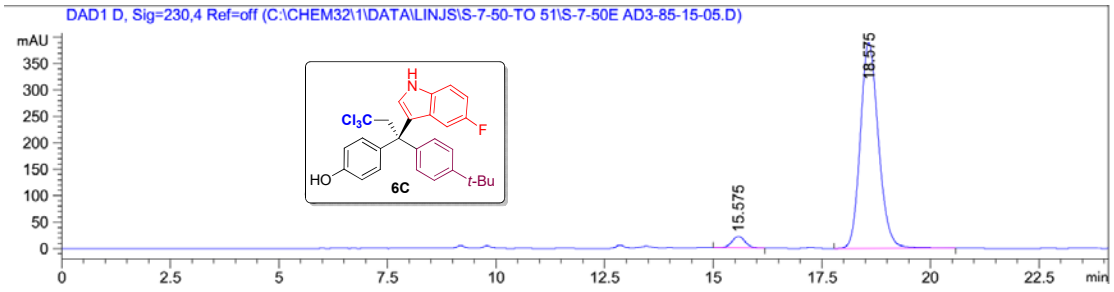
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.335	BB	0.4548	132.76080	3.77037	3.7408
2	27.492	BB	0.7475	3416.23218	66.48272	96.2592
Totals :				3548.99298	70.25309	



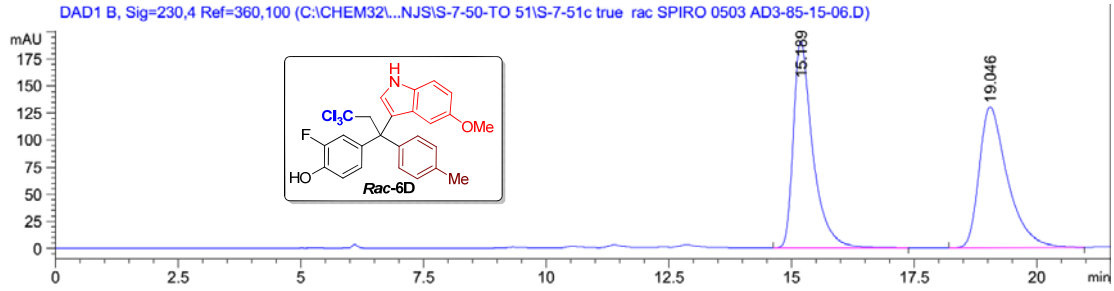
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.916	VB	0.3271	1.16133e4	552.89496	48.7492
2	17.620	MF	0.4903	1.22092e4	415.02579	51.2508
Totals :				2.38225e4	967.92075	



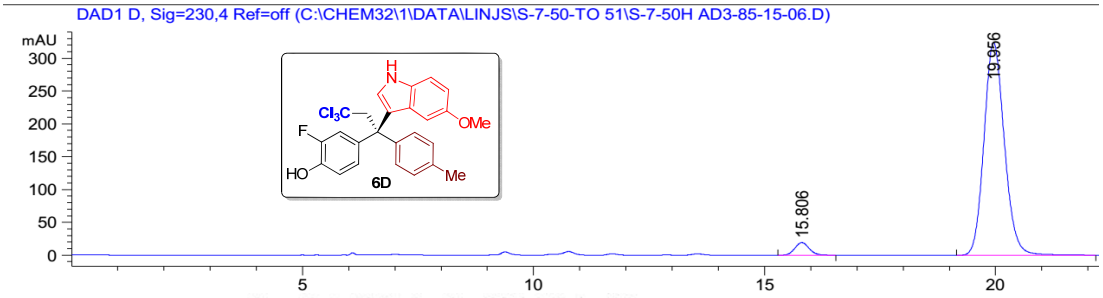
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.575	BB	0.3331	469.83603	21.83348	3.9936
2	18.575	BB	0.4485	1.12949e4	389.28247	96.0064
Totals :				1.17647e4	411.11595	



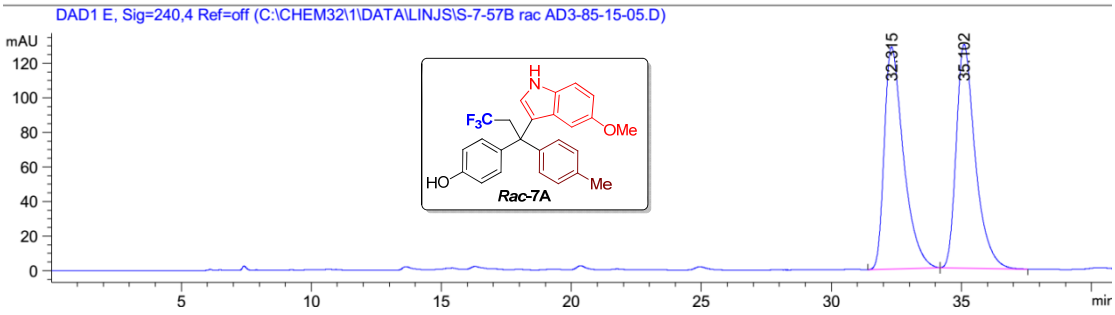
Signal 2: DAD1 B, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.189	BB	0.4047	5269.97607	191.73737	50.2010
2	19.046	BB	0.5986	5227.78076	130.16409	49.7990
Totals :				1.04978e4	321.90146	



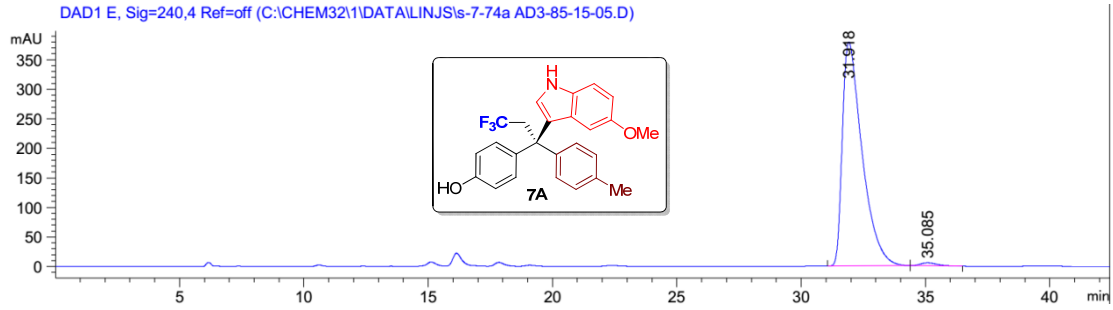
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.806	BB	0.3284	418.46799	19.34371	4.0397
2	19.956	BB	0.4736	9940.30762	324.29559	95.9603
Totals :				1.03588e4	343.63930	



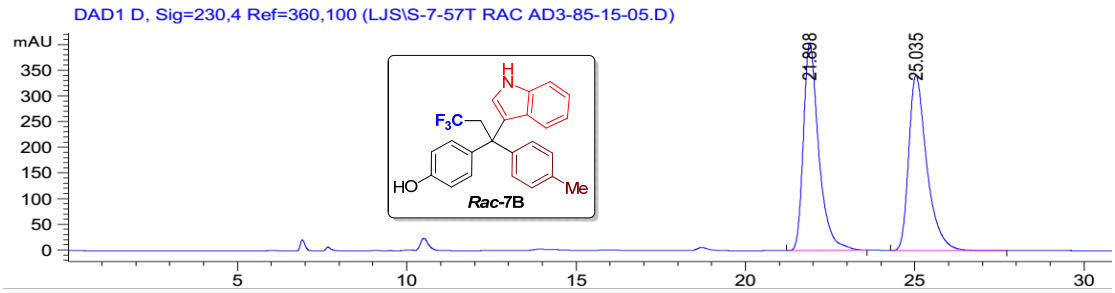
Signal 5: DAD1 E, Sig=240,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	32.315	BB	0.7764	6612.35742	128.47765	50.0544
2	35.102	BB	0.7703	6597.97168	129.53030	49.9456
Totals :				1.32103e4	258.00795	



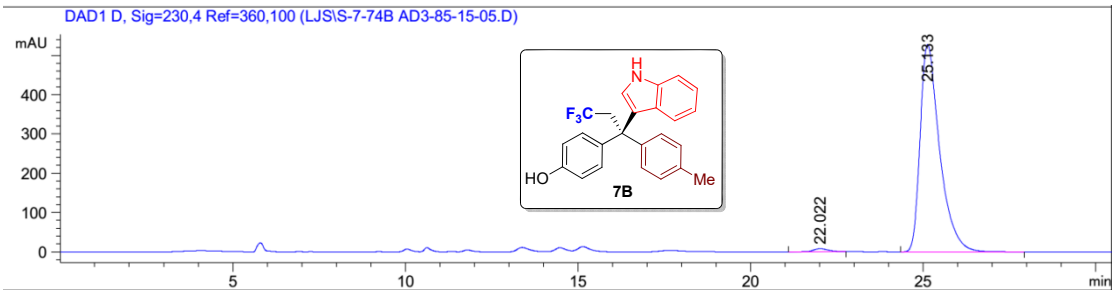
Signal 5: DAD1 E, Sig=240,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	31.918	BB	0.8218	2.09273e4	379.25125	98.8881
2	35.085	BB	0.6536	235.30417	5.10622	1.1119
Totals :				2.11626e4	384.35748	



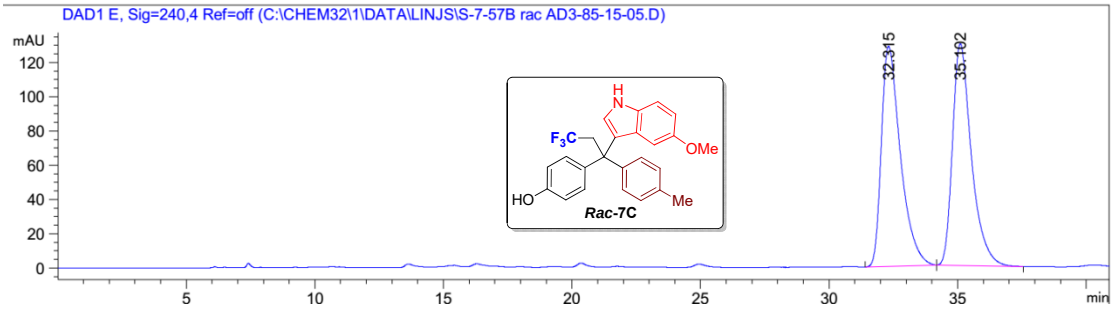
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	21.898	BB	0.4715	1.27169e4	403.73297	50.0820
2	25.035	BB	0.5575	1.26752e4	341.11676	49.9180
Totals :				2.53921e4	744.84973	



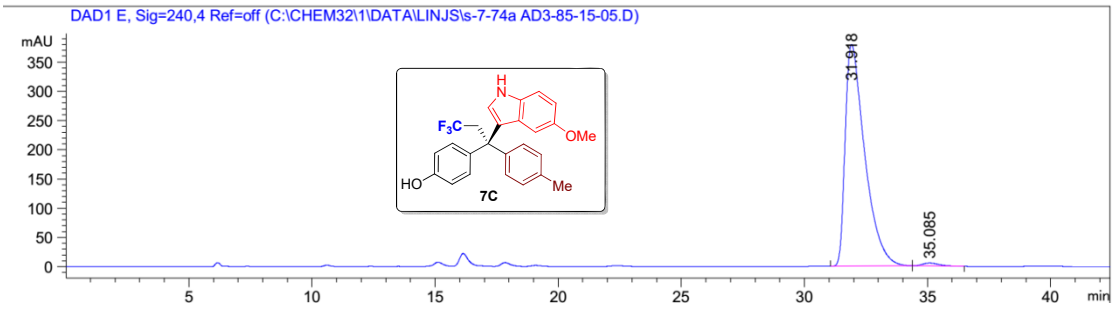
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	22.022	BB	0.4594	240.64098	7.94479	1.1468
2	25.133	BB	0.5904	2.07424e4	527.93439	98.8532
Totals :				2.09830e4	535.87918	



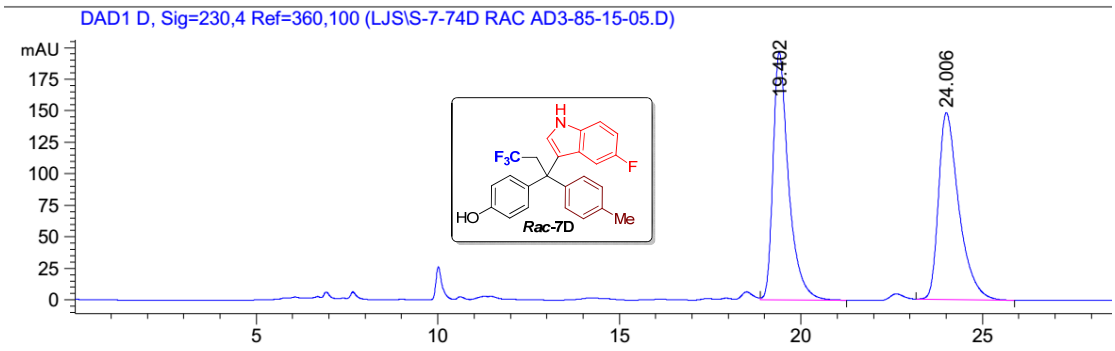
Signal 5: DAD1 E, Sig=240,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	32.315	BB	0.7764	6612.35742	128.47765	50.0544
2	35.102	BB	0.7703	6597.97168	129.53030	49.9456
Totals :				1.32103e4	258.00795	



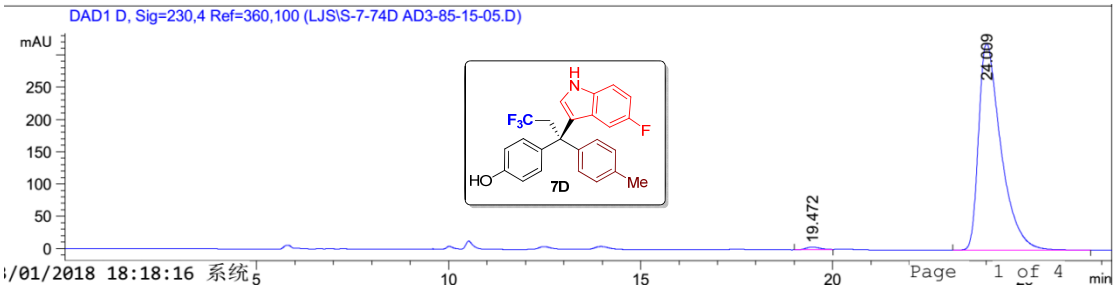
Signal 5: DAD1 E, Sig=240,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	31.918	BB	0.8218	2.09273e4	379.25125	98.8881
2	35.085	BB	0.6536	235.30417	5.10622	1.1119
Totals :				2.11626e4	384.35748	



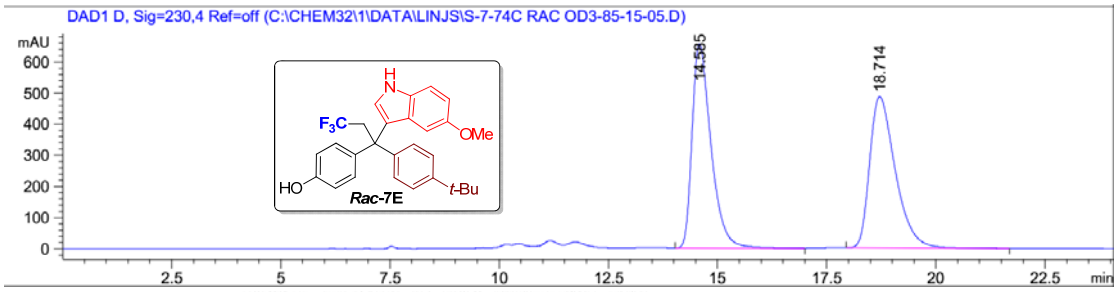
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.402	VB	0.4436	5854.65234	196.48738	50.3231
2	24.006	BB	0.5853	5779.47266	148.10806	49.6769
Totals :				1.16341e4	344.59544	



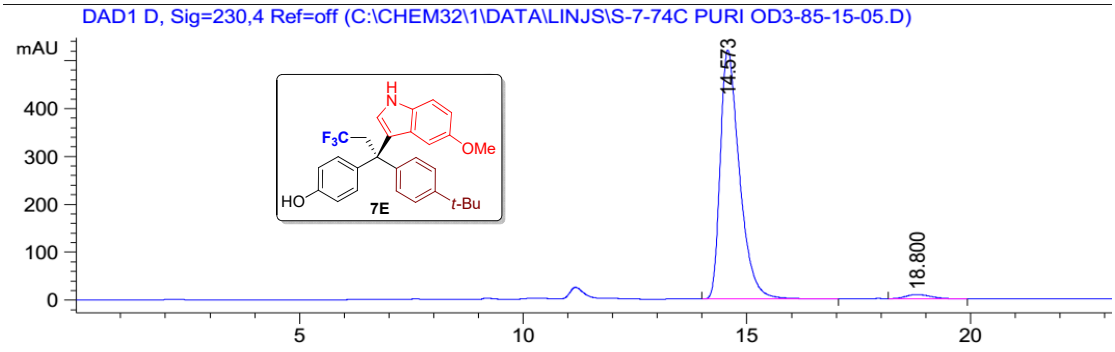
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.472	BB	0.3816	97.75062	3.99363	0.7504
2	24.009	BB	0.6051	1.29285e4	320.14935	99.2496
Totals :				1.30262e4	324.14298	



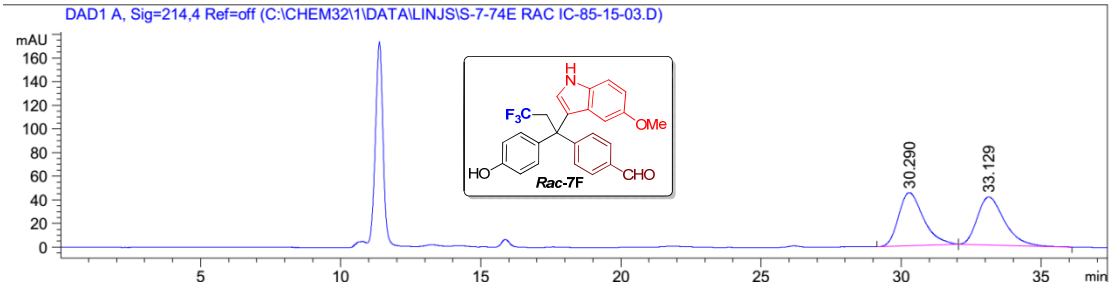
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.585	VB	0.4583	1.96687e4	655.07977	49.9871
2	18.714	BB	0.6182	1.96788e4	484.11731	50.0129
Totals :				3.93475e4	1139.19708	



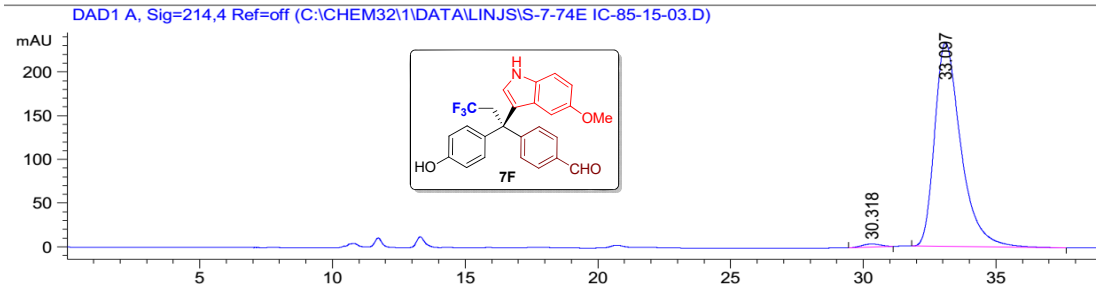
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.573	BB	0.4525	1.55315e4	519.93188	97.8470
2	18.800	BB	0.5788	341.75110	8.88438	2.1530
Totals :				1.58733e4	528.81626	



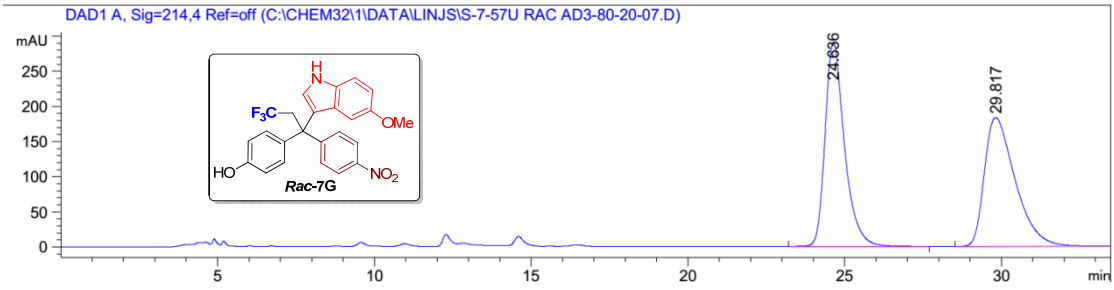
Signal 1: DAD1 A, Sig=214,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	30.290	BB	0.9239	2767.18872	44.96894	50.4949
2	33.129	BB	0.9853	2712.94727	40.61371	49.5051
Totals :				5480.13599	85.58265	



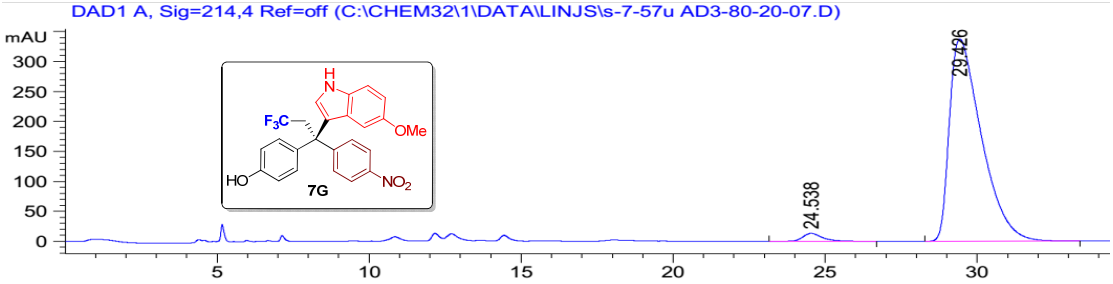
Signal 1: DAD1 A, Sig=214,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	30.318	BB	0.5880	171.91895	3.53110	1.0610
2	33.097	BB	1.0441	1.60309e4	233.18454	98.9390
Totals :				1.62028e4	236.71564	



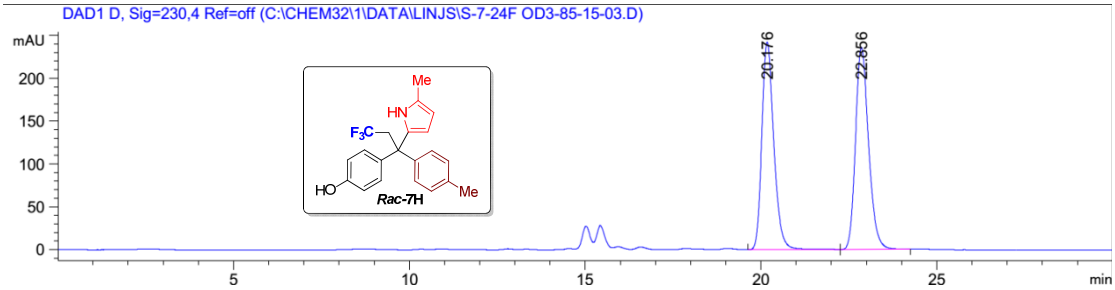
Signal 1: DAD1 A, Sig=214,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	24.636	BB	0.6494	1.24852e4	290.48050	49.9062
2	29.817	BBA	1.0382	1.25321e4	183.62177	50.0938
Totals :				2.50173e4	474.10226	



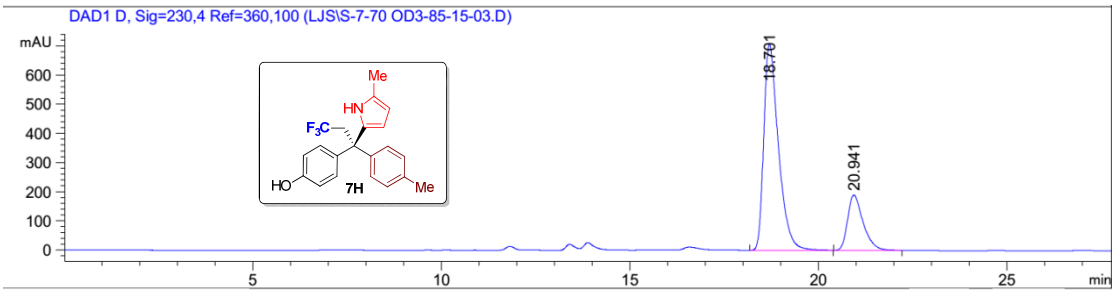
Signal 1: DAD1 A, Sig=214,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	24.538	BB	0.6477	599.16516	13.29788	2.3693
2	29.426	BB	1.0976	2.46898e4	337.45065	97.6307
Totals :				2.52890e4	350.74853	



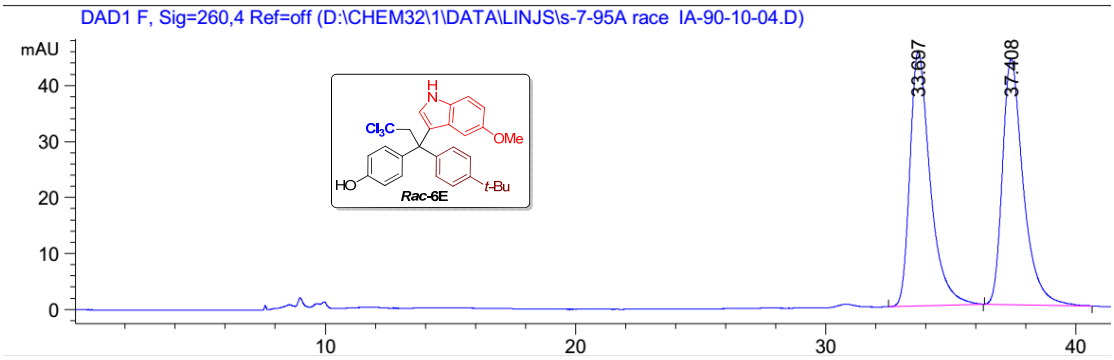
Signal 4: DAD1 D, Sig=230,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.176	BB	0.3644	5739.80225	242.26395	48.5271
2	22.856	BB	0.3976	6088.22559	235.47017	51.4729
Totals :				1.18280e4	477.73412	



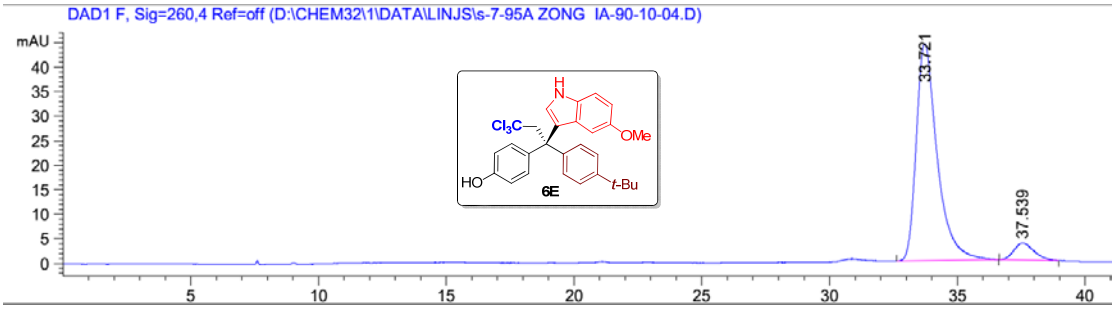
Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	18.701	BB	0.4020	1.90504e4	707.77466	77.8800
2	20.941	BB	0.4266	5410.84766	189.82509	22.1200
Totals :				2.44613e4	897.59975	



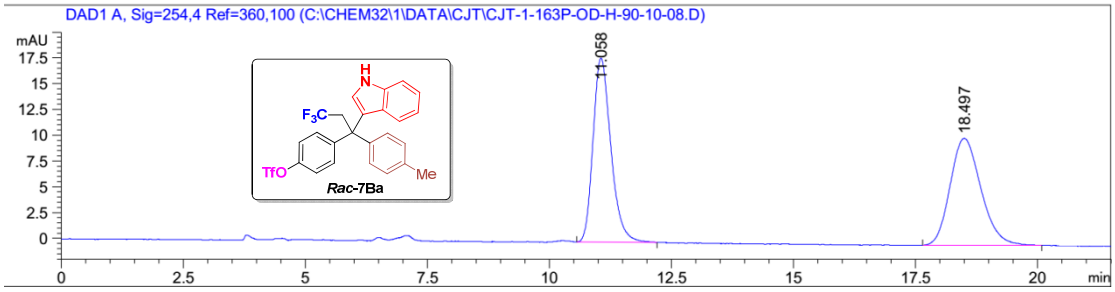
Signal 6: DAD1 F, Sig=260,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	33.697	BB	0.8309	2567.13330	45.45737	50.1823
2	37.408	BB	0.8339	2548.48364	43.86235	49.8177
Totals :				5115.61694	89.31972	



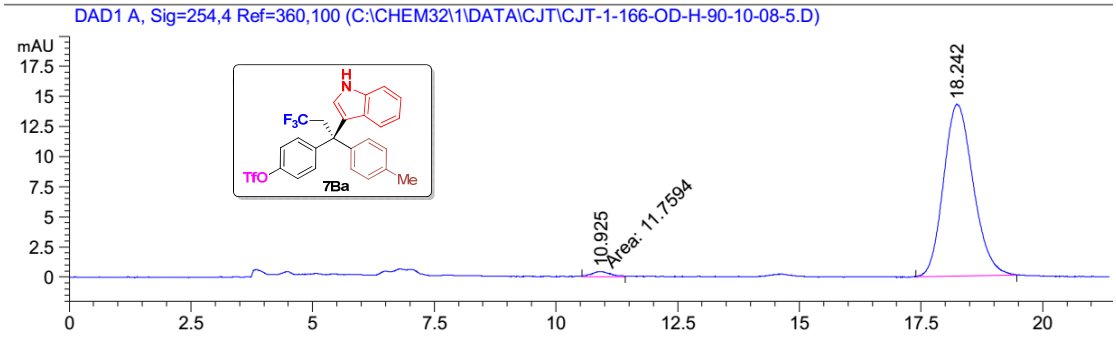
Signal 6: DAD1 F, Sig=260,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	33.721	BB	0.8365	2514.59985	44.27938	92.9835
2	37.539	BB	0.6441	189.75143	3.45831	7.0165
Totals :				2704.35129	47.73769	



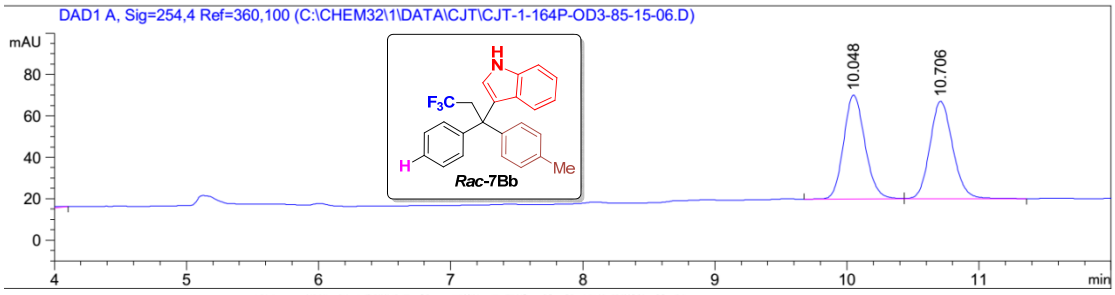
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.058	BB	0.3824	452.94437	17.82555	49.8745
2	18.497	BB	0.5975	455.22308	10.38251	50.1255
Totals :				908.16745	28.20805	



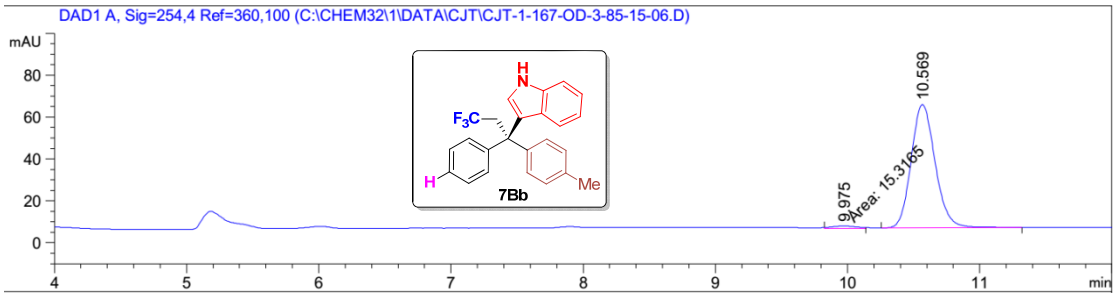
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.925	MM	0.4607	11.75939	4.25395e-1	1.9111
2	18.242	BB	0.6102	603.54974	14.24797	98.0889



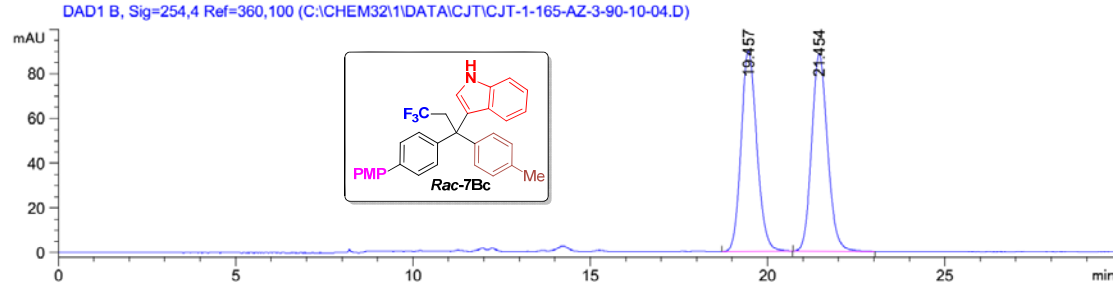
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.048	BV	0.1754	565.94891	50.25917	49.9188
2	10.706	VB	0.1865	567.79034	47.13157	50.0812
Totals :				1133.73926	97.39074	



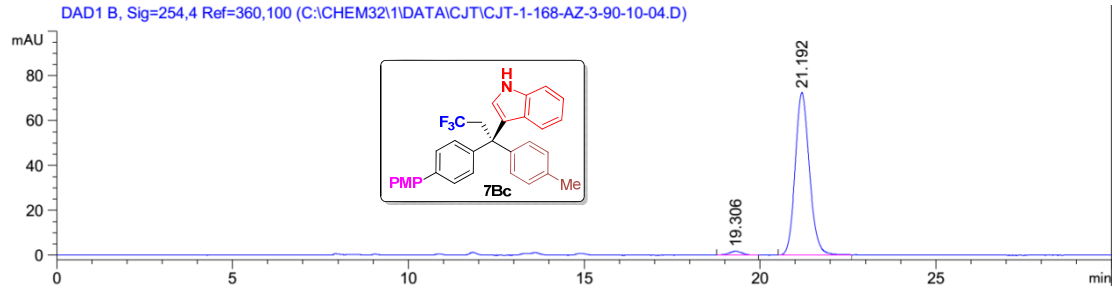
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.975	MM	0.2141	15.31647	1.19216	2.0208
2	10.569	BB	0.1952	742.63232	58.86787	97.9792



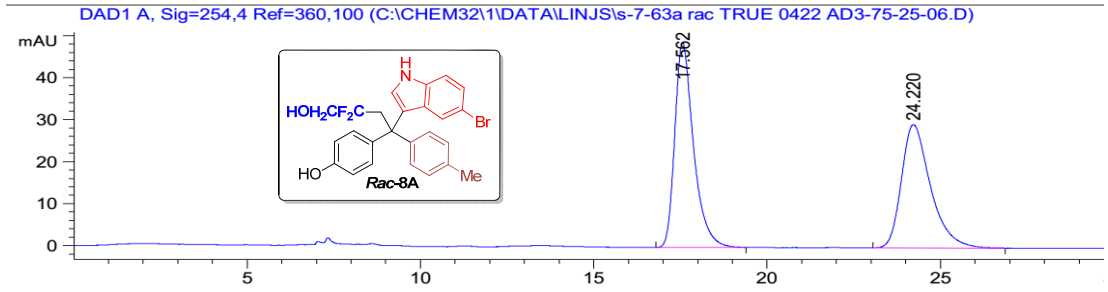
Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.457	BB	0.4756	2765.72485	89.71932	50.0864
2	21.454	BB	0.4799	2756.17969	88.35643	49.9136
Totals :				5521.90454	178.07575	



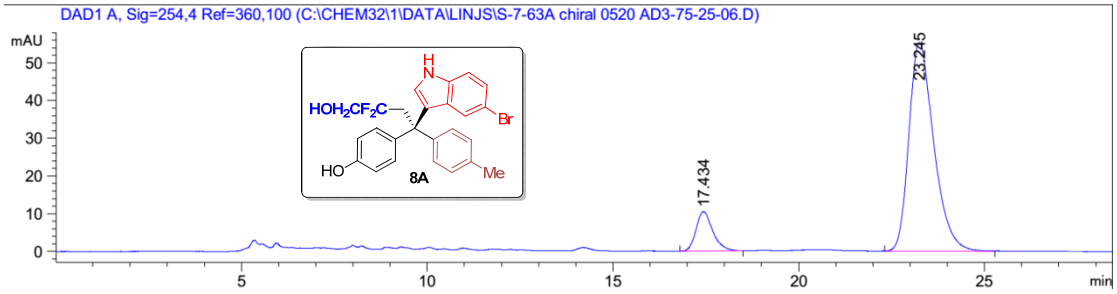
Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.306	BB	0.3130	45.81301	1.77564	2.2022
2	21.192	BB	0.4336	2034.49194	72.45654	97.7978
Totals :				2080.30495	74.23218	



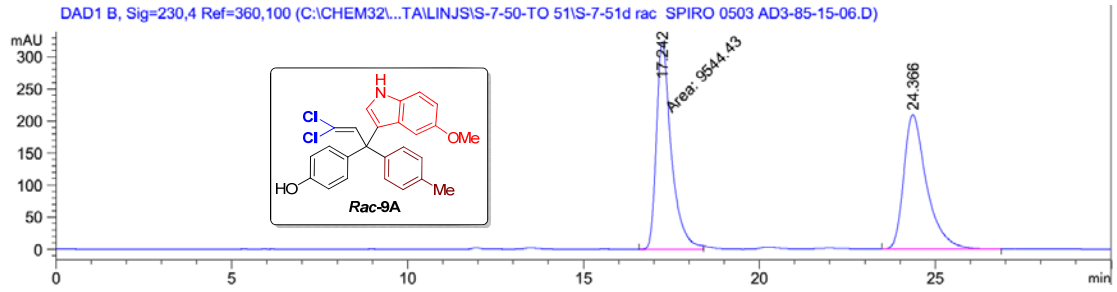
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.562	BB	0.5666	1835.43665	48.81974	51.6626
2	24.220	BB	0.8837	1717.30090	29.39046	48.3374
Totals :				3552.73755	78.21020	



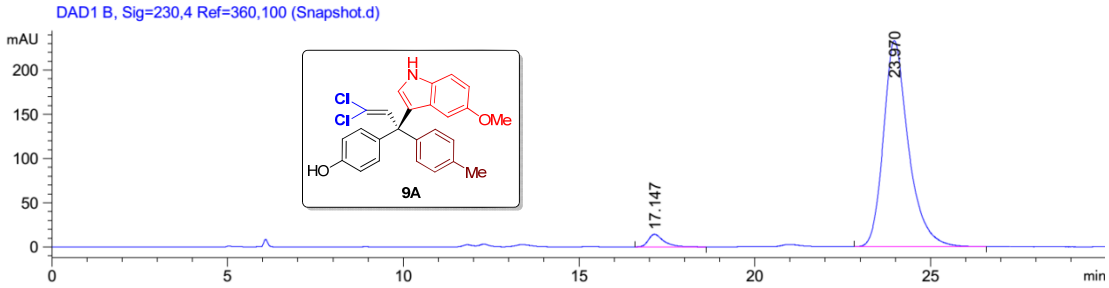
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.434	BB	0.4636	325.80014	10.45453	11.2672
2	23.245	BB	0.6997	2565.77026	55.25993	88.7328
Totals :				2891.57040	65.71446	



Signal 2: DAD1 B, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.242	MF	0.4913	9544.42773	323.80798	50.1099
2	24.366	BB	0.6720	9502.55762	209.96271	49.8901
Totals :				1.90470e4	533.77069	



Signal 2: DAD1 B, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.147	BB	0.4351	429.13293	14.25887	3.5938
2	23.970	BB	0.7389	1.15118e4	232.80385	96.4062
Totals :				1.19409e4	247.06272	