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Supporting Information

for

Synthesis of 3-Fluoro-2,5-disubstituted Furans through Ring expansion of *gem*-Difluorocyclopropyl Ketones

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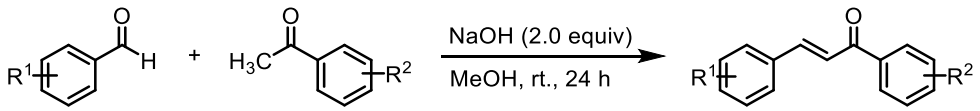
General Information

All reactions were carried out under an argon atmosphere in flame-dried glassware.

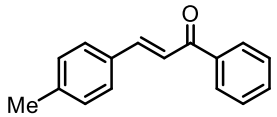
Syringes used to transfer anhydrous solvents or reagents were purged with argon prior to use. Most commercially supplied chemicals were purchased from commercial suppliers and used without further purification. THF was dried by reflux over Na chips in the presence of benzophenone as indicator. Analytical TLC was performed on aluminum silica gel 60 F_{254} (Merck) sheets, which were visualized by the quenching of UV fluorescence (254 nm). Column chromatography was conducted on silica gel (Cica, 60–210 mesh, spherical, neutral). NMR spectra were acquired on a JEOL JNM-ECA 600, JEOL JNM-ECS 400, and JNM-ECS 300 (400 MHz or 300 MHz for ^{1}H, 151 MHz or 76 MHz for ^{13}C, and 376 MHz or 283 MHz for ^{19}F, respectively) spectrometers. ^{1}H NMR spectra were recorded using TMS (Me_4Si) as the internal standard (δ = 0). ^{13}C NMR spectra were recorded relative to residual solvent peak (δ = 77.00). ^{19}F NMR spectra were recorded using hexafluorobenzene (C_6F_6) as an internal standard (δ = 0). GC-MS spectra (EI) were recorded on a Thermo TRACE DSQ. Elemental analyses were performed by J-Science Lab MICRO CORDER JM10 CHN analyzer. High-resolution mass spectra (ESI/DART) were recorded on a Thermo Scientific Exactive.

Synthesis of chalcones **1**[1a-c]

To a round bottom 100 mL flask, were added acetophenone (10 mmol), methanol (40 mL). Next, after addition of NaOH (20 mmol) and the corresponding benzaldehyde (10 mmol) to the flask, the mixture was stirred at room temperature in the air for a day. After that, observed crystals were filtrated and recrystallized from methanol. In the case that no crystal was observed after the reaction, the reaction mixture was extracted with ethyl acetate after the included volatiles had been evaporated. The organic layer was washed with water, dried over Na_2SO_4, and concentrated under reduced pressure. The residue after the extraction was purified with silica gel column chromatography (Hexane/AcOEt) affording the desired compound **1**.

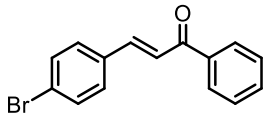


Compounds **1**



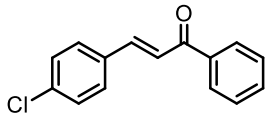
(E)-1-phenyl-3-(p-tolyl)prop-2-en-1-one[1c, 1f]

215.3 mg, 0.97 mmol, 32% (3.0 mmol scale), yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.40 (s, 3H), 7.22-7.27 (m, 2H), 7.48-7.61 (m, 6H), 7.80 (d, *J* = 16.0 Hz, 1H), 8.02 (d, *J* = 8.0 Hz, 2H). GC/MS *m/z* (%) 222 (M^+, 41), 207 (100), 179 (15), 145 (25), 115 (30), 105 (18), 91 (14), 77 (29).



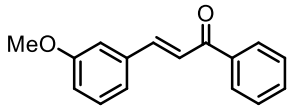
(E)-3-(4-bromophenyl)-1-phenylprop-2-en-1-one[1d]

301.5 mg, 1.1 mmol, 35% (3.0 mmol scale), yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50-7.62 (m, 8H), 7.75 (d, *J* = 16.0 Hz, 1H), 8.02 (d, *J* = 7.2 Hz, 2H). GC/MS *m/z* (%) 288 (M^++2, 40), 287 (35), 286 (M^+, 42), 207 (92), 179 (48), 130 (33), 105 (64), 102 (100), 77 (89).



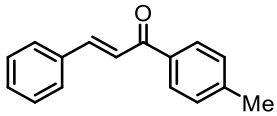
(E)-3-(4-chlorophenyl)-1-phenylprop-2-en-1-one[1c, 1f]

701.2 mg, 2.9 mmol, 29%, yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 (d, *J* = 8.4 Hz, 2H), 7.49-7.54 (m, 3H), 7.57-7.63 (m, 3H), 7.77 (d, *J* = 15.6 Hz, 1H), 8.02 (d, *J* = 8.0 Hz, 2H). GC/MS *m/z* (%) 242 (M^+, 100), 207 (77), 179 (52), 165 (51), 137 (31), 105 (63), 77 (78).



(E)-3-(3-methoxyphenyl)-1-phenylprop-2-en-1-one[1e]

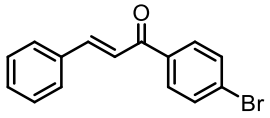
1301.7 mg, 5.5 mmol, 53% (10.4 mmol scale), yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.87 (s, 3H), 6.98 (dd, *J* = 8.0 Hz 2.6 Hz, 1H), 7.06-7.35 (m, 3H), 7.49-7.62 (m, 4H), 7.78 (d, *J* = 16.0 Hz, 1H), 8.03 (d, *J* = 8.0 Hz, 2H). GC/MS *m/z* (%) 238 (M^+, 81), 207 (100), 161 (38), 133 (23), 105 (49), 77 (83).



(E)-3-phenyl-1-(p-tolyl)prop-2-en-1-one[1f]

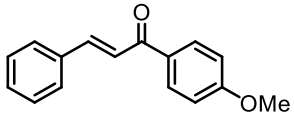
527.9 mg, 2.4 mmol, 23% (10.4 mmol scale), yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ

2.45 (s, 3H), 7.31 (d, J = 7.8 Hz, 2H), 7.41-7.43 (m, 3H), 7.55 (d, J = 15.6 Hz, 1H), 7.64-7.66 (m, 2H), 7.81 (d, J = 16.0 Hz, 1H), 7.95 (d, J = 8.0 Hz, 2H). GC/MS *m/z* (%) 222 (M^+, 100), 207 (23), 179 (23), 131 (22), 103 (23), 91 (34), 77 (18).



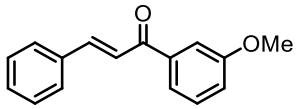
(E)-1-(4-bromophenyl)-3-phenylprop-2-en-1-one[1g]

775.3 mg, 2.7 mmol, 27%, white solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42-7.45 (m, 3H), 7.49 (d, J = 15.6 Hz, 1H), 7.66 (m, 4H), 7.83 (d, J = 15.6 Hz, 1H), 7.90 (d, J = 8.4 Hz, 2H). GC/MS *m/z* (%) 288 (M^++2, 56), 287 (100), 286 (M^+, 56), 207 (70), 178 (52), 154 (31), 131 (64), 103 (79), 77 (64).



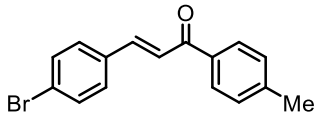
(E)-1-(4-methoxyphenyl)-3-phenylprop-2-en-1-one[1g]

1106.6 mg, 4.6 mmol, 47%, white solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.90 (s, 3H), 6.97-7.02 (m, 2H), 7.41-7.45 (m, 3H), 7.56 (d, J = 16.0 Hz, 1H), 7.64-7.68 (m, 2H), 7.81 (d, J = 15.6 Hz, 1H), 8.03-8.07 (m, 2H). GC/MS *m/z* (%) 238 (M^+, 100), 223 (18), 195 (16), 135 (88), 103 (31), 77 (60).



(E)-1-(3-methoxyphenyl)-3-phenylprop-2-en-1-one[1g]

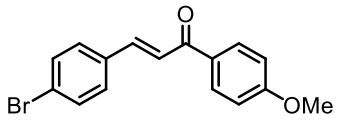
1048.5 mg, 4.4 mmol, 44%, yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.89 (s, 3H), 7.13-7.16 (m, 1H), 7.38-7.45 (m, 4H), 7.54-7.58 (m, 2H), 7.59-7.68 (m, 3H), 7.82 (d, J = 15.6 Hz, 1H). GC/MS *m/z* (%) 239 (14), 238 (M^+, 85), 237 (100), 194 (11), 165 (12), 131 (50), 103 (54), 77 (57).



(E)-3-(4-bromophenyl)-1-(*p*-tolyl)prop-2-en-1-one[1g]

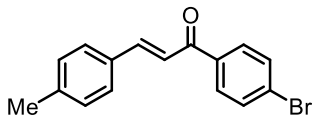
2208.6 mg, 7.3 mmol, 73%, white solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.45 (s, 3H), 7.31

(d, J = 7.6 Hz, 2H), 7.49-7.57 (m, 5H), 7.74 (d, J = 15.6 Hz, 1H), 7.94 (d, J = 8.0 Hz, 2H). GC/MS *m/z* (%) 302 (M^++2, 54), 301 (38), 300 (M^+,55), 299 (30), 285 (18), 221 (63), 178 (60), 102 (80), 119 (100), 91 (88), 76 (18).



***(E)*-3-(4-bromophenyl)-1-(4-methoxyphenyl)prop-2-en-1-one**[1d]

2379.4 mg, 7.5 mmol, 75%, white solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.90 (s, 3H), 6.97-7.01 (m, 2H), 7.49-7.56 (m, 5H), 7.73 (d, J = 15.6 Hz, 1H), 8.01-8.05 (m, 2H). GC/MS *m/z* (%) 318 (M^++2, 50), 317 (30), 316 (M^+, 55), 237 (21), 194 (16), 166 (26), 135 (100), 102 (48), 77 (39).



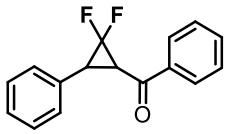
***(E)*-1-(4-bromophenyl)-3-(p-tolyl)prop-2-en-1-one**[1h]

2398.0 mg, 8.0 mmol, 80%, white solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.40 (s, 3H), 7.24 (d, J = 8.0 Hz, 2H), 7.44 (d, J = 15.6 Hz, 1H), 7.55 (d, J = 8.4 Hz, 2H), 7.63-7.67 (m, 2H), 7.76 (d, J = 16.0 Hz, 1H), 7.87-7.92 (m, 2H). GC/MS *m/z* (%) 302 (M^++2, 25), 301 (35), 300 (M^+, 26), 299 (35), 287 (100), 221 (56), 178 (38), 145 (42), 115 (65), 91 (26), 76 (18).

General Procedure for *gem*-difluoro cyclopropanes **2**: Synthesis of **2a**[2]

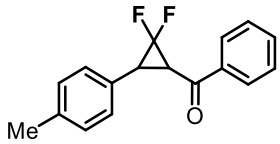
Chalcone **1a** (124.8 mg, 0.6 mmol) and diglyme (2 mL) were placed in a 20 mL two-necked round bottom flask equipped with a stirrer bar and refluxed at 180 °C under an argon atmosphere. Sodium bromodifluoroacetate (1017 mg, 4.8 mmol) solved in diglyme (2 mL) was added dropwise to the prepared refluxing solution for 10 min and stirred for additional 10 min. The reaction was cooled to room temperature and quenched with cold water (10 mL). The reaction mixture was extracted with ethyl acetate (3 × 30 mL), washed with water (4 × 30 mL), and dried over Na_2SO_4. The organic layer was concentrated using an evaporator and dried in vacuo, the ^{19}F NMR yield was determined using hexafluorobenzene as an internal standard. The residue was purified with column chromatography (hexane : ethyl acetate = 30 : 1) to afford 2,2-difluoro-3-phenyl-cyclopropylphenylmethanon **2a** (75.6 mg, 49%).

Compounds **2**



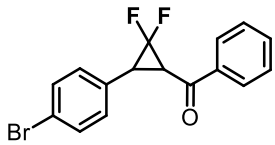
(2,2-difluoro-3-phenylcyclopropyl)(phenyl)methanone (2a)[3]

75.6 mg, 0.29 mmol, 49%, white solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.65 (ddd, *J* = 10.0 Hz, 8.4 Hz, 4.8 Hz, 1H), 3.83-3.89 (m, 1H), 7.30-7.39 (m, 5H), 7.51-7.56 (m, 2H), 7.62-7.67 (m, 1H), 8.03-8.06 (m, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 29.47-29.54 (m, 2F); ^{13}C NMR (151 MHz, $CDCl_3$) δ 190.1, 136.9, 133.8, 131.8, 128.8, 128.7, 128.5, 128.2, 127.8, 111.6 (t, *J* = 292.8 Hz), 36.7 (t, *J* = 9.4 Hz), 32.5 (t, *J* = 10.1 Hz); GC/MS *m/z* (%) 258 (M^+, 1), 151 (6), 133 (8), 105 (100), 77 (37); IR (KBr) cm^{-1} : 3048, 3018, 1681, 1603, 1443, 1339, 1294, 1234, 1171, 1052, 1004, 765.



(2,2-difluoro-3-(p-tolyl)cyclopropyl)(phenyl)methanone[3]

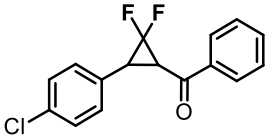
67.2 mg, 0.25 mmol, 26% (0.97 mmol scale), yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.35 (s, 3H), 3.61 (ddd, *J* = 11.2 Hz, 8.0 Hz, 2.8 Hz, 1H), 3.83 (ddd, *J* = 11.6 Hz, 8.0 Hz, 4.8 Hz, 1H), 7.16-7.22 (m, 4H), 7.51-7.56 (m, 2H), 7.64 (t, *J* = 7.4 Hz, 1H), 8.05 (d, *J* = 8.0 Hz, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 29.39-29.54 (m, 2F); ^{13}C NMR (151 MHz, $CDCl_3$) δ 190.3, 137.6, 137.0, 133.8, 129.4, 128.8, 128.7, 128.4, 128.1, 118.8 (t, *J* = 292.1 Hz), 36.7 (t, *J* = 10.1 Hz), 32.3 (t, *J* = 10.1 Hz), 21.0; GC/MS *m/z* (%) 272 (M^+, 1), 252 (31), 151 (11), 147 (11), 105 (100), 77 (33); IR (KBr) cm^{-1} : 3037, 2929, 1685, 1599, 1525, 1454, 1331, 1231, 1167, 1048, 1004, 758.



(3-(4-bromophenyl)-2,2-difluorocyclopropyl)(phenyl)methanone[4]

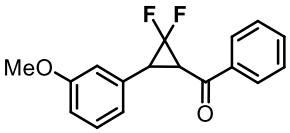
83.5 mg, 0.25 mmol, 25% (1.0 mmol scale), yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.61 (ddd, *J* = 10.4 Hz, 8.0 Hz, 3.2Hz, 1H), 3.78-3.84 (m, 1H), 7.20 (d, *J* = 8.0 Hz, 2H), 7.48-7.56 (m, 4H), 7.66 (t, *J* = 7.6 Hz, 1H), 8.04 (d, *J* = 7.6 Hz, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 29.45-29.54 (m, 2F); ^{13}C NMR (151 MHz, $CDCl_3$) δ 189.7, 136.8, 134.0, 131.9,

130.9, 129.9, 128.9, 128.5, 121.9, 112.2 (t, J= 292.0 Hz), 36.7 (t, J=10.1 Hz), 31.7 (t, J= 10.1 Hz); GC/MS *m/z* (%) 338 (M^++2, 1), 336 (M^+, 1), 318 (9), 316 (9), 152 (26), 151 (39), 105 (100), 77 (61); IR (KBr) cm^{-1} : 3033, 2966, 1681, 1599, 1499, 1454, 1328, 1294, 1171, 1018, 776; Elemental Analysis : Anal. Calcd. For $C_{16}H_{11}BrF_2O$: C, 57.00; H, 3.29. Found: C, 57.23; H, 3.60.



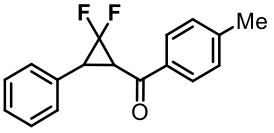
(3-(4-chlorophenyl)-2,2-difluorocyclopropyl)(phenyl)methanone[3]

84.4 mg, 0.29 mmol, 14% (2.0 mmol scale), yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.61 (ddd, J= 10.8 Hz, 8.0 Hz, 3.6 Hz, 1H), 3.82 (ddd, J= 10.4 Hz, 7.6 Hz, 5.2 Hz, 1H), 7.24-7.26 (m, 2H), 7.34 (d, J= 8.4 Hz, 2H), 7.52-7.57 (m, 2H), 7.63-7.67 (m, 1H), 8.04 (d, J= 7.6 Hz, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 29.43-29.51 (m, 2F); ^{13}C NMR (151 MHz, $CDCl_3$) δ 189.7, 136.8, 134.0, 133.8, 1303, 129.6, 129.6, 129.0, 128.9, 128.5, 111.3 (t, J= 292.0 Hz), 36.8 (t, J= 9.4 Hz), 31.6 (t, J= 10.1 Hz); GC/MS *m/z* (%) 292 (M^+, 1), 151 (11), 105 (100), 77 (24); IR (KBr) cm^{-1} : 3033, 2933, 1685, 1599, 1503, 1454, 1331, 1231, 1171, 1059, 1022, 776.



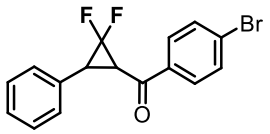
(2,2-difluoro-3-(3-methoxyphenyl)cyclopropyl)(phenyl)methanone

108.2 mg, 0.38 mmol, 38% (1.0 mmol scale), yellow solid. M.p. 60.5-62.1 °C , ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.64 (ddd, J= 10.0 Hz, 8.0 Hz, 4.4 Hz,, 1H), 3.79-3.87 (m, 1H), 3.82 (s, 3H), 6.85-6.92 (m, 3H), 7.26-7.31 (m, 1H), 7.52-7.56 (m, 2H), 7.65 (d, J= 7.6 Hz, 1H), 8.05 (d, J= 7.6 Hz, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 29.62-29.68 (m, 2F); ^{13}C NMR (151 MHz, $CDCl_3$) δ 190.1, 159.8, 136.9, 133.8, 133.3, 129.7, 128.9, 128.5, 120.5, 114.1, 113.2, 111.6, (t, J= 292.0 Hz), 55.2, 36.7 (t, J= 9.4 Hz), 32.4(t, J= 9.4 Hz); GC/MS *m/z* (%) 288 (M^+, 5), 268 (8), 164 (7), 151 (8), 105 (100), 77 (34); IR (KBr) cm^{-1} : 3048, 3000, 2970, 2843, 1678, 1603, 1458, 1339, 1294, 1227, 1156, 1045, 724; HRMS *m/z* (ESI) calcd. for $C_{17}H_{14}F_2NaO_2$ $[M+Na]^+$: 311.0860, found: 311.0849.



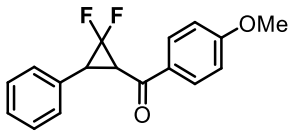
(2,2-difluoro-3-phenylcyclopropyl)(*p*-tolyl)methanone[3]

92.5 mg, 0.34 mmol, 33% (1.0 mmol scale), white solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.45 (s, 3H), 3.63 (ddd, *J* = 10.8 Hz, 8.0 Hz, 3.6 Hz, 1H), 3.85 (ddd, *J* = 10.4 Hz, 7.6 Hz, 5.6 Hz, 1H), 7.28-7.39 (m, 7H), 7.95 (d, *J* = 8.0 Hz, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 29.35-29.43 (m, 2F); ^{13}C NMR (151 MHz, $CDCl_3$) δ 189.6, 144.9, 134.5, 132.0, 129.5, 128.7, 128.6, 128.2, 127.8, 111.7 (t, *J* = 290.7 Hz), 36.6 (t, *J* = 10.2 Hz), 32.3 (t, *J* = 9.4 Hz), 21.7; GC/MS *m/z* (%) 272 (M^+, 1), 252 (14), 166 (14), 151 (22), 133 (14), 120 (27), 119 (73), 118 (100), 91 (91), 65 (19); IR (KBr) cm^{-1} : 3048, 2929, 1678, 1611, 1439, 1339, 1234, 1052, 1004, 743.



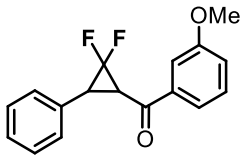
(4-bromophenyl)(2,2-difluoro-3-phenylcyclopropyl)methanone

99.6 mg, 0.30 mmol, 29% (1.0 mmol scale), white solid. M.p. 75.3-76.8 °C , ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.58 (ddd, *J* = 8.6 Hz, 8.4 Hz, 4.8 Hz, 1H), 3.82-3.89 (m, 1H), 7.30-7.40 (m, 5H), 7.68 (d, *J* = 8.4 Hz, 2H), 7.91 (d, *J* = 8.0 Hz, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 29.67-29.69 (m, 2F); ^{13}C NMR (151 MHz, $CDCl_3$) δ 189.2, 135.6, 132.2, 131.6, 130.0, 129.9, 128.7, 128.2, 128.0, 111.5 (t, *J* = 292.7 Hz), 36.6 (t, *J* = 10.1 Hz), 32.6 (t, *J* = 10.1 Hz); GC/MS *m/z* (%) 338 (M^++2, 1), 336 (M^+, 1), 318 (6), 316 (6), 184 (98), 182 (100), 156 (20), 154 (21), 151 (16), 133 (15); IR (KBr) cm^{-1} : 3055, 2933, 1681, 1588, 1458, 1342, 1234, 1048, 1015, 721; Elemental Analysis : Anal. Calcd. For $C_{16}H_{11}BrF_2O$: C, 57.00; H, 3.29 Found: C, 56.59; H, 3.43.



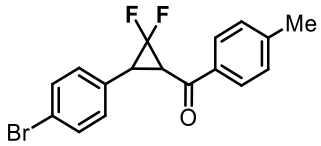
(2,2-difluoro-3-phenylcyclopropyl)(4-methoxyphenyl)methanone[3]

75.6 mg, 0.44 mmol, 44% (1.0 mmol scale), yellow solid. ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.60 (ddd, *J* = 10.5 Hz, 8.1 Hz, 4.5 Hz, 1H), 3.80-3.88 (m, 1H), 3.90 (s, 3H), 6.96-7.03 (m, 2H), 7.29-7.45 (m, 5H), 8.01-8.06 (m, 2H); ^{19}F NMR (283 MHz, $CDCl_3$) δ 29.31-29.40 (m, 2F); ^{13}C NMR (151 MHz, $CDCl_3$) δ 188.3, 164.1, 132.0, 130.8, 130.0, 128.7, 128.2, 127.7, 114.0, 111.7 (t, *J* = 292.8 Hz), 55.6, 36.4 (t, *J* = 10.1 Hz), 32.2 (t, *J* = 9.4 Hz); GC/MS *m/z* (%) 288 (M^+, 19), 182 (13), 135 (100), 107 (15), 77 (18); IR (KBr) cm^{-1} : 3033, 2940, 2851, 1674, 1607, 1577, 1439, 1320, 1264, 1175, 1033, 829, 776.



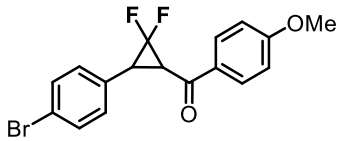
(2,2-difluoro-3-phenylcyclopropyl)(3-methoxyphenyl)methanone

103.9 mg, 0.36 mmol, 36% (1.0 mmol scale), yellow oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.60 (ddd, *J* = 8.1 Hz, 7.4 Hz, 5.1 Hz, 1H), 3.81-3.89 (m, 1H), 3.89 (s, 3H), 7.16-7.20 (m, 1H), 7.31-7.47 (m, 6H), 7.55-7.56 (m, 1H), 7.62-7.65 (m, 1H); ^{19}F NMR (283 MHz, $CDCl_3$) δ 29.48-29.57 (m, 2F); ^{13}C NMR (151 MHz, $CDCl_3$) δ 189.9, 160.0, 138.3, 131.8, 129.8, 128.7, 128.2, 127.8, 114.8, 114.6, 112.6, 111.6 (t, *J* = 291.6 Hz), 55.5, 36.8 (t, *J* = 10.1 Hz), 32.5 (t, *J* = 10.1 Hz); GC/MS *m/z* (%) 288 (M^+, 10), 268 (8), 135 (100), 107 (48), 77 (23); IR (neat) cm^{-1} : 3067, 3030, 2944, 2843, 1685, 1588, 1439, 1342, 1264, 1041; HRMS *m/z* (ESI) calcd. for $C_{17}H_{14}F_2NaO_2$ $[M+Na]^+$: 311.0860, found: 311.0850.



(3-(4-bromophenyl)-2,2-difluorocyclopropyl)(*p*-tolyl)methanone

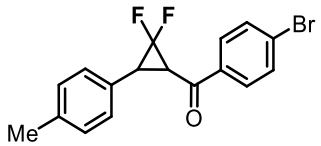
94.4 mg, 0.27 mmol, 27% (1.0 mmol scale), yellow solid. M.p. 80.1-81.0 °C ,^{1}H NMR (400 MHz, $CDCl_3$) δ 2.45 (s, 3H), 3.58 (ddd, *J* = 11.2 Hz, 8.0 Hz, 3.2 Hz, 1H), 3.79 (ddd, *J* = 10.8 Hz, 8.0 Hz, 4.8 Hz, 1H), 7.18-7.21 (m, 2H), 7.33 (d, *J* = 8.0 Hz, 2H), 7.47-7.50 (m, 2H), 7.92-7.50 (m, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 29.32-29.44 (m, 2F); ^{13}C NMR (151 MHz, $CDCl_3$) δ 189.2, 145.0, 134.3, 131.8, 131.0, 129.9, 129.6, 128.6, 121.8, 111.2 (t, *J* = 292.8 Hz), 36.6 (t, *J* = 9.4 Hz), 31.5 (t, *J* = 9.4 Hz), 21.7; GC/MS *m/z* (%) 352 (M^++2, 1), 350 (M^+, 1), 166 (3), 151 (8), 119 (100), 91 (27), 65 (8); IR (KBr) cm^{-1} : 3037, 2929, 1670, 1611, 1499, 1450, 1335, 1234, 1167, 1015, 780; Elemental Analysis : Anal. Calcd. For $C_{17}H_{13}BrF_2O$: C, 58.14; H, 3.73. Found: C, 58.15; H, 3.90.



(3-(4-bromophenyl)-2,2-difluorocyclopropyl)(4-methoxyphenyl)methanone

79.9 mg, 0.22 mmol, 23% (1.0 mmol scale), yellow solid. M.p. 84.7-85.9 °C , ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.54 (ddd, *J* = 10.8 Hz, 8.1 Hz, 3.6 Hz, 1H), 3.78 (ddd, *J* = 10.5 Hz, 7.8 Hz, 5.4 Hz, 1H), 3.91 (s, 3H), 6.98-7.03 (m, 2H), 7.17-7.20 (m, 2H), 7.46-7.51 (m, 2H), 8.00-

8.05 (m, 2H); ^{19}F NMR (283 MHz, $CDCl_3$) δ 29.23-29.38 (m, 2F); ^{13}C NMR (151 MHz, $CDCl_3$) δ 187.9, 164.2, 131.8, 131.1, 130.9, 129.0, 129.8, 121.8, 114.1, 111.2 (t, J = 292.8 Hz), 55.6, 36.4 (t, J =10.1 Hz), 31.4 (t, J = 10.1 Hz); GC/MS *m/z* (%) 368 (M^++2, 30), 366 (M^+, 31), 182 (31), 151 (15), 136 (25), 134 (100), 77 (23); IR (KBr) cm^{-1} : 3033, 2970, 2847, 1659, 1611, 1458, 1346, 1272, 1242, 1186, 1045, 1013, 765; Elemental Analysis : Anal. Calcd. For $C_{17}H_{13}BrF_2O_2$: C, 55.61; H, 3.57. Found: C, 55.59; H, 3.65.

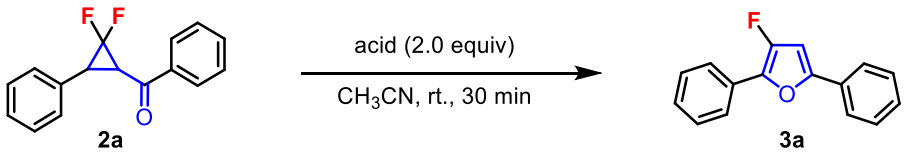


(4-bromophenyl)(2,2-difluoro-3-(*p*-tolyl)cyclopropyl)methanone

80.6 mg, 0.23 mmol, 23% (1.0 mmol scale), white solid. M.p. 74.3-75.7 °C , ^{1}H NMR (300 MHz, $CDCl_3$) δ 2.35 (s, 3H), 3.54 (ddd, J = 9.6 Hz, 7.8 Hz, 3.9 Hz, 1H), 3.78-3.86 (m, 1H), 7.15-7.22 (m, 4H), 7.65-7.70 (m, 2H), 7.88-7.92 (m, 2H); ^{19}F NMR (283 MHz, $CDCl_3$) δ 29.60-29.71 (m, 2F); ^{13}C NMR (151 MHz, $CDCl_3$) δ 189.3, 137.8, 135.7, 132.2, 129.9, 129.4, 129.1, 128.5, 128.1, 111.7 (t, J = 294.9 Hz), 36.6 (t, J = 9.3 Hz), 32.5 (t, J = 9.4 Hz), 21.1; GC/MS *m/z* (%) 352 (M^++2, 1), 350 (M^+, 1), 332 (27), 330 (29), 185 (92), 183 (100), 167 (23), 154 (20), 147 (20), 115 (5), 76 (6); IR (KBr) cm^{-1} : 3029, 2929, 2860, 1689, 1588, 1454, 1294, 1167, 1015; HRMS *m/z* (DART) calcd. for $C_{17}H_{14}BrF_2O$ $[M+H]^+$: 351.0196, found: 351.0191.

Screening of acids in synthesis of 3-fluorofuran **3a**

Table S1. Screening of acids



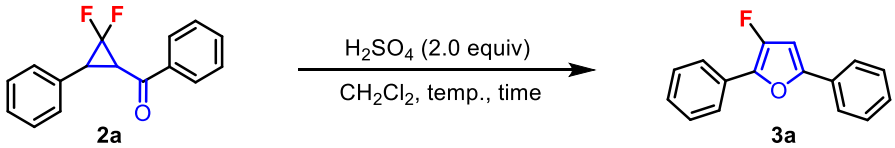
entry[a]	acid	yield of **3a** (%)[b]	recovery of **2a** (%)[b]
1	CF_3SO_3H	24	0
2	none	0	100
3	CH_3COOH	0	100
4	$(COOH)_2$	0	98
5	*p*-TsOH	0	100

6	CF_3CO_2H	0	98
7	HCl aq.	0	92

[a]Each reaction was carried out under an argon atmosphere.

[b]Determined by ^{19}F NMR analysis using C_6F_6 as an internal standard.

Table S2. Effect of H_2SO_4



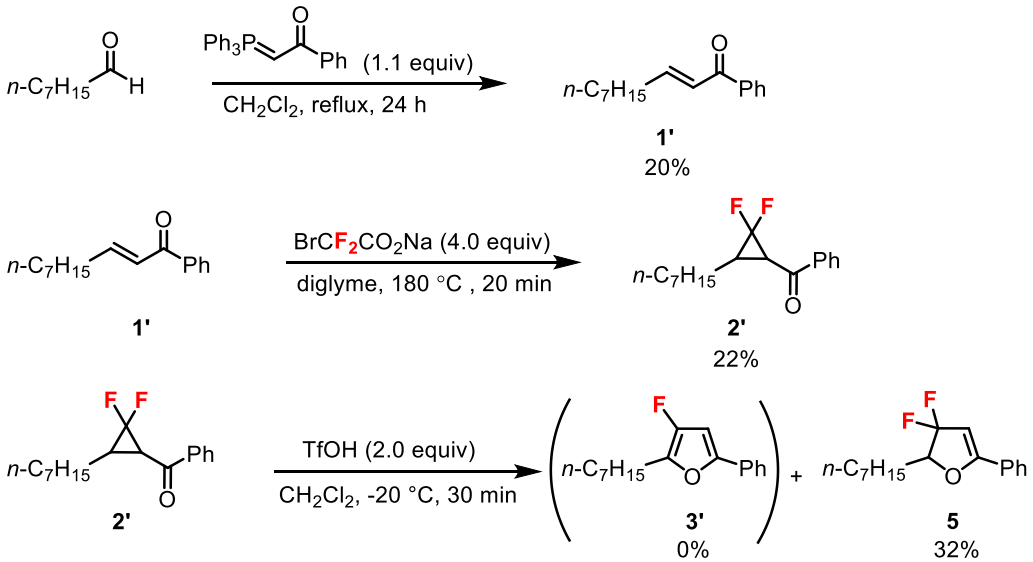
entry[a]	temp. (°C)	time (h)	yield of **3a** (%)[b]	recovery of **2a** (%)[b]
1	−20	0.5	19	77
2	−20	5	25	0
3	0	0.5	46	0
4	20	0.5	18	0

[a]Each reaction was carried out under an argon atmosphere.

[b]Determined by ^{19}F NMR analysis using C_6F_6 as an internal standard.

<u>Effect of functional group</u>

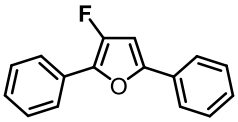
Scheme S1. Installation of alkyl group



General Procedure for 2,5-disubstituted 3-fluorofurans **3**: Synthesis of **3a**

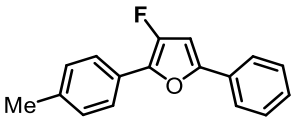
To a 10 mL two-necked round bottom flask equipped with a stirrer bar, were added *gem*-difluorocyclopropane **2a** (26.2 mg, 0.1 mmol) and dichloromethane (1.0 mL), and the solution was cooled to -20 °C under an argon atmosphere. The reaction mixture was stirred for 30 min at -20 °C after the addition of trifluoromethanesulfonic acid (17.7 μL, 0.2 mmol). After this period, the reaction was quenched with triethylamine (0.2 mL) and the reaction mixture was warmed to room temperature, extracted with diethylether (3 × 10 mL), washed with water, and dried over Na_2SO_4. The organic layer was concentrated using an evaporator and dried in vacuo, and the ^{19}F NMR yield was determined using hexafluorobenzene as an internal standard. The residue was purified with column chromatography (hexane : ethyl acetate = 30 : 1) to afford 3-fluoro-2,5-diphenylfuran **3a** (19.4 mg, 80%) as a white solid.

Compounds **3**



3-fluoro-2,5-diphenylfuran (3a)[5]

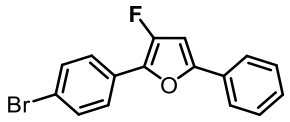
19.4 mg, 0.08 mmol, 80%, white solid. ^1H NMR (400 MHz, $CDCl_3$) δ 6.68 (s, 1H), 7.25-7.33 (m, 2H), 7.39-7.47 (m, 4H), 7.70-7.78 (m, 4H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 0.33 (s, 1F); ^{13}C NMR (76 MHz, $CDCl_3$) δ 150.5 (d, J = 251.7 Hz), 150.1 (d, J = 8.6 Hz), 135.9 (d, J = 20.0 Hz), 130.1, 129.0 (d, J = 5.0 Hz), 128.8, 128.7, 128.0, 127.0, 123.7, 123.4 (d, J = 5.0 Hz), 99.3 (d, J = 20.1 Hz); GC/MS *m/z* (%) 238 (M^+, 100), 209 (33), 189 (22), 133 (43), 119 (19), 77 (15); IR (KBr) cm^{-1} : 3126, 3063, 2929, 1633, 1599, 1495, 1428, 1056, 929, 769, 698; Elemental Analysis : Anal. Calcd. For $C_{16}H_{11}FO$: C, 80.66; H, 4.65 Found: C, 80.56; H, 4.79.



3-fluoro-5-phenyl-2-(*p*-tolyl)furan[3]

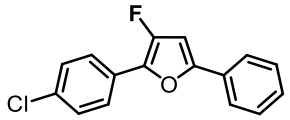
16.1 mg, 0.06 mmol, 64%, yellow solid. ^1H NMR (400 MHz, $CDCl_3$) δ 2.39 (s, 3H), 6.66 (s, 1H), 7.23-7.32 (m, 3H), 7.41 (t, J = 15.2, 2H), 7.65-7.71 (m, 4H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -0.70 (s, 1F); ^{13}C NMR (76 MHz, $CDCl_3$) δ 150.0 (d, J = 250.2 Hz), 149.6 (d, J = 7.9 Hz), 136.9, 136.1 (d, J = 20.1 Hz), 130.2, 129.4, 128.7, 127.9, 126.2 (d, J = 5.0 Hz),

123.6, 123.4 (d, J = 5.0 Hz), 99.2 (d, J = 20.0 Hz), 21.3; GC/MS *m/z* (%) 252 (M^+, 100), 209 (14), 147 (14), 133 (21), 126 (16), 91 (17), 77 (10); IR (KBr) cm^{-1} : 3130, 3041, 2925, 1637, 1514, 1413, 1182, 821, 762, 694.



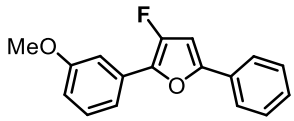
2-(4-bromophenyl)-3-fluoro-5-phenylfuran[5]

23.3 mg, 0.07 mmol, 73%, yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.67 (s, 1H), 7.33 (t, J = 7.2 Hz, 1H), 7.42 (t, J = 7.6 Hz, 2H), 7.55 (d, J = 9.2 Hz, 2H), 7.63 (d, J = 9.2 Hz, 2H), 7.69 (d, J = 7.2 Hz, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 1.60 (s, 1F); ^{13}C NMR (76 MHz, $CDCl_3$) δ 150.7 (d, J = 253.1 Hz), 150.5 (d, J = 8.6 Hz), 135.0 (d, J = 20.1 Hz), 131.8, 129.9, 128.8, 128.3, 127.8 (d, J = 5.0 Hz), 124.8 (d, J = 5.7 Hz), 123.7, 120.6, 99.3 (d, J = 19.4 Hz); GC/MS *m/z* (%) 318 (M^++2, 97), 316 (M^+, 100), 209 (48), 189 (42), 159 (25), 133 (62), 94 (20), 77 (17); IR (KBr) cm^{-1} : 3134, 3082, 1637, 1495, 1436, 1402, 1078, 825, 769, 694.



2-(4-chlorophenyl)-3-fluoro-5-phenylfuran[5]

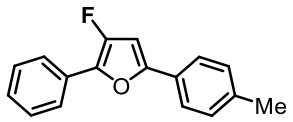
38.3 mg, 0.14 mmol, 71% (0.2 mmol scale), white solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.68 (s, 1H), 7.29-7.43 (m, 1H), 7.39-7.44 (m, 4H), 7.67-7.70 (m, 4H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 1.25 (s, 1F); ^{13}C NMR (76 MHz, $CDCl_3$) δ 150.6 (d, J = 252.5 Hz), 150.4 (d, J = 8.6 Hz), 135.0 (d, J = 20.0 Hz), 132.5, 129.9, 128.9, 128.8, 128.2, 127.4 (d, J = 5.0 Hz), 124.5 (d, J = 5.0 Hz), 123.7, 99.2 (d, J = 20.1 Hz); GC/MS *m/z* (%) 272 (M^+, 100), 209 (27), 189 (18), 133 (35), 111 (19); IR (KBr) cm^{-1} : 3130, 3078, 2929, 1637, 1495, 1406, 1097, 829, 769, 694.



3-fluoro-2-(3-methoxyphenyl)-5-phenylfuran

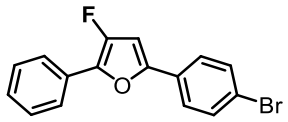
31.4 mg, 0.12 mmol, 59% (0.2 mmol scale), yellow solid. M.p. 37.6-39.2 °C , ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.88 (s, 3H), 6.67 (s, 1H), 6.81-6.84 (m, 1H), 7.31-7.44 (m, 6H), 7.70 (d, J = 7.6 Hz, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 1.02 (s, 1F); ^{13}C NMR (76 MHz, $CDCl_3$) δ 159.8, 150.6 (d, J = 252.4 Hz), 150.1 (d, J = 8.6 Hz), 135.7 (d, J = 19.4 Hz), 130.1 (d, J =

5.7 Hz), 130.0, 129.8, 128.8, 128.1, 123.7, 116.1 (d, J = 5.7 Hz), 112.7, 108.8 (d, J = 5.0 Hz), 99.2 (d, J = 19.4 Hz), 55.3; GC/MS *m/z* (%) 268 (M^+, 100), 225 (19), 133 (21), 77 (13); IR (KBr) cm^{-1} : 3085, 3015, 2933, 1607, 1495, 1421, 1298, 1227, 1153, 1059, 773, 694; HRMS *m/z* (DART) calcd. for $C_{17}H_{14}FO_2$ $[M+H]^+$: 269.0978, found: 269.0973.



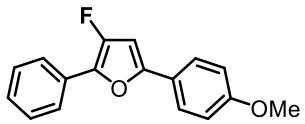
3-fluoro-2-phenyl-5-(*p*-tolyl)furan[3]

36.8 mg, 0.15 mmol, 76% (0.2 mmol scale), yellow solid. ^1H NMR (400 MHz, $CDCl_3$) δ 2.39 (s, 3H), 6.62 (s, 1H), 7.21-7.30 (m, 3H), 7.43 (t, J = 7.8 Hz, 2H), 7.60 (d, J = 8.4 Hz, 2H), 7.76 (d, J = 7.2 Hz, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 0.26 (s, 1F); ^{13}C NMR (76 MHz, $CDCl_3$) δ 150.5 (d, J = 251.7 Hz), 150.3 (d, J = 8.6 Hz), 138.1, 135.4 (d, J = 20.1 Hz), 129.4, 129.1 (d, J = 4.3 Hz), 128.7, 127.5, 126.8, 123.6, 123.3 (d, J = 5.0 Hz), 98.6 (d, J = 20.1 Hz), 21.3; GC/MS *m/z* (%) 252 (M^+, 100), 209 (18), 147 (20), 133 (21), 126 (17), 105 (12), 77 (25); IR (KBr) cm^{-1} : 3063, 3029, 2948, 1637, 1506, 1432, 1153, 925, 825, 799, 698.



5-(4-bromophenyl)-3-fluoro-2-phenylfuran

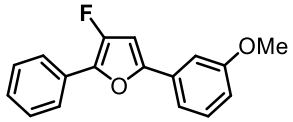
51.6 mg, 0.16 mmol, 80% (0.2 mmol scale), yellow solid. M.p. 62.1-63.5 °C, ^1H NMR (400 MHz, $CDCl_3$) δ 6.69 (s, 1H), 7.26-7.30 (m, 1H), 7.44 (t, J = 7.8 Hz, 2H), 7.52-7.58 (m, 4H), 7.76 (d, J = 8.0 Hz, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 0.58 (s, 1F); ^{13}C NMR (76 MHz, $CDCl_3$) δ 150.4 (d, J = 251.7 Hz), 149.0 (d, J = 8.6 Hz), 136.3 (d, J = 20.1 Hz), 131.9, 129.01, 128.99, 128.8, 127.2, 125.1, 123.5 (d, J = 5.0 Hz), 121.9, 99.8 (d, J = 20.1 Hz); GC/MS *m/z* (%) 318 (M^++2, 98), 316 (M^+, 100), 243 (23), 209 (49), 189 (47), 159 (23), 133 (42), 105 (41), 77 (64); IR (KBr) cm^{-1} : 3137, 3059, 2933, 1640, 1480, 1436, 1074, 1011, 929, 832, 795, 765, 698; HRMS *m/z* (DART) calcd. for $C_{16}H_{11}BrFO$ $[M+H]^+$: 316.9977, found: 316.9976.



3-fluoro-5-(4-methoxyphenyl)-2-phenylfuran[6]

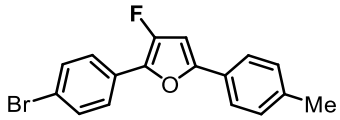
39.5 mg, 0.15 mmol, 74% (0.2 mmol scale), yellow solid. ^1H NMR (301 MHz, $CDCl_3$) δ 3.86 (s, 3H), 6.54 (d, J = 1.2 M Hz, 1H), 6.93-6.98 (m, 1H), 7.25-7.27 (m, 2H), 7.40-7.45

(m, 2H), 7.62-7.66 (m, 2H), 7.73-7.76 (m, 2H); ^{19}F NMR (283 MHz, $CDCl_3$) δ 0.25 (s, 1F); ^{13}C NMR (76 MHz, $CDCl_3$) δ 159.6, 150.6 (d, J = 255.0 Hz), 150.2 (d, J = 8.7 Hz), 135.1 (d, J = 20.4 Hz), 129.1 (d, J = 5.1 Hz), 128.7, 126.7, 125.2, 123.2 (d, J = 5.1 Hz), 114.2, 97.8 (d, J = 20.4 Hz), 55.3; GC/MS *m/z* (%) 268 (M^+, 100), 253 (56), 225 (7), 196 (4), 134 (10), 105 (5), 77 (14); IR (KBr) cm^{-1} : 3138, 3016, 2963, 2844, 1633, 1506, 1436, 125, 832, 788.



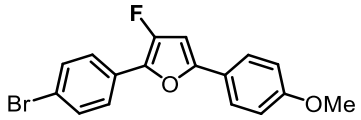
3-fluoro-5-(3-methoxyphenyl)-2-phenylfuran

32.5 mg, 0.13 mmol, 65% (0.2 mmol scale), yellow solid. M.p. 69.5-70.3 °C , ^{1}H NMR (301 MHz, $CDCl_3$) δ 3.88 (s, 3H), 6.67 (d, J = 0.9 MHz, 1H), 6.84-6.88 (m, 1H), 7.23-7.36 (m, 4H), 7.40-7.46 (m, 2H), 7.75-7.78 (m, 2H); ^{19}F NMR (283 MHz, $CDCl_3$) δ 0.40 (s, 1F); ^{13}C NMR (76 MHz, $CDCl_3$) δ 159.9, 150.4 (d, J = 255.1 Hz), 149.8 (d, J = 8.0 Hz), 135.9 (d, J = 20.4 Hz), 131.4, 129.9, 128.9 (d, J = 5.1 Hz), 128.7, 127.0, 123.4 (d, J = 5.1 Hz), 116.3, 113.6, 109.2, 99.6 (d, J = 20.4 Hz), 55.3; GC/MS *m/z* (%) 268 (M^+, 100), 225 (33), 196 (14), 163 (14), 134 (14), 105 (8), 77 (12); IR (KBr) cm^{-1} : 3134, 3033, 2918, 2858, 1514, 1640, 1480, 1443, 1398, 1074, 1011, 929, 829; Elemental Analysis : Anal. Calcd. For $C_{17}H_{13}FO_2$: C, 76.11; H, 4.88. Found: C, 75.61; H, 4.91. HRMS *m/z* (DART) calcd. for $C_{17}H_{14}FO_2$ $[M+H]^+$: 269.0978, found: 269.0972.



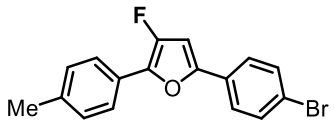
2-(4-bromophenyl)-3-fluoro-5-(4-methoxyphenyl)furan[7]

49.5 mg, 0.15 mmol, 75% (0.2 mmol scale), yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.38 (s, 3H), 6.60 (s, 1H), 7.22 (d, J = 8.0 Hz, 2H), 7.52-7.62 (m, 6H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 1.53 (s, 1F); ^{13}C NMR (76 MHz, $CDCl_3$) δ 150.8 (d, J = 252.0 Hz), 150.7 (d, J = 8.6 Hz), 138.4, 134.6 (d, J = 20.1 Hz), 131.8, 129.5, 127.9 (d, J = 5.0 Hz), 127.2, 124.7 (d, J = 5.8 Hz), 123.7, 120.4, 98.6 (d, J = 20.1 Hz), 21.3; GC/MS *m/z* (%) 332 (M^++2, 94), 300 (M^+, 100), 223 (16), 202 (10), 147 (15); IR (KBr) cm^{-1} : 3146, 3029, 2921, 2862, 1640, 1503, 1398, 1078, 1011, 829, 795.



2-(4-bromophenyl)-3-fluoro-5-(*p*-tolyl)furan

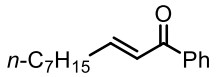
52.3 mg, 0.15 mmol, 77% (0.2 mmol scale), yellow solid. M.p. 104.4-106.2 °C , ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.86 (s, 3H), 6.54 (s, 1H), 6.93-6.97 (m, 2H), 7.52-7.55 (m, 2H), 7.58-7.65 (m, 4H); ^{19}F NMR (283 MHz, $CDCl_3$) δ 1.52 (s, 1F); ^{13}C NMR (76 MHz, $CDCl_3$) δ 159.7, 150.9 (d, J = 253.1 Hz), 150.7 (d, J = 8.6 Hz), 134.2 (d, J = 20.1 Hz), 131.8, 128.0 (d, J = 5.0 Hz), 125.3, 124.6 (d, J = 5.8 Hz), 122.9, 120.2, 114.2, 97.8 (d, J = 19.4 Hz), 55.3; GC/MS *m/z* (%) 348 (M^++2, 92), 346 (M^+, 100), 331 (59), 224 (16), 174 (22), 156 (15), 120 (14); IR (KBr) cm^{-1} : 3026, 2929, 2843, 1637, 1503, 1398, 1257, 1179, 840, 748; Elemental Analysis : Anal. Calcd. For $C_{17}H_{12}BrFO_2$: C, 58.81; H, 3.48. Found: C, 59.01; H, 3.94. HRMS *m/z* (DART) calcd. for $C_{17}H_{13}BrFO_2$ $[M+H]^+$: 347.0083, found: 347.0078.



5-(4-bromophenyl)-3-fluoro-2-(*p*-tolyl)furan

45.1 mg, 0.14 mmol, 68% (0.2 mmol scale), yellow solid. M.p. 110.6-111.3 °C , ^{1}H NMR (300 MHz, $CDCl_3$) δ 2.39 (s, 3H), 6.66 (d, J = 1.6 MHz, 1H), 7.23-7.26 (m, 2H), 7.51-7.58 (m, 4H), 7.63-7.66 (m, 2H); ^{19}F NMR (283 MHz, $CDCl_3$) δ -0.45 (s, 1F); ^{13}C NMR (76 MHz, $CDCl_3$) δ 149.9 (d, J = 255.0 Hz), 148.5 (d, J = 8.7 Hz), 137.1, 136.6 (d, J = 20.4 Hz), 131.9, 129.4, 129.1, 126.0 (d, J = 5.0 Hz), 125.0, 123.4, (d, J = 5.1 MHz), 121.7, 99.7 (d, J = 20.3 Hz), 21.3; GC/MS *m/z* (%) 332 (M^++2, 94), 330 (M^+, 100), 236 (10), 223 (14), 202 (12), 165 (8), 147 (19), 101 (15), 91 (19); IR (KBr) cm^{-1} : 3059, 3119, 3022, 2840, 1637, 1588, 1480, 1424, 1234, 1048, 776, 694; Elemental Analysis : Anal. Calcd. For $C_{17}H_{12}BrFO$: C, 61.65; H, 3.65. Found: C, 61.33; H, 3.70.

<u>Compounds **1'**, **2'** and **5**</u>

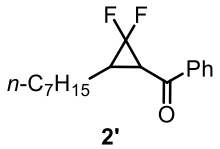


1'

***(E)*-1-phenyldec-2-en-1-one**

^{1}H NMR (400 MHz, CDCl3) δ 0.77-0.91 (m, 3H), 1.20-1.37 (m, 8H), 1.49-1.55 (m, 2H), 2.28-2.35 (m, 2H), 6.88 (dt, J = 15.2 Hz, 1.2 Hz, 1H), 7.07 (dt, J = 15.2 Hz, 6.8 Hz, 1H),

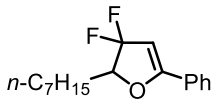
7.44-7.49 (m, 2H), 7.53-7.58 (m, 1H), 7.91-7.95 (m, 2H); GC/MS m/z(%) 230 (M^+,1), 159 (14), 133 (15), 120 (33), 105 (100), 77 (38).



2'

(2,2-difluoro-3-heptylcyclopropyl)(phenyl)methanone

^{1}H NMR (400 MHz, $CDCl_3$) δ 0.81-0.90 (m, 3H), 1.20-1.36 (m, 8H), 1.42-1.50 (m, 2H), 1.52-1.69 (m, 2H), 2.56-2.65 (m, 1H), 2.98-3.04 (m, 1H), 7.48-7.53 (m, 2H), 7.59-7.64 (m, 1H), 7.96-8.01 (m, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ 27.35-27.49 (m, 2F); GC/MS m/z(%) 280 (M^+,1), 181 (23), 105 (100), 77 (30).

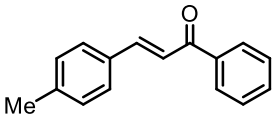


5

3,3-difluoro-2-heptyl-5-phenyl-2,3-dihydrofuran

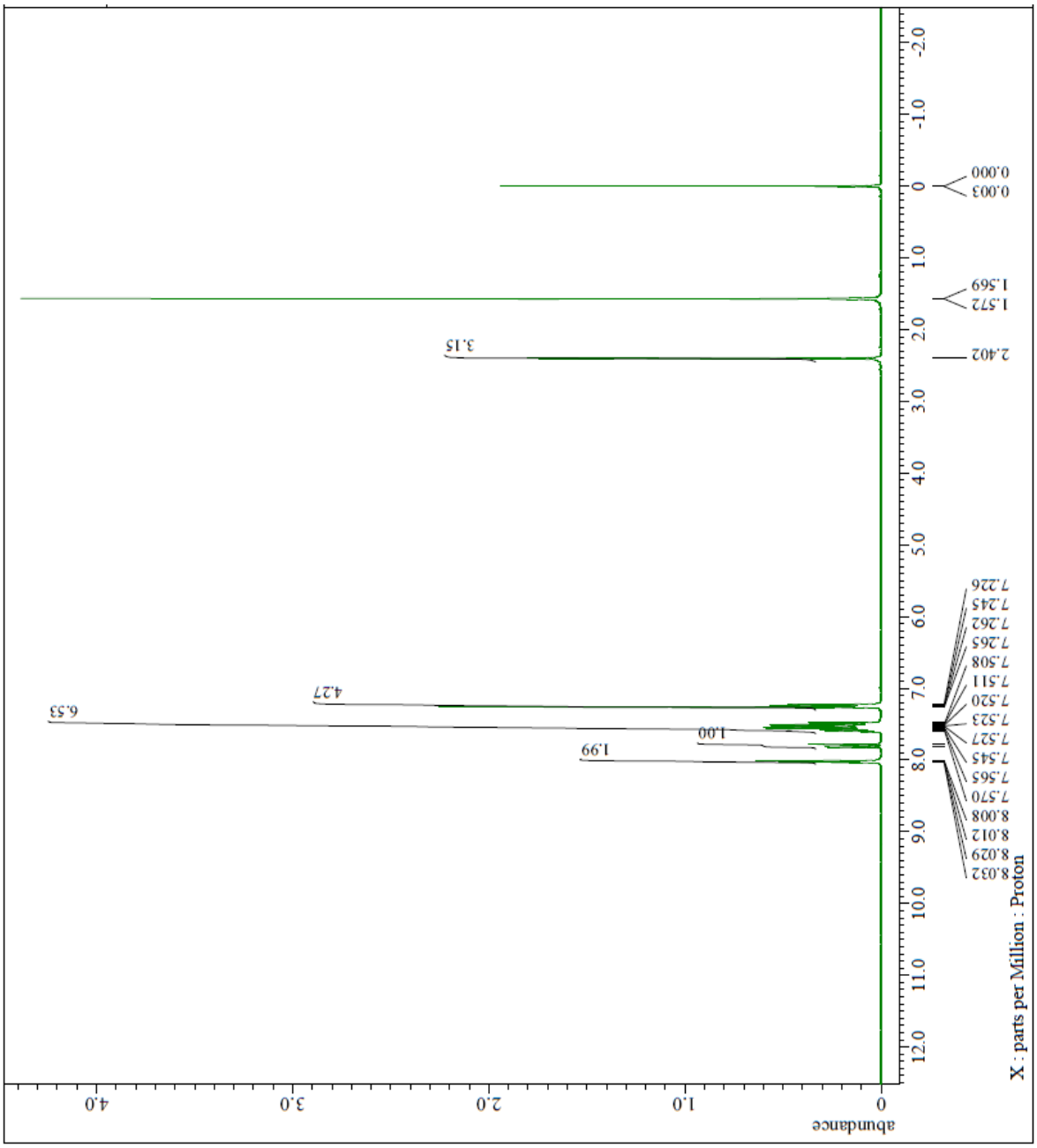
^{1}H NMR (300MHz, CDCl3) δ 0.86-0.92 (m, 3H), 1.25-1.55 (m, 10H), 1.67-1.81 (m, 2H), 3.21-3.37 (m, 1H), 5.54 (s, 1H), 7.33-7.41 (m, 3H), 7.52-7.58 (m, 2H); ^{19}F NMR (283 MHz, $CDCl_3$) δ 83.02 (dd, J = 152.8 Hz, 13.0 Hz, 1F), 100.16 (dd, J = 150.7 Hz, 19.7 Hz, 1F); GC/MS m/z(%) 280 (M^+,1), 260 (11), 181 (49), 176 (17), 153 (12), 133 (21), 105 (100), 77 (15).

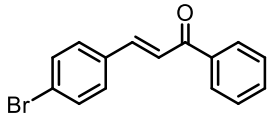
^{1}H, ^{13}C, and ^{19}F NMR spectra
for starting materials 1, 2 and products 3



(E)-1-phenyl-3-(p-tolyl)prop-2-en-1-one

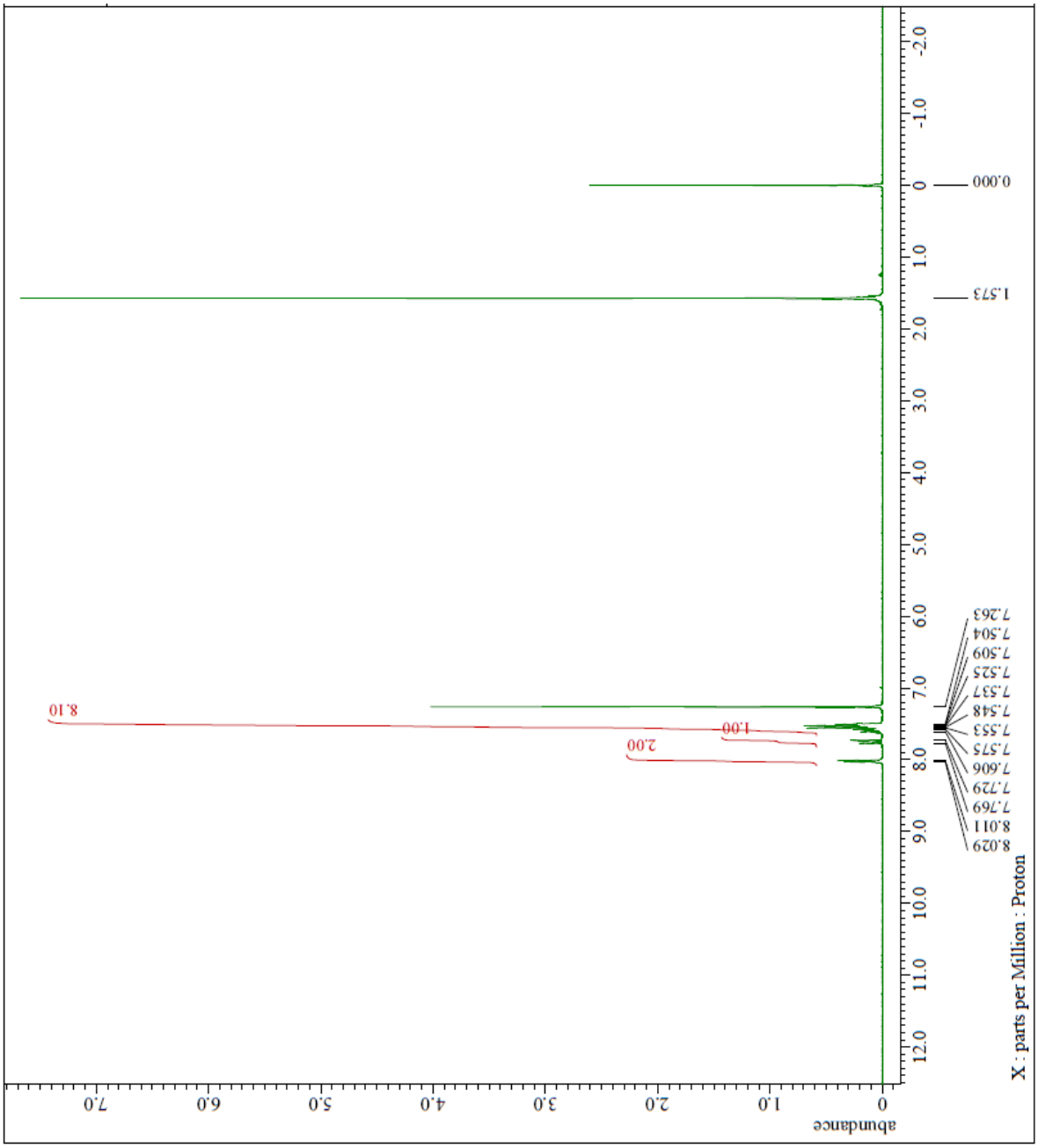
○ ^{1}H NMR (400 MHz)

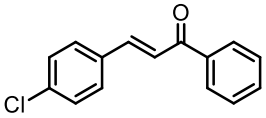




(E)-3-(4-bromophenyl)-1-phenylprop-2-en-1-one

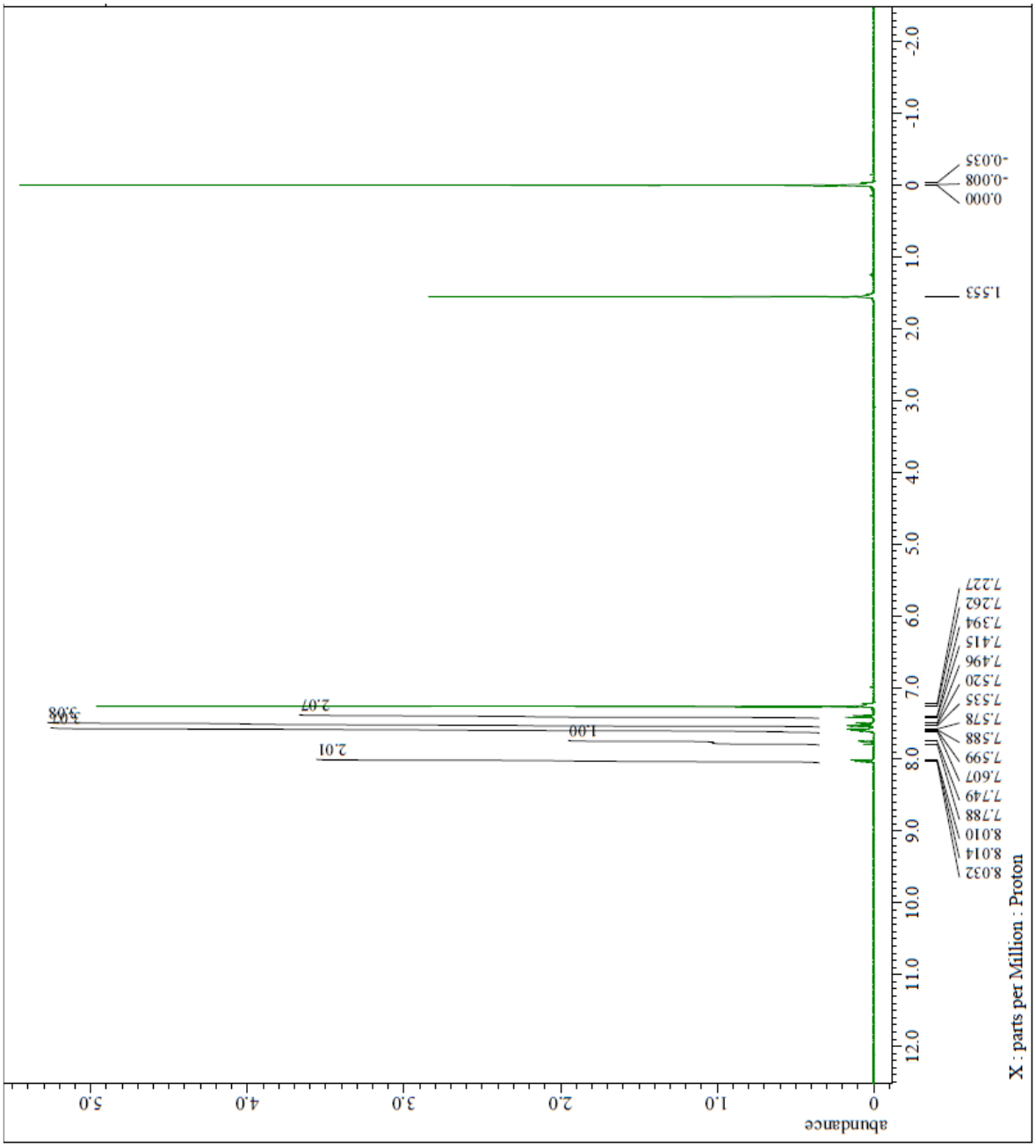
○ ^{1}H NMR (400 MHz)

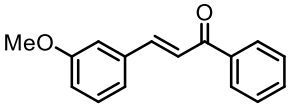




(E)-3-(4-chlorophenyl)-1-phenylprop-2-en-1-one

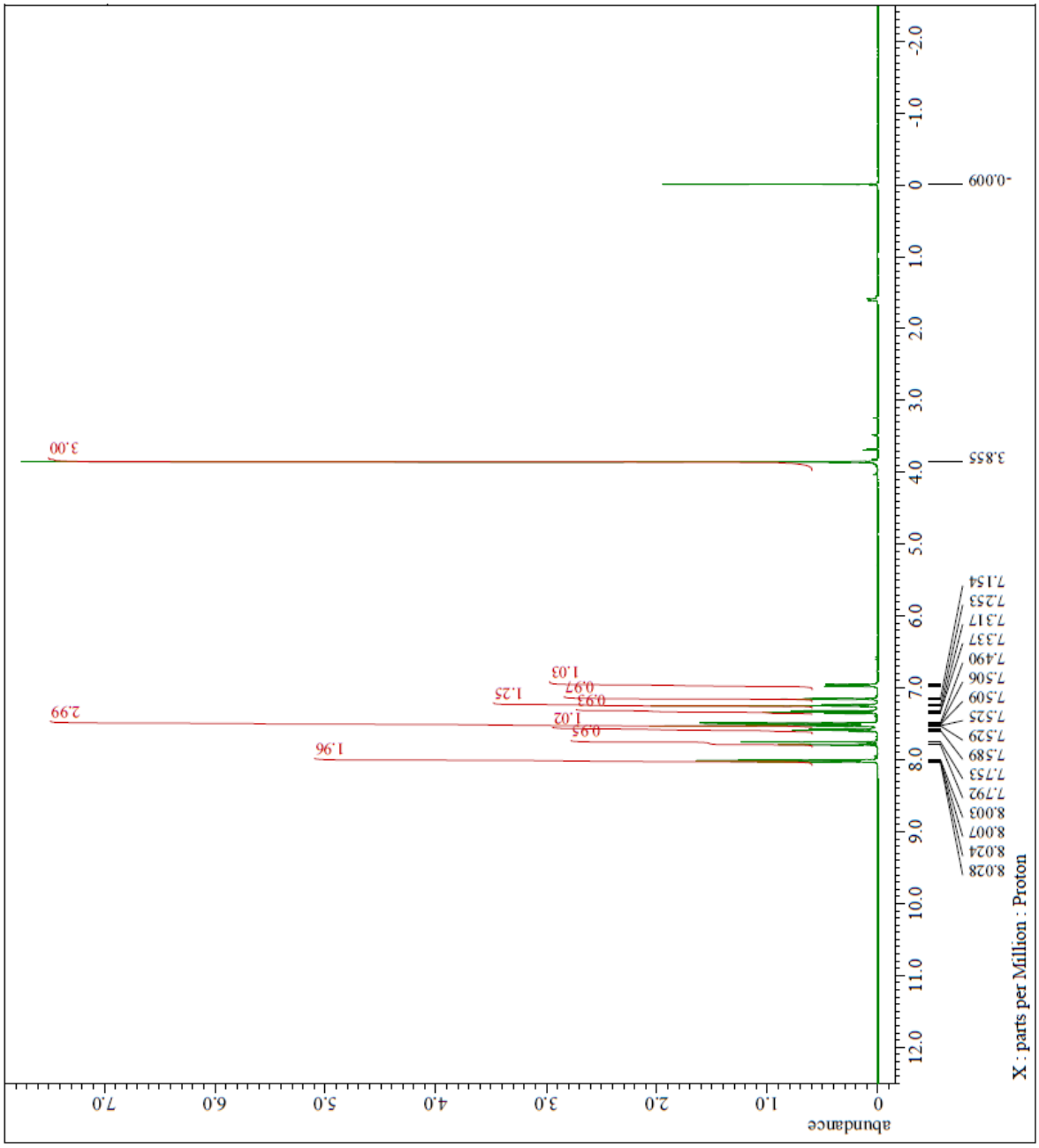
○ ^{1}H NMR (400 MHz)

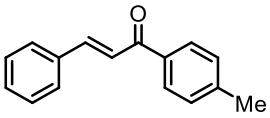




(E)-3-(3-methoxyphenyl)-1-phenylprop-2-en-1-one

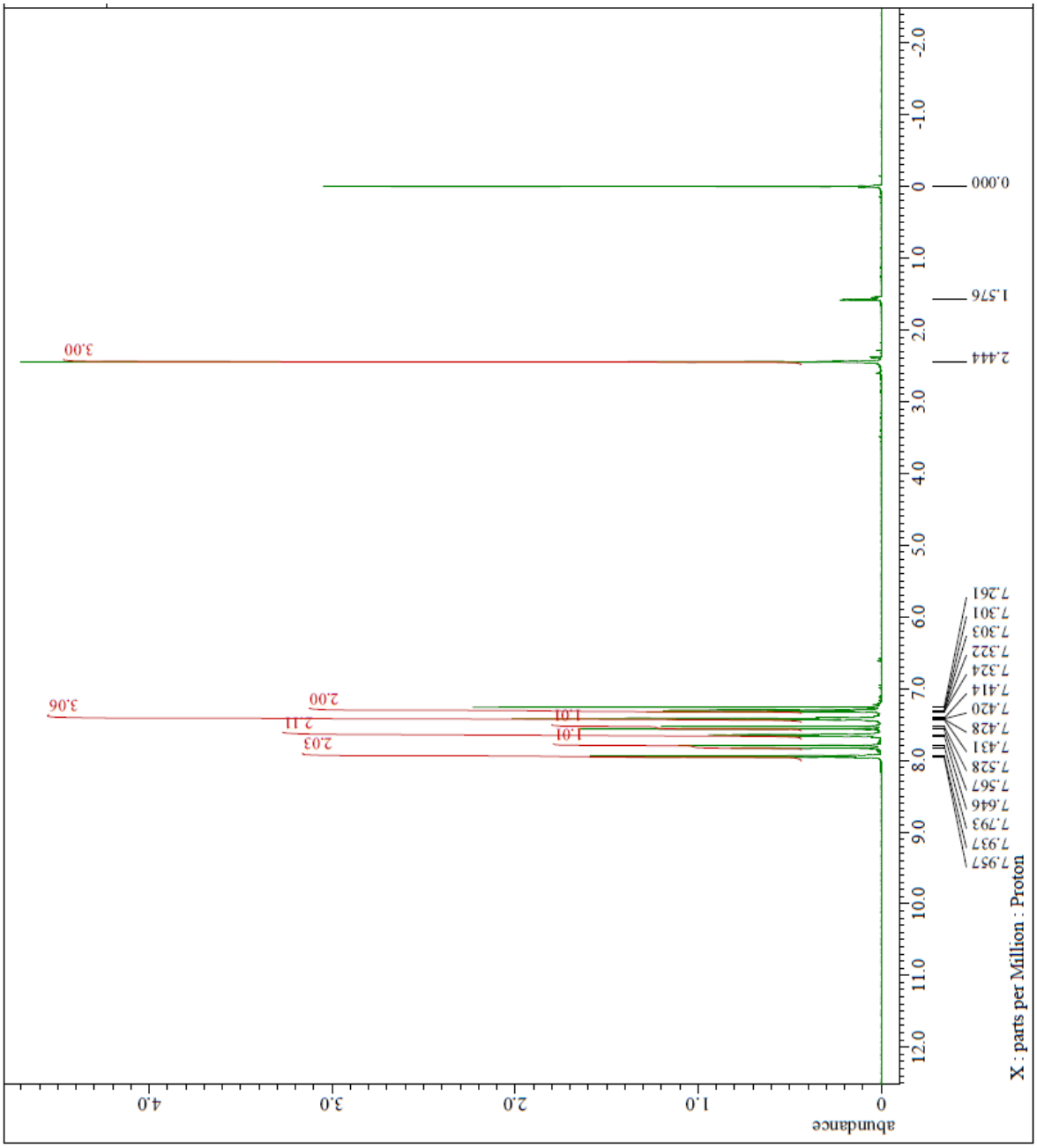
○ ^{1}H NMR (400 MHz)

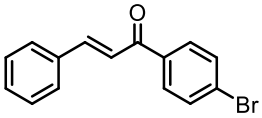




(E)-3-phenyl-1-(p-tolyl)prop-2-en-1-one

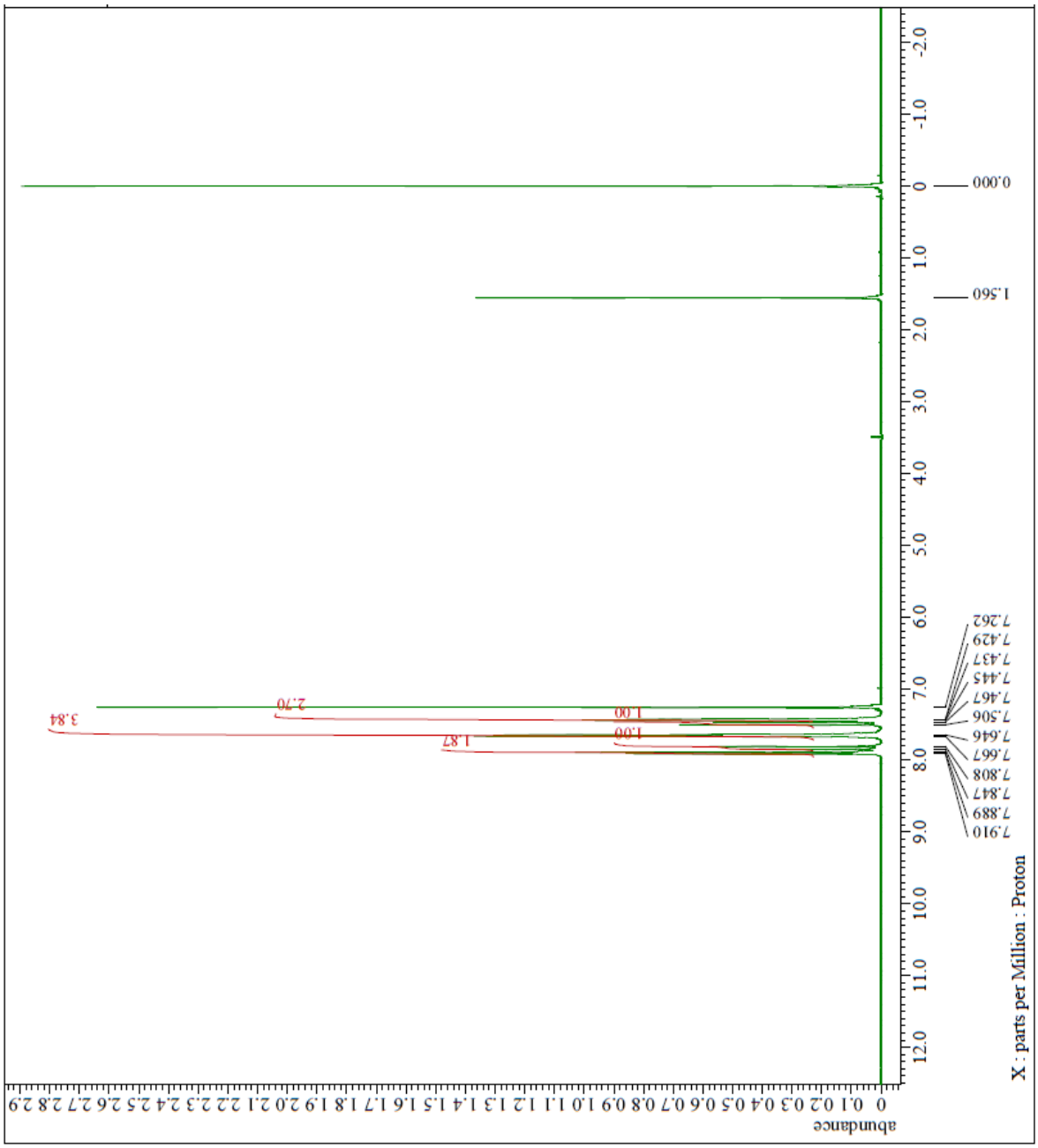
○ ^{1}H NMR (400 MHz)

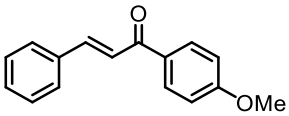




(E)-1-(4-bromophenyl)-3-phenylprop-2-en-1-one

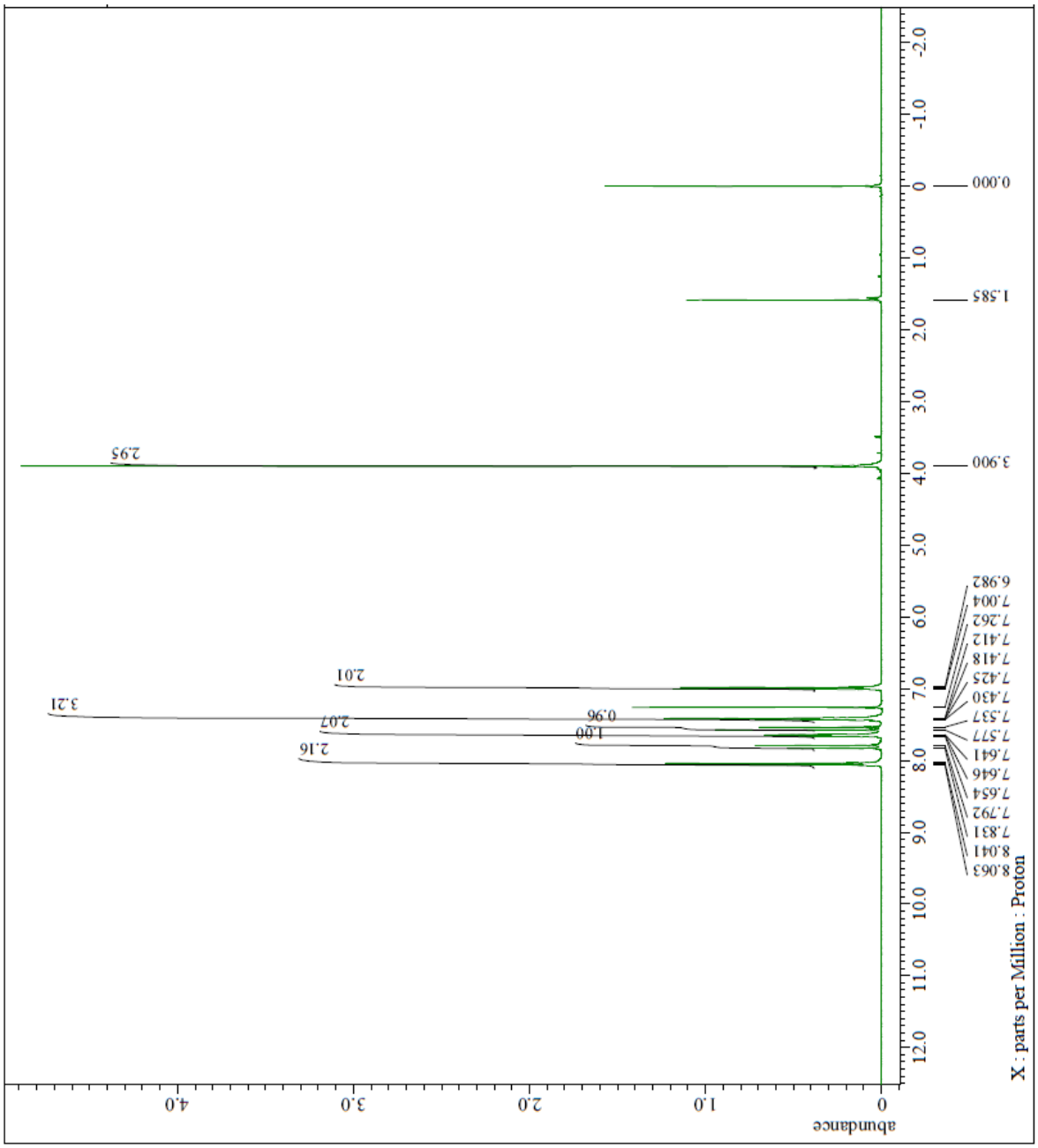
○ ^{1}H NMR (400 MHz)

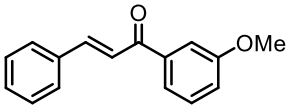




(E)-1-(4-methoxyphenyl)-3-phenylprop-2-en-1-one

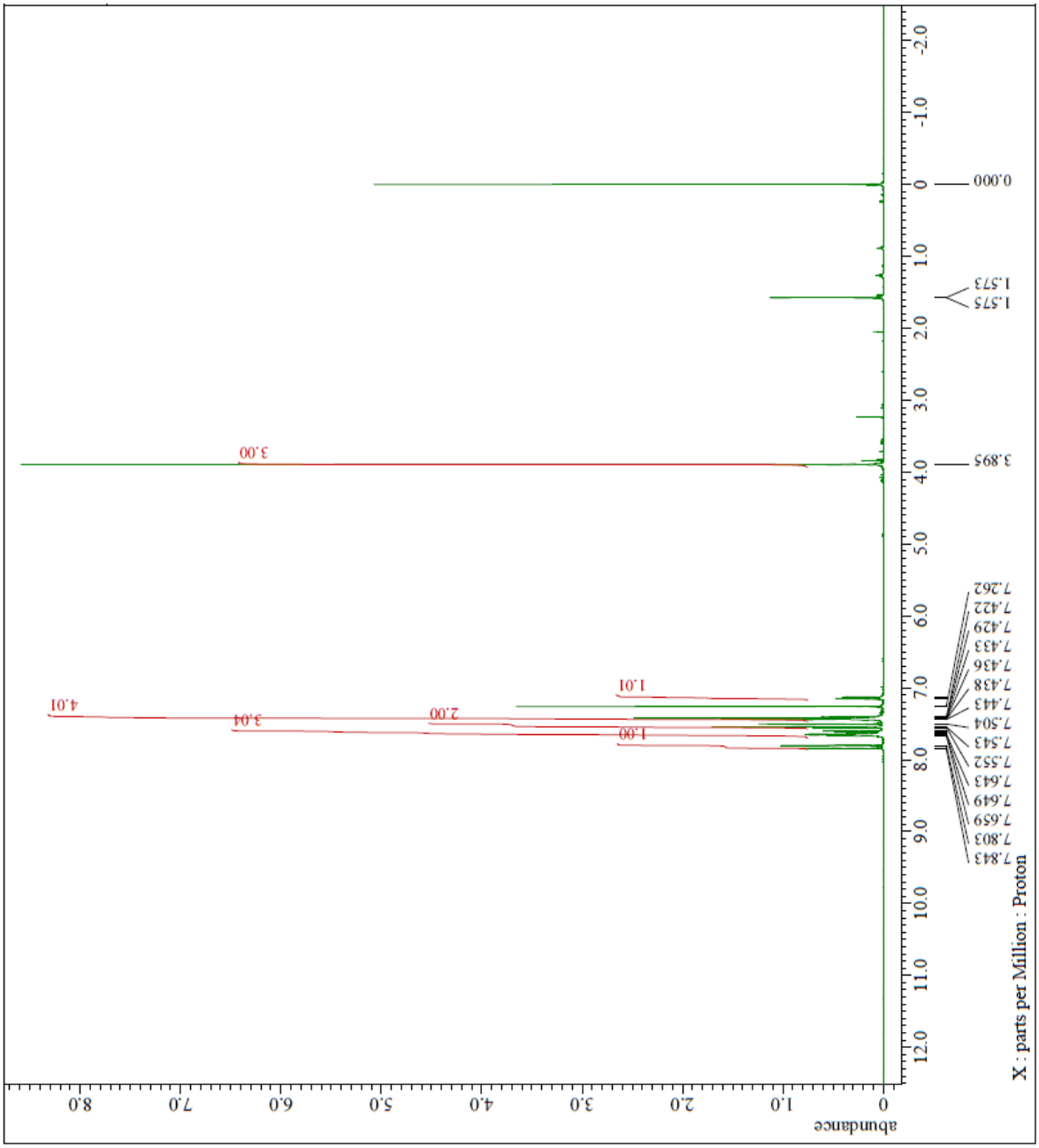
○ ^{1}H NMR (400 MHz)

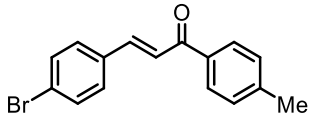




(E)-1-(3-methoxyphenyl)-3-phenylprop-2-en-1-one

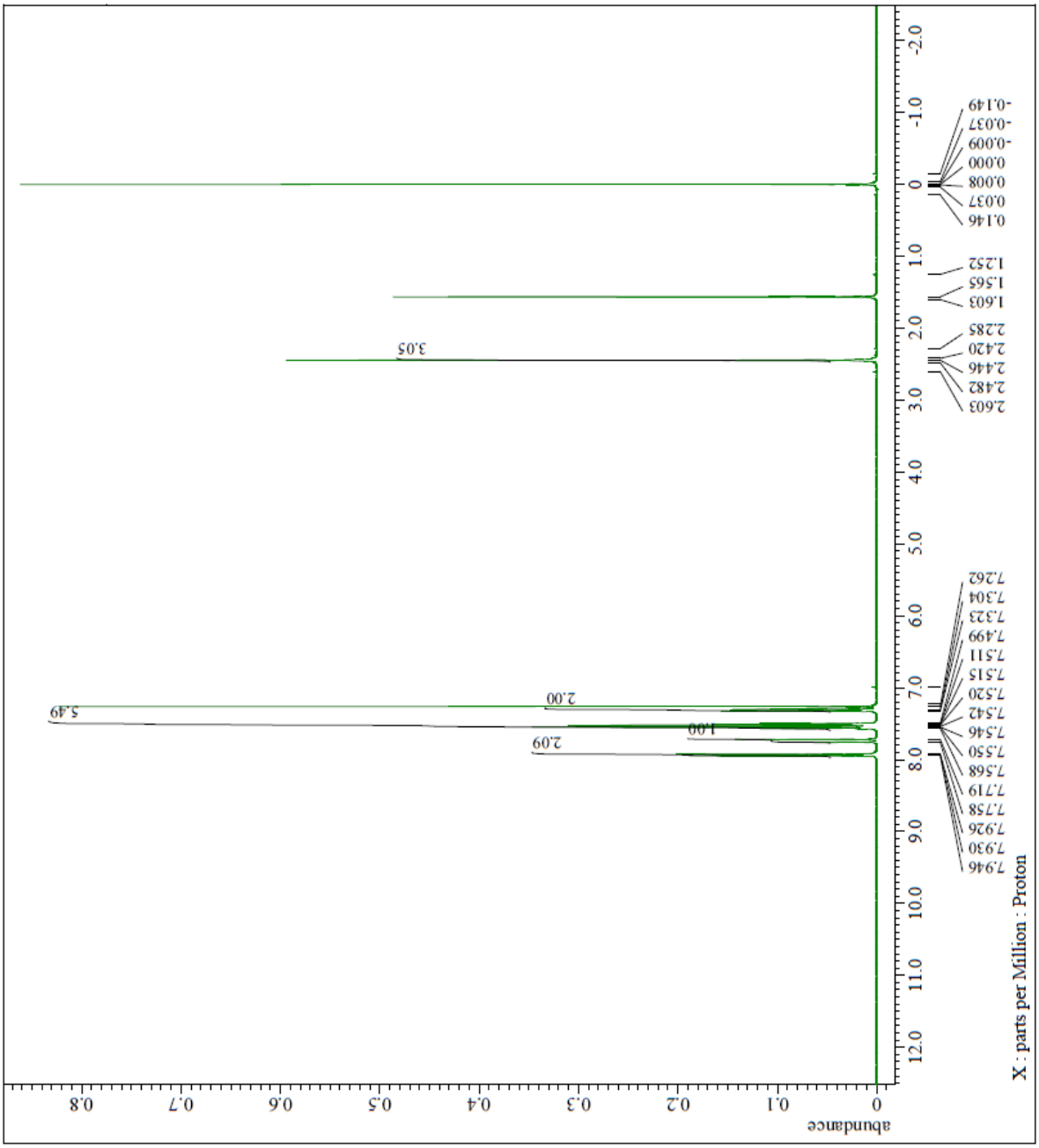
○ ^{1}H NMR (400 MHz)

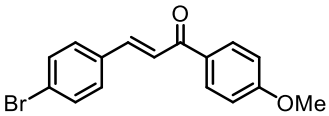




(E)-3-(4-bromophenyl)-1-(p-tolyl)prop-2-en-1-one

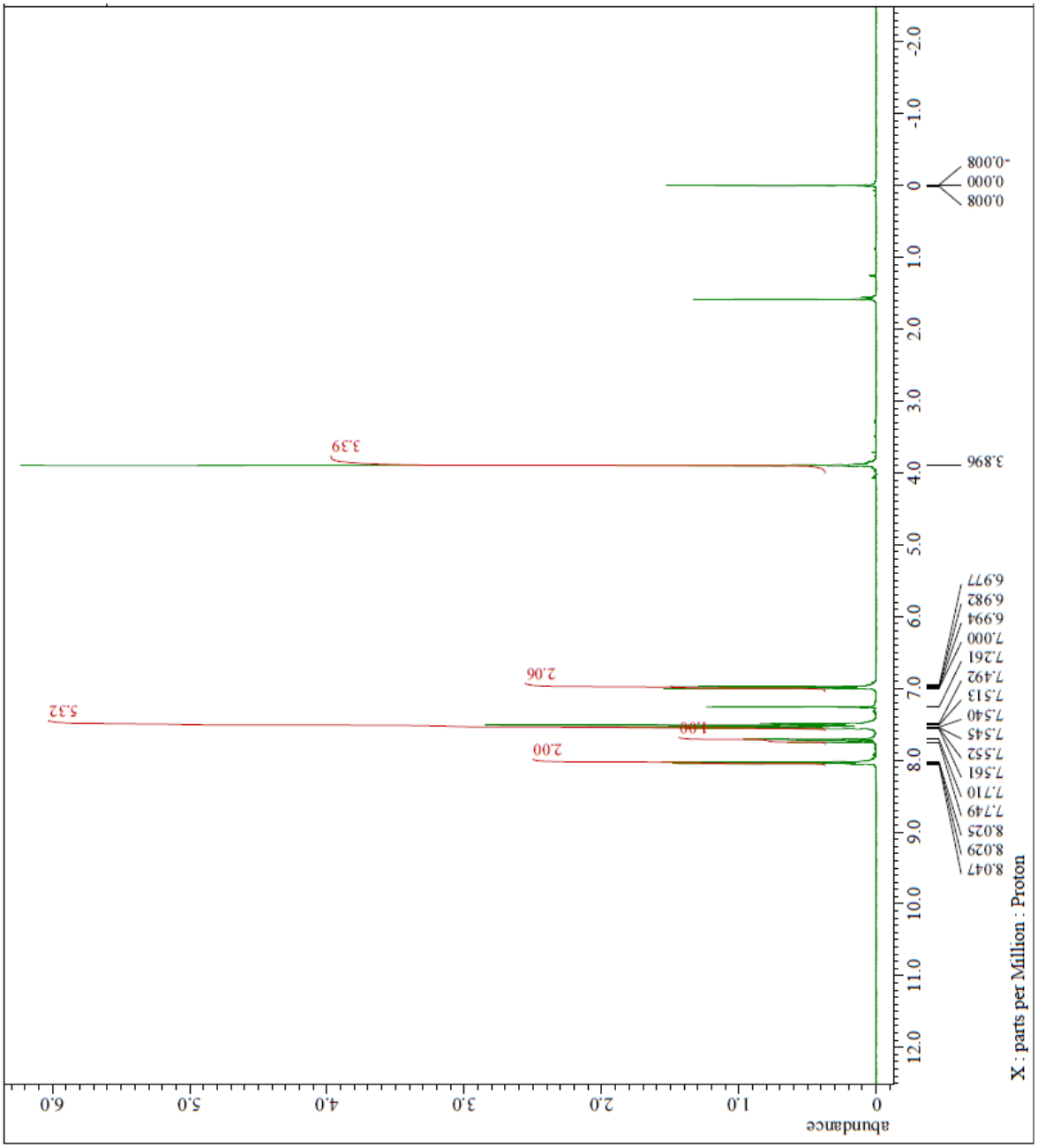
○ ^{1}H NMR (400 MHz)

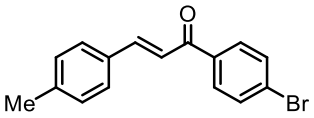




(E)-3-(4-bromophenyl)-1-(4-methoxyphenyl)prop-2-en-1-one

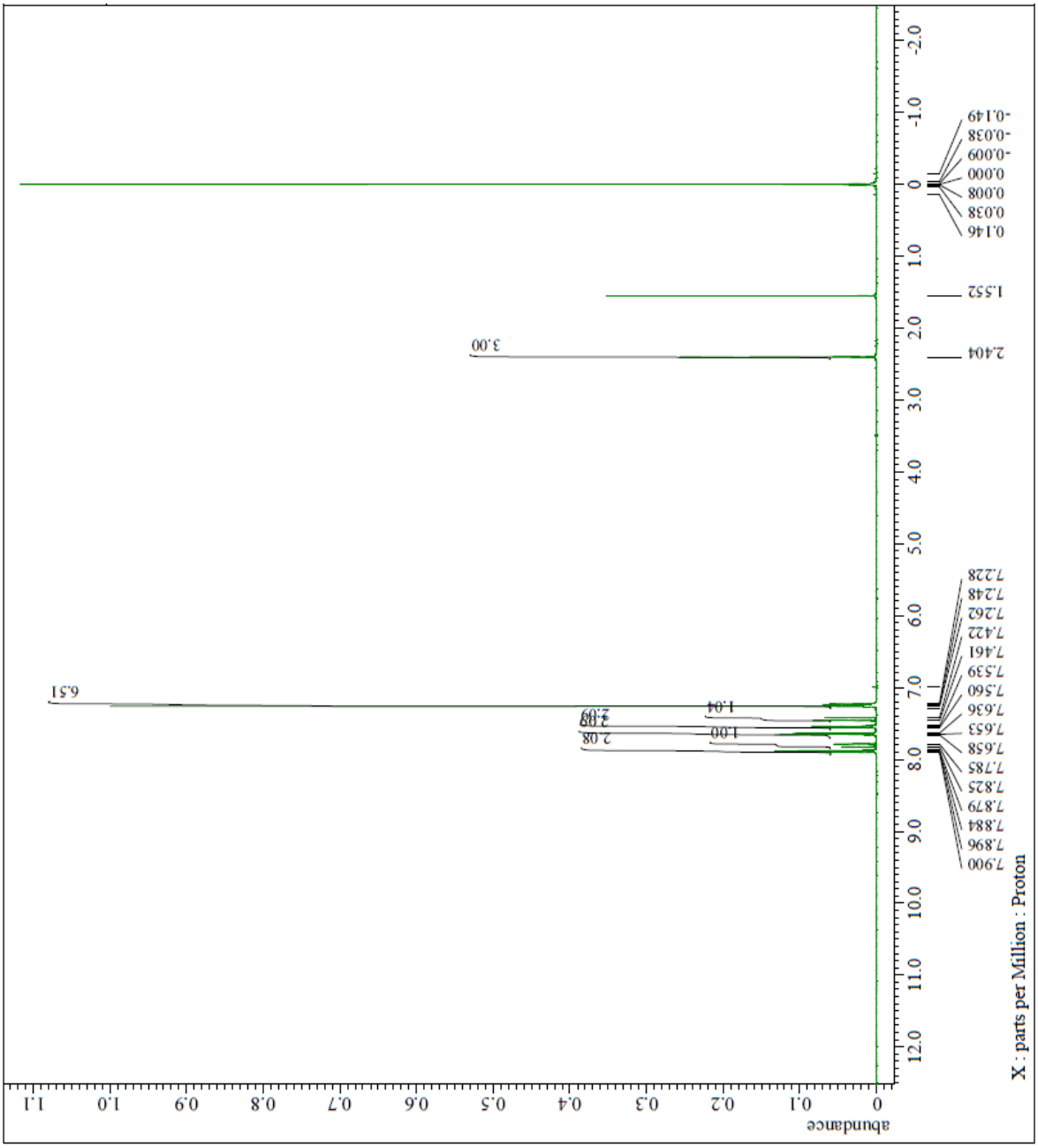
○ ^{1}H NMR (400 MHz)

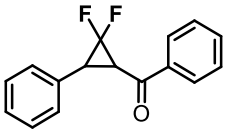




(E)-1-(4-bromophenyl)-3-(p-tolyl)prop-2-en-1-one

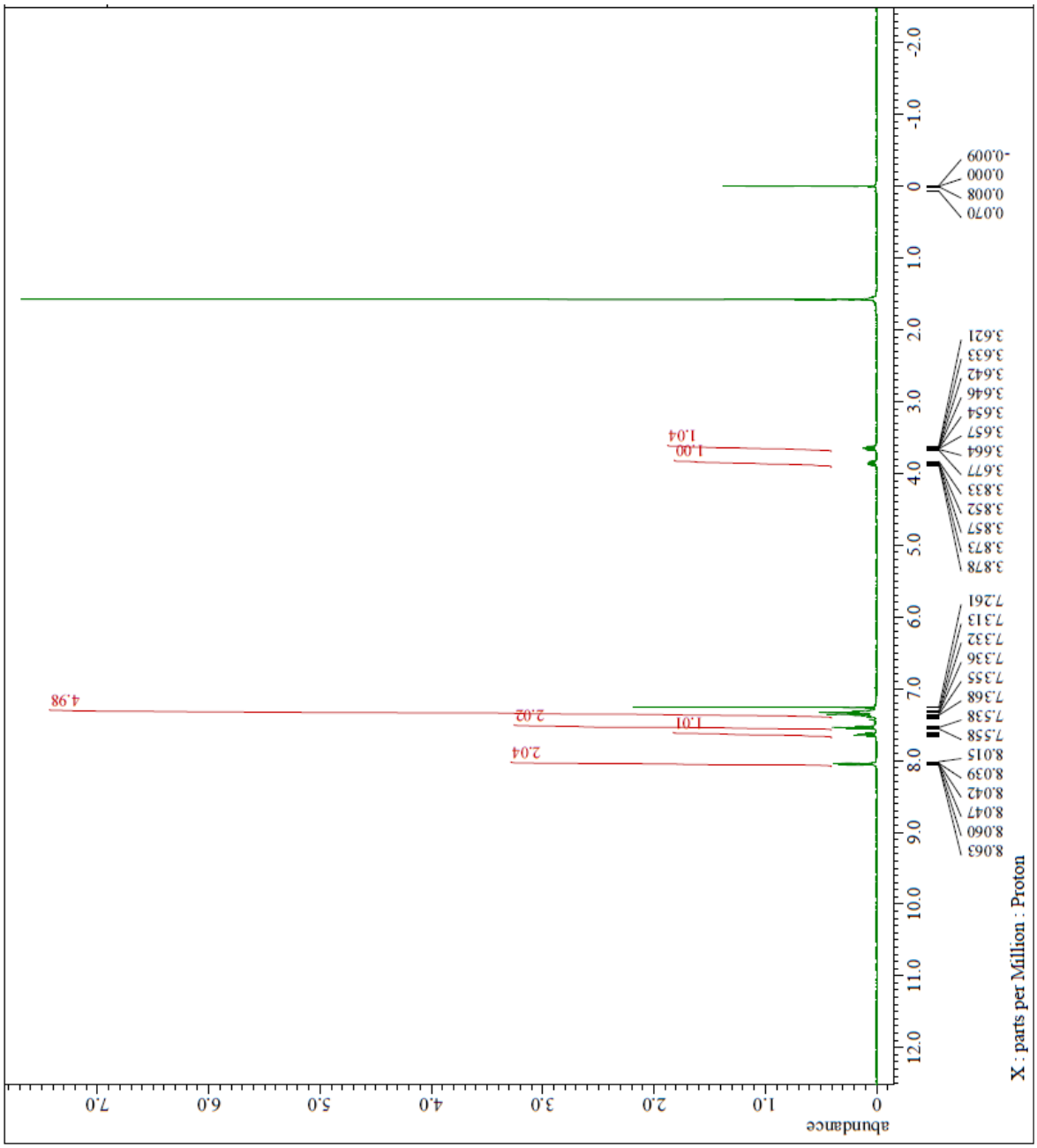
○ ^{1}H NMR (400 MHz)

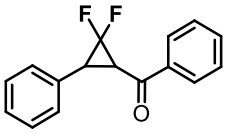




(2,2-difluoro-3-phenylcyclopropyl)(phenyl)methanone (2a)

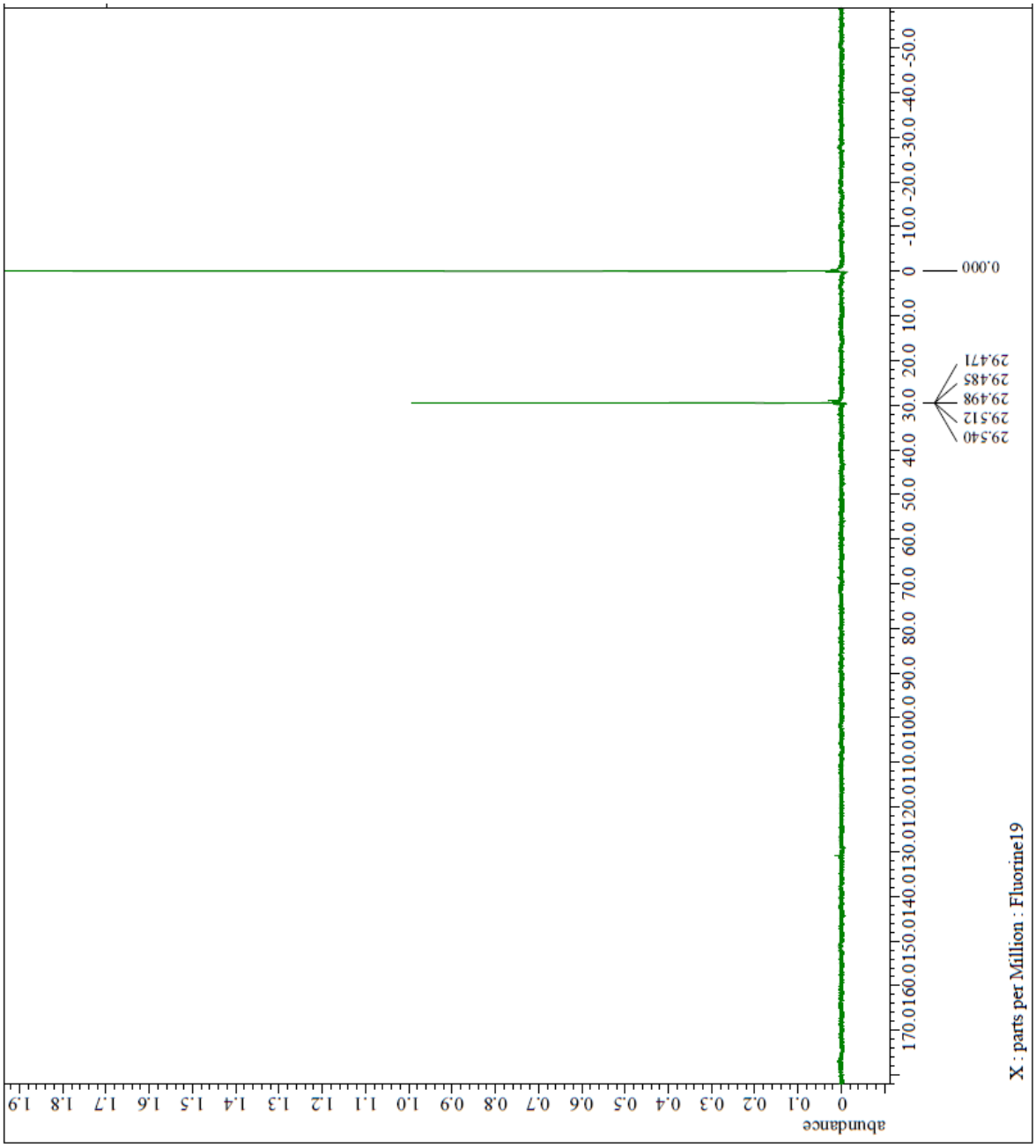
○ ^{1}H NMR (400 MHz)

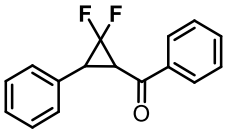




(2,2-difluoro-3-phenylcyclopropyl)(phenyl)methanone (2a)

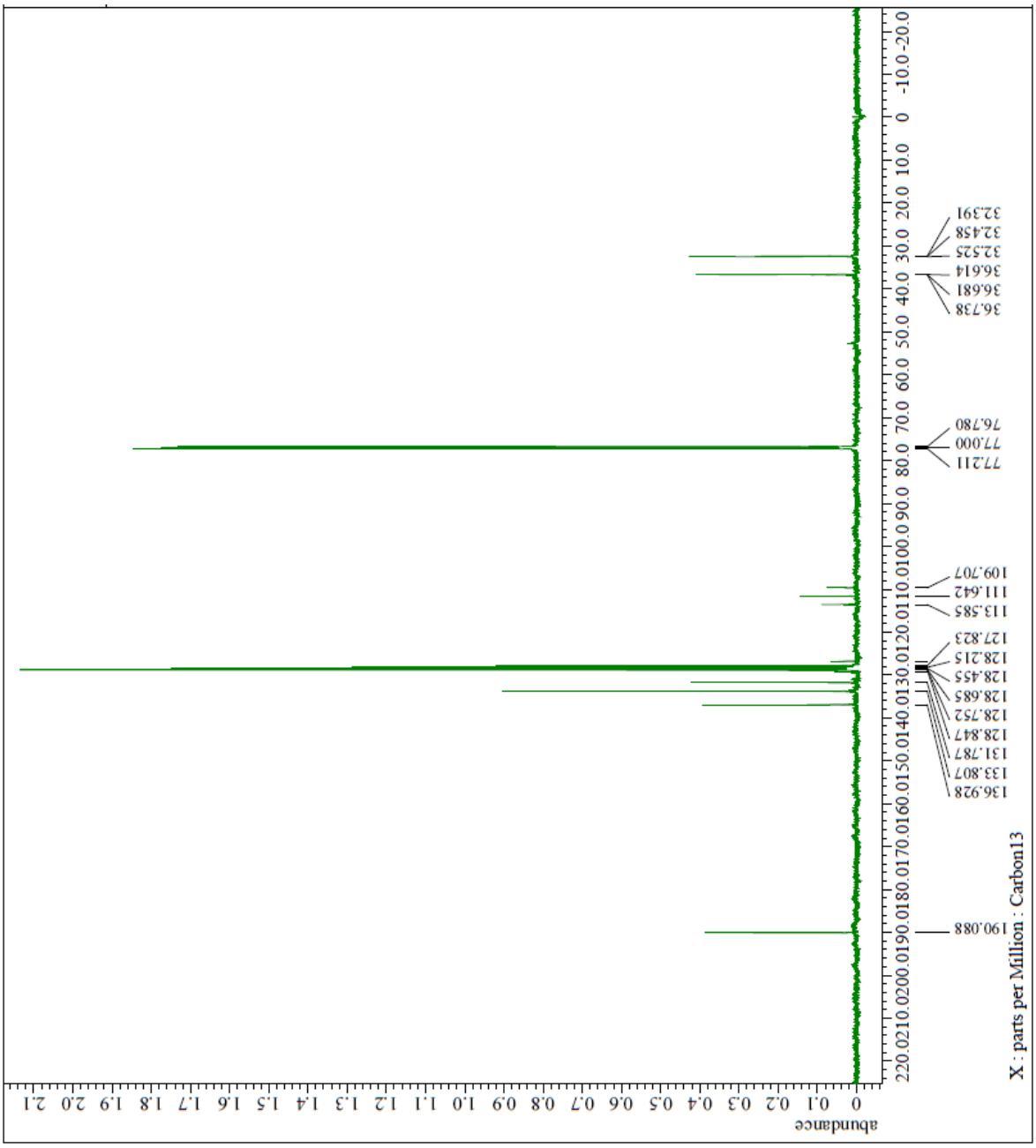
○ ^{19}F NMR (376 MHz)

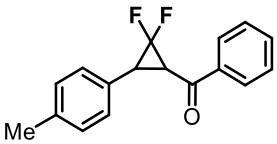




(2,2-difluoro-3-phenylcyclopropyl)(phenyl)methanone (2a)

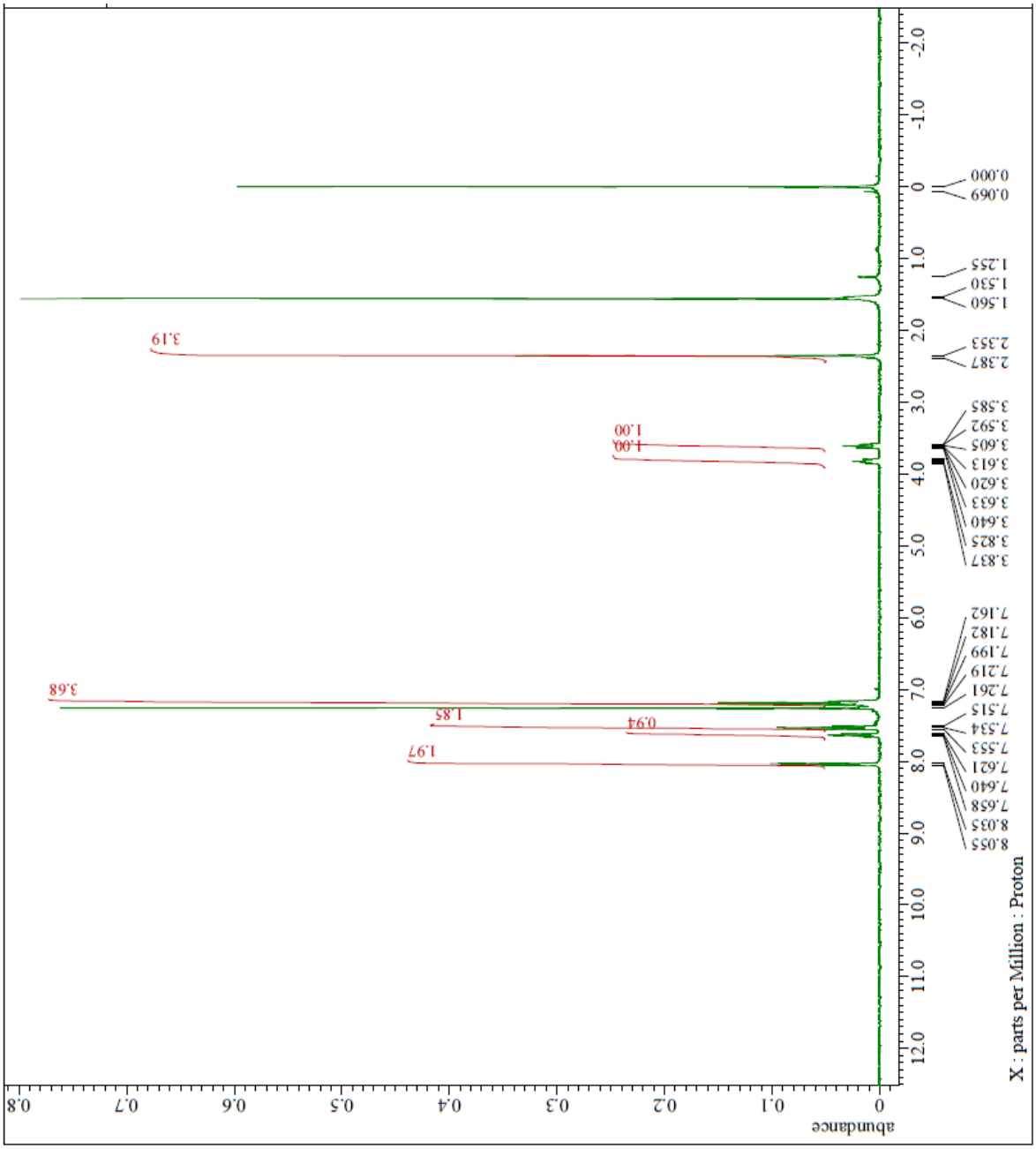
○ ^{13}C NMR (151 MHz)

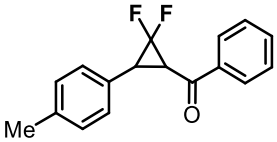




(2,2-difluoro-3-(p-tolyl)cyclopropyl)(phenyl)methanone

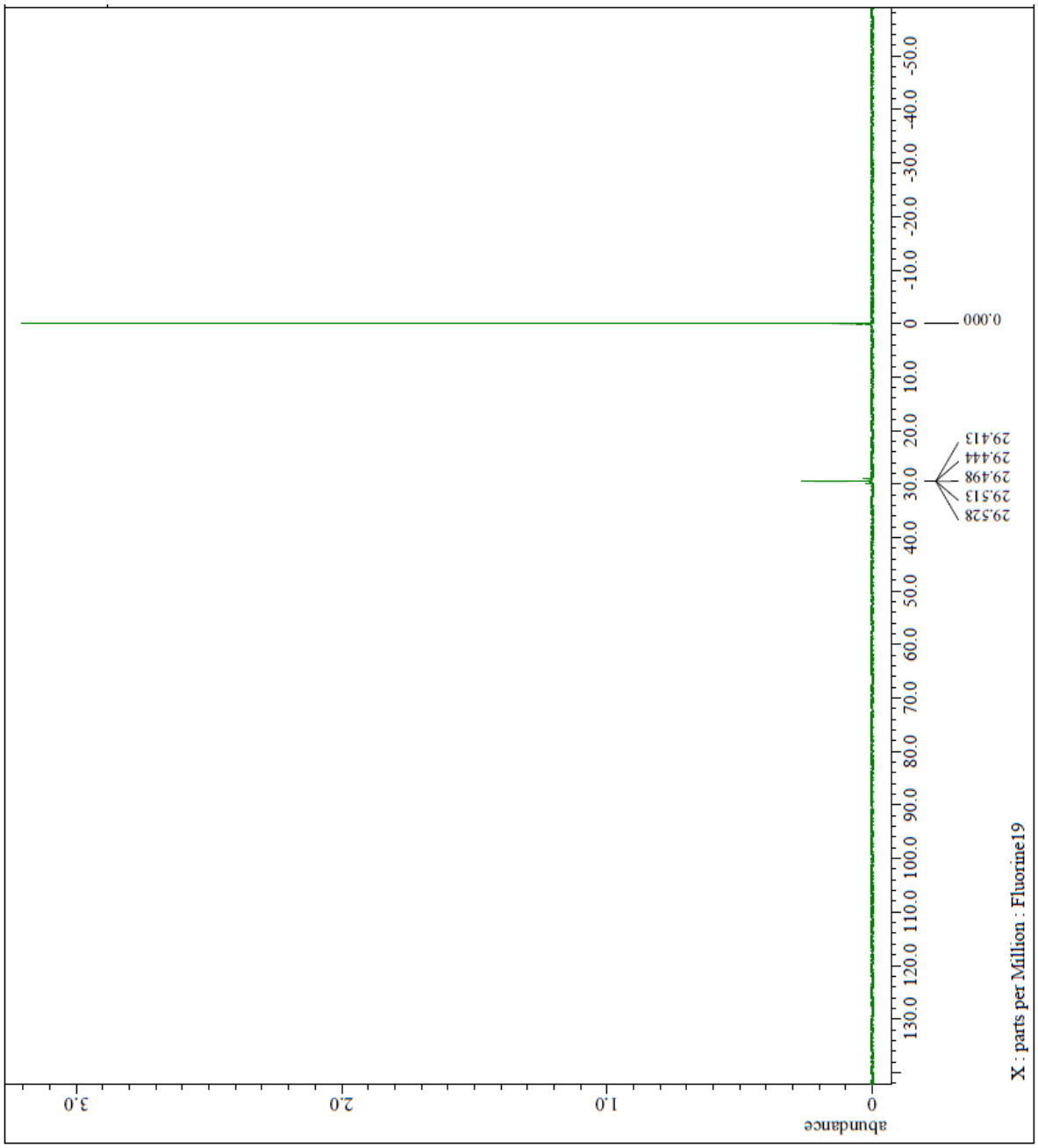
○ ^{1}H NMR (400 MHz)

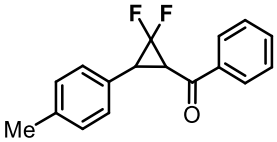




(2,2-difluoro-3-(p-tolyl)cyclopropyl)(phenyl)methanone

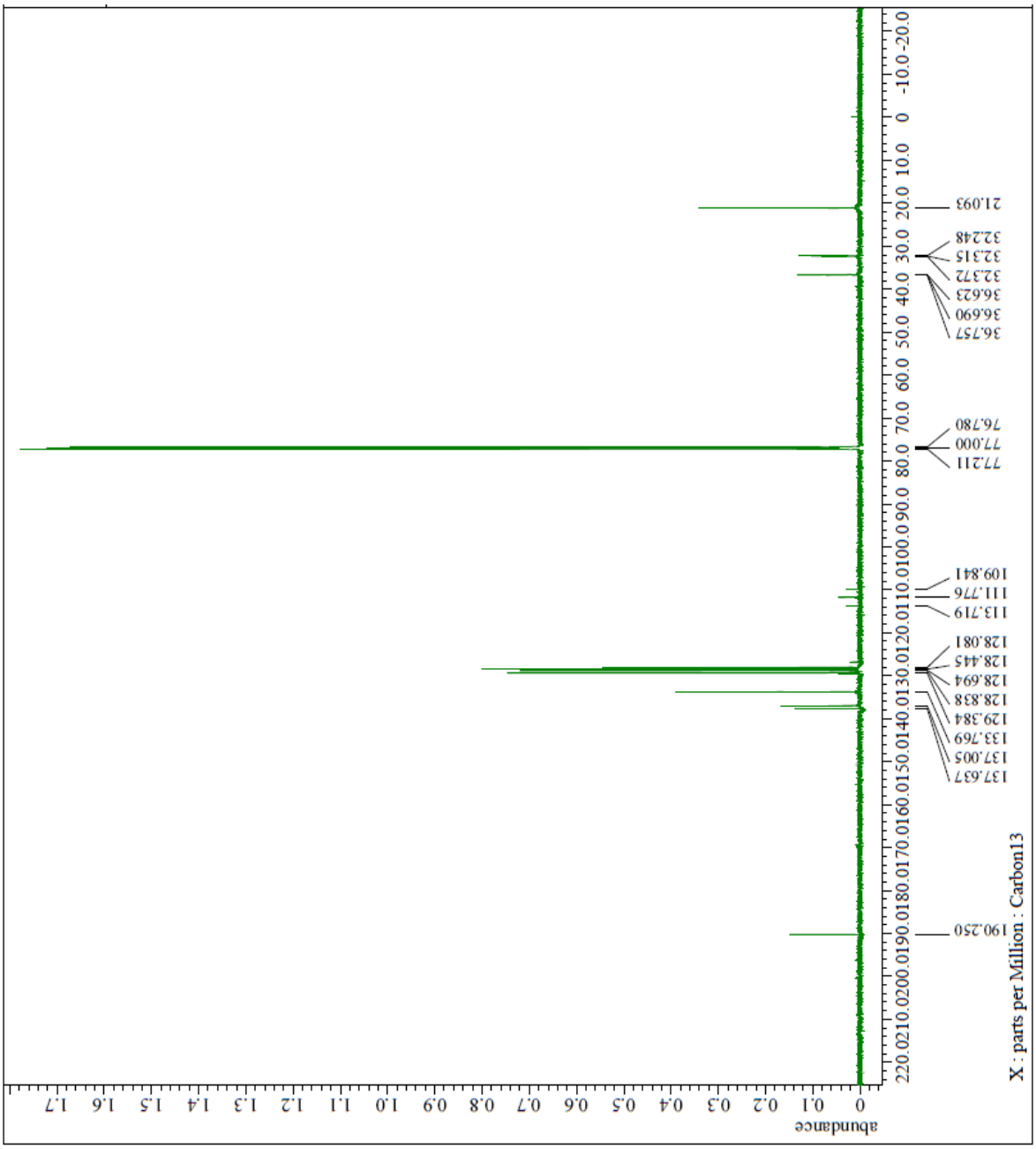
○ ^{19}F NMR (376 MHz)

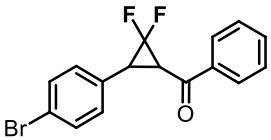




(2,2-difluoro-3-(p-tolyl)cyclopropyl)(phenyl)methanone

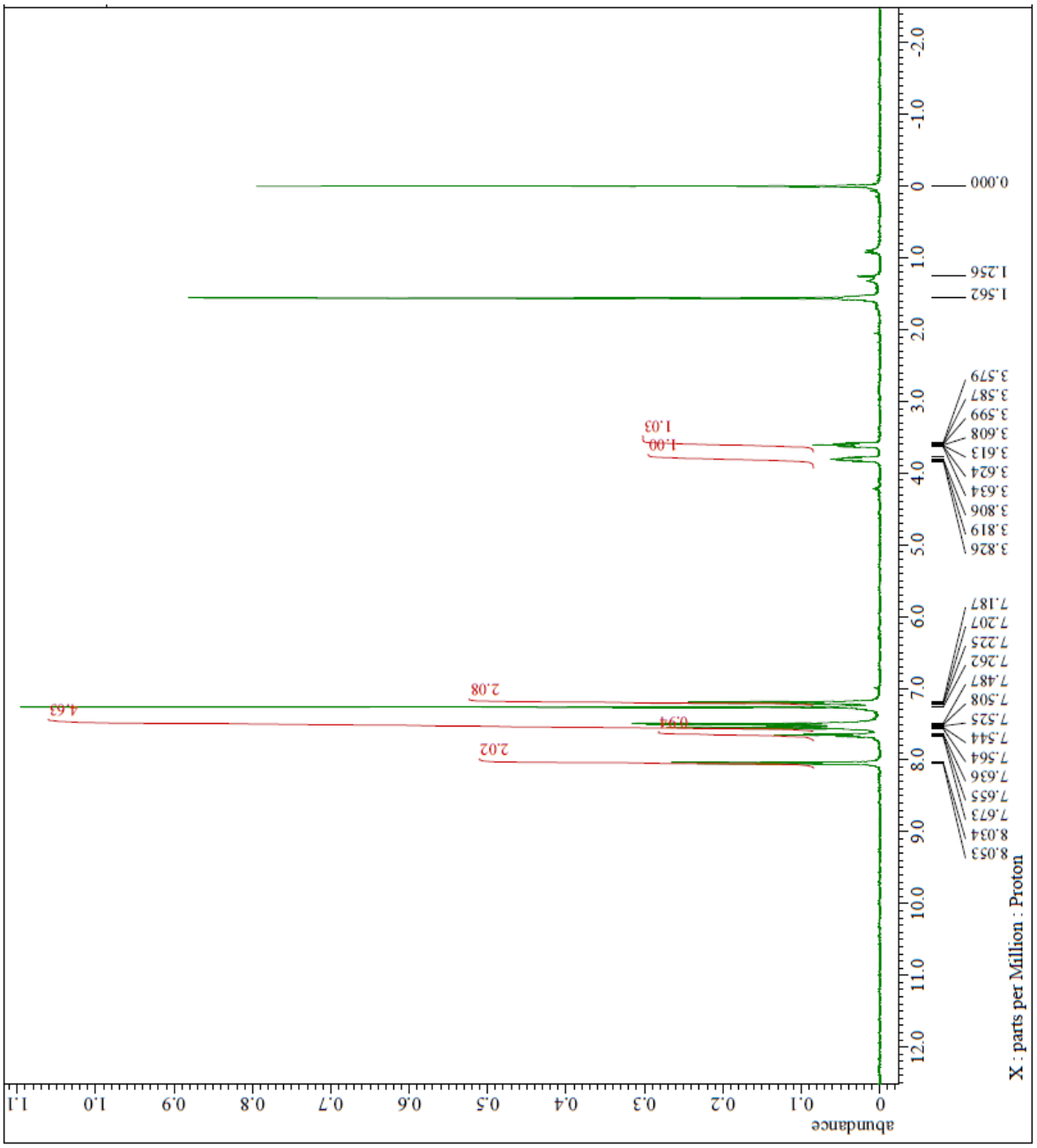
○ ^{13}C NMR (151 MHz)

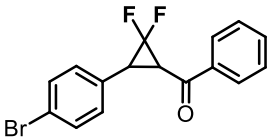




(3-(4-bromophenyl)-2,2-difluorocyclopropyl)(phenyl)methanone

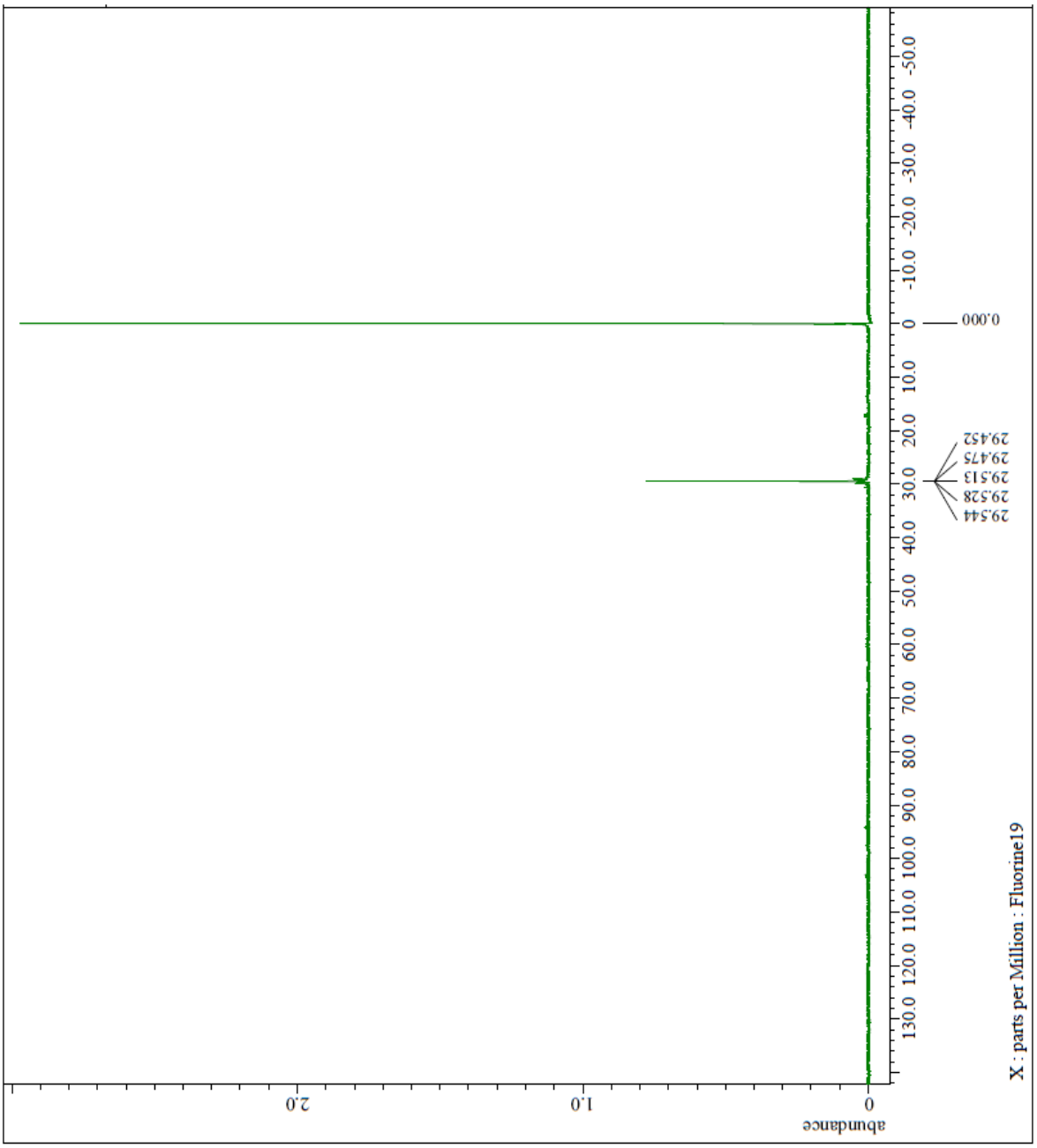
○ ^{1}H NMR (400 MHz)

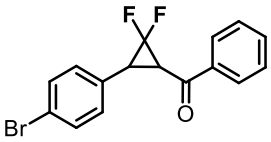




(3-(4-bromophenyl)-2,2-difluorocyclopropyl)(phenyl)methanone

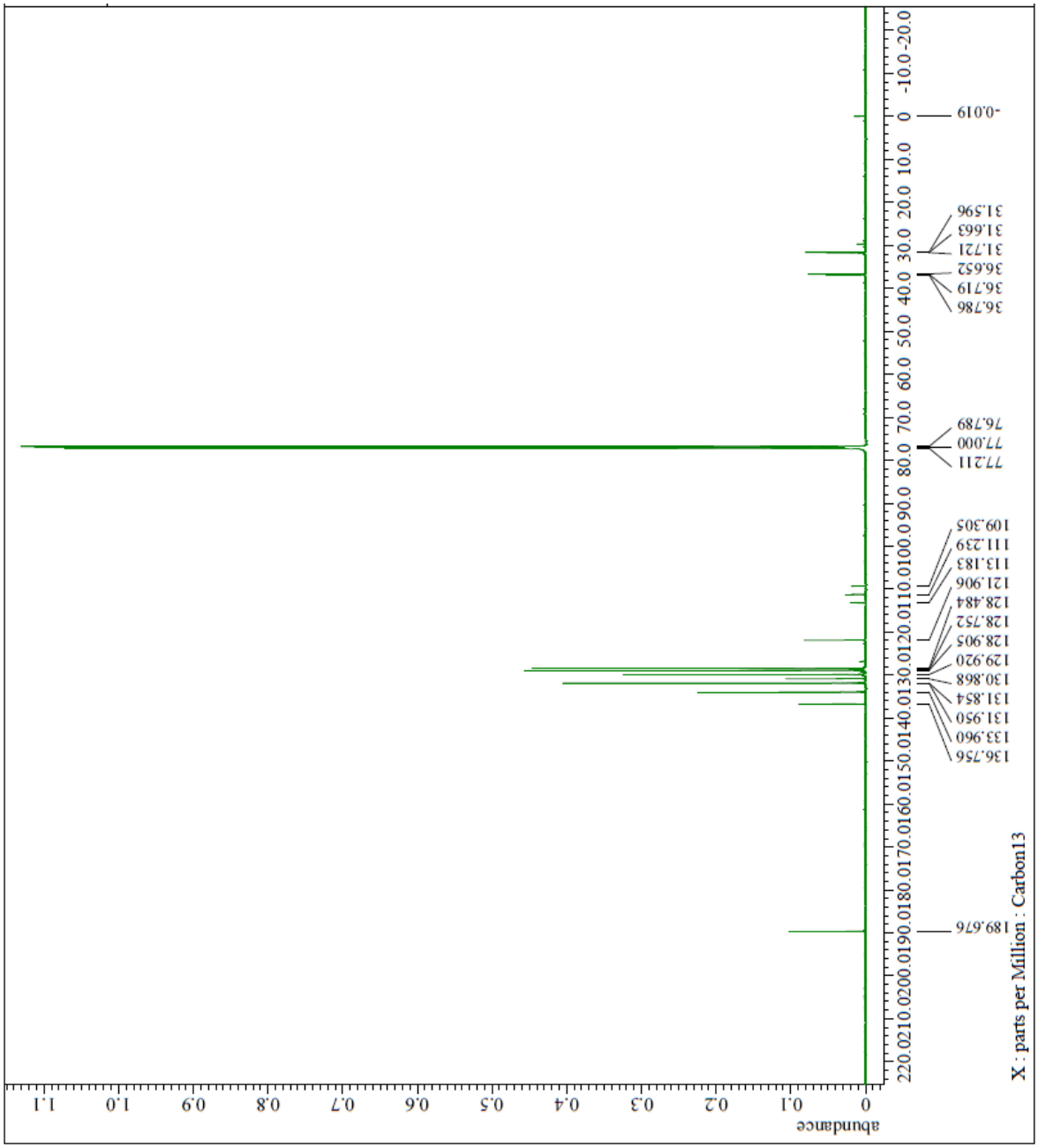
○ ^{19}F NMR (376 MHz)

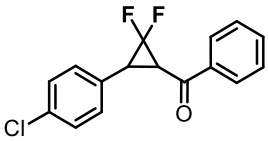




(3-(4-bromophenyl)-2,2-difluorocyclopropyl)(phenyl)methanone

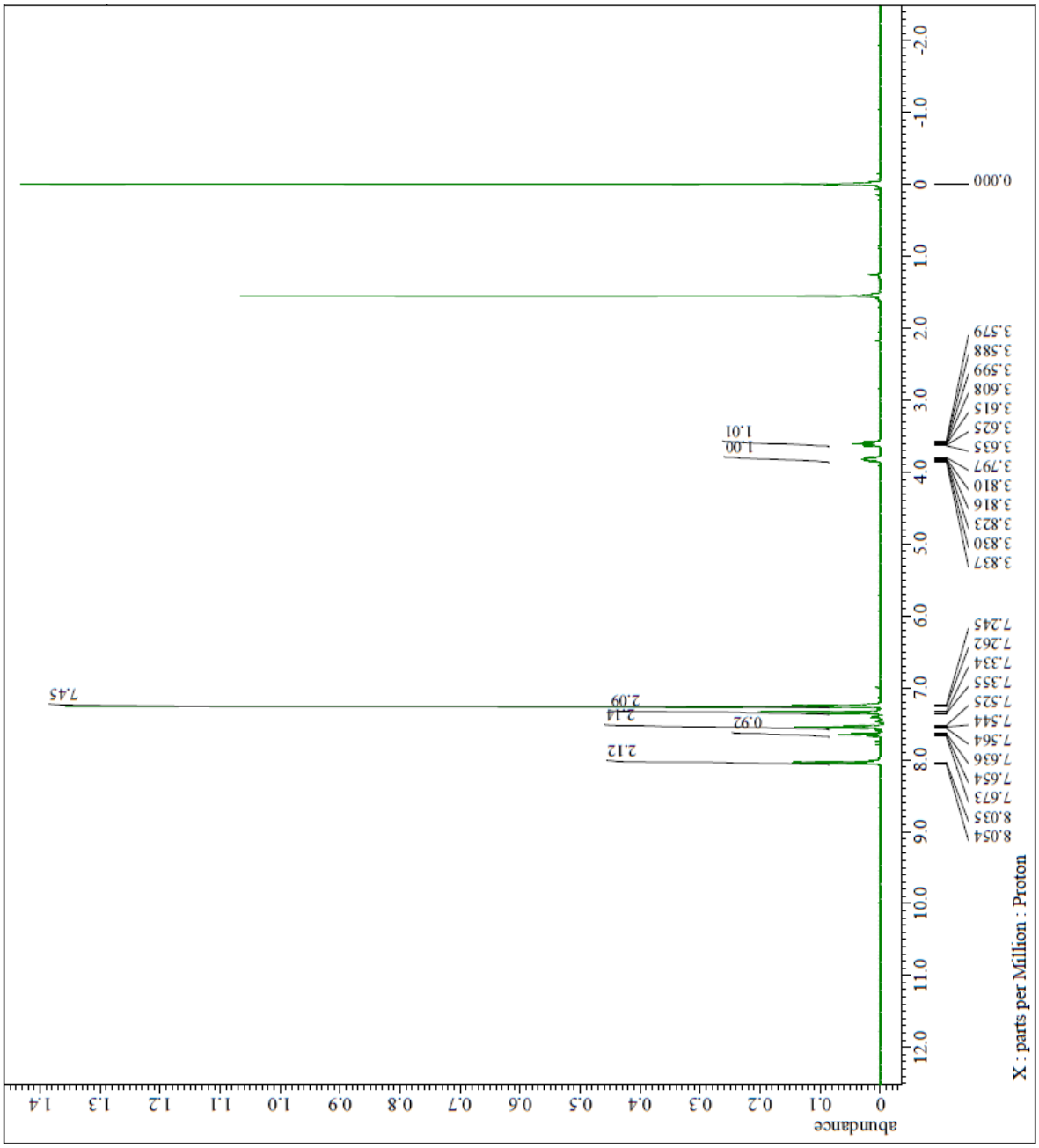
○ ^{13}C NMR (151 MHz)

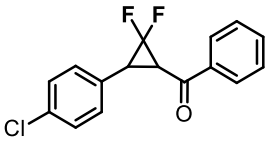




(3-(4-chlorophenyl)-2,2-difluorocyclopropyl)(phenyl)methanone

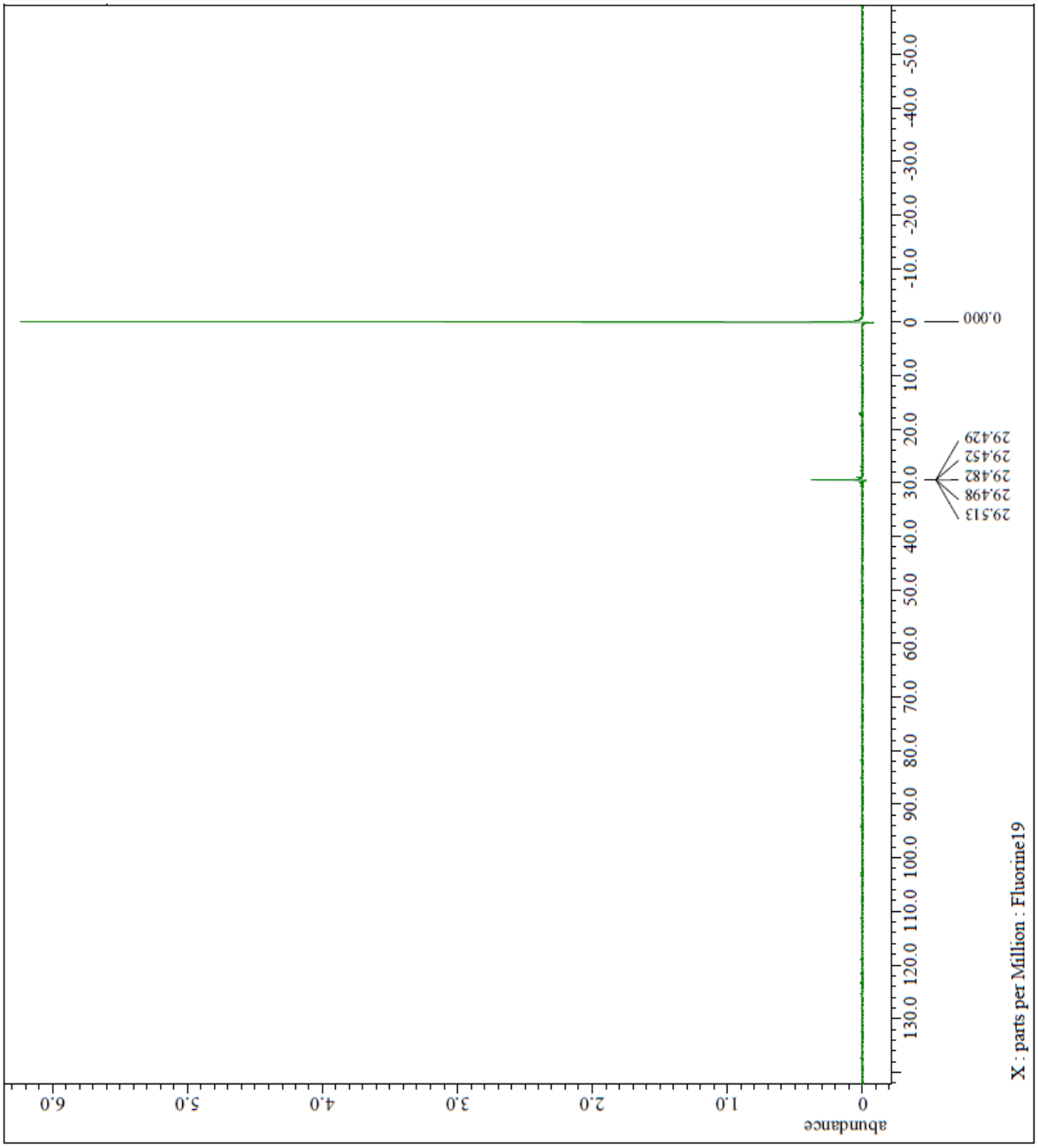
○ ^{1}H NMR (400 MHz)

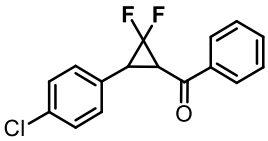




(3-(4-chlorophenyl)-2,2-difluorocyclopropyl)(phenyl)methanone

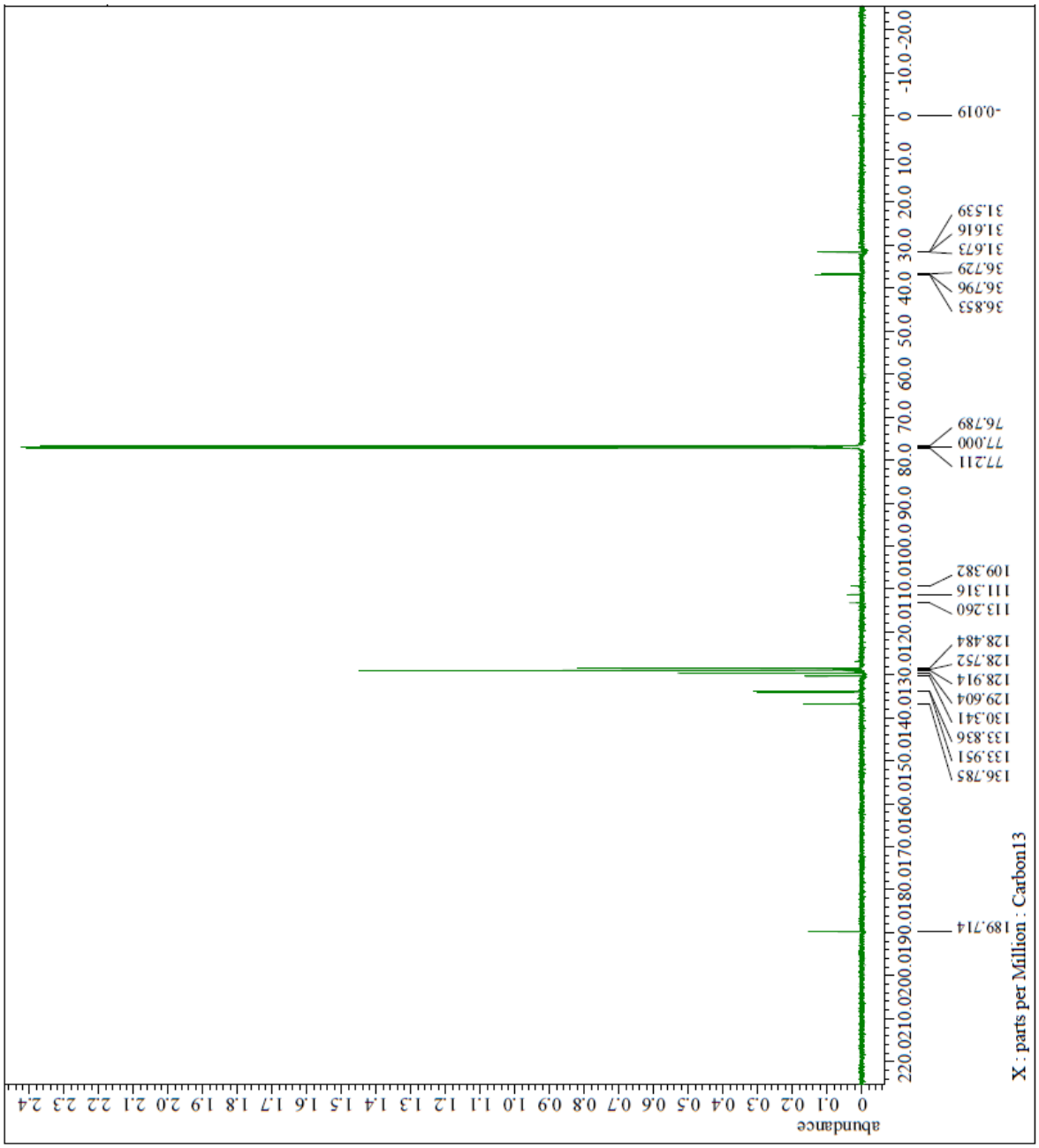
○ ^{19}F NMR (376 MHz)

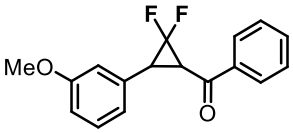




(3-(4-chlorophenyl)-2,2-difluorocyclopropyl)(phenyl)methanone

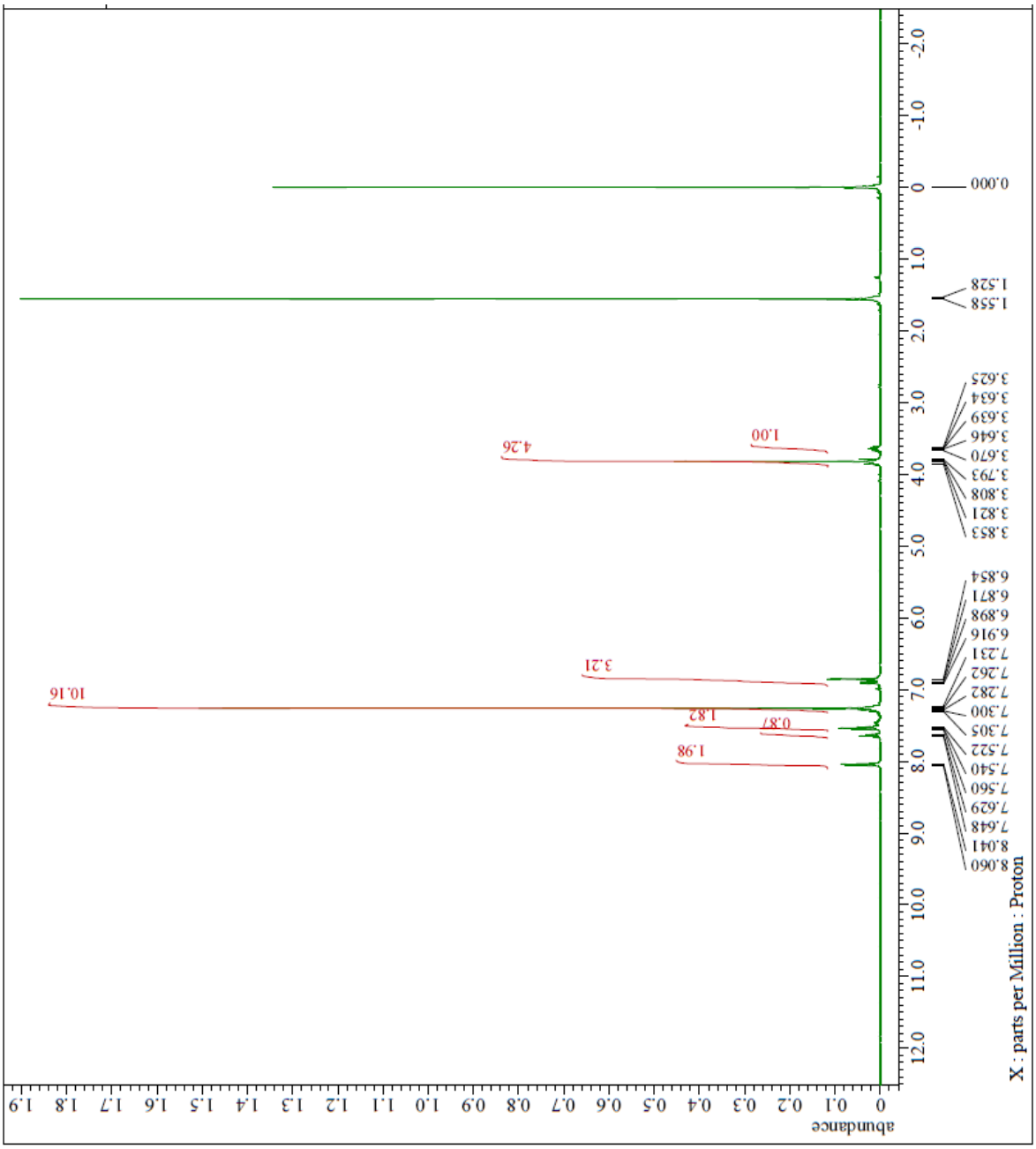
○ ^{13}C NMR (151 MHz)

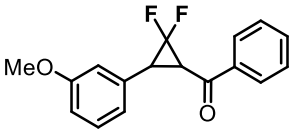




(2,2-difluoro-3-(3-methoxyphenyl)cyclopropyl)(phenyl)methanone

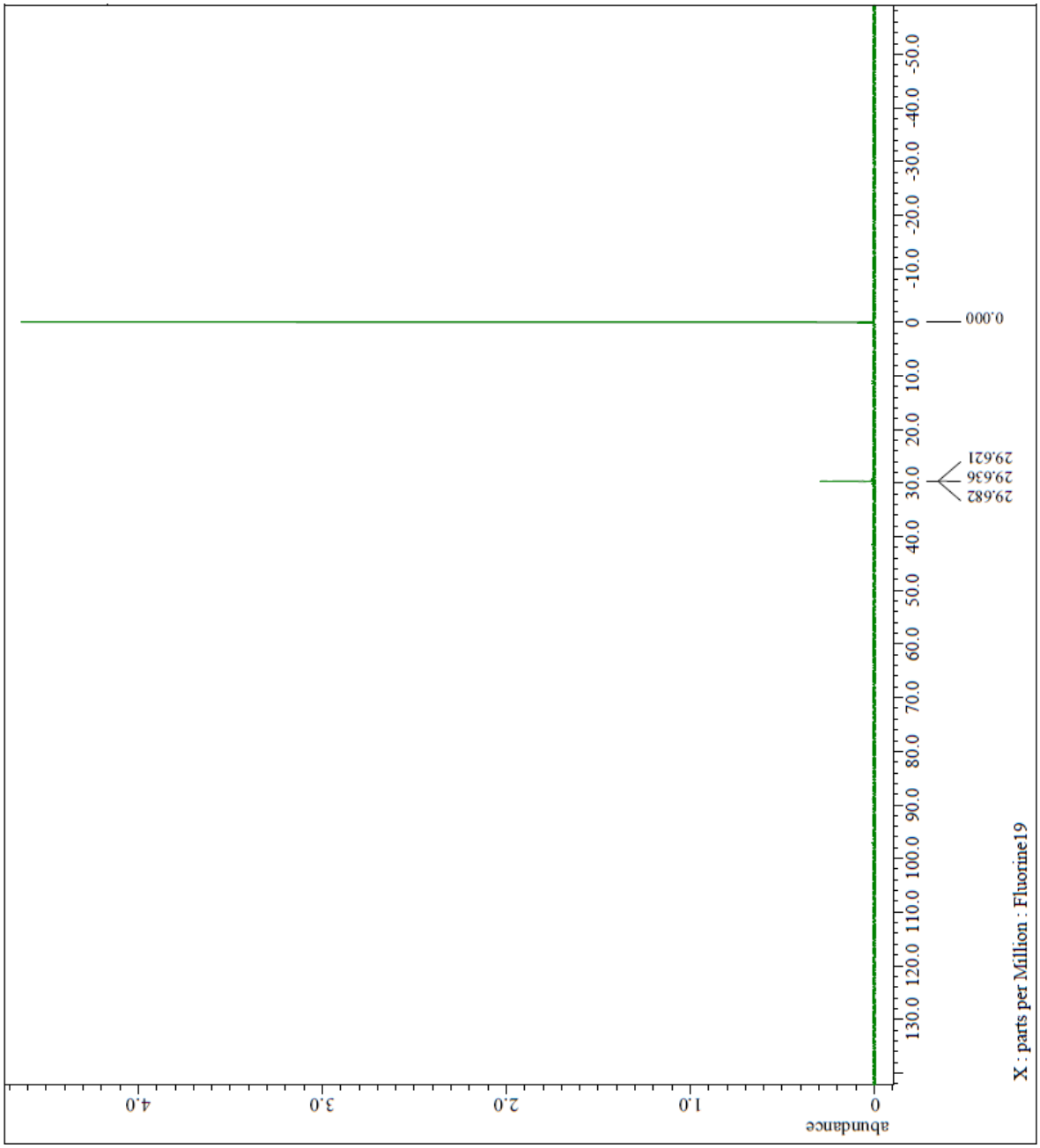
○ ^{1}H NMR (400 MHz)

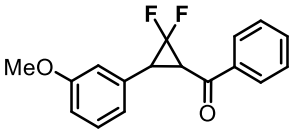




(2,2-difluoro-3-(3-methoxyphenyl)cyclopropyl)(phenyl)methanone

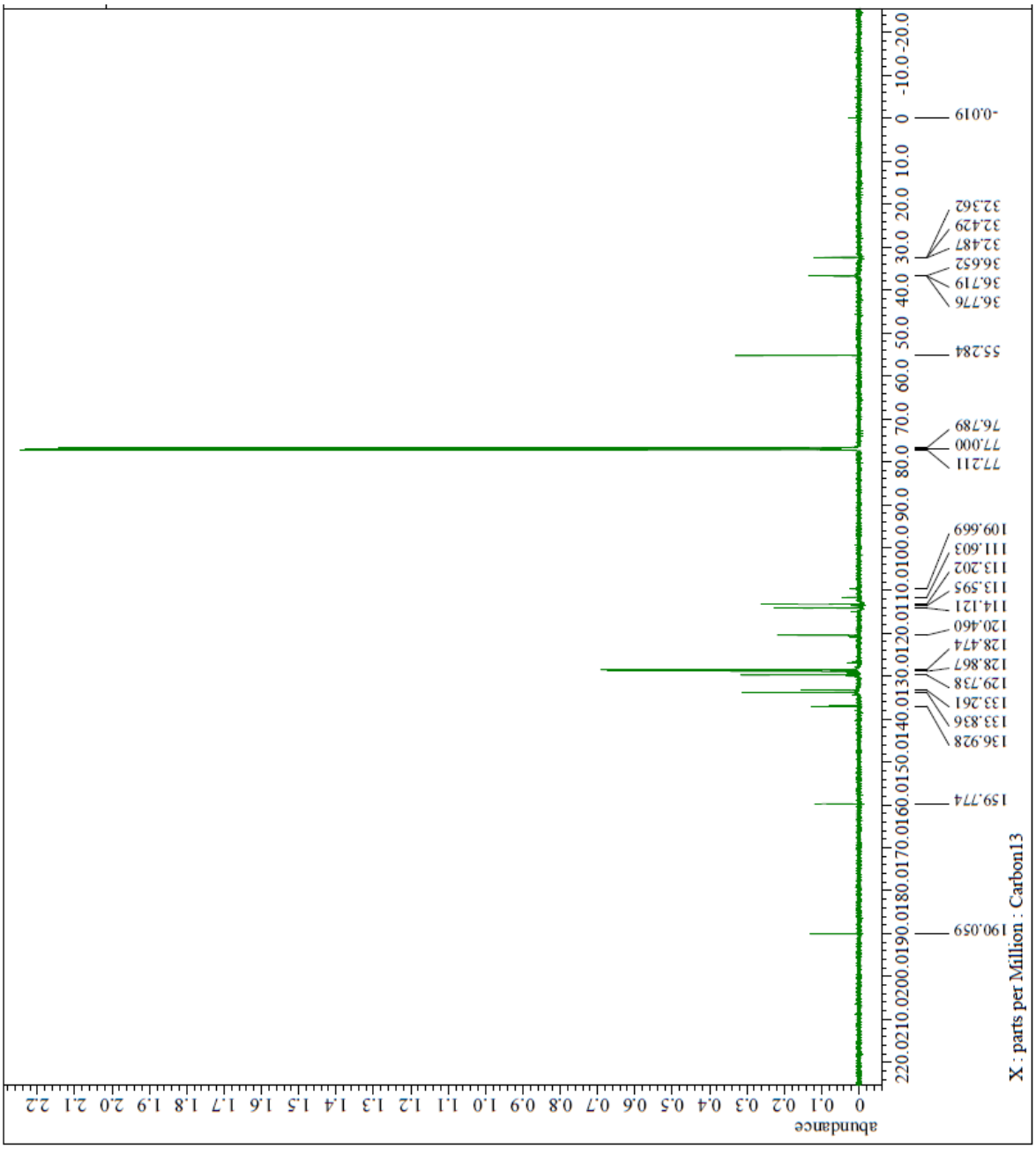
○ ^{19}F NMR (376 MHz)

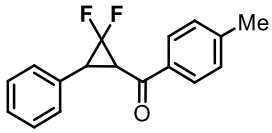




(2,2-difluoro-3-(3-methoxyphenyl)cyclopropyl)(phenyl)methanone

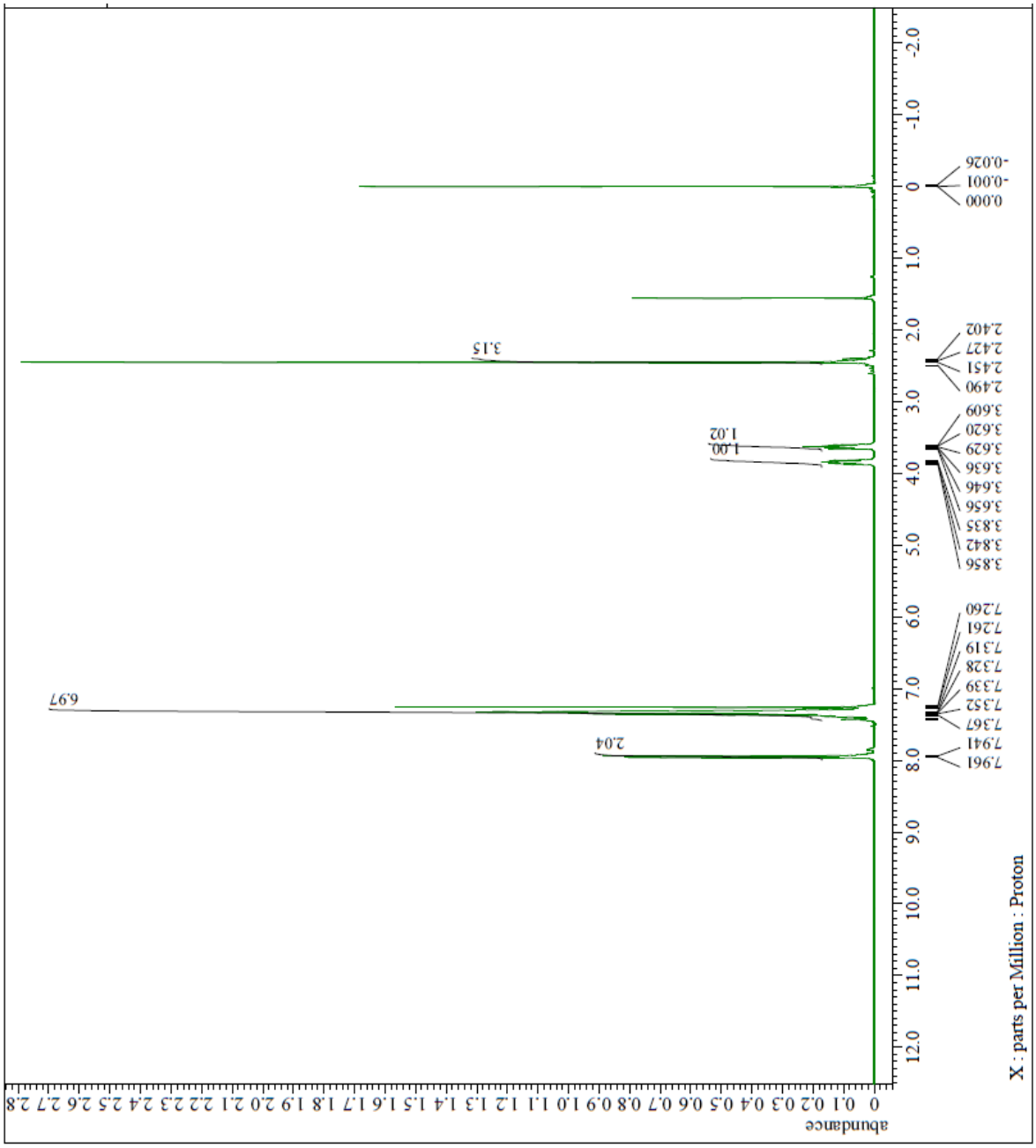
○ ^{13}C NMR (151 MHz)

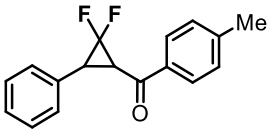




(2,2-difluoro-3-phenylcyclopropyl)(*p*-tolyl)methanone

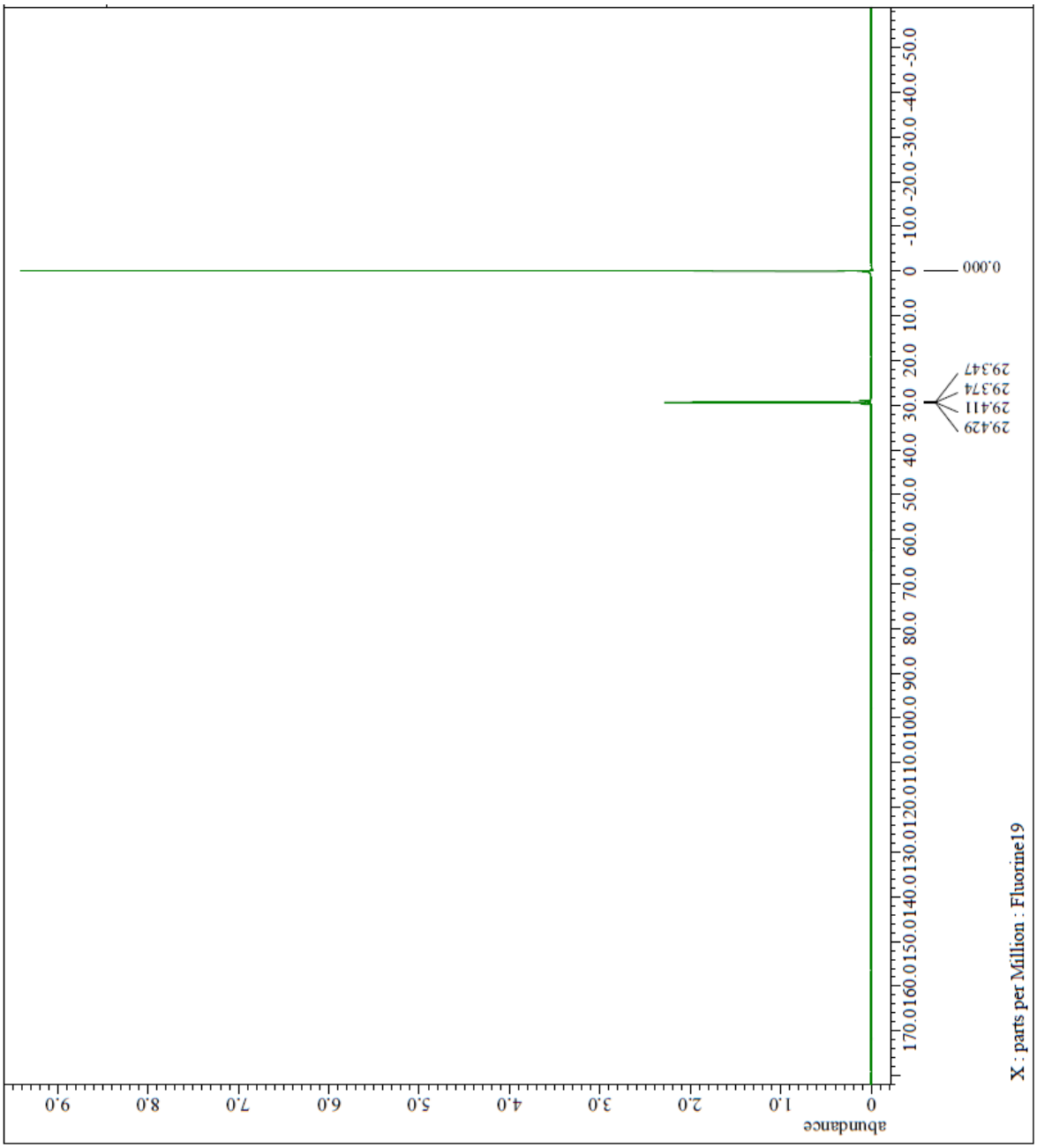
○ **^{1}H NMR** (400 MHz)

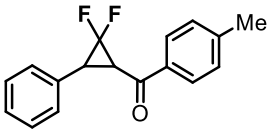




(2,2-difluoro-3-phenylcyclopropyl)(*p*-tolyl)methanone

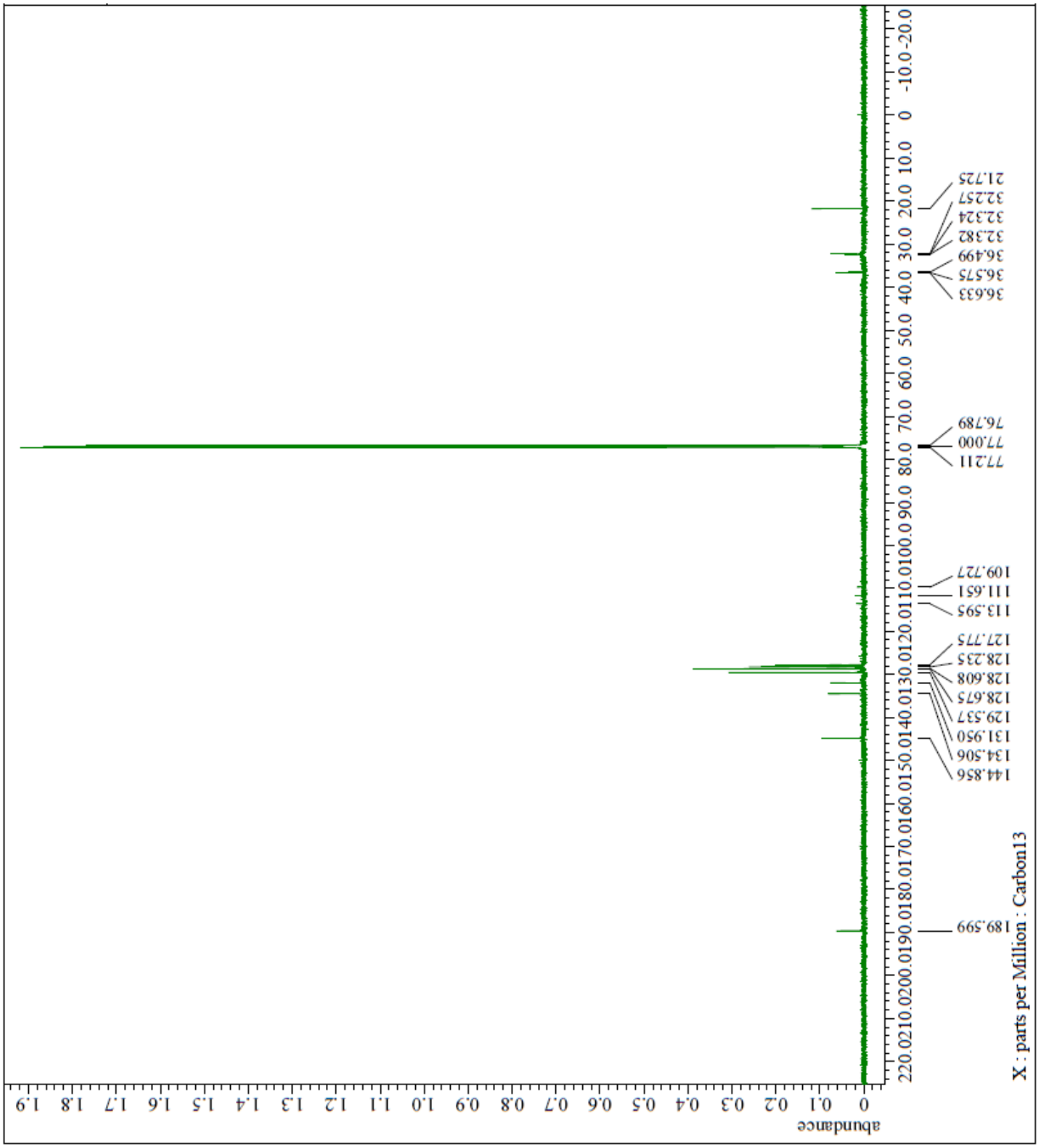
○ ^{19}F NMR (376 MHz)

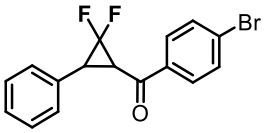




(2,2-difluoro-3-phenylcyclopropyl)(*p*-tolyl)methanone

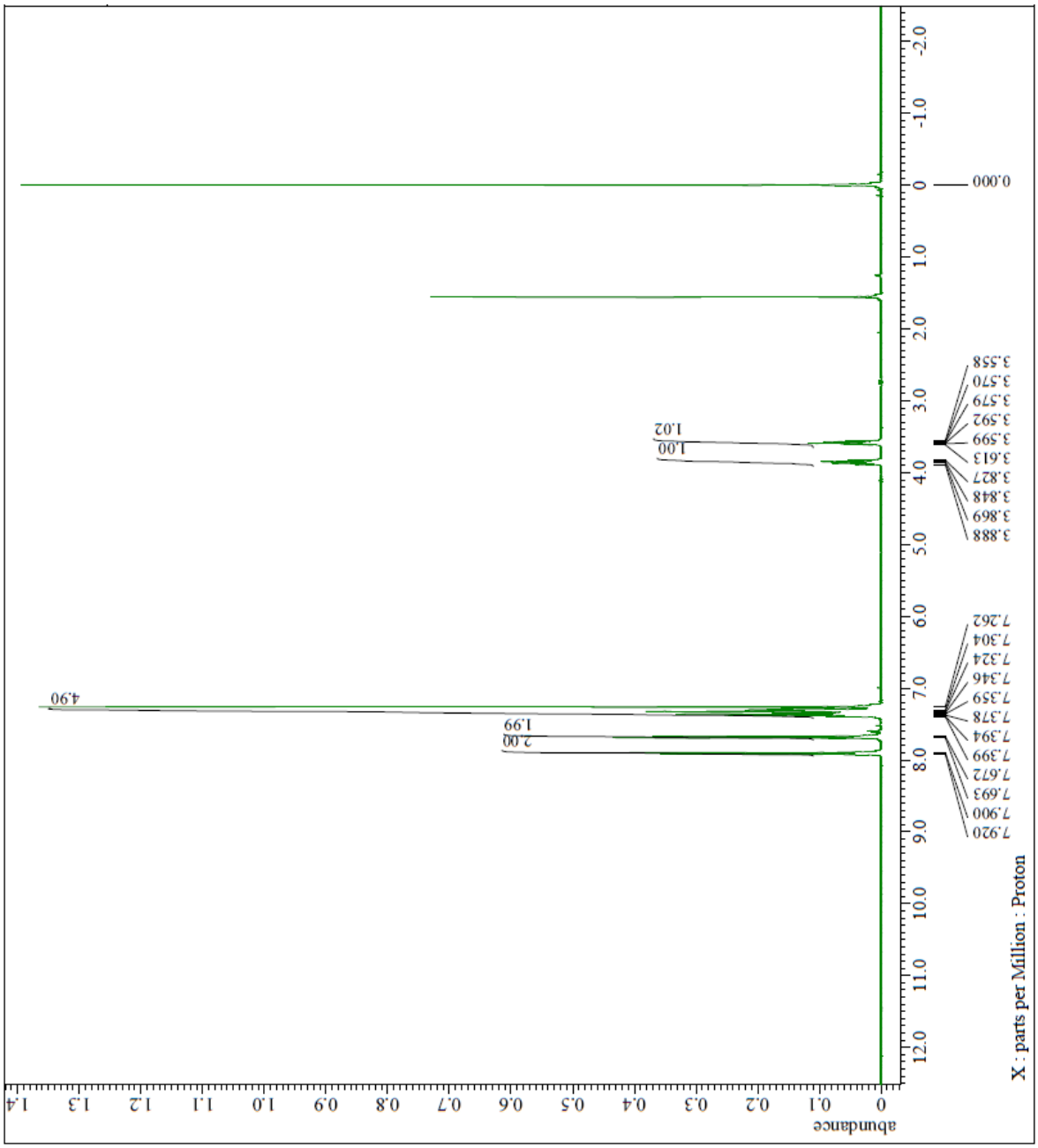
○ ^{13}C NMR (151 MHz)

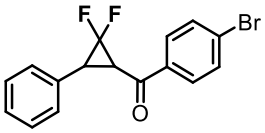




(4-bromophenyl)(2,2-difluoro-3-phenylcyclopropyl)methanone

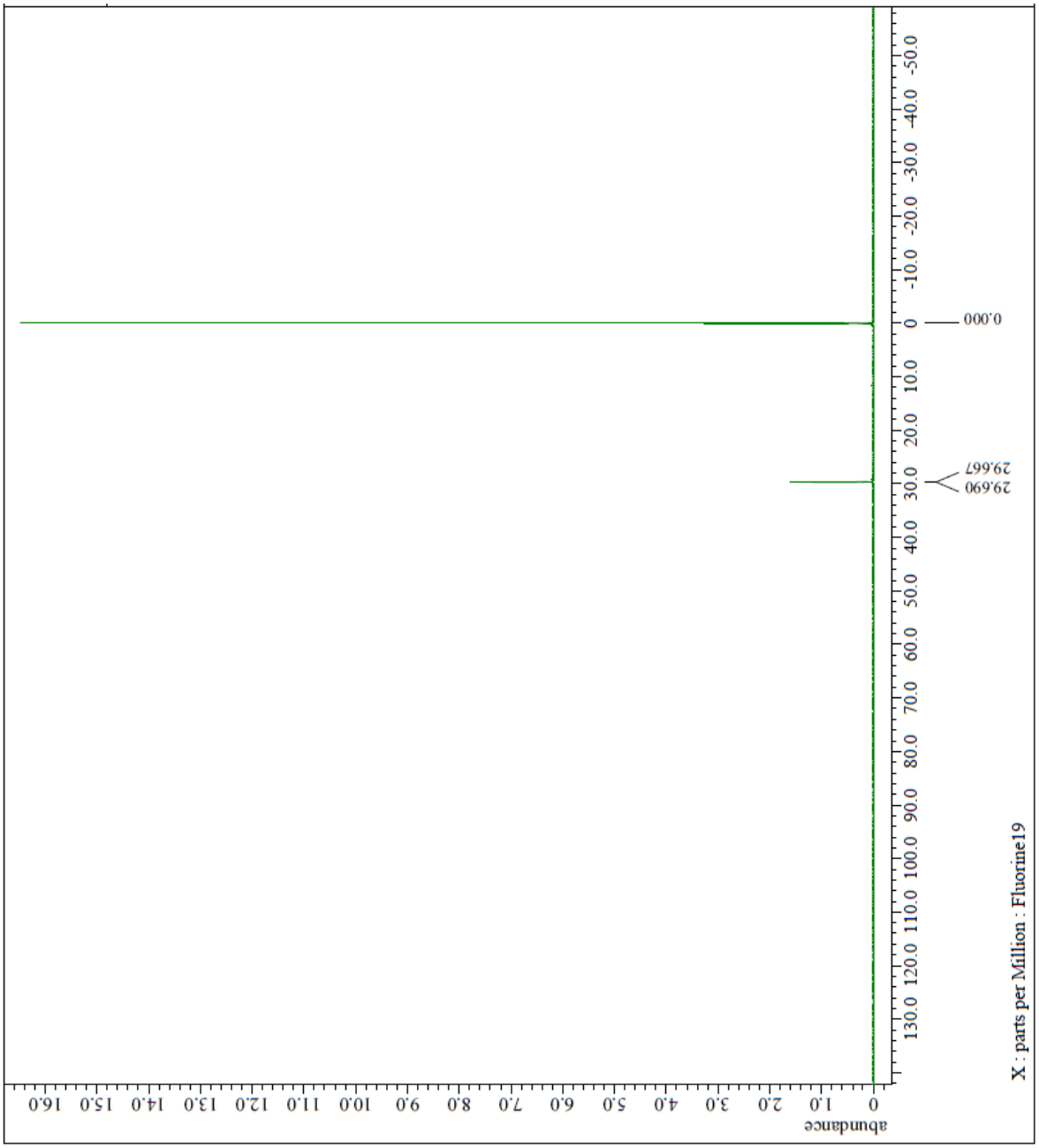
○ ^{1}H NMR (400 MHz)

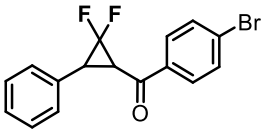




(4-bromophenyl)(2,2-difluoro-3-phenylcyclopropyl)methanone

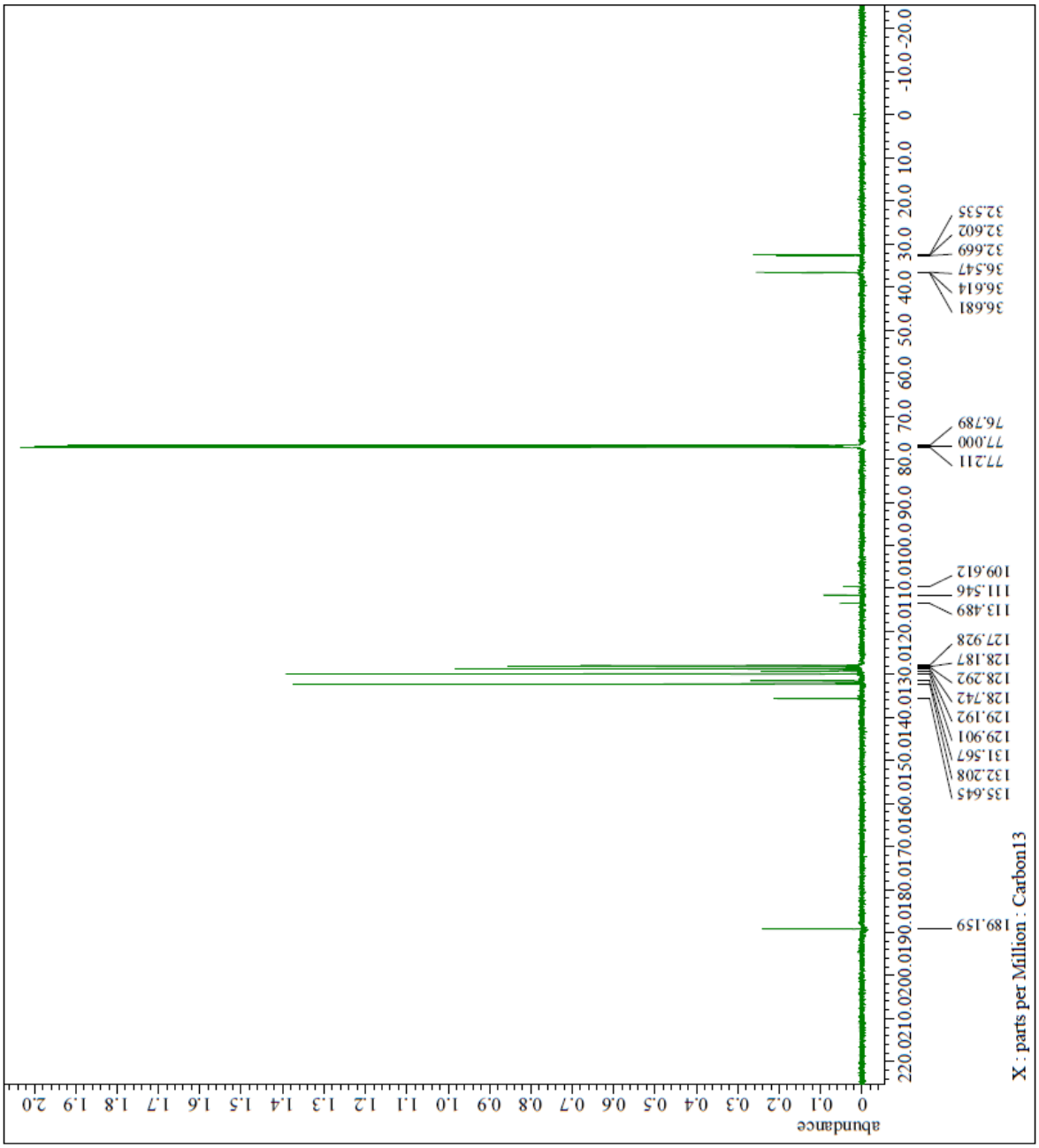
○ ^{19}F NMR (376 MHz)

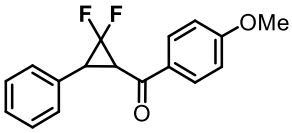




(4-bromophenyl)(2,2-difluoro-3-phenylcyclopropyl)methanone

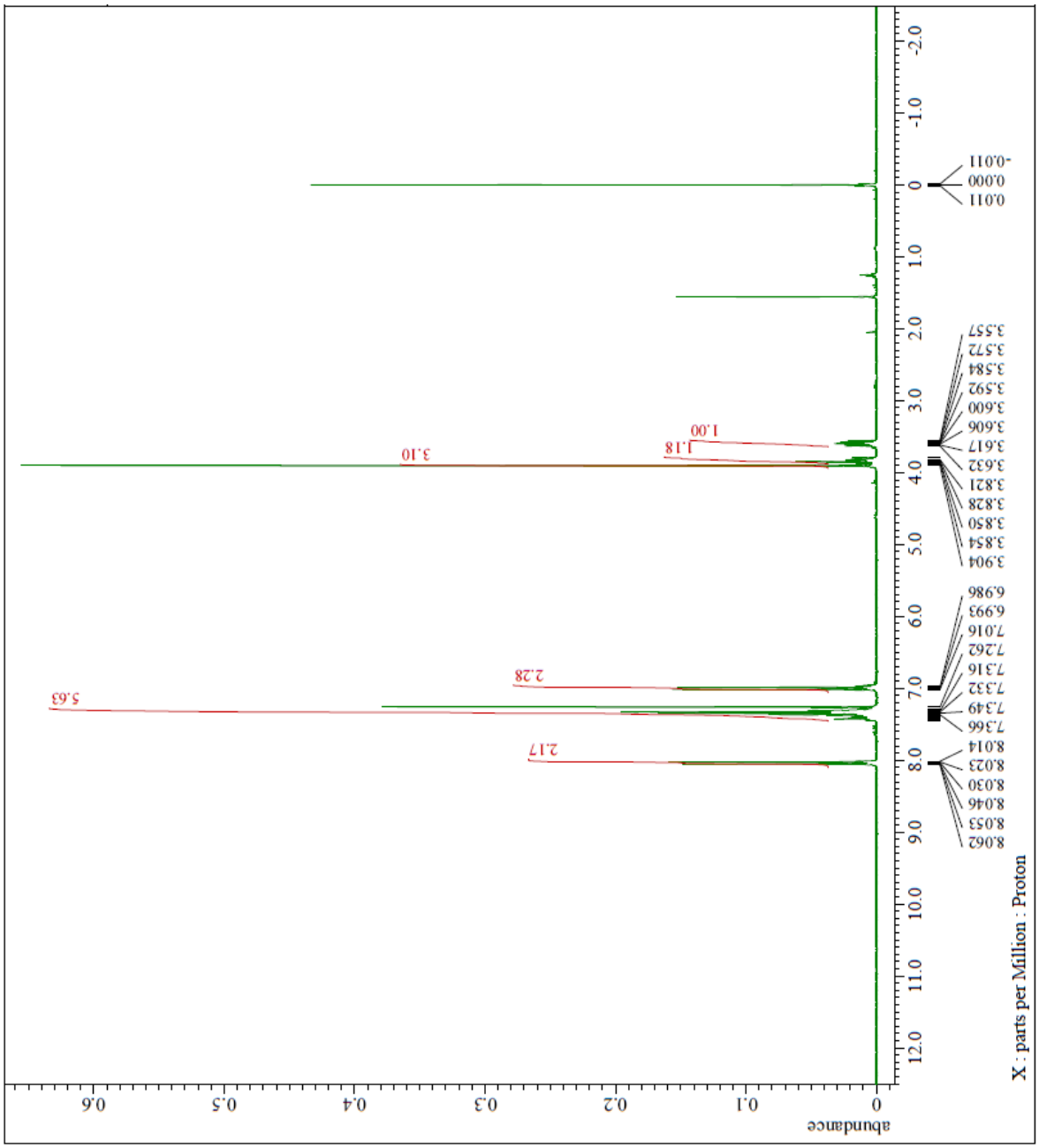
○ ^{13}C NMR (151 MHz)

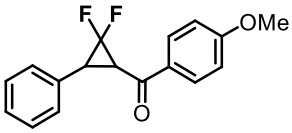




(2,2-difluoro-3-phenylcyclopropyl)(4-methoxyphenyl)methanone

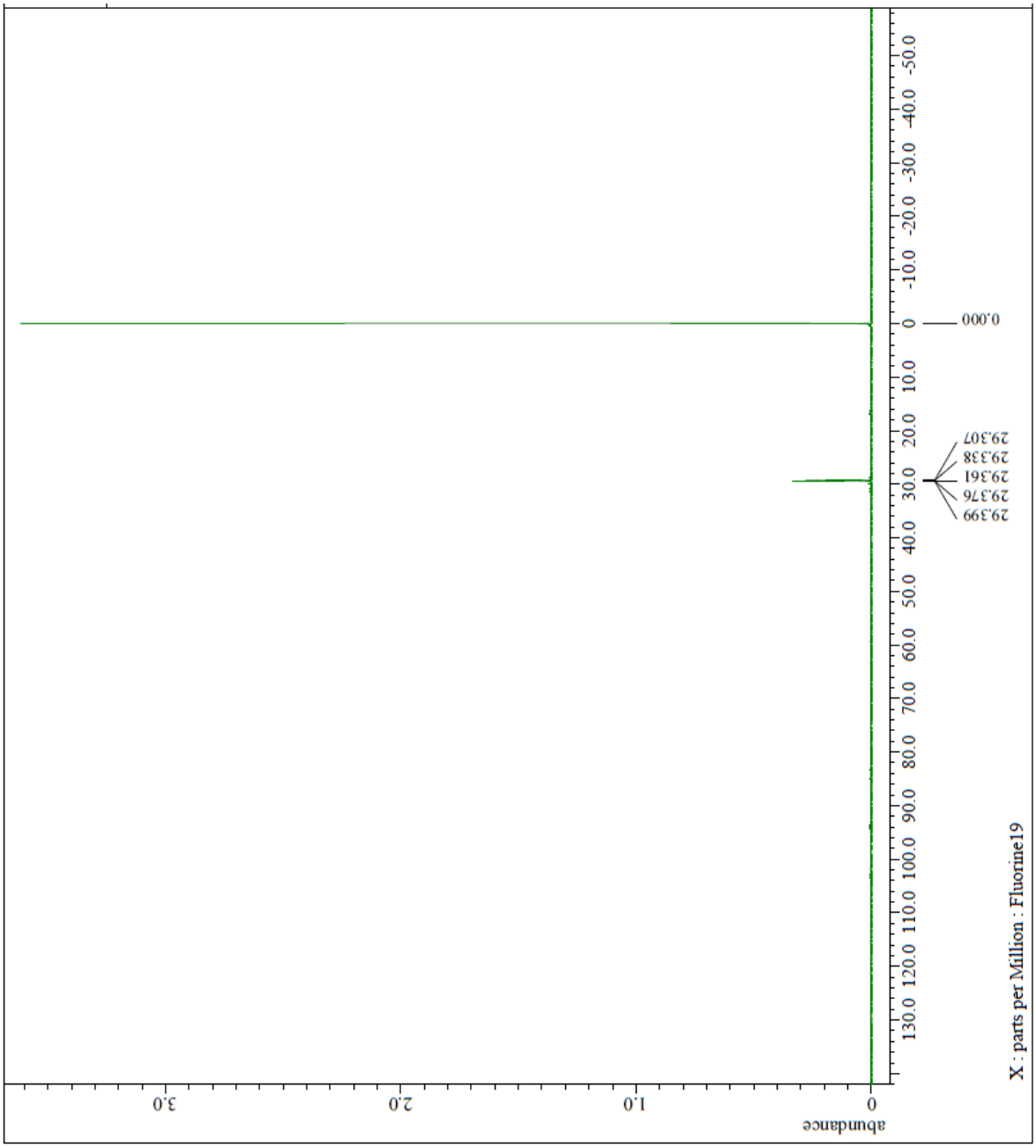
○ ^{1}H NMR (400 MHz)

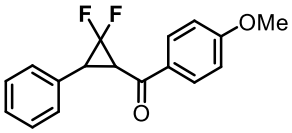




(2,2-difluoro-3-phenylcyclopropyl)(4-methoxyphenyl)methanone

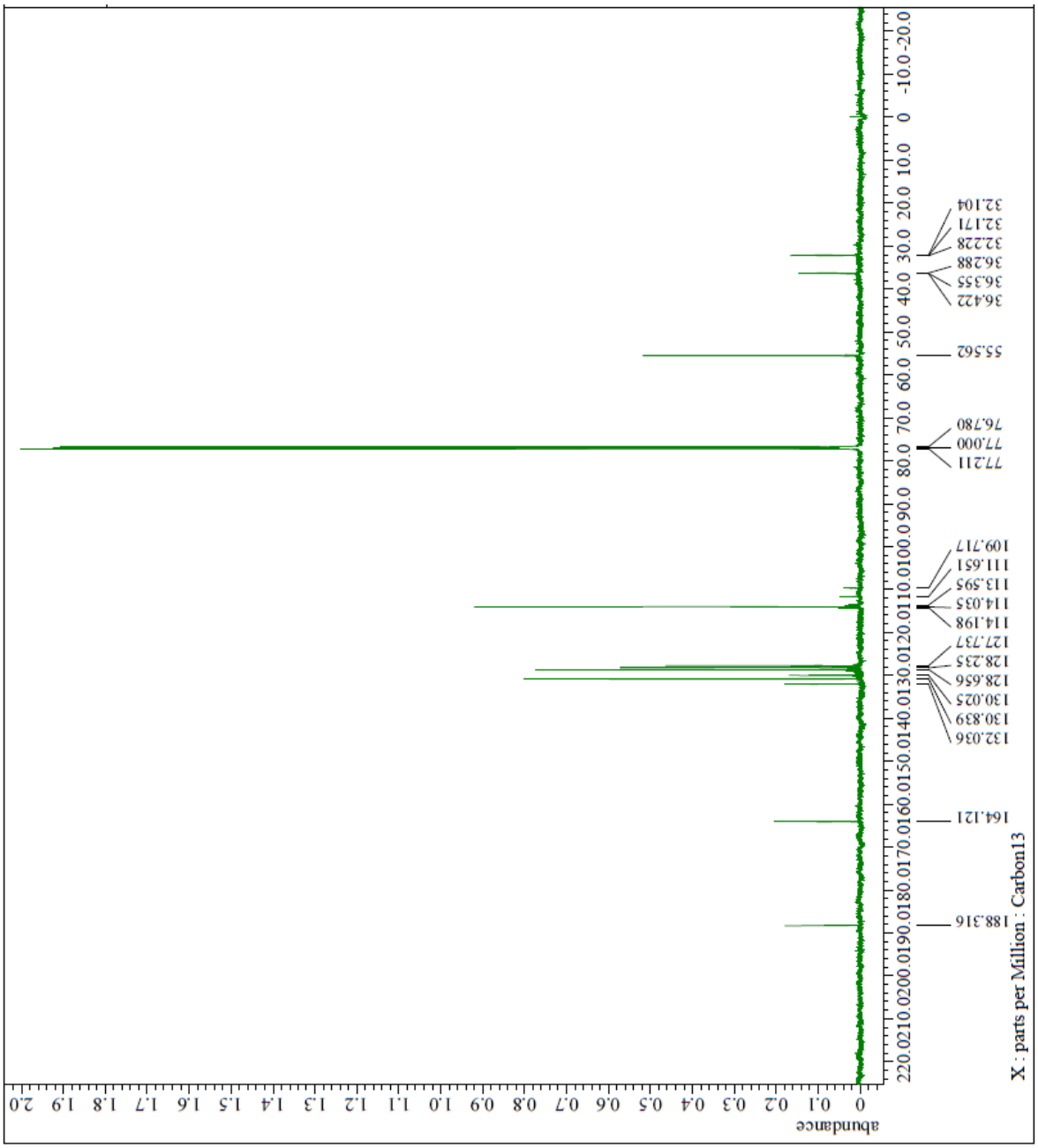
○ ^{19}F NMR (376 MHz)

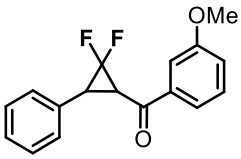




(2,2-difluoro-3-phenylcyclopropyl)(4-methoxyphenyl)methanone

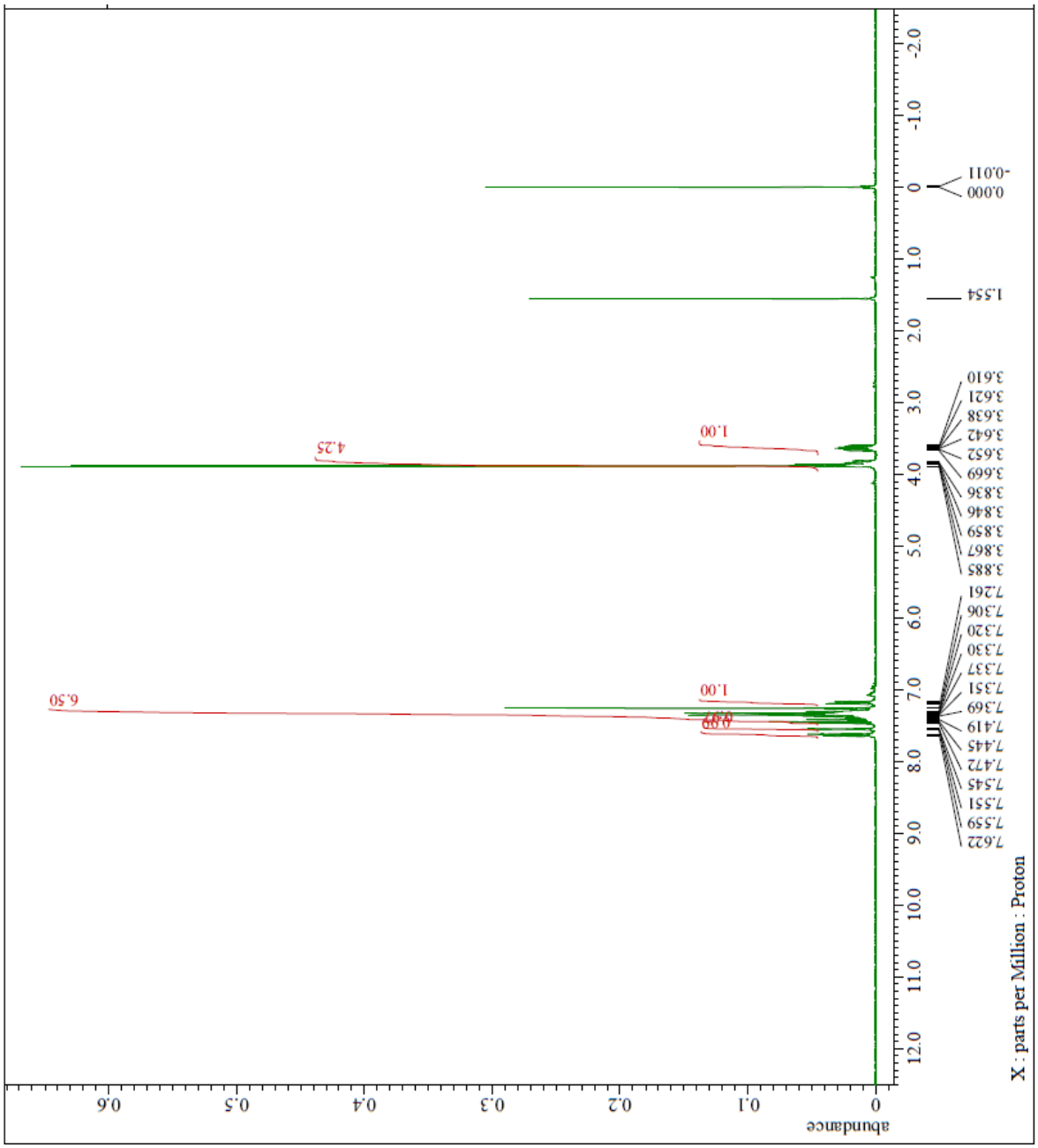
○ ^{13}C NMR (151 MHz)

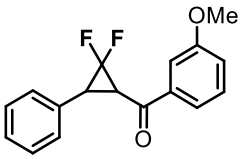




(2,2-difluoro-3-phenylcyclopropyl)(3-methoxyphenyl)methanone

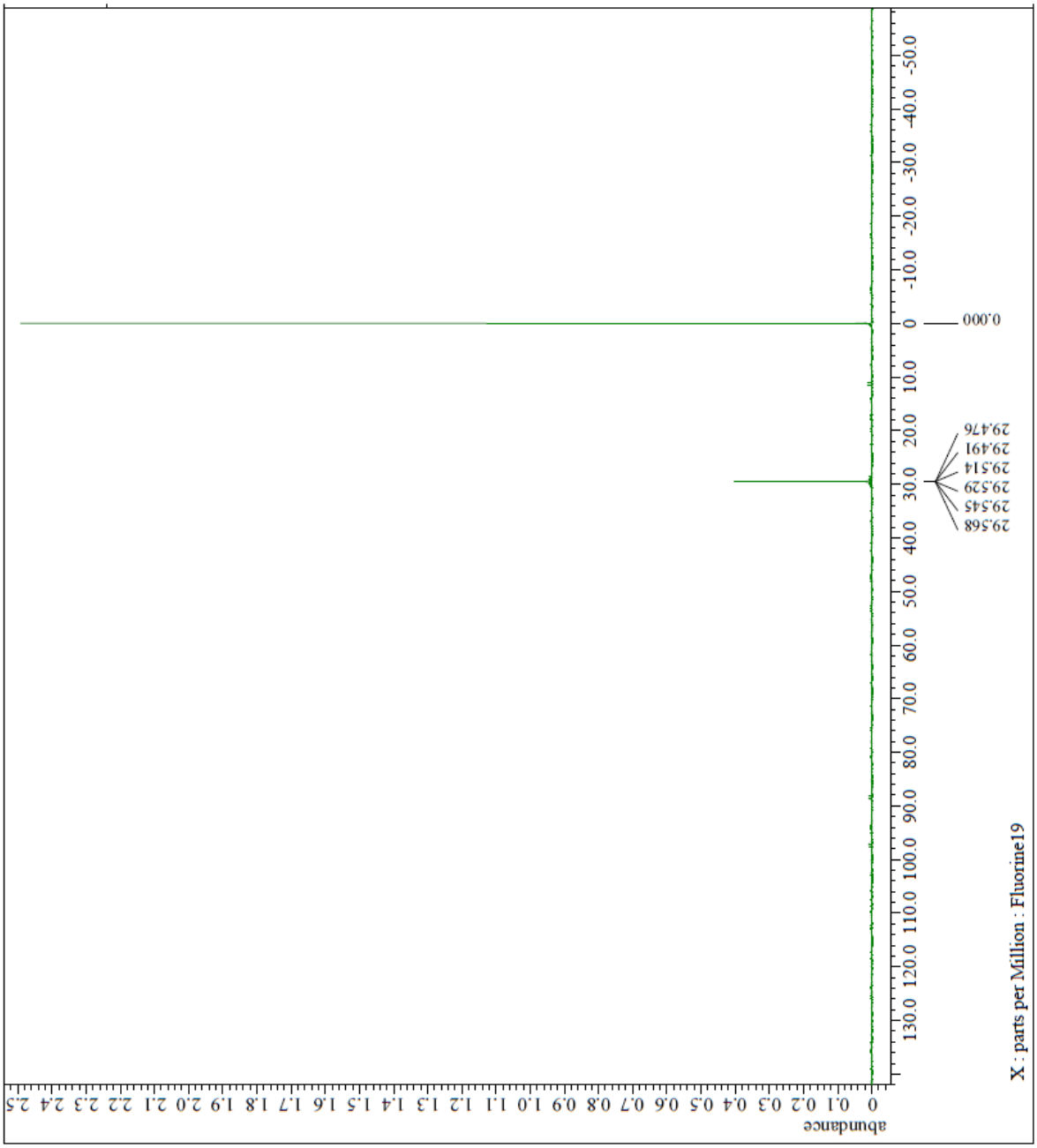
○ ^{1}H NMR (400 MHz)

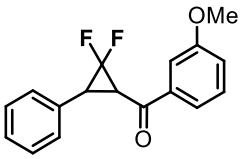




(2,2-difluoro-3-phenylcyclopropyl)(3-methoxyphenyl)methanone

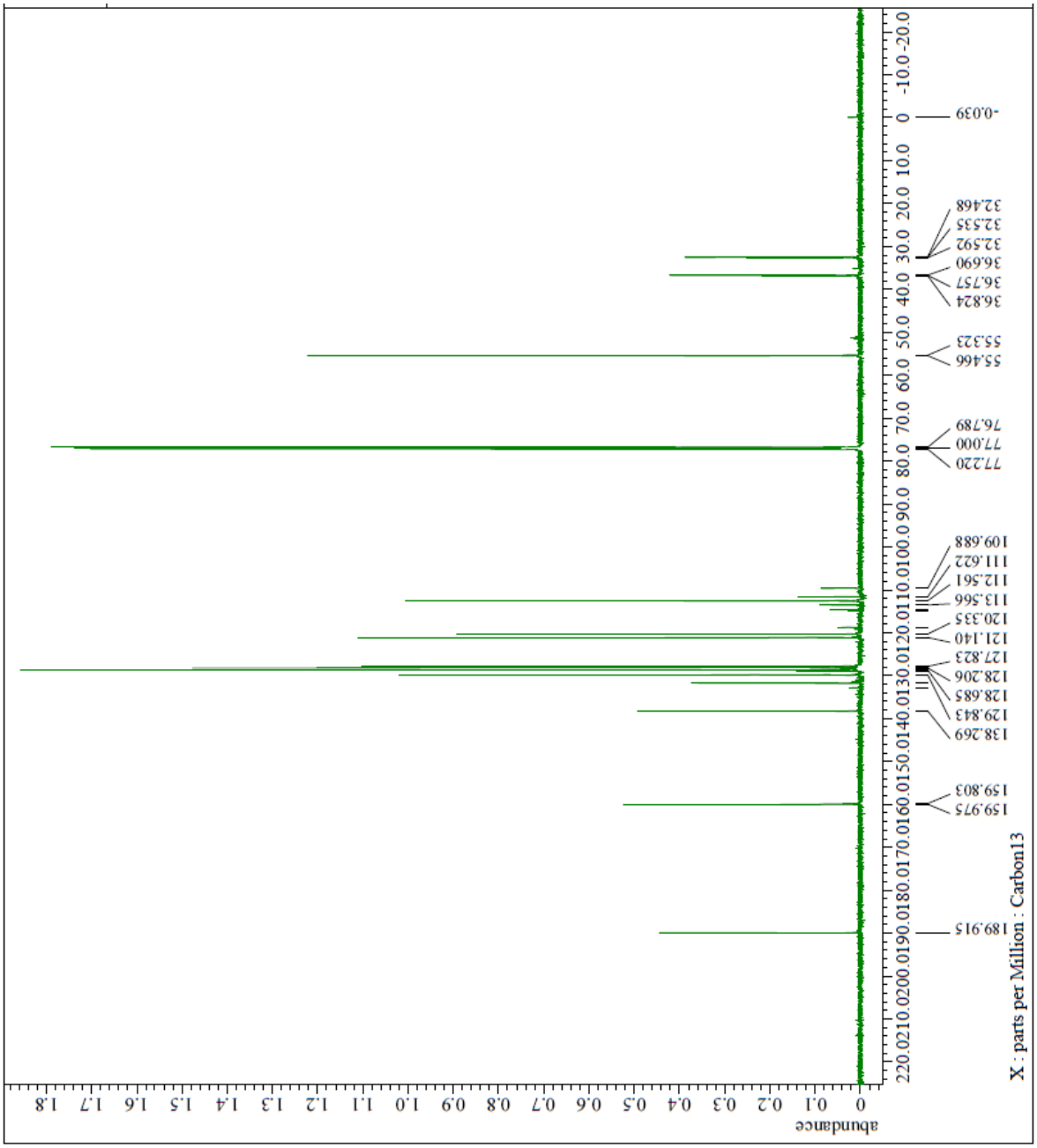
○ ^{19}F NMR (376 MHz)

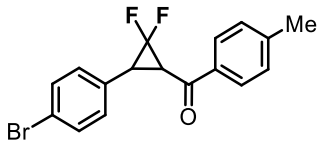




(2,2-difluoro-3-phenylcyclopropyl)(3-methoxyphenyl)methanone

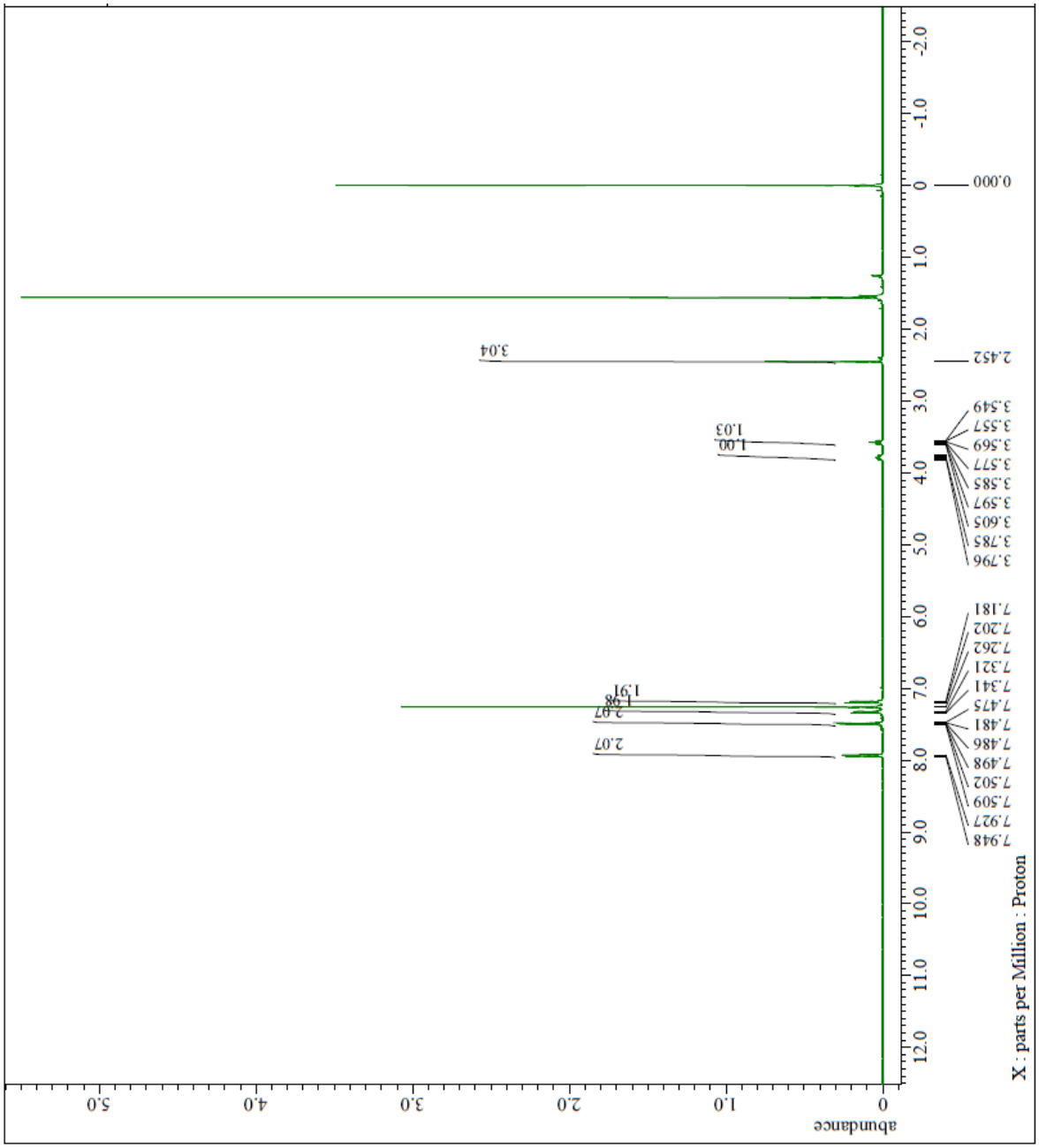
○ ^{13}C NMR (151 MHz)

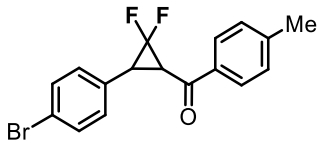




(3-(4-bromophenyl)-2,2-difluorocyclopropyl)(*p*-tolyl)methanone

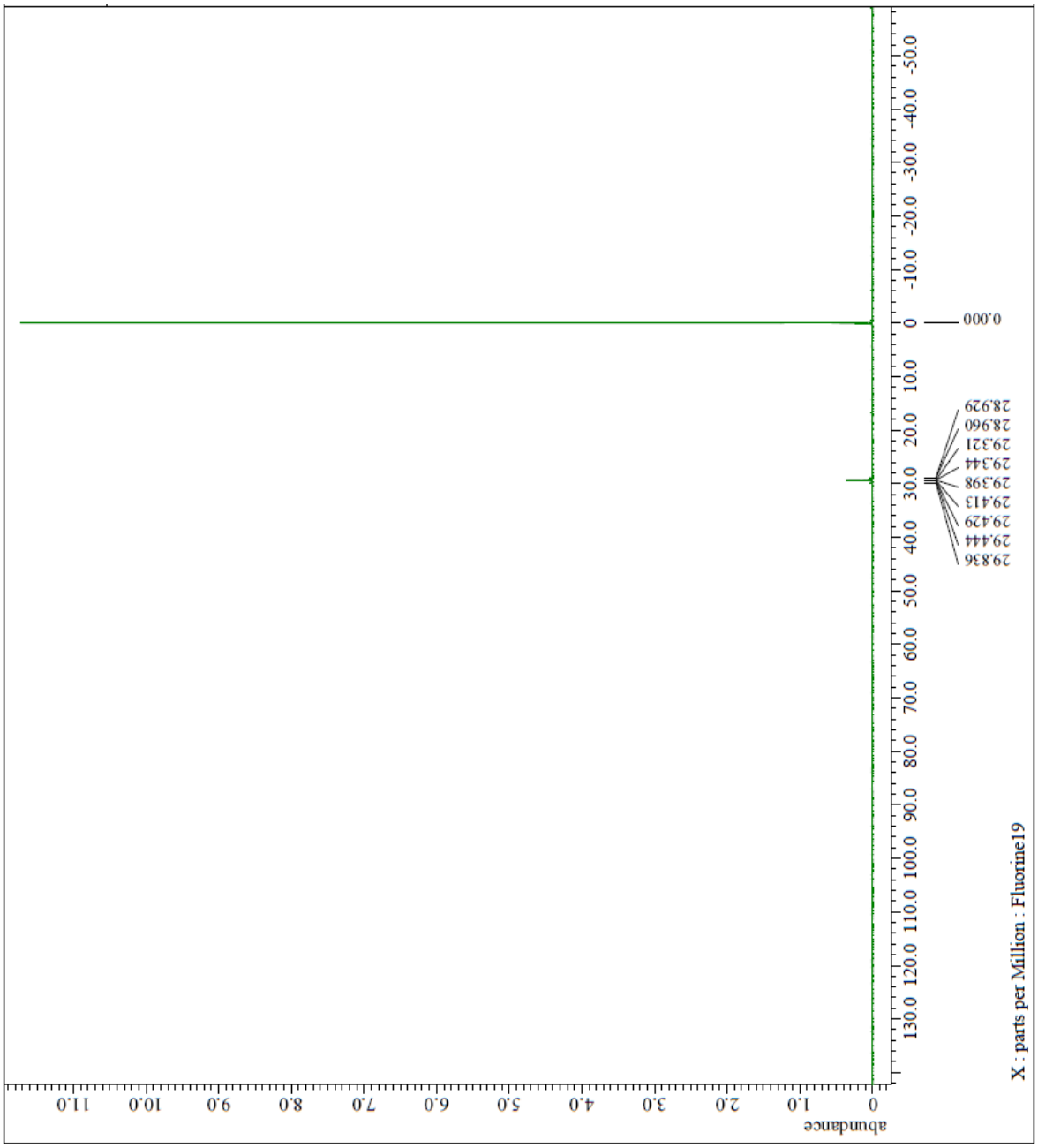
○ ^{1}H NMR (400 MHz)

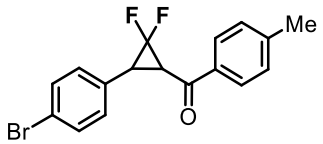




(3-(4-bromophenyl)-2,2-difluorocyclopropyl)(*p*-tolyl)methanone

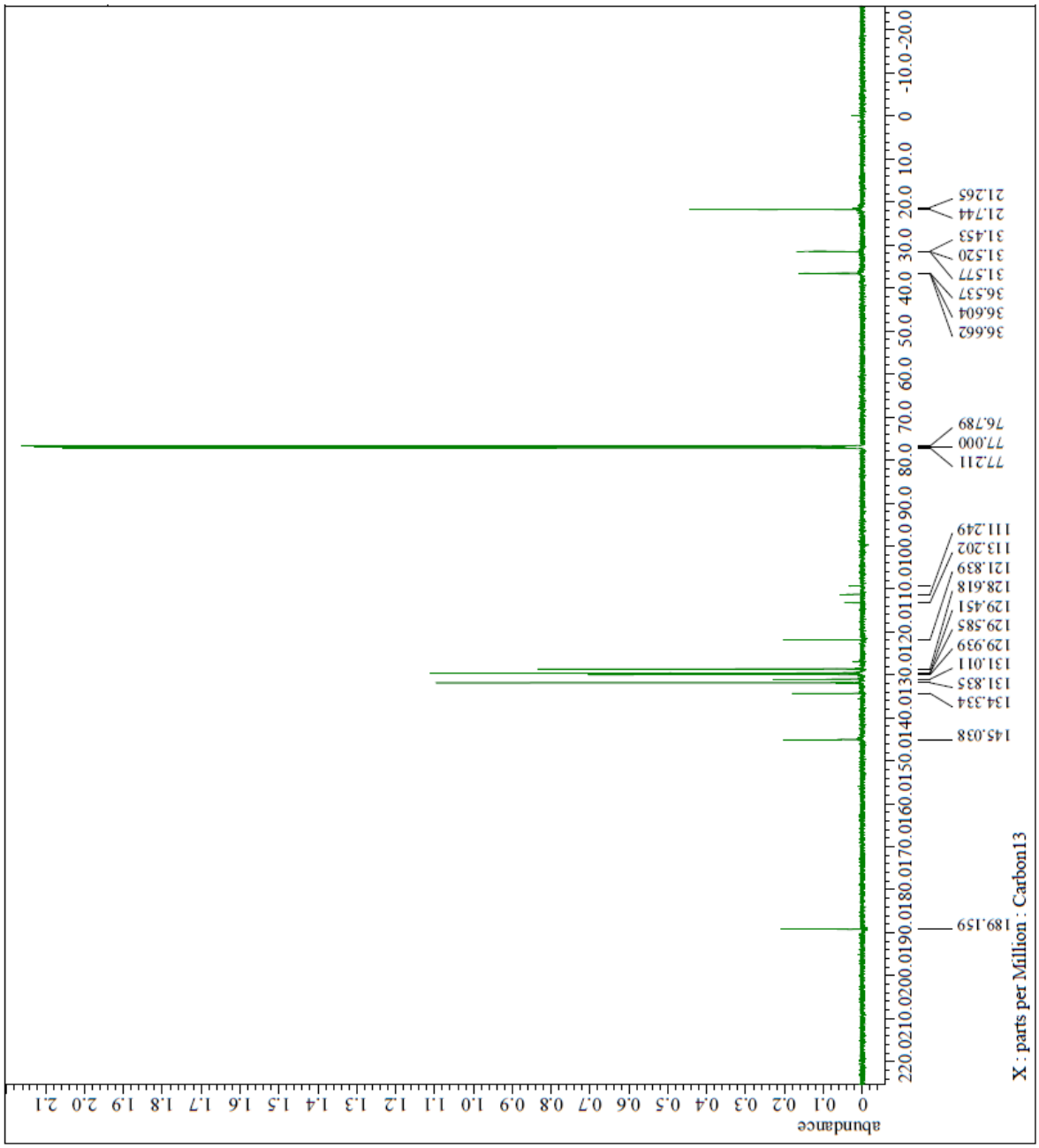
○ ^{19}F NMR (376 MHz)

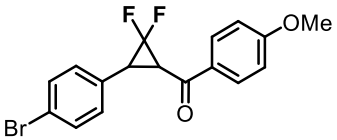




(3-(4-bromophenyl)-2,2-difluorocyclopropyl)(*p*-tolyl)methanone

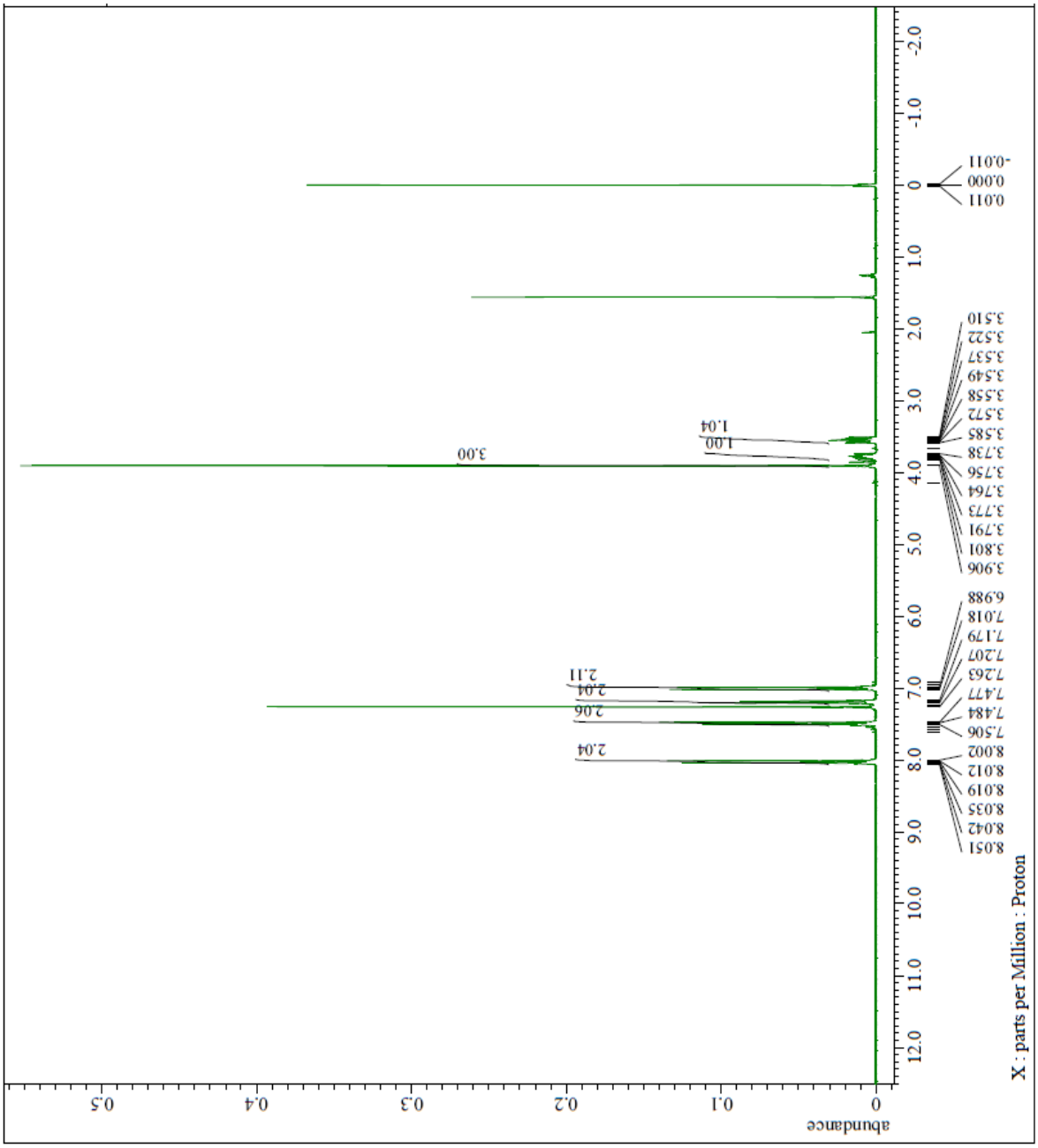
○ ^{13}C NMR (151 MHz)

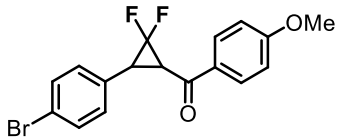




(3-(4-bromophenyl)-2,2-difluorocyclopropyl)(4-methoxyphenyl)methanone

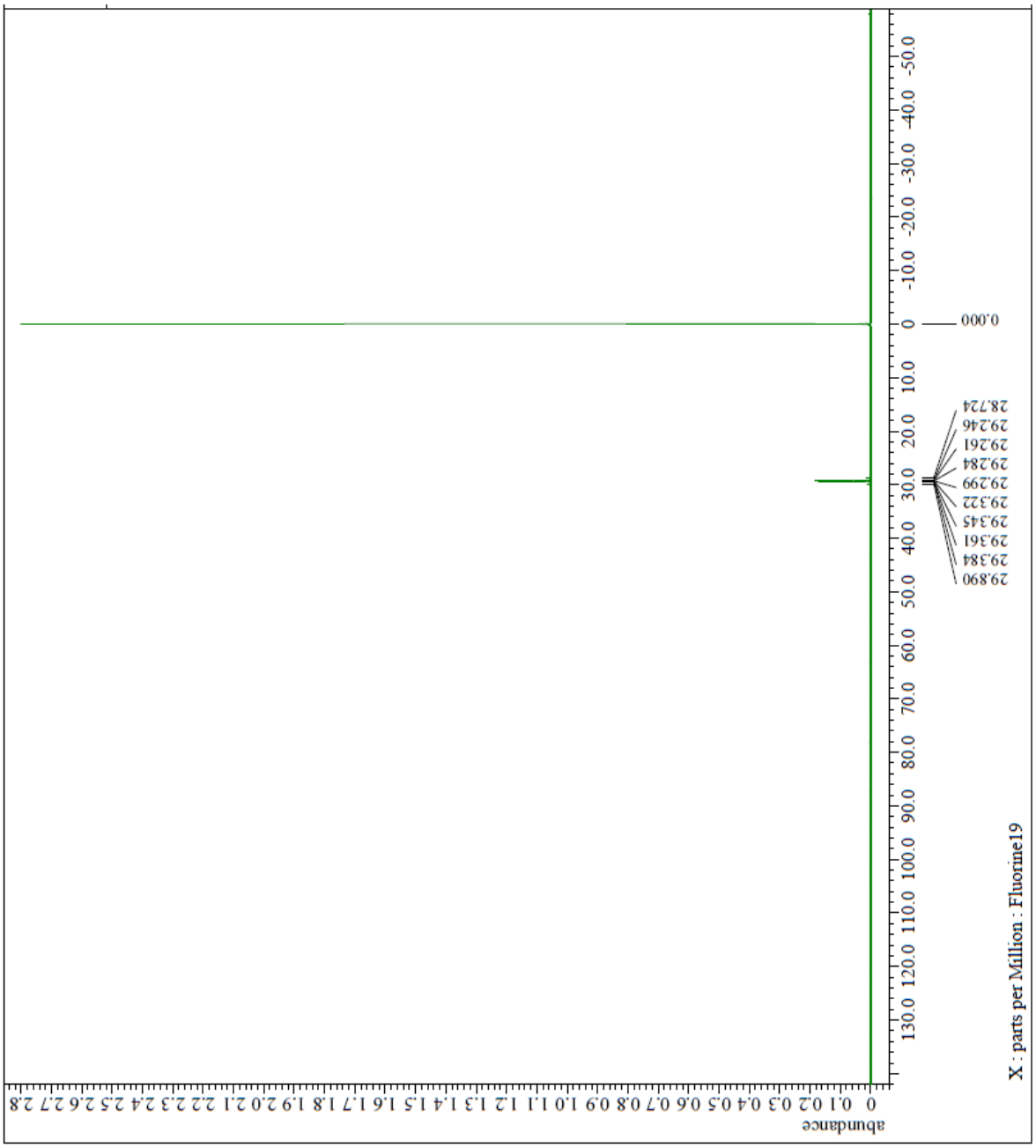
○ ^{1}H NMR (400 MHz)

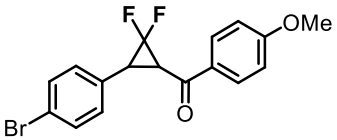




(3-(4-bromophenyl)-2,2-difluorocyclopropyl)(4-methoxyphenyl)methanone

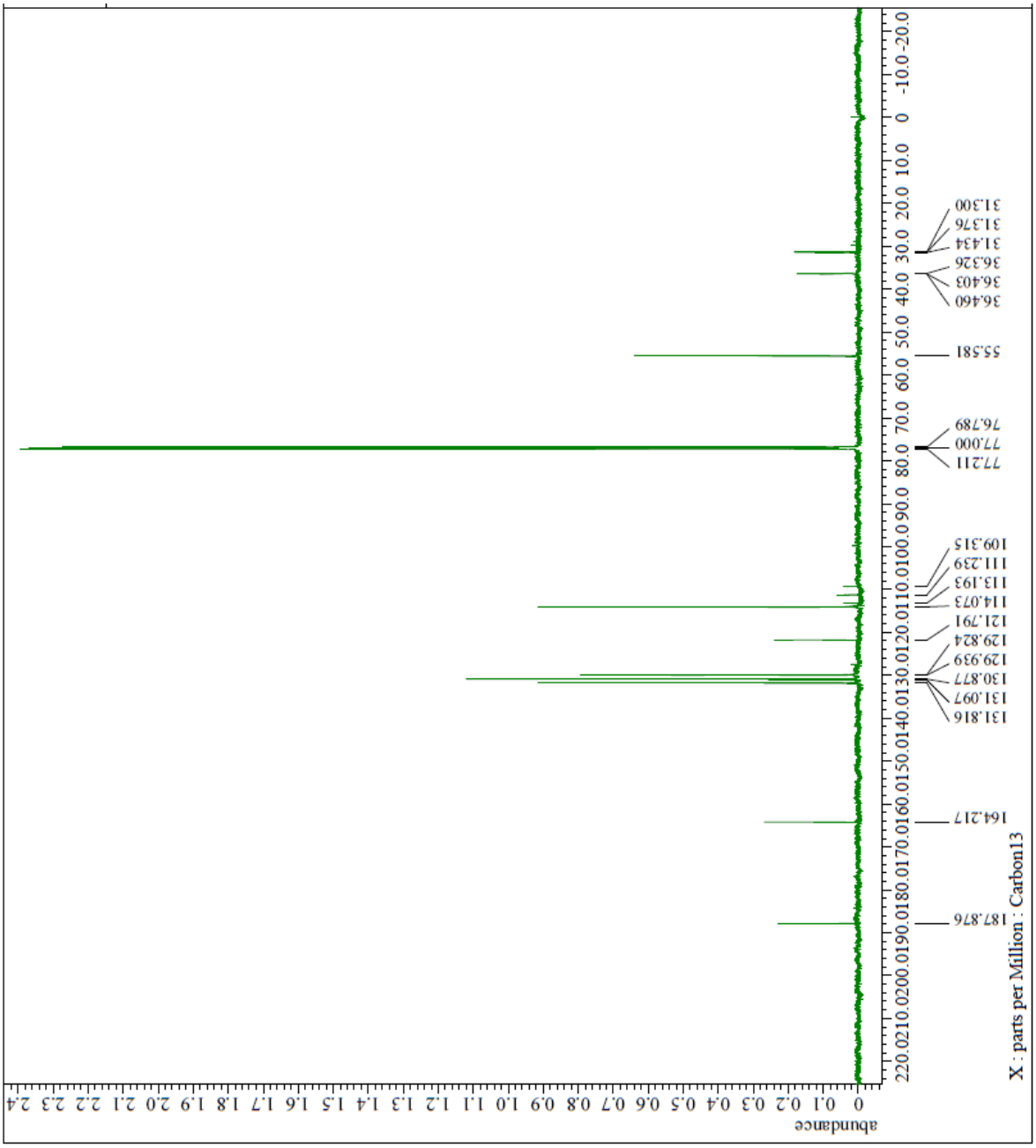
○ ^{19}F NMR (376 MHz)

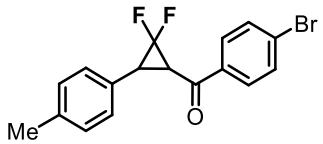




(3-(4-bromophenyl)-2,2-difluorocyclopropyl)(4-methoxyphenyl)methanone

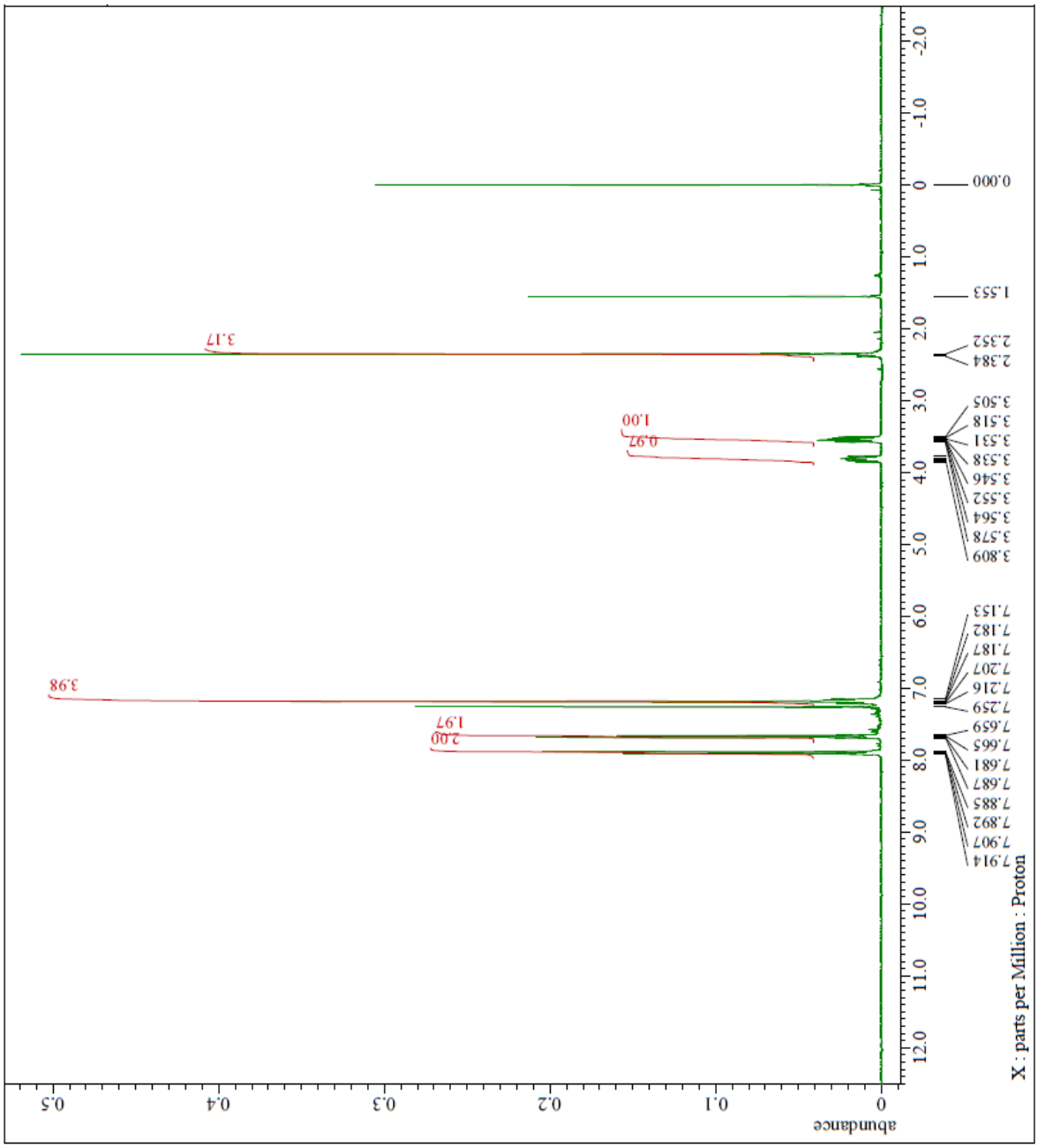
○ ^{13}C NMR (151 MHz)

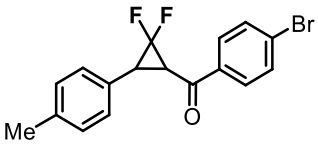




(4-bromophenyl)(2,2-difluoro-3-(*p*-tolyl)cyclopropyl)methanone

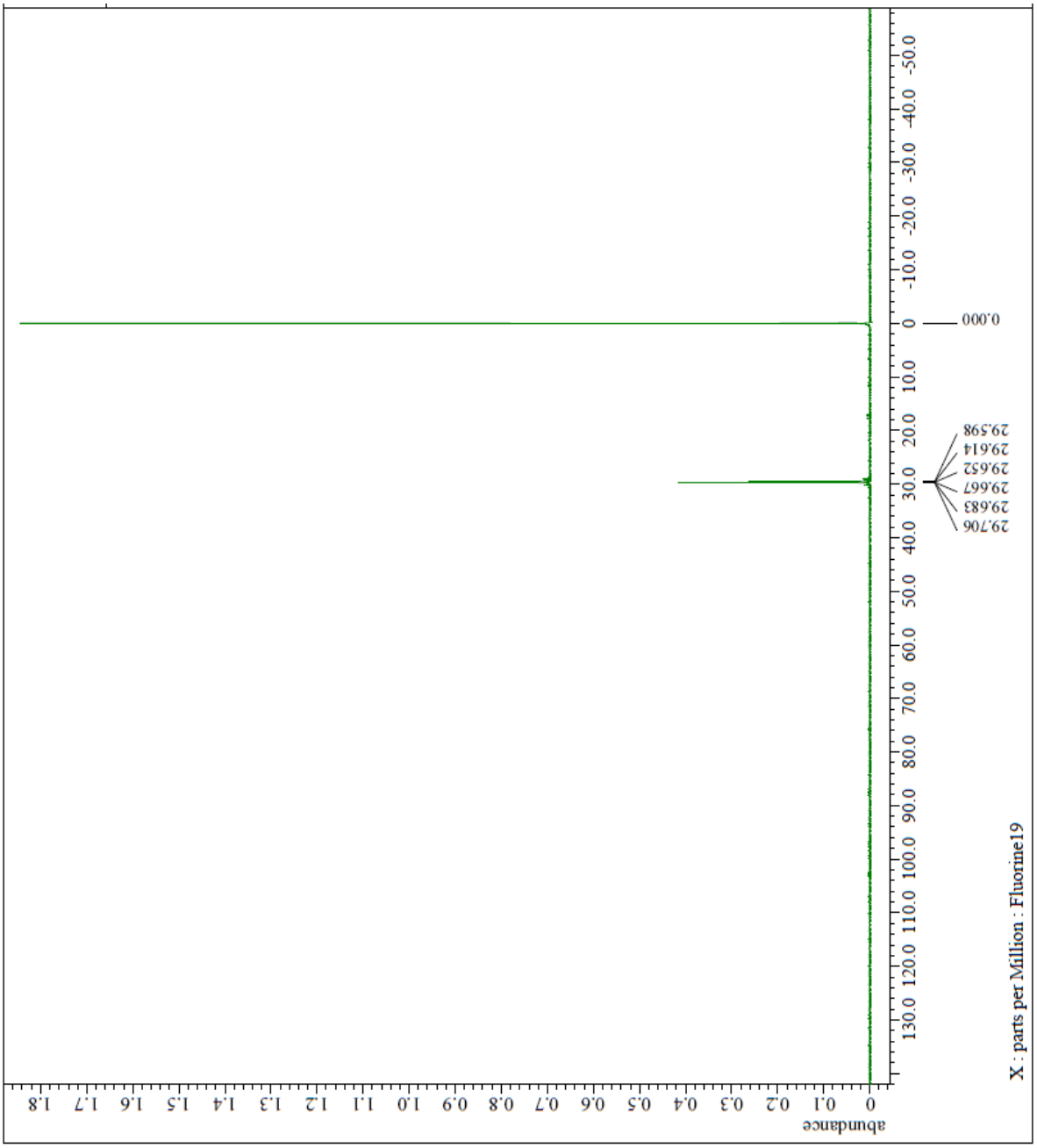
○ ^{1}H NMR (400 MHz)

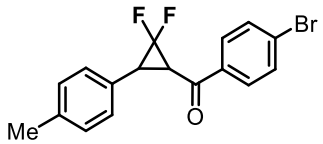




(4-bromophenyl)(2,2-difluoro-3-(*p*-tolyl)cyclopropyl)methanone

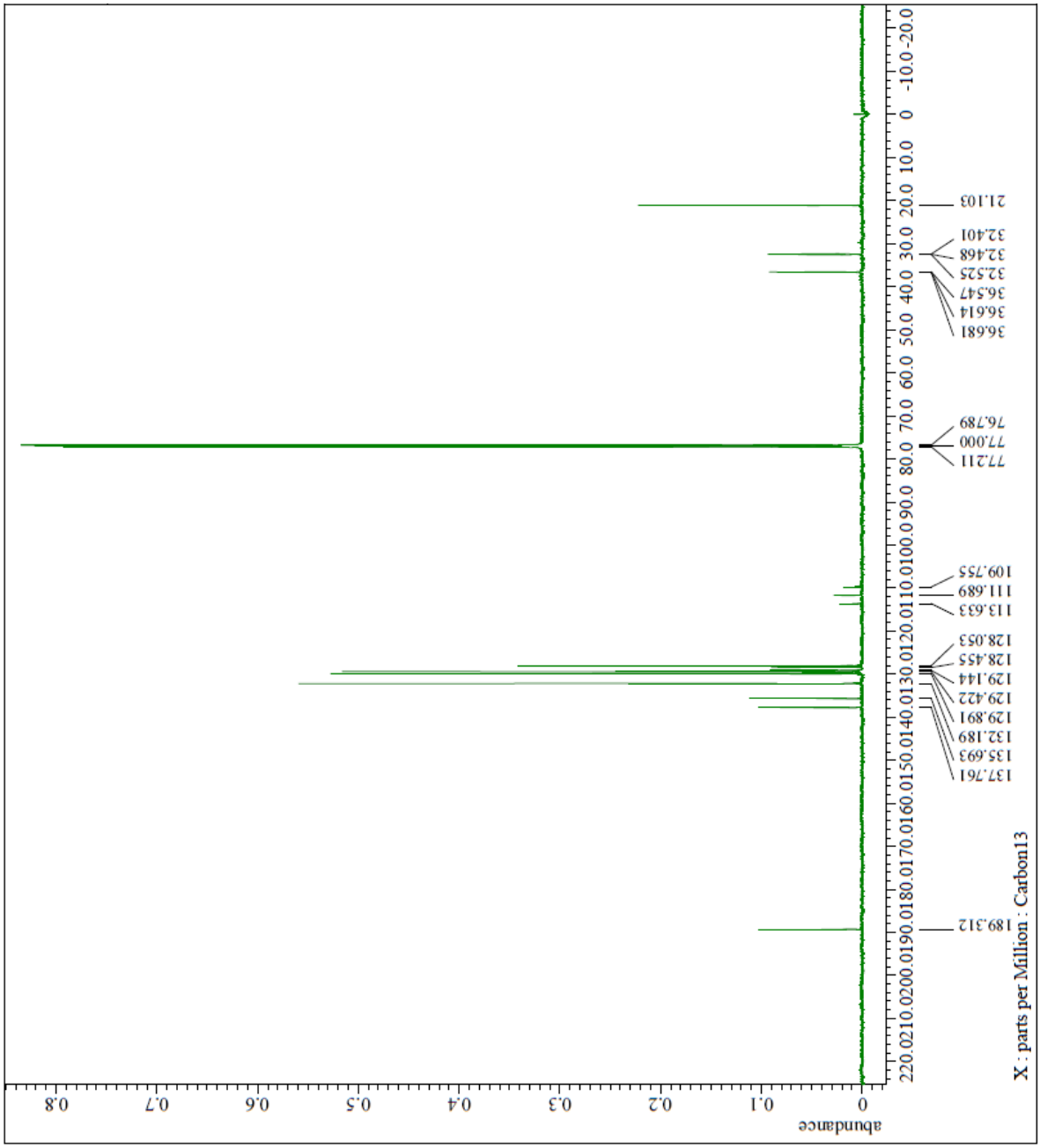
○ ^{19}F NMR (376 MHz)

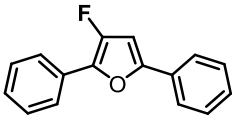




(4-bromophenyl)(2,2-difluoro-3-(*p*-tolyl)cyclopropyl)methanone

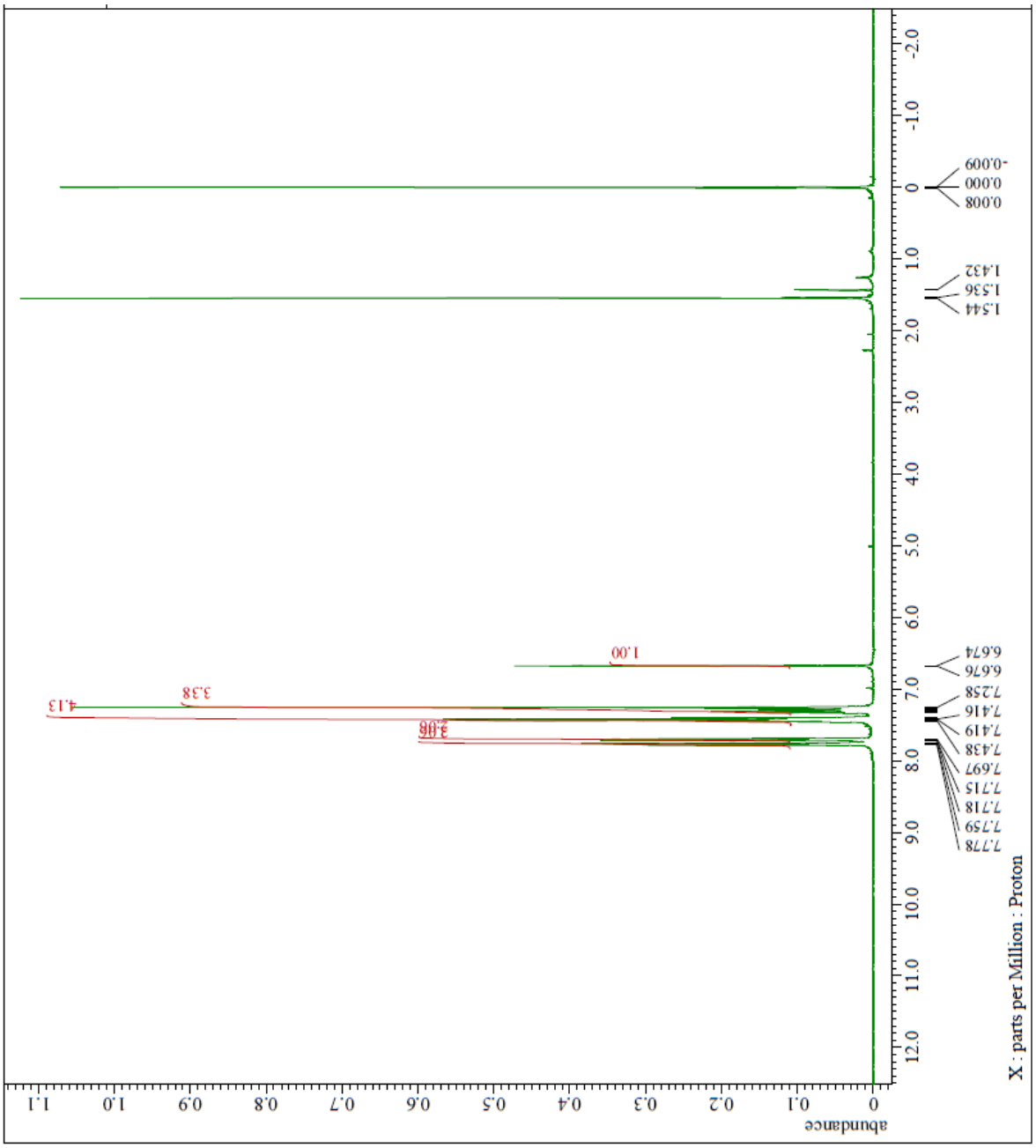
○ ^{13}C NMR (151 MHz)

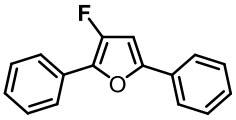




3-fluoro-2,5-diphenylfuran (3a)

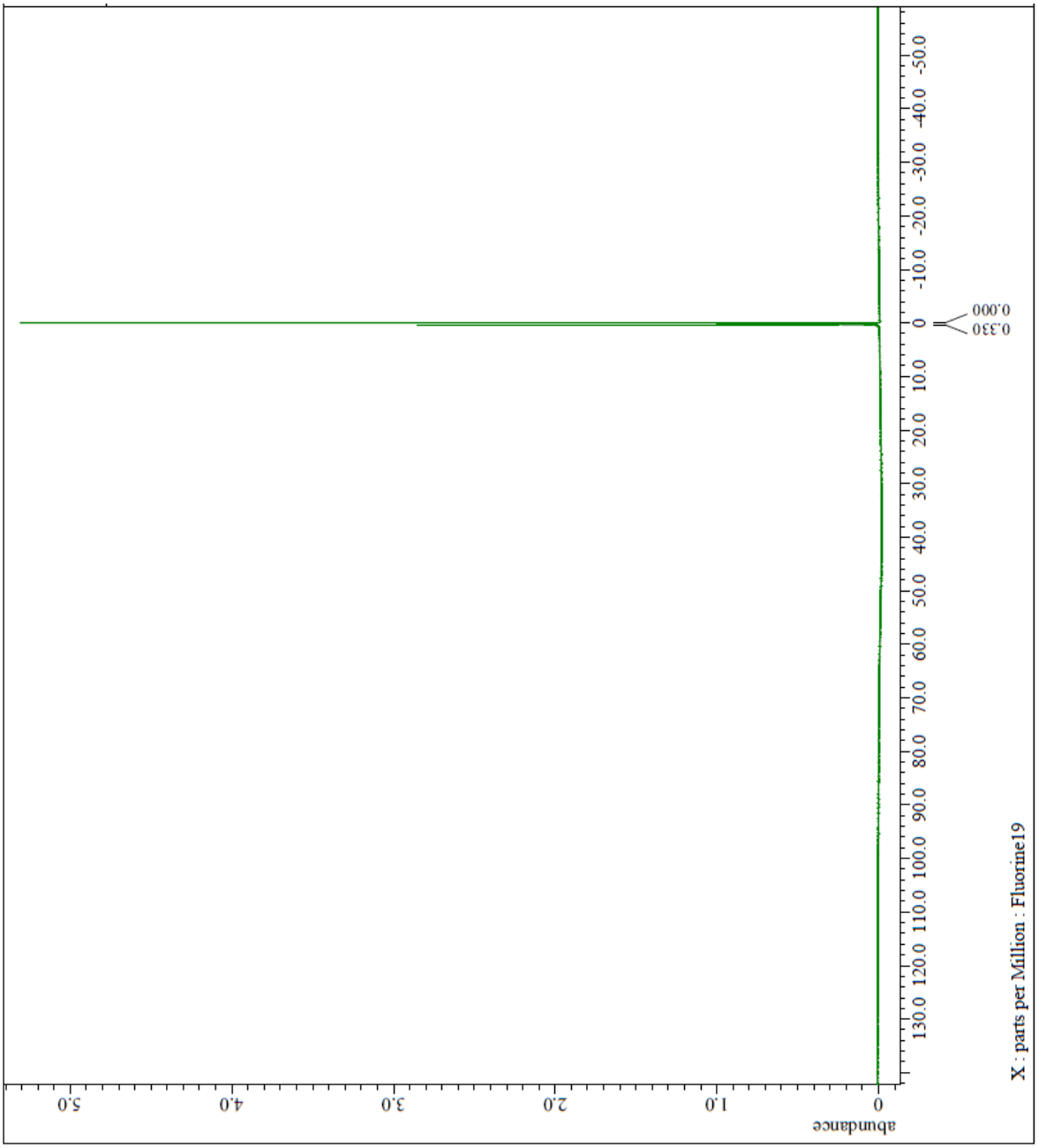
○ ^{1}H NMR (400 MHz)

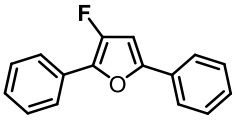




3-fluoro-2,5-diphenylfuran (3a)

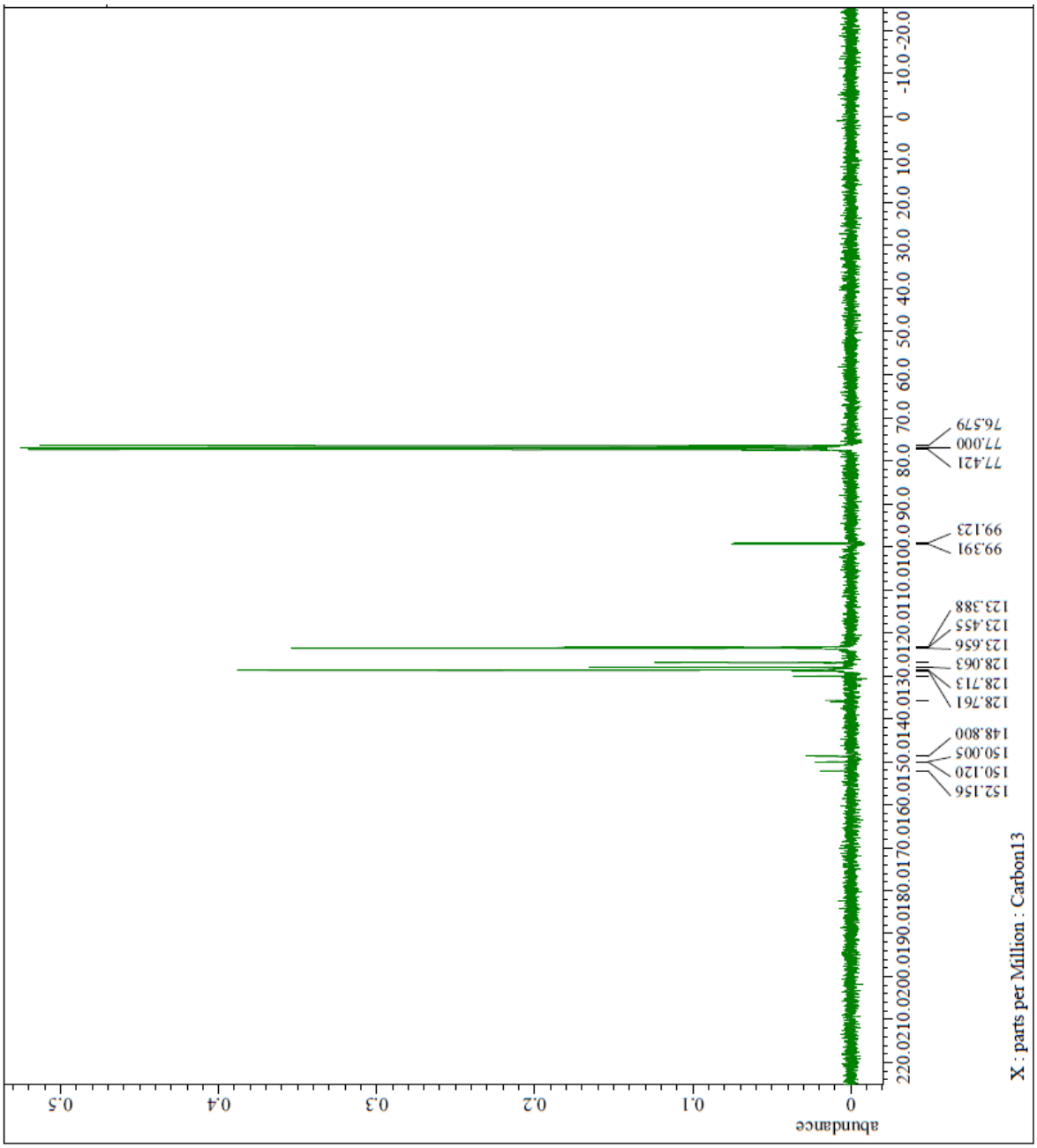
○ ^{19}F NMR (376 MHz)

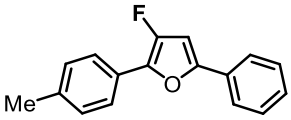




3-fluoro-2,5-diphenylfuran (3a)

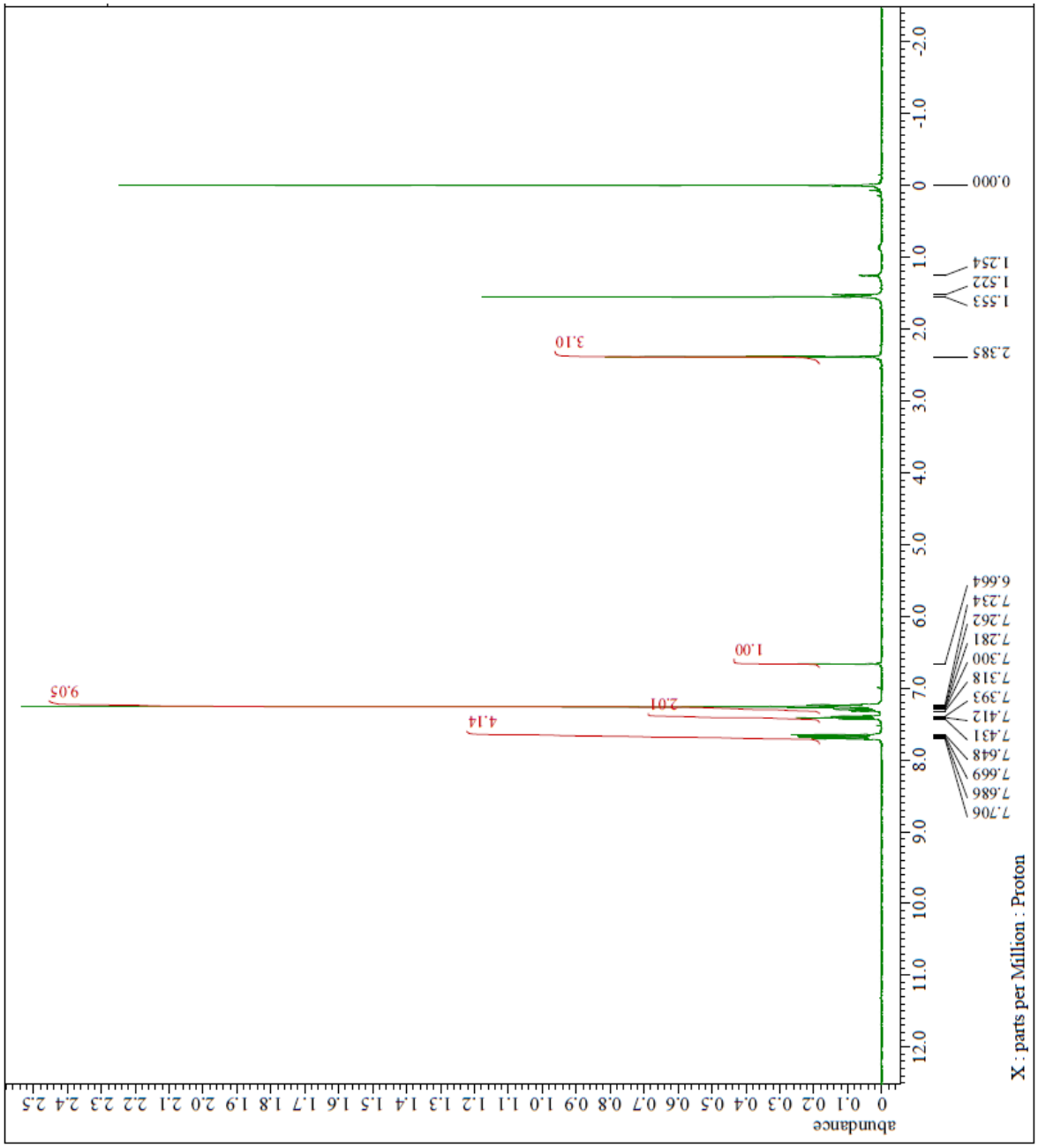
○ ^{13}C NMR (151 MHz)

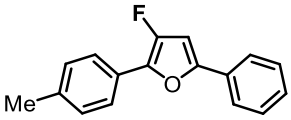




3-fluoro-5-phenyl-2-(*p*-tolyl)furan

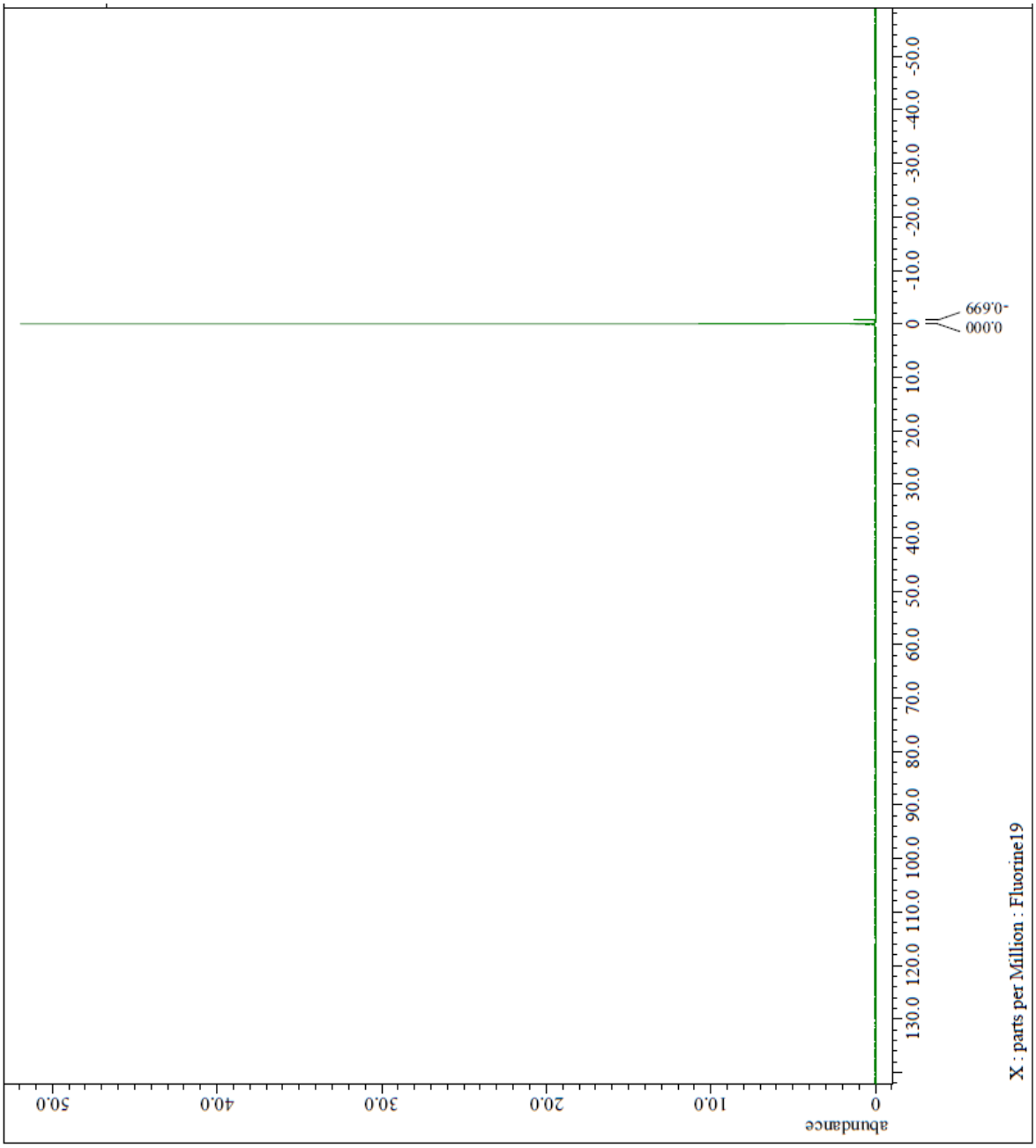
○ ^{1}H NMR (400 MHz)

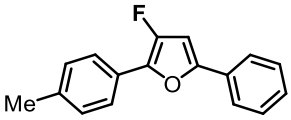




3-fluoro-5-phenyl-2-(*p*-tolyl)furan

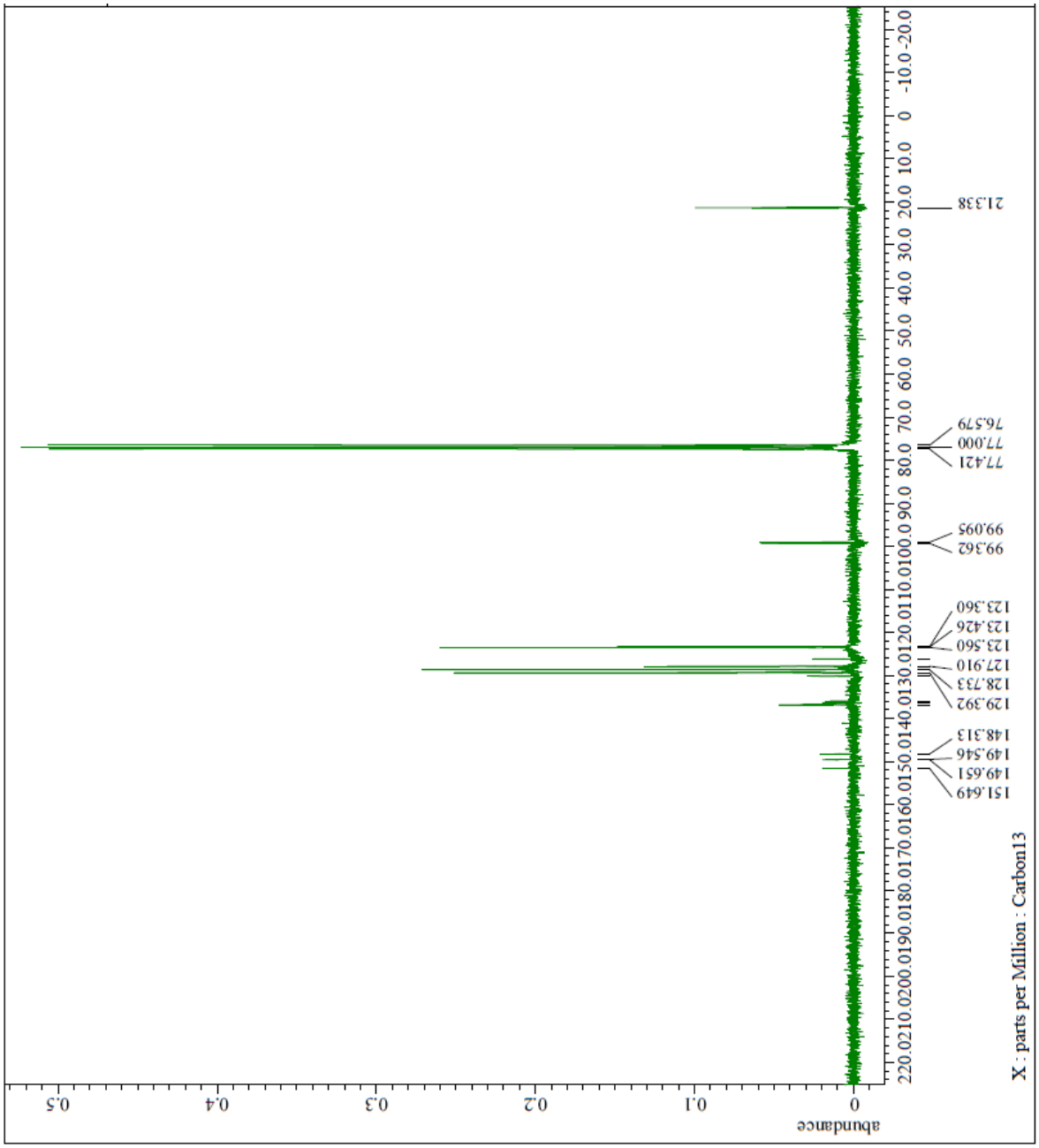
○ ^{19}F NMR (376 MHz)

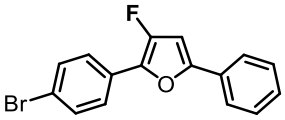




3-fluoro-5-phenyl-2-(*p*-tolyl)furan

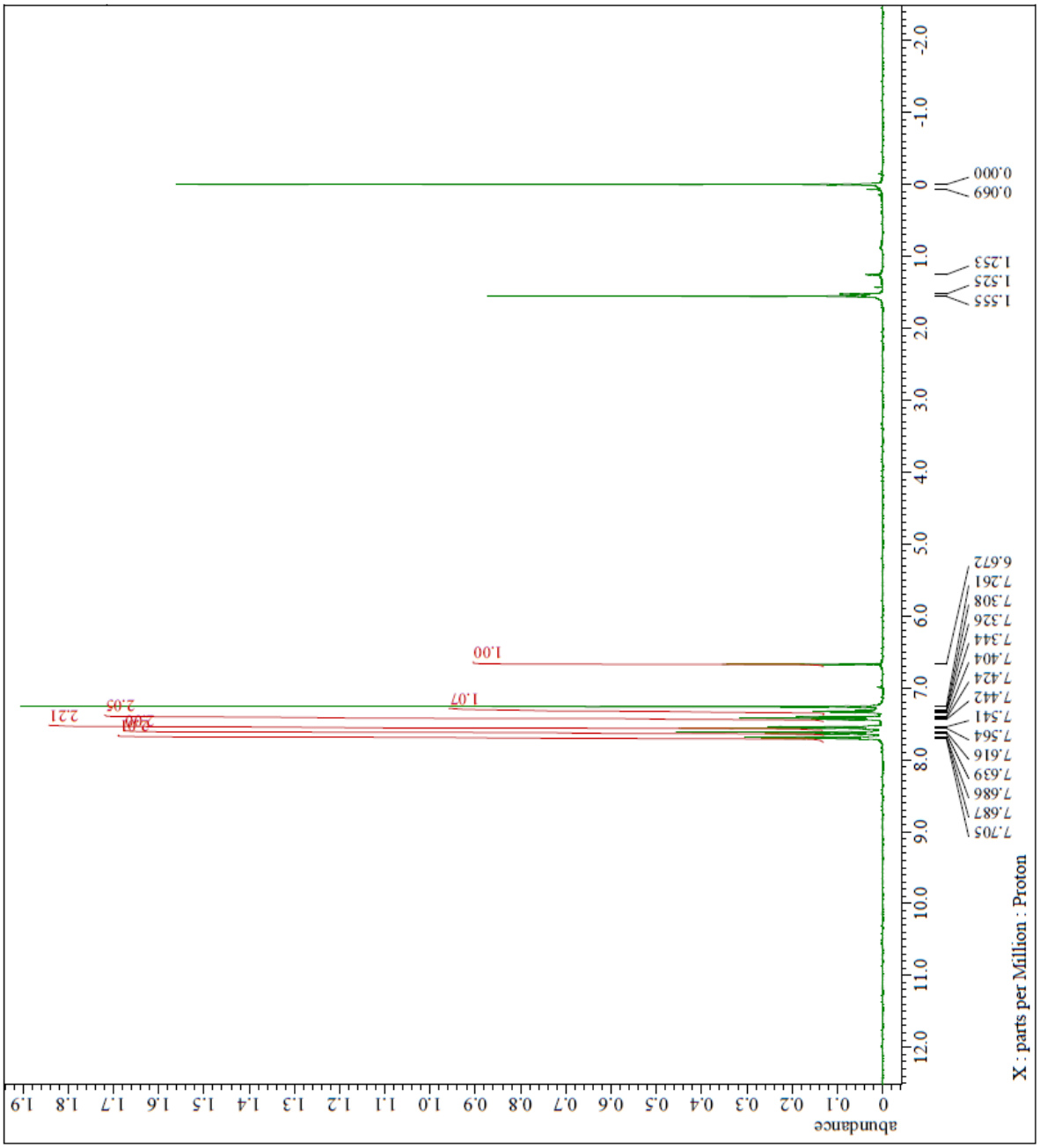
○ ^{13}C NMR (151 MHz)

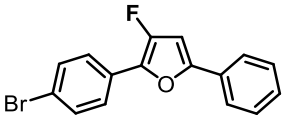




2-(4-bromophenyl)-3-fluoro-5-phenylfuran

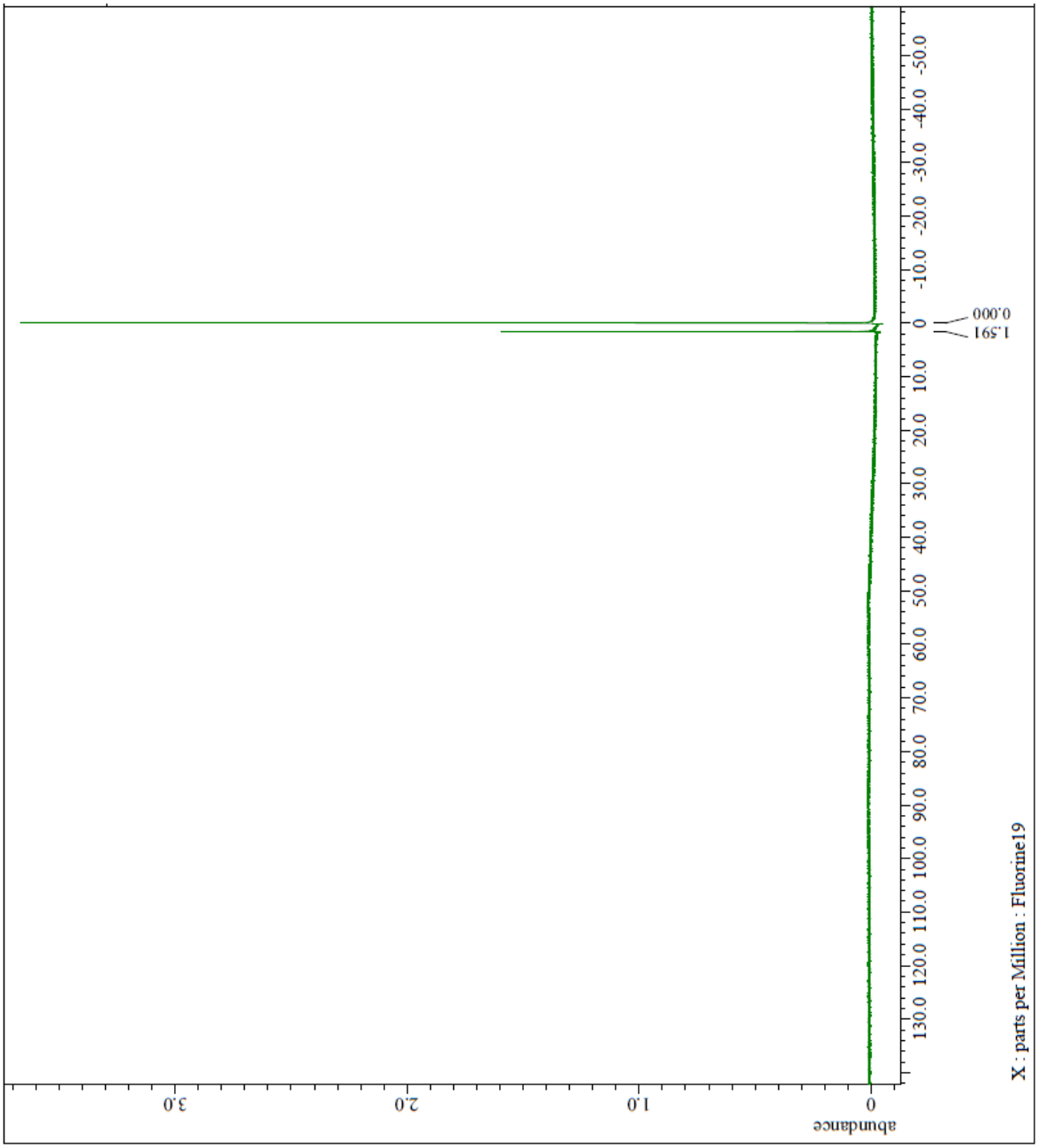
○ ^{1}H NMR (400 MHz)

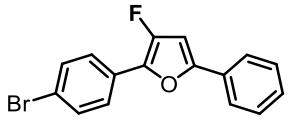




2-(4-bromophenyl)-3-fluoro-5-phenylfuran

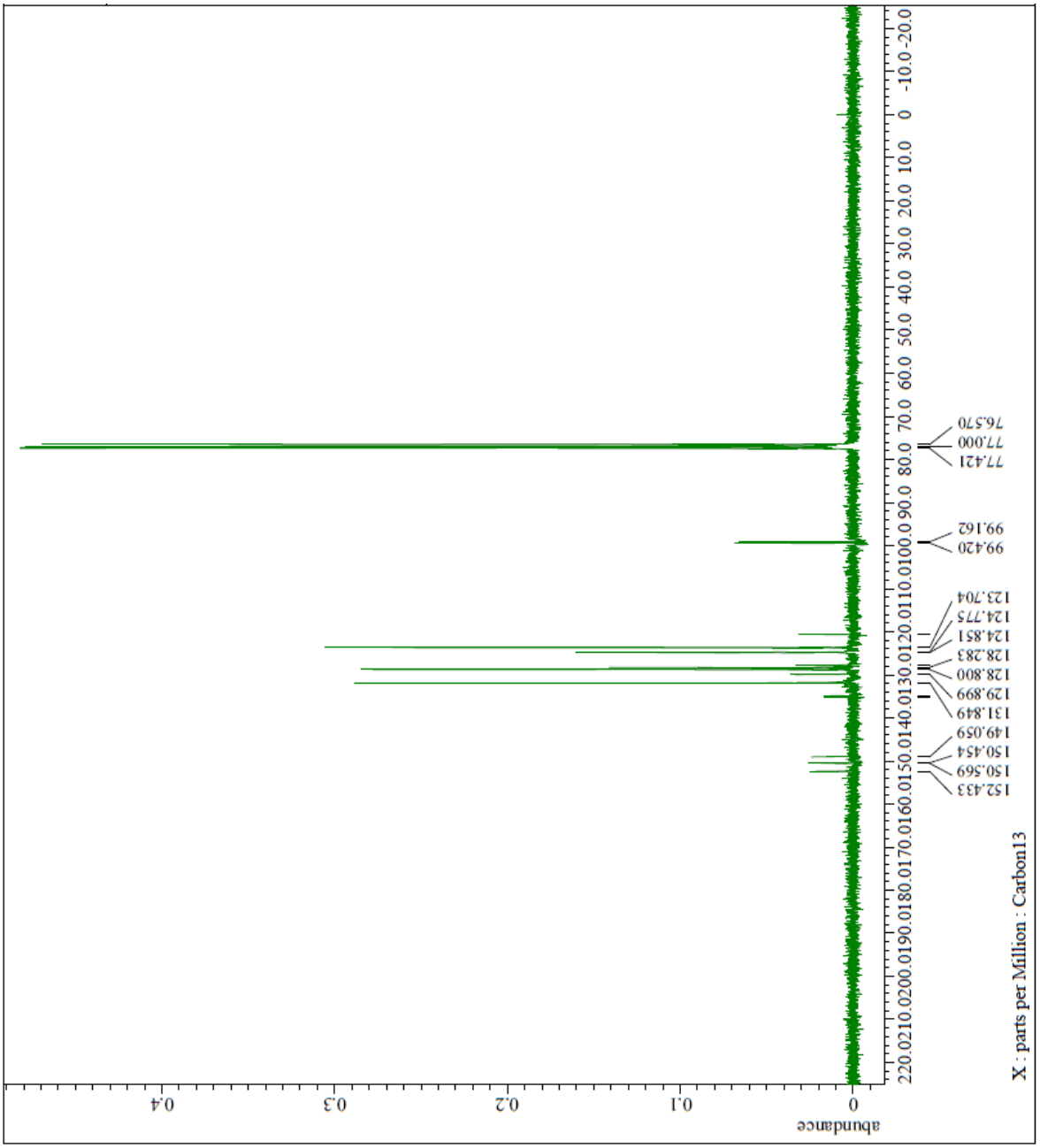
○ ^{19}F NMR (376 MHz)

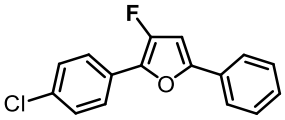




2-(4-bromophenyl)-3-fluoro-5-phenylfuran

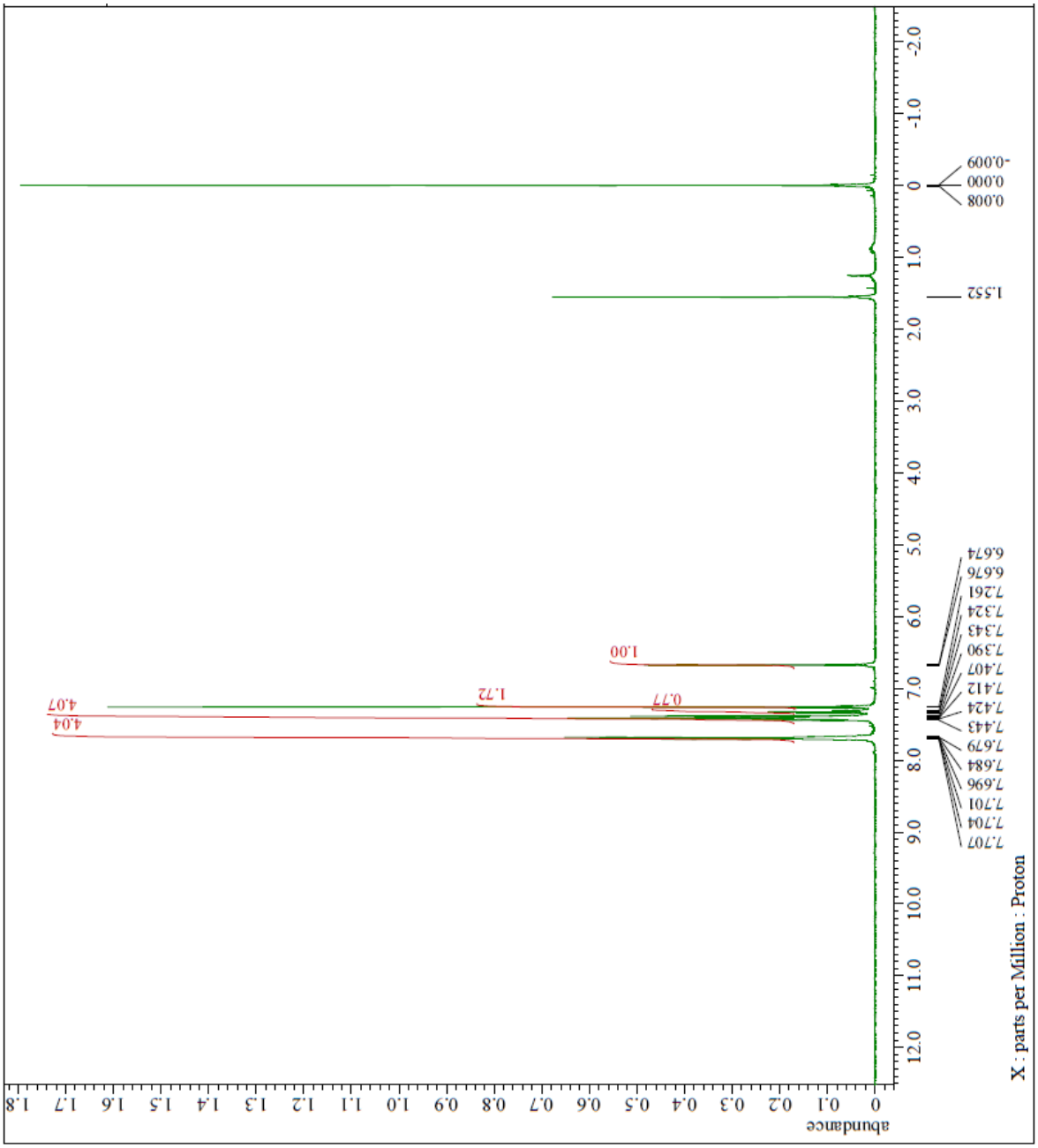
○ ^{13}C NMR (151 MHz)

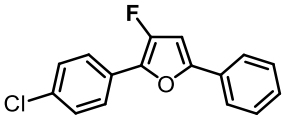




2-(4-chlorophenyl)-3-fluoro-5-phenylfuran

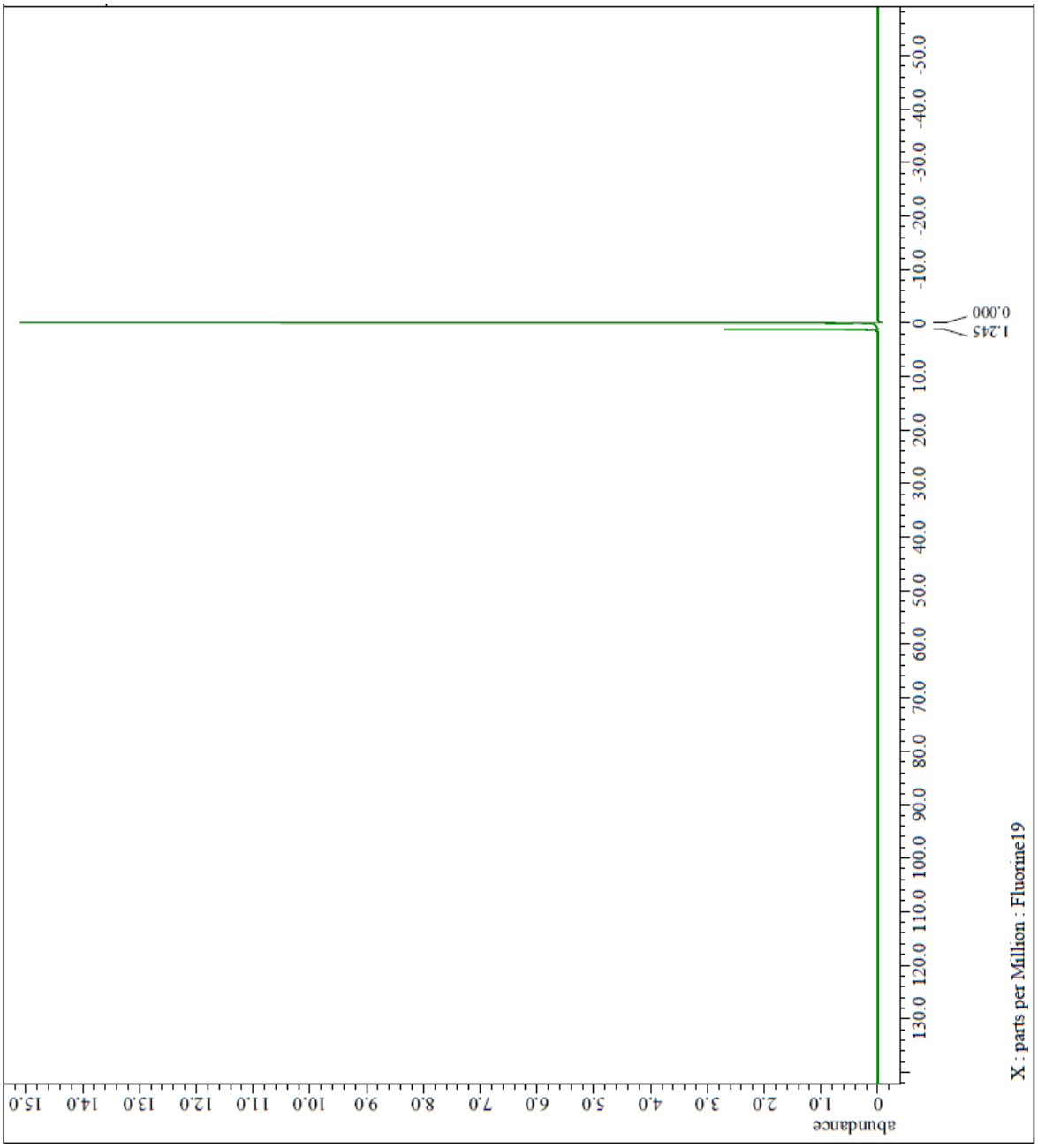
○ ^{1}H NMR (400 MHz)

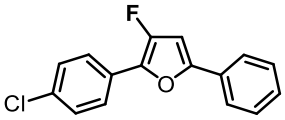




2-(4-chlorophenyl)-3-fluoro-5-phenylfuran

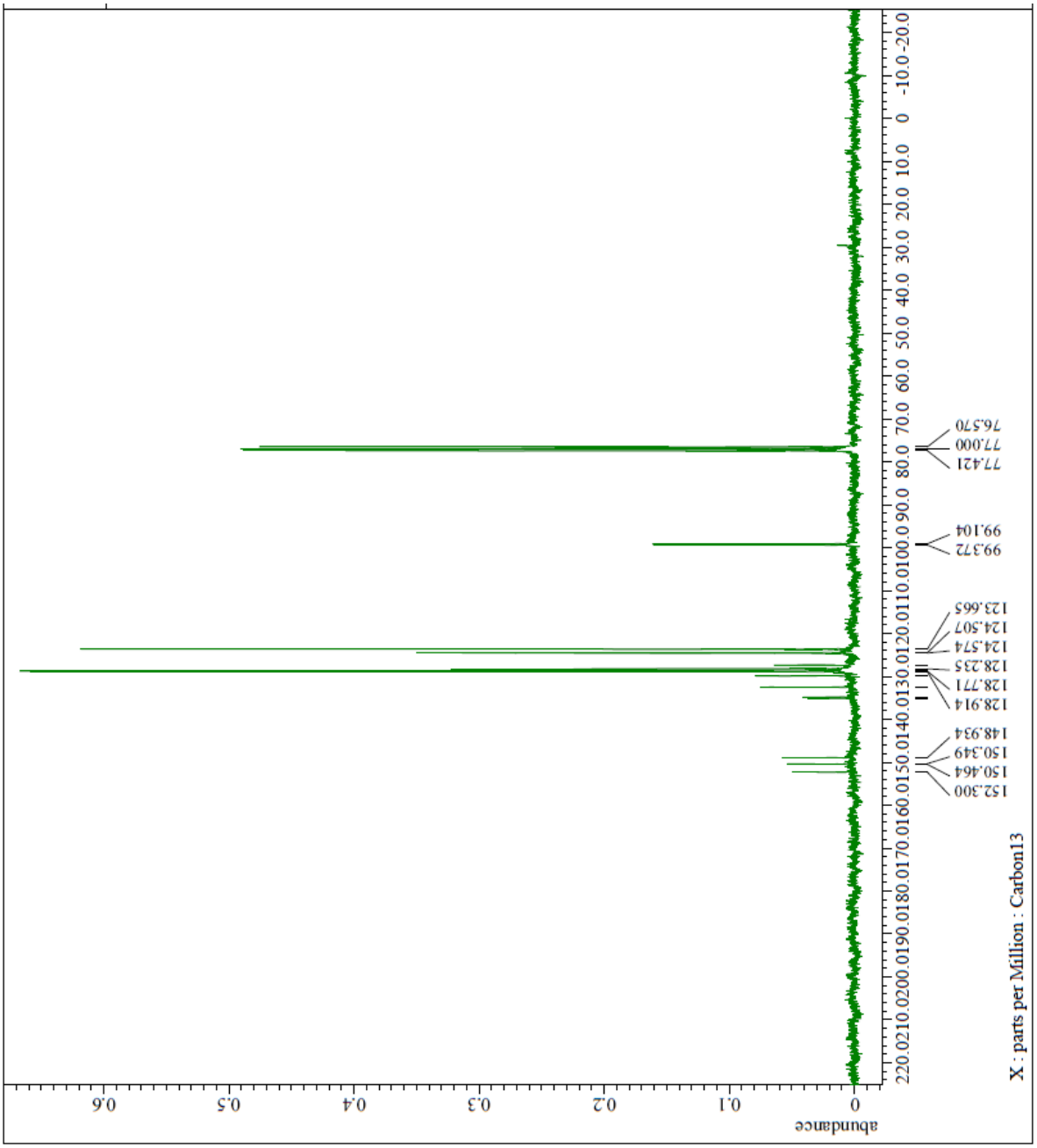
○ ^{19}F NMR (376 MHz)

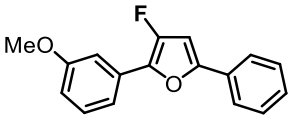




2-(4-chlorophenyl)-3-fluoro-5-phenylfuran

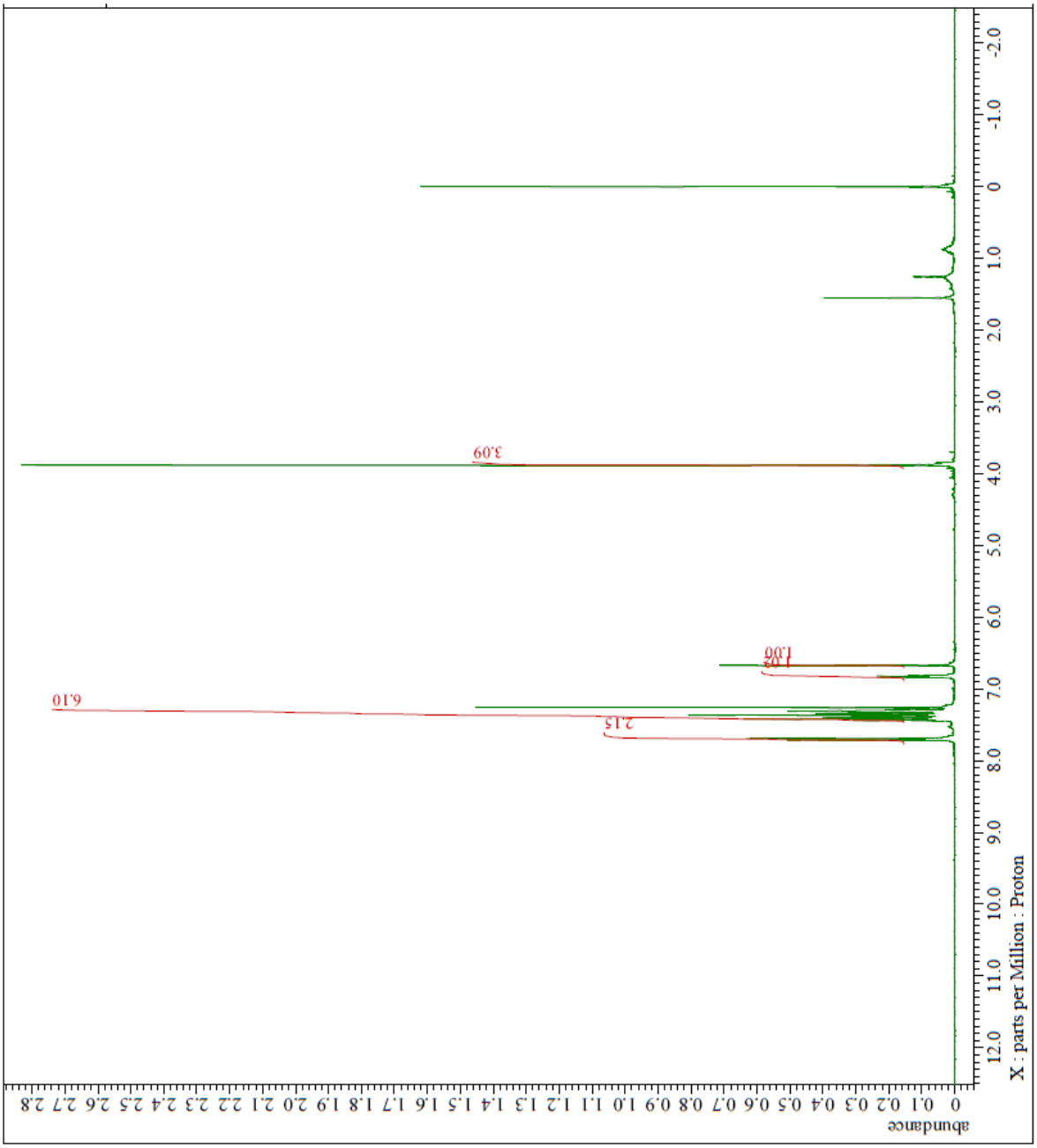
○ ^{13}C NMR (151 MHz)

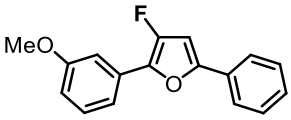




3-fluoro-2-(3-methoxyphenyl)-5-phenylfuran

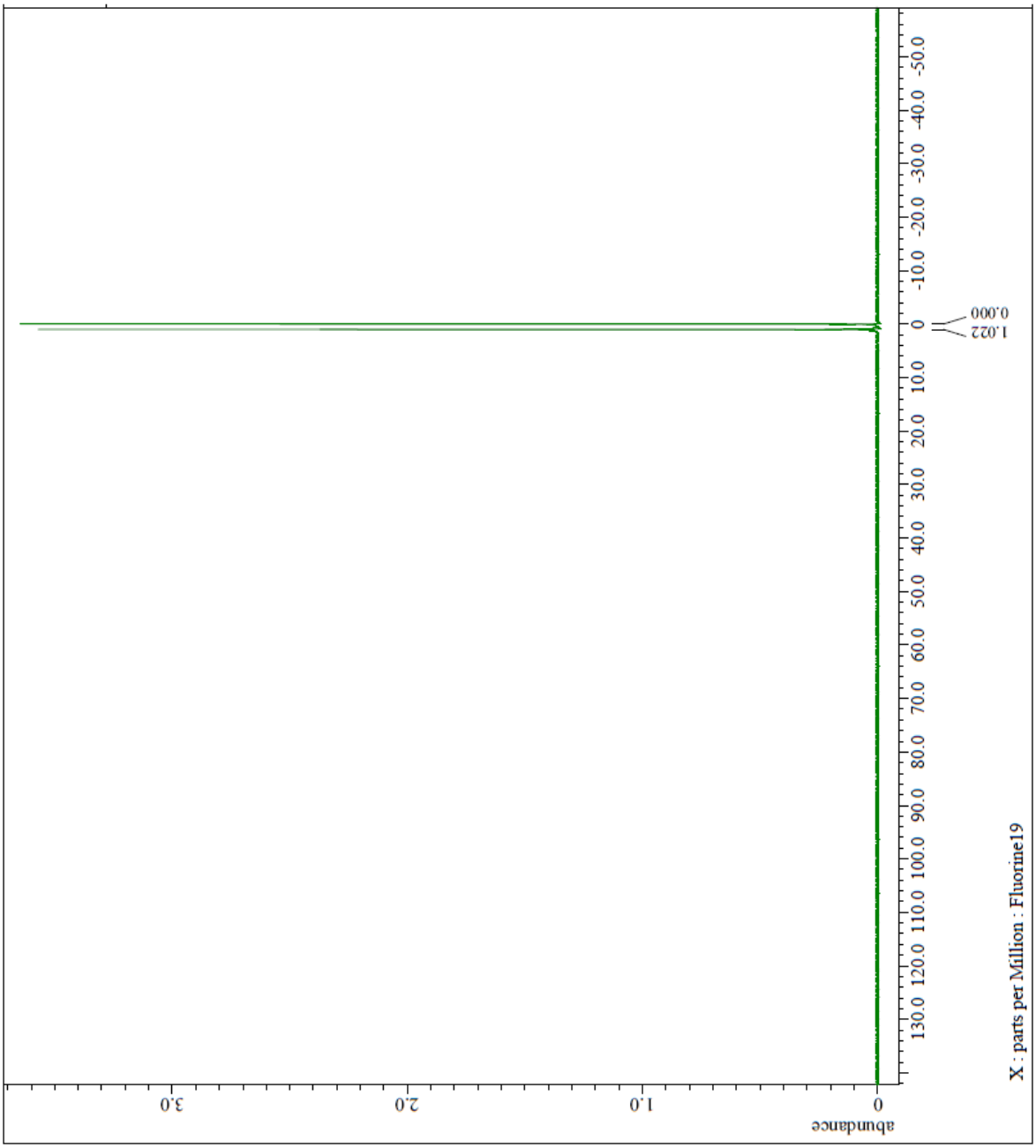
○ ^{1}H NMR (400 MHz)

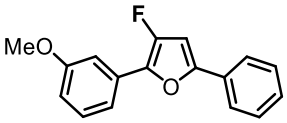




3-fluoro-2-(3-methoxyphenyl)-5-phenylfuran

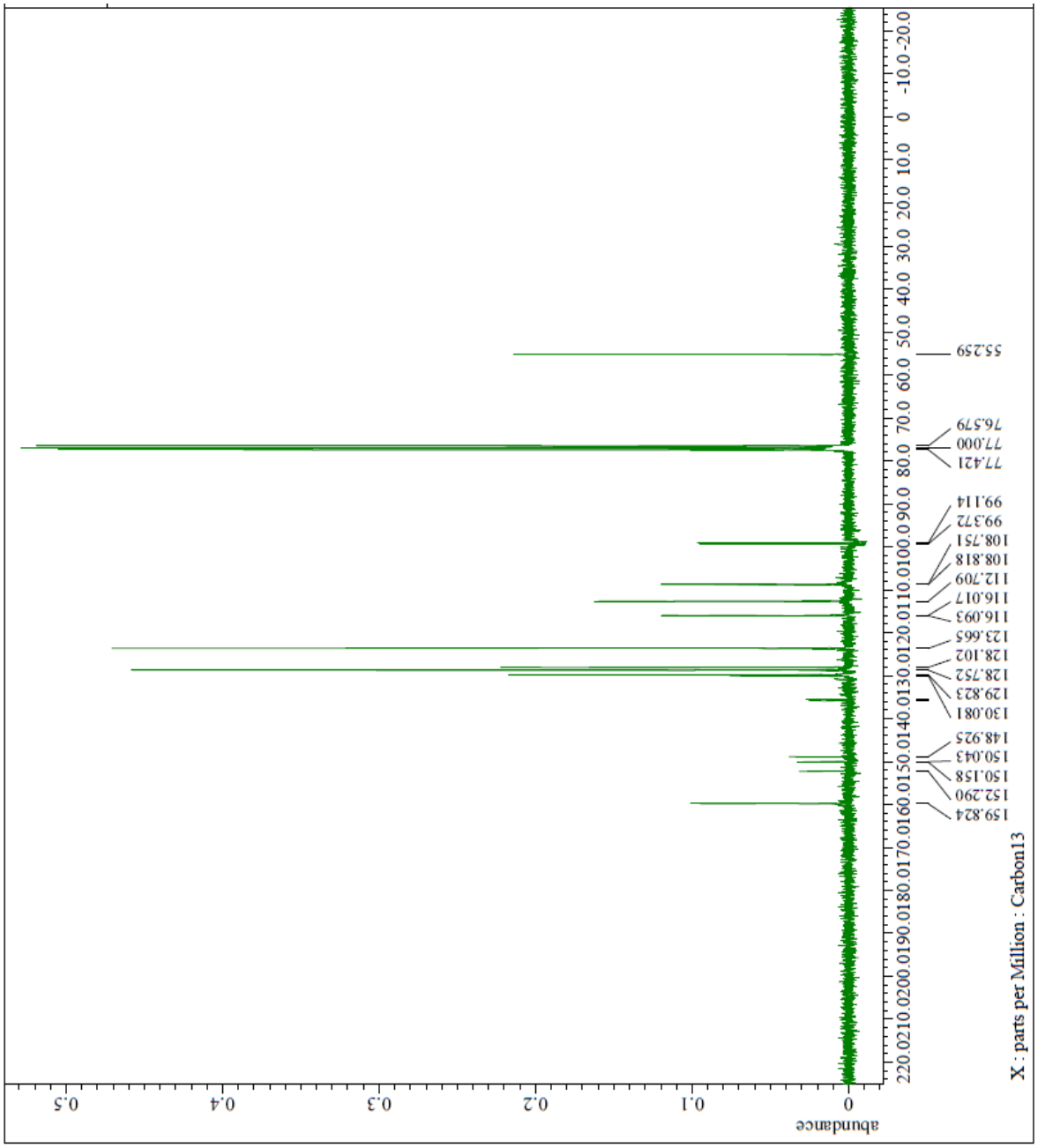
○ ^{19}F NMR (376 MHz)

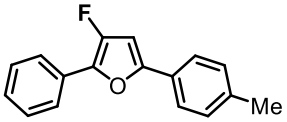




3-fluoro-2-(3-methoxyphenyl)-5-phenylfuran

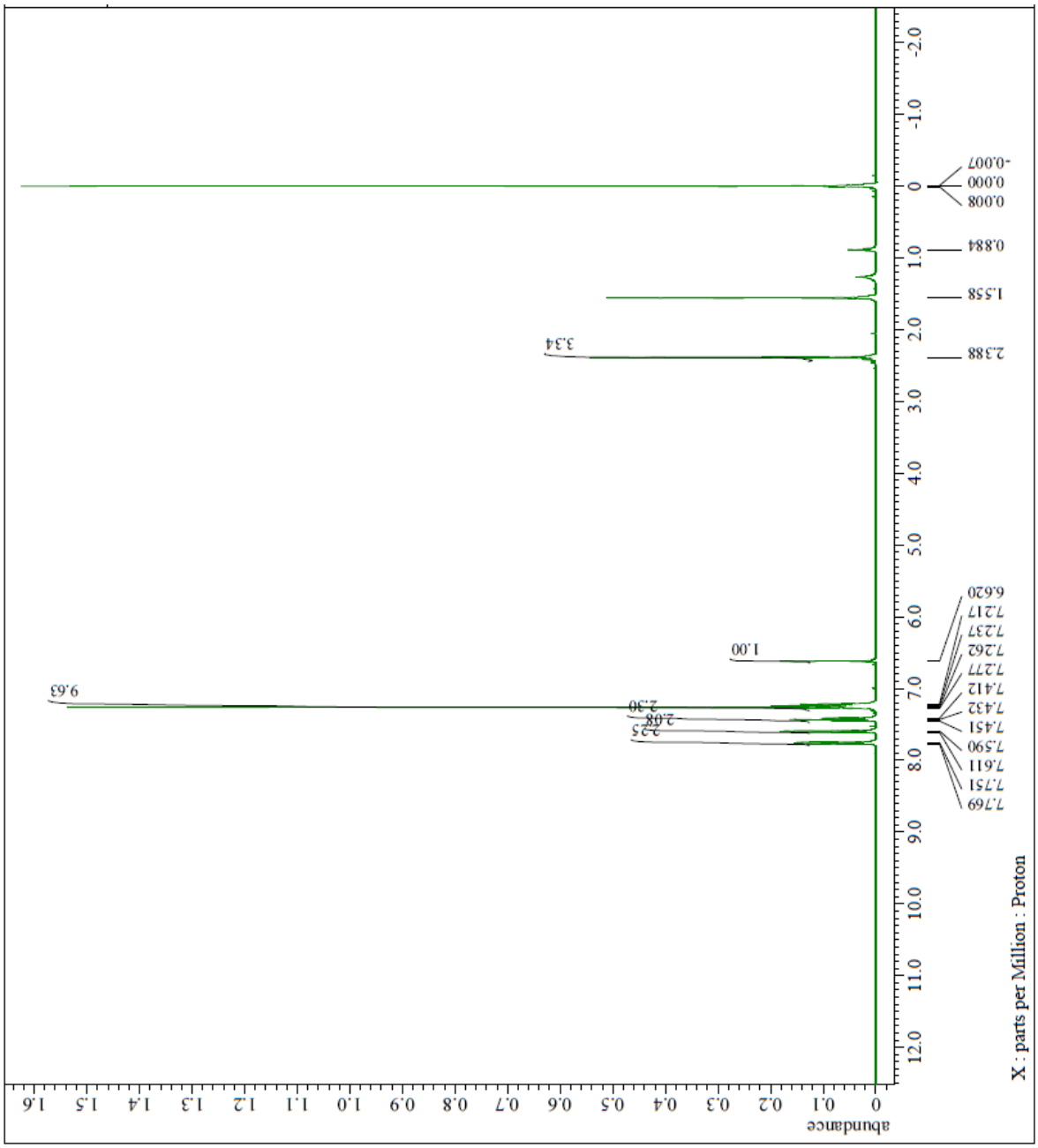
○ ^{13}C NMR (151 MHz)

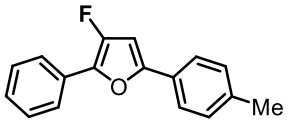




3-fluoro-2-phenyl-5-(*p*-tolyl)furan

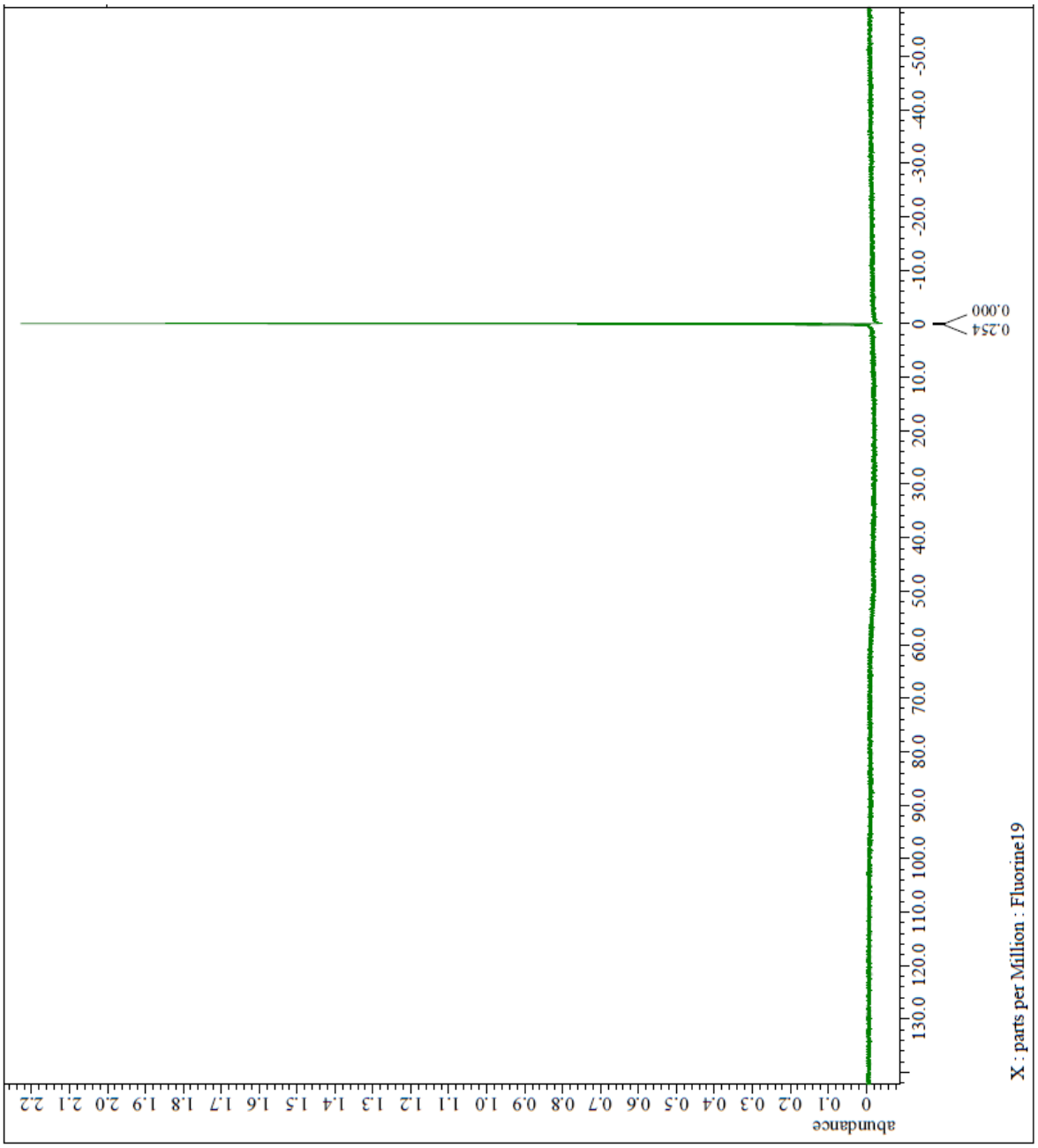
○ ^{1}H NMR (400 MHz)

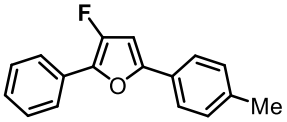




3-fluoro-2-phenyl-5-(*p*-tolyl)furan

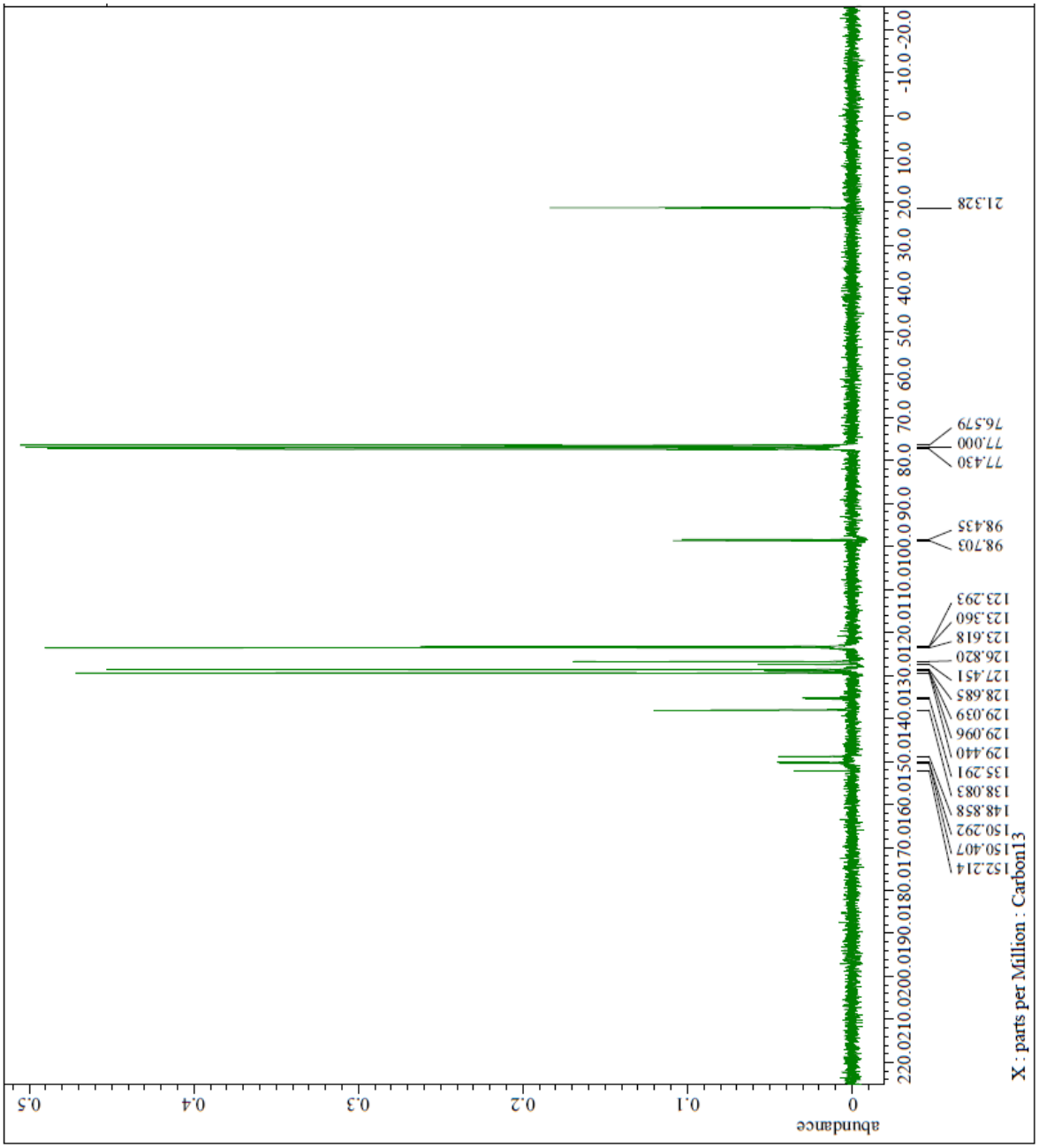
○ ^{19}F NMR (376 MHz)

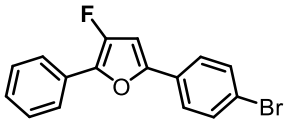




3-fluoro-2-phenyl-5-(*p*-tolyl)furan

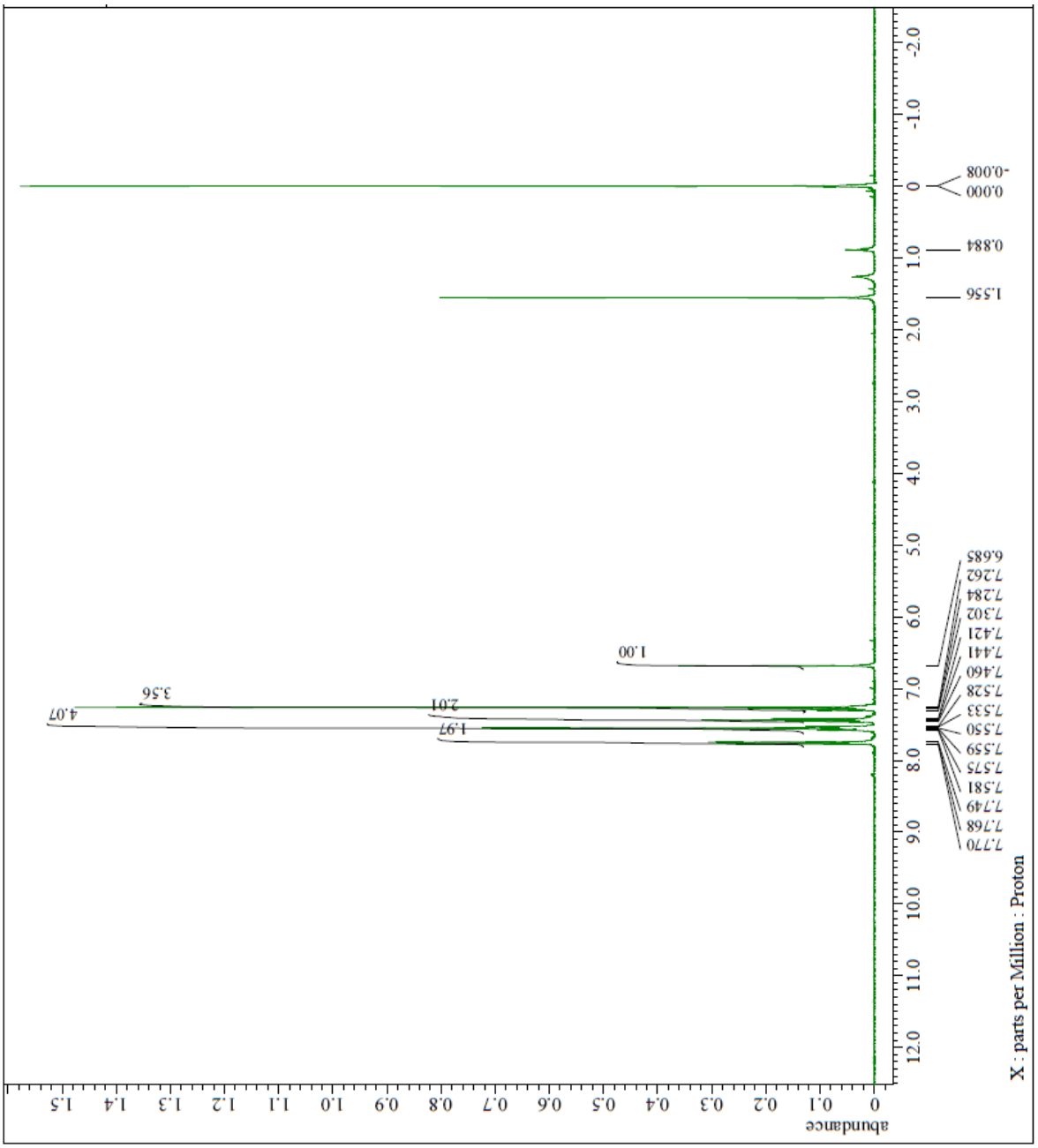
○ ^{13}C NMR (151 MHz)

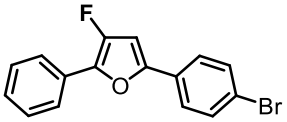




5-(4-bromophenyl)-3-fluoro-2-phenylfuran

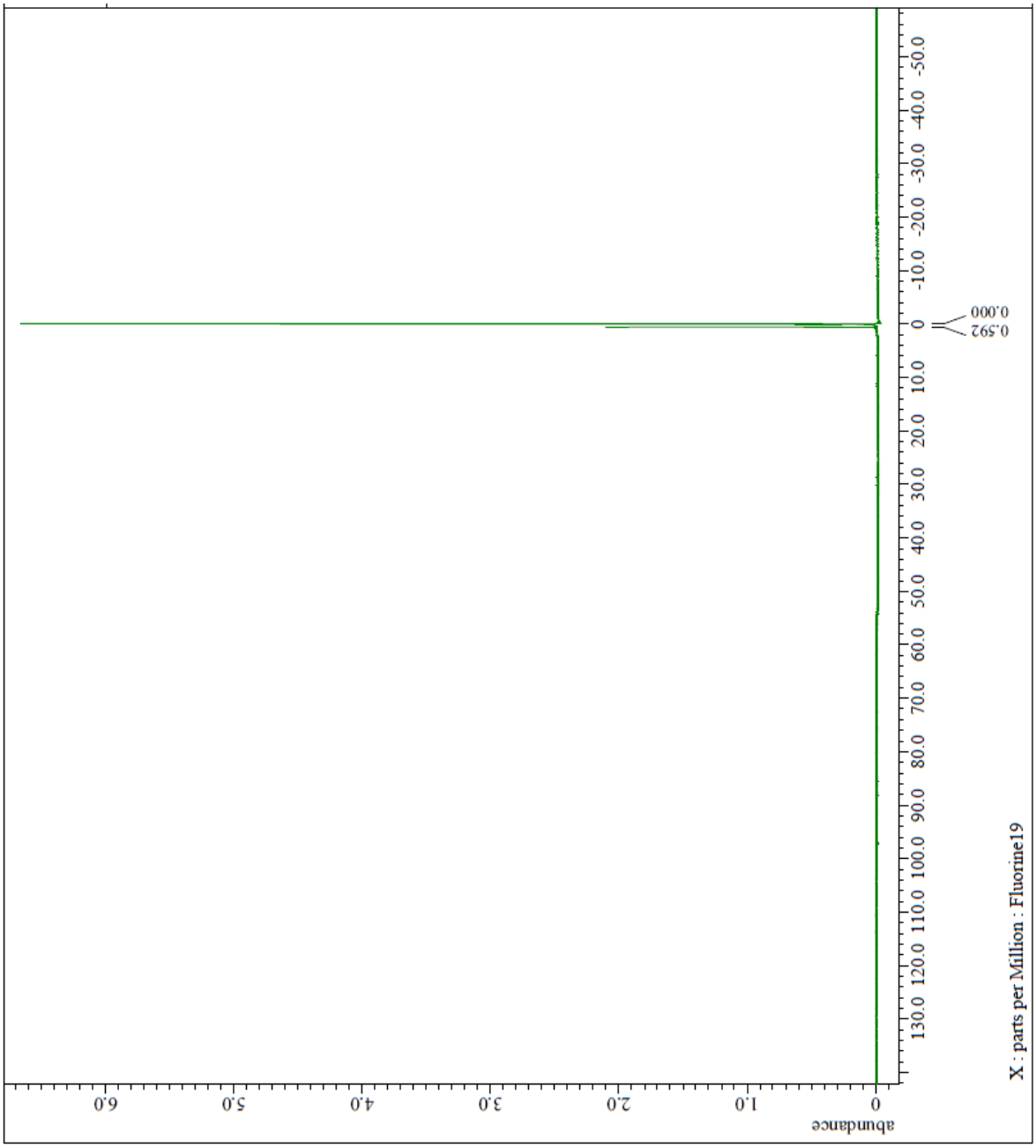
○ ^{1}H NMR (400 MHz)

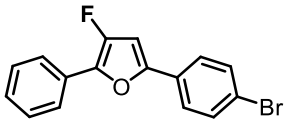




5-(4-bromophenyl)-3-fluoro-2-phenylfuran

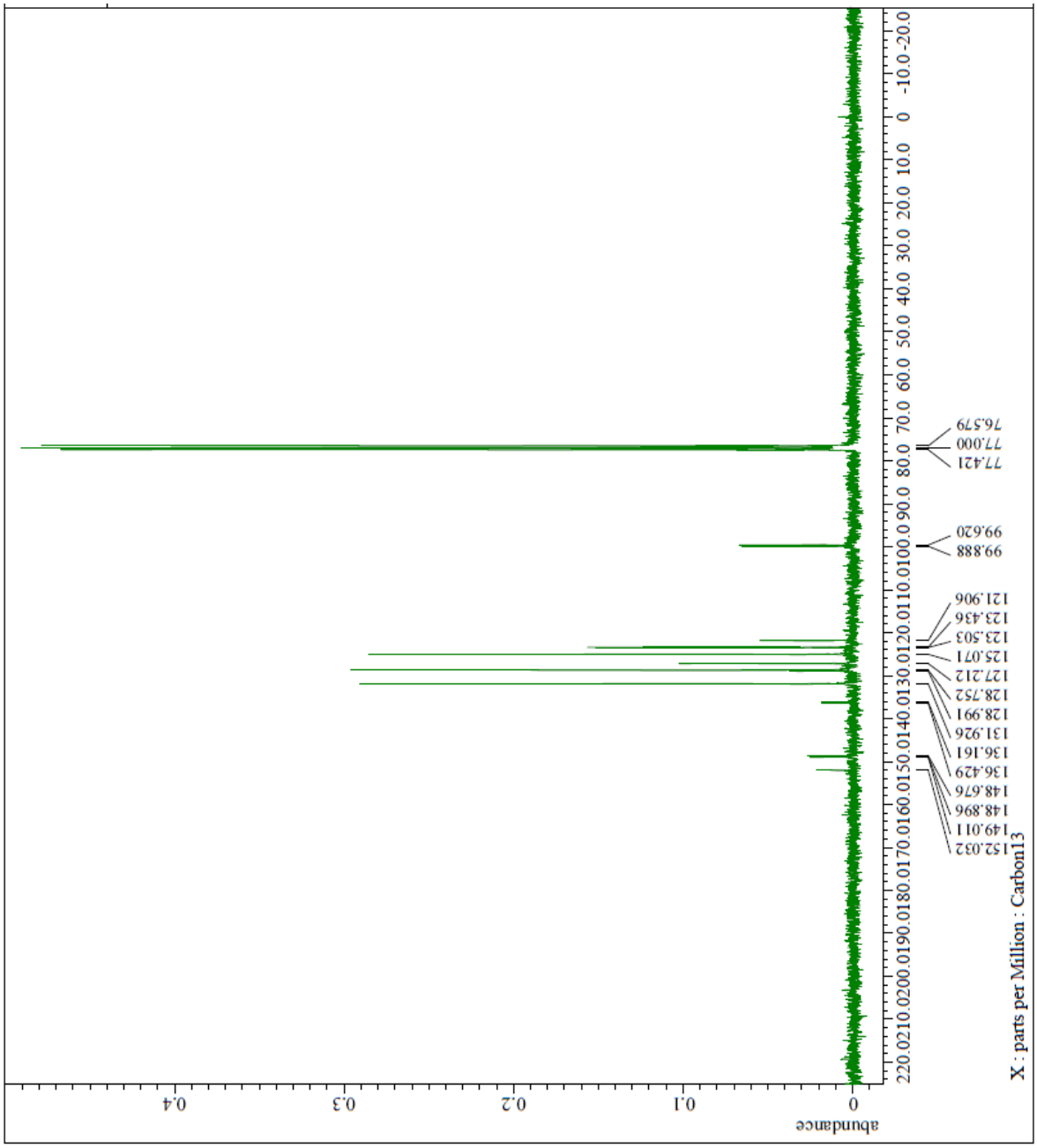
○ ^{19}F NMR (376 MHz)

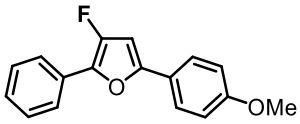




5-(4-bromophenyl)-3-fluoro-2-phenylfuran

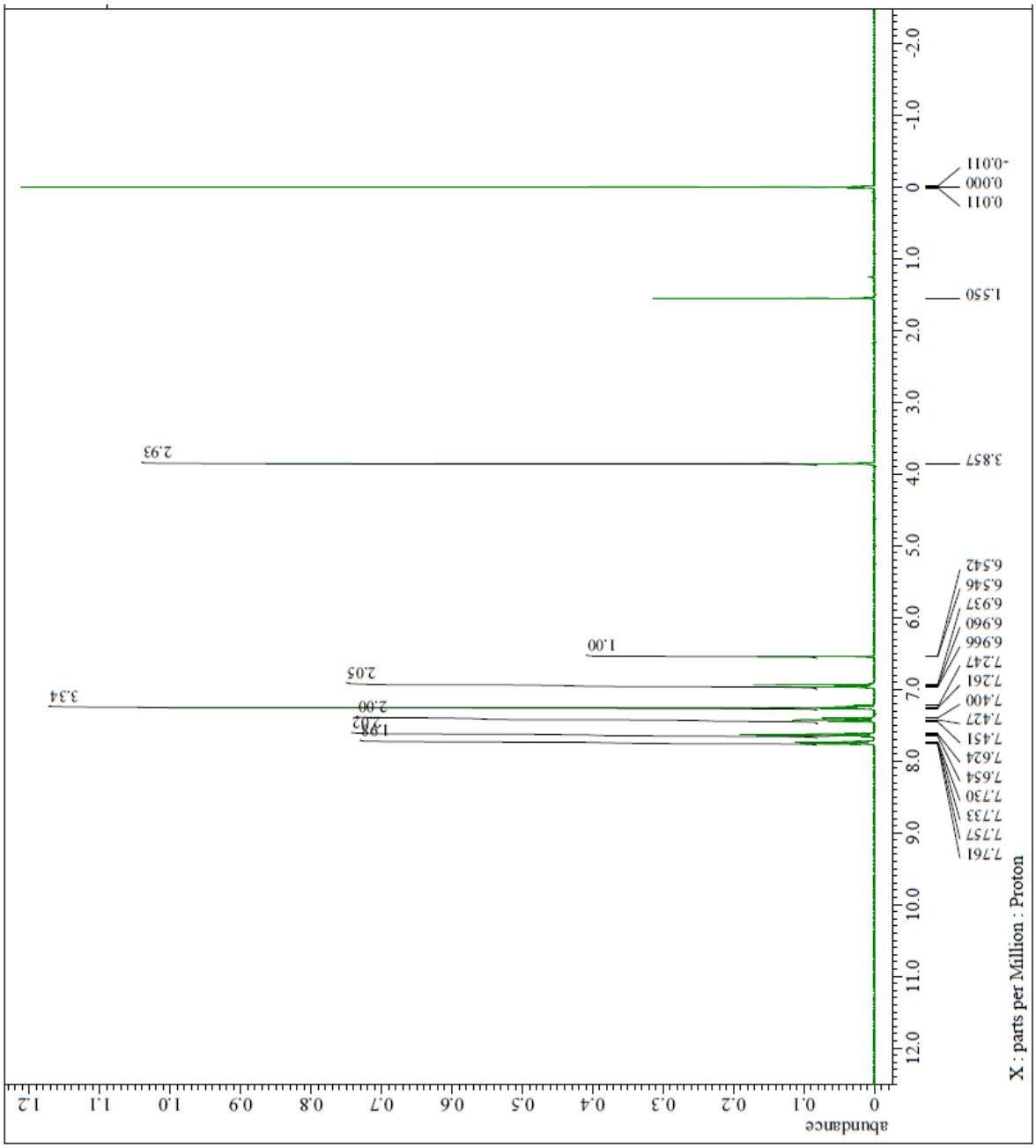
○ ^{13}C NMR (151 MHz)

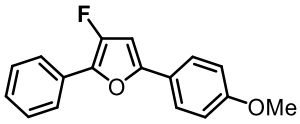




3-fluoro-5-(4-methoxyphenyl)-2-phenylfuran

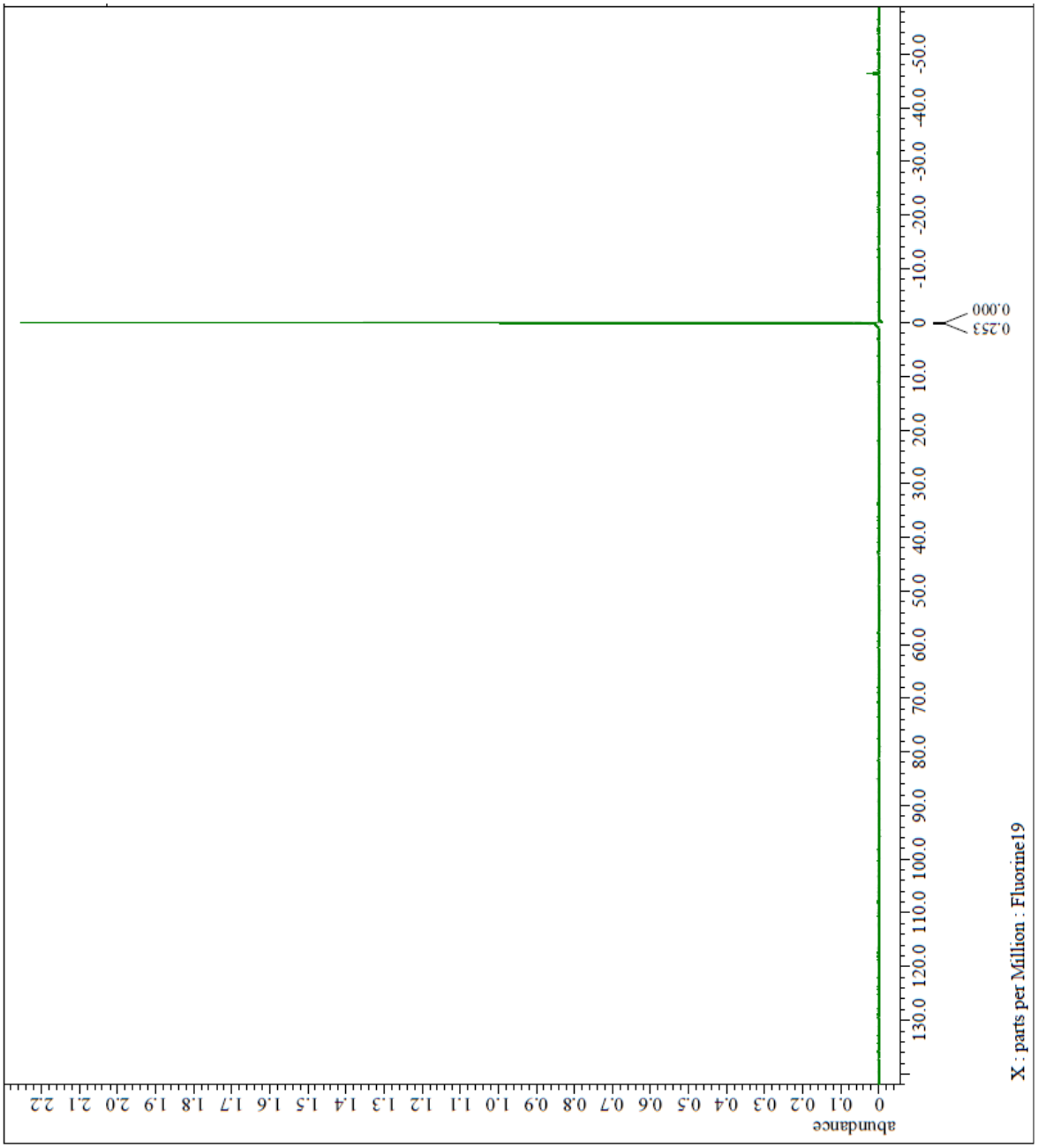
○ ^{1}H NMR (400 MHz)

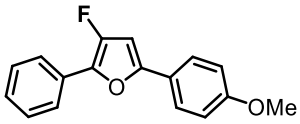




3-fluoro-5-(4-methoxyphenyl)-2-phenylfuran

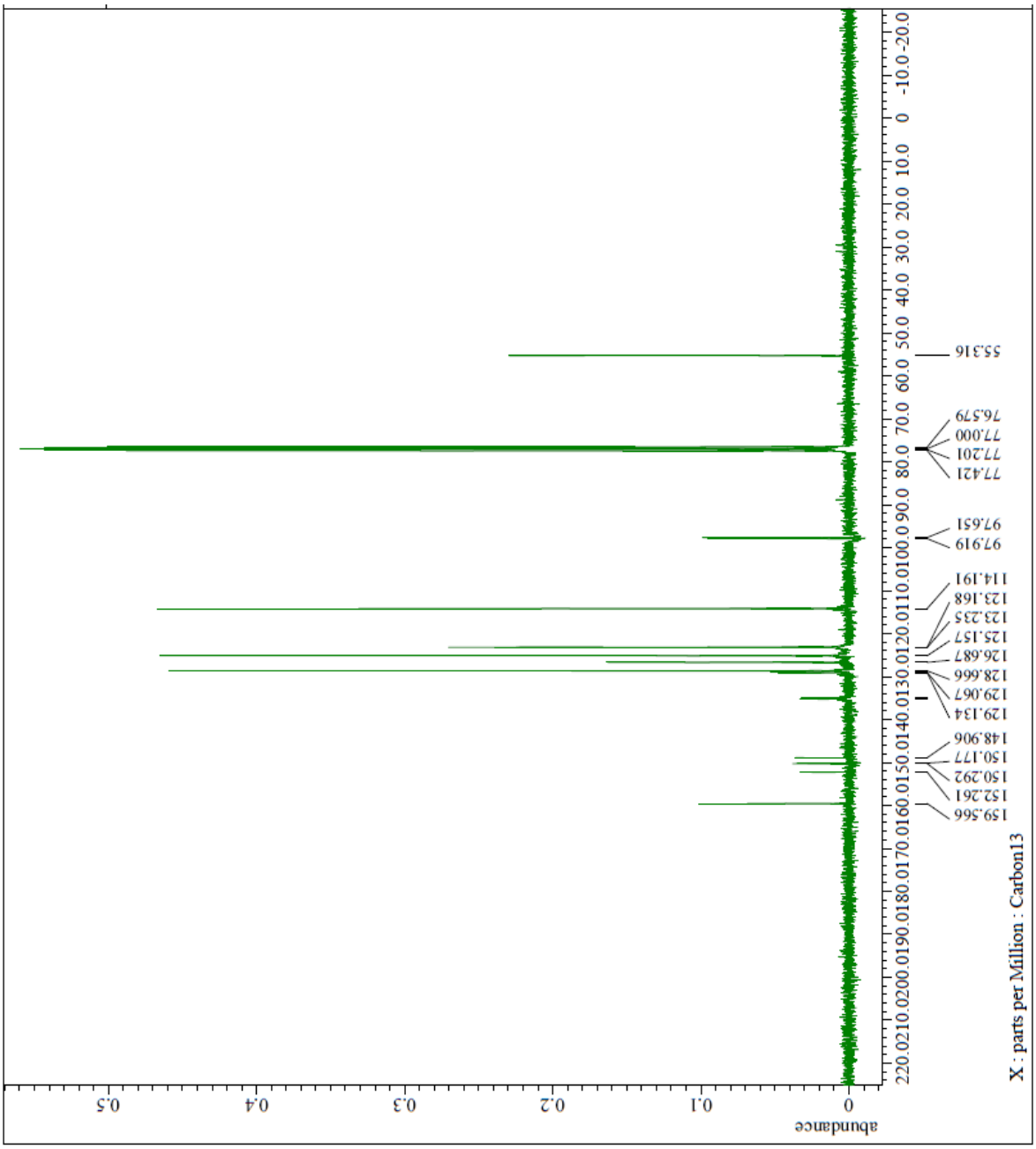
○ ^{19}F NMR (376 MHz)

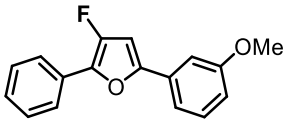




3-fluoro-5-(4-methoxyphenyl)-2-phenylfuran

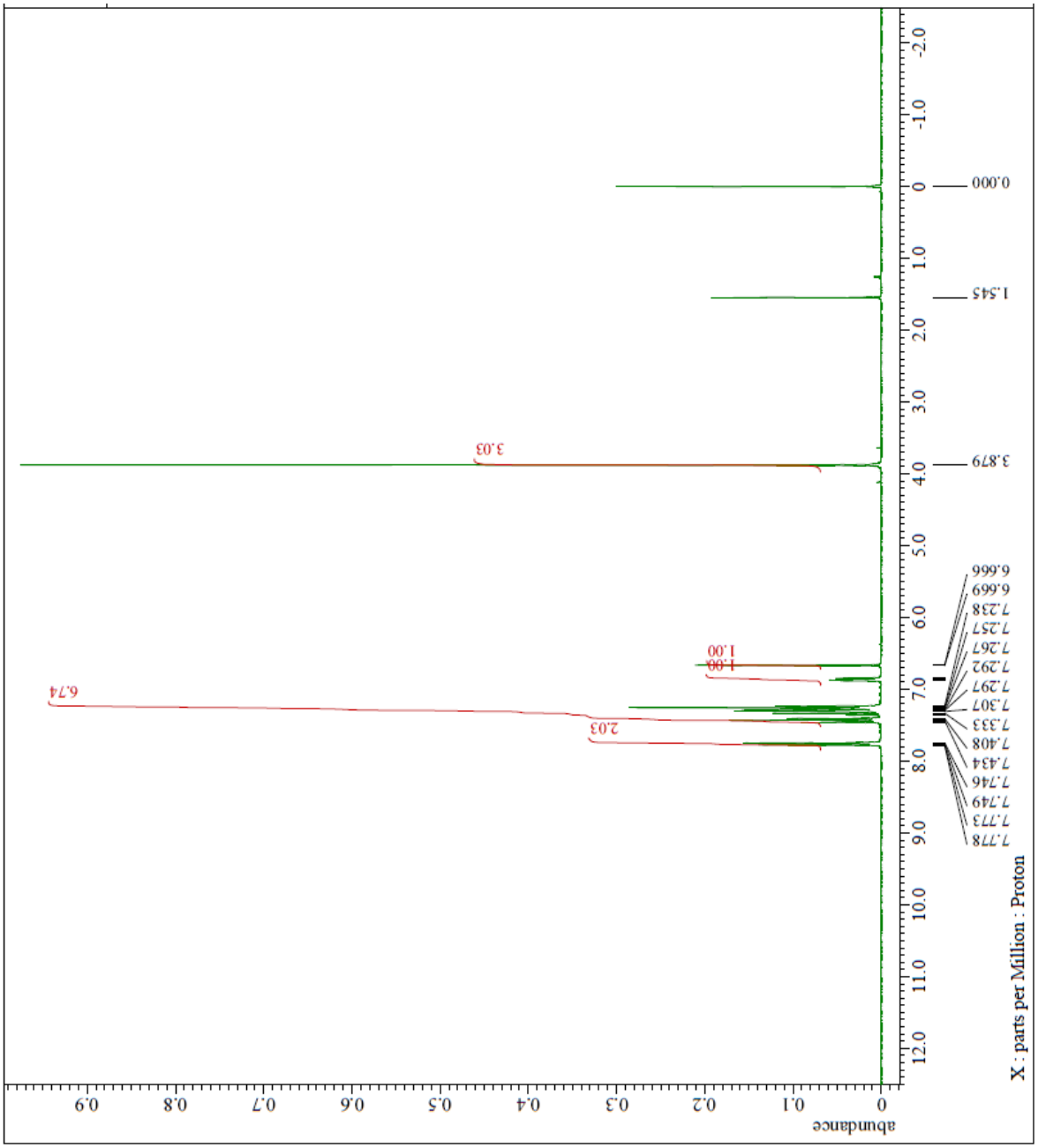
○ ^{13}C NMR (151 MHz)

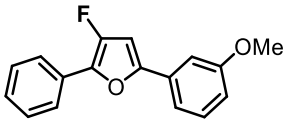




3-fluoro-5-(3-methoxyphenyl)-2-phenylfuran

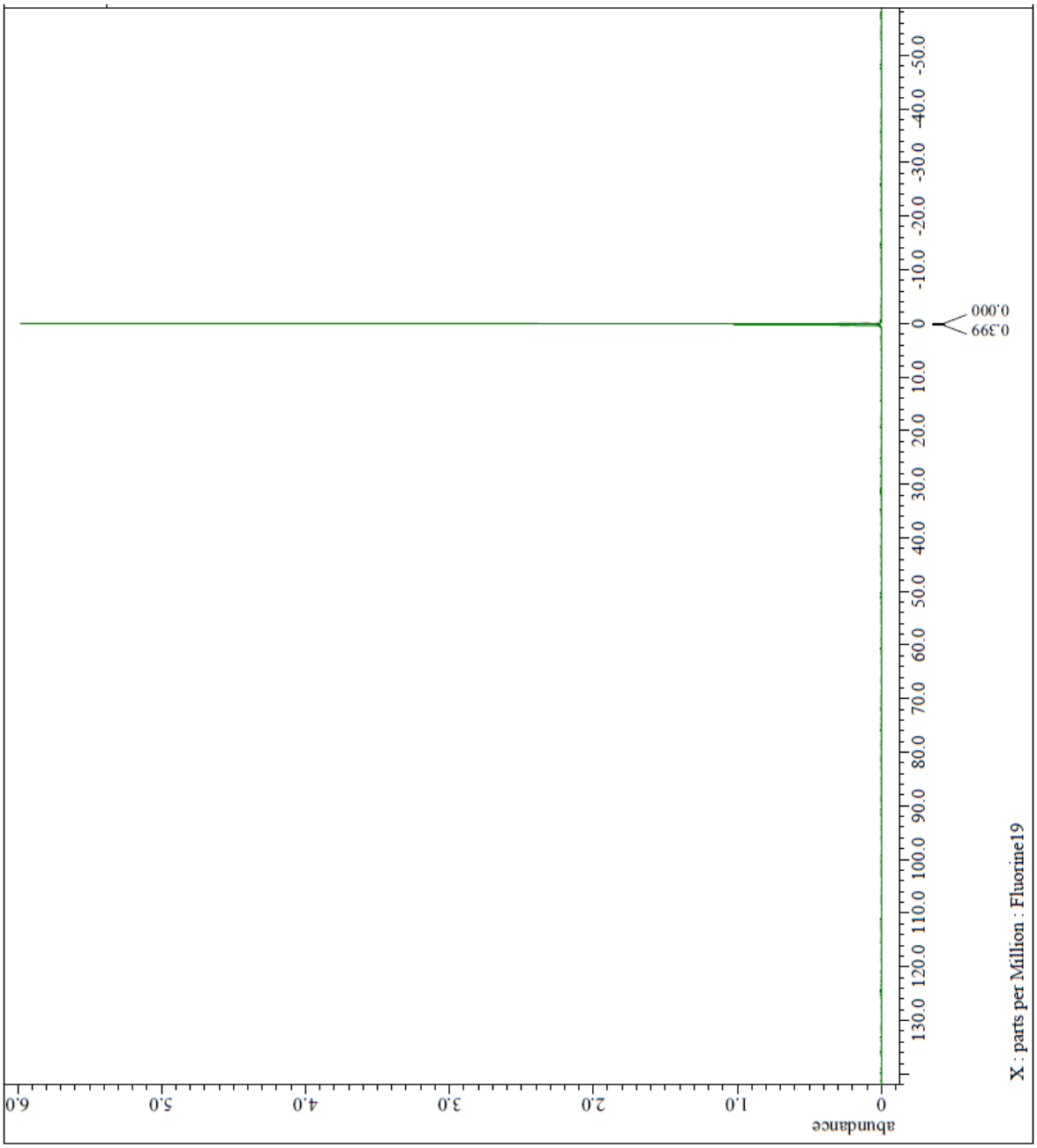
○ ^{1}H NMR (400 MHz)

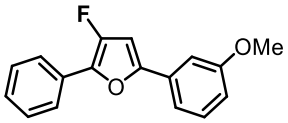




3-fluoro-5-(3-methoxyphenyl)-2-phenylfuran

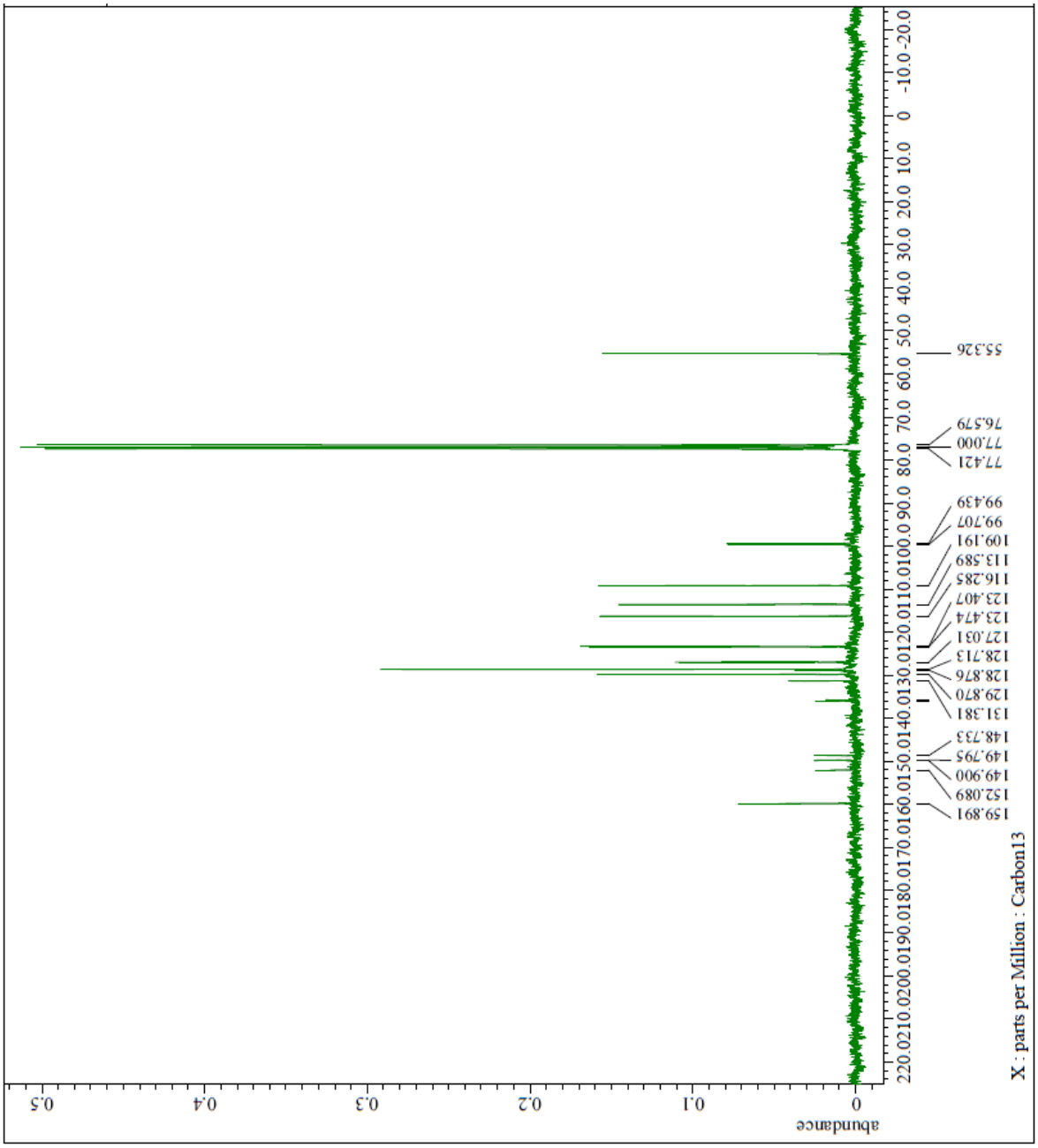
○ ^{19}F NMR (376 MHz)

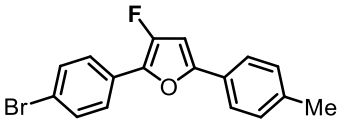




3-fluoro-5-(3-methoxyphenyl)-2-phenylfuran

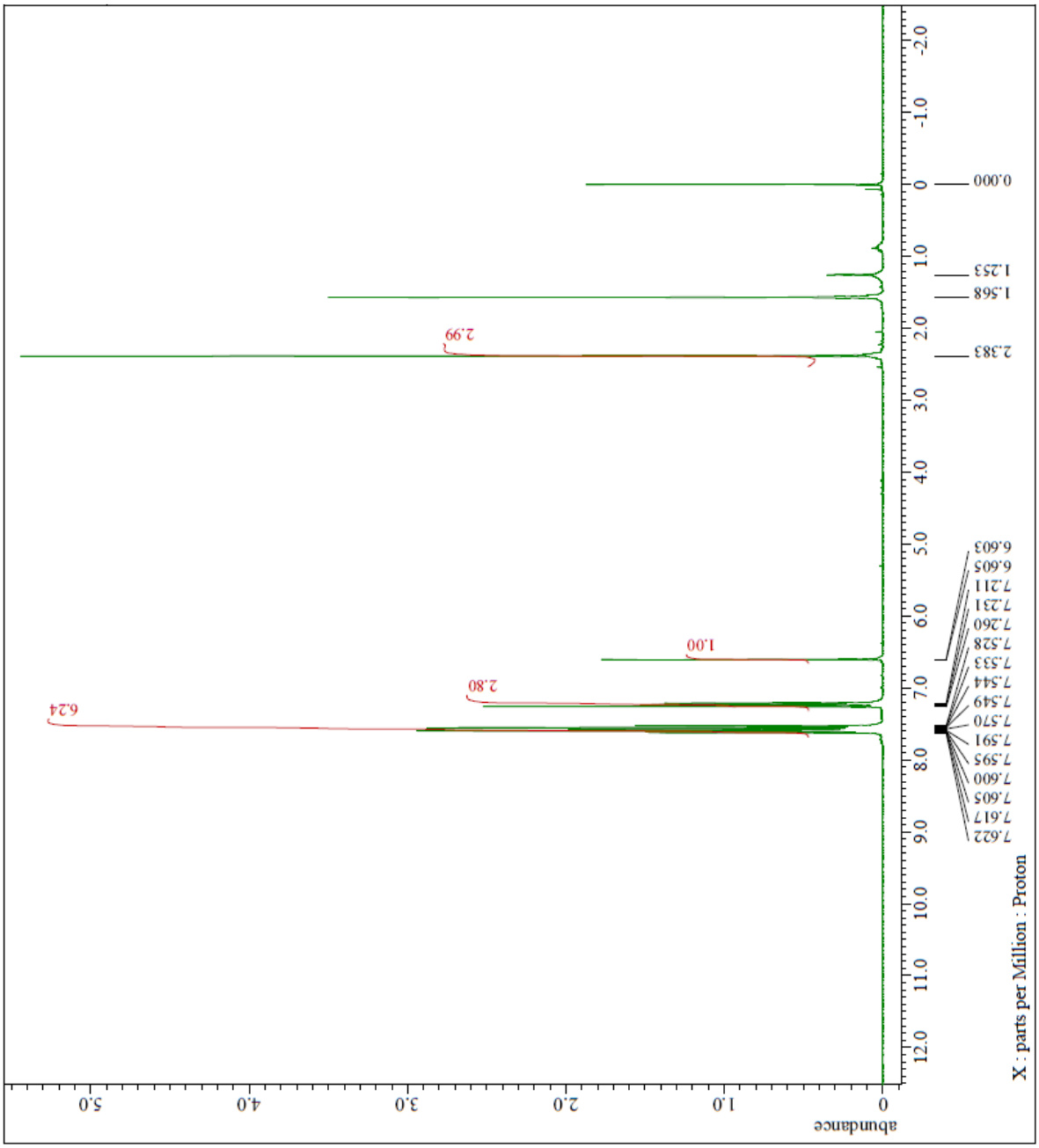
○ ^{13}C NMR (76 MHz)

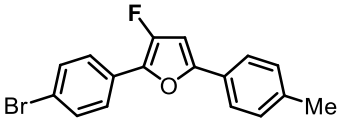




2-(4-bromophenyl)-3-fluoro-5-(*p*-tolyl)furan

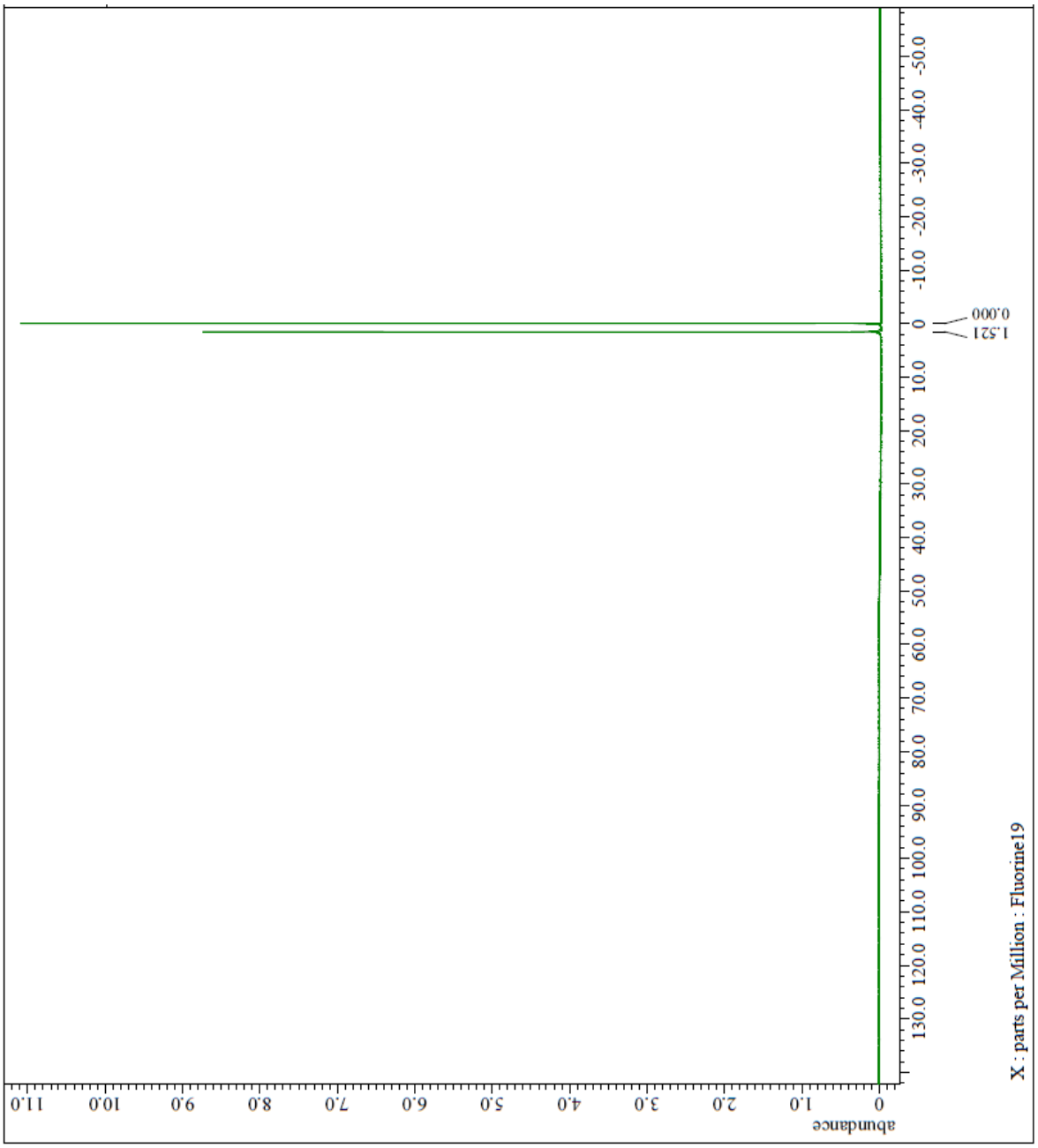
○ ^{1}H NMR (400 MHz)

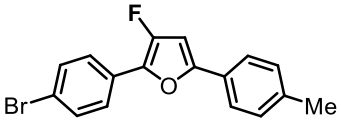




2-(4-bromophenyl)-3-fluoro-5-(*p*-tolyl)furan

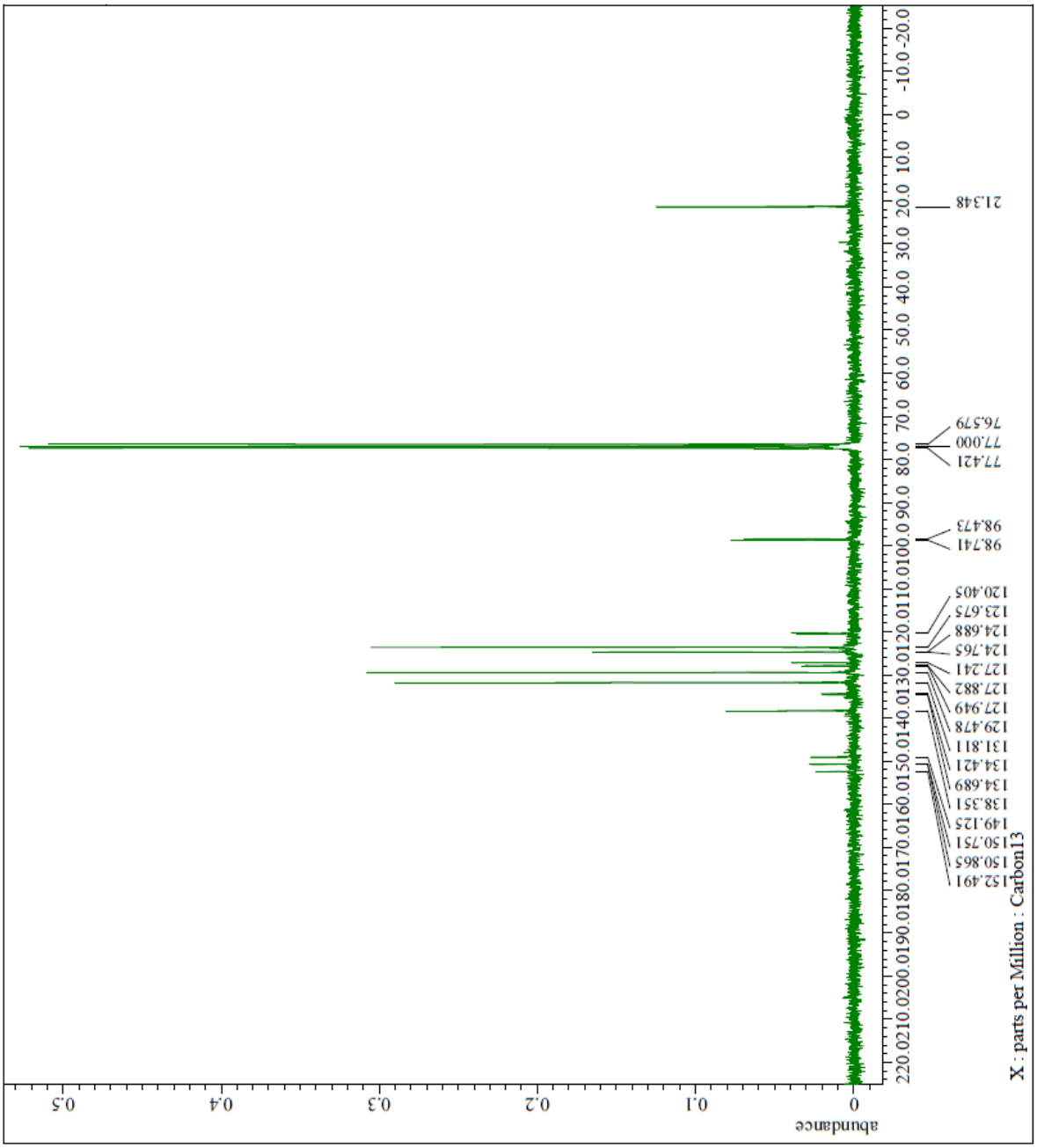
○ ^{19}F NMR (376 MHz)

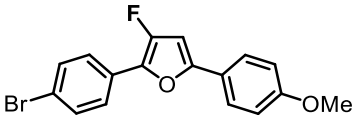




2-(4-bromophenyl)-3-fluoro-5-(*p*-tolyl)furan

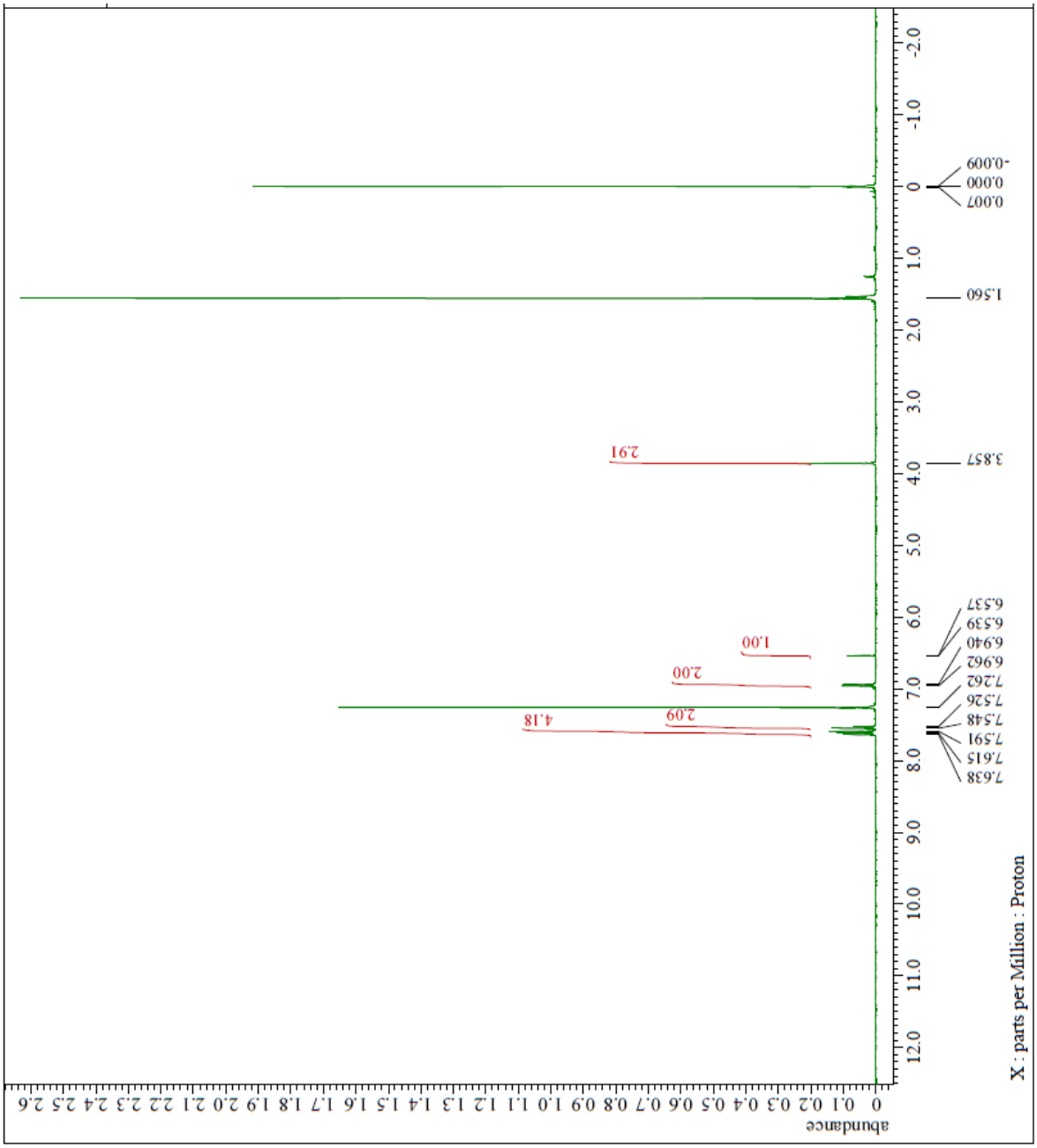
○ ^{13}C NMR (151 MHz)

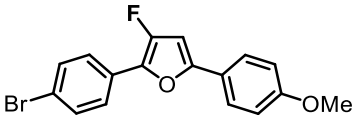




2-(4-bromophenyl)-3-fluoro-5-(4-methoxyphenyl)furan

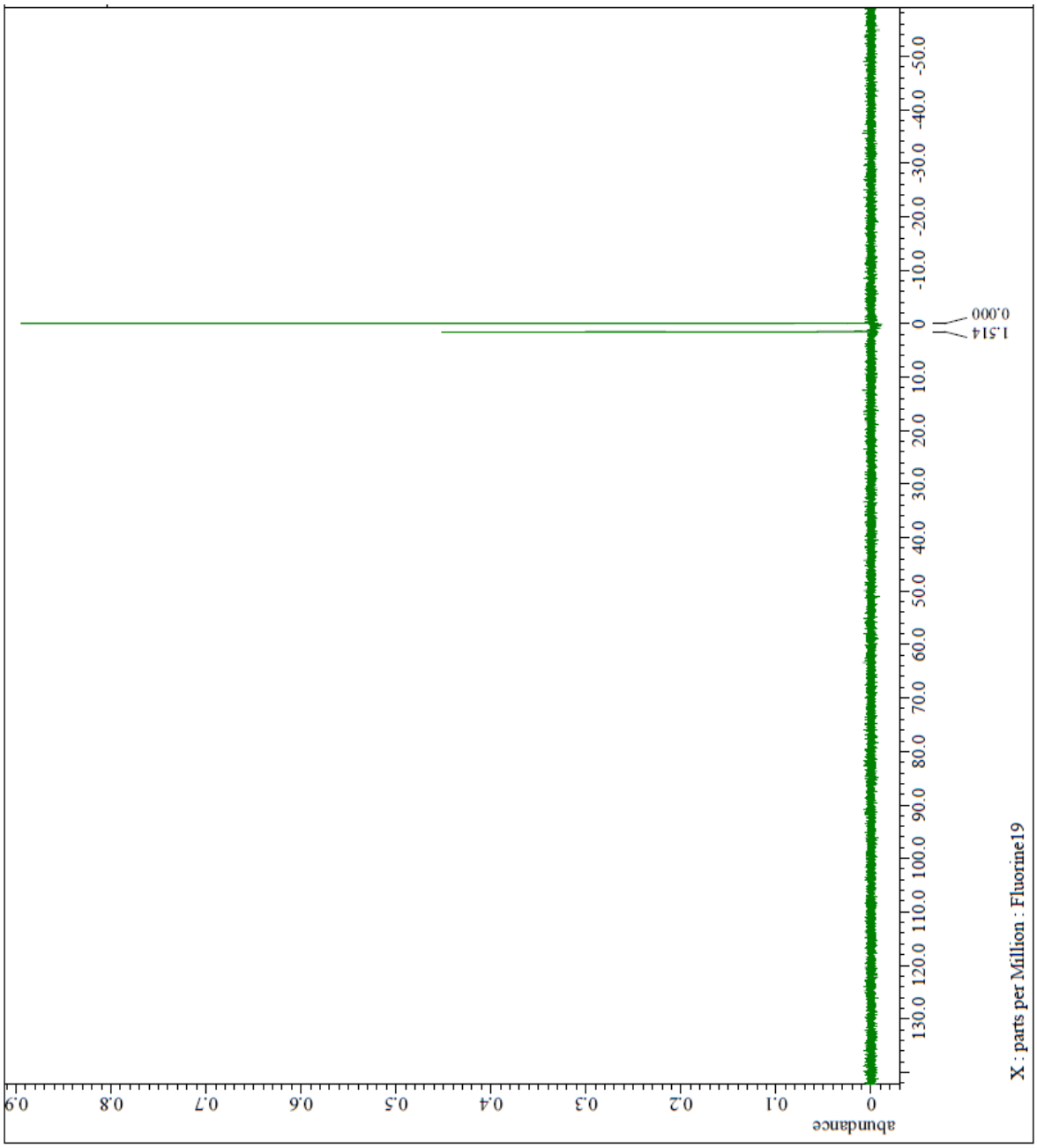
○ ^{1}H NMR (400 MHz)

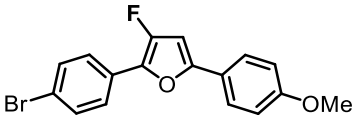




2-(4-bromophenyl)-3-fluoro-5-(4-methoxyphenyl)furan

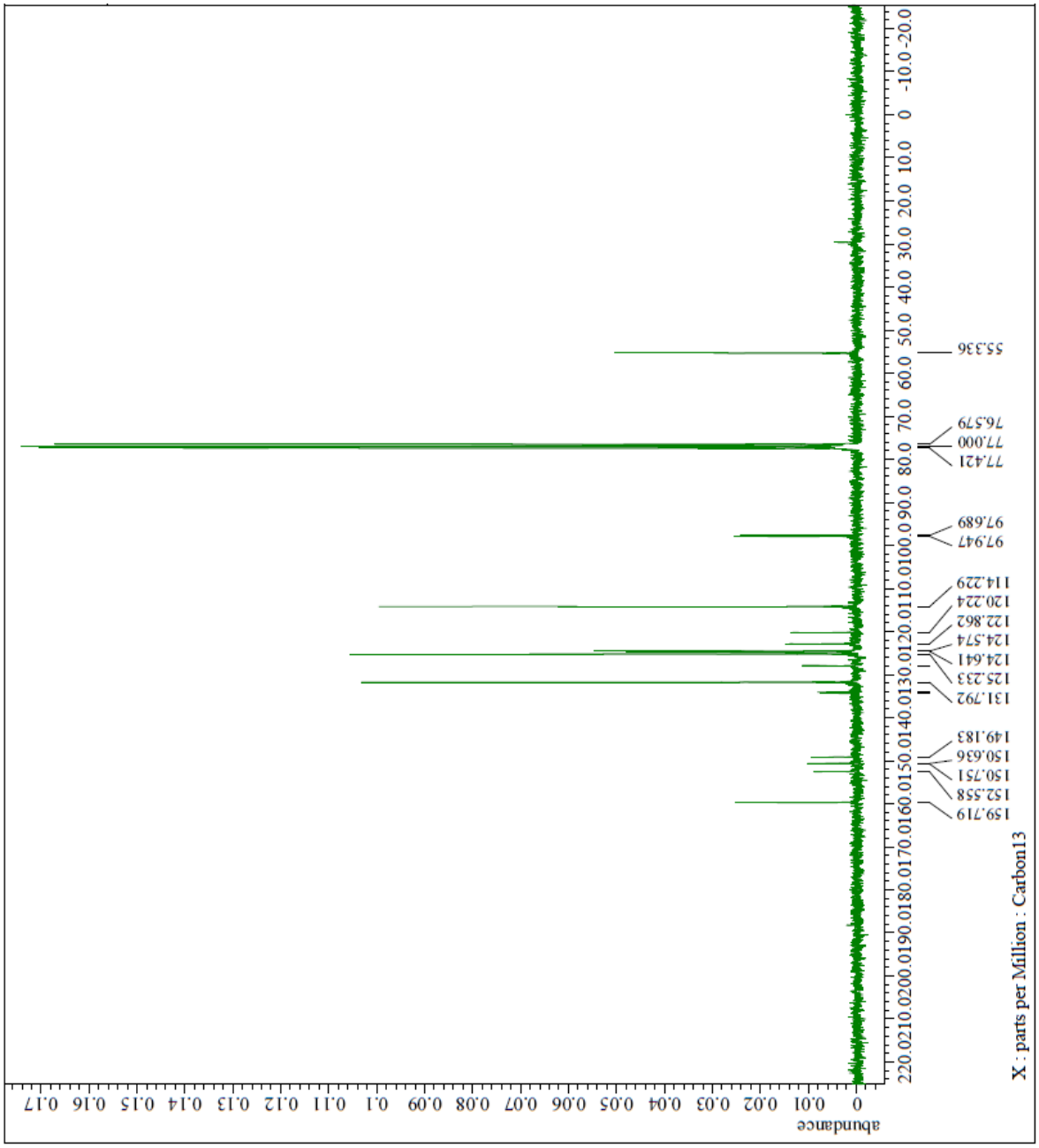
○ ^{19}F NMR (376 MHz)

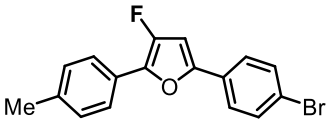




2-(4-bromophenyl)-3-fluoro-5-(4-methoxyphenyl)furan

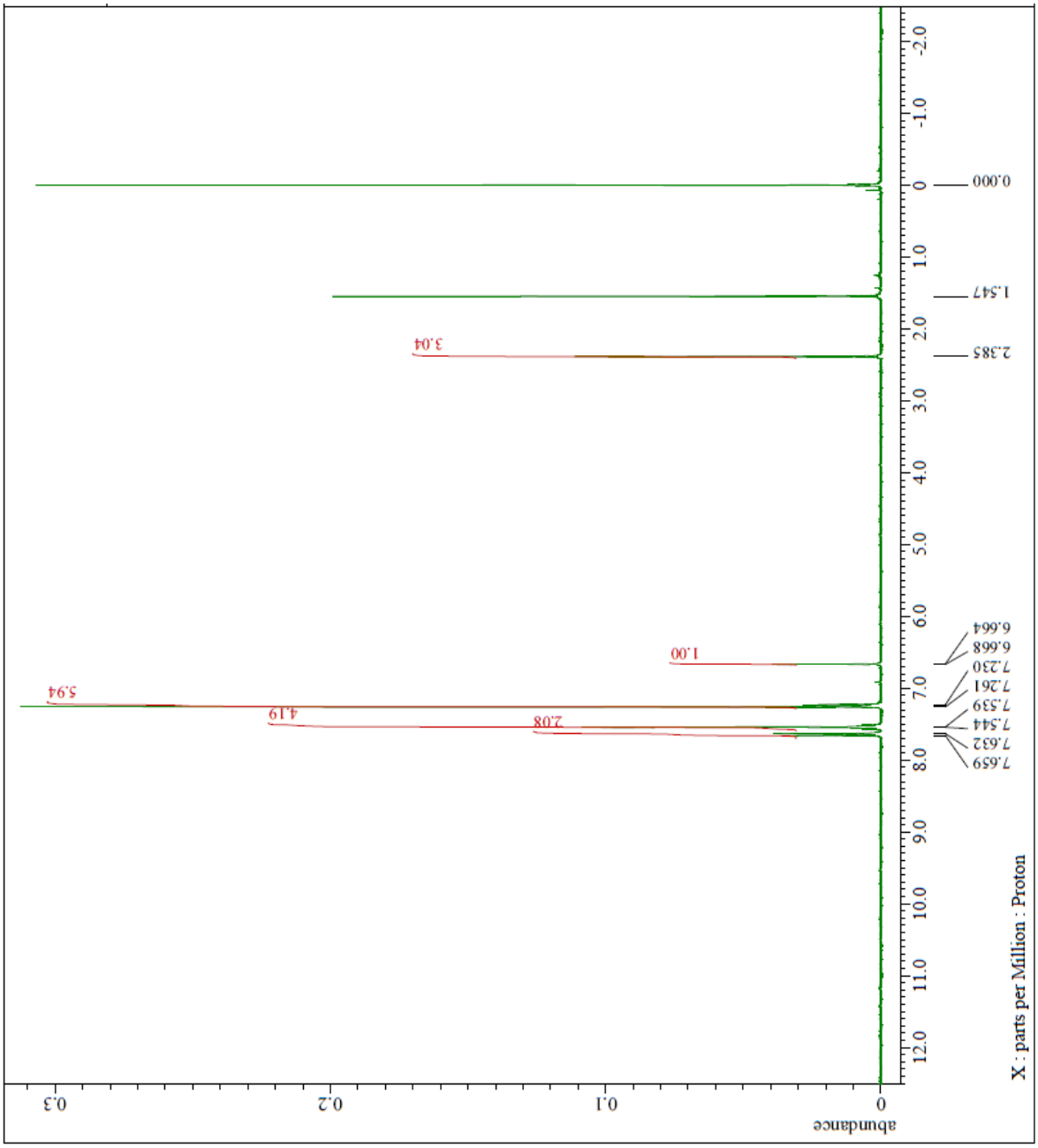
○ ^{13}C NMR (151 MHz)

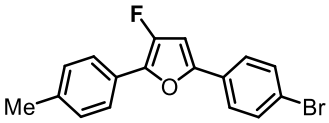




5-(4-bromophenyl)-3-fluoro-2-(*p*-tolyl)furan

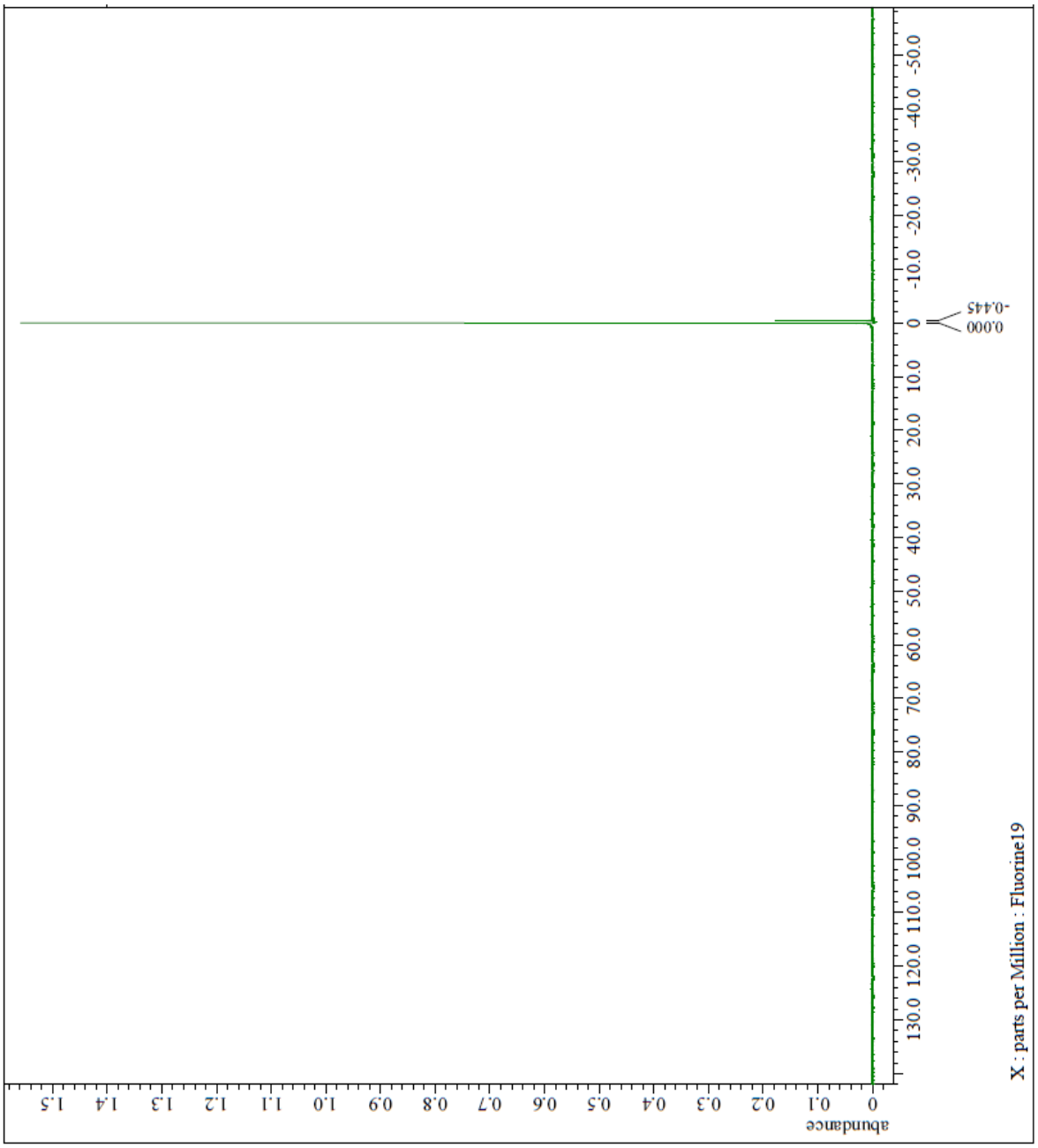
○ ^{1}H NMR (400 MHz)

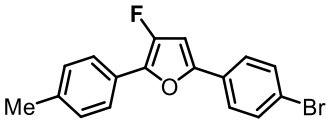




5-(4-bromophenyl)-3-fluoro-2-(*p*-tolyl)furan

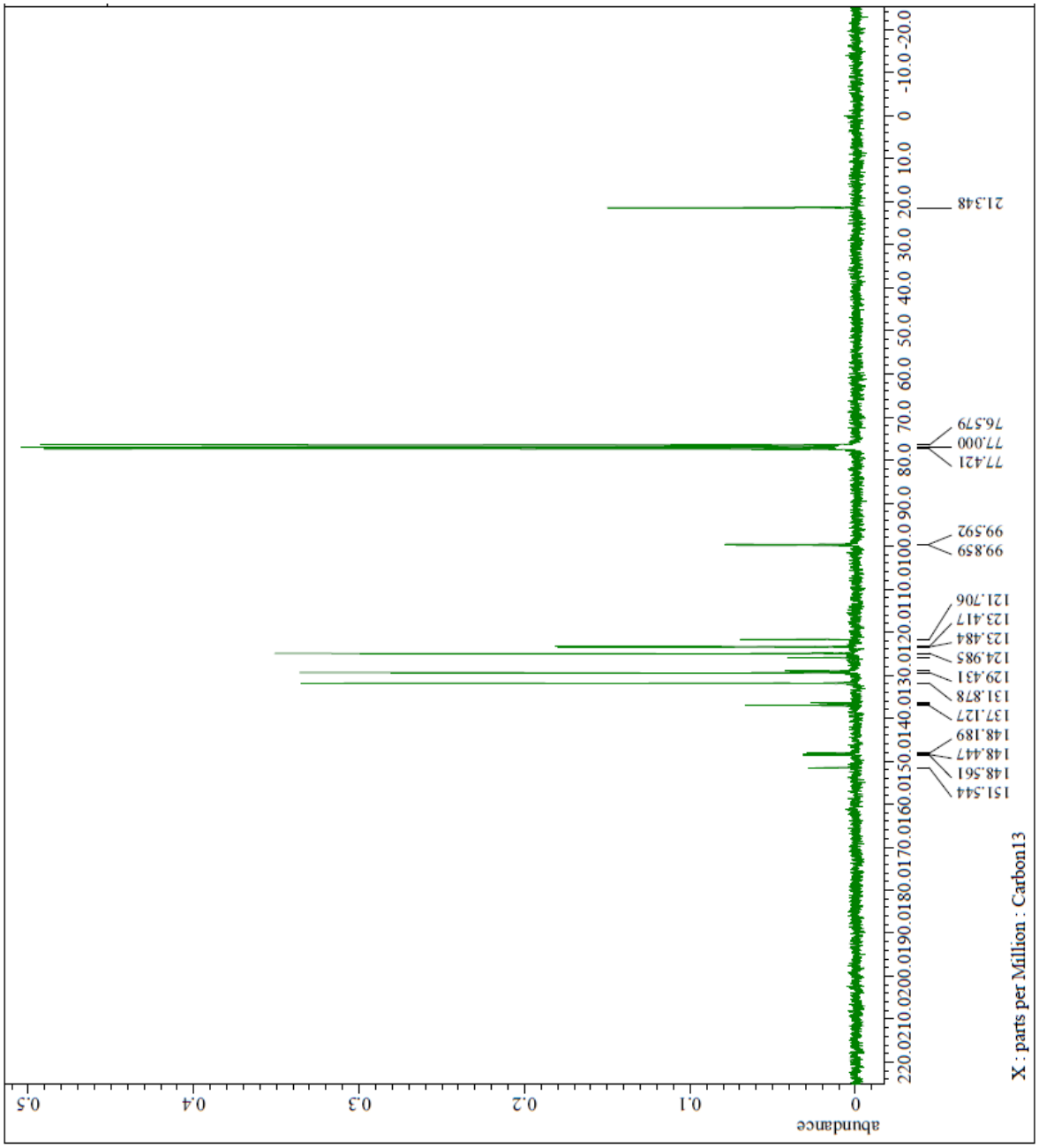
○ ^{19}F NMR (376 MHz)





5-(4-bromophenyl)-3-fluoro-2-(*p*-tolyl)furan

○ ^{13}C NMR (151 MHz)



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