Supplemental material for:

Cu(II)-PHOX Catalyzed Enantioselective Malonate Addition onto 3-Hydroxy 2-Oxindoles: Application in the Synthesis of Dimeric Pyrroloindoline Alkaloids*

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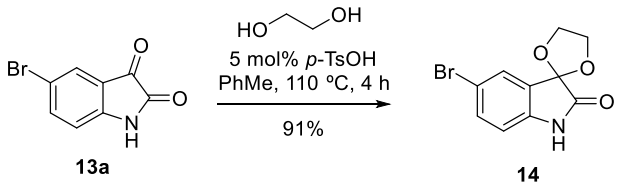
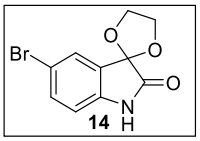
Materials and Methods

Unless otherwise stated, reactions were performed in oven-dried glassware fitted with rubber septa under an inert atmosphere and were stirred with Teflon-coated magnetic stirring bars. Liquid reagents and solvents were transferred *via* syringe using standard Schlenk techniques. Tetrahydrofuran (THF) and diethyl ether (Et_2O) were distilled over sodium/benzophenone ketyl. Dichloromethane (CH_2Cl_2), toluene, and benzene were distilled over calcium hydride. All other solvents and reagents were used as received unless otherwise noted. Reaction temperatures above 23 °C refer to oil bath temperature. Thin layer chromatography was performed using silica gel 60 F-254 precoated plates (0.25 mm) and visualized by UV irradiation, anisaldehyde stain and other stains. Silica gel of particle size 100-200 mesh was used for flash chromatography. Melting points were recorded on a digital melting point apparatus and are uncorrected. ^{1}H and ^{13}C NMR spectra were recorded 400, 500 MHz spectrometers with ^{13}C operating frequencies of 100, 125 MHz respectively. Chemical shifts (δ) are reported in ppm relative to the residual solvent ($CDCl_3$) signal (δ = 7.26 for ^{1}H NMR and δ = 77.0 for ^{13}C NMR). Data for ^{1}H NMR spectra are reported as follows: chemical shift (multiplicity, coupling constants, and number of hydrogen). Abbreviations are as follows: s (singlet), d (doublet), t (triplet), q (quartet), m (multiplet), br (broad). IR spectra were recorded on a FT-IR system (Spectrum BX) and are reported in frequency of absorption (cm^{-1}). Only selected IR absorbencies are reported. High-Resolution Mass Spectrometry (HRMS) and Low-Resolution Mass Spectrometry (LRMS) data were recorded on MicrOTOF-Q-II mass spectrometer using methanol as solvent. Optical rotations were measured on an Autopol I automatic polarimeter. Enantiomeric excess was determined by chiral HPLC analysis performed on HPLC system with Daicel Chiralpak AD-H, Chiralpak OD-3, Chiralpak OZ-3 and Chiralpak IB, Chiralpak ID-3, columns.

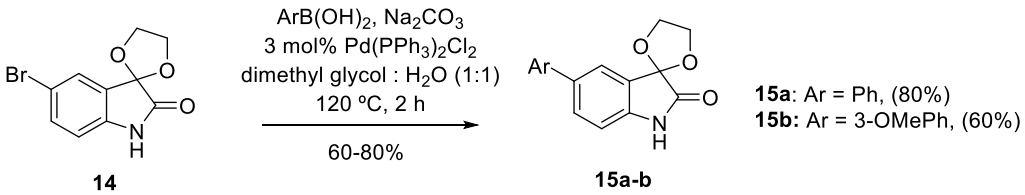
Compounds **13b-c**, **14** and **15a-b** were synthesized as per literature known protocol.[1]



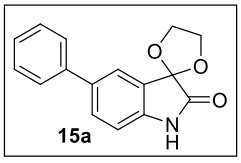
Synthetic preparation of compound 14: To the solution of 5-bromoisatin (750 mg, 3.3 mmol, 1.0 equiv) in toluene (30 mL) under nitrogen atmosphere at 25 ºC was added ethylene glycol (3.6 mL, 62.4 mmol, 19.0 equiv) and *p*-toluenesulphonic acid (28.5 mg, 0.2 mmol, 0.05 equiv). Then the reaction mixture was placed over a pre heated oil bath maintaining temperature 110 ºC and stirring was continued for 4 h. Upon completion of starting material (judged by TLC analysis under UV light and I_2 stain), reaction mixture was cooled down to room temperature to dryness and residue was diluted with dichloromethane (10 mL) and washed with saturated sodium bicarbonate solution (5 mL). Then the organic compound was extracted with dichloromethane (10 mL X 3). The combined organic layers were dried over anhydrous sodium sulphate and concentrated under reduced pressure. The crude product was purified through column chromatography using 30-40% (EtOAc/Hexane) as eluent to afford the desired product.



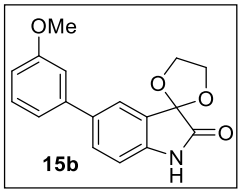
3-(5-Bromo-1*H*-indol-3-yl)-3-hydroxyindolin-2-one:[1] Compound **14** was obtained as colorless solid. (3.3 mmol scale of reaction, 812 mg of product, 91% yield); R_f = 0.60 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.57 (s, 1H), 7.47 (m, 1H), 7.43 - 7.41 (m, 1H), 6.72 (d, *J* = 8.3 Hz, 1H), 4.56 - 4.52 (m, 2H), 4.33 - 4.30 (m, 2H).



General procedure for the synthesis of compound 15a-b:[1] To a solution of **14** (1.0 equiv) in ethylene glycol dimethyl ether (4 mL) under nitrogen atmosphere at 25 ºC was added dichloro bis(triphenylphosphine)palladium(II) (0.03 equiv.). After 15 minutes stirring, phenylboronic acid (1.5 equiv), sodium bicarbonate (3.0 equiv), and water (4 mL) was added simultaneously. Then the reaction mixture was placed over a pre heated oil bath maintaining temperature 120 ºC and stirring was continued for 2 h. Upon completion of starting material (judged by TLC analysis under UV light and I_2 stain), the reaction mixture was cooled down to 25 ºC and. evaporated to dryness and residue was diluted with dichloromethane (20 mL) and washed with 10% sodium hydroxide solution (15 mL). The aqueous layer was extracted with dichloromethane (10 mL X 3). The combined organic layers were dried over anhydrous sodium sulphate and concentrated under reduced pressure. The crude product was purified through column chromatography using 30-40% (EtOAc/Hexane) as eluent to afford the desired product.

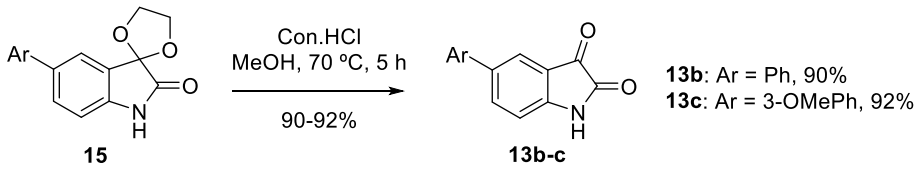


5'-Phenylspiro[[1,3]dioxolane-2,3'-indolin]-2'-one:[1] Compound **15a** was obtained as colorless solid (3.4 mmol scale of reaction, 720 mg of product, 80% yield); R_f = 0.55 (50% EtOAc in hexane); **^{1}H NMR** (500 MHz, 0.5 mL $CDCl_3$) δ 8.41 (brs, 1H), 7.59 - 7.58 (m, 1H), 7.53 - 7.50 (m, 3H), 7.42 - 7.39 (m, 2H), 7.33 - 7.30 (m, 1H), 6.88 (d, *J* = 8.1 Hz, 1H), 4.60 - 4.58 (m, 2H), 4.36 - 4.34 (m, 2H).

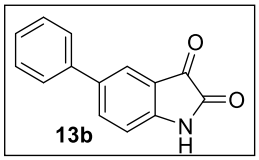


5'-(3-Methoxyphenyl)spiro[[1,3]dioxolane-2,3'-indolin]-2'-one:[1] Compound **15b** was obtained as colorless solid (3.3 mmol scale of reaction, 590 mg of product, 60% yield); R_f = 0.56 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 8.67 (brs, 1H), 7.57 (d, *J* = 1.8 Hz, 1H), 7.50 (dd, *J* = 8.1, 1.9 Hz, 1H), 7.31 (t, *J* = 7.9 Hz, 1H), 7.11 -

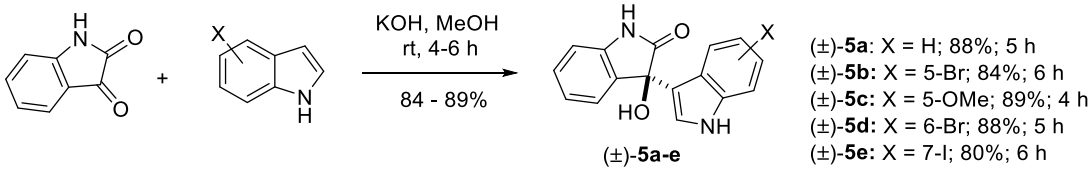
7.05 (m, 2H), 6.88 - 6.84 (m, 2H), 4.60 - 4.57 (m, 2H), 4.36 - 4.33 (m, 2H), 3.84 (s, 3H); **^{13}C NMR** (120 MHz, $CDCl_3$) δ 175.8, 159.9, 141.9, 141.3, 136.7, 136.5, 129.8, 124.9, 124.1, 119.4, 112.6, 112.5, 111.0, 102.5, 65.9, 55.3; **MP** 150 - 152 ºC.



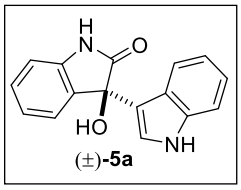
General procedure for the synthesis of compound 13b-c:[1] To the compound of **15** (1.0 equiv) in methanol (9 mL) at 25 ºC was added conc. HCl (4 mL). Then the reaction mixture was placed over a pre heated oil bath maintaining temperature 70 ºC for 5 h. Upon completion of starting material (judged by TLC analysis under UV light and cerium ammonium molybdate stain), the reaction mixture was evaporated to dryness. The residue was diluted with dichloromethane and washed with saturated sodium bicarbonate solution. Then the organic compound was extracted with dichloromethane (10 mL X 3). Then the combined organic layers were dried over anhydrous sodium sulphate and concentrated under reduced pressure. The crude product was purified through column chromatography using 35-45% (EtOAc/Hexane) as eluent to afford the desired product.



5-Phenylindoline-2,3-dione: Compound **13b** was obtained as colourless solid. (2.2 mmol scale of reaction; 400 mg of product; 80% yield; R_f = 0.50 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, DMSO) δ 10.38 (s, 1H), 7.77 - 7.75 (m, 1H), 7.7 (dd, *J* = 8.1, 2.0 Hz, 1H), 7.51 - 7.48 (m, 2H), 7.45 - 7.36 (m, 2H), 7.37 - 7.32 (m, 1H), 2.27(DMSO).

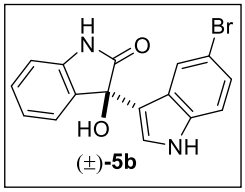


General procedure for the synthesis of 3-Hydroxy-3-indolyl-2-oxindole (±)-**5a-e**: In a round-bottom flask was charged with isatin (1.0 equiv) in MeOH (60 mL) under nitrogen atmosphere at 25 ºC indole (1.2 equiv) and KOH (0.2 equiv) were added successively. Then the reaction mixture was then allowed to stir for 4 - 6 h. Upon completion of starting material (judged by TLC analysis under UV light and I_2 stain), the reaction mixture was quenched with water (60 mL) and organic compound was extracted with ethyl acetate (2 X 80 mL). The combined organic layers were dried over anhydrous sodium sulphate and concentrated under reduced pressure. The crude product was purified through column chromatography using hexane-EtOAc as eluent to afford the desired product.



(±)-**5a**

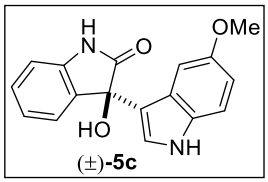
3-Hydroxy-3-(1*H*-indol-3-yl)indolin-2-one:[2] Compound (±)-**5a** was obtained as a colorless solid (13.6 mmol scale of reaction, 3.2 g of product, 88% yield); R_f = 0.30 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, DMSO) δ 10.94 (s, 1H), 10.32 (s, 1H), 7.31 - 7.28 (m, 2H), 7.24 - 7.19 (m, 2H), 7.06 (s, 1H), 7.00 (t, *J* = 7.5 Hz, 1H), 6.94 - 6.88 (m, 2H), 6.83 (t, *J* = 7.4 Hz, 1H), 6.37 (s, 1H), 3.68 (Water); **IR** (film) υ_{max} 3428, 2839, 2115, 1650, 1470, 1337, 1226, 1185, 1105, 940, 751 cm^{-1}; **MP** 350-352 ºC.



(±)-**5b**

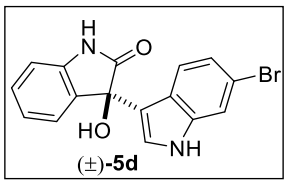
3-(5-Bromo-1*H*-indol-3-yl)-3-hydroxyindolin-2-one: Compound (±)-**5b** was obtained as a colorless solid (6.8 mmol scale of reaction, 1.95 g of product, 84% yield); R_f = 0.30 (50% EtOAc in hexane); **^{1}H NMR** (500 MHz, DMSO) δ 11.22 (s, 1H), 10.41 (s, 1H), 7.75 (s, 1H), 7.36 (d, *J* = 8.4 Hz, 1H), 7.32 - 7.28 (m, 2H), 7.21 (d, *J* = 8.2 Hz, 1H), 7.05 -

7.01 (m, 2H), 6.97 (d, *J* = 7.4 Hz, 1H), 6.55 (s, 1H); **^{13}C NMR** (125 MHz, DMSO) δ 178.8, 142.1, 136.0, 133.3, 129.8, 127.4, 125.6, 125.3, 124.2, 123.6, 122.4, 115.7, 114.1, 111.8, 110.3, 75.2; **IR** (film) 3420, 1792, 1644, 1469, 1245, 1170, 815, 697 cm^{-1}; **MP** 190 - 192 ºC.



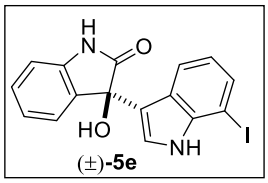
(±)-**5c**

3-Hydroxy-3-(5-methoxy-1*H*-indol-3-yl)indolin-2-one: Compound (±)-**5c** was obtained as a colorless solid. (6.5 mmol scale of reaction, 1.7 g of product, 89% yield); R_f = 3.1 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, 0.5 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 9.64 (s, 1H), 9.54 (s, 1H), 7.17 (d, *J* = 6.9 Hz, 1H), 7.01 - 6.96 (m, 2H), 6.86 - 6.82 (m, 2H), 6.76 (t, *J* = 7.2 Hz, 1H), 6.69 (d, *J* = 7.4 Hz, 1H), 6.51 (d, *J* = 8.6 Hz, 1H), 5.49 (s, 1H), 3.49 (s, 3H), 2.69 (s, 1H); **^{13}C NMR** (100 MHz, 0.5 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 179.3, 153.4, 141.4, 132.8, 132.2, 129.1, 125.4, 124.9, 124.3, 122.1, 114.8, 112.0, 111.6, 110.0, 102.5, 75.6, 55.5; **IR** (film) υ_{max} 3416, 2861, 2832, 2106, 1792, 1704, 1622, 1469, 1071, 904, 751 cm^{-1}; **MP** 194 - 196 ºC.



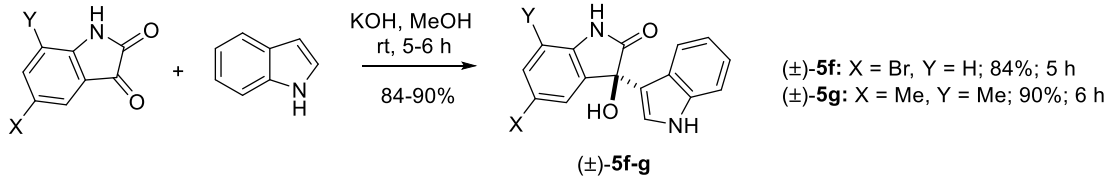
(±)-**5d**

3-(6-bromo-1*H*-indol-3-yl)-3-hydroxyindolin-2-one: Compound (±)-**5d** was obtained as a colorless solid. (6.8 mmol scale of reaction, 2.05 g of product, 88% yield); R_f = 2.5 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, DMSO-D_6) δ 11.14 (s, 1H), 10.38 (s, 1H), 7.57 (s, 1H), 7.44 (d, *J* = 8.6 Hz, 1H), 7.29 – 7.25 (m, 2H), 7.08 - 7.07 (m, 2H), 7.01 – 6.98 (m, 1H), 6.94 (d, *J* = 7.2 Hz, 1H), 6.49 (s, 1H); **^{13}C NMR** (100 MHz, DMSO-D_6) δ 178.8, 142.1, 138.2, 133.5, 129.7, 125.2, 125.1, 124.6, 122.8, 122.3, 122.0, 116.3, 114.6, 114.5, 110.3, 75.2, 75.2; **IR** (film) υ_{max} 3500, 2950, 2800, 2520, 1802, 1706, 1602, 1499, 1001, 984, 721 cm^{-1}; **MP** >260 ºC.

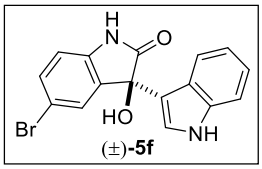


(±)-**5e**

3-hydroxy-3-(7-iodo-1*H*-indol-3-yl)indolin-2-one: Compound (±)**-5e** was obtained as a colorless solid. (6.5 mmol scale of reaction, 2.02 g of product, 80% yield); R_f = 2.9 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, DMSO-D_6) δ 10.9 (s, 1H), 10.40 (s, 1H), 7.48 – 7.42 (m, 2H), 7.29 – 7.24 (m, 2H), 7.07 (s, 1H), 7.99 – 6.93 (m, 2H), 6.74 (s, 1H), 6.47 (s, 1H); **^{13}C NMR** (100 MHz, DMSO-D_6) δ 178.6, 142.1, 138.9, 133.5, 130.6, 129.7, 125.9, 125.2, 124.8, 122.3, 121.0, 117.4, 110.2, 77.4, 75.5; **IR** (film) υ_{max} 3560, 2960, 2852, 2116, 1709, 1662, 1409, 1001, 924, 701 cm^{-1}; **MP** >260 ºC.

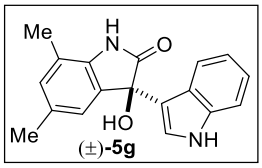


General procedure for the synthesis of 3-Hydroxy-3-indolyl-2-oxindole (±)**-5f-g**: In a round bottom flask was charged with isatin (1.0 equiv) in MeOH (60 mL) under nitrogen atmosphere at 25 ºC indole (1.2 equiv) and KOH (0.2 equiv) were added successively. Then the reaction mixture was then allowed to stir for 5-6 h. Upon completion of starting material (judged by TLC analysis under UV light and I_2 stain), the reaction mixture was quenched with water (60 mL) and organic compound was extracted with ethyl acetate (2 X 80 mL). The combined organic layers were dried over anhydrous sodium sulphate and concentrated under reduced pressure. The crude product was purified through column chromatography using hexane-EtOAc as eluent to afford the desired product.



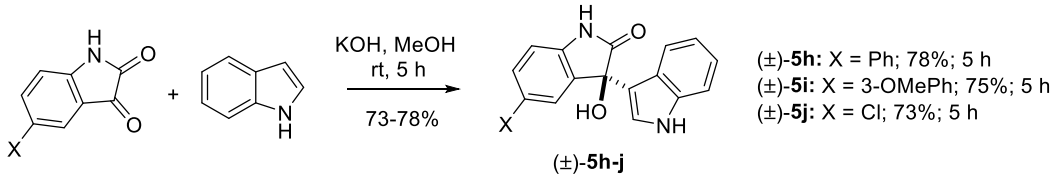
(±)-**5f**

5-Bromo-3-hydroxy-3-(1*H*-indol-3-yl)indolin-2-one: Compound (±)-**5f** was obtained as a colorless solid. (3.3 mmol scale of reaction, 1.0 g of product, 84% yield); R_f = 3.2 (50% EtOAc in hexane); **^{1}H NMR** (500 MHz, DMSO) δ 11.06 (s, 1H), 10.58 (s, 1H), 7.46 (d, *J* = 7.3 Hz, 1H), 7.38 (m, 3H), 7.19 (s, 1H), 7.08 (d, *J* = 12.6 Hz, 1H), 6.95 - 6.93 (m, 2H), 6.66 (s, 1H), (Water); **^{13}C NMR** (125 MHz, DMSO) δ 178.5, 141.4, 137.3, 136.3, 132.3, 127.9, 125.1, 124.1, 121.8, 120.4, 119.3, 115.1, 114.0, 112.4, 112.2, 75.3; **IR** (film) υ_{max} 3416, 1792, 1644, 1492, 1335, 1247, 1177, 1121, 815, 715 cm^{-1}; **MP** 310 - 312 ºC.



(±)-**5g**

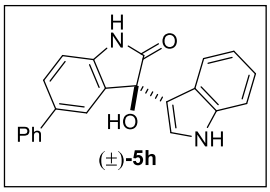
3-Hydroxy-3-(1*H*-indol-3-yl)-5,7-dimethylindolin-2-one: Compound (±)-**5g** was obtained as a colorless solid (3.9 mmol scale of reaction, 1.0 g of product, 90% yield); R_f = 0.55 (50% EtOAc in hexane); **^{1}H NMR** (500 MHz, 0.5 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 10.93 (s, 1H), 10.53 (s, 1H), 7.32 (dd, *J* = 47.6, 8.2 Hz, 2H), 7.02 (t, *J* = 7.6 Hz, 1H), 6.86 - 6.79 (m, 3H), 3.38 (s, 3H), 2.23 (d, *J* = 67.2 Hz, 3H); **^{13}C NMR** (125 MHz, DMSO-D_6) δ 179.7, 137.9, 137.4, 134.7, 130.5, 129.9, 126.2, 124.8, 123.3, 121.4, 121.3, 118.9, 118.6, 115.1, 112.0, 55.4, 21.2, 1; **IR** (film) υ_{max} 3387, 3304, 2924, 2852, 1735, 1701, 1624, 1544, 1465, 1286, 1099, 740, 617 cm^{-1}; **MP** 210 - 212 ºC.



(±)-**5h-j**

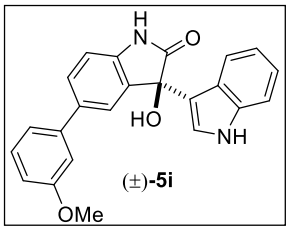
(±)-**5h:** X = Ph; 78%; 5 h
(±)-**5i:** X = 3-OMePh; 75%; 5 h
(±)-**5j:** X = Cl; 73%; 5 h

General procedure for the synthesis of 3-Hydroxy-3-indolyl-2-oxindoles (±)-**5h-j is like synthesis of** (±)-**5f-g.**



(±)-**5h**

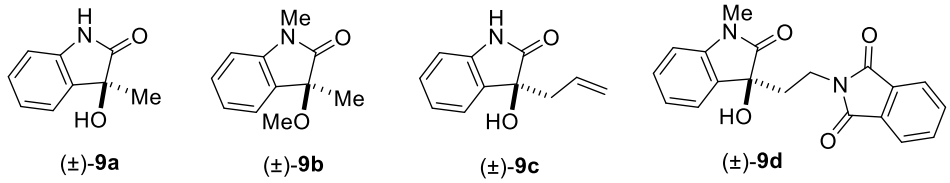
3-Hydroxy-3-(1*H*-indol-3-yl)-5-phenylindolin-2-one: Compound (±)-**5h** was obtained as a colorless solid (3.5 mmol scale of reaction, 930 mg of product, 78% yield); R_f = 3.2 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, DMSO-D_6) δ 10.96 (s, 1H), 10.42 (s, 1H), 7.55 - 7.47 (m, 3H), 7.41 - 7.22 (m, 5H), 7.01 (s, 1H), 7.01 - 6.82 (m, 3H), 6.41 (s, 1H), 3.32 (Water); **^{13}C NMR** (125 MHz, DMSO-D_6) δ 178.9, 141.7, 140.6, 137.2, 134.6, 134.3, 129.4 (2C), 127.9, 127.2, 126.5 (2C), 125.3, 124.1, 123.4, 121.5, 120.7, 118.9, 115.7, 111.9, 110.5, 75.5; **IR** (film) υ_{max} 3415, 3387, 2922, 2850, 2357, 1714, 1624, 1389, 1172, 744, 694 cm^{-1}; **MP** > 300 ºC.



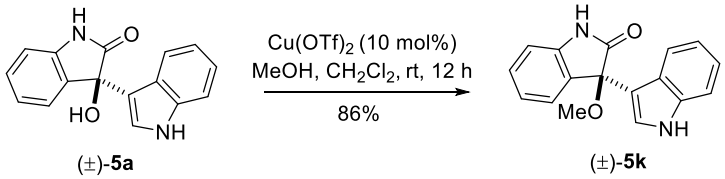
(±)-**5i**

3-Hydroxy-3-(1*H*-indol-3-yl)-5-(3-methoxyphenyl)indolin-2-one: Compound (±)-**5i** was obtained as an orange solid (2.0 mmol scale of reaction, 555 mg of product, 75% yield); R_f = 3.3 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, DMSO-D_6) δ 10.96 (s,1H), 10.42 (s, 1H), 7.55 (d, *J* = 8.1 MHz, 1H), 7.49 (s, 1H), 7.42 (d, *J* = 8.1 MHz, 1H), 7.32 - 7.25 (m, 2H), 7.09 - 7.06 (m, 2H), 7.02 - 6.95 (m, 3H), 6.87 - 6.81 (m, 2H), 6.41 (s, 1H), 3.75 (s, 3H), 3.33 (Water); **^{13}C NMR** (125 MHz, DMSO-D_6) δ 183.7, 164.9, 146.8, 146.6, 142.0, 139.3, 138.9, 135.1, 132.8, 130.1, 128.4, 128.2, 126.3, 125.5, 123.7, 123.6, 120.5, 117.6, 116.7, 116.6, 115.2, 80.2, 60.3; **IR** (film) υ_{max} 3388, 2926, 2355, 1712, 1641, 1624, 1579, 1477, 1392, 1165, 1082, 821, 740 cm^{-1}; **MP** > 300 ºC.

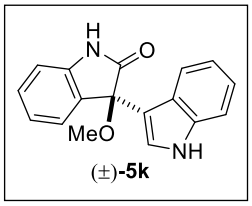
Compound (±)-**5j** was prepared as per literature report.[3]



Compound (±)-**9a**[4] and compounds (±)-**9b-d**[5] were synthesized as per literature reports.

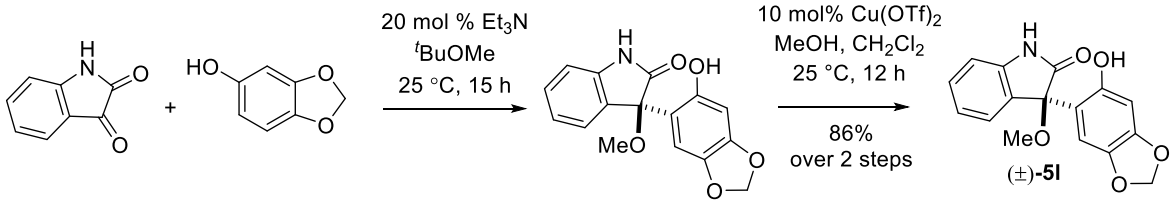


Synthetic procedure for the compound (±)-**5k**: In an oven-dried round bottom flask was charged with oxindole (±)-**5a** (1 g; 3.8 mmol; 1.0 equiv) in dichloromethane (15 mL) under nitrogen atmosphere at 25 ºC Lewis acid (0.38 mmol, 10 mol %) and MeOH (765 µl; 18.9 mmol, 5.0 equiv) was added. Then the reaction mixture was allowed to stir for 12 h. Upon completion of starting material (judged by TLC analysis under UV light and I_2 stain), the reaction mixture was quenched with water (20 mL) and organic compound was extracted with ethyl acetate (2 X 30 mL). The combined organic layers were dried over anhydrous sodium sulphate and concentrated under reduced pressure. The crude product was purified through column chromatography using 25-40% (EtOAc/Hexane) as eluent to afford the desired product.



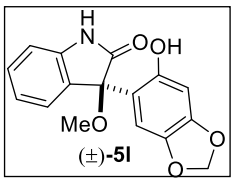
3-(1*H*-Indol-3-yl)-3-methoxyindolin-2-one: Compound (±)-**5k** was obtained as an orange solid (3.0 mmol scale of reaction, 760 mg of product, 92% yield); R_f = 3.3 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, DMSO-d_6) δ 11.08 (s, 1H), 10.58 (s, 1H), 7.58 (d, *J* = 8.0 Hz, 1H), 7.34 (dd, *J* = 13.9, 7.6 Hz, 3H), 7.06 (q, *J* = 8.1 Hz, 2H), 6.97 - 6.92 (m, 3H), 3.43 (Water), 3.15 (s, 3H); **^{13}C NMR** (101 MHz, DMSO-d_6) δ 176.4, 142.8, 137.2, 130.3, 128.8, 125.7, 125.5, 124.8, 122.4, 121.8, 121.4, 119.2, 113.2, 112.0, 110.5,

81.7, 52.3; **IR** (film) υ_{max} 3338, 2956, 2354, 1710, 1621, 1616, 1569, 1470, 1292, 1105, 1012, 921, 750 cm^{-1}.

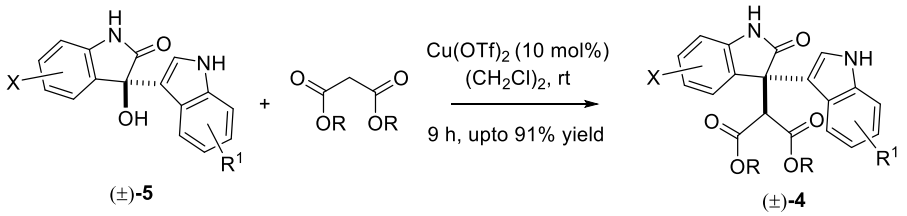


Synthetic procedure for the compound (±)**-5l**: In an oven-dried round bottom flask was charged with isatin (1g; 6.8 mmol; 1.0 equiv) in methyl *tert*-butyl ether (15 mL) under nitrogen atmosphere at 25 ºC. To this solution, sesamol (8.2 mmol, 1.2 equiv) and Et_3N (1.3 mmol, 20 mol%) was added sequentially and the reaction mixture was allowed to stir for 15 h. Upon completion of starting material (judged by TLC analysis), the reaction mixture was quenched with water (20 mL) and organic compound was extracted with ethyl acetate (2 X 30 mL). Then the combined organic layers were dried over anhydrous sodium sulphate and concentrated under reduced pressure. This crude product was used for next step without purification.

To the crude product of 3-hydroxy 2-oxindoles (~6.3 mmol; 1.0 equiv) in dichloromethane (30 mL) under nitrogen atmosphere at 25 ºC Lewis acid (~0.63 mmol, 10 mol %) and MeOH (~31.5 mmol, 5.0 equiv) was added. Then the reaction mixture was allowed to stir for 12 h. Upon completion of starting material (judged by TLC analysis under UV light and I_2 stain), the reaction mixture was quenched with water (30 mL) and organic compound was extracted with ethyl acetate (2 X 40 mL). The combined organic layers were dried over anhydrous sodium sulphate and concentrated under reduced pressure. The crude product was purified through column chromatography using 30-40% (EtOAc/Hexane) as eluent to afford the desired product.

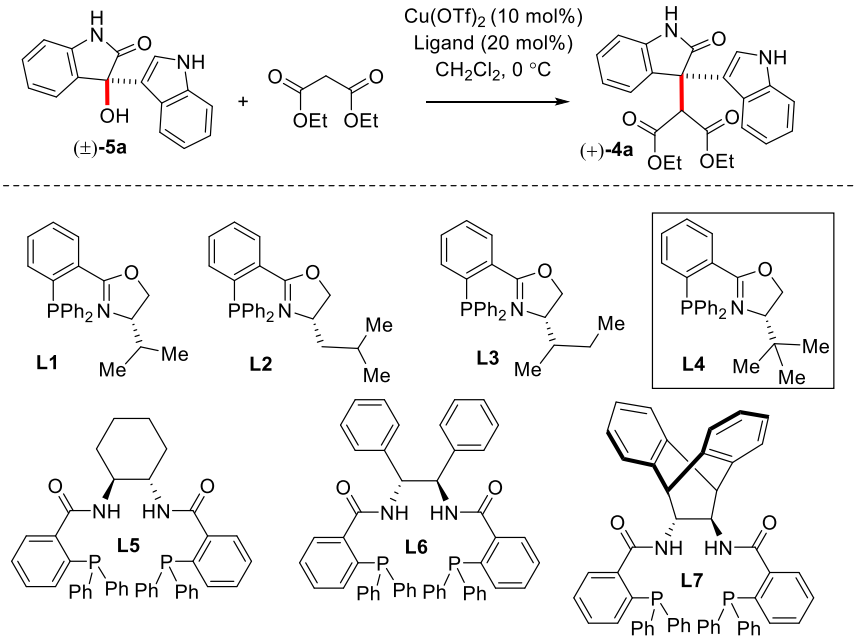


3-(6-Hydroxybenzo[*d*][1,3]dioxol-5-yl)-3-methoxyindolin-2-one: Compound (±)-**5l** was obtained as orange solid (6.8 mmol scale of reaction, 1.7 g of product, 86% yield over two steps); R_f = 3.3 (50% EtOAc in hexane); **^{1}H NMR** (500 MHz, DMSO-d_6) δ 10.50 (s, 1H), 9.19 (s, 1H), 7.21 (ddd, *J* = 7.8, 5.9, 3.0 Hz, 1H), 7.16 (s, 1H), 6.91 - 6.89 (m, 2H), 6.84 (d, *J* = 7.7 Hz, 1H), 6.27 (s, 1H), 5.93 (d, *J* = 8.6 Hz, 2H), 3.46 (Water), 3.04 (s, 3H); **^{13}C NMR** (125 MHz, DMSO-d_6) δ 176.3, 148.9, 147.2, 144.2, 140.0, 129.8, 128.7, 124.8, 122.1, 118.8, 109.7, 106.9, 101.2, 98.0, 81.0, 51.4; **IR** (film) υ_{max} 3382, 2916, 2255, 1722, 1631, 1614, 1568, 1452, 1390, 1105, 1002, 911, 720 cm^{-1}.



General procedure for the synthesis of (±)-**4a-t**: 3-Hydroxy 2-oxindoles (0.38 mmol; 1.0 equiv) was taken in dry dichloromethane (2 mL) under nitrogen atmosphere and 10 mol % $Cu(OTf)_2$ was added to this at room temperature under argon atmosphere. After 5 minutes stirring at room temperature, malonate (3 equiv) was added drop-wise over a period of 5 minutes. Then the reaction mixture was allowed to stir for 9 h. Upon completion of starting material (judged by TLC analysis under UV light and I_2 stain), the crude mixture was concentrated under reduced pressure and product was purified by column chromatography by using 25-40% (EtOAc/Hexane) as eluent to afford the desired products.

Table. Optimization of enantioselective malonate addition of (±)-**5a** with diethylmalonate.[a,b]

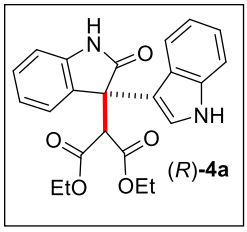


entry	catalyst	ligand	solvent	temp.	time	% yield	% ee
1	$Cu(OTf)_2$	12 mol% **L1**	CH_2Cl_2	25 ºC	12 h	79%	52%
2	$Cu(OTf)_2$	12 mol% **L2**	CH_2Cl_2	25 ºC	13 h	80%	38%
3	$Cu(OTf)_2$	12 mol% **L3**	CH_2Cl_2	25 ºC	12 h	81%	51%
4	$Cu(OTf)_2$	12 mol% **L4**	CH_2Cl_2	25 ºC	13 h	84%	72%
5	$Cu(OTf)_2$	12 mol% **L4**	CH_2Cl_2	0 ºC	16 h	83%	82%
6	$Cu(OTf)_2$	20 mol% **L4**	CH_2Cl_2	0 ºC	15 h	84%	92%
7	$Cu(OTf)_2$	10 mol% **L4**	CH_2Cl_2	0 ºC	17 h	75%	80%
8[c]	$Cu(OTf)_2$	20 mol% **L4**	CH_2Cl_2	0 ºC	16 h	79%	86%
9	$Cu(OTf)_2$	20 mol% **L4**	CH_2Cl_2	-5 ºC	16 h	75%	88%
10	$Cu(OTf)_2$	20 mol% **L4**	CH_2Cl_2	-5 ºC	28 h	83%	94%
11	$Cu(OTf)_2$	20 mol% **L4**	CH_2Cl_2	-10 ºC	45 h	69%	88%
12	$Cu(OTf)_2$	20 mol% **L4**	CH_2Cl_2	-15 ºC	21 h	70%	75%
13	$Cu(OTf)_2$	20 mol% **L4**	CH_2Cl_2	0 - 25 ºC	12 h	85%	82%
14	$Cu(OTf)_2$	20 mol% **L4**	PhMe	0 ºC	12 h	75%	71%
15	$Cu(OTf)_2$	20 mol% **L4**	THF	0 ºC	6 h	83%	14%
16	$Cu(OTf)_2$	20 mol% **L4**	$CHCl_3$	0 ºC	9 h	55%	61%
17	$Cu(OTf)_2$	20 mol% **L4**	$(CH_2Cl)_2$	0 ºC	20 h	55%	22%
18	$Cu(OTf)_2$	20 mol% **L4**	DCB[e]	0 ºC	15 h	85%	59%
19	$Cu(OTf)_2$	20 mol% **L5**	CH_2Cl_2	0 ºC	19 h	78%	24%

20	$Cu(OTf)_2$	20 mol% **L6**	CH_2Cl_2	0 ºC	19 h	72%	39%
21	$Cu(OTf)_2$	20 mol% **L7**	CH_2Cl_2	0 ºC	17 h	80%	40%
22	$In(OTf)_3$	20 mol% **L4**	CH_2Cl_2	0 ºC	15 h	20%	00%
23	Cu(OTf).PhMe	12 mol% **L4**	CH_2Cl_2	0 ºC	17 h	82%	77%
24	Cu(OTf).PhMe	20 mol%	CH_2Cl_2	0 ºC	16 h	86%	83%

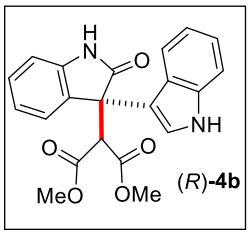
[a]All the reactions were carried out on a 0.08 mmol of **5a,** 0.23 mmol of dialkylmalonate in 3 mL of dichloromethane at 0 ºC. [b]Isolated yields after column chromatography. [c]Reactions were carried out on a 0.08 mmol of **5a,** 0.16 mmol of dialkylmalonate in 3 mL of dichloromethane at 0 ºC.

General procedure for the synthesis of enantioseletive compounds: (*R*)-**4a-s**, (+)-**4t**: An oven dried sample vial was charged with Lewis acid (0.1 equiv) and ligand (0.2 equiv) in dichloromethane (4 mL) at 25 ºC under nitrogen atmosphere. The reaction mixture was stirred for 30 minutes to make the complex. After that the reaction vessel was cooled to 0 ºC and malonate (3.0 equiv) was added to the mixture and stirring was continued for 15 minutes maintaining temperature 0 ºC. Then, a solution of 3-hydroxy 2-oxindole in dichloromethane (0.5 mL) was added slowly to the reaction mixture. Then the reaction mixture was allowed to stir for respective times at 0 ºC for condition A and -5 ºC for condition B. After complete consumption of starting material (as judged by running TLC), the crude mixture was concentrated under reduced pressure and purified by column chromatography by using 30-40% EtOAc-hexane mixture as eluent to afford the desired compound.

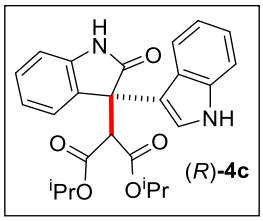


Diethyl (*R*)-2-(3-(1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4a** was obtained as yellow solid (0.08 mmol scale of reaction, 26 mg of product, 80% yield); R_f = 0.50 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 9.63 (brs, 1H), 9.49 (brs, 1H), 7.80 (d, *J* = 7.2 Hz, 1H), 7.63 (d, *J* = 7.7 Hz, 1H), 7.10 (t, *J*

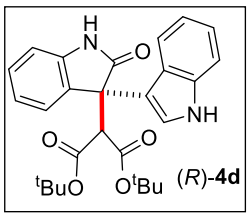
= 8.3 Hz, 2H), 6.91 - 6.80 (m, 3H), 6.76 (d, *J* = 7.7 Hz, 1H), 6.51 - 6.50 (m, 1H), 4.99 (s, 1H), 3.77 - 3.66 (m, 4H), 0.76 (t, *J* = 14.2 Hz, 3H), 0.62 (t, *J* = 14.2 Hz, 3H); **^{13}C NMR** (100 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 178.4, 167.3, 166.9, 142.5, 136.9, 129.8, 128.3, 126.9, 124.9, 124.2, 121.7, 121.4, 121.3, 118.8, 111.9, 111.2, 109.5, 61.1, 60.6, 56.4, 53.4, 13.2, 13.1; **IR** (film) υ_{max} 3375, 2989, 2359, 1724, 1615, 1265, 1034, 747, 700 cm^{-1}; **HRMS** (ESI) m/z $[M + H]^+$ Calcd for $[C_{19}H_{19}N_2O_5]^+$ 407.1601; Found 407.1604; **MP** 170 - 172 ºC; Enantiomeric excess of pure compound was determined via HPLC analysis using a Chiralpak ID-3 column; solvent: hexane/2-propanol = 50/50; flow rate: 1.0 mL/min; detection: at 254 nm): tR minor = 4.88 min, tR major = 5.92 min. $[\alpha]_D^{23.0}$ = +128.6 (c = 0.18, CH_2Cl_2 for 94% ee).



Dimethyl (*R*)-2-(3-(1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4b** was obtained as a colorless solid (0.08 mmol scale of reaction, 24 mg of product, 82% yield); R_f = 0.48 (50% EtOAc in hexane); **^{1}H NMR** (500 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 9.25 (s, 1H), 9.18 (s, 1H), 7.87 (d, *J* = 7.6 Hz, 1H), 7.62 (d, *J* = 8.2 Hz, 1H), 7.20 (t, *J* = 7.1 Hz, 2H), 7.01 (q, *J* = 8.0 Hz, 2H), 6.95 (d, *J* = 7.9 Hz, 1H), 6.86 (d, *J* = 7.8 Hz, 1H), 6.65 (s, 1H), 5.15 (s, 1H), 3.40 (s, 3H), 3.38 (s, 3H); **^{13}C NMR** (125 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 178.5, 168.0, 167.4, 142.4, 137.1, 129.8, 128.7, 127.1, 124.9, 124.4, 121.9, 121.7, 121.5, 119.4, 111.9, 111.5, 109.9, 56.5, 53.6, 52.4, 52.2; **IR** (film) υ_{max} 3361, 3059, 2983, 2938, 2308, 1720, 1455, 1316, 1104, 1015, 913, 838, 743 cm^{-1}; **HRMS** (ESI) m/z $[M + H]^+$ Calcd for $[C_{21}H_{19}N_2O_5]^+$ 379.1288; Found 379.1309; **MP** 240 - 242 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak OZ-3 column; solvent: hexane/2-propanol = 70/30; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 11.71 min, t_R major = 14.29 min. $[\alpha]_D^{22.1}$ = +250.0 (*c* = 0.22, $CHCl_3$ for 89% ee).

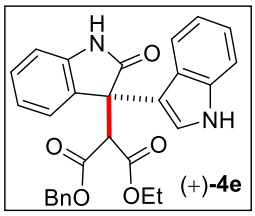


Diisopropyl (*R*)-2-(3-(1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4c** was obtained as a yellow solid (0.08 mmol scale of reaction, 27 mg of product, 79% yield); R_f = 0.52 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.63 (brs, 1H), 8.15 (brs, 1H), 8.05 (d, *J* = 6.0 Hz, 1H), 7.92 (d, *J* = 6.3 Hz, 1H), 7.24 - 7.18 (m, 2H), 7.06 - 7.05 (m, 3H), 6.84 (m, 1H), 6.53 (s, 1H), 5.16 (s, 1H), 4.71 - 4.70 (m, 2H), 1.01-0.91 (m, 6H), 0.68 - 0.59 (m, 6H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 179.1, 167.1, 166.6, 141.9, 137.0, 129.9, 128.7, 127.5, 125.1, 124.2, 122.4, 122.3, 122.1, 119.6, 112.8, 111.3, 109.9, 69.5, 68.6, 56.8, 53.7, 21.3, 21.2, 20.6, 20.6; **IR** (film) υ_{max} 3340, 2975, 2340, 2320, 1720, 1620, 1600, 1265, 1005, 1051, 700, 692 cm^{-1}; **HRMS** (ESI) m/z $[M + H]^+$ Calcd for $[C_{25}H_{27}N_2O_5]^+$ 435.1914; Found 435.1900; **MP** 110 - 112 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak IB column; solvent: hexane/2-propanol = 40/30; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 5.45 min, t_R major = 6.32 min. $[\alpha]_D^{23.0}$ = +179.7 (*c* = 0.30, $CHCl_3$ for 89% ee).



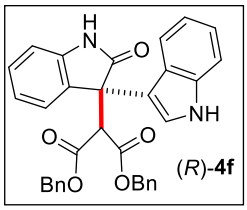
Ditert-butyl (*R*)-2-(3-(1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4d** was obtained as a colorless solid. (0.08 mmol scale of reaction, 29 mg of product, 79% yield); R_f = 0.56 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.35 (brs, 1H), 8.11 - 8.02 (m, 3H), 7.28 - 7.25 (m, 2H), 7.12 - 7.04 (m, 3H), 6.88 (d, *J* = 7.7 Hz, 1H), 6.55 (s, 1H), 5.08 (s, 1H), 1.05 (s, 9H), 0.99 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 179.2, 166.8, 166.5, 141.7, 137.1, 130.4, 128.6, 127.7, 125.3, 124.2, 122.90, 122.4, 122.2, 119.6, 113.4, 111.2, 109.6, 82.6, 81.4, 58.1, 53.8, 27.3, 27.1; **IR** (film) υ_{max} 3340, 2975,

2340, 2320, 1720, 1620, 1600, 1265, 1051, 700, 692 cm^{-1}; **HRMS** (ESI) m/z $[M + Na]^+$ Calcd for $[C_{27}H_{30}N_2O_5+Na]^+$ 485.2047; Found 485.2076; **MP** 138 - 140 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak OD-3 column; solvent: hexane/2-propanol = 50/50; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 4.78 min, t_R major = 6.86 min. $[\alpha]_D^{23.1}$ = +105.2 (*c* = 0.18, $CHCl_3$ for 77% ee).

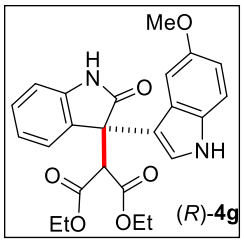


(+)-1-Benzyl-3-ethyl-2-(-3-(1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound **(+)-4e** was obtained as a yellow solid (0.08 mmol scale of reaction, 31 mg of product, 83% yield); R_f = 0.56 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, DMSO-D_6) δ 10.97 (brs, 1H for major diastereomer + 1H for minor diastereome), 10.47 (brs, 1H for minor diastereomer), 10.46 (s, 1H for major diastereomer), 7.76 (d, *J* = 7.3 Hz, 1H for minor diastereomer), 7.71 (d, *J* = 7.3 Hz, 1H for major diastereomer), 7.53 (d, *J* = 8.0 Hz, 1H for major diastereomer), 7.49 (d, *J* = 8.1 Hz, 1H for minor diastereomer), 7.36 - 7.22 (m, 3H for major diastereomer + 3H for minor diastereomer), 7.27 - 7.16 (m, 2H for major diastereomer + 2H for minor diastereomer), 7.04 - 6.95 (m, 3H for major diastereomer + 3H for minor diastereomer), 6.90 - 6.83 (m, 3H for major diastereomer + 3H for minor diastereomer), 6.66 (s, 1H for minor diastereomer), 6.63 (s, 1H for major diastereomer), 5.02 (s, 1H for major diastereomer), 5.01 (s, 1H for minor diastereomer), 4.93 - 4.81 (m, 2H for major diastereomer + 2H for minor diastereomer), 4.35 (Water), 3.81 - 3.80 (m, 2H for major diastereomer + 2H for minor diastereomer), 0.80 (t, *J* = 6.9 Hz, 3H for major diastereomer), 0.65 (t, *J* = 6.8 Hz, 3H for for minor diastereomer); **^{13}C NMR** (100 MHz, DMSO-D_6) δ 178.1, 177.9, 167.4, 167.3, 166.90, 166.87, 143.5, 143.4, 137.4, 137.3, 135.7, 135.5, 130.2, 130.1, 129.13, 129.11, 128.8, 128.6, 128.5, 128.2, 127.9, 127.7, 127.2, 127.0, 125.3, 125.2, 124.92, 124.91, 121.8, 121.75, 121.72, 121.67, 121.63 (2 C), 119.2, 119.0, 112.5, 112.1, 111.9, 111.8, 110.2, 110.1, 66.9, 66.7, 61.7, 61.1, 56.65, 56.61, 53.5, 53.4, 13.7, 13.6; **IR** (film) υ_{max} 3700, 3464, 2918, 2352, 1725, 1458,

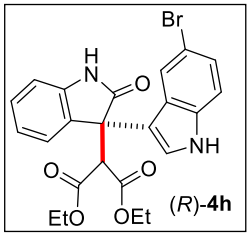
1322, 1241, 1148, 738 cm^{-1}; **HRMS** (ESI) m/z $[M + Na]^+$ Calcd for $[C_{28}H_{24}N_2O_5+Na]^+$ 491.1577; Found 491.1602; **MP** 190 - 192 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak AD-H column; solvent: hexane/2-propanol = 50/50; flow rate: 1.0 mL/min; detection: at 254 nm): in case of minor diastereomer (t_R minor = 9.40 min, t_R major = 17.8.54 min. 84% ee), in case of major diastereomer (t_R minor = 11.88 min, t_R major = 22.05 min. 85% ee). $[\alpha]_D^{22.0}$ = +192.1 (*c* = 0.26, in $CHCl_3$).



Dibenzyl (*R*)-2-(3-(1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4f** was obtained as a yellow solid (0.08 mmol scale of reaction 38 mg of product 90% yield); R_f = 0.60 (50% EtOAc in hexane); **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.99 (d, *J* = 7.6 Hz, 1H), 7.97 (s, 1H), 7.88 (d, *J* = 8.2 Hz, 1H), 7.68 (s, 1H), 7.28 – 7.23 (m, 6H), 7.19 – 7.15 (m, 3H), 7.09 – 7.04 (m, 4H), 6.86 (d, *J* = 7.1 Hz, 2H), 6.73 (d, *J* = 7.7 Hz, 1H), 6.62 (d, *J* = 2.7 Hz, 1H), 5.37 (s, 1H), 4.91 (m, 4H); **^{13}C NMR** (125 MHz, $CDCl_3$) δ 178.0, 167.2, 166.7, 141.4, 136.9, 135.0, 134.7, 129.4, 128.7, 128.4, 128.2, 128.2, 128.1, 127.9, 127.9, 127.3, 124.9, 124.3, 122.3, 122.3, 122.0, 120.0, 112.3, 111.4, 109.8, 67.3, 67.0, 56.5, 53.4; **IR** (film) υ_{max} 3390, 2928, 2251, 1729, 1621, 1400, 1360, 1311, 1260, 1100, 1022, 756, 698 cm^{-1}; **HRMS** (ESI) m/z $[M + H]^+$ Calcd for $[C_{33}H_{27}N_2O_5]^+$ 531.1914; Found 531.1939; **MP** 180 - 182 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak OD-3 column; solvent: hexane/2-propanol = 50/50; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 4.69 min, t_R major = 9.21 min. $[\alpha]_D^{21.0}$ = +222.6 (*c* = 0.18, MeOH for >99% ee).

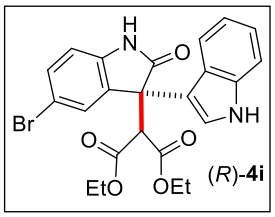


Diethyl (*R*)-2-(3-(5-methoxy-1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4g** was obtained as a colorless solid (0.08 mmol scale of reaction, 27 mg of product, 73% yield); R_f = 0.56 (50% EtOAc in hexane); ^{1}H **NMR** (400 MHz, DMSO-D_6) δ 10.82 (s, 1H), 10.46 (s, 1H), 7.76 (d, *J* = 7.4 Hz, 1H), 7.27 (td, *J* = 7.7, 0.9 Hz, 1H), 7.16 (d, *J* = 8.8 Hz, 1H), 7.01 (t, *J* = 7.3 Hz, 1H), 6.90 (d, *J* = 7.7 Hz, 1H), 6.76 (d, *J* = 1.8 Hz, 1H), 6.66 - 6.63 (m, 2H), 4.86 (s, 1H), 3.90- 3.76 (m, 4H), 3.58 (s, 3H), 3.48 (Water), 0.79 (t, *J* = 7.1 Hz, 3H), 0.75 (t, *J* = 7.1 Hz, 3H); **^{13}C NMR** (100 MHz, DMSO-D_6) δ 178.2, 167.4, 167.0, 153.1, 143.6, 132.4, 130.2, 129.2, 127.3, 125.6, 125.3, 121.7, 112.6, 111.6, 111.4, 110.0, 103.6, 61.6, 61.0, 56.6, 55.6, 53.3, 13.7, 13.7; **IR** (film) υ_{max} 3381, 2982, 1715, 1471, 1371, 1299, 1246, 1189, 1031, 860, 816, 741 cm^{-1}; **HRMS** (ESI) m/z $[M + Na]^+$ Calcd for $[C_{24}H_{24}N_2O_6+Na]^+$ 459.1527; Found 459.1551; **MP** 130 - 132 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak IE-3 column; solvent: hexane/2-propanol = 50/50; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 8.60 min, t_R major = 10.81 min. $[\alpha]_D^{24.0}$ = +110.0 (*c* = 0.20, $CHCl_3$ for 76% ee).

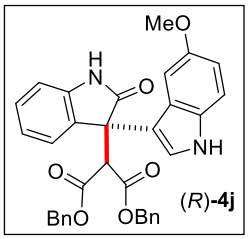


Diethyl (*R*)-2-(3-(5-bromo-1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4h** was obtained as a brown solid (0.08 mmol scale of reaction, 30 mg of product, 77% yield); R_f = 0.56 (50% EtOAc in hexane); **^{1}H NMR** (500 MHz, DMSO-D_6) δ 11.23 (s, 1H), 10.57 (s, 1H), 7.82 - 7.76 (m, 2H), 7.35 - 7.30 (m, 2H), 7.18 (d, *J* = 8.7 Hz, 1H), 7.08 (d, *J* = 7.8 Hz, 1H), 6.94 (t, *J* = 6.1 Hz, 1H), 6.73 (s, 1H), 4.91 (s, 1H), 3.93 – 3.81 (m, 4H), 0.84 (t, *J* = 7.1 Hz, 3H), 0.73 (t, *J* = 3.1 Hz, 3H); **^{13}C NMR** (125 MHz, DMSO-

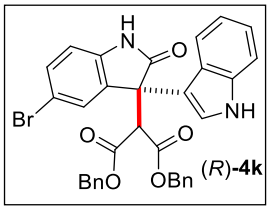
D_6) δ 178.0, 167.2, 166.7, 143.4, 136.1, 129.8, 129.2, 127.0, 126.9, 126.6, 124.1, 124.1, 121.8, 114.2, 111.8, 111.8, 110.1, 61.6, 61.0, 56.7, 53.2, 13.7, 13.6; **IR** (film) υ_{max} 3260, 3063, 2922, 2359, 1712, 1616, 1469, 1217, 1097, 1018, 746 cm^{-1}; **HRMS** (ESI) m/z $[M + Na]^+$ Calcd for $[C_{23}H_{21}BrN_2O_5+Na]^+$ 507.0526; Found 507.0534; **MP** 120 - 122 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak IB column; solvent: hexane/2-propanol = 70/30; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 4.72 min, t_R major = 6.65 min. $[\alpha]_D^{24.1}$ = +198.2 (*c* = 0.19, $CHCl_3$ for 88% ee).



Diethyl (*R*)-2-(5-bromo-3-(1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4i** was obtained as a brown solid (0.08 mmol scale of reaction, 27 mg of product, 70% yield); R_f = 0.60 (50% EtOAc in hexane); **^{1}H NMR** (100 MHz, DMSO-D_6) 11.02 (s, 1H), 10.65 (s, 1H), 7.96 - 7.95 (m, 1H), 7.50 (t, *J* = 6.7 Hz, 2H), 7.32 (d, *J* = 8.3 Hz, 1H), 7.04 (t, *J* = 7.6 Hz, 1H), 6.92 - 6.87 (m, 2H), 6.70 (d, *J* = 2.7 Hz, 1H), 4.95 (s, 1H), 3.92 - 3.79 (m, 4H), 3.34 (s, 3H), 0.87 (t, *J* = 7.1 Hz, 3H), 0.71 (t, *J* = 7.1 Hz, 3H); **^{13}C NMR** (100 MHz, DMSO-D_6) δ 177.5, 167.3, 166.7, 142.9, 137.3, 132.6, 131.8, 129.8, 125.0, 124.7, 121.7, 121.6, 119.1, 113.3, 112.2, 112.0, 111.1, 61.7, 61.1, 56.4, 53.6, 13.7, 13.6; **IR** (film) υ_{max} 3381, 2982, 1715, 1471, 1371, 1299, 1246, 1189, 1031, 860, 816, 741 cm^{-1}; **HRMS** (ESI) m/z $[M + Na]^+$ Calcd for $[C_{23}H_{21}BrN_2O_5+Na]^+$ 507.0526; Found 507.0530; **MP** 180 - 182 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak IB column; solvent: hexane/2-propanol = 70/30; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 6.00 min, t_R major = 11.09 min. $[\alpha]_D^{25.0}$ = +180.7 (*c* = 0.17, $CHCl_3$ for 88% ee).

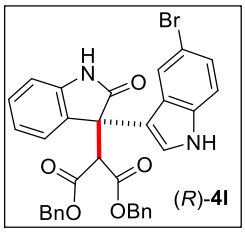


Dibenzyl (*R*)-2-(3-(5-methoxy-1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4j** was obtained as a colorless solid (0.08 mmol scale of reaction, 36 mg of product, 80% yield); R_f = 0.57 (50% EtOAc in hexane; **^{1}H NMR** (400 MHz, 0.5 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 9.05 (s, 1H), 8.95 (s, 1H), 7.91 (d, *J* = 7.5 Hz, 1H), 7.23 - 7.14 (m, 4H), 7.16 - 7.09 (m, 3H), 7.08 (d, *J* = 2.5 Hz, 1H), 7.03 - 6.92 (m, 3H), 6.87 - 6.78 (m, 2H), 6.76 (d, *J* = 7.7 Hz, 1H), 6.72 (dd, *J* = 8.8, 2.5 Hz, 1H), 6.63 (d, *J* = 2.8 Hz, 1H), 5.24 (s, 1H), 4.91 - 4.68 (m, 4H), 3.62 (s, 3H), 2.36 (Water); **^{13}C NMR** (125 MHz, DMSO-D_6) δ 178.1, 167.1, 166.7, 153.5, 142.1, 134.8, 134.6, 132.0, 129.4, 128.4, 128.2, 128.1, 127.9, 127.8, 127.7, 127.7, 127.2, 125.1, 124.9, 121.7, 112.3, 111.9, 111.4, 109.7, 103.0, 67.0, 66.7, 56.3, 55.4, 53.3; **IR** (film) υ_{max} 3377, 2355, 1713, 1615, 1469, 1308, 1214, 1146, 735 cm^{-1}; **HRMS** (ESI) m/z $[M + Na]^+$ Calcd for $[C_{34}H_{28}N_2O_6+Na]^+$ 583.1840; Found 583.1855; **MP** 158 - 160 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak OD-3 column; solvent: hexane/2-propanol = 60/40; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 5.60 min, t_R major = 16.12 min. $[\alpha]_D^{22.5}$ = +70.0 (*c* = 0.10, MeOH for 96% ee).

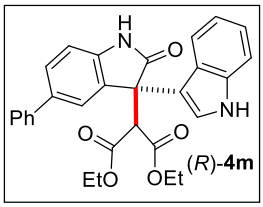


Dibenzyl (*R*)-2-(5-bromo-3-(1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4k** was obtained as a yellow solid (0.08 mmol scale of reaction, 36 mg of product, 74% yield); R_f = 0.60 (40% EtOAc in hexane); **^{1}H NMR** (500 MHz, 0.5 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 9.66 - 9.64 (m, 2H), 7.99 - 7.96 (m, 1H), 7.79 - 7.74 (m, 1H), 7.29 - 7.16 (m, 5H), 7.13 - 7.01 (m, 4H), 6.99 - 6.88 (m, 3H), 6.71- 6.67 (m, 2H), 6.62 - 6.58 (m, 1H), 6.54 - 6.51(m, 1H), 5.23 - 5.20 (m, 1H), 4.84 - 4.82 (m, 2H), 4.74 - 4.72 (m,

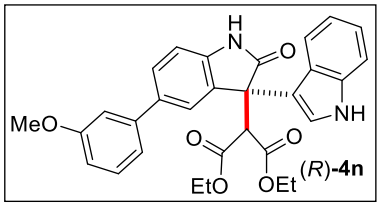
2H), ; **^{13}C NMR** (125 MHz, DMSO) δ177.6, 167.1, 166.6, 141.8, 137.2, 134.8, 134.7, 131.7, 131.4, 129.9, 128.4, 128.3, 128.1, 127.9, 127.8, 127.7, 127.6, 124.8, 124.5, 121.8, 121.7, 119.4, 114.0, 111.6, 111.4, 67.2, 66.9, 56.4, 53.7; **IR** (film) υ_{max} 3388, 3066, 2924, 2854, 2840, 1728, 1620, 1471, 1465, 1442, 1311, 1273, 1250, 1217, 1145, 750, 686 cm^{-1}; **HRMS** (ESI) m/z [M + Na]$^+$ Calcd for [$C_{33}H_{25}BrN_2O_5$+Na]$^+$ 631.0839; Found 631.0839; **MP** 220 - 222 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak OD-3 column; solvent: hexane/2-propanol = 60/40; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 6.18 min, t_R major = 13.88 min. $[\alpha]_D^{25.0}$ = +120.0 (*c* = 0.16, $CHCl_3$ for 94% ee).



Dibenzyl (*R*)-2-(3-(5-bromo-1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4l** was obtained as a colorless solid (0.08 mmol scale of reaction, 38 mg of product, 80% yield); R_f = 0.55 (50% EtOAc in hexane); **^{1}H NMR** (400 MHz, 0.5 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 9.85 (br, 1H), 9.41 (br, 1H), 7.98 (s, 1H), 7.83 - 7.81 (m, 1H), 7.1 - 7.08 (m, 9H), 6.95 - 6.91 (m, 3H), 6.7 - 6.73 (m, 3H), 6.5 - 6.53 (m, 1H), 5.16 (s, 1H), 4.81 - 4.72 (m, 4H); **^{13}C NMR** (125 MHz, DMSO-D_6) δ 178.1, 167.2, 166.7, 142.4, 142.4, 135.9, 134.8, 134.7, 129.2, 128, 4128.4, 128.3, 128.1, 127.9, 127.7, 126.9, 126.6, 126.1, 124.5, 124.3, 121.8, 113.2, 112.7, 111.5, 110.1, 67.2, 66.9, 56.5, 53.4; **IR** (film) υ_{max} 3391, 2925, 2257, 1728, 1621, 1471, 1379, 1312, 1266, 1147, 1025, 1005, 755, 698 cm^{-1}; **HRMS** (ESI) m/z [M + Na]$^+$ Calcd for [$C_{33}H_{25}BrN_2O_5$+Na]$^+$ 631.0839; Found 631.0867; **MP** 110 - 112 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak OD-3 column; solvent: hexane/2-propanol = 60/40; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 4.65 min, t_R major = 9.13 min. $[\alpha]_D^{25.2}$ = +200.0 (*c* = 0.18, MeOH for 92% ee).

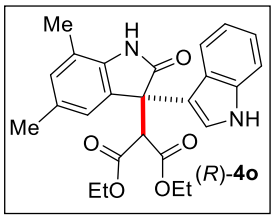


Diethyl (*R*)-2-(3-(1*H*-indol-3-yl)-2-oxo-5-phenylindolin-3-yl)malonate: Compound (*R*)-**4m** was obtained as a brown solid (0.08 mmol scale of reaction, 28 mg of product, 74% yield); R_f = 0.55 (40% EtOAc in hexane); **^{1}H NMR** (500 MHz, 0.5 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 9.72 - 9.68 (m, 2H), 8.29 - 8.28 (m, 1H), 7.86 - 7.85 (m, 1H), 7.61 - 7.48 (m, 3H), 7.42 - 7.35 (m, 2H), 7.31 - 7.24 (m, 2H), 7.06 - 6.97 (m, 3H), 6.73 - 6.71 (m, 1H) 5.21 (s, 1H), 3.94 - 3.83 (m, 4H), 2.73 (Water), 0.92 - 0.87 (m, 3 H), 0.78 - 0.75 (m, 3H); **^{13}C NMR** (125 MHz, 0.5 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 178.6, 167.4, 167.0, 142.1, 141.1, 137.2, 134.7, 130.6, 128.6, 127.2, 126.6, 126.5, 125.5, 125.1, 124.4, 121.9, 121.5, 119.1, 111.5, 110.0, 61.4, 60.8, 56.6, 53.7, 13.4, 13.2; **IR** (film) υ_{max} 3394, 3062, 2926, 2357, 1720, 1624, 1473, 1307, 1236, 827, 746 cm^{-1}; **HRMS** (ESI) m/z $[M + H]^+$ Calcd for $[C_{29}H_{27}N_2O_5]^+$ 483.1914; Found 483.1906; **MP** 180 - 182 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak OD-3 column; solvent: hexane/2-propanol = 50/50; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 6.56 min, t_R major = 8.17 min. $[\alpha]_D^{24.2}$ = +109.0 (*c* = 0.21, MeOH for 91% ee).

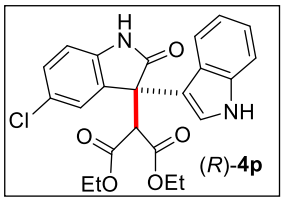


Diethyl (*R*)-2-(3-(1*H*-indol-3-yl)-5-(3-methoxyphenyl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4n** was obtained as a colorless solid (0.08 mmol scale of reaction, 31 mg of product, 77% yield); R_f = 0.56 (40% EtOAc in hexane); **^{1}H NMR** (400 MHz, 0.5 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 9.72 (brs, 1H), 9.68 (brs, 1H), 8.08 (s, 1H), 7.65 (d, *J* = 8.1 Hz, 1H), 7.33 (d, *J* = 7.6 Hz, 1H), 7.16 - 7.08 (m, 2H), 67.01 - 6.99 (m, 1H), 6.94 (s, 1H), 6.89 - 6.86 (m, 1H) 6.82 - 6.80 (m, 2H), 6.67 - 6.65 (m, 1H), 6.55 (s, 1H), 5.00 (s, 1H), 3.75 - 3.67 (m, 7H), 2.65 (Water), 0.75 - 0.72 (m, 3H), 0.61 - 0.57(m, 3H); **^{13}C NMR**

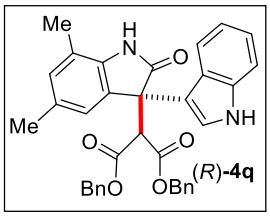
(100 MHz, 0.5 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 178.5, 167.3, 166.9, 159.8, 142.6, 142.4, 137.2, 130.4, 130.6, 129.6, 127.2, 125.8, 120.5, 124.4, 121.9, 121.4, 119.2, 118.9, 112.5, 111.8, 111.7, 111.4, 109.9, 61.3, 60.7, 56.6, 55.2, 53.7, 13.4, 13.3; **IR** (film) υ_{max} 3415, 2924, 2852, 1726, 1622, 1481, 1307, 1174, 1029, 848, 748 cm^{-1}; **HRMS** (ESI) m/z $[M + H]^+$ Calcd for $[C_{30}H_{29}N_2O_6]^+$ 513.2020; Found 513.2022; 513.2020; **MP** 270 - 272 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak ID-3 column; solvent: hexane/2-propanol = 50/50; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 5.05 min, t_R major = 6.26 min. $[\alpha]_D^{24.2}$ = +250.0 (*c* = 0.10, $CHCl_3$ for 88% ee).



Diethyl (*R*)-2-(3-(1*H*-indol-3-yl)-5,7-dimethyl-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4o** was obtained as a colorless solid (0.08 mmol scale of reaction, 27 mg of product, 79% yield); R_f = 0.56 (40% EtOAc in hexane); **^{1}H NMR** (500 MHz, 0.5 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 9.47 - 9.45 (m, 2H), 7.74 - 7.72 (m, 1H), 7.48 (s, 1H), 7.12 - 7.08 (m, 1H), 6.93-6.84 (m, 2H), 6.75 - 6.74 (m, 1H), 6.51 - 6.50 (m, 1H), 5.01 (s, 1H), 3.77 - 3.67 (m, 4H), 2.56 (Water), 2.17 (s, 3H), 2.02 (s, 3H); **^{13}C NMR** (125 MHz, 0.5 mL $CDCl_3$, 0.1 mL DMSO-D_6) δ 179.1, 167.4, 167.1, 138.5, 137.1, 130.8, 130.3, 129.5, 125.1, 125.0, 124.5, 122.2, 121.4, 118.6, 112.3, 111.3, 61.2, 60.7, 56.5, 54.0, 21.2, 16.5, 13.2 (2c); **IR** (film) υ_{max} 3444, 3386, 2920, 2848, 1707, 1624, 1456, 1261, 1103, 744 cm^{-1}; **HRMS** (ESI) m/z $[M + H]^+$ Calcd for $[C_{30}H_{29}N_2O_6]^+$ 457.1734; Found 457.1749; **MP** 190 - 192 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak ID-3 column; solvent: hexane/2-propanol = 70/30; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 7.09 min, t_R major = 10.79 min. $[\alpha]_D^{24.5}$ = +45.2 (*c* = 0.30, MeOH for 90% ee).

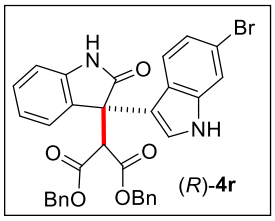


Diethyl (*R*)-2-(5-chloro-3-(1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4p** was obtained as a brown solid (0.08 mmol scale of reaction, 25 mg of product, 70% yield); R_f = 0.55 (40% EtOAc in hexane); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.33 (s, 1H), 8.09 (d, *J* = 2.6 Hz, 1H), 8.05 (d, *J* = 2.2 Hz, 1H), 7.87 (d, *J* = 8.0 Hz, 1H), 7.25 (d, *J* = 3.6 Hz, 1H), 7.24 – 7.23 (m, 1H), 7.15 – 7.05 (m, 2H), 6.76 (d, *J* = 8.3 Hz, 1H), 6.62 (d, *J* = 2.7 Hz, 1H), 5.19 (s, 1H), 4.00 – 3.84 (m, 4H), 0.90 (t, *J* = 7.1 Hz, 3H), 0.77 (t, *J* = 7.1 Hz, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 178.3, 167.3, 166.8, 140.4, 137.0, 131.5, 128.8, 127.8, 127.7, 124.8, 124.1, 122.4, 122.1, 119.9, 111.9, 111.4, 110.8, 61.9, 61.2, 56.4, 53.9, 13.5, 13.3; **IR** (film) υ_{max} 3389, 2990, 1721, 1620, 1461, 1381, 1289, 1256, 1159, 1011, 870, 800, 761, 720 cm^{-1}; **HRMS** (ESI) m/z $[M + Na]^+$ Calcd for $[C_{23}H_{22}ClN_2O_5]^+$ 441.1212; Found 441.1236; **MP** 192 - 194 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak OD-3 column; solvent: hexane/2-propanol = 70/30; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 5.10 min, t_R major = 7.48 min. $[\alpha]_D^{24.5}$ = +201.8 (*c* = 0.10, MeOH for 86% ee).

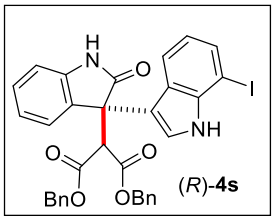


Dibenzyl (*R*)-2-(3-(1*H*-indol-3-yl)-5,7-dimethyl-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4q** was obtained as a colourless solid (0.08 mmol scale of reaction, 34 mg of product, 78% yield); R_f = 0.61 (40% EtOAc in hexane); **^{1}H NMR** (400 MHz, DMSO-D_6) δ 10.11 (s, 1H), 9.51 (s, 1H), 6.80 (d, *J* = 8.2 Hz, 1H), 6.51 - 6.30 (m, 8H), 6.23 - 6.18 (m, 3H), 6.08 - 5.97 (m, 4H), 5.77 (s, 1H), 4.29 (s, 1H) 4.12 - 4.01 (m, 4H), 1.31 (s, 3H), 1.28 (s, 3 H); **^{13}C NMR** (100 MHz, DMSO-D_6) δ 182.9, 172.1, 171.7, 144.1, 143.8, 142.2, 140.3, 140.2, 135.5, 134.9, 134.5, 133.5, 133.4, 133.2, 132.9, 132.7, 132.6, 130.0, 129.9, 126.7, 126.3, 123.8, 123.6, 116.9, 116.7, 71.8, 71.5, 61.5, 58.4, 26.1, 21.7; **IR**

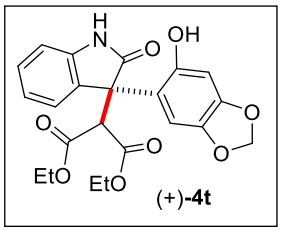
(film) υ_{max} 3385, 3064, 2924, 2854, 1718, 1612, 1471, 1465, 1311, 1273, 1217, 1155, 742, 696 cm^{-1}; **HRMS** (ESI) m/z $[M + Na]^+$ Calcd for $[C_{35}H_{30}N_2O_5+Na]^+$ 581.2047; Found 581.2064; **MP** 201 - 203 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak AD-H column; solvent: hexane/2-propanol = 50/50; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 29.05 min, t_R major = 35.36 min. $[\alpha]_D^{25.0}$ = +45.9 (*c* = 0.40, MeOH for 93% ee).



Dibenzyl (*R*)-2-(3-(6-bromo-1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4r** was obtained as a yellow solid (0.08 mmol scale of reaction, 23 mg of product, 92% yield; R_f = 0.60 (40% EtOAc in hexane); **^{1}H NMR** (400 MHz, DMSO-D_6) δ 11.14 (s, 1H), 10.53 (s, 1H), 7.73 (d, *J* = 7.6 Hz, 1H), 7.64 (d, *J* = 8.7 Hz, 1H), 7.55 (s, 1H), 7.37 - 7.30 (m, 2H), 7.29 – 7.28 (m, 2H), 7.22 (d, *J* = 7.1 Hz, 1H), 7.16 (t, *J* = 7.4 Hz, 2H), 7.06 – 6.98 (m, 4H), 6.88 (d, *J* = 7.8 Hz, 1H), 6.77 (d, *J* = 7.4 Hz, 2H), 6.67 (s, 1H), 5.12 (s, 1H), 5.00 – 4.80 (m, 4H); **^{13}C NMR** (100 MHz, DMSO-D_6) δ 177.7, 167.3, 166.7, 143.3, 138.4, 135.5, 135.5, 129.7, 129.2, 128.8, 128.6, 128.5, 128.3, 127.9, 127.8, 126.9, 126.2, 124.2, 123.7, 122.1, 121.8, 114.9, 114.6, 112.1, 110.3, 67.1, 66.8, 56.5, 53.2; **IR** (film) υ_{max} 3455, 3364, 2994, 2830, 1717, 1622, 1491, 1409, 1301, 1221, 1210, 1100, 772, 636 cm^{-1}; **HRMS** (ESI) m/z $[M + Na]^+$ Calcd for $[C_{33}H_{25}BrN_2O_5+Na]^+$ 631.0835; Found 631.0839; **MP** 195 - 197 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak ID-3 column; solvent: hexane/2-propanol = 60/40; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 7.18 min, t_R major = 10.29 min. $[\alpha]_D^{22.2}$ = +95.9 (*c* = 0.18, CH_2Cl_2 for 98% ee).

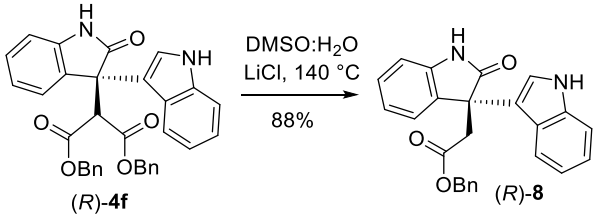


Dibenzyl (*R*)-2-(3-(7-iodo-1*H*-indol-3-yl)-2-oxoindolin-3-yl)malonate: Compound (*R*)-**4s** was obtained as a yellow solid (0.08 mmol scale of reaction, 44 mg of product, 85% yield); R_f = 0.63 (40% EtOAc in hexane); **^{1}H NMR** (400 MHz, DMSO-D_6) δ 8.0 (s, 1H), 7.9 (d, *J* = 7.6 Hz, 1H), 7.9 (s, 1H), 7.8 (d, *J* = 8.2 Hz, 1H), 7.5 (d, *J* = 7.5 Hz, 1H), 7.25 – 7.14 (m, 7H), 7.06 – 7.00 (m, 3H), 6.84 – 6.78 (m, 3H), 6.69 (d, *J* = 7.7 Hz, 1H), 6.64 (d, *J* = 2.7 Hz, 1H), 5.27 (s, 1H), 4.95 – 4.86 (m, 4H); **^{13}C NMR** (100 MHz, DMSO-D_6) δ 177.9, 167.1, 166.6, 141.5, 138.4, 134.9, 134.6, 131.0, 129.0, 128.9, 128.4, 128.3, 128.2, 128.2, 128.1, 128.0, 127.3, 125.1, 124.6, 122.5, 122.3, 121.7, 114.1, 110.0, 76.9, 67.4, 67.1, 56.5, 53.6; **IR** (film) υ_{max} 3443, 3364, 2994, 2804, 1719, 1622, 1441, 1400, 1301, 1290, 1200, 1105, 792, 606 cm^{-1}; **HRMS** (ESI) m/z $[M + H]^+$ Calcd for $[C_{33}H_{26}IN_2O_5]^+$ 657.0881; Found 657.0853; **MP** 150 - 152 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak IC-3 column; solvent: hexane/2-propanol = 50/50; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 4.93 min, t_R major = 6.44 min. $[\alpha]_D^{20.6}$ = +243.2 (*c* = 0.15, CH_2Cl_2 for 90% ee).

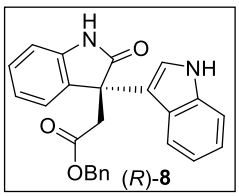


(+)-Diethyl 2-(3-(6-hydroxybenzo[*d*][1,3]dioxol-5-yl)-2-oxoindolin-3-yl)malonate: Compound (+)-**4t** was obtained as a colourless solid (0.08 mmol scale of reaction, 31 mg of product, 90% yield); R_f = 0.52 (40% EtOAc in hexane); **^{1}H NMR** (400 MHz, Chloroform-*d*) δ 9.90 (s, 1H), 8.74 (s, 1H), 8.01 (d, *J* = 7.2 Hz, 1H), 7.30 (td, *J* = 7.7, 1.3 Hz, 1H), 7.16 (td, *J* = 7.7, 1.2 Hz, 1H), 6.93 (d, *J* = 7.7 Hz, 1H), 6.51 (s, 1H), 6.32 (s, 1H), 5.80 (dd, *J* = 20.8, 1.5 Hz, 2H), 5.33 (s, 1H), 4.06 (q, *J* = 7.1 Hz, 2H), 3.82 (qd, *J* = 7.1, 4.7 Hz, 2H), 1.09 (t, *J* = 7.1 Hz, 3H), 0.85 (t, *J* = 7.1 Hz, 3H); **^{13}C NMR** (101 MHz,

Chloroform-*d*) δ 182.0, 167.2, 166.6, 152.4, 148.5, 141.6, 140.7, 129.5, 128.3, 123.5, 113.6, 110.7, 108.7, 101.9, 101.3, 61.8, 61.5, 57.8, 54.4, 13.3, 13.4; **IR** (film) υ_{max} 3355, 3264, 2920, 2884, 1719, 1622, 1451, 1465, 1311, 1273, 1217, 1155, 742, 696 cm^{-1}; **HRMS** (ESI) m/z $[M + H]^+$ Calcd for $[C_{22}H_{22}NO_8]^+$ 428.1340; Found 428.1331; **MP** 135 - 137 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak AD-H column; solvent: hexane/2-propanol = 50/50; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 7.17 min, t_R major = 24.25 min. $[\alpha]_D^{23.1}$ = +34.2 (*c* = 0.16, MeOH for 50% ee).

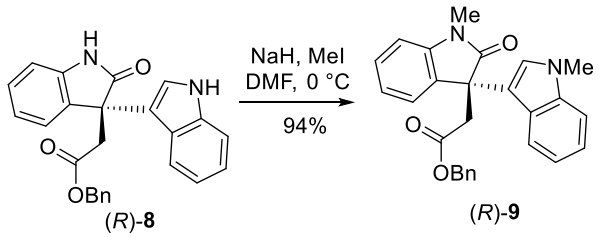


Synthetic procedure for the synthesis of compound (*R*)-**8**: To a stirred solution of (*R*)-**4f** (300 mg, 0.6 mmol; 1.0 equiv) in DMSO (5 mL) at 25 ºC was added lithium chloride (96 mg, 2.3 mmol, 4.0 equiv) and H_2O (104 µL, 5.6 mmol, 10.0 equiv). After 5 minutes starring, the reaction mixture was transferred to a pre-heated oil bath (140 ºC) and stirring was continued for 24 h. After complete consumption of starting material (as judged by running TLC), reaction mixture was cooled down to 25 ºC and quenched with water (4 mL). The organic compound was extracted with ethyl acetate (2 X 10 mL). Then the combined organic layers were dried over anhydrous sodium sulphate and concentrated under reduced pressure. The crude material was purified by column chromatography by using 20 - 30 % (EtOAc/Hexane) to afford compound (*R*)-**8** as a colorless solid.

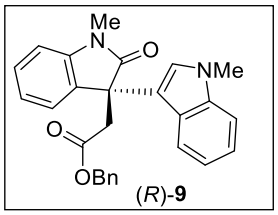


Benzyl (*R*)-2-(3-(1*H*-indol-3-yl)-2-oxoindolin-3-yl)acetate: Compound (*R*)-**8** was obtained as a yellow solid (0.6 mmol scale of reaction, 195 mg of product, 80% yield); R_f = 0.45 (40% EtOAc in hexane); **^{1}H NMR** (400 MHz, DMSO-d_6) δ 11.08 (s, 1H), 10.56

(s, 1H), 7.35 - 7.21 (m, 10H), 7.18 - 7.11 (m, 3H), 7.03 - 6.99 (m, 2H), 6.95 - 6.90 (m, 2H), 6.80 (t, *J* = 7.5 Hz, 1H), 4.92 (s, 3H), 3.63 (d, *J* = 16.0 Hz, 1H), 3.51 (d, *J* = 16.1 Hz, 2H), 3.44 (Water); **^{13}C NMR** (100 MHz, DMSO-d_6) δ 179.4, 169.9, 143.3, 137.2, 136.3, 133.1, 128.8, 128.6, 128.3, 128.1, 125.1, 124.4, 124.0, 121.8, 121.6, 119.8, 119.1, 114.2, 112.1, 109.9, 65.9, 49.8; **IR** (film) υ_{max} 3415, 3310, 2929, 2802, 1728, 1642, 1619, 1480, 1327,1154, 1059, 878, 760 cm^{-1}; **HRMS** (ESI) m/z [M + Na]$^+$ Calcd for [$C_{25}H_{20}N_2O_3$+Na]$^+$ 419.1366; Found 419.1380; **MP 1**65 - 167 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak OD-3 column; solvent: hexane/2-propanol = 50/50; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 5.71 min, t_R major = 13.53 min. $[\alpha]_D^{21.0}$ = +122.0 (*c* = 0.24, MeOH for 99% ee).

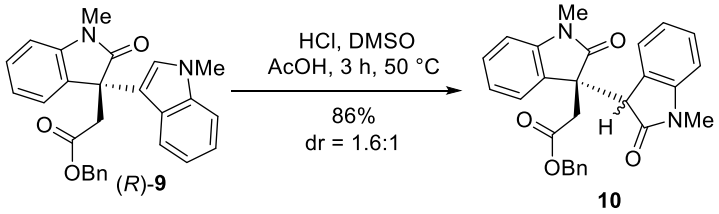


Synthetic procedure for compound (*R*)-**9**: Compound (*R*)-**8** (200 mg, 0.5 mmol; 1.0 equiv) was taken in dimethyl sulfoxide (3 mL) under nitrogen atmosphere. The reaction mixture was cooled to 0 ºC and potassium *tert*-butoxide (119 mg, 1.1 mmol, 2.2 equiv) was added to it. After 5 min of stirring, methyl iodide (66 µL, 1.1 mmol, 2.2 equiv) was added at same temperature and stirring was continued for 3 h. Upon completion of starting material (as judged by running TLC), the reaction mixture was quenched with careful addition of water (2 mL) and organic compound was extracted with ethyl acetate (2 X 10 mL). The combined organic layers were dried over anhydrous sodium sulphate and concentrated under reduced pressure. The crude material was purified by column chromatography by using 20-30 % (EtOAc/Hexane) to afford compound (*R*)-**9** as a white solid.



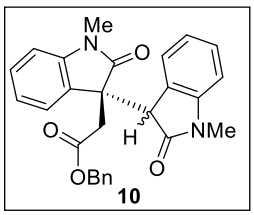
(*R*)-**9**

Benzyl (*R*)-2-(1-methyl-3-(1-methyl-1*H*-indol-3-yl)-2-oxoindolin-3-yl)acetate: Compound (*R*)-**9** was obtained as a brown solid (0.5 mmol scale of reaction, 191 mg of product, 94% yield); R_f = 0.53 (40% EtOAc in hexane); **^{1}H NMR** (400 MHz, $CDCl_3$) 7.30 - 7.28 (m, 3H), 7.09 - 7.04 (m, 6H), 6.85 - 6.81 (m, 2H), 6.52 (d, *J* = 7.8 Hz, 1H), 6.47 (d, *J* = 7.8 Hz, 1H), 4.89 - 4.81 (m, 2H), 4.37 (d, *J* = 16.7 Hz, 1H), 3.80 (s, 1H), 3.42 (d, *J* = 16.8 Hz, 1H), 3.13 (s, 3H), 3.05 (s, 3H); **^{13}C NMR** (125 MHz) δ177.8, 169.6, 144.4, 137.7, 135.3, 131.4, 128.6, 128.5, 128.4, 127.1, 125.5, 123.9, 122.4, 121.9, 120.8, 119.5, 112.9, 109.5, 108.3, 66.5, 49.7, 40.9, 32.7, 26.3; **IR** (film) υ_{max} 3415, 2924, 2852, 1726, 1622, 1481, 1307,1174, 1029, 848, 748 cm^{-1}; **HRMS** (ESI) m/z $[M + H]^+$ Calcd for $[C_{27}H_{25}N_2O_3]^+$ 425.1860; Found 425.1883; **MP** 68 - 70 ºC; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak OD-3 column; solvent: hexane/2-propanol = 50/50; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 7.82 min, t_R major = 13.17 min. $[\alpha]_D^{24.1}$ = +12.5 (*c* = 0.19, $CHCl_3$ for 99.5% ee).



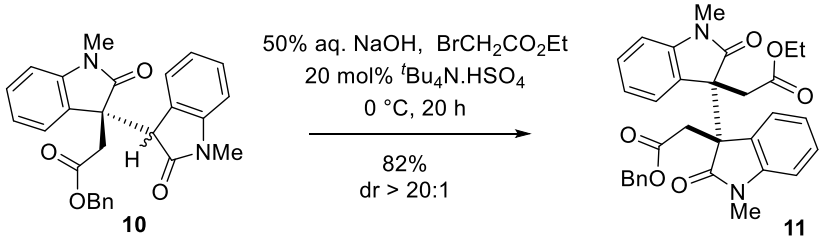
Synthetic procedure for compound 10: Compound (*R*)-**9** (150 mg, 0.33 mmol; 1.0 equiv) was taken in acetic acid (3 mL) at 25 ºC. To this solution was added HCl (61 µL, 1.7 mmol, 5.0 equiv), followed by dimethyl sulfoxide (236 µL, 3.3 mmol, 10.0 equiv). Then the reaction mixture was placed over a pre-heated oil bath maintaining 50 ºC for 3 h. Upon completion of starting material (as judged by running TLC), the reaction mixture was quenched with sat. Na_2CO_3 (2 mL) and organic compound was extracted with ethyl acetate (2 X 10 mL). The combined organic layers were dried over anhydrous sodium sulphate and concentrated under reduced pressure. The crude material was purified by

column chromatography by using 20-30% (EtOAc/Hexane) to afford compound **10** as an orange solid.



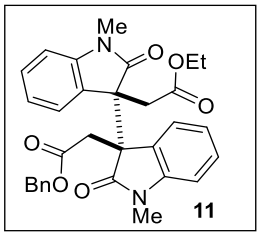
10

Benzyl 2-((3'*R*)-1,1'-dimethyl-2,2'-dioxo-[3,3'-biindolin]-3'-yl)acetate (**10**): Compound **10** (major diastereomer) was obtained as a orange colour gel (0.3 mmol scale of reaction, 85 mg of product, 50% yield); R_f = 0.44 (40% EtOAc in hexane); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.29 - 7.29 (m, 3H), 7.10 - 7.05 (m, 6H), 6.84 (td, *J* = 7.6, 1.4 Hz, 1H), 6.52 (d, *J* = 7.8 Hz, 1H), 6.47 (d, *J* = 7.8 Hz, 1H), 4.89 - 4.81 (m 2H), 4.37 (dd, *J* = 16.8, 1.3 Hz, 1H), 3.80 (s, 1H), 3.44 - 3.39 (m, 1H), 3.13 (d, *J* = 1.4 Hz, 1H), 3.13 (s, 3H), 3.05 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 177.3, 174.7, 169.7, 144.0, 143.9, 135.3, 128.7, 128.6, 128.4, 128.1, 128.1, 126.8, 124.3, 123.6, 122.4, 122.1, 121.9, 107.9, 107.6, 66.3, 51.3, 49.6, 37.5, 25.9, 25.8; **IR** (film) υ_{max} 3425, 2914, 2862, 1721, 1612, 1482, 1317,1124, 1009, 808, 758 cm^{-1}; **HRMS** (ESI) m/z $[M + H]^+$ Calcd for $[C_{27}H_{25}N_2O_4]^+$ 441.1809; Found 441.1810

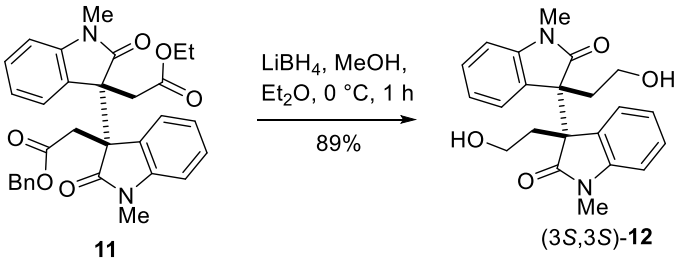


Synthetic procedure for compound 11: Compound **10** (100 mg, 0.2 mmol; 1.0 equiv) was taken in toluene (2 mL) under nitrogen atmosphere at 0 ºC. To this solution was added tetrabutyl ammonium hydrogen sulphate (16 mg, 0.05 mmol, 20 mol%), followed by 50% aq. sodium hydroxide (742 µL, 9.28 mmol, 40 equiv). After 5 minutes of stirring at 0 ºC, bromoethyl acetate (53 µL, 0.5 mmol, 2.0 equiv) was added to the reaction mixture. Then the reaction mixture allowed stirring for 20 h at the same temperature. Upon completion of starting material (monitored by running TLC), the reaction mixture

was diluted with water (2 mL) and organic compound was extracted with ethyl acetate (2 X 10 mL). Then the organic layer was dried with anhydrous sodium sulphate and concentrated in *vacuo*. The crude material was purified by column chromatography by using 20-30% (EtOAc/Hexane) to afford compound **11** as an orange solid.

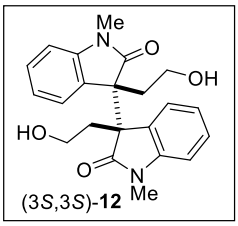


Benzyl 2-(3'-(2-ethoxy-2-oxoethyl)-1,1'-dimethyl-2,2'-dioxo-[3,3'-biindolin]-3-yl)acetate: Compound **11** was obtained as a colourless solid (0.22 mmol scale of reaction, 98 mg of product, 85% yield); R_f = 0.53 (40% EtOAc in hexane); **^{1}H NMR** (700 MHz) δ 7.19 - 7.17 (m, 3H), 6.96 - 6.91 (m, 2H), 6.31 - 6.29 (m, 1H), 6.20 - 6.19 (m, 1H), 4.68 - 4.62 (m, 2H), 4.02 (d, *J* = 16.0 Hz, 1H), 3.95 (d, *J* = 16.0 Hz, 1H), 3.73 - 3.64 (m, 2H) 3.18 (d, *J* = 16.0 Hz, 1H), 3.11 (d, *J* = 16.0 Hz, 1H), 3.00 (s, 3H), 0.83 (d, *J* = 7.11 Hz, 3H): **^{13}C NMR** (175 MHz) δ176.6, 176.4, 169.7, 169.6, 143.8, 143.7, 135.2, 128.8, 128.7, 128.4, 128.3, 128.2, 126.8, 126.7, 122.8, 121.5, 121.4, 107.5, 107.3, 77.2, 77.1, 76.8, 66.4, 60.4, 52.5, 52.4, 33.9 (2C), 25.8, 25.5, 13.7; **IR** (film) υ_{max} 3446, 3435, 2956, 2922, 2850, 2350, 2090, 1735, 1712, 1612, 1494, 1456, 1338, 1188, 1118, 1095, 906, 754 cm^{-1}; **HRMS** (ESI) m/z $[M + H]^+$ Calcd for $[C_{23}H_{21}N_2O_6]^+$ 549.1996; Found 549.2013; **MP** 135 - 137 ºC.



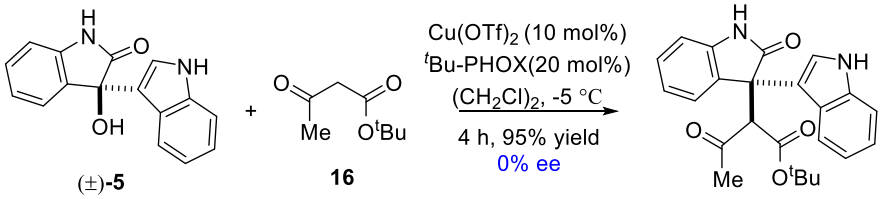
Synthetic procedure for the synthesis of compound (3*S*,3*S*)-12: Compound **11** (50 mg, 0.1 mmol; 1.0 equiv) was taken in diethyl ether (2 mL) under nitrogen atmosphere at 0 ºC. To this solution was added $LiBH_4$ (225 µL, 0.45 mmol, 5.0 equiv) followed by

methanol (44 µL, 0.9 mmol, 10.0 equiv). Then the reaction mixture allowed stirring for 1 h at the same temperature. Upon completion of starting material (monitored by running TLC), the reaction mixture was quenched with water (2 mL) and organic compound was extracted with ethyl acetate (2 X 5 mL). Then the organic layer was dried with anhydrous sodium sulphate and concentrated in *vacuo*. The crude material was purified by column chromatography by using 80 - 90% (EtOAc/Hexane) to afford compound (*S*,*S*)-**12** as a white crystalline solid.



(3*S*,3*S*)-**12**

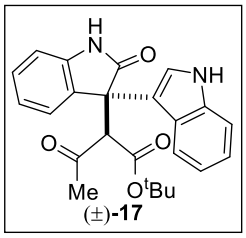
(3*S*,3*S*)-Bis(2-hydroxyethyl)-1,1'-dimethyl-[3,3'-biindoline]-2,2'-dione: Compound (3*S*, 3′*S*)-**12** was obtained as a colourless solid (0.1 mmol scale of reaction, 33 mg of product, 88% yield); R_f = 0.20 (in EtOAc); **^{1}H-NMR** (400 MHz, $CDCl_3$) δ 7.03-6.99 (m, 4H), 6.81 (t, *J* = 7.5 Hz, 2H), 6.39 (d, *J* = 7.7 Hz, 2H), 3.42-3.36 (m, 2H), 3.22-3.17 (m, 2H), 3.13-3.06 (m, 2H), 3.03 (s, 6H), 2.63-2.55 (m, 2H); **^{13}C NMR** (175 MHz) δ178.1, 143.4, 128.4, 127.2, 123.5, 121.5, 107.5, 59.7.8, 54.9, 31.4, 25.7; Enantiomeric excess of pure compound was determined *via* HPLC analysis using a Chiralpak AD-3 column; solvent: 2-propanol /hexane= 30/80; flow rate: 1.0 mL/min; detection: at 254 nm): t_R major = 16.66 min. t_R minor = 20.41 min. $[\alpha]_D^{23.0}$ = –145.2 (*c* = 0.4, $CHCl_3$ for 99.5% ee).



(±)-**5** **16** (±)-**17**

Synthesis of compound (±)-17 from enantioselective method: An oven dried sample vial was charged with $Cu(OTf)_2$ (0.1 equiv) and ^{t}Bu-PHOX (0.2 equiv) in dichloromethane (4 mL) at 25 ºC under nitrogen atmosphere. The reaction mixture was stirred for 30 minutes to make the complex. After that the reaction vessel was cooled to -

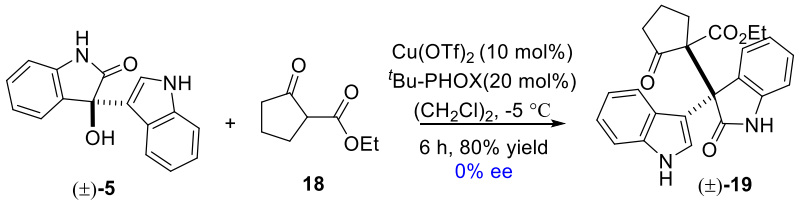
5 ºC and *tert*-Butyl acetoacetate (3.0 equiv) was added to the mixture and stirring was continued for 15 minutes maintaining temperature -5 ºC. Then, a solution of 3-hydroxy 2-oxindole in dichloromethane (0.5 mL) was added slowly to the reaction mixture. Then the reaction mixture was allowed to stir for 4 h at -5 ºC. After complete consumption of starting material (as judged by running TLC), the crude mixture was concentrated under reduced pressure and purified by column chromatography by using 20-30% EtOAc-hexane mixture as eluent to afford the desired compound.



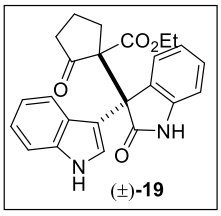
(±)-**17**

***tert*-Butyl-2-(3-(1*H*-indol-3-yl)-2-oxoindolin-3-yl)-3-oxobutanoate**: Compound (±)-**17** was obtained as a colourless solid (0.08 mmol scale of reaction, 31 mg of product, 95% yield); dr = 1.1:1 (determined from un purified reaction mixture] of (±)-**17**; R_f = 0.51 (40% EtOAc in hexane); **^{1}H NMR** (400 MHz, $CDCl_3$, spectrum contains ~1.1:1 diastereomers) δ 8.57 (d, *J* = 9.4, 1H for minor diastereomer), 8.44 (d, *J* = 8.7, 1H for major diastereomer), 8.20 – 8.17 (m, 2H for major + minor diastereomers), 8.06 - 8.02 (m, 2H for major + minor diastereomers), 7.93 (d, *J* = 7.5, 1H for major diastereomer), 7.85 (d, *J* = 7.5, 1H for minor diastereomer), 7.25 - 7.16 (m, 4H), 7.16 - 6.99 (m, 6H for major + minor diastereomers), 6.81 - 6.76 (m, 2H for major + minor diastereomers), 6.52 (s, 1H for minor diastereomer), 6.41 (s, 1H for major diastereomer), 5.43 (s, 1H for major diastereomer), 5.07 (s, 1H for minor diastereomer), 2.08 - 2.04 (m, 7H for major + minor diastereomers), 1.04 - 1.02 (m, 9H for major diastereomer), 0.99 (s, 9H for minor diastereomer **^{13}C NMR** (100 MHz, $CDCl_3$, spectrum contains ~1.1:1 diastereomers) δ 202.5, 201.5, 179.4, 178.9, 168.1, 166.7, 141.8, 141.5, 137.2, 137.1, 130.4, 130.1, 128.5, 128.4, 128.0, 126.5, 125.4 (two carbons), 124.9, 124.4, 122.6 (two carbons), 122.4, 122.1 (two carbons), 122.1, 121.7 (two carbons), 119.7, 119.6, 111.8, 111.3, 110.1, 109.8, 83.1, 81.9, 65.0, 61.4, 54.2, 53.5, 32.4, 29.3, 27.2, 27.2, 27.1; **IR** (film) υ_{max} 3455, 3364, 3220, 2884, 2019, 1722, 1711, 1665, 1461, 1223, 1207, 1185, 702, 606 cm^{-1}; **HRMS** (ESI) m/z

$[M + Na]^+$ Calcd for $[C_{24}H_{24}N_2O_4 + Na]^+$ 427.1628; Found 427.1606; **MP** 120 - 122 ºC; Enantiomeric peaks was determined *via* HPLC analysis using a Chiralpak OZ-3 column; solvent: hexane/2-propanol = 70/30; flow rate: 1.0 mL/min; detection: at 254 nm); in case of major diastereomer t_{R1} = 4.93 min, t_{R2} = 17.01 min. for 0% ee; in case of minor diastereomer t_{R1} = 8.58 min, t_{R2} = 10.53 min. for 0% ee.



Synthesis of compound (±)-19 from enantioselective method: An oven dried sample vial was charged with $Cu(OTf)_2$ (0.1 equiv) and ^{t}Bu-PHOX (0.2 equiv) in dichloromethane (4 mL) at 25 ºC under nitrogen atmosphere. The reaction mixture was stirred for 30 minutes to make the complex. After that the reaction vessel was cooled to -5 ºC and compound 18 (3.0 equiv) was added to the mixture and stirring was continued for 15 minutes maintaining temperature -5 ºC. Then, a solution of 3-hydroxy 2-oxindole in dichloromethane (0.5 mL) was added slowly to the reaction mixture. Then the reaction mixture was allowed to stir for 6 h at -5 ºC. After complete consumption of starting material (as judged by running TLC), the crude mixture was concentrated under reduced pressure and purified by column chromatography by using 30-40% EtOAc-hexane mixture as eluent to afford the desired compound.



Ethyl-1-(3-(1*H*-indol-3-yl)-2-oxoindolin-3-yl)-2-oxocyclopentane-1-carboxylate: Compound (±)-**19** was obtained as a colourless solid (0.08 mmol scale of reaction, 25 mg of product, 80% yield); dr = 4.7:1 (determined from un purified reaction mixture] of (±)-**19**; R_f = 0.31 (40% EtOAc in hexane); **^{1}H NMR** (400 MHz, $CDCl_3$, spectrum contains ~4.7:1 diastereomers) δ 8.92 (s, 2H for major + minor diastereomers), 8.65 (s,

2H for major + minor diastereomers), 8.26 (s, 2H for major + minor diastereomers), 7.87 (s, 1H for minor diastereomer), 7.67 (s, 1H for major diastereomer), 7.31 - 6.96 (m, 12H for major + minor diastereomers), 6.73 (s, 2H for major + minor diastereomers), 4.06 - 3.74 (m, 4H for major + minor diastereomers), 3.15 - 2.94 (m, 4H for major + minor diastereomers), 2.63 - 2.28 (m, 4H for major + minor diastereomers), 2.00 - 1.76 (m, 4H for major + minor diastereomers), 1.06 - 0.64 (m, 6H for major + minor diastereomers); **^{13}C NMR** (100 MHz, $CDCl_3$, spectrum contains ~4.7:1 diastereomers) δ 213.5, 212.8, 179.8, 179.0, 170.9, 170.2, 141.1, 141.1, 136.6, 136.5, 131.9, 131.6, 128.7, 128.6, 128.4, 128.3, 127.4, 127.3, 125.9, 125.8, 122.2, 121.8, 121.8, 121.7, 121.6, 121.3, 119.7, 119.6, 111.6, 110.6, 110.1, 109.7, 109.6, 109.1, 66.5, 66.3, 61.8, 61.7, 55.7, 55.7, 39.1, 38.7, 33.4, 33.1, 19.6, 19.4, 13.7, 13.5; **IR** (film) υ_{max} 3545, 3334, 3210, 2980, 2119, 1742, 1721, 1645, 1601, 1423, 1287, 1285, 1002, 806 cm^{-1}; **HRMS** (ESI) m/z $[M + Na]^+$ Calcd for $[C_{24}H_{22}N_2O_4 + Na]^+$ 425.1472; Found 425.1460; **MP** 100 - 102 ºC; Enantiomeric peaks was determined *via* HPLC analysis using a Chiralpak AS-3 column; solvent: hexane/2-propanol = 60/40; flow rate: 1.0 mL/min; detection: at 254 nm); in case of minor diastereomer t_{R1} = 5.24 min, t_{R2} = 12.72 min. for 0% ee; in case of major diastereomer t_{R1} = 7.11 min, t_{R2} = 21.71 min. for 0% ee.

References and notes:

1. Wang, C. H.; White, A. R.; Schwartz, S. N.; Alluri, S.; Cattabiani, T. M.; Zhang, L. K. Chan, T. M.; Buevich, A. V.; Ganguly, A. K. *Tetrahedron* **2012**, *68*, 9750.

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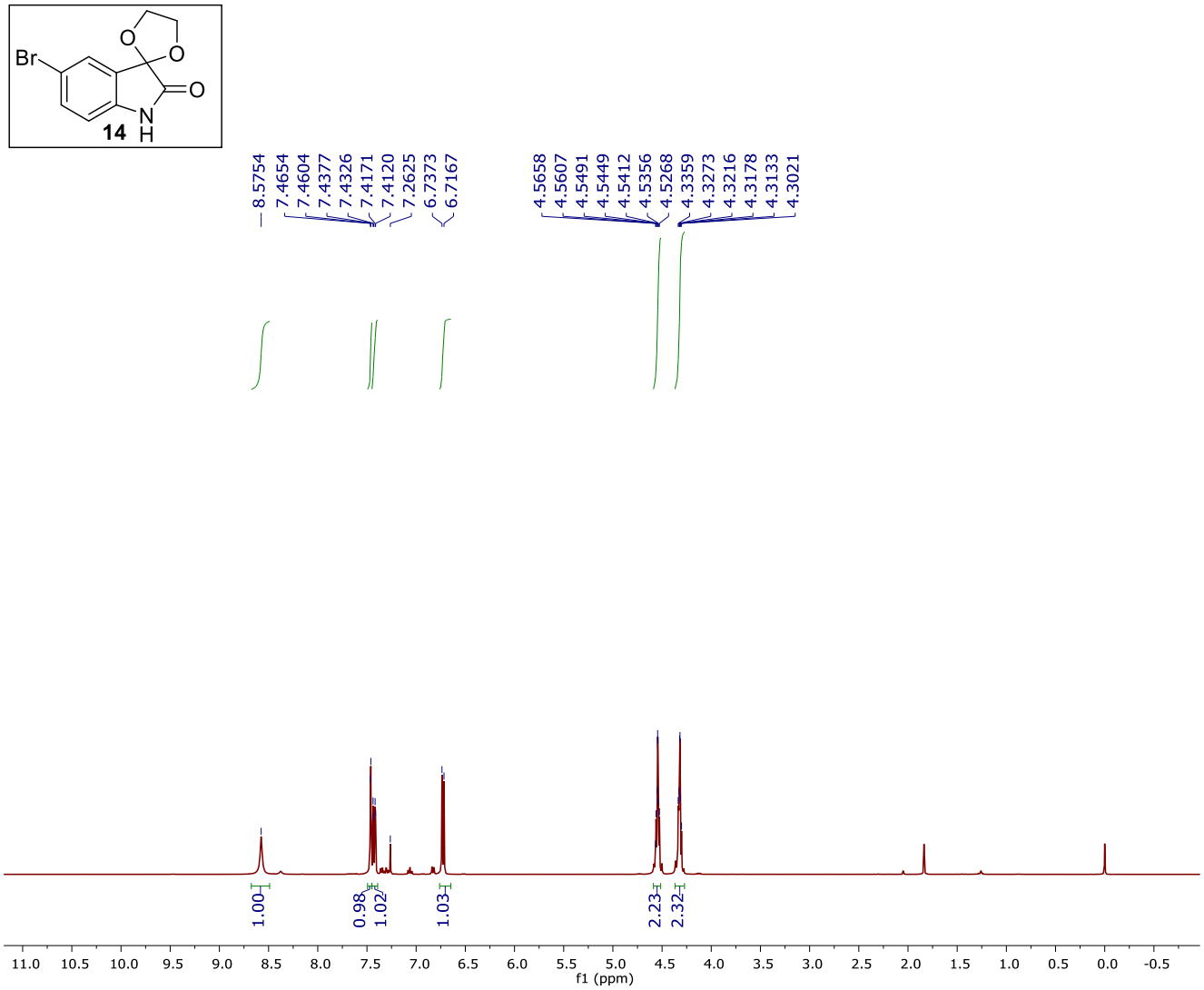
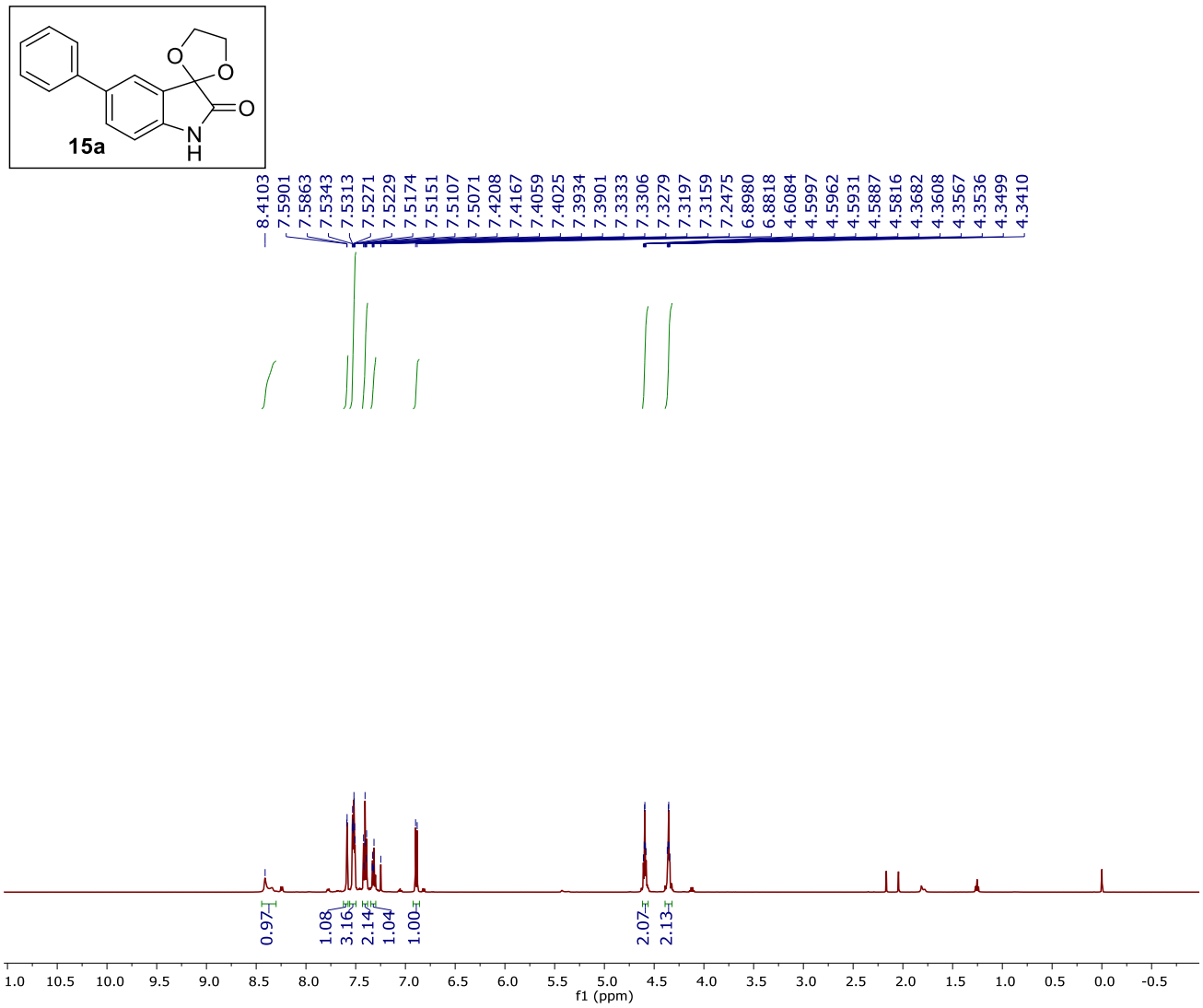
5. Babu, K. N.; Kinthada, L. K.; Ghosh, S.; Bisai, A. *Org. Biomol. Chem.* **2015**, *13*, 10641.

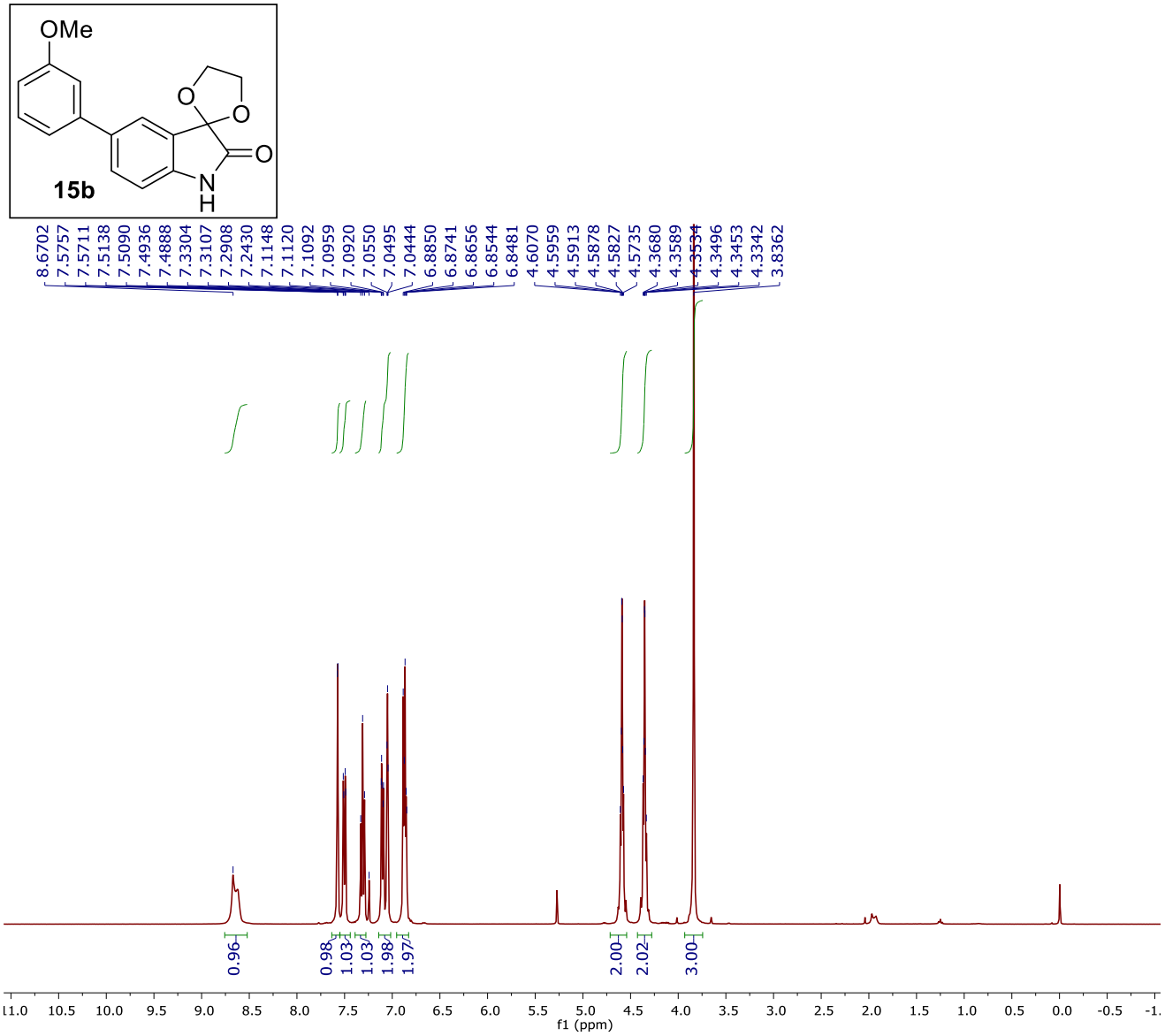
Spectral Graphics



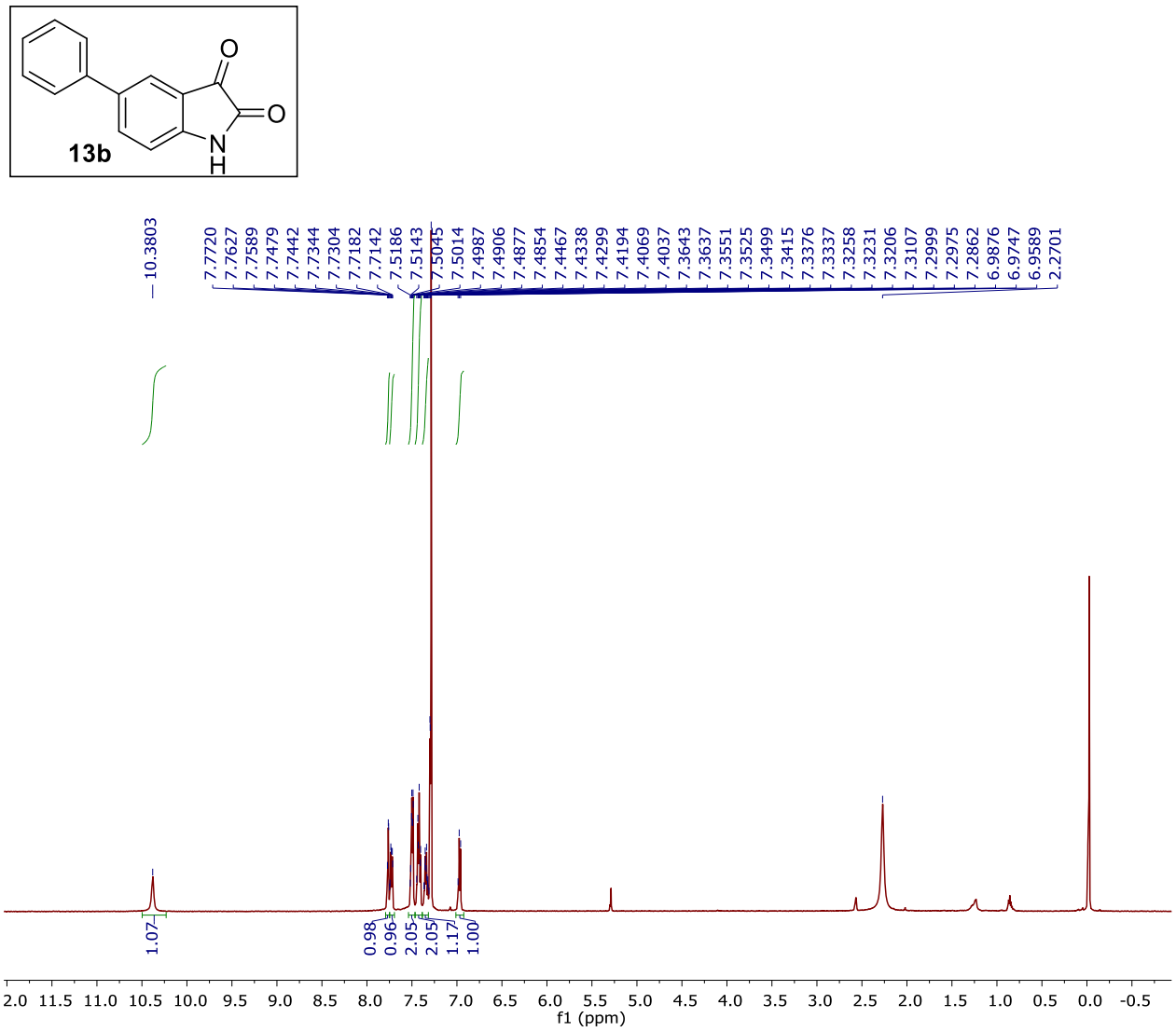
^{1}H NMR (400 MHz, $CDCl_3$) of compound **14**



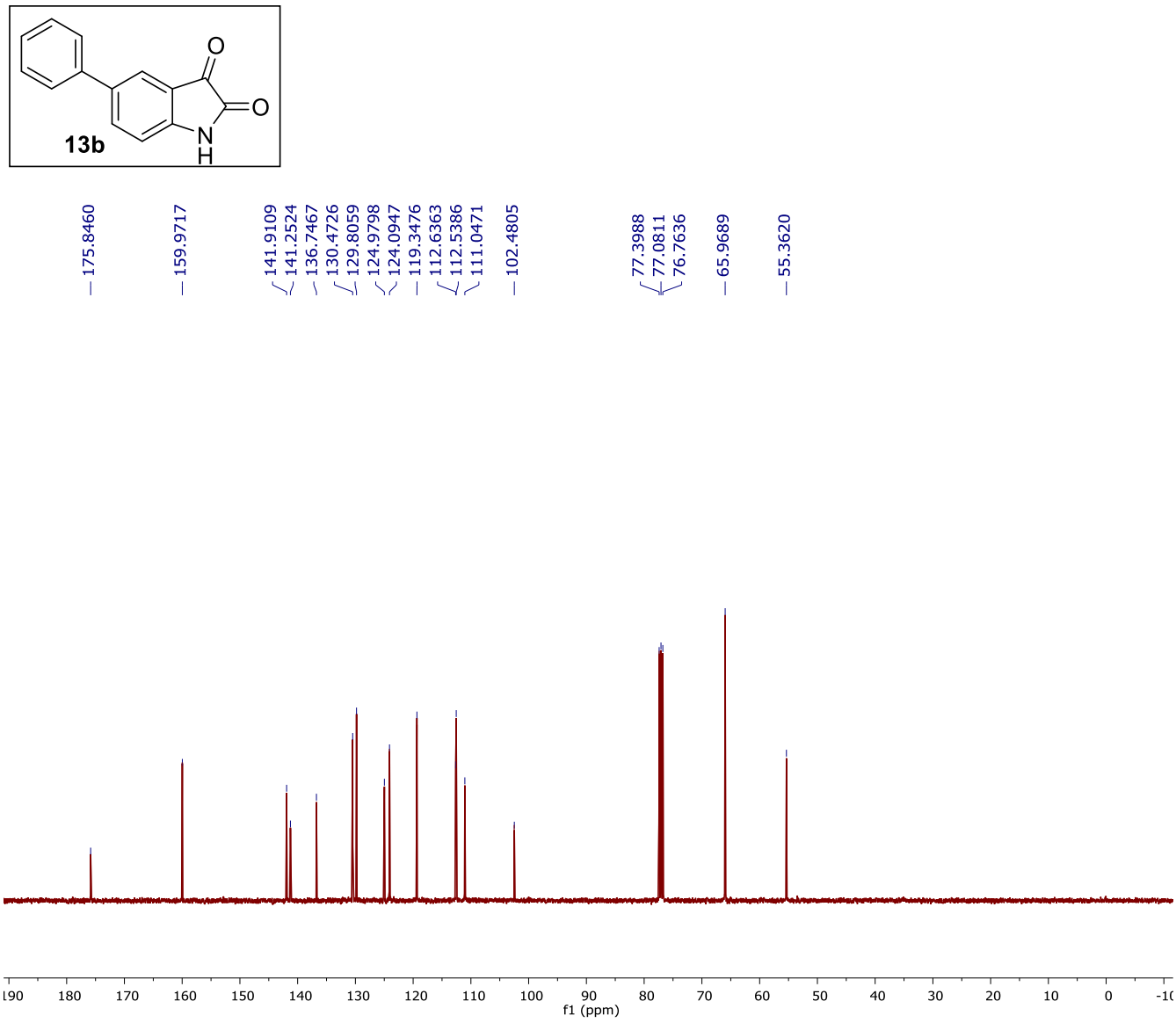
^{1}H NMR (500 MHz, $CDCl_3$) of compound **15a**



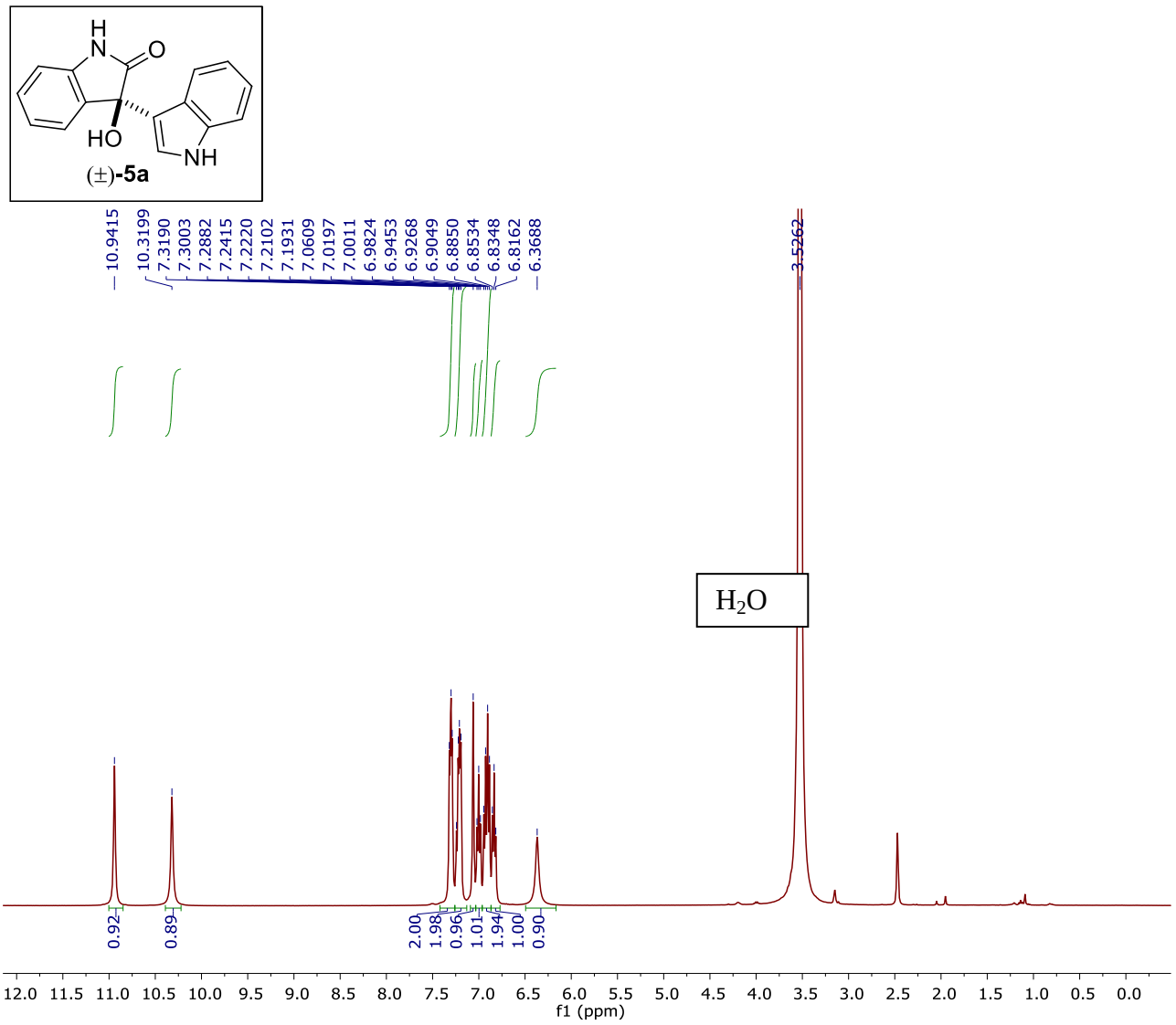
^{1}H NMR (400 MHz, $CDCl_3$) of compound **15b**



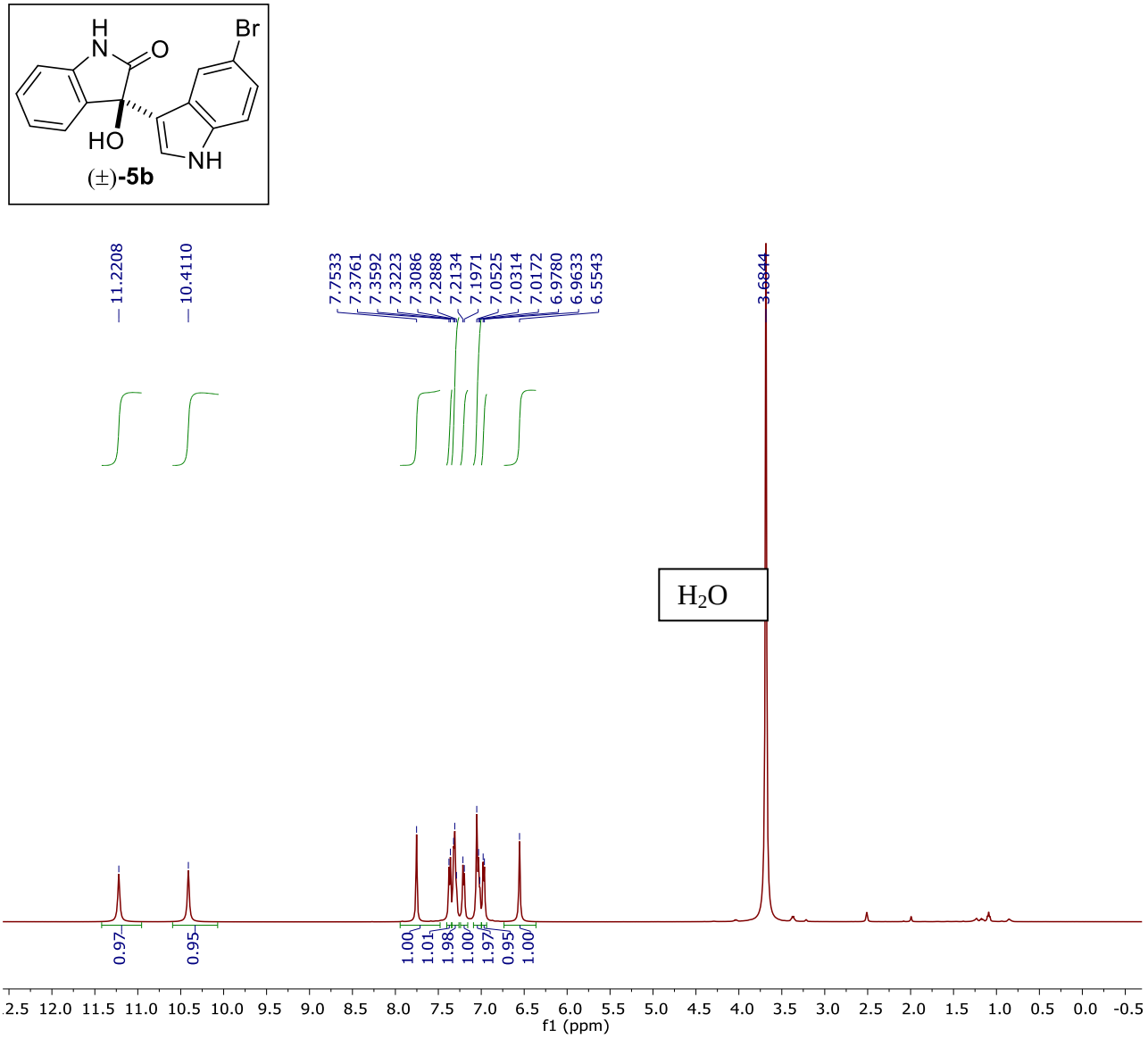
^{1}H NMR (100 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound **13b**



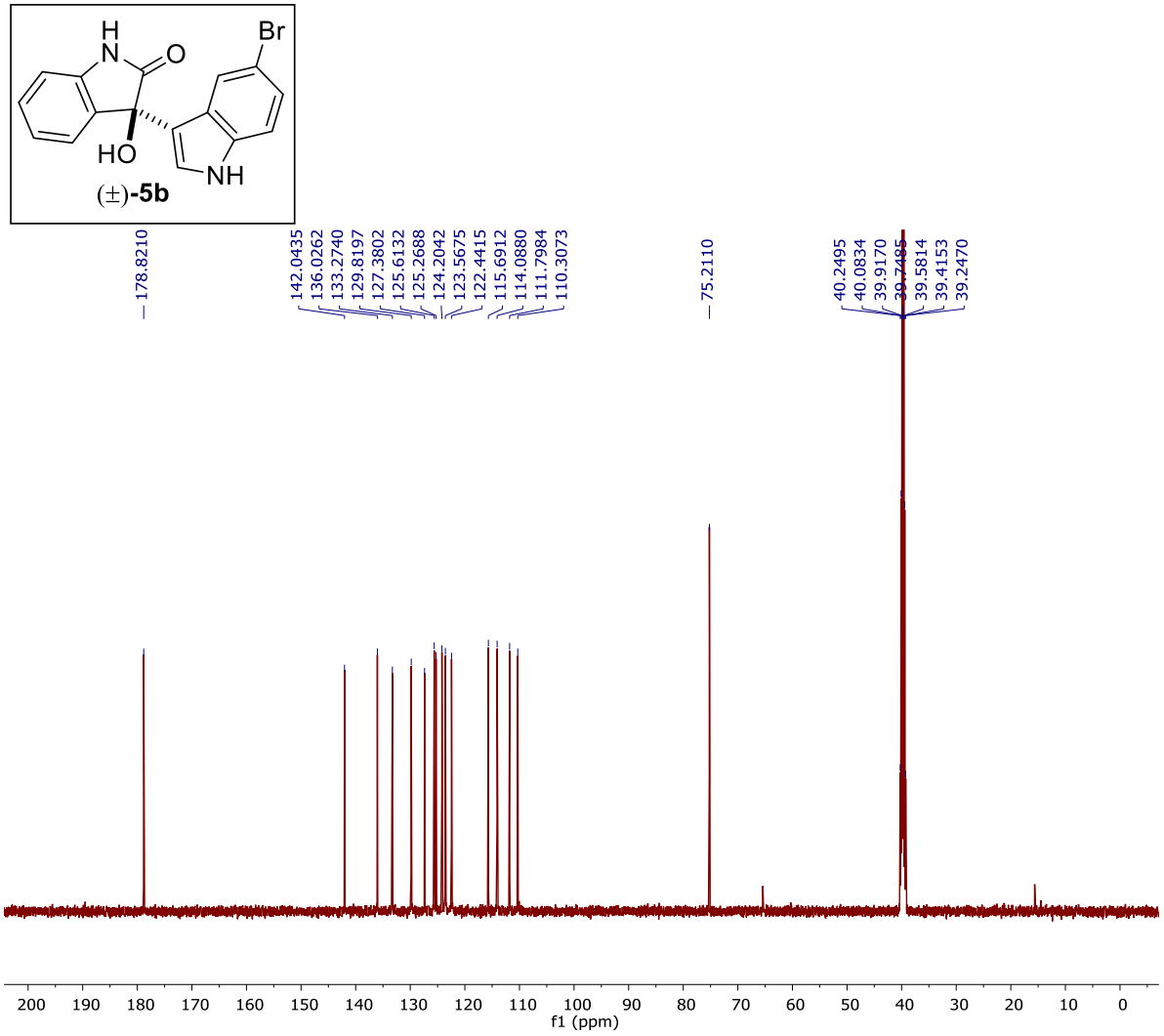
^{13}C NMR (100 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound **13b**



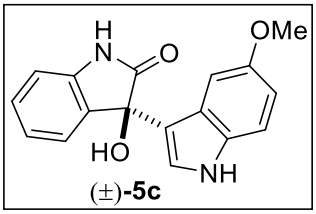
^{1}H NMR (400 MHz, DMSO-D_6) of compound (±)-**5a**



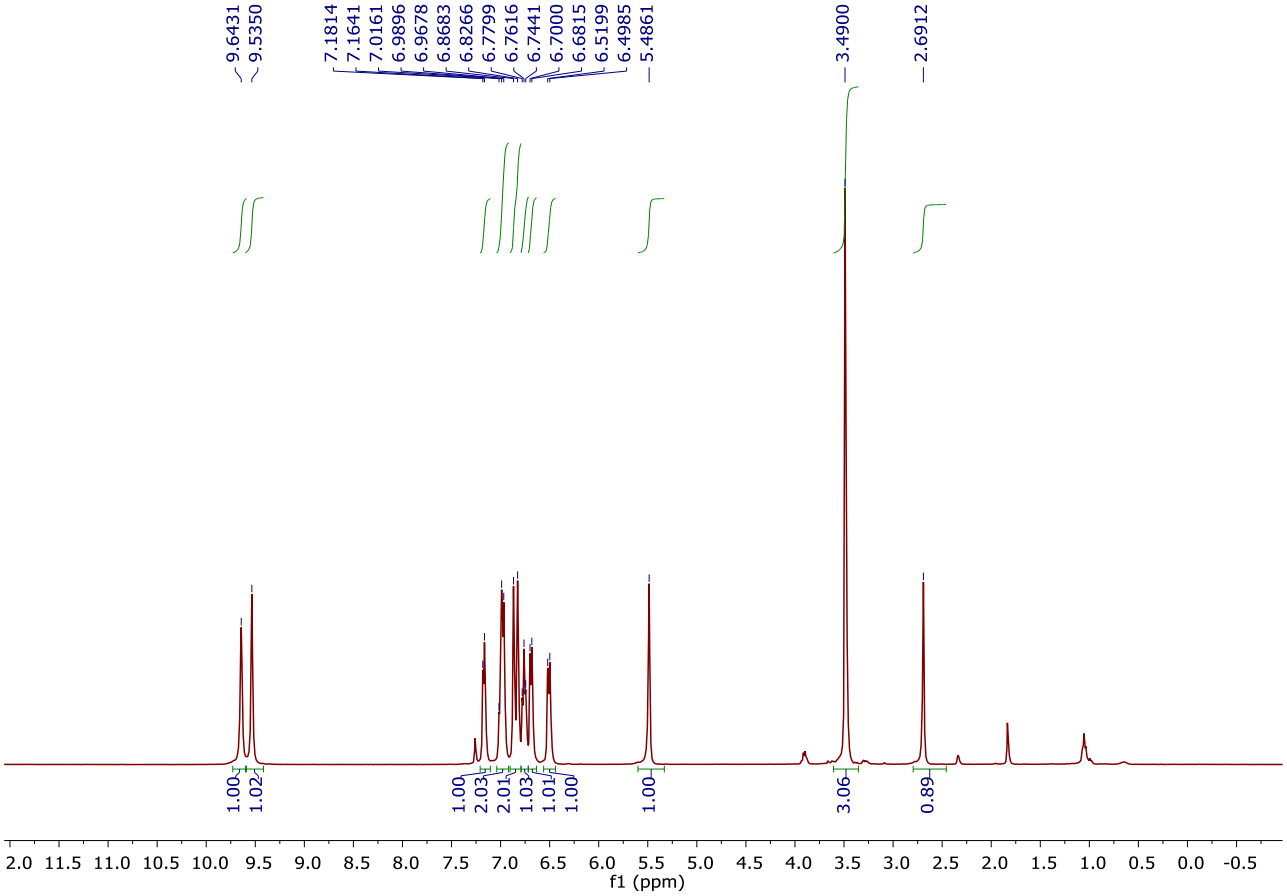
^{1}H NMR (500 MHz, DMSO-D_6) of compound (±)-**5b**



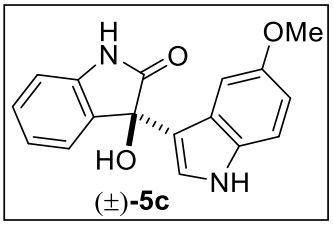
^{13}C NMR (125 MHz, DMSO-D_6) of compound (±)-**5b**



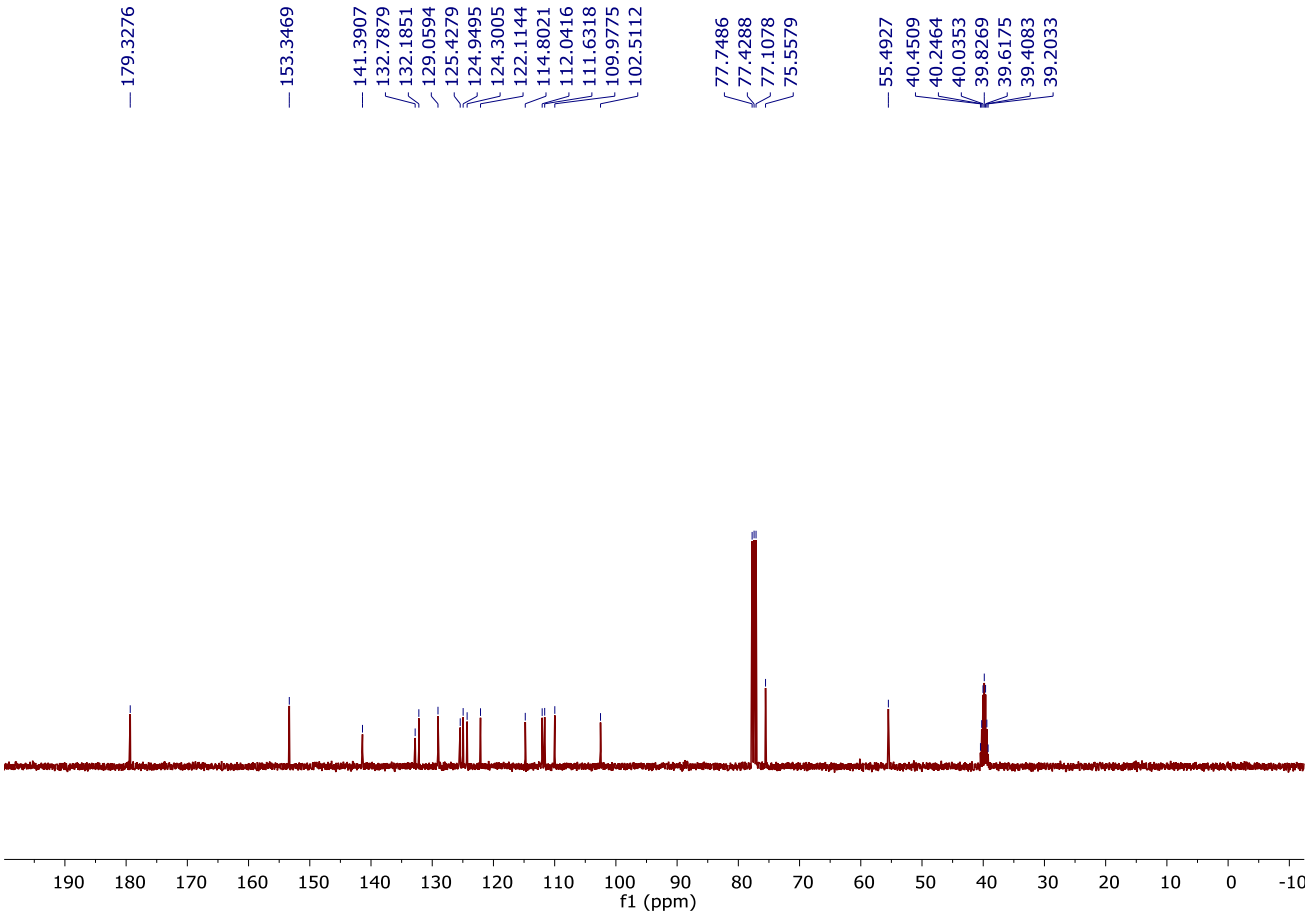
(±)-**5c**



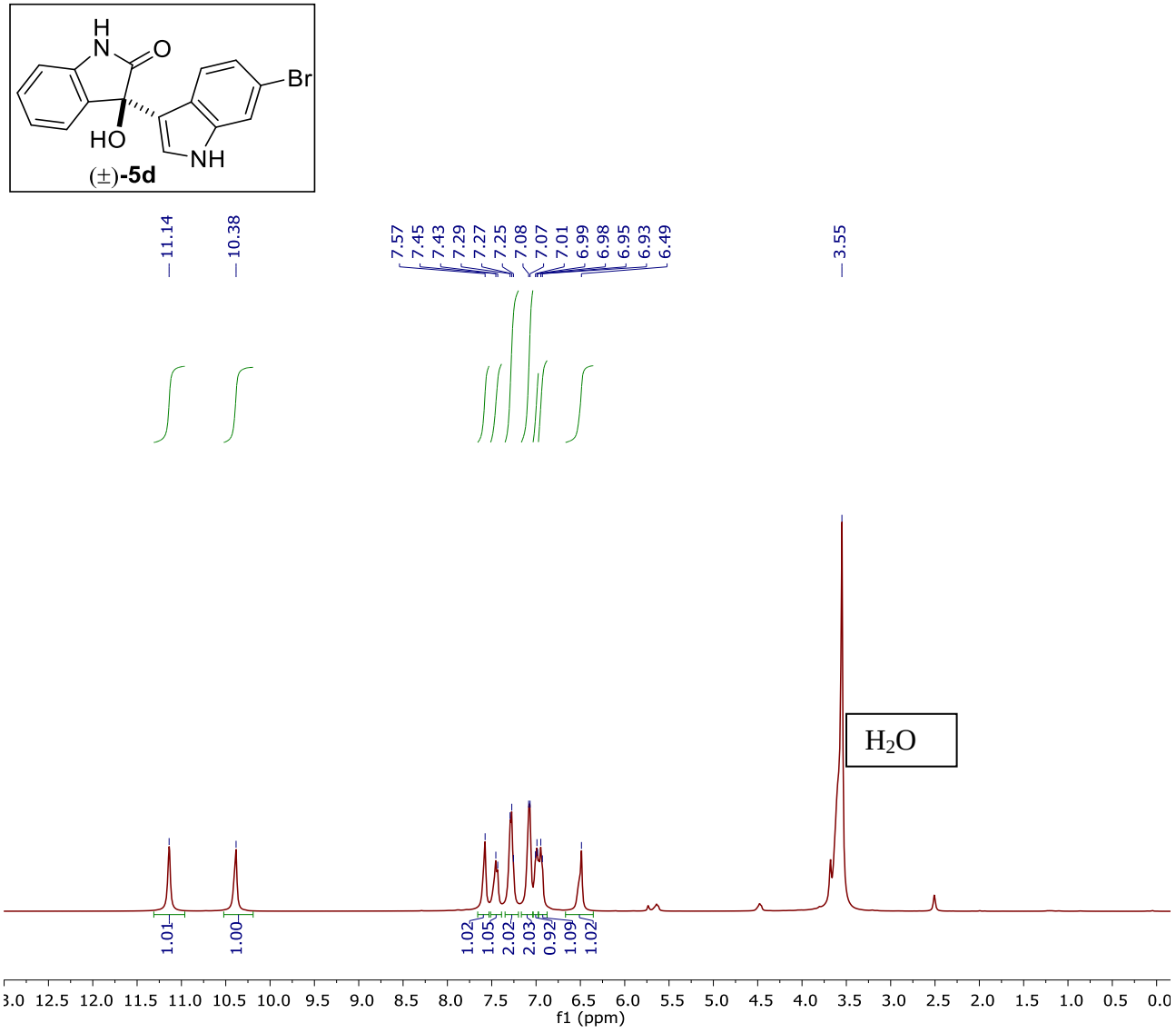
^{1}H NMR (400 MHz, $CDCl_3$) of compound (±)-**5c**



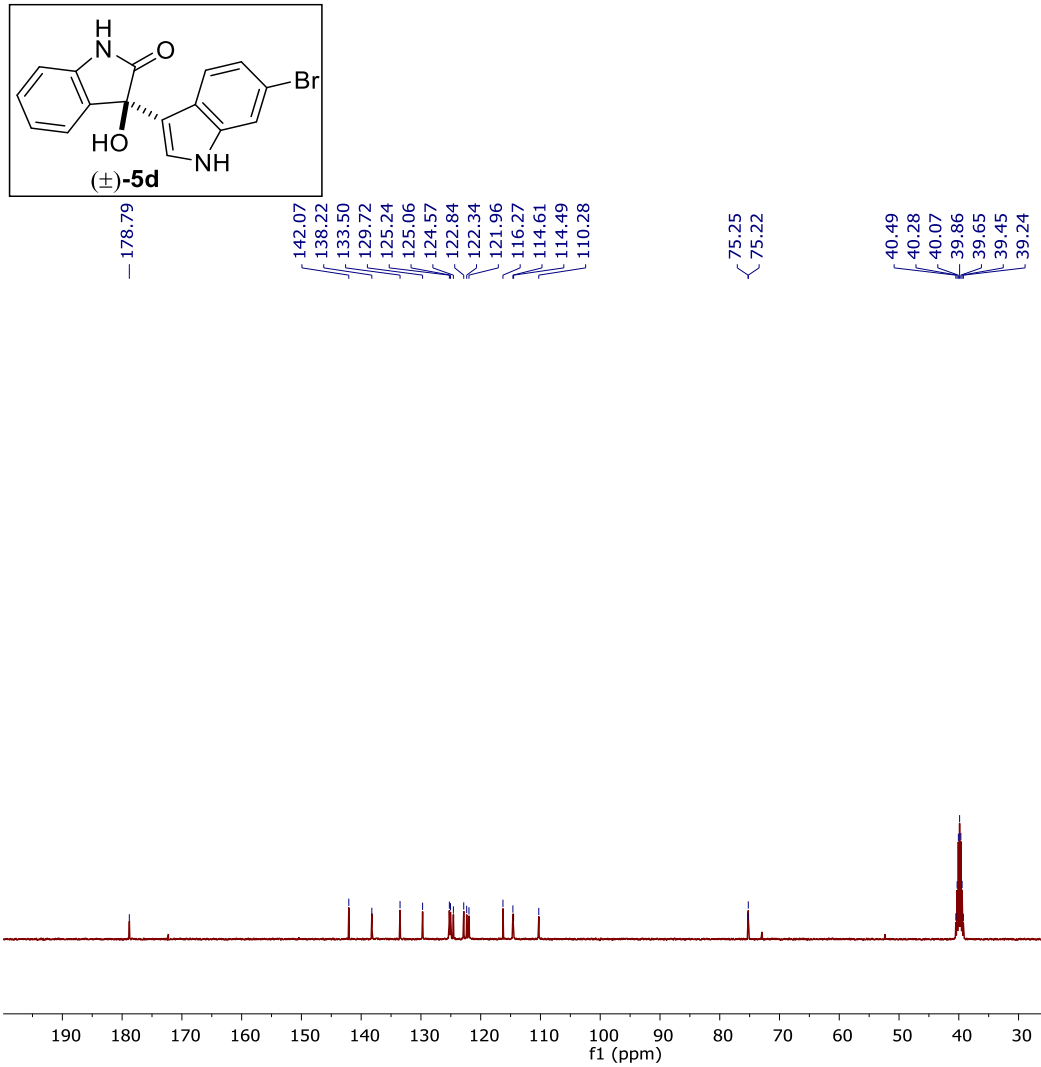
(±)-**5c**



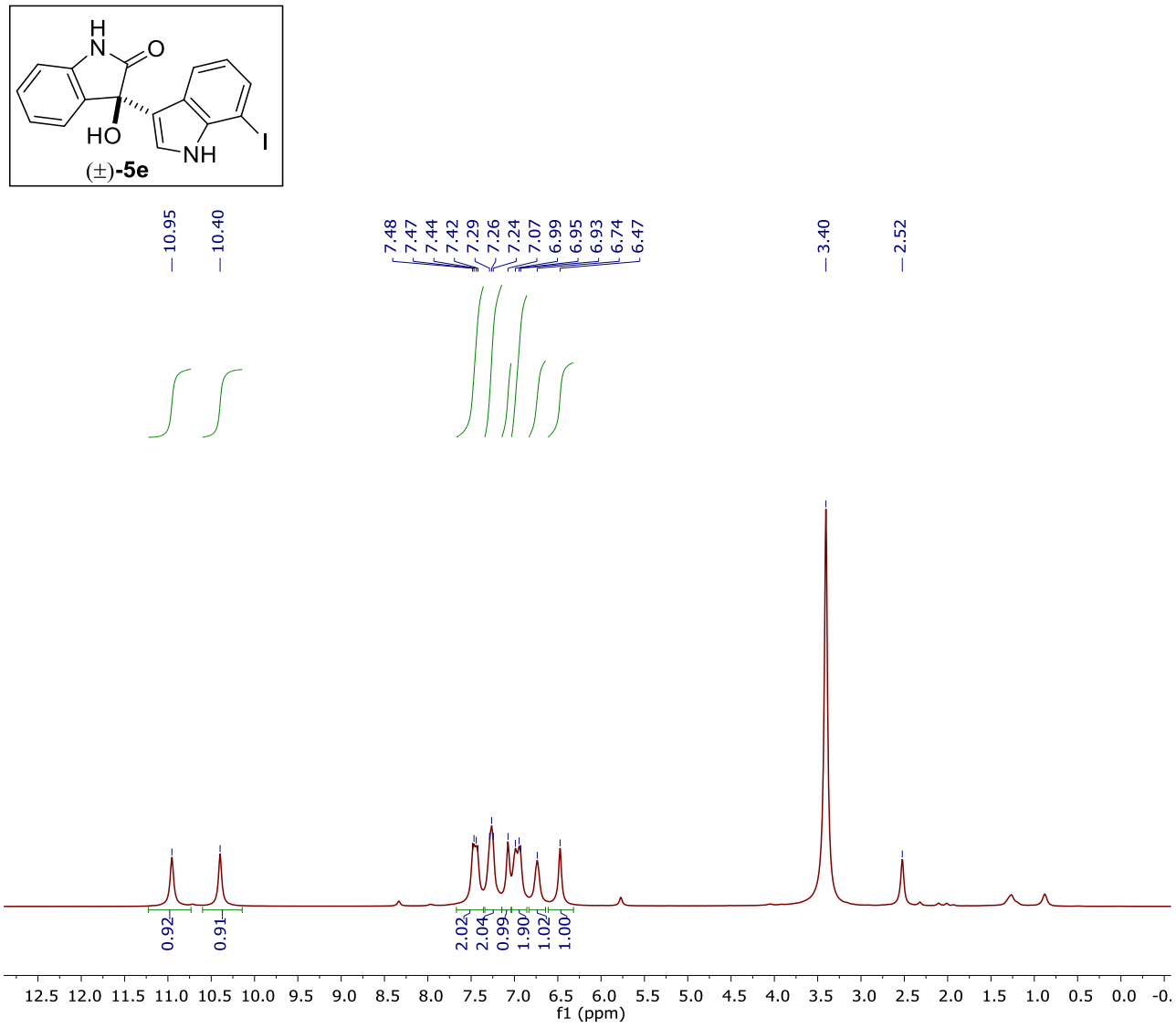
^{13}C NMR (100 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (±)-**5c**



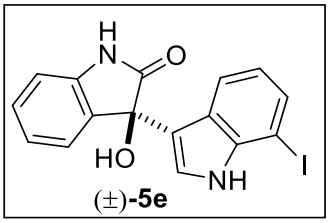
^{1}H NMR (400 MHz, DMSO-D_6) of compound (±)-**5d**



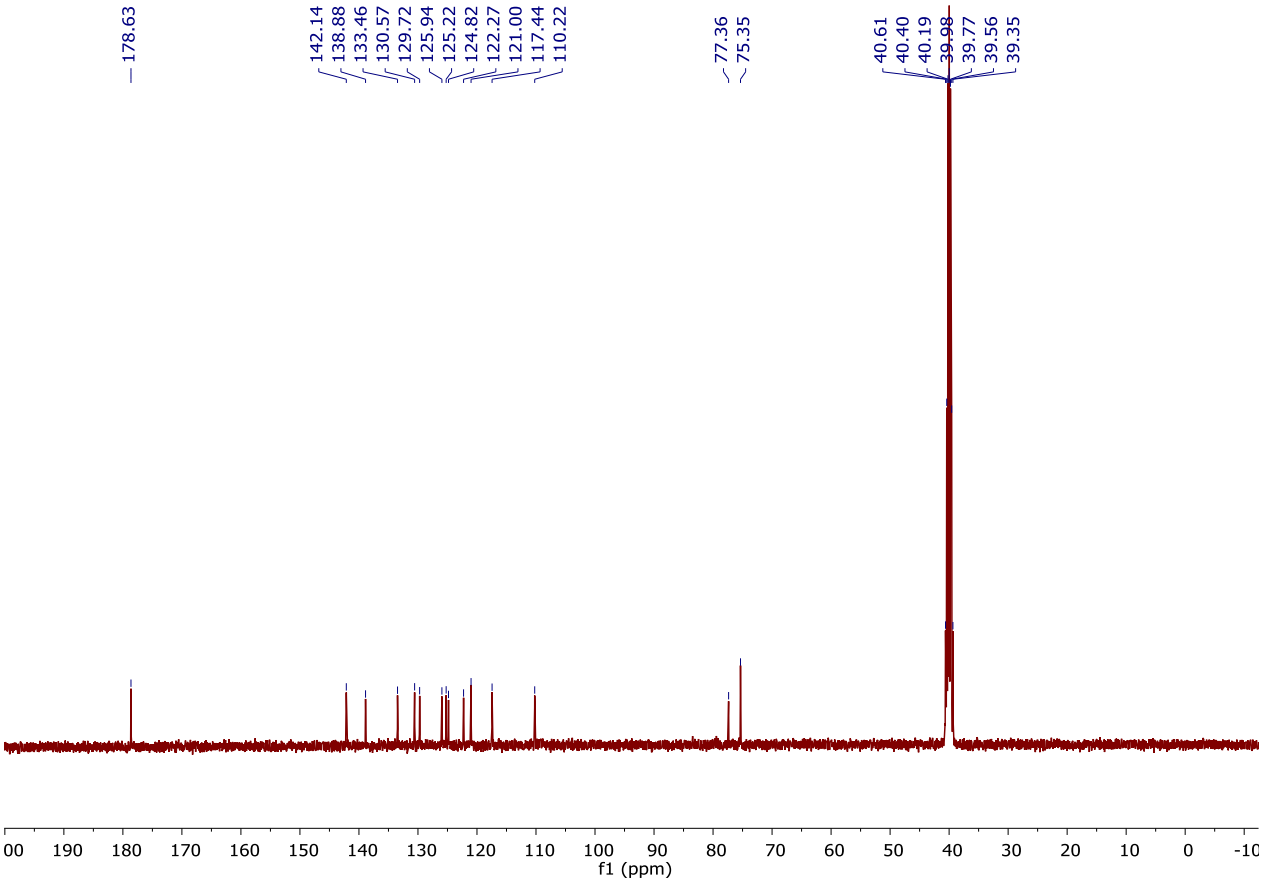
^{13}C NMR (100 MHz, DMSO-D_6) of compound (±)-**5d**



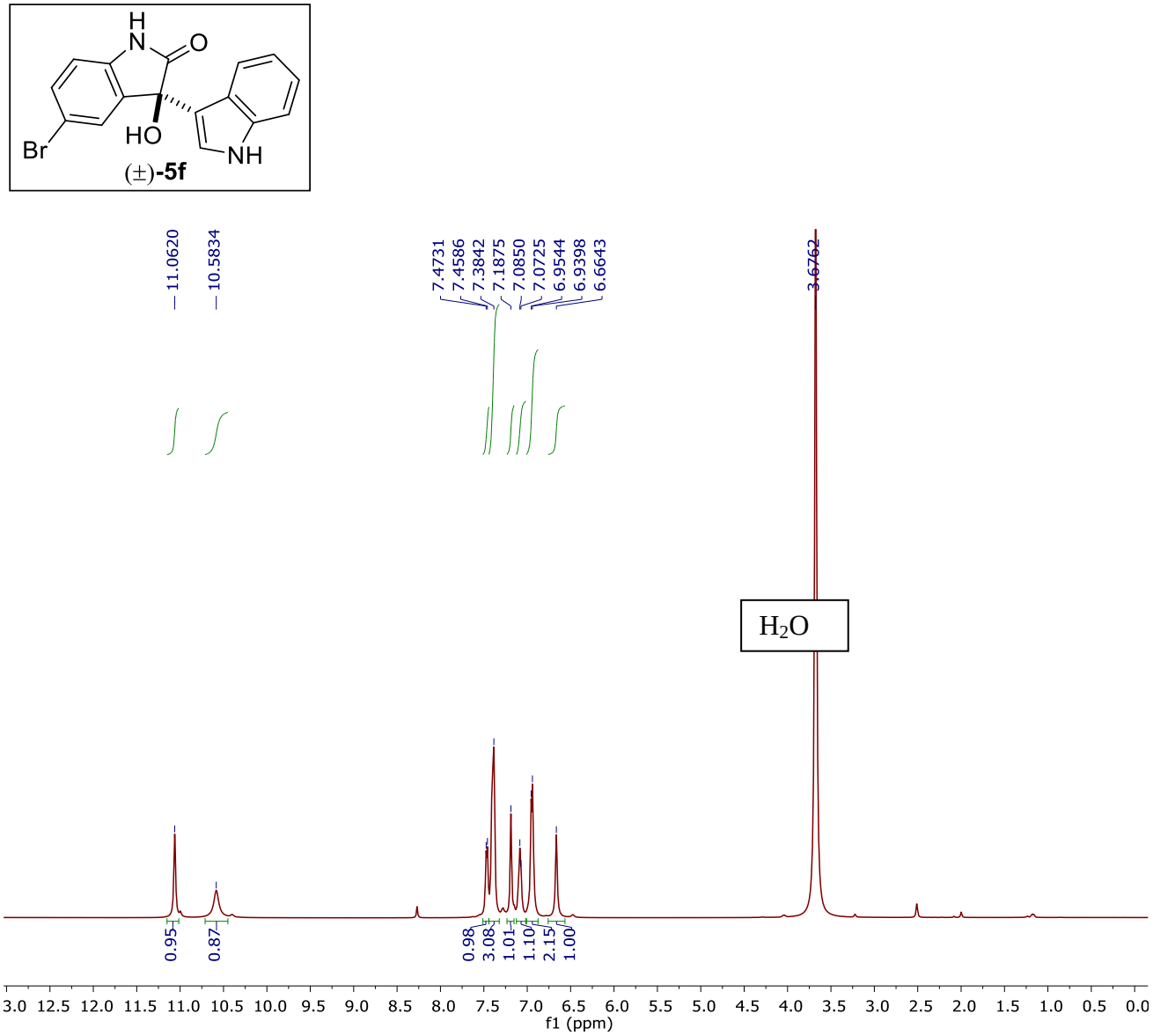
^{1}H NMR (400 MHz, DMSO-D_6) of compound (±)-**5e**



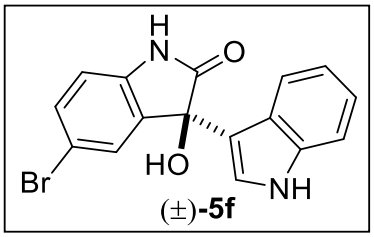
(±)-**5e**

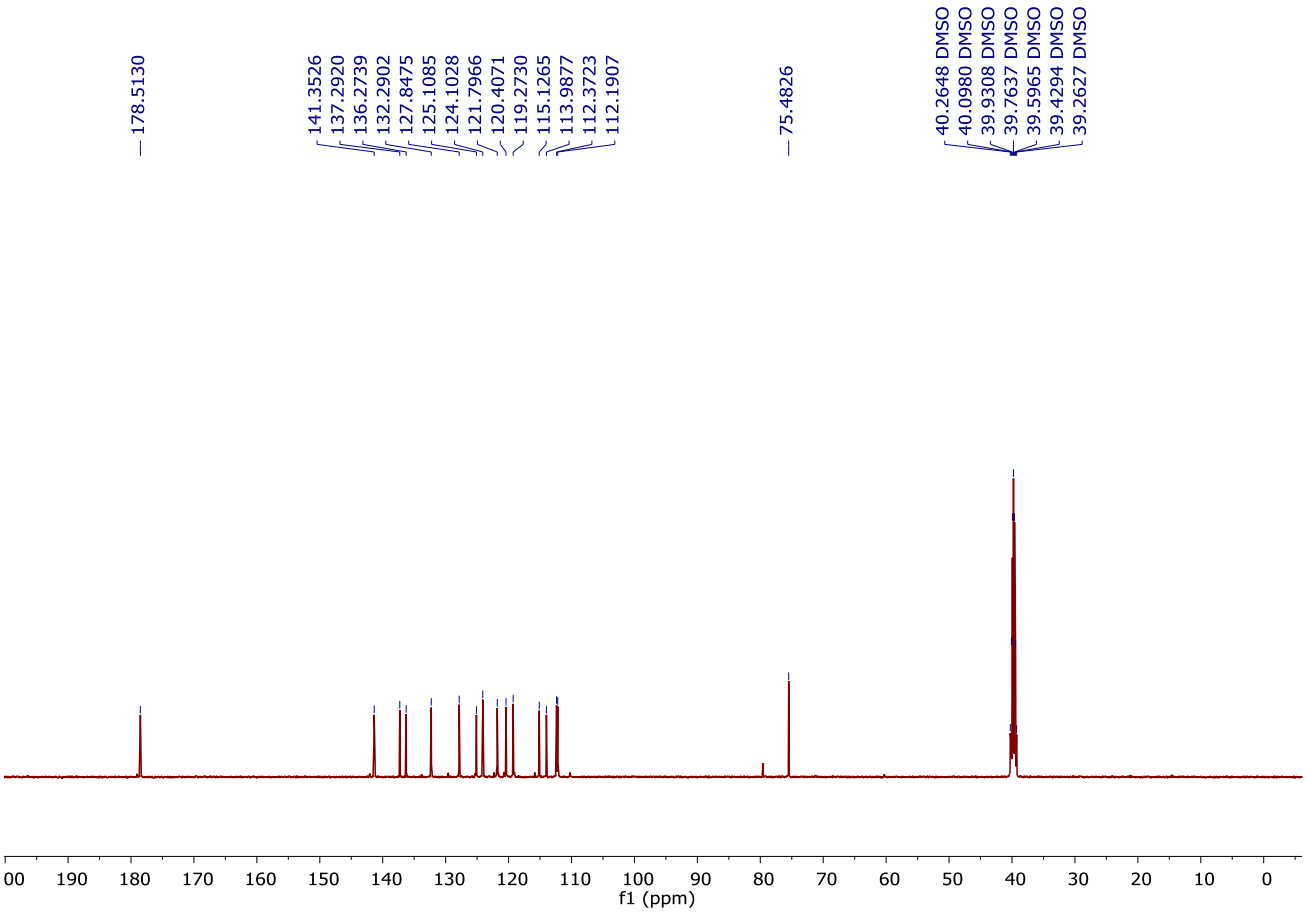


^{13}C NMR (100 MHz, DMSO-D_6) of compound (±)-**5e**

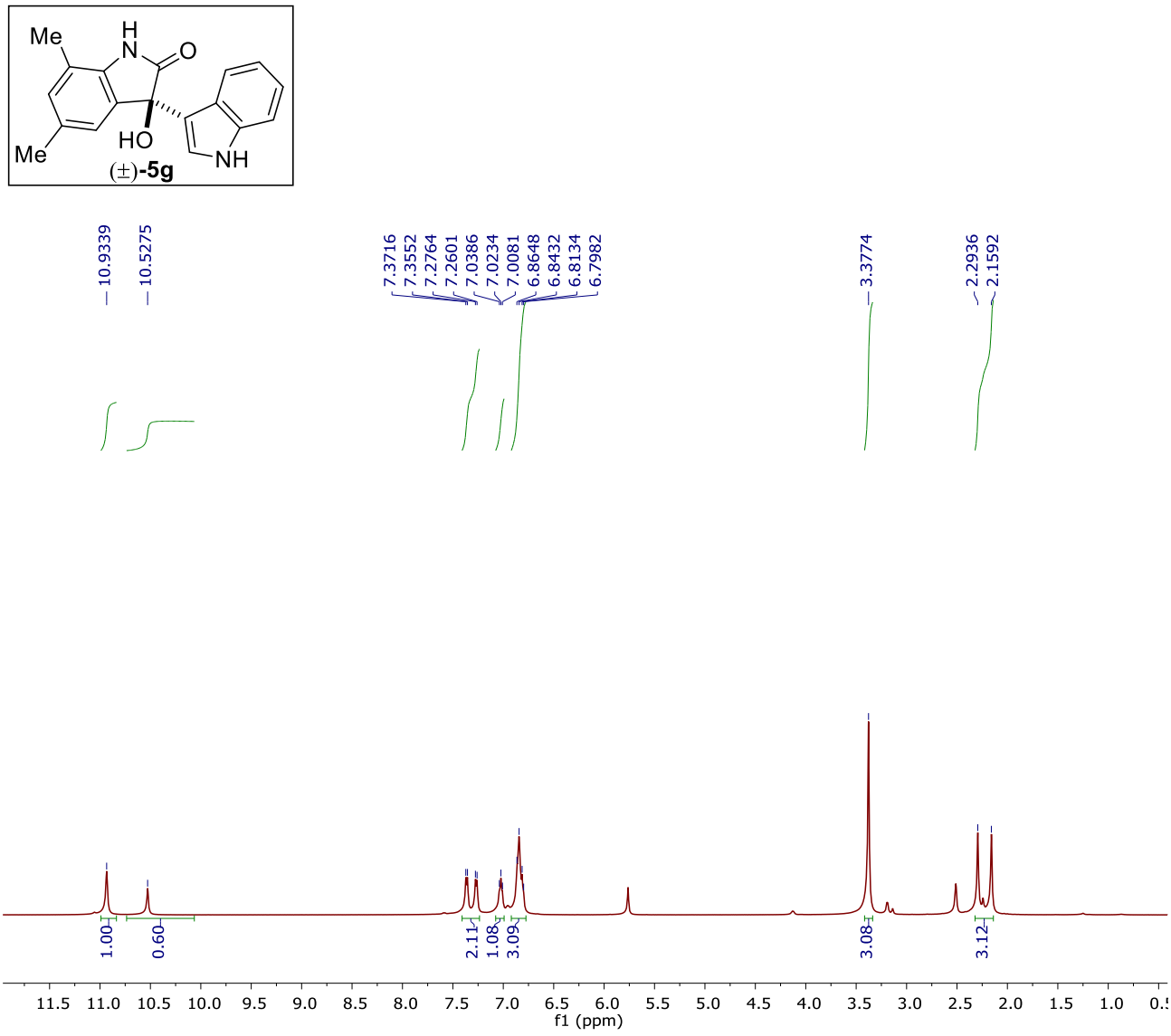


^{1}H NMR (500 MHz, DMSO-D_6) of compound (±)-**5f**

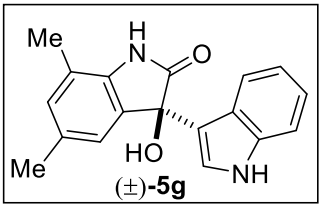


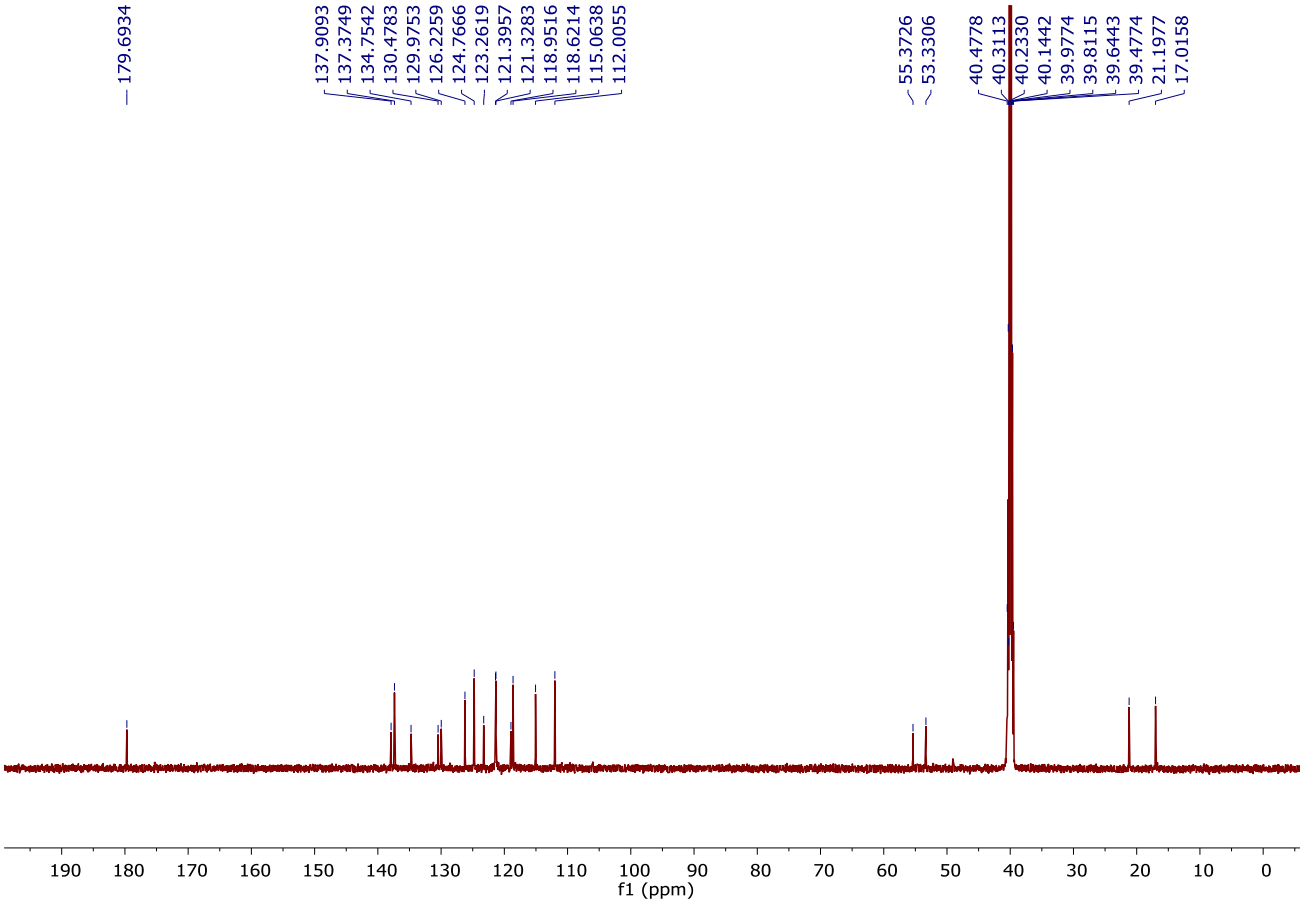


^{13}C NMR (125 MHz, DMSO-D_6) of compound (±)-**5f**

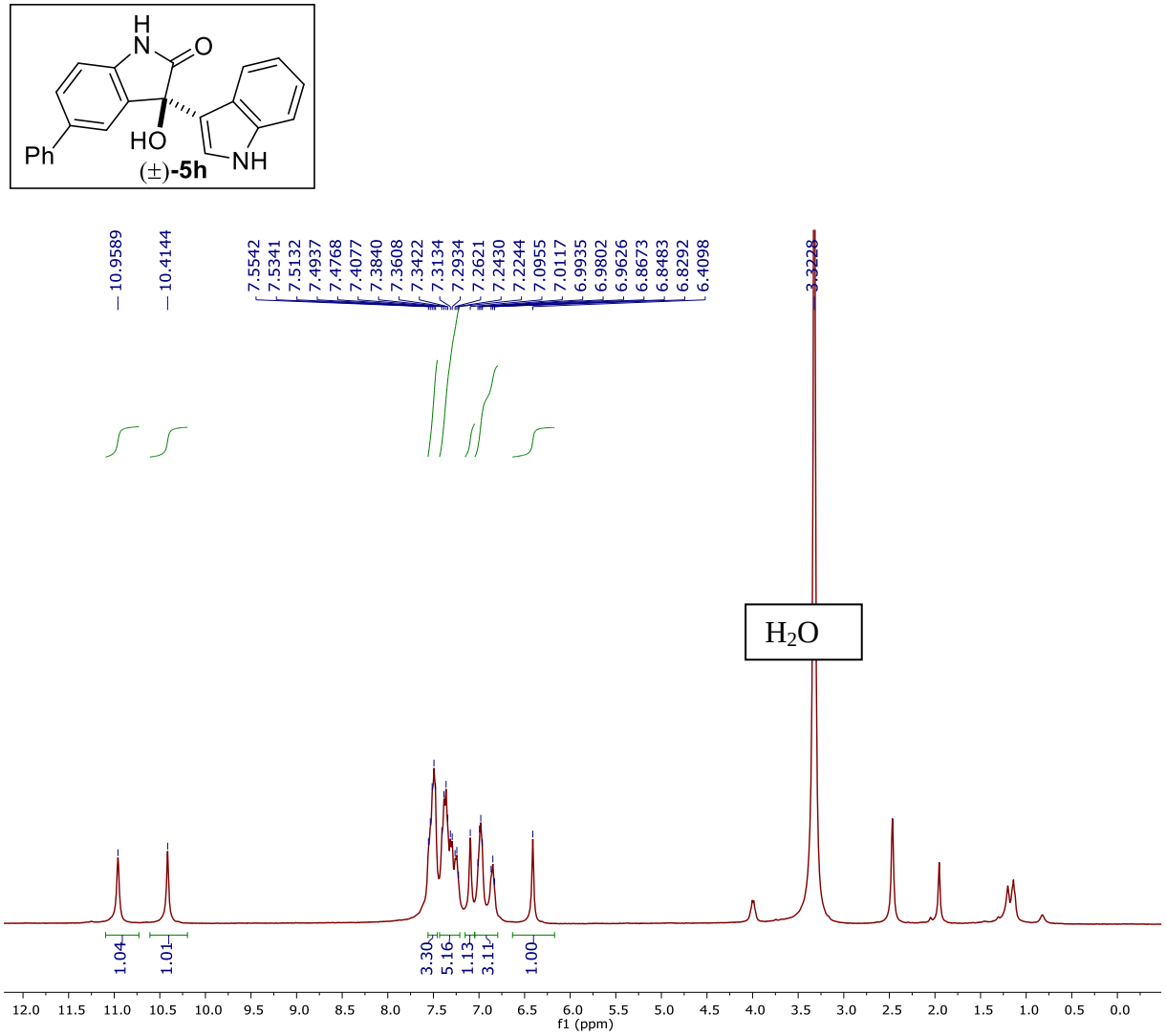


^{1}H NMR (500 MHz, DMSO-D_6) of compound (±)-**5g**

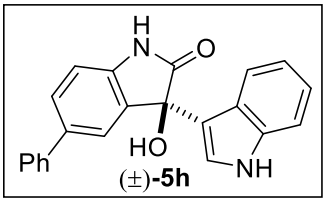


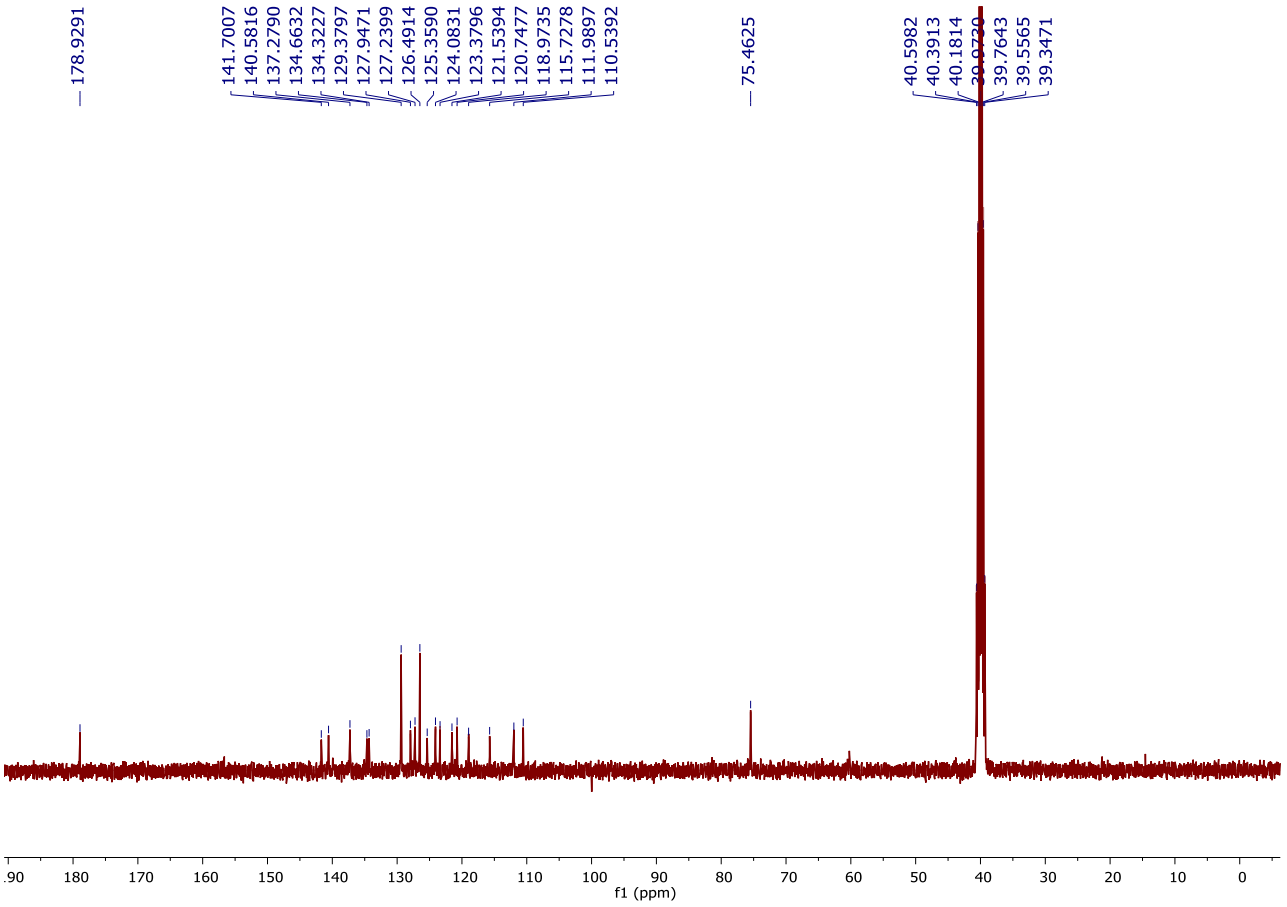


^{13}C NMR (125 MHz, DMSO-D$_6$) of compound (±)-**5g**

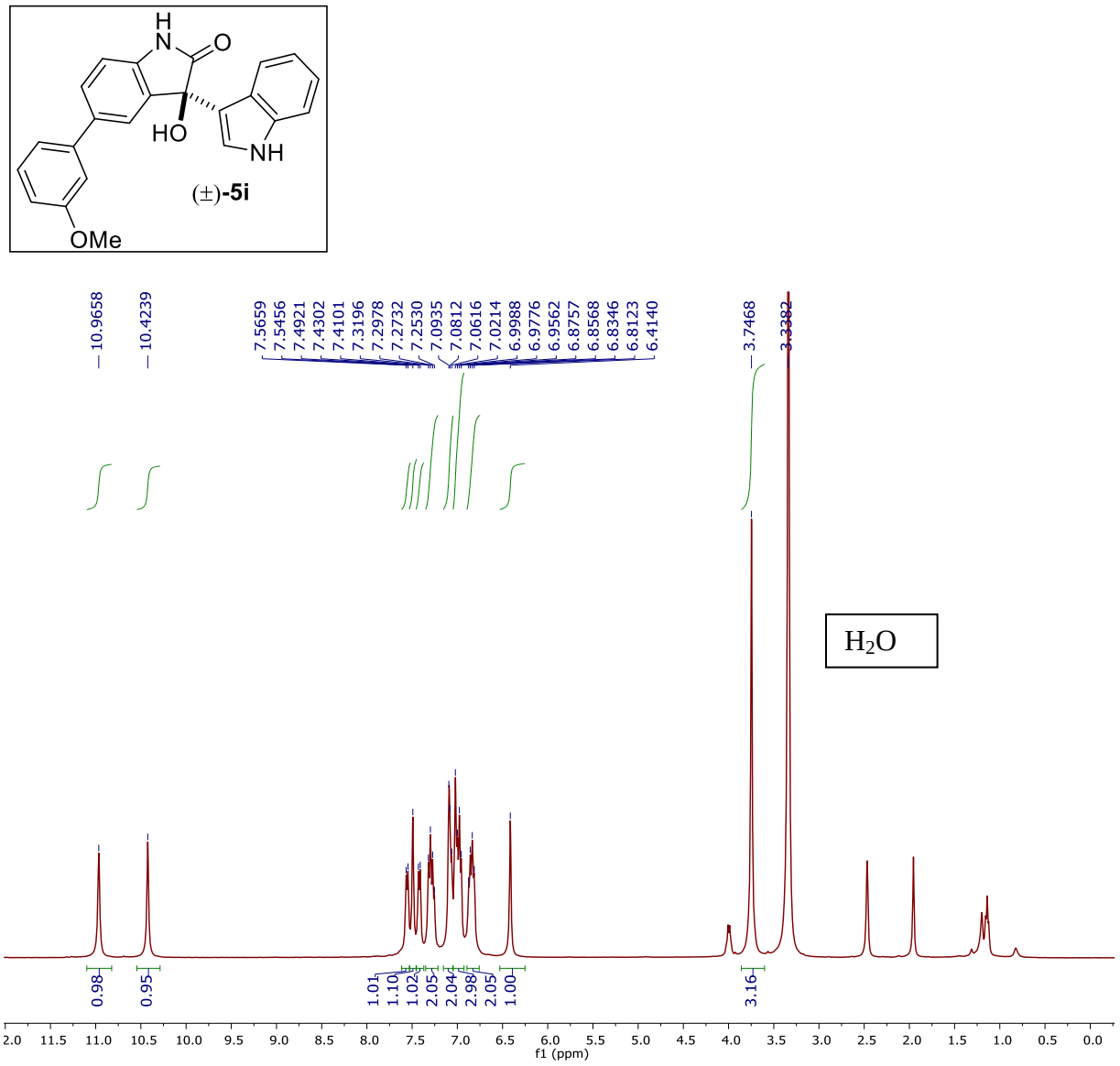


^{1}H NMR (500 MHz, DMSO-D_6) of compound (±)-**5h**

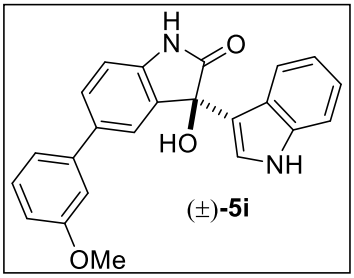




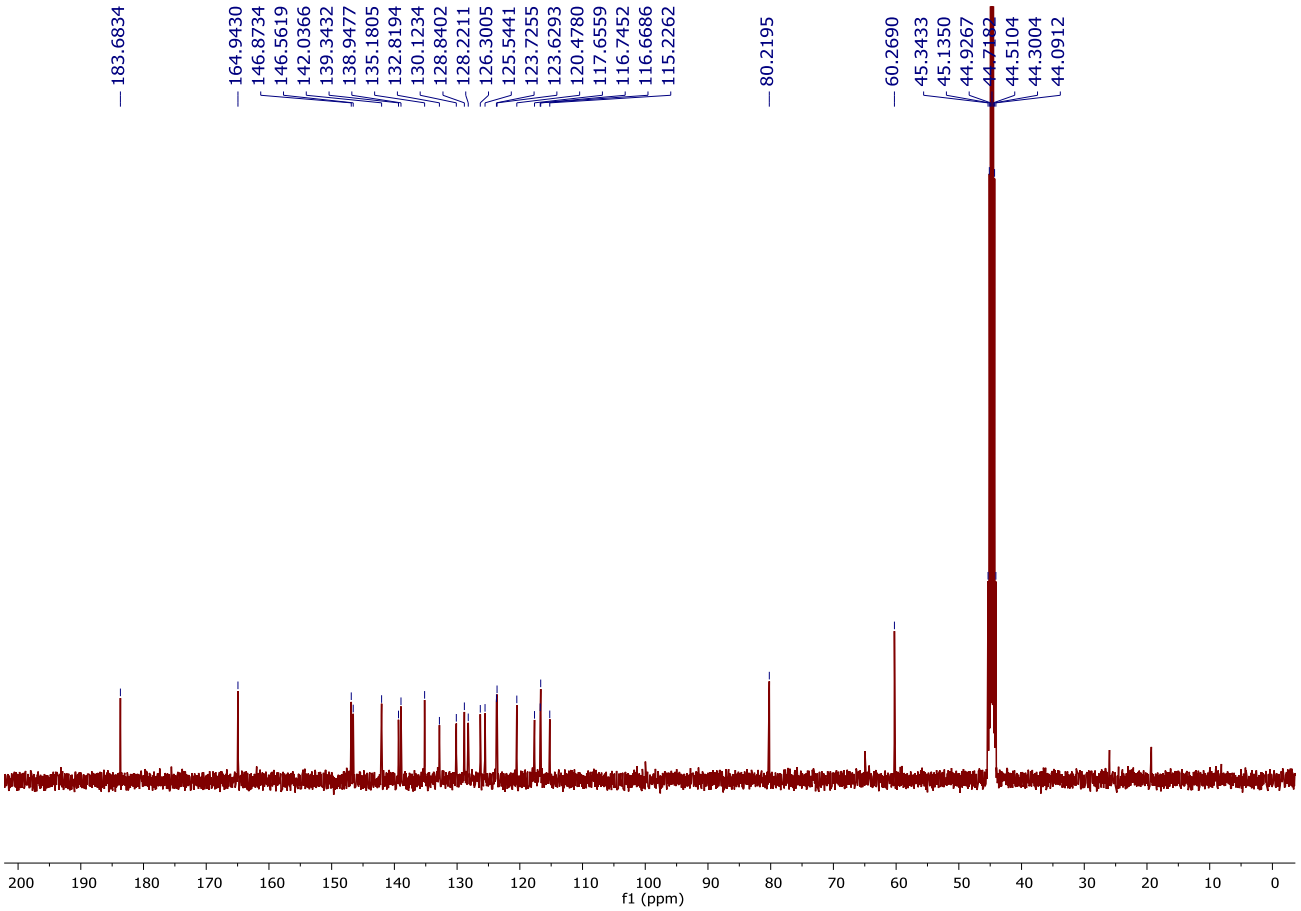
^{13}C NMR (125 MHz, DMSO-D_6) of compound (±)-**5h**



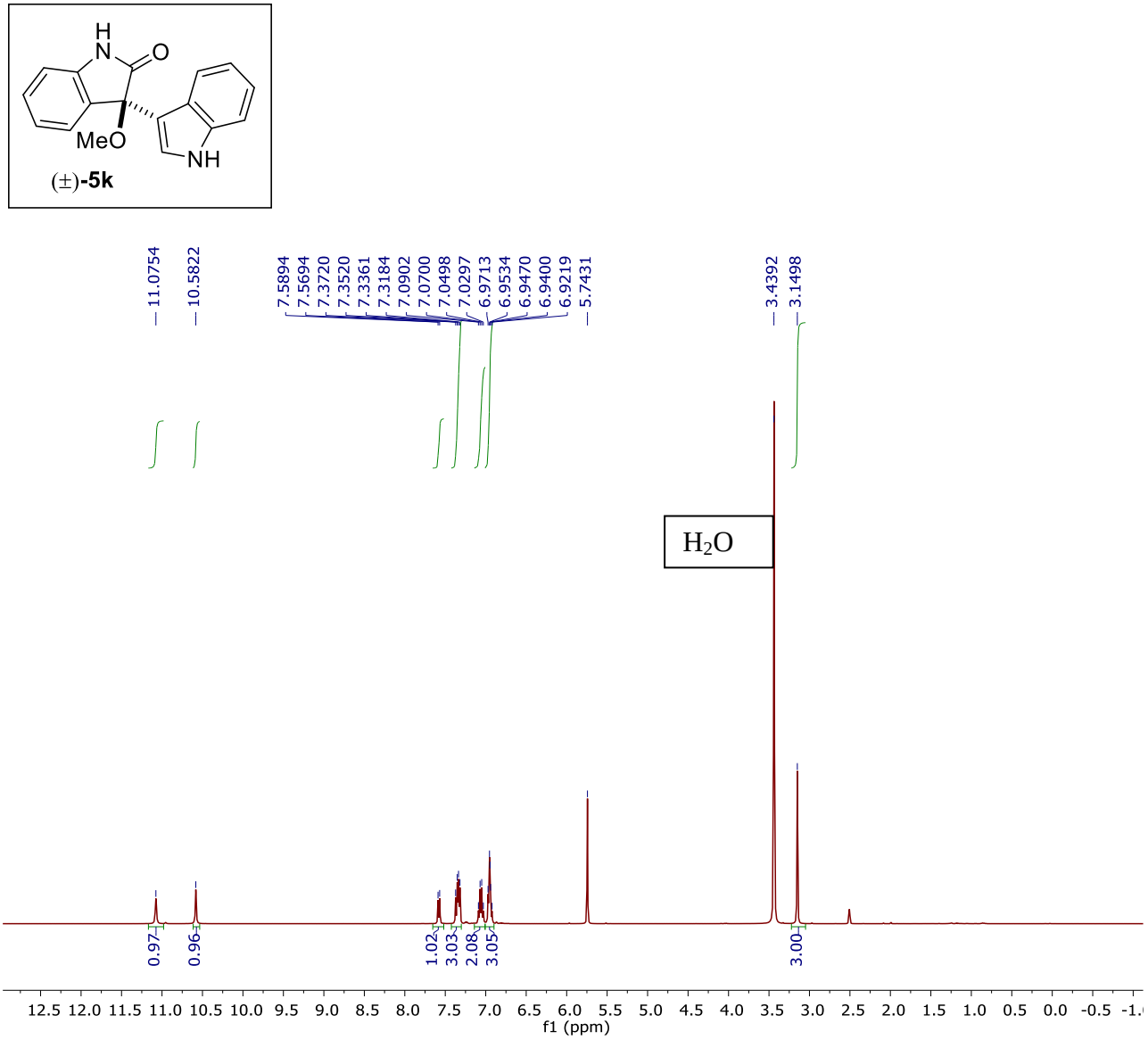
^{1}H NMR (500 MHz, DMSO-D_6) of compound (±)-**5i**



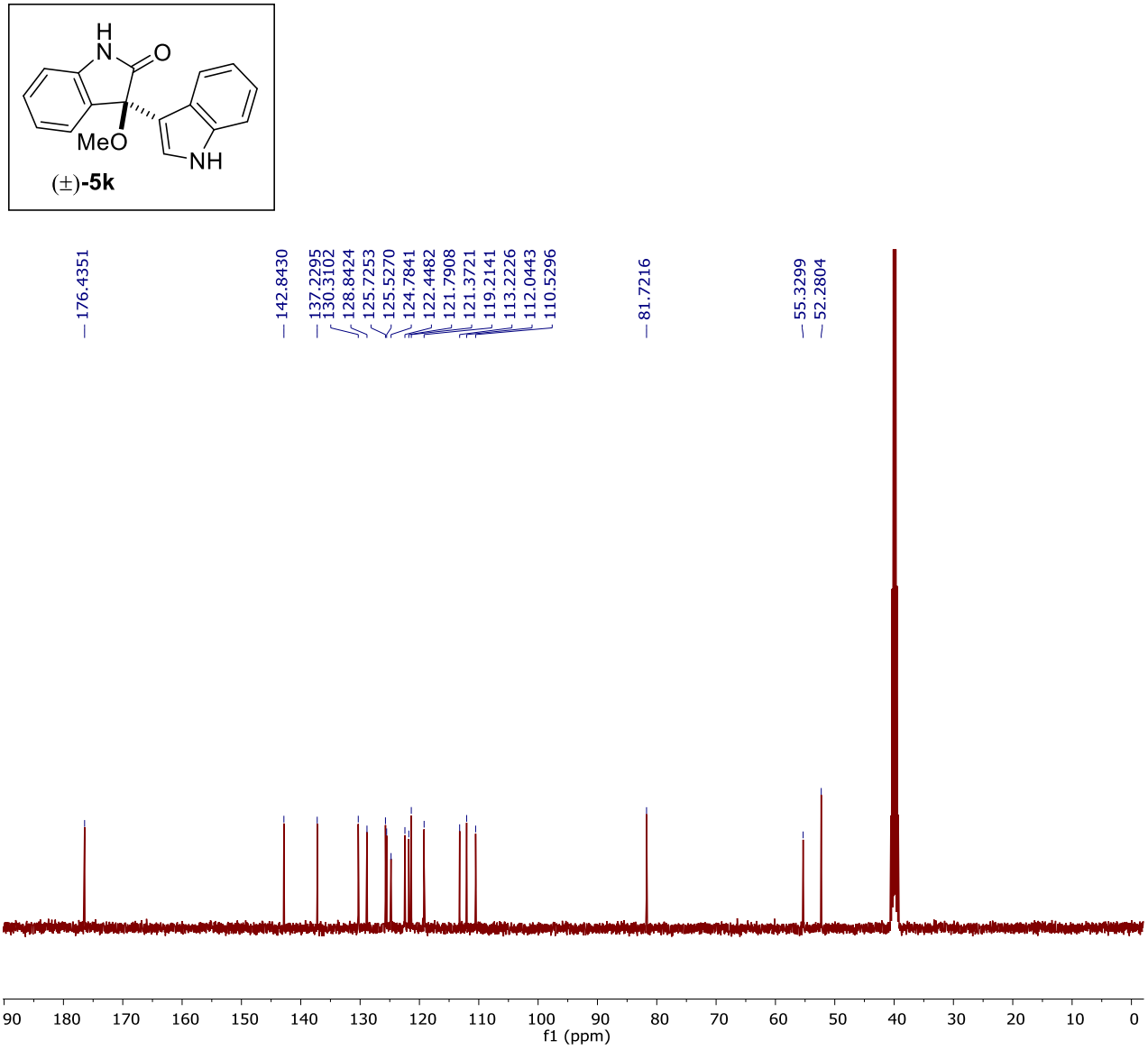
(±)**-5i**



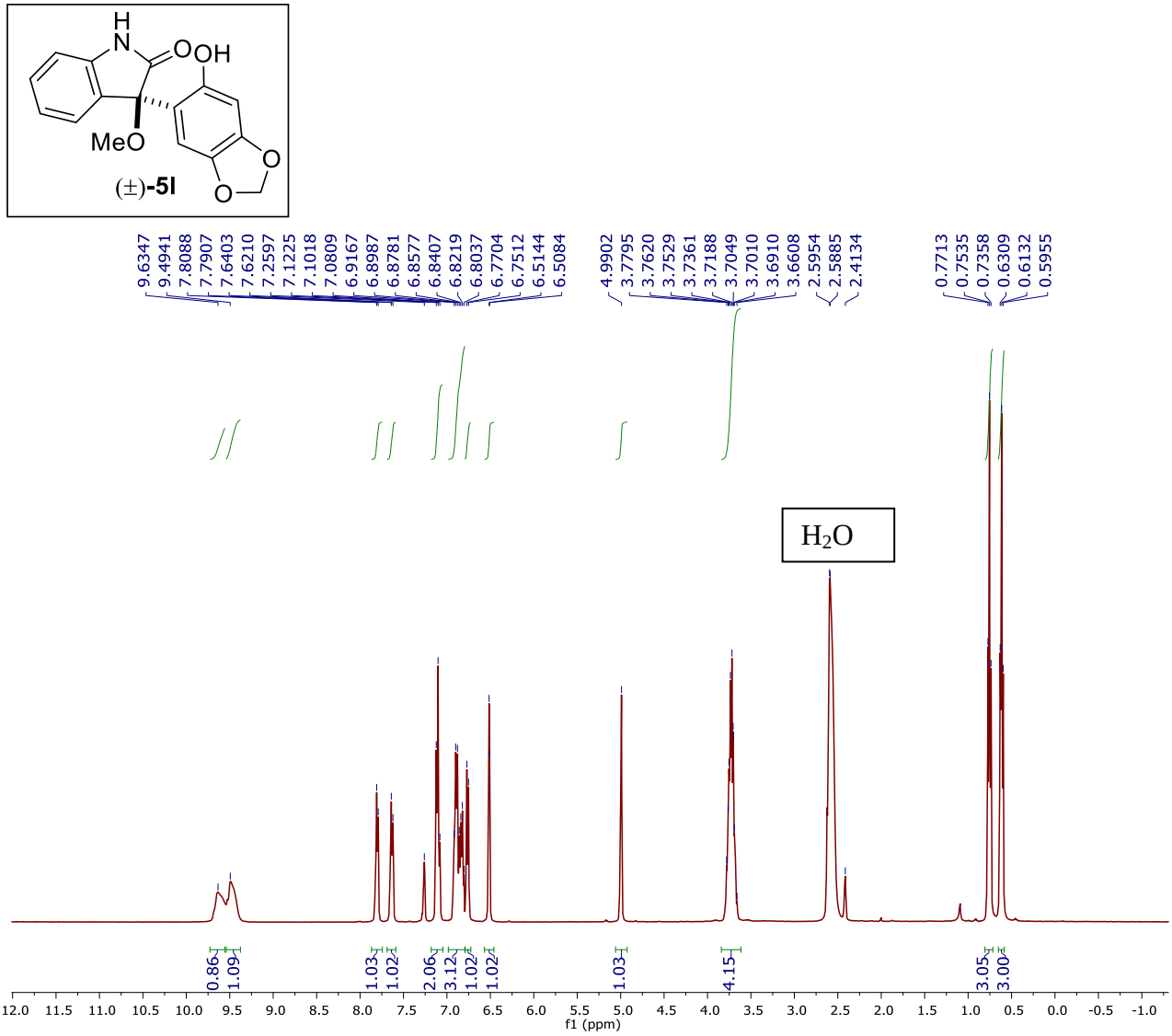
^{13}C NMR (125 MHz, DMSO-D_6) of compound (±)**-5i**



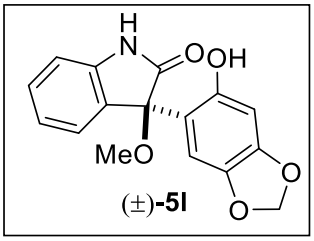
^{1}H NMR (500 MHz, DMSO-D_6) of compound (±)-**5k**

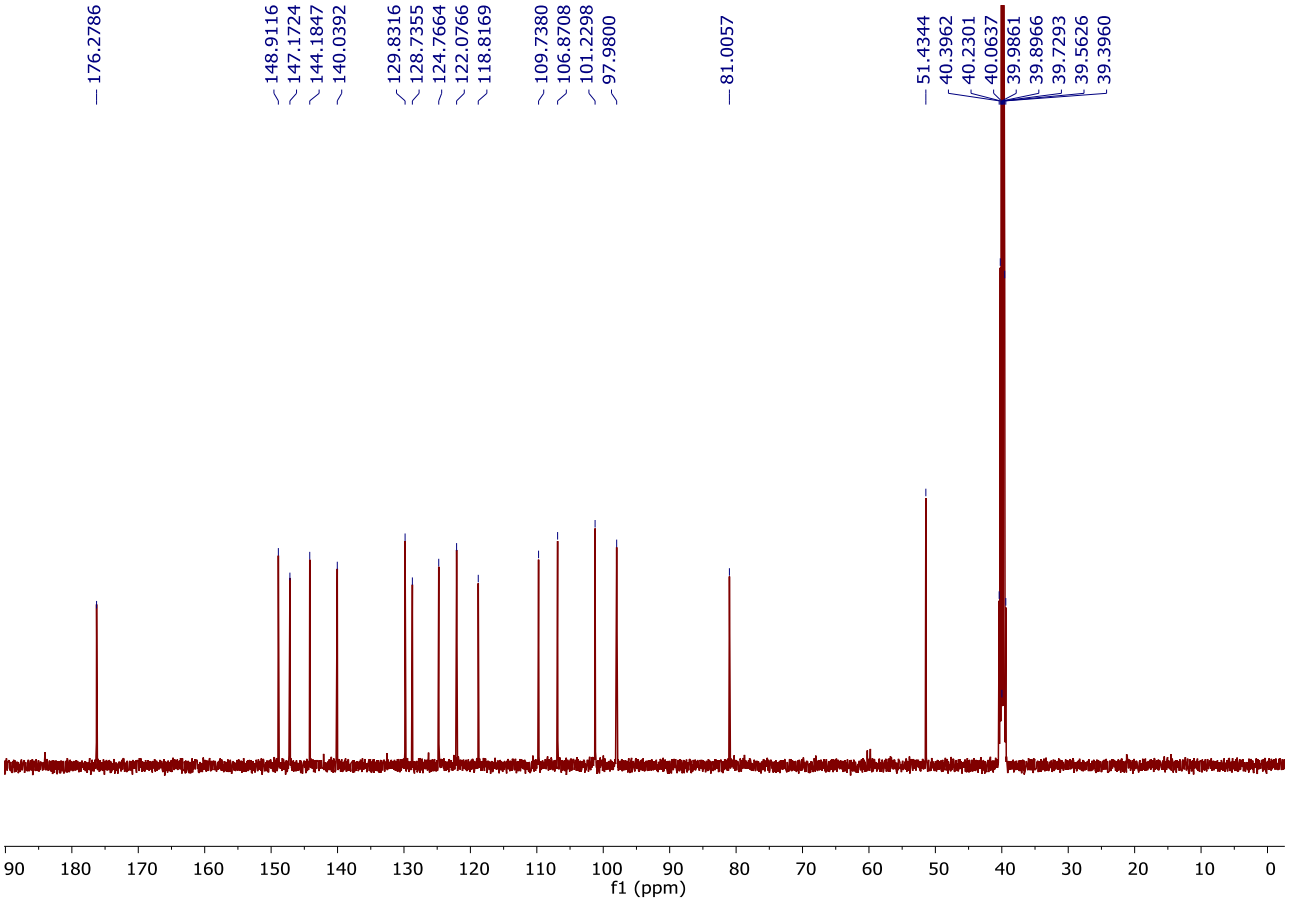


^{13}C NMR (125 MHz, DMSO-D_6) of compound (±)-**5k**

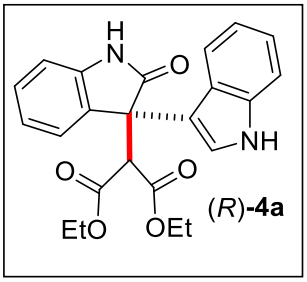


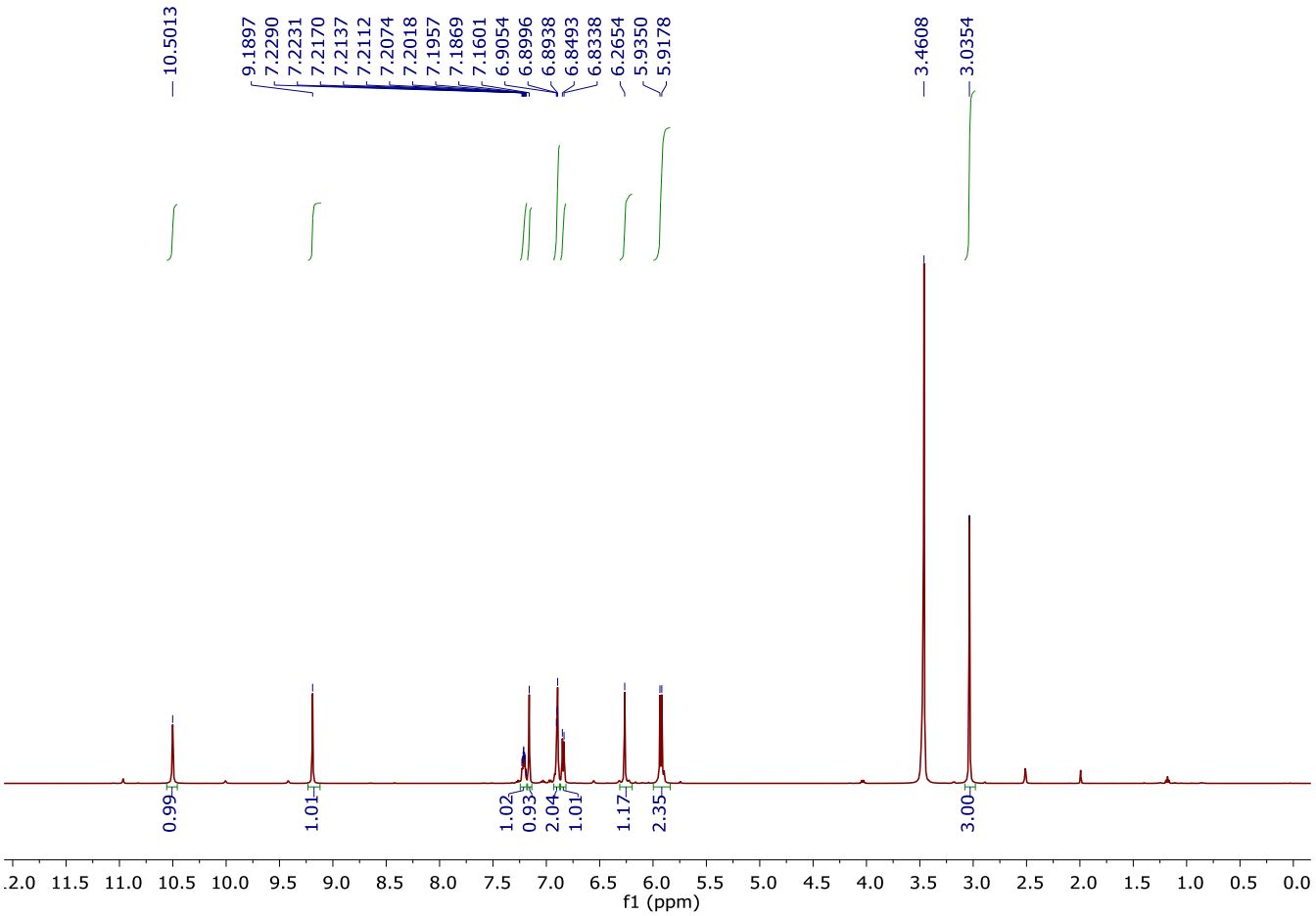
^{1}H NMR (500 MHz, DMSO-D_6) of compound (±)-**5l**



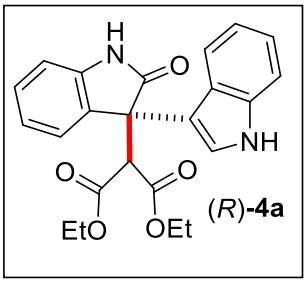


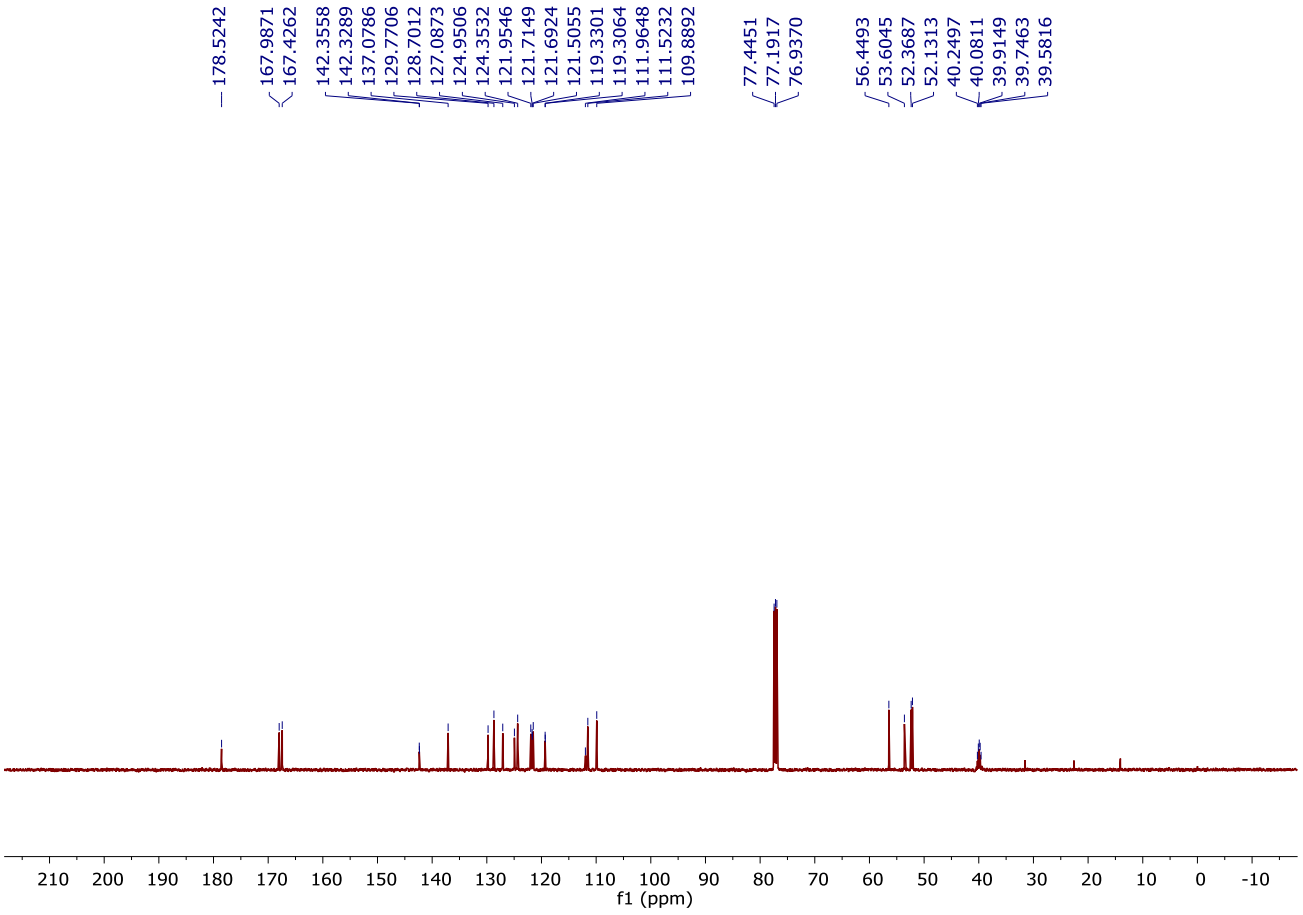
^{13}C NMR (125 MHz, DMSO-D_6) of compound (±)-**5l**



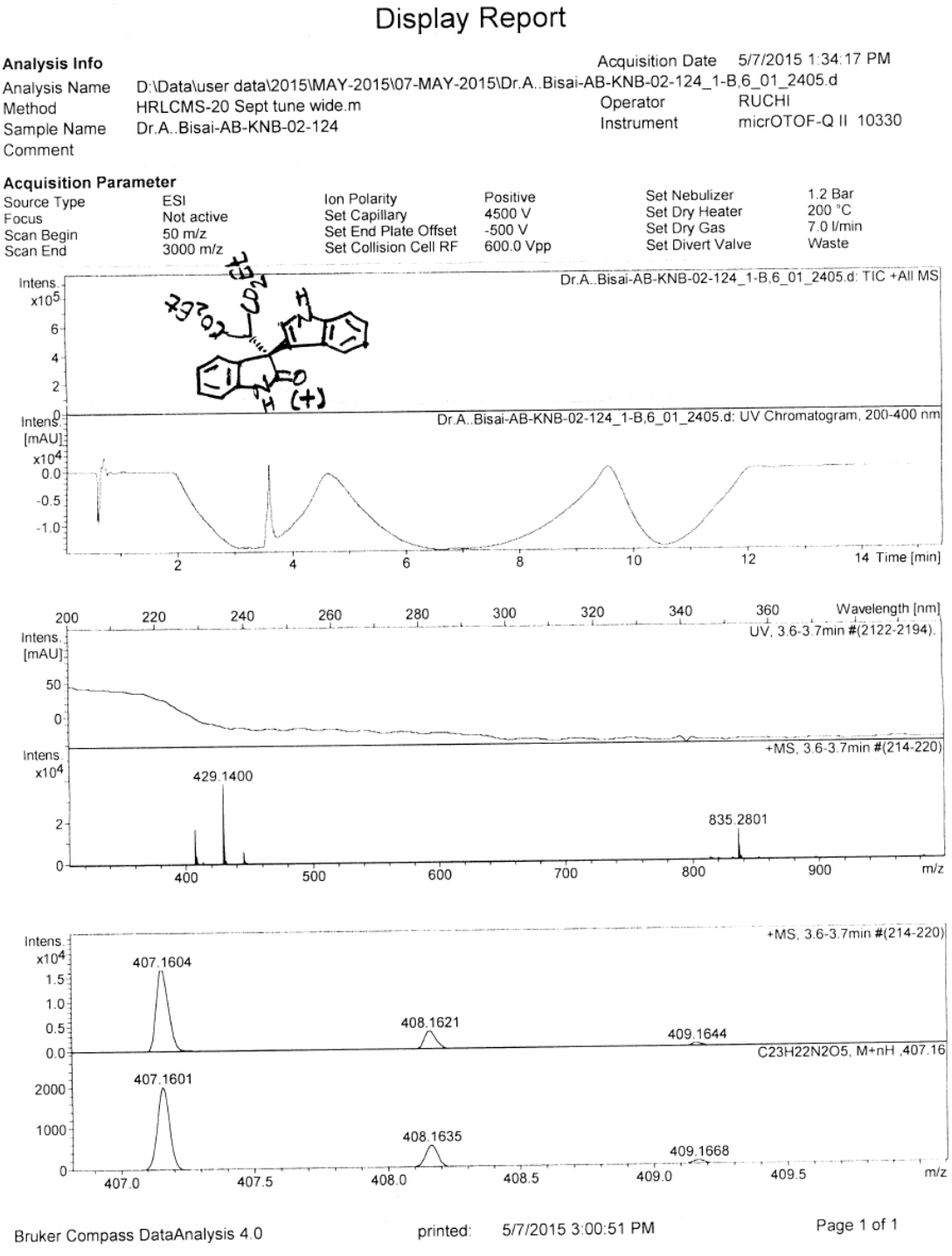


^{1}H NMR (400 MHz, 0.5 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4a**

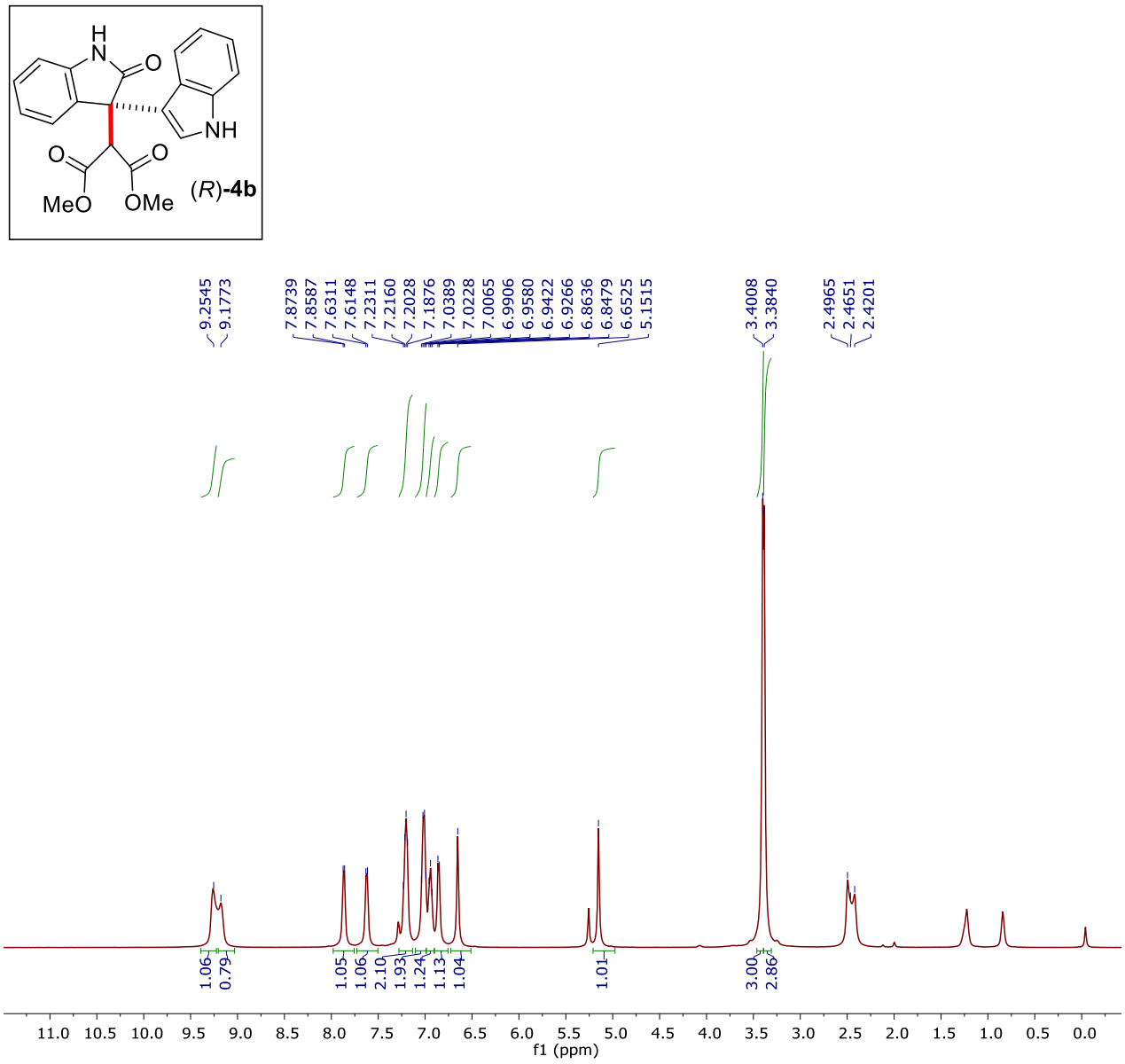




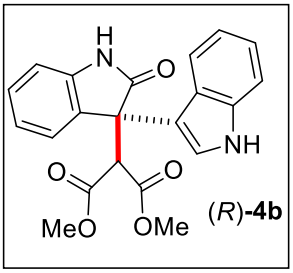
^{13}C NMR (100 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4a**

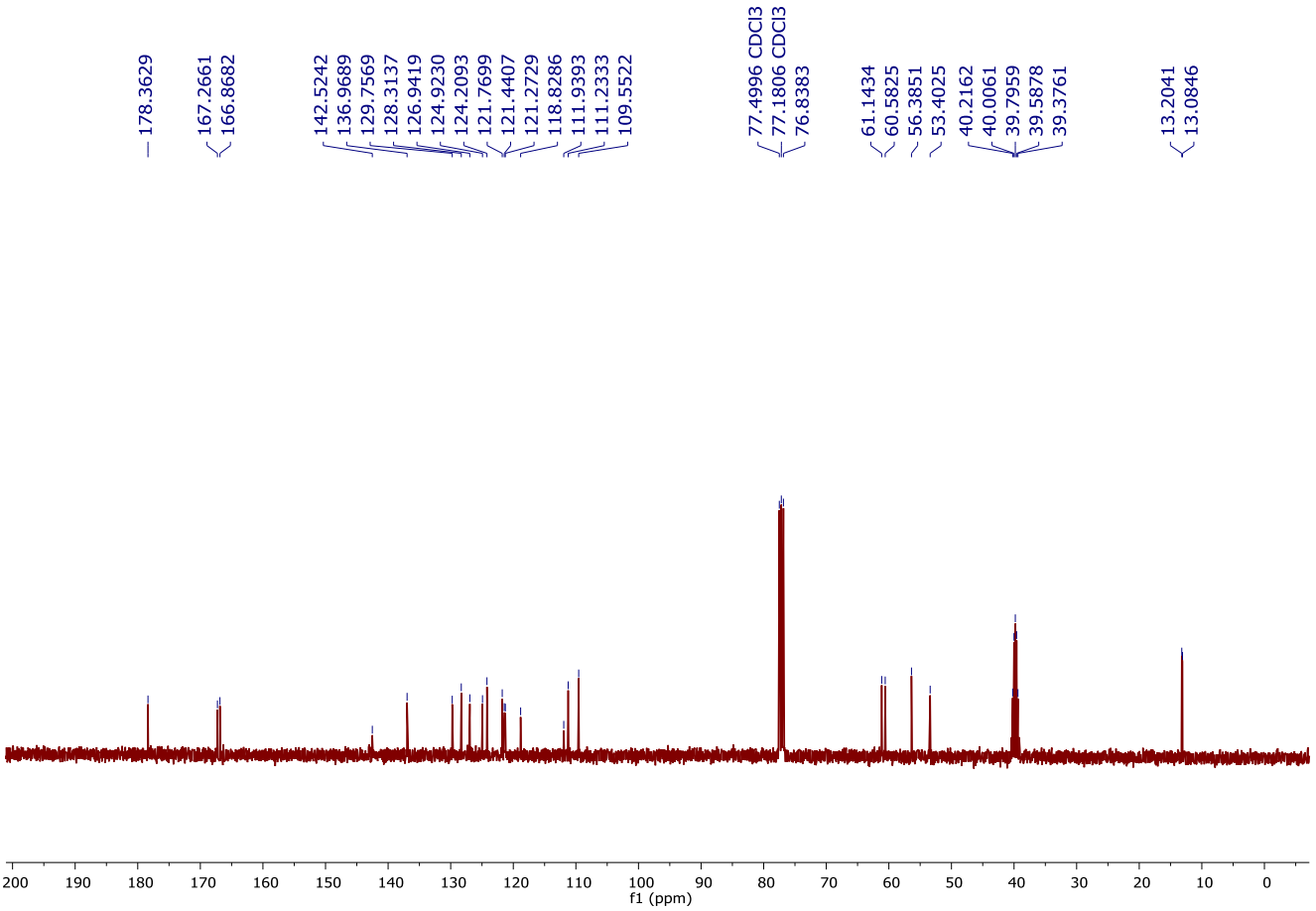


Scanned copy of mass spectrum of (*R*)-**4a**

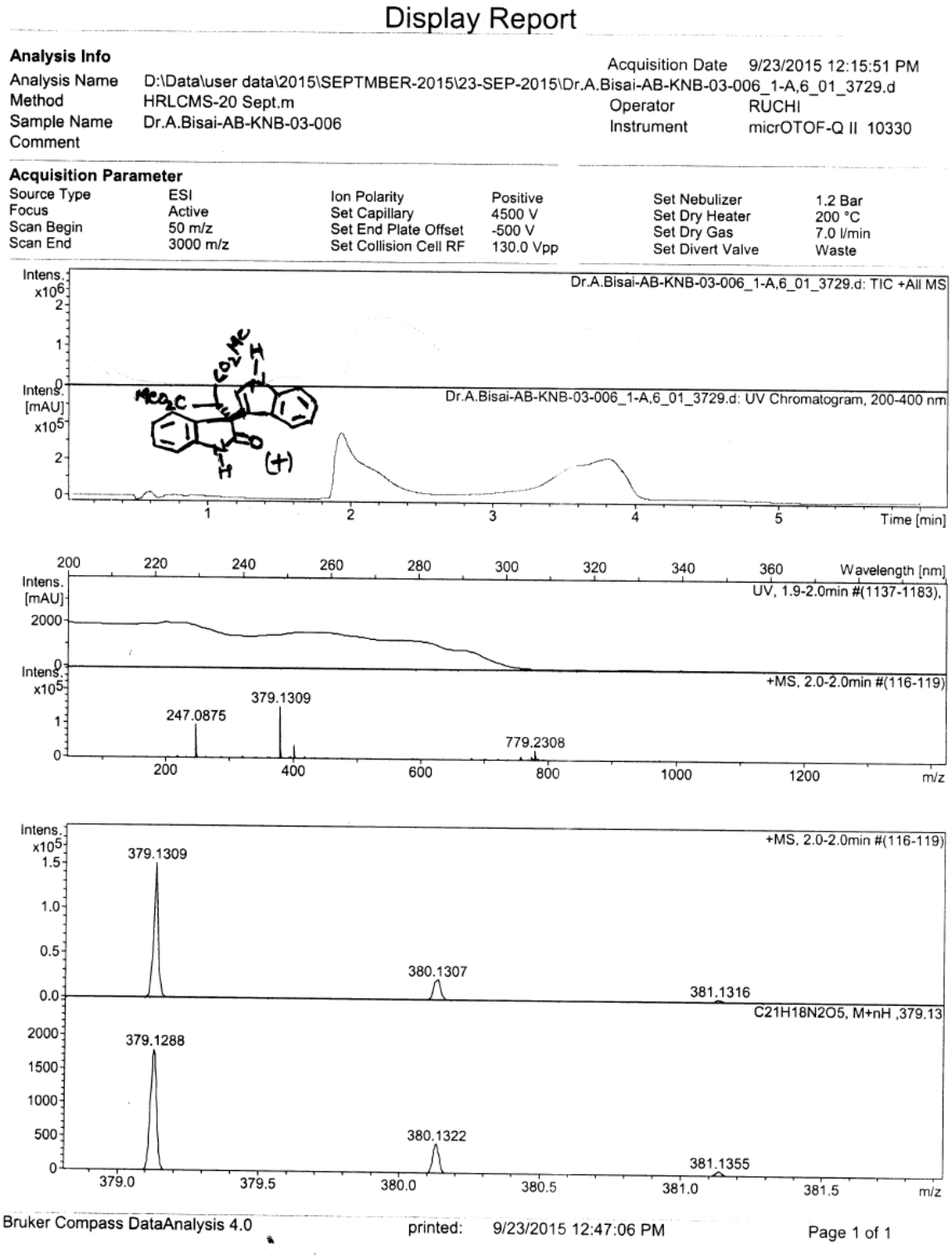


^{1}H NMR (500 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4b**

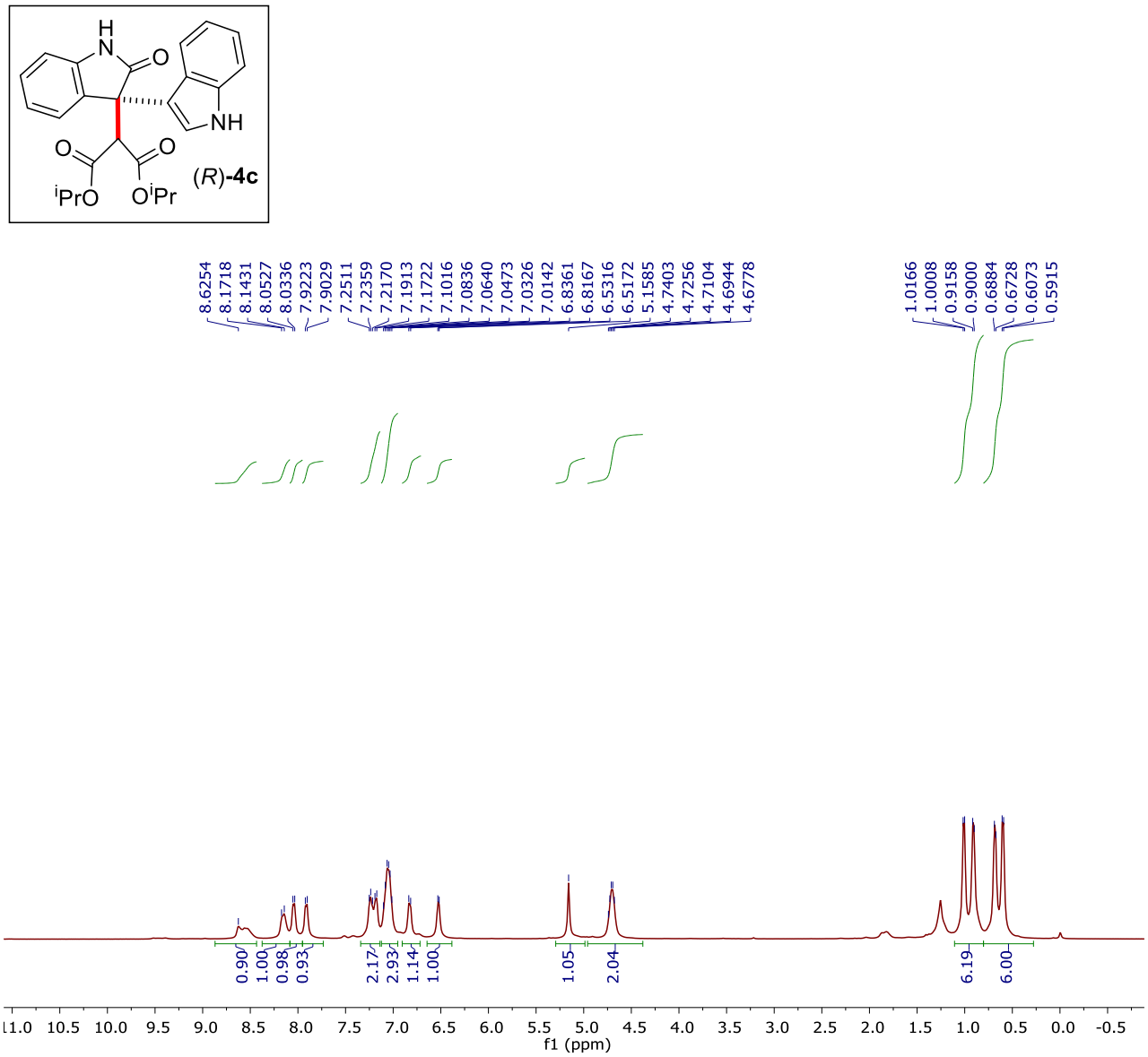




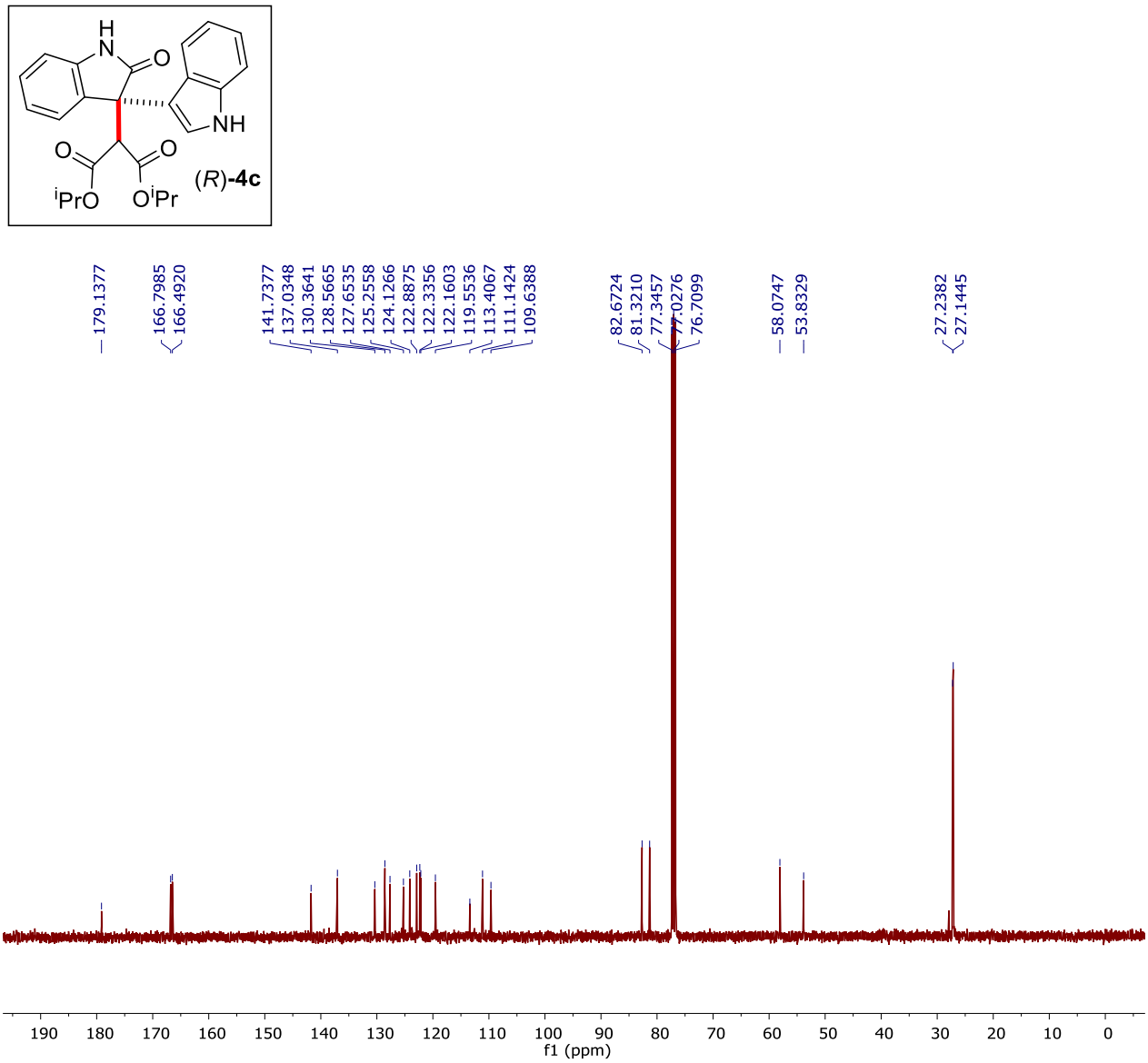
^{13}C NMR (100 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4b**



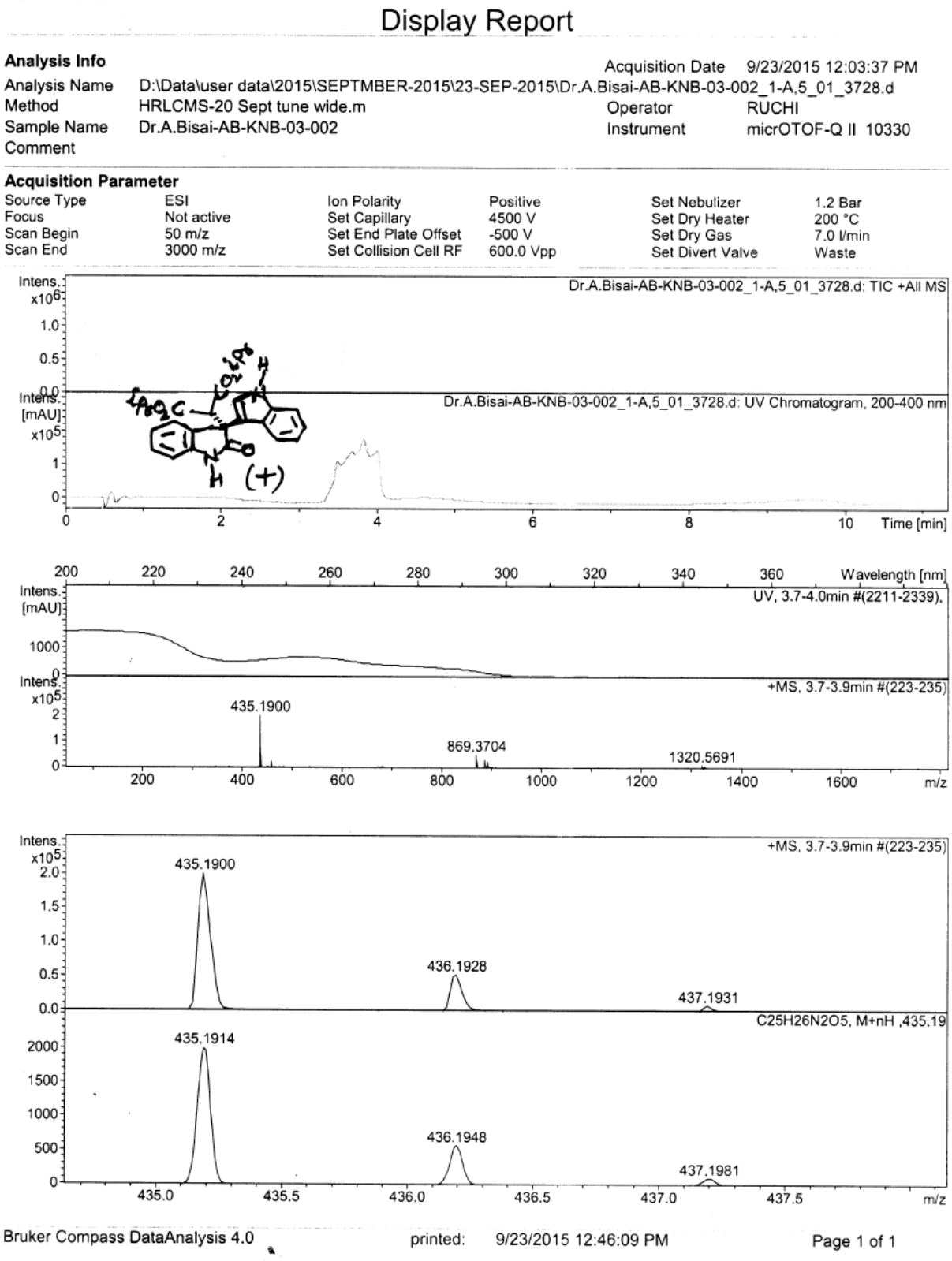
Scanned copy of mass spectrum of (*R*)-**4b**



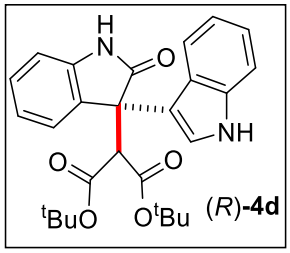
^{1}H NMR (400 MHz, $CDCl_3$) of compound (*R*)-**4c**

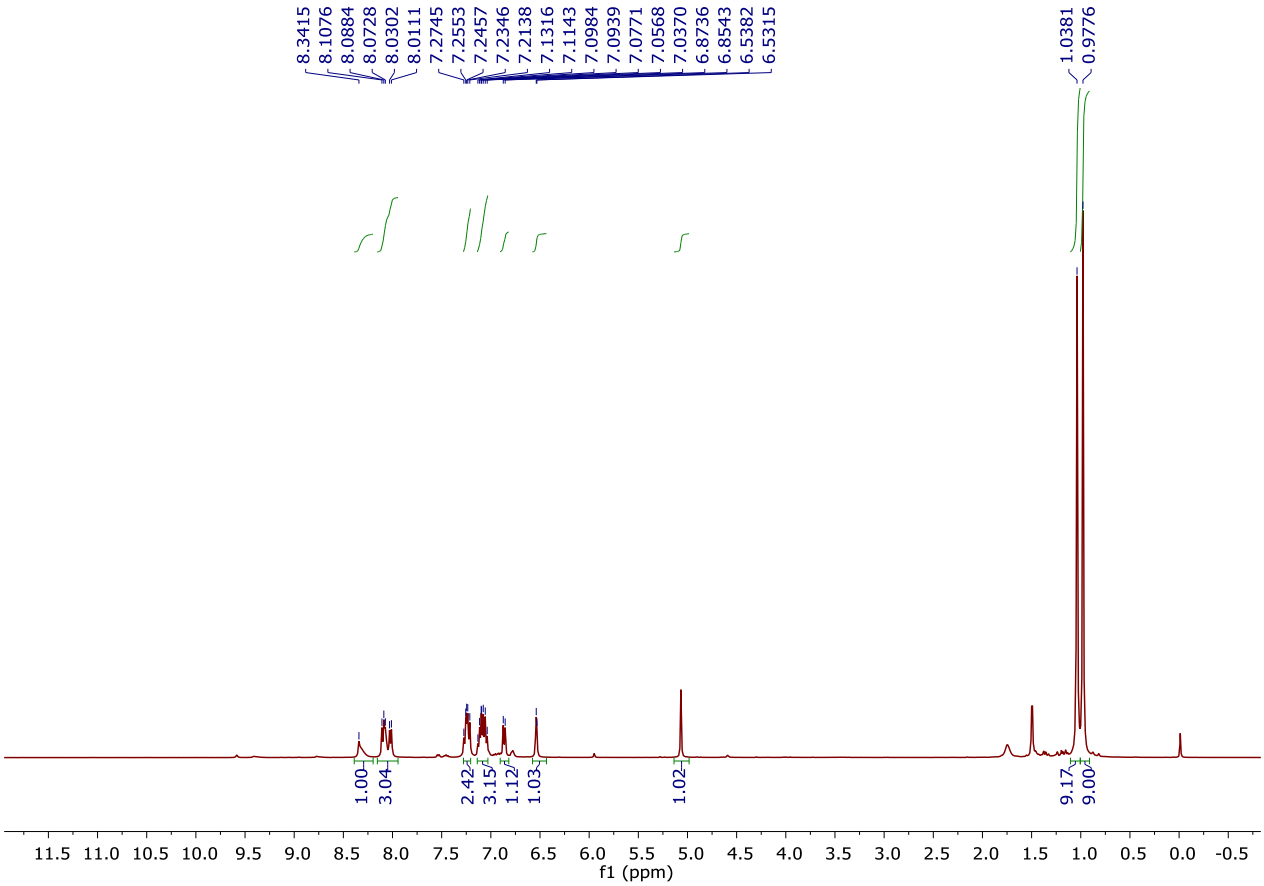


^{13}C NMR (100 MHz, $CDCl_3$) of compound (*R*)-**4c**

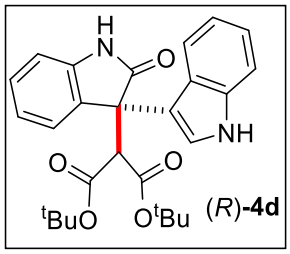


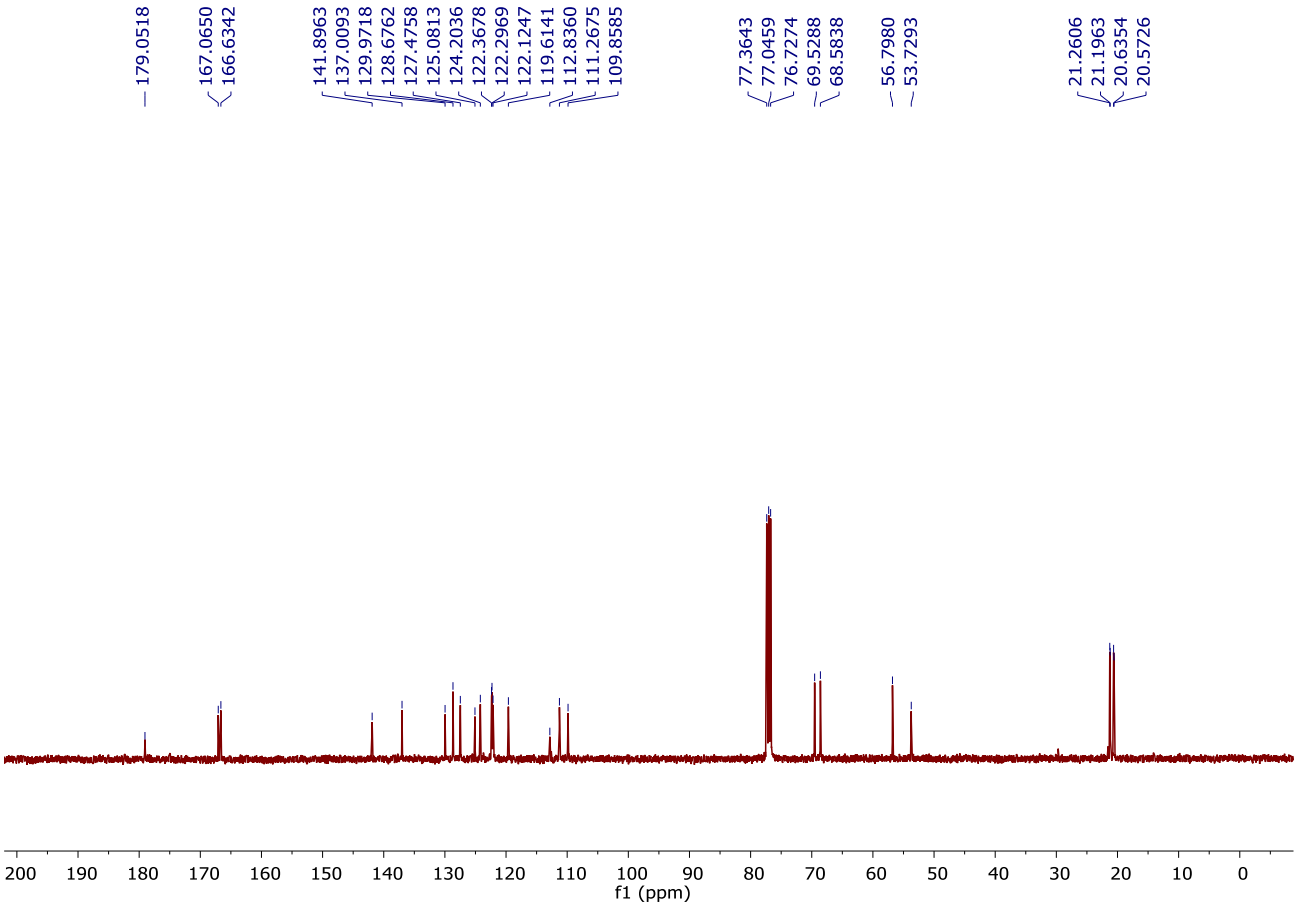
Scanned copy of mass spectrum of (*R*)-**4c**



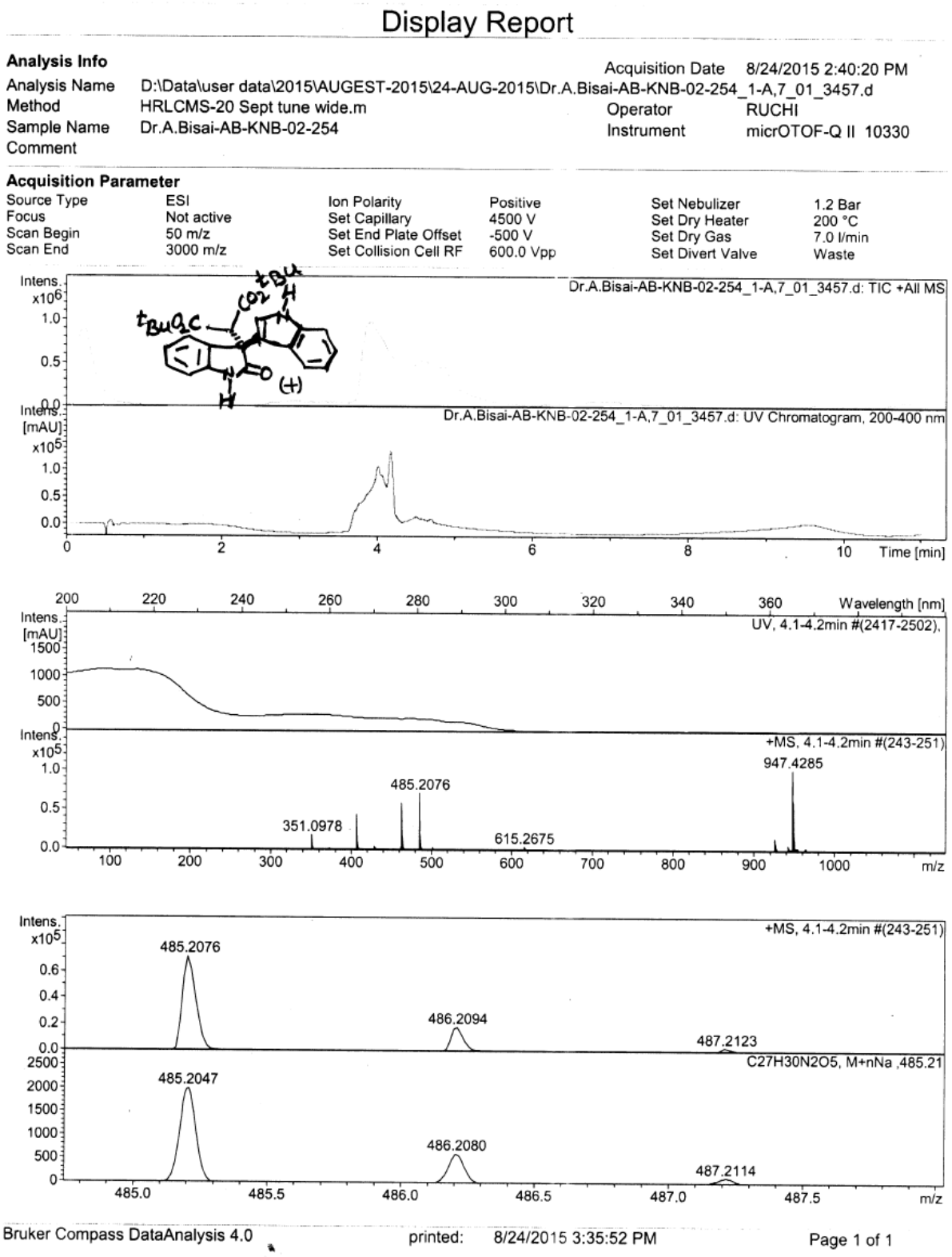


^{1}H NMR (400 MHz, $CDCl_3$) of compound (*R*)-**4d**

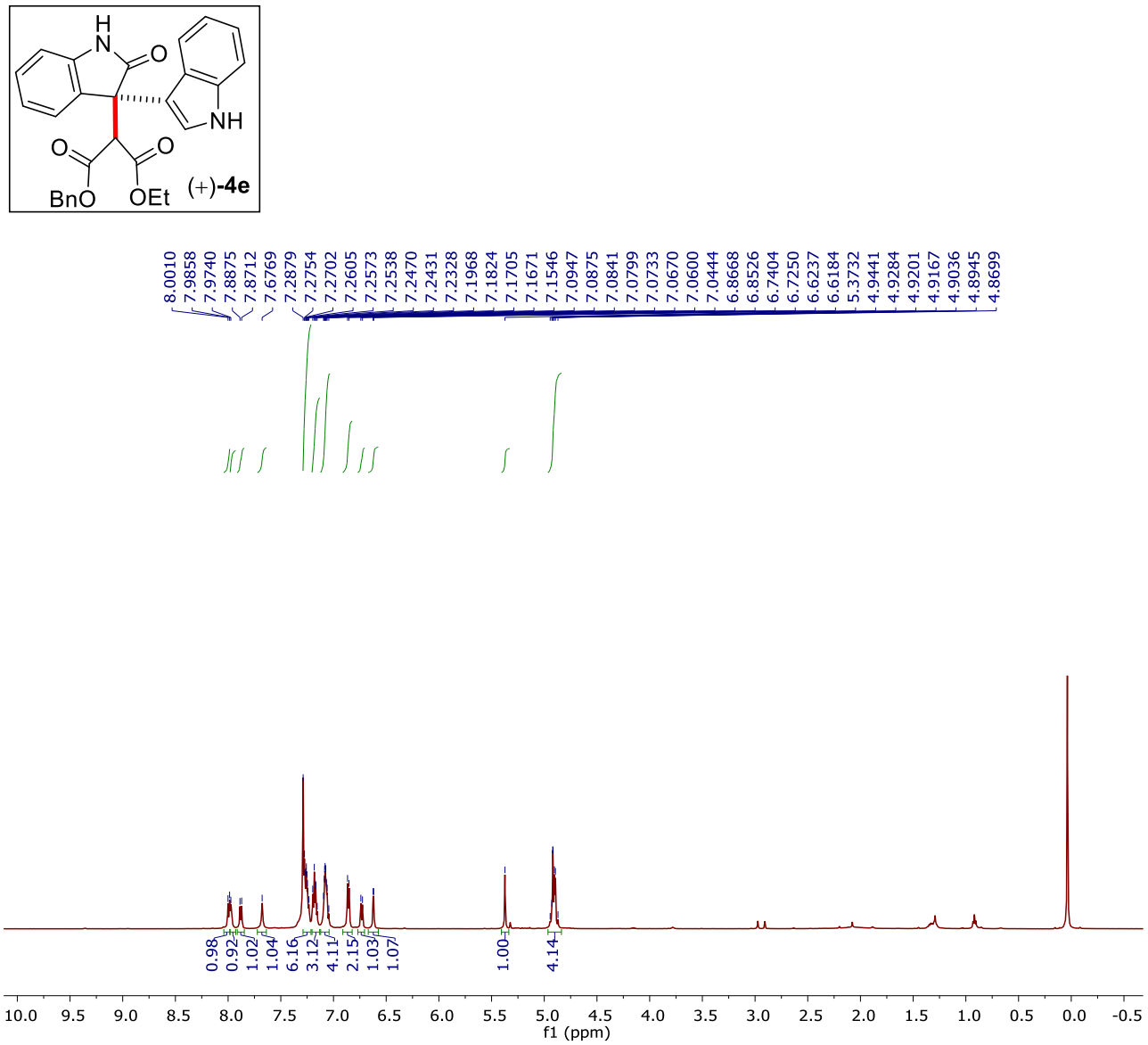




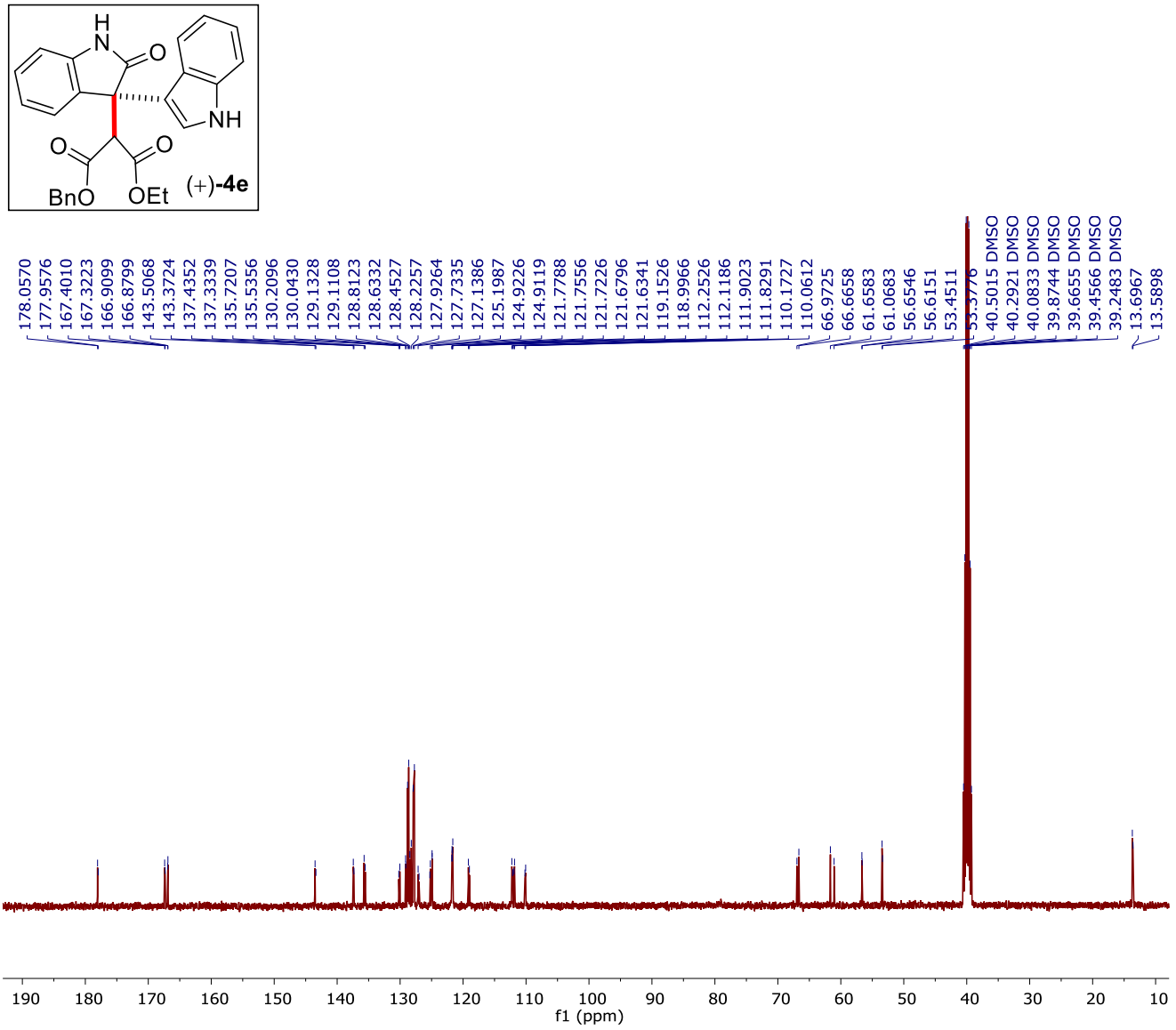
^{13}C NMR (100 MHz, $CDCl_3$) of compound (*R*)-**4d**



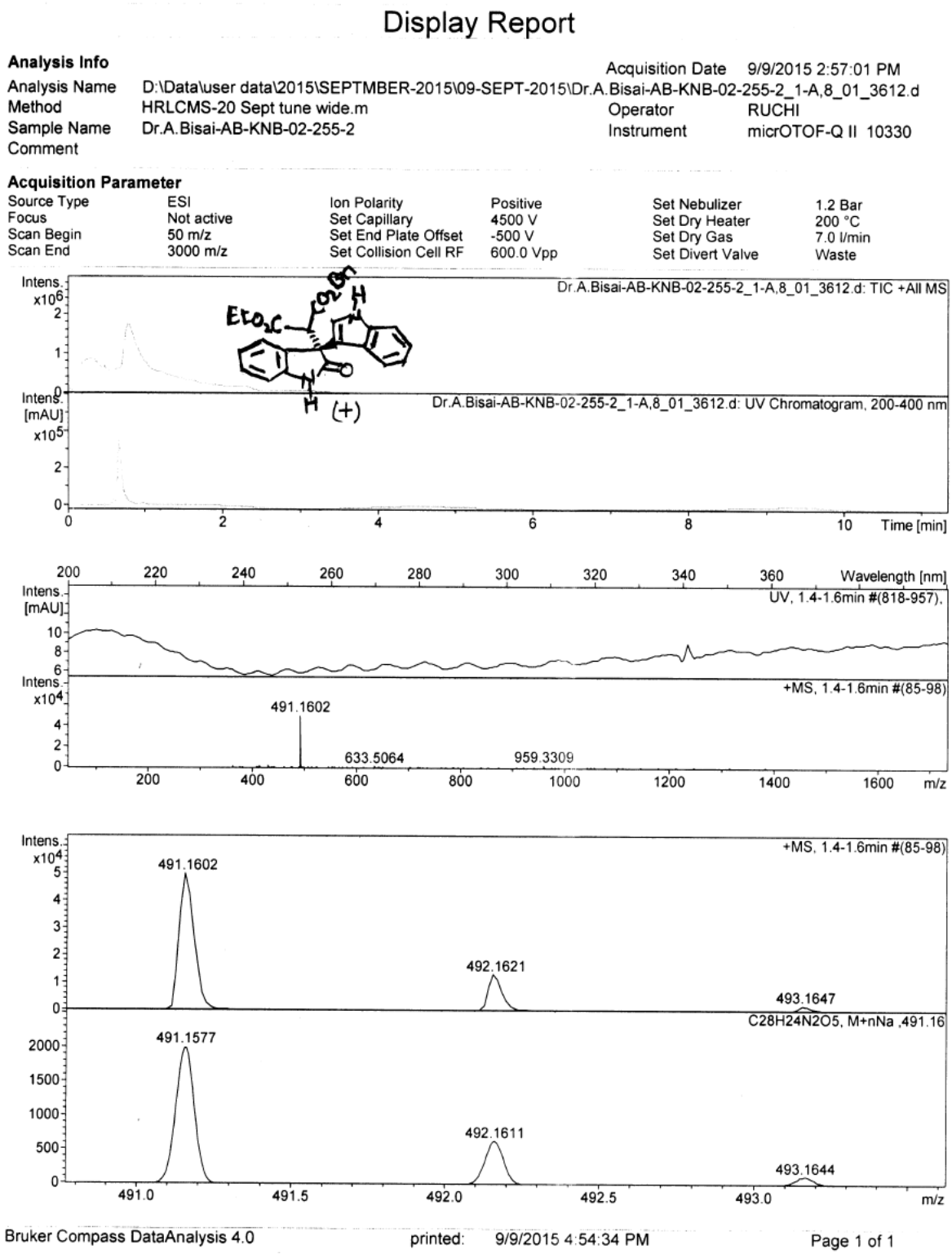
Scanned copy of mass spectrum of (*R*)-**4d**



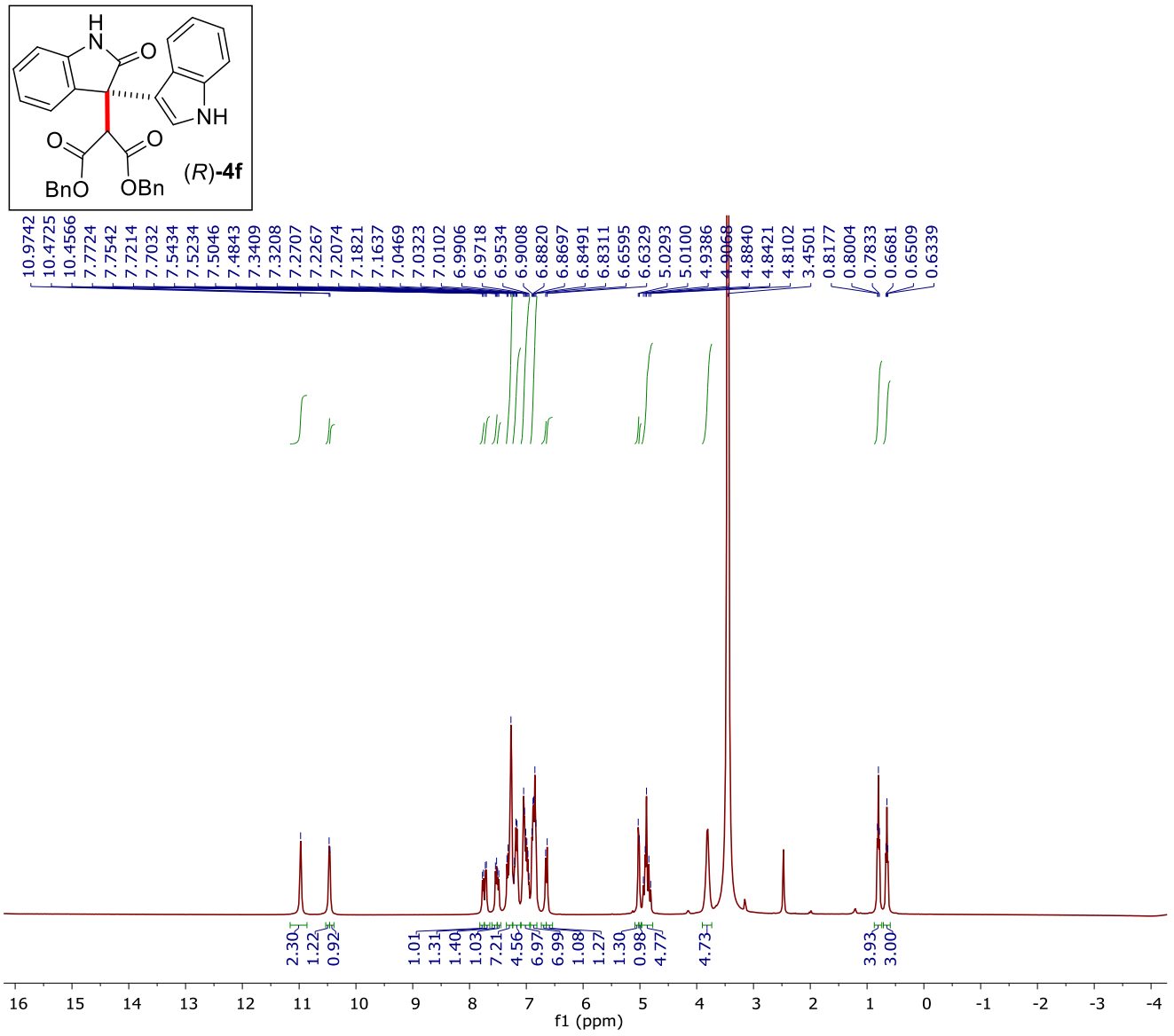
^{1}H NMR (400 MHz, DMSO-D_6) of compound (+)-**4e**



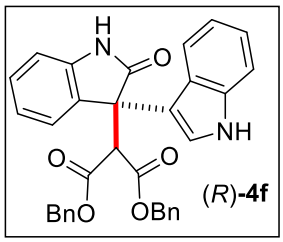
^{13}C NMR (100 MHz, DMSO-D_6) of compound (+)-**4e**

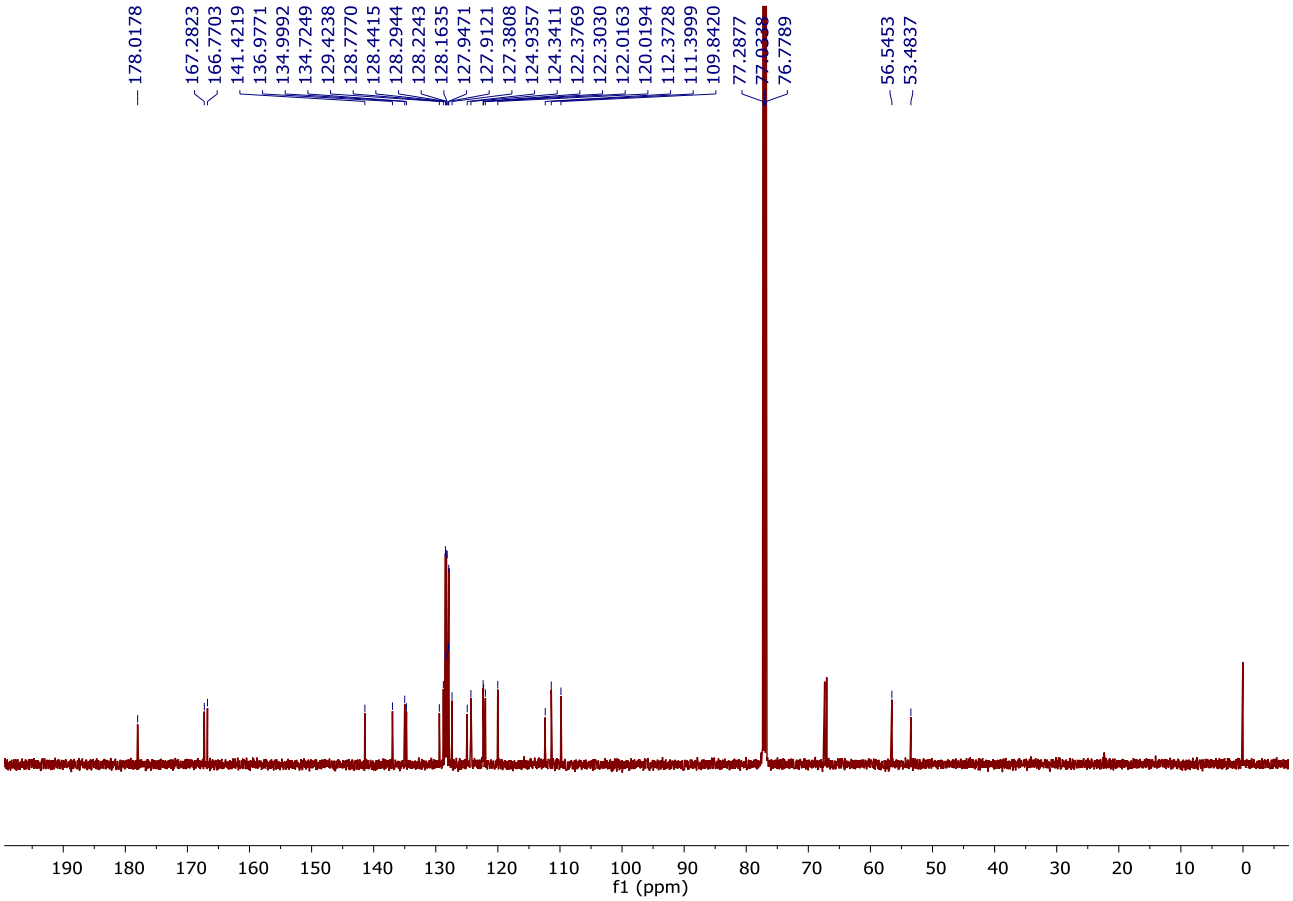


Scanned copy of mass spectrum of (+)-**4e**

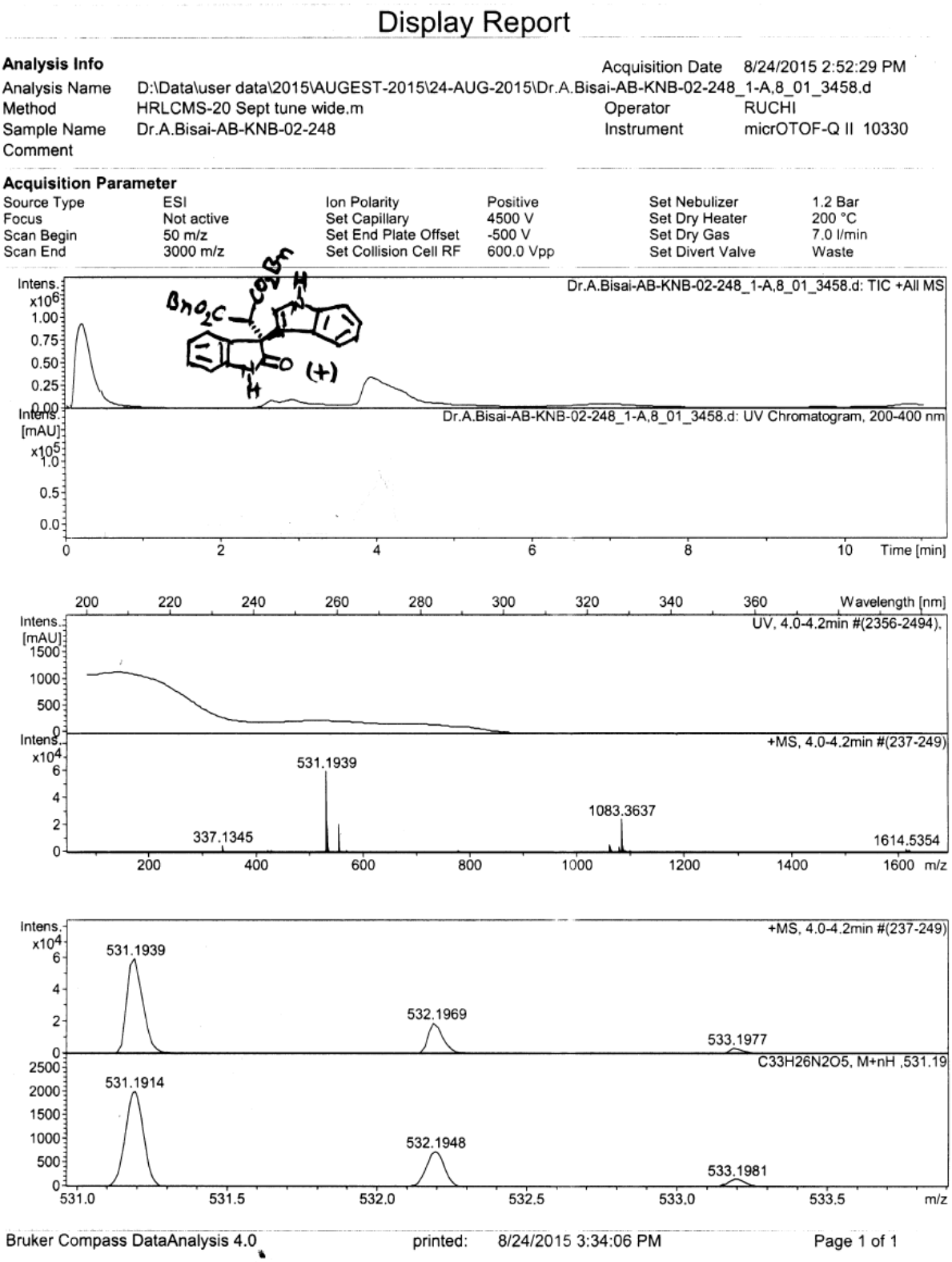


^{1}H NMR (500 MHz, $CDCl_3$) of compound (*R*)-**4f**

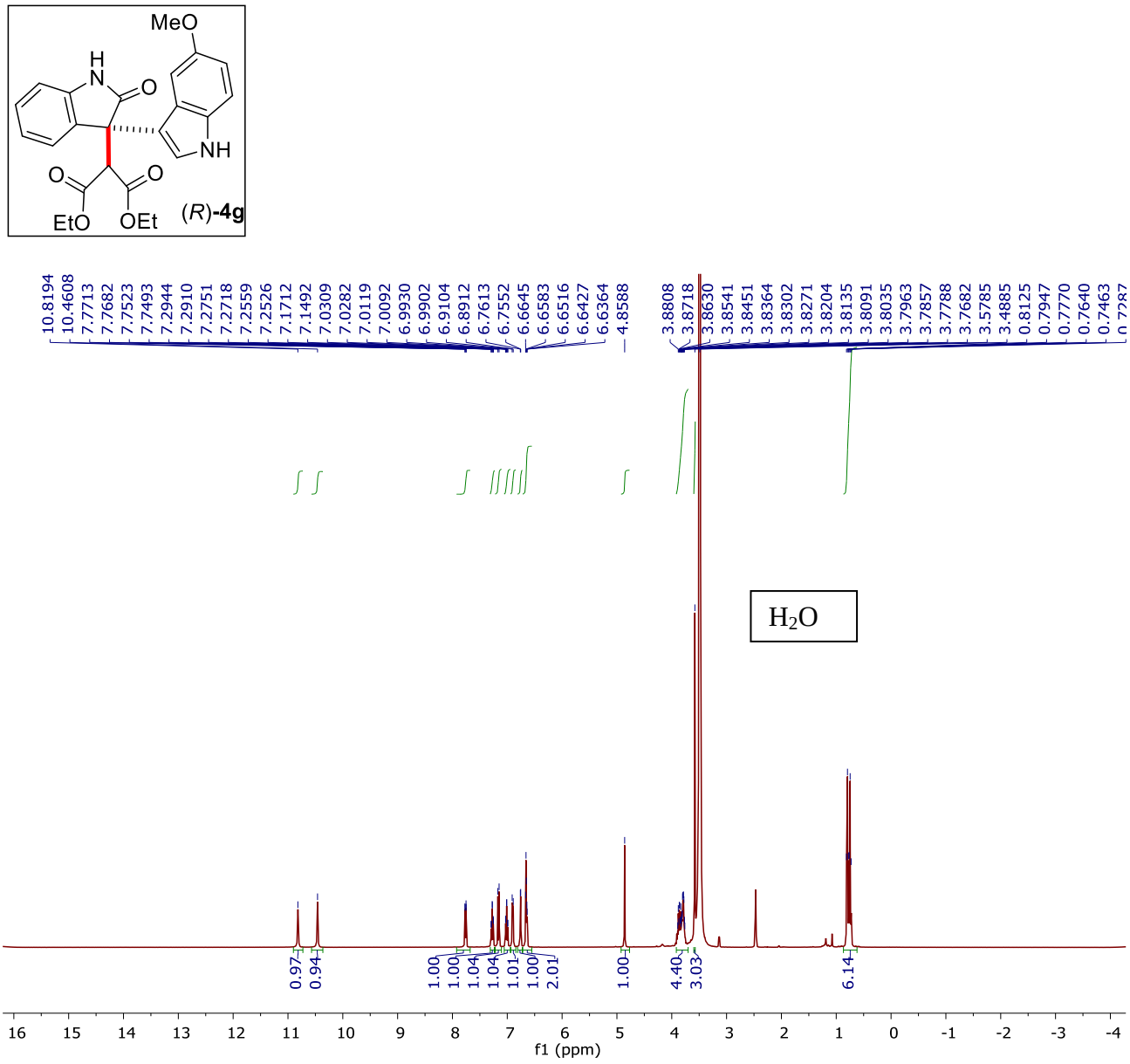




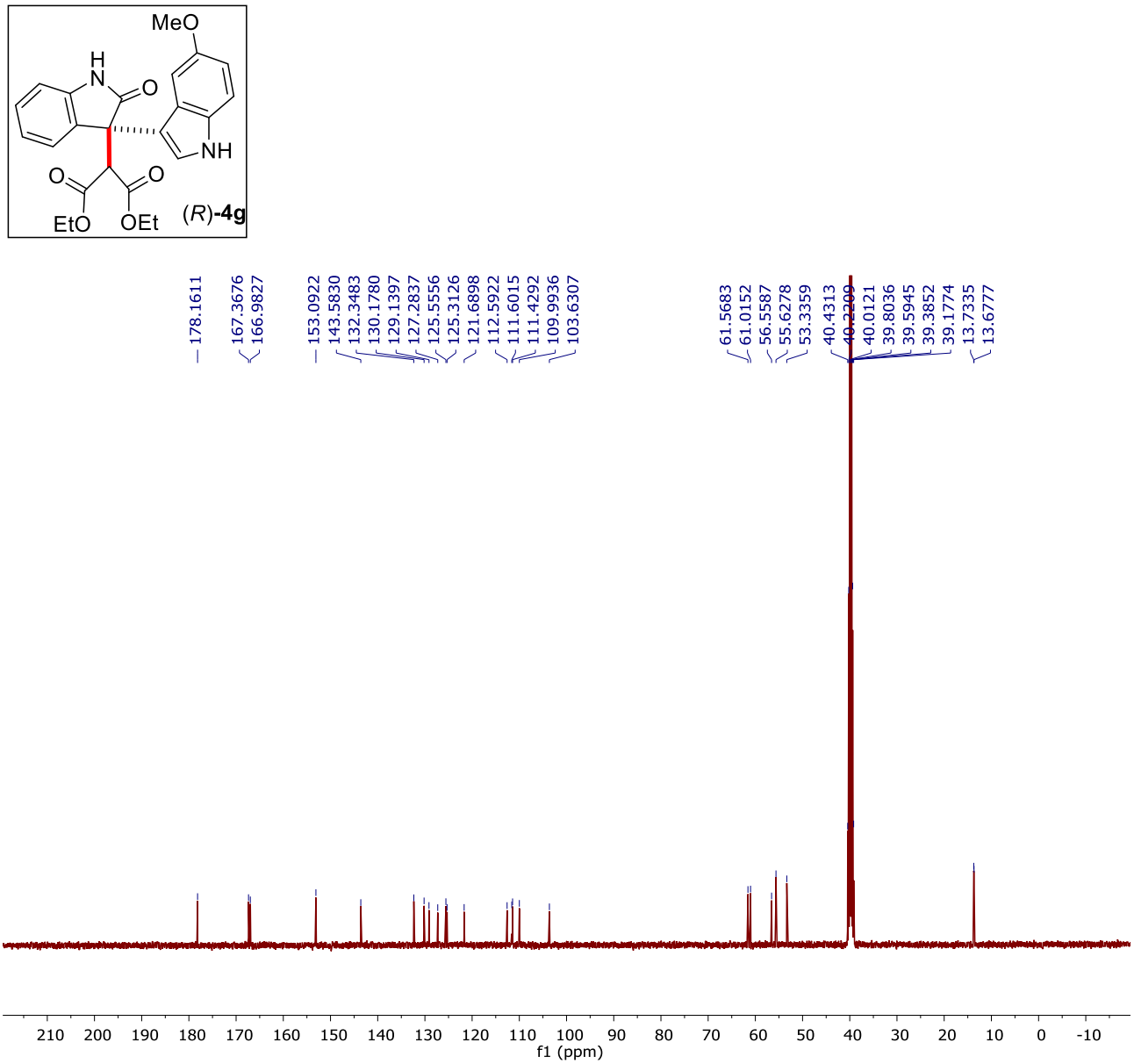
^{1}H NMR (500 MHz, $CDCl_3$) of compound (*R*)-**4f**



Scanned copy of mass spectrum of (*R*)-**4f**



^{1}H NMR (400 MHz, DMSO-D_6) of compound (*R*)-**4g**



^{13}C NMR (100 MHz, DMSO-D_6) of compound (*R*)-**4g**

Display Report

Analysis Info

Analysis Name	D:\Data\user data\2015\SEPTMBER-2015\09-SEPT-2015\Dr.A.Bisai-AB-KNB-02-258-R3_1-B,1_01_3613.d	Acquisition Date	9/9/2015 3:09:11 PM
Method	HRLCMS-20 Sept tune wide.m	Operator	RUCHI
Sample Name	Dr.A.Bisai-AB-KNB-02-258-R3	Instrument	micrOTOF-Q II 10330
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	1.2 Bar
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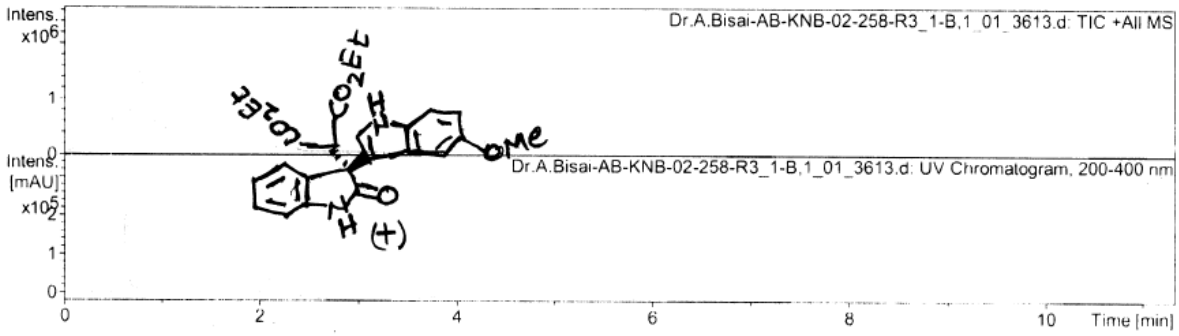
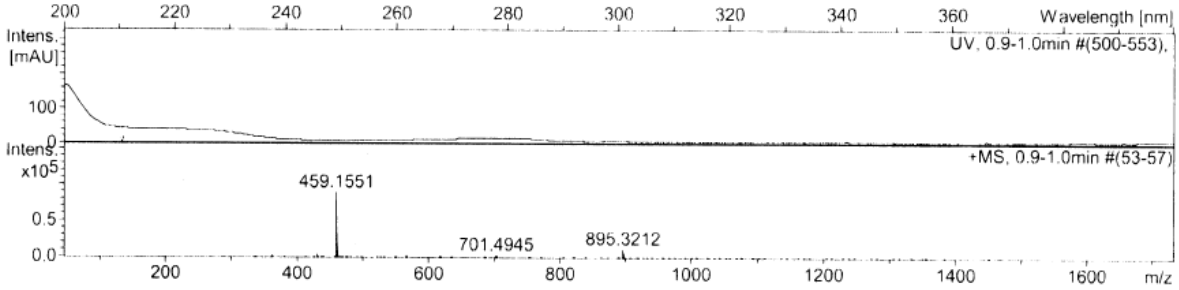
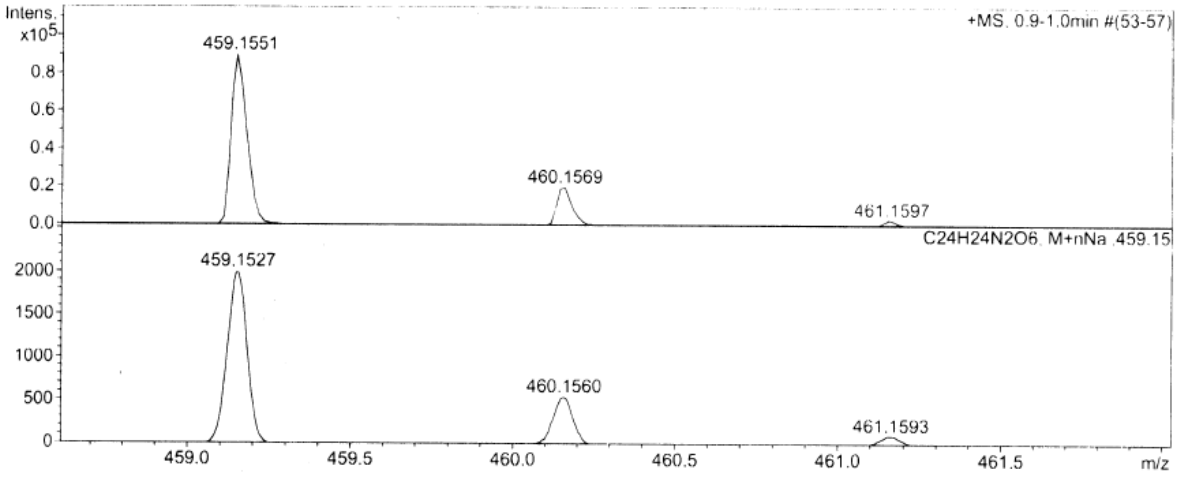
Scan End	3000 m/z	Set Collision Cell RF	600.0 Vpp	Set Divert Valve	Waste

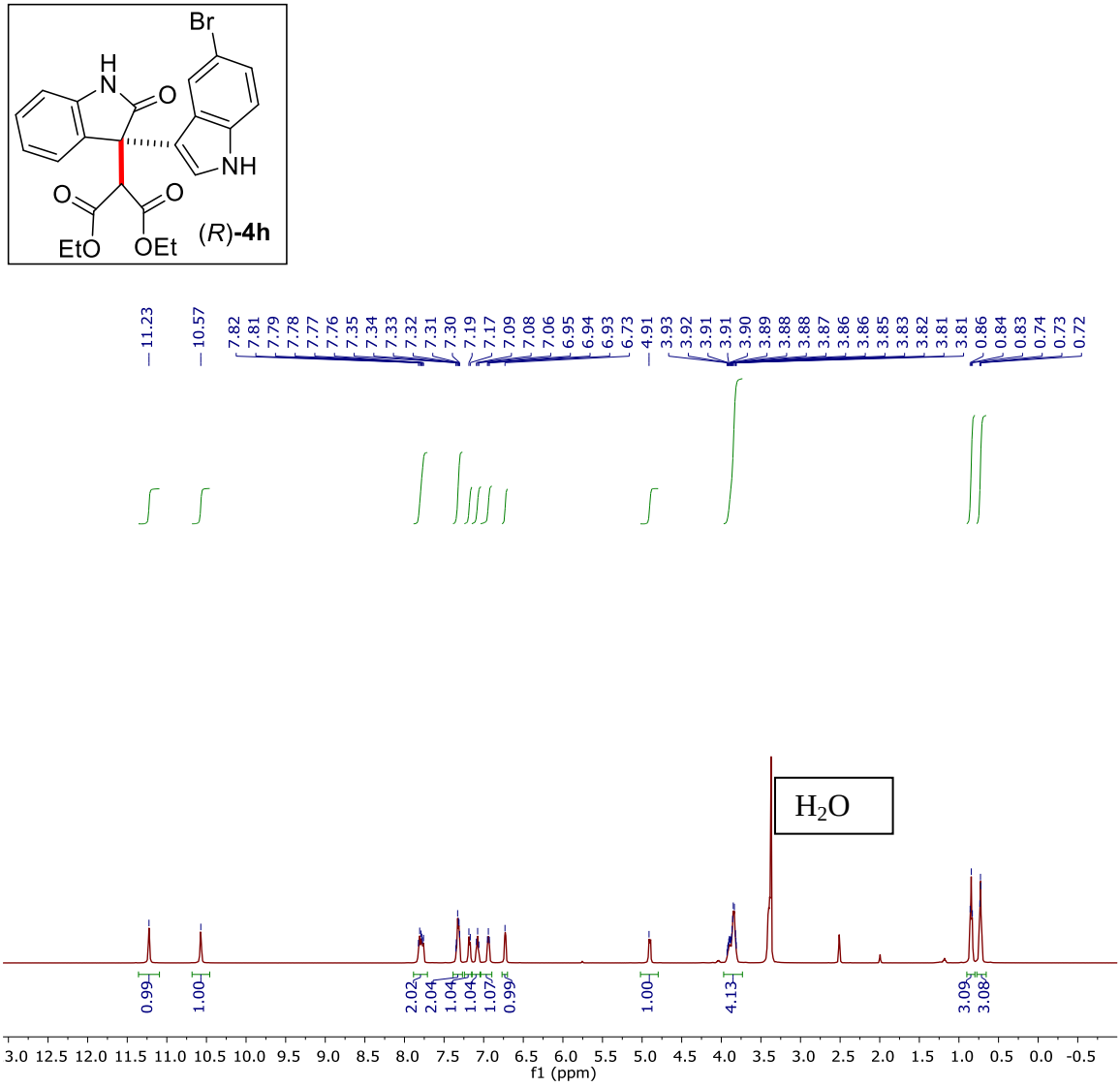




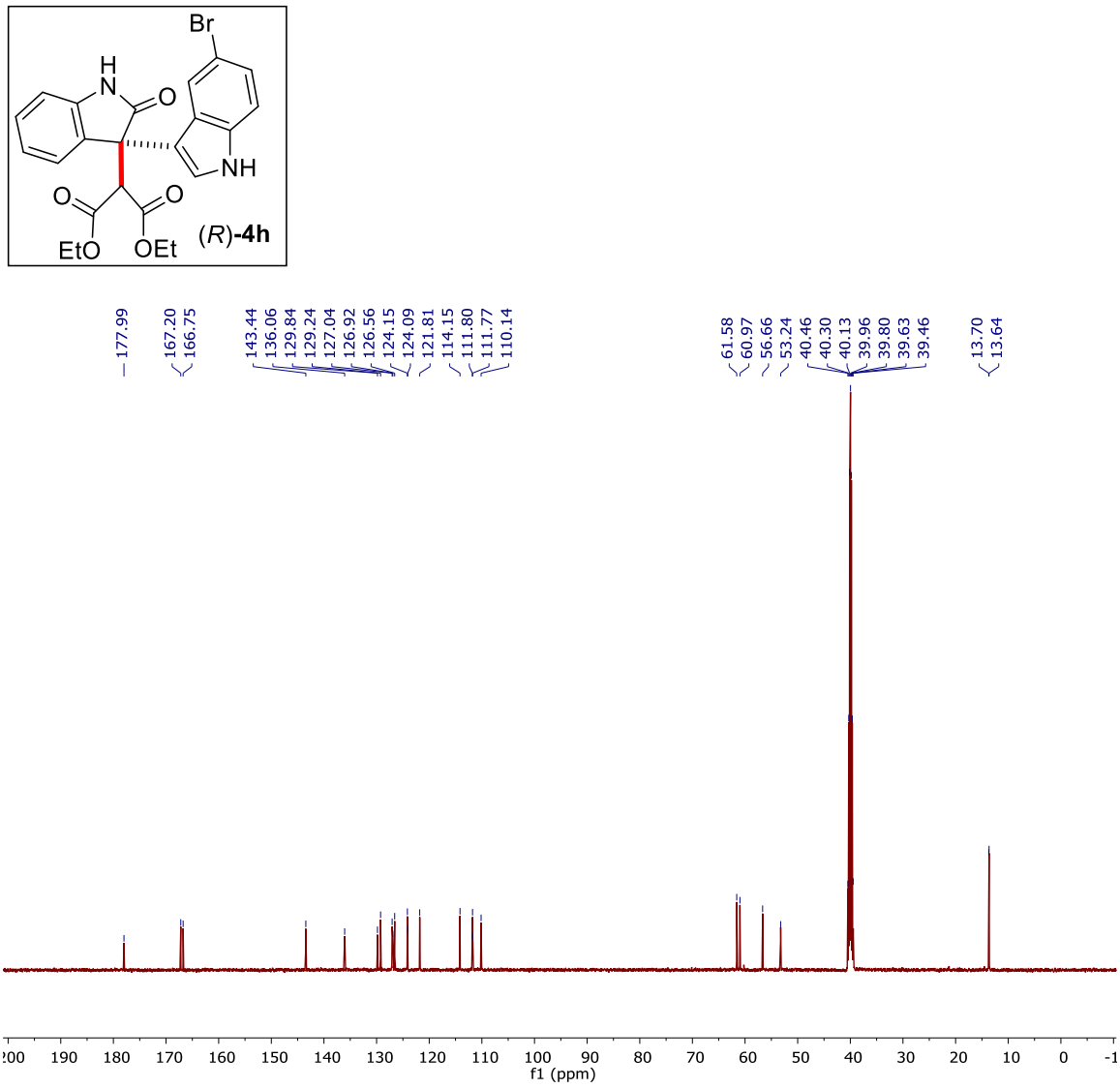


Bruker Compass DataAnalysis 4.0 printed: 9/9/2015 4:55:39 PM Page 1 of 1

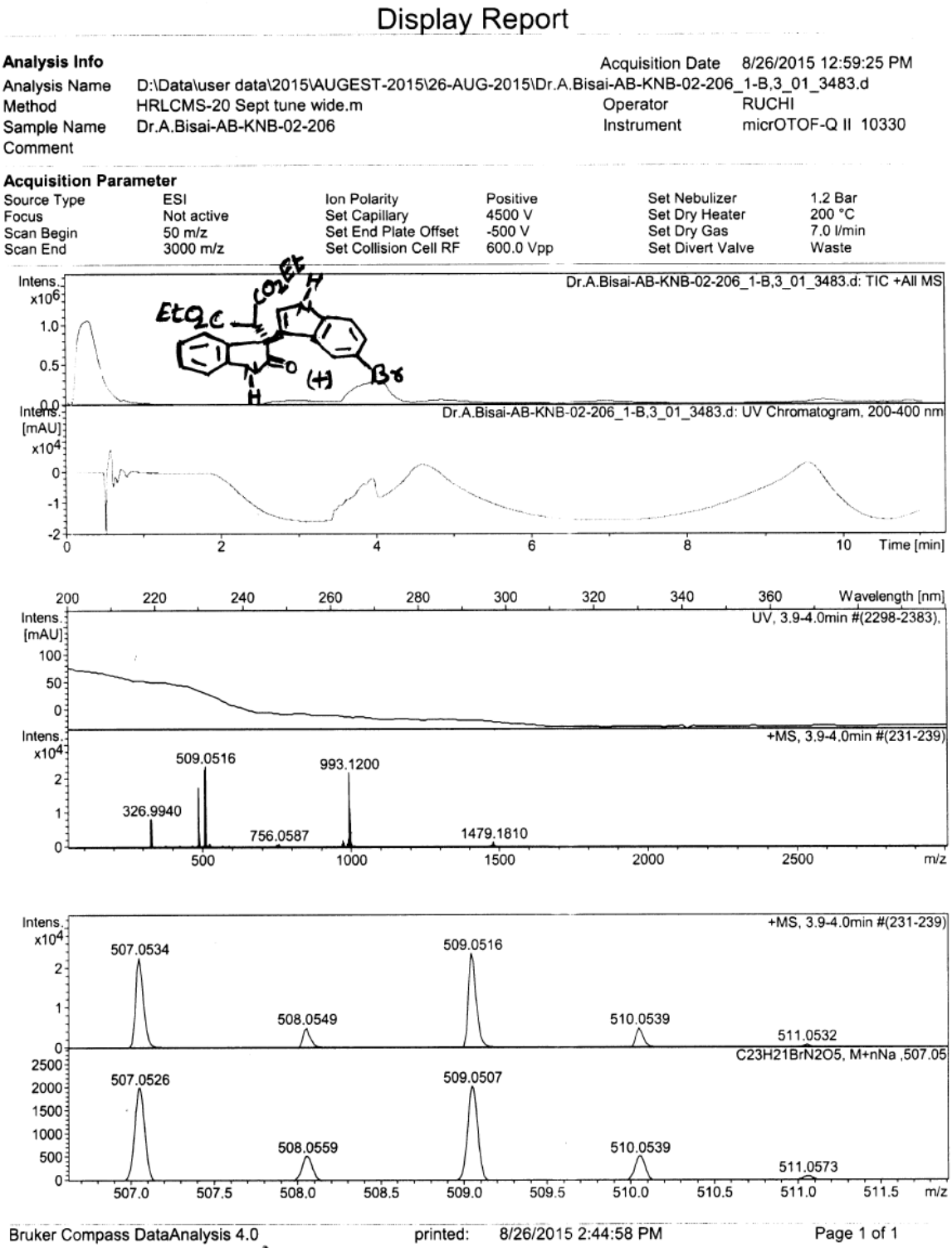
Scanned copy of mass spectrum of (*R*)-**4g**



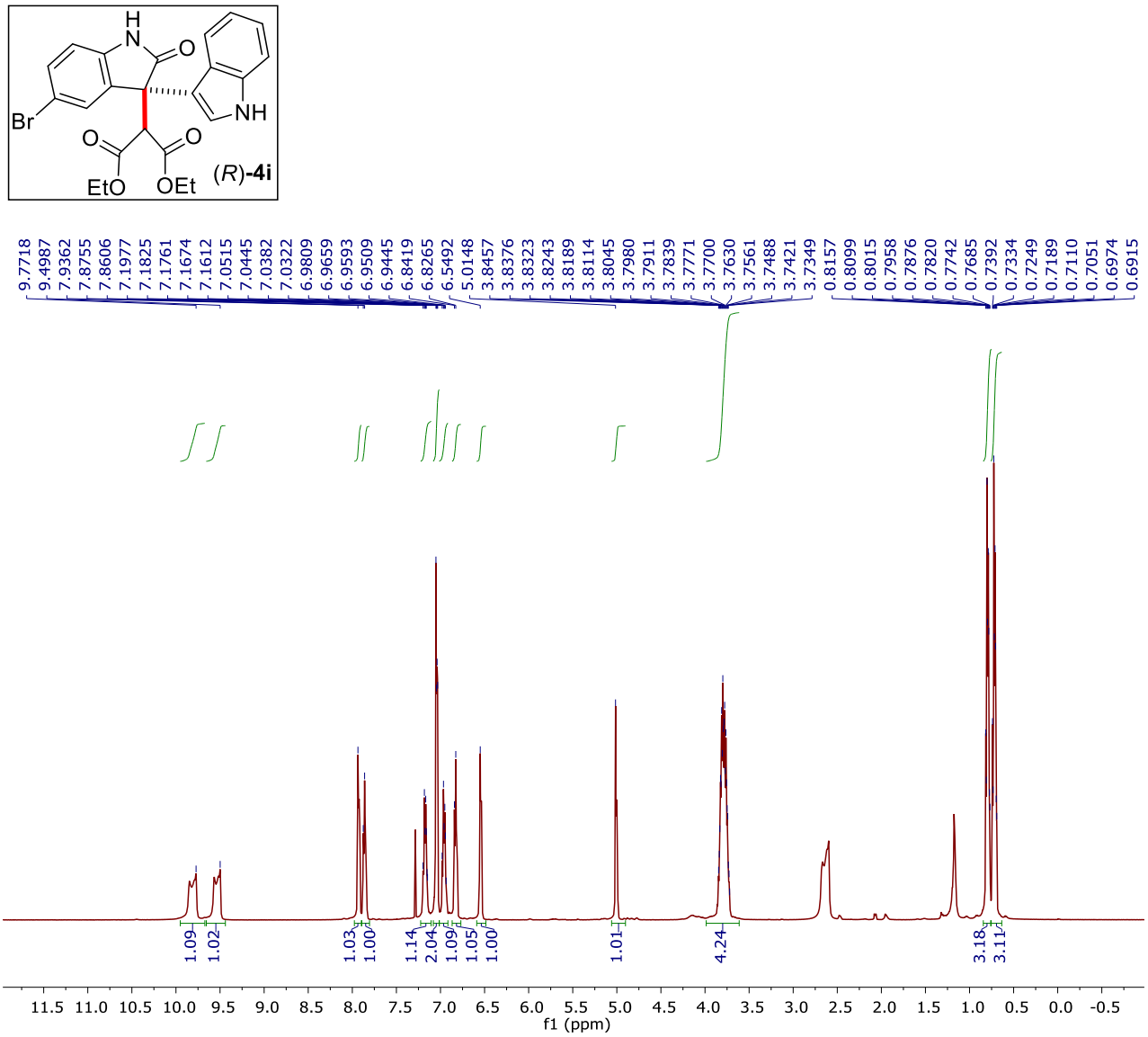
^{1}H NMR (500 MHz, DMSO-D_6) of compound (*R*)-**4h**



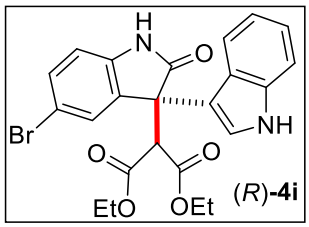
^{13}C NMR (125 MHz, DMSO-D_6) of compound (*R*)-**4h**

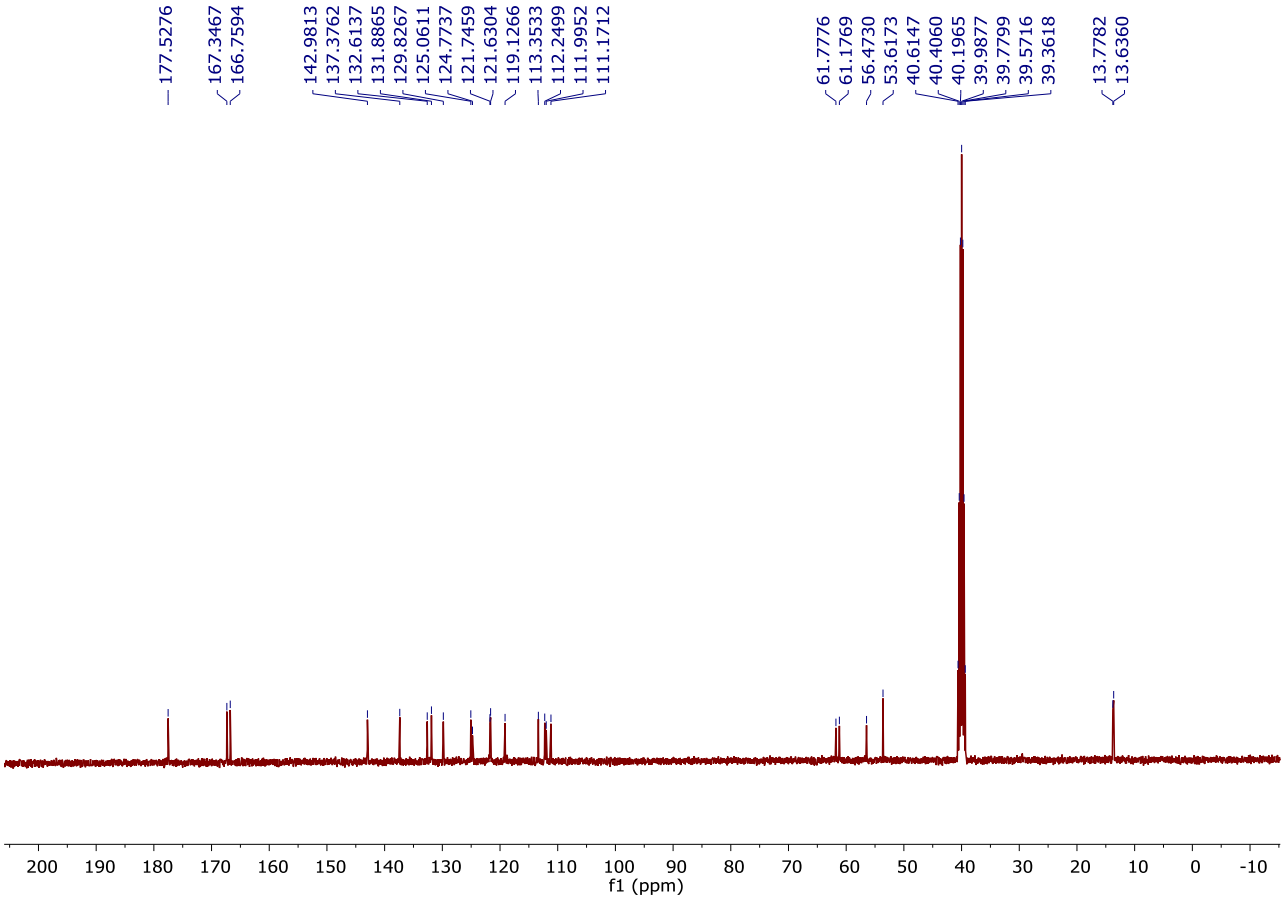


Scanned copy of mass spectrum of (*R*)-**4h**



^{1}H NMR (400 MHz, DMSO-D_6) of compound (*R*)-**4i**





^{13}C NMR (100 MHz, DMSO-D$_6$) of compound (*R*)-**4i**

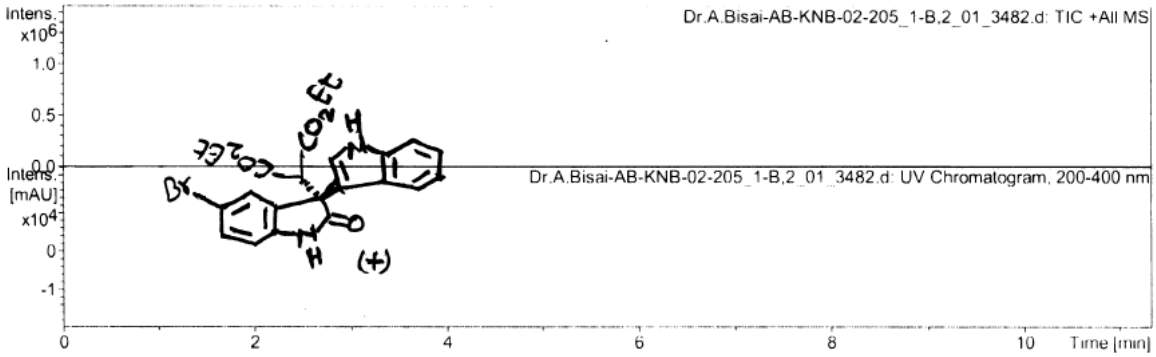
Display Report

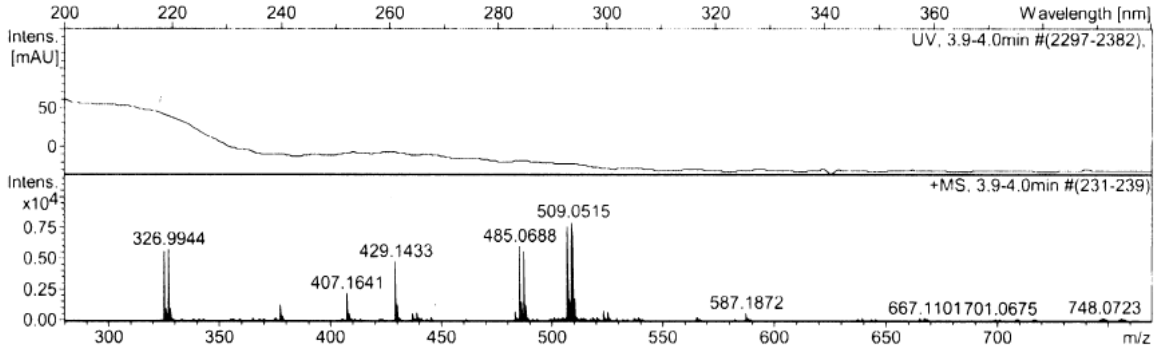
Analysis Info

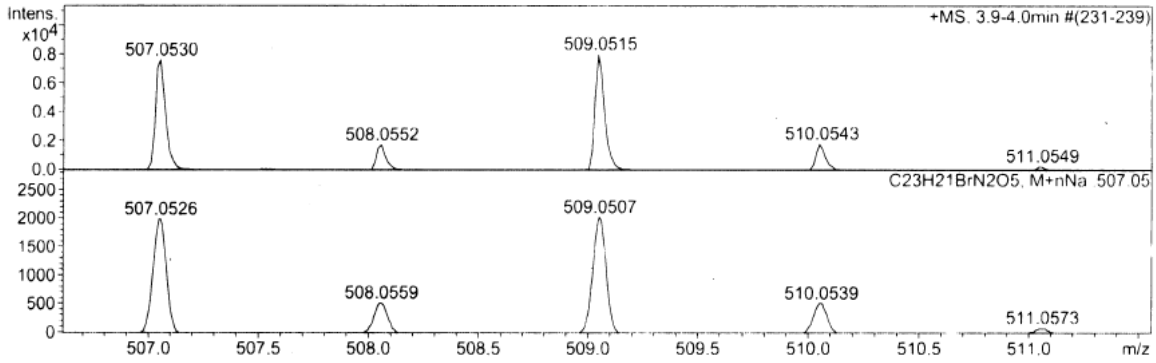
Analysis Name	D:\Data\user data\2015\AUGEST-2015\26-AUG-2015\Dr.A.Bisai-AB-KNB-02-205_1-B,2_01_3482.d	Acquisition Date	8/26/2015 12:47:16 PM
Method	HRLCMS-20 Sept tune wide.m	Operator	RUCHI
Sample Name	Dr.A.Bisai-AB-KNB-02-205	Instrument	micrOTOF-Q II 10330
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	1.2 Bar
Focus	Not active	Set Capillary	4500 V	Set Dry Heater	200 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	7.0 l/min
Scan End	3000 m/z	Set Collision Cell RF	600.0 Vpp	Set Divert Valve	Waste

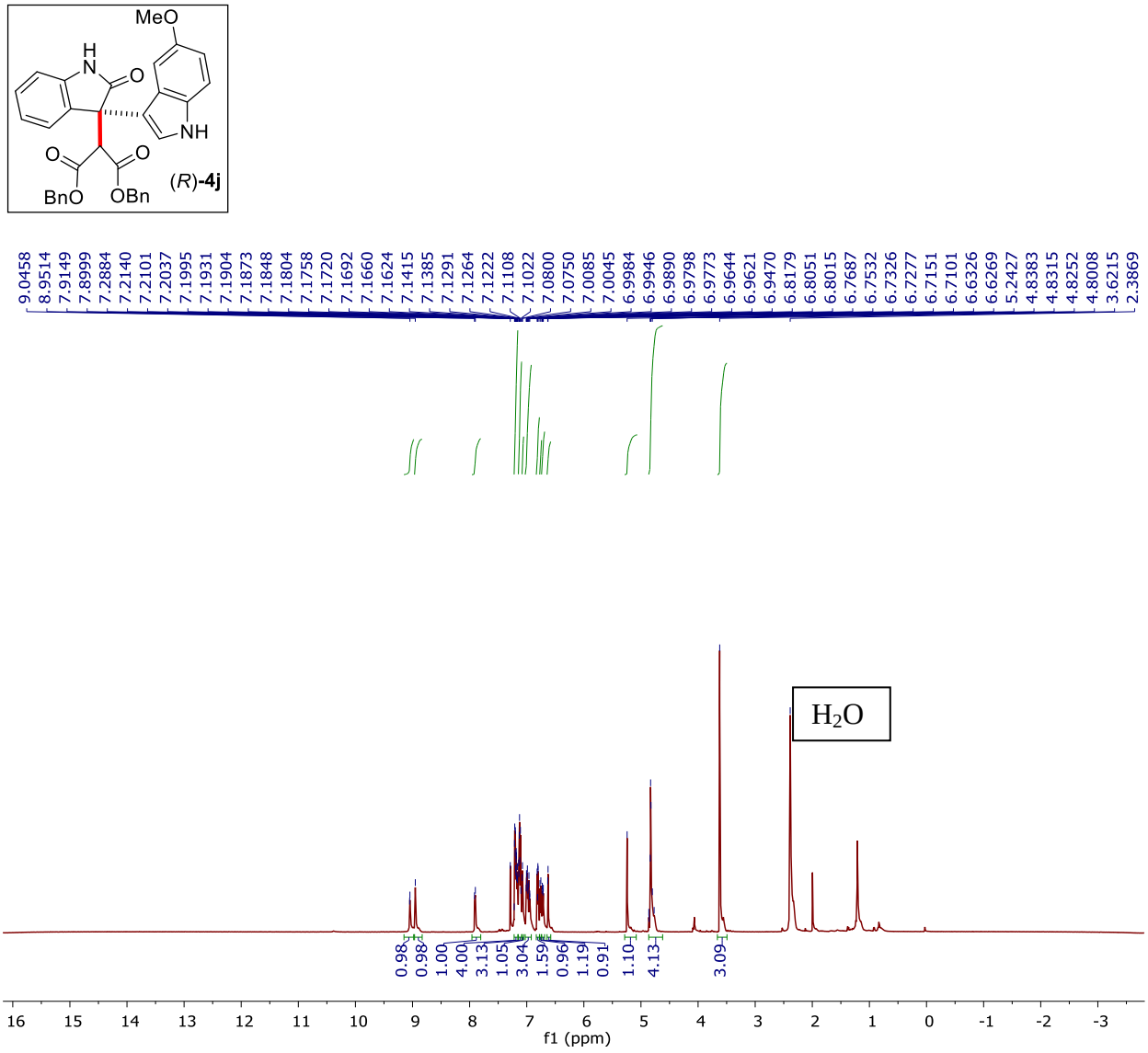




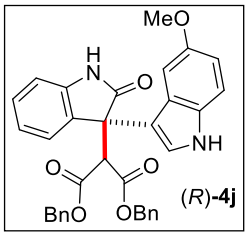


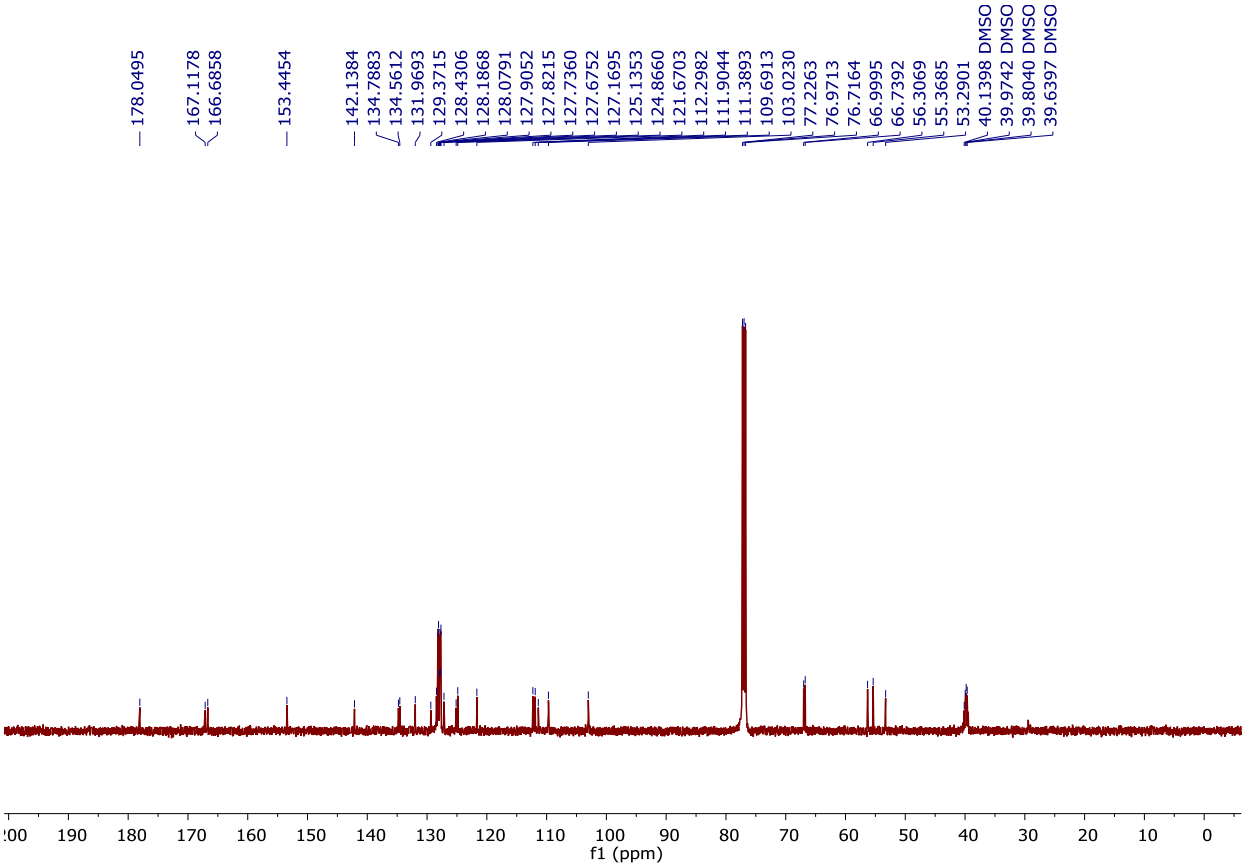
Bruker Compass DataAnalysis 4.0 printed: 8/26/2015 2:42:57 PM Page 1 of 1

Scanned copy of mass spectrum of (*R*)-**4i**



^{1}H NMR (0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4j**





^{13}C NMR (0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4j**

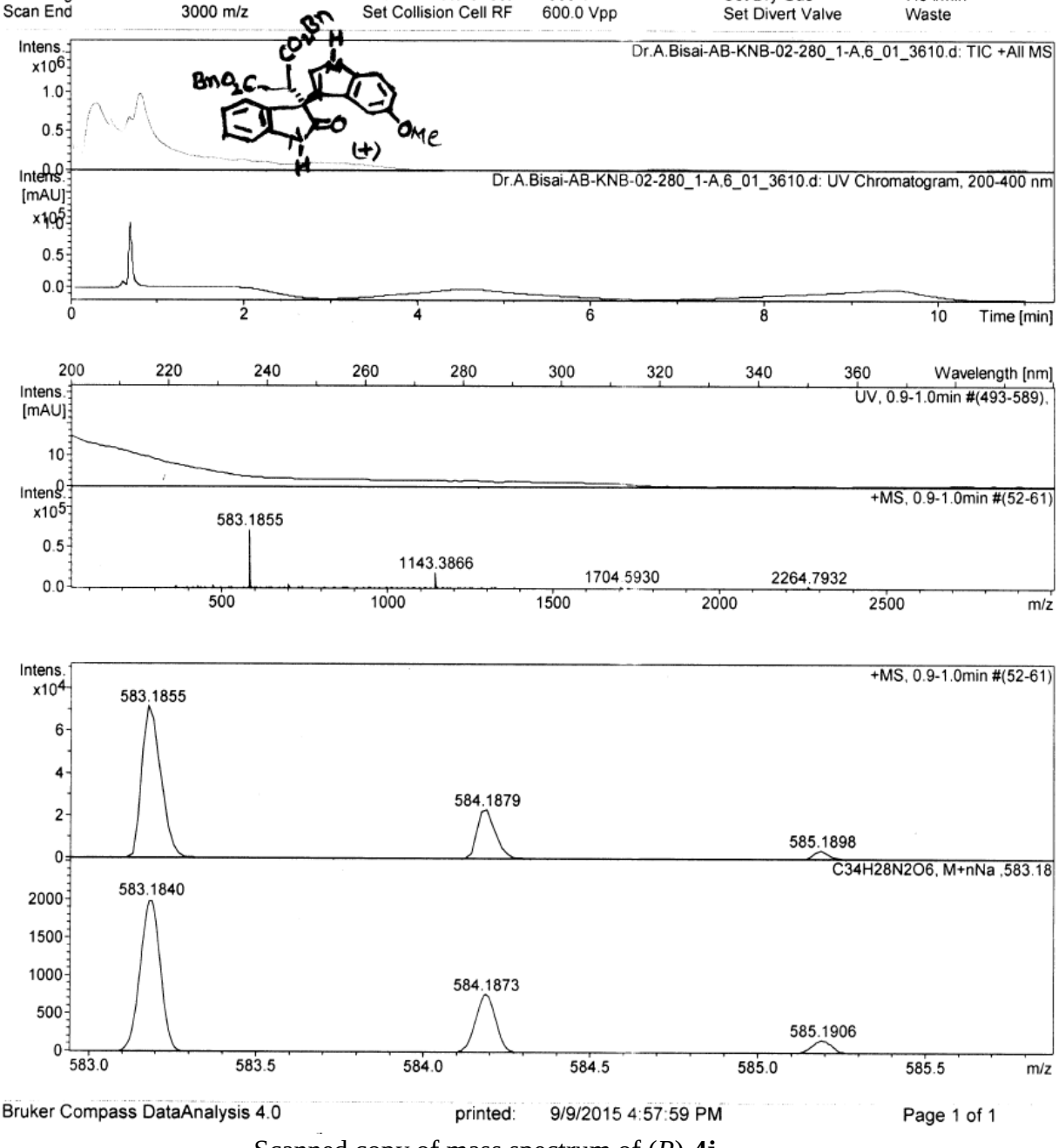
Display Report

Analysis Info

Analysis Name	D:\Data\user data\2015\SEPTMBER-2015\09-SEPT-2015\Dr.A.Bisai-AB-KNB-02-280_1-A,6_01_3610.d	Acquisition Date	9/9/2015 2:32:38 PM
Method	HRLCMS-20 Sept tune wide.m	Operator	RUCHI
Sample Name	Dr.A.Bisai-AB-KNB-02-280	Instrument	micrOTOF-Q II 10330
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	1.2 Bar
Focus	Not active	Set Capillary	4500 V	Set Dry Heater	200 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	7.0 l/min
Scan End	3000 m/z	Set Collision Cell RF	600.0 Vpp	Set Divert Valve	Waste



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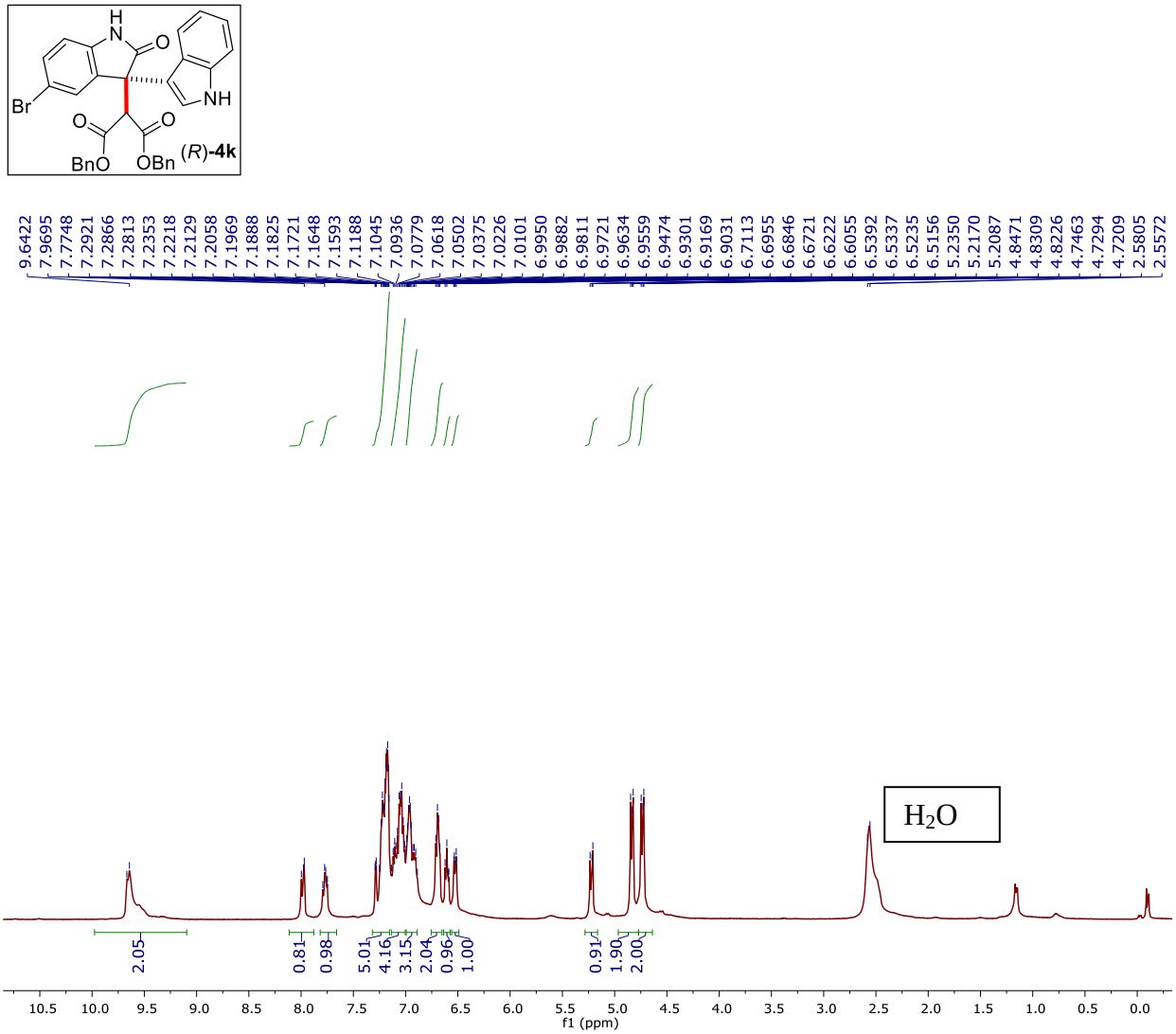
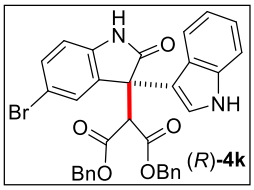
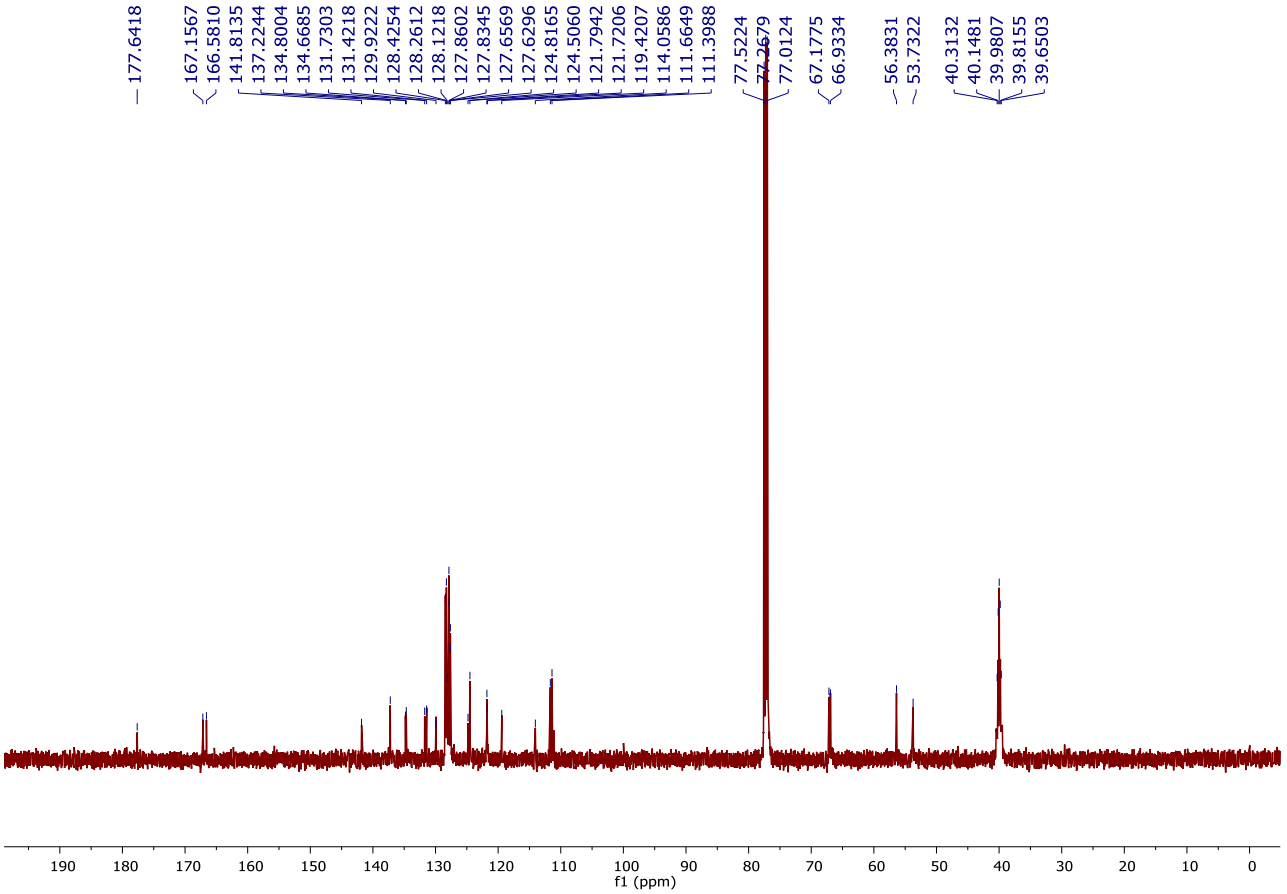
Scanned copy of mass spectrum of (*R*)-**4j**

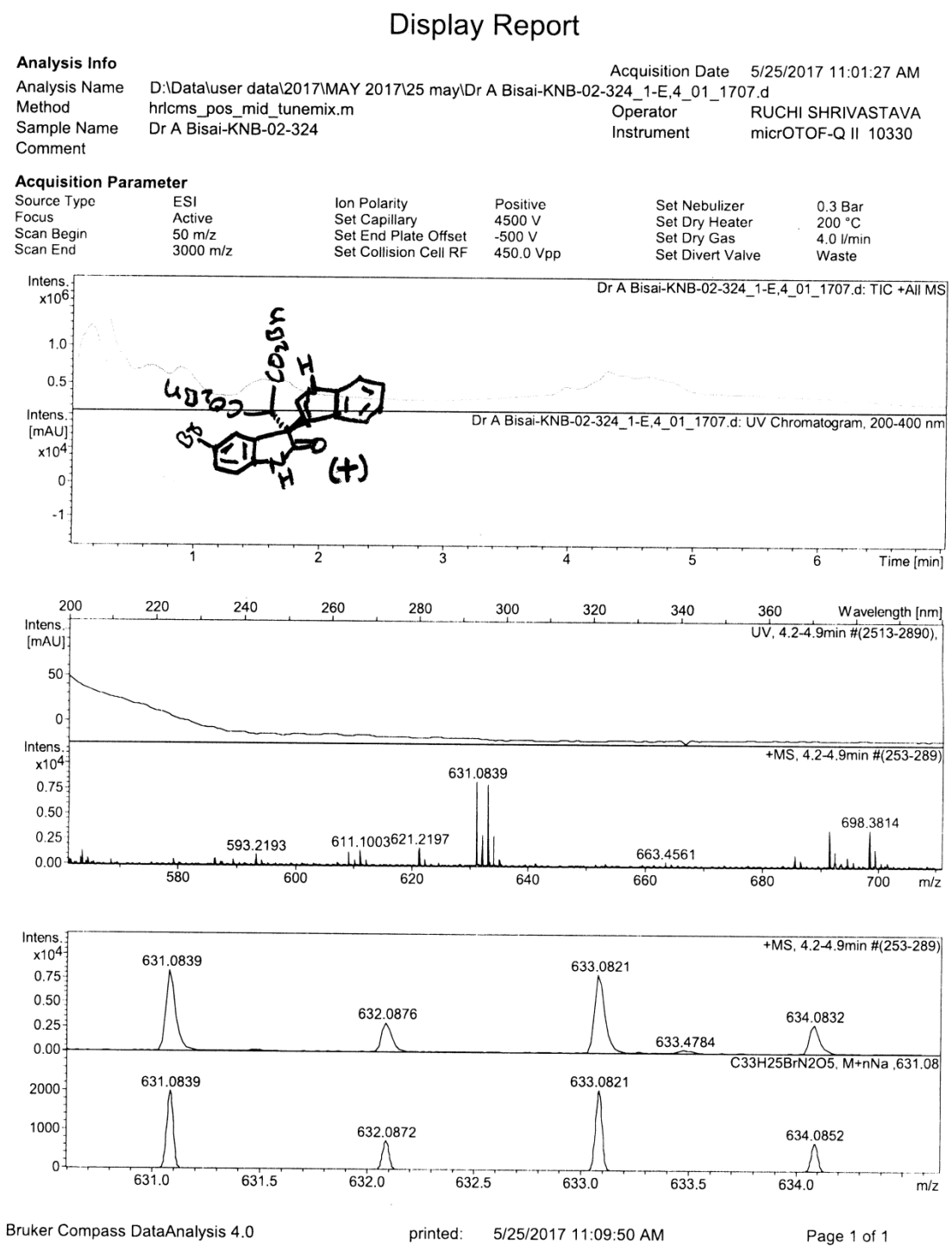


^{1}H NMR (500 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4k**

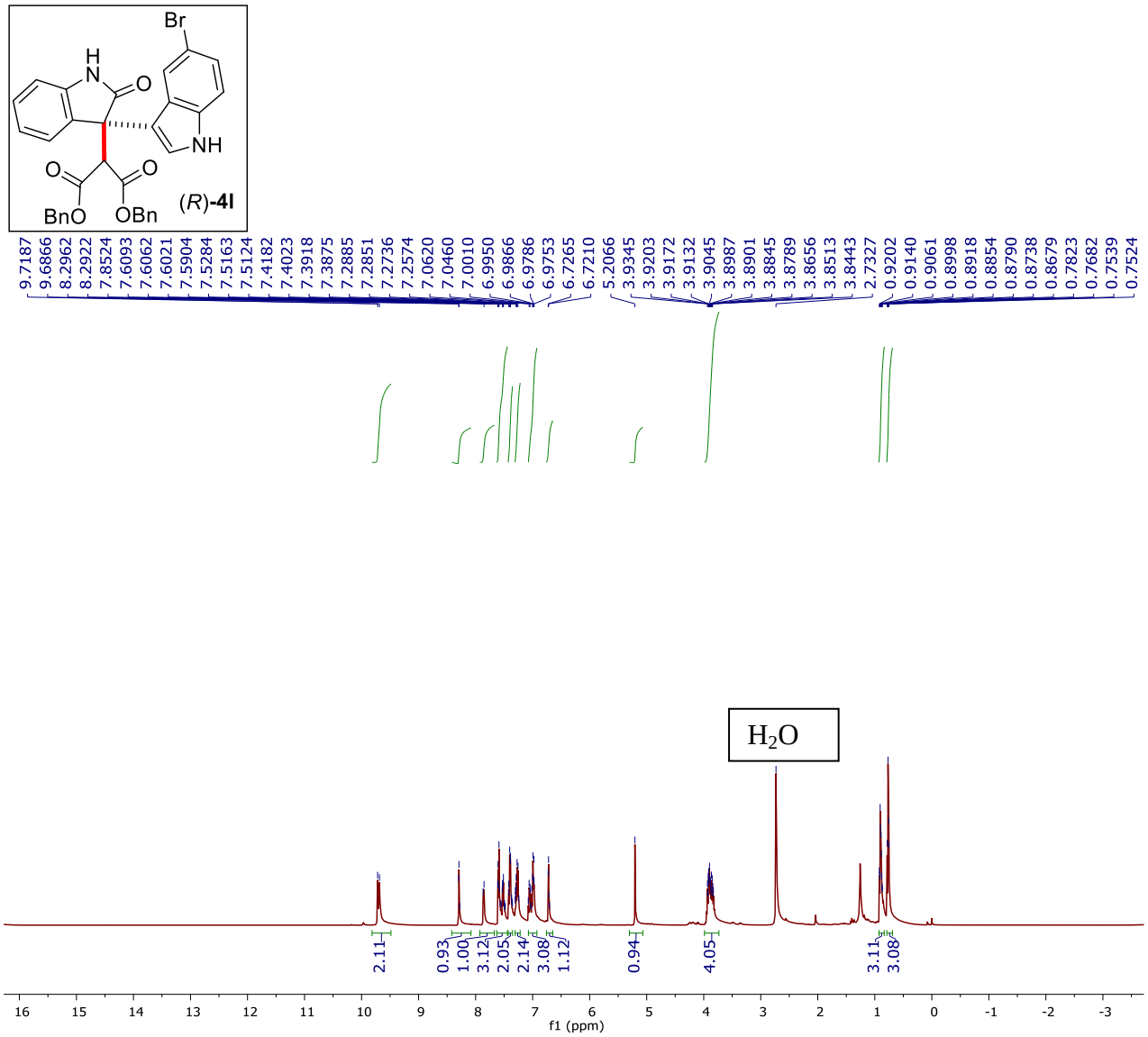




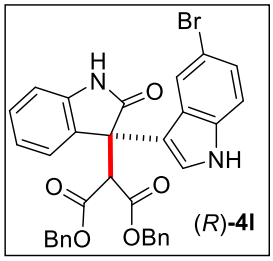
^{13}C NMR (120 MHz, 0.4 mL $CDCl_3$, 0.1 (*R*)-**4k**

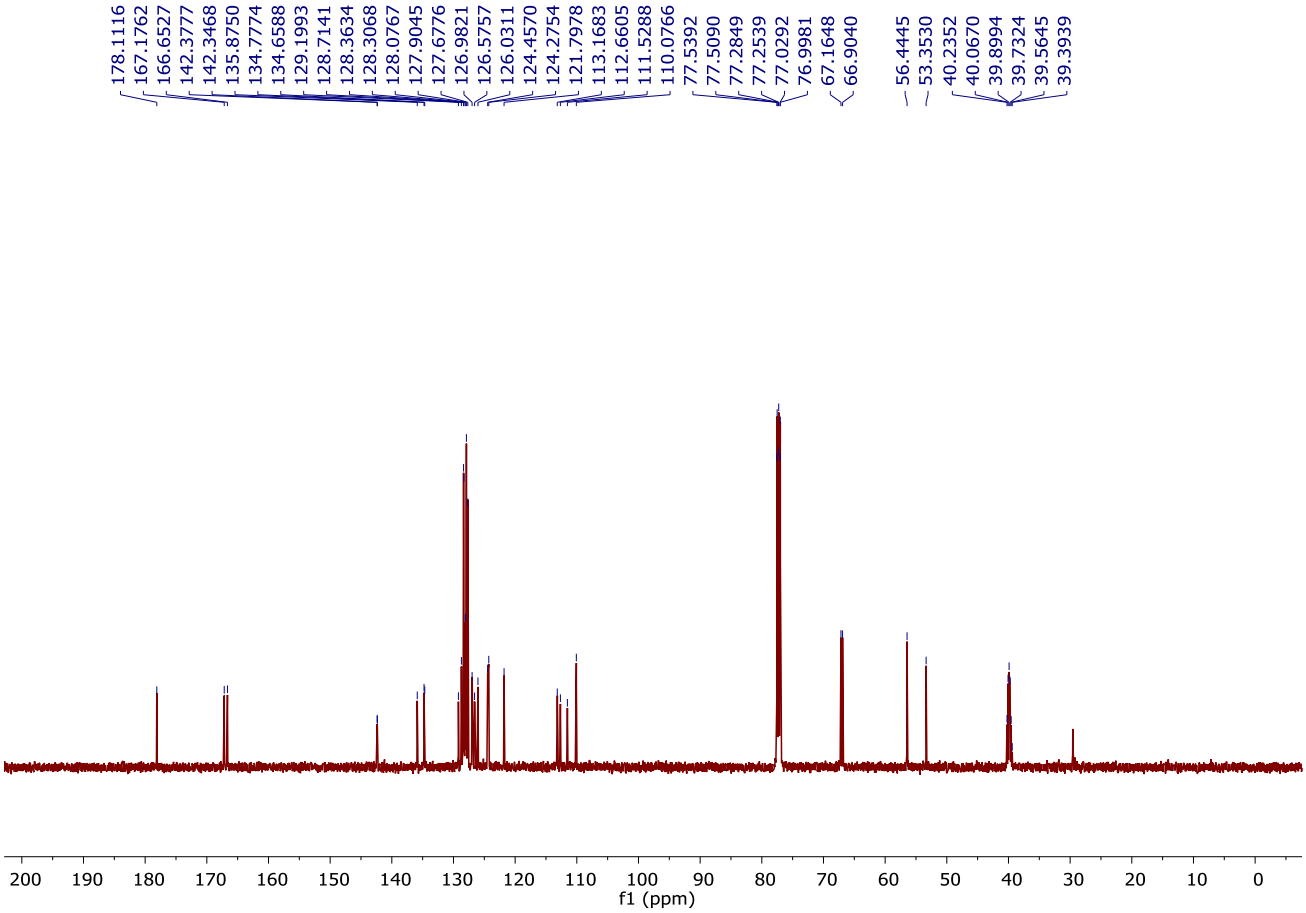


Scanned copy of mass spectrum of (*R*)-**4k**



^{1}H NMR (400 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4l**





^{13}C NMR (100 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4l**

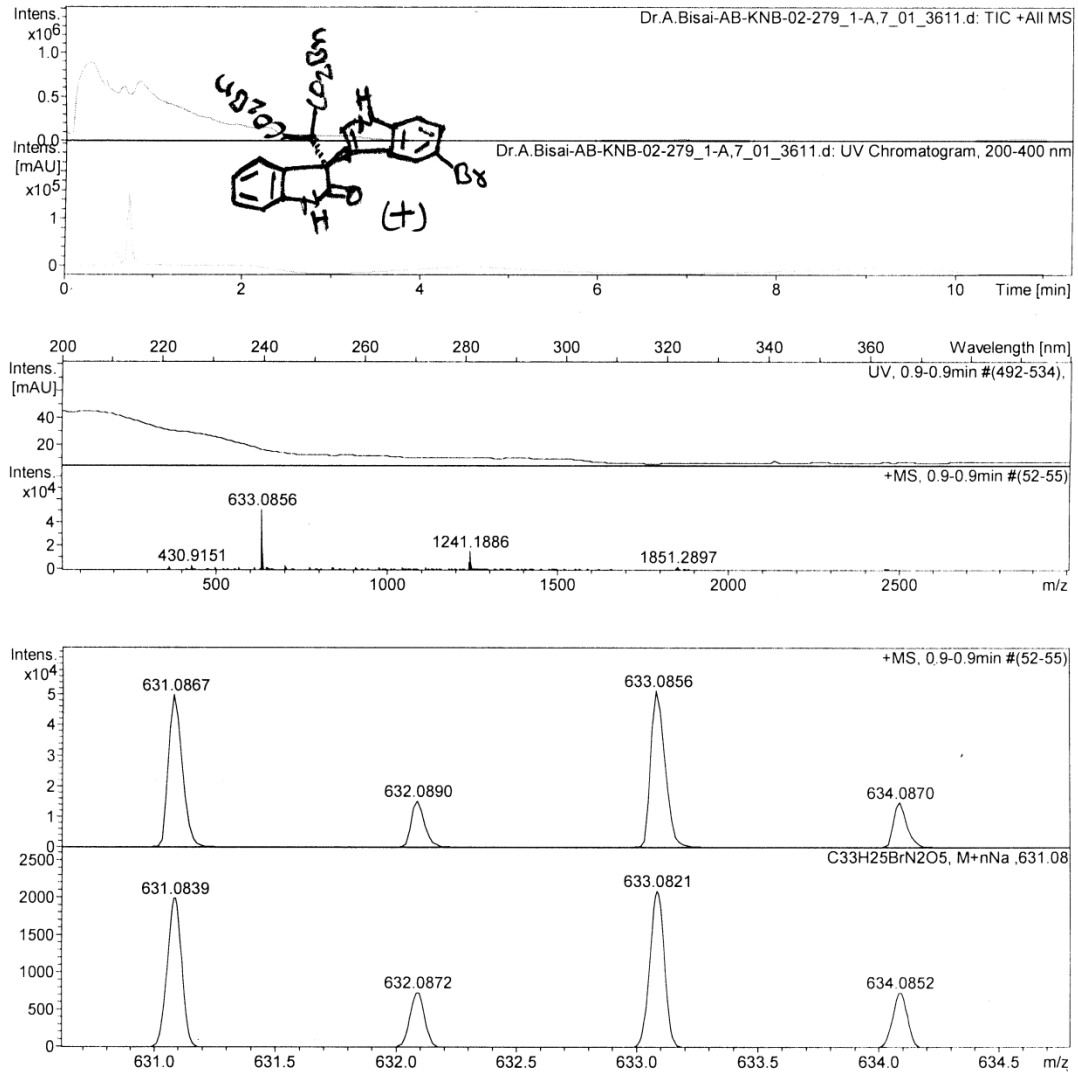
Display Report

Analysis Info

Analysis Name	D:\Data\user data\2015\SEPTMBER-2015\09-SEPT-2015\Dr.A.Bisai-AB-KNB-02-279_1-A,7_01_3611.d	Acquisition Date	9/9/2015 2:44:51 PM
Method	HRLCMS-20 Sept tune wide.m	Operator	RUCHI
Sample Name	Dr.A.Bisai-AB-KNB-02-279	Instrument	micrOTOF-Q II 10330
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	1.2 Bar
Focus	Not active	Set Capillary	4500 V	Set Dry Heater	200 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	7.0 l/min
Scan End	3000 m/z	Set Collision Cell RF	600.0 Vpp	Set Divert Valve	Waste



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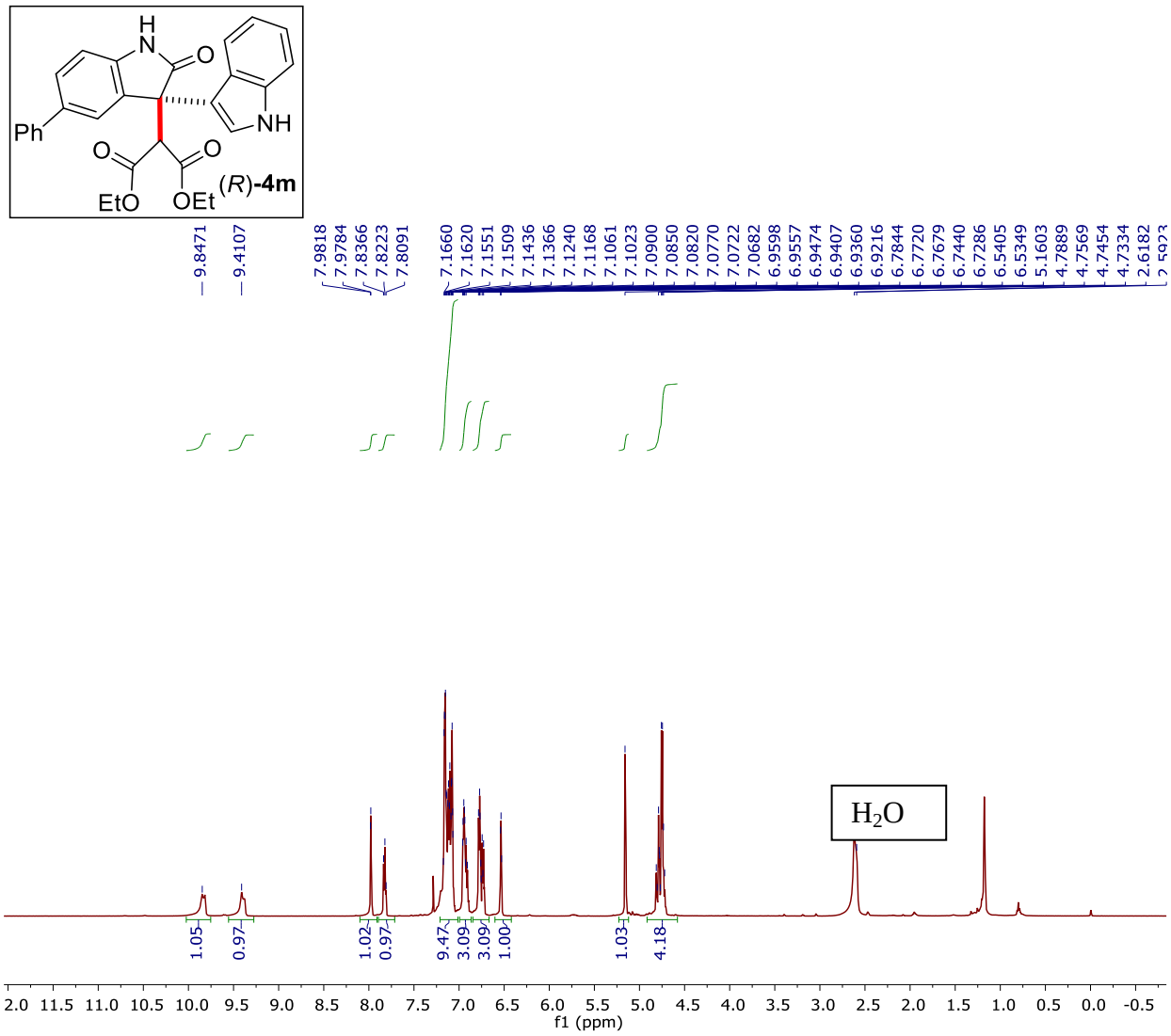
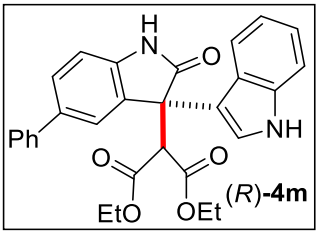
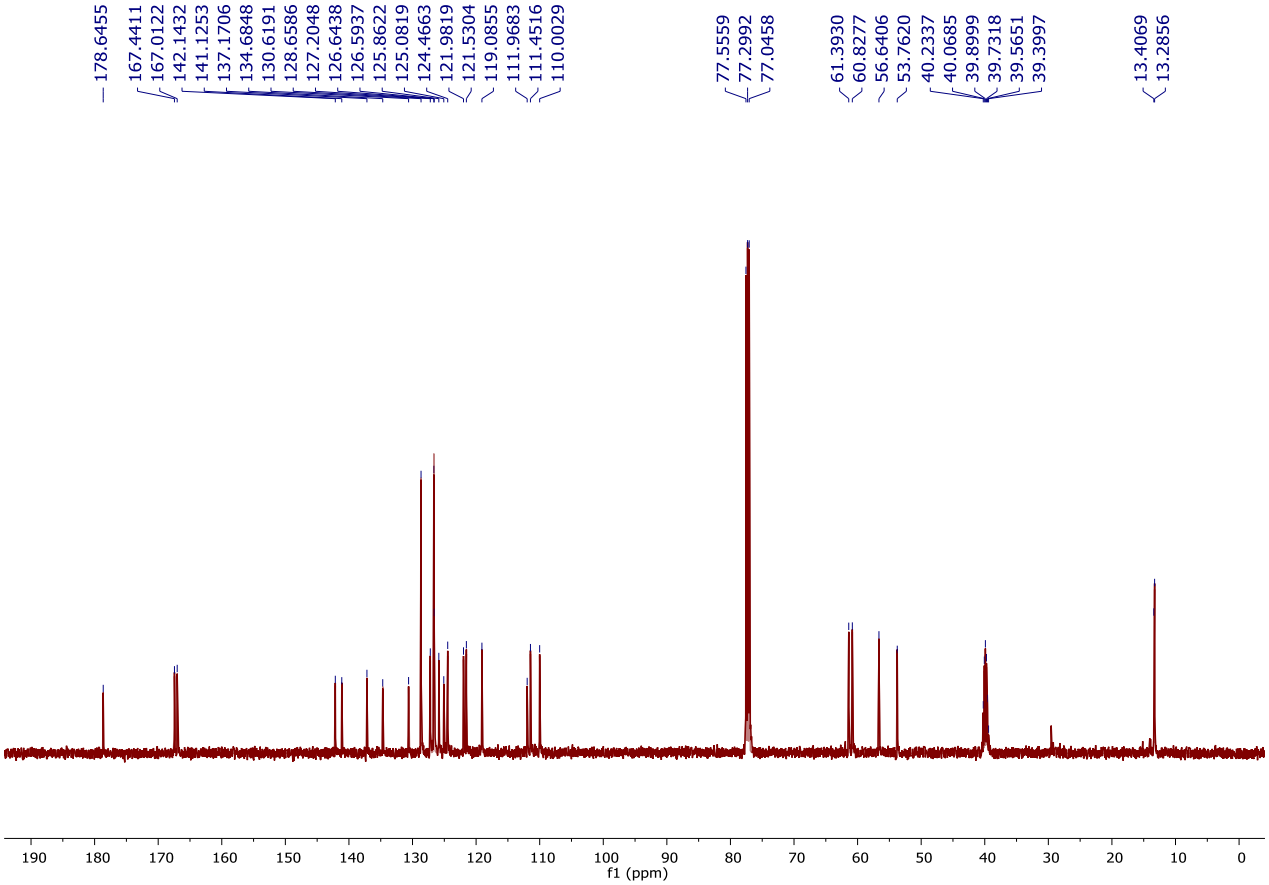
Scanned copy of mass spectrum of (*R*)-**4l**



^{1}H NMR (500 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4m**





^{13}C NMR (125 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4m**

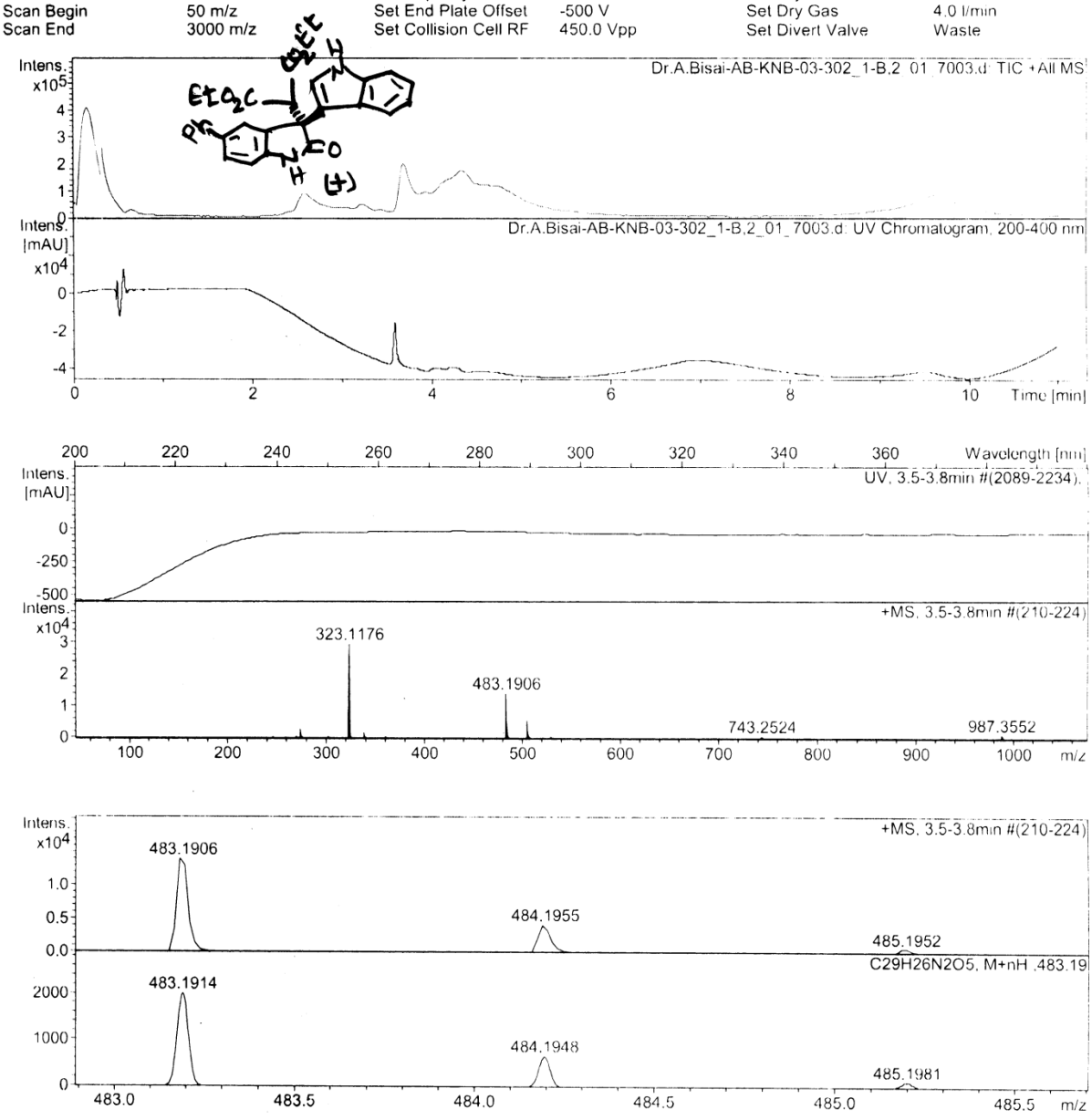
Display Report

Analysis Info

Analysis Name	D:\Data\user data\2016\July 2016\29-07-2016\Dr.A.Bisai-AB-KNB-03-302_1-B,2_01_7003.d	Acquisition Date	7/29/2016 3:31:06 PM
Method	hrlcms-pos_mid_tune wide.m	Operator	DIMPLE
Sample Name	Dr.A.Bisai-AB-KNB-03-302	Instrument	micrOTOF-Q II 10330
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.3 Bar
Focus	Active	Set Capillary	4500 V	Set Dry Heater	200 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	4.0 l/min
Scan End	3000 m/z	Set Collision Cell RF	450.0 Vpp	Set Divert Valve	Waste



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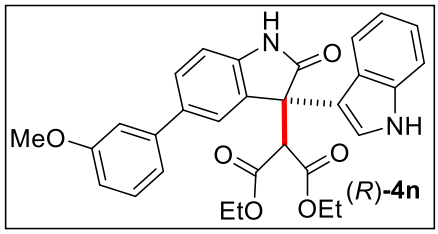
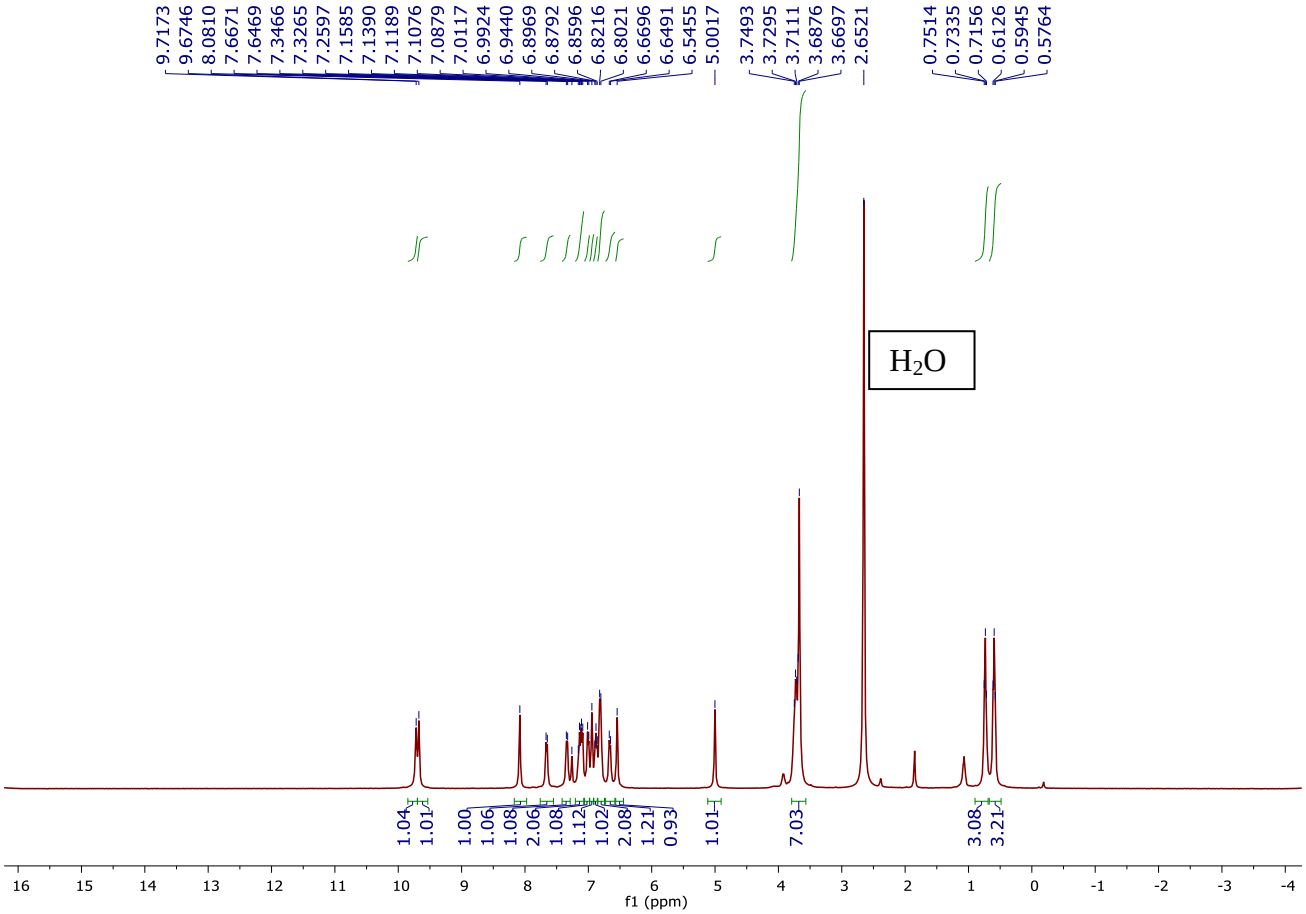
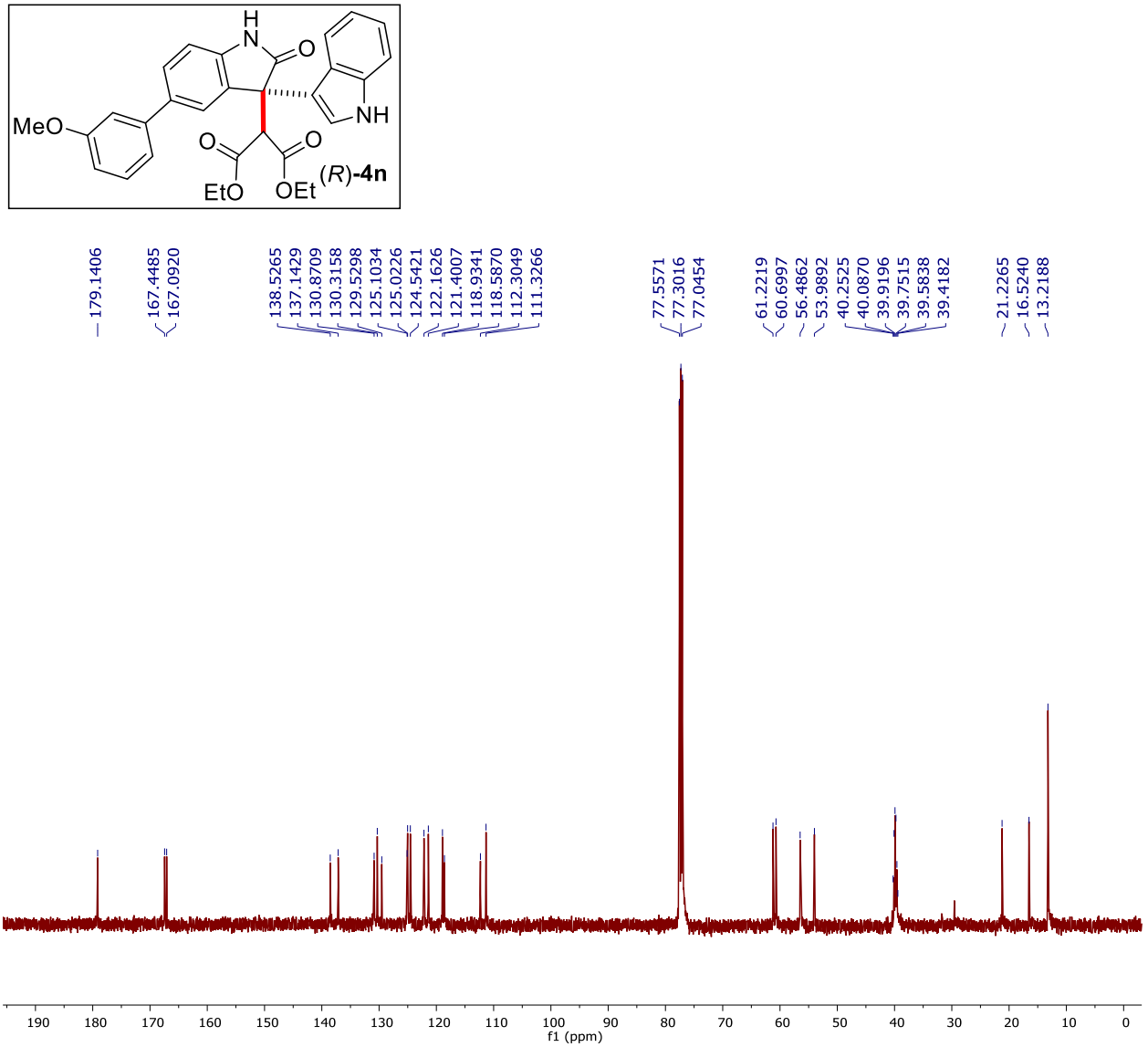
Scanned copy of mass spectrum of (*R*)-**4m**





^{1}H NMR (500 MHz, 0.4 mLCDCl$_3$, 0.1 mL DMSO-D$_6$) of compound (*R*)-**4n**



^{13}C NMR (100 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4n**

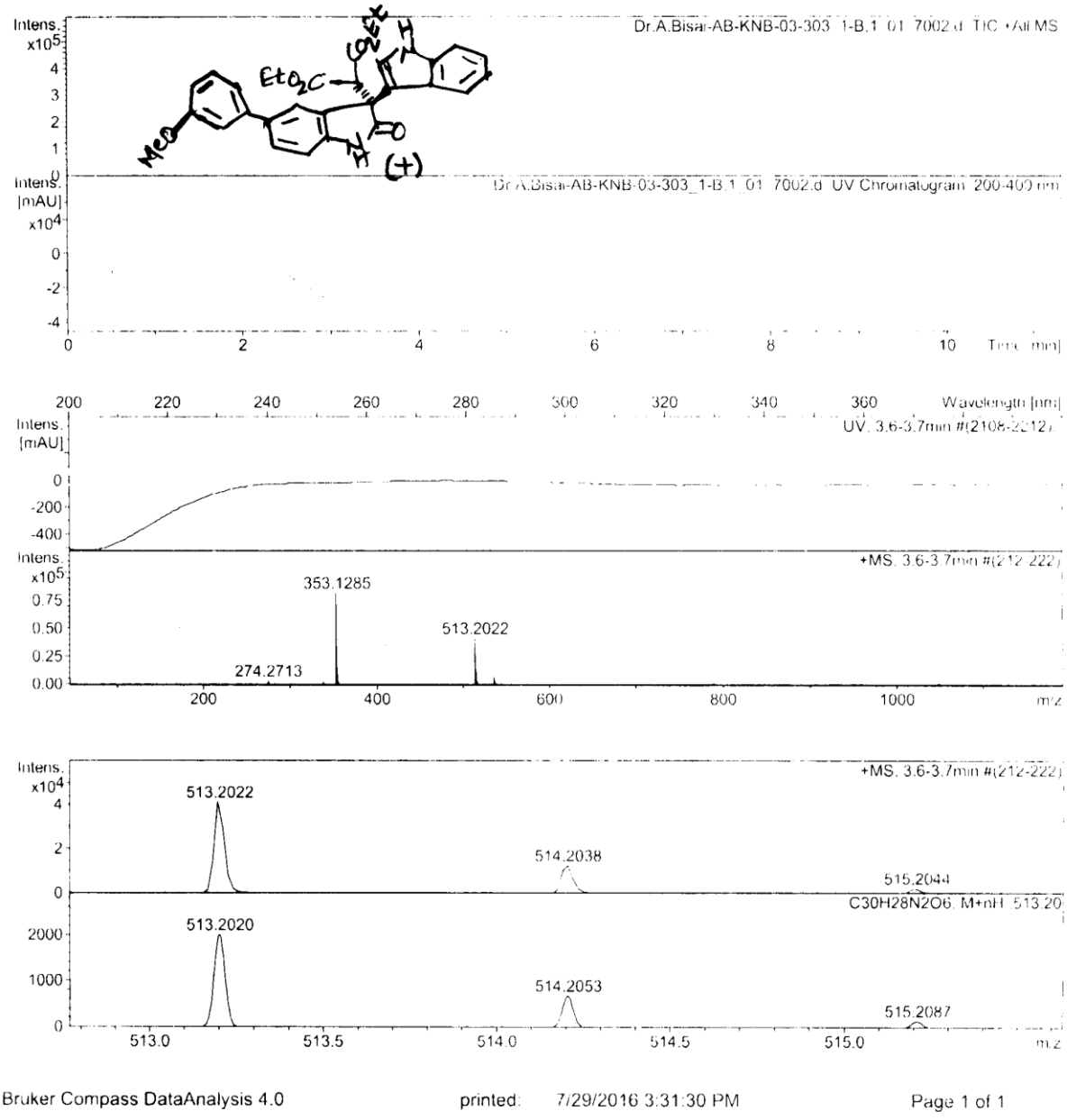
Display Report

Analysis Info

Analysis Name	D:\Data\user data\2016\July 2016\29-07-2016\Dr.A.Bisai-AB-KNB-03-303_1-B,1_01_7002.d	Acquisition Date	7/29/2016 3:18:56 PM
Method	hrlcms-pos_mid_tune wide.m	Operator	DIMPLE
Sample Name	Dr.A.Bisai-AB-KNB-03-303	Instrument	micrOTOF-Q II 10330
Comment			

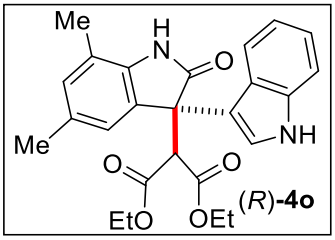
Acquisition Parameter

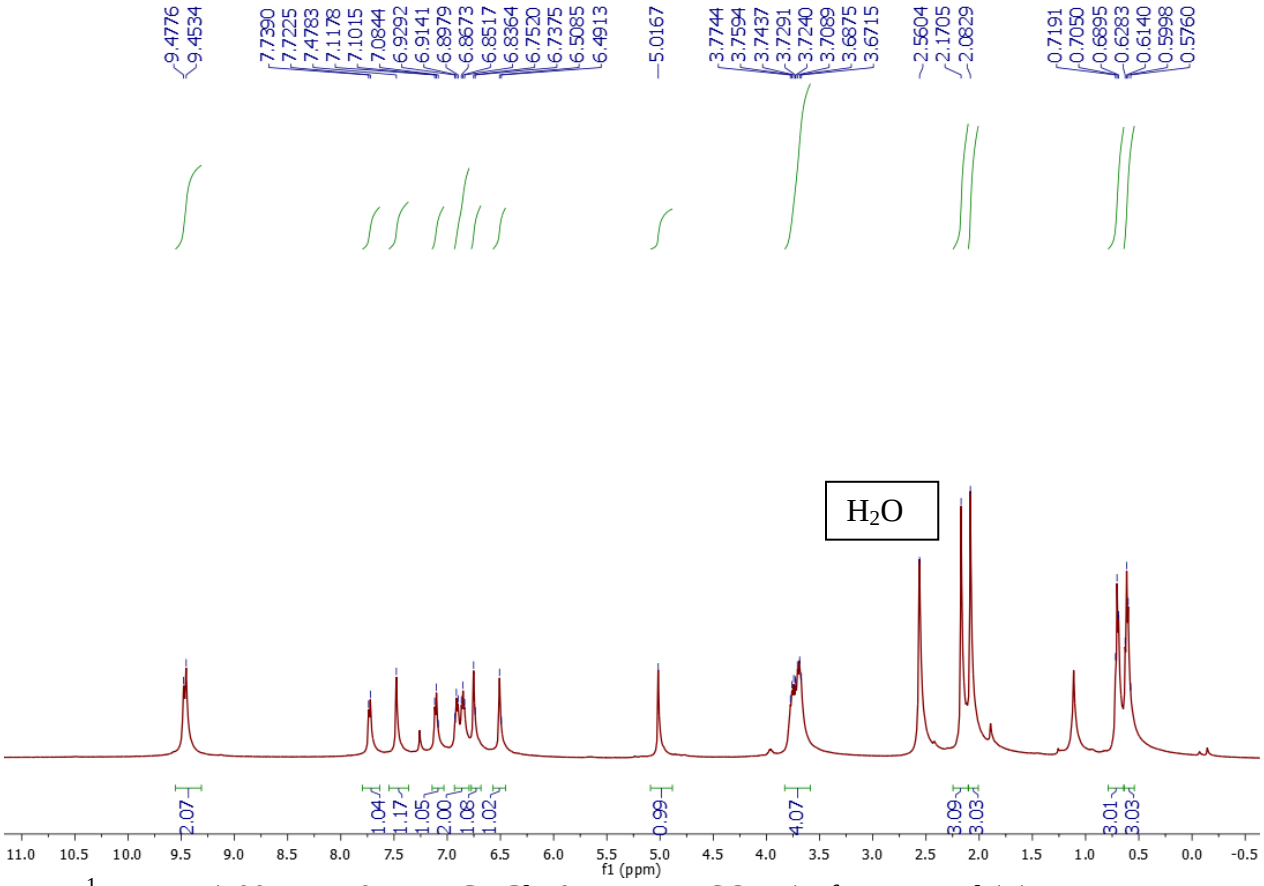
Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.3 Bar
Focus	Active	Set Capillary	4500 V	Set Dry Heater	200 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	4.0 l/min
Scan End	3000 m/z	Set Collision Cell RF	450.0 Vpp	Set Divert Valve	Waste



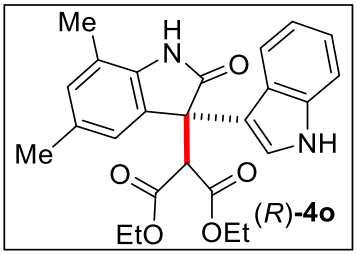
Bruker Compass DataAnalysis 4.0 printed: 7/29/2016 3:31:30 PM Page 1 of 1

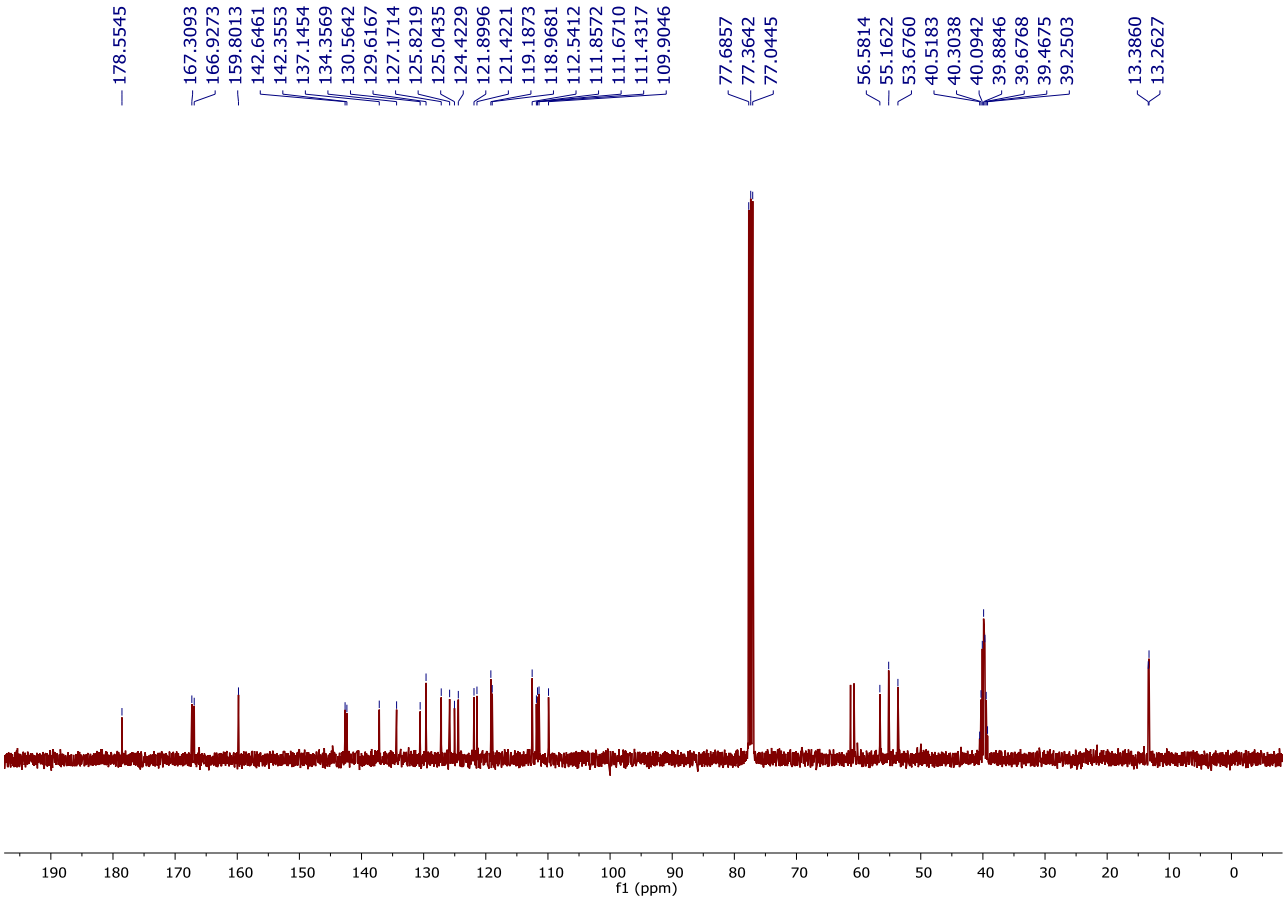
Scanned copy of mass spectrum of (*R*)-**4n**





^{1}H NMR (500 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4o**





^{13}C NMR (125 MHz, 0.4 mL $CDCl_3$, 0.1 mL DMSO-D_6) of compound (*R*)-**4o**

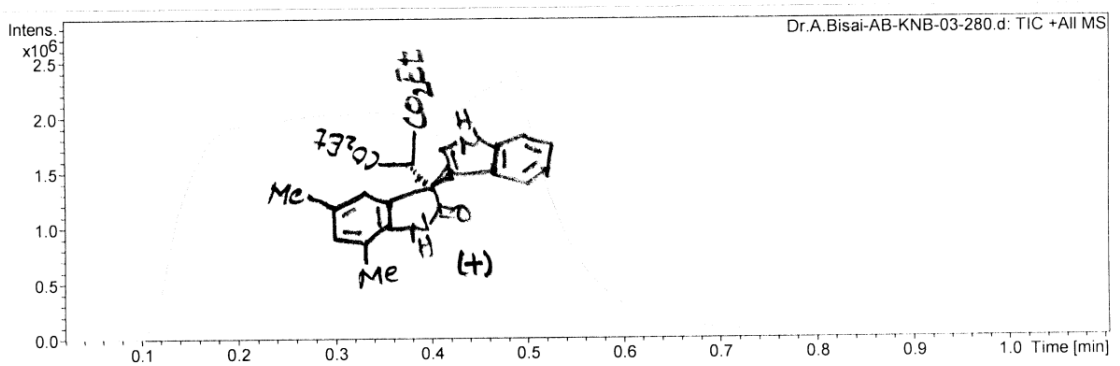
Display Report

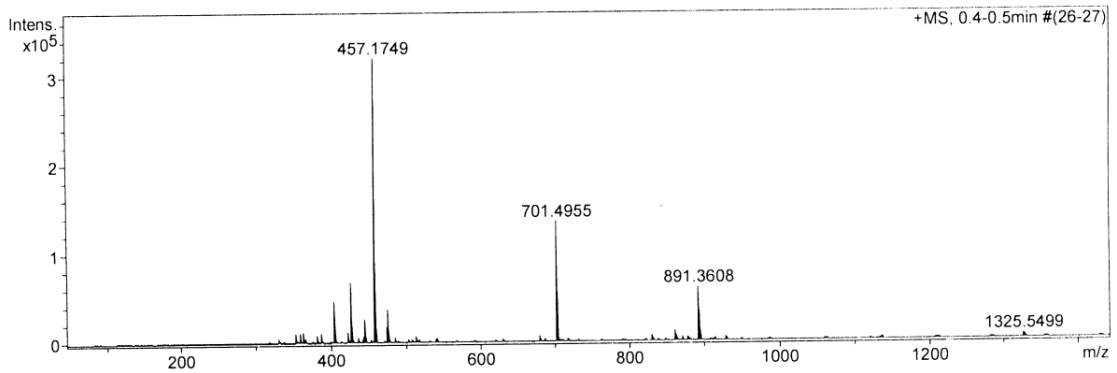
Analysis Info

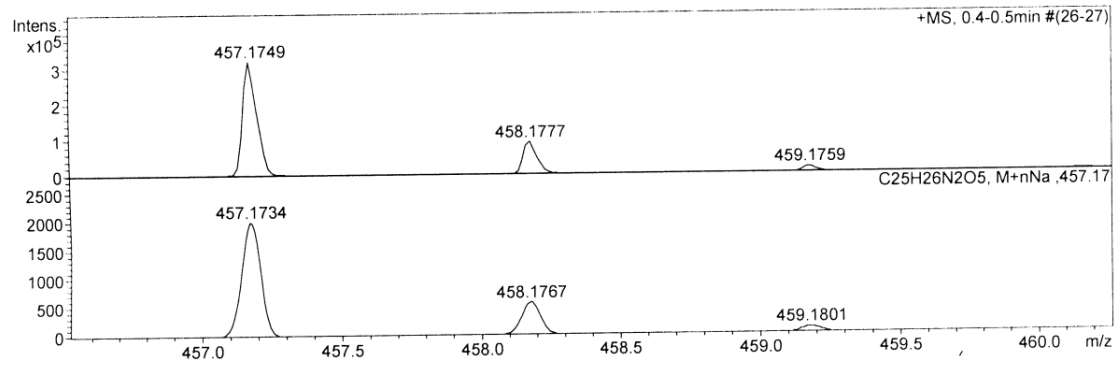
Analysis Name	D:\Data\user data\2017\MAY 2017\24 may\Dr.A.Bisai-AB-KNB-03-280.d	Acquisition Date	5/24/2017 4:29:39 PM
Method	tune_wide.m	Operator	RUCHI SHRIVASTAVA
Sample Name	AB-KNB-03-280	Instrument	micrOTOF-Q II 10330
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.4 Bar
Focus	Not active	Set Capillary	4500 V	Set Dry Heater	180 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	4.0 l/min
Scan End	3000 m/z	Set Collision Cell RF	600.0 Vpp	Set Divert Valve	Waste







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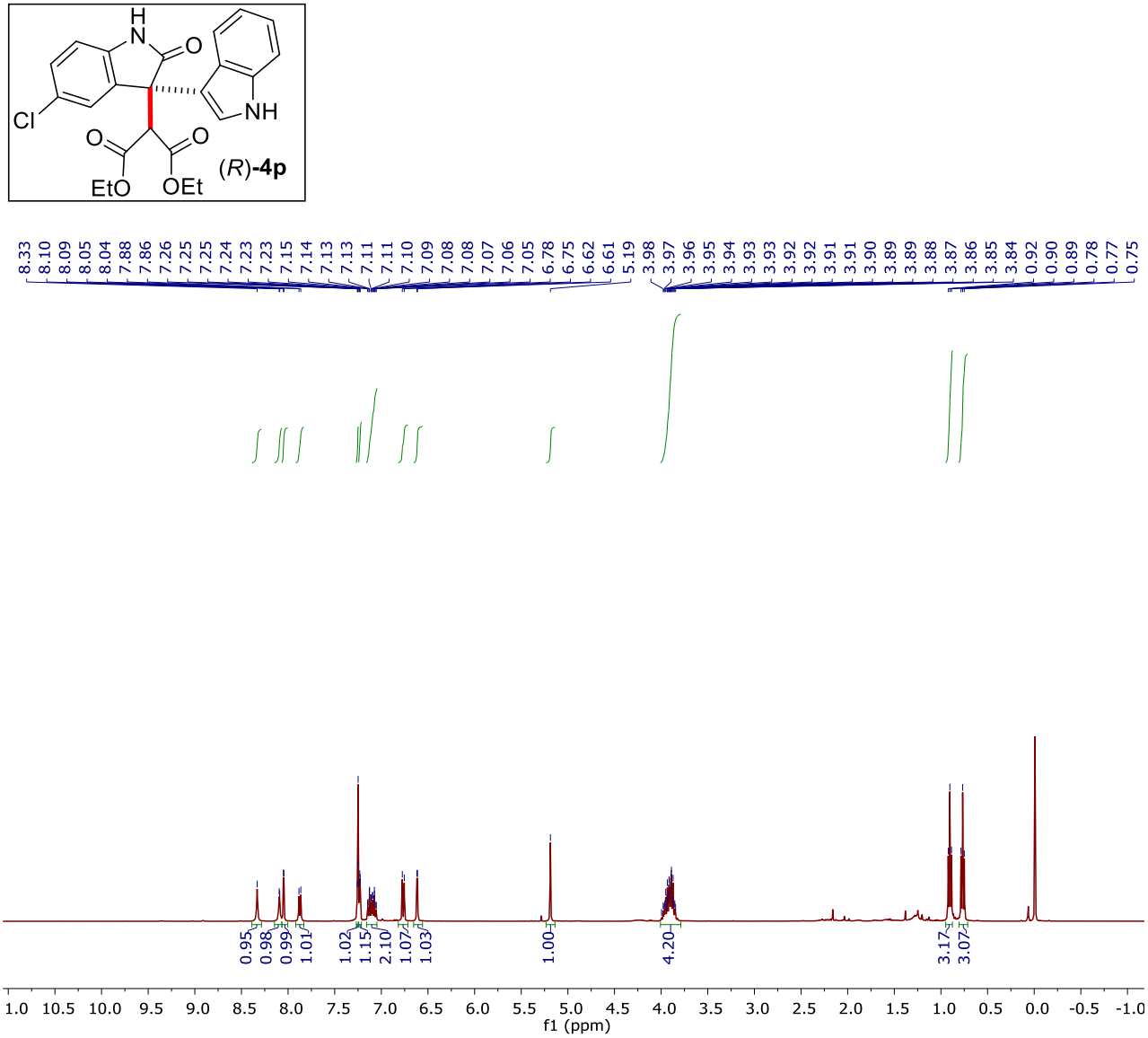
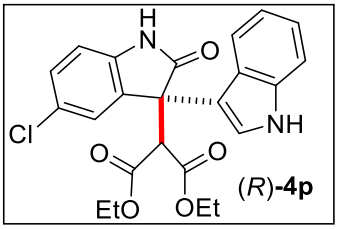
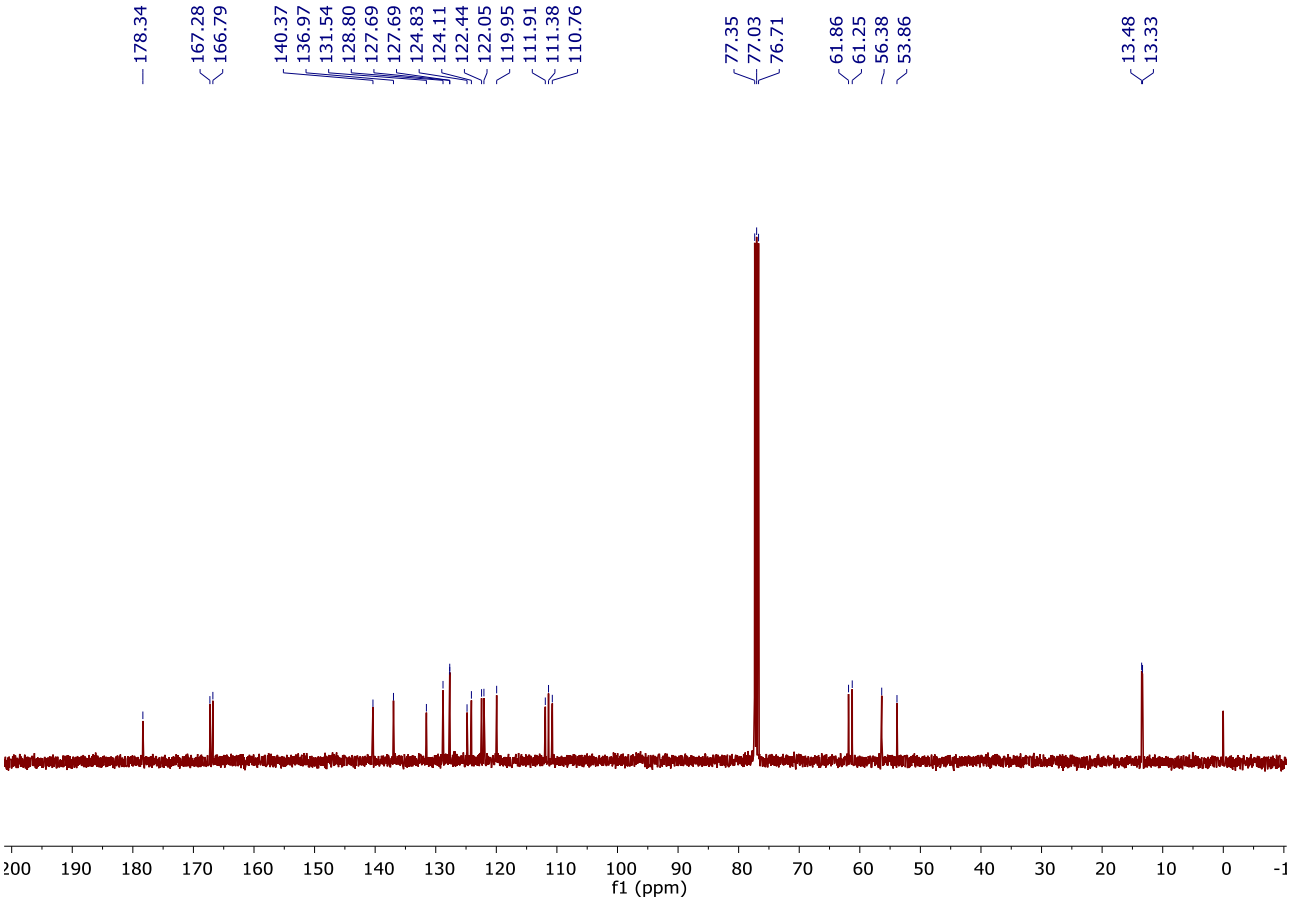
Scanned copy of mass spectrum of (*R*)-**4o**



^{1}H NMR (500 MHz, 0.4 mL $CDCl_3$) of compound (*R*)-**4p**





^{13}C NMR (125 MHz, 0.4 mL $CDCl_3$) of compound (*R*)-**4p**

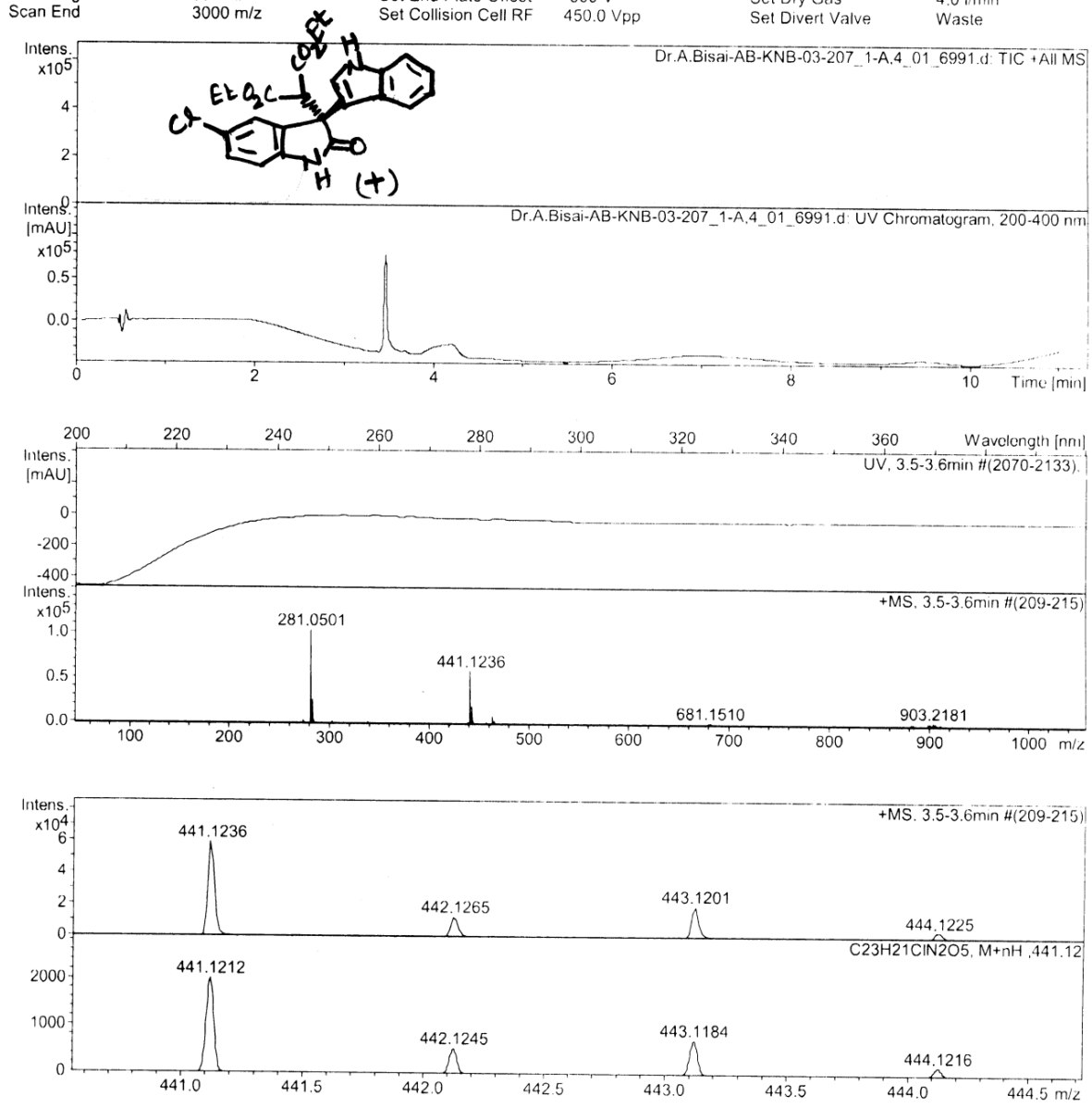
Display Report

Analysis Info

Analysis Name	D:\Data\user data\2016\July 2016\29-07-2016\Dr.A.Bisai-AB-KNB-03-207_1-A,4_01_6991.d	Acquisition Date	7/29/2016 1:11:26 PM
Method	hrlcms-pos_mid_tune wide.m	Operator	DIMPLE
Sample Name	Dr.A.Bisai-AB-KNB-03-207	Instrument	micrOTOF-Q II 10330
Comment			

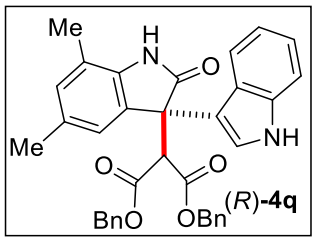
Acquisition Parameter

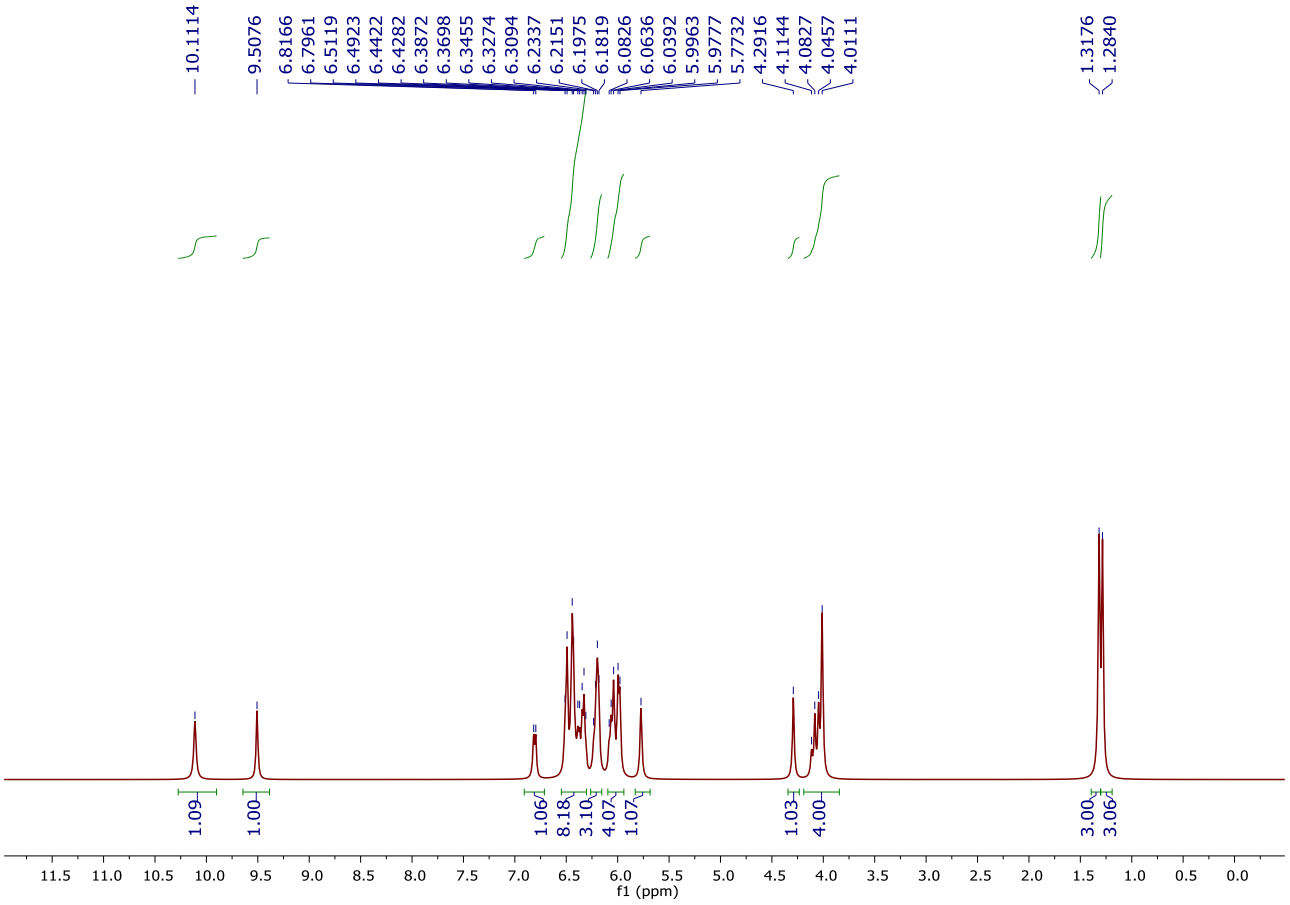
Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.3 Bar
Focus	Active	Set Capillary	4500 V	Set Dry Heater	200 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	4.0 l/min
Scan End	3000 m/z	Set Collision Cell RF	450.0 Vpp	Set Divert Valve	Waste



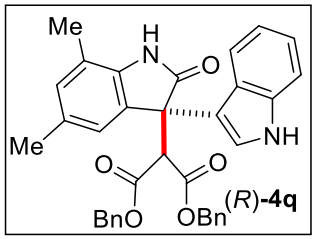
Bruker Compass DataAnalysis 4.0 printed: 7/29/2016 3:07:06 PM Page 1 of 1

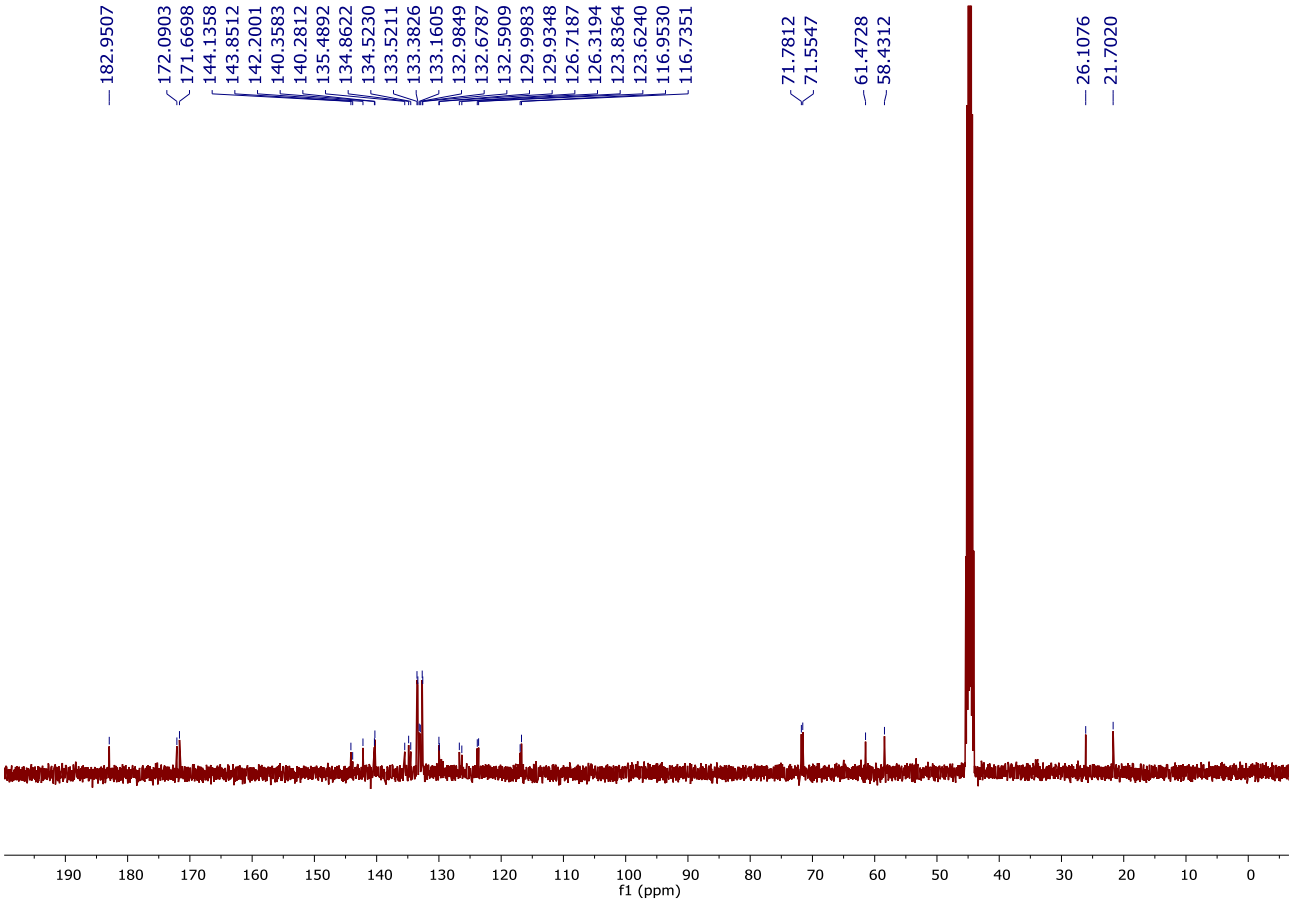
Scanned copy of mass spectrum of (*R*)-**4p**





^{1}H NMR (400 MHz, DMSO-D_6) of compound (*R*)-**4q**





^{13}C NMR (100 MHz, DMSO-D_6) of compound (*R*)-**4q**

Display Report

Analysis Info

Analysis Name	D:\Data\user data\2017\MAY 2017\24 may\Dr.A.Bisai-AB-KNB-03-310.d	Acquisition Date	5/24/2017 4:31:49 PM
Method	tune_wide.m	Operator	RUCHI SHRIVASTAVA
Sample Name	AB-KNB-03-310	Instrument	micrOTOF-Q II 10330
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.4 Bar
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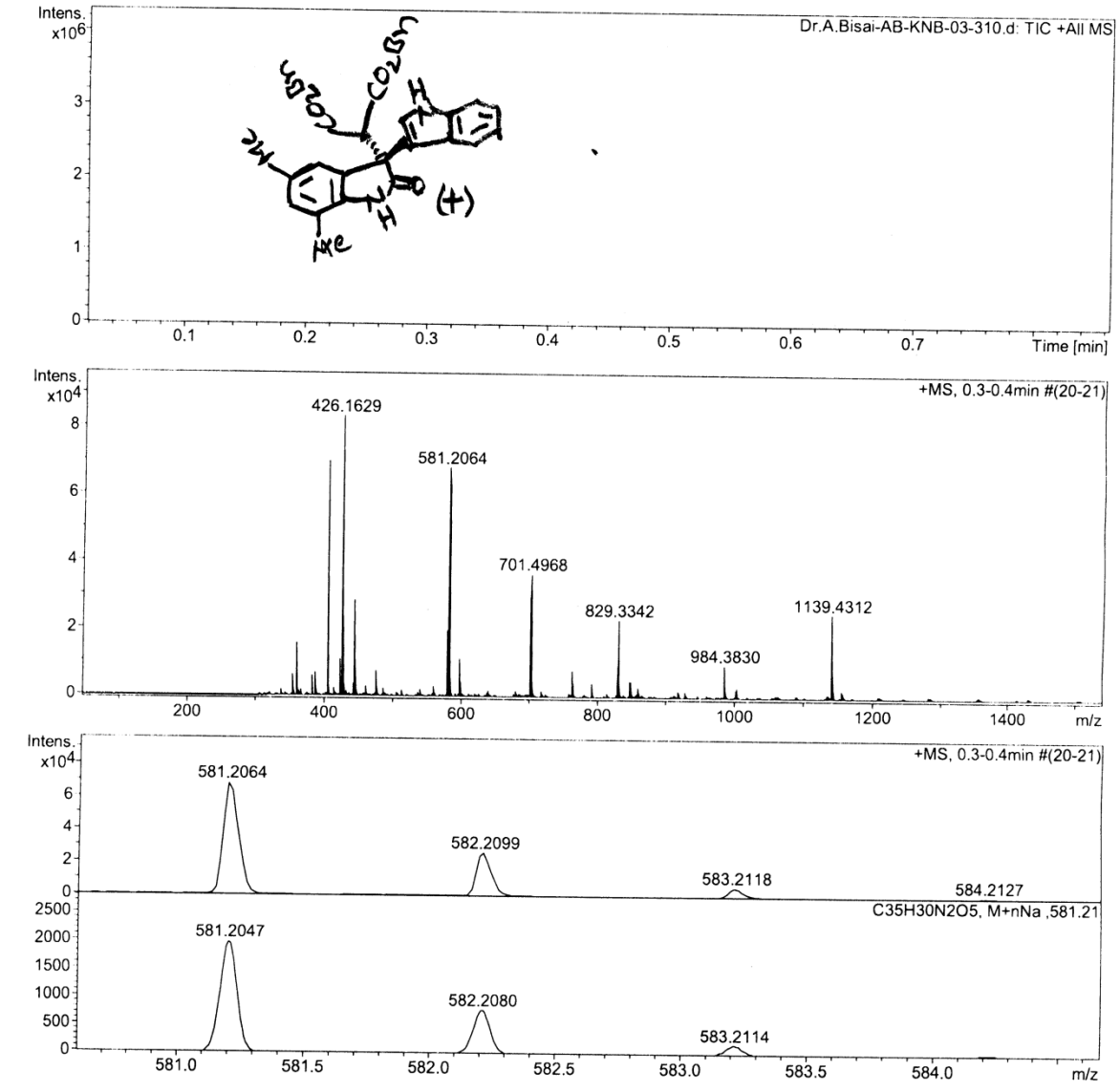
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	4.0 l/min
Scan End	3000 m/z	Set Collision Cell RF	600.0 Vpp	Set Divert Valve	Waste



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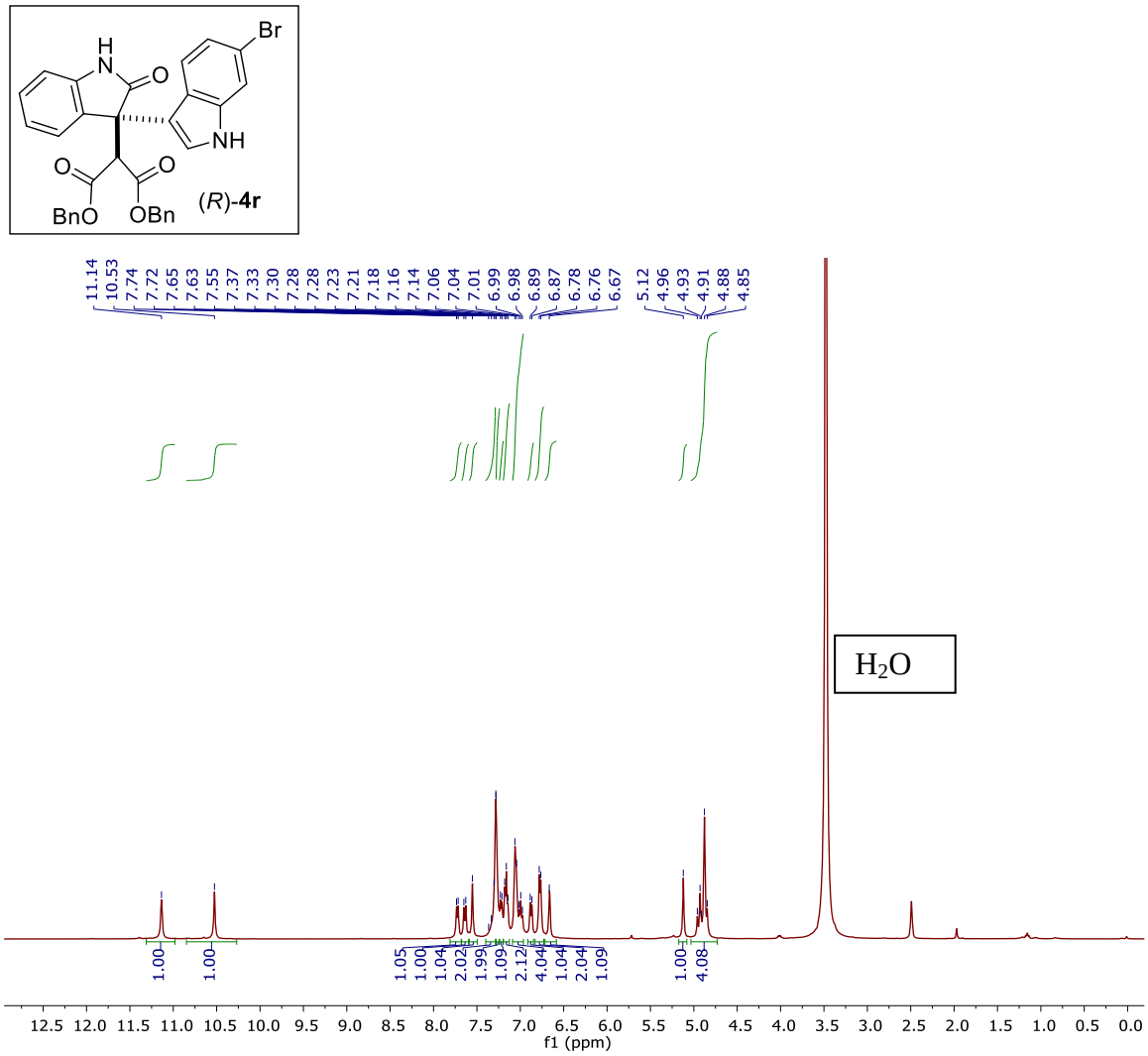
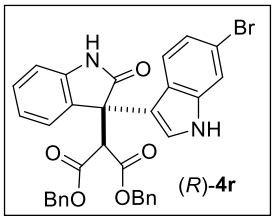
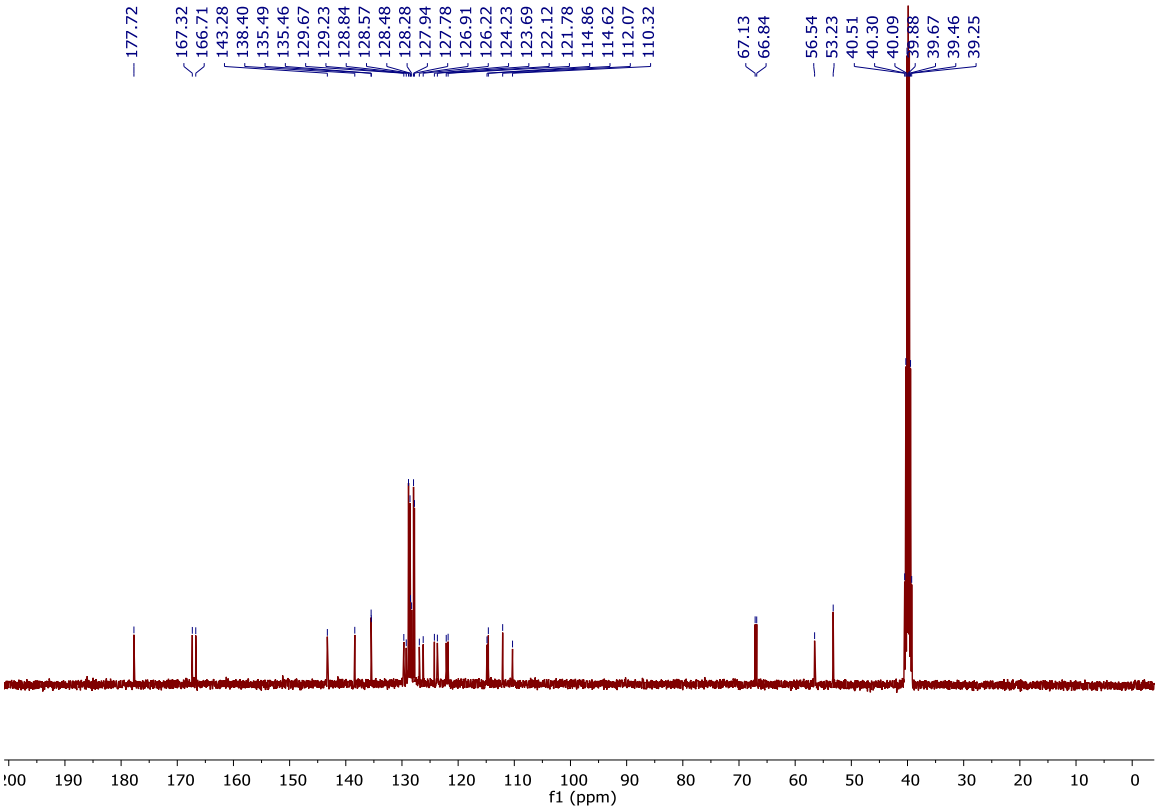
Scanned copy of mass spectrum of (*R*)-**4q**



^{1}H NMR (400 MHz, DMSO-D_6) of compound (*R*)-**4r**





^{13}C NMR (100 MHz, DMSO-D_6) of compound (*R*)-**4r**

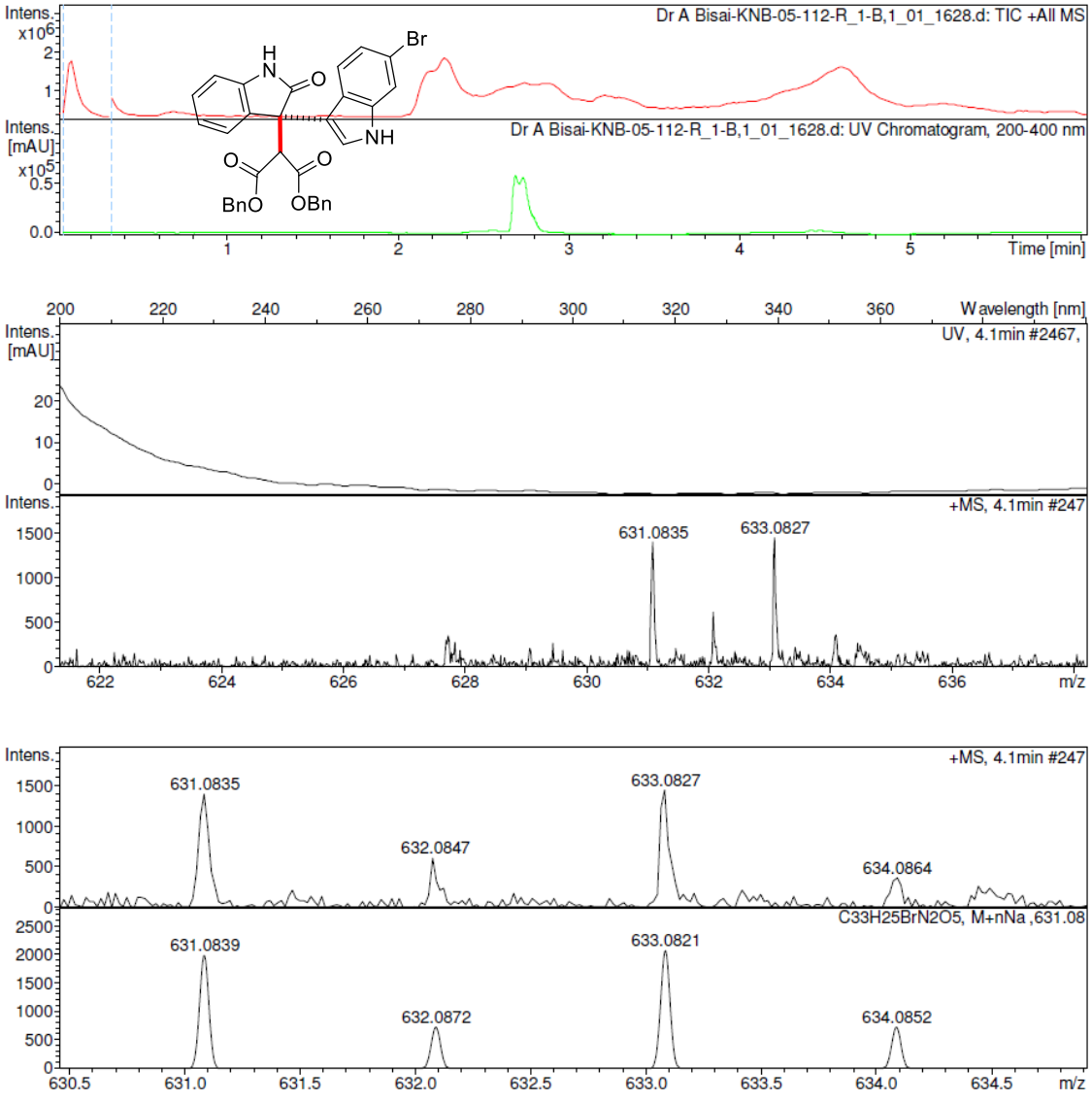
Display Report

Analysis Info

		Acquisition Date	5/8/2018 12:26:17 PM
Analysis Name	D:\Data\NEW USER DATA 2017\2018\May-2018\08-05-2018\Dr A Bisai-KNB-05-112-R_1-B,1_01_1628.d		
Method	hrlcms-20 sept.m	Operator	RUCHI
Sample Name	Dr A Bisai-KNB-05-112-R	Instrument	micrOTOF-Q II 10330
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	1.2 Bar
Focus	Active	Set Capillary	4500 V	Set Dry Heater	200 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	7.0 l/min
Scan End	3000 m/z	Set Collision Cell RF	130.0 Vpp	Set Divert Valve	Waste



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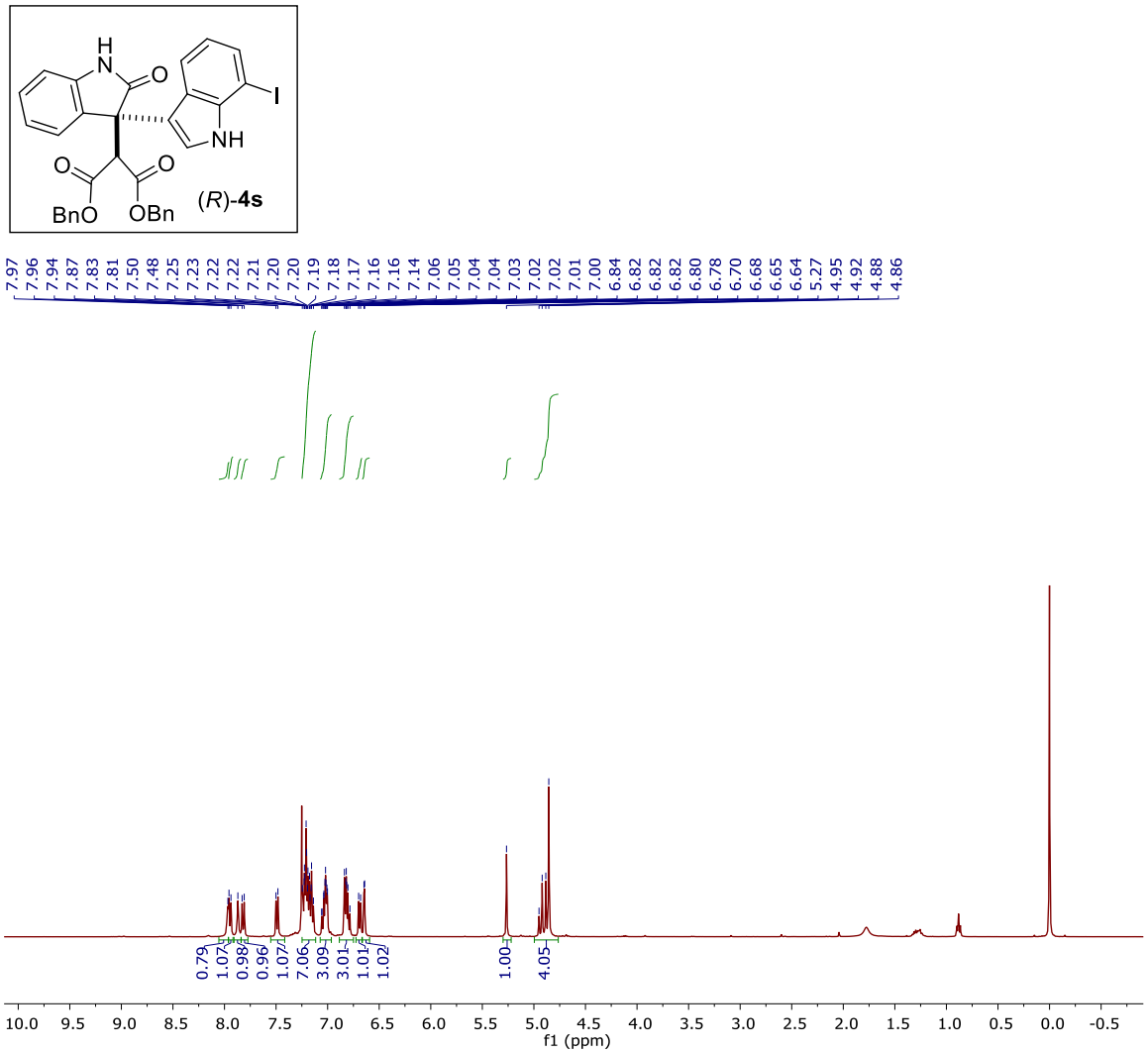
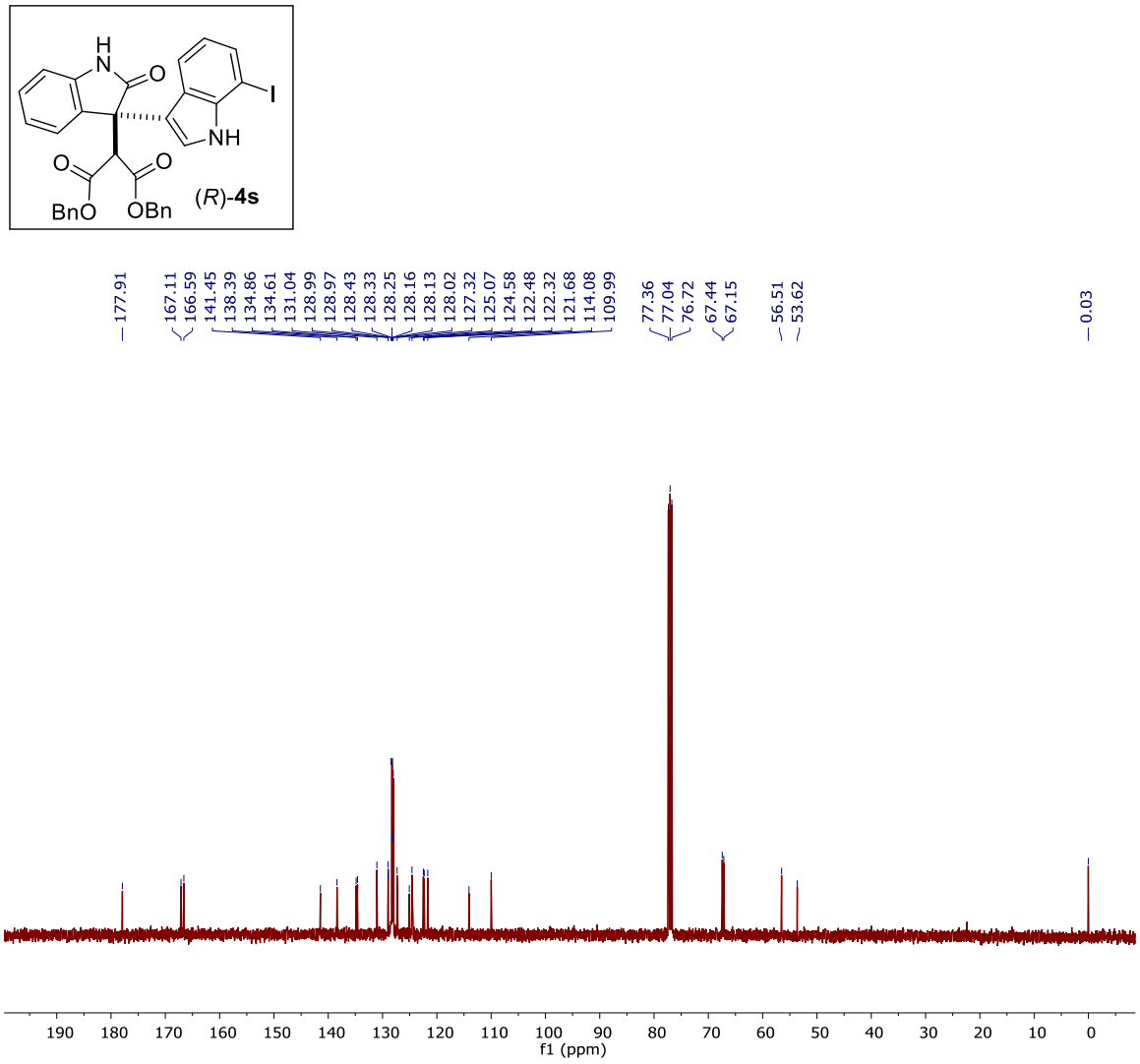
Mass spectrum of (*R*)-**4r**



^{1}H NMR (400 MHz, $CDCl_3$) of compound (*R*)-**4s**



^{13}C NMR (100 MHz, $CDCl_3$) of compound (*R*)-**4s**

Display Report

Analysis Info

Analysis Name	D:\Data\NEW USER DATA 2017\2018\May-2018\11-05-2018\Dr A Bisai-KNB-05-122_1-B,8_01_1724.d	Acquisition Date	5/11/2018 12:36:05 PM
Method	hrlcms-20 sept.m	Operator	RUCHI
Sample Name	Dr A Bisai-KNB-05-122	Instrument	micrOTOF-Q II 10330
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	1.2 Bar
Focus	Active	Set Capillary	4500 V	Set Dry Heater	200 °C
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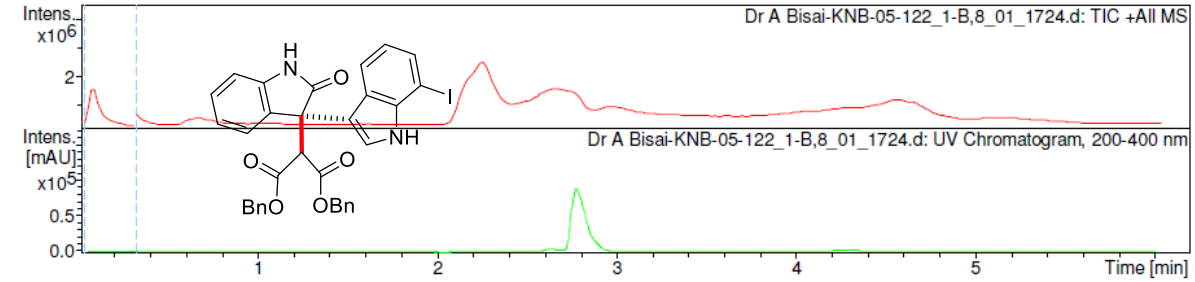
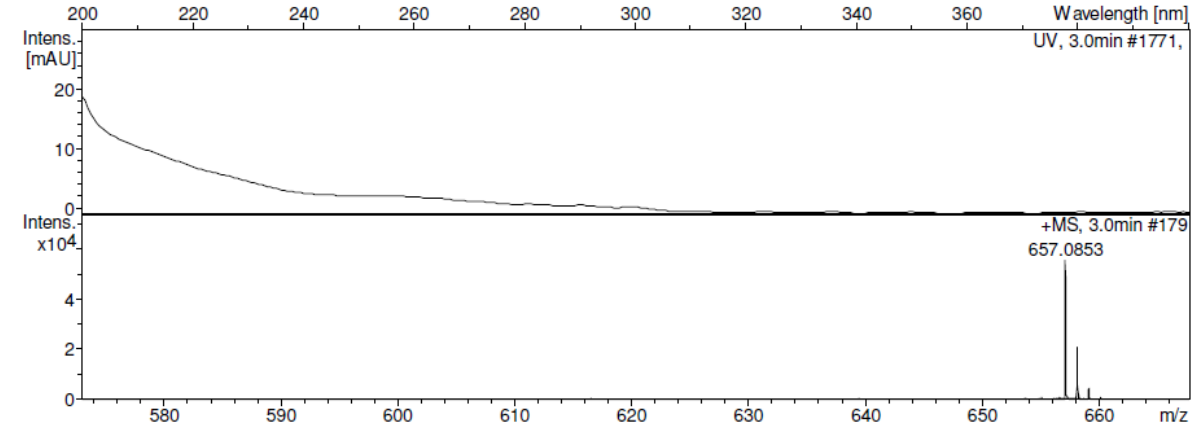
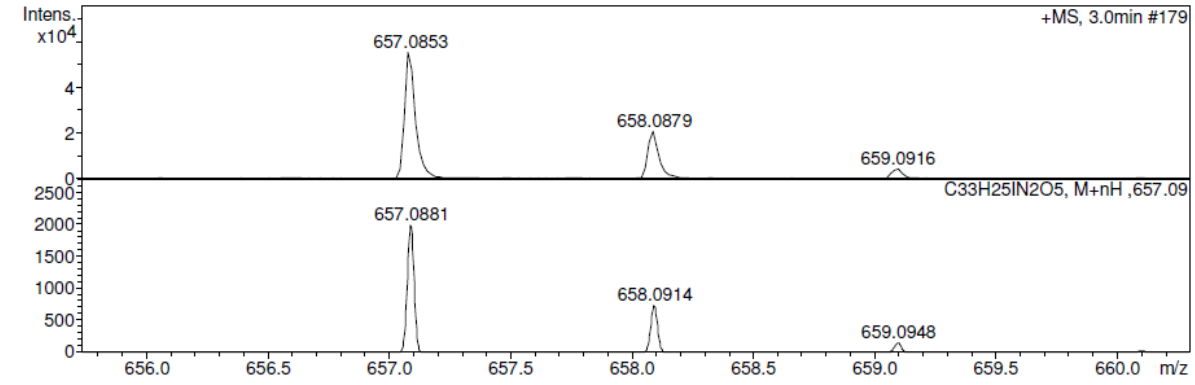
Scan End	3000 m/z	Set Collision Cell RF	130.0 Vpp	Set Divert Valve	Waste







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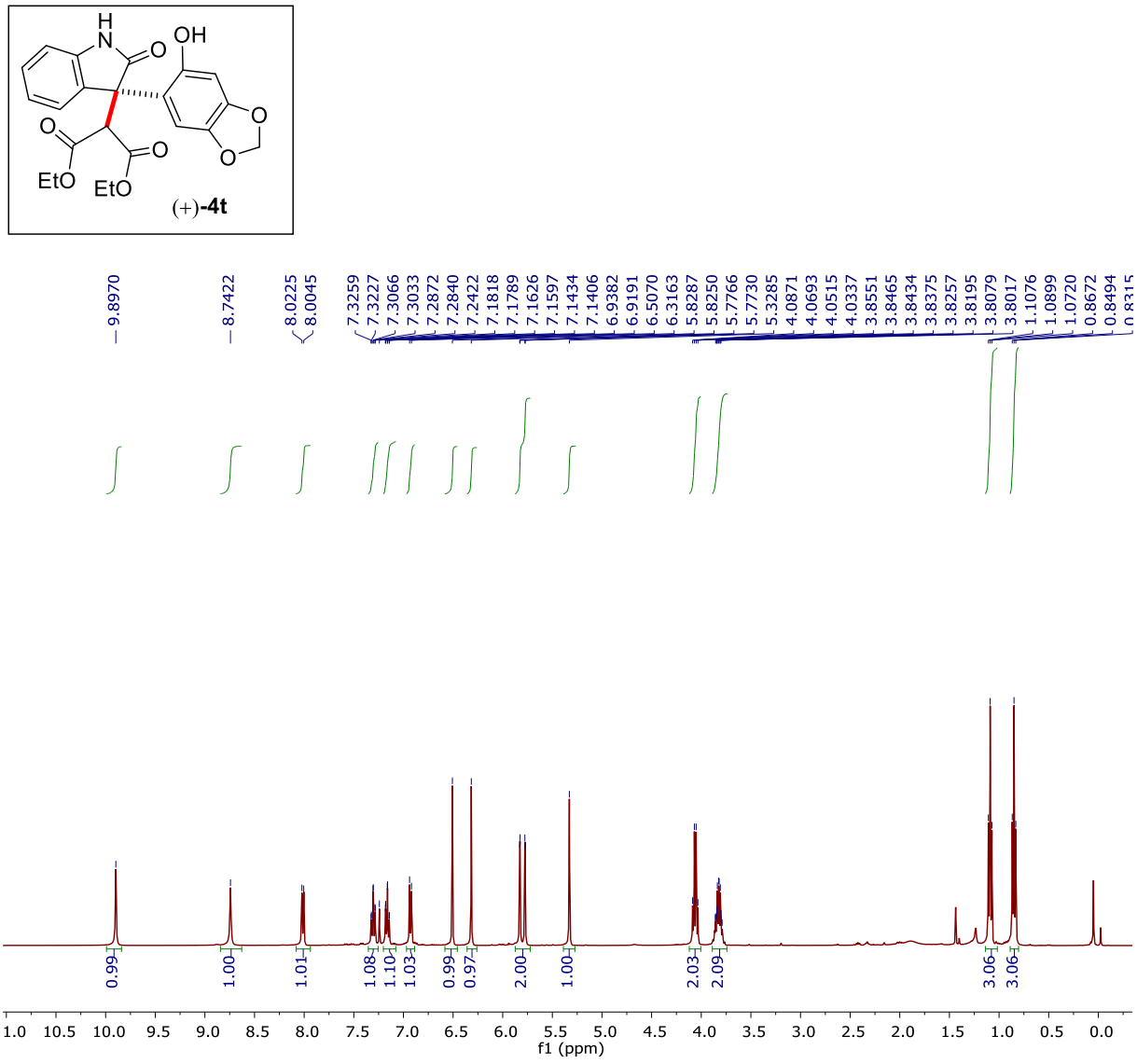
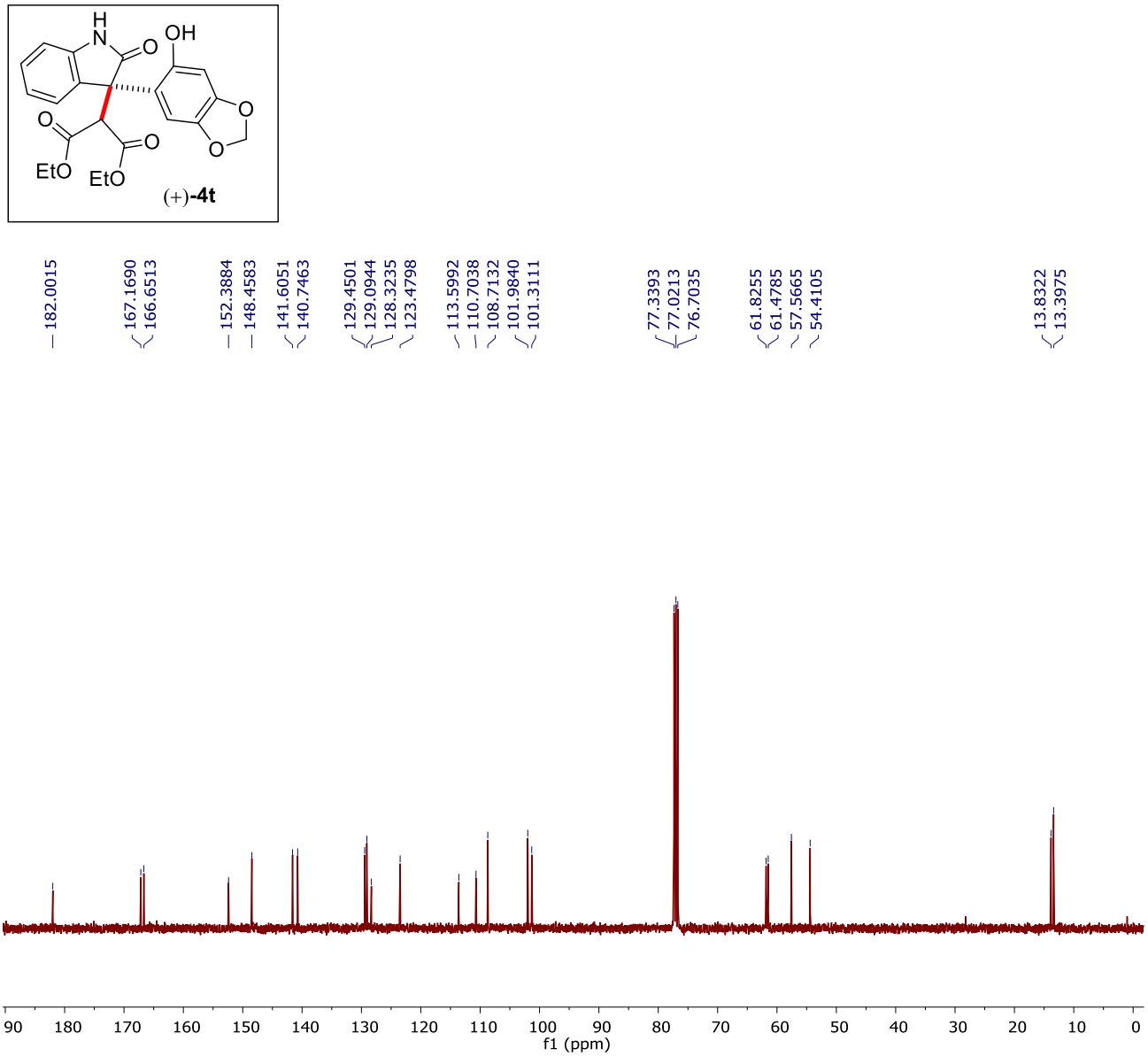
Mass spectrum of (*R*)-**4s**



^{1}H NMR (400 MHz, $CDCl_3$) of compound (+)-**4t**



^{13}C NMR (100 MHz, DMSO-D_6) of compound (+)-**4t**

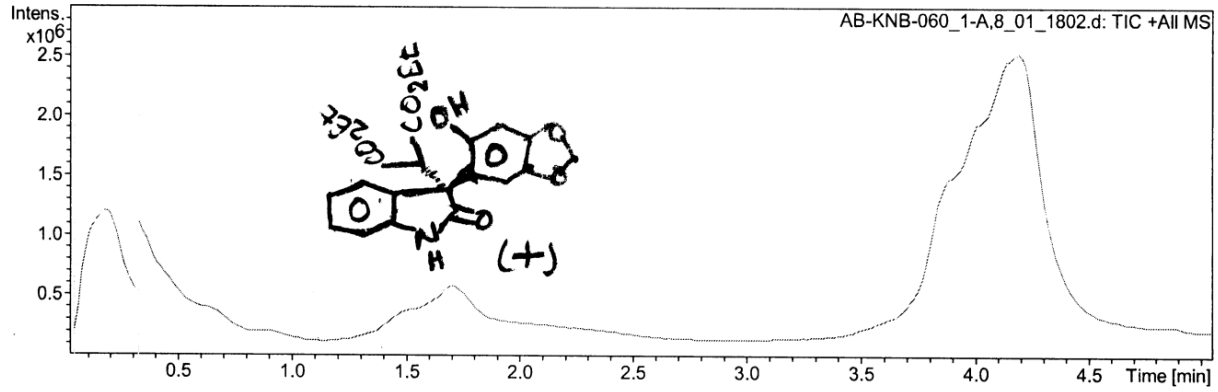
Display Report

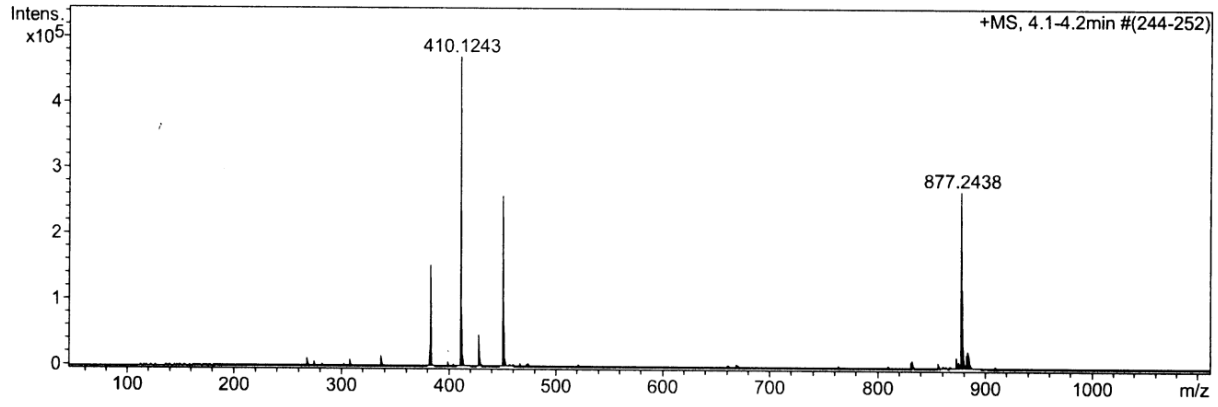
Analysis Info

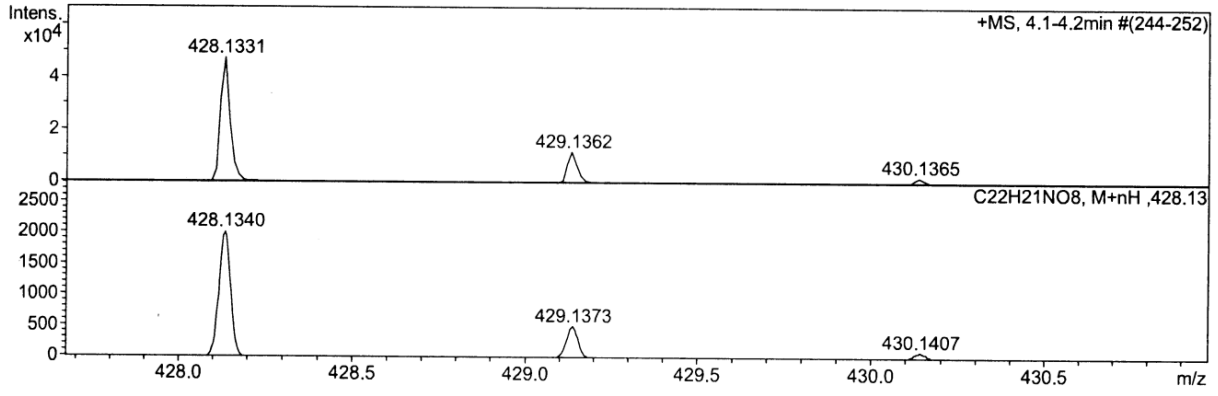
Analysis Name	D:\Data\user data\2017\JUNE 2017\03 JUNE\AB-KNB-060_1-A,8_01_1802.d	Acquisition Date	5/5/2017 11:40:37 AM
Method	hrlcms_pos_mid_tunemix.m	Operator	RUCHI SHRIVASTAVA
Sample Name	AB-KNB-060	Instrument	micrOTOF-Q II 10330
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.3 Bar
Focus	Active	Set Capillary	4500 V	Set Dry Heater	200 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	4.0 l/min
Scan End	3000 m/z	Set Collision Cell RF	450.0 Vpp	Set Divert Valve	Waste







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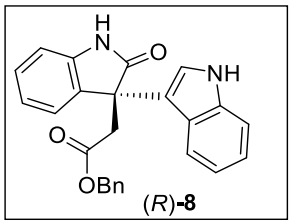
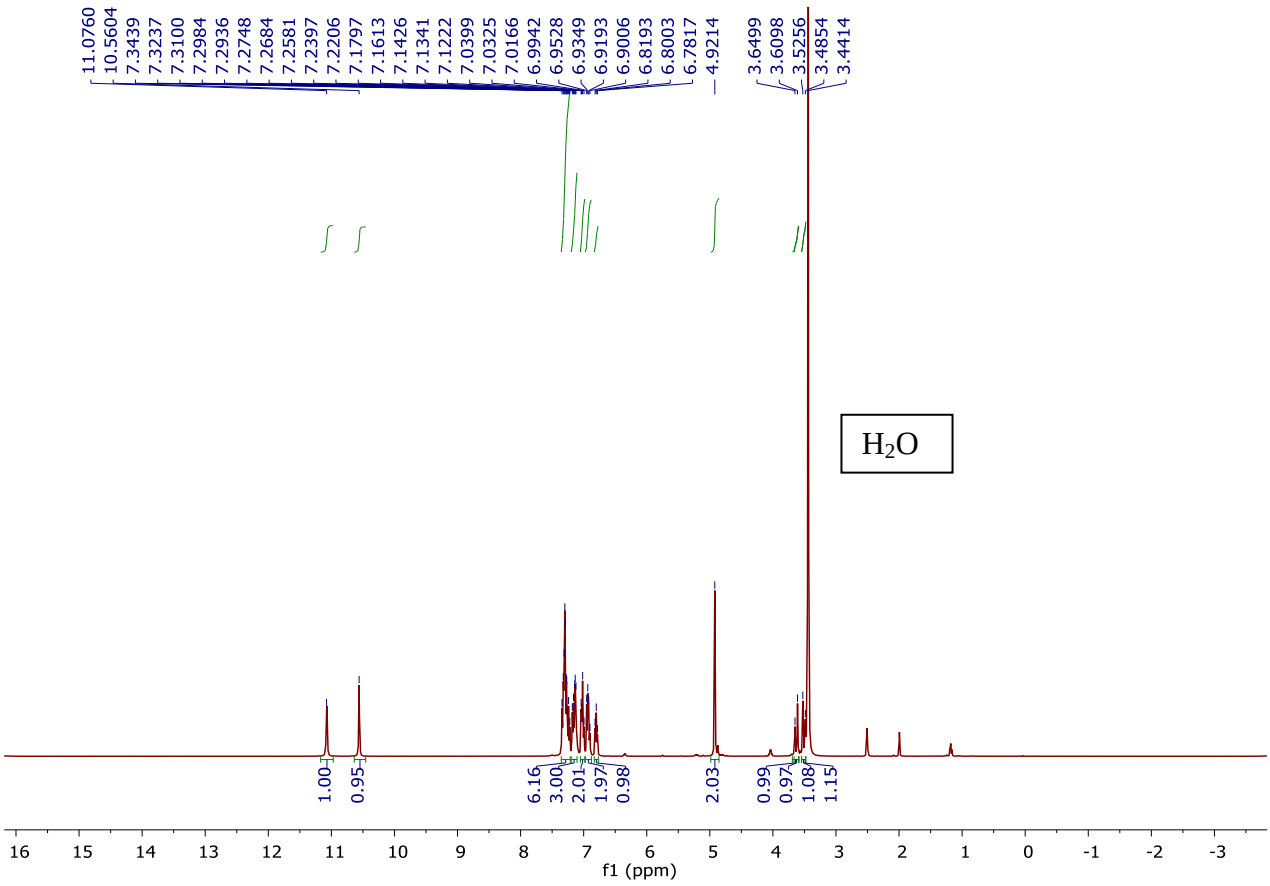
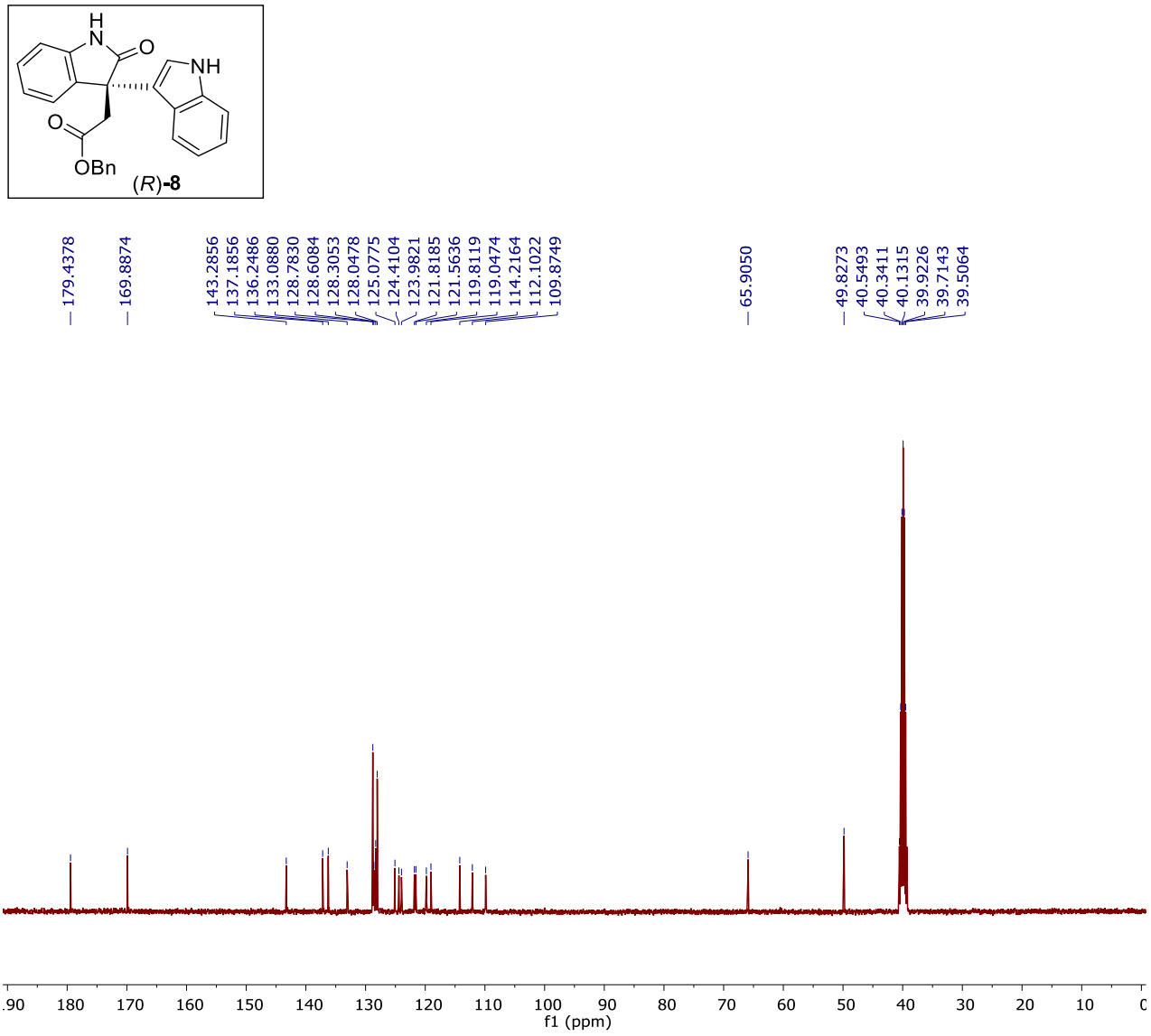
Scanned copy of mass spectrum of (+)-**4t**

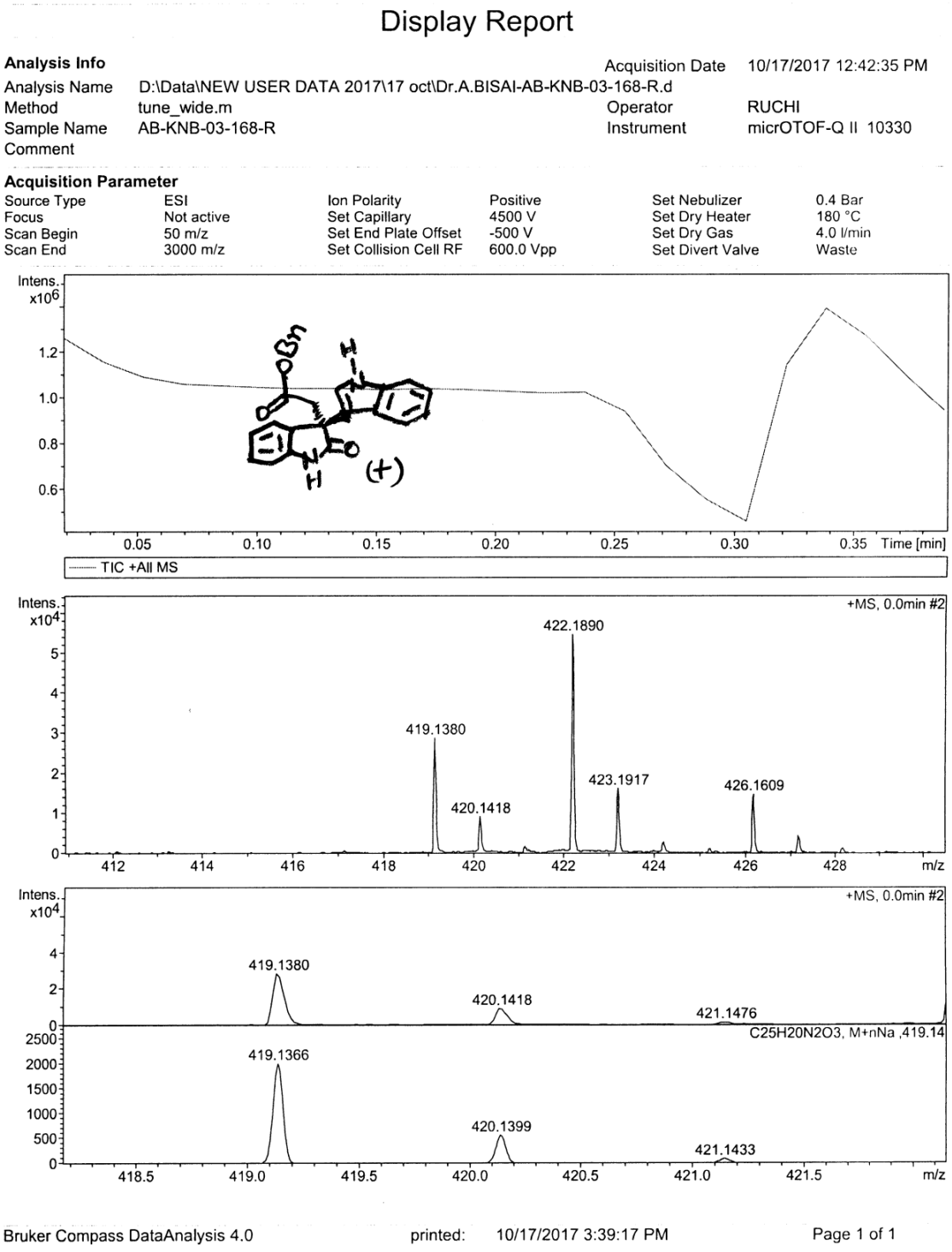




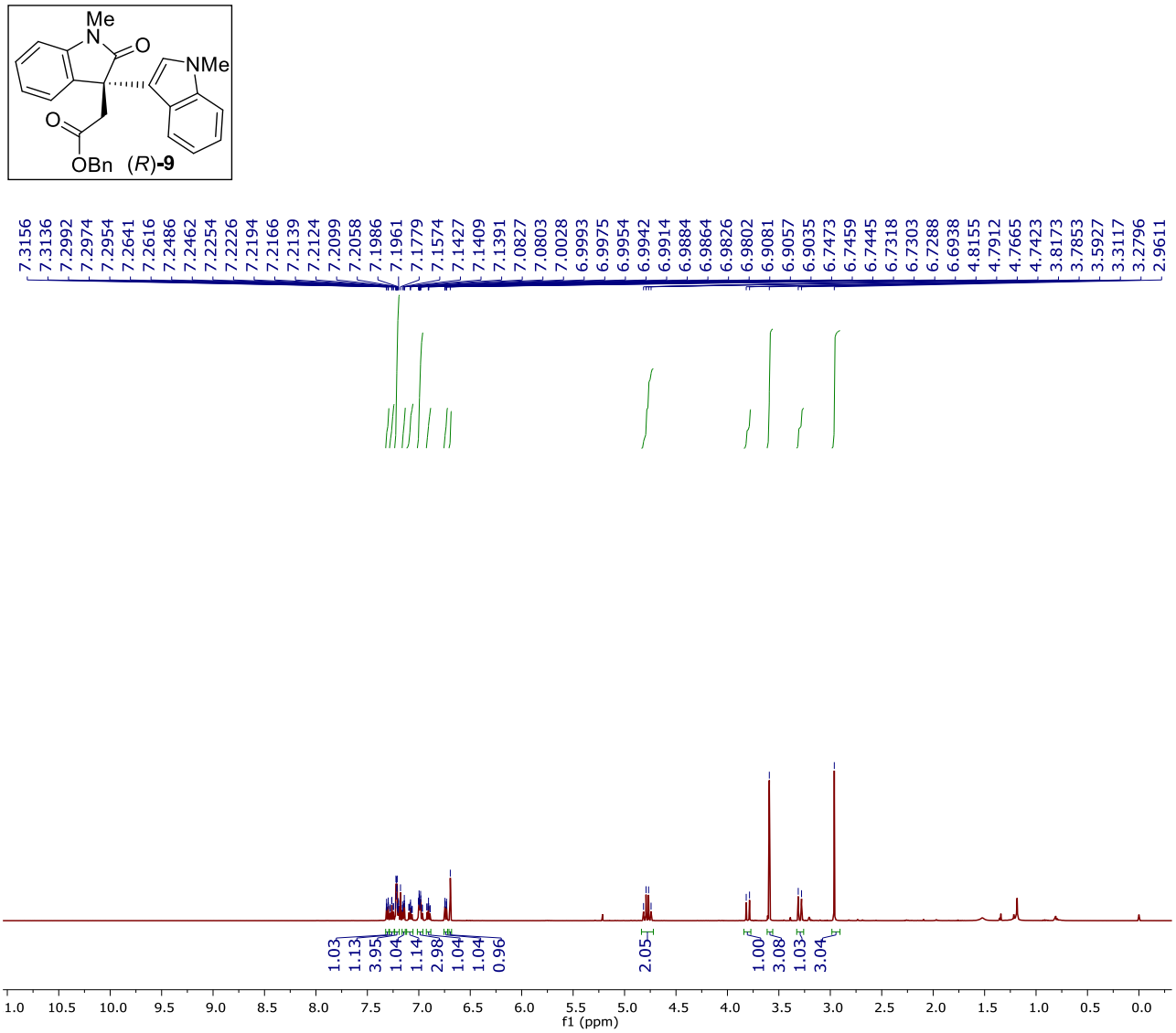
^{1}H NMR (400 MHz, DMSO-D$_6$) of compound (*R*)-**8**



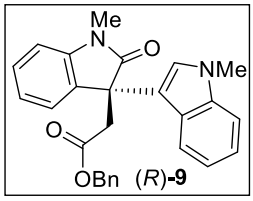
^{13}C NMR (400 MHz, DMSO-D_6) of compound (*R*)-**8**

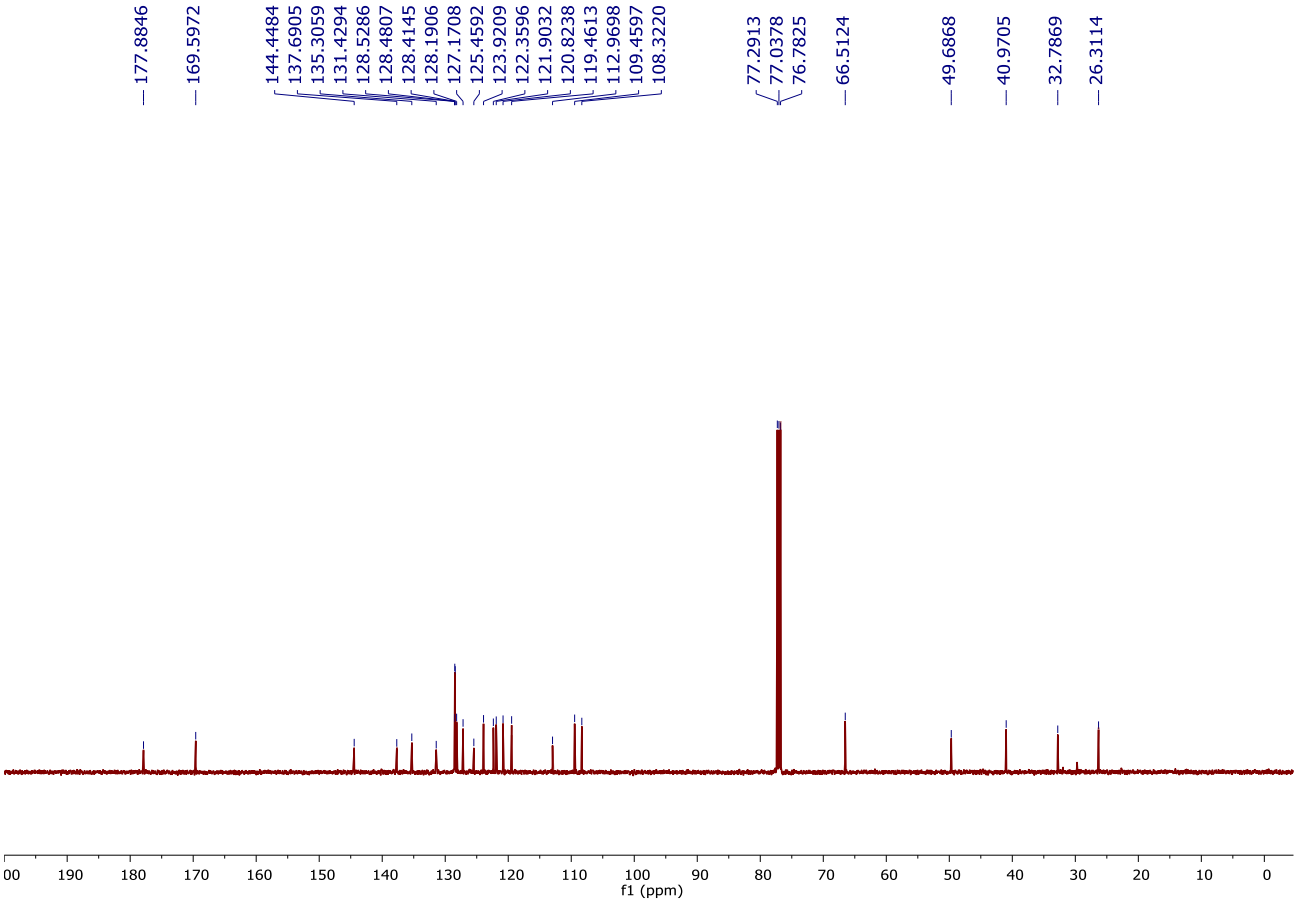


Scanned copy of mass spectrum of (*R*)-**8**



^{1}H NMR (400 MHz, $CDCl_3$) of compound (*R*)-**9**





^{13}C NMR (100 MHz, $CDCl_3$) of compound (*R*)-**9**

Display Report

Analysis Info

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Analysis Name	D:\Data\user data\2016\July 2016\29-07-2016\Dr.A.Bisai-AB-KNB-03-170_1-A,5_01_6993.d		
Method	hrlcms-pos_mid_tune wide.m	Operator	DIMPLE
Sample Name	Dr.A.Bisai-AB-KNB-03-170	Instrument	micrOTOF-Q II 10330
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.3 Bar
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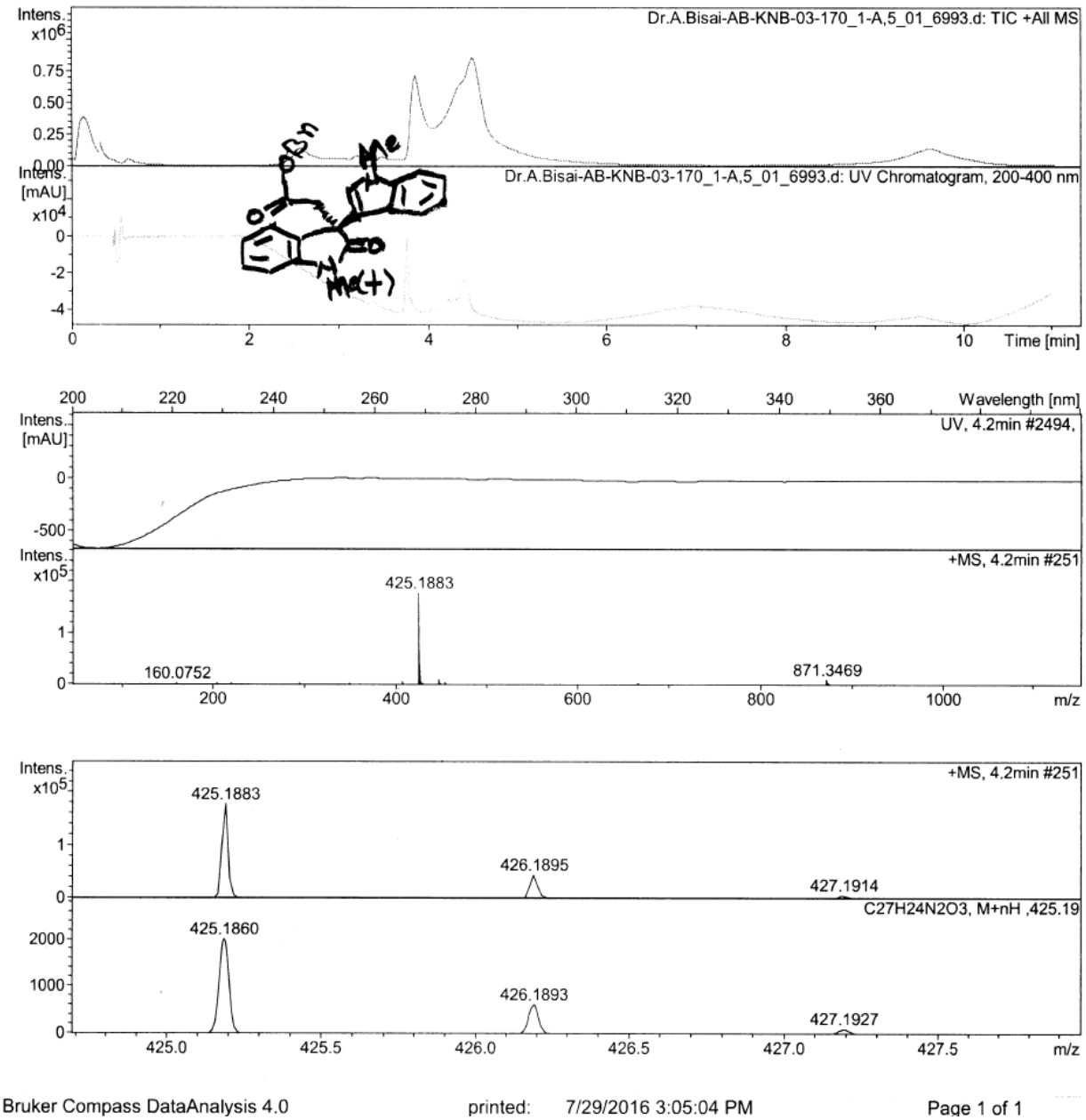
Scan End	3000 m/z	Set Collision Cell RF	450.0 Vpp	Set Divert Valve	Waste



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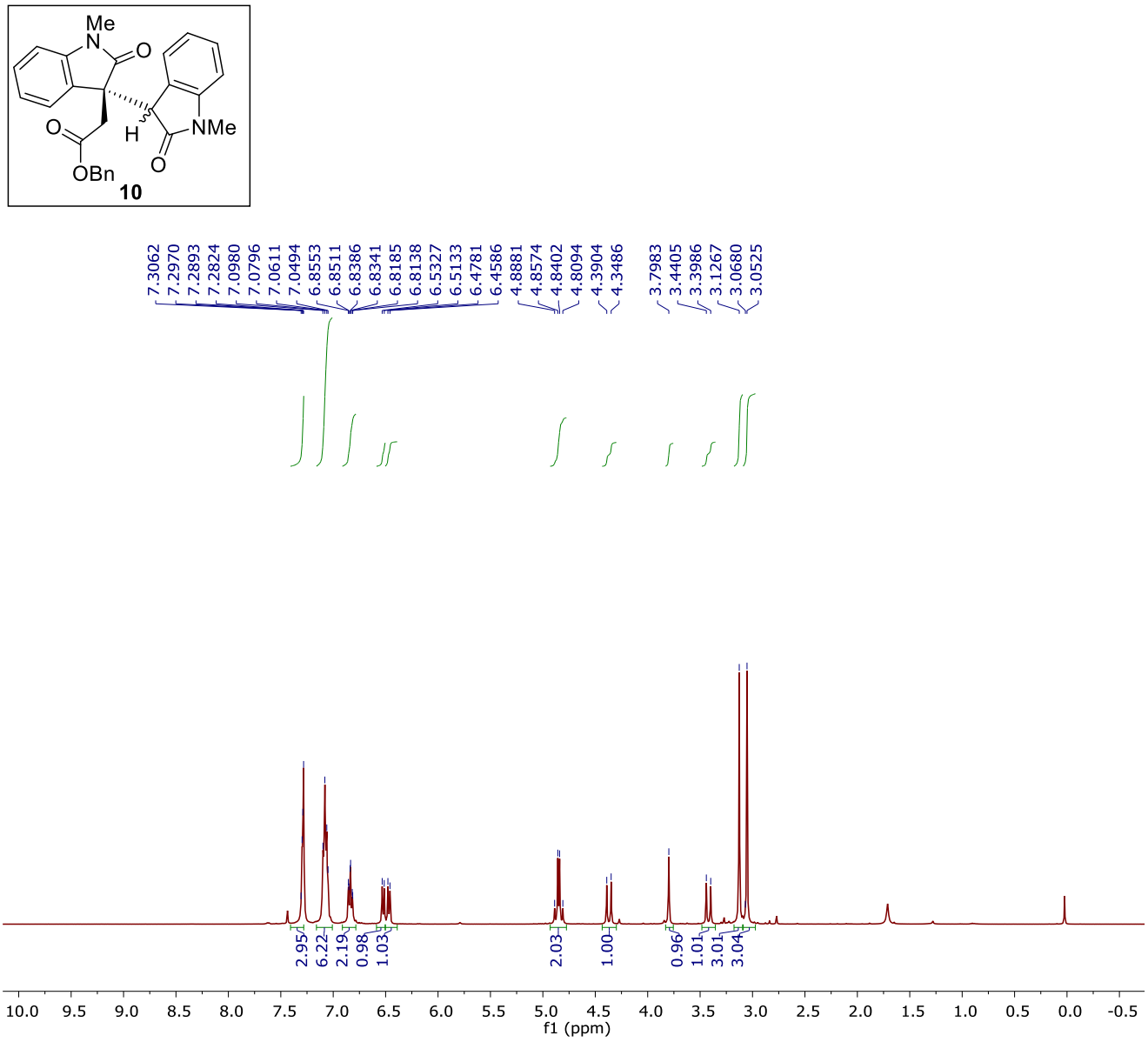
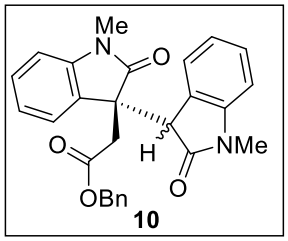
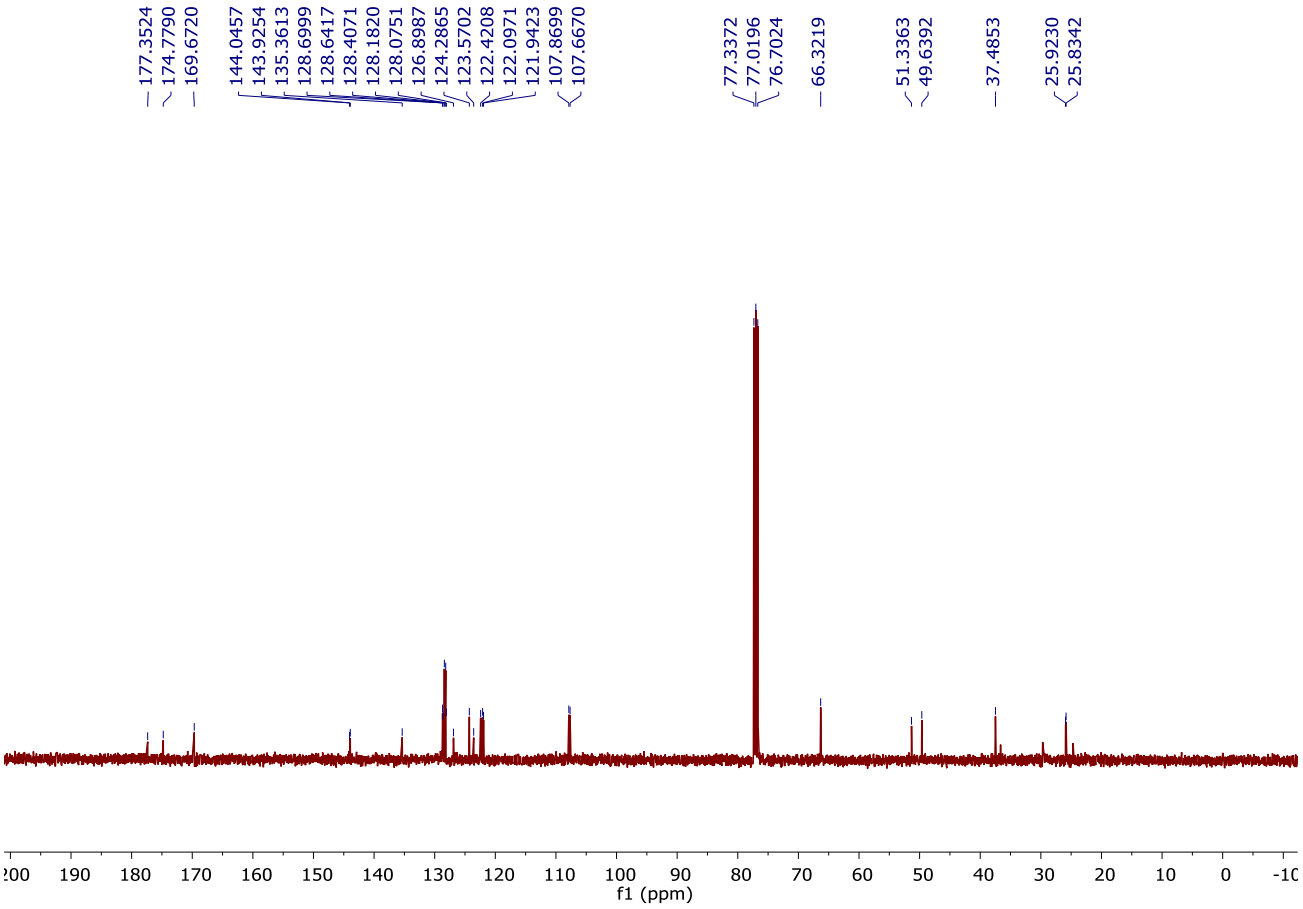
Scanned copy of mass spectrum of (*R*)-**9**

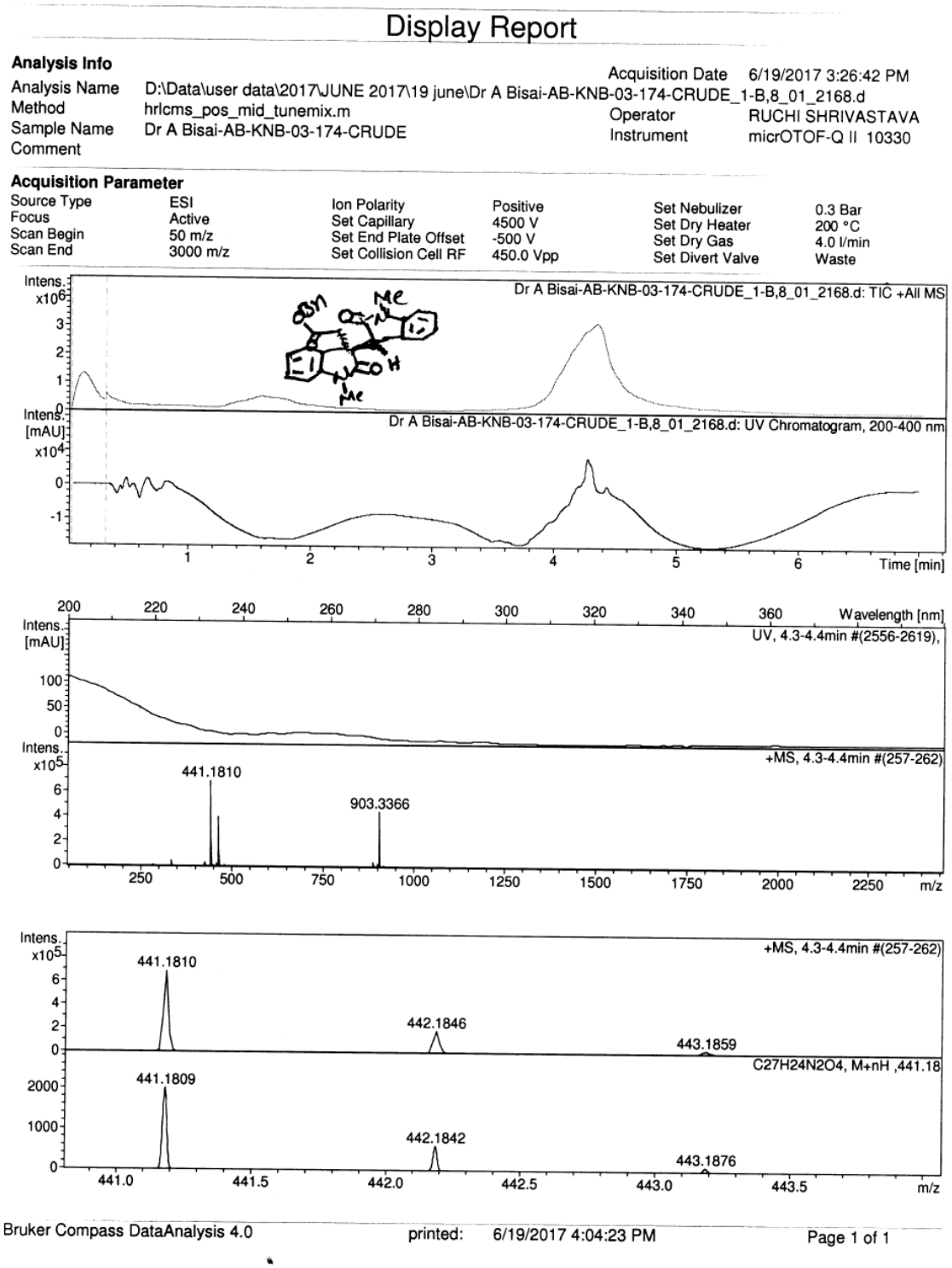


^{1}H NMR (400 MHz, $CDCl_3$) of compound **10**

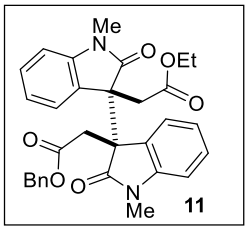


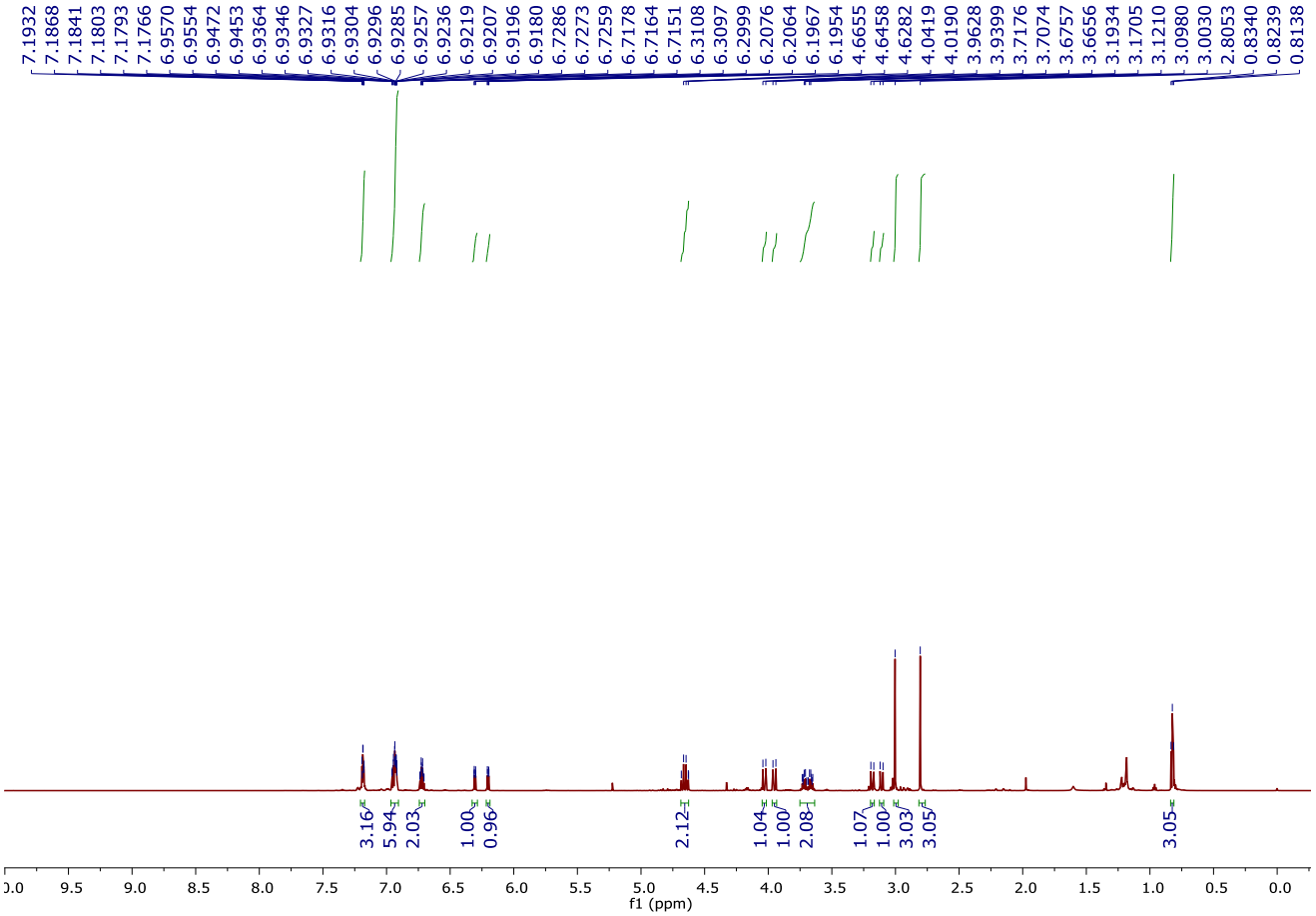


^{13}C NMR (100 MHz, $CDCl_3$) of compound **10**

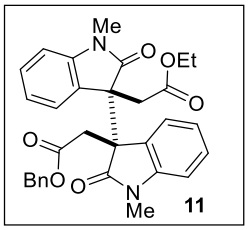


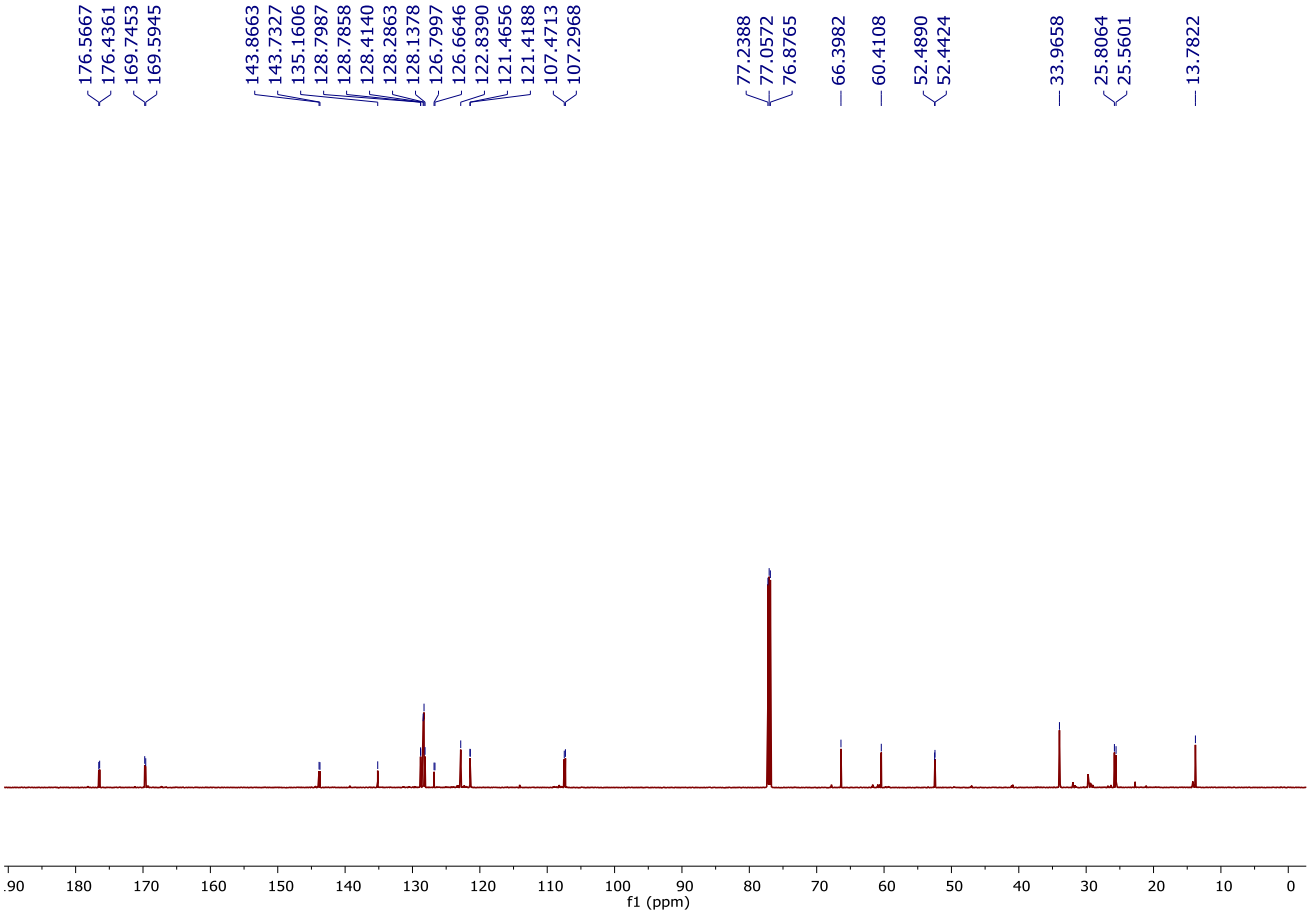
Scanned copy of mass spectrum of **10**



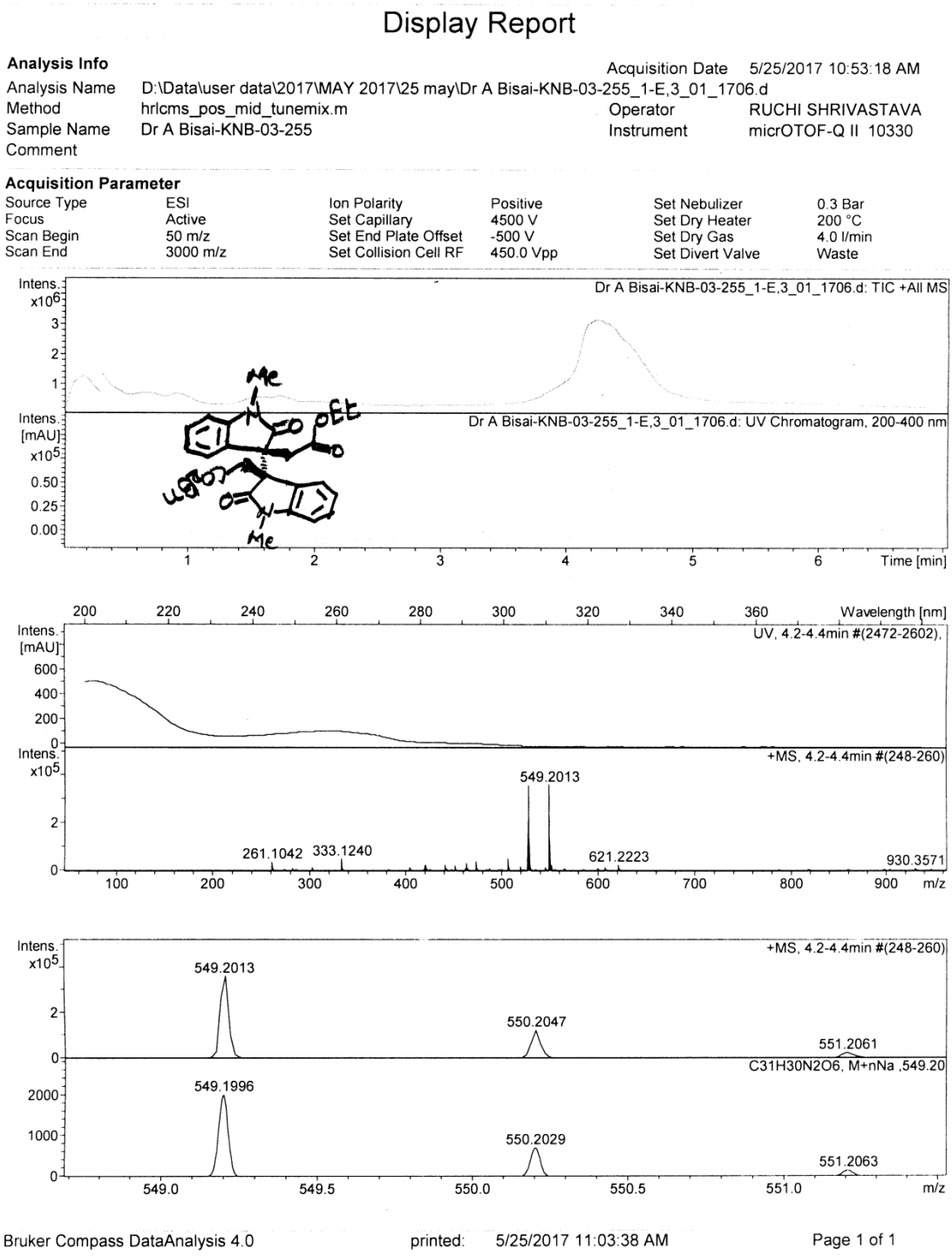


^{1}H NMR (400 MHz, $CDCl_3$) of compound **11**

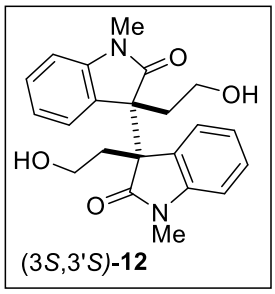




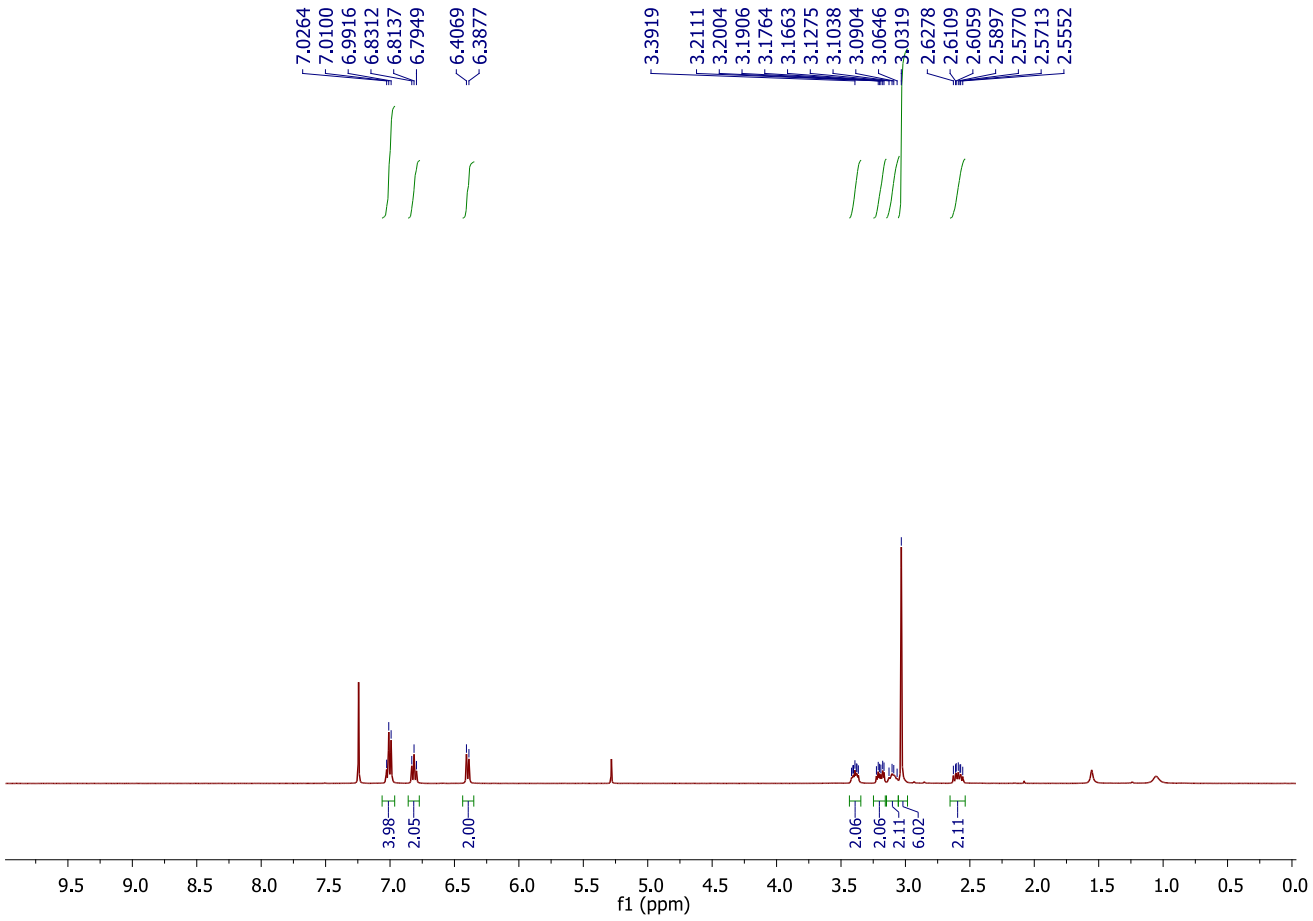
^{13}C NMR (100 MHz, $CDCl_3$) of compound **11**



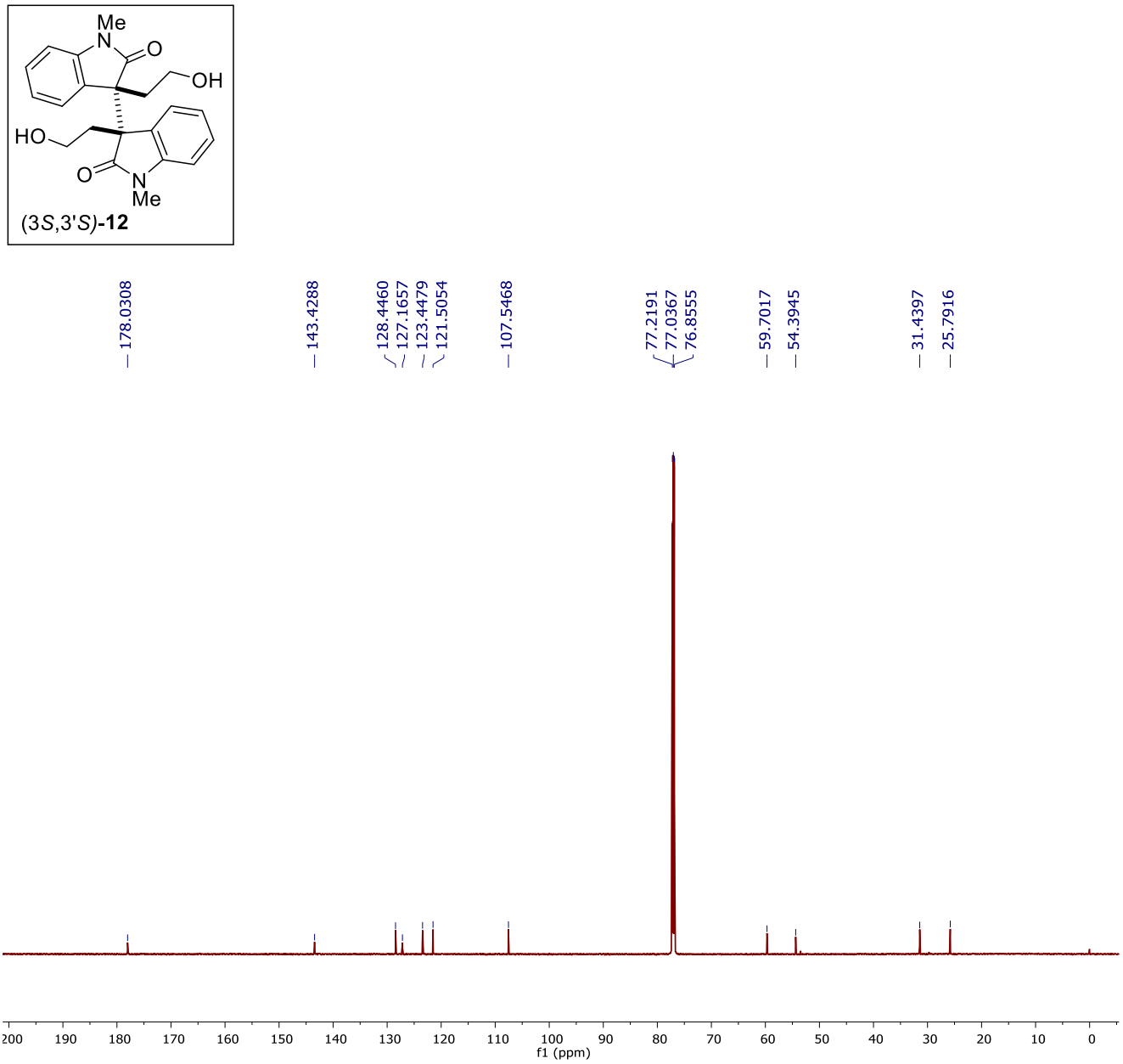
Scanned copy of mass spectrum of **11**



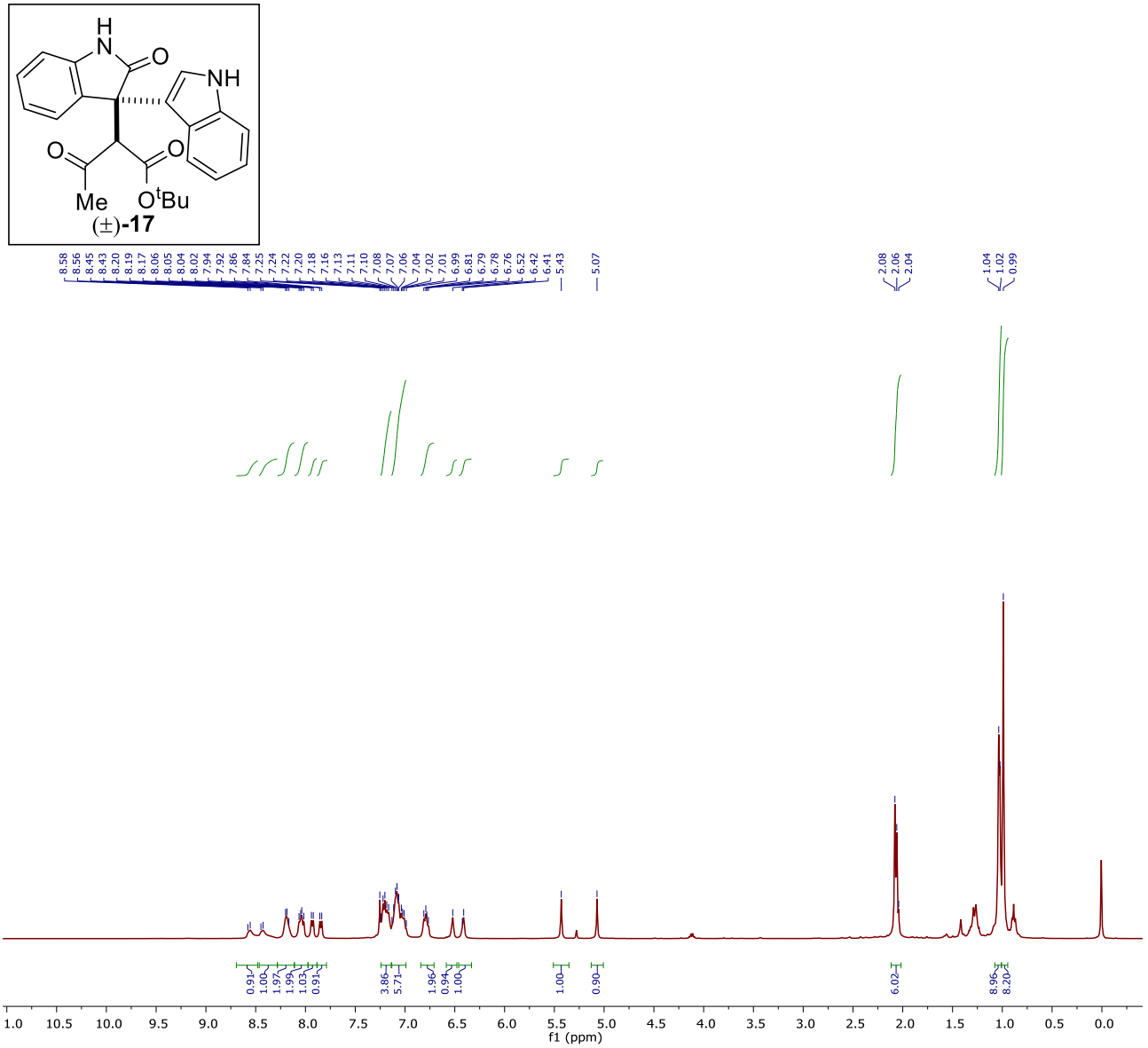
(3*S*,3′*S*)-**12**



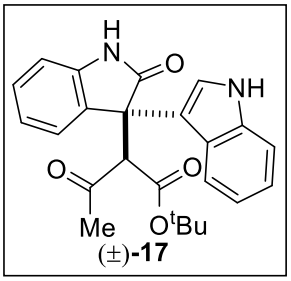
^{1}H NMR (400 MHz, $CDCl_3$) of compound (3*S*, 3′*S*)-**12**



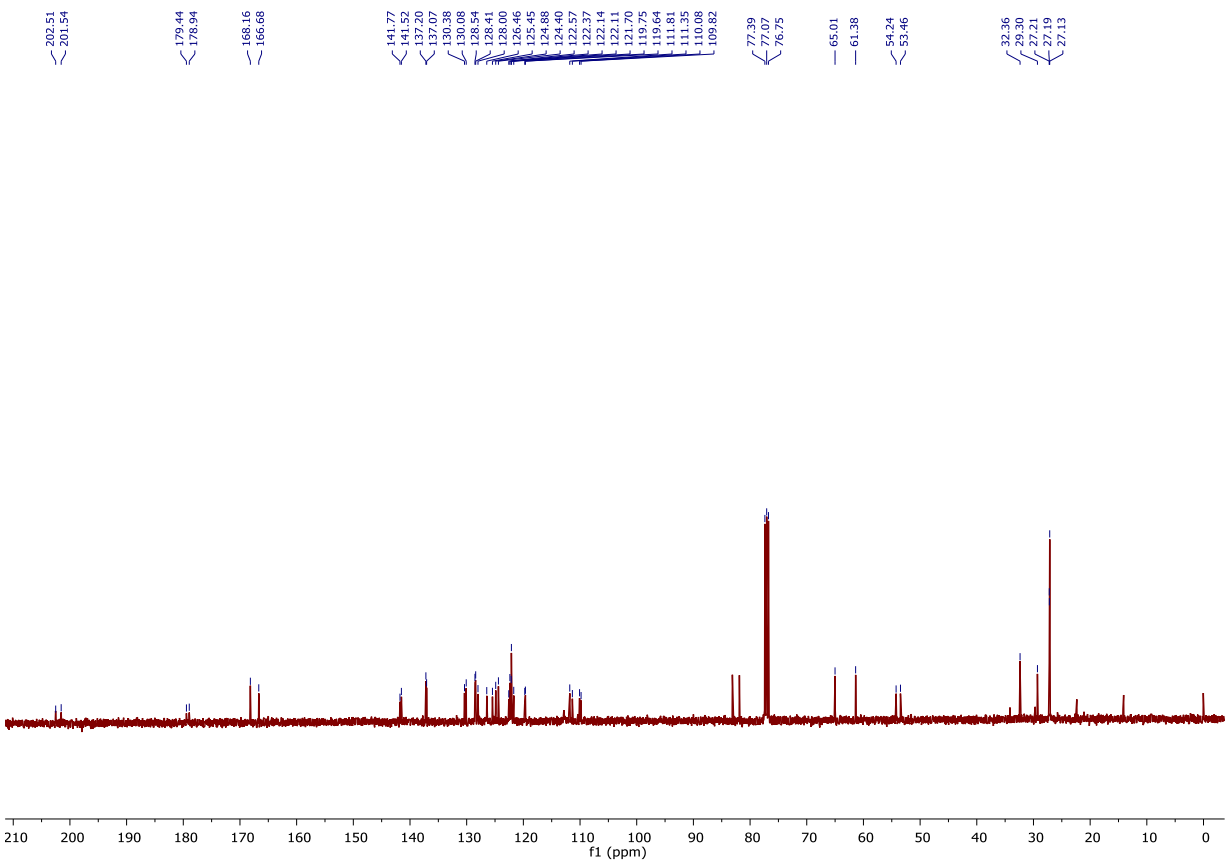
^{13}C NMR (100 MHz, $CDCl_3$) of compound (3*S*, 3'*S*)-**12**



^{1}H NMR (400 MHz, $CDCl_3$) of compound (±)-**17**



(±)-**17**



^{13}C NMR (100 MHz, $CDCl_3$) of compound (±)-**17**

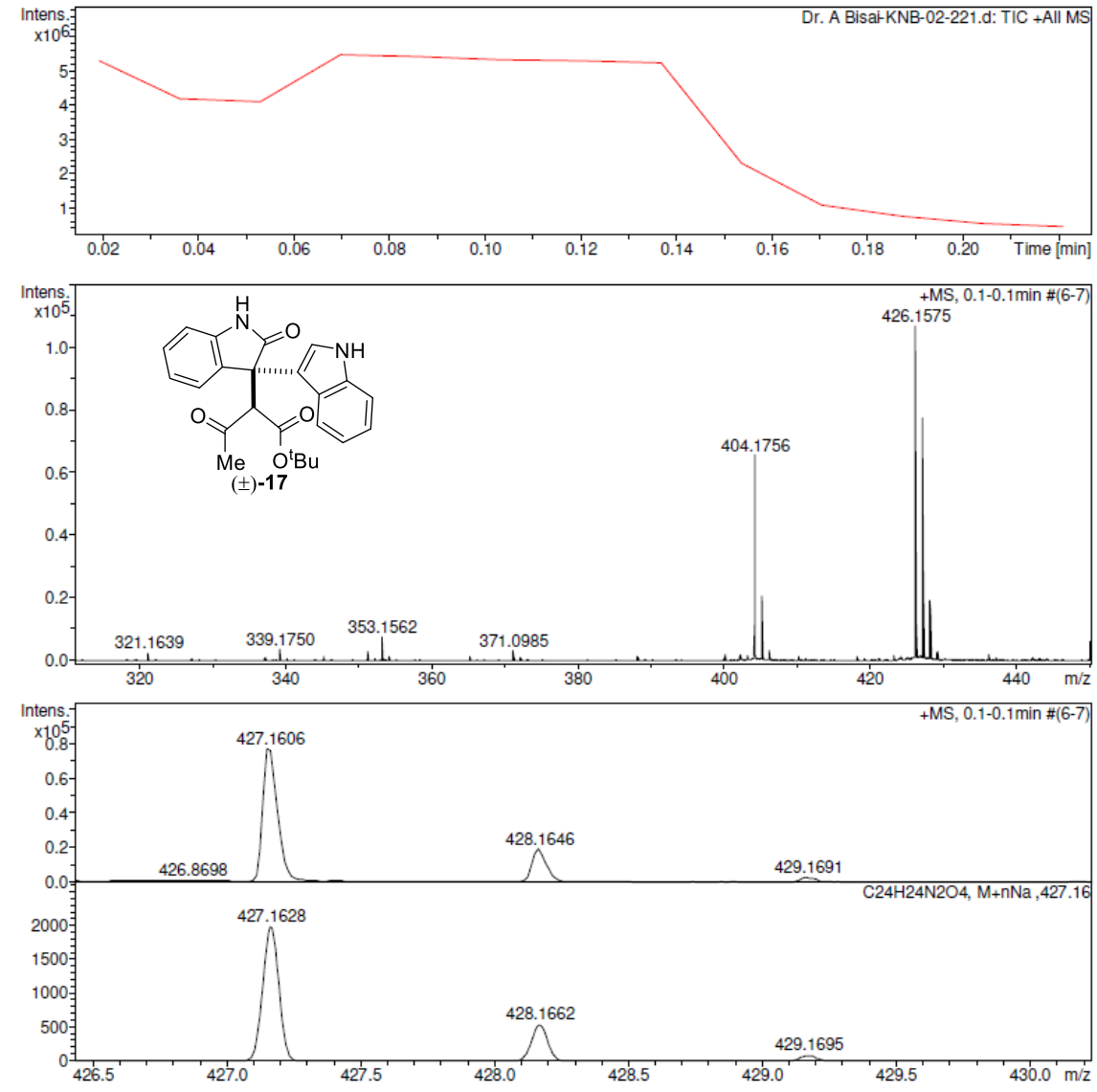
Display Report

Analysis Info

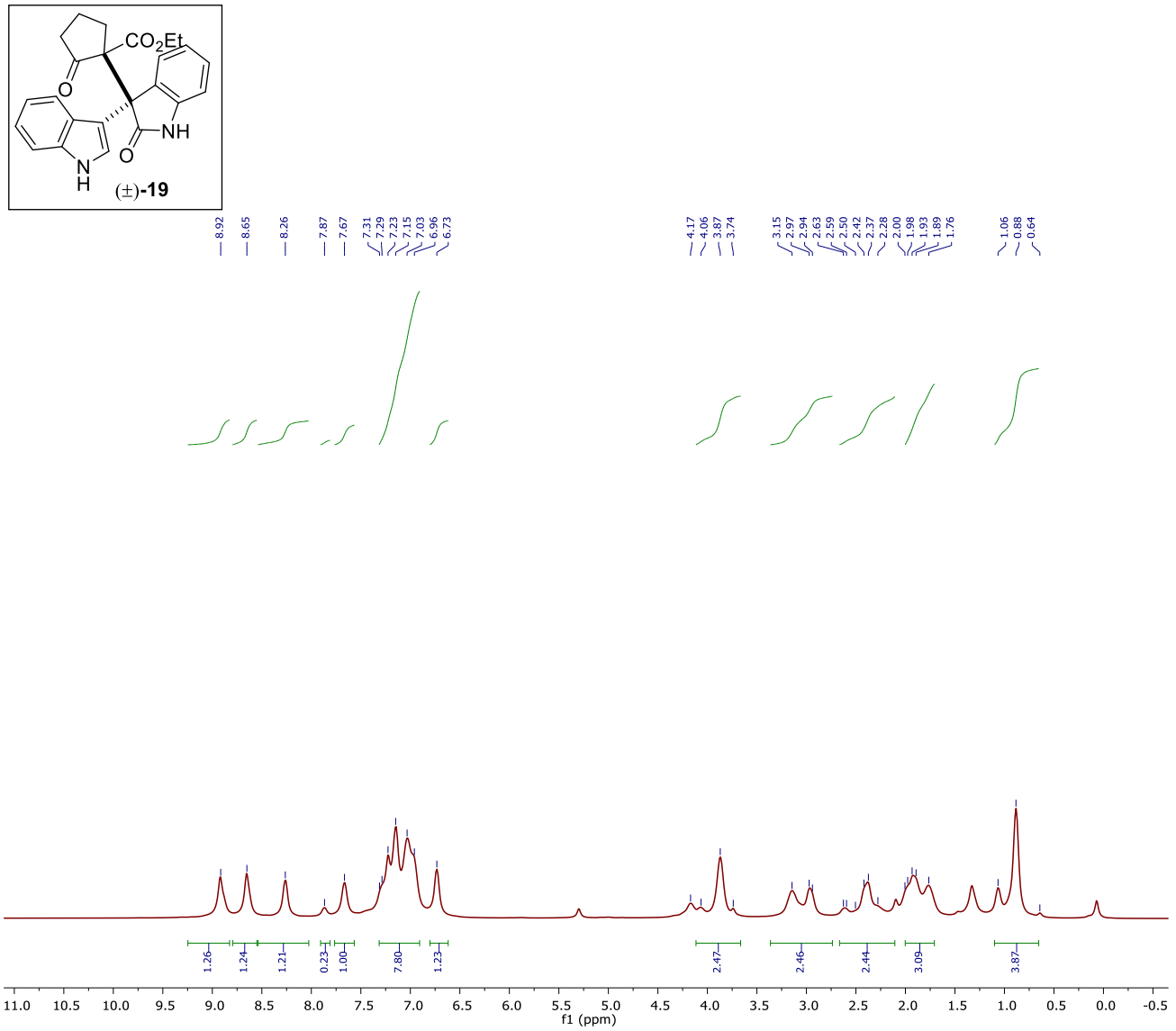
Analysis Name	D:\Data\NEW USER DATA 2017\2018\15-march-2018\Dr. A Bisai-KNB-02-221.d	Acquisition Date	3/15/2018 10:13:15 AM
Method	tune mix_low.New.021117.m	Operator	RUCHI
Sample Name	KNB-02-221	Instrument	micrOTOF-Q II 10330
Comment			

Acquisition Parameter

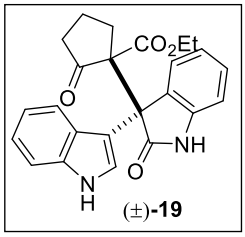
Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.4 Bar
Focus	Not active	Set Capillary	4600 V	Set Dry Heater	180 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	4.0 l/min
Scan End	3000 m/z	Set Collision Cell RF	100.0 Vpp	Set Divert Valve	Waste



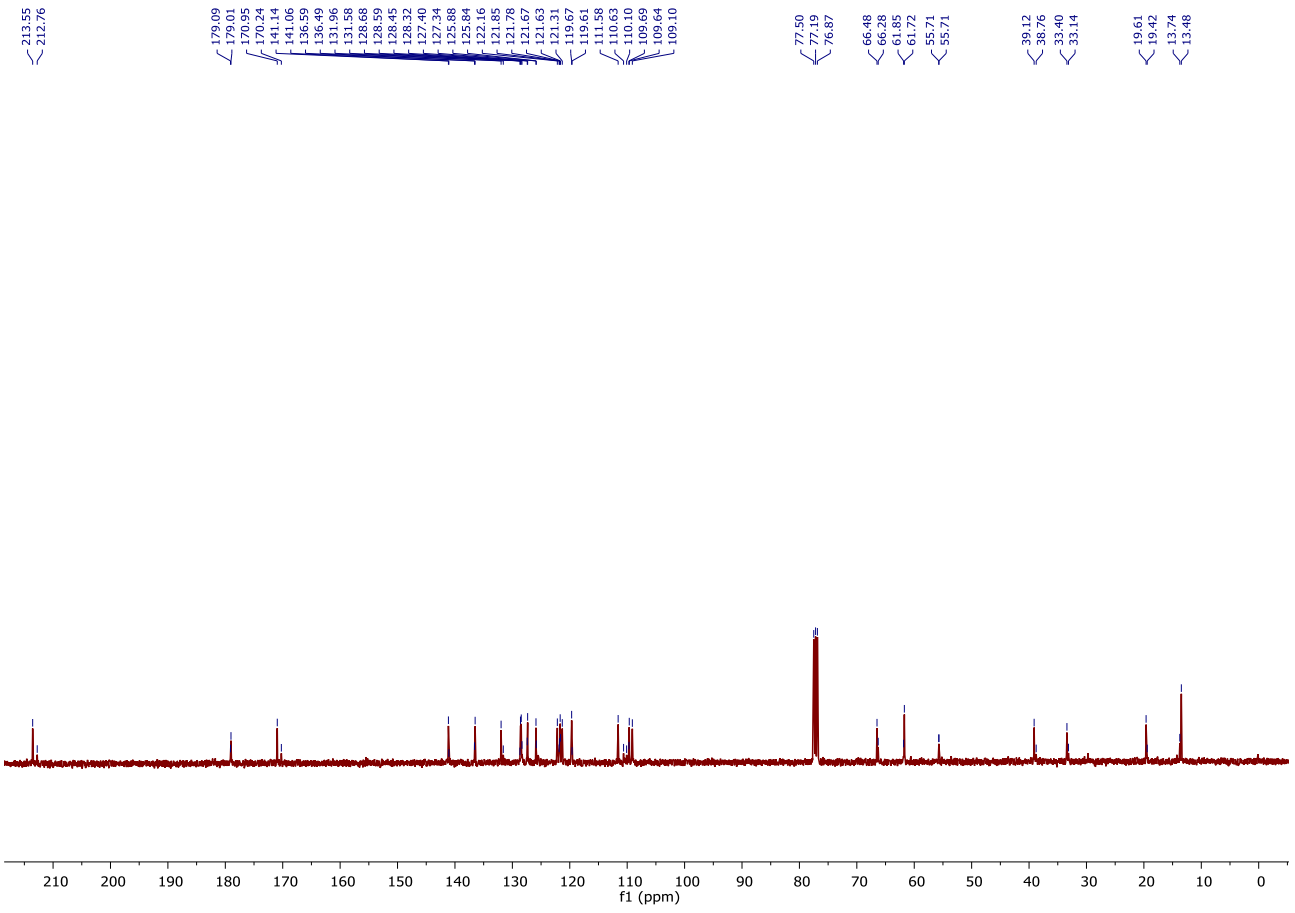
Mass spectrum of (±)-**17**



^{1}H NMR (400 MHz, $CDCl_3$) of compound (±)-**19**



(±)-**19**



^{13}C NMR (100 MHz, $CDCl_3$) of compound (±)-**19**

Display Report

Analysis Info

Acquisition Date	3/15/2018 10:54:55 AM		
Analysis Name	D:\Data\NEW USER DATA 2017\2018\15-march-2018\Dr. A Bisai-KNB-02-217.d		
Method	tune mix_low.New.021117.m	Operator	RUCHI
Sample Name	KNB-02-217	Instrument	micrOTOF-Q II 10330
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.4 Bar
Focus	Not active	Set Capillary	4600 V	Set Dry Heater	180 °C
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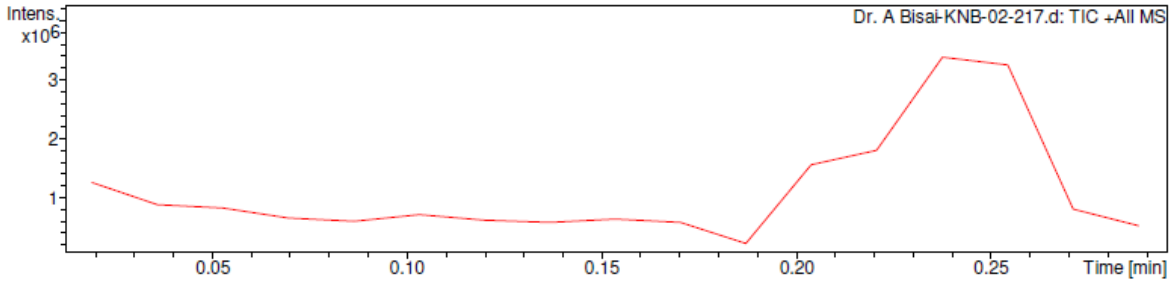
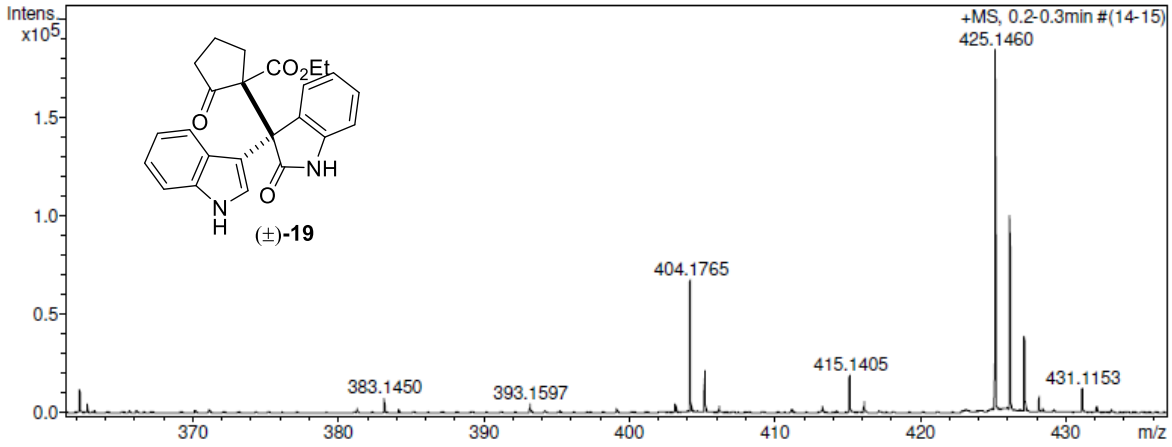
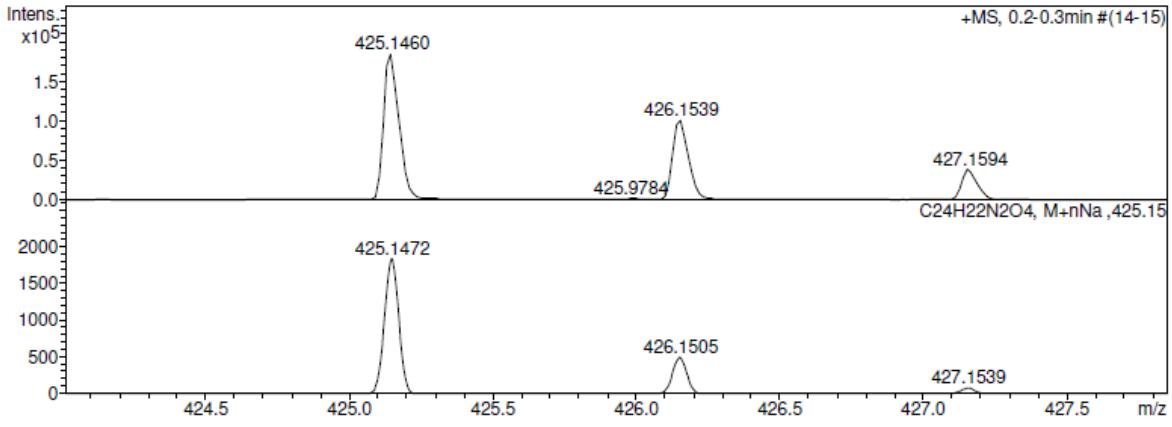
Scan End	3000 m/z	Set Collision Cell RF	100.0 Vpp	Set Divert Valve	Waste





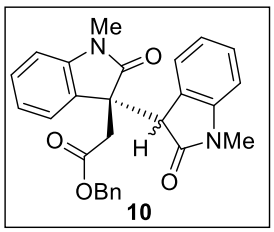
(±)-**19**



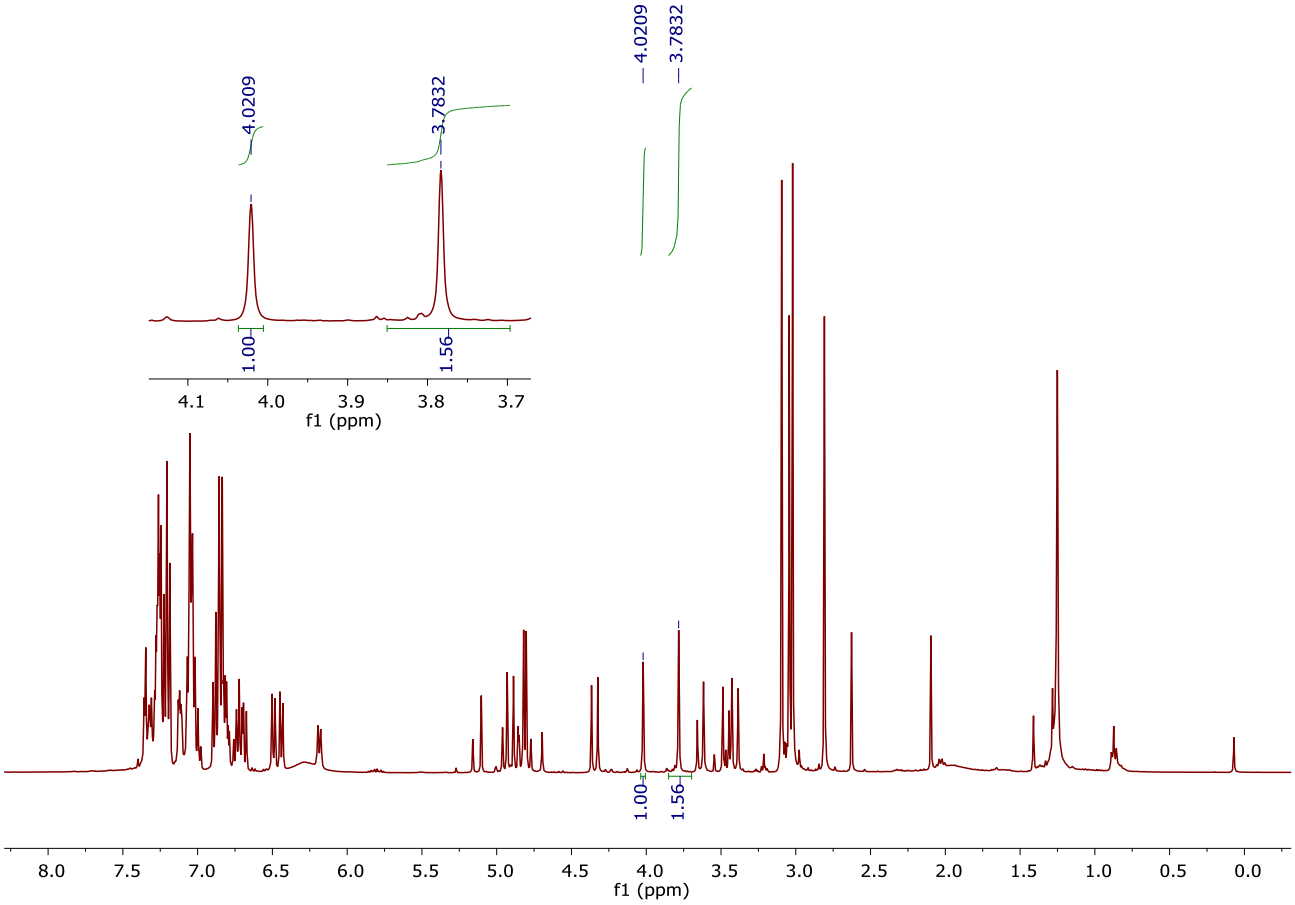
Bruker Compass DataAnalysis 4.0 printed: 3/15/2018 10:56:11 AM Page 1 of 1

Mass spectrum of (±)-**19**

Determination of diastereomeric ratio of compound 10 from ^{1}H NMR of crude reaction

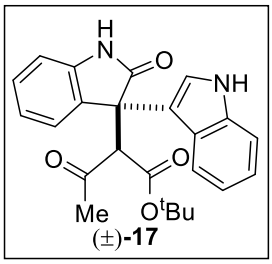


10

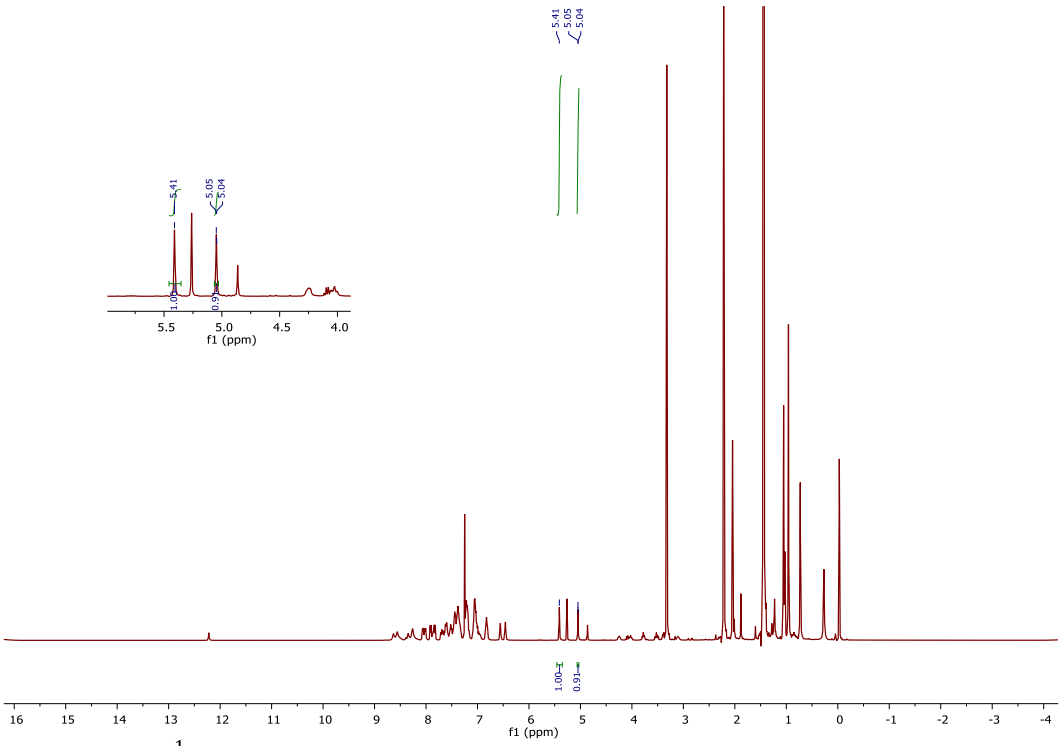


^{1}H NMR (400 MHz, $CDCl_3$) of crude compound **10**

Determination of diastereomeric ratio of compound (±)-17 from ^{1}H NMR of crude reaction

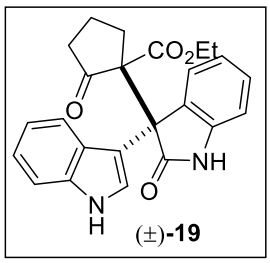


(±)-**17**

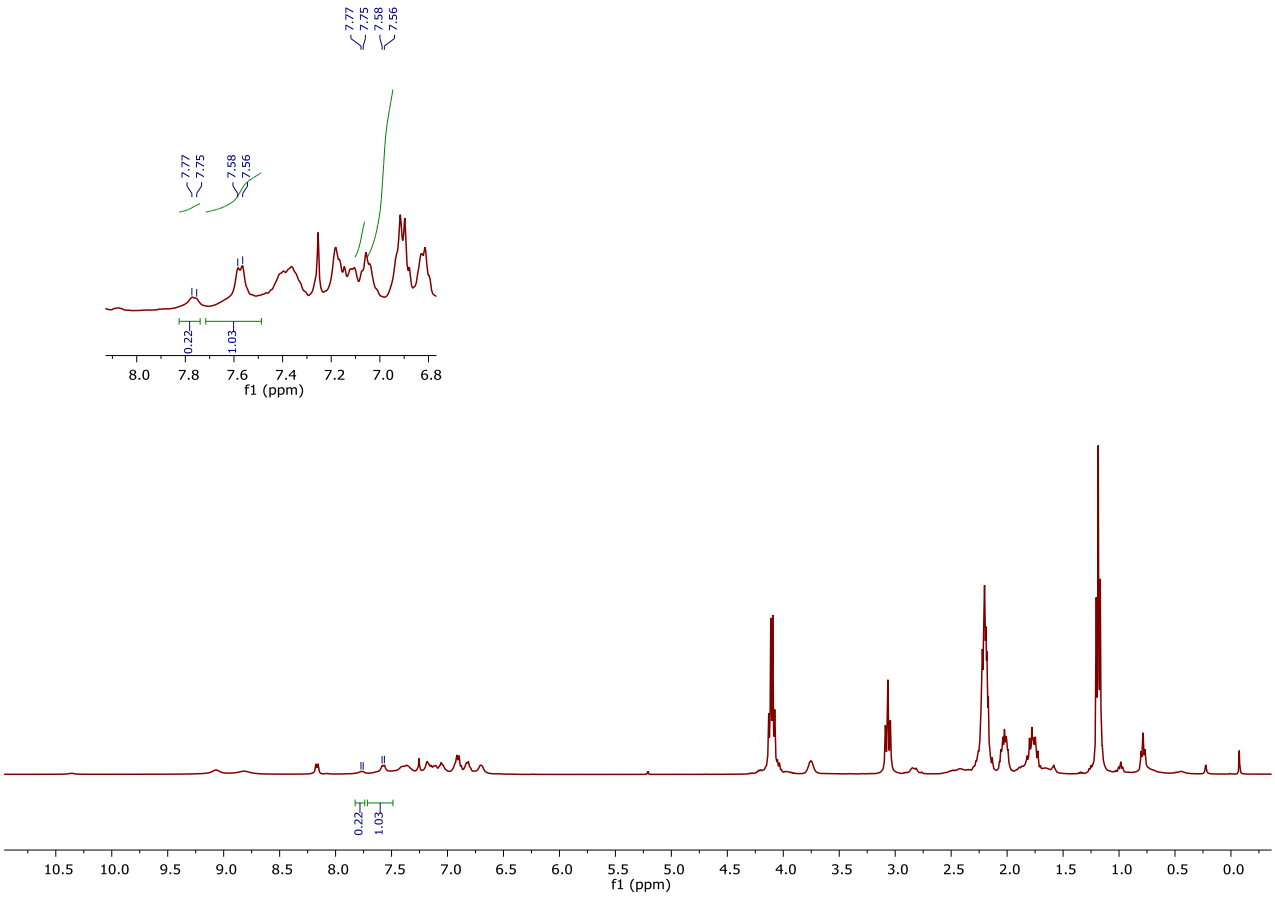


^{1}H NMR (400 MHz, $CDCl_3$) of crude compound (±)-**17**

Determination of diastereomeric ratio of compound 19 from ^{1}H NMR of crude reaction



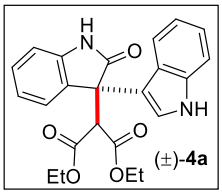
(±)-**19**



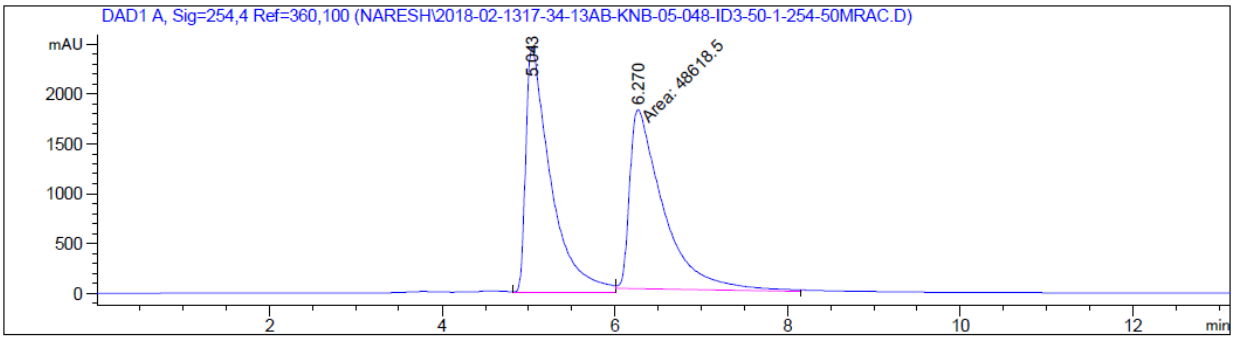
^{1}H NMR (400 MHz, $CDCl_3$) of crude compound (±)-**19**

HPLC Traces

HPLC data of compound-(±)-4a



Data File C:\CHEM32\1\DATA\NARESH\2018-02-1317-34-13AB-KNB-05-048-ID3-50-1-254-50MRAC.D
Sample Name: AB-KNB-05-048-ID3-50-1-254-50MRAC



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

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.043	VV	0.2780	4.92836e4	2457.59082	50.3397
2	6.270	MM	0.4505	4.86185e4	1798.77979	49.6603
Totals :				9.79021e4	4256.37061	

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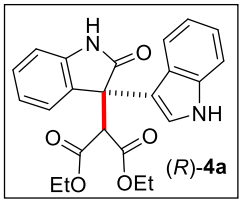
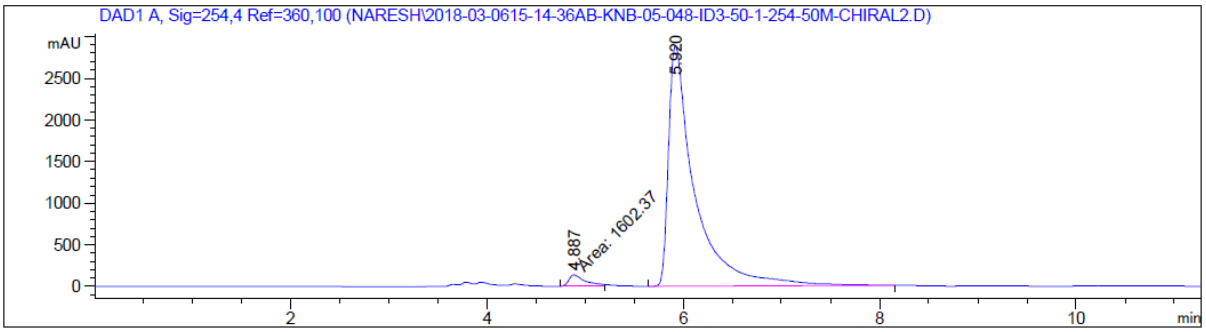
*** End of Report ***

HPLC data of compound (*R*)-4a



Data File C:\CHEM32\...A\NARESH\2018-03-0615-14-36AB-KNB-05-048-ID3-50-1-254-50M-CHIRAL2.D
Sample Name: AB-KNB-05-048-ID3-50-1-254-50M-CHIRAL2

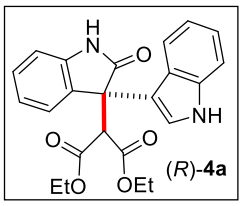


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.887	MM	0.1947	1602.37219	137.17230	2.9103
2	5.920	BB	0.2606	5.34571e4	2878.73560	97.0897
Totals :				5.50595e4	3015.90790	

*** End of Report ***

HPLC data of compound (*R*)-4a from 5k

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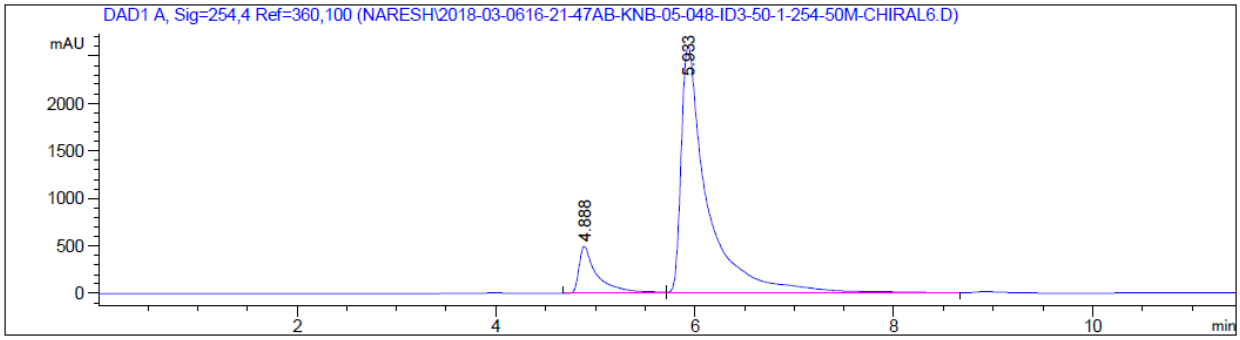
Data File C:\CHEM32\...A\NARESH\2018-03-0616-21-47AB-KNB-05-048-ID3-50-1-254-50M-CHIRAL6.D
Sample Name: AB-KNB-05-048-ID3-50-1-254-50M-CHIRAL6
```

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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   4.888 BV    0.1812 6495.49609  494.67331  11.7701
   2   5.933 VV    0.2605 4.86909e4  2599.23633  88.2299

Totals :                  5.51864e4  3093.90964

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                        *** End of Report ***
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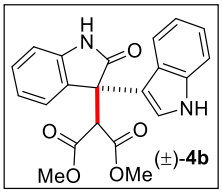
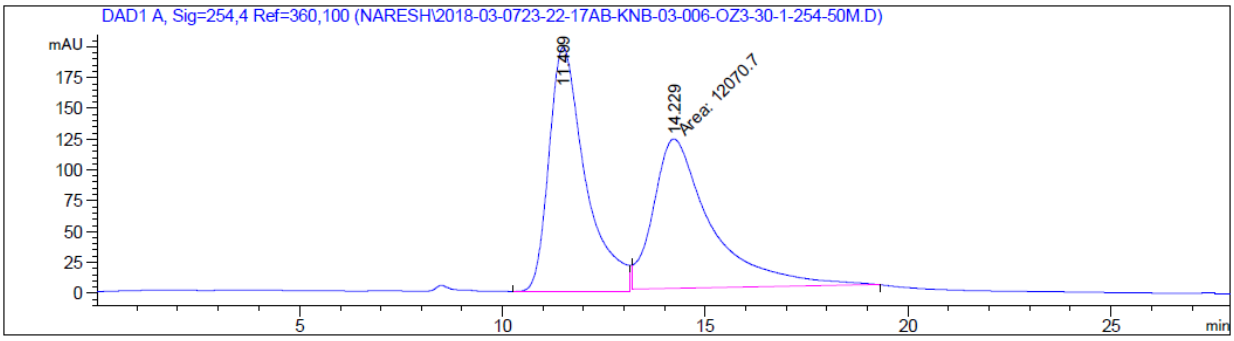
HPLC data of compound (±)-4b



Data File C:\CHEM32\1\DATA\NARESH\2018-03-0723-22-17AB-KNB-03-006-OZ3-30-1-254-50M.D
Sample Name: AB-KNB-03-006-OZ3-30-1-254-50M

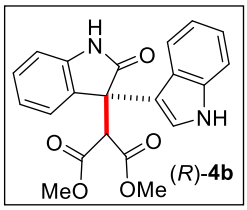


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

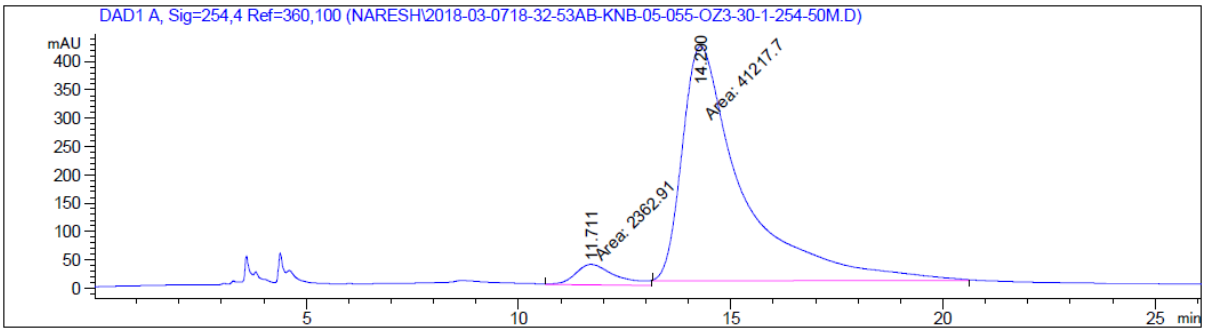
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.499	BV	0.9274	1.24358e4	198.35529	50.7449
2	14.229	MM	1.6576	1.20707e4	121.37089	49.2551
Totals :				2.45066e4	319.72617	

*** End of Report ***

HPLC data of compound (*R*)**-4b**



Data File C:\CHEM32\1\DATA\NARESH\2018-03-0718-32-53AB-KNB-05-055-OZ3-30-1-254-50M.D
Sample Name: AB-KNB-05-055-OZ3-30-1-254-50M

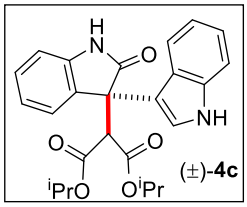


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

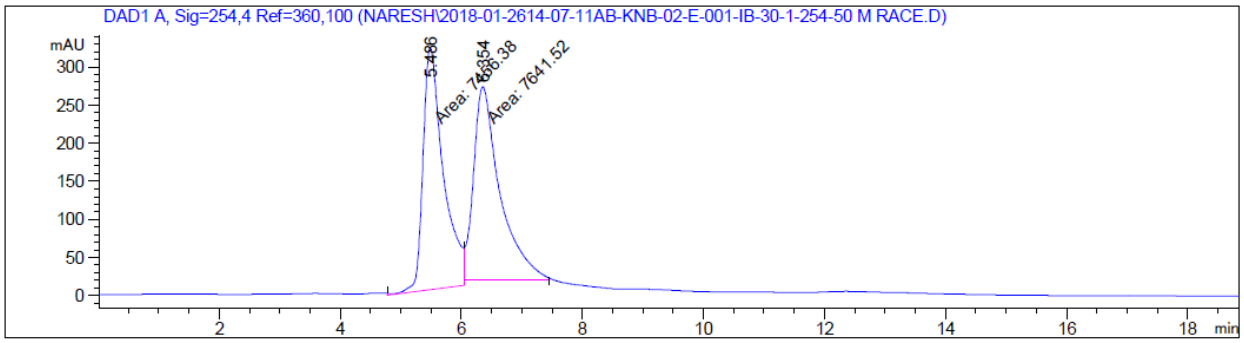
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.711	MM	1.0946	2362.91309	35.97766	5.4219
2	14.290	MM	1.6580	4.12177e4	414.34091	94.5781
Totals :				4.35806e4	450.31857	

*** End of Report ***

HPLC data of compound (±)-4c



Data File C:\CHEM32\...TA\NARESH\2018-01-2614-07-11AB-KNB-02-E-001-IB-30-1-254-50 M RACE.D
Sample Name: AB-KNB-02-E-001-IB-30-1-254-50 M RACE



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

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.486	MM	0.3911	7456.38379	317.74460	49.3869
2	6.354	MM	0.5032	7641.51709	253.08270	50.6131
Totals :				1.50979e4	570.82730	

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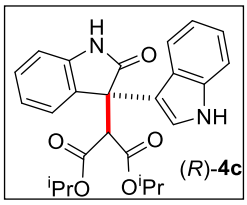
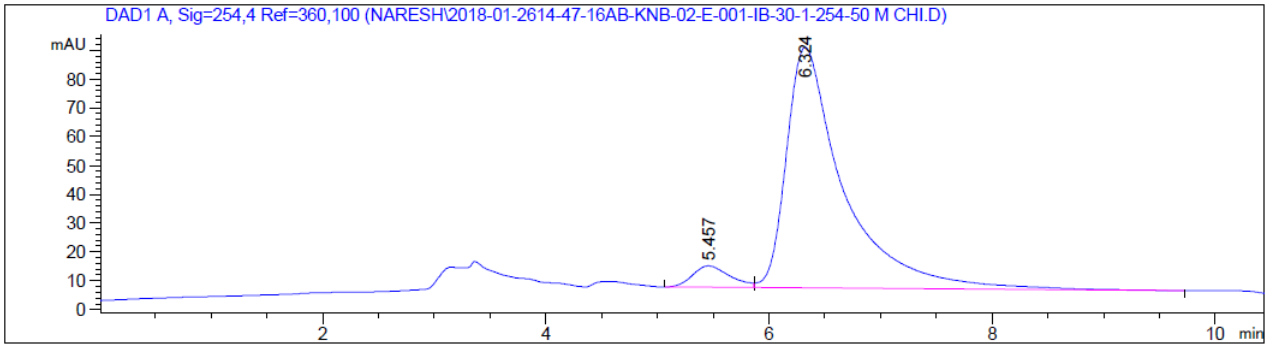
*** End of Report ***

HPLC data of compound (*R*)-4c



Data File C:\CHEM32\1\DATA\NARESH\2018-01-2614-47-16AB-KNB-02-E-001-IB-30-1-254-50 M CHI.D
Sample Name: AB-KNB-02-E-001-IB-30-1-254-50 M CHI

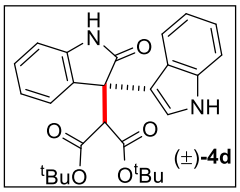


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

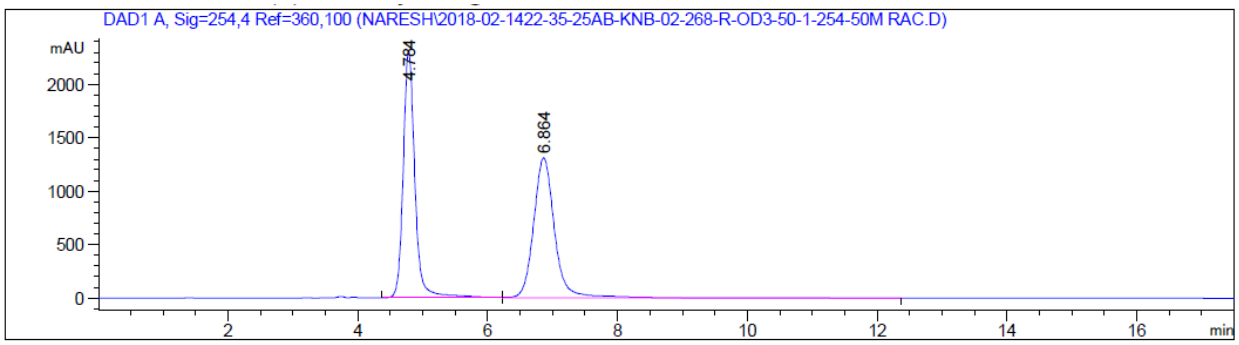
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.457	BV	0.3505	172.50580	7.43912	5.4415
2	6.324	VB	0.5144	2997.67676	83.58624	94.5585
Totals :				3170.18256	91.02535	

*** End of Report ***

HPLC data of compound (±)-4d



Data File C:\CHEM32\1\DATA\NARESH\2018-02-1422-35-25AB-KNB-02-268-R-OD3-50-1-254-50M RAC.D
Sample Name: AB-KNB-02-268-R-OD3-50-1-254-50M RAC

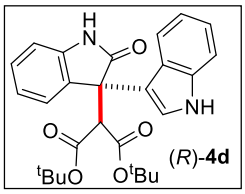


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

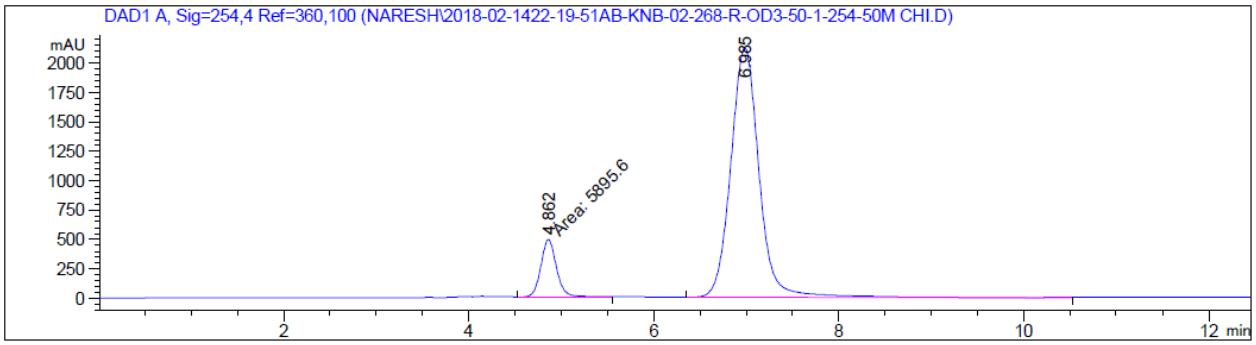
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.784	BV	0.1911	2.91449e4	2311.79590	49.4875
2	6.864	VB	0.3448	2.97486e4	1310.78491	50.5125
Totals :				5.88935e4	3622.58081	

*** End of Report ***

HPLC data of compound (*R*)-4d



Data File C:\CHEM32\1\DATA\NARESH\2018-02-1422-19-51AB-KNB-02-268-R-OD3-50-1-254-50M CHI.D
Sample Name: AB-KNB-02-268-R-OD3-50-1-254-50M CHI

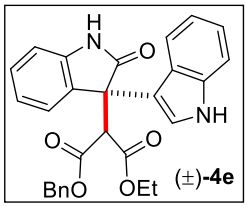


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

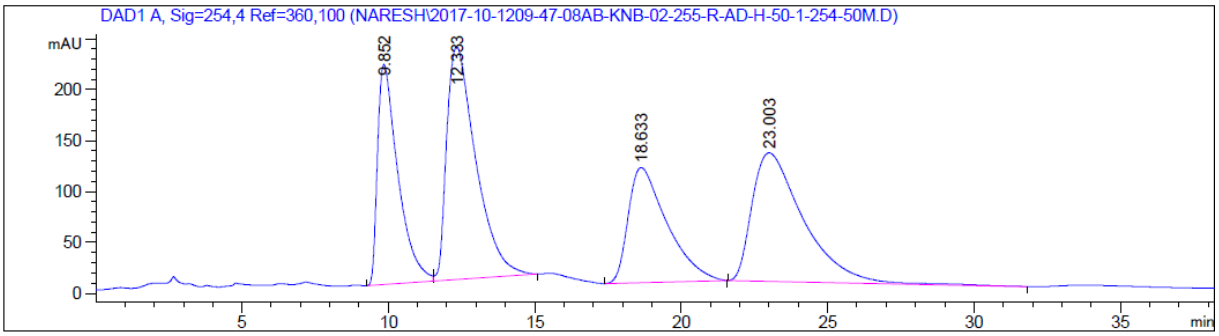
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.862	MM	0.2001	5895.59717	491.08658	11.5294
2	6.985	BBA	0.3270	4.52396e4	2119.83569	88.4706
Totals :				5.11352e4	2610.92227	

*** End of Report ***

HPLC data of compound (±)-4e



Data File C:\CHEM32\1\DATA\NARESH\2017-10-1209-47-08AB-KNB-02-255-R-AD-H-50-1-254-50M.D
Sample Name: AB-KNB-02-255-R-AD-H-50-1-254-50M



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

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.852	BV	0.7148	1.04855e4	215.83139	20.1239
2	12.333	VB	1.0442	1.58338e4	228.56190	30.3886
3	18.633	BB	1.3373	1.03880e4	112.91732	19.9368
4	23.003	BB	1.8207	1.53972e4	126.08580	29.5507
Totals :				5.21044e4	683.39642	

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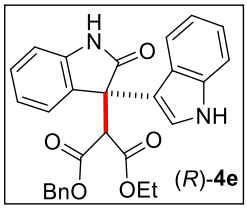
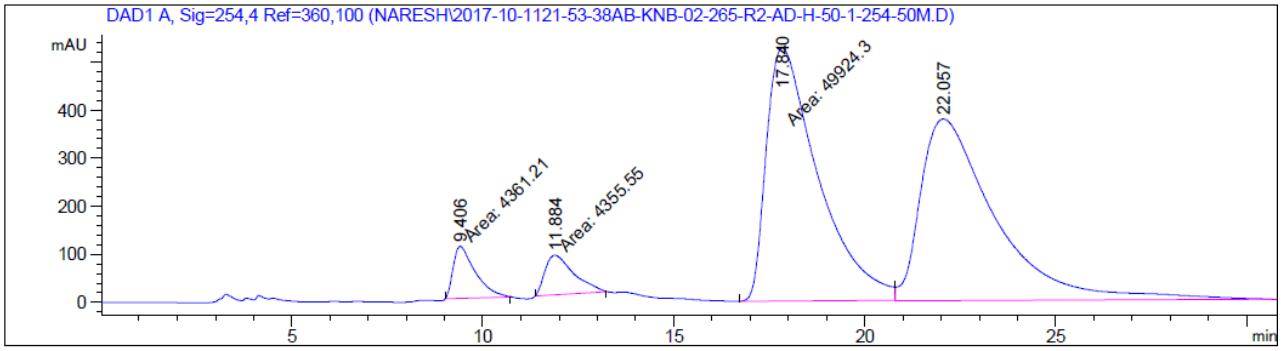
*** End of Report ***

HPLC data of compound (*R*)-4e



Data File C:\CHEM32\1\DATA\NARESH\2017-10-1121-53-38AB-KNB-02-265-R2-AD-H-50-1-254-50M.D
Sample Name: AB-KNB-02-265-R2-AD-H-50-1-254-50M

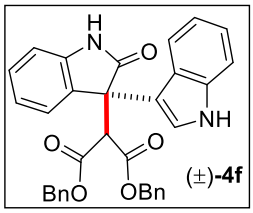


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

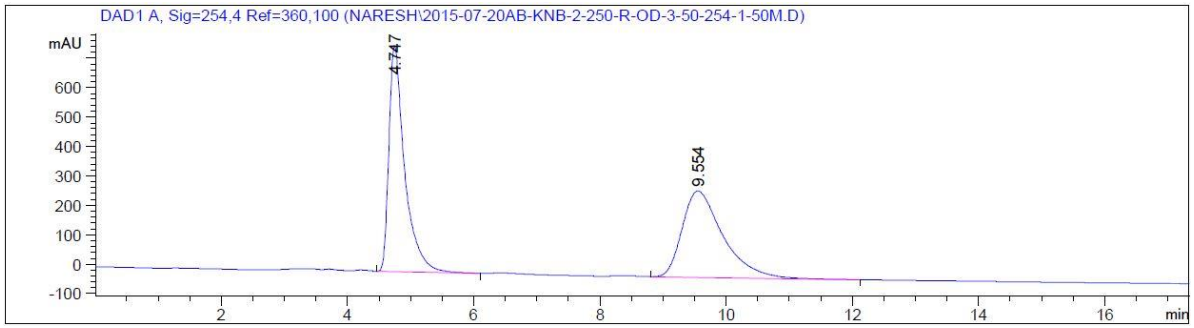
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.406	MM	0.6707	4361.21436	108.37340	3.9545
2	11.884	MM	0.8780	4355.54980	82.67854	3.9494
3	17.840	MM	1.5772	4.99243e4	527.54572	45.2686
4	22.057	VBA	1.9889	5.16434e4	378.23743	46.8275
Totals :				1.10284e5	1096.83508	

*** End of Report ***

HPLC data of compound (±)-4f



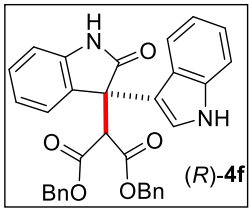
Data File C:\CHEM32\1\DATA\NARESH\2015-07-20AB-KNB-2-250-R-OD-3-50-254-1-50M.D
Sample Name: AB-KNB-2-250-R-OD-3-50-254-1-50M



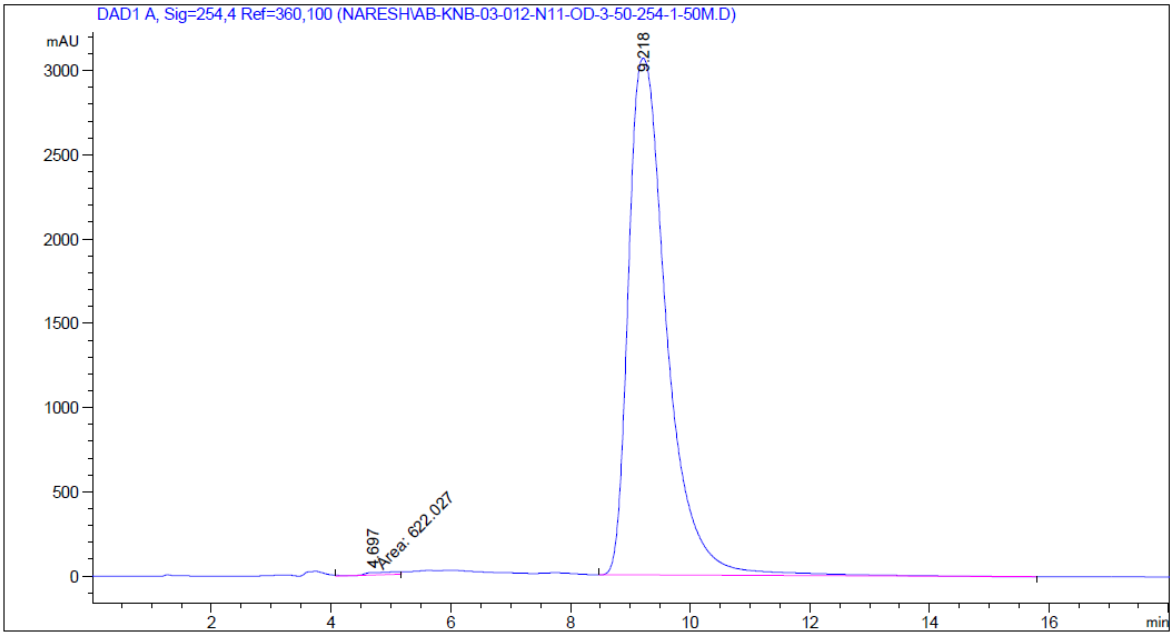
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.747	BB	0.2544	1.33140e4	767.55292	50.3227
2	9.554	BBA	0.6749	1.31432e4	293.25589	49.6773
Totals :				2.64572e4	1060.80881	

*** End of Report ***

HPLC data of compound (*R*)**-4f**



Data File C:\CHEM32\1\DATA\NARESH\AB-KNB-03-012-N11-OD-3-50-254-1-50M.D
Sample Name: AB-KNB-03-012-N11-OD-3-50-254-1-50M

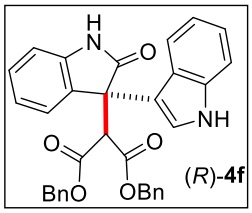


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

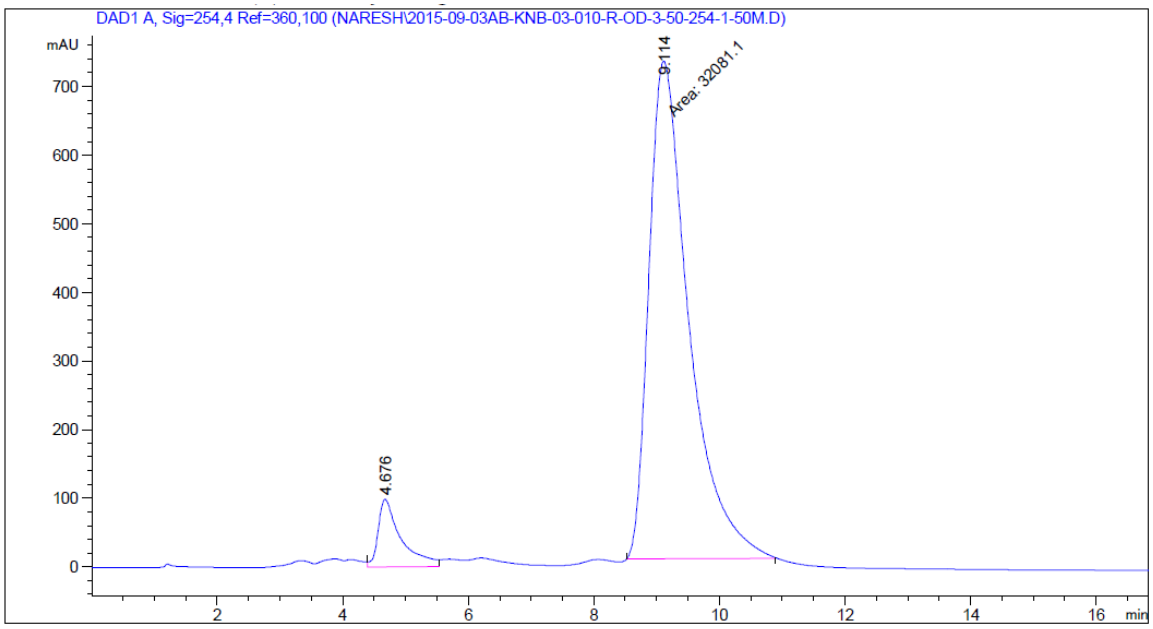
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.697	MM	0.6926	622.02673	14.96861	0.4542
2	9.218	BB	0.6744	1.36330e5	3068.00513	99.5458
Totals :				1.36952e5	3082.97373	

*** End of Report ***

HPLC data of compound (*R*)-4f from (*R*)-4a




```
Data File C:\CHEM32\1\DATA\NARESH\2015-09-03AB-KNB-03-010-R-OD-3-50-254-1-50M.D
Sample Name: AB-KNB-03-010-R-OD-3-50-254-1-50M
```




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]       [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   4.676 VV    0.3572 2487.07837   98.29729   7.1947
   2   9.114 MM    0.7370 3.20811e4   725.46271  92.8053

Totals :                  3.45682e4   823.76000

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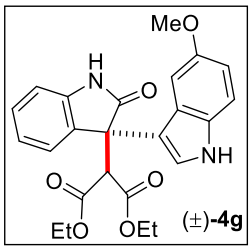
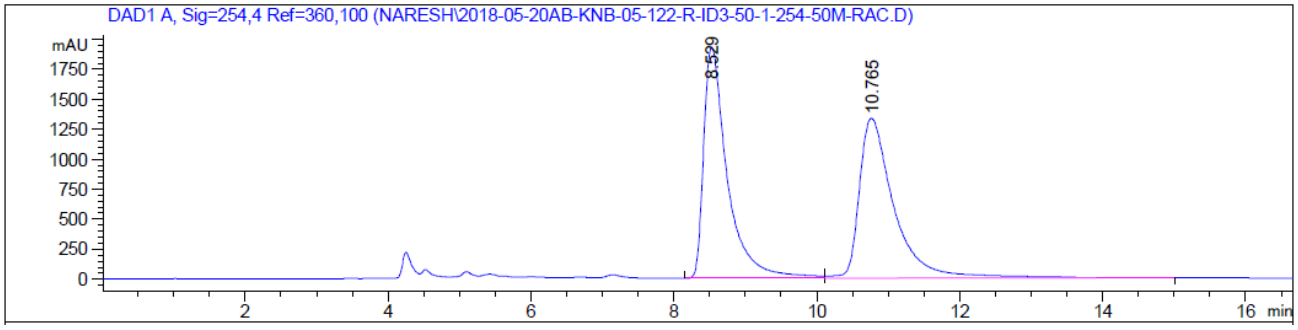
                        *** End of Report ***
```

HPLC data of compound (±)-4g



Data File C:\CHEM32\...\NARESH\2018-01-1512-38-31AB-KNB-04-346-2-IE-3-40-1-254-40 M RACE.D
Sample Name: AB-KNB-04-346-2-IE-3-40-1-254-40 M RACE

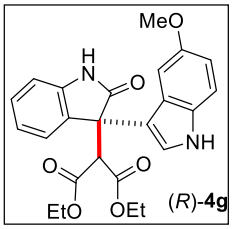


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

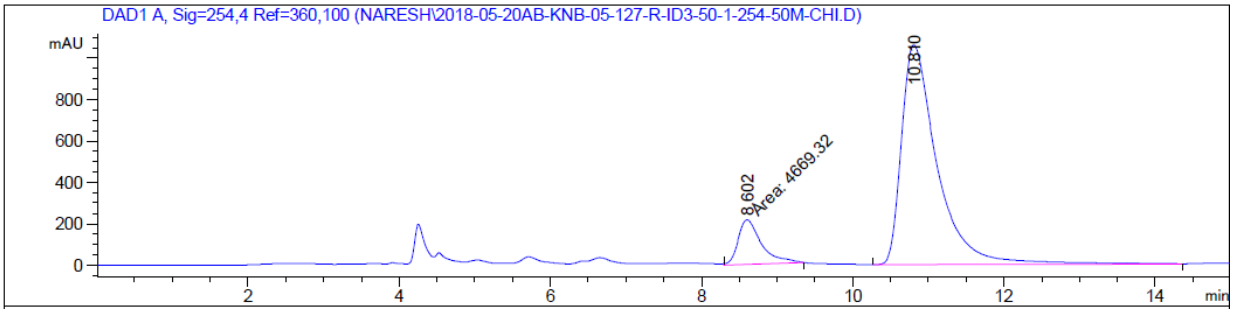
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.529	BV	0.3407	4.44467e4	1929.58862	49.5523
2	10.765	VB	0.5020	4.52498e4	1332.96252	50.4477
Totals :				8.96965e4	3262.55115	

*** End of Report ***

HPLC data of compound (*R*)**-4g**



Data File C:\CHEM32\...A\NARESH\2018-01-1512-58-24AB-KNB-04-347-2-IE-3-40-1-254-40 M CHI.D
Sample Name: AB-KNB-04-347-2-IE-3-40-1-254-40 M CHI

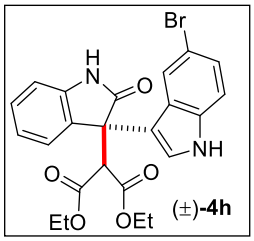


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

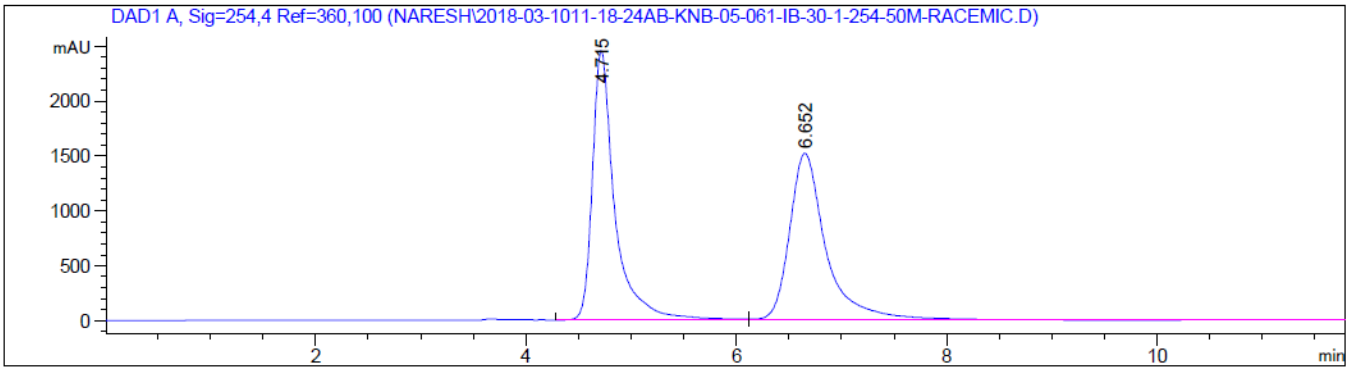
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.602	MM	0.3599	4669.31934	216.20741	11.8231
2	10.810	BB	0.4874	3.48239e4	1059.78052	88.1769
Totals :				3.94932e4	1275.98793	

*** End of Report ***

HPLC data of compound (±)-4h



Data File C:\CHEM32\...TA\NARESH\2018-03-1011-18-24AB-KNB-05-061-IB-30-1-254-50M-RACEMIC.D
Sample Name: AB-KNB-05-061-IB-30-1-254-50M-RACEMIC

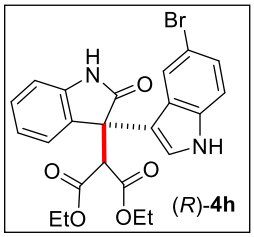


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

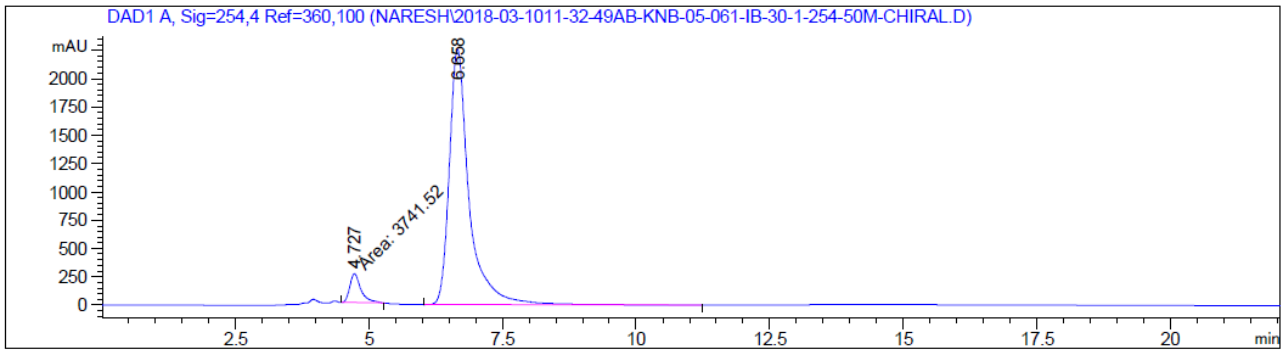
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.715	BV	0.2161	3.65746e4	2451.00928	49.5987
2	6.652	VBA	0.3596	3.71663e4	1518.29858	50.4013
Totals :				7.37409e4	3969.30786	

*** End of Report ***

HPLC data of compound (*R*)-4h



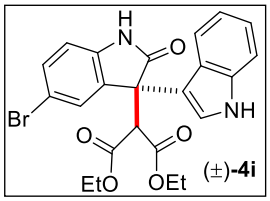
Data File C:\CHEM32\1\DATA\NARESH\2018-03-1011-32-49AB-KNB-05-061-IB-30-1-254-50M-CHIRAL.D
Sample Name: AB-KNB-05-061-IB-30-1-254-50M-CHIRAL



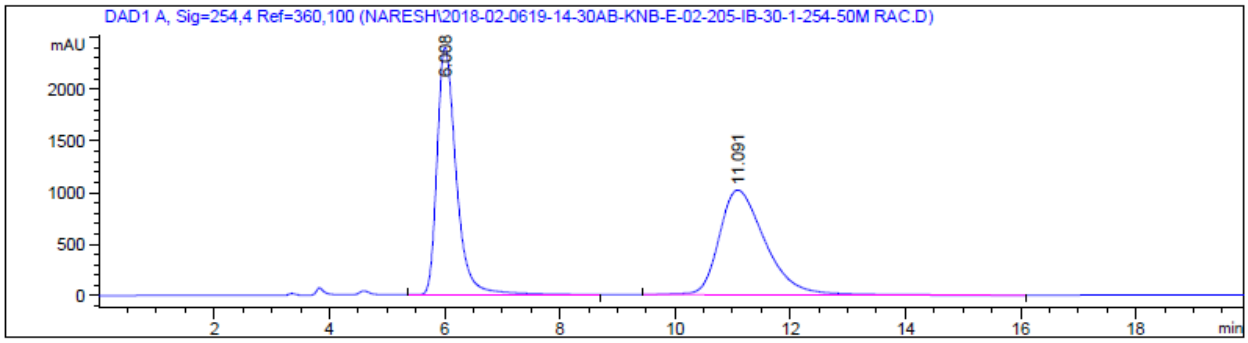
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.727	MM	0.2430	3741.52417	256.66464	6.0244
2	6.658	BB	0.3800	5.83646e4	2254.83691	93.9756
Totals :				6.21061e4	2511.50156	

HPLC data of compound (±)-4i



Data File C:\CHEM32\1\DATA\NARESH\2018-02-0619-14-30AB-KNB-E-02-205-IB-30-1-254-50M RAC.D
Sample Name: AB-KNB-E-02-205-IB-30-1-254-50M RAC

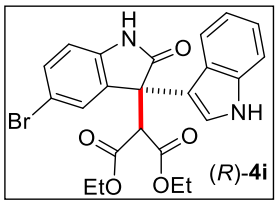


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

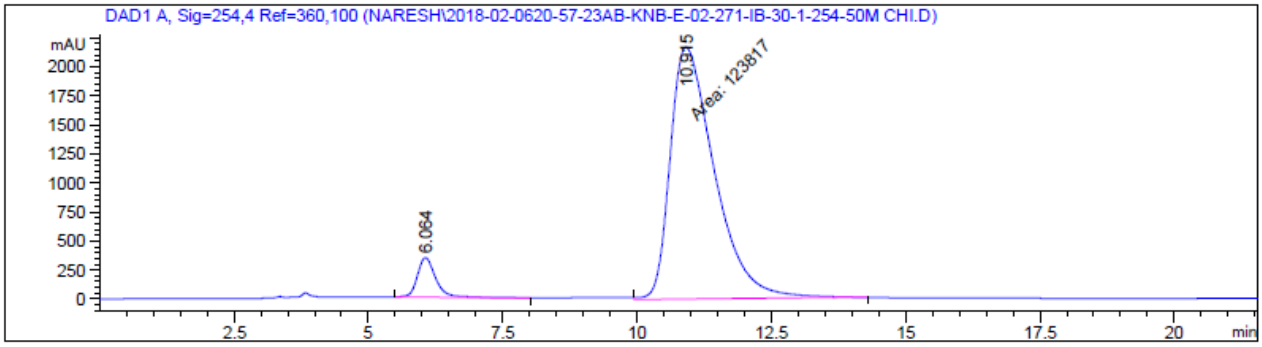
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.008	BB	0.3547	5.54719e4	2390.49780	49.7126
2	11.091	BBA	0.8487	5.61132e4	1012.32666	50.2874
Totals :				1.11585e5	3402.82446	

*** End of Report ***

HPLC data of compound (*R*)**-4i**



Data File C:\CHEM32\1\DATA\NARESH\2018-02-0620-57-23AB-KNB-E-02-271-IB-30-1-254-50M CHI.D
Sample Name: AB-KNB-E-02-271-IB-30-1-254-50M CHI

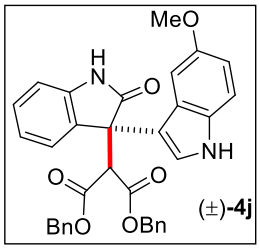


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

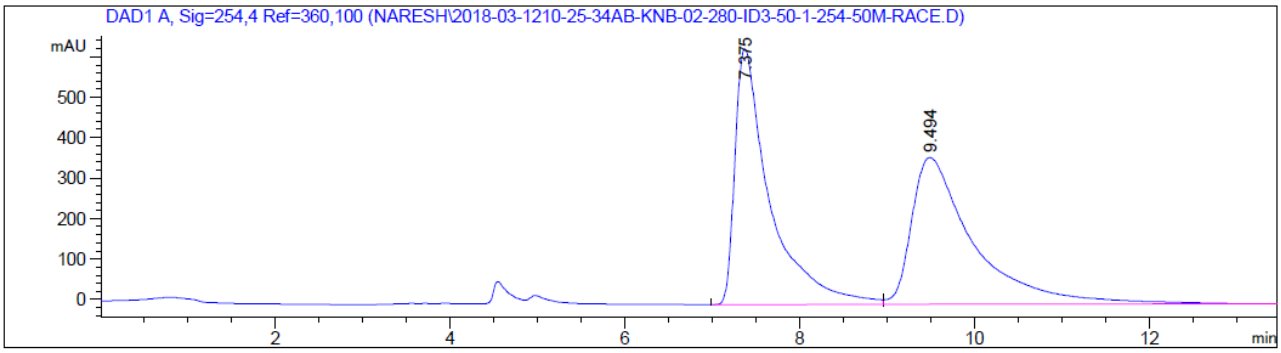
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.064	BB	0.3577	8029.52490	339.73129	6.0901
2	10.915	MM	0.9542	1.23817e5	2162.68433	93.9099
Totals :				1.31846e5	2502.41562	

*** End of Report ***

HPLC data of compound (±)-4j



Data File C:\CHEM32\1\DATA\NARESH\2018-03-1210-25-34AB-KNB-02-280-ID3-50-1-254-50M-RACE.D
Sample Name: AB-KNB-02-280-ID3-50-1-254-50M-RACE

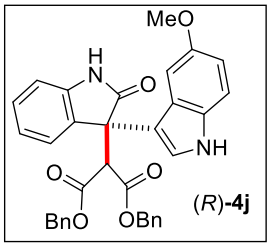


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

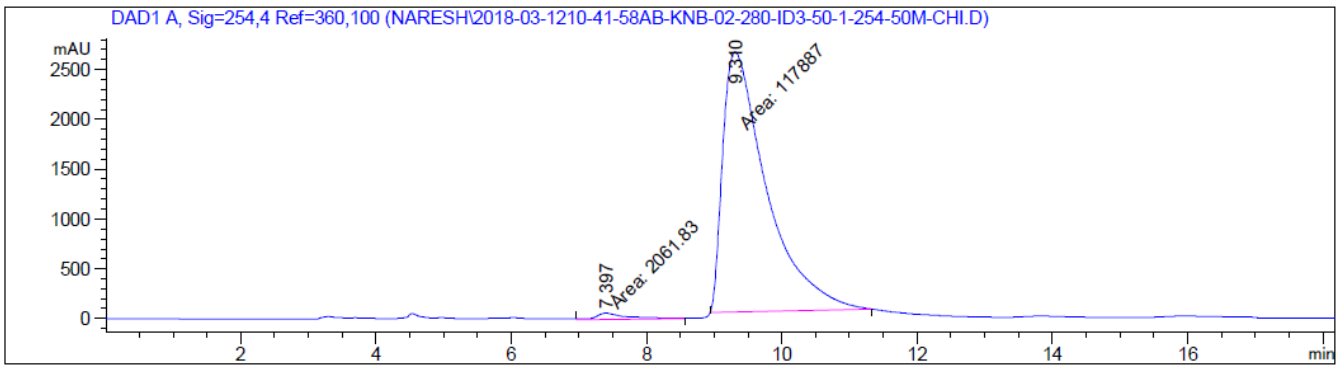
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.375	BV	0.3940	1.75442e4	631.78333	49.4226
2	9.494	VBA	0.7071	1.79542e4	362.98605	50.5774
Totals :				3.54984e4	994.76938	

*** End of Report ***

HPLC data of compound (*R*)**-4j**



Data File C:\CHEM32\1\DATA\NARESH\2018-03-1210-41-58AB-KNB-02-280-ID3-50-1-254-50M-CHI.D
Sample Name: AB-KNB-02-280-ID3-50-1-254-50M-CHI

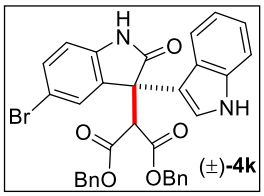


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

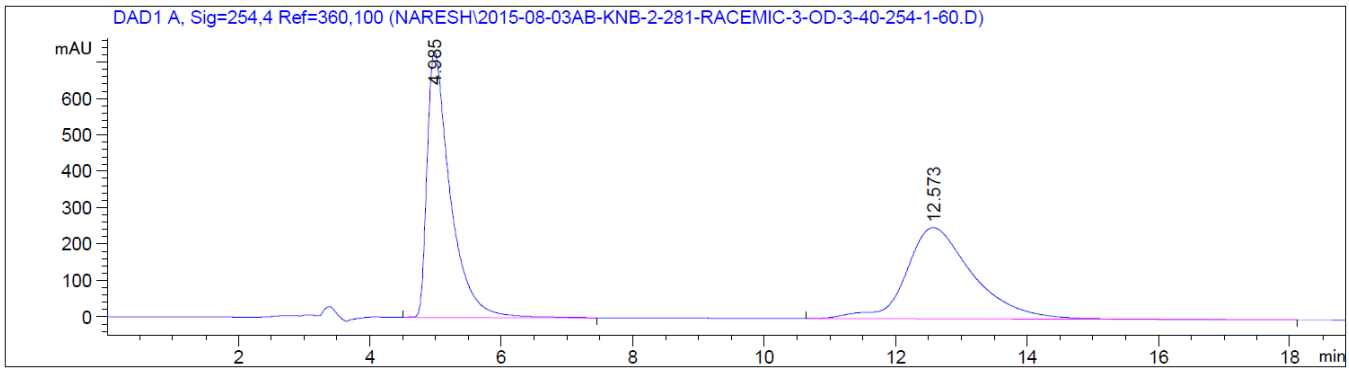
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.397	MM	0.5511	2061.82764	62.35340	1.7189
2	9.310	MM	0.7533	1.17887e5	2608.17261	98.2811
Totals :				1.19949e5	2670.52600	

*** End of Report ***

HPLC data of compound (±)-4k



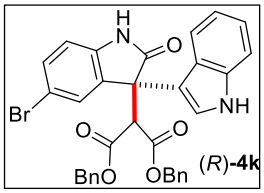
Data File C:\CHEM32\1\DATA\NARESH\2015-08-03AB-KNB-2-281-RACEMIC-3-OD-3-40-254-1-60.D
Sample Name: AB-KNB-2-281-RACEMIC-3-OD-3-40-254-1-60



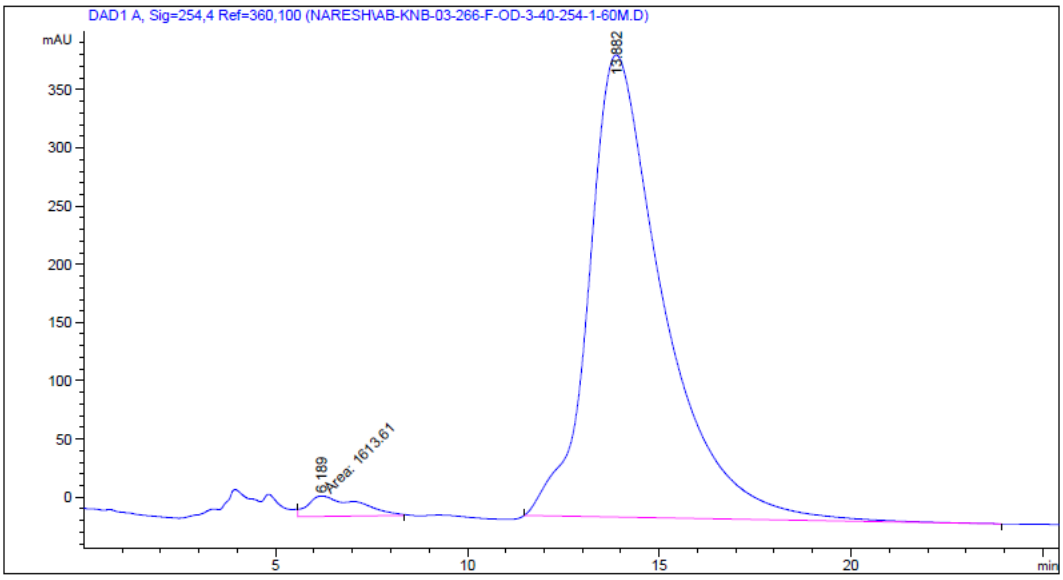
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.985	BB	0.3610	1.78174e4	729.31091	50.1061
2	12.573	BBA	1.0449	1.77419e4	250.93648	49.8939
Totals :				3.55593e4	980.24739	

*** End of Report ***

HPLC data of compound (*R*)**-4k**




```
Data File C:\CHEM32\1\DATA\NARESH\AB-KNB-03-266-F-OD-3-40-254-1-60M.D
Sample Name: AB-KNB-03-266-F-OD-3-40-254-1-60M
```




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   6.189 MM    1.5425 1613.61279   17.43466   2.9237
   2  13.882 BBA   1.9180 5.35778e4   396.61786  97.0763

Totals :                  5.51914e4   414.05252

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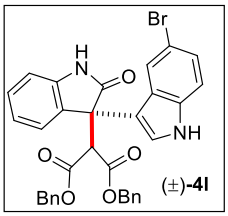
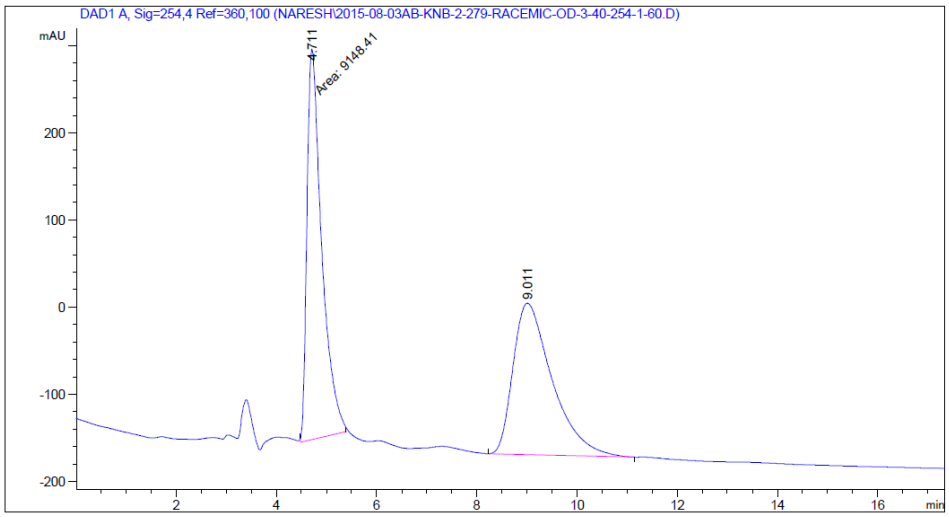
                        *** End of Report ***
```

HPLC data of compound (±)-4l



Data File C:\CHEM32\1\DATA\NARESH\2015-08-03AB-KNB-2-279-RACEMIC-OD-3-40-254-1-60.D
Sample Name: AB-KNB-2-279-RACEMIC-OD-3-40-254-1-60



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

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.711	MM	0.3406	9148.41016	447.67456	49.2353
2	9.011	BB	0.8137	9432.57910	173.66725	50.7647
Totals :				1.85810e4	621.34181	

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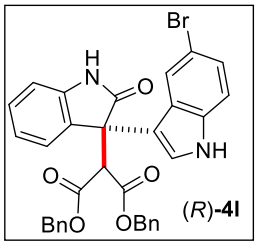
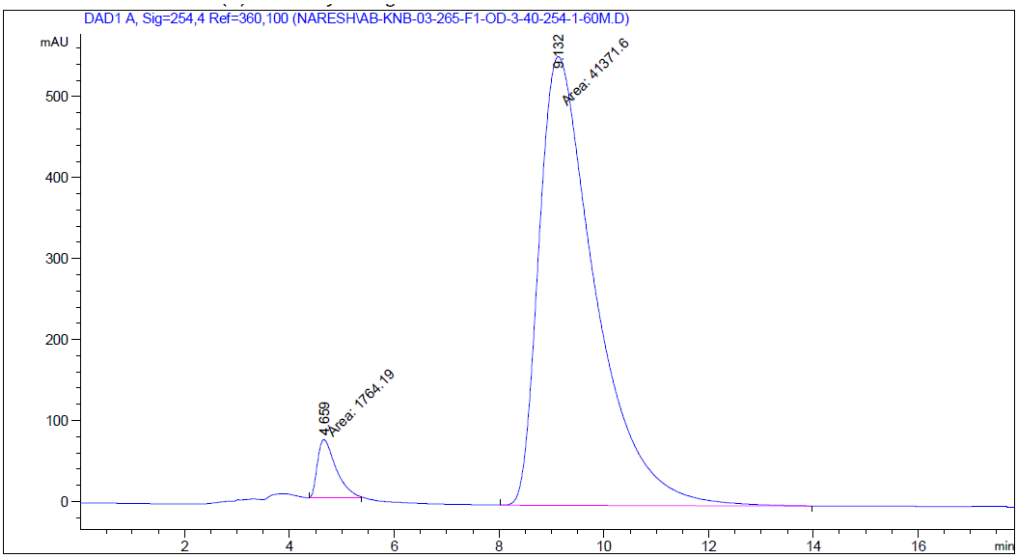
*** End of Report ***

HPLC data of compound (*R*)**-4l**



Data File C:\CHEM32\1\DATA\NARESH\AB-KNB-03-265-F1-OD-3-40-254-1-60M.D
Sample Name: AB-KNB-03-265-F1-OD-3-40-254-1-60M



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

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.659	MM	0.4098	1764.18835	71.75163	4.0898
2	9.132	MM	1.2439	4.13716e4	554.30914	95.9102
Totals :				4.31358e4	626.06078	

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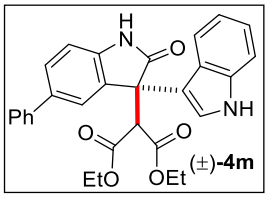
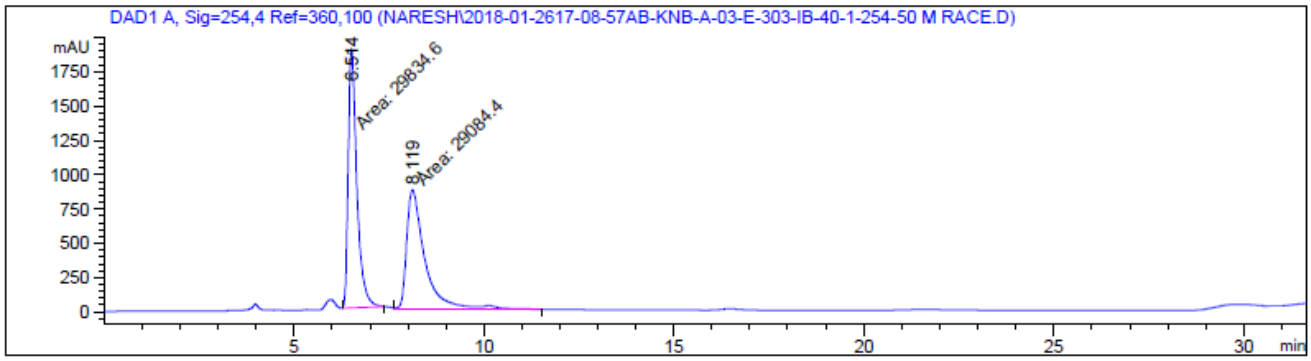
*** End of Report ***

HPLC data of compound (±)-4m



Data File C:\CHEM32\...\NARESH\2018-01-2617-08-57AB-KNB-A-03-E-303-IB-40-1-254-50 M RACE.D
Sample Name: AB-KNB-A-03-E-303-IB-40-1-254-50 M RACE



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

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.514	MM	0.2646	2.98346e4	1879.07813	50.6366
2	8.119	MM	0.5584	2.90844e4	868.13904	49.3634
Totals :				5.89189e4	2747.21716	

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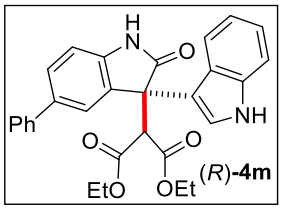
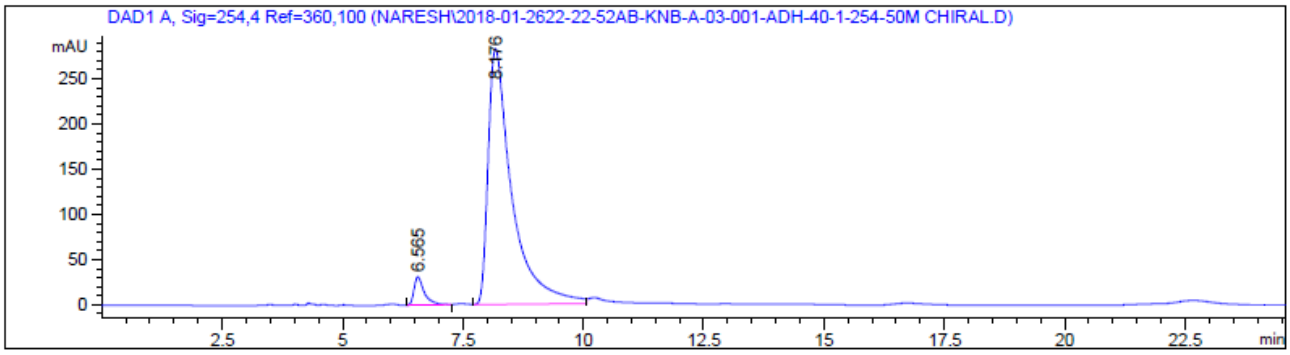
*** End of Report ***

HPLC data of compound (*R*)-4m



Data File C:\CHEM32\...\NARESH\2018-01-2622-22-52AB-KNB-A-03-001-ADH-40-1-254-50M CHIRAL.D
Sample Name: AB-KNB-A-03-001-ADH-40-1-254-50M CHIRAL

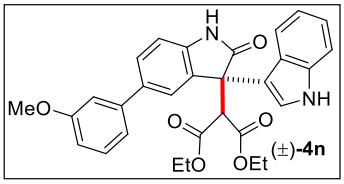


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

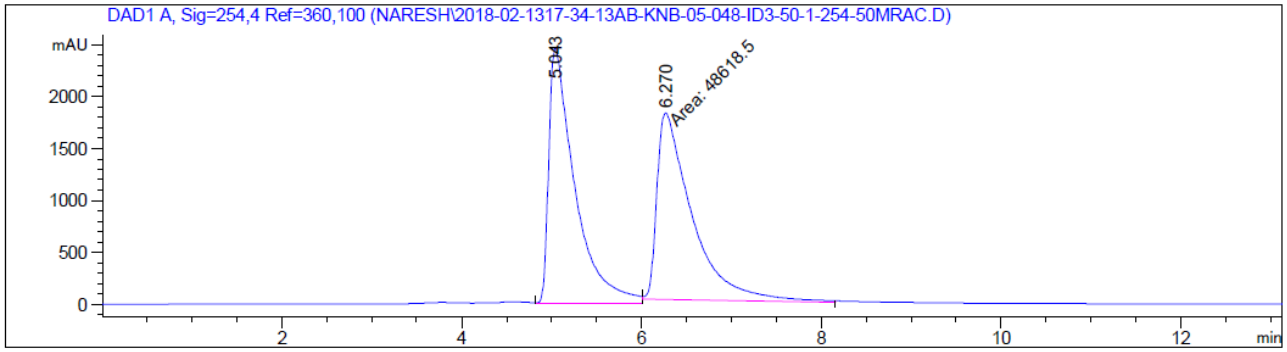
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.565	BB	0.2145	454.80374	31.11750	4.4828
2	8.176	BV	0.4949	9690.63867	281.99026	95.5172
Totals :				1.01454e4	313.10776	

*** End of Report ***

HPLC data of compound (±)-4n



Data File C:\CHEM32\1\DATA\NARESH\2018-02-1317-34-13AB-KNB-05-048-ID3-50-1-254-50MRAC.D
Sample Name: AB-KNB-05-048-ID3-50-1-254-50MRAC

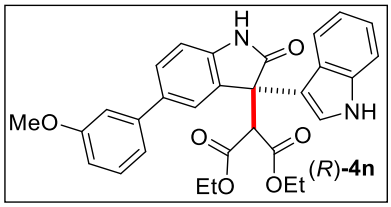


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

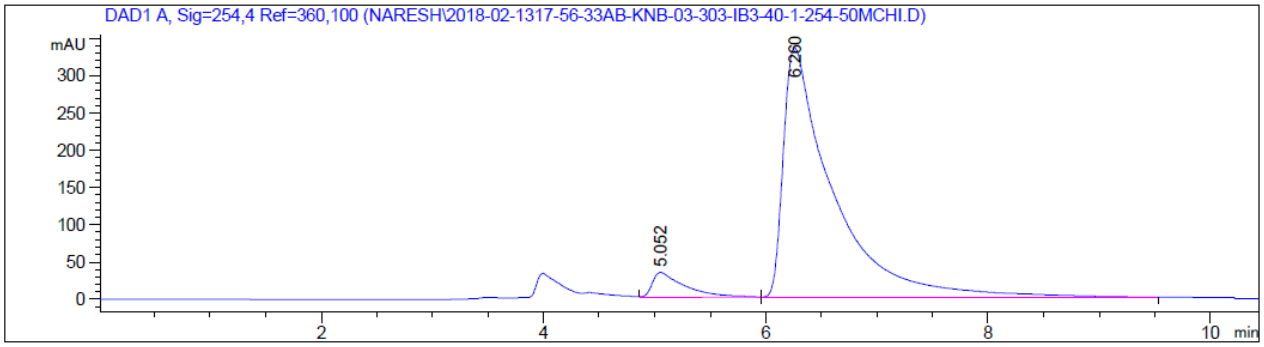
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.043	VV	0.2780	4.92836e4	2457.59082	50.3397
2	6.270	MM	0.4505	4.86185e4	1798.77979	49.6603
Totals :				9.79021e4	4256.37061	

*** End of Report ***

HPLC data of compound (*R*)-4n



Data File C:\CHEM32\1\DATA\NARESH\2018-02-1317-56-33AB-KNB-03-303-IB3-40-1-254-50MCHI.D
Sample Name: AB-KNB-03-303-IB3-40-1-254-50MCHI



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

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.052	VB	0.2734	670.75250	33.53104	6.0841
2	6.260	BB	0.4213	1.03540e4	334.37375	93.9159
Totals :				1.10247e4	367.90479	

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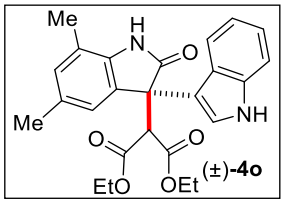
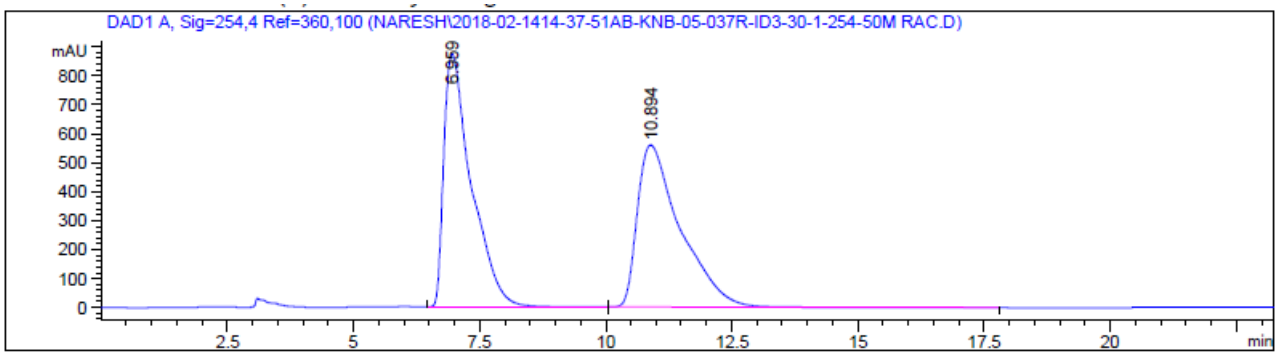
*** End of Report ***

HPLC data of compound (±)-4o



Data File C:\CHEM32\1\DATA\NARESH\2018-02-1414-37-51AB-KNB-05-037R-ID3-30-1-254-50M RAC.D
Sample Name: AB-KNB-05-037R-ID3-30-1-254-50M RAC



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

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.959	VB	0.5579	3.32450e4	873.78833	49.9643
2	10.894	BB	0.8681	3.32924e4	559.60413	50.0357
Totals :				6.65374e4	1433.39246	

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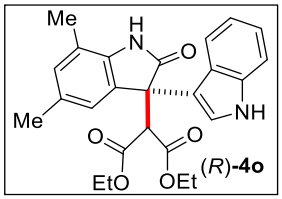
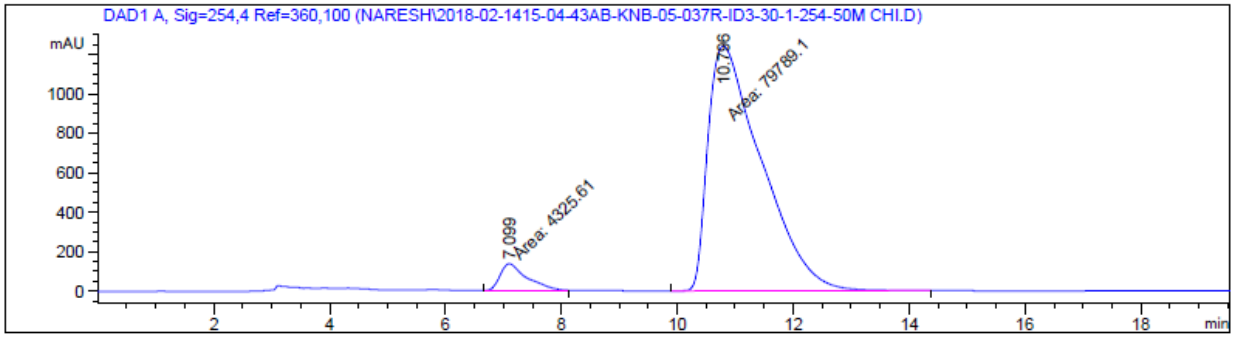
*** End of Report ***

HPLC data of compound (*R*)-4o



Data File C:\CHEM32\1\DATA\NARESH\2018-02-1415-04-43AB-KNB-05-037R-ID3-30-1-254-50M CHI.D
Sample Name: AB-KNB-05-037R-ID3-30-1-254-50M CHI

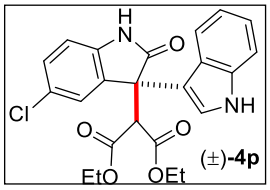


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

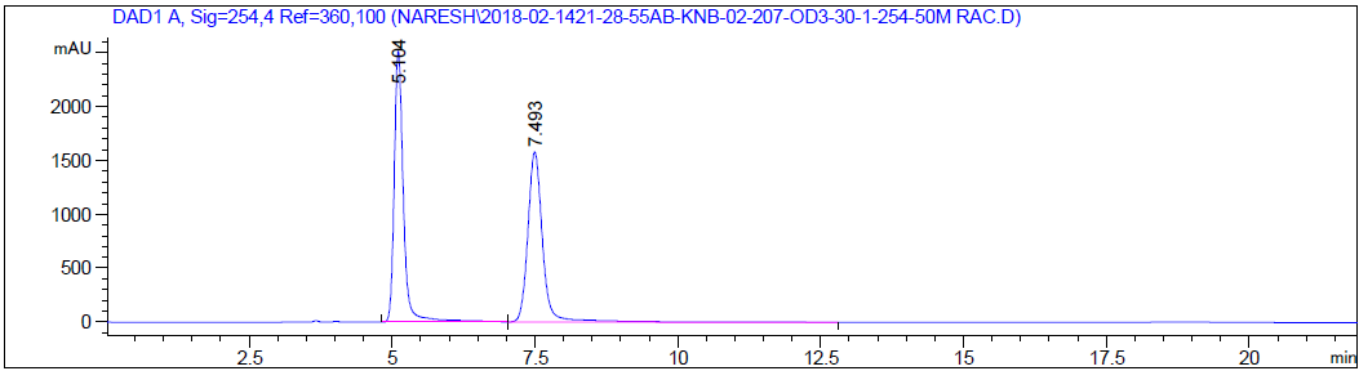
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.099	MM	0.5332	4325.61035	135.20688	5.1425
2	10.796	MM	1.0725	7.97891e4	1239.91064	94.8575
Totals :				8.41147e4	1375.11752	

*** End of Report ***

HPLC data of compound (±)-4p



Data File C:\CHEM32\1\DATA\NARESH\2018-02-1421-28-55AB-KNB-02-207-OD3-30-1-254-50M RAC.D
Sample Name: AB-KNB-02-207-OD3-30-1-254-50M RAC



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

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.104	BV	0.1700	2.83956e4	2509.90649	49.7502
2	7.493	VB	0.2763	2.86807e4	1576.14160	50.2498
Totals :				5.70763e4	4086.04810	

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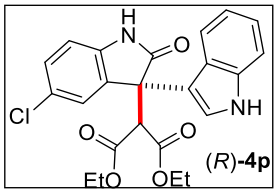
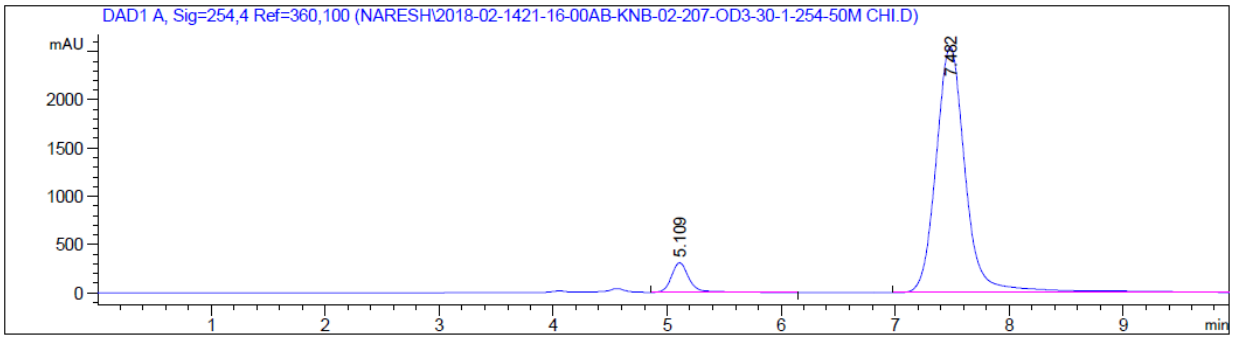
*** End of Report ***

HPLC data of compound (*R*)**-4p**



Data File C:\CHEM32\1\DATA\NARESH\2018-02-1421-16-00AB-KNB-02-207-OD3-30-1-254-50M CHI.D
Sample Name: AB-KNB-02-207-OD3-30-1-254-50M CHI

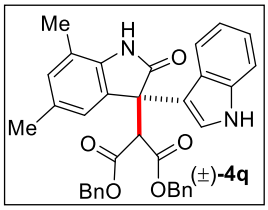


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

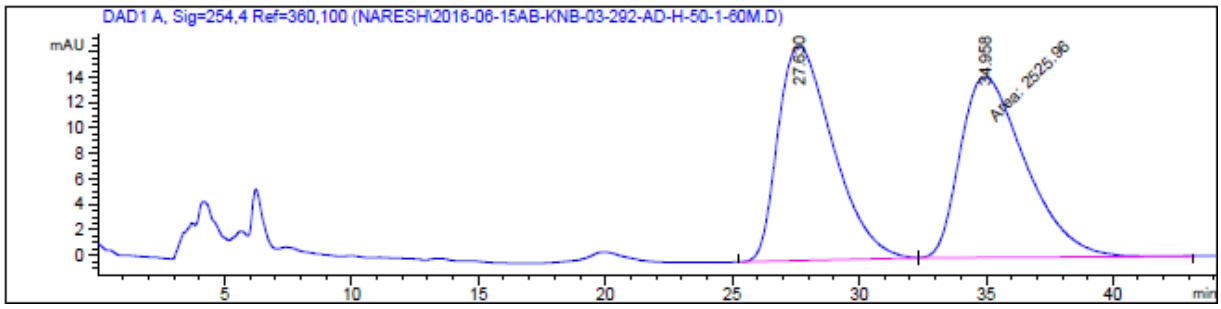
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.109	VB	0.1667	3396.52783	307.95407	6.8866
2	7.482	BBA	0.2746	4.59240e4	2543.94702	93.1134
Totals :				4.93205e4	2851.90109	

*** End of Report ***

HPLC data of compound (±)-4q

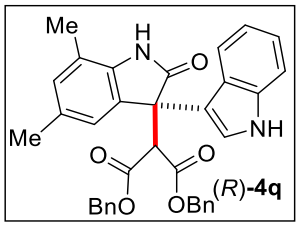


Data File C:\CHEM32\1\DATA\NARESH\2016-06-15AB-KNB-03-292-AD-H-50-1-60M.D
Sample Name: AB-KNB-03-292-AD-H-50-1-60M

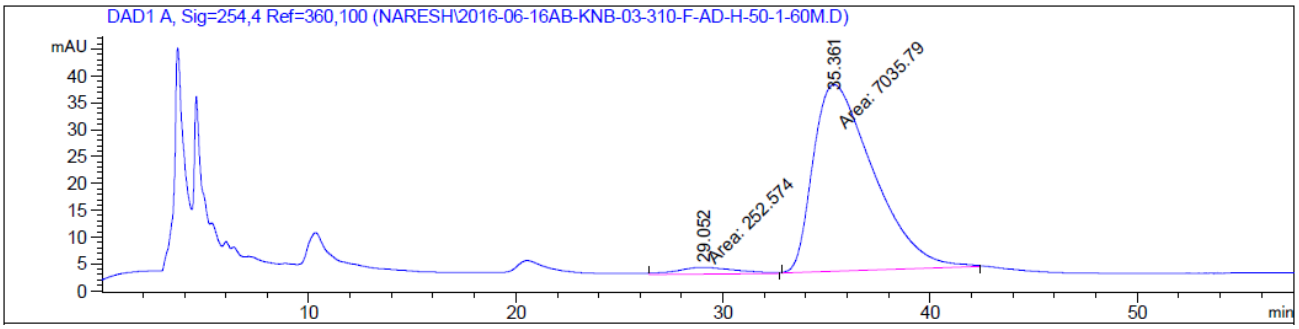


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	27.630	BB	2.1526	2533.41504	16.84519	50.0737
2	34.958	MM	2.9643	2525.95923	14.20229	49.9263
Totals :				5059.37427	31.04748	

HPLC data of compound (*R*)-4q



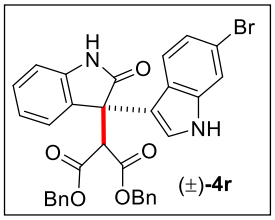
Data File C:\CHEM32\1\DATA\NARESH\2016-06-16AB-KNB-03-310-F1-AD-H-50-1-60M.D
Sample Name: AB-KNB-03-310-F1-AD-H-50-1-60M



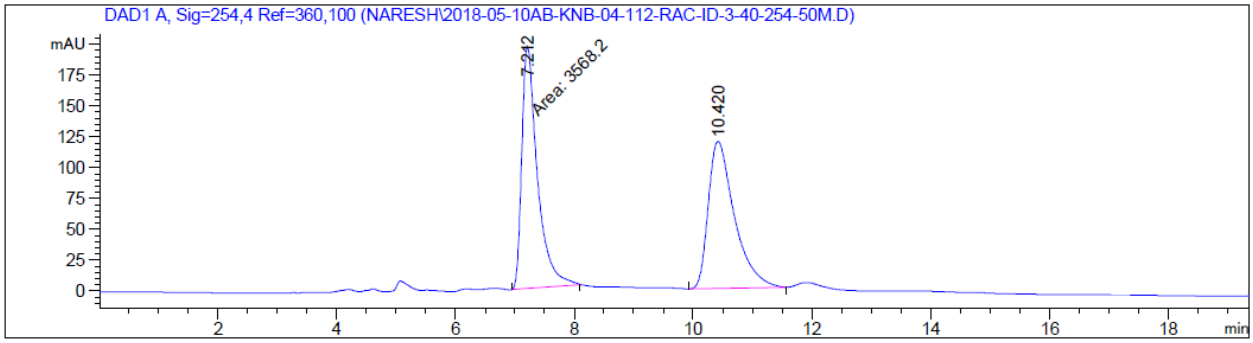
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	29.052	MM	3.3103	252.57382	1.27165	3.4654
2	35.361	MM	3.3765	7035.78955	34.72888	96.5346
Totals :				7288.36337	36.00053	

HPLC data of compound (±)-4r



Data File C:\CHEM32\1\DATA\NARESH\2018-05-10AB-KNB-04-112-RAC-ID-3-40-254-50M.D
Sample Name: AB-KNB-04-112-RAC-ID-3-40-254-50M



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.212	MM	0.3040	3568.20166	195.62561	49.5866
2	10.420	BB	0.4554	3627.69629	119.09343	50.4134
Totals :				7195.89795	314.71904	

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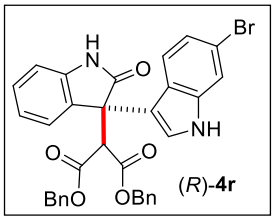
*** End of Report ***

HPLC data of compound (*R*)**-4r**

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Data File C:\CHEM32\1\DATA\NARESH\2018-05-10AB-KNB-05-123-4-CHI-ID-3-40-254-50M.D
Sample Name: AB-KNB-05-123-4-CHI-ID-3-40-254-50M
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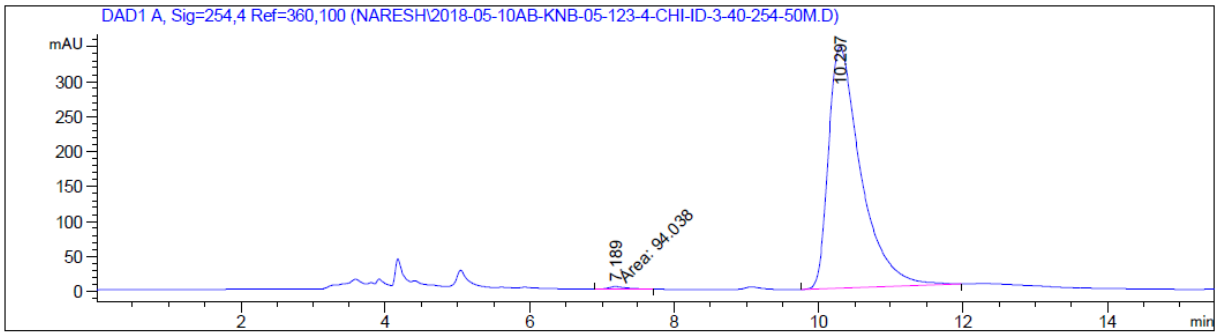


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Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   7.189 MM    0.3595   94.03797    4.35985   0.8658
   2  10.297 BB    0.4638 1.07675e4   345.30496  99.1342

Totals :                  1.08615e4   349.66482

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                        *** End of Report ***
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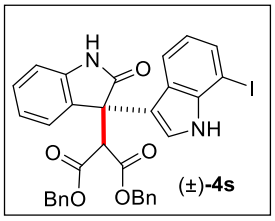
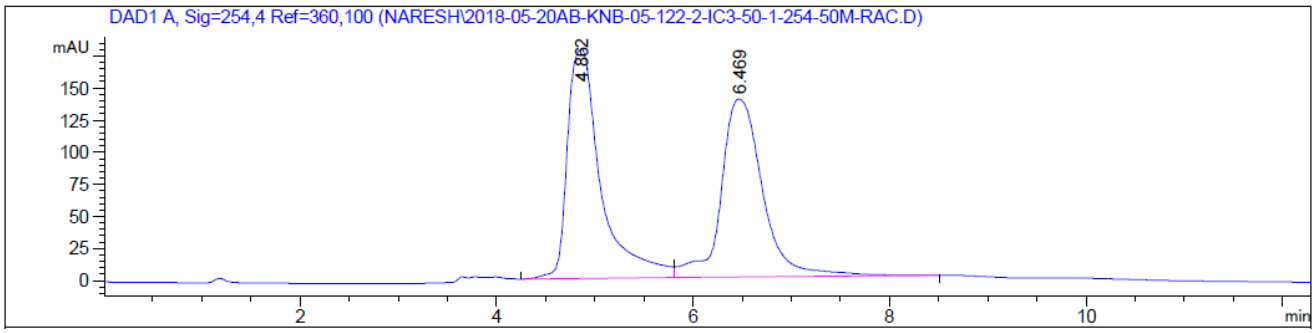
HPLC data of compound (±)-4s



Data File C:\CHEM32\1\DATA\NARESH\2018-05-20AB-KNB-05-122-2-IC3-50-1-254-50M-RAC.D
Sample Name: AB-KNB-05-122-2-IC3-50-1-254-50M-RAC

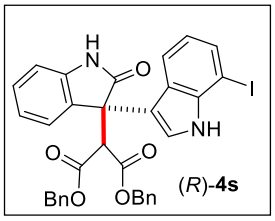


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

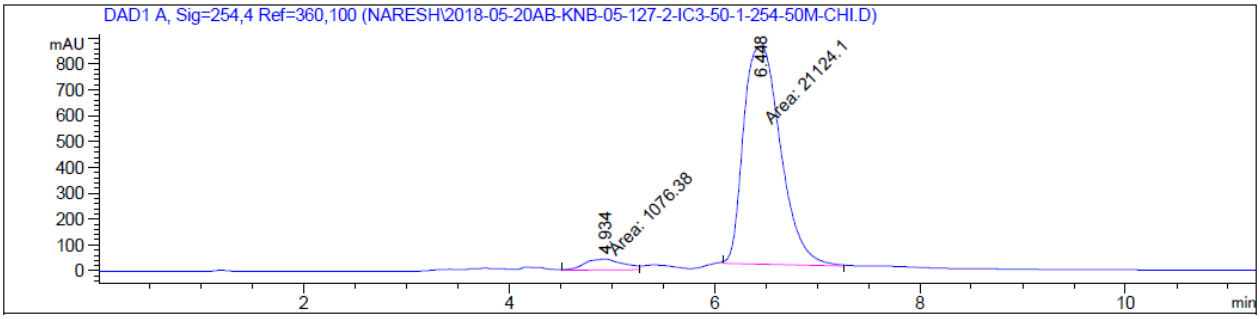
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.862	BV	0.3542	4233.64746	178.82172	50.7486
2	6.469	VB	0.4538	4108.74316	138.63490	49.2514
Totals :				8342.39063	317.45662	

*** End of Report ***

HPLC data of compound (*R*)**-4s**



Data File C:\CHEM32\1\DATA\NARESH\2018-05-20AB-KNB-05-127-2-IC3-50-1-254-50M-CHI.D
Sample Name: AB-KNB-05-127-2-IC3-50-1-254-50M-CHI

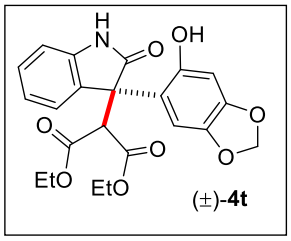


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

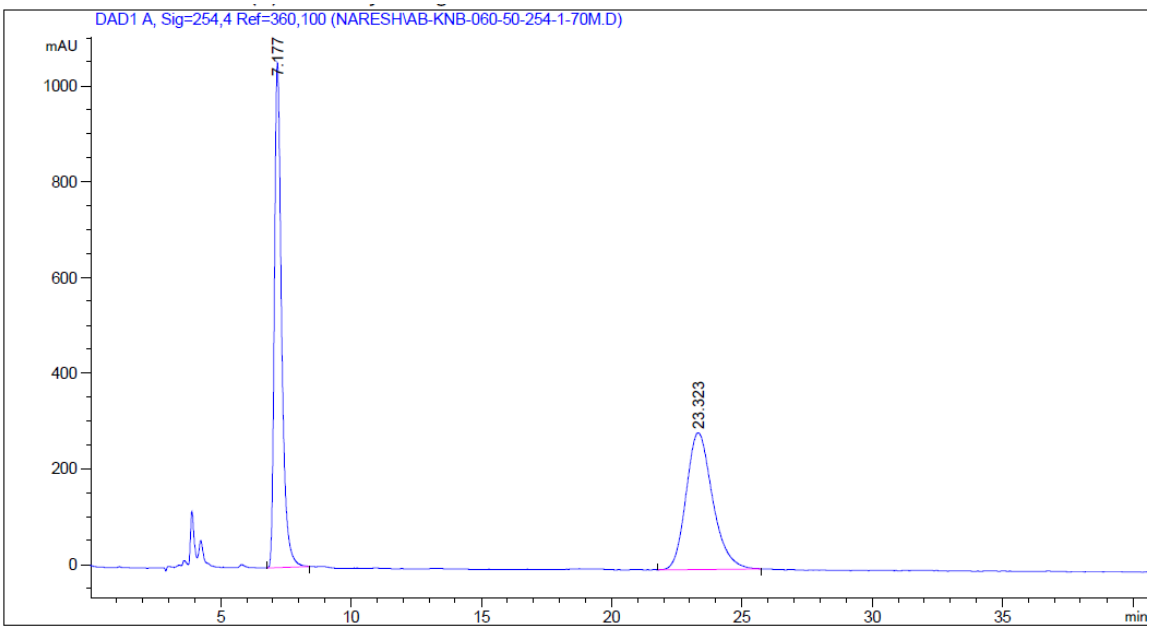
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.934	MM	0.4297	1076.37744	41.74997	4.8484
2	6.448	MM	0.4175	2.11241e4	843.34790	95.1516
Totals :				2.22005e4	885.09787	

*** End of Report ***

HPLC data of compound (±)-4t



Data File C:\CHEM32\1\DATA\NARESH\AB-KNB-060-50-254-1-70M.D
Sample Name: AB-KNB-060-50-254-1-70M

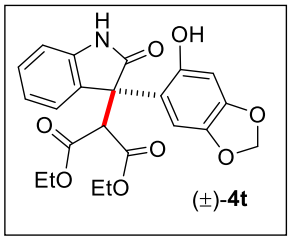


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

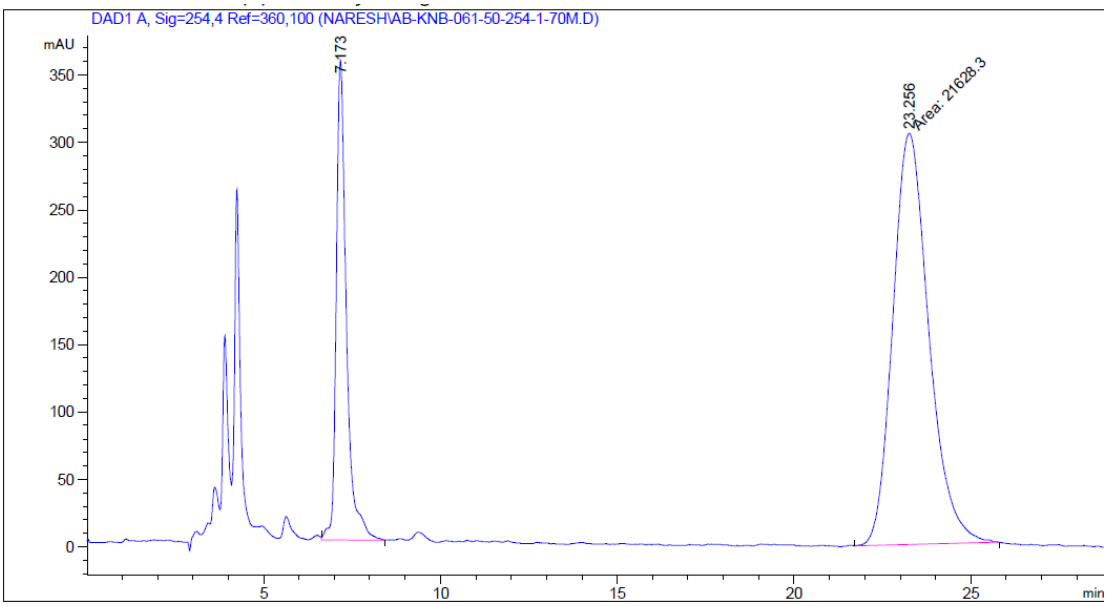
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.177	BB	0.2905	2.03153e4	1055.81726	50.2167
2	23.323	BB	1.0790	2.01400e4	285.49423	49.7833
Totals :				4.04553e4	1341.31149	

*** End of Report ***

HPLC data of compound (*R*)**-4t**



Data File C:\CHEM32\1\DATA\NARESH\AB-KNB-061-50-254-1-70M.D
Sample Name: AB-KNB-061-50-254-1-70M

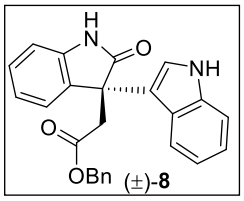


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

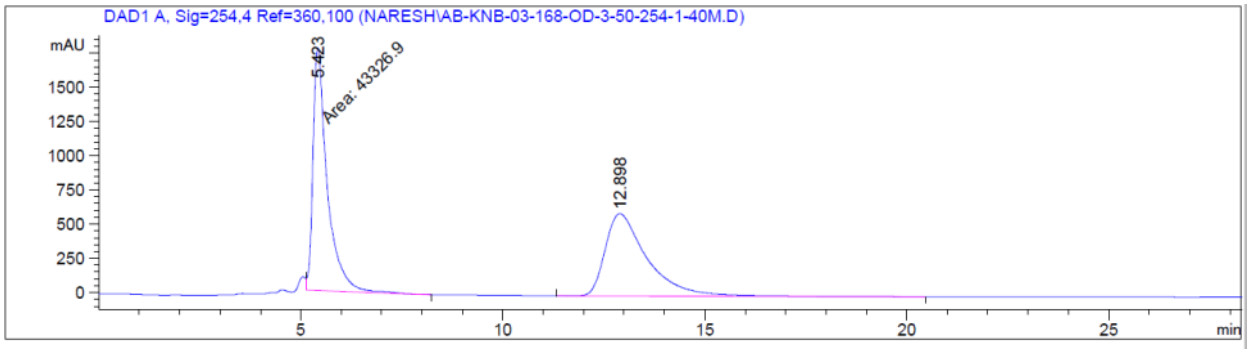
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.173	VB	0.2970	7107.71436	355.94263	24.7345
2	23.256	MM	1.1816	2.16283e4	305.07852	75.2655
Totals :				2.87360e4	661.02115	

*** End of Report ***

HPLC data of compound (±)-8



Data File C:\CHEM32\1\DATA\NARESH\AB-KNB-03-168-OD-3-50-254-1-40M.D
Sample Name: AB-KNB-03-168-OD-3-50-254-1-40M



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.423	MM	0.4080	4.33269e4	1769.70911	49.9355
2	12.898	BBA	1.0583	4.34388e4	601.63898	50.0645
Totals :				8.67657e4	2371.34808	

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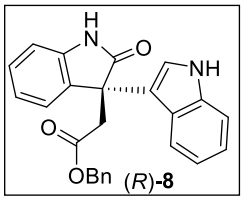
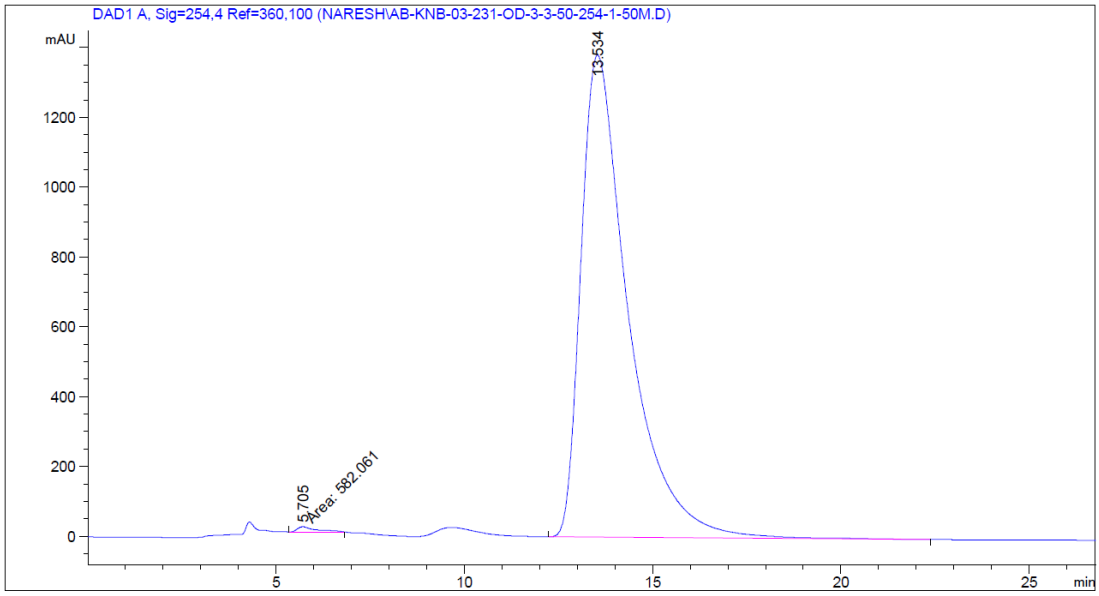
*** End of Report ***

HPLC data of compound (*R*)-8



Data File C:\CHEM32\1\DATA\NARESH\AB-KNB-03-231-OD-3-3-50-254-1-50M.D
Sample Name: AB-KNB-03-231-OD-3-3-50-254-1-50M



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

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.705	MM	0.6229	582.06079	15.57285	0.4784
2	13.534	BB	1.2969	1.21085e5	1381.03748	99.5216
Totals :				1.21667e5	1396.61033	

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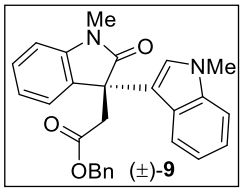
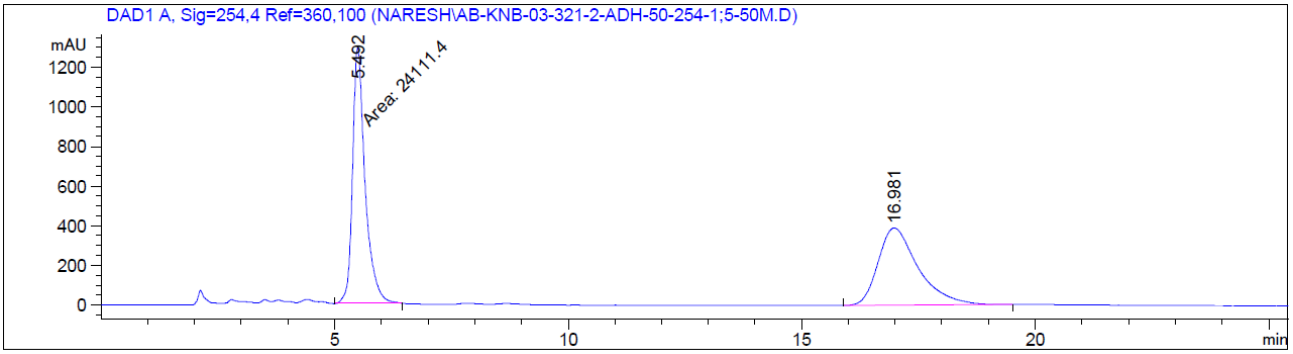
*** End of Report ***

HPLC data of compound (±)-9



Data File C:\CHEM32\1\DATA\NARESH\AB-KNB-03-321-2-ADH-50-254-1;5-50M.D
Sample Name: AB-KNB-03-321-2-ADH-50-254-1;5-50M

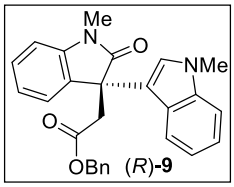


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

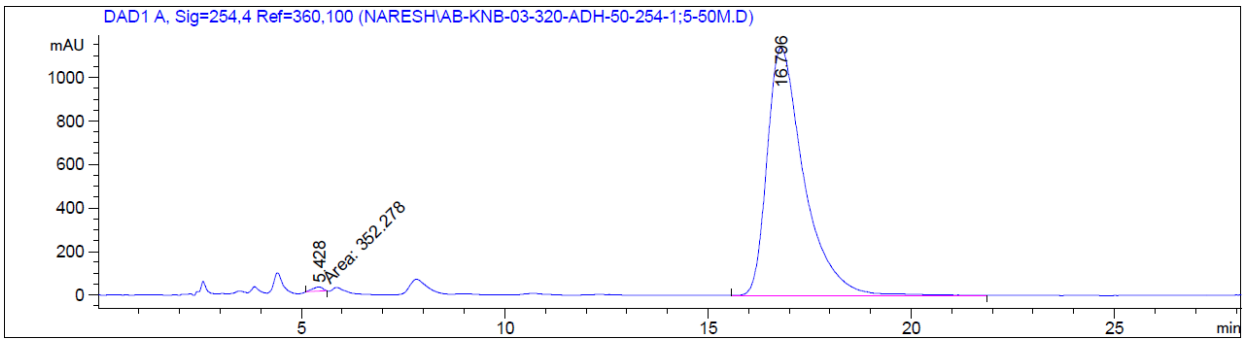
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.492	MM	0.3110	2.41114e4	1292.07007	50.9211
2	16.981	BB	0.8913	2.32392e4	389.91284	49.0789
Totals :				4.73506e4	1681.98291	

*** End of Report ***

HPLC data of compound (*R*)-9



Data File C:\CHEM32\1\DATA\NARESH\AB-KNB-03-320-ADH-50-254-1;5-50M.D
Sample Name: AB-KNB-03-320-ADH-50-254-1;5-50M

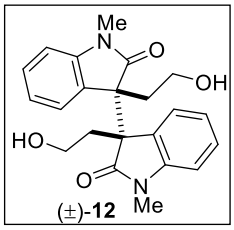


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

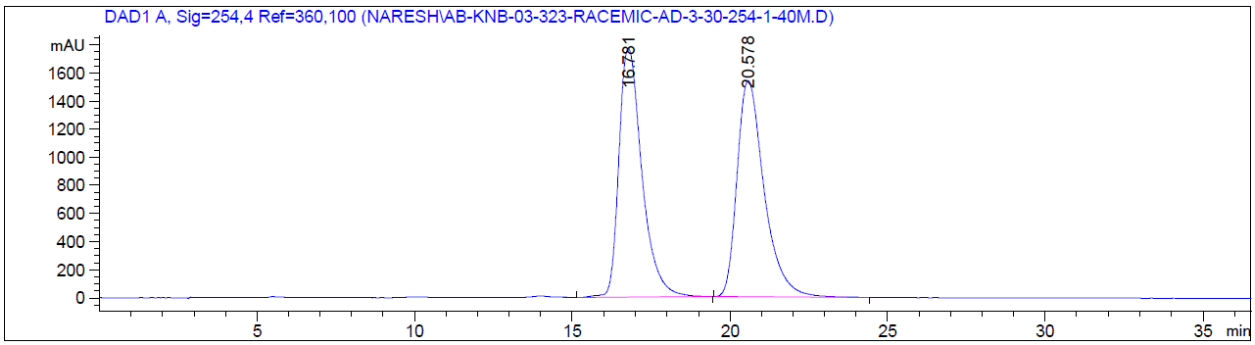
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.428	MM	0.2912	352.27847	20.16364	0.4899
2	16.796	BB	0.9376	7.15597e4	1138.11145	99.5101
Totals :				7.19119e4	1158.27509	

*** End of Report ***

HPLC data of compound (±)-12



Data File C:\CHEM32\1\DATA\NARESH\AB-KNB-03-323-RACEMIC-AD-3-30-254-1-40M.D
Sample Name: AB-KNB-03-323-Racemic-AD-3-30-254-1-40M

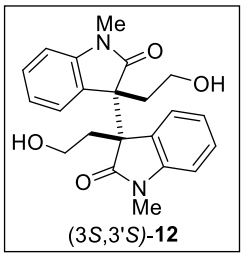


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.781	BB	0.7787	9.02859e4	1771.29431	49.5251
2	20.578	BB	0.9058	9.20173e4	1538.41589	50.4749
Totals :				1.82303e5	3309.71021	

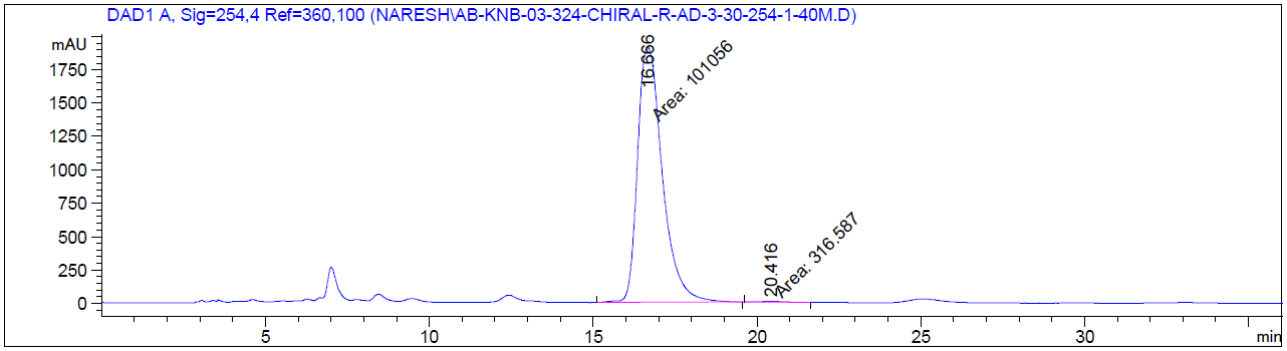
*** End of Report ***

HPLC data of compound (3*S*,3'*S*)-12



(3*S*,3'*S*)-**12**

Data File C:\CHEM32\1\DATA\NARESH\AB-KNB-03-324-CHIRAL-R-AD-3-30-254-1-40M.D
Sample Name: AB-KNB-03-324-Chiral-R-AD-3-30-254-1-40M



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

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.666	MM	0.8800	1.01056e5	1913.84778	99.6877
2	20.416	MM	0.7632	316.58658	6.91401	0.3123
Totals :				1.01372e5	1920.76179	

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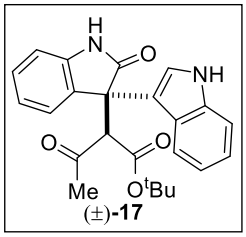
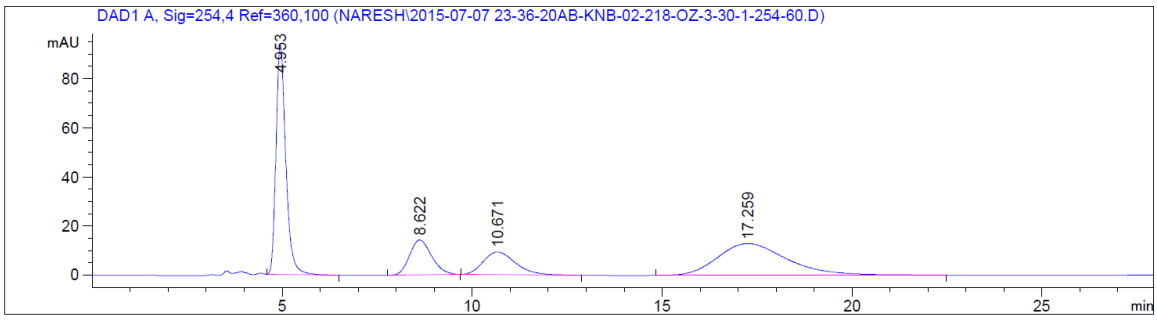
*** End of Report ***

HPLC data of compound (±)-17



Data File C:\CHEM32\1\DATA\NARESH\2015-07-07 23-36-20AB-KNB-02-218-OZ-3-30-1-254-60.D
Sample Name: AB-KNB-02-218-OZ-3-30-1-254-60



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

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.953	BB	0.2753	1677.64307	93.50455	37.6730
2	8.622	BB	0.6234	572.63696	14.23273	12.8591
3	10.671	BB	0.9090	548.16998	9.28238	12.3097
4	17.259	BB	1.8411	1654.72058	12.94718	37.1583
Totals :				4453.17059	129.96683	

==========

*** End of Report ***

HPLC data of compound (±)-17 under optimized condition

```
Data File C:\CHEM32\1\DATA\NARESH\2015-07-09 15-59-20AB-KNB-2-221-OZ-3-30-1-254-60.D
Sample Name: AB-KNB-2-221-OZ-3-30-1-254-60
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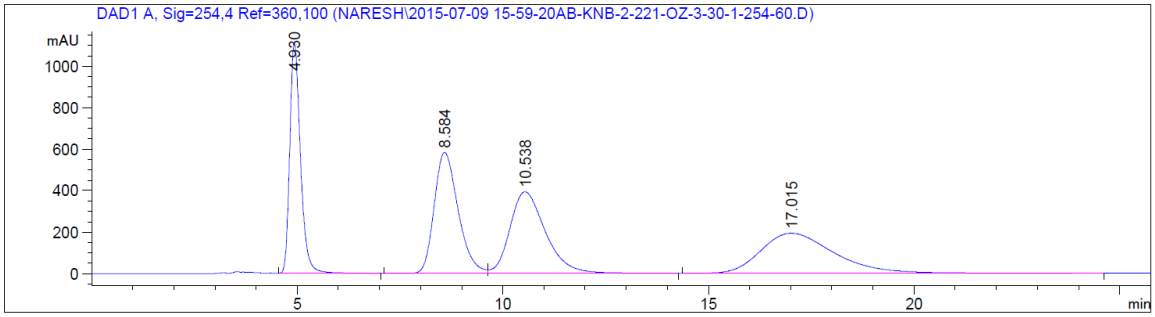


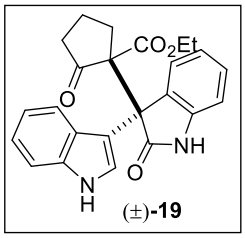
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.930	BB	0.2766	2.00435e4	1110.28333	21.9852
2	8.584	BV	0.6213	2.35663e4	583.36774	25.8492
3	10.538	VB	0.9167	2.35569e4	393.33795	25.8389
4	17.015	BB	1.8925	2.40015e4	193.31190	26.3266
Totals :				9.11682e4	2280.30092	

==========

*** End of Report ***

HPLC data of compound (±)-17



(±)-**19**

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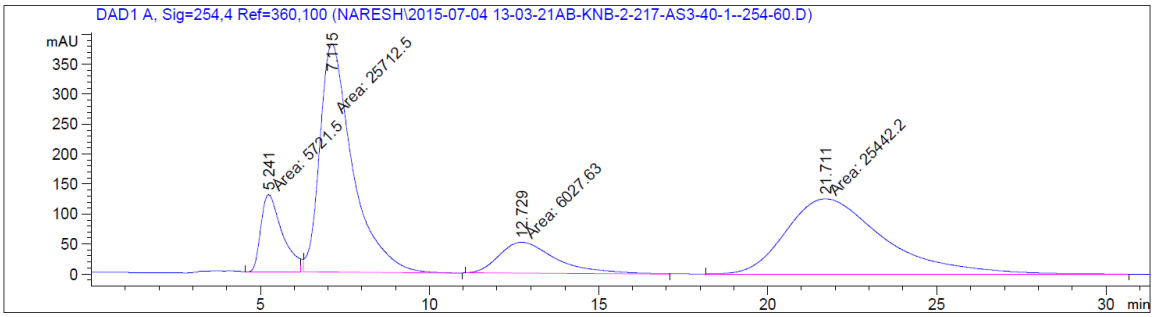
Data File C:\CHEM32\1\DATA\NARESH\2015-07-04 13-03-21AB-KNB-2-217-AS3-40-1--254-60.D
Sample Name: AB-KNB-2-217-AS3-40-1--254-60
```




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

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   5.241 MM    0.7369 5721.49902  129.40578   9.0956
   2   7.115 MM    1.1251 2.57125e4   380.90805  40.8758
   3  12.729 MM    1.9425 6027.63037   51.71767   9.5823
   4  21.711 MM    3.3720 2.54422e4   125.75417  40.4462

Totals :                 6.29038e4   687.78567

===================================================================
                        *** End of Report ***
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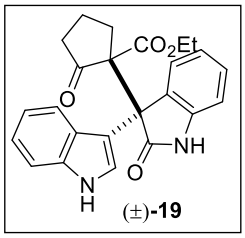
HPLC data of compound (±)-19 under optimized condition



(±)-**19**

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Data File C:\CHEM32\1\DATA\NARESH\2015-07-04 13-03-21AB-KNB-2-217-AS3-40-1--254-60.D
Sample Name: AB-KNB-2-217-AS3-40-1--254-60
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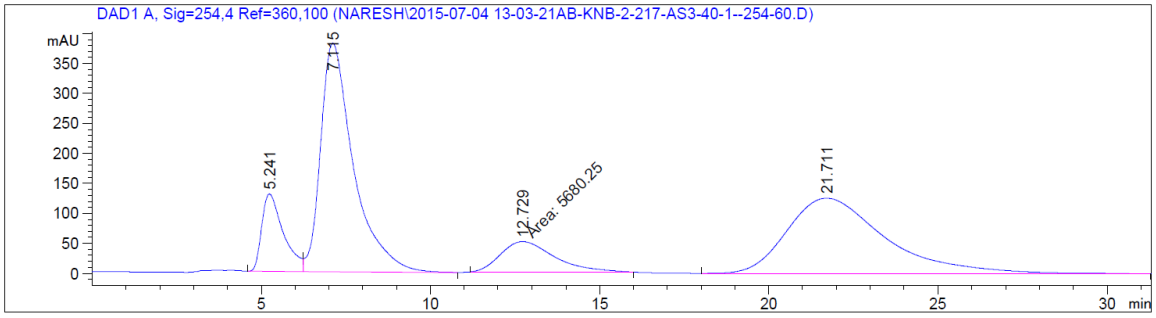
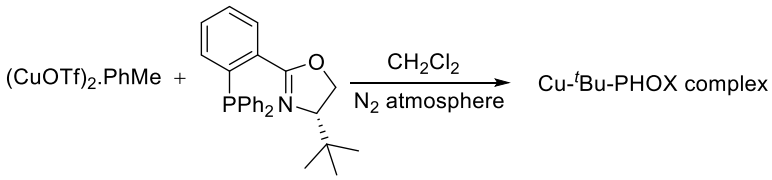


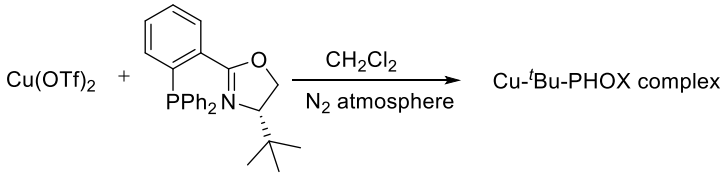

```
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   5.241 BV    0.6631 5746.32031  129.13928   9.2159
   2   7.115 VB    1.0013 2.57921e4   381.24588  41.3650
   3  12.729 MM    1.8627 5680.24561   50.82446   9.1099
   4  21.711 BBA   2.8471 2.51337e4   125.35922  40.3092

Totals :                  6.23524e4   686.56884

===================================================================
                        *** End of Report ***
```

Cu-^{t}Bu-PHOX preparation for EPR studies:

EPR experiment was performed with ^{t}Bu-PHOX under nitrogen atmosphere. The EPR tube was evacuated and backfilled with argon and then CH_2Cl_2 was added to the mixture. The reaction mixture was irradiated under light for 1-2 min, and then an EPR spectrum was recorded and did not show any EPR signal.

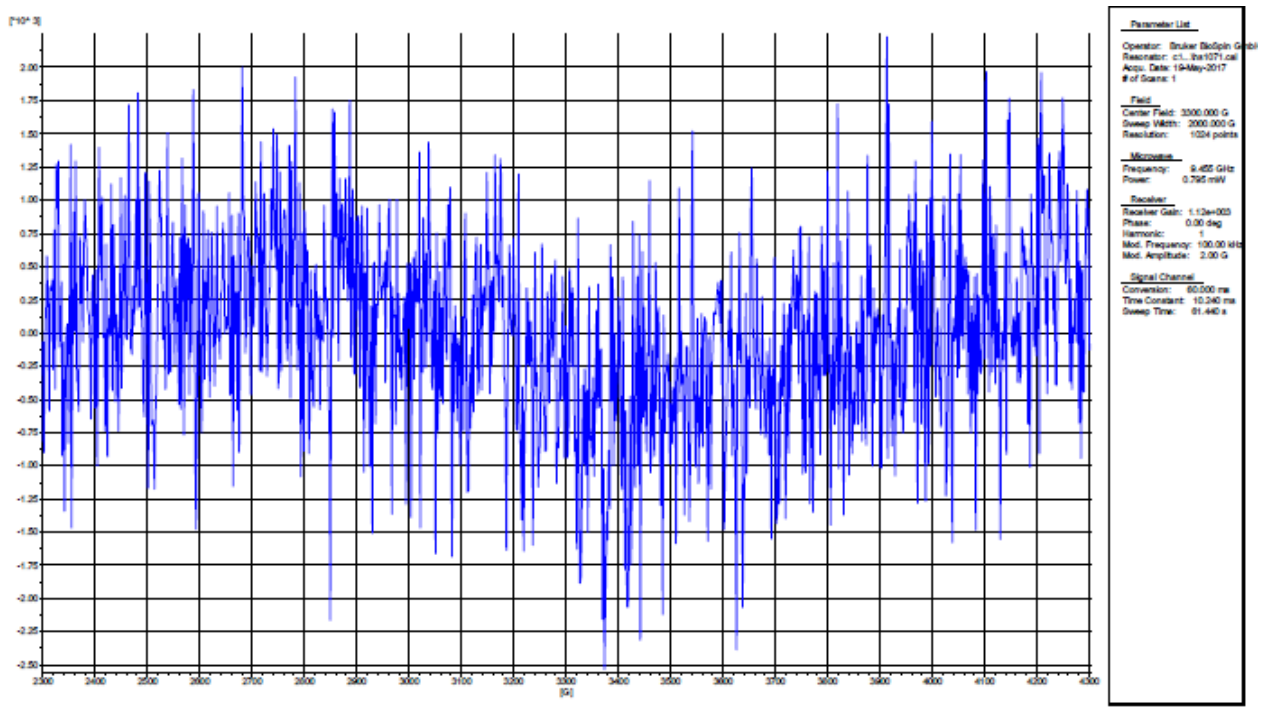


The reaction was performed using 0.007 mmol of ^{t}Bu-PHOX (**L4**) and 0.007 mmol of Cu(I)OTf.PhMe in an EPR tube under nitrogen atmosphere. The EPR tube was evacuated and backfilled with argon and then CH_2Cl_2 was added to the mixture. The reaction mixture was irradiated under light for 1-2 min and then an EPR spectrum was recorded and observed the EPR signal with a coupling constant (g = 2.1120) which indicates Cu(I) is converting to Cu(II) in the reaction course.

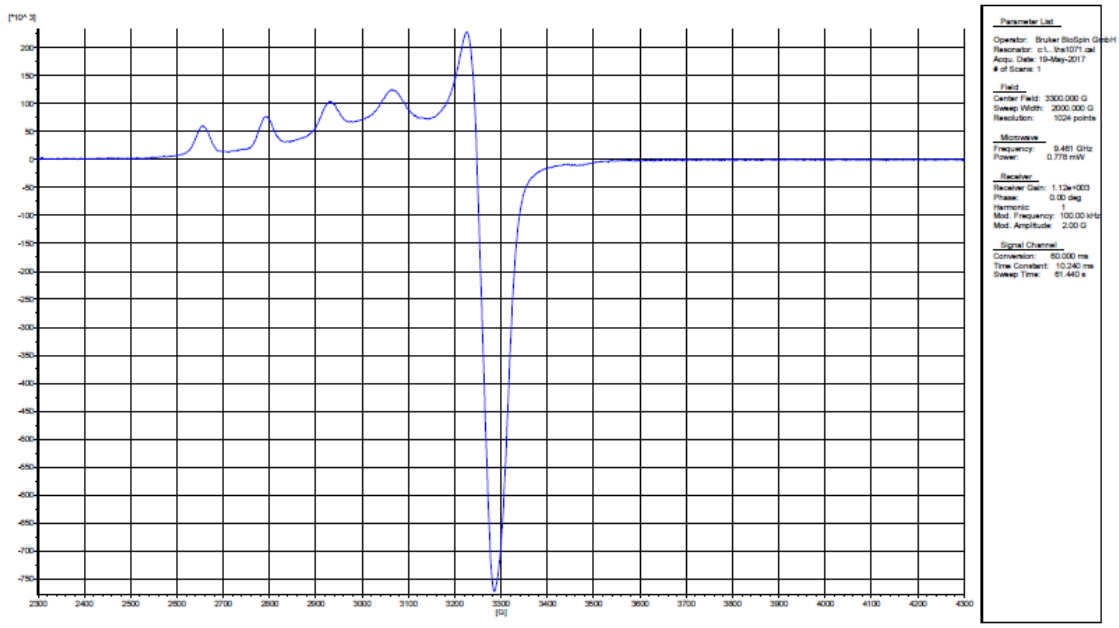


The reaction was performed using 0.034 mmol of ^{t}Bu-PHOX (**L4**) and 0.034 mmol of $Cu(OTf)_2$ in an EPR tube under nitrogen atmosphere. The EPR tube was evacuated and backfilled with argon and then CH_2Cl_2 was added to the mixture. The reaction mixture was irradiated under light for 1-2 min and then an EPR spectrum was recorded and observed the EPR signal with a coupling constant (g = 2.1062) which indicates the Cu(II) complex is the intermediate in the reaction course.

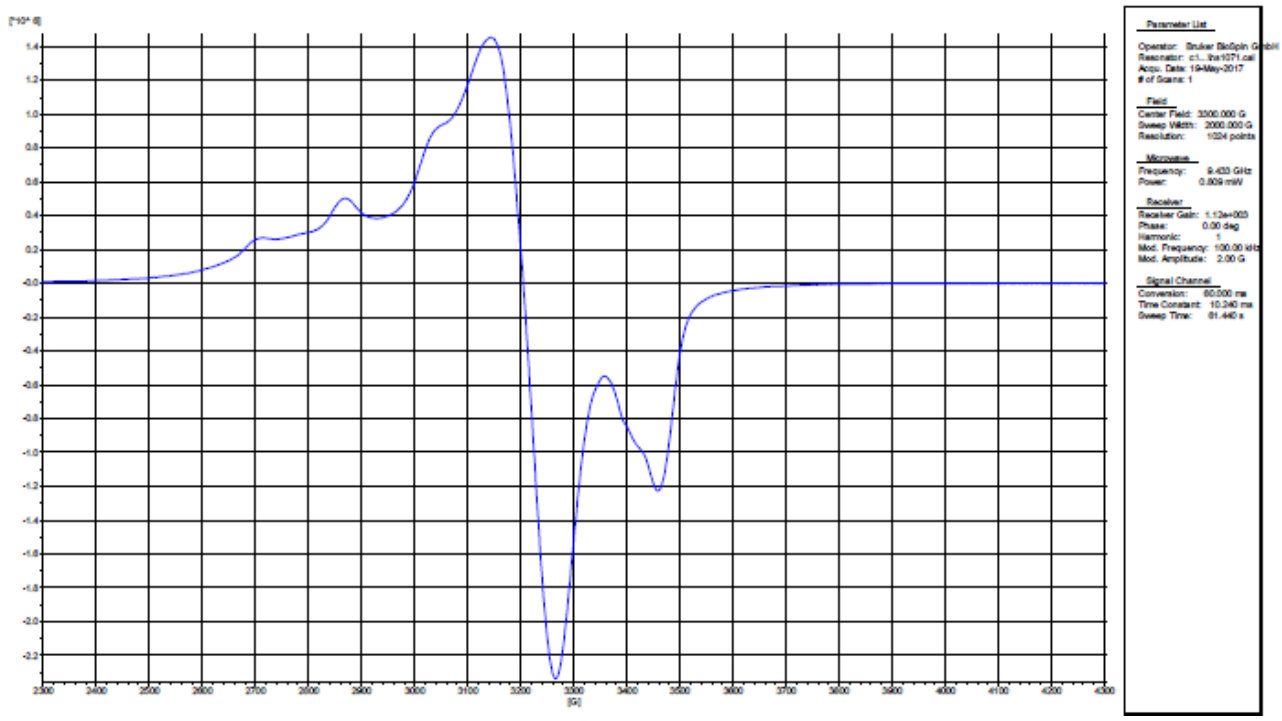
EPR studies of Cu-complex with ^{t}Bu-PHOX (L4)



X-band EPR spectra of ^{t}Bu-PHOX (**L4**) at 110K under nitrogen atmosphere (solid sample).



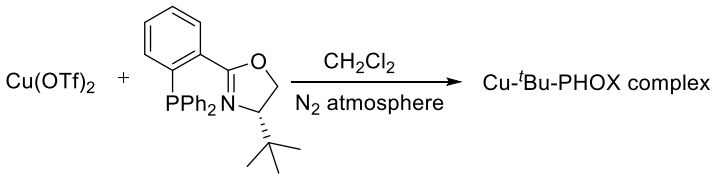
X-band EPR spectra of a complex of 1 equiv. of Cu(I)OTf.PhMe with 1 equiv. of ^{t}Bu-PHOX (**L4**) in dichloromethane at 110K under nitrogen atmosphere.



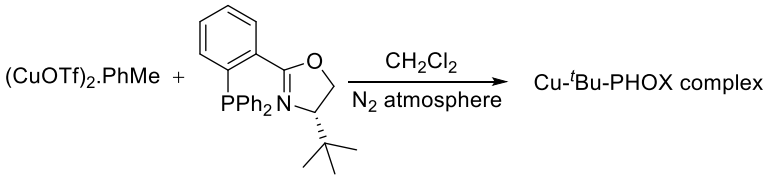
X-band EPR spectra of a complex of 1 equiv. of Cu(II)OTf with 1 equiv. of ^{t}Bu-PHOX (**L4**) in dichloromethane at 110K under nitrogen atmosphere.

Cu-^{t}Bu-PHOX preparation for ^{1}H-NMR and ^{31}P-NMR studies:

^{1}H-NMR of only ^{t}Bu-PHOX in $CDCl_3$ shows good spitting pattern of upfield protons.

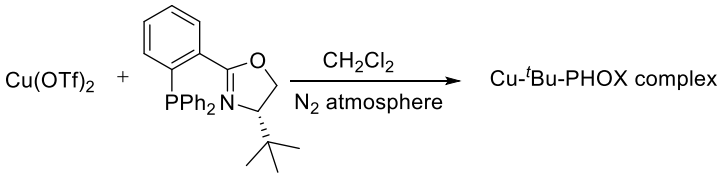


The reaction was performed using 0.034 mmol of ^{t}Bu-PHOX (**L4**) and 0.034 mmol of $Cu(OTf)_2$ in an NMR tube under nitrogen atmosphere in $CDCl_3$. The NMR spectrum was recorded and observed no NMR signal of the free ^{t}Bu-PHOX protons in the spectrum. This indicates that Cu(II) complex (paramagnetic species) is forming.

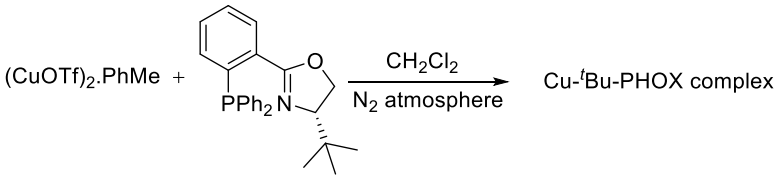


The reaction was performed using 0.034 mmol of ^{t}Bu-PHOX (**L4**) and 0.034 mmol of Cu(I)OTf.PhMe in an NMR tube under nitrogen atmosphere in $CDCl_3$. The NMR spectrum was recorded and observed the no NMR signal of the free ^{t}Bu-PHOX protons in the spectrum. This indicates that Cu(I) is converting to Cu(II) (paramagnetic species) complex.

^{31}P-NMR of only ^{t}Bu-PHOX in $CDCl_3$ shows ^{31}P signal at -5.96 ppm.

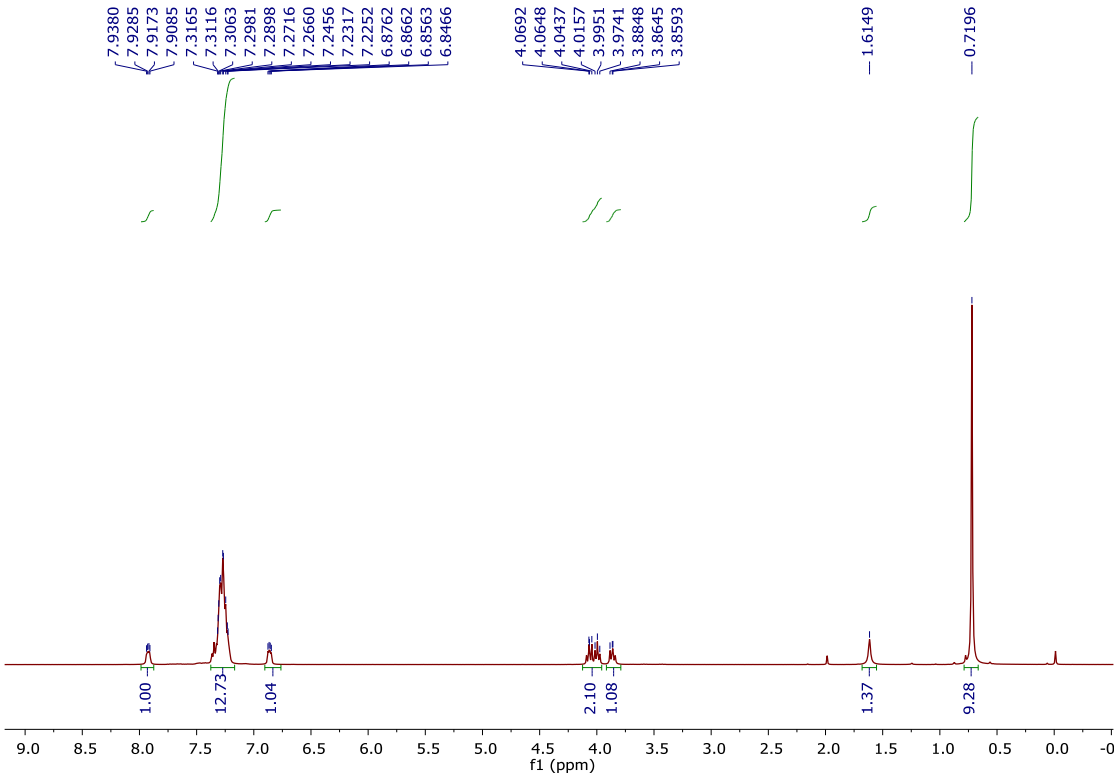


The reaction was performed using 0.034 mmol of ^{t}Bu-PHOX (**L4**) and 0.034 mmol of $Cu(OTf)_2$ in an NMR tube under nitrogen atmosphere in $CDCl_3$. The ^{31}P NMR spectrum was recorded and observed no ^{31}P signal of the ^{t}Bu-PHOX in the spectrum. This indicates that phosphorus atom is bound with Cu(II) complex.

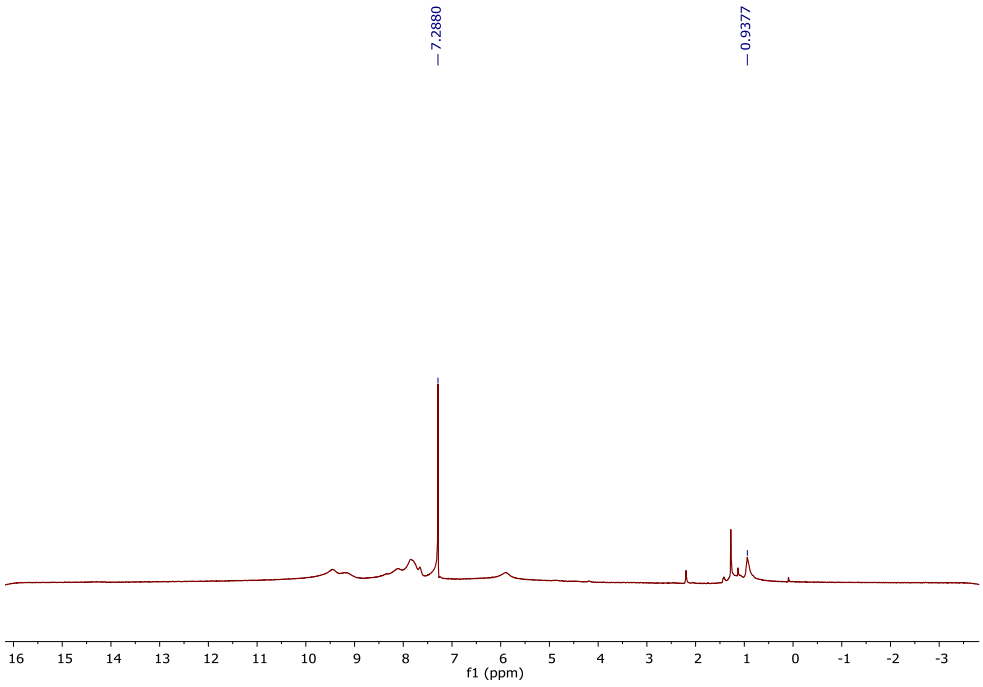


The reaction was performed using 0.034 mmol of ^{t}Bu-PHOX (**L4**) and 0.034 mmol of Cu(I)OTf.PhMe in an NMR tube under nitrogen atmosphere in $CDCl_3$. The ^{31}P NMR spectrum was recorded and observed no ^{31}P-signal of the ^{t}Bu-PHOX in the spectrum. This indicates that phosphorus atom is bound with Cu(II) complex, which is converted from Cu(I)OTf.PhMe.

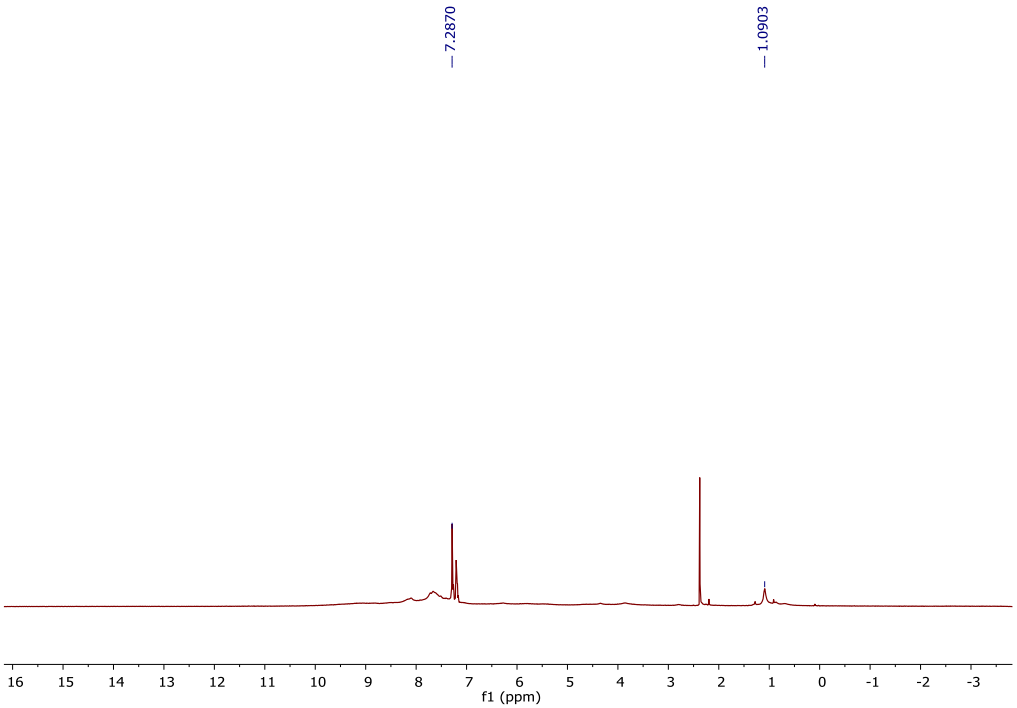
^{1}H-NMR and ^{31}P-NMR studies of Cu-complex with ^{t}Bu-PHOX (**L4**)



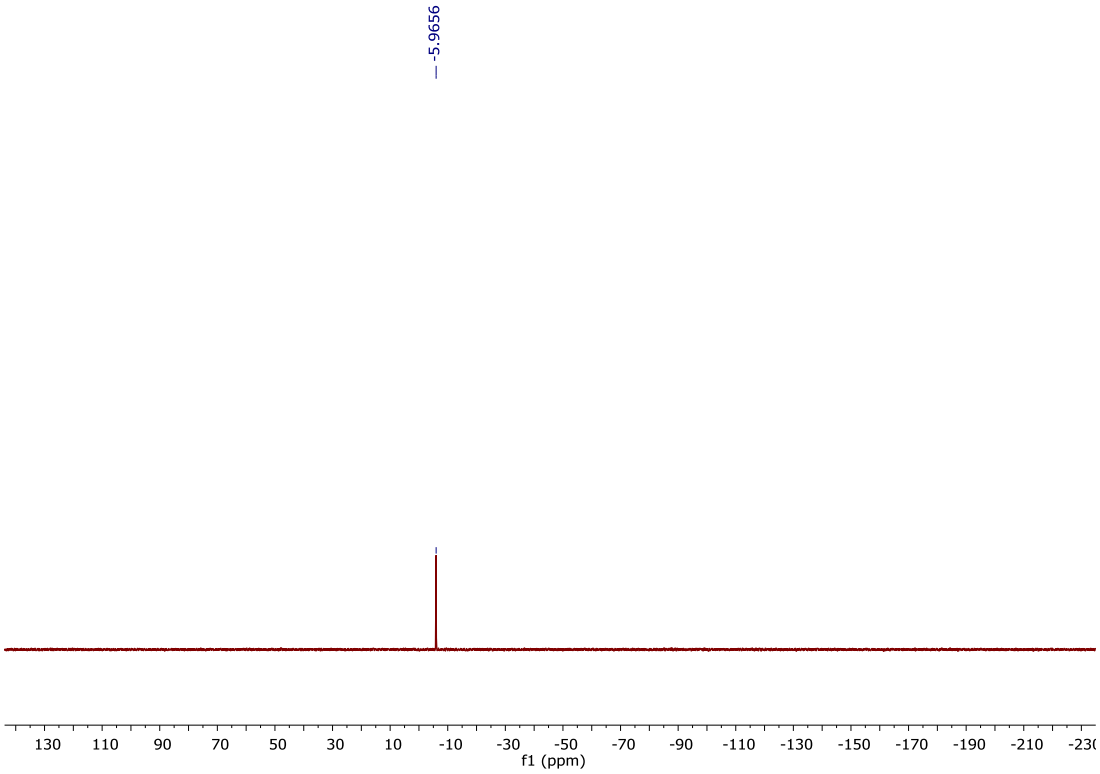
^{1}H-NMR of ^{t}Bu-PHOX (**L4**) (400 MHz, 0.4 mL $CDCl_3$)



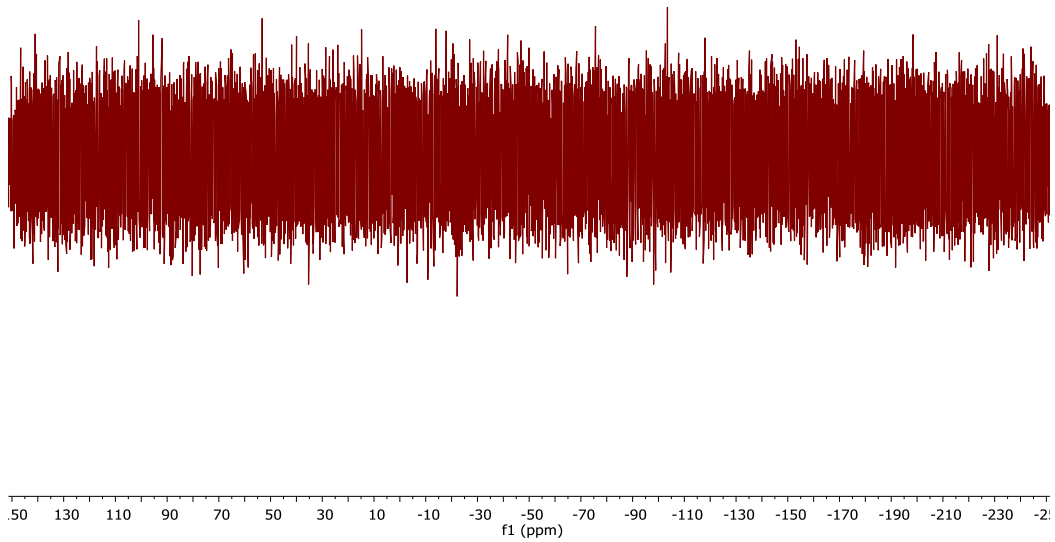
^{1}H-NMR of Cu(OTf)$_2$ + ^{t}Bu-PHOX (**L4**) (500 MHz, 0.4 mL $CDCl_3$), sample prepared under nitrogen atmosphere.



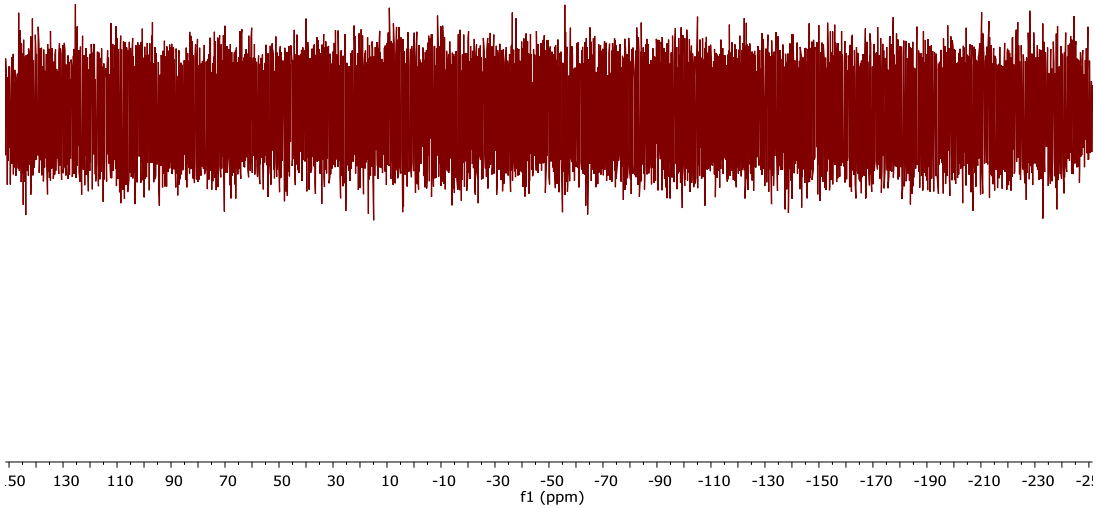
^{1}H-NMR of (CuOTf)$_2$ + ^{t}Bu-PHOX (**L4**) (500 MHz, 0.4 mL $CDCl_3$), sample prepared under nitrogen atmosphere.



^{31}P-NMR of ^{t}Bu-PHOX (**L4**) (400 MHz, 0.4 mL $CDCl_3$)



^{31}P-NMR of $Cu(OTf)_2$ + ^{t}Bu-PHOX (**L4**) (500 MHz, 0.4 mL $CDCl_3$), sample prepared under nitrogen atmosphere.

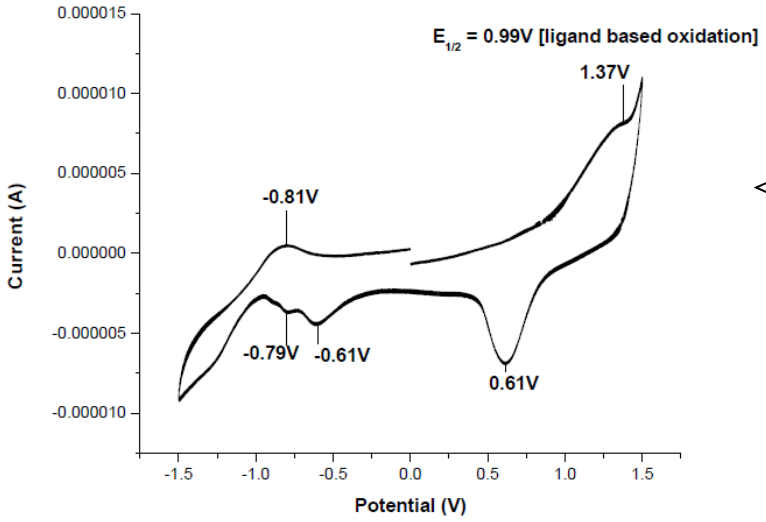


^{31}P-NMR of $(CuOTf)_2$ + ^{t}Bu-PHOX (**L4**) (500 MHz, 0.4 mL $CDCl_3$), sample prepared under nitrogen atmosphere.

Cu-^{i}Bu-PHOX (L2) preparation for Cyclic Voltagram studies:

Cyclic voltammetry (CV) were carried out by three electrode configuration with a glassy carbon (GC) working electrode, a platinum counter electrode, and standard calomel electrode (SCE) as reference electrode.

Reaction condition: Cu-^{i}Bu-PHOX complex crystals (5 mg) in 5 mL CH_2Cl_2 containing 1.0 M tetrabutylammonium hexafluorophosphate ($TBAPF_6$).



Cyclic voltammogram of the complex in CH_2Cl_2, potentials are *vs* SCE with Pt electrode using TBAP as supporting electrolyte.

Cyclic Voltagram of $Cu(OTf)_2$ + ^{i}Bu-PHOX (**L2**)

X-ray structure of $Cu(OTf)_2$ + ^{i}Bu-PHOX complex:

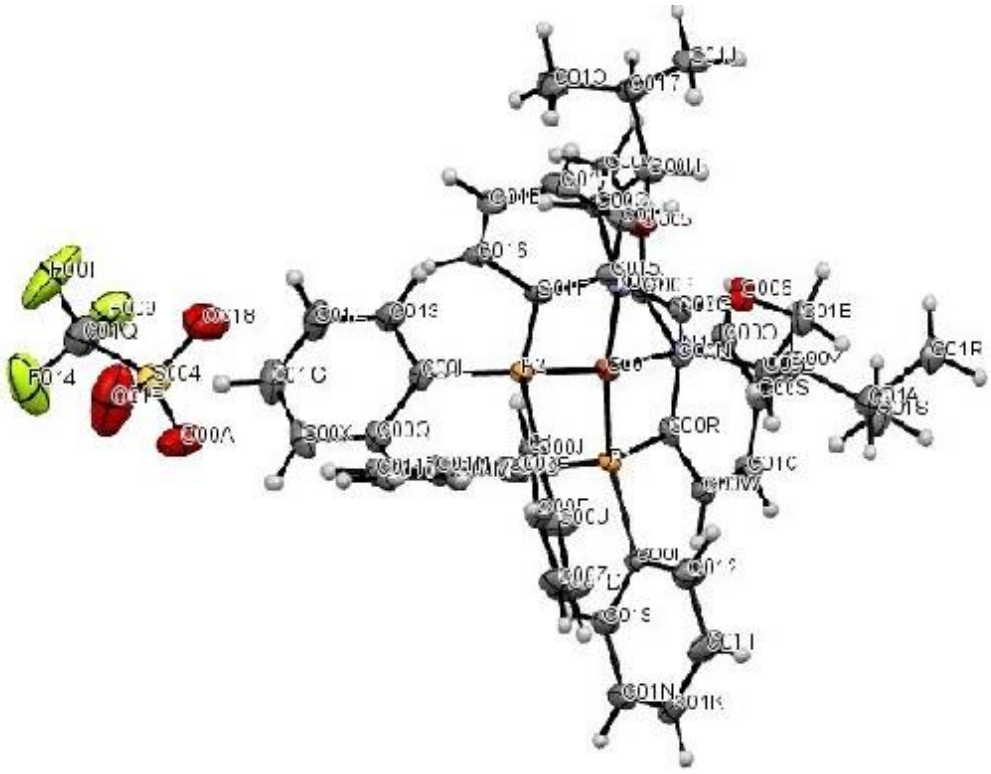


Figure: X-ray structure of $Cu(OTf)_2$ + ^{i}Bu-PHOX with 50% thermal ellipsoids.

checkCIF/PLATON report

You have not supplied any structure factors. As a result the full set of tests cannot be run.

THIS REPORT IS FOR GUIDANCE ONLY. IF USED AS PART OF A REVIEW PROCEDURE FOR PUBLICATION, IT SHOULD NOT REPLACE THE EXPERTISE OF AN EXPERIENCED CRYSTALLOGRAPHIC REFEREE.

No syntax errors found. CIF dictionary Interpreting this report

Datablock: M2_a

Bond precision: C-C = 0.0083 A Wavelength=0.71073

Cell: a=9.3999(9) b=22.436(2) c=11.7542(11)
alpha=90 beta=107.400(2) gamma=90
Temperature: 130 K

	Calculated	Reported
Volume	2365.5(4)	2365.4(4)
Space group	P 21	P 21
Hall group	P 2yb	P 2yb
Moiety formula	C50 H52 Cu N2 O2 P2, C F3 O3 S	?
Sum formula	C51 H52 Cu F3 N2 O5 P2 S	C50 H51 Cu F5 N3 O3 P2 S
Mr	987.50	994.47
Dx,g cm-3	1.386	1.396
Z	2	2
Mu (mm-1)	0.635	0.639
F000	1028.0	1032.0
F000'	1029.72	
h,k,lmax	12,29,15	12,29,15
Nref	11441[5865]	11406
Tmin,Tmax	0.912,0.944	
Tmin'	0.909	

Correction method= Not given

Data completeness= 1.94/1.00 Theta(max)= 28.000

R(reflections)= 0.0491(9001) wR2(reflections)= 0.1312(11406)

S = 0.830 Npar= 590

The following ALERTS were generated. Each ALERT has the format
test-name_ALERT_alert-type_alert-level.
Click on the hyperlinks for more details of the test.

Alert level B

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PLAT987_ALERT_1_B The Flack x is >> 0 -  Do a BASF/TWIN Refinement     Please Check
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Alert level C

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PLAT041_ALERT_1_C Calc. and Reported SumFormula    Strings  Differ     Please Check
PLAT043_ALERT_1_C Calculated and Reported Mol. Weight Differ by ..       6.97 Check
PLAT068_ALERT_1_C Reported F000 Differs from Calcd (or Missing)...     Please Check
PLAT220_ALERT_2_C Non-Solvent Resd 1   C   Ueq(max)/Ueq(min) Range       3.2 Ratio
PLAT244_ALERT_4_C Low    'Solvent' Ueq as Compared to Neighbors of       S004 Check
PLAT341_ALERT_3_C Low Bond Precision on  C-C Bonds ..............    0.00831 Ang.
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Alert level G

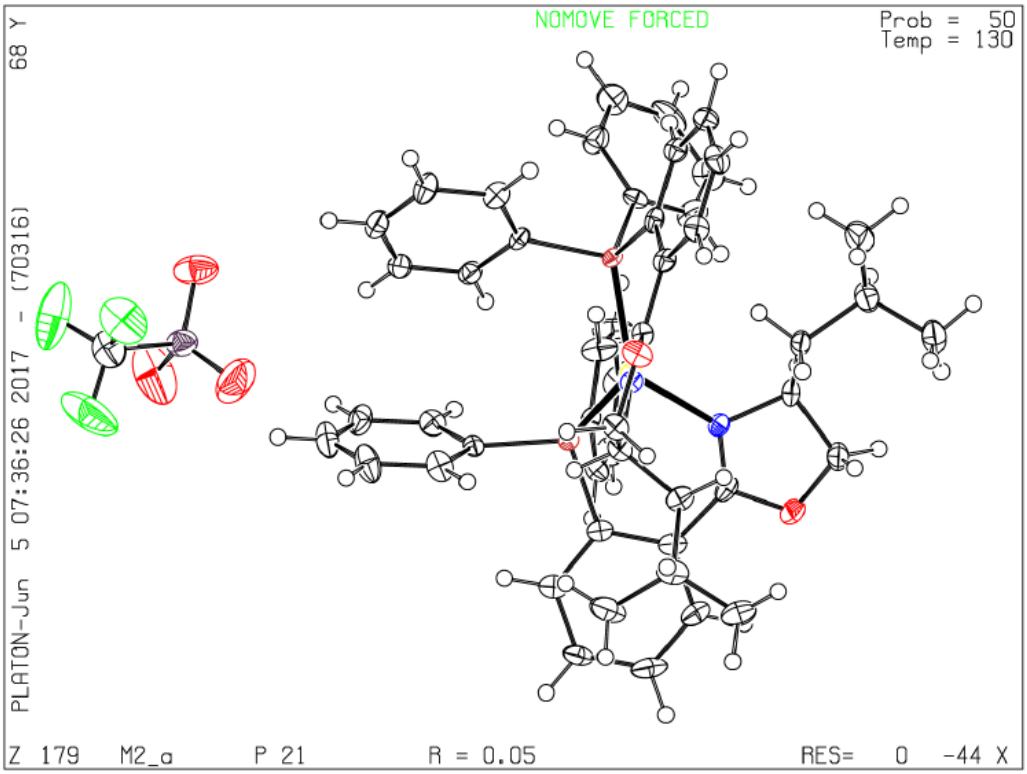
```
FORMU01_ALERT_2_G  There is a discrepancy between the atom counts in the
           _chemical_formula_sum and the formula from the _atom_site* data.
           Atom count from _chemical_formula_sum:C50 H51 Cu1 F5 N3 O3 P2 S1
           Atom count from the _atom_site data:  C51 H52 Cu1 F3 N2 O5 P2 S1
CELLZ01_ALERT_1_G Difference between formula and atom_site contents detected.
CELLZ01_ALERT_1_G ALERT: Large difference may be due to a
           symmetry error - see SYMMG tests
           From the CIF: _cell_formula_units_Z    2
           From the CIF: _chemical_formula_sum  C50 H51 Cu F5 N3 O3 P2 S
           TEST: Compare cell contents of formula and atom_site data

           atom    Z*formula  cif sites diff
           C        100.00    102.00   -2.00
           H        102.00    104.00   -2.00
           Cu         2.00      2.00    0.00
           F         10.00      6.00    4.00
           N          6.00      4.00    2.00
           O          6.00     10.00   -4.00
           P          4.00      4.00    0.00
           S          2.00      2.00    0.00
PLAT033_ALERT_4_G Flack x Value Deviates > 3.0 * sigma from Zero .      0.032 Note
PLAT244_ALERT_4_G Low    'Solvent' Ueq as Compared to Neighbors of       C01Q Check
PLAT398_ALERT_2_G Deviating  C-O-C  Angle from 120 Deg for O005         107.2 Degree
PLAT398_ALERT_2_G Deviating  C-O-C  Angle from 120 Deg for O006         105.6 Degree
PLAT720_ALERT_4_G Number of Unusual/Non-Standard Labels ..........        110 Note
PLAT791_ALERT_4_G The Model has Chirality at C00B    (Chiral SPGR)         S Verify
PLAT791_ALERT_4_G The Model has Chirality at C00C    (Chiral SPGR)         S Verify
```

```
   0 ALERT level A = Most likely a serious problem - resolve or explain
   1 ALERT level B = A potentially serious problem, consider carefully
   6 ALERT level C = Check. Ensure it is not caused by an omission or oversight
  10 ALERT level G = General information/check it is not something unexpected

   6 ALERT type 1 CIF construction/syntax error, inconsistent or missing data
   4 ALERT type 2 Indicator that the structure model may be wrong or deficient
   1 ALERT type 3 Indicator that the structure quality may be low
   6 ALERT type 4 Improvement, methodology, query or suggestion
   0 ALERT type 5 Informative message, check
```

Datablock M2_a - ellipsoid plot



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