Electronic Supplementary Information

Enantioselective Synthesis of Indole Derivatives by Rh/Pd Relay Catalysis and Their Anti-Inflammatory Evaluation

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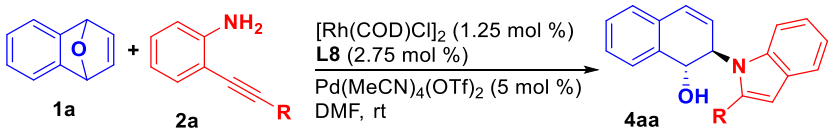
1. General method

The reactions and manipulations were performed under an atmosphere of argon by using standard Schlenk techniques and Drybox (Mikrouna, Supper 1220/750). Oxobenzonorbornadienes **1a**[1], **1b**[2], **1c**[3], **1d**[4], **1e**[5], **1f**[6], **1g**[3] and **1h**[4]were prepared by the literature procedures. Unless the stated cases, all the 2-alkynylaniline **2a-2t** were synthesized by Sonogashira cross-coupling reaction[7] and the other reagents were purchased from commercial domestic chemical company such as Energy, J&K, Alfa and Acros. Anhydrous toluene, THF (Tetrahydrofuran) and dioxane were distilled from sodium with benzophenone ketyl as indicator. Anhydrous DCE (sym-Dichloroethane) was distilled from calcium hydride and stored under argon. Anhydrous DMF (N, N-Dimethylformamide) was distilled from calcium hydride under reduced pressure and stored under argon. ^{1}H NMR and ^{13}C NMR spectra were recorded on Bruker-Avance 500 MHz or 400 MHz spectrometer. $CDCl_3$ was used as solvent. Chemical shifts (δ) were reported in ppm with tetramethylsilane as internal standard, and *J* values were given in Hz. The enantioselective excesses were determined by Agilent 1260 Series HPLC using Daicel AD-H, OD-H, OJ-3, or AS-H chiral columns eluted with a mixture of isopropyl alcohol and hexane. Melting points were measured on X-4 melting point apparatus and uncorrected. High resolution mass spectra (HRMS) were performed on Q Exactive HF MS from Thermo Scientific by using oribitrap type. Single crystal was selected and detected on a 'Bruker APEX-II CCD' diffractometer. The specific rotation of all products was measured by Atopol I from Rudolph Research Analytical. Column chromatography was performed with silica gel (200-300 mesh) by using EtOAc/hexane as eluent.

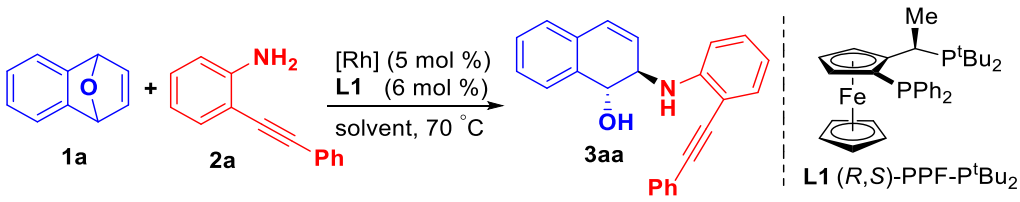
2. A typical procedure for Rh/Pd relay catalyzed hydroamination of oxabenzonorbornadienes with various 2-alkynylanilines.



$[Rh(COD)Cl]_2$ (1.2 mg, 0.0025 mmol) and (*R*)-(*S*)-cy_2PF-P^{t}Bu$_2$ **L8** (3.3 mg, 0.006 mmol) and 2.0 mL DMF were added to a Schlenk tube in argon atmosphere. The resulting solution was stirred at room temperature for 30 min, then oxabenzonorbornadiene **1a** (34.6 mg, 0.24 mmol) was added, and the mixture was stirred for additional 20 min. After the addition of 2-(phenylethynyl)aniline **2a** (38.6 mg, 0.2 mmol) and $Pd(MeCN)_4(OTf)_2$ (5.6 mg, 0.01 mmol), the mixture was stirred at room temperature under argon atmosphere with TLC monitoring until the completed consumption of **2a**. The residue was purified by silica gel column chromatography (using 5% EtOAc/hexane as eluent)

to afford the desired product **4aa** (58.0 mg, 86% yield). The enantioselective excess of the product was determined to be 96% *ee* by chiral HPLC.

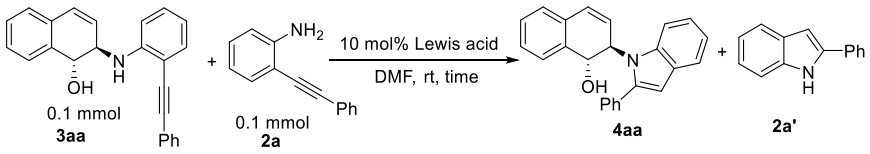
Screening of Rh-catalyzed ring opening reaction of oxabenzonorbornadiene 1a.[a]



entry	metal	solvent	time (h)	yield (%)[b]	ee (%)[c]
1	$[Rh(COD)Cl]_2$	THF	24	59	87
2	$[Rh(C_2H_4)Cl]_2$	THF	12	47	69
3	$[Rh(NBD)Cl]_2$	THF	24	35	83
4	$Rh_2(OAc)_4$	THF	72	NR	ND
5	$[Rh(COD)OH]_2$	THF	72	trace	ND
6	$[Rh(coe)_2Cl]_2$	THF	12	65	77
7	$[Rh(COD)Cl]_2$	dioxane	6	36	60
8	$[Rh(COD)Cl]_2$	DCE	6	54	76
9	$[Rh(COD)Cl]_2$	DMF	1	65	88

[a]Reaction conditions: $[Rh(COD)Cl]_2$ (2.5 mol %) and (*R, S*)-PPF-P^{t}Bu$_2$ (6 mol %) in 2 mL of solvent were stirred at room temperature for 30 min under Ar atmosphere. **1a** (0.2 mmol) and **2a** (0.24 mmol) were added, and the reaction mixture was stirred at 70 °C for the indicated period of time. [b]Isolated yields. Diastereomeric ratio (d.r.) >99:1 (determined by ^{1}H NMR spectroscopy). [c]Determined by HPLC analysis. THF = Tetrahydrofuran. DCE = Dichloroethane. DMF = N, N-Dimethylformamide. NR = no reaction. ND = not determinated

3. The screening of co-catalyst for the indole ring formation.[a]

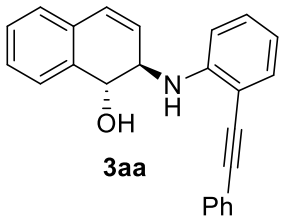


entry	Metal	time (h)	yield **4aa** (%)[b]	yield **2a'** (%)[b]
1	$PdCl_2$	6	94	96
2	$Pd(dppe)Cl_2$	24	0	0
3	$Pd(OAc)_2$	24	trace	trace
4	$Pd(MeCN)_4(OTf)_2$	12	93	trace
5	$FeCl_3$	24	0	0
6	$In(OTf)_3$	24	0	0
7	$Cu(OTf)_2$	24	0	0
8	$PtCl_4$	24	trace	trace
9	$[Ru(p\text{-}cymene)Cl]_2$	24	0	0

[a] Reaction conditions: **3aa** (0.1 mmol), **2a** (0.1 mmol) and Lewis acid (10 mol % respect to **3aa**) were added in 1 mL of DMF, then the reaction mixture was stirred at rt. [b] Isolated yields.

4. Characterization data (^{1}H-NMR, ^{13}C-NMR and HPLC) of asymmetric hydroamination products

(1R,2R)-2-((2-(phenylethynyl)phenyl)amino)-1,2-dihydronaphthalen-1-ol



3aa

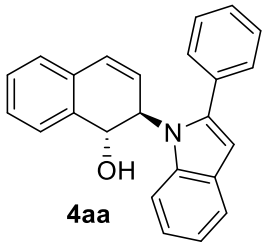
White solid, ethyl acetate/petroleum ether (1 : 20) was used for purification, 64.2 mg, 95% yield, mp 154 – 166 °C, 97% *ee*, $[\alpha]^{20}_D$ = -422 (*c* = 0.3, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.46 (d, *J* = 7.2 Hz, 1H), 7.37 (d, *J* = 7.2 Hz, 1H), 7.36 -7.31 (m, 2H), 7.31 – 7.24 (m, 5H), 7.24 – 7.17 (m, 1H), 7.14 – 7.09 (m, 1H), 6.83 (d, *J* = 8.3 Hz, 1H), 6.70 (t, *J* = 7.5 Hz, 1H), 6.54 (dd, *J* = 9.6 Hz, 1H), 6.01 (dd, *J* = 9.6, 3.5 Hz, 1H), 4.87 (d, *J* = 7.8 Hz, 1H), 4.68 (s, 1H), 4.38 (d, *J* = 5.4 Hz, 1H), 2.50 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 147.74, 135.50, 132.41, 131.91, 131.45, 130.10, 128.81, 128.55, 128.45, 128.34, 128.32, 127.96, 127.05, 126.82, 123.10, 117.58, 111.25, 108.98, 95.60, 85.77, 71.87, 55.63.

HRMS (ESI) m/z: $[M + H]^+$ $C_{24}H_{20}NO$ 338.1539; Found: 388.1538. The *ee* of **3aa** was determined by HPLC analysis using Daicel Chiralcel OD-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 90/10, 1.0 mL/min, 254 nm; t_{major} = 9.39 min, t_{minor} = 11.35 min.

(1R, 2R)-2-(2-phenyl-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4aa

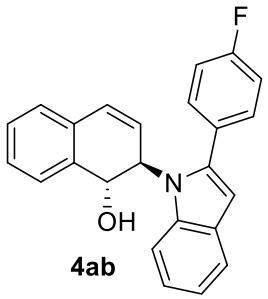
White solid, ethyl acetate/petroleum ether (1 : 20) was used for purification, 56.1 mg, 86% yield, mp 221 – 223 °C, 96% *ee*, $[\alpha]^{20}_D$ = 33.3 (*c* = 1.06, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.76 – 7.66 (m, 2H), 7.60 -7.52 (m, 3H), 7.43 (t, *J* = 7.5 Hz, 2H), 7.38 (d, *J* = 7.3 Hz, 1H), 7.32 – 7.24 (m, 2H), 7.22 – 7.13 (m, 3H), 6.68 – 6.58 (m, 2H), 6.25 (dd, *J* = 9.8, 2.3 Hz, 1H), 5.78 (dd, *J* = 12.6, 4.6 Hz, 1H), 5.45 (d, *J* = 12.7 Hz, 1H), 1.84 (d, *J* = 5.5 Hz, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 143.29, 136.69, 136.03, 132.84, 132.26, 130.11, 129.40, 129.09, 128.99, 128.64, 128.28, 128.13, 127.94, 126.49, 124.88, 121.31, 121.08, 120.21, 113.49, 103.10, 70.96, 60.66.

HRMS (ESI) m/z: $[M + H]^+$ $C_{24}H_{20}NO$ 338.1539; Found: 388.1537. The *ee* of **4aa** was determined by HPLC analysis using Daicel Chiralcel OD-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 95/5, 1.0 mL/min, 254 nm; t_{major} = 7.37 min, t_{minor} = 8.02 min.

(1R, 2R)-2-(2-(4-fluorophenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ab

Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 56.0 mg, 79% yield, 97% *ee*, $[\alpha]^{20}_D$ = 38.2 (*c* = 1.0, $CHCl_3$).

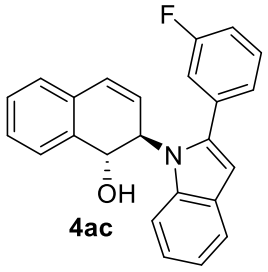
^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.74 – 7.65 (m, 2H), 7.57 – 7.47 (m, 3H), 7.32 – 7.23 (m, 2H), 7.19 – 7.04 (m, 5H), 6.60 (dd, *J* = 9.8, 3.2 Hz, 1H), 6.56 (s, 1H), 6.18 (dd, *J* = 9.7, 2.3 Hz, 1H), 5.76 (dd, *J* = 12.6, 5.3 Hz, 1H), 5.34 (dt, *J* = 12.6, 2.7 Hz, 1H), 1.87 (d, *J* = 5.5 Hz, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 163.69, 161.71, 142.12, 136.56, 135.89, 132.22, 131.94, 131.88, 129.22, 129.09, 128.87, 128.33, 128.00, 126.53, 124.82, 121.41, 121.04, 120.28, 115.73, 115.56, 113.41, 103.17, 70.95, 60.55.

^{19}F NMR (376 MHz, $CDCl_3$) δ -113.47.

HRMS (ESI) m/z: $[M + H]^+$ $C_{24}H_{19}NOF$ 356.1445; Found: 356.1444. The *ee* of **4ab** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 98/2, 1.0 mL/min, 254 nm; t_{major} = 12.79 min, t_{minor} = 10.28 min.

(1R, 2R)-2-(2-(3-fluorophenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ac

Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 54.0 mg, 76% yield, 96% *ee*, $[\alpha]^{20}_D$ = 64.2 (*c* = 1.0, $CHCl_3$).

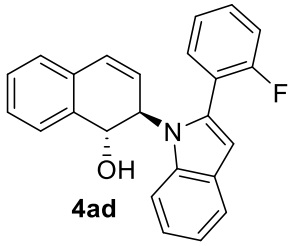
^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.73 (t, *J* = 6.7 Hz, 2H), 7.60 – 7.52 (m, 1H), 7.44 - 7.34 (m, 2H), 7.33 – 7.28 (m, 3H), 7.24 – 7.26 (m, 3H), 7.08 (t, *J* = 9.2 Hz, 1H), 6.71 – 6.65 (m, 1H), 6.64 (s, 1H), 6.25 (d, *J* = 12.6 Hz, 1H), 5.78 (dd, *J* = 12.7, 4.7 Hz, 1H), 5.45 (dd, *J* = 12.6, 3.0 Hz, 1H), 1.86 (d, *J* = 5.5 Hz, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 163.64, 161.68, 141.90, 136.59, 136.16, 134.94, 134.88, 132.22, 130.21, 130.14, 129.23, 129.15, 128.79, 128.35, 128.01, 126.55, 125.76, 125.74, 124.84, 122.85, 121.65, 121.24, 120.89, 120.51, 120.38, 117.10, 116.92, 115.14, 114.97, 113.58, 111.03, 103.59, 70.95, 60.72.

^{19}F NMR (376 MHz, $CDCl_3$) δ -112.24.

HRMS (ESI) m/z: $[M + H]^+$ $C_{24}H_{19}NOF$ 356.1445; Found: 356.1443. The *ee* of **4ac** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 99/1, 1.0 mL/min, 254 nm; t_{major} = 21.00 min, t_{minor} = 17.37 min.

(1R,2R)-2-(2-(2-fluorophenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ad

Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 61.5 mg, 87% yield, 96% *ee*, $[\alpha]^{20}_{D}$ = -9.4 (*c* = 0.96, $CHCl_3$).

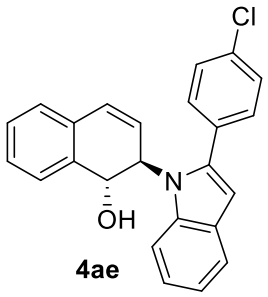
^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.75 (d, *J* = 9.0 Hz, 2H), 7.56 – 7.51 (m, 2H), 7.44 – 7.38 (m, 1H), 7.32 – 7.28 (m, 2H), 7.27 – 7.14 (m, 5H), 6.73 - 6.64 (m, 2H), 6.36 (d, *J* = 12.2 Hz, 1H), 5.72 (dd, *J* = 12.5, 4.7 Hz, 1H), 5.17 (d, *J* = 12.4 Hz, 1H), 1.84 (d, *J* = 5.5 Hz, 1H).

^{19}F NMR (376 MHz, $CDCl_3$) δ -113.59.

^{13}C NMR (126 MHz, $CDCl_3$) δ 160.89, 158.92, 135.86, 132.66, 132.64, 132.28, 130.62, 130.56, 129.40, 128.99, 128.87, 128.23, 127.97, 127.68, 126.54, 126.44, 125.88, 125.23, 124.95, 124.56, 124.53, 121.65, 121.59, 121.29, 120.89, 120.77, 120.58, 120.14, 116.05, 115.88, 113.33, 108.56, 104.05, 70.91, 61.52.

HRMS (ESI) m/z: $[M + H]^+$ $C_{24}H_{19}NOF$ 356.1445; Found: 356.1444. The *ee* of **4ad** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 95/5, 1.0 mL/min, 254 nm; t_{major} = 8.86 min, t_{minor} = 13.00 min.

(1R,2R)-2-(2-(4-chlorophenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ae

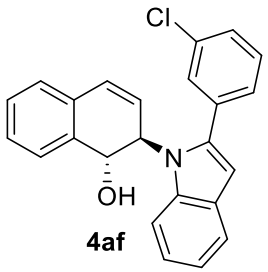
Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 59.2 mg, 80% yield, 97% *ee*, $[\alpha]^{20}_{D}$ = 102 (*c* = 1.0, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.74 – 7.67 (m, 2H), 7.55 – 7.52 (m, 1H), 7.52 – 7.48 (m, 2H), 7.44 – 7.37 (m, 2H), 7.34 – 7.27 (m, 2H), 7.22 – 7.12 (m, 3H), 6.64 (dd, *J* = 9.8, 3.2 Hz, 1H), 6.60 (s, 1H), 6.21 (dd, *J* = 9.8, 2.3 Hz, 1H), 5.74 (d, *J* = 12.6 Hz, 1H), 5.38 (dt, *J* = 12.7, 2.8 Hz, 1H), 1.96 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 142.00, 136.59, 136.10, 134.28, 132.23, 131.37, 131.27, 129.24, 129.17, 128.87, 128.80, 128.38, 128.03, 126.57, 124.86, 121.58, 121.16, 120.37, 113.51, 103.36, 70.95, 60.64.

HRMS (ESI) m/z: $[M + H]^+$ $C_{24}H_{19}ClNO$ 372.1150; Found: 372.1147. The *ee* of **4ae** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 95/5, 1.0 mL/min, 254 nm; t_{major} = 13.22 min, t_{minor} = 11.45 min.

(1R,2R)-2-(2-(3-chlorophenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4af

Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 60.0 mg, 81% yield, , 96% *ee*, $[\alpha]^{20}_{D}$ = 83.1 (*c* = 1.0, $CHCl_3$).

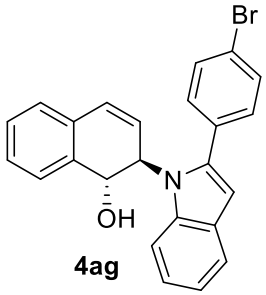
^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.81 – 7.68 (m, 2H), 7.61 (s, 1H), 7.58 – 7.53 (m, 1H), 7.51 – 7.45 (m, 1H), 7.41 – 7.37 (m, 2H), 7.36 – 7.30 (m, 2H), 7.27 – 7.18 (m, 3H), 6.68 (dd, *J* = 9.8, 3.2 Hz, 1H), 6.65 (s, 1H), 6.27 (dd, *J* = 9.7, 2.2 Hz, 1H), 5.77 (dd, *J* = 12.7, 4.8 Hz, 1H), 5.43 (dt, *J* = 12.6, 2.7 Hz, 1H), 1.96 (d, *J* = 5.6 Hz, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 141.74, 136.63, 136.20, 134.65, 134.50, 132.24, 130.04, 129.86, 129.23, 129.20, 128.78, 128.39, 128.23, 128.19, 128.04, 126.59, 124.90, 121.71, 121.28, 120.41,

113.60, 103.70, 70.96, 60.76.

HRMS (ESI) m/z: $[M + H]^+$ $C_{24}H_{19}ClNO$ 372.1150; Found: 372.1149. The *ee* of **4af** was determined by HPLC analysis using Daicel Chiralcel OD-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 98/2, 1.0 mL/min, 254 nm; t_{major} = 8.18 min, t_{minor} = 8.72 min.

(1R,2R)-2-(2-(4-bromophenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ag

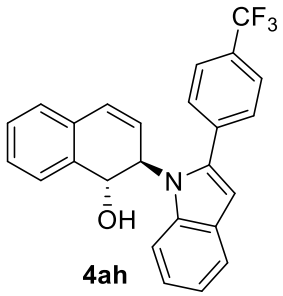
Brown solid, ethyl acetate/petroleum ether (1 : 20) was used for purification, 68.6 mg, 83% yield, mp 161 – 162 °C, 98% *ee*, $[\alpha]^{20}_D$ = 114 (*c* = 1.0, $CHCl_3$).

^1H NMR (500 MHz, Chloroform-*d*) δ 7.67 – 7.59 (m, 2H), 7.52 – 7.44 (m, 3H), 7.40 – 7.34 (m, 2H), 7.28 – 7.22 (m, 2H), 7.17 – 7.05 (m, 3H), 6.58 (dd, *J* = 9.8, 3.1 Hz, 1H), 6.54 (s, 1H), 6.15 (d, *J* = 11.8 Hz, 1H), 5.68 (d, *J* = 12.6 Hz, 1H), 5.31 (d, *J* = 12.6 Hz, 1H), 1.86 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 142.00, 136.57, 136.13, 132.22, 131.83, 131.74, 131.65, 129.26, 129.19, 128.78, 128.39, 128.05, 126.58, 124.85, 122.54, 121.61, 121.18, 120.39, 113.52, 103.37, 70.96, 60.65.

HRMS (ESI) m/z: $[M + H]^+$ $C_{24}H_{18}BrNO$ 416.0645; Found: 416.0646. The *ee* of **4ag** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 98/2, 1.0 mL/min, 254 nm; t_{major} = 14.19 min, t_{minor} = 12.79 min.

(1R,2R)-2-(2-(4-(trifluoromethyl)phenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ah

Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 68.8 mg, 85% yield, 97% *ee*, $[\alpha]^{20}_D$ = 52.1 (*c* = 1.08, $CHCl_3$).

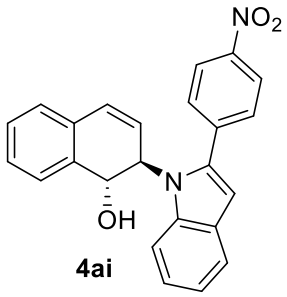
^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.78 – 7.69 (m, 6H), 7.63 – 7.52 (m, 1H), 7.37 – 7.30 (m, 2H), 7.27 – 7.16 (m, 3H), 6.72 – 6.64 (m, 2H), 6.26 (dd, *J* = 9.7, 2.3 Hz, 1H), 5.79 (d, *J* = 12.6 Hz, 1H), 5.41 (dt, *J* = 12.6, 2.7 Hz, 1H), 2.00 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 141.71, 136.52, 136.45, 136.34, 132.19, 130.27, 129.30, 129.22, 128.59, 128.42, 128.08, 126.62, 125.62, 125.59, 125.56, 124.81, 123.02, 121.90, 121.35, 120.51, 113.64, 104.04, 70.96, 60.80.

^{19}F NMR (376 MHz, $CDCl_3$) δ -62.61.

HRMS (ESI) m/z: $[M + H]^+$ $C_{25}H_{19}F_3NO$ 406.1413; Found: 406.1413. The *ee* of **4ah** was determined by HPLC analysis using Daicel Chiralcel OD-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 95/5, 1.0 mL/min, 254 nm; t_{major} = 7.12 min, t_{minor} = 7.86 min.

(1R,2R)-2-(2-(4-nitrophenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ai

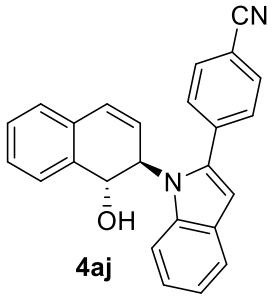
Brown paste, ethyl acetate/petroleum ether (1 : 5) was used for purification, 54.1 mg, 71% yield, 99% *ee*, $[\alpha]^{20}_D$ = 128 (*c* = 0.63, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.50 – 8.11 (m, 2H), 7.81 – 7.63 (m, 4H), 7.55 – 7.46 (m, 1H), 7.32 – 7.25 (m, 2H), 7.23 – 7.11 (m, 3H), 6.69 (s, 1H), 6.64 (dd, *J* = 9.8, 3.2 Hz, 1H), 6.20 (dd, *J* = 9.8, 2.3 Hz, 1H), 5.75 (dd, *J* = 12.6, 4.7 Hz, 1H), 5.35 (dt, *J* = 12.5, 2.8 Hz, 1H), 1.97 (d, *J* = 5.5 Hz, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 147.15, 140.81, 139.37, 136.77, 136.39, 132.09, 130.49, 129.49, 129.15, 128.47, 128.25, 128.14, 126.65, 124.76, 123.90, 122.38, 121.57, 120.73, 113.77, 105.02, 71.00, 60.95.

HRMS (ESI) m/z: $[M + H]^+$ $C_{24}H_{19}N_2O_3$ 383.1390; Found: 383.1389. The *ee* of **4ai** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 90/10, 1.0 mL/min, 254 nm; t_{major} = 19.37 min, t_{minor} = 17.06 min.

4-(1-((1R,2R)-1-hydroxy-1,2-dihydronaphthalen-2-yl)-1H-indol-2-yl)benzonitrile



4aj

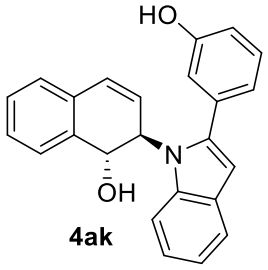
Brown solid, ethyl acetate/petroleum ether (1 : 5) was used for purification, 41.5 mg, 57% yield, mp 161 – 163 °C, 97% *ee*, $[\alpha]^{20}_D$ = 98.1 (*c* = 0.54, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.75 – 7.63 (m, 6H), 7.55 – 7.50 (m, 1H), 7.35 – 7.27 (m, 2H), 7.24 – 7.11 (m, 3H), 6.67 (s, 1H), 6.65 (dd, *J* = 9.8, 3.2 Hz, 1H), 6.20 (dd, *J* = 9.8, 2.3 Hz, 1H), 5.75 (dd, *J* = 12.6, 4.7 Hz, 1H), 5.35 (dt, *J* = 12.6, 2.7 Hz, 1H), 2.09 (d, *J* = 4.9 Hz, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 141.20, 137.47, 136.61, 136.48, 132.38, 132.13, 130.42, 129.41, 129.15, 128.46, 128.38, 128.11, 126.64, 124.80, 122.20, 121.48, 120.63, 118.68, 113.73, 111.43, 104.60, 70.93, 60.87.

HRMS (ESI) m/z: $[M + H]^+$ $C_{25}H_{19}N_2O$ 363.1492; Found: 363.1489. The *ee* of **4aj** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 90/10, 1.0 mL/min, 254 nm; t_{major} = 23.71 min, t_{minor} = 21.04 min.

(1R,2R)-2-(2-(3-hydroxyphenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ak

Dark green paste, ethyl acetate/petroleum ether (1 : 5) was used for purification, 57.7 mg, 82% yield, 97% *ee*, $[\alpha]^{20}_D$ = 62.3 (*c* = 1.19, $CHCl_3$).

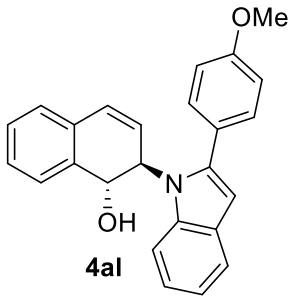
^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.64 (dt, *J* = 23.1, 4.3 Hz, 2H), 7.40 (d, *J* = 7.6 Hz, 1H), 7.31 – 7.25 (m, 1H), 7.24 – 7.12 (m, 5H), 7.10 – 6.99 (m, 2H), 6.72 (d, *J* = 8.2 Hz, 1H), 6.66 – 6.55 (m, 2H), 6.13 (d, *J* = 8.2 Hz, 2H), 5.76 (d, *J* = 12.2 Hz, 1H), 5.50 (d, *J* = 12.2 Hz, 1H), 2.60 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 155.65, 142.76, 136.06, 135.97, 133.95, 132.18, 129.96, 129.18, 128.93, 128.72, 128.42, 128.12, 126.63, 124.92, 122.25, 122.22, 121.41, 121.09, 120.25, 116.88, 115.26, 113.35, 103.04, 71.37, 60.37.

HRMS (ESI) m/z: $[M + H]^+$ $C_{24}H_{20}NO_2$ 354.1489; Found: 354.1487. The *ee* of **4ak** was determined

by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 95/5, 1.0 mL/min, 254 nm; t_{major} = 29.55 min, t_{minor} = 26.22 min.

(1R,2R)-2-(2-(4-methoxyphenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4al

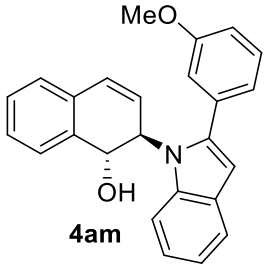
Dark green paste, ethyl acetate/petroleum ether (1 : 10) was used for purification, 52.3 mg, 71% yield, 97% *ee*, $[\alpha]^{20}_D$ = 152.6 (*c* = 1.0, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.77 – 7.65 (m, 2H), 7.60 – 7.54 (m, 1H), 7.52 – 7.47 (m, 2H), 7.32 – 7.27 (m, 2H), 7.22 – 7.13 (m, 3H), 7.00 – 6.93 (m, 2H), 6.63 (dd, *J* = 9.8, 3.2 Hz, 1H), 6.58 (s, 1H), 6.22 (dd, *J* = 9.7, 2.3 Hz, 1H), 5.78 (d, *J* = 12.6 Hz, 1H), 5.44 (d, *J* = 12.2, 2.4, 2.0 Hz, 1H), 3.83 (s, 3H), 2.06 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 159.55, 143.10, 136.76, 135.84, 132.31, 131.43, 129.37, 129.23, 128.92, 128.26, 127.91, 126.46, 125.15, 124.91, 121.08, 120.88, 120.11, 114.09, 113.35, 102.57, 70.92, 60.50, 55.34.

HRMS (ESI) m/z: $[M + H]^+$ $C_{25}H_{22}NO_2$ 368.1645; Found: 368.16.44. The *ee* of **4al** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 98/2, 1.0 mL/min, 254 nm; t_{major} = 17.76 min, t_{minor} = 11.77 min.

(1R,2R)-2-(2-(3-methoxyphenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4am

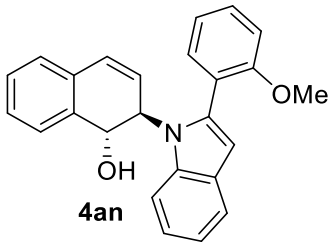
Dark green paste, ethyl acetate/petroleum ether (1 : 10) was used for purification, 56.2 mg, 77% yield, 97% *ee*, $[\alpha]^{20}_D$ = 27.9 (*c* = 1.0, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.77 – 7.68 (m, 2H), 7.59 – 7.54 (m, 1H), 7.37 – 7.34 (m, 1H), 7.32 – 7.27 (m, 2H), 7.24 – 7.13 (m, 5H), 6.93 (dd, *J* = 8.3, 2.6 Hz, 1H), 6.69 – 6.60 (m, 2H), 6.24 (dd, *J* = 9.7, 2.1 Hz, 1H), 5.78 (dd, *J* = 12.7, 4.7 Hz, 1H), 5.53 (dd, *J* = 12.7, 2.6 Hz, 1H), 3.83 (s, 3H), 2.06 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 159.54, 143.13, 136.81, 136.09, 134.08, 132.32, 129.68, 129.32, 129.18, 128.96, 128.28, 127.93, 126.49, 124.86, 122.49, 121.36, 121.12, 120.22, 115.65, 113.82, 113.50, 103.03, 70.91, 60.64, 55.33.

HRMS (ESI) m/z: $[M + H]^+$ $C_{25}H_{22}NO_2$ 368.1645; Found: 368.16.44. The *ee* of **4am** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 95/5, 1.0 mL/min, 254 nm; t_{major} = 12.46 min, t_{minor} = 10.90 min.

(1R,2R)-2-(2-(2-methoxyphenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4an

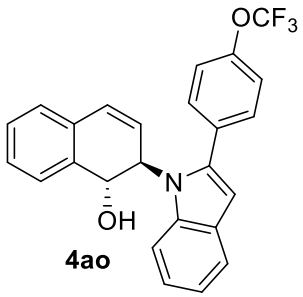
Light green solid, ethyl acetate/petroleum ether (1 : 10) was used for purification, 51.5 mg, 70% yield, mp 86 – 88 °C, 97% *ee*, $[\alpha]^{20}_D$ = -2.1 (*c* = 1.12, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.78 – 7.71 (m, 2H), 7.63 – 7.55 (m, 1H), 7.51 – 7.41 (m, 1H), 7.36 – 7.26 (m, 2H), 7.26 – 7.17 (m, 3H), 7.09 (t, *J* = 7.5 Hz, 1H), 6.99 (d, *J* = 8.5 Hz, 1H), 6.65 (d, *J* = 9.2 Hz, 1H), 6.59 (s, 1H), 6.32 (s, 1H), 5.77 (d, *J* = 12.6 Hz, 1H), 5.05 (d, *J* = 12.5 Hz, 1H), 3.81 (s, 3H), 1.77 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 156.85, 136.77, 135.55, 132.69, 132.25, 130.48, 129.53, 128.49, 128.14, 127.81, 126.40, 125.07, 121.87, 121.13, 120.56, 119.78, 113.03, 110.99, 110.71, 108.53, 102.86, 70.71, 61.50, 55.56.

HRMS (ESI) m/z: $[M + H]^+$ $C_{25}H_{22}NO_2$ 368.1645; Found: 368.1645. The *ee* of **4an** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 98/2, 1.0 mL/min, 254 nm; t_{major} = 10.19 min, t_{minor} = 12.55 min.

(1R,2R)-2-(2-(4-(trifluoromethoxy)phenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ao

Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 68.0 mg, 81% yield, 97% *ee*, $[\alpha]^{20}_D$ = 23.6 (*c* = 1.06, $CHCl_3$).

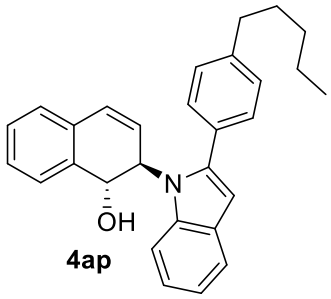
^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.72 (t, *J* = 8.8 Hz, 2H), 7.62 (d, *J* = 8.2 Hz, 2H), 7.59 – 7.51 (m, 1H), 7.37 – 7.25 (m, 4H), 7.25 – 7.14 (m, 3H), 6.65 (dd, *J* = 9.8, 3.3 Hz, 1H), 6.62 (s, 1H), 6.22 (d, *J* = 9.2 Hz, 1H), 5.77 (d, *J* = 11.2 Hz, 1H), 5.40 (d, *J* = 12.6 Hz, 1H), 2.01 (d, *J* = 5.5 Hz, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 149.09, 141.75, 136.58, 136.09, 132.25, 131.57, 131.49, 129.19, 128.79, 128.40, 128.06, 126.59, 124.86, 121.65, 121.55, 121.20, 121.03, 120.40, 119.50, 113.54, 103.59, 70.96, 60.63.

^{19}F NMR (376 MHz, $CDCl_3$) δ -57.60.

HRMS (ESI) m/z: $[M + H]^+$ $C_{25}H_{19}F_3NO_2$ 422.1362; Found: 422.1361. The *ee* of **4ao** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 98/2, 1.0 mL/min, 254 nm; t_{major} = 9.68 min, t_{minor} = 7.76 min.

(1R,2R)-2-(2-(4-pentylphenyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ap

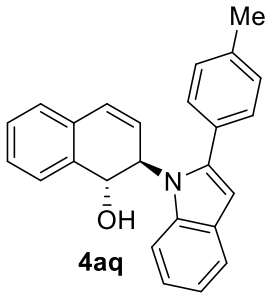
Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 61.0 mg, 75% yield, 96% *ee*, $[\alpha]^{20}_D$ = 61.4 (*c* = 0.83, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.74 – 7.68 (m, 2H), 7.63 – 7.56 (m, 1H), 7.47 (d, *J* = 7.9 Hz, 2H), 7.33 – 7.28 (m, 2H), 7.25 (d, *J* = 7.9 Hz, 2H), 7.21 – 7.15 (m, 3H), 6.64 (dd, *J* = 9.8, 3.2 Hz, 1H), 6.60 (s, 1H), 6.26 (dd, *J* = 9.8, 2.2 Hz, 1H), 5.82 (d, *J* = 12.6 Hz, 1H), 5.48 (dt, *J* = 12.6, 2.8 Hz, 1H), 2.80 – 2.54 (m, 2H), 1.85 (s, 1H), 1.70 -1.62 (m, 2H), 1.42 – 1.35 (m, 4H), 0.93 (t, *J* = 6.6 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 143.41, 143.05, 136.71, 135.94, 132.28, 130.00, 129.94, 129.43, 129.22, 128.88, 128.67, 128.23, 127.89, 126.45, 124.86, 121.10, 120.94, 120.11, 113.41, 102.82, 70.93, 60.59, 35.74, 31.62, 31.07, 22.57, 14.05.

HRMS (ESI) m/z: $[M + H]^+$ $C_{29}H_{30}NO$ 408.2322; Found: 408.2321. The *ee* of **4ap** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 95/5, 1.0 mL/min, 254 nm; t_{major} = 6.17 min, t_{minor} = 4.86 min.

(1R,2R)-2-(2-(p-tolyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4aq

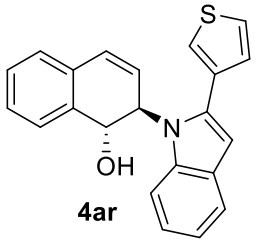
White solid, ethyl acetate/petroleum ether (1 : 20) was used for purification, 53.2 mg, 76% yield, mp 167 – 169 °C, 97% *ee*, $[\alpha]^{20}_{D}$ = 65 (*c* = 1.02, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.78 – 7.69 (m, 2H), 7.60 – 7.56 (m, 1H), 7.47 (d, *J* = 7.9 Hz, 2H), 7.35 – 7.29 (m, 2H), 7.27 (d, *J* = 7.8 Hz, 2H), 7.23 – 7.15 m, 3H), 6.65 (dd, *J* = 9.8, 3.2 Hz, 1H), 6.62 (s, 1H), 6.27 (dd, *J* = 9.7, 2.3 Hz, 1H), 5.79 (d, *J* = 12.7 Hz, 1H), 5.47 (dt, *J* = 12.7, 2.8 Hz, 1H), 2.42 (s, 3H), 1.89 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 143.35, 138.04, 136.71, 135.94, 132.28, 130.01, 129.89, 129.41, 129.36, 129.17, 128.93, 128.24, 127.90, 126.45, 124.89, 121.15, 120.96, 120.13, 113.40, 102.76, 70.93, 60.59, 21.29.

HRMS (ESI) m/z: $[M + H]^+$ $C_{25}H_{22}NO$ 352.1696; Found: 352.1694. The *ee* of **4aq** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 98/2, 1.0 mL/min, 254 nm; t_{major} = 11.65 min, t_{minor} = 9.88 min.

(1R,2R)-2-(2-(thiophen-3-yl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ar

Light yellow solid, ethyl acetate/petroleum ether (1 : 20) was used for purification, 51.2 mg, 75% yield, mp 125 – 127 °C, 96% *ee*, $[\alpha]^{20}_{D}$ = 16.1 (*c* = 0.28, $CHCl_3$).

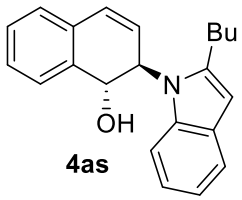
^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.73 – 7.66 (m, 2H), 7.64 – 7.58 (m, 2H), 7.0 -7.34 (m, 2H), 7.34 – 7.28 (m, 2H), 7.21 – 7.14 (m, 3H), 6.64 (s, 1H), 6.61 (dd, *J* = 9.8, 3.1 Hz, 1H), 6.12 (dd, *J* = 9.8, 2.3 Hz, 1H), 5.82 (d, *J* = 12.7 Hz, 1H), 5.57 (dt, *J* = 12.7, 2.7 Hz, 1H), 2.16 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 137.86, 136.58, 135.84, 133.02, 132.34, 129.42, 129.14, 128.81, 128.28, 127.98, 126.49, 125.95, 125.07, 124.88, 121.28, 120.96, 120.17, 113.25, 102.91, 71.10, 60.47.

HRMS (ESI) m/z: $[M + H]^+$ $C_{22}H_{24}NOS$ 344.1104; Found: 344.1103. The *ee* of **4ar** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-

hexane/*i*-PrOH = 95/5, 1.0 mL/min, 254 nm; t_{major} = 11.65 min, t_{minor} = 10.22 min.

(1R,2R)-2-(2-butyl-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4as

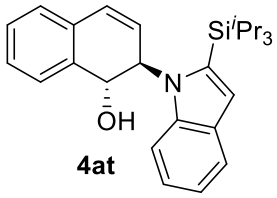
Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 52.5 mg, 83% yield, 96% *ee*, $[\alpha]^{20}_D$ = 16 (*c* = 0.52, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.61 – 7.50 (m, 3H), 7.34 – 7.25 (m, 2H), 7.19 – 7.13 (m, 1H), 7.08 – 7.00 (m, 2H), 6.61 (d, *J* = 9.2 Hz, 1H), 6.29 (s, 1H), 6.11 (d, *J* = 9.8 Hz, 1H), 5.62 (d, *J* = 12.7 Hz, 1H), 5.26 (d, *J* = 12.7 Hz, 1H), 2.90 – 2.69 (m, 2H), 2.13 (s, 1H), 1.73- 1.61 (m, 2H), 1.45 – 1.36 (m, 2H), 0.93 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 142.92, 136.56, 135.35, 132.36, 129.24, 128.96, 128.31, 127.99, 126.53, 124.91, 120.23, 119.50, 112.64, 99.68, 71.01, 59.85, 30.80, 27.06, 22.61, 14.04.

HRMS (ESI) m/z: $[M + H]^+$ $C_{22}H_{24}NO$ 318.1852; Found: 318.1852. The *ee* of **4as** was determined by HPLC analysis using Daicel Chiralcel OD-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 98/2, 1.0 mL/min, 254 nm; t_{major} = 6.14 min, t_{minor} = 7.06 min.

(1R,2R)-2-(2-(triisopropylsilyl)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4at

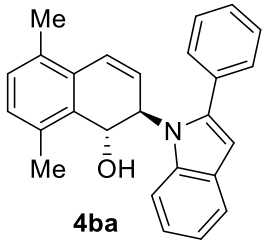
Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 56.0 mg, 67% yield, 97% *ee*, $[\alpha]^{20}_D$ = -80 (*c* = 0.25, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.50 -7.45 (m, 1H), 7.36 (dd, *J* = 7.6, 1.6 Hz, 1H), 7.33 – 7.27 (m, 2H), 7.27 -7.22 (m, 1H), 7.17 (dd, *J* = 7.0, 1.8 Hz, 1H), 6.87 (d, *J* = 8.3 Hz, 1H), 6.69 (t, *J* = 7.2 Hz, 1H), 6.61 (dd, *J* = 9.5, 1.5 Hz, 1H), 6.05 (dd, *J* = 9.6, 4.0 Hz, 1H), 4.85 (dd, *J* = 6.6, 2.3 Hz, 1H), 4.74 (d, *J* = 9.0 Hz, 1H), 4.50 – 4.38 (m, 1H), 2.27 (s, 1H), 1.06 (s, 18H), 1.05 – 0.98 (m, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 148.10, 135.12, 132.38, 131.68, 130.05, 128.86, 128.63, 128.28, 127.58, 127.20, 126.91, 117.00, 110.38, 109.01, 103.35, 96.93, 71.42, 54.65, 18.67, 11.18.

HRMS (ESI) m/z: $[M + H]^+$ $C_{27}H_{36}NOSi$ 418.2561; Found: 418.2559. The *ee* of **4at** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 98/2, 1.0 mL/min, 254 nm; t_{major} = 5.02 min, t_{minor} = 6.02 min.

(1R,2R)-5,8-dimethyl-2-(2-phenyl-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ba

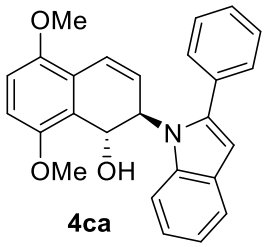
White solid, ethyl acetate/petroleum ether (1 : 20) was used for purification, 58.8 mg, 81% yield, mp 167 – 168 °C, 97% *ee*, $[\alpha]^{20}_D$ = -280.2 (*c* = 1.0, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.61 (d, *J* = 7.8 Hz, 1H), 7.56 (d, *J* = 7.4 Hz, 2H), 7.48 – 7.39 (m, 3H), 7.16 (d, *J* = 7.7 Hz, 1H), 7.12 -7.04 (m, 2H), 6.97 – 6.89 (m, 2H), 6.77 (d, *J* = 8.4 Hz, 1H), 6.58 (s, 1H), 5.92 (dd, *J* = 10.0, 4.8 Hz, 1H), 5.44 (s, 1H), 5.33 (s, 1H), 2.42 (s, 3H), 2.35 (s, 3H), 1.62 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 141.96, 136.45, 134.74, 133.00, 132.74, 132.49, 131.13, 130.76, 130.17, 129.51, 128.67, 128.41, 128.17, 125.94, 123.69, 121.64, 120.48, 120.00, 111.76, 103.25, 70.12, 57.89, 19.17, 18.89.

HRMS (ESI) m/z: $[M + H]^+$ $C_{26}H_{24}NO$ 366.1852; Found: 366.1850. The *ee* of **4ba** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 95/5, 1.0 mL/min, 254 nm; t_{major} = 14.19 min, t_{minor} = 20.07 min.

(1R,2R)-5,8-dimethoxy-2-(2-phenyl-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ca

Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 56.2 mg, 71% yield, 90% *ee*, $[\alpha]^{20}_D$ = -87.3 (*c* = 1.0, $CHCl_3$).

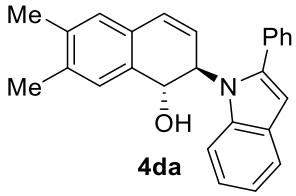
^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.75 – 7.66 (m, 3H), 7.48 (t, *J* = 7.5 Hz, 2H), 7.44 -7.39 (m, 1H), 7.28 – 7.23 (m, 1H), 7.14 (t, *J* = 7.4 Hz, 1H), 7.11 -6.99 (m, 2H), 6.83 (q, *J* = 9.0 Hz, 2H), 6.61 (s, 1H), 6.02 (dd, *J* = 10.1, 3.3 Hz, 1H), 5.85 (d, *J* = 8.1 Hz, 1H), 5.62 – 5.51 (m, 1H), 4.10 (s, 1H), 3.86 (s, 3H), 3.80 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 151.40, 149.94, 142.71, 136.30, 133.10, 130.29, 129.06, 128.37, 127.94, 126.72, 124.45, 121.90, 121.69, 121.16, 120.75, 119.86, 112.34, 111.13, 111.12, 102.56, 70.00, 58.45, 56.25, 55.80.

HRMS (ESI) m/z: $[M + H]^+$ $C_{26}H_{24}NO_3$ 398.1751; Found: 398.1750. The *ee* of **4ca** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-

hexane/*i*-PrOH = 80/20, 1.0 mL/min, 254 nm; t_{major} = 16.27 min, t_{minor} = 22.57 min.

(1R,2R)-6,7-dimethyl-2-(2-phenyl-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4da

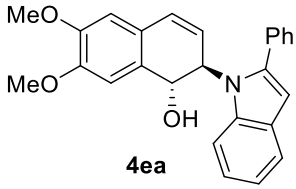
Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 64.1 mg, 88% yield, 94% *ee*, $[\alpha]^{20}_D$ = 21 (*c* = 1.15, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.78 -7.72 (m, 2H), 7.63 – 7.58 (m, 2H), 7.49 – 7.44 (m, 2H), 7.43 – 7.37 (m, 1H), 7.35 (s, 1H), 7.24 – 7.19 (m, 2H), 6.99 (s, 1H), 6.65 (s, 1H), 6.62 (dd, *J* = 9.8, 3.2 Hz, 1H), 6.21 (dd, *J* = 9.8, 2.2 Hz, 1H), 5.75 (d, *J* = 12.6 Hz, 1H), 5.45 (dt, *J* = 12.5, 2.8 Hz, 1H), 2.32 (s, 6H), 1.87 (d, *J* = 5.2 Hz, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 143.30, 136.79, 136.04, 134.03, 132.91, 130.13, 129.94, 129.35, 128.81, 128.63, 128.08, 128.00, 127.99, 126.26, 125.21, 121.26, 121.03, 120.16, 113.49, 102.97, 70.98, 60.87, 19.80, 19.39.

HRMS (ESI) m/z: $[M + H]^+$ $C_{26}H_{24}NO$ 366.1852; Found: 366.1851. The *ee* of **4da** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 95/5, 1.0 mL/min, 254 nm; t_{major} = 7.79 min, t_{minor} = 15.89 min.

(1R,2R)-6,7-dimethoxy-2-(2-phenyl-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ea

White solid, ethyl acetate/petroleum ether (1 : 5) was used for purification, 60.0 mg, 76% yield, mp 158 – 160 °C, 85% *ee*, $[\alpha]^{20}_D$ = 18.2 (*c* = 1.0, $CHCl_3$).

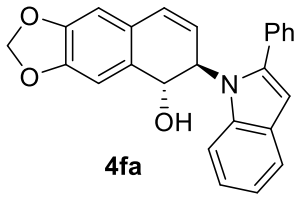
^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.71 – 7.66 (m, 2H), 7.56 – 7.52 (m, 2H), 7.46 – 7.40 (m, 2H), 7.39 -7.34 (m, 1H), 7.20 – 7.15 (m, 2H), 7.11 (s, 1H), 6.69 (s, 1H), 6.60 (s, 1H), 6.53 (dd, *J* = 9.7, 3.1 Hz, 1H), 6.14 (d, *J* = 10.6 Hz, 1H), 5.71 (dd, *J* = 12.7, 4.5 Hz, 1H), 5.41 (d, *J* = 12.6 Hz, 1H), 3.90 (s, 3H), 3.87 (s, 3H), 1.84 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 148.82, 148.30, 143.21, 136.04, 132.84, 130.03, 129.45, 129.30, 128.63, 128.49, 128.09, 127.07, 125.08, 121.24, 120.99, 120.17, 113.50, 110.11, 108.67, 103.03, 71.06, 60.87, 56.13, 56.06.

HRMS (ESI) m/z: $[M + H]^+$ $C_{26}H_{24}NO_3$ 398.1751; Found: 398.1750. The *ee* of **4ea** was determined

by HPLC analysis using Daicel Chiralcel OD-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 80/20, 1.0 mL/min, 254 nm; t_{major} = 5.47 min, t_{minor} = 6.27 min.

(5R,6R)-6-(2-phenyl-1H-indol-1-yl)-5,6-dihydronaphtho[2,3-d][1,3]dioxol-5-ol



4fa

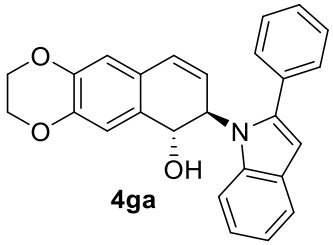
Dark green paste, ethyl acetate/petroleum ether (1 : 10) was used for purification, 63.1 mg, 83% yield, 92% *ee*, $[\alpha]^{20}_D$ = 8.1 (*c* = 0.95, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.72 – 7.65 (m, 2H), 7.54 (d, *J* = 7.6 Hz, 2H), 7.43 (t, *J* = 7.5 Hz, 2H), 7.41 – 7.33 (m, 1H), 7.23 – 7.12 (m, 2H), 7.06 (s, 1H), 6.64 (s, 1H), 6.59 (s, 1H), 6.48 (dd, *J* = 9.8, 3.1 Hz, 1H), 6.14 (dd, *J* = 9.8, 2.2 Hz, 1H), 5.99 – 5.88 (m, 2H), 5.73 – 5.54 (m, 1H), 5.37 (d, *J* = 12.2 Hz, 1H), 1.81 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 147.47, 147.03, 143.22, 136.00, 132.81, 131.23, 130.05, 129.31, 128.61, 128.59, 128.09, 127.16, 126.36, 121.22, 121.01, 120.16, 113.49, 107.13, 106.34, 103.05, 101.16, 71.10, 60.71.

HRMS (ESI) m/z: $[M + H]^+$ $C_{25}H_{20}NO_3$ 382.1438; Found: 382.1436. The *ee* of **4fa** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 95/5, 1.0 mL/min, 254 nm; t_{major} = 19.41 min, t_{minor} = 22.84 min.

(6R,7R)-7-(2-phenyl-1H-indol-1-yl)-2,3,6,7-tetrahydronaphtho[2,3-b][1,4]dioxin-6-ol



4ga

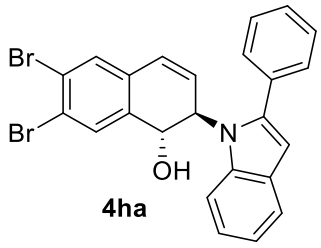
Dark green paste, ethyl acetate/petroleum ether (1 : 10) was used for purification, 63.0 mg, 80% yield, 90% *ee*, $[\alpha]^{20}_D$ = 12.6 (*c* = 0.95, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.71 – 7.65 (m, 2H), 7.58 – 7.52 (m, 2H), 7.42 (t, *J* = 7.5 Hz, 2H), 7.39 – 7.34 (m, 1H), 7.20 – 7.14 (m, 2H), 7.06 (s, 1H), 6.67 (s, 1H), 6.59 (s, 1H), 6.49 (dd, *J* = 9.8, 3.1 Hz, 1H), 6.13 (dd, *J* = 9.8, 2.2 Hz, 1H), 5.63 (dd, *J* = 12.5 Hz, 1H), 5.36 (d, *J* = 12.0 Hz, 1H), 4.20 (s, 4H), 1.86 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 143.29, 143.28, 142.79, 136.00, 132.88, 130.45, 130.09, 129.31, 128.59, 128.22, 128.06, 127.37, 126.06, 121.20, 120.98, 120.12, 115.53, 114.66, 113.42, 102.94, 70.64, 64.47, 64.40, 60.63.

HRMS (ESI) m/z: $[M + H]^+$ $C_{26}H_{22}NO_3$ 396.1594; Found: 396.1592. The *ee* of **4ga** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 80/20, 1.0 mL/min, 254 nm; t_{major} = 10.74 min, t_{minor} = 14.14 min.

(1R,2R)-6,7-dibromo-2-(2-phenyl-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



4ha

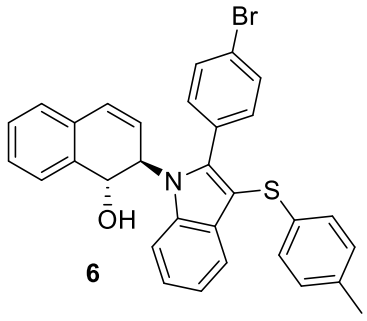
White solid, ethyl acetate/petroleum ether (1 : 20) was used for purification, 72.6 mg, 74% yield, mp 163 – 165 °C, 97% *ee*, $[\alpha]^{20}_D$ = 35.3 (*c* = 1.0, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.70 (s, 1H), 7.66 (d, *J* = 7.7 Hz, 1H), 7.60 (d, *J* = 8.0 Hz, 1H), 7.52 (d, *J* = 7.8 Hz, 2H), 7.47 – 7.41 (m, 2H), 7.40 – 7.37 (m, 1H), 7.35 (s, 1H), 7.21 – 7.14 (m, 2H), 6.60 (s, 1H), 6.50 (d, *J* = 9.9, 3.0 Hz, 1H), 6.30 (d, *J* = 9.4 Hz, 1H), 5.54 (d, *J* = 12.7 Hz, 1H), 5.42 – 5.31 (m, 1H), 1.95 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 143.21, 137.32, 135.79, 132.93, 132.52, 131.28, 130.91, 130.41, 130.06, 129.36, 128.72, 128.28, 127.14, 124.04, 124.02, 121.52, 121.20, 120.39, 113.19, 103.30, 70.05, 59.93.

HRMS (ESI) m/z: $[M + H]^+$ $C_{24}H_{18}Br_2NO$ 493.9750; Found: 493.9751. The *ee* of **4ha** was determined by HPLC analysis using Daicel Chiralcel AS-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 95/5, 1.0 mL/min, 254 nm; t_{major} = 11.85 min, t_{minor} = 18.80 min.

(1R,2R)-2-(2-(4-bromophenyl)-3-(p-tolylthio)-1H-indol-1-yl)-1,2-dihydronaphthalen-1-ol



6

Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 119.8 mg, 95% yield, 98% *ee*, $[\alpha]^{20}_D$ = 56 (*c* = 1.0, $CHCl_3$).

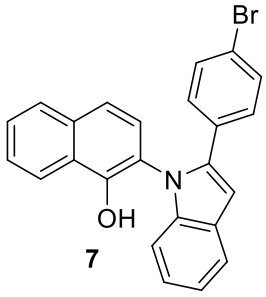
^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.80 -7.74 (m, 2H), 7.57 -7.53 (m, 3H), 7.40 – 7.29 (m, 3H), 7.29 -7.27 (m, 1H), 7.27 -7.19 (m, 2H), 7.19 – 7.14 (m, 1H), 7.01 (s, 4H), 6.68 (dd, *J* = 9.9, 3.0 Hz, 1H), 6.26 (dd, *J* = 9.8, 2.2 Hz, 1H), 5.79 (dd, *J* = 12.7, 5.6 Hz, 1H), 5.34 (d, *J* = 12.4 Hz, 1H), 2.30

(s, 3H), 1.92 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 146.26, 136.52, 135.63, 135.55, 134.58, 132.78, 132.09, 131.63, 131.00, 129.62, 129.60, 129.39, 128.52, 128.18, 128.14, 126.70, 126.06, 124.79, 123.43, 122.59, 121.23, 120.47, 113.61, 102.09, 70.94, 61.62, 20.93.

HRMS (ESI) m/z: $[M + H]^+$ $C_{31}H_{25}BrNOS$ 538.0835; Found: 538.0837. The *ee* of **6** was determined by HPLC analysis using Daicel Chiralcel OD-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 98/2, 1.0 mL/min, 254 nm; t_{major} = 9.33 min, t_{minor} = 8.73 min.

2-(2-(4-bromophenyl)-1H-indol-1-yl)naphthalen-1-ol



7

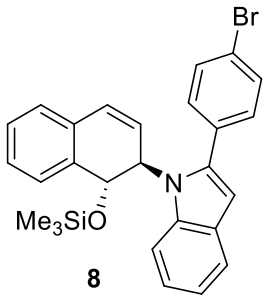
White solid, ethyl acetate/petroleum ether (1 : 20) was used for purification, 75.4 mg, 91% yield, mp 131 – 133 °C.

^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.91 – 7.82 (m, 2H), 7.82 – 7.76 (m, 2H), 7.72 – 7.66 (m, 1H), 7.58 – 7.50 (m, 2H), 7.35 – 7.27 (m, 3H), 7.26 – 7.22 (m, 1H), 7.21 – 7.08 (m, 4H), 6.84 (s, 1H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 139.53, 139.38, 135.79, 133.55, 132.24, 131.49, 130.28, 129.45, 128.24, 127.98, 127.93, 126.88, 126.62, 126.26, 126.11, 122.79, 121.61, 121.04, 120.74, 110.76, 104.26.

HRMS (ESI) m/z: $[M + H]^+$ $C_{24}H_{17}BrNO$ 414.0488; Found: 418.0486.

2-(4-bromophenyl)-1-((1R,2R)-1-((trimethylsilyl)oxy)-1,2-dihydronaphthalen-2-yl)-1H-indole



8

Dark green paste, ethyl acetate/petroleum ether (1 : 20) was used for purification, 89.5 mg, 92% yield, 98% *ee*, $[\alpha]^{20}_D$ = 153.6 (*c* = 1.0, $CHCl_3$).

^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.04 (d, *J* = 8.0 Hz, 1H), 7.96 (d, *J* = 7.5 Hz, 1H), 7.89 – 7.79 (m, 4H), 7.73 (d, *J* = 7.1 Hz, 1H), 7.62 – 7.52 (m, 2H), 7.49 – 7.42 (m, 2H), 7.41 – 7.36 (m, 1H),

6.92 – 6.80 (m, 2H), 6.35 (d, *J* = 9.7 Hz, 1H), 6.21 (d, *J* = 12.9 Hz, 1H), 5.75 (d, *J* = 13.1 Hz, 1H), -0.00 (s, 9H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 141.79, 138.54, 136.44, 132.97, 132.21, 132.16, 131.92, 130.36, 129.43, 129.10, 128.34, 128.08, 126.63, 125.12, 122.61, 121.58, 121.38, 120.23, 113.68, 103.43, 72.29, 60.21, 0.

HRMS (ESI) m/z: $[M + H]^+$ $C_{27}H_{27}BrNOSi$ 488.1040; Found: 488.1039. The *ee* of **8** was determined by HPLC analysis using Daicel Chiralcel OD-H column (25 cm × 0.46 cm ID), conditions: n-hexane/*i*-PrOH = 98/2, 1.0 mL/min, 254 nm; t_{major} = 4.56 min, t_{minor} = 6.37 min.

5. Discovery Studio auxiliary bioactive prediction

Discovery studio is an excellent docking software which is a comprehensive predictive application for the life sciences. Combining the virtual screening and molecular docking techniques have become one of the reputable methods in drug discovery and enhancing the efficiency in lead optimization. Molecular docking studies were carried out on the inhibitors to generate the bioactive conformation within the binding site of the protein and to understand the binding interactions through discovery studio (DS) 2016 (Accelrys Inc., USA) using CDOCKER Tool.

Protein preparation

As one of target proteins in anti-inflammatory, PTGS1 (Prostaglandin Endoperoxide Synthase 1) crystal was downloaded from Brookhaven Protein Data Bank (PDB, http://www.rcsb.org/pdb) named 5WBE at a resolution of 2.75 Å. PDB is a repository of experimentally determined crystal structures of macromolecules. The bound natural substrate ligand in the selected proteins was removed prior to the receptors were created using “prepare protein” tool in DS and typed using the CharmM force field. docking. The binding site was defined by “From Receptors Cavities” and created as a spherical region with the radius of 6 Å at 44.0909, 153.692, 24.0099.

Ligand preparation

The absolute configurations of all the synthesized indoles and Indomethacin were prepared from ChemDraw before imported in the DS and prepared by using “Full Minimization” and “Prepare ligands” tool in DS. In addition to the value of isomer remains false, default parameters were used for ligand preparation using ionization based on pH method. These synthesized compounds were fully minimized using Charm M forcefield method.

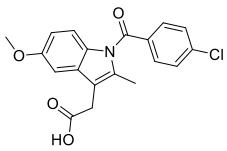
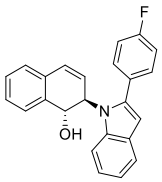
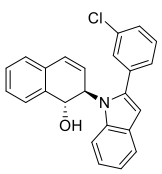
Docking using CDOCKER

To identify the molecular binding interaction of prepared small molecules with the active binding site of the enzyme PTGS1 from 5WBE, redocking studies were carried out by generating a sphere of hot spots (100) in the active site using “CDOCKER” mode with docking tolerance of 0.25. The

CDOCKER energy scoring function (-CDOCKER energy) that considers ligand-receptor interaction energy and internal ligand strain energy was used to rank docked poses. The -CDOCKER energy is a quantitative indication of the ligand pose best accepted by the protein and includes numerous mathematical models. In the -CDOCKER energy scores for the docked library a more positive value means a more favorable binding prediction. 2D and 3D diagrams were generated which further depicted interaction pattern. The docking process involves a conformational search for compound which compliments a target binding site, with the aim of identifying the best matching pose along with the active site to perform docking. The stability of the docked ligand-protein complex is due to hydrogen bonding and Vanderwaals interactions.

Finally, according to computational docking of all the small molecules to the receptor molecule, several indole derivatives have better internal ligand strain energy and receptor-ligand interaction energy (with higher -CDOCKER energy) in comparison with Indomethacin. Which means these indoles (**4ak**, **4at**, and **4fa**) maybe have better ability to inhibit inflammation than Indomethacin does. To highlight the virtual docking scores closely corelate to the performance of bioactivities, **4ab**, **4af**, **4ar**, **4as** and **4ba** which having lower -CDOCKER energy were selected and applied to the experiments for biological evaluation. The values of -CDOCKER energy and -CDOCKER interaction energy are listed in the **Table 1**. These 2D diagrams which showed interaction of the docked small molecules with receptor PTGS1 are performed in the **Figure 1**.

Table 1. The in silico binding analysis (CDOCER Score) of Indomethacin and selected indole derivatives that bound to PTGS1

compound	configuration	-CDOCKER energy	-CDOCKER interaction energy
Indomethacin		16.38	45.08
4ab		5.06	29.8
4af		7.99	34.66

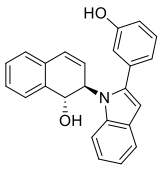
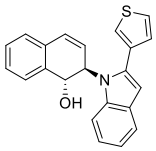
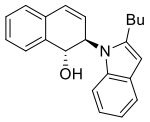
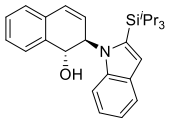
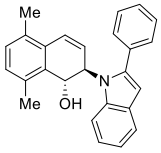
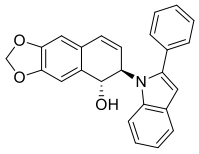
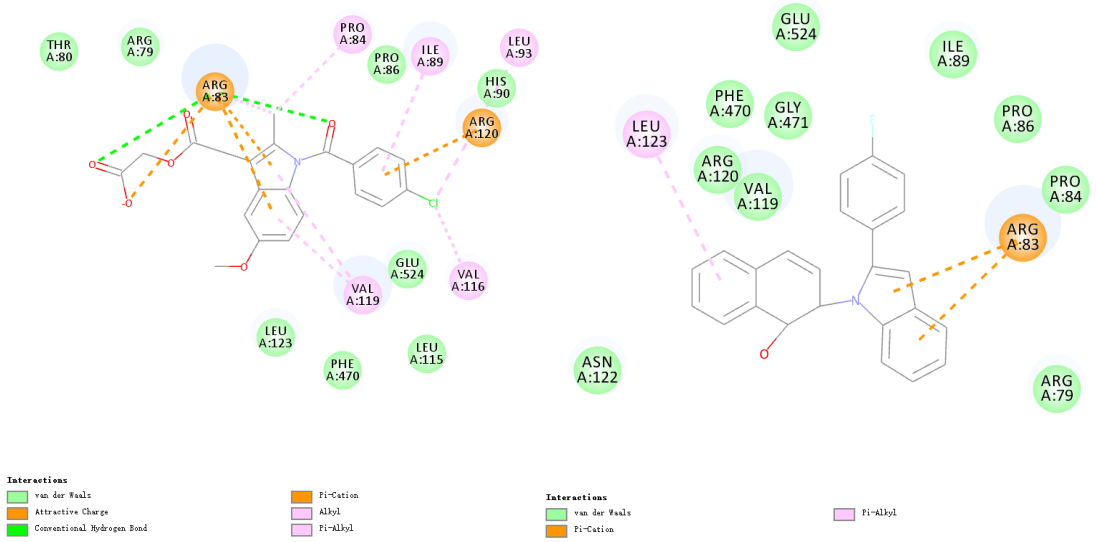
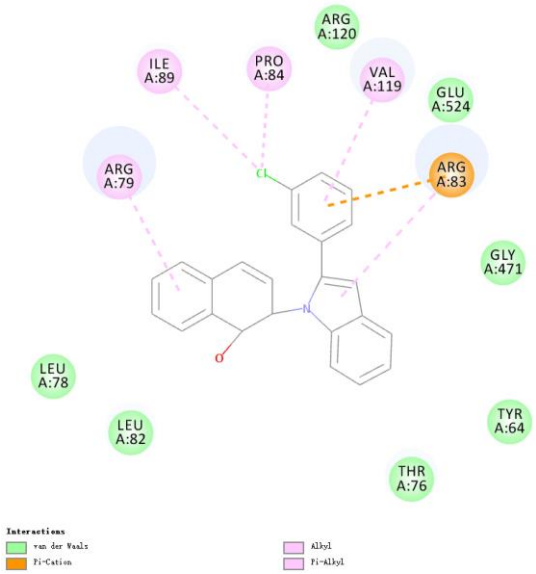
4ak		17.63	41.72
4ar		15.89	27.39
4as		14.55	34.54
4at		26.28	45.65
4ba		12.51	37.09
4fa		18.34	40.8

Figure 1 2D diagrams for the interaction of selected compounds docked with receptor PTGS1

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ARG A:83
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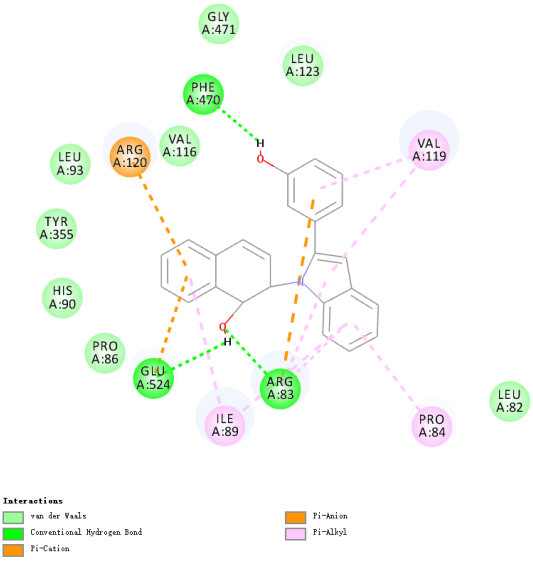
van der Waals
Pi-Cation
Alkyl
Pi-Alkyl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GLU A:524
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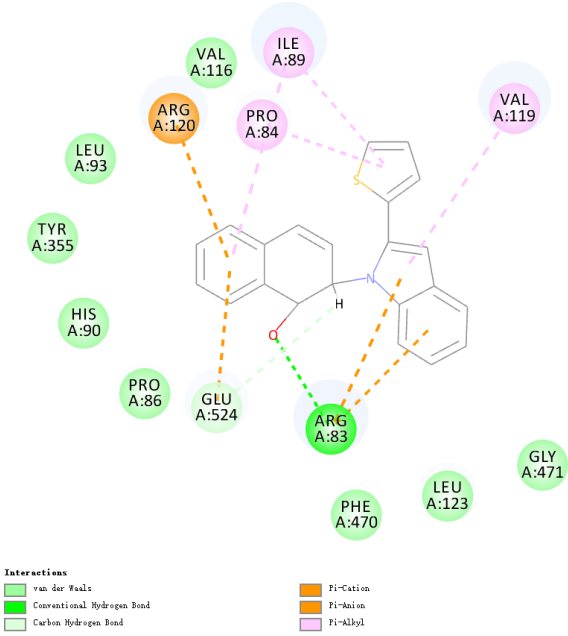
LEU A:82
Interactions
van der Waals
Conventional Hydrogen Bond
Pi-Cation
Pi-Anion
Pi-Alkyl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GLY A:471
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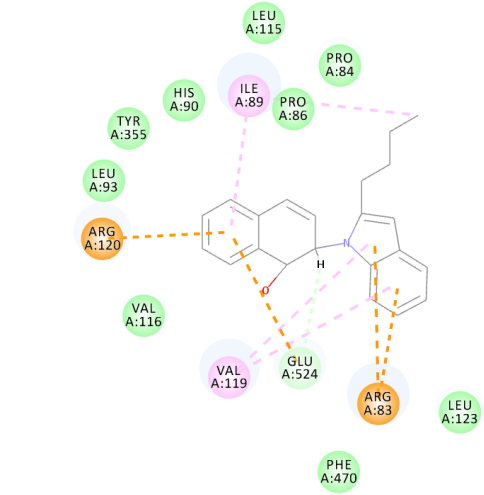
Interactions
van der Waals
Conventional Hydrogen Bond
Carbon Hydrogen Bond
Pi-Cation
Pi-Anion
Pi-Alkyl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GLU A:524
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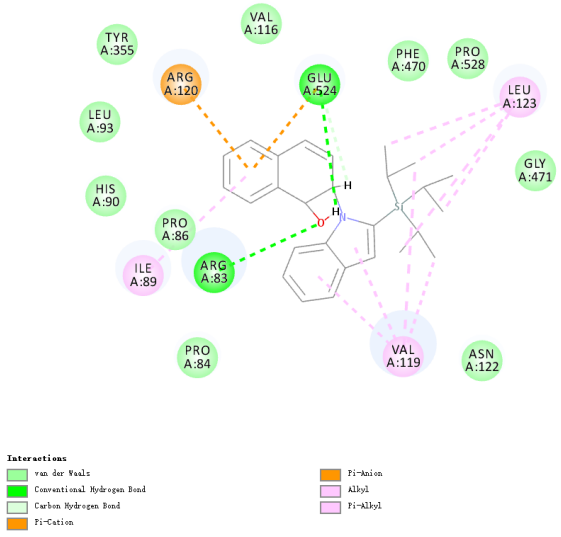
PHE A:470
Interactions
van der Waals
Carbon Hydrogen Bond
Pi-Cation
Pi-Anion
Alkyl
Pi-Alkyl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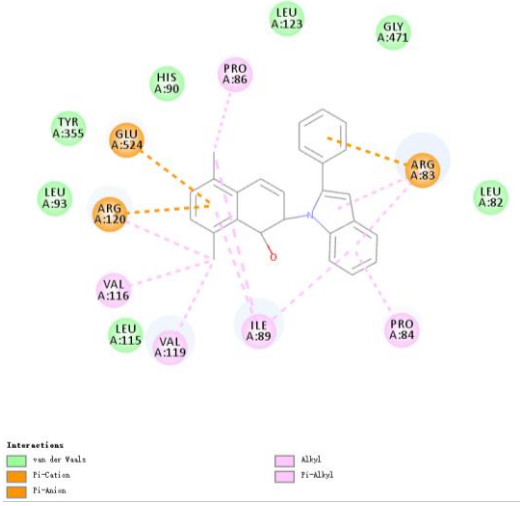
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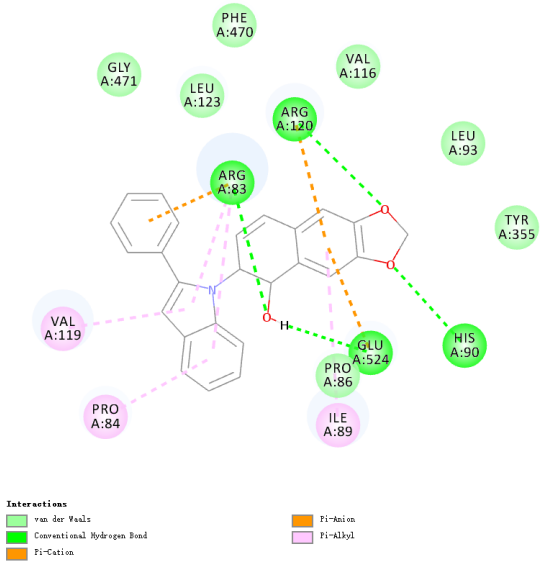

6. Biological evaluation

Cell culture and treatment

The RAW 264.7 (leukemia cells in mouse macrophage) cell line was purchased from the Cell Bank of Shanghai Institute of Biochemistry & Cell Biology at the Chinese Academy of Sciences (Shanghai, China) and cultured in DMEM (Dulbecco's modified Eagle's medium) supplemented with 10% (v/v) fetal bovine serum (FBS), 100 U/ml penicillin and 100 U/ml streptomycin, in a stable environment with 5% CO_2 at 37◦C. Before used in the following in vitro experiments, RAW264.7 cells were treated with each compound (10 μM) for 24 h, followed by stimulation with LPS (1μg/ml) for another 2 h.

Cell viability assay

The CCK-8 (Cell Counting Kit-8) assay was used to evaluate the effect of each compound and Indomethacin on the viability of RAW264.7 cells. Cells were plated into 96-well plates at a density of 2×10^5 cells/well in medium and cultured overnight. In the preliminary experiment, RAW264.7 cells were treated with each compound (0, 0.5, 1, 5, 10, and 25 μM), respectively. For formal experiments, cells were treated with each compound and Indomethacin (10 μM). After 24 h, 20 μL CCK8 solution (cat #A311-01/02, Vazyme Biotech Co., Ltd., Nanjing, China) was added into the medium and incubated for 45 min. The absorbance was measured at 450 nm. Results are expressed as the percentage of viable cells compared to the untreated control.

Enzyme-Linked Immunosorbent Assay (ELISA)

RAW 264.7 cells were treated with each compound at 10 μM for 24 h, followed by stimulation with LPS (1 μg/ml) for another 2 h and the culture supernatant was collected. The concentrations of IL-1β (nterleukin-1β), IL-6 (nterleukin-6), and TNF-α (tumor necrosis factor-α) in the culture

supernatant of RAW 264.7 cells were determined according to the manufacture instructions in Duo-set enzyme linked immune sorbent assay kits, purchased from R&D Systems Co. Ltd. (Minneapolis, MN, USA).

Statistics

The data shown in the study were obtained from at least three independent experiments, and all data in different experimental groups were expressed as the mean ± standard deviation (SD). Statistical analyses were performed using a one-way ANOVA, with post hoc analysis. Details of each statistical analysis are provided in the figure legends. Differences with P values < 0.05 were considered statistically significant.

Table 2. Cell viability experiment for compounds at 10 μM

entry	ctr	4ab	4af	4ak	4ar	4as	4at	4ba	4fa	Indo
1	0.943	0.933	0.955	0.923	0.902	0.908	0.876	0.935	0.871	0.942
2	0.901	0.907	0.921	0.946	0.923	0.889	0.928	0.906	0.926	0.915
3	0.879	0.865	0.885	0.884	0.915	0.883	0.96	0.839	0.909	0.912

Table 3. Concentrations of inflammatory cytokines in ELISA

	ctr	-	4ab	4af	4ak	4ar	4as	4at	4ba	4fa	Indo
IL-1β	20.2	100	105.2	96.3	90.3	99.8	106.8	76.2	92.7	72.3	74.9
SD	2.3	2.56	4.2	3.9	3.5	3.6	5.9	2.9	4.5	3.1	4.8
IL-6	18.3	100	94.3	110.1	94.6	102.4	110.8	78.1	103.4	70.9	85.3
SD	1.1	2.5	4.9	5.8	4.2	3.5	5.8	3.2	4.6	2.4	5.2
TNF-α	30.9	100	106	105	96.3	112	94.6	79.3	99.4	82.1	80.2
SD	2.5	4	3.8	2.9	4.3	1.6	5	2.8	3.2	4.1	3.6

7. Reference

[1] S. Hiroki, I. Naohiro, M. Irie, M. Miwako, *Tetrahedron*, 1996, **52**, 8143

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[5] T. Wenderski, K. M. Light, D. Ogrin, S. G. Bottc, C. J. Harlan, *Tetrahedron Lett*., 2004, **45**, 6851.

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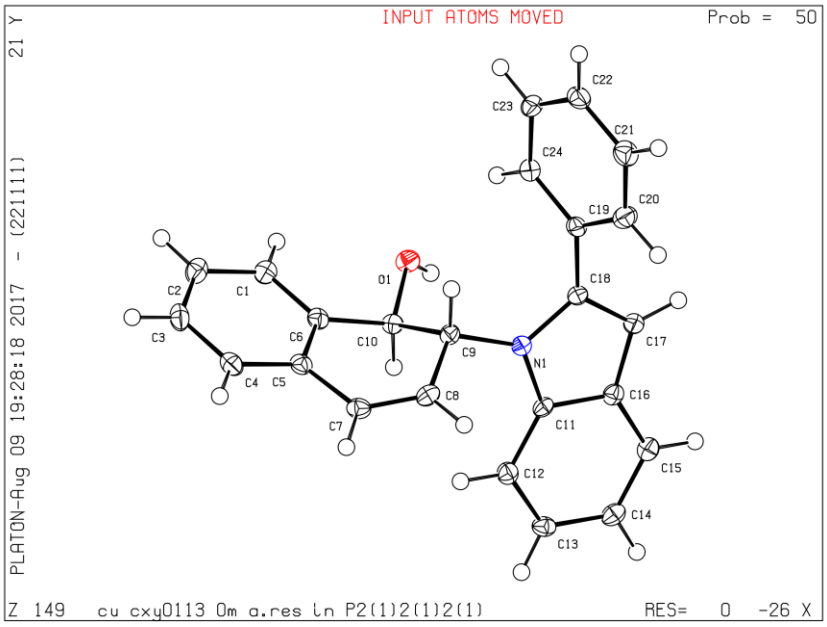
8. Crystal data and structure refinement of 4aa

The crystal was prepared in ethyl acetate underneath methol through evaporation, the structure was measured by 'Bruker APEX-II CCD' diffractometer.



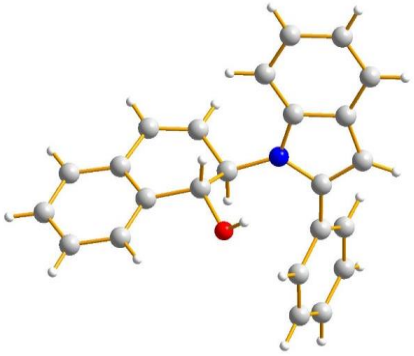
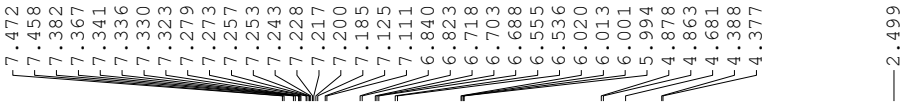


Table 1 Crystal data and structure refinement for 4aa.

Identification code	**4aa**
Empirical formula	$C_{24}H_{19}NO$
Formula weight	337.40
Temperature/K	100
Crystal system	orthorhombic
Space group	$P2_12_12_1$
a/Å	9.9107(3)
b/Å	12.0632(3)
c/Å	14.3759(4)
α/°	90
β/°	90
γ/°	90
Volume/Å^3	1718.71(8)

Z	4
ρ_{calc}g/cm^3	1.304
μ/mm^{-1}	0.616
F(000)	712.0
Crystal size/mm^3	0.5 × 0.42 × 0.36
Radiation	CuKα (λ = 1.54178)
2Θ range for data collection/	9.57 to 136.852
Index ranges	$-11 \leq h \leq 11$, $-14 \leq k \leq 14$, $-17 \leq l \leq 17$
Reflections collected	23392
Independent reflections	3150 [R_{int} = 0.0314, R_{sigma} = 0.0189]
Data/restraints/parameters	3150/0/237
Goodness-of-fit on F^2	1.065
Final R indexes [I>=2σ (I)]	R_1 = 0.0249, wR_2 = 0.0606
Final R indexes [all data]	R_1 = 0.0254, wR_2 = 0.0610
Largest diff. peak/hole / e Å^{-3}	0.19/-0.14
Flack parameter	-0.02(7)

9. NMR spectra of asymmetric hydroamination compounds



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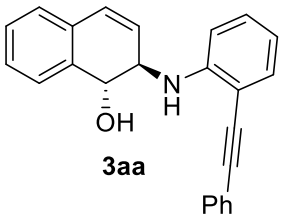

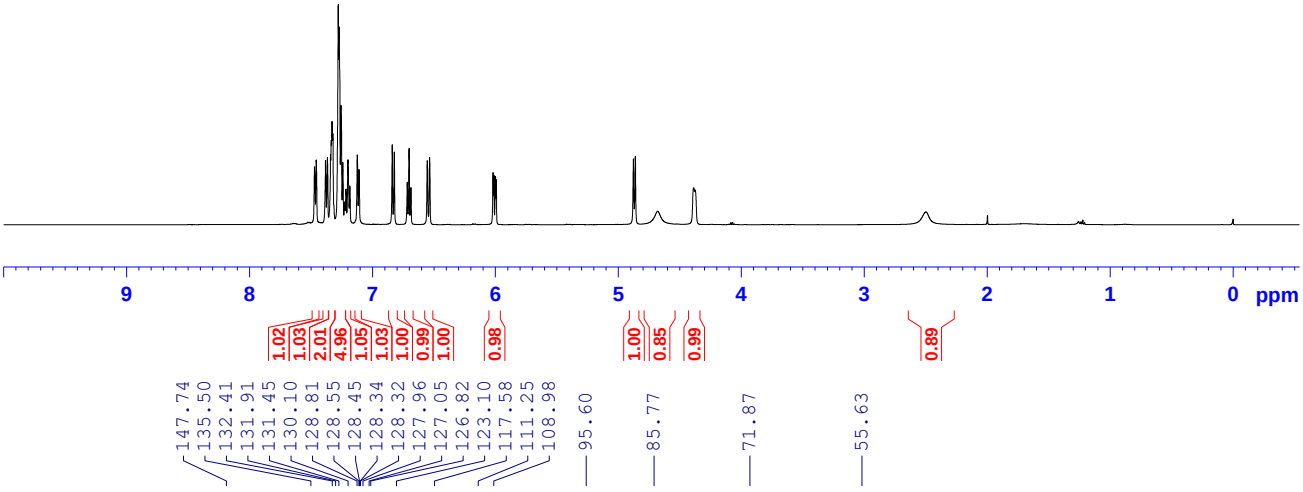

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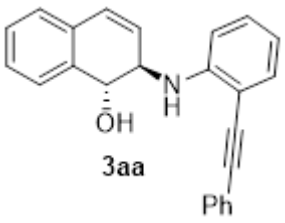

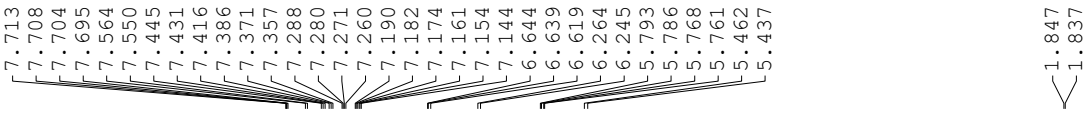

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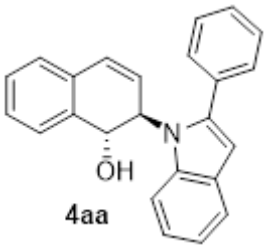
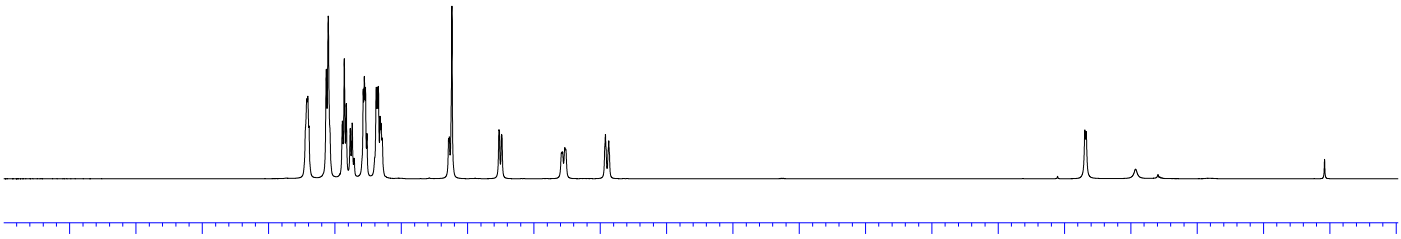
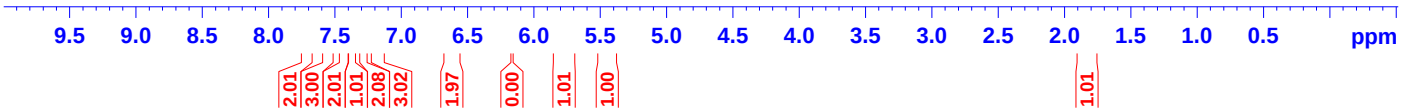
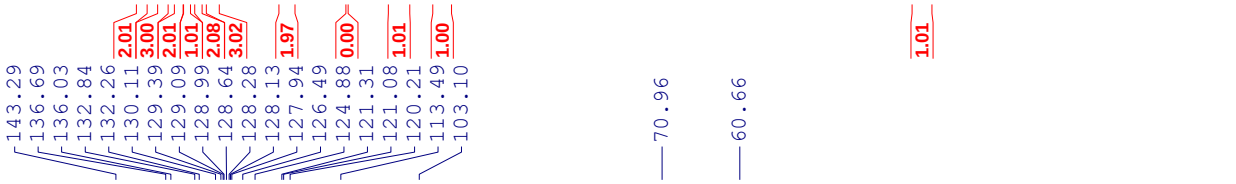


4aa







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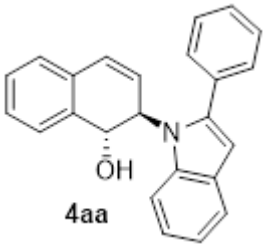

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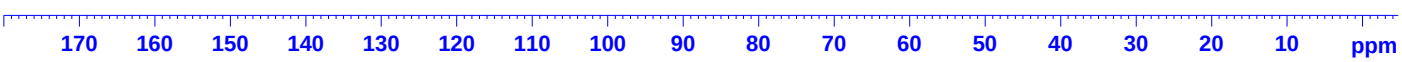

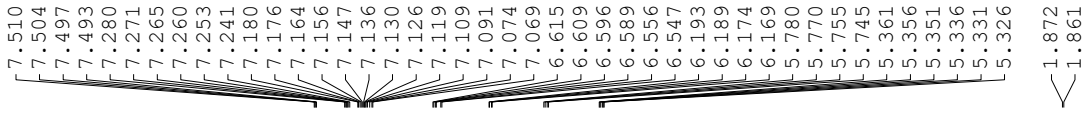

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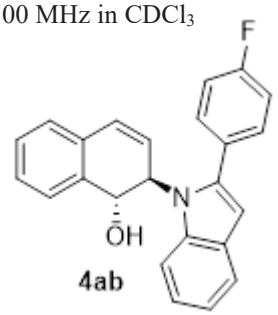

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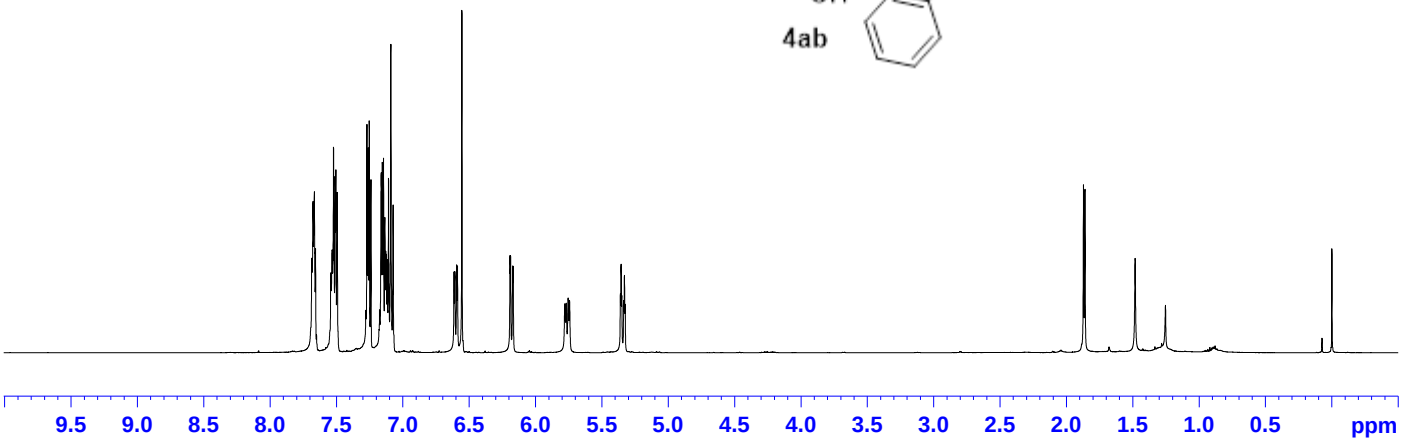

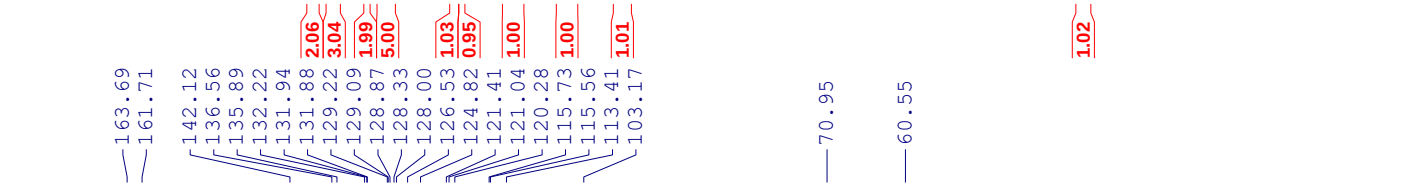

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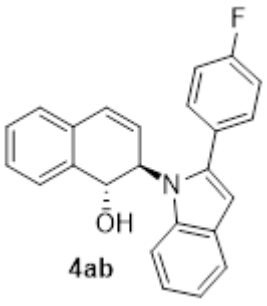

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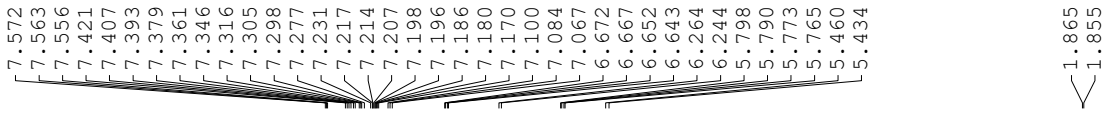
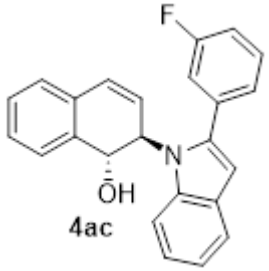
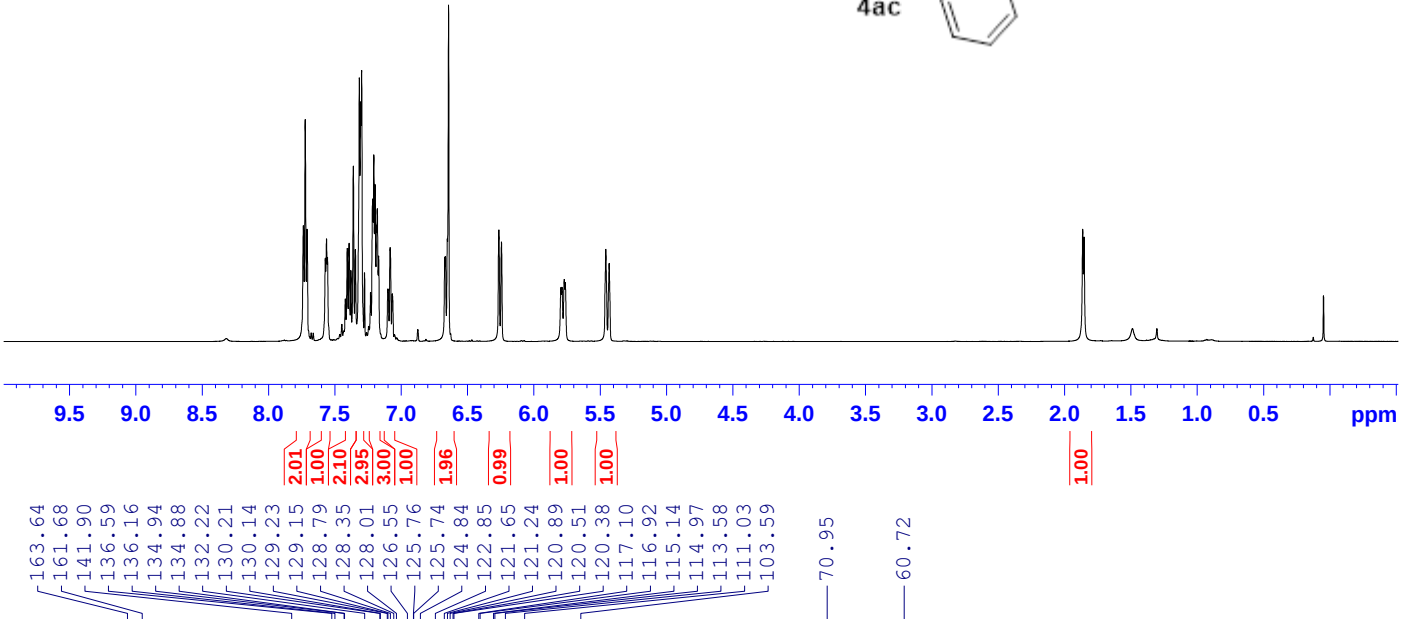
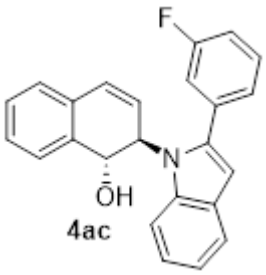


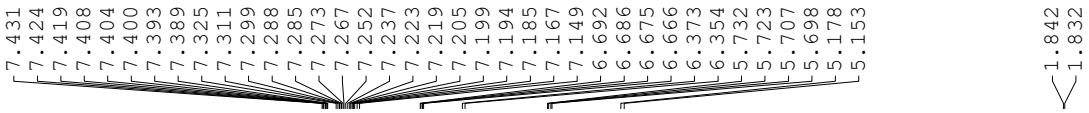
500 MHz in $CDCl_3$



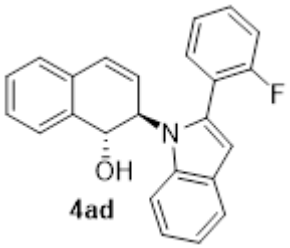


126 MHz in $CDCl_3$





500 MHz in $CDCl_3$



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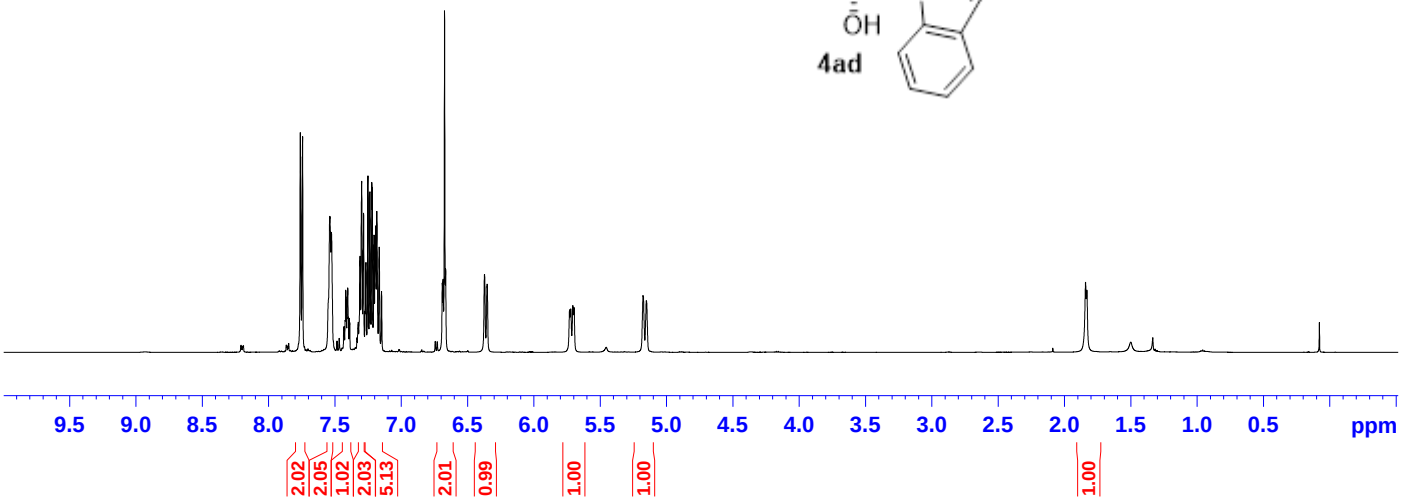
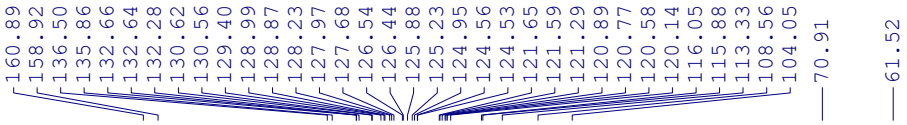
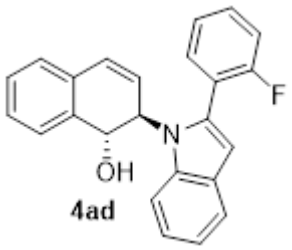




126 MHz in $CDCl_3$



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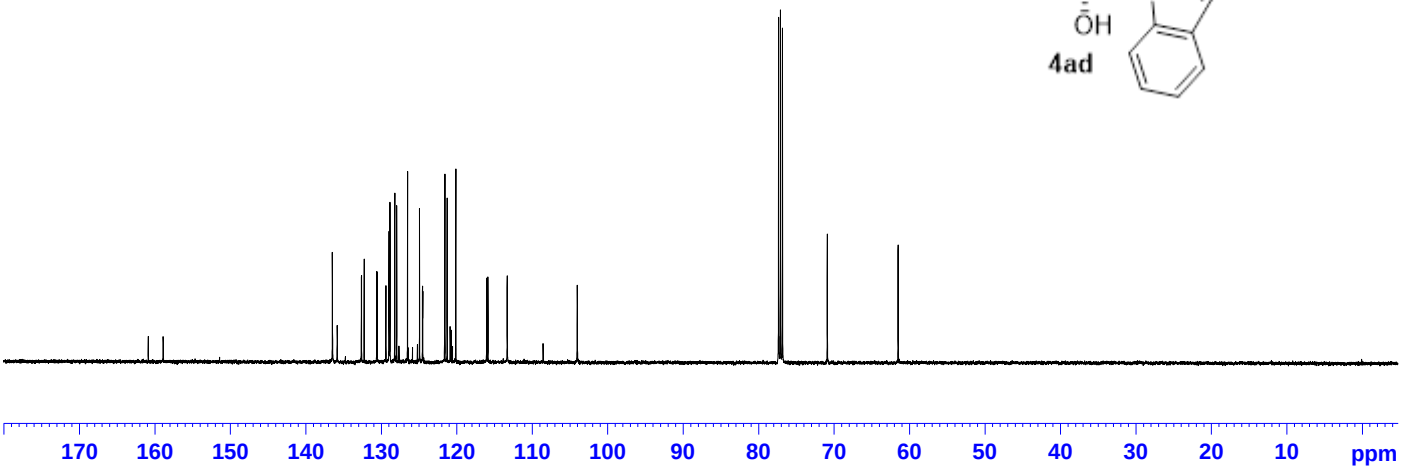
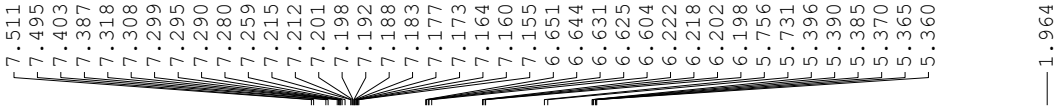
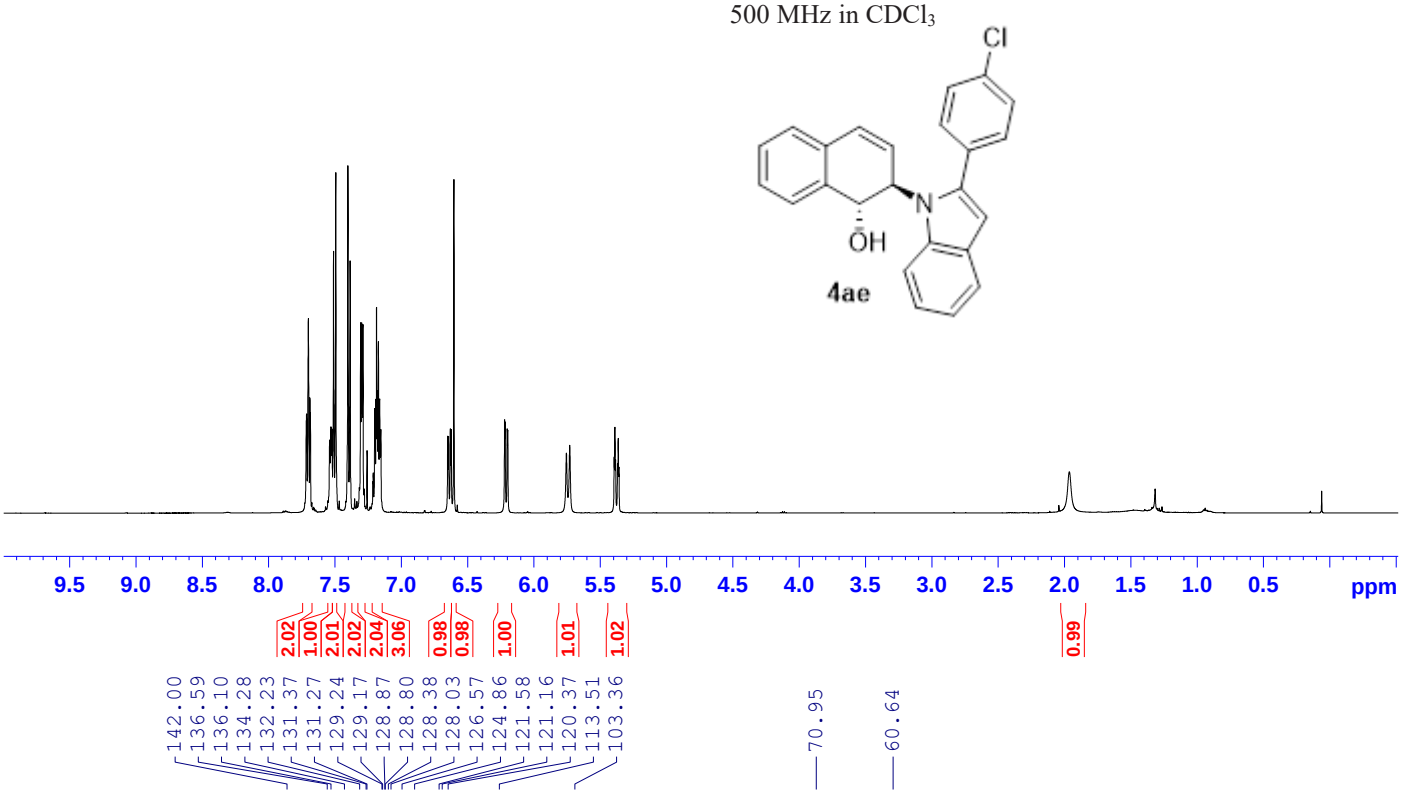
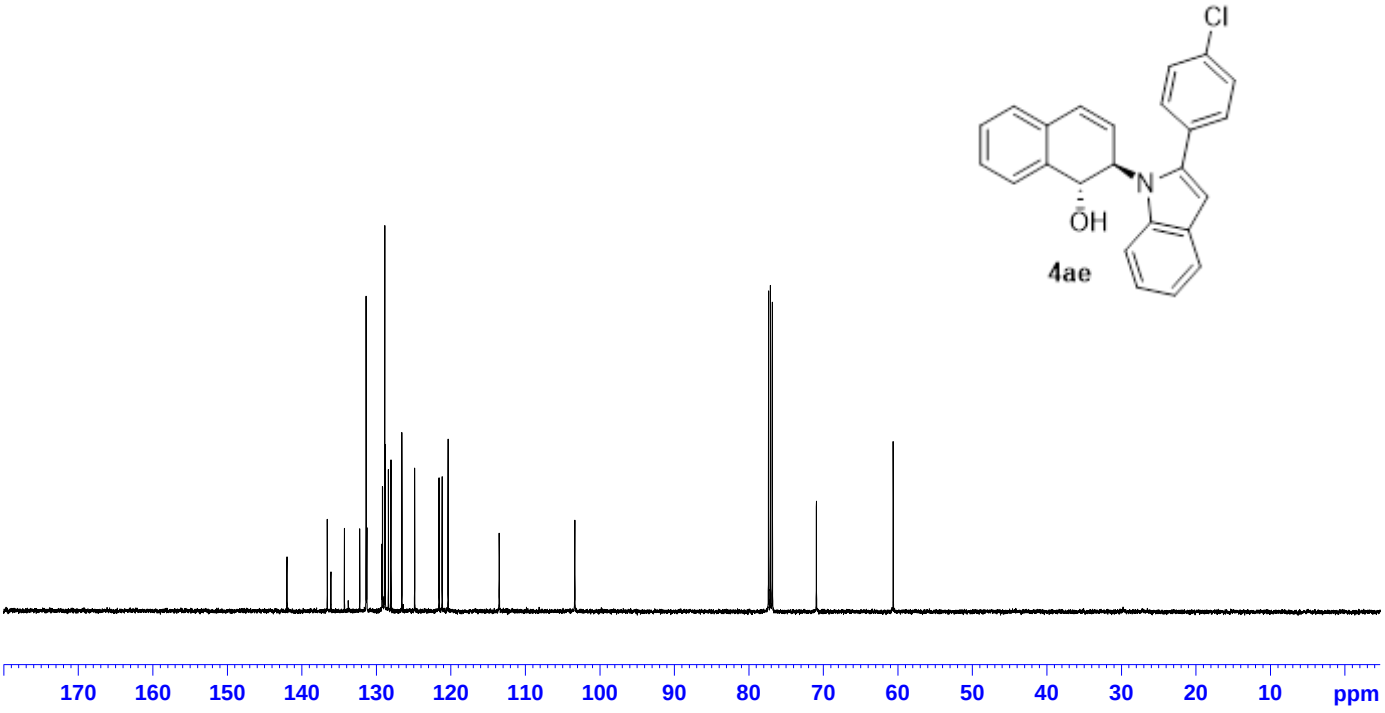


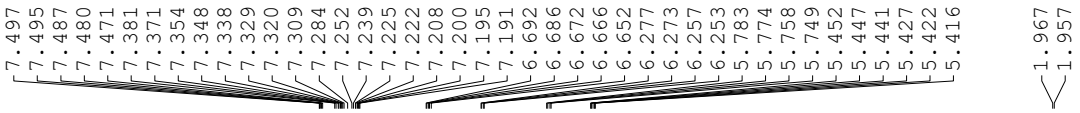


500 MHz in $CDCl_3$

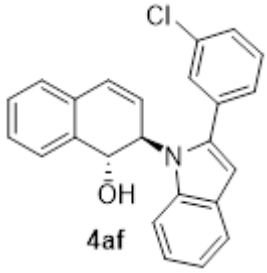


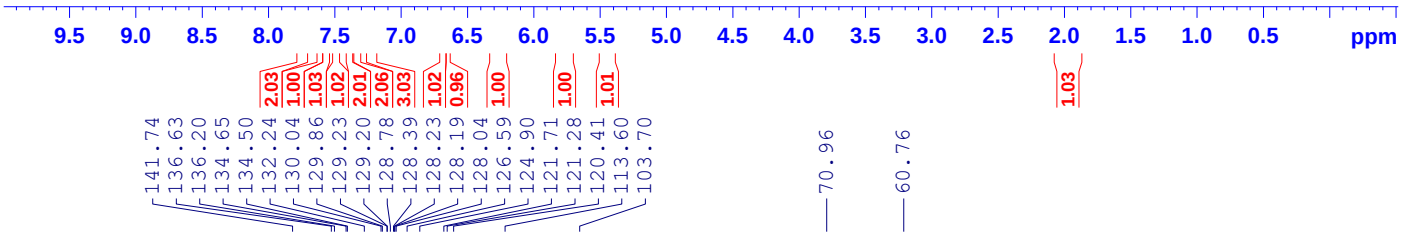
126 MHz in $CDCl_3$



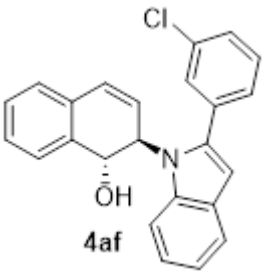


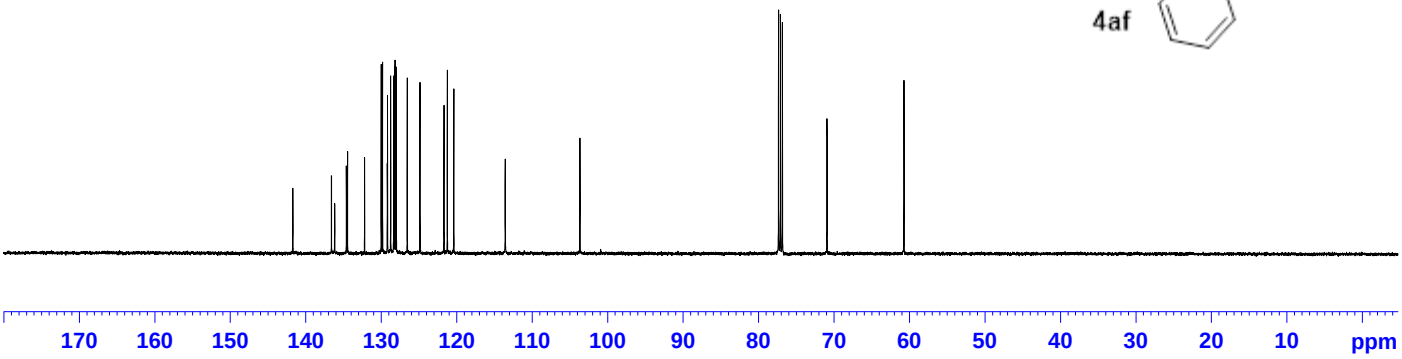
500 MHz in $CDCl_3$

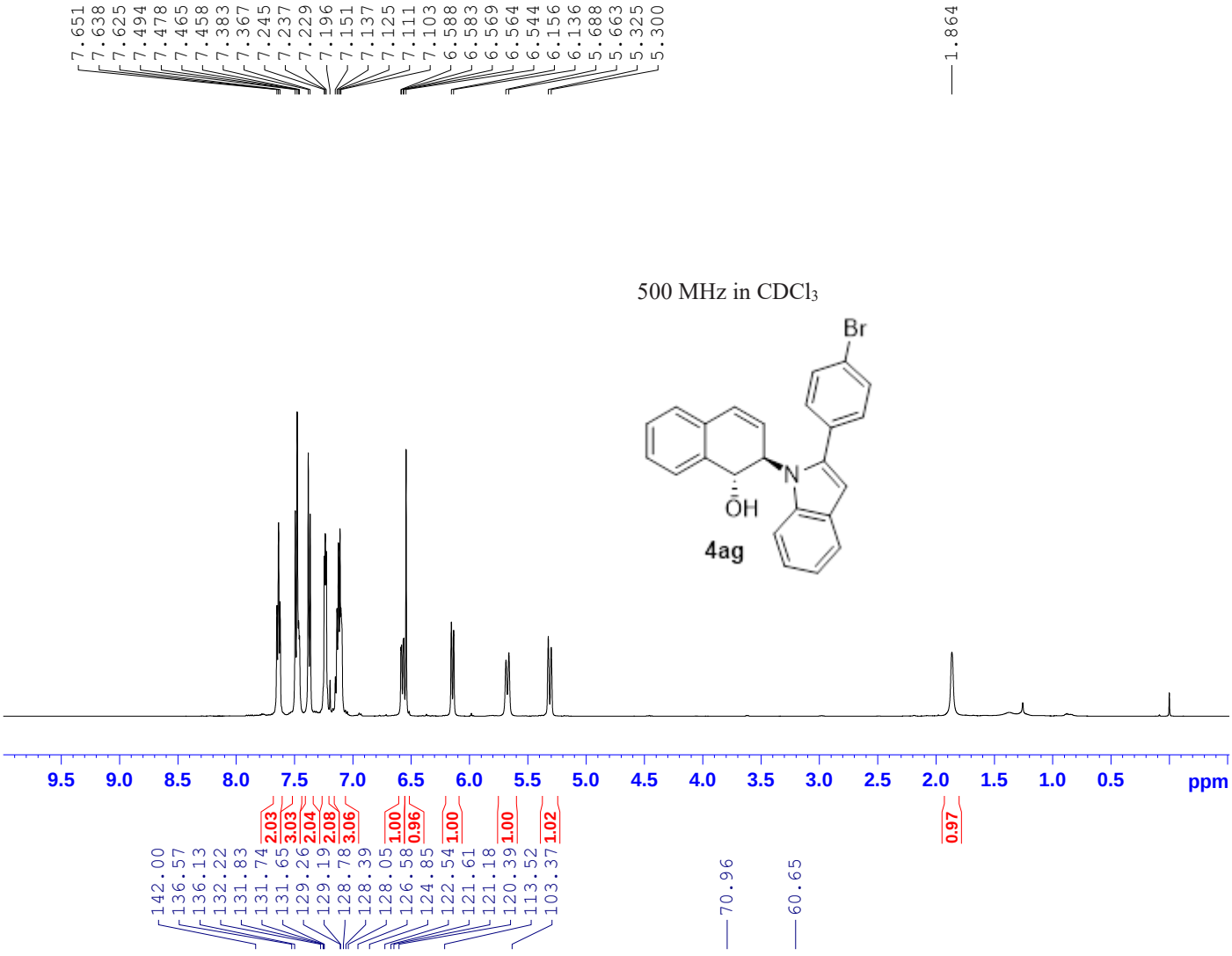




126 MHz in $CDCl_3$






7.651
7.638
7.625
7.494
7.478
7.465
7.458
7.383
7.367
7.245
7.237
7.229
7.196
7.151
7.137
7.125
7.111
7.103
6.588
6.583
6.569
6.564
6.544
6.156
6.136
5.688
5.663
5.325
5.300
1.864
500 MHz in CDCl3
Br
N
OH
4ag
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 ppm
2.03 3.03 2.04 2.08 3.06 1.00 0.96 1.00 1.00 1.02 0.97
142.00
136.57
136.13
132.22
131.83
131.74
131.65
129.26
129.19
128.78
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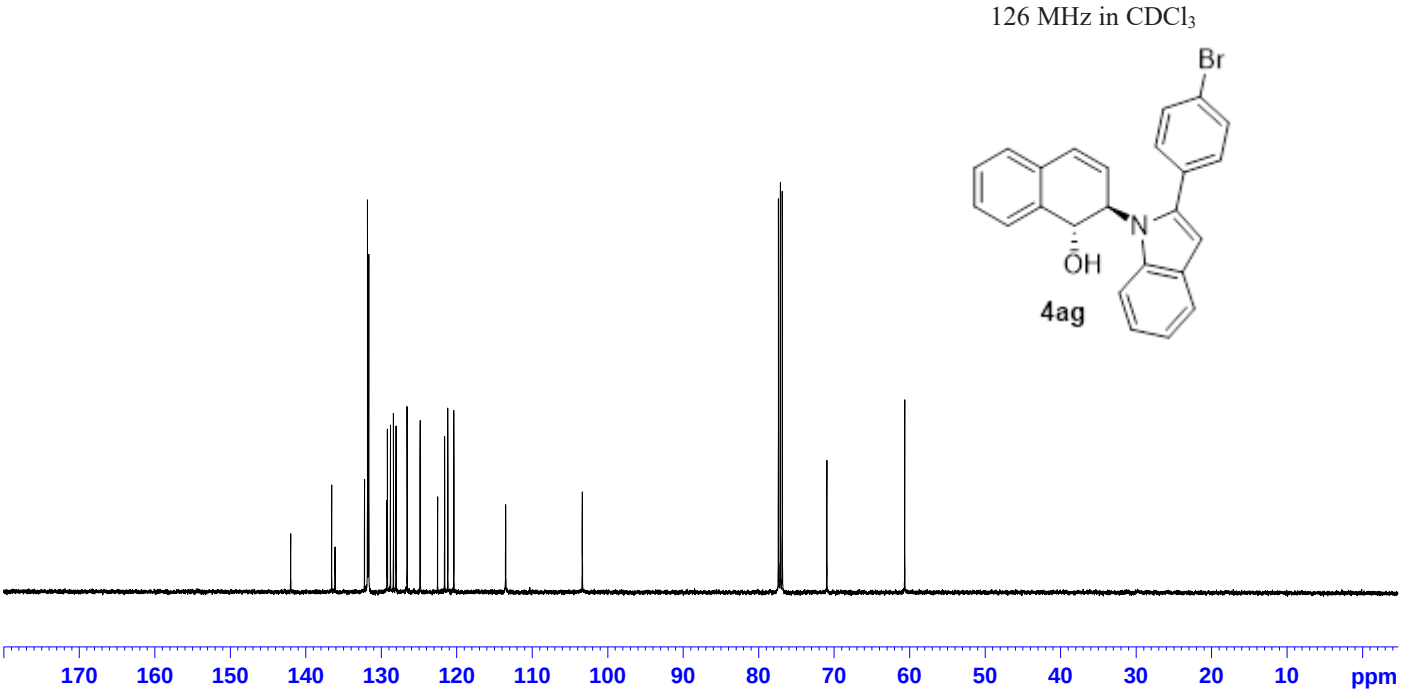
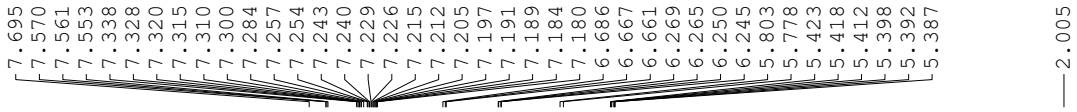
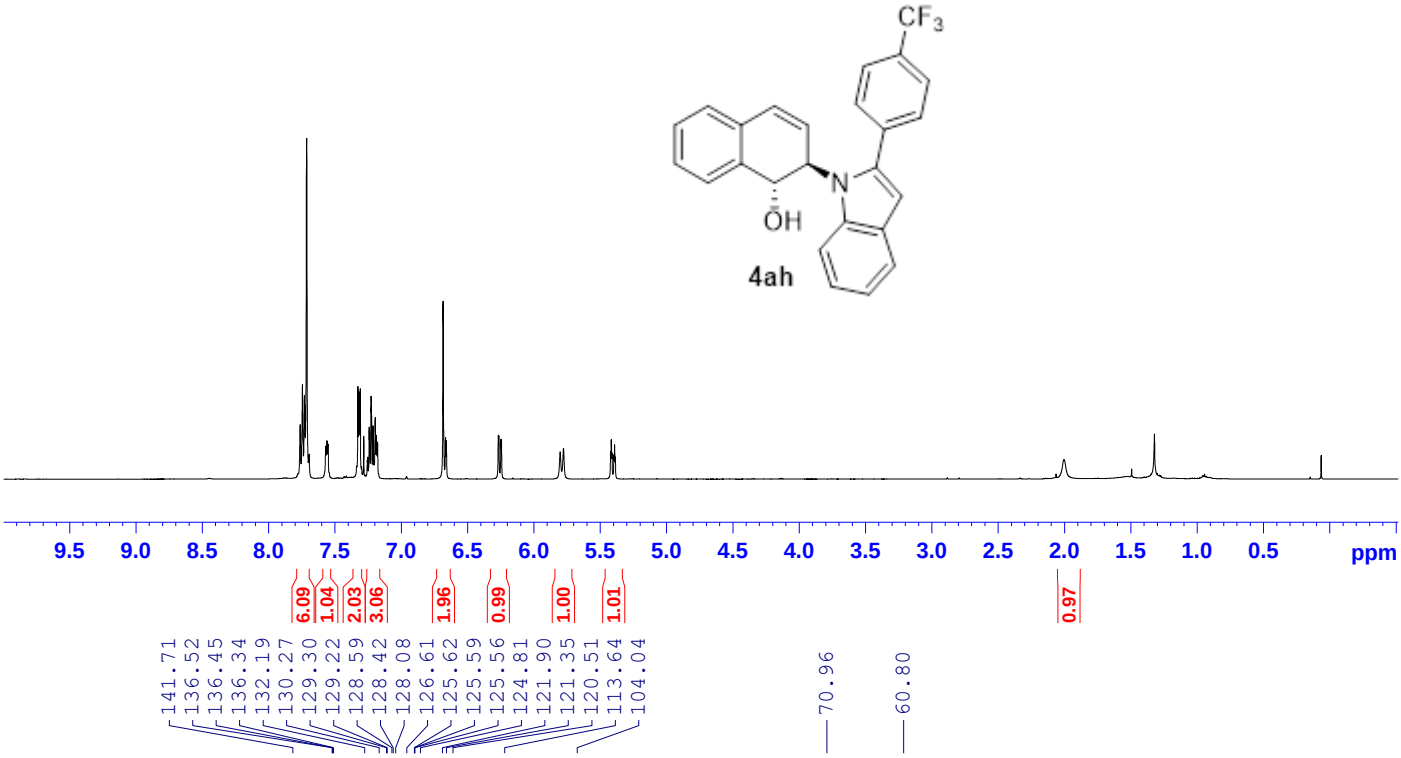
121.18
120.39
113.52
103.37
70.96
60.65

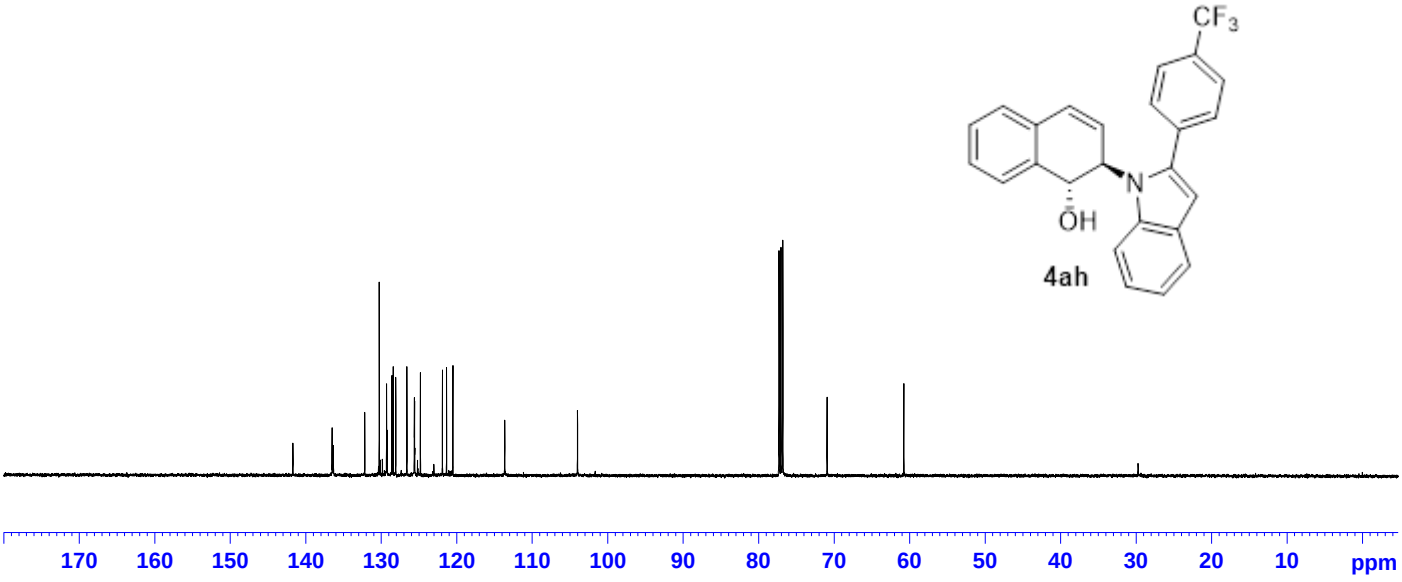

126 MHz in CDCl3
Br
N
OH
4ag
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

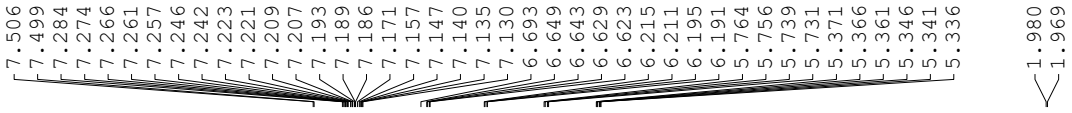


500 MHz in $CDCl_3$

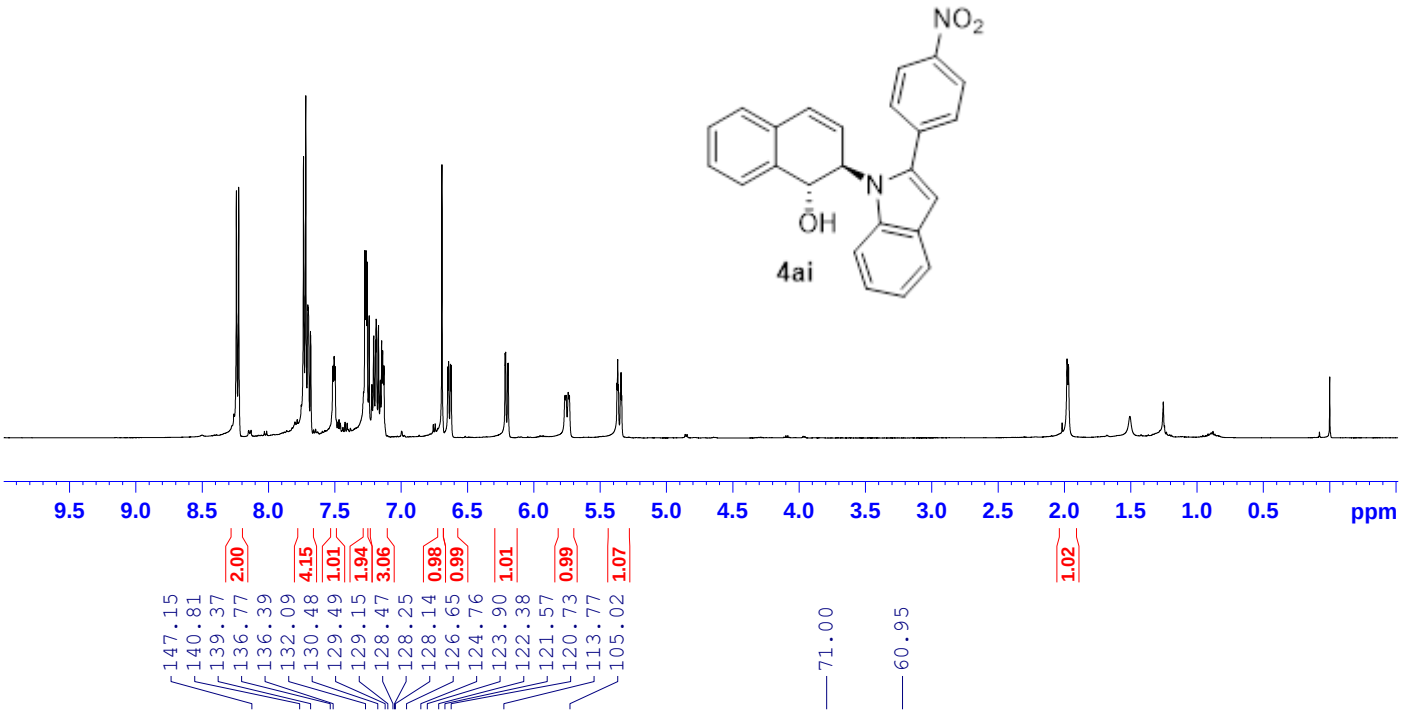


126 MHz in $CDCl_3$

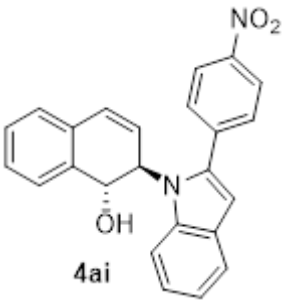


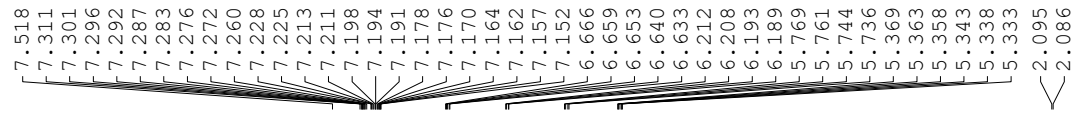


500 MHz in $CDCl_3$

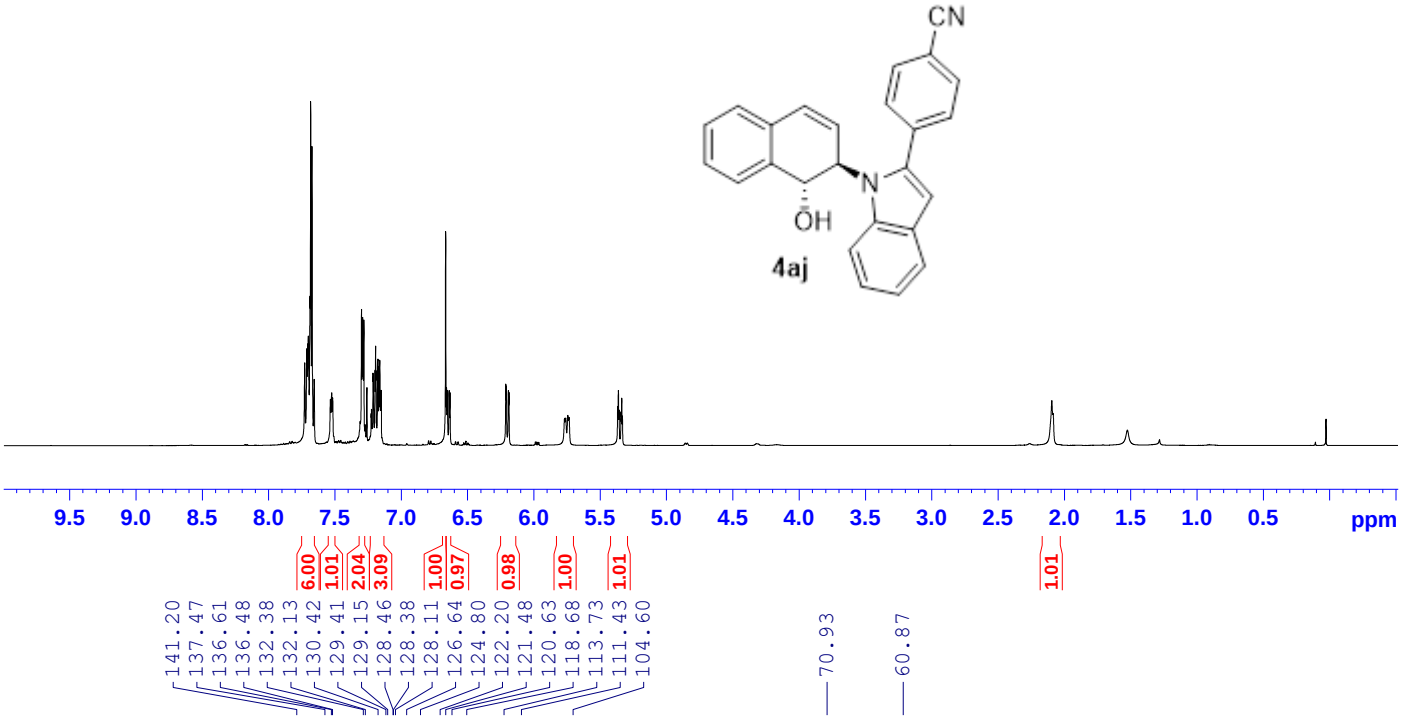


126 MHz in $CDCl_3$

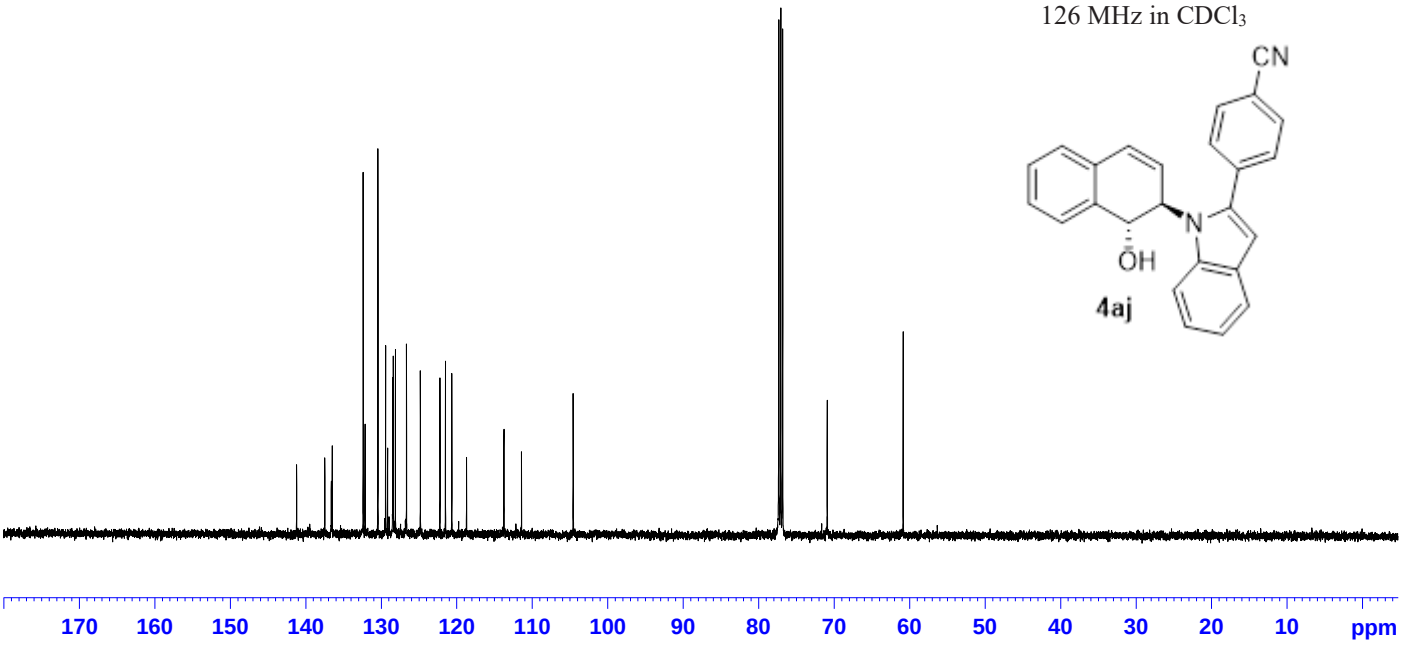


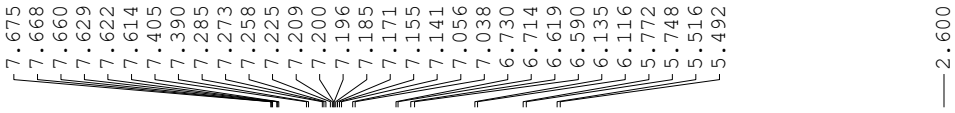


500 MHz in $CDCl_3$

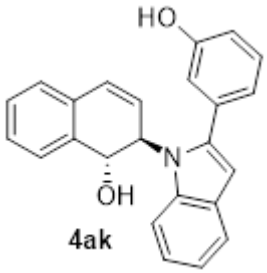


126 MHz in $CDCl_3$





500 MHz in $CDCl_3$



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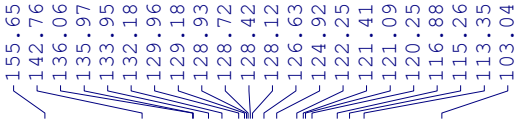
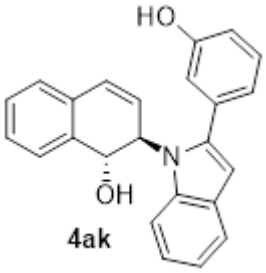


126 MHz in $CDCl_3$



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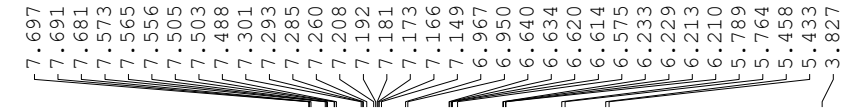

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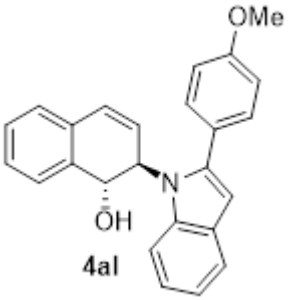
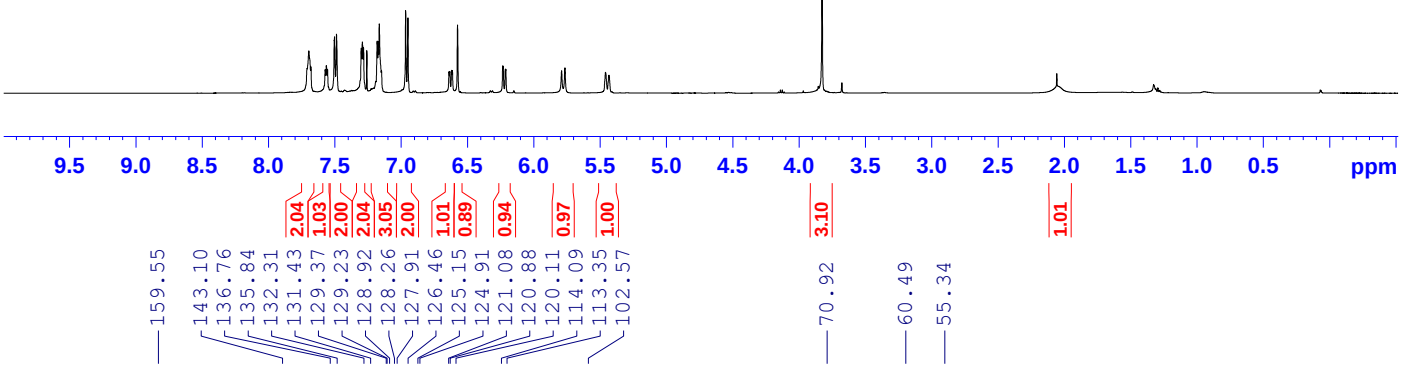
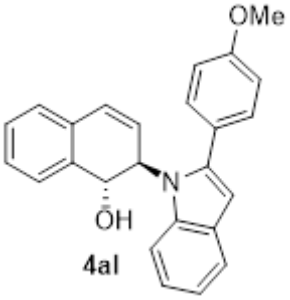
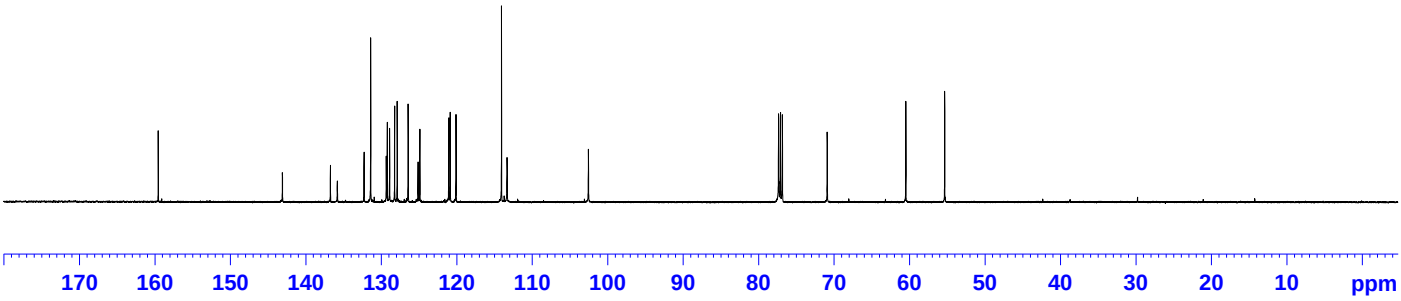
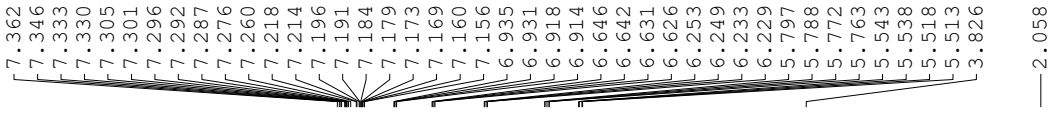




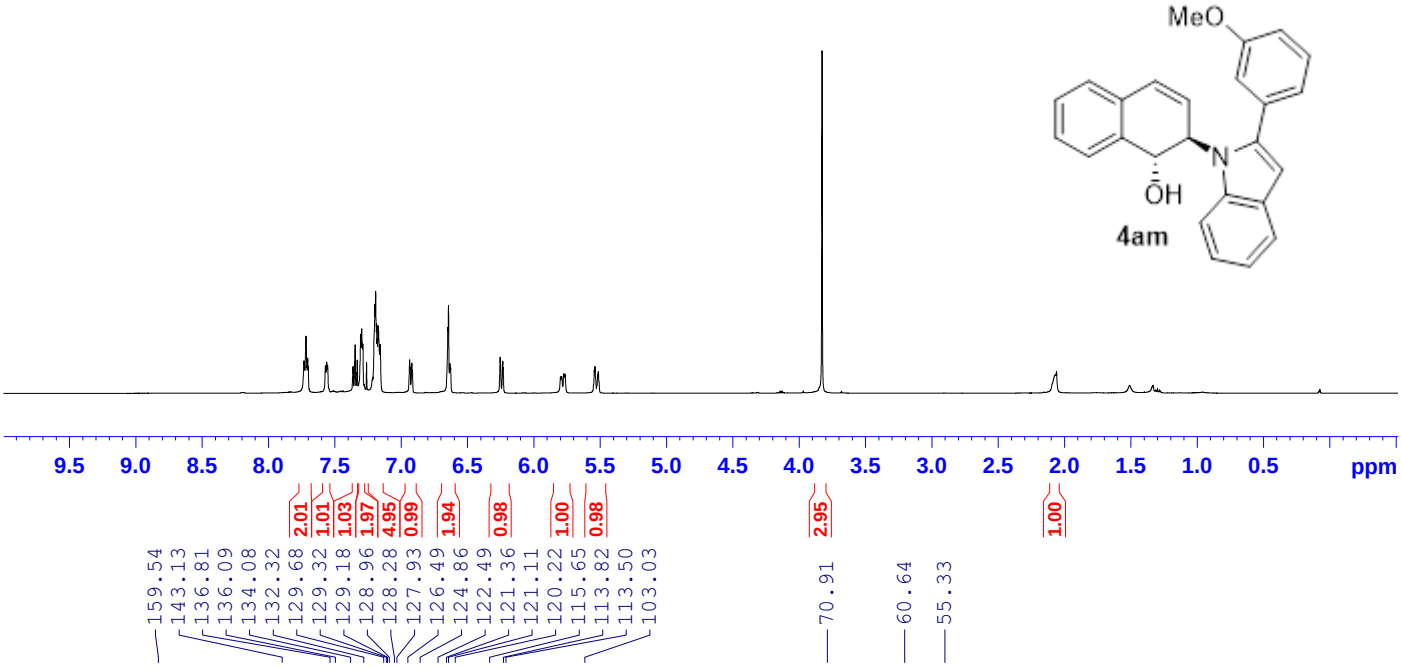
126 MHz in $CDCl_3$



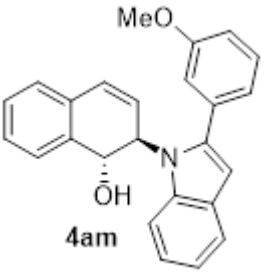


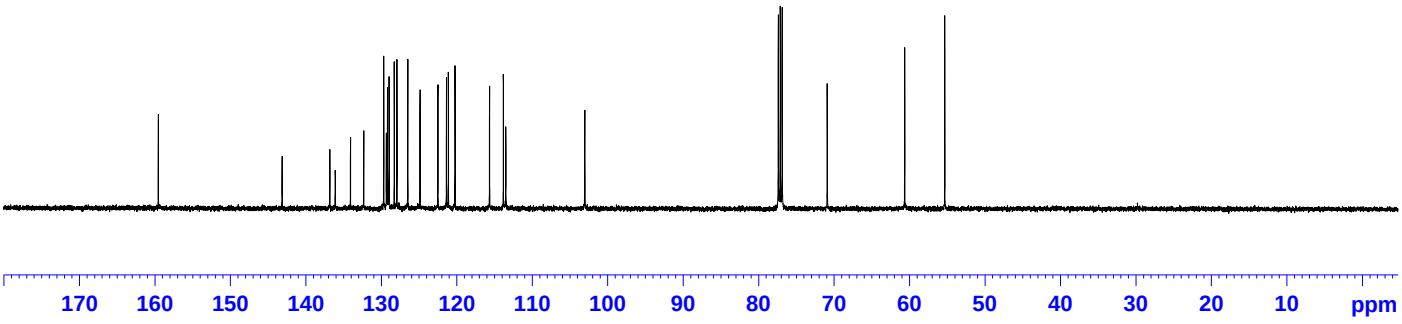


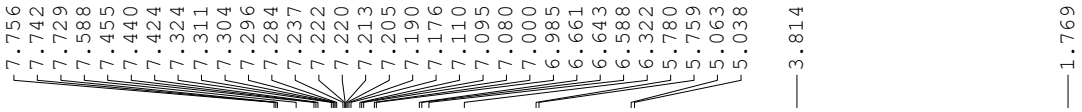
500 MHz in $CDCl_3$



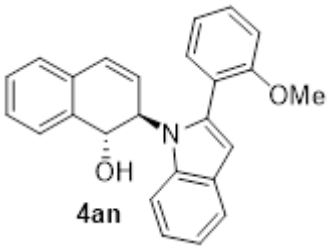
126 MHz in $CDCl_3$







500 MHz in $CDCl_3$



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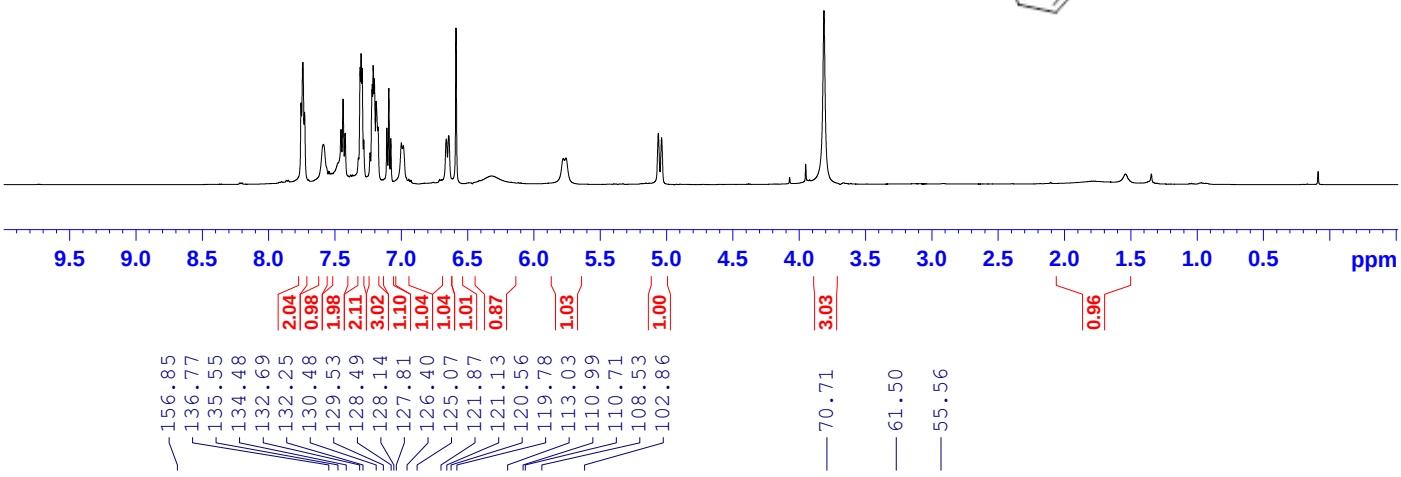
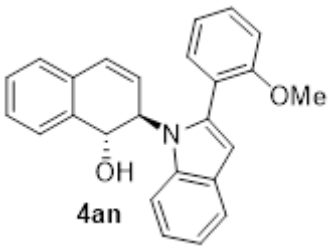


126 MHz in $CDCl_3$



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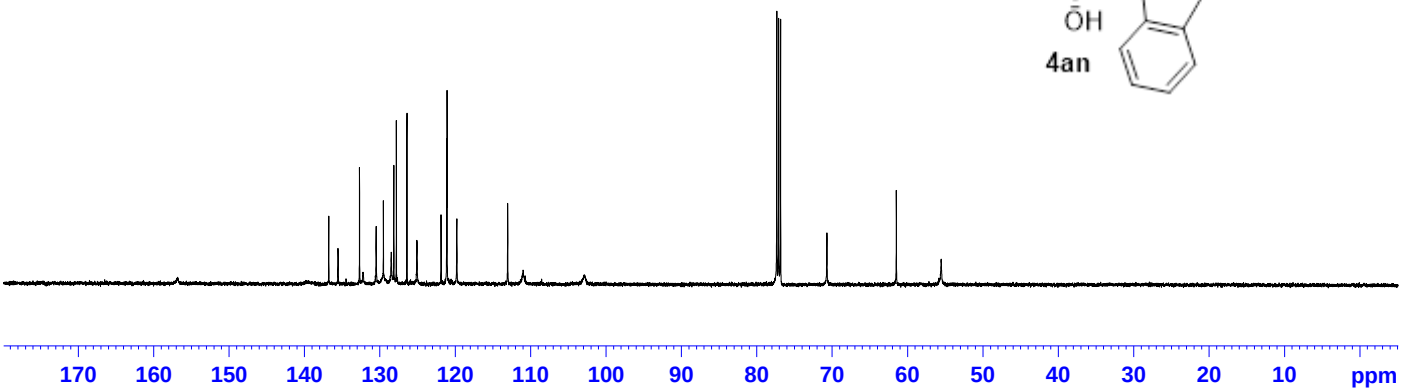
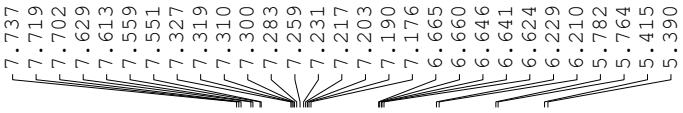
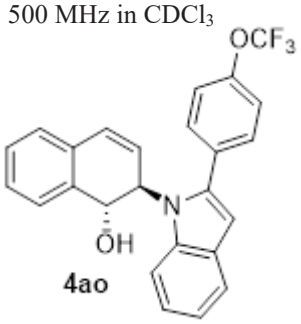




500 MHz in $CDCl_3$



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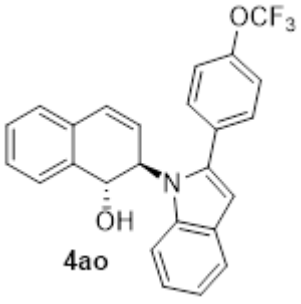
126 MHz in $CDCl_3$



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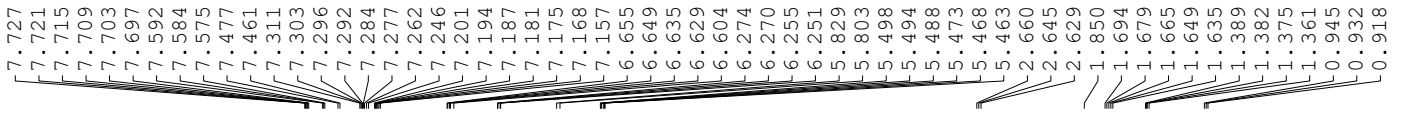
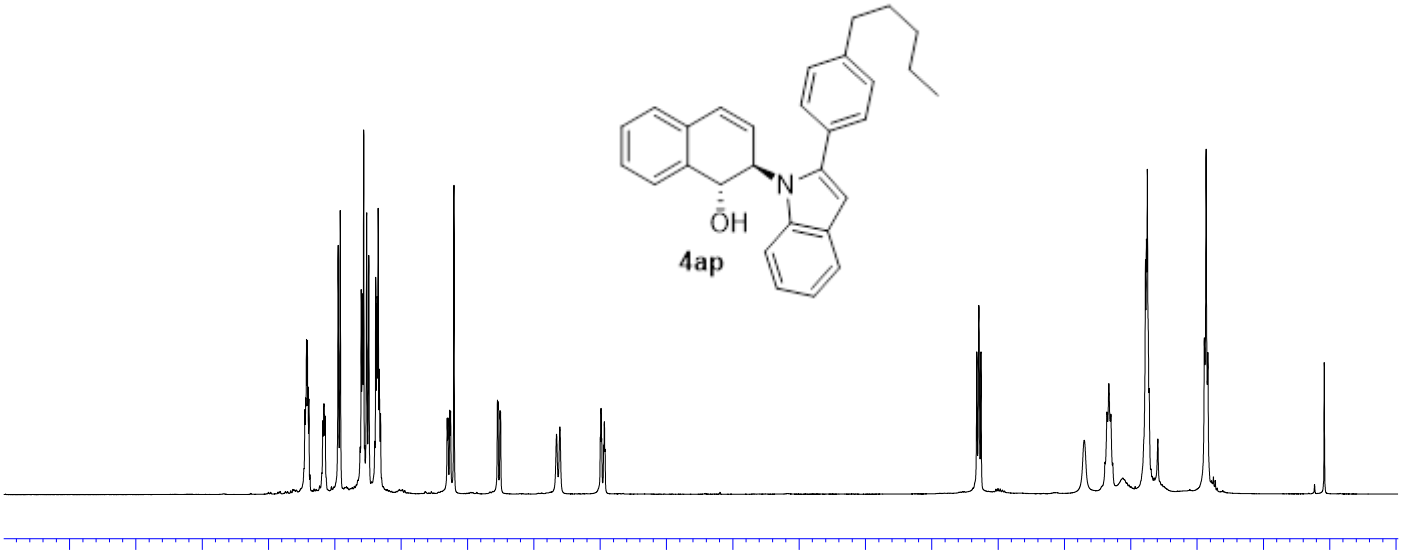
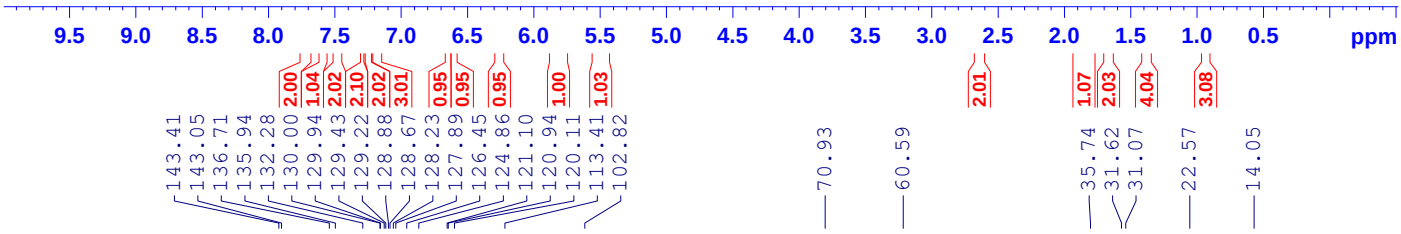
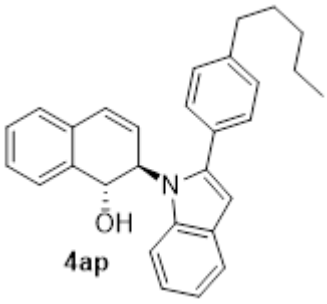


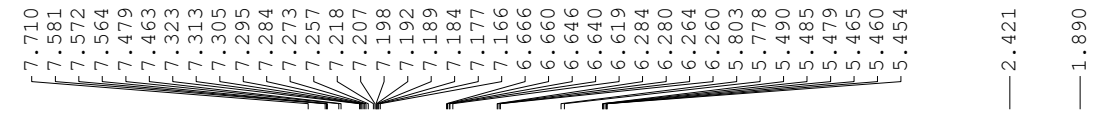
500 MHz in $CDCl_3$



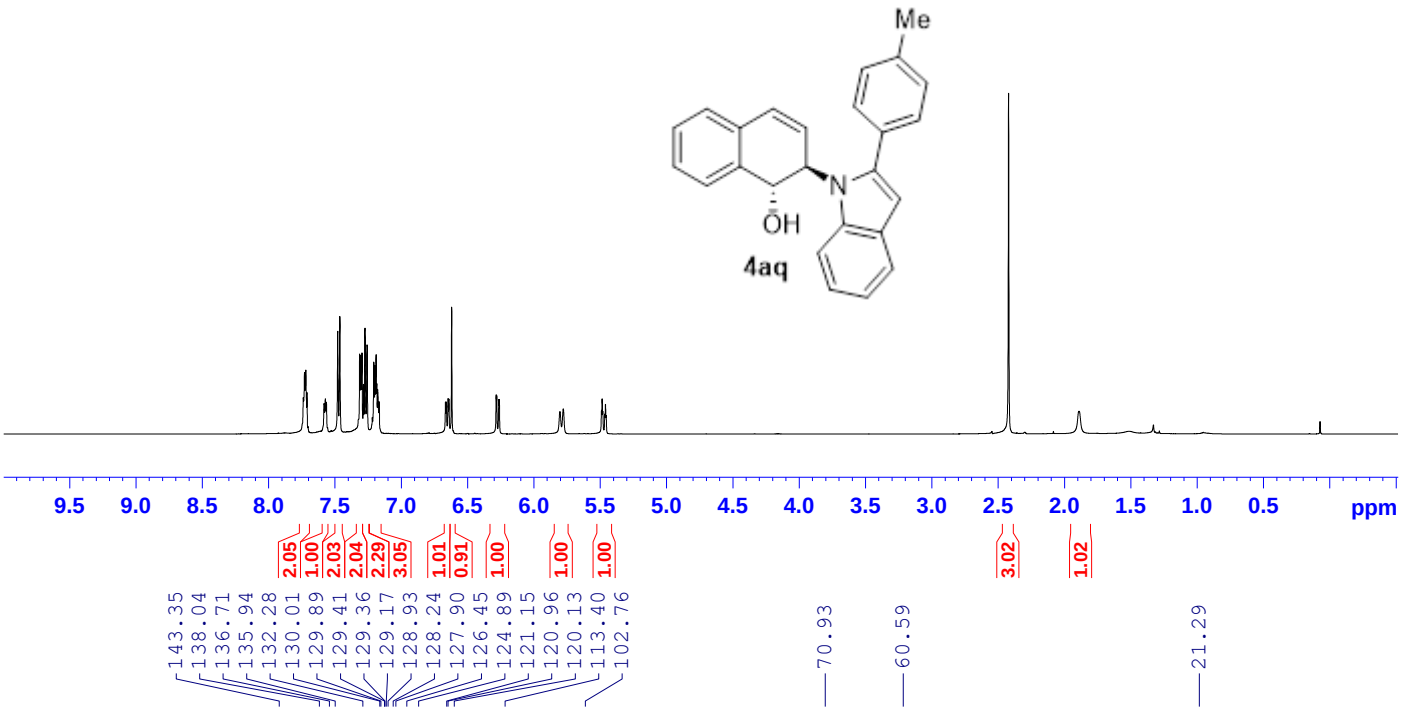


126 MHz in $CDCl_3$

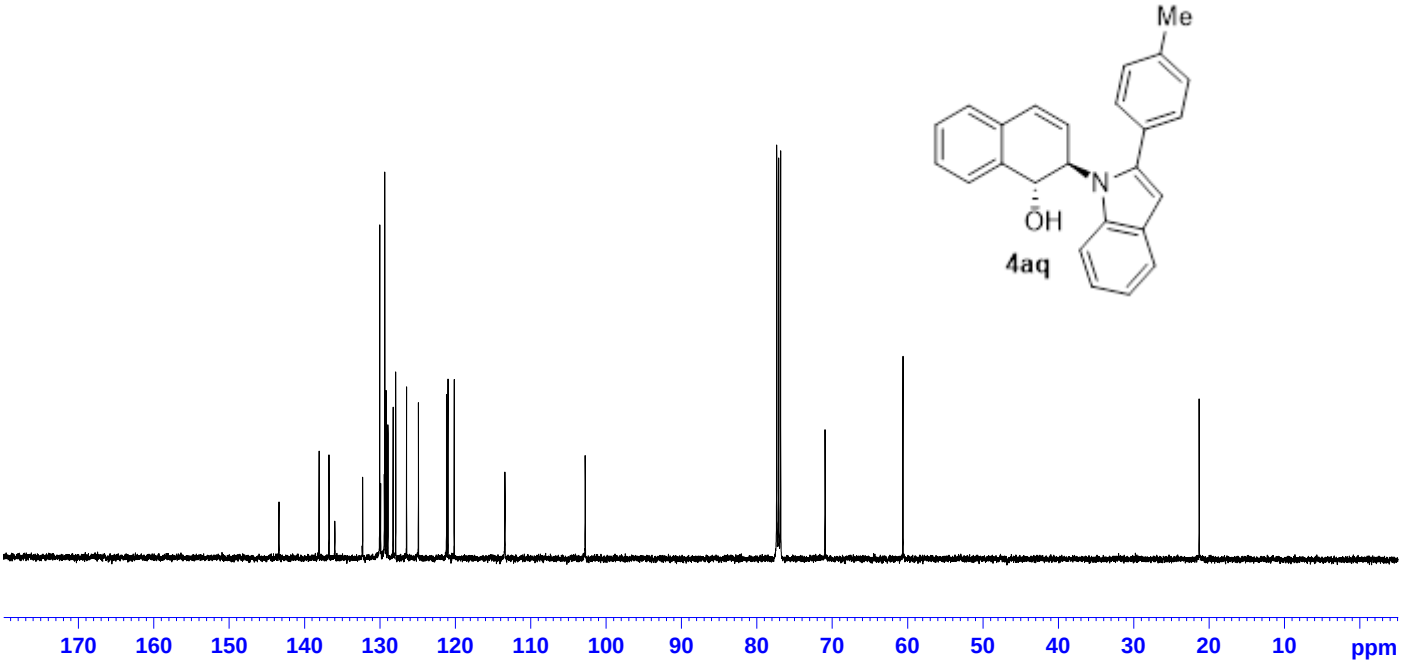


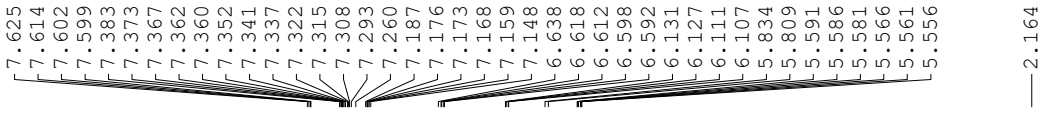


500 MHz in $CDCl_3$

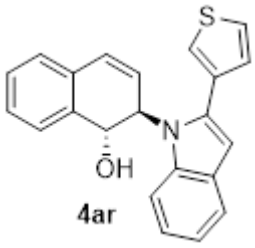


126 MHz in $CDCl_3$

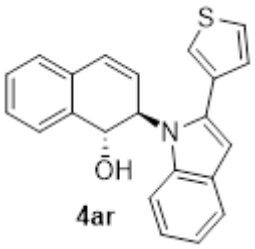


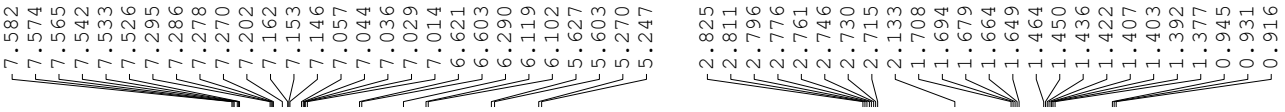


500 MHz in $CDCl_3$

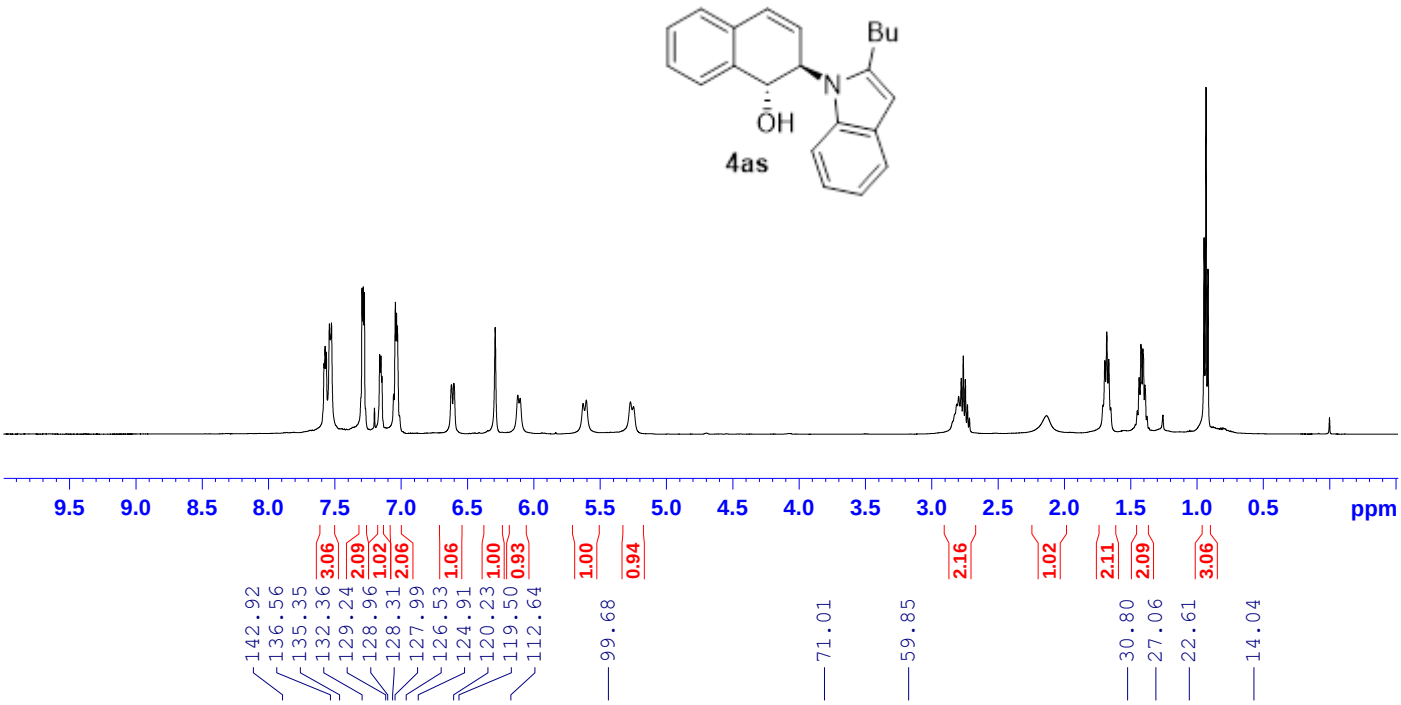


126 MHz in $CDCl_3$

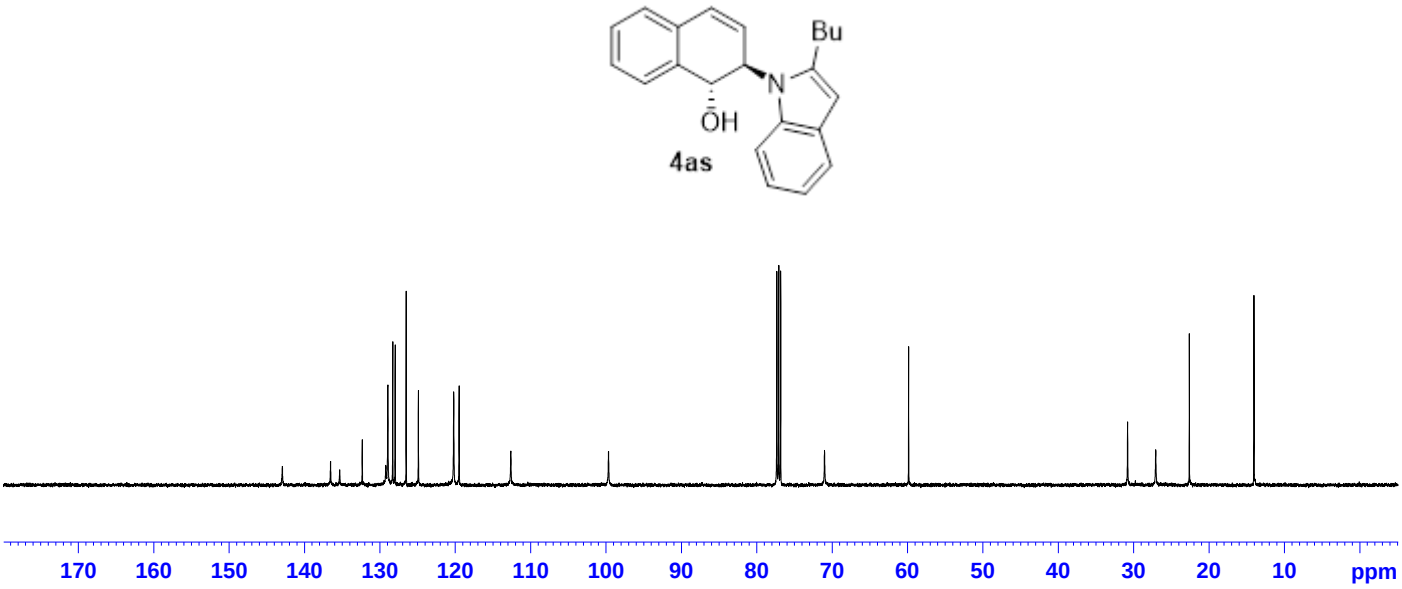


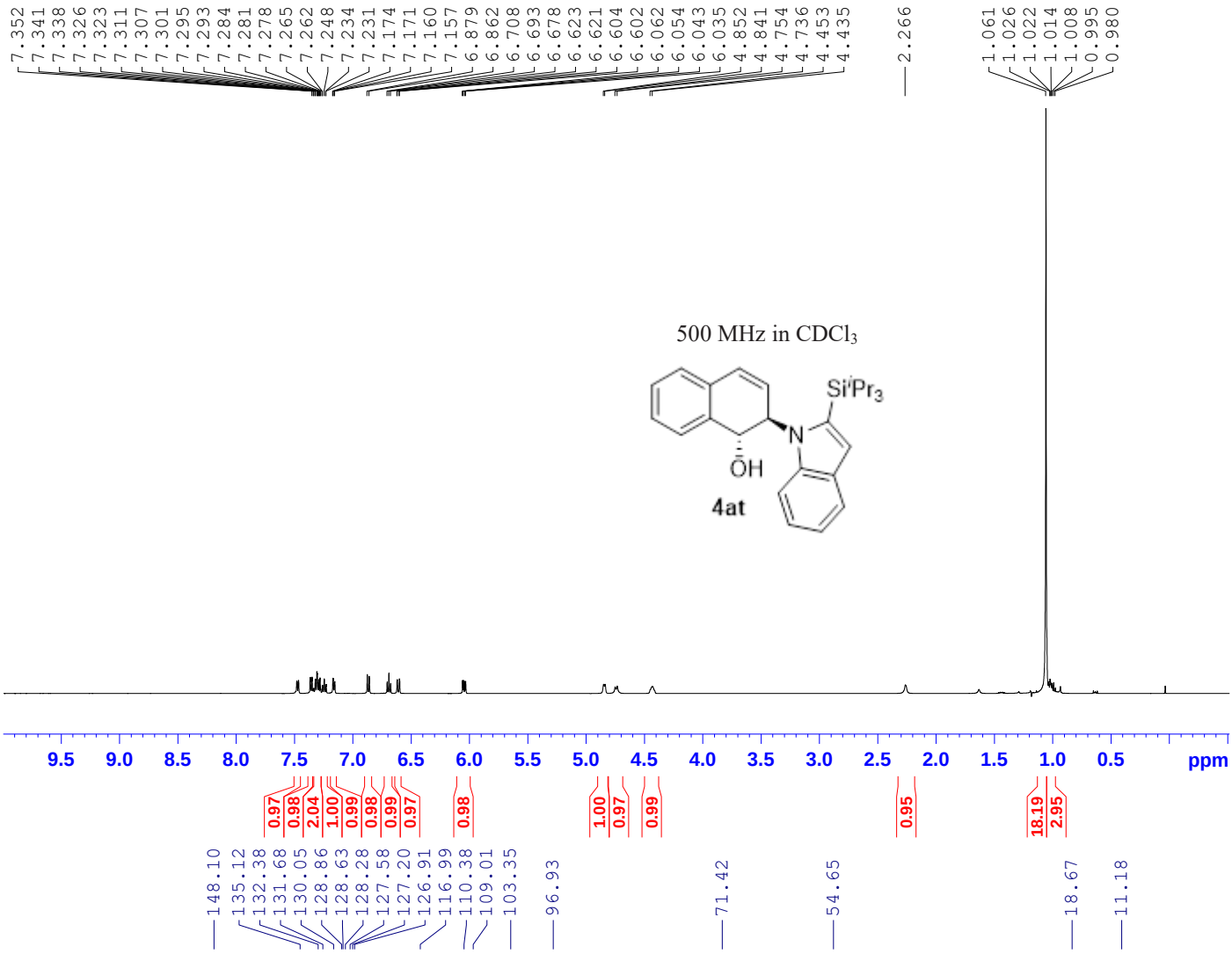


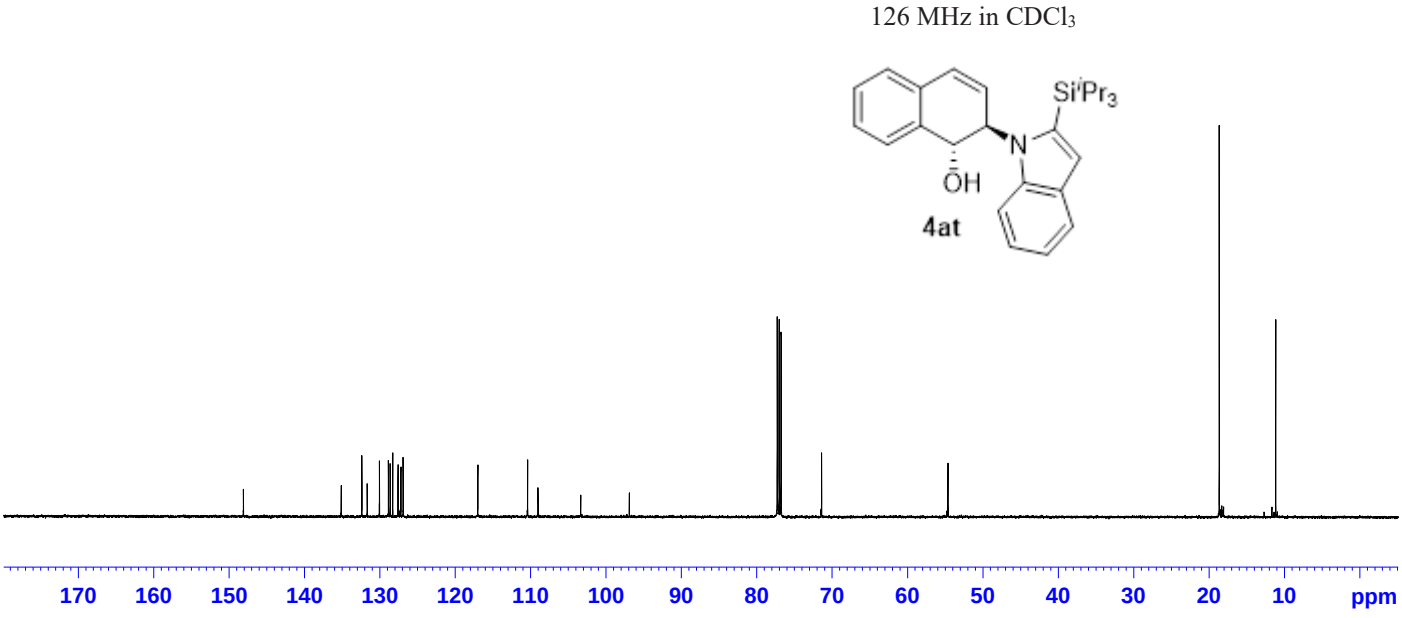
500 MHz in $CDCl_3$

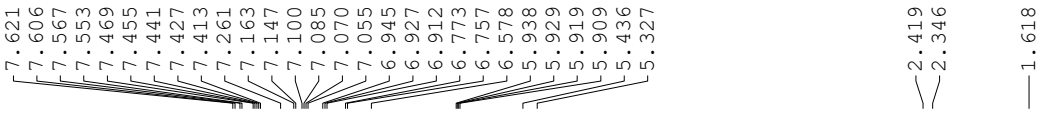


126 MHz in $CDCl_3$

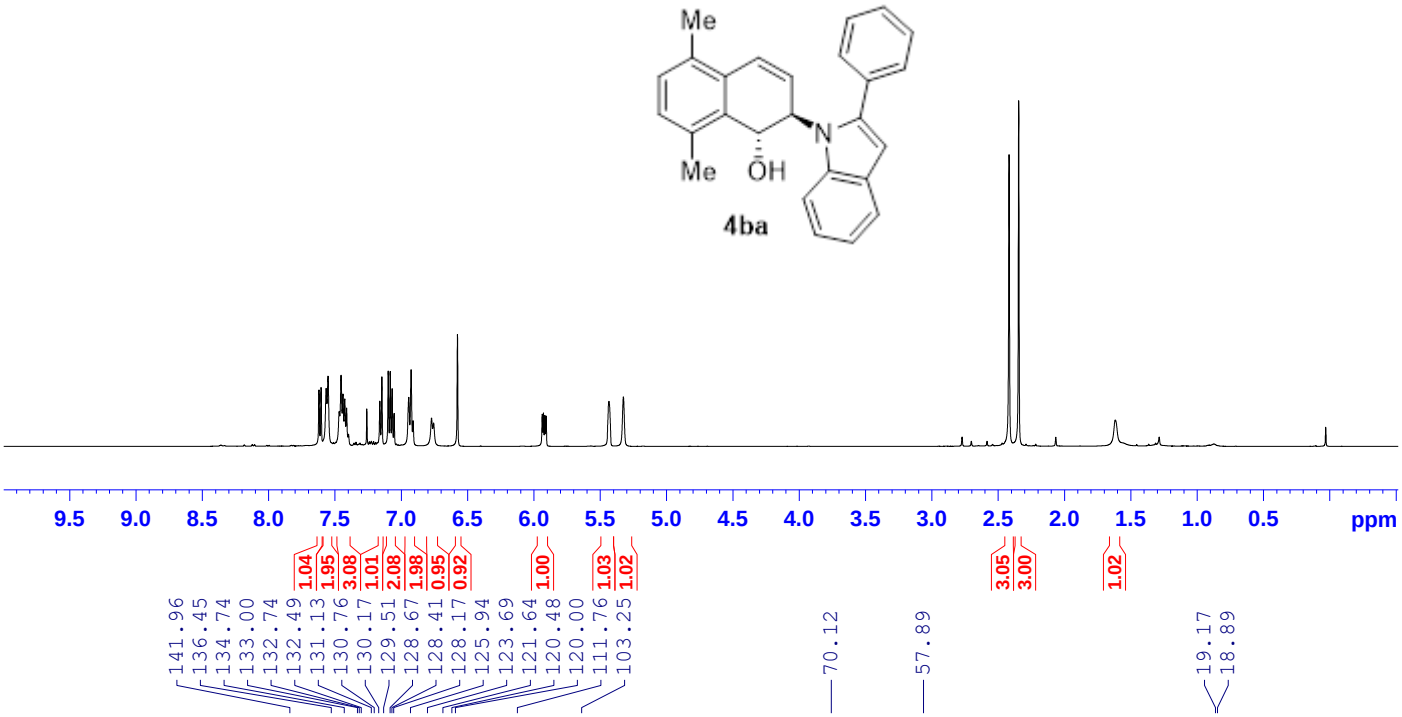



7.352
7.341
7.338
7.326
7.323
7.311
7.307
7.301
7.295
7.293
7.284
7.281
7.278
7.265
7.262
7.248
7.234
7.231
7.174
7.171
7.160
7.157
6.879
6.862
6.708
6.693
6.678
6.623
6.621
6.604
6.602
6.062
6.054
6.043
6.035
4.852
4.841
4.754
4.736
4.453
4.435
2.266
1.061
1.026
1.022
1.014
1.008
0.995
0.980
500 MHz in CDCl3
Si^{i}Pr$_3$
N
OH
4at
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
ppm
0.97
0.98
2.04
1.00
0.99
0.98
0.99
0.97
0.98
1.00
0.97
0.99
0.95
18.19
2.95
148.10
135.12
132.38
131.68
130.05
128.86
128.63
128.28
127.58
127.20
126.91
116.99
110.38
109.01
103.35
96.93
71.42
54.65
18.67
11.18

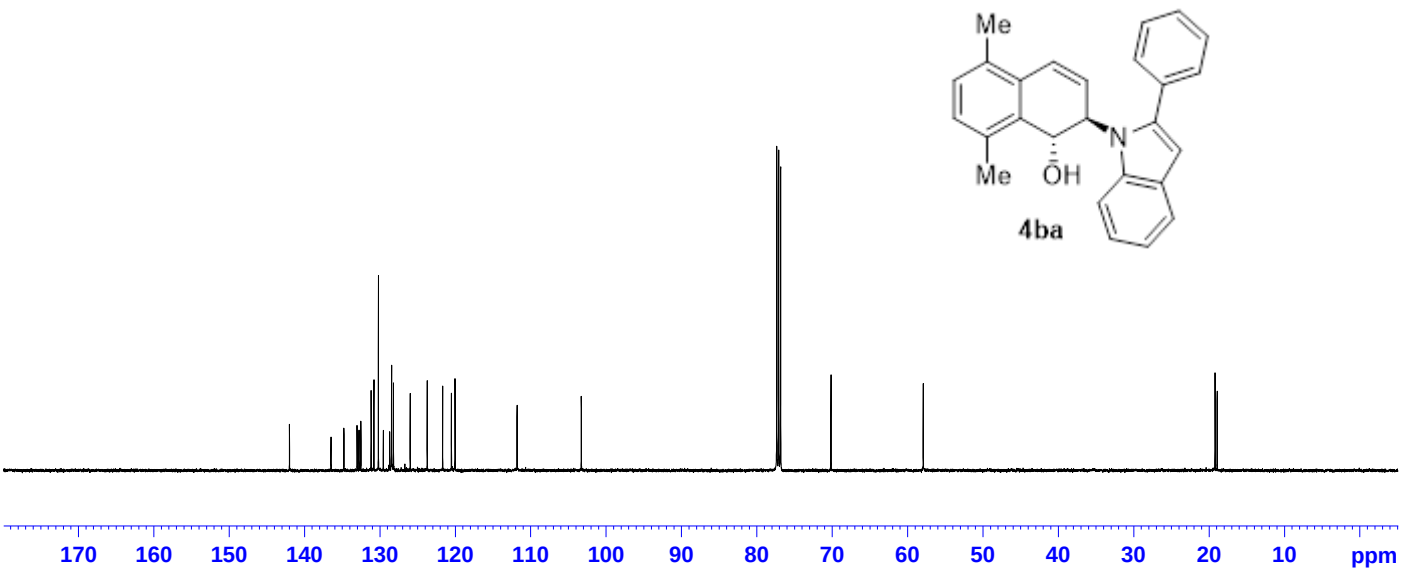

126 MHz in CDCl3
Si^{i}Pr$_3$
N
OH
4at
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

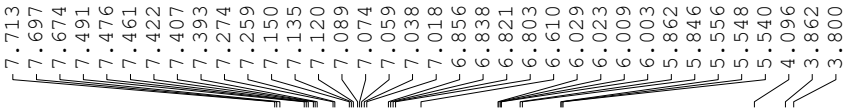


500 MHz in $CDCl_3$

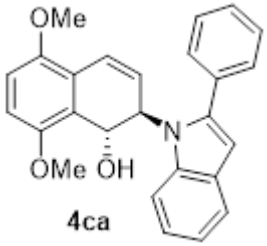


126 MHz in $CDCl_3$

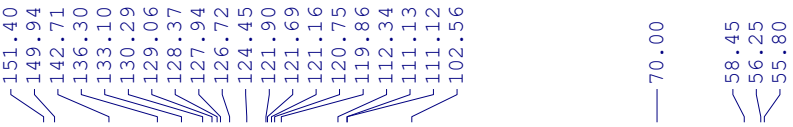




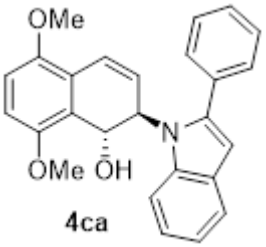
500 MHz in $CDCl_3$



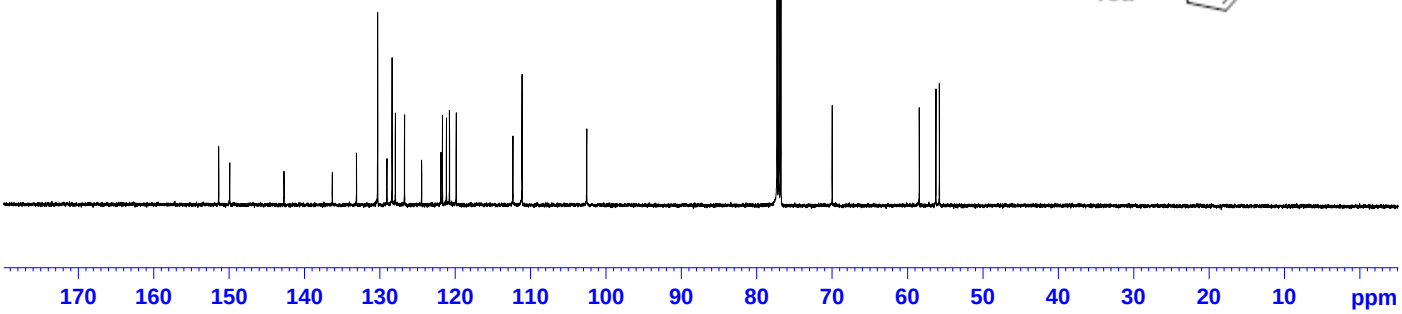
4ca

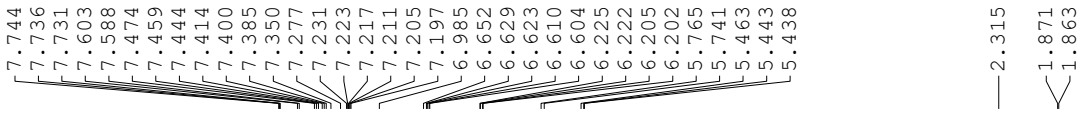


126 MHz in $CDCl_3$

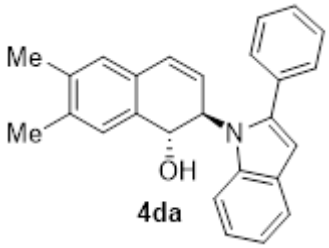


4ca

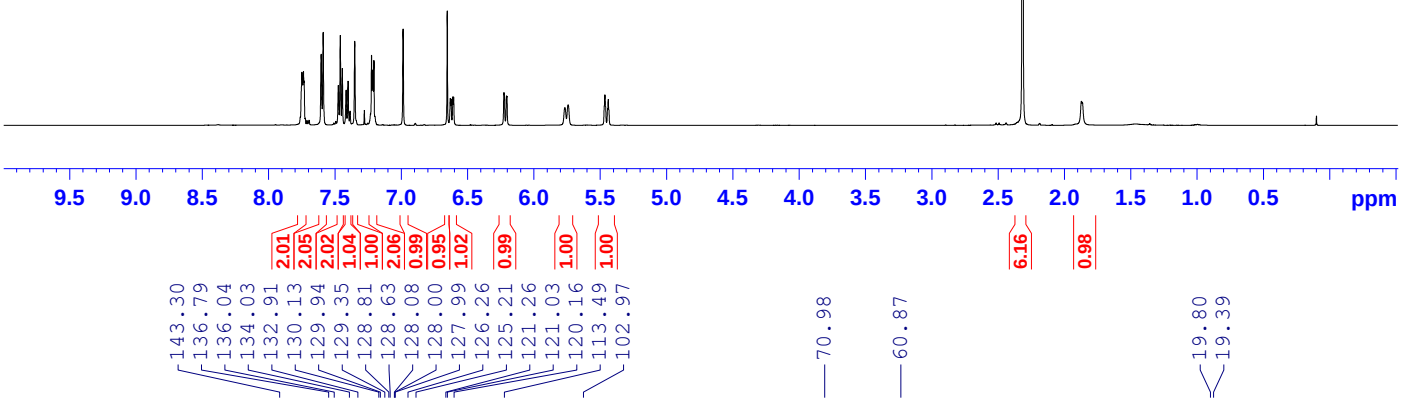




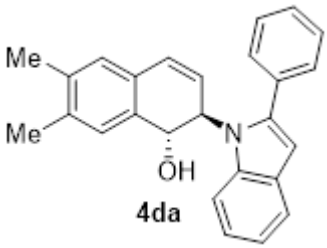
500 MHz in $CDCl_3$



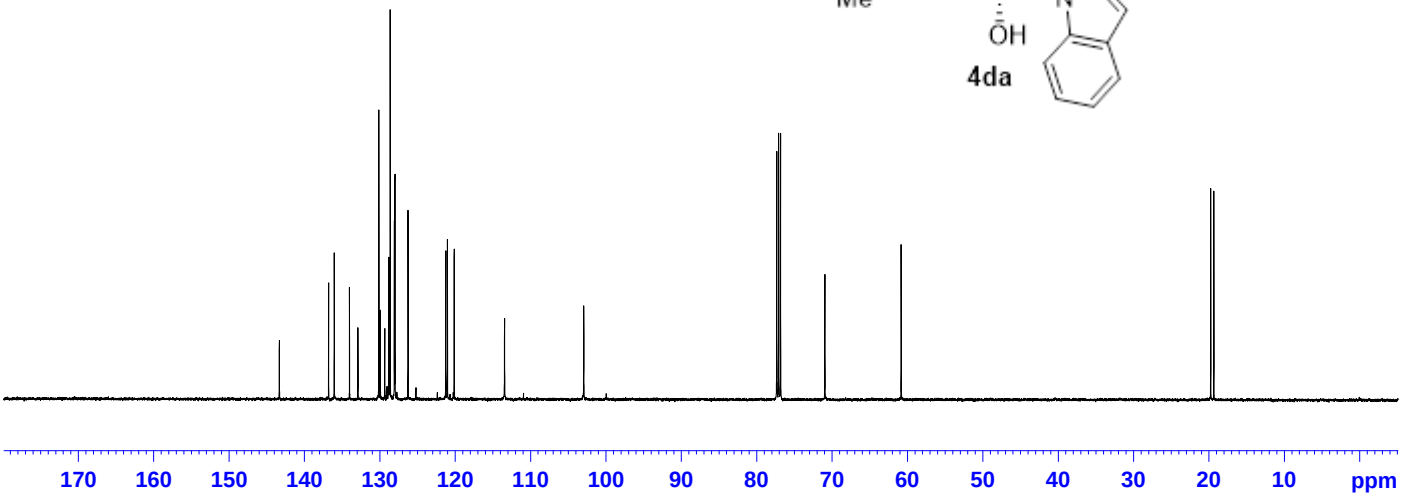
4da

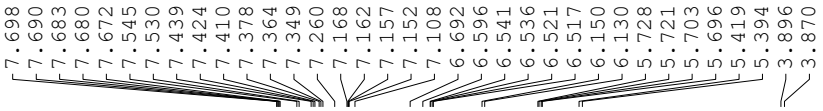


126 MHz in $CDCl_3$

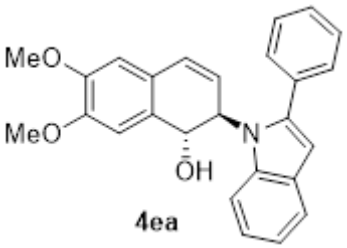


4da

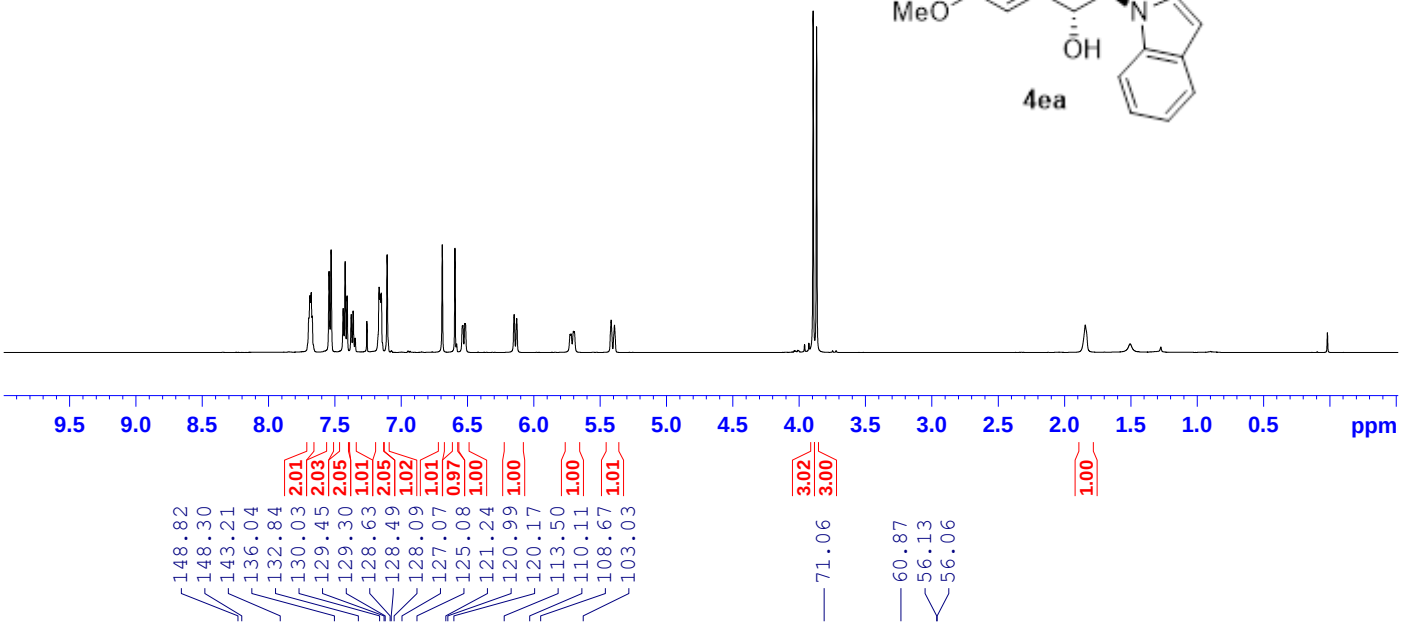




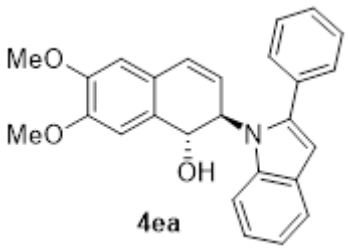
500 MHz in $CDCl_3$



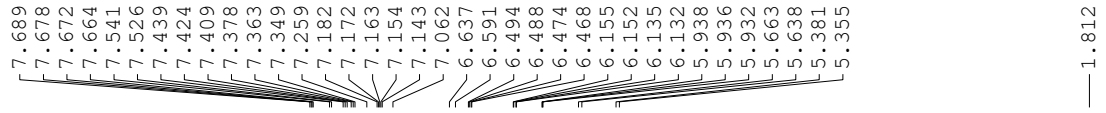
4ea



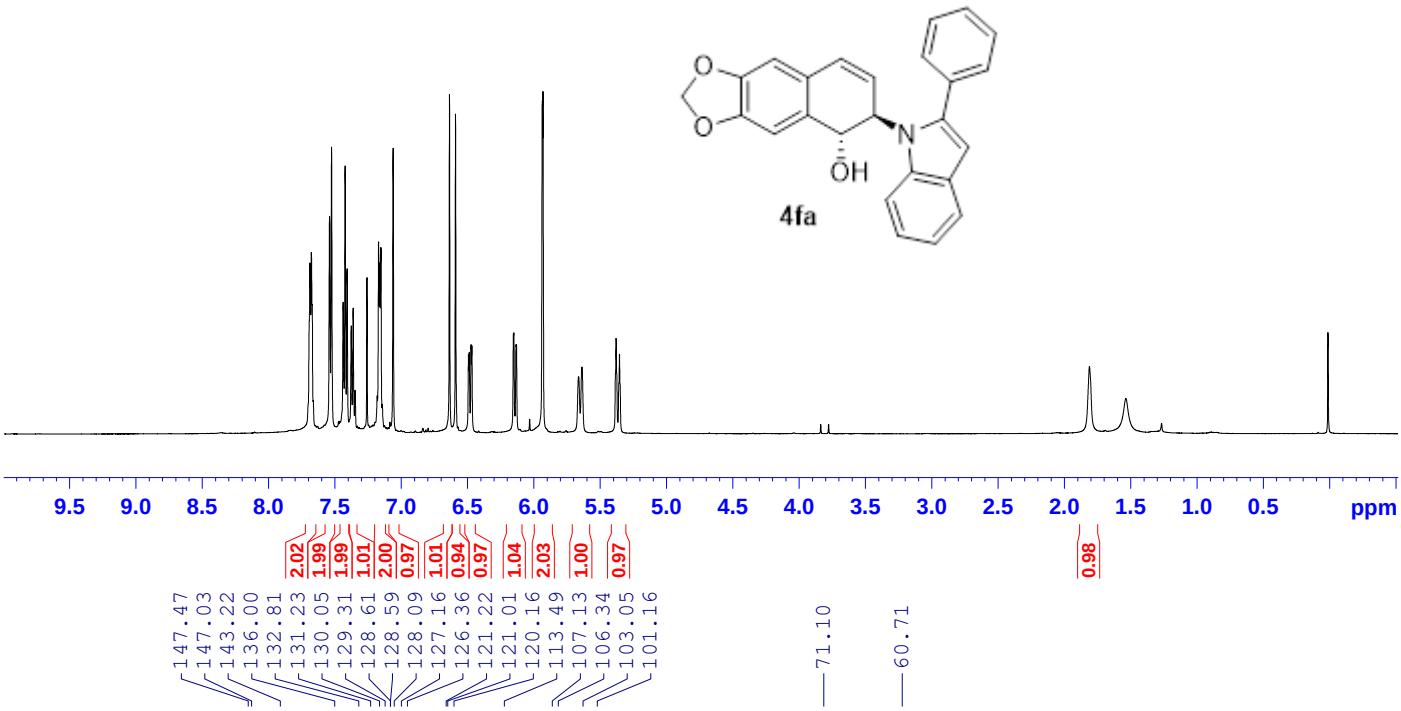
126 MHz in $CDCl_3$



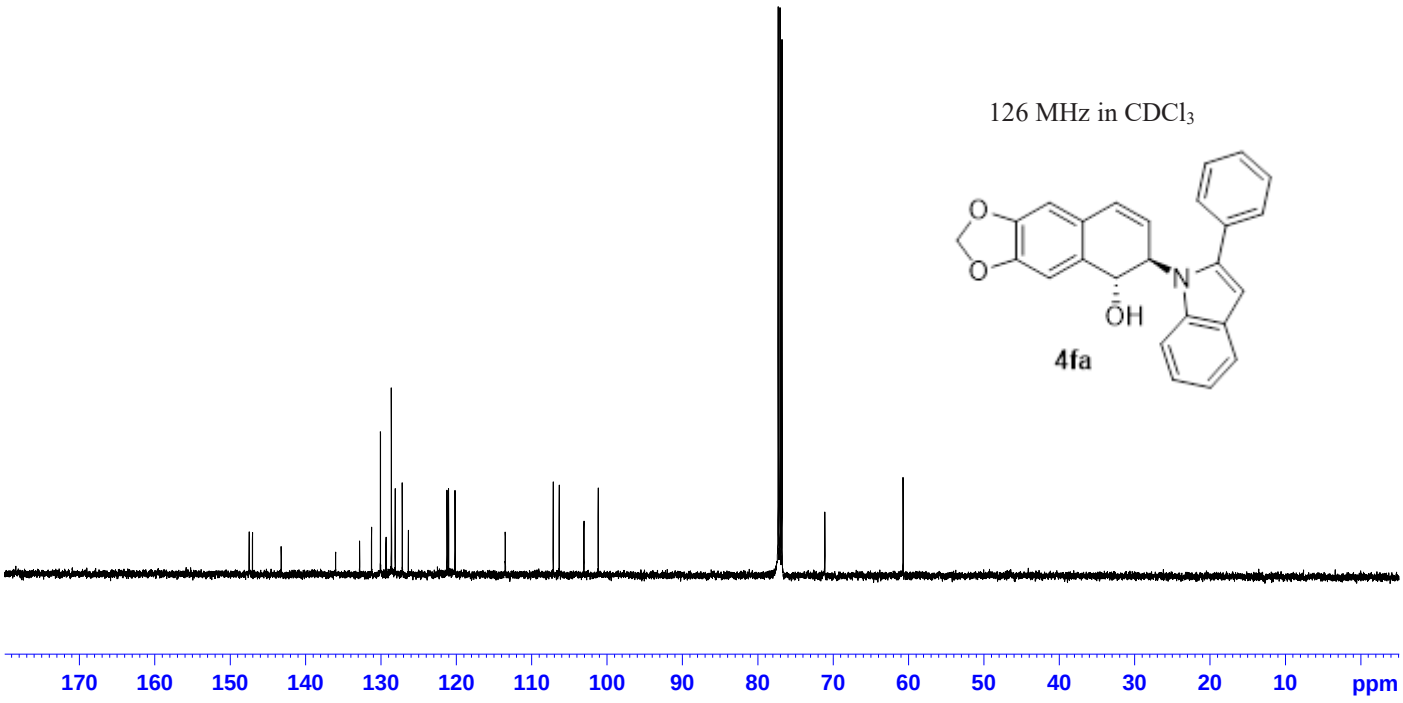
4ea

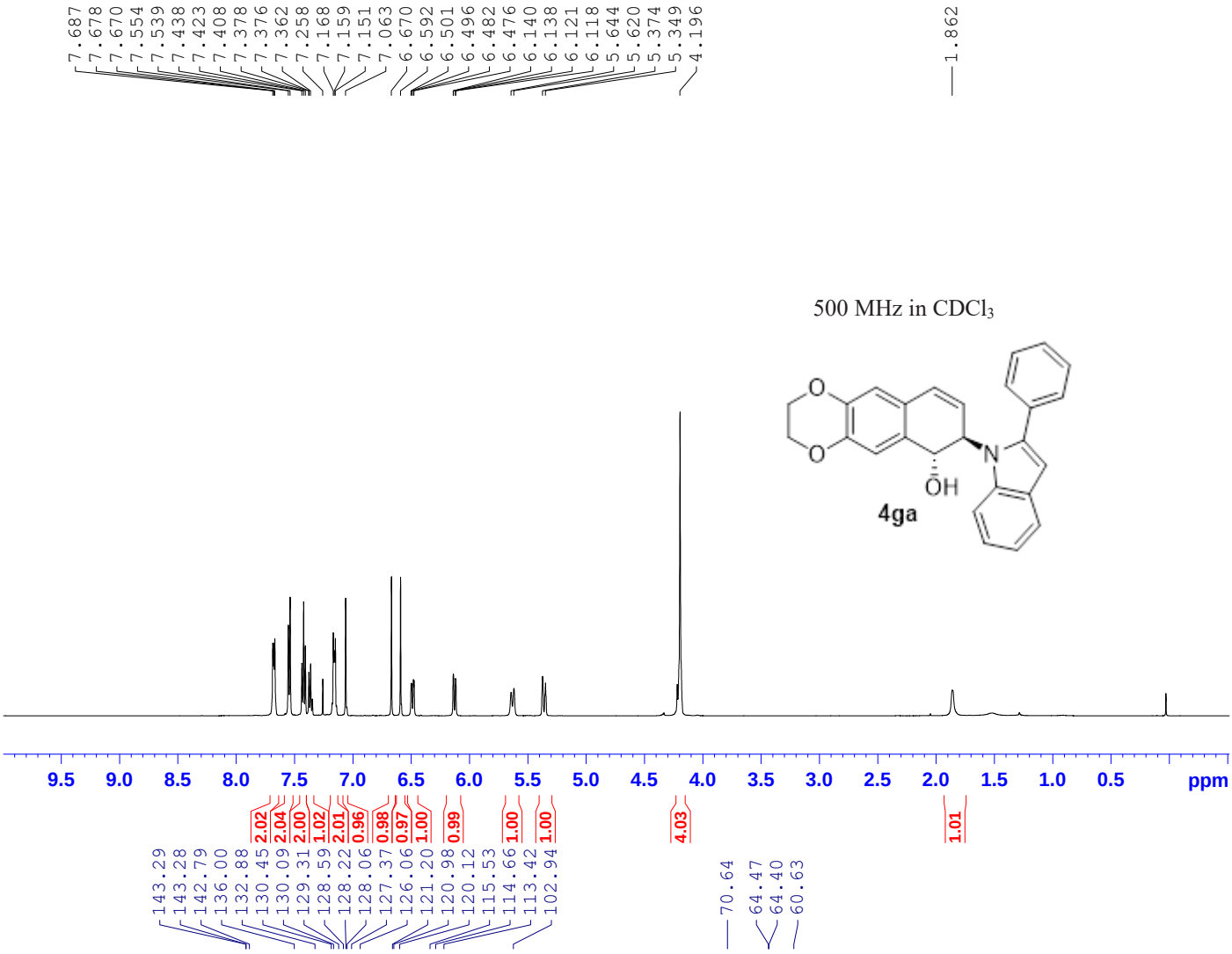


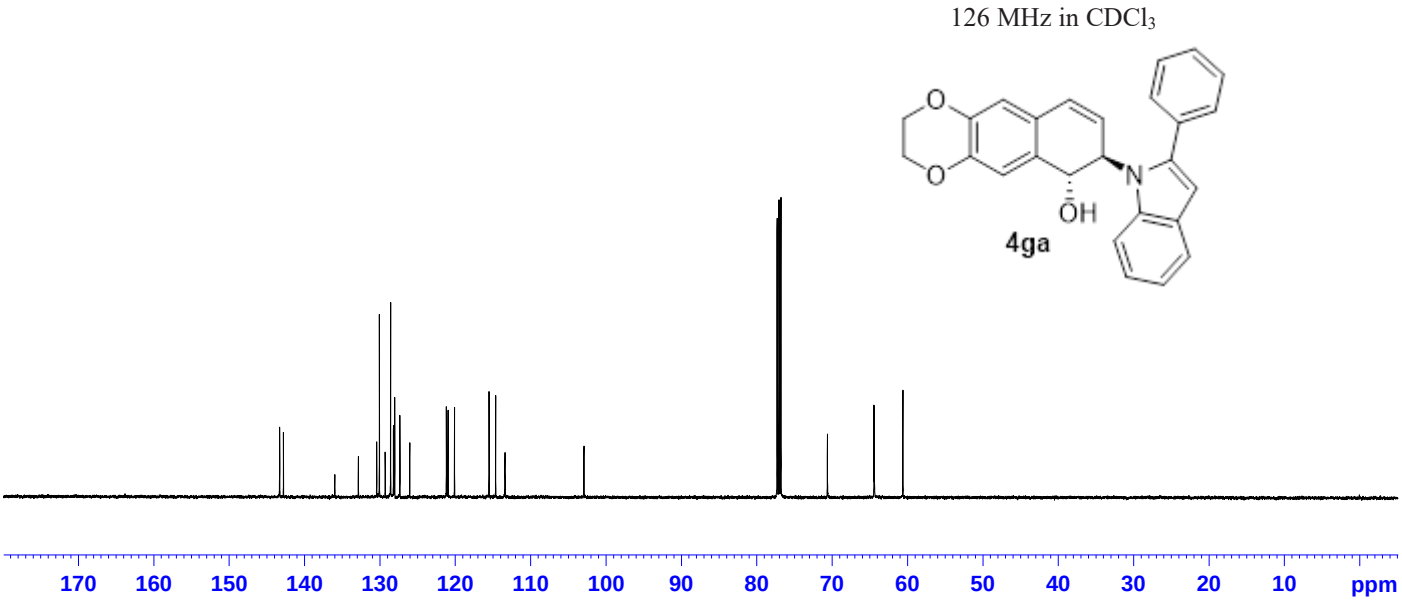
500 MHz in $CDCl_3$

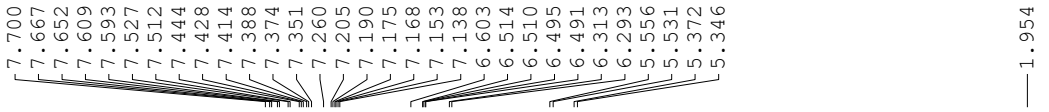


126 MHz in $CDCl_3$

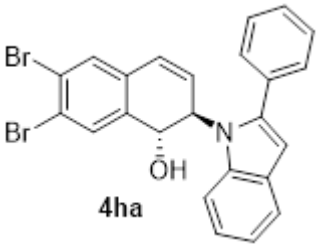



7.687
7.678
7.670
7.554
7.539
7.438
7.423
7.408
7.378
7.376
7.362
7.258
7.168
7.159
7.151
7.063
6.670
6.592
6.501
6.496
6.482
6.476
6.140
6.138
6.121
6.118
5.644
5.620
5.374
5.349
4.196
1.862
500 MHz in CDCl3
4ga
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
2.02 2.04 2.00 1.02 2.01 0.96 0.98 0.97 1.00 0.99 1.00 1.00 4.03 1.01
143.29 143.28 142.79 136.00 132.88 130.45 130.09 129.31 128.59 128.22 128.06 127.37 126.06 121.20 120.98 120.12 115.53 114.66 113.42 102.94
70.64 64.47 64.40 60.63

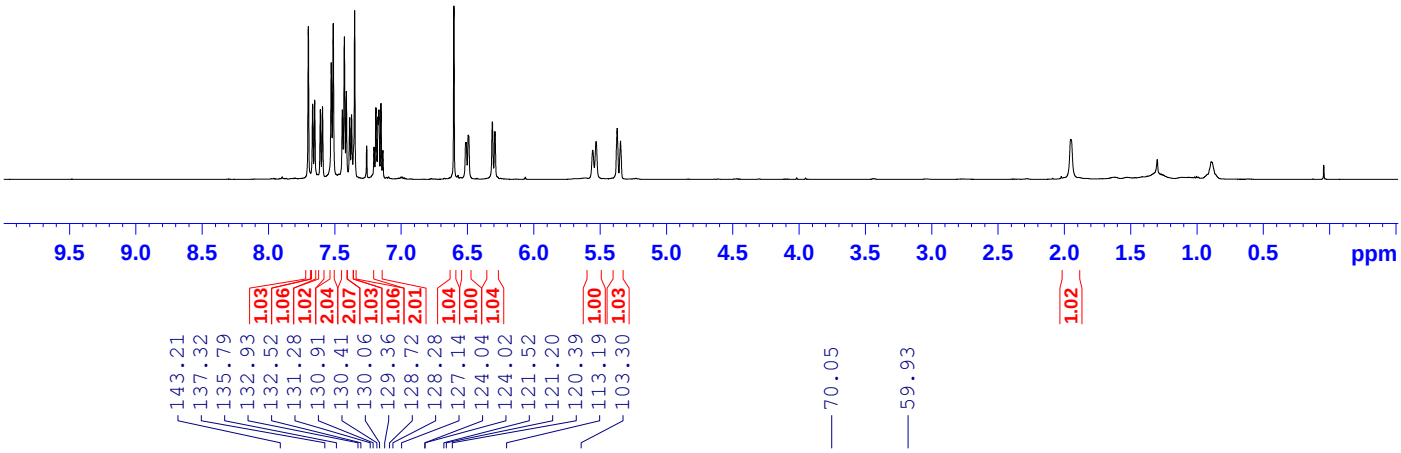

126 MHz in CDCl3
4ga
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm



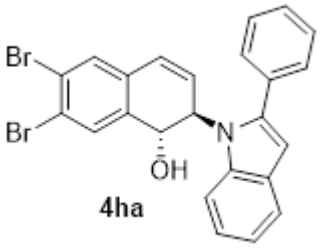
500 MHz in $CDCl_3$



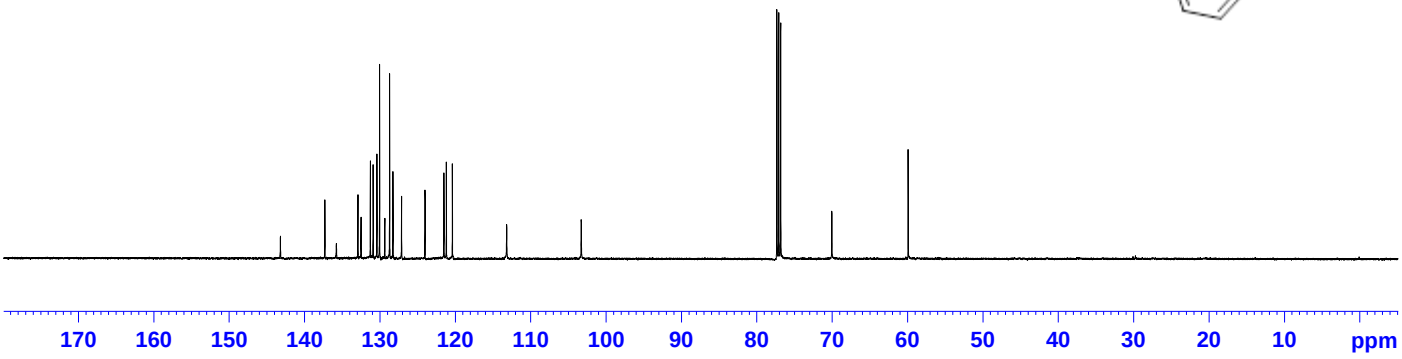
4ha

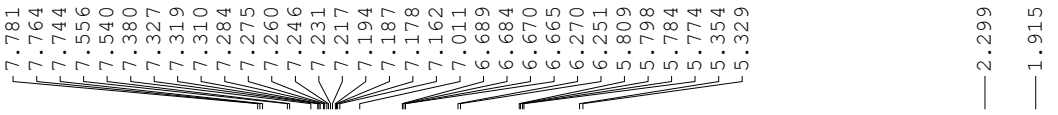


126 MHz in $CDCl_3$

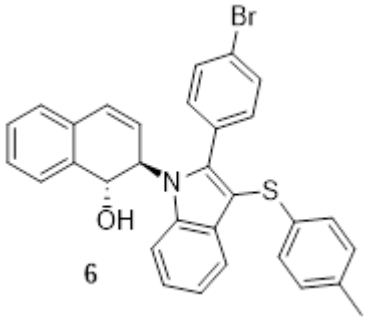


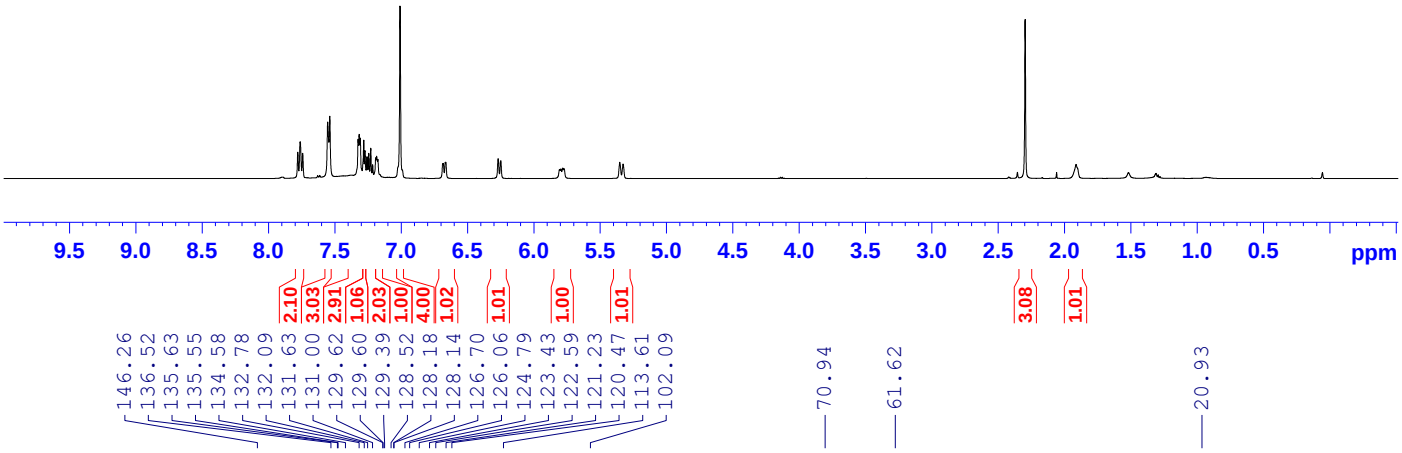
4ha



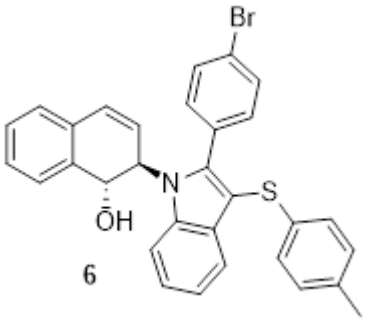


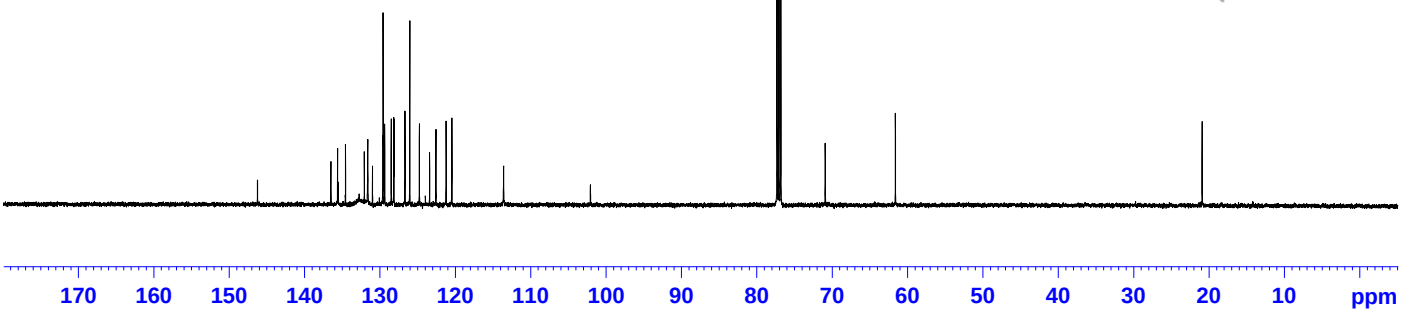
500 MHz in $CDCl_3$

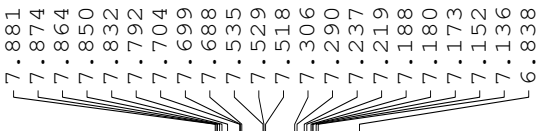




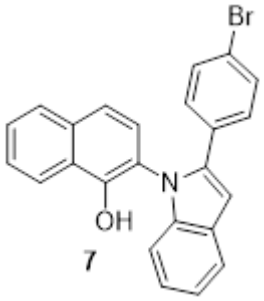
126 MHz in $CDCl_3$

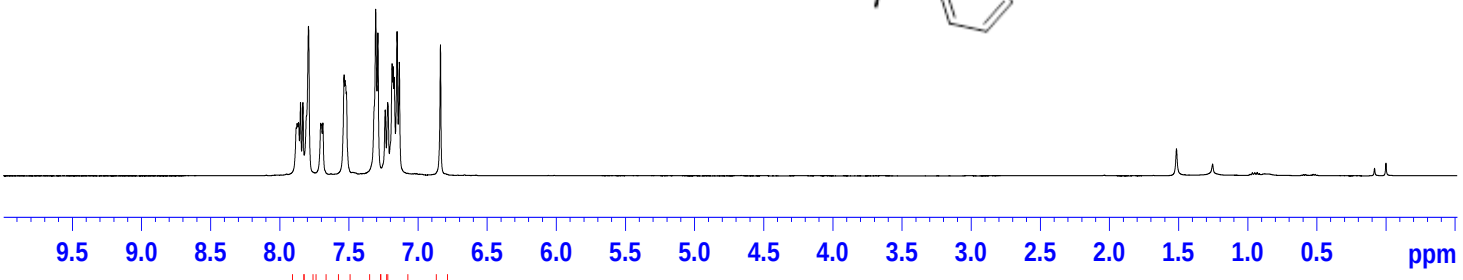


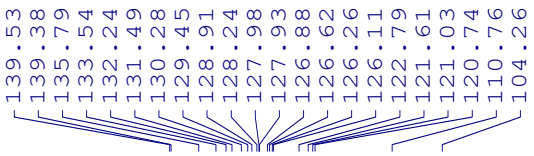




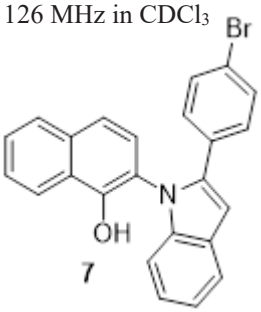
500 MHz in $CDCl_3$

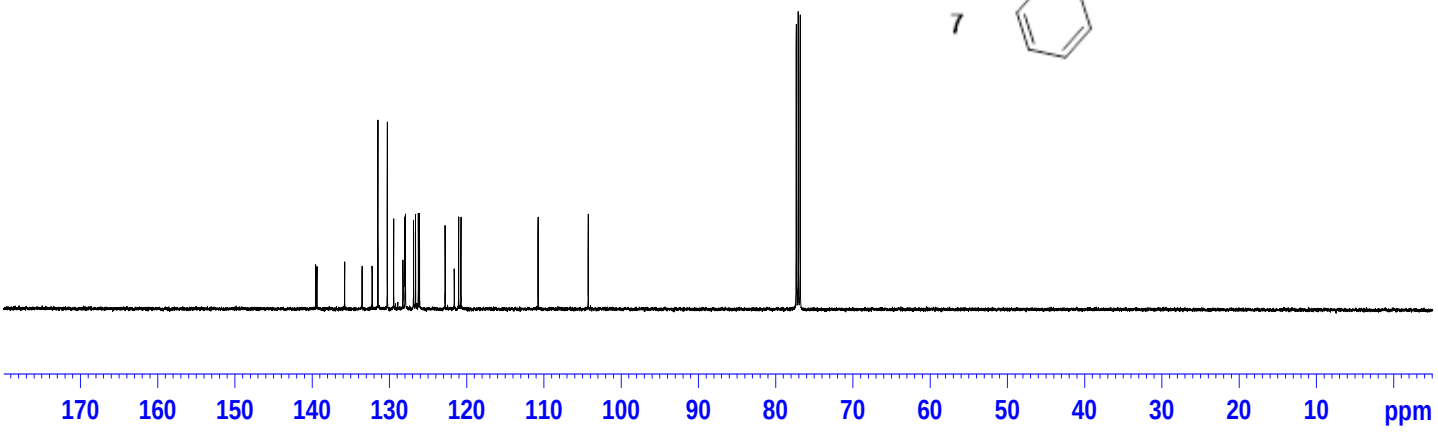


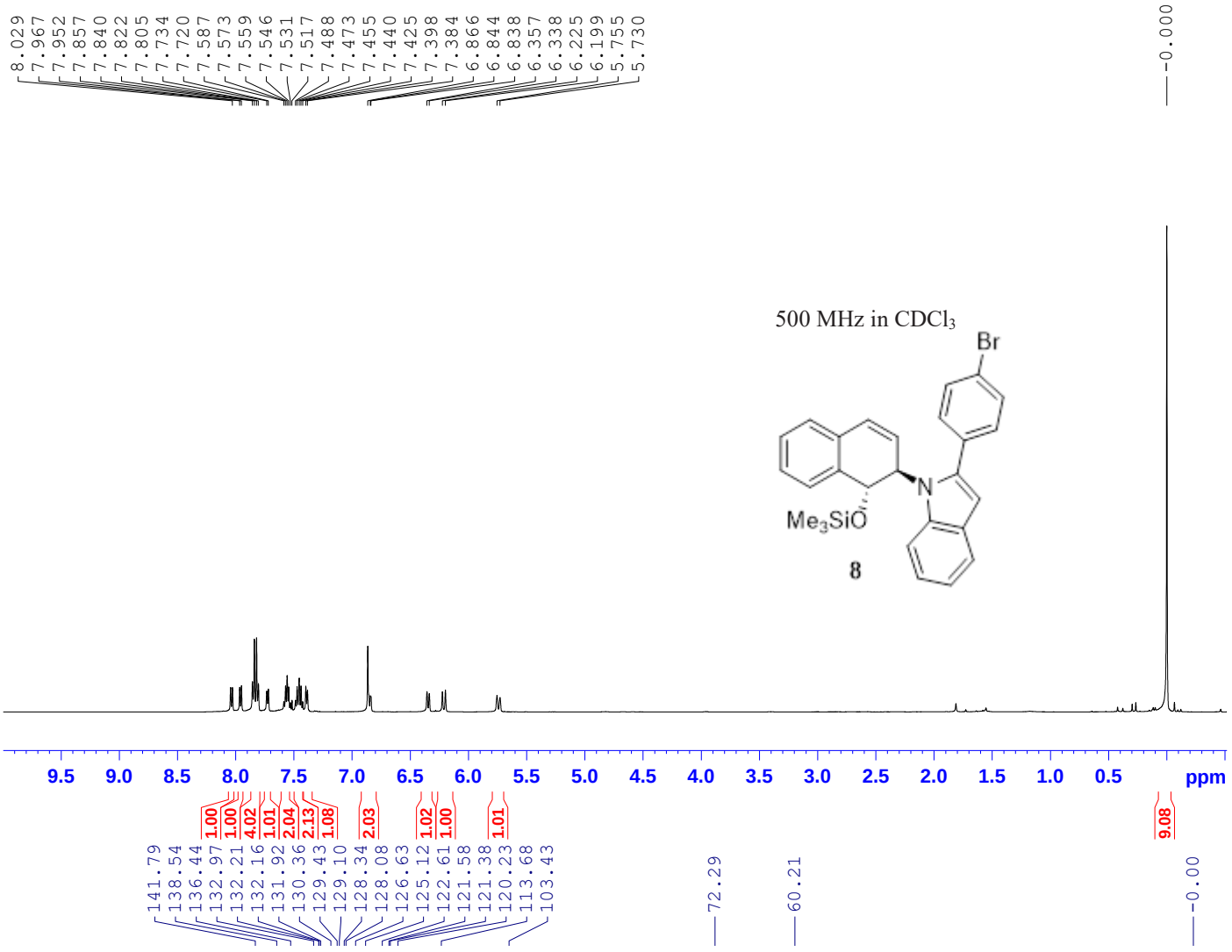


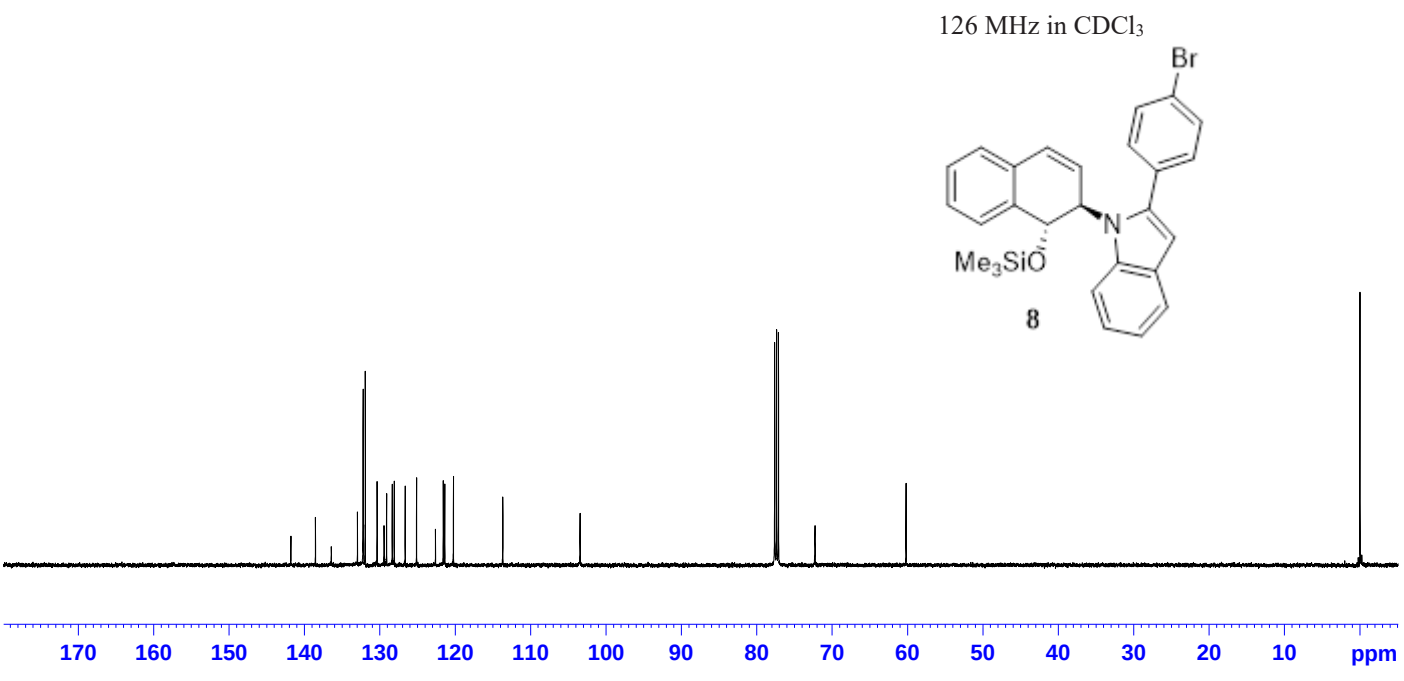


126 MHz in $CDCl_3$

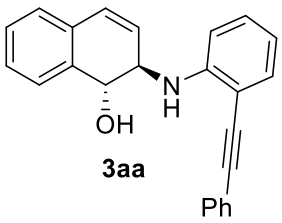





8.029
7.967
7.952
7.857
7.840
7.822
7.805
7.734
7.720
7.587
7.573
7.559
7.546
7.531
7.517
7.488
7.473
7.455
7.440
7.425
7.398
7.384
6.866
6.844
6.838
6.357
6.338
6.225
6.199
5.755
5.730
0.000
500 MHz in CDCl3
Br
N
Me3SiO
8
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
1.00 1.00 4.02 1.01 2.04 2.13 1.08 2.03 1.02 1.00 1.01 9.08
141.79
138.54
136.44
132.97
132.21
132.16
131.92
130.36
129.43
129.10
128.34
128.08
126.63
125.12
122.61
121.58
121.38
120.23
113.68
103.43
72.29
60.21
0.00


126 MHz in CDCl3
Br
N
Me3SiO
8
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

10. HPLC spectra of asymmetric hydroamination compounds



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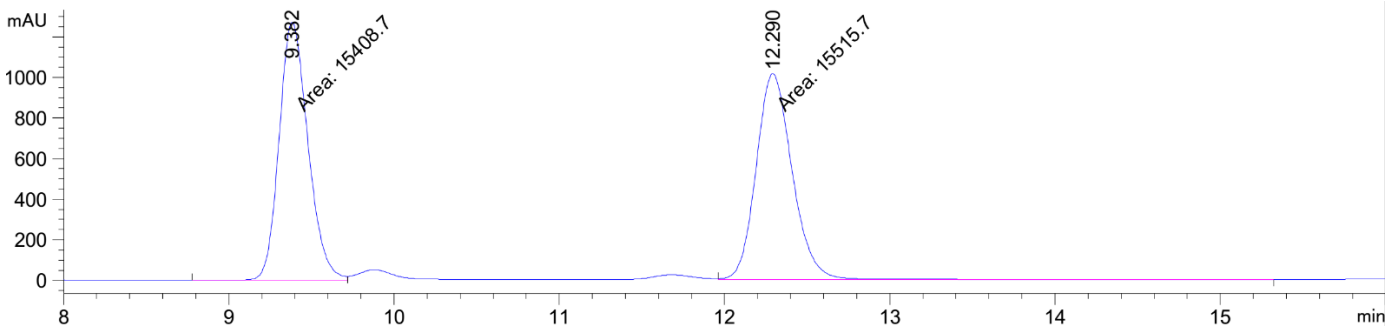
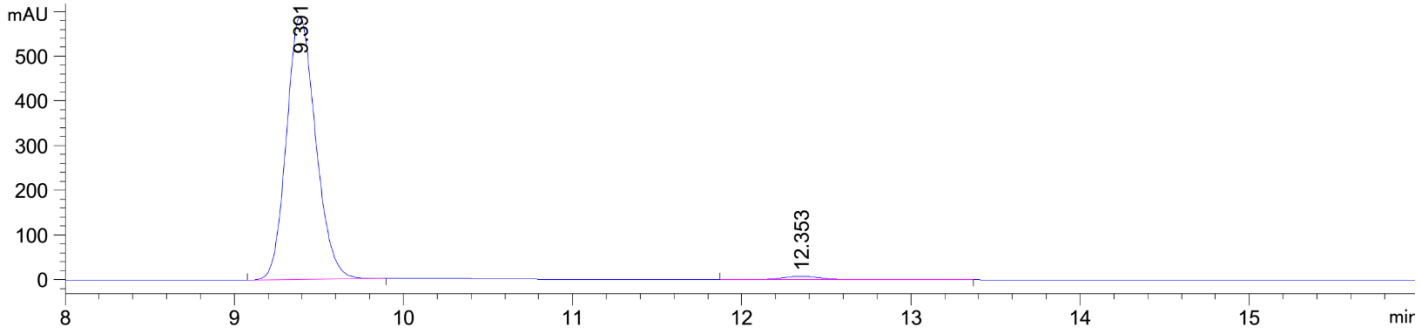
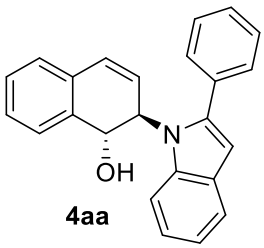


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.382	MF	0.2021	1.54087e4	1270.68884	49.8270
2	12.290	FM	0.2548	1.55157e4	1015.02942	50.1730



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.391	BB	0.1861	7068.26416	588.46344	98.3616
2	12.353	BB	0.2421	117.73714	7.54388	1.6384



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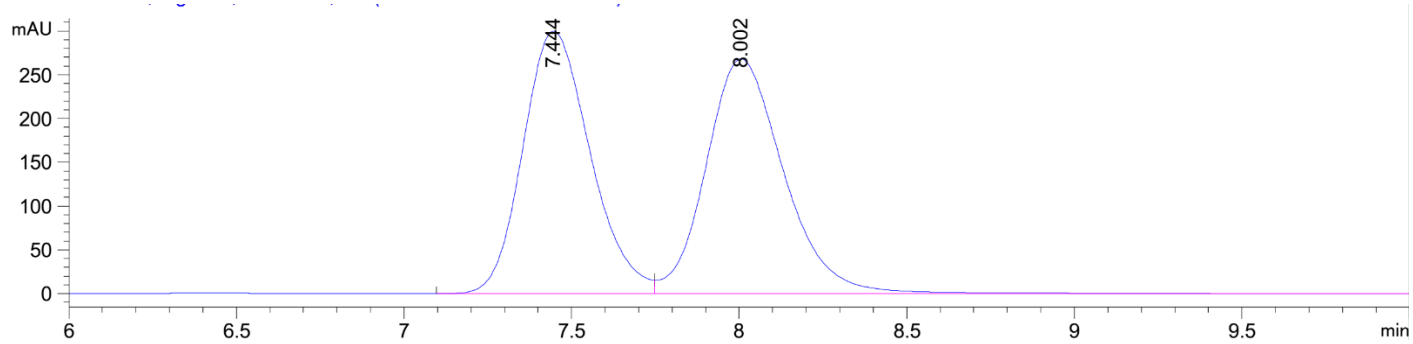
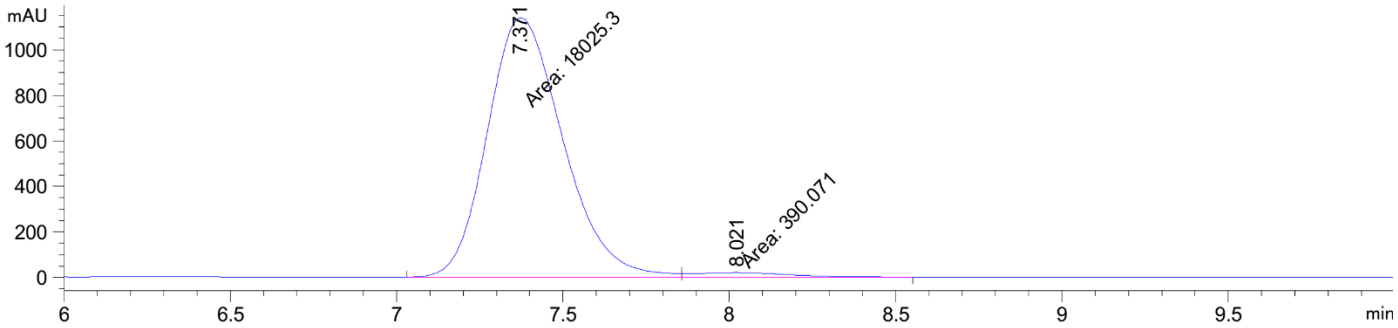
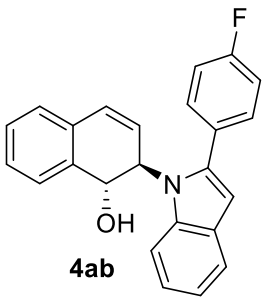


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.444	BV	0.2165	4175.93652	299.74347	49.1428
2	8.002	VB	0.2461	4321.61523	268.06409	50.8572



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.371	MF	0.2636	1.80253e4	1139.77454	97.8818
2	8.021	FM	0.3307	390.07129	19.65850	2.1182



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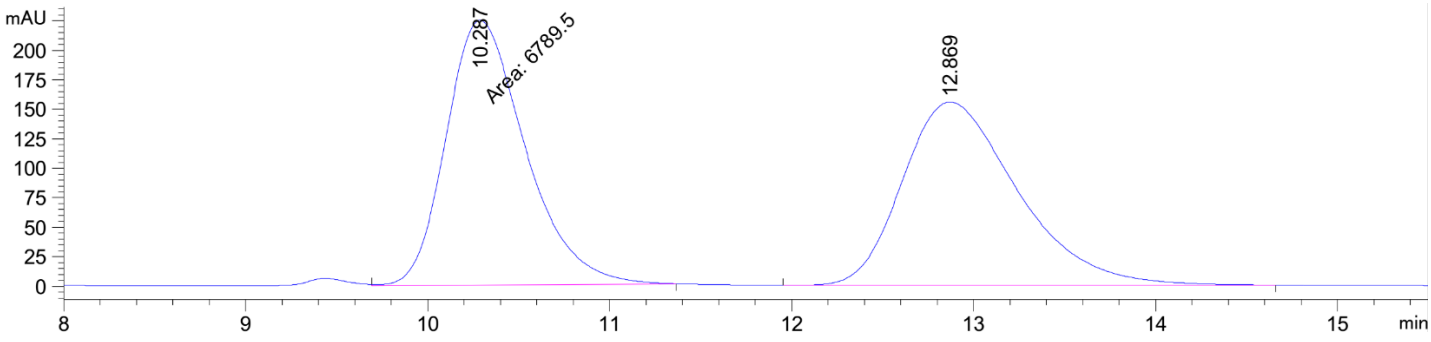
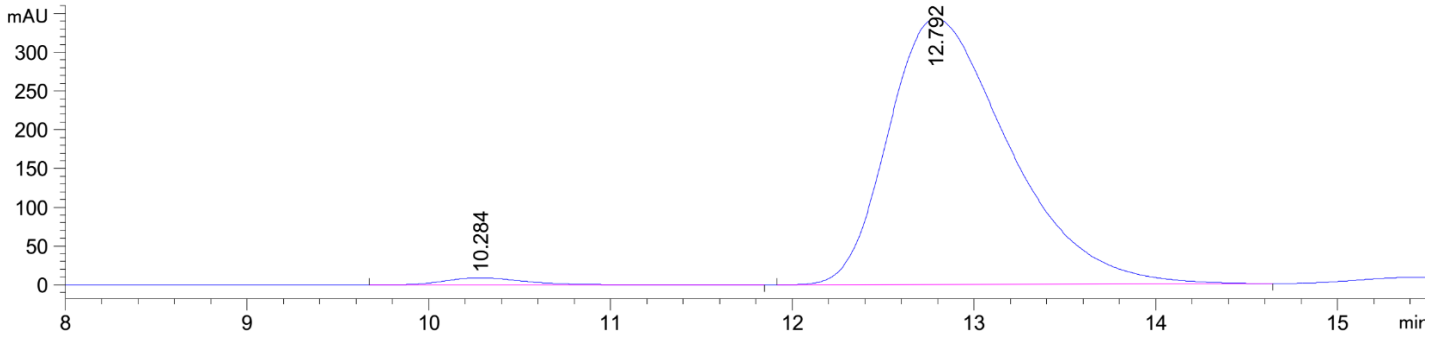
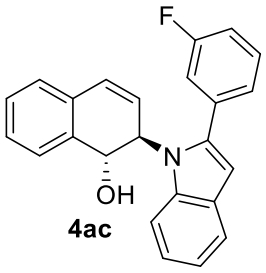


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.287	MP	0.5035	6789.49951	224.75934	49.8871
2	12.869	BB	0.6744	6820.22998	155.29370	50.1129



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.284	BB	0.4789	287.84900	9.20330	1.7856
2	12.792	BB	0.7101	1.58324e4	343.26578	98.2144



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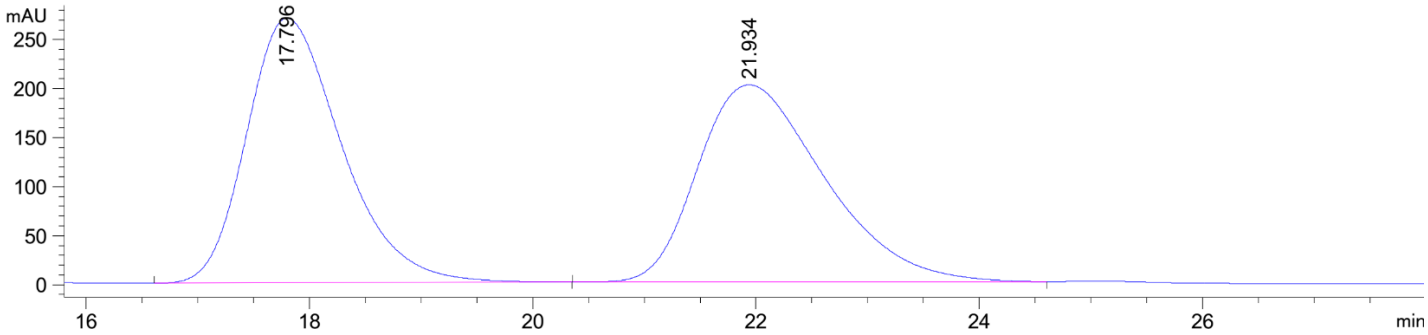
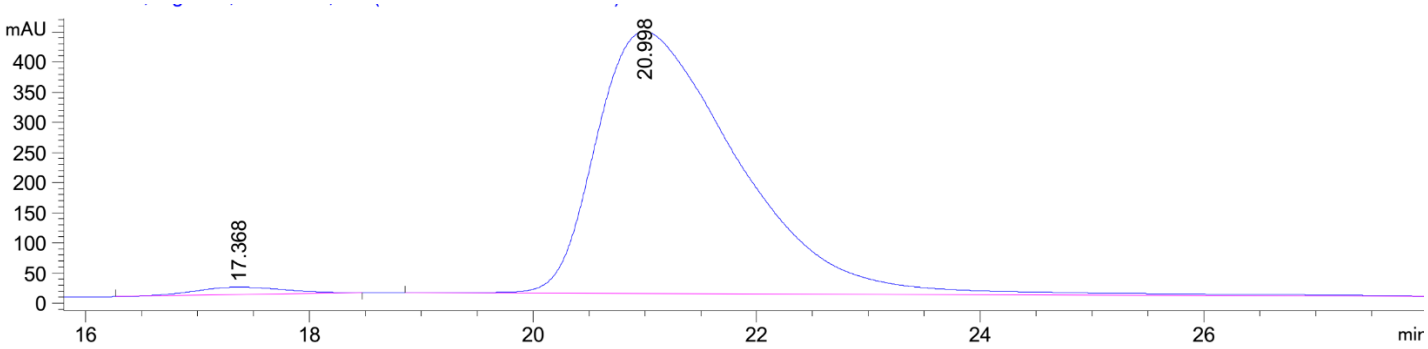
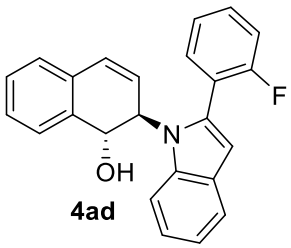


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.796	BB	0.9076	1.59558e4	269.92334	50.1434
2	21.934	BB	1.2164	1.58645e4	201.09505	49.8566



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.368	BB	0.8444	696.39557	12.45413	1.7754
2	20.998	BB	1.3675	3.85292e4	434.95813	98.2246



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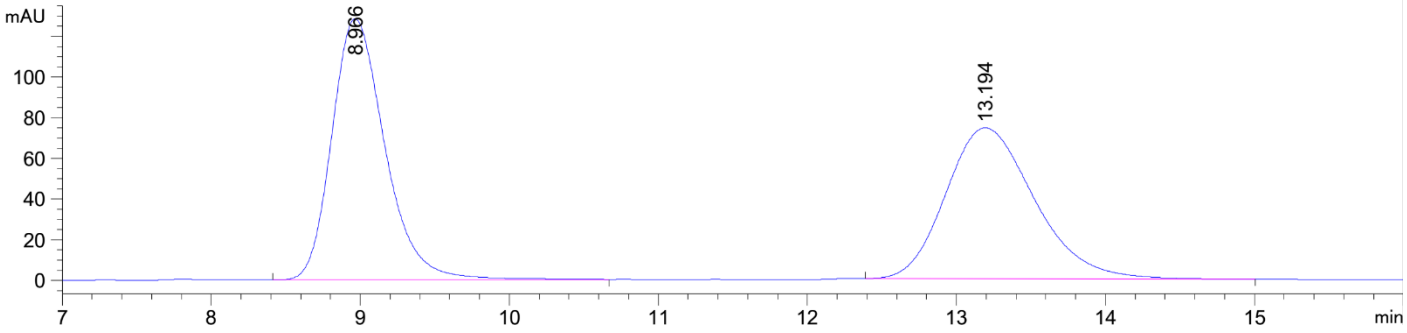
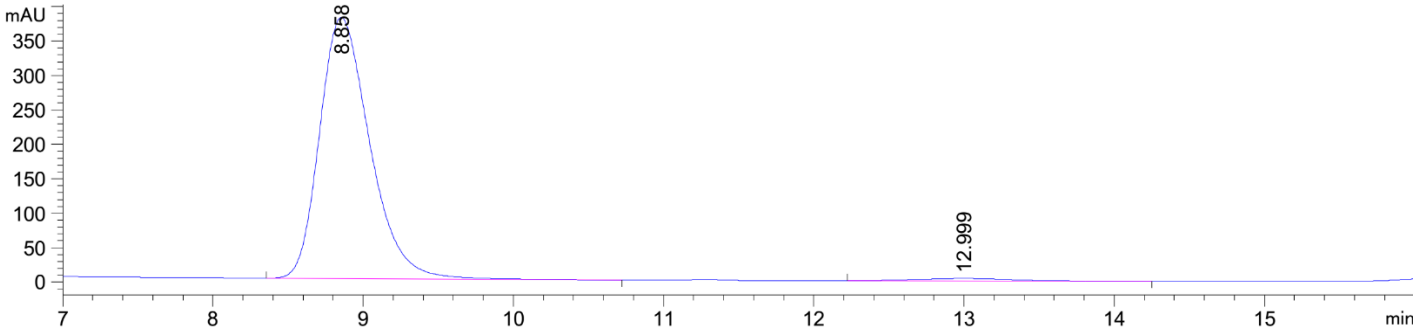
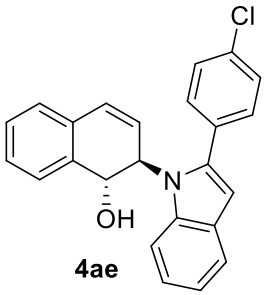


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.966	BB	0.3805	3177.32837	128.47258	50.8530
2	13.194	BB	0.6427	3070.74170	74.21474	49.1470



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.858	BB	0.3597	8829.11523	379.09848	98.1765
2	12.999	BB	0.6129	163.98701	3.78918	1.8235



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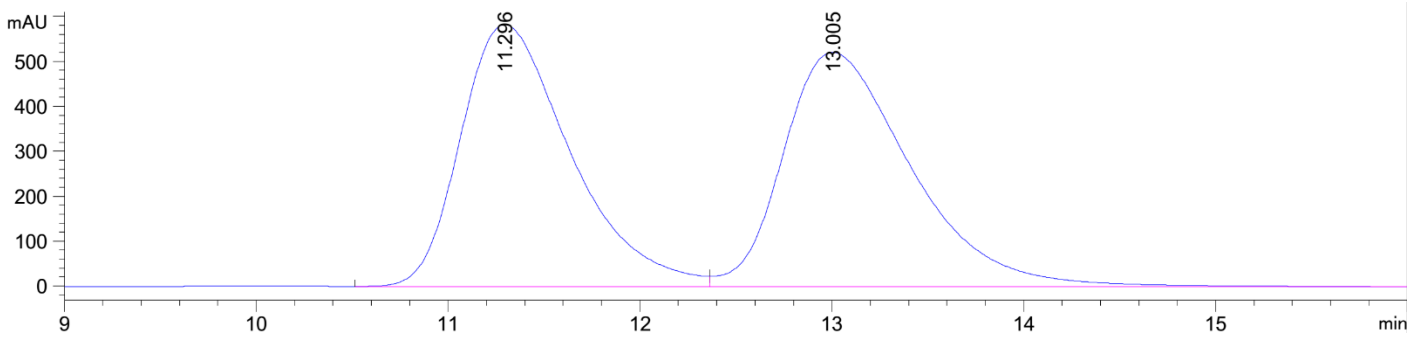
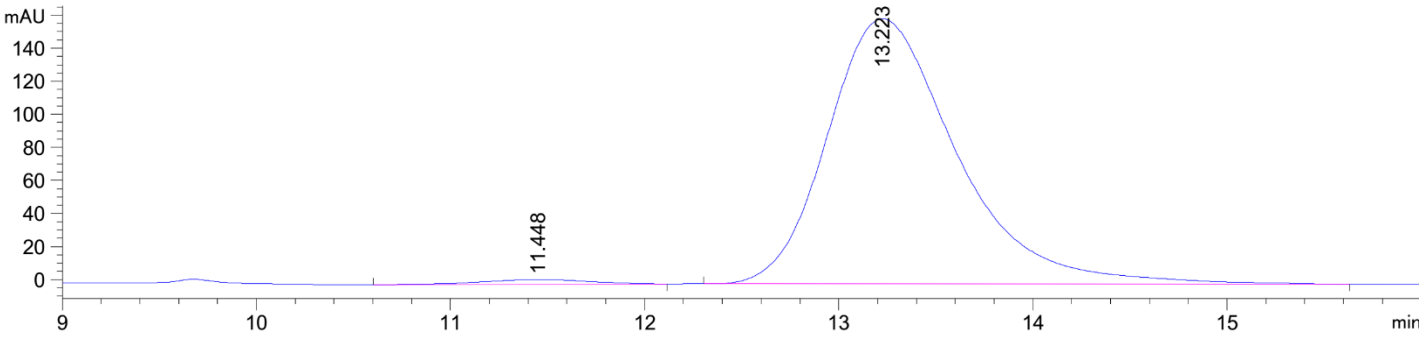
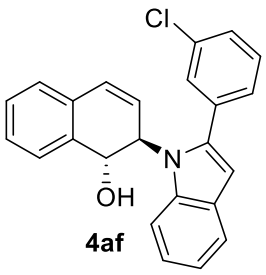


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.296	BV	0.6078	2.31591e4	582.60712	48.9544
2	13.005	VBA	0.7106	2.41484e4	521.15118	51.0456



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.448	BB	0.5370	113.68744	2.91519	1.5020
2	13.223	BB	0.7081	7455.13770	160.43588	98.4980



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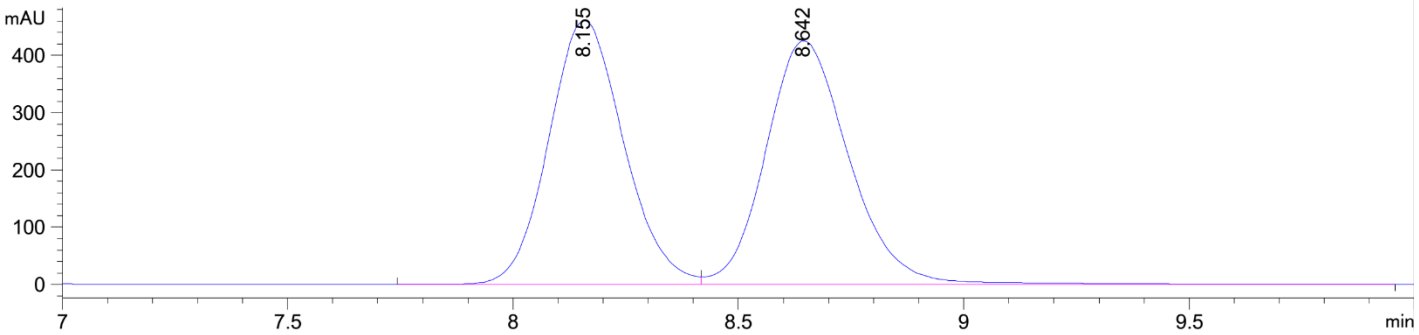
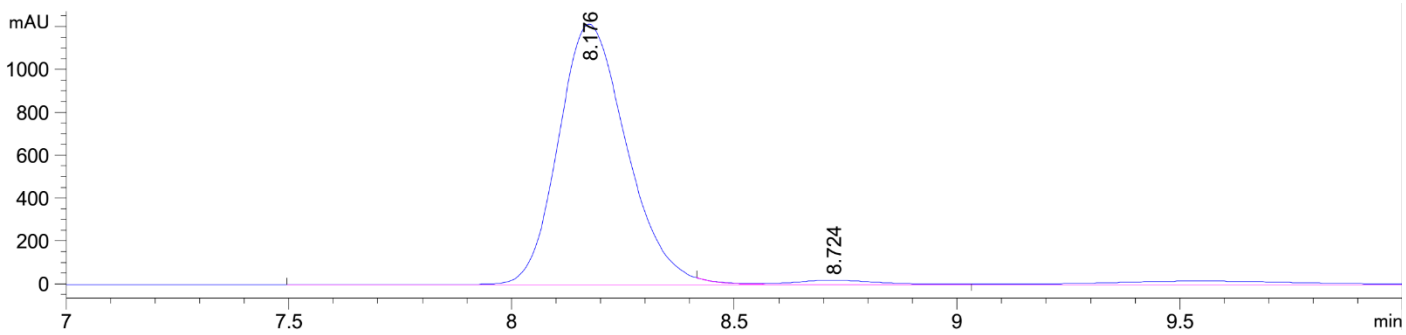
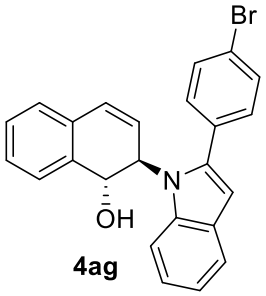


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.155	BV	0.1787	5323.42920	461.16577	49.3194
2	8.642	VB	0.1979	5470.35010	425.61646	50.6806



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.176	BV R	0.1645	1.34489e4	1215.77759	97.9980
2	8.724	VV E	0.2011	274.75146	20.40084	2.0020



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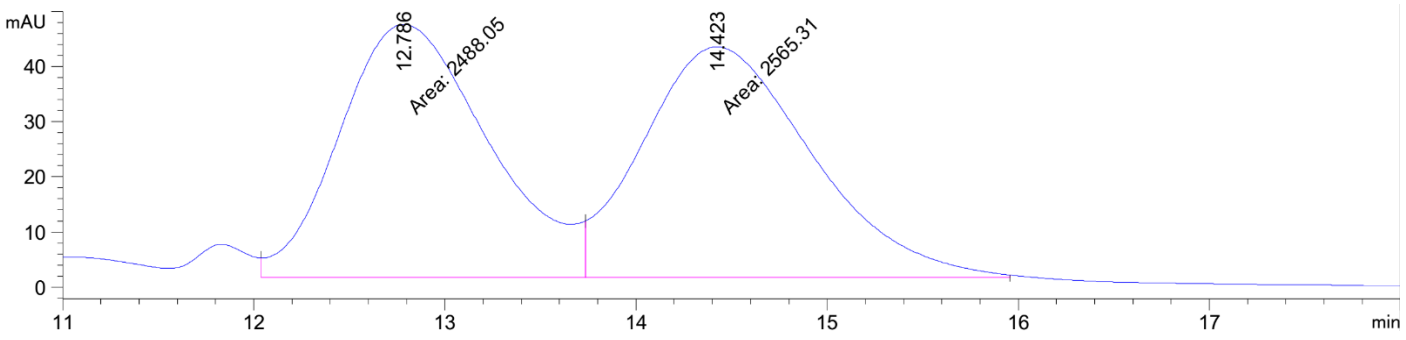
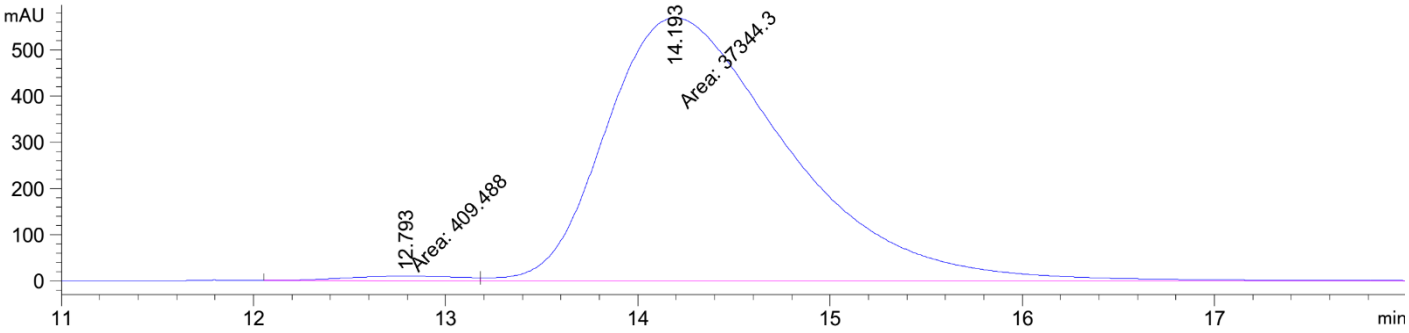
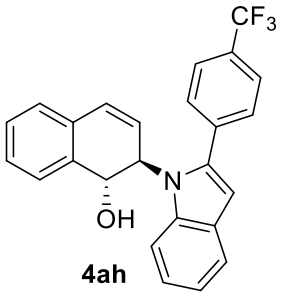


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.786	MF	0.9037	2488.04565	45.88862	49.2355
2	14.423	FM	1.0225	2565.31104	41.81253	50.7645



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.793	MF	0.6955	409.48807	9.81277	1.0846
2	14.193	FM	1.0944	3.73443e4	568.69946	98.9154



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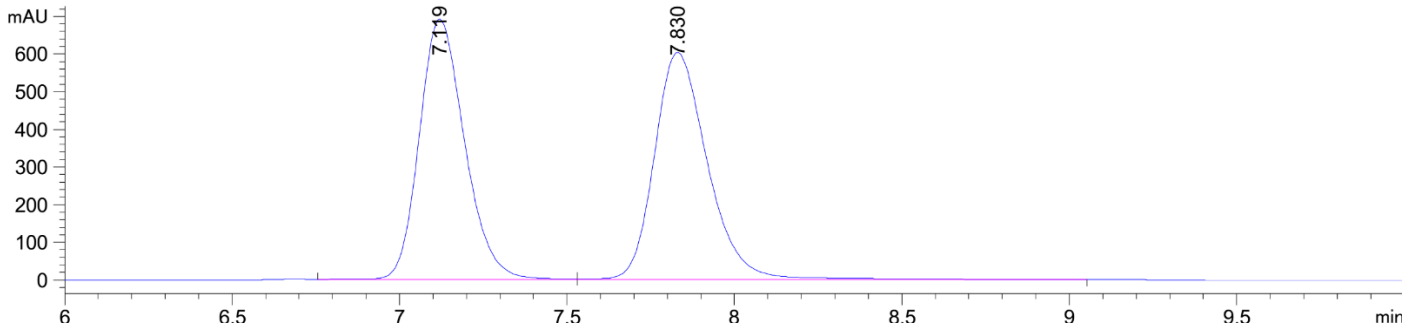
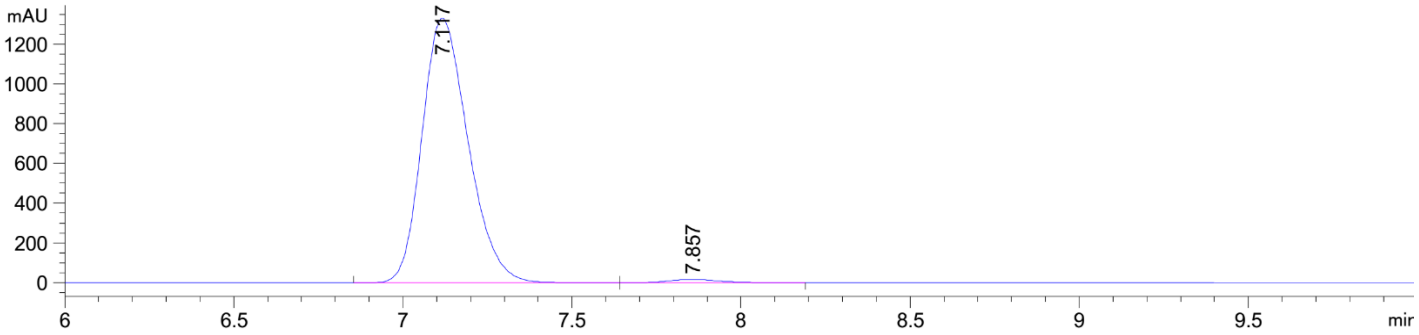
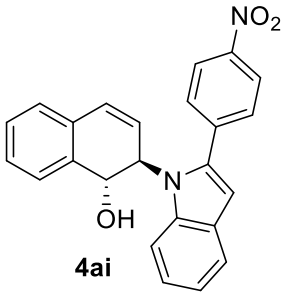


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.119	VV R	0.1436	6508.98584	692.07098	49.3474
2	7.830	VB	0.1691	6681.14941	603.73358	50.6526



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.117	BV	0.1466	1.26312e4	1332.85388	98.5986
2	7.857	VB	0.1656	179.52307	16.67180	1.4014



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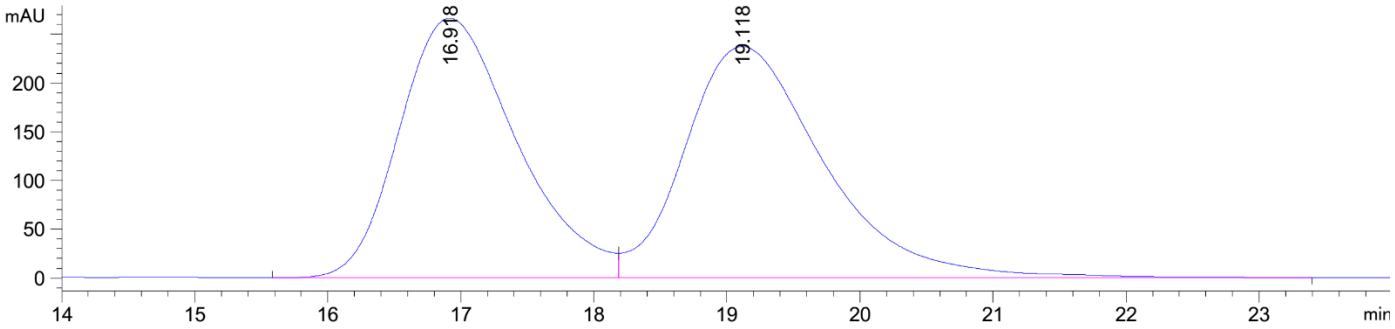
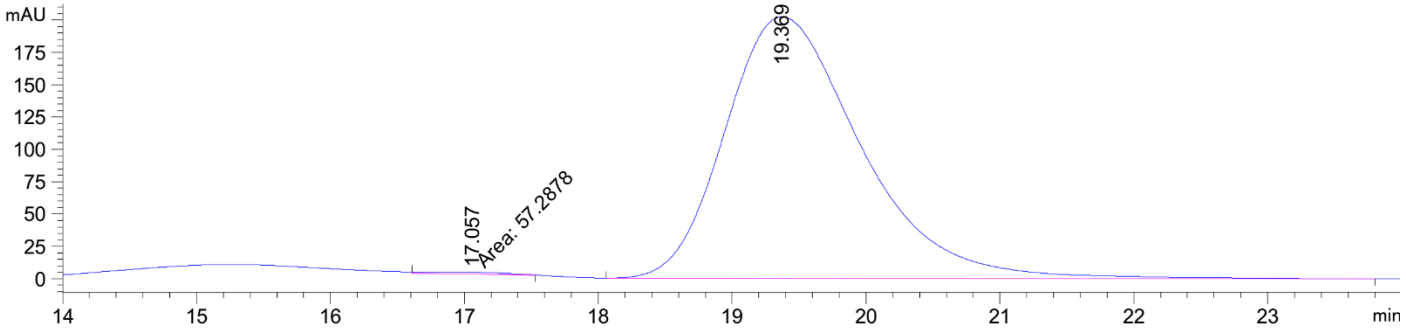
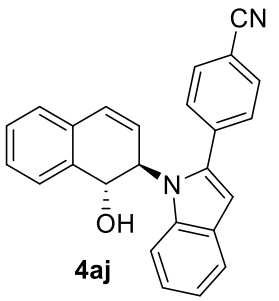


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.918	BV	0.9433	1.63210e4	266.19296	48.6702
2	19.118	VB	1.1032	1.72129e4	237.04314	51.3298



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.057	MP	0.6642	57.28777	1.43742	0.4002
2	19.369	BB	1.0788	1.42560e4	202.12958	99.5998



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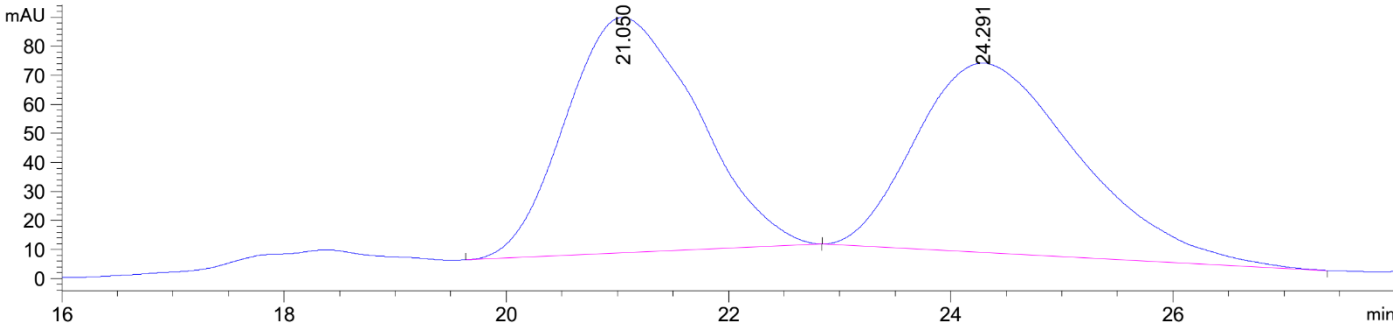
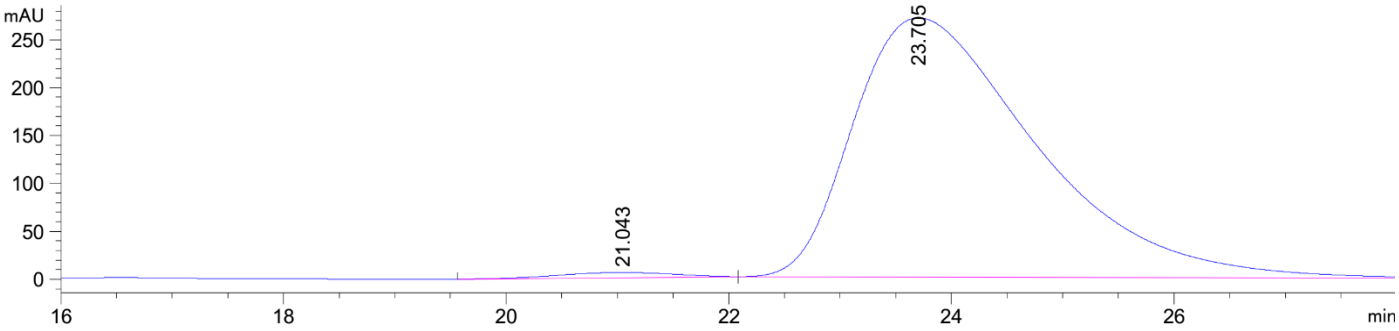
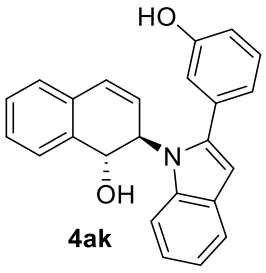


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	21.050	BB	1.2142	6691.86377	81.14285	50.0294
2	24.291	BB	1.5471	6683.99805	65.24969	49.9706



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	21.043	BB	0.8919	385.79474	5.41024	1.2293
2	23.705	BB	1.7386	3.09982e4	270.57681	98.7707



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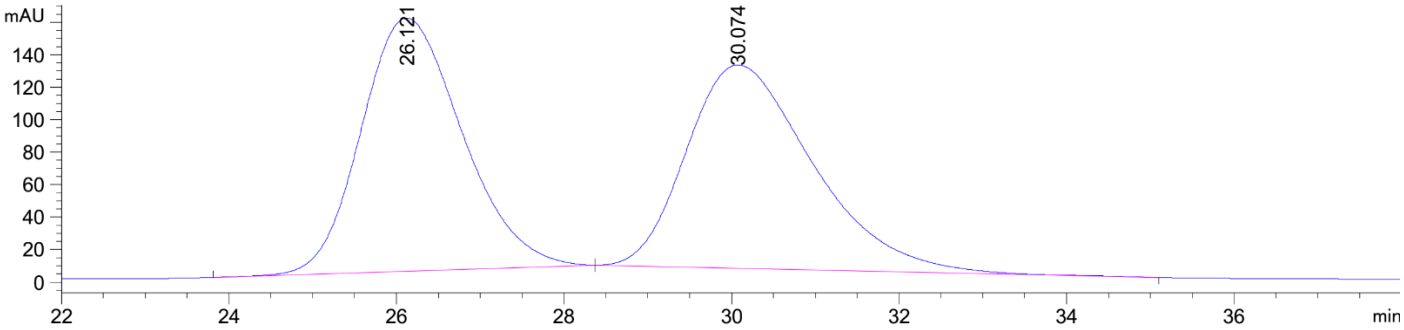
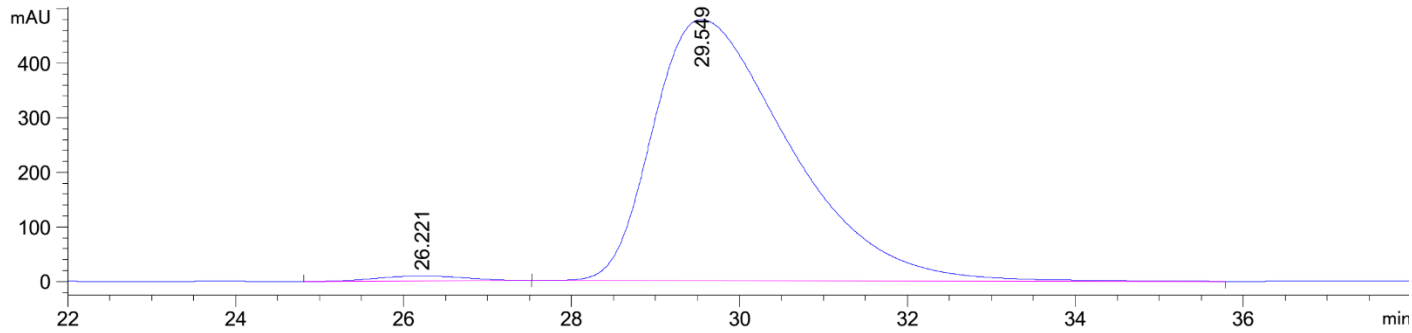
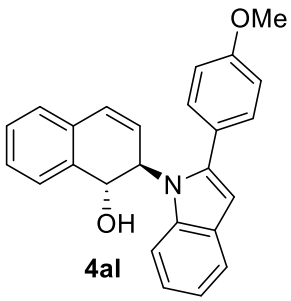


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.121	BB	1.3047	1.30557e4	155.94487	49.8251
2	30.074	BB	1.6207	1.31473e4	125.24734	50.1749



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.221	BB	1.0186	680.95538	9.45149	1.2452
2	29.549	BB	1.7287	5.40037e4	478.51865	98.7548



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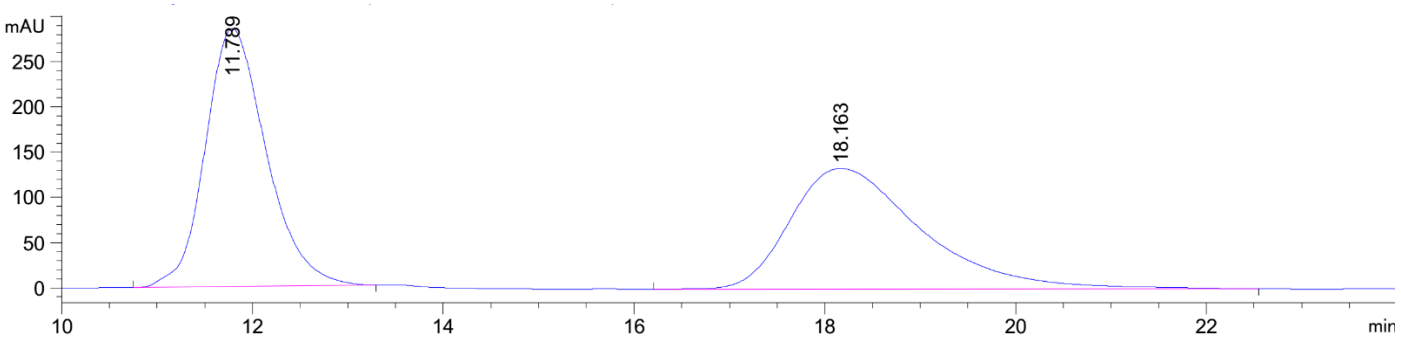
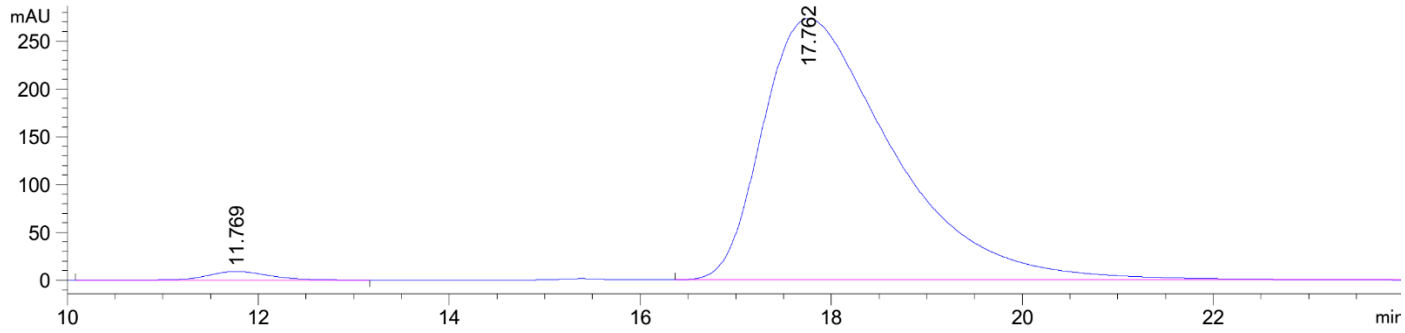
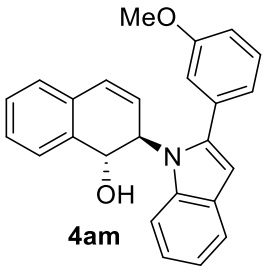


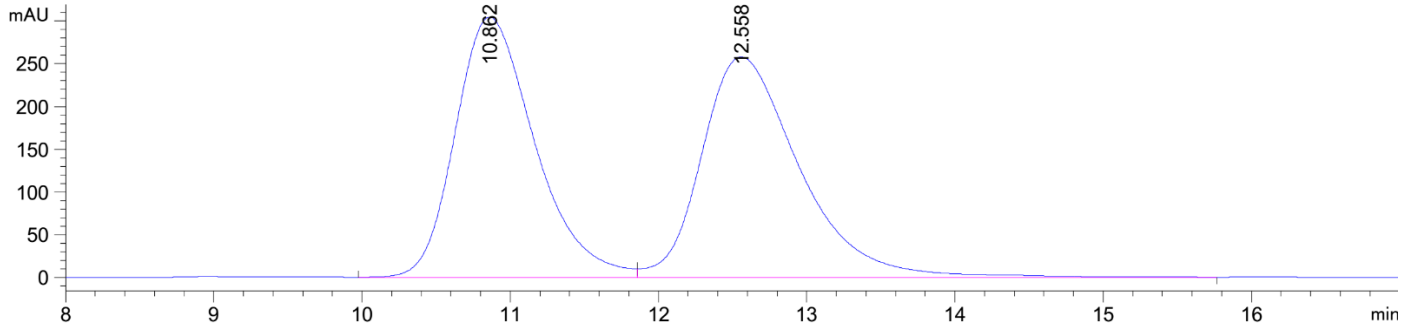
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.789	BB	0.6829	1.26864e4	285.22369	49.8417
2	18.163	BB	1.4405	1.27670e4	133.40508	50.1583



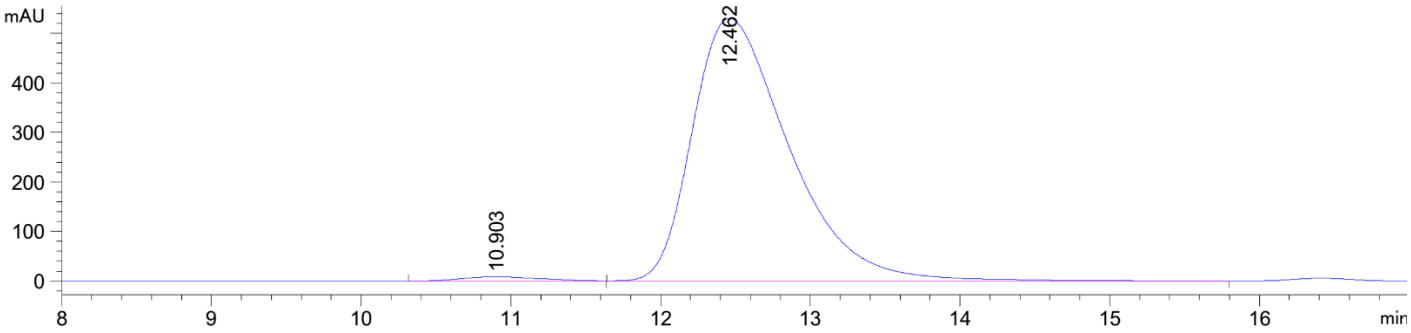
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.769	BB	0.6810	420.79242	9.21118	1.5987
2	17.762	BBA	1.4345	2.58994e4	273.08798	98.4013



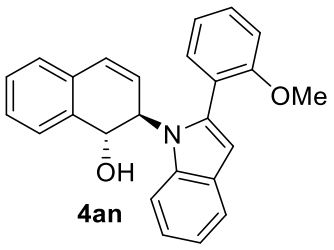
4am



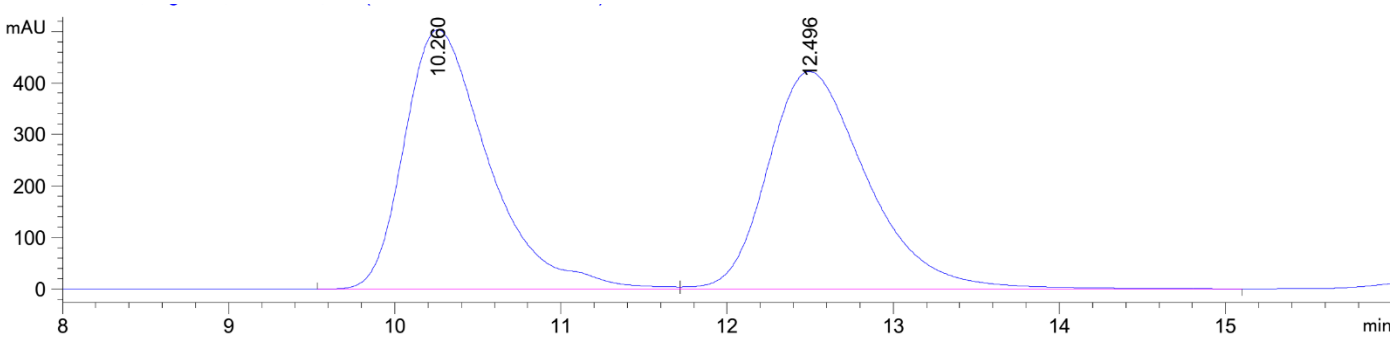
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.862	BV	0.5707	1.13262e4	303.95602	49.0063
2	12.558	VB	0.6959	1.17855e4	257.52634	50.9937



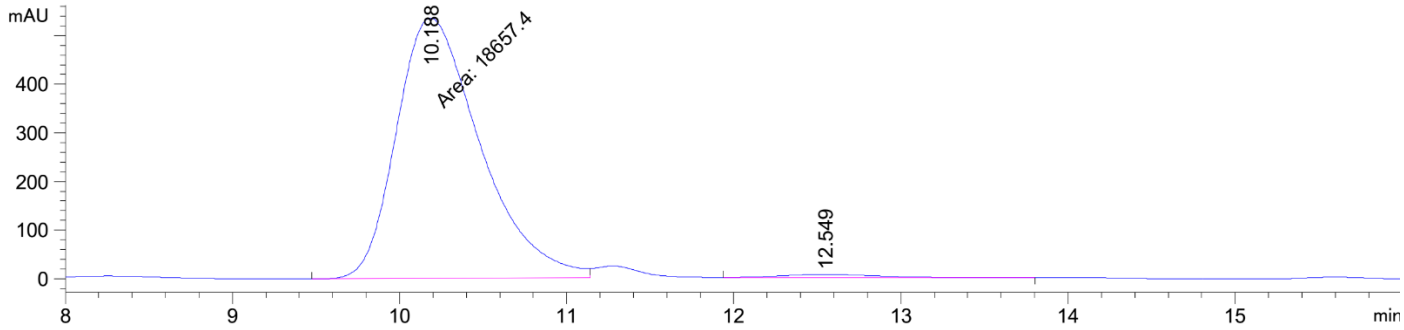
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.903	BB	0.5378	306.16293	8.63193	1.2706
2	12.462	BB	0.6833	2.37894e4	530.35358	98.7294



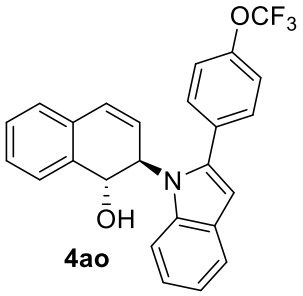
4an



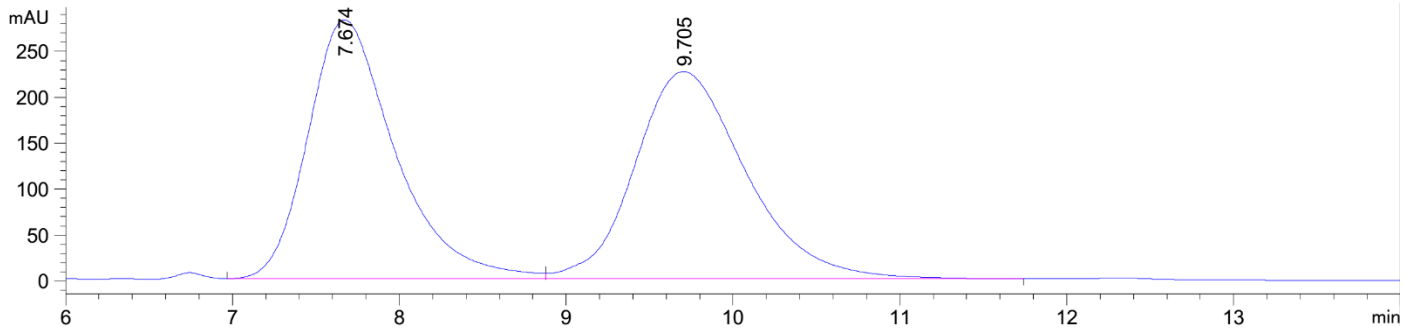
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.260	BV	0.5350	1.77147e4	502.82324	50.3065
2	12.496	VB	0.6343	1.74988e4	421.52823	49.6935



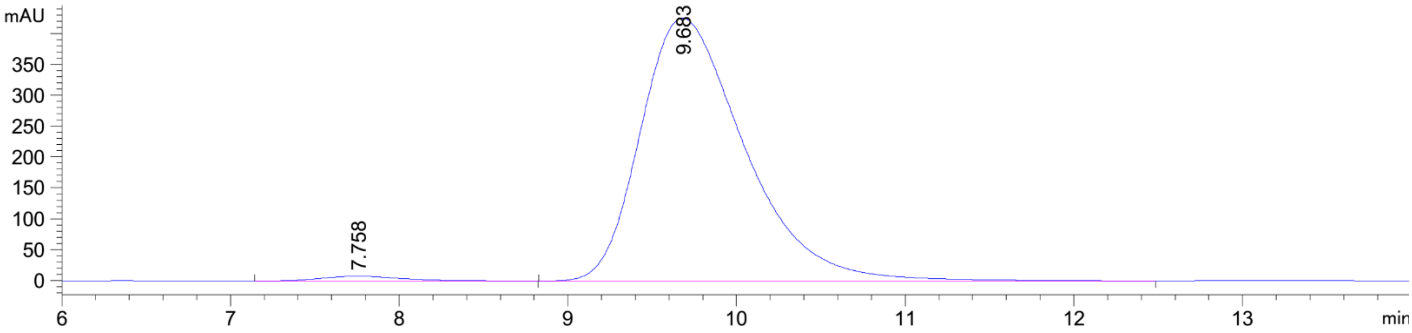
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.188	MF	0.5805	1.86574e4	535.62598	98.7136
2	12.549	BB	0.5804	243.14108	6.35380	1.2864



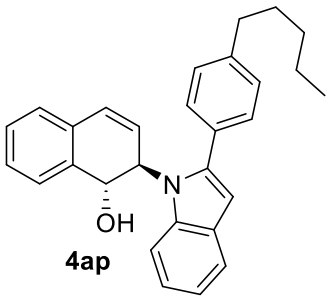
4ao



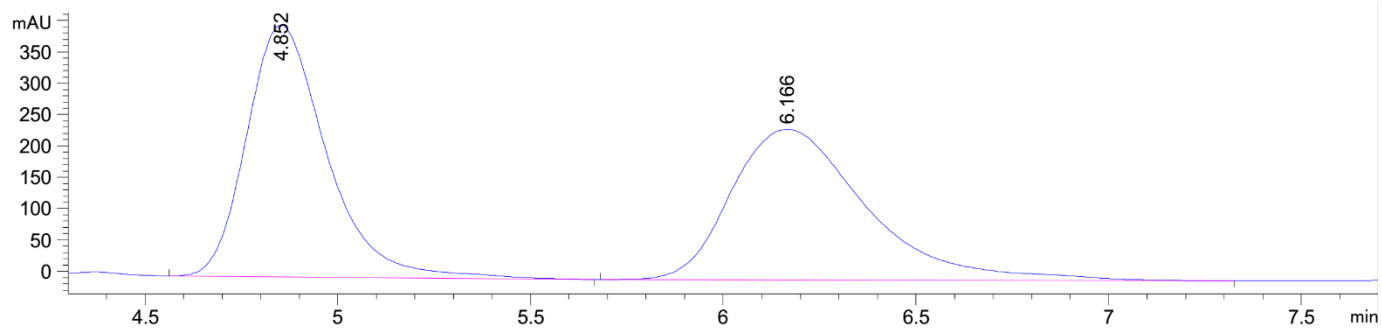
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.674	BV	0.5452	1.02699e4	281.80679	49.5879
2	9.705	VB	0.7101	1.04406e4	225.50491	50.4121



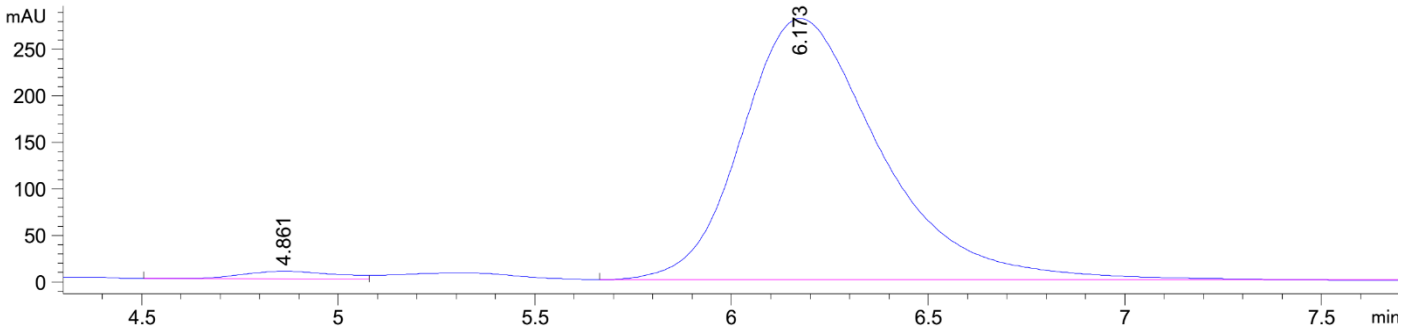
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.758	BB	0.4983	262.67307	8.01657	1.4145
2	9.683	BB	0.6591	1.83077e4	426.27628	98.5855



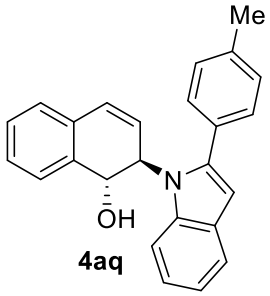
4ap



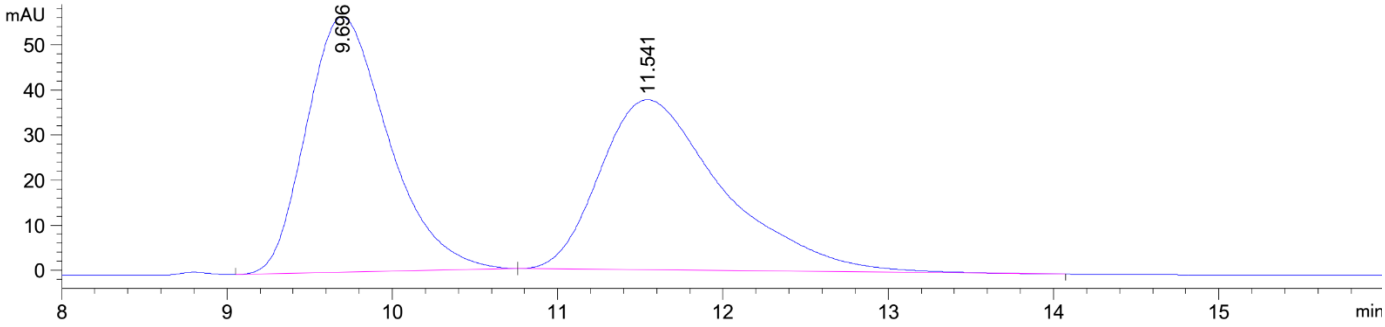
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.852	BB	0.2202	5792.66357	401.78497	49.7464
2	6.166	BB	0.3757	5851.72559	240.66660	50.2536



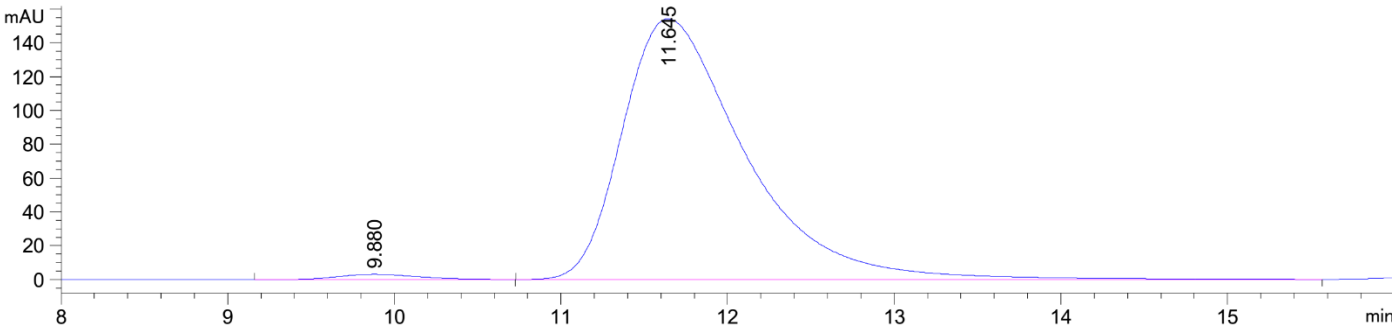
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.861	BV	0.2538	137.53735	8.27996	1.9439
2	6.173	BB	0.3739	6937.64111	281.12146	98.0561



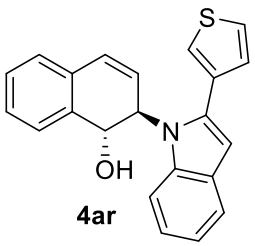
4aq



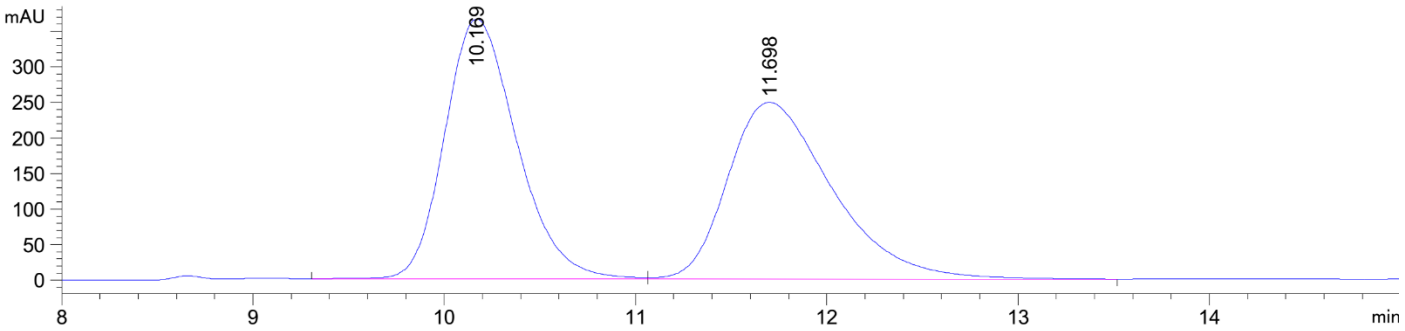
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.696	BB	0.5339	1951.47314	56.65125	49.9869
2	11.541	BB	0.7794	1952.49854	37.75062	50.0131



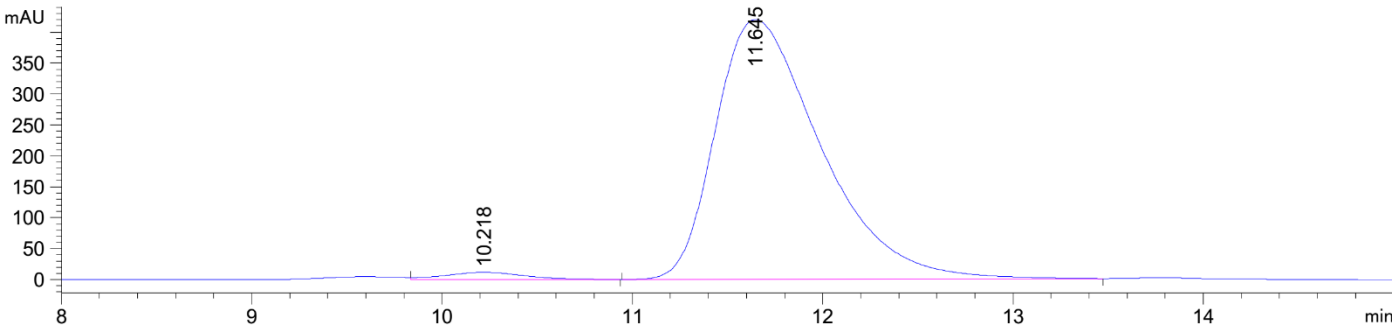
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.880	BB	0.5106	101.75326	3.03893	1.2756
2	11.645	BB	0.7720	7875.31738	154.15065	98.7244



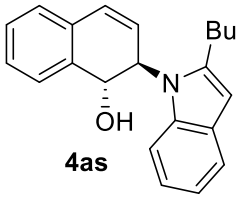
4ar



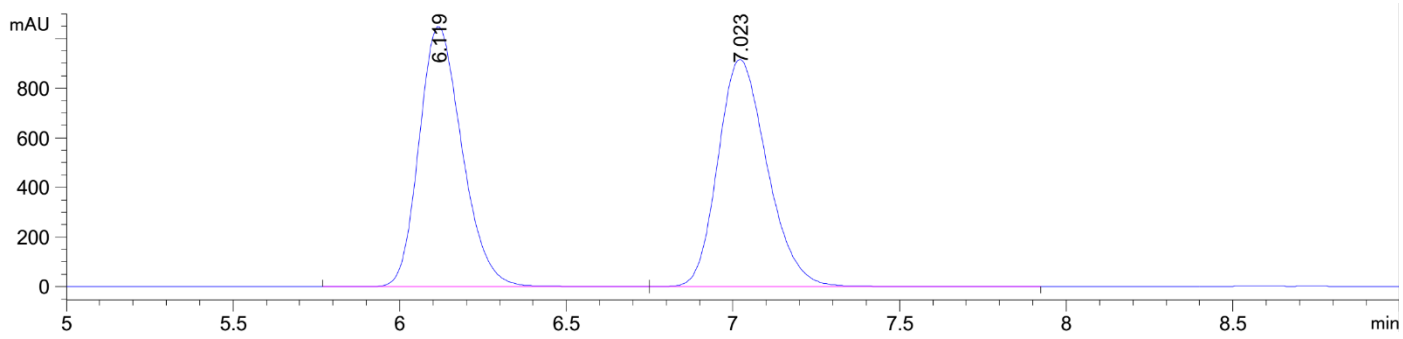
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.169	BV	0.4040	9579.87891	365.28452	50.3804
2	11.698	VB	0.5814	9435.20605	248.27147	49.6196



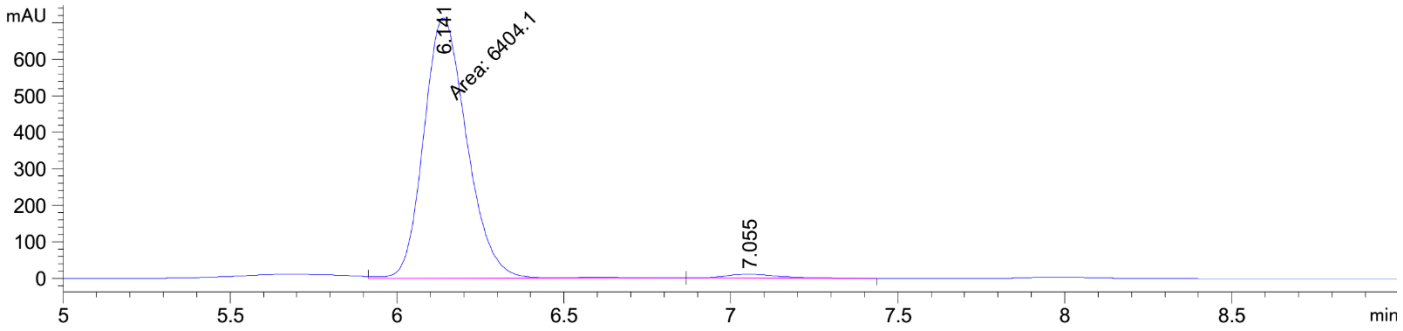
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.218	VB	0.4362	331.28104	11.49565	2.0112
2	11.645	BB	0.5886	1.61403e4	419.79047	97.9888



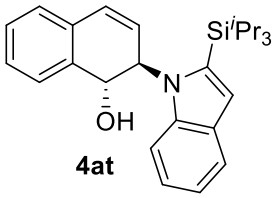
4as



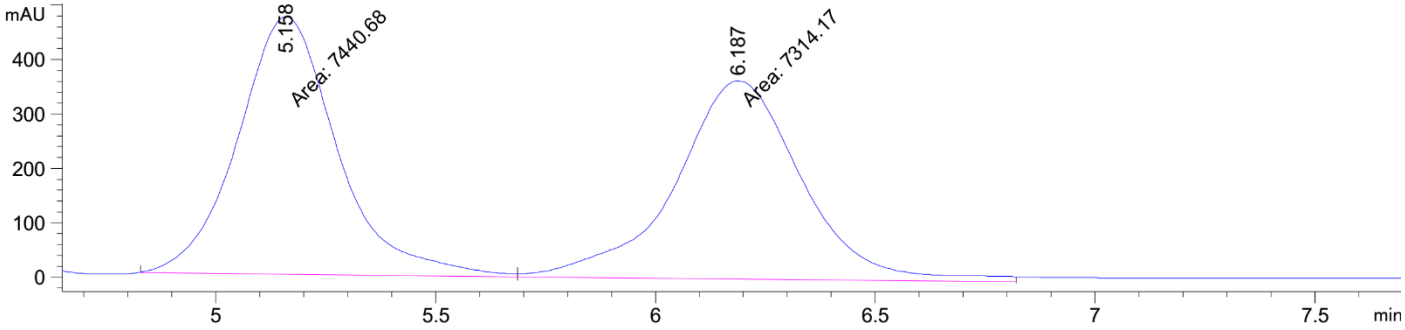
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.119	BB	0.1384	9388.50586	1049.26465	49.9750
2	7.023	BB	0.1577	9397.89258	916.29993	50.0250



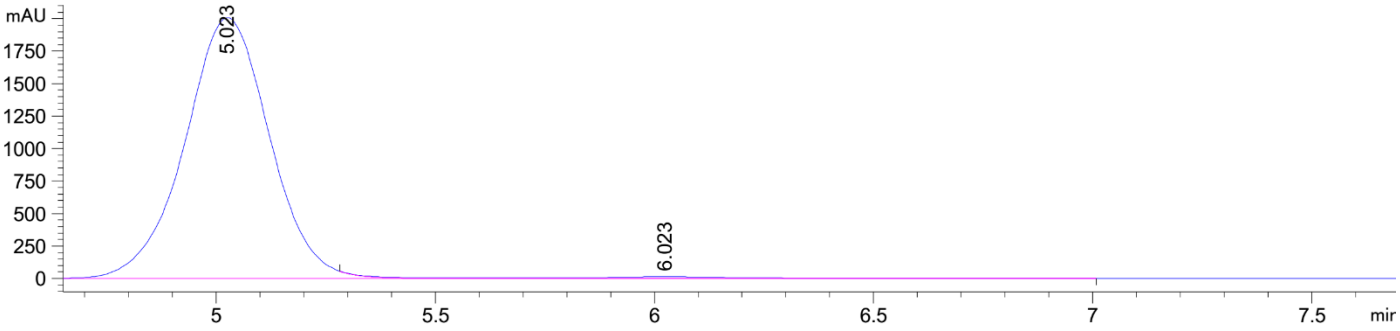
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.141	FM	0.1496	6404.09863	713.36560	98.1555
2	7.055	BB	0.1690	120.34609	10.88455	1.8445



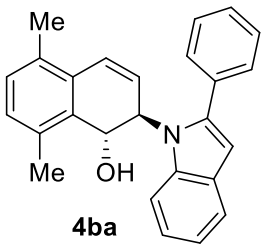
4at



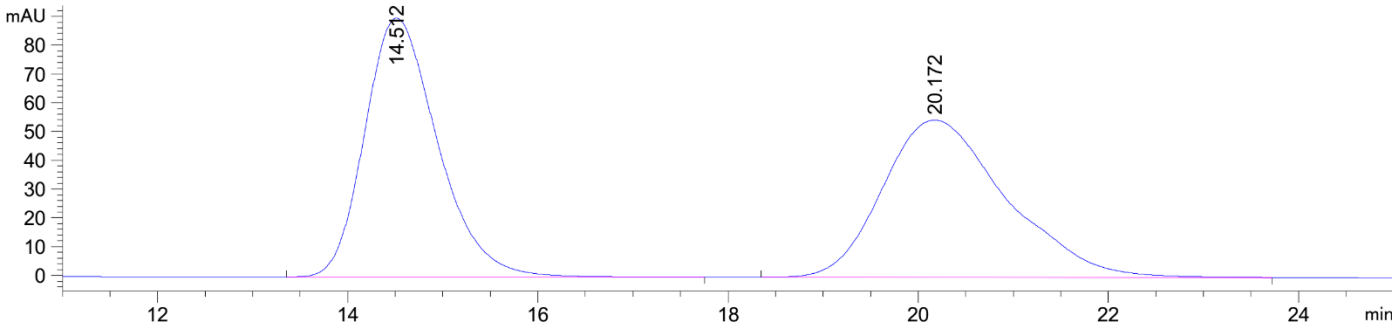
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.158	MF	0.2617	7440.67627	473.84766	50.4287
2	6.187	FM	0.3343	7314.16602	364.67282	49.5713



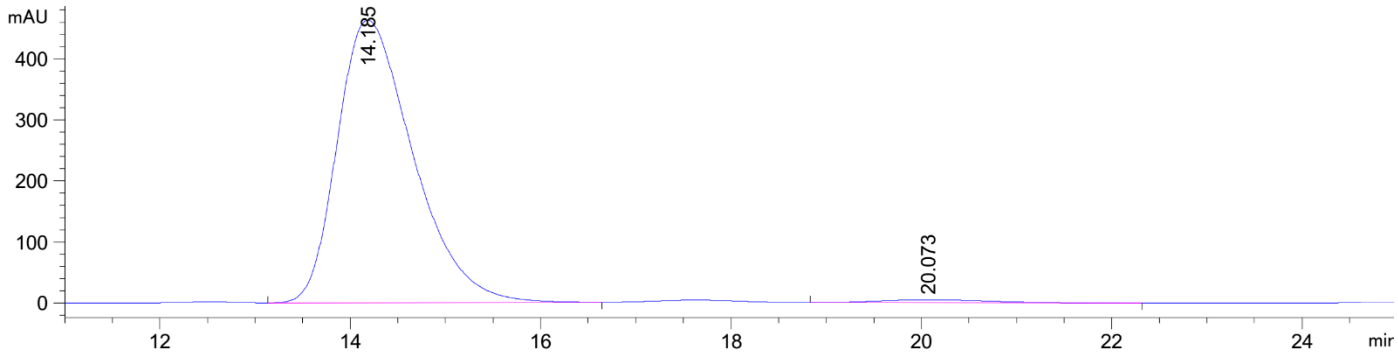
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.023	VV R	0.2049	2.69933e4	2006.81506	98.5899
2	6.023	VB E	0.3970	386.08929	13.44744	1.4101



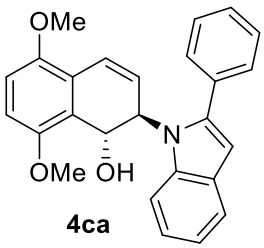
4ba



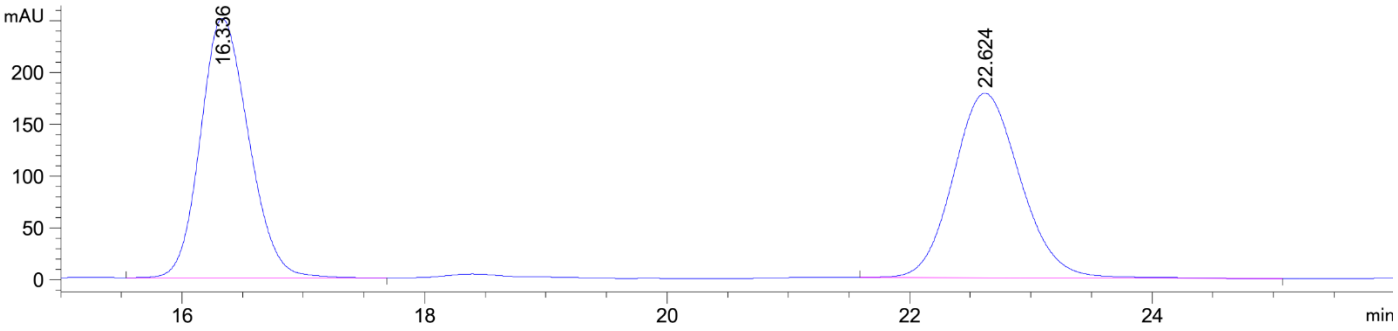
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.512	BB	0.8174	4792.42725	89.97608	49.2895
2	20.172	BB	1.3626	4930.59131	54.65108	50.7105



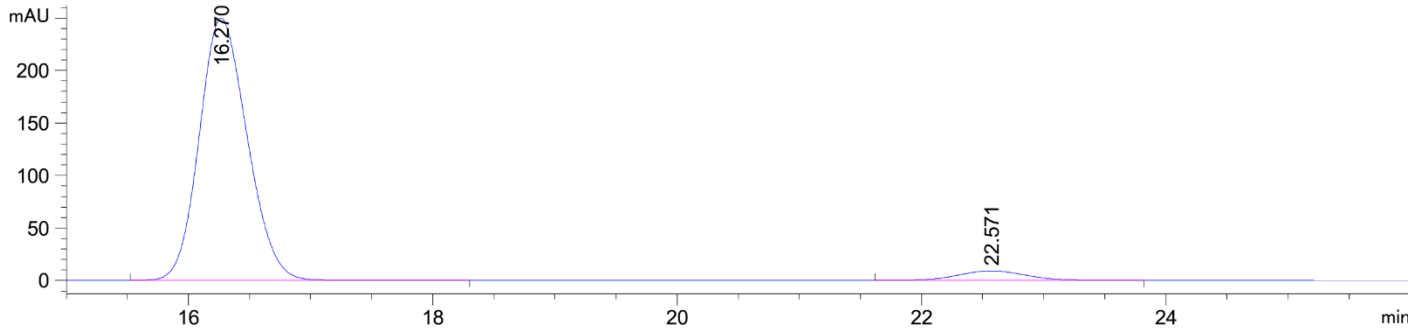
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.185	BB	0.8513	2.56216e4	463.19958	98.4282
2	20.073	BB	1.0114	409.15005	5.00685	1.5718



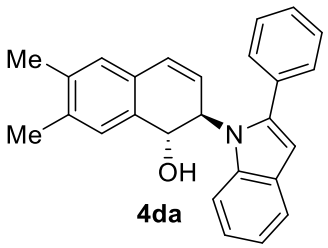
4ca



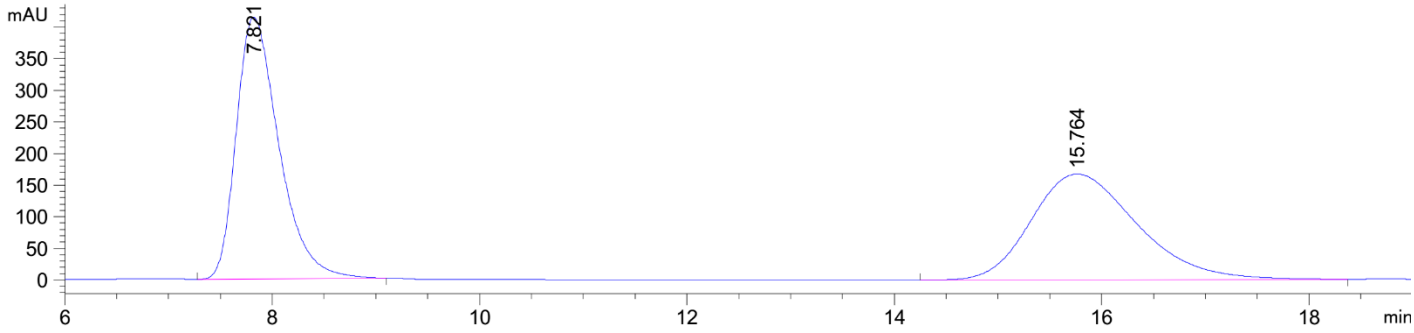
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.336	BB	0.4284	6923.08740	250.50041	50.3108
2	22.624	BB	0.5941	6837.54834	178.03790	49.6892



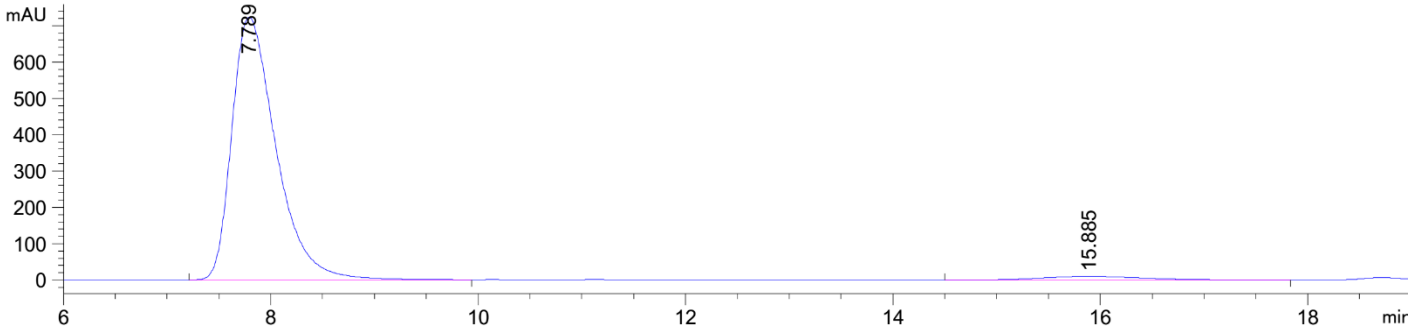
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.270	BB	0.4235	6793.28076	249.59502	95.1906
2	22.571	BB	0.5850	343.22372	9.03964	4.8094



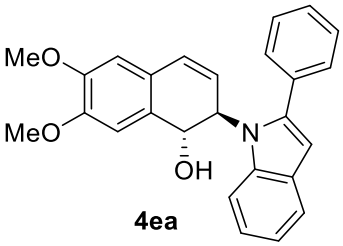
4da



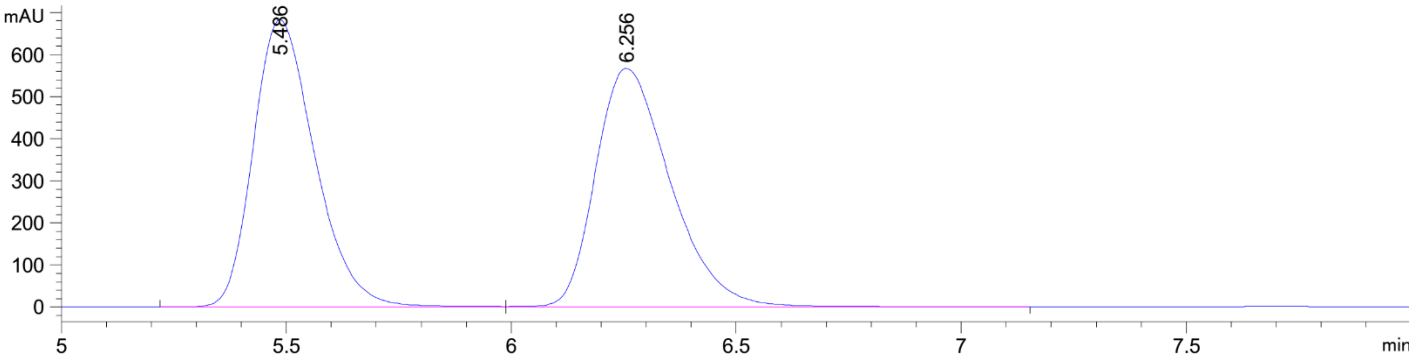
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.821	BB	0.4380	1.18597e4	414.25125	49.9780
2	15.764	BB	1.1000	1.18701e4	167.25397	50.0220



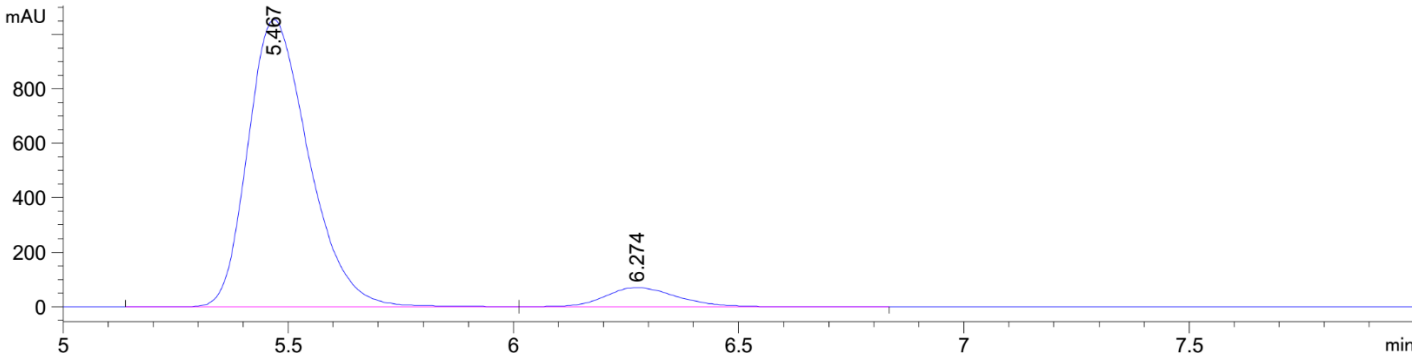
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.789	BB	0.4530	2.13804e4	723.03827	96.8471
2	15.885	BB	1.0284	696.04797	10.04528	3.1529



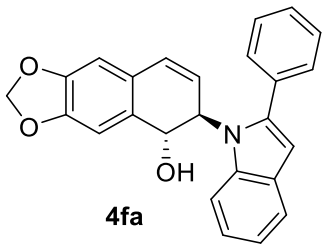
4ea



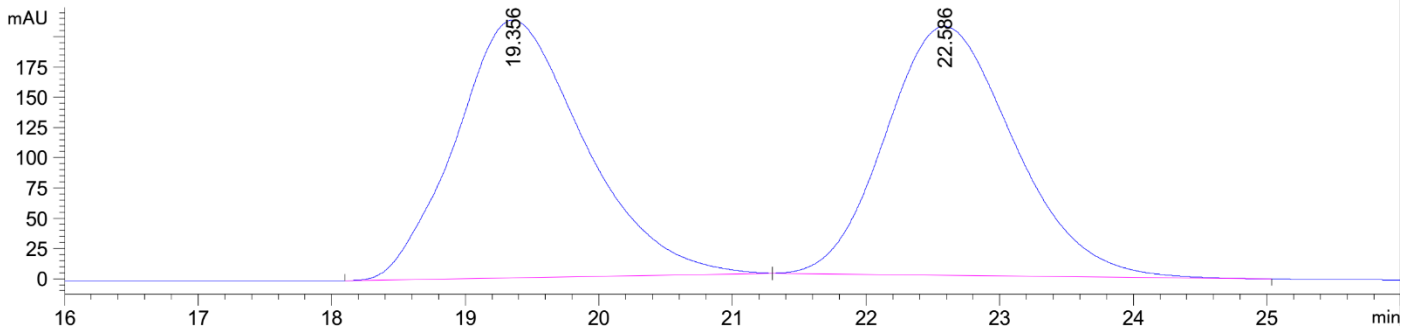
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.486	BB	0.1466	6473.99023	682.94873	49.8271
2	6.256	BB	0.1783	6518.91357	566.21136	50.1729



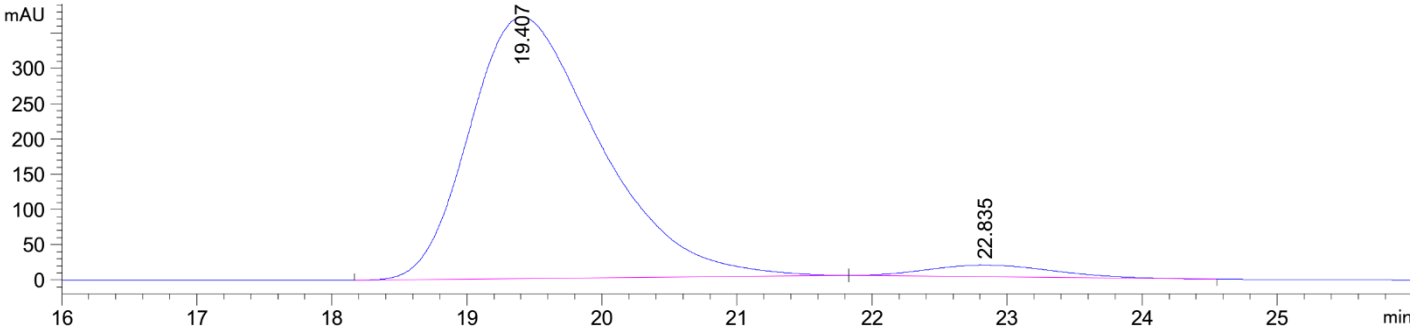
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.467	BV	0.1458	9933.86328	1055.93396	92.5572
2	6.274	VB	0.1708	798.81158	71.27607	7.4428



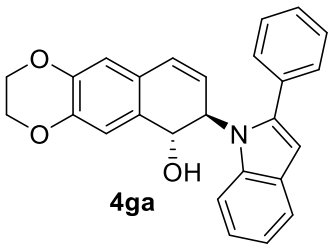
4fa



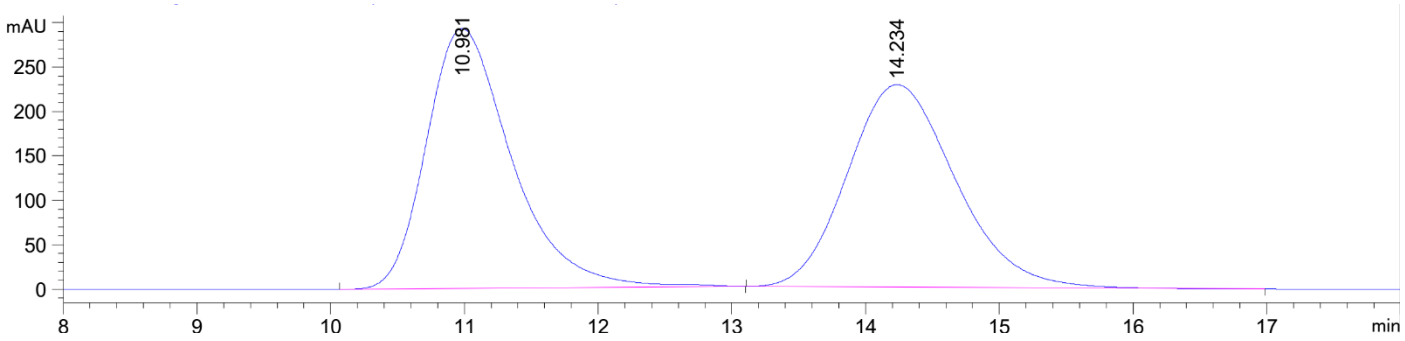
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.356	BB	1.0052	1.42249e4	212.98962	50.8807
2	22.586	BB	1.0391	1.37324e4	205.63382	49.1193



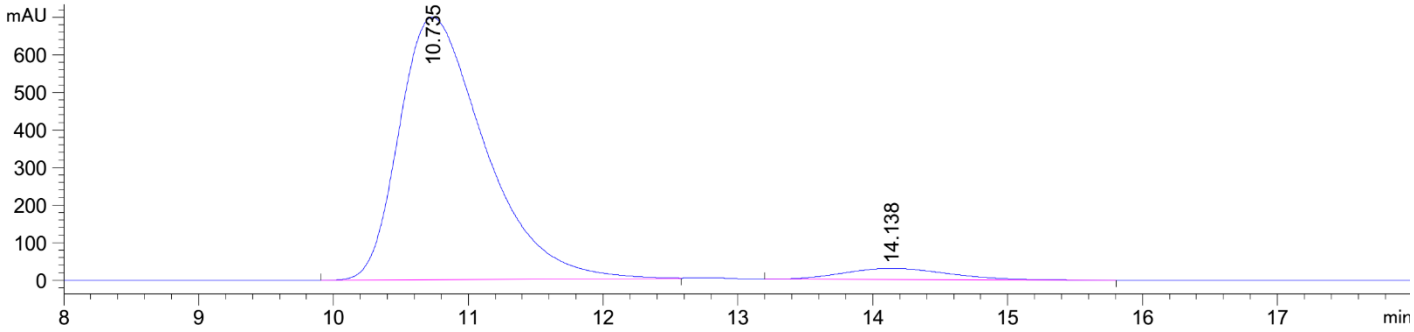
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.407	BB	1.0223	2.48299e4	371.25290	95.8667
2	22.835	BB	1.0040	1070.53320	16.60889	4.1333



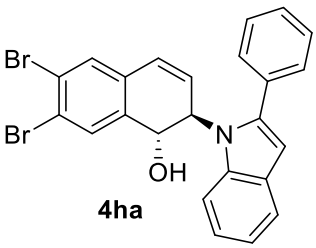
4ga



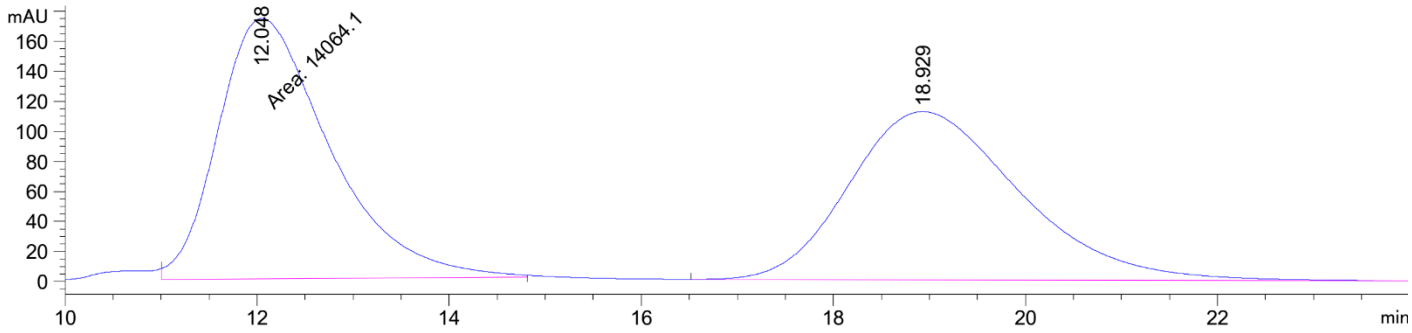
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.981	BB	0.6757	1.29957e4	292.88120	50.3560
2	14.234	BB	0.8710	1.28119e4	228.20490	49.6440



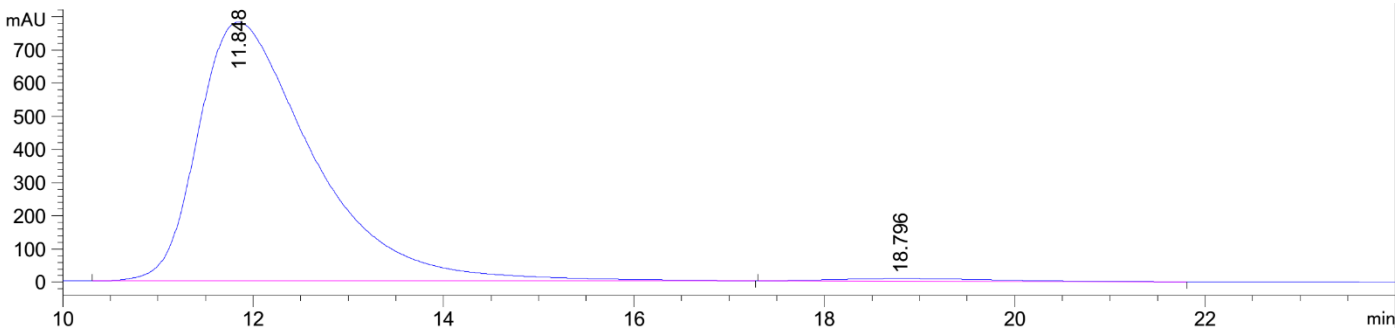
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.735	BB	0.6726	3.08051e4	698.37585	94.9740
2	14.138	BB	0.8519	1630.18103	30.00139	5.0260



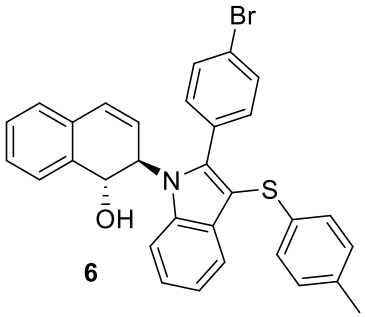
4ha



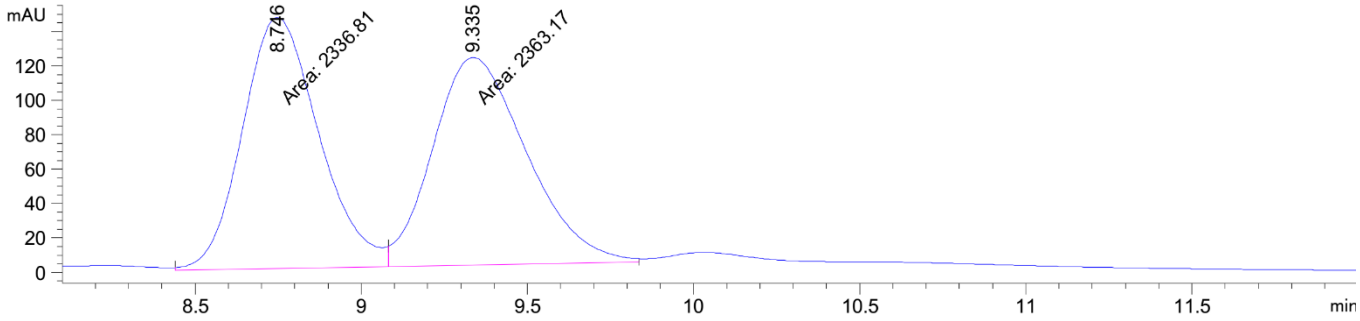
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.048	MM	1.3507	1.40641e4	173.54475	50.3159
2	18.929	BB	1.8767	1.38875e4	112.15165	49.6841



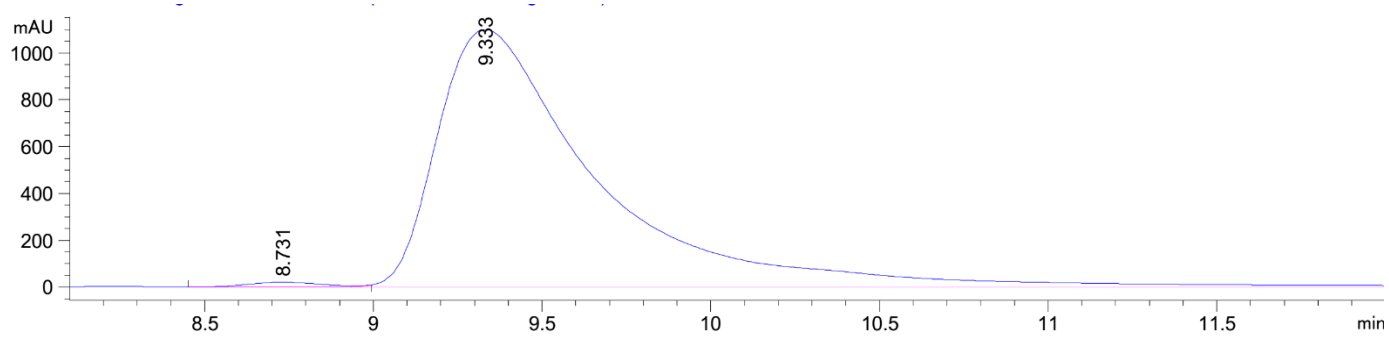
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.848	BB	1.2681	6.54131e4	780.24817	98.7207
2	18.796	BB	1.3442	847.64319	7.43422	1.2793



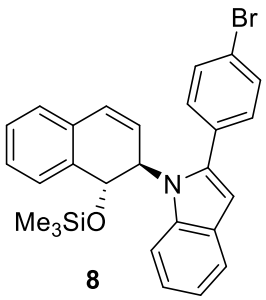
6



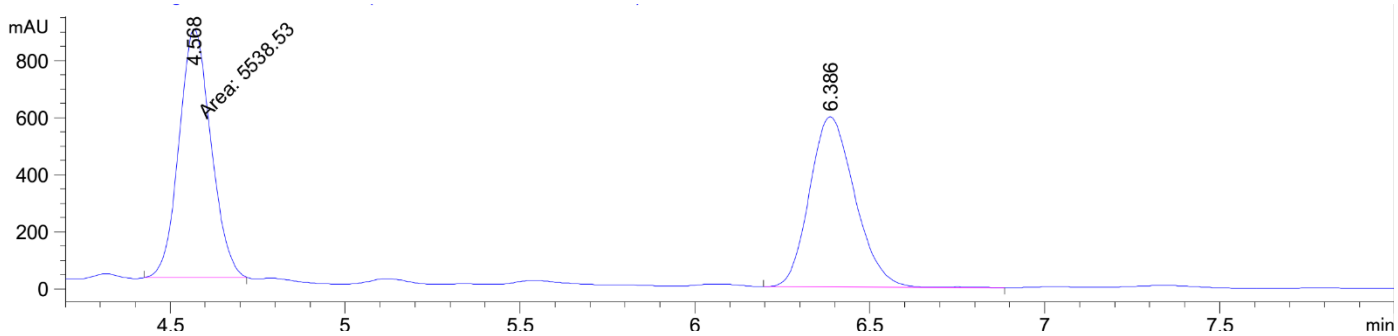
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.746	MF	0.2666	2336.81226	146.07805	49.7196
2	9.335	FM	0.3263	2363.17212	120.70324	50.2804



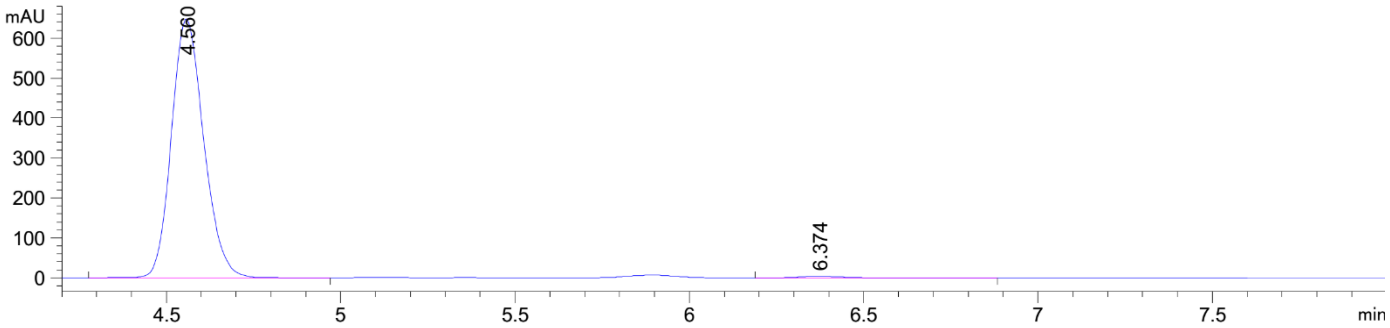
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.731	BV E	0.2289	307.80484	21.01835	0.8262
2	9.333	VV R	0.4807	3.69465e4	1099.76270	99.1738



8



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.568	PP	0.1057	5538.53271	872.90771	50.7458
2	6.386	BV R	0.1388	5375.74414	596.34479	49.2542



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.560	BB	0.0990	4177.27588	649.83508	98.9877
2	6.374	BB	0.1443	42.72097	4.51709	1.0123