

Supporting Information

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1. General Information

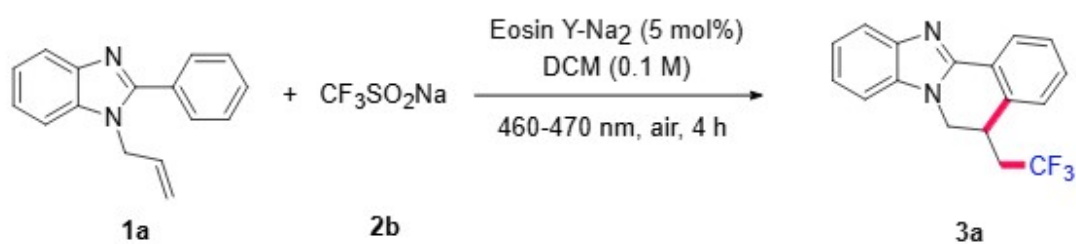
All solvents and reagents were purchased from commercial suppliers and used as received unless otherwise noted. ^1H and ^{13}C NMR spectra were recorded on Bruker Avance 400 spectrometers. Chemical shifts are reported in ppm relative to tetramethylsilane (TMS) as an internal standard. High-resolution mass spectra (HRMS) were acquired on a Shimadzu LCMS-9030 Q-TOF mass spectrometer. GC-MS analyses were performed on a Shimadzu GCMS-QP2010 SE. Melting points were measured on an X-4 microscope melting point apparatus and are uncorrected. Reaction progress was monitored by thin layer chromatography (TLC). Flash column chromatography was performed using silica gel (100–200 mesh). Blue LED irradiation (25 W, $\lambda_p = 465.4$ nm, $\Delta\lambda = 18.6$ nm) was carried out with a commercial LED source (Xuzhou Ai Jia Electronic Technology Co., Ltd.). The reaction vessel was positioned approximately 2 cm from the light source. Fans were used to maintain the reaction temperature at ambient conditions. All reactions were performed in standard borosilicate glass vials without the use of cut-off filters.

2. Synthetic Procedure for 1 mmol Scale Reaction Using Method A

A 25 mL borosilicate glass vial was charged with 1-allyl-2-phenyl-1H-benzo[d]imidazole (**1a**, 234 mg, 1.0 mmol, 1.0 equiv), Togni's reagent II (**2a**, 632 mg, 2.0 mmol, 2.0 equiv), and Eosin Y-Na₂ (19 mg, 0.03 mmol, 3 mol%). The vial was evacuated and backfilled with nitrogen (three cycles). Anhydrous CH₂Cl₂ (10 mL) was then added via syringe under a nitrogen atmosphere. The vial was sealed with a cap, and the mixture was stirred vigorously. The reaction vessel was positioned approximately 2 cm from a blue LED source (460–470 nm), with irradiation directed at the side of the vial. The reaction was stirred at room temperature for 8 h, and a fan was used to maintain ambient temperature. After completion (monitored by TLC), the reaction mixture was diluted with ethyl acetate (50 mL), washed with water (20 mL) and brine (20 mL), dried over anhydrous Na₂SO₄, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 4:1, v/v) to afford **3a** as a colorless oil (212 mg, 70% yield). The analytical data were consistent with those obtained for the 0.1 mmol scale reaction (see main text and general experimental section for details).

3. Screening Parameters for Method B (Langlois reagent)

Table S1 Reaction condition optimization for Method B



Entry	Variation of standard conditions	Yield (%) ^b
1	none	72
2	DCE, CH ₃ CN, EtOAc	58, 35, 40
3	in DCM (0.2 M)	59
4	Eosin Y	64
5	Riboflavin	45
6	[Ir(dtbbpy)(ppy) ₂] ₂ PF ₆	50
7	[Ir(dFppy) ₂ (dtbbpy)]PF ₆	41
8	Eosin Y-Na ₂ (3 mol%, 10 mol%)	60, 62
9	420-430 nm	55
10	450-460 nm	62
11	510-520 nm	53
12	for 3 h, 5 h	60, 70
13	w/o photocatalyst	N. R.
14	natural light	N. R.
15	in dark	N. R.
16	N ₂	trace

^a Reactions were performed with 0.1 mmol of **1a** and 0.3 mmol of **2b** in 1 mL of DCM (0.1 M) with 5 mol% eosin Y-Na₂ under 460-470 nm irradiation under air, for 4 h, unless noted otherwise. ^b Isolated yields. DCM = dichloromethane. N.R. = no reaction.

4. General Procedure for Radical Trapping Experiments

To a 10 mL borosilicate glass vial were added 1-allyl-2-phenyl-1H-benzo[d]imidazole (**1a**, 23.4 mg, 0.1 mmol), Eosin Y- Na_2 (1.9 mg for Method A; 3.2 mg for Method B), the corresponding radical scavenger (TEMPO, BHT, or 1,1-diphenylethylene, 2.0 equiv for Method A, 3.0 equiv for Method B), and anhydrous CH_2Cl_2 (1.0 mL). For Method A, Togni's reagent II (**2a**, 63.2 mg, 0.2 mmol) was added, and the vial was purged with nitrogen (three cycles) before sealing. For Method B, $\text{CF}_3\text{SO}_2\text{Na}$ (**2b**, 46.8 mg, 0.3 mmol) was added, and the vial was sealed without inert atmosphere protection. The mixture was stirred rapidly under irradiation with blue LEDs (460–470 nm, positioned approximately 2 cm from the vial) at room temperature for 4 h. The resulting mixture was analyzed directly by GC-MS (EI mode). The corresponding spectra are shown in Figures S1–S4.

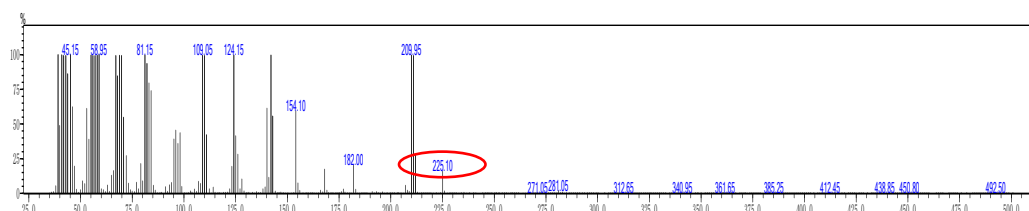


Figure S1 GC-MS spectra of the reaction mixture using TEMPO as a radical scavenger (Method A).

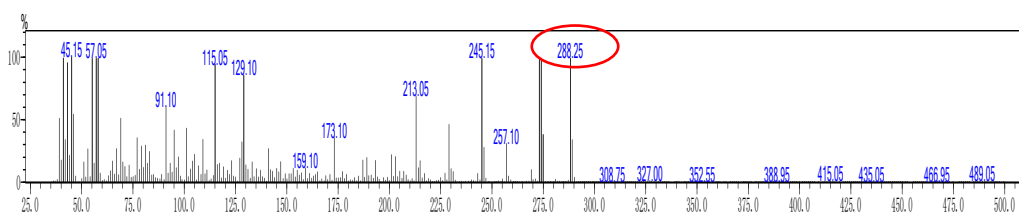


Figure S2 GC-MS spectra of the reaction mixture using BHT as a radical scavenger (Method A).

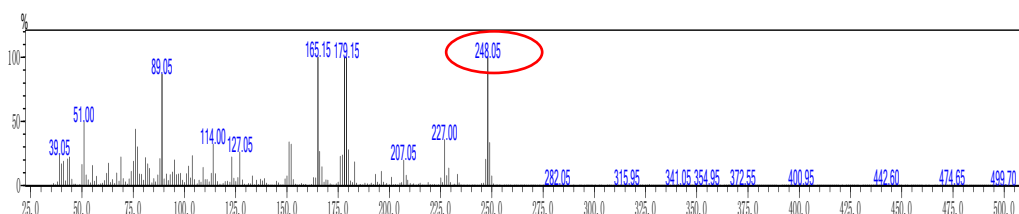


Figure S3 GC-MS spectra of the reaction mixture using DPE as a radical scavenger (Method A).

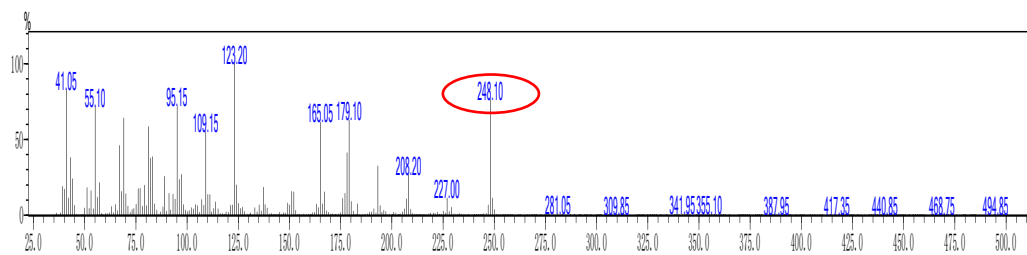


Figure S4 GC-MS spectra of the reaction mixture using DPE as a radical scavenger (Method B).

5. On/Off Light Experiment

Eight parallel reaction tubes were set up under the standard conditions (Method A) with 25 W blue LED irradiation. After 1 h, one tube was removed from the light source and worked up immediately for yield determination. The remaining seven tubes were kept stirring in the dark for an additional 1 h. After this period, a second tube was removed and analyzed. The remaining six tubes were then re-exposed to blue LED irradiation for another 1 h, and a third tube was taken for analysis. This on/off cycle was repeated until all eight tubes were processed. The results are shown in Figure S5.

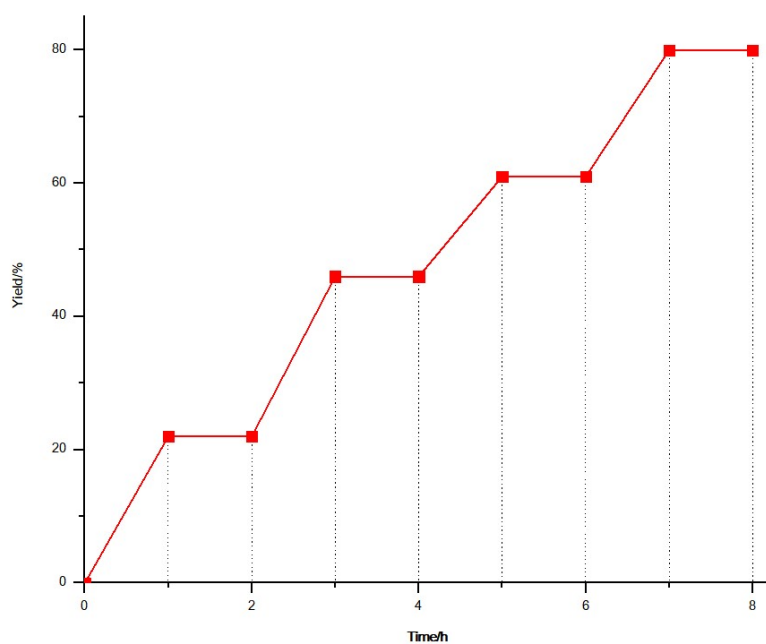
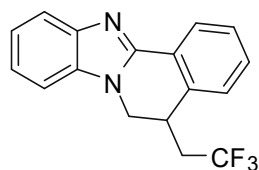


Figure S5 On/OFF experiment

6. Characterization Data of Products

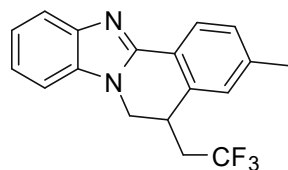
5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3a)



Togni: 24.2 mg, yield 80%; CF₃SO₂Na: 21.8 mg, yield 72%, colorless oil.

¹H NMR (400 MHz, CDCl₃) δ 8.36 – 8.34 (m, 1H), 7.89 – 7.87 (m, 1H), 7.54 – 7.47 (m, 2H), 7.43 – 7.38 (m, 2H), 7.37 – 7.34 (m, 2H), 4.59 (dd, *J* = 12.8, 2.0 Hz, 1H), 4.30 (dd, *J* = 13.2, 4.0 Hz, 1H), 3.68 – 3.65 (m, 1H), 2.47 – 2.33 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) δ 148.2, 143.9, 136.3, 134.8, 130.8, 128.8, 127.7, 126.2, 126.1 (q, ¹*J*_{C-F} = 276 Hz), 125.8, 123.2, 122.9, 119.9, 109.1, 43.7, 37.5 (q, ²*J*_{C-F} = 28 Hz), 33.3 (q, ³*J*_{C-F} = 2 Hz). ¹⁹F NMR (376 MHz, CDCl₃) δ -63.5. HRMS (ESI) *m/z*: [M+Na]⁺ Calcd for C₁₇H₁₃F₃N₂Na 325.0923; Found 325.0925.

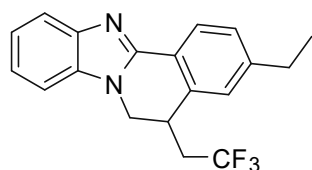
3-methyl-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3b)



Togni: 26.9 mg, yield 85%; CF₃SO₂Na: 20.5 mg, yield 65%, colorless oil.

¹H NMR (400 MHz, CDCl₃) δ 8.20 (d, *J* = 7.6 Hz, 1H), 7.82 – 7.85 (m, 1H), 7.39 – 7.35 (m, 1H), 7.32 – 7.30 (m, 2H), 7.30–7.28 (m, 1H), 7.17 (s, 1H), 4.55 (dd, *J* = 13.2, 2.0 Hz, 1H), 4.24 (dd, *J* = 12.8, 4.0 Hz, 1H), 3.60 – 3.57 (m, 1H), 2.43 (s, 3H), 2.39 – 2.28 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) δ 148.5, 143.9, 141.3, 136.4, 134.8, 129.6, 128.3, 126.2 (q, ¹*J*_{C-F} = 276 Hz), 126.1, 123.1, 123.0, 122.7, 119.8, 108.9, 43.6, 37.5 (q, ²*J*_{C-F} = 27 Hz), 33.4 (q, ³*J*_{C-F} = 3 Hz), 21.6. ¹⁹F NMR (376 MHz, CDCl₃) δ -63.6. HRMS (ESI) *m/z*: [M+Na]⁺ Calcd for C₁₈H₁₅F₃N₂Na 339.1080; Found 339.1077.

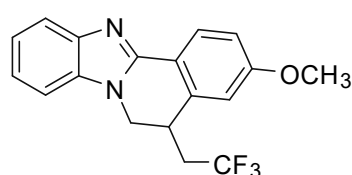
3-ethyl-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3c)



Togni: 27.4 mg, yield 82%; CF₃SO₂Na: 25.4 mg, yield 77%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 8.25 (dd, $J = 8.0, 1.6$ Hz, 1H), 7.87 – 7.85 (m, 1H), 7.39 – 7.38 (m, 1H), 7.36 – 7.31 (m, 3H), 7.21 (s, 1H), 4.57 (d, $J = 12.8$ Hz, 1H), 4.27 (d, $J = 12.4$ Hz, 1H), 3.63 – 3.61 (m, 1H), 2.78 – 2.72 (m, 2H), 2.43 – 2.29 (m, 2H), 1.34 – 1.28 (m, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 148.6, 147.6, 144.0, 136.5, 134.9, 128.4, 127.1, 126.203, 126.199 (q, $^1J_{\text{C-F}} = 276$ Hz), 123.3, 122.9, 122.7, 119.8, 109.0, 43.6, 37.5 (q, $^2J_{\text{C-F}} = 28$ Hz), 33.4 (q, $^3J_{\text{C-F}} = 3$ Hz), 29.0, 15.3. ^{19}F NMR (376 MHz, CDCl_3) δ -63.5. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{19}\text{H}_{17}\text{F}_3\text{N}_2\text{Na}$ 353.1236; Found 353.1233.

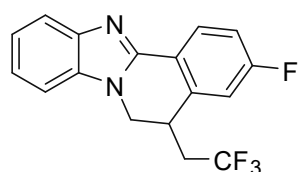
3-methoxy-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3d)



Togni: 25.2 mg, yield 76%; $\text{CF}_3\text{SO}_2\text{Na}$: 20.6 mg, yield 62%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 8.28 (d, $J = 8.8$ Hz, 1H), 7.86 – 7.82 (m, 1H), 7.38 – 7.35 (m, 1H), 7.33 – 7.30 (m, 2H), 7.05 – 7.02 (m, 1H), 6.89 (d, $J = 2.4$ Hz, 1H), 4.55 (dd, $J = 12.8, 2.0$ Hz, 1H), 4.24 (dd, $J = 12.8, 4.0$ Hz, 1H), 3.91 (s, 3H), 3.62 – 3.57 (m, 1H), 2.44 – 2.29 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 161.6, 148.6, 143.9, 138.3, 134.8, 128.0, 126.1 (q, $^1J_{\text{C-F}} = 276$ Hz), 122.7, 122.7, 119.5, 118.5, 114.1, 113.3, 108.8, 55.5, 43.6, 37.4 (q, $^2J_{\text{C-F}} = 28$ Hz), 33.6 (q, $^3J_{\text{C-F}} = 3$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -63.5. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{18}\text{H}_{15}\text{F}_3\text{N}_2\text{ONa}$ 355.1029; Found 355.1023.

3-fluoro-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3e)

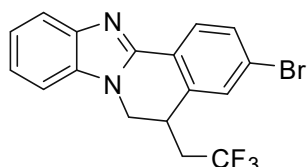


Togni: 24.9 mg, yield 78%; $\text{CF}_3\text{SO}_2\text{Na}$: 17.9 mg, yield 56%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 8.36 – 8.33 (m, 1H), 7.87-7.84 (m, 1H), 7.41 – 7.39 (m, 1H), 7.36 – 7.34 (m, 2H), 7.24 – 7.19 (m, 1H), 7.11 (dd, $J = 8.8, 2.4$ Hz, 1H), 4.57 (dd, $J = 13.2, 2.4$ Hz, 1H), 4.30 (dd, $J = 13.2, 4.0$ Hz, 1H), 3.66 – 3.63 (m, 1H), 2.48 – 2.30 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 163.9 (d, $^1J_{\text{C-F(F, Ar)}} = 251$ Hz), 147.6, 144.0, 138.7 (d, $^3J_{\text{C-F(F, Ar)}} = 7$ Hz), 134.8, 128.5 (d, $^3J_{\text{C-F(F, Ar)}} = 9$ Hz), 126.0 (q, $^1J_{\text{C-F}} = 276$ Hz), 123.2, 122.9, 122.3 (d, $^4J_{\text{C-F(F, Ar)}} = 3$ Hz), 119.9, 116.2

(d, $^2J_{C-F(Ar)} = 21$ Hz), 114.8 (d, $^2J_{C-F(Ar)} = 23$ Hz), 109.0, 43.6, 37.3 (q, $^2J_{C-F} = 28$ Hz), 33.4 (q, $^3J_{C-F} = 2$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -63.5, -108.2. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{17}\text{H}_{12}\text{F}_4\text{N}_2\text{Na}$ 343.0829; Found 343.0824.

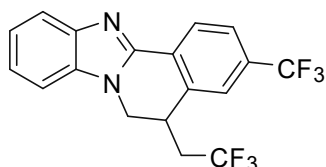
3-bromo-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline(3f)



Togni: 28.1 mg, yield 74%; $\text{CF}_3\text{SO}_2\text{Na}$: 19.4 mg, yield 51%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 8.21 (d, $J = 8.0$ Hz, 1H), 7.88 – 7.84 (m, 1H), 7.65 (dd, $J = 8.0, 1.6$ Hz, 1H), 7.56 (d, $J = 1.6$ Hz, 1H), 7.43 – 7.33 (m, 3H), 4.58 (dd, $J = 13.2, 2.0$ Hz, 1H), 4.29 (dd, $J = 12.8, 3.6$ Hz, 1H), 3.69 – 3.59 (m, 1H), 2.48 – 2.30 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 147.4, 144.0, 138.0, 134.8, 132.1, 130.8, 127.6, 126.0 (q, $^1J_{C-F} = 276$ Hz), 124.9, 124.8, 123.5, 123.1, 120.1, 109.1, 43.5, 37.3 (q, $^2J_{C-F} = 28$ Hz), 33.2 (q, $^3J_{C-F} = 3$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -63.5. HRMS (ESI) m/z : $[\text{M}+\text{H}]^+$ Calcd for $\text{C}_{17}\text{H}_{16}\text{N}_2\text{Na}$ 403.0028; Found 403.0032.

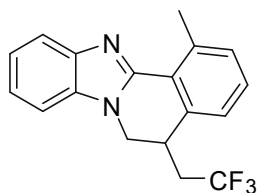
5-(2,2,2-trifluoroethyl)-3-(trifluoromethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3g)



Togni: 29.9 mg, yield 81%; $\text{CF}_3\text{SO}_2\text{Na}$: 19.2 mg, yield 52%, white solid, mp 101-102 °C.

^1H NMR (400 MHz, CDCl_3) δ 8.46 (d, $J = 8.4$ Hz, 1H), 7.90 – 7.88 (m, 1H), 7.77 (d, $J = 8.0$ Hz, 1H), 7.65 (s, 1H), 7.45 – 7.42 (m, 1H), 7.39 – 7.35 (m, 2H), 4.63 (dd, $J = 13.2, 2.0$ Hz, 1H), 4.33 (dd, $J = 13.2, 4.0$ Hz, 1H), 3.76 – 3.74 (m, 1H), 2.49 – 2.32 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 145.4 (q, $^1J_{C-F(CF_3,Ar)} = 271$ Hz), 136.7, 134.9, 132.3 (q, $^2J_{C-F(CF_3,Ar)} = 32$ Hz), 129.5, 129.2, 126.6, 125.9 (q, $^1J_{C-F(CF_3)} = 276$ Hz), 125.7 (q, $^3J_{C-F(CF_3,Ar)} = 4$ Hz), 124.8 (q, $^3J_{C-F(CF_3,Ar)} = 4$ Hz), 123.9, 123.6 (q, $^1J_{C-F(CF_3)} = 270$ Hz), 123.3, 120.4, 109.3, 43.6, 37.3 (q, $^2J_{C-F(CF_3)} = 28$ Hz), 33.4 (q, $^3J_{C-F(CF_3)} = 2$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -62.8, -63.4. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{18}\text{H}_{12}\text{F}_6\text{N}_2\text{Na}$ 393.0797; Found 393.0795

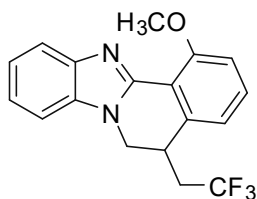
1-methyl-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3h)



Togni: 24.3 mg, yield 77%; $\text{CF}_3\text{SO}_2\text{Na}$: 22.4 mg, yield 71%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 7.88 (d, $J = 6.8$ Hz, 1H), 7.37 (d, $J = 7.2$ Hz, 1H), 7.34 – 7.29 (m, 4H), 7.19 (s, 1H), 4.53 (d, $J = 12.8$ Hz, 1H), 4.21 (d, $J = 12.8$ Hz, 1H), 3.56 (s, 1H), 2.97 (s, 3H), 2.22 – 2.15 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 148.4, 143.9, 139.1, 137.8, 134.1, 131.8, 129.8, 126.2 (q, $^1J_{\text{C-F}} = 276$ Hz), 125.5, 124.5, 123.2, 122.4, 120.2, 108.8, 43.2, 37.1 (q, $^2J_{\text{C-F}} = 28$ Hz), 34.5 (q, $^3J_{\text{C-F}} = 3$ Hz), 22.5. ^{19}F NMR (376 MHz, CDCl_3) δ -63.6. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{18}\text{H}_{15}\text{F}_3\text{N}_2\text{Na}$ 339.1080; Found 339.1080.

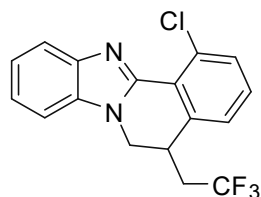
1-methoxy-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3i)



Togni: 19.9 mg, yield 60%; $\text{CF}_3\text{SO}_2\text{Na}$: 16.3 mg, yield 49%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 7.96 – 7.93 (m, 1H), 7.46 – 7.42 (m, 1H), 7.38 – 7.30 (m, 3H), 7.08 (d, $J = 8.0$ Hz, 1H), 6.99 (d, $J = 7.6$ Hz, 1H), 4.56 (dd, $J = 13.2, 2.0$ Hz, 1H), 4.24 (dd, $J = 13.2, 3.6$ Hz, 1H), 4.10 (s, 3H), 3.61 – 3.58 (m, 1H), 2.27 – 2.22 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 158.2, 146.1, 144.1, 139.2, 133.9, 131.5, 126.1 (q, $^1J_{\text{C-F}} = 277$ Hz), 123.2, 122.3, 120.6, 119.9, 114.8, 111.6, 108.5, 56.4, 43.2, 36.9 (q, $^2J_{\text{C-F}} = 27$ Hz), 34.4 (q, $^3J_{\text{C-F}} = 3$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -63.6. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{18}\text{H}_{15}\text{F}_3\text{N}_2\text{ONa}$ 355.1029; Found 355.1029

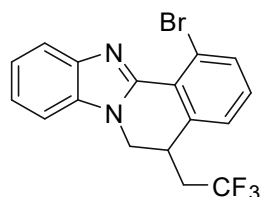
1-chloro-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3j)



Togni: 25.5 mg, yield 76%; $\text{CF}_3\text{SO}_2\text{Na}$: 21.2 mg, yield 63%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 7.99 (d, $J = 7.2$ Hz, 1H), 7.58 (d, $J = 7.2$ Hz, 1H), 7.40 – 7.37 (m, 3H), 7.36 – 7.34 (m, 1H), 7.31 (d, $J = 7.2$ Hz, 1H), 4.58 (dd, $J = 13.2, 1.6$ Hz, 1H), 4.29 (dd, $J = 13.2, 3.6$ Hz, 1H), 3.63 (s, 1H), 2.26 – 2.16 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 145.4, 143.7, 139.5, 134.0, 133.3, 131.8, 130.6, 126.5, 126.0 (q, $^1J_{\text{C-F}} = 276$ Hz), 124.2, 123.8, 122.8, 120.9, 108.8, 43.2, 36.8 (q, $^2J_{\text{C-F}} = 28$ Hz), 34.7 (q, $^3J_{\text{C-F}} = 3$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -63.5. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{17}\text{H}_{12}\text{ClF}_3\text{N}_2\text{Na}$ 359.0533; Found 359.0534.

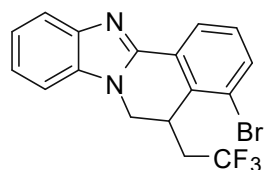
1-bromo-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3k)



Togni: 28.1 mg, yield 74%; $\text{CF}_3\text{SO}_2\text{Na}$: 23.6 mg, yield 62%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 7.97 (d, $J = 8.4$ Hz, 1H), 7.78 (d, $J = 8.0$, 1H), 7.39 – 7.36 (m, 2H), 7.34 (d, $J = 7.6$ Hz, 2H), 7.28 – 7.24 (m, 2H), 4.56 (dd, $J = 13.2, 2.0$ Hz, 1H), 4.26 (dd, $J = 13.2, 3.6$ Hz, 1H), 3.59 (s, 1H), 2.16 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 145.9, 143.4, 139.7, 135.4, 134.1, 130.7, 127.3, 126.0 (q, $^1J_{\text{C-F}} = 276$ Hz), 125.9, 123.8, 122.8, 121.5, 121.0, 108.8, 43.1, 36.8 (q, $^2J_{\text{C-F}} = 28$ Hz), 34.8 (q, $^3J_{\text{C-F}} = 2$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -63.5. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{17}\text{H}_{12}\text{BrF}_3\text{N}_2\text{Na}$ 403.0028; Found 403.0030.

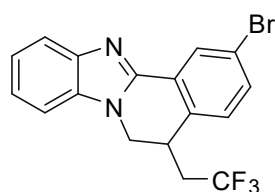
2-bromo-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3l)



Togni: 14.4 mg, yield 38%; $\text{CF}_3\text{SO}_2\text{Na}$: 12.9 mg, yield 34%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 8.51 (d, $J = 2.0$ Hz, 1H), 7.89 – 7.84 (m, 1H), 7.60 (dd, $J = 8.0, 2.0$ Hz, 1H), 7.43 – 7.39 (m, 1H), 7.39 – 7.34 (m, 2H), 7.29 – 7.28 (m, 1H), 4.58 (dd, $J = 12.8, 2.0$ Hz, 1H), 4.29 (dd, $J = 12.8, 4.0$ Hz, 1H), 3.67 – 3.62 (m, 1H), 2.46 – 2.35 (m, 1H), 2.34 – 2.26 (m, 1H). ^{13}C NMR (100 MHz, CDCl_3) δ 146.9, 143.9, 134.9, 134.8, 133.6, 129.4, 129.0, 127.7, 126.0 (q, $^1J_{\text{C-F}} = 276$ Hz) 123.6, 123.2, 122.8, 120.2, 109.2, 43.7, 37.4 (q, $^2J_{\text{C-F}} = 28$ Hz), 33.0 (q, $^3J_{\text{C-F}} = 3$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -63.4. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{17}\text{H}_{12}\text{BrF}_3\text{N}_2\text{Na}$ 403.0028; Found 403.0034.

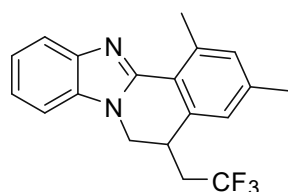
2-bromo-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3m)



Togni: 14.4 mg, yield 38%; $\text{CF}_3\text{SO}_2\text{Na}$: 12.9 mg, yield 34%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 8.32 (d, $J = 8.0$ Hz, 1H), 7.88 – 7.82 (m, 1H), 7.70 (d, $J = 7.6$ Hz, 1H), 7.46 – 7.40 (m, 1H), 7.39 – 7.30 (m, 3H), 4.73 (d, $J = 13.2$ Hz, 1H), 4.20 (dd, $J = 13.6, 4.0$ Hz, 1H), 4.10 (dd, $J = 9.4, 5.4$ Hz, 1H), 2.34 – 2.22 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 147.3, 144.1, 135.5, 134.8, 134.7, 130.0, 128.1, 126.0 (q, $^1J_{\text{C-F}} = 277$ Hz), 125.4, 123.6, 123.4, 123.1, 120.1, 109.3, 42.3, 34.5 (q, $^2J_{\text{C-F}} = 28$ Hz), 33.2 (q, $^3J_{\text{C-F}} = 2$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -63.5. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{17}\text{H}_{12}\text{BrF}_3\text{N}_2\text{Na}$ 403.0028; Found 403.0024.

1,3-dimethyl-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3n)



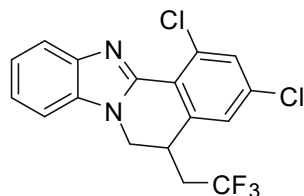
Togni: 25.8 mg, yield 78%; $\text{CF}_3\text{SO}_2\text{Na}$: 20.8 mg, yield 63%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 7.91 – 7.89 (m, 1H), 7.40 – 7.36 (m, 1H), 7.35 – 7.30 (m, 2H), 7.16 (s, 1H), 7.04 (s, 1H), 4.56 (dd, $J = 12.8, 1.6$ Hz, 1H), 4.21 (dd, $J = 12.8, 3.2$ Hz, 1H), 3.54 (s, 1H), 2.97 (s, 3H), 2.41 (s, 3H), 2.29 – 2.18 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 148.7, 143.9, 140.1, 139.0, 137.9, 134.1, 132.5, 127.2 (q, $^1J_{\text{C-F}} = 276$ Hz), 126.2, 122.9, 122.3, 121.8, 120.0, 108.7, 43.2,

37.1 (q, $^2J_{C-F}$ = 27 Hz), 34.5 (q, $^3J_{C-F}$ = 3 Hz), 22.4, 21.3. ^{19}F NMR (376 MHz, CDCl_3) δ -63.6.

HRMS (ESI) m/z: $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{19}\text{H}_{17}\text{F}_3\text{N}_2\text{Na}$ 353.1236; Found 353.1233.

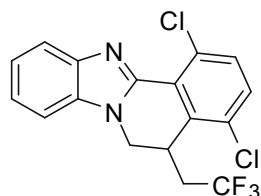
1,3-dichloro-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3o)



Togni: 23.7 mg, yield 64%; $\text{CF}_3\text{SO}_2\text{Na}$: 18.1 mg, yield 49%, white solid, mp 194-195 °C.

^1H NMR (400 MHz, CDCl_3) δ 7.96 – 7.94 (m, 1H), 7.57 (d, J = 2.0 Hz, 1H), 7.37 – 7.36 (m, 2H), 7.35 – 7.30 (m, 2H), 4.55 (dd, J = 13.2, 1.6 Hz, 1H), 4.25 (dd, J = 13.2, 3.2 Hz, 1H), 3.57 (s, 1H), 2.24 – 2.14 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 144.7, 143.7, 140.5, 135.7, 134.2, 133.9, 131.5, 125.8 (q, $^1J_{C-F}$ = 275 Hz), 126.8, 124.1, 123.0, 122.9, 121.0, 108.8, 43.0, 36.6 (q, $^2J_{C-F}$ = 29 Hz), 34.7 (q, $^3J_{C-F}$ = 3 Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -63.5. HRMS (ESI) m/z: $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{17}\text{H}_{11}\text{Cl}_2\text{F}_3\text{N}_2\text{Na}$ 393.0144; Found 393.0140.

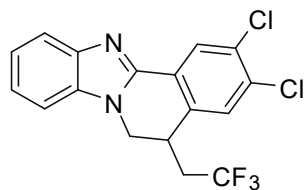
1,4-dichloro-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3p)



Togni: 25.2 mg, yield 68%; $\text{CF}_3\text{SO}_2\text{Na}$: 23.7 mg, yield 64%, white solid, mp 175-176 °C.

^1H NMR (400 MHz, CDCl_3) δ 7.96 (d, J = 8.0 Hz, 1H), 7.52 – 7.50 (m, 1H), 7.43 – 7.40 (m, 2H), 7.38 – 7.33 (m, 2H), 4.70 (d, J = 13.6 Hz, 1H), 4.22 – 4.12 (m, 2H), 2.26 – 2.13 (m, 1H), 2.07 – 1.98 (m, 1H). ^{13}C NMR (100 MHz, CDCl_3) δ 144.7, 143.7, 136.8, 133.8, 132.4, 131.9, 131.4, 131.2, 126.1, 125.9 (q, $^1J_{C-F}$ = 277 Hz), 124.2, 123.1, 121.0, 109.0, 41.8, 33.8 (q, $^2J_{C-F}$ = 28 Hz), 31.7 (q, $^3J_{C-F}$ = 3 Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -63.5. HRMS (ESI) m/z: $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{17}\text{H}_{11}\text{Cl}_2\text{F}_3\text{N}_2\text{Na}$ 393.0144; Found 393.0141.

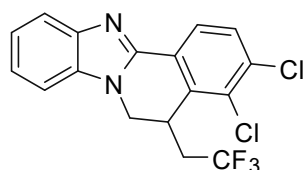
2,3-dichloro-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline(3q)



Togni: 12.9 mg, yield 35%; CF₃SO₂Na: 11.1 mg, yield 30%, white solid, mp 200-201 °C.

¹H NMR (400 MHz, CDCl₃) δ 8.44 (s, 1H), 7.87 – 7.85 (m, 1H), 7.50 (s, 1H), 7.42 – 7.39 (m, 1H), 7.38 – 7.34 (m, 2H), 4.57 (dd, *J* = 13.1, 2.3 Hz, 1H), 4.29 (dd, *J* = 13.1, 4.1 Hz, 1H), 3.66 – 3.63 (m, 1H), 2.47 – 2.29 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) δ 146.3, 143.9, 135.6, 134.8, 134.6, 133.5, 129.7, 127.8, 125.9 (q, ¹*J*_{C-F} = 276 Hz), 125.8, 123.8, 123.3, 120.2, 109.2, 43.6, 37.3 (q, ²*J*_{C-F} = 28 Hz), 32.8 (q, ³*J*_{C-F} = 2 Hz). ¹⁹F NMR (376 MHz, CDCl₃) δ -63.4. HRMS (ESI) *m/z*: [M+Na]⁺ Calcd for C₁₇H₁₁Cl₂F₃N₂Na 393.0144; Found 393.0140.

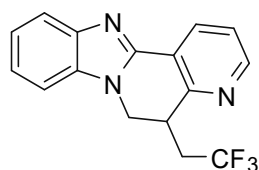
3,4-dichloro-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3r)



Togni: 12.9 mg, yield 35%; CF₃SO₂Na: 11.1 mg, yield 30%, white solid, mp 200-201 °C.

¹H NMR (400 MHz, CDCl₃) δ 8.22 (d, *J* = 8.4 Hz, 1H), 7.85 – 7.81 (m, 1H), 7.60 (d, *J* = 8.4 Hz, 1H), 7.42 – 7.40 (m, 1H), 7.38 – 7.33 (m, 2H), 4.72 (d, *J* = 12.0 Hz, 1H), 4.21 – 4.15 (m, 2H), 2.33 – 2.23 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) δ 146.7, 144.1, 135.8, 135.4, 134.8, 131.5, 130.6, 126.2, 125.9 (q, ¹*J*_{C-F} = 276 Hz), 125.1, 123.8, 123.3, 120.2, 109.3, 42.4, 34.5 (q, ²*J*_{C-F} = 28 Hz), 31.5 (q, ³*J*_{C-F} = 3 Hz). ¹⁹F NMR (376 MHz, CDCl₃) δ -63.5. HRMS (ESI) *m/z*: [M+Na]⁺ Calcd for C₁₇H₁₁Cl₂F₃N₂Na 393.0144; Found 393.0138.

5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-f][1,6]naphthyridine (3s)

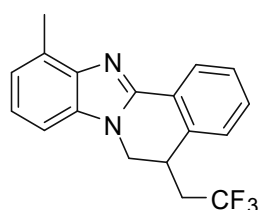


Togni: 19.1 mg, yield 63%; CF₃SO₂Na: 16.1 mg, yield 53%, colorless oil.

¹H NMR (400 MHz, CDCl₃) δ 8.65 – 8.64 (m, 1H), 8.57 (d, *J* = 8.0 Hz, 1H), 7.84 (d, *J* = 7.2 Hz,

1H), 7.43 – 7.41 (m, 2H), 7.38 – 7.32 (m, 2H), 4.63 (dd, $J = 12.8, 5.2$ Hz, 1H), 4.38 – 4.33 (m, 1H), 3.85 (d, $J = 5.2$ Hz, 1H), 3.39 (t, $J = 12.8$ Hz, 1H), 2.45 – 2.36 (m, 1H). ^{13}C NMR (100 MHz, CDCl_3) δ 154.4, 150.6, 147.0, 144.1, 134.6, 133.2, 125.8(q, $^1J_{\text{C-F}} = 270$ Hz), 123.7, 123.6, 123.1, 122.4, 120.1, 109.4, 43.4, 35.3 (q, $^3J_{\text{C-F}} = 2$ Hz), 34.4 (q, $^2J_{\text{C-F}} = 28$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -63.3. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{16}\text{H}_{12}\text{F}_3\text{N}_3\text{Na}$ 326.0876; Found 326.0867.

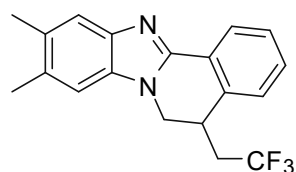
11-methyl-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3t)



Togni: 24.9 mg, yield 79%; $\text{CF}_3\text{SO}_2\text{Na}$: 20.5 mg, yield 65%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 8.40 (d, $J = 6.8$ Hz, 1H), 7.48 – 7.44 (m, 2H), 7.36 (d, $J = 6.8$ Hz, 1H), 7.26 – 7.21 (m, 2H), 7.14 – 7.11 (m, 1H), 4.53 (dd, $J = 13.2, 1.6$ Hz, 1H), 4.26 (dd, $J = 12.8, 3.6$ Hz, 1H), 3.63 – 3.62 (m, 1H), 2.75 (s, 3H), 2.39 – 2.27 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 147.5, 142.9, 136.3, 134.4, 130.7, 130.1, 128.8, 127.7, 126.4, 126.1 (q, $^1J_{\text{C-F}} = 276$ Hz), 125.8, 123.4, 123.2, 106.5, 43.8, 37.4 (q, $^2J_{\text{C-F}} = 28$ Hz), 33.3 (q, $^3J_{\text{C-F}} = 2$ Hz), 16.9. ^{19}F NMR (376 MHz, CDCl_3) δ -63.5. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{18}\text{H}_{15}\text{F}_3\text{N}_2\text{Na}$ 339.1080; Found 339.1074.

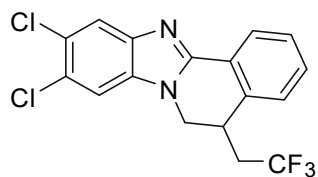
9,10-dimethyl-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3u)



Togni: 28.1 mg, yield 85%; $\text{CF}_3\text{SO}_2\text{Na}$: 23.8 mg, yield 72%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 8.28 (dd, $J = 7.6, 1.6$ Hz, 1H), 7.61 (s, 1H), 7.49 – 7.41 (m, 2H), 7.34 (d, $J = 7.2$ Hz, 1H), 7.14 (s, 1H), 4.50 (dd, $J = 13.2, 2.0$ Hz, 1H), 4.22 (dd, $J = 12.8, 4.0$ Hz, 1H), 3.62 – 3.59 (m, 1H), 2.42 (s, 3H), 2.40 (s, 3H), 2.36 – 2.23 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 147.5, 142.4, 136.1, 133.4, 132.6, 131.9, 130.4, 128.8, 127.7, 126.2 (q, $^1J_{\text{C-F}} = 276$ Hz), 126.1, 126.0, 120.0, 109.3, 43.6, 37.5 (q, $^2J_{\text{C-F}} = 28$ Hz), 33.4 (q, $^3J_{\text{C-F}} = 3$ Hz), 20.6, 20.4. ^{19}F NMR (376 MHz, CDCl_3) δ -63.5. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{19}\text{H}_{17}\text{F}_3\text{N}_2\text{Na}$ 353.1236; Found 353.1229.

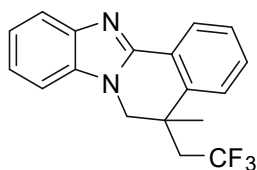
9,10-dichloro-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3v)



Togni:30.3 mg, yield 82%; $\text{CF}_3\text{SO}_2\text{Na}$: 22.6mg, yield 61%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 8.27 – 8.24 (m, 1H), 7.89 (s, 1H), 7.51 – 7.48 (m, 2H), 7.47 (s, 1H), 7.39 – 7.36 (m, 1H), 4.47 (dd, $J = 13.2, 2.4$ Hz, 1H), 4.26 (dd, $J = 12.8, 4.0$ Hz, 1H), 3.68 – 3.63 (m, 1H), 2.38 – 2.28 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 150.1, 143.4, 136.3, 134.2, 131.5, 129.0, 127.8, 127.2, 126.9, 126.4, 126.0 (q, $^1J_{\text{C-F}} = 276$ Hz), 125.2, 121.0, 110.4, 43.9, 37.5 (q, $^2J_{\text{C-F}} = 28$ Hz), 33.2 (q, $^3J_{\text{C-F}} = 3$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -63.4. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{17}\text{H}_{11}\text{Cl}_2\text{F}_3\text{N}_2\text{Na}$ 393.0144; Found 393.0140.

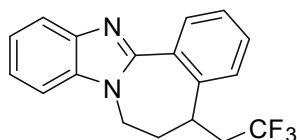
5-methyl-5-(2,2,2-trifluoroethyl)-5,6-dihydrobenzo[4,5]imidazo[2,1-a]isoquinoline (3w)



Togni:22.4 mg, yield 71%; $\text{CF}_3\text{SO}_2\text{Na}$: 16.4mg, yield 52%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 8.39 (dd, $J = 6.8, 1.6$ Hz, 1H), 7.89 – 7.87 (m, 1H), 7.54 – 7.48 (m, 3H), 7.41 – 7.40 (m, 1H), 7.35 – 7.33 (m, 2H), 4.50 (d, $J = 12.8$ Hz, 1H), 4.01 (d, $J = 12.8$ Hz, 1H), 2.43 – 2.29 (m, 2H), 1.77 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 156.8, 148.4, 143.8, 140.7, 134.6, 130.9, 128.4, 126.3, 126.0 (q, $^1J_{\text{C-F}} = 277$ Hz), 125.3, 124.8, 123.1, 122.8, 119.9, 109.1, 49.4, 41.6 (q, $^2J_{\text{C-F}} = 27$ Hz), 36.3 (q, $^4J_{\text{C-F}} = 1$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -59.6. HRMS (ESI) m/z : $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{18}\text{H}_{15}\text{F}_3\text{N}_2\text{Na}$ 339.1080; Found 339.1074

5-(2,2,2-trifluoroethyl)-6,7-dihydro-5H-benzo[c]benzo[4,5]imidazo[1,2-a]azepine (3x)



Togni:22.4mg, yield 71%; $\text{CF}_3\text{SO}_2\text{Na}$: 14.5mg, yield 46%, colorless oil.

^1H NMR (400 MHz, CDCl_3) δ 8.04 – 7.99 (m, 1H), 7.91 – 7.86 (m, 1H), 7.50 – 7.45 (m, 2H), 7.42-7.38 (m, 1H), 7.34 – 7.30 (m, 3H), 4.27 – 4.16 (m, 1H), 4.06 – 3.96 (m, 1H), 3.38 – 3.27 (m, 1H),

2.77 – 2.66 (m, 1H), 2.42 – 2.18 (m, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 153.3, 143.2, 139.3, 134.9, 130.4, 130.3, 130.2, 127.9, 127.1, 126.3(q, $^1J_{\text{C-F}} = 276$ Hz), 122.7, 122.3, 120.1, 108.9, 40.6, 38.1(q, $^2J_{\text{C-F}} = 28$ Hz), 36.10, 35.0(q, $^3J_{\text{C-F}} = 3$ Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -63.7. HRMS (ESI) m/z: $[\text{M}+\text{Na}]^+$ Calcd for $\text{C}_{18}\text{H}_{15}\text{F}_3\text{N}_2\text{Na}$ 339.1080; Found 339.1091

7. Copies of NMR Spectra of Products

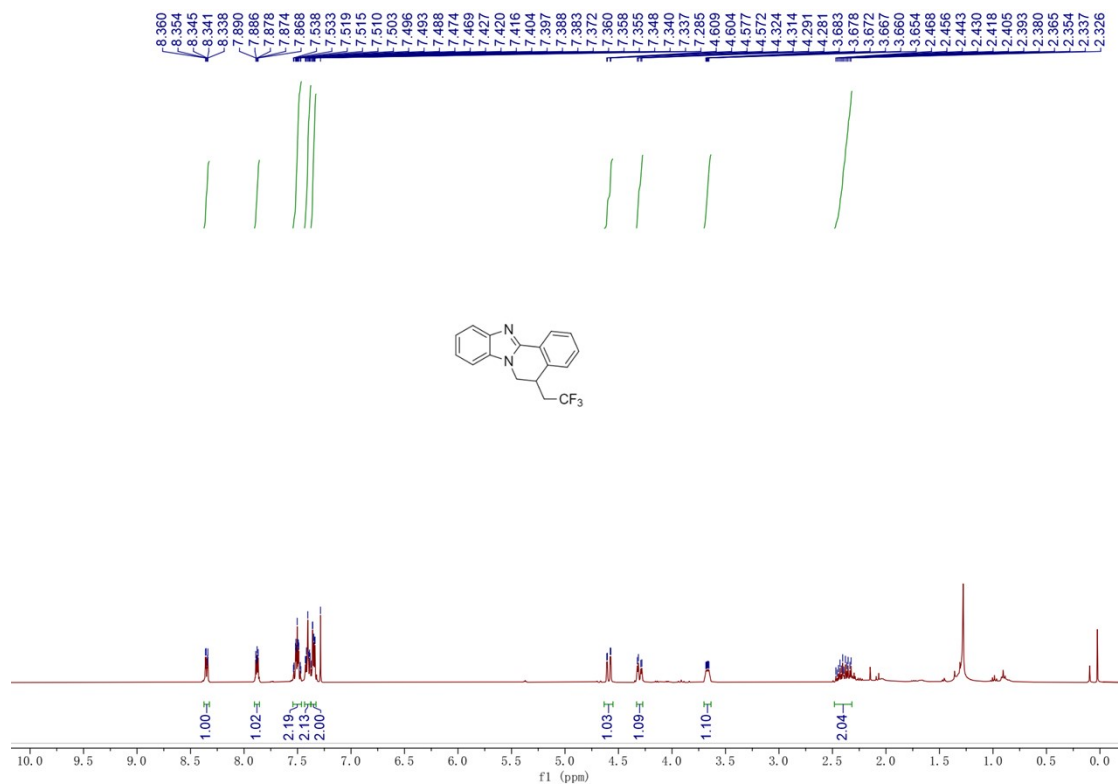


Figure S6 ^1H NMR spectrum of **3a** (400 MHz, CDCl_3)

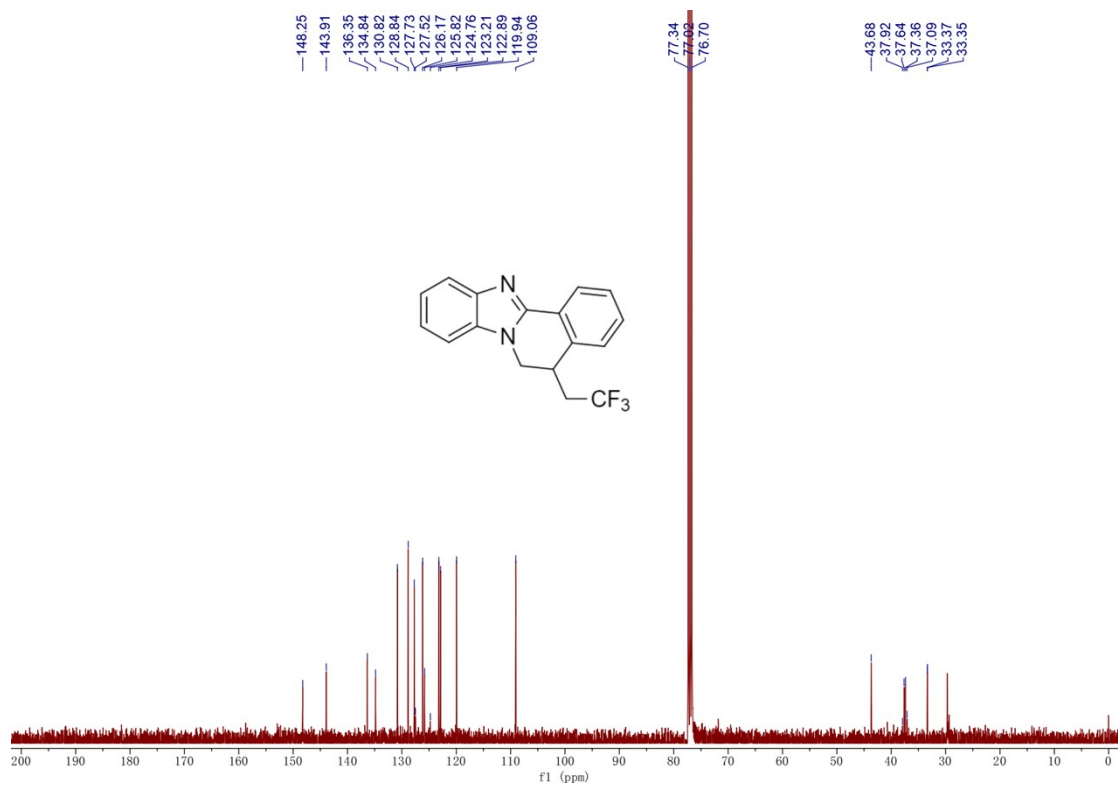


Figure S7 ^{13}C NMR spectrum of **3a** (100 MHz, CDCl_3)

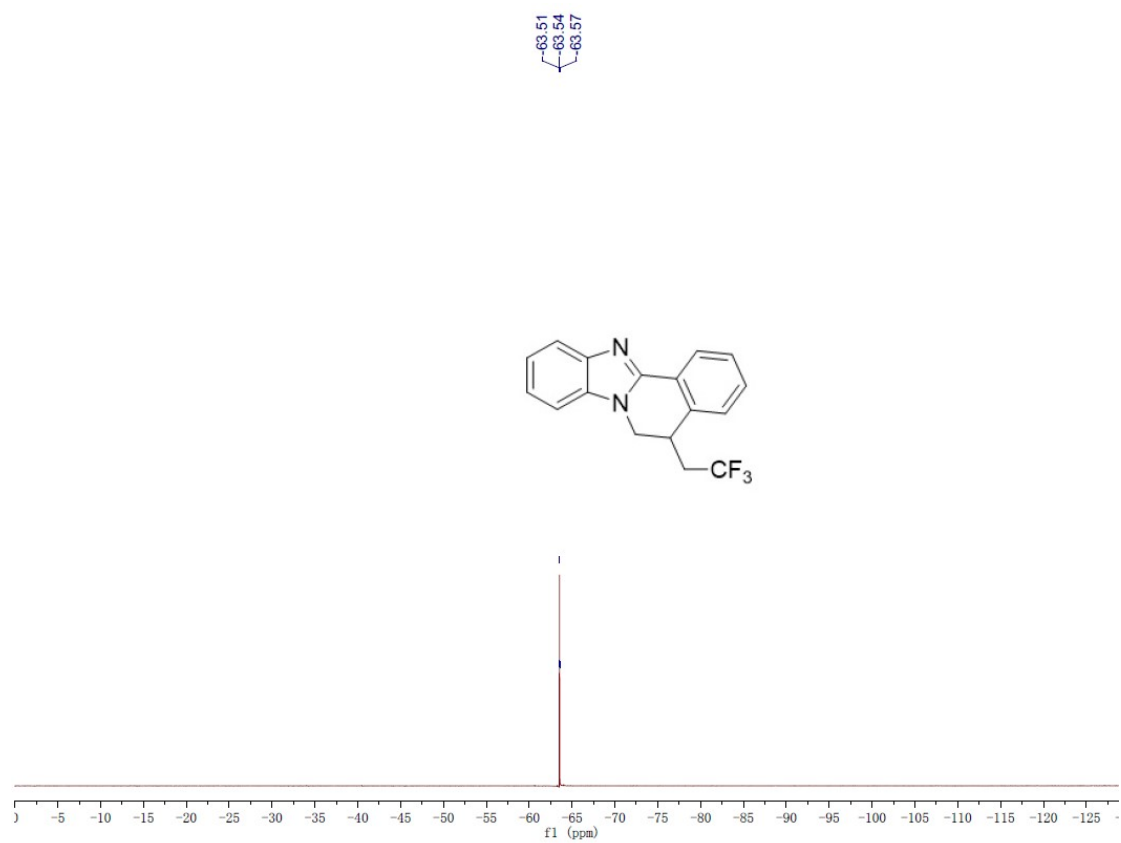


Figure S8 ^{19}F NMR spectrum of **3a** (376 MHz, CDCl_3)

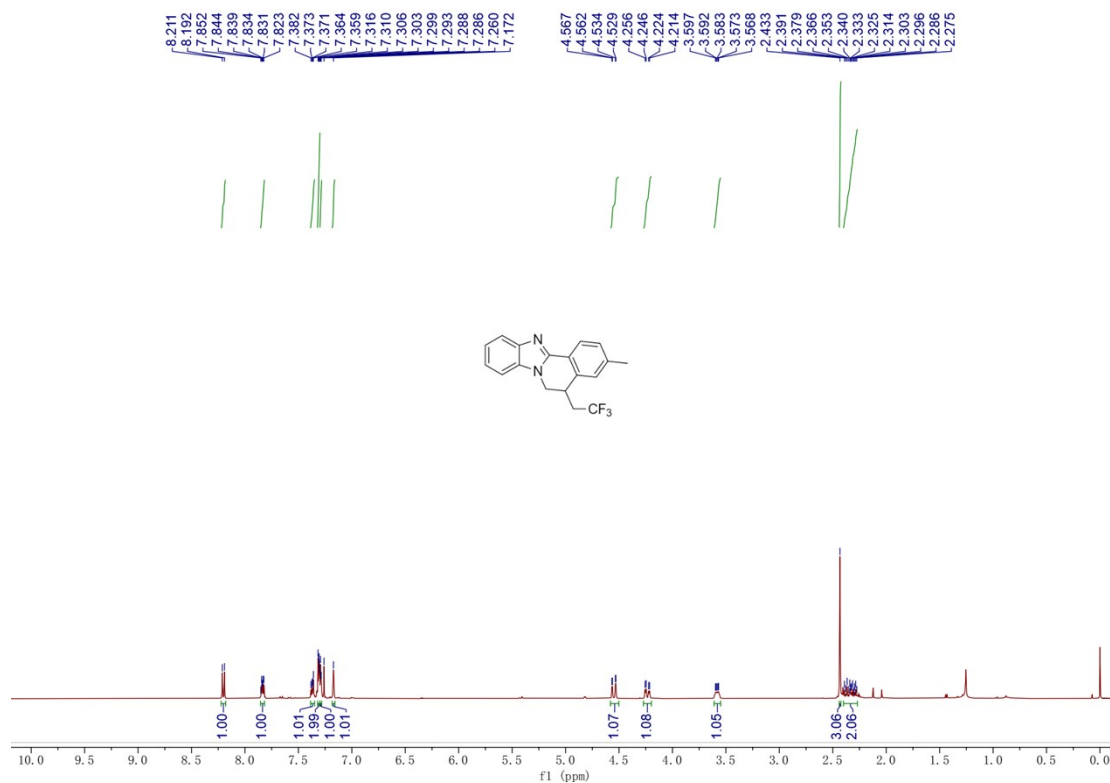


Figure S9 ¹H NMR spectrum of **3b** (400 MHz, CDCl₃)

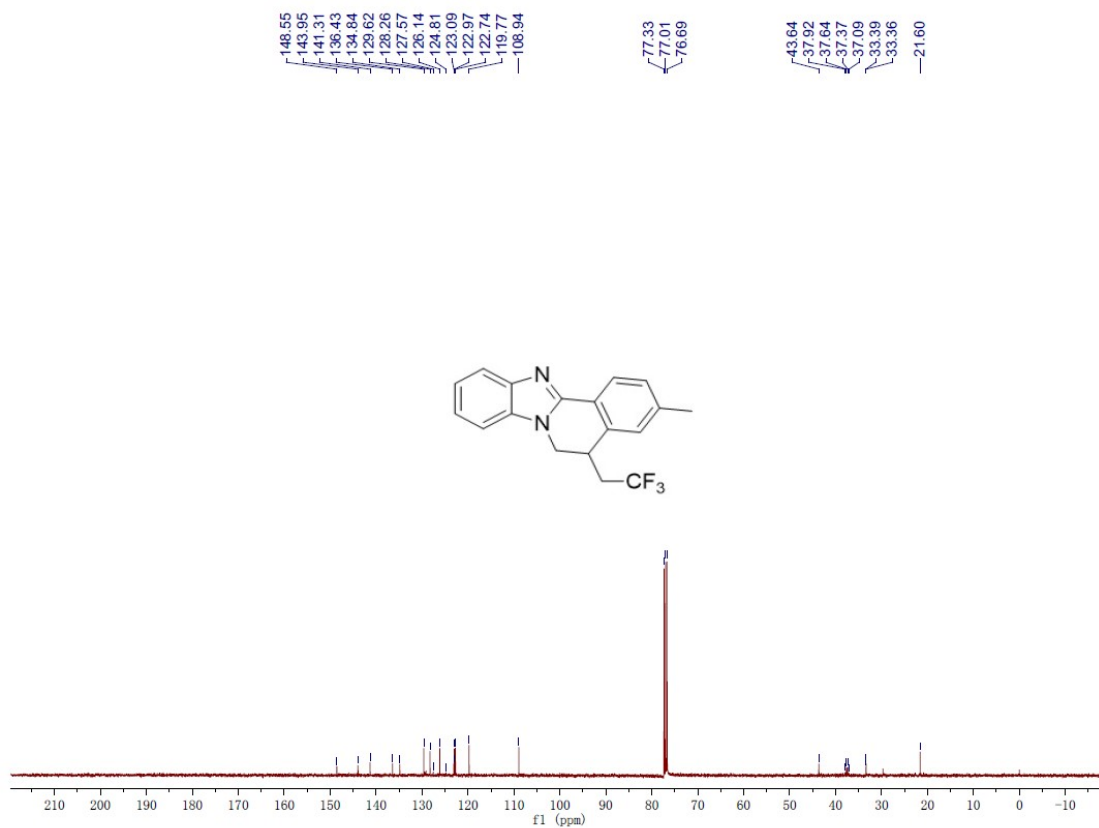


Figure S10 ¹³C NMR spectrum of **3b** (100 MHz, CDCl₃)

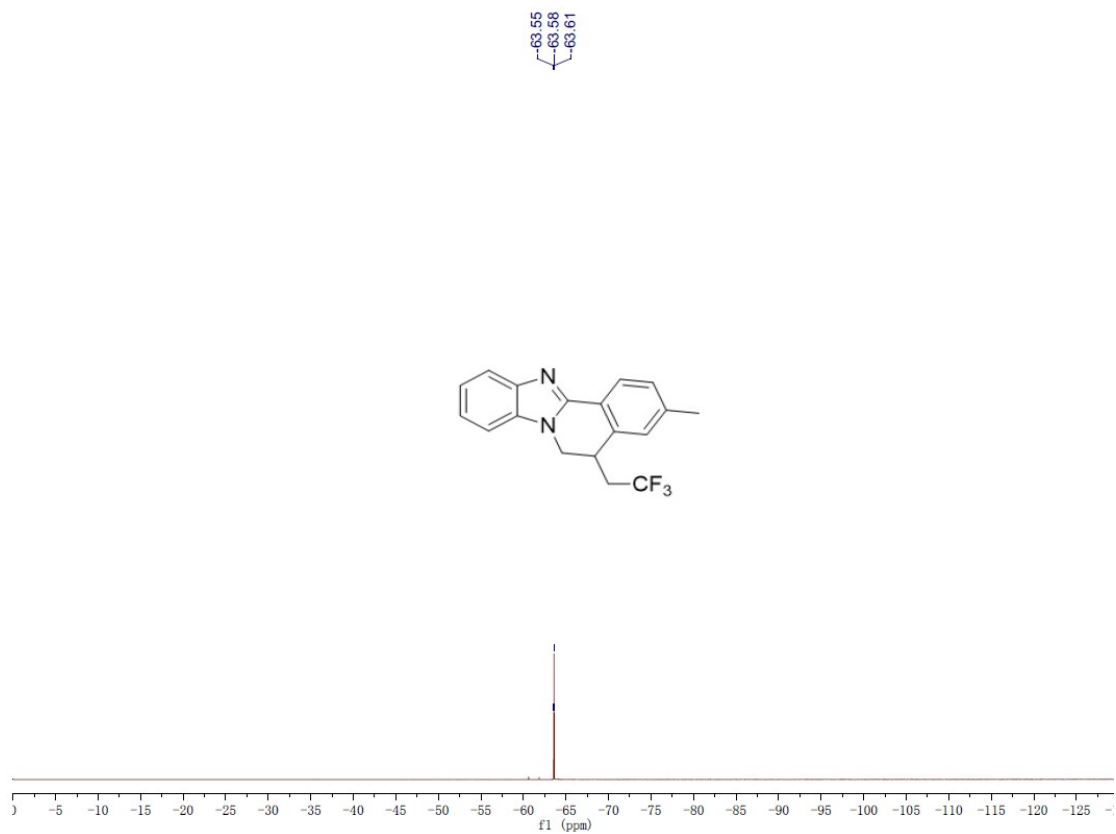


Figure S11 ¹⁹F NMR spectrum of **3b** (376 MHz, CDCl₃)

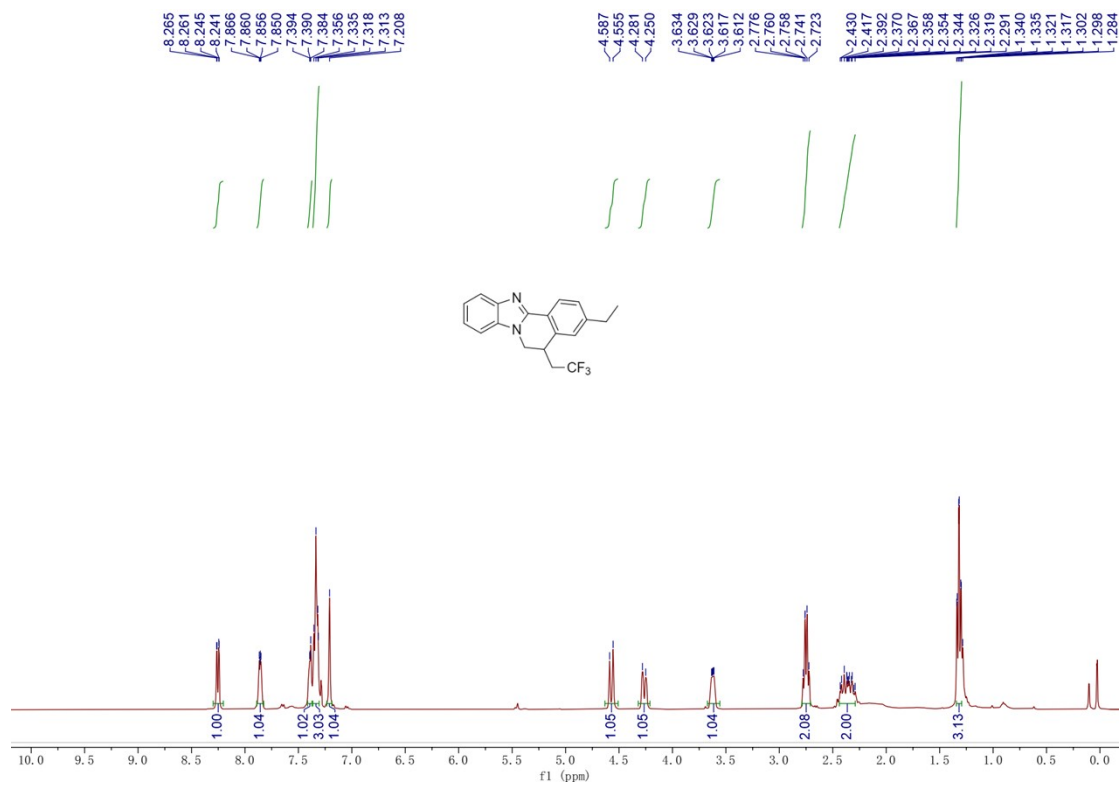


Figure S12 ¹H NMR spectrum of **3c** (400 MHz, CDCl₃)

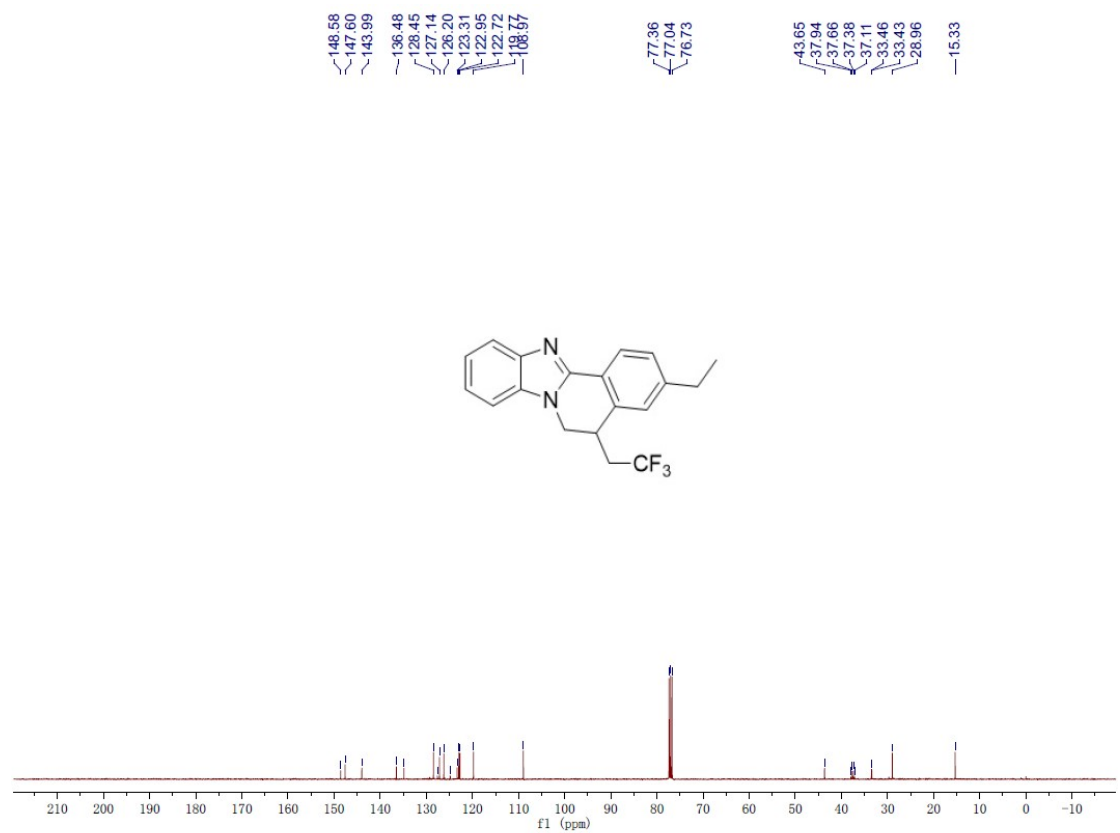


Figure S13 ¹³C NMR spectrum of **3c** (100 MHz, CDCl₃)

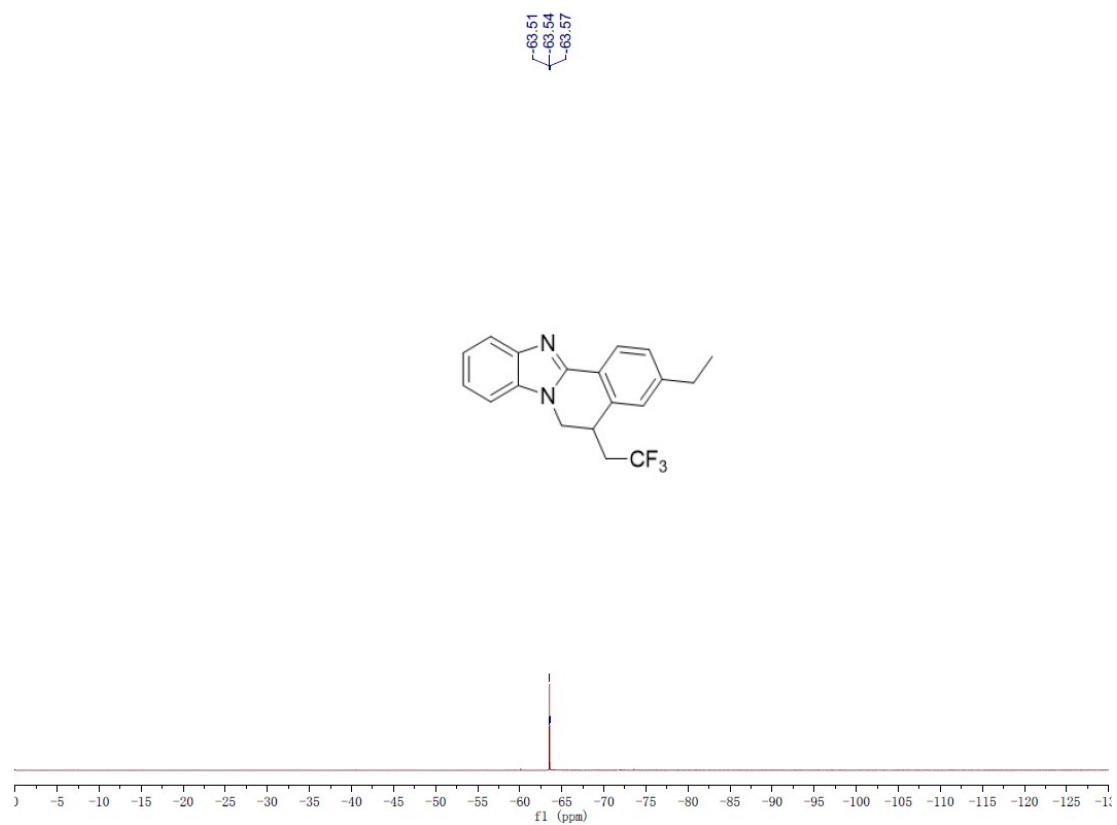


Figure S14 ^{19}F NMR spectrum of **3c** (376 MHz, CDCl_3)

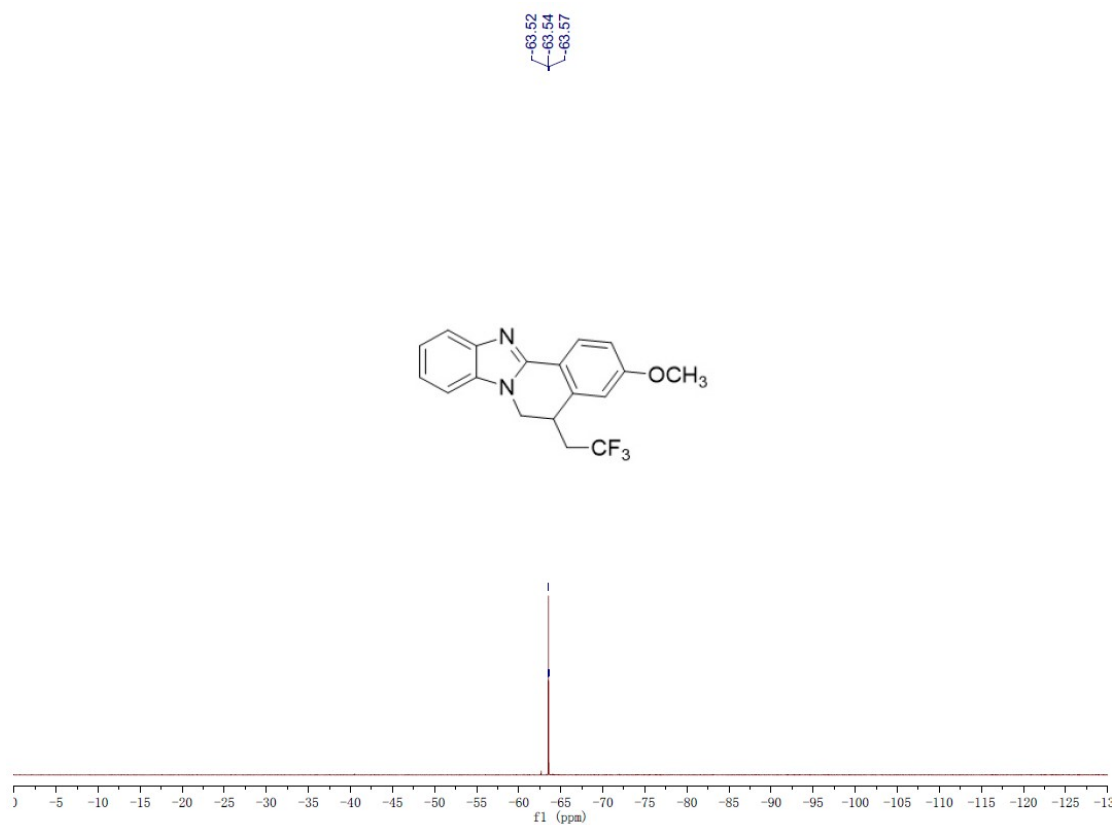


Figure S17 ^{19}F NMR spectrum of **3d** (376 MHz, CDCl_3)

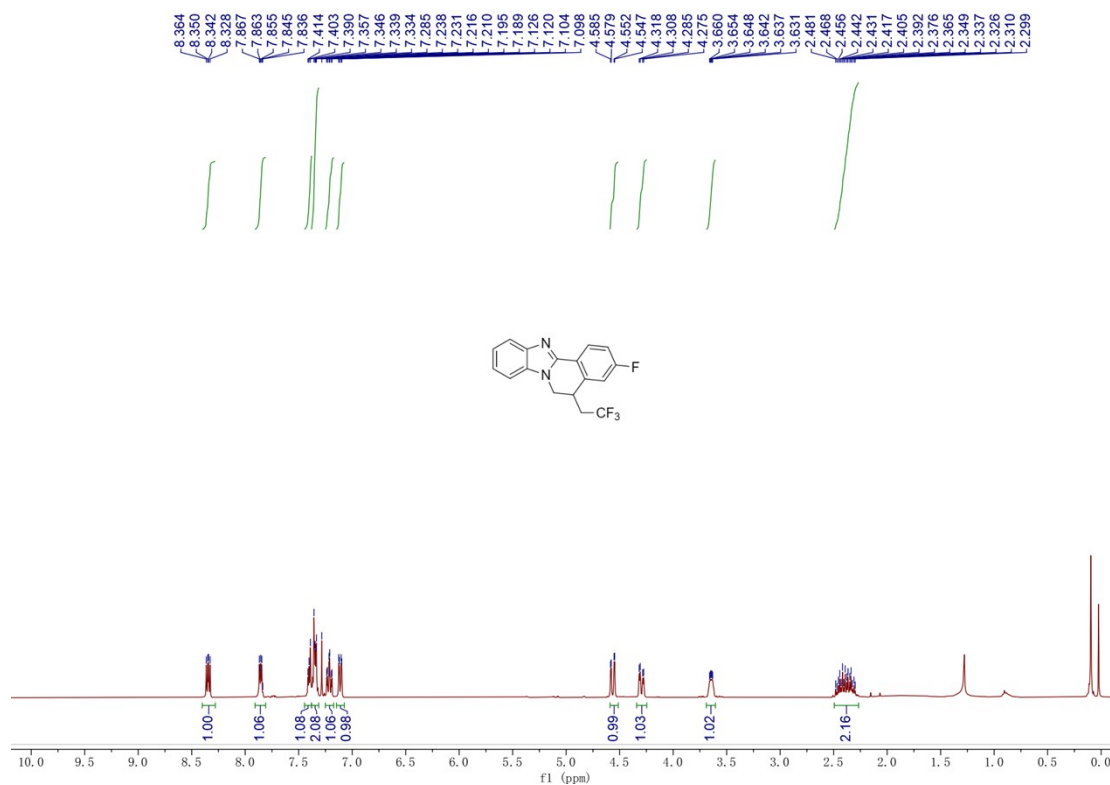


Figure S18 ¹H NMR spectrum of **3e** (400 MHz, CDCl₃)

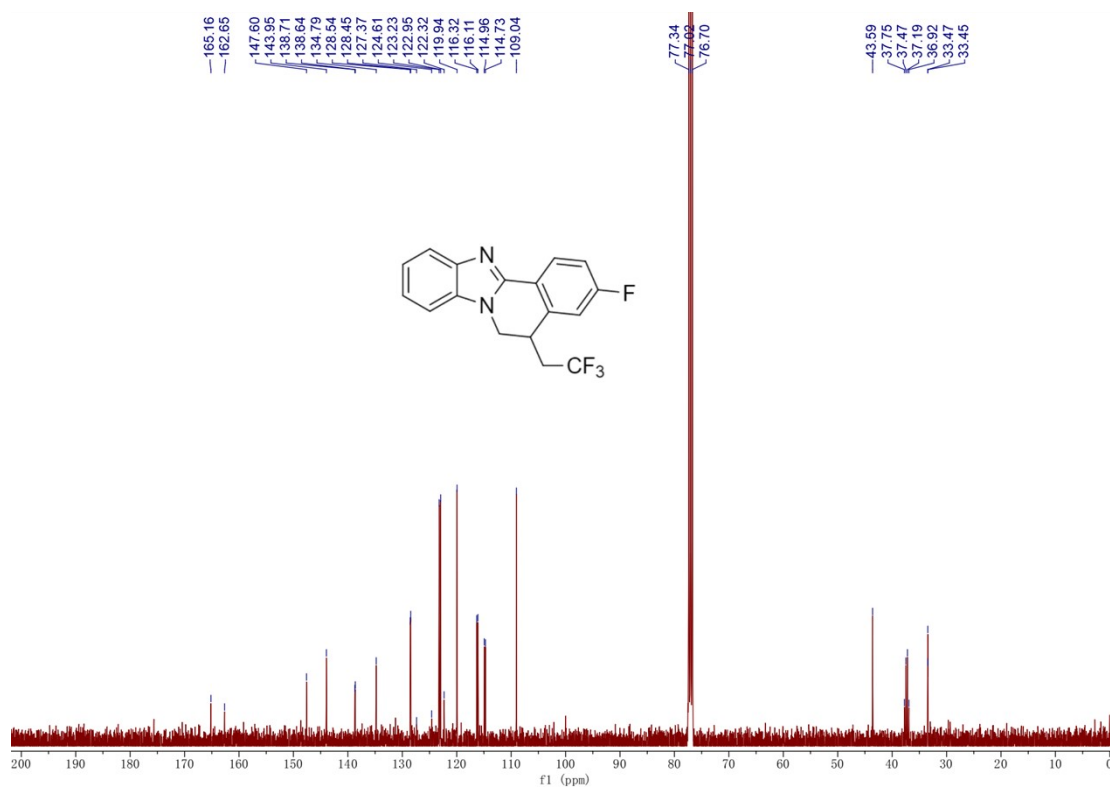


Figure S19 ¹³C NMR spectrum of **3e** (100 MHz, CDCl₃)

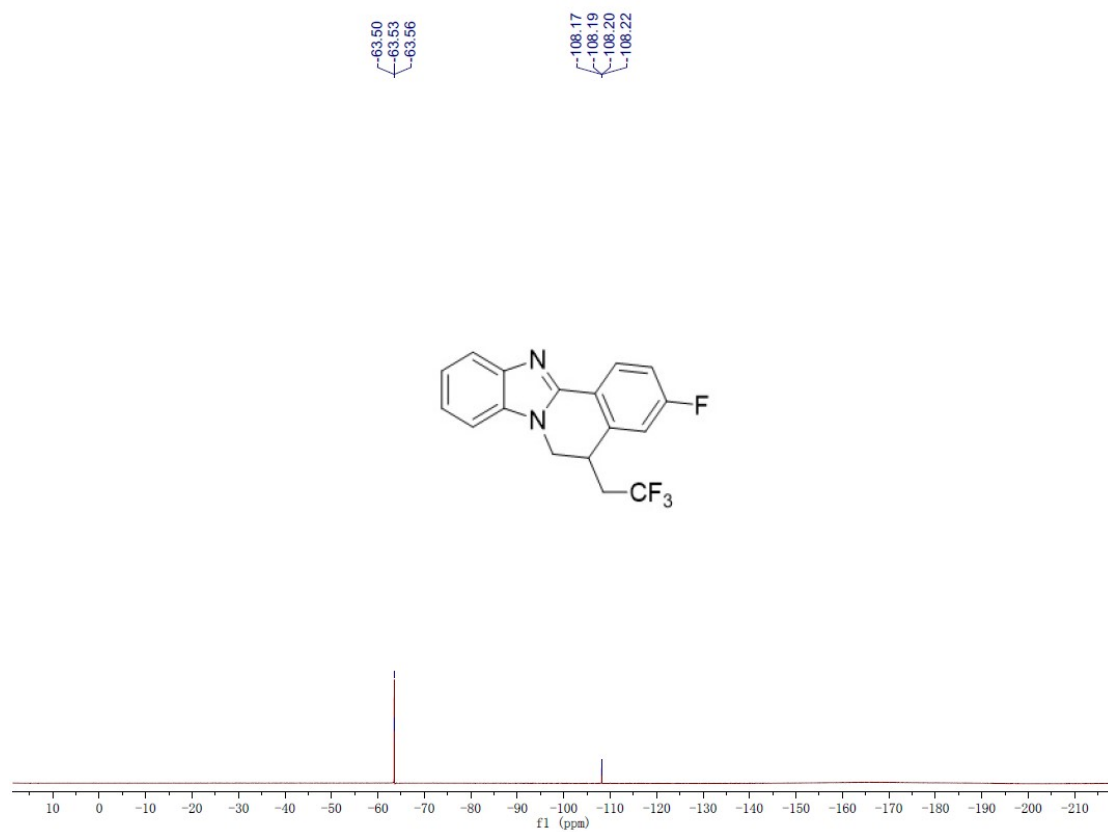


Figure S20 ^{19}F NMR spectrum of **3e** (376 MHz, CDCl_3)

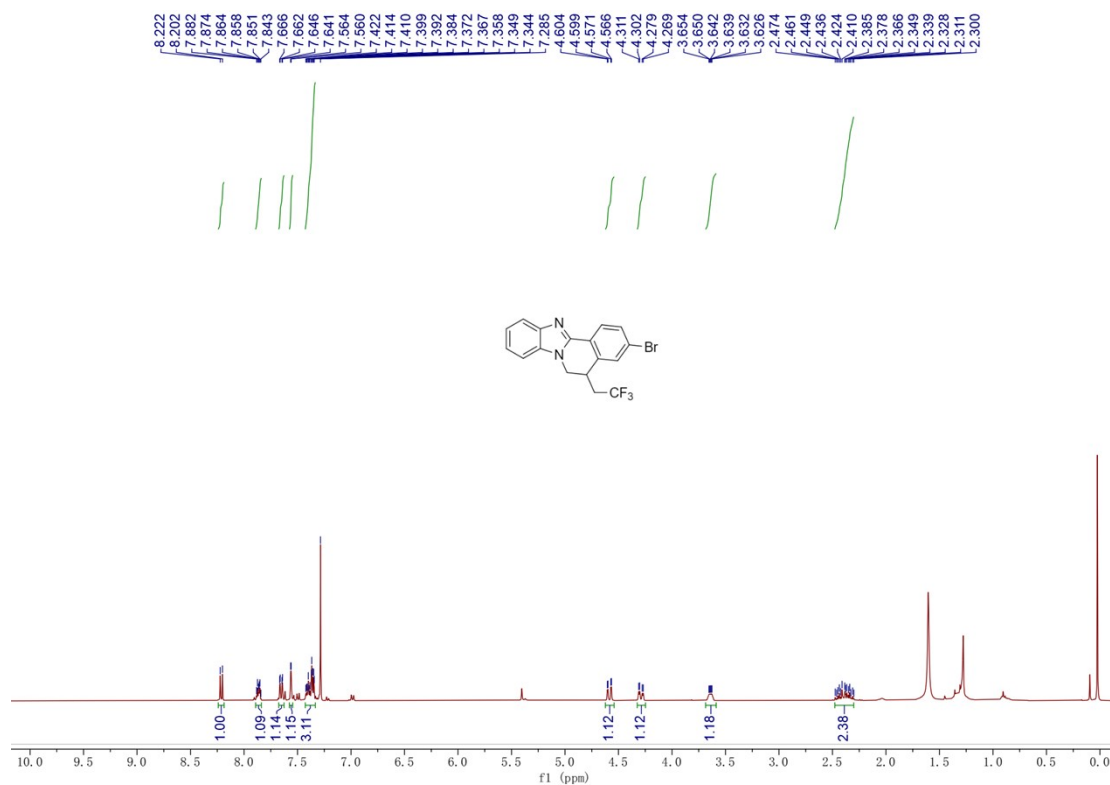


Figure S21 ¹H NMR spectrum of **3f** (400 MHz, CDCl₃)

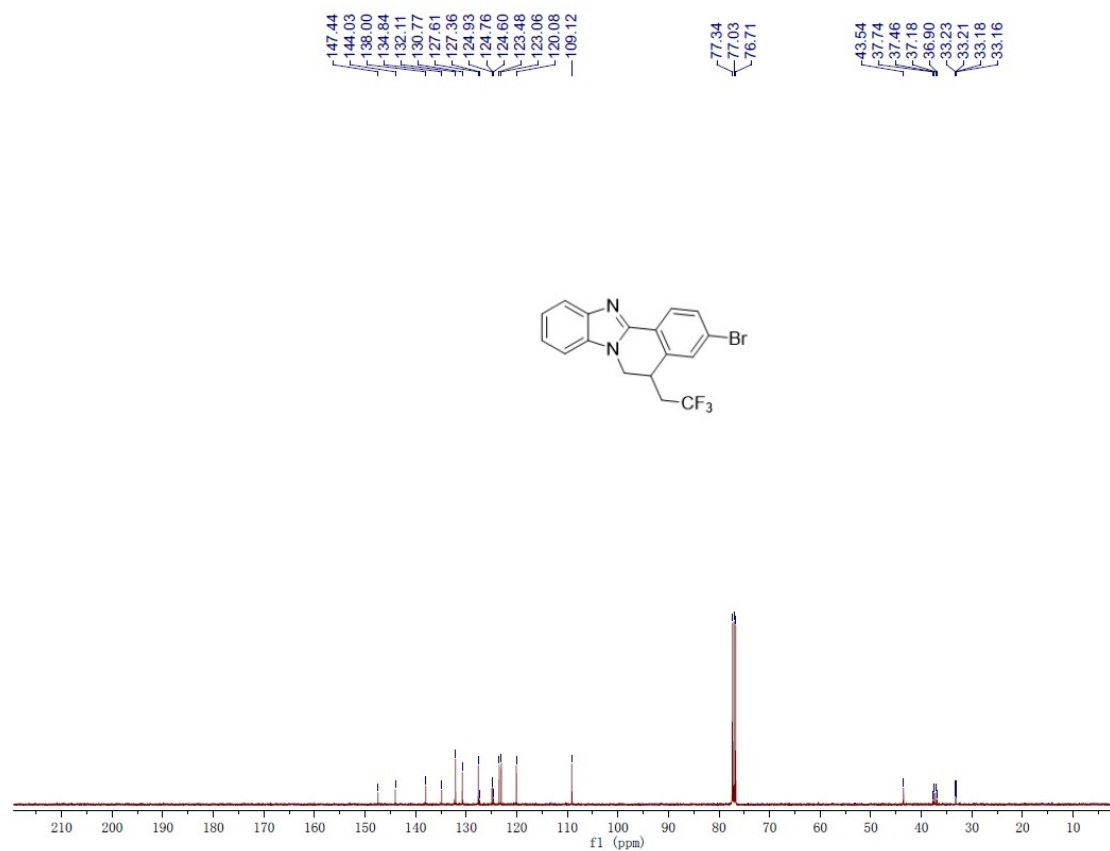


Figure S22 ¹³C NMR spectrum of **3f** (100 MHz, CDCl₃)

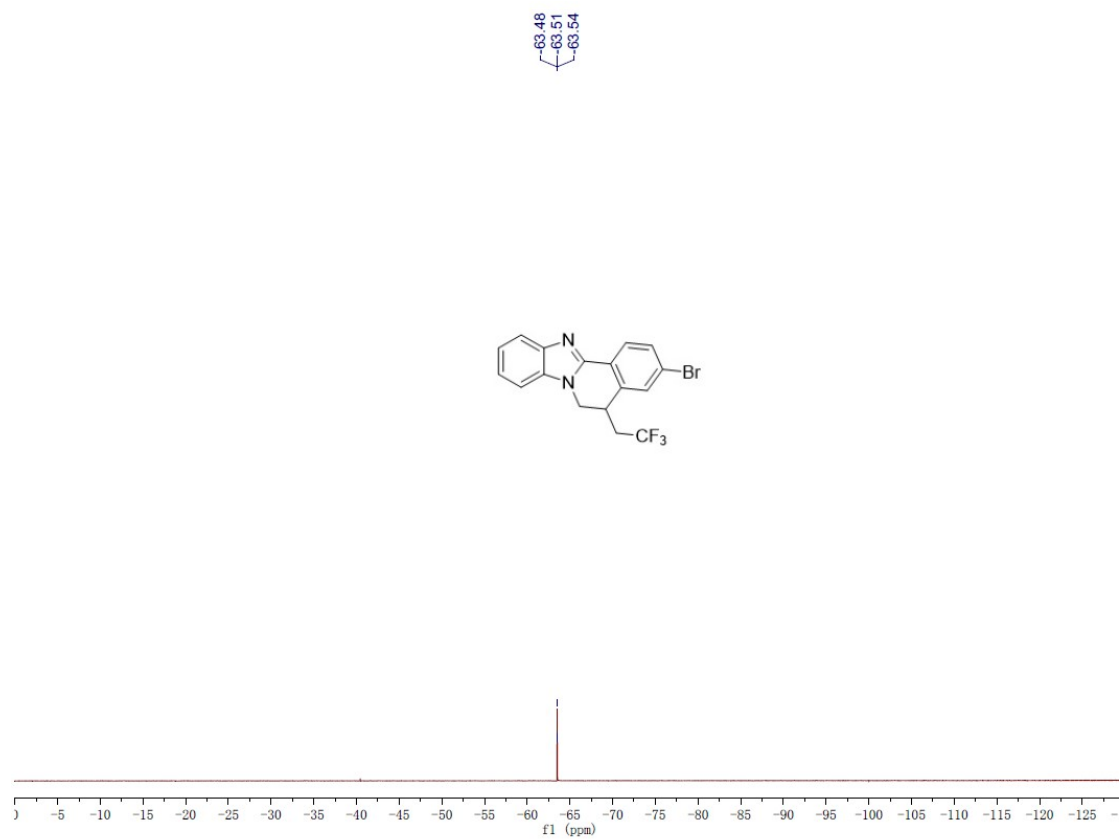


Figure S23 ^{19}F NMR spectrum of **3f** (376 MHz, CDCl_3)

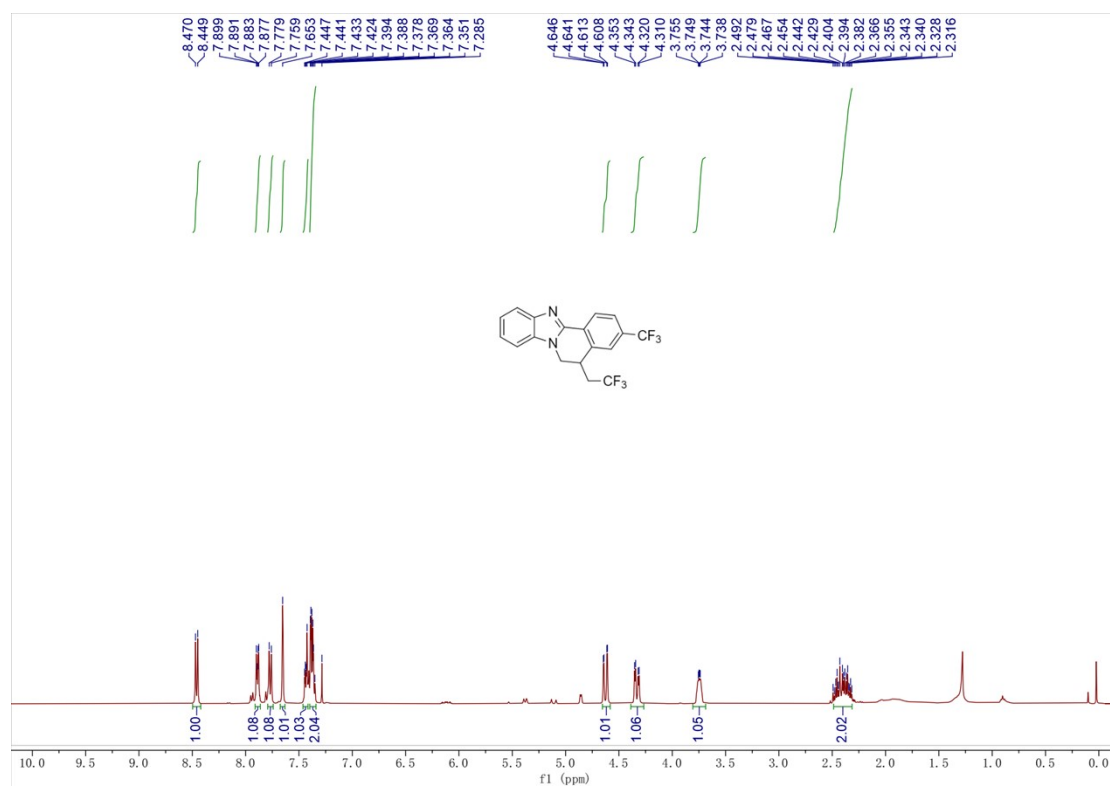


Figure S24 ^1H NMR spectrum of **3g** (400 MHz, CDCl_3)

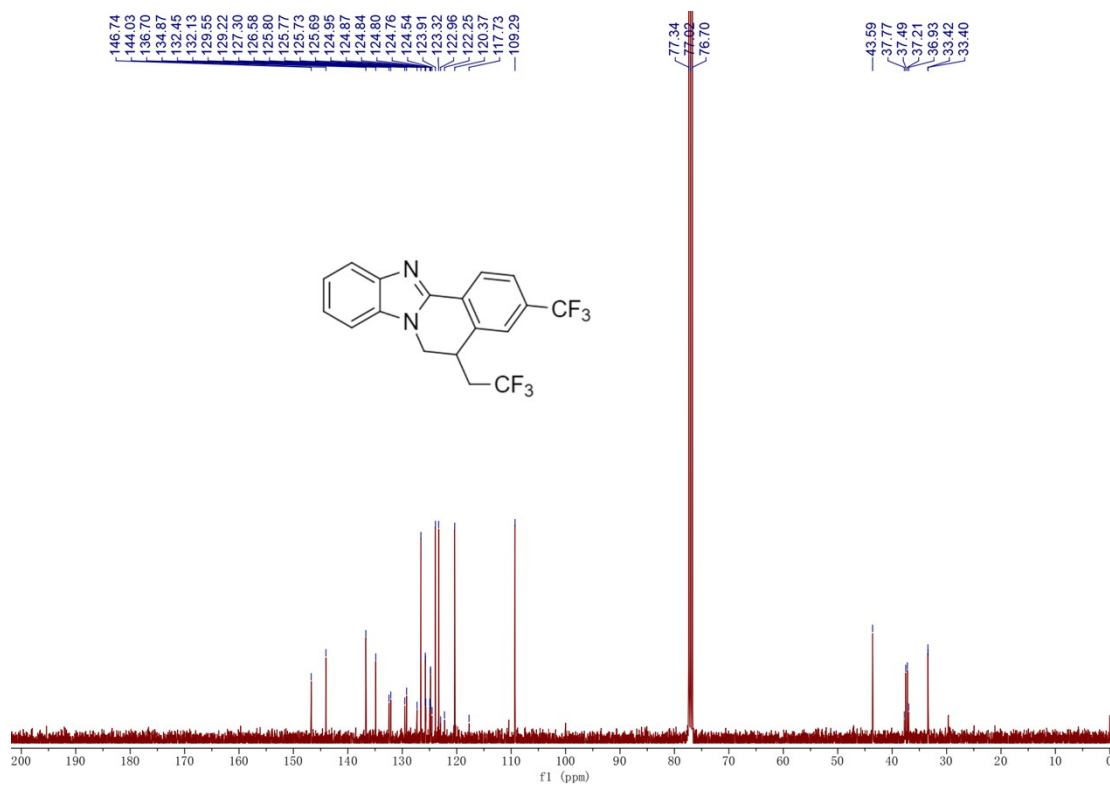


Figure S25 ^{13}C NMR spectrum of **3g** (100 MHz, CDCl_3)

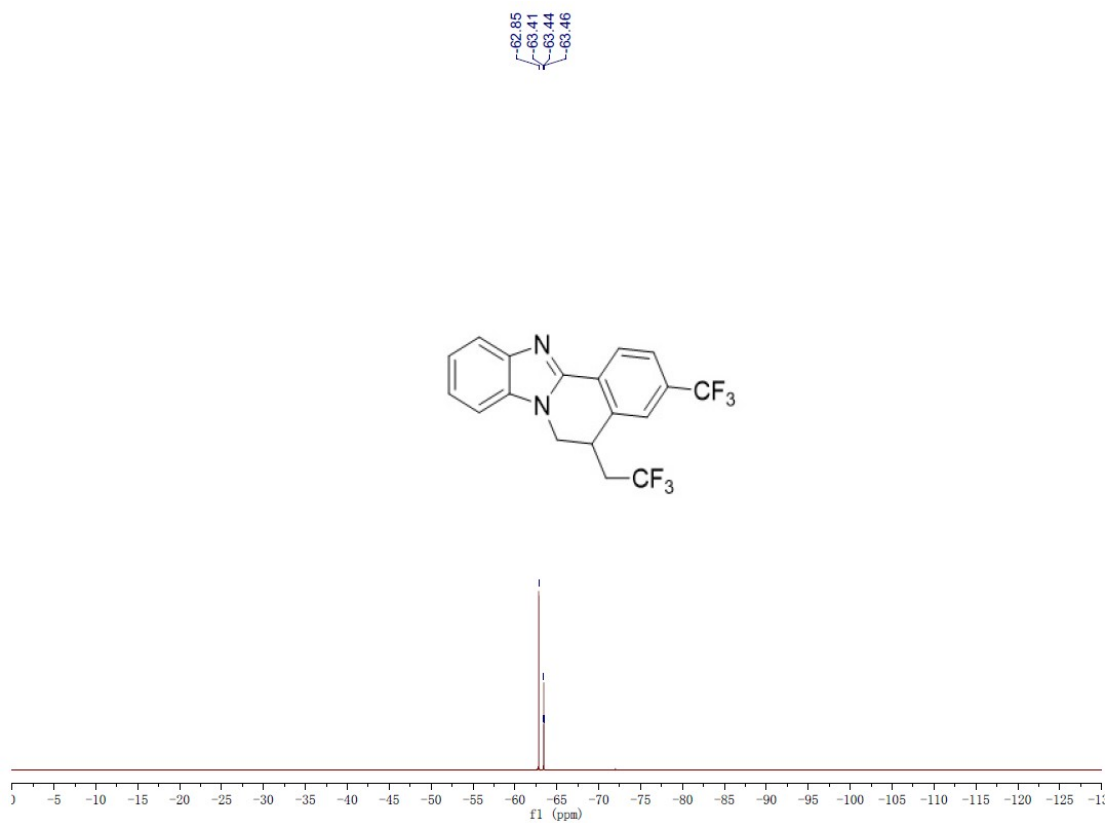
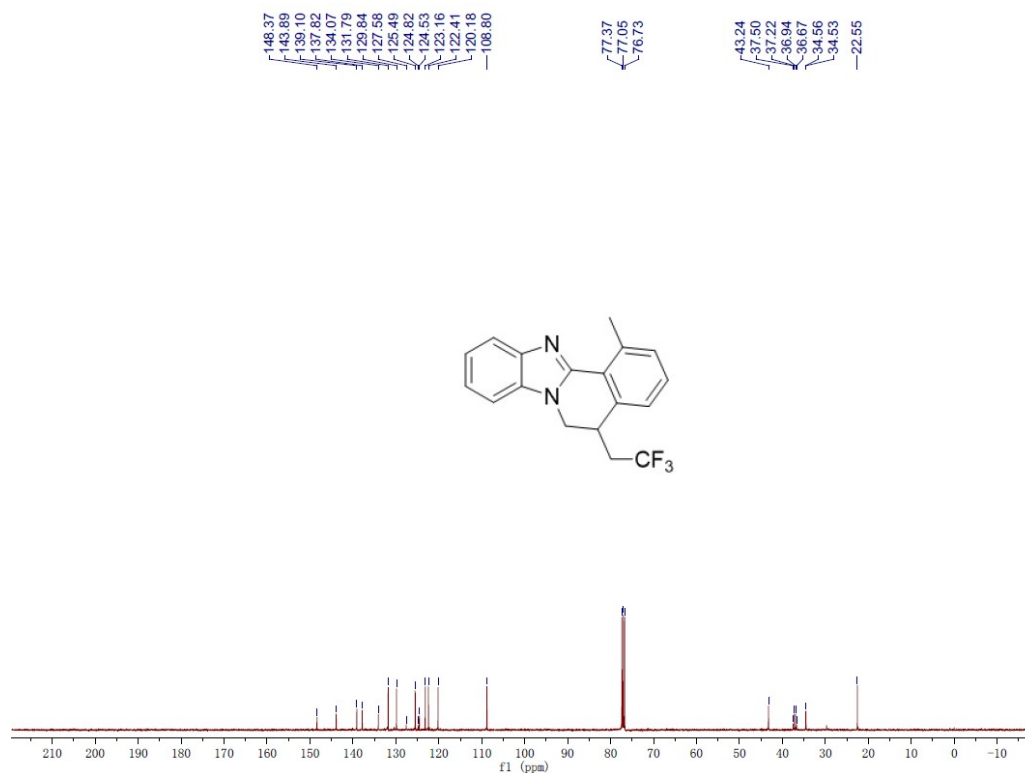
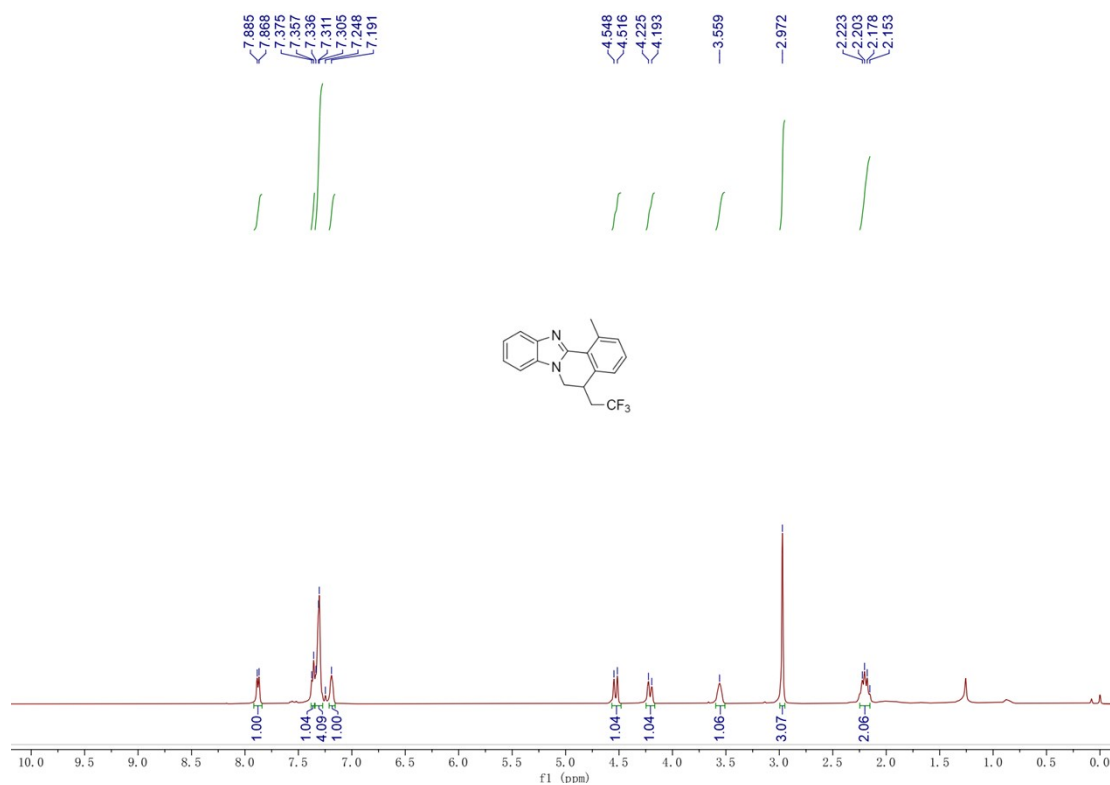


Figure S26 ¹⁹F NMR spectrum of **3g** (376 MHz, CDCl₃)



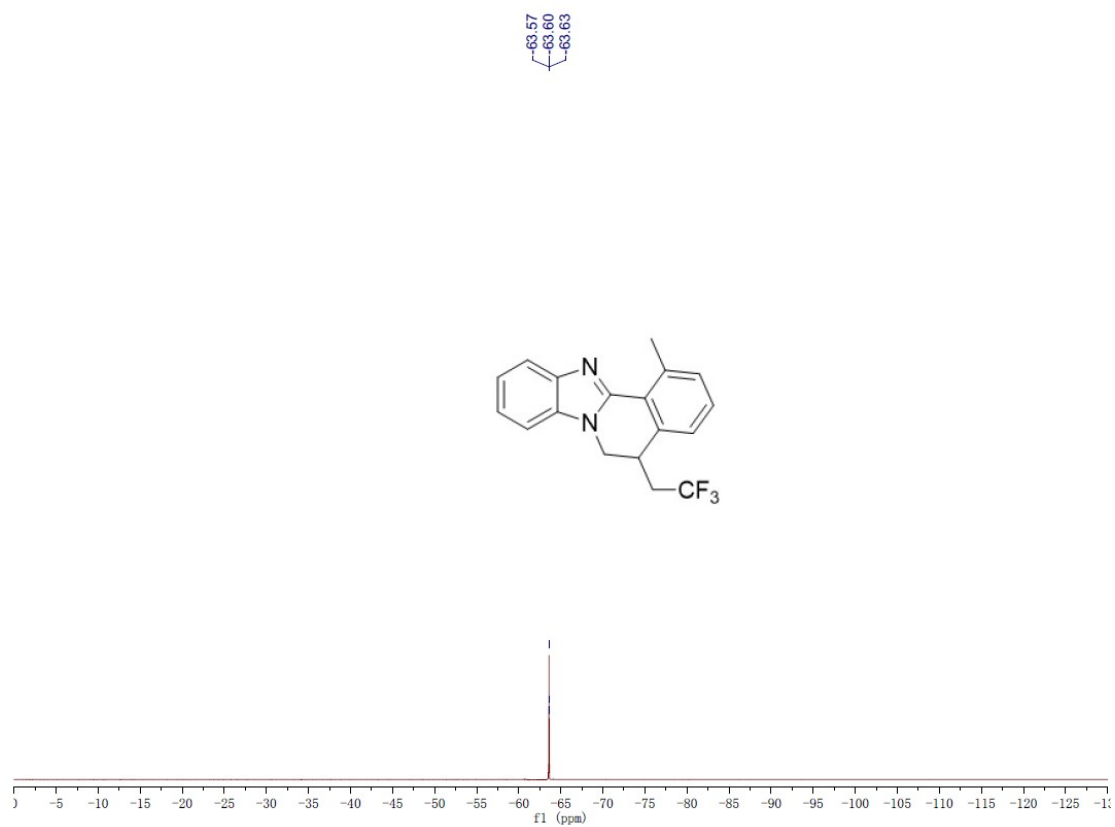


Figure S29 ^{19}F NMR spectrum of **3h** (376 MHz, CDCl_3)

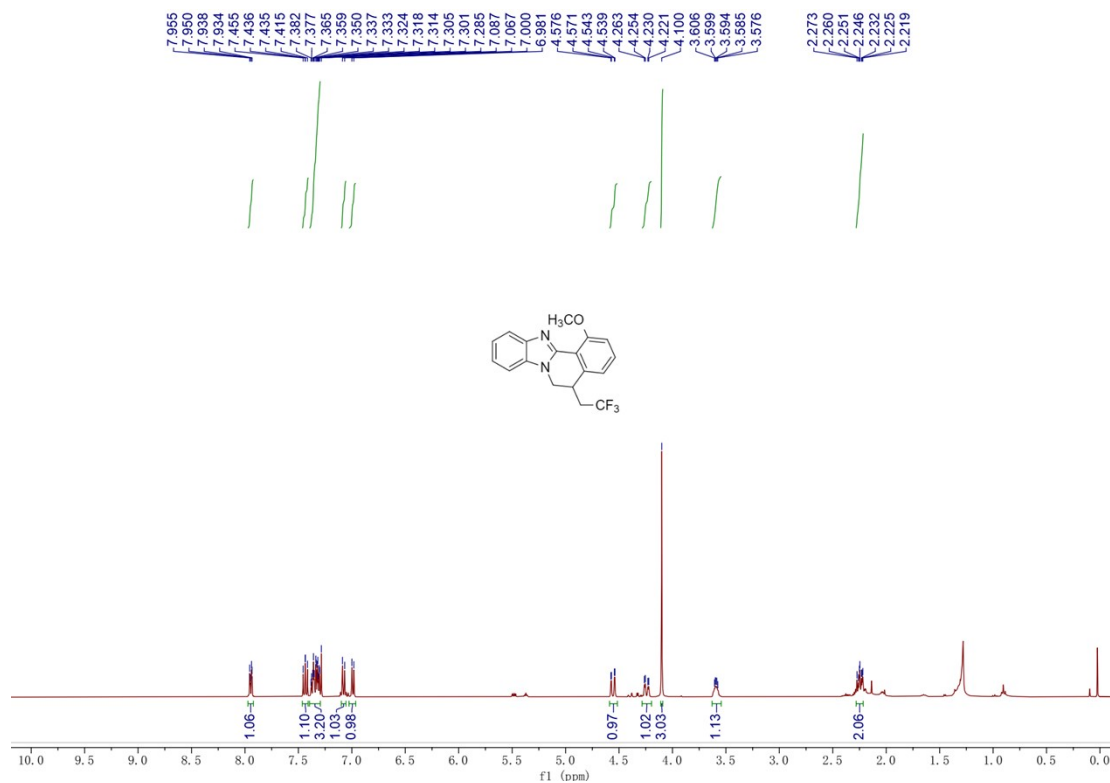


Figure S30 ¹H NMR spectrum of **3i** (400 MHz, CDCl₃)

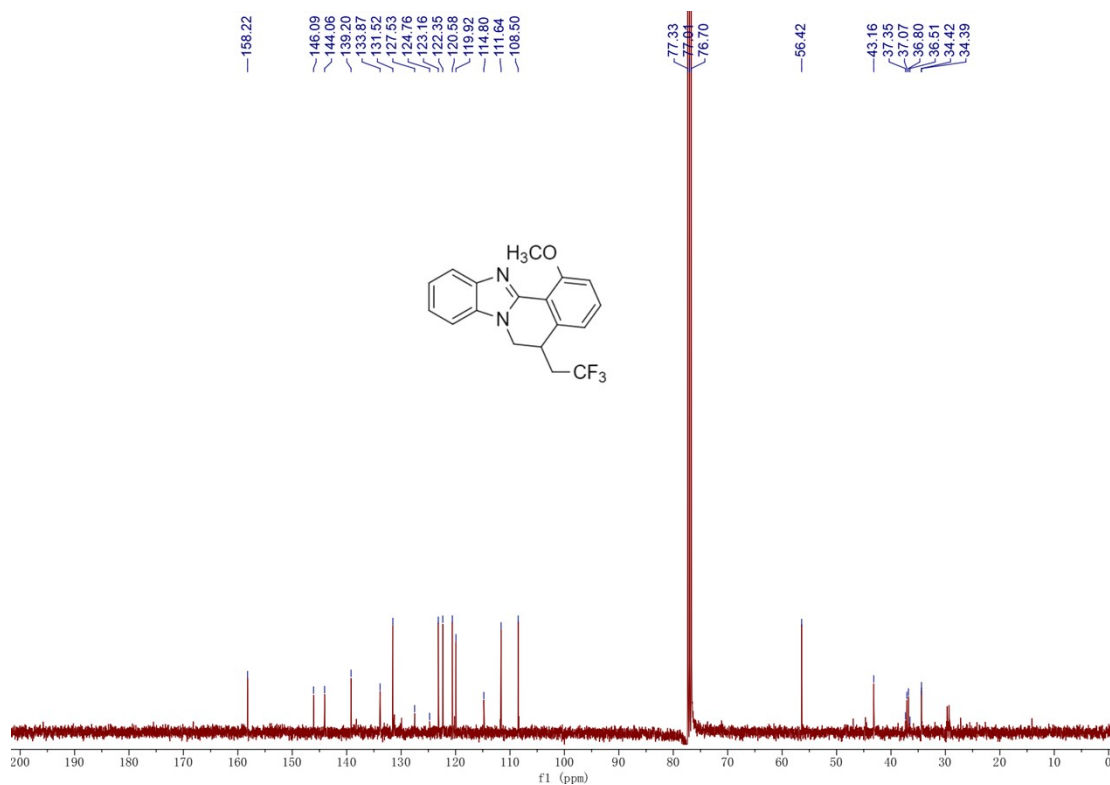


Figure S31 ¹³C NMR spectrum of **3i** (100 MHz, CDCl₃)

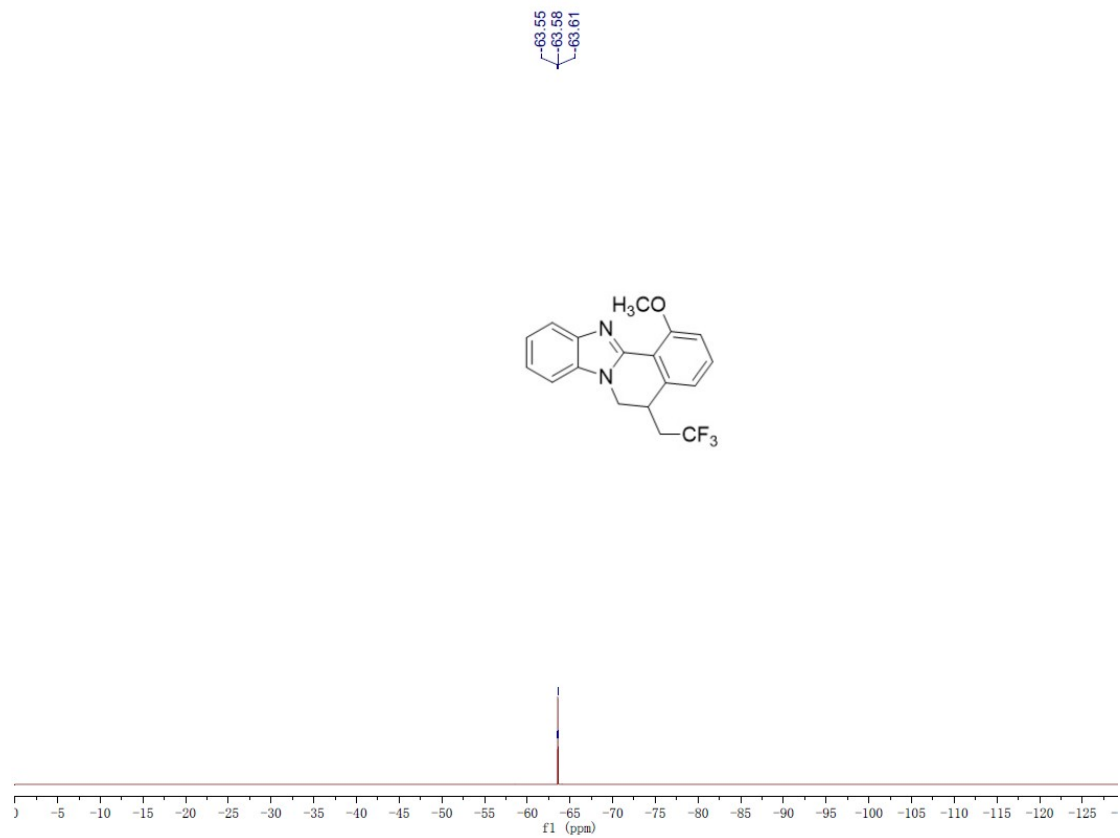


Figure S32 ^{19}F NMR spectrum of **3i** (376 MHz, CDCl_3)

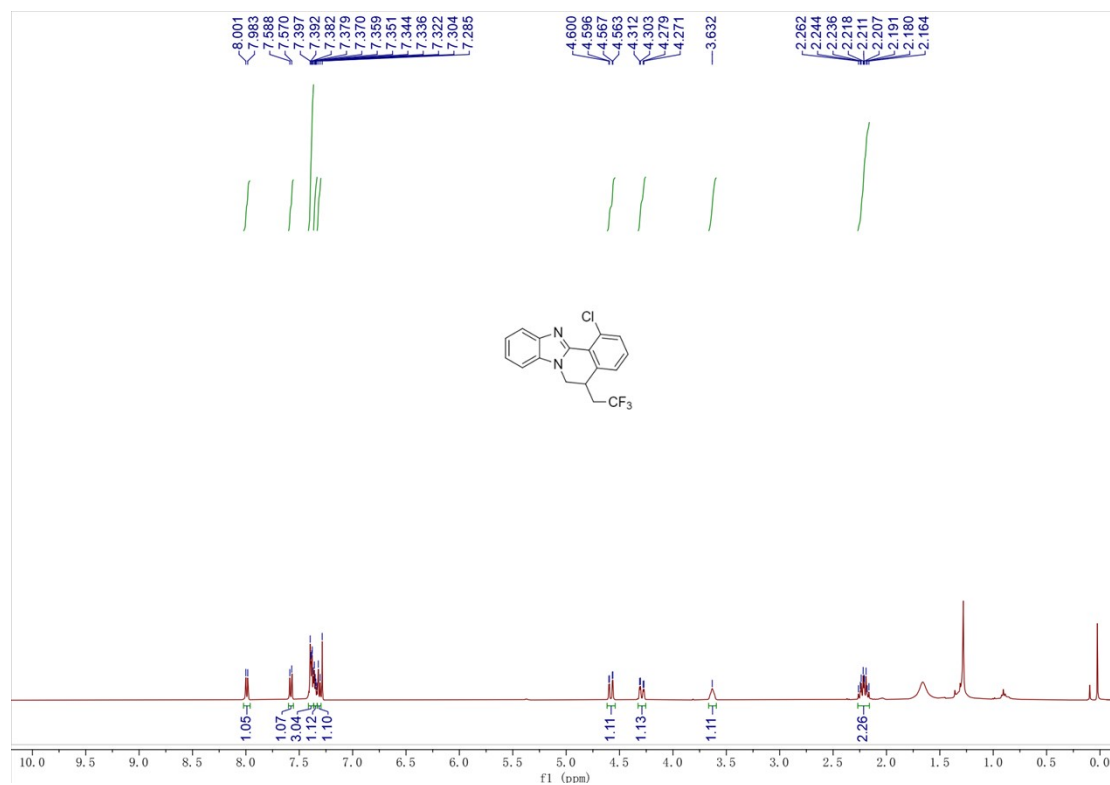


Figure S33 ¹H NMR spectrum of **3j** (400 MHz, CDCl₃)

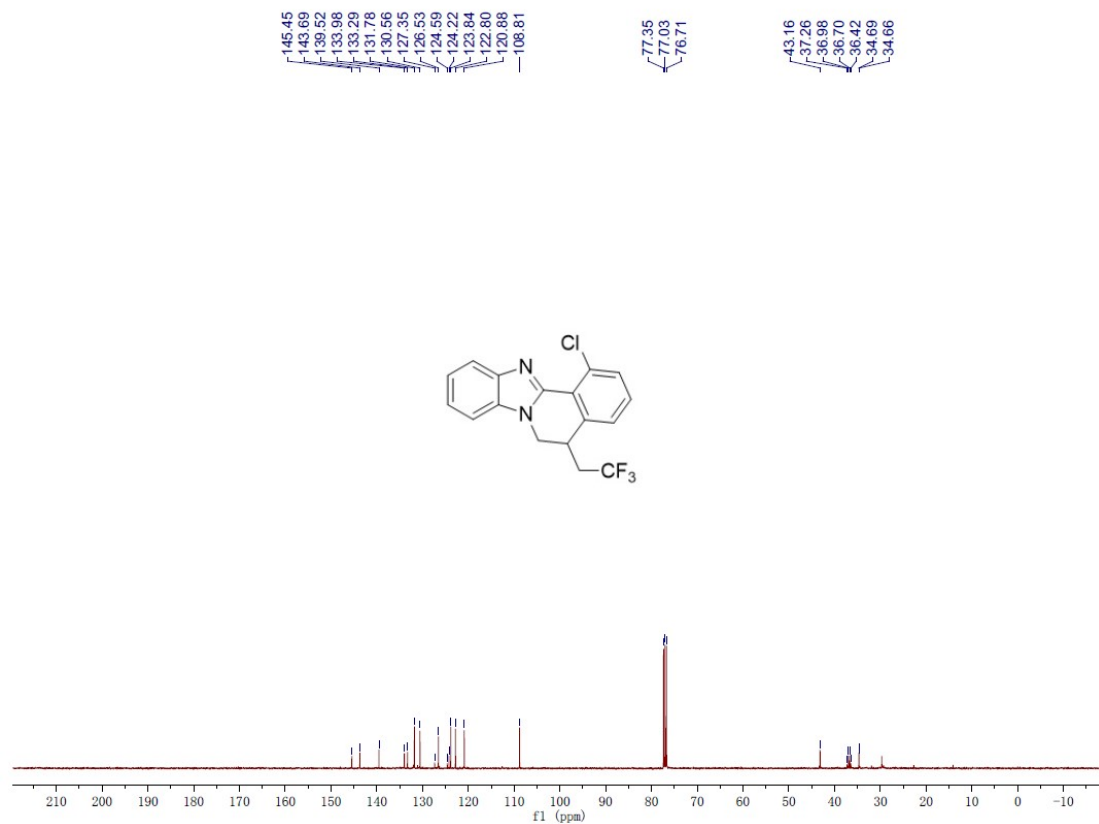


Figure S34 ¹³C NMR spectrum of **3j** (100 MHz, CDCl₃)

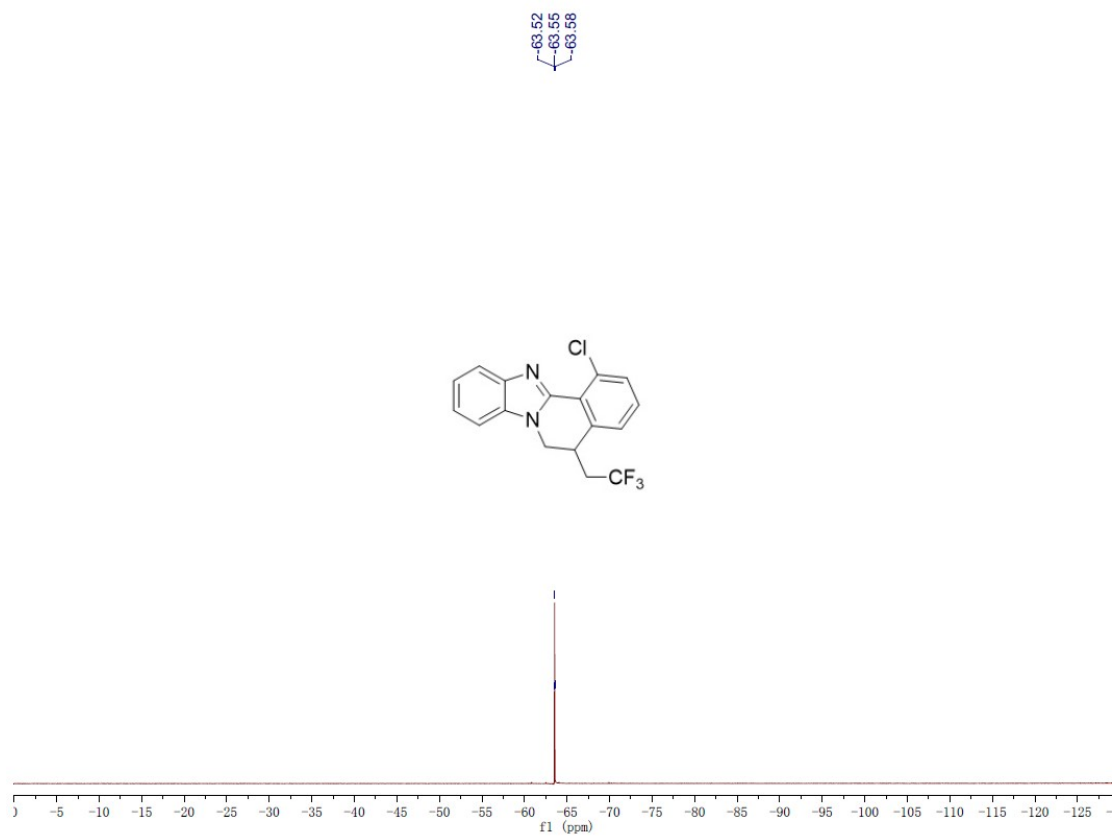


Figure S35 ^{19}F NMR spectrum of **3j** (376 MHz, CDCl_3)

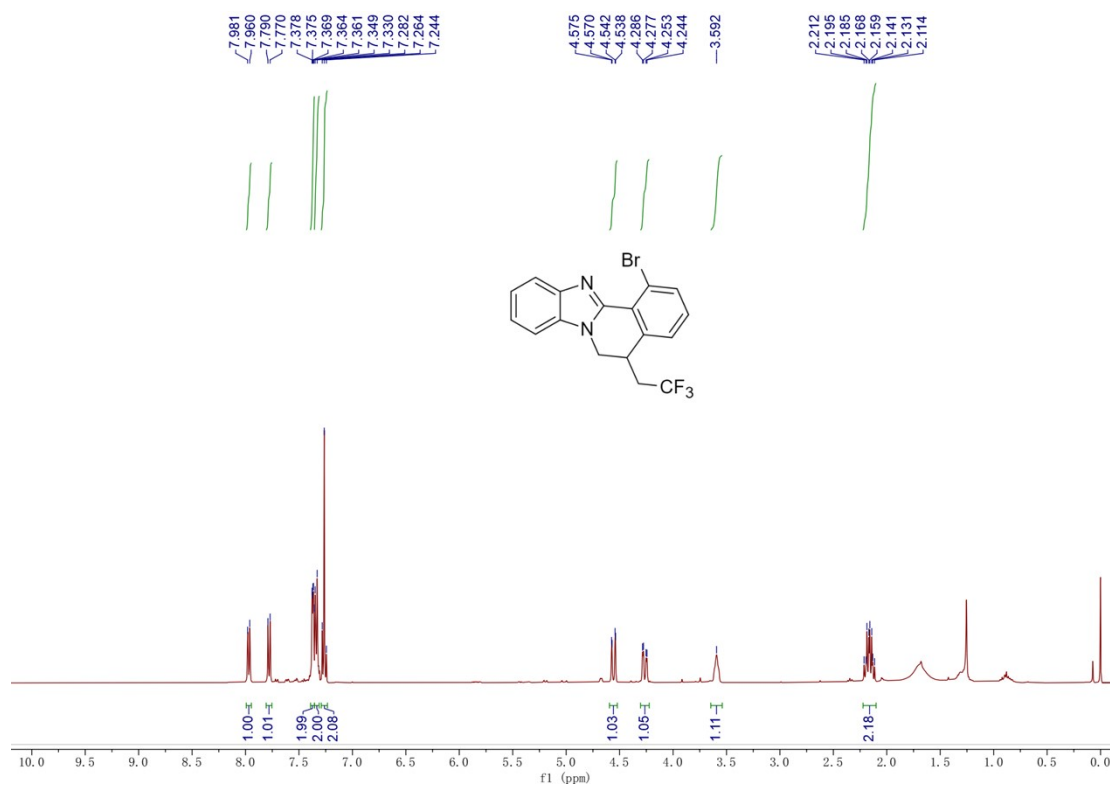


Figure S36 ¹H NMR spectrum of **3k** (400 MHz, CDCl₃)

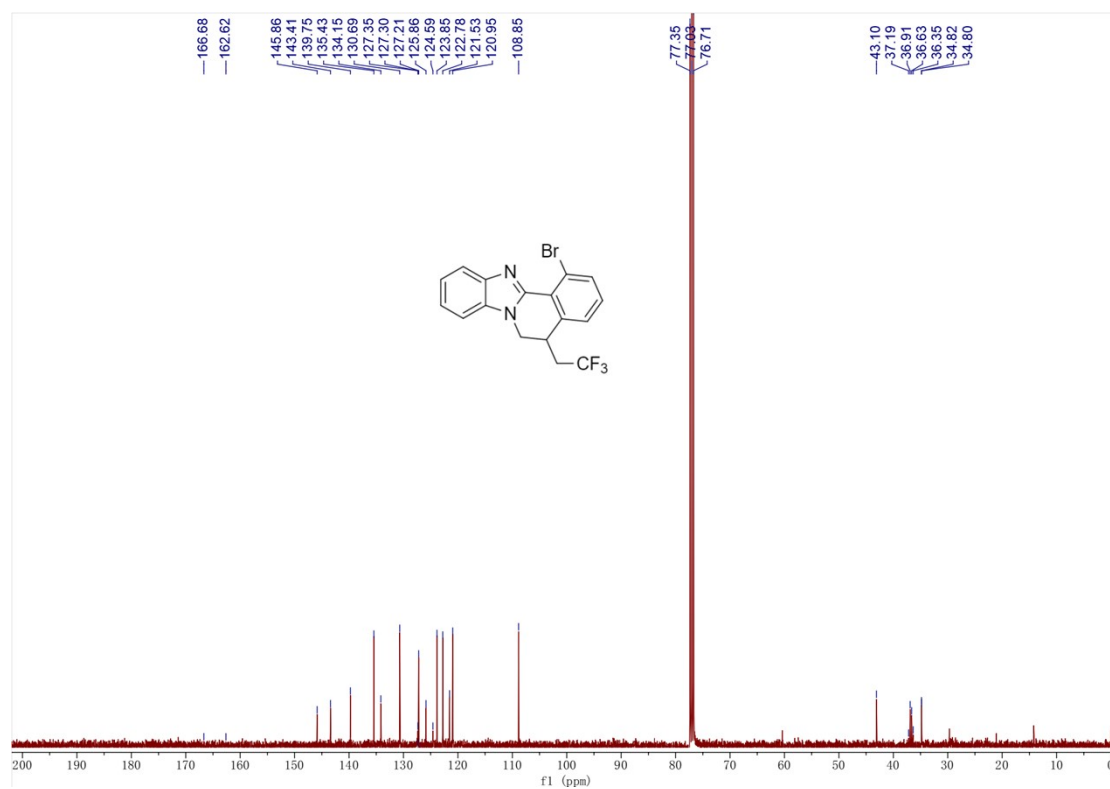


Figure S37 ¹³C NMR spectrum of **3k** (100 MHz, CDCl₃)

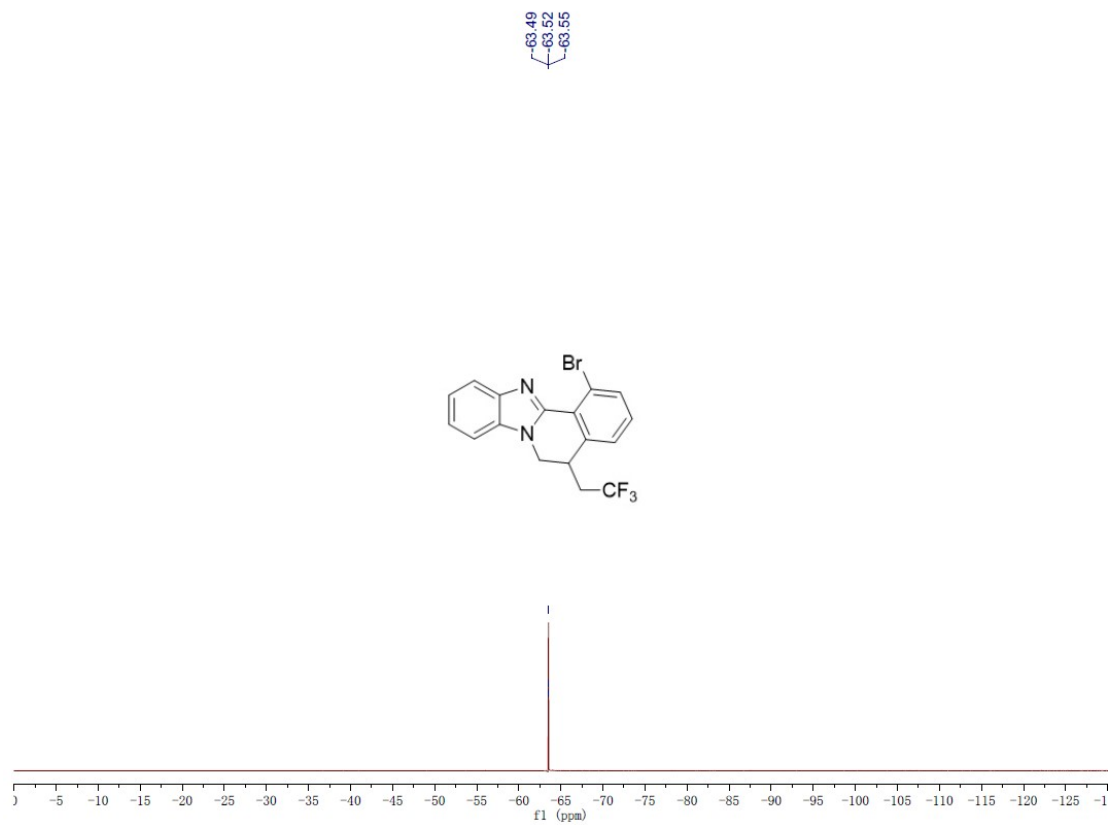


Figure S38 ^{19}F NMR spectrum of **3k** (376 MHz, CDCl_3)

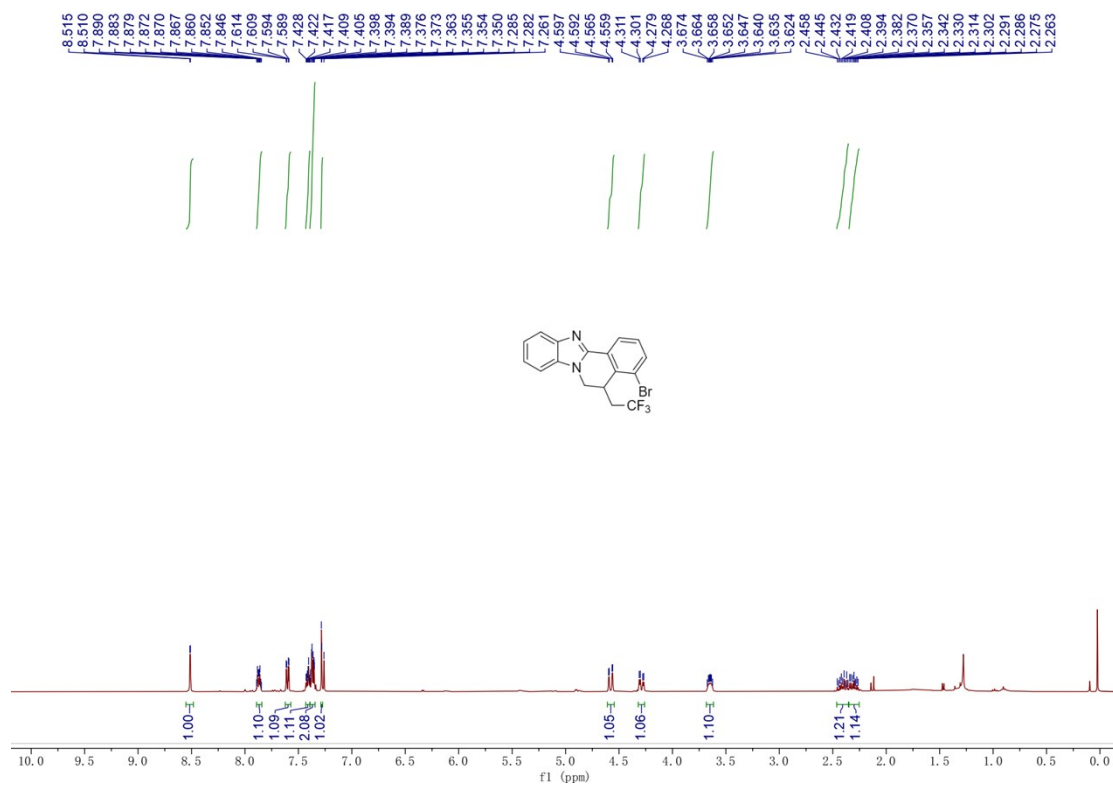


Figure S39 ¹H NMR spectrum of **31** (400 MHz, CDCl₃)

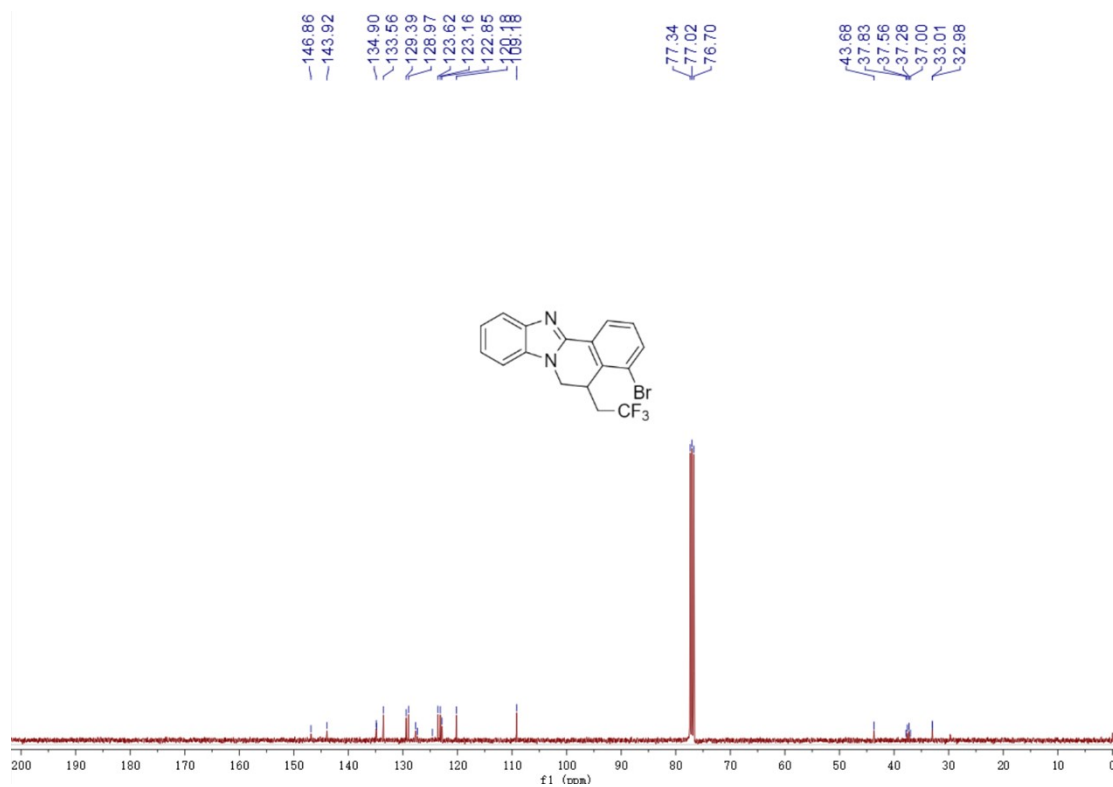


Figure S40 ¹³C NMR spectrum of **31** (100 MHz, CDCl₃)



Figure S41 ^{19}F NMR spectrum of **31** (376 MHz, CDCl_3)

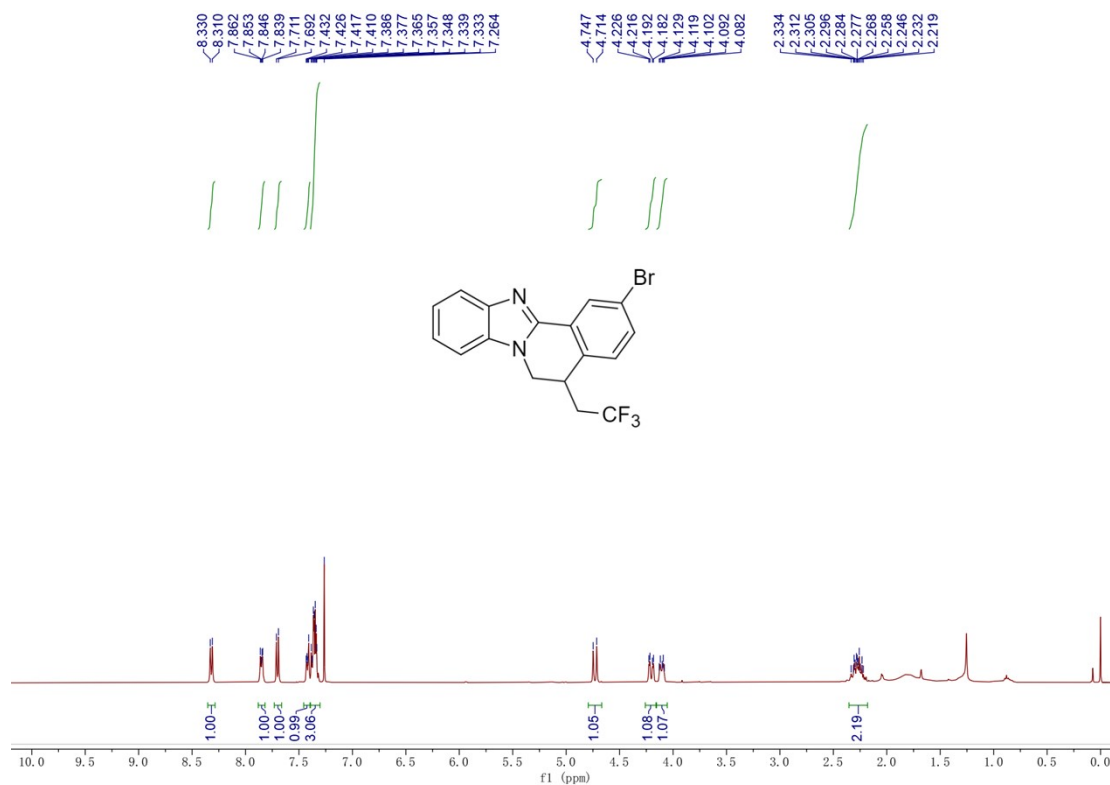


Figure S42 ^1H NMR spectrum of **3m** (400 MHz, CDCl_3)

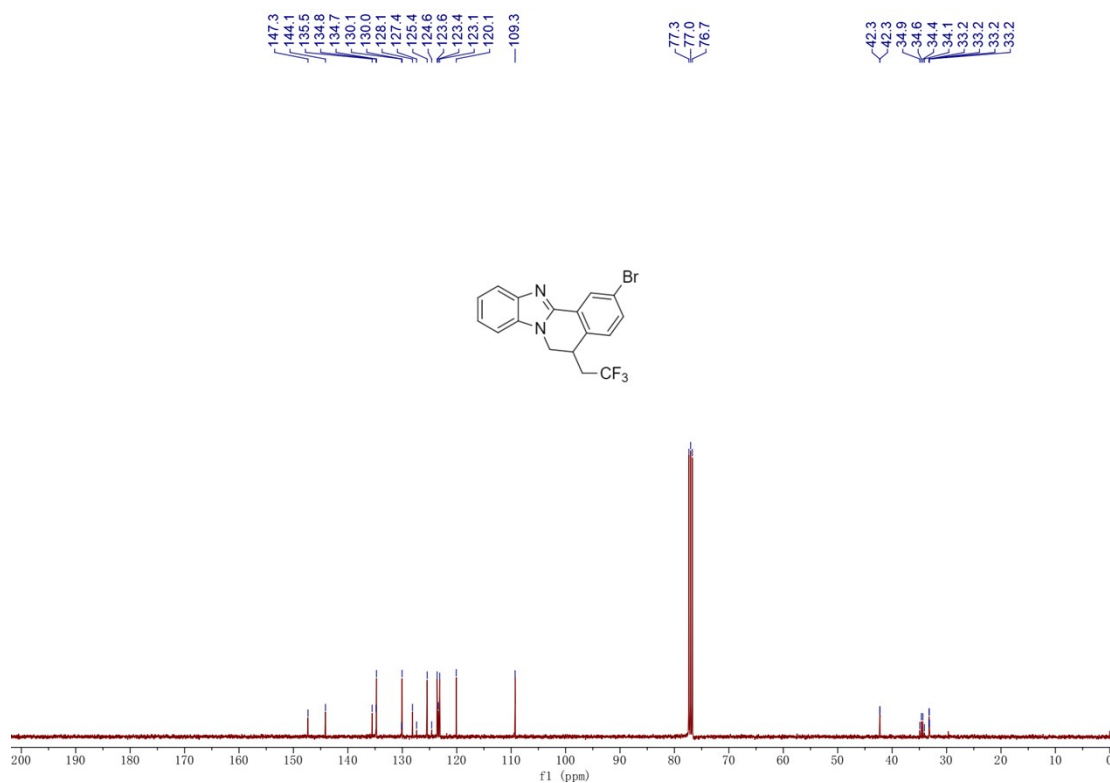


Figure S43 ^{13}C NMR spectrum of **3m** (100 MHz, CDCl_3)

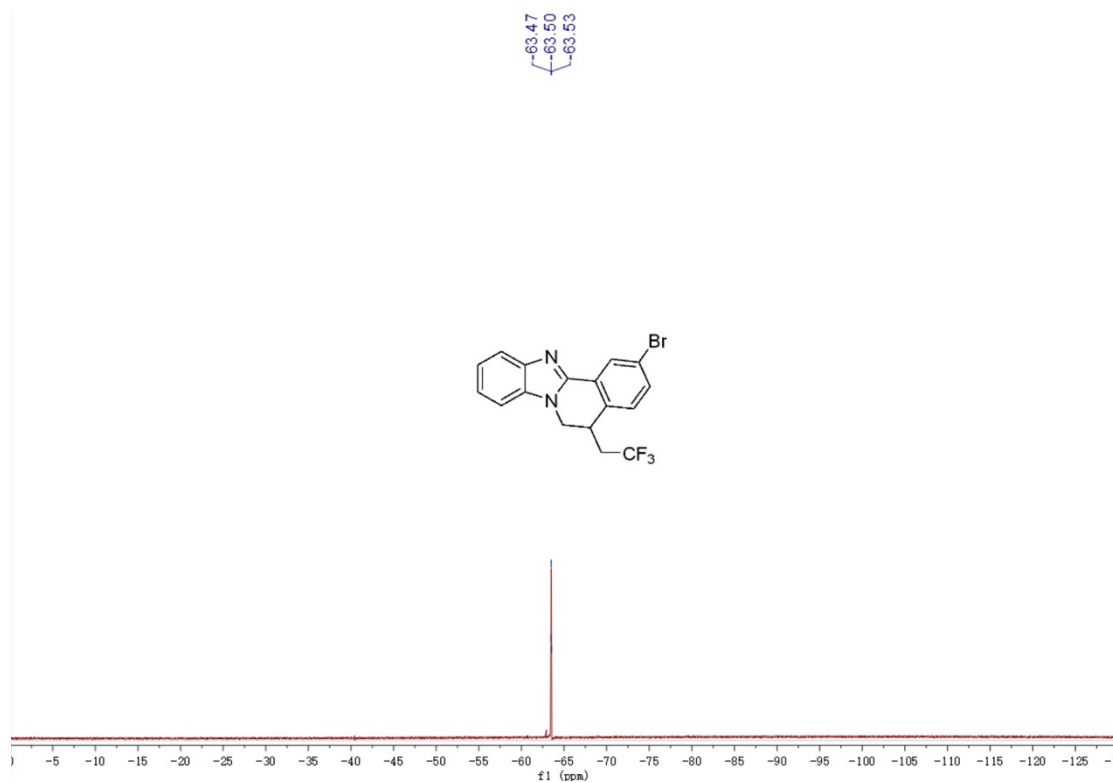


Figure S44 ^{19}F NMR spectrum of **3m** (376 MHz, CDCl_3)

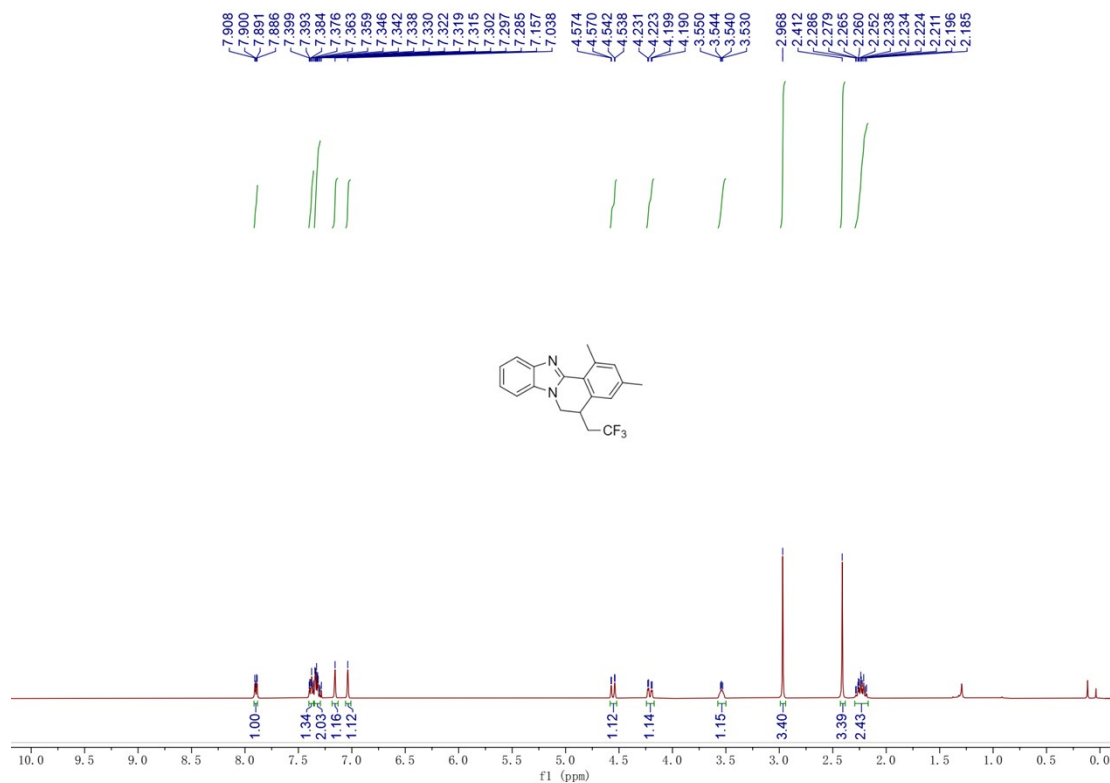


Figure S45 ¹H NMR spectrum of **3n** (400 MHz, CDCl₃)

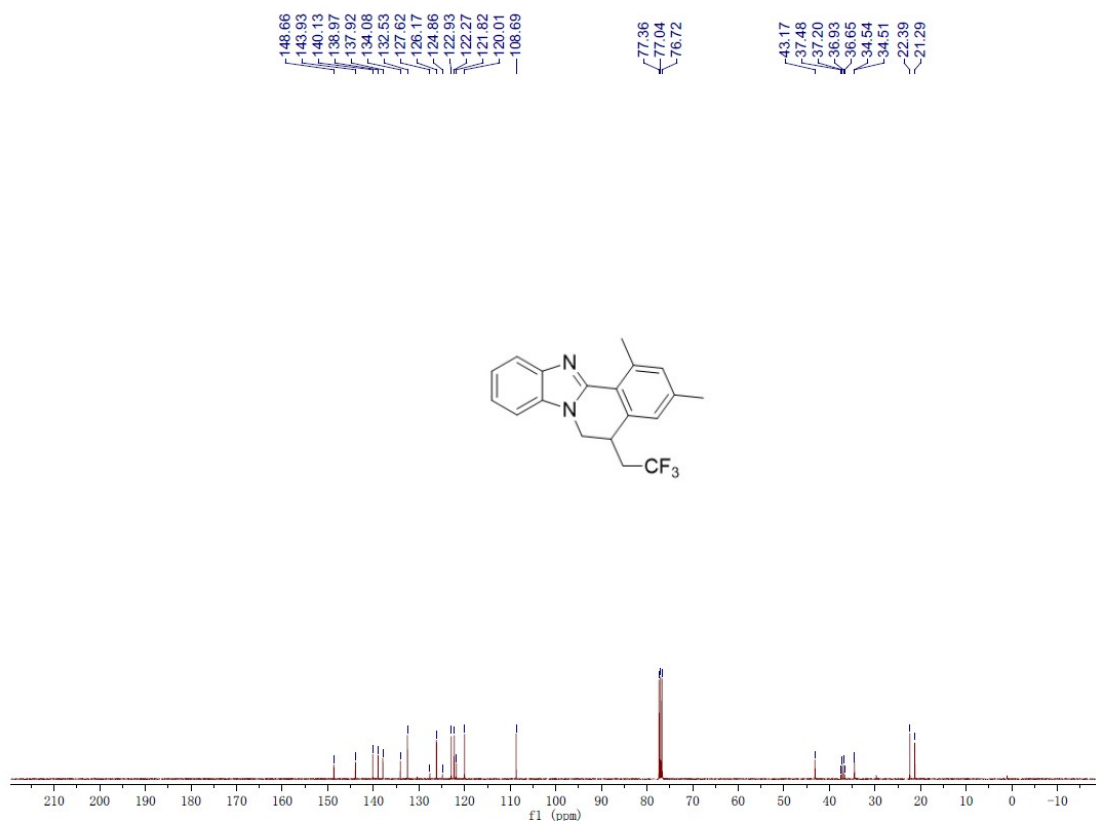


Figure S46 ¹³C NMR spectrum of **3n** (100 MHz, CDCl₃)

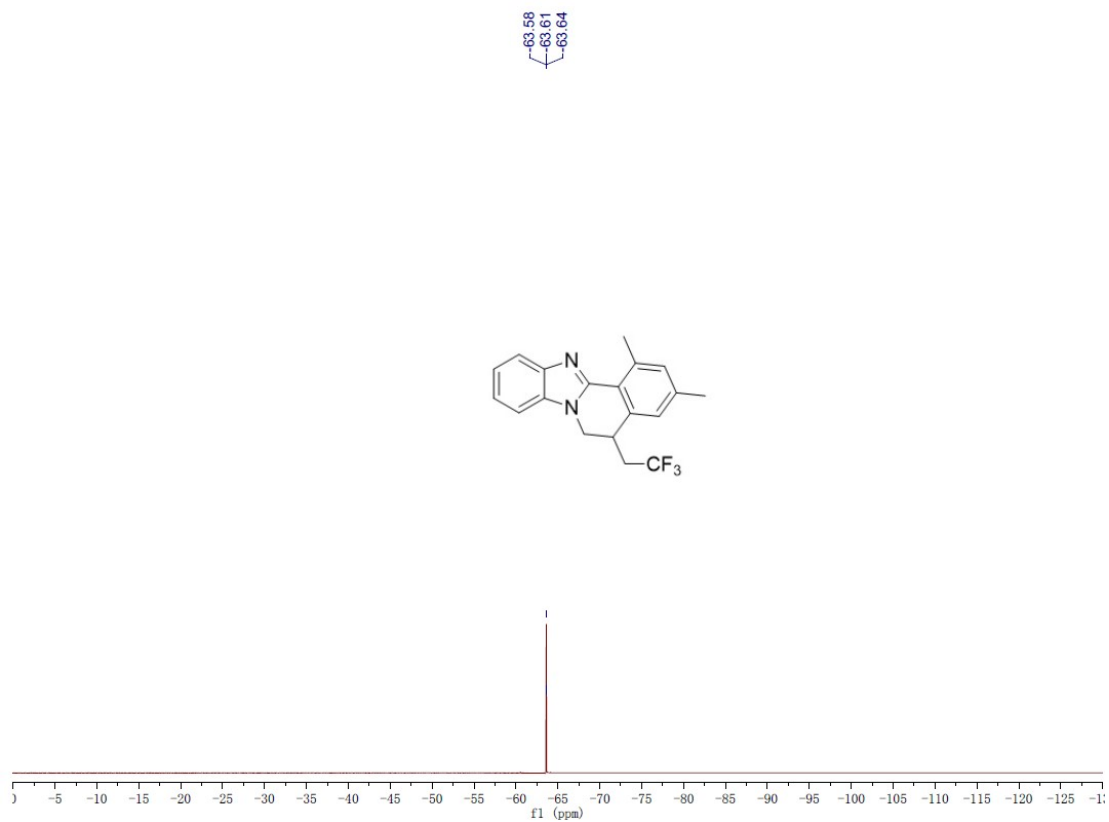


Figure S47 ^{19}F NMR spectrum of **3n** (376 MHz, CDCl_3)

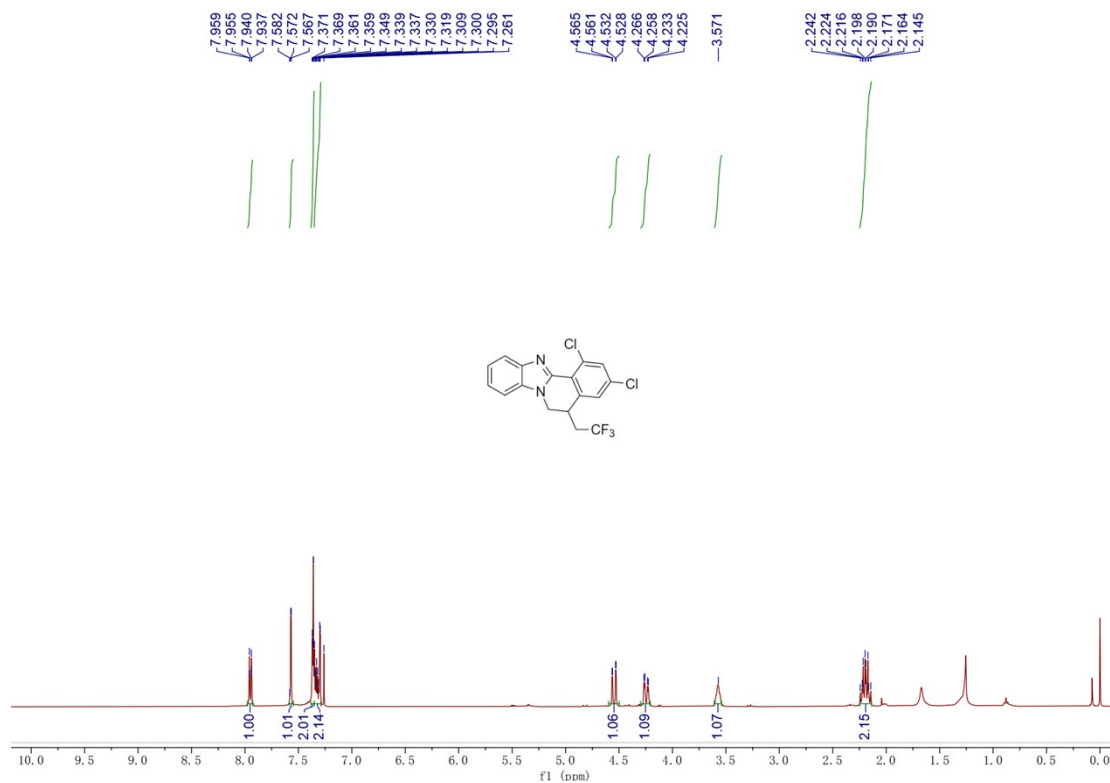


Figure S48 ^1H NMR spectrum of **3o** (400 MHz, CDCl_3)

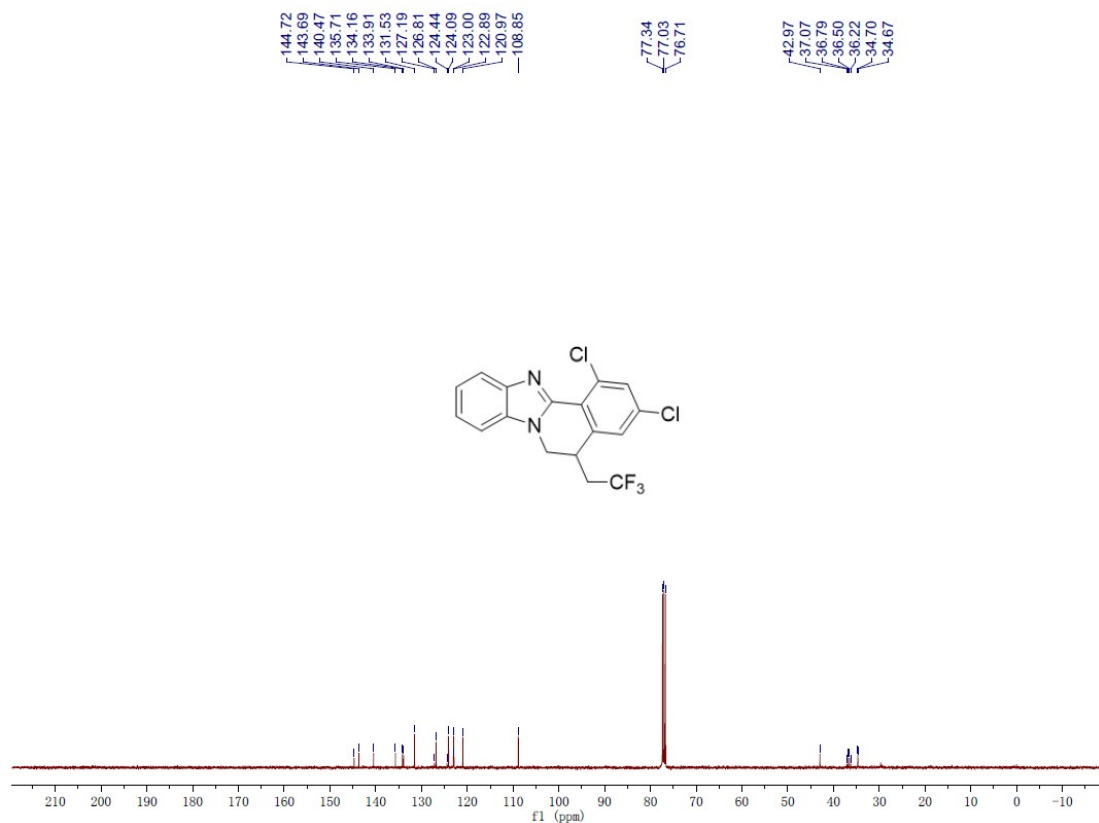


Figure S49 ^{13}C NMR spectrum of **3o** (100 MHz, CDCl_3)

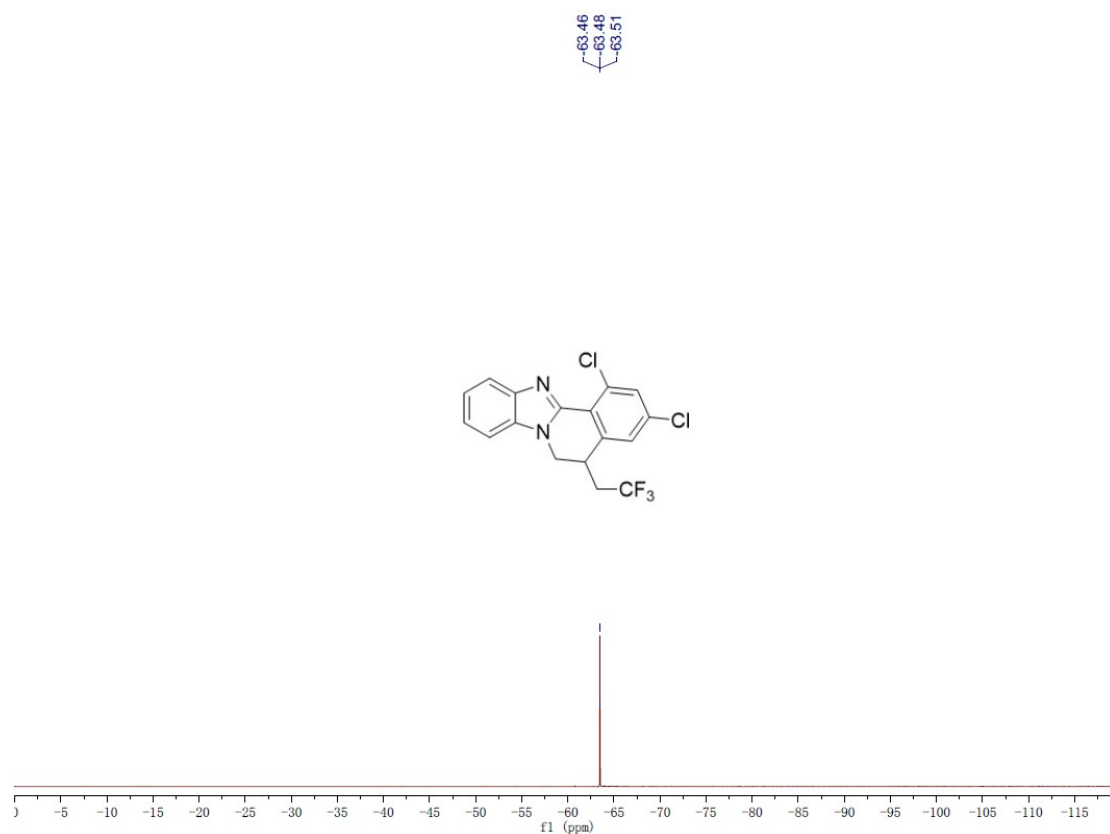


Figure S50 ^{19}F NMR spectrum of **3o** (376 MHz, CDCl_3)

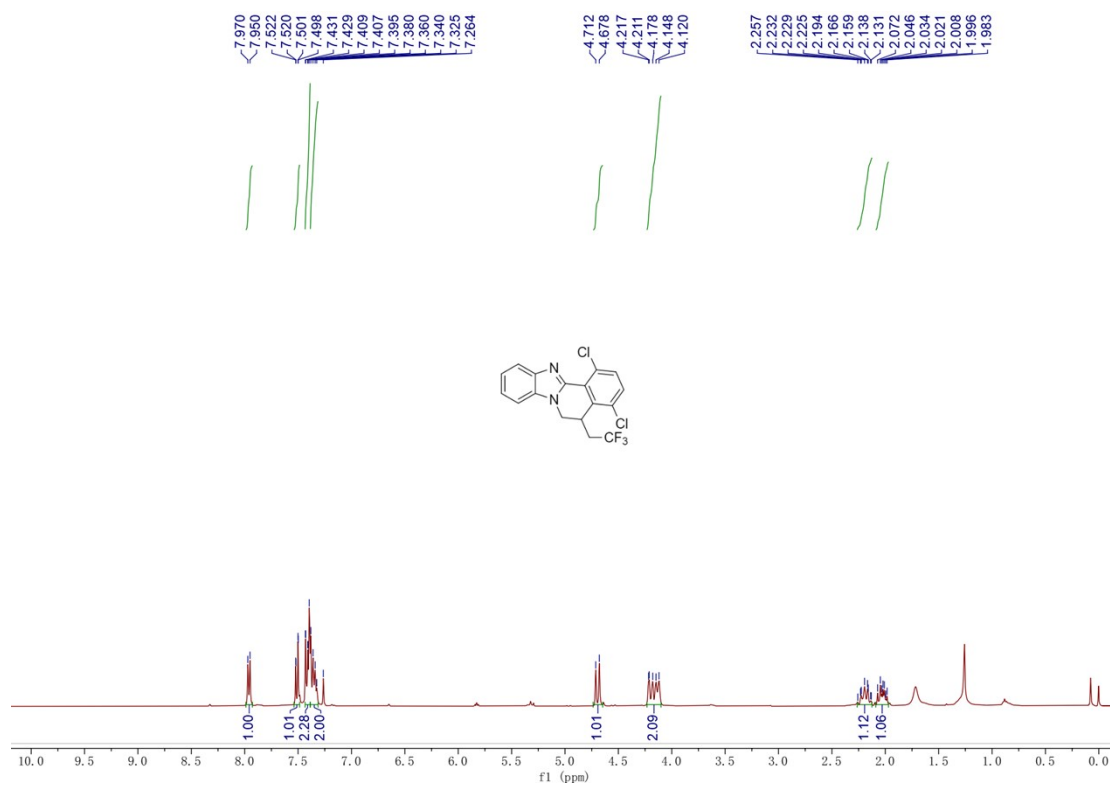


Figure S51 ^1H NMR spectrum of **3p** (400 MHz, CDCl_3)

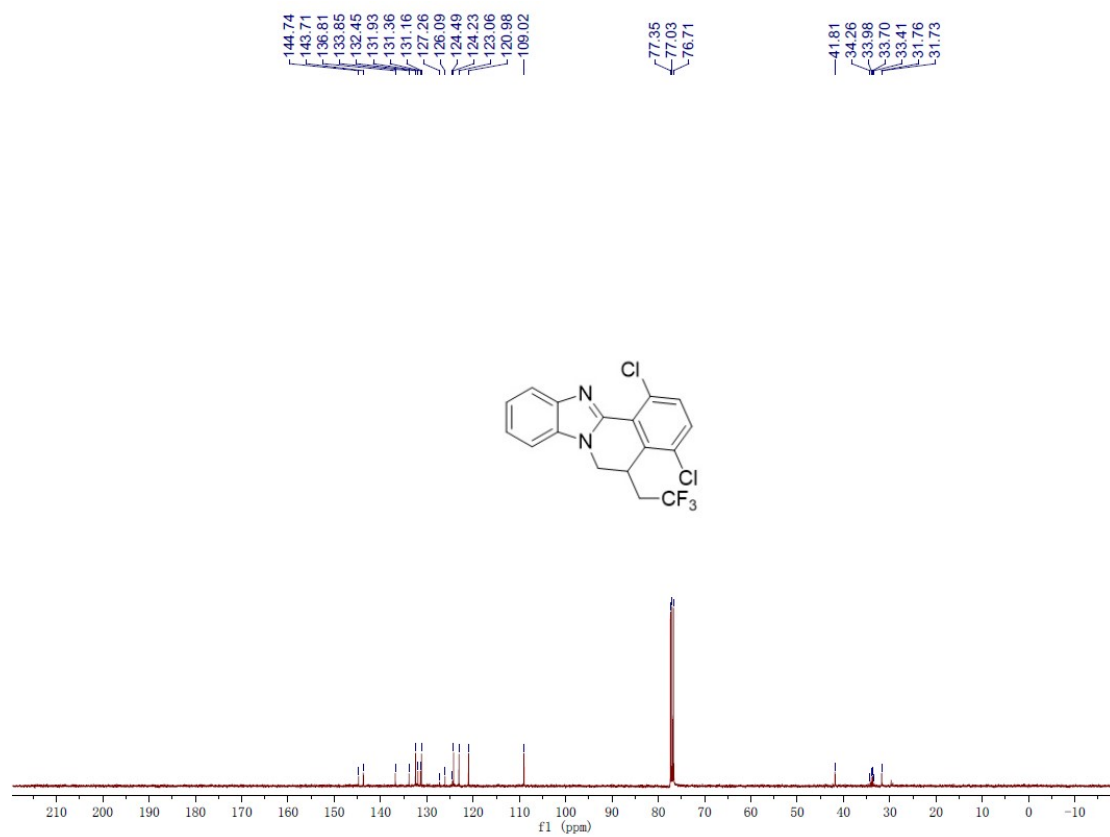


Figure S52 ^{13}C NMR spectrum of **3p** (100 MHz, CDCl_3)

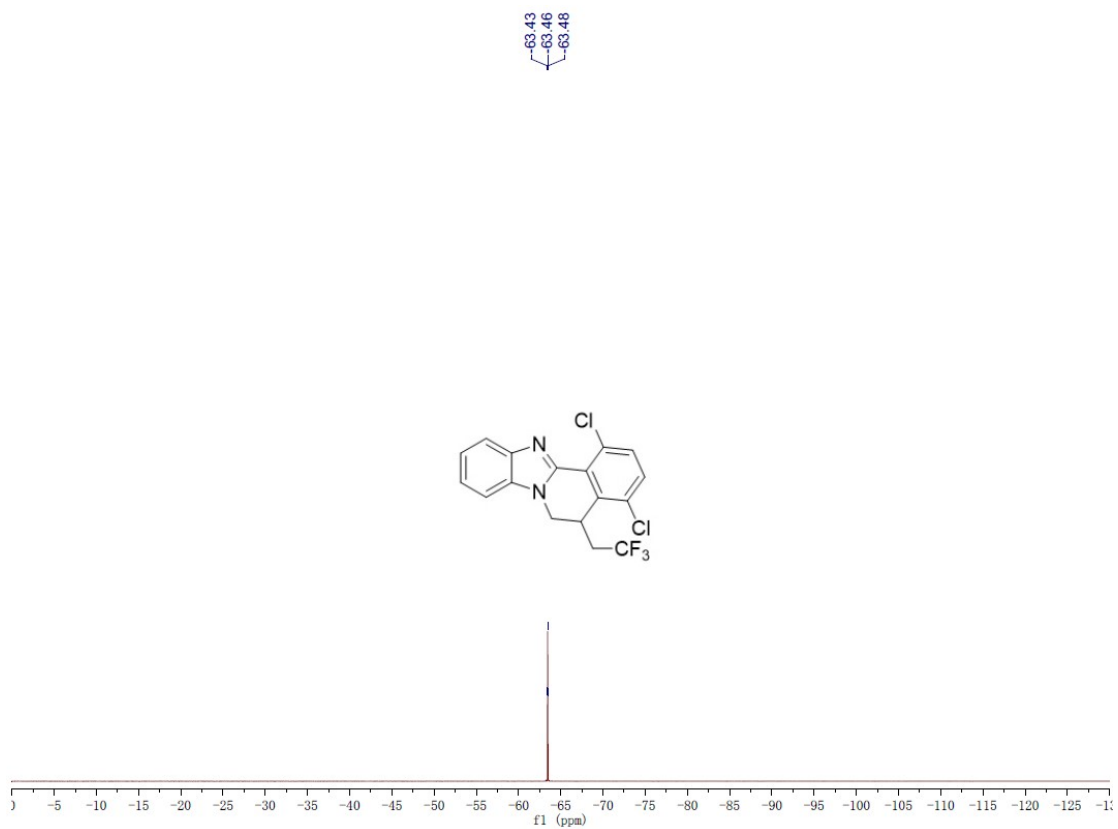


Figure S53 ^{19}F NMR spectrum of **3p** (376 MHz, CDCl_3)

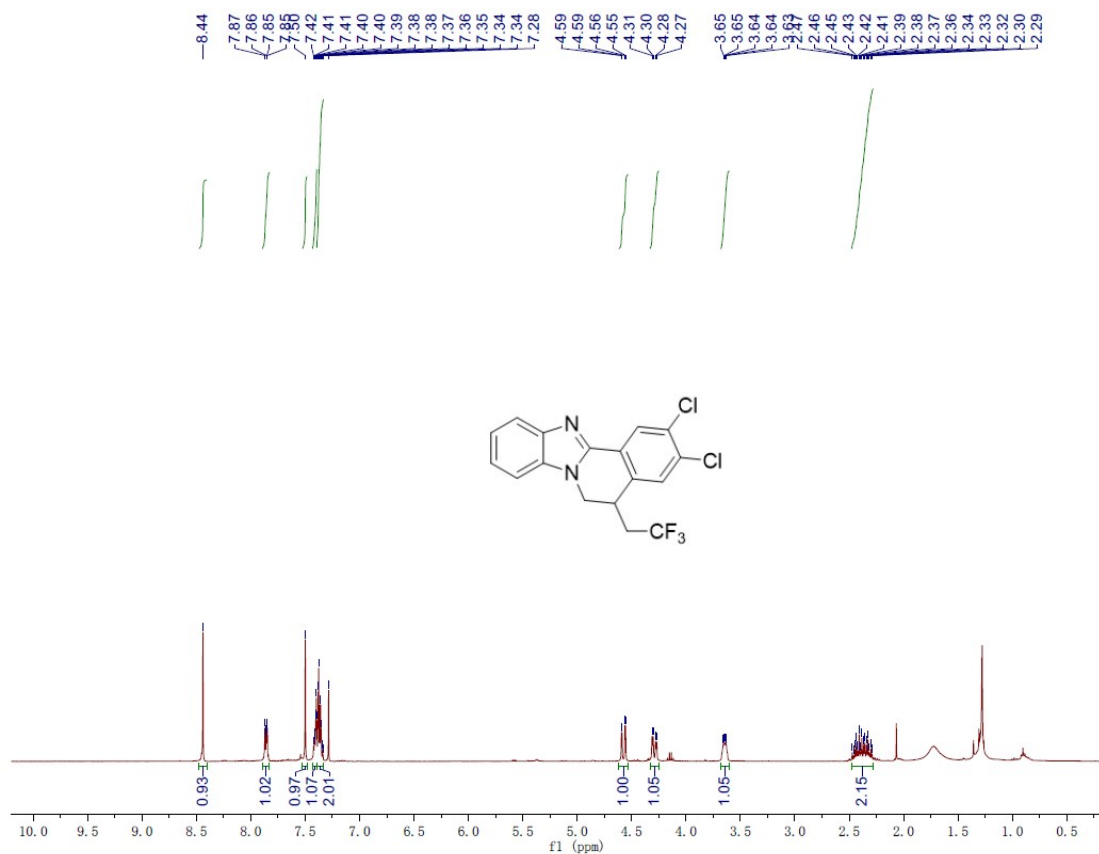


Figure S54 ¹H NMR spectrum of **3q** (400 MHz, CDCl₃)

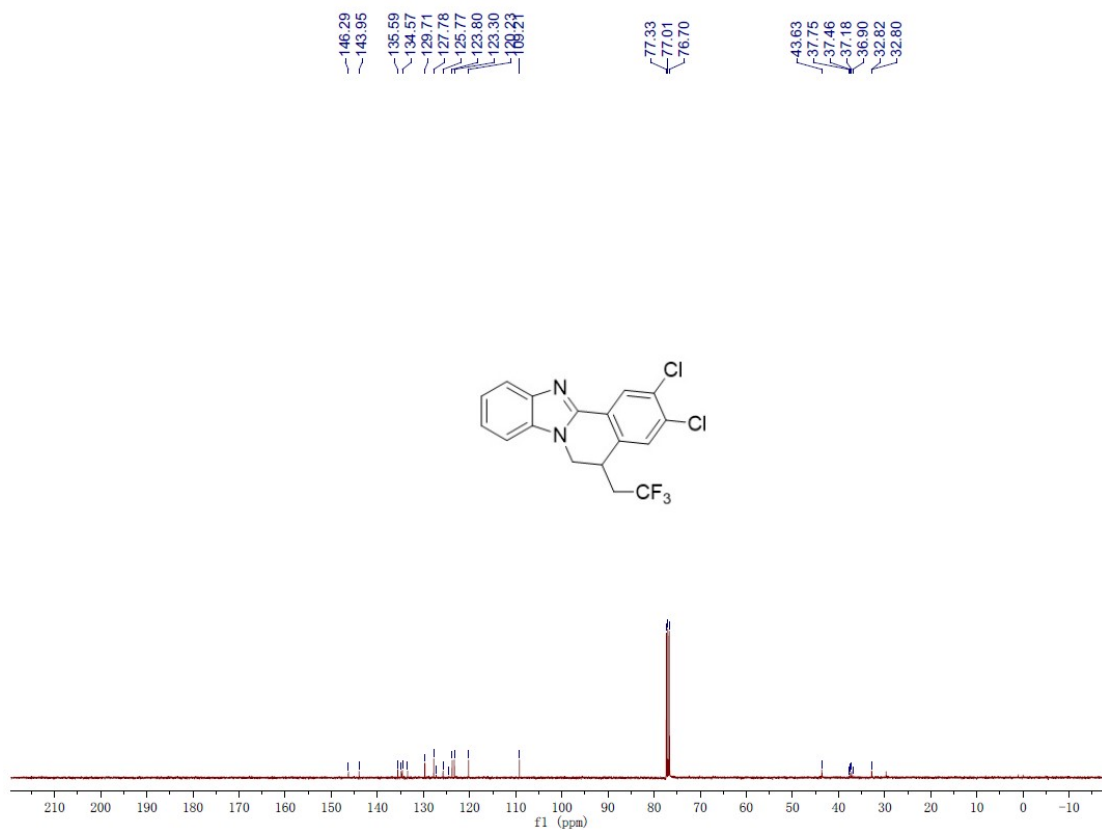


Figure S55 ¹³C NMR spectrum of **3q** (100 MHz, CDCl₃)

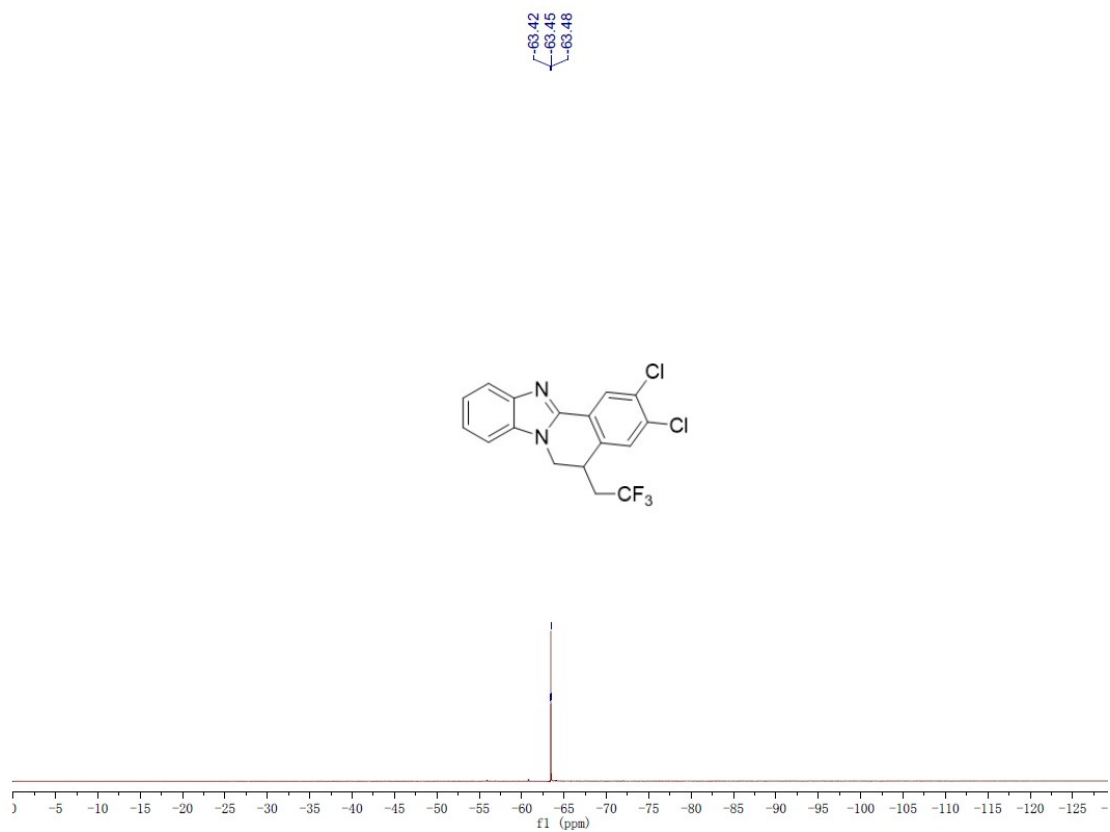


Figure S56 ^{19}F NMR spectrum of **3q** (376 MHz, CDCl_3)

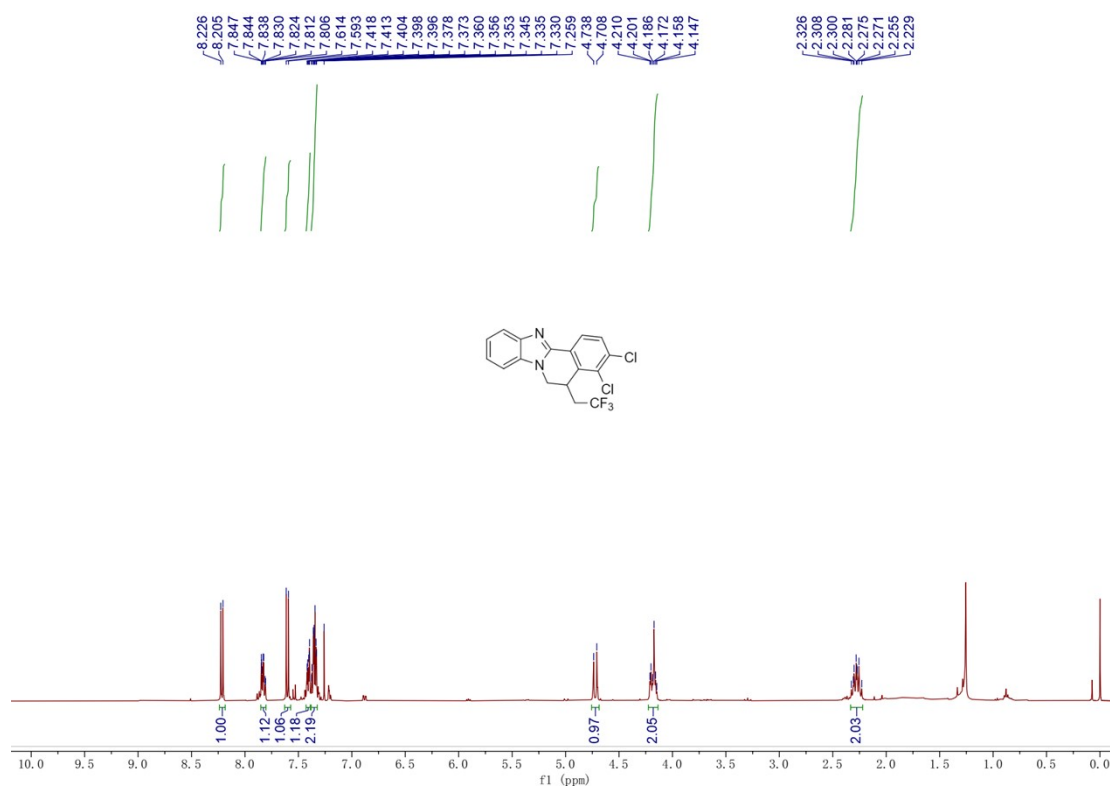


Figure S57 ¹H NMR spectrum of **3r** (400 MHz, CDCl₃)

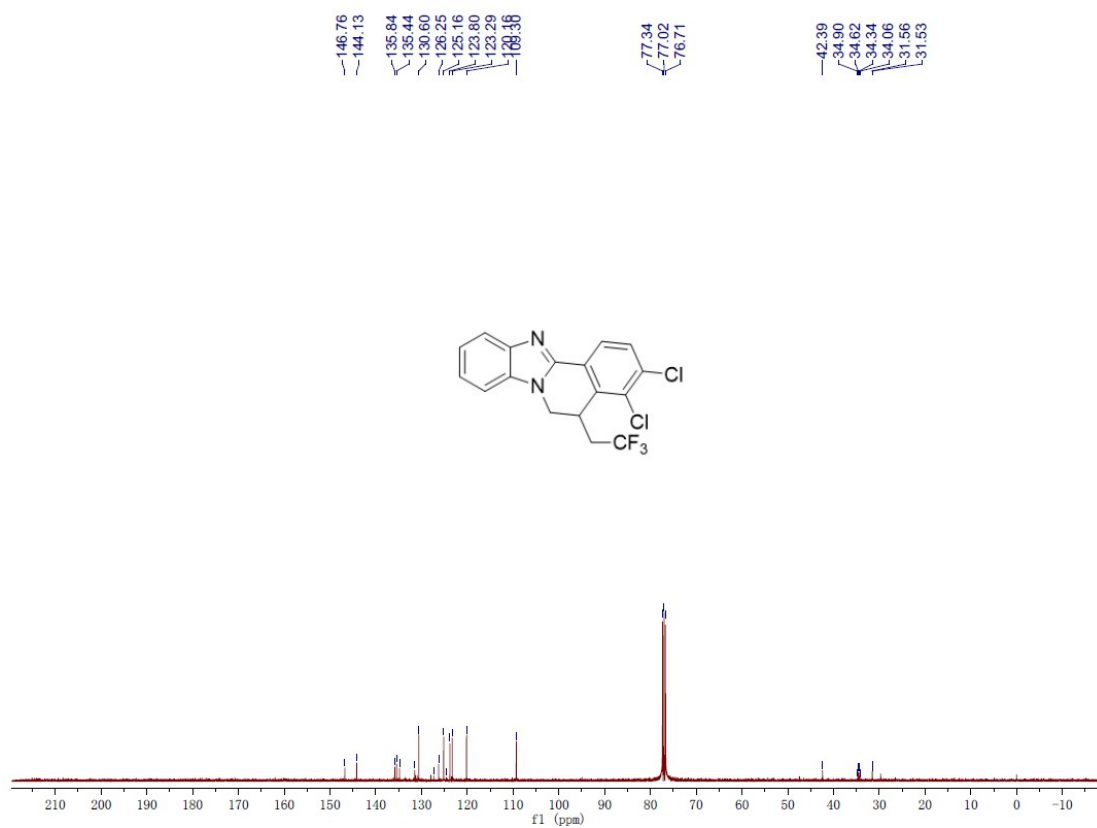


Figure S58 ¹³C NMR spectrum of **3r** (100 MHz, CDCl₃)

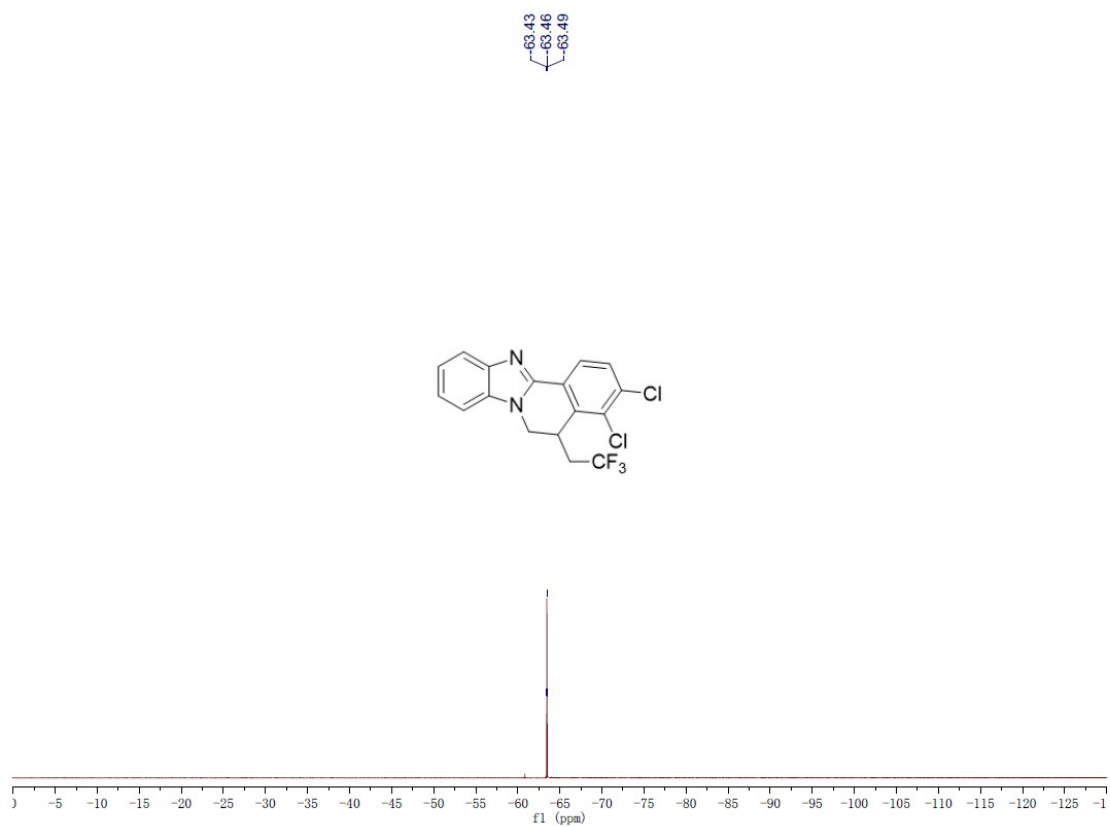


Figure S59 ^{19}F NMR spectrum of **3r** (376 MHz, CDCl_3)

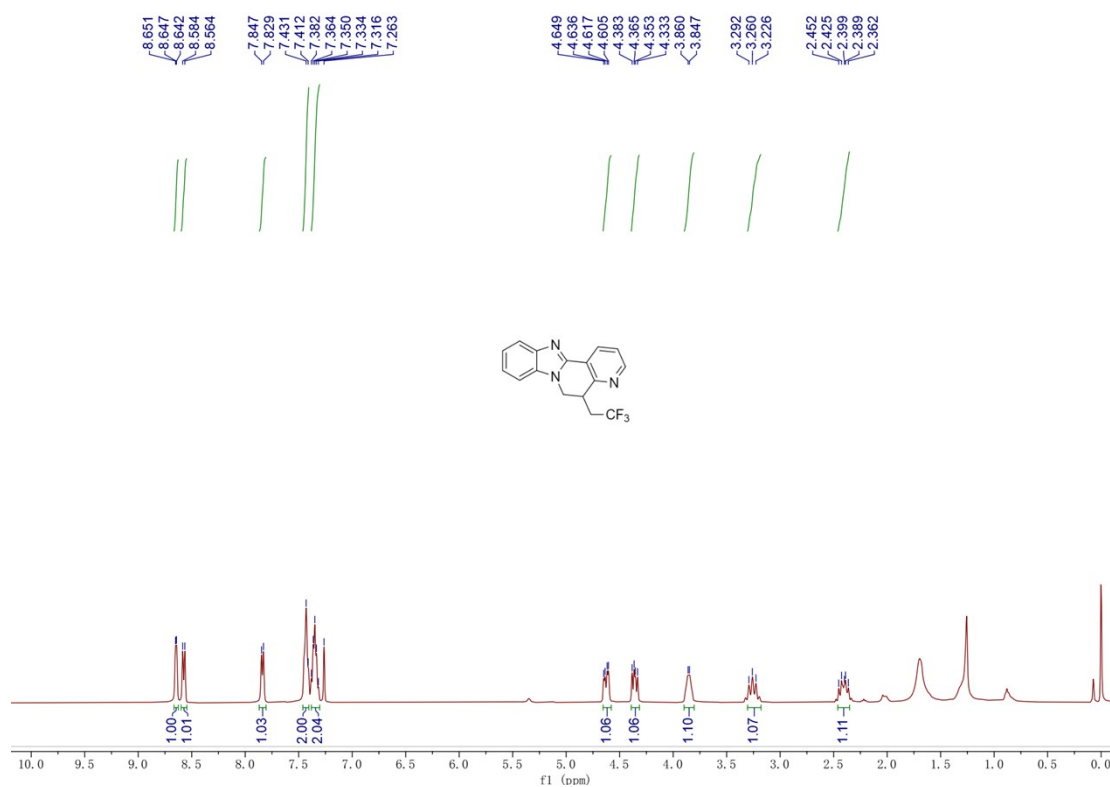


Figure S60 ¹H NMR spectrum of **3s** (400 MHz, CDCl₃)

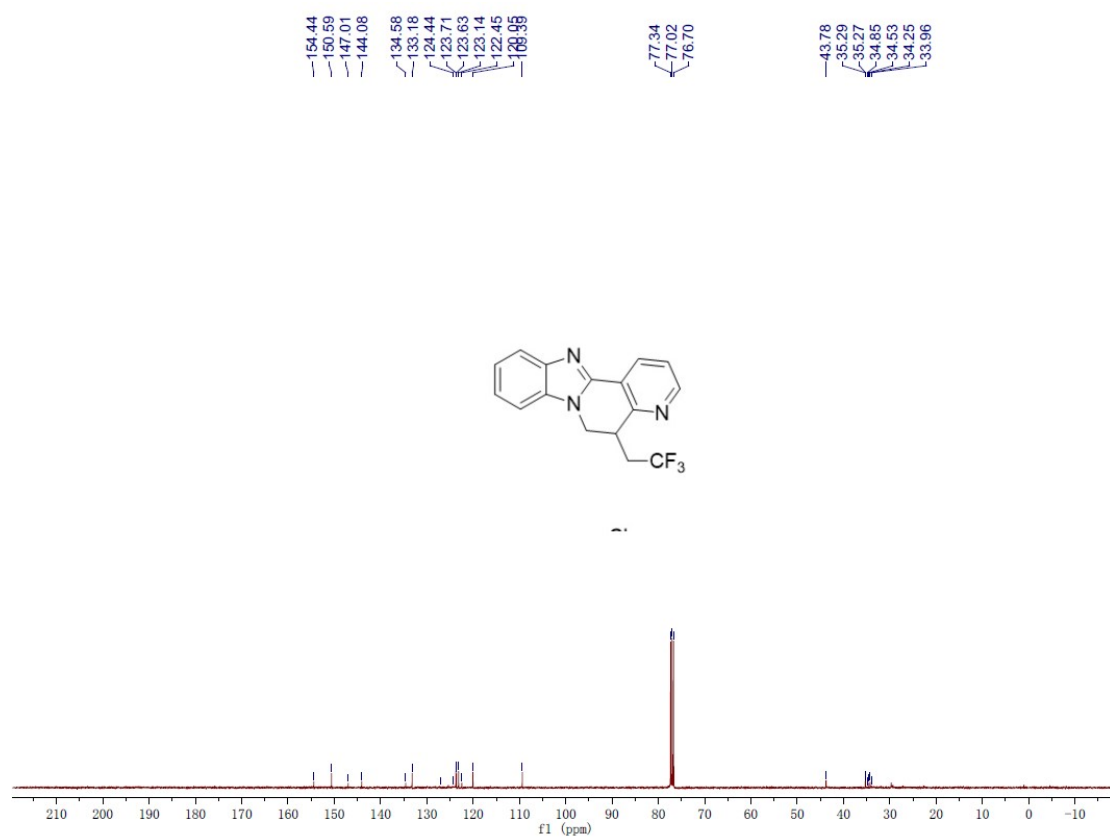


Figure S61 ¹³C NMR spectrum of **3s** (100 MHz, CDCl₃)

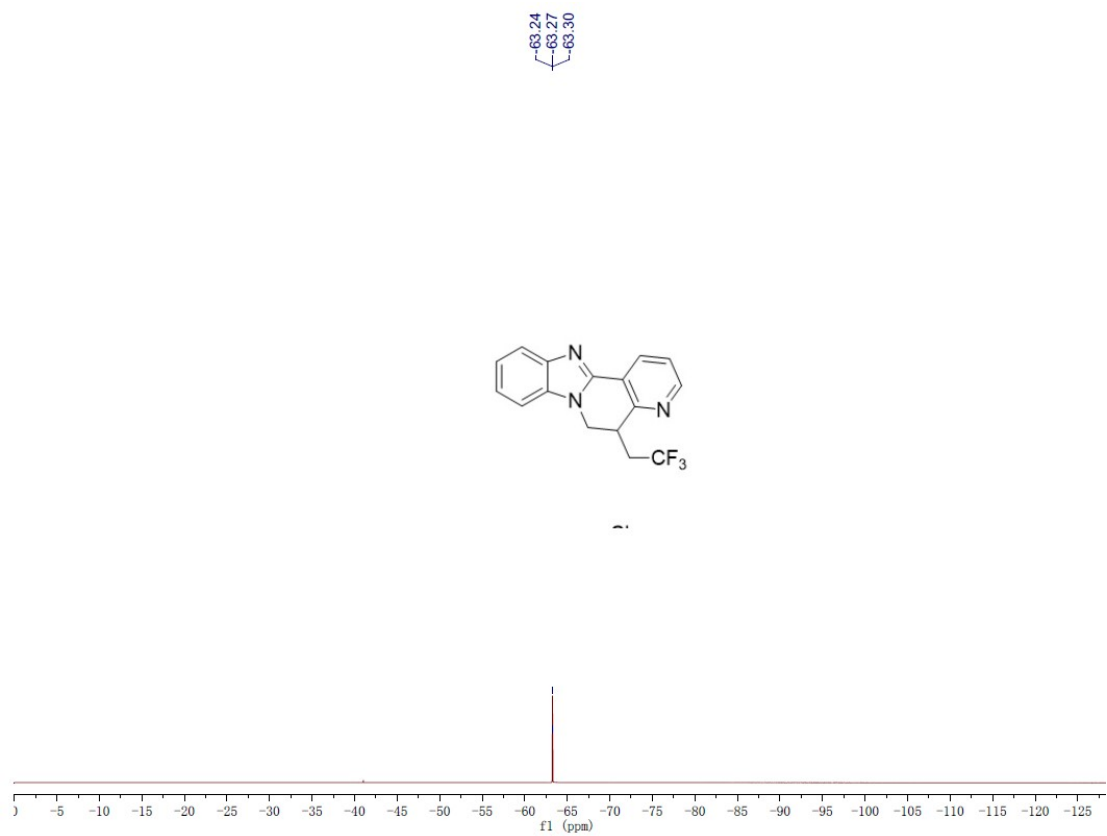


Figure S62 ^{19}F NMR spectrum of **3s** (376 MHz, CDCl_3)

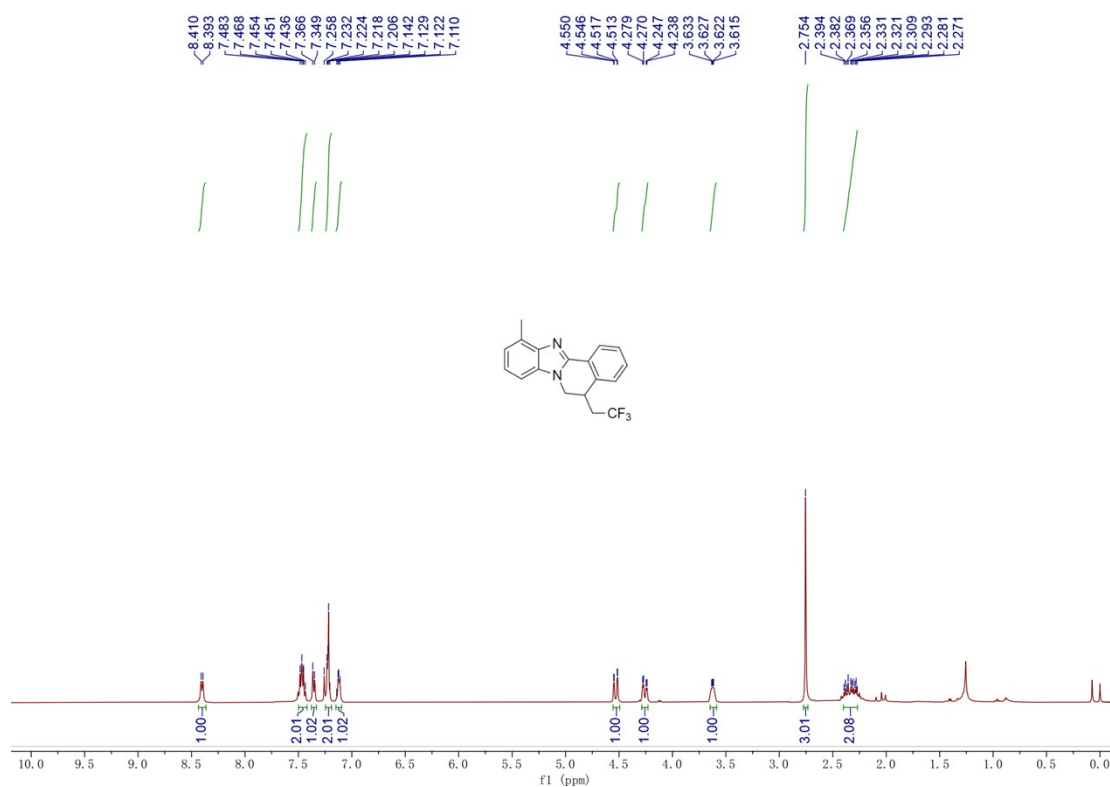


Figure S63 ¹H NMR spectrum of **3t** (400 MHz, CDCl₃)

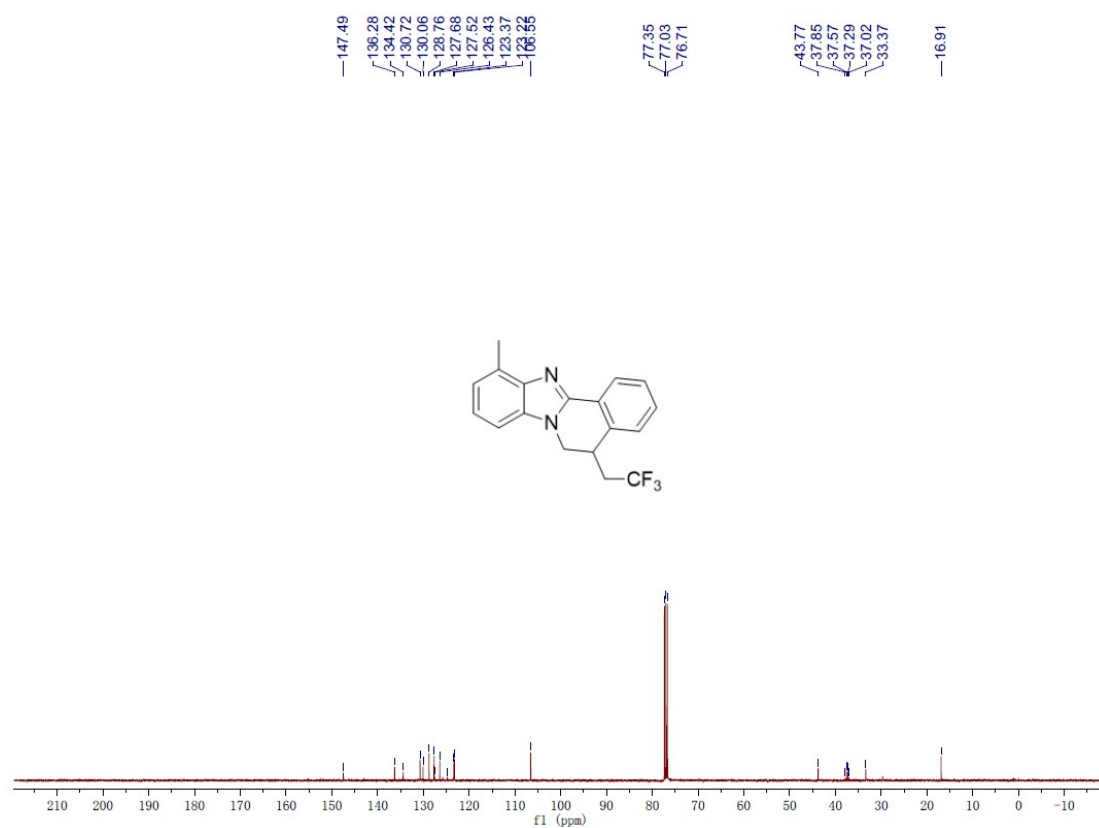


Figure S64 ¹³C NMR spectrum of **3t** (100 MHz, CDCl₃)

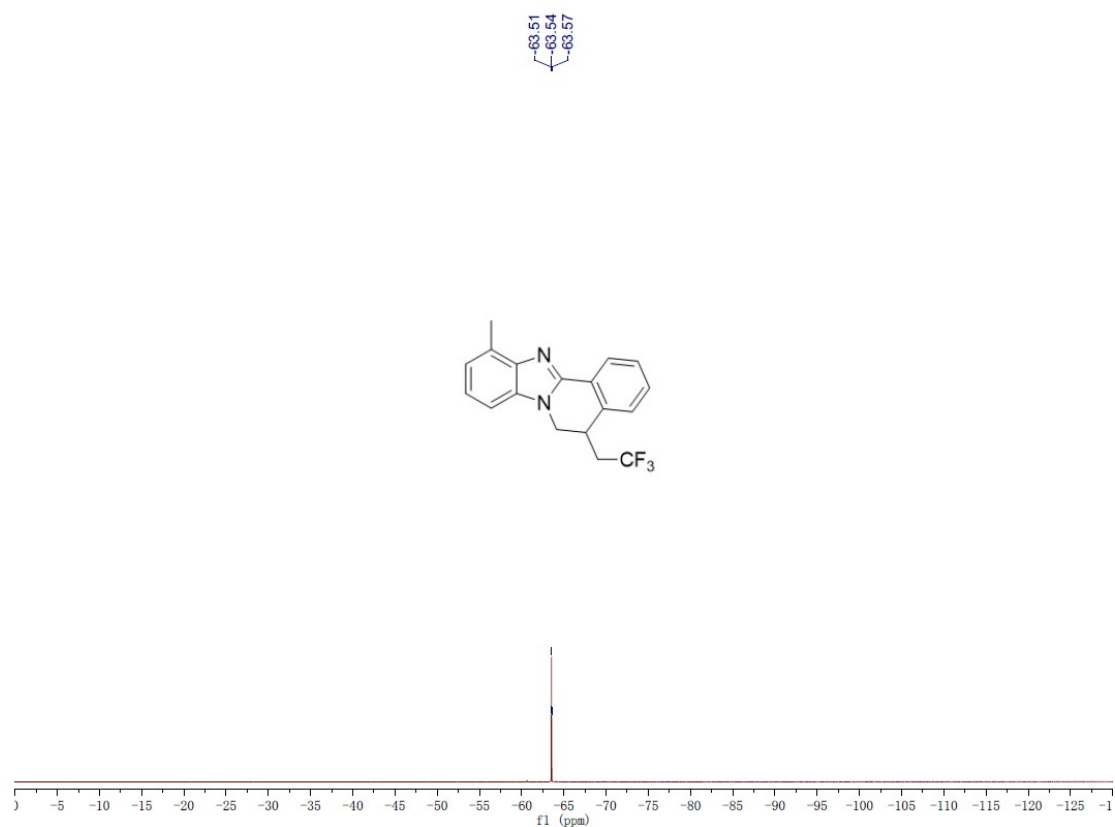


Figure S65 ^{19}F NMR spectrum of **3t** (376 MHz, CDCl_3)

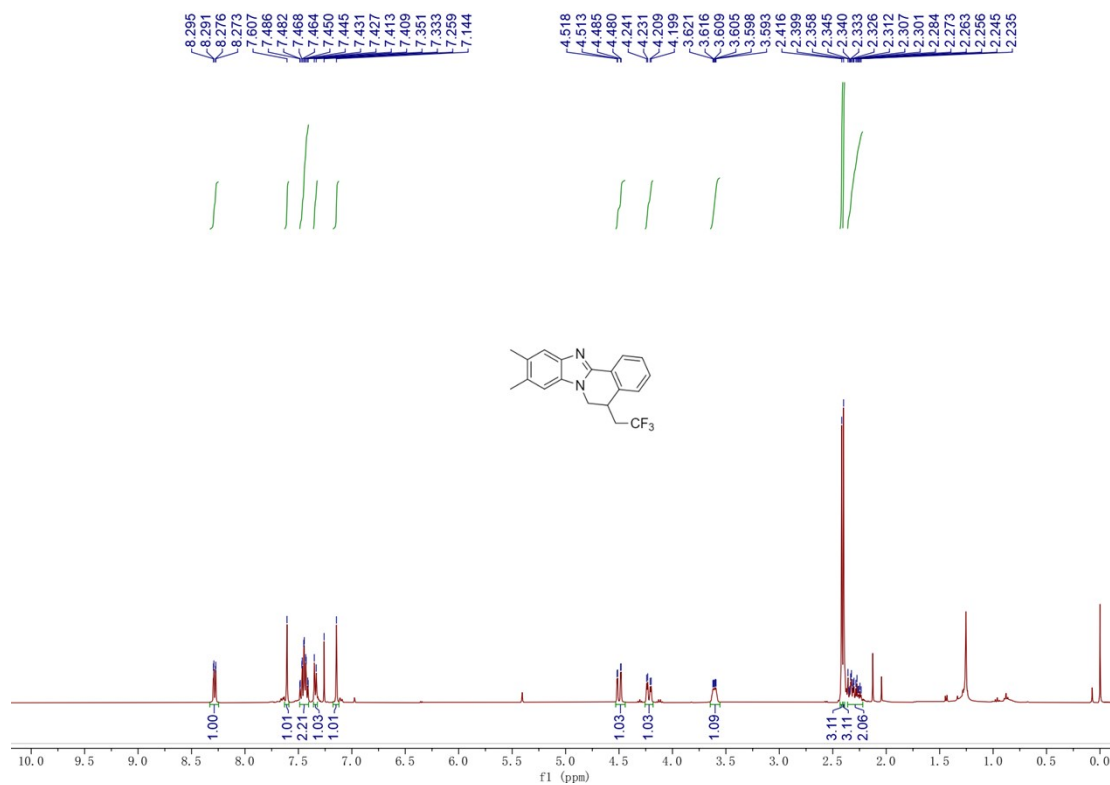


Figure S66 ¹H NMR spectrum of **3u** (400 MHz, CDCl₃)

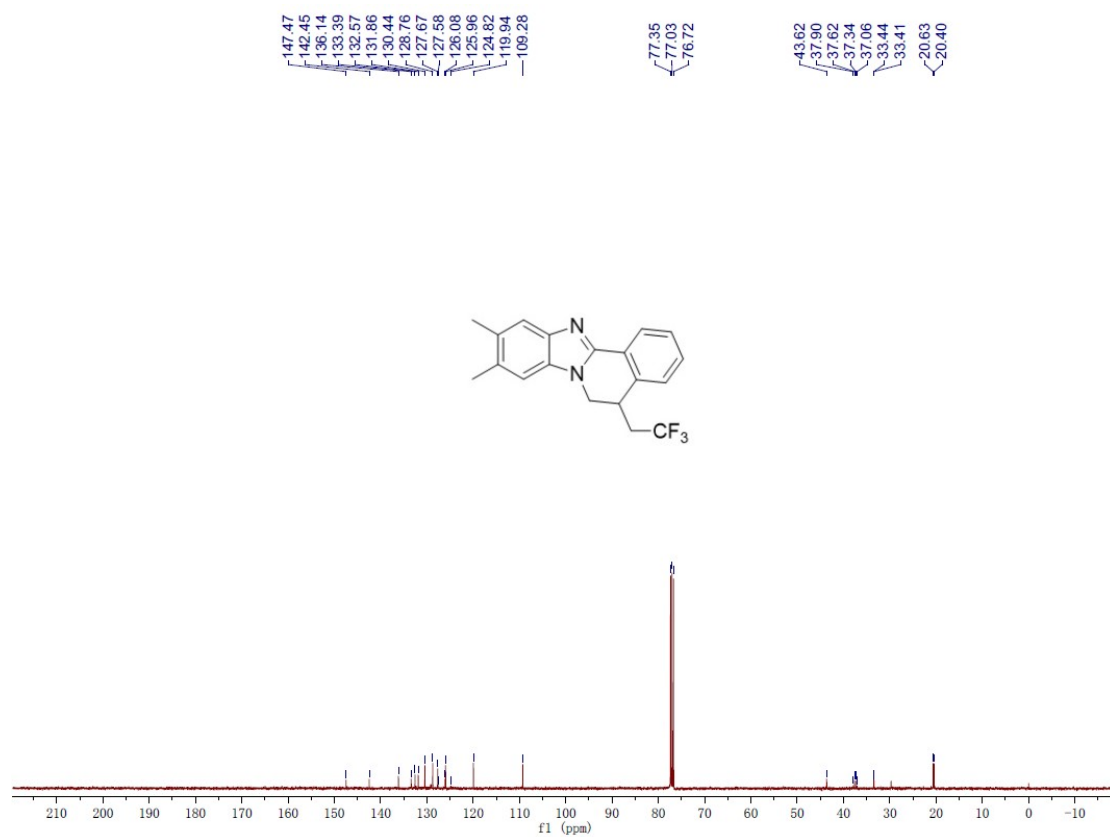


Figure S67 ¹³C NMR spectrum of **3u** (100 MHz, CDCl₃)

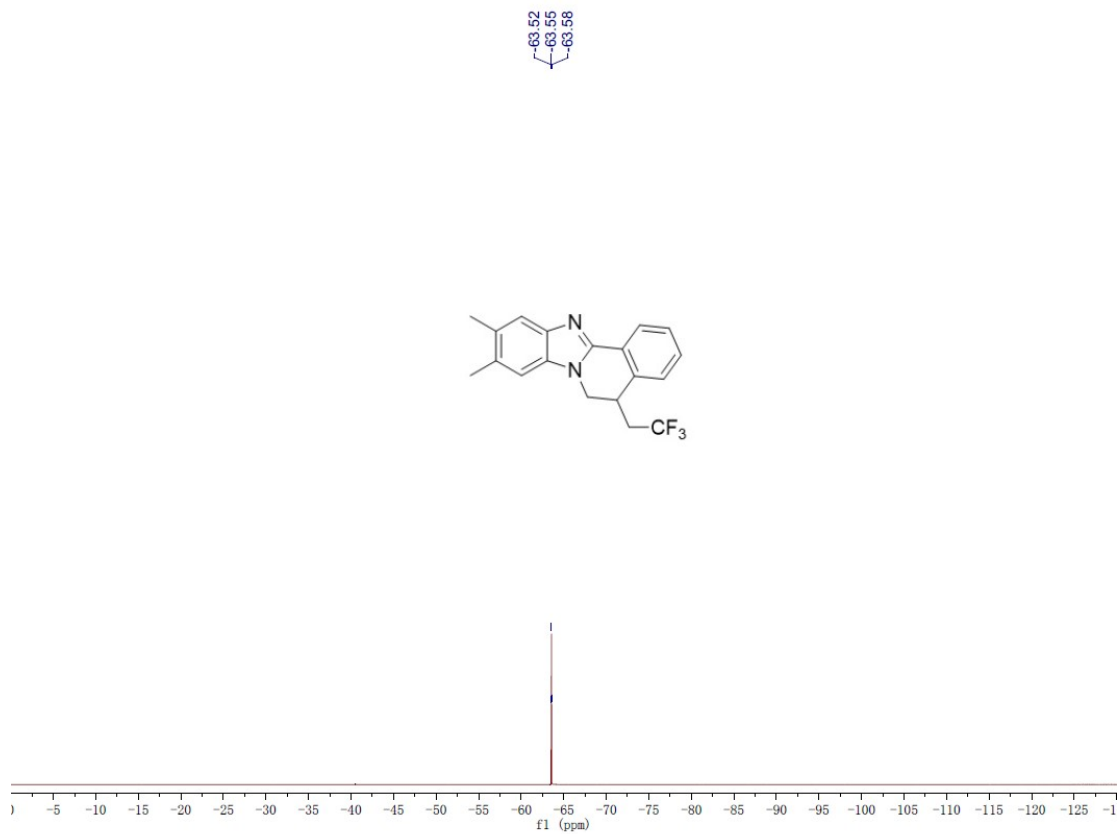


Figure S68 ^{19}F NMR spectrum of **3u** (376 MHz, CDCl_3)

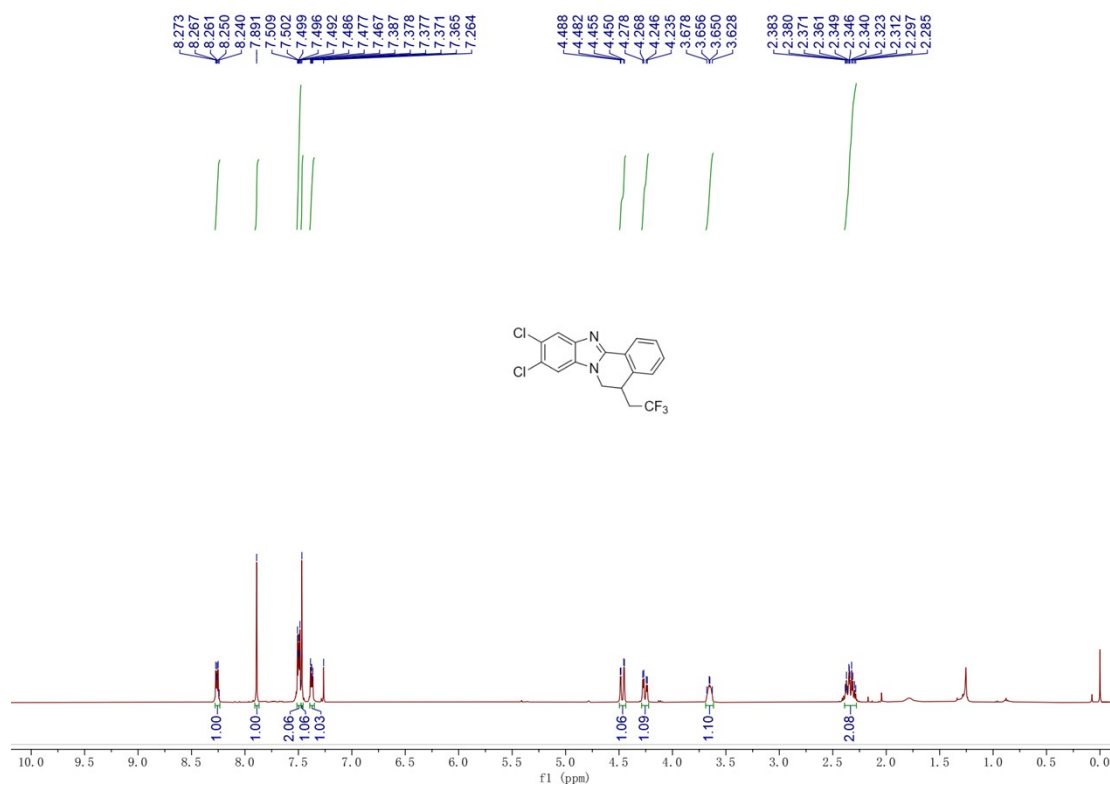


Figure S69 ^1H NMR spectrum of **3v** (400 MHz, CDCl_3)

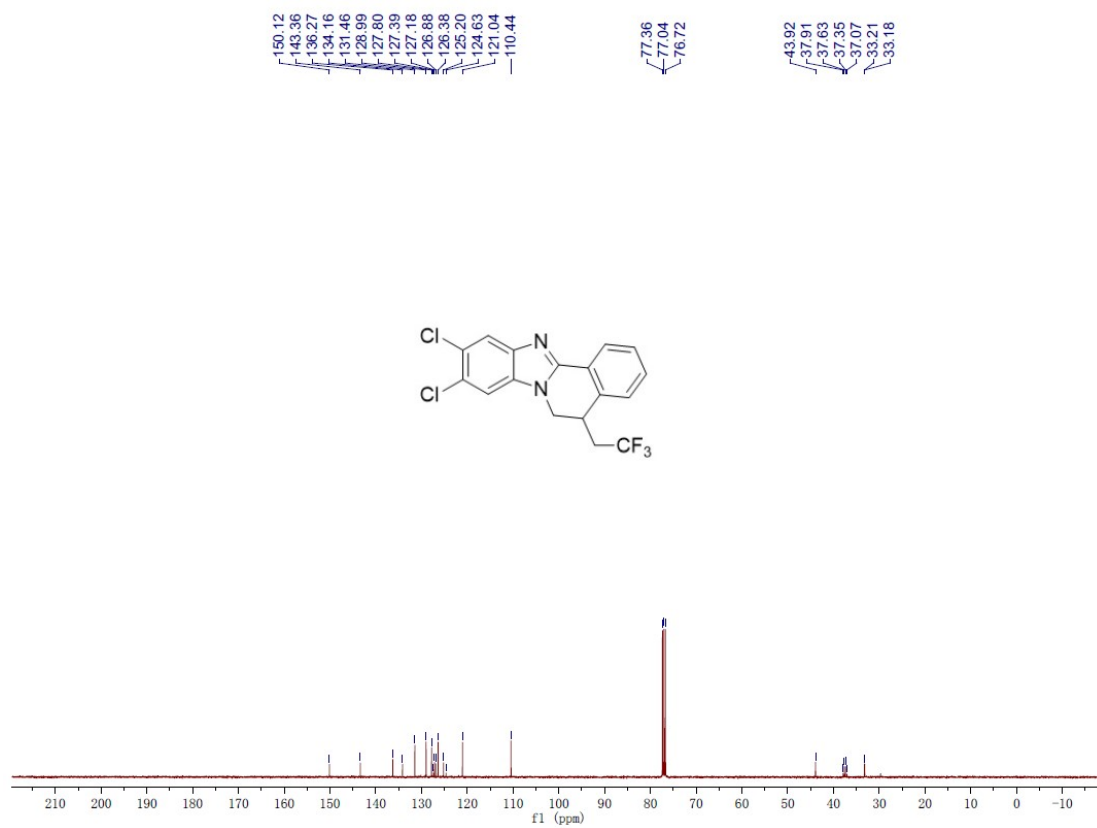


Figure S70 ^{13}C NMR spectrum of **3v** (100 MHz, CDCl_3)

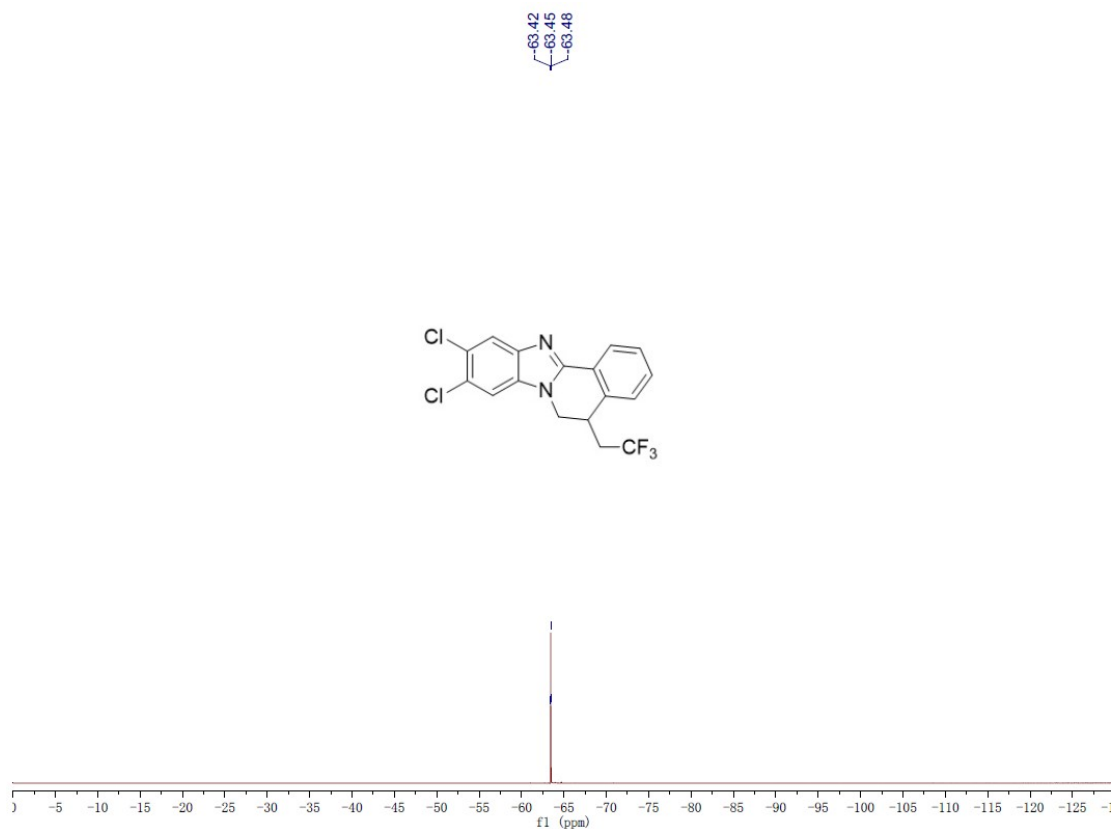
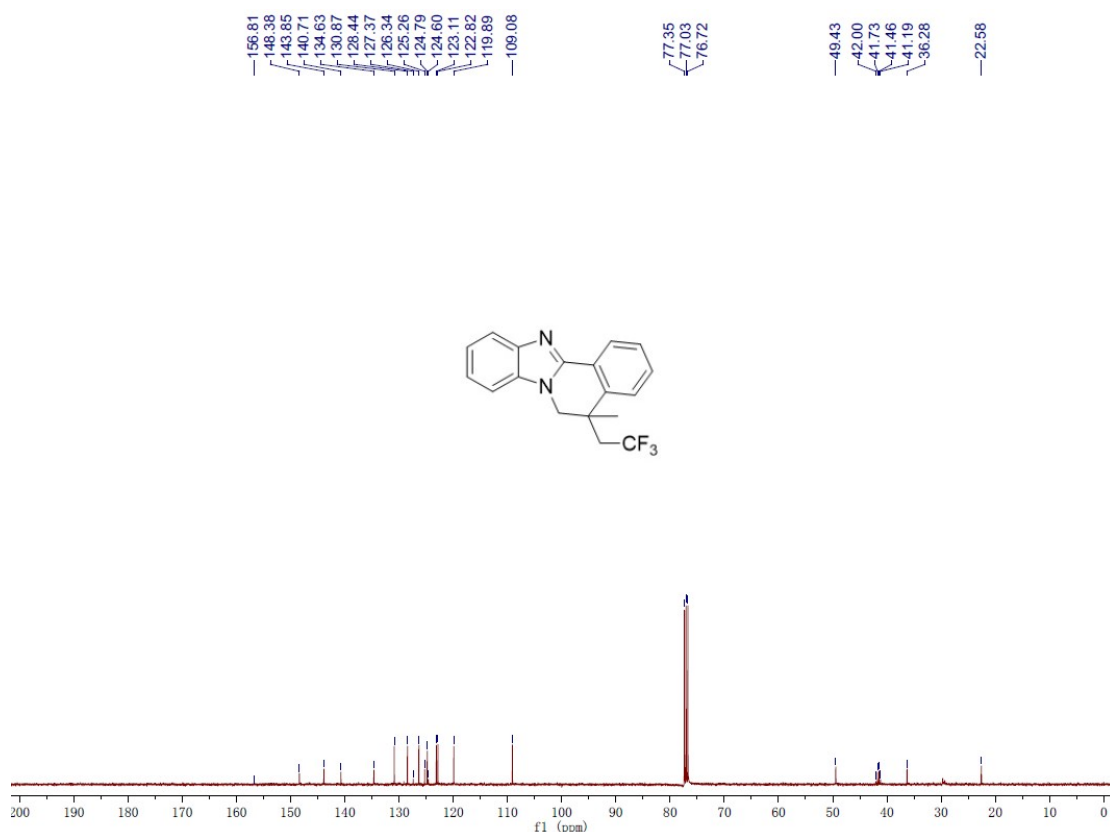
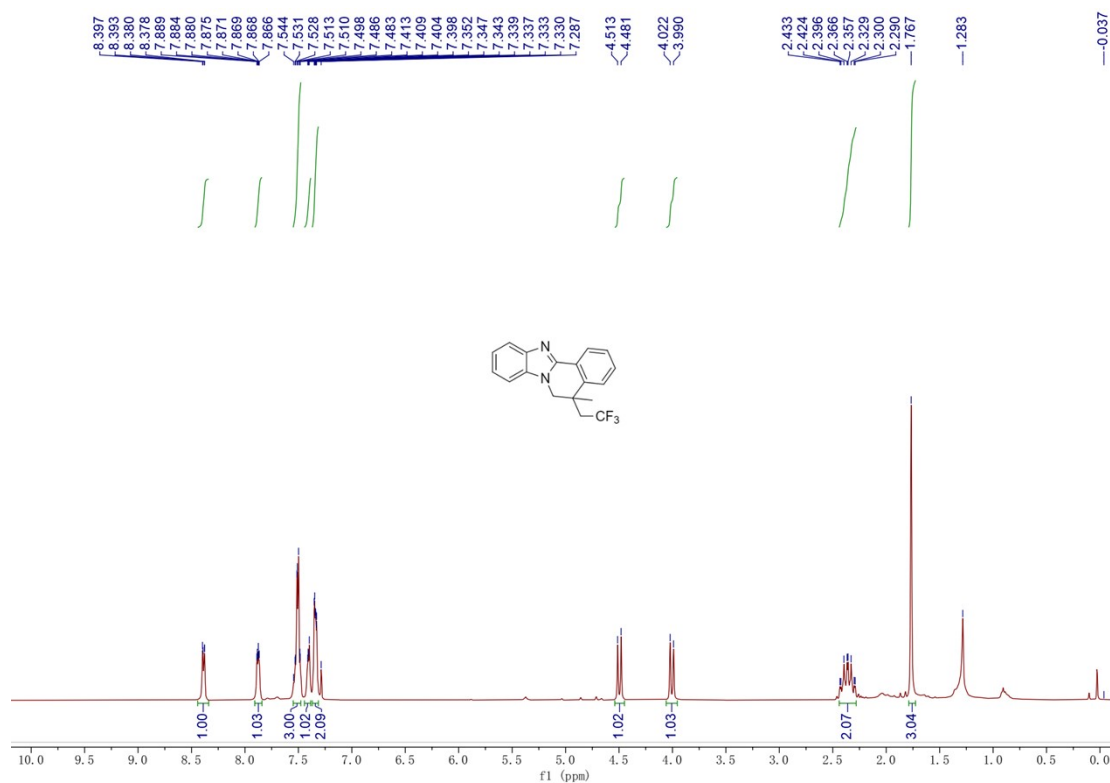


Figure S71 ¹⁹F NMR spectrum of **3v** (376 MHz, CDCl₃)



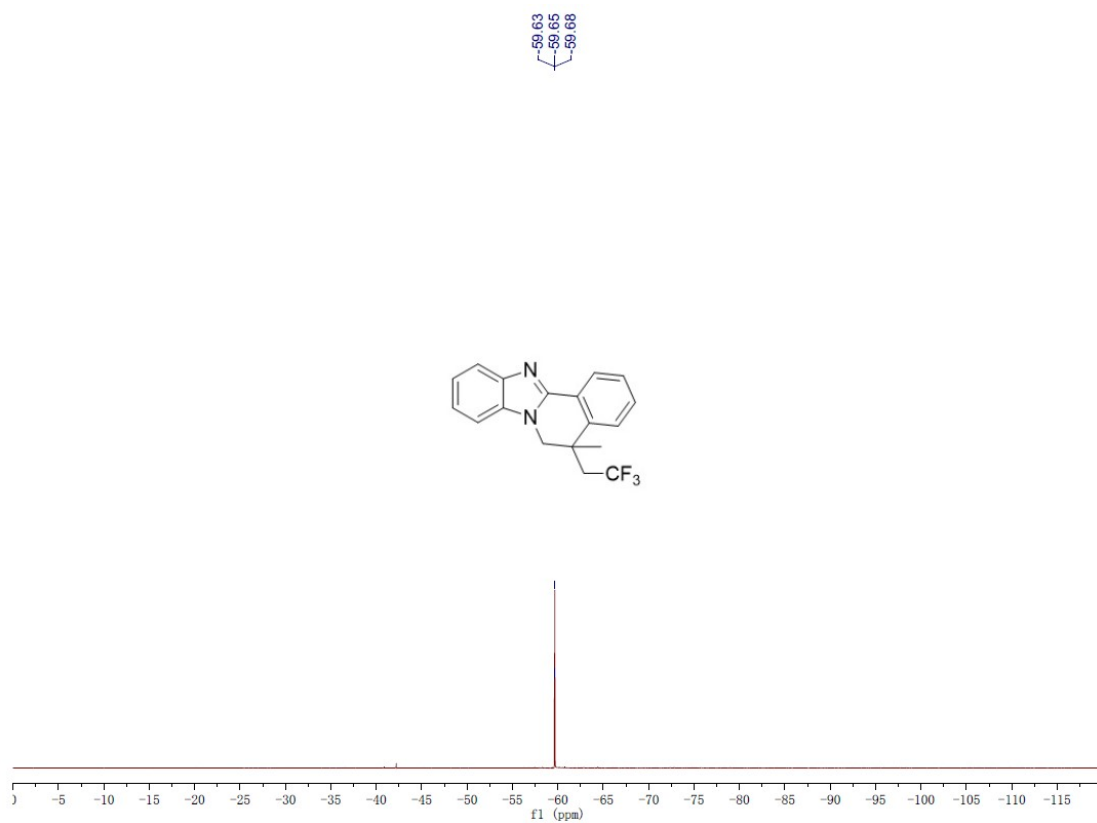


Figure S74 ^{19}F NMR spectrum of **3w** (376 MHz, CDCl_3)

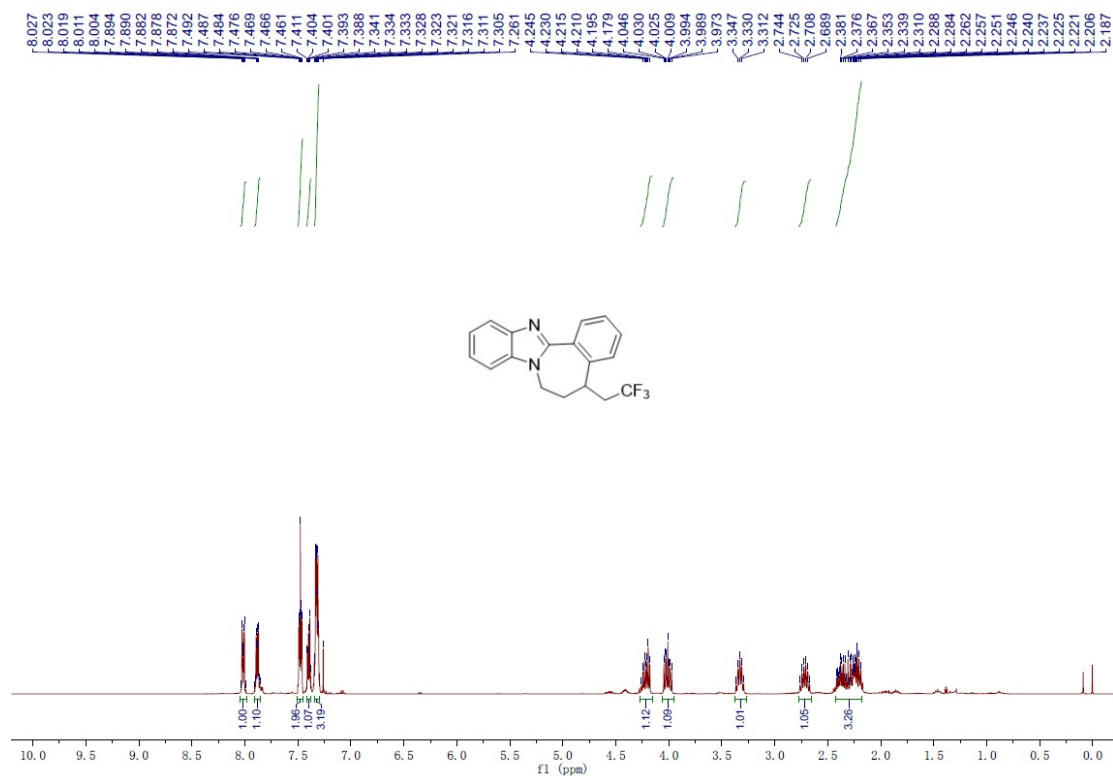


Figure S75 ¹H NMR spectrum of **3x** (400 MHz, CDCl₃)

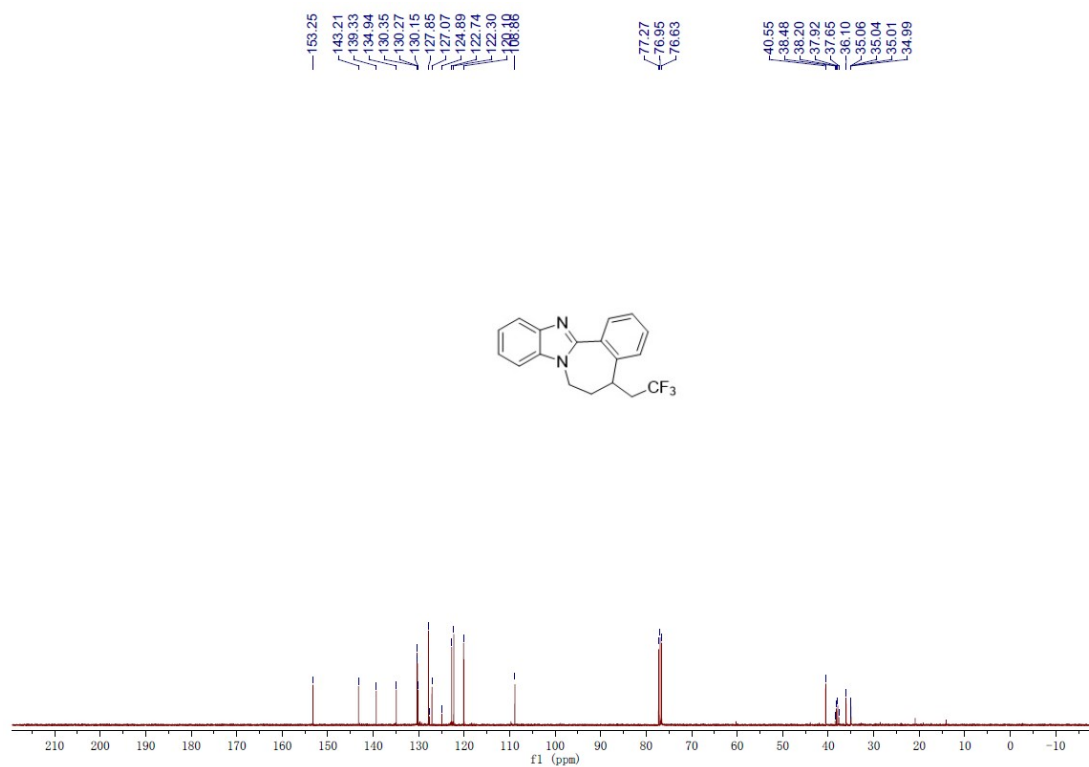


Figure S76 ¹³C NMR spectrum of **3x** (100 MHz, CDCl₃)



Figure S77 ^{19}F NMR spectrum of **3x** (376 MHz, CDCl_3)