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Ultrasound-Generated Cyclodextrin–Amino Acid Inclusion Complex with NH_3^+-Mediated Chalcone Activation: Metal-Free Catalysis Surpassing Nanoparticles

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1. EXPERIMENTAL SECTION

1.1 Materials & Methods

All reagents were used as purchased from commercial suppliers without further purification. Chalcones were synthesized as per the procedure reported in literature.[1,2] FT-IR spectra were recorded using Bruker alpha Eco-ATR spectrometer in the spectral region of 4000-650 cm-1. ^{1}H-NMR spectra were recorded on Bruker Avance Neo 500 MHz spectrometer in $CDCl_3$ and/or D_2O solvents. Spectroscopic data are represented as follows: chemical shift (ppm), multiplicity (s = singlet, d = doublet, t = triplet, dd = doublet of doublets m = multiplet, br = broad singlet, ddd = doublet of doublet of doublet, dddd = doublet of doublet of doublet of doublet, td = triplet of doublet, dt = doublet of triplet, qd = quartet of doublet), integration, coupling constants in Hertz (Hz). ^{13}C NMR spectra were recorded at 125 MHz in $CDCl_3$ and/or D_2O relative to trimethylsilane as internal standard. Reference peak for solvents were set as follows: in ^{1}H-NMR: $CDCl_3$ = 7.26 ppm, D_2O = 4.79 ppm; in ^{13}C-NMR: $CDCl_3$ = 77.0 ppm. Chiral HPLC analysis was carried out on Shimadzu L202260 instrument by using chiral columns. Pure products were isolated and purified by column chromatography over 60-120 mesh size silica gel using hexane: EtOAc as eluent. The progress of the reaction was monitored by thin layer chromatography (TLC) on silica coated aluminum plates F_{254} and visualized under UV chamber.

[1] J. Li, J. Zhang, M. Li, C. Zhang, Y. Yuanb and R. Liu, *Chem. Commun*., 2019, **55**, 2348. DOI: 10.1039/c8cc09369e

[2] Y. Zhang, J. Su, W. Niu and Y. Li, *Chem. Asian J*., 2019, **14**, 1477. DOI: 10.1002/asia.201900170

2. CHARACTERISATION DATA OF DA ADDUCTS

Phenyl(3-phenylbicyclo[2.2.1]hept-5-en-2-yl)methanone (3a)

Results: 97% yield, pale-yellow oily liquid, dr = 72:28 (*endo:exo*); **IR (ATR):** ν_{max} 3054, 3026, 2998, 2974, 1665, 1598, 1445, 1331, 1213, 1018, 746, 696, 664 cm^{-1}; **^{1}H-NMR: (500 MHz, $CDCl_3$)**: δ 7.93-7.89 (m, 1.46H (*endo*)), 7.88-7.86 (m, 0.56H (*exo*)), 7.53-7.47 (m, 1H), 7.44-7.27 (m, 4H), 7.25-7.12 (m, 3H), 6.47-6.43 (m, 1H), 6.14 (dd, *J* = 3.0 Hz, 8.5 Hz, 0.28H (*exo*)), 5.85 (dd, *J* = 2.5 Hz, 5.5 Hz, 0.72H (*endo*)), 3.88 (dd, *J* = 3.5 Hz, 5.0 Hz, 1H), 3.45 (dd, *J* = 1.5 Hz, 4.5 Hz, 0.72H (*endo*)), 3.41 (dd, *J* = 1.5 Hz, 5.5 Hz, 0.28H (*exo*)), 3.32 (s, 0.72H (*endo*)), 3.15 (s, 0.28H (*exo*)), 3.12-3.08 (m,1H), 2.01 (dd, *J* = 1.5 Hz, 6 Hz 0.72H (*endo*)), 1.87 (dd, *J* = 1.0 Hz, 6 Hz 0.28H (*exo*)), 1.62 (dq, *J* = 2.0, 8.5 Hz, 0.72H (*endo*)), 1.51 (dq, *J* = 1.5 Hz, 8.5 Hz, 0.28H (*exo*)) ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 201.7, 200.1, 144.8, 143.6, 139.3, 137.4, 137.1, 137.0, 136.6, 133.1, 133.0, 132.9, 128.7, 128.6, 128.5, 128.3, 128.2, 127.6, 126.3, 126.1, 56.3, 54.6, 49.0, 48.9, 48.7, 48.6, 48.1, 48.0, 47.8, 46.0 ppm.

4-Fluorophenyl-(3-phenylbicyclo[2.2.1]hept-5-en-2-yl)methanone (3b)

Results: 95% yield, colorless oily liquid, dr = 74:26 (*endo:exo*); **IR (ATR):** ν_{max} 3057, 3029, 2988, 1678, 1499, 1451, 1331, 1216, 1014, 833, 742, 669 cm^{-1}; **^{1}H-NMR: (500 MHz, $CDCl_3$)**: δ 7.90-7.86 (m, 1.57H (*endo*)), 7.83-7.78 (m, 0.53H (*exo*)), 7.24-7.09 (m, 5H), 7.04-6.93 (m, 2H), 6.41-6.37 (m, 1H), 6.09 (dd, *J* = 3.0 Hz, 5.0 Hz, 0.26H (*exo*)), 5.80 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.74H (*endo*)), 3.78 (dd, *J* = 2.5 Hz, 5.5 Hz, 0.74H (*endo*)), 3.75 (dd, *J* = 3.5 Hz, 5.0 Hz, 0.26H (*exo*)), 3.36 (dd, *J* = 5.0 Hz, 8.5 Hz, 0.74H (*endo*)), 3.29 (dd, *J* = 4.0 Hz, 8.5 Hz, 0.26H (*exo*)), 3.24 (s, 0.74H (*endo*)), 3.09 (s, 0.26H (*exo*)), 3.06-3.02 (m, 1H), 1,95 (d, *J* = 8.5 Hz, 0.74H (*endo*)), 1.85 (d, *J* = 9.0 Hz, 0.26H (*exo*)), 1.58 (dd, *J* = 1.5 Hz, 8.5 Hz, 0.76H (*endo*)), 1.47 (dd, *J* = 1.0 Hz, 8.5 Hz, 0.24H (*exo*)) ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 199.8, 198.6, 165.8 (d, *J* = 253.7 Hz), 165.7 (d, *J* = 252.5 Hz), 144.6, 143.4, 139.4, 137.0, 136.6, 133.7 (d, *J* = 3.7 Hz), 133.5 (d, *J* = 3.7 Hz), 133.0, 131.2 (d, *J* = 6.2 Hz), 131.1 (d, *J* = 6.2 Hz), 128.7, 128.3, 128.1, 127.6, 126.5, 126.2, 115.8 (d, *J* = 12.5 Hz), 115.6 (d, *J* = 15.0 Hz), 56.2, 54.6, 49.1, 48.8, 48.7, 48.7, 48.2, 48.1, 46.2 ppm. δ –105.69 (e*xo*), –105.80 (*endo*) ppm

4-Chlorophenyl-(3-phenylbicyclo[2.2.1]hept-5-en-2-yl)methanone (3c)

Results: 92% yield, colorless oily liquid, dr = 71:29 (*endo:exo*); **IR (ATR):** ν_{max} 3054, 3027, 2994, 2973, 1665, 1594, 1443, 1215, 1015, 743, 691, 664 cm^{-1}; **^{1}H-NMR (500 MHz, $CDCl_3$)**: δ 7.85 (dt, *J* = 2.5 Hz, 9.0 Hz, 1.48H (*endo*)), 7.78 (dt, *J* = 2.5 Hz, 9.0 Hz, 0.60H (*exo*)), 7.39

(dt, *J* =2.5 Hz, 9.0 Hz, 1.43H (*endo*)), 7.33 (dt, *J* = 2.5 Hz, 9.0 Hz 0.63H (*exo*)), 7.31-7.12 (m, 5H), 6.48-6.44 (m, 1H), 6.16 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.29H (*exo*)), 5.87 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.71H (*endo*)), 3.84 (dd, *J* = 3.5 Hz, 5.0 Hz, 0.71H (*endo*)), 3.81 (dd, *J* = 4.0 Hz, 5.0 Hz, 0.29H (*exo*)), 3.43 (dd, *J* = 1.5 Hz, 5.0 Hz, 0.71H (*endo*)), 3.35 (dd, *J* = 1.5 Hz, 5.0 Hz 0.29H (*exo*)), 3.31 (s, 0.71H (*endo*)), 3.16 (s, 0.29H (*exo*)), 3.13-3.10 (m, 1H), 2.02 (d, *J* = 8.5 Hz, 0.71H (*endo*)), 1.87 (d, *J* = 9.0 Hz, 0.29H (*exo*)), 1.65 (dd, *J* = 1.5 Hz, 7.0 Hz 0.71H (*endo*)), 1.54 (d, *J* = 1.5 Hz, 0.29H (*exo*)) ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 200.2, 199.0, 144.6, 143.4, 139.5, 139.4, 139.4, 137.0, 136.6, 136.1, 135.6, 135.3, 133.0, 129.9, 129.0, 128.9, 128.7, 128.3, 128.1, 128.0, 127.6, 126.5, 126.2, 56.3, 54.7, 49.1, 48.7, 48.6, 48.2, 48.1, 46.2 ppm.

4-Bromophenyl(3-phenylbicyclo[2.2.1]hept-5-en-2-yl)methanone (3d)

Results: 89% yield, colorless oily liquid, dr = 69:31 (*endo:exo*); **IR (ATR):** ν_{max} 3058, 3021, 2964, 1742, 1678, 1459, 1362, 1223, 1015, 793, 715, 694 cm^{-1}; **^{1}H-NMR (500 MHz, $CDCl_3$)**: δ 7.78 (dd, *J* = 2.0 Hz, 5.0 Hz, 1.44H (*endo*)), 7.71 (dd, *J* = 2.0 Hz, 5.0 Hz, 0.64H (*exo*)), 7.56 (dd, *J* = 2.0 Hz, 6.5 Hz, 1.36H (*endo*)) 7.51 (dd, *J* = 1.5 Hz, 6.5 Hz, 0.68H (*exo*)), 7.32-7.27 (m, 3H), 7.25-7.12 (m, 2H), 6.48-6.44 (m, 1H), 6.16 (dd, *J* = 2.5 Hz, 5.5 Hz, 0.31H (*exo*)), 5.87 (dd, *J* = 2.5 Hz, 5.5 Hz, 0.69H (*endo*)), 3.84 (dd, *J* = 3.0 Hz, 5.0 Hz, 0.69H (*endo*)), 3.81 (dd, *J* = 3.0 Hz, 5.0 Hz, 0.31H (*exo*)), 3.43 (dd, *J* = 1.0 Hz, 4.5 Hz, 0.69H (*endo*)), 3.35 (dd, *J* = 1.0 Hz, 4.5 Hz, 0.31H (*exo*)), 3.31 (s, 0.69H (*endo*)), 3.16 (s, 0.31H (*exo*)), 3.14-3.10 (m, 1H), 2.02 (d, *J* = 8.5 Hz, 0.69H (*endo*)), 1.87 (d, *J* = 8.5 Hz, 0.31H (*exo*)), 1.65 (dd, *J* = 1.5 Hz, 8.5 Hz, 0.69H (*endo*)), 1.55 (d, *J* = 1.5 Hz, 0.31H (*exo*)) ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 200.4 199.2, 144.5, 143.3, 139.4, 137.0, 136.6, 136.0, 135.8, 133.0, 132.0, 130.2, 130.1, 128.7, 128.4, 128.2, 128.1, 128.1, 127.6, 126.5, 126.2, 56.3, 54.7, 49.1, 48.7, 48.7, 48.6, 48.2, 48.2, 46.2 ppm.

4-Methoxyphenyl(3-phenylbicyclo[2.2.1]hept-5-en-2-yl)methanone (3e)

Results: 91% yield, yellow oily liquid , dr = 40:60 (*endo:exo*); **IR (ATR):** ν_{max} 3021, 2956, 2922, 1741, 1667, 1607, 1443, 1362, 1225, 1012, 813, 742, 692 cm^{-1}; **^{1}H-NMR (500 MHz, $CDCl_3$):** δ 7.91 (dt, *J* = 5.0 Hz, 9.5 Hz, 0.86H (*endo*)) 7.86 (dd, *J* = 5.0 Hz, 9.5 Hz, 1.21H (*exo*)), 7.31-7.25 (m, 2H), 7.23-7.13 (m, 3H), 6.90 (dd, *J* = 2.0 Hz, 7.0 Hz, 0.84H (*endo*)), 6.85 (dd, *J* = 2.0 Hz, 7.0 Hz, 1.23H (*exo*)), 6.47-6.44 (m, 1H), 6.16 (dd, *J* = 2.5 Hz, 5.5 Hz, 0.60H (*exo*)), 5.88 (dd, *J* = 2.5 Hz, 5.5 Hz, 0.40H (*endo*)), 3.90-3.85 (m, 2.2H {1.2H, -OCH_3 (*endo*) + 1H (*endo* + *exo*)}), 3.83 (s, 1.8H, -OCH_3 (*exo*)), 3.46 (dd, *J* = 1.5 Hz, 5.0 Hz, 0.40H (*endo*)), 3.38 (dd, *J* = 1.5 Hz, 5.0 Hz, 0.60H (*exo*)), 3.32 (s, 0.40H (*endo*)), 3.16 (s, 0.60H (*exo*)), 3.11

(s, 1H), 2.01 (d, *J* = 8.5 Hz, 0.40H(*endo*)), 1.91(d, *J* = 8.5 Hz, 0.60H (*exo*)), 1.63 (dd, *J* = 1.5 Hz, 8.5 Hz, 0.40H(*endo*)), 1.53 (dd, *J* = 1.5 Hz, 8.5 Hz, 0.60H(*exo*)) ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 199.8, 198.5, 163.5, 145.0, 143.8, 139.2, 136.9, 136.7, 133.2, 130.9, 130.8, 130.3, 130.1, 128.6, 128.2, 128.2, 127.7, 126.3, 126.1, 113.8 113.8, 55.9,, 55.9, 55.6 55.6, 54.2, 49.1, 48.9, 48.6, 48.2, 48.1, 48.0, 46.0 ppm.

(3-(4-Fluorophenyl)bicyclo[2.2.1]hept-5-en-2-yl)(phenyl)methanone (3f)

Results: 93% yield, colorless oily liquid, dr = 68:32 (*endo:exo*); **IR (ATR):** ν_{max} 3057, 3024, 2984, 1672, 1491, 1452, 1331, 1213, 1014, 832, 743, 701 cm^{-1}; **^{1}H-NMR: (500 MHz, $CDCl_3$)**: δ 7.92 (dd, *J* = 1.5 Hz, 7.0 Hz, 1.39H (*endo*)), 7.87 (dd, *J* = 1.5 Hz, 7.0 Hz, 0.64H (*exo*)), 7.57-7.50 (m, 1H), 7.47-7.37 (m, 2H), 7.24-7.20 (m, 1.39H), 7.13-7.09 (m, 0.68H), 7.00-6.89 (m, 2H), 6.48 (dd, *J* = 3.0 Hz, 5.0 Hz, 0.32H (*exo*)), 6.45 (dd, *J* = 3.0 Hz, 5.0 Hz, 0.68H (*endo*)), 6.14 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.32H(*exo*)), 5.86(dd, *J* = 3.0 Hz, 5.0 Hz, 0.68H (*endo*)), 3.87 (dd, *J* = 3.5 Hz, 5.0 Hz, 0.32H (*exo*)), 3.83 (dd, *J* = 3.5 Hz, 5.0 Hz, 0.68H (*endo*)), 3.44 (d, *J* = 4.5 Hz, 0.68H (*endo*)), 3.36 (dd, *J* = 1.5 Hz, 5.5 Hz, 0.32H (*exo*)), 3.35 (s, 0.68H (*endo*)), 3.15-3.13 (m,0.64H), 3.07 (s, 0.68H (*endo*)), 1.98 (d, *J* = 8.5 Hz, 0.55H (*endo*)), 1.87 (d, *J* = 9.0 Hz, 0.45H (*exo*)), 1.65 (dd, *J* = 1.5 Hz, 6.5 Hz, 0.68H (*endo*)), 1.53 (dd, *J* = 1.5 Hz, 8.5 Hz, 0.32H (*exo*)) ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 200.8, 200.0, 161.5 (d, *J* = 248.7 Hz), 161.4 (d, *J* = 248.7 Hz), 140.4 (d, *J* = 3.7 Hz), 139.3, 137.3, 137.0, 136.8, 136.7, 133.1, 133.0 (d, *J* = 3.7 Hz), 129.4 (d, *J* = 7.5 Hz), 128.9 (d, *J* = 7.5 Hz), 128.7, 128.7, 128.6, 128.5, 115.4 (d, *J* = 20.0 Hz), 114.9 (d, *J* = 20.0 Hz), 56.6, 54.9, 49.0, 48.7, 48.7 48.1, 48.0, 47.1, 45.2 ppm. **^{19}F NMR (470 MHz, $CDCl_3$):** δ –117.76 (*exo*), –117.48 (*endo*) ppm

(3-(4-Chlorophenyl)bicyclo[2.2.1]hept-5-en-2-yl)(phenyl)methanone (3g)

Results: 92% yield, yellow oily liquid, dr = 63:37 (*endo:exo*); **IR (ATR):** ν_{max} 2953, 2927, 1731, 1672, 1453, 1254, 1014, 795, 734, 692 cm^{-1}; **^{1}H-NMR (500 MHz, $CDCl_3$)**: δ 7.92 (dd, *J* = 1.5 Hz, 8.5 Hz, 1.29H (*endo*)), 7.88 (dd, *J* = 1.5 Hz, 8.5 Hz, 0.71H (*exo*)), 7.57- 7.50 (m, 1H), 7.46- 7.38 (m, 2H), 7.27-7.23 (m, 1.41H), 7.21-7.17 (m, 2H), 7.07(dd, *J* = 1.5 Hz, 7.0 Hz, 0.75H), 6.48 (dd, *J* = 2.0 Hz, 7.0 Hz, 0.37H(*exo*)), 6.45 (dd, *J* = 2.0 Hz, 7.0 Hz, 0.63H(*endo*))), 6.14-6.12 (m, 0.37H (*exo*)), 5.86 (dd, *J* = 2.5 Hz, 5.5 Hz, 0.63H (*endo*)), 3.88 (dd, *J* = 3.5 Hz, 8.5 Hz, 0.37H), 3.83 (dd, *J* = 3.5 Hz, 8.5 Hz, 0.63H (*endo*)), 3.44 (dd, *J* = 1.5 Hz, 5.0 Hz, 0.63H (*endo*)), 3.37 (dd, *J* = 1.5 Hz, 5.0 Hz, 0.37H (*exo*)), 3.34 (s, 0.67H), 3.15-3.12 (m, 0.74H), 3.10-3.05 (m, 0.63H), 1.96 (d, *J* = 8.5 Hz, 0.63H (*endo*)), 1.87 (d, *J* = 9.0 Hz, 0.37H (*exo*)), 1.65 (dd, *J* = 3.5 Hz, 8.5 Hz 0.63H (*endo*)), 1.54 (dd, *J* = 1.5 Hz, 8.5 Hz, 0.37H (*exo*)) ppm; **^{13}C**

NMR (125 MHz, $CDCl_3$): δ 200.9, 199.8, 143.3, 142.1, 139.2, 137.2, 136.9, 136.7, 133.1, 133.1, 133.0, 132.1, 131.8, 129.4, 128.9, 128.8, 128.7, 128.6, 128.5, 128.3, 56.5, 54.7, 49.0, 48.9, 48.8, 48.5, 48.1, 48.0, 47.2, 45.3 ppm.

(3-(4-Bromophenyl)bicyclo[2.2.1]hept-5-en-2-yl)(phenyl)methanone (3h)

Results: 89% yield, yellow oily liquid, dr = 55:45 (*endo:exo*); **IR (ATR):** ν_{max} 3062, 2964, 2923, 1672, 1592, 1442, 1333, 1257, 1213, 1015, 814, 752, 723, 691 cm^{-1}; **^{1}H-NMR (500 MHz, $CDCl_3$)**: δ 7.92 (dd, *J* = 2.0 Hz, 7.0 Hz, 1.17H (*endo*)), 7.89 (dd, *J* = 2.0 Hz, 7.0 Hz, 0.88H (*exo*)), 7.57-7.51 (m, 1H), 7.47-7.33 (m, 4H), 7.14 (dd, *J* = 2.5 Hz, 10.5 Hz 1.13H), 7.03 (dd, *J* = 1.0 Hz, 7.0 Hz, 0.91H), 6.48 (dd, *J* = 3.5 Hz, 5.5 Hz, 0.45H (*exo*)), 6.45 (dd, *J* = 3.5 Hz, 6.0 Hz, 0.55H (*endo*)), 6.13 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.45H (*exo*)), 5.86 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.55H (*endo*)), 3.87 (dd, *J* = 3.5 Hz, 5.0 Hz, 0.45H (*exo*)), 3.83 (dd, *J* = 3.5 Hz, 5.0 Hz, 0.55H (*endo*)), 3.43 (d, *J* = 4.0 Hz, 0.55H (*endo*)), 3.37 (dd, *J* = 1.5 Hz, 5.5 Hz, 0.45H (*exo*)), 3.35 (s, 0.55H), 3.15-3.12 (m, 0.85H), 3.08 (d, *J* = 1.5 Hz, 0.55H (*endo*)), 1.96 (d, *J* = 8.5 Hz, 0.55H (*endo*)), 1.87 (d, *J* = 8.5 Hz, 0.45H (*exo*)), 1.66 (dq, *J* = 1.5 Hz, 8.5 Hz, 0.65H (*endo*)), 1.53 (d, *J* = 1.5 Hz, 0.45H (*exo*)) ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 200.9, 199.8, 139.2, 137.2, 136.9, 136.7, 133.2, 133.1, 133.1, 131.7, 131.3, 130.3, 129.8, 128.7, 128.6, 128.5, 56.5, 54.7, 49.1, 48.9,, 48.8, 48.5, 48.1,48.0, 47.2, 45.4 ppm.

Phenyl-(3-(*p*-tolyl)bicyclo[2.2.1]hept-5-en-2-yl)methanone (3i)

Results: 91% yield, yellow oily liquid dr = 68:32 (*endo:exo*); **IR (ATR):** ν_{max} 3051, 2973, 1672, 1592, 1444, 1325, 1204, 1013, 805, 766, 789, 662 cm^{-1}; **^{1}H-NMR (500 MHz, $CDCl_3$)**: δ 7.95- 7.92 (m, 1.40H (*endo*)), 7.91-7.88 (m, 0.64H (*exo*)), 7.56-7.49 (m, 1H), 7.46-7.37 (m, 2H), 7.18-7.09(m, 3H), 7.05 (s, 1H), 6.50 - 6.45 (m, 1H), 6.18 (dd, *J* = 3.0 Hz, 6.0 Hz, 0.32H (*exo*)), 5.87 (dd, *J* = 3.0 Hz, 6.0 Hz, 0.68H (*endo*)), 3.90 (dd, *J* = 3.5 Hz, 5.0 Hz, 0.68H (*endo*)), 3.87 (dd, *J* = 3.0 Hz, 5.0 Hz, 0.32H(*exo*)) 3.44 (d, *J* = 4.0 Hz, 0.68H (*endo*)), 3.42 (dd, *J* = 1.0 Hz, 5.0 Hz, 0.32H (*exo*)), 3.33 (s, 0.68H (*endo*)), 3.16 (s, 0.32H (*exo*)), 3.13 (s, 0.32H (*exo*)), 3.09 (d, *J* = 1.5 Hz, 0.68H (*endo*)), 2.32 (s, 2H, CH_3 (*endo*)), 2.30 (s, 1H, CH_3 (*exo*)), 2.03 (d, *J* = 10.0 Hz, 0.68H (*endo*)), 1.90 (d, *J* = 10.0 Hz, 0.32H (*exo*)), 1.64 (dq, *J* = 1.5 Hz, 8.5 Hz, 0.68H (*endo*)), 1.54 (dq, *J* = 1.5 Hz, 8.5 Hz, 0.32H (*exo*)) ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 201.4, 200.2, 141.7, 140.6, 139.3, 137.4, 137.1,, 137.0, 136.6, 135.8, 135.6, 133.0, 133.0,, 132.9, 129.3, 128.9, 128.6, 128.6, 128.5, 128.0, 127.5, 56.3, 54.7, 49.0, 48.9, 48.8, 48.7, 48.1, 47.9, 47.5, 45.6, 46.0, 30.5, 29.8, 21.1, 21.1 ppm.

(3-(4-Nitrophenyl)bicyclo[2.2.1]hept-5-en-2-yl)(phenyl)methanone (3j)

Results: 95% yield, yellow oily liquid, dr = 67:33 (*endo:exo*); **IR (ATR):** ν_{max} 3052, 2983, 2854, 1678, 1593, 1509, 1448, 1422, 1346, 1271, 1226, 1015, 822, 747, 672 cm^{-1}; **^{1}H-NMR (500 MHz, $CDCl_3$)**: δ 8.13 (dt, *J* = 2.5 Hz, 4.0 Hz, 1.32H), 8.09 (dt, *J* = 0.5 Hz, 8.0 Hz, 0.64H), 7.96- 7.90 (m, 2H), 7.59-7.53 (m, 1H), 7.48- 7.40 (m, 3.38H), 7.30 (dt, *J* = 2.0 Hz, 3.5 Hz, 0.68H), 6.54 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.33H), 6.47 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.67H) 6.13 (dd, *J* = 3.0 Hz, 6.0 Hz, 0.33H), 5.87(dd, *J* = 3.0 Hz, 6.0 Hz, 0.67H), 4.10 (dd, *J* = 3.5 Hz, 5.0 Hz, 0.33H), 3.85 (dd, *J* = 1.0 Hz, 5.0 Hz, 0.67H), 3.62 (d, *J* = 4 Hz, 0.67H), 3.45(dd, *J* = 1.5 Hz, 9.0 Hz, 0.33H), 3.41(s, 0.68H), 3.22(s, 0.33H), 3.19- 3.16(m, 1H), 1.97 (d, *J* = 8.5 Hz, 0.68H), 1.89 (d, *J* = 8.5 Hz, 0.33H), 1.71(dq, *J* = 1.5 Hz, 9.0 Hz, 0.67H), 1.57 (dq, *J* = 1.5 Hz, 9.0 Hz, 0.33H) ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 200.0, 199.2, 152.9, 151.7, 146.6, 146.4, 139.1, 137.3, 136.9, 136.6, 136.4, 133.4, 133.2, 133.2, 128.8, 128.8, 128.6, 128.4, 128.3, 123.9, 123.5, 56.7, 54.7, 49.3, 49.0, 48.9,, 48.2, 48.1, 47.9, 47.5, 45.8 ppm.

4-(3-Benzoylbicyclo[2.2.1]hept-5-en-2-yl)benzonitrile (3k)

Results: 94% yield, yellow oily liquid, dr = 45:55 (*endo:exo*); **IR (ATR):** ν_{max} 2971, 2980, 2227, 1675, 1607, 1597, 1505, 1448, 1330, 1211, 1017, 833, 761, 695, 563 cm^{-1}; **^{1}H-NMR (500 MHz, $CDCl_3$)**: δ 7.95- 7.89 (m, 2H), 7.59-7.51 (m, 3H), 7.50-7.42 (m, 2H) 7.40- 7.35 (m, 1H), 7.26-7.24 (m, 1H), 6.52 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.54H (*exo*)), 6.46 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.46H (*endo*)), 6.12 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.54H(*exo*)), 5.86 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.46H (*endo*)), 4.04 (dd, *J* = 3.5 Hz, 5.0 Hz, 0.54H), 3.83 (dd, *J* = 3.5 Hz, 5.0 Hz, 0.46H) 3.56 (d, *J* = 4.0 Hz, 0.46H), 3.42 (dd, *J* = 1.5 Hz, 5.5 Hz, 0.54H(*exo*)), 3.39 (s, 0.46H (*endo*)), 3.20 (s, 0.56H), 3.17 (s, 0.55H), 3.14 (s, 0.45H), 1.95 (d, *J* = 8.5 Hz, 0.46H (*endo*)), 1.88 (d, *J* = 8.5 Hz, 0.54H (*exo*)), 1.70(dd, *J* = 2.0 Hz, 9.0 Hz, 0.46H), 1.56 (dd, *J* = 2.0 Hz, 9.0 Hz, 0.54H), ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 200.2, 199.3, 150.6, 149.4, 139.1, 137.2, 137.0, 136.7, 136.4, 133.3, 133.2, 132.5, 132.1, 128.9, 128.8, 128.6, 128.5, 128.4, 127.3, 119.1, 110.2, 110.0,, 56.6, 54.6, 49.3, 48.9, 48.8, 48.2, 48.0, 47.9, 47.6, 45.9 ppm.

(4-Fluorophenyl)(3-(*p*-tolyl)bicyclo[2.2.1]hept-5-en-2-yl)methanone (3l)

Results: 88% yield, yellow oily liquid, dr = 63:37 (*endo:exo*); **IR (ATR):** ν_{max} 3061, 2963, 2924, 1742, 1672, 1455, 1362, 1223, 1013, 805, 713, 674 cm^{-1}; **^{1}H-NMR (500 MHz, $CDCl_3$)**: δ7.97-7.93 (m, 1.30H (*endo*)), 7.90-7.86 (m, 0.74H (*exo*)), 7.18-7.02 (m, 6H), 6.48-6.43 (m, 1H), 6.17 (dd, *J* = 2.5 Hz, 5.5 Hz, 0.37H (*exo*)), 5.88 (dd, *J* = 3.0 Hz, 6.0 Hz, 0.63H (*endo*)), 3.84 (dd, *J* = 3.5 Hz, 5.0 Hz, 0.63H (*endo*)), 3.78 (dd, *J* = 3.5 Hz, 5.5 Hz, 0.37H (*exo*)), 3.38 (d, *J* = 4.0 Hz, 0.63H (*endo*)), 3.34 (dd, *J* = 1.0 Hz, 5.0 Hz, 0.37H (*exo*)), 3.31 (s, 0.63H (*endo*)),

3.15-3.10 (m, 0.75H (*exo*)), 3.09- 3.06 (m, 0.63H (*endo*)), 2.32 (s, 2H CH_3 (*endo*)), 2.30 (s, 1H CH_3 (*exo*)), 2.02 (d, *J* = 8.5 Hz, 0.63H (*endo*)), 1.88 (d, *J* = 8.5 Hz, 0.37H (*exo*)), 1.63 (dq, *J* = 1.5 Hz, 3.5 Hz, 0.63H (*endo*)), 1.54 (m, 0.37H (*exo*)) ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 200.0, 198.7, 165.7 (d, *J* = 253.7 Hz), 165.6 (d, *J* = 253.7 Hz), 141.6, 139.3, 137.0, 135.7, 133.7 (d, *J* = 2.5 Hz), 133.5 (d, *J* = 2.5 Hz), 133.0, 131.2 (d, *J* = 8.7 Hz), 131.1 (d, *J* = 8.7 Hz), 129.4, 129.0, 128.0, 127.5, 115.8 (d, *J* = 21.2 Hz), 115.6 (d, *J* = 21.2 Hz), 56.3, 54.7, 49.1, 48.9, 48.8, 48.6, 48.2, 48.1, 47.8, 45.9, 21.1 ppm; **^{19}F NMR (470 MHz, $CDCl_3$):** δ –105.79 (*exo*), –105.89 (*endo*) ppm.

(4-Chlorophenyl)(3-(*p*-tolyl)bicyclo[2.2.1]hept-5-en-2-yl)methanone (3m)

Results: 87% yield, yellow oily liquid, dr = 73:27 (*endo:exo*); **IR (ATR):** ν_{max} 3052, 2962, 2921, 1731, 1672, 1581, 1362, 1212, 1013, 804, 712, 674 cm^{-1}; **^{1}H-NMR (500 MHz, $CDCl_3$):** δ 7.85 (dt, *J* = 2.5 Hz, 9.0 Hz, 1.54H (*endo*)), 7.78 (dt, *J* = 2.5 Hz, 9.5 Hz, 0.57H (*exo*)), 7.39 (dt, *J* = 2.5 Hz, 9.5 Hz, 1.55H (*endo*)), 7.34 (dt, *J* = 2.5 Hz, 9.5 Hz 0.62H (*exo*)), 7.19- 7.02 (m, 4H), 6.45 (m, 1H), 6.16 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.27H (*exo)*) 5.86 (dd, *J* = 3.0 Hz, 6.0 Hz, 0.73H (*endo*)), 3.82 (dd, *J* = 3.5 Hz, 5.0 Hz, 0.73H (*endo*)), 3.76 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.27H (*exo*)), 3.37 (d, *J* = 4.0 Hz, 0.72H (*endo*)), 3.33 (dd, *J* = 1.5 Hz, 5.5 Hz, 0.27H (*exo*)), 3.29 (s, 0.73H (*endo*)), 3.14-3.10 (m, 0.59H), 3.08-3.06 (m, 0.73H (*endo*)), 2.32 (s, 2H, CH_3 (*endo*)), 2.30 (s, 1H, CH_3 (*exo*)), 2.01 (d, *J* = 8.5 Hz, 0.73H (*endo*)), 1.87 (d, *J* = 9.0 Hz, 0.27H (*exo*)), 1.63 (dd, *J* = 3.5 Hz, 10.5 Hz, 0.72H (*endo*)), 1.42 (s, 0.27H (*exo*)) ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 200.5, 199.1, 141.3, 139.4, 139.3, 137.0, 136.5, 135.8, 135.7, 133.0, 130.0, 129.9, 129.4, 129.0, 129.0, 128.9, 128.0, 127.5, 56.4,, 54.7, 49.2, 49.0, 48.7, 48.6, 48.2, 48.1, 45.9, 21.1 ppm.

4-Bromophenyl-(3-(*p*-tolyl)bicyclo[2.2.1]hept-5-en-2-yl)methanone (3n)

Results: 86% yield, yellow oily liquid, dr = 66:34 (*endo:exo*); **IR (ATR):** ν_{max} 2951, 2923, 2851, 1741, 1585, 1457, 1371, 1212, 1025, 803, 721, 682 cm^{-1}; **^{1}H-NMR (500 MHz, $CDCl_3$)**: δ 7.77 (dt, *J* = 2.0 Hz, 9.0 Hz, 1.37H (*endo*)), 7.70 (dt, *J* = 2.0 Hz, 9.0 Hz, 0.69H (*exo*)), 7.56 (dt, *J* = 2.5 Hz, 9.5 Hz, 1.34H (*endo*)), 7.50 (dt, *J* = 2.0 Hz, 9.0 Hz, 0.68H (*exo*)), 7.17-7.01 (m, 4H), 6.47-6.42 (m, 1H), 6.16 (dd, *J* = 2.8 Hz, 5.6 Hz, 0.34H (*exo*)), 5.86 (dd, *J* = 2.8 Hz, 5.6 Hz, 0.66H (*endo*)), 3.81 (dd, *J* = 3.4 Hz, 5.0 Hz, 0.66H), 3.75 (dd, *J* = 3.5 Hz, 5.5 Hz, 0.34H), 3.37 (d, *J* = 4.0 Hz, 0.66H (*endo*)), 3.31 (dd, *J* = 1.5 Hz, 5.4 Hz, 0.34H (*exo*)), 3.29 (s, 0.66H (*endo*)), 3.11 (d, *J*= 8.0 Hz, 0.90H (*exo*)), 3.06 (s, 0.55H (*endo*)), 2.32 (s, 2H, CH_3 (*endo*)), 2.30 (s, 1H, CH_3 (*exo*)), 2.01 (d, *J* = 8.5 Hz, 0.66H (*endo*)), 1.86 (d, *J* = 8.6 Hz, 0.34H (*exo*)),

1.63(dd, *J* = 3.4 Hz, 10.5 Hz, 1H) ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 200.5, 198.7, 141.6, 138.6, 137.1, 136.0, 135.8, 133.0, 132.0, 131.9, 131.9, 130.2, 130.1,, 129.4, 129.0, 128.0, 127.5, 56.3, 49.2, 49.0,, 48.7, 48.6, 48.6, 48.2, 48.1, 47.9, 45.9, 29.8, 21.1 ppm.

4-Methoxyphenyl(3-(*p*-tolyl)bicyclo[2.2.1]hept-5-en-2-yl)methanone (3o)

Results: 84% yield, yellow oily liquid, dr = 59:41 (*endo:exo*); **IR (ATR):** ν_{max} 3012, 2963, 2934, 1732, 1669, 1592, 1457, 1367, 1225, 1027, 837, 719, 689 cm^{-1}; **^{1}H-NMR (500 MHz, $CDCl_3$)**: δ 7.92 (dt, *J* = 2.0, 10.0 Hz, 1.23H (*endo*)), 7.86 (dt, *J* = 2.5 Hz, 9.5 Hz, 0.84H (*exo*)), 7.19-7.08 (m, 2.5H (*endo*)), 7.04 (s, 1.6H (*exo*)), 6.90 (dd, *J* = 2.0 Hz, 7.0 Hz, 1.25H (*endo*)), 6.86 (dd, *J* = 2.5 Hz, 7.0 Hz, 0.80H (*exo*)), 6.47-6.43 (m, 1H), 6.16 (dd, *J* = 3.0 Hz, 5.5 Hz, 0.41H (*exo*)), 5.88 (dd, *J* = 2.5 Hz, 5.6 Hz, 0.59H (*endo*)), 3.86 (s, 1.8H –OCH_3 (*endo*)), 3.85-3.82 (m, 2.2H {1.2H, –O*C*H_3, (*exo*) + 1H (*endo* + *exo*)}), 3.42 (d, *J* = 4.3 Hz, 0.59H (*endo*)), 3.35 (dd, *J* = 1.4 Hz, 5.0 Hz, 0.41H (*exo*)), 3.31 (s, 0.59H (*endo*)), 3.13 (s, 0.41H (*exo*)), 3.07 (d, *J* = 1.5 Hz, 0.59H), 2.31 (s, 1.8H, C*H*$_3$ (*endo*)), 2.29 (s, 1.2H, C*H*$_3$ (*exo*)), 2.01 (d, *J* = 8.4 Hz, 0.59H (*endo*)), 1.90 (d, *J* = 8.6 Hz, 0.41H (*exo*)), 1.62 (dd, *J* = 1.6 Hz, 8.5 Hz, 0.59H), 1.52 (dd, *J* = 1.6 Hz, 8.5 Hz, 0.41H) ppm; **^{13}C NMR (125 MHz, $CDCl_3$):** δ 200.0, 198.6, 163.4, 163.4, 141.9, 140.7, 139.2, 136.9, 136.7, 135.8, 135.6, 133.1, 130.9, 130.8, 130.3, 130.2, 129.3, 128.9, 128.0, 127.5, 113.8, 113.8, 55.9, 55.6, 55.6, 54.3, 49.1, 48.9, 48.8, 48.8, 48.1, 48.1, 47.6, 45.7, 29.8, 21.1, 21.1 ppm.

Copies of ^{1}H-NMR spectra of CDs, Amino acids and Inclusion Complexes

&

Copies of ^{1}H and ^{13}C NMR Spectra of DA adducts

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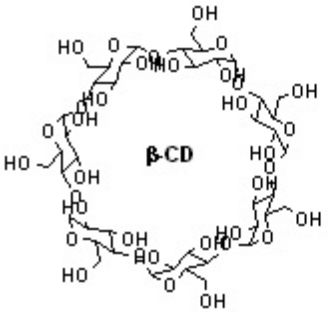

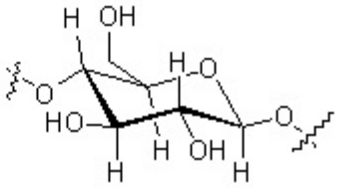

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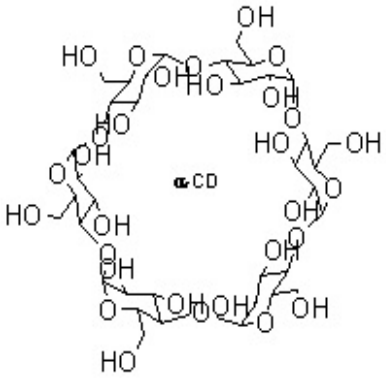
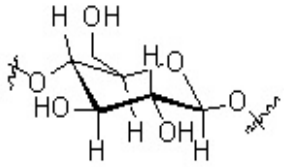
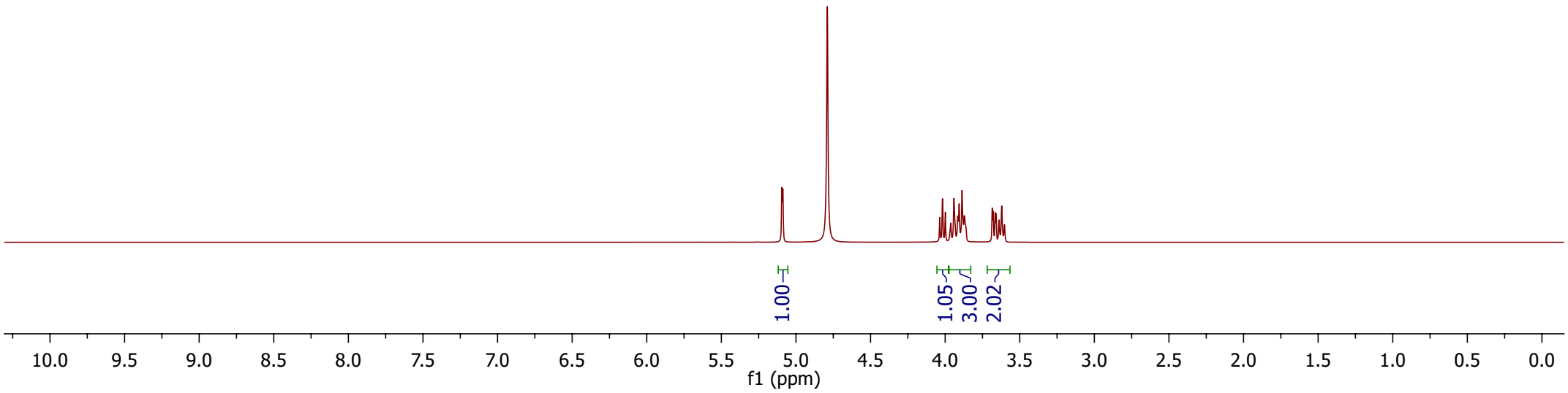




Monomeric unit



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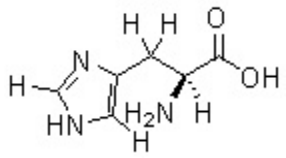

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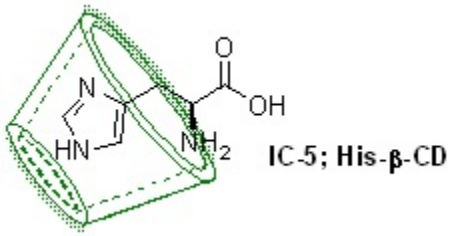

IC-5; His-β-CD

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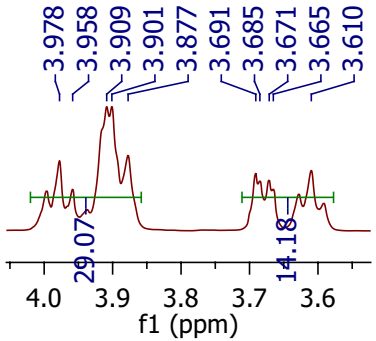

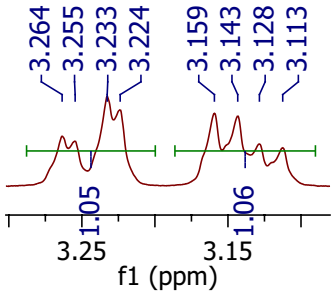

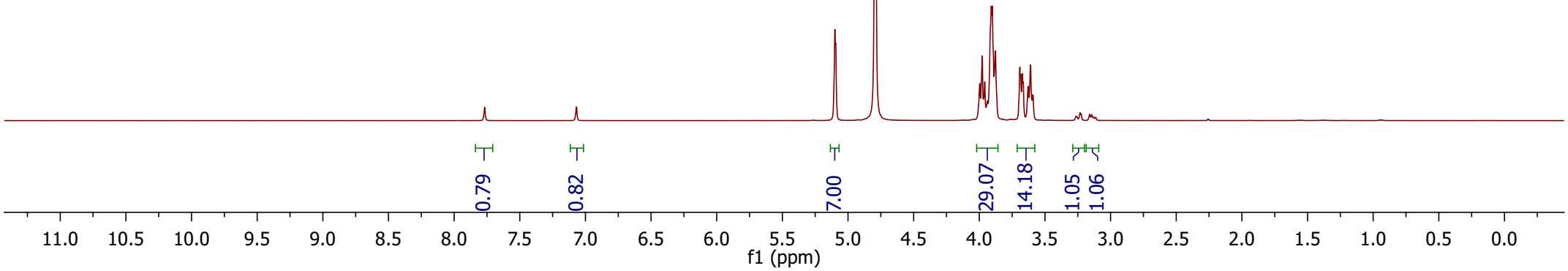

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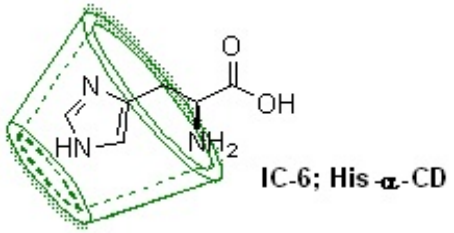

IC-6; His-α-CD

f1 (ppm)

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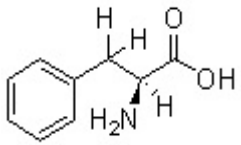

divya
AJ-3
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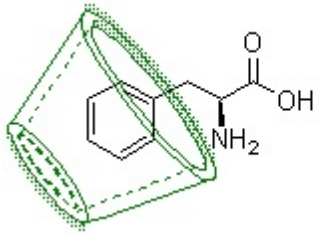

IC-8; Phe-β-CD

f1 (ppm)

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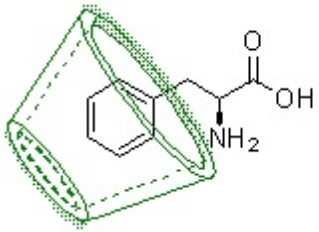

IC-9; Phe-α-CD

Mar05-2024
DJ-198
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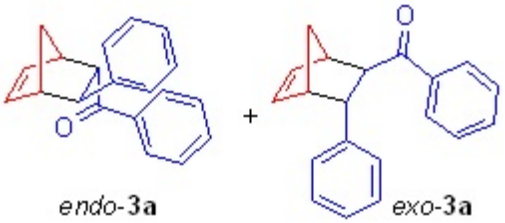

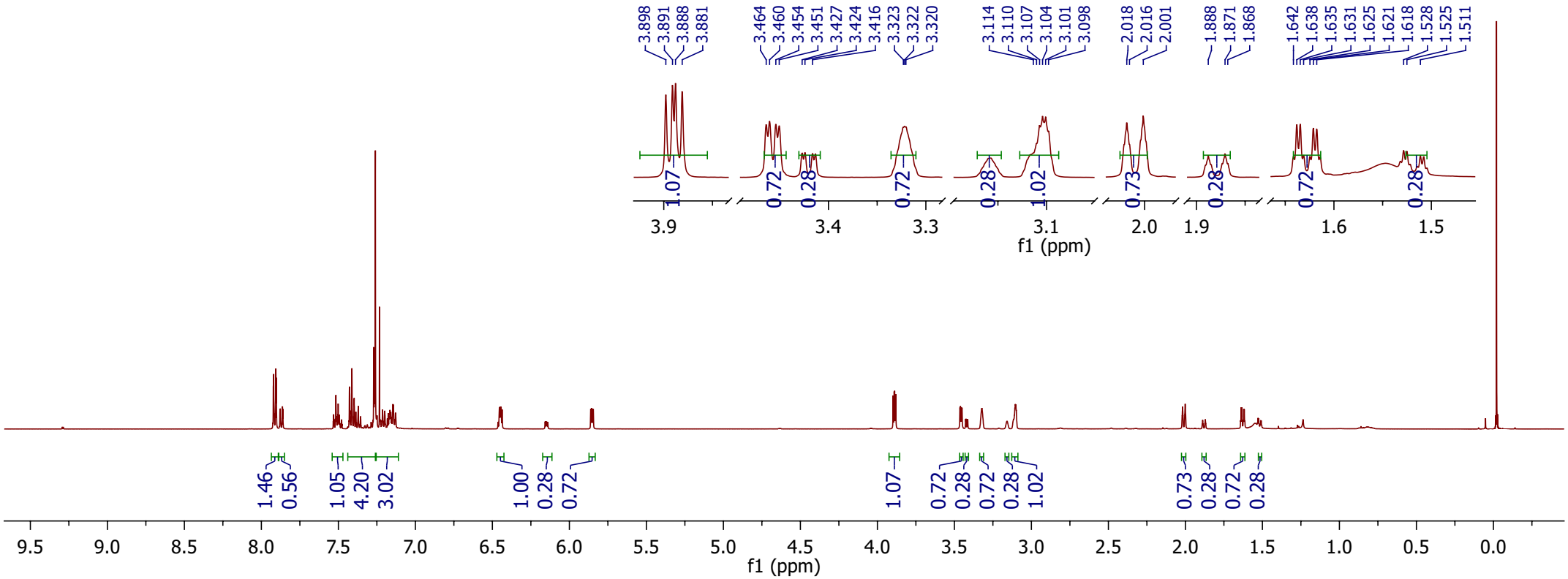

Mar05-2024
DT-1981
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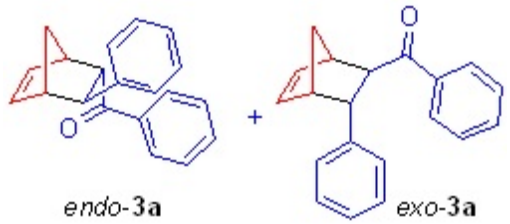
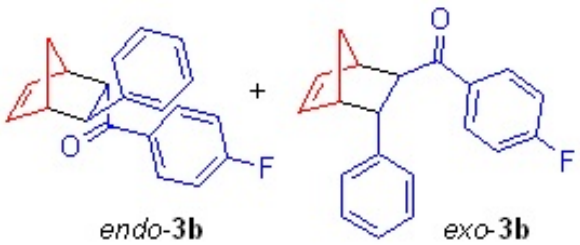
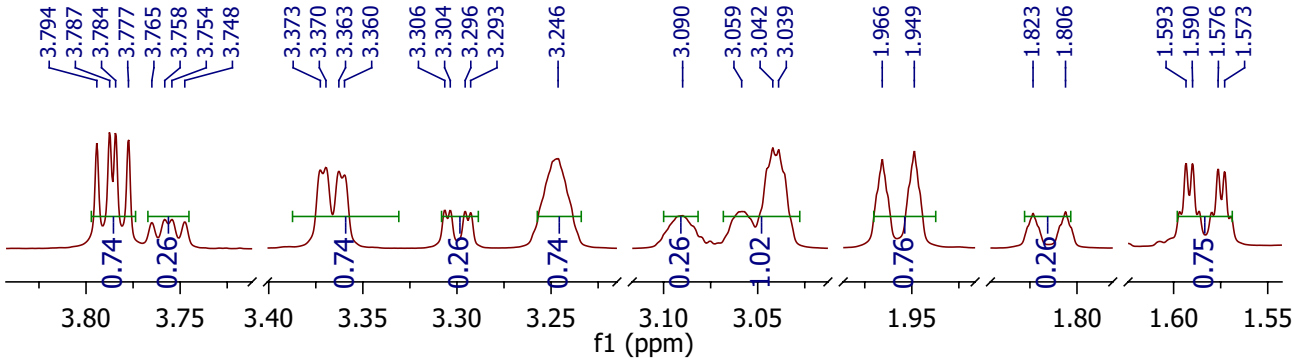


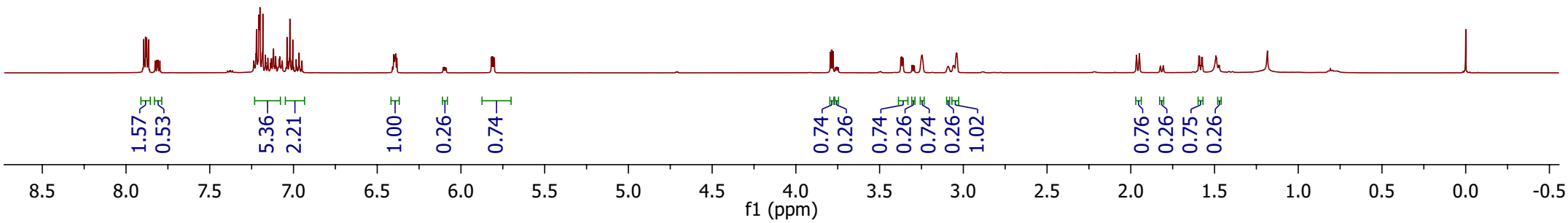
f1 (ppm)

D4 SUBSTRATES asymm Nmrs
D6-223
1H_8scan CDCl3 {D:\Spectra} nmr 22



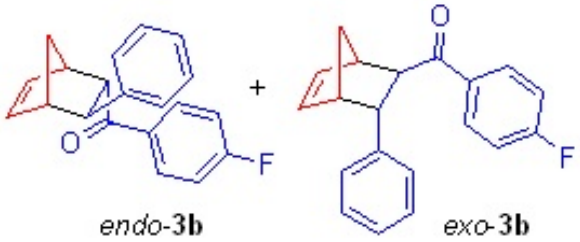
endo-**3b** *exo*-**3b**





DA SUBSTRATES asymm Nmrs
DT-273
C13CPD CDCl3 {D:\Spectra} nmr 6

199.4 198.4 166.7 164.7 139.4 137.0 133.0 131.3 131.1 131.1 128.7 128.3 128.1 127.6 126.5 126.2 115.8 115.6 77.4 77.2 76.9 56.2 54.6 49.1 48.8 48.7 48.7 48.2 48.1 46.2



endo-**3b** *exo*-**3b**

144.64 143.43 139.36 136.99 136.60 133.70 133.67 133.46 133.43 133.03 131.26 131.19 131.13 131.06 128.72 128.32 128.14 127.61 126.46 126.20 115.82 115.77 115.65 115.59

145 134 132 129 127
f1 (ppm)

49.06 48.79 48.72 48.67 48.15 48.12

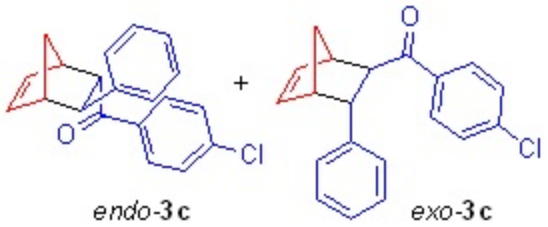
49.0 48.5 48.0
f1 (ppm)

166.78 166.72 164.75 164.70

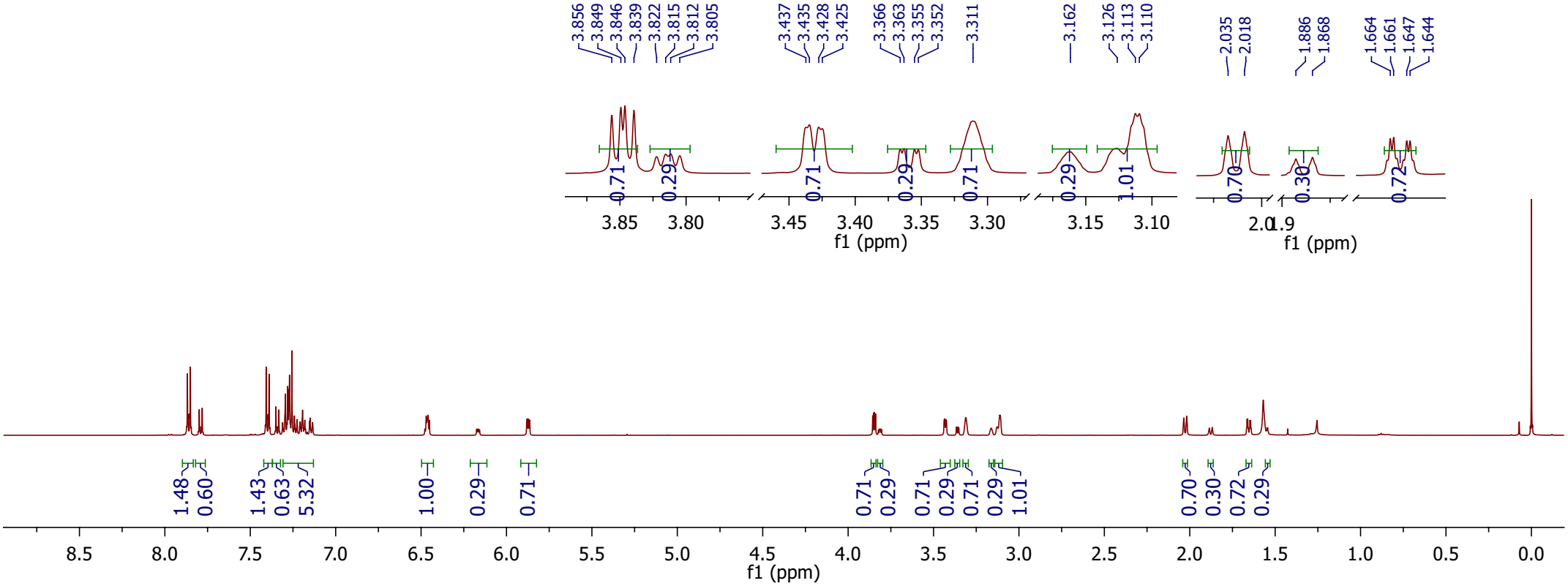
166.8 164.8
f1 (ppm)

220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

DA SUBSTRATESasymm_Nmrs
DB-224
1H_8scan CDCl3 {D:\Spectra} nmr 7

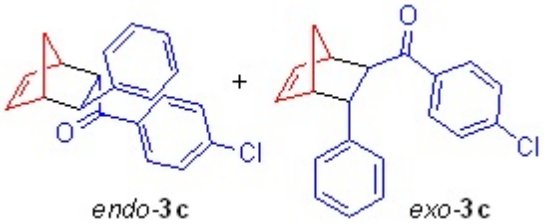


endo-**3c** *exo*-**3c**



DA SUBSTRATES asymm Nmrs
DT-274
C13CPD CDCl3 {D:\Spectra} nmr 7

200.1 199.4 144.6 143.4 139.5 139.4 139.4 137.0 136.6 135.6 135.3 133.0 130.0 129.9 129.0 128.9 128.7 128.3 128.1 128.0 127.6 126.5 126.2 77.4 77.2 76.9 56.3 54.7 49.1 48.7 48.6 48.2 48.1 46.2



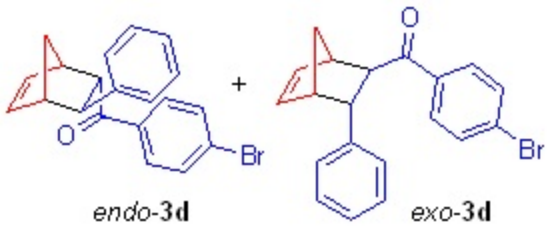
endo-**3c** *exo*-**3c**

144.6 143.4 139.5 139.4 139.4 137.0 136.6 135.6 135.3 133.0 130.0 129.9 129.0 128.9 128.7 128.3 128.1 128.0 127.6 126.5 126.2

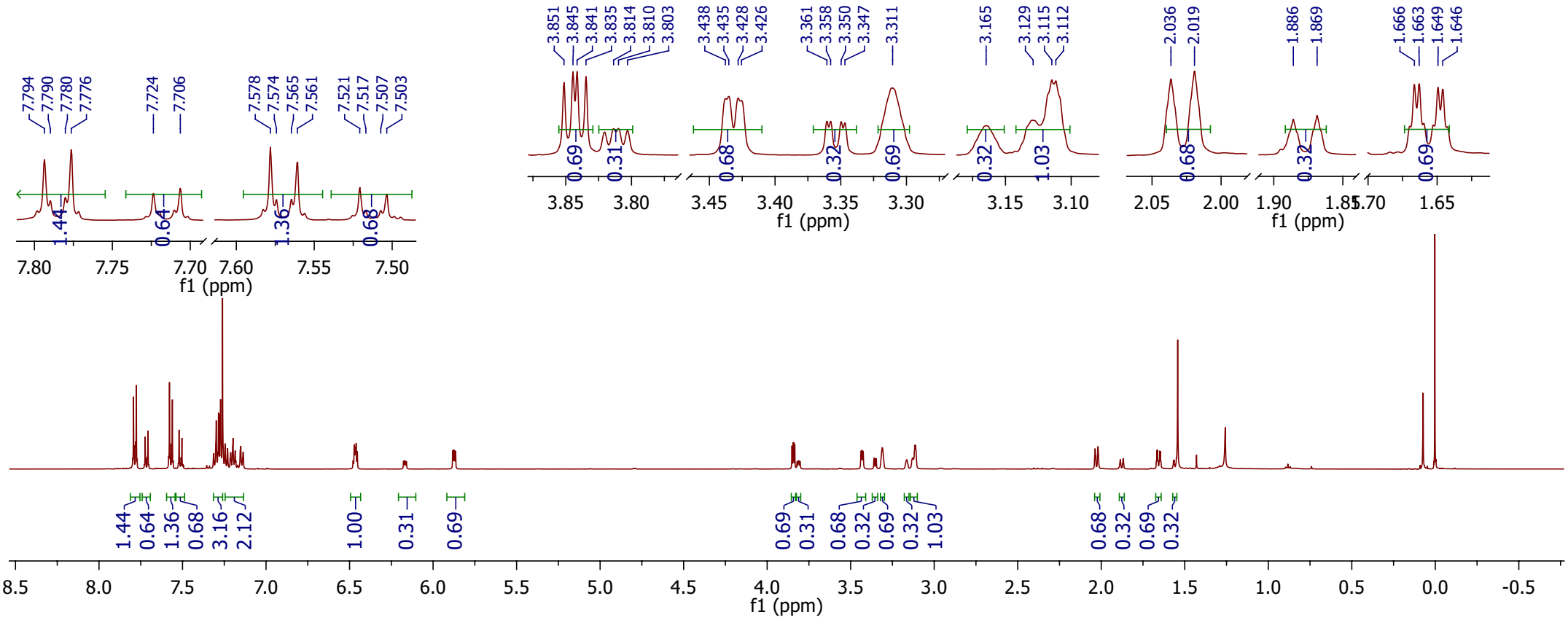
144 140 137 135 131 129 127
f1 (ppm)

220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

DA SUBSTRATES asymm Nmrs
D-277
1H_8scan CDCl3 {D:\Spectra} nmr 3

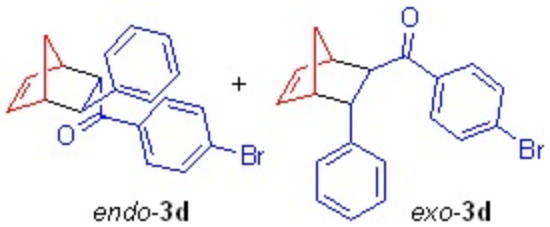


endo-**3d** *exo*-**3d**

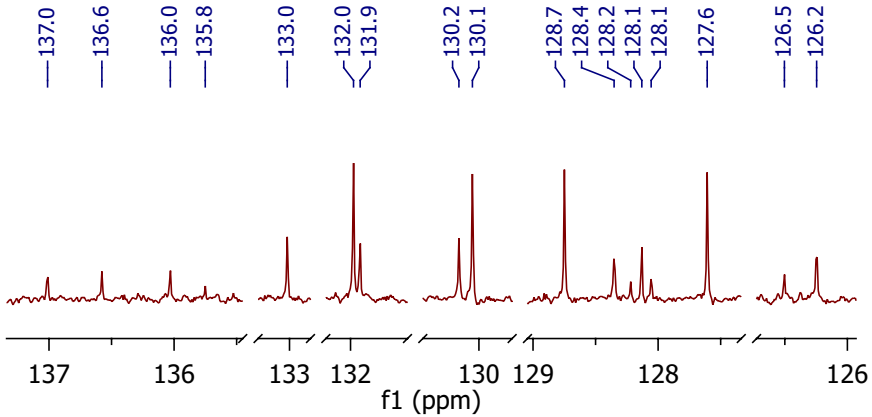


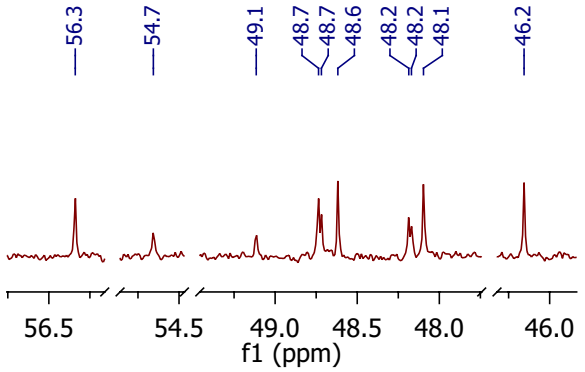
DA SUBSTRATES asymm Nmrs
DT-277
C13CPD CDCl3 {D:\Spectra} nmr 3

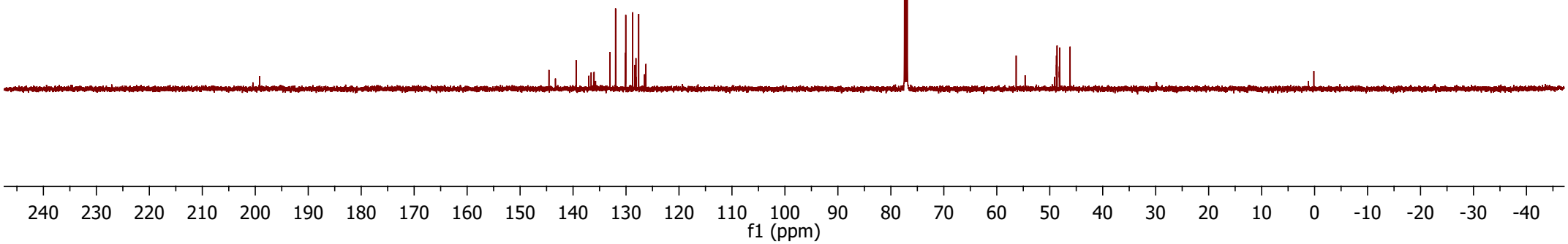
200.4 199.2 144.5 143.3 139.4 137.0 136.6 136.0 135.8 133.0 132.0 131.9 130.2 130.1 128.7 128.4 128.2 128.1 128.1 127.6 126.5 126.2 77.4 77.2 76.9 56.3 54.7 49.1 48.7 48.7 48.6 48.2 48.2 48.1 46.2



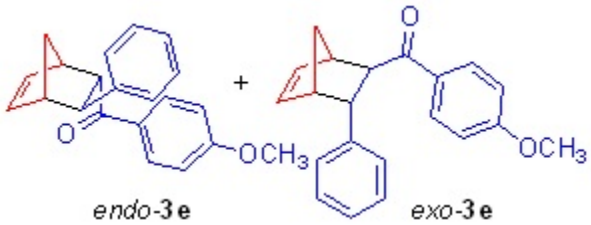
endo-**3d** *exo*-**3d**





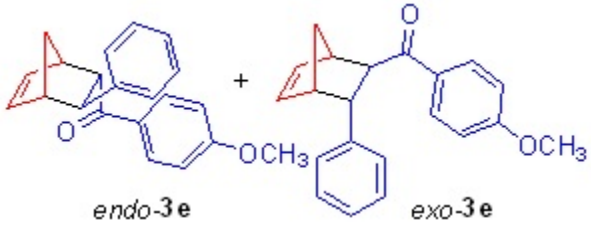


DA SUBSTRATES asymm Nmrs
D:\275
1H_8scan CDCl3 (D:\Spectra) nmr 1



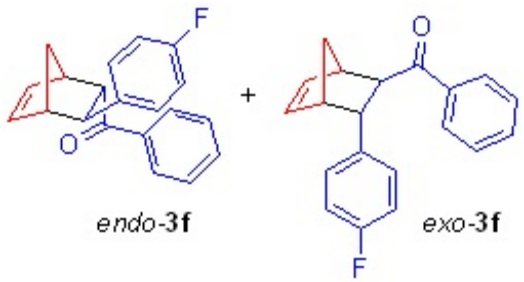
endo-**3e** *exo*-**3e**

DA SUBSTRATES asymm Nmrs
DT-275
C13CPD CDCl3 {D:\Spectra} nmr 1

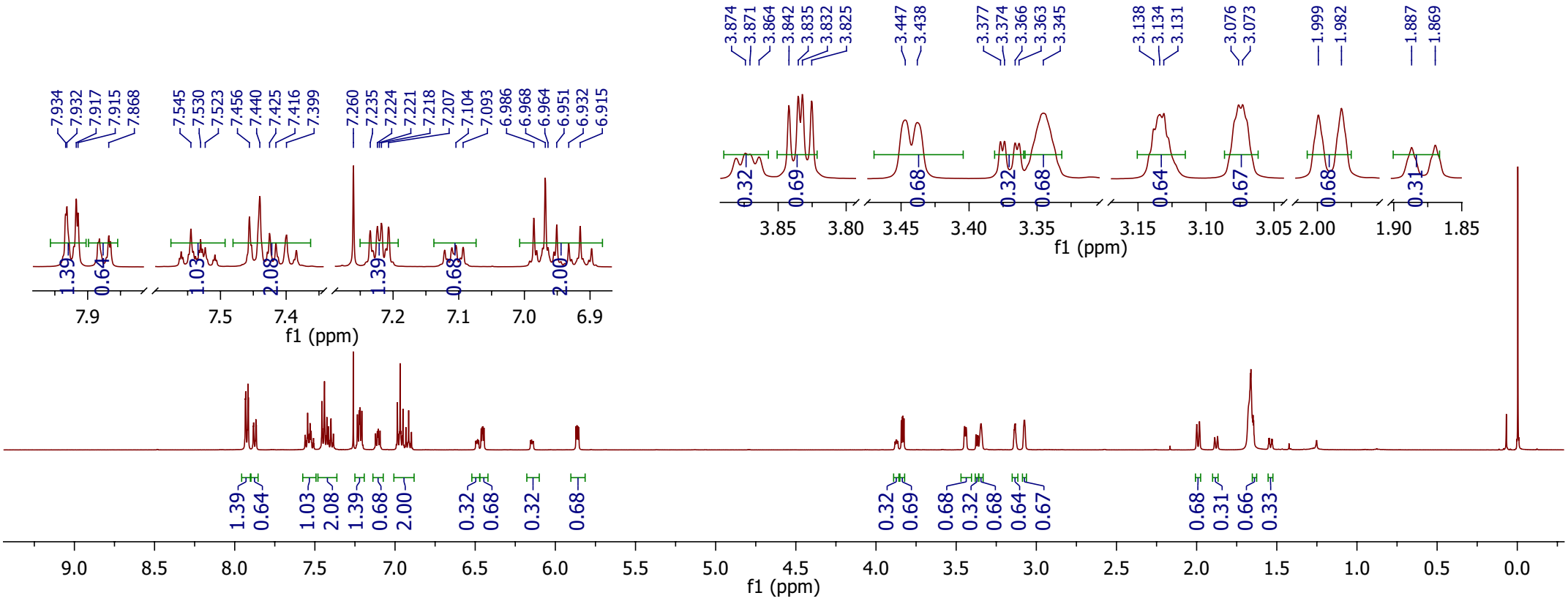


endo-**3e** *exo*-**3e**

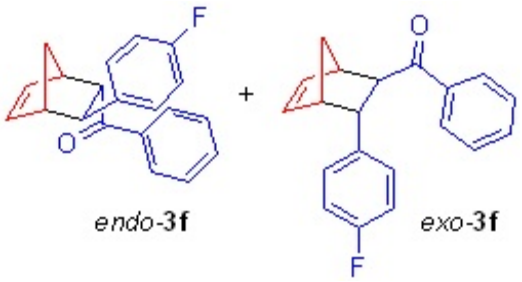
D4 SUBSTRATES asymm Nmrs
D9_278
1H_8scan CDCl3 (D:\Spectra) nmr 1



endo-**3f** + *exo*-**3f**

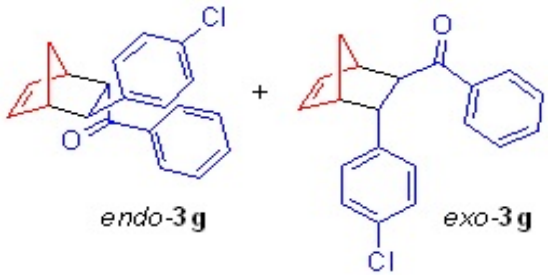


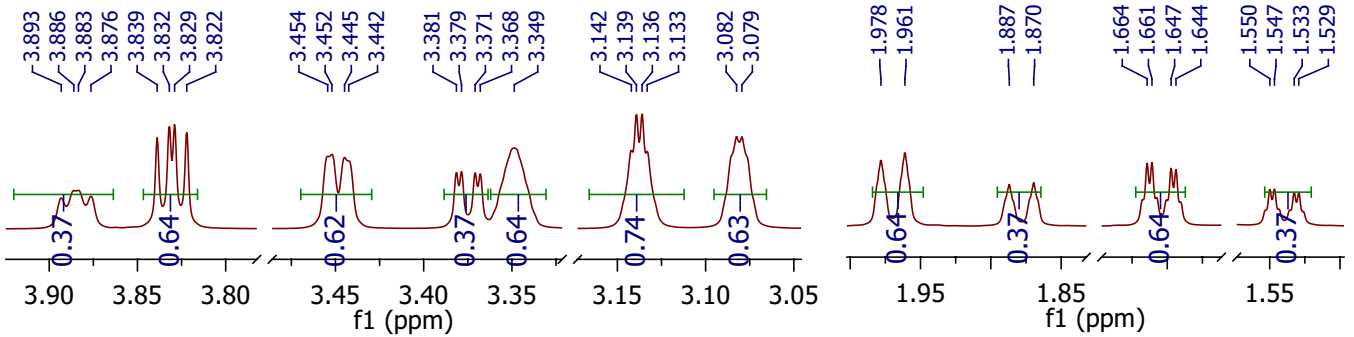
DA SUBSTRATES asymm Nmrs
DT-278
C13CPD CDCl3 {D:\Spectra} nmr 1

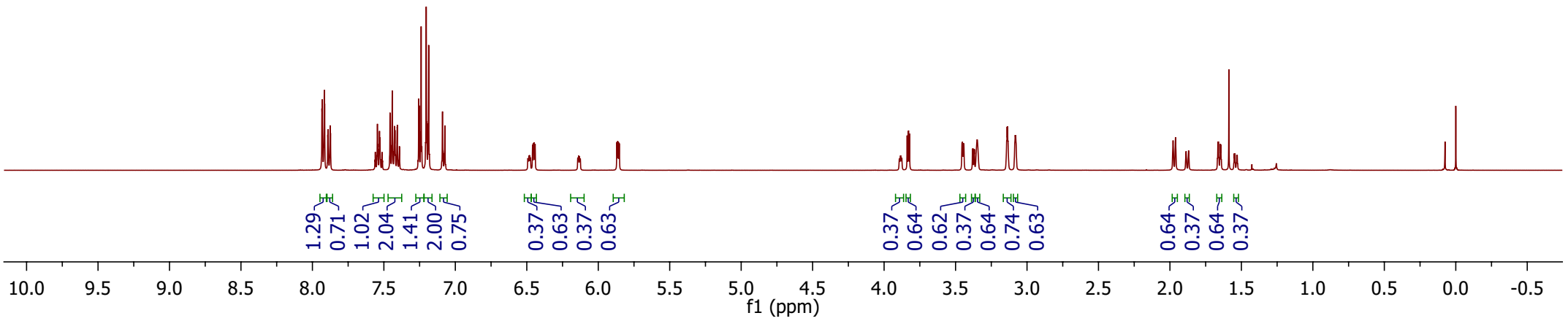


endo-**3f** *exo*-**3f**

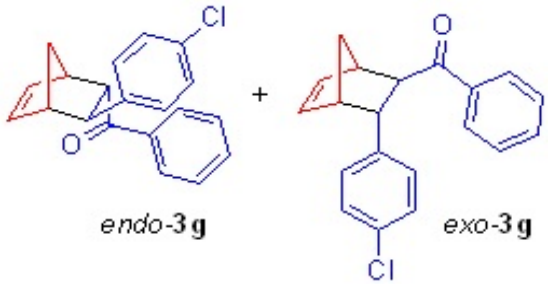
DA SUBSTRATES asymm Nmrs
DS-279
1H_8scan CDCl3 (D:\Spectra) nmr_1





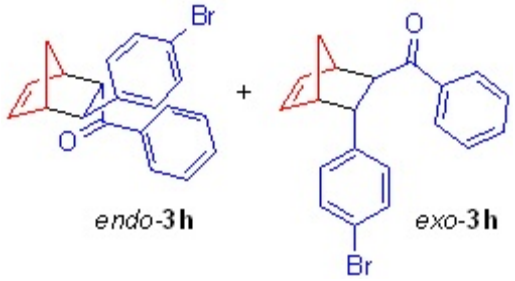


DA SUBSTRATES asymm Nmrs
DT-279
C13CPD CDCl3 {D:\Spectra} nmr 1

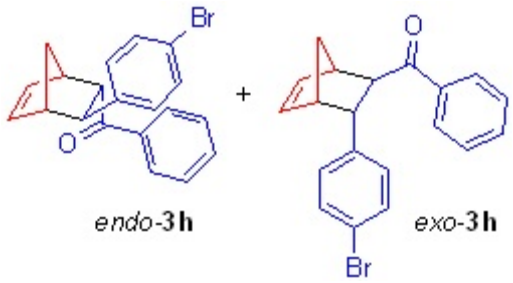


endo-**3g** *exo*-**3g**

D4 SUBSTRATES asymm Nmrs
D4-281
1H_8scan CDCl3 (D:\Spectra) nmr 8



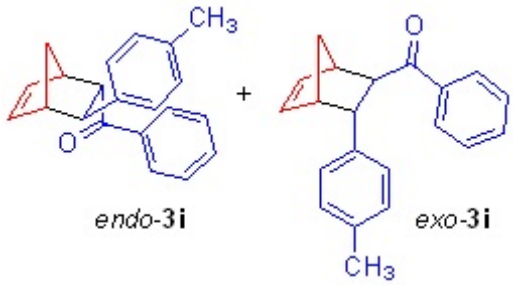
DA SUBSTRATES asymm Nmrs
DT-280
C13CPD CDCl3 {D:\Spectra} nmr 8



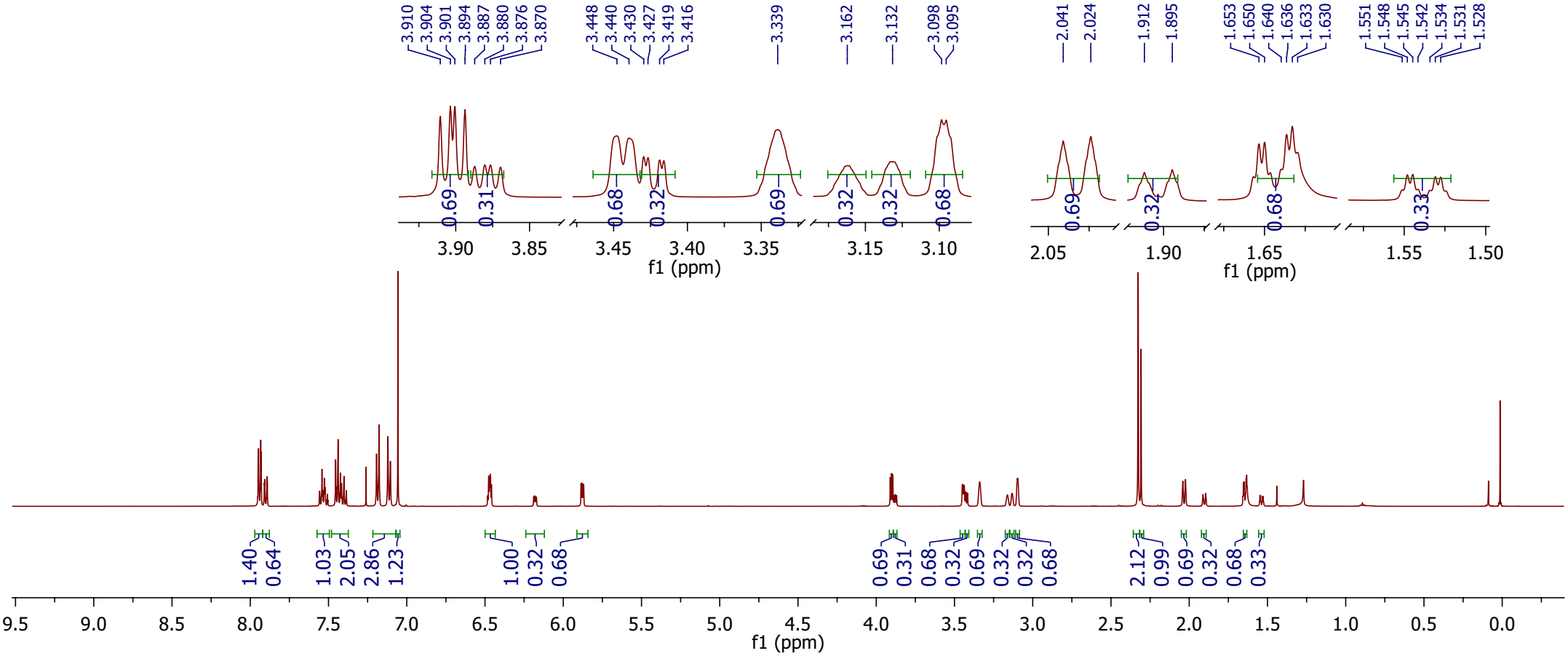
endo-**3h** *exo*-**3h**

f1 (ppm)

DA SUBSTRATES asymm Nmrs
D:\280
1H_8scan CDCl3 (D:\Spectra) nmr 13

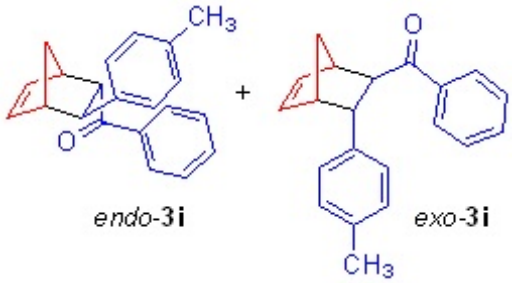


endo-**3i** *exo*-**3i**

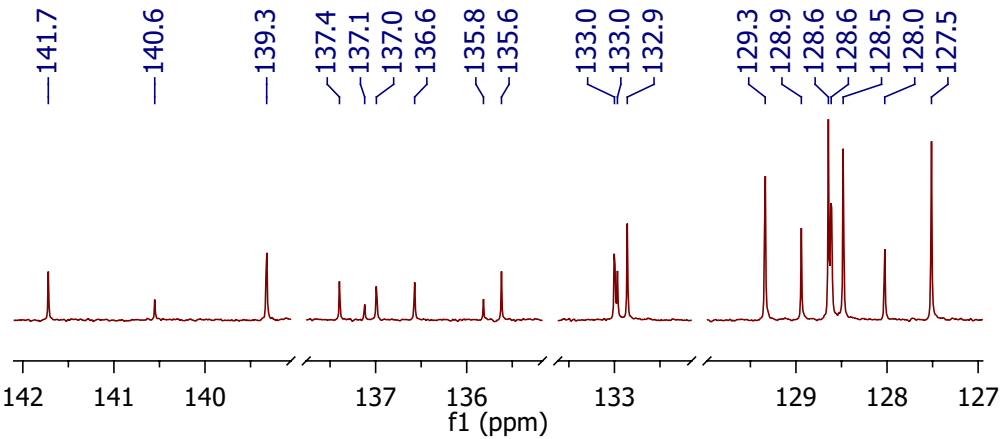


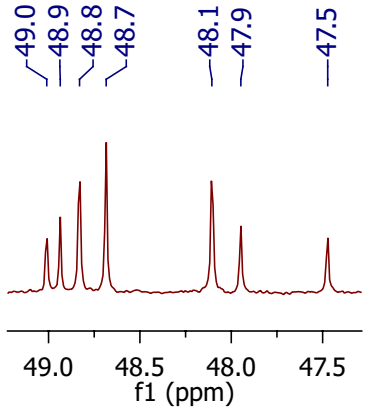
DA SUBSTRATES asymm Nmrs
DT-28g
C13CPD CDCl3 {D:\Spectra} nmr 13

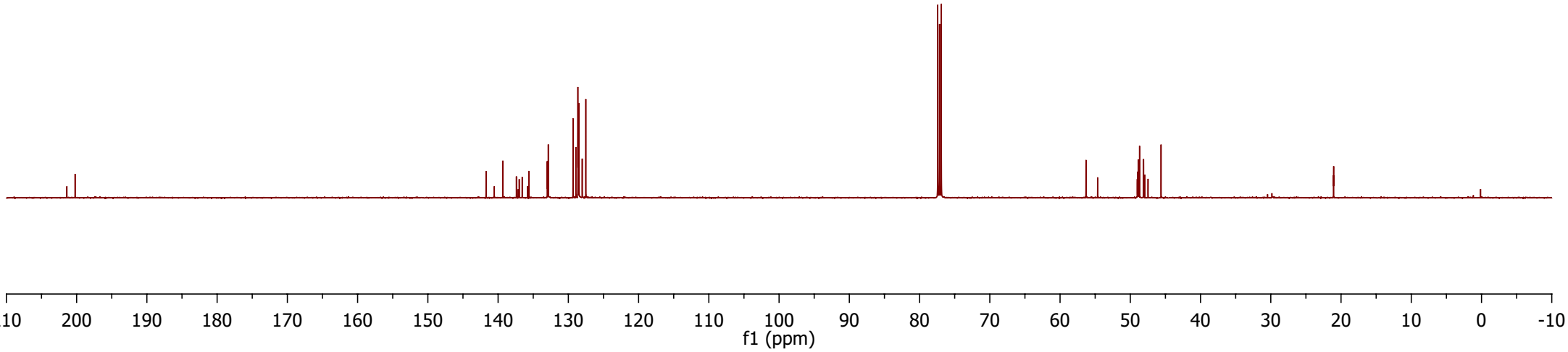
200.1
200.0
141.7
140.6
139.3
137.4
137.1
137.0
136.6
135.8
135.6
133.0
133.0
132.9
129.3
128.9
128.6
128.6
128.5
128.0
127.5
77.4
77.2
76.9
56.3
54.7
49.0
48.9
48.8
48.7
48.1
47.9
47.5
45.6
30.5
29.8
21.1
21.1



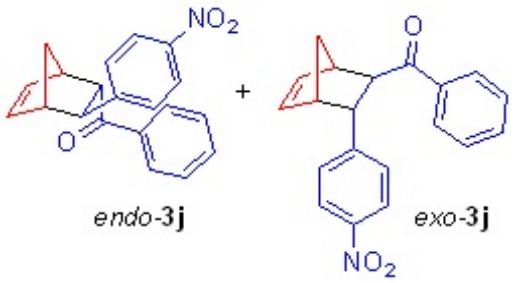
endo-**3i** *exo*-**3i**



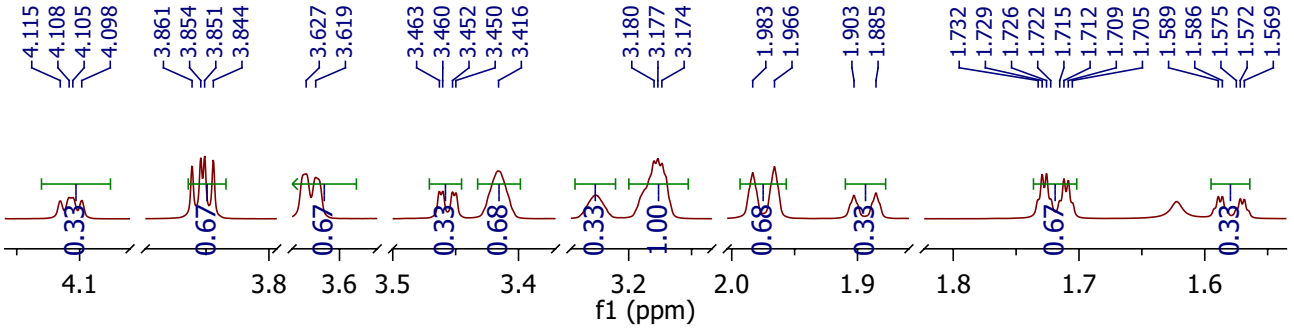


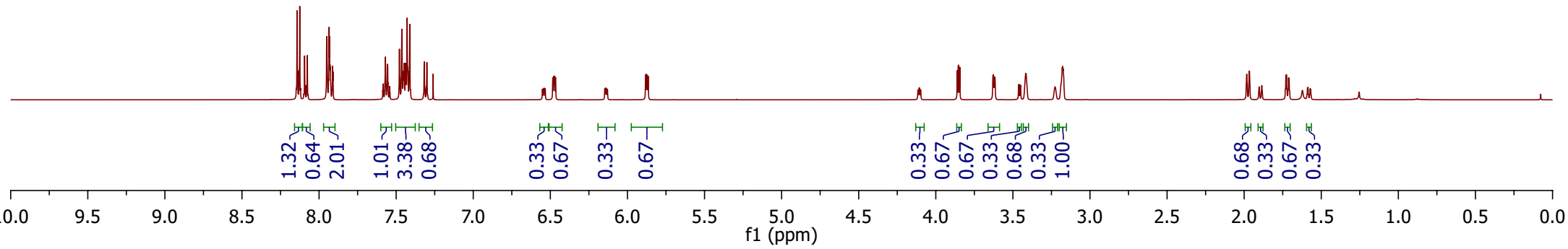


DA SUBSTRATES asymm Nmrs
DT-287
1H_dscan CDCl3 (D:\Spectra) nmr 1

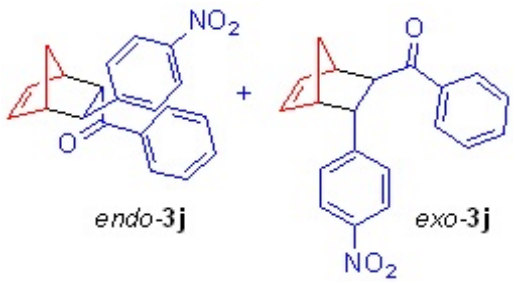


endo-**3j** *exo*-**3j**

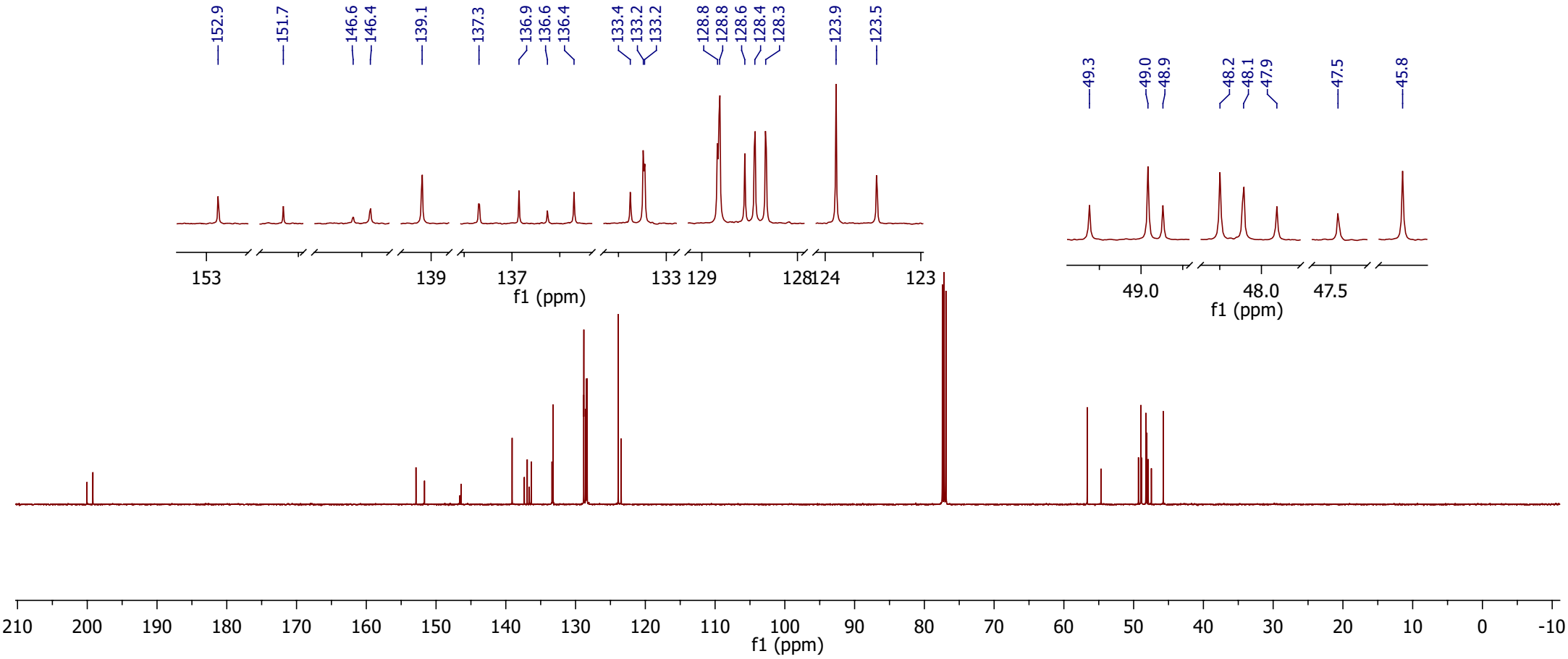




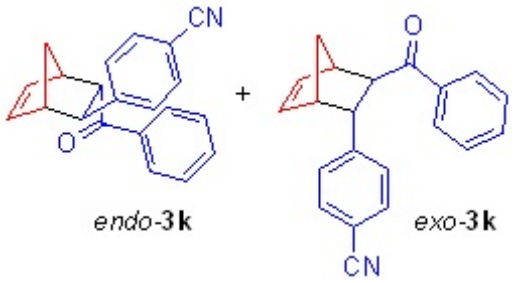
DA SUBSTRATES asymm Nmrs
DT-287
C13CPD CDCl3 {D:\Spectra} nmr 1



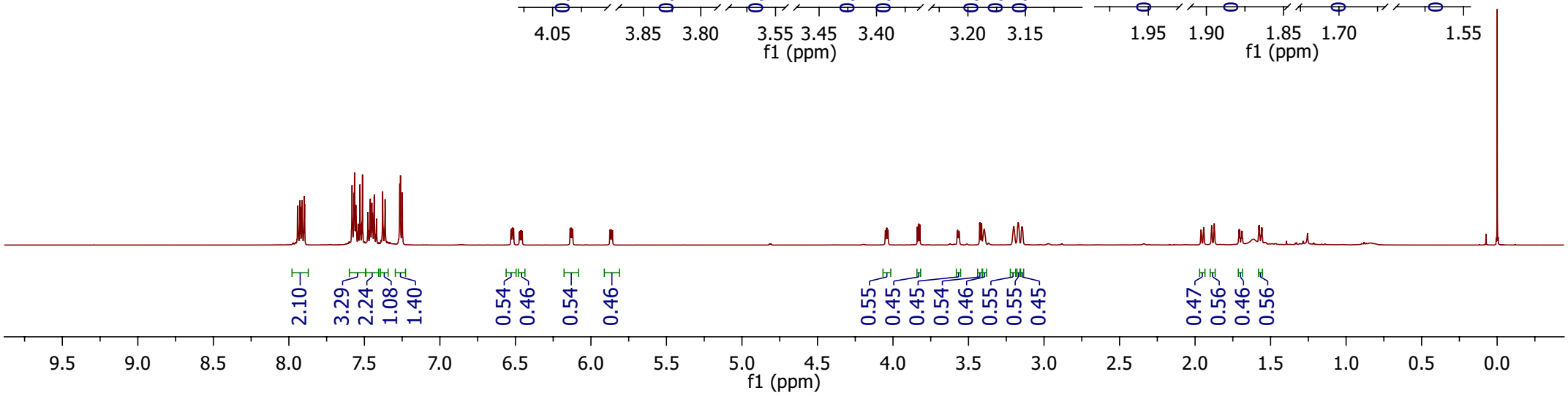
endo-**3j** *exo*-**3j**



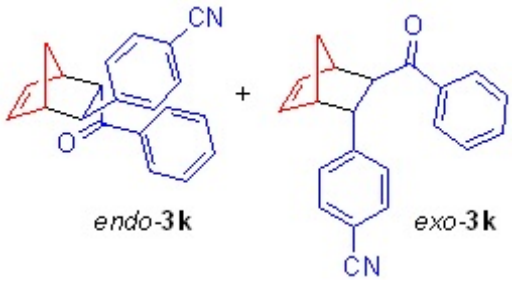
DA SUBSTRATES asymm Nmrs
D:\286
1H_8scan CDCl3 (D:\Spectra) nmr 19



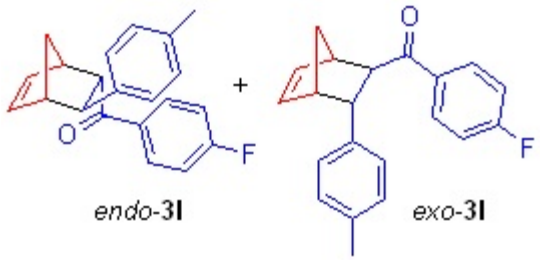
endo-**3k** *exo*-**3k**



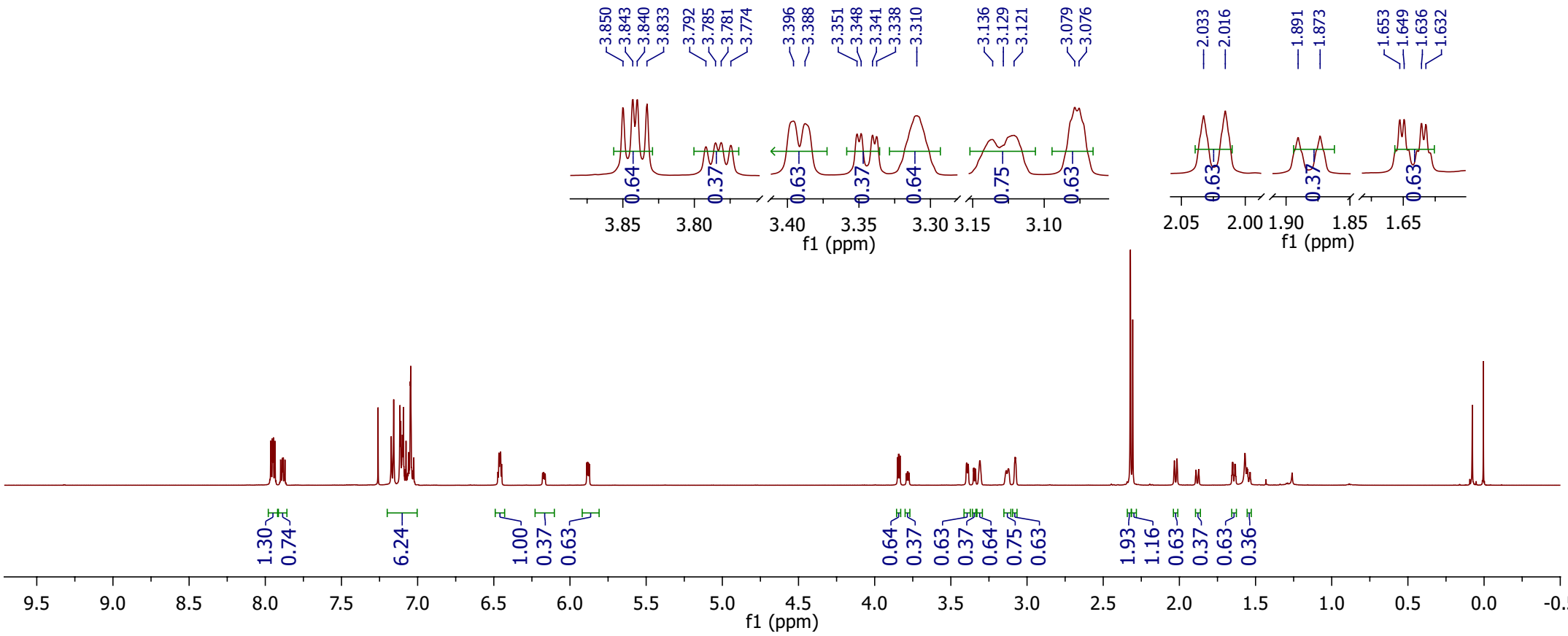
DA SUBSTRATES asymm Nmrs
DT-286
C13CPD CDCl3 {D:\Spectra} nmr 19



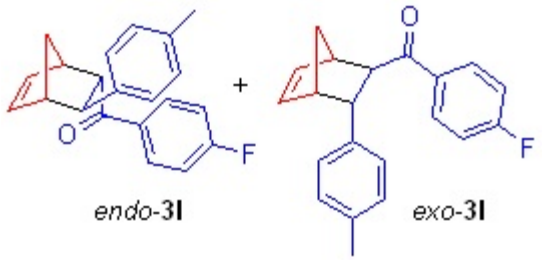
D4 SUBSTRATES\asymm Nmrs
D:\282
1H_8scan CDCl3 (D:\Spectra) nmr 4



endo-3l *exo*-3l

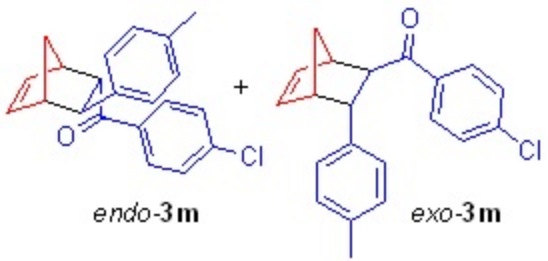


DA SUBSTRATES asymm Nmrs
DT-282
C13CPD CDCl3 {D:\Spectra} nmr 52



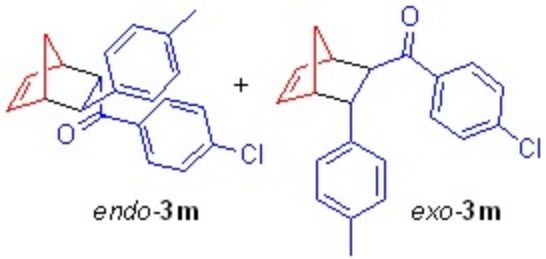
endo-**3l** *exo*-**3l**

D4 SUBSTRATES asymm Nmrs
D6-283
1H_8scan CDCl3 (D:\Spectra) nmr 31

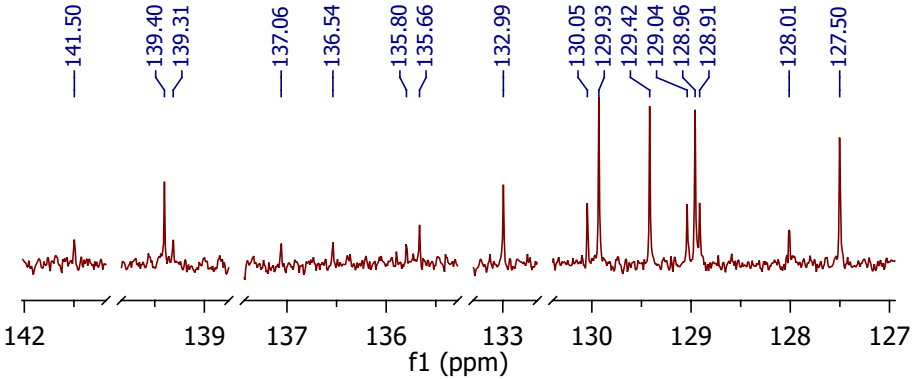


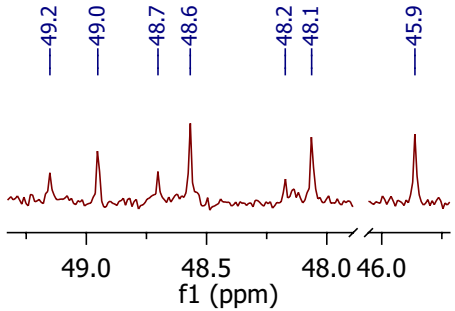
endo-**3m** *exo*-**3m**

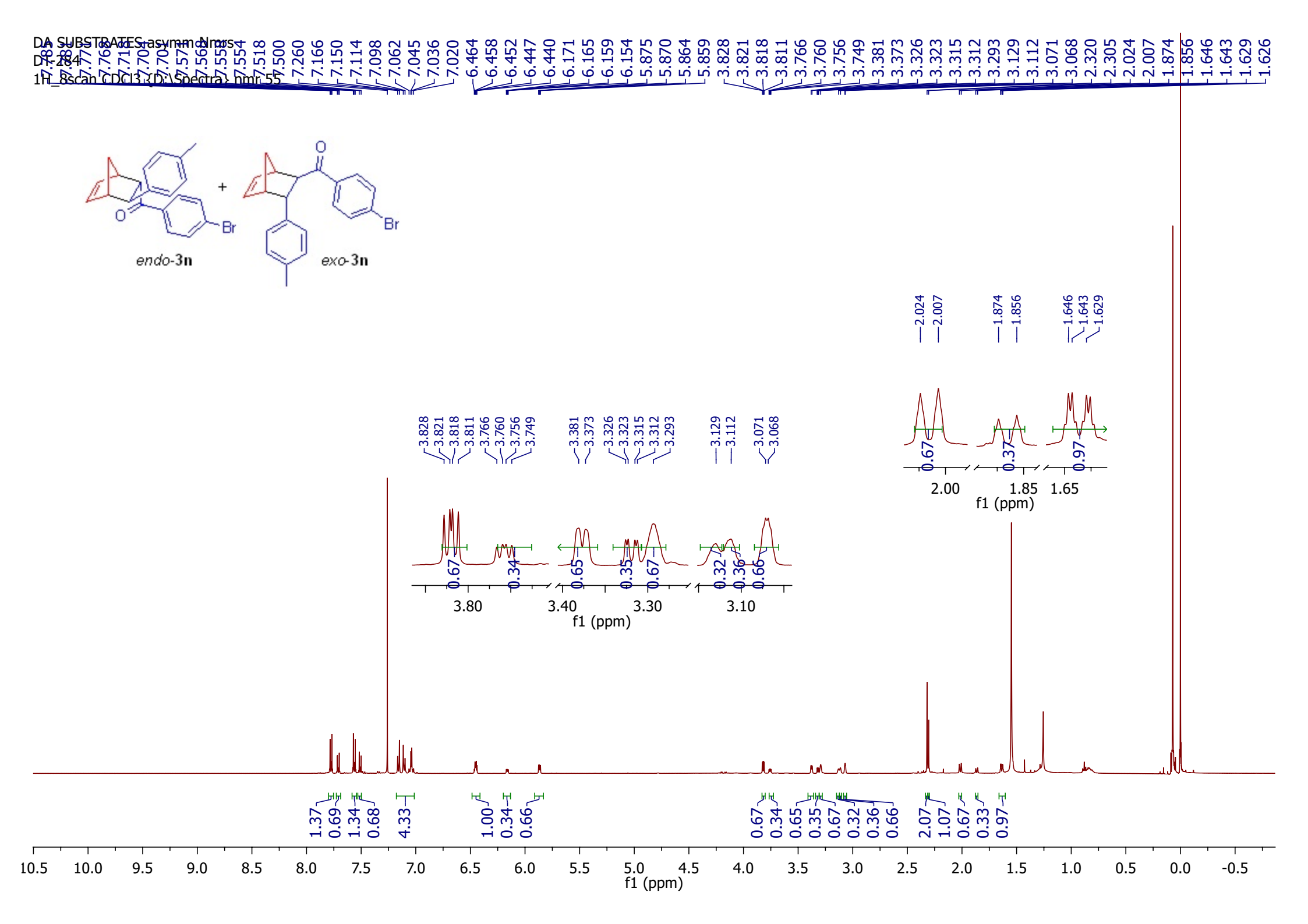
DA SUBSTRATES asymm Nmrs
DT-283
C13CPD CDCl3 {D:\Spectra} nmr 31



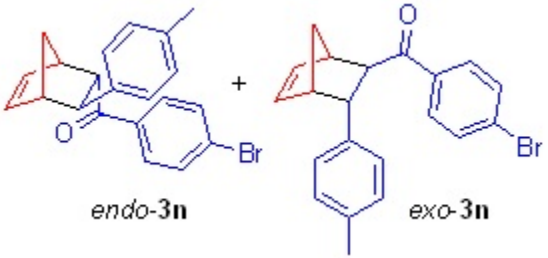
endo-**3m** *exo*-**3m**





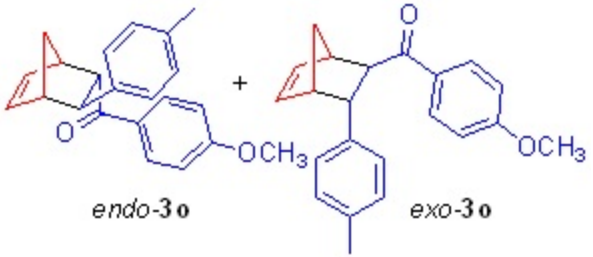

DA SUBSTRATES asymm Nmrs
D1-284
1H_8scan CDCl3 (D:\Spectra) nmr 55
endo-3n
exo-3n
f1 (ppm)

DA SUBSTRATES asymm Nmrs
DT-284
C13CPD CDCl3 {D:\Spectra} nmr 55

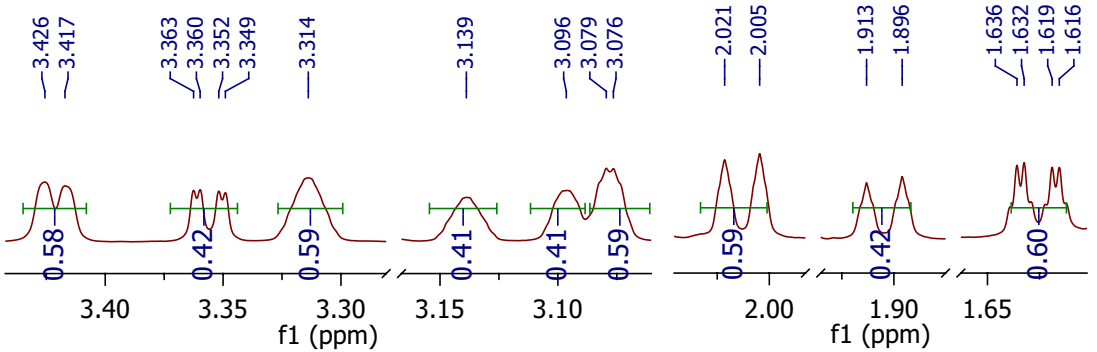


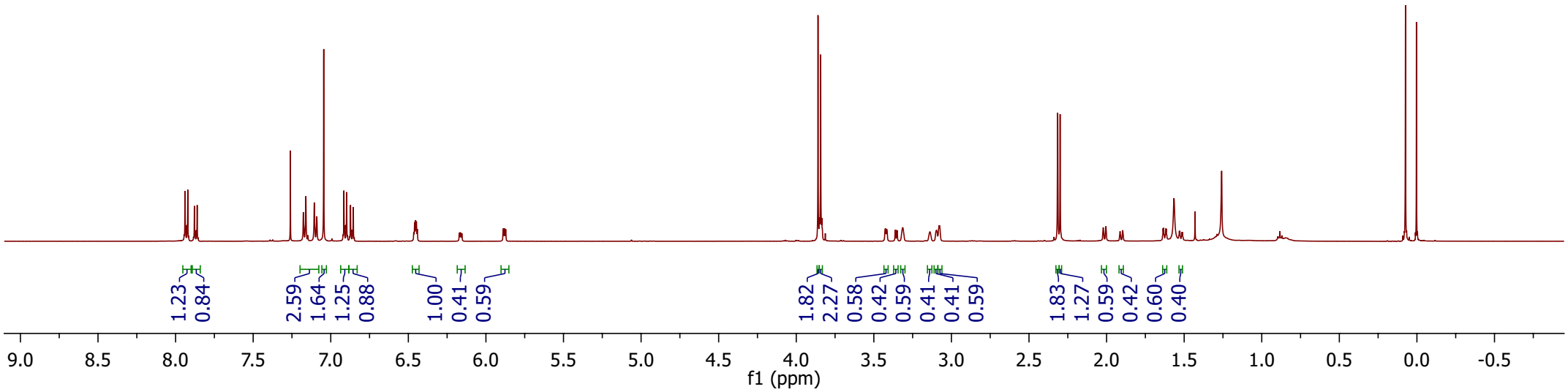
endo-**3n** *exo*-**3n**

DA SUBSTRATES asymm Nmrs
D:\285 CHB\CDCl3
1H_8scan CDCl3 (D:\Spectra) nmr 14



endo-**3o** *exo*-**3o**





DA SUBSTRATES asymm Nmrs
DT-285 CH3/OCH3
C13CPD CDCl3 {D:\Spectra} nmr 14