Supporting Information

Part A

Transforming 2D Azolium Salts to 3D Caged Tertiary Amines via Stereoselective Dearomative Cascade Annulation

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General procedure:

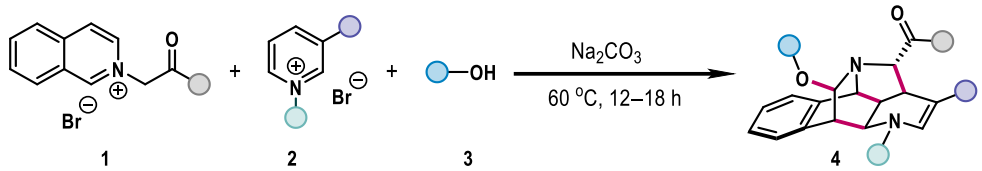
All non-aqueous reactions were carried out under an atmosphere of nitrogen in flame-dried glassware and were stirred using a magnetic stir plate. All reactions were carried out using commercial grade solvent unless otherwise noted. CH_3CN, DCE, and CH_2Cl_2 were dried over calcium hydride. Dry THF was prepared by distilling over sodium ketyl.

All reactions were monitored by thin layer chromatography (TLC) on WhatmanPartisil® K6F TLC plates (silica gel 60 Å, 0.25 mm thickness) and visualized using a UV lamp (366 or 254 nm) or by use of one of the following visualization reagents: PMA: 10 g phosphomolybdic acid/ 100 mL ethanol; $KMnO_4$: 0.75 g potassium permanganate, 5 g K_2CO_3, / 100mL water. Products were isolated by column chromatography (Merck silica gel 100-200μm). Yields refer to chromatographically and spectroscopically homogenous materials unless noted otherwise. ^{13}C and ^{1}H NMR spectra were recorded on a Bruker400 or Bruker 500 MHz spectrometers. Chemical shift values (δ) are reported in ppm and calibrated to the residual solvent peak $CDCl_3$ δ = 7.2600 ppm for ^{1}H, δ = 77.16 for ^{13}C, DMSO-d6 δ = 2.500 ppm for ^{1}H, δ = 39.500 ppm for 13C; or calibrated to tetramethylsilane (δ = 0.00 ppm). All NMR spectra were recorded at ambient temperature (290 K) unless otherwise noted. 1H NMR spectra are reported as follows: chemical shift (multiplicity, coupling constant, integration). The following abbreviations are used to indicate multiplicities: s, singlet; d, doublet; t, triplet; q, quartet; quint, quintet; sext, sextet; sept, septet; m, multiplet; dd, doublet of doublet; dt, doublet of triplet; dq, doublet of quartet; td, triplet of doublet; tt, triplet of triplet; dq, doublet of quartet; br, broad; app, apparent.

Mass spectra were recorded by electrospray ionization (ESI) method on a Q-TOF Micro with lock spray source. The crystal data were collected and integrated using a BrukerAxs kappa apex2 CCD diffractometer, with graphite monochromated Mo-Kα radiation.

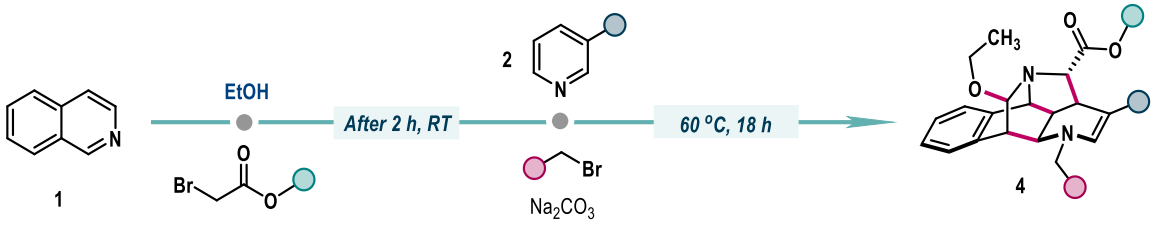
The Isoquinolinium salts **1** were synthesized following literature procedures (*Org. Lett.* **2021**, *23*, 525−529; *Eur. J. Org. Chem.* **2013**, 6379–6388; *J. Am. Chem. Soc.* **2013**, *135*, 15216–15224; *J. Am. Chem. Soc.* **2020**, *142*, 15975−15985, and *J. Heterocyclic Chem.* **1988**, *25*, 1449). The Pyridinium salts **2** were synthesized following literature procedures (*Chem. Sci.* **2021**, *12*, 12001–12011; *Org. Lett.* **2020**, *22*, 7617–7621, and *Tetrahedron* **2012**, *68*, 9687–9693).

Synthesis of cage tertiary amines (4a-4aj & 8):



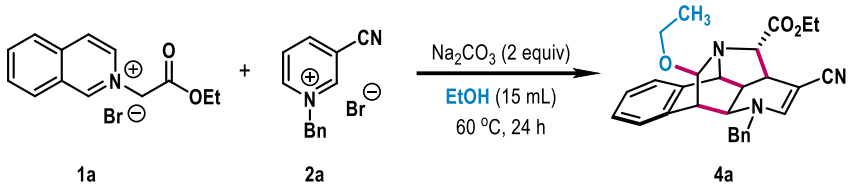
A 16x100 mm oven dried reaction tube equipped with a magnetic stir was charged with isoquinolinium salts **1** (0.24 mmol, 1.2 equiv), pyridinium salts **2** (0.2 mmol, 1.0 equiv), and sodium carbonate (2.0 equiv) under N_2 atmosphere. Then, corresponding alcohol **3** (1.5 mL) was added as solvent. The reaction mixture was allowed to stir for 12–18 h at 60 °C. After completion of the reaction (TLC monitored), volatiles were removed under reduced pressure and the crude product was purified by silica gel column chromatography to provide pure product **4**.

Synthesis of compound 4 (Five-component: one pot sequential approach):

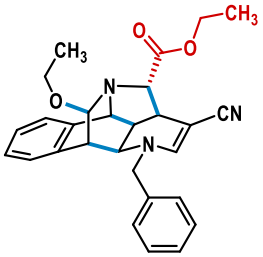


A 16x100 mm oven dried reaction tube equipped with a magnetic stir was charged with isoquinoline **1** (0.24 mmol), alkyl bromoacetate (0.288 mmol) and EtOH (1.5 mL) under N_2 atmosphere. Then, the reaction mixture was allowed to stir for 2 h at room temperature. After that, pyridine **2** (0.2 mmol) followed by bromo alkane (0.24 mmol), Na_2CO_3 (2.0 equiv) were added and allowed to stir at 60 °C for 18 h. After completion of the reaction (TLC monitored), volatiles were removed under reduced pressure and the crude product was purified by silica gel column chromatography to provide pure product **4**.

Gram scale synthesis of compound 4a:

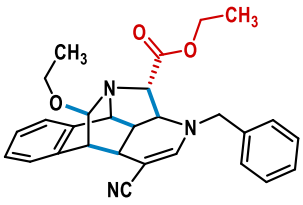


A 100 mL oven dried round bottom flask equipped with a magnetic stir was charged with isoquinolinium salts **1a** (4.36 mmol, 1.2 equiv), pyridinium salts **2a** (3.63 mmol, 1.0 equiv), and sodium carbonate (2.0 equiv) under N_2 atmosphere. Then, Ethanol (15 mL) was added as solvent. The reaction mixture was allowed to stir for 24 h at 60 °C. After completion of the reaction (TLC monitored), volatiles were removed under reduced pressure and the crude product was purified by silica gel column chromatography to provide pure product **4a** (1.24 g, 75%).



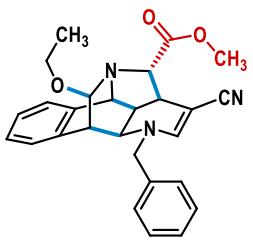
4a

Compound, **4a**: Pale yellow solid; **MP:** 174 °C; eluent (20% ethyl acetate in hexane). **Yield:** 83% (76 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.38 – 7.23 (m, 7H), 7.19 (d, *J* = 7.2 Hz, 2H), 7.09 (s, 1H), 4.55 – 4.47 (m, 2H), 4.41 (d, *J* = 3.0 Hz, 1H), 4.37 – 4.31 (m, 1H), 4.31 – 4.22 (m, 1H), 3.98 (d, *J* = 3.1 Hz, 1H), 3.69 – 3.61 (m, 1H), 3.49 – 3.46 (m, 2H), 3.42 (s, 1H), 3.30 – 3.22 (m, 1H), 3.04 (d, *J* = 9.2 Hz, 1H), 2.10 – 2.06 (m, 1H), 1.37 (t, *J* = 7.1 Hz, 3H), 1.02 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.2, 145.3, 137.3, 136.0, 133.4, 129.2, 128.4, 128.3, 127.4, 127.1, 125.9, 124.9, 122.1, 92.8, 76.6, 76.4, 64.3, 61.5, 61.2, 57.8, 53.5, 41.2, 41.1, 34.5, 14.6, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{28}H_{29}N_3O_3H^+$ 456.2282; Found 456.2289.



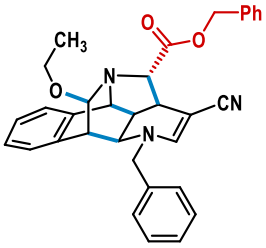
4a'

Compound, **4a'**: Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 8% (7 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.35 – 7.25 (m, 5H), 7.18 – 7.16 (m, 4H), 7.05 (s, 1H), 4.49 (d, *J* = 14.8 Hz, 1H), 4.32 (d, *J* = 14.9 Hz, 1H), 4.25 (t, *J* = 5.0 Hz, 1H), 4.20 – 4.08 (m, 3H), 3.83 (d, *J* = 3.3 Hz, 1H), 3.55 – 3.48 (m, 2H), 3.23 – 3.15 (m, 1H), 3.03 (d, *J* = 4.1 Hz, 1H), 2.16 (d, *J* = 9.4 Hz, 1H), 2.04 – 2.00 (m, 1H), 1.23 (t, *J* = 7.1 Hz, 3H), 0.93 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.2, 145.3, 139.1, 135.7, 133.2, 129.2, 128.5, 128.4, 128.1, 126.6, 125.6, 125.3, 122.4, 95.0, 76.4, 76.1, 62.3, 62.1, 61.7, 61.4, 59.1, 41.4, 37.7, 31.0, 14.7, 14.3. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{28}H_{29}N_3O_3H^+$ 456.2282; Found 456.2290.



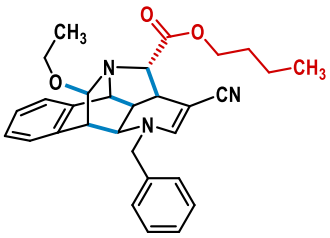
4b

Compound, **4b:** Pale yellow solid; **MP:** 172 °C; eluent (20% ethyl acetate in hexane). **Yield:** 76% (73 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.31 – 7.15 (m, 7H), 7.11 (d, *J* = 7.1 Hz, 2H), 7.02 (s, 1H), 4.48 – 4.39 (m, 2H), 4.31 – 4.30 (m, 1H), 3.90 – 3.90 (m, 1H), 3.77 (s, 3H), 3.62 – 3.55 (m, 1H), 3.49 – 3.46 (m, 1H), 3.42 – 3.41 (m, 1H), 3.34 (s, 1H), 3.21 – 3.14 (m, 1H), 2.96 (d, *J* = 9.1 Hz, 1H), 2.03 – 2.00 (m, 1H), 0.94 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.6, 145.3, 137.3, 135.9, 133.3, 129.2, 128.5, 128.4, 127.4, 127.2, 126.0, 124.9, 122.2, 92.8, 76.4, 76.2, 64.3, 61.4, 57.9, 53.5, 52.7, 41.2, 40.9, 34.4, 14.6. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{27}H_{27}N_3O_3H^+$ 442.2125; Found 442.2128.



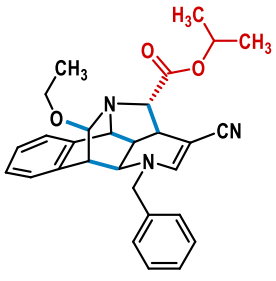
4c

Compound, **4c**: Yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 83% (86 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.40 – 7.38 (m, 2H), 7.33 – 7.15 (m, 10H), 7.11 – 7.09 (m, 2H), 7.00 (s, 1H), 5.22 (q, *J* = 12.4 Hz, 2H), 4.46 – 4.37 (m, 2H), 4.33 – 4.33 (m, 1H), 3.91 – 3.90 (m, 1H), 3.59 – 3.52 (m, 1H), 3.46 – 3.45 (m, 1H), 3.43 – 3.41 (m, 1H), 3.34 (s, 1H), 3.19 – 3.12 (m, 1H), 2.95 (d, *J* = 9.2 Hz, 1H), 2.00 – 1.96 (m, 1H), 0.90 (t, *J* = 6.9 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.0, 145.4, 137.4, 135.9, 135.7, 133.4, 129.2, 128.6, 128.5, 128.4, 128.3, 128.1, 127.4, 127.2, 125.9, 124.9, 122.1, 92.7, 76.5, 76.3, 67.1, 64.3, 61.2, 57.8, 53.5, 41.1, 41.1, 34.5, 14.6. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{33}H_{31}N_3O_3H^+$ 518.2438; Found 518.2438.



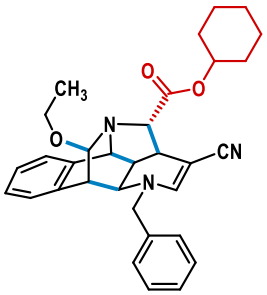
4d

Compound, **4d**: Yellow solid; **MP:** 144 °C; eluent (20% ethyl acetate in hexane). **Yield:** 79% (76 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.26 – 7.10 (m, 7H), 7.06 (d, *J* = 7.3 Hz, 2H), 6.96 (s, 1H), 4.38 (d, *J* = 3.4 Hz, 2H), 4.29 – 4.29 (m, 1H), 4.20 – 4.14 (m, 1H), 4.11 – 4.05 (m, 1H), 3.85 – 3.85 (m, 1H), 3.57 – 3.49 (m, 1H), 3.38 – 3.36 (m, 1H), 3.34 – 3.33 (m, 1H), 3.29 (s, 1H), 3.17 – 3.09 (m, 1H), 2.91 (d, *J* = 9.3 Hz, 1H), 1.97 – 1.93 (m, 1H), 1.64 – 1.57 (m, 2H), 1.39 – 1.29 (m, 2H), 0.91 – 0.83 (m, 6H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.4, 145.3, 137.4, 136.0, 133.5, 129.3, 128.6, 128.4, 127.4, 127.2, 126.0, 124.9, 122.2, 92.8, 76.6, 76.5, 65.5, 64.4, 61.2, 57.9, 53.6, 41.24, 41.20, 34.6, 30.7, 19.2, 14.7, 13.8. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{30}H_{33}N_3O_3H^+$ 484.2595; Found 484.2601.



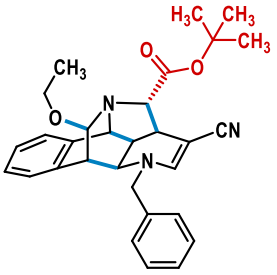
4e

Compound, **4e**: Yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 78% (73 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.36 – 7.21 (m, 7H), 7.17 (d, *J* = 7.3 Hz, 2H), 7.06 (s, 1H), 5.18 – 5.08 (m, 1H), 4.53 – 4.45 (m, 2H), 4.43 – 4.42 (m, 1H), 3.95 (d, *J* = 2.3 Hz, 1H), 3.65 – 3.58 (m, 1H), 3.41 – 3.37 (m, 3H), 3.27 – 3.19 (m, 1H), 3.02 (d, *J* = 9.3 Hz, 1H), 2.06 – 2.02 (m, 1H), 1.36 (d, *J* = 6.2 Hz, 3H), 1.33 (d, *J* = 6.3 Hz, 3H), 0.99 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 171.8, 145.2, 137.4, 136.0, 133.6, 129.2, 128.4, 128.3, 127.4, 127.1, 125.9, 124.9, 122.1, 92.7, 76.7, 76.6, 69.0, 64.4, 61.1, 57.8, 53.5, 41.7, 41.0, 34.6, 21.8, 21.8, 14.6. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{29}H_{31}N_3O_3H^+$ 470.2438; Found 470.2438.



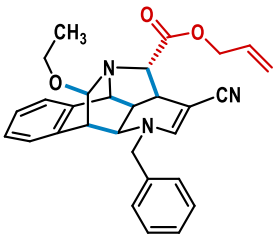
4f

Compound, **4f**: Yellow solid; **MP:** 166 °C; eluent (20% ethyl acetate in hexane). **Yield:** 86% (88 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.26 – 7.12 (m, 7H), 7.07 (d, *J* = 7.4 Hz, 2H), 6.96 (s, 1H), 4.84 – 4.77 (m, 1H), 4.43 – 4.34 (m, 2H), 4.32 (d, *J* = 2.9 Hz, 1H), 3.86 (d, *J* = 3.1 Hz, 1H), 3.56 – 3.48 (m, 1H), 3.34 – 3.27 (m, 3H), 3.17 – 3.10 (m, 1H), 2.92 (d, *J* = 9.3 Hz, 1H), 1.96 – 1.92 (m, 1H), 1.86 – 1.78 (m, 2H), 1.75 – 1.65 (m, 2H), 1.54 – 1.40 (m, 3H), 1.36 – 1.18 (m, 3H), 0.89 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 171.6, 145.2, 137.4, 136.0, 133.6, 129.2, 128.4, 128.3, 127.3, 127.1, 125.8, 124.8, 122.1, 92.5, 76.7, 76.6, 73.7, 64.3, 61.0, 57.7, 53.5, 41.7, 41.1, 34.5, 31.5, 31.4, 25.3, 23.6, 14.6. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{32}H_{35}N_3O_3H^+$ 510.2751; Found 510.2747.



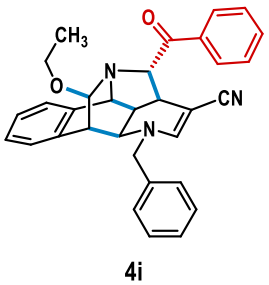
4g

Compound, **4g**: Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 85% (82 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.39 – 7.24 (m, 7H), 7.20 (d, *J* = 7.4 Hz, 2H), 7.08 (s, 1H), 4.56 – 4.47 (m, 2H), 4.44 (d, *J* = 2.9 Hz, 1H), 3.97 (d, *J* = 3.0 Hz, 1H), 3.68 – 3.61 (m, 1H), 3.43 (s, 1H), 3.38 – 3.34 (m, 2H), 3.29 – 3.22 (m, 1H), 3.04 (d, *J* = 9.3 Hz, 1H), 2.08 – 2.03 (m, 1H), 1.60 (s, 9H), 1.02 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 171.5, 145.2, 137.5, 136.0, 133.7, 129.2, 128.4, 128.3, 127.4, 127.1, 125.8, 124.9, 122.2, 92.5, 81.9, 77.2, 76.8, 64.4, 61.0, 57.8, 53.6, 41.9, 41.1, 34.6, 28.1, 14.6. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{30}H_{33}N_3O_3H^+$ 484.2595; Found 484.2598.



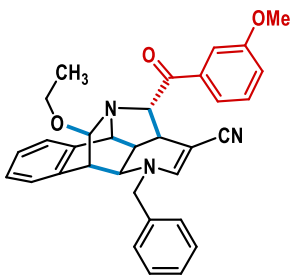
4h

Compound, **4h**: Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 74% (69 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.38 – 7.22 (m, 7H), 7.18 (d, *J* = 7.1 Hz, 2H), 7.08 (s, 1H), 6.05 – 5.95 (m, 1H), 5.42 (d, *J* = 17.2 Hz, 1H), 5.28 (d, *J* = 10.4 Hz, 1H), 4.78 (dd, *J* = 13.2, 5.5 Hz, 1H), 4.70 (dd, *J* = 13.3, 5.5 Hz, 1H), 4.54 – 4.46 (m, 2H), 4.40 – 4.40 (m, 1H), 3.98 – 3.97 (m, 1H), 3.69 – 3.61 (m, 1H), 3.53 – 3.49 (m, 2H), 3.40 (s, 1H), 3.28 – 3.21 (m, 1H), 3.03 (d, *J* = 9.2 Hz, 1H), 2.10 – 2.06 (m, 1H), 1.01 (t, *J* = 6.9 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 171.9, 145.4, 137.4, 136.0, 133.4, 131.8, 129.3, 128.6, 128.5, 127.4, 127.2, 126.0, 124.9, 122.2, 118.7, 92.8, 76.5, 76.4, 66.2, 64.4, 61.3, 57.9, 53.6, 41.2, 41.1, 34.6, 14.7. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{29}H_{29}N_3O_3H^+$ 468.2282; Found 468.2280.



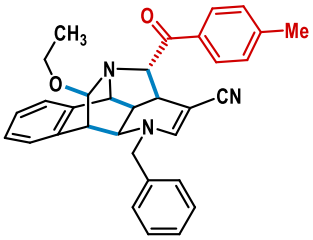
4i

Compound, **4i**: Yellow solid; **MP:** 207 °C; eluent (20% ethyl acetate in hexane). **Yield:** 71% (69 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 8.17 (d, *J* = 7.6 Hz, 2H), 7.63 (t, *J* = 7.3 Hz, 1H), 7.54 (t, *J* = 7.5 Hz, 2H), 7.46 – 7.38 (m, 3H), 7.36 – 7.33 (m, 1H), 7.29 – 7.26 (m, 5H), 7.21 (s, 1H), 4.65 – 4.55 (m, 2H), 4.41 (d, *J* = 3.3 Hz, 1H), 4.39 (d, *J* = 2.2 Hz, 1H), 4.30 – 4.29 (m, 1H), 3.97 – 3.94 (m, 1H), 3.51 (s, 1H), 3.46 – 3.39 (m, 1H), 3.32 – 3.25 (m, 1H), 3.15 (d, *J* = 9.1 Hz, 1H), 2.25 – 2.20 (m, 1H), 1.02 (t, *J* = 6.9 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 197.2, 145.6, 137.4, 136.3, 136.1, 133.6, 133.4, 129.3, 129.2, 128.6, 128.5, 128.4, 127.4, 127.2, 126.0, 124.8, 122.4, 93.8, 76.8, 76.4, 63.5, 61.7, 58.1, 53.8, 41.3, 37.8, 34.8, 14.9. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{32}H_{29}N_3O_2H^+$ 488.2333; Found 488.2333.



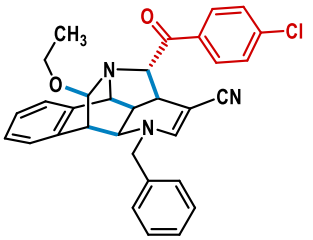
4j

Compound, **4j**: Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 70% (72 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.59 (d, *J* = 7.6 Hz, 1H), 7.53 (s, 1H), 7.31 – 7.24 (m, 4H), 7.20 – 7.11 (m, 6H), 7.05 – 7.02 (m, 2H), 4.50 – 4.39 (m, 2H), 4.24 – 4.23 (m, 2H), 4.13 – 4.12 (m, 1H), 3.81 – 3.78 (m, 4H), 3.36 (s, 1H), 3.33 – 3.25 (m, 1H), 3.17 – 3.10 (m, 1H), 2.99 (d, *J* = 9.1 Hz, 1H), 2.09 – 2.05 (m, 1H), 0.87 (t, *J* = 6.9 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 197.0, 159.9, 145.7, 137.6, 137.4, 136.1, 133.5, 129.6, 129.3, 128.5, 128.4, 127.4, 127.2, 126.0, 124.8, 122.5, 121.8, 120.0, 113.6, 93.8, 76.8, 76.4, 63.5, 61.8, 58.1, 55.5, 53.8, 41.2, 37.8, 34.8, 14.8. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{33}H_{31}N_3O_3H^+$ 518.2438; Found 518.2440.



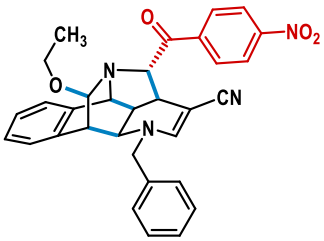
4k

Compound, **4k**: Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 76% (76 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.92 (d, *J* = 8.0 Hz, 2H), 7.32 – 7.24 (m, 3H), 7.20 – 7.17 (m, 3H), 7.15 – 7.11 (m, 5H), 7.05 (s, 1H), 4.50 – 4.40 (m, 2H), 4.27 (d, *J* = 3.0 Hz, 1H), 4.24 (d, *J* = 3.6 Hz, 1H), 4.13 (d, *J* = 2.9 Hz, 1H), 3.78 (dd, *J* = 6.3, 3.5 Hz, 1H), 3.36 (s, 1H), 3.34 – 3.26 (m, 1H), 3.18 – 3.10 (m, 1H), 2.98 (d, *J* = 9.1 Hz, 1H), 2.32 (s, 3H), 2.08 – 2.04 (m, 1H), 0.88 (t, *J* = 7.0 Hz, 3H).**^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 196.8, 145.7, 144.4, 137.5, 136.1, 133.6, 133.6, 129.4, 129.3, 129.3, 128.5, 128.3, 127.4, 127.2, 126.1, 124.8, 122.5, 93.7, 76.6, 76.5, 63.5, 61.7, 58.0, 53.8, 41.3, 37.9, 34.8, 21.8, 14.9. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{33}H_{31}N_3O_3H^+$ 502.2489; Found 502.2491.



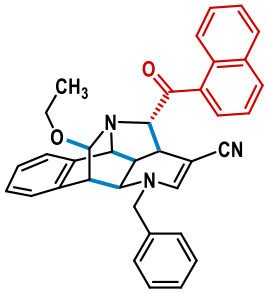
4l

Compound, **4l**: Yellow solid; **MP:** 192 °C; eluent (20% ethyl acetate in hexane). **Yield:** 68% (71 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 8.06 (d, *J* = 8.5 Hz, 2H), 7.44 (d, *J* = 8.5 Hz, 2H), 7.40 – 7.33 (m, 3H), 7.30 – 7.26 (m, 1H), 7.22 – 7.18 (m, 5H), 7.14 (s, 1H), 4.58 – 4.47 (m, 2H), 4.27 (d, *J* = 3.4 Hz, 1H), 4.26 (d, *J* = 2.3 Hz, 1H), 4.22 (d, *J* = 2.2 Hz, 1H), 3.89 (dd, *J* = 5.9, 3.6 Hz, 1H), 3.44 (s, 1H), 3.38 – 3.31 (m, 1H), 3.26 – 3.18 (m, 1H), 3.08 (d, *J* = 9.1 Hz, 1H), 2.18 – 2.13 (m, 1H), 0.97 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 195.9, 145.6, 139.9, 137.3, 136.1, 134.6, 133.4, 130.7, 129.3, 128.9, 128.6, 128.5, 127.5, 127.3, 126.0, 124.8, 122.4, 93.8, 77.0, 76.4, 63.6, 61.8, 58.2, 53.9, 41.2, 37.7, 34.7, 15.0. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{32}H_{28}ClN_3O_2H^+$ 522.1943; Found 522.1941.



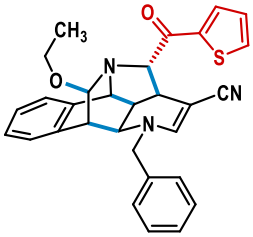
4m

Compound, **4m**: Yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 61% (65 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 8.21 – 8.16 (m, 4H), 7.32 – 7.24 (m, 3H), 7.23 – 7.15 (m, 2H), 7.13 – 7.08 (m, 4H), 7.05 (s, 1H), 4.49 – 4.38 (m, 2H), 4.19 (d, *J* = 3.3 Hz, 1H), 4.14 (d, *J* = 2.3 Hz, 1H), 4.05 (d, *J* = 2.3 Hz, 1H), 3.84 (dd, *J* = 6.0, 3.5 Hz, 1H), 3.34 (s, 1H), 3.23 – 3.16 (m, 1H), 3.16 – 3.08 (m, 1H), 3.00 (d, *J* = 9.2 Hz, 1H), 2.10 – 2.06 (m, 1H), 0.88 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 195.6, 150.4, 145.7, 141.0, 137.1, 136.1, 133.2, 130.4, 129.4, 128.70, 128.66, 127.6, 127.5, 126.1, 124.9, 123.8, 122.3, 93.9, 77.8, 76.2, 63.6, 62.0, 58.4, 53.9, 41.1, 37.4, 34.8, 15.1. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{32}H_{28}N_4O_4H^+$ 533.2183; Found 533.2185.



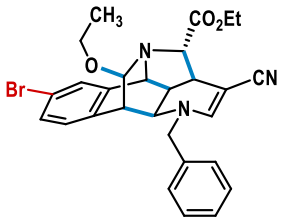
4n

Compound, **4n**: Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 62% (67 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 8.21 (d, *J* = 8.4 Hz, 1H), 7.84 (d, *J* = 8.2 Hz, 1H), 7.79 (d, *J* = 7.2 Hz, 1H), 7.76 (d, *J* = 8.2 Hz, 1H), 7.50 (t, *J* = 7.5 Hz, 1H), 7.44 – 7.36 (m, 2H), 7.29 – 7.11 (m, 6H), 7.08 – 7.06 (m, 3H), 7.00 (s, 1H), 4.43 – 4.34 (m, 2H), 4.28 (d, *J* = 2.3 Hz, 1H), 4.14 (d, *J* = 3.5 Hz, 1H), 3.96 – 3.96 (m, 1H), 3.82 (dd, *J* = 5.7, 4.0 Hz, 1H), 3.28 (s, 1H), 2.94 (d, *J* = 9.2 Hz, 1H), 2.91 – 2.83 (m, 1H), 2.75 – 2.67 (m, 1H), 2.09 – 2.04 (m, 1H), 0.57 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 201.9, 145.6, 137.6, 136.9, 136.0, 133.9, 133.6, 132.1, 130.5, 129.3, 128.6 (2C), 128.4, 127.9, 127.5, 127.3, 126.8, 126.6, 125.9, 125.5, 124.9, 124.5, 122.4, 93.4, 80.9, 76.5, 63.7, 61.1, 58.0, 53.8, 41.4, 37.8, 35.1, 14.5. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{36}H_{31}N_3O_2H^+$ 538.2489; Found 538.2492.



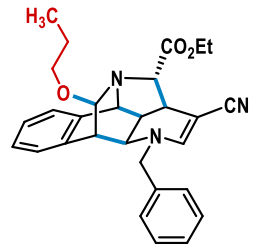
4o

Compound, **4o**: Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 64% (63 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.92 (d, *J* = 3.6 Hz, 1H), 7.59 (d, *J* = 4.8 Hz, 1H), 7.31 – 7.19 (m, 4H), 7.16 – 7.12 (m, 5H), 7.07 – 7.05 (m, 2H), 4.50 – 4.40 (m, 2H), 4.28 (d, *J* = 2.6 Hz, 1H), 4.09 (d, *J* = 2.4 Hz, 1H), 4.00 (d, *J* = 3.5 Hz, 1H), 3.72 (dd, *J* = 5.9, 3.7 Hz, 1H), 3.50 – 3.42 (m, 1H), 3.36 (s, 1H), 3.24 – 3.17 (m, 1H), 2.99 (d, *J* = 9.2 Hz, 1H), 2.08 – 2.03 (m, 1H), 0.92 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 190.8, 145.5, 142.4, 137.4, 136.1, 135.2, 133.9, 133.5, 129.3, 128.5, 128.4, 128.2, 127.4, 127.3, 126.0, 124.9, 122.4, 93.4, 79.0, 76.6, 64.3, 62.0, 58.1, 53.7, 41.4, 39.1, 34.5, 14.9. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{30}H_{27}N_3O_2SH^+$ 494.1897; Found 494.1895.



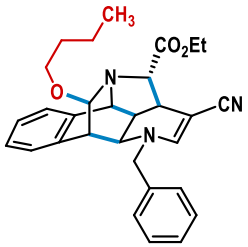
4p

Compound, **4p**: Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 68% (66 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.39 – 7.30 (m, 5H), 7.17 – 7.12 (m, 3H), 7.05 (s, 1H), 4.51 – 4.43 (m, 2H), 4.36 (d, *J* = 2.4 Hz, 1H), 4.34 – 4.27 (m, 1H), 4.27 – 4.19 (m, 1H), 3.92 (d, *J* = 2.6 Hz, 1H), 3.65 – 3.58 (m, 1H), 3.46 – 3.43 (m, 1H), 3.42 – 3.41 (m, 1H), 3.33 (s, 1H), 3.25 – 3.17 (m, 1H), 2.98 (d, *J* = 9.3 Hz, 1H), 2.05 – 2.01 (m, 1H), 1.34 (t, *J* = 7.1 Hz, 3H), 1.00 (t, *J* = 7.0 Hz, 3H**). ^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.2, 145.3, 139.6, 135.9, 132.5, 130.4, 129.4, 128.7, 128.1, 127.7, 127.4, 122.4, 122.0, 103.5, 92.5, 76.7, 76.5, 63.8, 61.7, 61.5, 58.0, 53.5, 41.2, 34.4, 14.7, 14.3. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{28}H_{28}BrN_3O_3H^+$ 536.1387; Found 536.1370.



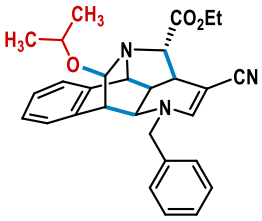
4q

Compound, **4q**: Yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 77% (72 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.40 – 7.33 (m, 3H), 7.32 – 7.26 (m, 3H), 7.25 – 7.20 (m, 3H), 7.10 (s, 1H), 4.57 – 4.48 (m, 2H), 4.42 (d, *J* = 2.2 Hz, 1H), 4.39 – 4.32 (m, 1H), 4.31 – 4.24 (m, 1H), 3.98 (d, *J* = 2.4 Hz, 1H), 3.57 – 3.49 (m, 2H), 3.47 – 3.45 (m, 1H), 3.42 (s, 1H), 3.18 – 3.12 (m, 1H), 3.06 (d, *J* = 9.3 Hz, 1H), 2.11 – 2.07 (m, 1H), 1.47 – 1.36 (m, 5H), 0.74 (t, *J* = 7.4 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.3, 145.3, 137.5, 136.0, 133.5, 129.2, 128.5, 128.3, 127.4, 127.1, 125.9, 124.9, 122.2, 93.0, 76.6, 76.5, 67.5, 64.3, 61.5, 57.9, 53.6, 41.1 (2C), 34.6, 22.4, 14.2, 10.4. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{29}H_{31}N_3O_3H^+$ 470.2438; Found 470.2441.



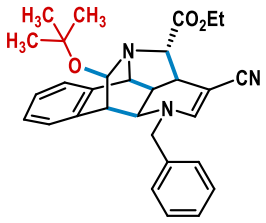
4r

Compound, **4r**: Yellow solid; **MP:**150 °C eluent (20% ethyl acetate in hexane). **Yield:** 76% (73 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.32 – 7.26 (m, 3H), 7.24 – 7.19 (m, 3H), 7.16 – 7.12 (m, 3H), 7.02 (s, 1H), 4.49 – 4.40 (m, 2H), 4.34 – 4.34 (m, 1H), 4.32 – 4.24 (m, 1H), 4.24 – 4.16 (m, 1H), 3.90 – 3.89 (m, 1H), 3.54 – 3.49 (m, 1H), 3.45 – 3.42 (m, 1H), 3.39 – 3.39 (m, 1H), 3.34 (s, 1H), 3.14 – 3.08 (m, 1H), 2.98 (d, *J* = 9.3 Hz, 1H), 2.04 – 1.99 (m, 1H), 1.32 – 1.28 (m, 5H), 1.13 – 1.04 (m, 2H), 0.74 (t, *J* = 7.3 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.3, 145.3, 137.5, 136.1, 133.5, 129.3, 128.5, 128.3, 127.4, 127.1, 125.9, 124.9, 122.2, 93.0, 76.6, 76.5, 65.5, 64.3, 61.6, 57.9, 53.6, 41.2, 41.1, 34.6, 31.2, 19.2, 14.2, 13.8. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{30}H_{33}N_3O_3H^+$ 484.2595; Found 484.2588.



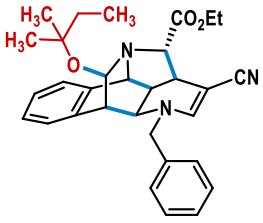
4s

Compound, **4s**: Yellow solid; **MP:** 184 °C; eluent (20% ethyl acetate in hexane). **Yield:** 70% (66 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.26 – 7.20 (m, 3H), 7.18 – 7.13 (m, 3H), 7.10 – 7.06 (m, 3H), 6.96 (s, 1H), 4.43 – 4.33 (m, 2H), 4.26 (d, *J* = 2.3 Hz, 1H), 4.23 – 4.17 (m, 1H), 4.16 – 4.09 (m, 1H), 3.98 (d, *J* = 2.6 Hz, 1H), 3.77 – 3.68 (m, 1H), 3.36 – 3.34 (m, 1H), 3.33 – 3.32 (m, 1H), 3.21 (s, 1H), 2.93 (d, *J* = 9.3 Hz, 1H), 1.97 – 1.92 (m, 1H), 1.23 (t, *J* = 7.1 Hz, 3H), 0.90 (d, *J* = 6.1 Hz, 3H), 0.76 (d, *J* = 6.2 Hz, 3H).**^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.3, 145.4, 137.7, 136.2, 133.6, 129.2, 128.5, 128.2, 127.3, 127.0, 125.8, 125.0, 122.2, 90.2, 76.7, 76.5, 65.6, 64.2, 61.5, 58.0, 53.8, 41.4, 41.2, 34.8, 23.1, 20.9, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{29}H_{31}N_3O_3H^+$ 470.2438; Found 470.2450.



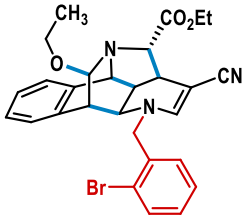
4t

Compound, **4t**: Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 59% (57 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.34 – 7.28 (m, 3H), 7.26 – 7.19 (m, 3H), 7.16 – 7.15 (m, 2H), 7.10 (d, *J* = 6.8 Hz, 1H), 7.05 (s, 1H), 4.49 – 4.38 (m, 2H), 4.35 (d, *J* = 2.6 Hz, 1H), 4.29 – 4.23 (m, 1H), 4.21 – 4.12 (m, 1H), 4.10 (d, *J* = 3.1 Hz, 1H), 3.49 – 3.45 (m, 2H), 3.05 (s, 1H), 2.98 (d, *J* = 9.4 Hz, 1H), 2.03 – 1.99 (m, 1H), 1.29 (t, *J* = 7.1 Hz, 3H), 1.04 (s, 9H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.3, 145.3, 137.9, 136.2, 133.7, 129.3, 128.6, 128.1, 127.6, 127.0, 126.1, 125.2, 122.4, 87.5, 76.7, 76.3, 74.0, 64.2, 61.6, 58.3, 54.1, 43.3, 40.8, 34.5, 28.8 (3C), 14.1. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{30}H_{33}N_3O_3H^+$ 484.2595; Found 484.2605.



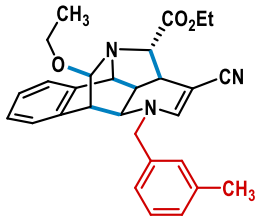
4u

Compound, **4u**: Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 57% (57 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.40 – 7.31 (m, 3H), 7.28 – 7.22 (m, 3H), 7.20 – 7.17 (m, 2H), 7.12 (d, *J* = 6.9 Hz, 1H), 7.06 (s, 1H), 4.51 – 4.40 (m, 2H), 4.37 (d, *J* = 2.2 Hz, 1H), 4.33 – 4.25 (m, 1H), 4.23 – 4.15 (m, 1H), 4.13 (d, *J* = 2.7 Hz, 1H), 3.49 – 3.46 (m, 2H), 3.09 – 3.08 (m, 1H), 3.01 (d, *J* = 9.3 Hz, 1H), 2.06 – 2.02 (m, 1H), 1.41 – 1.20 (m, 5H), 1.04 (s, 3H), 1.01 (s, 3H), 0.64 (t, *J* = 7.4 Hz, 3H). **^{13}C NMR (126 MHz, Chloroform-*d*) δ:** 172.4, 145.3, 138.1, 136.2, 133.7, 129.4, 128.6, 128.1, 127.6, 127.0, 126.1, 125.2, 122.4, 87.3, 76.7, 76.2, 76.1, 64.2, 61.6, 58.3, 54.1, 43.2, 40.8, 34.5, 34.4, 26.8, 25.5, 14.2, 8.3. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{31}H_{35}N_3O_3H^+$ 498.2751; Found 498.2749.



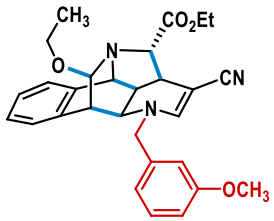
4v

Compound, **4v**: Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 74% (79 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.50 (d, *J* = 8.0 Hz, 1H), 7.24 – 7.11 (m, 6H), 7.07 (d, *J* = 7.6 Hz, 1H), 6.93 (s, 1H), 4.61 (d, *J* = 15.4 Hz, 1H), 4.42 (d, *J* = 15.4 Hz, 1H), 4.32 (d, *J* = 3.0 Hz, 1H), 4.29 – 4.21 (m, 1H), 4.20 – 4.12 (m, 1H), 3.90 (d, *J* = 3.1 Hz, 1H), 3.60 – 3.52 (m, 1H), 3.42 – 3.37 (m, 2H), 3.32 (d, *J* = 2.9 Hz, 1H), 3.20 – 3.12 (m, 1H), 2.91 (d, *J* = 9.3 Hz, 1H), 2.04 – 1.99 (m, 1H), 1.27 (t, *J* = 7.1 Hz, 3H), 0.93 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.2, 145.1, 137.3, 134.9, 133.7, 133.4, 130.3, 129.4, 128.4, 128.2, 127.2, 126.0, 125.1, 124.1, 122.1, 92.8, 76.8, 76.5, 64.4, 61.7, 61.4, 57.8, 53.9, 41.2, 41.1, 34.4, 14.7, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{28}H_{28}BrN_3O_3H^+$ 534.1387; Found 534.1390.



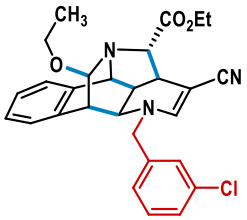
4w

Compound, **4w**: Yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 77% (73 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.26 – 7.15 (m, 5H), 7.06 (d, *J* = 7.6 Hz, 1H), 7.00 (s, 1H), 6.92 – 6.90 (m, 2H), 4.44 – 4.34 (m, 2H), 4.34 (d, *J* = 2.3 Hz, 1H), 4.31 – 4.23 (m, 1H), 4.23 – 4.15 (m, 1H), 3.90 (d, *J* = 2.3 Hz, 1H), 3.62 – 3.54 (m, 1H), 3.43 – 3.41 (m, 1H), 3.38 (s, 1H), 3.34 (s, 1H), 3.22 – 3.15 (m, 1H), 2.96 (d, *J* = 9.3 Hz, 1H), 2.28 (s, 3H), 2.02 – 1.98 (m, 1H), 1.30 (t, *J* = 7.1 Hz, 3H), 0.95 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.2, 145.3, 139.0, 137.4, 135.9, 133.5, 129.3, 129.1, 128.3, 128.1, 127.1, 125.9, 124.9, 124.5, 122.3, 92.8, 76.6, 76.2, 64.3, 61.5, 61.3, 57.9, 53.5, 41.2, 41.1, 34.5, 21.5, 14.6, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{29}H_{31}N_3O_3H^+$ 470.2438; Found 470.2448.



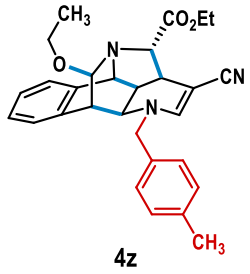
4x

Compound, **4x**: Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 75% (73 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.36 – 7.26 (m, 5H), 7.10 (s, 1H), 6.89 – 6.87 (m, 1H), 6.80 (d, *J* = 7.6 Hz, 1H), 6.73 (s, 1H), 4.55 – 4.46 (m, 2H), 4.44 (d, *J* = 2.3 Hz, 1H), 4.42 – 4.34 (m, 1H), 4.33 – 4.25 (m, 1H), 4.01 (d, *J* = 2.5 Hz, 1H), 3.83 (s, 3H), 3.72 – 3.65 (m, 1H), 3.54 – 3.51 (m, 1H), 3.49 – 3.48 (m, 1H), 3.44 (s, 1H), 3.32 – 3.25 (m, 1H), 3.08 (d, *J* = 9.3 Hz, 1H), 2.14 – 2.10 (m, 1H), 1.40 (t, *J* = 7.1 Hz, 3H), 1.05 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.2, 160.3, 145.3, 137.6, 137.4, 133.5, 130.4, 128.4, 127.2, 126.0, 124.9, 122.2, 119.5, 113.42, 113.38, 92.8, 76.6, 76.5, 64.4, 61.6, 61.3, 57.8, 55.3, 53.6, 41.2 (2C), 34.6, 14.7, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{29}H_{31}N_3O_4H^+$ 486.2387; Found 486.2395.



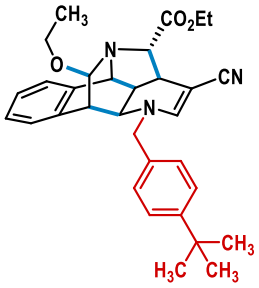
4y

Compound, **4y**: Yellow solid; **MP:** 162 °C; eluent (20% ethyl acetate in hexane). **Yield:** 71% (70 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.33 – 7.27 (m, 5H), 7.23 (d, *J* = 6.9 Hz, 1H), 7.16 (s, 1H), 7.07 – 7.05 (m, 1H), 7.04 (s, 1H), 4.53 – 4.43 (m, 2H), 4.41 (d, *J* = 2.3 Hz, 1H), 4.38 – 4.30 (m, 1H), 4.30 – 4.22 (m, 1H), 3.96 (d, *J* = 2.5 Hz, 1H), 3.69 – 3.61 (m, 1H), 3.51 – 3.48 (m, 1H), 3.46 – 3.45 (m, 1H), 3.37 (s, 1H), 3.29 – 3.21 (m, 1H), 3.00 (d, *J* = 9.3 Hz, 1H), 2.12 – 2.07 (m, 1H), 1.36 (t, *J* = 7.1 Hz, 3H), 1.01 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.2, 145.1, 138.2, 137.3, 135.3, 133.4, 130.6, 128.8, 128.5, 127.4, 127.3, 126.0, 125.4, 125.0, 121.9, 92.8, 77.3, 76.5, 64.4, 61.7, 61.4, 57.3, 53.8, 41.3, 41.2, 34.6, 14.7, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{28}H_{28}ClN_3O_3H^+$ 490.1892; Found 490.1902.



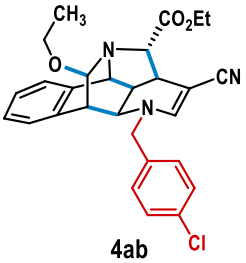
4z

Compound, **4z**: Yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 74% (70 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.26 – 7.17 (m, 4H), 7.09 (d, *J* = 7.8 Hz, 2H), 7.02 (d, *J* = 2.7 Hz, 3H), 4.44 – 4.35 (m, 2H), 4.34 (d, *J* = 2.3 Hz, 1H), 4.32 – 4.23 (m, 1H), 4.23 – 4.15 (m, 1H), 3.90 (d, *J* = 2.4 Hz, 1H), 3.62 – 3.55 (m, 1H), 3.42 – 3.38 (m, 2H), 3.36 (s, 1H), 3.23 – 3.15 (m, 1H), 2.95 (d, *J* = 9.3 Hz, 1H), 2.27 (s, 3H), 2.00 – 1.96 (m, 1H), 1.30 (t, *J* = 7.1 Hz, 3H), 0.95 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.2, 145.3, 138.3, 137.4, 133.4, 132.8, 129.8, 128.3, 127.4, 127.1, 125.9, 124.9, 122.2, 92.8, 76.6, 76.1, 64.3, 61.5, 61.2, 57.6, 53.3, 41.2, 41.0, 34.5, 21.1, 14.6, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{29}H_{31}N_3O_3H^+$ 470.2438; Found 470.2433.



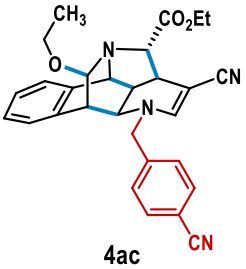
4aa

Compound, **4aa**: Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 72% (70 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.31 (d, *J* = 8.0 Hz, 2H), 7.28 – 7.18 (m, 4H), 7.05 (d, *J* = 7.9 Hz, 2H), 7.01 (s, 1H), 4.45 – 4.35 (m, 2H), 4.35 – 4.35 (m, 1H), 4.32 – 4.24 (m, 1H), 4.24 – 4.16 (m, 1H), 3.90 – 3.89 (m, 1H), 3.61 – 3.54 (m, 1H), 3.43 – 3.41 (m, 1H), 3.39 – 3.38 (m, 1H), 3.36 (s, 1H), 3.22 – 3.14 (m, 1H), 3.00 (d, *J* = 9.2 Hz, 1H), 2.04 – 2.00 (m, 1H), 1.30 (t, *J* = 7.1 Hz, 3H), 1.25 (s, 9H), 0.95 (t, *J* = 6.9 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.3, 151.7, 145.4, 137.5, 133.6, 132.9, 128.4, 127.2 (2C), 126.2, 126.0, 125.0, 122.3, 92.9, 76.7, 76.3, 64.4, 61.6, 61.4, 57.5, 53.6, 41.28, 41.25, 34.71, 34.65, 31.4, 14.7, 14.3. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{32}H_{37}N_3O_3H^+$ 512.2908; Found 512.2922.



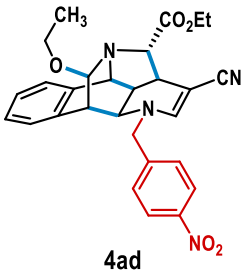
4ab

Compound, **4ab**: Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 70% (67 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.29 – 7.21 (m, 5H), 7.18 (d, *J* = 6.8 Hz, 1H), 7.07 (d, *J* = 8.2 Hz, 2H), 7.00 (s, 1H), 4.47 – 4.38 (m, 2H), 4.35 (d, *J* = 2.3 Hz, 1H), 4.33 – 4.25 (m, 1H), 4.25 – 4.16 (m, 1H), 3.90 (d, *J* = 2.1 Hz, 1H), 3.64 – 3.56 (m, 1H), 3.43 (d, *J* = 5.8 Hz, 1H), 3.40 – 3.39 (m, 1H), 3.33 (s, 1H), 3.23 – 3.15 (m, 1H), 2.93 (d, *J* = 9.2 Hz, 1H), 2.03 – 1.99 (m, 1H), 1.31 (t, *J* = 7.1 Hz, 3H), 0.96 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.2, 145.1, 137.3, 134.52, 134.46, 133.4, 129.5, 128.8, 128.5, 127.3, 126.0, 124.9, 121.9, 92.8, 77.1, 76.5, 64.3, 61.7, 61.3, 57.2, 53.6, 41.2 (2C), 34.6, 14.7, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{28}H_{28}ClN_3O_3H^+$ 490.1892; Found 490.1904.



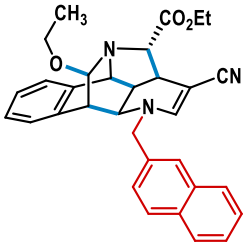
4ac

Compound, **4ac**: Yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 77% (74 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.59 (d, *J* = 7.9 Hz, 2H), 7.24 – 7.15 (m, 6H), 6.98 (s, 1H), 4.56 – 4.46 (m, 2H), 4.34 (d, *J* = 2.1 Hz, 1H), 4.32 – 4.24 (m, 1H), 4.24 – 4.15 (m, 1H), 3.91 – 3.90 (m, 1H), 3.63 – 3.55 (m, 1H), 3.45 – 3.43 (m, 1H), 3.40 – 3.39 (m, 1H), 3.31 (s, 1H), 3.21 – 3.14 (m, 1H), 2.89 (d, *J* = 9.2 Hz, 1H), 2.06 – 2.01 (m, 1H), 1.30 (t, *J* = 7.1 Hz, 3H), 0.94 (t, *J* = 6.9 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.0, 144.9, 141.6, 137.1, 133.3, 133.1, 128.5, 127.8, 127.4, 126.1, 124.9, 121.6, 118.2, 112.5, 92.7, 78.0, 76.4, 64.3, 61.7, 61.3, 57.1, 53.9, 41.3, 41.1, 34.5, 14.7, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{29}H_{28}N_4O_3H^+$ 481.2234; Found 481.2245.



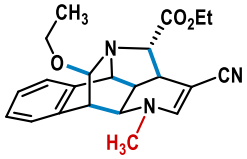
4ad

Compound, **4ad**: Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 71% (71 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 8.24 (d, *J* = 8.4 Hz, 2H), 7.39 (d, *J* = 8.4 Hz, 2H), 7.35 – 7.29 (m, 3H), 7.25 (d, *J* = 6.9 Hz, 1H), 7.09 (s, 1H), 4.71 – 4.60 (m, 2H), 4.44 – 4.44 (m, 1H), 4.41 – 4.33 (m, 1H), 4.33 – 4.25 (m, 1H), 4.02 – 4.01 (m, 1H), 3.73 – 3.65 (m, 1H), 3.56 – 3.53 (m, 1H), 3.50 – 3.49 (m, 1H), 3.41 (s, 1H), 3.31 – 3.24 (m, 1H), 2.99 (d, *J* = 9.2 Hz, 1H), 2.16 – 2.12 (m, 1H), 1.39 (t, *J* = 7.1 Hz, 3H), 1.03 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.0, 148.0, 144.9, 143.5, 137.1, 133.3, 128.5, 128.0, 127.4, 126.1, 124.9, 124.5, 121.5, 92.7, 78.2, 76.4, 64.3, 61.7, 61.4, 56.9, 54.0, 41.3, 41.1, 34.6, 14.7, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{28}H_{28}N_4O_5H^+$ 501.2132; Found 501.2138.



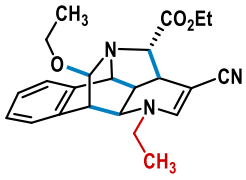
4ae

Compound, **4ae**: Yellow solid; **MP:** 208 °C; eluent (20% ethyl acetate in hexane). **Yield:** 75% (76 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.87 – 7.81 (m, 3H), 7.63 (s, 1H), 7.56 – 7.49 (m, 2H), 7.32 – 7.28 (m, 3H), 7.26 – 7.22 (m, 2H), 7.16 (s, 1H), 4.71 – 4.62 (m, 2H), 4.42 (d, *J* = 2.1 Hz, 1H), 4.38 – 4.32 (m, 1H), 4.32 – 4.23 (m, 1H), 4.02 – 4.02 (m, 1H), 3.71 – 3.63 (m, 1H), 3.53 – 3.49 (m, 2H), 3.47 (s, 1H), 3.31 – 3.23 (m, 1H), 3.09 (d, *J* = 9.2 Hz, 1H), 2.11 – 2.06 (m, 1H), 1.38 (t, *J* = 7.1 Hz, 3H), 1.02 (t, *J* = 6.9 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.2, 145.3, 137.3, 133.4, 133.3 (2C), 133.2, 129.3, 128.4, 127.8 (2C), 127.2, 126.9, 126.7, 126.6, 126.0, 124.9, 124.8, 122.2, 92.8, 76.60, 76.57, 64.3, 61.6, 61.3, 58.2, 53.6, 41.2, 41.2, 34.5, 14.7, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{32}H_{31}N_3O_3H^+$ 506.2438; Found 506.2452.



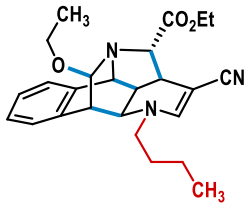
4af

Compound, **4af**: Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 78% (59 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.28 – 7.19 (m, 4H), 6.82 (s, 1H), 4.32 (d, *J* = 3.5 Hz, 1H), 4.29 – 4.21 (m, 1H), 4.20 – 4.12 (m, 1H), 3.81 (d, *J* = 4.2 Hz, 1H), 3.62 – 3.54 (m, 1H), 3.37 – 3.35 (m, 2H), 3.29 (s, 1H), 3.18 – 3.12 (m, 1H), 3.05 (s, 3H), 2.85 (d, *J* = 9.3 Hz, 1H), 2.07 – 2.02 (m, 1H), 1.27 (t, *J* = 7.1 Hz, 3H), 0.92 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.3, 145.7, 137.3, 133.5, 128.3, 127.2, 126.0, 125.0, 122.3, 92.8, 76.7, 75.4, 64.2, 61.5, 61.3, 55.9, 42.3, 40.9, 40.6, 34.6, 14.7, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{22}H_{25}N_3O_3H^+$ 380.1969; Found 380.1975.



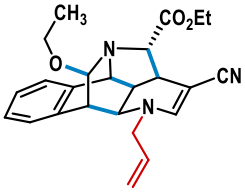
4ag

Compound, **4ag**: Yellow solid; **MP:** 142 °C; eluent (20% ethyl acetate in hexane). **Yield:** 79% (63 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.26 – 7.17 (m, 4H), 6.85 (s, 1H), 4.31 (d, *J* = 2.9 Hz, 1H), 4.27 – 4.19 (m, 1H), 4.18 – 4.11 (m, 1H), 3.81 (d, *J* = 3.1 Hz, 1H), 3.60 – 3.52 (m, 1H), 3.37 – 3.34 (m, 1H), 3.32 – 3.19 (m, 4H), 3.17 – 3.09 (m, 1H), 2.96 (d, *J* = 9.3 Hz, 1H), 2.03 – 1.98 (m, 1H), 1.25 (t, *J* = 7.1 Hz, 3H), 1.12 (t, *J* = 7.1 Hz, 3H), 0.90 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.3, 144.2, 137.5, 133.5, 128.3, 127.2, 125.9, 124.9, 122.4, 92.8, 76.7, 75.8, 64.3, 61.5, 61.2, 53.5, 48.3, 41.8, 41.1, 34.7, 14.6, 14.4, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{23}H_{27}N_3O_3H^+$ 394.2125; Found 394.2137.



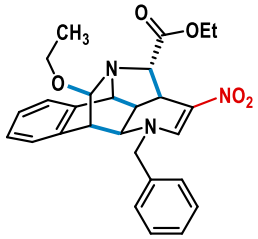
4ah

Compound, **4ah**: Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 75% (63 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.26 – 7.17 (m, 4H), 6.83 (s, 1H), 4.31 (d, *J* = 2.4 Hz, 1H), 4.27 – 4.19 (m, 1H), 4.18 – 4.10 (m, 1H), 3.80 (d, *J* = 3.0 Hz, 1H), 3.59 – 3.52 (m, 1H), 3.37 – 3.34 (m, 1H), 3.31 – 3.30 (m, 1H), 3.27 – 3.21 (m, 2H), 3.17 – 3.09 (m, 2H), 2.94 (d, *J* = 9.2 Hz, 1H), 2.03 – 1.98 (m, 1H), 1.46 (p, *J* = 7.5 Hz, 2H), 1.27 – 1.17 (m, 5H), 0.90 (t, *J* = 7.0 Hz, 3H), 0.84 (t, *J* = 7.3 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.3, 144.7, 137.6, 133.6, 128.4, 127.2, 126.0, 124.9, 122.5, 92.8, 76.7, 75.4, 64.3, 61.6, 61.3, 53.8, 53.6, 41.7, 41.1, 34.6, 31.1, 19.9, 14.7, 14.2, 13.8. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{25}H_{31}N_3O_3H^+$ 422.2438; Found 422.2431.



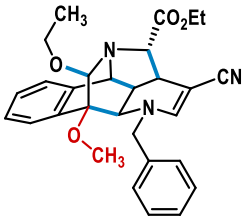
4ai

Compound, **4ai**: Yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 81% (66 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.30 – 7.22 (m, 4H), 6.91 (s, 1H), 5.74 (ddt, *J* = 16.3, 10.8, 5.8 Hz, 1H), 5.22 (d, *J* = 10.2 Hz, 1H), 5.17 (d, *J* = 17.1 Hz, 1H), 4.37 (d, *J* = 2.2 Hz, 1H), 4.33 – 4.25 (m, 1H), 4.25 – 4.17 (m, 1H), 3.92 – 3.82 (m, 3H), 3.66 – 3.58 (m, 1H), 3.44 – 3.42 (m, 1H), 3.38 – 3.37 (m, 1H), 3.33 (s, 1H), 3.23 – 3.16 (m, 1H), 3.03 (d, *J* = 9.3 Hz, 1H), 2.09 – 2.05 (m, 1H), 1.32 (t, *J* = 7.1 Hz, 3H), 0.96 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.2, 144.8, 137.4, 133.5, 132.6, 128.3, 127.2, 125.9, 124.9, 122.1, 119.2, 92.8, 76.6, 76.4, 64.3, 61.5, 61.2, 56.3, 53.8, 41.5, 41.2, 34.6, 14.6, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{24}H_{27}N_3O_3H^+$ 406.2125; Found 406.2132.



4aj

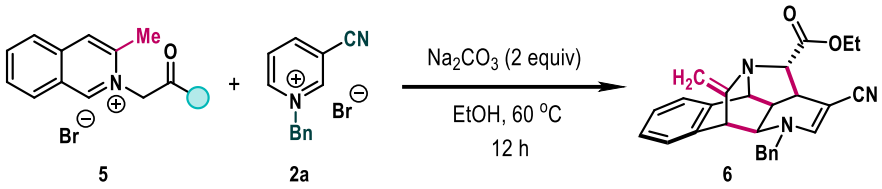
Compound, **4aj**: Yellow solid; **MP:** 162 °C (Isolated by crystallization in DCM : Hexane) **Yield:** 74% (70 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 8.37 (s, 1H), 7.39 – 7.33 (m, 3H), 7.32 – 7.26 (m, 3H), 7.24 – 7.19 (m, 3H), 4.69 – 4.60 (m, 3H), 4.40 – 4.32 (m, 1H), 4.27 – 4.17 (m, 2H), 3.89 (d, *J* = 2.9 Hz, 1H), 3.68 – 3.60 (m, 1H), 3.39 (d, *J* = 3.3 Hz, 2H), 3.27 – 3.19 (m, 1H), 3.08 (d, *J* = 9.0 Hz, 1H), 2.29 – 2.25 (m, 1H), 1.32 (t, *J* = 7.1 Hz, 3H), 0.99 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 172.2, 143.0, 137.2, 134.6, 133.5, 129.6, 129.1, 128.6, 127.7, 127.5, 126.3, 124.9, 123.5, 92.8, 75.5, 63.8, 61.7, 61.6, 58.9, 55.0, 41.0, 39.0, 35.3, 14.7, 14.3. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{27}H_{29}N_3O_5H^+$ 476.2180; Found 476.2183.



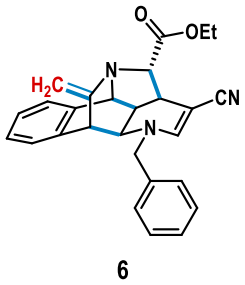
8

Compound, **8:** Pale yellow solid; eluent (20% ethyl acetate in hexane). **Yield:** 80% (78 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.53 (d, *J* = 7.5 Hz, 1H), 7.29 – 7.24 (m, 2H), 7.22 – 7.09 (m, 5H), 6.92 – 6.91 (m, 2H), 4.47 (d, *J* = 15.0 Hz, 1H), 4.31 (d, *J* = 15.0 Hz, 1H), 4.05 – 4.00 (m, 4H), 3.68 – 3.59 (m, 1H), 3.50 (s, 3H), 3.33 – 3.26 (m, 1H), 2.88 (s, 1H), 2.57 – 2.57 (m, 1H), 2.53 (d, *J* = 4.4 Hz, 1H), 1.71 (t, *J* = 4.0 Hz, 1H), 1.16 (t, *J* = 7.1 Hz, 3H), 1.11 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 171.6, 142.3, 136.2, 133.0, 132.8, 129.2, 128.7, 128.5, 128.0, 127.8, 127.5, 126.9, 122.9, 100.7, 76.1, 75.8, 73.8, 69.1, 61.7, 59.5, 59.0, 57.8, 49.5, 40.9, 30.2, 15.1, 14.1. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{29}H_{31}N_3O_4H^+$ 486.2387; Found 486.2380.

Synthesis of cage tertiary amine 6:

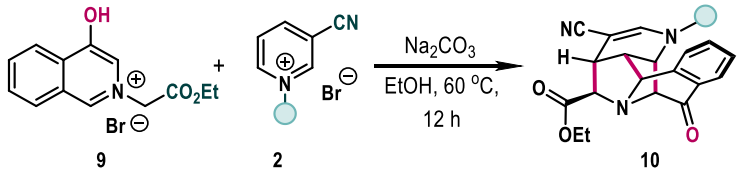


A 16x100 mm oven dried reaction tube equipped with a magnetic stir was charged with 3-methyl substituted isoquinolinium salts **5** (0.12 mmol, 1.2 equiv), pyridinium salts **2a** (0.1 mmol, 1.0 equiv), and sodium carbonate (2.0 equiv) under N_2 atmosphere. Then, Ethanol (1.5 mL) was added as solvent. The reaction mixture was allowed to stir for 12 h at 60 °C. After completion of the reaction, volatiles were removed under reduced pressure and the crude product was purified by silica gel column chromatography to provide pure product **6**.



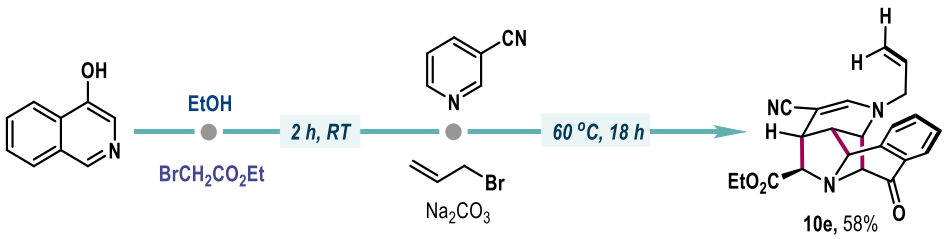
Compound, **6:** Yellow sticky liquid; eluent (10% ethyl acetate in hexane). **Yield:** 57% (24 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.40 – 7.28 (m, 5H), 7.24 – 7.21 (m, 4H), 7.05 (s, 1H), 4.59 – 4.36 (m, 4H), 4.27 – 4.21 (m, 4H), 3.78 (d, *J* = 1.7 Hz, 1H), 3.35 (d, *J* = 4.1 Hz, 1H), 2.29 (d, *J* = 9.1 Hz, 1H), 2.19 – 2.14 (m, 1H), 1.32 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*):** δ 172.4, 154.7, 145.2, 140.7, 135.9, 133.3, 129.2, 128.9, 128.5, 128.1, 127.0, 125.9, 123.3, 122.5, 96.4, 80.3, 76.6, 63.5, 62.1, 62.0, 58.9, 46.1, 37.1, 33.4, 14.4. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{27}H_{25}N_3O_2H^+$ 424.2020; Found 424.2026.

Synthesis of cage tertiary amines (10a-10f):

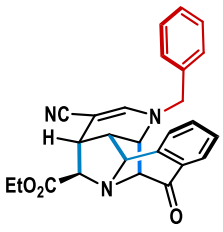


A 16x100 mm oven dried reaction tube equipped with a magnetic stir was charged with isoquinolinium salts **9** (0.24 mmol, 1.1 equiv), pyridinium salts **2** (0.22 mmol, 1.0 equiv), and sodium carbonate (2.0 equiv) under N_2 atmosphere. Then, Ethanol (1.5 mL) was added as solvent. The reaction mixture was allowed to stir for 12 h at 60 °C. After completion of the reaction, volatiles were removed under reduced pressure and the crude product was purified by silica gel column chromatography to provide pure product **10**.

Synthesis of compound 10e (four-component: one pot sequential approach):

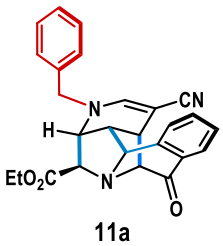


A 16x100 mm oven dried reaction tube equipped with a magnetic stir was charged with 4-hydroxyisoquinoline (0.24 mmol), Ethyl bromoacetate (0.288 mmol) and EtOH (1.5 mL) under N_2 atmosphere. Then, the reaction mixture was allowed to stir for 2 h at room temperature. After that, 3-cyanopyridine (0.2 mmol) followed by Allyl bromide (0.24 mmol), and Na_2CO_3 (2.0 equiv) were added and allowed to stir at 60 °C for 18 h. After completion of the reaction (TLC monitored), volatiles were removed under reduced pressure and the crude product was purified by silica gel column chromatography to provide pure product **10e**.



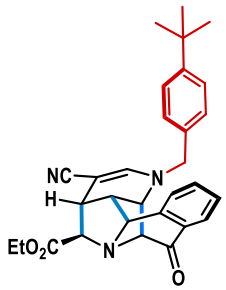
10a

Compound, **10a**: Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 70% (32 mg); **^{1}H NMR (500 MHz, Chloroform-*d*) δ:** 7.96 (dd, *J* = 7.6, 1.3 Hz, 1H), 7.54 (td, *J* = 7.5, 1.4 Hz, 1H), 7.42 (td, *J* = 7.6, 1.2 Hz, 1H), 7.35 – 7.27 (m, 4H), 7.13 – 7.12 (m, 2H), 7.02 (s, 1H), 4.49 – 4.48 (m, 1H), 4.45 – 4.40 (m, 2H), 4.35 – 4.28 (m, 1H), 4.27 – 4.21 (m, 1H), 3.48 – 3.46 (m, 1H), 3.30 – 3.28 (m, 1H), 3.03 (t, *J* = 2.2 Hz, 1H), 2.70 (d, *J* = 4.8 Hz, 1H), 2.01 (td, *J* = 4.1, 1.1 Hz, 1H), 1.35 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (126 MHz, Chloroform-*d*) δ:** 194.3, 171.4, 142.4, 139.0, 135.1, 134.5, 129.4, 129.3, 129.2, 128.7, 128.0, 127.8, 126.9, 121.4, 79.0, 75.97, 75.95, 70.8, 62.0, 59.5, 55.3, 39.1, 36.6, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{26}H_{23}N_3O_3H^+$ 426.1812; Found 426.1818.



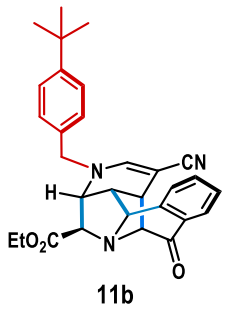
11a

Compound, **11a**: Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 14% (7 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 8.02 (d, *J* = 7.7 Hz, 1H), 7.52 (t, *J* = 7.5 Hz, 1H), 7.45 – 7.34 (m, 4H), 7.22 – 7.20 (m, 3H), 7.06 (s, 1H), 4.65 – 4.46 (m, 2H), 4.27 (s, 1H), 4.21 – 4.12 (m, 3H), 3.15 (s, 1H), 2.64 – 2.59 (m, 2H), 1.96 (t, *J* = 4.0 Hz, 1H), 1.27 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 193.9, 171.2, 142.2, 138.8, 135.9, 134.1, 129.6, 129.3, 129.1, 128.7, 128.0, 127.3, 127.1, 121.5, 79.4, 75.2, 72.8, 69.7, 62.1, 60.0, 59.5, 37.5, 32.3, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{26}H_{23}N_3O_3H^+$ 426.1812; Found 426.1818.



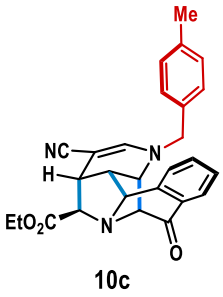
10b

Compound, **10b**: Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 74% (32 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.97 (dd, *J* = 7.7, 1.4 Hz, 1H), 7.54 (td, *J* = 7.5, 1.4 Hz, 1H), 7.48 – 7.40 (m, 1H), 7.37 – 7.29 (m, 2H), 7.31 – 7.25 (m, 1H), 7.08 – 7.01 (m, 2H), 7.00 (s, 1H), 4.49 (d, *J* = 1.9 Hz, 1H), 4.40 (d, *J* = 13.3 Hz, 2H), 4.34 – 4.17 (m, 2H), 3.50 (dd, *J* = 4.5, 2.2 Hz, 1H), 3.32 – 3.25 (m, 1H), 3.04 (t, *J* = 2.2 Hz, 1H), 2.69 (d, *J* = 4.8 Hz, 1H), 2.04 – 2.02 (m, 1H), 1.34 – 1.32 (m, 3H), 1.27 (s, 9H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 194.3, 171.3, 151.7, 142.4, 139.0, 134.4, 132.0, 129.4, 129.1, 127.8, 127.7, 126.9, 126.1(2H), 121.5, 79.0, 76.0, 75.6, 70.8, 61.9, 59.0, 55.5, 39.1, 36.6, 31.3, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{30}H_{31}N_3O_3H^+$ 482.2438; Found 482.2440.



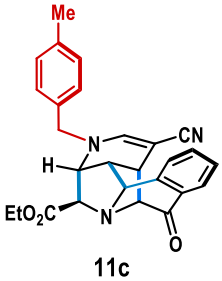
11b

Compound, **11b**: Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 16% (7 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 8.01 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.51 (td, *J* = 7.5, 1.4 Hz, 1H), 7.44 – 7.38 (m, 3H), 7.22 (d, *J* = 7.4 Hz, 1H), 7.13 (d, *J* = 8.3 Hz, 2H), 7.04 (s, 1H), 4.59 (d, *J* = 15.0 Hz, 1H), 4.45 (d, *J* = 15.0 Hz, 1H), 4.28 – 4.28 (m, 1H), 4.26 – 4.16 (m, 3H), 3.14 (t, *J* = 2.1 Hz, 1H), 2.65 – 2.60 (m, 2H), 1.97 – 1.95 (m, 1H), 1.32–1.27 (m, 12H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 194.0, 171.1, 151.7, 142.2, 138.8, 134.0, 132.8, 129.6, 129.0, 127.6, 127.3, 126.9, 126.1, 121.6, 79.3, 74.8, 72.9, 69.8, 62.0, 60.1, 58.9, 37.5, 34.7, 32.3, 31.4, 14.3. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{30}H_{31}N_3O_3H^+$ 482.2438; Found 482.2440.



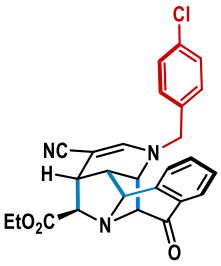
10c

Compound, **10c**: Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 75% (34 mg); **^{1}H NMR (500 MHz, Chloroform-*d*) δ:**7.96 (dd, *J* = 7.7, 1.4 Hz, 1H), 7.53 (td, *J* = 7.6, 1.4 Hz, 1H), 7.42 (td, *J* = 7.5, 1.1 Hz, 1H), 7.27 (d, *J* = 7.4 Hz, 1H), 7.11 (d, *J* = 7.7 Hz, 2H), 7.01 – 7.00 (m, 3H), 4.47 (s, 1H), 4.42 (d, *J* = 15.0 Hz, 1H), 4.35 (d, *J* = 15.1 Hz, 1H), 4.32 – 4.27 (m, 1H), 4.26 – 4.20 (m, 1H), 3.47 – 3.45 (m, 1H), 3.28 – 3.26 (m, 1H), 3.02 (t, *J* = 2.2 Hz, 1H), 2.68 (d, *J* = 5.0 Hz, 1H), 2.30 (s, 3H), 2.00 – 1.98 (m, 1H), 1.34 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (126 MHz, Chloroform-*d*) δ:** 194.3, 171.3, 142.4, 139.0, 138.6, 134.4, 131.9, 129.88, 129.4, 129.1, 128.0, 127.8, 126.8, 121.5, 78.9, 75.9, 75.6, 70.8, 61.9, 59.2, 55.2, 39.1, 36.6, 21.2, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{27}H_{25}N_3O_3H^+$ 440.1969; Found 440.1975.



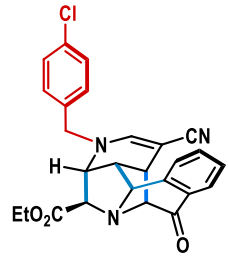
11c

Compound, **11c:** Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 13% (6 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 8.02 – 8.00 (m, 1H), 7.53 – 7.49 (m, 1H), 7.44 – 7.40 (m, 1H), 7.21 – 7.18 (m, 3H), 7.10 (d, *J* = 8.0 Hz, 2H), 7.05 (s, 1H), 4.58 (d, *J* = 14.8 Hz, 1H), 4.43 (d, *J* = 14.9 Hz, 1H), 4.27 (s, 1H), 4.20 – 4.10 (m, 3H), 3.13 (t, *J* = 1.9 Hz, 1H), 2.62 – 2.60 (m, 1H), 2.58 (d, *J* = 4.6 Hz, 1H), 2.36 (s, 3H), 1.94 (t, *J* = 4.2 Hz, 1H), 1.27 (t, *J* = 7.2 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 194.0, 171.1, 142.2, 138.8, 138.5, 134.1, 132.7, 129.9, 129.6, 129.1, 128.0, 127.3, 127.0, 121.6, 79.4, 74.8, 72.8, 69.7, 62.1, 59.8, 59.3, 37.5, 32.3, 21.3, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{27}H_{25}N_3O_3H^+$ 440.1969; Found 440.1975.



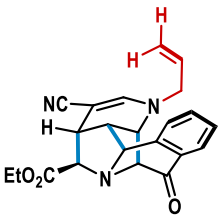
10d

Compound, **10d:** Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 72% (35 mg); **^{1}H NMR (500 MHz, Chloroform-*d*) δ:** 7.96 (d, *J* = 7.7 Hz, 1H), 7.54 (td, *J* = 7.5, 1.4 Hz, 1H), 7.43 (td, *J* = 7.6, 1.1 Hz, 1H), 7.30 – 7.26 (m, 3H), 7.07 (d, *J* = 8.2 Hz, 2H), 7.01 (s, 1H), 4.49 – 4.48 (m, 1H), 4.44 – 4.34 (m, 2H), 4.33 – 4.28 (m, 1H), 4.27 – 4.20 (m, 1H), 3.41 – 3.39 (m, 1H), 3.29 – 3.27 (m, 1H), 3.01 (t, *J* = 2.2 Hz, 1H), 2.68 (d, *J* = 4.8 Hz, 1H), 2.00 – 1.99 (m, 1H), 1.34 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (126 MHz, Chloroform-*d*) δ:**194.3, 171.3, 142.2, 138.9, 134.7, 134.6, 133.5, 129.5, 129.3 (2H), 129.2, 127.9, 126.9, 121.2, 78.9, 76.6, 75.9, 70.8, 62.0, 58.8, 55.2, 39.0, 36.6, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{26}H_{22}ClN_3O_3H^+$ 460.1422; Found 460.1420.



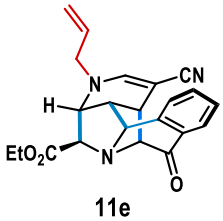
11d

Compound, **11d:** Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 13% (7 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 8.01 (d, *J* = 7.6 Hz, 1H), 7.54 – 7.50 (m, 1H), 7.43 (t, *J* = 7.6 Hz, 1H), 7.37 – 7.35 (m, 2H), 7.22 – 7.16 (m, 3H), 7.05 (s, 1H), 4.60 (d, *J* = 15.0 Hz, 1H), 4.43 (d, *J* = 15.0 Hz, 1H), 4.25 (s, 1H), 4.21 – 4.08 (m, 3H), 3.14 – 3.13 (m, 1H), 2.62 – 2.56 (m, 2H), 1.95 – 1.94 (m, 1H), 1.28 – 1.25 (m, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 193.9, 171.1, 142.1, 138.7, 134.6, 134.4, 134.1, 129.6, 129.48, 129.46, 129.1, 127.3, 127.0, 121.4, 79.4, 75.6, 72.8, 69.7, 62.3, 59.8, 58.8, 37.6, 32.2, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{26}H_{22}ClN_3O_3H^+$ 460.1422; Found 460.1420.



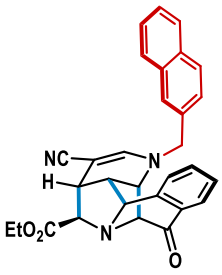
10e

Compound, **10e**: Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 70% (26 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 8.00 (dd, *J* = 7.7, 1.5 Hz, 1H), 7.57 (td, *J* = 7.5, 1.5 Hz, 1H), 7.46 (td, *J* = 7.6, 1.2 Hz, 1H), 7.32 – 7.30 (m, 1H), 6.91 (s, 1H), 5.80 – 5.70 (m, 1H), 5.25 – 5.22 (m, 1H), 5.19 – 5.14 (m, 1H), 4.51 (d, *J* = 1.7 Hz, 1H), 4.34 – 4.18 (m, 2H), 3.88 – 3.86 (m, 2H), 3.53 – 3.51 (m, 1H), 3.29 – 3.26 (m, 1H), 2.99 (t, *J* = 2.2 Hz, 1H), 2.67 (d, *J* = 4.9 Hz, 1H), 2.02 (td, *J* = 4.2, 1.1 Hz, 1H), 1.34 (t, *J* = 7.2 Hz, 4H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 194.2, 171.4, 142.0, 139.1, 134.5, 132.0, 129.6, 129.2, 127.8, 126.9, 121.4, 120.4, 79.2, 76.1, 76.0, 70.8, 61.9, 58.5, 55.6, 39.1, 36.6, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{22}H_{21}N_3O_3H^+$ 376.1656; Found 376.1660.



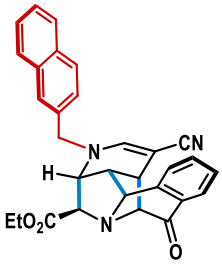
11e

Compound, **11e**: Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 14% (5 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 8.01 (d, *J* = 7.5 Hz, 1H), 7.53 (t, *J* = 7.4 Hz, 1H), 7.43 (t, *J* = 7.5 Hz, 1H), 7.26 – 7.24 (m, 1H), 6.89 (s, 1H), 5.84 – 5.74 (m, 1H), 5.28 – 5.21 (m, 2H), 4.36 (s, 1H), 4.28 – 4.20 (m, 3H), 3.97 (ddd, *J* = 50.7, 15.3, 5.9 Hz, 2H), 3.11 (s, 1H), 2.60 (d, *J* = 4.3 Hz, 2H), 2.00 (t, *J* = 3.9 Hz, 1H), 1.30 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 194.0, 171.3, 141.9, 138.8, 134.1, 132.8, 129.6, 129.1, 127.4, 127.0, 121.5, 119.9, 79.4, 75.1, 73.0, 69.8, 62.1, 60.4, 58.0, 37.5, 32.2, 14.3. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{22}H_{21}N_3O_3H^+$ 376.1656; Found 376.1660.



10f

Compound, **10f**: Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 71% (34 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 7.94 (d, *J* = 7.7 Hz, 1H), 7.82 – 7.78 (m, 3H), 7.57 – 7.56 (m, 1H), 7.52 – 7.47 (m, 3H), 7.38 (t, *J* = 7.6 Hz, 1H), 7.26 – 7.22 (m, 2H), 7.10 (s, 1H), 4.60 (q, *J* = 15.0 Hz, 2H), 4.49 (s, 1H), 4.39 – 4.21 (m, 2H), 3.52 – 3.50 (m, 1H), 3.32 – 3.29 (m, 1H), 3.08 (t, *J* = 2.3 Hz, 1H), 2.71 (d, *J* = 4.7 Hz, 1H), 2.00 (t, *J* = 4.2 Hz, 1H), 1.35 (t, *J* = 7.2 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 194.4, 171.4, 142.5, 139.0, 134.5, 133.4, 133.3, 132.4, 129.4, 129.4, 129.2, 128.0, 127.9, 127.8, 127.4, 126.9, 126.9, 126.8, 125.3, 121.4, 79.1, 76.2, 76.1, 70.9, 62.0, 59.7, 55.2, 39.2, 36.7, 14.2. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{30}H_{25}N_3O_3H^+$ 476.1969; Found 476.1966.



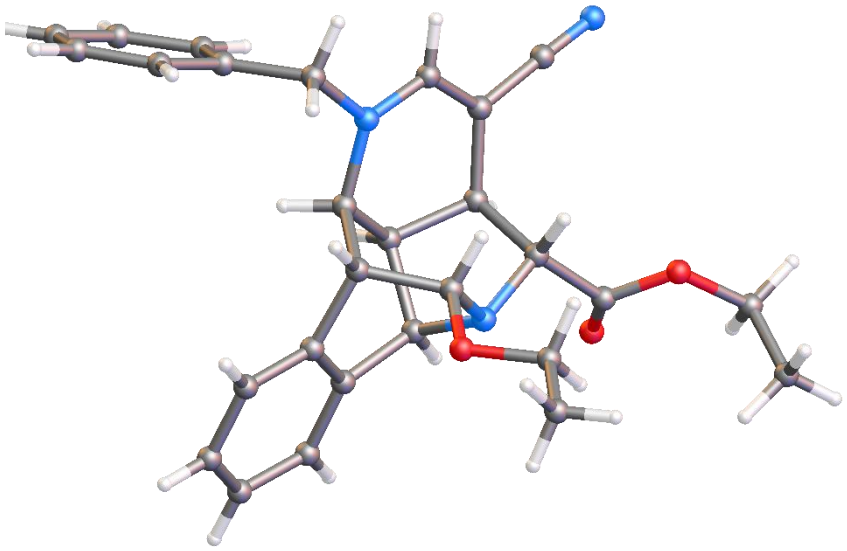
11f

Compound, **11f**: Yellow sticky liquid; eluent (20% ethyl acetate in hexane). **Yield:** 17% (8 mg); **^{1}H NMR (400 MHz, Chloroform-*d*) δ:** 8.01 (d, *J* = 7.5 Hz, 1H), 7.89 – 7.84 (m, 3H), 7.67 (s, 1H), 7.56 – 7.48 (m, 3H), 7.42 (t, *J* = 7.4 Hz, 1H), 7.32 – 7.29 (m, 1H), 7.19 – 7.16 (m, 2H), 4.78 (d, *J* = 14.9 Hz, 1H), 4.61 (d, *J* = 14.9 Hz, 1H), 4.27 – 4.25 (m, 2H), 4.03 – 3.95 (m, 1H), 3.78 – 3.70 (m, 1H), 3.15 (t, *J* = 2.0 Hz, 1H), 2.64 – 2.62 (m, 1H), 2.53 (d, *J* = 4.6 Hz, 1H), 1.97 – 1.95 (m, 1H), 1.07 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*) δ:** 193.9, 171.1, 142.3, 138.8, 134.1, 133.4, 133.3, 133.1, 129.6, 129.4, 129.1, 128.00, 127.96, 127.6, 127.3, 127.01, 126.97, 126.8, 125.3, 121.6, 79.5, 75.1, 72.7, 69.5, 62.0, 59.9, 59.7, 37.5, 32.3, 14.0. **HRMS** (ESI/TOF-Q) m/z: $[M+H]^+$ Calculated for $C_{30}H_{25}N_3O_3H^+$ 476.1969; Found 476.1966.

Crystallographic experimental section

Crystallization: Crystals of compound **4a** obtained through slow evaporation technique at room temperature from their respective solution in hexane: DCM solvent combinations.

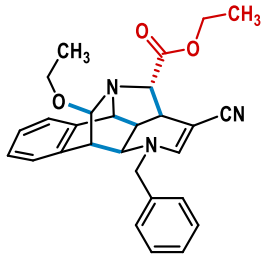
Crystal structure of compound **4a (CCDC number: 2190610,** Ellipsoid Probability 50%):



Identification code	**4a**
Empirical formula	C_{28} H_{29} N_3 O_3
Formula weight	455.54
Temperature	297(2) K
Wavelength	0.71073 A
Crystal system, space group	Orthorhombic, P n a 21
Unit cell dimensions	a = 17.5170(13) A alpha = 90 deg.
	b = 14.5182(9) A beta = 90 deg.
	c = 9.5517(7) A gamma = 90 deg.
Volume	2429.1(3) A^3

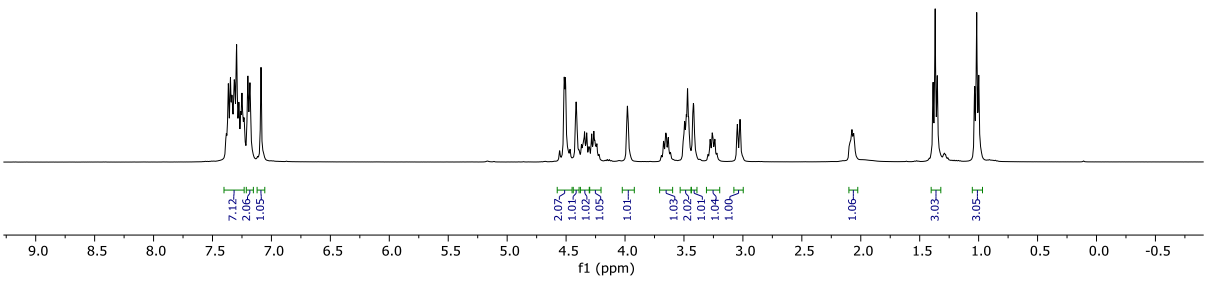
Z, Calculated density	4, 1.246 Mg/m^3
Absorption coefficient	0.082 mm^-1
F(000)	968
Crystal size	0.122 x 0.076 x 0.032 mm
Theta range for data collection	2.716 to 25.047 deg.
Limiting indices	-20<=h<=20, -17<=k<=15, -11<=l<=11
Reflections collected / unique	70501 / 4292 [R(int) = 0.1442]
Completeness to theta = 25.047	99.7 %
Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	1.000 and 0.940
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	4292 / 37 / 336
Goodness-of-fit on F^2	1.135
Final R indices [I>2sigma(I)]	R1 = 0.0743, wR2 = 0.1548
R indices (all data)	R1 = 0.0898, wR2 = 0.1627
Extinction coefficient	n/a
Largest diff. peak and hole	0.377 and -0.224 e.A^-3

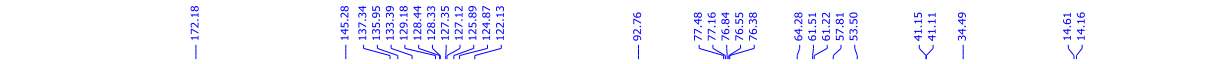
NMR spectra of synthesized compounds

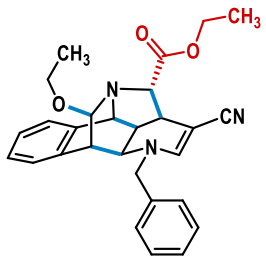


4a

400 MHz, $CDCl_3$

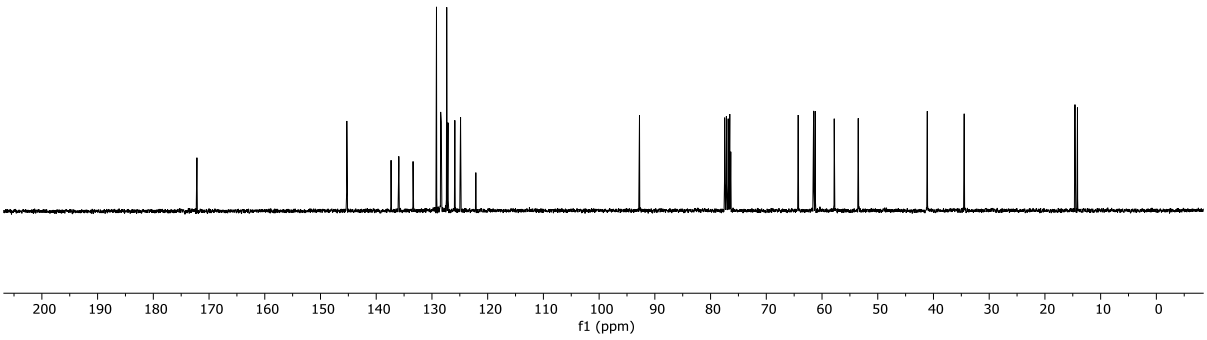


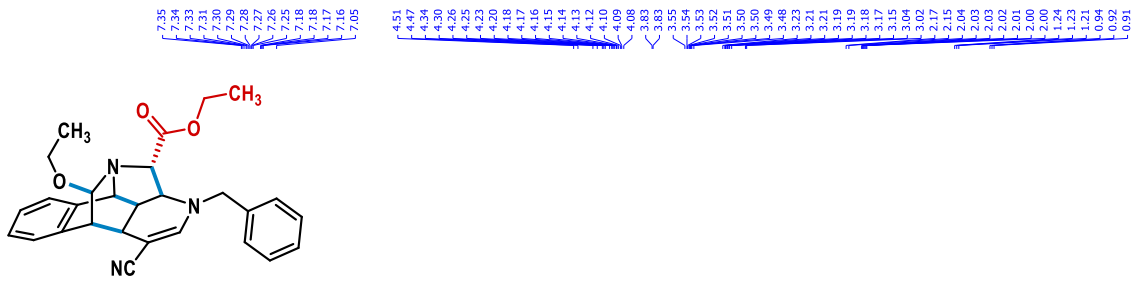




4a

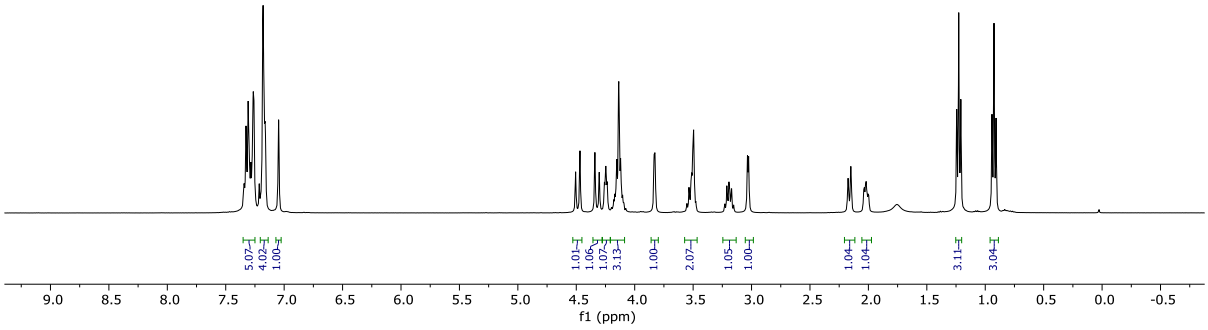
101 MHz, $CDCl_3$

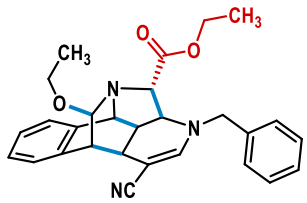




4a'

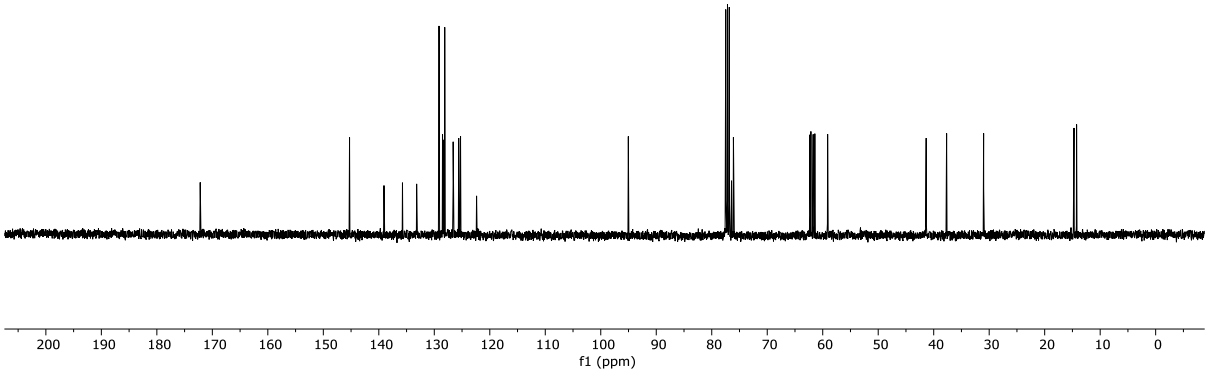
400 MHz, $CDCl_3$

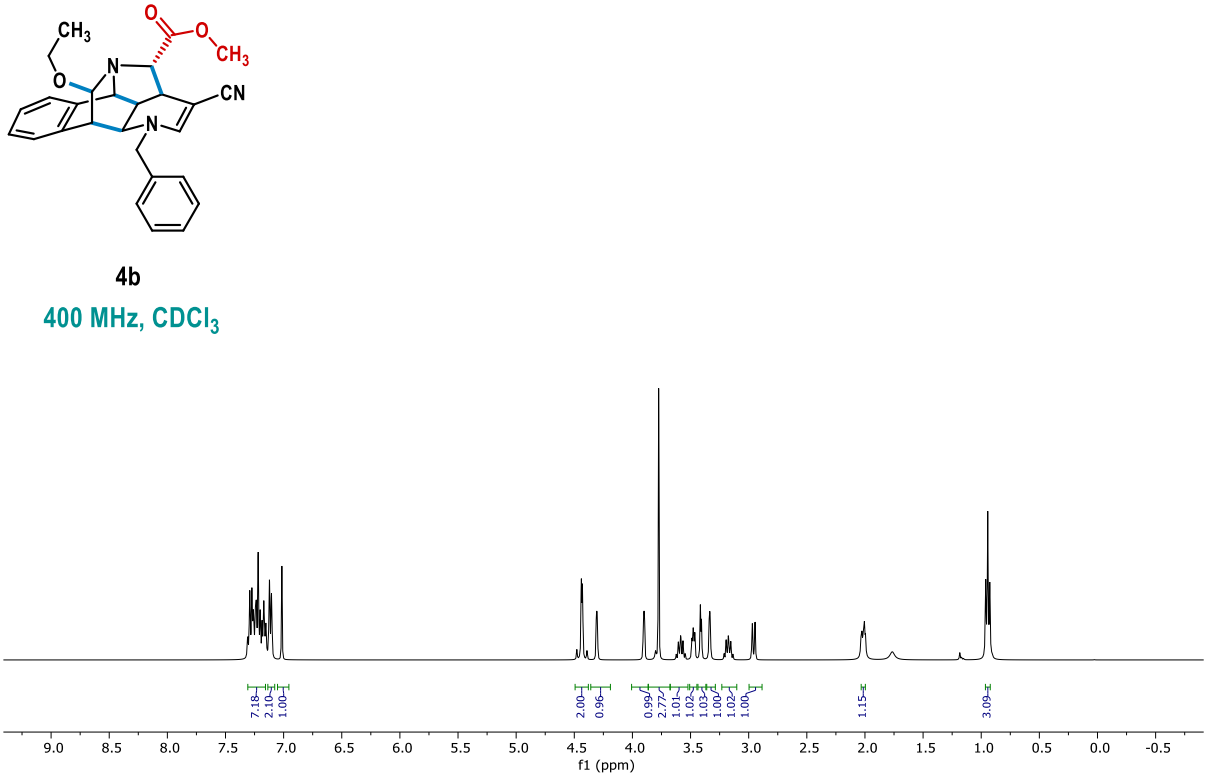




4a'

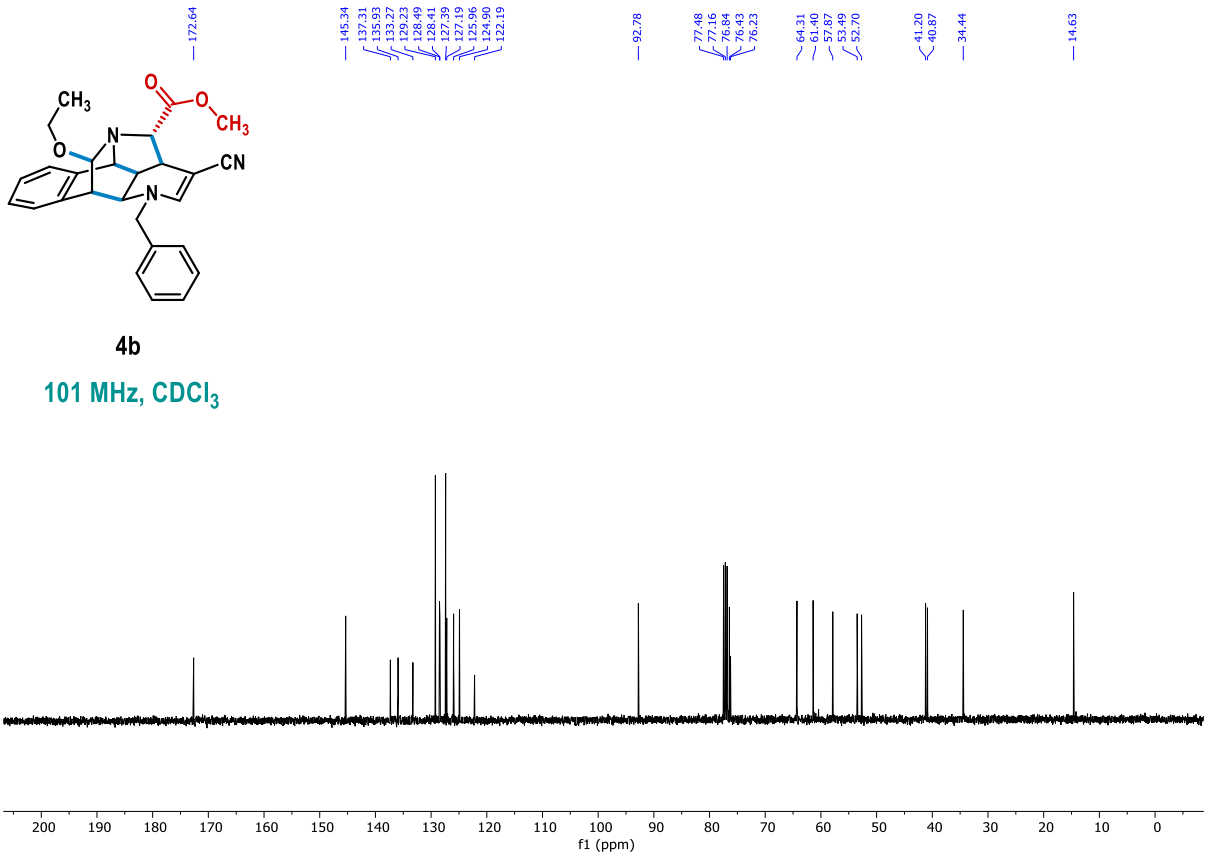
101 MHz, $CDCl_3$





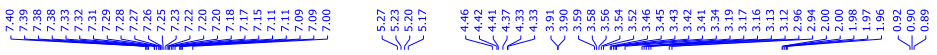
4b

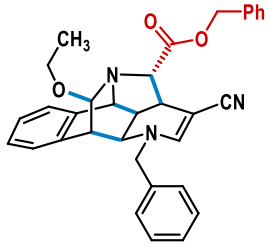
400 MHz, $CDCl_3$



4b

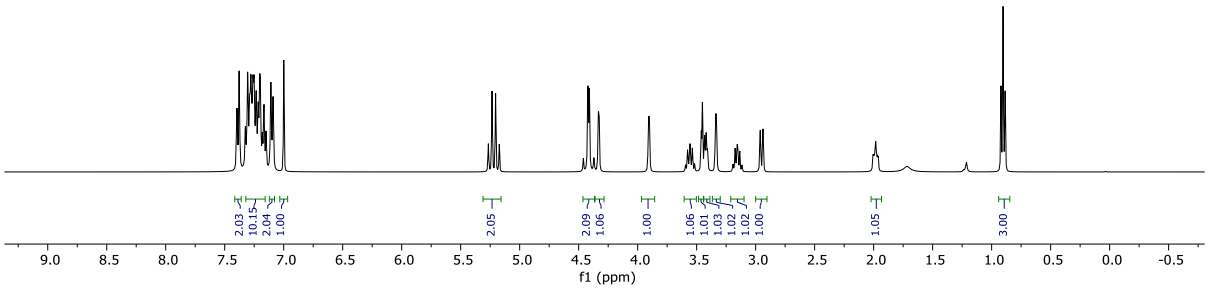
101 MHz, $CDCl_3$

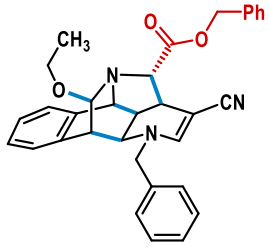




4c

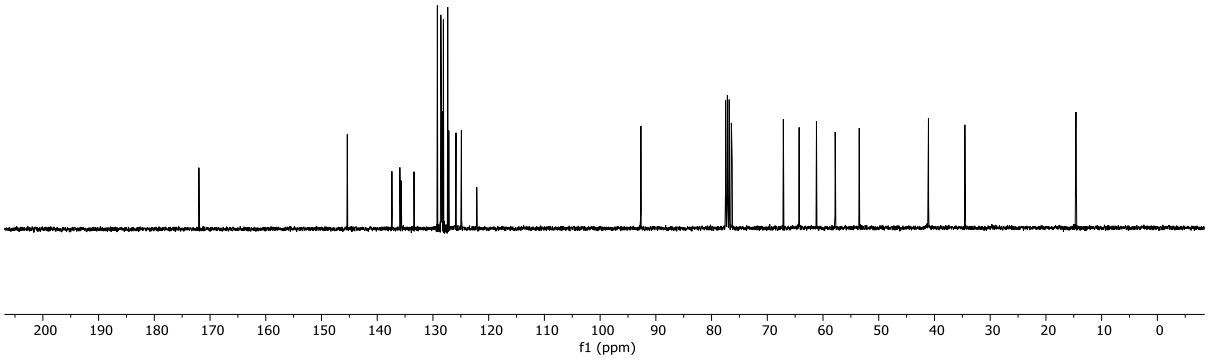
400 MHz, $CDCl_3$

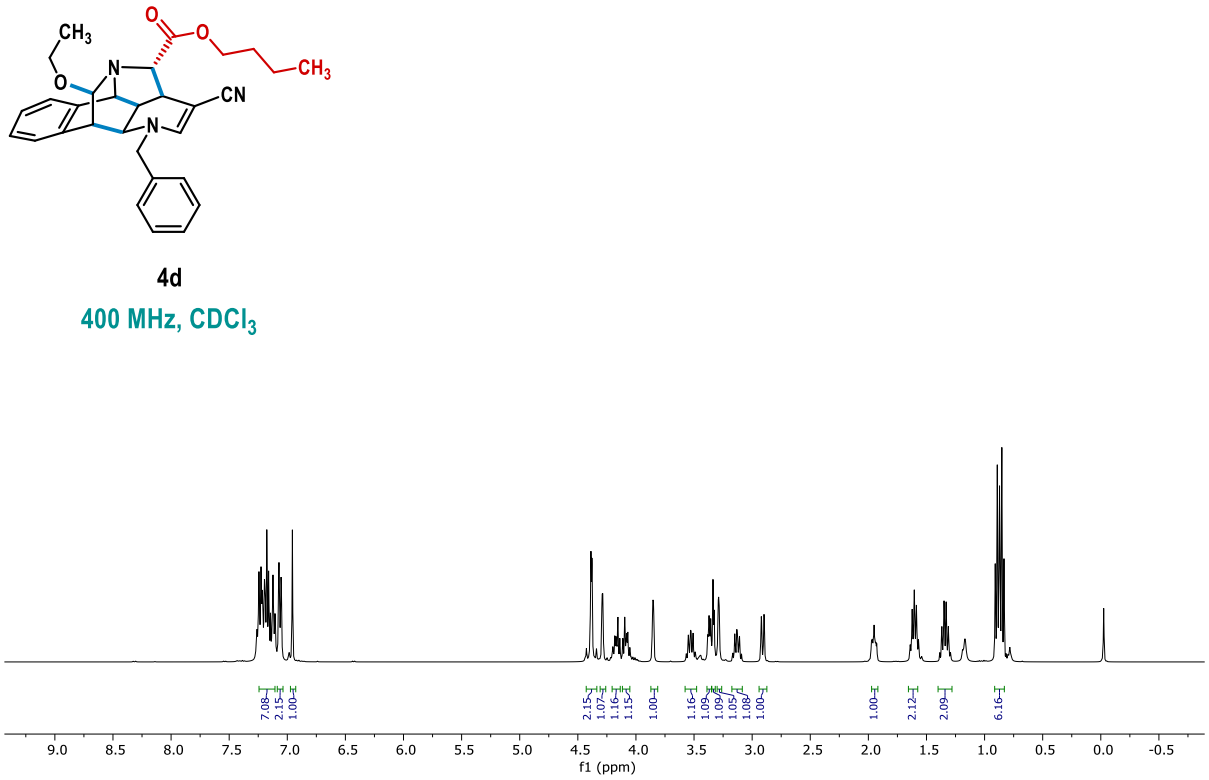


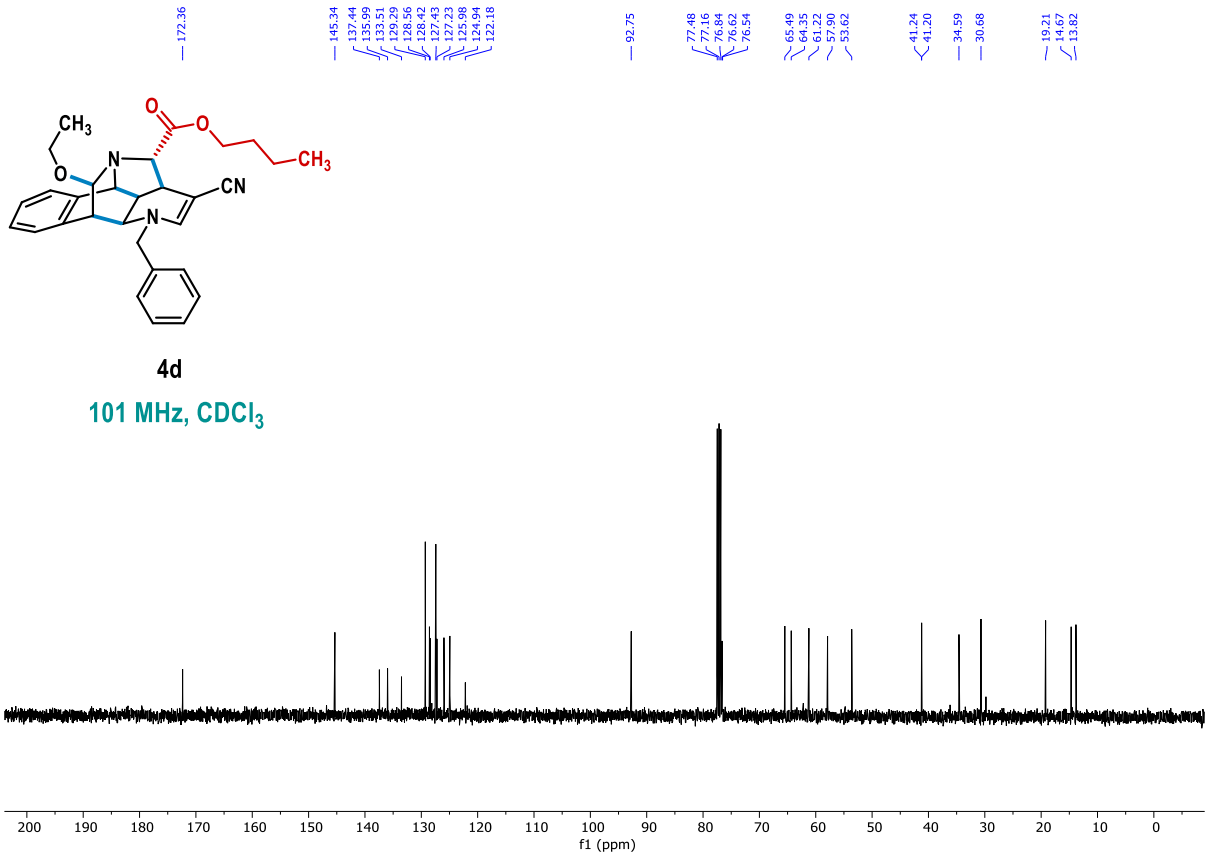


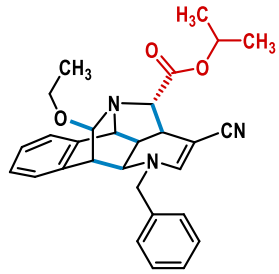
4c

101 MHz, $CDCl_3$



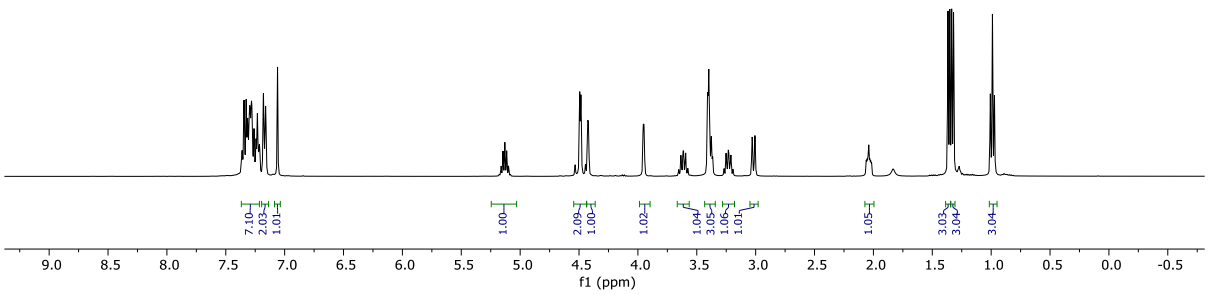

4d
400 MHz, CDCl3
f1 (ppm)

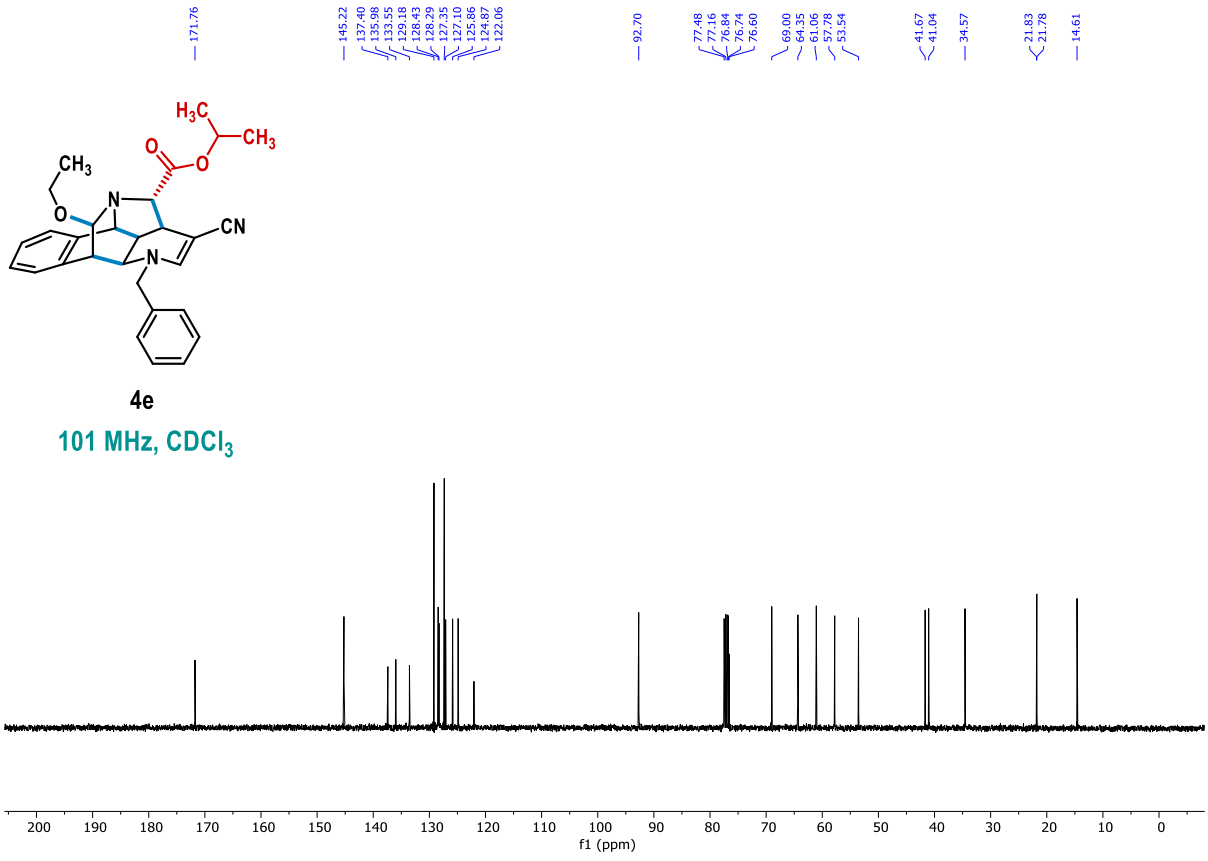

4d
101 MHz, CDCl3
f1 (ppm)



4e

400 MHz, $CDCl_3$





4e

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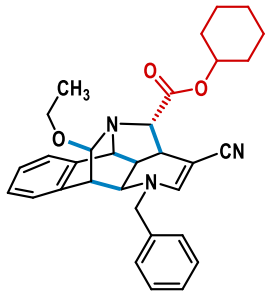
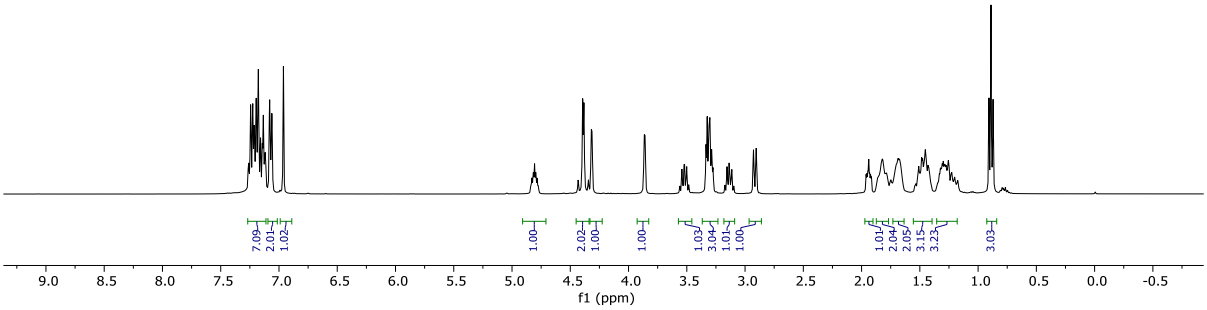
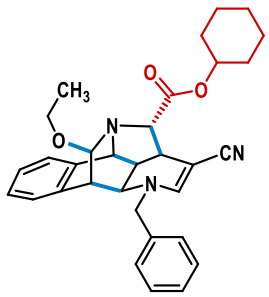


4f

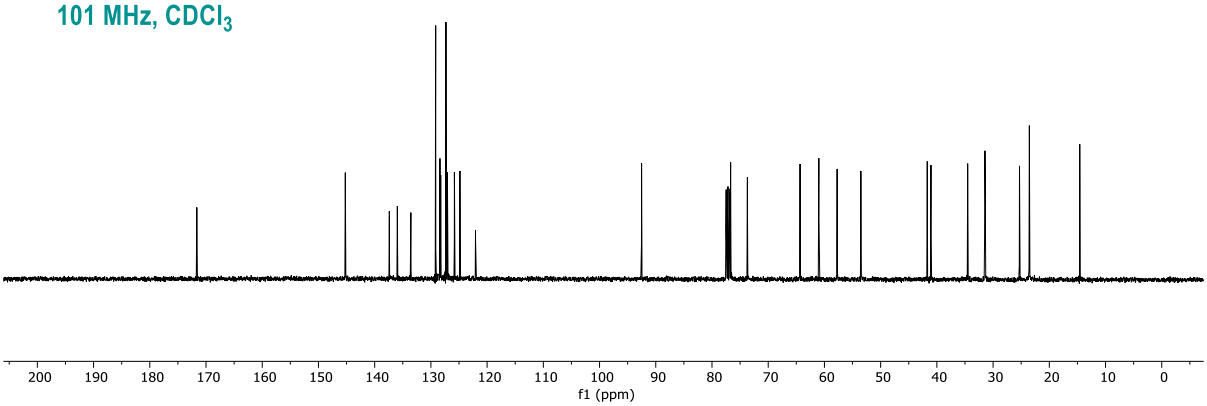
400 MHz, $CDCl_3$

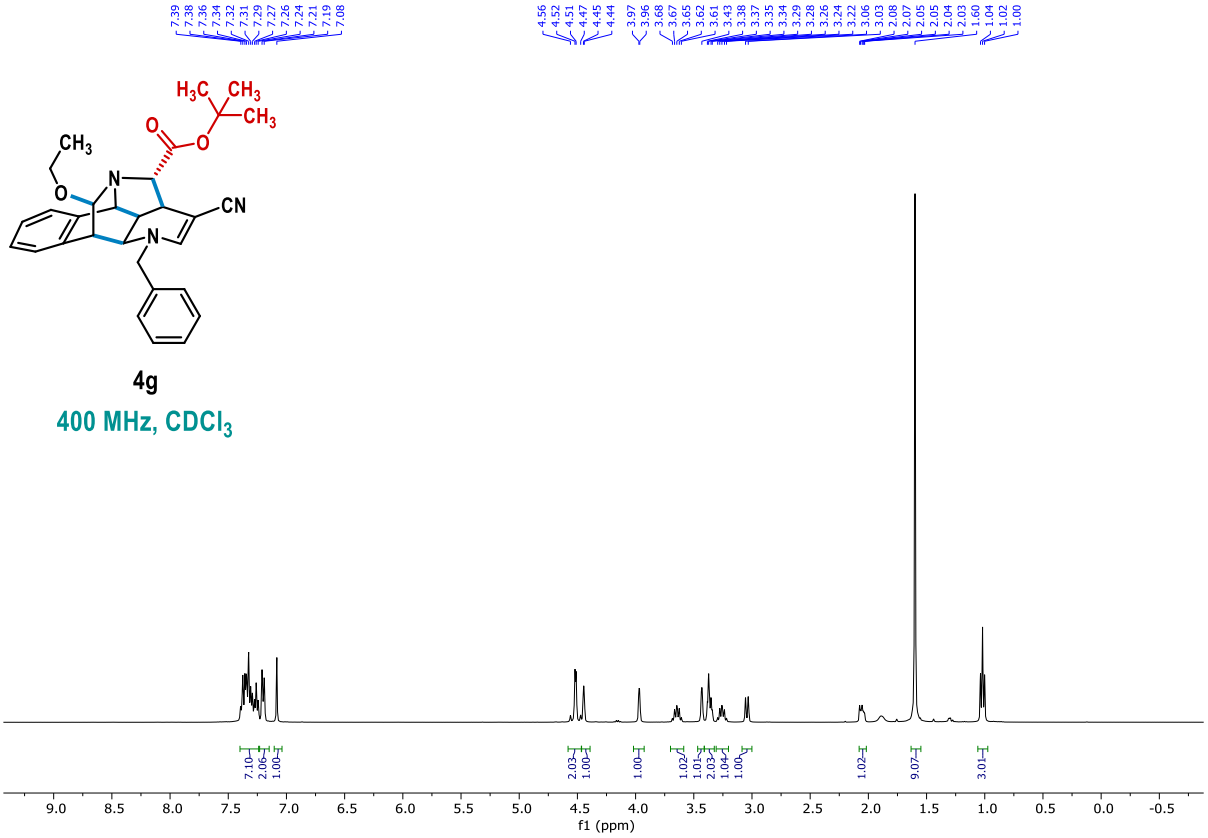


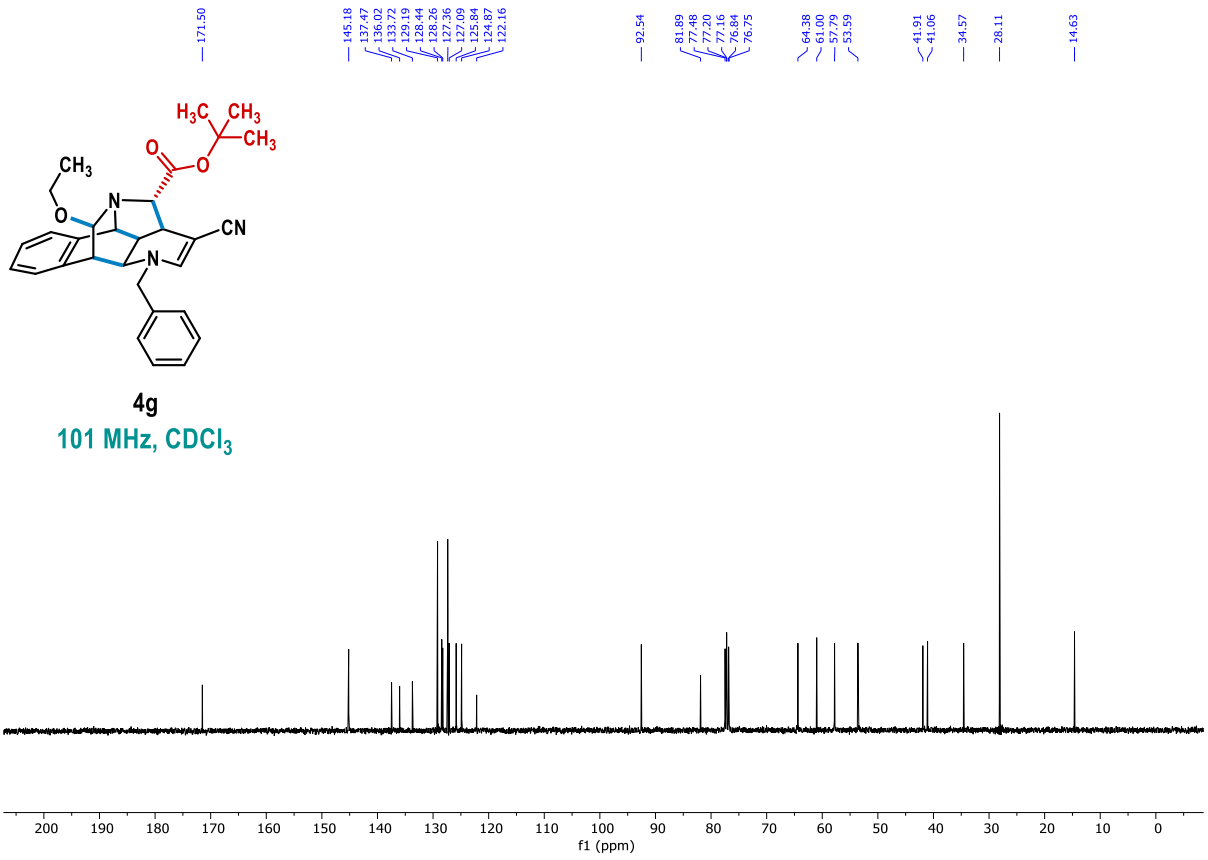


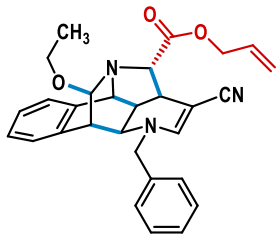
4f

101 MHz, $CDCl_3$



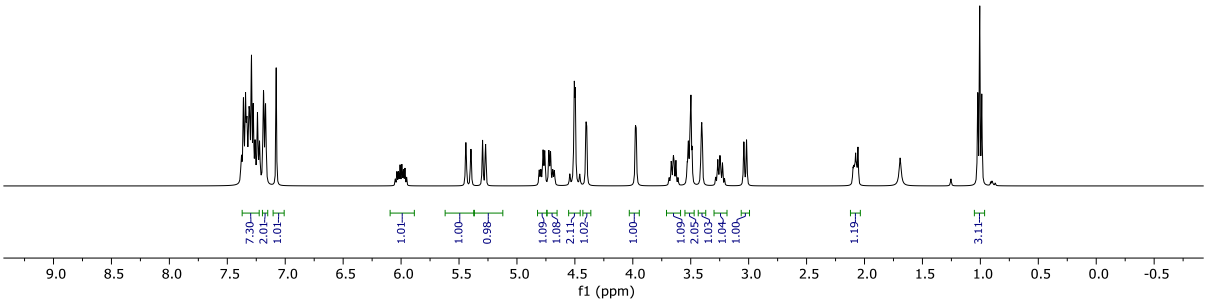

4g
400 MHz, CDCl3
f1 (ppm)

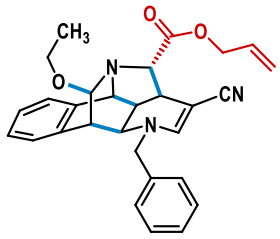

4g
101 MHz, CDCl3
f1 (ppm)



4h

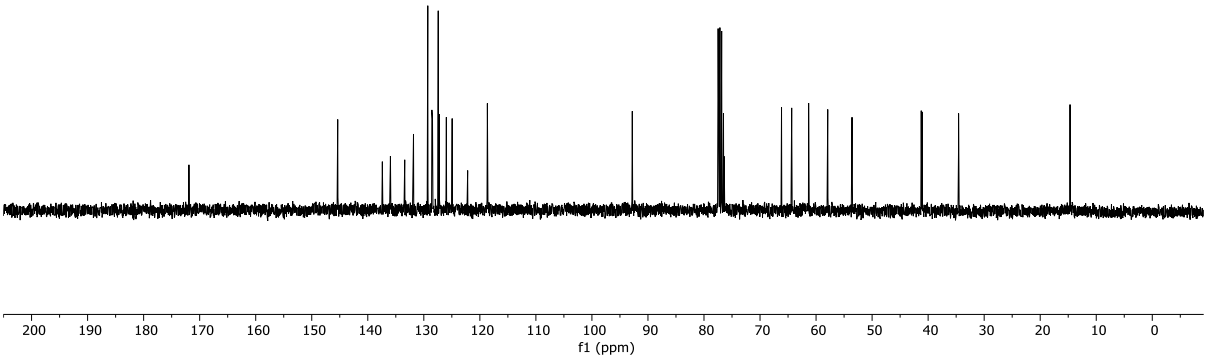
400 MHz, $CDCl_3$

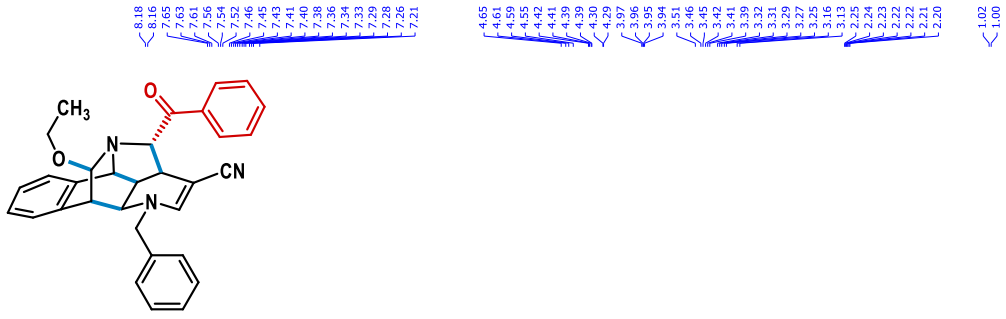


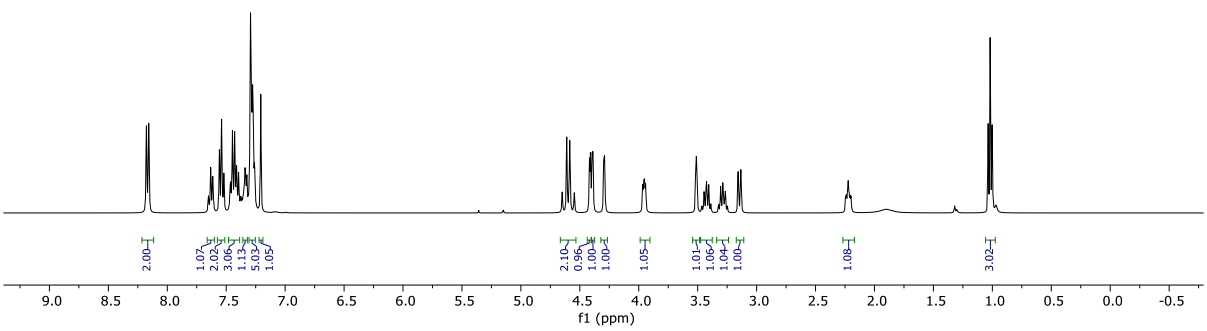


4h

101 MHz, $CDCl_3$

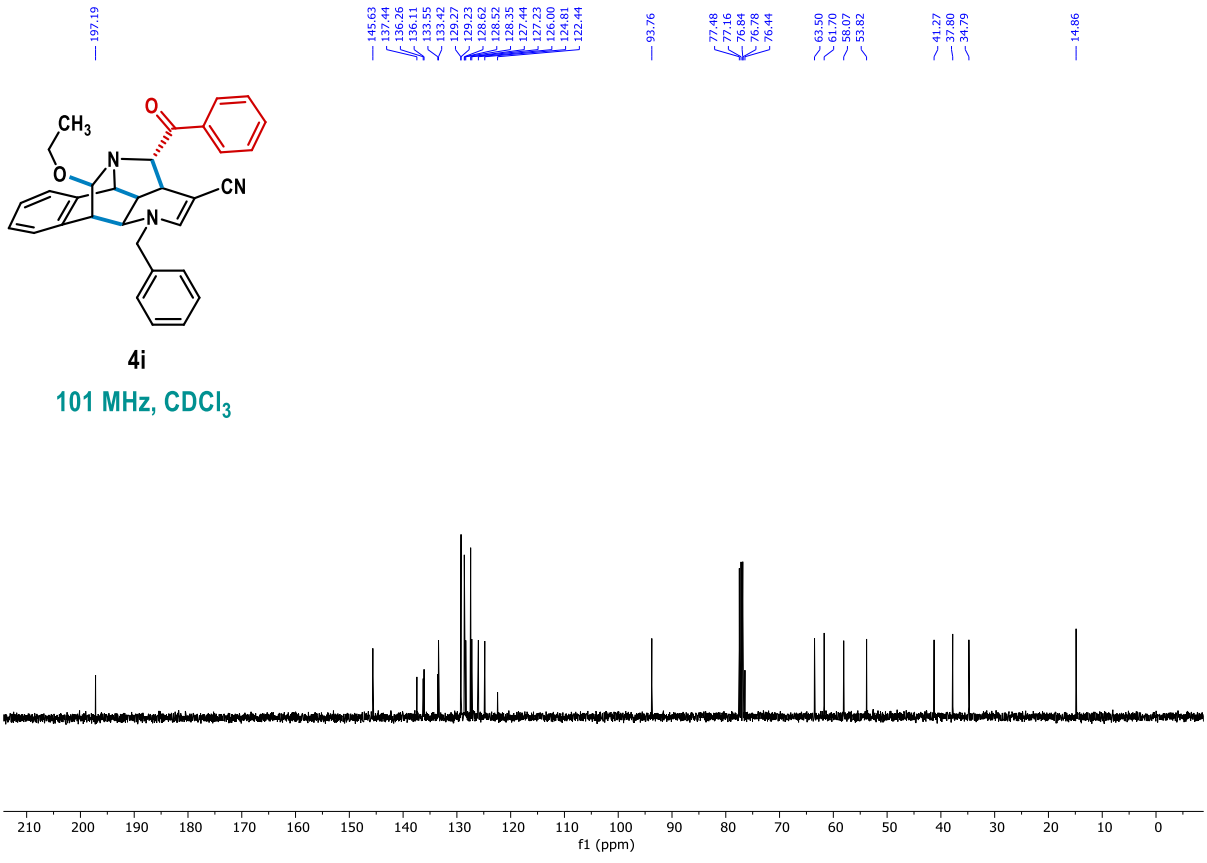






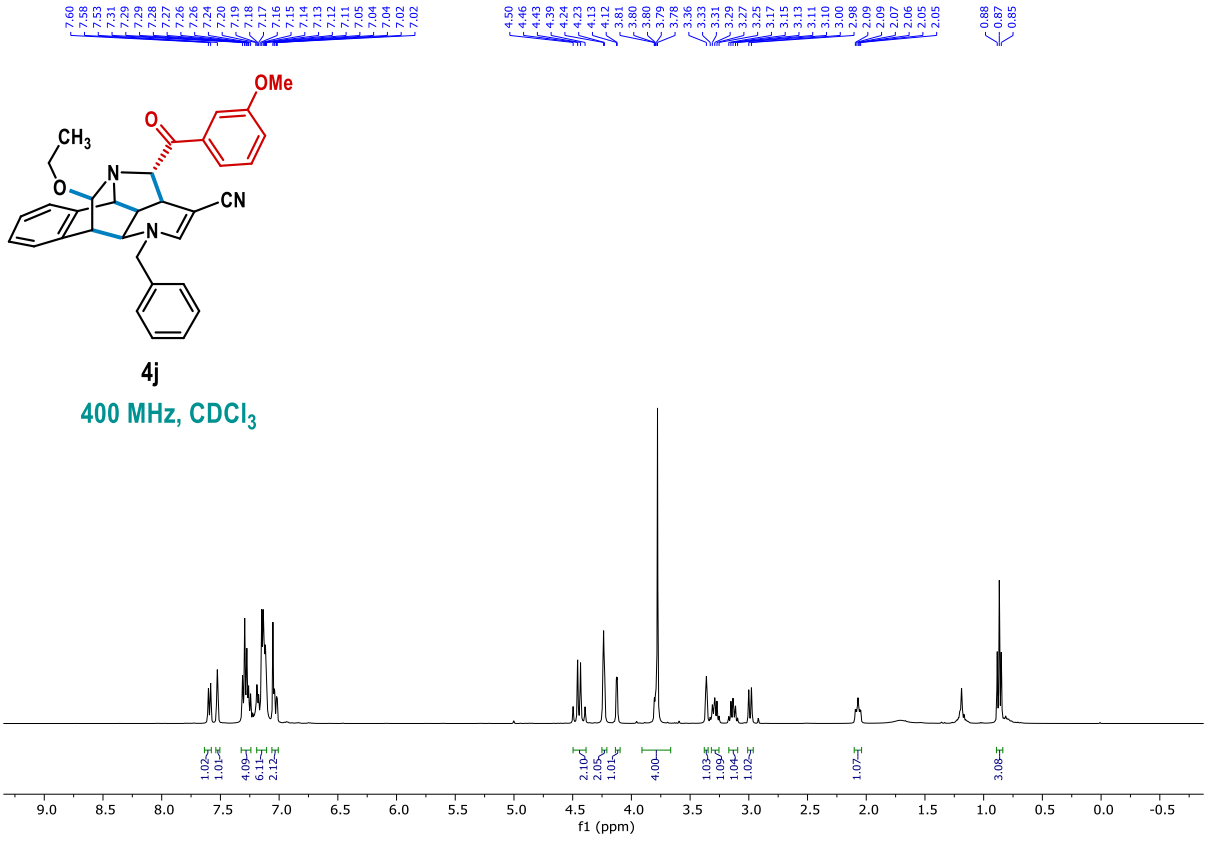
4i

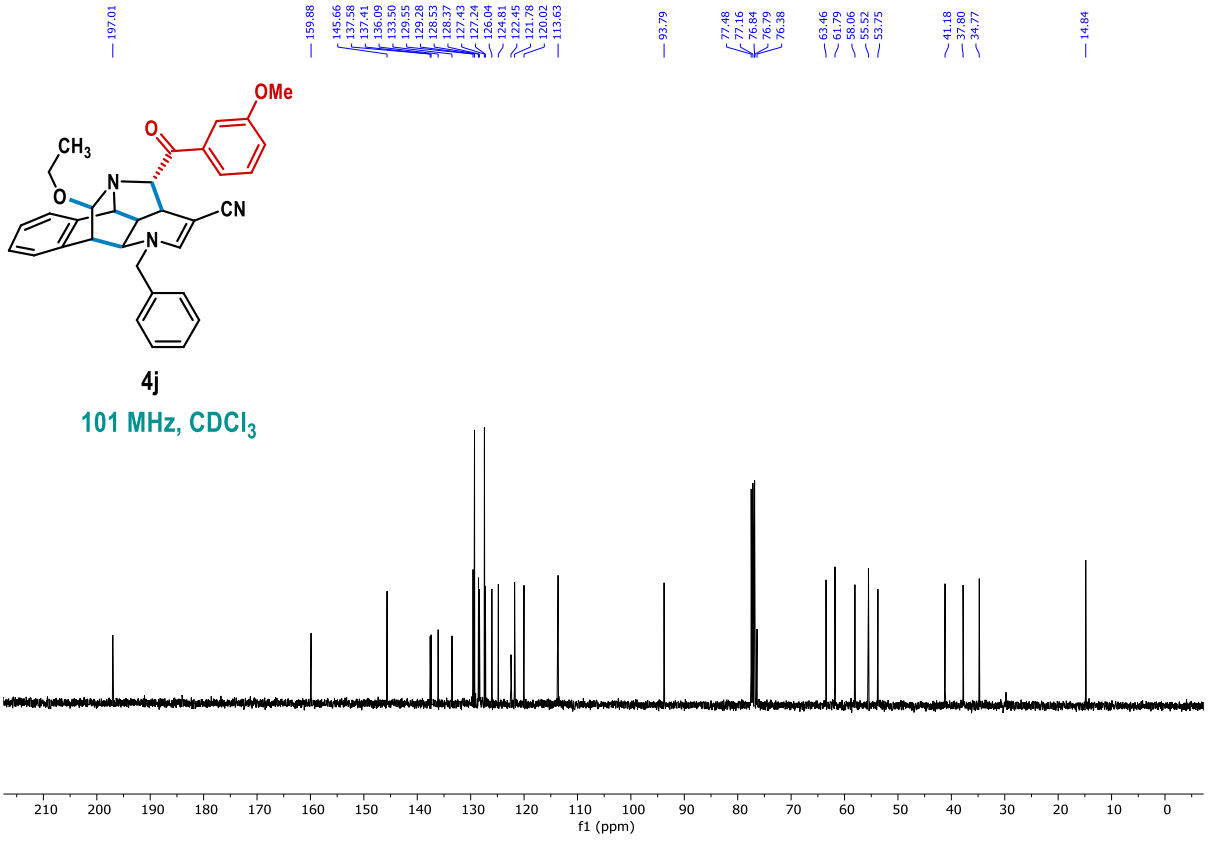
400 MHz, $CDCl_3$

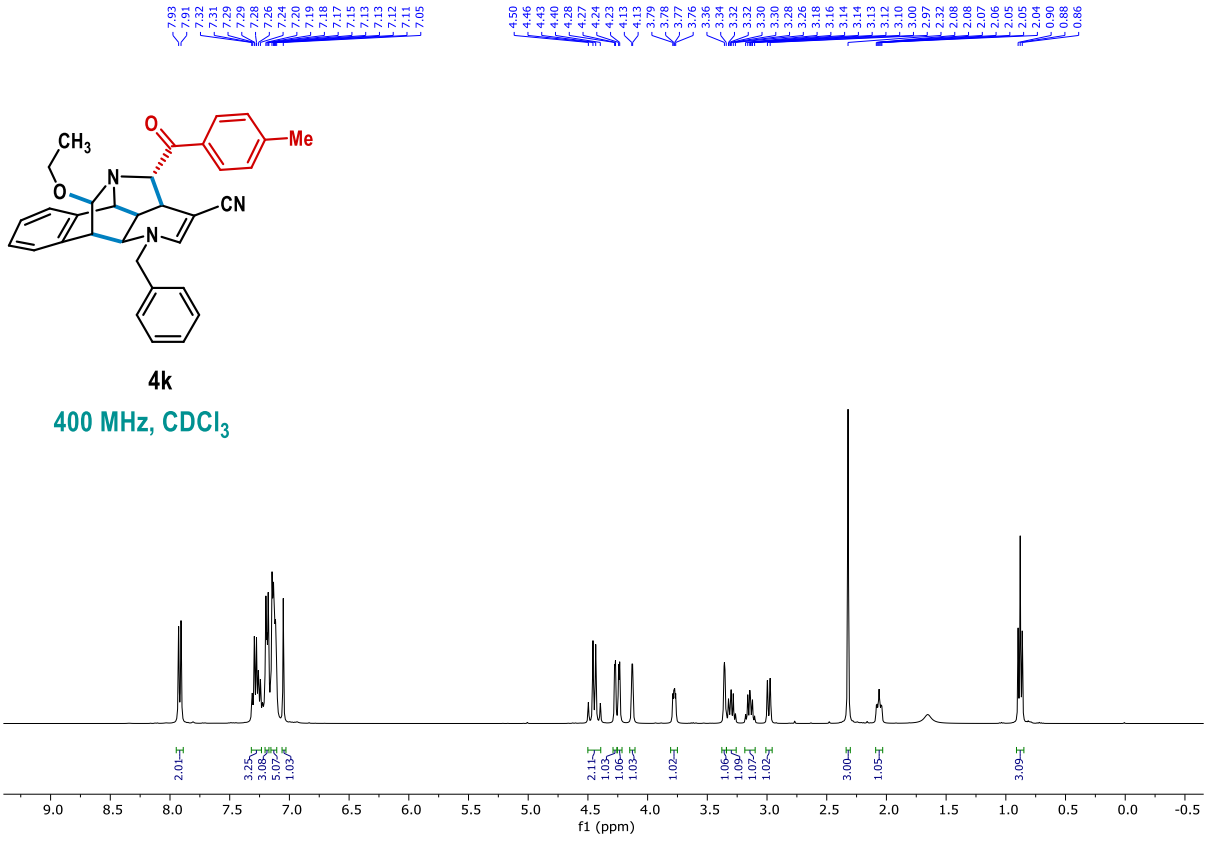


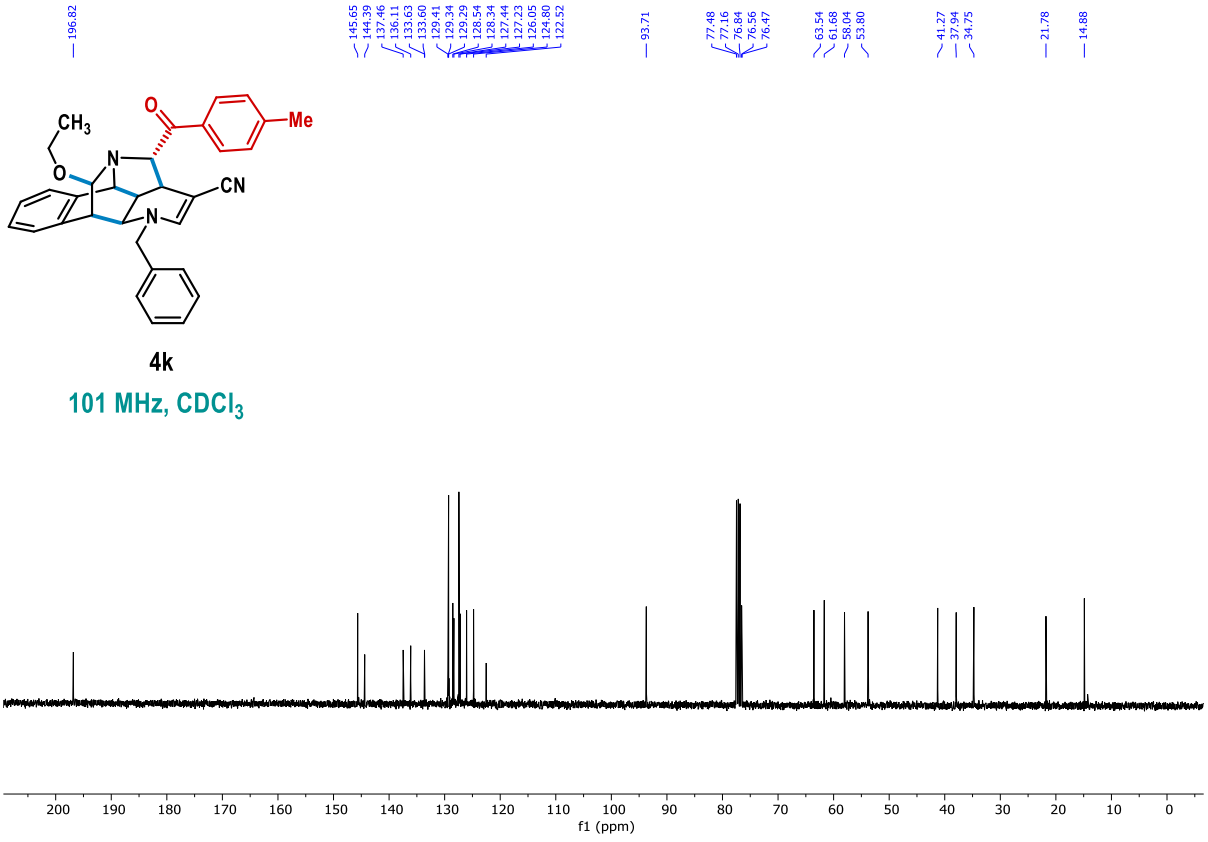
4i

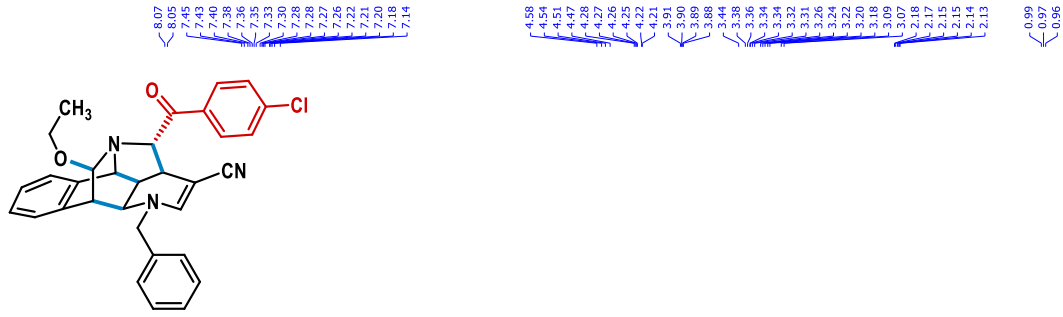
101 MHz, $CDCl_3$


OMe
O
CH3
N
O
CN
N
4j
400 MHz, CDCl3
f1 (ppm)


OMe
O
CH3
N
O
CN
N
4j
101 MHz, CDCl3
f1 (ppm)

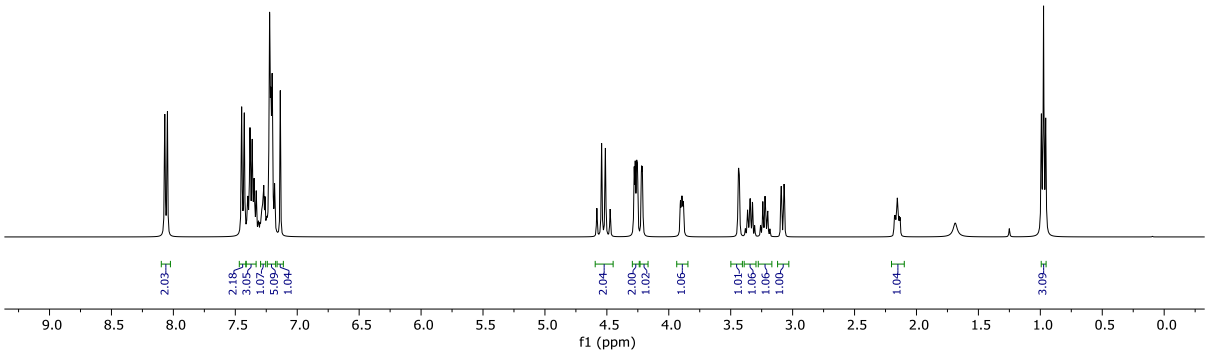

4k
400 MHz, CDCl3
f1 (ppm)

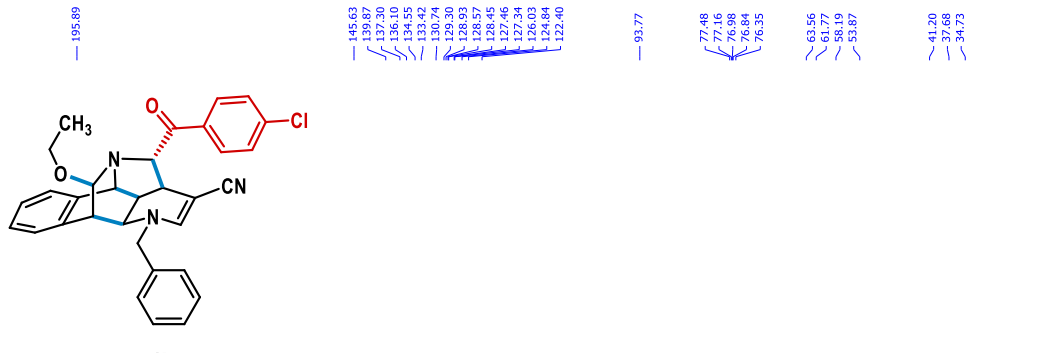

4k
101 MHz, CDCl3
f1 (ppm)



4l

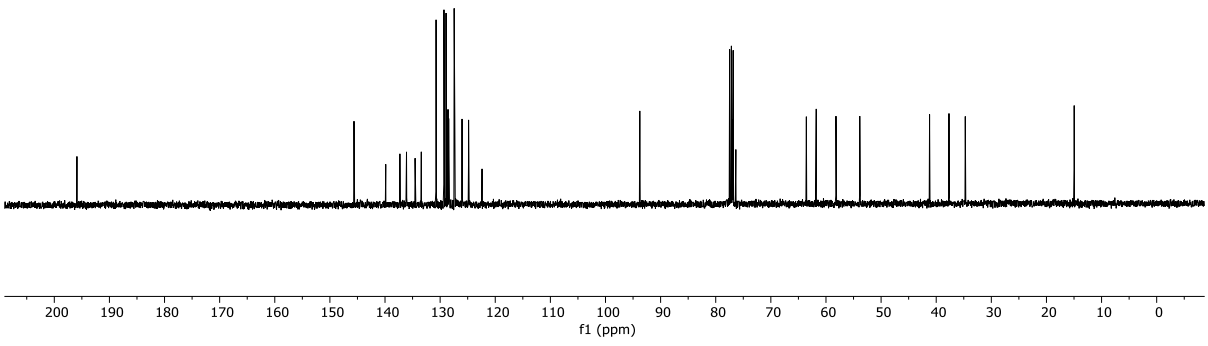
400 MHz, $CDCl_3$

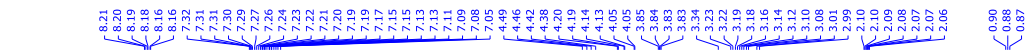


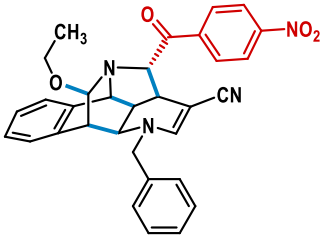


4l

101 MHz, $CDCl_3$

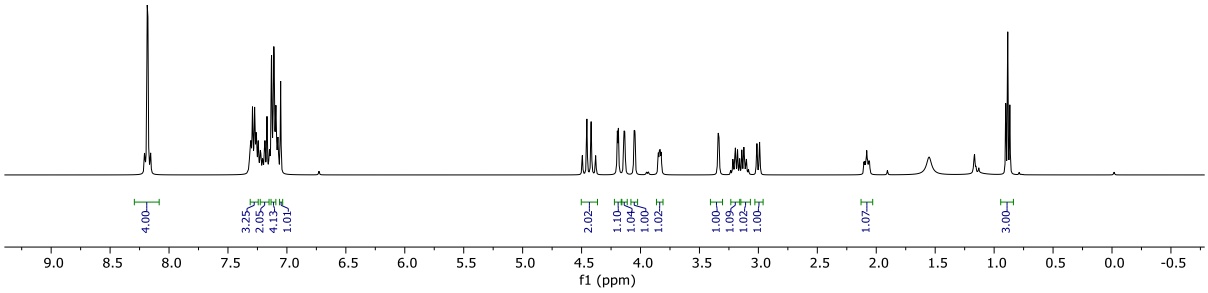


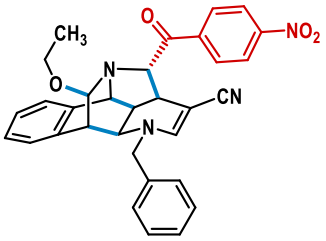




4m

400 MHz, $CDCl_3$





4m

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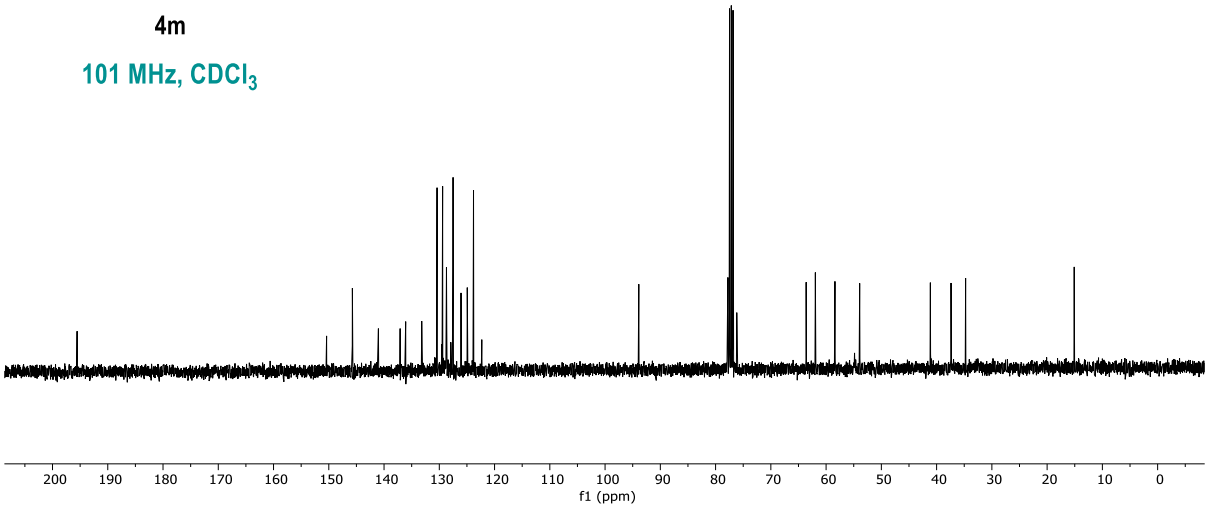

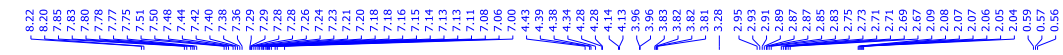

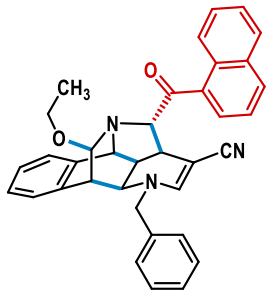

4n

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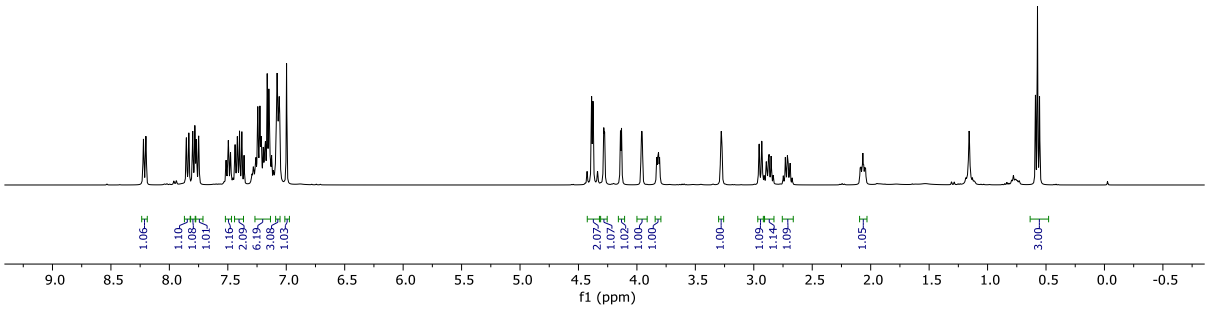
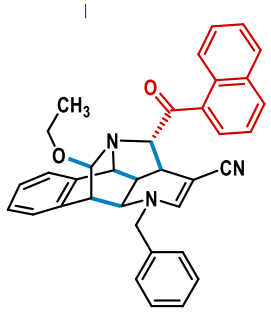
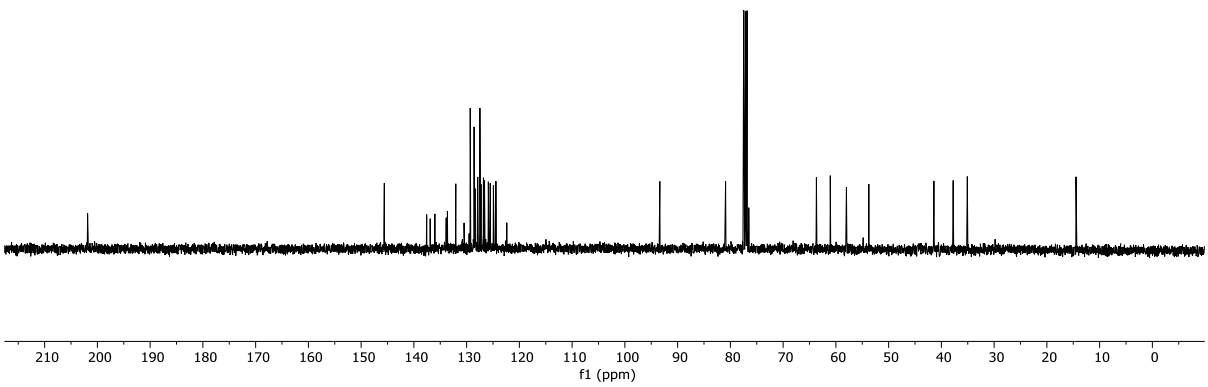
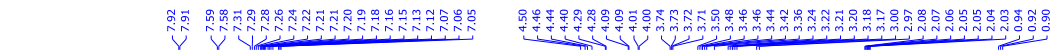


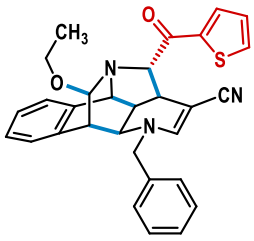


4n

101 MHz, $CDCl_3$

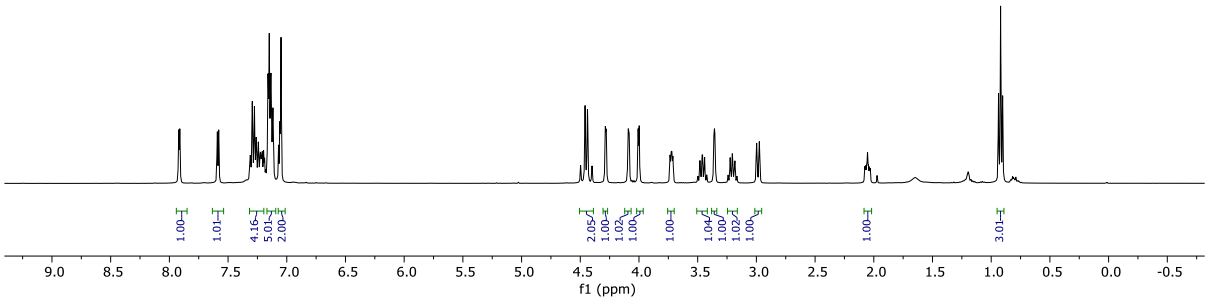


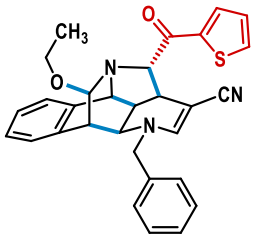




4o

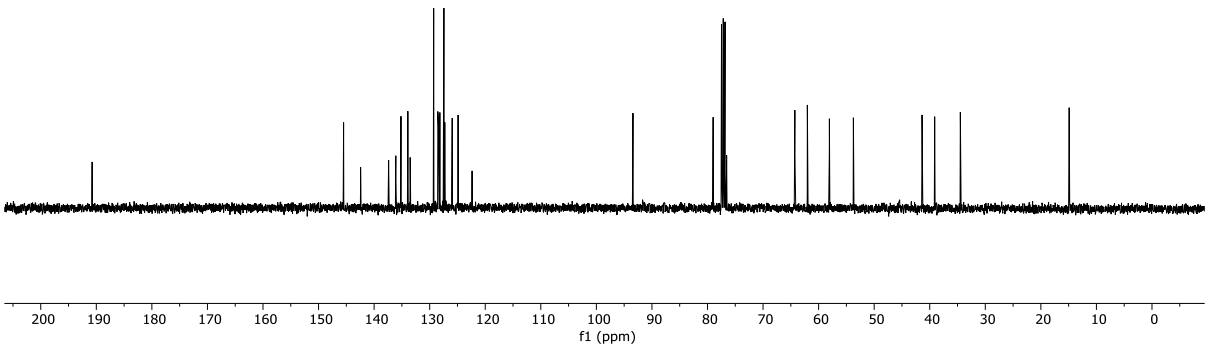
400 MHz, $CDCl_3$

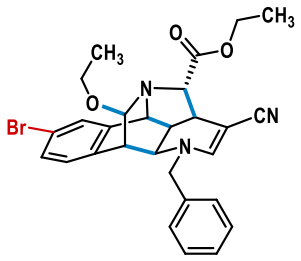




4o

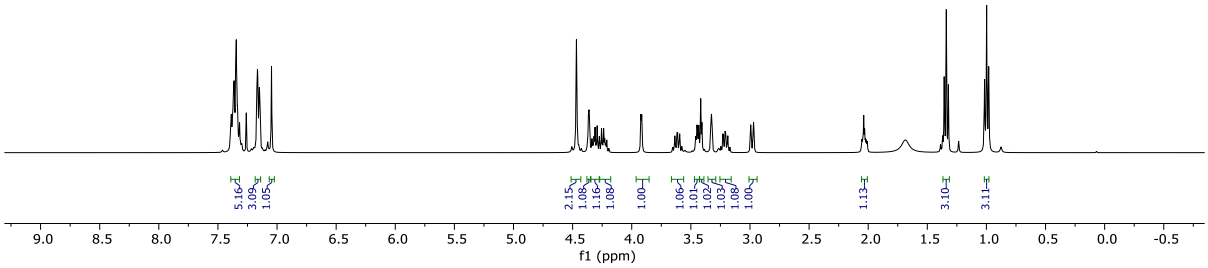
101 MHz, $CDCl_3$

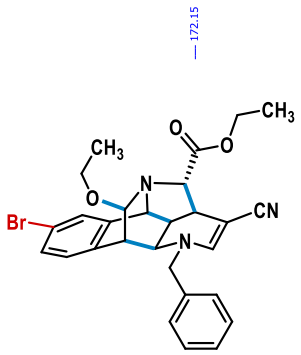




4p

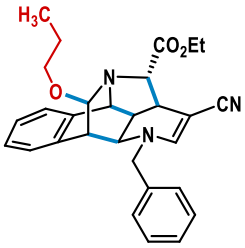
400 MHz, $CDCl_3$





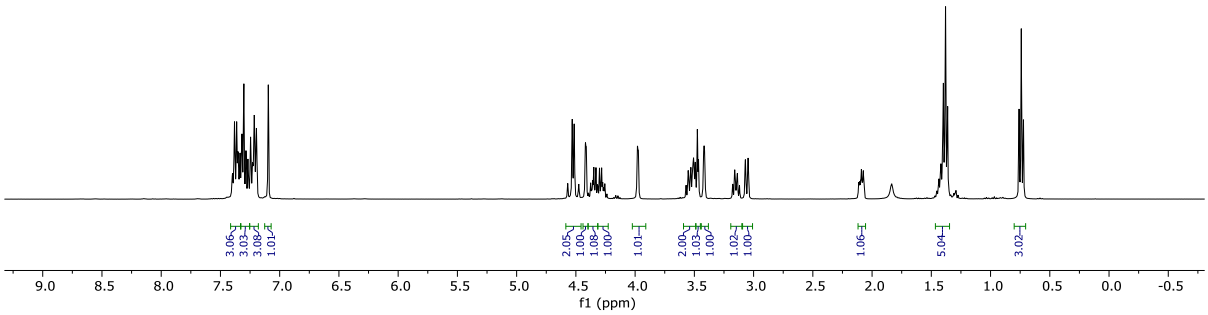
4p

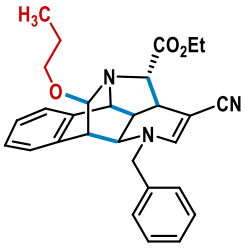
101 MHz, $CDCl_3$



4q

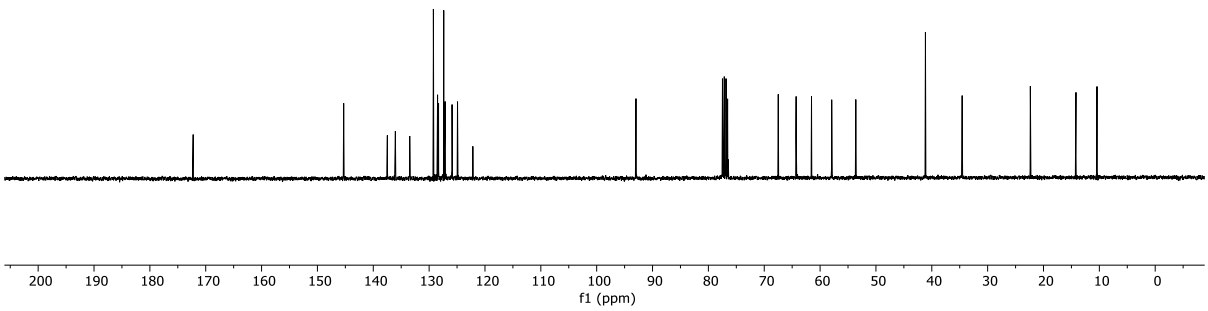
400 MHz, $CDCl_3$

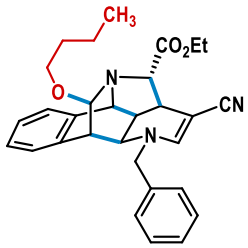




4q

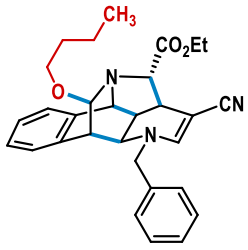
101 MHz, $CDCl_3$





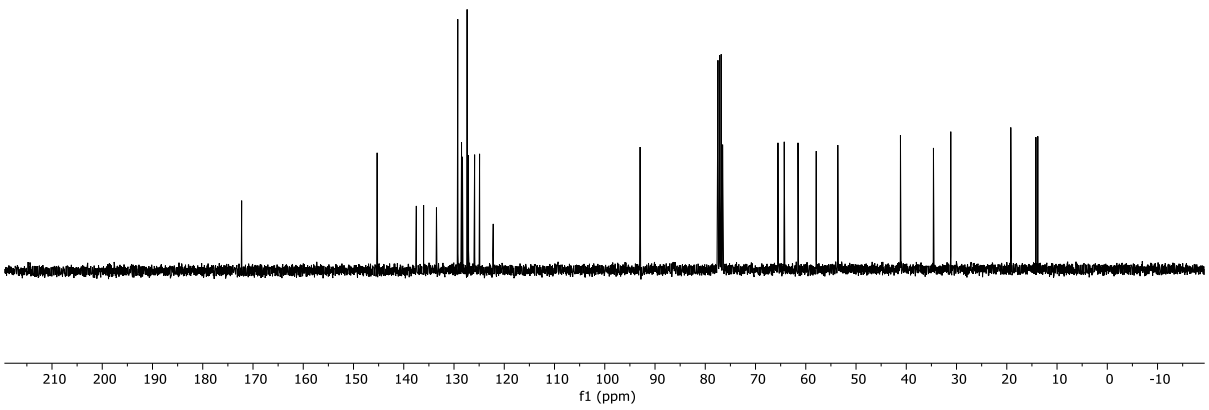
4r

400 MHz, $CDCl_3$



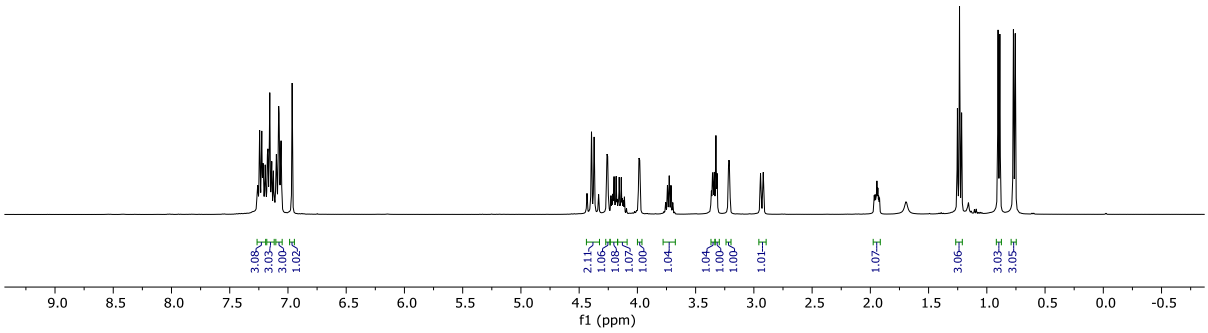
4r

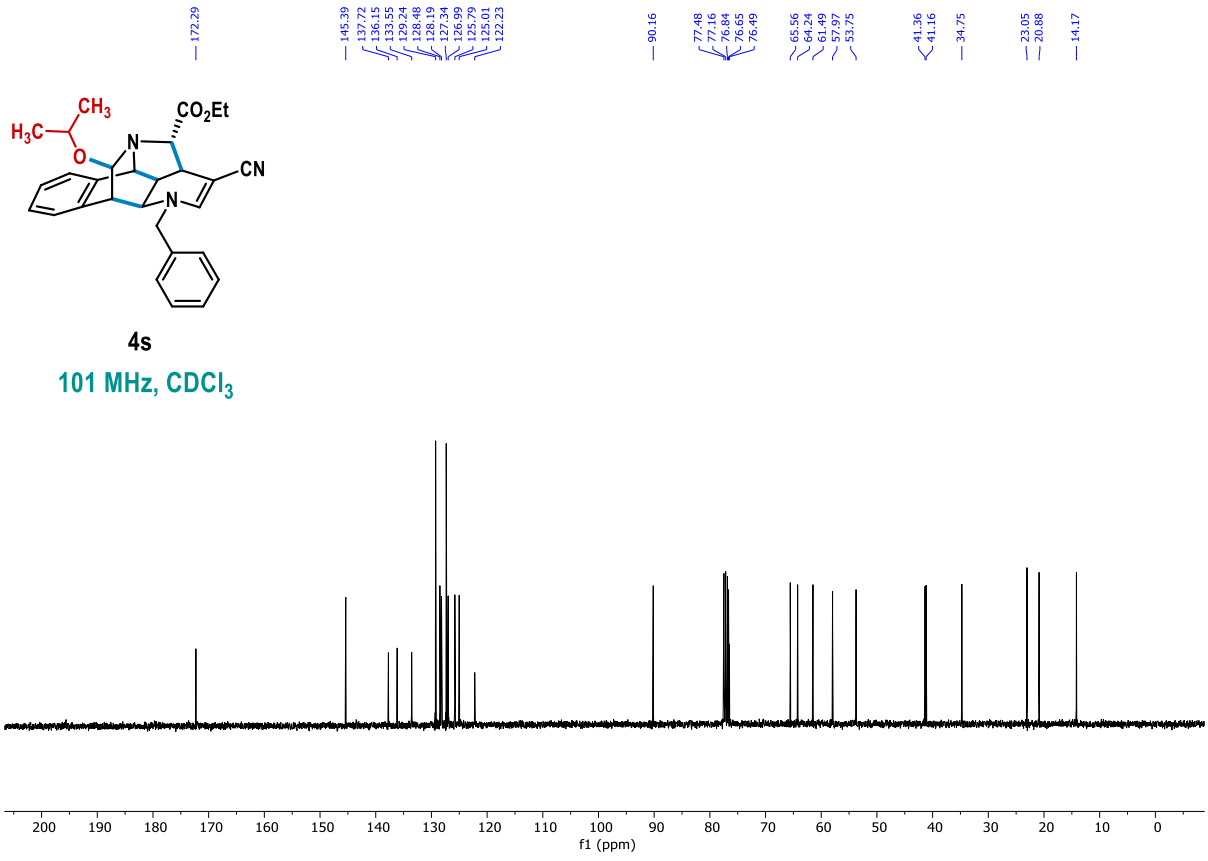
101 MHz, $CDCl_3$



4s

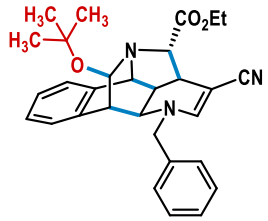
400 MHz, $CDCl_3$





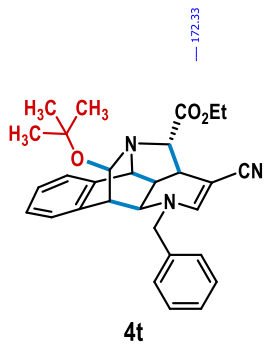
4s

101 MHz, $CDCl_3$



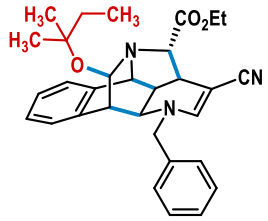
4t

400 MHz, $CDCl_3$



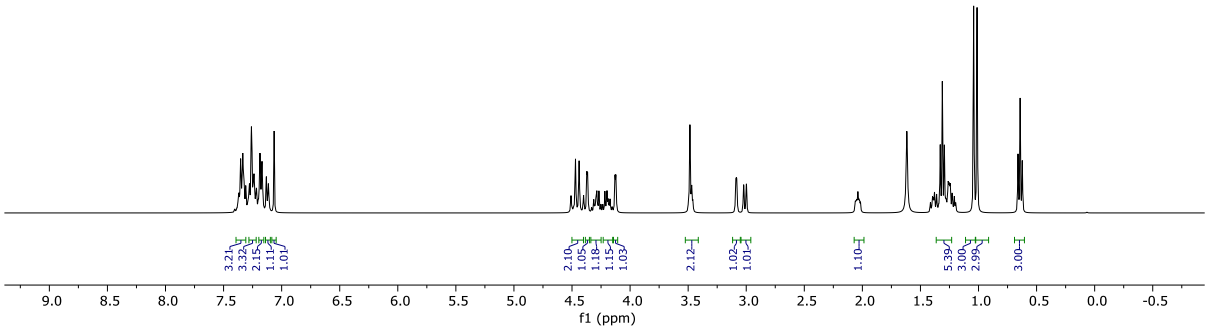
4t

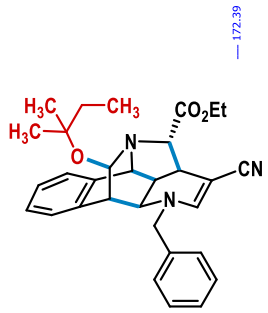
101 MHz, $CDCl_3$



4u

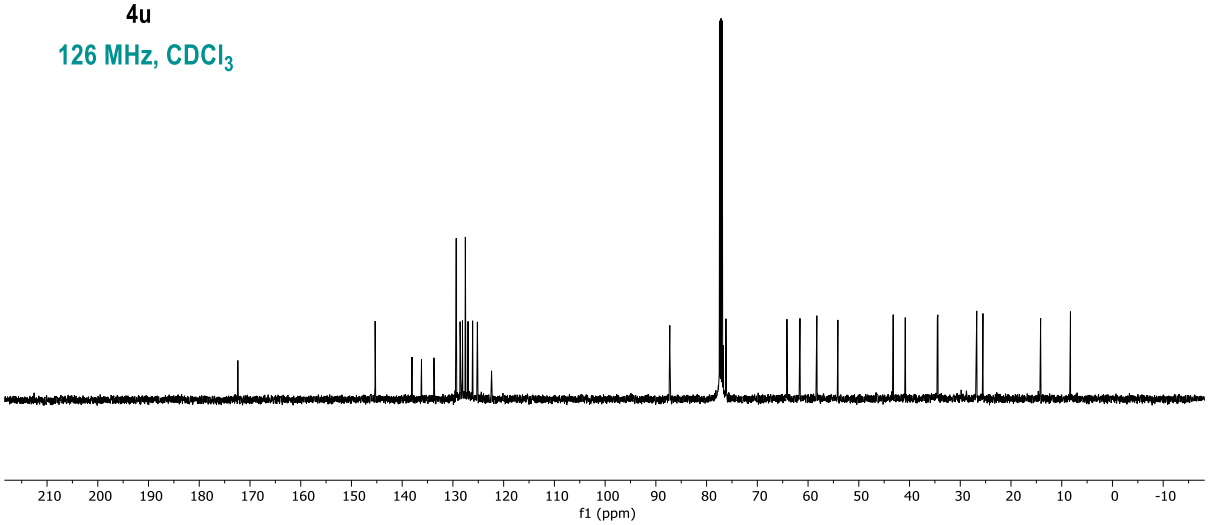
400 MHz, $CDCl_3$

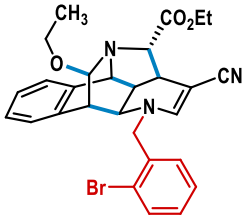




4u

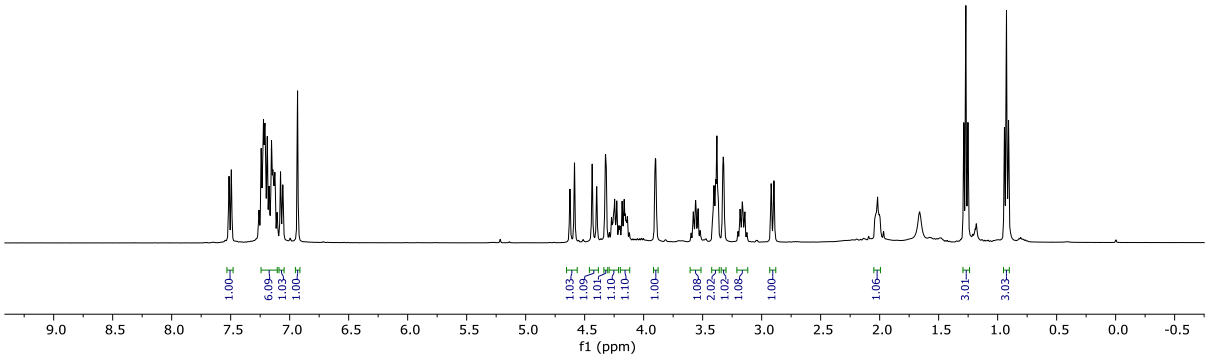
126 MHz, $CDCl_3$

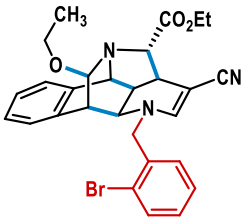




4v

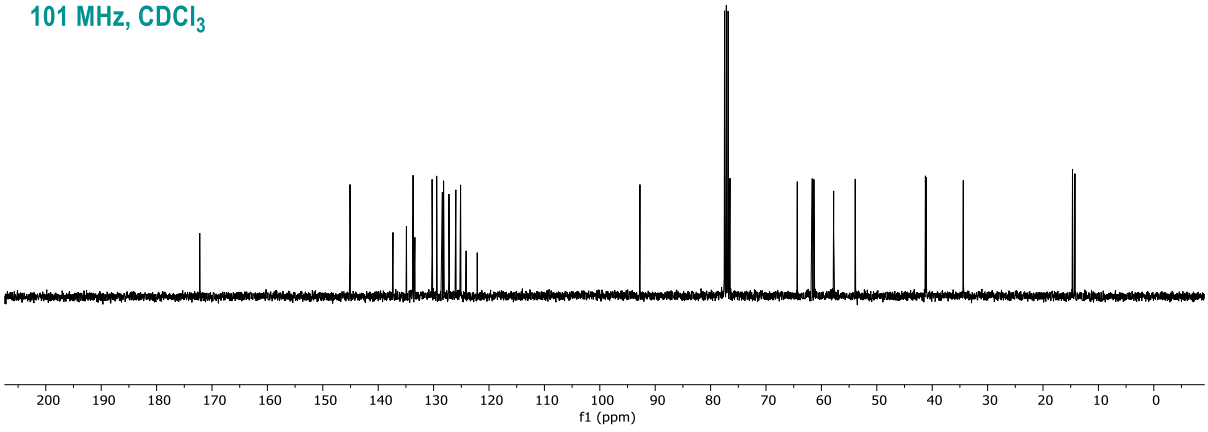
400 MHz, $CDCl_3$

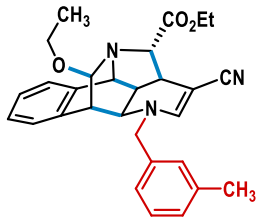




4v

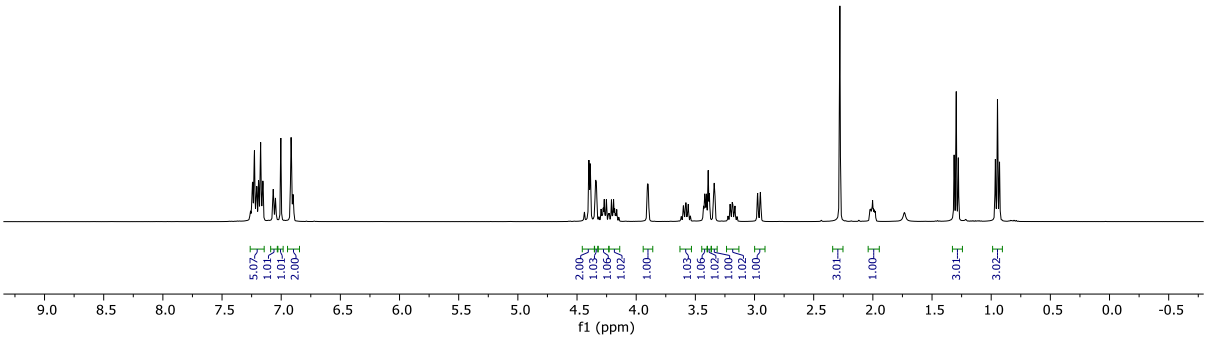
101 MHz, $CDCl_3$

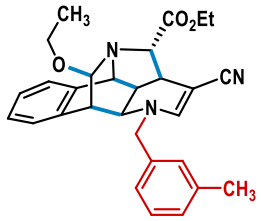




4w

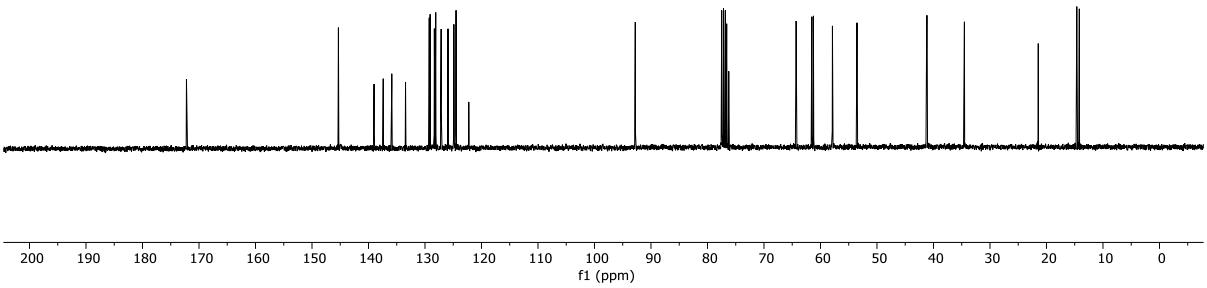
400 MHz, $CDCl_3$

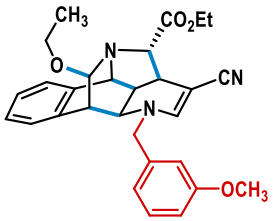




4w

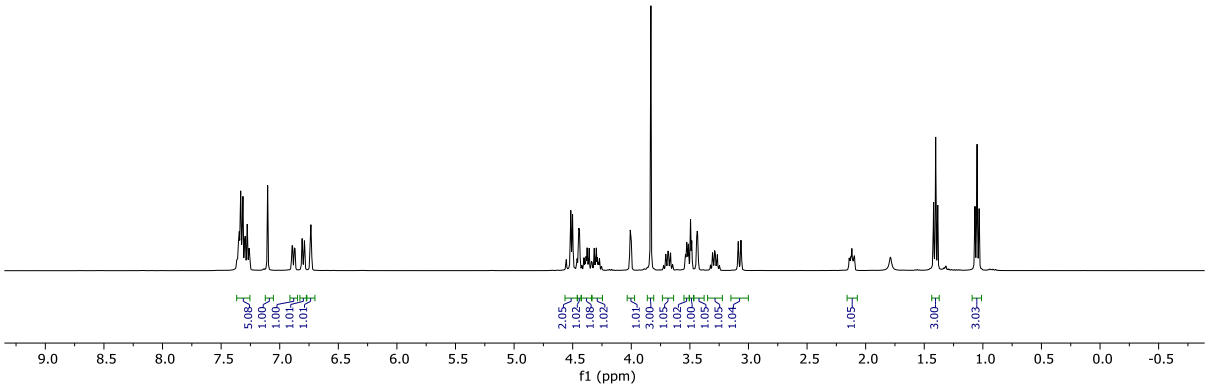
101 MHz, $CDCl_3$

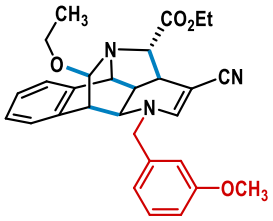




4x

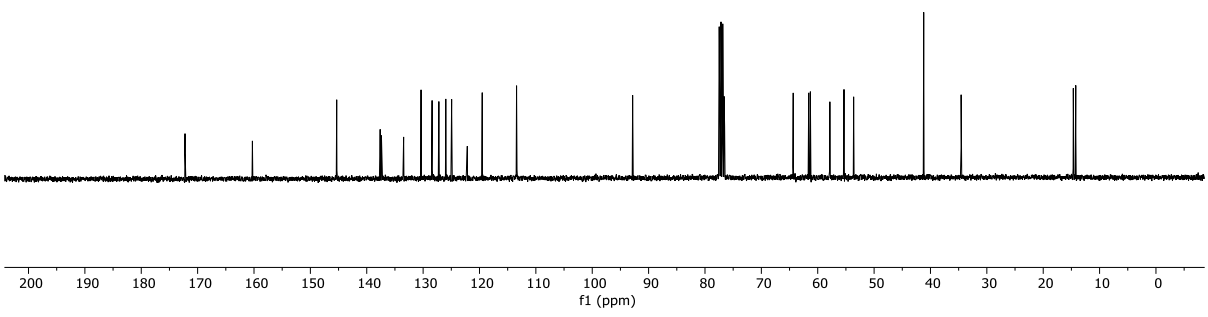
400 MHz, $CDCl_3$

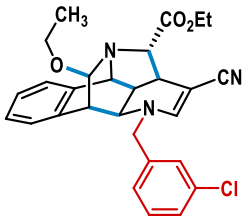




4x

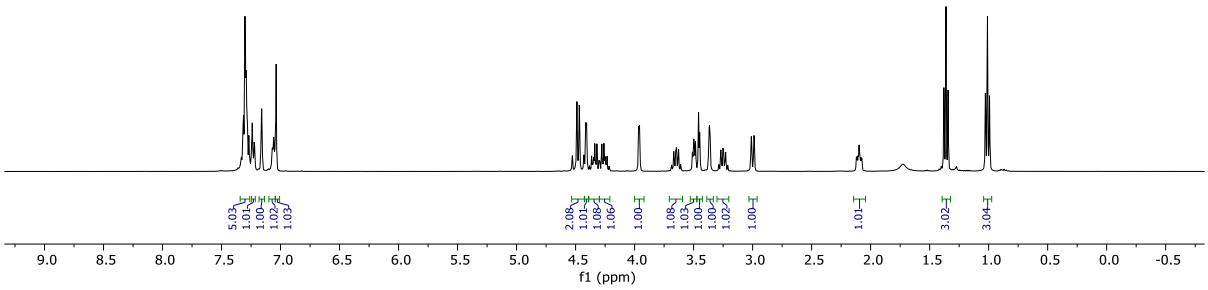
101 MHz, $CDCl_3$

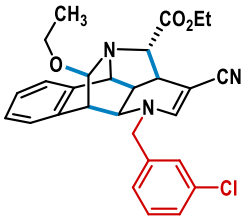




4y

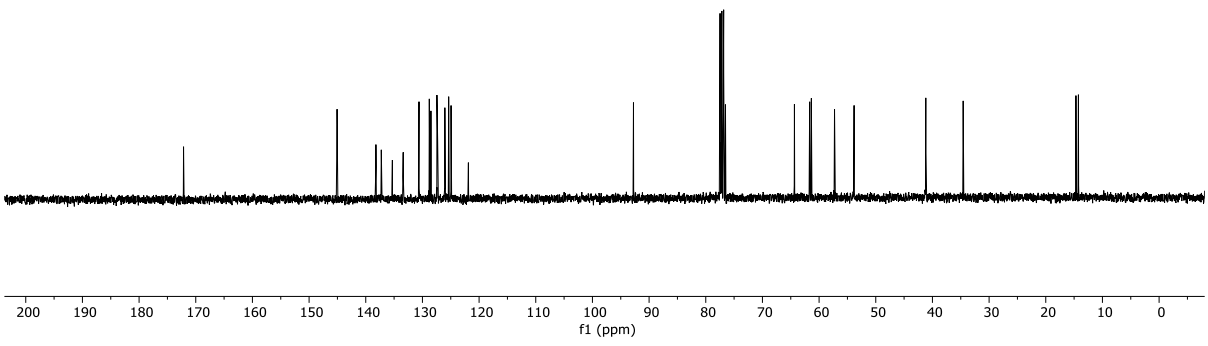
400 MHz, $CDCl_3$

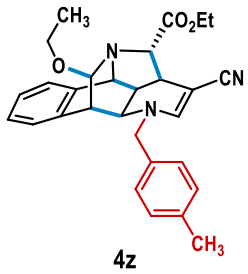




4y

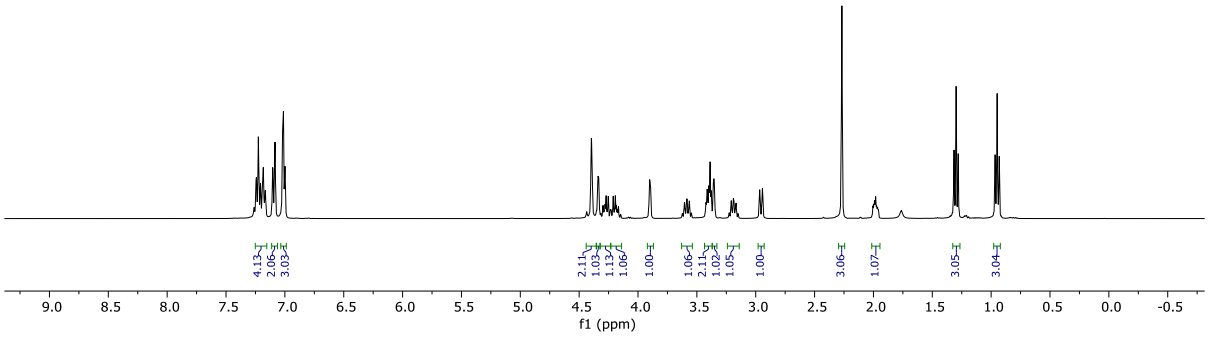
101 MHz, $CDCl_3$

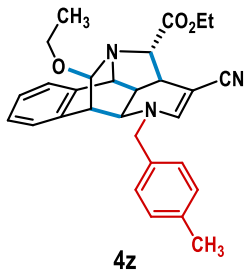




4z

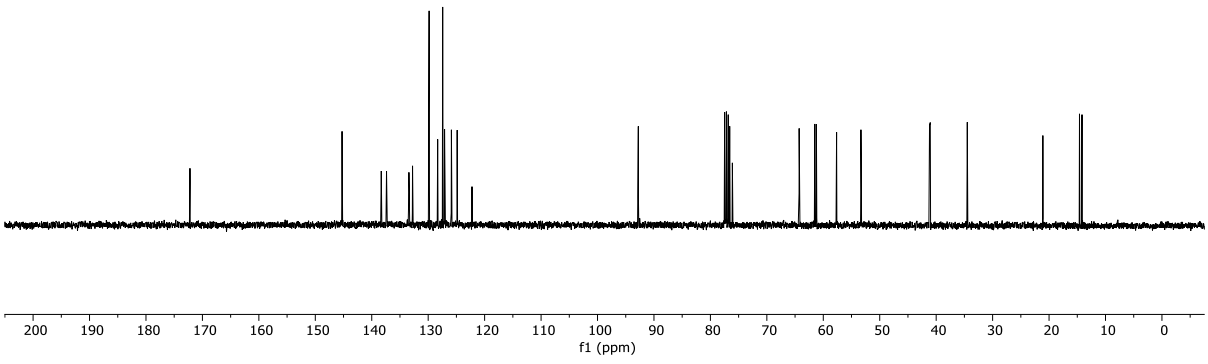
400 MHz, $CDCl_3$

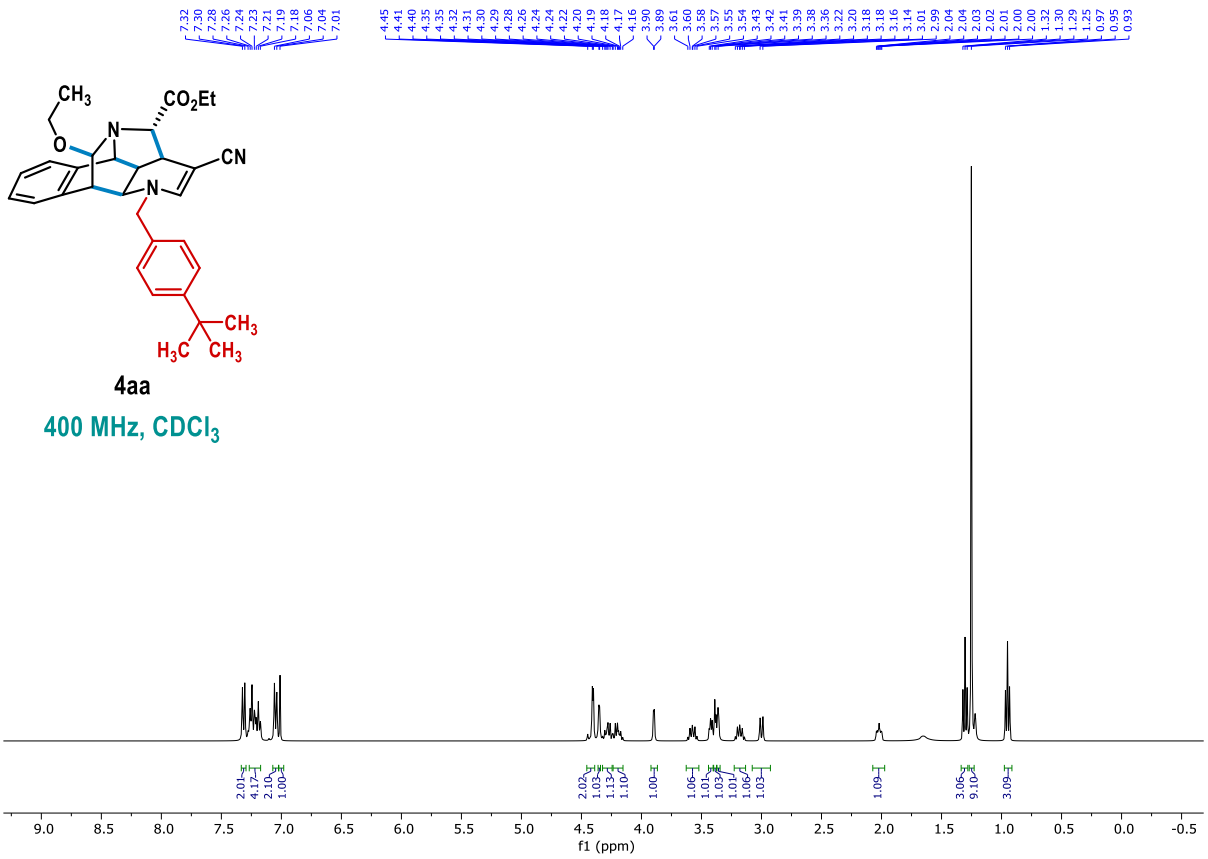


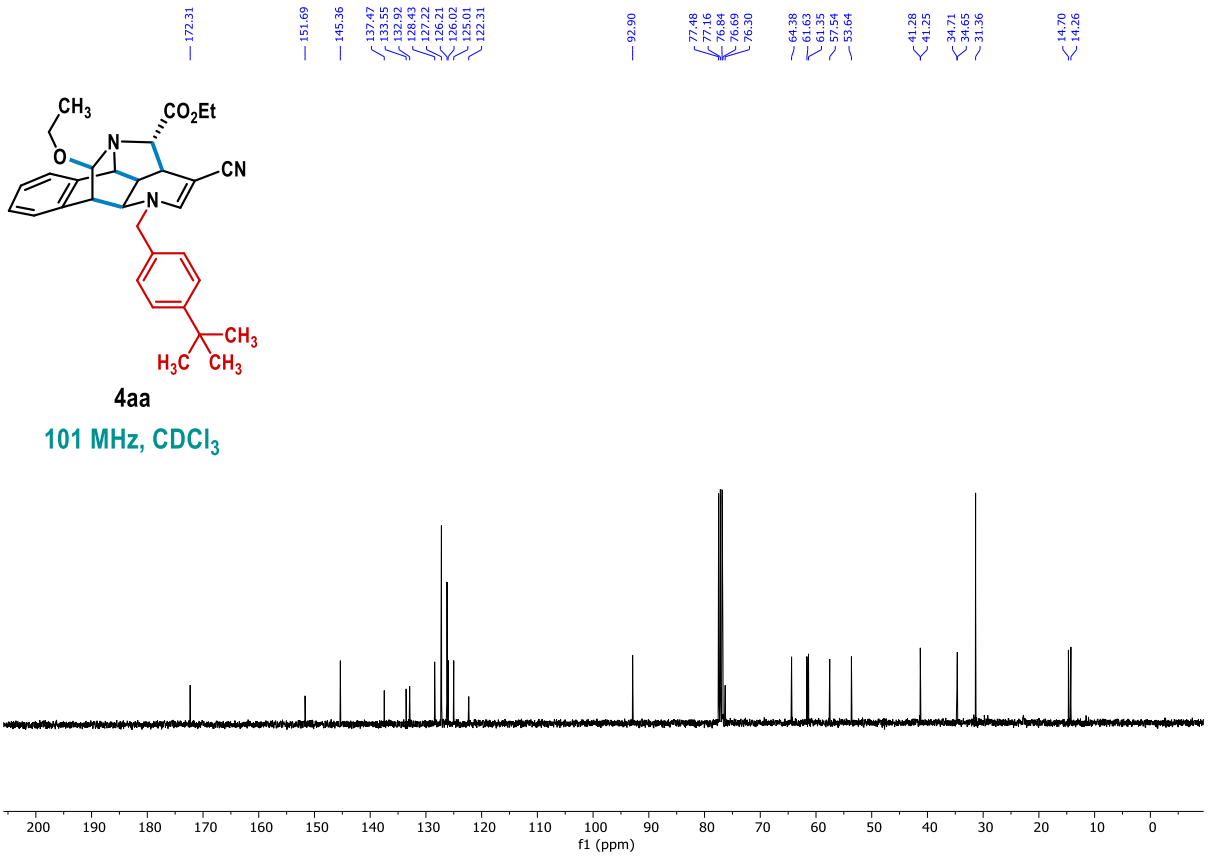


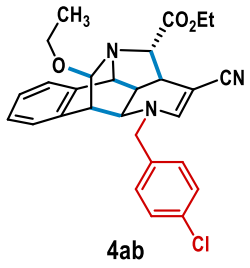
4z

101 MHz, $CDCl_3$



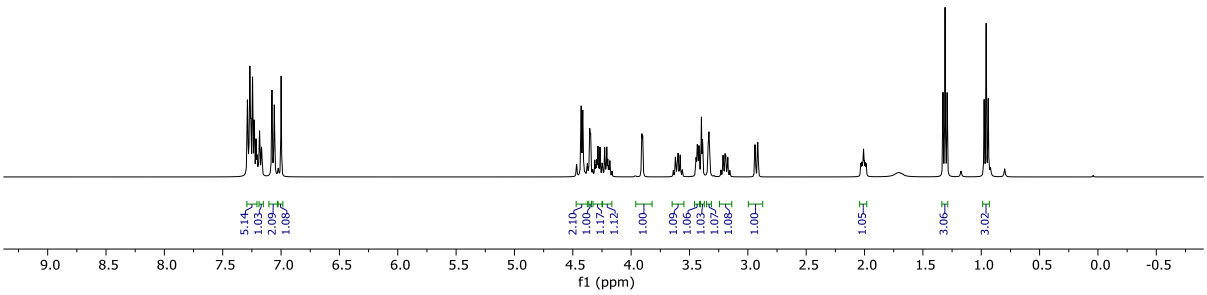

4aa
400 MHz, CDCl3
f1 (ppm)

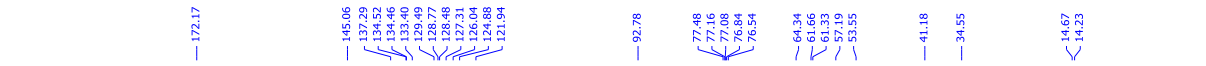

4aa
101 MHz, CDCl3
f1 (ppm)

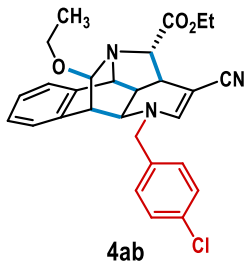


4ab

400 MHz, $CDCl_3$

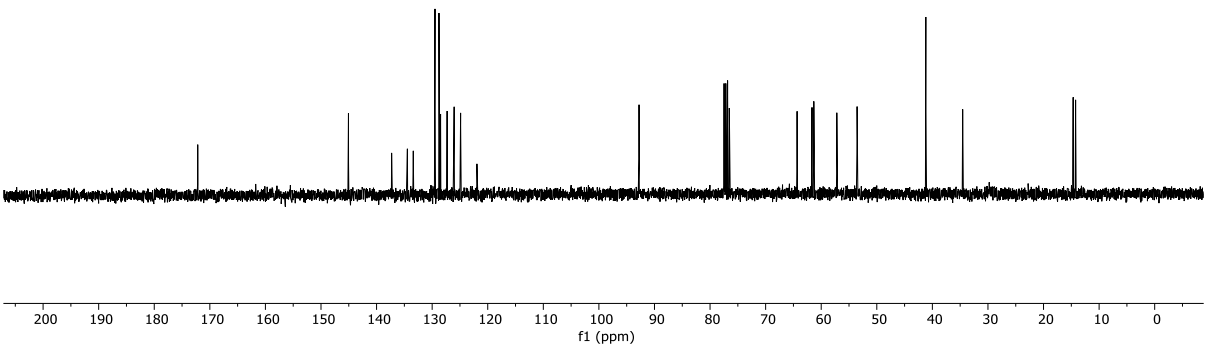


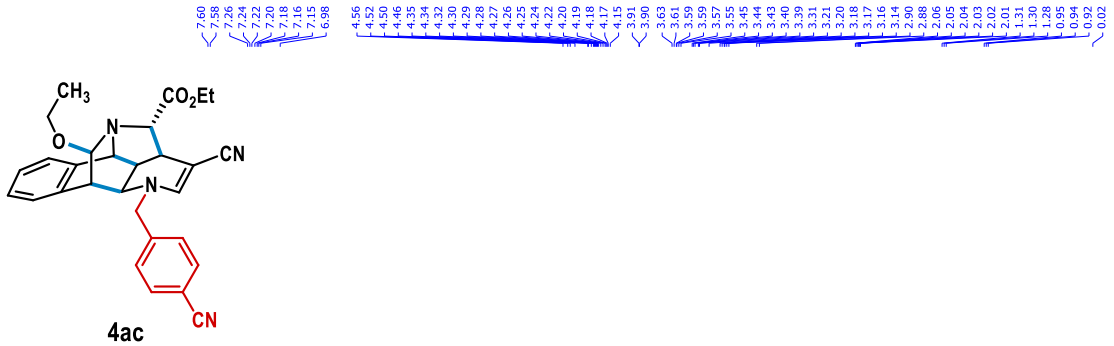




4ab

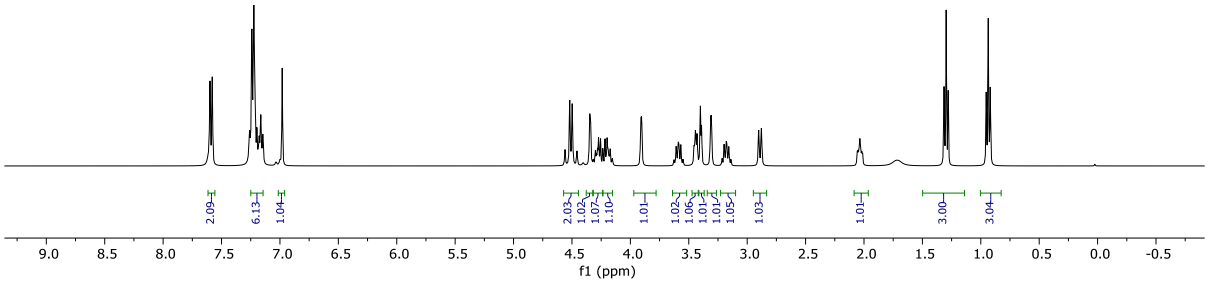
101 MHz, $CDCl_3$





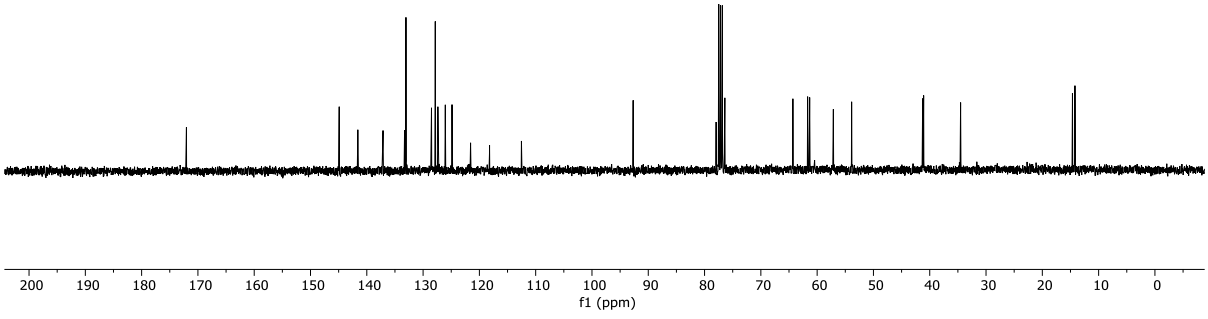
4ac

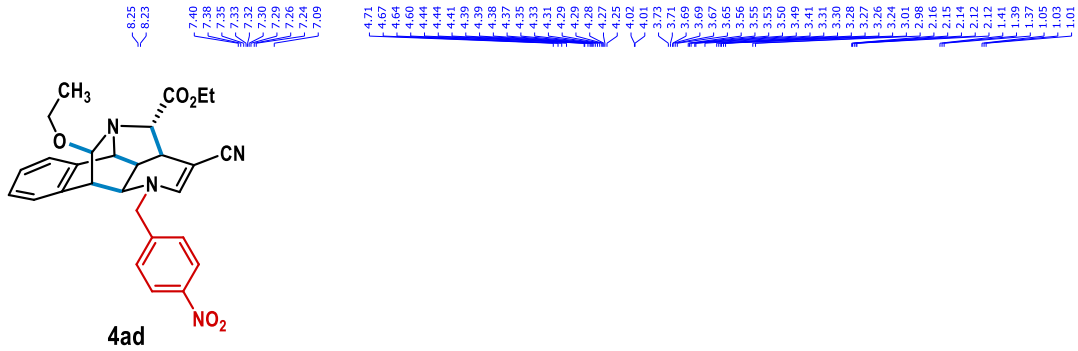
400 MHz, $CDCl_3$



4ac

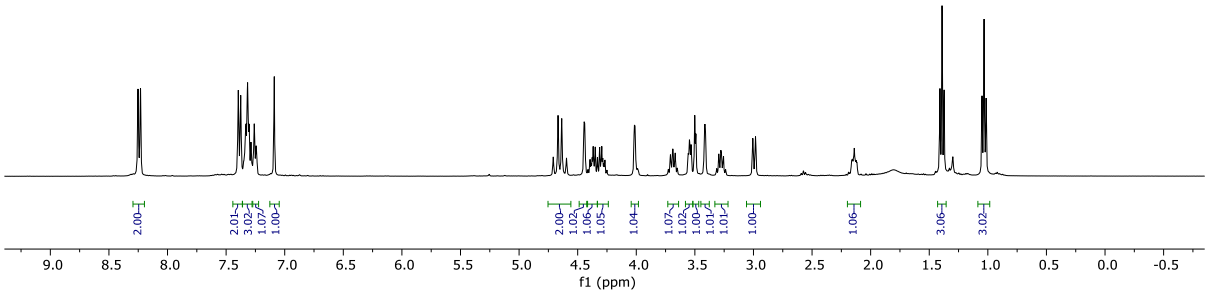
101 MHz, $CDCl_3$





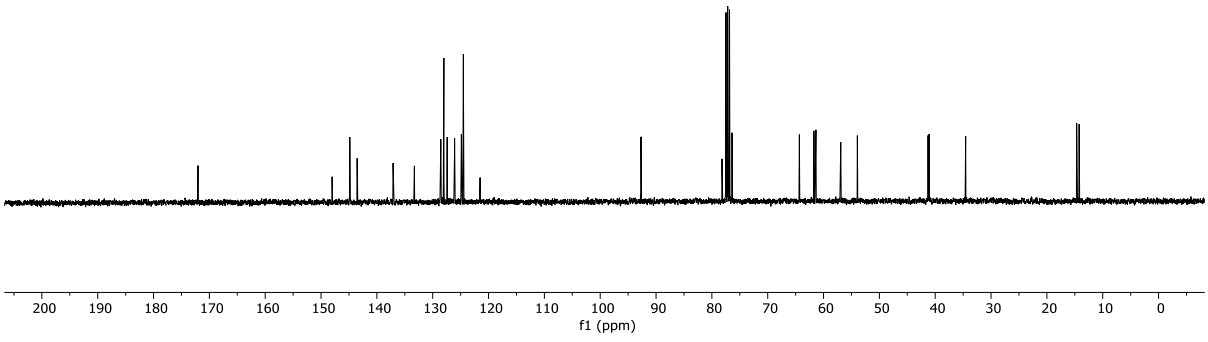
4ad

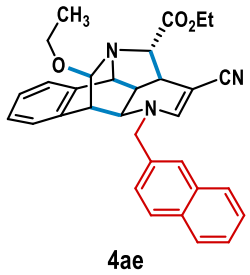
400 MHz, $CDCl_3$



4ad

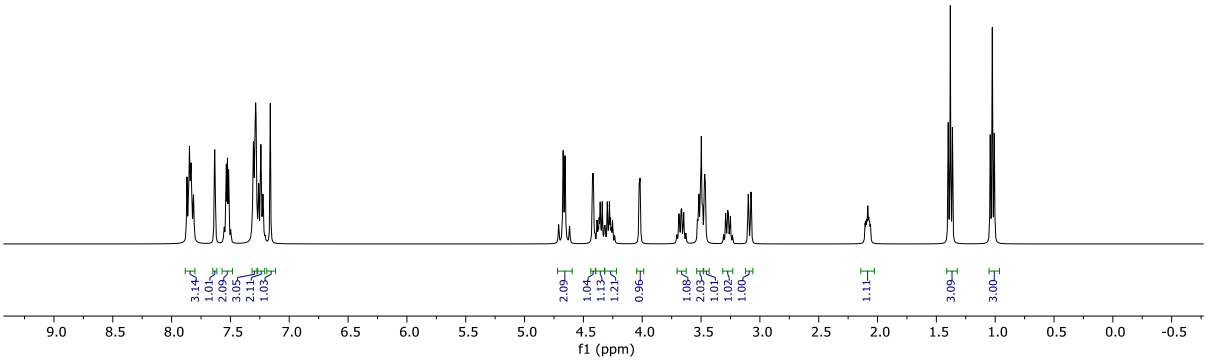
101 MHz, $CDCl_3$

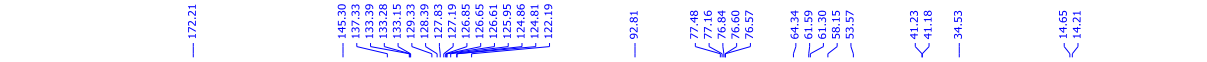


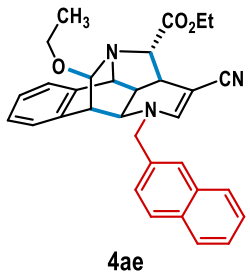


4ae

400 MHz, $CDCl_3$

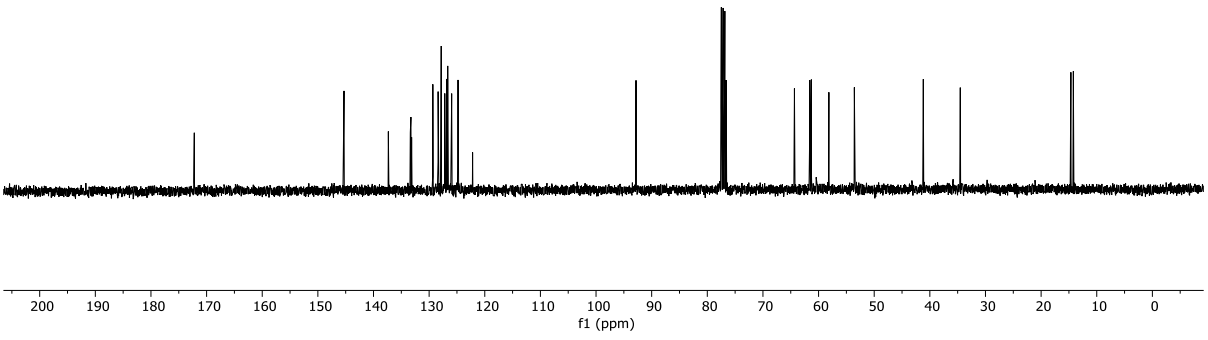


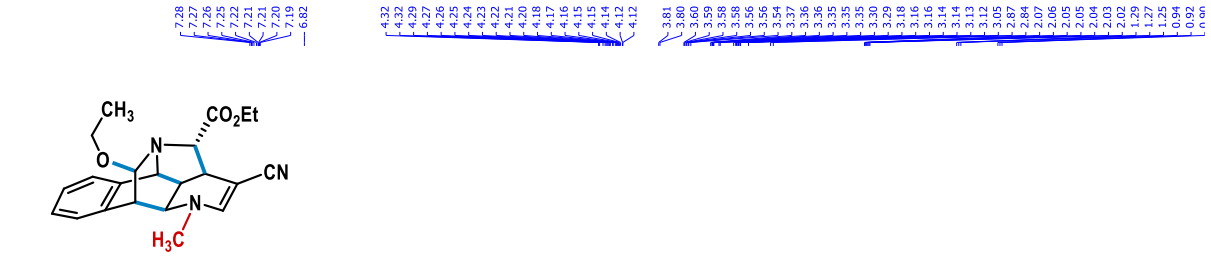




4ae

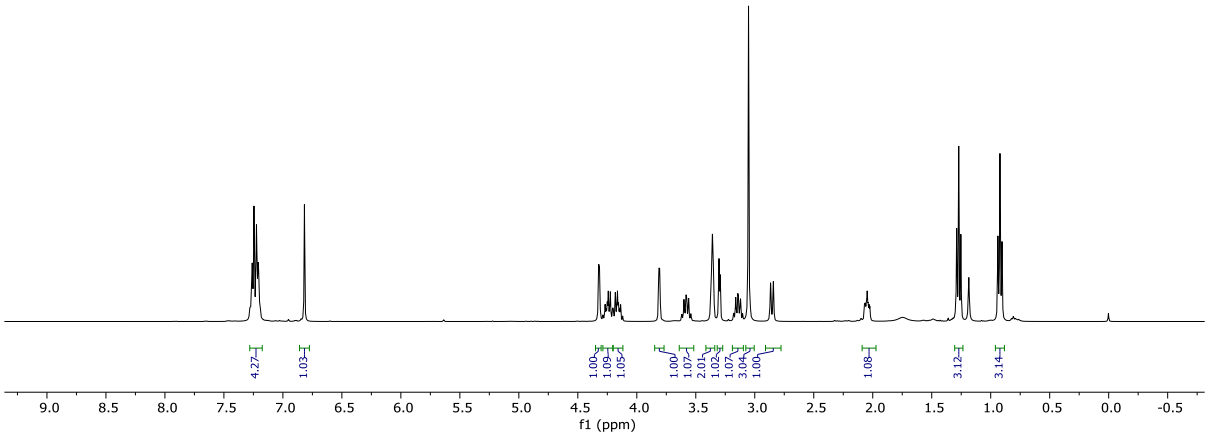
101 MHz, $CDCl_3$

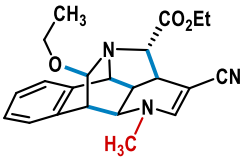




4af

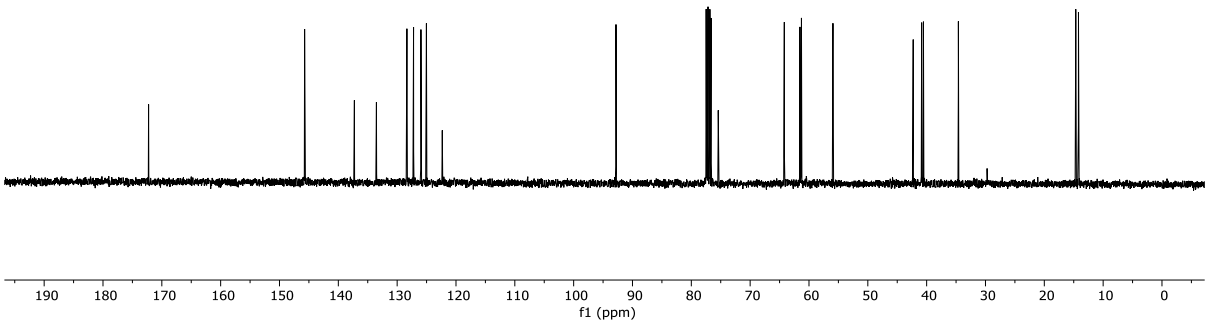
400 MHz, $CDCl_3$

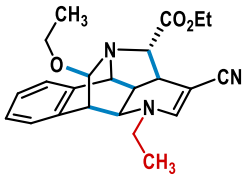




4af

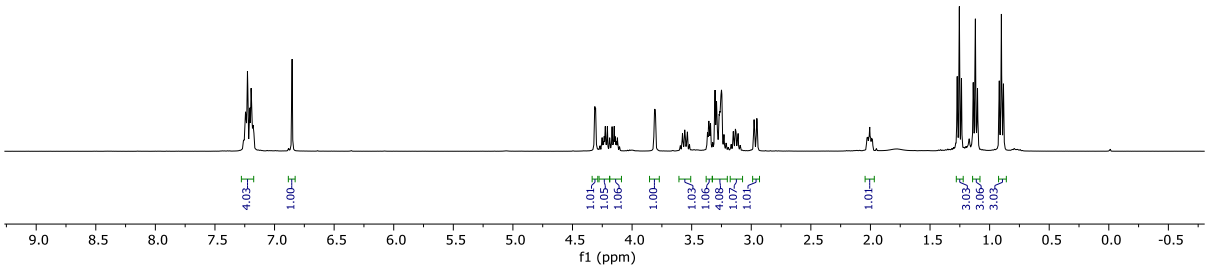
101 MHz, $CDCl_3$

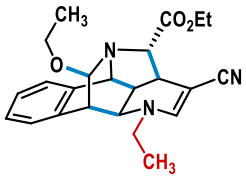




4ag

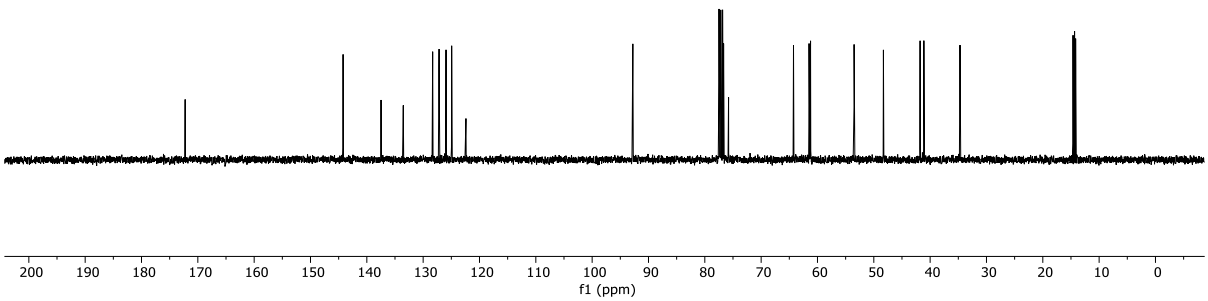
400 MHz, $CDCl_3$

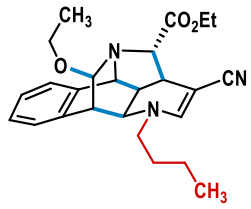




4ag

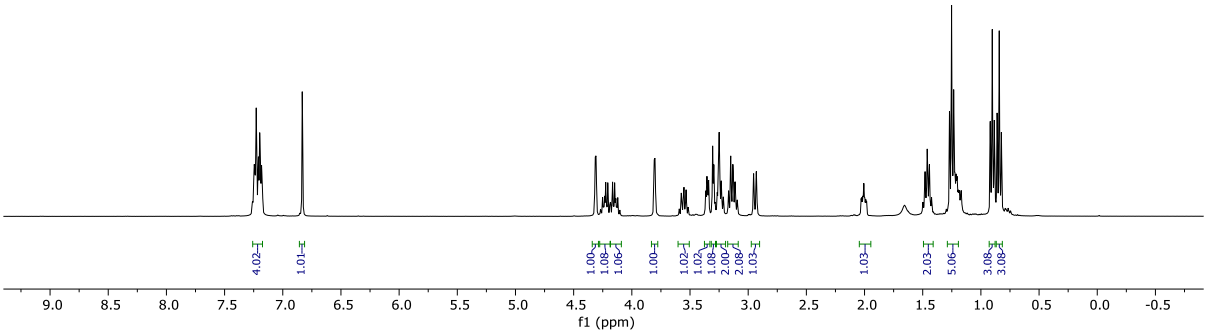
101 MHz, $CDCl_3$

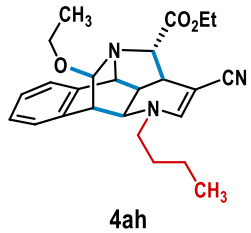




4ah

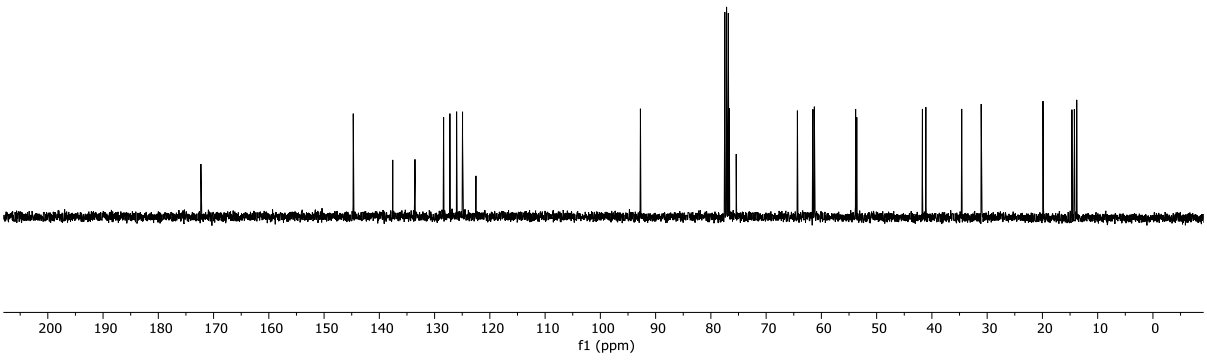
400 MHz, $CDCl_3$

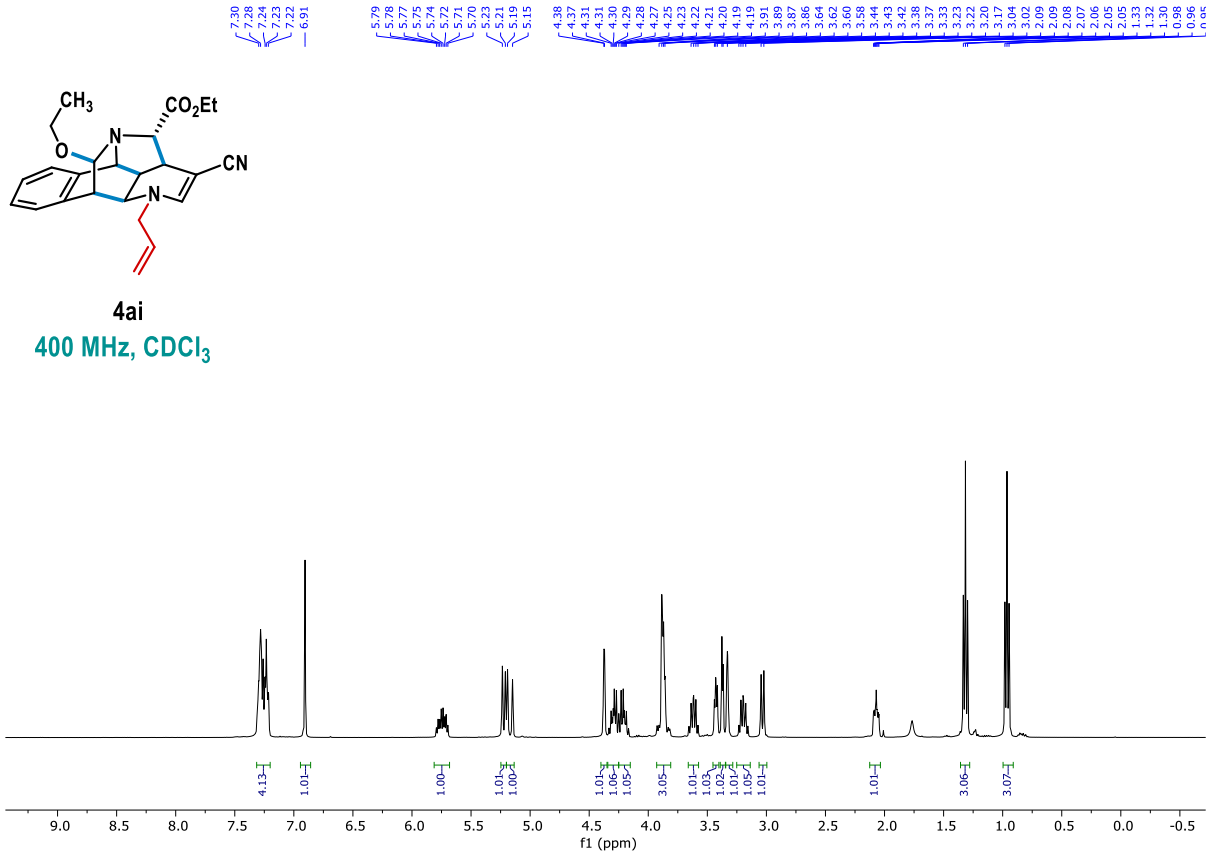




4ah

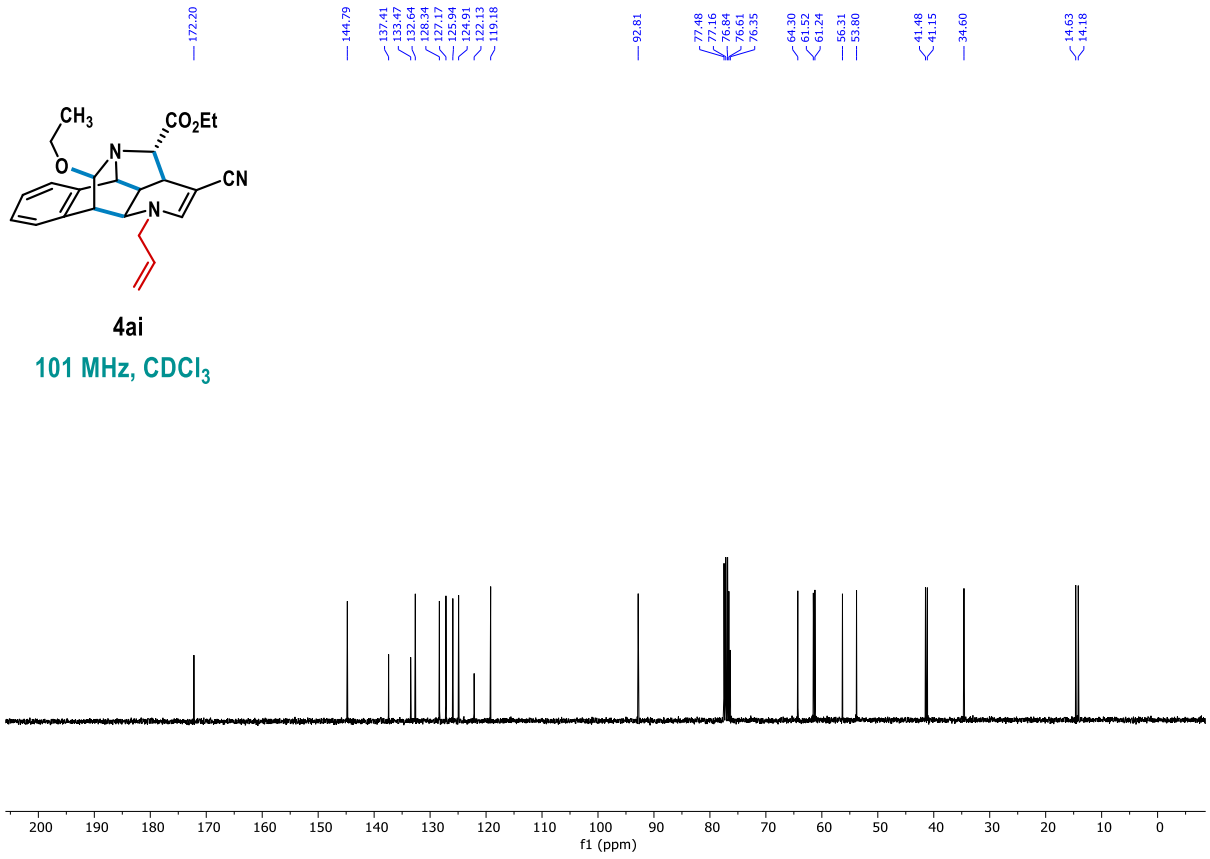
101 MHz, $CDCl_3$





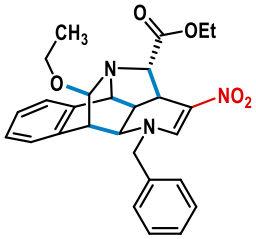
4ai

400 MHz, $CDCl_3$



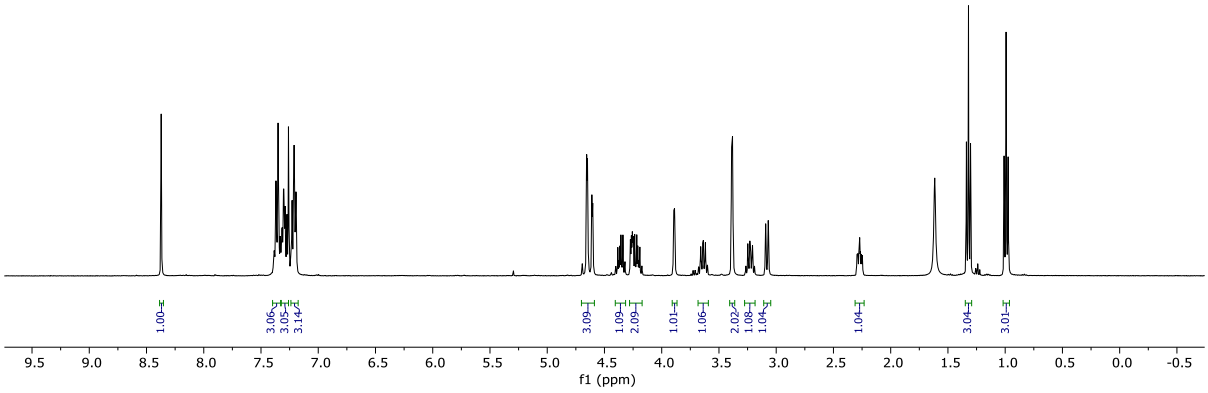
4ai

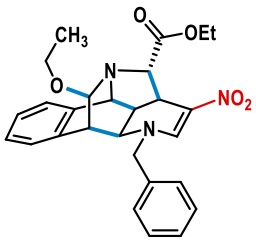
101 MHz, $CDCl_3$



4aj

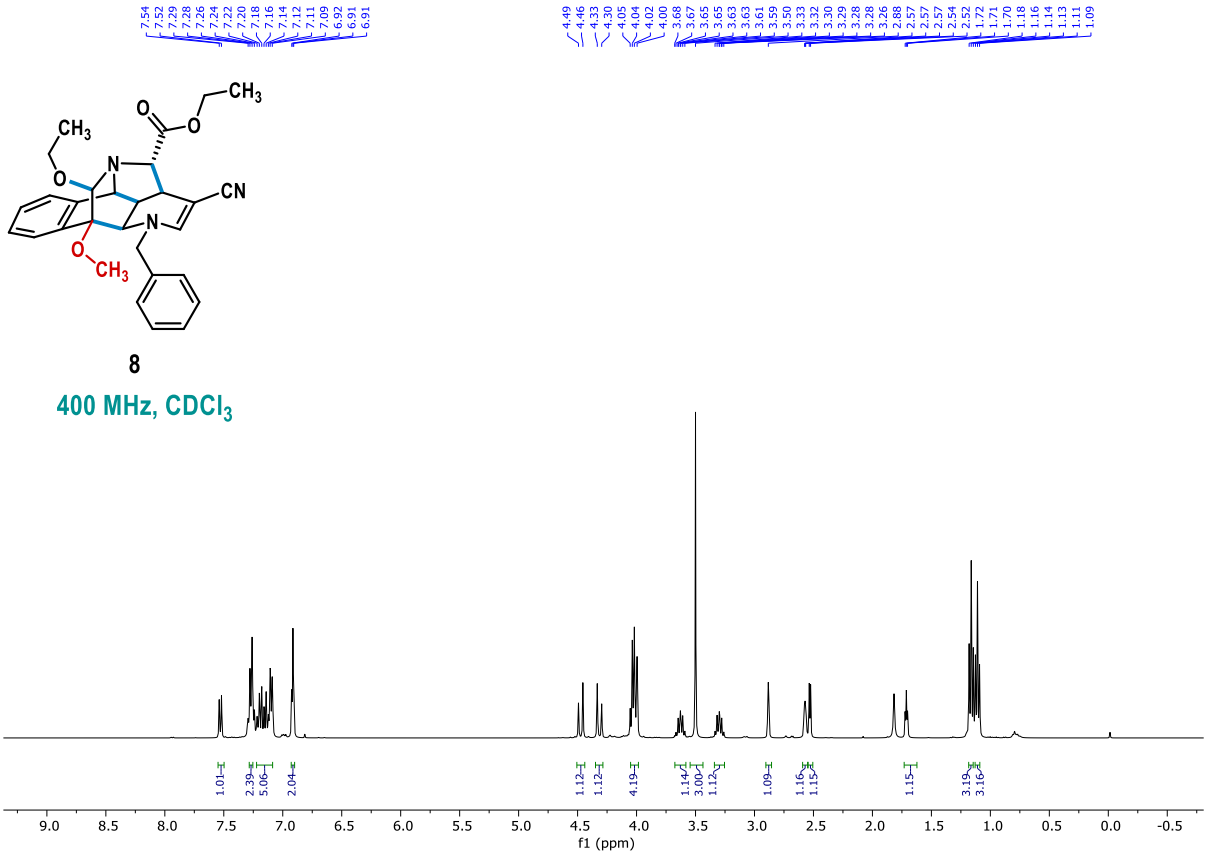
400 MHz, $CDCl_3$

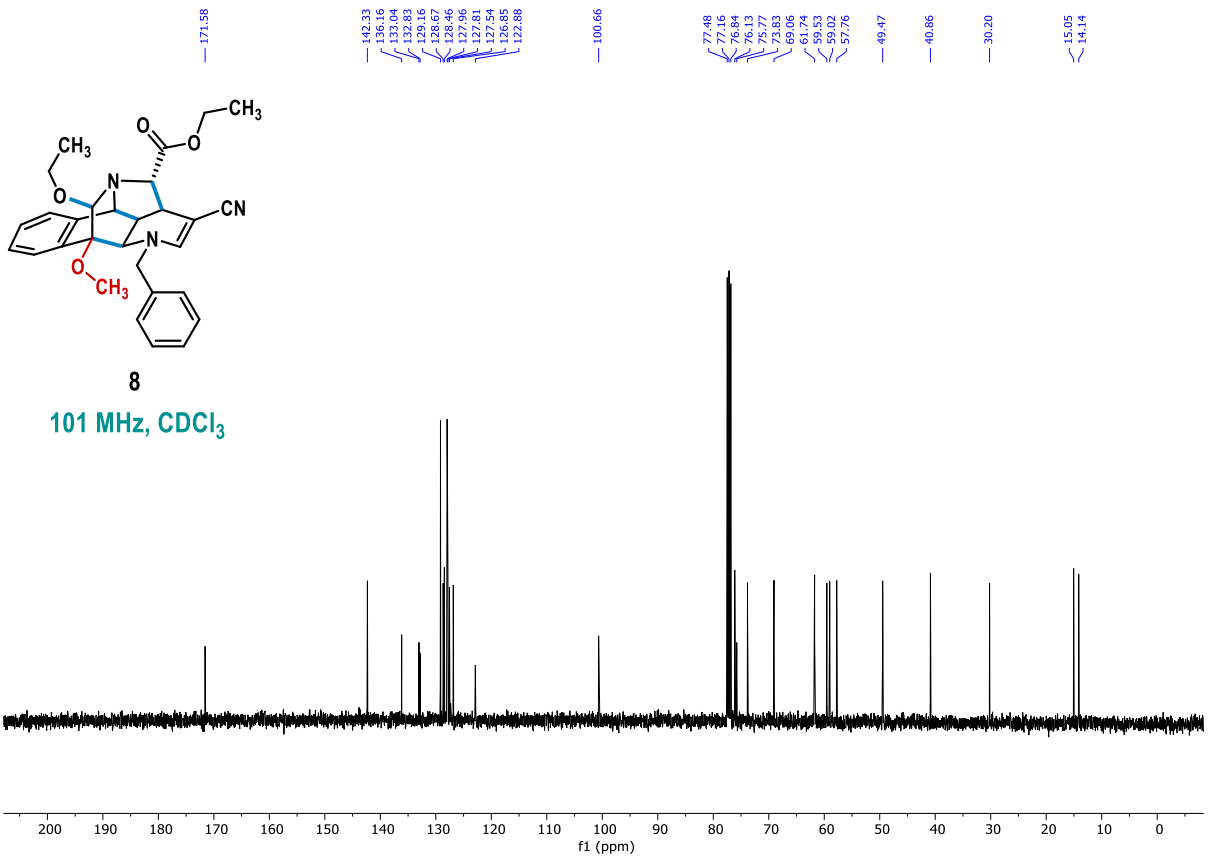


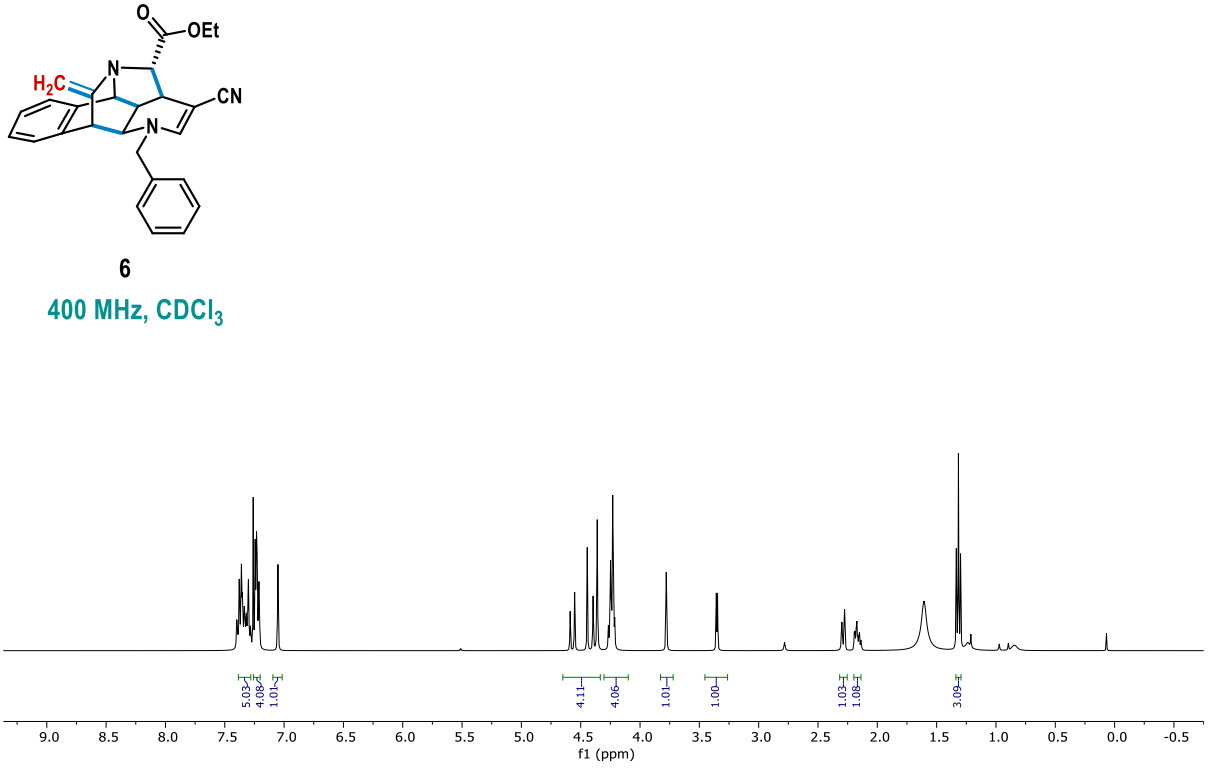


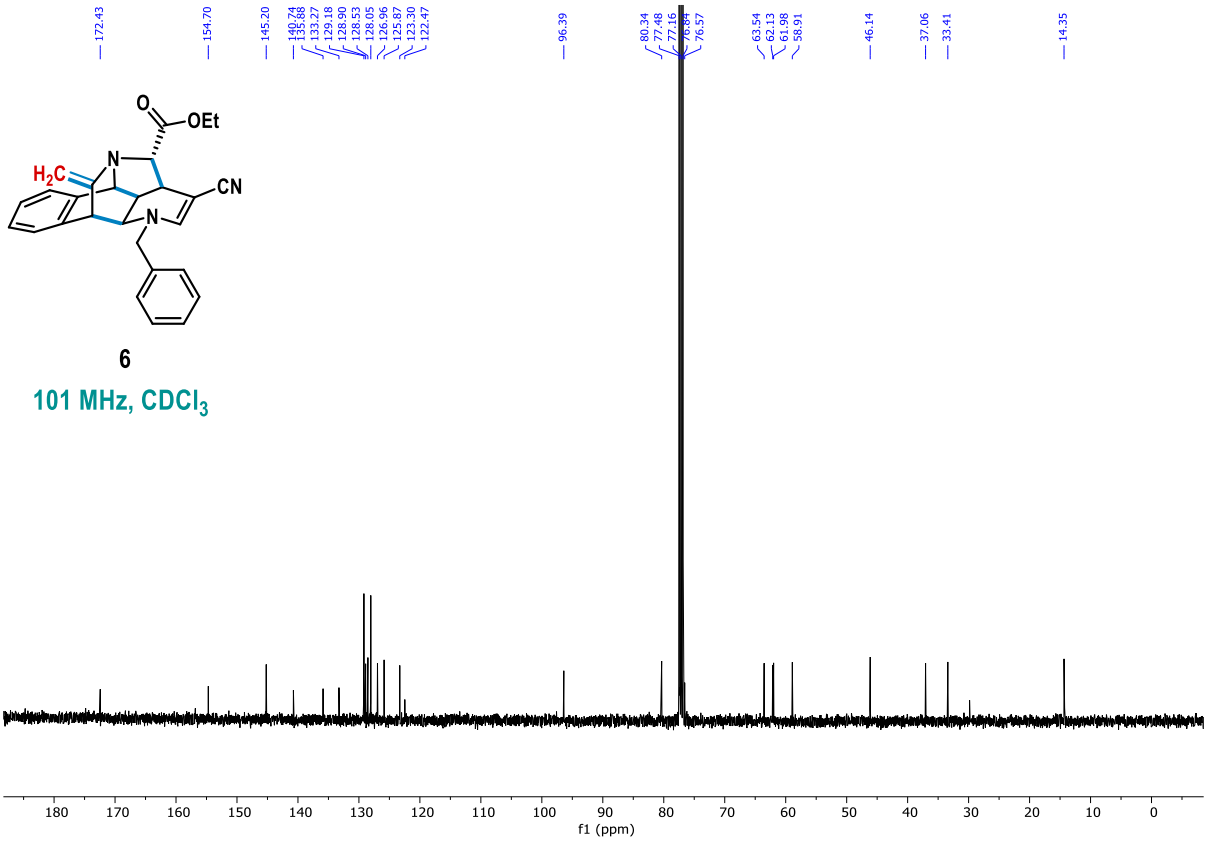
4aj

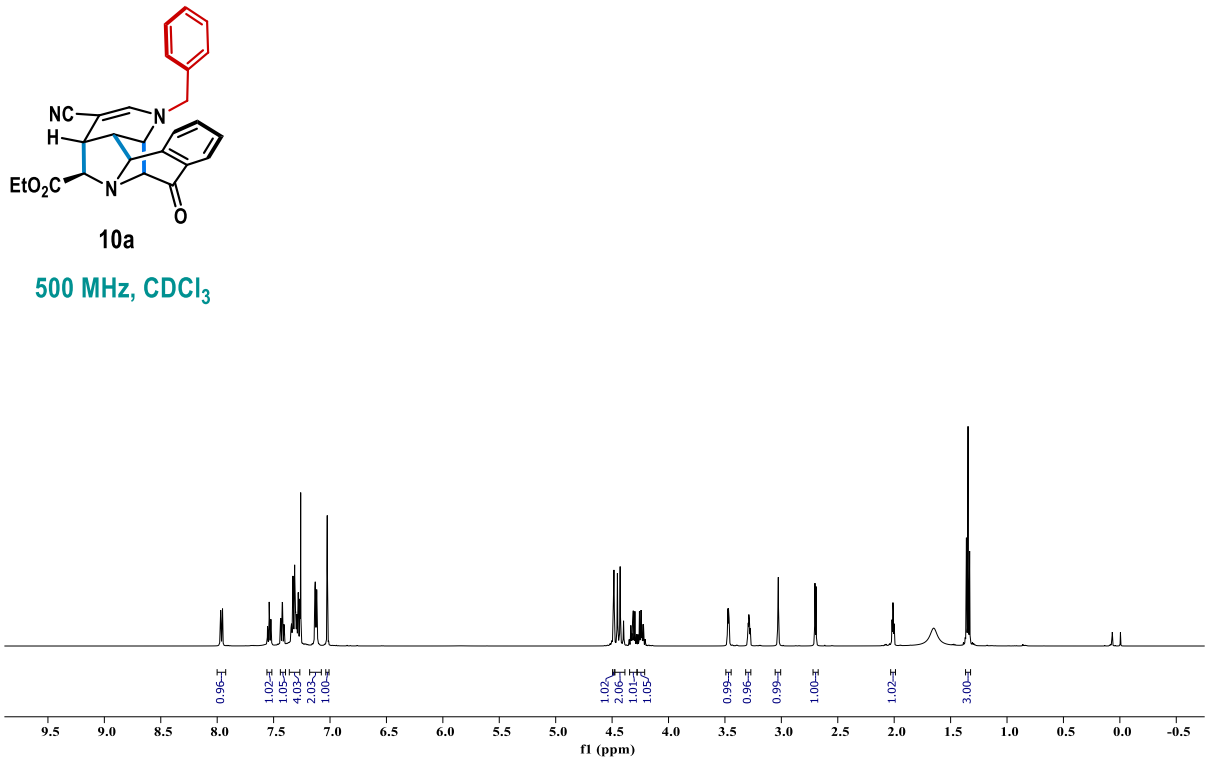
101 MHz, $CDCl_3$

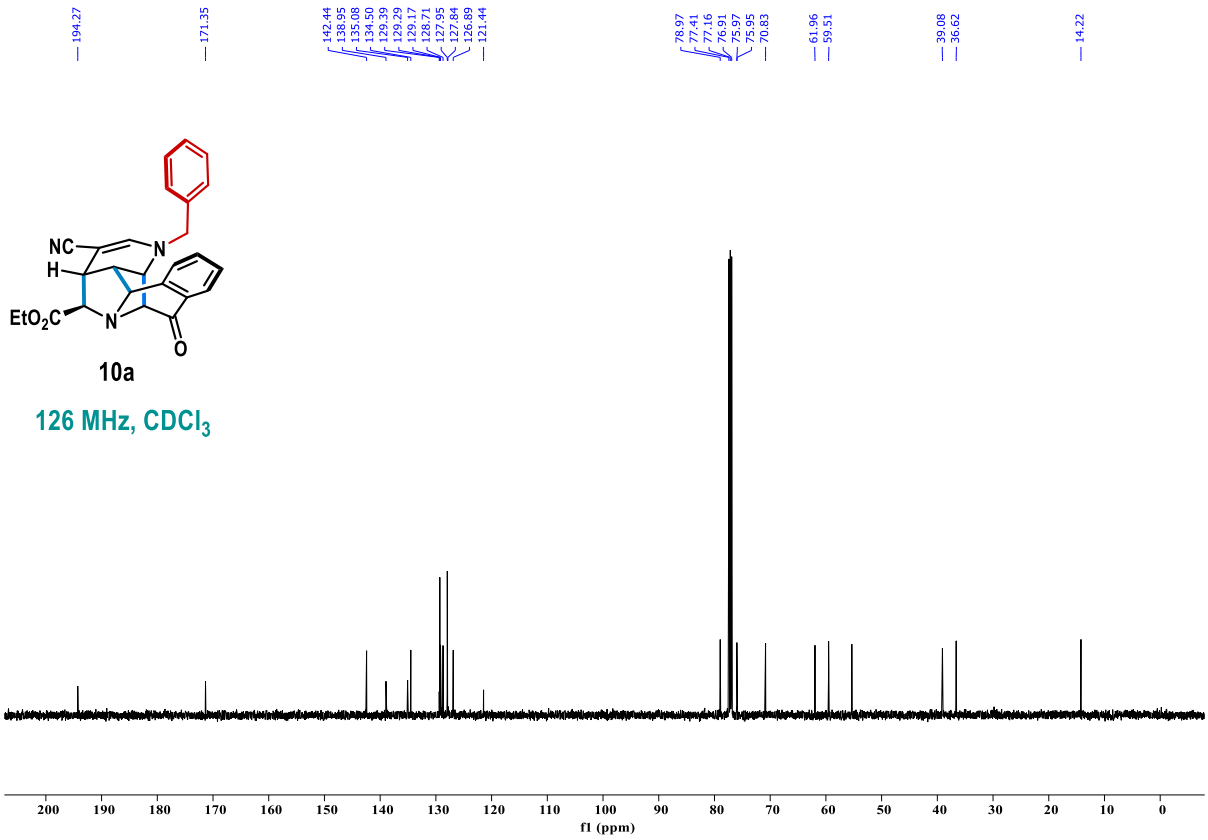

8
400 MHz, CDCl3
f1 (ppm)

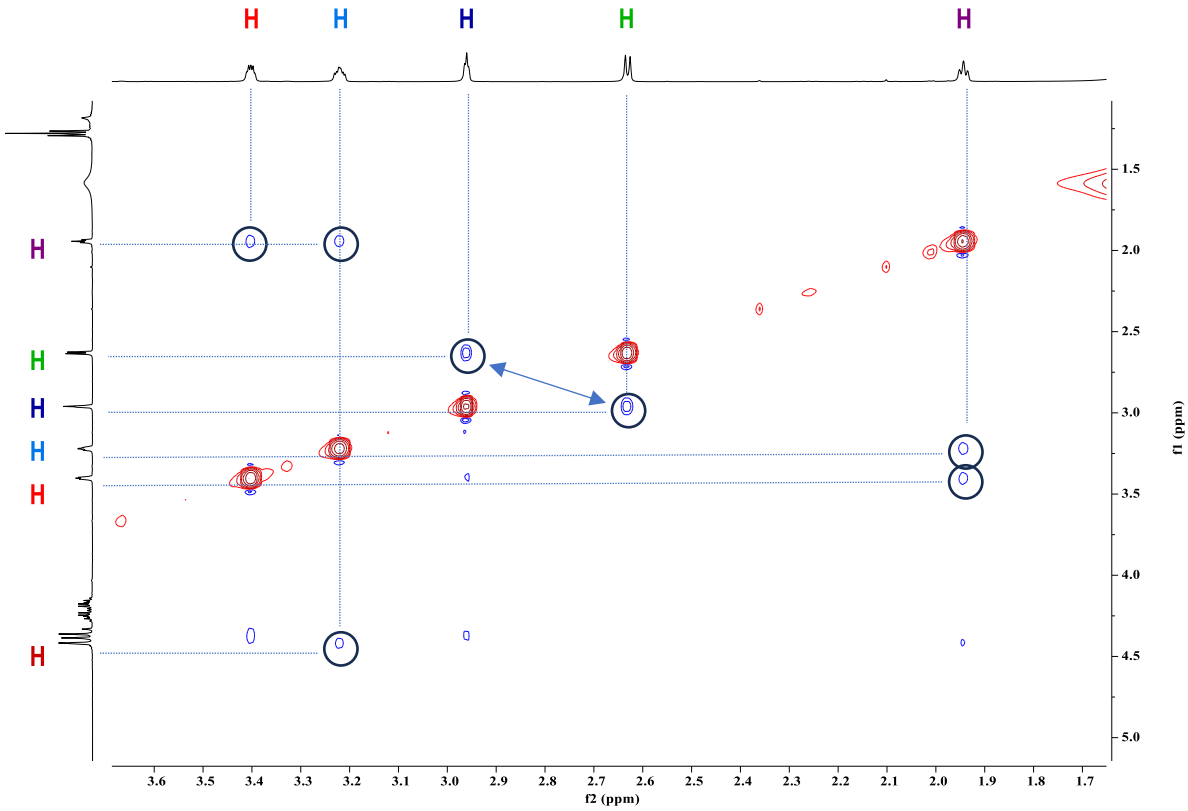

8
101 MHz, CDCl3
f1 (ppm)

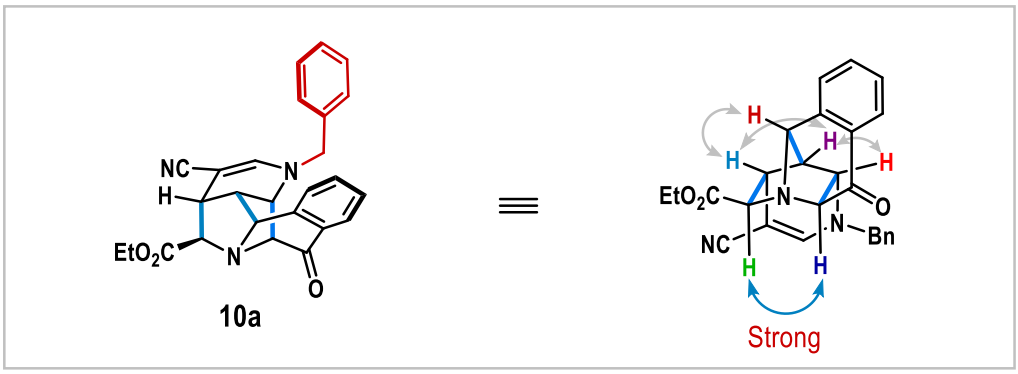

7.40 7.39 7.38 7.37 7.36 7.35 7.35 7.34 7.33 7.32 7.32 7.31 7.30 7.28 7.26 7.24 7.23 7.23 7.21 7.21 7.05
4.59 4.55 4.44 4.40 4.36 4.27 4.26 4.25 4.24 4.23 4.22 4.21 3.78 3.78
3.36 3.35
2.30 2.28 2.19 2.19 2.18 2.17 2.16 2.16 2.15 2.14
1.33 1.32 1.30
O
OEt
N
H2C
CN
N
6
400 MHz, CDCl3
5.03 4.06 1.01 4.11 4.06 1.01 1.00 1.03 1.08 3.09
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
f1 (ppm)

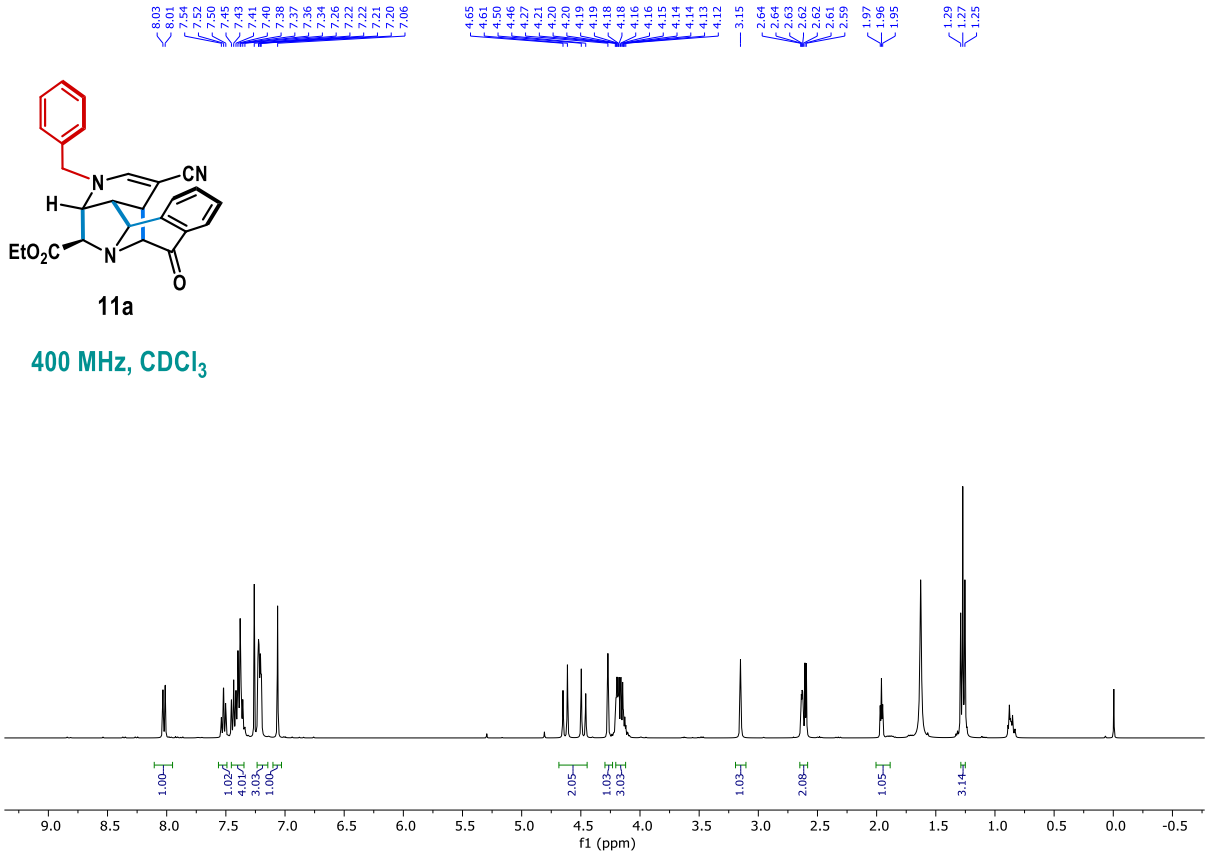

172.43 154.70 145.20 140.74 135.88 133.77 129.18 128.90 128.53 128.05 126.96 125.87 123.30 122.47
96.39
80.34 77.48 77.16 76.84 76.57
63.54 62.13 61.98 58.91
46.14
37.06 33.41
14.35
O
OEt
N
H2C
CN
N
6
101 MHz, CDCl3
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

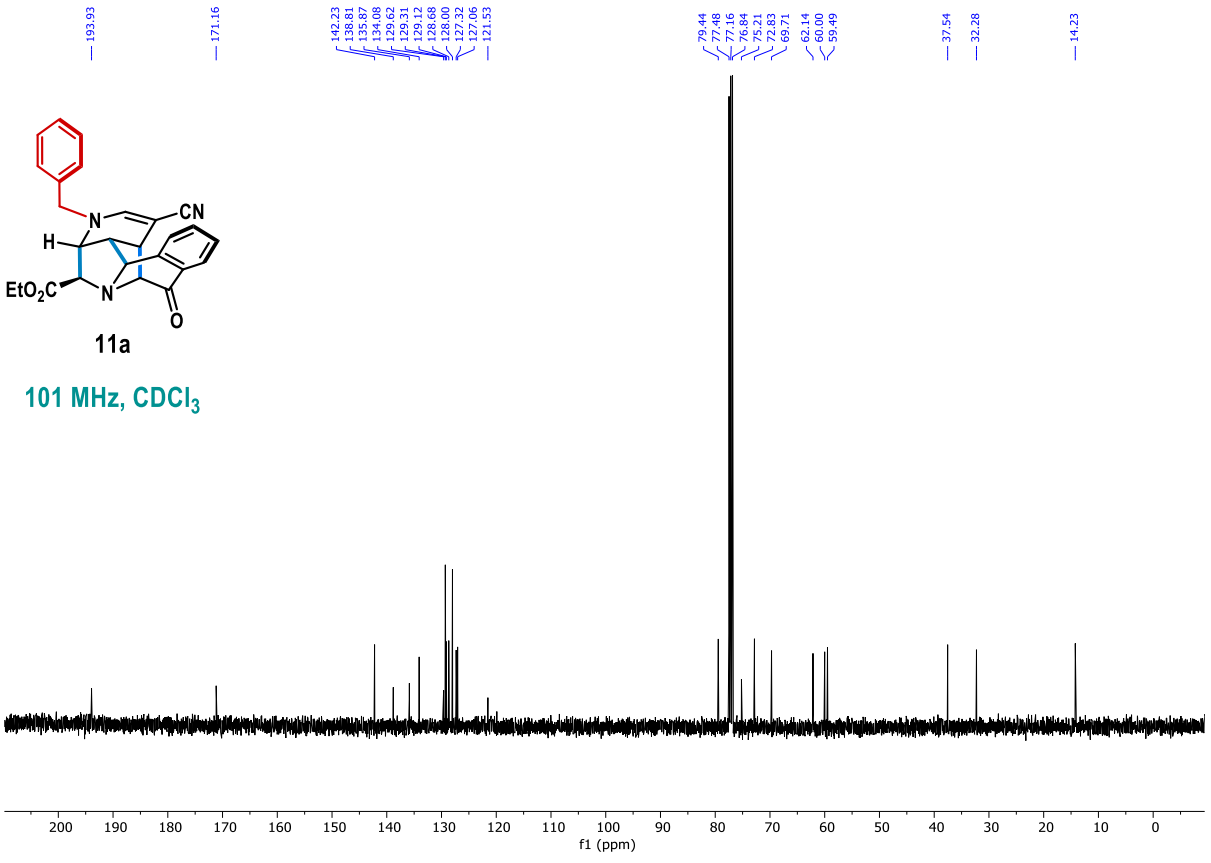

NC
H
EtO2C
N
N
O
10a
500 MHz, CDCl3
f1 (ppm)

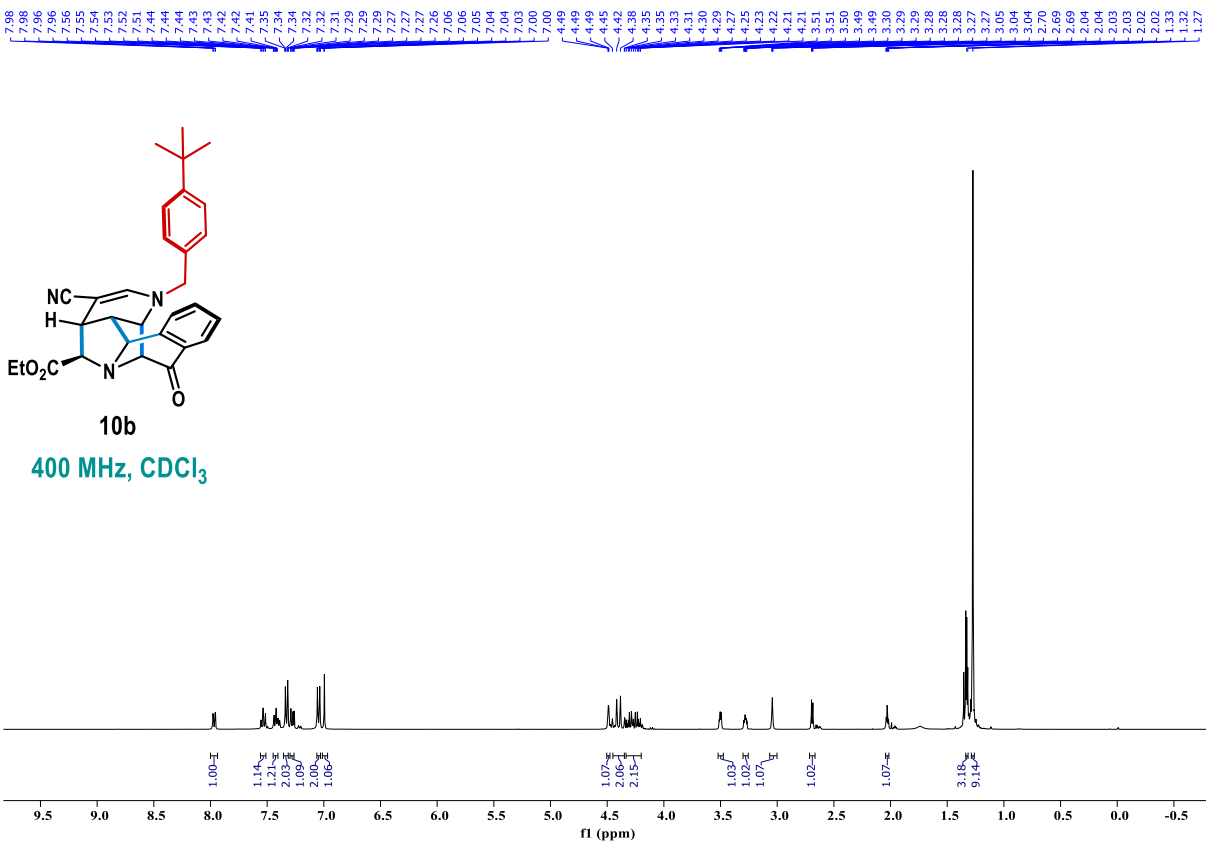

NC
H
EtO2C
N
N
O
10a
126 MHz, CDCl3
f1 (ppm)

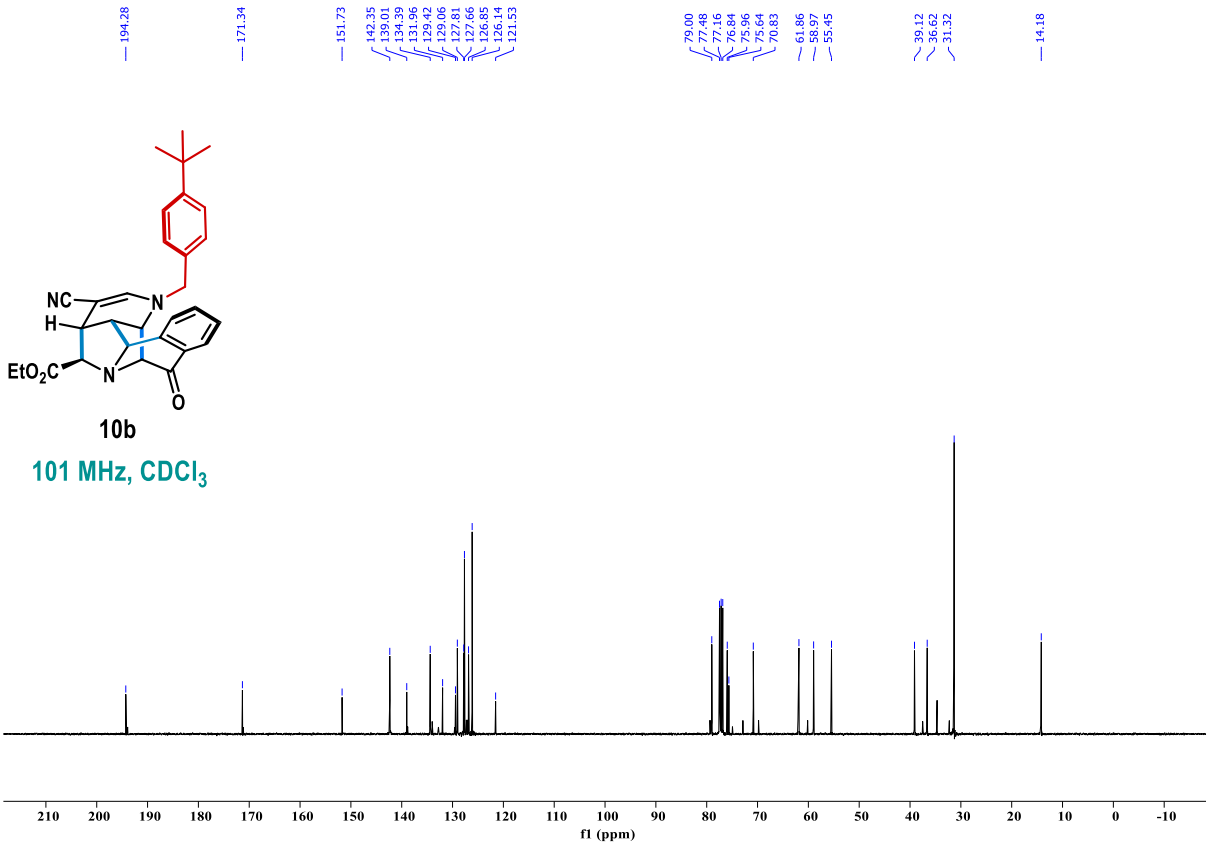

H
H
H
H
H
H
H
H
H
H
f2 (ppm)
f1 (ppm)

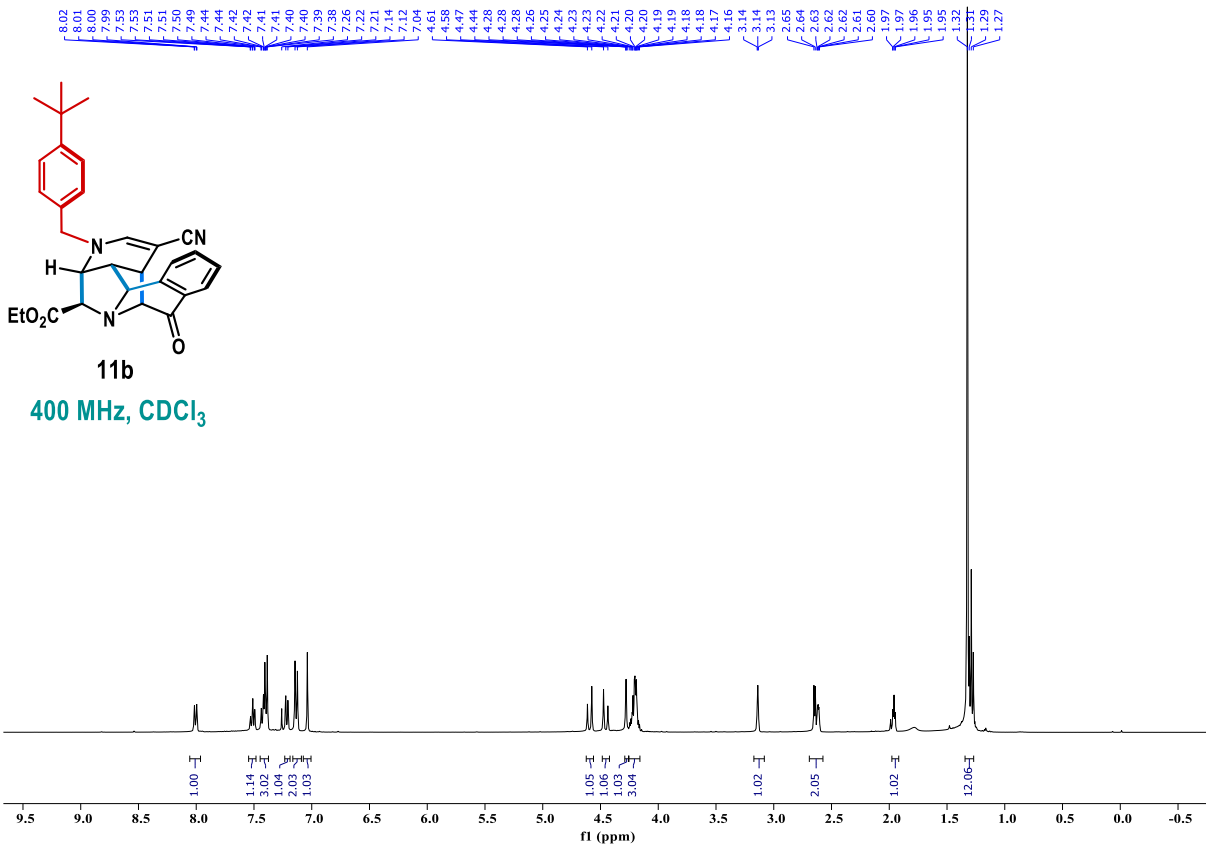

NC
H
EtO2C
N
O
10a
≡
H
H
H
H
EtO2C
N
O
NC
N
Bn
H
H
Strong

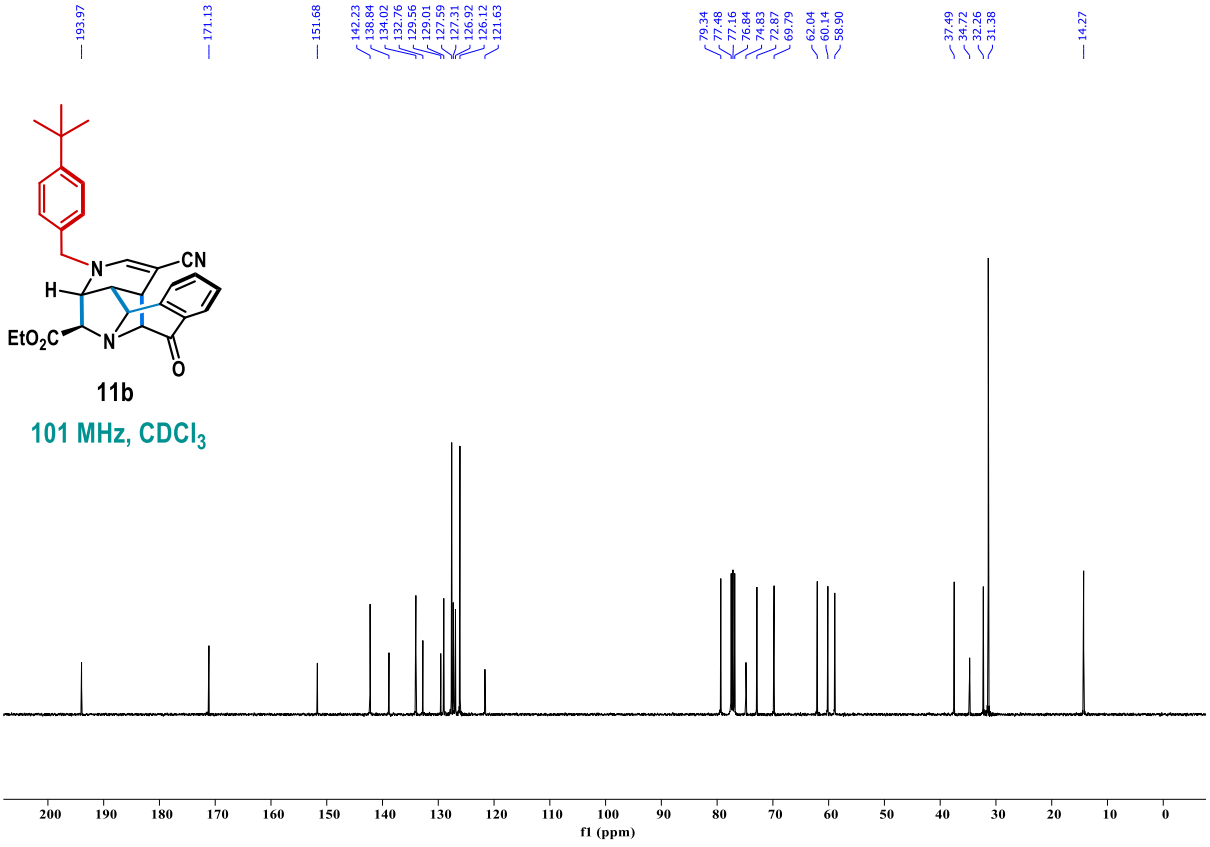

8.03
8.01
7.54
7.52
7.50
7.45
7.43
7.41
7.40
7.38
7.37
7.36
7.34
7.26
7.22
7.22
7.21
7.20
7.06
4.65
4.61
4.50
4.46
4.27
4.21
4.20
4.20
4.19
4.19
4.18
4.18
4.16
4.16
4.15
4.14
4.14
4.13
4.12
3.15
2.64
2.64
2.63
2.62
2.62
2.61
2.59
1.97
1.96
1.95
1.29
1.27
1.25
CN
H
N
EtO2C
N
O
11a
400 MHz, CDCl3
1.00
1.02
4.01
3.03
1.00
2.05
1.03
3.03
1.03
2.08
1.05
3.14
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
f1 (ppm)

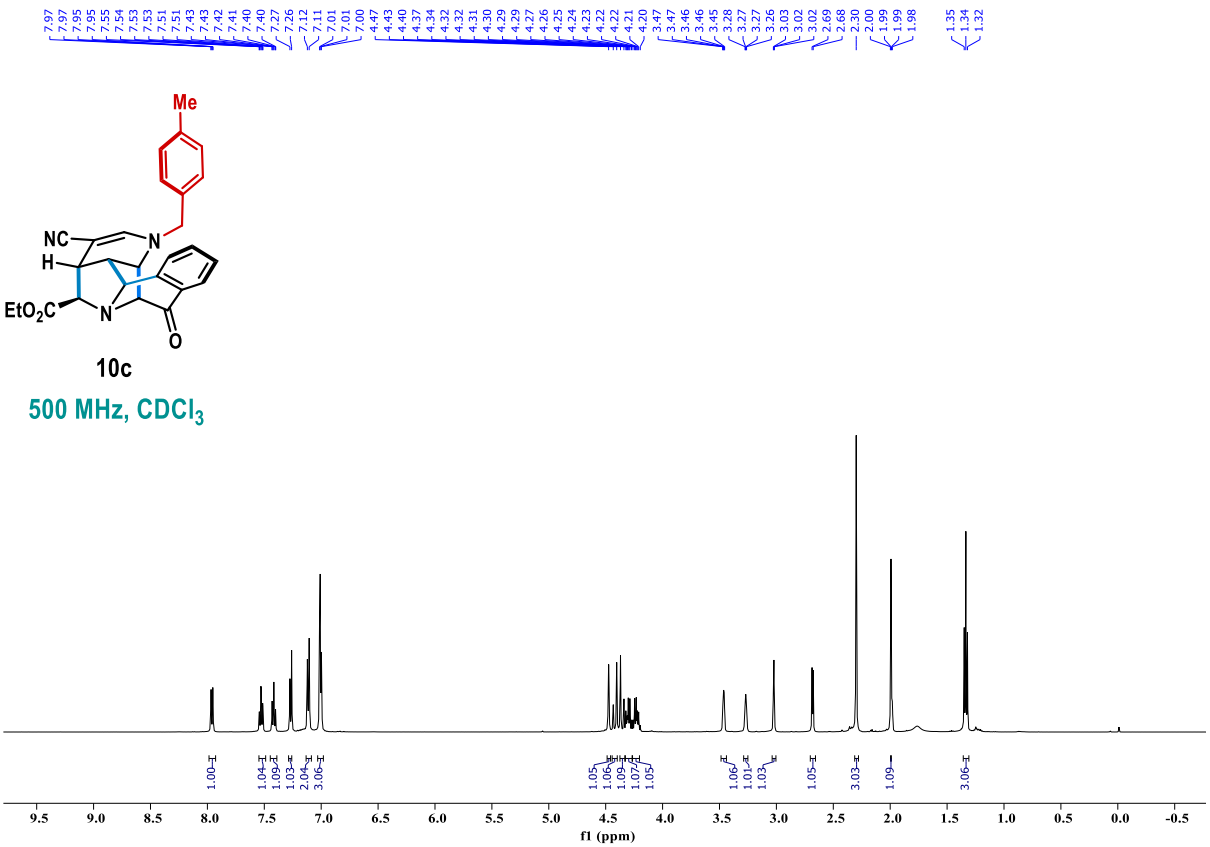

193.93
171.16
142.23
138.81
135.87
134.08
129.62
129.31
129.12
128.68
128.00
127.32
127.06
121.53
79.44
77.48
77.16
76.84
75.21
72.83
69.71
62.14
60.00
59.49
37.54
32.28
14.23
CN
H
N
EtO2C
N
O
11a
101 MHz, CDCl3
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

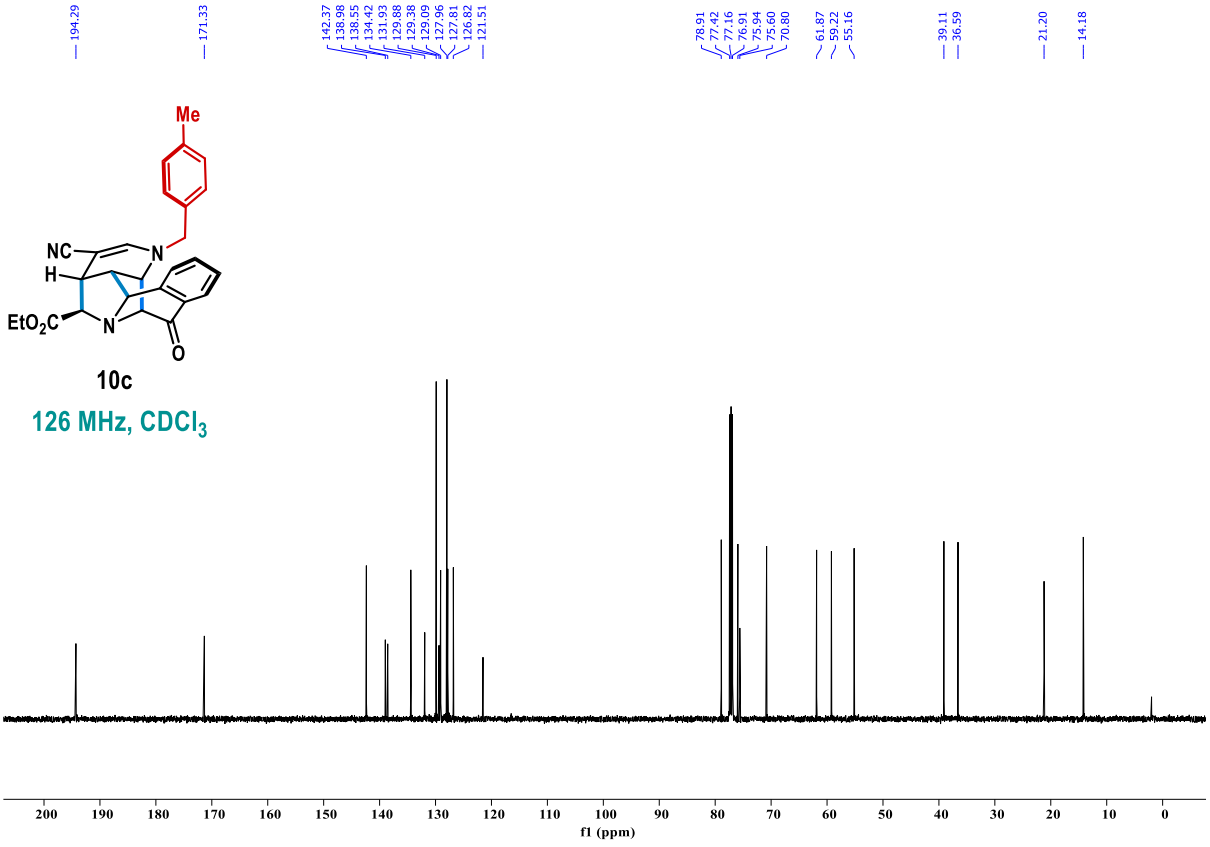

NC
H
EtO2C
N
N
O
10b
400 MHz, CDCl3
f1 (ppm)

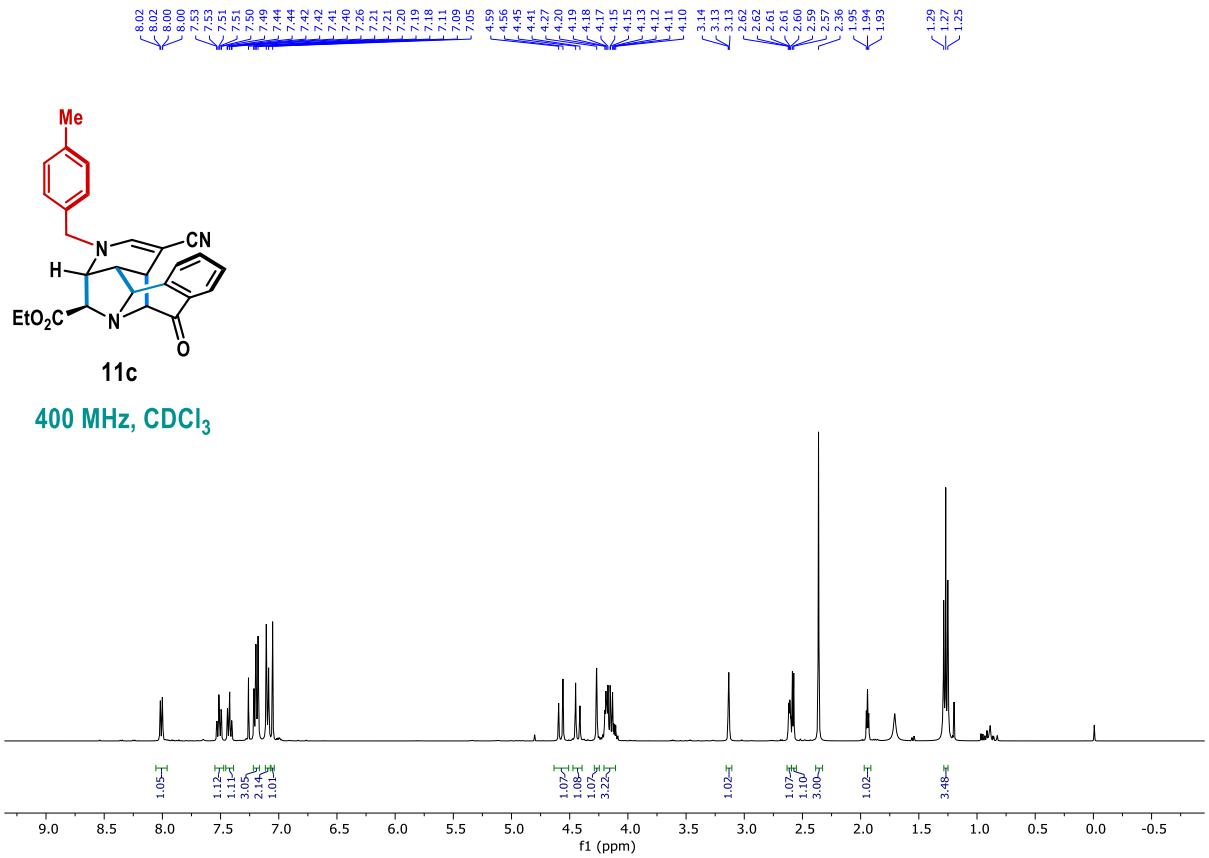

NC
H
EtO2C
N
N
O
10b
101 MHz, CDCl3
f1 (ppm)

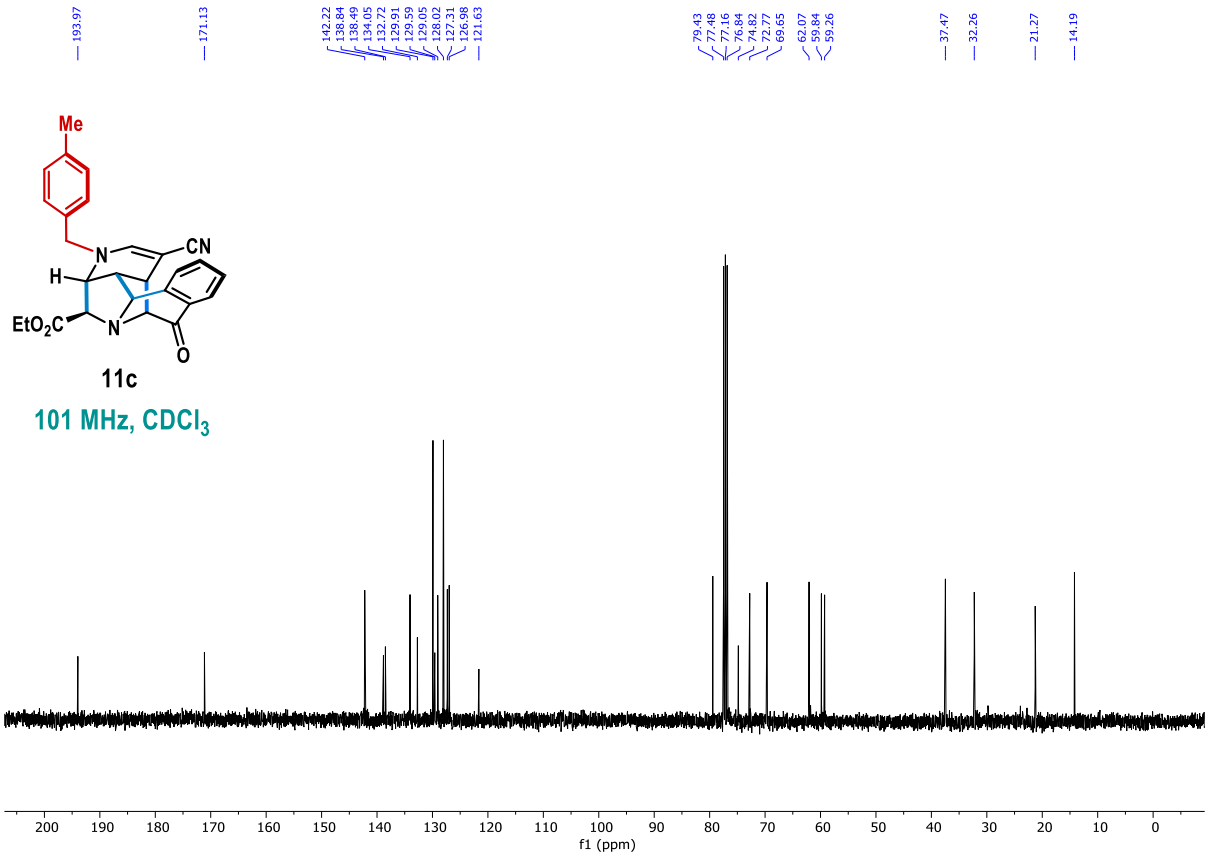

11b
400 MHz, CDCl3
f1 (ppm)

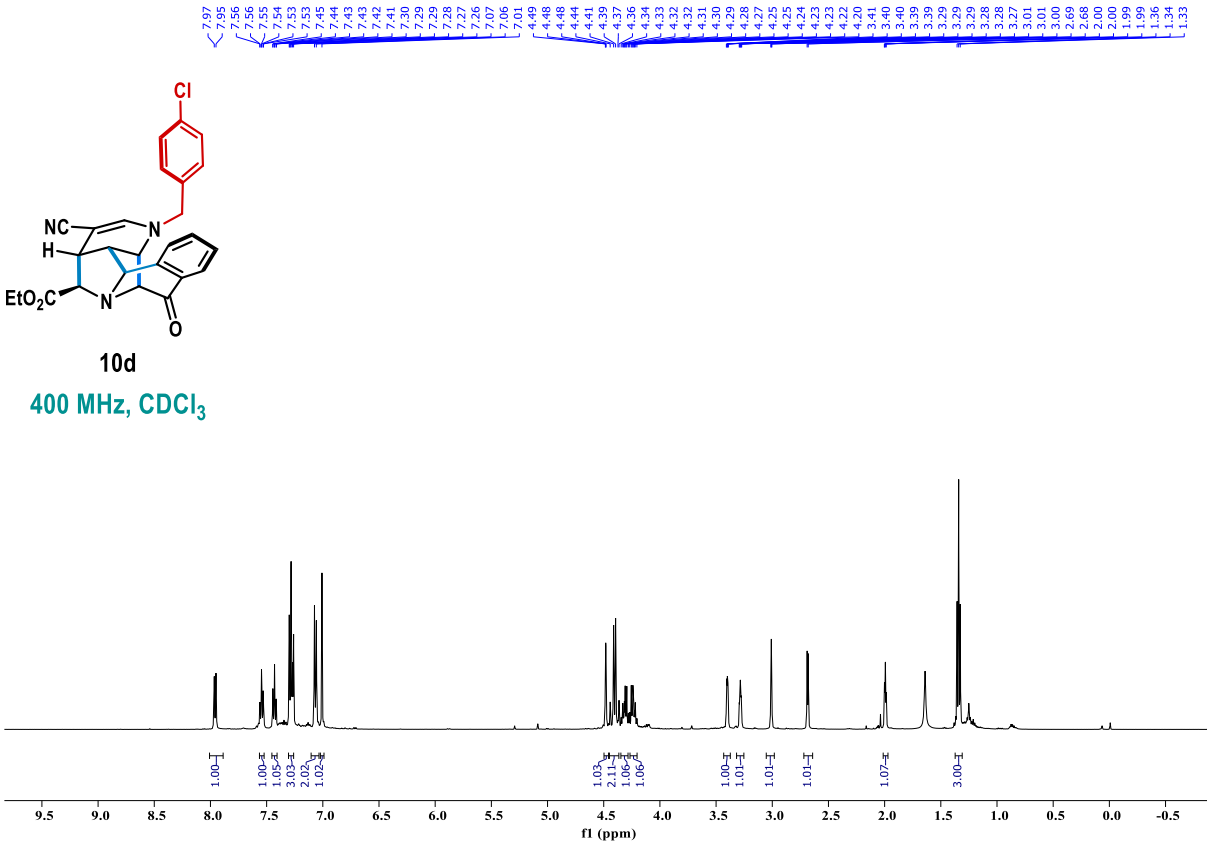

11b
101 MHz, CDCl3
f1 (ppm)

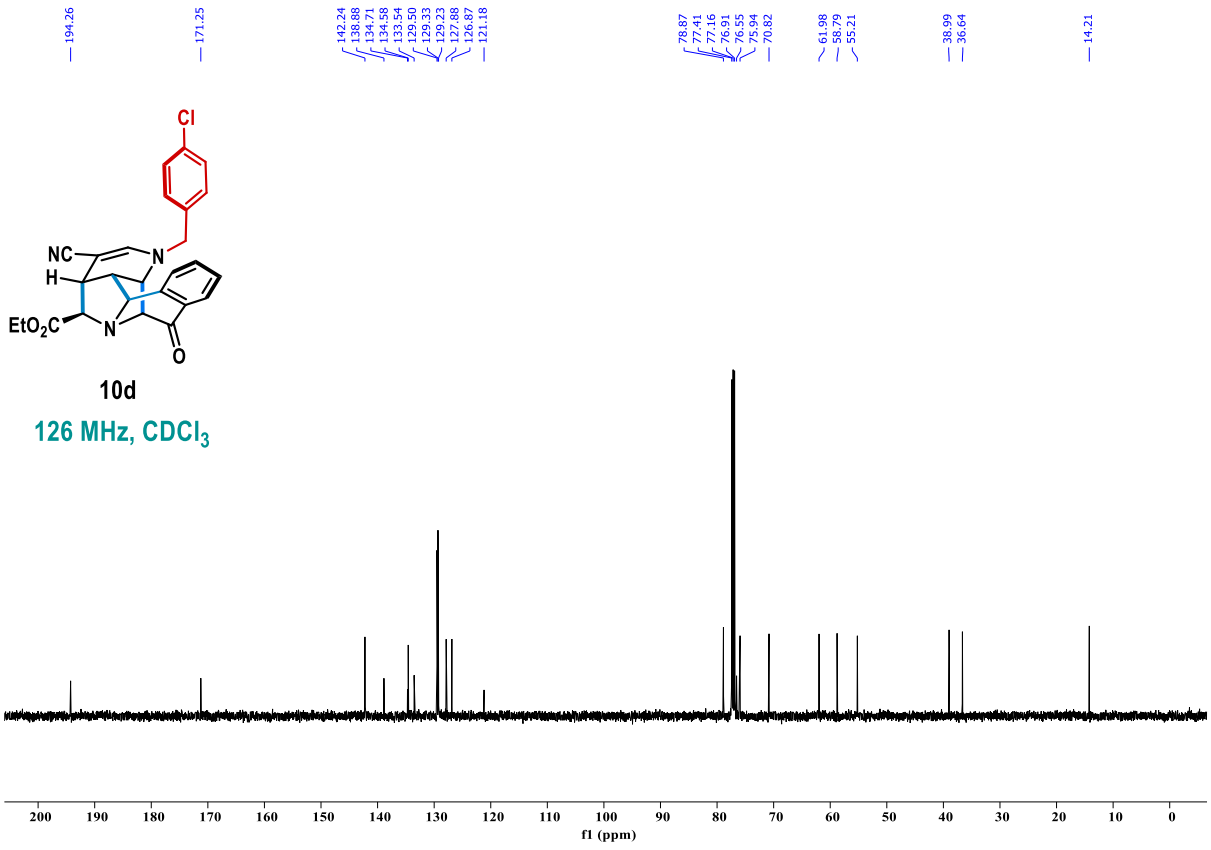

Me
NC
H
N
EtO2C
N
O
10c
500 MHz, CDCl3
f1 (ppm)

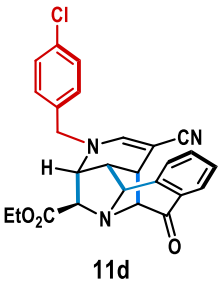

Me
NC
H
N
EtO2C
N
O
10c
126 MHz, CDCl3
f1 (ppm)


Me
CN
H
N
EtO2C
O
11c
400 MHz, CDCl3
f1 (ppm)


Me
CN
H
N
EtO2C
O
11c
101 MHz, CDCl3
f1 (ppm)

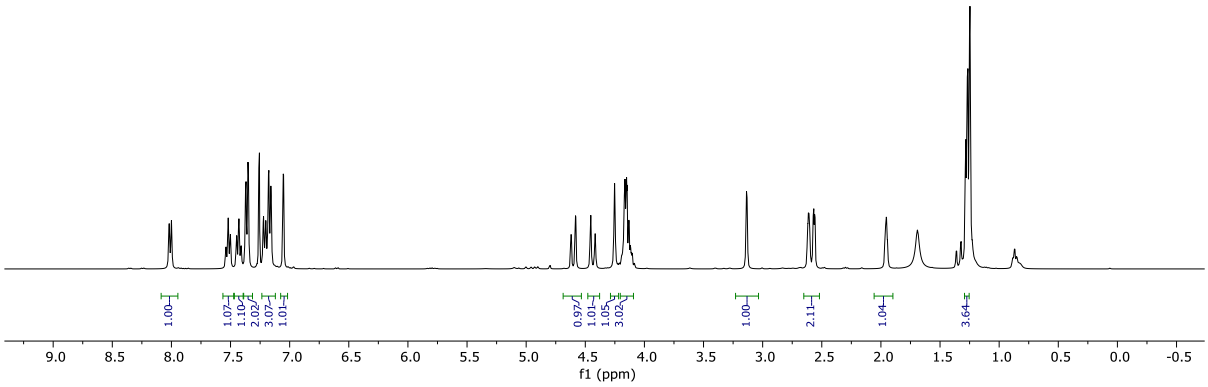

Cl
NC
H
N
EtO2C
N
O
10d
400 MHz, CDCl3
f1 (ppm)

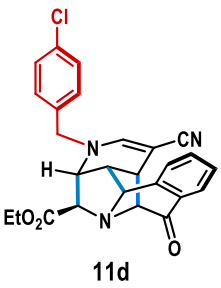

Cl
NC
H
N
EtO2C
N
O
10d
126 MHz, CDCl3
f1 (ppm)



11d

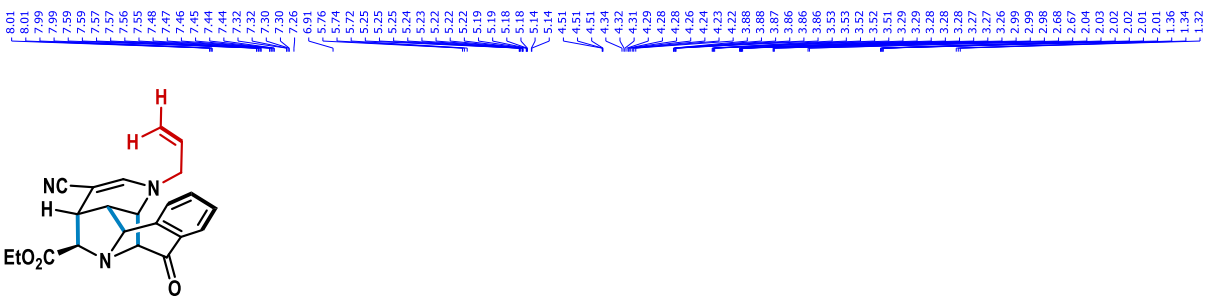
400 MHz, $CDCl_3$





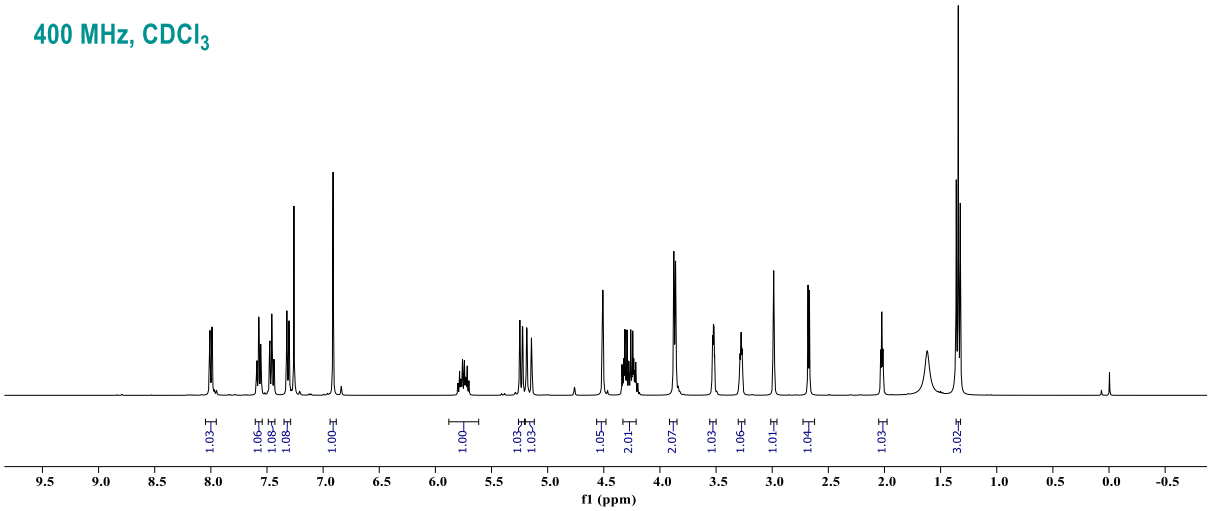
11d

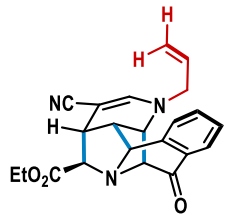
101 MHz, $CDCl_3$



10e

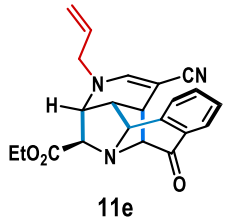
400 MHz, $CDCl_3$





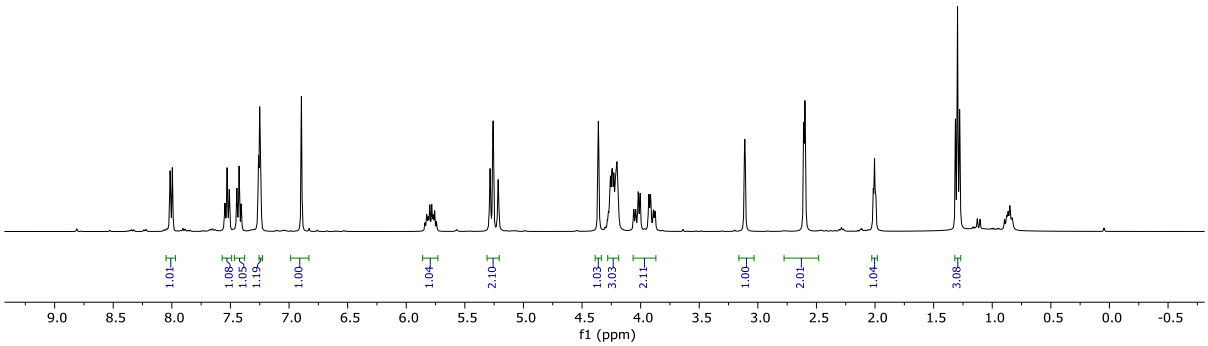
10e

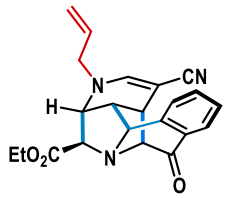
101 MHz, $CDCl_3$



11e

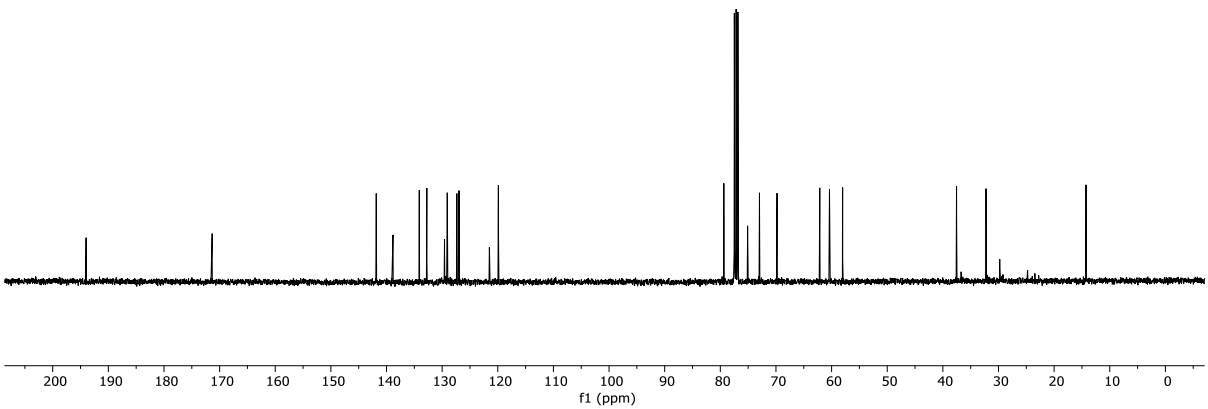
400 MHz, $CDCl_3$

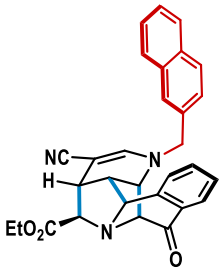




11e

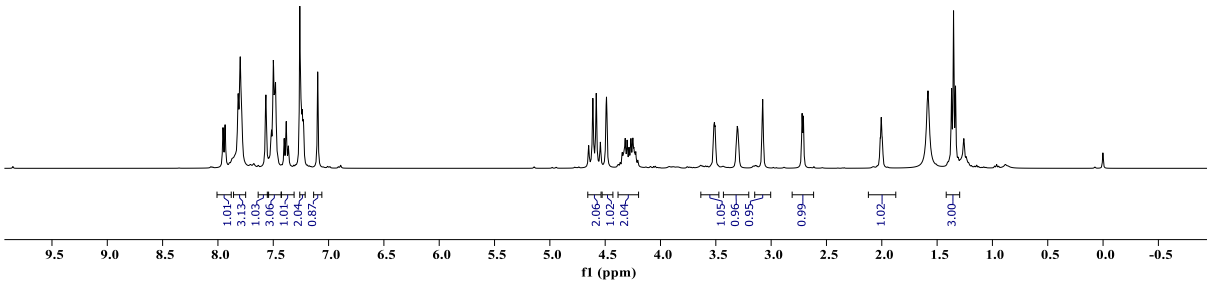
101 MHz, $CDCl_3$

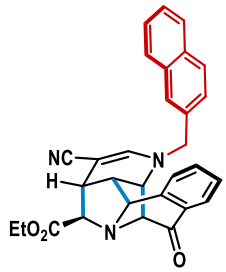




10f

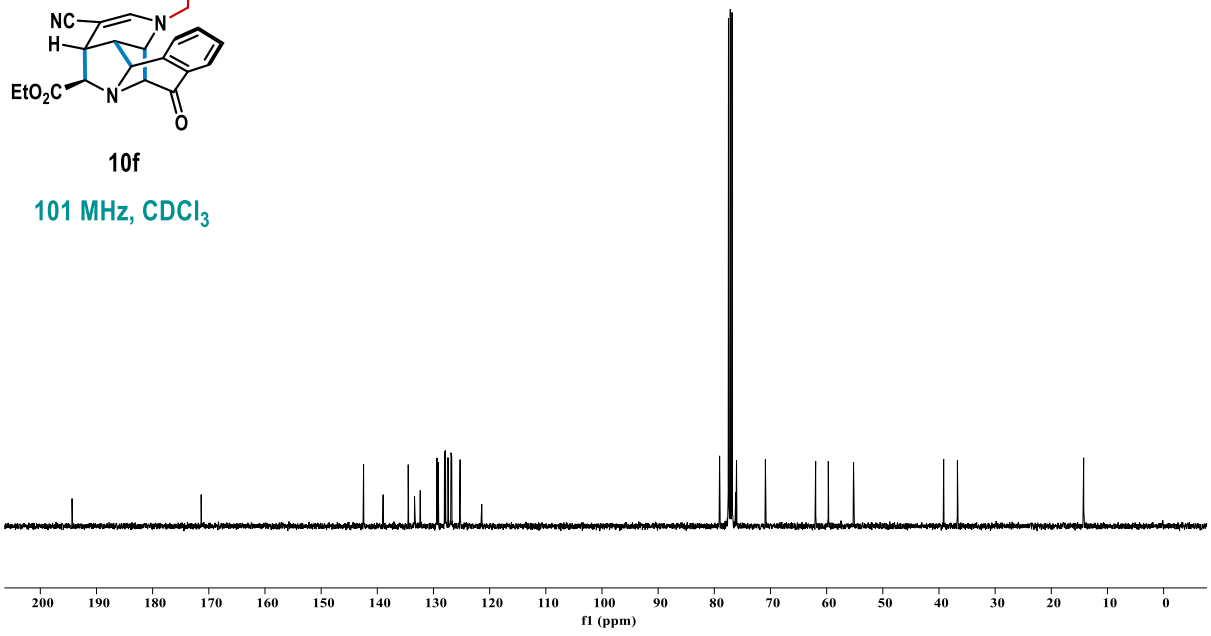
400 MHz, $CDCl_3$

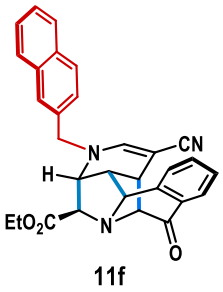




10f

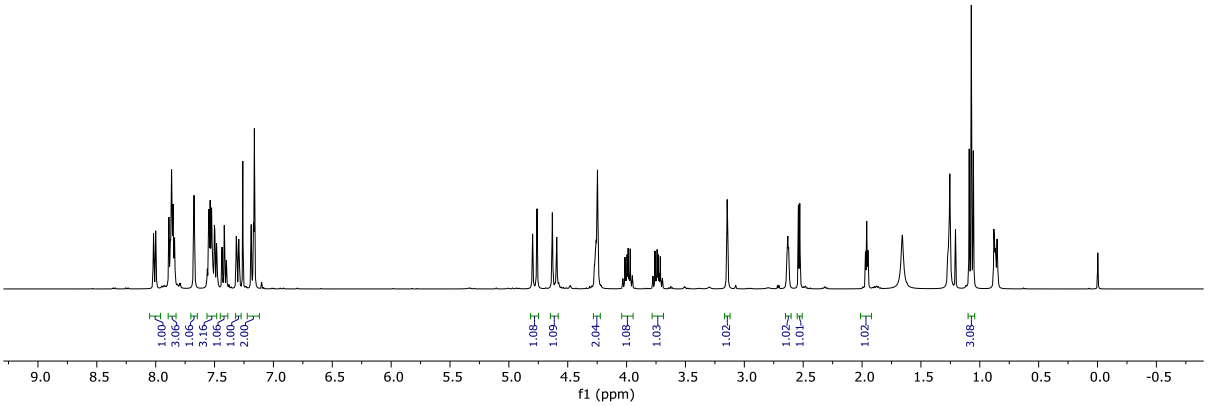
101 MHz, $CDCl_3$

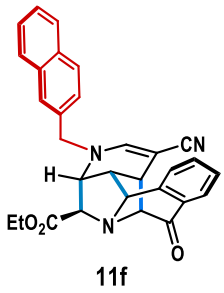




11f

400 MHz, $CDCl_3$





11f

101 MHz, $CDCl_3$