Supplementary Information (SI) for ChemComm.

Photosensitizer-free polarity-mismatched electrophilic α,α-bis-functionalization of acetone with quinoxaline and maleimide

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Contents

I. General Information:

All the reagents were commercial grade and purified according to the established procedures. All the reactions were carried out in oven-dried glassware. The highest commercial quality reagents were purchased and were used without further purification unless otherwise stated. Reactions were monitored by thin-layer chromatography (TLC) on a 0.25 mm silica gel plates (60 F_{254}) visualized under UV illumination at 254 nm. Organic extracts were dried over anhydrous sodium sulfate (Na_2SO_4). Solvents were removed using a rotary evaporator under reduced pressure. Column chromatography was performed to purify the crude product on silica gel 60−120 mesh using a mixture of hexane and ethyl acetate as eluents. All the isolated compounds were characterized by ^{1}H, $^{13}C\{^{1}H\}$ NMR and IR spectroscopic (HRMS-spectrometric) techniques. NMR spectra for all the samples were recorded in deuterochloroform ($CDCl_3$). ^{1}H, $^{13}C\{^{1}H\}$ were recorded in 500 (126) or 400 (101) MHz spectrometer and were calibrated using tetramethylsilane or residual undeuterated solvent for ^{1}H NMR, deuterochloroform for ^{13}C NMR as an internal reference {Si $(CH_3)_4$: 0.00 ppm or $CHCl_3$: 7.26 ppm for ^{1}H NMR, 77.16 ppm for ^{13}C NMR}. The chemical shifts are quoted in δ units, parts per million (ppm). ^{1}H NMR data is represented as follows: Chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, dd = doublet of doublet, integration and coupling constant(s) J in hertz (Hz). High-resolution mass spectra (HRMS) were recorded on a mass spectrometer using electrospray ionization-time of flight (ESI-TOF) reflection experiments. FT-IR spectra were recorded as neat and reported in the frequency of absorption (cm^{-1}). All UV–vis experiments were performed in 1 mL quartz cuvettes with a path length equal to 1 cm. Photoluminescence was carried out upon exciting at a suitable wavelength in 1 mL quartz cuvettes.

II. Experimental Procedure:

1. Photochemical Set-up for purple LEDs Irradiation:

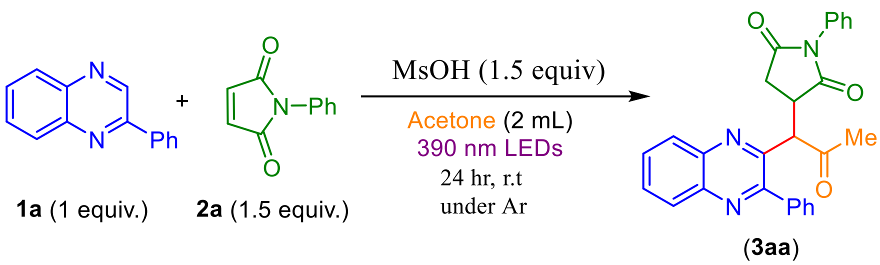
Torpe full spectrum grow light purple LEDs (λ_{em}^{max})=390 nm, 3 × 9 W) was used as the light source for carrying out these multicomponent reactions without using any filter. A borosilicate 15 mL oven-dried glass vial was used as the reaction vessel. The distance from the light source to the irradiation vessel was ~3–4 cm. A DC fan was used to ventilate the area to maintain the temperature 25–30 ºC. A typical reaction setup for blue LEDs is portrayed below (Figure S1).

Figure S1. Photochemical reaction setup.

2. Procedure for the synthesis of starting materials:

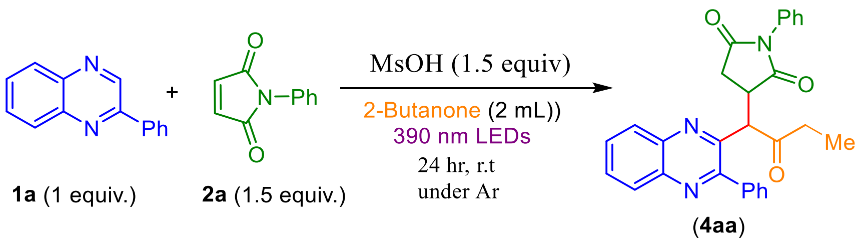
All 2-aryl quinoxalines (**1a–1n**) were synthesized following the reported procedure.[1] The *N*-alkylated and *N*-arylated maleimides (**2a–2m)** were also prepared according to the reported procedure.[2]

3. Procedure for the synthesis of 3-(2-oxo-1-(3-Phenylquinoxalin-2-yl)propyl)-1-phenylpyrrolidine-2,5-dione (3aa):



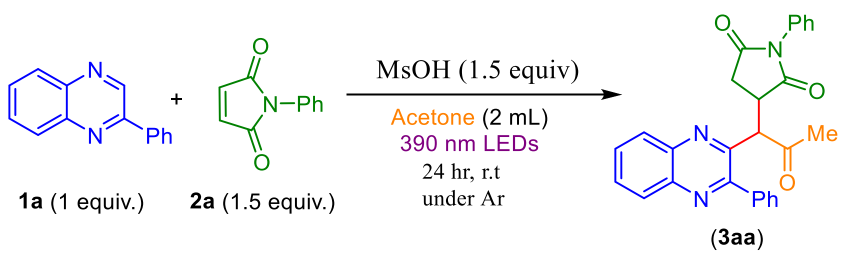
An oven-dried 15 mL reaction vial was charged with a magnetic stir bead, 2-phenylquinoxaline (0.25 mmol, 52 mg), *N*-phenyl maleimide (0.375 mmol, 65 mg) and MsOH (0.375 mmol, 36 mg). The glass vial was capped with a rubber septum, followed by evacuation using a vacuum pump through an appropriately fitted needle. Then, acetone (2 mL) was added *via* a syringe to the glass vial under Ar atmosphere. The reaction mixture was stirred at room temperature in an argon atmosphere for 24 h under the irradiation of purple LEDs ($\lambda_{em}{}^{max}$ = 390 nm, 3 × 9 W) approximately at a distance of ~3-4 cm. The progress of the reaction was monitored *via* TLC. After completion of the reaction, the solvent was removed by rotary evaporation and then the reaction mixture was neutralized with saturated $NaHCO_3$ solution and extracted with ethyl acetate (2 x 10 mL). The organic layer was dried over anhydrous Na_2SO_4 and was evaporated under reduced pressure. Then the crude mixture was purified over column chromatography (60–120 mesh silica) by eluting it with hexane/EtOAc (3:1) mixtures to afford the desired product **3aa** in 72% isolated yield (78 mg).

4. Procedure for the synthesis of 3-(2-oxo-1-(3-phenylquinoxalin-2-yl)butyl)-1-phenylpyrrolidine-2,5-dione (4aa)



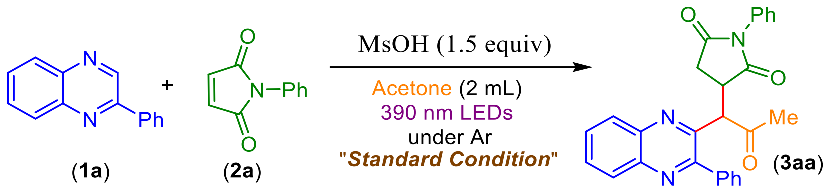
An oven-dried 15 mL reaction vial was charged with a magnetic stir bead, 2-phenylquinoxaline (0.25 mmol, 52 mg), *N*-phenyl maleimide (0.375 mmol, 65 mg) and MsOH (0.375 mmol, 36mg). The glass vial was capped with a rubber septum, followed by evacuation using a vacuum pump through an appropriately fitted needle. Then, 2-butanone (2 mL) was added *via* a syringe to the glass vial under Ar atmosphere. The reaction mixture was stirred at room temperature in an argon atmosphere for 20-24 h under the irradiation of purple LEDs ($\lambda_{em}{}^{max}$ = 390 nm, 3 × 9W) approximately at a distance of ~3-4 cm. The progress of the reaction was monitored via TLC. After completion of the reaction, the solvent was removed by rotary evaporation and then the reaction mixture was neutralized with saturated $NaHCO_3$ solution and extracted with ethyl acetate (2 x 10 mL). The organic layer was dried over anhydrous Na_2SO_4 and was evaporated under reduced pressure. Then the crude mixture was purified over column chromatography (60–120 mesh silica) by eluting it with hexane/EtOAc (19:6) mixtures to afford the desired product **4aa** in 57% isolated yield (64 mg).

5. Procedure for 1 mmol scale synthesis of 3aa:



An oven-dried 15 mL reaction vial was charged with a magnetic stir bead, 2-phenylquinoxaline (**1a**, 1 mmol, 206 mg), *N*-phenyl maleimide (**2a**, 1.5 mmol, 259 mg), and MsOH (1.5 mmol, 144 mg). The glass vial was capped with a rubber septum, followed by evacuation using a vacuum pump through an appropriately fitted needle. Then, acetone (4 mL) was added via a syringe to the glass vial under Ar atmosphere. The reaction mixture was stirred at room temperature in an argon atmosphere for 30 h under the irradiation of purple LEDs ($\lambda_{em}{}^{max}$ = 390 nm, 3 × 9 W) approximately at a distance of ~3–4 cm. The progress of the reaction was monitored *via* TLC. After completion of the reaction, the solvent was removed by rotary evaporation and then the reaction mixture was neutralized with saturated $NaHCO_3$ solution and extracted with ethyl acetate (2 x 15 mL). The organic layer was dried over anhydrous Na_2SO_4 and evaporated under reduced pressure. Then the crude mixture was purified over column chromatography (60–120 mesh silica) by eluting it with hexane/EtOAc (75:25) mixtures to afford the desired products **3aa** in 52% isolated yield (226 mg).

Table S1. Optimization of reaction conditions



Entry	Deviation from standard conditions	Yield (%)[b]
1	**none**	**72**
2	*p*-TSA instead of MsOH	46
3	TFA instead of MsOH	25
4	AcOH instead of MsOH	19
5	TfOH instead of MsOH	16
6	absence of MsOH	nd
7	1.0 equiv of MsOH	55
8	2.0 equiv of MsOH	69
9	Acetone : DCE (1 mL:1 mL)	33
10	Acetone : $CHCl_3$ (1 mL:1 mL)	38
11	Acetone : MeCN (1 mL:1 mL)	26
12	Acetone : DMSO (1 mL:1 mL)	31
13	under the open air	<15
14	under dark conditions	nd
15	365 nm blue LEDs	61
16	460 nm UV light	traces
17	white LEDs	22
18	30 h reaction time instead of 24 h	68

[a]Reaction conditions unless specified otherwise: **1a** (0.25 mmol), **2a** (0.375 mmol), MsOH (0.375 mmol) in degassed acetone (2 mL), 27 W 390 nm purple LEDs, under argon atmosphere, rt, 24 h. [b]Isolated yields.

IV. Crystallographic Description:

Crystal data were collected with Bruker Smart Apex-II CCD diffractometer using graphite monochromated MoKα radiation (λ = 0.71073 Å) at 296 K. Cell parameters were retrieved using SMART[a] software and refined with SAINT[a] on all observed reflections. Data reduction was performed with the SAINT software and corrected for Lorentz and polarization effects. Absorption corrections were applied with the program SADABS[b]. The structure was solved by direct methods implemented in SHELX-2014[c] program and refined by full-matrix least-squares methods on F2. All non-hydrogen atomic positions were located in difference Fourier maps and refined anisotropically. The hydrogen atoms were placed in their geometrically generated positions. yellow crystals of **3ca** were isolated from ethyl acetate solvent at room temperature.

a. SMART V 4.043 Software for the CCD Detector System; Siemens Analytical Instruments Division: Madison, WI, 2008.

b. SAINT Plus (v 6.14) Bruker AXS Inc., Madison, WI, 2008.

c. Sheldrick, G. M. SHELXL-2014, Program for the Refinement of Crystal Structures; University of Göttingen: Göttingen (Germany), 1997

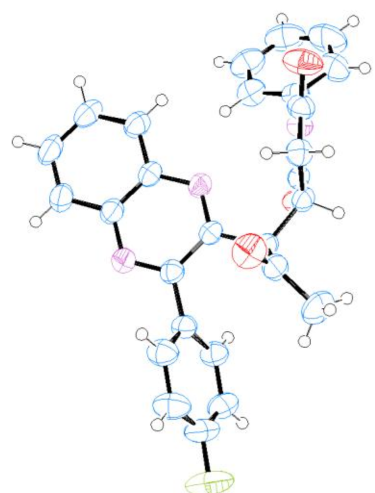


Figure S2. ORTEP diagram of **3ca** with the thermal ellipsoids set at 50% probability.

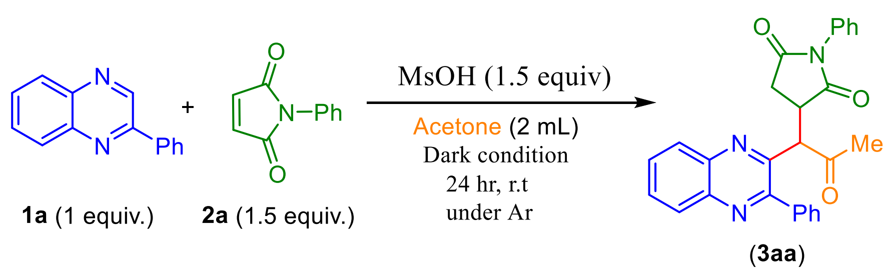
Crystal Data table for 3ca

Empirical formula	$C_{27} H_{20} F N_3 O_3$

CCDC number	2476168
Formula weight	453.46
Temperature	298(2)
Wavelength	0.71073 Å
Crystal system	Triclinic
Space group	P21/c
Unit cell dimensions	a = 9.5015(7) Å, b = 10.5542(8) Å, c = 12.0742(9) Å α= 68.976(2)°, β= 87.437(2)°, γ= 76.468(2)°
Volume	1097.80(14) $Å^3$
Z	2
Density (calculated)	1.372 g/cm^{-3}
Absorption coefficient	0.097
F(000)	472
Theta range for data collection	2.126 to 24.999°
Index ranges	-5 < = h < = 5, -23 < = k < = 23, -19< = l < = 19
Reflections collected	27122
Refinement method	Full-matrix least-squares on FC2
Data / restraints / parameters	3833/ 0/ 309
Goodness-of-fit on F2	0.943
Final R indices [I>2 sigma(I)]	0.171371, wR2 = 0.90370
R indices (all data)	0.050011, wR2 = 0.069754

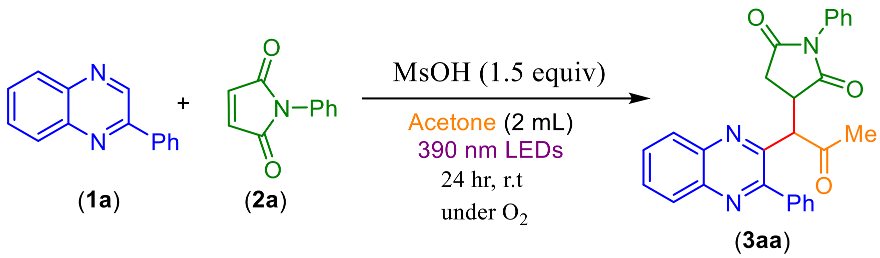
IV. Mechanistic studies:

1. Dark (Absence of Light) Reaction:



An oven-dried 15 mL reaction vial was charged with a magnetic stir bead, 2-phenylquinoxaline (0.25 mmol, 52 mg), *N*-phenyl maleimide (0.375 mmol, 65 mg) and MsOH (0.375 mmol, 36 mg). The glass vial was capped with a rubber septum, followed by evacuation using a vacuum pump through an appropriately fitted needle. Then, acetone (2 mL) was added *via* a syringe to the glass vial under an Ar atmosphere. The glass vial was covered with aluminium foil to prevent light exposure and was subsequently stirred at room temperature under an argon atmosphere for 24 h. The progress of the reaction was monitored *via* TLC. After 24 h, TLC analysis of the reaction mixture indicated no detectable product formation, and both starting materials were recovered unchanged.

2. Reaction in the Presence of Oxygen:



An oven-dried 15 mL reaction vial was charged with a magnetic stir bead, 2-phenylquinoxaline (0.25 mmol, 52 mg), *N*-phenyl maleimide (0.375 mmol, 65 mg) and MsOH (0.375 mmol, 36 mg). The glass vial was capped with a rubber septum, followed by evacuation using a vacuum pump through an appropriately fitted needle. Then, acetone (2 mL) was added *via* a syringe to the glass vial. The reaction mixture was stirred at room temperature in an oxygen atmosphere (using oxygen ballon) for 24 h under the irradiation of purple LEDs ($\lambda_{em}{}^{max}$ = 390 nm, 3 × 9W) approximately at a distance of ~3-4 cm. The progress of the reaction was monitored *via* TLC. After 24 h, TLC analysis of the reaction mixture indicated no detectable product formation, and both starting materials were recovered unchanged.

3. UV-Visible Analysis:

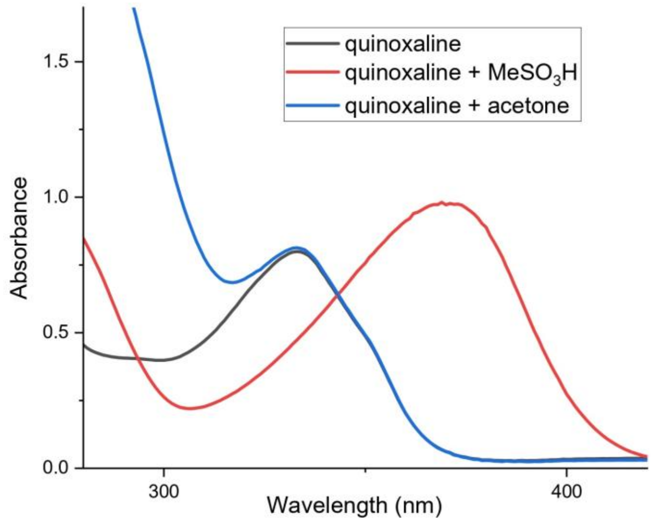


Figure S3. UV-Vis experiment.

4. Radical Quenching and Trapping:

To an oven-dried 10 mL borosilicate glass vial equipped with a magnetic stir bar, 2-phenyl quinoxalines (**1a**) (0.25 mmol, 52 mg), *N*-phenyl maleimide (**2a**) (65 mg 0.5 mmol), MsOH (36 mg, 0.5 mmol) TEMPO (0.5 mmol, 90 mg), or BHT (0.5 mmol, 110.2 mg), or 1,1–DPE (0.5 mmol, 90 mg) were added. The glass vial was capped with a rubber septum, followed by evacuation using a vacuum pump through an appropriately fitted needle. Then, acetone (2 mL) was added *via* a syringe to the glass vial under Ar atmosphere. The reaction mixture was stirred at room temperature in an argon atmosphere for 20-24 h under the irradiation of purple LEDs ($\lambda_{em}{}^{max}$ = 390 nm, 3 × 9 W) approximately at a distance of ~3-4 cm. The progress of the reaction was monitored via TLC. After completion of the reaction, the solvent was removed by rotary evaporation and then the reaction mixture was neutralized with saturated $NaHCO_3$ solution and extracted with ethyl acetate (2 × 10 mL). The organic layer was dried over anhydrous Na_2SO_4 and the solvent was evaporated under reduced pressure. Then the crude residue was then purified by column chromatography over silica gel (60–120 mesh) using hexane and ethyl acetate (3:1) as an eluent to afford the product **3aa** in 00% (for TEMPO), traces for BHT and 12% for 1,1-DPE. These results suggest that the reaction goes through a radical pathway. The corresponding TEMPO and

BHT radical trapped adduct (Shown below Figure S4–S7) have been detected by HRMS analysis of the reaction aliquot.

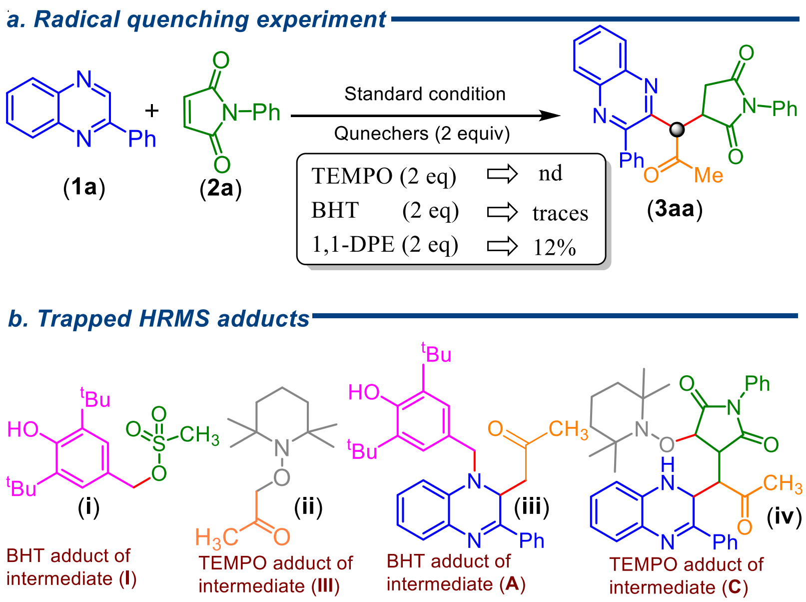


Figure S5. ESI-MS spectrum for BHT adduct of intermediate (**I**).

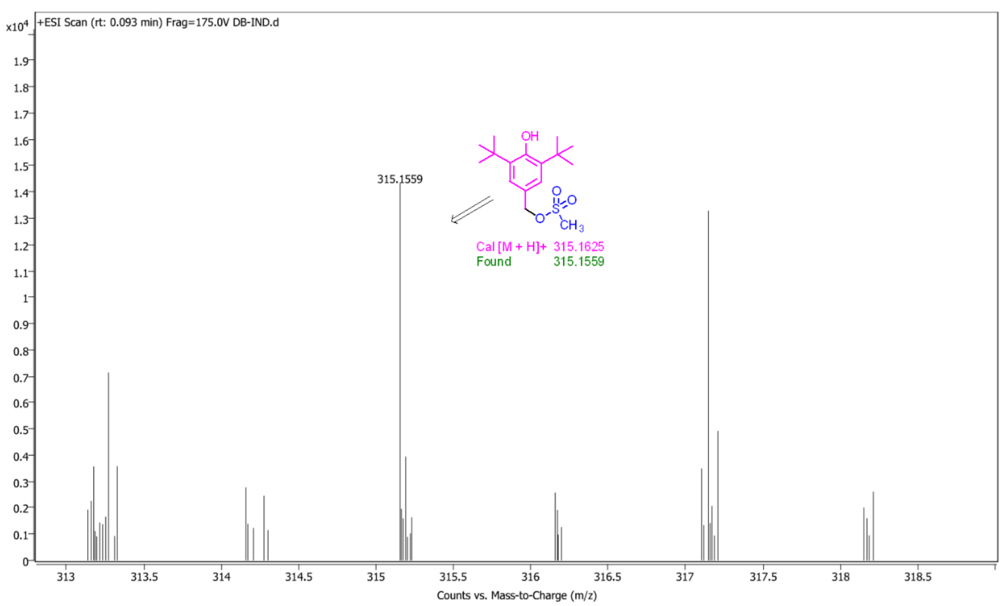


Figure S6. ESI-MS spectrum for BHT adduct of intermediate (**I**).

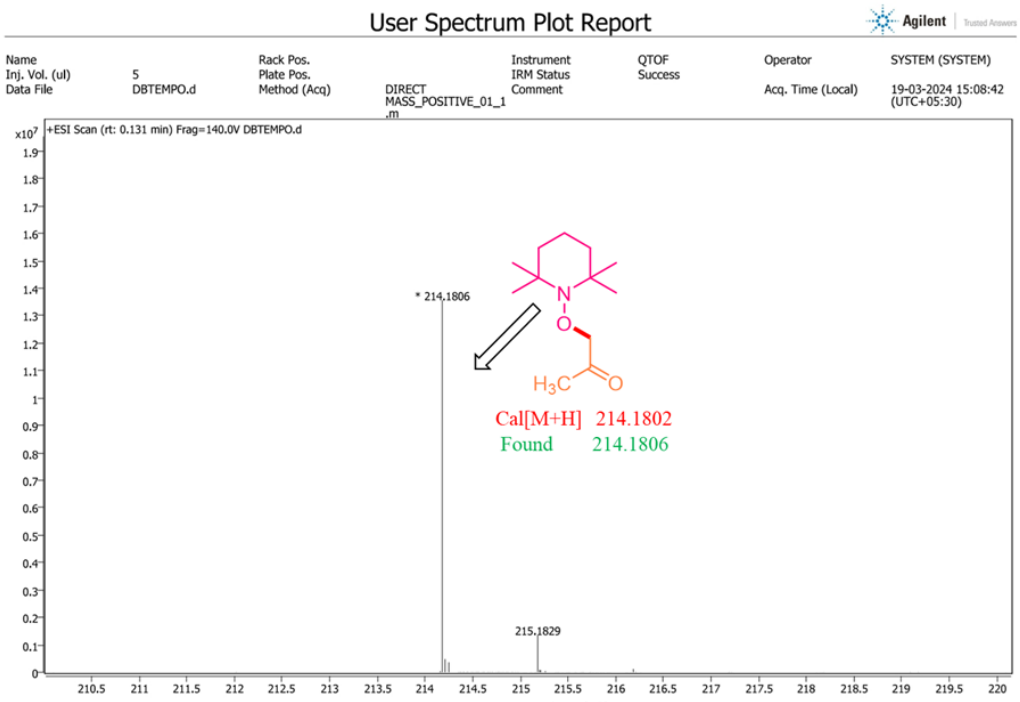


Figure S7. ESI-MS spectrum for TEMPO adduct of intermediate (**III**).

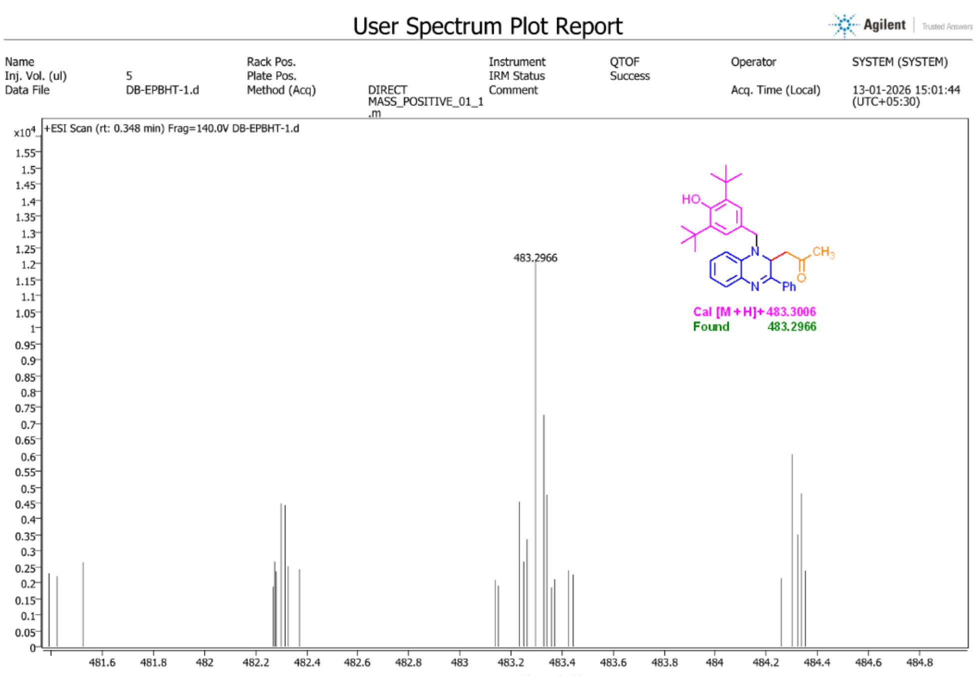


Figure S8. ESI-MS spectrum for BHT adduct of intermediate (**A**).

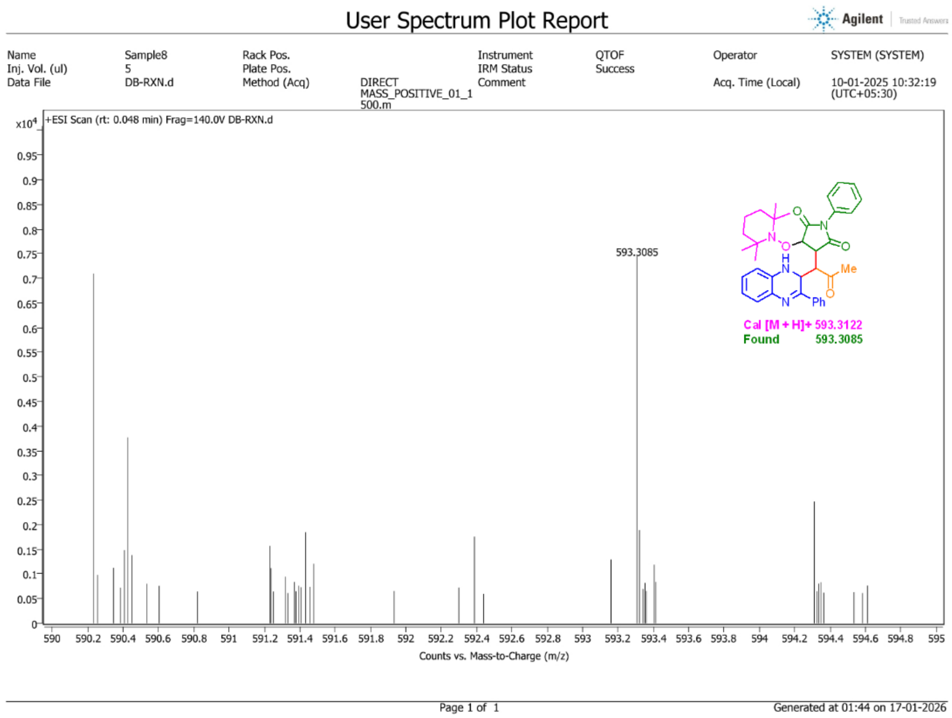
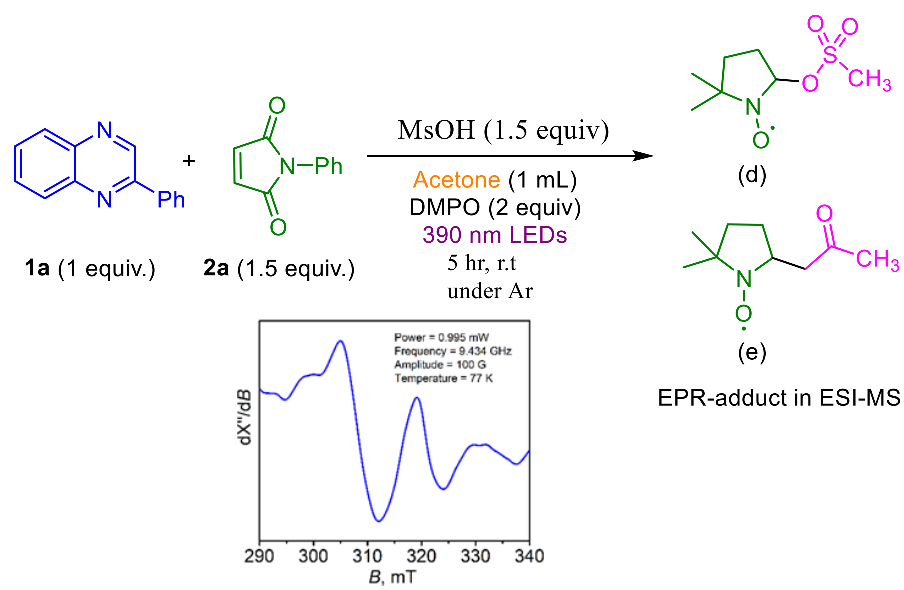


Figure S9. ESI-MS spectrum for TEMPO adduct of intermediate (**C**).

5. Spin Trapping EPR Experiment:

An oven-dried 15 mL reaction vial was charged with a magnetic stir bead, 2-phenylquinoxaline (0.1 mmol, 21 mg), *N*-phenyl maleimide (0.15 mmol, 26 mg), MsOH (0.15 mmol, 15 mg) and 5,5-dimethyl-1-pyrroline *N*-oxide (DMPO) (0.2 mmol, 23 mg). The glass vial was capped with a rubber septum, followed by evacuation using a vacuum pump through an appropriately fitted needle. Then, acetone (1 mL) was added *via* a syringe to the glass vial under Ar atmosphere. The reaction mixture was stirred at room temperature in an argon atmosphere under the irradiation of purple LEDs ($\lambda_{em}{}^{max}$ = 390 nm, 3 × 9 W) approximately at a distance of ~3-4 cm. Now, after 5 hour a small portion of the reaction aliquots was collected and electron paramagnetic resonance (EPR) was recorded at low temperature (Liquid N_2). The observed EPR signal supports the formation of the radical intermediate in this photochemical reaction. Furthermore, the EPR adduct was also detected by ESI-MS analysis of the reaction aliquot (Figure S8-S9).



EPR Spectrum

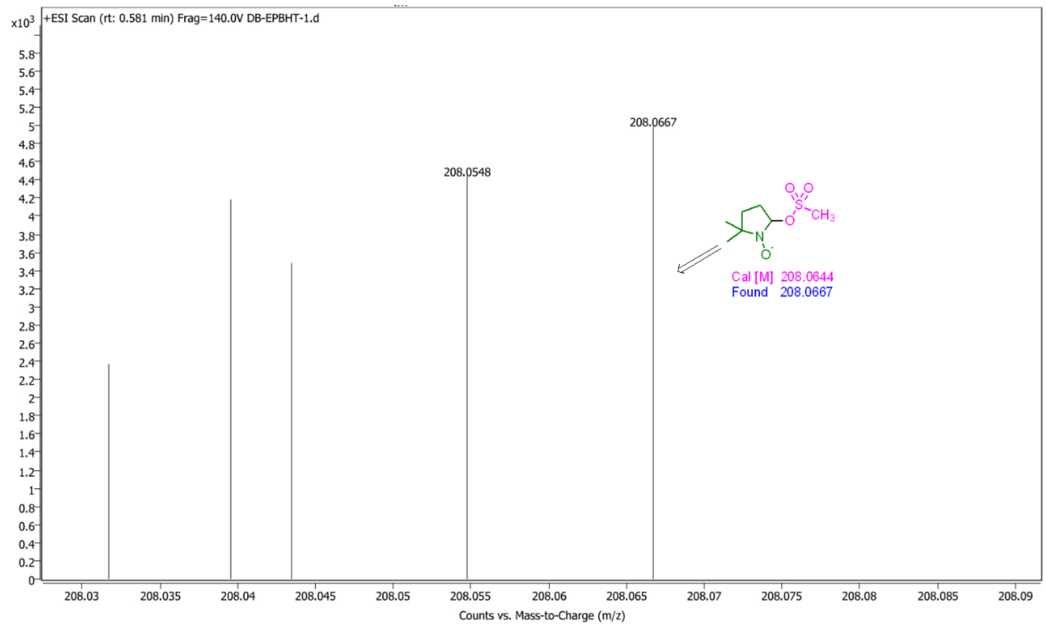


Figure S10. ESI-MS spectrum for EPR adduct of intermediate (**I**).

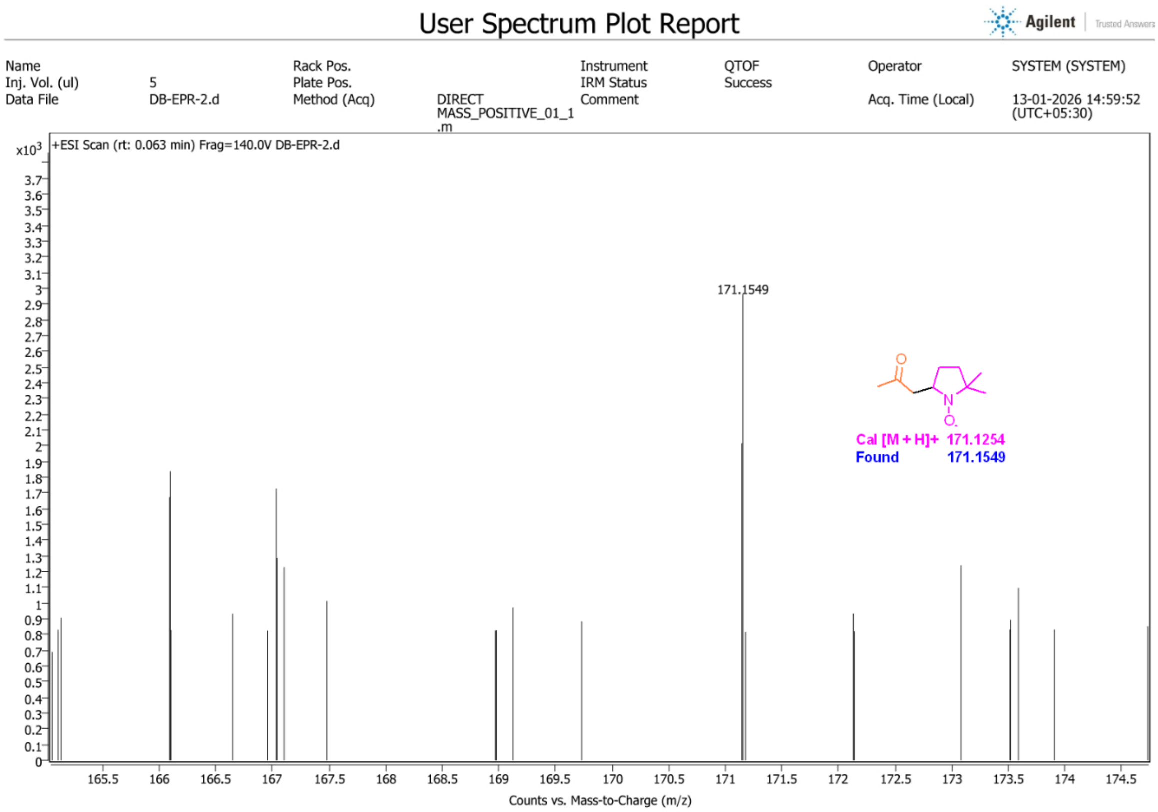
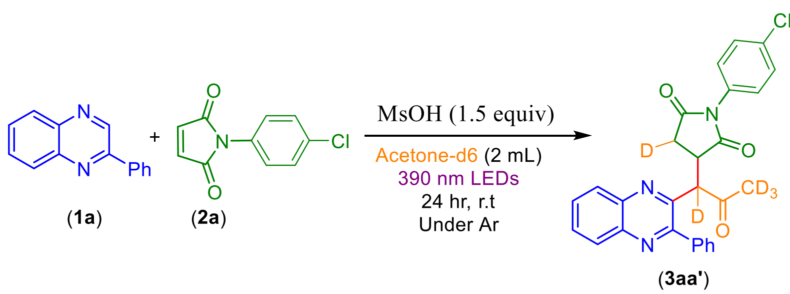


Figure S11. ESI-MS spectrum for EPR adduct of intermediate (**III**).

6. Isotope labelling experiment

An oven-dried 15 mL reaction vial was charged with a magnetic stir bead, 2-phenylquinoxaline (0.25 mmol, 52 mg), *N*-phenyl maleimide (0.375 mmol, 65 mg) and MsOH (0.375 mmol, 36 mg). The glass vial was capped with a rubber septum, followed by evacuation using a vacuum pump through an appropriately fitted needle. Then, acetone-d6 (2 mL) was added *via* a syringe to the glass vial under Ar atmosphere. The reaction mixture was stirred at room temperature in an argon atmosphere for 24 h under the irradiation of purple LEDs ($\lambda_{em}{}^{max}$ = 390 nm, 3 × 9 W) approximately at a distance of ~3-4 cm. The progress of the reaction was monitored *via* TLC. After completion of the reaction, the solvent was removed by rotary evaporation and then the reaction mixture was neutralized with saturated $NaHCO_3$ solution and extracted with ethyl acetate (2 x 10 mL). The organic layer was dried over anhydrous Na_2SO_4 and was evaporated under reduced pressure. Then the crude mixture was purified over column chromatography (60–120 mesh silica) by eluting it with hexane/EtOAc (3:1) mixtures to afford the desired product **3aa'**.



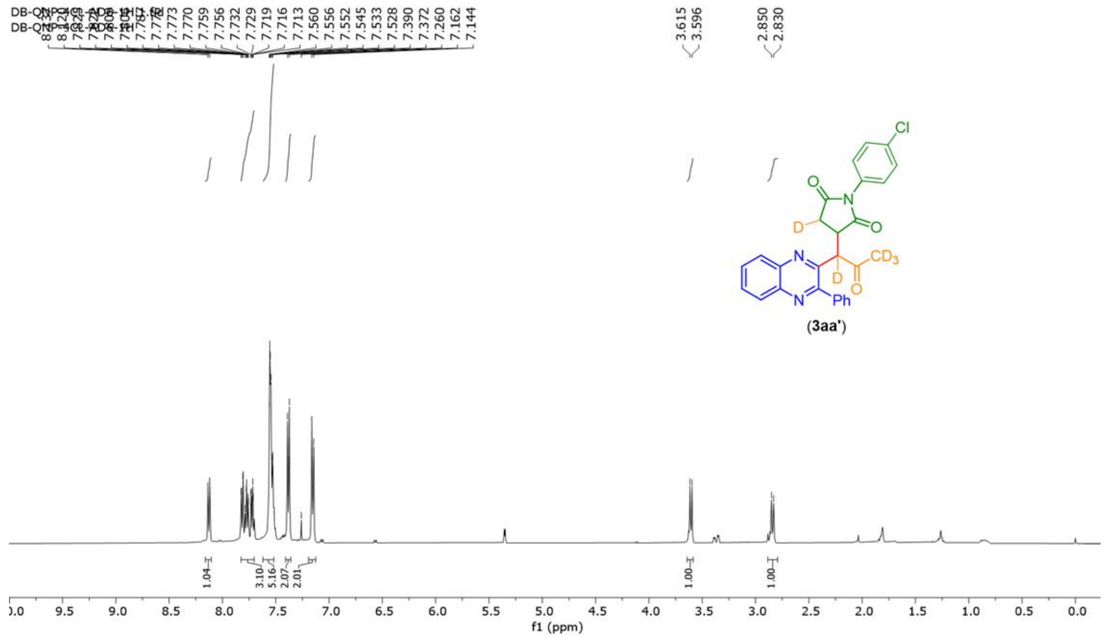


Figure S12. ^{1}H NMR spectrum of **3aa'**.

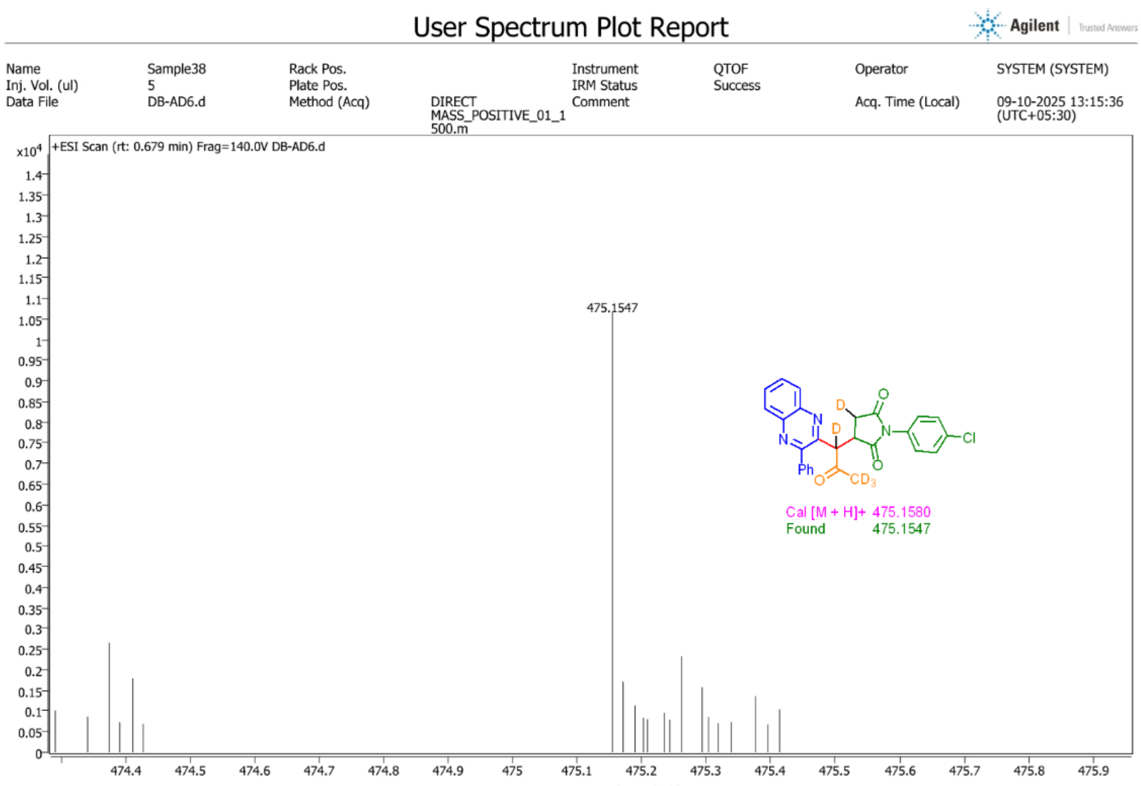
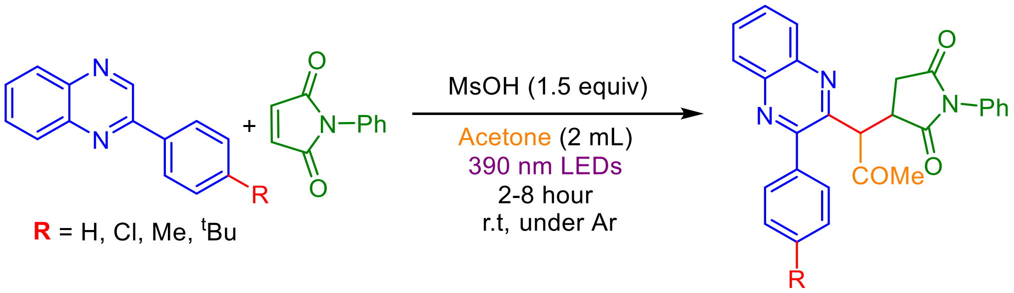


Figure S13. ESI-MS spectrum of **3aa'**.

7. Kinetic Hammett studies

An oven-dried 15 mL reaction vial was charged with a magnetic stir bead, *para*-substituted 2-phenylquinoxaline (0.25 mmol, 52 mg), *N*-phenyl maleimide (0.375 mmol, 65 mg) and MsOH (0.375 mmol, 36 mg). The glass vial was capped with a rubber septum, followed by evacuation using a vacuum pump through an appropriately fitted needle. Then, acetone (2 mL) was added *via* a syringe to the glass vial under Ar atmosphere. The reaction mixture was stirred at room temperature in an argon atmosphere under the irradiation of purple LEDs ($\lambda_{em}{}^{max}$ = 390 nm, 3 × 9 W) approximately at a distance of ~3–4 cm. Reaction yields were determined by ^{1}H-NMR spectroscopy using methanesulfonic acid as an internal standard. The conversion of para-substituted 2-phenylquinoxaline was monitored at different time intervals, and plots of ln(a/(a−x)) versus time (h) were used to obtain rate constants from the slopes.



Substrate	k × 10^{-3} (hour^{-1})	k_X/k_H	log (k_X/k_H)	σ_p	*P*
p-ᵗBu	85.5	1.51	+0.18	-0.20	-0.97
p-Me	79.5	1.40	+0.15	-0.17	
H	56.5	1	0	0	
P-Cl	32	0.57	-0.24	0.23	

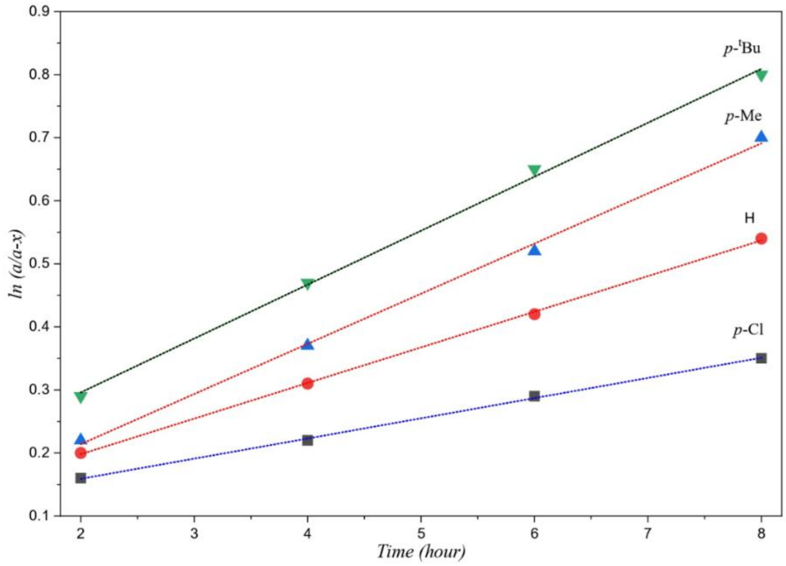


Figure S14. ln(a/a-x) vs time (hour) plot for different substrates.

The individual rate constants (log k_X/k_H) were then plotted against the substituent constants (σ) and a Hammett correlation with a negative slope was obtained (ρ = -0.97, R^2 = 0.9983). The negative ρ^+ value indicates the development of an electron-deficient transition state in the rate determining step, which is stabilized by the electron-donating substituents on the aromatic ring.

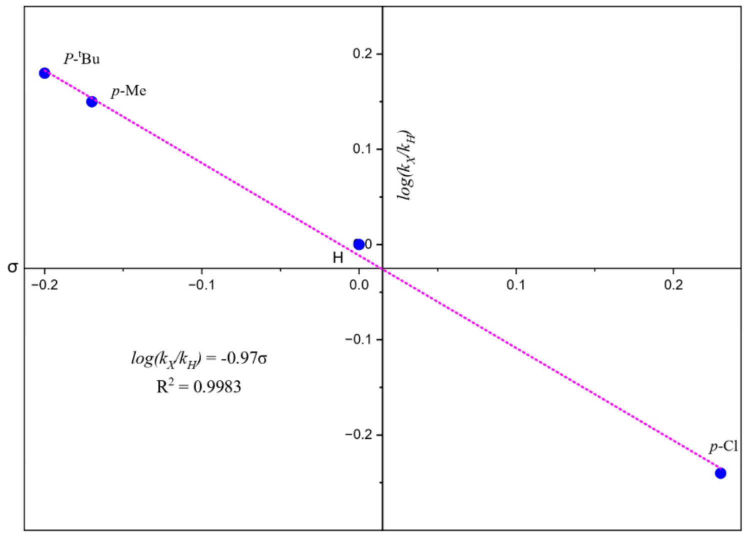
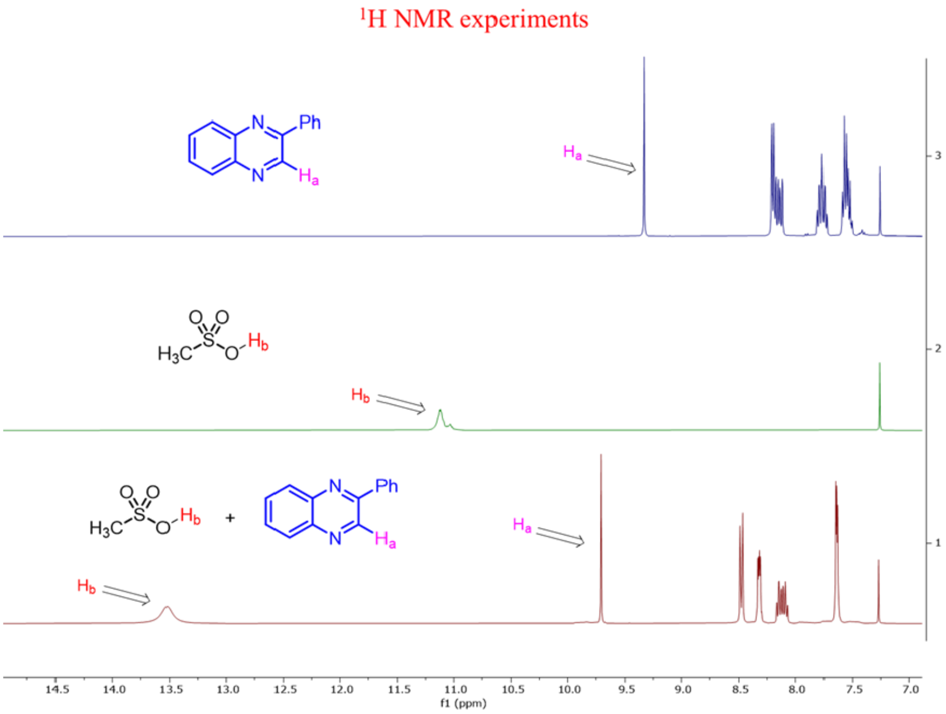


Figure S15. Hammett plot

g. ^{1}H NMR analysis



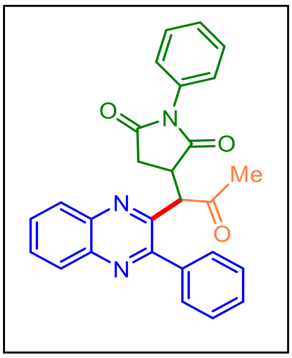
S16. ^{1}H NMR analysis

V. **References**:

1. K. Kumar, S. R. Mudshinge, Goyal, S.; Gangar, M.; Nair, V. A, *Tetrahedron Letters*., 2015, **56**, 1266.
2. Mandal, R.; Emayavaramban, B.; Sundararaju, B, *Org. Lett.*, 2018, **20**, 2835.
3. Lassagne, F.; Chevallier, F.; Roisnel, T.; Dorcet, V.; Mongin, F.; Domingo, L. R, *Synthesis.*, 2015, **47**, 2680.

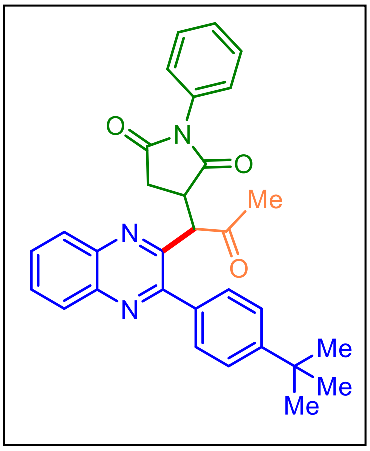
VI. Spectral Data:

3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)propyl)-1-phenylpyrrolidine-2,5-dione (3aa):



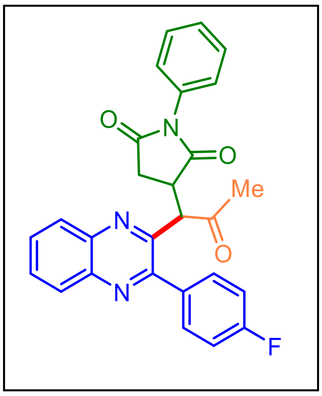
A pale brown solid (78 mg, 72% yield); mp 172–174 °C; purified over a column of silica gel (25% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.13 (d, J = 8.0 Hz, 1H), 7.88 (d, J = 8.0 Hz, 1H), 7.80–7.71 (m, 2H), 7.58–7.52 (m, 5H), 7.44–7.37 (m, 3H), 7.20–7.17 (m, 2H), 5.37 (d, J = 4.8 Hz, 1H), 3.67–3.62 (m, 1H), 3.41 (dd, J = 18.2, 5.0 Hz, 1H), 2.87 (dd, J = 18.2, 9.8 Hz, 1H), 1.87 (s, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): δ 205.2, 177.6, 176.2, 155.5, 150.4, 141.2, 140.3, 138.1, 132.3, 130.7, 130.5, 129.5, 129.3, 129.2, 128.9, 128.7, 126.5, 56.2, 40.2, 32.3, 29.5; IR (neat, cm^{-1}): 2926, 1706, 1598, 1500, 1386, 1182, 1087, 762, 739, 695; HRMS (ESI-TOF) calcd for $C_{27}H_{22}N_3O_3$ [M + H]$^+$ 436.1656, found 436.1657.

3-(1-(3-(4-(Tert-butyl)phenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3ba):



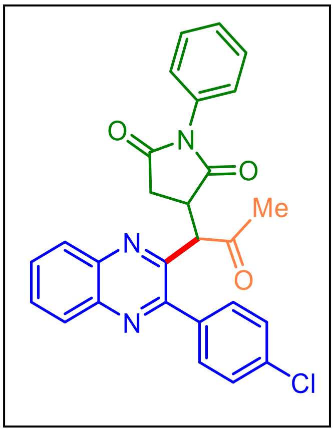
A brown solid (87 mg, 71% yield); mp 209–211 °C; purified over a column of silica gel (22% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.12 (d, J = 8.4 Hz, 1H), 7.87 (d, J = 8.4 Hz, 1H), 7.78–7.69 (m, 2H), 7.56 (d, J = 8.4 Hz, 2H), 7.50 (d, J = 8.0 Hz, 2H), 7.44–7.34 (m, 3H), 7.19 (d, J = 7.2 Hz, 2H), 5.39 (d, J = 4.4 Hz, 1H), 3.66–3.61 (m, 1H), 3.41 (dd, J = 18.2, 5.0 Hz, 1H), 2.87 (dd, J = 18.4, 10.0 Hz, 1H), 1.84 (s, 3H), 1.38 (s, 9H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): δ 205.3, 177.6, 176.2, 155.6, 152.8, 150.6, 141.3, 140.2, 135.1, 132.3, 130.6, 130.4, 129.4, 129.3, 129.0, 128.8, 128.7, 126.5, 126.1, 56.1, 40.2, 34.9, 32.3, 31.4, 29.4; IR (neat, cm^{-1}): 2962, 1708, 1598, 1500, 1384, 1364, 1181, 762, 735, 693; HRMS (ESI-TOF) calcd for $C_{31}H_{30}N_3O_3$ [M + H]$^+$ 492.2282, found 492.2281.

3-(1-(3-(4-Fluorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3ca):



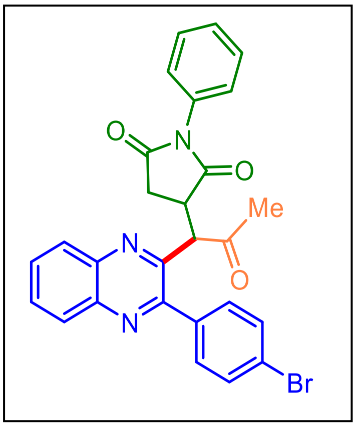
A pale brown solid (70 mg, 62% yield); mp 173–175 °C; purified over a column of silica gel (25% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 500 MHz): δ 8.12 (d, J = 8.0 Hz, 1H), 7.89 (d, J = 8.5 Hz, 1H), 7.81–7.73 (m, 2H), 7.60–7.57 (m, 2H), 7.43–7.36 (m, 3H), 7.27–7.23 (m, 2H), 7.16 (d, J = 7.5 Hz, 2H), 5.31 (d, J = 5.0 Hz, 1H), 3.71–3.67 (m, 1H), 3.42 (dd, J = 18.0, 5.0 Hz, 1H), 2.92 (dd, J = 18.3, 9.8 Hz, 1H), 1.95 (s, 3H); $^{13}C\{^{1}H\}$ NMR ($CDCl_3$, 126 MHz): δ 204.9, 177.6, 176.1, 163.5 (d, J = 250.7 Hz), 154.5, 150.3, 141.2, 140.3, 134.2 (d, J = 3.5 Hz), 132.2, 131.4 (d, J = 8.3 Hz), 130.9, 130.7, 129.4, 129.3, 128.8 (d, J = 12.8 Hz), 126.5, 116.4, 116.2, 56.2, 40.4, 32.4, 29.5; ^{19}F NMR ($CDCl_3$) δ -111.1 (s); IR (neat, cm^{-1}): 2924, 1711, 1597, 1387, 1182, 1082, 1227, 1185, 764, 696; HRMS (ESI-TOF) calcd for $C_{27}H_{21}FN_3O_3$ $[M + H]^+$ 454.1561, found 454.1560.

3-(1-(3-(4-Chlorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3da):



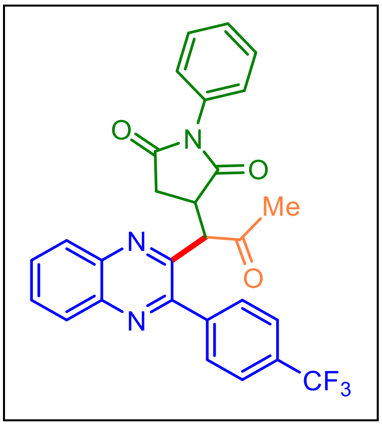
A pale orange solid (74 mg, 63% yield); mp 176–178 °C; purified over a column of silica gel (25% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.12 (d, J = 8.4 Hz, 1H), 7.89 (d, J = 8.0 Hz, 1H), 7.80–7.74 (m, 2H), 7.59–7.52 (m, 4H), 7.43–7.36 (m, 3H), 7.15 (d, J = 8.4 Hz, 2H), 5.29 (d, J = 4.8 Hz, 1H), 3.72–3.68 (m, 1H), 3.41 (dd, J = 18.2, 5.0 Hz, 1H), 2.92 (dd, J = 18.2, 9.8 Hz, 1H), 1.97 (s, 3H); $^{13}C\ \{^{1}H\}$ NMR ($CDCl_3$, 126 MHz): δ 204.9, 177.6, 176.1, 154.3, 150.1, 141.2, 140.3, 136.6, 135.9, 132.2, 130.9, 130.8, 130.7, 129.5, 129.4, 129.3, 128.9, 128.8, 126.5, 56.2, 40.4, 32.4, 29.5; IR (neat, cm^{-1}): 2924, 1706, 1596, 1494, 1385, 1181, 1092, 762, 737, 694; HRMS (ESI-TOF) calcd for $C_{27}H_{21}ClN_3O_3$ $[M + H]^+$ 470.1266, found 470.1273.

3-(1-(3-(4-Bromophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3ea):



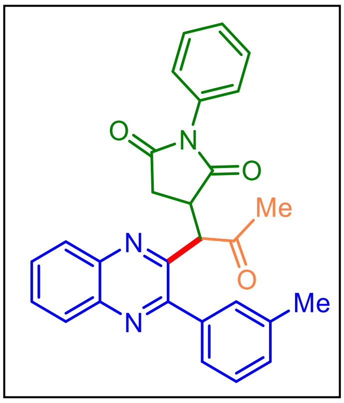
A pale yellow solid (86 mg, 67% yield); mp 172–174 °C; purified over a column of silica gel (24% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.11 (d, J = 8.0 Hz, 1H), 7.89 (d, J = 8.0 Hz, 1H), 7.81–7.72 (m, 2H), 7.71–7.68 (m, 2H), 7.49–7.46 (m, 2H), 7.43–7.36 (m, 3H), 7.15–7.13 (m, 2H), 5.29 (d, J = 4.8 Hz, 1H), 3.73–3.68 (m, 1H), 3.42 (dd, J = 18.4, 4.8 Hz, 1H), 2.92 (dd, J = 18.2, 9.8 Hz, 1H), 1.97 (s, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): δ 204.8, 177.5, 176.1, 154.4, 150.1, 141.2, 140.4, 137.1, 132.3, 132.2, 131.0, 130.9, 130.8, 129.5, 129.3, 128.9, 128.8, 126.5, 124.1, 56.2, 40.4, 32.5, 29.5; IR (neat, cm^{-1}): 2925, 1707, 1591, 1500, 1387, 1182, 1070, 762, 739, 694; HRMS (ESI-TOF) calcd for $C_{27}H_{21}BrN_3O_3$ [M + H]$^+$ 514.0761, found 514.0758.

3-(2-Oxo-1-(3-(4-(trifluoromethyl)phenyl)quinoxalin-2-yl)propyl)-1-phenylpyrrolidine-2,5-dione (3fa):



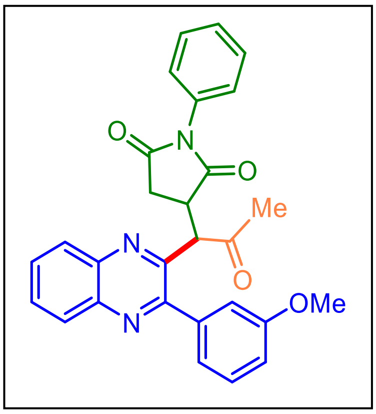
A pale yellow solid (65 mg, 52% yield); mp 143–145 °C; purified over a column of silica gel (25% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.13 (d, J = 8.4 Hz, 1H), 7.91 (d, J = 8.4 Hz, 1H), 7.83–7.72 (m, 6H), 7.43–7.36 (m, 3H), 7.14 (d, J = 6.8 Hz, 2H), 5.26 (d, J = 4.8 Hz, 1H), 3.74–3.70 (m, 1H), 3.42 (dd, J = 18.4, 4.8 Hz, 1H), 2.94 (dd, J = 18.4, 10.0 Hz, 1H), 1.94 (s, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 101 MHz): δ 204.8, 177.5, 176.0, 154.0, 149.8, 141.7, 141.1, 140.4, 132.1, 131.1, 131.0, 129.8, 129.5, 129.4, 128.9, 128.8, 126.4, 126.1, 56.2, 40.3, 32.4, 29.3; ^{19}F NMR ($CDCl_3$) δ -62.8 (s); IR (neat, cm^{-1}):2927, 1707, 1500, 1385, 1321, 1166, 1066, 761, 737, 694; HRMS (ESI-TOF) calcd for $C_{28}H_{21}F_3N_3O_3$ [M + H]$^+$ 504.1530, found 504.1544.

3-(2-Oxo-1-(3-(m-tolyl)quinoxalin-2-yl)propyl)-1-phenylpyrrolidine-2,5-dione (3ga):



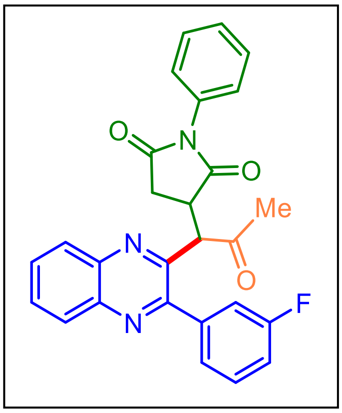
A brown solid (70 mg, 62% yield); mp 170–172 °C; purified over a column of silica gel (23% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 500 MHz): δ 8.13 (d, J = 8.5 Hz, 1H), 7.88 (d, J = 7.5 Hz, 1H), 7.79–7.76 (m, 1H), 7.74–7.71 (m, 1H), 7.44–7.41 (m, 3H), 7.38–7.32 (m, 4H), 7.19 (d, J = 9.0 Hz, 2H), 5.37 (d, J = 4.5 Hz, 1H), 3.67–3.63 (m, 1H), 3.41 (dd, J = 18.5, 5.0 Hz, 1H), 2.88 (dd, J = 18.3, 9.8 Hz, 1H), 2.45 (s, 3H), 1.89 (s, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): δ 205.3, 177.6, 176.3, 155.6, 150.4, 141.2, 140.2, 139.1, 138.0, 132.3, 130.7, 130.5, 130.2, 129.9, 129.4, 129.3, 129.0, 128.9, 128.7, 126.5, 126.2, 56.2, 40.2, 32.3, 29.5, 21.6; IR (neat, cm^{-1}): 2923, 1707, 1598, 1499, 1385, 1184, 1087, 761, 738, 694; HRMS (ESI-TOF) calcd for $C_{28}H_{24}N_3O_3$ $[M + H]^+$ 450.1812, found 450.1808.

3-(1-(3-(3-Methoxyphenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3ha):



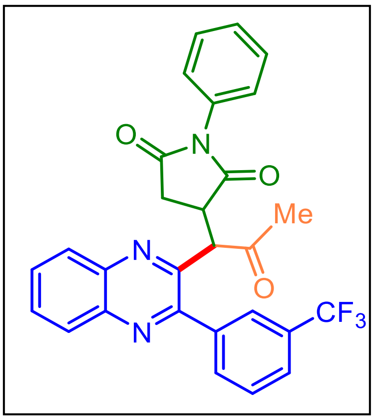
A brown solid (71 mg, 61% yield); mp 136–138 °C; purified over a column of silica gel (25% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.13 (d, J = 8.4 Hz, 1H), 7.89 (d, J = 8.4 Hz, 1H), 7.80–7.71 (m, 2H), 7.47–7.36 (m, 5H), 7.18–7.13 (m, 2H), 7.09 (s, 1H), 7.06 (d, J = 8.4 Hz, 1H), 5.37 (d, J = 4.8 Hz, 1H), 3.86 (s, 3H), 3.69–3.64 (m, 1H), 3.43 (dd, J = 18.4, 4.8 Hz, 1H), 2.90 (dd, J = 18.2, 9.8 Hz, 1H), 1.94 (s, 3H); ^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) δ 205.1, 177.6, 176.2, 160.1, 155.2, 150.4, 141.2, 140.3, 139.3, 132.3, 130.8, 130.6, 130.3, 129.5, 129.3, 128.9, 128.7, 126.5, 121.4, 115.6, 114.6, 56.1, 55.6, 40.4, 32.4, 29.6; IR (neat, cm^{-1}): 2927, 1711, 1599, 1500, 1387, 1259, 1184, 1026, 763, 695; HRMS (ESI-TOF) calcd for $C_{28}H_{24}N_3O_4$ $[M + H]^+$ 466.1761, found 466.1778.

3-(1-(3-(3-Fluorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3ia):



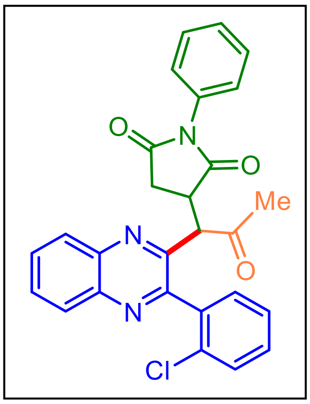
A pale yellow solid (67 mg, 59% yield); mp 167–169 °C; purified over a column of silica gel (25% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 500 MHz): δ 8.12 (d, J = 8.5 Hz, 1H), 7.89 (d, J = 8.0 Hz, 1H), 7.82–7.74 (m, 2H), 7.55 – 7.51 (m, 1H), 7.43–7.35 (m, 5H), 7.32 (d, J = 9.5 Hz, 1H), 7.16 (d, J = 7.5 Hz, 2H), 5.33 (d, J = 4.5 Hz, 1H), 3.72–3.68 (m, 1H), 3.42 (dd, J = 18.0, 5.0 Hz, 1H), 2.92 (dd, J = 18.2, 9.7 Hz, 1H), 1.97 (s, 3H); ^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) δ 204.9, 177.5, 176.1, 150.0, 141.2, 140.4, 132.2, 130.9 (d, J = 3.3 Hz), 129.4 (d, 17.6 Hz), 128.91, 128.79, 126.74, 126.47, 125.06, 116.7 (d, J = 8.8 Hz), 116.59, 116.53, 56.18, 40.36, 32.39, 29.47; ^{19}F NMR ($CDCl_3$) δ -111.0 (s); IR (neat, cm^{-1}): 3064, 1708, 1617, 1495, 1385, 1183, 1019, 762, 696, 620; HRMS (ESI-TOF) calcd for $C_{27}H_{21}FN_3O_3$ [M + H]$^+$ 454.1561, found 454.1564.

3-(2-Oxo-1-(3-(3-(trifluoromethyl)phenyl)quinoxalin-2-yl)propyl)-1-phenylpyrrolidine-2,5-dione (3ja):



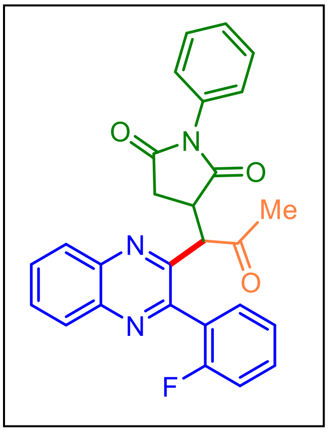
A light brown solid (57 mg, 45% yield); mp 170–172 °C; purified over a column of silica gel (26% EtOAc in hexane); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, J = 10.0 Hz, 1H), 7.86–7.83 (m, 2H), 7.82–7.78 (m, 3H), 7.70 (d, J = 8.0 Hz, 1H), 7.49–7.45 (m, 1H), 7.43–7.36 (m, 2H), 7.32 (d, J = 7.1 Hz, 1H), 7.15 (d, J = 6.8 Hz, 2H), 5.23 (d, J = 4.7 Hz, 1H), 3.73-3.68 (m, 1H), 3.41 (dd, J = 18.2, 5.0 Hz, 1H), 2.98–2.84 (m, 1H), 1.95 (s, 3H);; ^{13}C {^{1}H} (126 MHz, $CDCl_3$) δ 204.8, 177.4, 176.0, 153.9, 149.9, 141.2, 140.5, 139.0, 132.8, 132.2, 132.0, 131.3, 131.1 (d, J = 2.5 Hz), 129.7, 129.5, 129.3, 128.9 (d, J = 13.9 Hz), 126.7, 126.4, 56.3, 40.4, 32.4, 29.3; ^{19}F NMR ($CDCl_3$) δ -62.6 (s); IR (neat, cm^{-1}): 2930, 1710, 1499, 1387, 1323, 1171, 1127, 1068, 763, 696; HRMS (ESI-TOF) calcd for $C_{28}H_{21}F_3N_3O_3$ [M + H]$^+$ 504.1530, found 504.1511.

3-(1-(3-(2-Chlorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3ka):



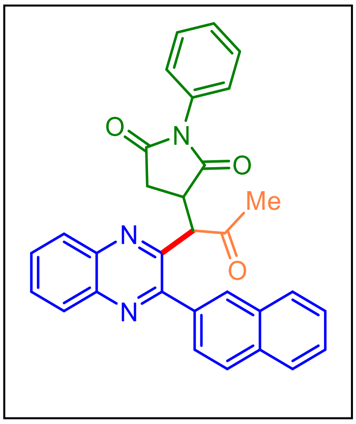
A pale yellow solid (76 mg, 65% yield); mp 208–210 °C; purified over a column of silica gel (20% EtOAc in hexane); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, J = 8.0 Hz, 1H), 7.91 (d, J = 8.0 Hz, 1H), 7.83–7.73 (m, 2H), 7.56 (d, J = 8.8 Hz, 1H), 7.49–7.43 (m, 4H), 7.41–7.36 (m, 1H), 7.30 (d, J = 7.6 Hz, 3H), 5.14 (d, J = 4.8 Hz, 1H), 3.71–3.64 (m, 1H), 3.28 (dd, J = 17.8, 5.8 Hz, 1H), 2.93–2.81 (m, 1H), 1.80 (s, 3H);^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) δ 205.5, 176.9, 176.0, 153.3, 150.6, 141.2, 140.5, 136.7, 133.0, 132.58, 132.42, 132.19, 131.03, 130.92, 130.88, 130.83, 130.64, 129.9, 129.5, 129.3, 129.0, 128.6, 127.7, 126.5, 56.3, 39.8, 32.1, 29.4; IR (neat, cm^{-1}): 2930, 1699, 1599, 1495, 1450, 1323, 1157, 1093, 814, 661; HRMS (ESI-TOF) calcd for $C_{27}H_{21}ClN_3O_3$ $[M + H]^+$ 470.1266, found 470.1263.

3-(1-(3-(2-Fluorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3la):



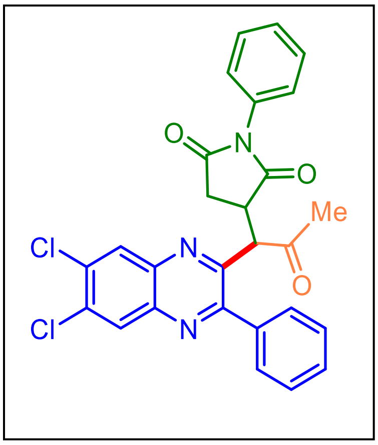
A pale orange solid (69 mg, 61% yield); mp 210–212 °C; purified over a column of silica gel (26% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.14 (d, J = 8.0 Hz, 1H), 7.93 (d, J = 7.6 Hz, 1H), 7.82–7.74 (m, 2H), 7.55–7.28 (m, 7H), 7.24–7.19 (m, 2H), 5.16 (d, J = 4.8 Hz, 1H), 3.76–3.71 (m, 1H), 3.27 (dd, J = 18.2, 5.4 Hz, 1H), 2.89 (dd, J = 18.2, 9.8 Hz, 1H), 1.92 (s, 3H); ^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) δ 204.9, 177.2, 176.0, 150.0, 141.2, 140.1, 132.2, 130.9 (d, J = 3.3 Hz), 129.4 (d, J = 17.6 Hz), 128.9, 128.8, 126.7, 126.5, 125.1, 116.7 (d, J = 8.8 Hz), 116.6 (d, J = 7.6 Hz), 56.2, 40.4, 32.4, 29.5; ^{19}F NMR ($CDCl_3$) δ -113.6 (s); IR (neat, cm^{-1}):2926, 1706, 1499, 1384, 1365, 1181, 760, 736, 694, 675; HRMS (ESI-TOF) calcd for $C_{27}H_{21}FN_3O_3$ $[M + H]^+$ 454.1561, found 454.1560.

3-(1-(3-(Naphthalen-2-yl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3ma):



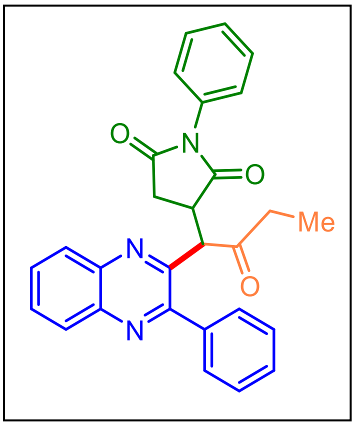
A brown solid (90 mg, 74% yield); mp 178–180 °C; purified over a column of silica gel (20% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.16 (d, J = 8.0 Hz, 1H), 8.08 (s, 1H), 8.03 (d, J = 8.4 Hz, 1H), 7.95–7.90 (m, 3H), 7.82–7.74 (m, 2H), 7.68 (d, J = 8.4 Hz, 1H), 7.60–7.57 (m, 2H), 7.45–7.37 (m, 3H), 7.19 (d, J = 8.4 Hz, 2H), 5.44 (d, J = 4.8 Hz, 1H), 3.70–3.65 (m, 1H), 3.44 (dd, J = 18.4, 4.8 Hz, 1H), 2.90 (dd, J = 18.2, 9.8 Hz, 1H), 1.79 (s, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): δ 205.1, 177.7, 176.2, 155.4, 150.5, 141.3, 140.3, 135.4, 133.4, 133.1, 132.3, 130.8, 130.6, 129.5, 129.4, 129.1, 129.0, 128.9, 128.8, 128.6, 128.0, 127.4, 127.1, 126.5, 126.3, 56.3, 40.3, 32.4, 29.5; IR (neat, cm^{-1}): 2926, 1707, 1598, 1500, 1385, 1184, 825, 756, 694, 622; HRMS (ESI-TOF) calcd for $C_{31}H_{24}N_3O_3$ $[M + H]^+$ 486.1812, found 486.1806.

3-(1-(6,7-Dichloro-3-phenylquinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3na):



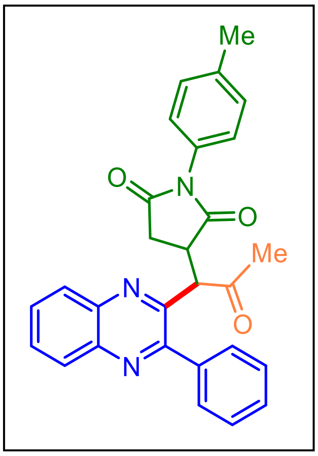
A pale orange solid (69 mg, 55% yield); mp 190–192 °C; purified over a column of silica gel (25% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.24 (s, 1H), 7.99 (s, 1H), 7.57–7.53 (m, 5H), 7.48–7.39 (m, 3H), 7.20 (d, J = 7.6 Hz, 2H), 5.35 (d, J = 4.8 Hz, 1H), 3.67–3.62 (m, 1H), 3.32 (dd, J = 18.4, 5.2 Hz, 1H), 2.87 (dd, J = 18.4, 10.0 Hz, 1H), 1.87 (s, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 101 MHz): δ 204.8, 177.3, 175.9, 156.5, 151.8, 140.0, 138.9, 137.4, 135.4, 135.3, 132.1, 130.1, 129.8, 129.4, 129.2, 129.1, 128.9, 126.3, 56.2, 40.0, 32.1, 29.4; IR (neat, cm^{-1}): 2927, 1710, 1599, 1495, 1385, 1179, 1091, 763, 738, 694; HRMS (ESI-TOF) calcd for $C_{27}H_{20}Cl_2N_3O_3$ $[M + H]^+$ 504.0876, found 504.0854.

3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)butyl)-1-phenylpyrrolidine-2,5-dione (4aa):



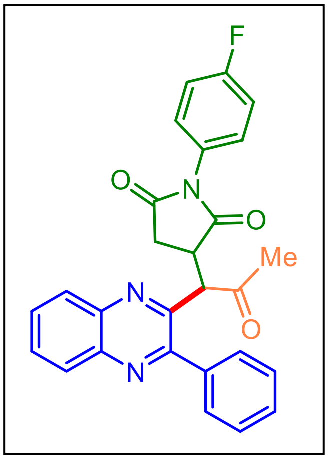
A pale orange solid (64 mg, 57% yield); mp 192–194 °C; purified over a column of silica gel (20% EtOAc in hexane); ^1H NMR ($CDCl_3$, 500 MHz): δ 8.12 (d, J = 8.5 Hz, 1H), 7.87 (d, J = 8.0 Hz, 1H), 7.78–7.75 (m, 1H), 7.73–7.70 (m, 1H), 7.55–7.50 (m, 5H), 7.43–7.40 (m, 2H), 7.38–7.35 (m, 1H), 7.20 (d, J = 7.5 Hz, 2H), 5.33 (d, J = 5.0 Hz, 1H), 3.61–3.57 (m, 1H), 3.41 (dd, J = 18.0, 5.0 Hz, 1H), 2.83 (dd, J = 18.2, 9.7 Hz, 1H), 2.39–2.31 (m, 1H), 1.82–1.74 (m, 1H), 0.79 (t, J = 7.2 Hz, 3H); ^{13}C {^1H} NMR ($CDCl_3$, 126 MHz): δ 207.9, 177.7, 176.2, 155.4, 150.5, 141.1, 140.2, 138.2, 132.3, 130.6, 130.5, 129.5, 129.4, 129.3, 129.2, 129.0, 128.8, 128.7, 126.5, 55.5, 40.4, 35.6, 32.3, 7.5; IR (neat, cm^{-1}): 2937, 1709, 1598, 1500, 1386, 1180, 1090, 1014, 763, 699; HRMS (ESI-TOF) calcd for $C_{28}H_{24}N_3O_3$ $[M + H]^+$ 450.1812, found 450.1811.

3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)propyl)-1-(p-tolyl)pyrrolidine-2,5-dione (3ab):



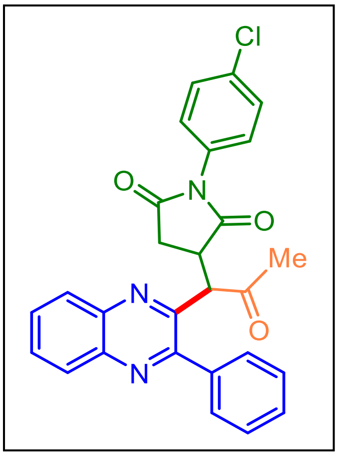
A pale orange solid (82 mg, 73% yield); mp 190–192 °C; purified over a column of silica gel (25% EtOAc in hexane); ^1H NMR ($CDCl_3$, 400 MHz): δ 8.12 (d, J = 8.0 Hz, 1H), 7.89 (d, J = 8.0 Hz, 1H), 7.80–7.70 (m, 2H), 7.58–7.50 (m, 5H), 7.22 (d, J = 8.0 Hz, 2H), 7.05 (d, J = 8.0 Hz, 2H), 5.36 (d, J = 4.8 Hz, 1H), 3.66–3.61(m, 1H), 3.40 (dd, J = 18.0, 4.8 Hz, 1H), 2.87 (dd, J = 18.2, 9.8 Hz, 1H), 2.35 (s, 3H), 1.86 (s, 3H); ^{13}C{^1H} NMR ($CDCl_3$, 126 MHz): δ 205.2, 177.7, 176.4, 155.5, 150.4, 141.2, 140.3, 138.8, 138.1, 130.7, 130.5, 130.0, 129.6, 129.4, 129.3, 129.1, 128.9, 126.3, 56.2, 40.3, 32.3, 29.5, 21.3; IR (neat, cm^{-1}): 2924, 1706, 1515, 1389, 1365, 1182, 766, 739, 702, 665; HRMS (ESI-TOF) calcd for $C_{28}H_{24}N_3O_3$ $[M + H]^+$ 450.1812, found 450.1814.

1-(4-Fluorophenyl)-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione (3ac):



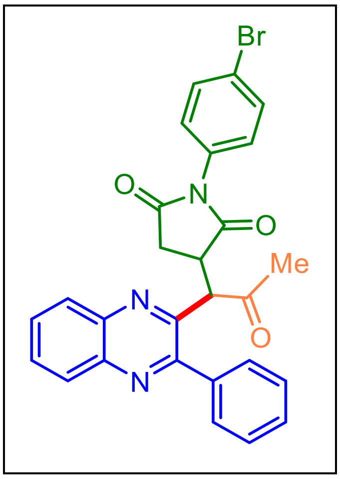
A pale yellow solid (77 mg, 68% yield); mp 169–171 °C; purified over a column of silica gel (25% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.14 (d, J = 8.4 Hz, 1H), 7.85–7.71 (m, 3H), 7.58–7.52 (m, 5H), 7.19–7.16 (m, 2H), 7.13–7.08 (m, 2H), 5.36 (d, J = 4.8 Hz, 1H), 3.66–3.61 (m, 1H), 3.40 (dd, J = 18.4, 4.8 Hz, 1H), 2.88 (dd, J = 18.2, 9.8 Hz, 1H), 1.86 (s, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): δ 205.1, 177.5, 176.1, 162.3 (d, J = 249.1 Hz), 155.5, 150.4, 141.3, 140.2, 138.1, 130.7, 130.6, 129.5 (d, J = 3.5 Hz), 129.3, 129.2, 128.7, 128.3 (d, J = 8.8 Hz), 128.2 (d, J = 3.3 Hz), 116.4, 116.3, 56.2, 40.2, 32.2, 29.5; ^{19}F NMR ($CDCl_3$) δ -112.3 (s); IR (neat, cm^{-1}): 2927, 1706, 1509, 1391, 1222, 1178, 835, 765, 702, 665; HRMS (ESI-TOF) calcd for $C_{27}H_{21}FN_3O_3$ $[M + H]^+$ 454.1561, found 454.1561.

1-(4-Chlorophenyl)-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione (3ad):



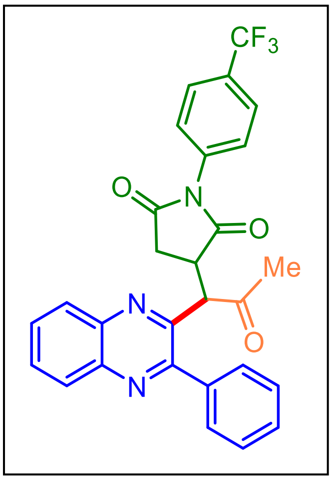
A dark brown solid (88 mg, 75% yield); mp 158–160 °C; purified over a column of silica gel (22% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.13 (d, J = 8.4 Hz, 1H), 7.83–7.70 (m, 3H), 7.57–7.52 (m, 5H), 7.39 (d, J = 8.8 Hz, 2H), 7.16 (d, J = 8.8 Hz, 2H), 5.36 (d, J = 4.8 Hz, 1H), 3.65–3.60 (m, 1H), 3.39 (dd, J = 18.4, 4.8 Hz, 1H), 2.87 (dd, J = 18.4, 10.0 Hz, 1H), 1.86 (s, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): δ 205.1, 177.3, 175.9, 155.5, 150.3, 141.3, 140.2, 138.0, 134.5, 130.8, 130.6, 129.6, 129.5, 129.3, 129.2, 128.7, 127.7, 56.2, 40.1, 32.2, 29.5; IR (neat, cm^{-1}): 2927, 1710, 1493, 1386, 1179, 1092, 1017, 767, 731, 703; HRMS (ESI-TOF) calcd for $C_{27}H_{21}ClN_3O_3$ $[M + H]^+$ 470.1266, found 470.1239.

1-(4-Bromophenyl)-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione (3ae):



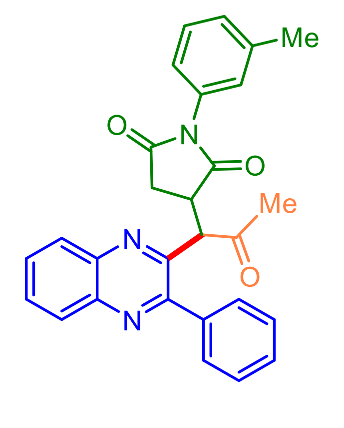
A pale yellow solid (81 mg, 63% yield); mp 146–148 °C; purified over a column of silica gel (20% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.13 (d, J = 8.4 Hz, 1H), 7.82–7.70 (m, 3H), 7.58– .52 (m, 7H), 7.10 (d, J = 8.4 Hz, 2H), 5.36 (d, J = 4.8 Hz, 1H), 3.65–3.60 (m, 1H), 3.38 (dd, J = 18.4, 4.8 Hz, 1H), 2.86 (dd, J = 18.4, 10.0 Hz, 1H), 1.86 (s, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): δ 205.1, 177.3, 175.8, 155.4, 150.3, 141.2, 140.2, 138.0, 132.5, 131.3, 130.7, 130.6, 129.5, 129.3, 129.2, 128.7, 128.0, 122.6, 56.2, 40.1, 32.2, 29.5; IR (neat, cm^{-1}): 2928, 1708, 1489, 1384, 1169, 1070, 824, 766, 702, 674; HRMS (ESI-TOF) calcd for $C_{27}H_{21}BrN_3O_3$ [M + H]$^+$ 514.0761, found 514.0742.

3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)propyl)-1-(4-(trifluoromethyl)phenyl)pyrrolidine-2,5-dione (3af):



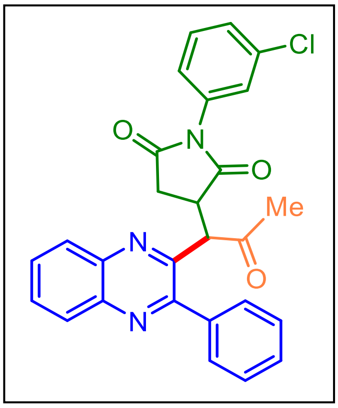
A pale brown solid (65 mg, 52% yield); mp 169–171 °C; purified over a column of silica gel (20% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.14 (d, J = 8.4 Hz, 1H), 7.82–7.77 (m, 2H), 7.75–7.68 (m, 3H), 7.59–7.53 (m, 5H), 7.38 (d, J = 8.0 Hz, 2H), 5.38 (d, J = 4.4 Hz, 1H), 3.67–3.62 (m, 1H), 3.41 (dd, J = 18.4, 5.2 Hz, 1H), 2.89 (dd, J = 18.2, 9.8 Hz, 1H), 1.86 (s, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): δ 205.1, 177.2, 175.7, 155.5, 150.2, 141.3, 140.2, 138.0, 135.4, 130.8, 130.7, 129.5, 129.3, 129.2, 128.6, 126.7, 126.4 (q, J = 3.6 Hz), 56.2, 40.1, 32.2, 29.5; ^{19}F NMR ($CDCl_3$) δ -62.7 (s); IR (neat, cm^{-1}): 2925, 1710, 1383, 1322, 1166, 1124, 1066, 763, 734, 675; HRMS (ESI-TOF) calcd for $C_{28}H_{21}F_3N_3O_3$ [M + H]$^+$ 504.1530, found 504.1514.

3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)propyl)-1-(m-tolyl)pyrrolidine-2,5-dione (3ag):



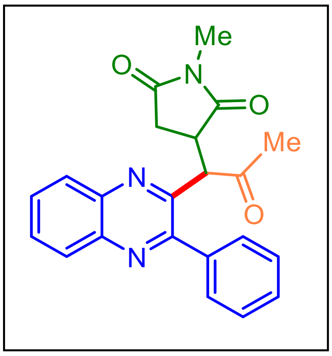
A light orange solid (75 mg, 67% yield); mp 123–125 °C; purified over a column of silica gel (22% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.13 (d, *J* = 8.0 Hz, 1H), 7.91 (d, *J* = 8.0 Hz, 1H), 7.81–7.71 (m, 2H), 7.59–7.52 (m, 5H), 7.29 (t, *J* = 7.8 Hz, 1H), 7.17 (d, *J* = 8.0 Hz, 1H), 6.95 (d, *J* = 8.4 Hz, 2H), 5.35 (d, *J* = 4.8 Hz, 1H), 3.67–3.62 (m, 1H), 3.41 (dd, *J* = 18.2, 5.0 Hz, 1H), 2.88 (dd, *J* = 18.2, 9.8 Hz, 1H), 2.30 (s, 3H), 1.87 (s, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): *δ* 205.2, 177.7, 176.4, 155.5, 150.4, 141.3, 140.3, 139.4, 138.1, 132.2, 130.7, 130.5, 129.7, 129.5, 129.3, 129.2, 128.9, 127.2, 123.6, 56.2, 40.3, 32.4, 29.5, 21.4; IR (neat, cm^{-1}): 2924, 1708, 1609, 1491, 1384, 1335, 1186, 767, 739, 697; HRMS (ESI-TOF) calcd for $C_{28}H_{24}N_3O_3$ $[M + H]^+$ 450.1812, found 450.1815.

1-(3-Chlorophenyl)-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione (3ah):



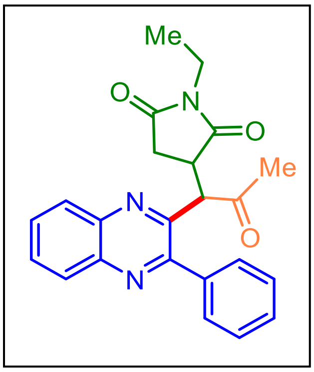
A pale orange solid (73 mg, 62% yield); mp 168–170 °C; purified over a column of silica gel (20% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): *δ* 8.14 (d, *J* = 8.0 Hz, 1H), 7.85 (d, *J* = 7.6 Hz, 1H), 7.81–7.72 (m, 2H), 7.57–7.54 (m, 5H), 7.36–7.34 (m, 2H), 7.24 (s, 1H), 7.12–7.10 (m, 1H), 5.36 (d, *J* = 4.8 Hz, 1H), 3.66–3.61 (m, 1H), 3.39 (dd, *J* = 18.4, 4.8 Hz, 1H), 2.88 (dd, *J* = 18.4, 10.0 Hz, 1H), 1.87 (s, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): *δ* 205.1, 177.2, 175.8, 155.5, 150.3, 141.3, 140.2, 138.1, 134.9, 133.4, 130.8, 130.7, 130.2, 129.6, 129.5, 129.3, 129.2, 128.9, 128.7, 126.8, 124.7, 56.2, 40.2, 32.3, 29.5; IR (neat, cm^{-1}): 2926, 1709, 1594, 1481, 1381, 1179, 1092, 769, 734, 688; HRMS (ESI-TOF) calcd for $C_{27}H_{21}ClN_3O_3$ $[M + H]^+$ 470.1266, found 470.1265.

1-Methyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione (3ai):



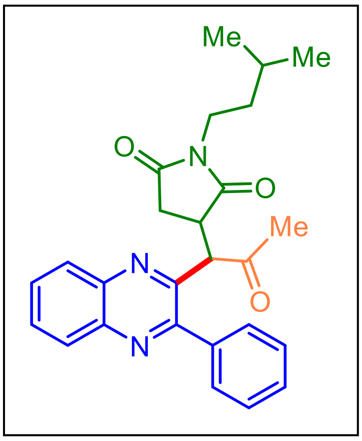
A brown solid (55 mg, 59% yield); mp 110–112 °C; purified over a column of silica gel (20% EtOAc in hexane); ^{1}H NMR (CDCl$_3$, 400 MHz): δ 8.11 (d, J = 6.8 Hz, 1H), 7.84 (d, J = 7.2 Hz, 1H), 7.79–7.70 (m, 2H), 7.57–7.53 (m, 5H), 5.23 (d, J = 4.8 Hz, 1H), 3.54–3.49 (m, 1H), 3.17 (dd, J = 18.0, 4.8 Hz, 1H), 3.00 (s, 3H), 2.72 (dd, J = 18.0, 9.6 Hz, 1H), 1.86 (s, 3H). ^{13}C {^{1}H} NMR (CDCl$_3$, 126 MHz): δ 205.1, 178.7, 177.3, 155.4, 150.2, 141.1, 140.4, 138.1, 130.6, 130.5, 129.5, 129.4, 129.3, 129.1, 128.8, 56.1, 40.3, 32.2, 29.4, 25.2; IR (neat, cm^{-1}): 2927, 1697, 1438, 1385, 1360, 1282, 1125, 768, 705, 676; HRMS (ESI-TOF) calcd for $C_{22}H_{20}N_3O_3$ [M + H]$^+$ 374.1499, found 374.1499.

1-Ethyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione (3aj):



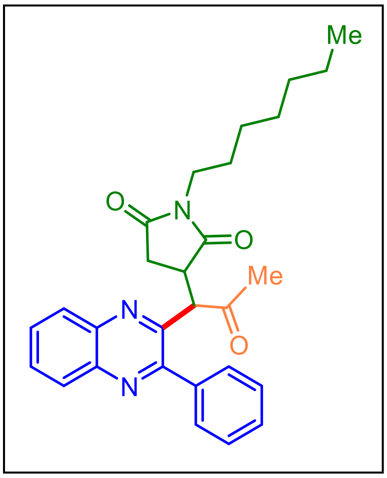
A brown solid (59 mg, 61% yield); mp 117–119 °C; purified over a column of silica gel (20% EtOAc in hexane); ^{1}H NMR (CDCl$_3$, 400 MHz): δ 8.11 (d, J = 7.2 Hz, 1H), 7.88 (d, J = 7.6 Hz, 1H), 7.79 – 7.71 (m, 2H), 7.59 – 7.52 (m, 5H), 5.21 (d, J = 4.8 Hz, 1H), 3.59 – 3.47 (m, 3H), 3.27 (dd, J = 18.2, 5.0 Hz, 1H), 2.71 (dd, J = 18.0, 9.6 Hz, 1H), 1.86 (s, 3H), 1.04 (t, J = 7.2 Hz, 3H); ^{13}C {^{1}H} NMR (CDCl$_3$, 126 MHz): δ 205.1, 178.3, 177.1, 155.4, 150.4, 141.1, 140.3, 138.1, 130.6, 130.4, 129.5, 129.4, 129.3, 129.1, 128.9, 55.8, 40.4, 34.1, 32.4, 29.4, 12.9; IR (neat, cm^{-1}): 2927, 1695, 1444, 1406, 1352, 1226, 1129, 766, 704, 675; HRMS (ESI-TOF) calcd for $C_{23}H_{22}N_3O_3$ [M + H]$^+$ 388.1656, found 388.1655.

1-Isopentyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione (3ak):



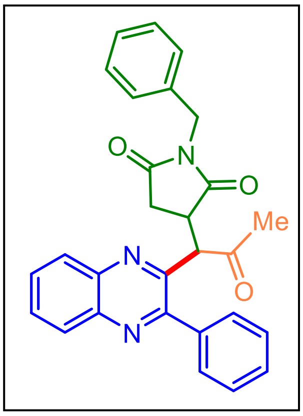
A pale brown gummy (58 mg, 54% yield); purified over a column of silica gel (20% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.11 (d, J = 7.2 Hz, 1H), 7.89 (d, J = 7.6 Hz, 1H), 7.80–7.72 (m, 2H), 7.60–7.52 (m, 5H), 5.20 (d, J = 5.2 Hz, 1H), 3.54–3.42 (m, 3H), 3.32 (dd, J = 18.0, 4.8 Hz, 1H), 2.74 (dd, J = 18.0, 9.6 Hz, 1H), 1.87 (s, 3H), 1.36–1.30 (m, 2H), 0.94–0.88 (m, 1H), 0.78 (dd, J = 13.4, 6.2 Hz, 6H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): δ 205.0, 178.5, 177.2, 155.4, 150.4, 141.2, 140.4, 138.1, 130.6, 130.4, 129.5, 129.4, 129.3, 129.1, 129.0, 55.7, 40.5, 37.6, 36.4, 32.5, 29.5, 26.0, 22.4, 22.3; IR (neat, cm^{-1}): 2956, 1697, 1439, 1404, 1357, 1191, 1136, 768, 702, 675; HRMS (ESI-TOF) calcd for $C_{26}H_{28}N_3O_3$ $[M + H]^+$ 430.2125, found 430.2125.

1-Heptyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione (3al):



A pale brown gummy (54 mg, 47% yield); purified over a column of silica gel (20% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 500 MHz): δ 8.11 (d, J = 7.5 Hz, 1H), 7.89 (d, J = 8.0 Hz, 1H), 7.78–7.71 (m, 2H), 7.60–7.52 (m, 5H), 5.20 (d, J = 5.0 Hz, 1H), 3.54–3.43 (m, 3H), 3.32 (dd, J = 18.0, 5.0 Hz, 1H), 2.74 (dd, J = 18.0, 9.5 Hz, 1H), 1.87 (s, 3H), 1.20 (q, J = 7.2 Hz, 2H), 1.13–1.09 (m, 6H), 0.89–0.85 (m, 2H), 0.83 (t, J = 7.2 Hz, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): δ 205.0, 178.5, 177.2, 155.4, 150.4, 141.1, 140.4, 138.1, 130.6, 130.3, 129.5, 129.4, 129.3, 129.1, 128.9, 55.7, 40.5, 39.2, 32.4, 31.6, 29.4, 28.8, 27.8, 26.9, 22.6, 14.1; IR (neat, cm^{-1}): 2927, 1695, 1442, 1403, 1355, 1169, 1132, 765, 702, 675; HRMS (ESI-TOF) calcd for $C_{28}H_{32}N_3O_3$ $[M + H]^+$ 458.2438, found 458.2436.

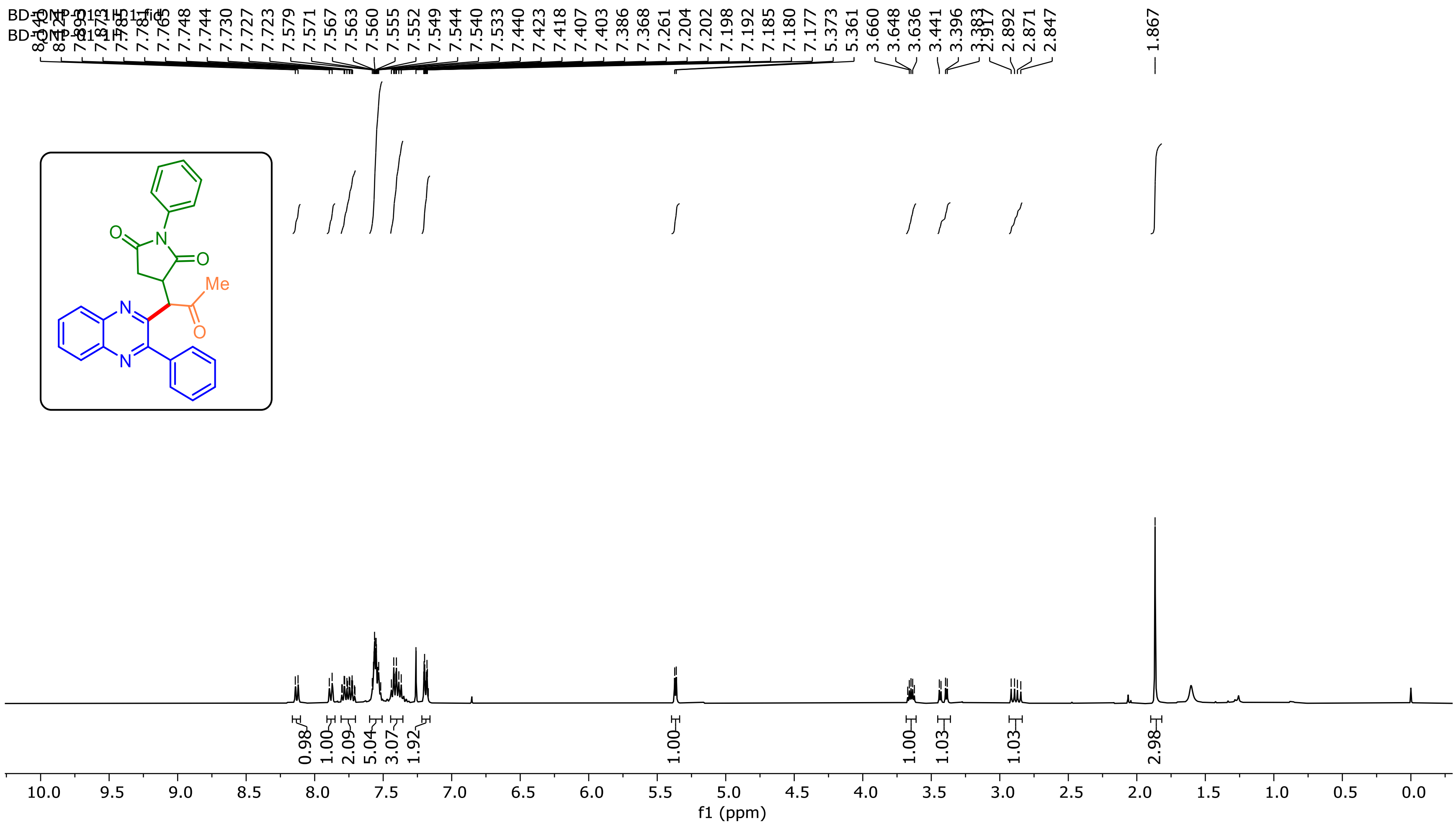
1-Benzyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione (3am):



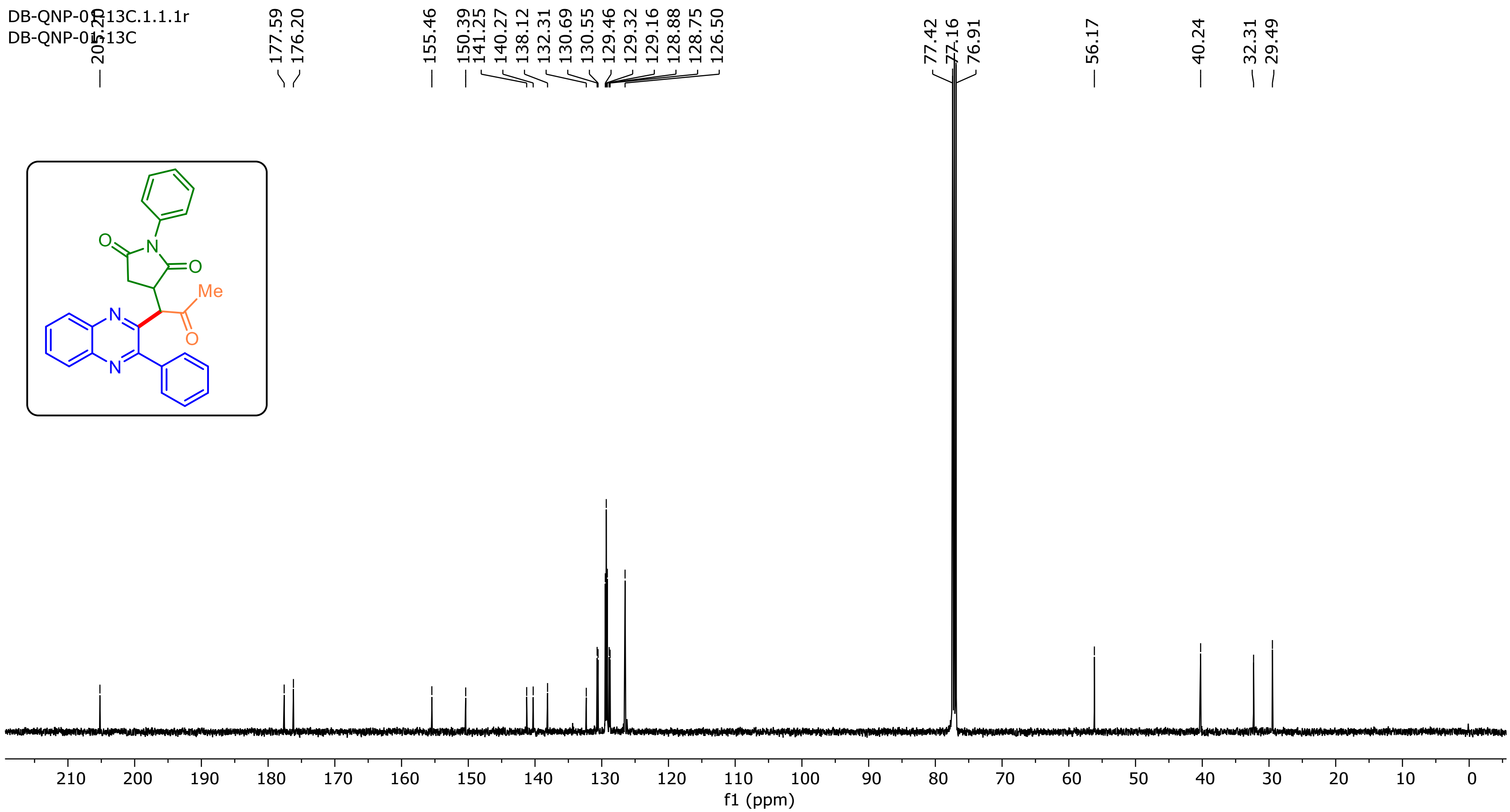
A pale brown solid (76 mg, 68% yield); mp 185–187 °C; purified over a column of silica gel (25% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 500 MHz): δ 8.05 (d, J = 8.0 Hz, 1H), 7.74–7.70 (m, 1H), 7.60–7.51 (m, 6H), 7.39 (d, J = 8.5 Hz, 1H), 7.23 (d, J = 7.0 Hz, 2H), 7.14–7.11 (m, 1H), 7.09–7.06 (m, 2H), 5.22 (d, J = 4.5 Hz, 1H), 4.69 (d, J = 14.0 Hz, 1H), 4.57 (d, J = 14.0 Hz, 1H), 3.54–3.50 (m, 1H) 3.34 (dd, J = 18.2, 4.7 Hz, 1H), 2.74 (dd, J = 18.0, 9.5 Hz, 1H), 1.82 (s, 3H); ^{13}C {^{1}H} NMR ($CDCl_3$, 126 MHz): δ 204.9, 178.3, 176.8, 155.3, 150.1, 141.0, 140.2, 138.2, 135.5, 130.5, 130.3, 129.4, 129.3, 129.2, 129.1, 129.0, 128.9, 128.6, 128.0, 55.6, 42.8, 40.6, 32.5, 29.4; IR (neat, cm^{-1}): 2927, 1700, 1497, 1431, 1400, 1351, 1169, 1084, 765, 701; HRMS (ESI-TOF) calcd for $C_{28}H_{24}N_3O_3$ $[M + H]^+$ 450.1812, found 450.1809.

VII. NMR spectra

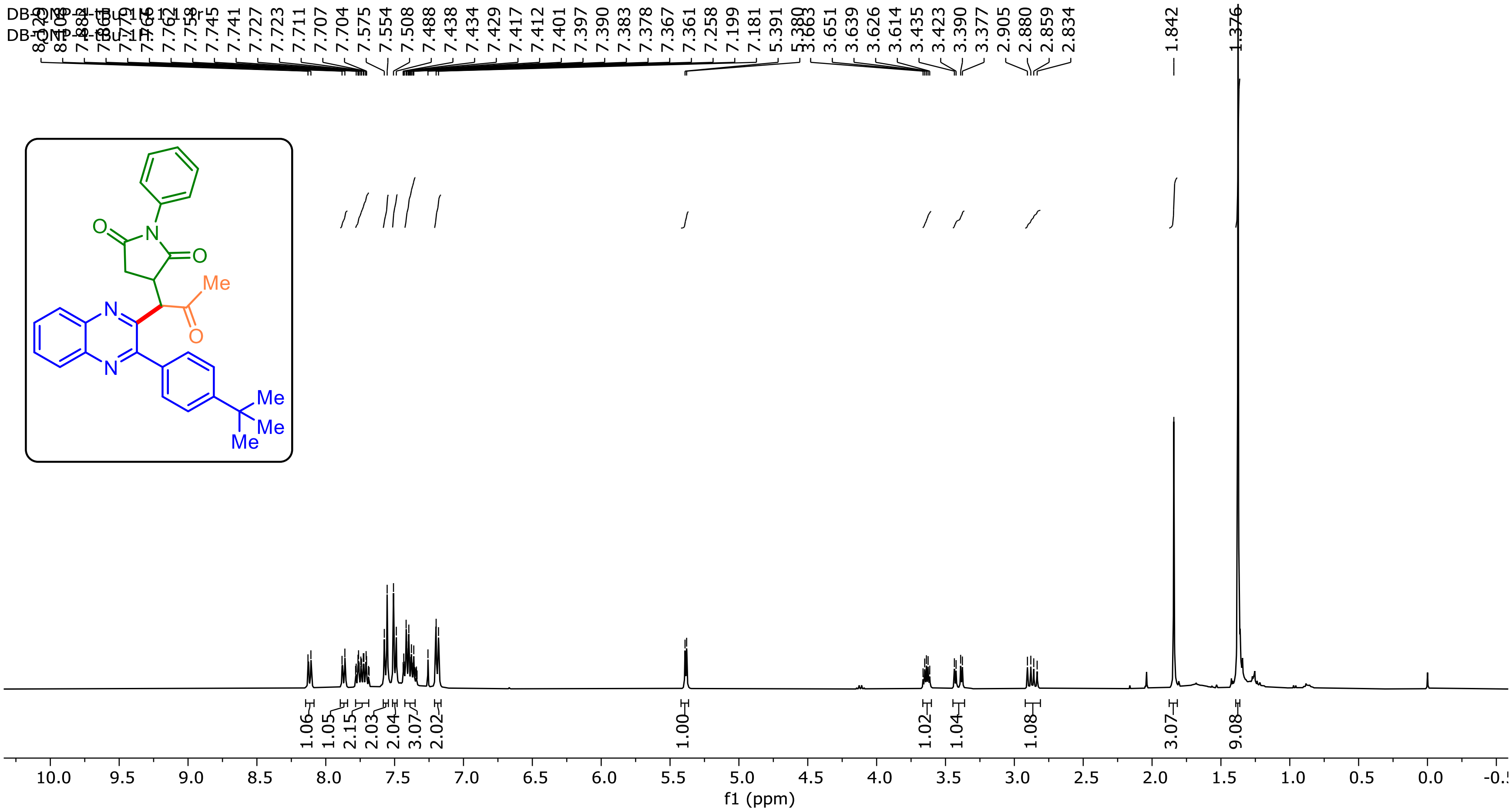
[1]H NMR of 3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)propyl)-1-phenylpyrrolidine-2,5-dione: (3aa) ($CDCl_3$, 400 MHz)



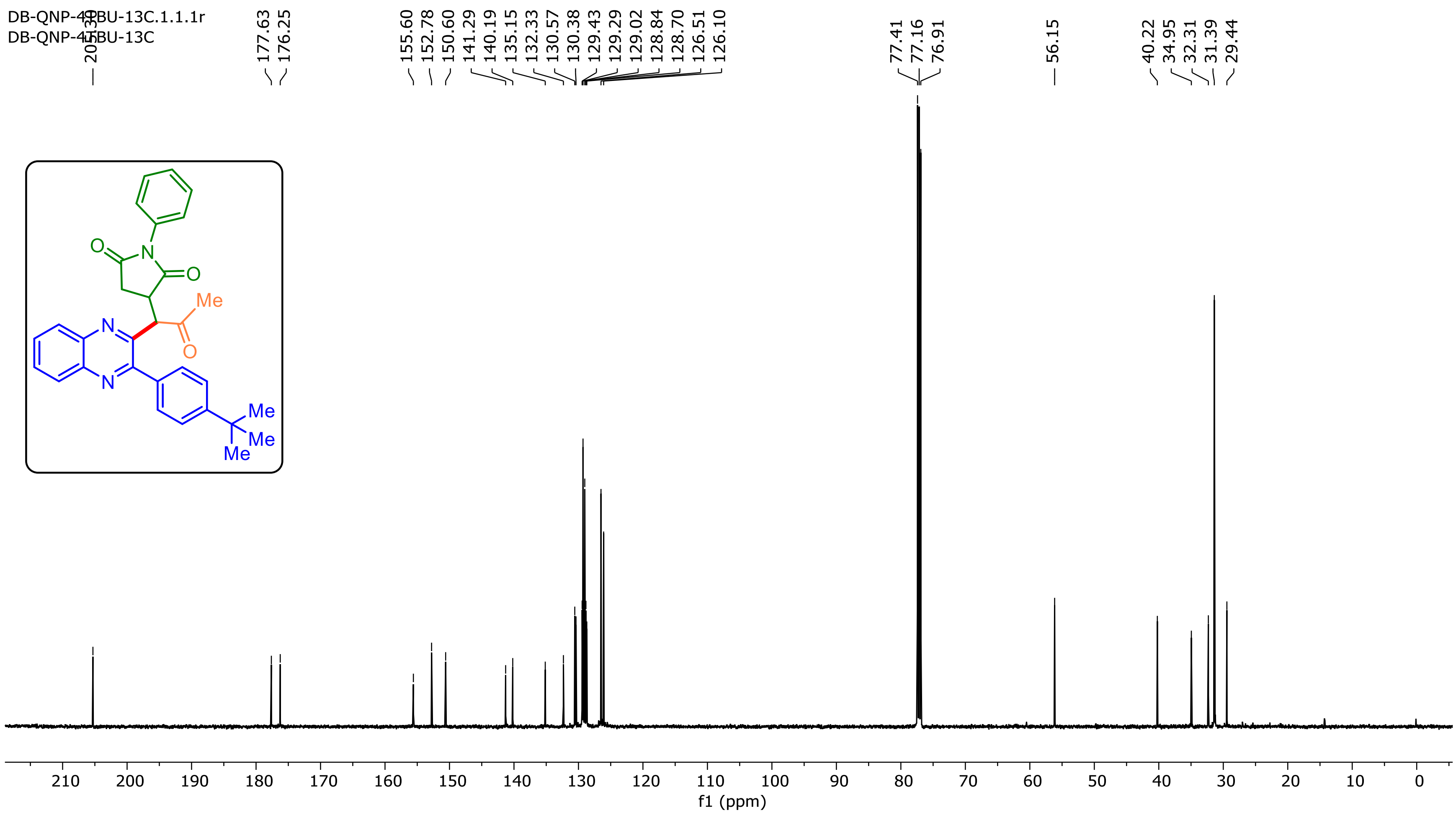
[13]C{[1]H} NMR of 3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)propyl)-1-phenylpyrrolidine-2,5-dione: (3aa) ($CDCl_3$, 126 MHz)



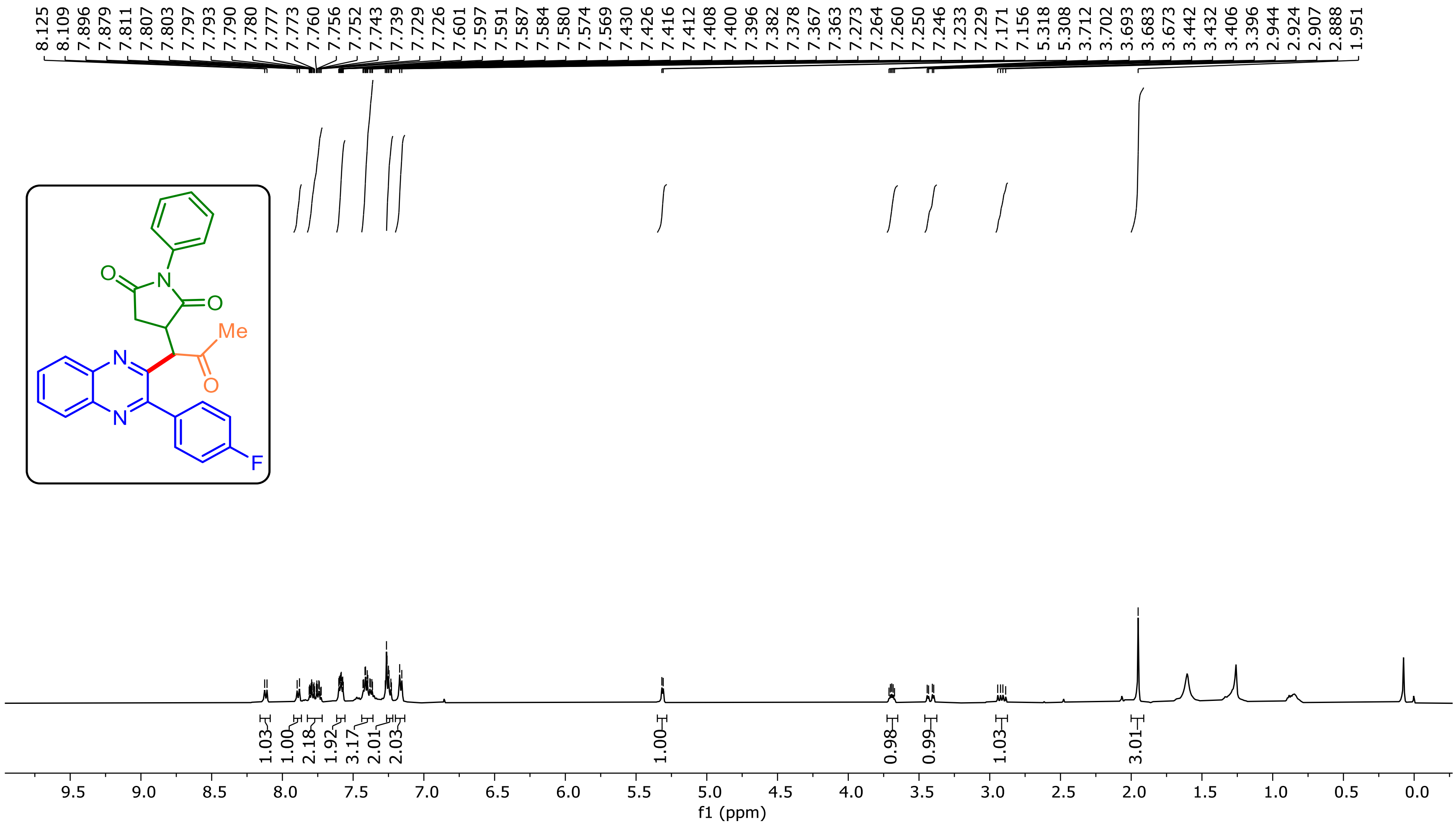
[1]H NMR of 3-(1-(3-(4-(tert-Butyl)phenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione:(3ba) ($CDCl_3$, 400 MHz)



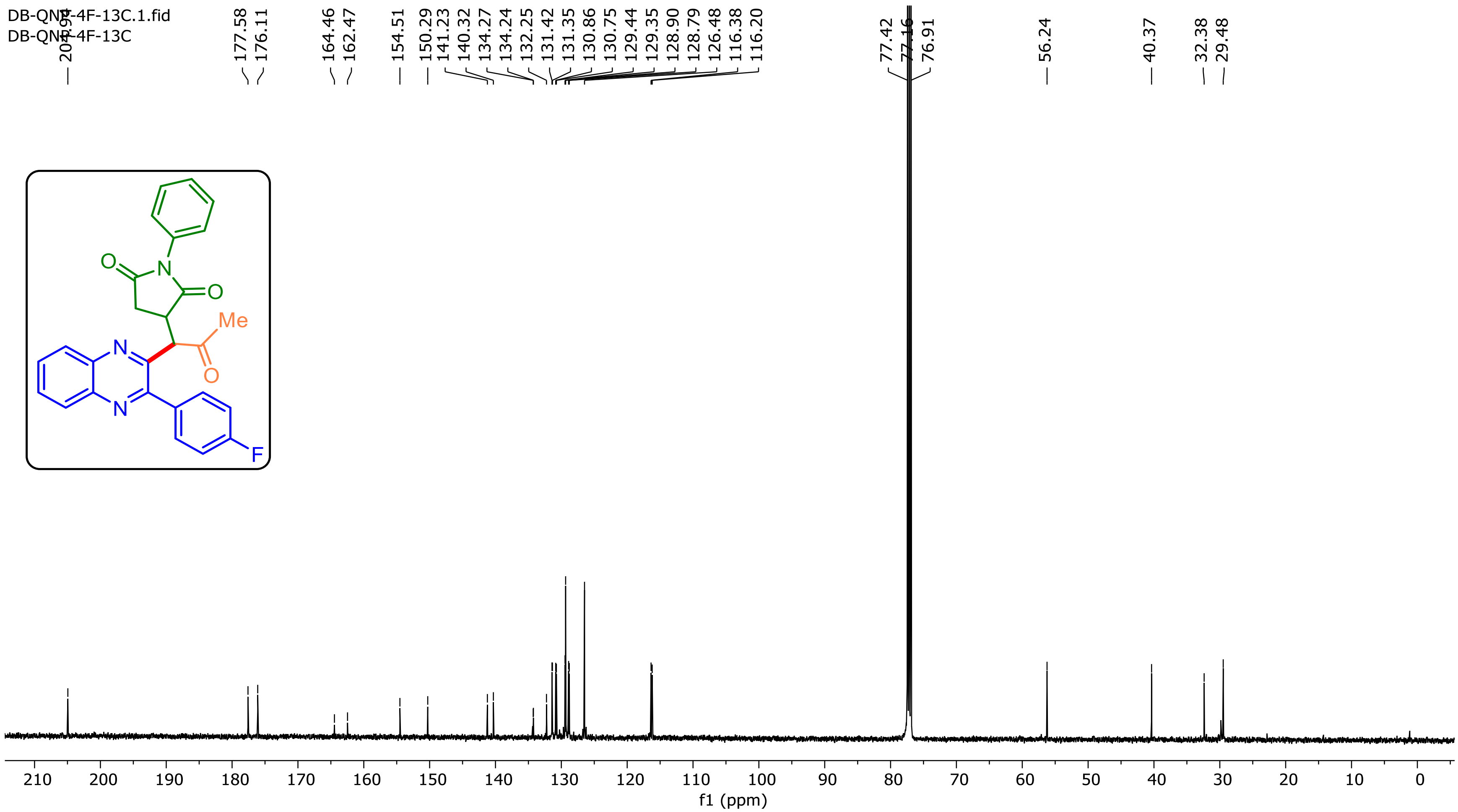
[13]C{[1]H} NMR of 3-(1-(3-(4-(tert-Butyl)phenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3ba) (CDCl$_3$, 126 MHz)



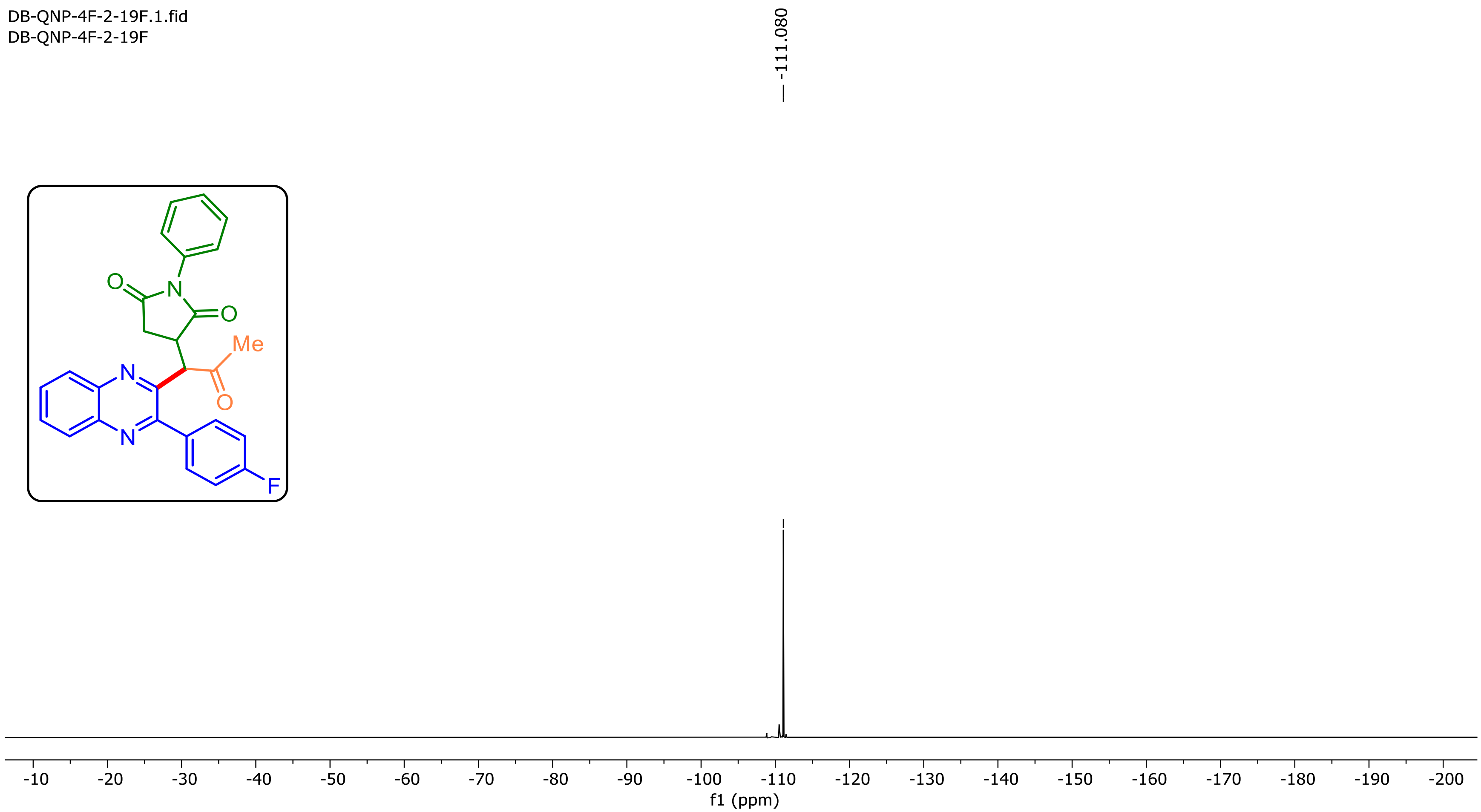
[1]H NMR of 3-(1-(3-(4-Fluorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione: (3ca) ($CDCl_3$, 500 MHz)



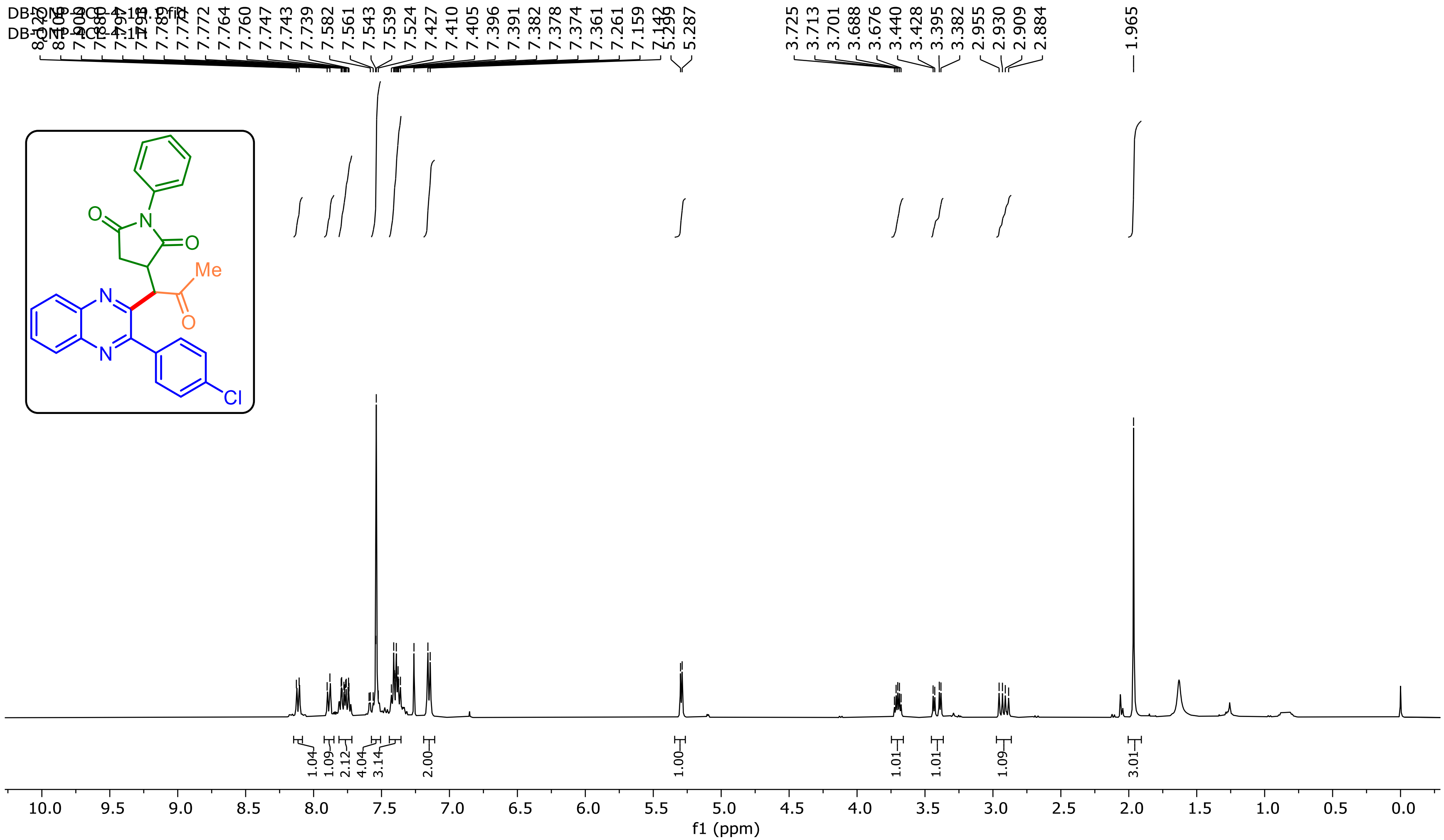
$^{13}C\{^{1}H\}$ NMR of 3-(1-(3-(4-Fluorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione: (3ca) ($CDCl_3$, 126 MHz)



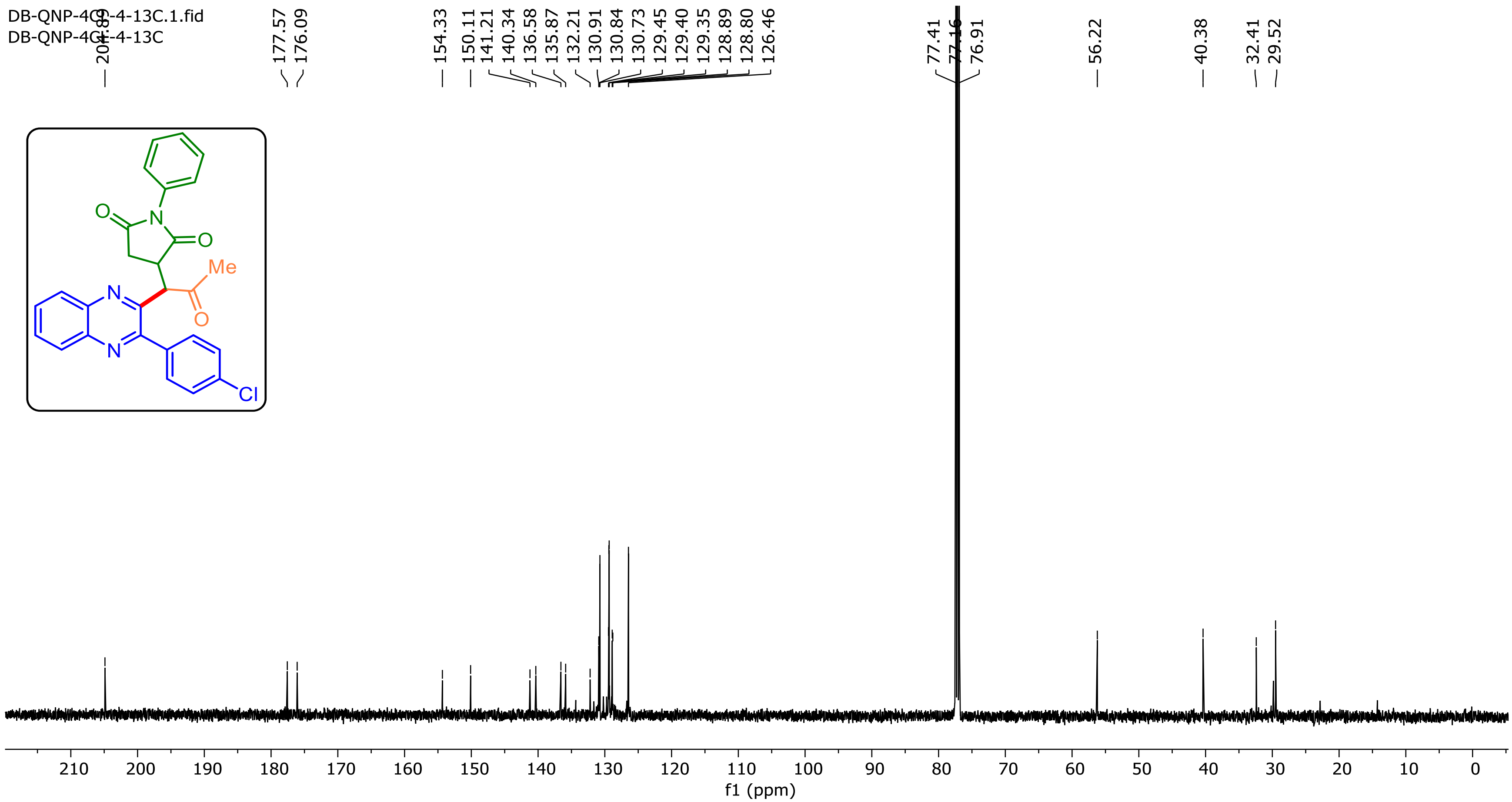
^{19}F NMR of 3-(1-(3-(4-Fluorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione: (3ca) ($CDCl_3$)



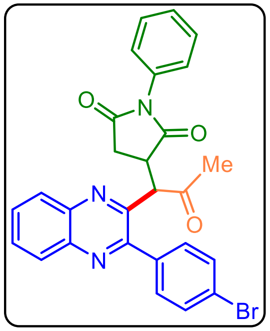
[1]H NMR of 3-(1-(3-(4-Chlorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione: (3da) ($CDCl_3$, 400 MHz)

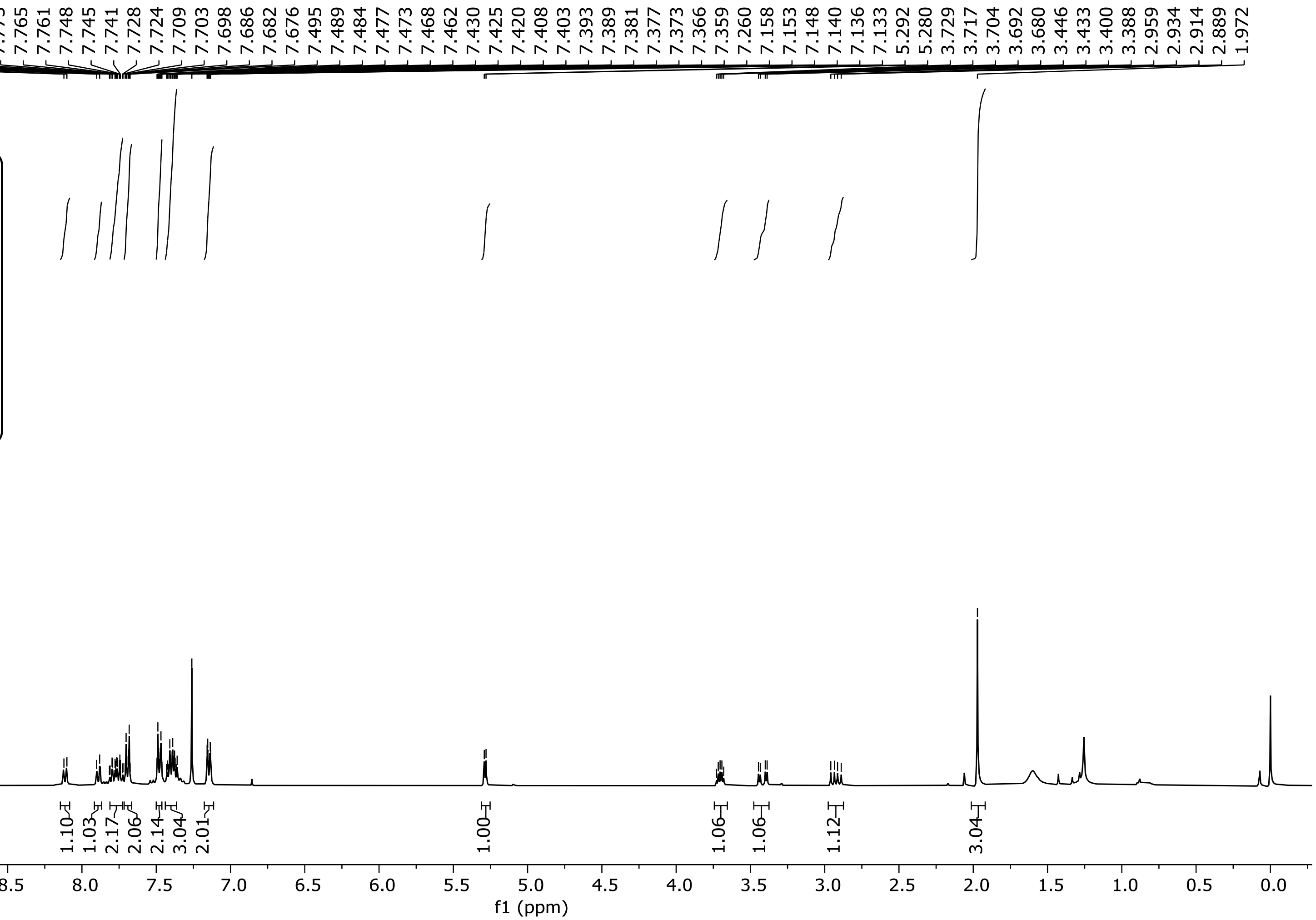


$^{13}C\{^{1}H\}$ ***NMR of 3-(1-(3-(4-Chlorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione: (3da) ($CDCl_3$, 126 MHz)***

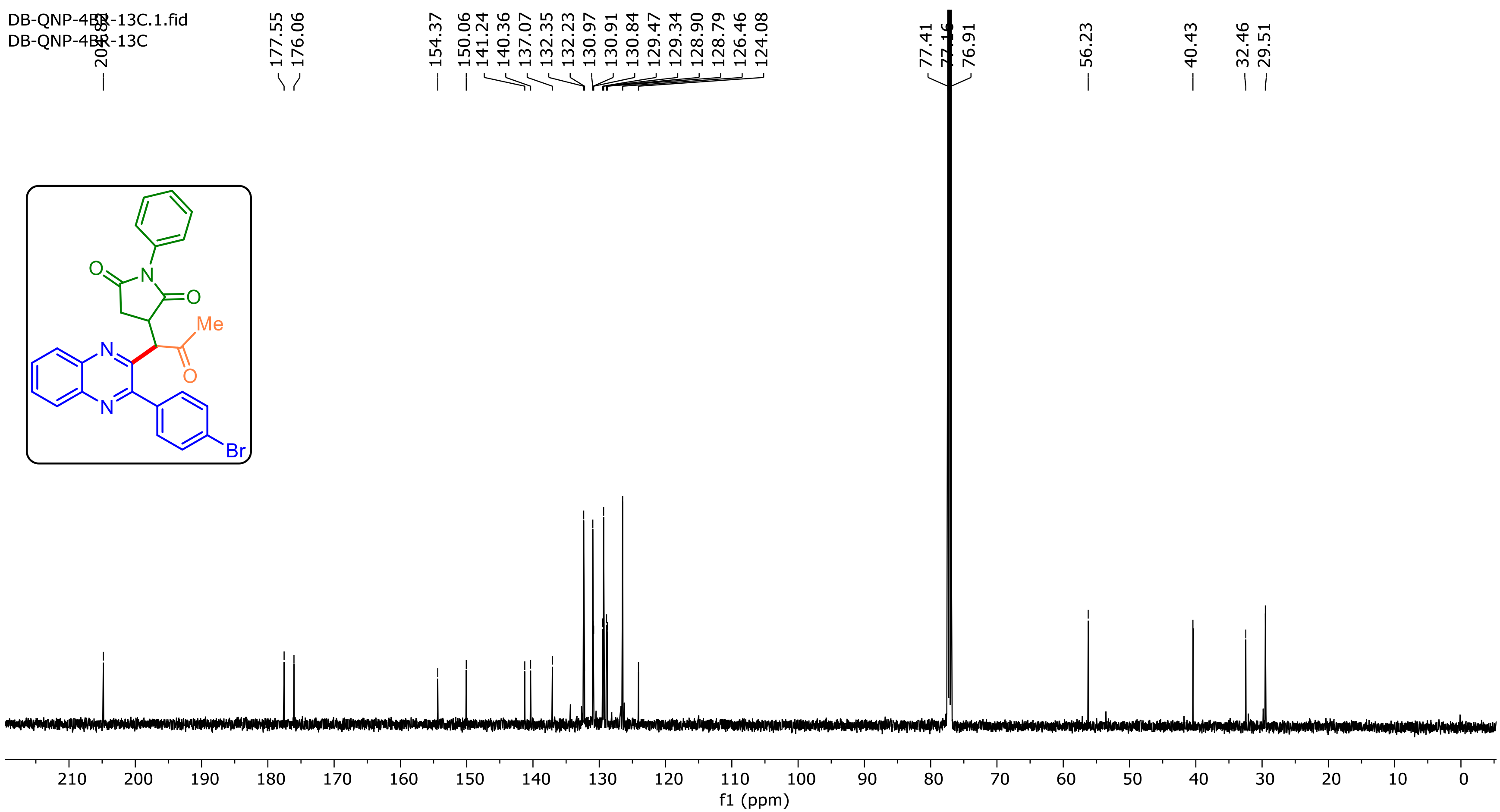


^{1}H NMR of 3-(1-(3-(4-Bromophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione: (3ea) ($CDCl_3$, 400 MHz)

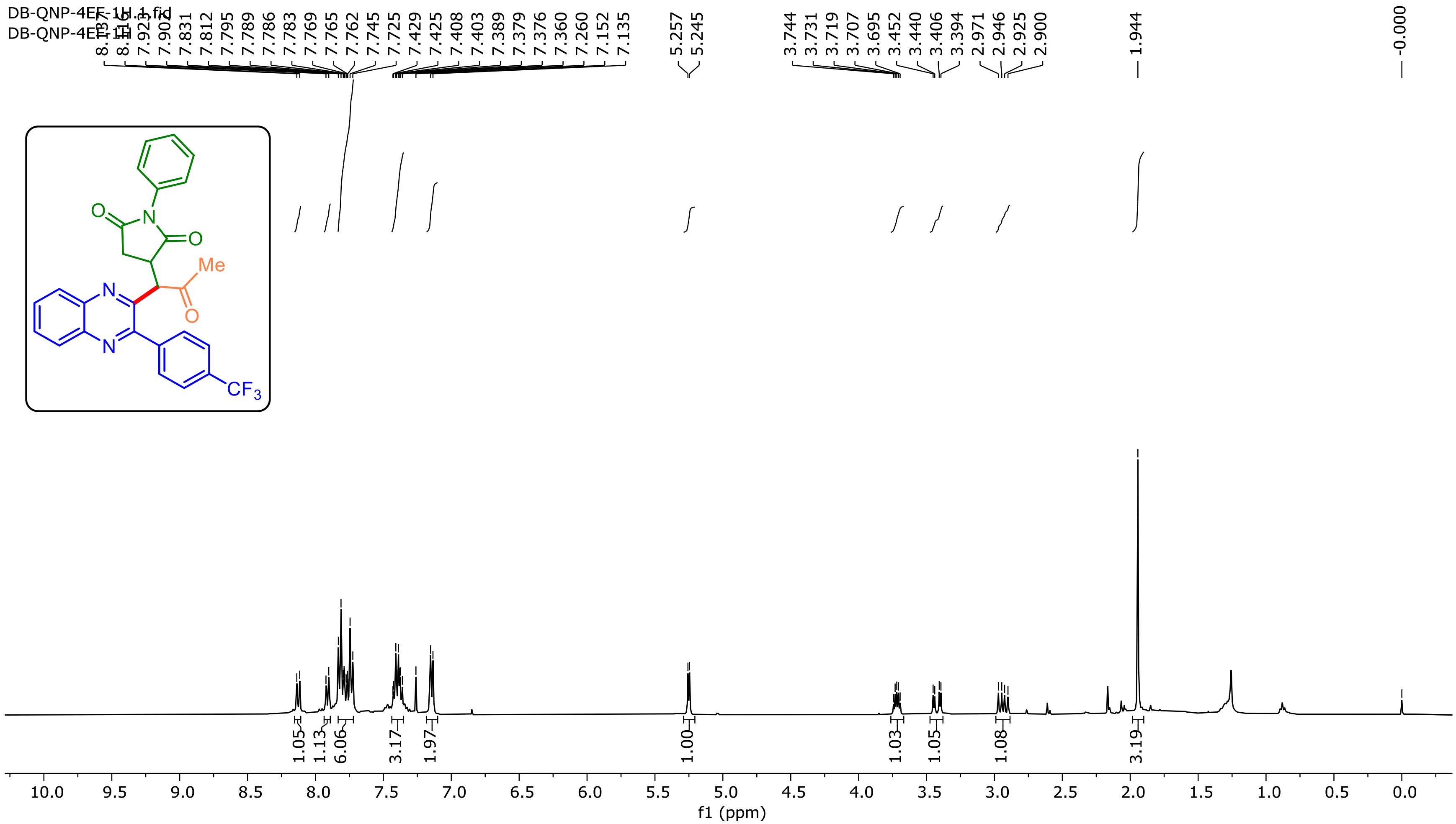




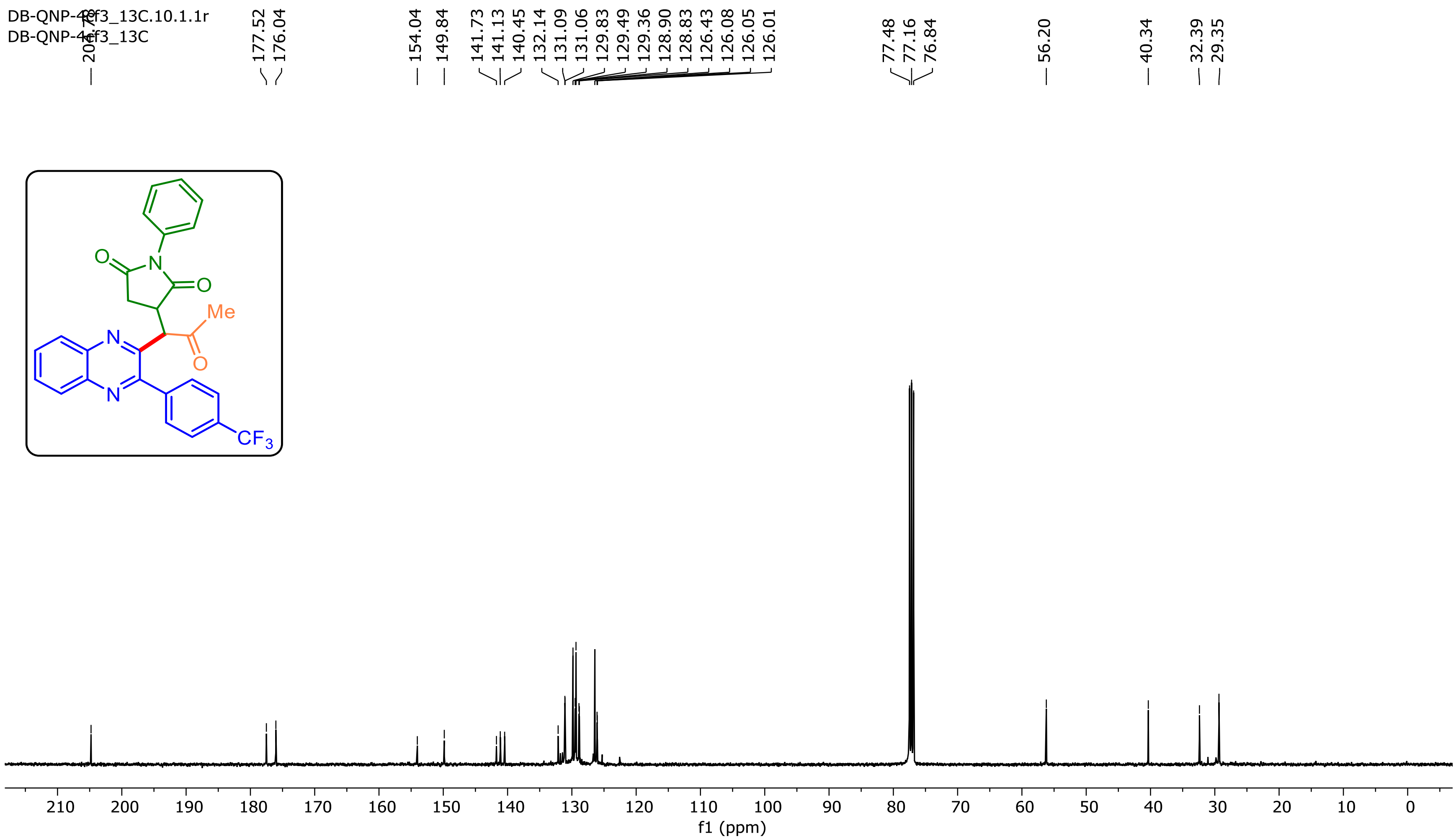
13C{1H} NMR of 3-(1-(3-(4-Bromophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione: (3ea) (CDCl$_3$, 126 MHz)



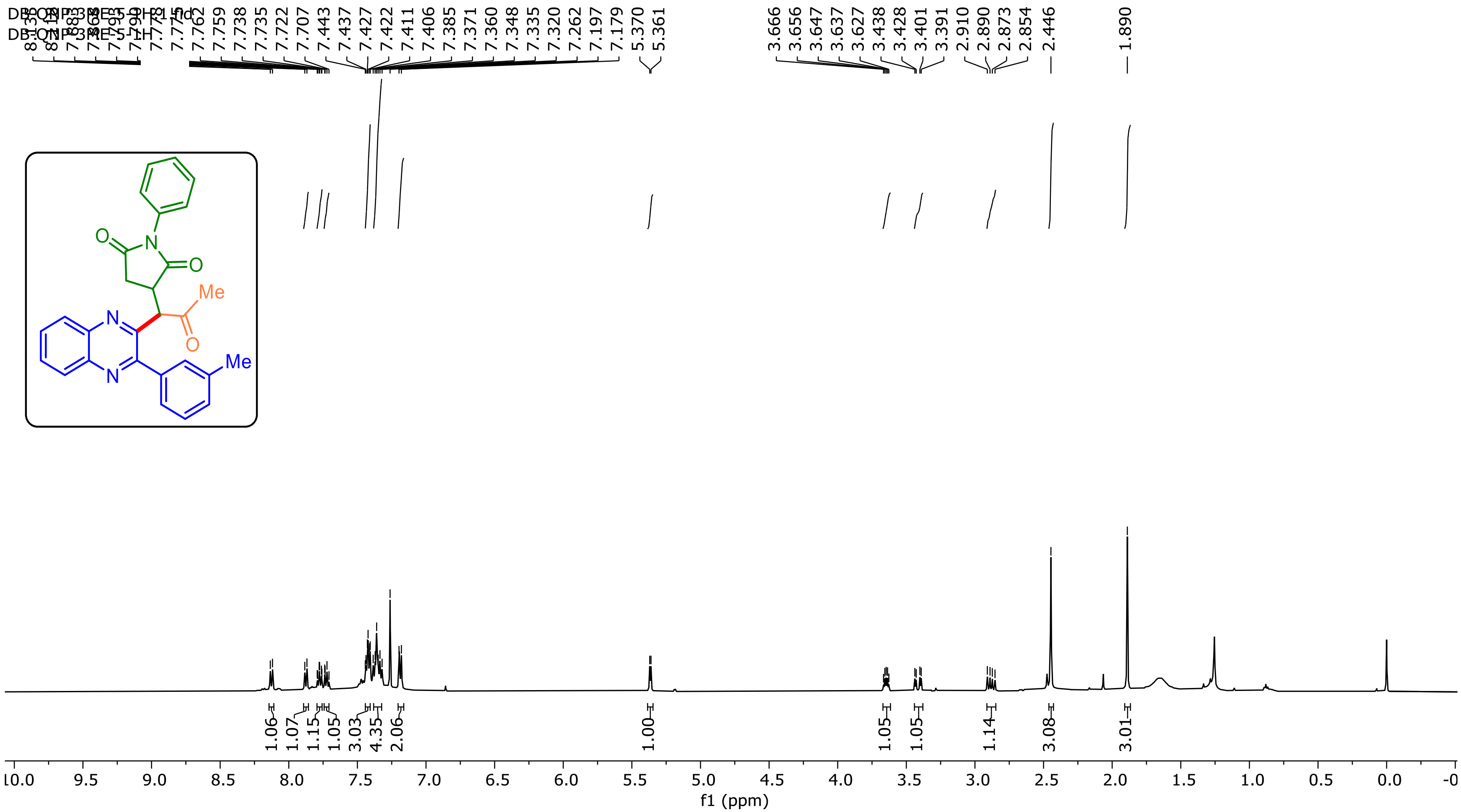
[1]H NMR of 3-(2-Oxo-1-(3-(4-(trifluoromethyl)phenyl)quinoxalin-2-yl)propyl)-1-phenylpyrrolidine-2,5-dione: (3fa) (CDCl$_3$, 400 MHz)



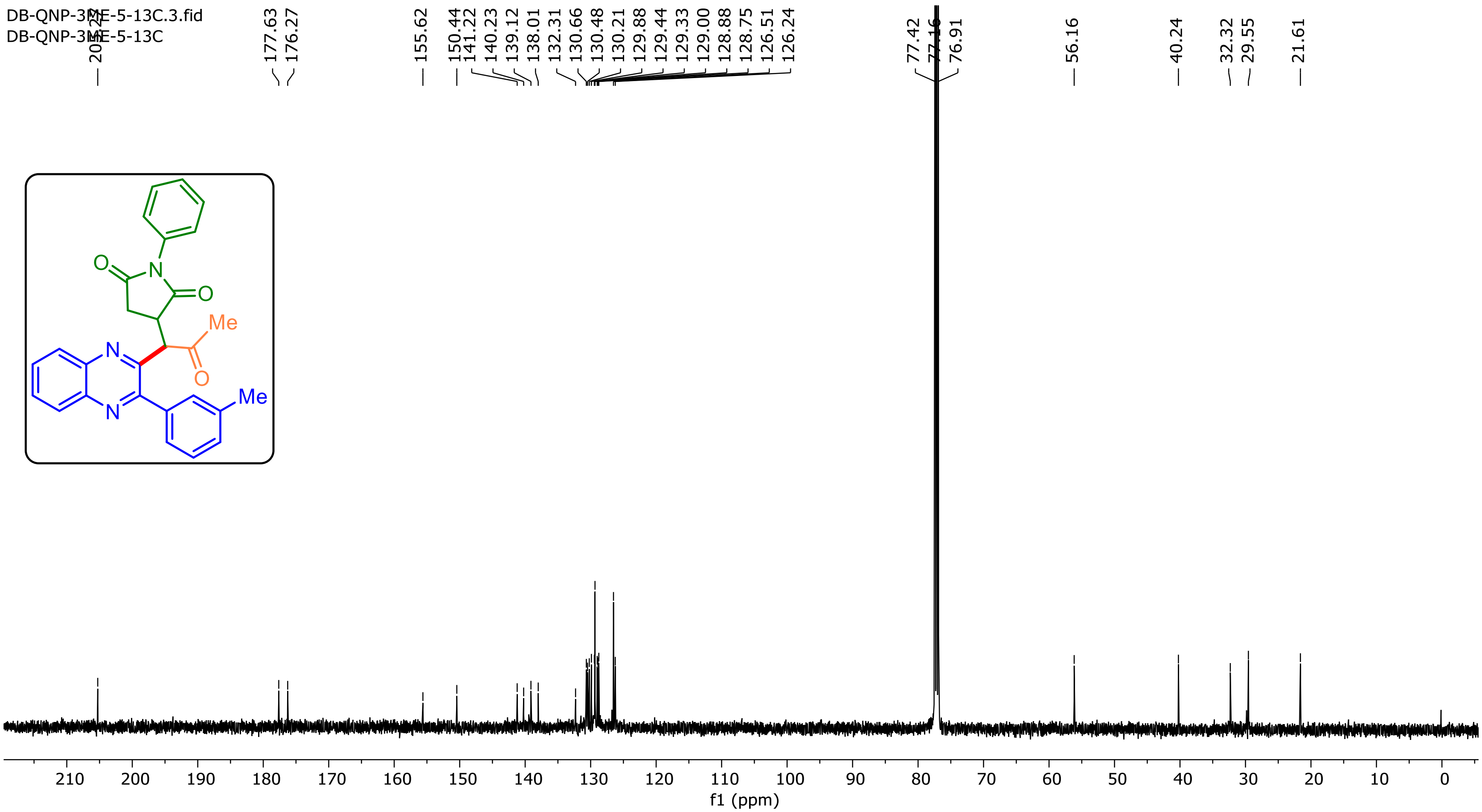
$^{13}C\{^{1}H\}$ NMR of 3-(2-Oxo-1-(3-(4-(trifluoromethyl)phenyl)quinoxalin-2-yl)propyl)-1-phenylpyrrolidine-2,5-dione: (3fa) ($CDCl_3$, 101 MHz)



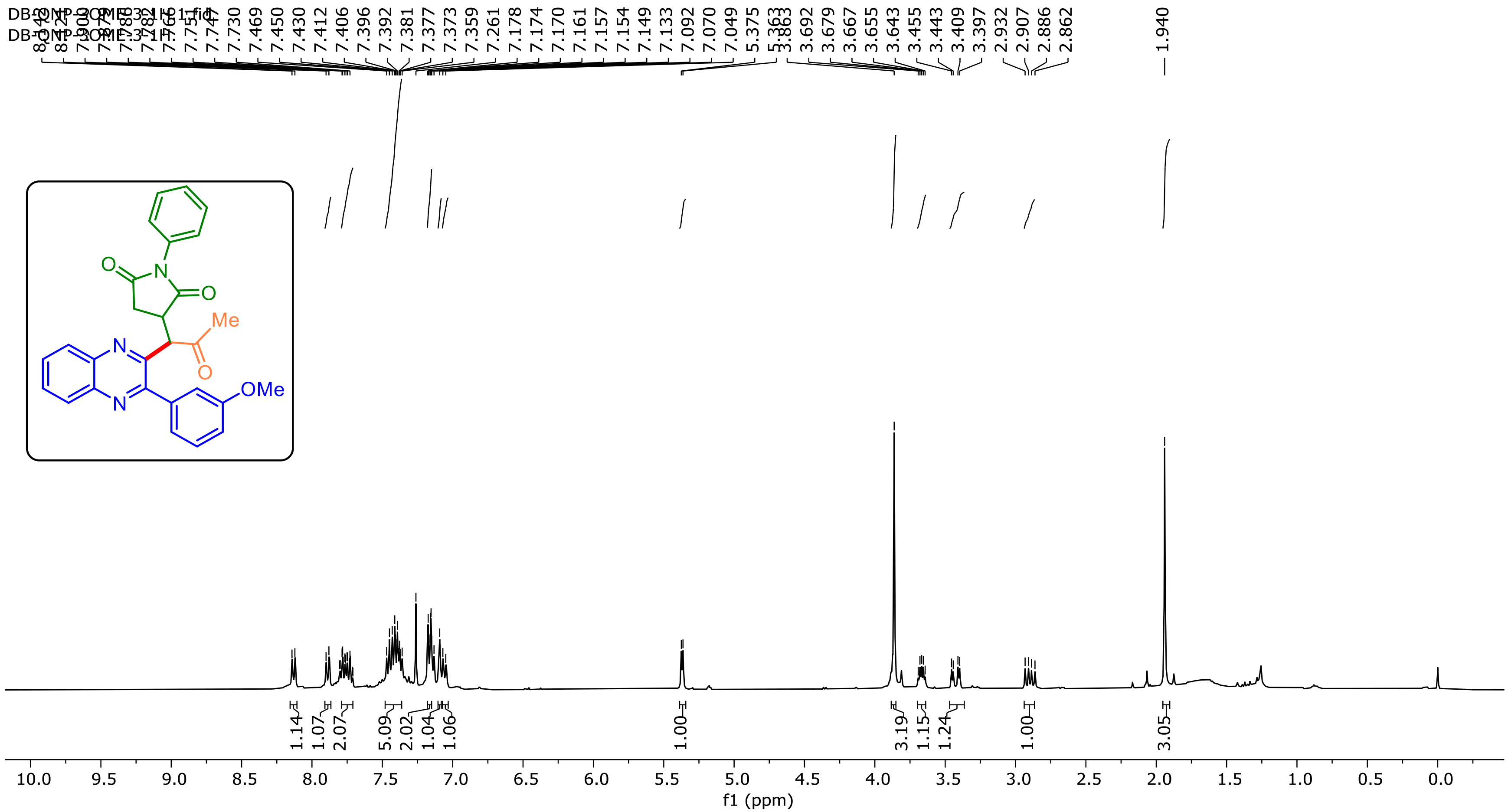
[1]H NMR of 3-(2-Oxo-1-(3-(m-tolyl)quinoxalin-2-yl)propyl)-1-phenylpyrrolidine-2,5-dione: (3ga) ($CDCl_3$, 500 MHz)



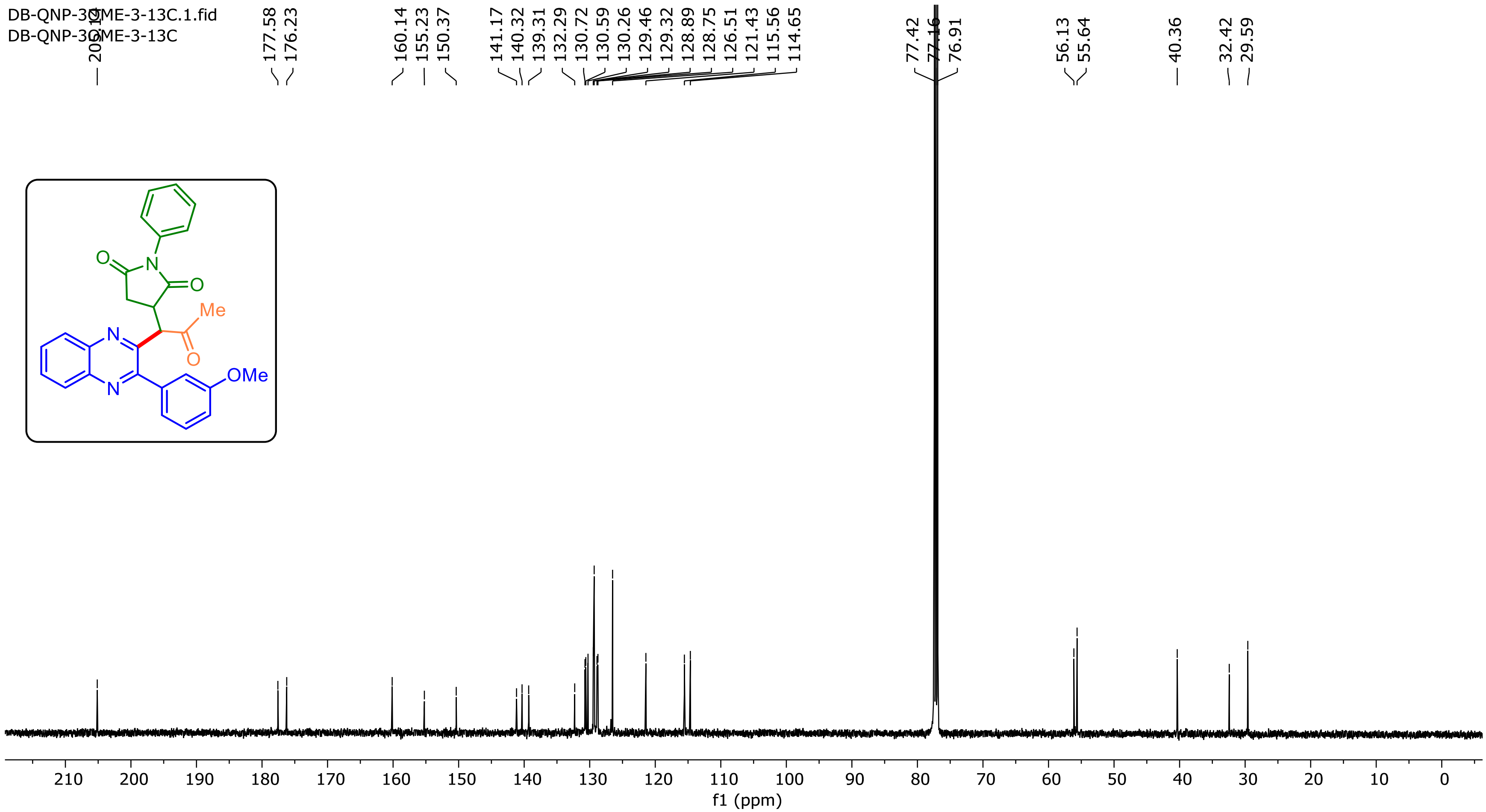
$^{13}C\{^{1}H\}$ NMR of 3-(2-Oxo-1-(3-(m-tolyl)quinoxalin-2-yl)propyl)-1-phenylpyrrolidine-2,5-dione: (3ga) ($CDCl_3$, 126 MHz)



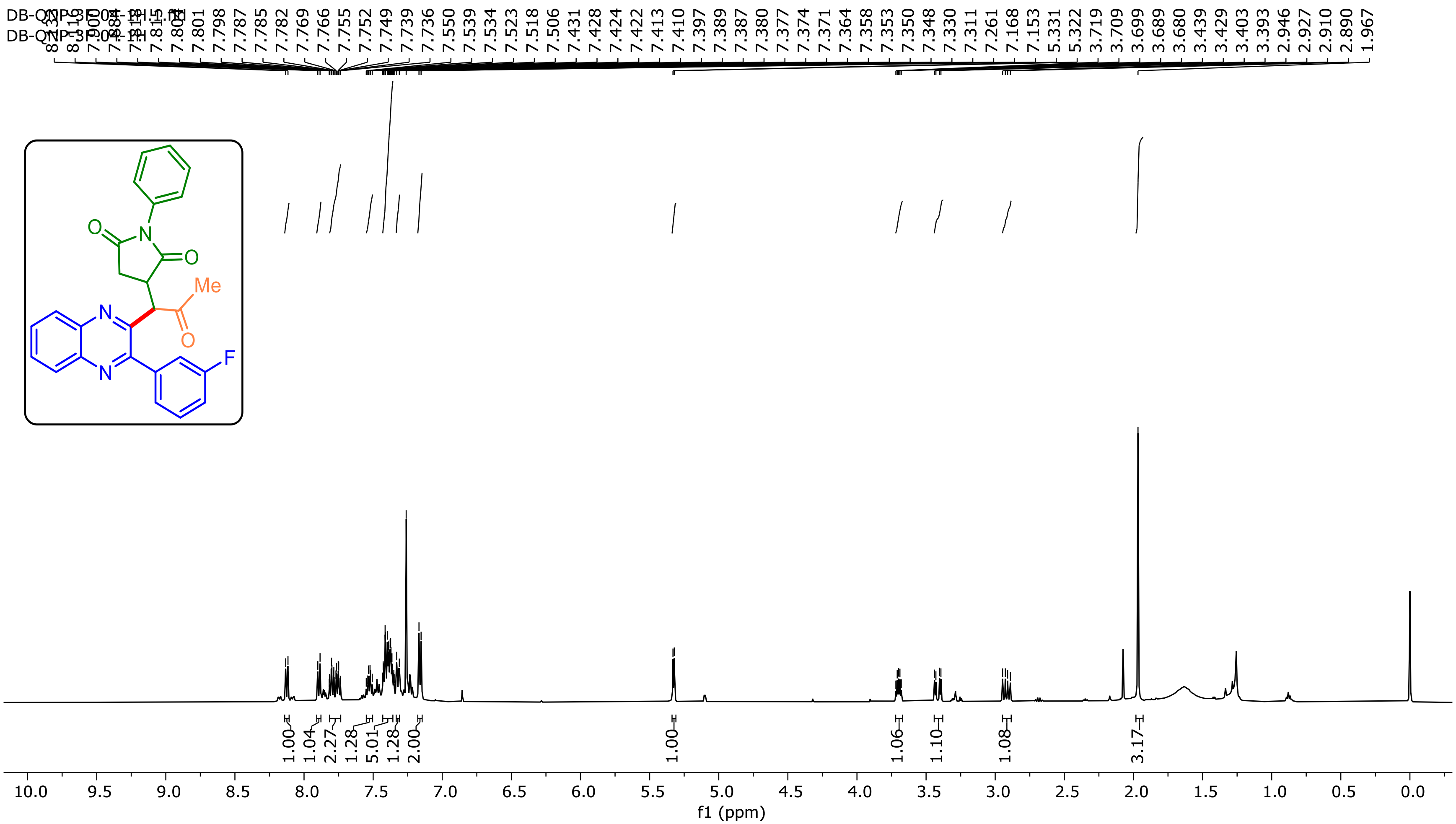
[1]H NMR of 3-(1-(3-(3-Methoxyphenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione: (3ha) ($CDCl_3$, 400 MHz)



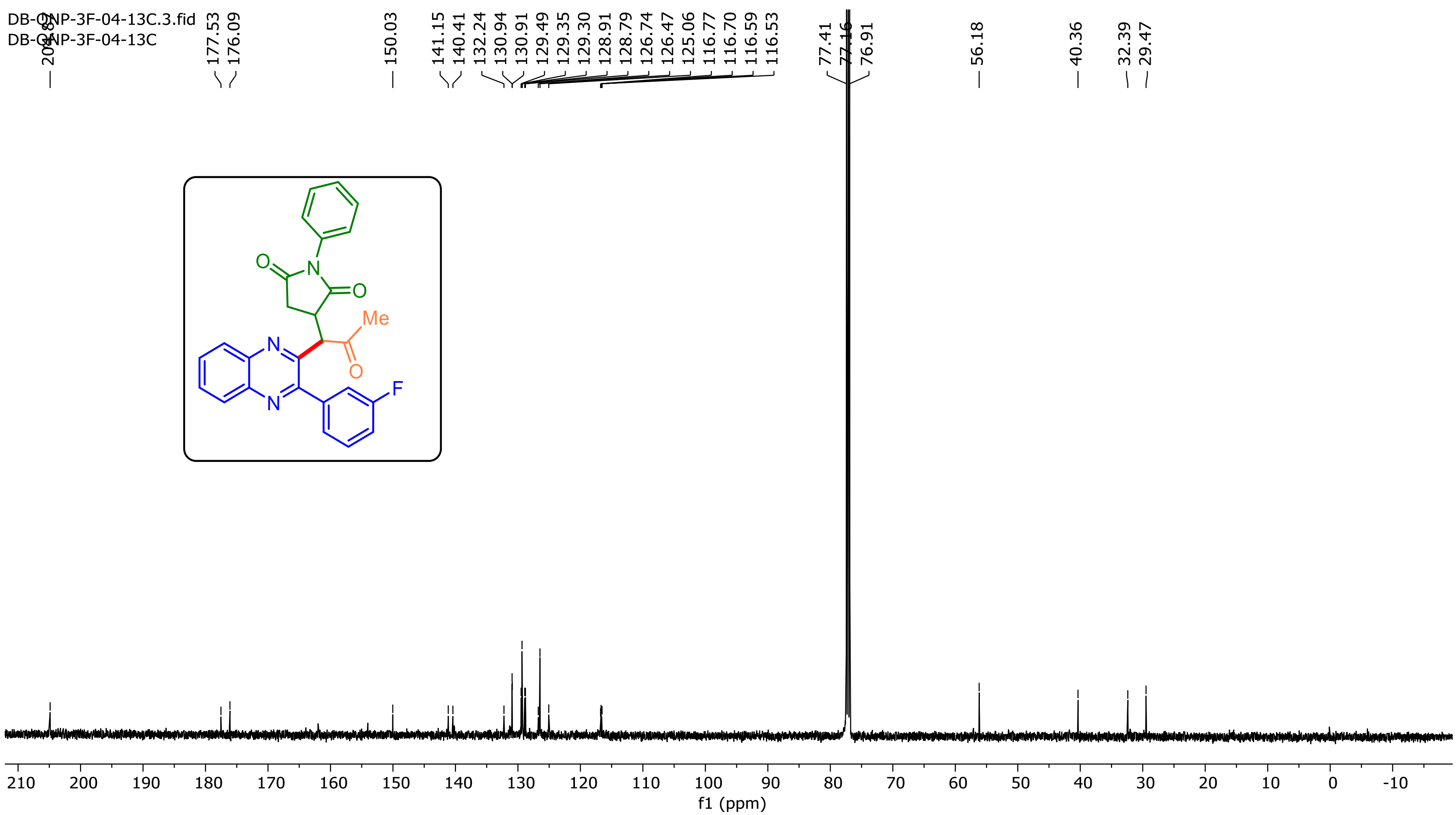
$^{13}C\{^{1}H\}$ NMR of 3-(1-(3-(3-Methoxyphenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione: (3ha) ($CDCl_3$,126MHz)



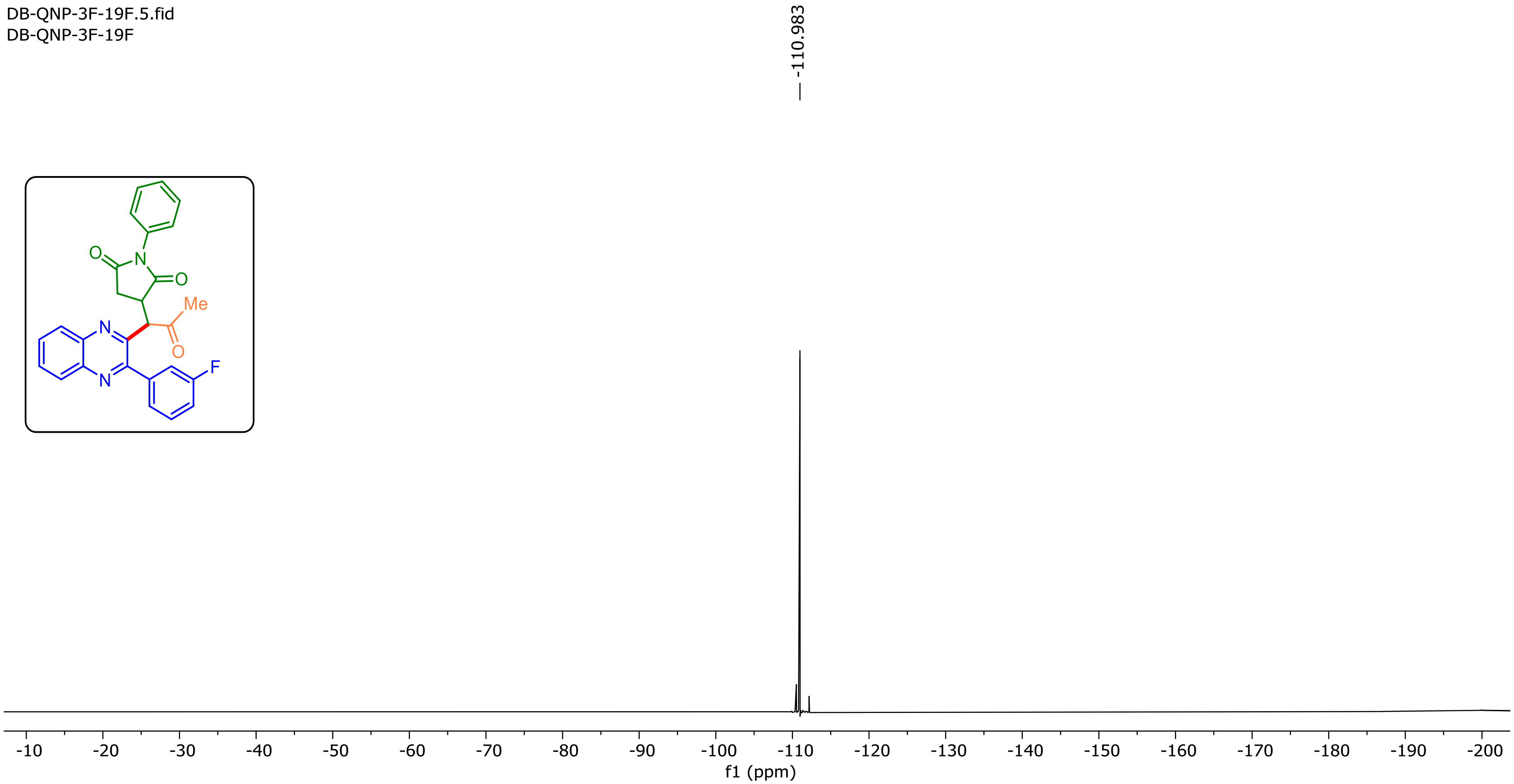
[1]H NMR of 3-(1-(3-(3-Fluorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione: (3ia) (CDCl$_3$, 500 MHz)



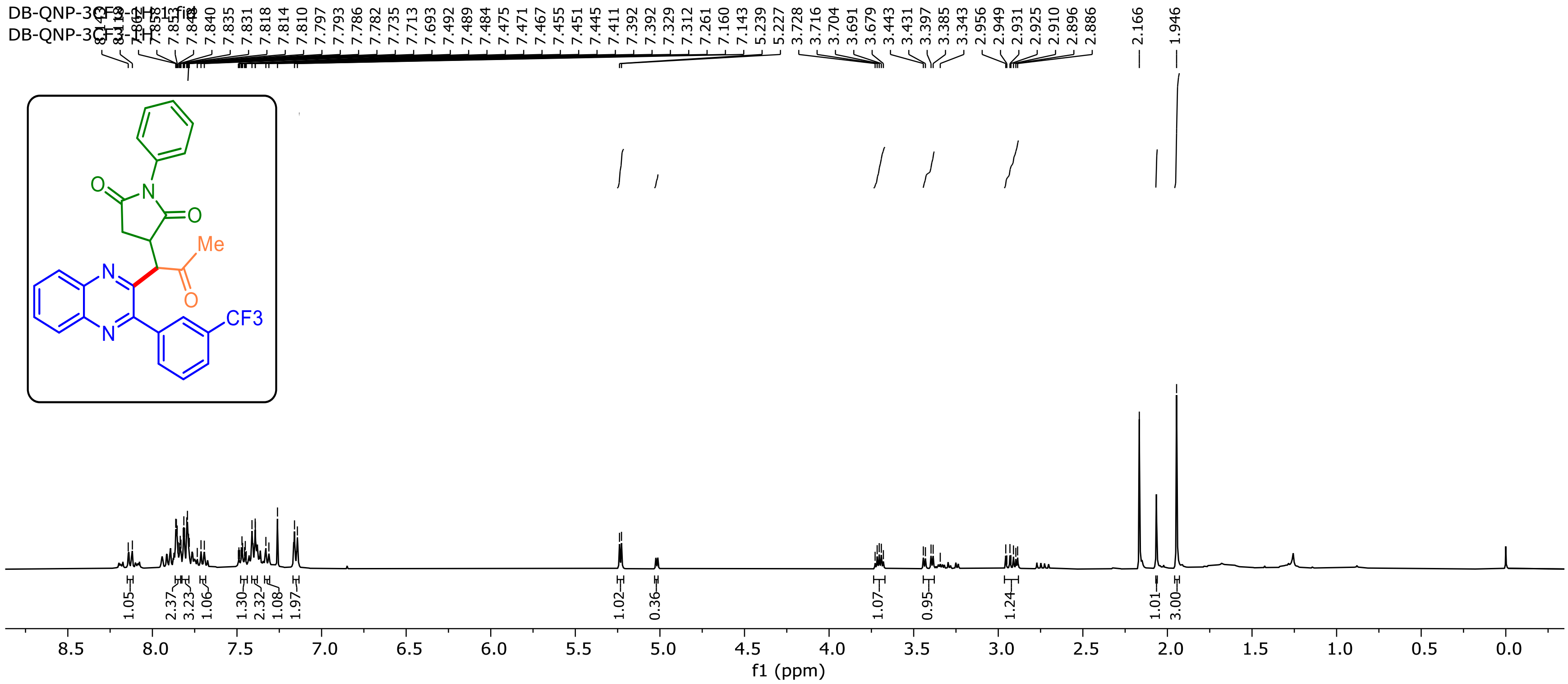
13C{1H} NMR of 3-(1-(3-(3-Fluorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione: (3ia) (CDCl$_3$, 126 MHz)



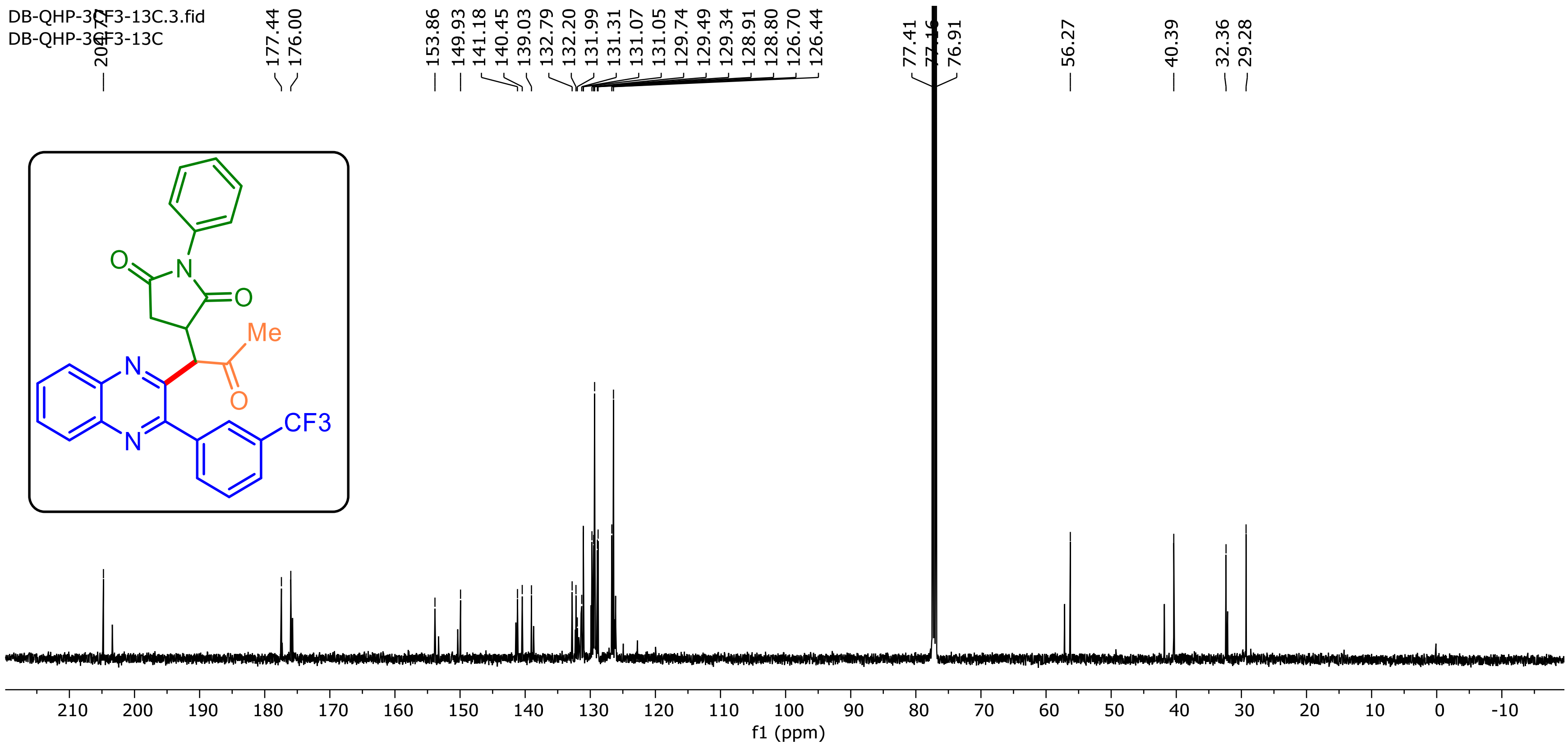
[19]F NMR of 3-(1-(3-(3-Fluorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione: (3ia) $CDCl_3$



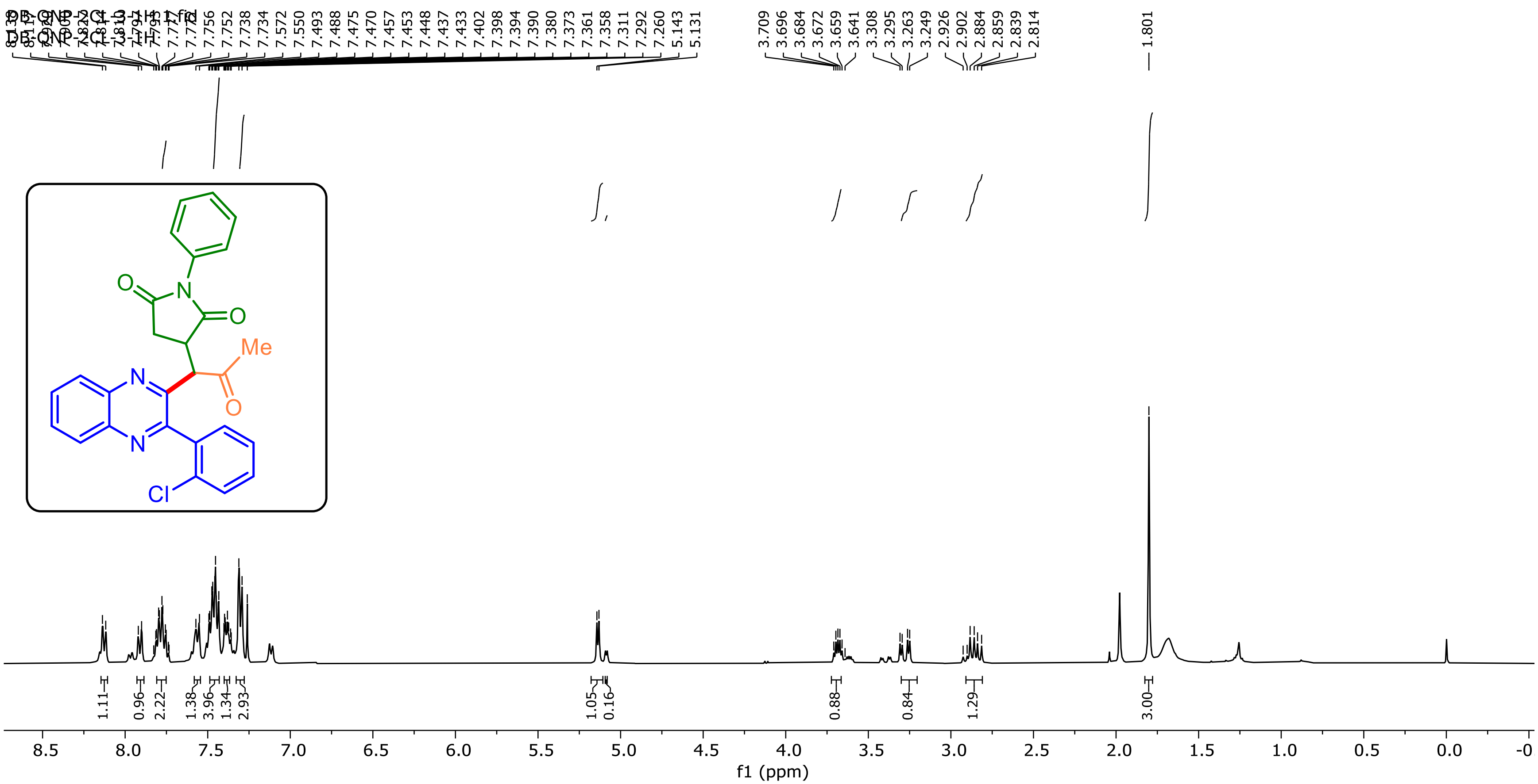
[1]H NMR of 3-(2-Oxo-1-(3-(3-(trifluoromethyl)phenyl)quinoxalin-2-yl)propyl)-1-phenylpyrrolidine-2,5-dione (3ja):



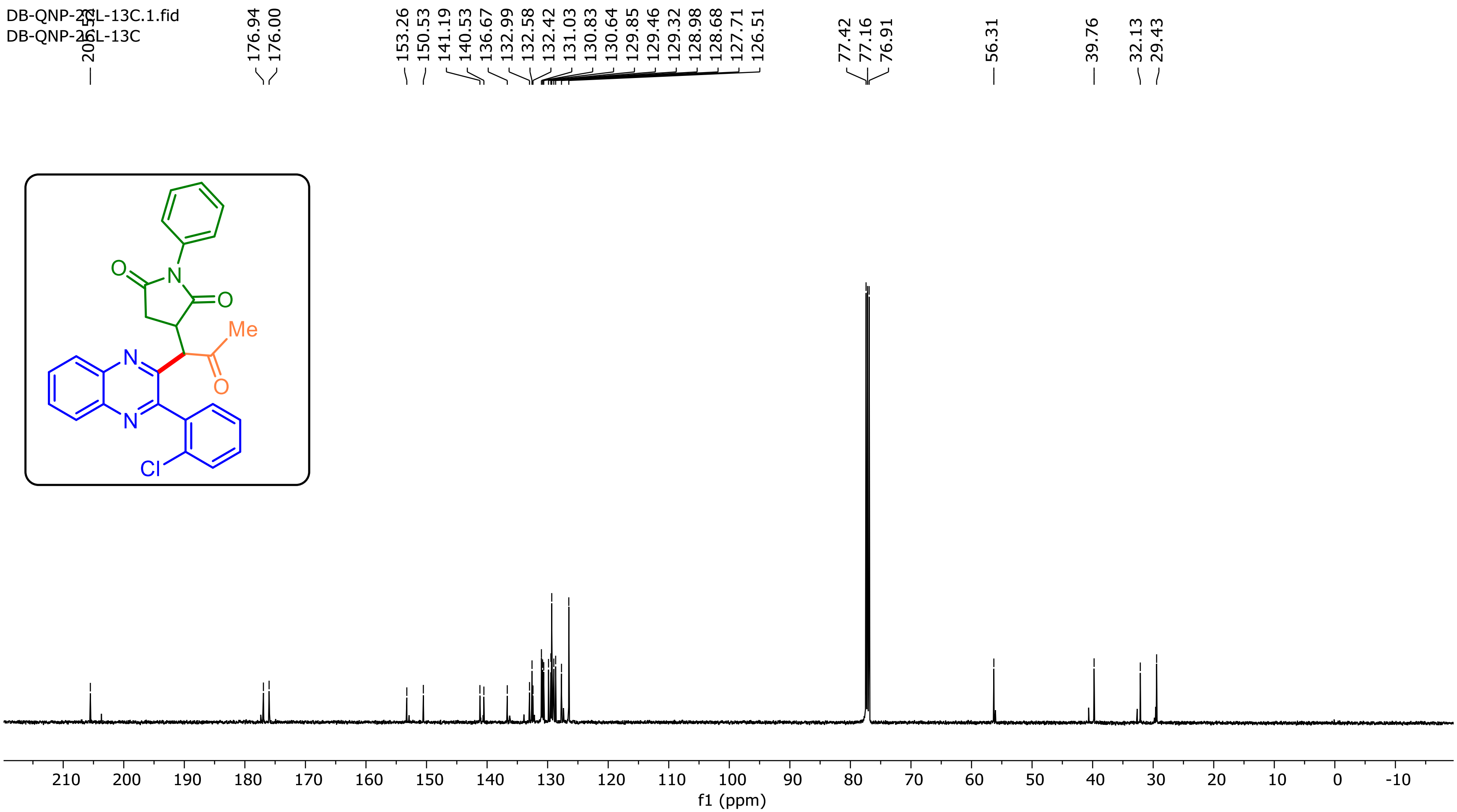
[13]C{[1]H} of 3-(2-Oxo-1-(3-(3-(trifluoromethyl)phenyl)quinoxalin-2-yl)propyl)-1-phenylpyrrolidine-2,5-dione (3ja):



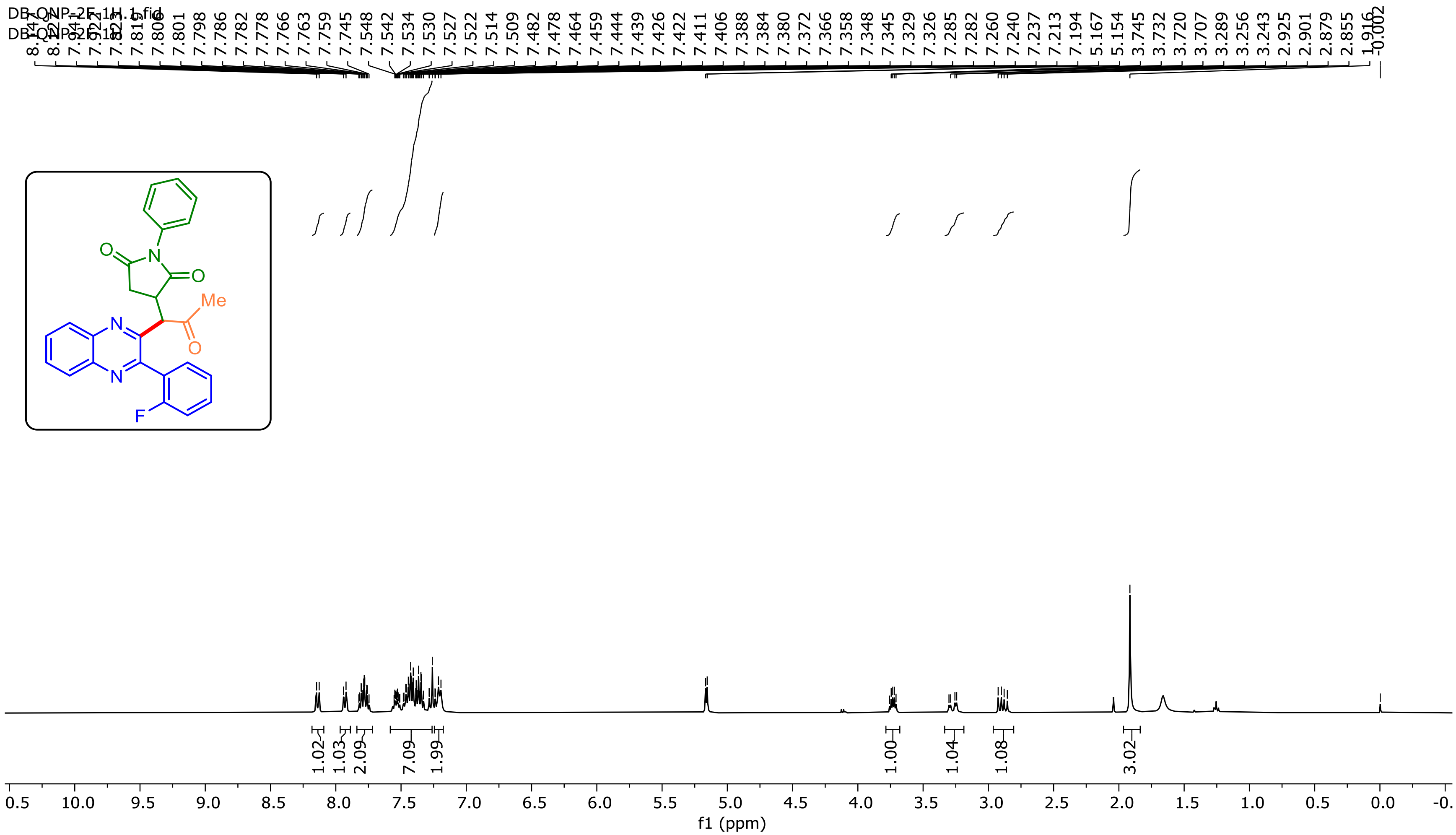
[1]H NMR of 3-(1-(3-(2-Chlorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3ka):



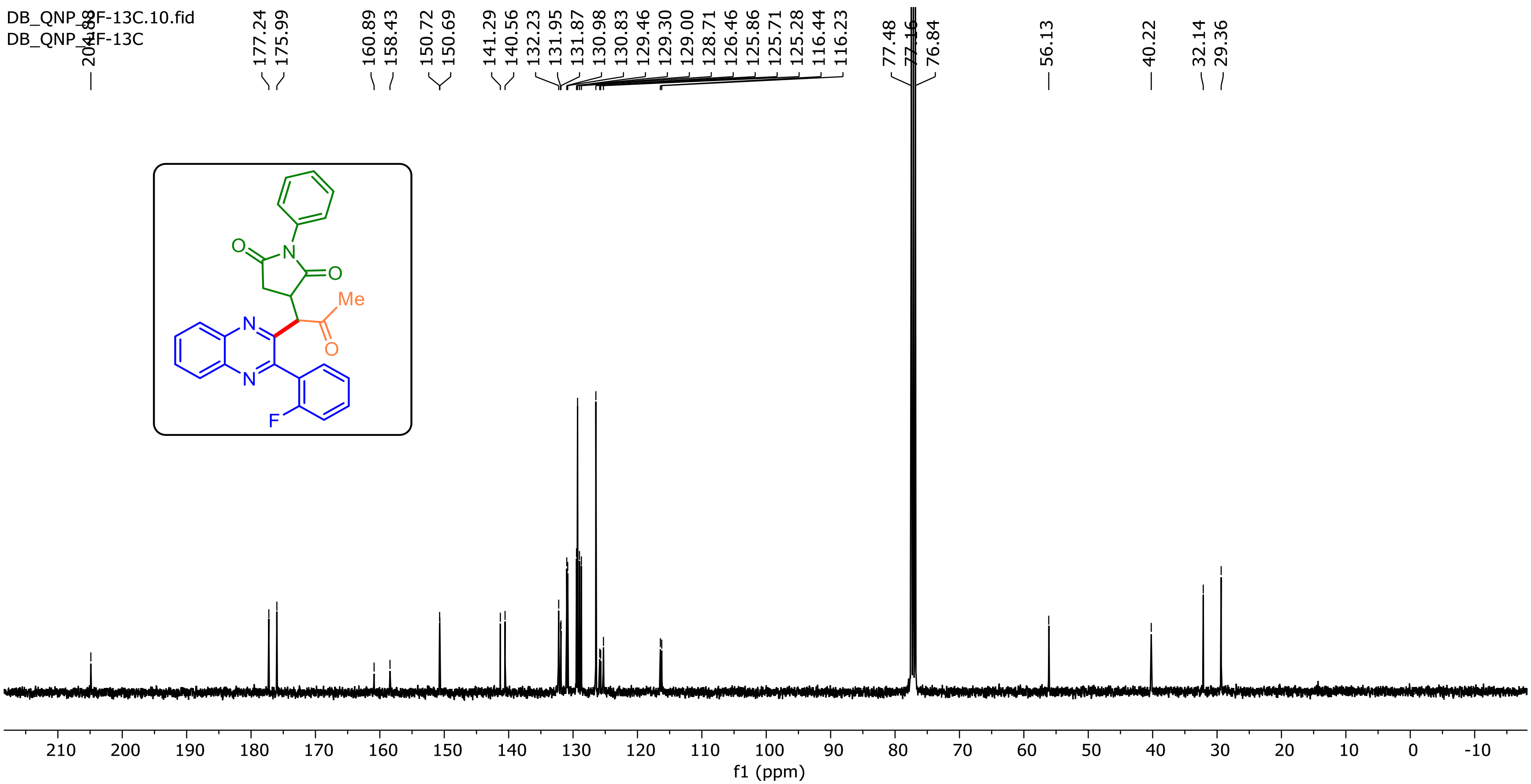
[13]C{[1]H} NMR of 3-(1-(3-(2-Chlorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3ka):



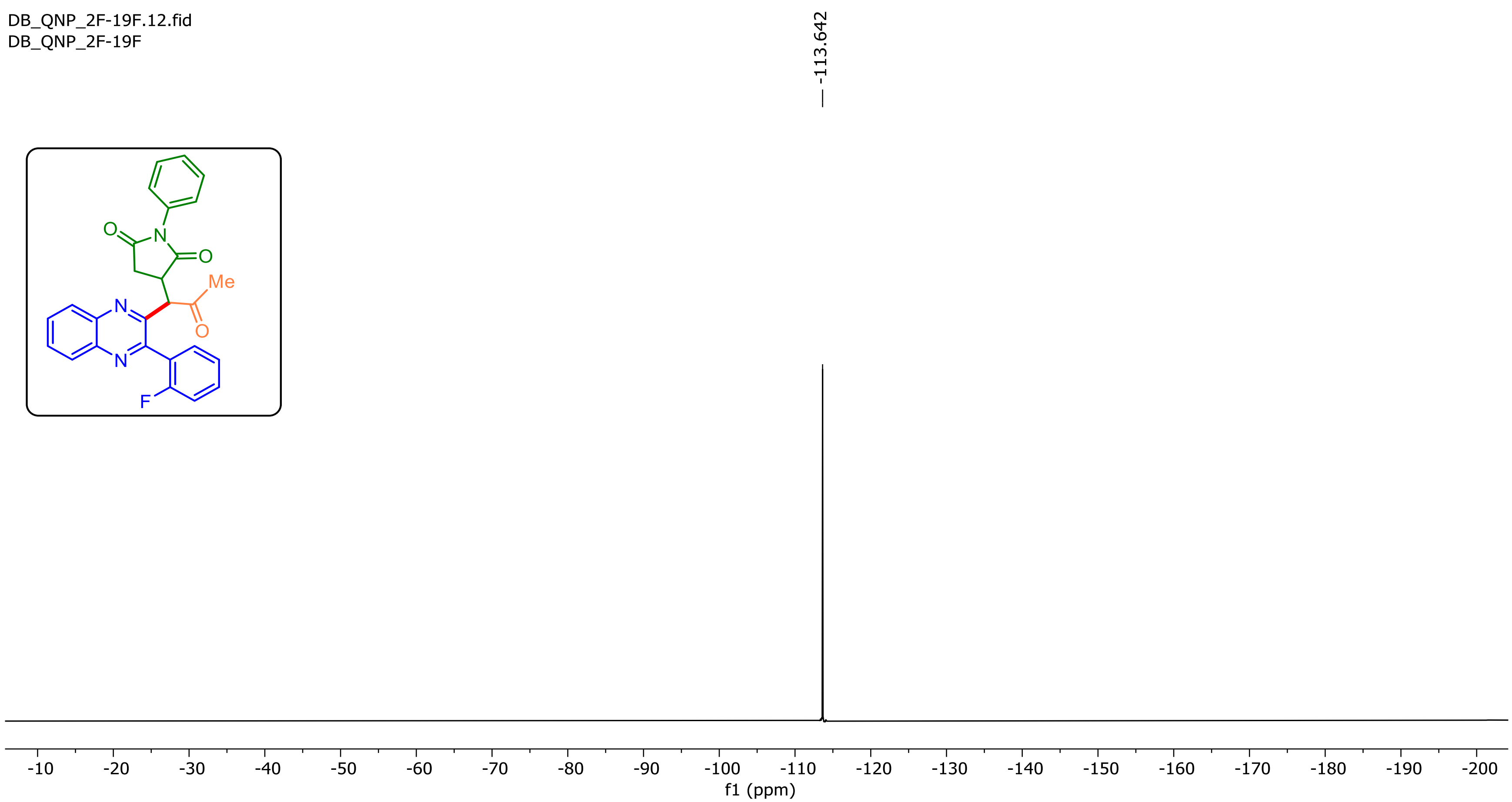
[1]H NMR of 3-(1-(3-(2-Fluorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3la) ($CDCl_3$, 400 MHz)



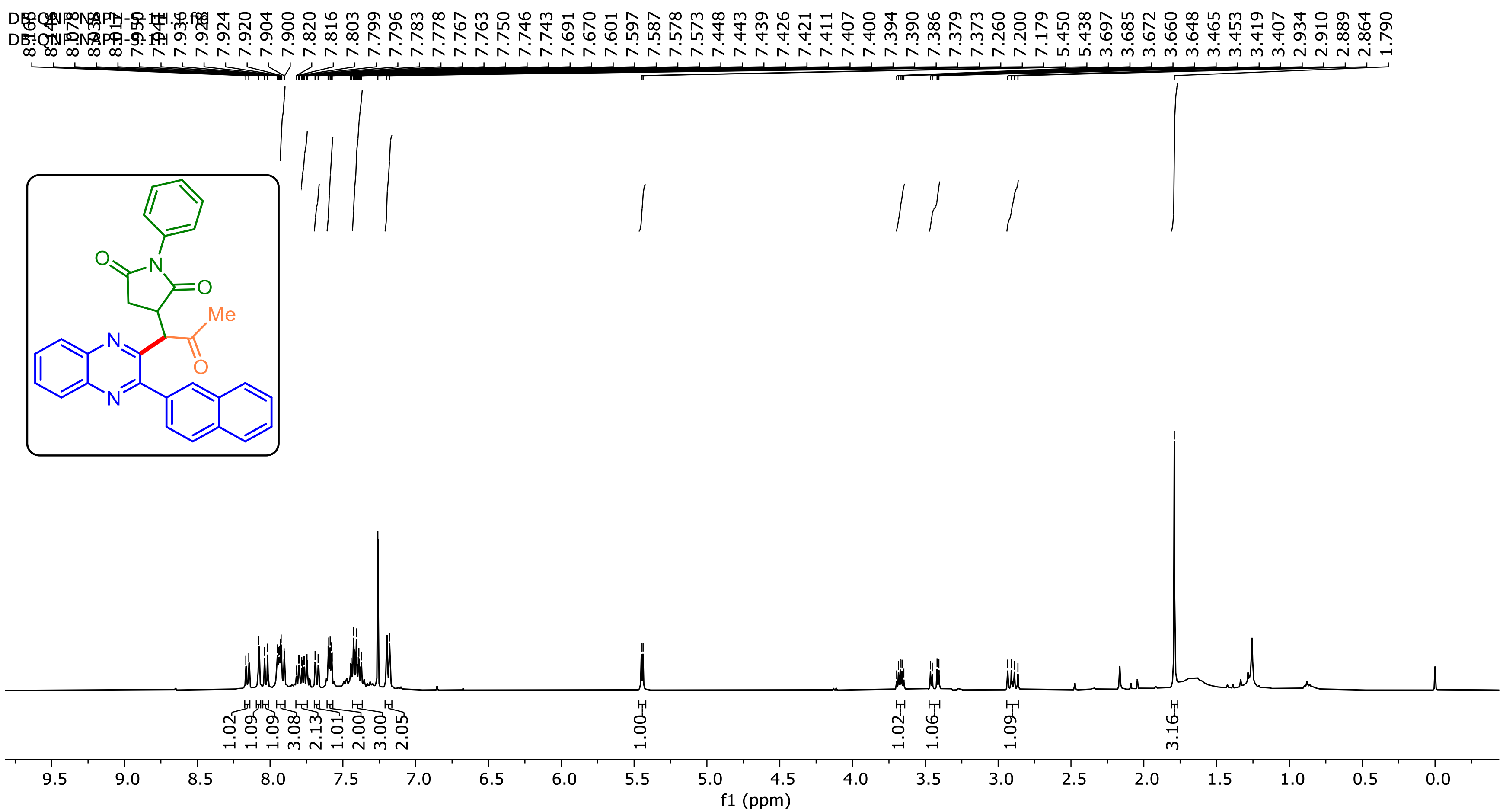
$^{13}C\{^{1}H\}$ ***NMR of 3-(1-(3-(2-Fluorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3la) (CDCl$_3$, 101 MHz)***



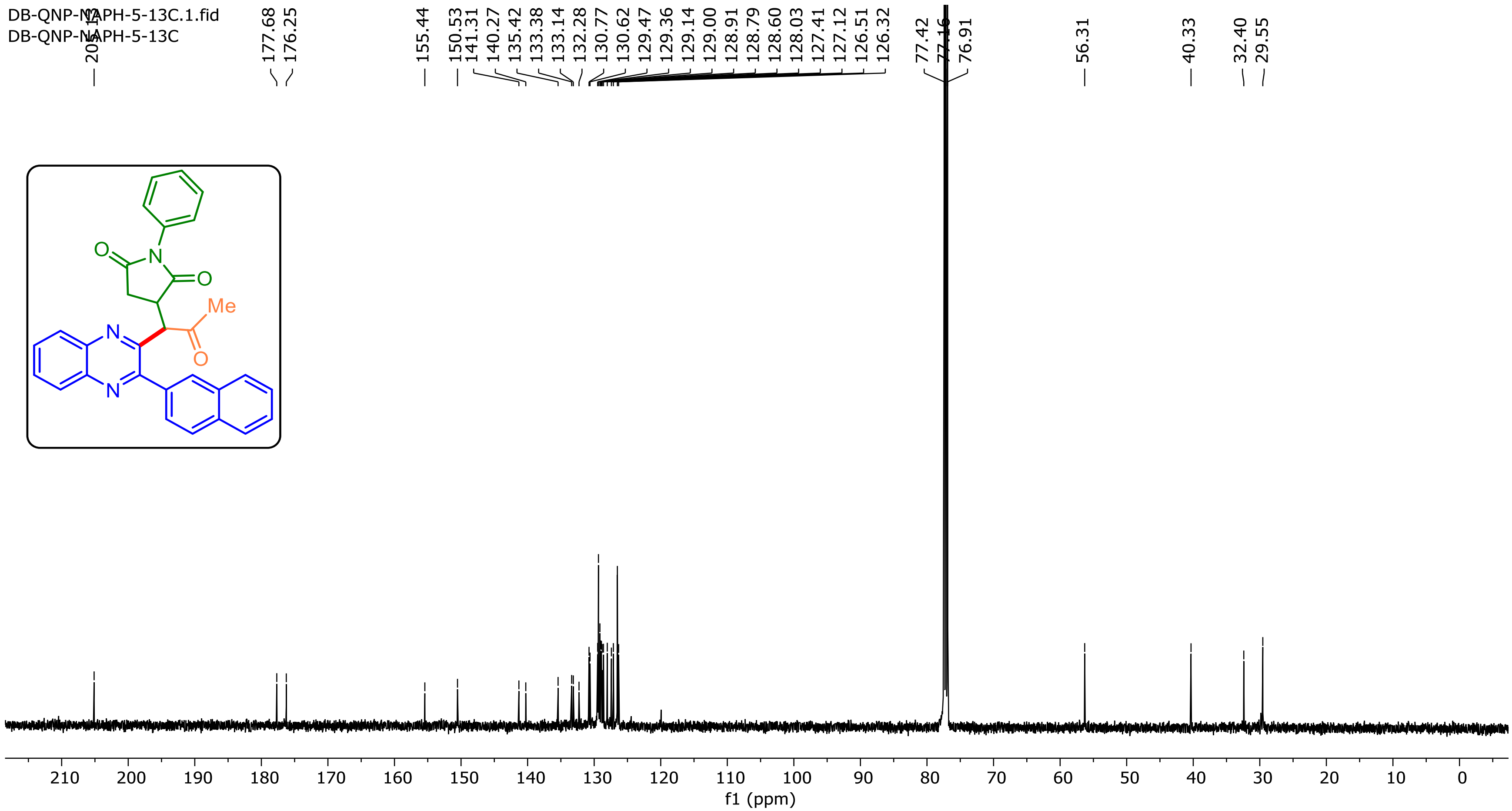
[19]F NMR of 3-(1-(3-(2-Fluorophenyl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3la) ($CDCl_3$)



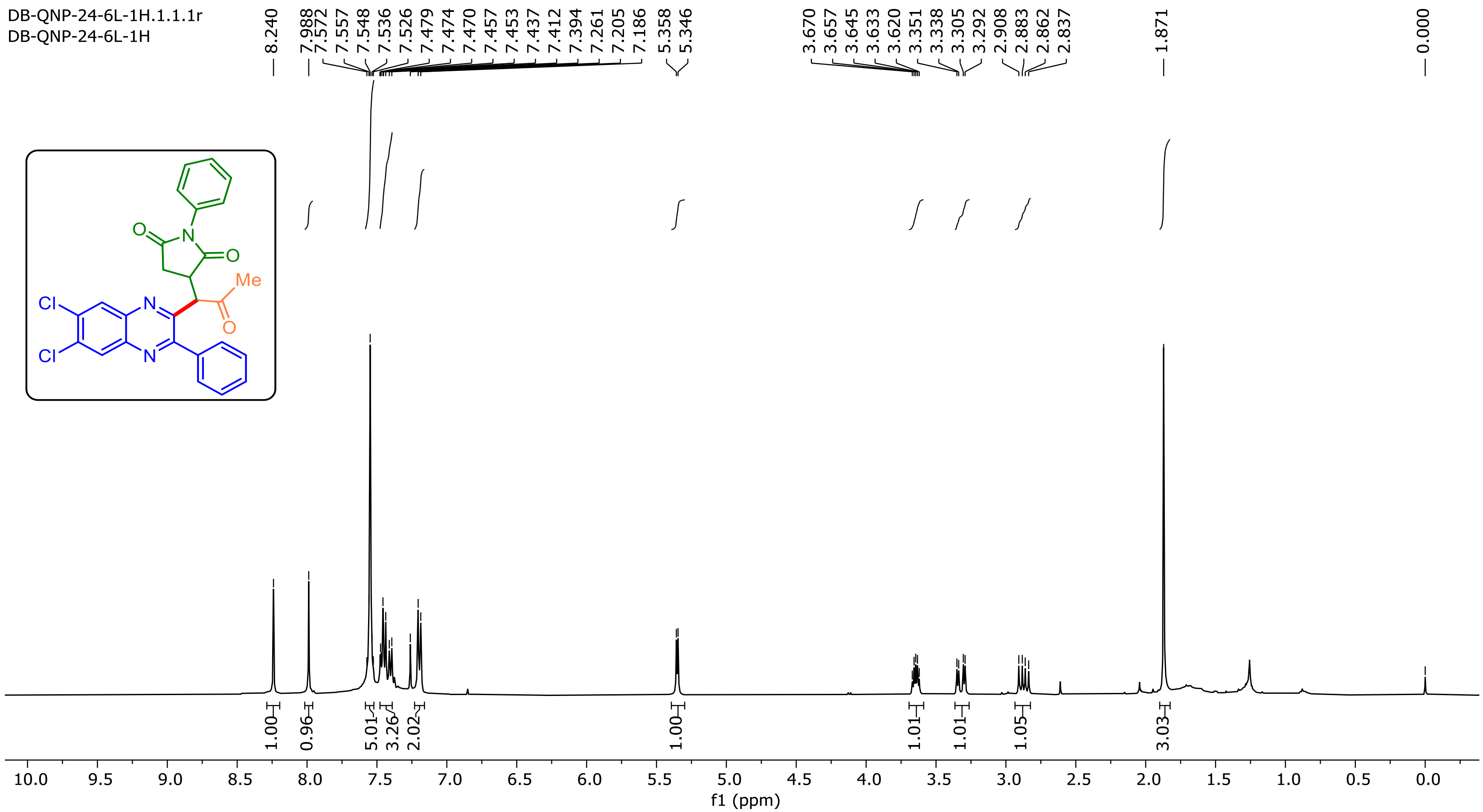
[1]H NMR of 3-(1-(3-(Naphthalen-2-yl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione: (3ma) ($CDCl_3$, 400 MHz)



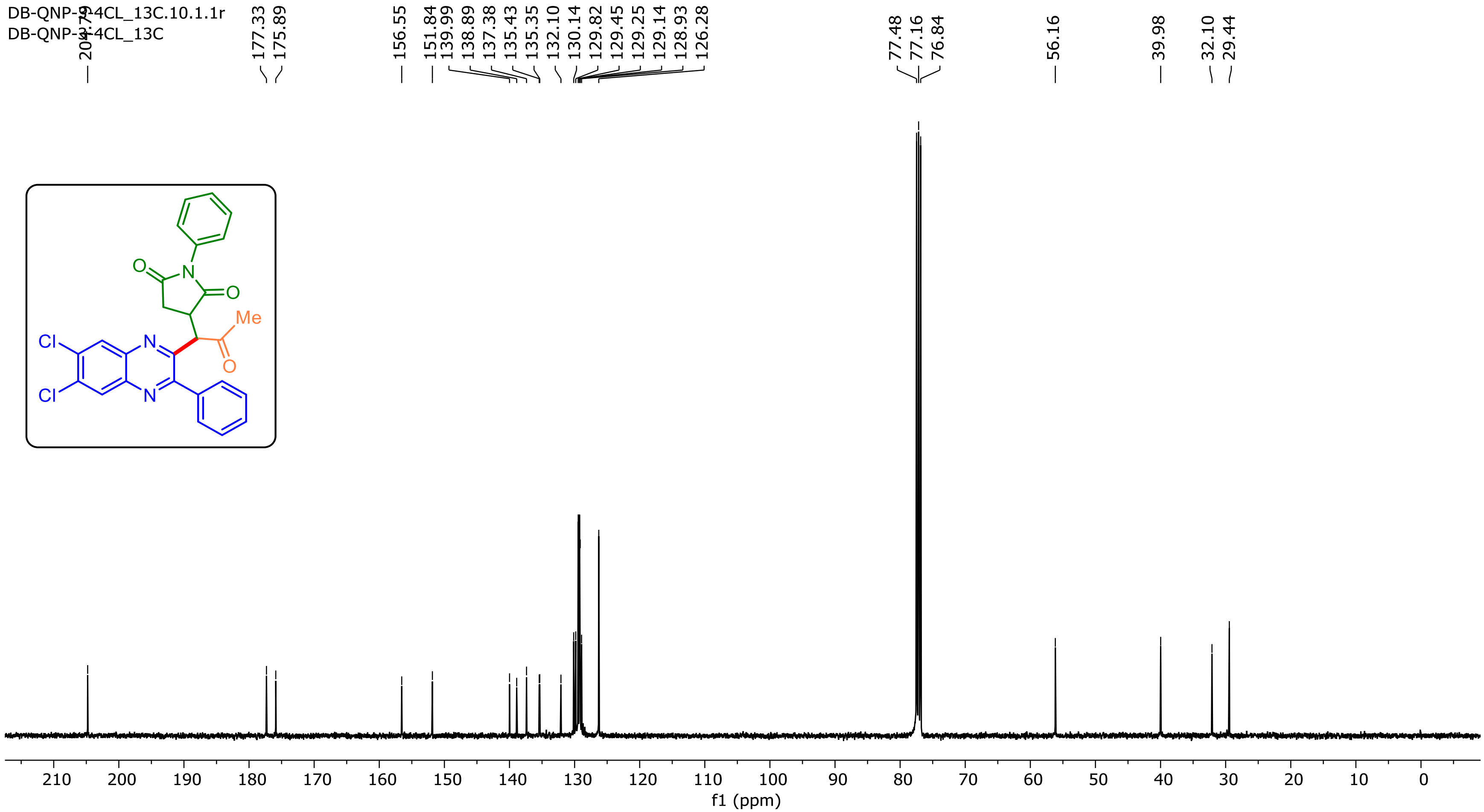
[13]C{[1]H} NMR of 3-(1-(3-(Naphthalen-2-yl)quinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3ma) ($CDCl_3$, 126 MHz)



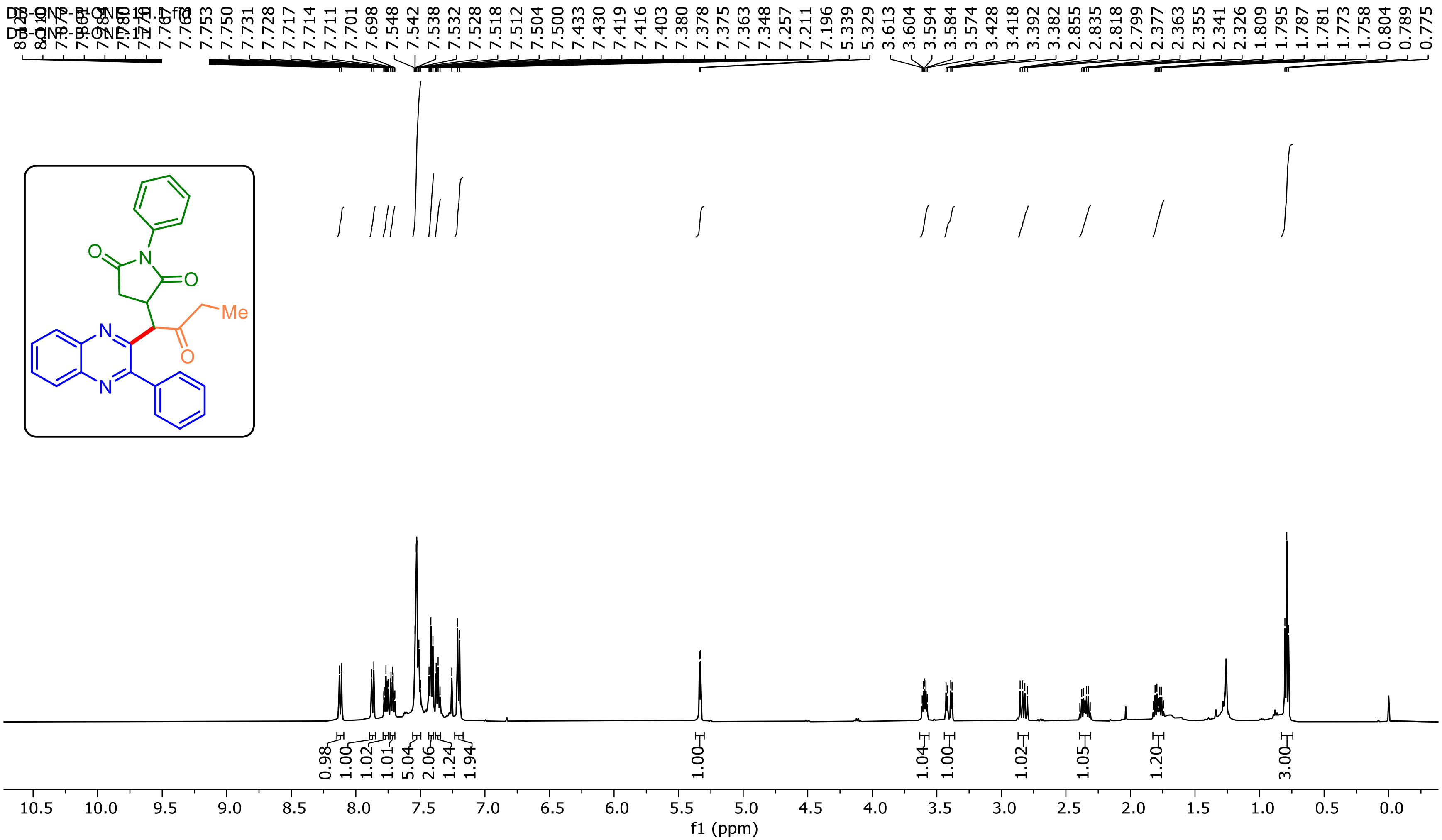
[1]H NMR of 3-(1-(6,7-Dichloro-3-phenylquinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3na) ($CDCl_3$, 400 MHz)



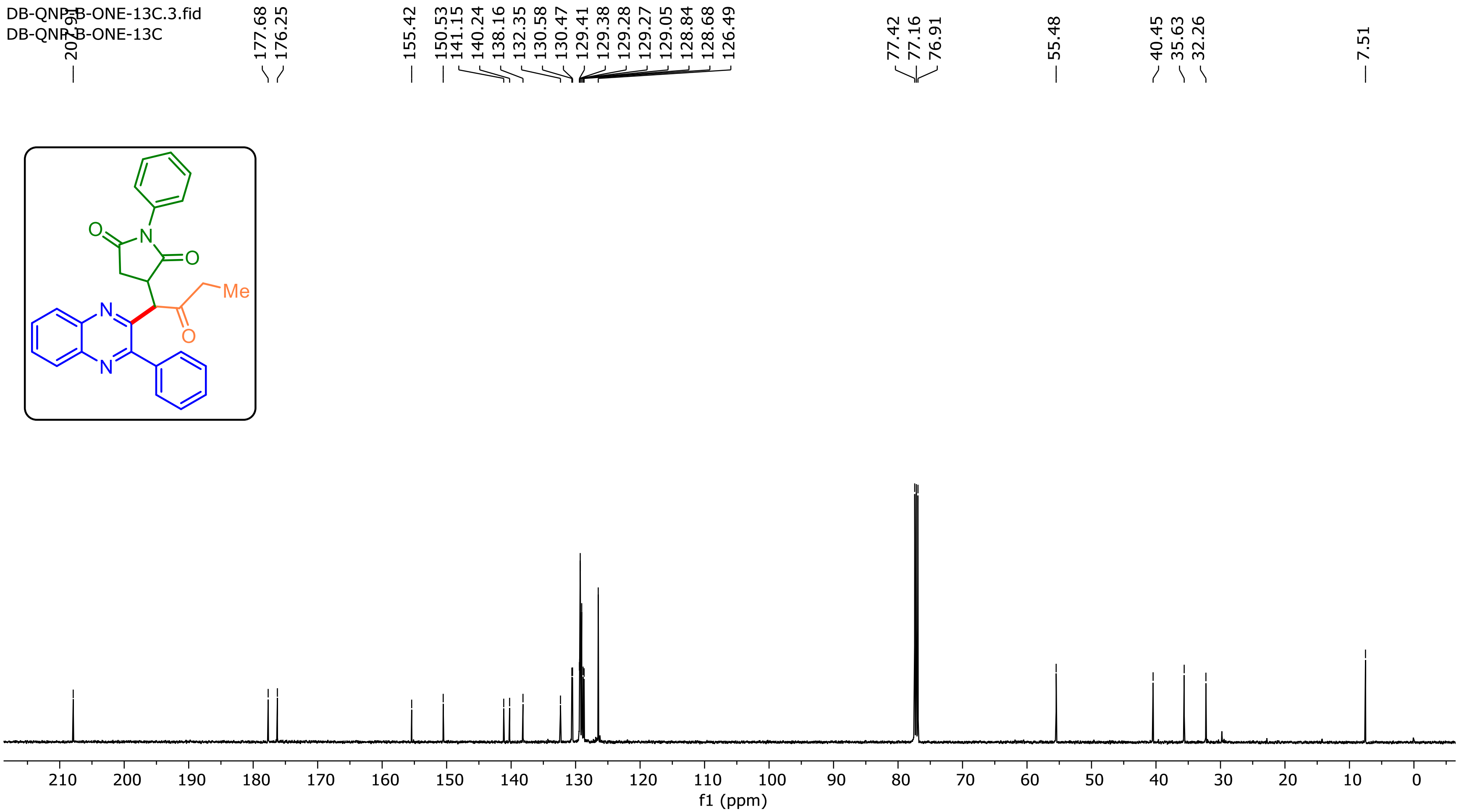
[13]C{[1]H} NMR of 3-(1-(6,7-Dichloro-3-phenylquinoxalin-2-yl)-2-oxopropyl)-1-phenylpyrrolidine-2,5-dione (3na) ($CDCl_3$, 101 MHz)



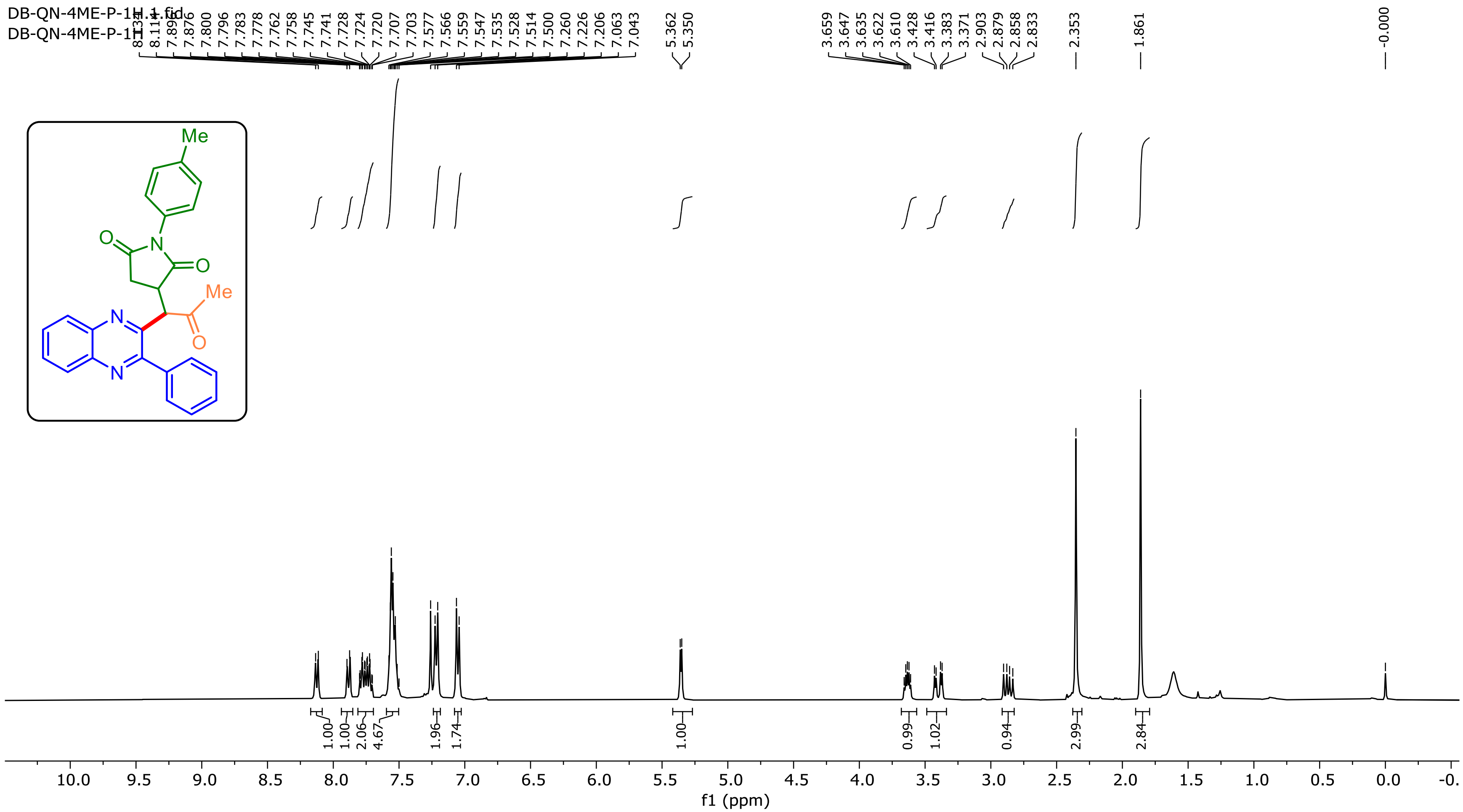
[1]H NMR of 3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)butyl)-1-phenylpyrrolidine-2,5-dione (4aa) ($CDCl_3$, 500 MHz)



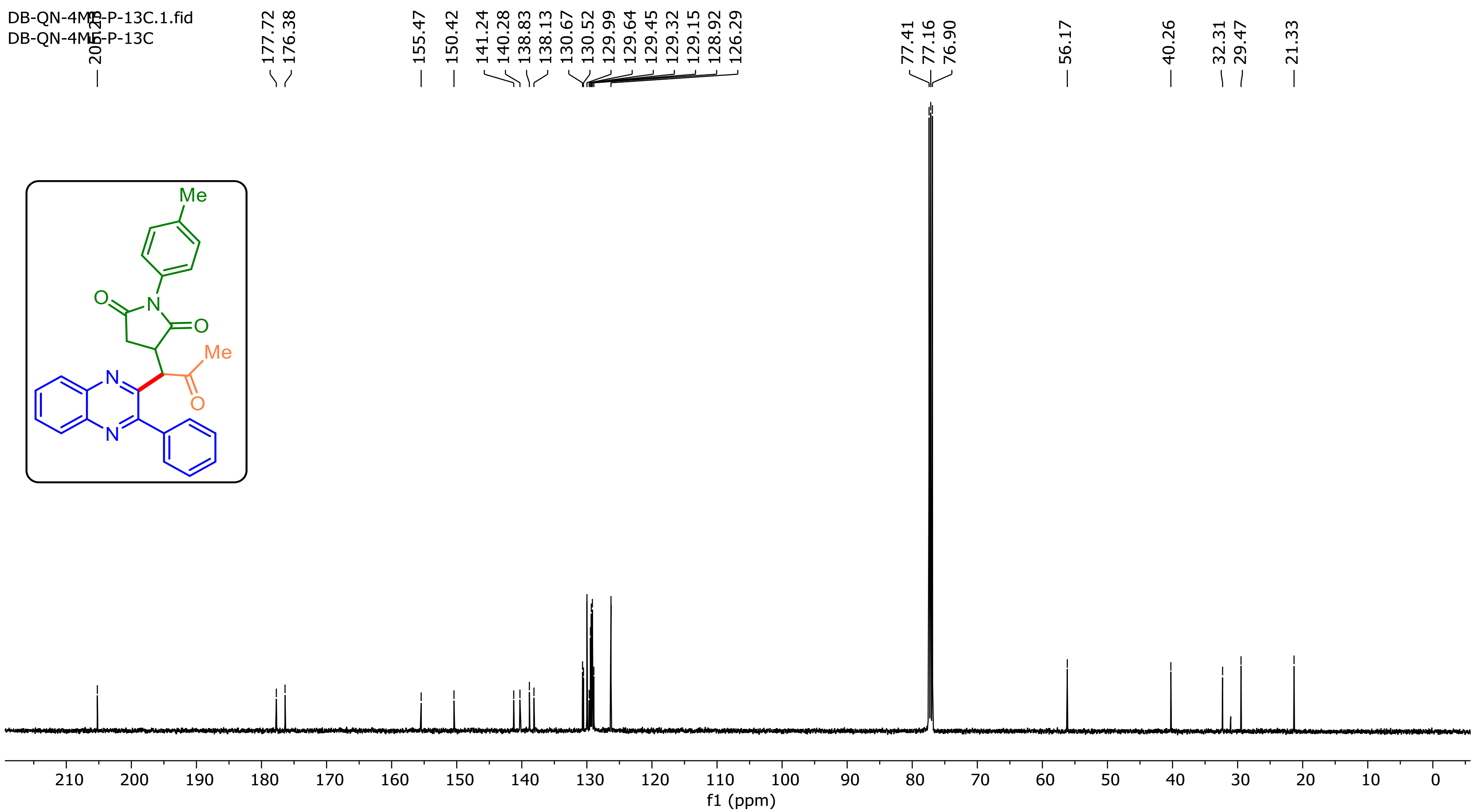
$^{13}C\{^{1}H\}$ NMR of 3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)butyl)-1-phenylpyrrolidine-2,5-dione (4aa) ($CDCl_3$, 126 MHz)



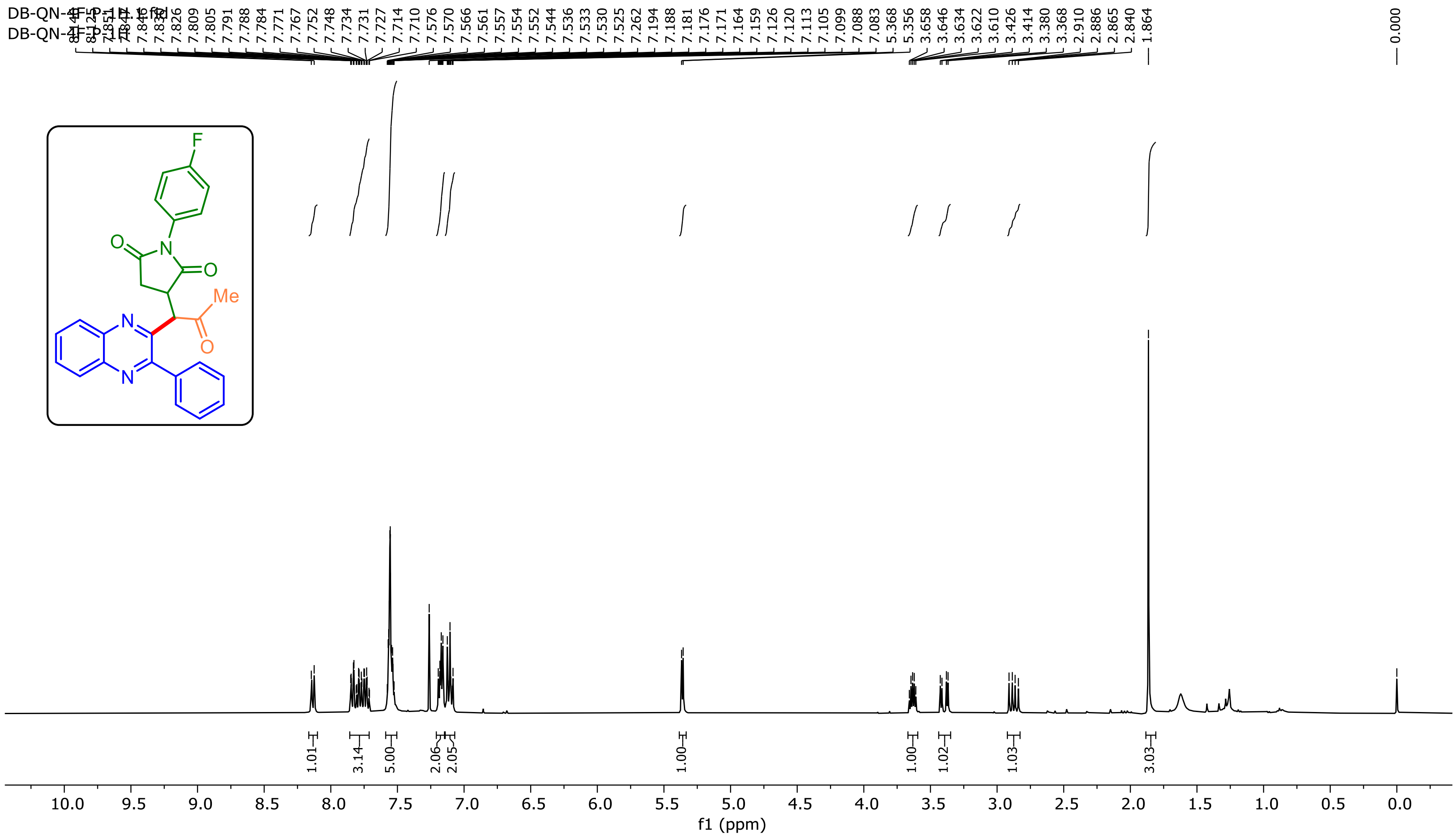
[1]H NMR of 3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)propyl)-1-(p-tolyl)pyrrolidine-2,5-dione: (3ab) ($CDCl_3$, 400 MHz)



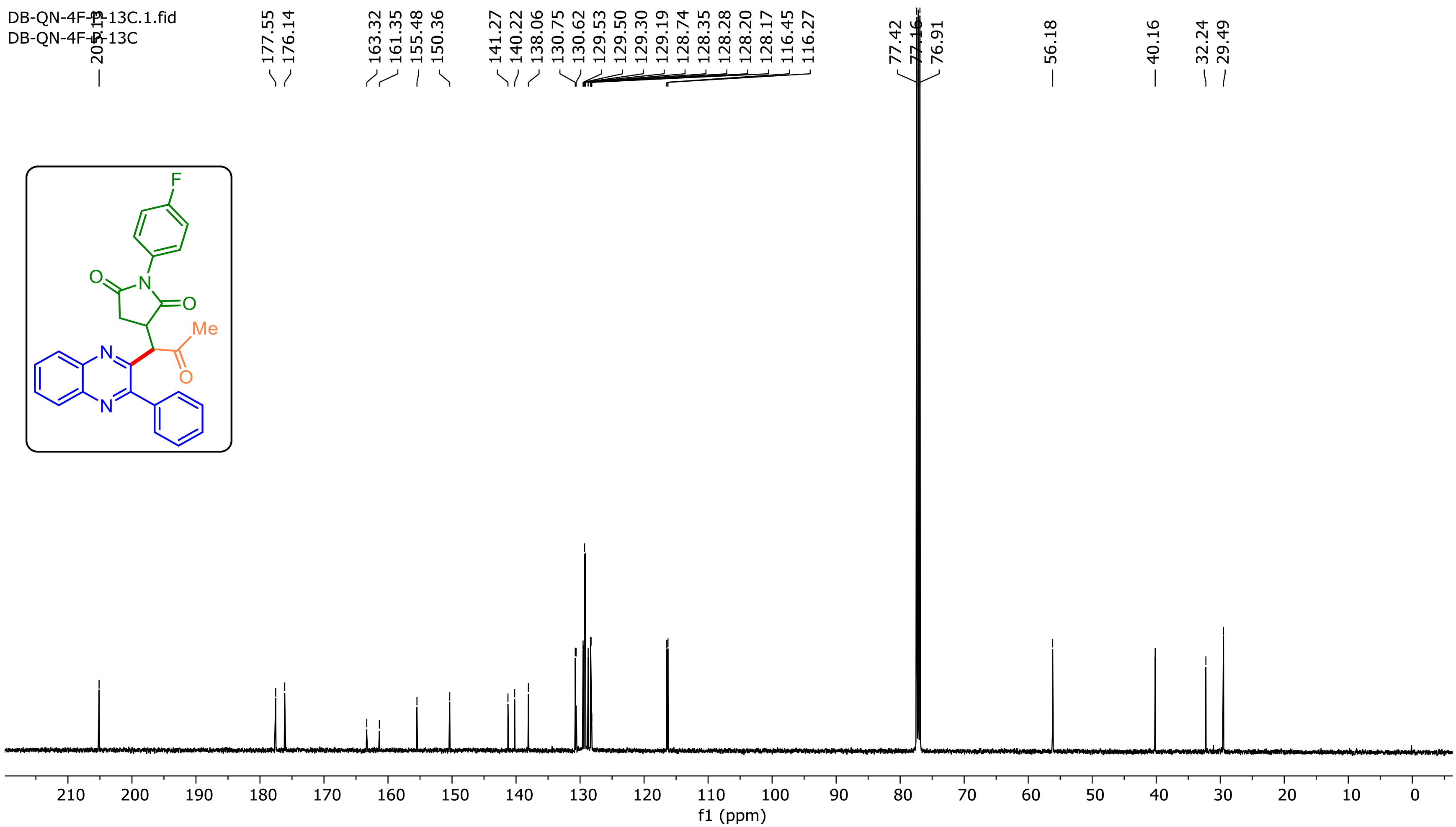
[13]C{[1]H} NMR of 3-(2-oxo-1-(3-Phenylquinoxalin-2-yl)propyl)-1-(p-tolyl)pyrrolidine-2,5-dione: (3ab) (CDCl$_3$, 126 MHz)



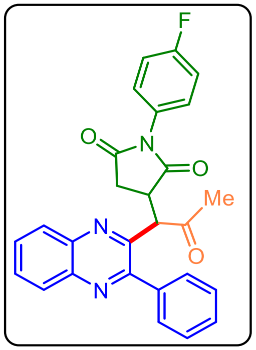
[1]H NMR of 1-(4-Fluorophenyl)-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3ac) (CDCl$_3$, 400 MHz)

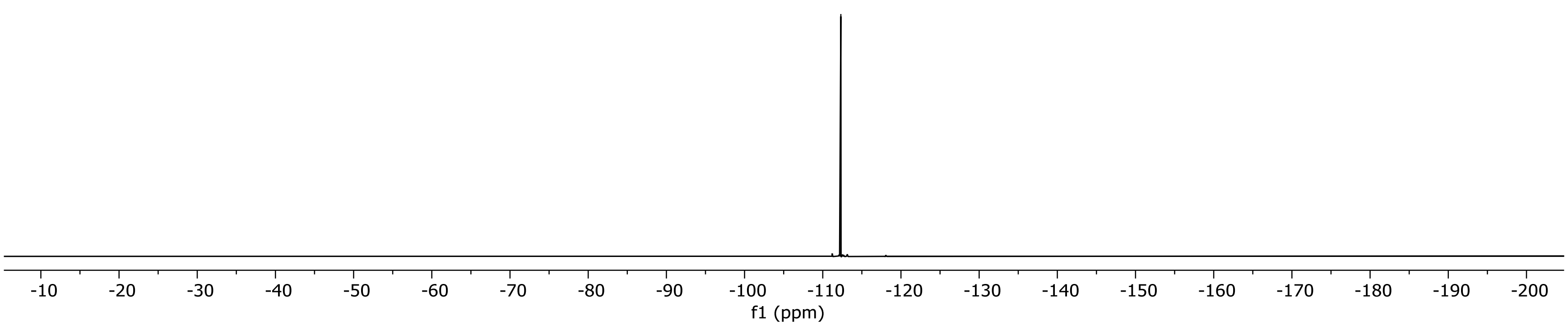


$^{13}C\{^1H\}$ ***NMR of 1-(4-Fluorophenyl)-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3ac) ($CDCl_3$, 126 MHz)***

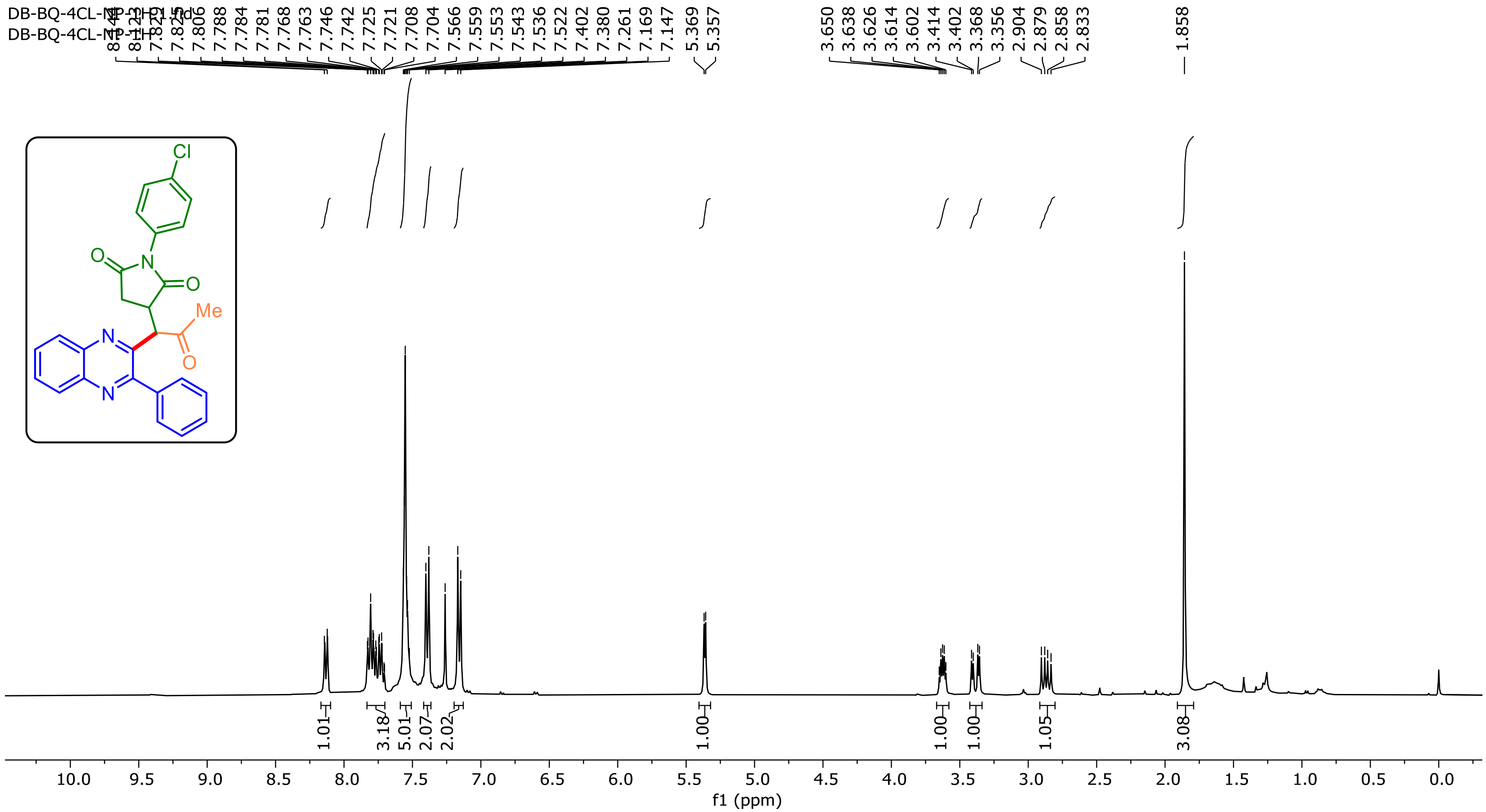


[19]F NMR of 1-(4-Fluorophenyl)-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3ac)

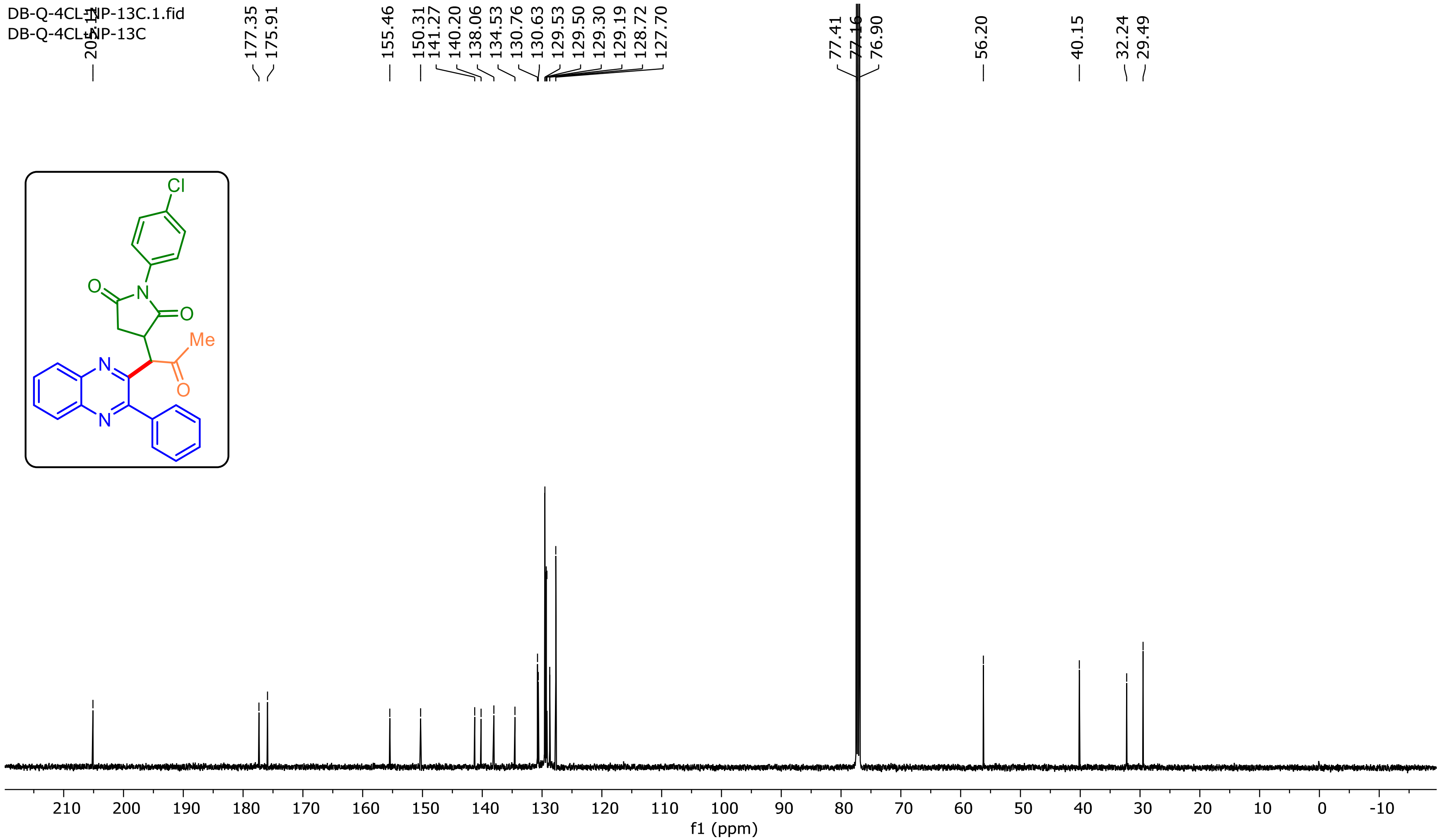




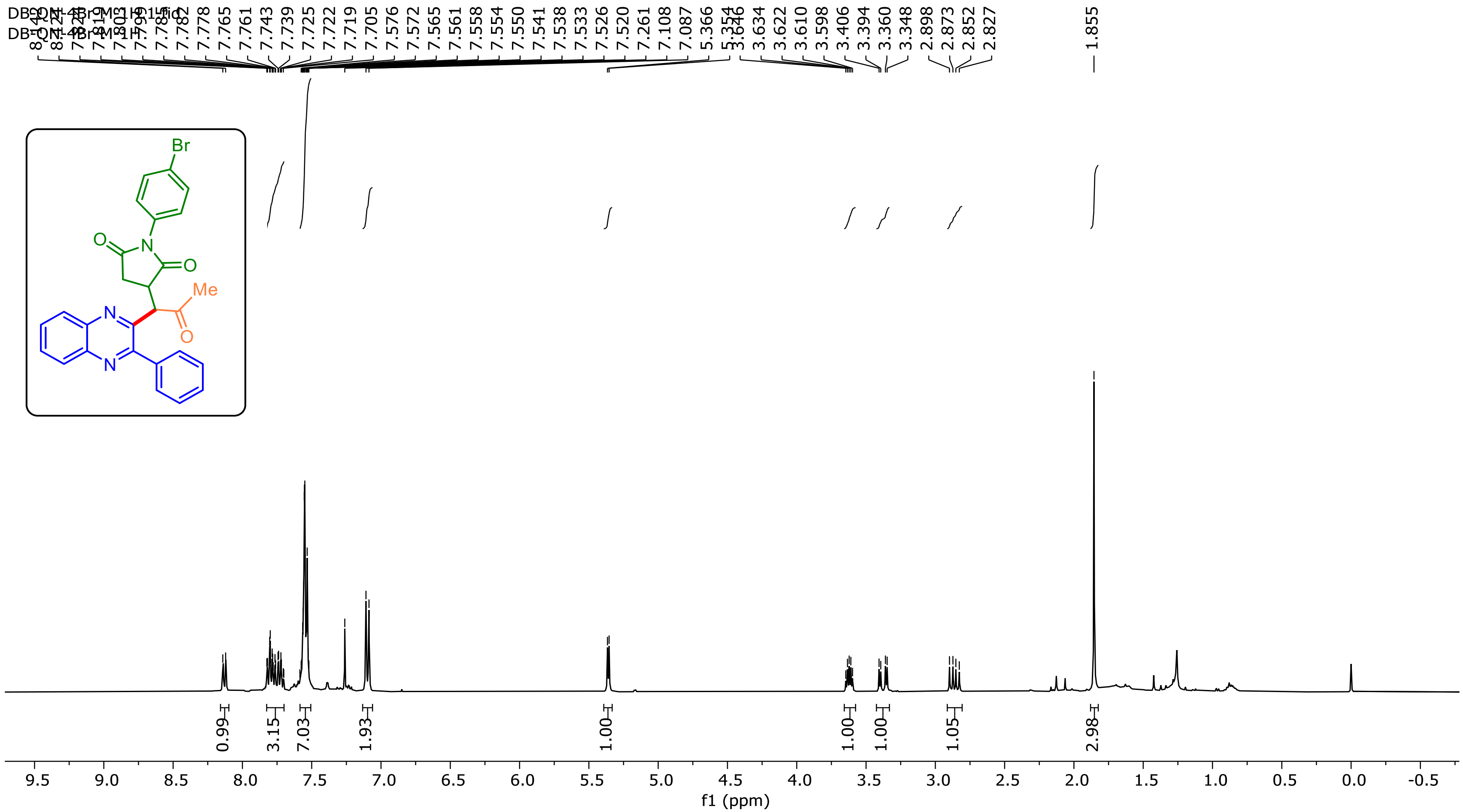
[1]H NMR of 1-(4-Chlorophenyl)-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3ad) ($CDCl_3$, 400 MHz)



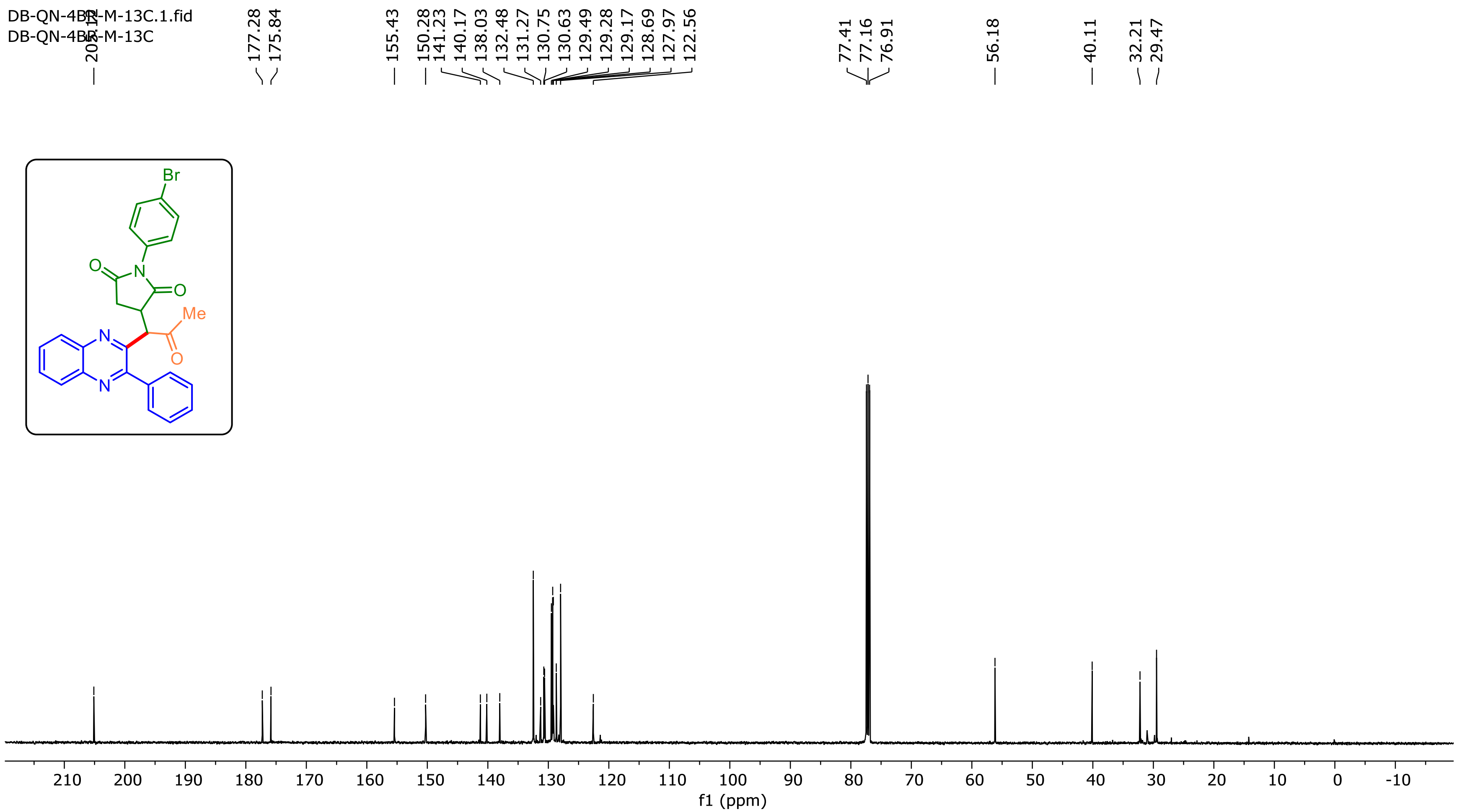
$^{13}C\{^1H\}$ NMR of 1-(4-Chlorophenyl)-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3ad) ($CDCl_3$, 126 MHz)



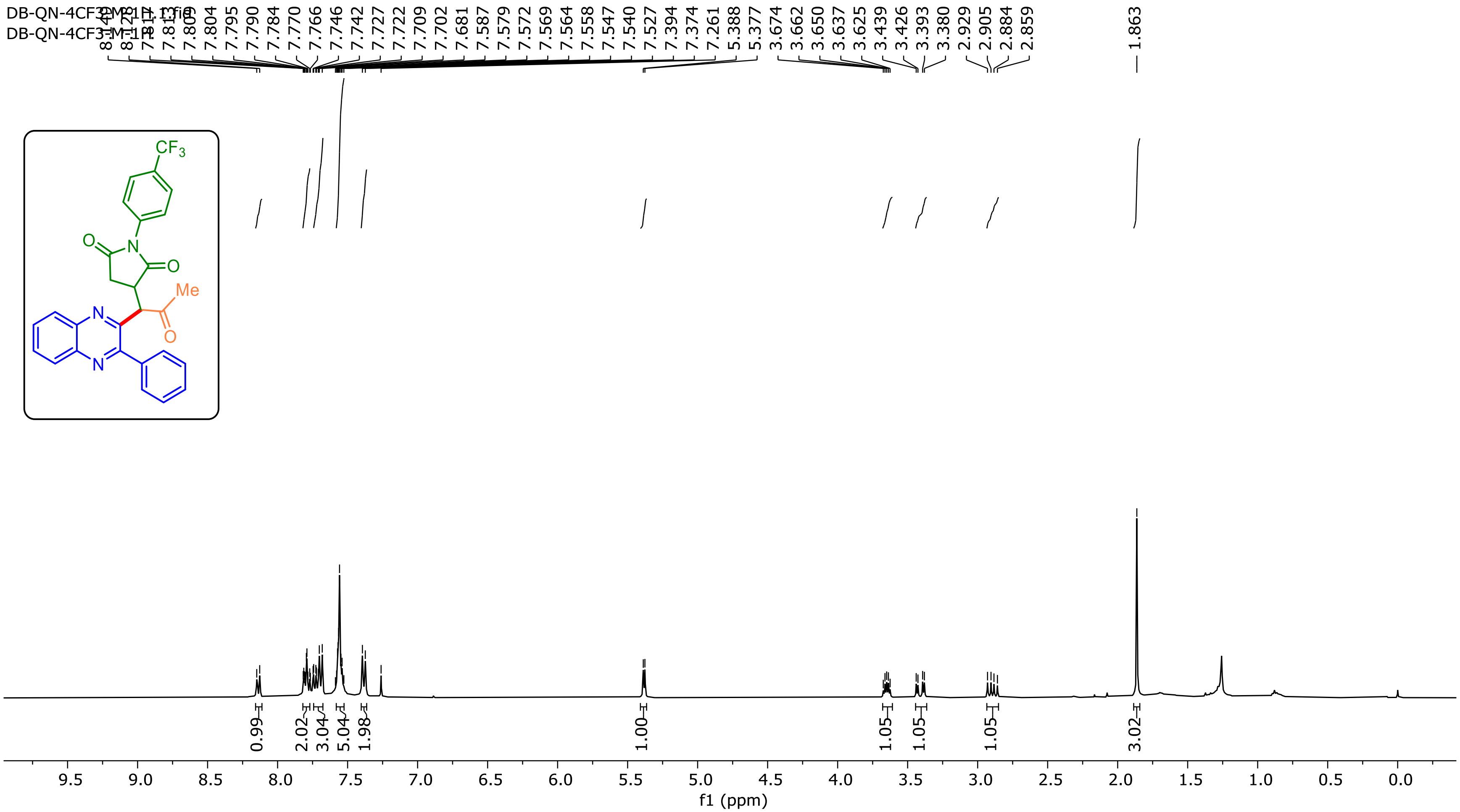
^{1}H NMR of 1-(4-Bromophenyl)-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3ae) (CDCl$_3$, 400 MHz)



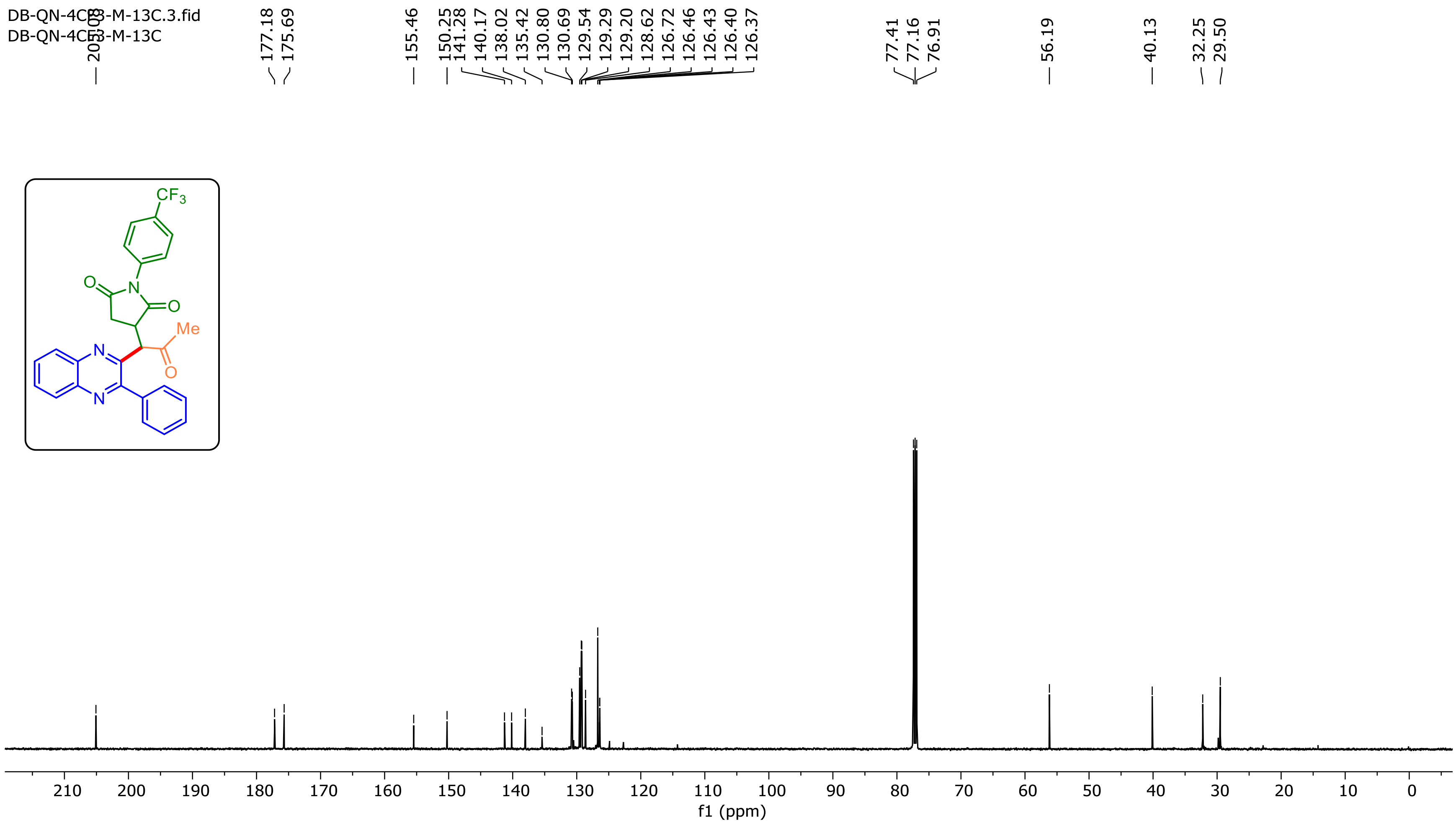
$^{13}C\{^{1}H\}$ NMR of 1-(4-Bromophenyl)-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3ae) ($CDCl_3$, 126 MHz)



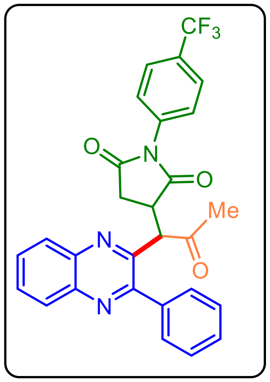
^{1}H NMR of 3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)propyl)-1-(4-(trifluoromethyl)phenyl)pyrrolidine-2,5-dione: (3af) ($CDCl_3$, 400 MHz)

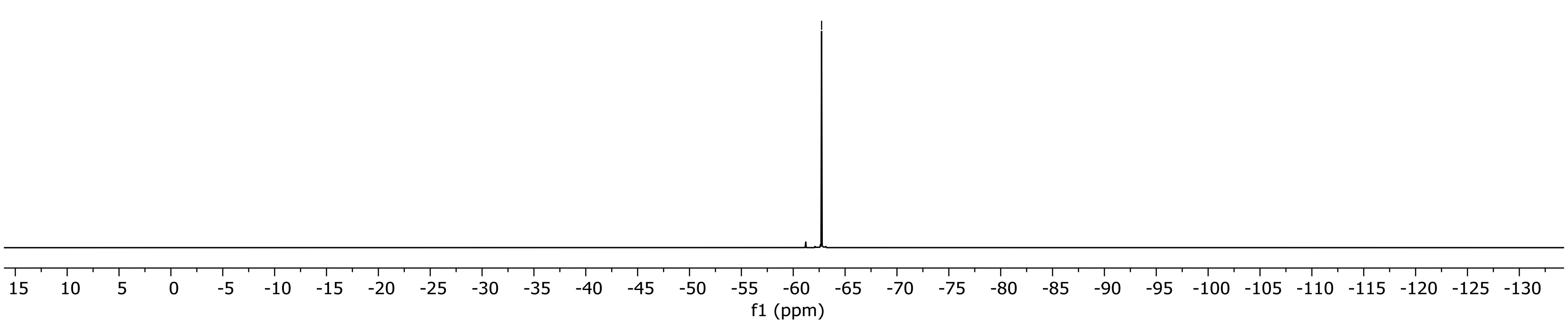


[13]C{[1]H} NMR of 3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)propyl)-1-(4-(trifluoromethyl)phenyl)pyrrolidine-2,5-dione: (3af) ($CDCl_3$, 126 MHz)

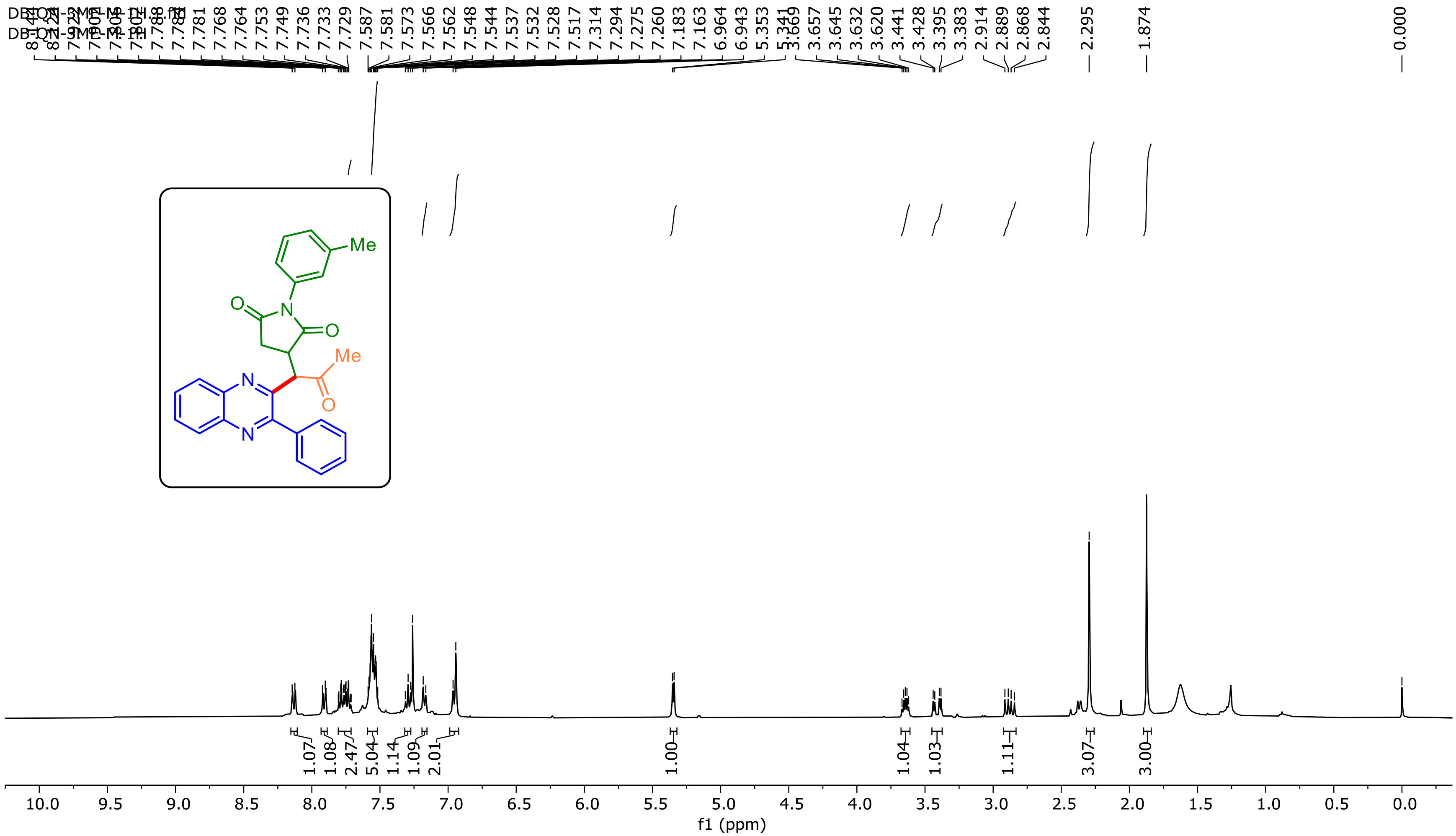


[19]F NMR of 3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)propyl)-1-(4-(trifluoromethyl)phenyl)pyrrolidine-2,5-dione: (3af) ($CDCl_3$)

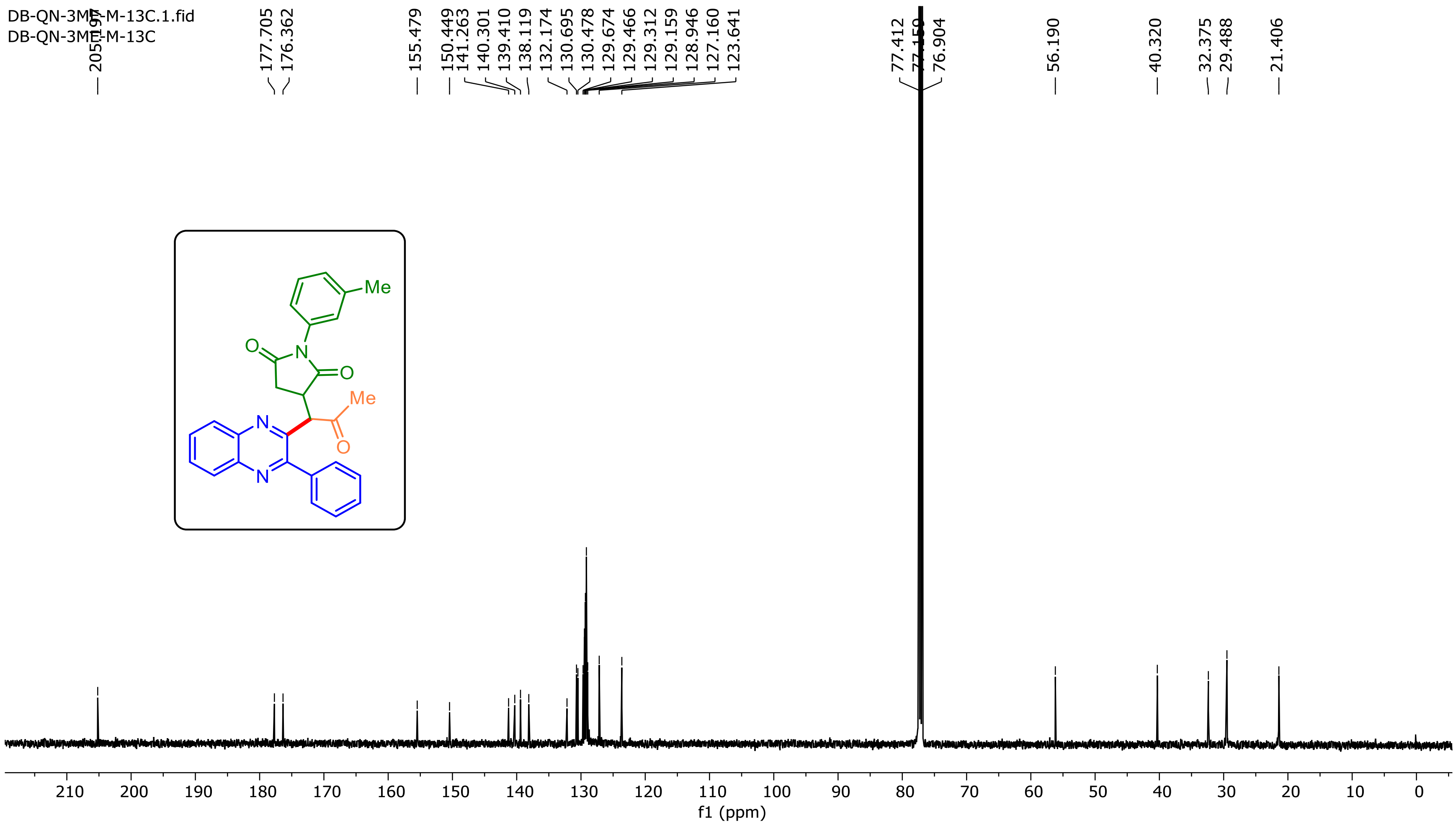




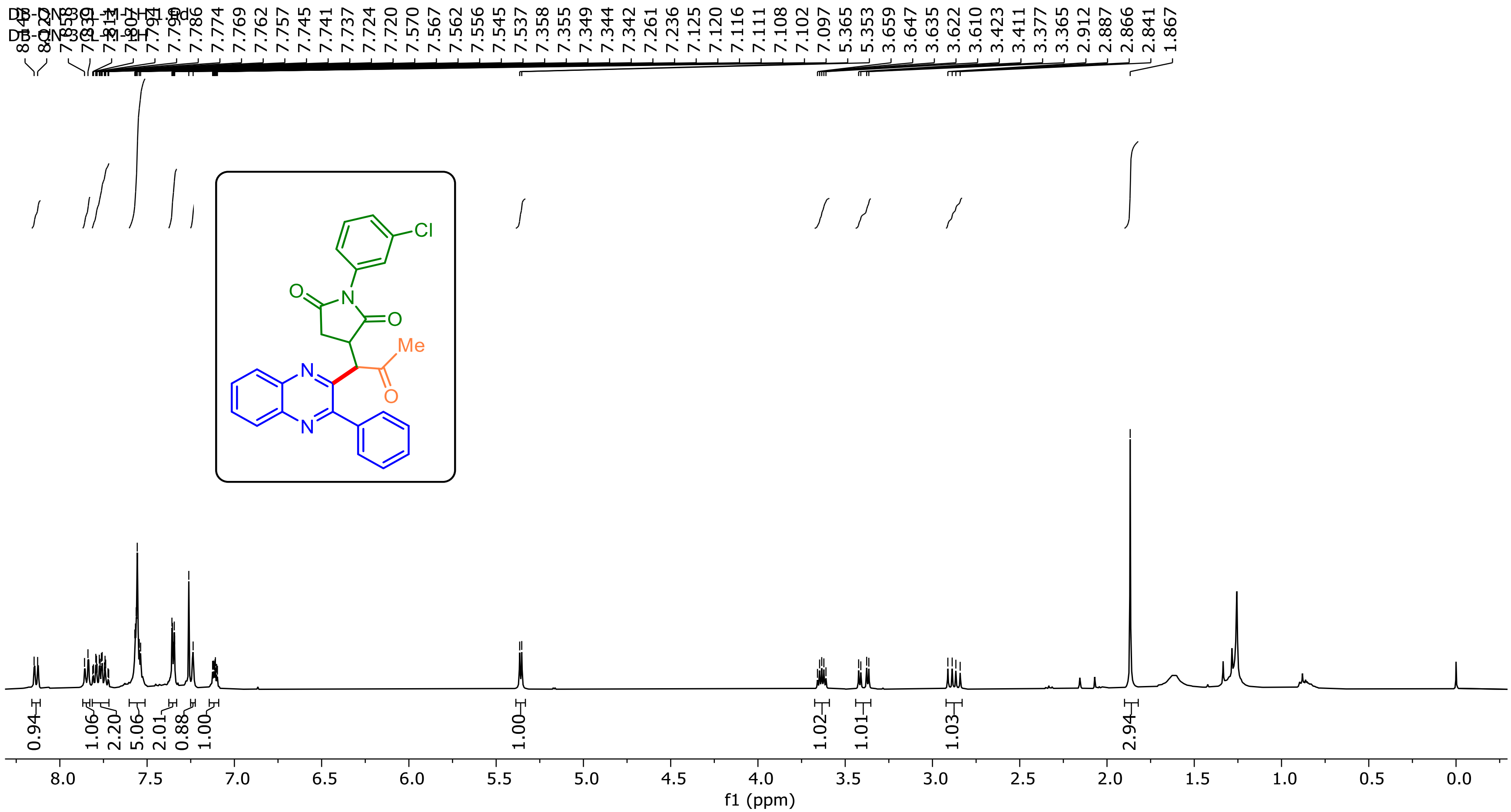
[1]H NMR of 3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)propyl)-1-(m-tolyl)pyrrolidine-2,5-dione: (3ag) (CDCl$_3$, 400 MHz)



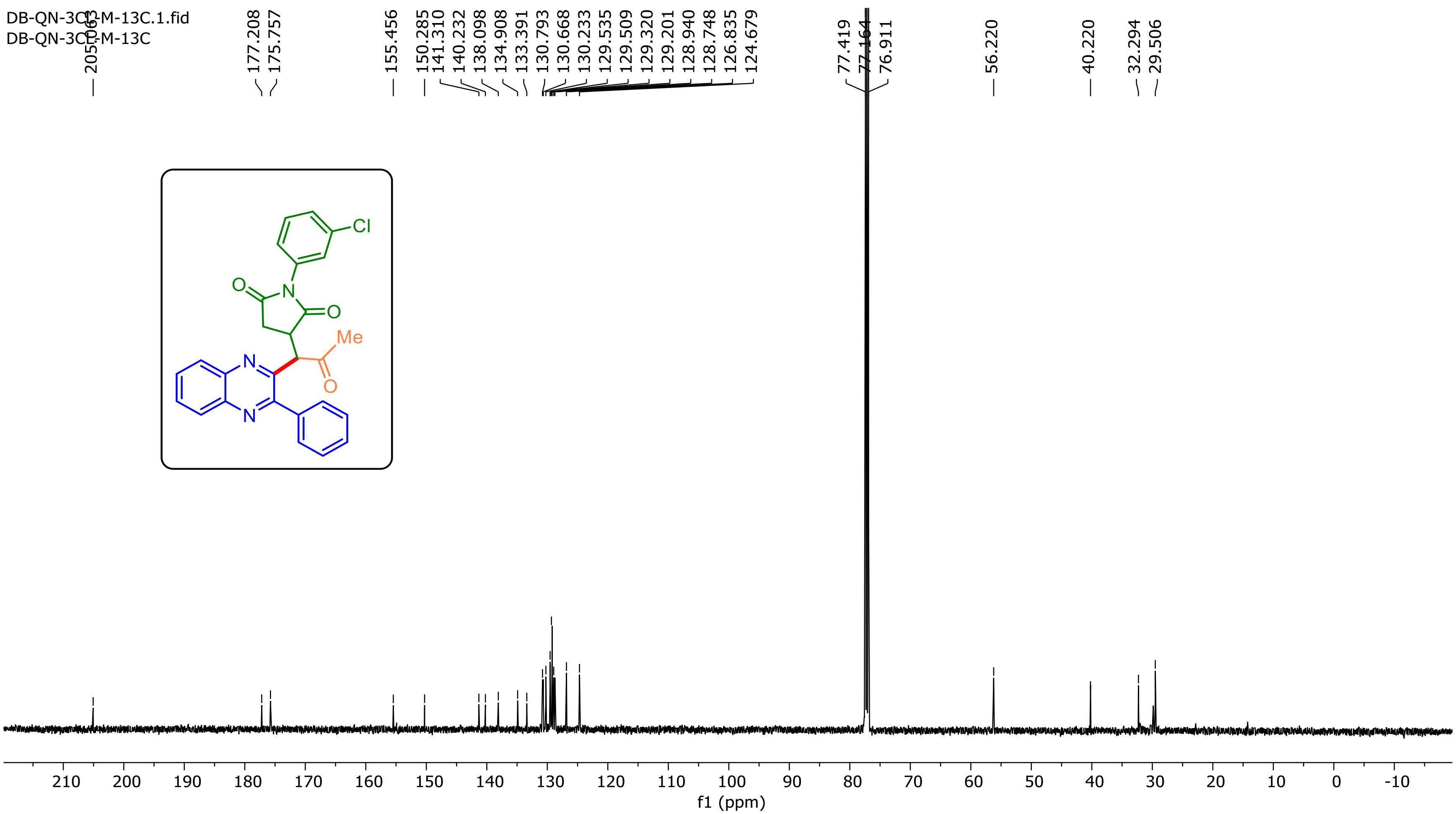
[13]C{[1]H} NMR of 3-(2-Oxo-1-(3-phenylquinoxalin-2-yl)propyl)-1-(m-tolyl)pyrrolidine-2,5-dione: (3ag) (CDCl$_3$, 126 MHz)



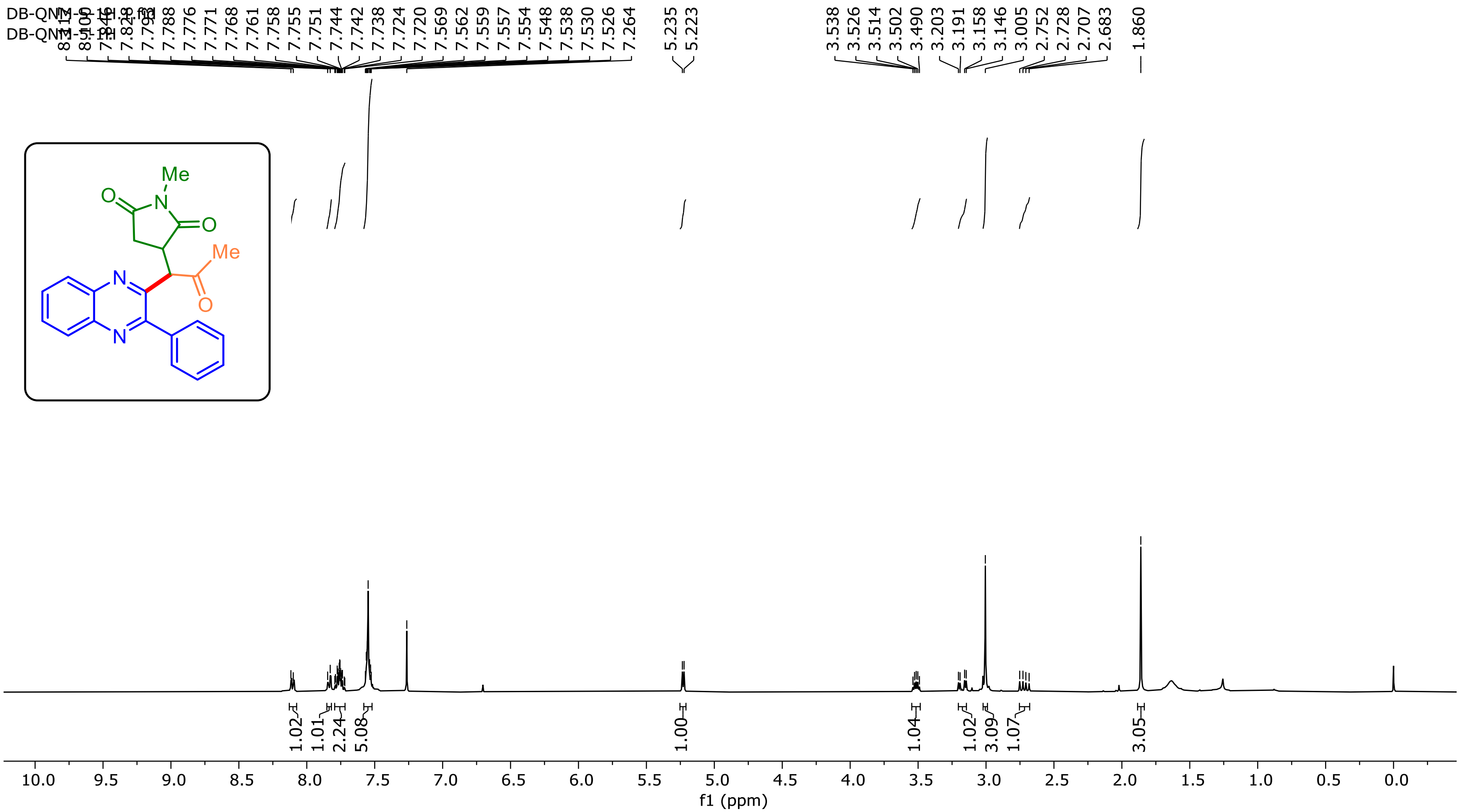
[1]H NMR of 1-(3-Chlorophenyl)-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3ah) ($CDCl_3$, 400 MHz)



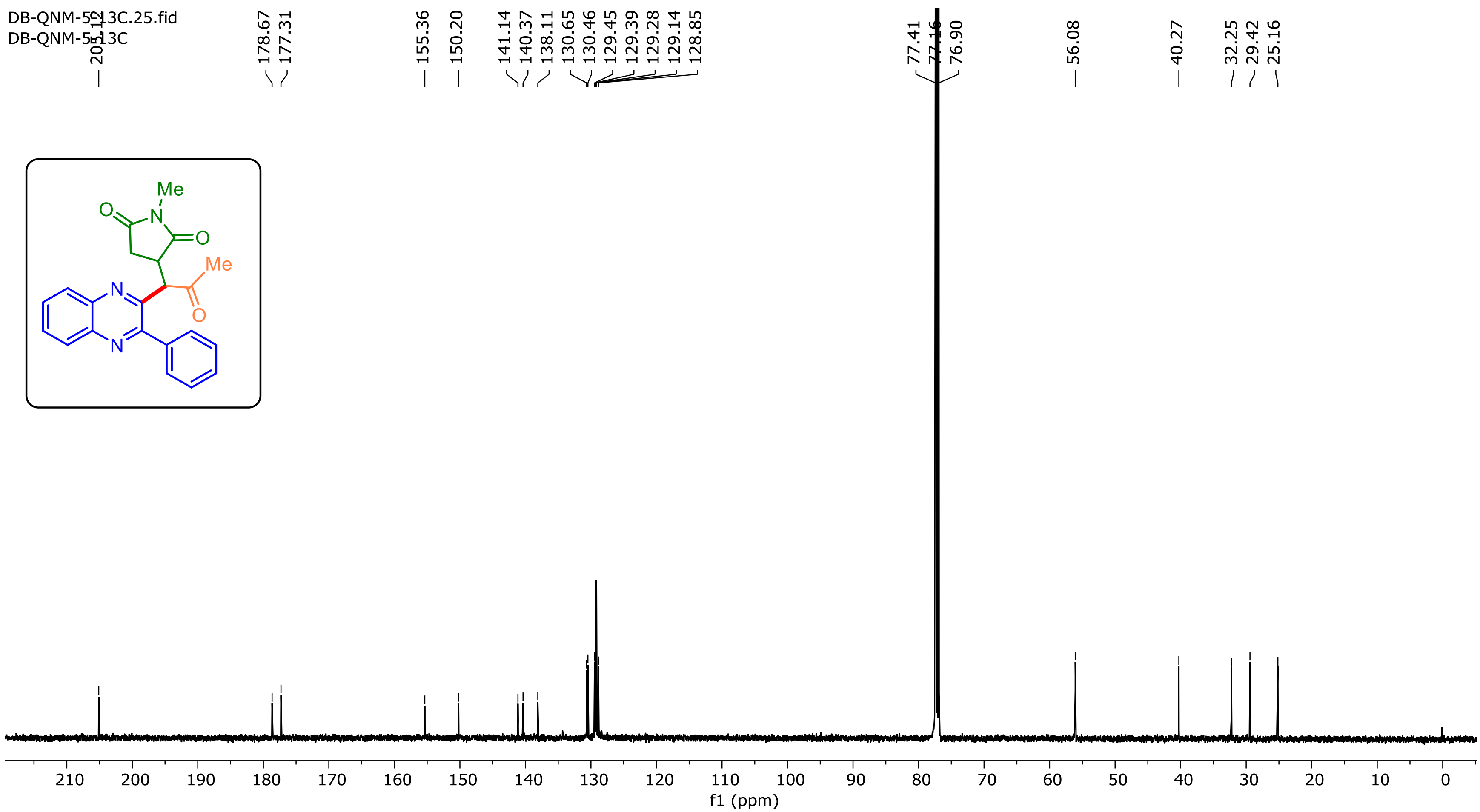
$^{13}C\{^{1}H\}$ ***NMR of 1-(3-Chlorophenyl)-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3ah) ($CDCl_3$, 126 MHz)***



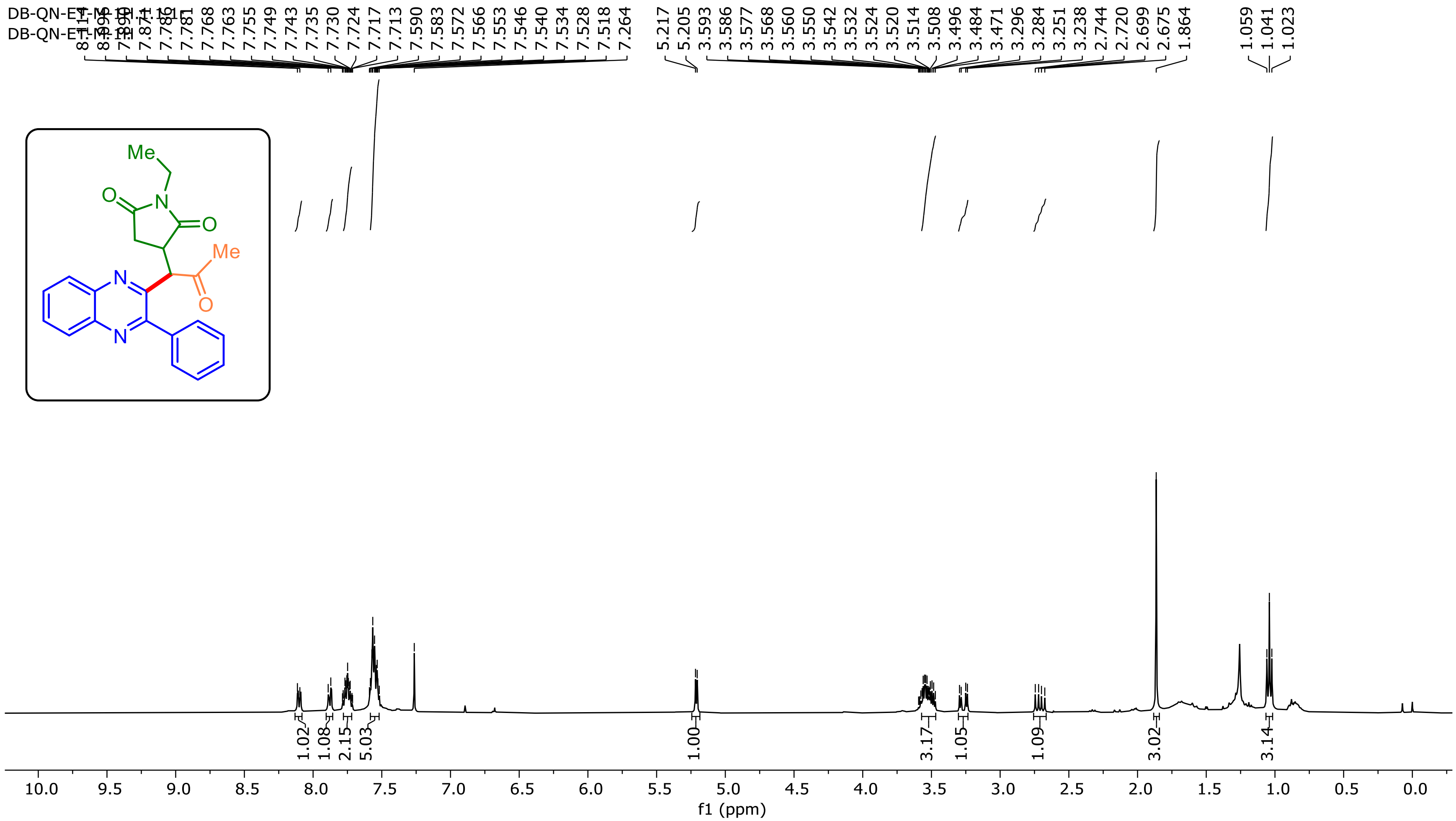
[1]H NMR of 1-Methyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3ai) ($CDCl_3$, 400 MHz)



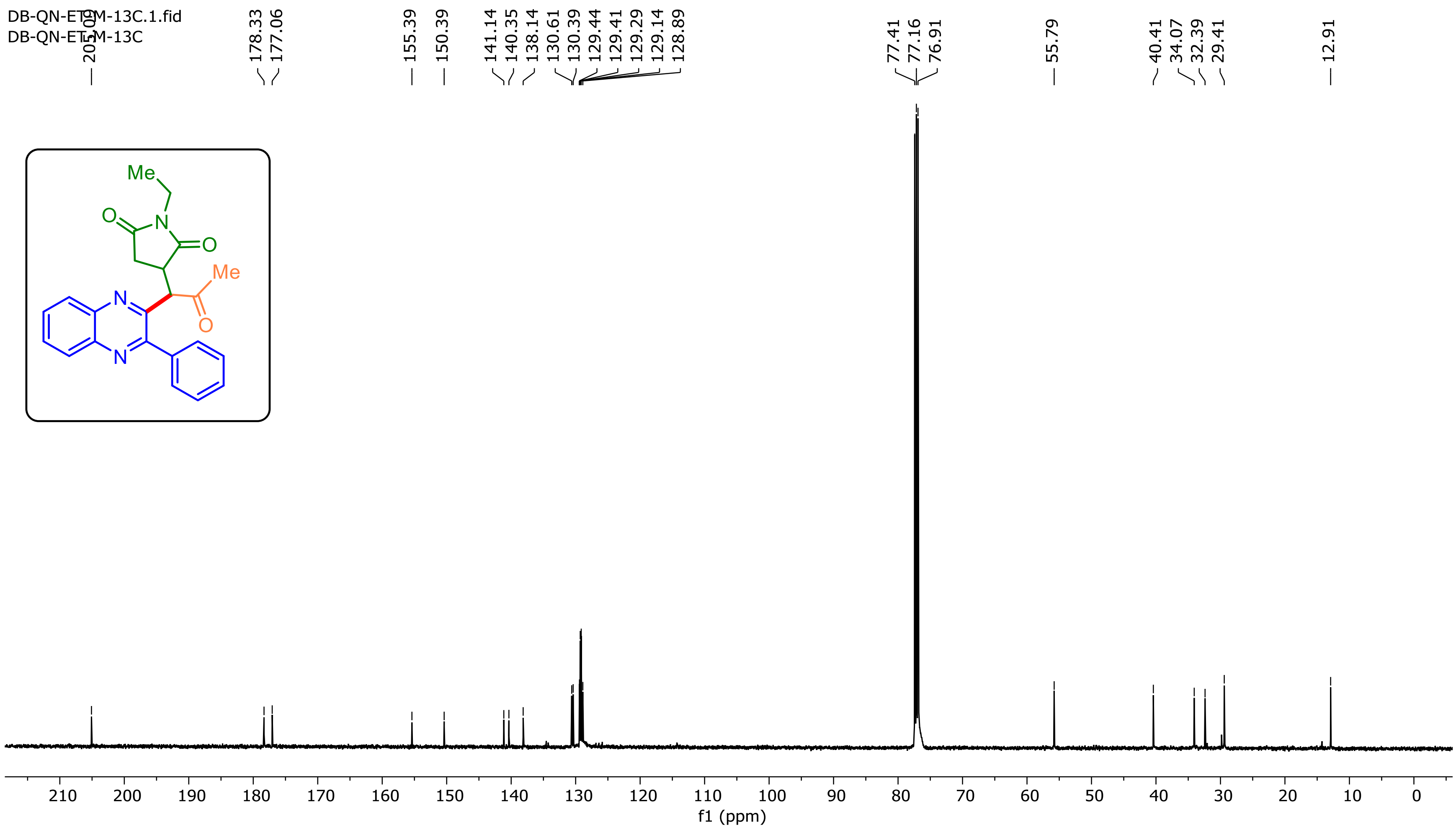
$^{13}C\{^{1}H\}$ NMR of 1-Methyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3ai) ($CDCl_3$, 126 MHz)



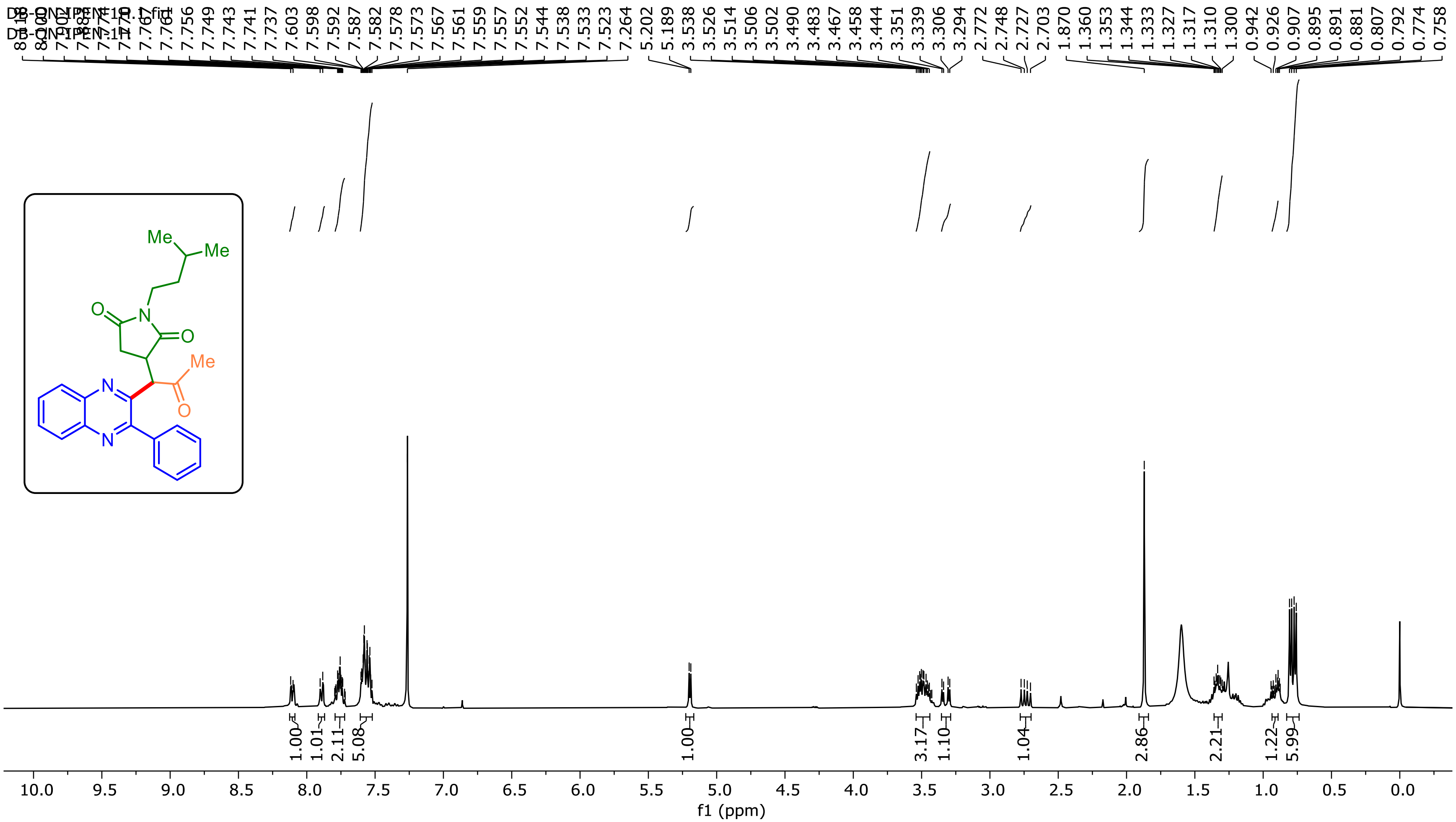
[1]H NMR of 1-Ethyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3aj) ($CDCl_3$, 400 MHz)



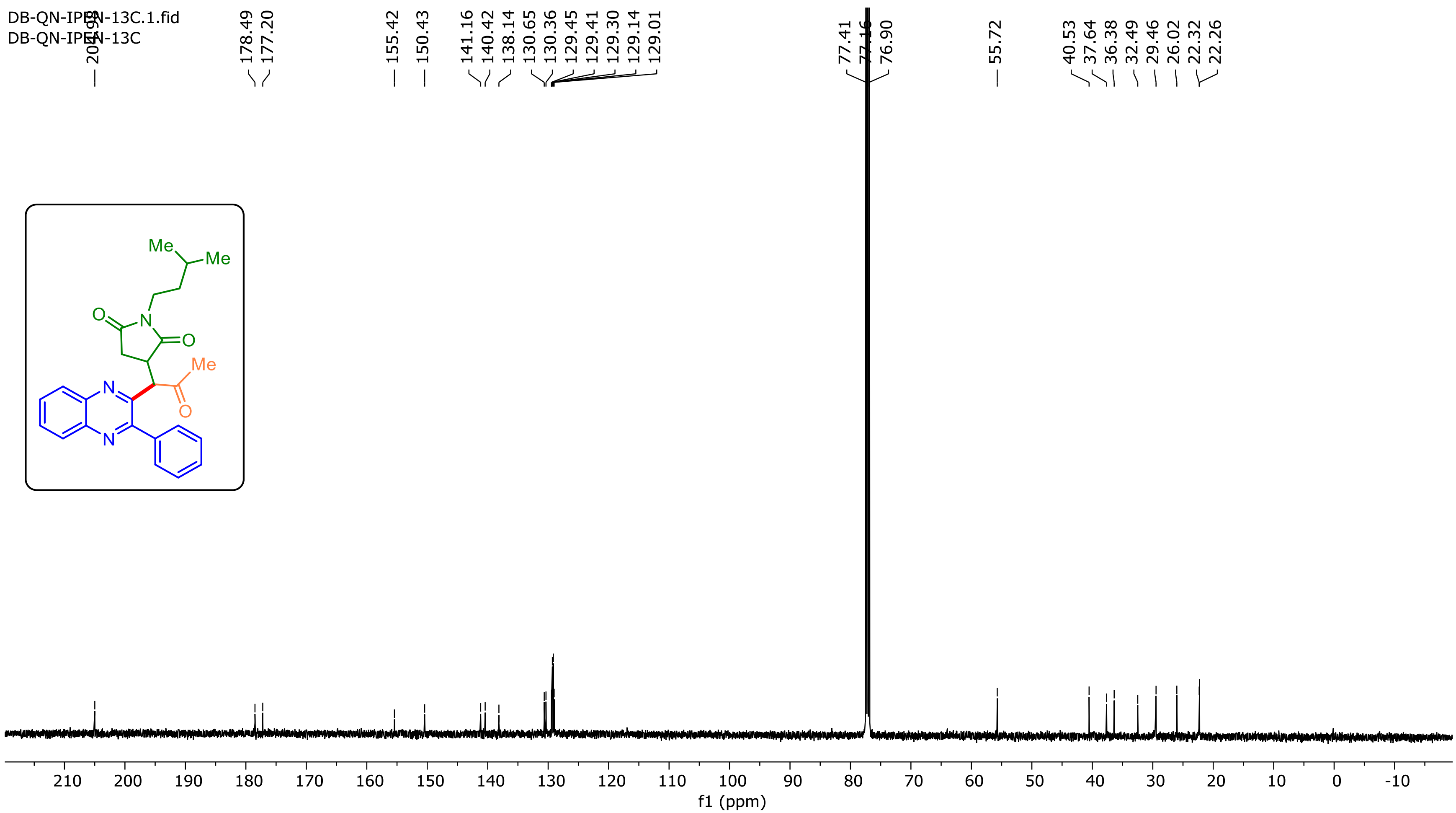
$^{13}C\{^{1}H\}$ NMR of 1-Ethyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3aj) ($CDCl_3$, 126 MHz)



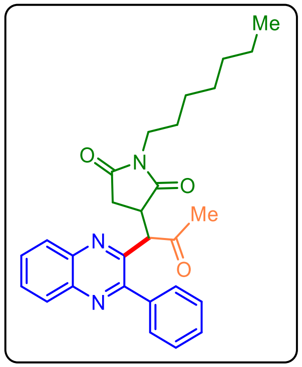
[1]H NMR of 1-Isopentyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3ak) ($CDCl_3$, 400 MHz)

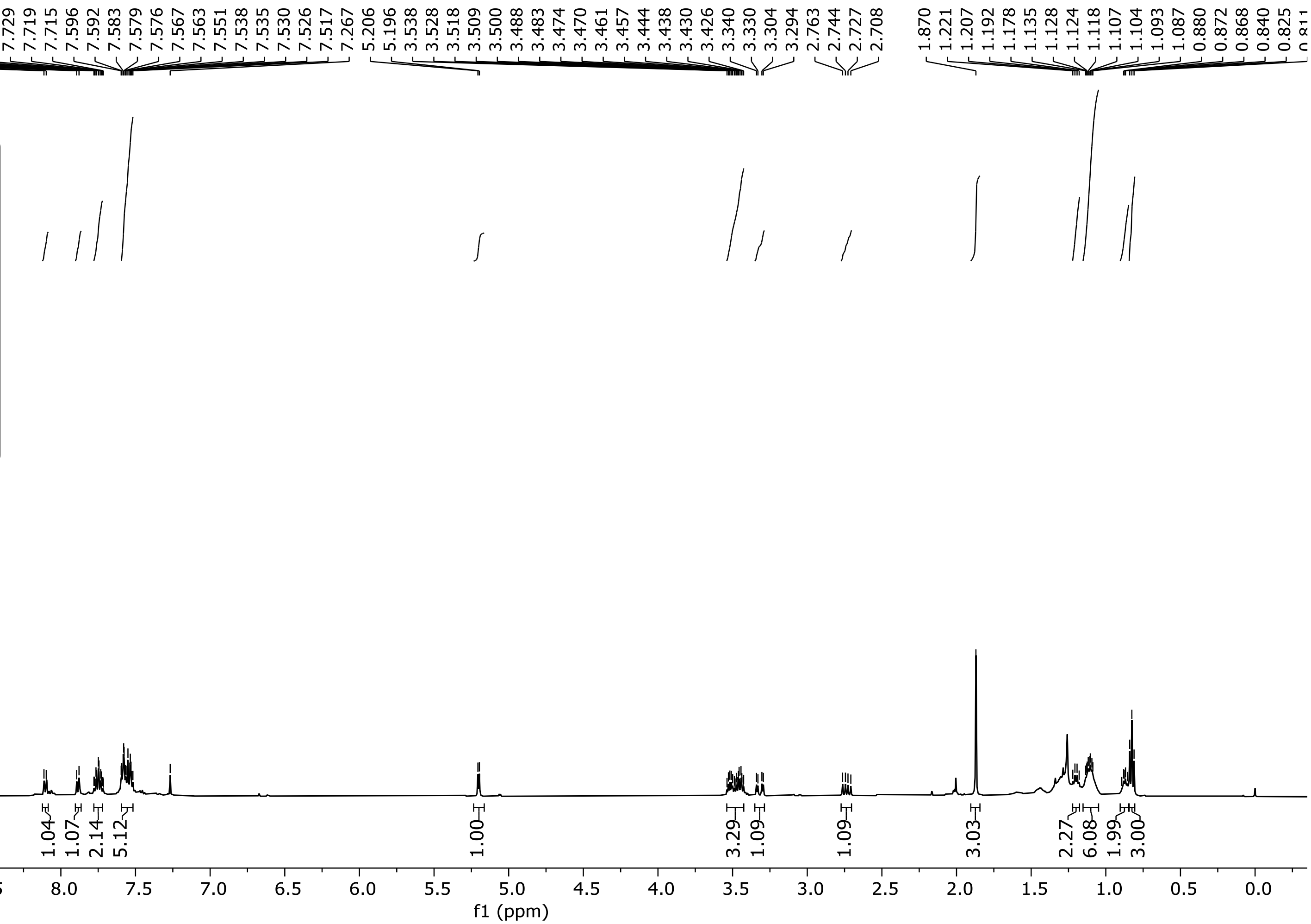


[13]C{[1]H} NMR of 1-Isopentyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3ak) ($CDCl_3$, 126 MHz)

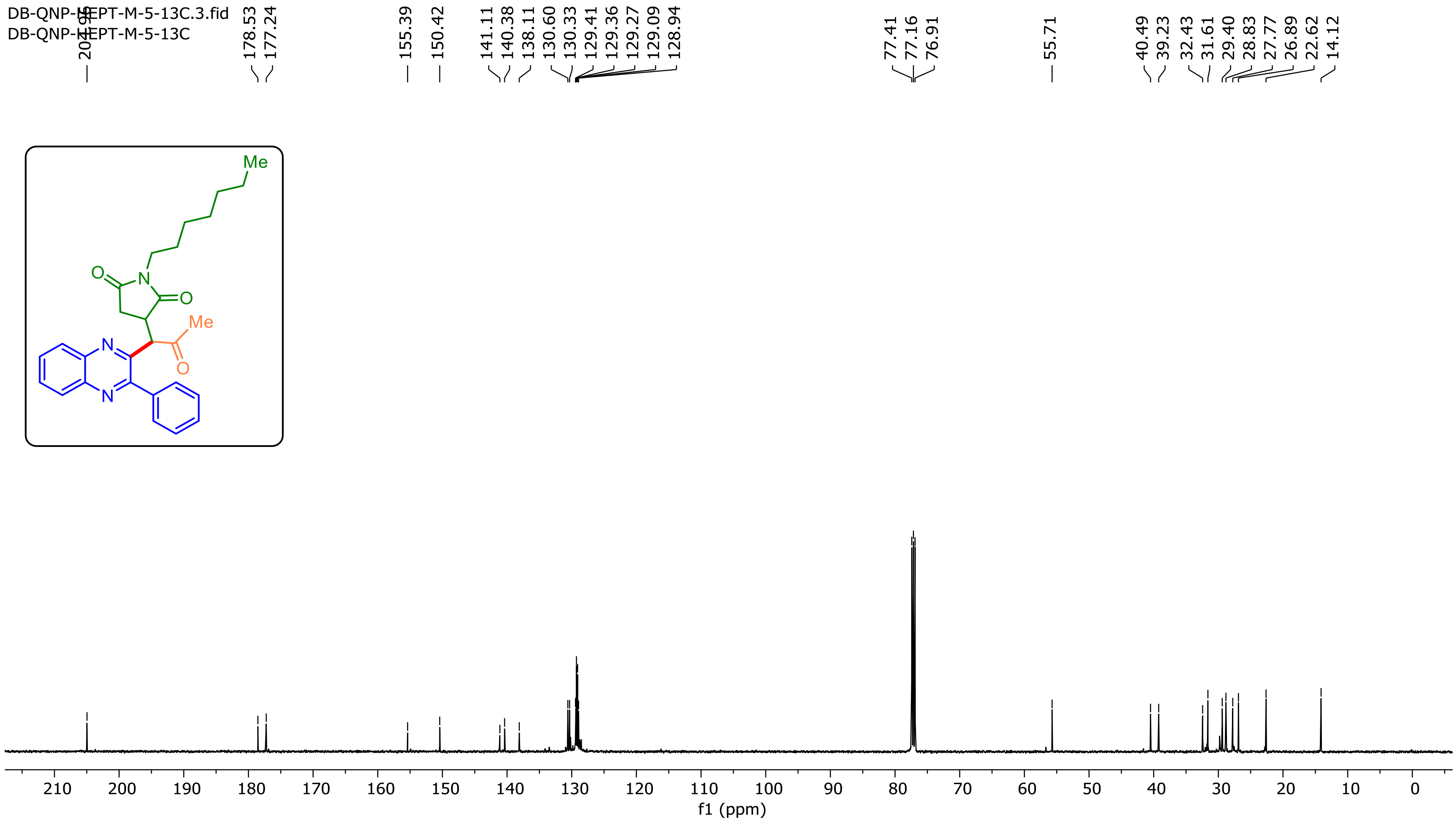


^{1}*H NMR of 1-Heptyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3al) ($CDCl_3$, 500 MHz)*

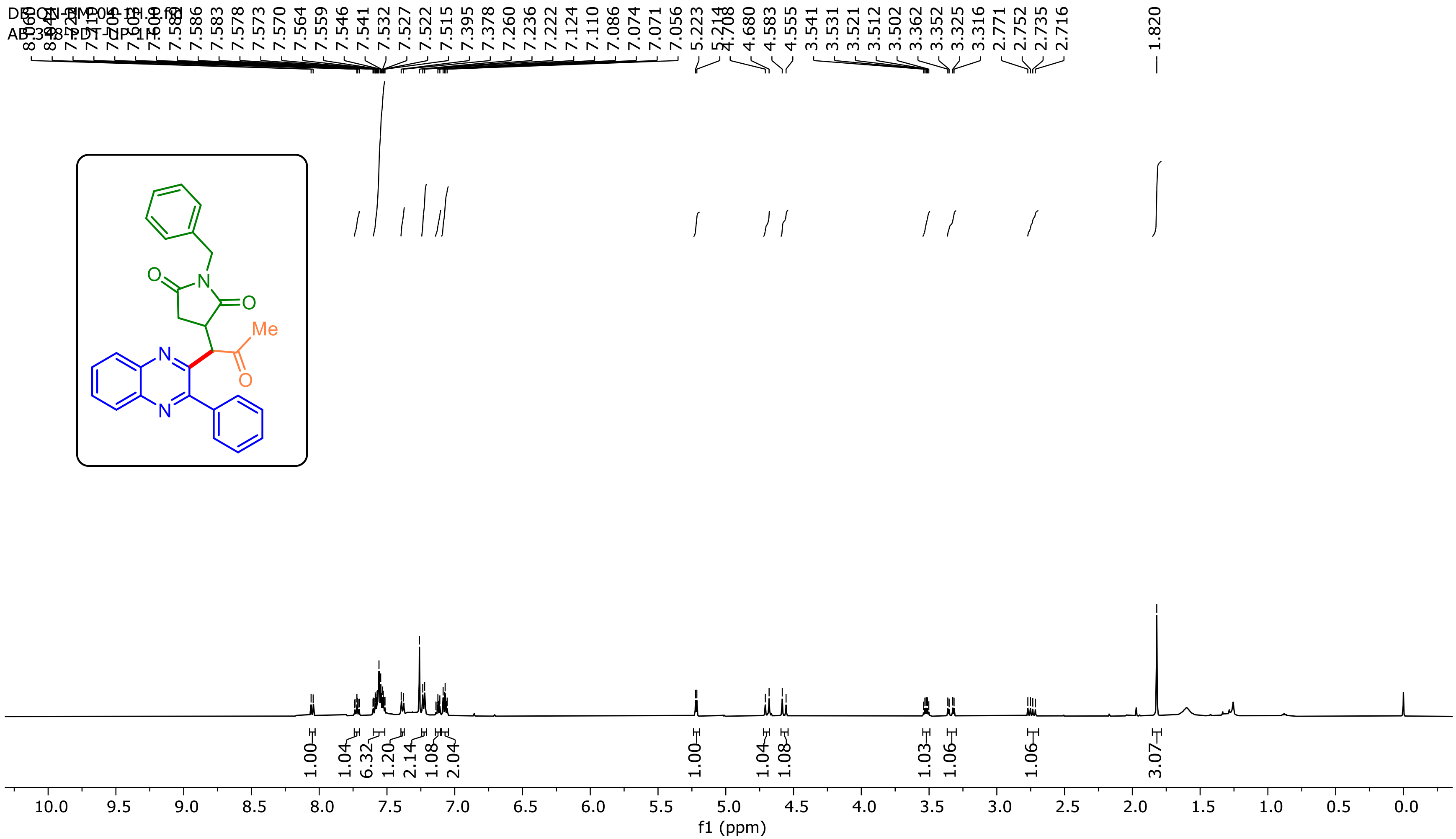




$^{13}C\{^{1}H\}$ NMR of 1-Heptyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3al) ($CDCl_3$, 126 MHz)



[1]H NMR of 1-Benzyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3am) ($CDCl_3$, 500 MHz)



$^{13}C\{^1H\}$ NMR of 1-Benzyl-3-(2-oxo-1-(3-phenylquinoxalin-2-yl)propyl)pyrrolidine-2,5-dione: (3am) ($CDCl_3$, 126 MHz)