Supporting Information

Enantioselective organocatalytic intramolecular Morita-Baylis-Hillman (IMBH) reaction of dienones, and elaboration of the IMBH adducts to fluorenones

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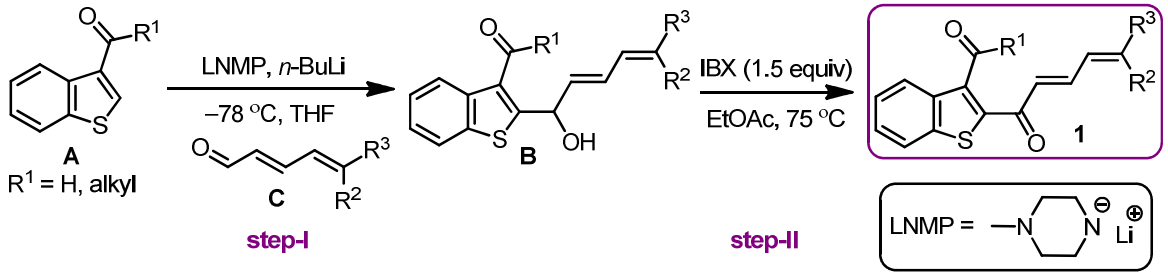
General experimental methods: All the starting compounds and catalysts employed in this study were procured from Sigma-Aldrich and were used without further purification. For thin layer chromatography (TLC), silica aluminium foils with fluorescent indicator 254 nm (from Aldrich) were used and compounds were visualised by irradiation with UV light and/or by treatment with a solution of *p*-anisaldehyde (23 mL), conc. H_2SO_4 (35 mL), and acetic acid (10 mL) in ethanol (900 mL) followed by heating. Column chromatography was performed using SD Fine silica gel 100-200 mesh (approximately 15–20 g per 1 g of the crude product). Dry THF was obtained by distillation over sodium and stored over sodium wire. IR spectra were recorded on a Perkin–Elmer FT IR spectrometer as thin films or KBr pellet, as indicated, with ν_{max} in inverse centimetres. Melting points were recorded on a digital melting point apparatus Stuart SMP30 and were uncorrected. ^{1}H NMR and ^{13}C NMR spectra were recorded on a 400 MHz Bruker Biospin Avance III FT-NMR spectrometer. NMR shifts are reported as delta (δ) units in parts per million (ppm) and coupling constants (*J*) are reported in Hertz (Hz). The following abbreviations are utilised to describe peak patterns when appropriate: br=broad, s=singlet, d=doublet, t=triplet, q=quartet and m=multiplet. Proton chemical shifts are given in δ relative to tetramethylsilane (δ 0.00 ppm) in $CDCl_3$ or in $(CD_3)_2SO$ (δ 2.50 ppm). Carbon chemical shifts are internally referenced to the deuterated solvent signals in $CDCl_3$ (δ 77.1 ppm) or in $(CD_3)_2SO$ (δ 39.5 ppm). Single crystal X-ray analysis was carried on a Bruker AXS KAPPA APEX II system or Rigaku XtaLAB mini X-ray diffractometer. High-resolution mass spectra were recorded on a Waters QTOF mass spectrometer. Optical rotations were recorded on Rudolph APIII/2W instrument. HPLC data was acquired from a Waters machine (model no 515).

General procedure-1: Synthesis of the dienones 1q and 1r.

The dienones **1q** and **1r** were synthesised as in the literature methods.[1] Directed α-alkylation of benzothiophene-3-carboxaldehydes **A** afforded the dienols **B** which upon IBX oxidation generated the dienones, Scheme 1S.



Scheme 1S. Synthesis of the dienones **1q** and **1r**.

Representative procedure for step-I (Scheme 1S): To a solution of *N*-methylpiperazine (NMP, 0.18 mL, 1.6 mmol) in THF (5 mL) at −78 °C was added *n*-BuLi (1.6 *M* in hexane, 1.0 mL, 1.6 mmol). After 15 min, benzothiophene-3-carboxaldehyde (200 mg, 1.2 mmol) was added and then the reaction mixture was stirred for an additional 30 min. A hexane solution of *n*-BuLi (2.0 mL, 3.2 mmol) was added and the mixture was stirred for an additional 15 min and then the mixture was warmed to –30 °C in 2 h. The solution was again cooled to −78 °C and a dienal **C** (1.5 mmol) was added drop wise over 5 min. The mixture was warmed to room temperature over 30 min. The reaction progress was monitored by TLC. Reaction mixture was quenched with saturated aqueous ammonium chloride solution and extracted with ethyl acetate. The organic extracts were combined, dried over anhydrous sodium sulphate and concentrated. The crude product was purified by silica gel column chromatography using hexane/ethyl acetate as eluent to afford dienol **B.**

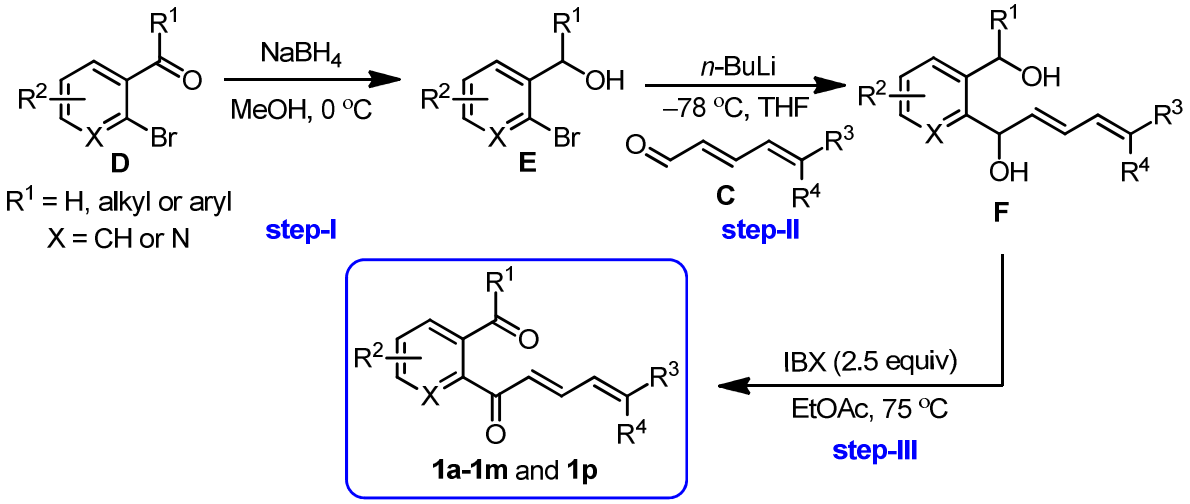
Representative procedure for step-II (Scheme 1S): Alcohol **B** (1 mmol) was dissolved in ethyl acetate (10 mL), and IBX (1.5 mmol) was added. The resulting suspension was immersed in an oil bath set to 75 °C and stirred until alcohol **B** disappeared as monitored by TLC. The reaction was cooled to room temperature and filtered through Buchner funnel. The filter cake was washed with 3× 2 mL of ethyl acetate. Organic extracts were combined and worked up using saturated sodium bicarbonate solution to remove excess iodobenzoic acid. The extract was dried over anhydrous sodium sulphate and concentrated under vacuum. The

[1] (a) S. Dhiman and S. S. V. Ramasastry, *Ind. J. Chem., Sect. A*, 2013, **52**, 1103; (b) R. P. Shirke and S. S. V. Ramasastry, *J. Org. Chem.,* 2015, **80**, 4893.

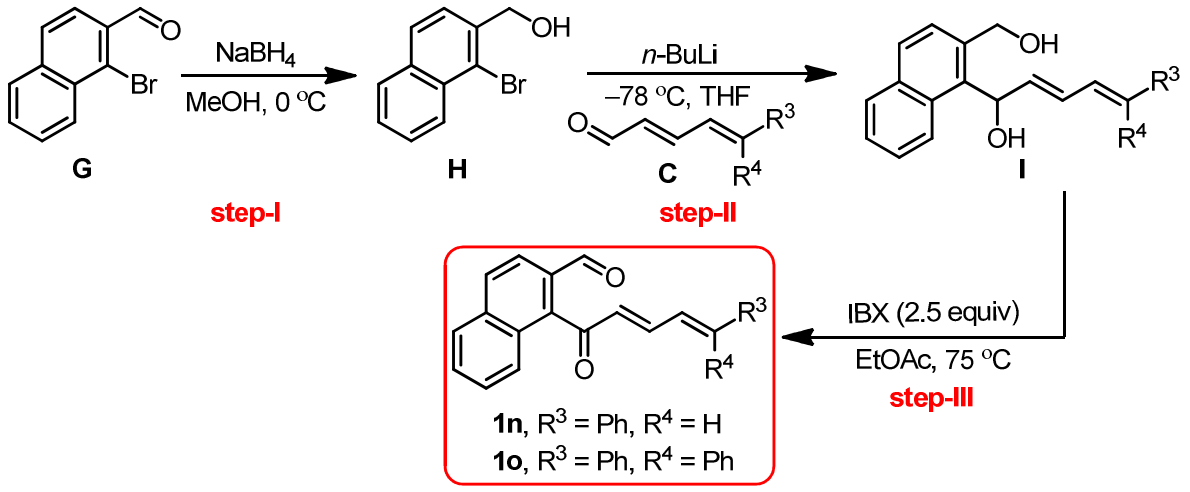
crude product was purified by silica gel column chromatography using hexane/ethyl acetate as eluent to afford the dienone **1**.

General procedure-2: Synthesis of the dienones 1a-1p, 1s and 1t.

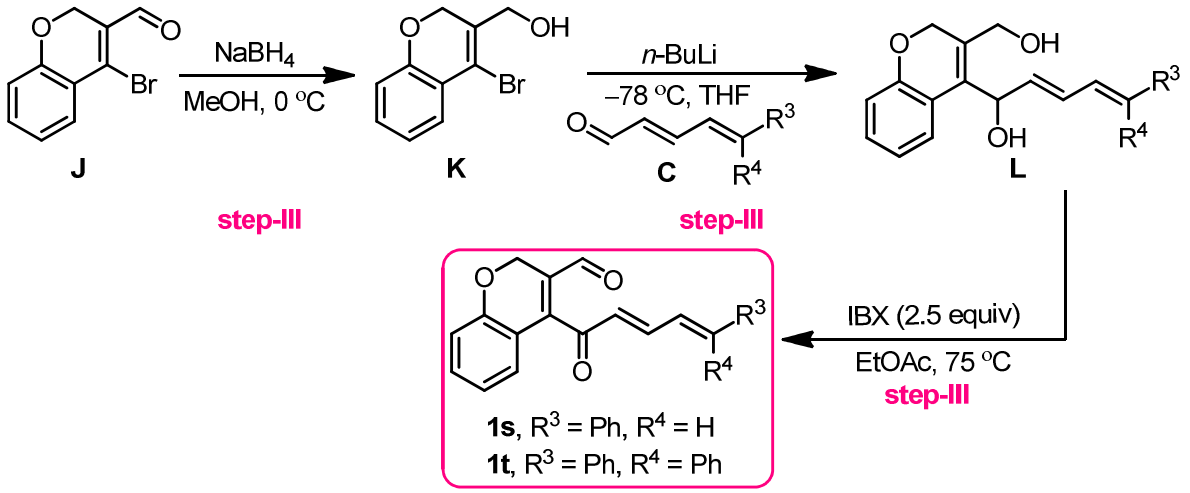
All these dienones were prepared as in Scheme 2S and 3S. For example, commercially available 2-bromobenzaldehydes **C** (when R^1 = H and X = CH) were converted to 2-bromo benzyl alcohols **E** via a straightforward sodium borohydride reduction. *n*-Butyllithium mediated metal-halogen exchange followed by alkylation with an appropriate dienal **C** generated the diols **F**. IBX oxidation of the diols **F** led to the formation of the dienone-aldehydes **1a-1m** and **1p**, Scheme 2S. Similarly, **1n** and **1o** were prepared as in Scheme 3S, and the dienones **1s** and **1t** were prepared as described in Scheme 4S.



Scheme 2S. Synthesis of the dienones **1a-1m** and **1p**.



Scheme 3S. Synthesis of the dienones **1n** and **1o.**



Scheme 4S. Synthesis of the dienones **1s** and **1t.**

Representative procedure for step-I (Scheme 2S): An oven dried 25 mL RB flask was charged with 2-bromo benzaldehyde **D** (2.0 mmol), 10 mL dry MeOH and placed at 0 °C. Sodium borohydride (2.1 mmol) was added portion wise under nitrogen atmosphere and stirred at room temperature until **D** disappeared (monitored by TLC) and quenched by saturated aqueous ammonium chloride. Methanol was removed under vacuum and extracted using ethyl acetate. Organic extracts were combined, dried over anhydrous sodium sulphate. Solvent was distilled off under reduced pressure to afford crude bromoalcohol **E** and proceeded to the next step without further purification.

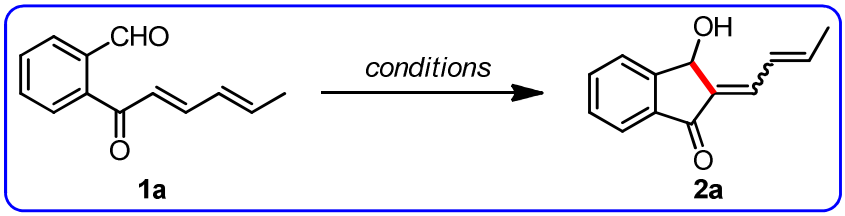
Representative procedure for step-II (Scheme 2S):[2] An oven dried 25 mL long neck RB flask was charged with bromoalcohol **E** (1.0 mmol), 5 mL dry THF and placed at –78 °C. *n*-BuLi (1.6 *M* in hexanes, 2.2 mmol) was added drop wise at same temperature and stirred for 2 hours. A dienal **C** (1.3 mmol) dissolved in 1 mL of dry THF, was added dropwise over 2 mins and stirred at room temperature for 30 mins. The reaction mixture was quenched with saturated aq. ammonium chloride solution and extracted using ethyl acetate. The organic extracts were combined, dried over anhydrous sodium sulphate and concentrated. The crude product was purified by silica gel column chromatography using hexanes/ethyl acetate as eluent to afford the diol **F**.

Representative procedure for step-III (Scheme 2S): The diol **F** were oxidised using IBX following the general procedure described for step II in Scheme 1S to afford dienones **1a-1p, 1s** and **1t**.

[2] S. R. Flanagan, D. C. Harrowven and M. Bradely, *Tetrahedron,* 2002, **58**, 5989.

General procedure-3: Screening of reaction parameters

An oven dried 5 mL glass vial was charged with **1a** (30 mg, 0.15 mmol). An appropriate solvent (1 mL) and a catalyst (0.015 mmol) were introduced at room temperature under nitrogen atmosphere and stirring continued at appropriate temperature until **1a** disappeared as monitored by TLC. All the volatiles were removed under reduced pressure. The crude product was directly purified by silica gel flash chromatography using hexane/ethyl acetate as eluent, to afford **2a** as a pale yellow solid.



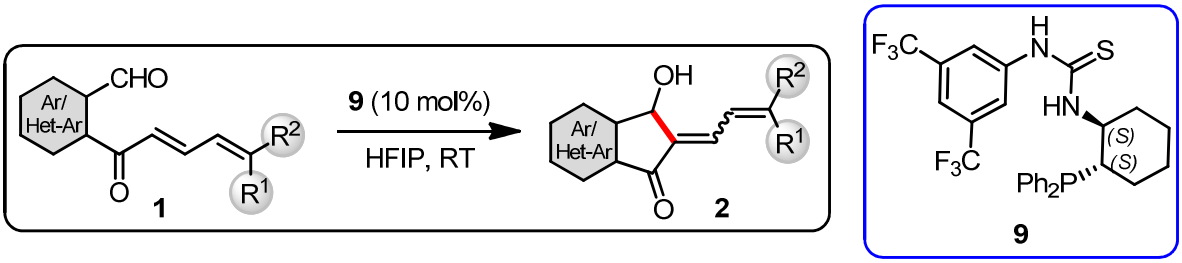
S.No	catalyst (10 mol%)	solvent	temp (°C)	time	% yield/(*E*/*Z*)
1	PPh_3	Toluene	50	48 h	no reaction
2	PCy_3	Toluene	rt	1 h	91 (4/1)
3	PCy_3	DCE	rt	1 h	90 (4/1)
4	**PMe_3**	**Toluene**	**rt**	**15 min**	**95 (3/1)**
5	PMe_3	DCM	rt	15 min	92 (3/1)
6[a]	DBU	DCM	rt	24 h	86 (5/1)
7[a]	DABCO	DCM	45	24 h	81 (3/1)
8	PPh_2Et	Toluene	rt	30 min	89 (4/1)
9	PPh_2Et	DCM	rt	30 min	88 (4/1)
10[a]	DMAP	Toluene	rt	24 h	85 (3/1)

[a]Yields are based on starting material recovery

General procedure-4: Evaluating the substrate scope (Table 1).

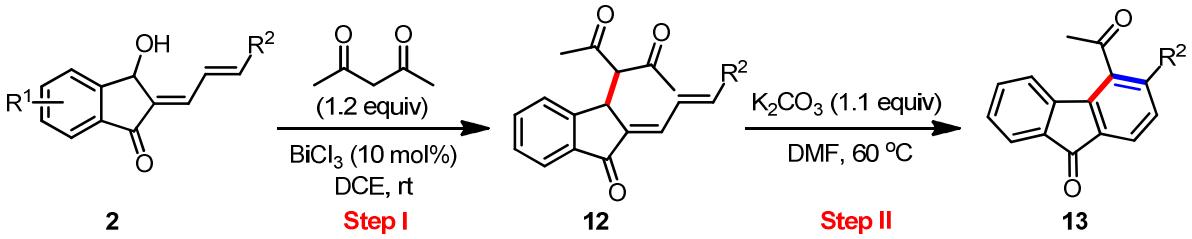
An oven dried 5 mL glass vial was charged with **1** (30 mg, 0.15 mmol). Toluene (1 mL) and PMe_3 (1 M solution in toluene, 0.1 mL, 0.015 mmol) were introduced at room temperature (rt) under nitrogen atmosphere and stirring continued at rt until **1** disappeared as monitored by TLC. All the volatiles were removed under reduced pressure. The crude product was purified by silica gel flash chromatography using hexane/ethyl acetate as eluent, to afford **2**.

General Procedure-5: Substrate scope with chiral catalyst (Table 2).



An oven dried 5 mL glass vial was charged with **1** (20 mg, 0.1 mmol) in 1,1,1,3,3,3-hexafluoroisopropanol (HFIP, 0.5 mL), catalyst **9** was introduced at room temperature (rt) under nitrogen atmosphere and stirring continued at rt until **1** disappeared as monitored by TLC. Volatiles were removed under reduced pressure. The crude product was purified by silica gel flash chromatography using hexane/ethyl acetate as eluent, to afford **2**.

General Procedure-6: Synthesis of 3-substituted-4-acetylated-9-fluorenones 13.



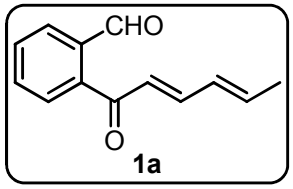
Scheme 5S: Synthesis of fluorenones (**13**).

Representative procedure for step-I (Scheme 5S):[1] An oven dried 5 mL glass vial was charged with **2** (30 mg, 0.15 mmol) and acetylacetone (20 mg, 0.2 mmol) in dichloroethane (DCE, 1 mL) and bismuth(III)chloride (10 mol %) was introduced at room temperature (rt). Stirring continued at RT until **2** disappeared as monitored by TLC. Reaction mixture was quenched with water and extracted using dichloromethane. Volatiles were removed under reduced pressure. The crude product **12** was subjected to next step without further purification.

Representative procedure for step-II (Scheme 5S): An oven dried 5 mL glass vial was charged with **12** (0.1 mmol) in dimethylformamide (DMF, 1 mL) and potassium carbonate (0.11 mmol) was introduced at room temperature (rt) and stirring continued at 60 °C until **12** disappeared as monitored by TLC. The crude reaction mixture was purified by silica gel flash chromatography using hexanes/ethyl acetate as eluent, to afford **13**.

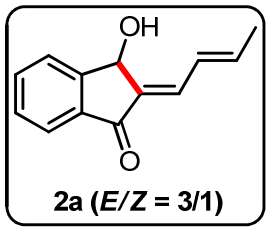
Spectroscopic data of the newly synthesised compounds during the present study

2-((2*E*,4*E*)-Hexa-2,4-dienoyl)benzaldehyde (1a).



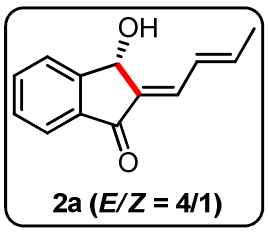
This compound was prepared by following the general procedure-2 and isolated as pale yellow oil. R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3447, 2910, 1701, 1663, 1586, 1199, 1002, 770. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.12 (s, 1H), 7.97-7.95 (m, 1H), 7.68-7.56 (m, 3H), 7.06 (dd, *J* = 15.3 and 10.8 Hz, 1H), 6.56 (d, *J* =15.3 Hz, 1H), 6.31-6.18 (m, 2H), 1.88 (d, *J* = 6.4 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 194.6, 191.2, 147.6, 142.6, 142.0, 135.4, 133.2, 130.7, 130.2, 129.2, 128.3, 127.3, 19.0. **HRMS (ESI):** *m/z* calcd for $C_{13}H_{13}O_2$ (M+H): 201.0916. Found: 201.0905.

(*E*)-2-((*E*)-But-2-en-1-ylidene)-3-hydroxy-2,3-dihydro-1*H*-inden-1-one (2a).



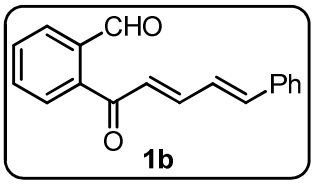
This compound was isolated as pale yellow solid. Following the general procedure-3, 30 mg of **1a** afforded 28.5 mg of **2a** (95% yield). M.P = 117-119 °C. R_f = 0.2 (Hexane/EtOAc = 5/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3382, 2910, 1687, 1632, 1030, 922, 754. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.76 (t, *J* = 7.6 Hz, 2H), 7.69 (dt, *J* = 7.6 and 1.2 Hz, 1H), 7.50-7.46 (m, 1H), 7.28-7.26 (m, 1H), 6.86-6.79 (m, 1H), 6.41 (sextet, 3.2 Hz, 1H), 5.73 (d, *J* = 9.6 Hz, 1H), 2.25 (d, *J* = 9.5 Hz, 1H), 2.00 (dd, *J*= 7.0 and 0.8 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 192.1, 151.0, 143.8, 138.0, 137.3, 136.3, 135.1, 129.6, 127.7, 125.9, 123.4, 69.0, 19.3. **HRMS (ESI):** *m/z* calcd for *m/z* calcd for $C_{13}H_{11}O$ (M-OH): 183.0810. Found: 183.0821.

(*S*)-2-((*E*)-But-2-en-1-ylidene)-3-hydroxy-2,3-dihydro-1*H*-inden-1-one (2a).



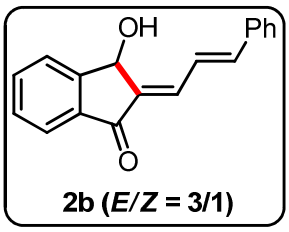
Following the general procedure-5, 25 mg of **1a** afforded 24 mg of **2a** (97% yield, *E/Z* = 4:1). **Optical rotation:** $[\alpha]^{23}_D$ +31.7 (*c* 0.20, $CHCl_3$) for a sample with *ee* 97%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralpak AS Column (92:8 *n*-Hexane/2-Propanol, 0.8 mL/min, 254 nm, τ_{major} = 34.4 min, τ_{minor} = 39.7 min).

2-((2*E*,4*E*)-5-Phenylpenta-2,4-dienoyl)benzaldehyde (1b).



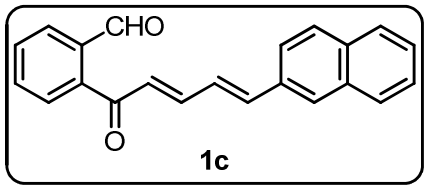
This compound was prepared by following the general procedure-2 and isolated as a pale yellow solid. M.P = 67-69 ^{o}C. R_f = 0.5 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3029, 2859, 1695, 1649, 1614, 1581, 1253, 1022, 775. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.18 (s, 1H), 8.02 (d, *J* = 7.2 Hz, 1H), 7.71-7.64 (m, 3H), 7.50 (d, *J* = 7.2 Hz, 2H), 7.41-7.35 (m, 3H), 7.31-7.25 (m, 1H), 7.01-6.99 (m, 2H), 6.80 (d, *J* = 7.3 Hz, 1H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 194.3, 191.2, 147.1, 143.0, 141.9, 135.7, 135.5, 133.2, 130.9, 129.6, 129.3, 129.1, 128.9(2C), 128.3, 127.4(2C), 126.4. **HRMS (ESI):** *m/z* calcd for $C_{18}H_{15}O_2$ (M+H): 263.1072 Found: 263.1081.

(*E*)-3-Hydroxy-2-((*E*)-3-phenylallylidene)-2,3-dihydro-1*H*-inden-1-one (2b).



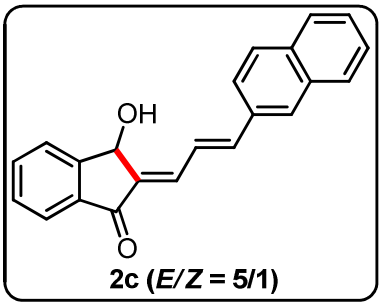
This compound was isolated as pale yellow solid. Following the general procedure-4, 50 mg of **1b** afforded 46 mg of **2b** (91% yield). M.P = 162-164 ^{o}C. R_f = 0.3 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3395, 3064, 1691, 1614, 1293, 976, 765. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.80-7.78 (m, 1H), 7.70-7.51 (m, 5H), 7.43-7.34 (m, 5H), 7.02 (dd, *J* = 15.2 and 3.2 Hz, 1H), 5.97 (d, *J* = 4.8 Hz, 1H), 2.86 (d, *J* = 4.9 Hz, 1H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 192.2, 151.2, 144.1, 138.3, 137.9, 137.3, 136.0, 135.2, 129.6, 129.5, 128.9(2C), 127.7(2C), 125.9, 124.0, 123.4, 69.1. **HRMS (ESI):** *m/z* calcd for $C_{18}H_{13}O$ (M-OH): 245.0966. Found: 245.0970.

2-((2*E*,4*E*)-5-(Naphthalen-2-yl)penta-2,4-dienoyl)benzaldehyde (1c).



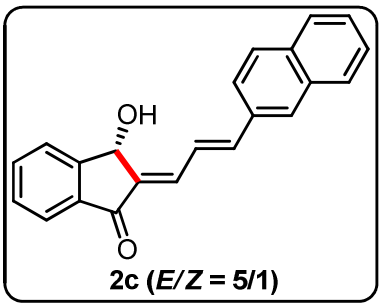
This compound was prepared by following the general procedure-2 and isolated as pale yellow solid. M.P = 107-109 ^{o}C. R_f = 0.4 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3056, 1695, 1650, 1579, 1326, 1274, 1022, 748. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.20 (s, 1H), 8.02 (d, *J* = 7.5 Hz, 1H), 7.85-7.83 (m, 4H), 7.72-7.65 (m, 4H), 7.53-7.50 (m, 2H), 7.36-7.33 (m, 1H), 7.13-7.12 (m, 2H), 6.83 (d, *J* = 15.2 Hz, 1H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 194.2, 191.3, 147.1, 143.1, 141.9, 135.6, 133.8, 133.4, 133.3, 133.2, 130.9, 129.4, 129.0, 128.8, 128.7, 128.43, 128.4, 127.8, 127.0, 126.8, 126.7, 123.3. **HRMS (ESI):** *m/z* calcd for $C_{22}H_{16}NaO_2$ (M+Na): 335.1048. Found: 335.1051.

(*E*)-3-Hydroxy-2-((*E*)-3-(naphthalen-2-yl)allylidene)-2,3-dihydro-1*H*-inden-1-one (2c).



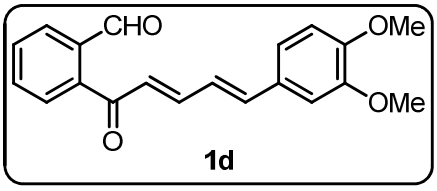
This compound was isolated as pale yellow solid. Following the general procedure-4, 30 mg of **1c** afforded 29 mg of **2c** (95% yield). M.P = 169-171 ^{o}C. R_f = 0.2 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3660, 2937, 1697, 1604, 1072, 1022, 746. **^{1}H NMR (400 MHz, $(CD_3)_2SO$):** δ 8.08 (s, 1H), 7.99-7.87 (m, 4H), 7.81-7.68 (m, 4H), 7.59-7.54 (m, 3H), 7.54-7.37 (m, 2H), 6.18 (d, *J* = 8.4 Hz, 1H), 5.85 (d, *J* = 8.4 Hz, 1H). **^{13}C NMR (100 MHz, $(CD_3)_2SO$):** δ 192.0, 152.9, 142.8, 140.6, 138.0, 135.6, 135.3, 134.3, 133.7, 133.5, 129.7, 129.0, 128.8, 128.7, 128.1, 127.4, 127.2, 126.9, 125.7, 124.1, 123.0, 67.7. **HRMS (ESI):** *m/z* calcd for $C_{22}H_{15}O$ (M-OH): 295.1123. Found: 295.1129.

(*S*)-3-Hydroxy-2-((*E*)-3-(naphthalen-2-yl)allylidene)-2,3-dihydro-1*H*-inden-1-one (2c).



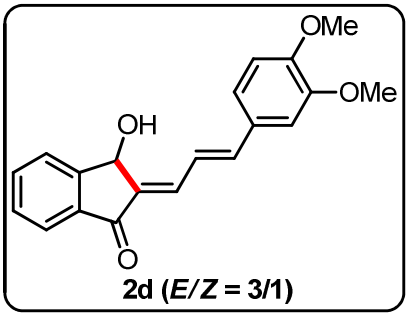
Following the general procedure-5, 20 mg of **1c** afforded 19.4 mg of **2c** (97% yield, *E/Z* = 5:1). **Optical rotation:** $[\alpha]^{23}_{D}$ +78.9 (*c* 0.08, DMSO) for a sample with *ee* 92%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralpak AS Column (88:12 *n*-Hexane/2-Propanol, 0.8 mL/min, 254 nm, τ_{major} = 22.1 min, τ_{minor} = 30.2 min).

2-((2*E*,4*E*)-5-(3,4-Dimethoxyphenyl)penta-2,4-dienoyl)benzaldehyde (1d).



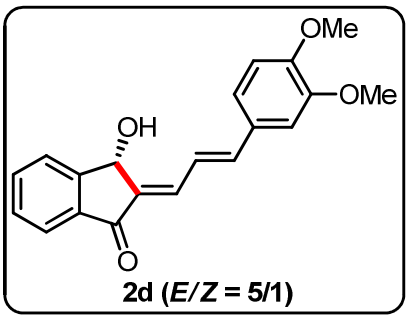
This compound was prepared by following the general procedure-2 and isolated as pale yellow oil. R_f = 0.4 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2956, 2925, 1712, 1654, 1463, 1378, 1267, 1023, 745. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.17 (s, 1H), 8.00 (d, *J* = 7.6 Hz, 1H), 7.68-7.62 (m, 3H), 7.30-7.23 (m, 1H), 7.05-7.02 (m, 2H), 6.90-6.85 (m, 3H), 6.75 (d, *J* = 14.9 Hz, 1H), 3.93 (s, 3H), 3.91 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 194.2, 191.2, 150.6, 149.2, 147.6, 143.2, 142.1, 135.4, 133.2, 130.8, 129.2, 128.8, 128.3, 128.0, 124.5, 121.8, 111.1, 109.1, 56.0, 55.9. **HRMS (ESI):** *m/z* calcd for $C_{20}H_{19}O_4$ (M+H): 323.1283. Found: 323.1290.

(*E*)-2-((*E*)-3-(3,4-dimethoxyphenyl)allylidene)-3-hydroxy-2,3-dihydro-1*H*-inden-1-one



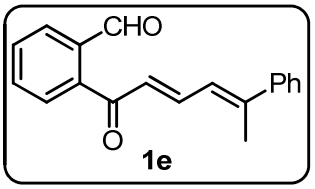
(2d). This compound was isolated as pale brown solid. Following the general procedure-4, 30 mg of **1d** afforded 27 mg of **2d** (90% yield). M.P = 144-146 ^{o}C. R_f = 0.2 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3456, 2932, 1694, 1608, 1517, 1269, 1023, 759. **^{1}H NMR (400 MHz, $(CD_3)_2SO$):** δ 7.77-7.76 (m, 2H), 7.72 (d, *J* = 7.6 Hz, 1H), 7.57-7.53 (m, 1H), 7.43 (dd, *J* = 15.4 and 12.1 Hz, 1H), 7.31-7.16 (m, 4H), 7.02 (d, *J* = 8.4 Hz, 1H), 6.11 (d, *J* = 8.0 Hz, 1H), 5.80 (d, *J* = 8.0 Hz, 1H), 3.85 (s, 3H), 3.81 (s, 3H). **^{13}C NMR (100 MHz, $(CD_3)_2SO$):** δ 191.9, 152.8, 150.7, 149.4, 143.4, 139.2, 138.1, 135.8, 135.4, 129.6, 129.5, 126.8, 123.0, 122.9, 122.2, 112.2, 110.1, 67.7, 56.0, 55.9. **HRMS (ESI):** *m/z* calcd for $C_{20}H_{17}O_3$ (M-OH): 305.1178. Found: 305.1180.

(*S*)-2-((*E*)-3-(3,4-dimethoxyphenyl)allylidene)-3-hydroxy-2,3-dihydro-1*H*-inden-1-one



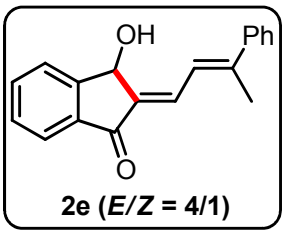
(2d). Following the general procedure-5, 20 mg of **1d** afforded 17.5 mg of **2d** (87% yield, *E/Z* = 5:1). **Optical rotation:** $[\alpha]^{23}_{D}$ +135.8 (*c* 0.18, $CHCl_3$) for a sample with *ee* 78%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralpak AD Column (85:15 *n*-Hexane/2-Propanol, 1.0 mL/min, 254 nm, τ_{major} = 20.3 min, τ_{minor} = 29.1 min).

2-((2*E*,4*E*)-5-Phenylhexa-2,4-dienoyl)benzaldehyde (1e).



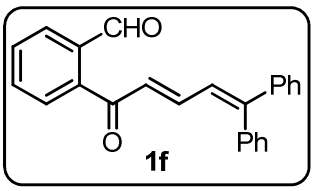
This compound was prepared by following the general procedure-2 and isolated as pale yellow oil. R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3379, 3058, 1695, 1651, 1578, 1445, 1291, 1022, 761. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.22 (s, 1H), 8.02 (d, *J* = 7.3 Hz, 1H), 7.74-7.66 (m, 3H), 7.55-7.53 (m, 2H), 7.42-7.35 (m, 4H), 6.82 (d, *J* = 15.4 Hz, 1H), 6.73 (d, *J* = 7.5 Hz, 1H), 2.30 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 193.9, 191.4, 148.7, 142.7, 142.2, 141.6, 135.7, 133.1, 131.0, 129.2, 128.8, 128.6(2C), 128.4, 128.3, 126.0(2C), 125.2, 16.8. **HRMS (ESI):** *m/z* calcd for $C_{19}H_{17}O_2$ $(M+H)^+$: 277.1229. Found: 277.1223.

(*E*)-3-Hydroxy-2-((*E*)-3-phenylbut-2-en-1-ylidene)-2,3-dihydro-1*H*-inden-1-one (2e).



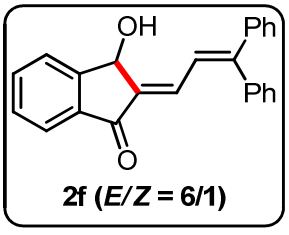
This compound was isolated as pale yellow solid. Following the general procedure-4, 25 mg of **1e** afforded 22 mg of **2e** (87% yield). M.P = 158-160 ^{o}C. R_f = 0.4 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3416, 3006, 1681, 1610, 1275, 749. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.80-7.75 (m, 1H), 7.70 (t, *J* = 7.2 Hz, 1H), 7.62-7.60 (m, 2H), 7.50-7.37 (m, 6H), 7.29-7.25 (m, 1H), 5.83 (s, 1H), 2.48 (br s, 1H), 2.39 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 192.2, 151.0, 149.9, 141.9, 138.2, 138.0, 135.2, 132.8, 129.6, 128.8, 128.5(2C), 126.2(2C), 125.9, 123.5, 122.4, 69.1, 16.5. **HRMS (ESI):** *m/z* calcd for $C_{19}H_{15}O$ (M-OH): 259.1123. Found: 259.1136.

(*E*)-2-(5,5-Diphenylpenta-2,4-dienoyl)benzaldehyde (1f).



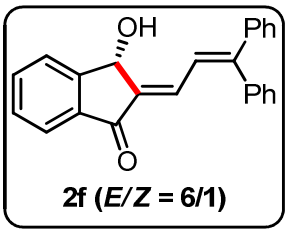
This compound was prepared by following the general procedure-2 and isolated as pale yellow oil. R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3378, 3057, 2854, 1696, 1647, 1577, 1445, 1278, 1023, 772, 700. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.15 (s, 1H), 7.95-7.93 (m, 1H), 7.64-7.58 (m, 2H), 7.40-7.17 (m, 12H), 6.93 (d, *J* = 11.2 Hz, 1H), 6.85 (dd, *J* = 15.2 and 0.6 Hz, 1H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 194.1, 191.2, 153.8, 145.1, 142.0, 141.0, 138.2, 135.5, 133.1, 130.8, 130.4(2C), 129.6, 129.2, 129.1, 128.6, 128.5(2C), 128.4(2C), 128.3(2C), 125.5. **HRMS (ESI):** *m/z* calcd for $C_{24}H_{19}O_2$ (M+H): 339.1385. Found: 339.1392.

(*E*)-2-(3,3-Diphenylallylidene)-3-hydroxy-2,3-dihydro-1*H*-inden-1-one (2f).



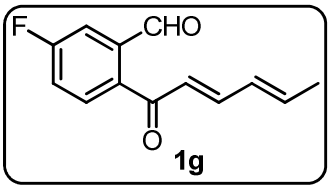
This compound was isolated as pale yellow solid. Following the general procedure-4, 30 mg of **1f** afforded 28 mg of **2f** (93% yield). M.P = 162-164 ^{o}C. R_f = 0.3 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3395, 3056, 1681, 1610, 1275, 749. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.80 (d, *J* = 6.5 Hz, 2H), 7.70-7.66 (m, 1H), 7.50-7.34 (m, 11H), 7.28-7.25 (m, 2H), 5.88 (d, *J* = 7.2 Hz, 1H), 2.39 (d, *J* = 7.1 Hz, 1H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 191.7, 154.2, 150.8, 141.5, 139.2, 138.3, 138.2, 135.1, 134.5, 130.6(2C), 129.6, 129.1, 128.6, 128.5(2C), 128.4(2C), 128.3 (2C), 125.9, 123.5, 122.9, 69.2. **HRMS (ESI):** *m/z* calcd for $C_{24}H_{17}O$ (M-OH): 321.1279. Found: 321.1283.

(*S*)-2-(3,3-Diphenylallylidene)-3-hydroxy-2,3-dihydro-1*H*-inden-1-one (2f).



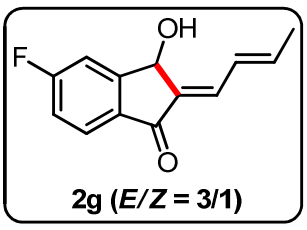
Following the general procedure-5, 25 mg of **1f** afforded 23 mg of **2f** (92% yield, *E/Z* = 6:1). **Optical rotation:** $[\alpha]^{23}_{D}$ +20.5 (*c* 0.05, $CHCl_3$) for a sample with *ee* 97%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralpak AS Column (90:10 *n*-Hexane/2-Propanol, 1.0 mL/min, 254 nm, τ_{major} = 44.5 min, τ_{minor} = 20.7 min).

5-Fluoro-2-((2*E*,4*E*)-hexa-2,4-dienoyl)benzaldehyde (1g).



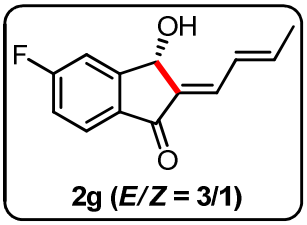
This compound was prepared by following the general procedure-2 and isolated as a pale yellow solid. M.P = 100-102 ^{o}C. R_f = 0.4 (Hexane/EtOAc = 5/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2956, 1691, 1658, 1588, 1341, 1257, 1000, 836. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.14 (d, *J* = 2.8 Hz, 1H), 7.70-7.65 (m, 2H0, 7.35 (dt, *J* = 8.1 and 2.6 Hz, 1H), 7.20-7.13 (m, 1H), 6.61 (d, *J* = 15.2 Hz, 1H), 6.34-6.29 (m, 2H), 1.93 (d, *J* = 6.0 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 192.5, 189.9, 163.2 (d, *J* = 260.3 Hz), 147.9, 143.1, 138.5 (d, *J* = 6.2 Hz), 138.1 (d, *J* = 3.7 Hz), 131.0 (d, *J* = 8.2 Hz), 130.2, 126.4, 119.8 (d, *J* = 22.1 Hz), 115.5 (d, *J* = 23.0 Hz), 19.0. **^{19}F NMR (376 MHz, $CDCl_3$):** δ -106.7. **HRMS (ESI):** *m/z* calcd for $C_{13}H_{12}FO_2$ (M+H): 219.0821. Found: 219.0821.

(*E*)-2-((*E*)-But-2-en-1-ylidene)-5-fluoro-3-hydroxy-2,3-dihydro-1*H*-inden-1-one (2g).



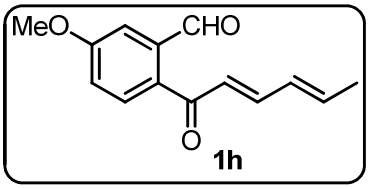
This compound was isolated as pale yellow solid. Following the general procedure-4, 30 mg of **1g** afforded 29 mg of **2g** (97% yield). M.P = 159-161 ^{o}C. R_f = 0.3 (Hexane/EtOAc = 5/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3442, 2927, 1703, 1634, 1266, 1015, 750. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.75-7.72 (m, 1H), 7.42 (dd, *J* = 8.1 and 1.9 Hz, 1H), 7.24 (dd, *J* = 11.2 and 2.4 Hz, 1H), 7.18-7.13 (m, 1H), 6.84-6.77 (m, 1H), 6.40 (sextet, *J* = 3.2 Hz, 1H), 5.60 (s, 1H), 2.42 (br s, 1H), 2.01 (dd, *J* = 6.8 and 1.2 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 190.6, 163.3 (d, *J* = 253.1 Hz), 144.3, 137.5, 135.9, 134.2, 127.5, 125.8 (d, *J* = 10.3 Hz), 117.6 (d, *J* = 32.0 Hz), 117.5, 112.8 (d, *J* = 25.3 Hz), 68.7, 19.4. **^{19}F NMR (376 MHz, $CDCl_3$):** δ -101.1. **HRMS (ESI):** *m/z* calcd for $C_{13}H_{10}FO$ (M-OH): 201.0716. Found: 201.0722.

(*S*)-2-((*E*)-But-2-en-1-ylidene)-5-fluoro-3-hydroxy-2,3-dihydro-1*H*-inden-1-one (2g).



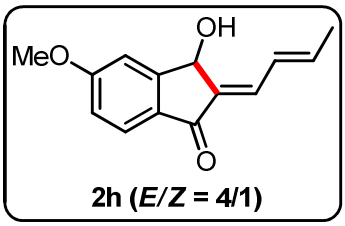
Following the general procedure-5, 20 mg of **1g** afforded 18.5 mg of **2g** (93% yield, *E/Z* = 3:1). **Optical rotation:** $[\alpha]^{23}_{D}$ +69.1 (*c* 0.12, $CHCl_3$) for a sample with *ee* 99%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralpak IC Column (95:5 *n*-Hexane/2-Propanol, 1.0 mL/min, 254 nm, τ_{major} = 39.5 min, τ_{minor} = 27.7 min).

2-((2*E*,4*E*)-Hexa-2,4-dienoyl)-5-methoxybenzaldehyde (1h).



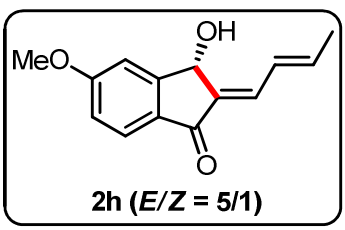
This compound was prepared by following the general procedure-2 and isolated as pale yellow solid. M.P = 82-85 ^{o}C. R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3440, 2938, 1693, 1653, 1596, 1260, 1015, 750. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.20 (s, 1H), 7.67 (d, *J* = 8.5 Hz, 1H), 7.45 (d, *J* = 2.4 Hz, 1H), 7.25-7.12 (m, 2H), 6.65 (d, *J* = 15.2 Hz, 1H), 6.33-6.27 (m, 2H), 3.92 (s, 3H), 1.91 (d, *J* = 6.0 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 192.2, 191.6, 161.8, 146.7, 142.2, 138.6, 134.3, 130.8, 130.3, 126.1, 118.9, 112.3, 55.7, 18.9. **HRMS (ESI):** *m/z* calcd for $C_{14}H_{14}NaO_3$ (M+Na): 253.0841. Found: 253.0836.

(*E*)-2-((*E*)-But-2-en-1-ylidene)-3-hydroxy-5-methoxy-2,3-dihydro-1*H*-inden-1-one (2h).



This compound was isolated as pale yellow solid. Following the general procedure-4, 30 mg of **1h** afforded 27.6 mg of **2h** (92% yield). M.P = 129-131 ^{o}C. R_f = 0.2 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3374, 2926, 1681, 1631, 1597, 1290, 1018, 759. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.69-7.67 (m, 1H), 7.21-7.18 (m, 2H), 6.99-6.97 (m, 1H), 6.83-6.76 (m, 1H), 6.38-6.33 (m, 1H), 5.65 (s, 1H), 3.94 (s, 3H), 2.46 (br s, 1H), 1.98 (dd, *J* = 6.8 and 1.2 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 190.8, 165.5, 154.1, 143.0, 136.7, 136.2, 131.3, 127.6, 125.3, 117.5, 108.9, 68.9, 55.8, 19.3. **HRMS (ESI):** *m/z* calcd for $C_{14}H_{15}O_3$ (M+H): 231.1021. Found: 231.1009.

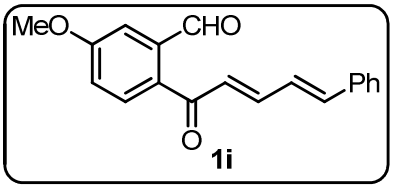
(*S*)-2-((*E*)-But-2-en-1-ylidene)-3-hydroxy-5-methoxy-2,3-dihydro-1*H*-inden-1-one (2h).



Following the general procedure-5, 25 mg of **1h** afforded 23.5 mg of **2h** (94% yield, *E/Z* = 5:1). **Optical rotation:** $[\alpha]^{23}_{D}$ -2.7 (*c* 0.14, $CHCl_3$) for a sample with *ee* 94%. The enantiomeric excess was determined by HPLC analysis using Daicel

Chiralpak AS Column (90:10 *n*-Hexane/2-Propanol, 0.8 mL/min, 254 nm, τ_{major} = 18.2 min, τ_{minor} = 16.2 min).

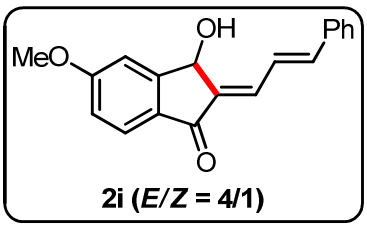
5-Methoxy-2-((2*E*,4*E*)-5-phenylpenta-2,4-dienoyl)benzaldehyde (1i).



1i

This compound was prepared by following the general procedure-2 and isolated as pale brown oil. R_f = 0.4 (Hexane/EtOAc = 4/1). IR (thin film, neat): ν_{max}/cm^{-1} 3027, 1692, 1653, 1596, 1579, 1350, 1237, 1016, 736. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.25 (s, 1H), 7.73 (d, *J* = 8.4 Hz, 1H), 7.51-7.34 (m, 7H), 7.16 (dd, *J* = 8.4 and 2.7 Hz, 1H), 7.02 (d, *J* = 4.8 Hz, 1H), 7.00 (s, 1H), 6.89 (d, *J* = 15.2 Hz, 1H), 3.93 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 191.6, 162.0, 146.2, 142.7, 138.9, 138.8, 135.8, 134.2, 130.9, 129.5, 128.9(2C), 127.9, 127.4(2C), 126.5, 118.9, 112.5, 55.8. **HRMS (ESI):** *m/z* calcd for $C_{19}H_{17}O_3$ (M+H): 293.1178. Found: 293.1178.

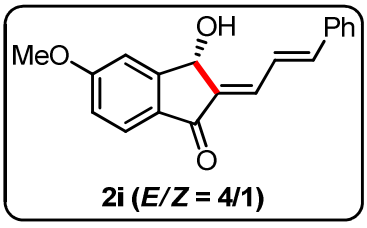
(*E*)-3-Hydroxy-5-methoxy-2-((*E*)-3-phenylallylidene)-2,3-dihydro-1*H*-inden-1-one (2i).



2i (*E*/*Z* = 4/1)

This compound was isolated as pale yellow solid. Following the general procedure-4, 30 mg of **1i** afforded 27 mg of **2i** (90% yield). M.P = 170-172 ^oC. R_f = 0.2 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3308, 2928, 1667, 1601, 1275, 1260, 1020, 749. **^{1}H NMR (400 MHz, $(CD_3)_2SO$):** δ 7.68 (d, *J* = 8.3 Hz, 1H), 7.64-7.62 (m, 2H), 7.55 (dd, *J* = 16.0 and 12.0 Hz, 1H), 7.45-7.42 (m, 2H), 7.38-7.35 (m, 1H), 7.24-7.18 (m, 3H), 7.09 (dd, *J* = 8.0 and 2.4 Hz, 1H), 6.12 (d, *J* = 8.4 Hz, 1H), 5.73 (d, *J* = 8.2 Hz, 1H), 3.91 (s, 3H). **^{13}C NMR (100 MHz, $(CD_3)_2SO$):** δ 190.2, 165.5, 155.9, 141.9, 141.0, 136.7, 133.9, 131.3, 129.6, 129.4(2C), 127.8(2C), 125.2, 125.0, 117.4, 110.0, 67.7, 56.3. **HRMS (ESI):** *m/z* calcd for $C_{19}H_{15}O_2$ (M-OH): 275.1072. Found: 275.1085.

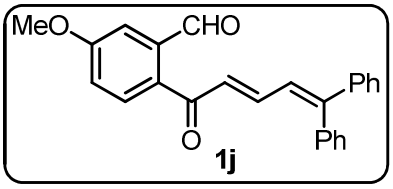
(*S*)-3-Hydroxy-5-methoxy-2-((*E*)-3-phenylallylidene)-2,3-dihydro-1*H*-inden-1-one (2i).



2i (*E*/*Z* = 4/1)

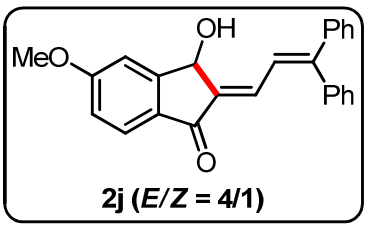
Following the general procedure-5, 18 mg of **1i** afforded 17 mg of **2i** (95% yield, *E*/*Z* = 4:1). **Optical rotation:** $[\alpha]^{23}_D$ +125.2 (*c* 0.10, $CHCl_3$) for a sample with *ee* 96%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralcel OD-H Column (80:10 *n*-Hexane/2-Propanol, 1.0 mL/min, 254 nm, τ_{major} = 28.7 min, τ_{minor} = 22.0 min).

(*E*)-2-(5,5-Diphenylpenta-2,4-dienoyl)-5-methoxybenzaldehyde (1j).



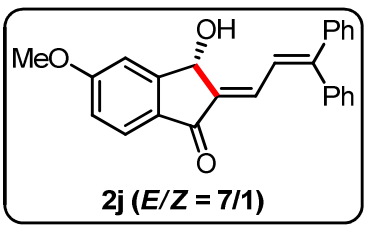
This compound was prepared by following the general procedure-2 and isolated as pale brown oil. R_f = 0.4 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3055, 1690, 1595, 1577, 1444, 1276, 1018, 765. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.22 (s, 1H), 7.75-7.70 (m, 1H), 7.44-7.36 (m, 11H), 7.24-7.21 (m, 1H), 7.15-7.11 (m, 1H), 7.01-6.95 (m, 2H), 3.98 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 191.7, 191.5, 161.9, 153.4, 144.0, 141.2, 138.9, 138.4, 134.3, 130.8, 130.4(2C), 129.1, 128.7, 128.6, 128.5(2C), 128.4(2C), 128.3(2C), 125.7, 118.8, 112.3, 55.8. **HRMS (ESI):** *m/z* calcd for $C_{25}H_{21}O_3$ (M+H): 369.1491. Found: 369.1479.

(*E*)-2-(3,3-Diphenylallylidene)-3-hydroxy-5-methoxy-2,3-dihydro-1*H*-inden-1-one (2j).



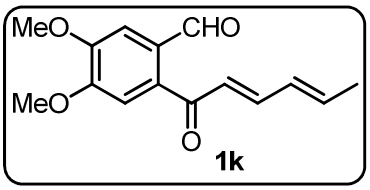
This compound was isolated as pale yellow solid. Following the general procedure-4, 20 mg of **1j** afforded 18.5 mg of **2j** (92% yield). M.P = 191-193 ^oC. R_f = 0.3 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3006, 2919, 1691, 1609, 1275, 1260, 750. **^{1}H NMR (400 MHz, $(CD_3)_2SO$):** δ 7.63 (d, *J* = 8.8 Hz, 1H), 7.54-7.50 (m, 4H), 7.43-7.35 (m, 5H), 7.25-7.23 (m, 3H), 7.07 (dd, *J* = 8.6 and 2.2 Hz, 1H), 6.96 (dd, *J* = 8.1 and 1.4 Hz, 1H), 6.15 (d, *J* = 8.0 Hz, 1H), 5.78 (d, *J* = 7.9 Hz, 1H), 3.91 (s, 3H). **^{13}C NMR (100 MHz, $(CD_3)_2SO$):** δ 190.1, 165.6, 156.0, 151.2, 141.9, 141.3, 138.5, 131.2, 130.7, 130.5(2C), 129.4, 129.1(2C), 129.0(2C), 128.9, 128.2(2C), 125.0, 123.7, 117.3, 169.9, 67.7, 56.3. **HRMS (ESI):** *m/z* calcd for $C_{25}H_{19}O_2$ (M-OH): 351.1385. Found: 351.1399.

(*S*)-2-(3,3-Diphenylallylidene)-3-hydroxy-5-methoxy-2,3-dihydro-1*H*-inden-1-one (2j).



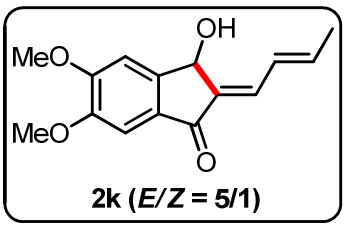
Following the general procedure-5, 15 mg of **1j** afforded 13 mg of **2j** (88% yield, *E/Z* = 7:1). **Optical rotation:** $[\alpha]^{23}_D$ +20.2 (*c* 0.30, $CHCl_3$) for a sample with *ee* 97%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralpak AD Column (94:6 *n*-Hexane/2-Propanol, 1.0 mL/min, 254 nm, τ_{major} = 39.8 min, τ_{minor} = 30.2 min).

2-((2*E*,4*E*)-Hexa-2,4-dienoyl)-4,5-dimethoxybenzaldehyde (1k).



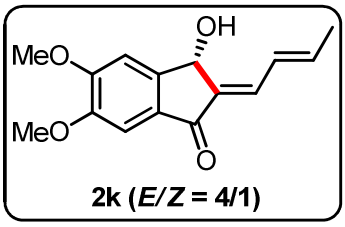
This compound was prepared by following the general procedure-2 and isolated as a pale yellow solid. M.P = 127-129 ^{o}C. R_f = 0.3 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3006, 2851, 1672, 1588, 1519, 1355, 1283, 1118, 871, 736. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.05 (s, 1H), 7.50 (s, 1H), 7.15-7.08 (m, 1H), 7.03 (s, 1H), 6.54 (d, *J* = 15.2 Hz, 1H), 6.32-6.25 (m, 2H), 3.98 (s, 6H), 1.89 (d, *J* = 6.2 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 193.5, 189.8, 152.7, 150.7, 147.4, 142.7, 137.1, 130.2, 129.2, 127.5, 110.5, 109.5, 56.3, 56.2, 19.0. **HRMS (ESI):** *m/z* calcd for $C_{15}H_{16}NaO_4$ (M+H): 283.0946. Found: 283.0965.

(*E*)-2-((*E*)-But-2-en-1-ylidene)-3-hydroxy-5,6-dimethoxy-2,3-dihydro-1*H*-inden-1-one (2k).

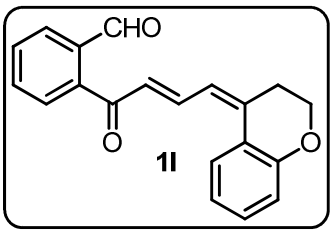


This compound was isolated as Pale yellow solid. Following the general procedure-4, 25 mg of **1k** afforded 23 mg of **2k** (91% yield). M.P = 147-149 ^{o}C. R_f = 0.2 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3374, 2931, 1682, 1591, 1306, 1100, 760. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.17 (s, 1H), 7.05 (d, *J* = 12.1 Hz, 1H), 7.02 (s, 1H), 6.84-6.77 (m, 1H), 6.34-6.29 (m, 1H), 5.60 (s, 1H), 4.02 (s, 3H), 3.89 (s, 3H), 2.55 (br s, 1H), 1.98 (dd, *J* = 6.8 and 0.8 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 191.3, 155.6, 150.8, 146.4, 142.7, 136.8, 135.6, 131.3, 127.7, 106.7, 103.8, 68.8, 56.4, 56.1, 19.2. **HRMS (ESI):** *m/z* calcd for $C_{15}H_{15}O_3$ (M-OH): 243.1021. Found: 243.1035.

(*S*)-2-((*E*)-But-2-en-1-ylidene)-3-hydroxy-5,6-dimethoxy-2,3-dihydro-1*H*-inden-1-one (2k). Following the general procedure-5, 25 mg of **1k** afforded 23 mg of **2k** (93% yield, *E/Z* = 4:1). **Optical rotation:** $[\alpha]^{23}_{D}$ -49.6 (*c* 0.15, $CHCl_3$) for a sample with *ee* 93%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralpak AD Column (88:12 *n*-Hexane/2-Propanol, 0.7 mL/min, 254 nm, τ_{major} = 20.8 min, τ_{minor} = 25.6 min).



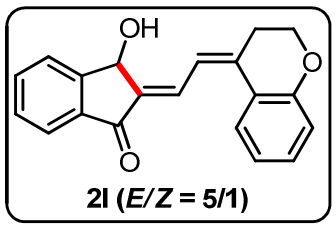
2-((2*E*,4*Z*)-4-(Chroman-4-ylidene)but-2-enoyl)benzaldehyde (1l).



This compound was prepared by following the general procedure-2 and isolated as pale brown oil. R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2925,

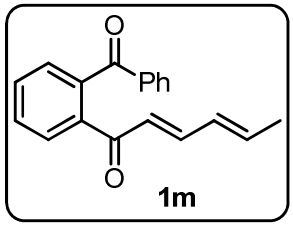
1694, 1646, 1578, 1481, 1276, 750. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.22 (s, 1H), 8.01 (d, *J* = 7.2 Hz, 1H), 7.71-7.64 (m, 5H), 7.28-7.26 (m, 1H), 6.98-6.95 (m, 1H), 6.92-6.87 (m, 2H), 6.84 (d, *J* = 15.2 Hz, 1H), 4.27 (t, *J* = 6.0 Hz, 2H), 2.90 (t, *J* = 6.1 Hz, 2H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 193.4, 191.4, 156.0, 142.2, 141.4, 141.2, 135.7, 133.2, 131.2, 131.0, 129.2, 128.3, 128.1, 124.4, 121.5, 121.2, 118.8, 118.0, 65.6, 26.5. **HRMS (ESI):** *m/z* calcd for $C_{20}H_{17}O_3$ (M+H): 305.1178. Found: 305.1163.

(*E*)-2-((*Z*)-2-(Chroman-4-ylidene)ethylidene)-3-hydroxy-2,3-dihydro-1*H*-inden-1-one (2l).



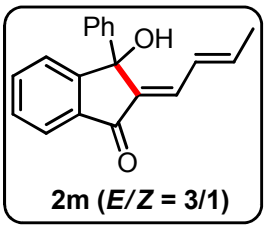
This compound was isolated as Pale brown solid. Following the general procedure-4, 25 mg of **1l** afforded 22 mg of **2l** (89% yield). M.P = 166-168 ^oC. R_f = 0.3 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3400, 3002, 1683, 1609, 1260, 750. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.82-7.78 (m, 3H), 7.72-7.63 (m, 2H), 7.49 (t, *J* = 8.0 Hz, 1H), 7.43-7.40 (m, 1H), 7.28-7.24 (m, 1H), 6.97 (dt, *J* = 6.9 and 1.2 Hz, 1H), 6.90 (dd, *J* = 8.0 and 1.1 Hz, 1H), 5.85 (s, 1H), 4.27 (t, *J* = 6.0 Hz, 2H), 3.01-2.97 (m, 2H), 2.62 (br s, 1H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 192.0, 156.0, 151.1, 142.0, 138.1, 137.9, 135.1, 131.6, 131.2, 129.6, 125.9, 124.9, 123.5, 121.9, 121.2, 117.9, 116.2, 69.1, 65.7, 26.3. **HRMS (ESI):** *m/z* calcd for $C_{20}H_{15}O_2$ (M-OH): 287.1072. Found: 287.1099.

(2*E*,4*E*)-1-(2-Benzoylphenyl)hexa-2,4-dien-1-one (1m).



This compound was prepared by following the general procedure-2 and isolated as pale brown oil. R_f = 0.5 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** $_{max}/cm^{-1}$ 3451, 3061, 2930, 1664, 1587, 1448, 1284, 704. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.79-7.77 (m, 3H), 7.61-7.56 (m, 2H), 7.55-7.48 (m, 2H), 7.44-7.40 (m, 2H), 7.16-7.10 (m, 1H), 6.56 (d, *J* = 15.1 Hz, 1H), 6.24-6.17 (m, 2H), 1.86 (d, *J* = 6.2 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 197.4, 192.5, 146.5, 141.7, 140.6, 139.3, 137.2, 132.9, 131.0, 130.3, 129.9, 129.6(2C), 128.7, 128.6, 128.3(2C), 125.1, 18.9. **HRMS (ESI):** *m/z* calcd for $C_{19}H_{17}O_2$ (M+H): 277.1229. Found: 277.1244.

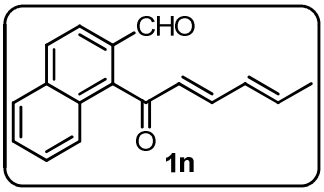
(*E*)-2-((*E*)-But-2-en-1-ylidene)-3-hydroxy-3-phenyl-2,3-dihydro-1*H*-inden-1-one (2m).



2m (*E*/*Z* = 3/1)

This compound was isolated as pale yellow sticky oil. Following the general procedure-4, 25 mg of **1m** afforded 23 mg of **2m** (92% yield). R_f = 0.2 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** $_{max}$/cm^{-1} 3413, 2929, 1687, 1624, 1288, 982, 699. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.75 (d, *J* = 8.4 Hz, 1H), 7.65 (dt, *J* = 11.6 and 1.2 Hz, 1H), 7.50 (dt, *J* = 7.7 and 0.9 Hz, 1H), 7.37-7.33 (m, 3H), 7.31-7.27 (m, 2H), 7.21-7.17 (m, 1H), 7.04 (d, *J* = 10.6 Hz, 1H), 6.56 (s, 1H), 6.36-6.29 (m, 2H), 1.72 (d, *J* = 5.8 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 192.7, 157.3, 145.9, 143.1, 142.2, 136.4, 136.0, 134.6, 129.4, 128.6(2C), 127.8, 127.0, 125.7, 125.5(2C), 122.9, 77.6, 19.5. **HRMS (ESI):** *m/z* calcd for $C_{19}H_{15}O$ (M-OH): 259.1123. Found: 259.1143.

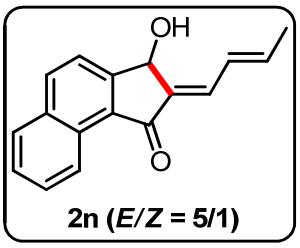
1-((2*E*,4*E*)-Hexa-2,4-dienoyl)-2-naphthaldehyde (1n).



1n

This compound was prepared by following the general procedure-2 and isolated as pale brown solid. M.P = 85-87 ^{o}C. R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3016, 1697, 1275, 1260, 764, 750. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.17 (s, 1H), 8.05-7.94 (m, 3H), 7.85 (d, *J* = 8.8 Hz, 1H), 7.69-7.65 (m, 1H), 7.60-7.56 (m, 1H), 6.79-6.72 (m, 1H), 6.60 (d, *J* = 15.6 Hz, 1H), 6.31-6.28 (m, 1H), 6.09-6.03 (m, 1H), 1.85 (d, *J* = 6.8 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 198.2, 190.4, 149.0, 143.3, 139.4, 136.1, 130.7, 130.4, 130.2, 129.9, 129.7, 129.3, 128.4, 127.8, 126.7, 123.0, 19.0. **HRMS (ESI):** *m/z* calcd for $C_{17}H_{14}O_2$ $(M+H)^+$: 251.1072. Found: 251.1053.

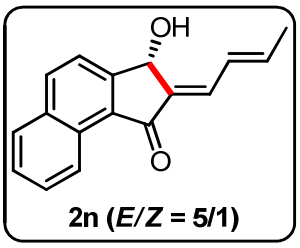
(*E*)-2-((*E*)-But-2-en-1-ylidene)-3-hydroxy-2,3-dihydro-1*H*-cyclopenta[*a*]naphthalen-1-one (2n).



2n (*E*/*Z* = 5/1)

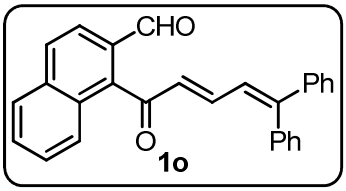
This compound was isolated as pale yellow solid. Following the general procedure-4, 30 mg of **1n** afforded 27 mg of **2n** (90% yield). M.P = 196-198 ^{o}C. R_f = 0.2 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3365, 2926, 1693, 1608, 1517, 1441, 1176, 834, 760. **^{1}H NMR (400 MHz, $(CD_3)_2SO$):** δ 9.13 (d, *J* =8.4 Hz, 1H), 8.31 (d, *J* = 8.4 Hz, 1H), 8.09 (d, *J* = 8.0 Hz, 1H), 7.83 (d, *J* = 8.4 Hz, 1H), 7.77-7.73 (m, 1H), 7.68-7.64 (m, 1H), 7.11 (d, *J* = 11.9 Hz, 1H), 6.86-6.79 (m, 1H), 6.45-6.40 (m, 1H), 5.99 (d, *J* = 8.4 Hz, 1H), 5.71 (d, *J* = 8.3 Hz, 1H), 1.94 (dd, *J* = 6.8 and 1.1 Hz, 3H). **^{13}C NMR (100 MHz, $(CD_3)_2SO$):** δ 193.0, 155.2, 141.9, 138.3, 136.5, 134.2,

133.5, 131.7, 129.5, 129.1, 128.6, 128.5, 127.6, 124.3, 123.7, 67.5, 19.5. HRMS (ESI): *m/z* calcd for $C_{17}H_{14}O_2$ $(M+H)^+$: 251.1072. Found: 251.1089.

(*S*)-2-((*E*)-But-2-en-1-ylidene)-3-hydroxy-2,3-dihydro-1*H*-cyclopenta[*a*]naphthalen-1-one (2n). 

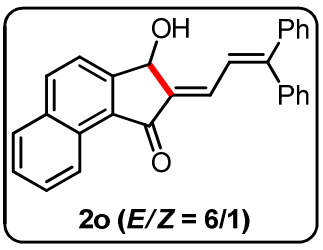
Following the general procedure-5, 20 mg of **1n** afforded 18.6 mg of **2n** (93% yield, *E/Z* = 5:1). **Optical rotation:** $[\alpha]^{23}_D$ +44.9 (*c* 0.08, $CHCl_3$) for a sample with *ee* 99%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralcel OD-H Column (90:10 *n*-Hexane/2-Propanol, 1.0 mL/min, 254 nm, τ_{major} = 19.6 min, τ_{minor} = 13.7 min).

(*E*)-1-(5,5-Diphenylpenta-2,4-dienoyl)-2-naphthaldehyde (1o).



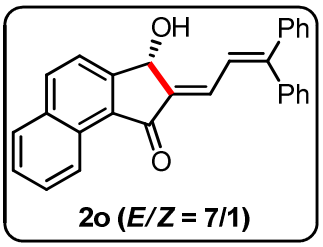
This compound was prepared by following the general procedure-2 and isolated as pale yellow solid. M.P = 122-124 ^oC. R_f = 0.4 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3007, 1695, 1641, 1604, 1275, 1260, 749. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.17 (s, 1H), 7.93-7.89 (m, 3H), 7.69-7.61 (m, 2H), 7.36-7.19 (m, 7H), 7.07 (t, *J* = 7.6 Hz, 2H), 6.92-6.84 (m, 5H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 197.9, 190.5, 154.3, 147.2, 147.1, 143.5, 140.8, 137.8, 136.0, 132.5, 130.4, 130.3, 129.7, 129.6, 129.3, 129.2(2C), 128.4(2C), 128.3(2C), 127.9, 127.6(2C), 126.7, 125.2, 122.9. **HRMS (ESI):** *m/z* calcd for $C_{28}H_{21}O_2$ (M+H): 389.1542. Found: 389.1546.

(*E*)-2-(3,3-Diphenylallylidene)-3-hydroxy-2,3-dihydro-1*H*-cyclopenta[*a*]naphthalen-1-one (2o).



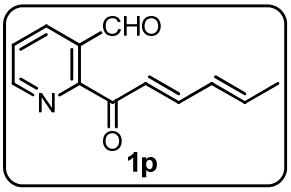
This compound was isolated as pale yellow solid. Following the general procedure-4, 35 mg of **1o** afforded 31 mg of **2o** (89% yield). M.P = 147-149 ^oC. R_f = 0.2 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3418, 3056, 1681, 1609, 1275, 1173, 749. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 9.19-9.17 (m, 1H), 8.14-8.10 (m, 1H), 7.93-7.89 (m, 1H), 7.83-7.78 (m, 1H), 7.71-7.57 (m, 2H), 7.54-7.21 (m, 12H), 5.91 (s, 1H), 2.40 (br s, 1H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 192.5, 153.5, 152.73, 152.71, 141.5, 139.5, 138.3, 136.4, 139.5, 136.4, 133.1, 130.6(2C), 129.1, 129.0, 128.9, 128.5(2C), 128.4(4C), 128.3, 127.4, 125.0, 122.9, 122.4, 69.0. **HRMS (ESI):** *m/z* calcd for $C_{28}H_{19}O$ (M–OH): 371.1436. Found: 371.1453.

(*S*)-2-(3,3-Diphenylallylidene)-3-hydroxy-2,3-dihydro-1*H*-cyclopenta[*a*]naphthalen-1-one (2o). Following the general procedure-5, 24 mg of **1o** afforded 23 mg of **2o** (95% yield, *E/Z* = 7:1). **Optical rotation:** $[\alpha]^{23}_{D}$ +114.7 (*c* 0.18, $CHCl_3$) for a sample with *ee* 89%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralcel OD-H Column (95:5 *n*-Hexane/2-Propanol, 1.0 mL/min, 254 nm, τ_{major} = 59.6 min, τ_{minor} = 37.8 min).



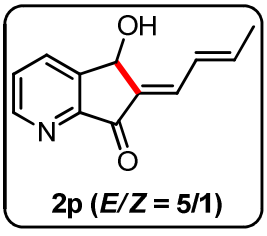
2-((2*E*,4*E*)-Hexa-2,4-dienoyl)nicotinaldehyde (1p).

This compound was prepared by following the general procedure-2 and isolated as pale brown solid. M.P = 114-116 ^{o}C. R_f = 0.4 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3009, 1700, 1662, 1574, 1275, 997, 750. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.49 (s, 1H), 8.86-8.85 (m, 1H), 8.23 (d, *J* = 7.6 Hz, 1H), 7.60 (dd, *J* = 7.6 and 4.8 Hz, 1H), 7.55-7.49 (m, 1H), 7.33 (d, *J* = 15.6 Hz, 1H), 6.41-6.37 (m, 2H), 1.94 (d, *J* = 5.6 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 191.2, 190.8, 156.0, 151.9, 147.0, 143.1, 136.3, 133.0, 130.8, 126.2, 123.5, 19.1. **HRMS (ESI):** *m/z* calcd for $C_{12}H_{12}NO_2$ (M+H): 202.0868. Found: 202.0881.



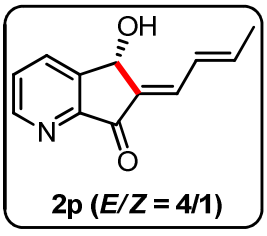
(*E*)-6-((*E*)-But-2-en-1-ylidene)-5-hydroxy-5*H*-cyclopenta[*b*]pyridin-7(6*H*)-one (2p).

This compound was isolated as Pale brown solid. Following the general procedure-4, 20 mg of **1p** afforded 17.5 mg of **2p** (87% yield). M.P = 123-125 ^{o}C. R_f = 0.2 (Hexane/EtOAc = 5/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3417, 2834, 1659, 1651, 1025, 999, 764. **^{1}H NMR (400 MHz, $(CD_3)_2SO$):** δ 8.81-8.80 (m, 1H), 8.21-8.19 (m, 1H), 7.68 (dd, *J* = 8.0 and 6.9 Hz, 1H), 7.20 (d, *J* = 7.0 Hz, 1H), 6.84-6.76 (m, 1H), 6.53-6.47 (m, 1H), 6.00 (d, *J* = 8.4 Hz, 1H), 5.67 (d, J = 8.1 Hz, 1H), 1.94 (d, *J* = 6.8 Hz, 3H). **^{13}C NMR (100 MHz, $(CD_3)_2SO$):** δ 191.5, 154.6, 152.2, 148.1, 144.0, 137.0, 136.8, 135.5, 128.6, 128.4, 65.9, 19.6. **HRMS (ESI):** *m/z* calcd for $C_{12}H_{10}NO$ (M-OH): 184.0762. Found: 184.0756.



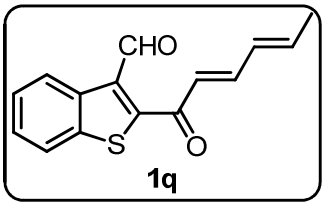
(*S*)-6-((*E*)-But-2-en-1-ylidene)-5-hydroxy-5*H*-cyclopenta[*b*]pyridin-7(6*H*)-one (2p).

Following the general procedure-5, 20 mg of **1p** afforded 17.7 mg of **2p** (88% yield, *E/Z* = 4:1). **Optical rotation:** $[\alpha]^{23}_{D}$ +39.2 (*c* 0.05,



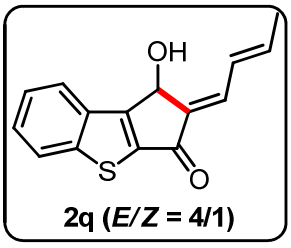
DMSO) for a sample with *ee* 96%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralpak AS Column (87:13 *n*-Hexane/2-Propanol, 1.0 mL/min, 254 nm, τ_{major} = 9.2 min, τ_{minor} = 11.8 min).

2-((2*E*,4*E*)-Hexa-2,4-dienoyl)benzo[b]thiophene-3-carbaldehyde (1q).



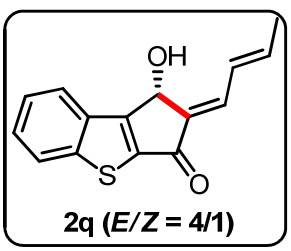
This compound was prepared by following the general procedure-1 and isolated as a pale yellow solid. M.P = 122-124 ^{o}C. R_f = 0.5 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3442, 3002, 1671, 1655, 1592, 1499, 1000, 751. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.65 (s, 1H), 8.80-8.78 (m, 1H), 7.92-7.90 (m, 1H), 7.58-7.54 (m, 2H), 7.53-7.47 (m, 1H), 6.70 (d, *J* = 14.8 Hz, 1H), 6.40-6.39 (m, 2H), 1.96 (d, *J* = 5.2 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 188.0, 184.7, 150.7, 147.7, 144.3, 138.9, 136.6, 136.4, 130.2, 127.8, 126.9, 126.7, 125.4, 122.2, 19.1. **HRMS (ESI):** *m/z* calcd for $C_{15}H_{13}O_2S$ (M+H): 257.0636. Found: 257.0654.

(*E*)-2-((*E*)-But-2-en-1-ylidene)-1-hydroxy-1*H*-benzo[*b*]cyclopenta[*d*]thiophen-3(2*H*)-one



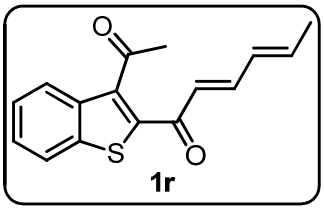
(2q). This compound was isolated as pale yellow solid. Following the general procedure-4, 25 mg of **1q** afforded 23 mg of **2q** (93% yield). M.P = 127-129 ^{o}C. R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3467, 2925, 1690, 1633, 1270, 1019, 760. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.16-8.14 (m, 1H), 7.92-7.90 (m, 1H), 7.56-7.49 (m, 2H), 7.16 (d, *J* = 11.6 Hz, 1H), 6.85-6.78 (m, 1H), 6.36 (sextet, *J* = 7.2 Hz, 1H), 5.91 (d, *J* = 6.5 Hz, 1H), 2.35 (d, *J* = 6.4 Hz, 1H), 2.00 (dd, *J* = 6.9 and 1.3 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 185.4, 158.9, 148.1, 145.0, 143.2, 138.9, 135.3, 133.3, 128.3, 127.2, 125.5, 124.6, 124.3, 67.0, 19.3. HRMS (ESI): *m/z* calcd for $C_{15}H_{13}O_2S$ $(M+H)^+$: 257.0636. Found: 257.0644.

(*S*)-2-((*E*)-But-2-en-1-ylidene)-1-hydroxy-1*H*-benzo[*b*]cyclopenta[*d*]thiophen-3(2*H*)-one



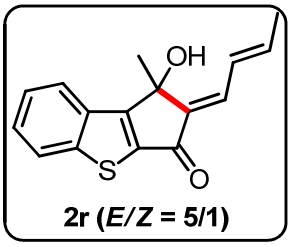
(2q). Following the general procedure-5, 20 mg of **1q** afforded 18.3 mg of **2q** (91% yield, *E*/*Z* = 4:1). **Optical rotation:** $[\alpha]^{23}_{D}$ -36.3 (*c* 0.11, $CHCl_3$) for a sample with *ee* 94%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralpak AS Column (98:2 *n*-Hexane/2-Propanol, 1.0 mL/min, 254 nm, τ_{major} = 13.2 min, τ_{minor} = 23.9 min).

(2*E*,4*E*)-1-(3-Acetylbenzo[b]thiophen-2-yl)hexa-2,4-dien-1-one (1r).



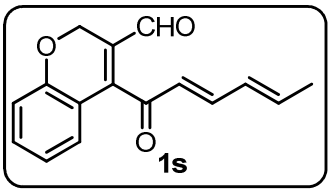
This compound was prepared by following the general procedure-1 and isolated as pale yellow oil. R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** $_{max}$/cm^{-1} 3444, 3064, 2918, 1699, 1652, 1585, 1510, 1140, 757. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.89 (d, *J* = 8.0 Hz, 1H), 7.85 (d, *J* = 7.9 Hz, 1H), 7.52-7.47 (m, 3H), 6.67 (d, *J* = 14.8 Hz, 1H), 6.37-6.35 (m, 2H), 2.62 (s, 3H), 1.94 (d, *J* = 4.8 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 200.9, 184.0, 146.9, 143.5, 142.1, 140.5, 136.7, 130.2, 127.6, 125.8, 125.2, 124.5, 124.3, 122.7, 31.5, 19.1. **HRMS (ESI):** *m/z* calcd for $C_{16}H_{15}O_2S$ (M+H): 271.0793. Found: 271.0793.

(*E*)-2-((*E*)-But-2-en-1-ylidene)-1-hydroxy-1-methyl-1*H*-benzo[*b*]cyclopenta[*d*]thiophen-3(2*H*)-one (2r).



This compound was isolated as light yellow semi solid. Following the general procedure-4, 20 mg of **1r** afforded 17.8 mg of **2r** (89% yield). R_f = 0.3 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** $_{max}$/cm^{-1} 3387, 2929, 1681, 1632, 1267, 1041, 735. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.18-8.15 (m, 1H), 7.93-7.90 (m, 1H), 7.53-7.49 (m, 2H), 7.03 (d, *J* = 12.0 Hz, 1H), 6.97-6.93 (m, 1H), 6.34-6.28 (m, 1H), 2.61 (br s, 1H), 2.00 (dd, *J* = 6.7 and 1.6 Hz, 3H), 1.96 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 185.1, 162.8, 148.3, 143.0, 142.8, 133.4, 132.2, 128.8, 127.2, 126.5, 125.3, 125.0, 124.4, 74.7, 26.1, 19.3. **HRMS (ESI):** *m/z* calcd for $C_{16}H_{15}O_2S$ $(M+H)^+$: 271.0793. Found: 271.0782.

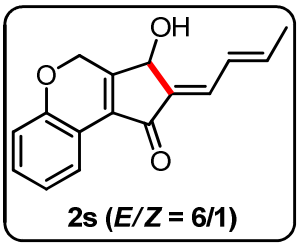
4-((2*E*,4*E*)-Hexa-2,4-dienoyl)-2*H*-chromene-3-carbaldehyde (1s).



This compound was prepared by following the general procedure-2 and isolated as light brown oil. R_f = 0.5 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3370, 3030, 2832, 2745, 1701, 1654, 1616, 1578, 1458, 1100, 752. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 9.65 (s, 1H), 7.36-7.32 (m, 1H), 7.16-7.09 (m, 2H), 6.97-6.94 (m, 2H), 6.37 (d, *J* = 15.2 Hz, 1H), 6.31-6.29 (m, 2H), 5.03 (s, 2H), 1.91 (d, *J* = 5.0 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 194.2, 187.8, 155.8, 149.8, 149.7, 149.3, 144.6, 133.6,

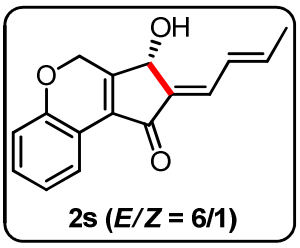
130.0, 128.6, 127.0, 122.3, 119.4, 117.2, 62.4, 19.1. **HRMS (ESI):** *m/z* calcd for $C_{16}H_{15}O_3$(M+H): 255.1021. Found: 255.1036.

***(E)*-2-((*E*)-But-2-en-1-ylidene)-3-hydroxy-2,3-dihydrocyclopenta[*c*]chromen-1(4*H*)-one**



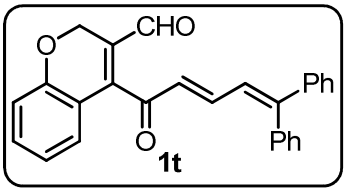
(2s). This compound was isolated as pale brown solid. Following the general procedure-4, 20 mg of **1s** afforded 19 mg of **2s** (93% yield). M.P = 167-169 ^{o}C. R_f = 0.3 (Hexane/EtOAc = 5/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2929, 1696, 1608, 1459, 1277, 1072, 1019, 757. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.16-8.12 (m, 1H), 7.24-7.20 (m, 1H), 7.05 (d, *J* = 11.6 Hz, 1H), 6.98-6.94 (m, 1H), 6.85 (dd, *J* = 8.0 and 0.8 Hz, 1H), 6.69-6.28 (m, 1H), 6.37-6.30 (m, 1H), 5.41-5.35 (m, 1H), 5.26 (s, 2H), 5.25-5.19 (m, 1H), 1.98 (dd, *J* = 6.8 and 1.2 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 190.3, 156.9, 153.0, 143.2, 134.5, 134.1, 133.9, 130.8, 127.0, 125.2, 121.7, 116.5, 115.9, 68.5, 65.2, 19.2. **HRMS (ESI):** *m/z* calcd for $C_{16}H_{15}O_3$ $(M+H)^+$: 255.1021. Found: 255.1043.

(*S*)-2-((*E*)-But-2-en-1-ylidene)-3-hydroxy-2,3-dihydrocyclopenta[*c*]chromen-1(4*H*)-one



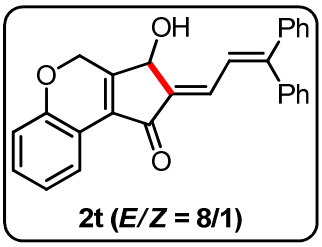
(2s). Following the general procedure-5, 22 mg of **1s** afforded 21.3 mg of **2s** (97% yield, *E/Z* = 6:1). **Optical rotation:** $[\alpha]^{23}_{D}$ +3.1 (*c* 0.05, $CHCl_3$) for a sample with *ee* 95%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralcel OD-H Column (95:5 *n*-Hexane/2-Propanol, 1.0 mL/min, 254 nm, τ_{major} = 34.6 min, τ_{minor} = 23.4 min).

(*E*)-4-(5,5-Diphenylpenta-2,4-dienoyl)-2*H*-chromene-3-carbaldehyde (1t).



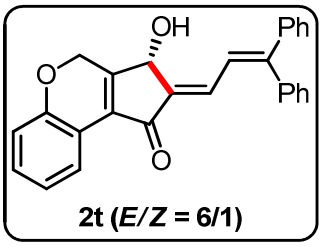
This compound was prepared by following the general procedure-2 and isolated as pale brown sticky oil. R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3058, 2855, 1759, 1672, 1602, 1445, 1275, 751. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 9.66 (s, 1H), 7.40-7.35 (m, 4H), 7.34-7.28 (m, 4H), 7.27-7.25 (m, 2H), 7.12 (dd, *J* = 8.0 and 1.6 Hz, 1H), 7.01-6.98 (m, 3H), 6.93 (dd, *J* = 8.0 and 0.8 Hz, 1H), 6.89 (d, *J* = 11.6 Hz, 1H), 6.61 (d, *J* = 15.2 Hz, 1H), 4.90 (s, 2H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 194.1, 187.8, 155.7, 155.5, 149.4, 148.1, 140.7, 137.8, 133.5, 130.5, 130.4(2C), 129.5, 128.9, 128.6(2C), 128.5(2C), 128.3(2C), 127.2, 126.9, 124.9, 122.1, 119.4, 117.1, 62.1. **HRMS (ESI):** *m/z* calcd for $C_{27}H_{21}O_3$ $(M+H)^+$: 393.1491. Found: 393.1473.

(*E*)-2-(3,3-Diphenylallylidene)-3-hydroxy-2,3-dihydrocyclopenta[*c*]chromen-1(4*H*)-one

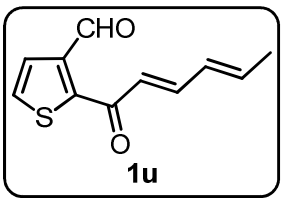


(2t). This compound was isolated as light yellow liquid. Following the general procedure-4, 25 mg of **1t** afforded 24 mg of **2t** (96% yield). R_f = 0.3 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3437, 2924, 1634, 1614, 1269, 760. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 8.11 (dd, *J* = 7.8 and 0.8 Hz, 1H),7.44-7.43 (m, 3H), 7.36-7.35 (m, 5H), 7.32-7.28 (m, 2H), 7.26-7.19 (m, 3H), 6.96-6.93 (m, 1H), 6.92-6.83 (m, 1H), 5.42-5.20 (m, 3H), 2.07 (br s, 1H) . **^{13}C NMR (100 MHz, $CDCl_3$):** δ 189.9, 156.7, 153.8, 153.0, 141.4, 138.1, 136.9, 134.1, 131.8, 130.6(2C), 129.0, 128.6, 128.4(6C), 125.2, 122.3, 121.7, 116.5, 115.9, 68.7, 65.2. **HRMS (ESI):** *m/z* calcd for $C_{27}H_{21}O_3$ $(M+H)^+$: 393.1491. Found: 393.1474.

(*S*,*E*)-2-(3,3-Diphenylallylidene)-3-hydroxy-2,3-dihydrocyclopenta[*c*]chromen-1(4*H*)-one (2t). Following the general procedure-5, 20 mg of **1t** afforded 18.3 mg of **2t** (91% yield, *E*/*Z* = 6:1). **Optical rotation:** $[\alpha]^{23}_D$ +49.9 (*c* 0.10, $CHCl_3$) for a sample with *ee* 98%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralcel OD-H Column (93:7 *n*-Hexane/2-Propanol, 0.8 mL/min, 254 nm, τ_{major} = 35.7 min, τ_{minor} = 32.3 min).

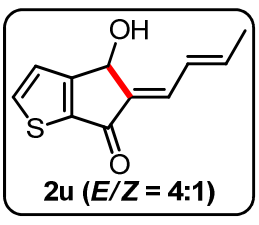


2-((2*E*,4*E*)-Hexa-2,4-dienoyl)thiophene-3-carbaldehyde (1u).



This compound was prepared by following the general procedure-2 and isolated as pale yellow oil. R_f = 0.5 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2928, 1680, 1651, 1623, 1584, 1244, 1156, 732. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.50 (s, 1H), 7.65 (d, *J* = 4.9 Hz, 1H), 7.50-7.47 (m, 2H), 6.68 (d, *J* = 14.8 Hz, 1H), 6.36-6.34 (m, 2H), 1.43 (d, *J* = 5.3 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 187.5, 182.8, 147.1, 146.6, 144.3, 143.5, 130.1, 129.2, 128.4, 124.6, 19.0. **HRMS (ESI):** *m/z* calcd for $C_{11}H_{11}O_2S$ $(M+H)^+$: 207.0480. Found: 207.0467.

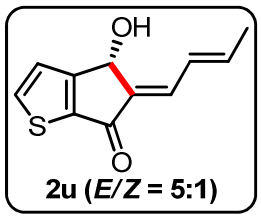
(*E*)-5-((*E*)-But-2-en-1-ylidene)-4-hydroxy-4*H*-cyclopenta[*b*]thiophen-6(5*H*)-one (2u).



This compound was isolated as Pale yellow oil. Following the general procedure-3, 25 mg of **1u** afforded 23.5 mg of **2u** (94% yield). R_f = 0.3

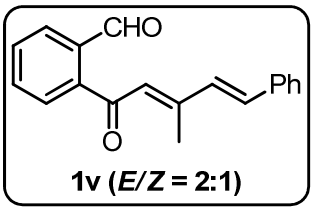
(Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3383, 2961, 2925, 1692, 1633, 1434, 1377, 1035, 732. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.89 (d, *J* = 4.8 Hz, 1H), 7.30 (d, *J* = 4.9 Hz, 1H), 7.09 (d, *J* = 12.0 Hz, 1H), 6.77-6.69 (m, 1H), 6.34-6.29 (m, 1H), 5.65 (s, 1H), 2.41 (br.s, 1H), 1.97 (dd, *J* = 8.0 and 1.5 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 184.1, 163.7, 144.6, 142.7, 140.0, 139.8, 135.4, 127.1, 123.3, 66.7, 19.2. **HRMS (ESI):** *m/z* calcd for $C_{11}H_9OS$ $(M\text{-}OH)^+$: 189.0374. Found: 189.0389.

(*R*,*E*)-5-((*E*)-But-2-en-1-ylidene)-4-hydroxy-4*H*-cyclopenta[*b*]thiophen-6(5*H*)-one (2u).



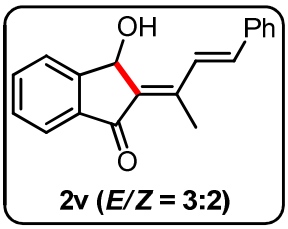
Following the general procedure-5, 20 mg of **1u** afforded 19.4 mg of **2u** (89% yield, *E/Z* = 5:1). **Optical rotation:** $[\alpha]^{23}_D$ -6.6 (*c* 0.10, $CHCl_3$) for a sample with *ee* 92%. The enantiomeric excess was determined by HPLC analysis using Daicel Chiralcel OD-H Column (90:10 *n*-Hexane/2-Propanol, 1.0 mL/min, 254 nm, τ_{major} = 22.1 min, τ_{minor} = 33.2 min).

2-((2*E*,4*E*)-3-Methyl-5-phenylpenta-2,4-dienoyl)benzaldehyde (1v).



This compound was prepared by following the general procedure-2 and isolated as pale yellow oil. R_f = 0.4 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2922, 1694, 1654, 1575, 1246, 968, 725. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 10.28 (s, 1H), 7.96 (d, *J* = 7.6 Hz, 1H), 7.74-7.72 (m, 1H), 7.68-7.52 (m, 4H), 7.41-7.28 (m, 3H), 7.14 (d, *J* = 16.0 Hz, 1H), 6.93 (d, *J* = 16.0 Hz, 1H), 6.78 (s, 1H), 2.52 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 192.8, 191.8, 153.9, 143.8, 136.7, 136.1, 135.8, 133.0, 132.0, 129.1, 128.9(2C), 128.8, 128.1, 127.3(2C), 125.9, 124.0, 14.7. **HRMS (ESI):** *m/z* calcd for $C_{19}H_{17}O_2$ $(M+H)^+$: 277.1229. Found: 277.1216.

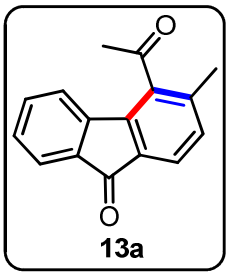
(*E*)-3-Hydroxy-2-((*E*)-4-phenylbut-3-en-2-ylidene)-2,3-dihydro-1*H*-inden-1-one (2v).



This compound was isolated as Pale yellow solid. Following the general procedure-3, 40 mg of **1v** afforded 36.5 mg of **2v** (91% yield). M.P = 127-129 °C. R_f = 0.2 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 3400, 2924, 1668, 1605, 1579, 1336, 1094, 751. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.74-7.70 (m, 2H), 7.65-7.53 (m, 4H), 7.42-7.28 (m, 4H), 7.12 (d, *J* = 16.0 Hz, 1H), 5.8 (s, 1H), 2.92 (br.s, 2.50 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 193.7, 149.7, 149.3, 131.9, 137.6, 136.5, 135.3, 134.9,

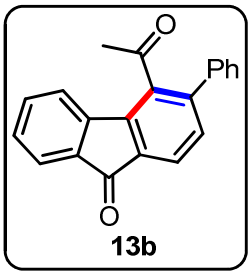
129.2, 128.8(2C), 128.5, 127.6(2C), 125.8, 125.7, 123.2, 69.9, 13.3. **HRMS (ESI):** *m/z* calcd for $C_{19}H_{17}O_2$ $(M+H)^+$: 277.1229. Found: 277.1215.

4-Acetyl-3-methyl-9*H*-fluoren-9-one (13a).



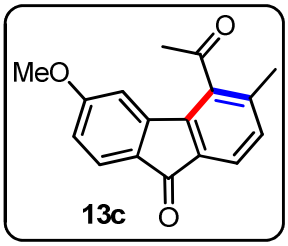
This compound was isolated as pale yellow solid. Following the general procedure-6, 30 mg of **2a** afforded 16 mg of **13a** (46% yield, over two steps). M.P = 150-152 °C. R_f = 0.5 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2924, 2854, 1714, 1695, 1357, 1111, 752. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.70 (d, *J* = 7.3 Hz, 1H), 7.61 (d, *J* = 7.6 Hz, 1H), 7.46 (dt, *J* = 7.6 and 1.1 Hz, 1H), 7.35-7.28 (m, 2H), 7.71 (d, *J* = 7.6 Hz, 1H), 2.67 (s, 3H), 2.35 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 206.7, 192.5, 142.5, 139.8, 139.2, 137.2, 134.7, 134.6, 132.5, 130.9, 129.4, 124.6, 124.5, 122.1, 32.3, 19.3. **HRMS (ESI):** *m/z* calcd for $C_{16}H_{11}O_2$ $(M-H)^+$: 235.0759. Found: 235.0750.

4-Acetyl-3-phenyl-9*H*-fluoren-9-one (13b).



This compound was isolated as pale yellow solid. Following the general procedure-6, 25 mg of **2b** afforded 12 mg of **13b** (43% yield, over two steps). M.P = 115-117 °C. R_f = 0.5 (Hexane/EtOAc = 5/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2993, 1715, 1698, 1606, 1576, 1412, 1275, 1259, 749. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.78 (d, *J* = 7.6 Hz, 1H), 7.73 (dd, *J* = 7.4 and 0.8 Hz, 1H), 7.48-7.41 (m, 7H), 7.36 (d, *J* = 7.6 Hz, 1H), 7.35 (dt, *J* = 7.6 and 1.3 Hz, 1H), 2.11 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 206.3, 192.5, 144.8, 142.8, 142.6, 139.7, 138.9, 136.5, 135.0, 134.5, 133.6, 130.7, 129.5, 128.9(2C), 128.8(2C), 128.7, 124.7, 124.5, 122.6, 32.0. HRMS (ESI): *m/z* calcd for $C_{21}H_{13}O_2$ $(M-H)^+$: 297.0916. Found: 297.0903.

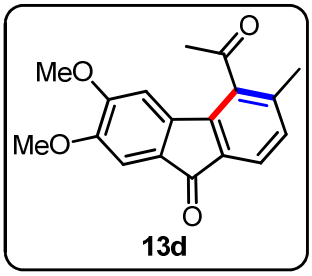
4-Acetyl-6-methoxy-3-methyl-9*H*-fluoren-9-one (13c).



This compound was isolated as pale yellow solid. Following the general procedure-6, 30 mg of **2h** afforded 15 mg of **13c** (44% yield). M.P = 116-117 °C. R_f = 0.3 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2928, 1704, 1688, 1612, 1584, 1363, 1228, 782. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.67 (d, *J* = 8.2 Hz, 1H), 7.58 (d, *J* = 7.7 Hz, 1H), 7.17 (d, *J* = 7.7 Hz, 1H), 6.81 (d, *J* = 2.0 Hz, 1H), 6.77 (dd, *J* = 8.2 and

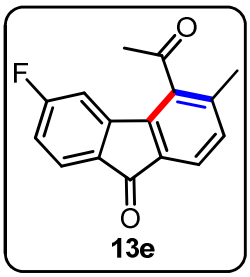
2.0 Hz, 1H), 3.89 (s, 3H), 2.67 (s, 3H), 2.37 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 206.5, 191.1, 165.2, 144.9, 139.2, 138.0, 137.2, 133.7, 131.1, 129.6, 126.5, 124.1, 112.5, 109.7, 55.8, 32.3, 19.2. HRMS (ESI): *m/z* calcd for $C_{17}H_{15}O_3$ $(M+H)^+$: 267.1021. Found: 267.1009.

5-Acetyl-2,3-dimethoxy-6-methyl-9*H*-fluoren-9-one (13d).



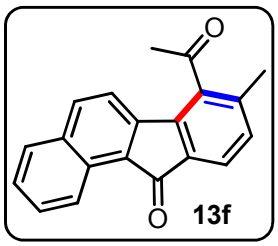
This compound was isolated as pale yellow solid. Following the general procedure-6, 35 mg of **2k** afforded 16 mg of **13d** (43% yield). M.P = 178-180 °C. R_f = 0.3 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2926, 1704, 1681, 1609, 1480, 1276, 749. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.50 (d, *J* = 7.6 Hz, 1H), 7.23 (s, 1H), 7.07 (d, *J* = 7.6 Hz, 1H), 6.78 (s, 1H), 3.96 (s, 3H), 3.95 (s, 3H), 2.67 (s, 3H), 2.33 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 206.8, 191.8, 154.2, 149.8, 139.3, 138.8, 137.4, 136.1, 133.2, 129.9, 127.7, 124.0, 107.2, 105.3, 56.29, 56.28, 32.3, 19.3. **HRMS (ESI):** *m/z* calcd for $C_{18}H_{17}O_4$ $(M+H)^+$: 297.1127. Found: 297.1123.

4-Acetyl-6-fluoro-3-methyl-9*H*-fluoren-9-one (13e).



This compound was isolated as off white solid. Following the general procedure-6, 25 mg of **2g** afforded 15 mg of **13e** (50% yield). M.P = 110-112 °C. R_f = 0.3 (Hexane/EtOAc = 4/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2990, 1714, 1690, 1612, 1584, 1275, 1260, 750. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 7.70 (dd, *J* = 8.0 and 2.8 Hz, 1H), 7.61 (d, *J* = 8.0 Hz, 1H), 7.21 (7.7 Hz, 1H), 7.01-6.96 (m, 2H), 2.67 (s, 3H), 2.37 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 206.1, 190.7, 165.7 (d, *J* = 254.1 Hz), 145.4 (d, *J* = 9.7 Hz), 139.9, 137.53, 137.51, 132.9, 131.6, 130.6 (d, *J* = 2.5 Hz), 126.5 (d, *J* = 10.2 Hz), 124.5, 115.8 (d, *J* = 23.2 Hz), 110.4 (d, *J* = 25.0 Hz), 32.2, 19.3. **^{19}F NMR (376 MHz, $CDCl_3$):** δ -101.9. **HRMS (ESI):** *m/z* calcd for $C_{16}H_{12}FO_2$ $(M+H)^+$: 255.0821. Found: 255.0819.

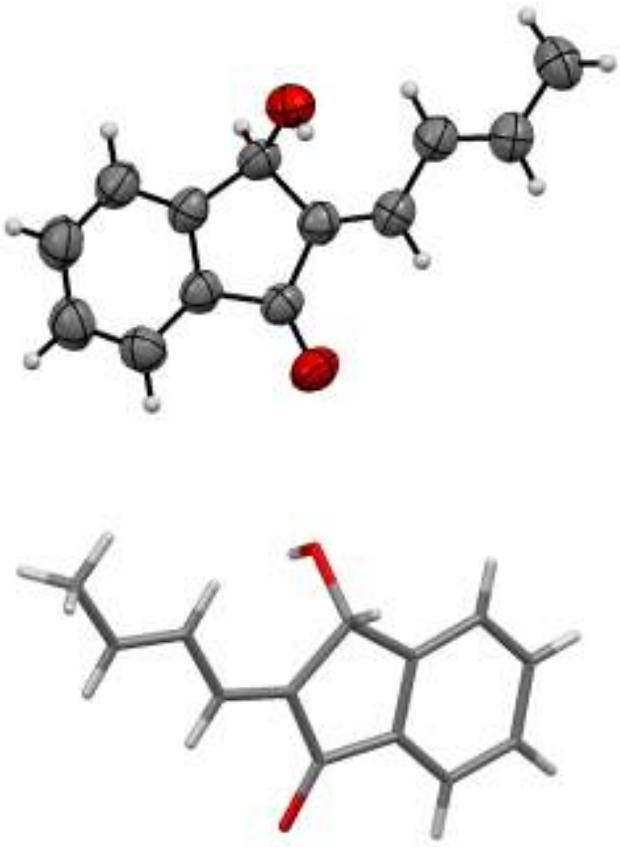
7-Acetyl-8-methyl-11*H*-benzo[*a*]fluoren-11-one (13f).



This compound was isolated as pale yellow solid. Following the general procedure-6, 40 mg of **2n** afforded 22 mg of **13f** (48% yield). M.P = 162-164 °C. R_f = 0.4 (Hexane/EtOAc = 3/1). **IR (thin film, neat):** ν_{max}/cm^{-1} 2935, 1702, 1692, 1604, 1581, 1280, 1060, 761. **^{1}H NMR (400 MHz, $CDCl_3$):** δ 9.02 (d, *J* = 8.5 Hz, 1H), 7.95 (*J* = 8.4

Hz, 1H), 7.80 (d, *J* = 8.1 Hz, 1H), 7.64-7.62 (m, 1H), 7.55 (d, *J* = 7.7 Hz, 1H), 7.49-7.46 (m, 1H), 7.41 (d, *J* = 8.1 Hz, 1H), 7.14 (d, *J* = 7.8 Hz, 1H), 2.71 (s, 3H), 2.34 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$):** δ 206.8, 194.0, 144.3, 139.2, 138.6, 137.0, 135.8, 134.3, 132.9, 130.9, 130.2, 129.6, 128.3, 127.6, 126.8, 124.4, 123.9, 119.4, 32.6, 19.2. **HRMS (ESI):** *m/z* calcd for $C_{20}H_{15}O_2$ $(M+H)^+$: 287.1072. Found: 287.1076.

Crystal structure of racemic 2a (CCDC 1520613): Structure of the racemic indanone **2a** was confirmed by single crystal X-ray diffraction analysis.



Crystal Data for $C_{13}H_{12}O_2$ (M =200.24 g/mol): triclinic, space group P-1 (no. 2), a = 7.8751(9) Å, b = 8.2320(4) Å, c = 8.8523(12) Å, α = 73.986(8)°, β = 73.564(11)°, γ = 83.983(8)°, V = 528.84(10) Å^3, Z = 2, T = 298 K, μ(Mo Kα) = 0.084 mm^{-1}, *Dcalc* = 1.2574 g/cm^3, 11929 reflections measured (4.96° ≤ 2Θ ≤ 65.5°), 3626 unique (R_{int} = 0.0618, R_{sigma} = 0.0428) which were used in all calculations. The final R_1 was 0.0969 (I>=2u(I)) and wR_2 was 0.2917 (all data).

Table 1: Crystal data and structure refinement for racemic 2a

Identification code	Racemic 2a
Empirical formula	$C_{13}H_{12}O_2$
Formula weight	200.24
Temperature/K	298
Crystal system	triclinic
Space group	P-1
a/Å	7.8751(9)
b/Å	8.2320(4)

c/Å	8.8523(12)
α/°	73.986(8)
β/°	73.564(11)
γ/°	83.983(8)
Volume/Å^3	528.84(10)
Z	2
ρ_{calc}g/cm^3	1.2574
μ/mm^{-1}	0.084
F(000)	212.1
Crystal size/mm^3	0.25 × 0.2 × 0.14
Radiation	Mo Kα (λ = 0.71073)
2Θ range for data collection/°	4.96 to 65.5
Index ranges	-11 ≤ h ≤ 10, -11 ≤ k ≤ 12, -12 ≤ l ≤ 13
Reflections collected	11929
Independent reflections	3626 [R_{int} = 0.0618, R_{sigma} = 0.0428]
Data/restraints/parameters	3626/0/137
Goodness-of-fit on F^2	1.467
Final R indexes [I>=2σ (I)]	R_1 = 0.0969, wR_2 = 0.2396
Final R indexes [all data]	R_1 = 0.1444, wR_2 = 0.2917
Largest diff. peak/hole / e Å^{-3}	0.72/-0.35

Table 2: Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for 2a. U_{eq} is defined as 1/3 of of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
O001	6489.9(19)	7938.7(19)	1949.2(16)	67.3(5)
O002	2431(2)	5482.5(18)	6815.7(18)	69.9(5)
C003	5107(3)	7023(2)	6204(2)	53.9(5)
C004	3686(3)	7263(2)	4112(2)	54.2(5)
C005	6154(3)	8021(2)	4790(2)	55.4(5)
C006	3576(2)	6465(2)	5852(2)	53.3(5)
C007	5327(3)	8328(2)	3368(2)	56.3(5)
C008	2483(3)	6998(2)	3406(2)	57.5(5)
C009	2413(3)	7727(3)	1744(3)	61.1(5)
C00A	1145(3)	7332(3)	1181(3)	63.2(5)
C00B	5564(3)	6618(3)	7674(3)	67.3(6)
C00C	7750(3)	8594(3)	4801(3)	67.7(6)
C00D	8210(3)	8167(3)	6260(3)	76.5(7)
C00E	7123(4)	7225(3)	7685(3)	76.0(7)
C00F	952(3)	8043(4)	-500(3)	76.7(7)

Table 3: Anisotropic Displacement Parameters (Å^2×10^3) for bsme. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.

Atom	U_{11}	U_{22}	U_{33}	U_{12}	U_{13}	U_{23}
O001	67.6(9)	67.5(10)	61.0(9)	-9.4(7)	-10.6(7)	-11.3(7)

O002	70.5(10)	59.5(9)	73.3(10)	-16.9(7)	-9.7(7)	-10.9(7)
C003	60.7(10)	43.3(9)	59.9(10)	-1.0(7)	-18.8(8)	-14.1(8)
C004	57.6(10)	47.8(9)	58.6(10)	-0.2(8)	-16.6(8)	-15.1(8)
C005	57.3(10)	45.2(9)	65.8(11)	-3.6(8)	-17.5(9)	-15.7(8)
C006	56.4(10)	44.8(9)	58.7(11)	-4.0(7)	-13.7(8)	-14.0(8)
C007	62.7(11)	45.6(9)	58.9(11)	-9.5(8)	-17.2(9)	-6.9(8)
C008	55.2(10)	52.8(10)	66.0(12)	-5.3(8)	-15.7(9)	-16.9(9)
C009	58.8(11)	59.5(11)	66.7(12)	-5.4(8)	-18.4(9)	-15.9(9)
C00A	60.7(11)	63.3(12)	70.8(13)	-2.3(9)	-21.0(9)	-21.7(10)
C00B	80.2(14)	60.9(12)	61.9(12)	-1.1(10)	-24.7(11)	-12.0(9)
C00C	65.6(12)	62.1(12)	76.3(14)	-11.8(10)	-20.1(10)	-14.5(10)
C00D	74.2(14)	76.3(15)	89.5(16)	-8.8(11)	-35.0(12)	-22.3(12)
C00E	85.8(16)	72.6(15)	80.7(15)	-0.8(12)	-40.6(13)	-19.2(12)
C00F	76.2(15)	89.0(17)	74.2(14)	0.9(12)	-29.4(12)	-27.5(12)

Table 4: Bond Lengths for racemic 2a.

Atom	Atom	Length/Å	Atom	Atom	Length/Å
O001	C007	1.425(3)	C005	C007	1.525(3)
O002	C006	1.238(2)	C005	C00C	1.391(3)
C003	C005	1.383(3)	C008	C009	1.442(3)
C003	C006	1.472(3)	C009	C00A	1.338(3)
C003	C00B	1.390(3)	C00A	C00F	1.486(3)
C004	C006	1.480(3)	C00B	C00E	1.377(3)
C004	C007	1.520(3)	C00C	C00D	1.382(3)
C004	C008	1.337(3)	C00D	C00E	1.383(4)

Table 5: Bond Angles for racemic 2a.

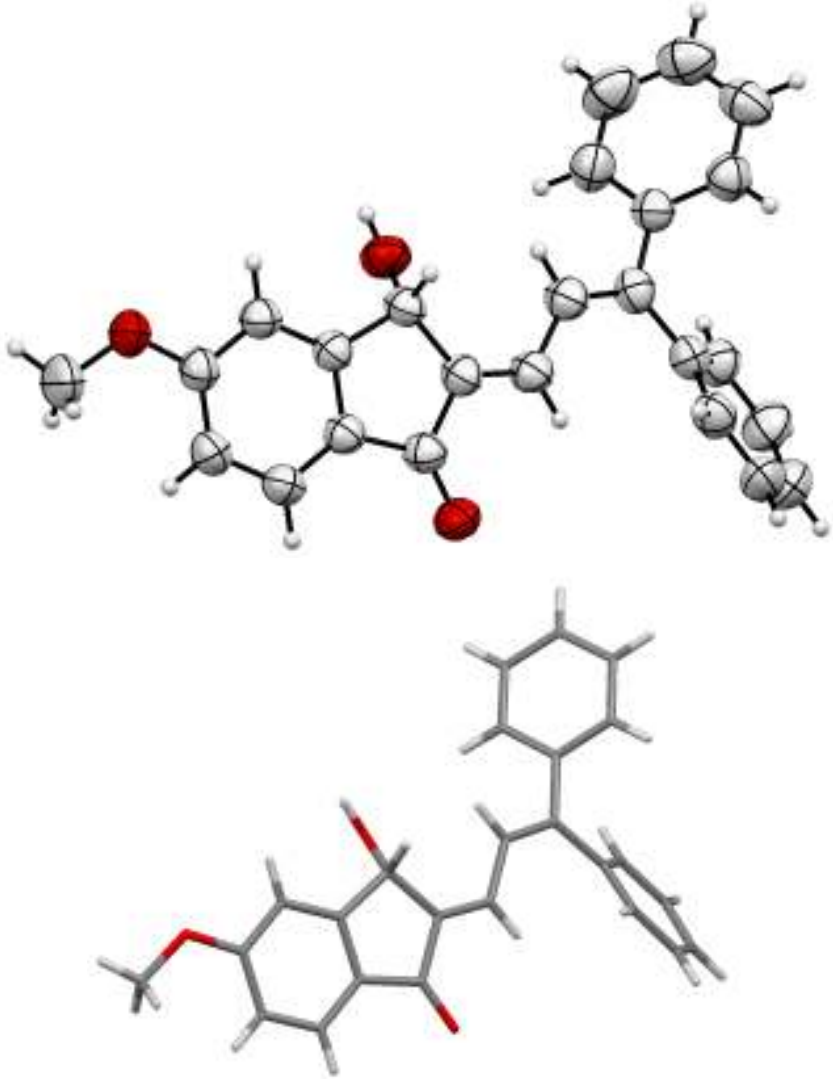
Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
C006	C003	C005	109.58(17)	C004	C006	C003	107.19(16)
C00B	C003	C005	121.9(2)	C004	C007	O001	114.40(16)
C00B	C003	C006	128.44(19)	C005	C007	O001	113.86(16)
C007	C004	C006	108.84(16)	C005	C007	C004	102.62(15)
C008	C004	C006	121.95(18)	C009	C008	C004	127.4(2)
C008	C004	C007	129.21(18)	C00A	C009	C008	121.4(2)
C007	C005	C003	111.61(17)	C00F	C00A	C009	125.1(2)
C00C	C005	C003	119.8(2)	C00E	C00B	C003	117.9(2)
C00C	C005	C007	128.54(18)	C00D	C00C	C005	117.9(2)
C003	C006	O002	126.68(17)	C00E	C00D	C00C	122.0(2)
C004	C006	O002	126.10(18)	C00D	C00E	C00B	120.4(2)

Table 6: Hydrogen Atom Coordinates (Å×10^4) and Isotropic Displacement Parameters (Å^2×10^3) for racemic 2a.

Atom	*x*	*y*	*z*	U(eq)
H00C	8485(3)	9243(3)	3855(3)	81.2(7)

H00D	9281(3)	8525(3)	6285(3)	91.8(8)
H00E	7447(4)	7000(3)	8656(3)	91.2(8)
H00B	4840(3)	5958(3)	8619(3)	80.8(7)
H001	6820(30)	6942(11)	2172(10)	100.9(7)
H007	4951(3)	9521(2)	3084(2)	67.5(6)
H008	1591(3)	6259(2)	4062(2)	69.0(6)
H009	3266(3)	8489(3)	1050(3)	73.3(6)
H00A	320(3)	6553(3)	1897(3)	75.9(7)
H00f	1895(17)	8800(20)	-1124(8)	115.1(10)
H00g	1000(30)	7141(4)	-1006(10)	115.1(10)
H00h	-165(13)	8650(20)	-456(3)	115.1(10)

Crystal structure of chiral 2j (CCDC 1520308): Structure of the chiral indanone **2j** was confirmed by single crystal X-ray diffraction analysis. Absolute stereochemistry was realised to be (*S*).



Crystal Data for $C_{25}H_{20}O_3$ (*M* =368.42 g/mol): orthorhombic, space group $P2_12_12_1$ (no. 19), *a* = 10.1899(4) Å, *b* = 13.3377(5) Å, *c* = 14.4940(7) Å, *V* = 1969.88(14) Å^3, *Z* = 8, *T* = 298 K, μ(Mo Kα) = 0.081 mm^{-1}, *Dcalc* = 1.2422 g/cm^3, 15325 reflections measured (5.62° ≤ 2Θ ≤ 65.52°), 6671 unique (R_{int} = 0.0263, R_{sigma} = 0.0399) which were used in all calculations. The final R_1 was 0.0593 (I>=2u(I)) and wR_2 was 0.1979 (all data).

Table 1: Crystal data and structure refinement for Chiral 2j

Identification code	Chiral 2j
Empirical formula	$C_{25}H_{20}O_3$
Formula weight	368.42
Temperature/K	298

Crystal system	orthorhombic
Space group	$P2_12_12_1$
a/Å	10.1899(4)
b/Å	13.3377(5)
c/Å	14.4940(7)
α/°	90
β/°	90
γ/°	90
Volume/Å^3	1969.88(14)
Z	8
ρ_{calc}g/cm^3	1.2422
μ/mm^{-1}	0.081
F(000)	776.4
Crystal size/mm^3	0.2 × 0.15 × 0.12
Radiation	Mo Kα (λ = 0.71073)
2Θ range for data collection/°	5.62 to 65.52
Index ranges	-14 ≤ h ≤ 14, -16 ≤ k ≤ 19, -15 ≤ l ≤ 21
Reflections collected	15325
Independent reflections	6671 [R_{int} = 0.0263, R_{sigma} = 0.0399]
Data/restraints/parameters	6671/0/254
Goodness-of-fit on F^2	1.053
Final R indexes [I>=2σ (I)]	R_1 = 0.0593, wR_2 = 0.1576
Final R indexes [all data]	R_1 = 0.1099, wR_2 = 0.1979
Largest diff. peak/hole / e Å^{-3}	0.28/-0.20
Flack parameter	-0.6(9)

Table 2: Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for BS06OMediph. U_{eq} is defined as 1/3 of of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
O001	-5270.0(17)	-9422.2(12)	-3131.7(14)	71.4(5)
O002	-6061.1(16)	-6272.1(12)	-1904.2(13)	71.0(5)
O003	-1220.6(18)	-6755.7(13)	-683.1(14)	76.9(5)
C004	-4027.7(18)	-7214.5(15)	-2114.1(14)	48.2(4)
C005	-3937.0(19)	-8244.4(14)	-2271.1(14)	49.6(4)
C006	-3090(2)	-6727.5(16)	-1593.1(15)	54.8(5)
C007	-5060(2)	-8576.9(15)	-2825.9(14)	53.5(5)
C008	-5915.0(19)	-7689.5(15)	-2962.4(15)	52.1(5)
C009	-9242(2)	-6956.4(17)	-3781.7(15)	53.6(5)
C00A	-10059(2)	-6043.4(16)	-3685.7(15)	54.3(5)
C00B	-2075(2)	-7279.5(17)	-1207.6(15)	56.2(5)
C00C	-1981(2)	-8312.5(17)	-1365.4(17)	59.7(5)
C00D	-5244(2)	-6771.3(15)	-2551.7(16)	52.4(5)
C00E	-7104(2)	-7759.1(16)	-3355.1(16)	56.8(5)
C00F	-9878(2)	-7846.6(16)	-4197.6(14)	53.4(5)

C00G	-2902(2)	-8791.1(16)	-1902.4(16)	58.2(5)
C00H	-8009(2)	-6933.9(17)	-3437.9(17)	59.1(5)
C00I	-11174(2)	-8073.9(18)	-3941.7(17)	62.2(6)
C00J	-10774(2)	-5667.7(19)	-4416.8(17)	65.1(6)
C00K	-9248(2)	-8475.2(18)	-4820.5(16)	63.1(6)
C00L	-11550(3)	-4821(2)	-4311(2)	77.3(7)
C00M	-11789(3)	-8921(2)	-4278.6(19)	75.2(7)
C00N	-10133(3)	-5542(2)	-2833.3(18)	69.6(6)
C00O	-11623(3)	-4351(2)	-3471(2)	84.8(8)
C00P	-11132(3)	-9551(2)	-4873(2)	83.2(8)
C00Q	-9876(3)	-9326(2)	-5141.5(19)	76.0(7)
C00R	-10912(3)	-4709(2)	-2748(2)	87.7(9)
C00S	-208(4)	-7278(2)	-209(3)	111.3(13)

Table 3: Anisotropic Displacement Parameters ($Å^2×10^3$) for BS06OMediph. The Anisotropic displacement factor exponent takes the form: $-2π^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+...]$.

Atom	U_{11}	U_{22}	U_{33}	U_{12}	U_{13}	U_{23}
O001	66.9(9)	52.5(8)	94.9(12)	-3.0(7)	-19.3(9)	-8.7(8)
O002	58.1(8)	59.1(9)	95.7(12)	9.7(8)	-7.5(9)	-14.5(9)
O003	73.6(11)	65.1(10)	92.0(12)	2.7(9)	-34.5(10)	-8.5(9)
C004	44.1(9)	48.6(9)	51.9(10)	-1.5(8)	-0.7(9)	3.9(8)
C005	46.9(9)	47.5(9)	54.4(11)	-1.6(8)	-0.5(9)	2.1(8)
C006	54(1)	46.4(10)	64.1(12)	-0.6(9)	-5.5(10)	1.2(9)
C007	53.8(10)	48.4(10)	58.2(11)	-1.8(9)	0.9(10)	0.8(9)
C008	44.9(9)	50.7(10)	60.7(12)	-3.4(8)	-3.4(9)	4.5(9)
C009	46.6(9)	60.2(12)	54.1(11)	-3.3(9)	-0.4(9)	4.5(9)
C00A	46.7(9)	52.6(10)	63.6(12)	-0.8(9)	-0.3(9)	0.1(10)
C00B	49.7(10)	58.6(12)	60.3(12)	-1.2(10)	-8.2(10)	1.9(10)
C00C	54.5(11)	58.6(12)	66.0(13)	6.2(10)	-10.5(11)	1.4(10)
C00D	48.1(9)	45.1(9)	63.9(12)	-1.2(8)	-5.5(10)	7.2(9)
C00E	50.1(10)	50.9(11)	69.3(13)	-4.3(9)	-3.4(10)	3.5(10)
C00F	49.9(10)	57.1(11)	53.4(10)	3.1(9)	-4.2(9)	2.7(9)
C00G	59.5(11)	48.4(10)	66.7(13)	5.4(9)	-5.4(11)	-0.4(10)
C00H	50.3(10)	54.9(11)	72.1(13)	-3.9(9)	-3.9(11)	2.9(10)
C00I	55.3(11)	64.0(12)	67.2(13)	-2(1)	-1.2(11)	-3.4(11)
C00J	60.4(12)	69.7(14)	65.1(14)	0.9(11)	-3.5(11)	-2.1(11)
C00K	61.0(12)	68.5(14)	59.8(13)	11.9(11)	-2.9(11)	-3.1(11)
C00L	64.7(14)	68.0(14)	99(2)	9.0(12)	-4.4(14)	13.1(15)
C00M	67.7(15)	73.0(15)	84.8(16)	-15.6(13)	-5.0(14)	-4.7(14)
C00N	64.6(13)	79.4(15)	64.7(13)	2.7(12)	-5.8(12)	-9.2(12)
C00O	63.2(14)	72.7(16)	118(2)	8.8(13)	6.8(16)	-12.2(17)
C00P	90(2)	68.7(15)	90.4(19)	-6.3(15)	-24.4(17)	-9.3(14)
C00Q	92.3(19)	69.1(14)	66.7(14)	17.0(14)	-15.7(14)	-14.3(12)

C00R	73.3(16)	90.7(19)	99(2)	6.7(15)	7.1(17)	-34.0(17)
C00S	106(2)	89(2)	139(3)	8(2)	-74(2)	-10(2)

Table 4: Bond Lengths for chiral 2j

Atom	Atom	Length/Å	Atom	Atom	Length/Å
O001	C007	1.230(3)	C00A	C00J	1.380(3)
O002	C00D	1.420(3)	C00A	C00N	1.407(3)
O003	C00B	1.351(3)	C00B	C00C	1.400(3)
O003	C00S	1.422(3)	C00C	C00G	1.376(3)
C004	C005	1.395(3)	C00E	C00H	1.441(3)
C004	C006	1.380(3)	C00F	C00I	1.405(3)
C004	C00D	1.512(3)	C00F	C00K	1.389(3)
C005	C007	1.467(3)	C00I	C00M	1.381(3)
C005	C00G	1.389(3)	C00J	C00L	1.387(4)
C006	C00B	1.387(3)	C00K	C00Q	1.383(3)
C007	C008	1.483(3)	C00L	C00O	1.371(4)
C008	C00D	1.524(3)	C00M	C00P	1.377(4)
C008	C00E	1.342(3)	C00N	C00R	1.370(4)
C009	C00A	1.482(3)	C00O	C00R	1.361(4)
C009	C00F	1.481(3)	C00P	C00Q	1.371(5)
C009	C00H	1.351(3)			

Table 5: Bond Angles for chiral 2j

Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
C00S	O003	C00B	119.1(2)	C00C	C00B	C006	120.5(2)
C006	C004	C005	120.44(18)	C00G	C00C	C00B	120.1(2)
C00D	C004	C005	111.76(17)	C004	C00D	O002	112.74(18)
C00D	C004	C006	127.78(18)	C008	C00D	O002	111.82(16)
C007	C005	C004	109.59(18)	C008	C00D	C004	102.56(15)
C00G	C005	C004	120.28(19)	C00H	C00E	C008	124.1(2)
C00G	C005	C007	130.11(19)	C00I	C00F	C009	118.5(2)
C00B	C006	C004	119.13(19)	C00K	C00F	C009	123.12(19)
C005	C007	O001	127.6(2)	C00K	C00F	C00I	118.4(2)
C008	C007	O001	125.51(19)	C00C	C00G	C005	119.47(19)
C008	C007	C005	106.87(17)	C00E	C00H	C009	127.5(2)
C00D	C008	C007	109.00(16)	C00M	C00I	C00F	120.7(2)
C00E	C008	C007	122.1(2)	C00L	C00J	C00A	120.8(2)
C00E	C008	C00D	128.80(19)	C00Q	C00K	C00F	120.0(2)
C00F	C009	C00A	116.80(17)	C00O	C00L	C00J	120.1(3)
C00H	C009	C00A	118.0(2)	C00P	C00M	C00I	120.0(3)
C00H	C009	C00F	125.1(2)	C00R	C00N	C00A	119.7(3)
C00J	C00A	C009	121.5(2)	C00R	C00O	C00L	119.6(3)
C00N	C00A	C009	120.2(2)	C00Q	C00P	C00M	119.9(3)
C00N	C00A	C00J	118.2(2)	C00P	C00Q	C00K	121.0(3)
C006	C00B	O003	115.7(2)	C00O	C00R	C00N	121.5(3)

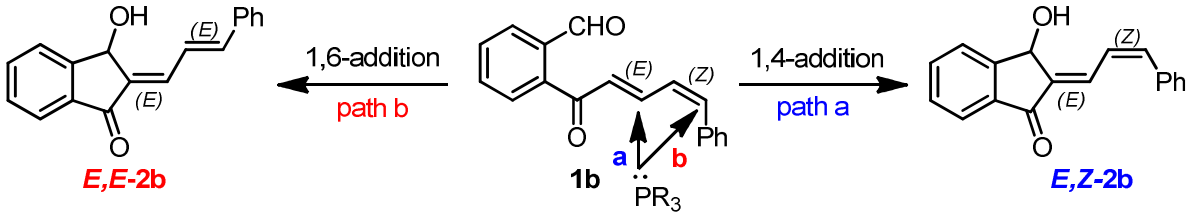
C00C	C00B	O003	123.8(2)

Table 6: Hydrogen Atom Coordinates (Å×10^4) and Isotropic Displacement Parameters (Å^2×10^3) for chiral 2j

Atom	*x*	*y*	*z*	U(eq)
H002	-5770(20)	-5708(10)	-1810(20)	106.4(7)
H006	-3139(2)	-6038.4(16)	-1501.7(15)	65.8(6)
H00C	-1294(2)	-8676.0(17)	-1106.9(17)	71.6(6)
H00D	-4993(2)	-6307.3(15)	-3045.4(16)	62.8(6)
H00E	-7359(2)	-8378.5(16)	-3588.6(16)	68.1(6)
H00G	-2832(2)	-9474.9(16)	-2017.5(16)	69.8(6)
H00H	-7711(2)	-6314.5(17)	-3230.7(17)	70.9(6)
H00I	-11623(2)	-7649.9(18)	-3541.5(17)	74.6(7)
H00J	-10735(2)	-5985.8(19)	-4987.1(17)	78.1(7)
H00K	-8405(2)	-8323.9(18)	-5021.8(16)	75.7(7)
H00L	-12022(3)	-4572(2)	-4810(2)	92.7(9)
H00M	-12647(3)	-9065(2)	-4104.5(19)	90.2(8)
H00N	-9656(3)	-5774(2)	-2330.0(18)	83.5(7)
H00O	-12155(3)	-3791(2)	-3396(2)	101.7(10)
H00P	-11539(3)	-10128(2)	-5091(2)	99.8(10)
H00Q	-9439(3)	-9752(2)	-5546.1(19)	91.2(9)
H00R	-10955(3)	-4382(2)	-2182(2)	105.2(10)
H00a	399(17)	-7550(20)	-648(3)	167(2)
H00b	240(20)	-6823(6)	194(17)	167(2)
H00f	-585(4)	-7811(16)	148(18)	167(2)

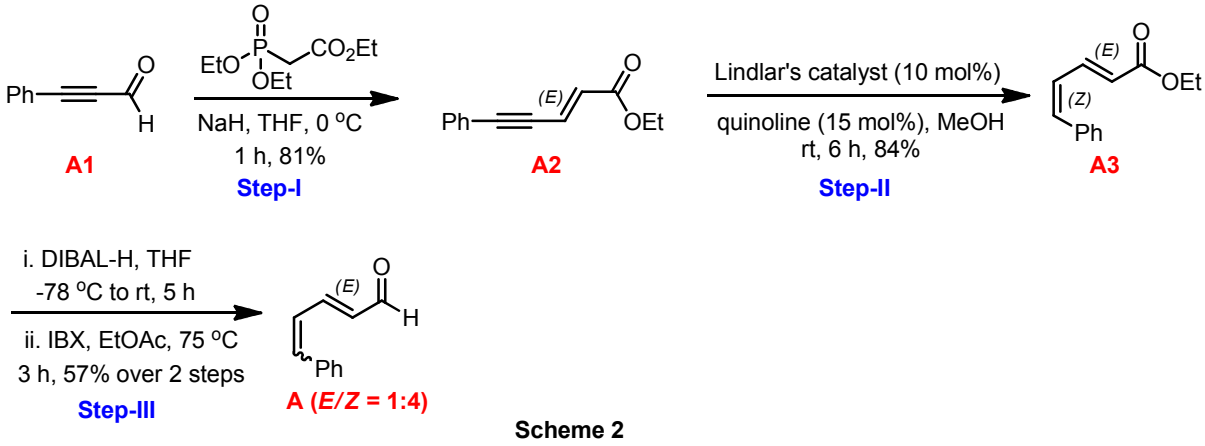
Efforts to gain evidence for 1,4- *vs* 1,6-addition of phosphines

In an attempt to prove 1,4- *vs* 1,6-addition of phosphine, we planned to synthesize the substrate **1b**, where the two double bonds (of the dienone moiety) are disposed *E* and *Z*, Scheme 1. In case of a 1,4-addition of phosphine (path a), the stereochemical integrity of the *Z*-configured double bond should remain unchanged, leading to the formation of ***E,Z*-2b**. But in case of a 1,6-addition (path b), the stereochemical information at the *Z*-configured double bond (of **1b**) should be lost and thus should lead to a thermodynamically preferred ***E,E*-2b**, Scheme 1.



Scheme 1

Accordingly, we have designed a synthetic route to access the ***E,Z*-1b** as in Scheme 2. The required *E,Z*-aldehyde **A** was obtained from phenylpropargyl aldehyde **A1** via Wittig-Horner reaction, hydrogenation of **A2** using Lindlar's catalyst, DIBAL-H reduction of the ester **A3**, and IBX oxidation sequence.

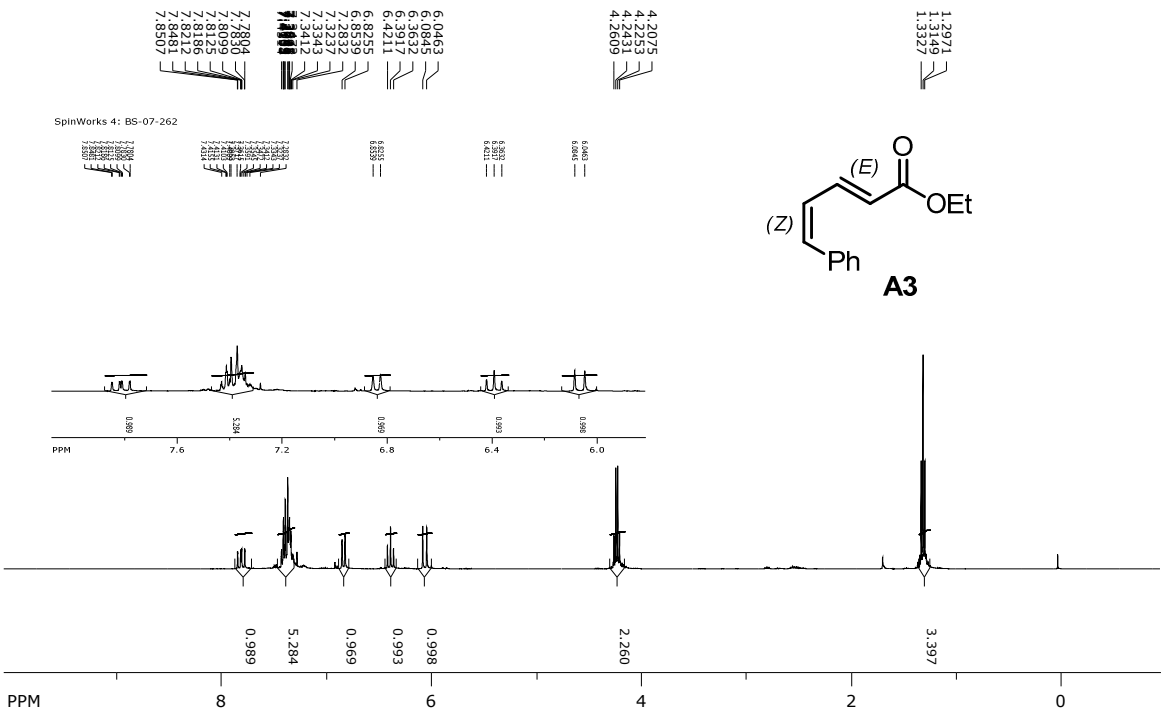


Scheme 2

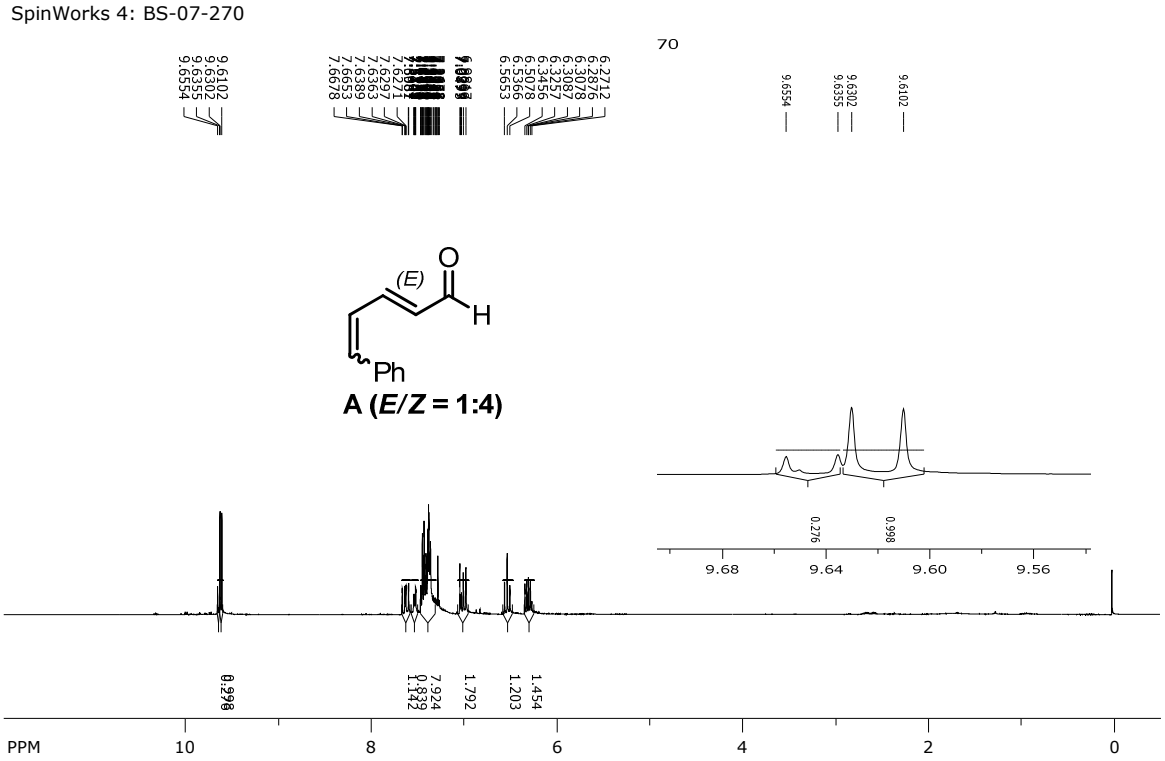
SpinWorks 4: bs 07 260

A2

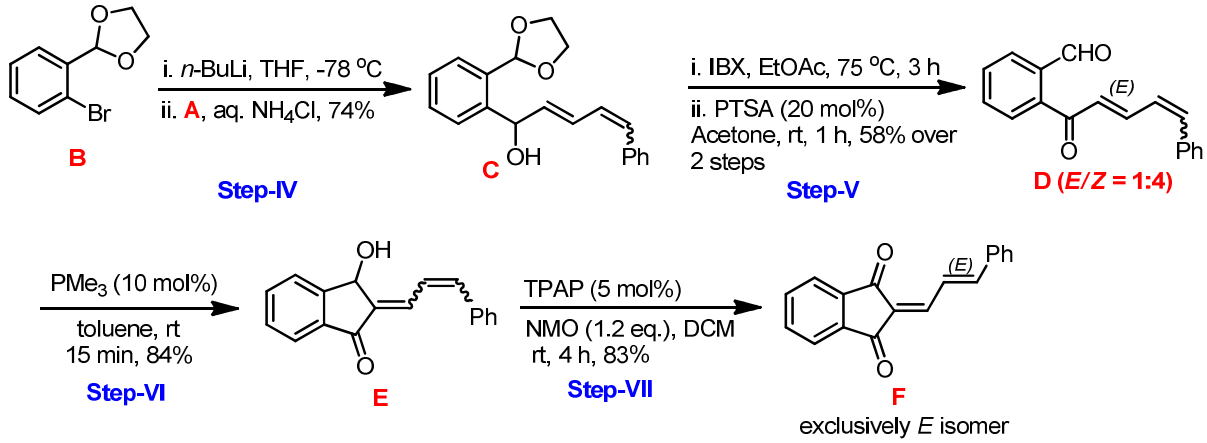
SpinWorks 4: BS-07-262



A3



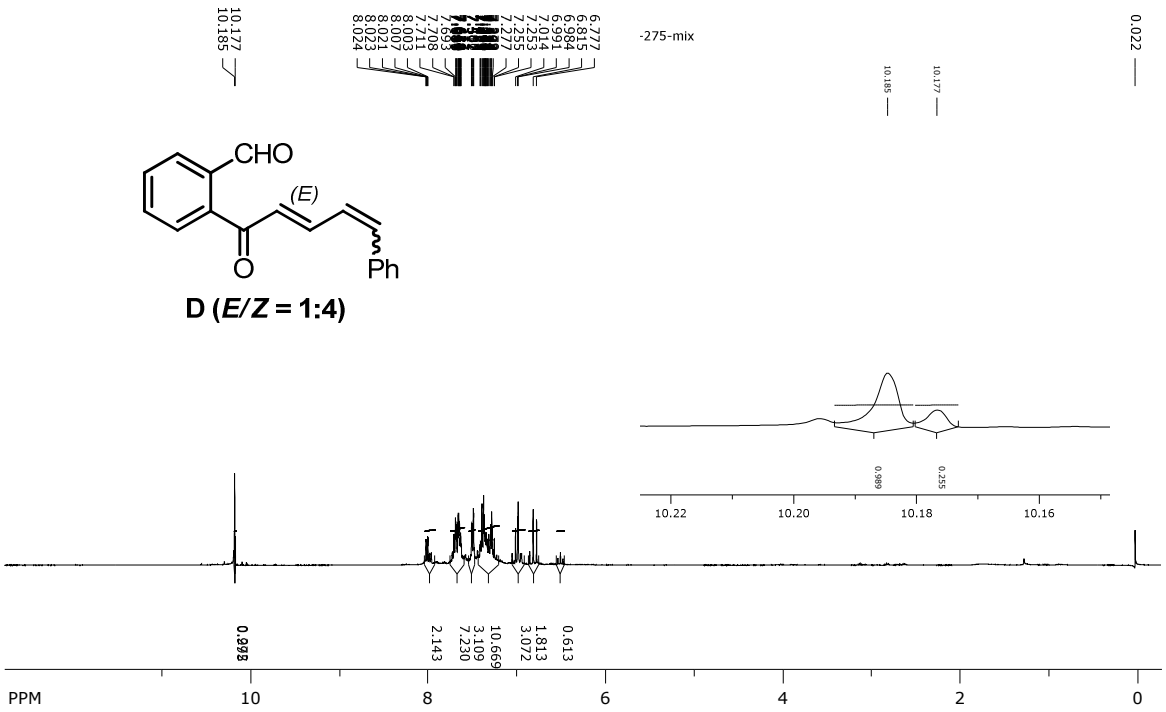
Further, *n*-butyllithium mediated alkylation, IBX oxidation, and acetal deprotection furnished the desired dienone **D** in 1:4 *E/Z* ratio (Scheme 3). IMBH reaction of **D** under the optimized conditions generated the indanone **E**. However, at this stage we were unable to extract the stereochemical information across the double bonds (see the ^{1}H-NMR of **E**). Thus, the indanone **E** was oxidized using tetrapropylammonium perruthenate (TPAP) to indanedione **F**. ^{1}H-NMR of indanedione **F** clearly indicated the presence of *E*-configured double bond. The data of **F** was also verified with the literature report.[3]



Scheme 3

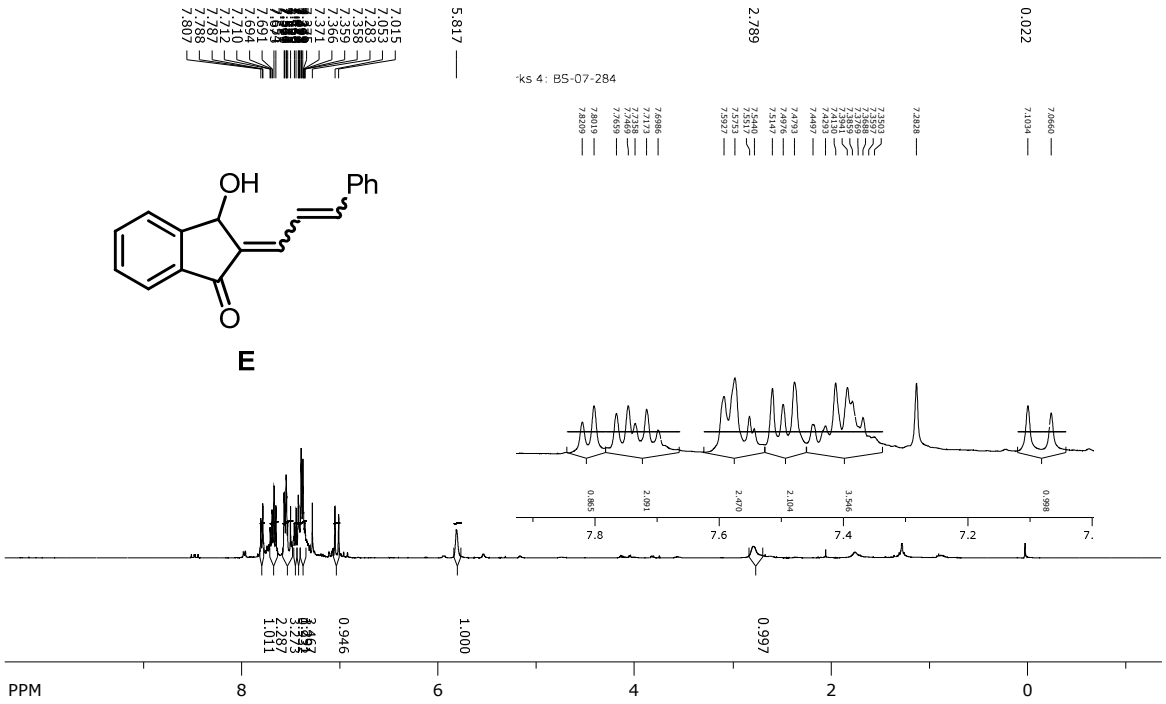
[3] F. J. Chang, R. Gurubrahamam and K. Chen, *Adv. Synth. Catal.*, 2017, **359**, 1277.

SpinWorks 4: bs-07-275-mix

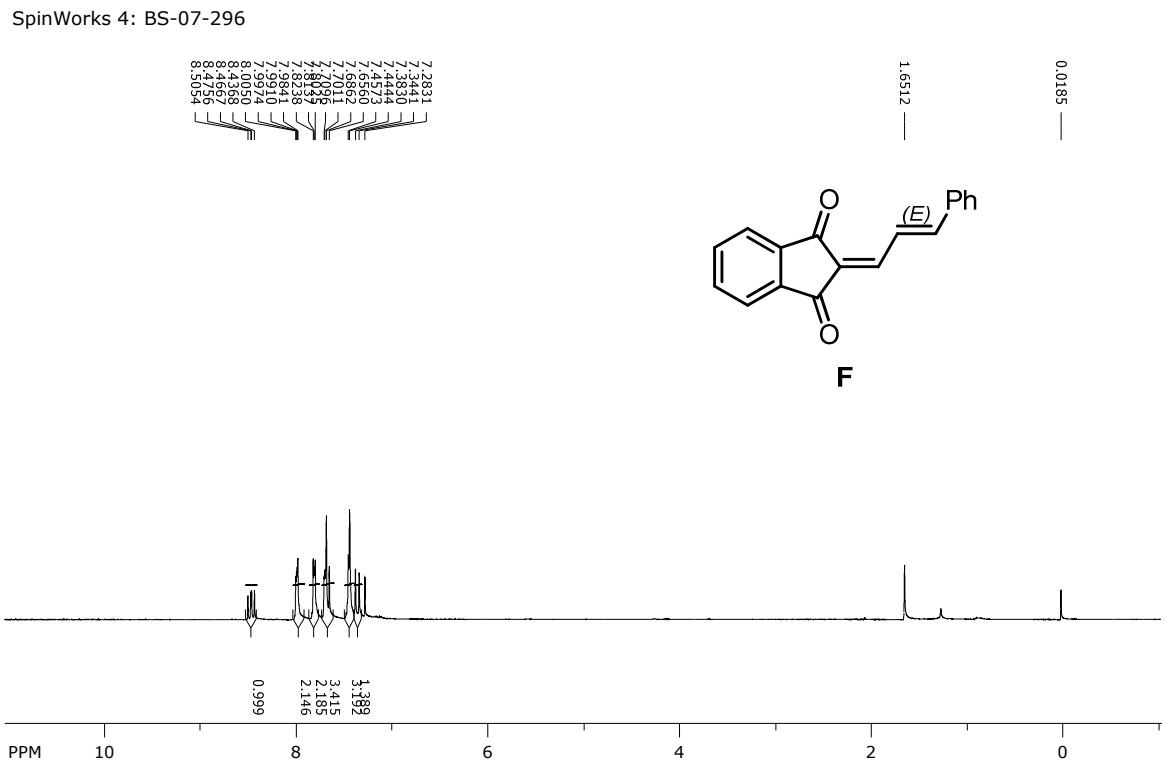


D (*E*/*Z* = 1:4)

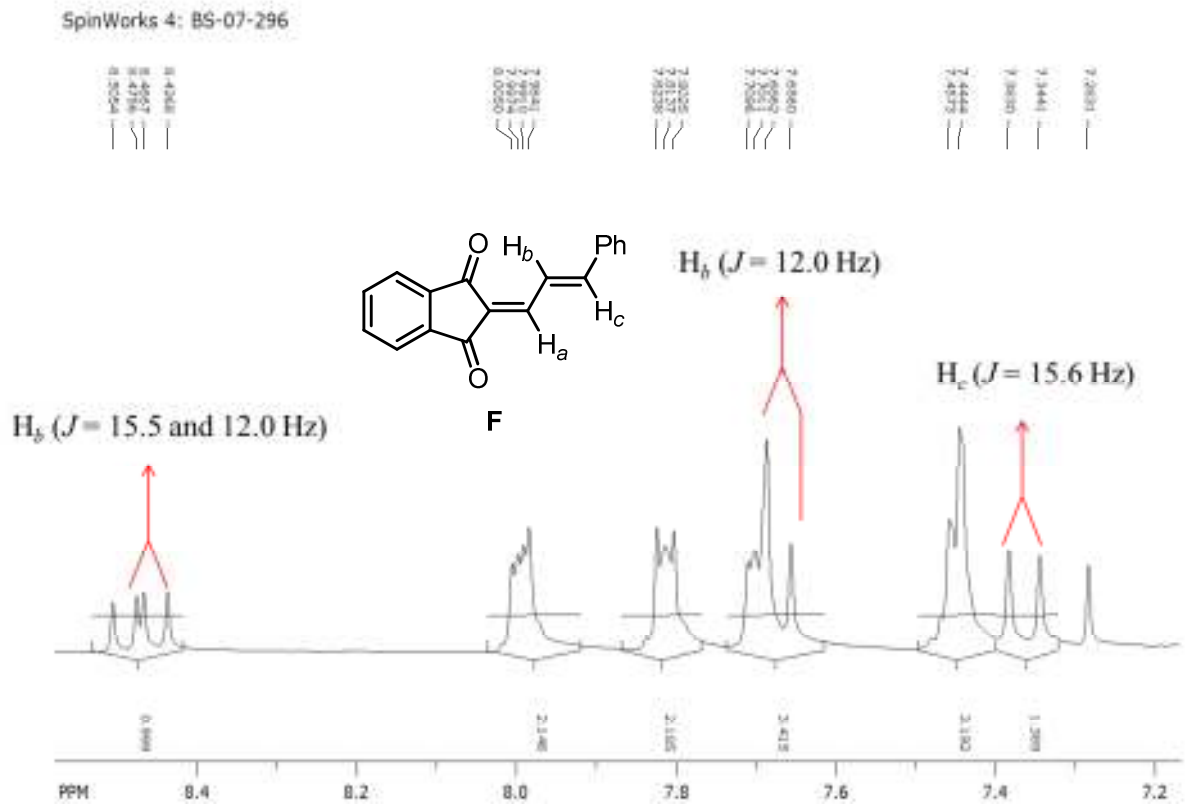
SpinWorks 4: bs-07-284



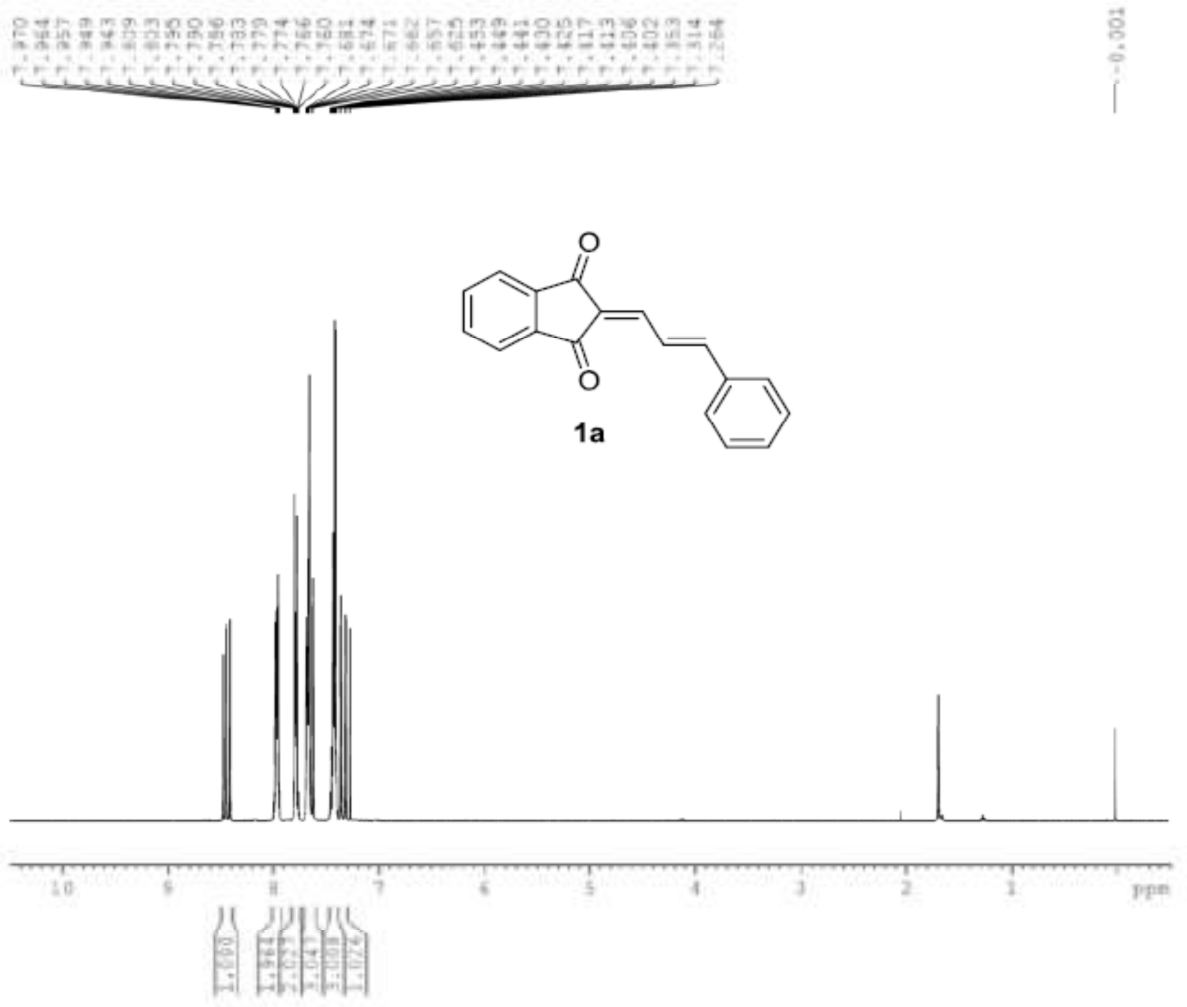
E



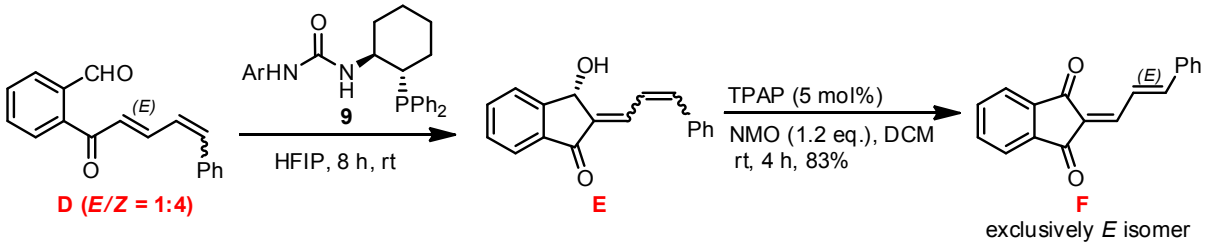
Expansion of the aromatic region of F (below):



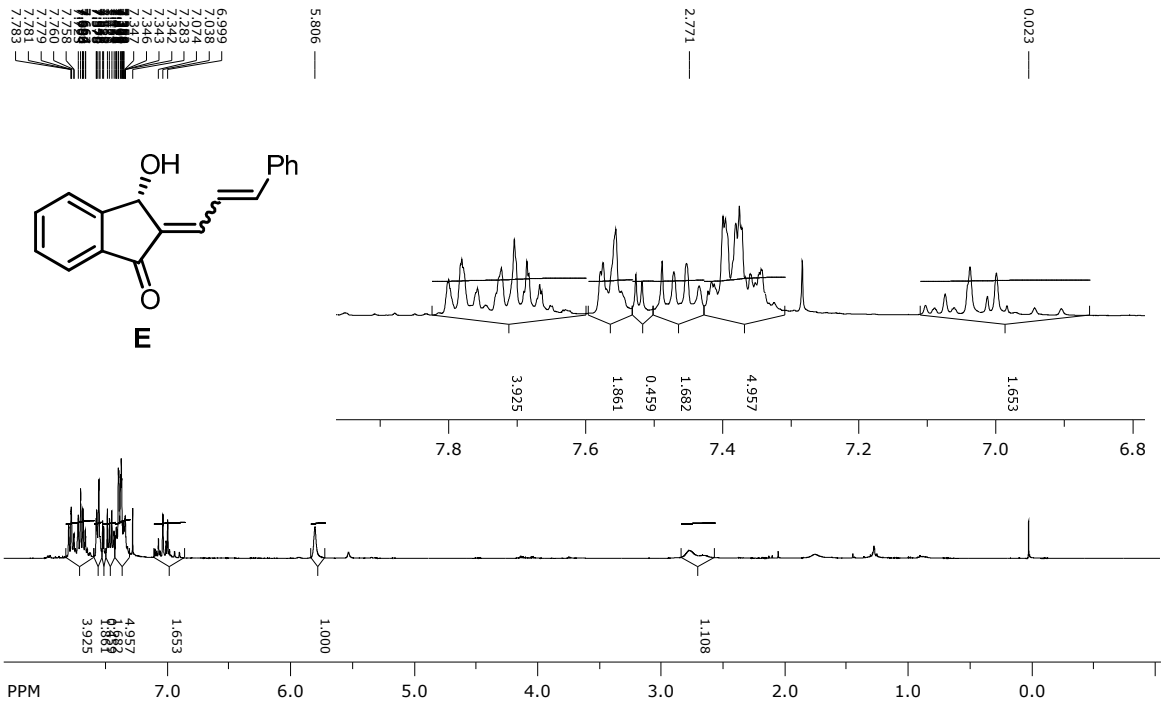
Reported ^{1}H NMR of Compound F (F. J. Chang, R. Gurubrahamam and K. Chen, *Adv. Synth. Catal*., 2017, **359**, 1277)



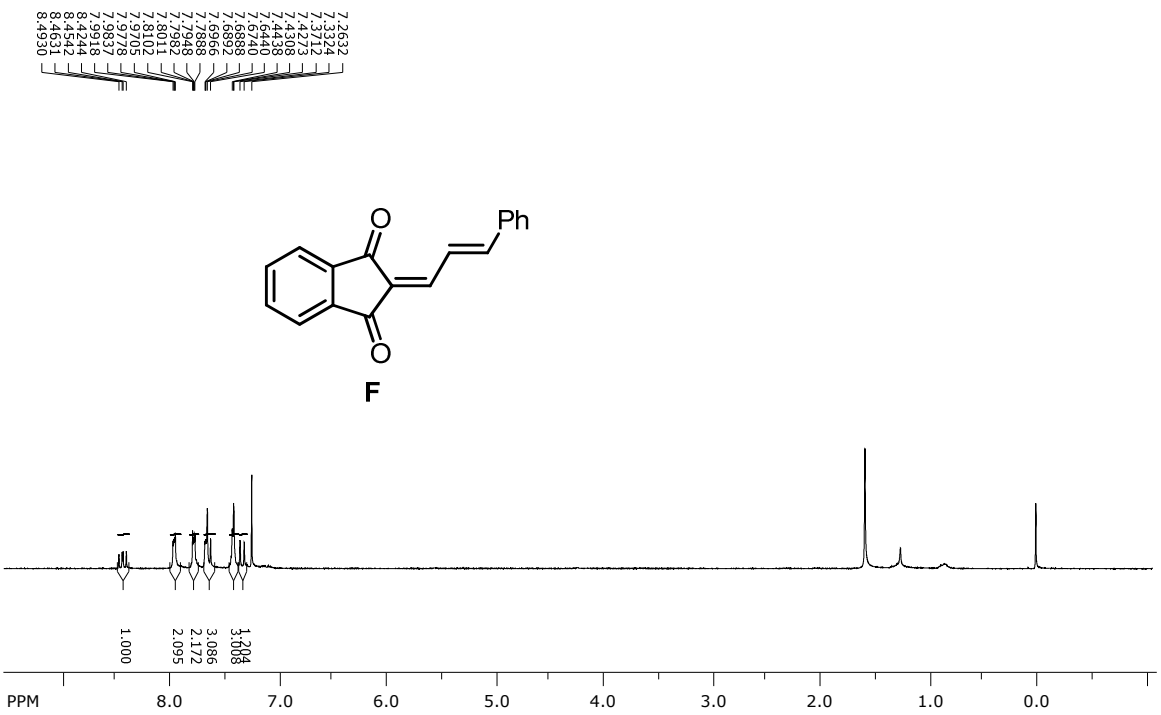
We also have performed the reaction of the dienone **D** (*E*/*Z* = 1:4) with the chiral catalyst **9**. ^{1}H-NMR of the diketone **F** also indicated the exclusive formation of the *E*-isomer.

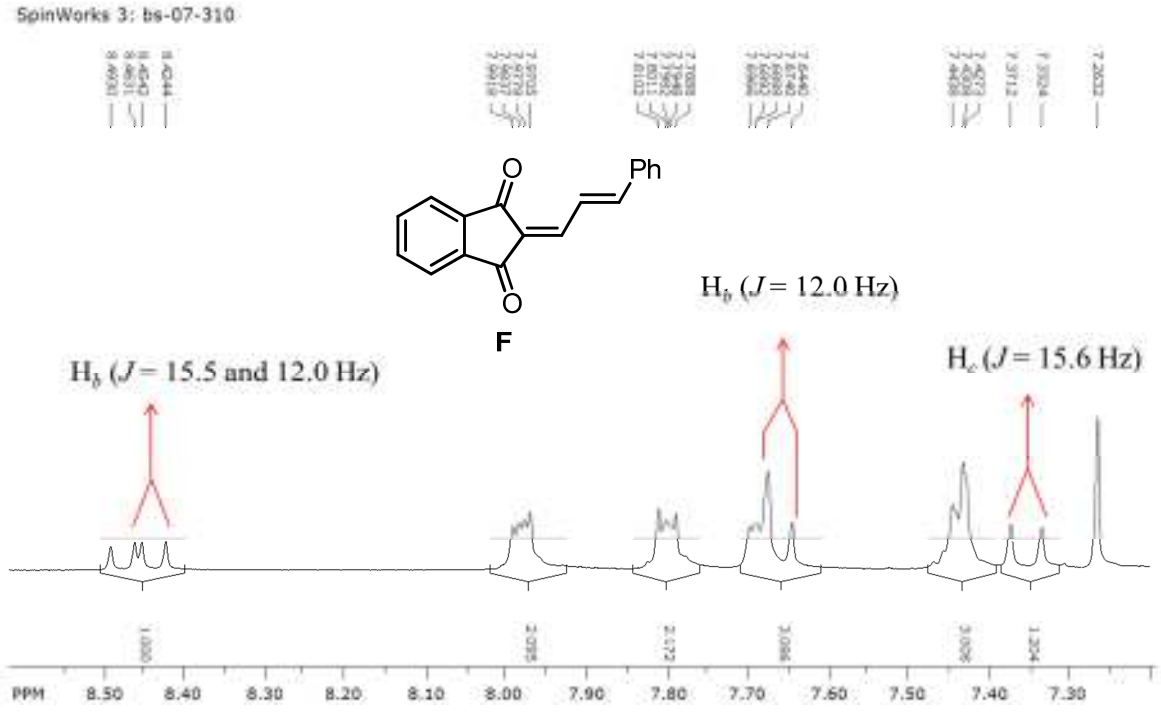


SpinWorks 4: bs-07-283

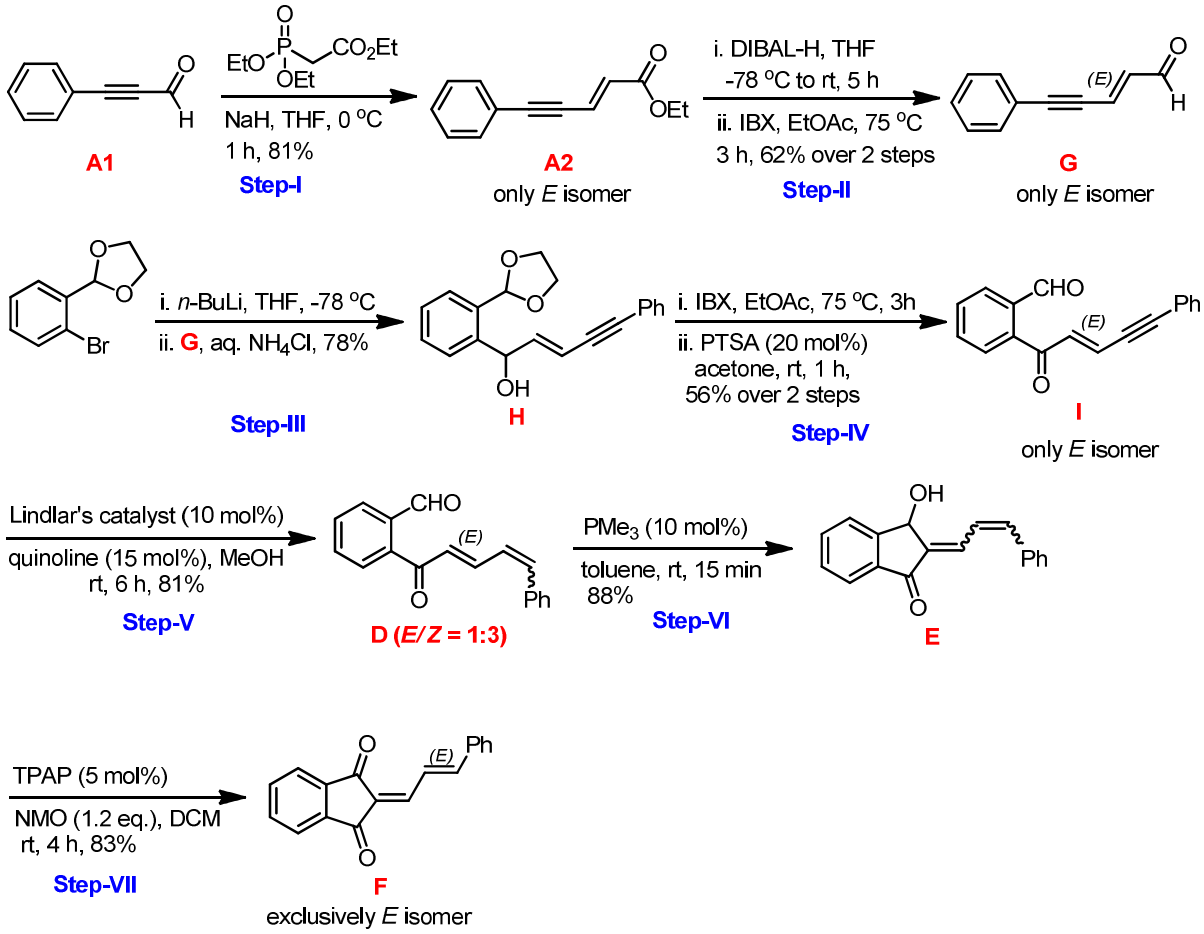


SpinWorks 3: bs-07-310



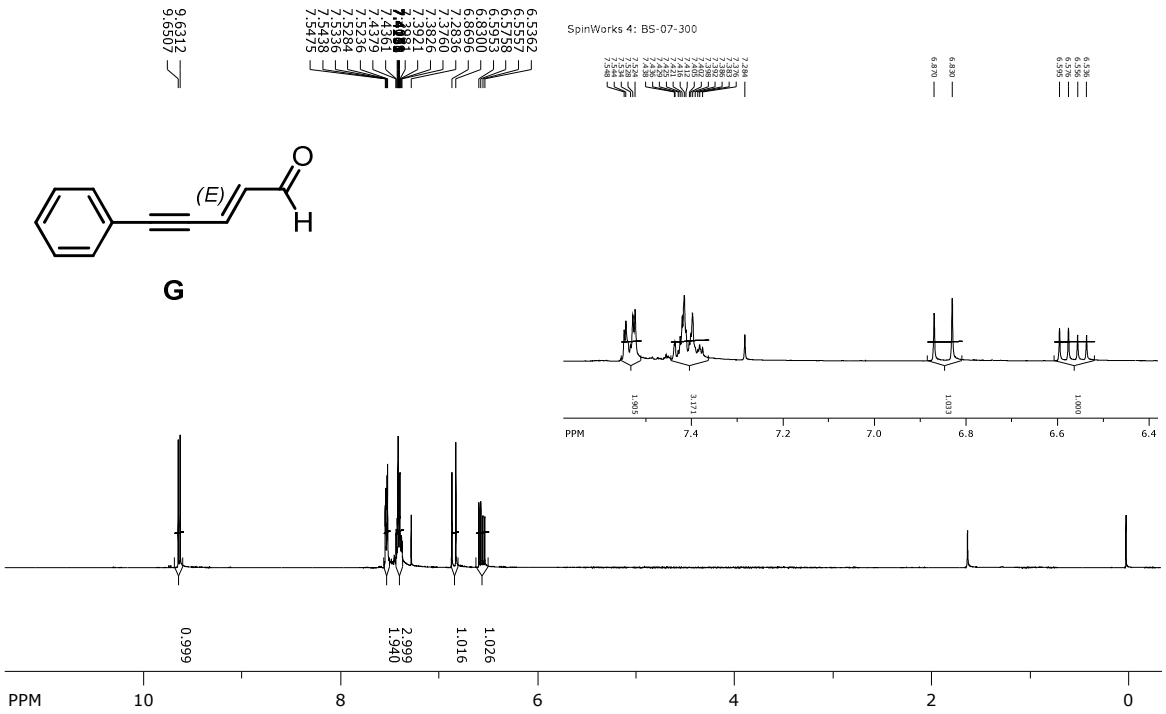

SpinWorks 3: bs-07-310
O
Ph
O
F
H_b (J = 12.0 Hz)
H_b (J = 15.5 and 12.0 Hz)
H_c (J = 15.6 Hz)
PPM
8.50
8.40
8.30
8.20
8.10
8.00
7.90
7.80
7.70
7.60
7.50
7.40
7.30

A parallel approach has also been considered for the stereoselective synthesis of the required starting material, the dienone **D** (Scheme 4). Towards this, the enynone **I** was synthesized by following a similar synthetic sequence described in Scheme 3. The dienone **D** was achieved via the selective hydrogenation of **I** using the Lindlar's catalyst. Reaction of **D** with trimethyl phosphine produced the indanone **E**, but the stereochemical information across the double bonds could not be extracted. As described earlier, the indanone **E** was oxidised to indanedione **F** and the ^{1}H-NMR spectrum indicated the formation of only the *E*-isomer of **F**. The data of **F** was also verified with the literature report.[1]



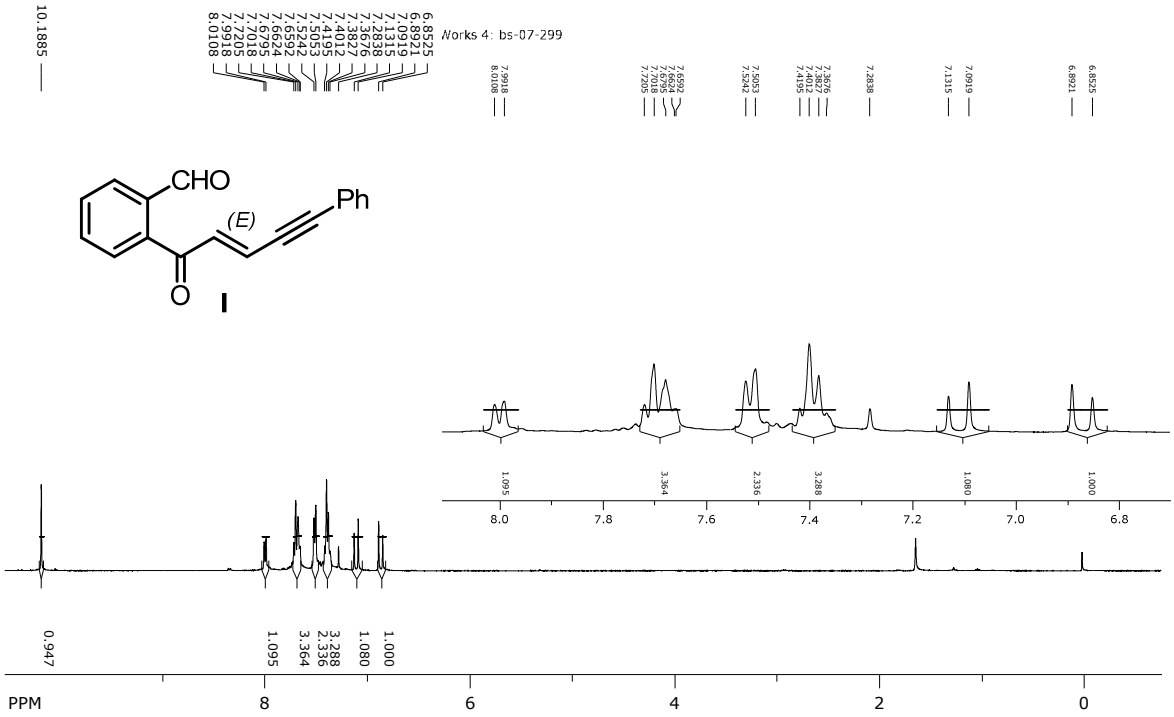
Scheme 4

SpinWorks 4: BS-07-300



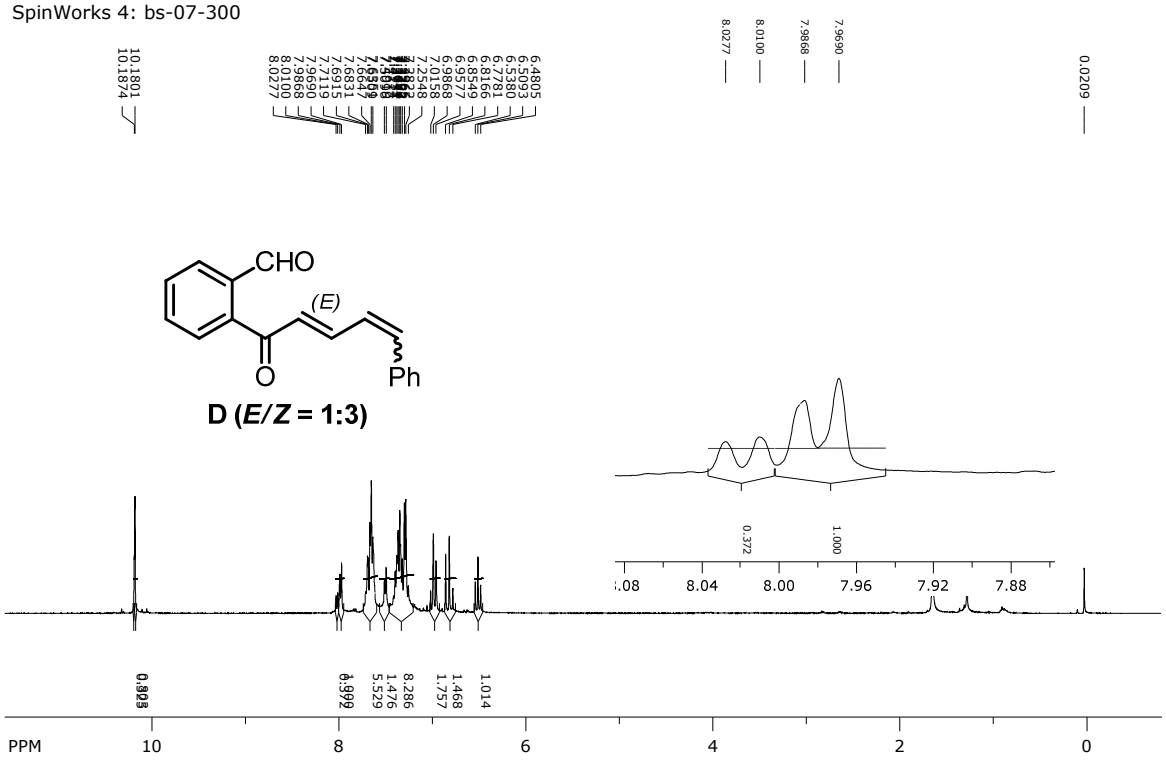
G

SpinWorks 4: bs-07-299

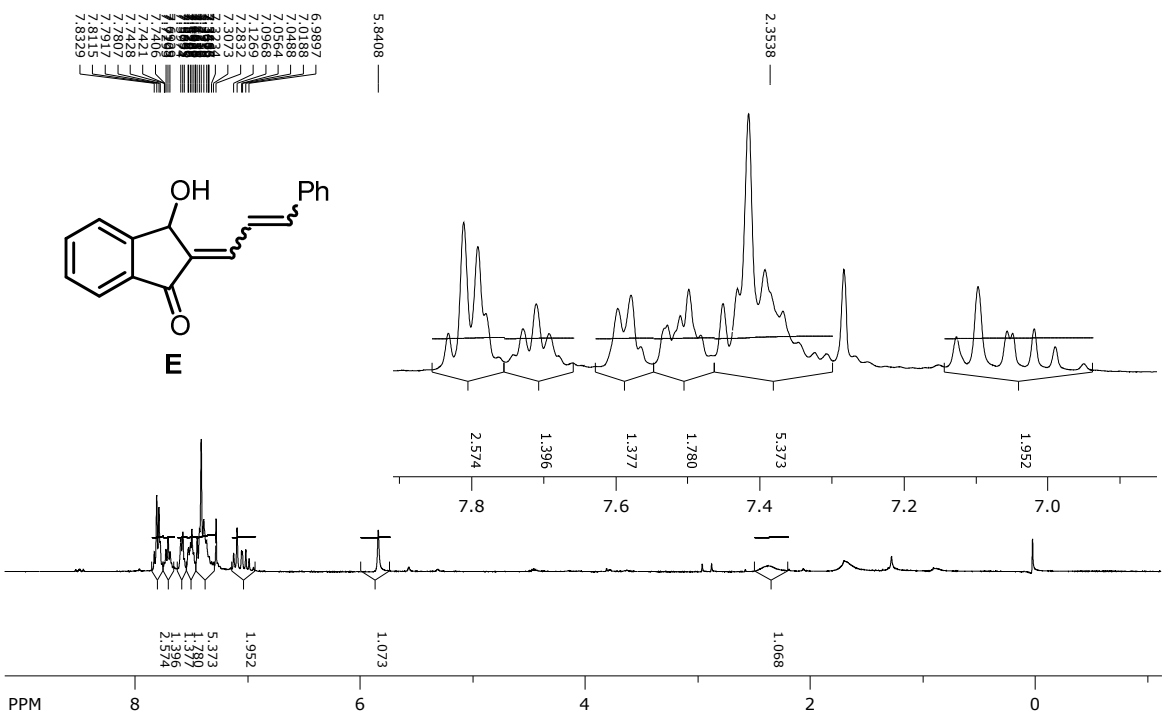


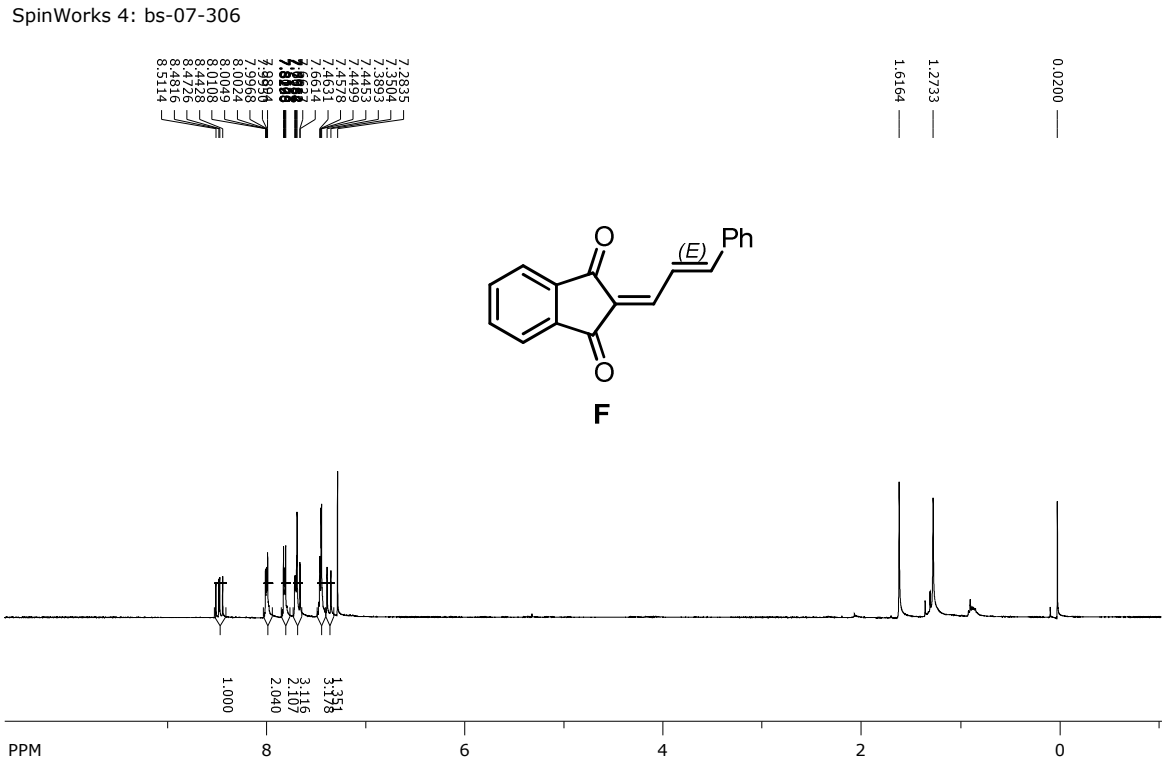
I

SpinWorks 4: bs-07-300

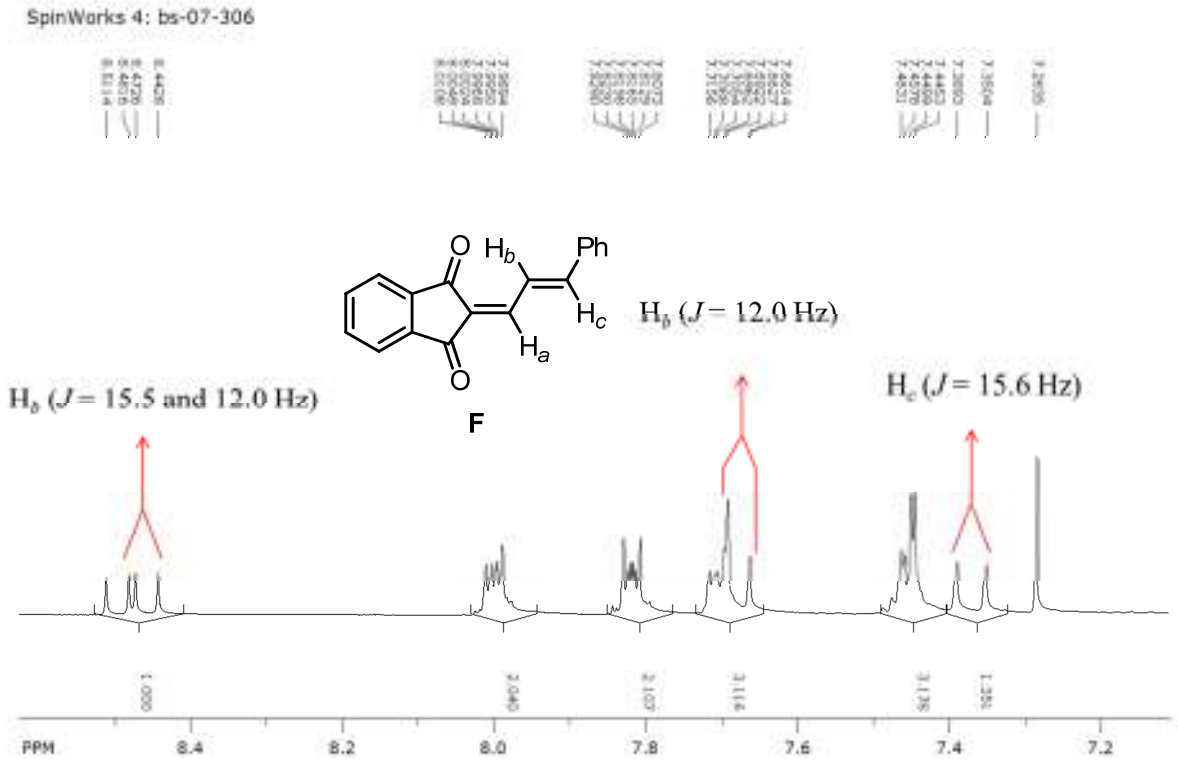


SpinWorks 4: bs-07-302

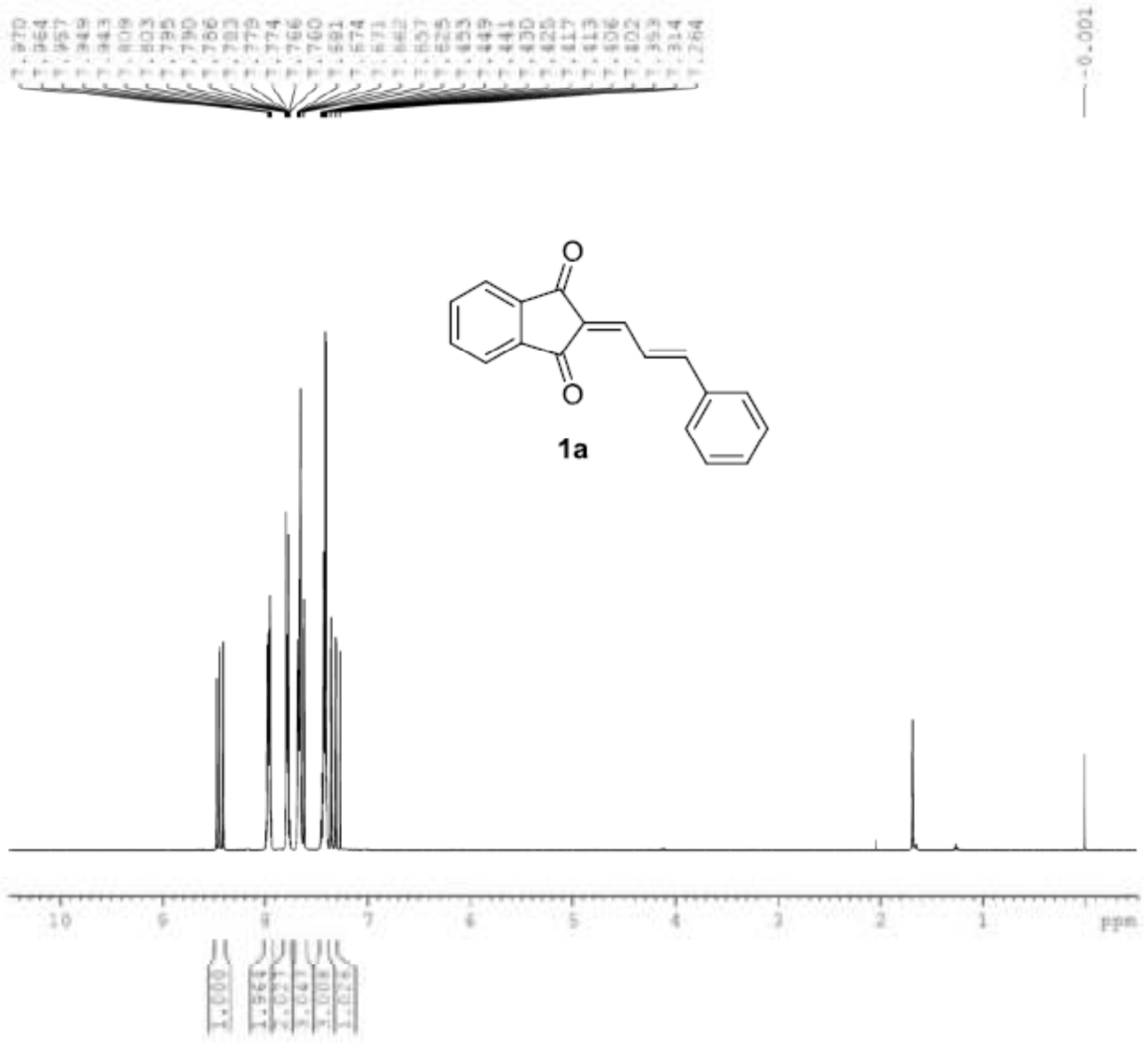




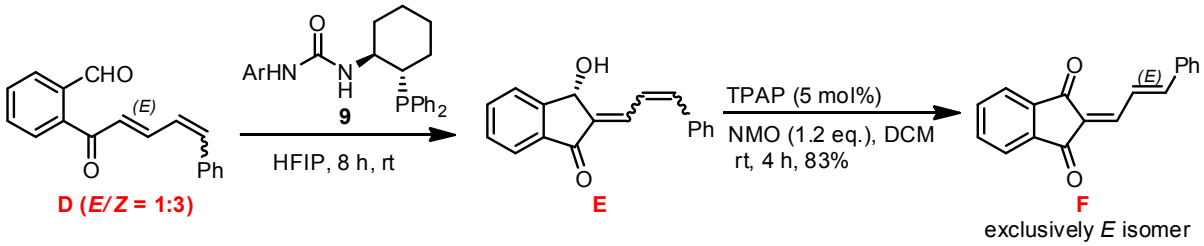
Expansion of the aromatic region of F (below):



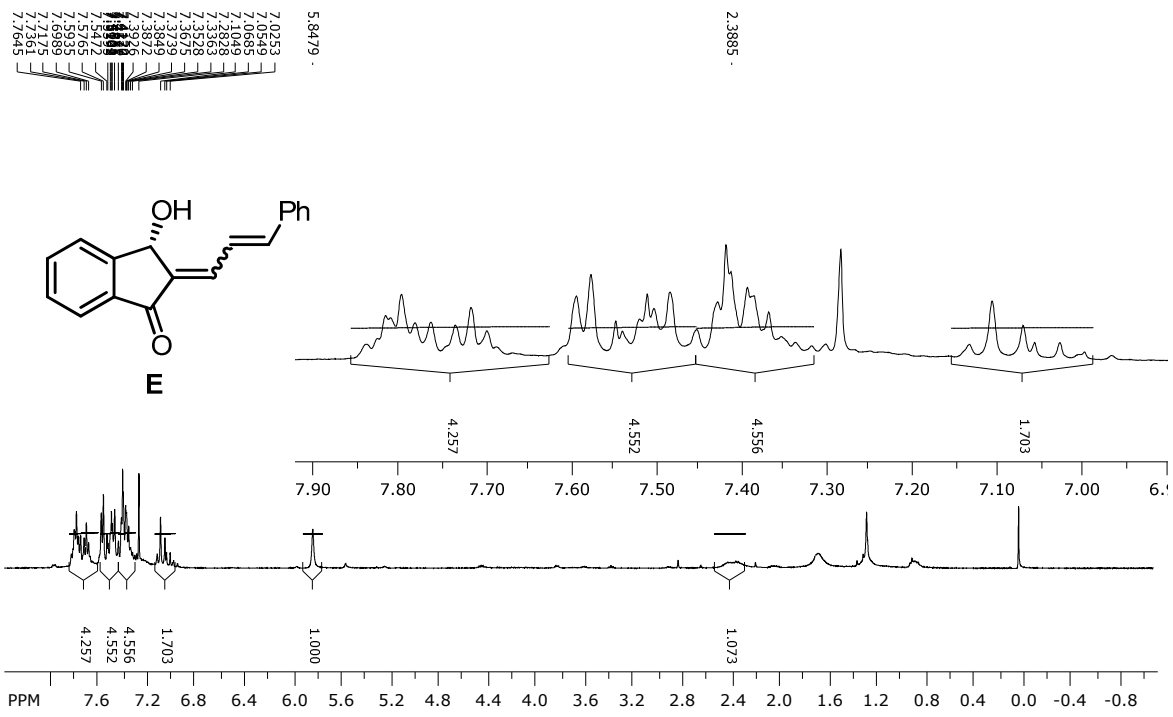
Reported ^{1}H NMR of Compound F (F. J. Chang, R. Gurubrahamam and K. Chen, *Adv. Synth. Catal*., 2017, **359**, 1277)



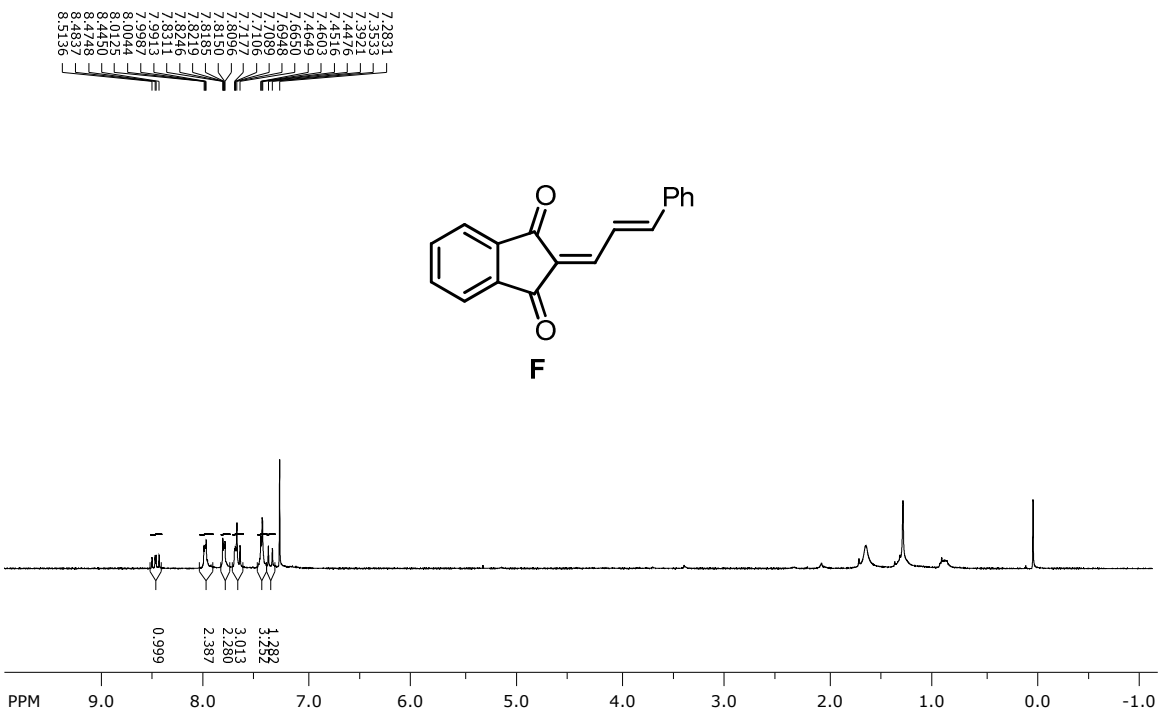
We also have performed the reaction of the dienone **D** (*E*/*Z* = 1:3) with the chiral catalyst **9**. ^{1}H-NMR of the diketone **F** also indicated the exclusive formation of the *E*-isomer.



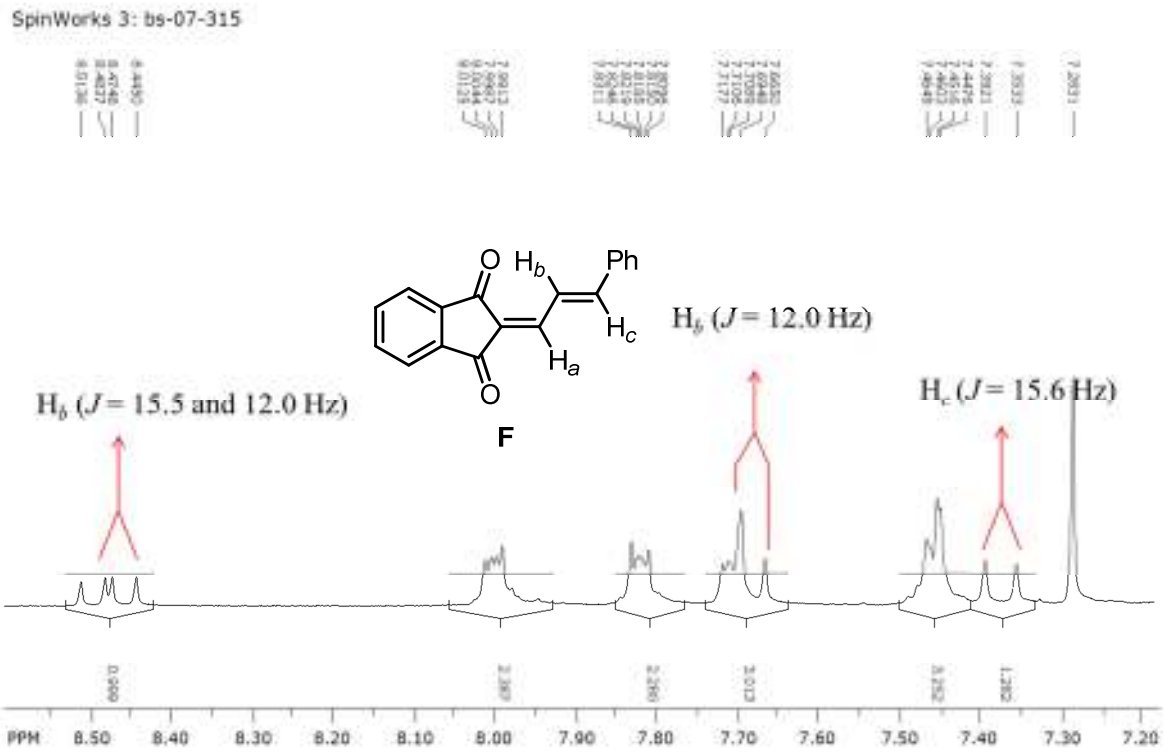
SpinWorks 3: bs-07-312



SpinWorks 3: bs-07-315

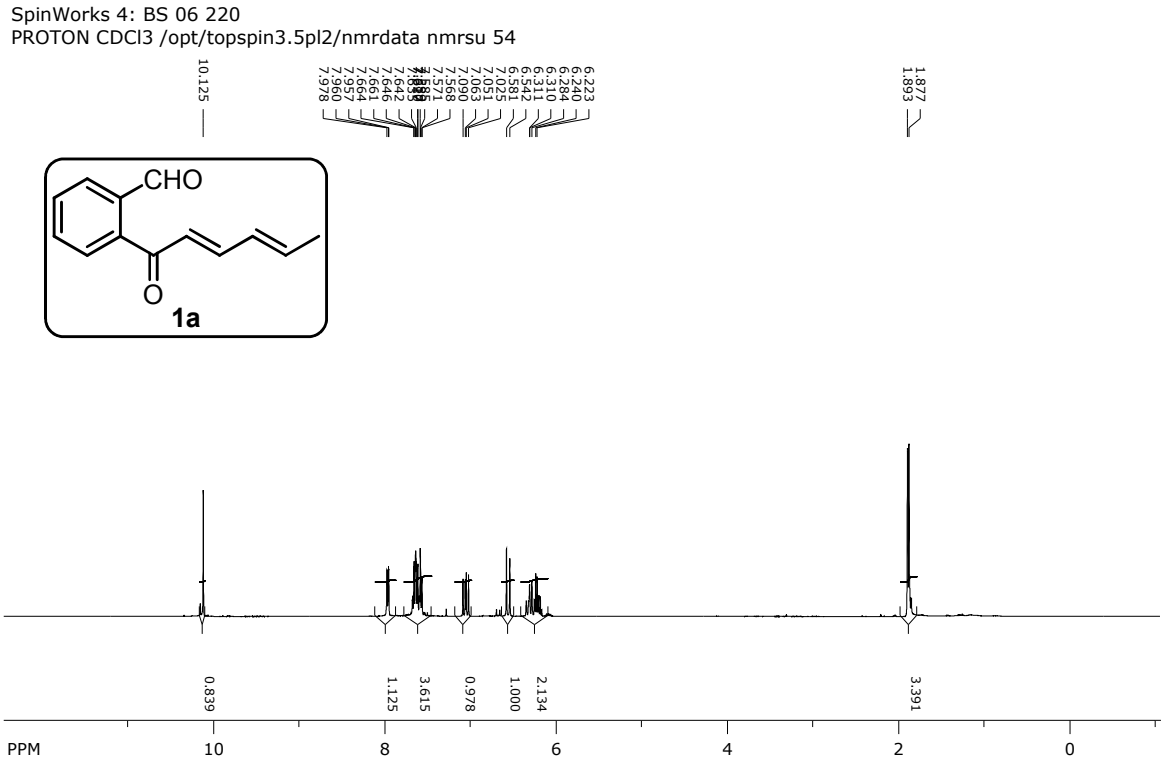


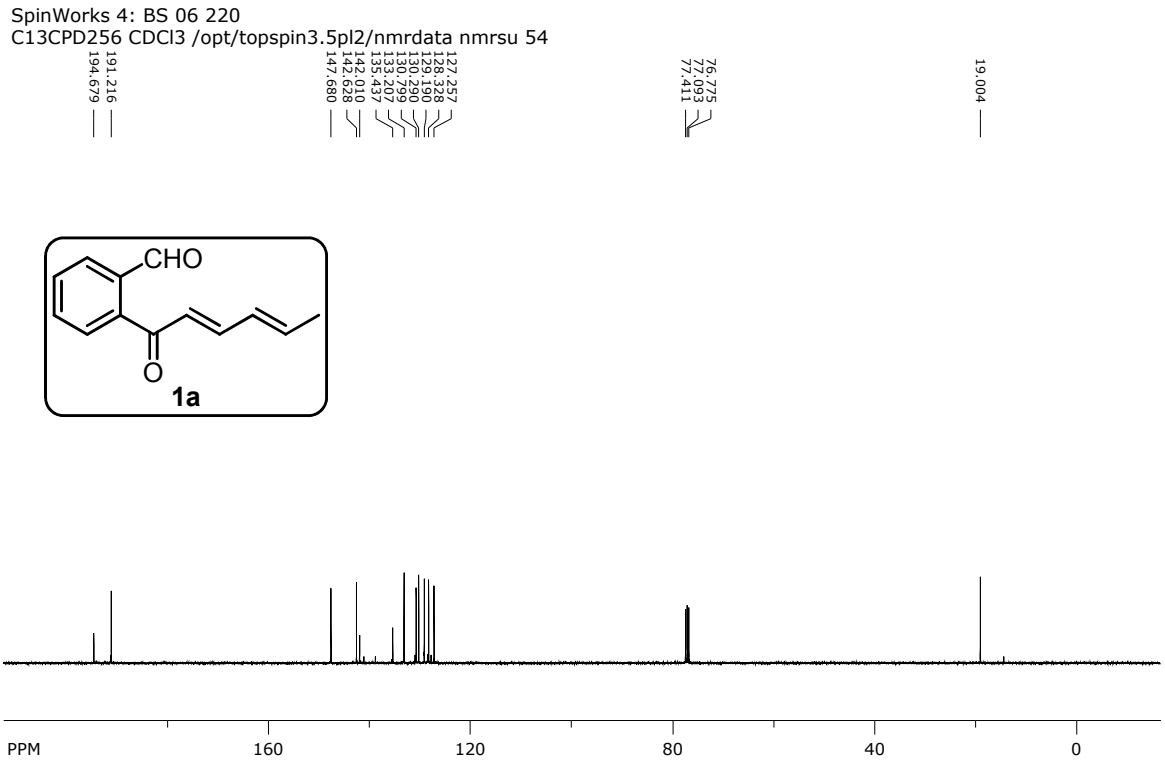
Expansion of the aromatic region of F (below):



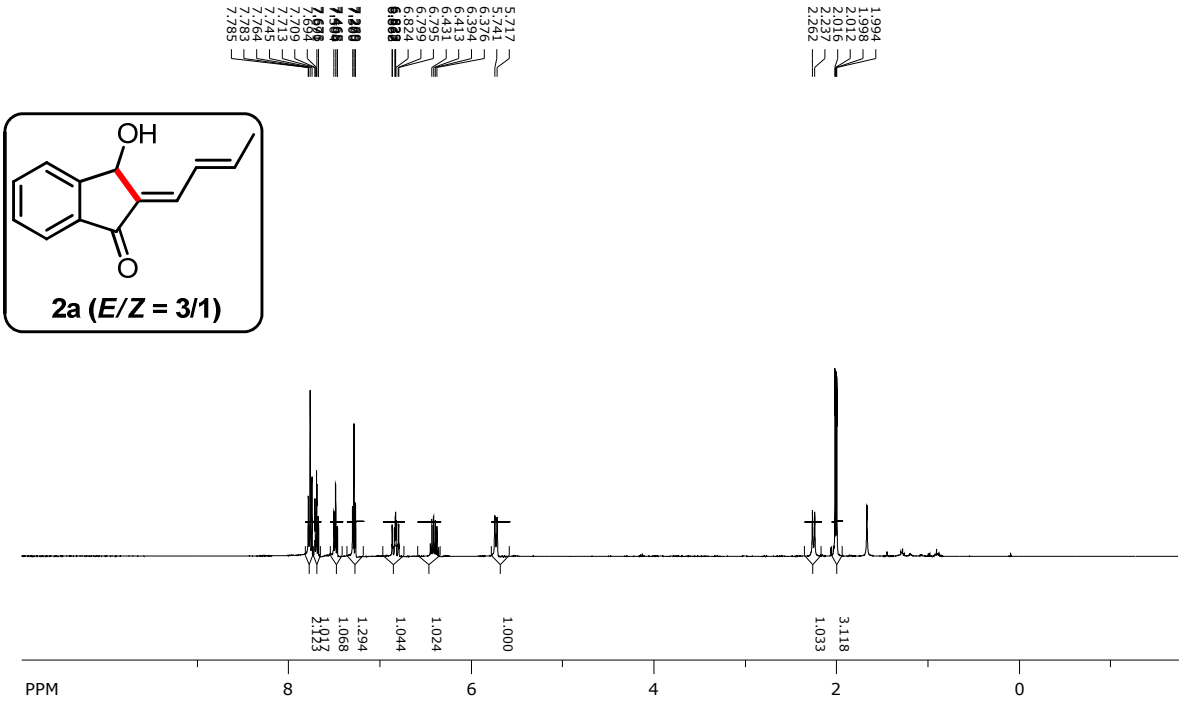
Copies of ^{1}H and ^{13}C-NMR spectra of all the new compounds reported in this study

(**Note**: In general, in a ^{1}H NMR spectrum recorded in $CDCl_3$, a peak at around δ 1.6 refers to moisture in the solvent/sample and a peak at about δ 1.2 refers to oil/grease present in the sample. In a ^{13}C NMR spectrum recorded in $CDCl_3$, a peak at about δ 29.7 usually represents oil/grease)

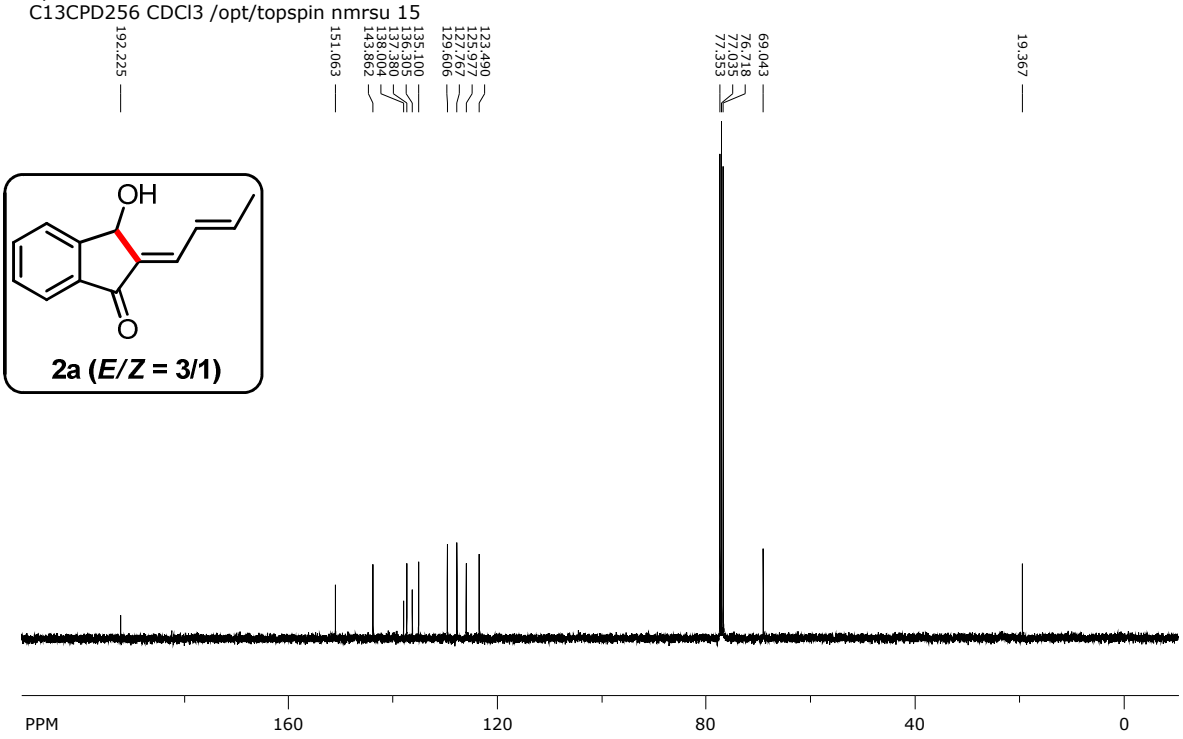




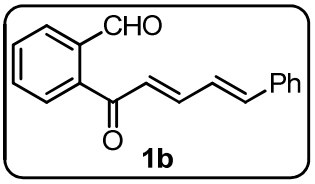
SpinWorks 4: BS 05 212
PROTON CDCl3 /opt/topspin nmrsu 15

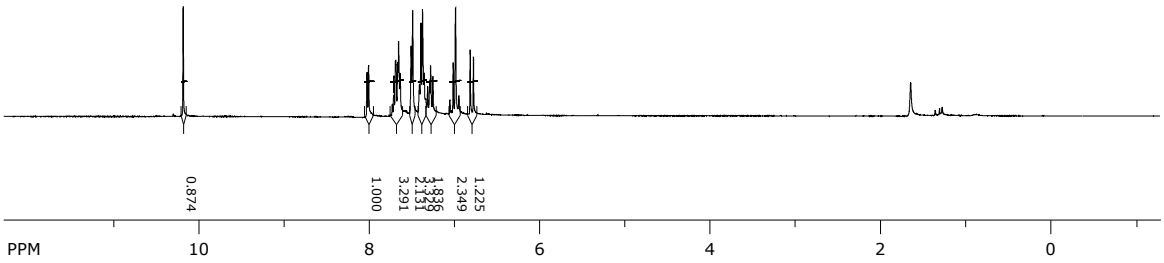


SpinWorks 4: BS 05 212
C13CPD256 CDCl3 /opt/topspin nmrsu 15

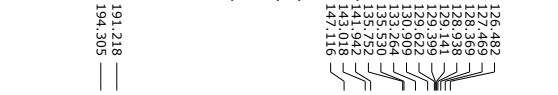


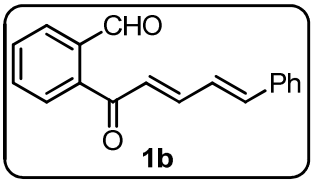
SpinWorks 4: BS 06 270
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 26



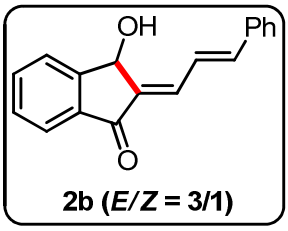


SpinWorks 4: BS 06 270
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 26

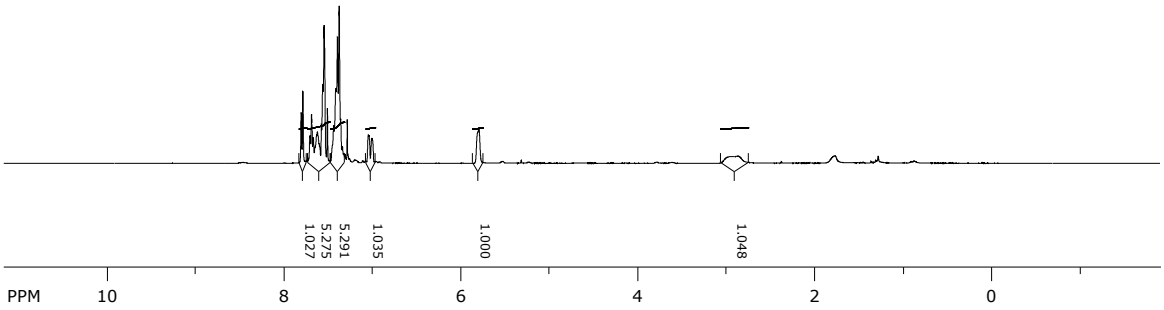




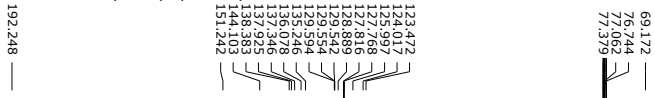
SpinWorks 4: BS 06 281
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 45

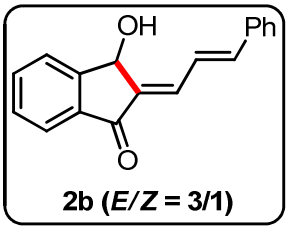


2b (*E*/*Z* = 3/1)

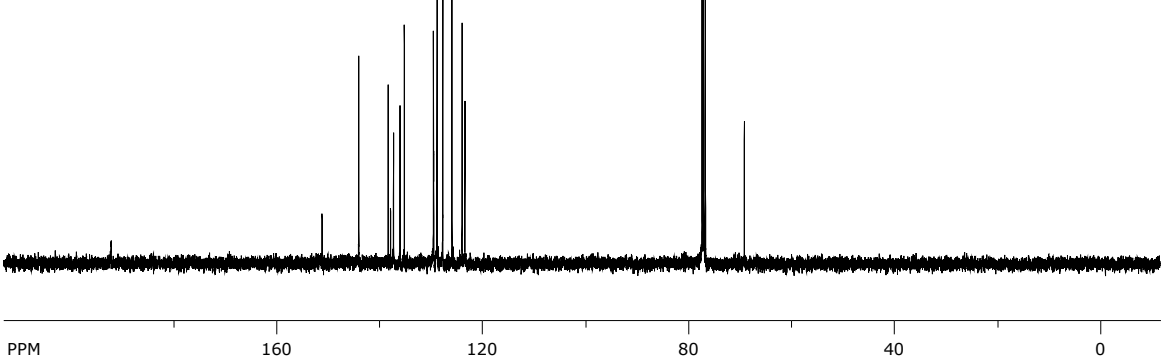


SpinWorks 4: BS 06 281
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 45

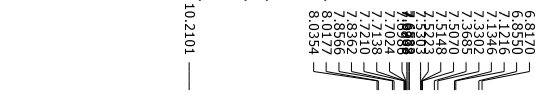


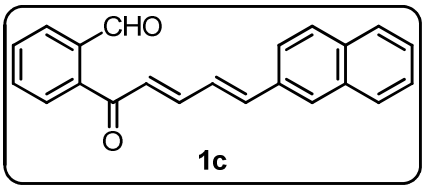


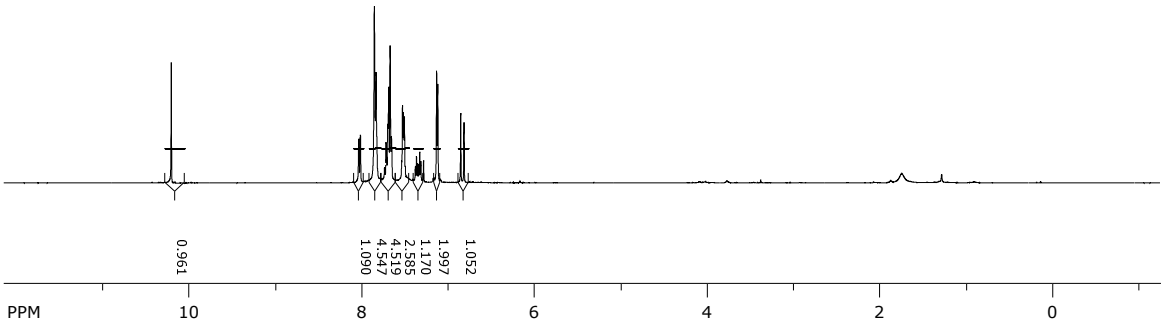
2b (*E*/*Z* = 3/1)



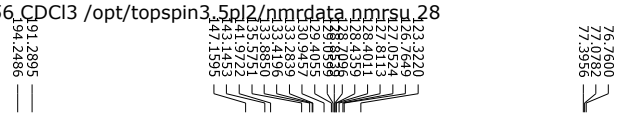
SpinWorks 4: BS 06 510
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 28

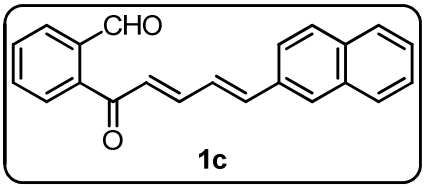


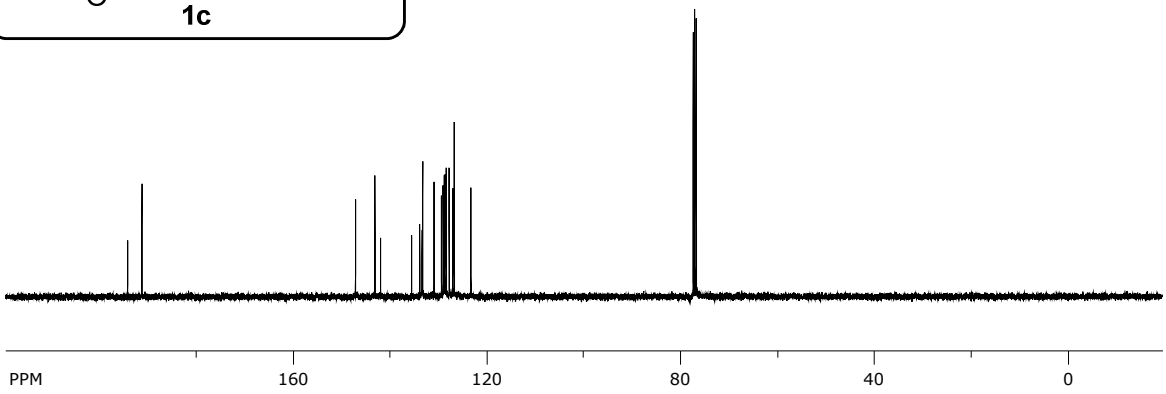




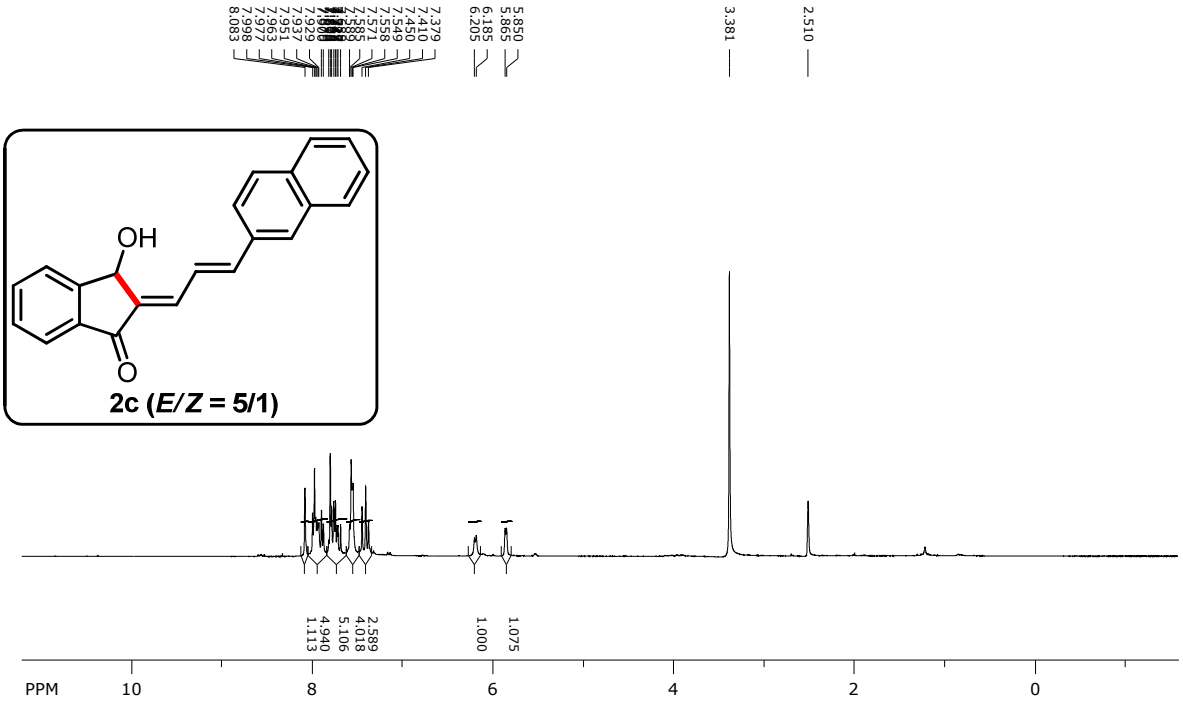
SpinWorks 4: BS 06 510
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 28



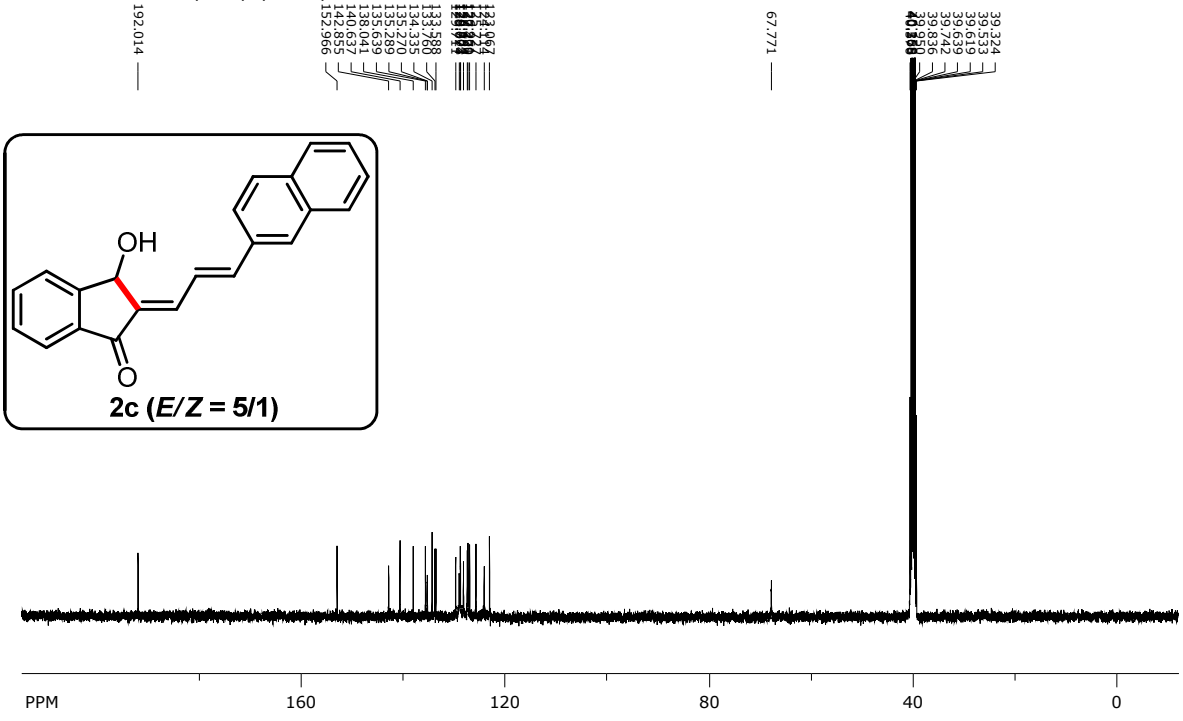




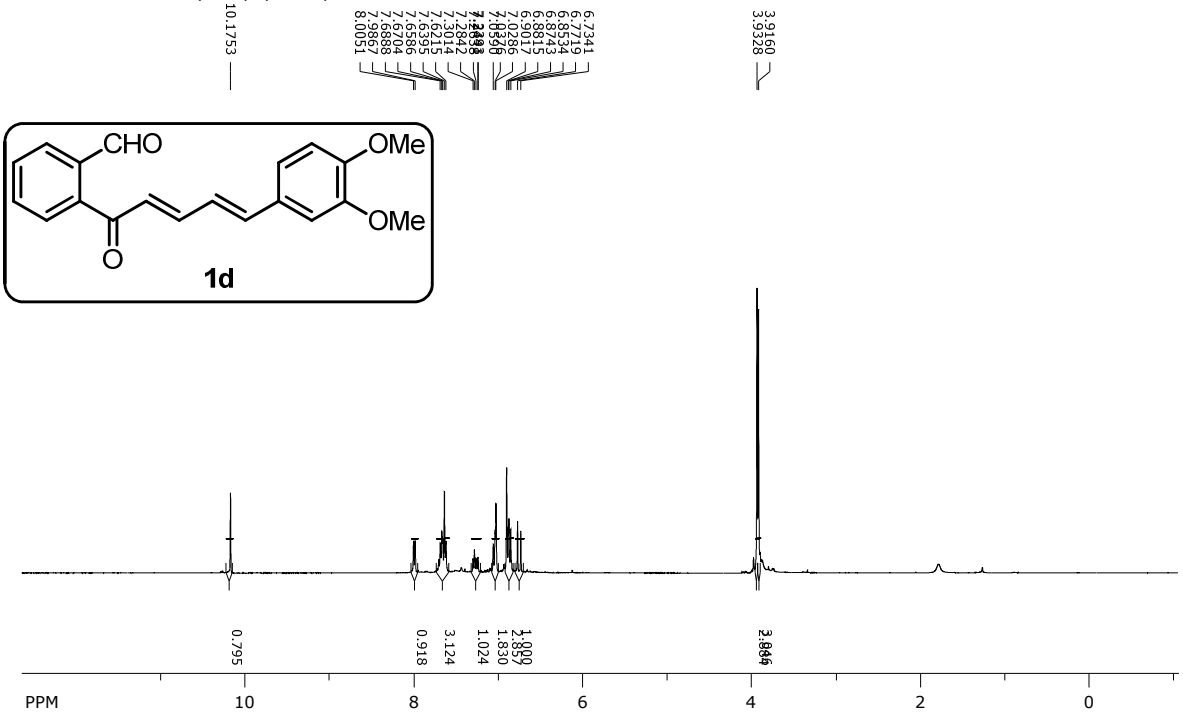
SpinWorks 4: BS 06 512 RE
PROTON DMSO /opt/topspin3.5pl2/nmrdata nmrsu 33



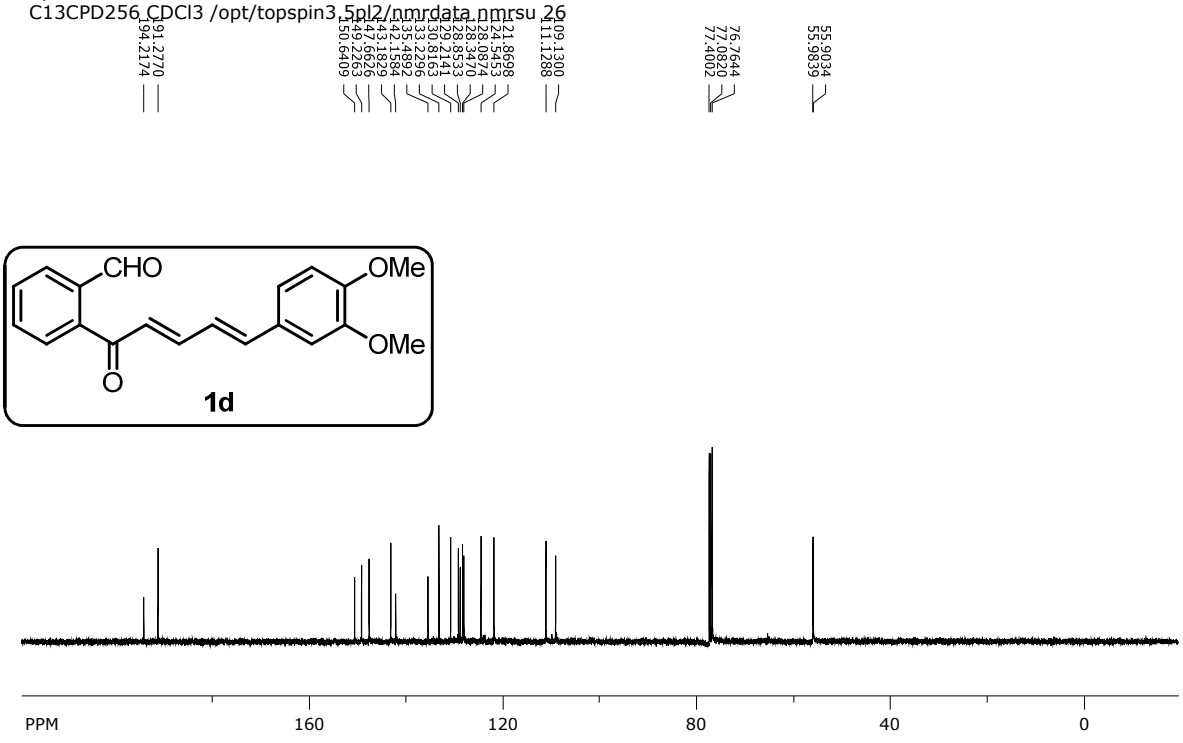
SpinWorks 4: BS 06 512 RE
C13CPD DMSO /opt/topspin3.5pl2/nmrdata nmrsu 33



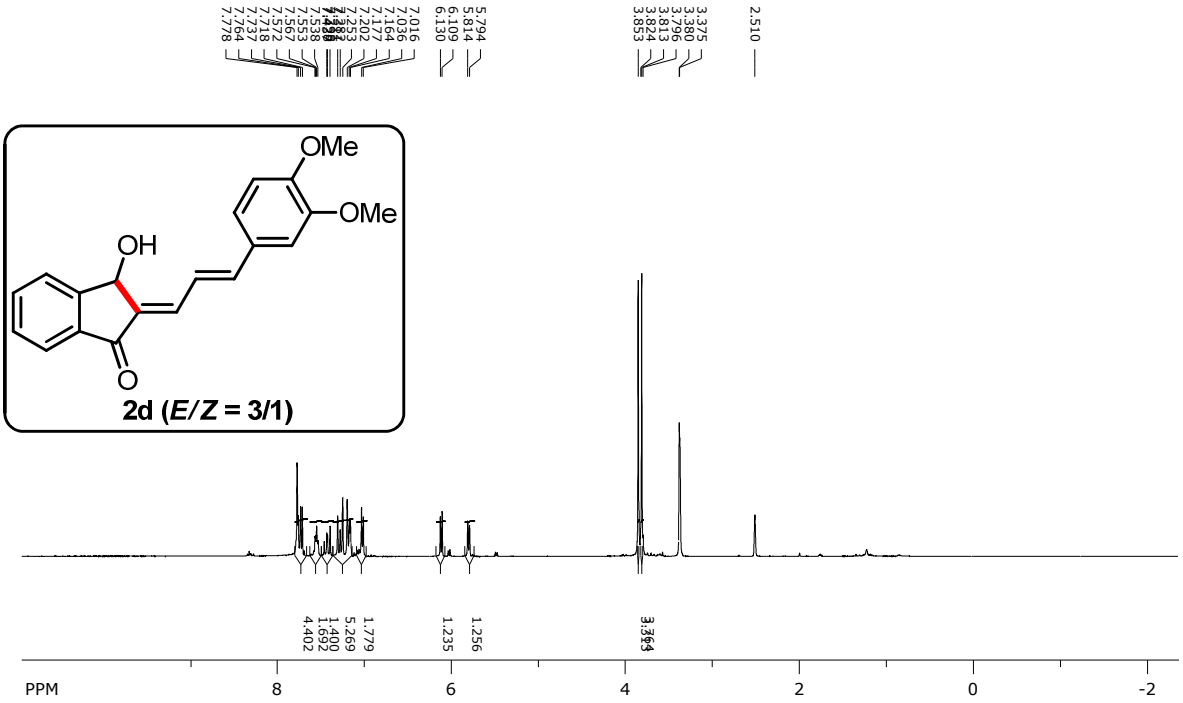
SpinWorks 4: BS 06 500
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 26



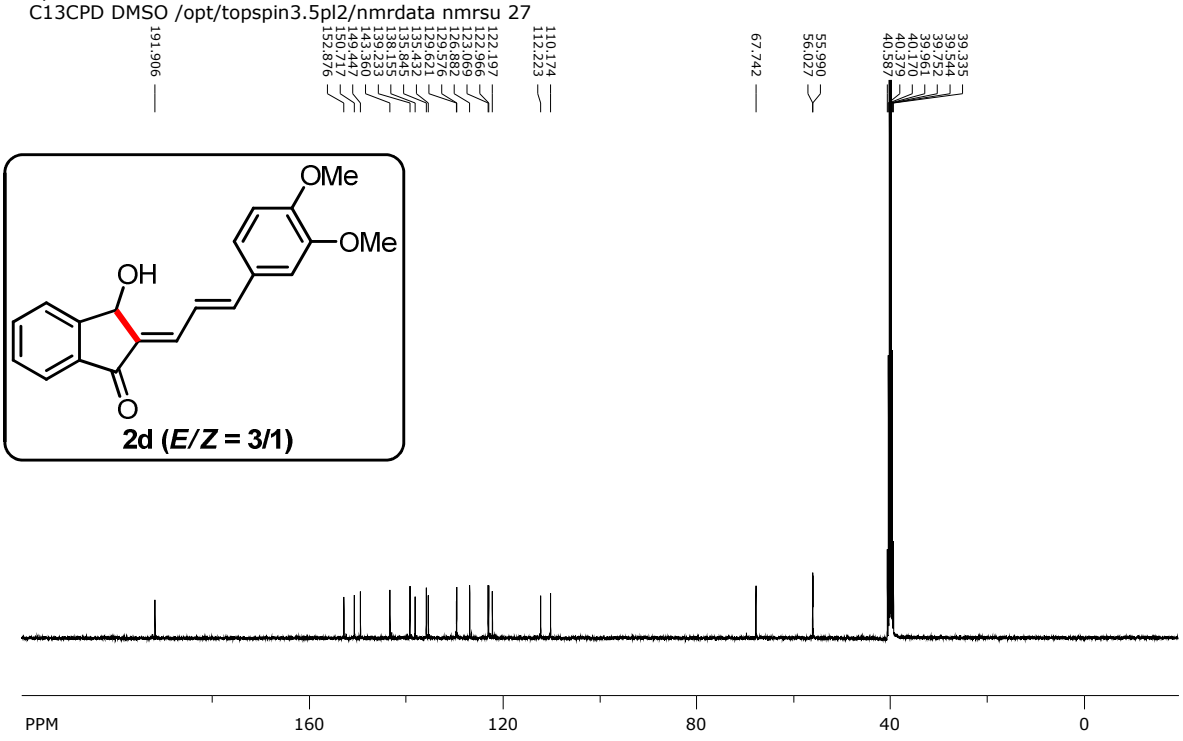
SpinWorks 4: BS 06 500
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 26



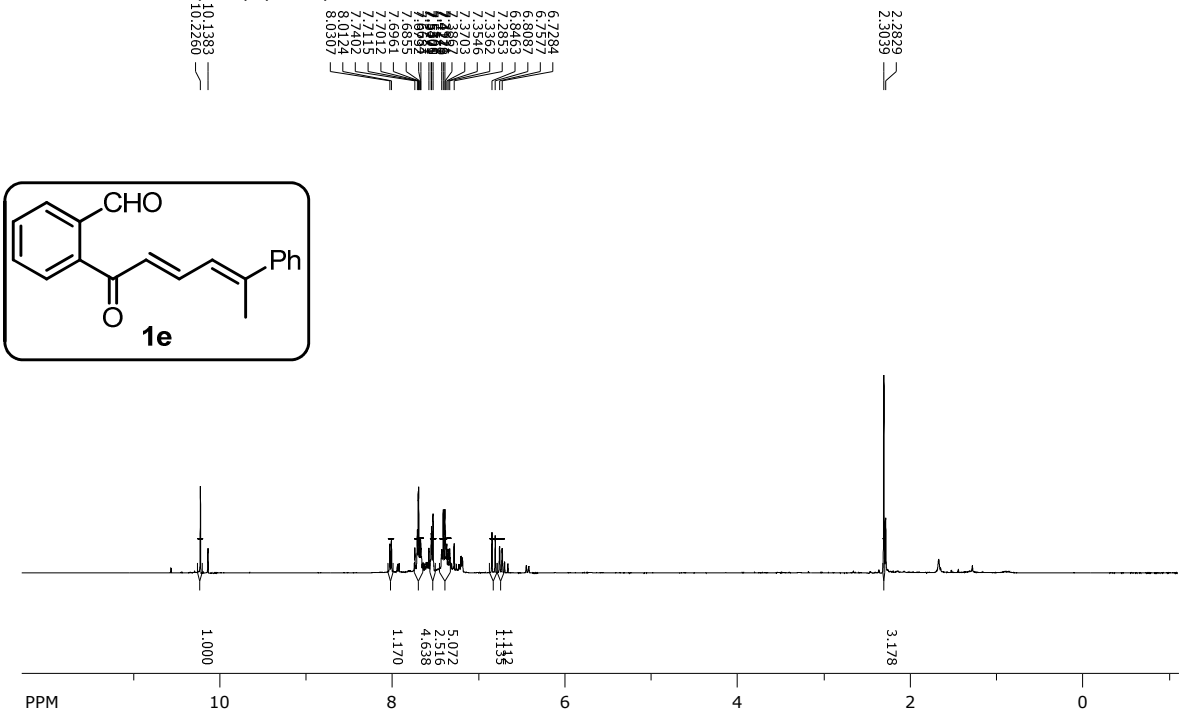
SpinWorks 4: BS 06 502
PROTON DMSO /opt/topspin3.5pl2/nmrdata nmrsu 27



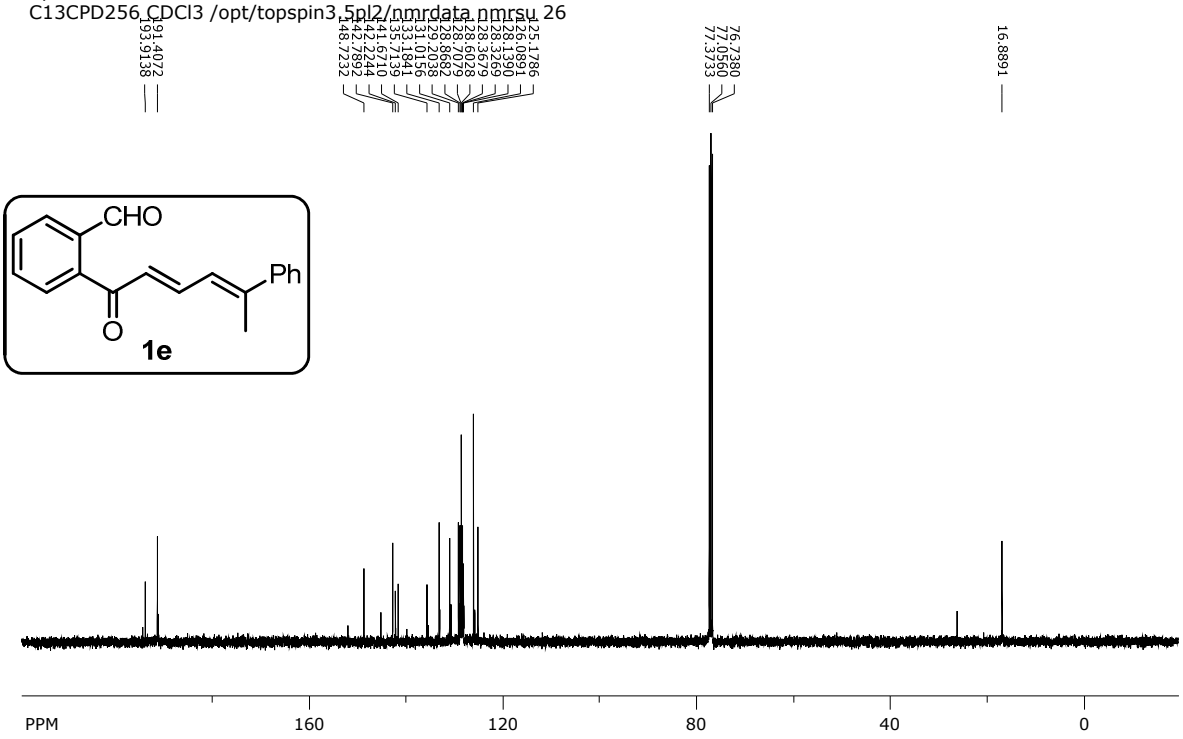
SpinWorks 4: BS 06 502
C13CPD DMSO /opt/topspin3.5pl2/nmrdata nmrsu 27



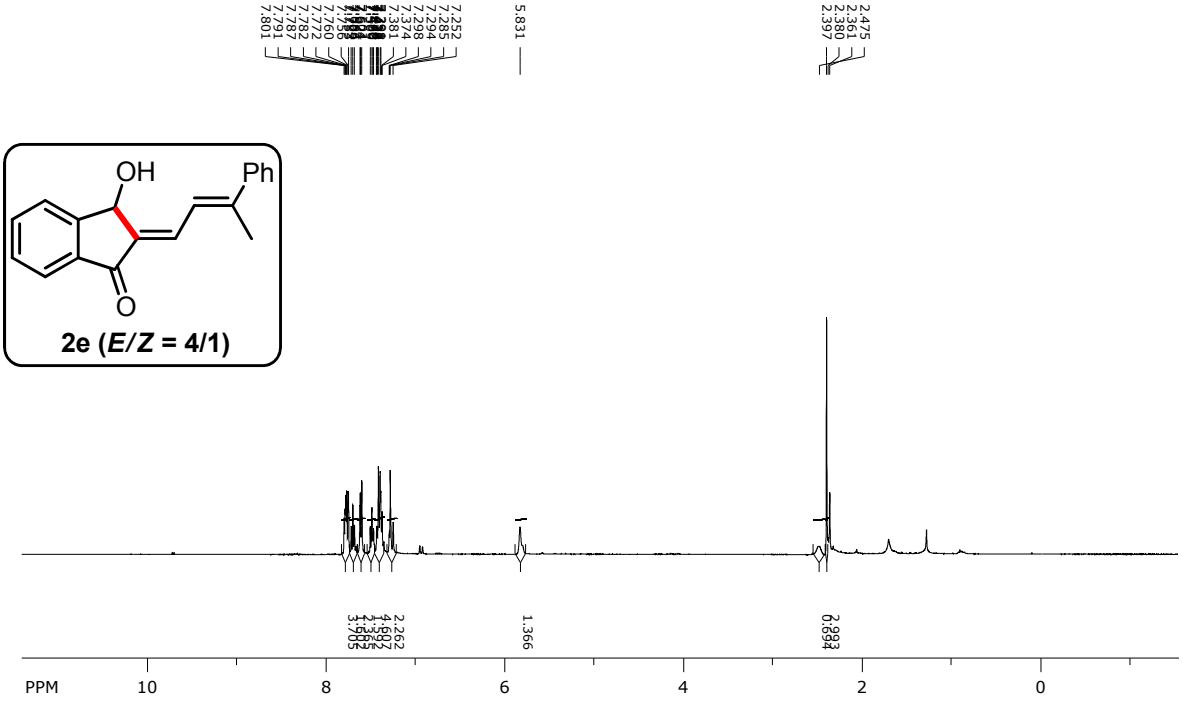
SpinWorks 4: BS 06 326
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 26



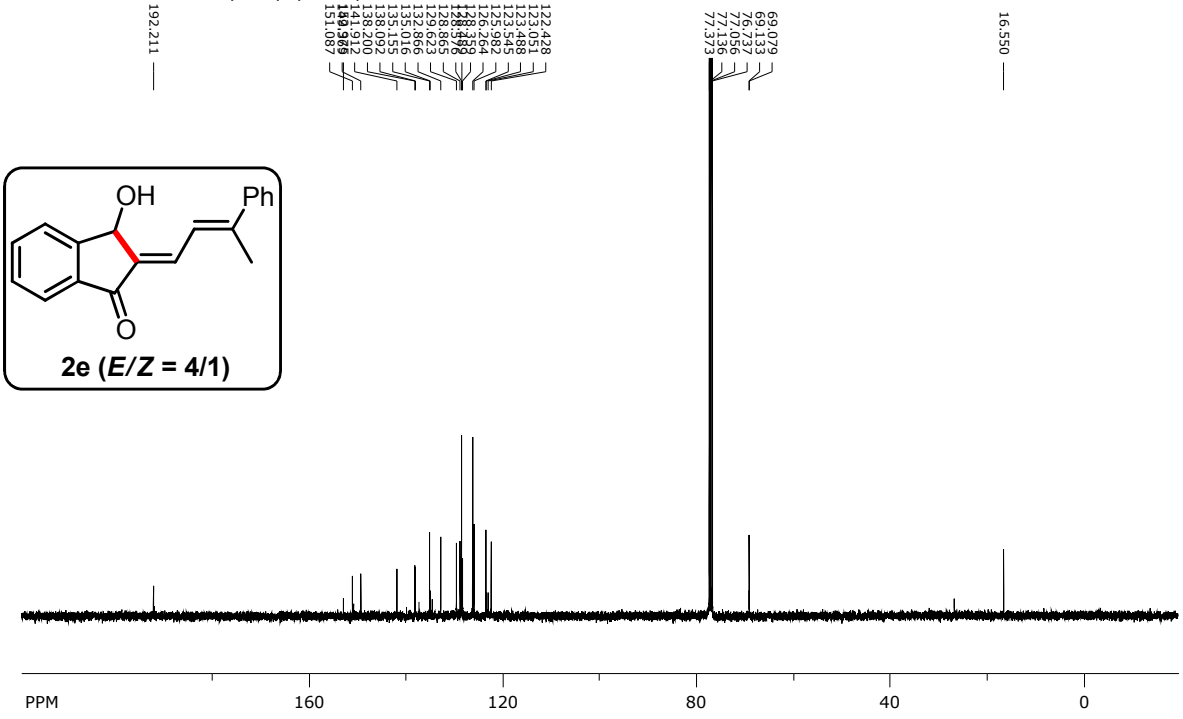
SpinWorks 4: BS 06 326
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 26



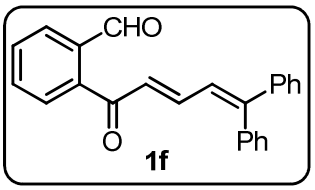
SpinWorks 4: BS 06 355
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 46

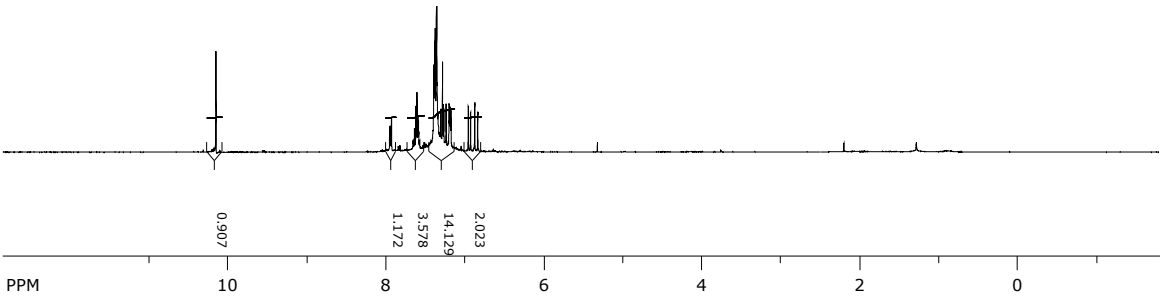


SpinWorks 4: BS 06 355
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 46

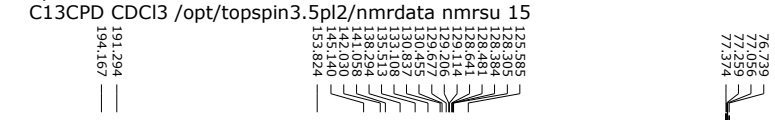


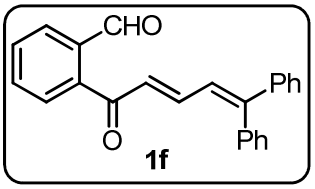
SpinWorks 4: bs-06-217

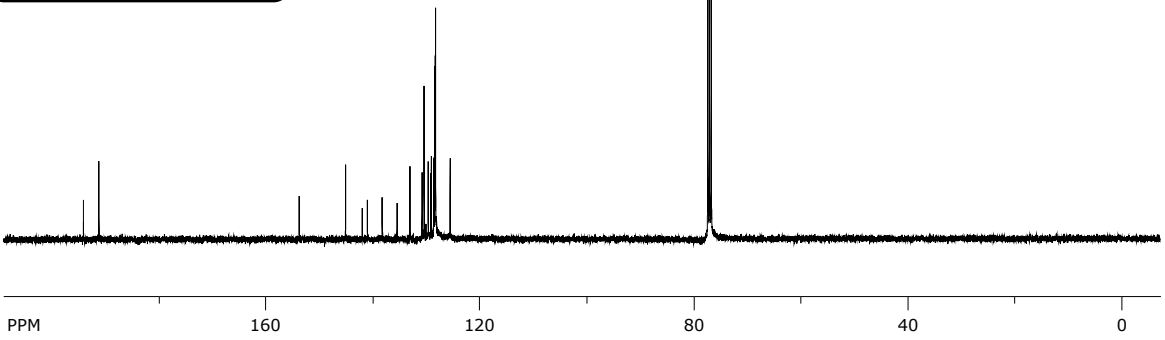




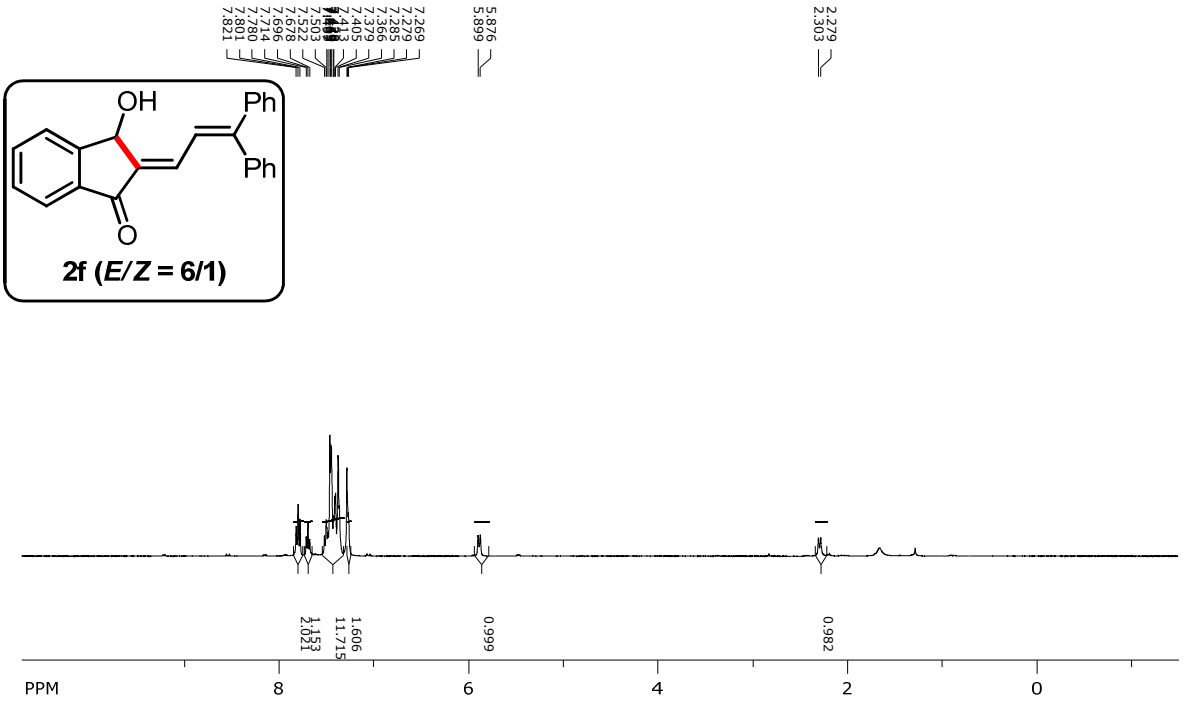
SpinWorks 4: BS 06 217
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 15



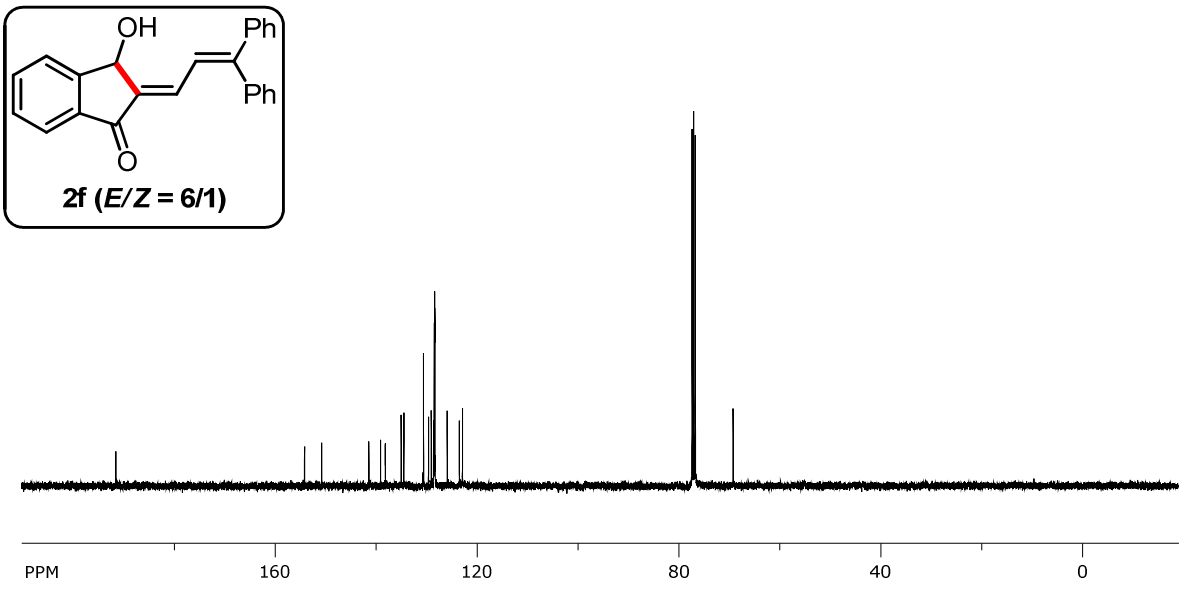




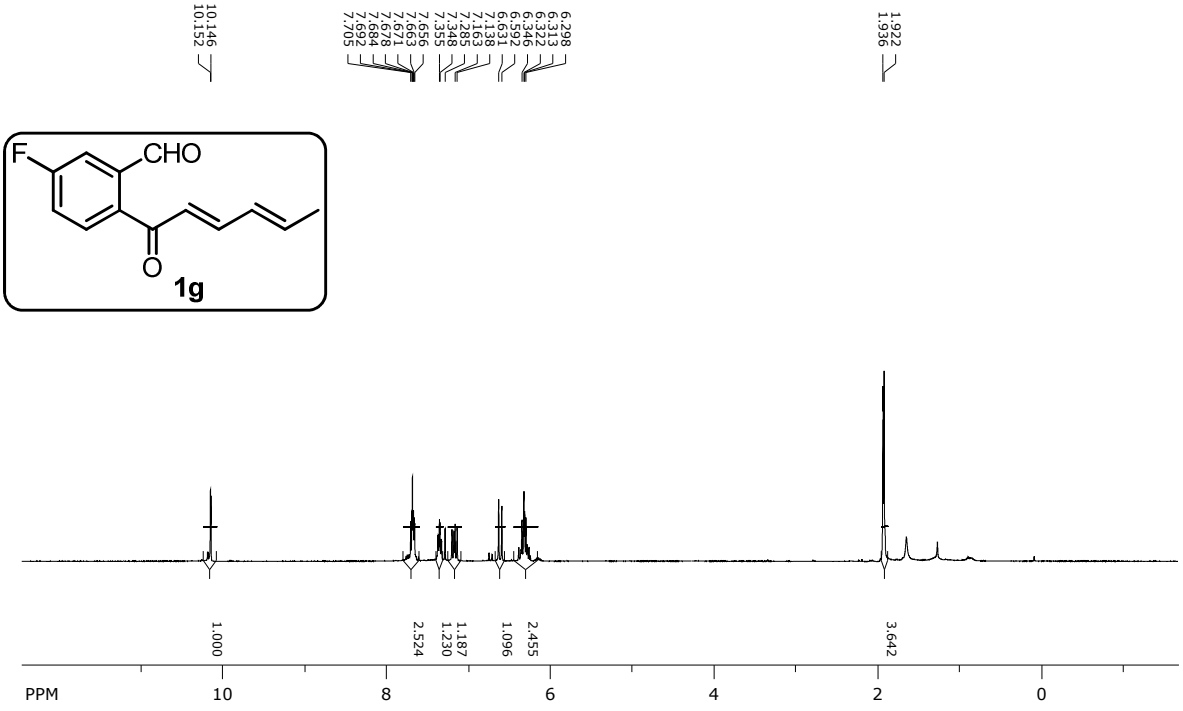
SpinWorks 4: BS-06-218-Re



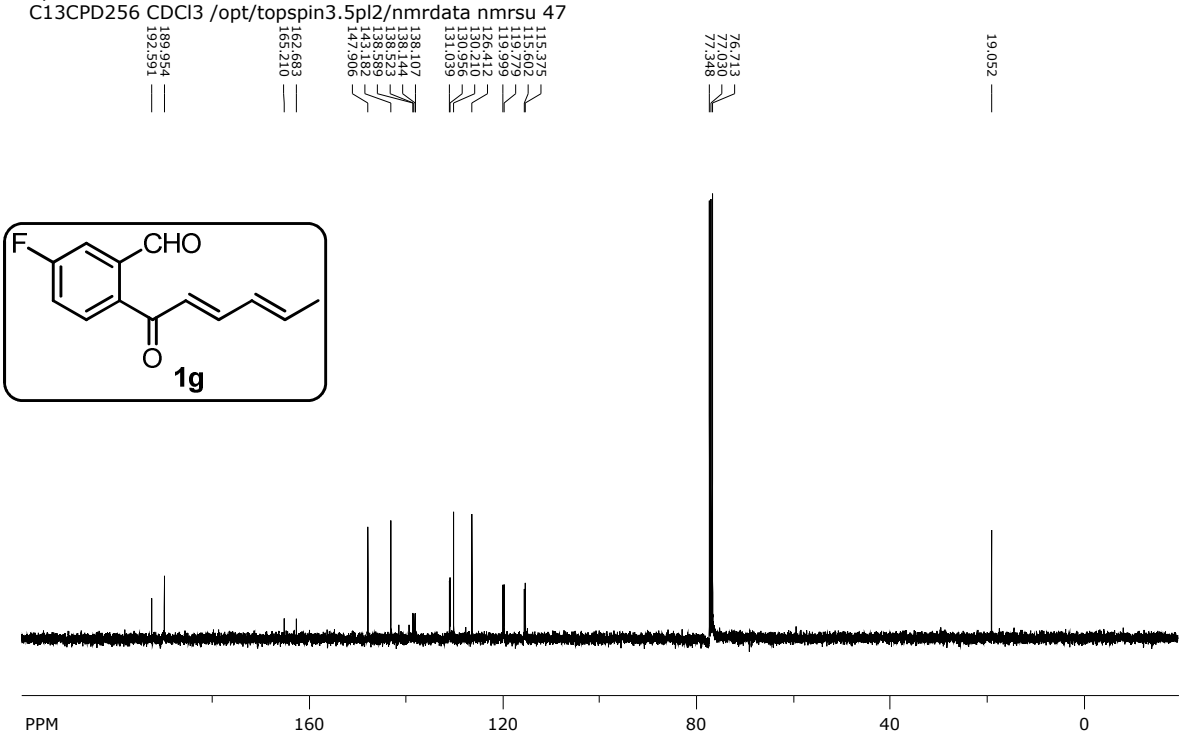
SpinWorks 4: BS 06 218 RE
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 55



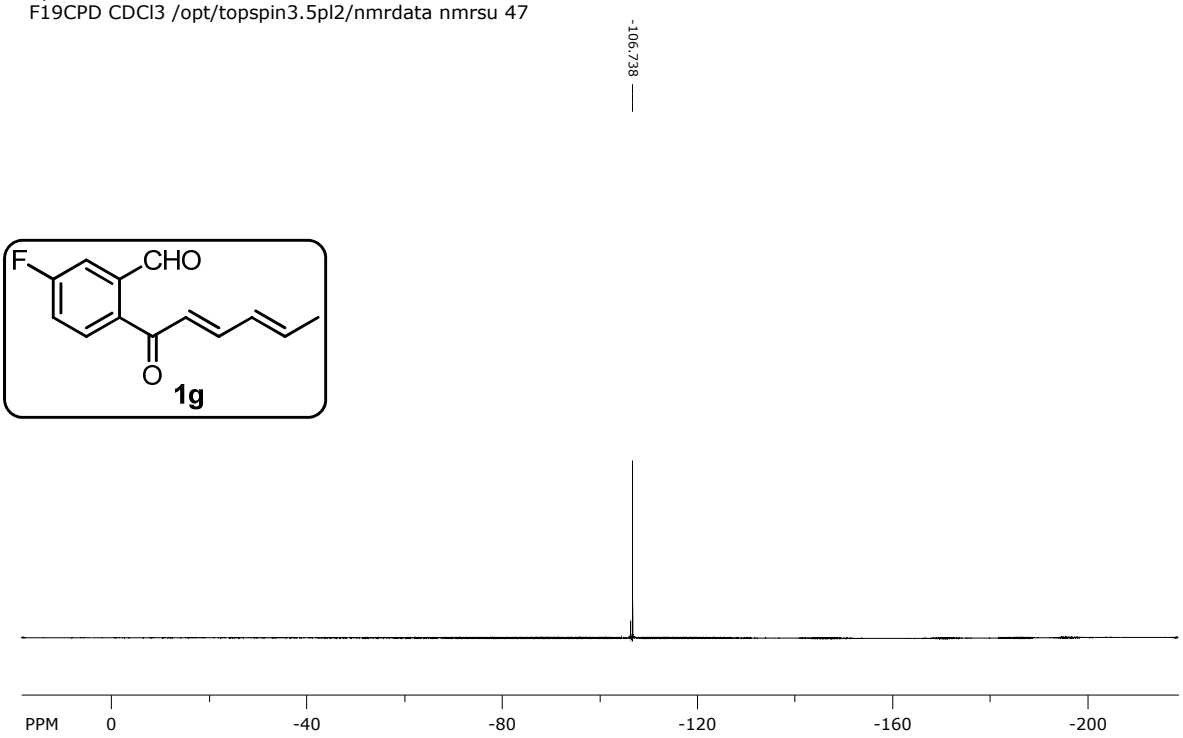
SpinWorks 4: BS 06 200
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 47



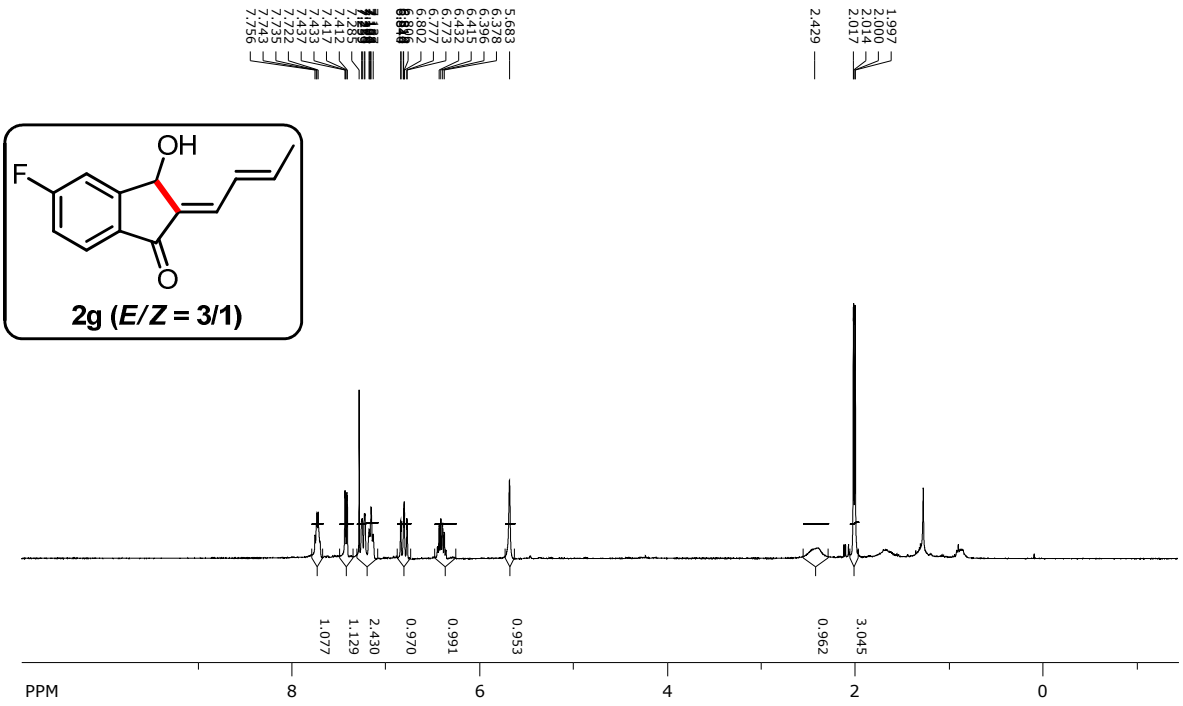
SpinWorks 4: BS 06 200
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 47



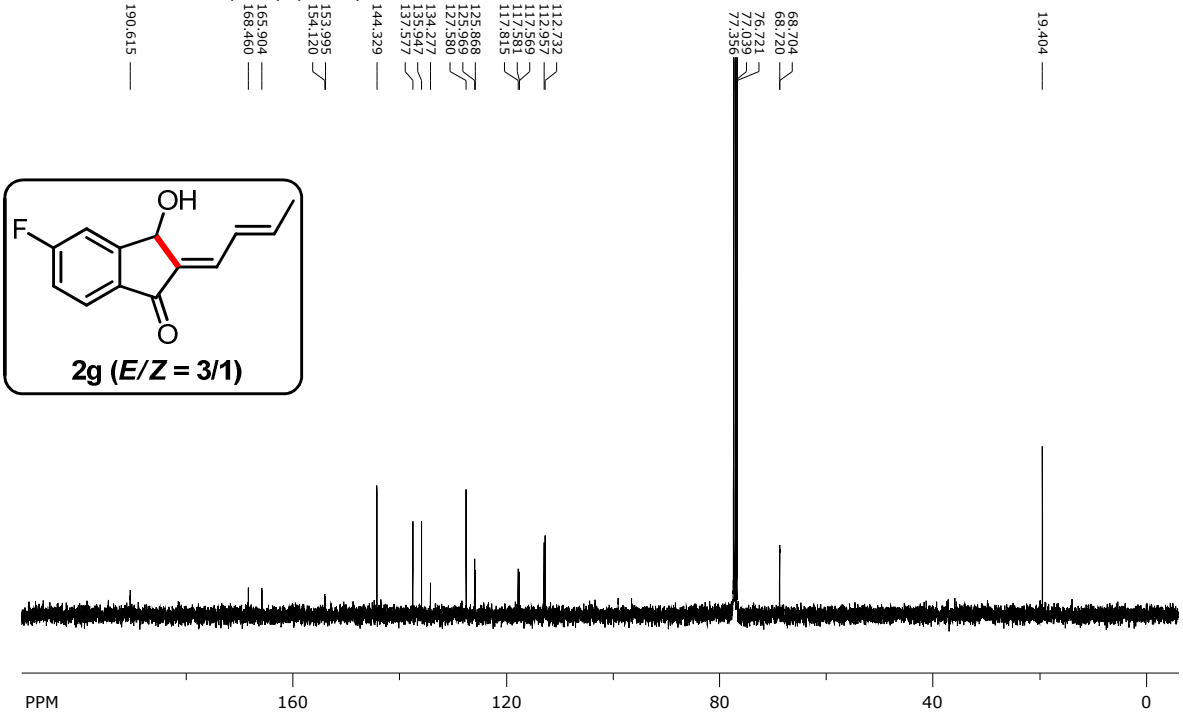
SpinWorks 4: BS 06 200
F19CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 47



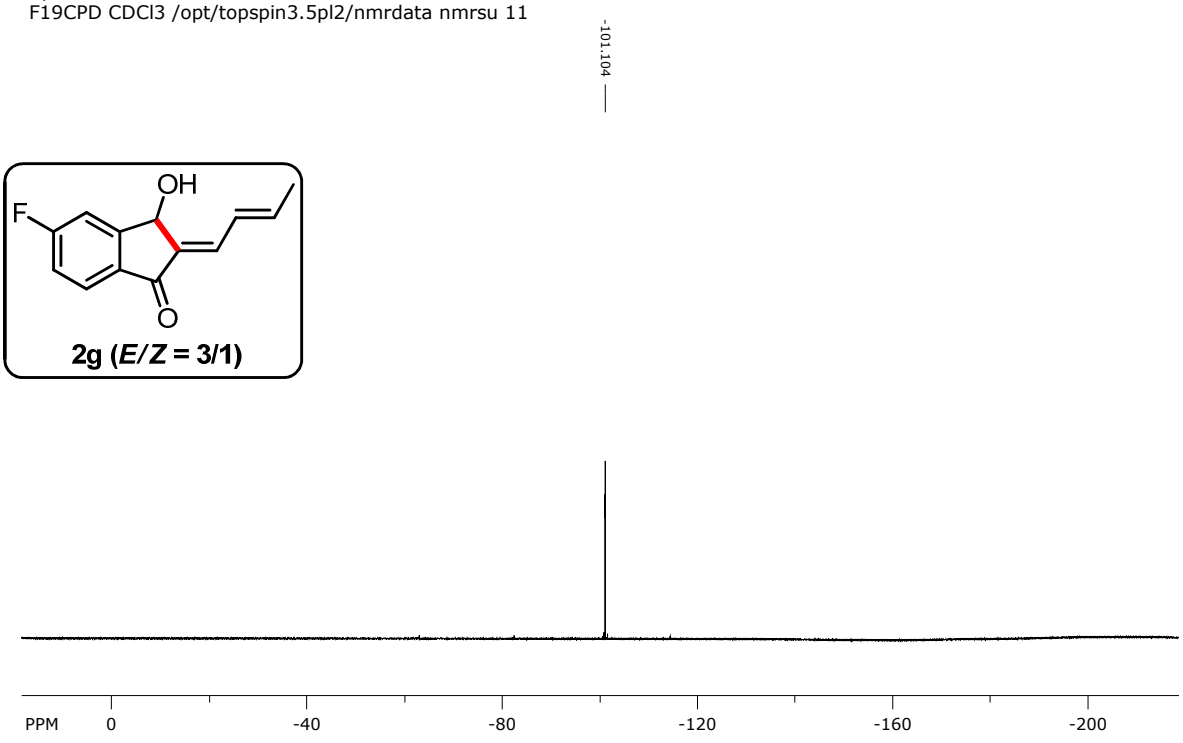
SpinWorks 4: BS 06 208
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 11



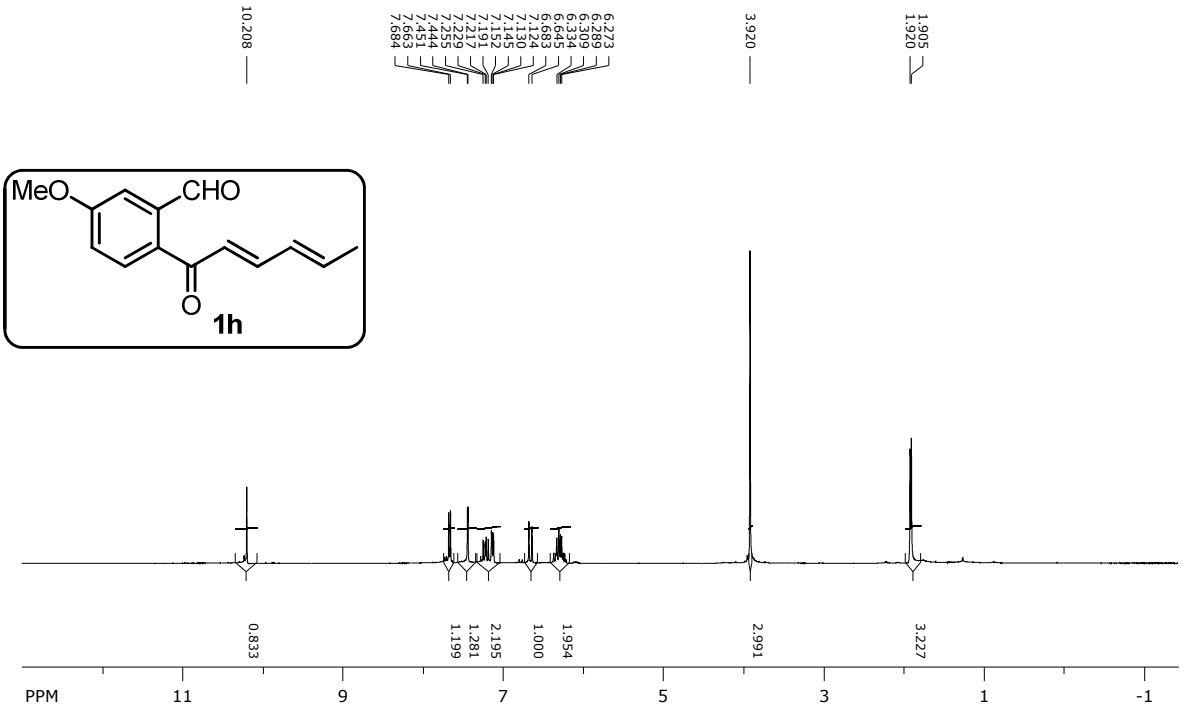
SpinWorks 4: BS 06 208
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 11



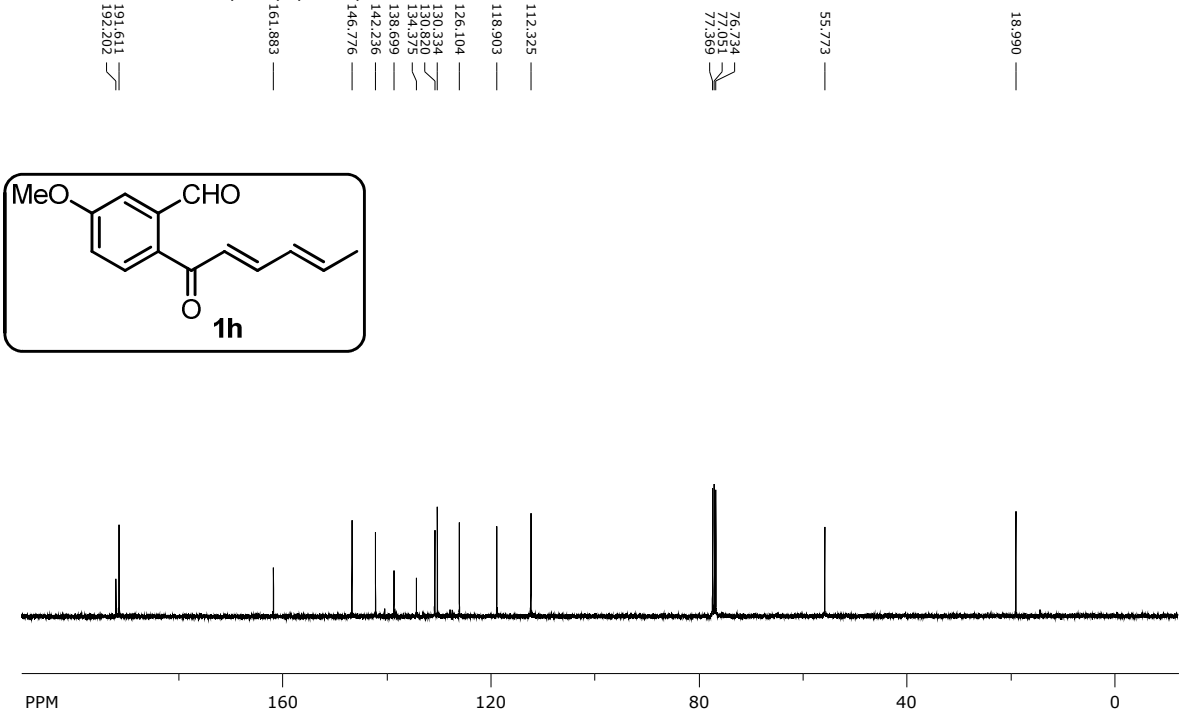
SpinWorks 4: BS 06 208
F19CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 11



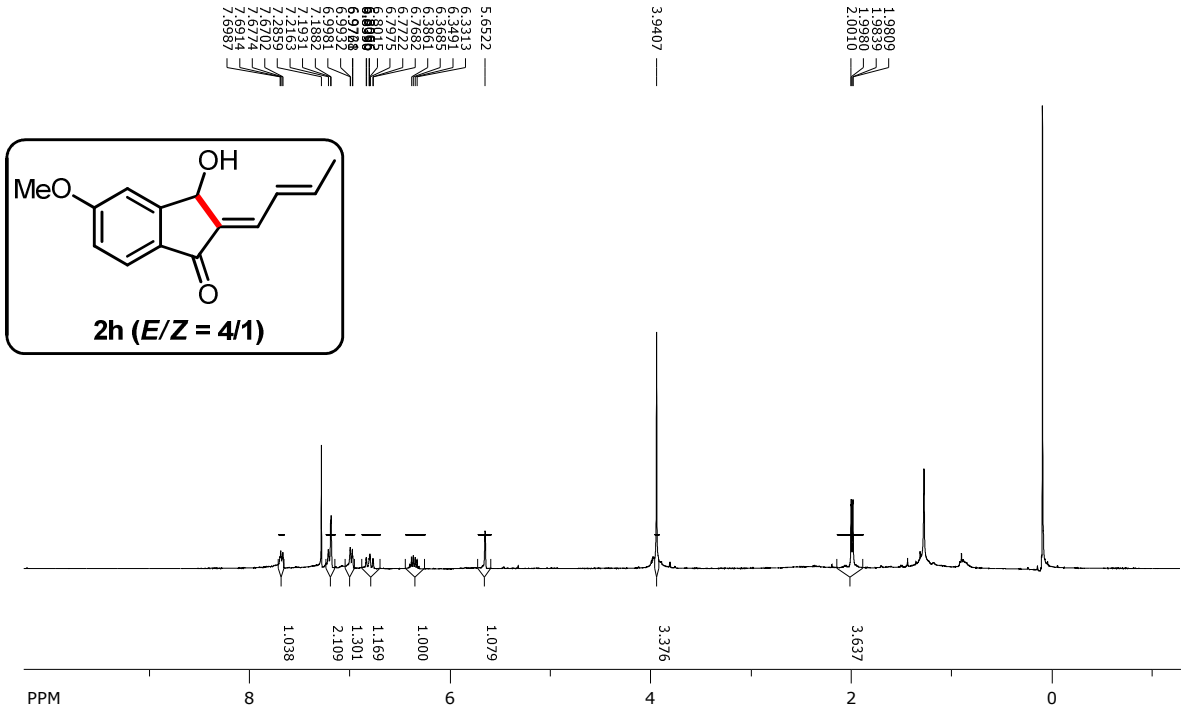
SpinWorks 4: BS 06 185
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 24



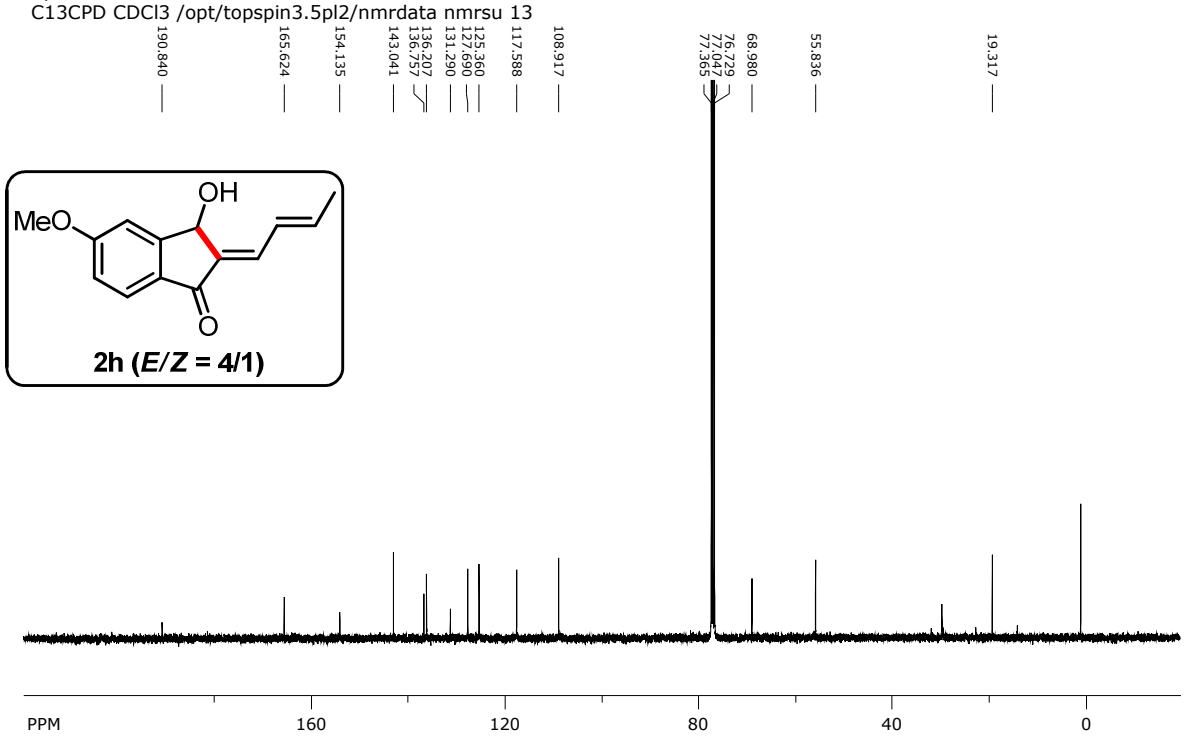
SpinWorks 4: BS 06 185
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 24



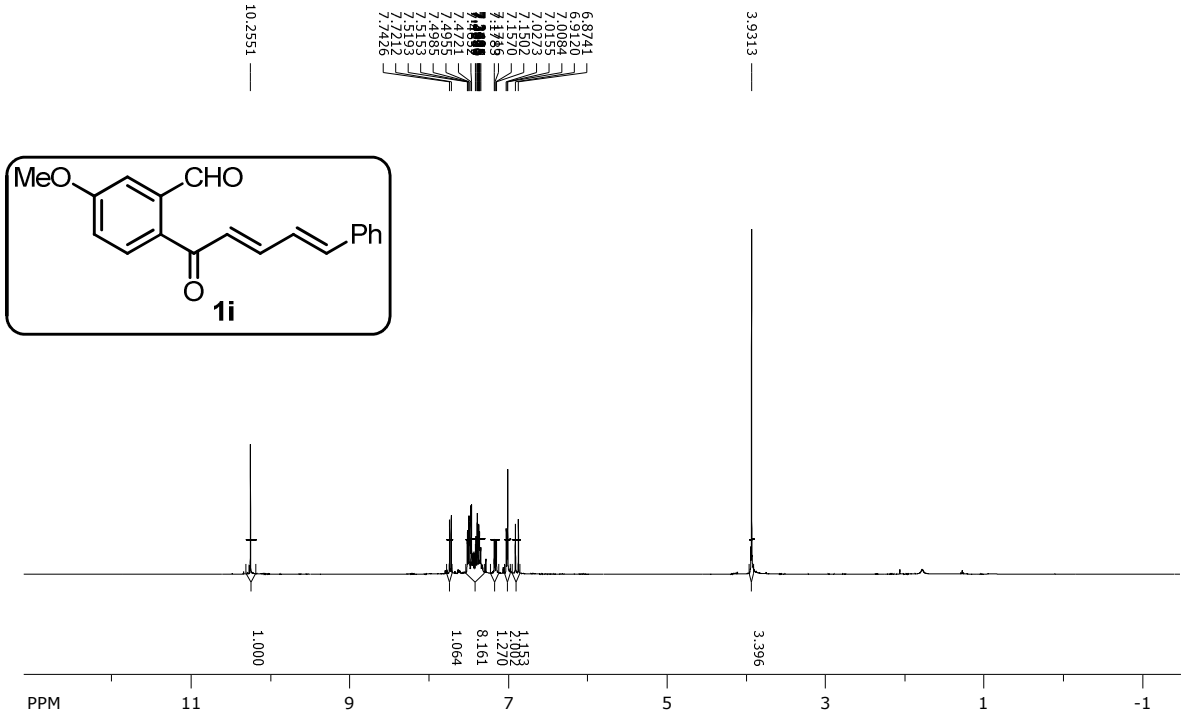
SpinWorks 4: bs-06-186



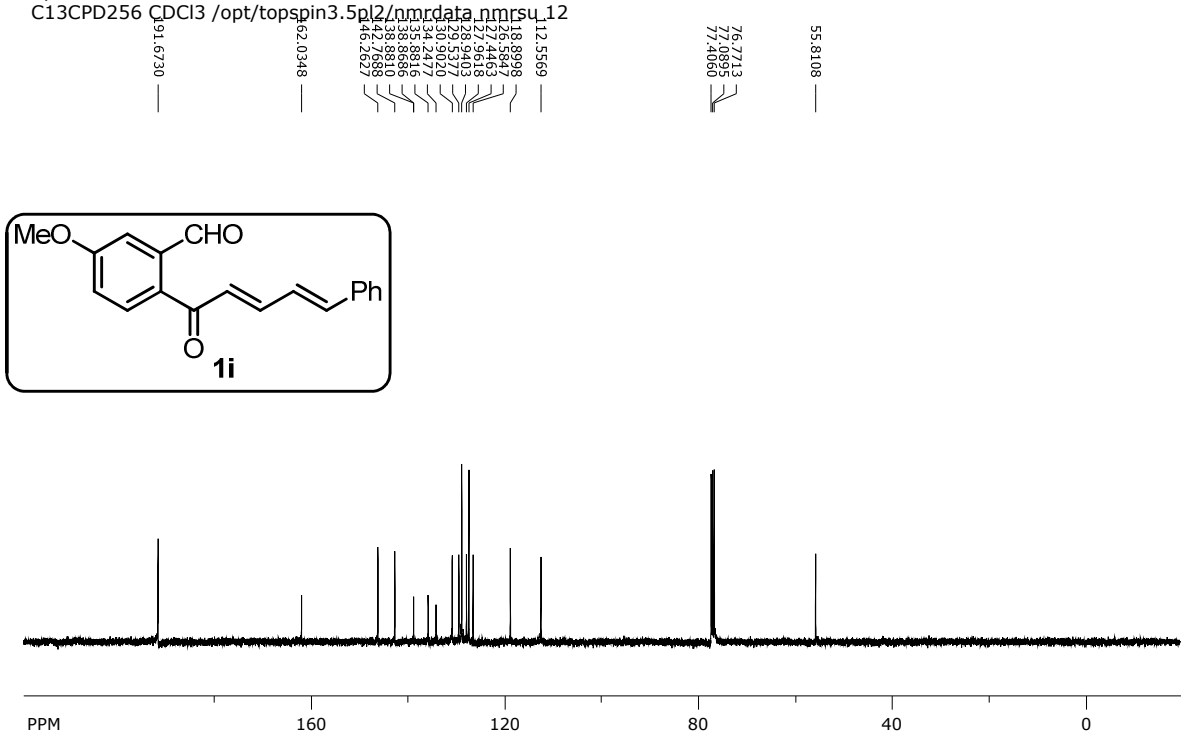
SpinWorks 4: BS 06 186
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 13



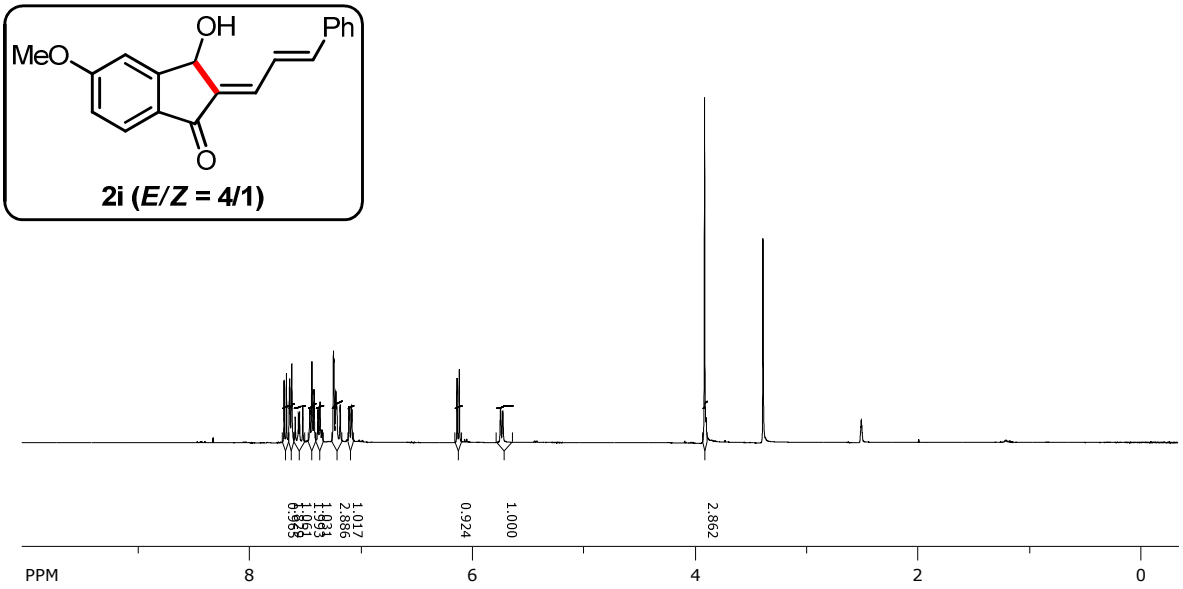
SpinWorks 4: bs-06-550



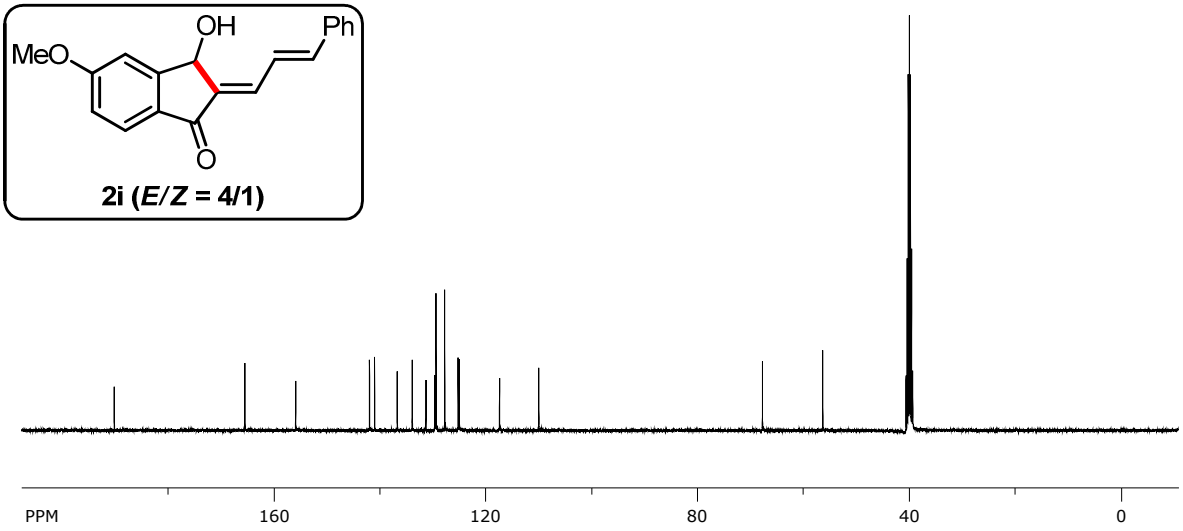
SpinWorks 4: BS 06 550
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 12



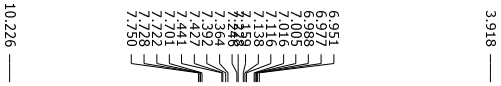
SpinWorks 4: BS 06 608
PROTON DMSO /opt/topspin3.5pl2/nmrdata nmrsu 34

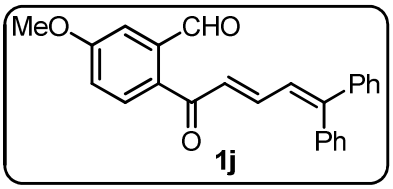


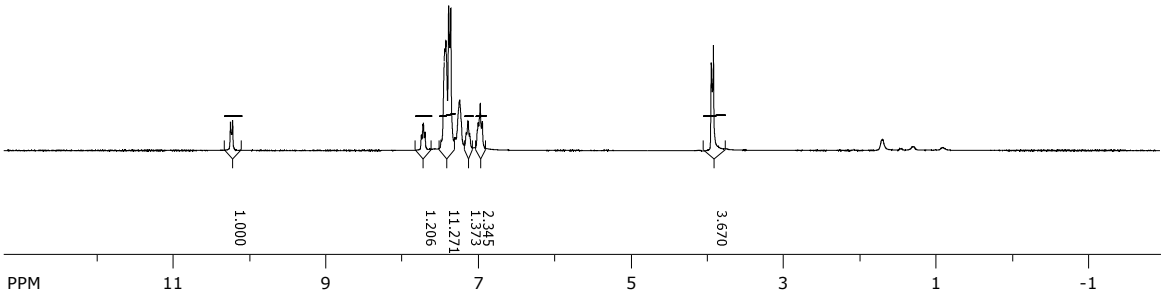
SpinWorks 4: BS 06 608
C13CPD DMSO /opt/topspin3.5pl2/nmrdata nmrsu 34



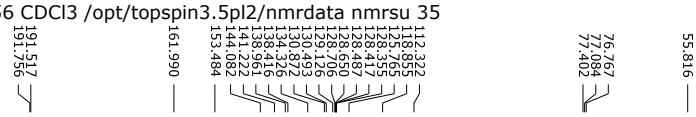
SpinWorks 4: BS 06 610
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 35

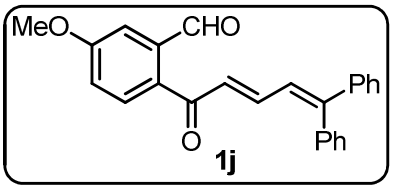


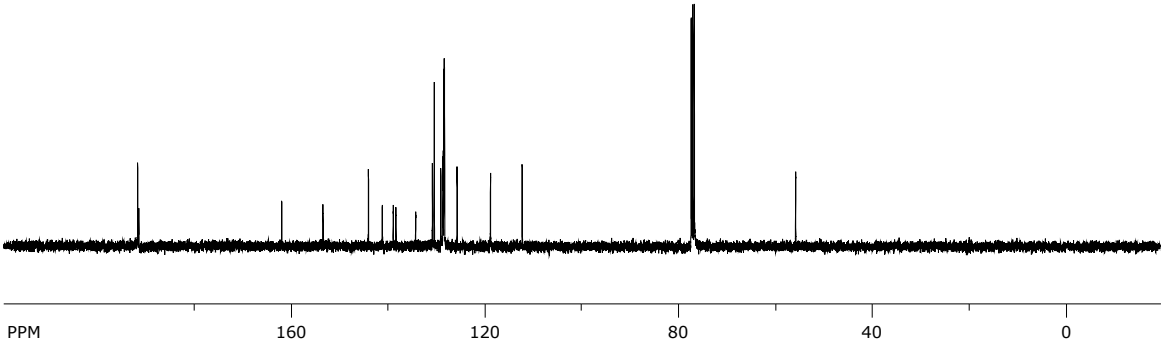




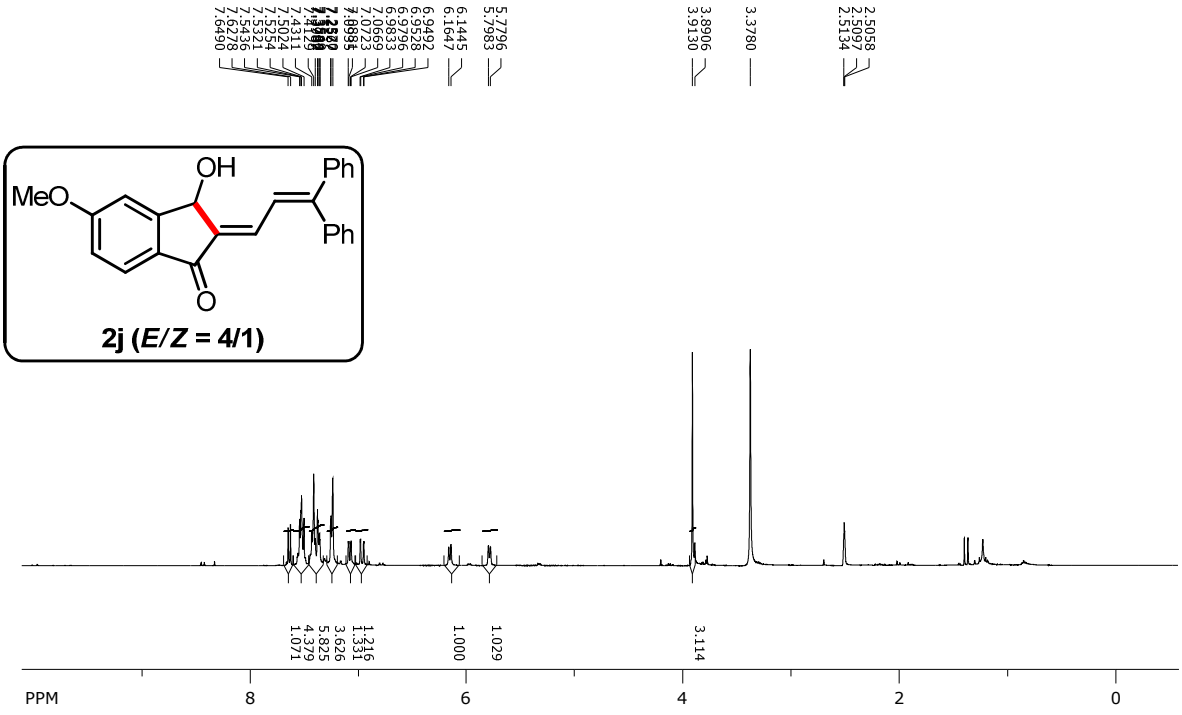
SpinWorks 4: BS 06 610
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 35



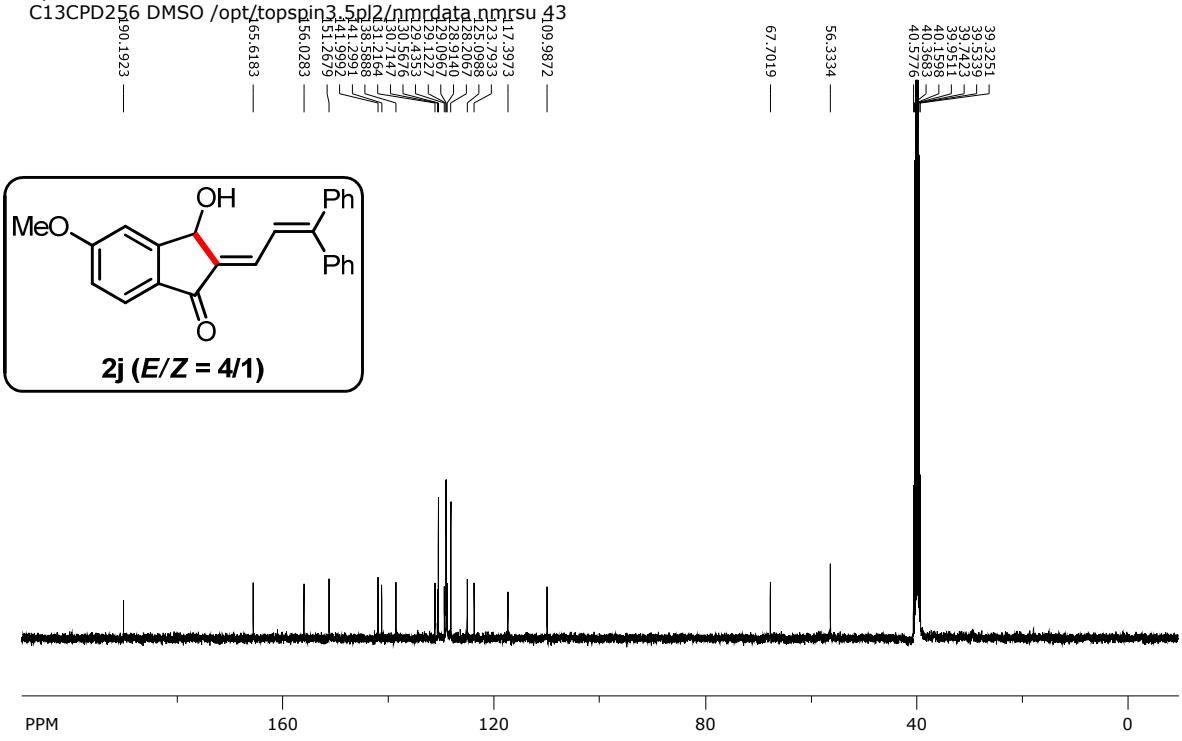




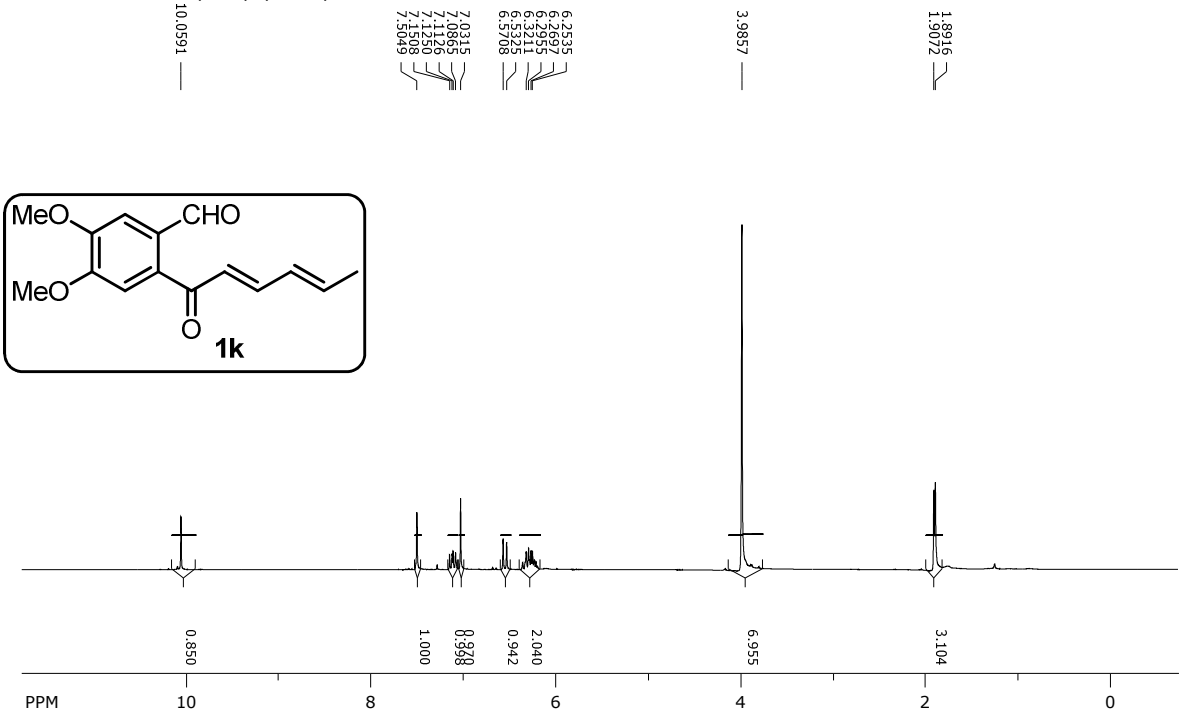
SpinWorks 4: BS 06 615
PROTON DMSO /opt/topspin3.5pl2/nmrdata nmrsu 43



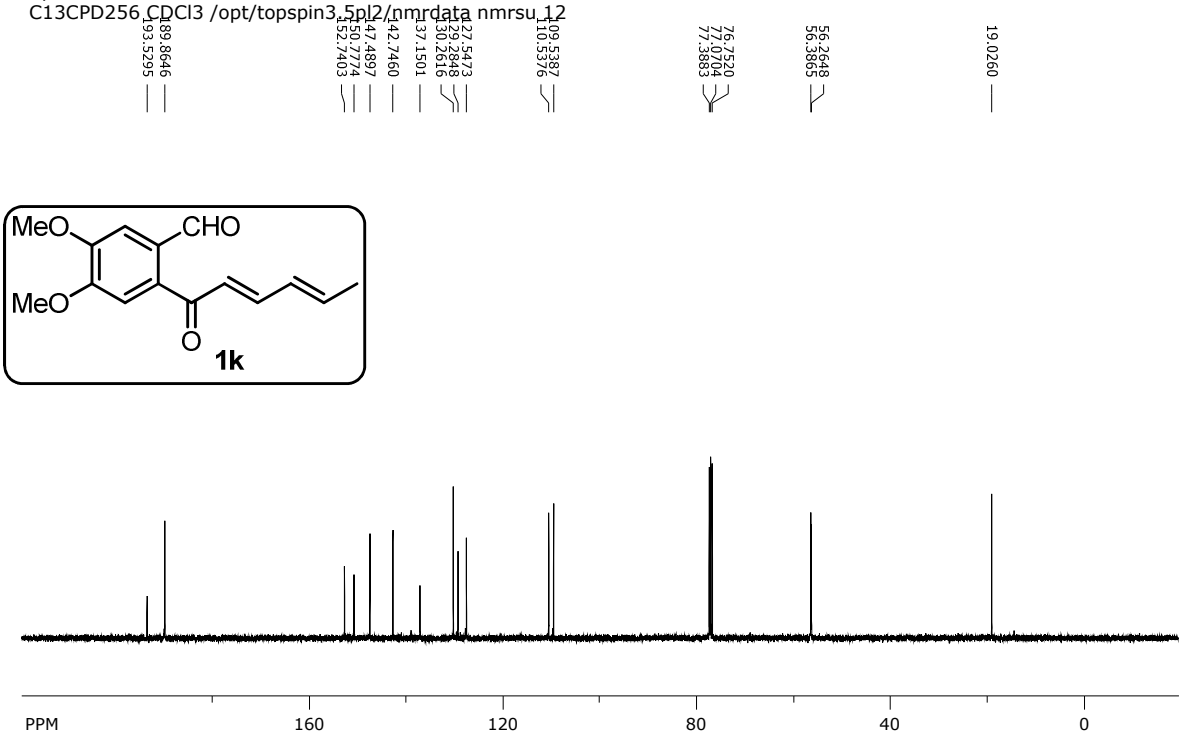
SpinWorks 4: BS 06 615
C13CPD256 DMSO /opt/topspin3.5pl2/nmrdata nmrsu 43



SpinWorks 4: BS 06 210
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 12



SpinWorks 4: BS 06 210
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 12



SpinWorks 4: BS 06 215
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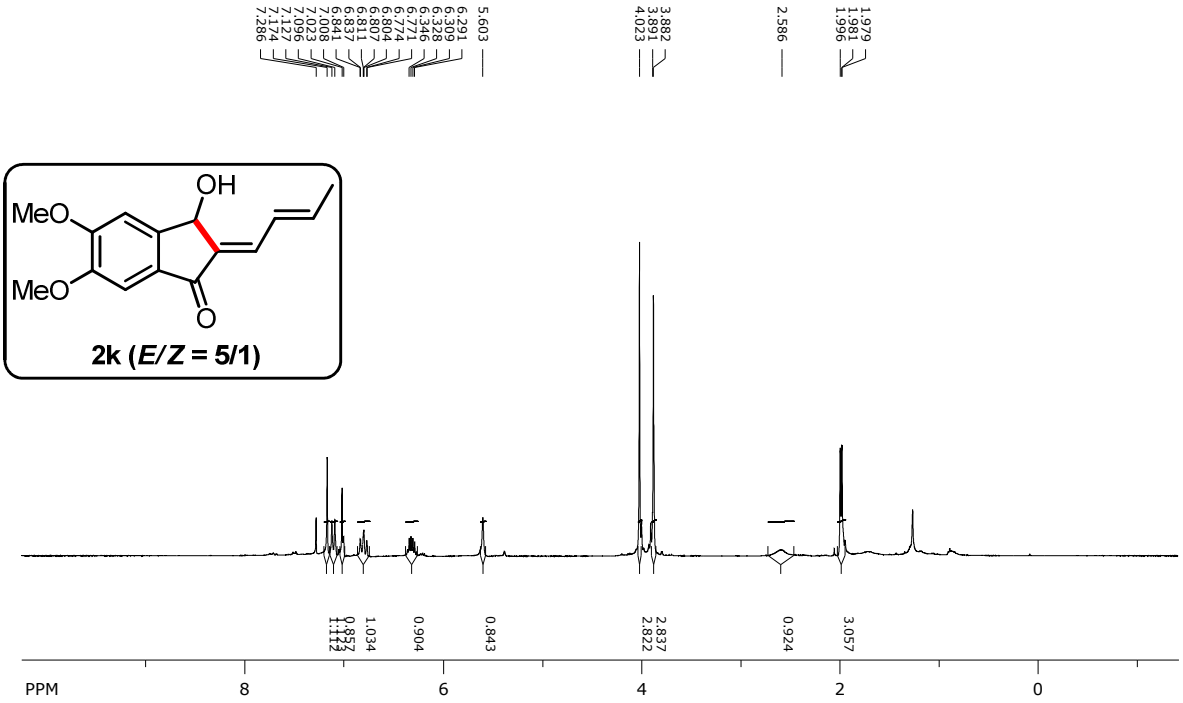
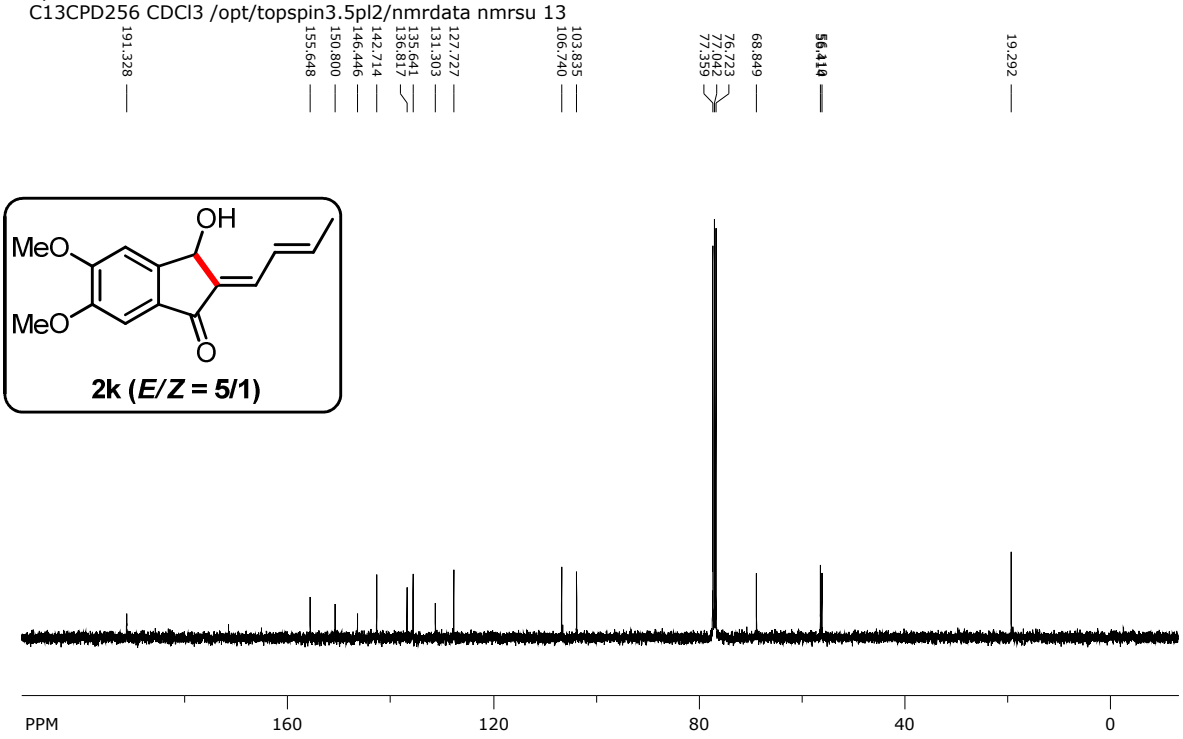
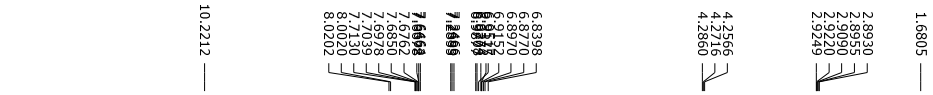
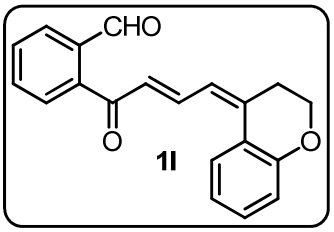


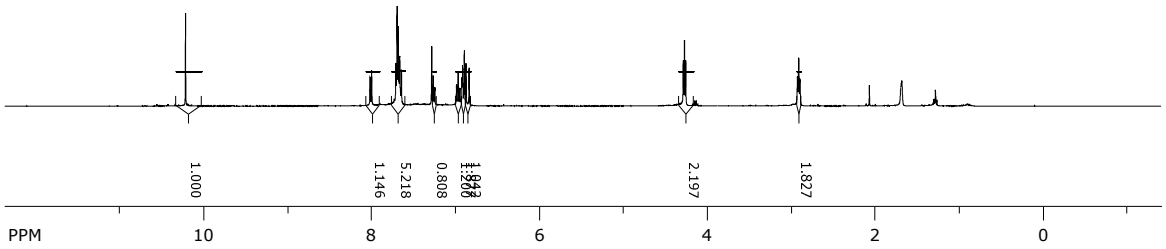
SpinWorks 4: BS 06 215
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 13



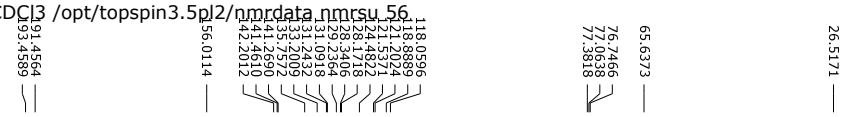
SpinWorks 4: BS-06-523

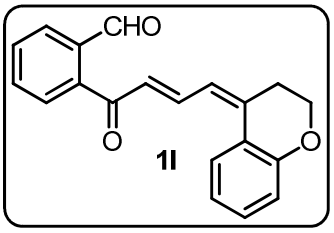




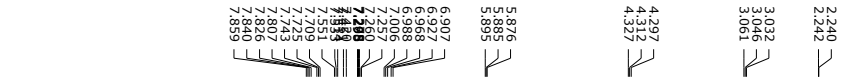


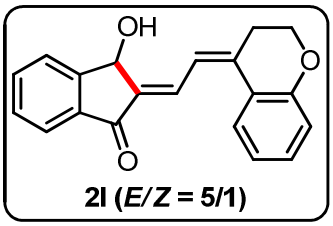
SpinWorks 4: BS 06 523
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 56

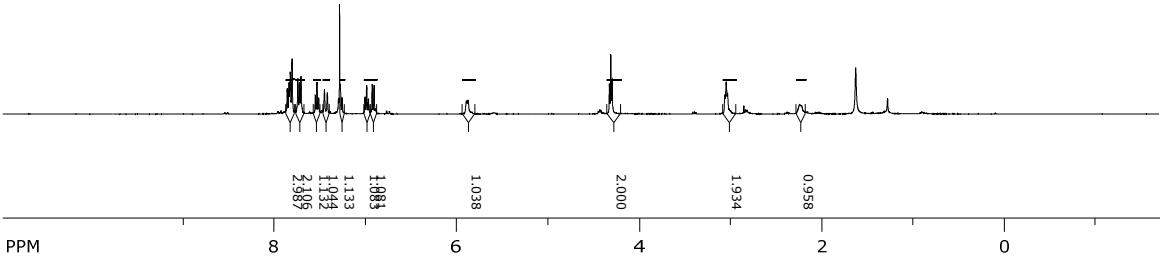




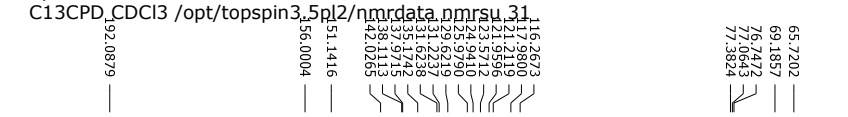
SpinWorks 4: BS-06-522-re

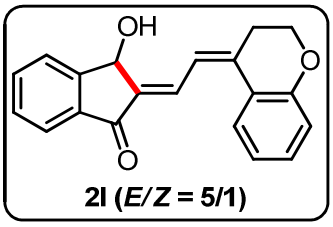




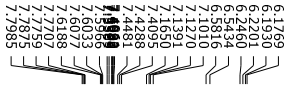


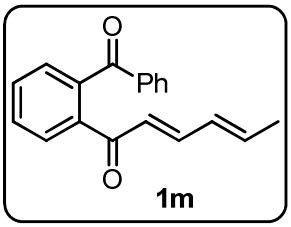
SpinWorks 4: BS 06 522
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 31

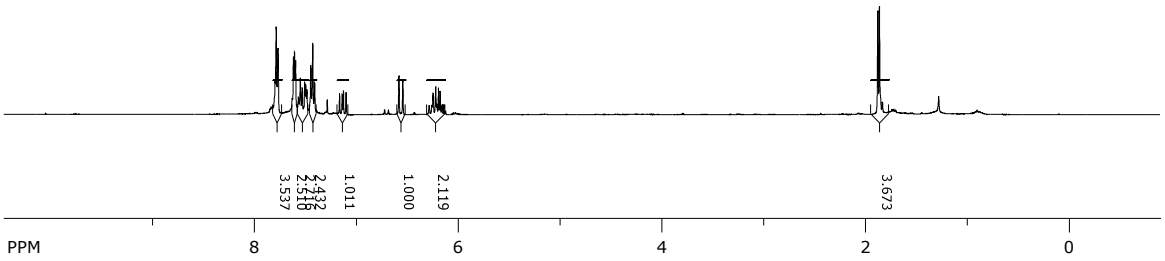




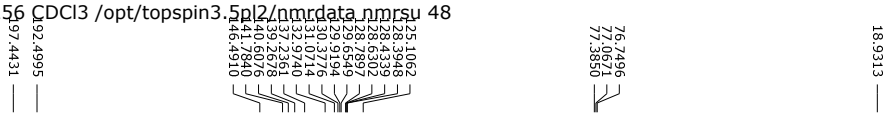
SpinWorks 4: BS 06 197
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 48

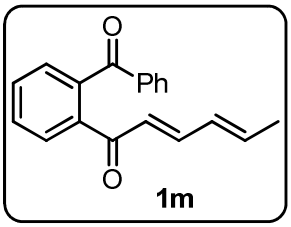


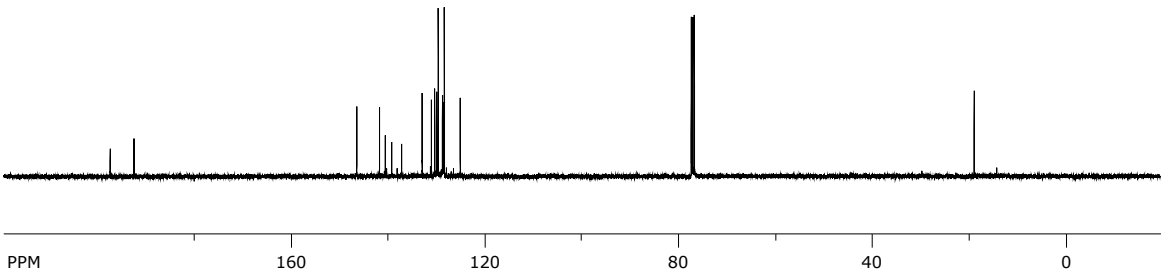




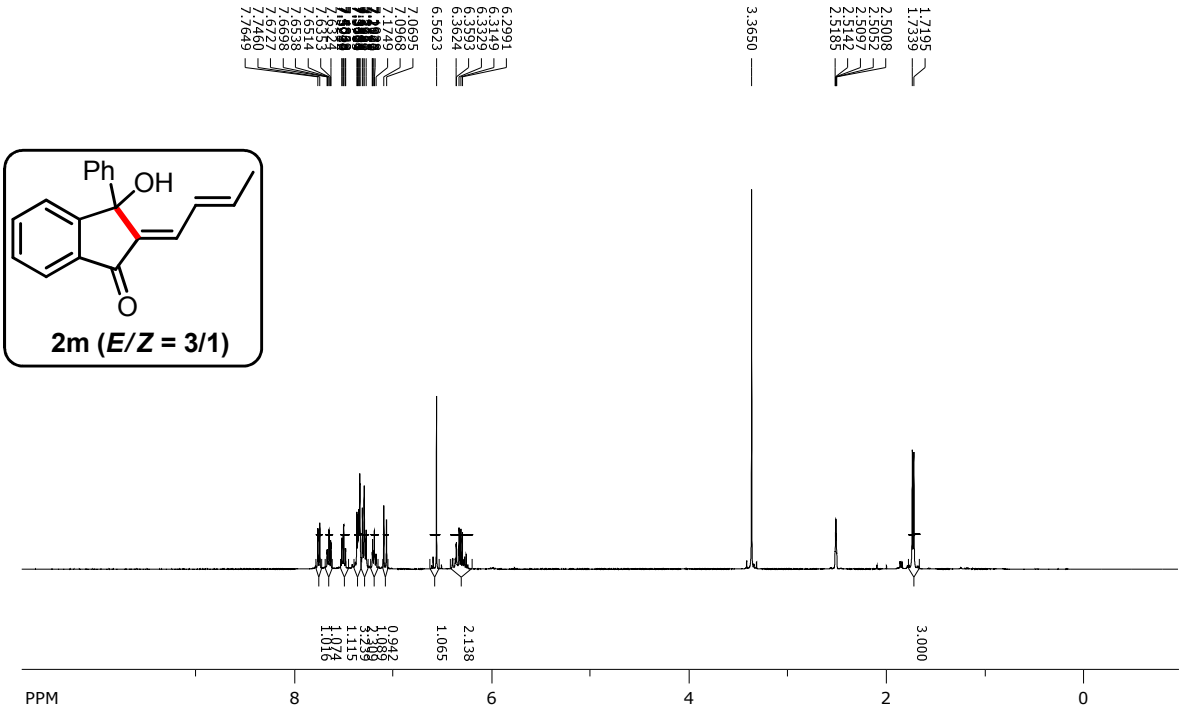
SpinWorks 4: BS 06 197
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 48



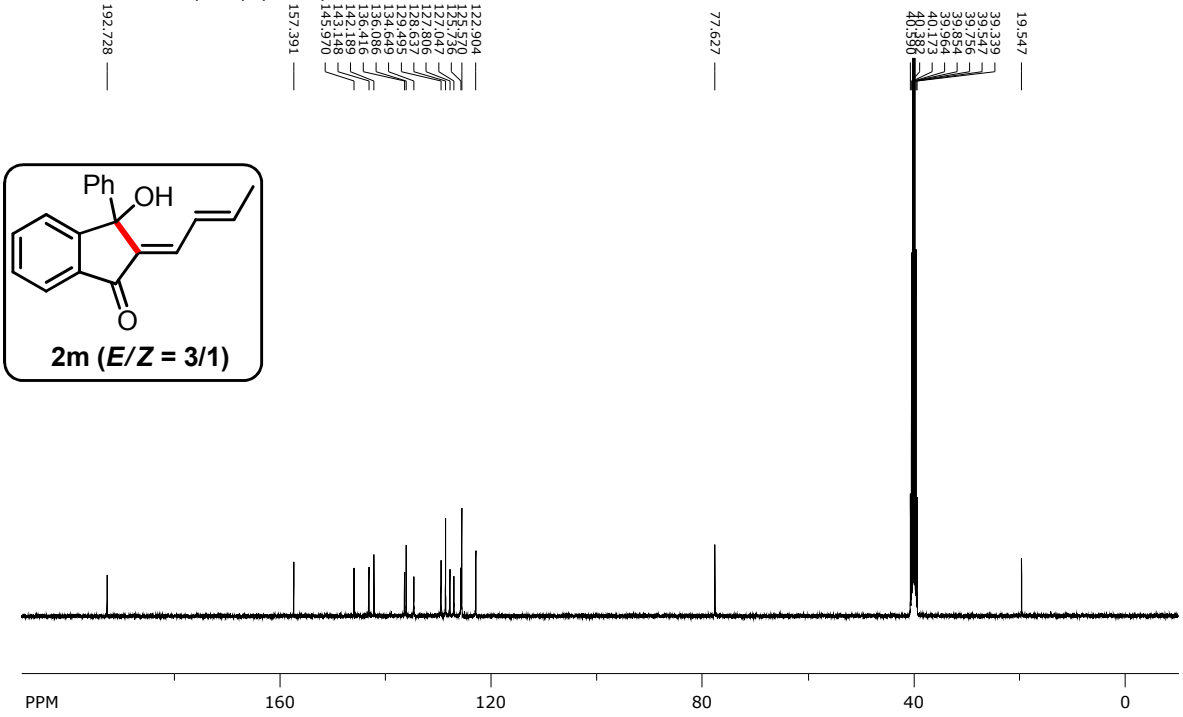




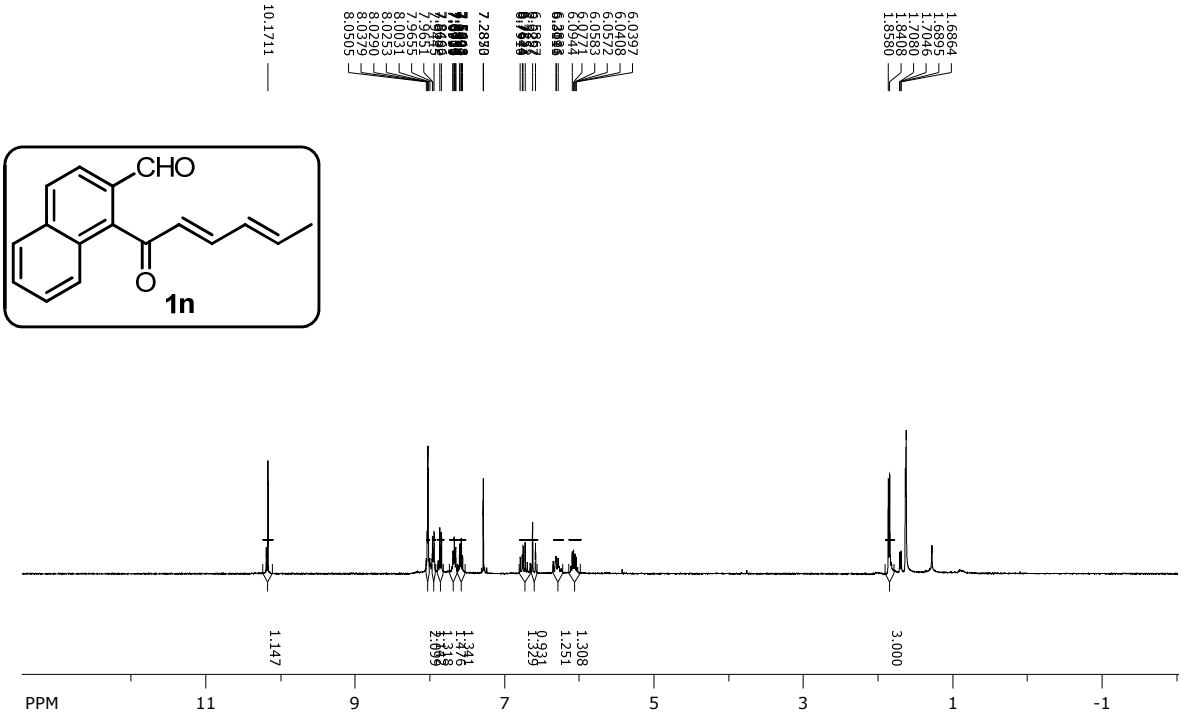
SpinWorks 4: bs-07-70



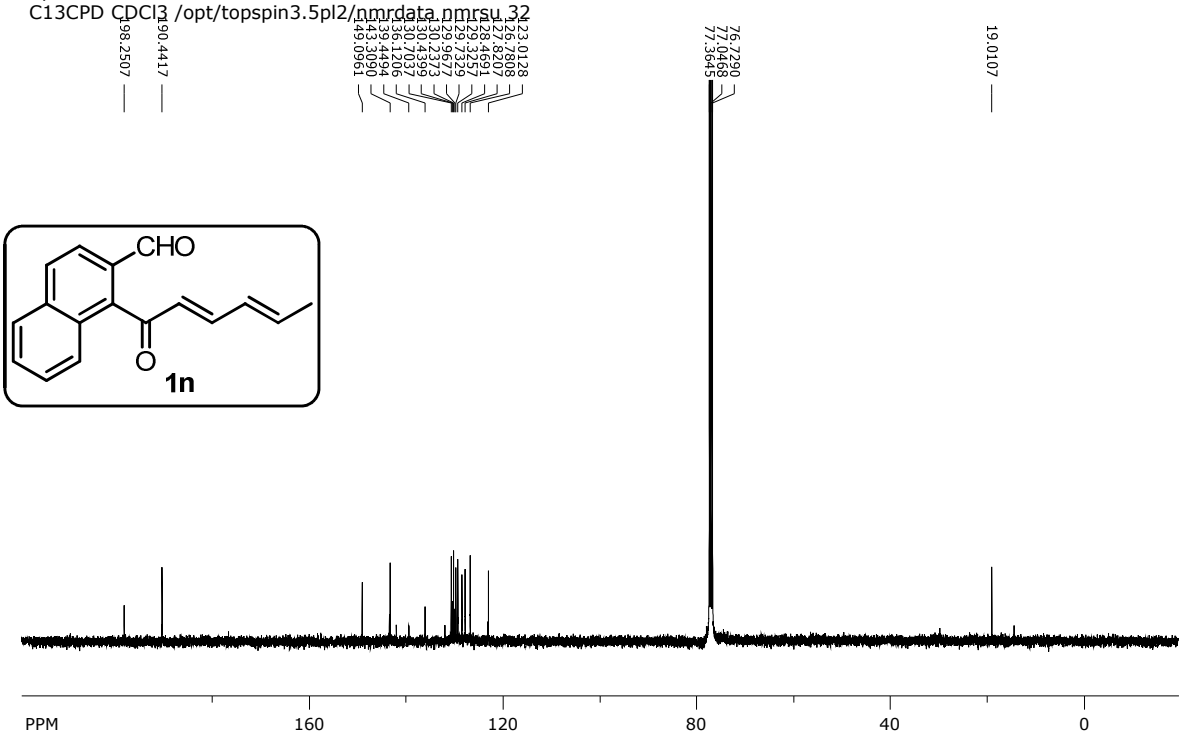
SpinWorks 4: BS 07 70
C13CPD DMSO /opt/topspin3.5pl2/nmrdata nmrsu 14



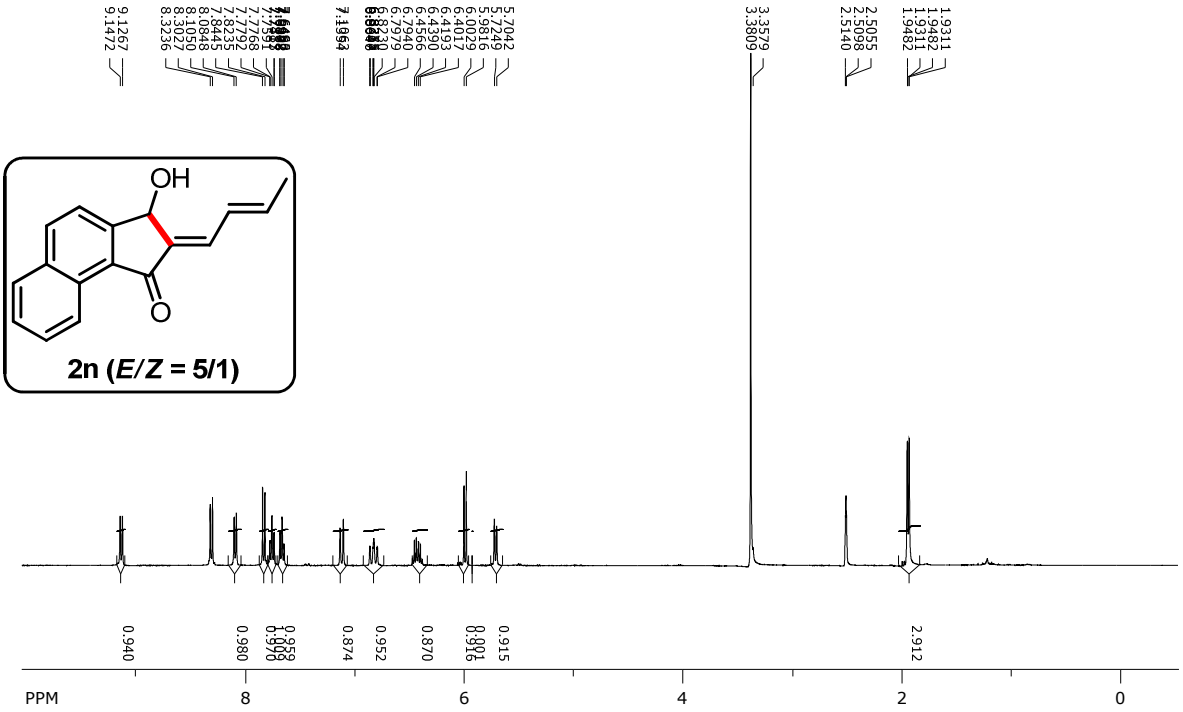
SpinWorks 4: BS-06-597



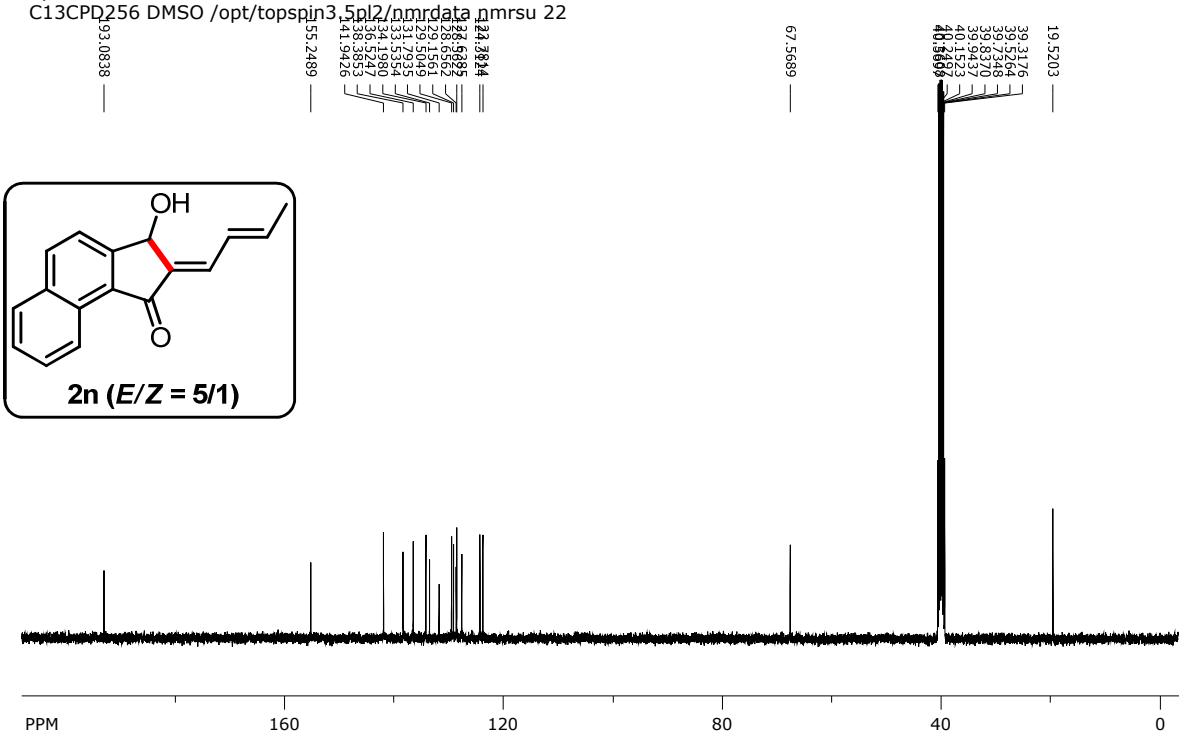
SpinWorks 4: BS 06 597
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 32



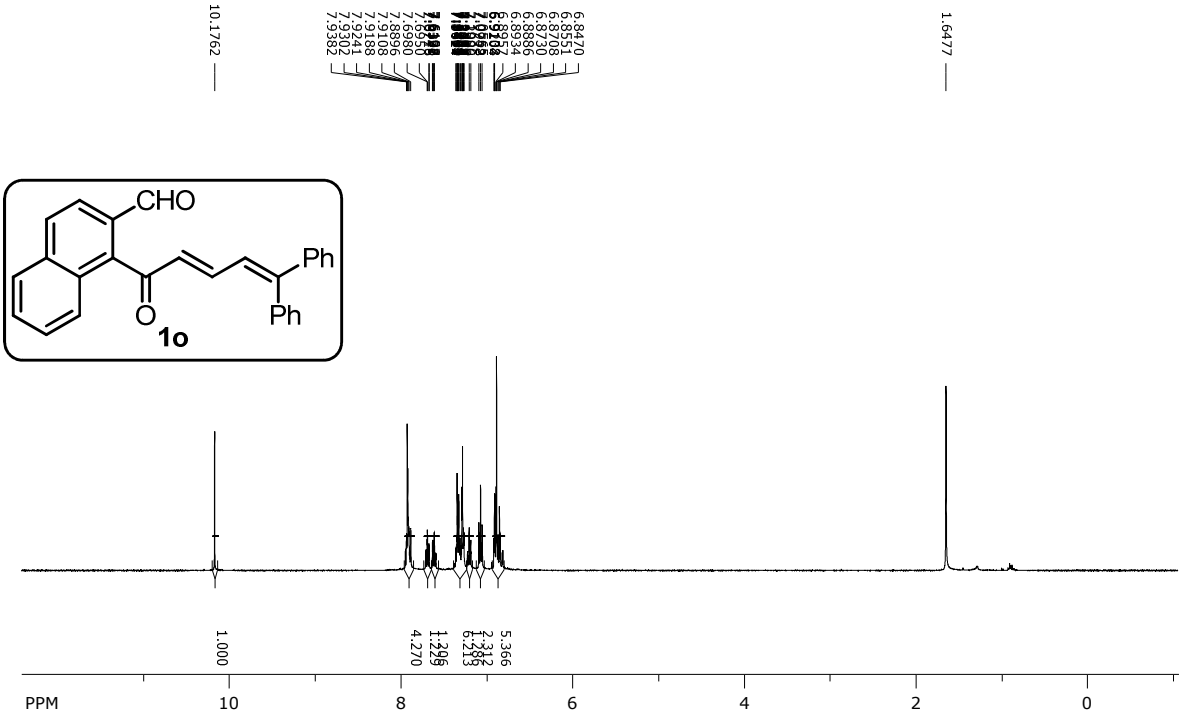
SpinWorks 4: BS 06 600
PROTON DMSO /opt/topspin3.5pl2/nmrdata nmrsu 22



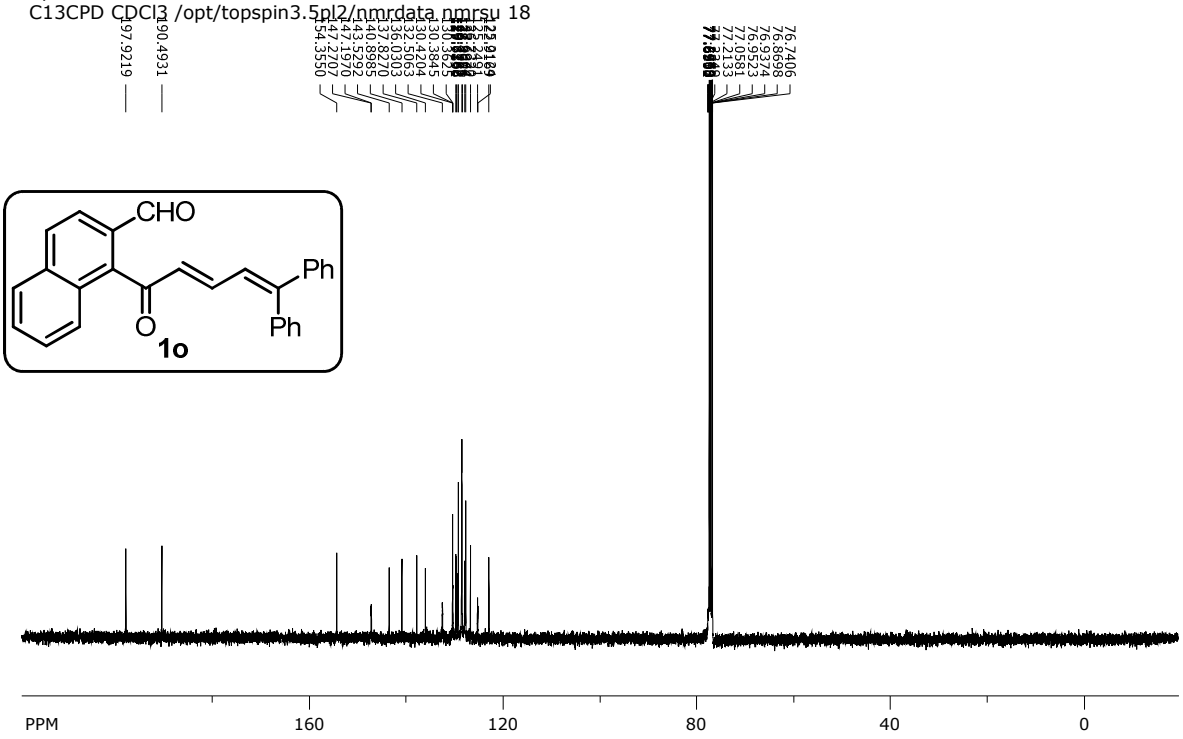
SpinWorks 4: BS 06 600
C13CPD256 DMSO /opt/topspin3.5pl2/nmrdata nmrsu 22



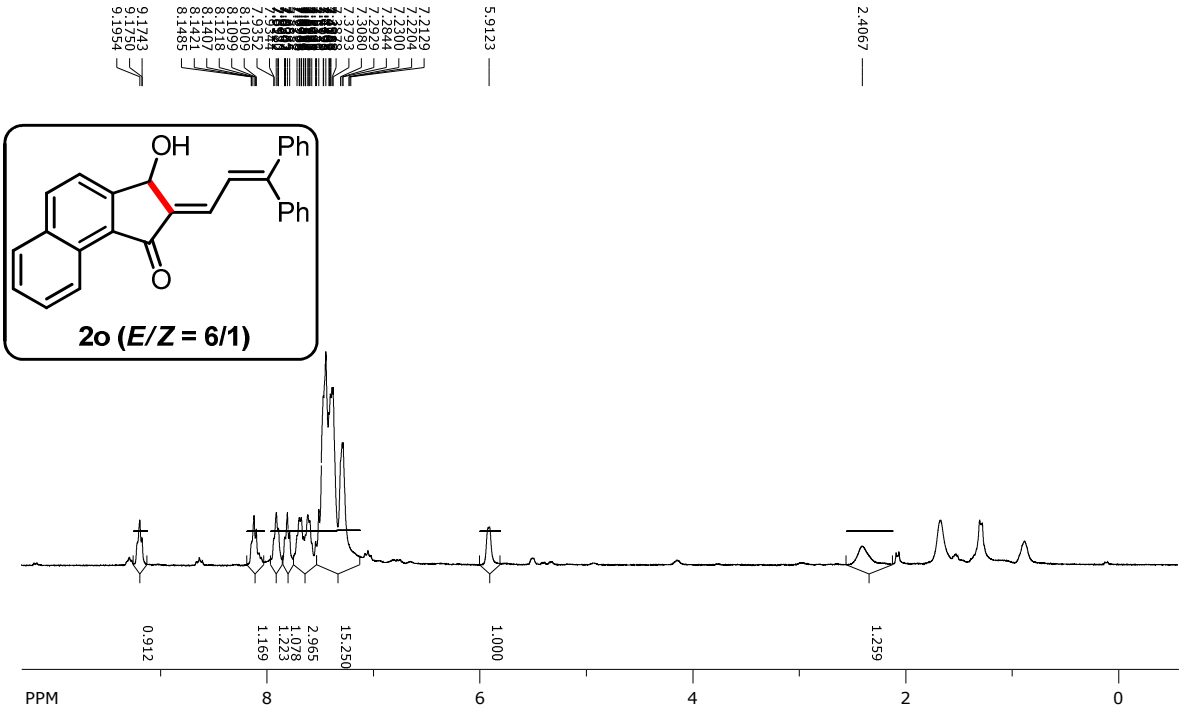
SpinWorks 4: bs-06-620



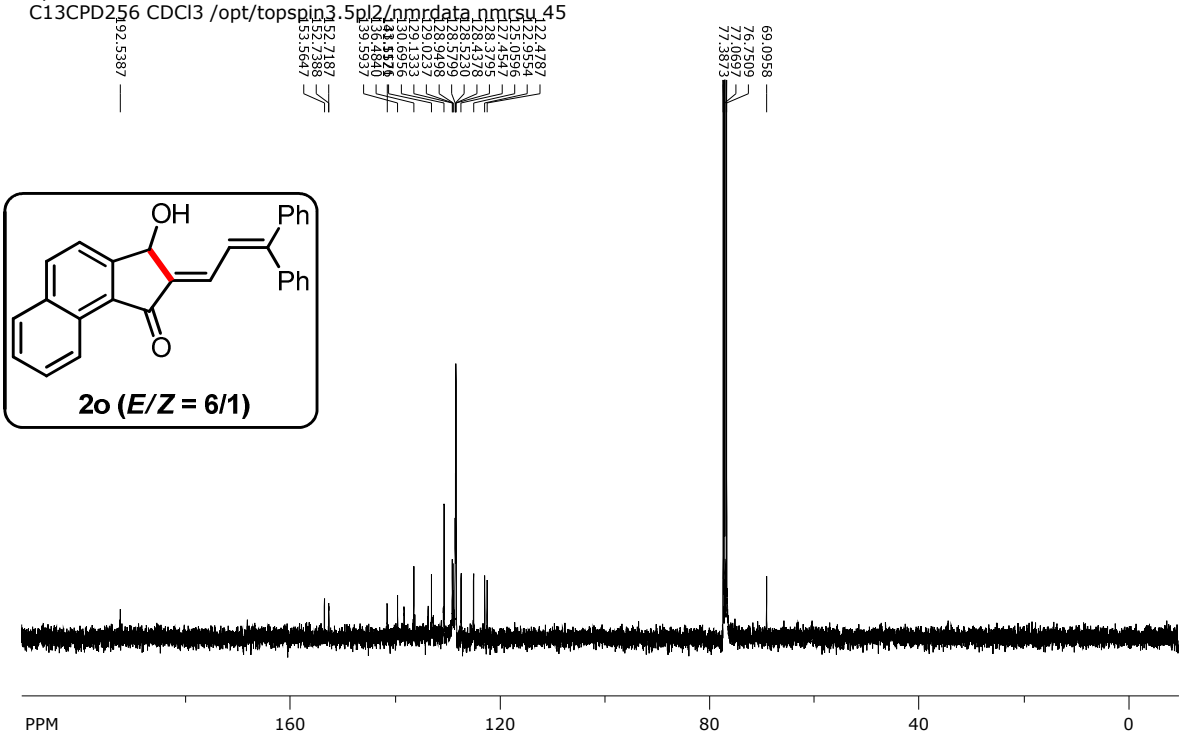
SpinWorks 4: BS 06 620
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 18



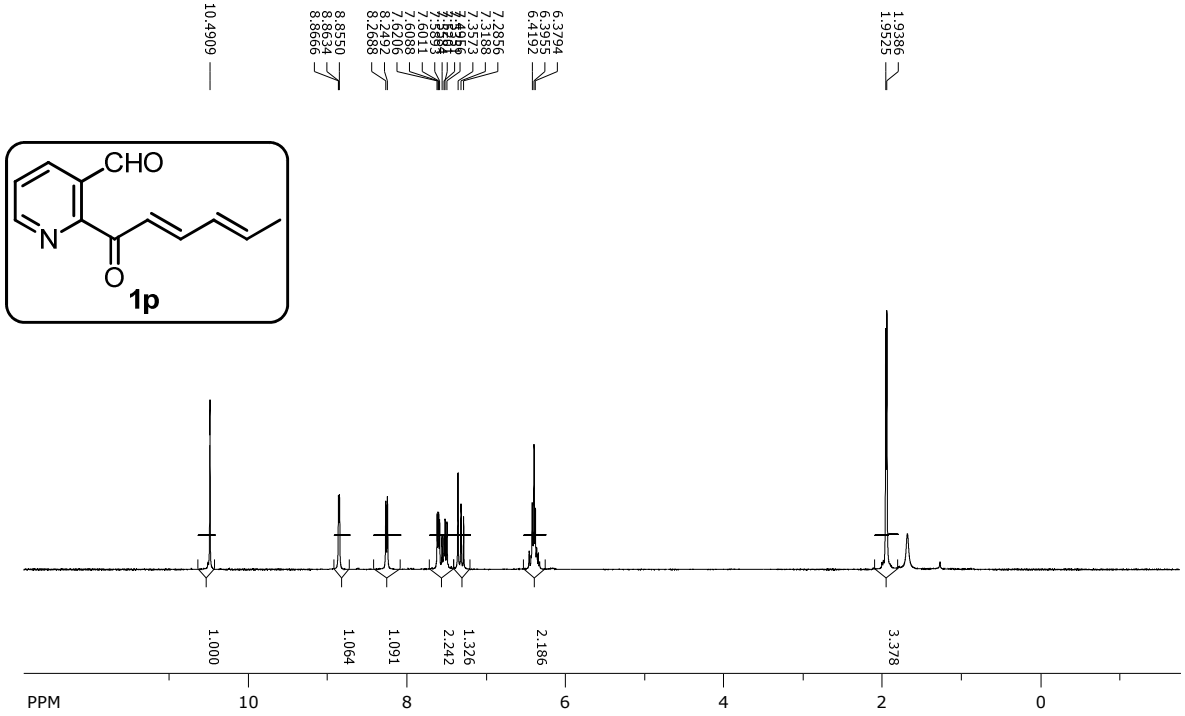
SpinWorks 4: BS 06 627
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 45



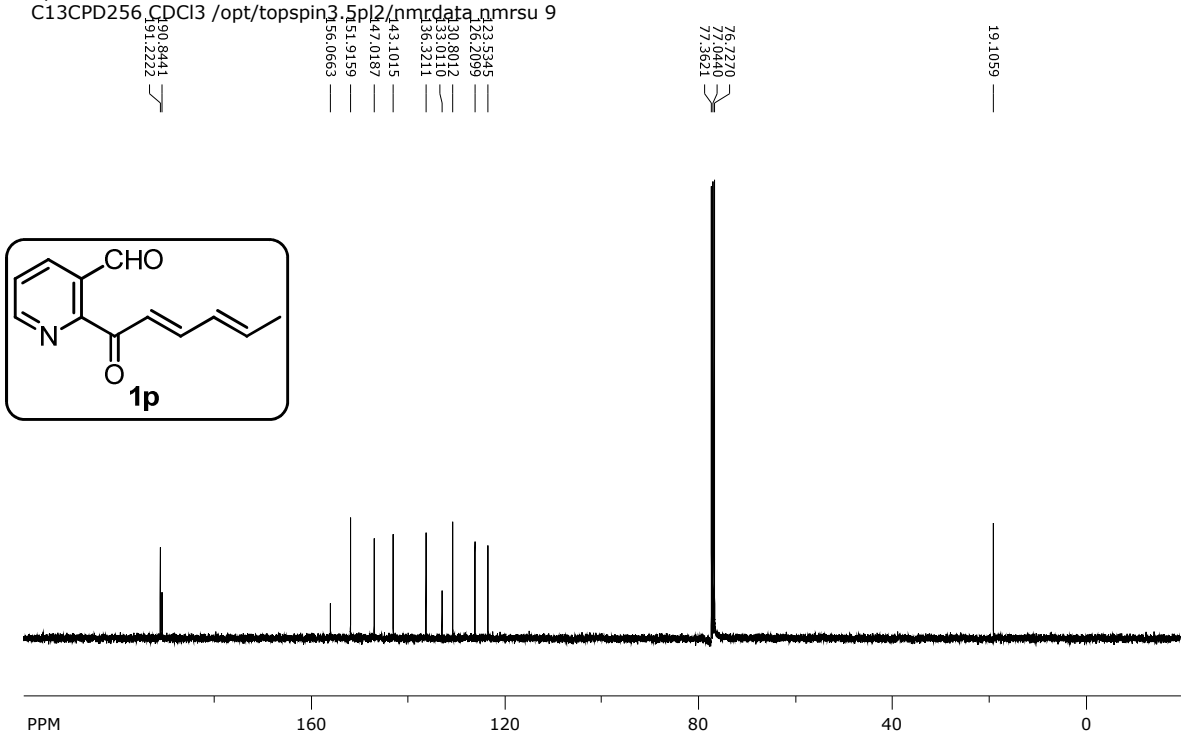
SpinWorks 4: BS 06 627
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 45



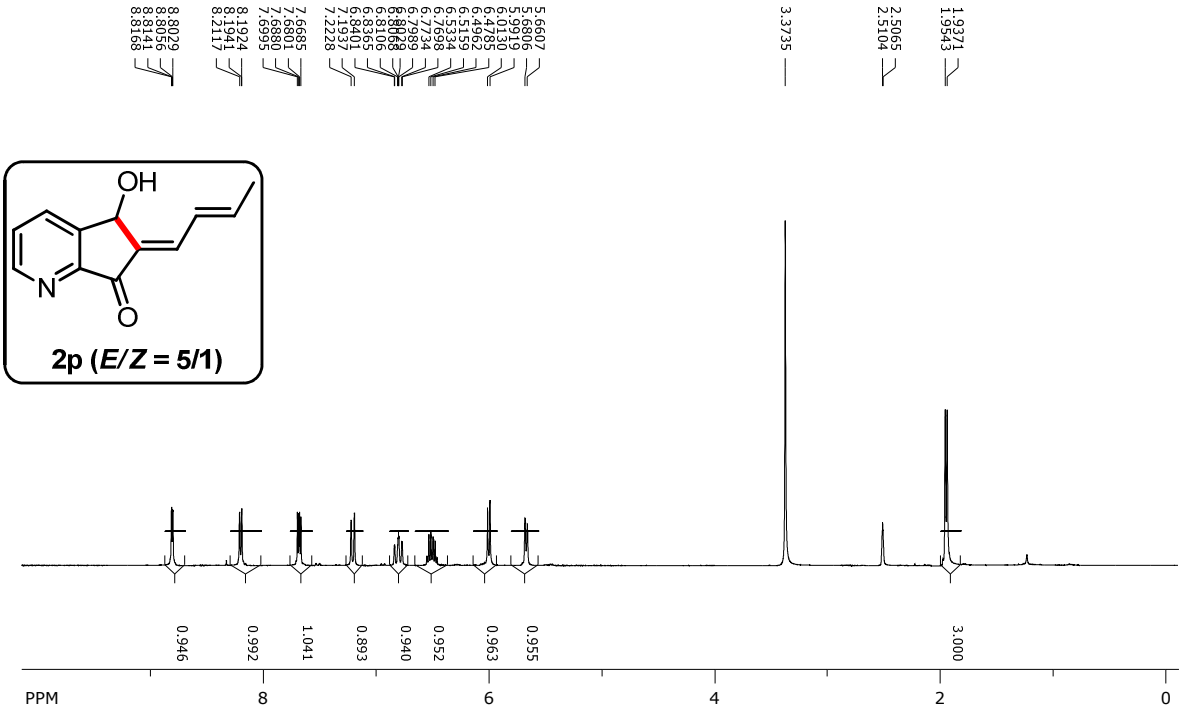
SpinWorks 4: BS-06-667



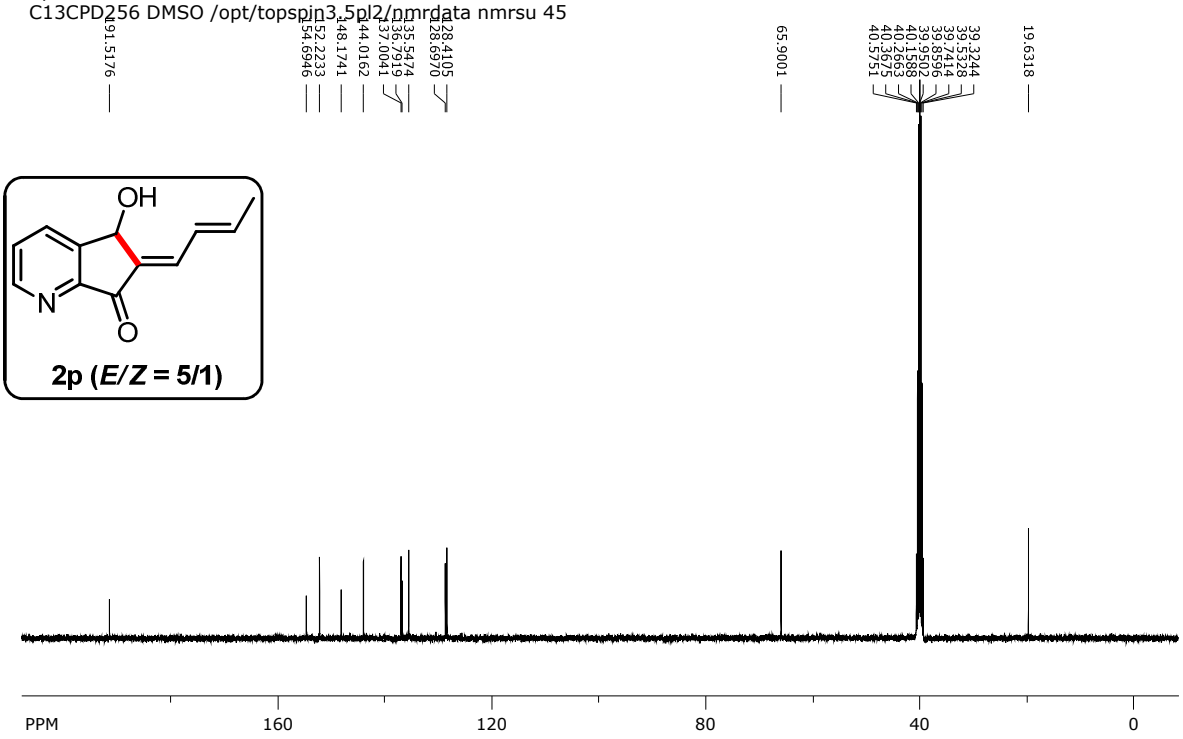
SpinWorks 4: BS 06 667
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 9



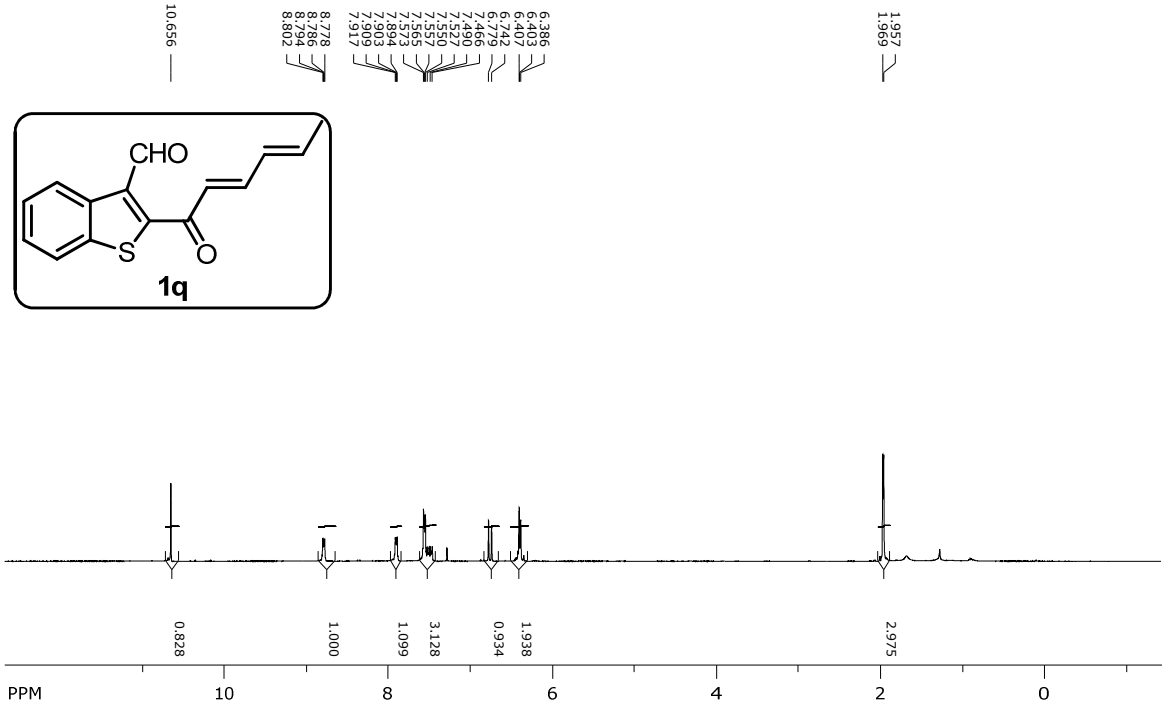
SpinWorks 4: BS-06-697
PROTON DMSO /opt/topspin3.5pl2/nmrdata nmrsu 45



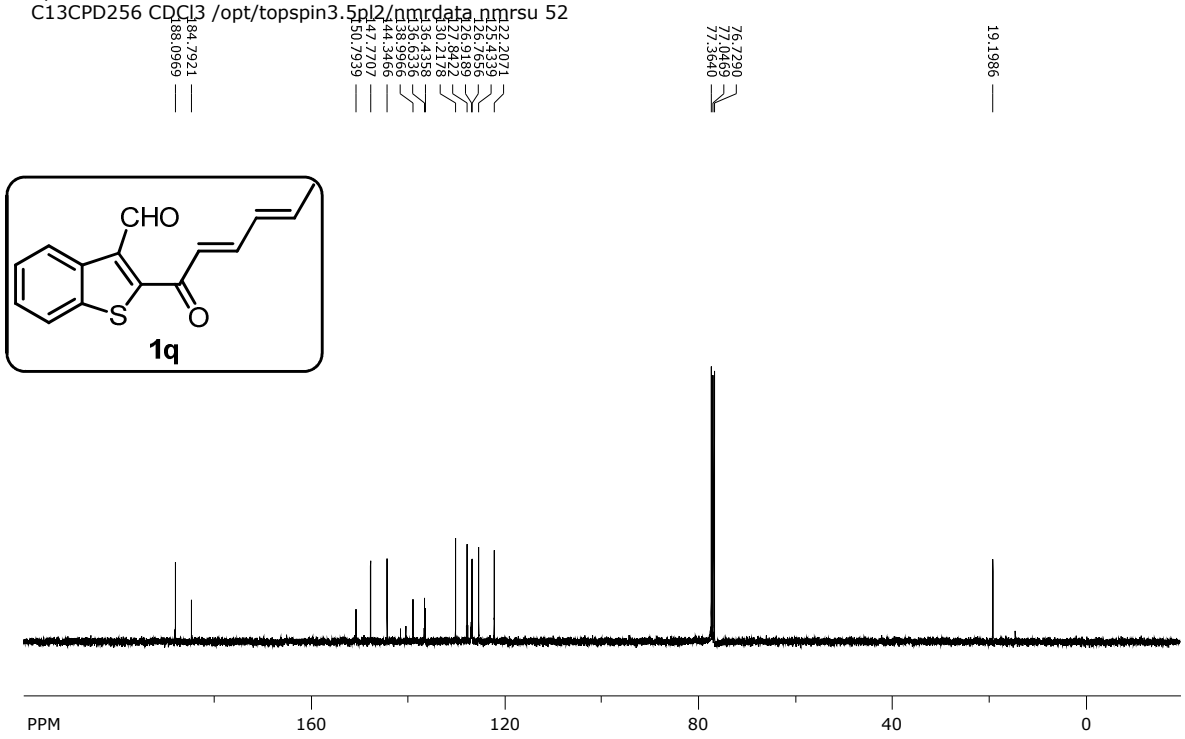
SpinWorks 4: BS-06-697
C13CPD256 DMSO /opt/topspin3.5pl2/nmrdata nmrsu 45



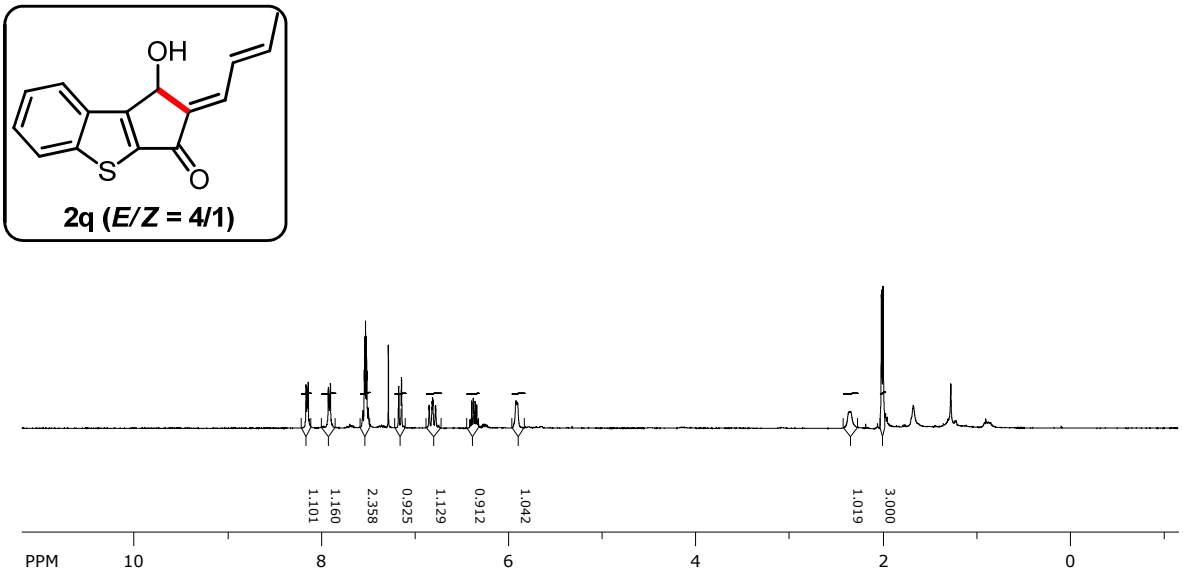
SpinWorks 4: BS 06 223 RE
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 55



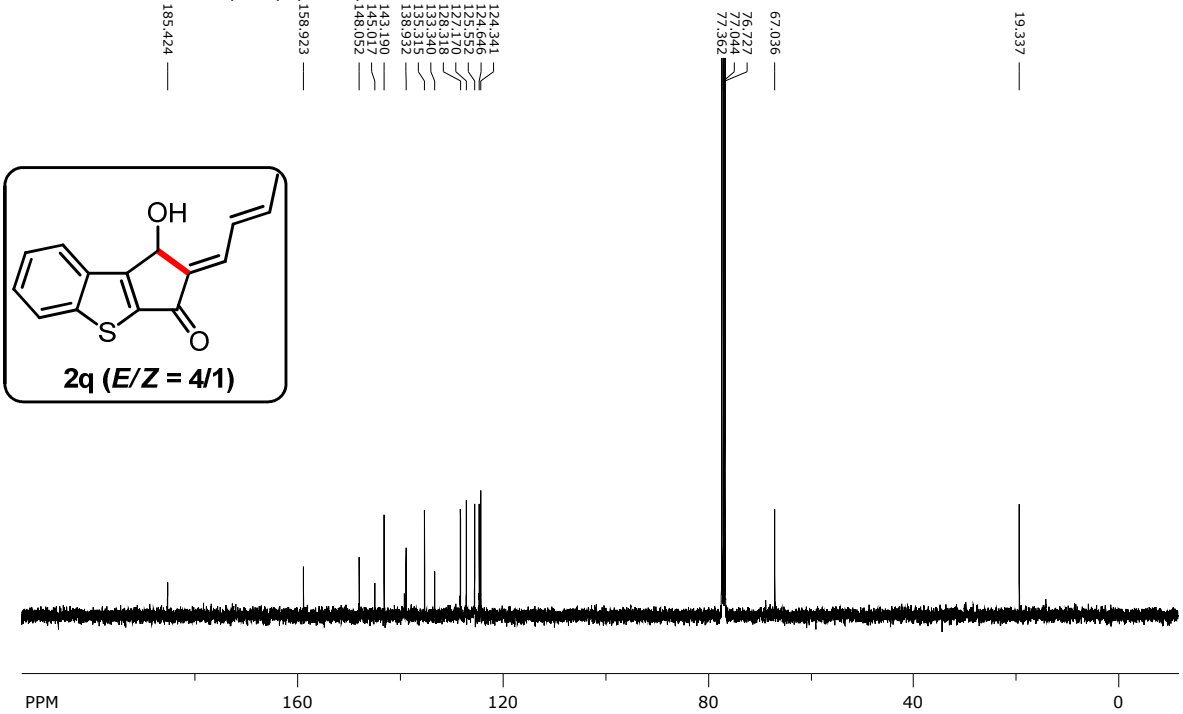
SpinWorks 4: BS 06 223
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 52



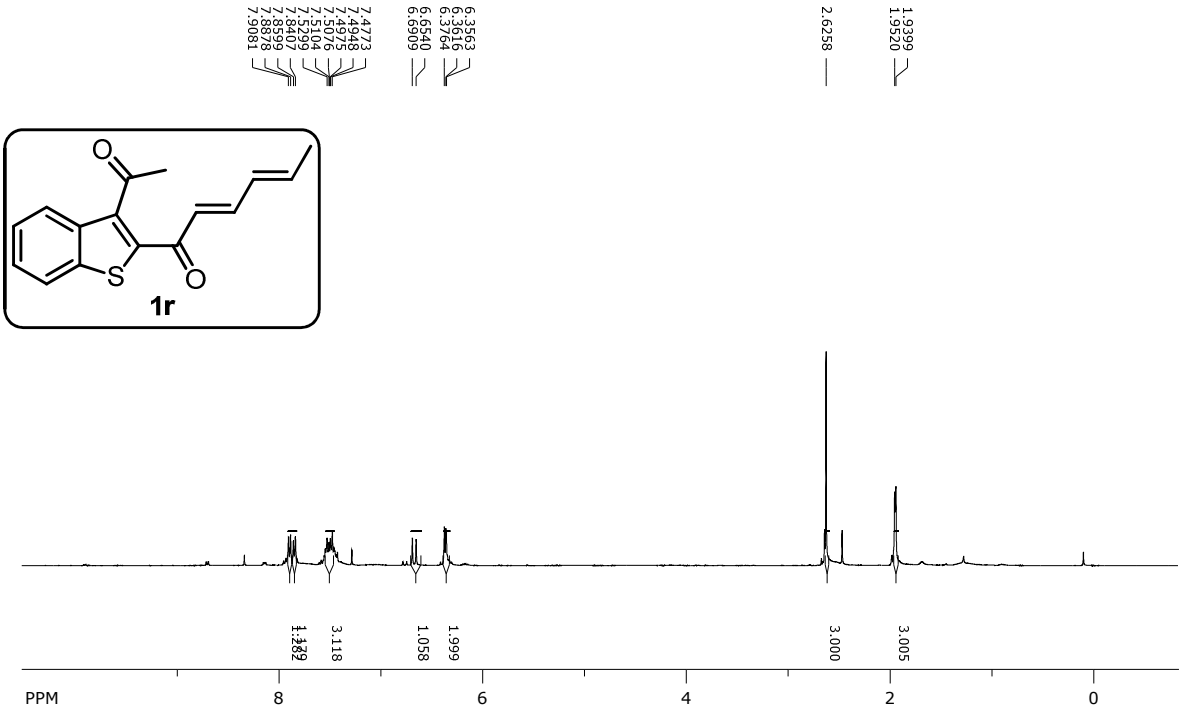
SpinWorks 4: BS 06 228
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 55



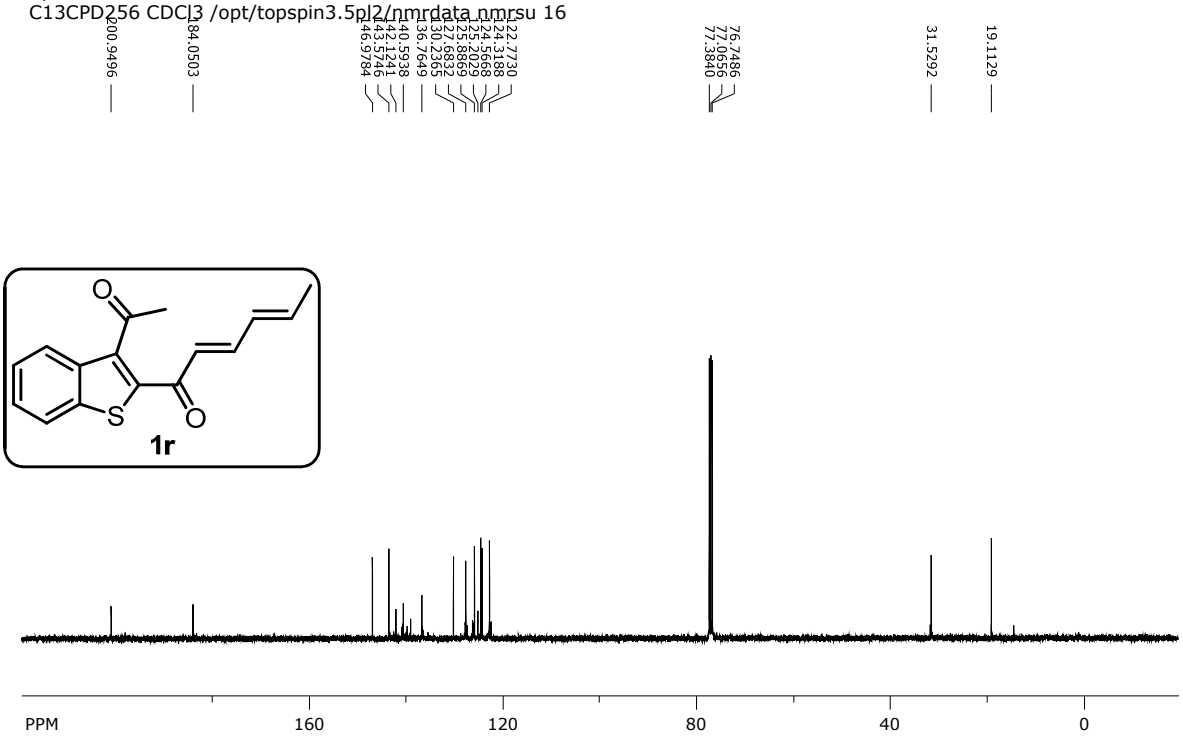
SpinWorks 4: BS 06 228
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 55



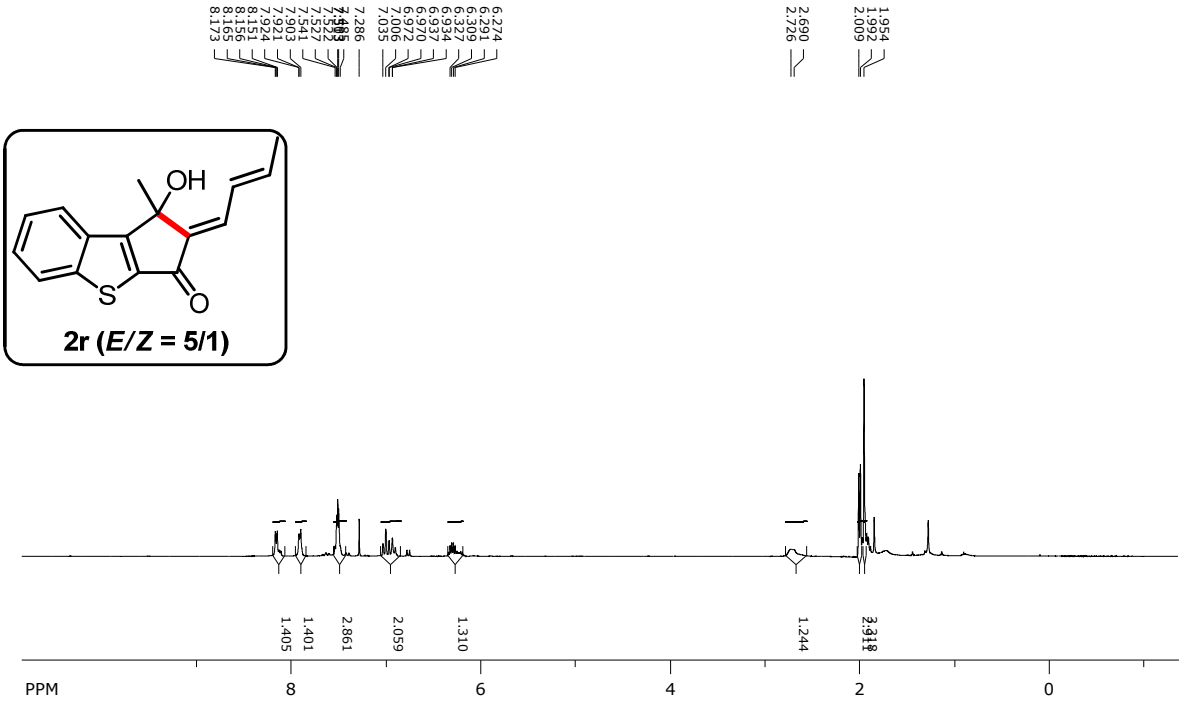
SpinWorks 4: BS-07-18



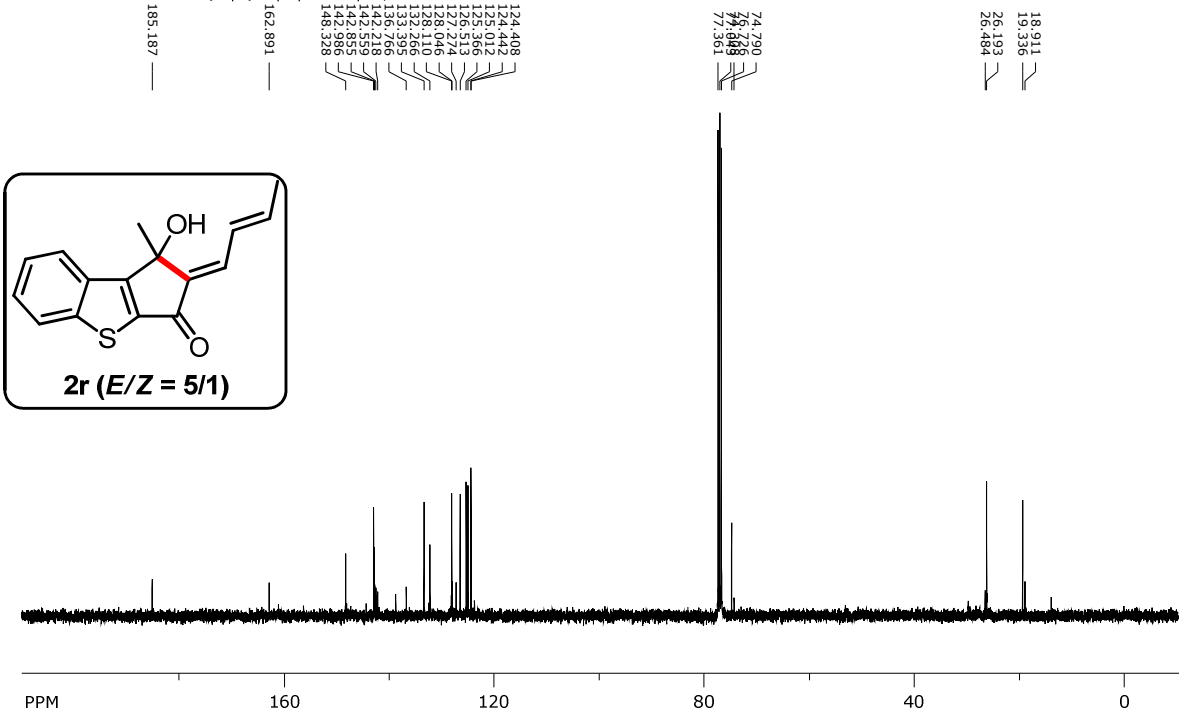
SpinWorks 4: BS 07 18
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 16



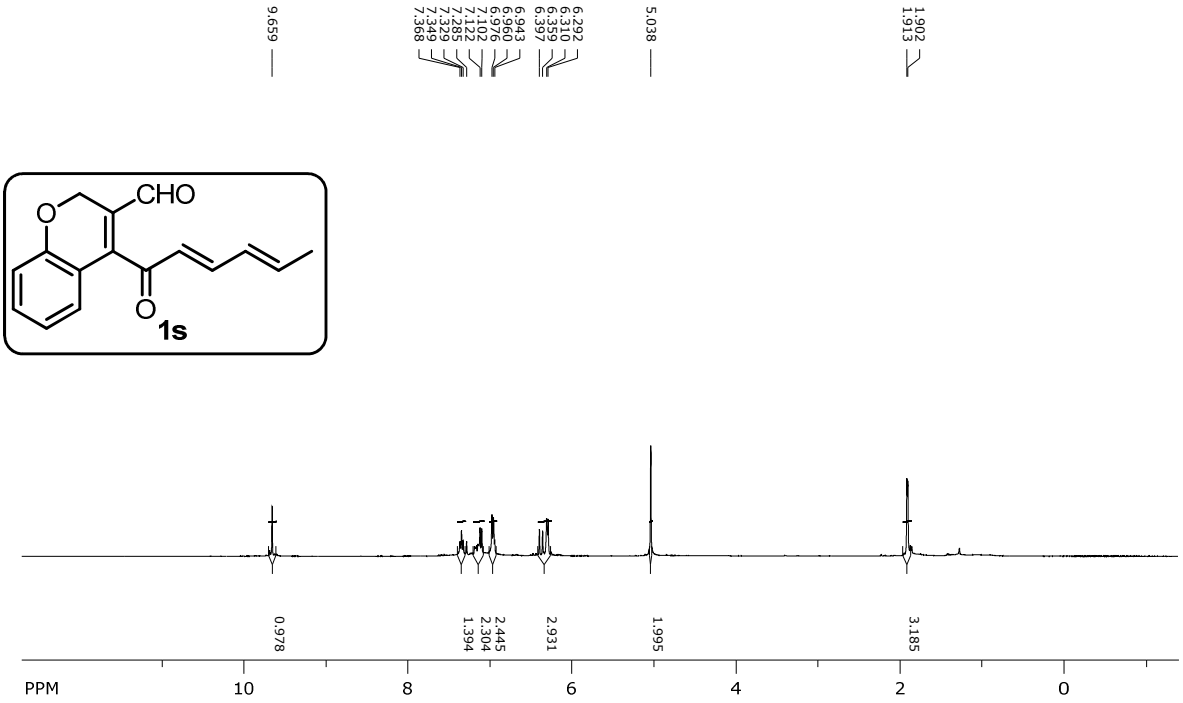
SpinWorks 4: BS-07-20-Re



SpinWorks 4: BS 07 20 RE
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 19



SpinWorks 4: BS 07 113
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 14



SpinWorks 4: BS 07 113
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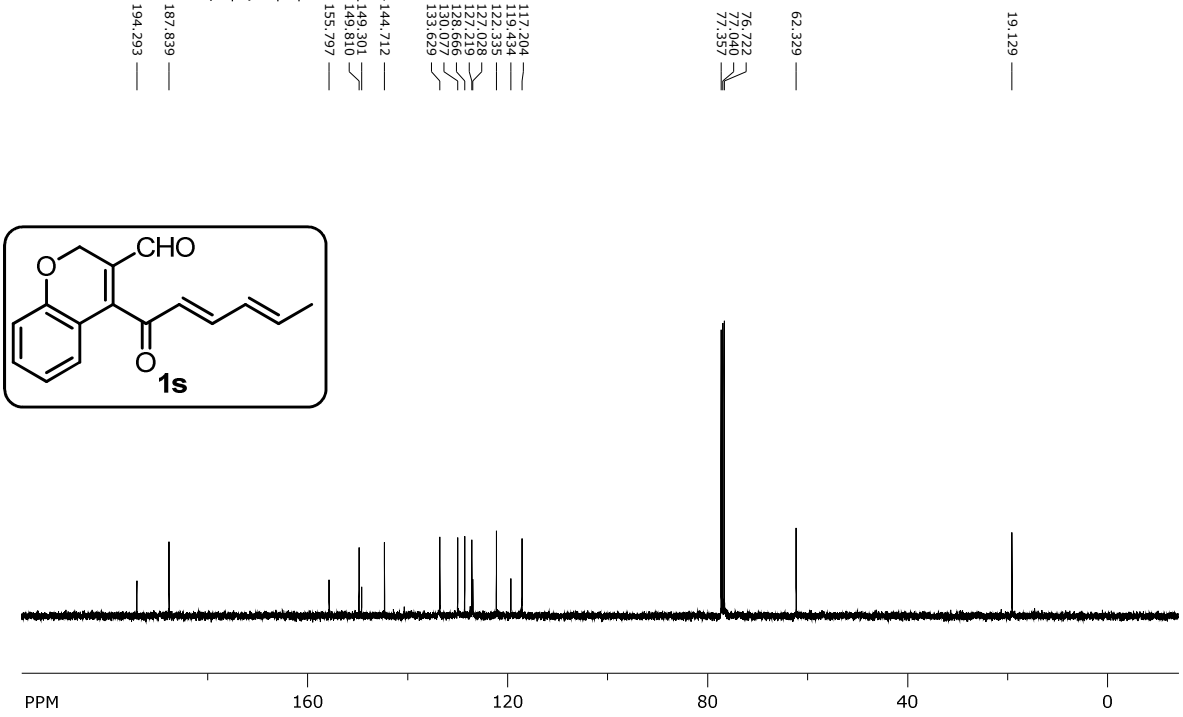
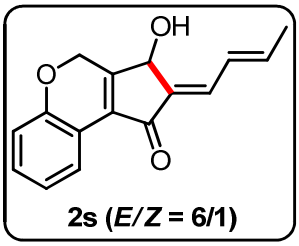
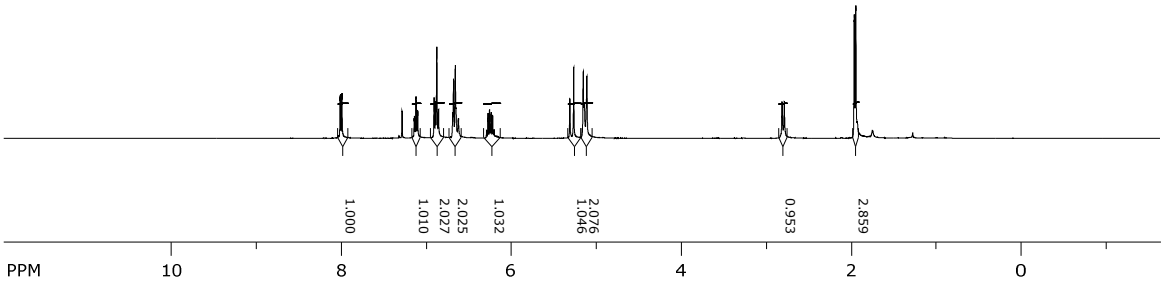


SpinWorks 4: bs 07 120





SpinWorks 4: BS 07 120
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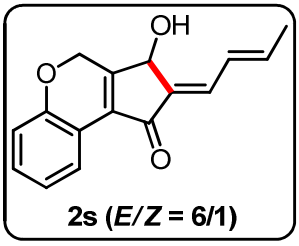
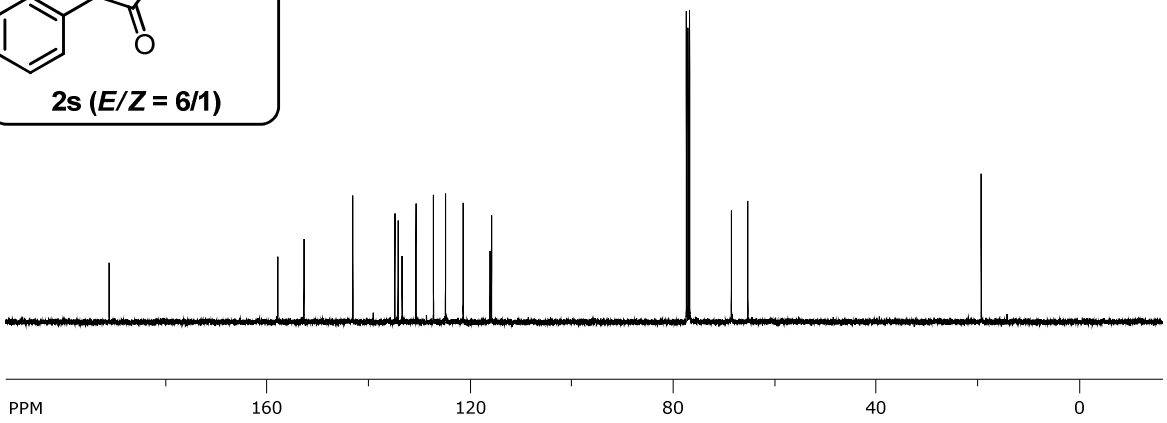
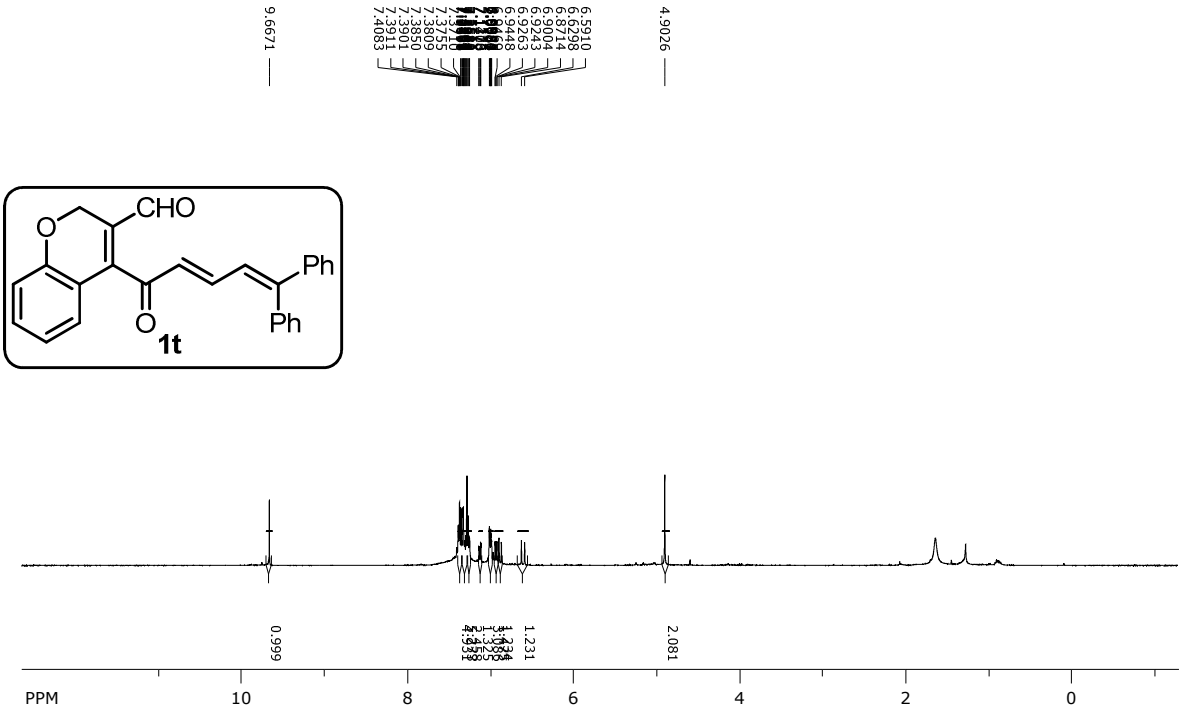
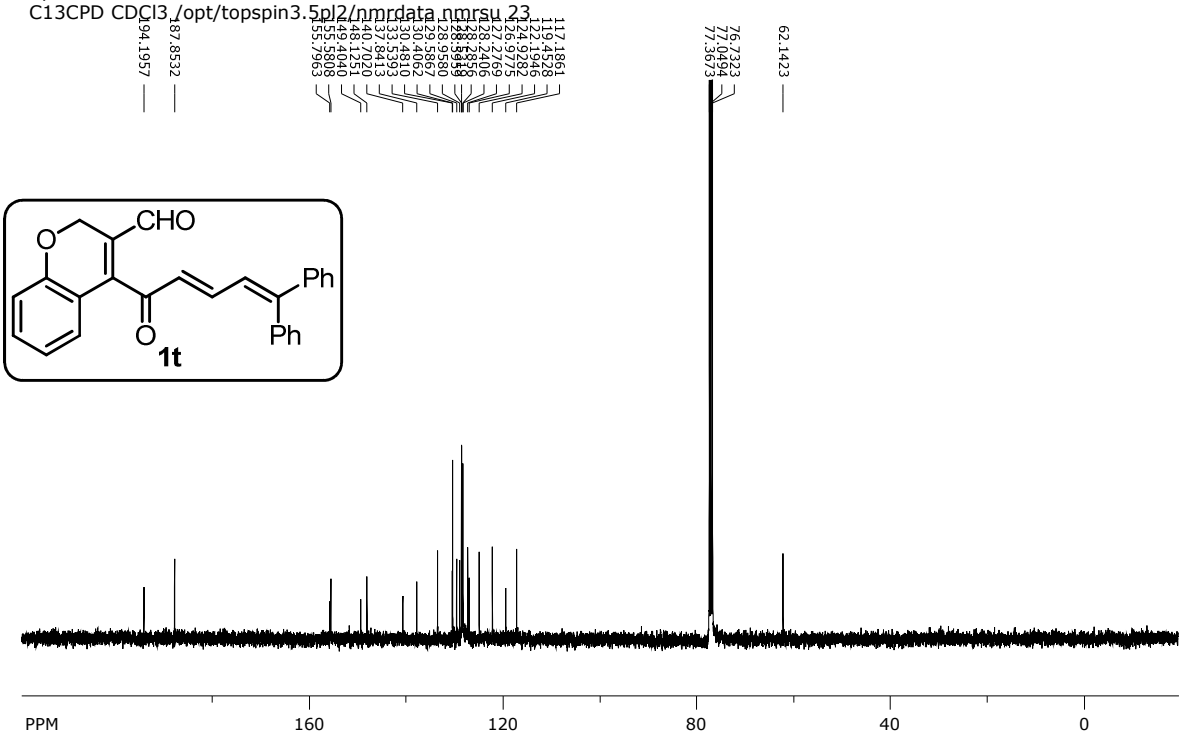




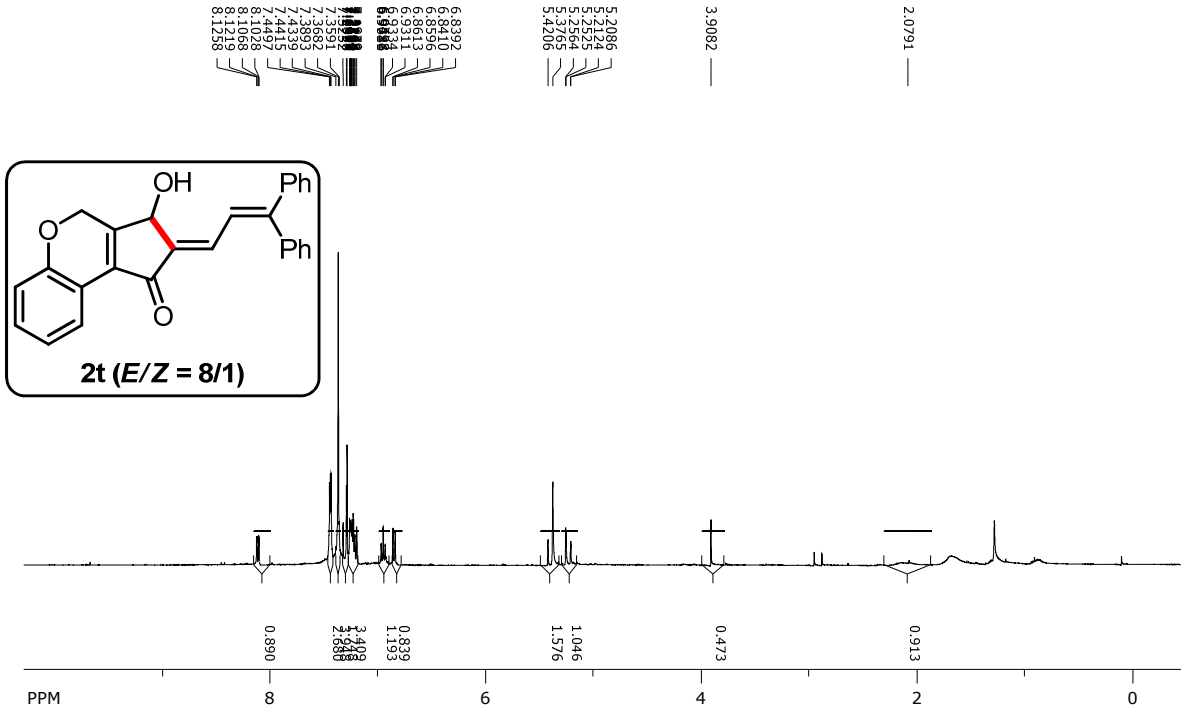
SpinWorks 4: BS-06-640



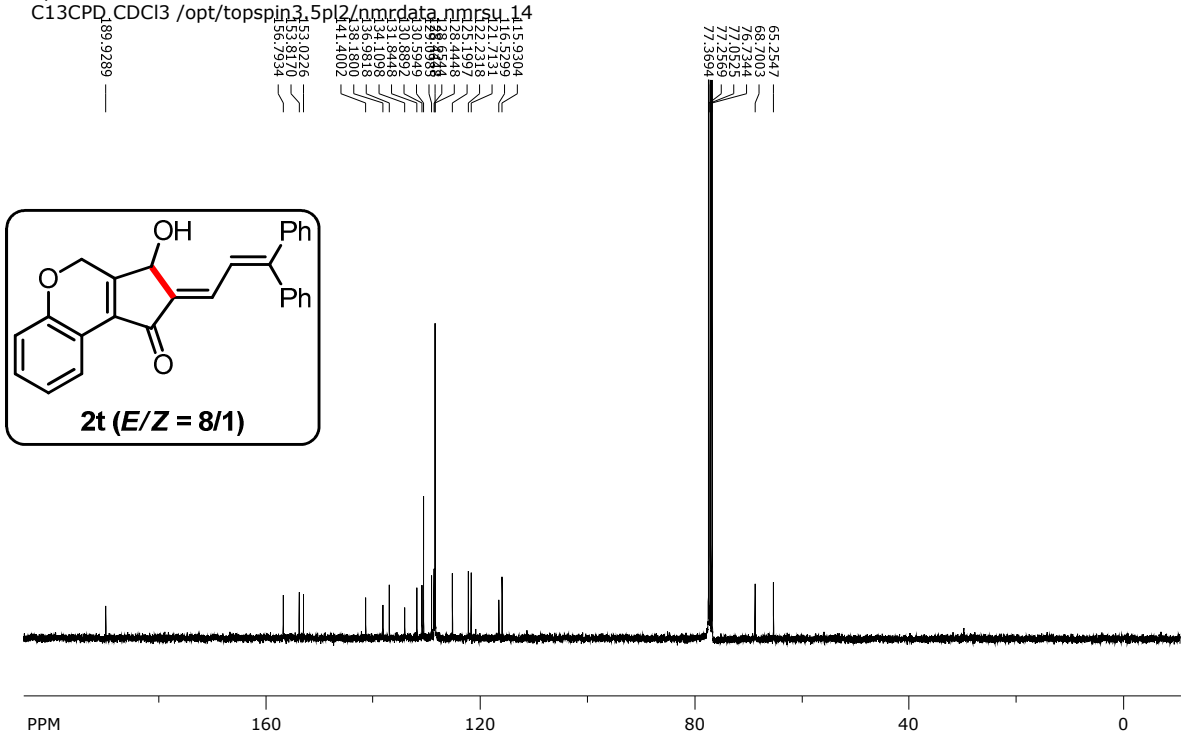
SpinWorks 4: BS 06 640
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 23



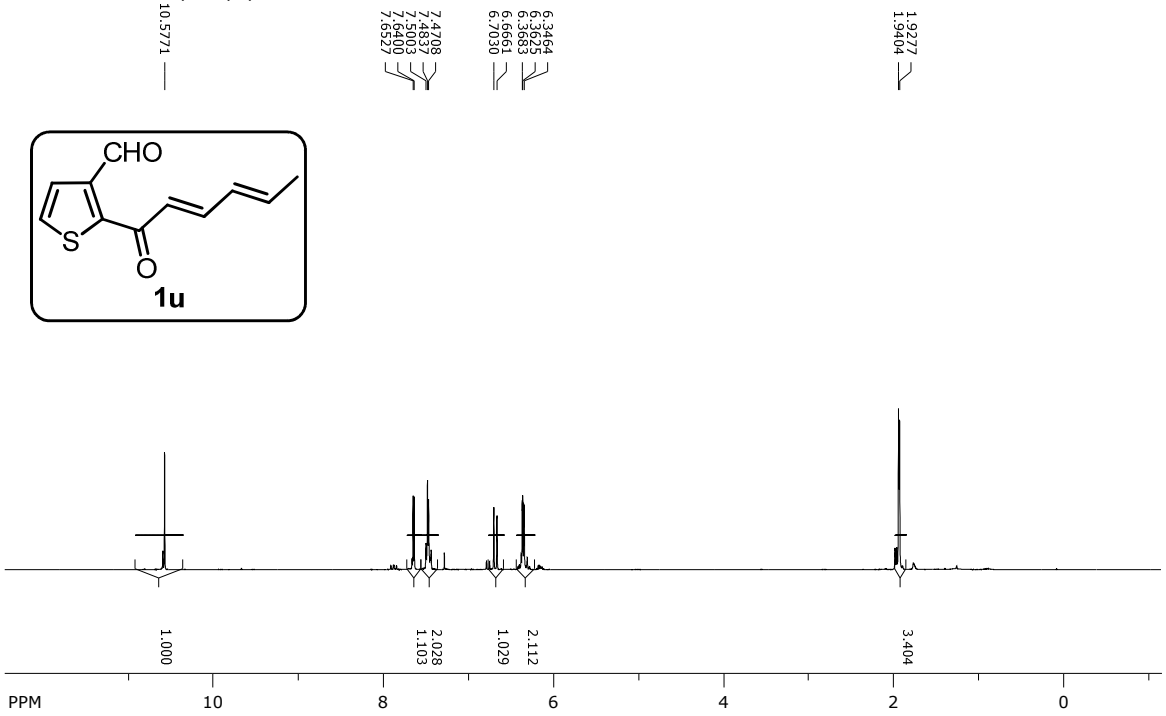
SpinWorks 4: BS 06 657
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 14



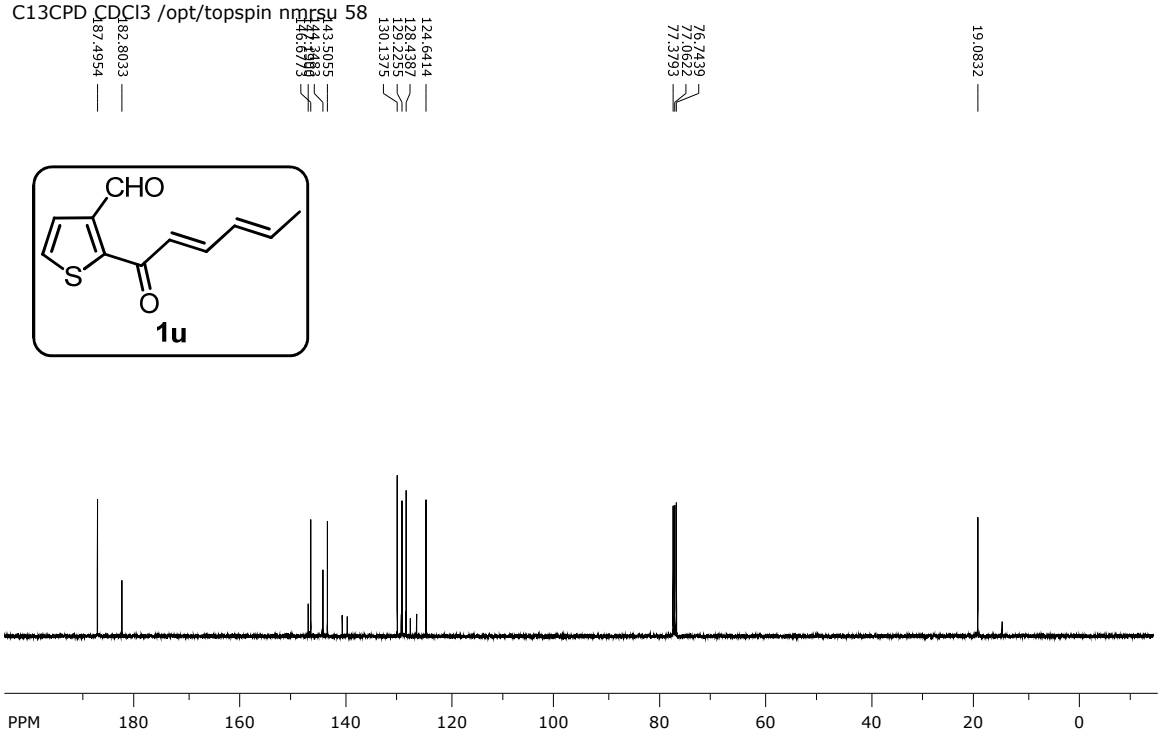
SpinWorks 4: BS 06 657
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 14



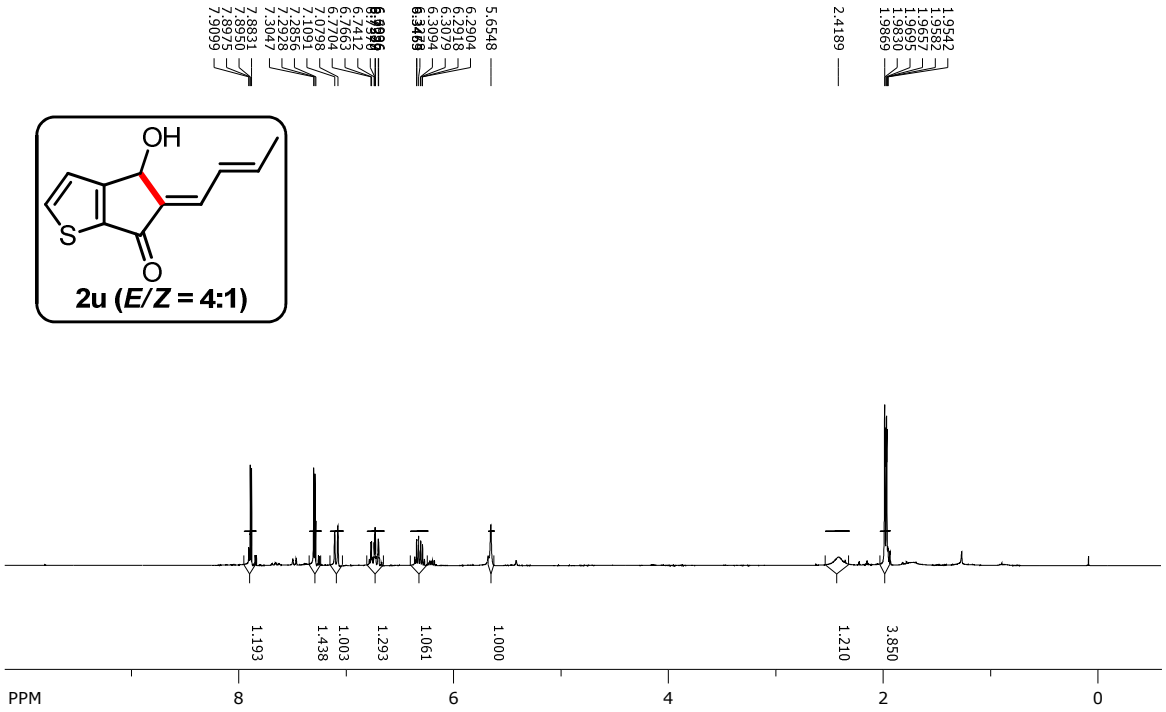
SpinWorks 4: BS-05-111
PROTON CDCl3 /opt/topspin nmrsu 21



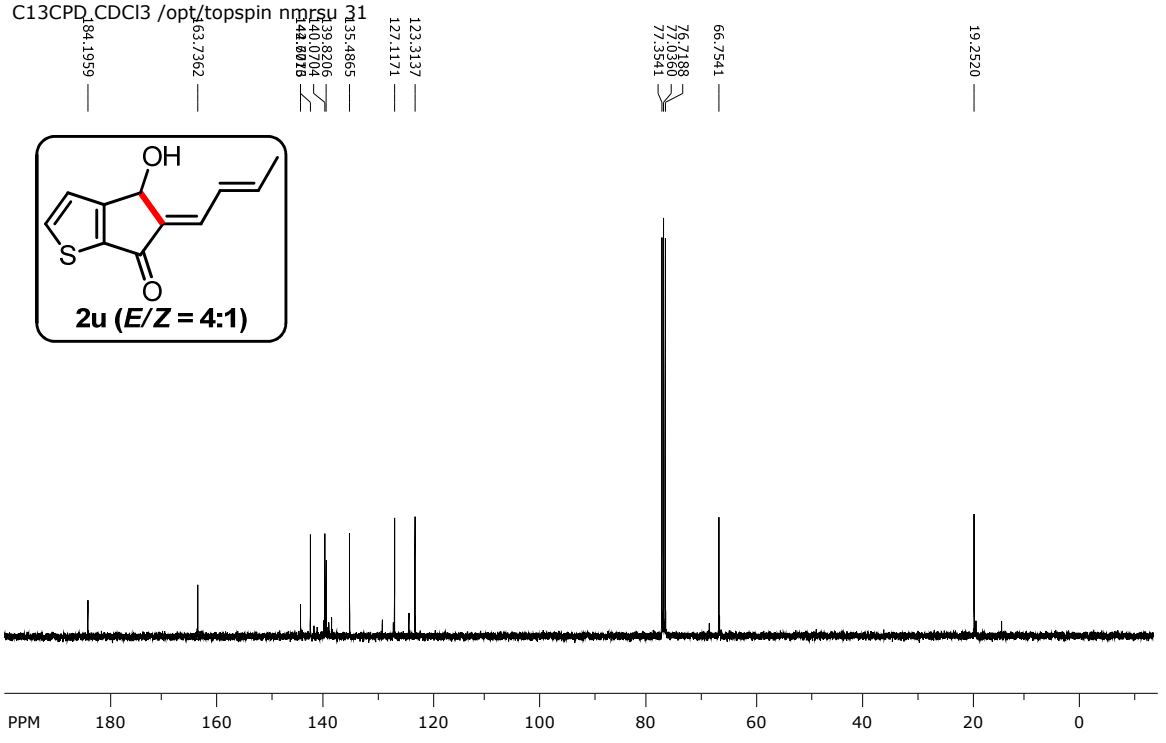
SpinWorks 3: BS 05 111
C13CPD CDCl3 /opt/topspin nmrsu 58



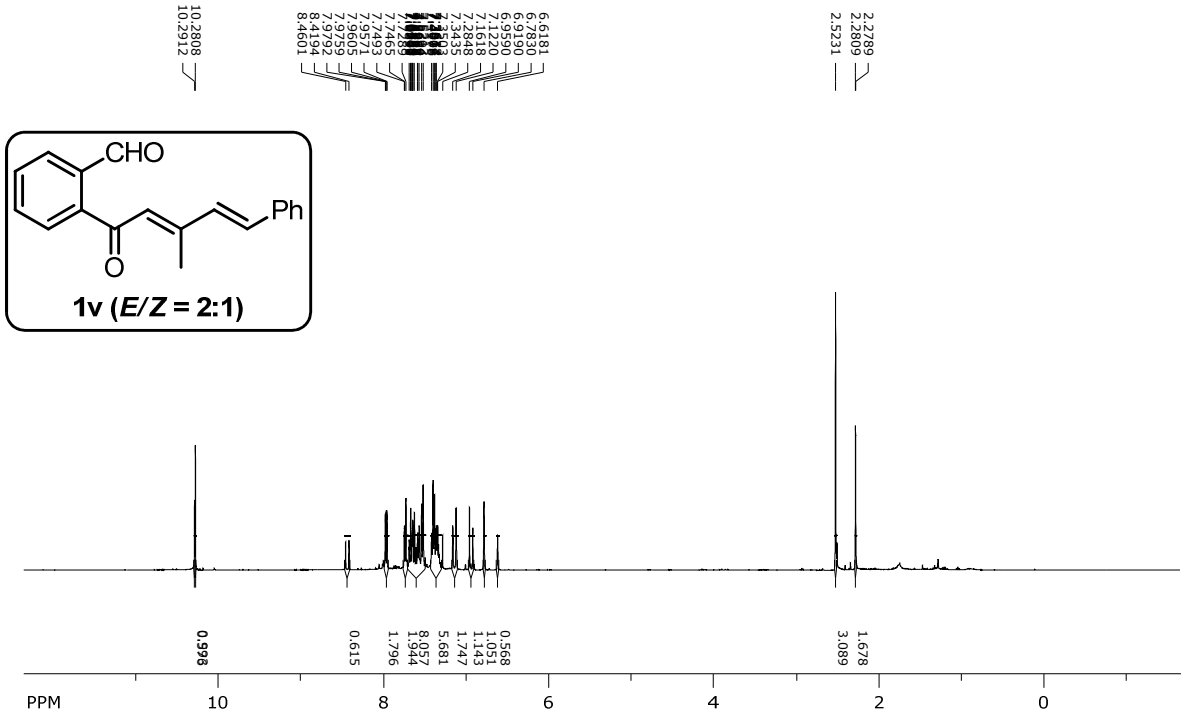
SpinWorks 4: BS 05 113
PROTON CDCl3 /opt/topspin nmrsu 31



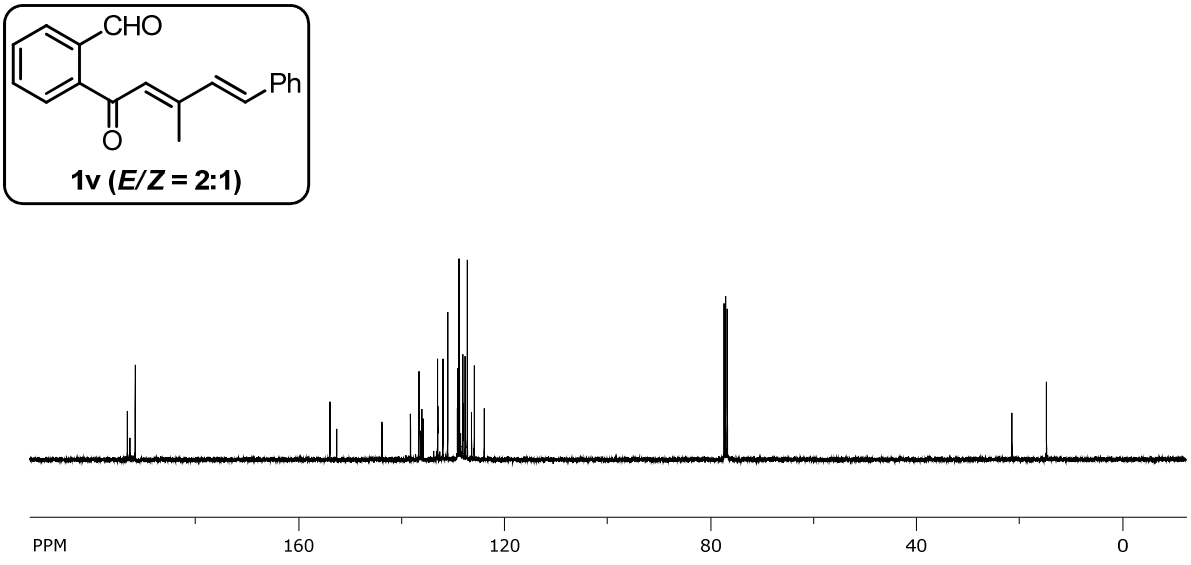
SpinWorks 3: BS 05 113
C13CPD CDCl3 /opt/topspin nmrsu 31



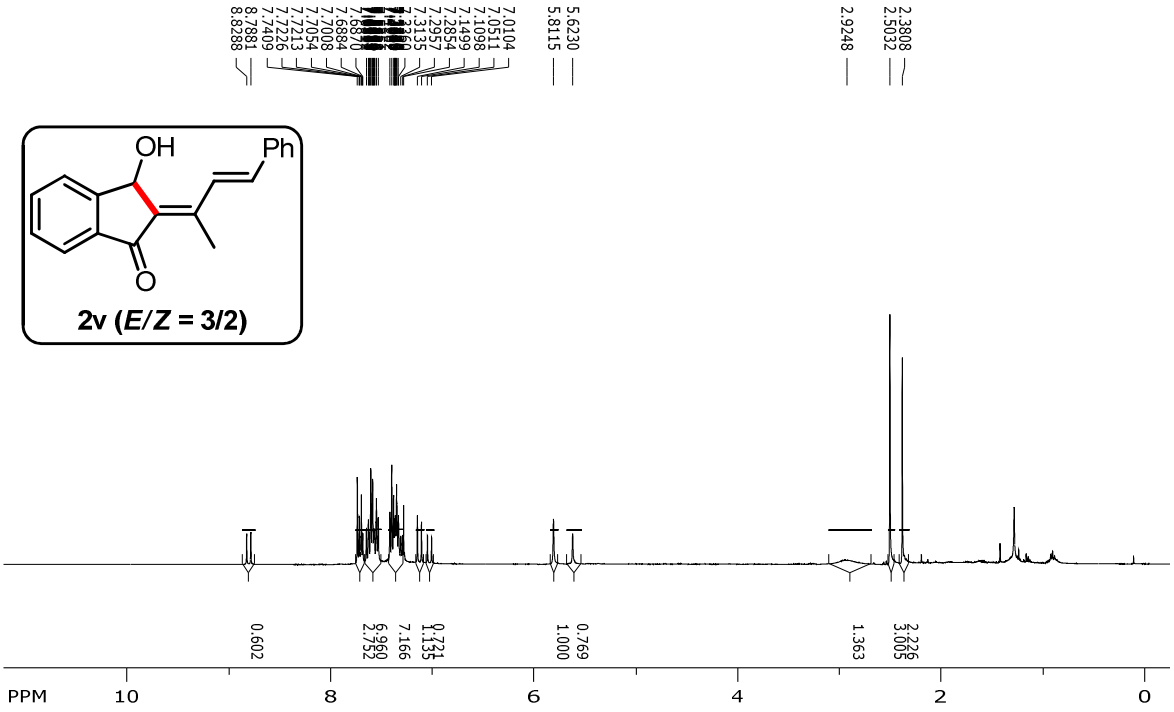
SpinWorks 4: BS-07-160



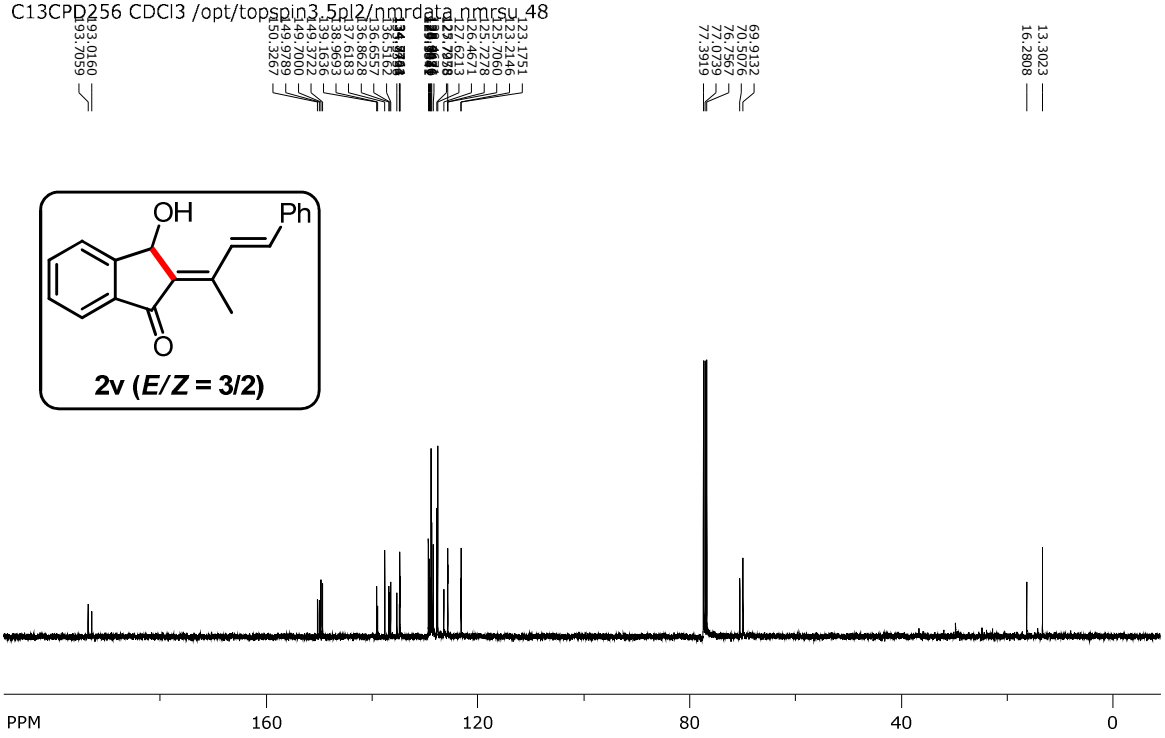
SpinWorks 4: BS 07 160
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 14



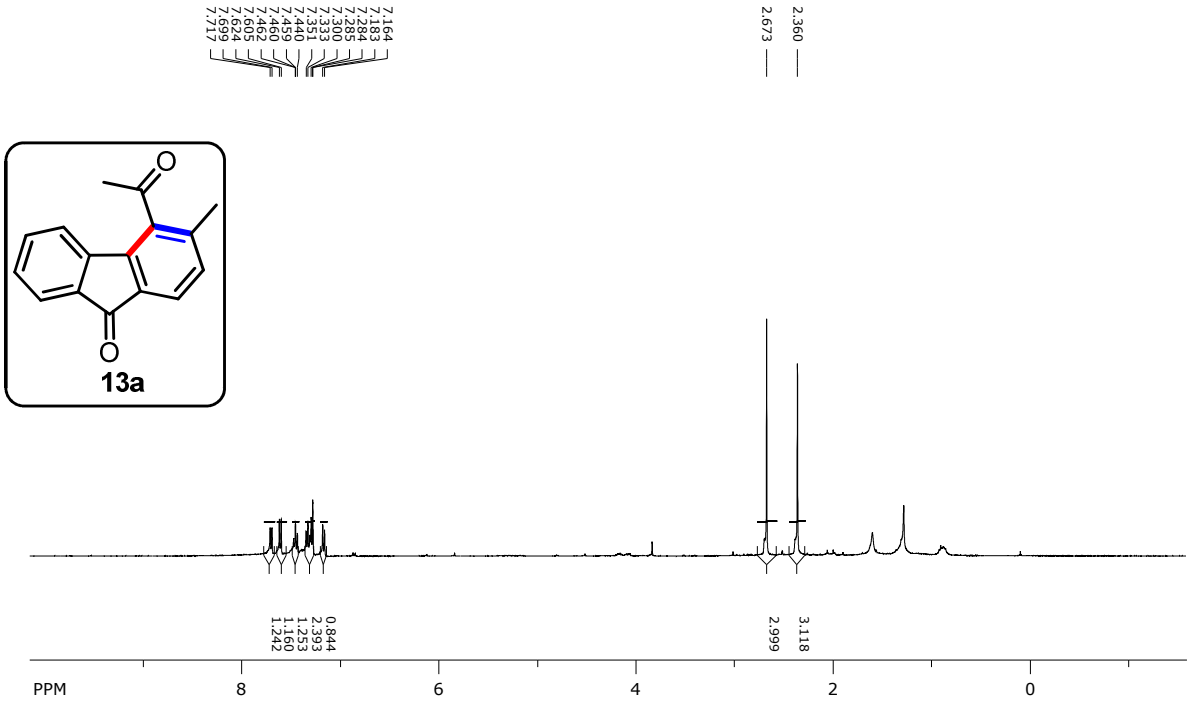
SpinWorks 4: BS-07-163-mix



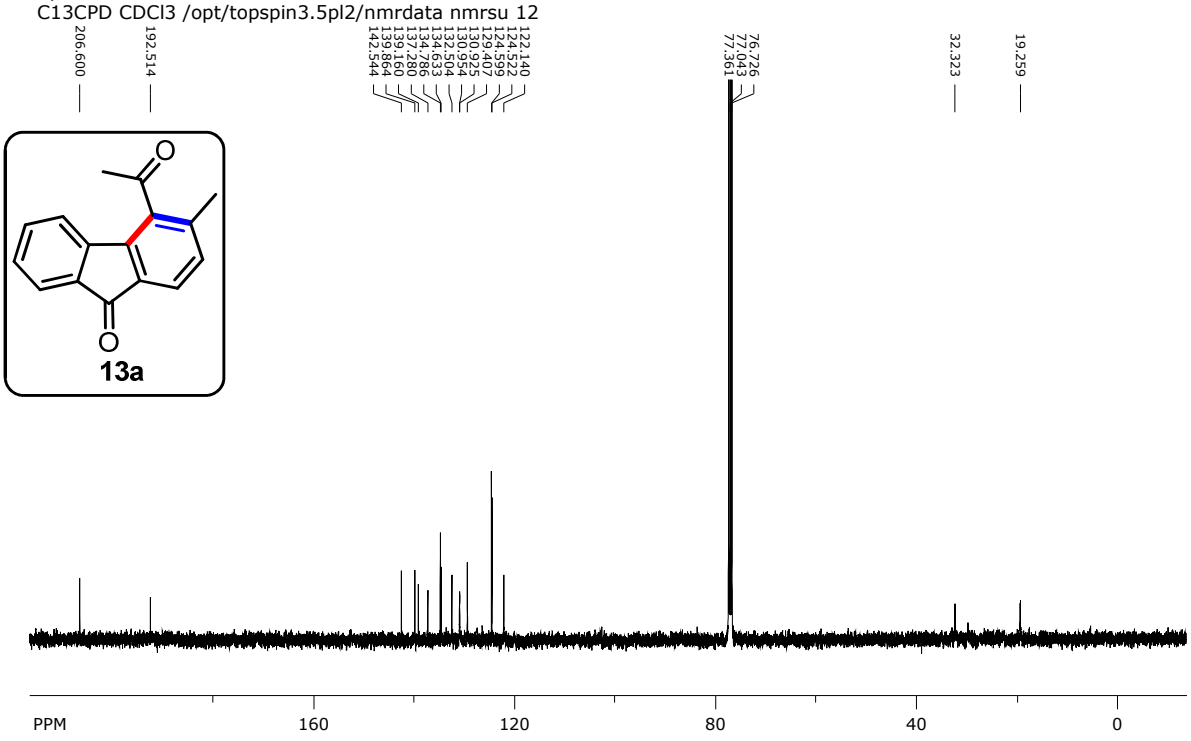
SpinWorks 4: BS 07 163 MIX
C13CPD256 CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 48



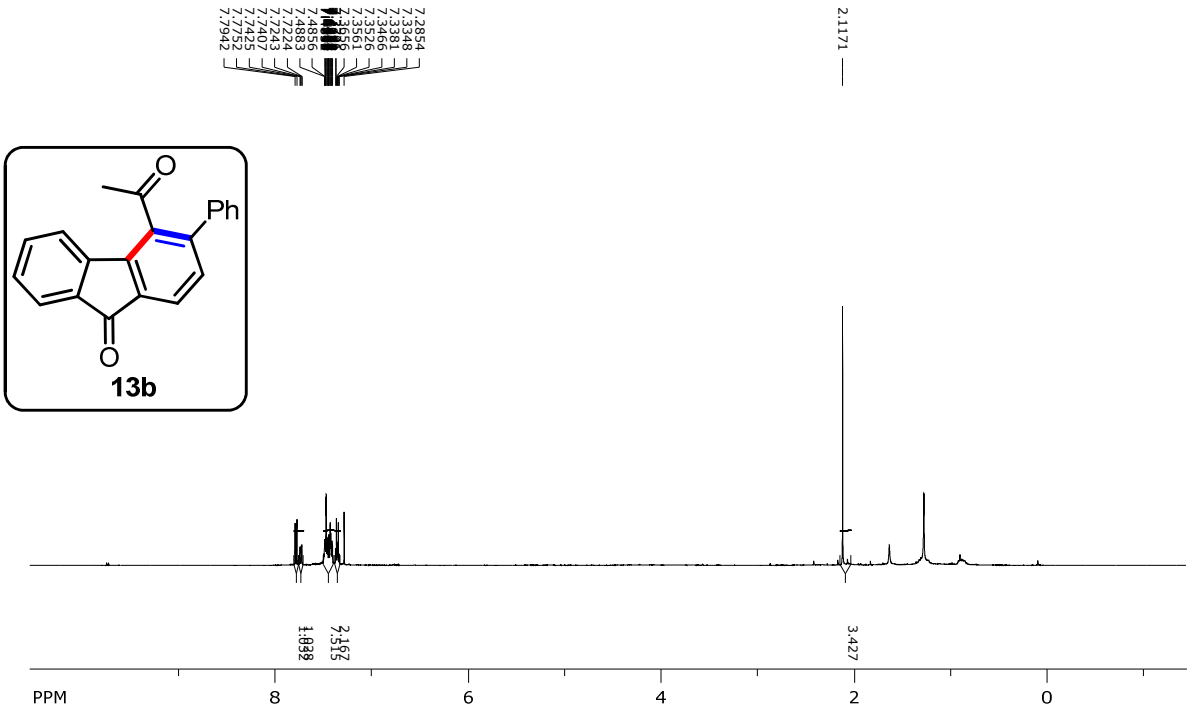
SpinWorks 4: BS-07-35



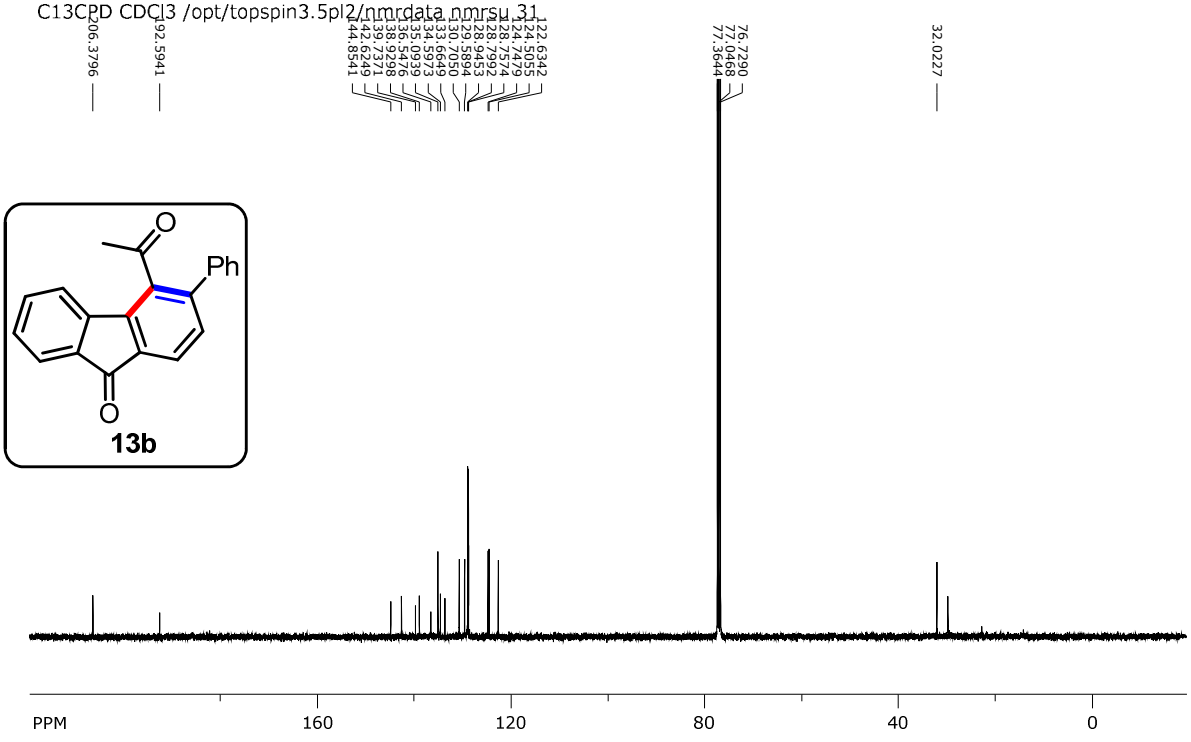
SpinWorks 4: BS 7 35
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 12



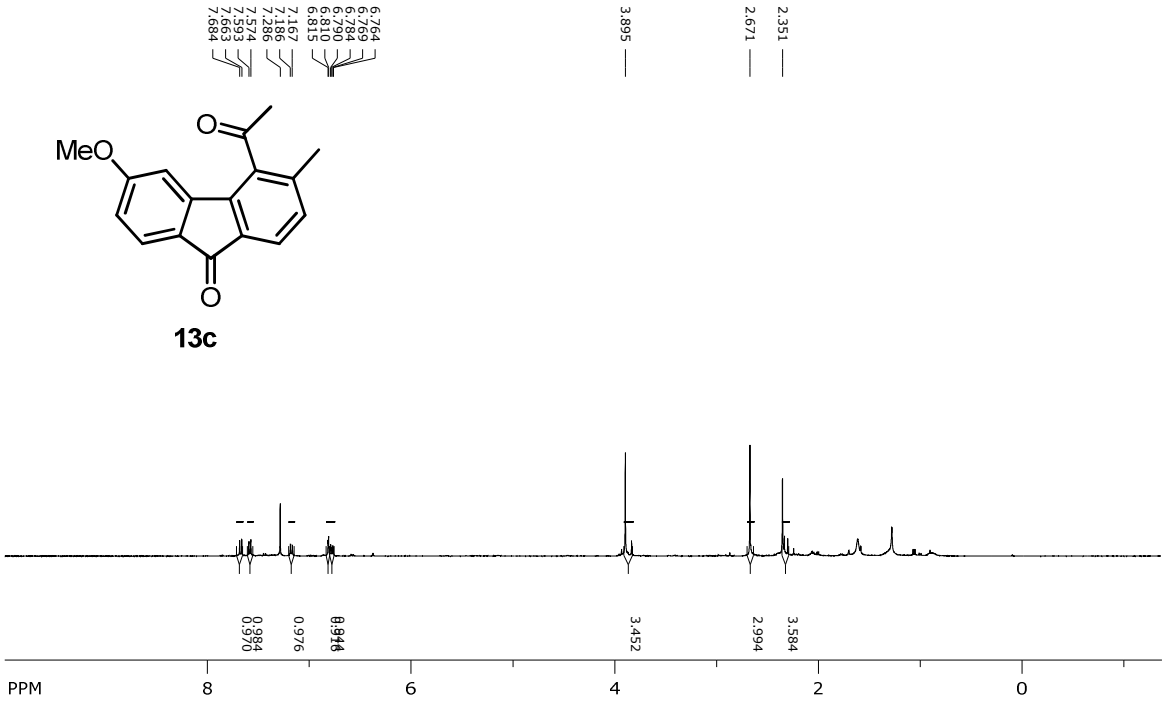
SpinWorks 4: PBS-07-38-Re



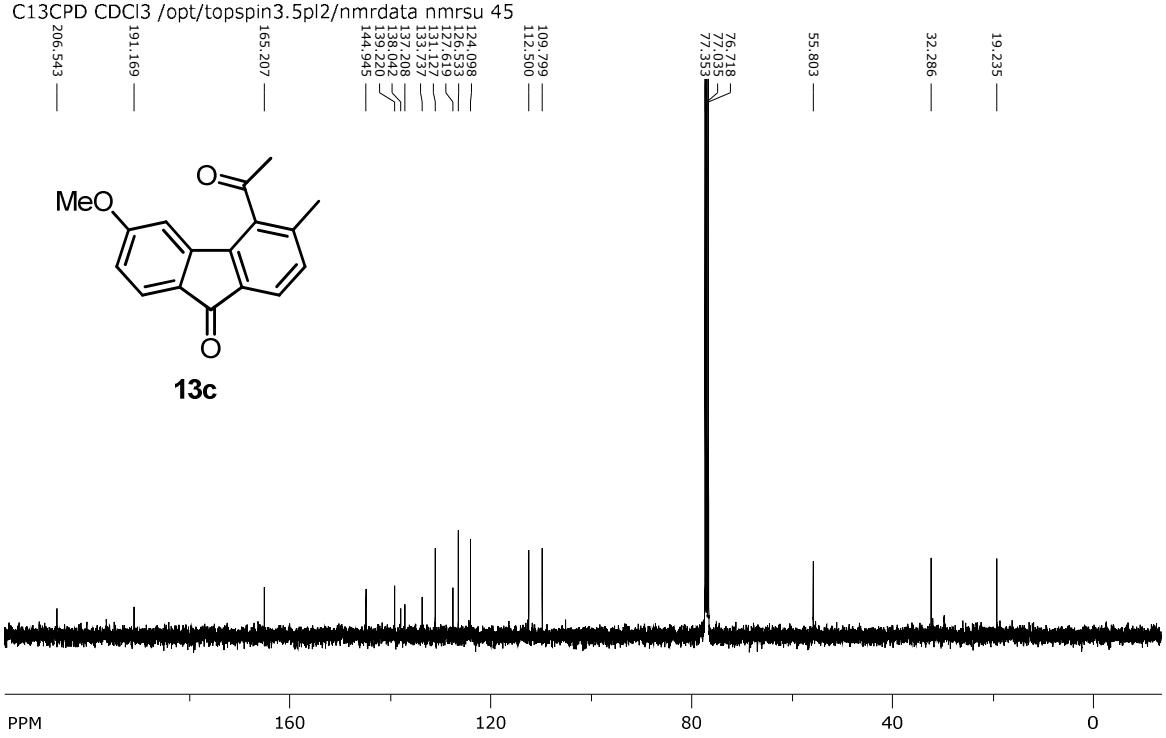
SpinWorks 4: BS 07 38 RE
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 31



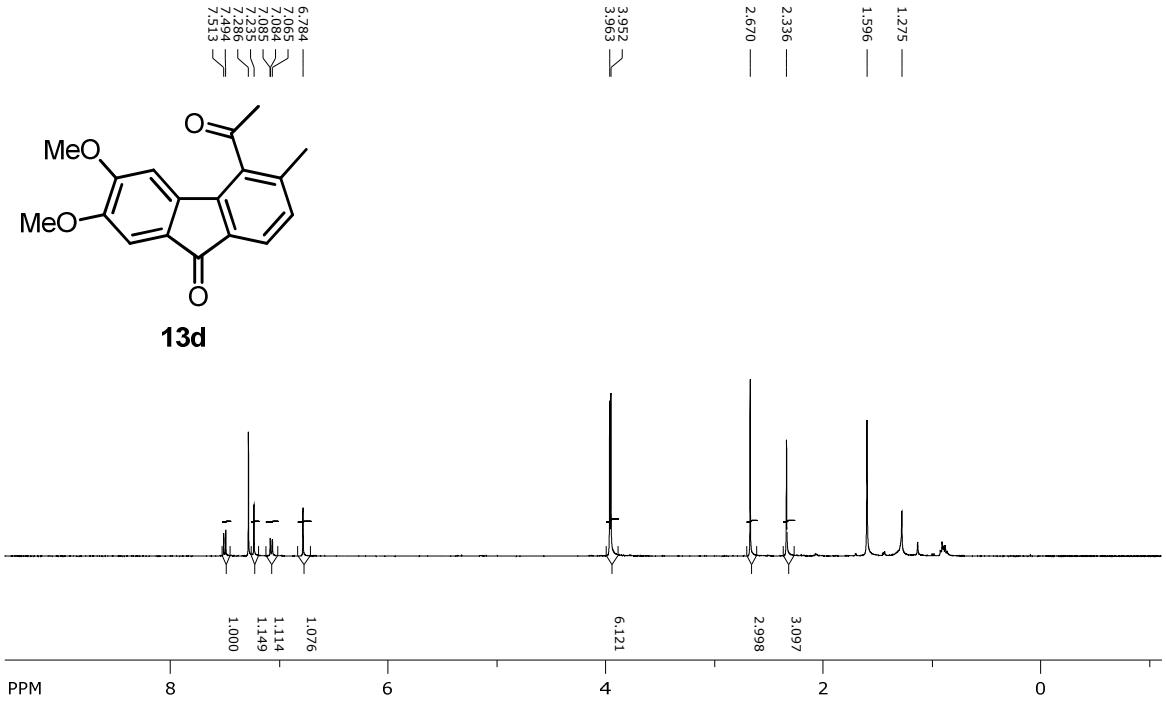
SpinWorks 4: bs 07 f1
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 41



SpinWorks 4: BS 07 FL
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 45

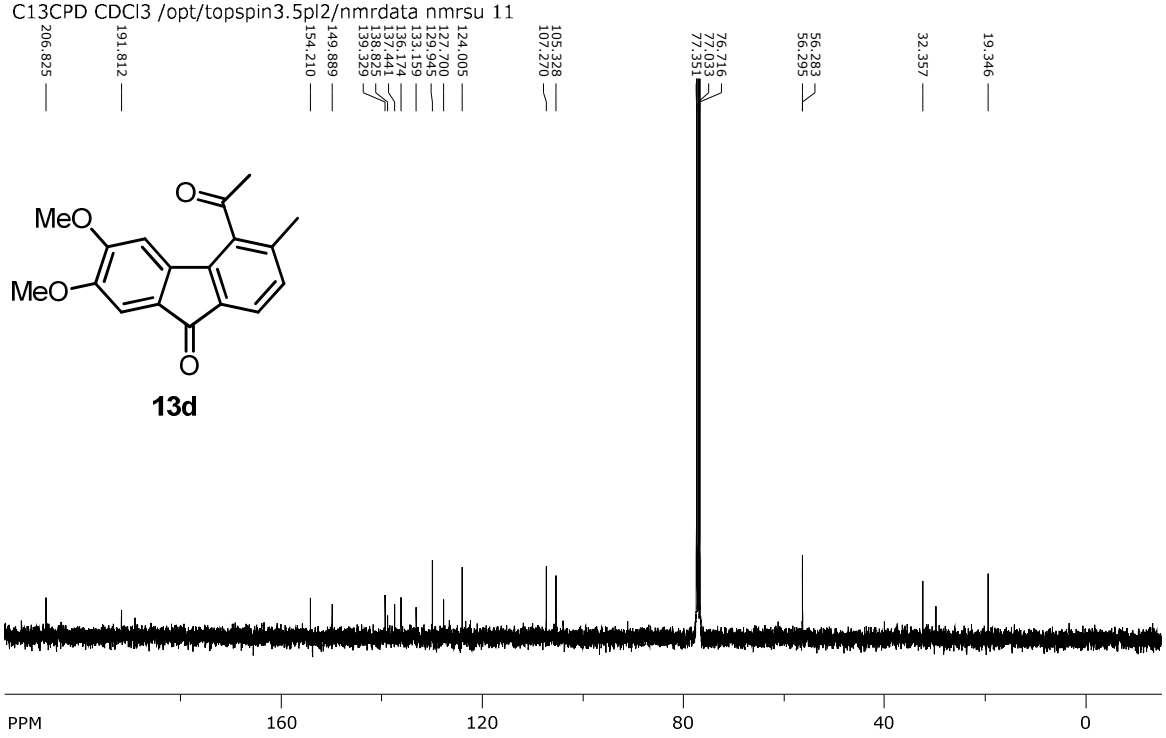


SpinWorks 4: bs 07 140



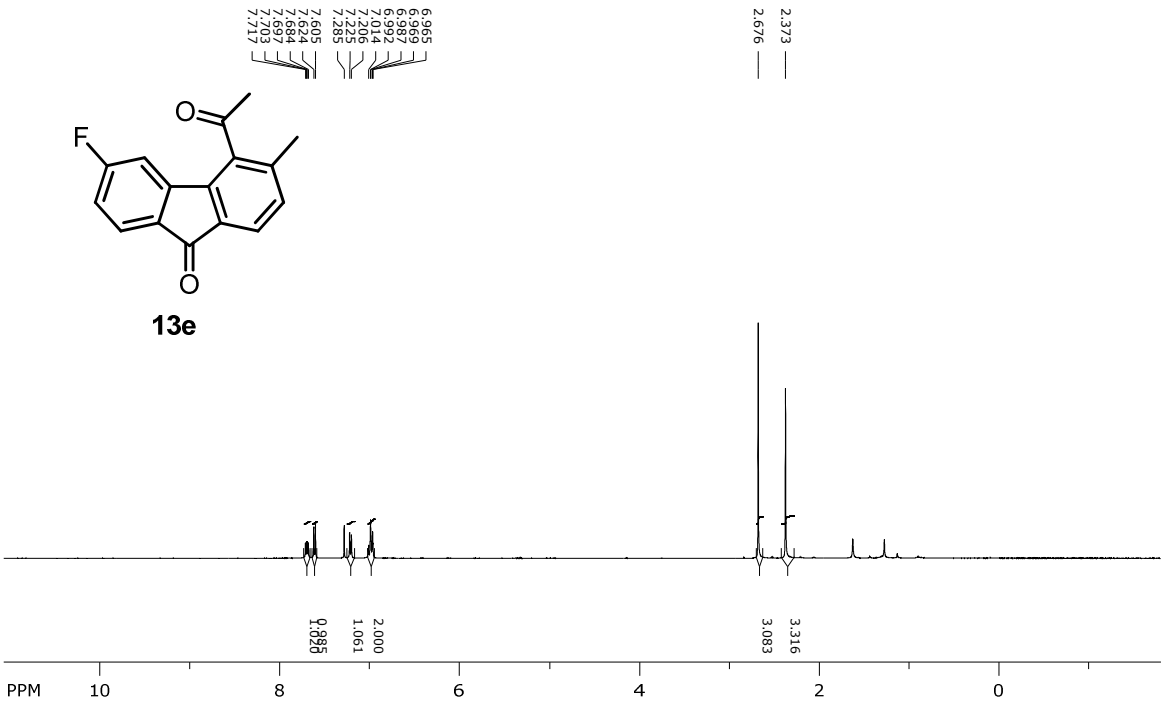
13d

SpinWorks 4: BS-07-140
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 11

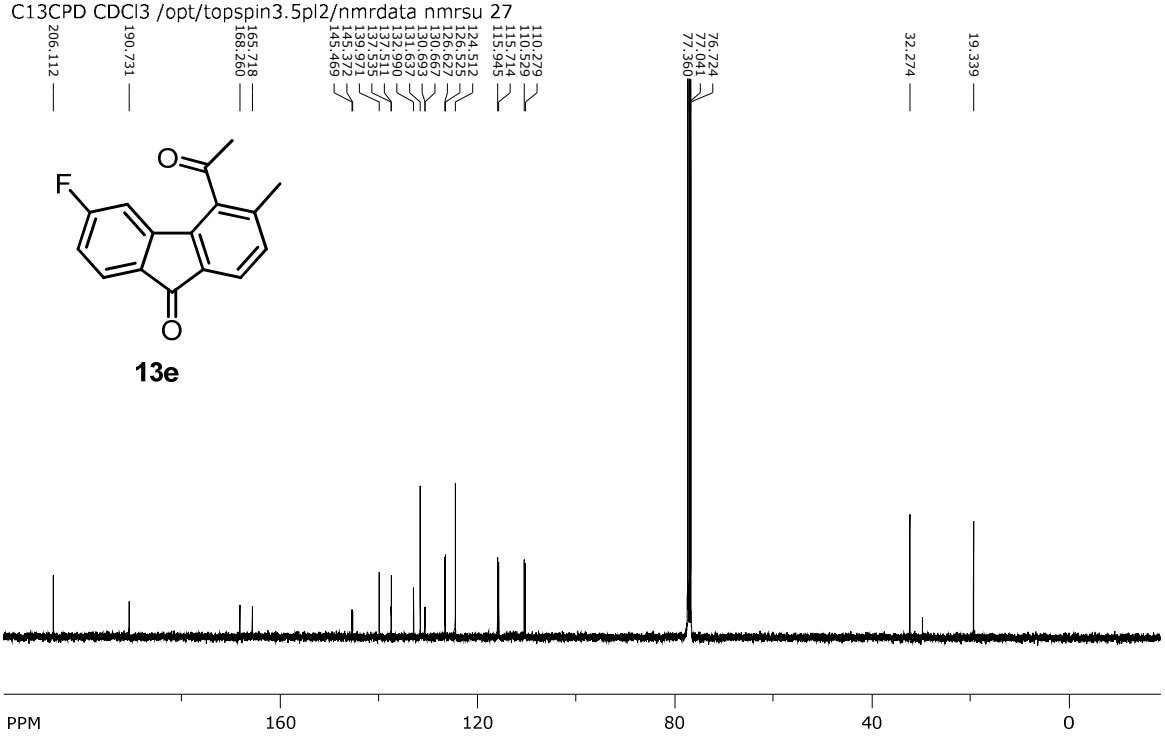


13d

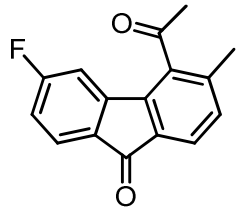
SpinWorks 4: bs-07-143



SpinWorks 4: BS 07 143
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 27

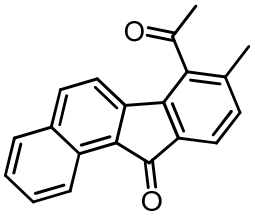


SpinWorks 4: BS 07 143
F19CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 27

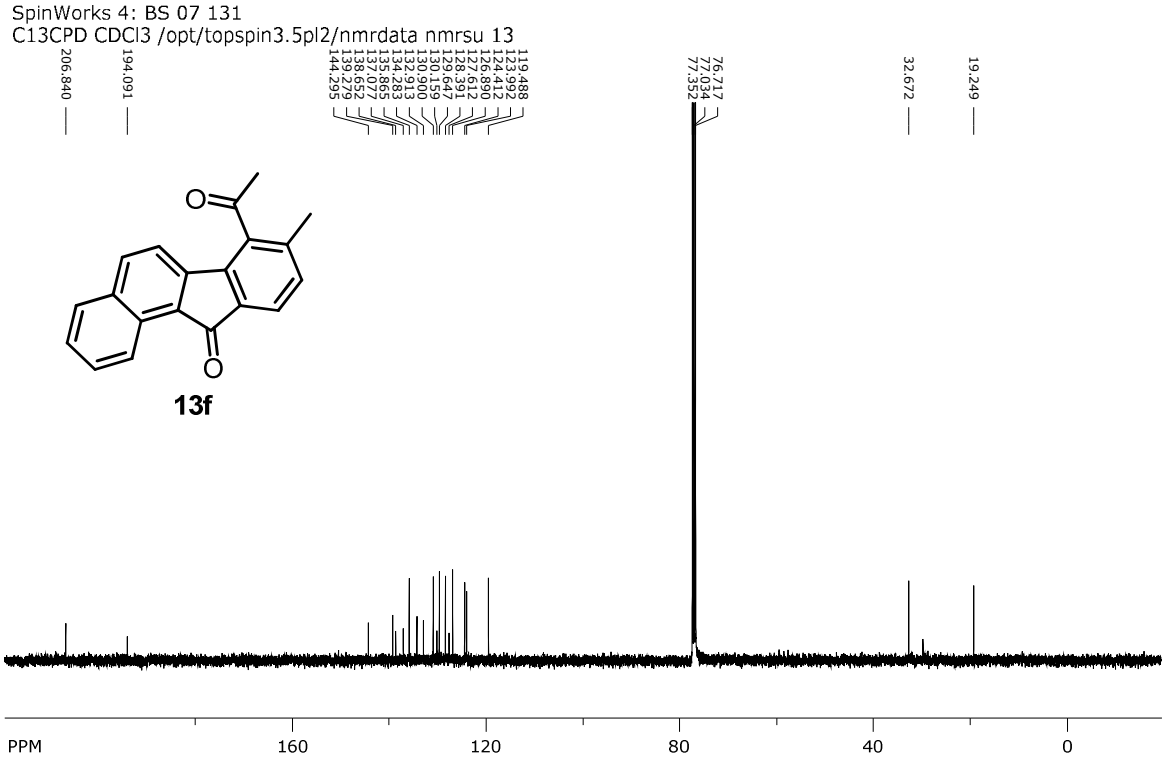


13e

SpinWorks 4: BS 07 131
PROTON CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 13



13f


SpinWorks 4: BS 07 131
C13CPD CDCl3 /opt/topspin3.5pl2/nmrdata nmrsu 13
206.840
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144.295
139.279
138.652
137.077
135.865
134.283
132.911
130.900
130.159
129.647
128.391
127.612
126.890
124.412
123.992
119.488
77.352
77.034
76.717
32.672
19.249
O
O
13f
PPM
160
120
80
40
0

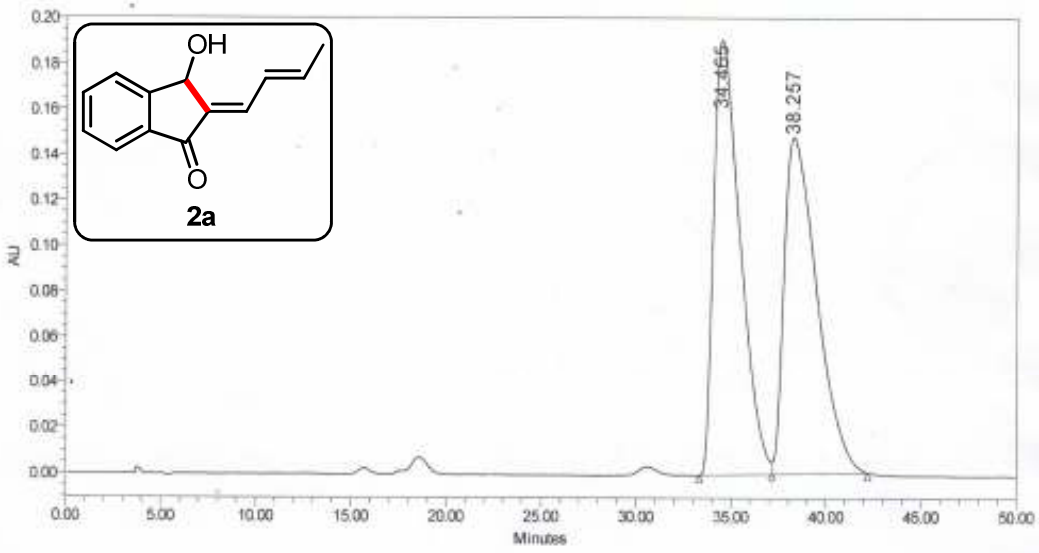
HPLC Spectra

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-benzhexdien racAS8%.8ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Methoc	bs06benzhexdiracAS8%8ml
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	21-04-2017 20:40:26 IST		
Date Processed:	25-04-2017 21:42:27 IST		



	RT	Area	% Area	Height
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2	38.257	17803583	49.01	147866

Reported by User: System
Report Method: Vishnu
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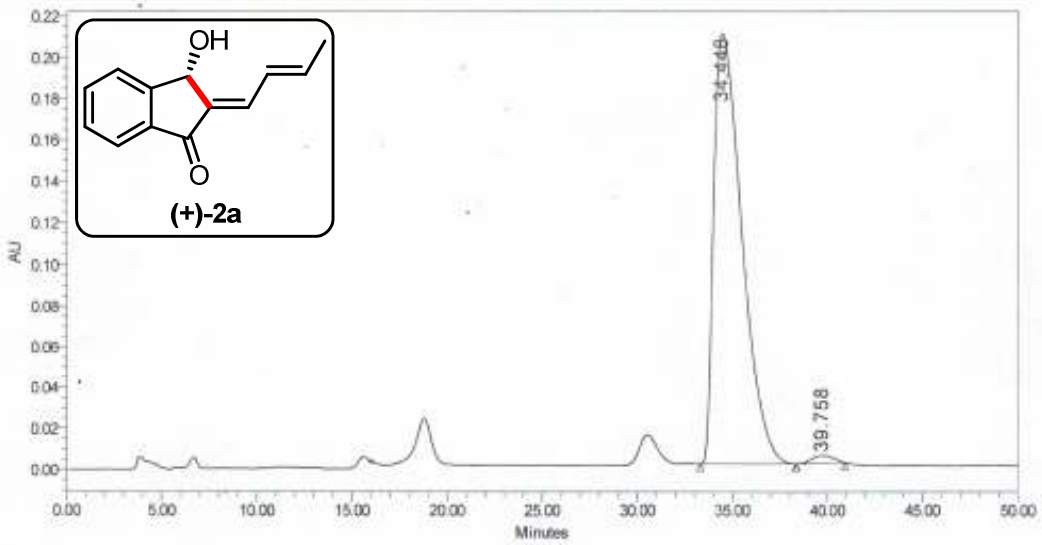
25-04-2017
22:34:29 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-benzhexdiencat15AS8%.8ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	2	Processing Method:	bs06 benzhexdicat15
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	21-04-2017 21:34:09 IST		
Date Processed:	25-04-2017 21:43:14 IST		



	RT	Area	% Area	Height
1	34.448	21522395	98.66	208979
2	39.758	291380	1.34	3699

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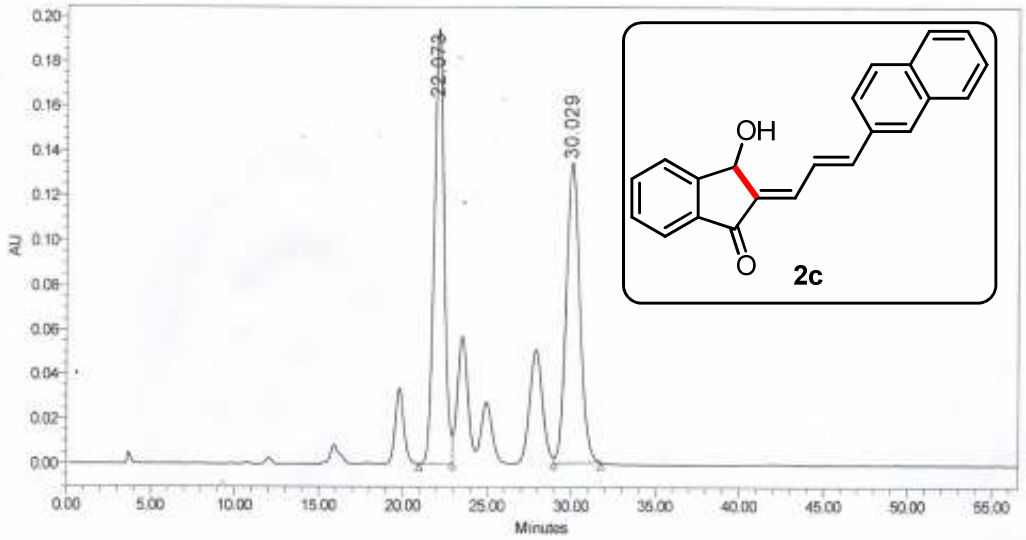
22:34:44 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-benznaphracAD12%.8ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Methoc	bs benznaphracAD12%8ml
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	24-04-2017 23:37:32 IST		
Date Processed:	25-04-2017 21:57:17 IST		



	RT	Area	% Area	Height
1	22.073	7939004	51.32	194339
2	30.029	7531677	48.68	134345

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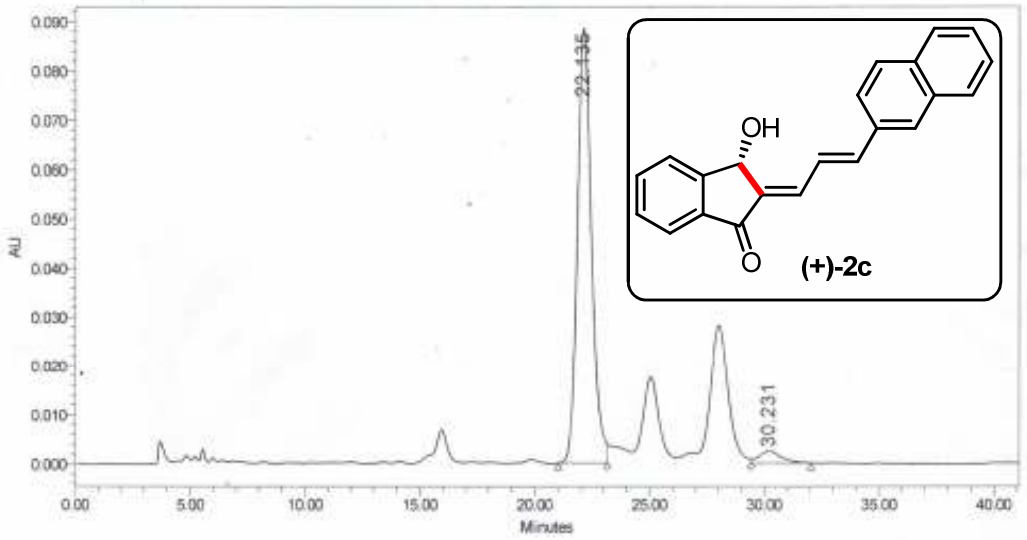
Project Name: YR_01
Date Printed:
25-04-2017
22:43:59 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-benznaphcat15AD12%.8ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Methoc	bs.benznaphcat15
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	25-04-2017 12:20:47 IST		
Date Processed:	25-04-2017 21:59:44 IST		



	RT	Area	% Area	Height
1	22.135	3750575	96.01	88444
2	30.231	155961	3.99	2373

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Project Name: YR_01
Date Printed:
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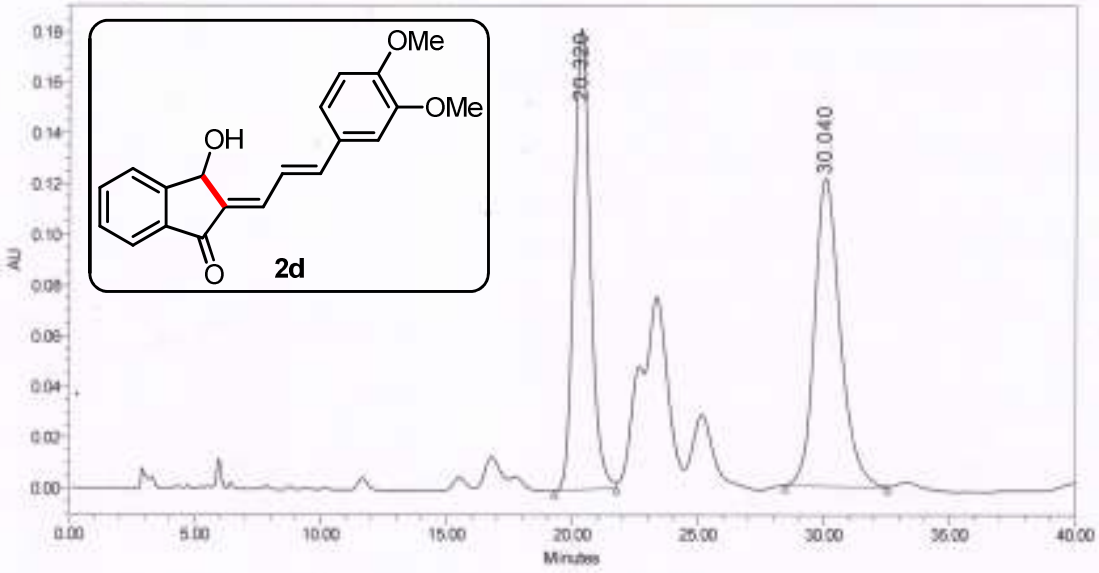
22:44:11 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS06-benzdiomeracAD15%1ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Method	bs06benzdiomeracAD15%1ml
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	100.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	03-09-2016 15:22:49 IST		
Date Processed:	20-09-2016 22:32:38 IST		



	RT	Area	% Area	Height
1	20.320	8188970	48.70	181834
2	30.040	8627414	51.30	121391

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Project Name: YR_01
Date Printed:
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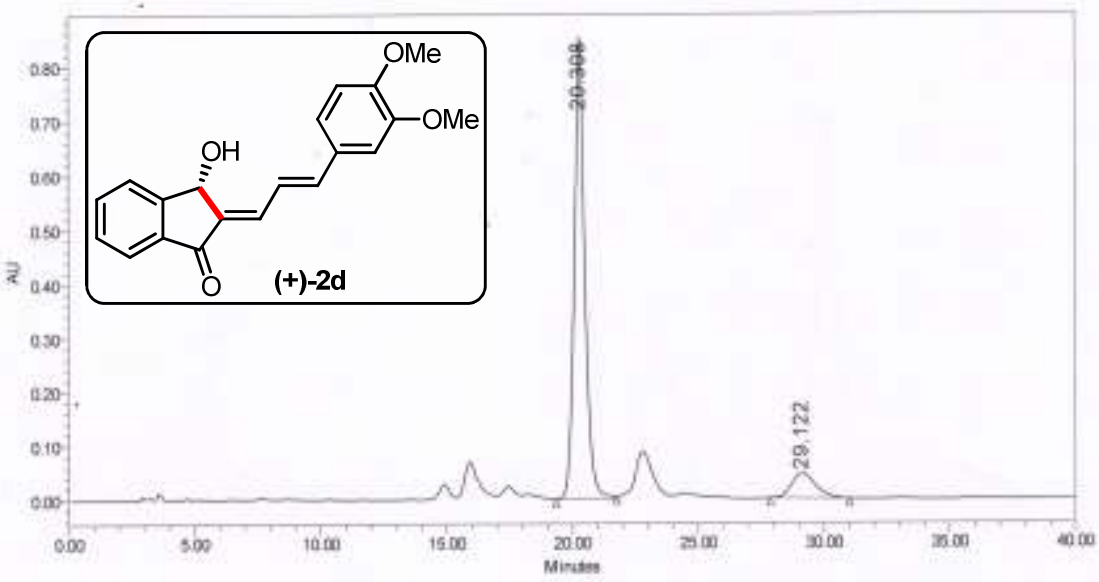
22:37:55 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:		Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	2	Processing Method	bs06benzdiomecat15
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	100.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	03-09-2016 16:10:29 IST		
Date Processed:	20-09-2016 22:33:16 IST		



	RT	Area	% Area	Height
1	20.308	24270612	88.89	851849
2	29.122	3033272	11.11	45409

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Report Method: Vishnu
Report Method ID: 6497
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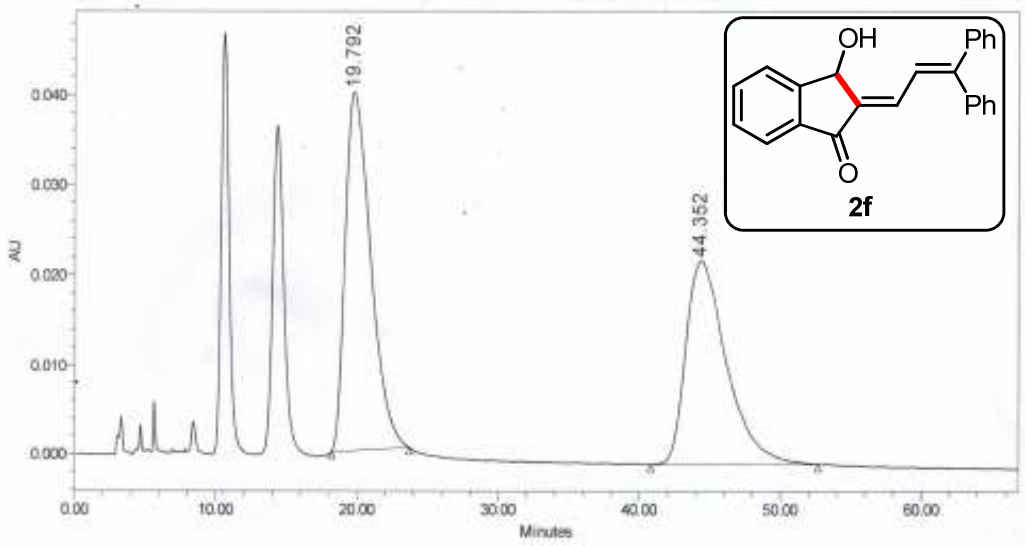
Project Name: YR_01
Date Printed:
20-09-2016
22:37:28 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-benzdiphracAS10%	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Methoc	bs benzdiphracAS10%
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	23-04-2017 11:11:38 IST		
Date Processed:	25-04-2017 21:50:30 IST		



	RT	Area	% Area	Height
1	19.792	5014124	52.11	39982
2	44.352	4608068	47.89	22791

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Date Printed:
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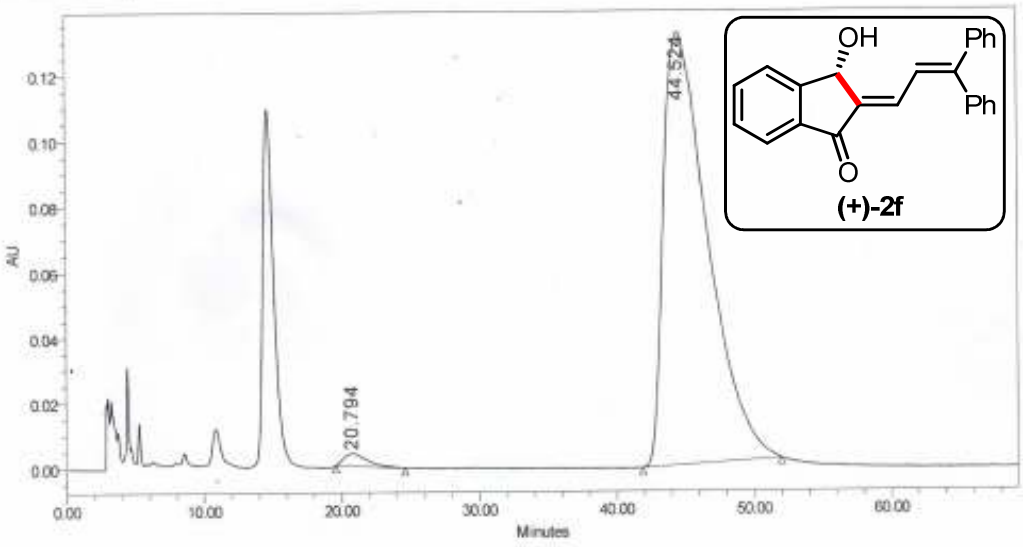
22:39:05 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-benzdiphcat15AS10%	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Method	bs benzdiphcat15
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	24-04-2017 16:20:42 IST		
Date Processed:	25-04-2017 21:51:15 IST		



	RT	Area	% Area	Height
1	20.794	457981	1.53	3786
2	44.524	29536340	98.47	132123

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Date Printed:
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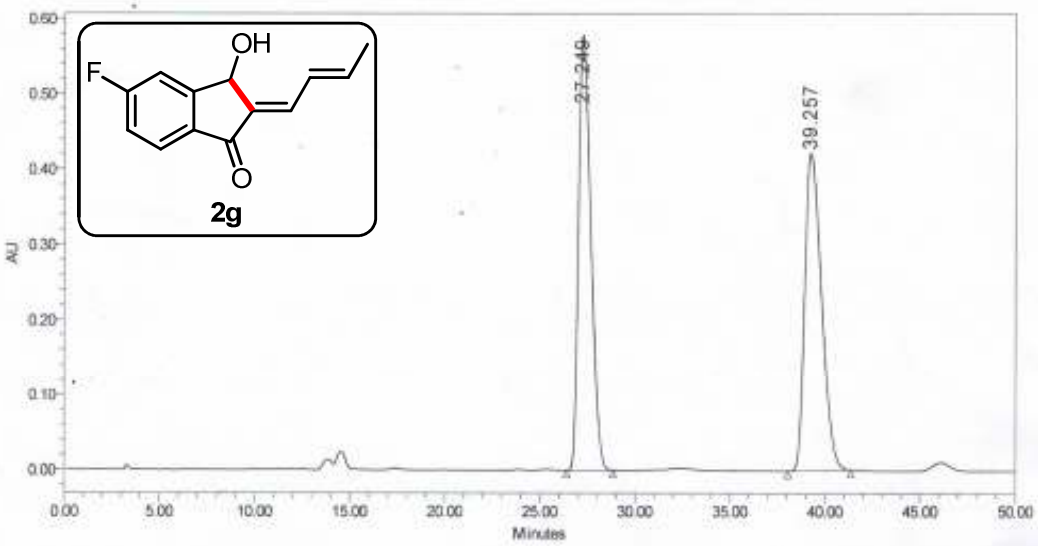
22:43:04 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-06FbenzhexraclC5%1ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Methoc	bs06 FbenzhexraclC5%1ml
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	21-04-2017 10:53:28 IST		
Date Processed:	25-04-2017 21:39:49 IST		



	RT	Area	% Area	Height
1	27.249	26005920	49.87	578837
2	39.257	26139020	50.13	422721

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Report Method ID: 7317
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Project Name: YR_01
Date Printed:
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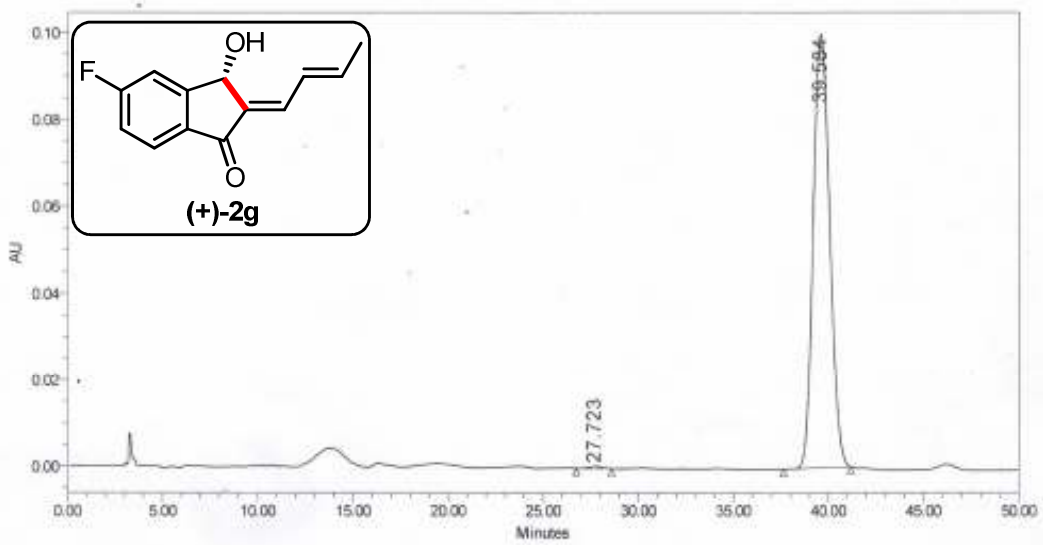
22:33:35 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-06Fbenzhexcat15IC5%1ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	2	Processing Methoc	bs06 Fbenzhexcat15
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	21-04-2017 11:52:24 IST		
Date Processed:	25-04-2017 21:41:44 IST		



	RT	Area	% Area	Height
1	27.723	23684	0.39	516
2	39.584	6060191	99.61	100066

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Report Method: Vishnu
Report Method ID: 7929
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Project Name: YR_01
Date Printed:
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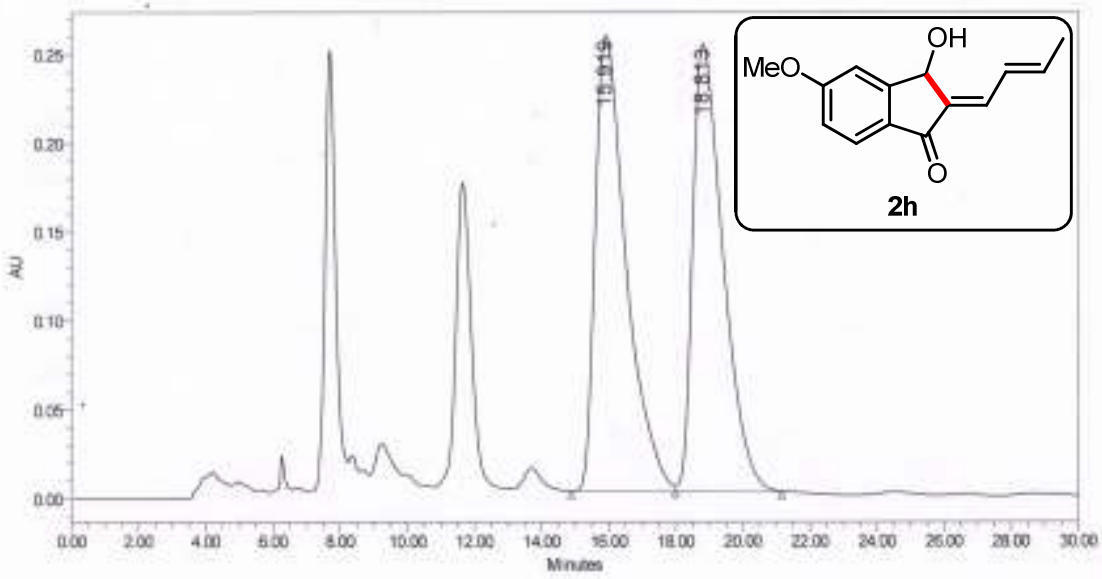
22:33:50 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:		Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Method:	bs06omebenzhexadienerac
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	11-02-2016 22:12:01 IST		
Date Processed:	11-02-2016 23:21:25 IST		



2h

	RT	Area	% Area	Height
1	15.919	16462182	51.04	256579
2	18.813	15790919	48.96	251667

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Report Method II 5354
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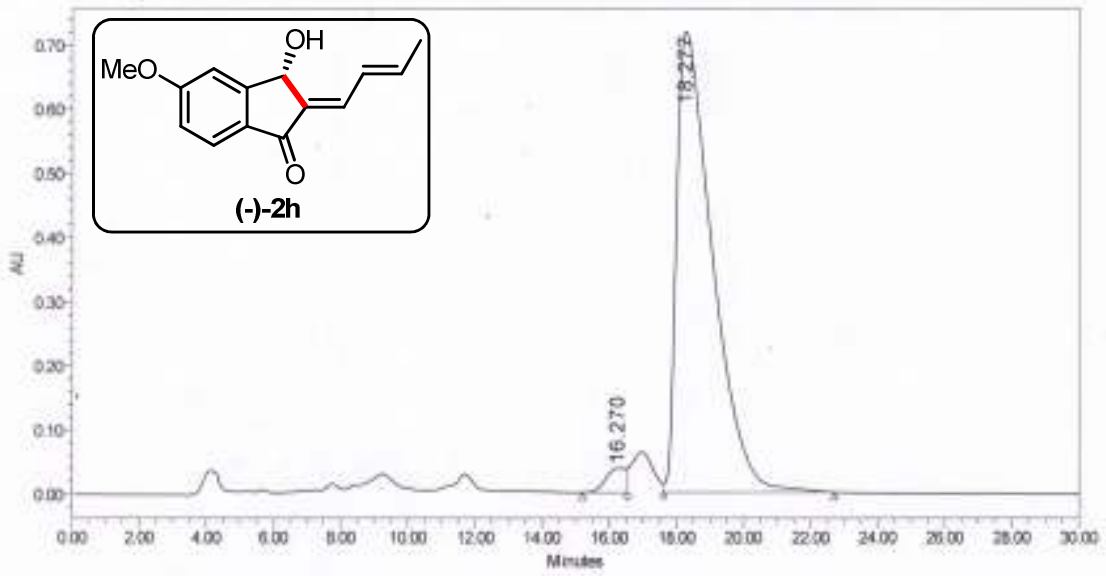
Date Printed:
11-02-2016
23:23:03 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:		Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	2	Processing Method:	bsomehexdieneAS10%08ml
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	11-02-2016 22:48:40 IST		
Date Processed:	11-02-2016 23:36:04 IST		



	RT	Area	% Area	Height
1	16.270	1578372	2.88	38052
2	18.277	53189581	97.12	718271

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Report Method: Vishnu
Report Method ID: 5354
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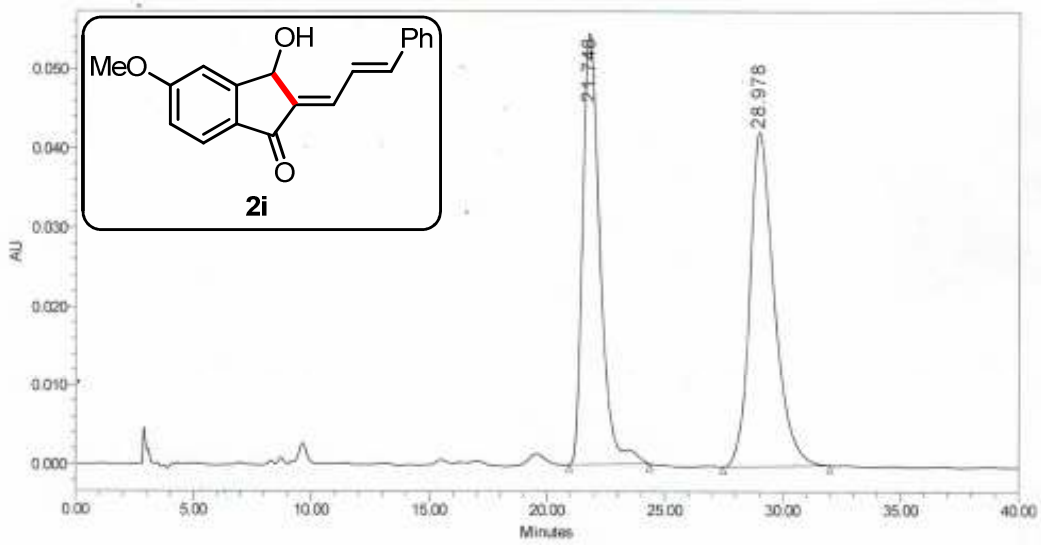
Project Name: YR_01
Date Printed:
11-02-2016
23:36:20 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-omebenzcinndien	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Methoc	bs06omebenzcinhexracODH10%
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	21-04-2017 23:45:49 IST		
Date Processed:	25-04-2017 22:35:21 IST		



	RT	Area	% Area	Height
1	21.748	2806044	47.88	54470
2	28.978	3054353	52.12	42290

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Report Method: Vishnu
Report Method II 7929
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Project Name: YR_01
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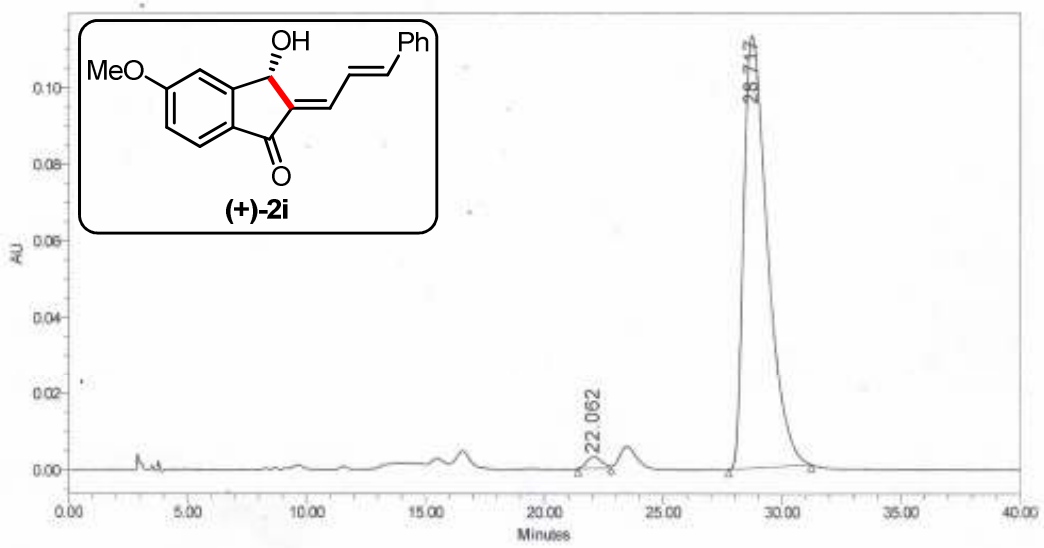
Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:		Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	2	Processing Method	bs06omebenzcinhexcat15
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	22-04-2017 00:28:49 IST		
Date Processed:	25-04-2017 21:44:59 IST		



	RT	Area	% Area	Height
1	22.062	138454	1.73	3077
2	28.717	7854129	98.27	113139

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Date Printed:
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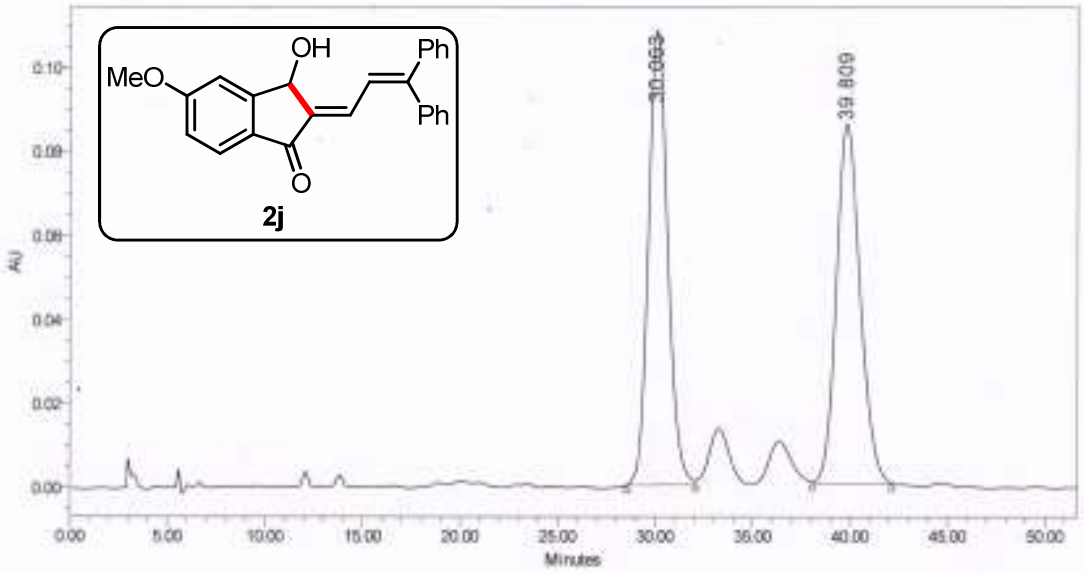
22:36:57 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS06-omebenzdiphracAD6%1ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Methoc	bsomebenzdiphracAD6%1ml
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	100.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	04-09-2016 00:29:43 IST		
Date Processed:	04-09-2016 02:34:04 IST		



	RT	Area	% Area	Height
1	30.063	7410004	50.27	108359
2	39.809	7330164	49.73	85657

Reported by User: System
Report Method: Vishnu
Report Method ID: 6354
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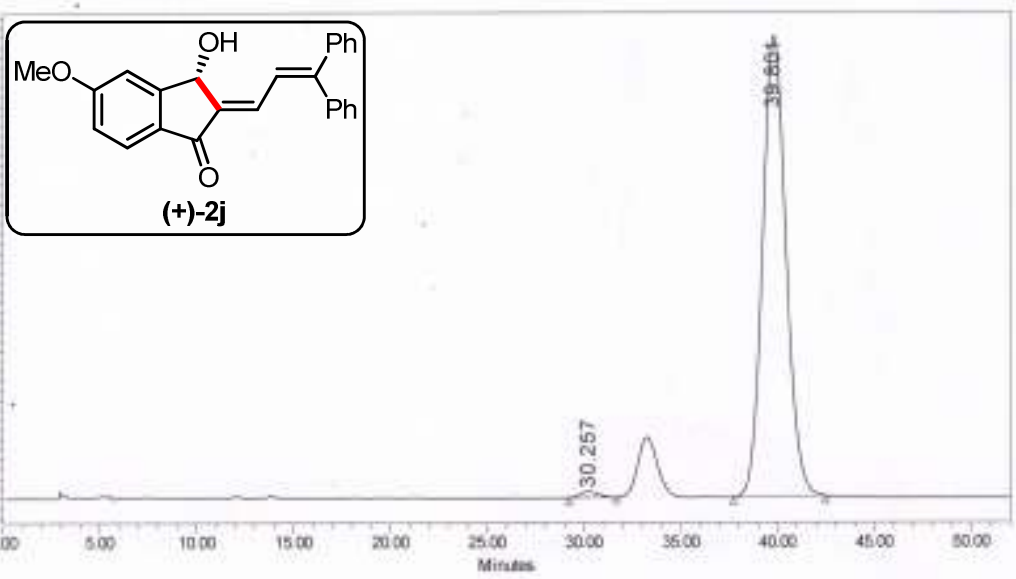
Project Name: YR_01
Date Printed:
04-09-2016
02:34:53 Asia/Calcutta

power 3

Vishnu

SAMPLE INFORMATION

Sample Name:		Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	2	Processing Method	bs06omebenzdiphcat15
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	100.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	04-09-2016 01:24:27 IST		
Date Processed:	04-09-2016 02:32:56 IST		



	RT	Area	% Area	Height
1	30.257	390447	0.98	6058
2	39.801	39487865	99.02	470009

Reported by User: System
Report Method: Vishnu
Report Method ID: 6404
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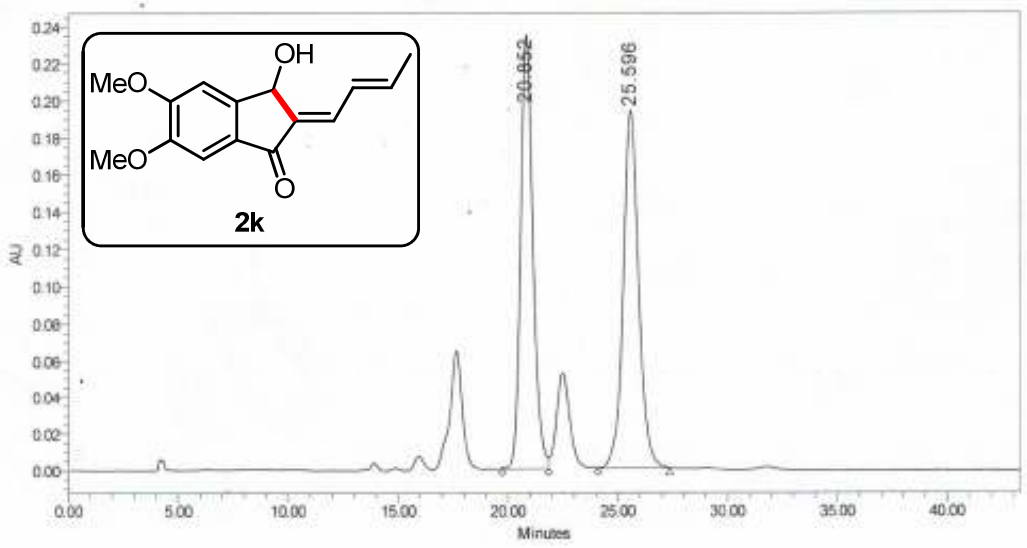
Project Name: YR_01
Date Printed:
04-09-2016
02:36:00 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-diomehexracAD12%.7ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Methoc	bs diomehexracAD12%7ml
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	22-04-2017 23:09:24 IST		
Date Processed:	25-04-2017 21:47:56 IST		



	RT	Area	% Area	Height
1	20.852	9086127	49.03	234790
2	25.596	9445436	50.97	193654

Reported by User: System
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Project Name: YR_01
Date Printed:
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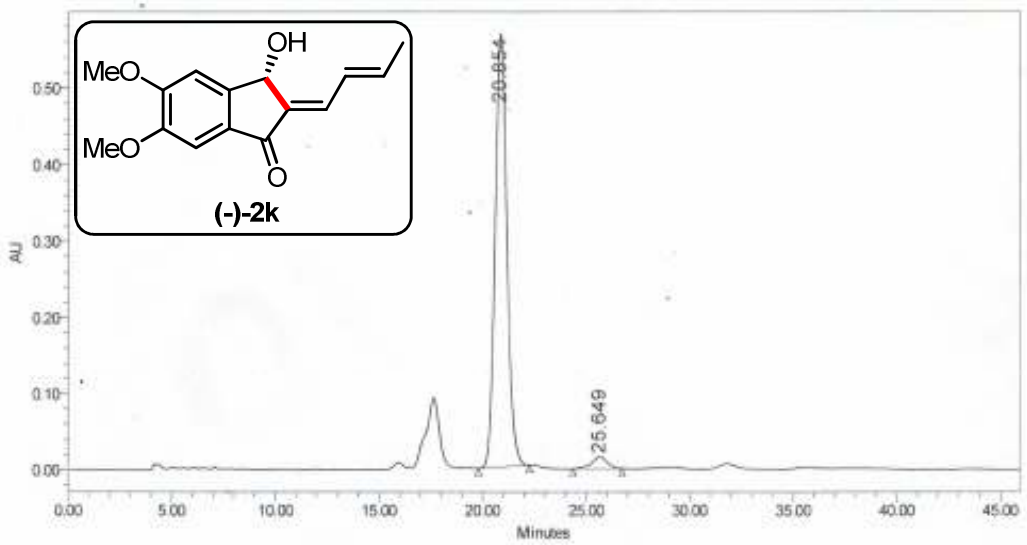
22:38:37 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-diomehexcat15AD12%.7ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	2	Processing Methoc	bs diomehexcat15
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	23-04-2017 00:02:56 IST		
Date Processed:	25-04-2017 21:48:49 IST		



	RT	Area	% Area	Height
1	20.854	22431058	96.54	566589
2	25.649	804320	3.46	15332

Reported by User: System
Report Method: Vishnu
Report Method Id: 7934
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Project Name: YR_01
Date Printed:
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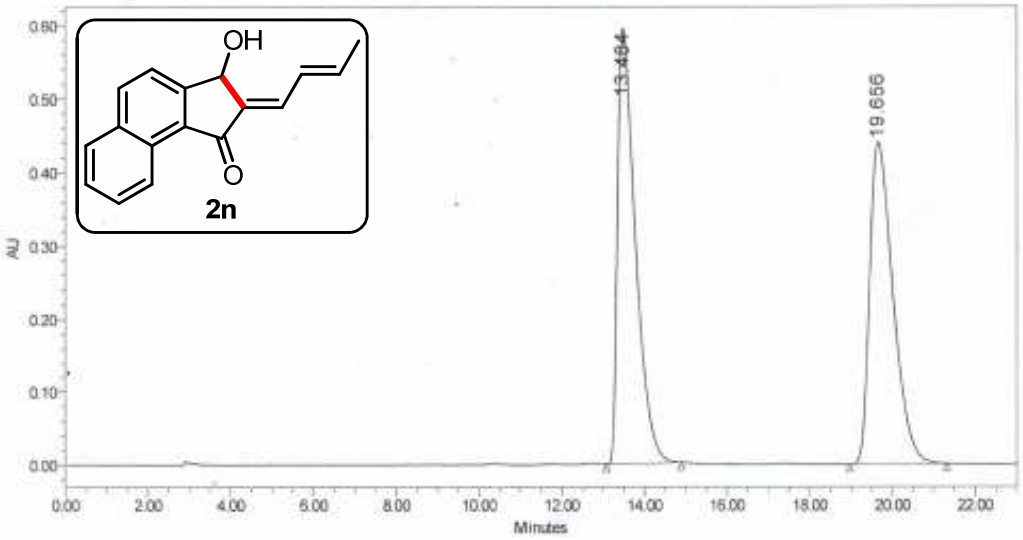
23:17:34 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-naphhexracODH10%	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Method	bsnaphhexracODH10%
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	22-04-2017 10:36:36 IST		
Date Processed:	25-04-2017 21:45:47 IST		



	RT	Area	% Area	Height
1	13.484	17756116	50.73	594348
2	19.656	17243709	49.27	439915

Reported by User: System
Report Method: Vishnu
Report Method ID: 7932
Page: 1 of 2

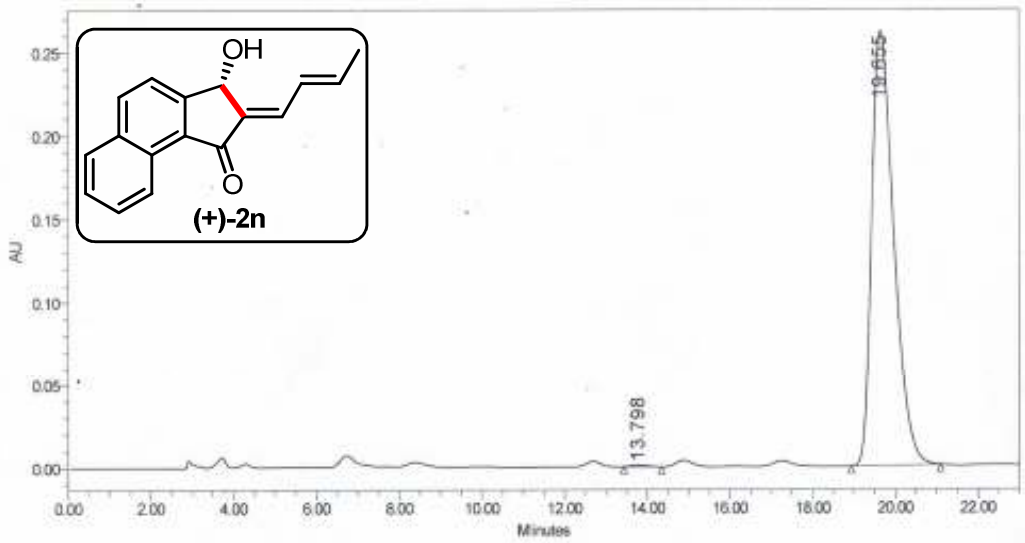
Project Name: YR_01
Date Printed:
25-04-2017
22:38:01 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-naphhexraccat15ODH10%	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	2	Processing Methoc	bsnaphhexcat15
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.	PDA 254.0 nm
Date Acquired:	22-04-2017 11:21:08 IST		
Date Processed:	25-04-2017 21:47:03 IST		



	RT	Area	% Area	Height
1	13.798	29375	0.30	1100
2	19.655	9719027	99.70	261473

Reported by User: System
Report Method: Vishnu
Report Method II 7931
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Project Name: YR_01
Date Printed:
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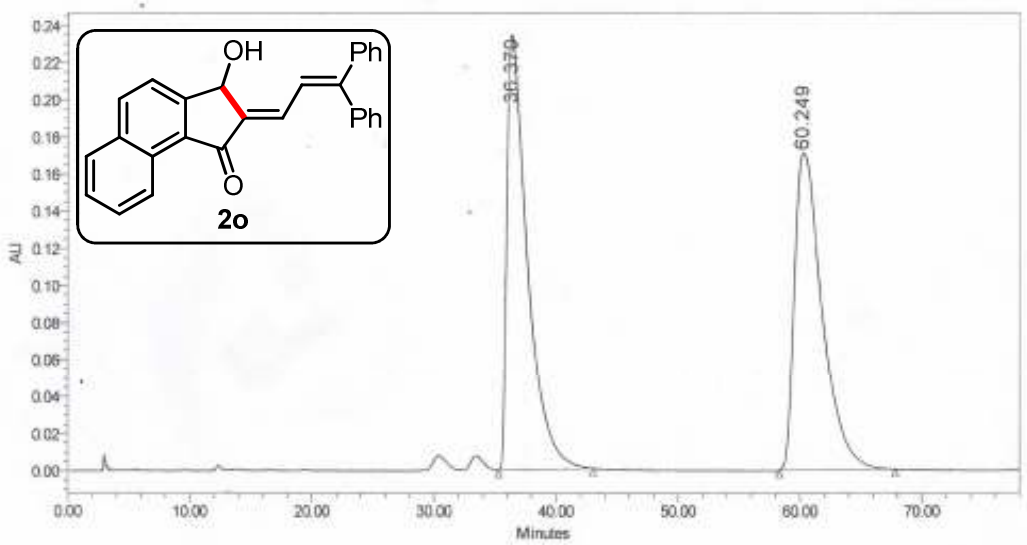
22:37:48 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-06naphdiphrac5%	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	2	Processing Methoc	bs naphdiphracODH5%
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	25-04-2017 20:33:45 IST		
Date Processed:	25-04-2017 22:01:31 IST		



	RT	Area	% Area	Height
1	36.370	27443564	50.36	234410
2	60.249	27049868	49.64	170737

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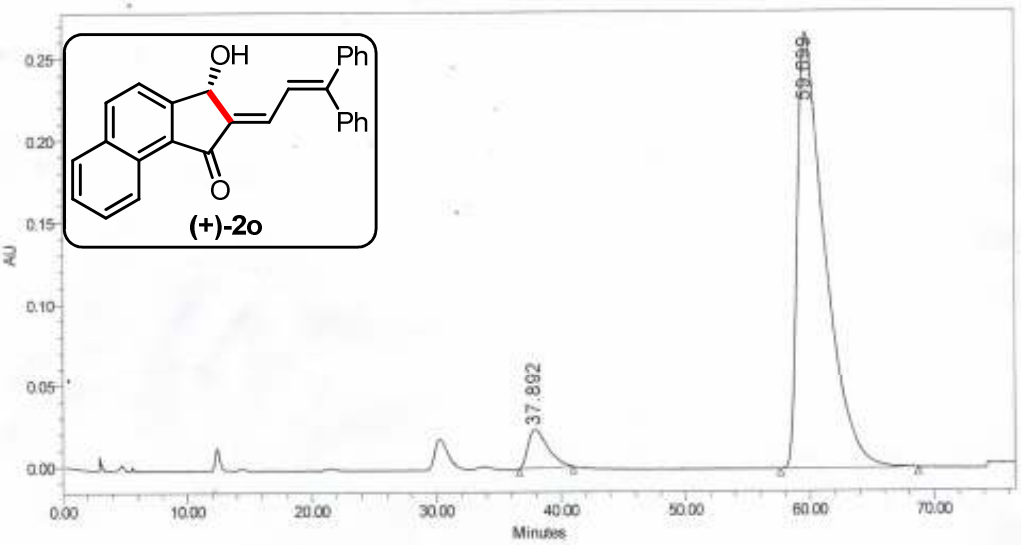
Project Name: YR_01
Date Printed:
25-04-2017
22:44:50 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-06naphdiphcat15 5%	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	3	Processing Methoc	bsnaphdiphcat15
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	25-04-2017 21:54:04 IST		
Date Processed:	25-04-2017 23:03:44 IST		



	RT	Area	% Area	Height
1	37.892	2613063	5.95	23744
2	59.699	41273723	94.05	266201

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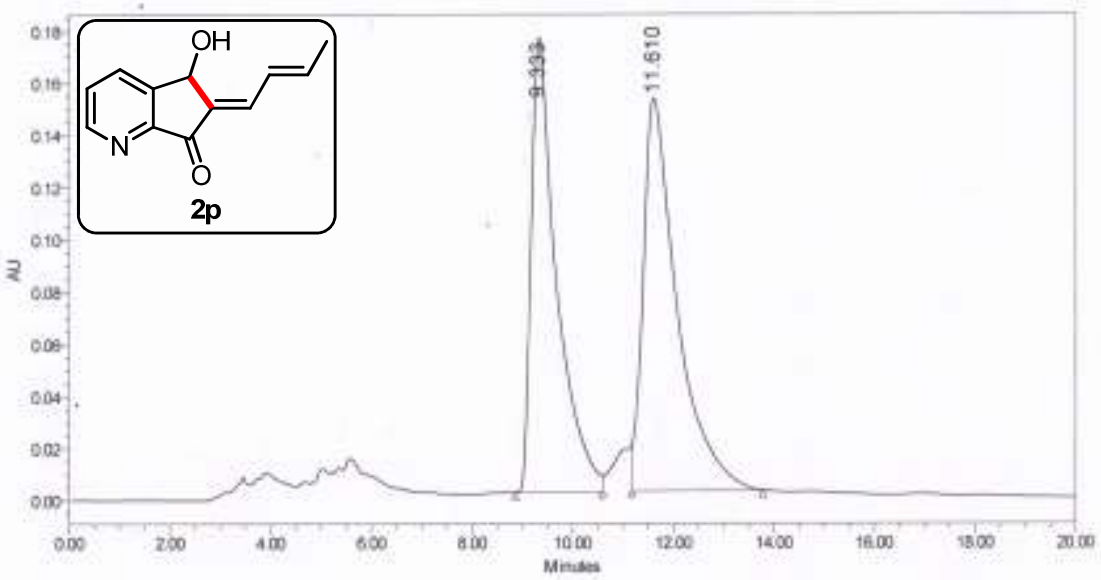
Date Printed:
25-04-2017
23:14:59 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS06-pyrhexracADH13%1ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Method	bs06pyrhexracADH13%1ml
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	23-09-2016 22:41:06 IST		
Date Processed:	23-09-2016 23:18:17 IST		



	RT	Area	% Area	Height
1	9.333	6120025	46.45	174487
2	11.610	7056757	53.55	150815

Reported by User: System
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Report Method ID: 6497
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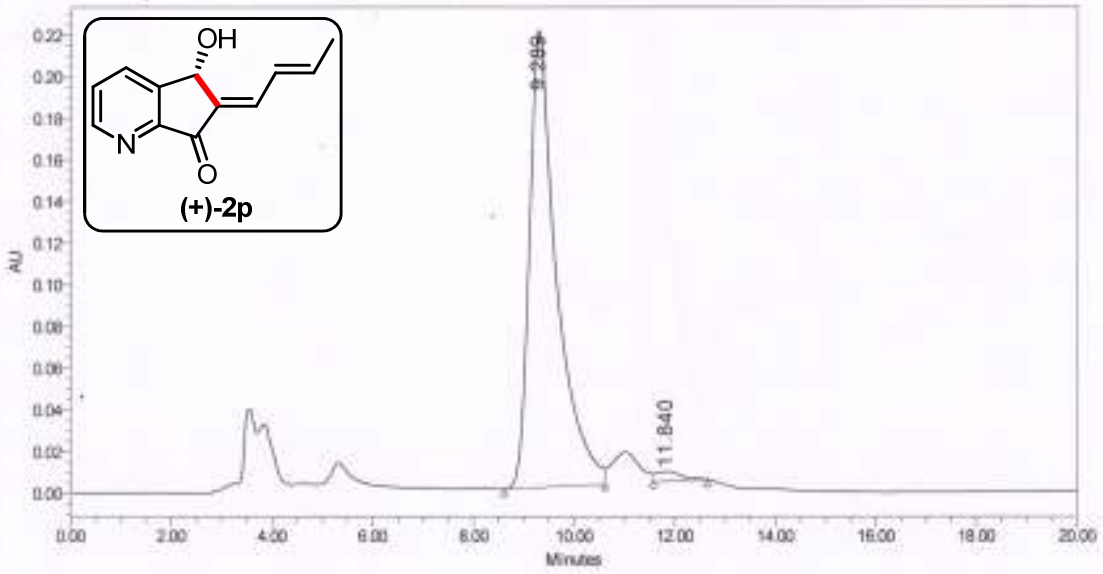
Project Name: YR_01
Date Printed:
23-09-2016
23:52:06 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS06-pyrhexracADH13%1ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	2	Processing Methoc	bs06pyrhexcat15
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	23-09-2016 23:23:33 IST		
Date Processed:	23-09-2016 23:53:36 IST		



	RT	Area	% Area	Height
1	9.289	8225125	98.04	219272
2	11.840	164209	1.96	4720

Reported by User: System
Report Method: Vishnu
Report Method ID: 6497
Page: 1 of 2

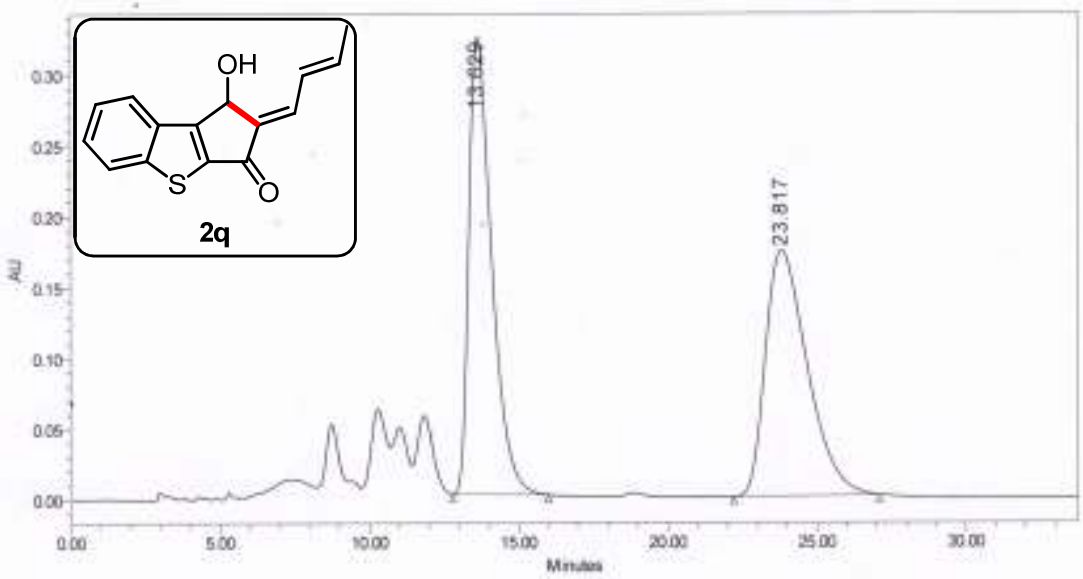
Project Name: YR_01
Date Printed:
23-09-2016
23:54:26 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	bs-06-benzthiohexracAS2%	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Methoc	bs06benzthiohexracAS2%
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	18-02-2016 10:04:49 IST		
Date Processed:	18-02-2016 11:24:32 IST		



	RT	Area	% Area	Height
1	13.629	17129243	50.28	322727
2	23.817	16940650	49.72	173745

Reported by User: System
Report Method: Vishnu
Report Method ID: 5530
Page: 1 of 2

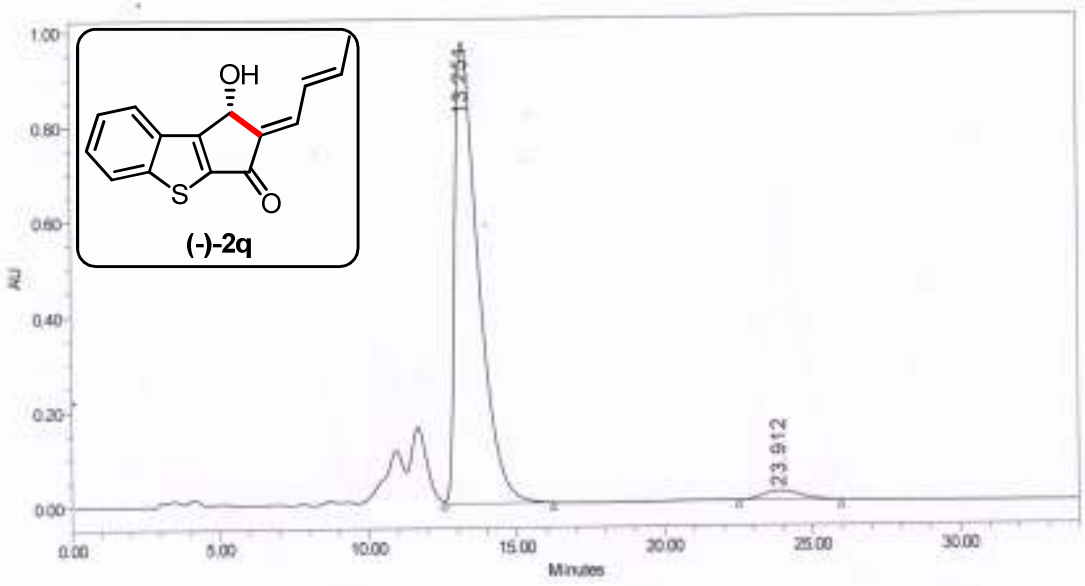
Project Name: YR_01
Date Printed:
18-02-2016
11:24:59 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	bs-06-benzthiohexcat15AS2%	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	2	Processing Methoc	bs06benzthiohexcat15AS2%
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	18-02-2016 10:41:22 IST		
Date Processed:	18-02-2016 11:26:44 IST		



	RT	Area	% Area	Height
1	13.251	53252016	96.92	969867
2	23.912	1693262	3.08	19010

Reported by User: System
Report Method: Vishnu
Report Method II 5533
Page: 1 of 2

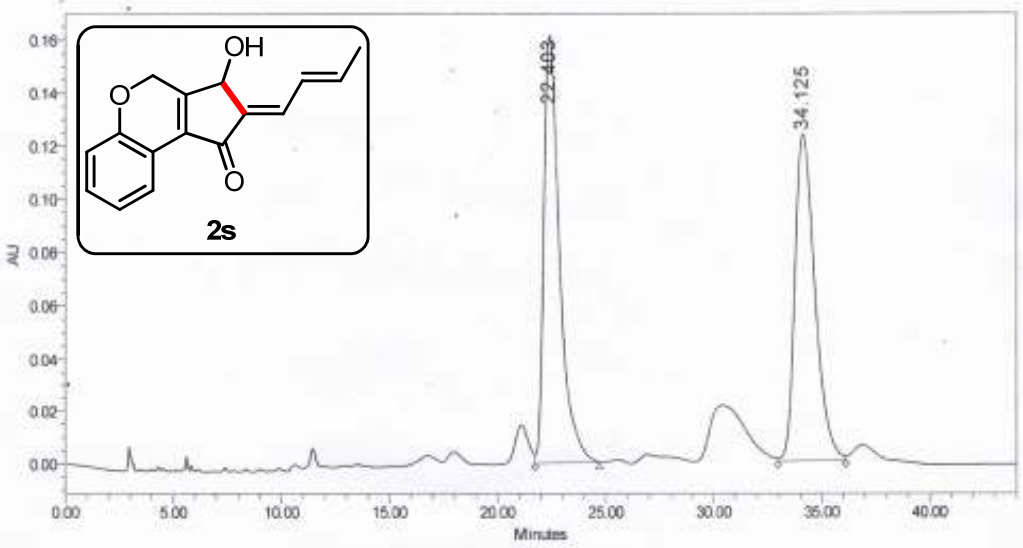
Project Name: YR_01
Date Printed:
16-02-2016
11:27:01 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS-06chromhexracODH 5%	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	4	Processing Methoc	bschromhexracODH5%
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	25-04-2017 23:14:16 IST		
Date Processed:	26-04-2017 00:46:21 IST		



	RT	Area	% Area	Height
1	22.403	8143691	50.40	161244
2	34.125	8015049	49.60	123231

Reported by User: System
Report Method: Vishnu
Report Method II 7934
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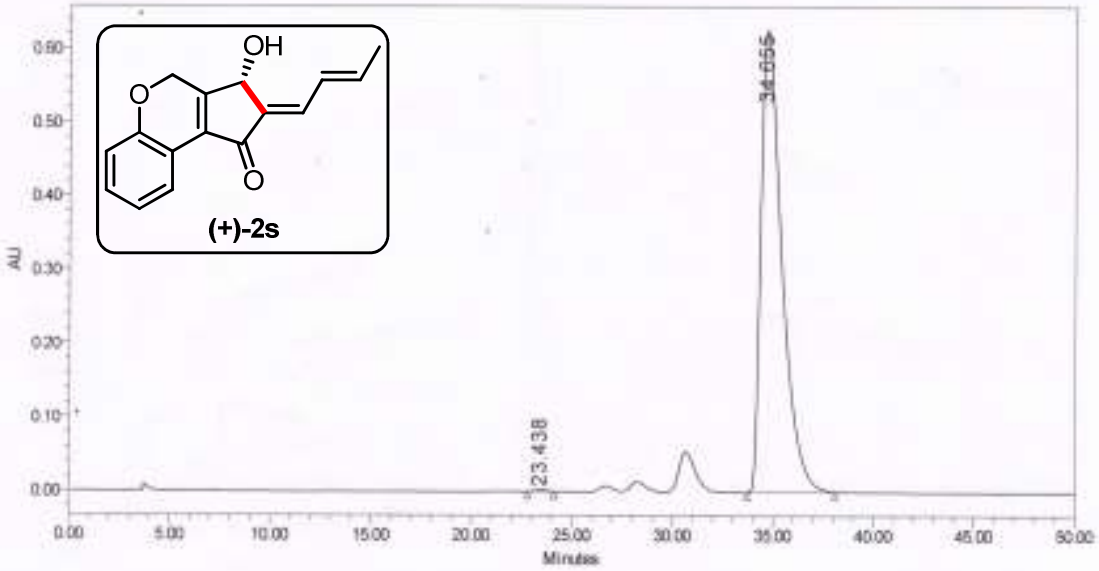
Project Name: YR_01
Date Printed:
26-04-2017
00:49:19 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	bs-chromhexchiODH76%.8ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Atanu
Injection #:	2	Processing Methoc	bschromhexchiral
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	03-01-2017 11:44:32 IST		
Date Processed:	03-01-2017 12:42:06 IST		



	RT	Area	% Area	Height
1	23.438	92314	0.20	2194
2	34.655	45202379	99.80	626864

Reported by User: System
Report Method: Vishnu
Report Method ID: 6925
Page: 1 of 2

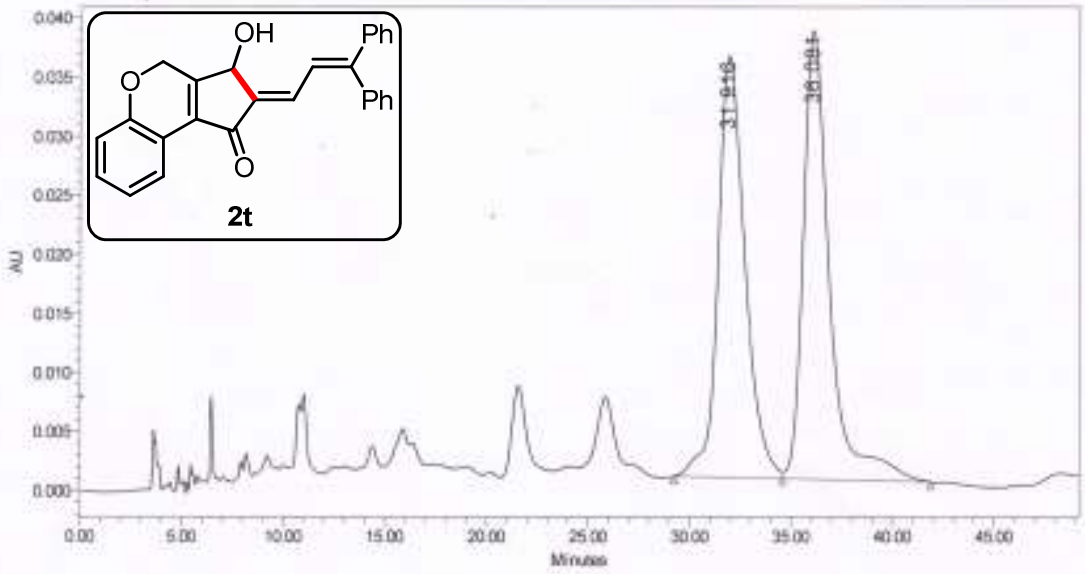
Project Name: YR_01
Date Printed:
03-01-2017
12:46:55 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	BS05-chromdiphracOOH10%1ml	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Methoc	bs06chromdiphracOOH7%8ml
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	19-09-2016 20:58:35 IST		
Date Processed:	19-09-2016 22:38:49 IST		



	RT	Area	% Area	Height
1	31.916	3292861	49.07	35634
2	36.081	3417566	50.93	37980

Reported by User: System
Report Method: Vishnu
Report Method ID: 6497
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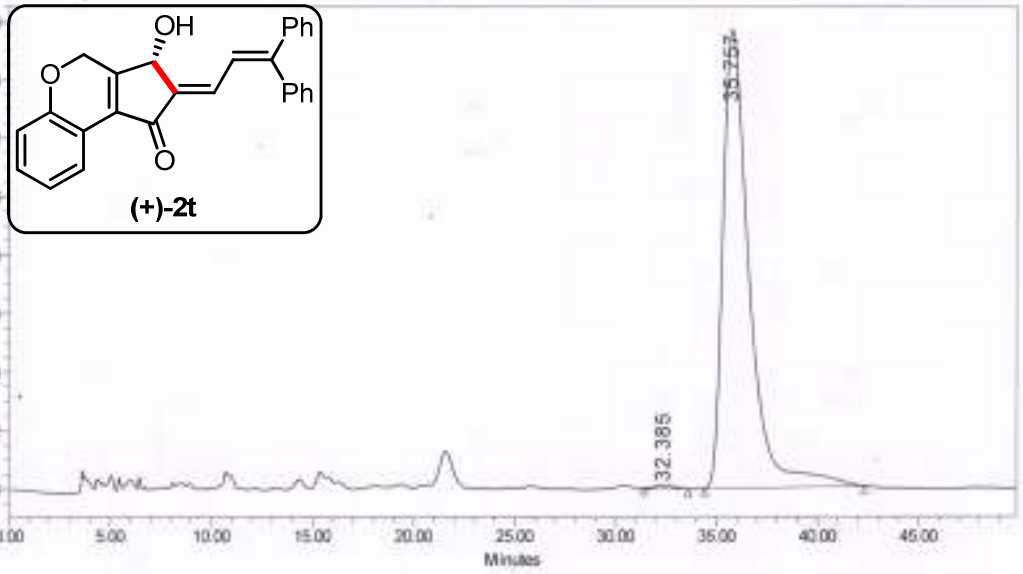
Project Name: YR_01
Date Printed:
19-09-2016
22:44:30 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:		Acquired By:	System
Sample Type:	Unknown	Sample Set Name:	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	2	Processing Method:	bs06chromdiphcat15
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	120.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	19-09-2016 21:50:19 IST		
Date Processed:	19-09-2016 22:42:18 IST		



	RT	Area	% Area	Height
1	32.385	85107	0.60	1168
2	35.757	14130097	99.40	156656

Reported by User: System
Report Method: Vishnu
Report Method ID: 6497
Page: 1 of 2

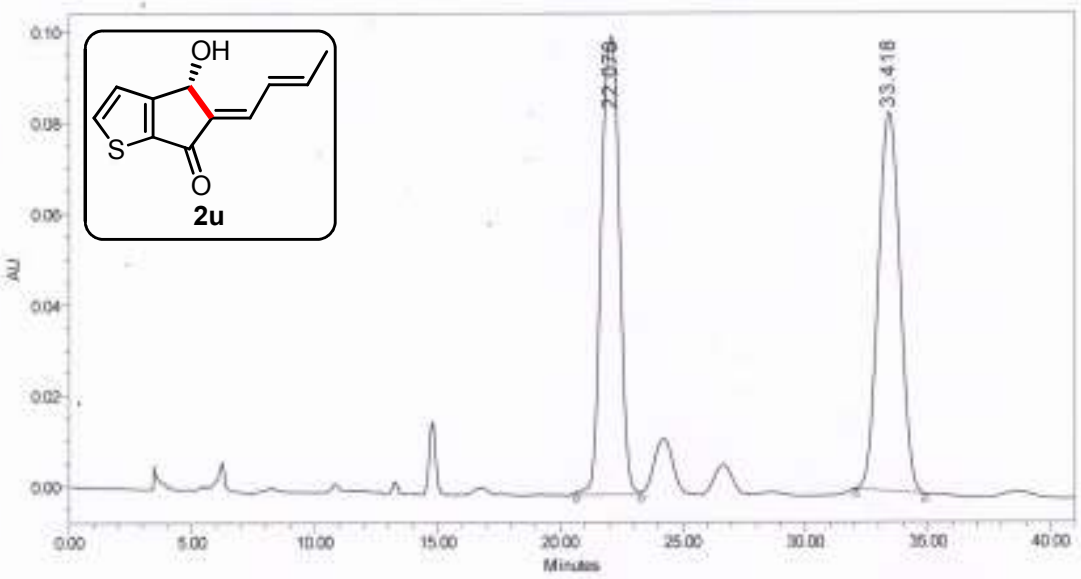
Project Name: YR_01
Date Printed:
19-09-2016
22:44:57 Asia/Calcutta

Empower 3

Vishnu

SAMPLE INFORMATION

Sample Name:	bs05113racemic	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Methoc	bs05113rac
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	80.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	06-06-2015 16:00:03 IST		
Date Processed:	28-11-2016 22:21:27 IST		



	RT	Area	% Area	Height
1	22.078	5198848	50.31	100860
2	33.418	5134171	49.69	83335

Reported by User: System
Report Method: Vishnu
Report Method ID: 6497
Page: 1 of 2

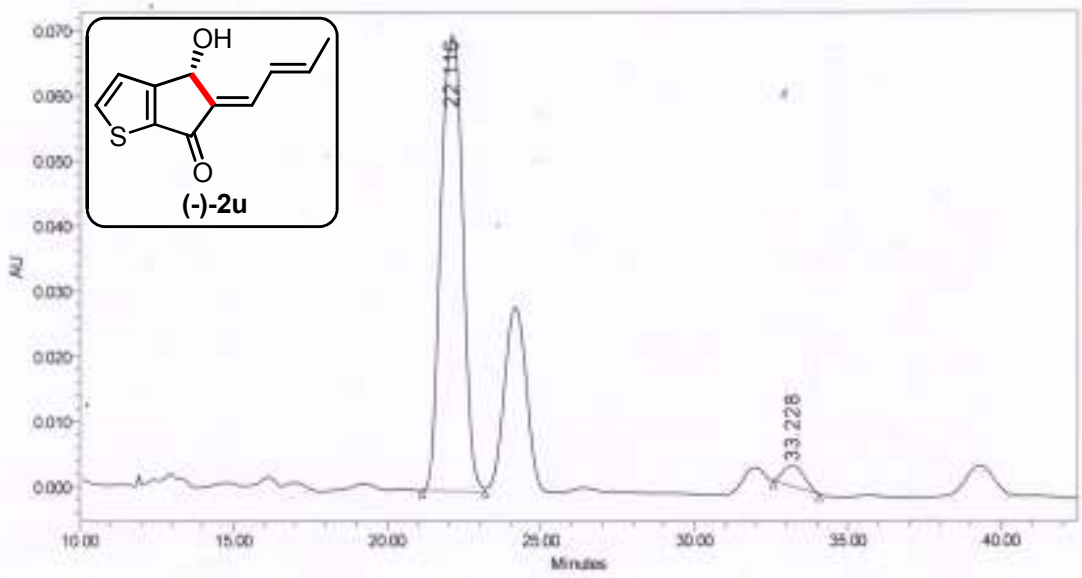
Project Name: YR_01
Date Printed:
28-11-2016
22:22:15 Asia/Calcutta

Empower 3

Vishnu

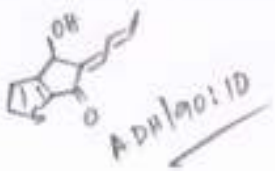
SAMPLE INFORMATION

Sample Name:	bs05113cat15	Acquired By:	System
Sample Type:	Unknown	Sample Set Name	
Vial:	1	Acq. Method Set:	Bishnu MBH
Injection #:	1	Processing Method:	bs05113cat15
Injection Volume:	10.00 ul	Channel Name:	254.0nm
Run Time:	80.0 Minutes	Proc. Chnl. Descr.:	PDA 254.0 nm
Date Acquired:	06-06-2015 17:59:14 IST		
Date Processed:	06-06-2015 18:44:03 IST		



	RT	Area	% Area	Height
1	22.116	3452139	95.94	69898
2	33.228	145959	4.06	3137

Reported by User: System
Report Method: Vishnu
Report Method ID: 3837
Page: 1 of 1



Project Name: YR_01
Date Printed:
06-06-2015
18:47:37 Asia/Calcutta