Highly Regioselective α-Alkylation of $\alpha,\beta,\gamma,\delta$-Unsaturated Aldehydes Through Morita–Baylis–Hillman-Type Reaction

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Supporting Information

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1. General information

All the reagents and catalysts were purchased from Aldrich, TCI, and used without further purification unless otherwise mentioned. All the solvents were purchased from Merck or SD Fine and used for the purification of products. Thin-layer chromatography (SiO_2, TLC) was performed on Merck TLC silica gel 60 F_{254} visualized by ultraviolet irradiation, $KMnO_4$ solution or iodine staining. Column chromatography was performed on Merck silica gel 60-120 using standard flash chromatographic methods. The NMR spectra were recorded on Bruker Advance III (500 MHz) spectrometer and were referenced against the residual solvent peaks [$CDCl_3$: δ 7.26 ppm (^{1}H NMR) and 77.00 ppm (^{13}C NMR)]. Chemical shifts are reported in parts per million as follows: chemical shift, multiplicity (s = singlet, bs = broad singlet, d = doublet, t = triplet, q = quartet, m = multiplet), coupling constant, and integration. Infrared spectra were recorded on Perkin Elmer Spectrum Two FT-IR spectrometer. Selected absorption bands are reported in wavenumbers (cm^{-1}). The HRMS data for all the compounds was recorded (in positive ion mode) with Waters Synapt-G2S ESI-Q-TOF Mass instrument. Aldehyde **1g**,[1] Michler's hydrol **2a**,[2] (4-(diethylamino)phenyl)(4-(dipropylamino)phenyl)methanol **2b**[3] and 9H-thioxanthen-9-ol **2d**[4] were prepared according to the reported procedure.

2. General procedure for the Reaction optimization for the regioselective *α*-alkylation of *α,β,γ,δ*-unsaturated aldehyde 1d

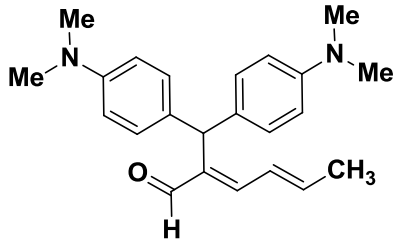
To a solution of alcohol **2a** (65 mg, 0.24 mmol) in solvent, catalyst and aldehyde **1d** (30 mg, 0.20 mmol) and acid additive (as mentioned in Table 1) were added and stirred for the stated time. Then, the reaction mixture was diluted with Et_2O (2 mL) and quenched with saturated aq. $NaHCO_3$. The reaction mixture was then extracted with Et_2O (10 mL) and the separated Organic layer was filtered through a short pad of silica using Et_2O (30 ml) and dried over anhydrous sodium sulphate. The solvent was evaporated and the crude product was purified by column chromatography (SiO_2, hexane/EtOAc) in case of isolated yield.

3. Experimental procedure and characterization data for products 5aa–5fc

Alcohol **2a** or **2d** (0.24 mmol) was dissolved in DCE (200 μL) into a glass vial. To the above solution pyrrolidine (5.0 μL, 0.06 mmol), aldehyde **1** (0.20 mmol) and benzoic acid (as mentioned in Table 2) were added and stirred vigorously at room temperature. After stated time reaction was diluted with Et_2O (2 mL) and quenched with saturated aq.

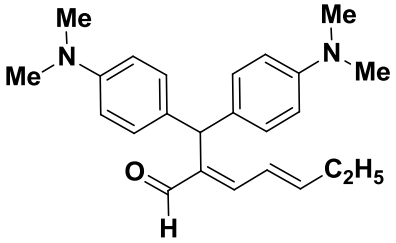
$NaHCO_3$. The reaction mixture was then extracted with Et_2O (10 mL) and the separated Organic layer was filtered through a short pad of silica using Et_2O (30 ml) and dried over anhydrous sodium sulphate. The solvent was evaporated and the crude product was purified by column chromatography (SiO_2, hexane/EtOAc).

(2E,4E)-2-(bis(4-(dimethylamino)phenyl)methyl)hexa-2,4-dienal (5aa)



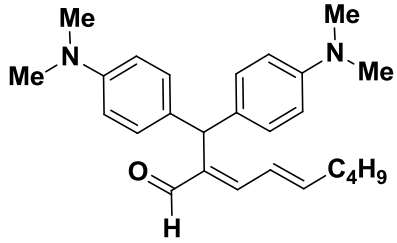
The reaction was performed by following the experimental procedure and the product **5aa** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.5:0.5) as a yellow sticky liquid (60 mg, 86% yield).**^{1}H NMR**: δ 9.44 (s, 1H), 7.00 (d, *J* = 8.0 Hz, 4H), 6.97-6.90 (m, 1H), 6.67(d, *J* = 7.0 Hz, 4H), 6.27-6.14 (m, 2H), 5.49 (s, 1H), 2.91 (s, 12H), 1.76 (d, *J* = 5.5 Hz, 3H). **^{13}C NMR**: δ 194.6, 150.3, 149.2, 149.1, 141.9, 141.3, 130.4, 129.7, 129.5, 128.1, 112.7, 45.1, 40.8, 19.1. **FTIR** (film) ν_{max}: 2926, 2855, 2805, 1681, 1635, 1613, 1519, 1447, 1351, 1165, 1126, 1070, 948, 814, 713 cm^{-1}. **ESI-HRMS** calculated for $C_{23}H_{28}N_2O$ $(M+H)^+$: 349.2274 and found: 349.2275.

(2E,4E)-2-(bis(4-(dimethylamino)phenyl)methyl)hepta-2,4-dienal (5ba)



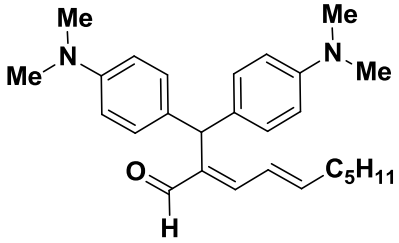
The reaction was performed by following the experimental procedure and the product **5ba** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.5:0.5) as a yellow sticky liquid (60 mg, 83% yield). **^{1}H NMR**: δ 9.45 (s, 1H), 7.00 (d, *J* = 8.0 Hz, 4H), 6.93-6.92 (m, 1H), 6.67 (d, *J* = 7.5 Hz, 4H), 6.20-6.19 (m, 2H), 5.51 (s, 1H), 2.91 (s, 12H), 2.08 (bs, 2H), 0.90-0.88 (m, 3H). **^{13}C NMR**: δ 194.7, 150.7, 149.2, 147.8, 142.2, 130.5, 129.6, 125.7, 112.8, 45.1, 40.8, 26.2, 12.5. **FTIR** (film) ν_{max}: 2926, 2849, 2805, 1680, 1633, 1614, 1519, 1349, 1227, 1124, 948, 814, 714 cm^{-1}. **ESI-HRMS** calculated for $C_{24}H_{30}N_2O$ $(M+H)^+$: 363.2431 and found: 363.2407.

(2E,4E)-2-(bis(4-(dimethylamino)phenyl)methyl)nona-2,4-dienal (5ca)



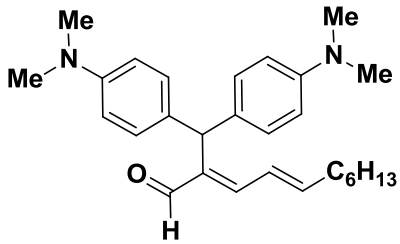
The reaction was performed by following the experimental procedure and the product **5ca** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.5:0.5) as a yellow sticky liquid (66 mg, 85% yield). **^{1}H NMR**: δ 9.45 (s, 1H), 7.00 (d, *J* = 9.0 Hz, 4H), 6.93-6.91(m 1H), 6.67 (d, *J* = 8.5 Hz, 4H), 6.22-6.11 (m, 2H), 5.51 (s, 1H), 2.91 (s, 12H), 2.07-2.03 (m, 2H), 1.31-1.20 (m, 4H), 0.85 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR**: δ 194.6, 150.7, 149.2, 146.5, 142.2, 130.4, 129.6, 126.7, 112.7, 45.0, 40.8, 32.8, 30.4, 22.1, 13.8. **FTIR** (film) ν_{max}: 2926, 2856, 2799, 1681, 1633, 1614, 1519, 1455, 1350, 1165, 948, 814 cm^{-1}. **ESI-HRMS** calculated for $C_{26}H_{34}N_2O$ $(M+H)^+$: 391.2744 and found: 391.2723.

(2E,4E)-2-(bis(4-(dimethylamino)phenyl)methyl)deca-2,4-dienal (5da)



The reaction was performed by following the experimental procedure and the product **5da** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.5:0.5) as a yellow sticky liquid (69 mg, 85% yield). **^{1}H NMR**: δ 9.44 (s, 1H), 7.00 (d, *J* = 7.0 Hz, 4H), 6.93-6.91 (m, 1H), 6.68 (bs, 4H), 6.22-6.12 (m, 2H), 5.50 (s, 1H), 2.91 (s, 12H), 2.05-2.04 (m, 2H), 1.30-1.20 (m, 6H), 0.87 (bs, 3H). **^{13}C NMR**: δ 194.6, 150.7, 149.2, 146.6, 142.1, 129.6, 126.7, 112.7, 45.1, 40.8, 33.1, 29.7, 27.9, 22.4, 14.0. **FTIR** (film) ν_{max}: 2923, 2859, 2793, 1685, 1609, 1513, 1446, 1345, 1188, 954, 809 cm^{-1}. **ESI-HRMS** calculated for $C_{27}H_{36}N_2O$ $(M+H)^+$: 405.2900 and found: 405.2916.

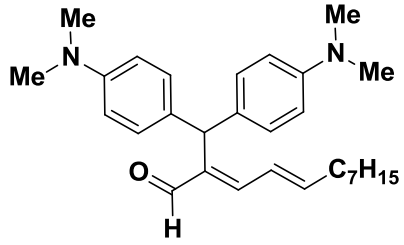
(2E,4E)-2-(bis(4-(dimethylamino)phenyl)methyl)undeca-2,4-dienal (5ea)



The reaction was performed by following the experimental procedure and the product **5ea** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.5:0.5) as a yellow sticky liquid (70 mg, 84% yield). **^{1}H NMR**: δ 9.45 (s, 1H), 7.00 (d, *J* = 7.5 Hz, 4H), 6.93-6.91 (m, 1H), 6.67 (d, *J* = 7.5 Hz, 4H), 6.22-6.12 (m, 2H), 5.51 (s, 1H), 2.91 (s, 12H), 2.05-2.04 (m, 2H), 1.29-1.22 (m, 8H), 0.88-0.87 (m, 3H). **^{13}C NMR**: δ 194.6, 150.7, 149.2, 146.6, 142.1, 130.4, 129.6, 126.7, 112.7, 45.1, 40.8, 33.2, 31.8, 29.7, 28.3, 22.7, 14.1. **FTIR** (film) ν_{max}: 2925, 2880, 2855, 1680, 1632, 1614, 1518, 1348, 1165,

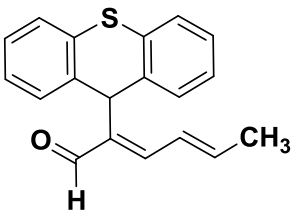
1126, 948, 813, 800 cm^{-1}. **ESI-HRMS** calculated for $C_{28}H_{38}N_2O$ $(M+H)^+$: 419.3057 and found: 419.3070.

(2E,4E)-2-(bis(4-(dimethylamino)phenyl)methyl)dodeca-2,4-dienal (5fa)



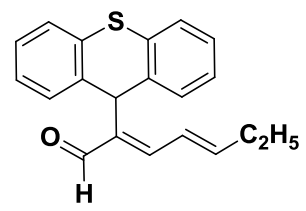
The reaction was performed by following the experimental procedure and the product **5fa** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.5:0.5) as a yellow sticky liquid (74 mg, 86% yield). **^{1}H NMR**: δ 9.48 (s, 1H), 7.01 (d, *J* = 8.0 Hz, 4H), 6.93-6.91 (m, 1H), 6.67 (d, *J* = 7.5 Hz, 4H), 6.23-6.13 (m, 2H), 5.51 (s, 1H), 2.92 (s, 12H), 2.05-2.04 (m, 2H), 1.30-1.24 (m, 10H), 0.89-0.88 (m, 3H). **^{13}C NMR**: δ 194.7, 150.7, 149.2, 146.6, 142.1, 130.4, 129.7, 129.6, 126.7, 123.5, 112.7, 45.1, 40.8, 40.7, 33.2, 31.9, 31.6, 29.7, 28.7, 28.2, 22.7, 22.6, 14.1. **FTIR** (film) ν_{max}: 2923, 2885, 2859, 1685, 1609, 1513, 1445, 1345, 1189, 954, 809 cm^{-1}. **ESI-HRMS** calculated for $C_{29}H_{40}N_2O$ $(M+H)^+$: 433.3213 and found: 433.3242.

(2E,4E)-2-(9H-thioxanthen-9-yl)hexa-2,4-dienal (5ad)



The reaction was performed by following the experimental procedure and the product **5ad** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.7:0.3) as a pale yellow sticky liquid (55 mg, 94% yield).**^{1}H NMR**: δ 9.70 (s, 1H), 7.41 (d, *J* = 7.5 Hz, 2H), 7.36-7.34 (m, 1H), 7.19-7.16 (m, 2H), 7.13 (t, *J* = 7.5 Hz, 2H), 7.05-7.04 (m, 2H), 6.38-6.31 (m, 1H), 6.26-6.21 (m, 1H), 5.30 (s, 1H), 1.77 (d, *J* = 7.0 Hz, 3H). **^{13}C NMR**: δ 193.8, 153.3, 143.6, 137.8, 135.1, 132.7, 128.7, 127.5, 126.7, 126.5, 126.3, 41.1, 19.1. **FTIR** (film) ν_{max}: 3059, 2922, 2853, 1680, 1634, 1457, 1378, 1189, 1114, 969, 748 cm^{-1}. **ESI-HRMS** calculated for $C_{19}H_{16}OS$ $(M+H)^+$: 293.0995 and found: 293.1001.

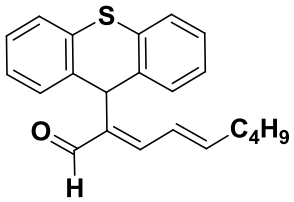
(2E,4E)-2-(9H-thioxanthen-9-yl)hepta-2,4-dienal (5bd)



The reaction was performed by following the experimental procedure and the product **5bd** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.7:0.3) as a pale yellow sticky liquid (57 mg, 93% yield). **^{1}H NMR**: δ 9.68 (s,

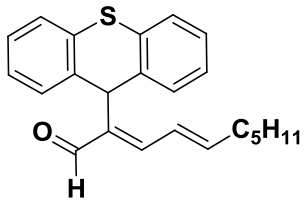
1H), 7.40 (d, *J* = 7.5 Hz, 2H), 7.33-7.31 (m, 1H), 7.17 (t, *J* = 7.0 Hz, 2H), 7.12 (t, *J* = 7.5 Hz, 2H), 7.07-7.05 (m, 2H), 6.39-6.33 (m, 1H), 6.26-6.20 (m, 1H), 5.34 (s, 1H), 2.13-2.07 (m, 2H), 0.92 (t, *J* = 7.5 Hz, 3H). **^{13}C NMR**: δ 193.8, 153.4, 150.2, 138.4, 135.1, 132.6, 127.8, 126.7, 126.4, 126.3, 41.1, 26.4, 12.7. **FTIR** (film) ν_{max}: 3053, 2922, 2853, 2716, 1680, 1632, 1458, 1378, 1191, 1122, 971, 748 cm^{-1}. **ESI-HRMS** calculated for $C_{20}H_{18}OS$ $(M+H)^+$: 307.1151 and found: 307.1163.

(2E,4E)-2-(9H-thioxanthen-9-yl)nona-2,4-dienal (5cd)



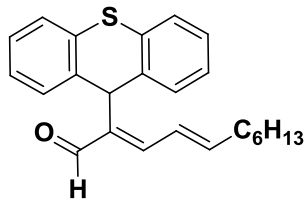
The reaction was performed by following the experimental procedure and the product **5cd** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.5:0.3) as a pale yellow sticky liquid (61 mg, 91% yield). **^{1}H NMR**: δ 9.70 (s, 1H), 7.41 (d, *J* = 7.5 Hz, 2H), 7.35-7.33 (m, 1H), 7.19-7.11 (m, 4H), 7.07-7.06 (m, 2H), 6.33-6.29 (m, 1H), 6.23-6.18 (m, 1H), 5.33 (s, 1H), 2.07-2.06 (m, 2H), 1.32-1.29 (m, 2H), 1.22-1.18 (m, 2H), 0.82 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR**: δ 193.8, 153.5, 148.9, 138.1, 135.1, 132.7, 127.7, 127.4, 126.7, 126.4, 126.3, 41.1, 32.9, 30.5, 22.0, 13.7. **FTIR** (film) ν_{max}: 3060, 2956, 2928, 2858, 2716, 2716, 1678, 1630, 1457, 1441, 1184, 1122, 974, 747 cm^{-1}. **ESI-HRMS** calculated for $C_{22}H_{22}OS$ $(M+H)^+$: 335.1464 and found: 335.1459.

(2E,4E)-2-(9H-thioxanthen-9-yl)deca-2,4-dienal (5dd)



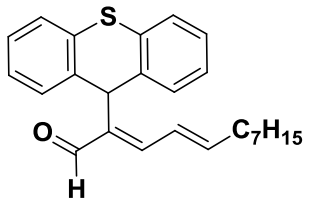
The reaction was performed by following the experimental procedure and the product **5dd** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.5:0.3) as a pale yellow sticky liquid (65 mg, 93% yield). **^{1}H NMR**: δ 9.69 (s, 1H), 7.42-7.40 (m, 2H), 7.35-7.33 (m, 1H), 7.17 (t, *J* = 7.0 Hz, 2H), 7.16-7.11 (m, 2H), 7.07-7.05 (m, 2H), 6.34-6.23 (m, 1H), 6.21-6.18 (m, 1H), 5.33 (s, 1H), 2.08-2.04 (m, 2H), 1.35-1.29 (m, 2H), 1.26-1.19 (m, 2H), 1.18-1.13 (m, 2H), 0.85-0.82 (m, 3H). **^{13}C NMR**: δ 193.8, 153.6, 149.0, 135.1, 132.7, 127.6, 127.4, 126.7, 126.5, 126.3, 41.1, 33.2, 31.1, 28.1, 22.4, 14.0. **FTIR** (film) ν_{max}: 3061, 2955, 2923, 2853, 2728, 1680, 1632, 1457, 1376, 1200, 1120, 947, 747 cm^{-1}. **ESI-HRMS** calculated for $C_{23}H_{24}OS$ $(M+H)^+$: 349.1621 and found: 349.1622.

(2E,4E)-2-(9H-thioxanthen-9-yl)undeca-2,4-dienal (5ed)



The reaction was performed by following the experimental procedure and the product **5ed** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.5:0.3) as a yellow sticky liquid (67 mg, 92% yield). **^{1}H NMR**: δ 9.69 (s, 1H), 7.41 (d, *J* = 7.5 Hz, 2H), 7.35-7.33 (m, 1H), 7.19-7.16 (m, 2H), 7.14-7.11 (m, 2H), 7.07-7.05 (m, 2H), 6.34-6.29 (m, 1H), 6.23-6.18 (m, 1H), 5.33 (s, 1H), 2.08-2.05 (m, 2H), 1.31-1.30 (m, 2H), 1.26-1.23 (m, 2H), 1.18 (s, 4H), 0.87-0.84 (m, 3H). **^{13}C NMR**: δ 193.8, 153.6, 149.0, 138.0, 135.1, 132.7, 127.6, 127.4, 126.7, 126.5, 126.3, 41.1, 33.2, 31.5, 28.6, 28.4, 22.5, 14.0. **FTIR** (film) ν_{max}: 3066, 2926, 2856, 2716, 1680, 1631, 1457, 1378, 1198, 1119, 971, 747 cm^{-1}. **ESI-HRMS** calculated for $C_{24}H_{26}OS$ $(M+H)^+$: 363.1777 and found: 363.1759.

(2E,4E)-2-(9H-thioxanthen-9-yl)dodeca-2,4-dienal (5fd)



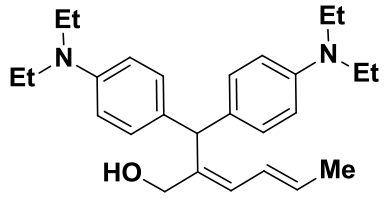
The reaction was performed by following the experimental procedure and the product **5fd** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.5:0.5) as a yellow sticky liquid (71 mg, 94% yield). **^{1}H NMR**: δ 9.70 (s, 1H), 7.41 (d, *J* = 7.5 Hz, 2H), 7.35-7.33 (m, 1H), 7.19-7.11 (m, 4H), 7.07-7.05 (m, 2H), 6.34-6.29 (m, 1H), 6.23-6.18 (m, 1H), 5.33 (s, 1H), 2.08-2.04 (m, 2H), 1.33-1.25 (m, 4H), 1.19 (bs, 6H), 0.88-0.86 (m, 3H). **^{13}C NMR**: δ 193.8, 153.6, 149.0, 138.0, 135.1, 132.7, 127.6, 126.7, 126.5, 126.3, 41.1, 33.2, 31.7, 29.0, 28.9, 28.4, 22.6, 14.1. **FTIR** (film) ν_{max}: 3066, 2923, 2853, 1684, 1634, 1459, 1278, 1197, 1116, 974, 747 cm^{-1}. **ESI-HRMS** calculated for $C_{25}H_{28}OS$ $(M+H)^+$: 377.1934 and found: 377.1947.

4. Experimental procedure and characterization data for products 6ab–6cc

Alcohol **2b** or **2c** (0.24 mmol) was dissolved in DCE (200 μL) into a glass vial. To the above solution pyrrolidine (5.0 μL, 0.06 mmol), aldehyde (0.20 mmol) and benzoic acid (as mentioned in Table 2) were added and stirred vigorously at room temperature. After stated time, reaction was diluted with MeOH (2 mL) and cooled to 0 °C. $NaBH_4$ (76 mg, 2.0 mmol) was then slowly added and reaction mixture was stirred for 3 h at the same temperature before quenched with H_2O and extracted with DCM (10 x 3 mL). Organic

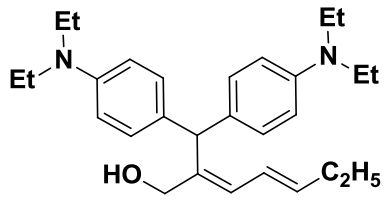
layer was dried over anhydrous sodium sulphate. The solvent was evaporated and the crude product was purified by column chromatography (SiO_2, hexane/EtOAc).

(2E,4E)-2-(bis(4-(diethylamino)phenyl)methyl)hexa-2,4-dienal (6ab)



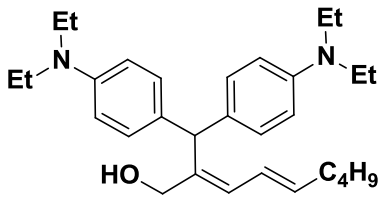
The reaction was performed by following the experimental procedure and the product **6ab** was purified by flash column chromatography (silica gel, Hexane/EtOAc 9.0:1.0) as a yellow sticky liquid (76 mg, 94% yield). **^{1}H NMR**: δ 7.04 (d, *J* = 8.0 Hz, 4H), 6.63 (d, *J* = 8.5, 4H), 6.36-6.30 (m, 2H), 5.80-5.73 (m, 1H), 5.27 (s, 1H), 4.04 (s, 2H), 3.33 (q, *J* = 7.0 Hz, 8H), 1.74 (d, *J* = 6.5 Hz, 3H), 1.16 (t, *J* = 7.0 Hz, 12H), 1.11 (s, 1H). **^{13}C NMR**: δ 146.4, 139.9, 130.7, 129.9, 129.5, 127.7, 127.3, 111.9, 65.8, 48.7, 44.4, 18.5, 12.7. **FTIR** (film) ν_{max}: 3374, 2969, 2930, 2870, 1610, 1515, 1450, 1395, 1375, 1355, 1265, 1196, 965, 810 cm^{-1}. **ESI-HRMS** calculated for $C_{27}H_{38}N_2O$ $(M+H)^+$: 407.3057 and found: 407.3065.

(2E,4E)-2-(bis(4-(diethylamino)phenyl)methyl)hepta-2,4-dien-1-ol (6bb)



The reaction was performed by following the experimental procedure and the product **6bb** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.0:1.0) as a yellow sticky liquid (78 mg, 93% yield). **^{1}H NMR**: δ 7.05 (d, *J* = 8.5 Hz, 4H), 6.63 (d, *J* = 8.5, 4H), 6.33-6.26 (m, 2H), 5.81-5.76 (m, 1H), 5.26 (s, 1H), 4.06 (s, 2H), 3.34 (q, *J* = 7.0 Hz, 8H), 2.11-2.06 (m, 2H), 1.16 (t, *J* = 7.0 Hz, 12H), 1.12-1.09 (m, 1H), 0.97 (t, *J* = 7.5 Hz, 3H). **^{13}C NMR**: δ 146.4, 140.3, 137.8, 129.9, 129.5, 127.9, 125.1, 112.0, 66.0, 48.9, 44.4, 26.0, 13.5, 12.7. **FTIR** (film) ν_{max}: 3373, 2966, 2930, 2870, 1610, 1515, 1462, 1395, 1375, 1355, 1265, 1196, 965, 810 cm^{-1}. **ESI-HRMS** calculated for $C_{28}H_{40}N_2O$ $(M+H)^+$: 421.3213 and found: 421.3237.

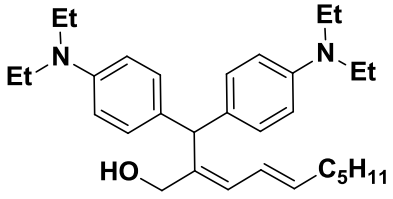
(2E,4E)-2-(bis(4-(dimethylamino)phenyl)methyl)nona-2,4-dienal (6cb)



The reaction was performed by following the experimental procedure and the product **6cb** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.0:1.0) as a pale yellow sticky liquid (82 mg, 91% yield). **^{1}H NMR**: δ 7.03 (d, *J* = 8.5 Hz, 4H), 6.62 (d, *J* = 8.5, 4H), 6.31-6.25 (m,

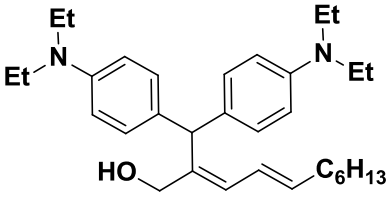
2H), 5.76-5.71 (m, 1H), 5.24 (s, 1H), 4.05 (s, 2H), 3.35-3.30 (m, 8H), 2.06-2.02 (m, 2H), 1.32-1.26 (m, 4H), 1.16-1.13 (m, 12H), 1.09 (s, 1H), 0.87 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR**: δ 146.4, 140.2, 136.3, 129.9, 129.5, 128.0, 126.0, 111.9, 66.0, 48.8, 44.3, 32.6, 31.4, 22.2, 13.9, 12.6. **FTIR** (film) ν_{max}: 3380, 2966, 2929, 2868, 1615, 1515, 1465, 1399, 1375, 1355, 1265, 1198, 965, 810 cm^{-1}. **ESI-HRMS** calculated for $C_{30}H_{44}N_2O$ $(M+H)^+$: 449.3526 and found: 449.3532.

(2E,4E)-2-(bis(4-(diethylamino)phenyl)methyl)deca-2,4-dien-1-ol (6db)



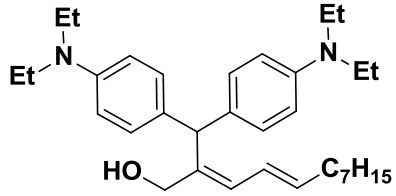
The reaction was performed by following the experimental procedure and the product **6db** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.0:1.0) as a pale yellow sticky liquid (86 mg, 93% yield). **^{1}H NMR**: δ 7.03 (d, *J* = 8.5 Hz, 4H), 6.61 (d, *J* = 8.5, 4H), 6.31-6.25 (m, 2H), 5.77-5.71 (m, 1H), 5.24 (s, 1H), 4.05 (s, 2H), 3.32 (q, *J* = 7.0 Hz, 8H), 2.06-2.01 (m, 2H), 1.37-1.23 (m, 6H), 1.14 (t, *J* = 7.0 Hz, 12H), 1.10-1.09 (m, 1H), 0.88-0.86 (m, 3H). **^{13}C NMR**: δ 146.4, 140.1, 136.4, 129.9, 129.5, 128.0, 125.9, 111.9, 66.0, 48.8, 44.3, 32.9, 31.4, 28.9, 22.5, 14.0, 12.6. **FTIR** (film) ν_{max}: 3386, 2966, 2926, 2868, 1610, 1515, 1465, 1395, 1375, 1355, 1265, 1199, 965, 811 cm^{-1}. **ESI-HRMS** calculated for $C_{31}H_{46}N_2O$ $(M+H)^+$: 463.3683 and found: 463.3672.

(2E,4E)-2-(bis(4-(diethylamino)phenyl)methyl)undeca-2,4-dien-1-ol (6eb)



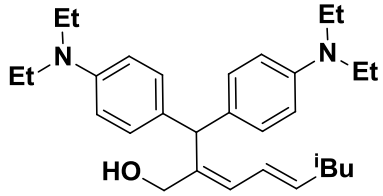
The reaction was performed by following the experimental procedure and the product **6eb** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.0:1.0) as a yellow sticky liquid (90 mg, 94% yield). **^{1}H NMR**: δ 7.03 (d, *J* = 8.0 Hz, 4H), 6.61 (d, *J* = 8.5, 4H), 6.31-6.25 (m, 2H), 5.76-5.71 (m, 1H), 5.24 (s, 1H), 4.05 (s, 2H), 3.32 (q, *J* = 7.0 Hz, 8H), 2.06-2.01 (m, 2H), 1.33-1.25 (m, 8H), 1.14 (t, *J* = 7.0 Hz, 12H), 1.09-1.08 (m, 1H), 0.87 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR**: δ 146.4, 140.1, 136.4, 129.9, 129.5, 128.0, 125.9, 111.9, 66.0, 48.8, 44.3, 32.9, 31.7, 29.2, 28.9, 22.6, 14.1, 12.6. **FTIR** (film) ν_{max}: 3369, 2968, 2925, 2855, 1610, 1515, 1465, 1395, 1375, 1355, 1261, 1196, 965, 810 cm^{-1}. **ESI-HRMS** calculated for $C_{32}H_{48}N_2O$ $(M+H)^+$: 477.3839 and found: 477.3834.

(2E,4E)-2-(bis(4-(diethylamino)phenyl)methyl)dodeca-2,4-dien-1-ol (6fb)



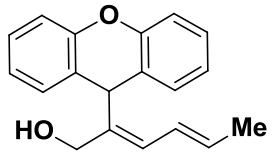
The reaction was performed by following the experimental procedure and the product **6fb** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.0:1.0) as a yellow sticky liquid (92 mg, 94% yield). **^{1}H NMR**: δ 7.03 (d, *J* = 8.0 Hz, 4H), 6.61 (d, *J* = 8.5, 4H), 6.31-6.25 (m, 2H), 5.76-5.71 (m, 1H), 5.24 (s, 1H), 4.04 (d, *J* = 3.5 Hz, 2H), 3.32 (q, *J* = 7.0 Hz, 8H), 2.03 (q, *J* = 7.0 Hz, 2H), 1.34-1.25 (m, 10H), 1.14 (t, *J* = 7.0 Hz, 12H), 1.09-1.08 (m, 1H), 0.88 (t, *J* = 3.5 Hz, 3H). **^{13}C NMR**: δ 146.4, 140.1, 136.4, 129.9, 129.5, 128.0, 125.9, 111.9, 66.0, 48.8, 44.3, 32.9, 31.9, 29.3, 29.2, 22.7, 14.1, 12.6. **FTIR** (film) ν_{max}: 3373, 2966, 2924, 2855, 1610, 1515, 1465, 1395, 1375, 1355, 1261, 1195, 965, 810 cm^{-1}. **ESI-HRMS** calculated for $C_{33}H_{50}N_2O$ $(M+H)^+$: 491.3996 and found: 491.3968.

(2E,4E)-2-(bis(4-(diethylamino)phenyl)methyl)-7-methylocta-2,4-dien-1-ol (6gb)



The reaction was performed by following the experimental procedure and the product **6gb** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.0:1.0) as a yellow sticky liquid (82 mg, 91% yield).**^{1}H NMR**: δ 7.04 (d, *J* = 8.5 Hz, 4H), 6.63-6.60 (m, 4H), 6.32-6.23 (m, 2H), 5.75-5.69 (m, 1H), 5.24 (s, 1H), 4.06 (d, *J* = 3.5 Hz,, 2H), 3.33 (q, *J* = 7.0 Hz, 8H), 1.94-1.91 (m, 2H), 1.63-1.57 (m, 1H), 1.16-1.13 (m, 12H), 1.11-1.09 (m, 1H), 0.85 (d, *J* = 7.0 Hz, 6H). **^{13}C NMR**: δ 146.4, 140.3, 134.9, 129.9, 129.5, 127.9, 127.1, 112.0, 66.1, 48.9, 44.4, 42.3, 28.5, 22.3, 12.6. **FTIR** (film) ν_{max}: 3396, 2967, 2926, 2871, 1612, 1517, 1469, 1374, 1351, 1265, 1198, 965, 810 cm^{-1}. **ESI-HRMS** calculated for $C_{30}H_{44}N_2O$ $(M+H)^+$: 449.3526 and found: 449.3551.

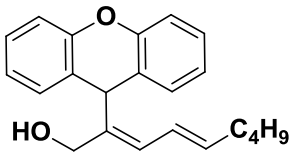
(2E,4E)-2-(9H-xanthen-9-yl)hexa-2,4-dien-1-ol (6ac)



The reaction was performed by following the experimental procedure and the product **6ac** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.5:0.5) as a yellow sticky liquid (33 mg, 59% yield). **^{1}H NMR**: δ 7.22-7.19 (m, 2H), 7.14-7.13 (m, 2H), 7.05-6.99 (m, 4H), 6.74-6.69 (m, 1H), 6.38 (d, *J* = 11.0 Hz, 1H), 6.02-5.95 (m, 1H), 5.49 (s, 1H), 3.87 (s, 2H), 1.90 (d, *J* = 6.5 Hz, 3H), 0.96 (m, 1H). **^{13}C NMR**:

δ 151.2, 140.3, 132.6, 129.0, 128.2, 126.7, 126.2, 123.2, 121.6, 116.6, 96.1, 63.7, 37.0, 18.6. **FTIR** (film) ν_{max}: 3340, 2912, 1600, 1575, 1480, 1449, 1319, 1253, 962, 751 cm^{-1}. ESI-HRMS calculated for $C_{19}H_{18}O_2$ $(M+H)^+$: 279.1380 and found: 279.1382.

(2E,4E)-2-(9H-xanthen-9-yl)nona-2,4-dien-1-ol (6cc)

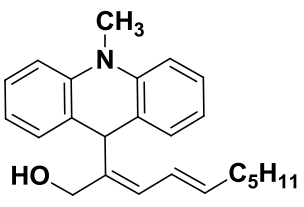


The reaction was performed by following the experimental procedure and the product **6cc** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.5:0.5) as a yellow sticky liquid (35 mg, 55% yield). **^{1}H NMR**: δ 7.24-7.19 (m, 2H), 7.15-7.13 (m, 2H), 7.06-6.99 (m, 4H), 6.71-6.66 (m, 1H), 6.39 (d, *J* = 10.5 Hz, 1H), 6.01-5.95 (m, 1H), 5.50 (s, 1H), 3.87 (d, *J* = 6.0 Hz, 2H), 2.24-2.20 (m, 2H), 1.49-1.43 (m, 2H), 1.42-1.35 (m, 2H), 1.00 (t, *J* = 6.0 Hz, 1), 0.96-0.93 (m, 3H). **^{13}C NMR**: δ 151.2, 140.5, 138.3, 129.3,129.0, 128.2, 126.9, 124.7, 123.2, 121.7, 116.6, 63.8, 37.0, 32.8, 31.5, 22.3, 14.0. **FTIR** (film) ν_{max}: 3333, 2925, 1601, 1575, 1480, 1449, 1318, 1253, 965, 751 cm^{-1}. **ESI-HRMS** calculated for $C_{22}H_{24}O_2$ $(M+H)^+$: 321.1849 and found: 321.1846.

5. Experimental procedure and characterization data for the MBH-type reaction of aldehyde 1d with N-methylacridinium iodide

Acridinium salt **7** (0.24 mmol) was dissolved in DCE (200 μL) into a mass vial. To the above solution pyrrolidine (5.0 μL, 0.06 mmol), aldehyde **1d** (0.20 mmol) and DMAP (24.4 mg, 0.20 mmol) were added and stirred vigorously at room temperature. After stated time reaction was diluted with MeOH (2 mL) and cooled to 0 °C. $NaBH_4$ (75.7 mg, 2.0 mmol) was then slowly added and reaction mixture was stirred for 4hr. The reaction mixture was then quenched with H_2O and extracted with DCM (10 x 3 mL). Organic layer was dried over anhydrous sodium sulphate. The solvent was evaporated and the crude product was purified by column chromatography (SiO_2, hexane/EtOAc).

(2E,4E)-2-(10-methyl-9,10-dihydroacridin-9-yl)deca-2,4-dien-1-ol (8d)



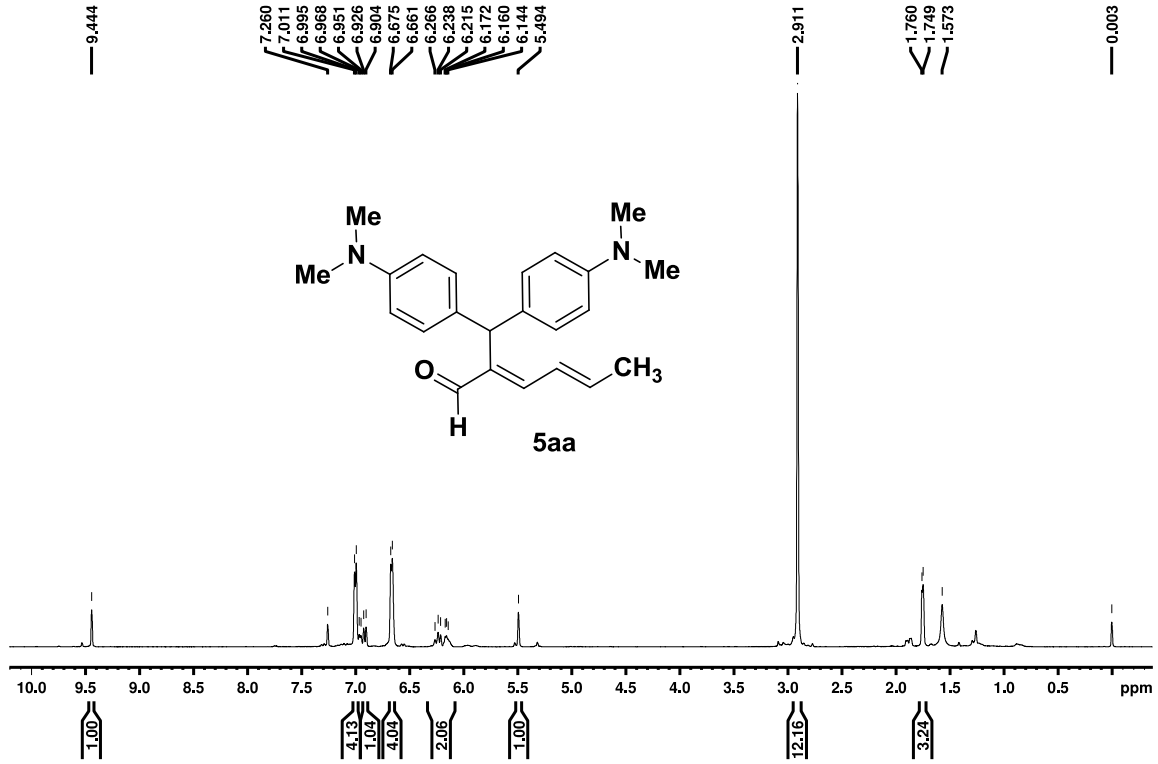
The reaction was performed by following the general experimental procedure and the product **8d** was obtained after flash column chromatography (silica gel, Hexane/EtOAc 9.5:0.5) as a yellow sticky liquid (54 mg, 78% yield). **^{1}H NMR**:

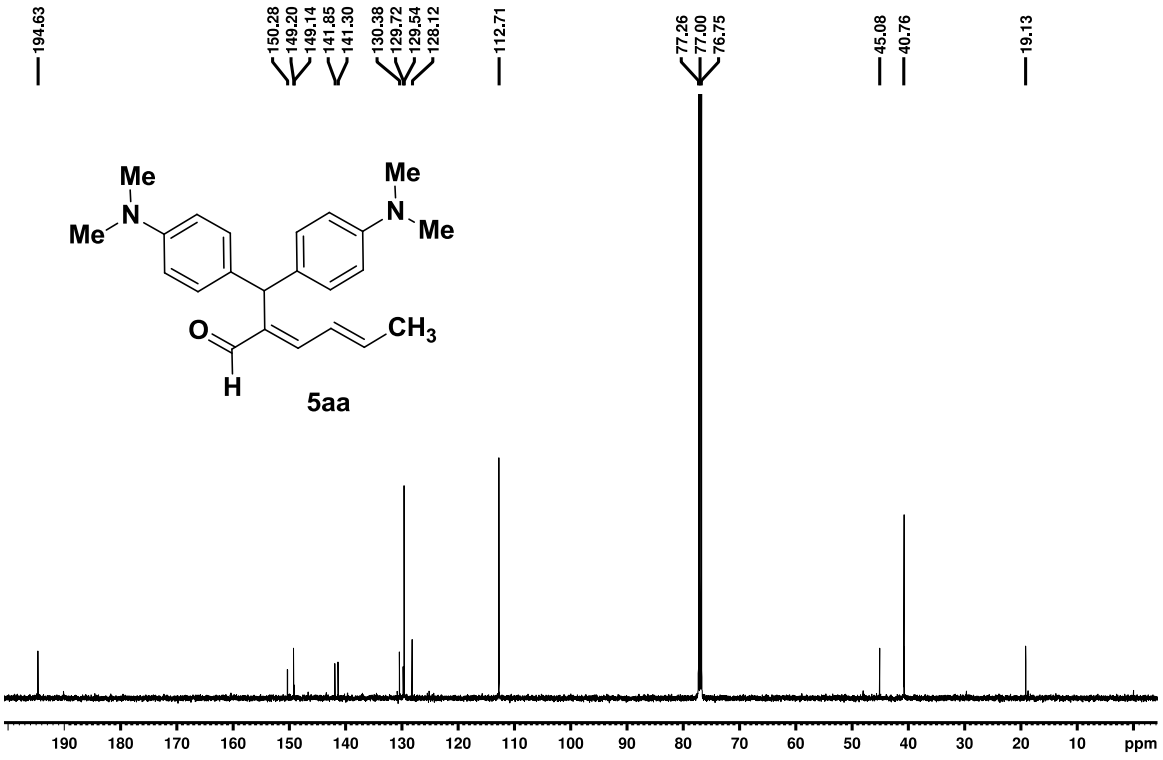
δ 7.22-7.18 (m, 2H), 7.13 (d, *J* = 7.5 Hz, 2H), 6.98-6.87 (m, 4H), 6.72-6.67 (m, 1H), 6.23 (d, *J* = 11.0 Hz, 1H), 5.93-5.87 (m, 1H), 5.46 (s, 1H), 3.96 (s, 2H), 3.39 (s, 3H), 2.21-2.17 (m, 2H), 1.47-1.44 (m, 2H), 1.34-1.26 (m, 4H), 1.11-1.10 (m, 1 H), 0.92 (t, *J* = 6.5 Hz, 3H). **^{13}C NMR**: δ 142.3, 141.5, 137.5, 128.6, 127.6, 125.4, 125.3, 124.7, 120.6, 112.4, 112.1, 64.1, 41.5, 33.2, 33.0, 31.4, 29.0, 22.6, 14.1. **FTIR** (film) ν_{max}: 3365, 2957, 2925, 2858, 1601, 1595, 1475, 1449, 1349, 1270, 965, 748 cm^{-1}. **ESI-HRMS** calculated for $C_{24}H_{29}NO$ $(M+H)^+$: 348.2322 and found: 348.2310.

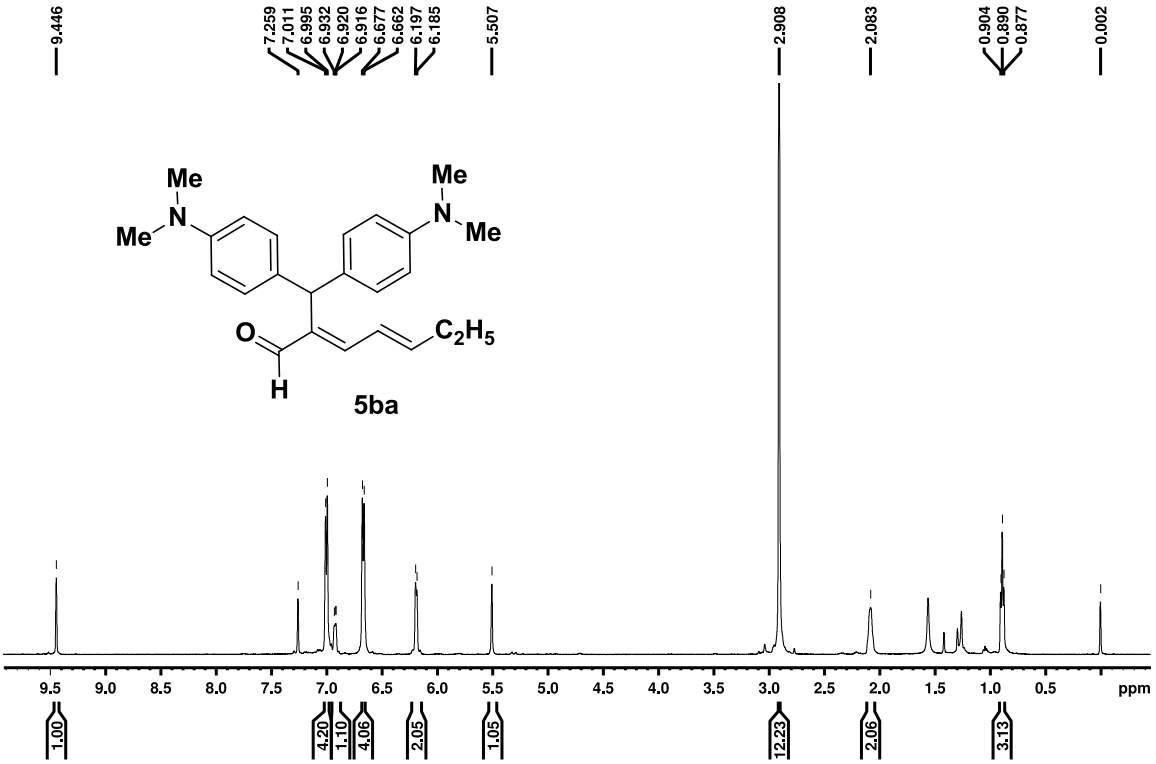
6. Reference

1. P. Valenta, N. A. Drucker, J. W. Bode and P. J. Walsh, *Org. Lett.*, 2009, **11**, 2117.
2. F. Dumur, C. R. Mayer, E. Dumas, F. Miomandre, M. Frigoli and F. Sécheresse, *Org. Lett.*, 2008, **10**, 321.
3. Y. Yang, H. Xu, F. Liu, H. Wang, G. Deng, P. Si, H. Huang, S. Bo, J. Liu, L. Qiu, Z. Zhen and X. Liu, *J. Mater. Chem. C*, 2014, **2**, 5124.
4. G. Bergonzini, S. Vera and P. Melchiorre, *Angew. Chem., Int. Ed.*, 2010, **49**, 9685.

7. ^{1}H NMR and ^{13}C NMR spectra



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2.908
2.083
0.904
0.890
0.877
0.002
Me
N
Me
Me
N
Me
O
H
C_2H_5
5ba
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
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4.06
2.05
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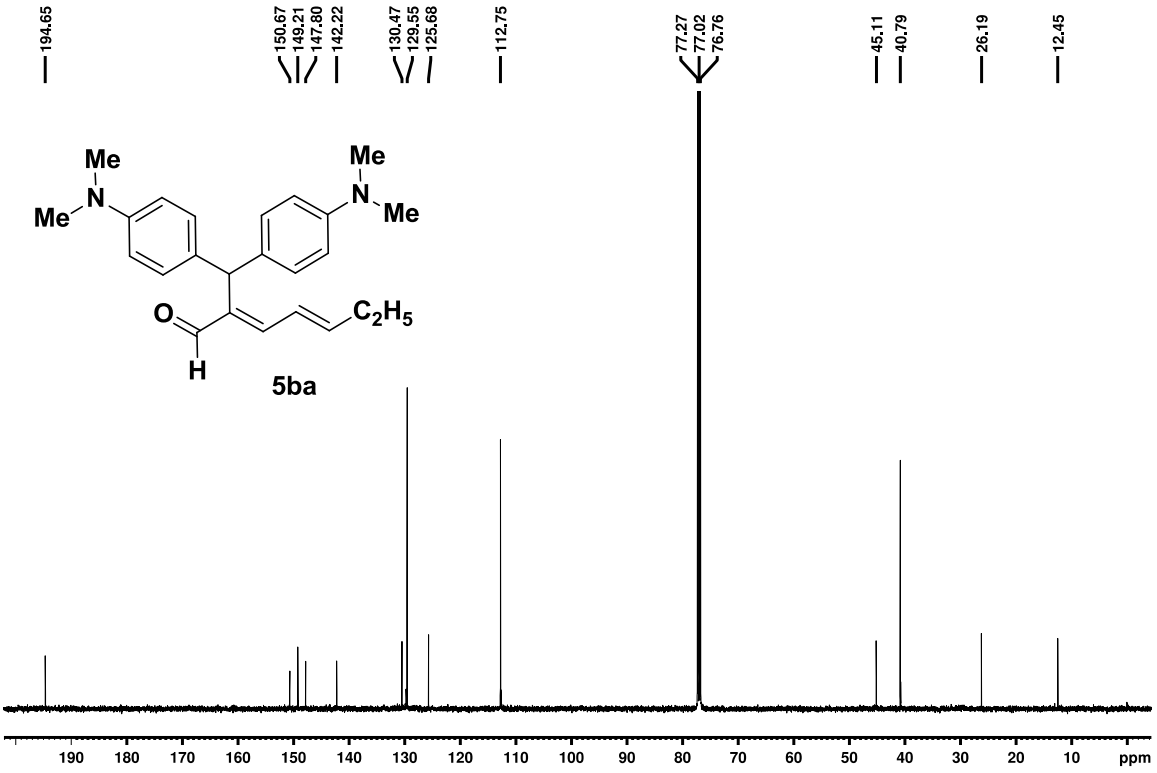
2.06
3.13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26.19
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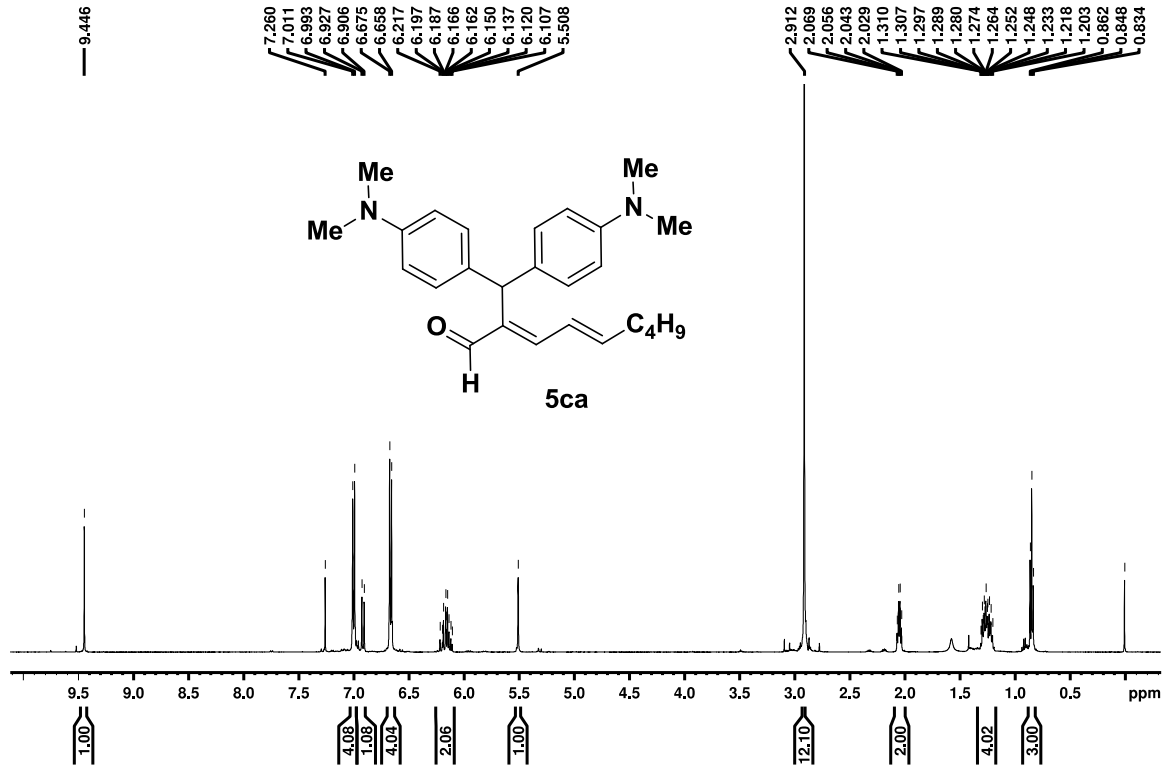
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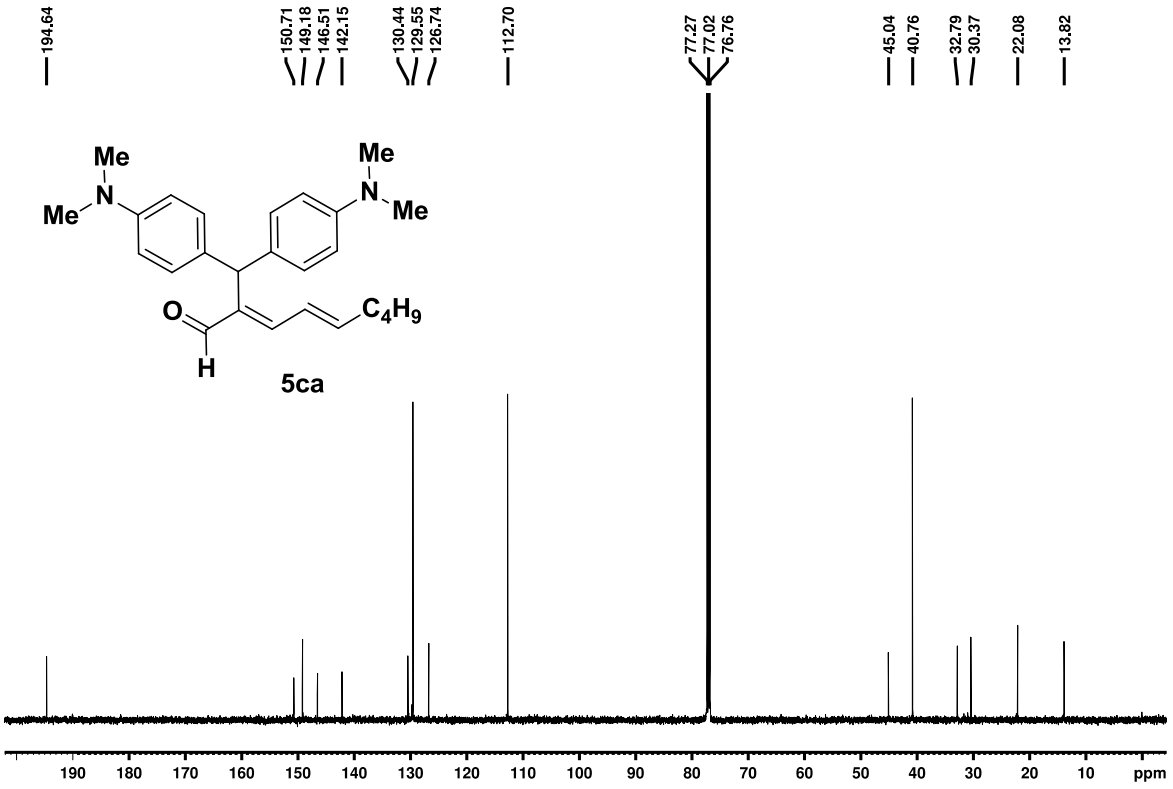
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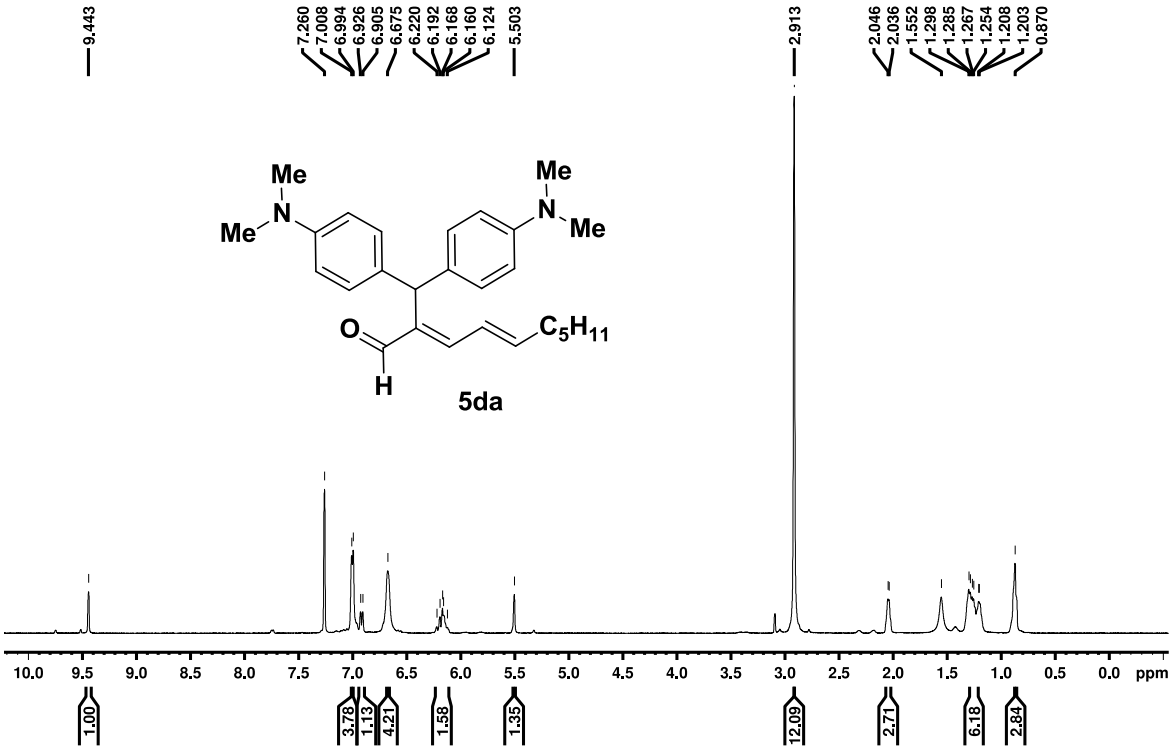
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N
Me
O
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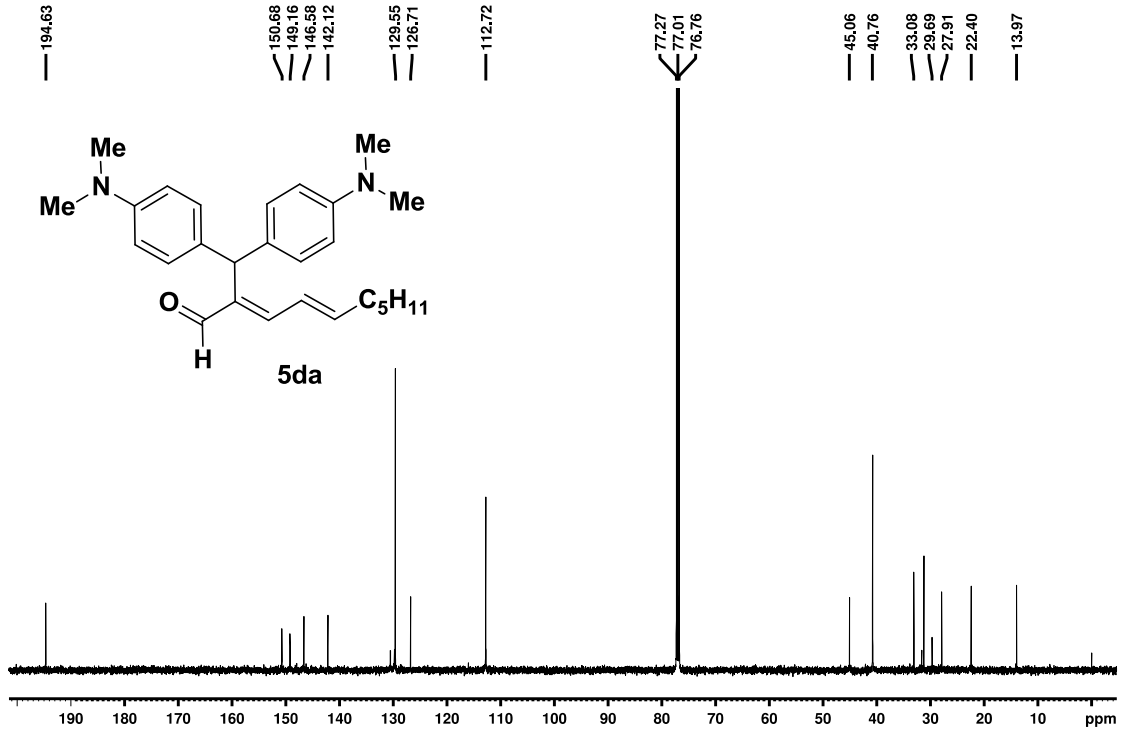
6.18
2.84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149.16
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142.12
129.55
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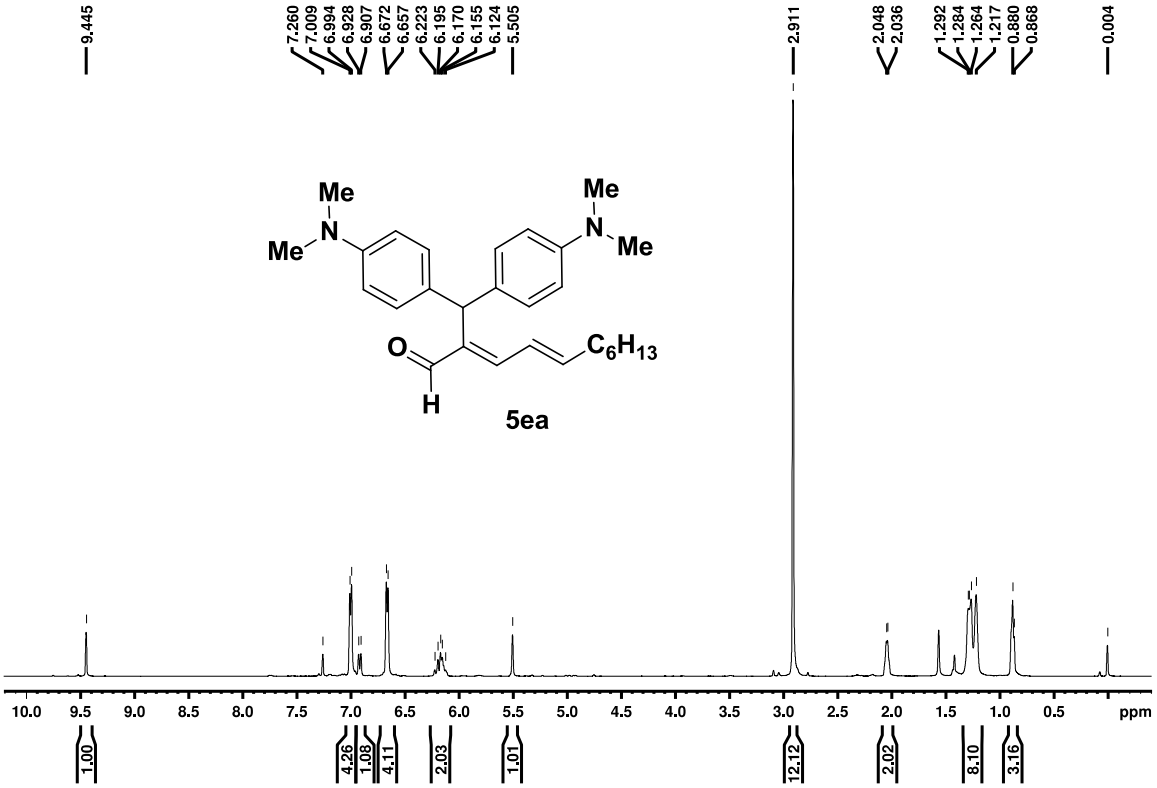
112.72
77.27
77.01
76.76
45.06
40.76
33.08
29.69
27.91
22.40
13.97
Me
N
Me
Me
N
Me
O
H
C5H11
5da
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm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7.260
7.009
6.994
6.928
6.907
6.672
6.657
6.223
6.195
6.170
6.155
6.124
5.505
2.911
2.048
2.036
1.292
1.284
1.264
1.217
0.880
0.868
0.004
Me
N
Me
Me
N
Me
O
H
C6H13
5ea
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
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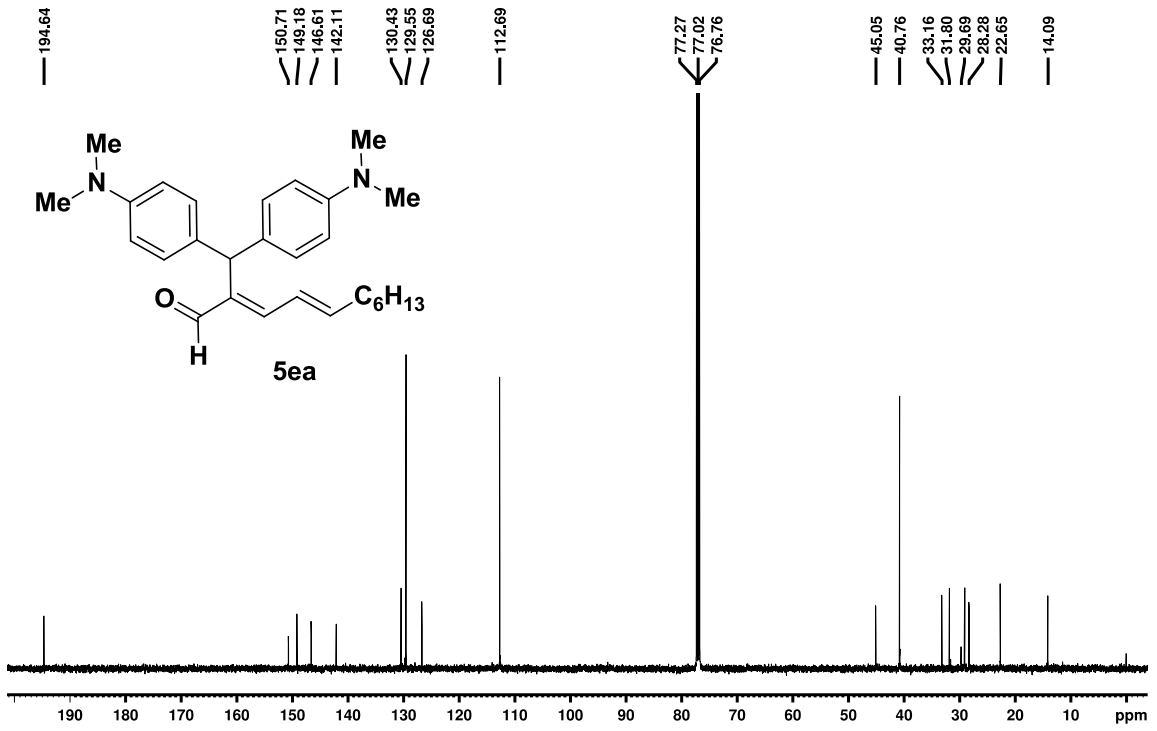
4.26
1.08
4.11
2.03
1.01
12.12
2.02
8.10
3.16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126.69
112.69
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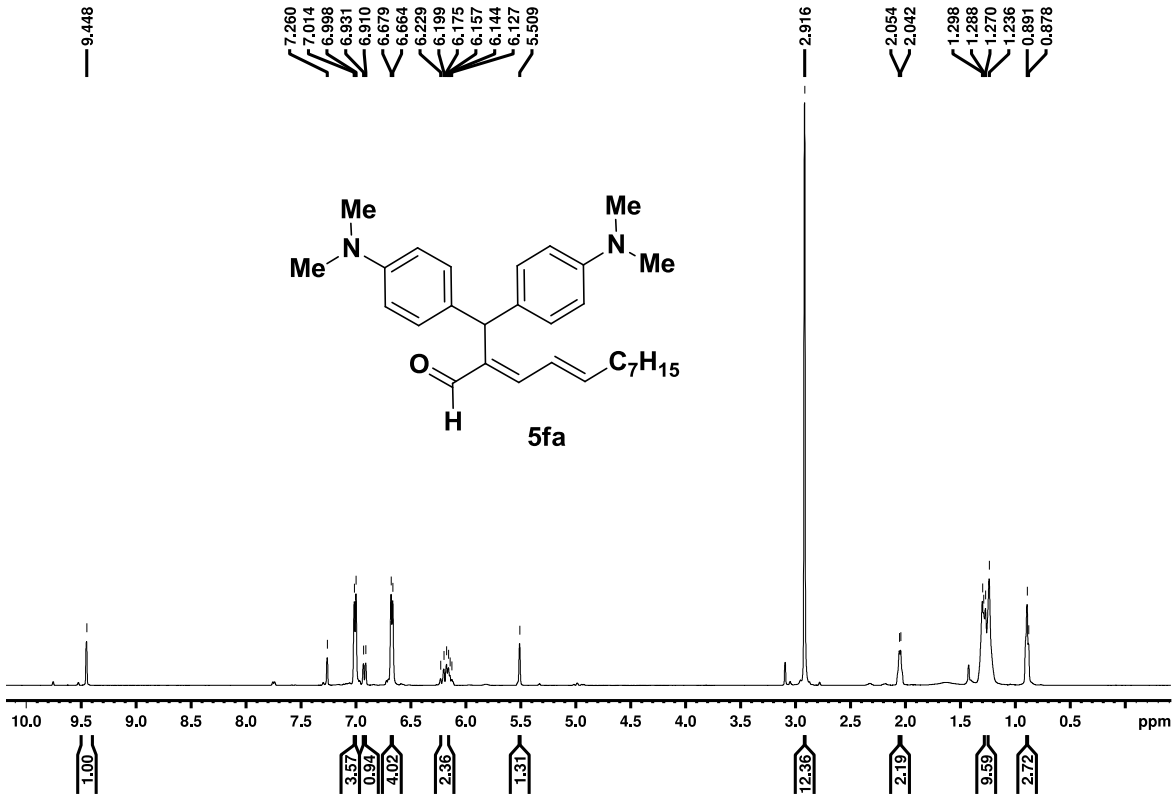
77.02
76.76
45.05
40.76
33.16
31.80
29.69
28.28
22.65
14.09
Me
N
Me
Me
N
Me
O
H
C6H13
5ea
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm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6.679
6.664
6.229
6.199
6.175
6.157
6.144
6.127
5.509
2.916
2.054
2.042
1.298
1.288
1.270
1.236
0.891
0.878
Me
N
Me
Me
N
Me
O
H
C7H15
5fa
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
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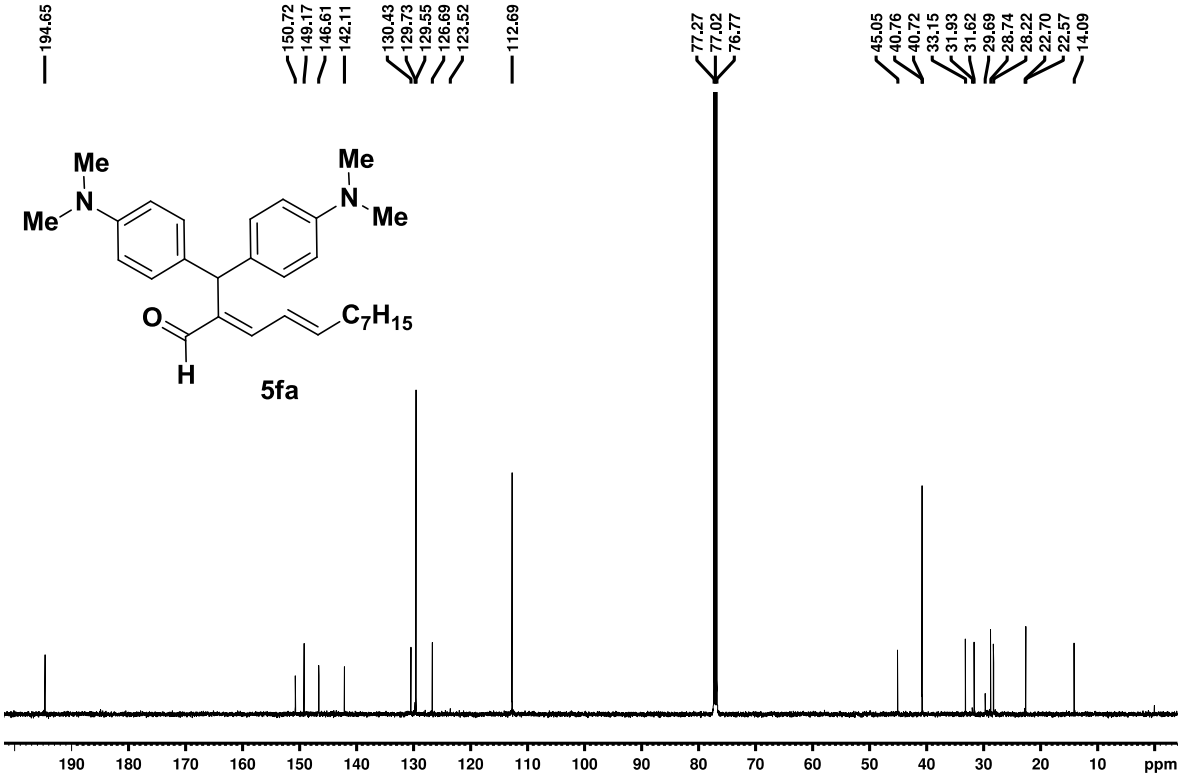
3.57
0.94
4.02
2.36
1.31
12.36
2.19
9.59
2.72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129.55
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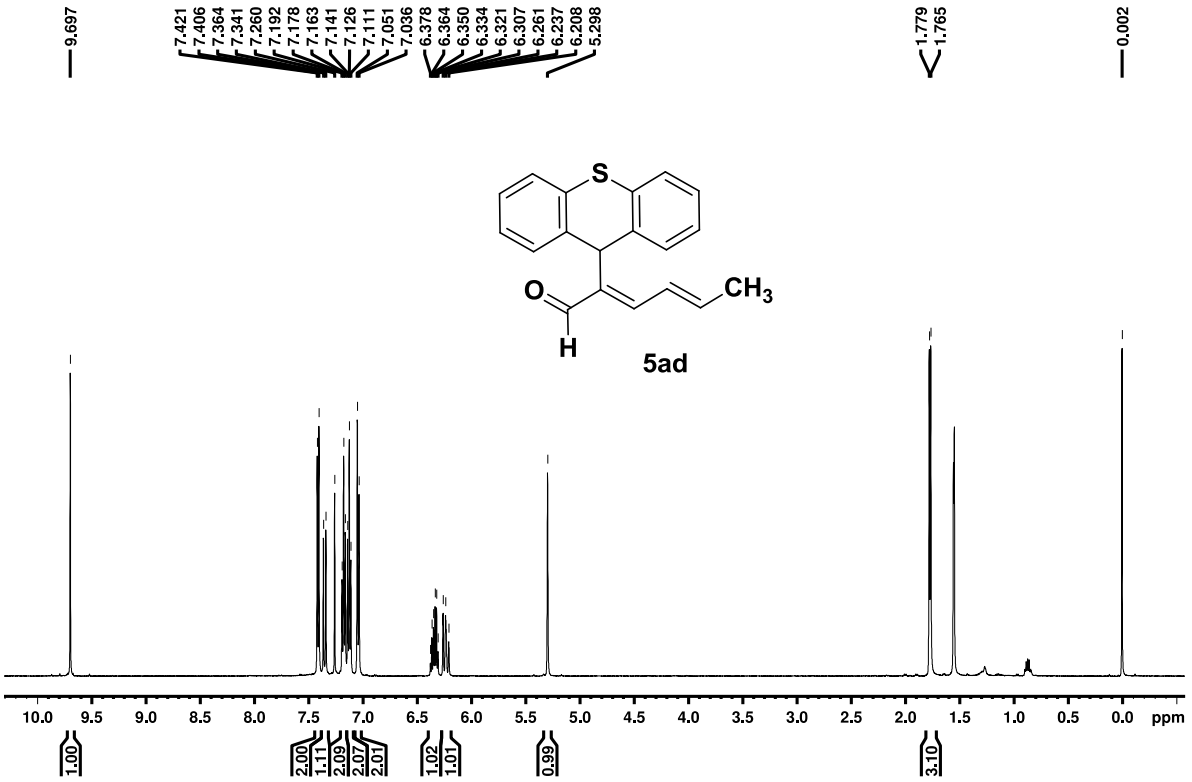
123.52
112.69
77.27
77.02
76.77
45.05
40.76
40.72
33.15
31.93
31.62
29.69
28.74
28.22
22.70
22.57
14.09
Me
N
Me
Me
N
Me
O
H
C7H15
5fa
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm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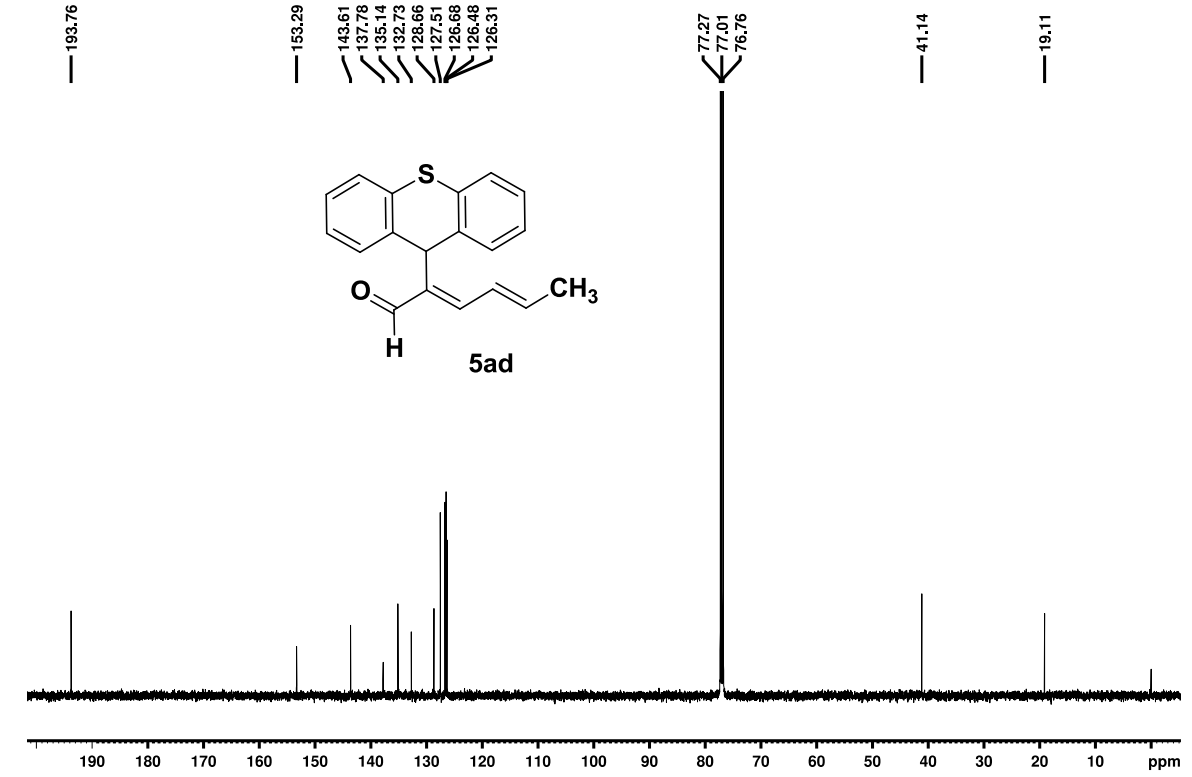
7.421
7.406
7.364
7.341
7.260
7.192
7.178
7.163
7.141
7.126
7.111
7.051
7.036
6.378
6.364
6.350
6.334
6.321
6.307
6.261
6.237
6.208
5.298
1.779
1.765
0.002
S
O
H
CH3
5ad
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
1.00
2.00
1.11
2.09
2.07
2.01
1.02
1.01
0.99
3.10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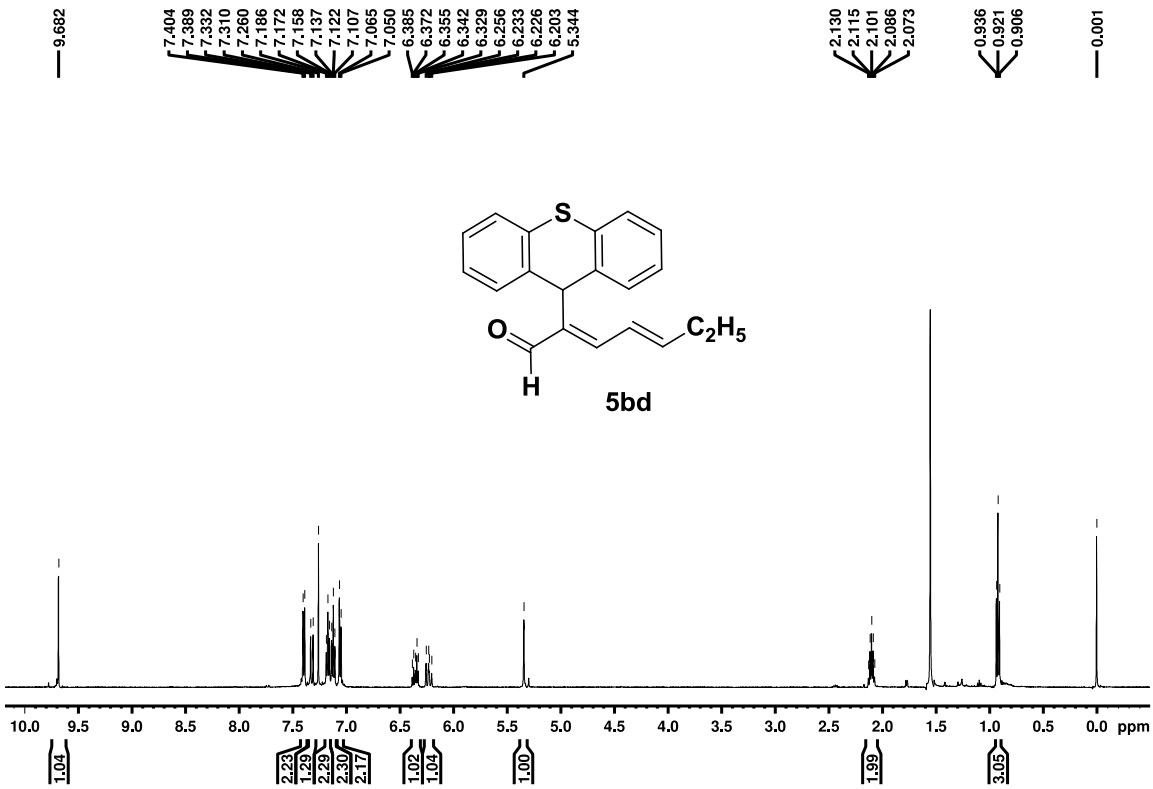
153.29
143.61
137.78
135.14
132.73
128.66
127.51
126.68
126.48
126.31
77.27
77.01
76.76
41.14
19.11
S
O
H
CH3
5ad
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm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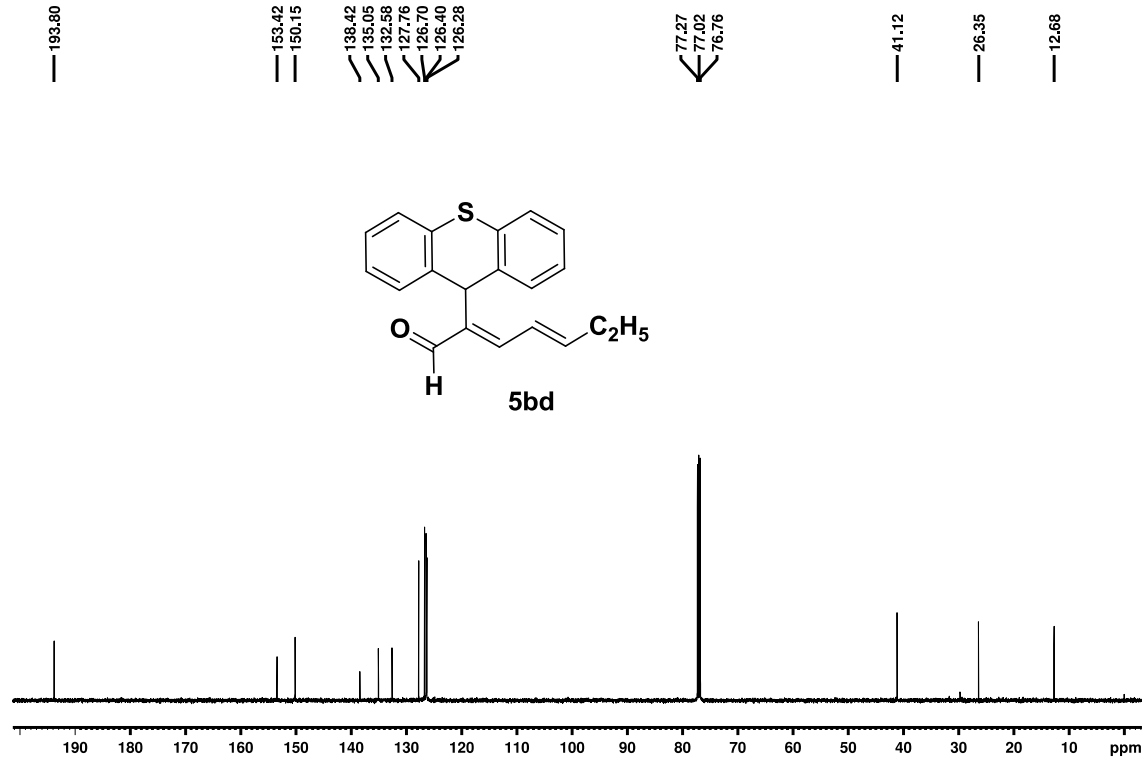
7.404
7.389
7.332
7.310
7.260
7.186
7.172
7.158
7.137
7.122
7.107
7.065
7.050
6.385
6.372
6.355
6.342
6.329
6.256
6.233
6.226
6.203
5.344
2.130
2.115
2.101
2.086
2.073
0.936
0.921
0.906
0.001
S
O
H
C2H5
5bd
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
1.04
2.23
1.26
2.29
2.30
2.17
1.02
1.04
1.00
1.99
3.05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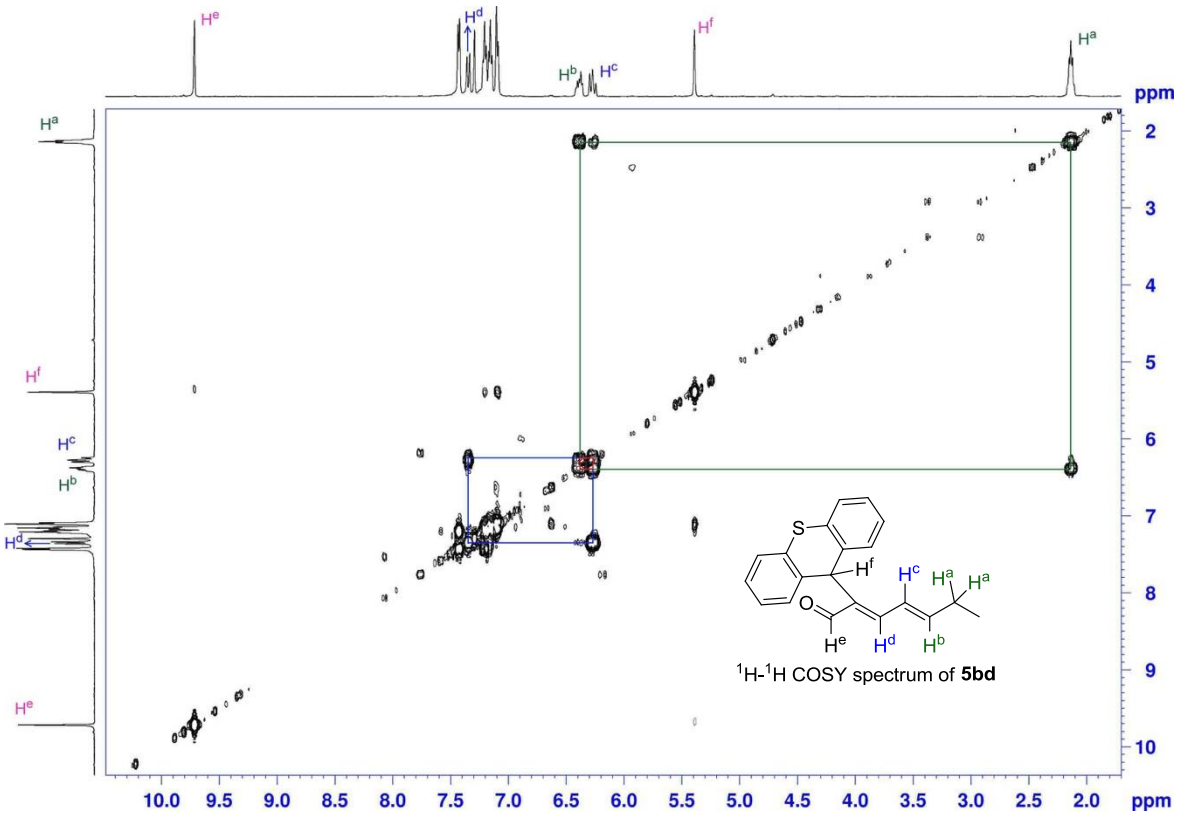
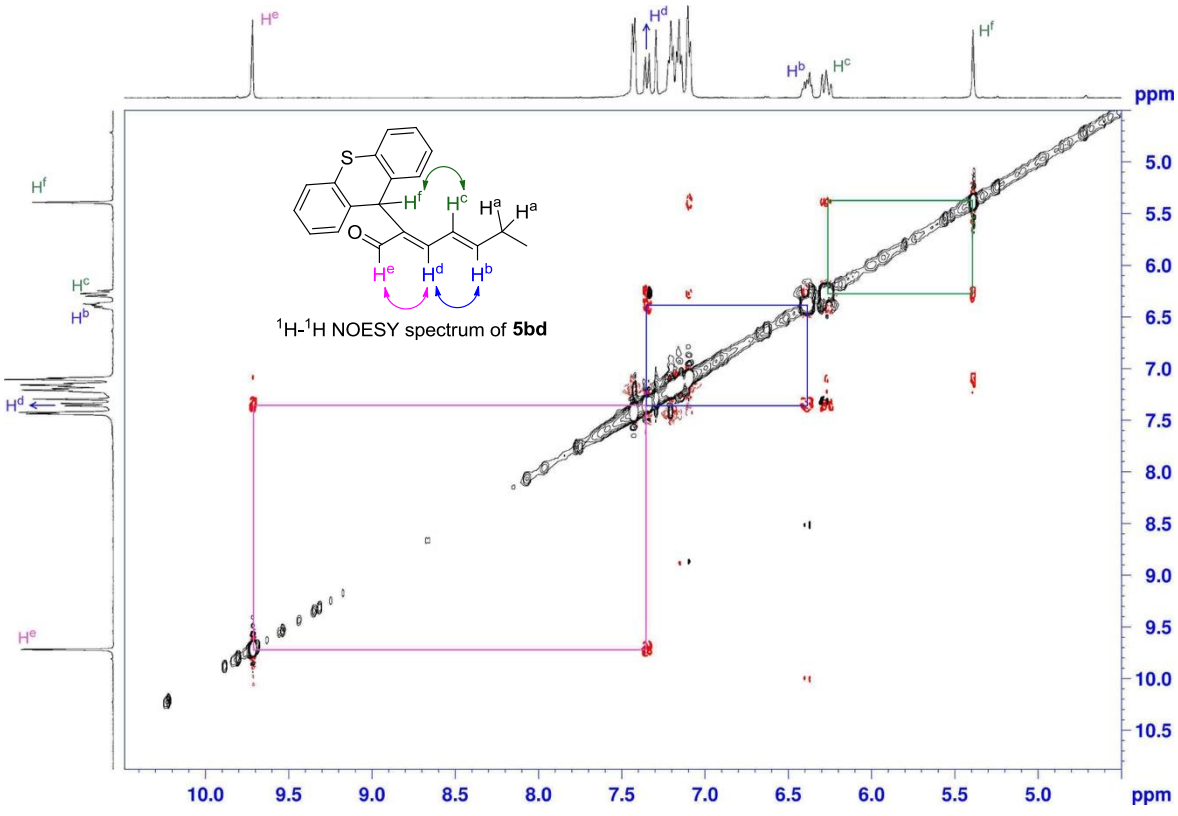
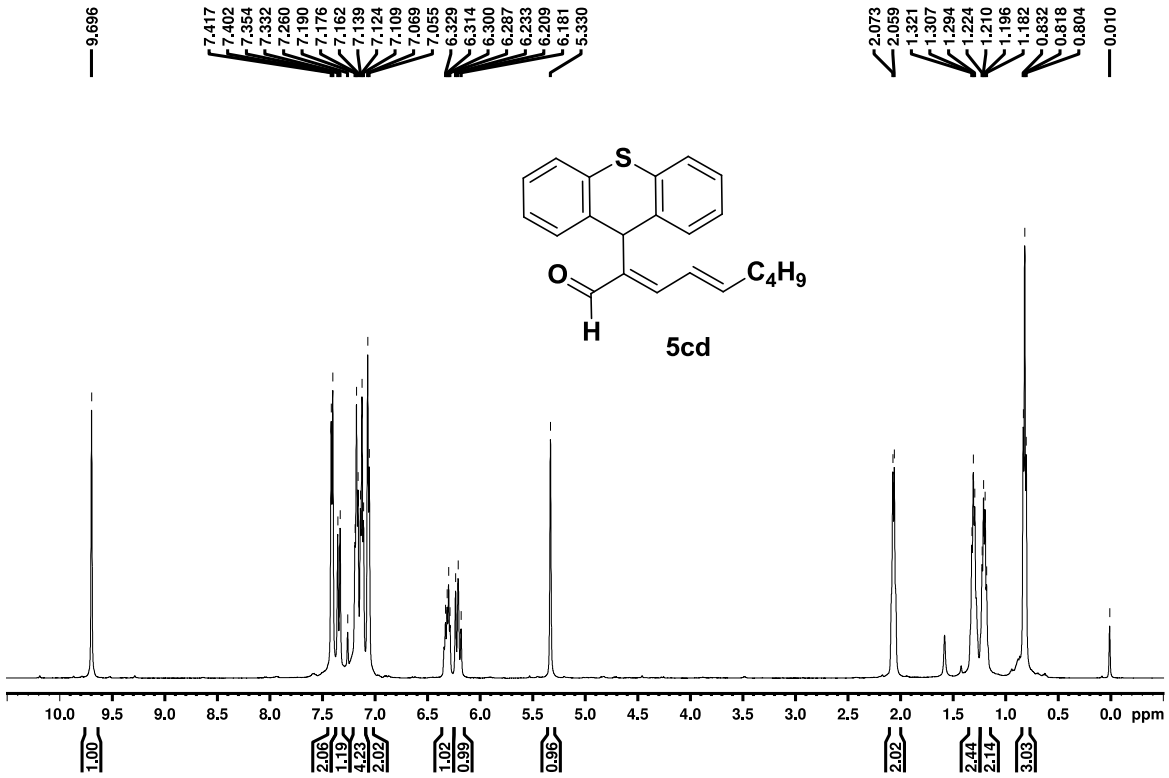
153.42
150.15
138.42
135.05
132.58
127.76
126.70
126.40
126.28
77.27
77.02
76.76
41.12
26.35
12.68
S
O
H
C2H5
5bd
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


^{1}H-^{1}H COSY spectrum of **5bd**


^{1}H-^{1}H NOESY spectrum of **5bd**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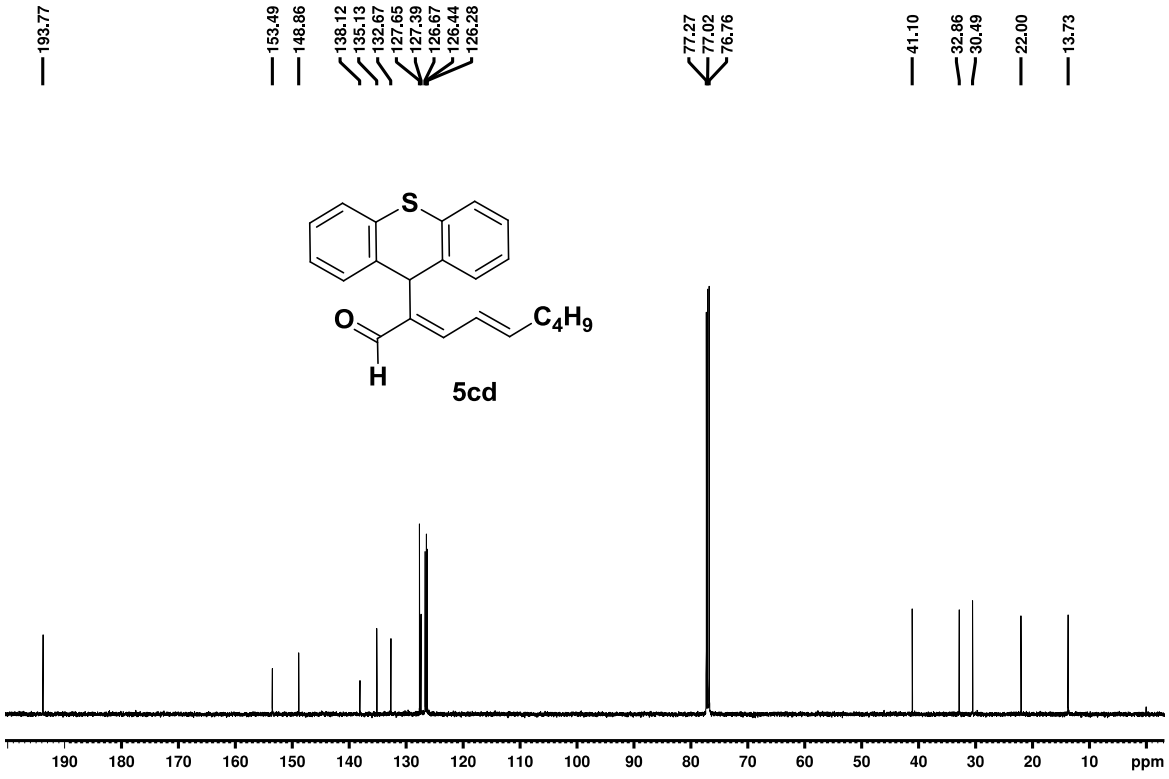
7.417
7.402
7.354
7.332
7.260
7.190
7.176
7.162
7.139
7.124
7.109
7.069
7.055
6.329
6.314
6.300
6.287
6.233
6.209
6.181
5.330
2.073
2.059
1.321
1.307
1.294
1.224
1.210
1.196
1.182
0.832
0.818
0.804
0.010
S
O
H
C_4H_9
5cd
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
1.00
2.06
1.19
4.23
2.02
1.02
0.99
0.96
2.02
2.44
2.14
3.03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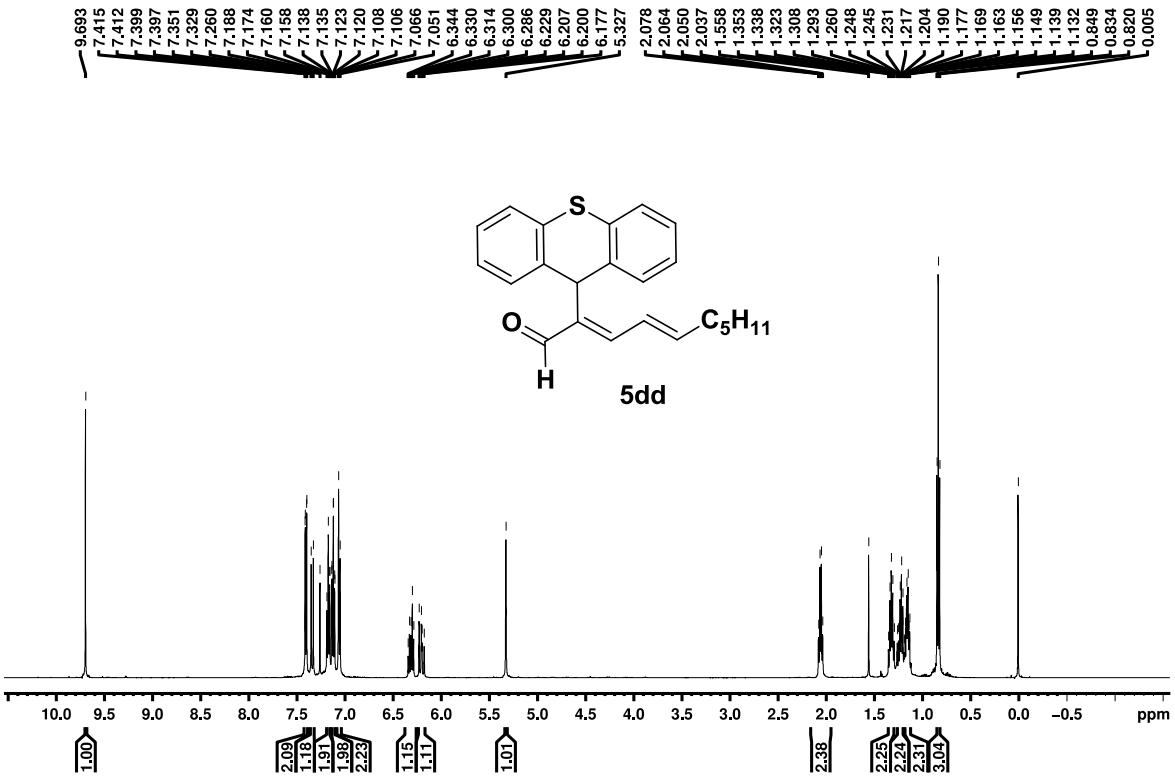
135.13
132.67
127.65
127.39
126.67
126.44
126.28
77.27
77.02
76.76
41.10
32.86
30.49
22.00
13.73
S
O
H
C_4H_9
5cd
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm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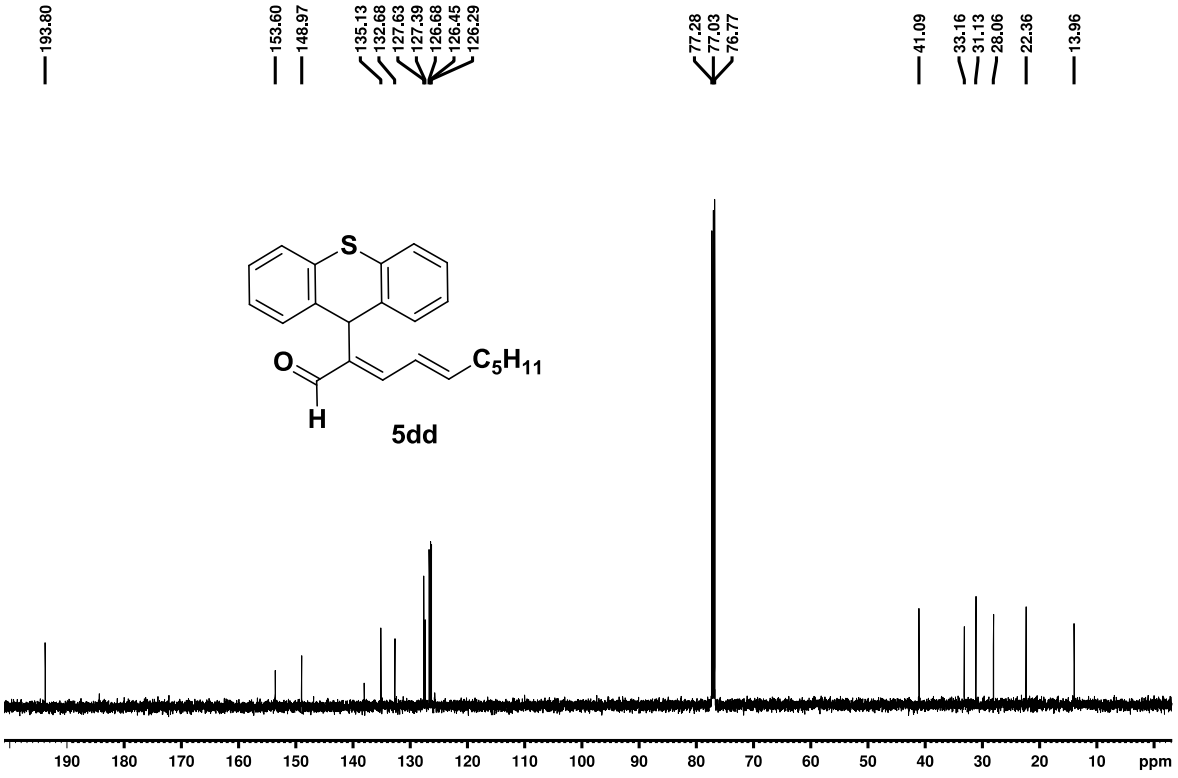
7.415
7.412
7.399
7.397
7.351
7.329
7.260
7.188
7.174
7.160
7.158
7.138
7.135
7.123
7.120
7.108
7.106
7.066
7.051
6.344
6.330
6.314
6.300
6.286
6.229
6.207
6.200
6.177
5.327
2.078
2.064
2.050
2.037
1.558
1.353
1.338
1.323
1.308
1.293
1.260
1.248
1.245
1.231
1.217
1.204
1.190
1.177
1.169
1.163
1.156
1.149
1.139
1.132
0.849
0.834
0.820
0.005
S
O
H
C_5H_{11}
5dd
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 −0.5 ppm
1.00
2.09
1.18
1.91
1.98
2.23
1.15
1.11
1.01
2.38
2.25
2.24
2.31
3.04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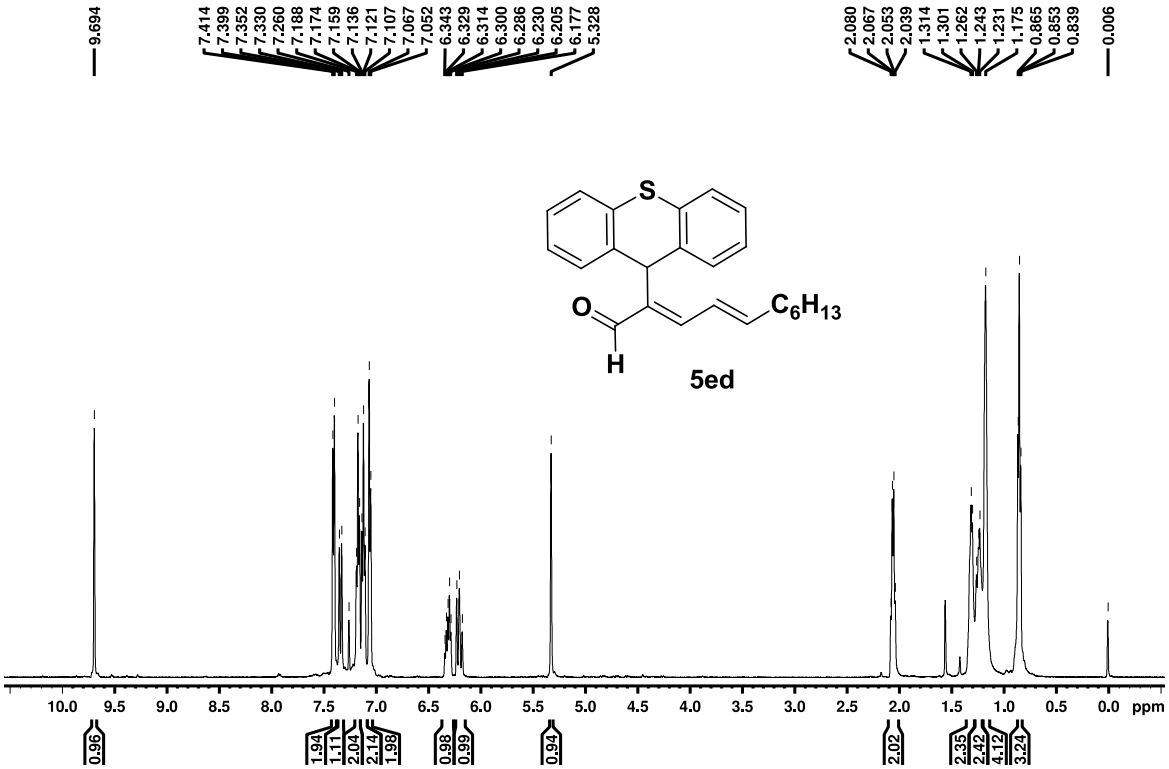
148.97
135.13
132.68
127.63
127.39
126.68
126.45
126.29
77.28
77.03
76.77
41.09
33.16
31.13
28.06
22.36
13.96
S
O
H
C_5H_{11}
5dd
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm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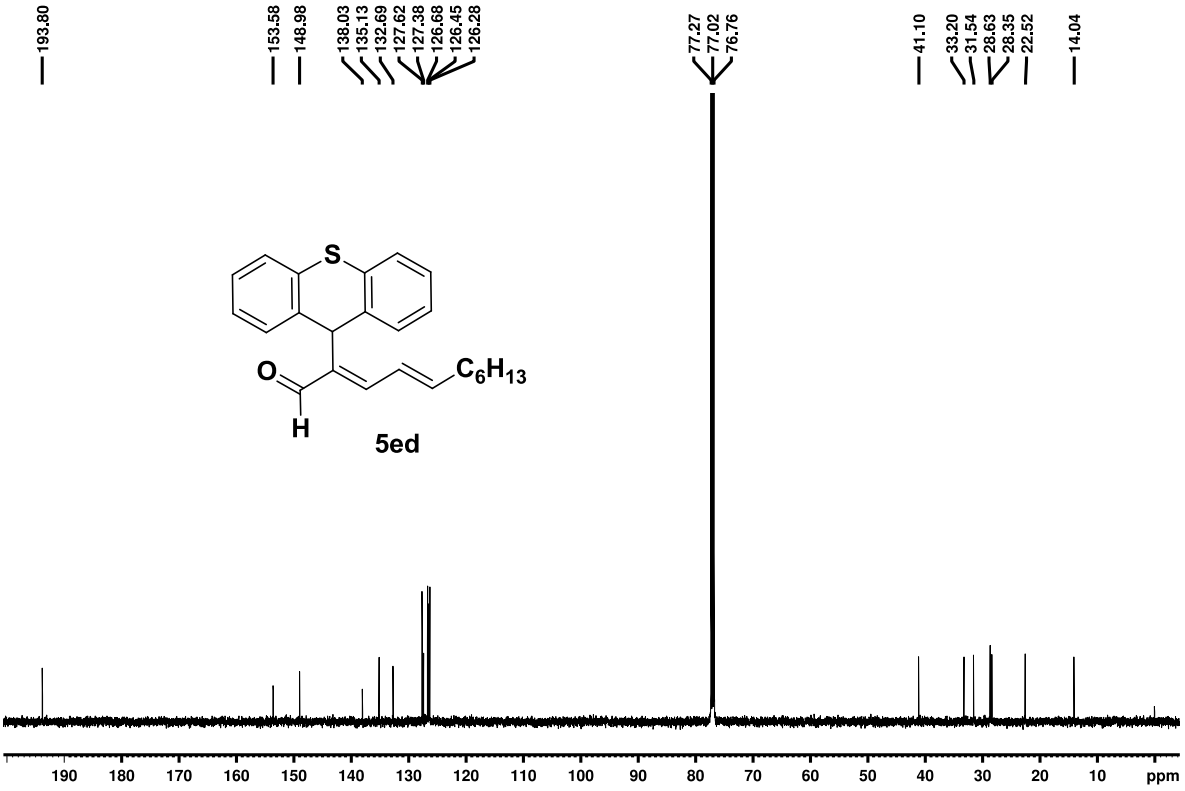
7.352
7.330
7.260
7.188
7.174
7.159
7.136
7.121
7.107
7.067
7.052
6.343
6.329
6.314
6.300
6.286
6.230
6.205
6.177
5.328
2.080
2.067
2.053
2.039
1.314
1.301
1.262
1.243
1.231
1.175
0.865
0.853
0.839
0.006
S
O
H
C6H13
5ed
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
0.96
1.94
1.11
2.04
2.14
1.98
0.98
0.99
0.94
2.02
2.35
2.42
4.12
3.24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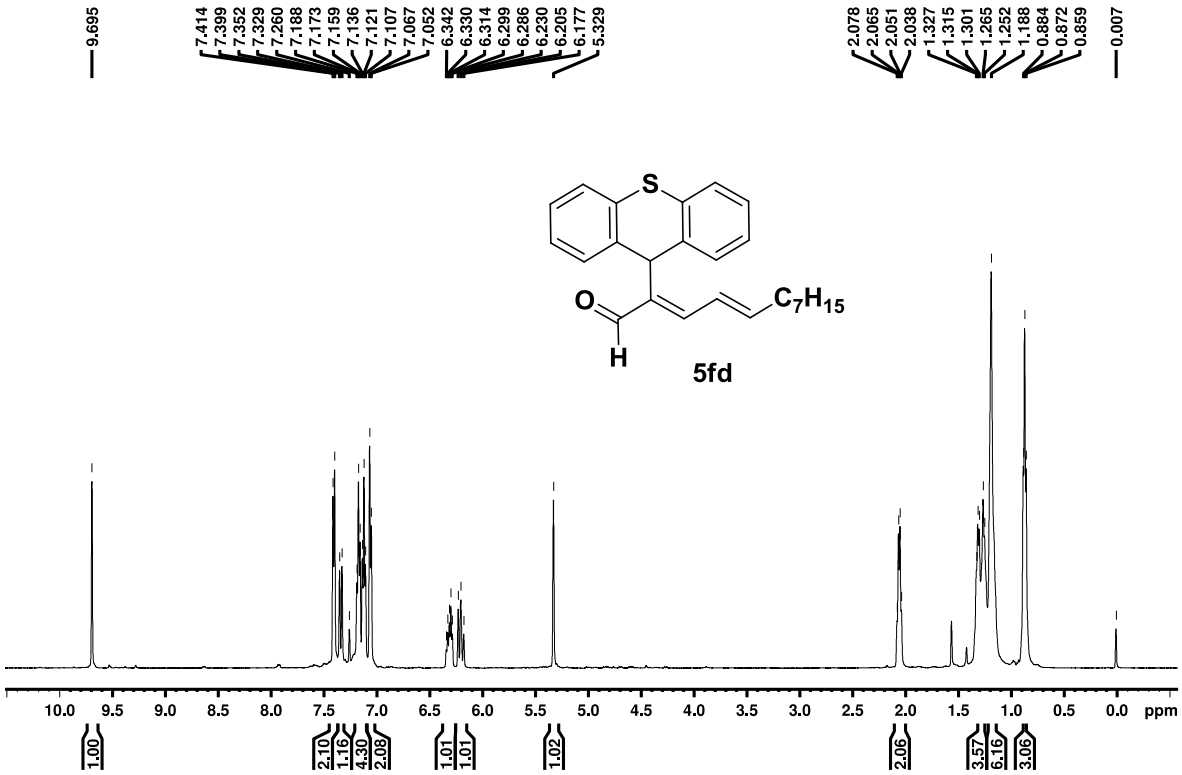
153.58
148.98
138.03
135.13
132.69
127.62
127.38
126.68
126.45
126.28
77.27
77.02
76.76
41.10
33.20
31.54
28.63
28.35
22.52
14.04
S
O
H
C6H13
5ed
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm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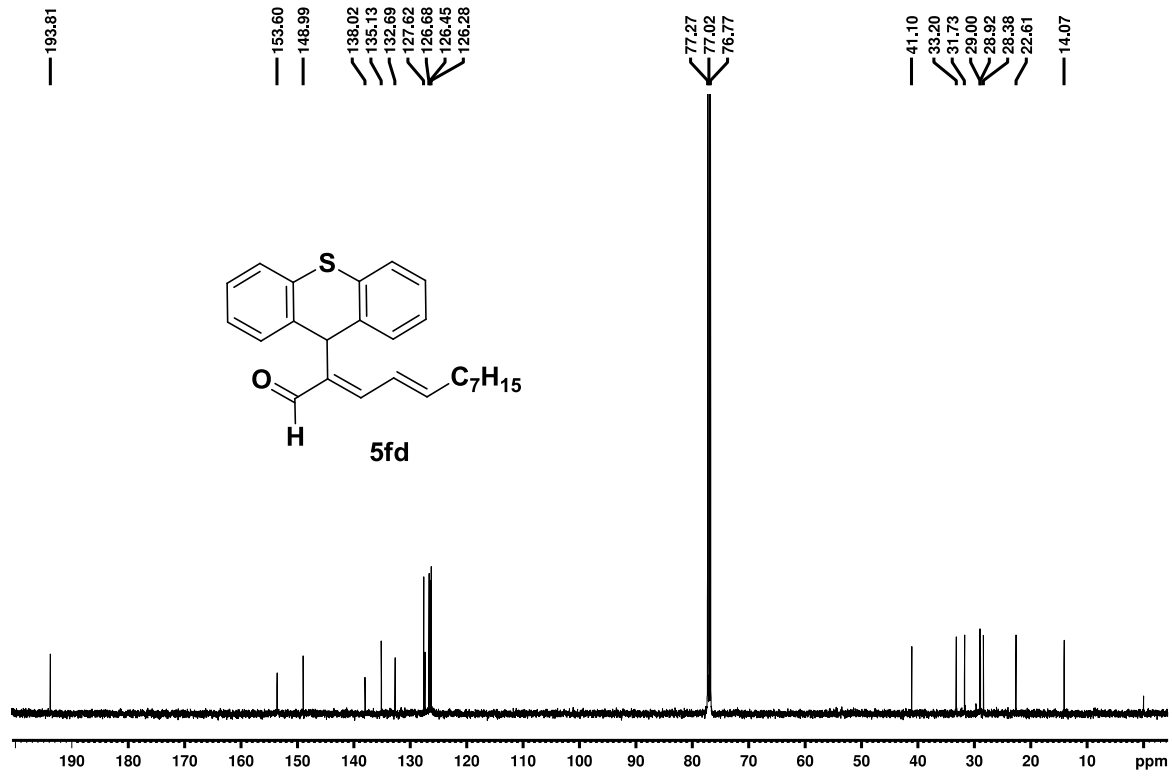
7.414
7.399
7.352
7.329
7.260
7.188
7.173
7.159
7.136
7.121
7.107
7.067
7.052
6.342
6.330
6.314
6.299
6.286
6.230
6.205
6.177
5.329
2.078
2.065
2.051
2.038
1.327
1.315
1.301
1.265
1.252
1.188
0.884
0.872
0.859
0.007
S
O
H
C7H15
5fd
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
1.00
2.10
1.16
4.30
2.08
1.01
1.01
1.02
2.06
3.57
6.16
3.06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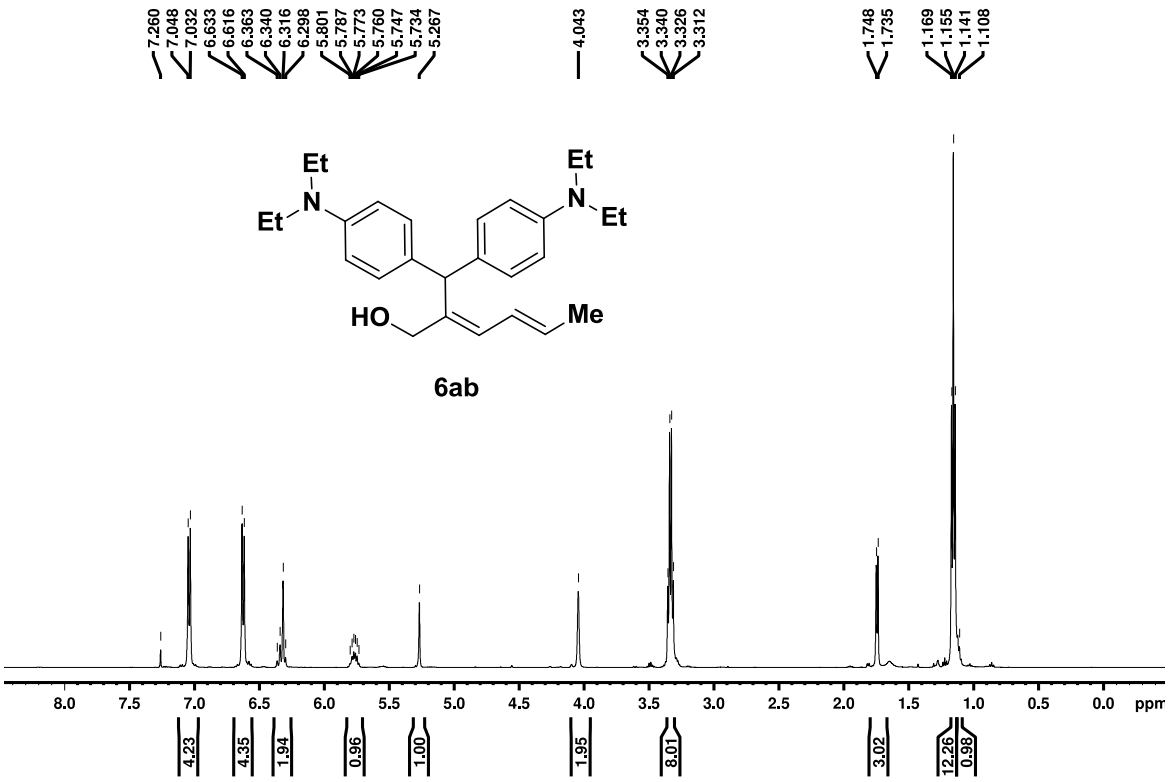
148.99
138.02
135.13
132.69
127.62
126.68
126.45
126.28
77.27
77.02
76.77
41.10
33.20
31.73
29.00
28.92
28.38
22.61
14.07
S
O
H
C7H15
5fd
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm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7.032
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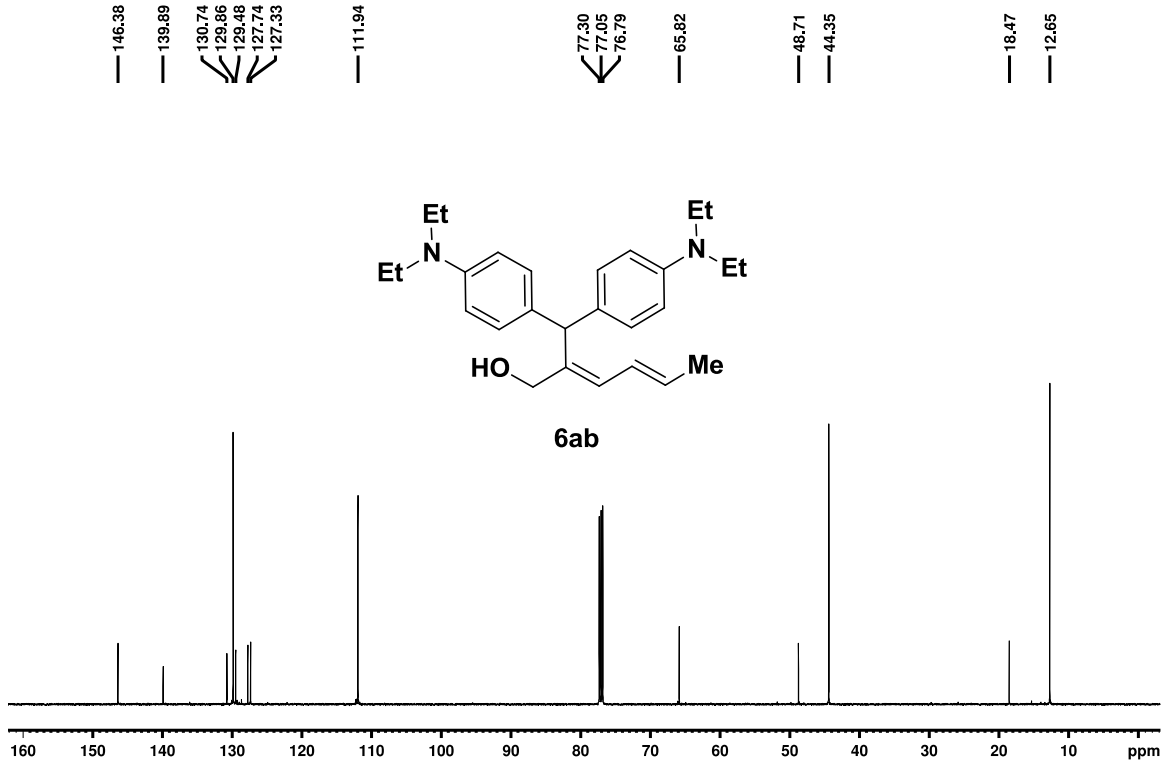
6.363
6.340
6.316
6.298
5.801
5.787
5.773
5.760
5.747
5.734
5.267
4.043
3.354
3.340
3.326
3.312
1.748
1.735
1.169
1.155
1.141
1.108
Et
N
Et
Et
N
Et
HO
Me
6ab
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
4.23
4.35
1.94
0.96
1.00
1.95
8.01
3.02
12.26
0.98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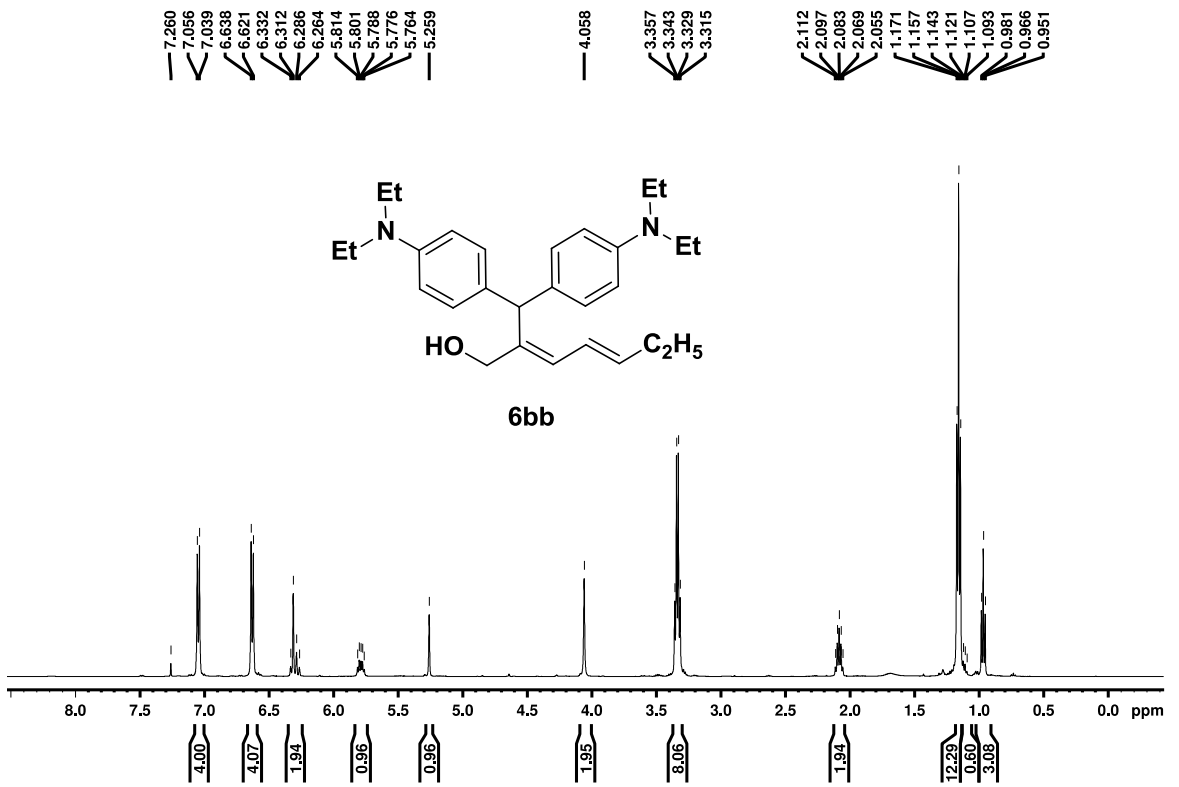
139.89
130.74
129.86
129.48
127.74
127.33
111.94
77.30
77.05
76.79
65.82
48.71
44.35
18.47
12.65
Et
N
Et
Et
N
Et
HO
Me
6ab
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm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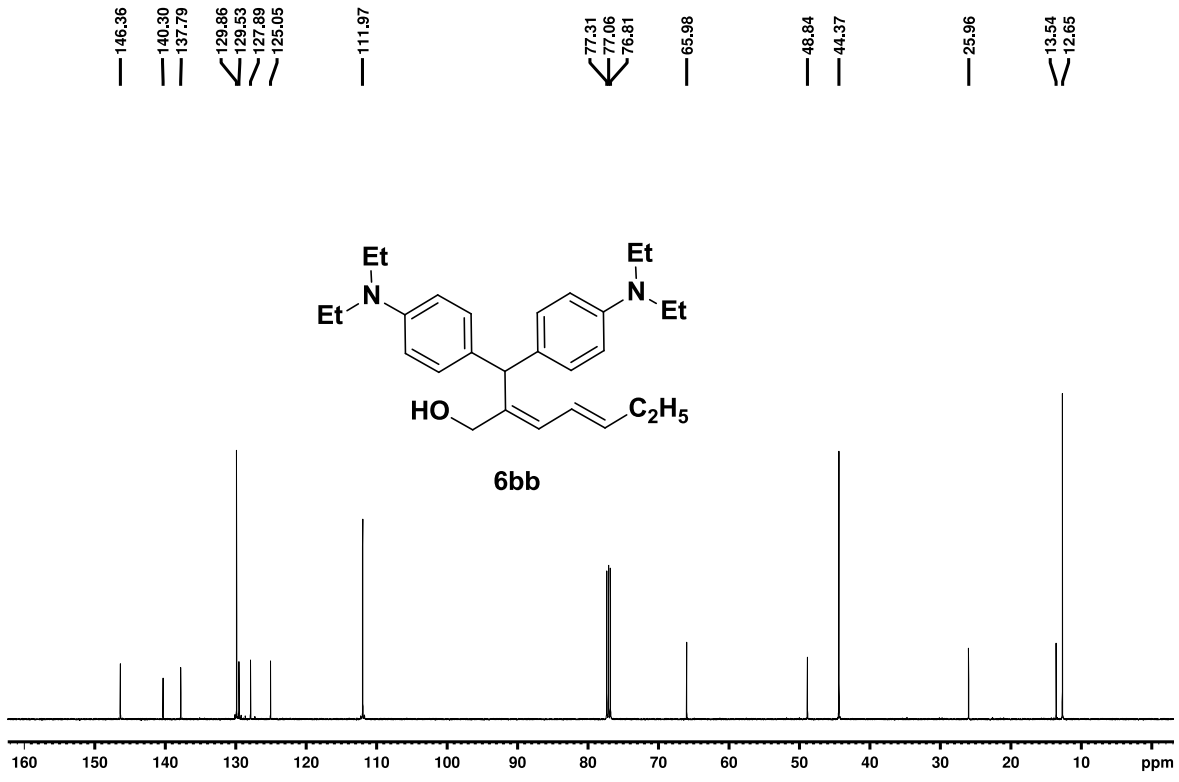
6.332
6.312
6.286
6.264
5.814
5.801
5.788
5.776
5.764
5.259
4.058
3.357
3.343
3.329
3.315
2.112
2.097
2.083
2.069
2.055
1.171
1.157
1.143
1.121
1.107
1.093
0.981
0.966
0.951
Et
N
Et
Et
N
Et
HO
C2H5
6bb
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
4.00
4.07
1.94
0.96
0.96
1.95
8.06
1.94
12.29
0.60
3.08


146.36
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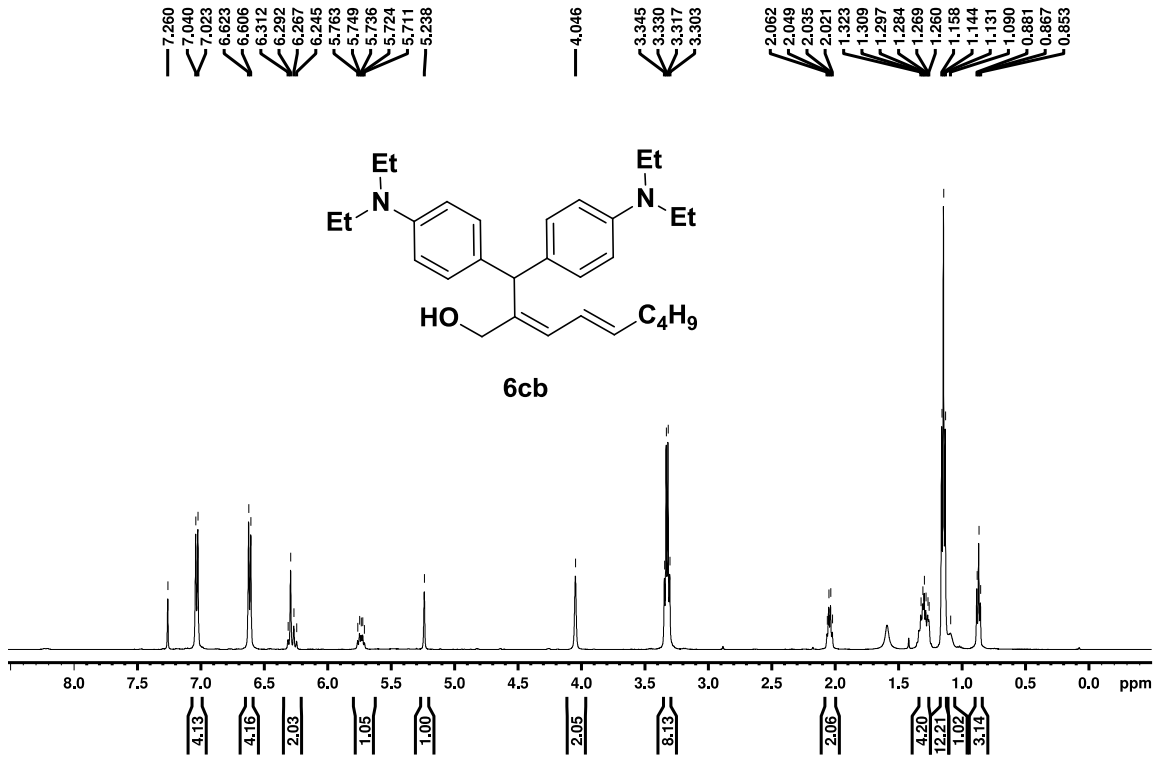
129.53
127.89
125.05
111.97
77.31
77.06
76.81
65.98
48.84
44.37
25.96
13.54
12.65
Et
N
Et
Et
N
Et
HO
C2H5
6bb
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm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3.330
3.317
3.303
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0.853
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Et
Et
N
Et
HO
C4H9
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4.0
3.5
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2.0
1.5
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0.0
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2.06
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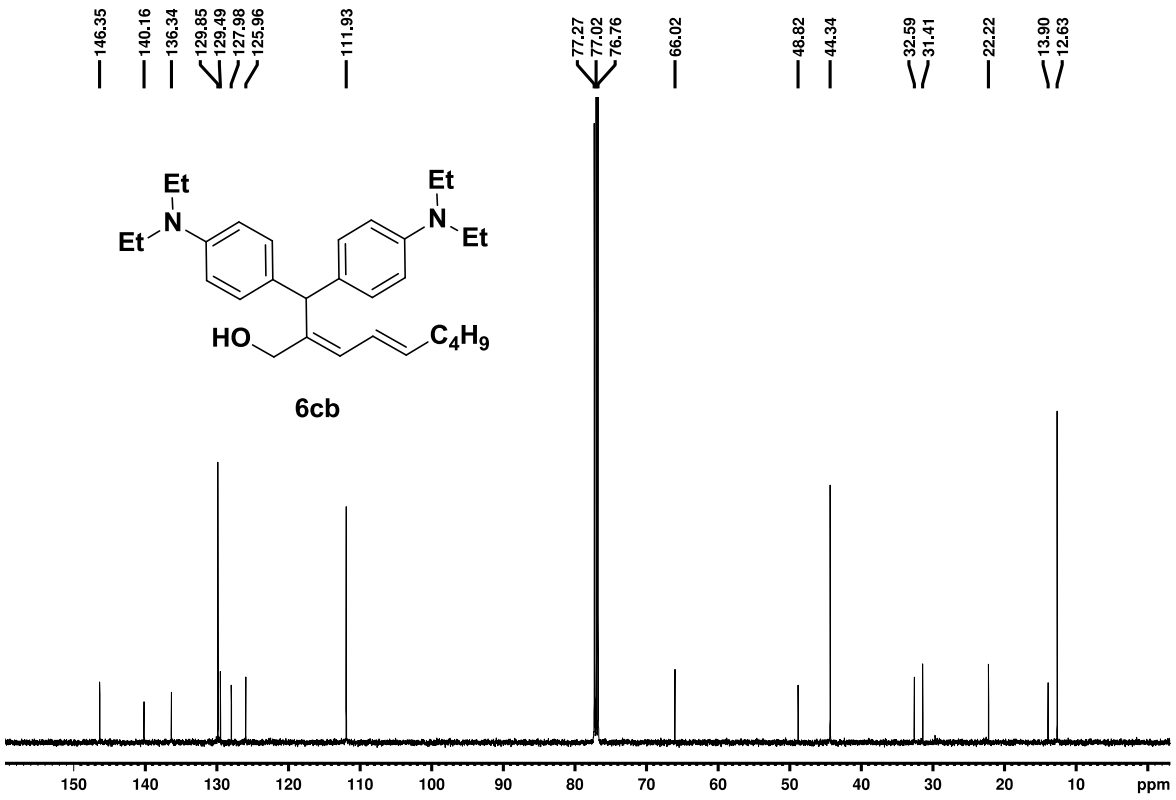
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44.34
32.59
31.41
22.22
13.90
12.63
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Et
Et
N
Et
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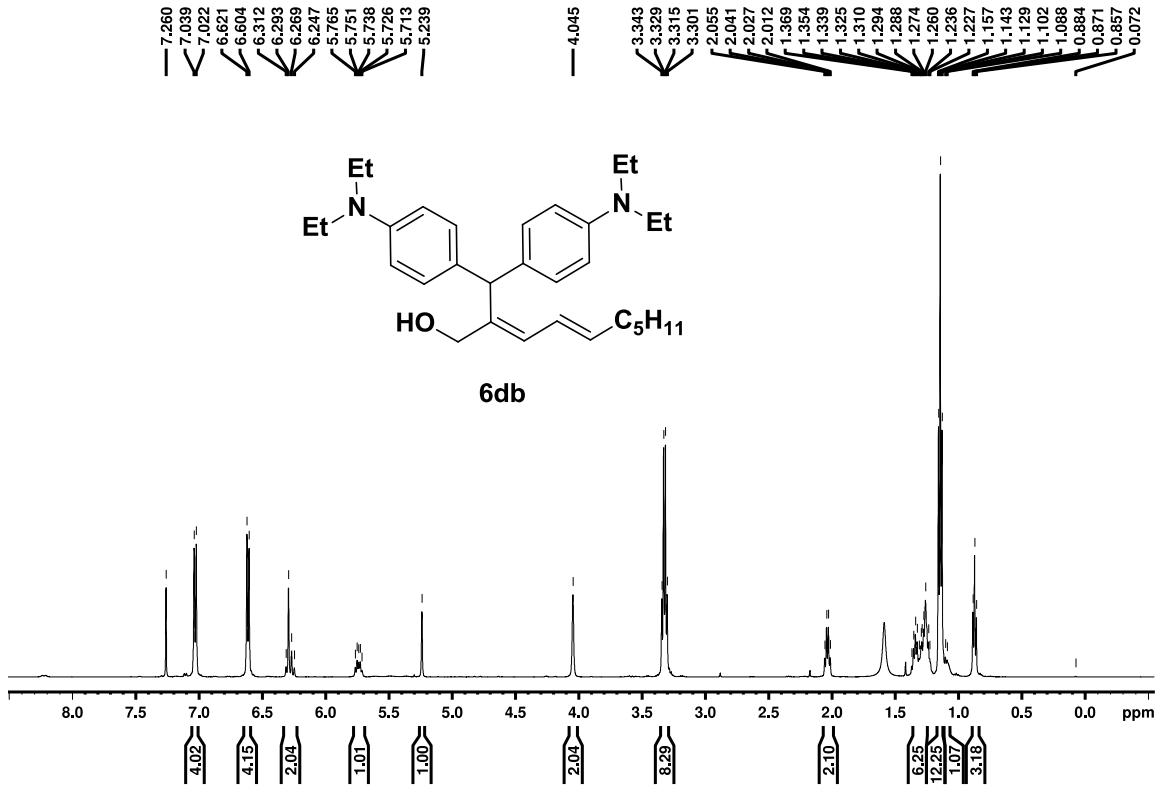
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5.713
5.239
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3.343
3.329
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3.301
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2.041
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1.354
1.339
1.325
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1.294
1.288
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1.157
1.143
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Et
Et
N
Et
HO
C5H11
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7.0
6.5
6.0
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5.0
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4.0
3.5
3.0
2.5
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1.0
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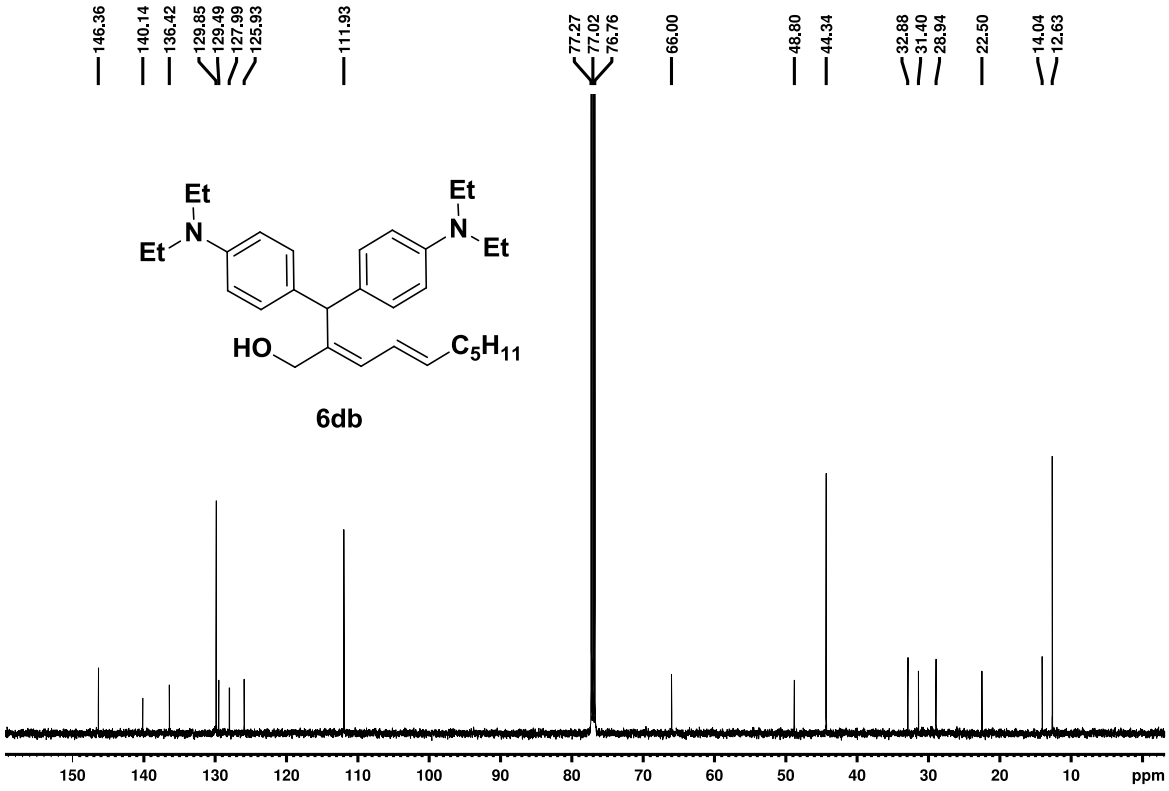
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28.94
22.50
14.04
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Et
Et
N
Et
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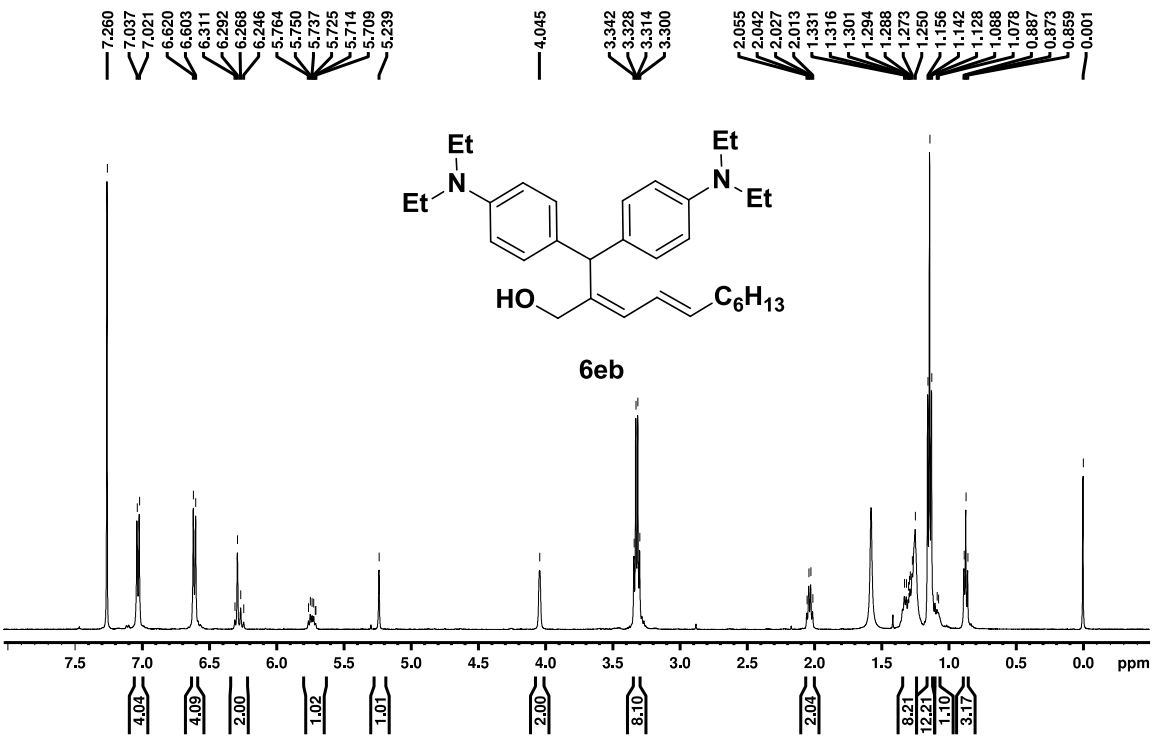
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5.725
5.714
5.709
5.239
4.045
3.342
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3.300
2.055
2.042
2.027
2.013
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1.316
1.301
1.294
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0.873
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Et
Et
N
Et
HO
C6H13
6eb
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4.0
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2.00
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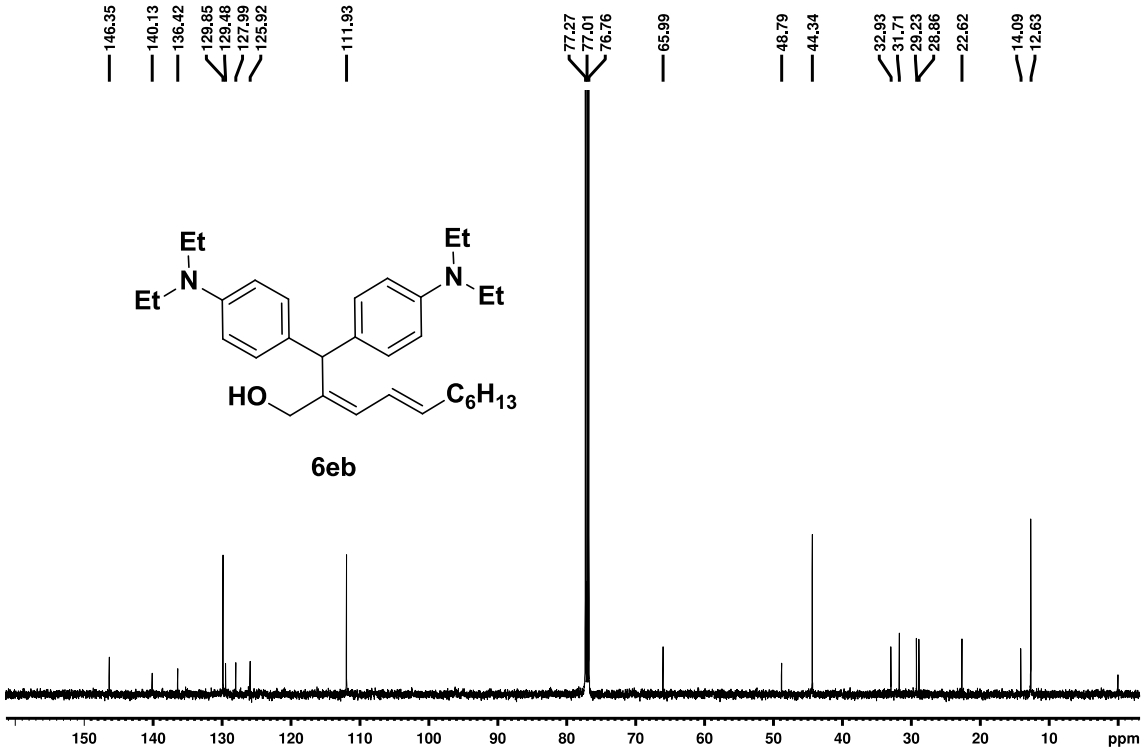
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31.71
29.23
28.86
22.62
14.09
12.63
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Et
Et
N
Et
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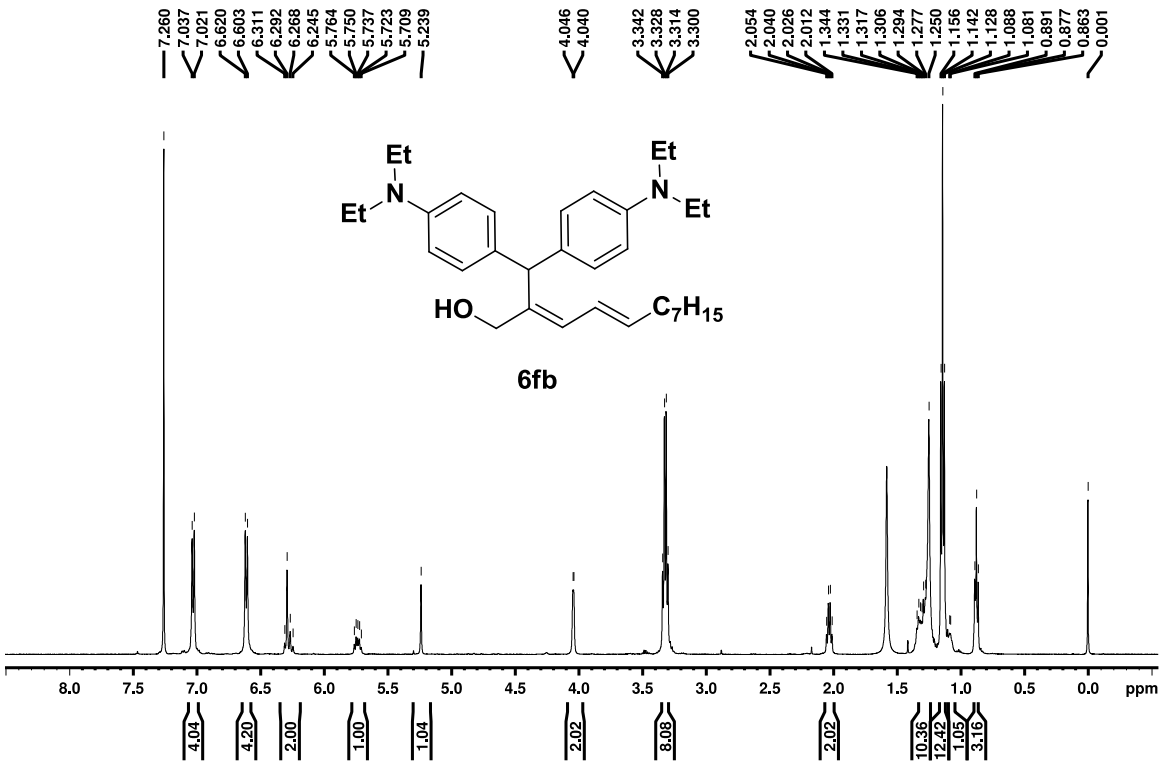
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5.239
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2.040
2.026
2.012
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1.277
1.250
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1.142
1.128
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Et
Et
N
Et
HO
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7.0
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6.0
5.5
5.0
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4.0
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3.0
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2.0
1.5
1.0
0.5
0.0
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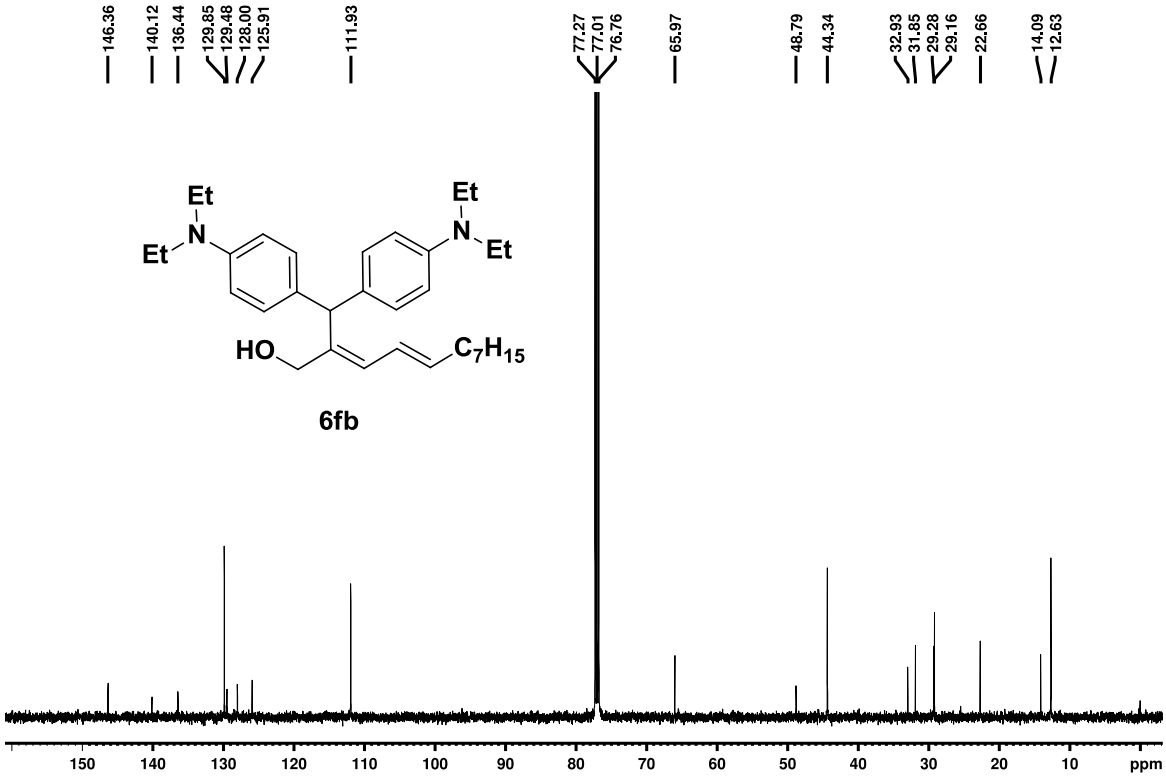
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32.93
31.85
29.28
29.16
22.66
14.09
12.63
Et
N
Et
Et
N
Et
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140
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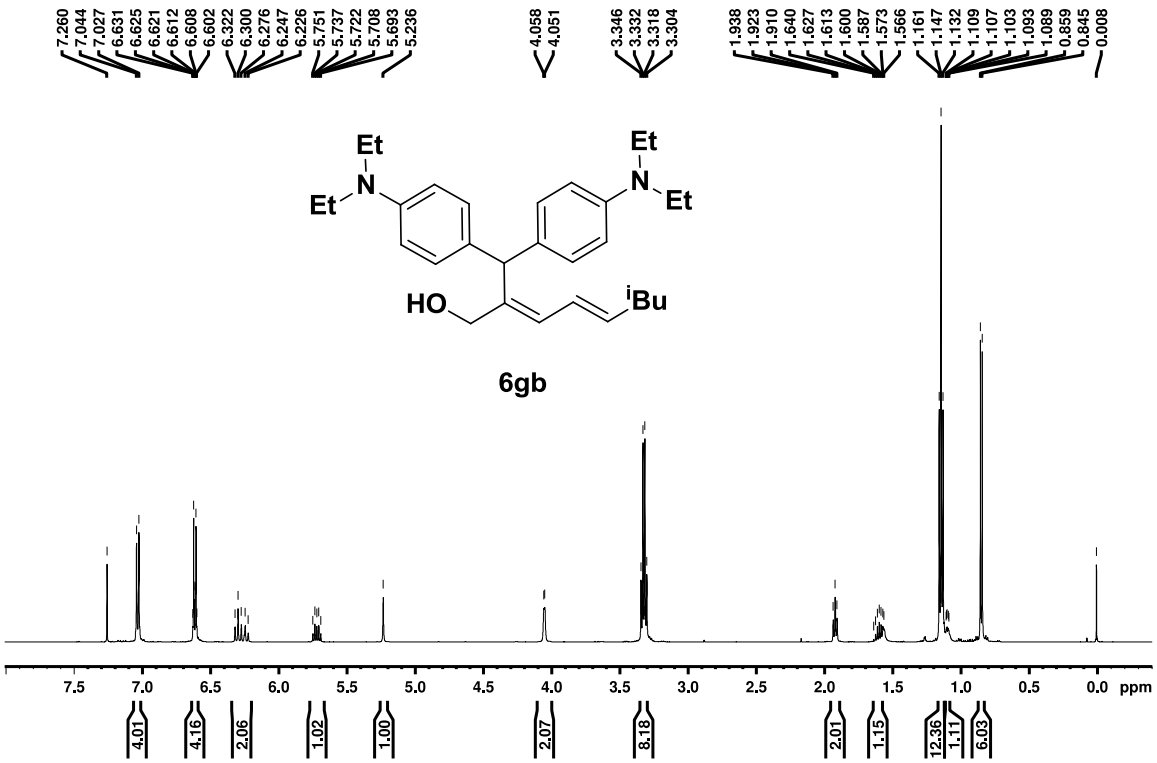
10
ppm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4.051
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3.318
3.304
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1.613
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1.566
1.161
1.147
1.132
1.109
1.107
1.103
1.093
1.089
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0.008
Et
N
Et
Et
N
Et
HO
iBu
6gb
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6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
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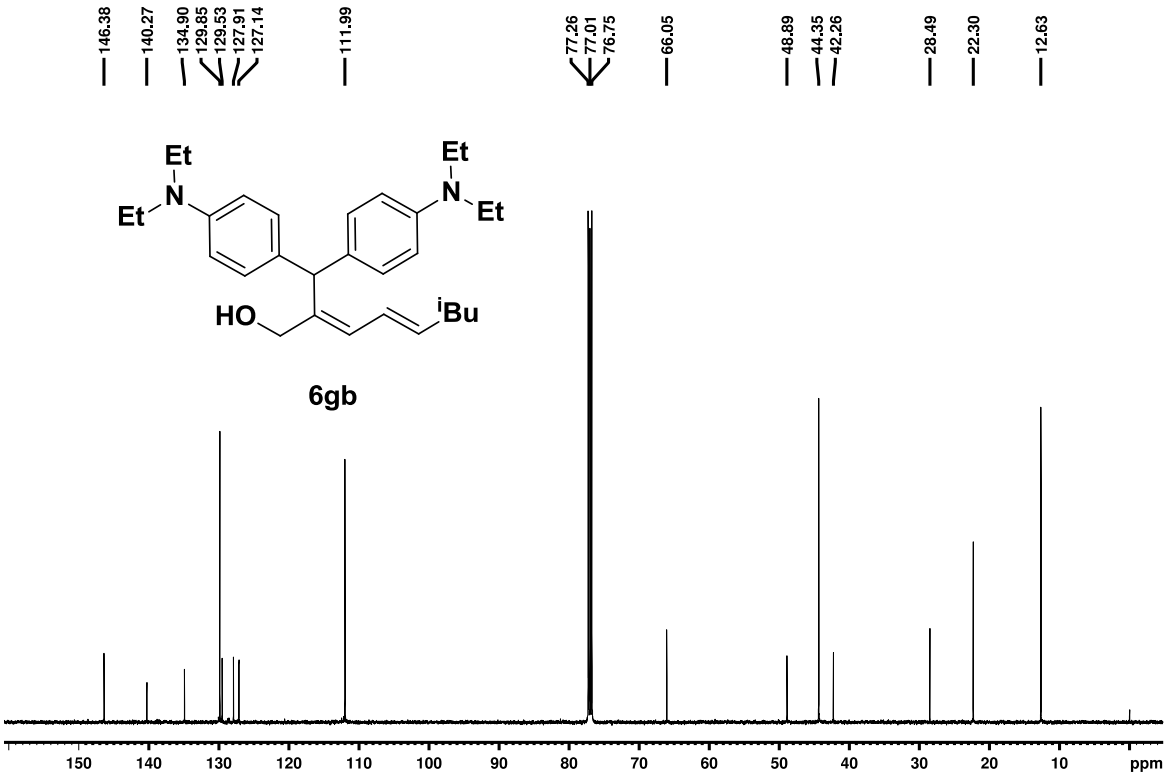
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44.35
42.26
28.49
22.30
12.63
Et
N
Et
Et
N
Et
HO
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150
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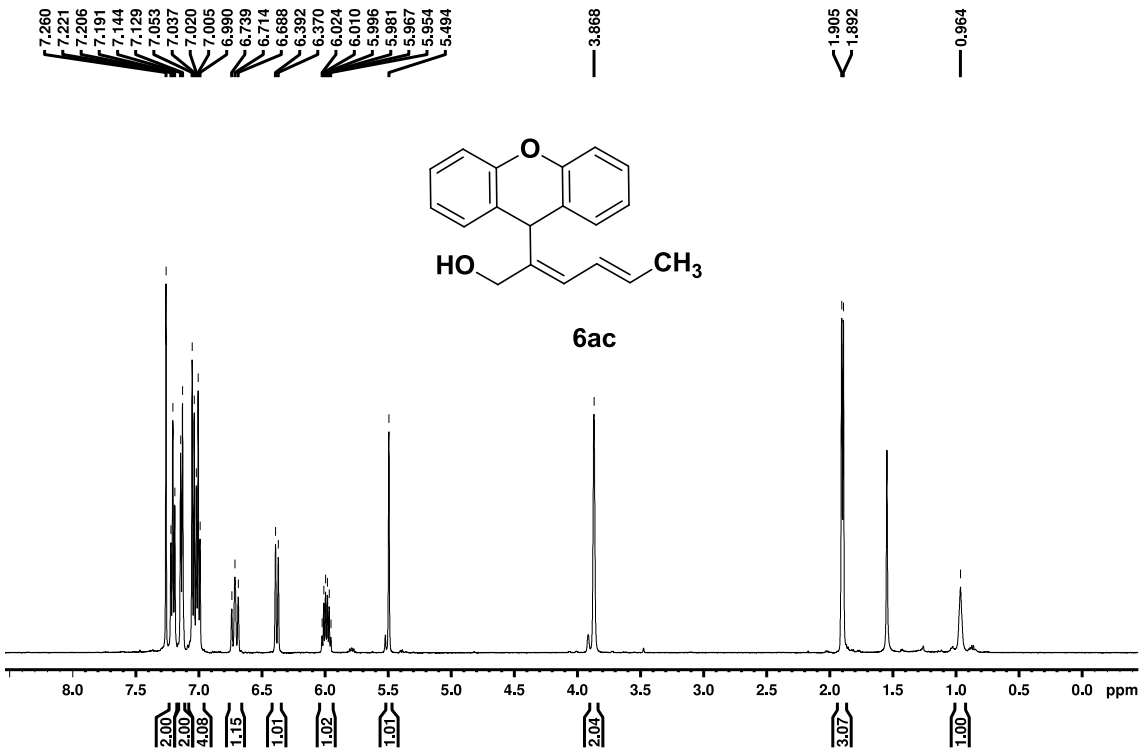
ppm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5.981
5.967
5.954
5.494
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1.905
1.892
0.964
O
HO
CH3
6ac
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
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2.00
4.08
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1.01
1.02
1.01
2.04
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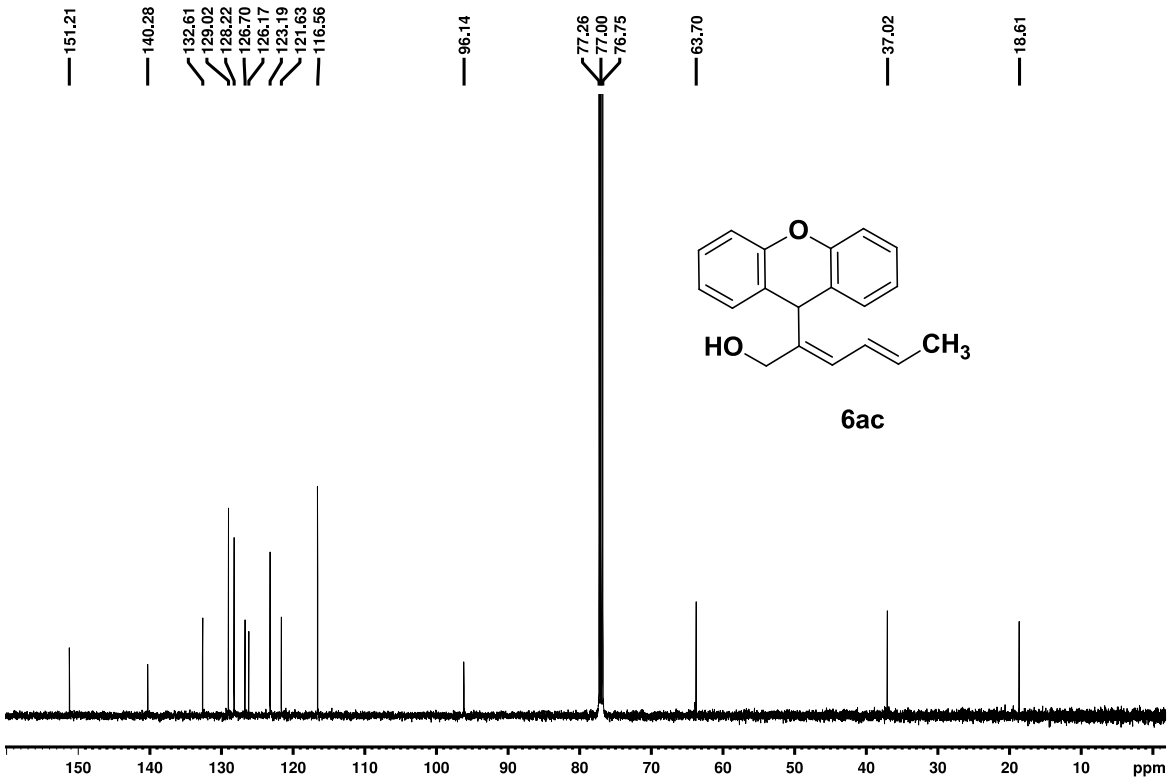
1.00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HO
CH3
6ac
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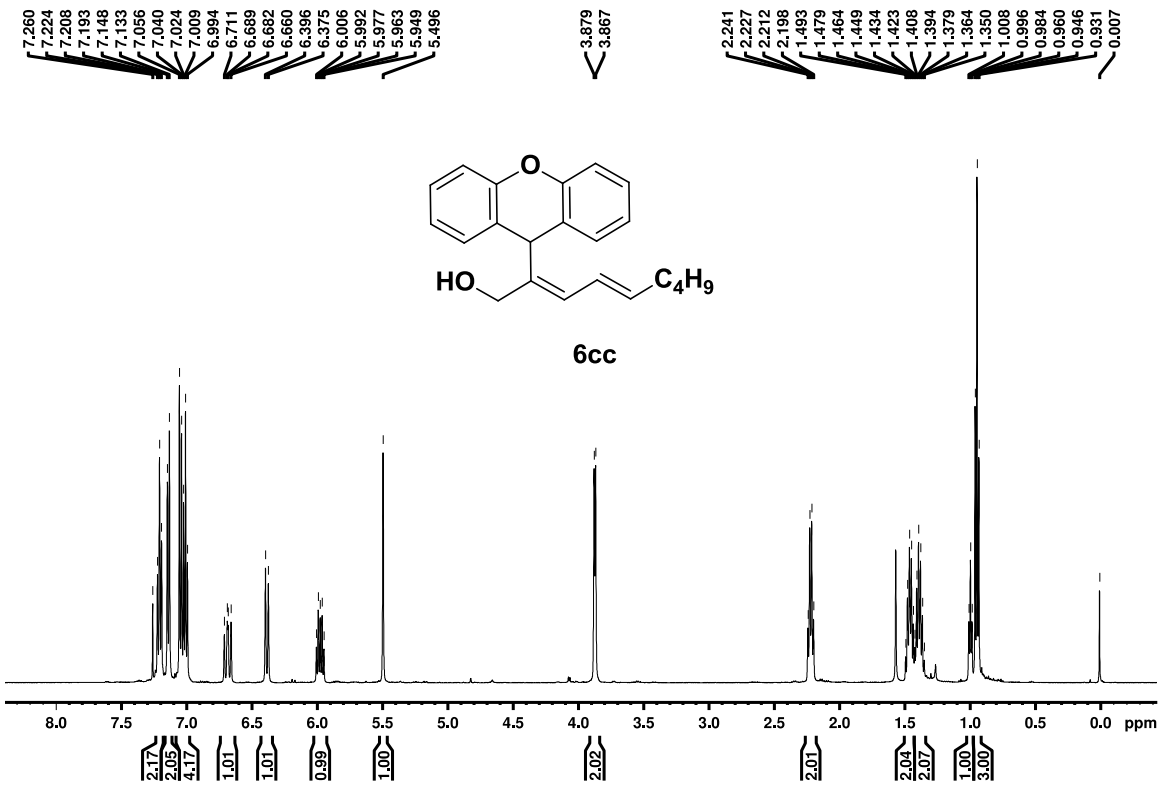
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1.434
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0.931
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C4H9
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4.5
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0.0
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2.01
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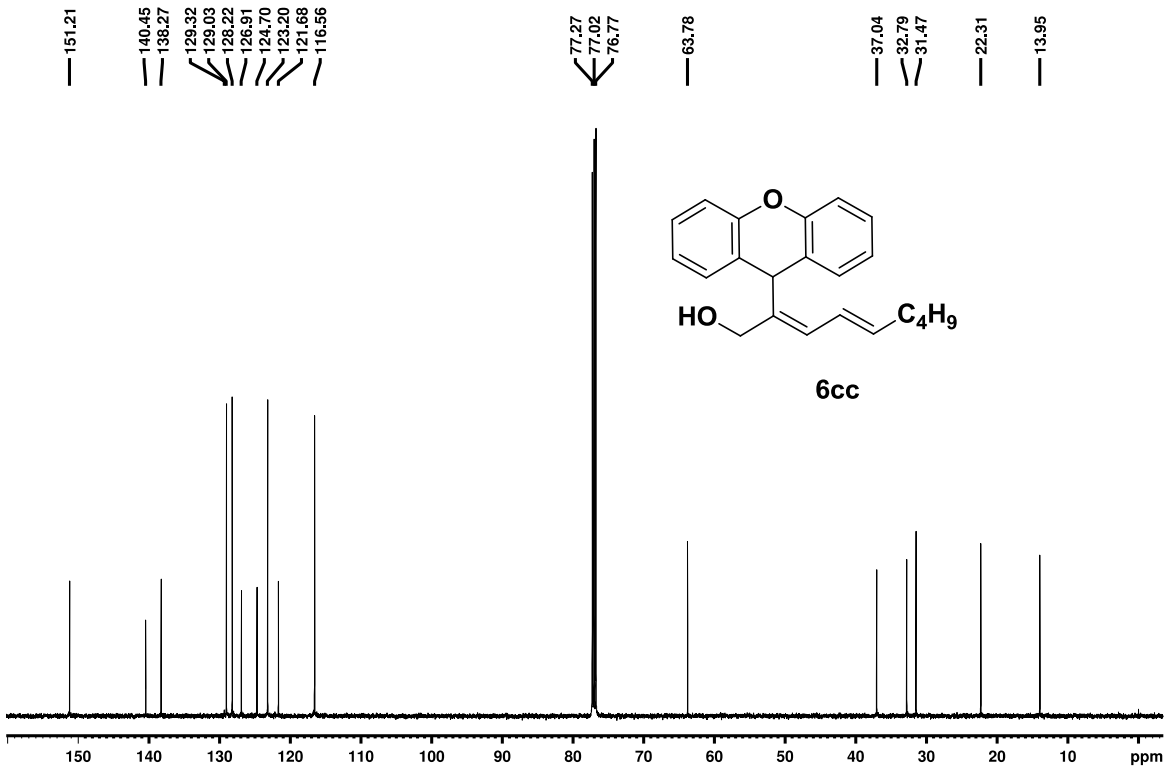
3.00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37.04
32.79
31.47
22.31
13.95
O
HO
C4H9
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120
110
100
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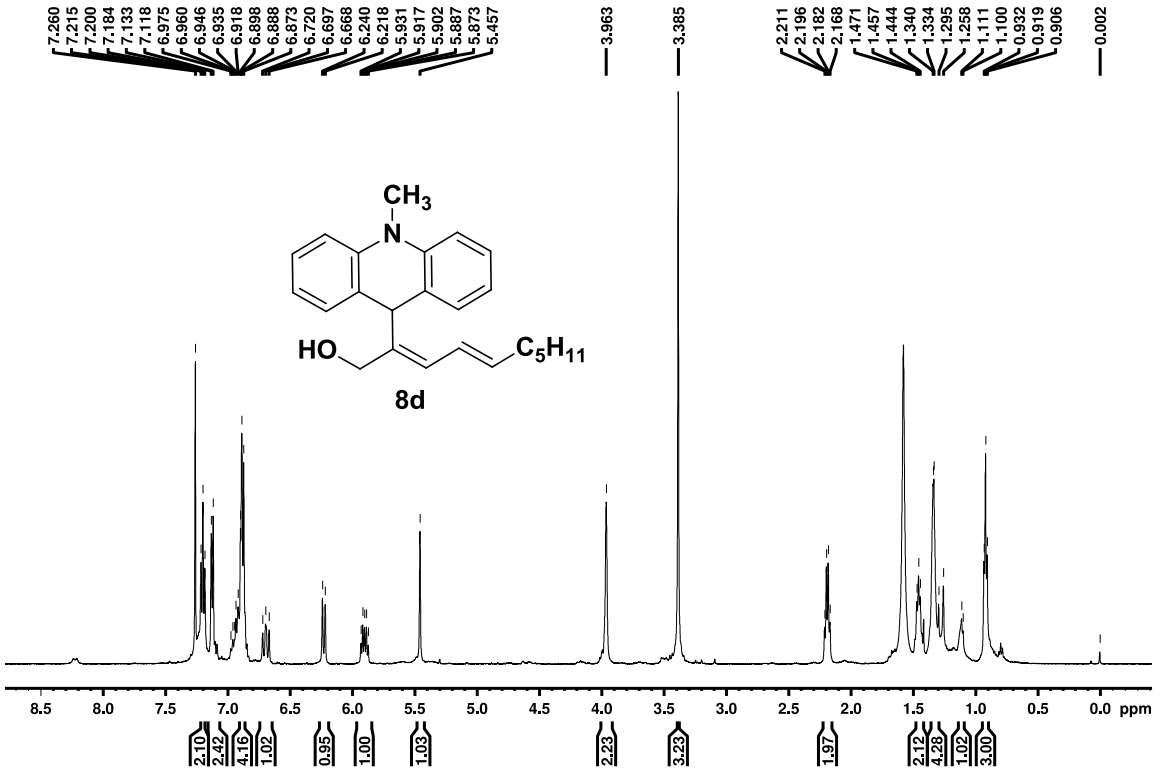
70
60
50
40
30
20
10
ppm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0.002
CH3
N
HO
C5H11
8d
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2.42
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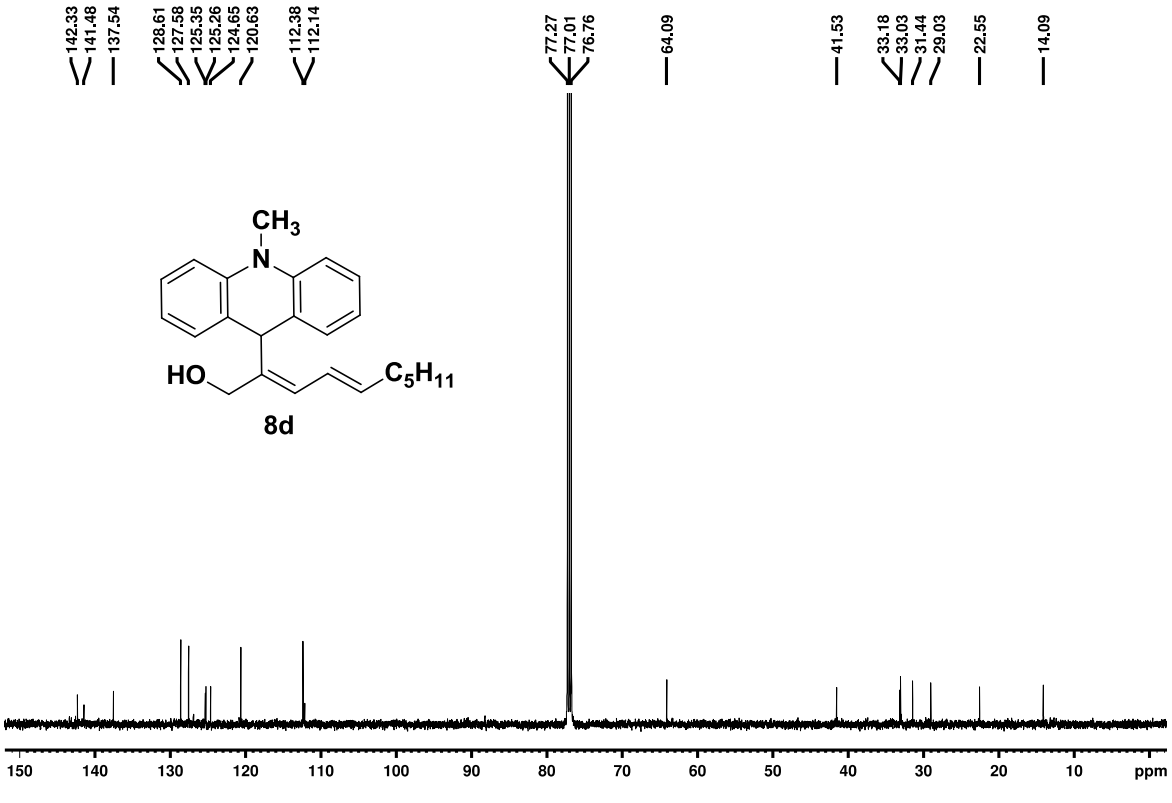
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41.53
33.18
33.03
31.44
29.03
22.55
14.09
CH3
N
HO
C5H11
8d
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm