Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

Silver-Catalyzed Cascade Reactions of 3-Cyanochromone with 1,1-Enediamines: Synthesis of Highly Functionalized 2-(Pyridin-3-yl)-chromeno[2,3-*d*]pyrimidines

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Supporting Information

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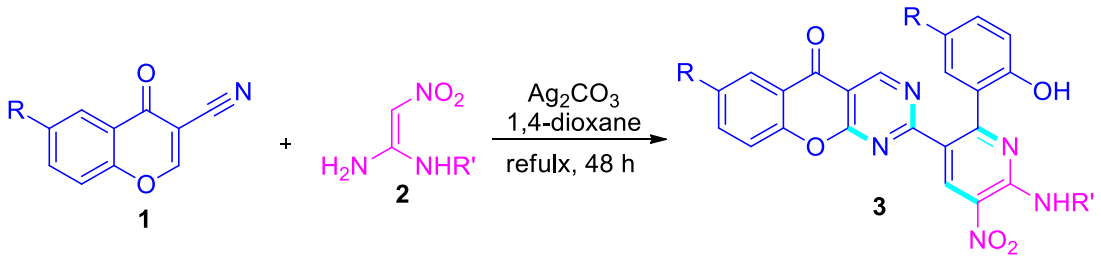
General information

All compounds were fully characterised by spectroscopic data. The NMR spectra were recorded on a Bruker Ascend III 600 (^{1}H: 600 MHz, ^{13}C: 150 MHz) or Bruker DRX500 (^{1}H: 500 MHz, ^{13}C: 125 MHz). Chemical shifts (δ) are expressed in ppm and J values are given in Hz. Deuterated DMSO-d_6 or $CDCl_3$ was used as solvents. IR spectra were recorded on a FT-IR Thermo Nicolet Avatar 360 using a KBr pellet. The reactions were monitored by thin layer chromatography (TLC) using silica gel GF254. The melting points were determined on a XT-4A melting point apparatus and are uncorrected. HRMs were performed on an Agilent LC/Msd TOF instrument. Column chromatography was performed on silica gel (200–300 mesh). X-ray diffraction was obtained by Bruker Apex II CCD. 1,1-enediamines (EDAMs) **2** were synthesized by known literature procedures.[1] All the other chemicals used in the experiment were purchased from commercial sources and were used without further purification.

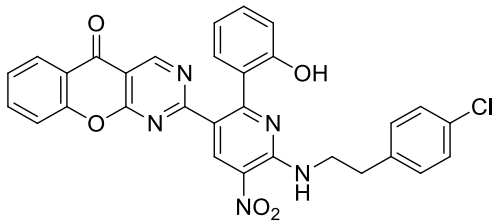
General procedure for the synthesis of 2-(pyridin-3-yl)-chromeno-[2,3-*d*]pyrimidines 3



3-Cyanochromone **1** (2.0 mmol), EDAM derivative **2** (1.0 mmol), and dioxane (6 mL) were placed into a 25-mL round-bottom flask, and the mixture was stirred at room temperature for 5 min. Then, Ag_2CO_3 (0.5 mmol) was added while stirring under reflux conditions. The mixture was stirred until the completion of the reaction, which was monitored by TLC (approximately 48 h). The reaction mixture was extracted with dichloromethane (3×10 mL), washed with water and brine, and then dried over Na_2SO_4. The combined organic phases were evaporated under reduced pressure to afford the crude product. Finally, the product was obtained in pure form through column chromatography over silica gel using a mixture of petroleum ether/ethyl acetate (3:1, v/v) as the eluent.

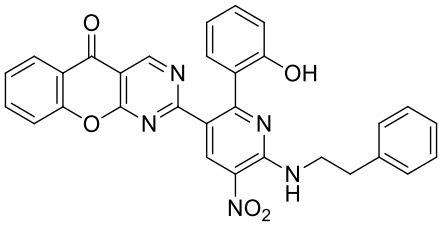
Spectroscopic data of 2-(pyridin-3-yl)-chromeno[2,3-*d*]pyrimidines 3

2-(6-((4-Chlorophenethyl)amino)-2-(2-hydroxyphenyl)-5-nitropyridin-3-yl)-5*H*-chromeno[2, 3-*d*]pyrimidin-5-one (3a)



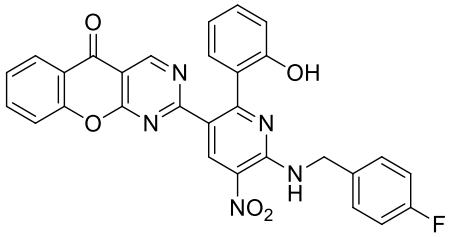
Yellow solid; Mp: 288.4–289.5°C; IR(KBr): 3551, 3475, 3415, 1675, 1616, 1577, 1396, 1276 cm^{-1}; ^1H NMR (600 MHz, DMSO-d_6): δ = 9.30 (m, 2H, ArH), 9.00 (br, 1H, OH), 8.91–8.89 (m, 1H, ArH), 8.18–8.17 (m, 1H, ArH), 7.94–7.92 (m, 1H, ArH), 7.73–7.72 (m, 1H, ArH), 7.62–7.54 (m, 2H, ArH), 7.36–7.26 (m, 4H, PhH), 7.25–7.24 (m, 1H, ArH), 7.00–6.98 (m, 1H, ArH), 6.63–6.61 (br, 1H, NH), 3.90–3.87 (m, 2H, NCH_2), 3.02–3.00 (t, J = 1.8 Hz, 2H, $ArCH_2$); ^{13}C NMR (150 MHz, DMSO-d_6): δ = 176.0, 168.6, 165.5, 162.5, 158.7, 155.4, 155.0, 151.6, 138.8, 138.2, 137.0, 131.5, 131.4, 131.4, 131.1, 128.8, 127.5, 126.4, 126.2, 126.0, 122.7, 122.4, 119.8, 119.1, 115.9, 111.9, 43.0, 34.7; HRMS (TOF ES^+): *m/z* calcd for $C_{30}H_{21}ClN_5O_5$ $[M+H]^+$, 566.1226; found, 566.1222.

2-(2-(2-Hydroxyphenyl)-5-nitro-6-(phenethylamino)pyridin-3-yl)-5*H*-chromeno[2,3-*d*]pyrimi din-5-one (3b)



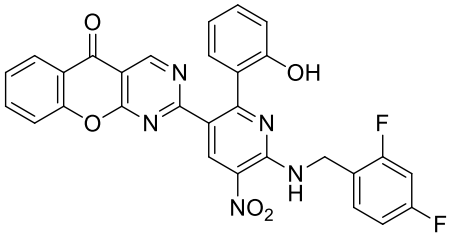
Yellow solid; Mp: 210.3–212.1°C; IR(KBr): 3415, 3378, 1678, 1612, 1577, 1467, 1396, 1301 cm^{-1}; ^1H NMR (600 MHz, DMSO-d_6): δ = 9.31 (m, 2H, ArH), 9.00 (br, 1H, OH), 8.94–9.92 (m, 1H, ArH), 8.18–8.17 (m, 1H, ArH), 7.95–7.92 (m, 1H, ArH), 7.74–7.72 (m, 1H, ArH), 7.65–7.64 (m, 1H, ArH), 7.57–7.55 (m, 1H, ArH), 7.33–7.21 (m, 6H, ArH), 7.00–6.98 (m, 1H, ArH), 6.63–6.61 (br, 1H, NH), 3.91–3.87 (m, 2H, NCH_2), 3.03–3.00 (m, 2H, $ArCH_2$); ^{13}C NMR (150 MHz, DMSO-d_6): δ = 176.0; 168.6, 165.5, 162.5, 158.7, 155.4, 155.0, 151.6, 139.7, 138.2, 137.0, 131.5, 131.4, 129.2, 128.9, 127.5, 126.7, 126.4, 126.2, 126.0, 122.7, 122.4, 119.8, 119.1, 115.9, 111.9, 43.3, 35.5; HRMS (TOF ES^+): *m/z* calcd for $C_{30}H_{22}N_5O_5$ $[M+H]^+$, 532.1615; found, 532.1609.

2-(6-((4-Fluorobenzyl)amino)-2-(2-hydroxyphenyl)-5-nitropyridin-3-yl)-5*H*-chromeno[2,3-*d*] pyrimidin-5-one (3c)



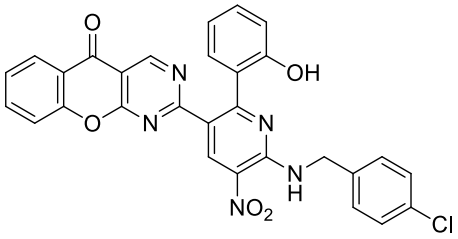
Yellow solid; Mp: 120.6–121.8℃; IR(KBr): 3552, 3477, 3415, 1617, 1578, 1397, 1341, 1225 cm^{-1}; ^1H NMR (500 MHz, DMSO-d_6): δ = 9.39 (br, 1H, OH), 9.29–9.26 (m, 2H, ArH), 9.00 (s, 1H, ArH), 8.18–8.17 (m, 1H, ArH), 7.93–7.92 (m, 1H, ArH), 7.73–7.71 (m, 1H, ArH), 7.57–7.55 (m, 1H, ArH), 7.47–7.42 (m, 2H, ArH), 7.36–7.35 (m, 1H, ArH), 7.23–7.15 (m, 3H, ArH), 6.92–-6.91 (m, 1H, ArH), 6.58–6.56 (br, 1H, NH), 4.87-4.86 (m, 2H, $ArCH_2$); ^{13}C NMR (125 MHz, DMSO-d_6): δ = 176.0, 168.6, 165.5, 162.6, 162.1, 161.4 (d, J = 237.5), 158.7, 155.4, 154.9, 151.4, 138.2, 129,9, 137.0, 136.0, 131.5, 131.4, 129.9, 127.3, 126.4, 126.2, 122.7, 122.6, 119.7, 119.1, 115.9, 115.4 (d, J = 21.3Hz), 112.0, 44.3; HRMS (TOF ES^+):*m/z* calcd for $C_{29}H_{19}FN_5O_5$ $[M+H]^+$, 536.1365; found,536.1360.

2-(6-((2,4-Difluorobenzyl)amino)-2-(2-hydroxyphenyl)-5-nitropyridin-3-yl)-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3d)



Yellow solid; Mp: 215.6–216.3℃; IR (KBr): 3421.5, 3312.6, 3158.3, 1603.2, 1521.6, 1418.3, 1281.5, 1211.2cm^{-1}; ^1H NMR (500 MHz, DMSO-d_6): δ = 9.32 (br, 1H, OH), 9.30–9.28 (m, 2H, ArH), 9.00 (s, 1H, ArH), 8.18–8.16 (m, 1H, ArH), 7.94–7.91 (m, 1H, ArH), 7.72–7.70 (m, 1H, ArH), 7.57–7.54 (m, 1H, ArH), 7.49–7.47 (m, 1H, ArH), 7.30–7.20 (m, 3H, ArH), 7.06–7.04 (m, 1H, ArH), 6.91–6.88 (m, 1H, ArH), 6.58–6.55 (br, 1H, NH), 4.91-4.90 (m, 2H, $ArCH_2$); ^{13}C NMR (125 MHz, DMSO-d_6): δ = 176.0, 168.7, 165.5, 161.9, 161.8 (d, $^1J_{CF}$ = 249.4 Hz), 160.5 (d, $^1J_{CF}$ = 246.3 Hz), 158.7, 155.4, 154.9, 151.3, 138.1, 137.0, 131.5, 131.0, 130.9, 127.2, 126.5, 126.3, 122.8, 119.7, 119.1, 115.8, 111.1, 104.1 (t, $^2J_{CF}$ = 25.0 Hz, $^2J_{CF}$ = 26.3 Hz), 38.5; HRMS(TOF ES^+): *m/z* calcd for $C_{29}H_{18}F_2N_5O_5$ $[M+H]^+$, 554.1271; found, 554.1265.

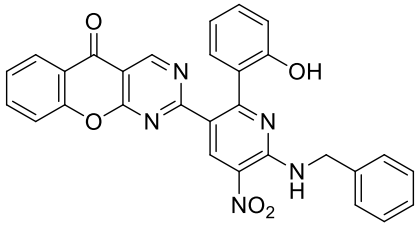
2-(6-((4-Chlorobenzyl)amino)-2-(2-hydroxyphenyl)-5-nitropyridin-3-yl)-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3e)



Yellow solid; Mp: 214.1–215.2℃; IR(KBr): 3385, 1616, 1581, 1396, 1343, 1256, 1218, 1093; ^1H NMR (600 MHz, DMSO-d_6): δ = 9.43–9.41 (br, 1H, OH), 9.29–9.26 (m, 2H, ArH), 9.00 (s, 1H,

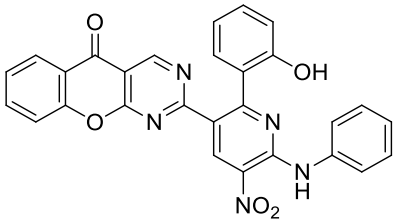
ArH), 8.18–8.16 (m, 1H, ArH), 7.94–7.92 (m, 1H, ArH), 7.72–7.71 (m, 1H, ArH), 7.57–7.54 (m, 2H, ArH), 7.44–7.39 (m, 4H, PhH), 7.31–7.30 (m, 1H, ArH), 7.23–6.20 (m, 1H, ArH), 6.91–6.88 (m, 1H, ArH), 6.57–6.56 (br, 1H, NH), 4.87–4.86 (m, 2H, $ArCH_2$); ^{13}C NMR (150 MHz, DMSO-d_6): δ = 176.0; 168.6, 165.5, 162.0, 158.7, 155.4, 154.9, 151.4, 139.0, 138.2, 137.0, 131.8, 131.5, 129.7, 129.5, 128.8, 128.7, 127.2, 126.4, 126.3, 126.2, 122.7, 119.7, 119.1, 115.9, 112.0, 44.3; HRMS(TOF ES$^+$):*m/z* calcd for $C_{29}H_{19}ClN_5O_5$ $[M+H]^+$, 552.1069; found, 552.1064.

2-(6-(Benzylamino)-2-(2-hydroxyphenyl)-5-nitropyridin-3-yl)-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3f)



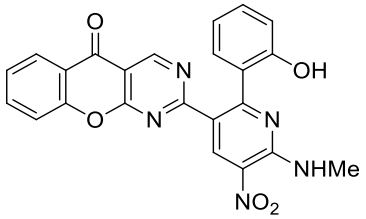
Yellow solid; Mp: 186.6–188.1°C; IR(KBr): 3448, 1616, 1584, 1434, 1399, 1341, 1247; ^1H NMR (500 MHz, DMSO-d_6): δ = 9.38 (br, 1H, OH), 9.29–9.25 (m, 2H, ArH), 9.00 (s, 1H, ArH), 8.18–8.17 (m, 1H, ArH), 7.94–7.92 (m, 1H, ArH), 7.73–7.71 (m, 1H, ArH), 7.57–7.55 (m, 2H, ArH), 7.42–7.33 (m, 4H, ArH), 7.28–7.21 (m, 2H, ArH), 6.90–6.88 (m, 1H, ArH), 6.57–6.56 (br, 1H, NH), 4.90–4.89 (m, 2H, $ArCH_2$); ^{13}C NMR (125 MHz, DMSO-d_6): δ = 176.0; 168.7, 165.5, 162.1, 158.7, 155.4, 155.0, 151.5, 139.8, 138.2, 137.0, 131.6, 131.4, 128.8, 127.9, 127.3, 127.3, 126.4, 126.2, 126.2, 122.7, 122.6, 119.7, 119.1, 115.8, 112.0, 45.0; HRMS (TOF ES$^+$): *m/z* calcd for $C_{29}H_{20}N_5O_5$ $[M+H]^+$, 518.1459; found, 518.1456.

2-(2-(2-Hydroxyphenyl)-5-nitro-6-(phenylamino)pyridin-3-yl)-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3g)



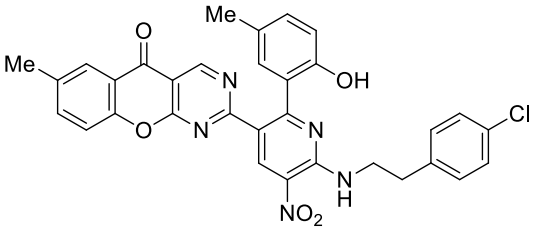
Yellow solid; ^1H NMR (600 MHz, DMSO-d_6): δ = 10.31 (br, 1H, OH), 9.33 (m, 2H, ArH), ,9.09 (m, 1H, ArH), 8.19–8.18 (m, 1H, ArH), 7.95–7.94 (m, 1H, ArH), 7.92–7.72 (m, 2H, ArH), 7.57–7.55 (m, 2H, ArH), 7.42–7.39 (m, 2H, ArH), 7.25–7.17 (m, 2H, ArH), 6.96–6.93 (m, 1H, ArH), 6.62–6.61 (br, 1H, NH); ^{13}C NMR (150 MHz, DMSO-d_6): δ = 176.0; 168.3, 165.5, 162.8, 158.8, 155.4, 155.1, 149.1, 138.4, 138.2, 137.0, 131.5,131.4, 129.1, 127.1, 126.9, 126.5, 126.2, 125.1, 124.5, 123.4, 122.8, 119.9, 119.1, 116.1, 112.1; HRMS(TOF ES$^+$): *m/z* calcd for $C_{28}H_{18}N_5O_5$ $[M+H]^+$, 504.1302; found, 504.1305.

2-(2-(2-Hydroxyphenyl)-6-(methylamino)-5-nitropyridin-3-yl)-5H-chromeno[2,3-d]pyrimidin-5-one (3h)



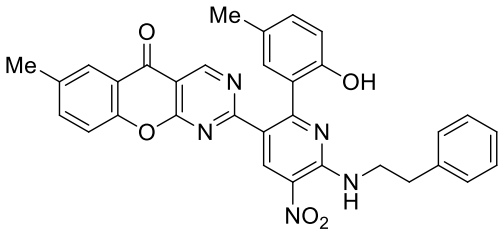
Yellow solid; Mp: 287–288°C; IR(KBr): 3396.6, 1620.4, 1588.4, 1392.7, 1107.0, 761.8; ^{1}H NMR (600 MHz, $CDCl_3$): δ = 11.64 (br, 1H, OH), 9.51 (m, 1H, ArH), ,9.18 (m, 1H, ArH), 8.61–8.60 (br, 1H, NH), 8.36–8.34 (m, 1H, ArH), 7.87–7.84 (m, 1H, ArH), 7.65–7.64 (m, 1H, ArH), 7.54–7.52 (m, 1H, ArH), 7.33–7.31 (m, 1H, ArH), 7.11–7.10 (m, 1H, ArH), 6.81–6.79 (m, 1H, ArH), 6.59–6.57 (m, 1H, ArH), 3.33–3.32 (m, 3H, CH_3); ^{13}C NMR (150 MHz, $CDCl_3$): δ = 175.8, 169.2, 165.9, 163.3, 159.6, 158.4, 155.4, 151.4, 140.7, 136.3, 133.0, 131.7, 126.8, 126.3, 125.8, 122.9, 121.3, 120.0, 118.7, 118.5, 112.0, 28.8; HRMS(TOF ES$^+$): *m/z* calcd for $C_{23}H_{16}N_5O_5$ $[M+H]^+$, 442.1146; found, 442.1148.

2-(6-((4-Chlorobenzyl)amino)-2-(2-hydroxy-5-methylphenyl)-5-nitropyridin-3-yl)-7-methyl-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3i)



Yellow solid; Mp: 243.1–244.0°C; IR(KBr): 3443.1, 3341.7, 3195.6, 1660.5, 1616.6, 1457.5, 1403.8, 1170.3 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ = 9.30 (br, 1H, OH), 9.03 (m, 1H, ArH) 8.98 (m, 1H, ArH), 8.93–8.92 (m, 1H, ArH), 7.98–7.97 (m, 1H, ArH), 7.77–7.75 (m, 1H, ArH), 7.66–7.64 (m, 1H, ArH), 7.47–7.46 (m, 1H, ArH), 7.38–7.32 (m, 4H, PhH), 7.08–7.06 (m, 1H, ArH), 6.51–6.49 (br, 1H, NH), 3.90–3.86 (m, 2H, NCH_2), 3.02–3.00 (m, 2H, $ArCH_2$), 2.51 (m, 3H, CH_3), 2.33 (s, 3H, CH_3); ^{13}C NMR (150 MHz, DMSO-d_6): δ = 176.0, 165.5, 162.4, 158.7, 153.6, 152.9, 151.5, 138.8, 138.2, 137.9, 135.9, 132.1, 131.8, 131.4, 131.0, 128.8, 128.1, 127.1, 126.0, 125.8, 122.6, 122.4, 119.0, 115.9, 111.8, 43.1, 34.8, 20.8, 20.7; HRMS (TOF ES$^+$): *m/z* calcd for $C_{32}H_{25}ClN_5O_5$ $[M+H]^+$, 594.1539; found,594.1534.

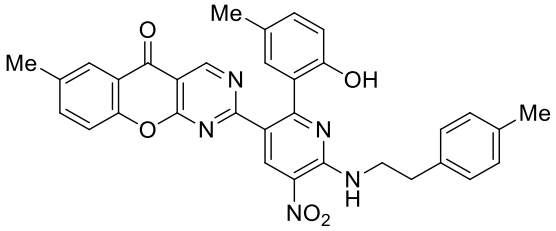
2-(2-(2-Hydroxy-5-methylphenyl)-5-nitro-6-(phenethylamino)pyridin-3-yl)-7-methyl-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3j)



Yellow solid; Mp:232.1–233.2°C; IR(KBr): 3433.8, 3336.9, 3184.6, 1669.4, 1584.4, 1543.0, 1405.4, 1237.4 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ = 10.00 (br, 1H, OH), 9.22 (m, 1H, ArH), 9.16 (m, 1H, ArH), 9.02 (m, 1H, ArH), 7.95–7.92 (m, 2H, ArH), 7.74–7.72 (m, 2H, ArH), 7.57–7.55 (m, 1H, ArH), 7.29–7.25 (m, 5H, ArH), 7.22–7.21 (br, 1H, NH), 3.85–3.84 (m, 2H,

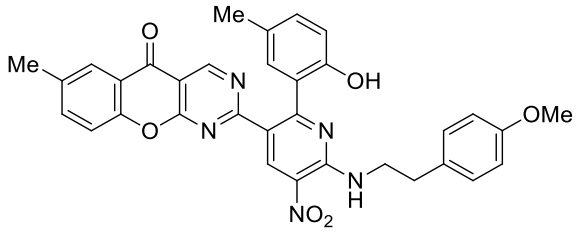
NCH_2), 2.99–2.98 (m, 2H, $ArCH_2$), 2.51 (m, 3H, CH_3), 2.44–2.43 (m, 3H, CH_3); ^{13}C NMR (150 MHz, DMSO-d_6): δ = 175.9, 166.7, 165.4, 160.4, 158.8, 153.6, 151.7, 148.8, 139.7, 138.4, 138.2, 137.9, 135.9, 135.8, 132.8, 129.6, 129.2, 128.9, 126.9, 126.7, 125.9, 125.7, 122.4, 121.6, 118.8, 112.1, 43.4, 35.5, 20.8, 20.3; HRMS (TOF ES$^+$): *m/z* calcd for $C_{32}H_{26}N_5O_5$ $[M+H]^+$, 560.1928; found, 560.1931

2-(2-(2-Hydroxy-5-methylphenyl)-6-((4-methoxyphenethyl)amino)-5-nitropyridin-3-yl)-7-methyl-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3k)



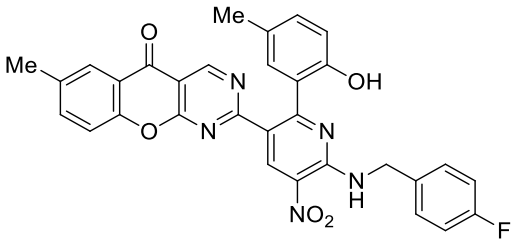
Yellow solid; Mp: 265–266°C; IR(KBr): 3439.1, 1595.5, 1385.4, 1103.7, 608.6 cm^{-1}; ^1H NMR (600 MHz, $CDCl_3$): δ = 9.39 (br, 1H, OH), 9.05 (m, 1H, ArH), 8.53–8.51 (m, 1H, ArH), 8.03 (m, 1H, ArH), 7.57–7.55 (m, 1H, ArH), 7.45–7.44 (m, 1H, ArH), 7.19 (m, 1H, ArH), 7.13–7.12 (m, 2H, ArH), 7.09–7.08 (m, 2H, ArH), 7.03–7.02 (m, H, ArH), 6.90–6.89 (m, H, ArH), 6.49 (br, H, NH), 3.84–3.81 (m, 2H, NCH_2), 2.98–2.946 (m, 2H, $ArCH_2$), 2.43 (m, 3H, CH_3), 2.26 (m, 3H, CH_3), 1.87 (m, 3H, CH_3); ^{13}C NMR (150 MHz, $CDCl_3$): δ = 175.9, 169.1, 165.8, 163.3, 159.3, 155.8, 153.6, 150.7, 140.6, 137.4, 136.6, 136.0, 134.7, 133.7, 131.9, 129.6, 128.7, 127.7, 126.2, 126.0, 122.5, 121.4, 120.1, 118.5, 118.2, 111.7, 43.6, 34.8, 21.0, 20.9, 20.4; HRMS (TOF ES$^+$): *m/z* calcd for $C_{33}H_{28}N_5O_5$ $[M+H]^+$, 574.2085; found, 574.2084.

2-(2-(2-Hydroxy-5-methylphenyl)-6-((4-methoxyphenethyl)amino)-5-nitropyridin-3-yl)-7-methyl-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3l)



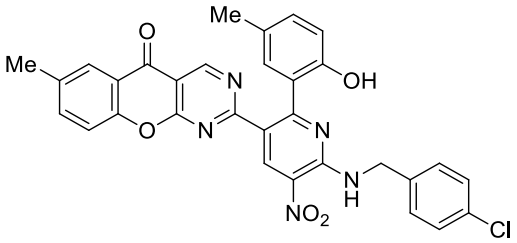
Yellow solid; Mp: 185.1–186.9°C; IR(KBr): 3434.9, 3336.5, 1658.6, 1612.8, 1544.7, 1462.0, 1402.3, 1278.4 cm^{-1}; ^1H NMR (600 MHz, DMSO-d_6): δ = 9.30 (br, 1H, OH), 9.00 (m, 2H, ArH), 8.89 (m, 1H, ArH), 7.98 (m, H, ArH), 7.74–7.73 (m, H, ArH), 7.63–7.62 (m, H, ArH), 7.50–7.49 (m, 1H, ArH), 7.22–7.21 (m, 2H, ArH), 7.06–7.05 (m, H, ArH), 6.87–6.86 (m, H, ArH), 6.51–6.49 (br, H, NH), 3.87–3.84 (m, 2H, NCH_2), 3.73 (s, 3H, OCH_3), 2.96–2.94 (m, 2H, $ArCH_2$), 2.51–2.50 (m, 3H, CH_3), 2.35 (m, 3H, CH_3); ^{13}C NMR (150 MHz, DMSO-d_6): δ = 175.9, 165.4, 162.5, 158.6, 158.3, 153.6, 152.9, 151.6, 138.3, 137.8, 135.8, 132.0, 131.8, 131.5, 130.1, 128.0, 127.1, 125.9, 125.8, 122.5, 122.4, 118.9, 115.9, 114.3, 111.8, 55.5, 43.6, 34.7, 20.8, 20.7; HRMS (TOF ES$^+$): *m/z* calcd for $C_{33}H_{28}N_5O_6$ $[M+H]^+$, 590.2034; found, 590.2037.

2-(6-((4-Fluorobenzyl)amino)-2-(2-hydroxy-5-methylphenyl)-5-nitropyridin-3-yl)-7-methyl-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3m)



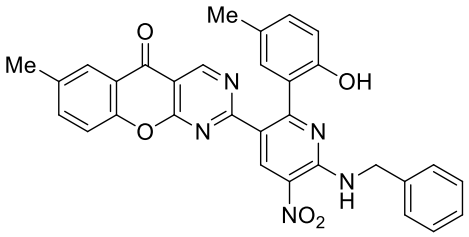
Yellow solid; Mp: 209.5–210.6°C; IR (KBr): 3458.1, 3354.3, 3195.8, 1674.1, 1658.3, 1627.1, 1600.0, 1414.8; ^{1}H NMR (500 MHz, DMSO-d_6): 9.43–9.41 (m, 1H, ArH), 9.27 (br, 1H, OH), 9.04–8.96 (m, 2H, ArH), 9.97 (m, 1H, ArH), 7.76–7.74 (m, 1H, ArH), 7.64–7.63 (m, 1H, ArH), 7.47–7.44 (m, 1H, ArH), 7.20–7.17 (m, 2H, ArH), 7.01–7.6.99 (m, 2H, ArH), 6.44–6.43 (br, 1H, NH), 4.85–4.84 (m, 2H, $ArCH_2$), 2.54–2.51 (m, 3H, CH_3), 2.27–2.24 (m, 3H, CH_3); ^{13}C NMR (125 MHz, DMSO-d_6): δ = 176.0, 168.7 165.4, 161.9, 161.6 (d, J = 240 Hz), 158.7, 153.6, 152.8, 151.3, 138.1, 138.0, 136.3, 135.9, 132.0, 131.9, 129.7, 129.6, 127.9, 126.8, 126.2, 125.8, 122.7, 122.4, 118.9, 115.6 (d, J = 23.8Hz), 115.4, 111.9, 44.5, 20.8, 20.6; HRMS (TOF ES$^+$): *m/z* calcd for $C_{31}H_{23}FN_5O_5$ $[M+H]^+$, 564.1678; found, 564.1678.

2-(6-((4-Chlorobenzyl)amino)-2-(2-hydroxy-5-methylphenyl)-5-nitropyridin-3-yl)-7-methyl-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3n)



Yellow solid; Mp:136.1–137.5°C; IR(KBr): 3436.0, 3337.0, 3201.5, 1658.6, 1641.8, 1619.8, 1461.3, 1402.7 cm^{-1}; ^{1}H NMR (500 MHz, DMSO-d_6): δ = 9.45–9.42 (m, H, ArH), 9.26 (br, 1H, OH), 9.00–8.96 (m, 2H, ArH), 7.96–7.95 (m, 1H, ArH), 7.75–7.73 (m, 1H, ArH), 7.63–7.61 (m, 1H, ArH), 7.42–7.40 (m, 4H, ArH), 7.00–6.98 (m, 1H, ArH), 6.87–6.86 (m, 1H, ArH), 6.43–6.42 (br, 1H, NH), 4.84–4.83 (m, 2H, $ArCH_2$), 2.41 (m, 3H, CH_3), 2.21 (m, 3H, CH_3); ^{13}C NMR (125 MHz, DMSO-d_6): δ = 175.9, 168.7, 165.4, 161.8, 158.7, 153.6, 152.8, 151.3, 139.3, 138.1, 137.9, 135.9, 132.0, 131.6, 129.4, 128.8, 128.7, 127.9, 126.8, 126.3, 125.7, 122.7, 122.4, 118.9, 115.7, 111.8, 44.7, 20.8, 20.6; HRMS (TOF ES$^+$): *m/z* calcd for $C_{31}H_{23}ClN_5O_5$ $[M+H]^+$, 580.1382; found, 580.1377.

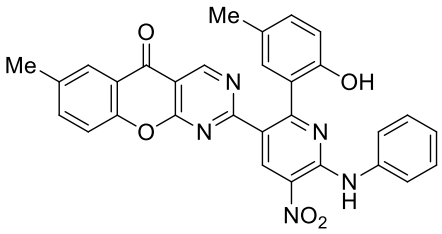
2-(6-(Benzylamino)-2-(2-hydroxy-5-methylphenyl)-5-nitropyridin-3-yl)-7-methyl-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3o)



Yellow solid; Mp: 148.3–150.1°C; IR(KBr): 3389, 2926, 1668, 1600, 1581, 1424, 1399, 1292 cm^{-1}; ^{1}H NMR (500 MHz, DMSO-d_6): δ = 9.41–9.39 (br, 1H, OH), 9.25 (m, 1H, ArH), 8.97–8.96 (m,

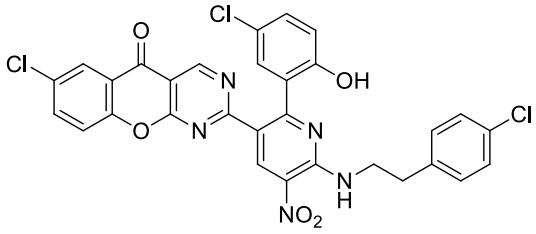
2H, ArH), 7.95 (m, 1H, ArH), 7.74–7.72 (m, 1H, ArH), 7.62–7.60 (m, 1H, ArH), 7.43–7.33 (m, 4H, ArH), 7.30–7.27 (m, 2H, ArH), 7.01–7.00 (m, 1H, ArH), 6.44–6.43 (br, 1H, NH), 4.88–4.87 (m, 2H, $ArCH_2$), 2.41–2.40 (m, 3H, CH_3), 2.23 (m, 3H, CH_3);^{13}C NMR (125 MHz, DMSO-d_6): δ = 175.9, 168.7, 165.4, 161.9, 158.6, 153.6, 152.8, 151.4, 140.1, 138.1, 137.9, 135.8, 132.0, 128.9, 128.8, 127.9, 127.7, 127.2, 126.8, 126.1, 125.7, 122.6, 122.3, 118.9, 115.7, 111.8, 45.2, 20.8, 20.6 HRMS (TOF ES$^+$): *m/z* calcd for $C_{31}H_{24}N_5O_5$ [M+H]$^+$, 546.1772; found, 546.1772.

2-(2-(2-Hydroxy-5-methylphenyl)-5-nitro-6-(phenylamino)pyridin-3-yl)-7-methyl-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3p)



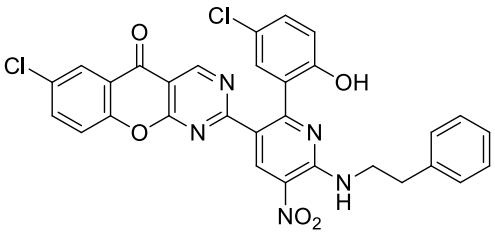
Yellow solid; Mp:171.8–172.9°C; IR (KBr): 3411.2, 3321.8, 3206.7, 1641.6, 1629.3, 1609.7, 1470.5, 1408.4 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ = 10.29 (br, 1H, OH), 9.33 (s, 1H, ArH), 9.09–9.07 (m, 2H, ArH), 7.99 (m, 1H, ArH), 7.81–7.60 (m, 1H, ArH), 7.62–7.76 (m, 3H, ArH), 7.67–7.65 (m, 1H, ArH), 7.43–7.40 (m, 3H, ArH), 7.21–7.19 (m, 1H, ArH), 7.05–7.03 (m, 1H, ArH), 6.44–6.43 (br, 1H, NH), 2.47 (m, 3H, CH_3), 2.28 (m, 3H, CH_3); ^{13}C NMR (150 MHz, DMSO-d_6): δ = 175.3, 162.1, 155.6, 153.3, 137.3, 137.2, 135.3, 129.0, 127.2, 125.8, 127.2, 125.8, 123.5, 120.9, 118.5, 107.3, 20.7, 20.7; HRMS(TOF ES$^+$): *m/z* calcd for $C_{30}H_{22}N_5O_5$ [M+H]$^+$, 532.1615; found, 532.1610.

7-Chloro-2-(2-(5-chloro-2-hydroxyphenyl)-6-((4-chlorophenethyl)amino)-5-nitropyridin-3-yl)-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3q)



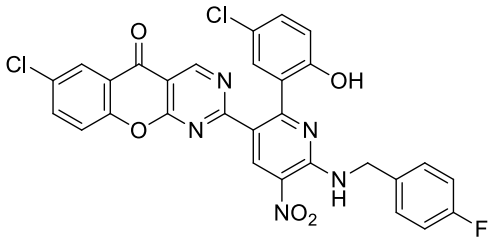
Yellow solid; Mp:238.5–239.1°C; IR(KBr): 3437.3, 3340.9, 3203.9, 1664.9, 1614.8, 1469.7, 1402.9, 1099.6 cm^{-1}; ^{1}H NMR (500 MHz, DMSO-d_6): δ = 9.72 (br, 1H, OH), 9.32 (m, 1H, ArH), 9.01–8.97 (m, 2H, ArH), 8.08 (m, H, ArH), 7.98–7.96 (m, H, ArH), 7.82–7.81 (m, 1H, ArH), 7.61 (m, 1H, ArH), 7.36–7.26 (m, 5H, ArH), 6.60–6.59 (br, H, NH), 3.87–3.85 (m, 2H, NCH_2), 3.00–2.98 (m, 2H, $ArCH_2$); ^{13}C NMR (125 MHz, DMSO-d_6): δ = 175.0, 168.2, 165.4, 160.8, 158.9, 154.0, 151.6, 138.8, 138.3, 136.6, 131.1, 130.8, 130.6, 129.3, 128.8, 126.4, 125.3, 123.9, 122.0, 121.6, 117.7, 111.7, 43.2, 34.8; HRMS (TOF ES$^+$): *m/z* calcd for $C_{30}H_{19}Cl_3N_5O_5$ [M+H]$^+$, 634.0446; found, 634.0444.

7-Chloro-2-(2-(5-chloro-2-hydroxyphenyl)-5-nitro-6-(phenethylamino)pyridin-3-yl)-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3r)



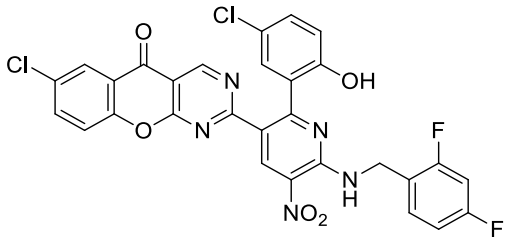
Yellow solid; Mp: 193.9–195.1°C; IR(KBr): 3437.1, 3339.4, 3197.0, 1688.5, 1658.8, 1641.7, 1613.9, 1402.7 cm^{-1}; ^1H NMR (500 MHz, DMSO-d_6): δ = 9.61 (br, 1H, OH), 9.35 (m, H, ArH), 9.04–9.00 (m, 2H, ArH), 8.11–8.10 (m, H, ArH), 7.99–7.97 (m, H, ArH), 7.84–7.82 (m, H, ArH), 7.67 (m, 1H, ArH), 7.34–7.23 (m, 6H, ArH), 6.65–6.64 (br, H, NH), 3.90–3.86 (m, 2H, NCH_2), 3.02–2.99 (m, 2H, $ArCH_2$); ^{13}C NMR (125 MHz, DMSO-d_6): δ = 175.1, 168.3, 165.4, 160.8, 158.9, 154.1, 154.0, 151.6, 139.7, 138.3, 136.6,130.9, 130.6, 130.6, 129.4, 129.2, 128.9, 126.8, 126.4, 125.4, 124.0,123.3, 122.0, 121.6, 117.7, 111.8, 43.5, 35.6; HRMS (TOF ES^+): *m/z* calcd for $C_{30}H_{20}Cl_2N_5O_5$ $[M+H]^+$, 600.0836; found, 600.0836.

7-Chloro-2-(2-(5-chloro-2-hydroxyphenyl)-6-((4-fluorobenzyl)amino)-5-nitropyridin-3-yl)-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3s)



Yellow solid; Mp:212.4–213.5°C; IR(KBr): 3438.8, 3339.4, 3200.1, 1664.6, 1615.6, 1459.9, 1403.2, 1275.3 cm^{-1}; ^1H NMR (600 MHz, DMSO-d_6): δ = 9.60 (br, 1H, OH), 9.46–9.44 (m, 1H, ArH), 9.31 (s, 2H, ArH), 9.02 (m, 1H, ArH), 8.09 (m, 1H, ArH), 7.98–7.96 (m, 1H, ArH), 7.82–7.80 (m, 1H, ArH), 7.45–7.43 (m, 2H, ArH), 7.25–7.14 (m, 4H, ArH), 6.58–6.57 (br, 1H, NH), 4.84–4.83 (m, 2H, $ArCH_2$); ^{13}C NMR (150 MHz, DMSO-d_6): δ = 175.1, 168.3, 165.4, 161.6 (d, J = 241.5 Hz), 161.3, 158.9, 154.0, 151.4, 138.3, 136.6, 136.1, 130.8, 130.6, 130.6, 129.7, 129.7, 129.1, 126.7, 125.4, 124.0, 123.1, 122.2, 121.6, 117.6, 115.5, (d, J = 21.0 Hz), 111.8, 44.6; HRMS (TOF ES^+): *m/z* calcd for $C_{29}H_{17}Cl_2FN_5O_5$ $[M+H]^+$, 604.0585; found, 604.0583.

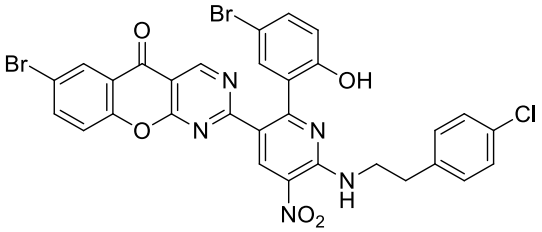
7-Chloro-2-(2-(5-chloro-2-hydroxyphenyl)-6-((2,4-difluorobenzyl)amino)-5-nitropyridin-3-yl)-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3t)



Yellow solid; Mp:230.3–231.6°C; IR (KBr): 3434.9, 3337.6, 3184.8, 1614.4, 1504.6, 1402.6, 1276.1, 1228.2 cm^{-1}; ^1H NMR (500 MHz, DMSO-d_6): δ = 9.57 (br, 1H, OH), 9.40–9.38 (m, H, ArH), 9.33 (m, H, ArH), 9.03 (m, H, ArH), 8.10 (m, 1H, ArH), 7.99–7.97 (m, 1H, ArH), 7.83–7.81 (m, 1H, ArH), 7.49–7.44 (m, 1H, ArH), 7.26–7.22 (m, 2H, ArH), 7.09–7.03 (m, 2H, ArH),

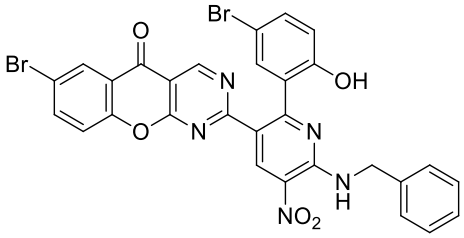
6.59–6.57 (br, H, NH), 4.87–4.86 (m, 2H, $ArCH_2$); ^{13}C NMR (125 MHz, DMSO-d_6): δ = 175.1, 168.4, 165.4, 160.1, 158.9, 154.0, 153.9, 151.3, 138.3, 136.6, 130.7, 130.6, 129.0, 127.0, 125.4, 124.0, 123.2, 122.4, 121.6, 117.6, 111.9, 111.7, 104.1, 38.8; HRMS (TOF ES^+): *m/z* calcd for $C_{29}H_{16}Cl_2F_2N_5O_5$ $[M+H]^+$, 622.0491; found, 622.0492.

7-Bromo-2-(2-(5-bromo-2-hydroxyphenyl)-6-((4-chlorophenethyl)amino)-5-nitropyridin-3-yl)-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3u)



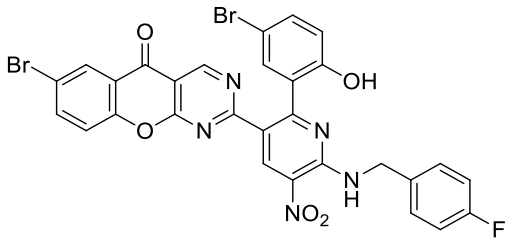
Yellow solid; Mp:138.1–139.2℃; IR(KBr): 3442.5, 3342.3, 3198.5, 1664.5, 1613.2, 1587.0, 1459.9, 1404.2 cm^{-1}; ^1H NMR (500 MHz, DMSO-d_6): δ = 9.66 (br, 1H, OH), 9.33 (m, H, ArH), 9.02–8.98 (m, 2H, ArH), 8.22–8.21 (m, H, ArH), 8.09–8.07 (m, H, ArH), 7.78–7.74 (m, 2H, ArH), 7.42–7.32 (m, 6H, ArH), 6.59–6.57 (br, H, NH), 3.87–3.83 (m, 2H, NCH_2), 3.00–2.98 (m, 2H, $ArCH_2$); ^{13}C NMR (125 MHz, DMSO-d_6): δ = 174.9, 168.3, 165.4, 160.6, 158.9, 154.4, 151.6, 139.4, 138.8, 138.3, 133.7, 133.4, 131.4, 131.1, 129.9, 128.9, 128.4, 126.4, 124.3, 122.0, 121.8, 118.4, 118.2, 111.8, 43.3, 34.8; HRMS (TOF ES^+): *m/z* calcd for $C_{30}H_{19}Br_2ClN_5O_5$ $[M+H]^+$, 721.9436; found, 721.9443.

2-(6-(Benzylamino)-2-(5-bromo-2-hydroxyphenyl)-5-nitropyridin-3-yl)-7-bromo-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3v)



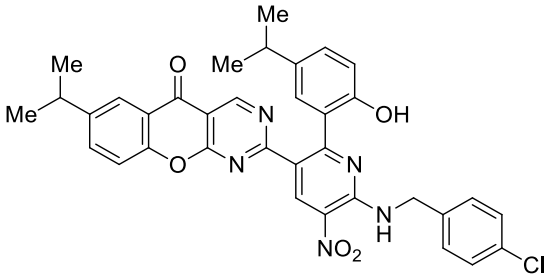
Yellow solid; Mp:134.9–136.1℃; IR(KBr): 3434.8, 3338.6, 3193.8, 1674.4, 1604.3, 1462.4, 1399.7, 1277.3 cm^{-1}; ^1H NMR (600 MHz, DMSO-d_6): δ = 9.60 (br, 1H, OH), 9.50–9.47 (m, 1H, ArH), 9.30 (s, 1H, ArH), 9.01 (m, 1H, ArH), 8.20 (m, 1H, ArH), 8.07–8.06 (m, 1H, ArH), 7.74–7.72 (m, 1H, ArH), 7.43–7.26 (m, 7H, ArH), 6.54–6.53 (br, 1H, NH), 4.85–4.84 (m, 2H, $ArCH_2$); ^{13}C NMR (150 MHz, DMSO-d_6): δ = 174.9, 168.4, 165.4, 160.2, 158.9, 154.5, 154.3, 151.5, 139.9, 139.4, 138.3, 133.7, 133.5, 129.6, 128.9, 128.4, 127.9, 127.9, 127.3, 126.7, 124.3, 122.1, 121.8, 118.5, 118.01, 111.9, 110.8, 45.4; HRMS (TOF ES^+): *m/z* calcd for $C_{29}H_{18}Br_2N_5O_5$ $[M+H]^+$, 673.9669; found, 673.9668.

7-Bromo-2-(2-(5-bromo-2-hydroxyphenyl)-6-((4-fluorobenzyl)amino)-5-nitropyridin-3-yl)-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3w)



Yellow solid; Mp:145.1–146.2℃; IR(KBr): 3439.1, 3340.8, 3185.9, 1665.9, 1586.5, 1401.3, 1277.3, 1227.6 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ = 9.60 (br, 1H, OH), 9.48 (s, 1H, ArH), 9.31 (s, 1H, ArH), 9.00 (m, 1H, ArH), 8.22 (m, 1H, ArH), 8.09–8.07 (m, 1H, ArH), 7.76–7.74 (m, 1H, ArH), 7.46–7.44 (m, 2H, ArH), 7.32–7.27 (m, 2H, ArH), 7.20–7.16 (m, 2H, ArH), 6.50 (br, 1H, NH), 4.83–4.82 (m, 2H, $ArCH_2$); ^{13}C NMR (150 MHz, DMSO-d_6): δ = 174.9, 168.3, 165.4, 161.6 (d, J = 241.5 Hz), 160.2, 158.9, 154.4, 151.4, 139.4, 138.3, 136.1, 133.7, 133.4, 129.7, 129.7, 129.6, 128.4, 126.7, 124.3, 122.2, 121.8, 118.4, 118.1, 115.5(d, J = 17.5Hz), 111.8, 44.6; HRMS (TOF ES^+): *m/z* calcd for $C_{29}H_{17}Br_2FN_5O_5$ $[M+H]^+$, 691.9575; found, 691.9571.

2-(6-((4-Chlorobenzyl)amino)-2-(2-hydroxy-5-isopropylphenyl)-5-nitropyridin-3-yl)-7-isopropyl-5*H*-chromeno[2,3-*d*]pyrimidin-5-one (3x)



Yellow solid; Mp: 120.5–121.5℃; IR(KBr): 3447.2,3213.4, 2375.8, 1669.0, 1624.4, 1401, 1228.1, 466.1 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ = 9.42 (br, 1H, OH), 9.26 (m, H, ArH), 9.03–8.99 (m, 2H, ArH), 7.99 (m, 1H, ArH), 7.84–7.83 (m, 1H, ArH), 7.65–7.63 (m, 1H, ArH), 7.43–7.38 (m, 4H, ArH), 7.07–7.05 (m, 2H, ArH), 6.48–6.47 (br, 1H, NH), 4.87–4.86 (m, 2H, $ArCH_2$), 3.09 (m, 1H, CH), 2.77 (m, 1H, CH), 1.27–1.26 (m, 6H, $2CH_3$), 1.15–1.14 (m, 6H, $2CH_3$); ^{13}C NMR (150 MHz, DMSO-d_6): δ = 176.0, 168.7, 165.4, 162.1, 158.6, 153.8, 153.1, 151.4, 146.5, 139.1, 139.1, 138.2, 135.6, 131.7, 129.4, 129.3, 128.7, 126.5, 126.3, 123.0, 122.8, 122.5, 119.1, 115.8, 111.8, 44.5, 33.3, 32.9, 24.4, 24.1; HRMS (TOF ES^+): *m/z* calcd for $C_{35}H_{30}ClN_5O_5$ $[M+H]^+$, 636.2008; found, 636.2003.

X-ray Structure and Data of 3v

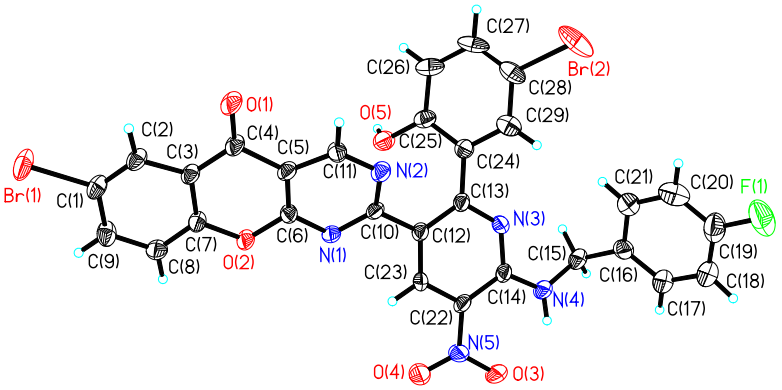


Figure S1. X-Ray crystal structure of **3v**.

Table S1. Crystal data and structure refinement for **3v**

Empirical formula	$C_{29}H_{16}Br_2FN_5O_5$
Formula weight	693.29
Temperature	296.15 K
Wavelength	0.71073 Å
Crystal system, space group	Monoclinic, C 1 2/c 1
Unit cell dimensions	a = 27.834(5) Å alpha = 90 deg. b = 16.568(3) Å beta = 136.959(2)°. deg. c = 23.084(4) Å gamma = 90 deg.
Volume	7266(2) $Å^3$
Z, Calculated density	8, 1.268 Mg/m3
Absorption coefficient	2.274 mm^{-1}
F(000)	2752
Theta range for data collection	2.521 to 27.653°.
Index ranges	-36<=h<=36, -21<=k<=21, -28<=l<=29
Reflections collected / unique	28770 / 8060 [R(int) = 0.0682]
Completeness to theta = 25.242	99.8%
Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	0.7456 and 0.3434
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	8060 / 37 / 380
Goodness-of-fit on F^2	1.008
Final R indices [I>2sigma(I)]	R1 = 0.0538, wR2 = 0.1178
R indices (all data)	R1 = 0.1361, wR2 = 0.1441
Extinction coefficient	n/a
Largest diff. peak and hole	0.562 and -0.585 e.Å-3

Table S2. Bond lengths [A] and angles [deg] for **3v**

Br(1)-C(1)	1.893(3)	C(24)-C(25)	1.410(5)
Br(2)-C(28)	1.888(4)	C(1)-C(9)	1.387(5)
F(1)-C(19)	1.363(5)	C(5)-C(11)	1.391(4)
O(2)-C(6)	1.353(4)	C(29)-H(29)	0.9300
O(2)-C(7)	1.386(4)	C(29)-C(28)	1.387(5)
O(1)-C(4)	1.216(4)	C(11)-H(11)	0.9300
O(5)-H(5)	0.8200	C(7)-C(8)	1.370(5)
O(5)-C(25)	1.350(4)	C(14)-C(22)	1.423(5)
O(3)-N(5)	1.233(4)	C(16)-C(15)	1.507(5)
O(4)-N(5)	1.224(4)	C(16)-C(17)	1.391(5)
N(1)-C(10)	1.340(4)	C(16)-C(21)	1.368(5)
N(1)-C(6)	1.322(4)	C(9)-H(9)	0.9300
N(3)-C(13)	1.330(4)	C(9)-C(8)	1.375(5)
N(3)-C(14)	1.344(4)	C(25)-C(26)	1.395(5)
N(2)-C(10)	1.340(4)	C(8)-H(8)	0.9300
N(2)-C(11)	1.326(4)	C(15)-H(15A)	0.9700
N(4)-H(4)	0.8600	C(15)-H(15B)	0.9700
N(4)-C(14)	1.343(4)	C(28)-C(27)	1.377(6)
N(4)-C(15)	1.463(4)	C(26)-H(26)	0.9300
N(5)-C(22)	1.421(4)	C(26)-C(27)	1.356(6)
C(10)-C(12)	1.464(4)	C(17)-H(17)	0.9300
C(6)-C(5)	1.387(4)	C(17)-C(18)	1.382(6)
C(4)-C(3)	1.470(5)	C(27)-H(27)	0.9300
C(4)-C(5)	1.468(4)	C(21)-H(21)	0.9300
C(2)-H(2)	0.9300	C(21)-C(20)	1.384(6)
C(2)-C(3)	1.402(4)	C(19)-C(20)	1.374(7)
C(2)-C(1)	1.348(5)	C(19)-C(18)	1.344(7)
C(23)-H(23)	0.9300	C(20)-H(20)	0.9300
C(23)-C(12)	1.376(4)	C(18)-H(18)	0.9300
C(23)-C(22)	1.386(4)	C(6)-O(2)-C(7)	118.8(3)
C(12)-C(13)	1.419(5)	C(25)-O(5)-H(5)	109.5
C(13)-C(24)	1.479(5)	C(6)-N(1)-C(10)	115.7(3)
C(3)-C(7)	1.395(4)	C(13)-N(3)-C(14)	121.1(3)
C(24)-C(29)	1.385(5)	C(11)-N(2)-C(10)	115.6(3)
C(15)-N(4)-H(4)	118.2	C(14)-N(4)-H(4)	118.2
O(3)-N(5)-C(22)	119.4(3)	C(14)-N(4)-C(15)	123.5(3)
O(4)-N(5)-O(3)	121.2(3)	C(11)-C(5)-C(4)	124.2(3)
O(4)-N(5)-C(22)	119.4(3)	C(24)-C(29)-H(29)	119.8
N(1)-C(10)-N(2)	126.1(3)	C(24)-C(29)-C(28)	120.5(4)
N(1)-C(10)-C(12)	115.2(3)	C(28)-C(29)-H(29)	119.8

N(2)-C(10)-C(12)	118.6(3)	N(2)-C(11)-C(5)	123.7(3)
O(2)-C(6)-C(5)	122.9(3)	N(2)-C(11)-H(11)	118.1
N(1)-C(6)-O(2)	113.2(3)	C(5)-C(11)-H(11)	118.1
N(1)-C(6)-C(5)	123.9(3)	O(2)-C(7)-C(3)	122.3(3)
O(1)-C(4)-C(3)	123.3(3)	C(8)-C(7)-O(2)	115.4(3)
O(1)-C(4)-C(5)	123.1(3)	C(8)-C(7)-C(3)	122.3(3)
C(5)-C(4)-C(3)	113.6(3)	N(3)-C(14)-C(22)	119.4(3)
C(3)-C(2)-H(2)	120.0	N(4)-C(14)-N(3)	117.2(3)
C(1)-C(2)-H(2)	120.0	N(4)-C(14)-C(22)	123.3(3)
C(1)-C(2)-C(3)	120.0(3)	C(17)-C(16)-C(15)	121.1(4)
C(12)-C(23)-H(23)	119.4	C(21)-C(16)-C(15)	120.5(4)
C(12)-C(23)-C(22)	121.3(3)	C(21)-C(16)-C(17)	118.5(4)
C(22)-C(23)-H(23)	119.4	N(5)-C(22)-C(14)	123.3(3)
C(23)-C(12)-C(10)	118.5(3)	C(23)-C(22)-N(5)	117.8(3)
C(23)-C(12)-C(13)	116.6(3)	C(23)-C(22)-C(14)	118.8(3)
C(13)-C(12)-C(10)	124.9(3)	C(1)-C(9)-H(9)	120.2
N(3)-C(13)-C(12)	122.5(3)	C(8)-C(9)-C(1)	119.6(3)
N(3)-C(13)-C(24)	114.2(3)	C(8)-C(9)-H(9)	120.2
C(12)-C(13)-C(24)	123.4(3)	O(5)-C(25)-C(24)	119.5(3)
C(2)-C(3)-C(4)	121.7(3)	O(5)-C(25)-C(26)	121.3(4)
C(7)-C(3)-C(4)	120.7(3)	C(26)-C(25)-C(24)	119.2(4)
C(7)-C(3)-C(2)	117.5(3)	C(7)-C(8)-C(9)	118.9(3)
C(29)-C(24)-C(13)	119.1(3)	C(7)-C(8)-H(8)	120.6
C(29)-C(24)-C(25)	118.7(3)	C(9)-C(8)-H(8)	120.6
C(25)-C(24)-C(13)	122.1(3)	N(4)-C(15)-C(16)	113.8(3)
C(2)-C(1)-Br(1)	120.6(3)	N(4)-C(15)-H(15A)	108.8
C(2)-C(1)-C(9)	121.7(3)	N(4)-C(15)-H(15B)	108.8
C(9)-C(1)-Br(1)	117.7(3)	C(16)-C(15)-H(15A)	108.8
C(6)-C(5)-C(4)	121.3(3)	C(16)-C(15)-H(15B)	108.8
C(6)-C(5)-C(11)	114.5(3)	H(15A)-C(15)-H(15B)	107.7
C(27)-C(26)-C(25)	121.2(4)	C(27)-C(28)-C(29)	120.4(4)
C(27)-C(26)-H(26)	119.4	C(25)-C(26)-H(26)	119.4
C(16)-C(17)-H(17)	119.3	C(29)-C(28)-Br(2)	119.2(4)
C(18)-C(17)-C(16)	121.4(5)	C(27)-C(28)-Br(2)	120.5(3)
C(18)-C(17)-H(17)	119.3	C(18)-C(19)-F(1)	118.8(5)
C(28)-C(27)-H(27)	120.0	C(18)-C(19)-C(20)	122.4(5)
C(26)-C(27)-C(28)	120.1(4)	C(21)-C(20)-H(20)	120.6
C(26)-C(27)-H(27)	120.0	C(19)-C(20)-C(21)	118.8(5)
C(16)-C(21)-H(21)	119.7	C(19)-C(20)-H(20)	120.6
C(16)-C(21)-C(20)	120.6(4)	C(17)-C(18)-H(18)	120.9
C(20)-C(21)-H(21)	119.7	C(19)-C(18)-C(17)	118.3(5)
F(1)-C(19)-C(20)	118.7(5)	C(19)-C(18)-H(18)	120.9

Table S3. Torsion angles [°] for **3v**

Br(1)-C(1)-C(9)-C(8)	177.9(3)	Br(2)-C(28)-C(27)-C(26)	179.7(3)
F(1)-C(19)-C(20)-C(21)	179.1(4)	C(10)-N(1)-C(6)-O(2)	-179.2(3)
F(1)-C(19)-C(18)-C(17)	-178.7(4)	C(10)-N(1)-C(6)-C(5)	0.8(5)
O(2)-C(6)-C(5)-C(4)	-5.7(6)	C(10)-N(2)-C(11)-C(5)	2.3(5)
O(2)-C(6)-C(5)-C(11)	174.9(3)	C(10)-C(12)-C(13)-N(3)	176.6(3)
O(2)-C(7)-C(8)-C(9)	-178.9(3)	C(10)-C(12)-C(13)-C(24)	-3.5(5)
O(1)-C(4)-C(3)-C(2)	-2.6(6)	C(6)-O(2)-C(7)-C(3)	2.6(5)
O(1)-C(4)-C(3)-C(7)	179.1(4)	C(6)-O(2)-C(7)-C(8)	-179.0(3)
O(1)-C(4)-C(5)-C(6)	-174.7(4)	C(6)-N(1)-C(10)-N(2)	6.0(5)
O(1)-C(4)-C(5)-C(11)	4.7(6)	C(6)-N(1)-C(10)-C(12)	-177.4(3)
O(5)-C(25)-C(26)-C(27)	-178.0(4)	C(6)-C(5)-C(11)-N(2)	3.5(5)
O(3)-N(5)-C(22)-C(23)	-170.3(3)	C(4)-C(3)-C(7)-O(2)	-3.6(6)
O(3)-N(5)-C(22)-C(14)	12.0(6)	C(4)-C(3)-C(7)-C(8)	178.1(3)
O(4)-N(5)-C(22)-C(23)	10.8(6)	C(4)-C(5)-C(11)-N(2)	-176.0(3)
O(4)-N(5)-C(22)-C(14)	-166.9(4)	C(2)-C(3)-C(7)-O(2)	178.1(3)
N(1)-C(10)-C(12)-C(23)	-32.2(5)	C(2)-C(3)-C(7)-C(8)	-0.3(6)
N(1)-C(10)-C(12)-C(13)	145.5(3)	C(2)-C(1)-C(9)-C(8)	-2.5(6)
N(1)-C(6)-C(5)-C(4)	174.3(3)	C(23)-C(12)-C(13)-N(3)	-5.7(5)
N(1)-C(6)-C(5)-C(11)	-5.2(5)	C(23)-C(12)-C(13)-C(24)	174.2(3)
N(3)-C(13)-C(24)-C(29)	-46.2(5)	C(12)-C(23)-C(22)-N(5)	-177.4(3)
N(3)-C(13)-C(24)-C(25)	131.7(4)	C(12)-C(23)-C(22)-C(14)	0.4(5)
N(3)-C(14)-C(22)-N(5)	172.8(3)	C(12)-C(13)-C(24)-C(29)	133.8(4)
N(3)-C(14)-C(22)-C(23)	-4.9(5)	C(12)-C(13)-C(24)-C(25)	-48.3(5)
N(2)-C(10)-C(12)-C(23)	144.6(3)	C(13)-N(3)-C(14)-N(4)	-178.8(3)
N(2)-C(10)-C(12)-C(13)	-37.7(5)	C(13)-N(3)-C(14)-C(22)	4.0(5)
N(4)-C(14)-C(22)-N(5)	-4.3(6)	C(13)-C(24)-C(29)-C(28)	179.0(3)
N(4)-C(14)-C(22)-C(23)	178.0(3)	C(13)-C(24)-C(25)-O(5)	-0.6(5)
C(5)-C(4)-C(3)-C(2)	178.4(3)	C(13)-C(24)-C(25)-C(26)	-178.8(3)
C(5)-C(4)-C(3)-C(7)	0.1(5)	C(3)-C(4)-C(5)-C(6)	4.3(5)
C(29)-C(24)-C(25)-O(5)	177.3(3)	C(3)-C(4)-C(5)-C(11)	-176.3(3)
C(29)-C(24)-C(25)-C(26)	-0.9(5)	C(3)-C(2)-C(1)-Br(1)	-178.6(3)
C(29)-C(28)-C(27)-C(26)	-0.2(7)	C(3)-C(2)-C(1)-C(9)	1.7(6)
C(11)-N(2)-C(10)-N(1)	-7.5(5)	C(3)-C(7)-C(8)-C(9)	-0.5(6)
C(11)-N(2)-C(10)-C(12)	176.1(3)	C(24)-C(29)-C(28)-Br(2)	179.7(3)
C(7)-O(2)-C(6)-N(1)	-177.9(3)	C(24)-C(29)-C(28)-C(27)	-0.5(6)
C(7)-O(2)-C(6)-C(5)	2.1(5)	C(24)-C(25)-C(26)-C(27)	0.3(6)
C(14)-N(3)-C(13)-C(12)	1.4(5)	C(1)-C(2)-C(3)-C(4)	-178.7(4)
C(14)-N(3)-C(13)-C(24)	-178.6(3)	C(1)-C(2)-C(3)-C(7)	-0.3(5)
C(14)-N(4)-C(15)-C(16)	99.2(4)	C(1)-C(9)-C(8)-C(7)	1.8(6)
C(15)-C(16)-C(17)-C(18)	178.1(4)	C(16)-C(17)-C(18)-C(19)	-1.2(7)
C(15)-C(16)-C(21)-C(20)	-177.6(4)	C(16)-C(21)-C(20)-C(19)	0.3(7)
C(17)-C(16)-C(15)-N(4)	82.7(4)	C(22)-C(23)-C(12)-C(10)	-177.5(3)
C(17)-C(16)-C(21)-C(20)	0.8(6)	C(22)-C(23)-C(12)-C(13)	4.6(5)
C(21)-C(16)-C(15)-N(4)	-98.9(4)	C(25)-C(24)-C(29)-C(28)	1.0(5)
C(21)-C(16)-C(17)-C(18)	-0.3(7)	C(25)-C(26)-C(27)-C(28)	0.3(7)
C(20)-C(19)-C(18)-C(17)	2.4(8)	C(15)-N(4)-C(14)-N(3)	-12.3(5)
C(18)-C(19)-C(20)-C(21)	-2.0(8)	C(15)-N(4)-C(14)-C(22)	164.9(4)

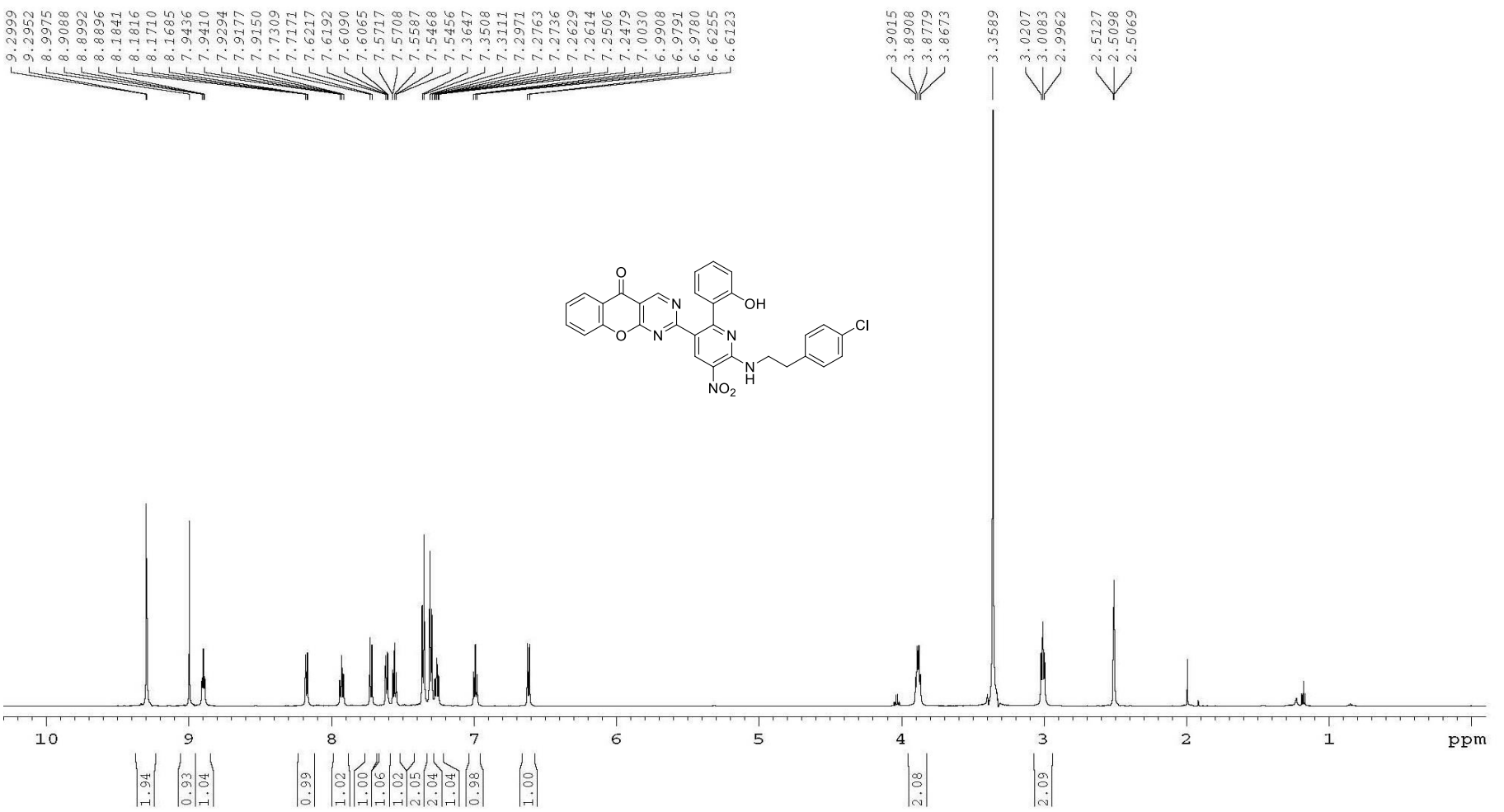


Figure S2. ^{1}H NMR (600 MHz, DMSO-d_6) spectra of compound **3a**

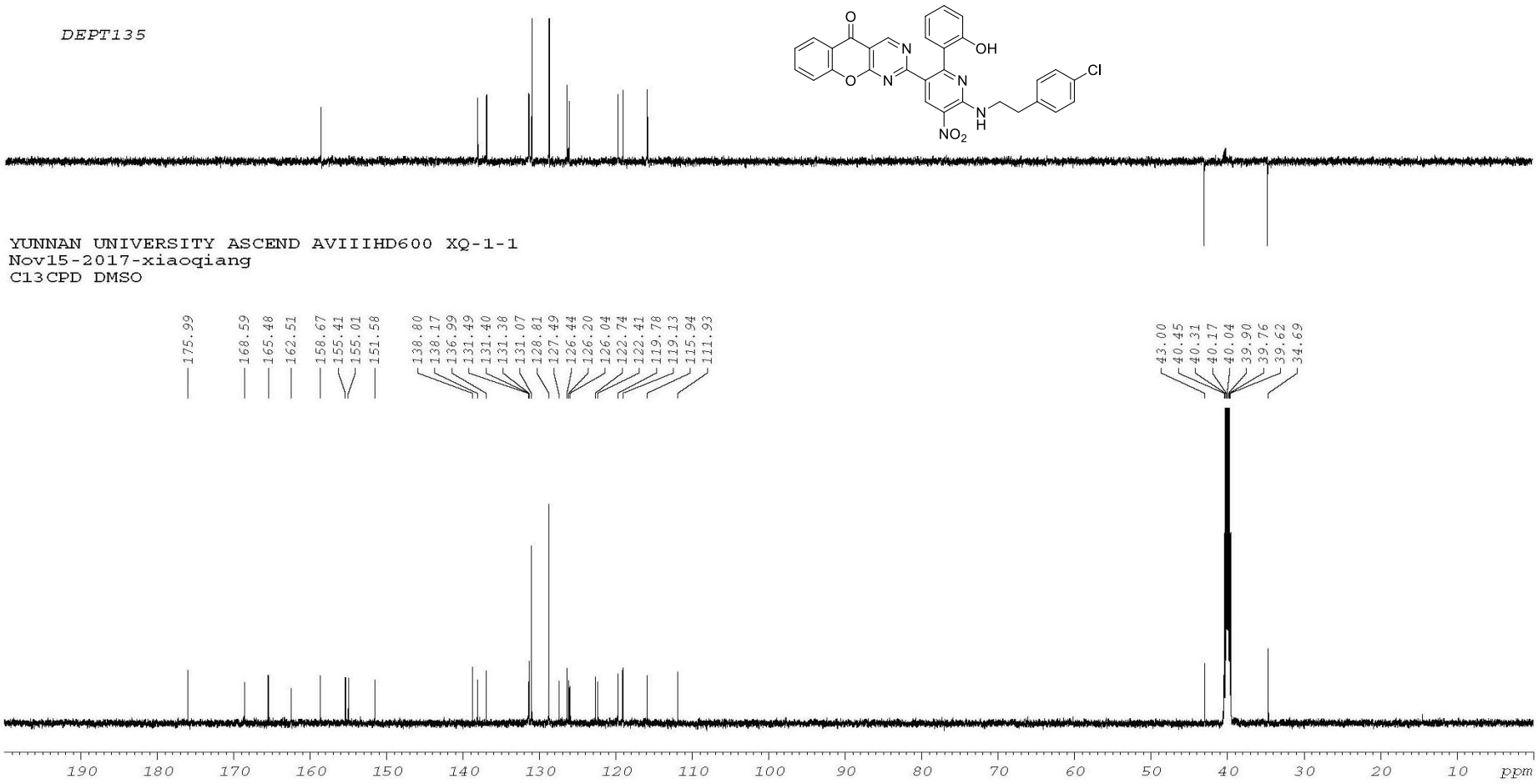


Figure S3. ^{13}C NMR (150 MHz, DMSO-d_6) spectra of compound **3a**

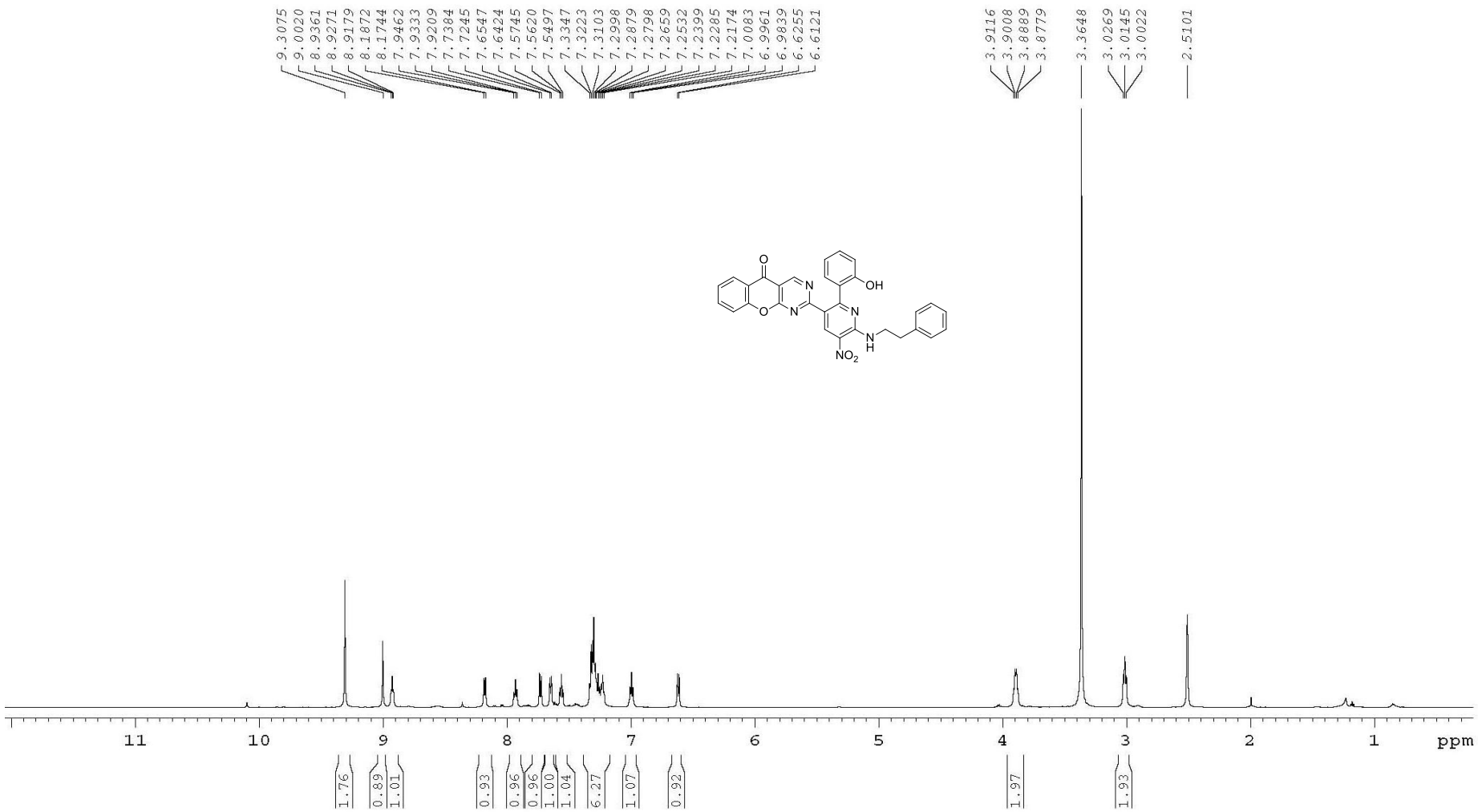


Figure S4. ^{1}H NMR (600 MHz, DMSO-d_6) spectra of compound **3b**

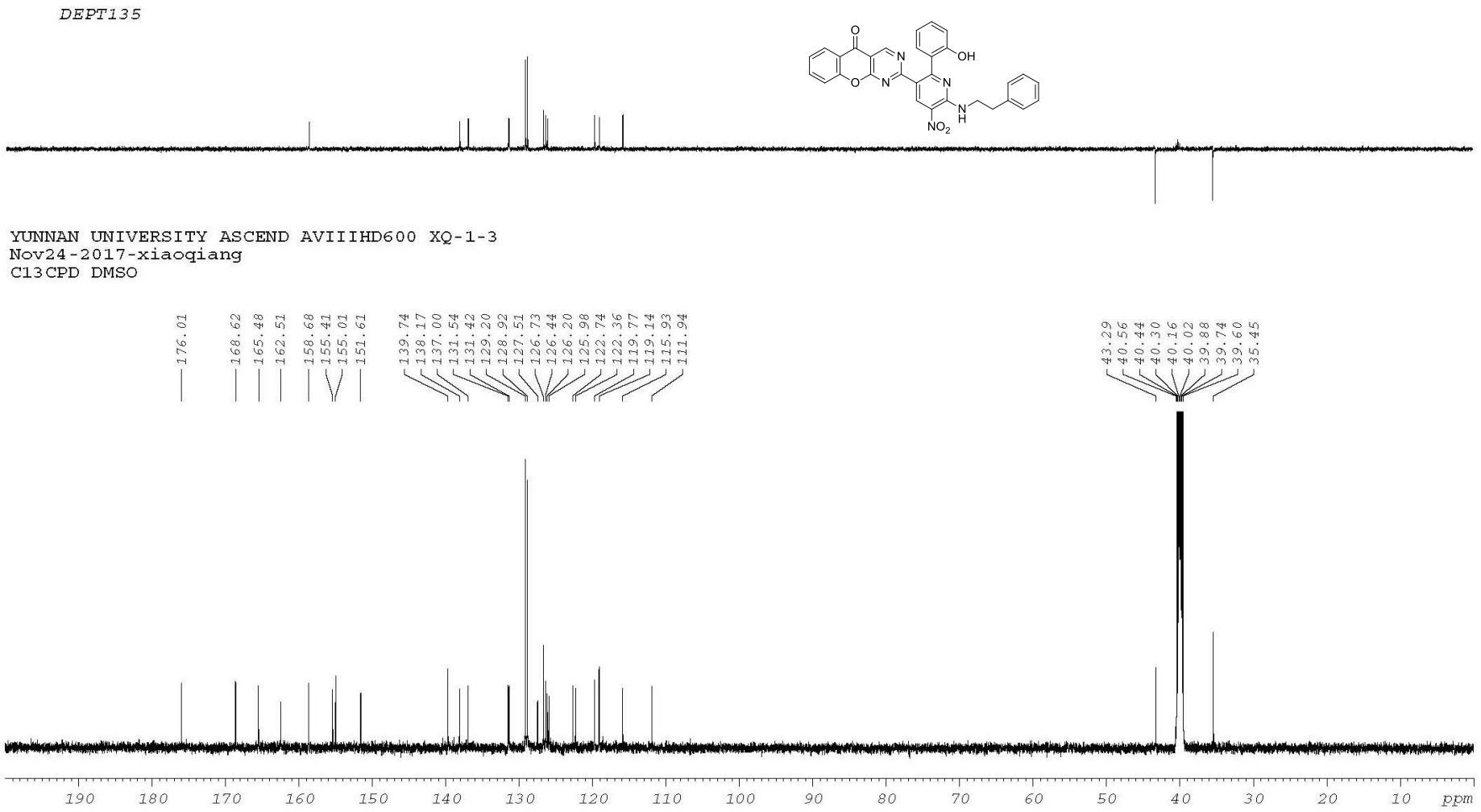


Figure S5. ^{13}C NMR (150 MHz, DMSO-d_6) spectra of compound **3b**

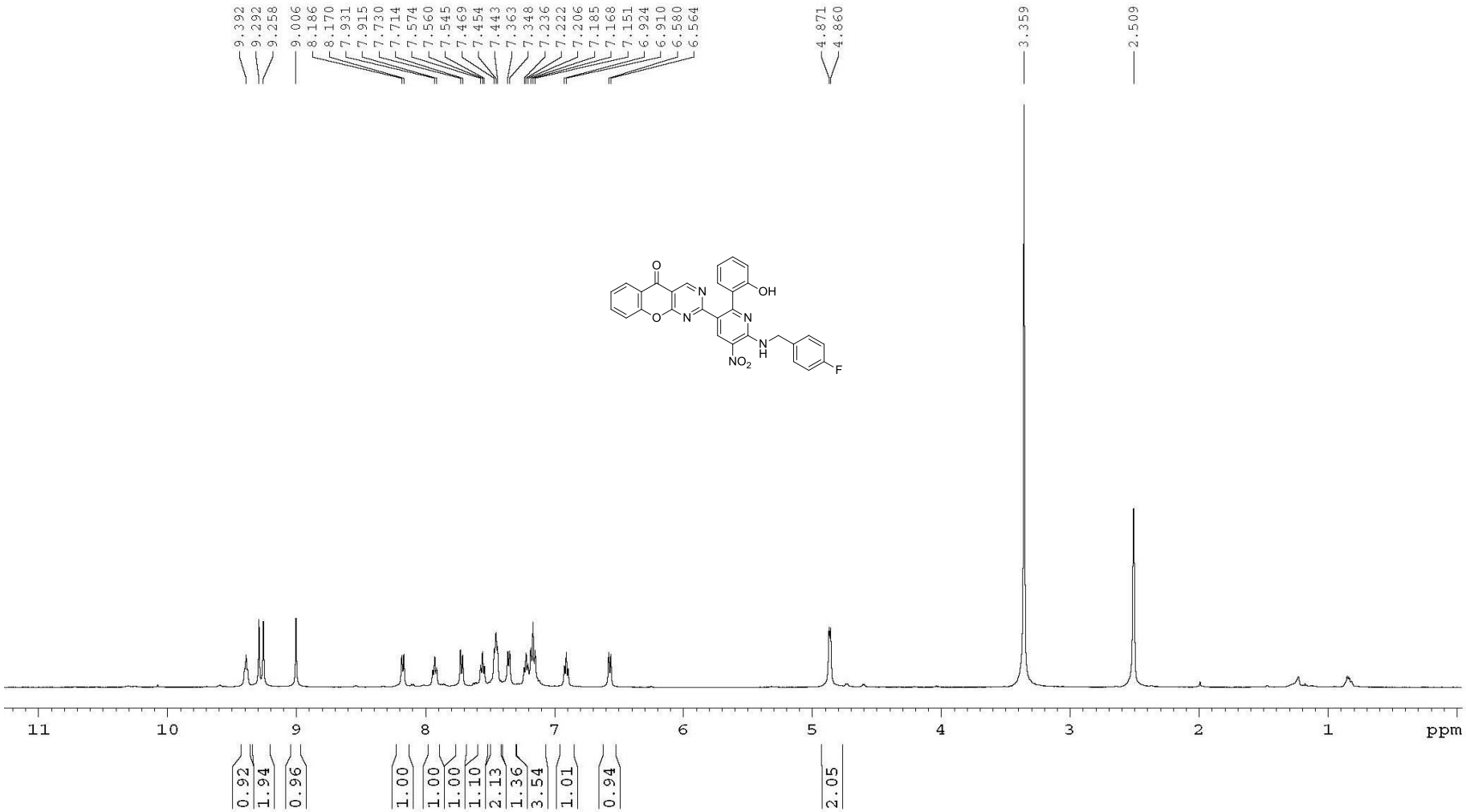


Figure S6. ^{1}H NMR (500 MHz, DMSO-d_6) spectra of compound **3c**

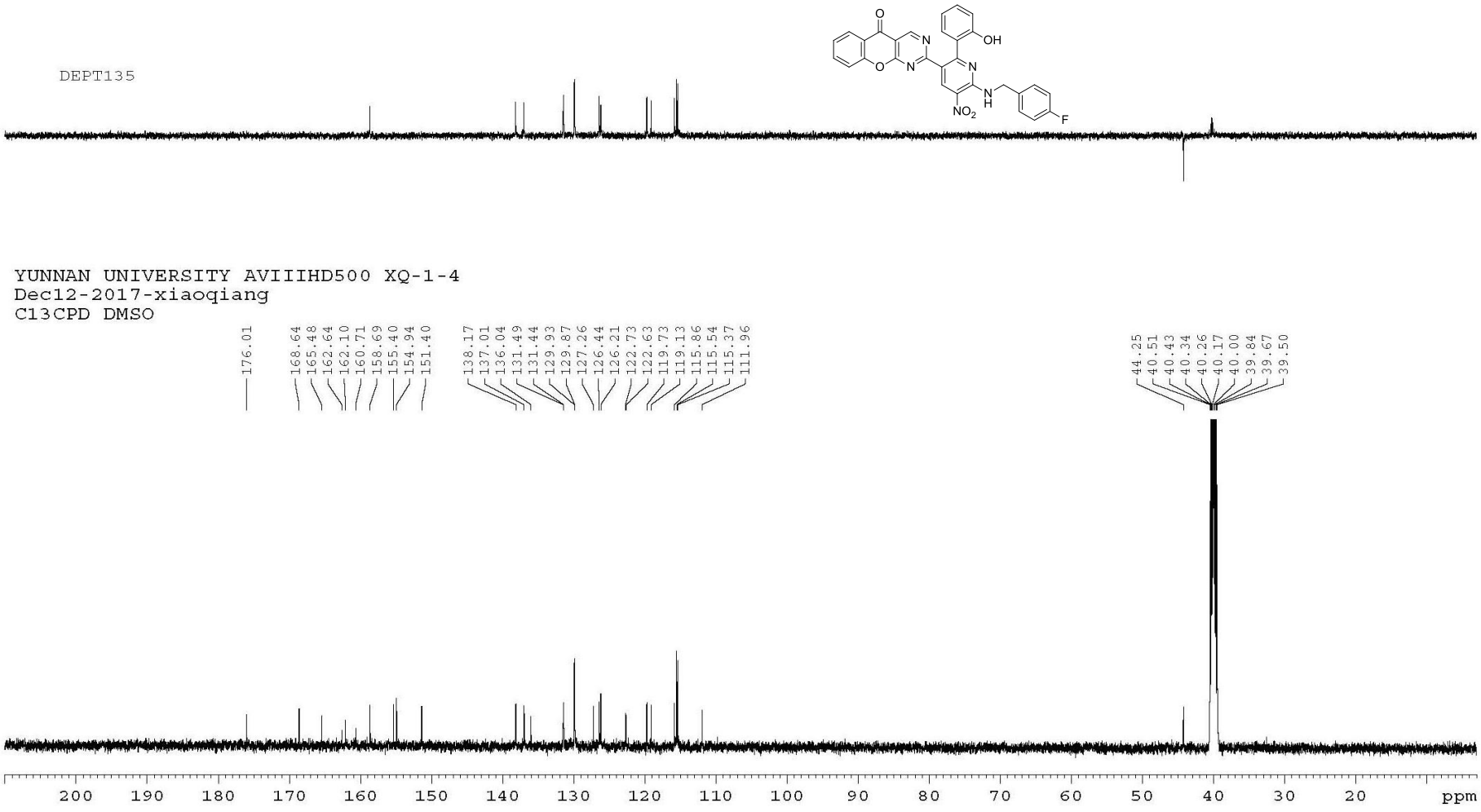


Figure S7. ^{13}C NMR (125 MHz, DMSO-d_6) spectra of compound **3c**

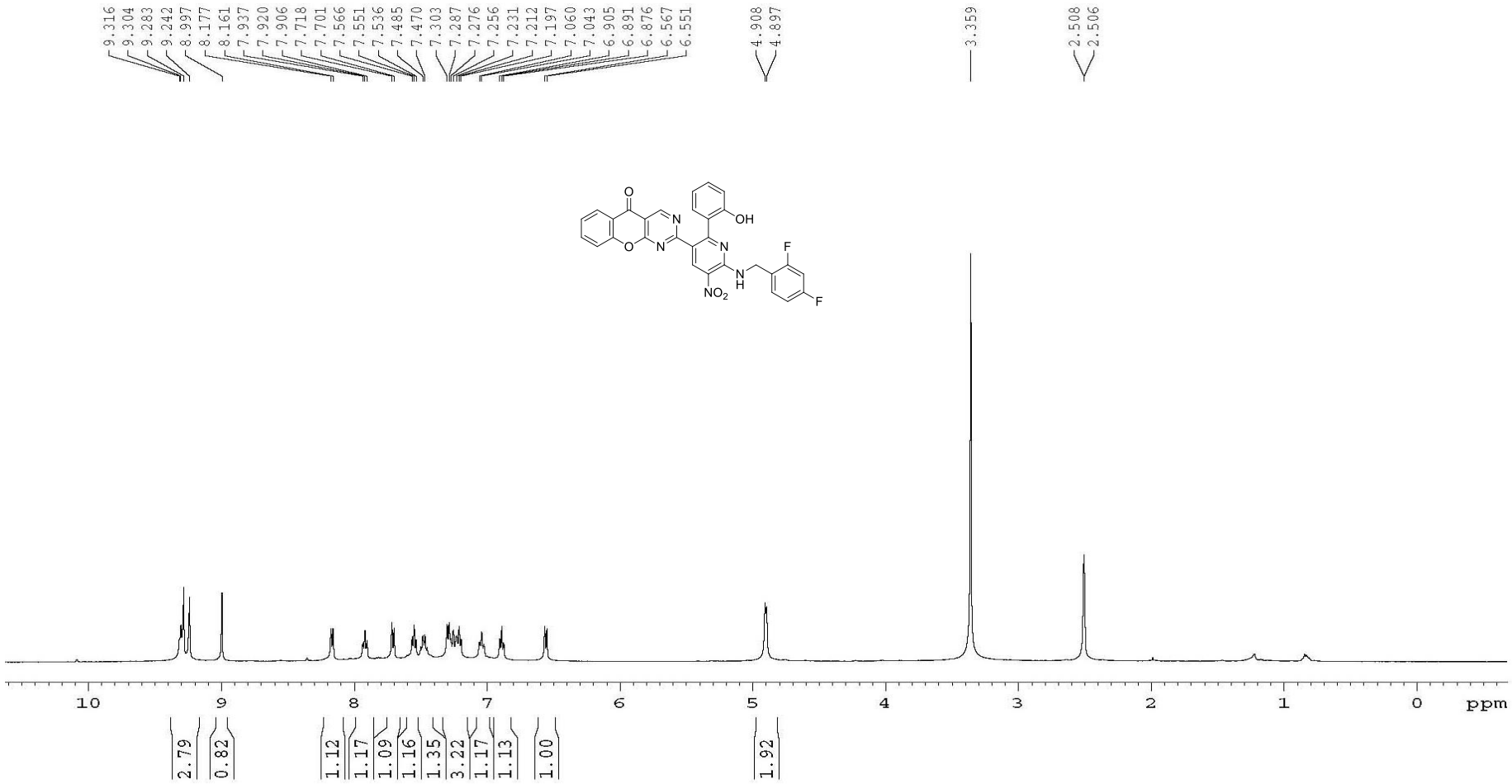


Figure S8. ^{1}H NMR (500 MHz, DMSO-d_6) spectra of compound **3d**

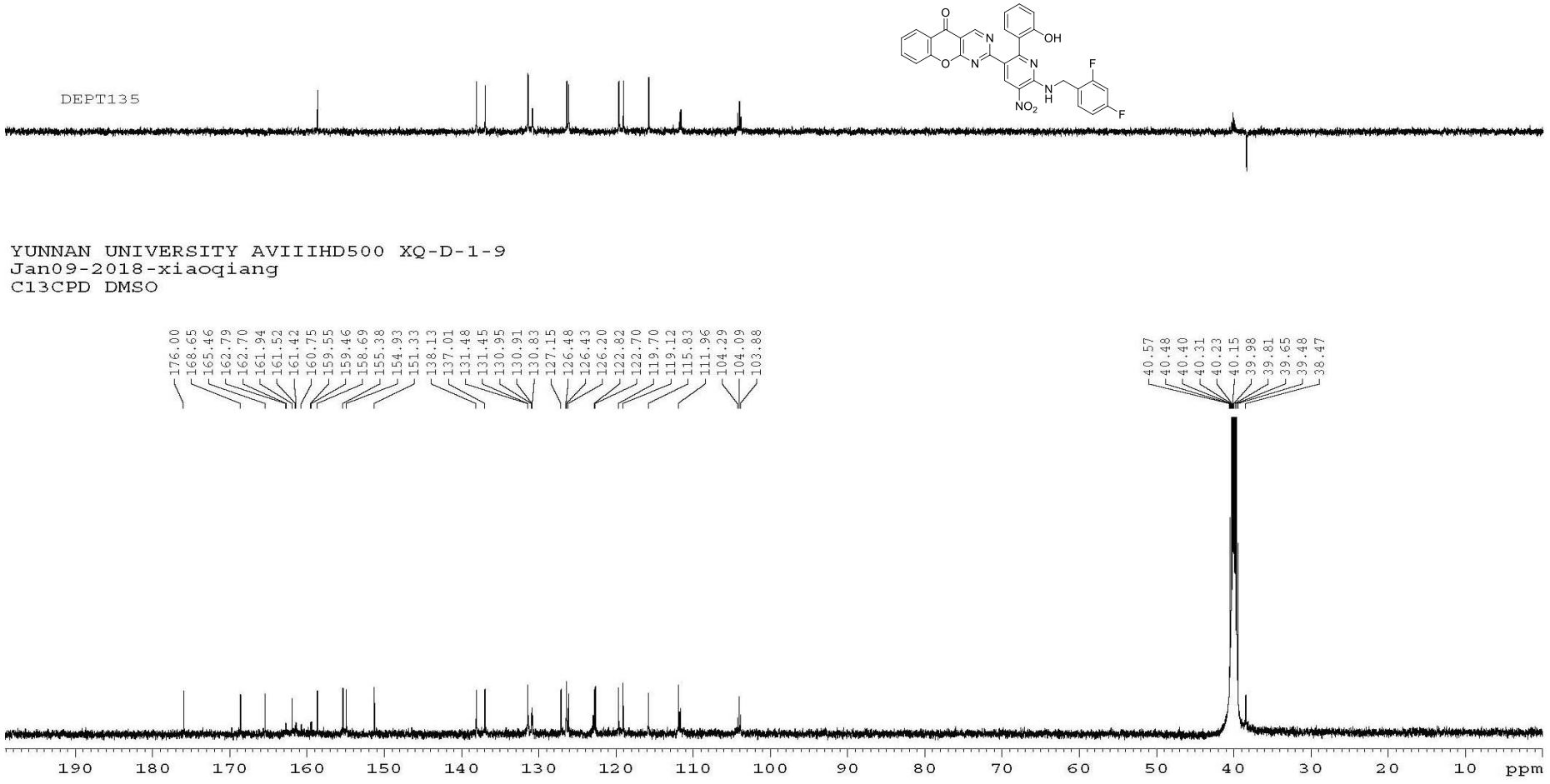


Figure S9. ^{13}C NMR (125 MHz, DMSO-d_6) spectra of compound **3d**

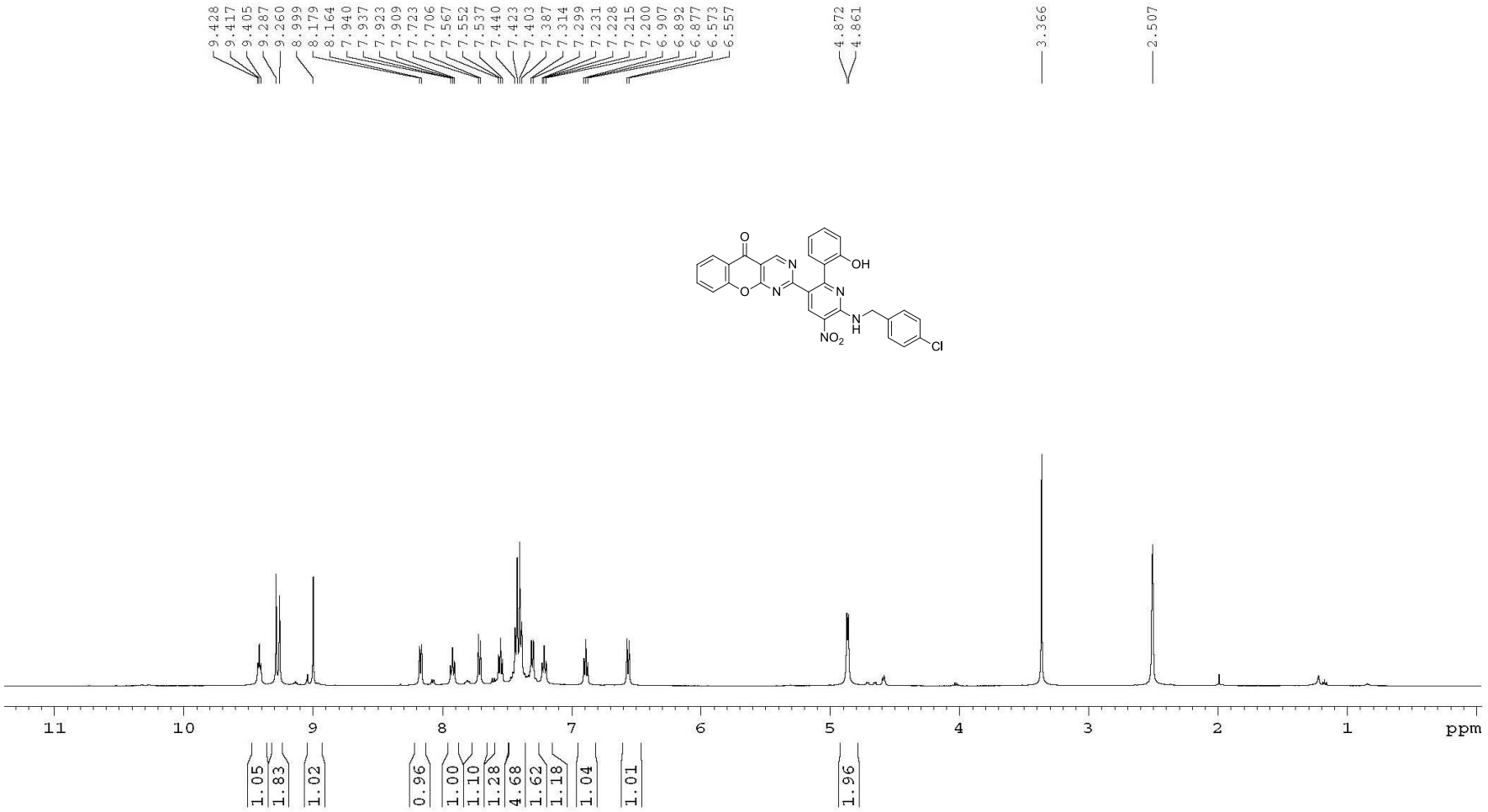


Figure S10. ^{1}H NMR (600 MHz, DMSO-d_6) spectra of compound **3e**

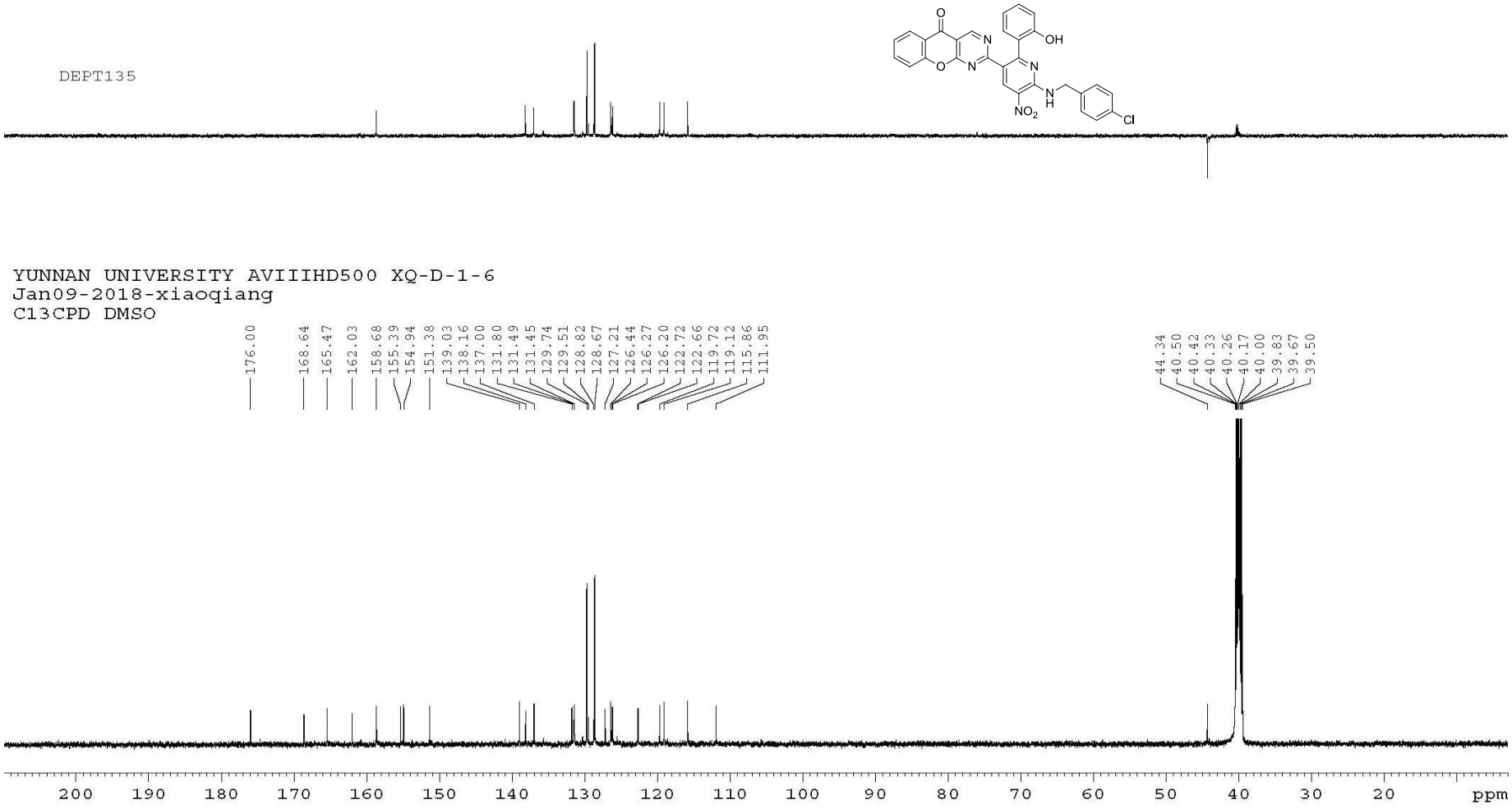


Figure S11. ^{13}C NMR (150 MHz, DMSO-d_6) spectra of compound **3e**

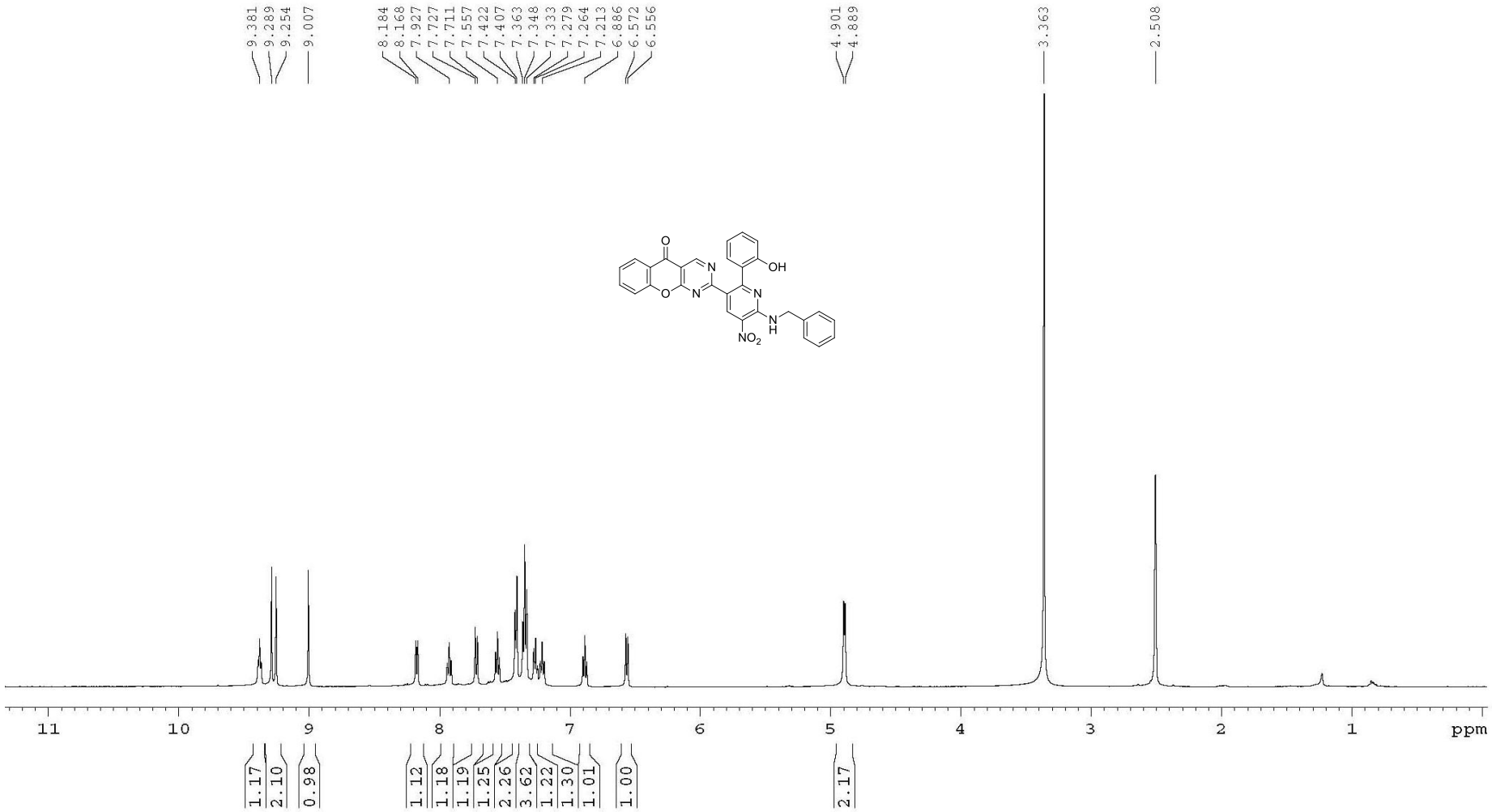


Figure S12. ^{1}H NMR (500 MHz, DMSO-d_6) spectra of compound **3f**

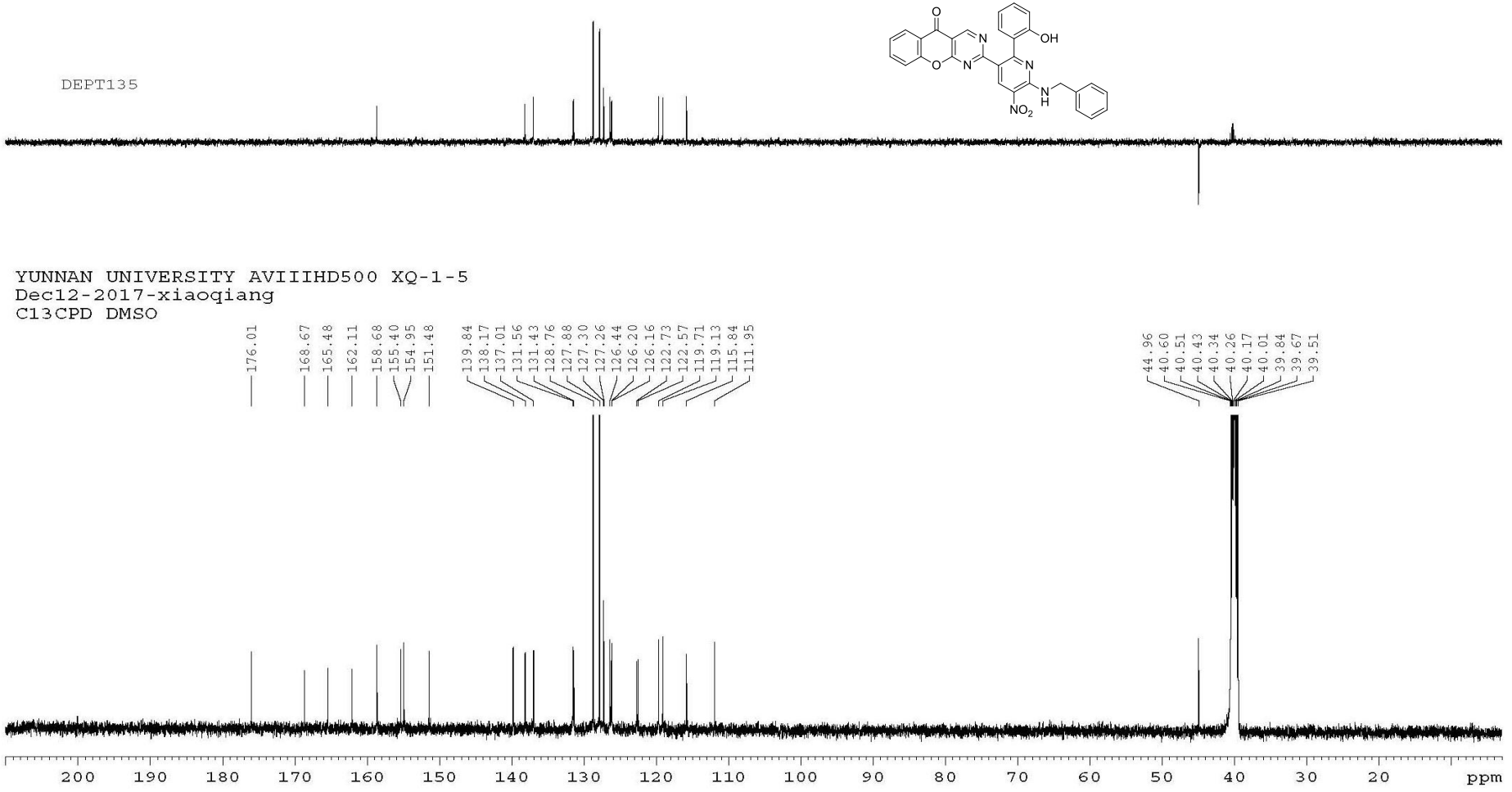


Figure S13. ^{13}C NMR (125 MHz, DMSO-d_6) spectra of compound **3f**

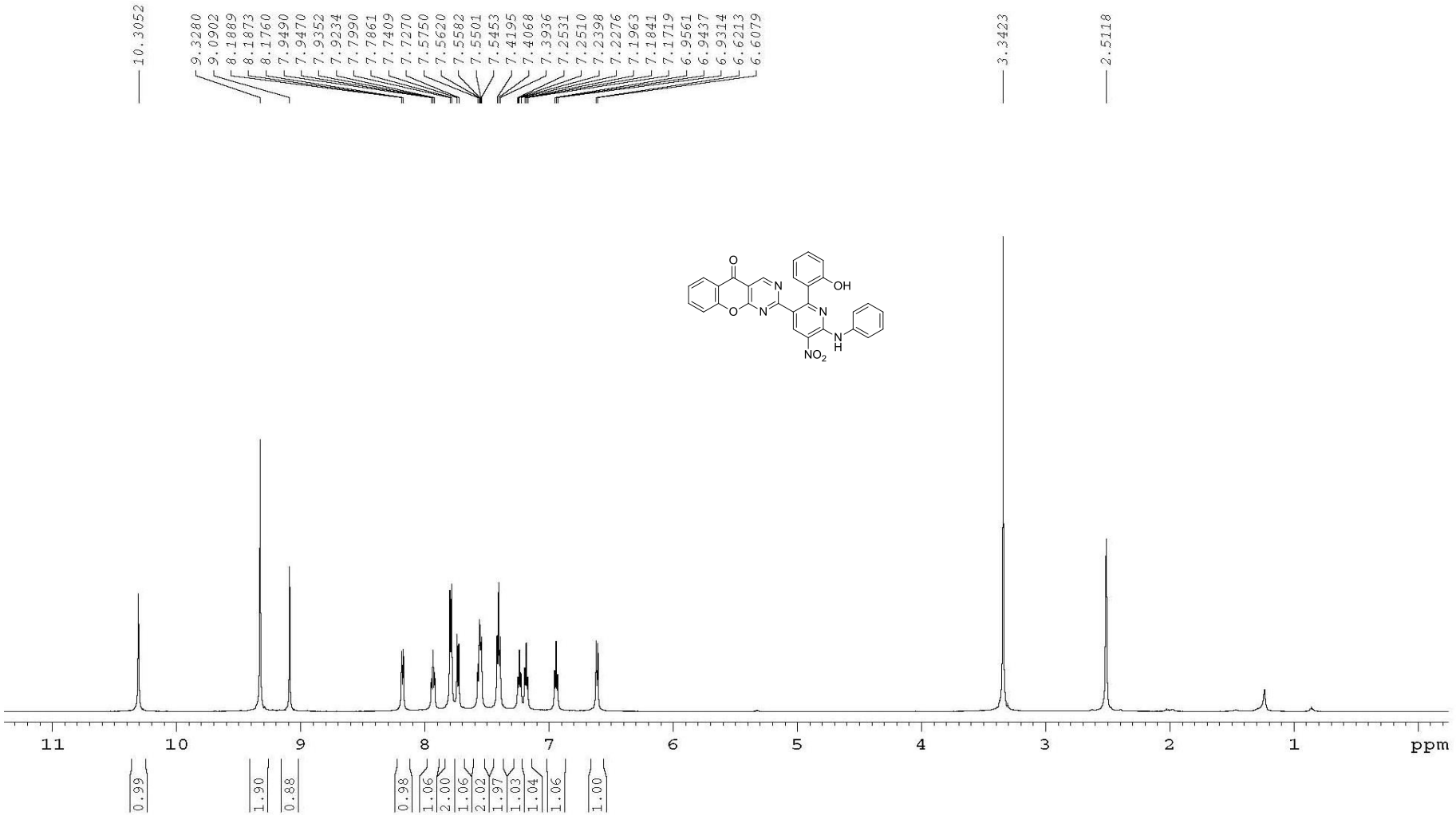


Figure S14. ^{1}H NMR (600 MHz, DMSO-d_6) spectra of compound **3g**

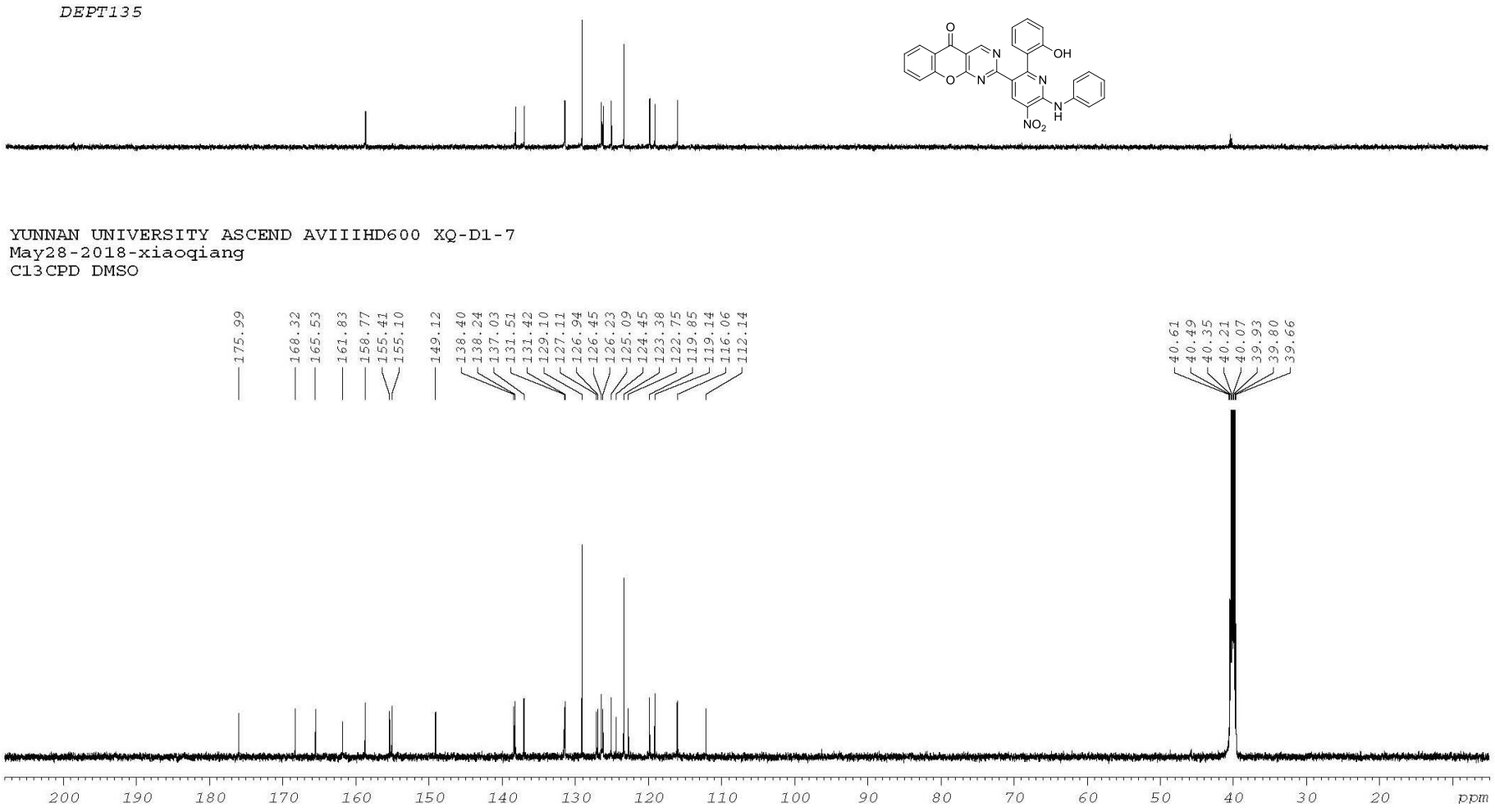


Figure S15. ^{13}C NMR (150 MHz, DMSO-d_6) spectra of compound **3g**

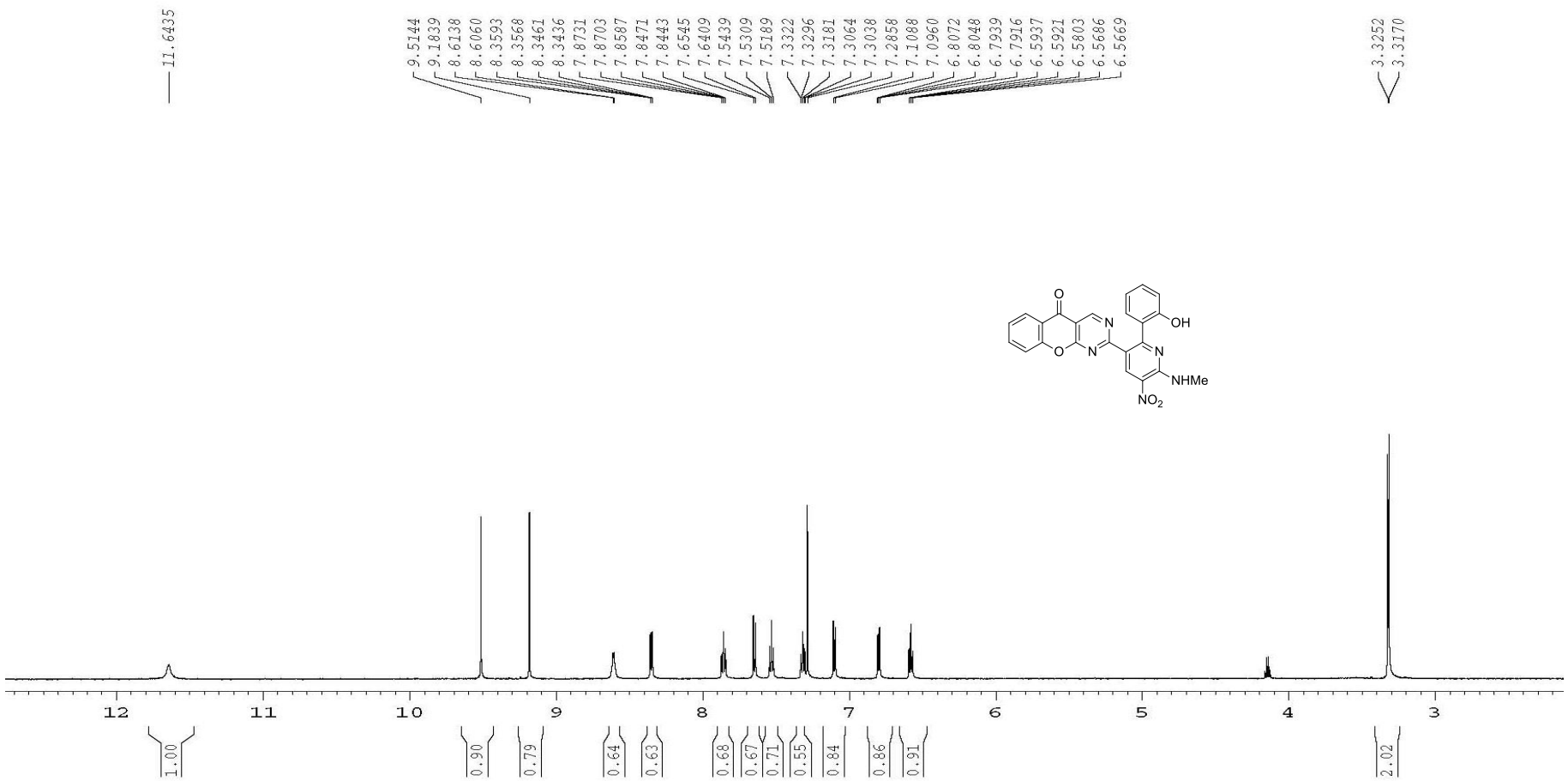


Figure S16. ^{1}H NMR (600 MHz, $CDCl_3$) spectra of compound **3h**

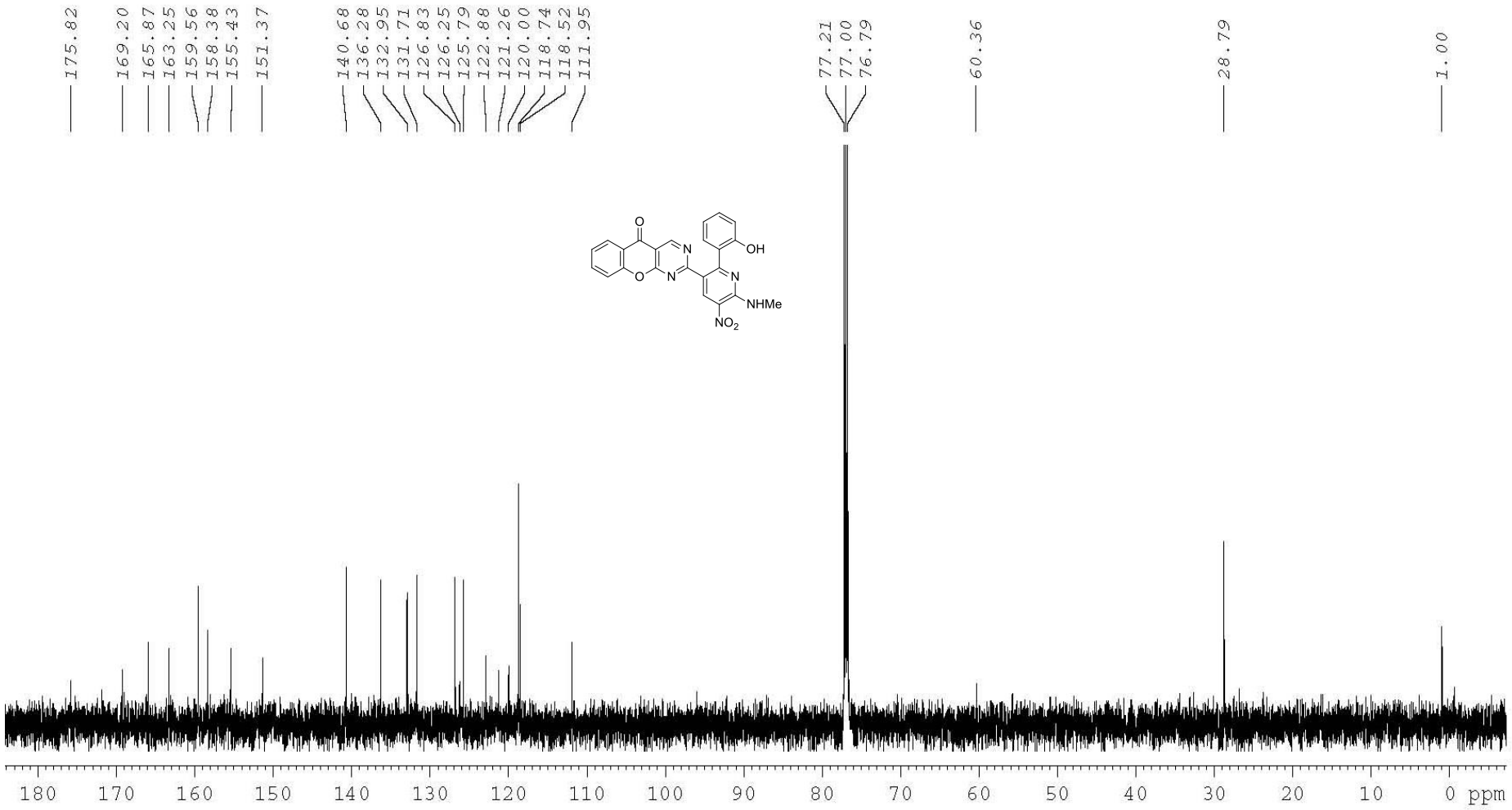


Figure S17. ^{13}C NMR (150 MHz, $CDCl_3$) spectra of compound **3h**

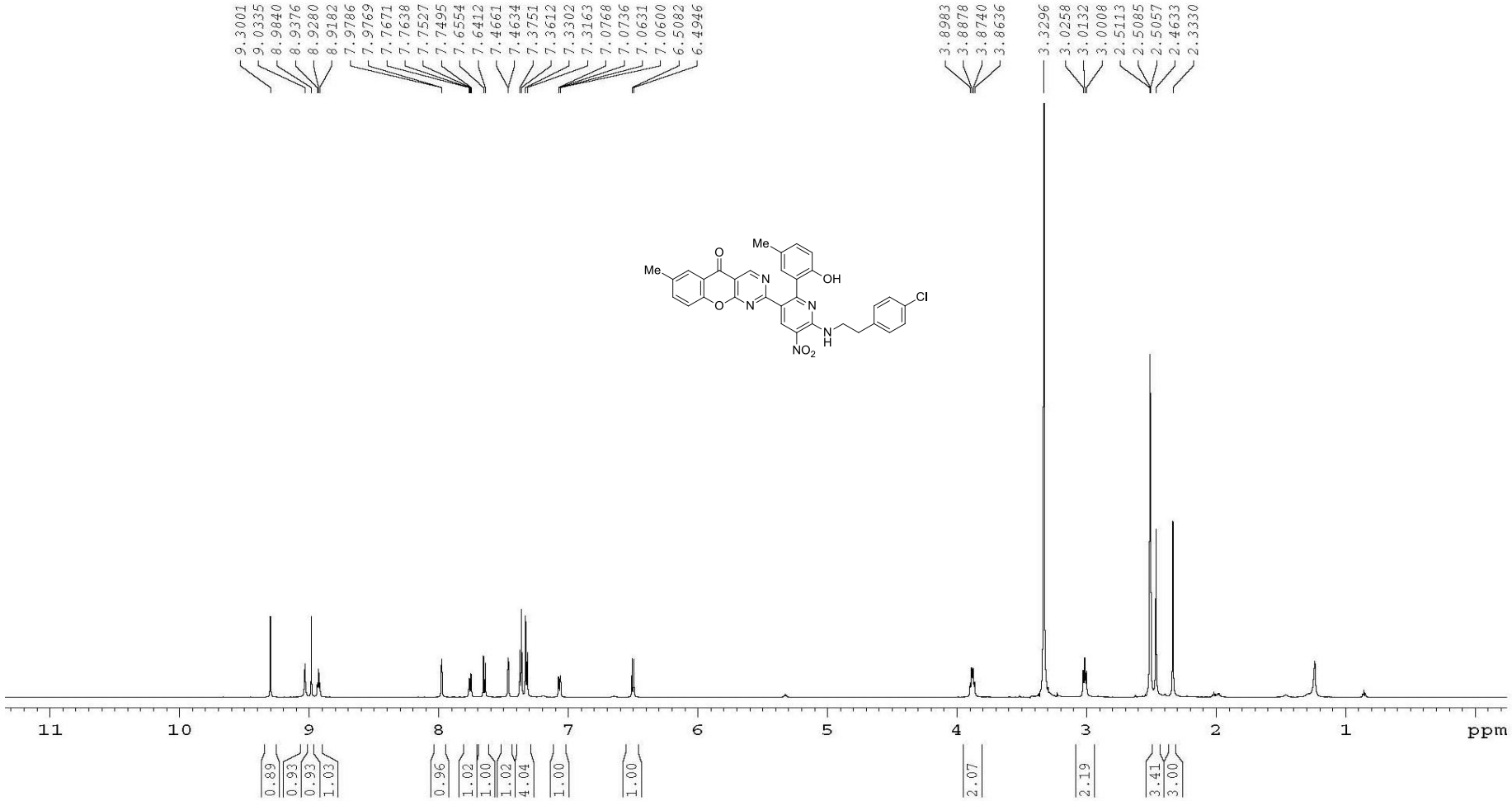


Figure S18. ^{1}H NMR (600 MHz, DMSO-d_6) spectra of compound **3i**

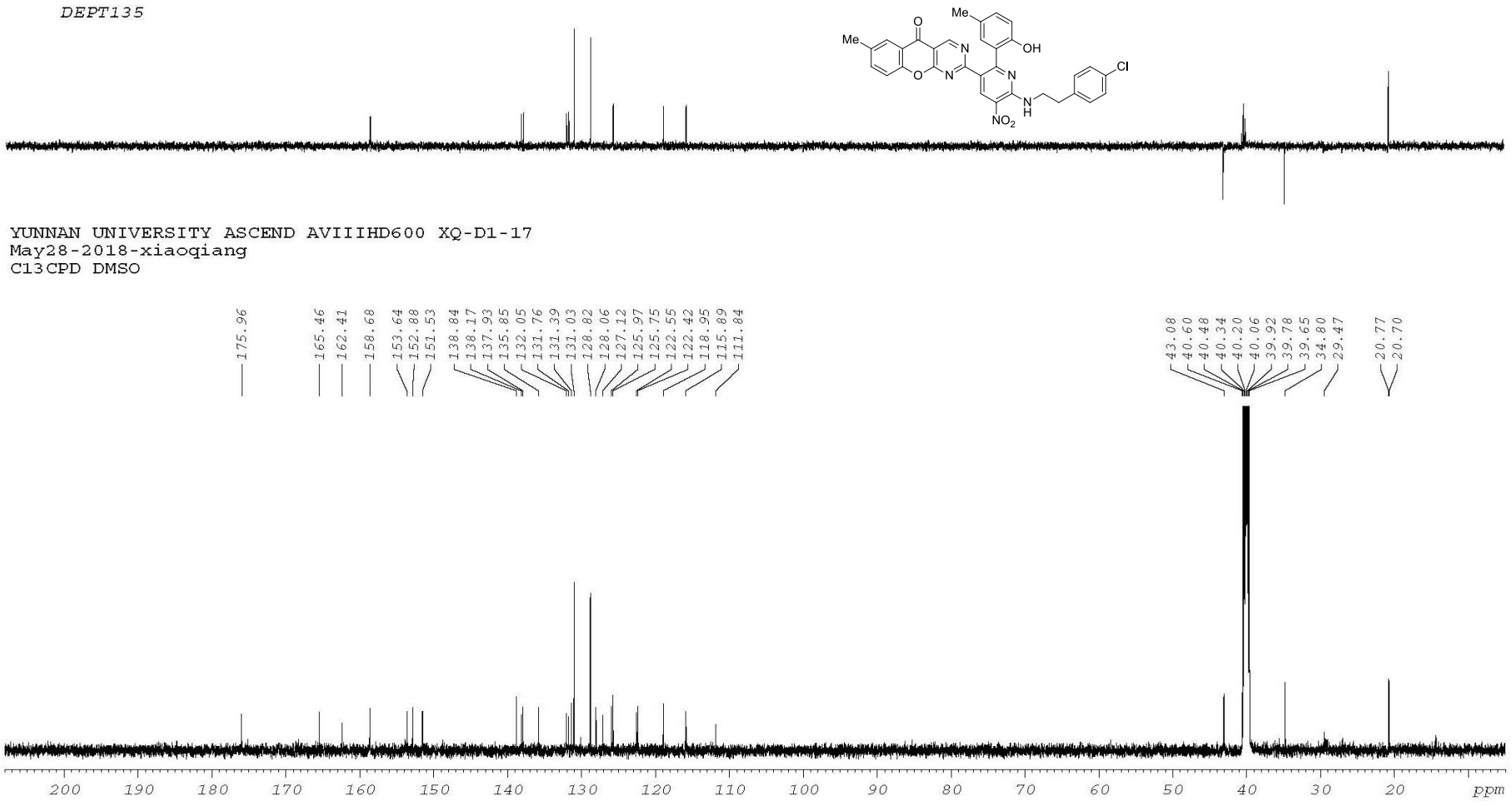


Figure S19. ^{13}C NMR (150 MHz, DMSO-d_6) spectra of compound **3i**

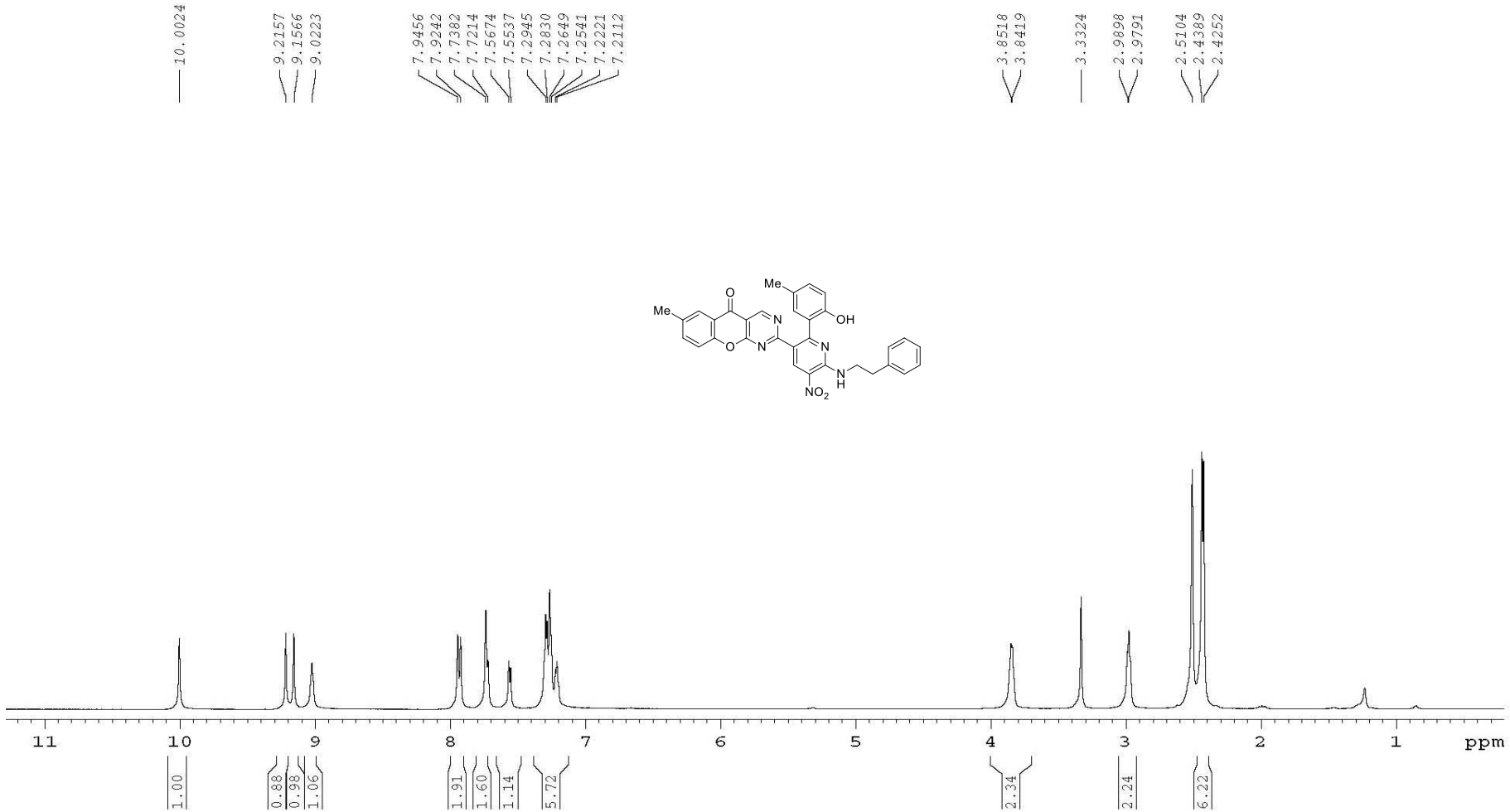


Figure S20. ^{1}H NMR (600 MHz, DMSO-d_6) spectra of compound **3j**

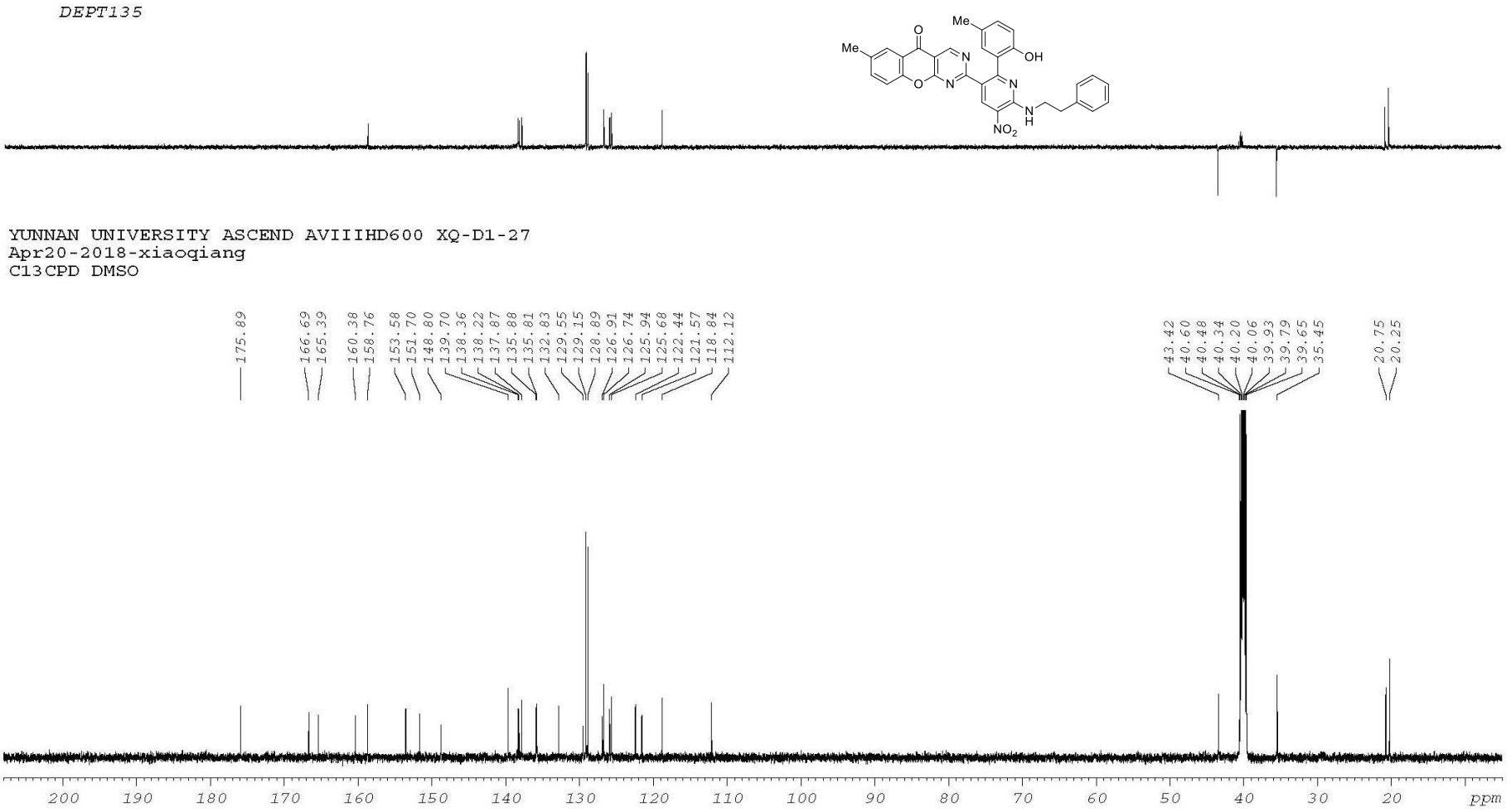


Figure S21. ^{13}C NMR (150 MHz, DMSO-d_6) spectra of compound **3j**

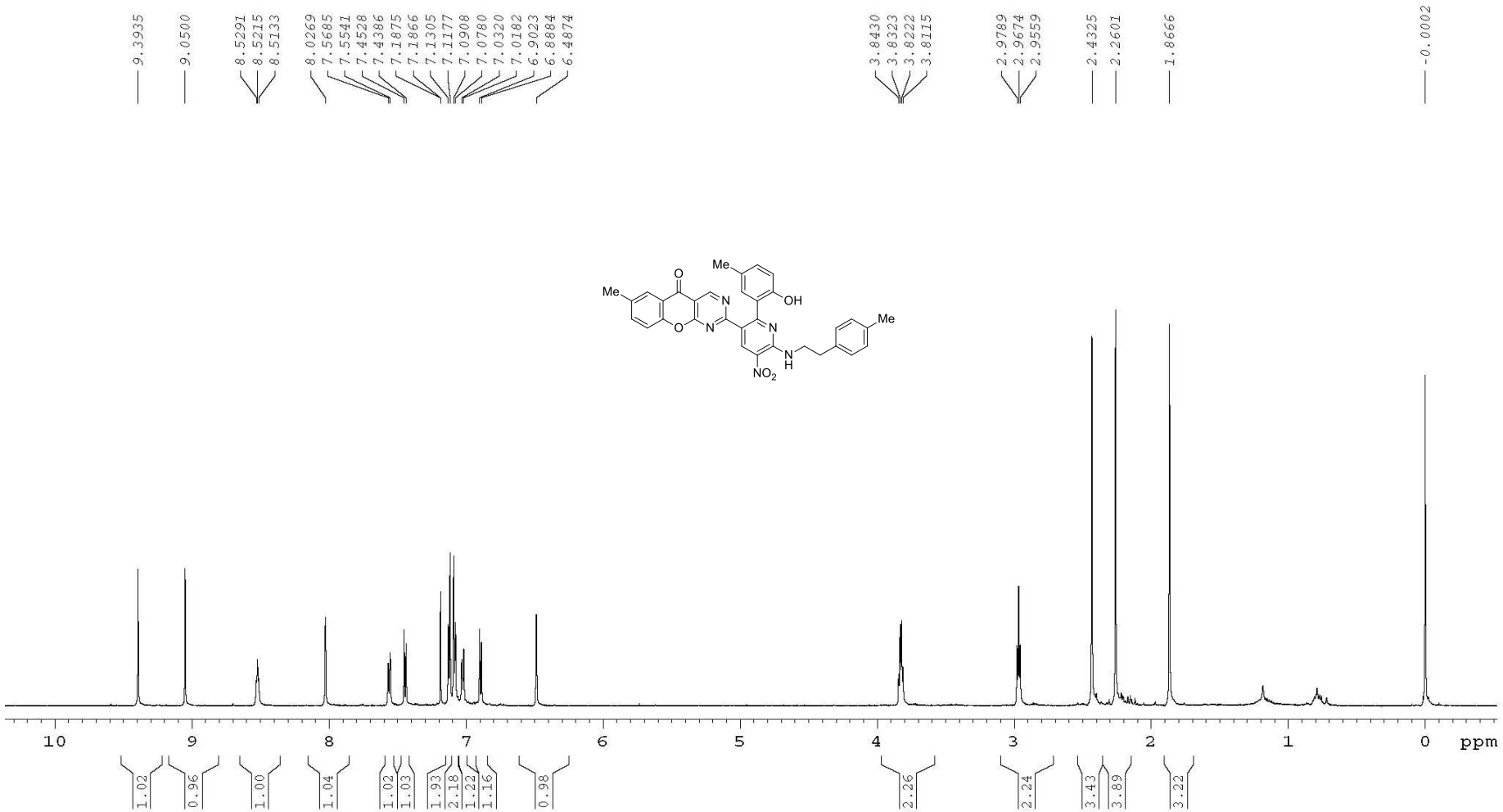


Figure S22. ^{1}H NMR (600 MHz, $CDCl_3$) spectra of compound **3k**

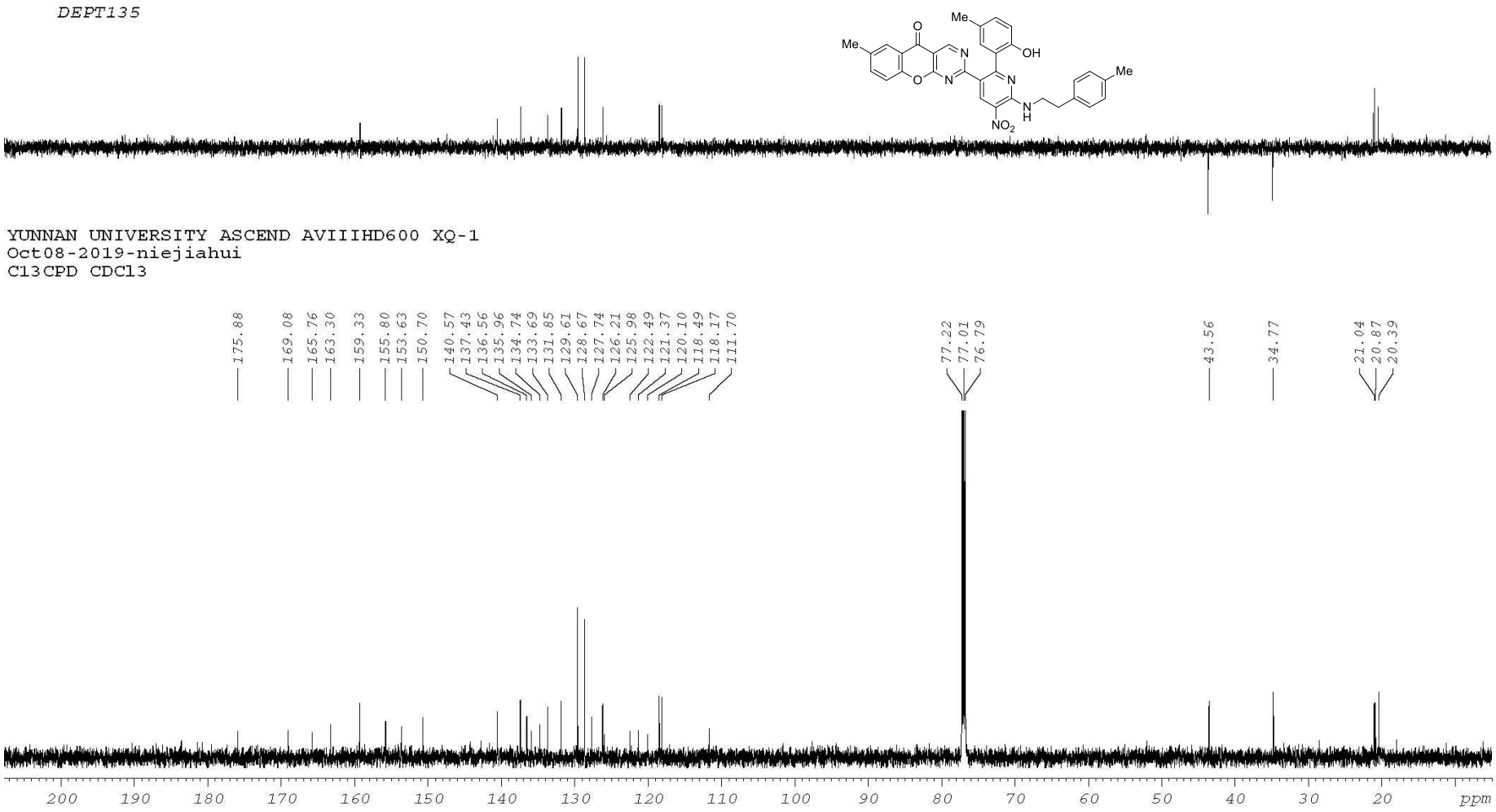


Figure S23. ^{13}C NMR (150 MHz, $CDCl_3$) spectra of compound **3k**

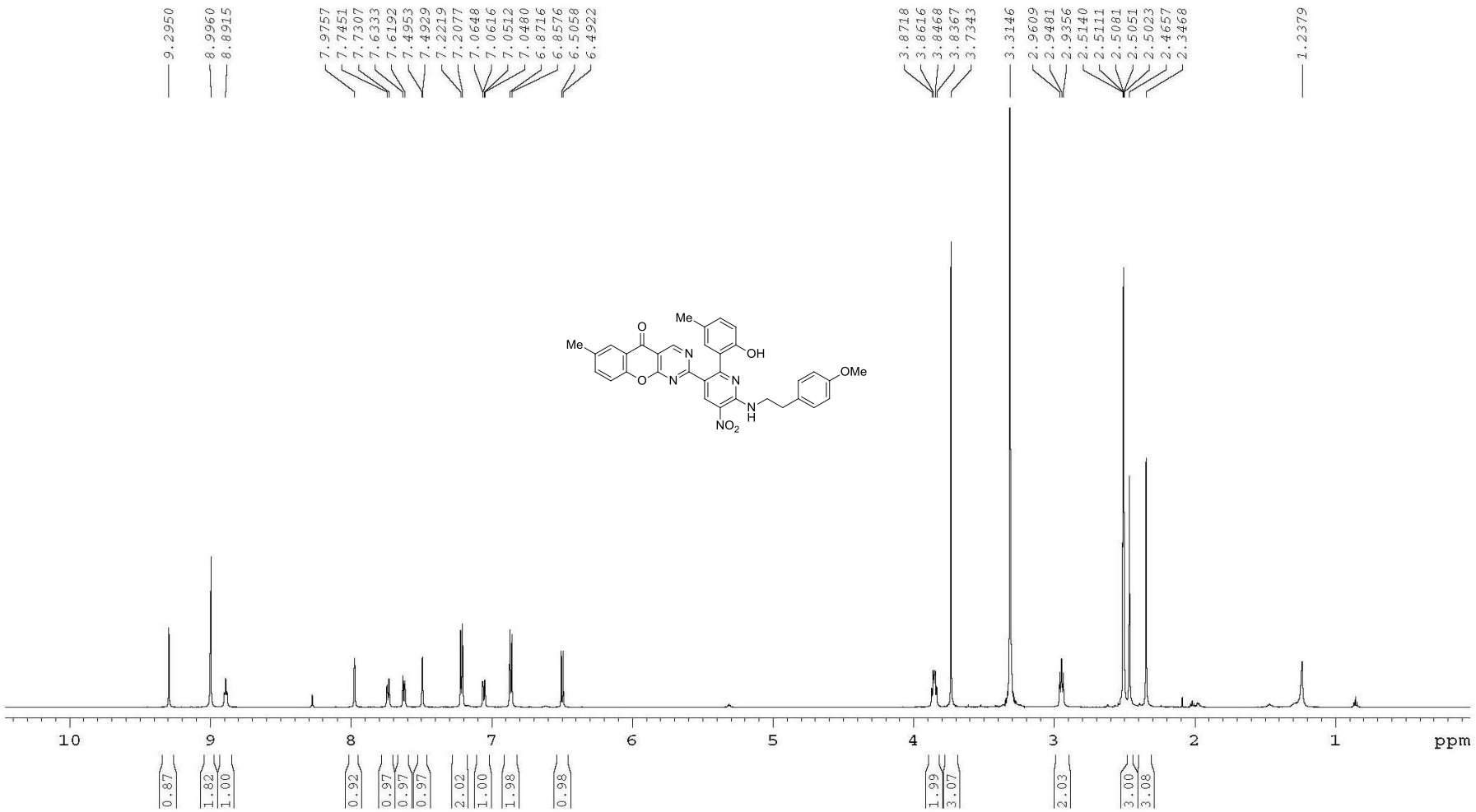


Figure S24. ^{1}H NMR (600 MHz, DMSO-d_6) spectra of compound **3l**

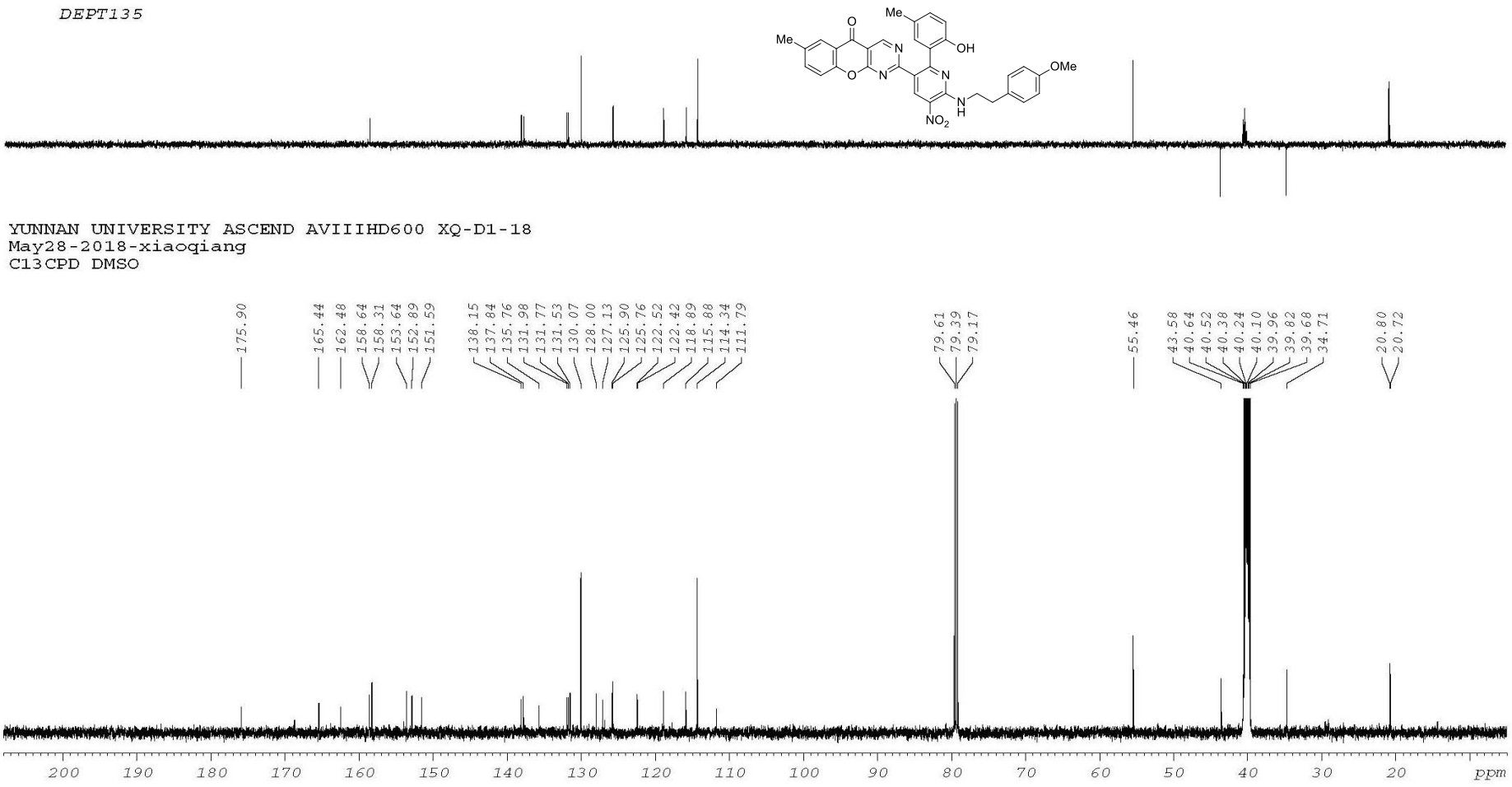


Figure S25. ^{13}C NMR (150 MHz, DMSO-d_6) spectra of compound **3l**

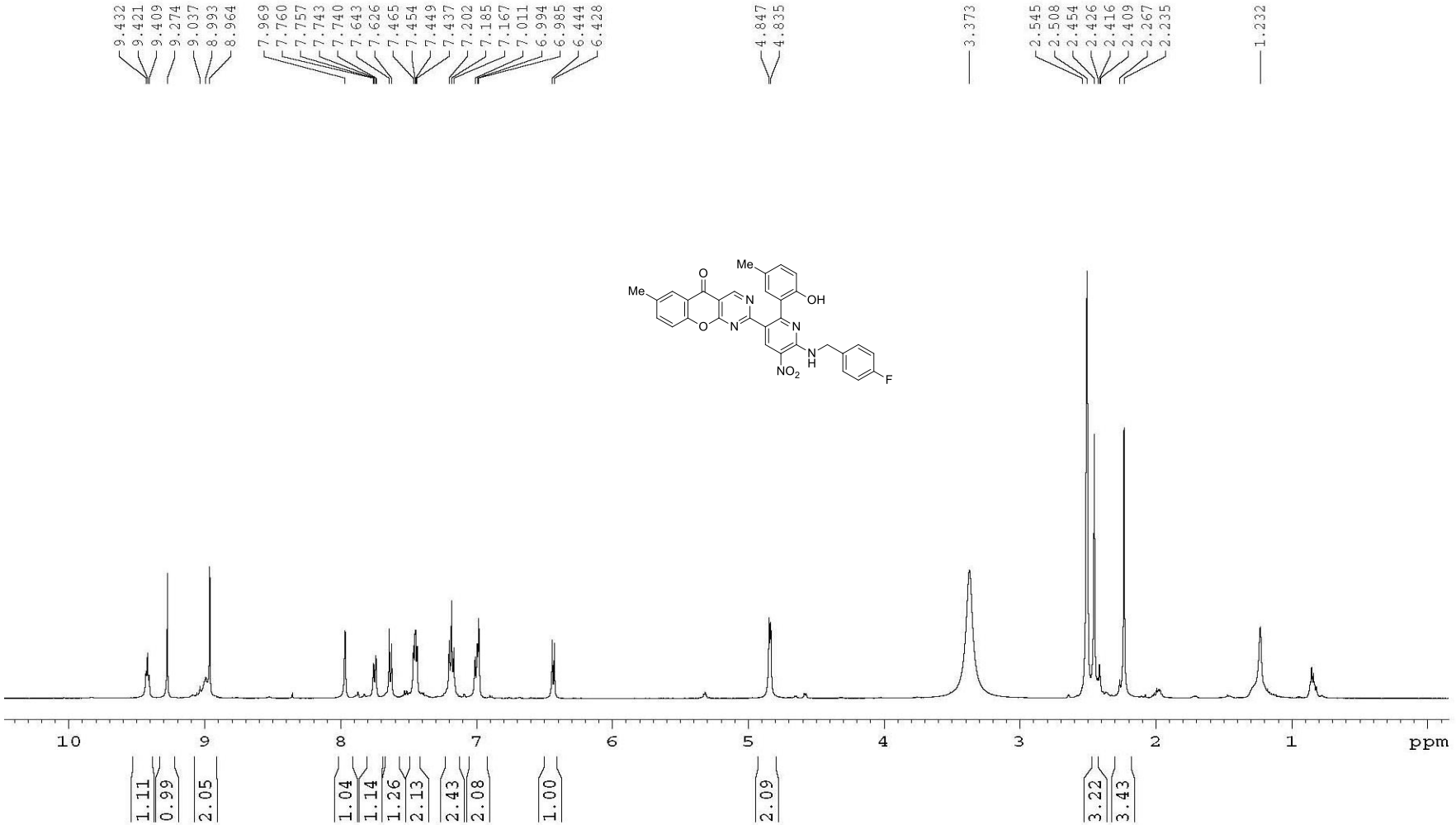


Figure S26. ^{1}H NMR 500 MHz, DMSO-d_6) spectra of compound **3m**

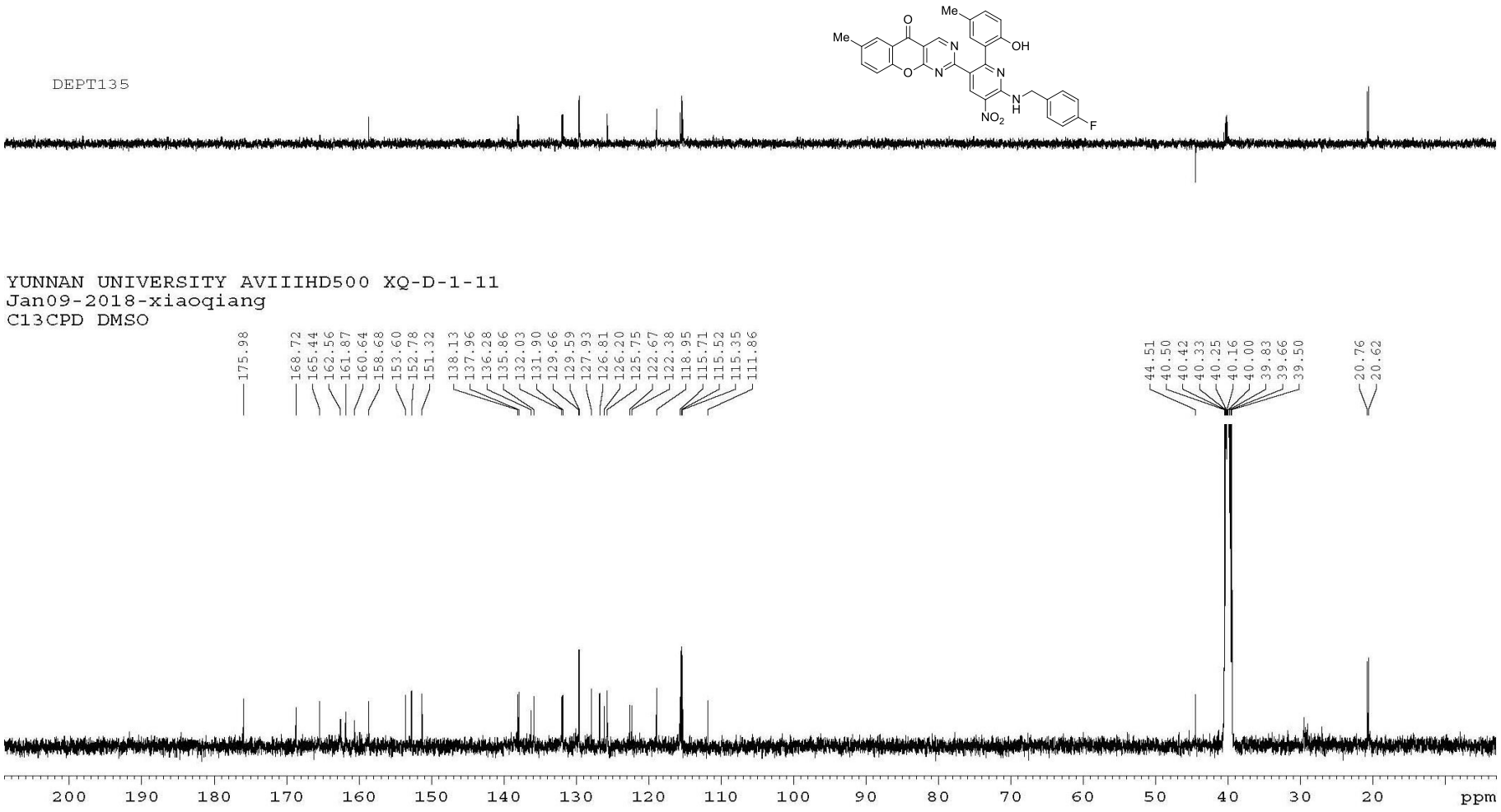


Figure S27. ^{13}C NMR (125 MHz, DMSO-d_6) spectra of compound **3m**

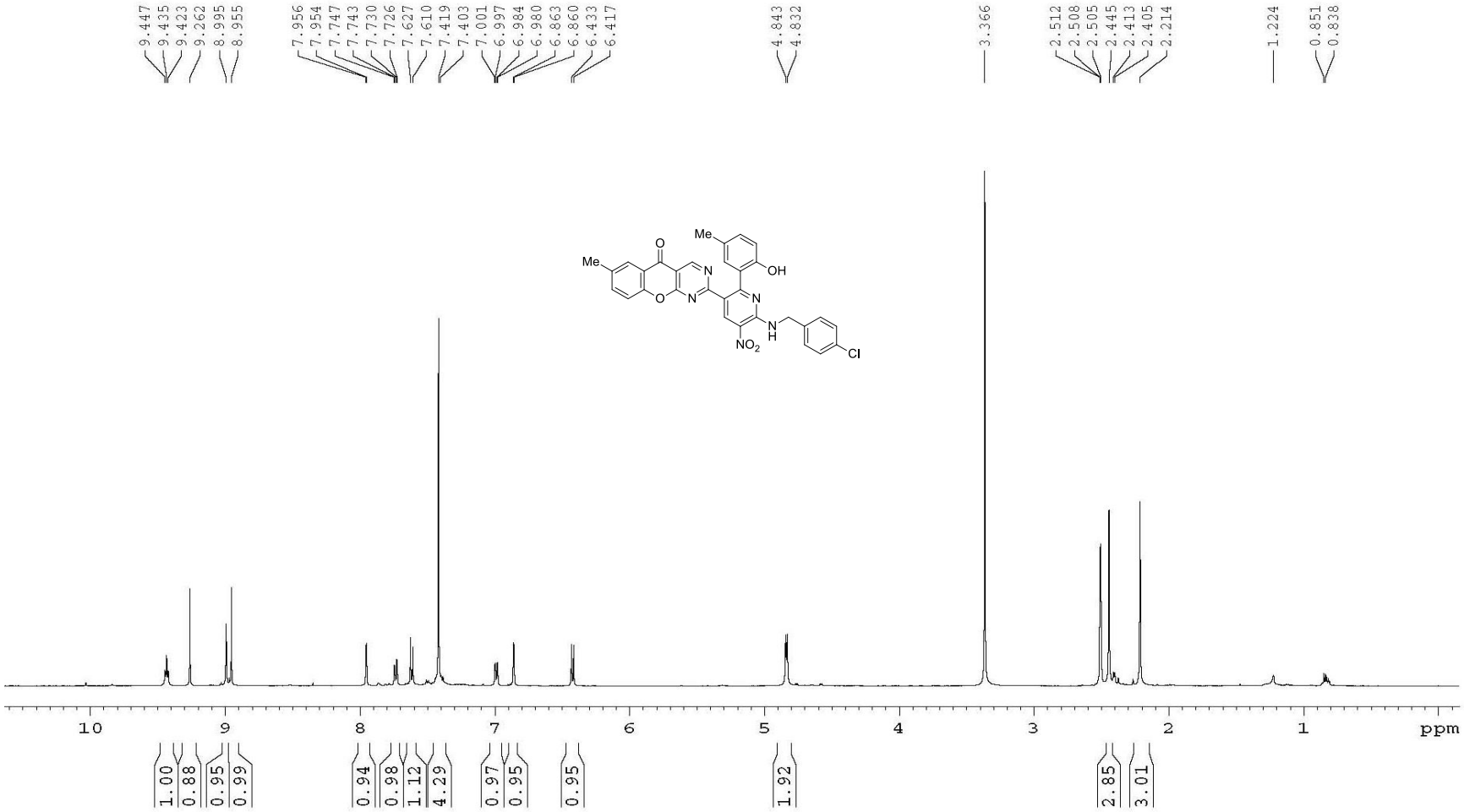


Figure S28. ^{1}H NMR (500 MHz, DMSO-d_6) spectra of compound **3n**

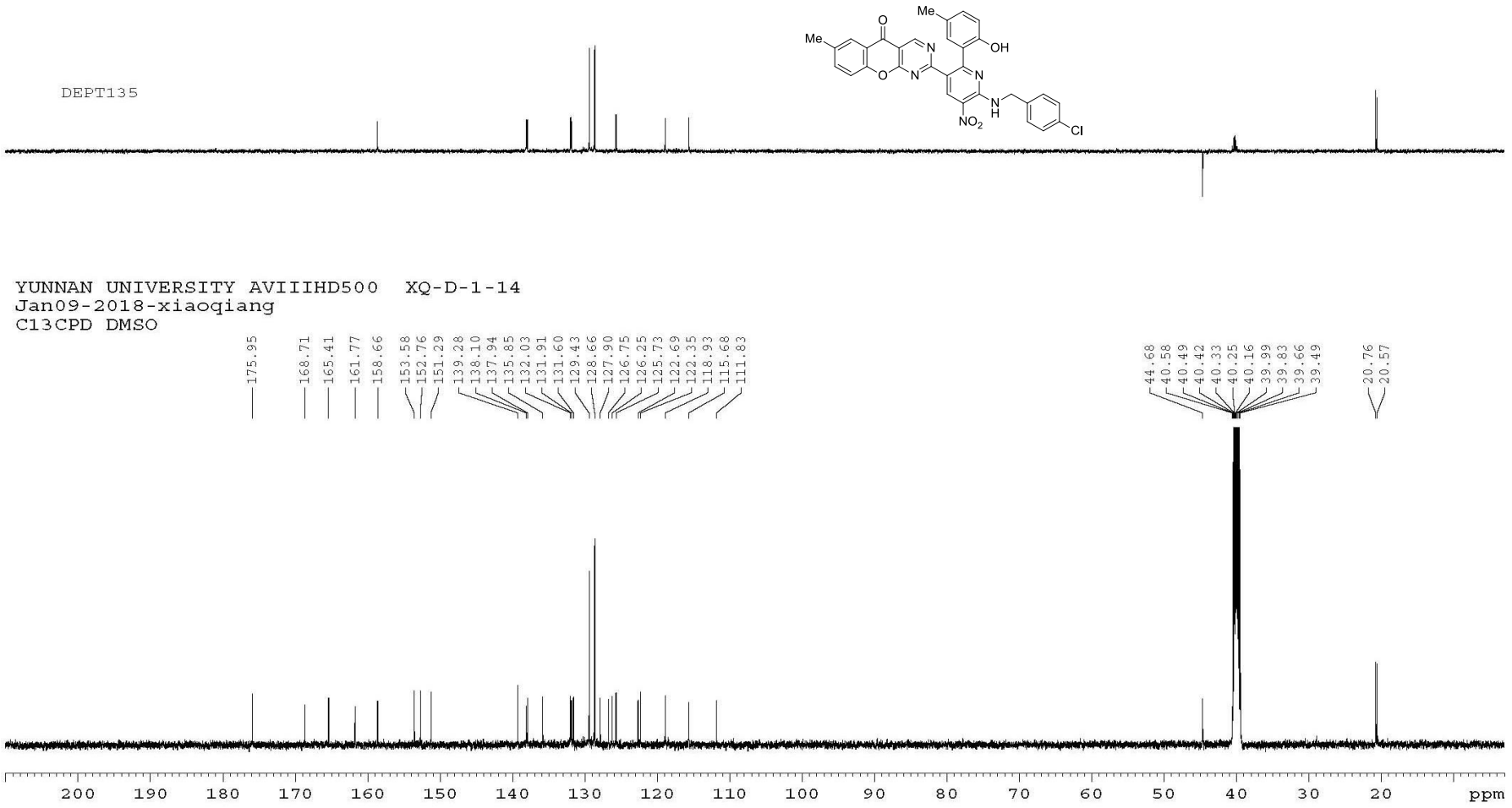


Figure S29. ^{13}C NMR (125 MHz, DMSO-d_6) spectra of compound **3n**

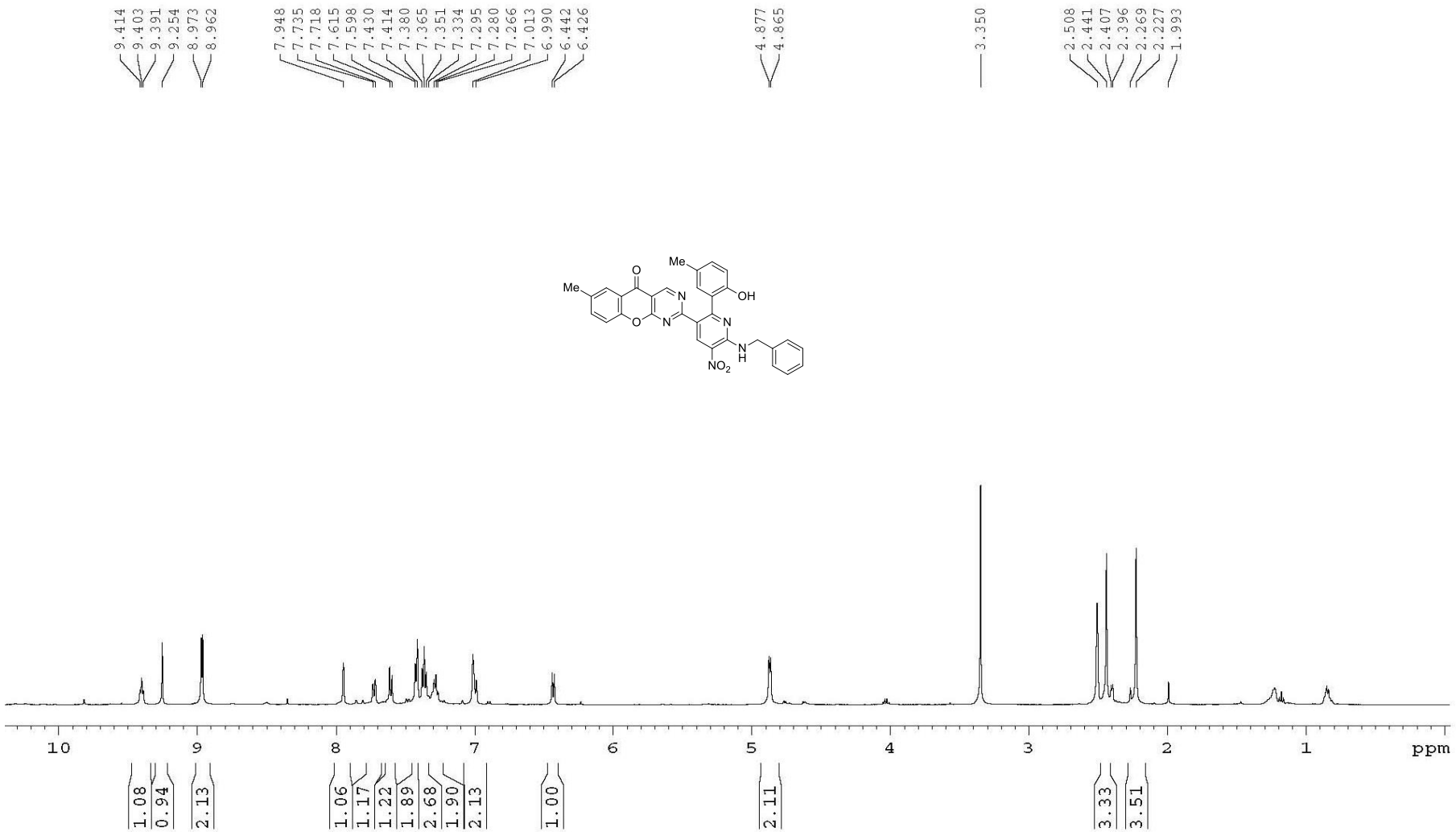


Figure S30. ^{1}H NMR (500 MHz, DMSO-d_6) spectra of compound **3o**

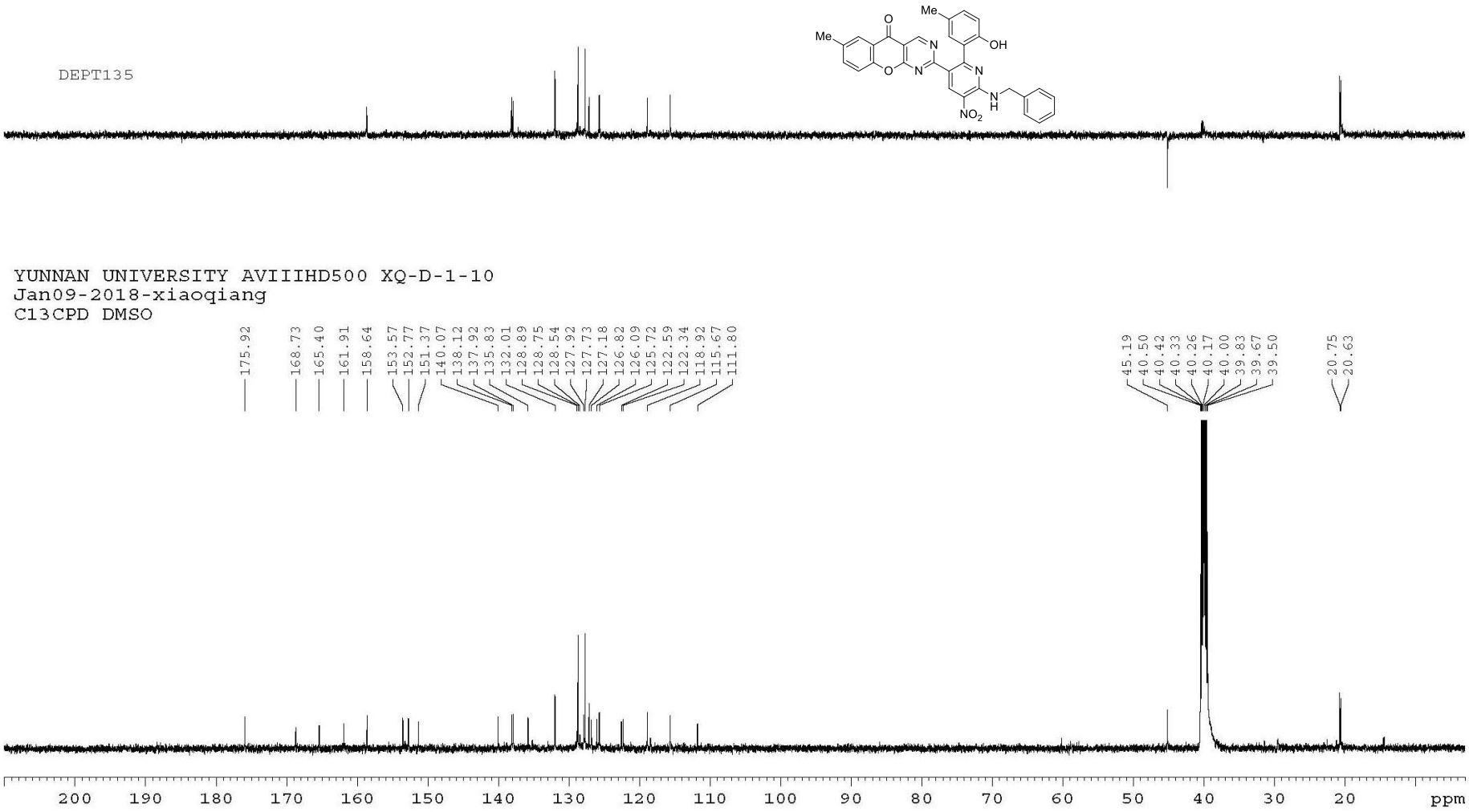


Figure S31. ^{13}C NMR (125 MHz, DMSO-d_6) spectra of compound **3o**

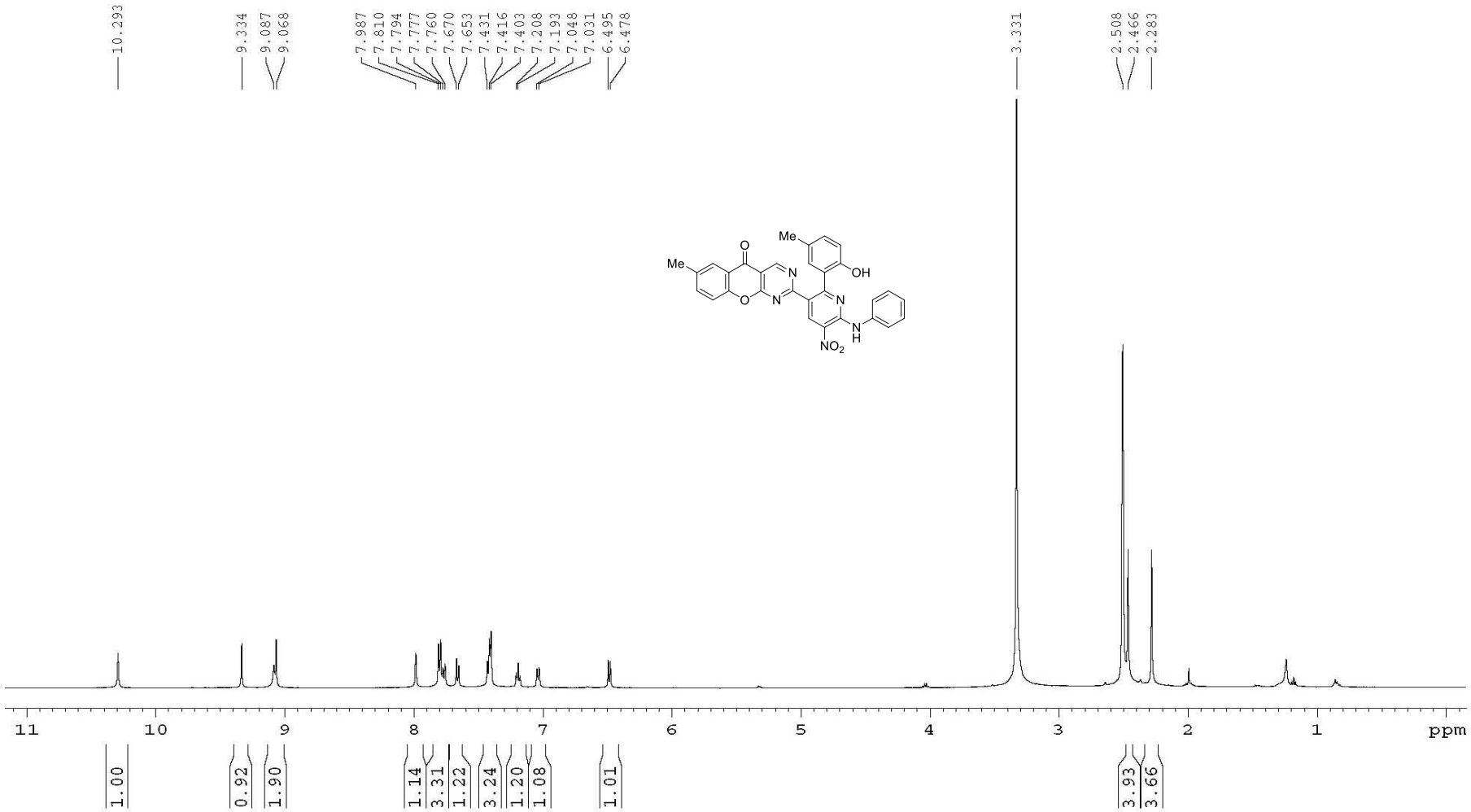


Figure S32. ^{1}H NMR (600 MHz, DMSO-d_6) spectra of compound **3p**

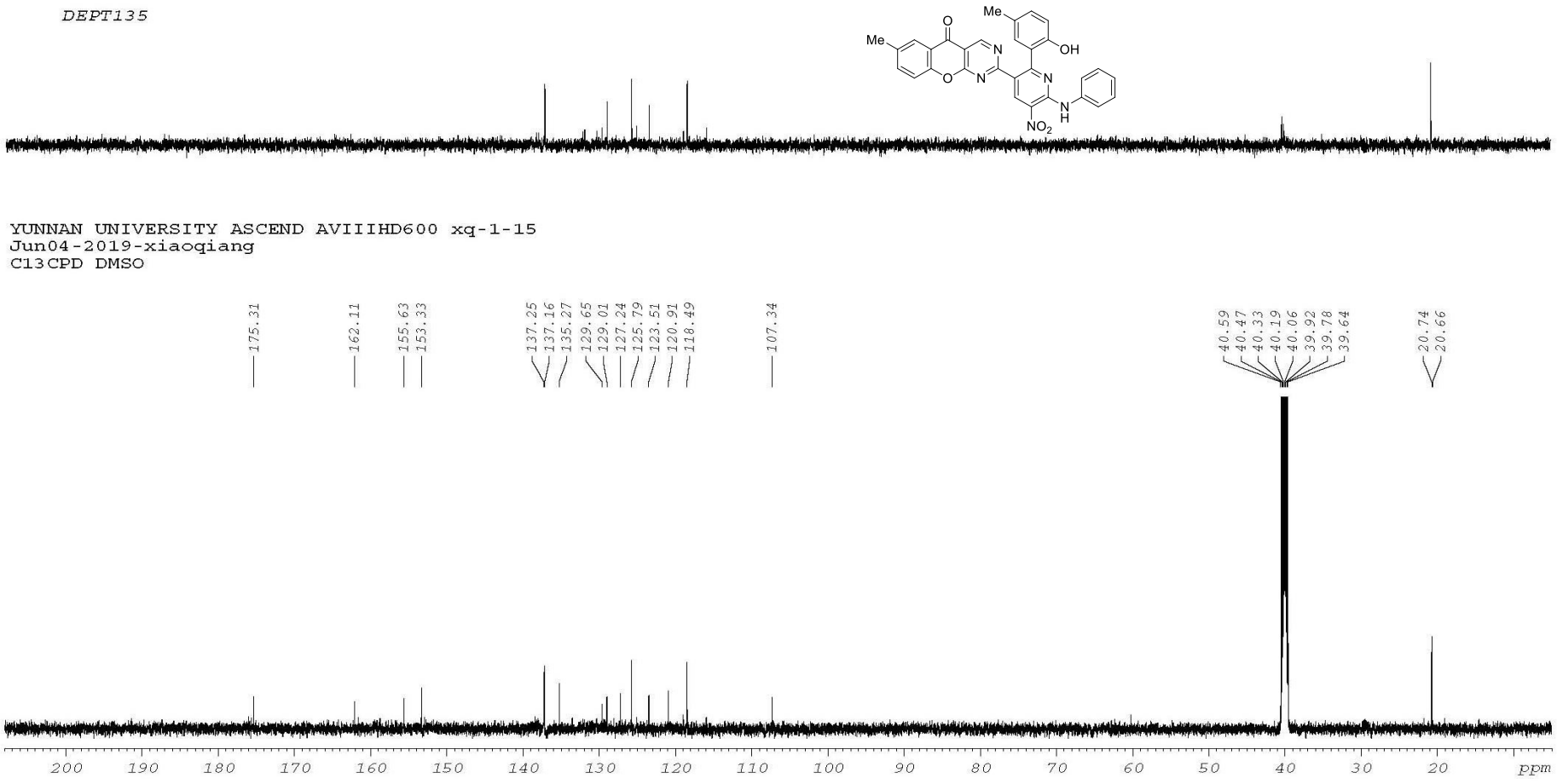


Figure S33. ^{13}C NMR (150 MHz, DMSO-d_6) spectra of compound **3p**

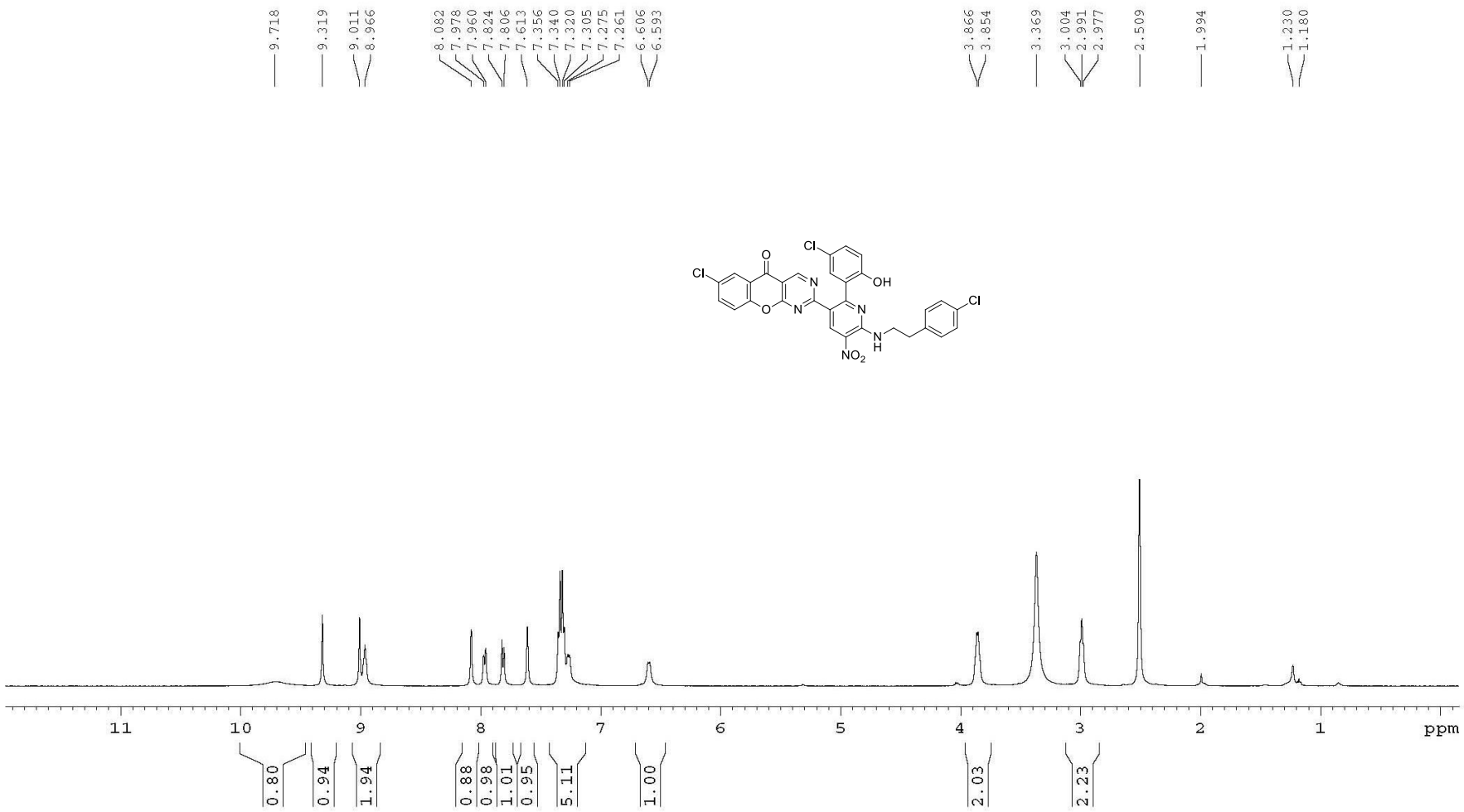


Figure S34. ^{1}H NMR (500 MHz, DMSO-d_6) spectra of compound **3q**

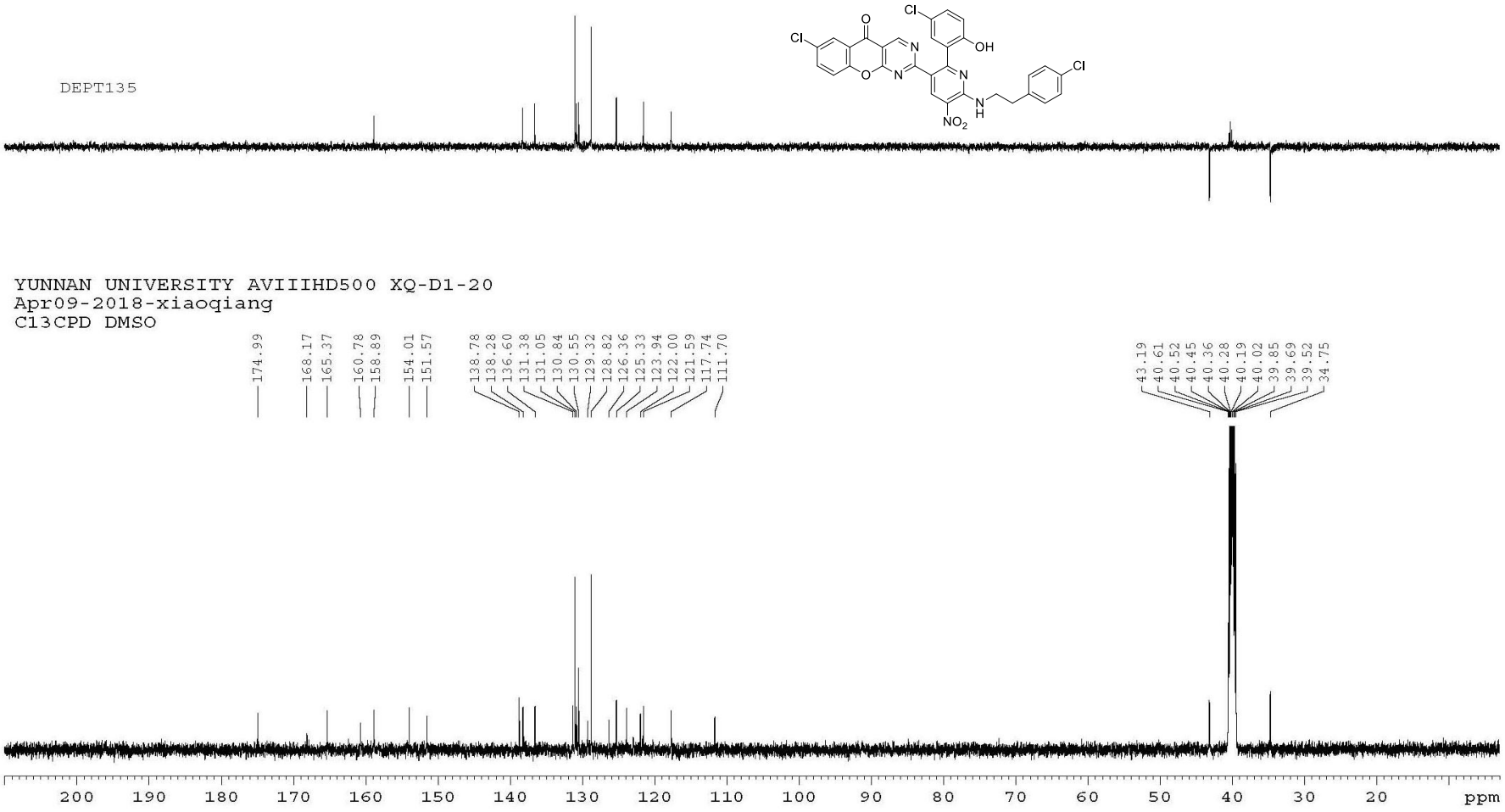


Figure S35. ^{13}C NMR (125 MHz, DMSO-d_6) spectra of compound **3q**

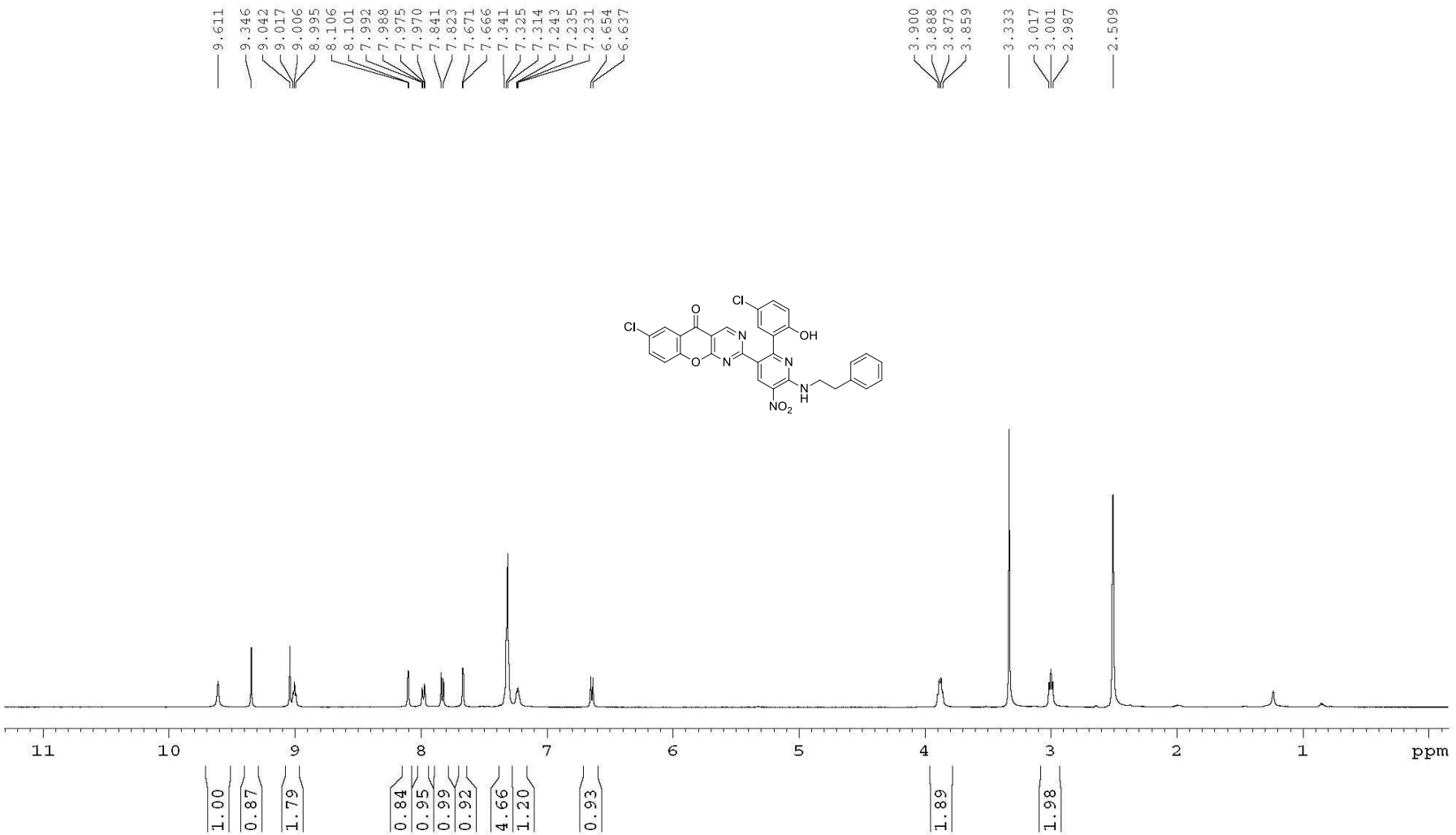


Figure S36. ^{1}H NMR (500 MHz, DMSO-d_6) spectra of compound **3r**

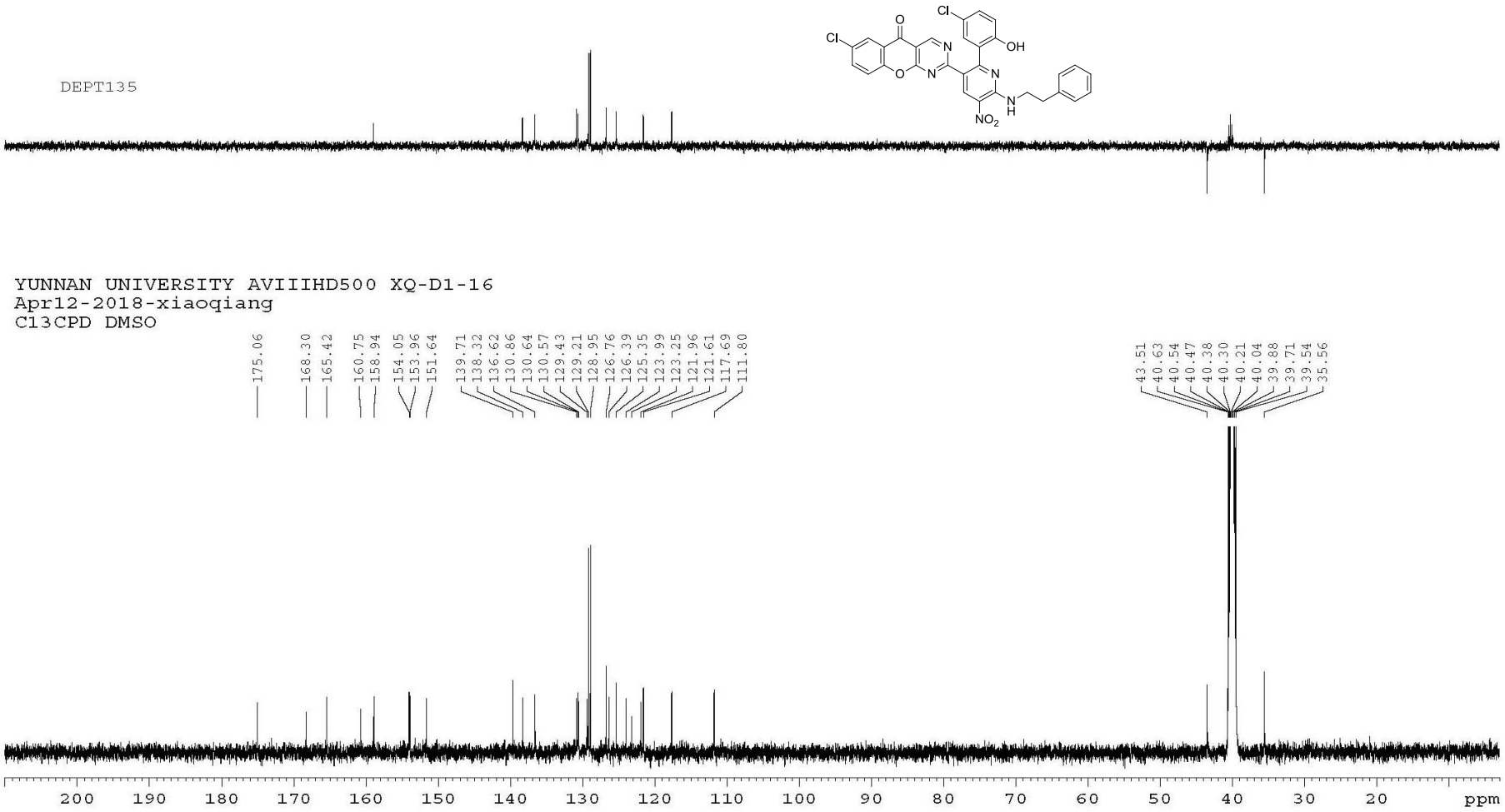


Figure S37. ^{13}C NMR (125 MHz, DMSO-d_6) spectra of compound **3r**

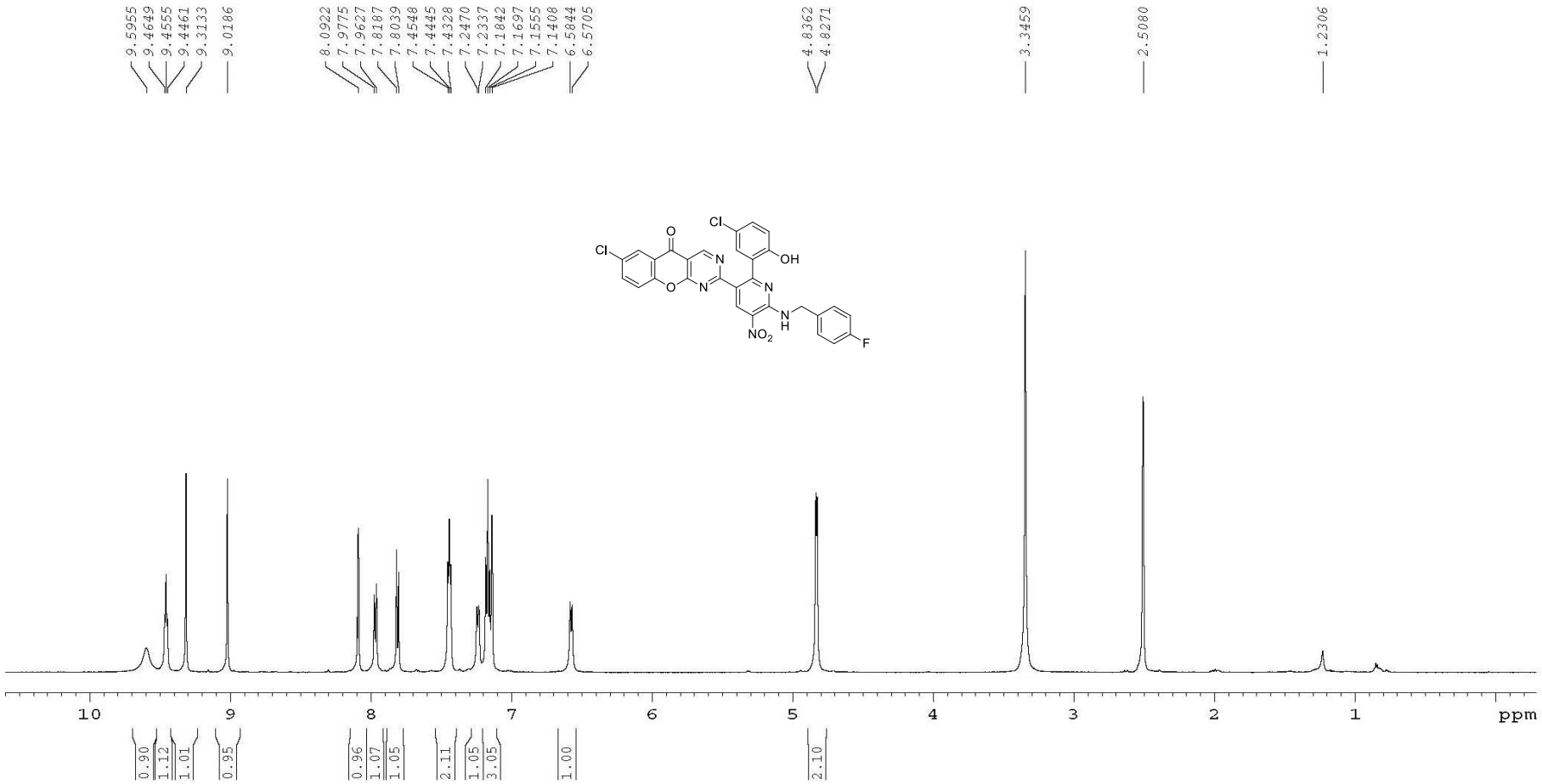


Figure S38. ^{1}H NMR (600 MHz, DMSO-d_6) spectra of compound **3s**

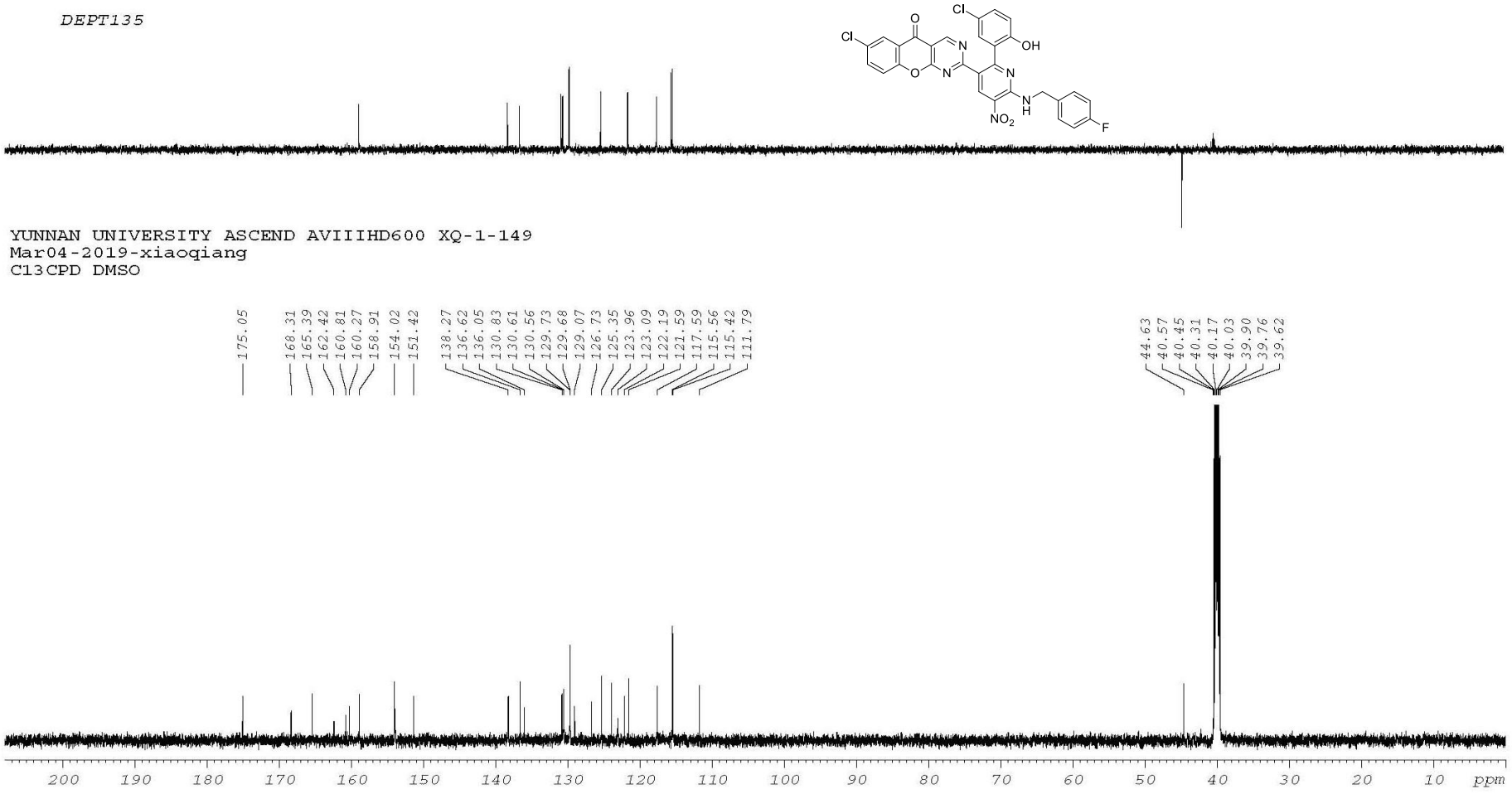


Figure S39. ^{13}C NMR (150 MHz, DMSO-d_6) spectra of compound **3s**

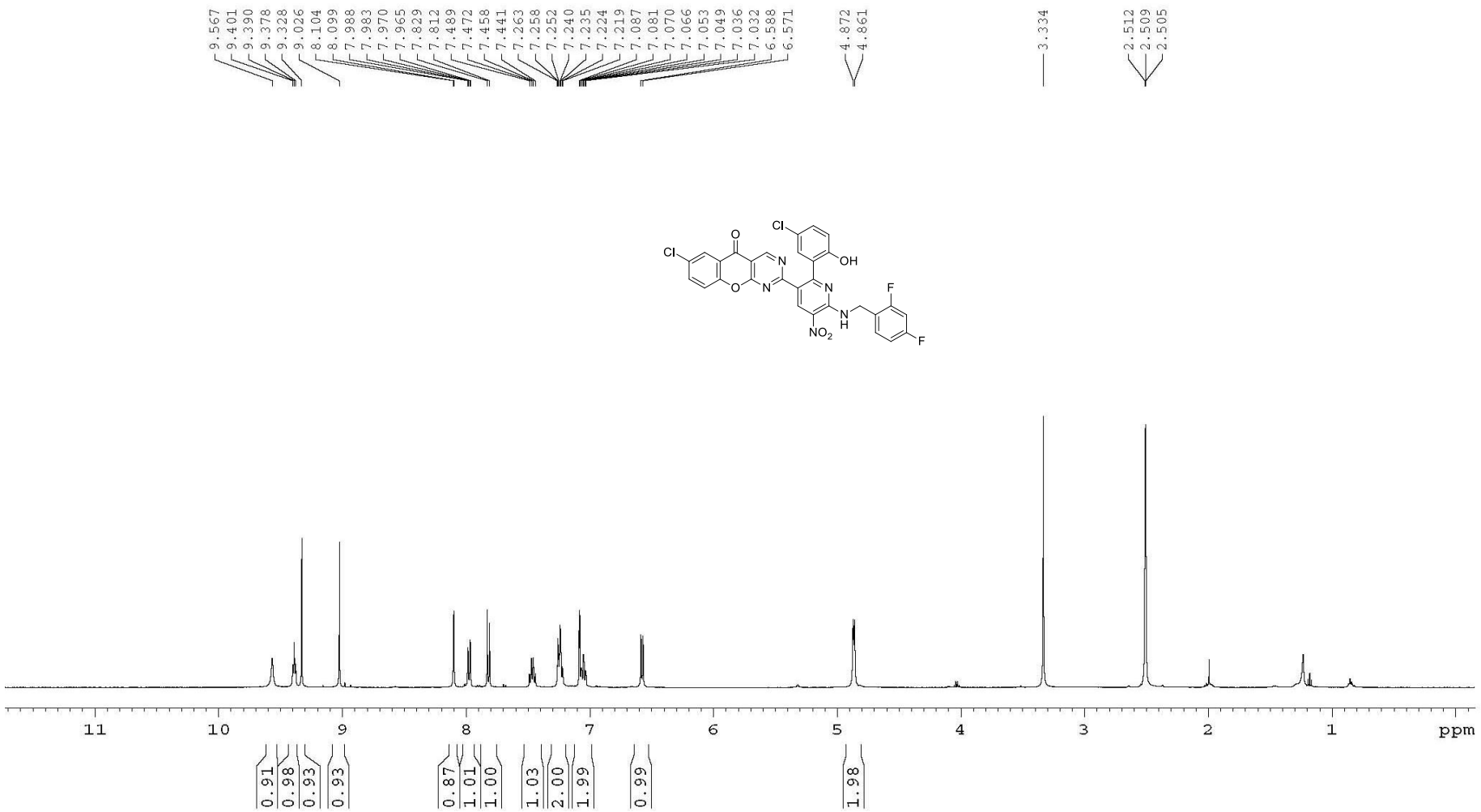


Figure S40. ^{1}H NMR (500 MHz, DMSO-d_6) spectra of compound **3t**

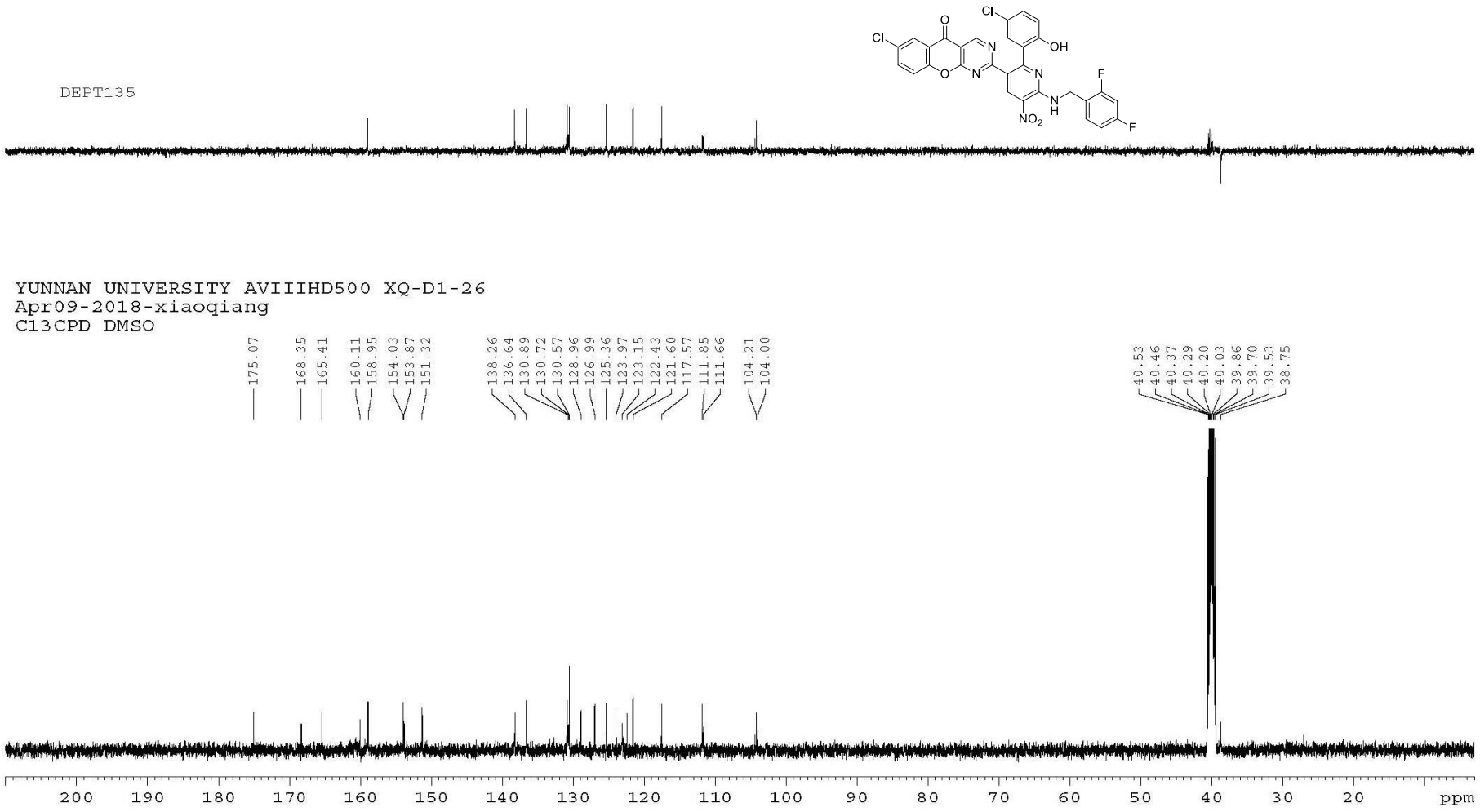


Figure S41. ^{13}C NMR (125 MHz, DMSO-d_6)) spectra of compound **3t**

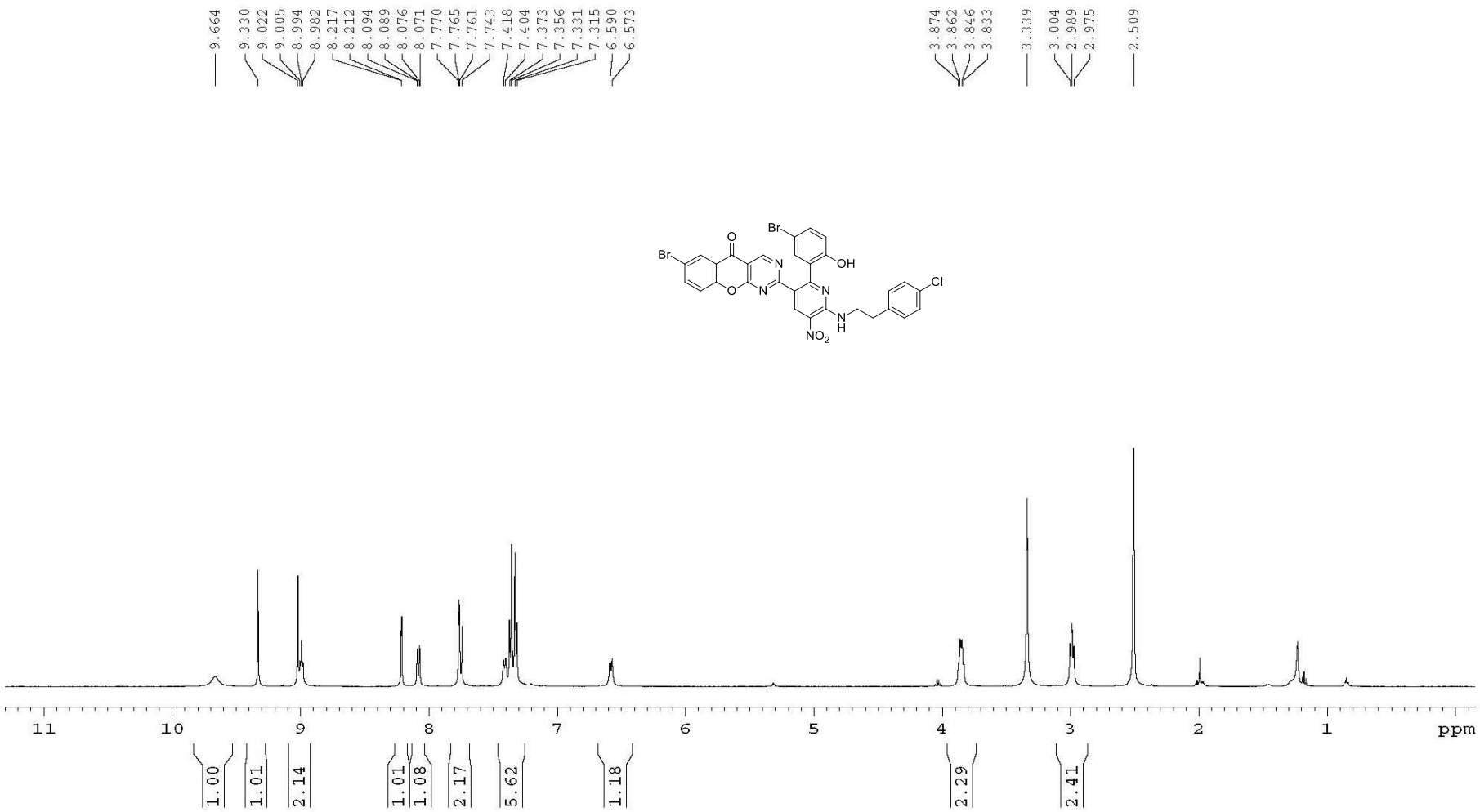


Figure S42. ^{1}H NMR (500 MHz, DMSO-d_6) spectra of compound **3u**

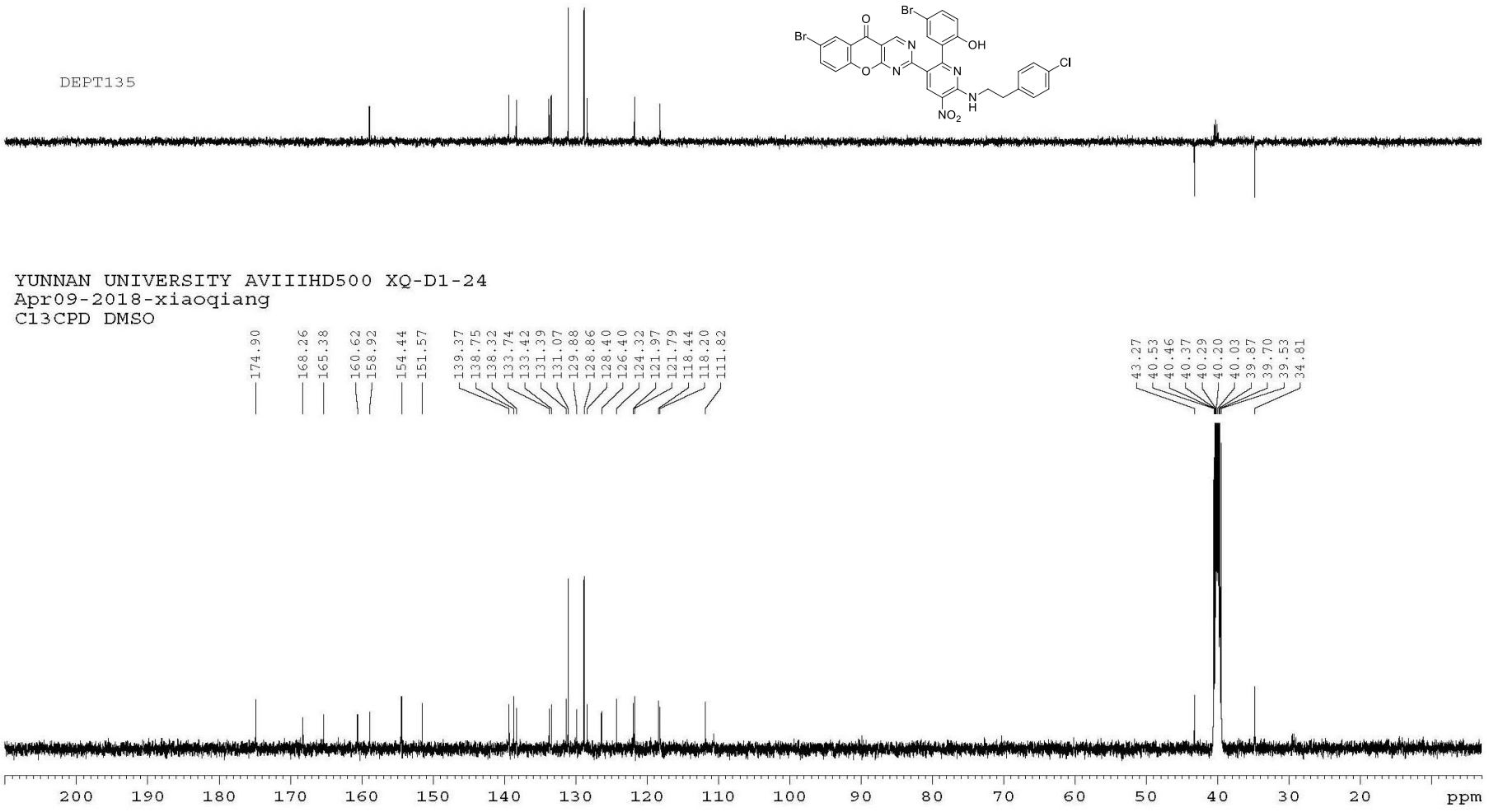


Figure S43. ^{13}C NMR (125 MHz, DMSO-d_6) spectra of compound **3u**

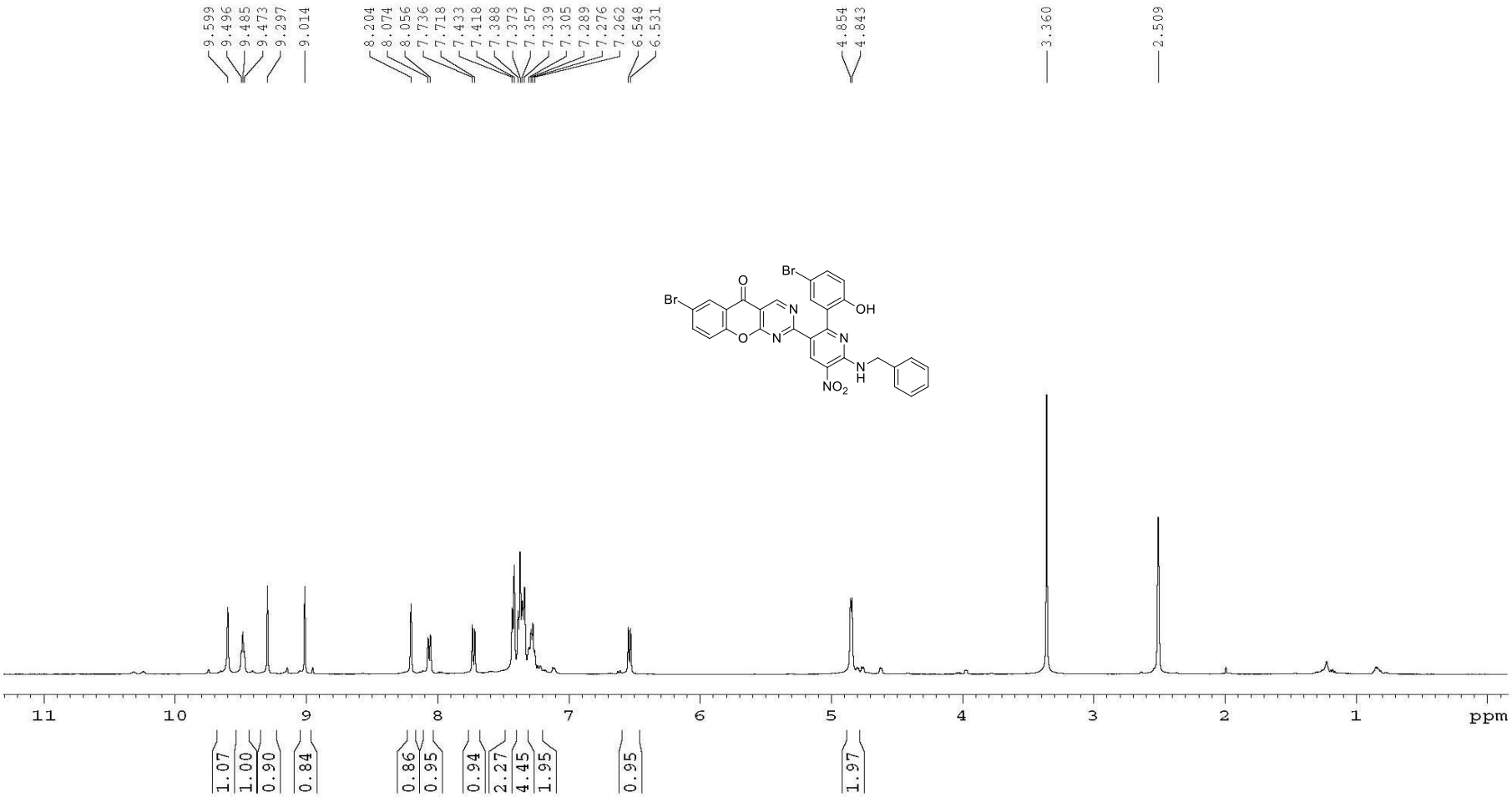


Figure S44. ^{1}H NMR (600MHz, DMSO-d_6) spectra of compound **3v**

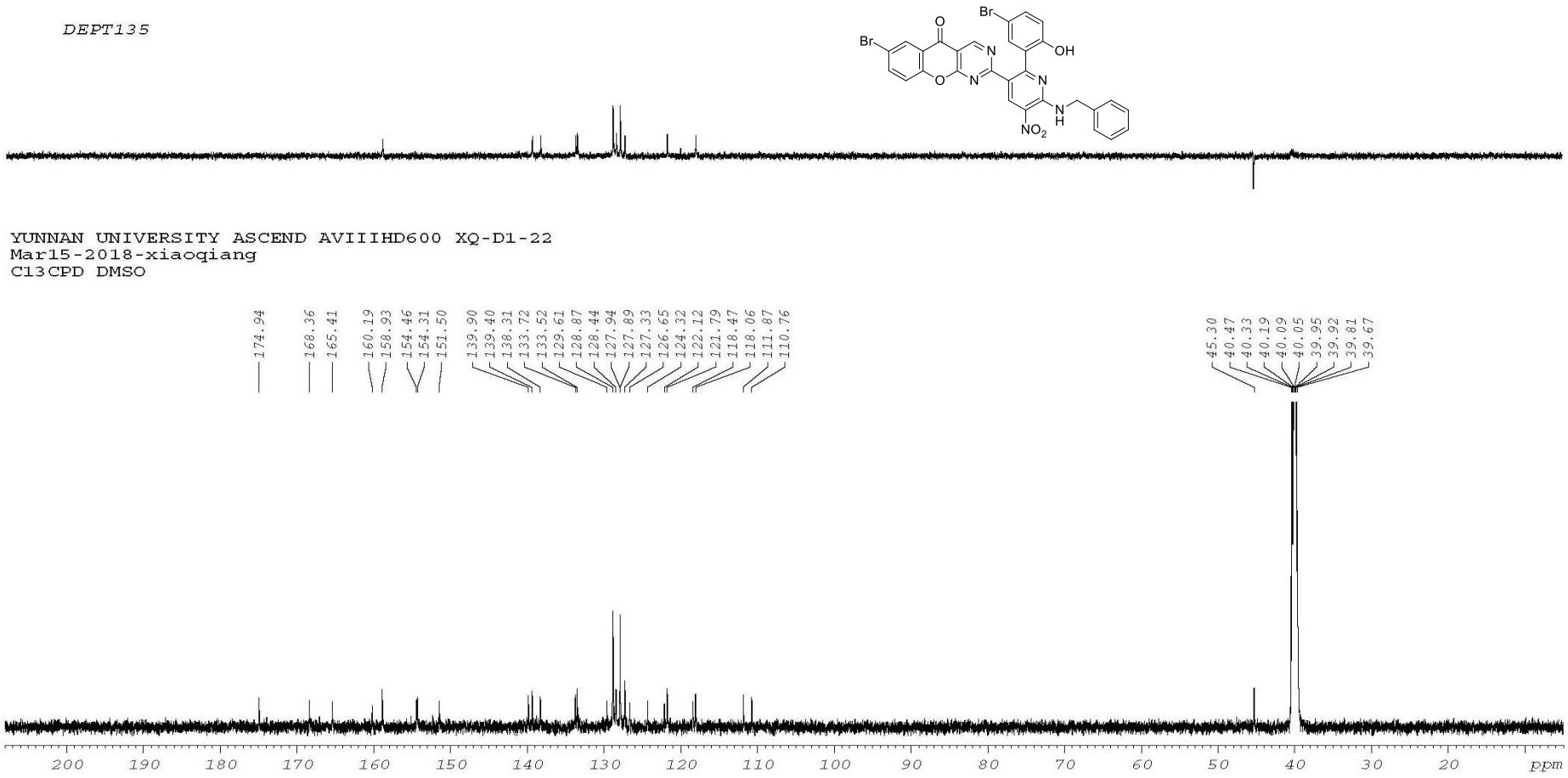


Figure S45. ^{13}C NMR (150 MHz, DMSO-d_6) spectra of compound **3v**

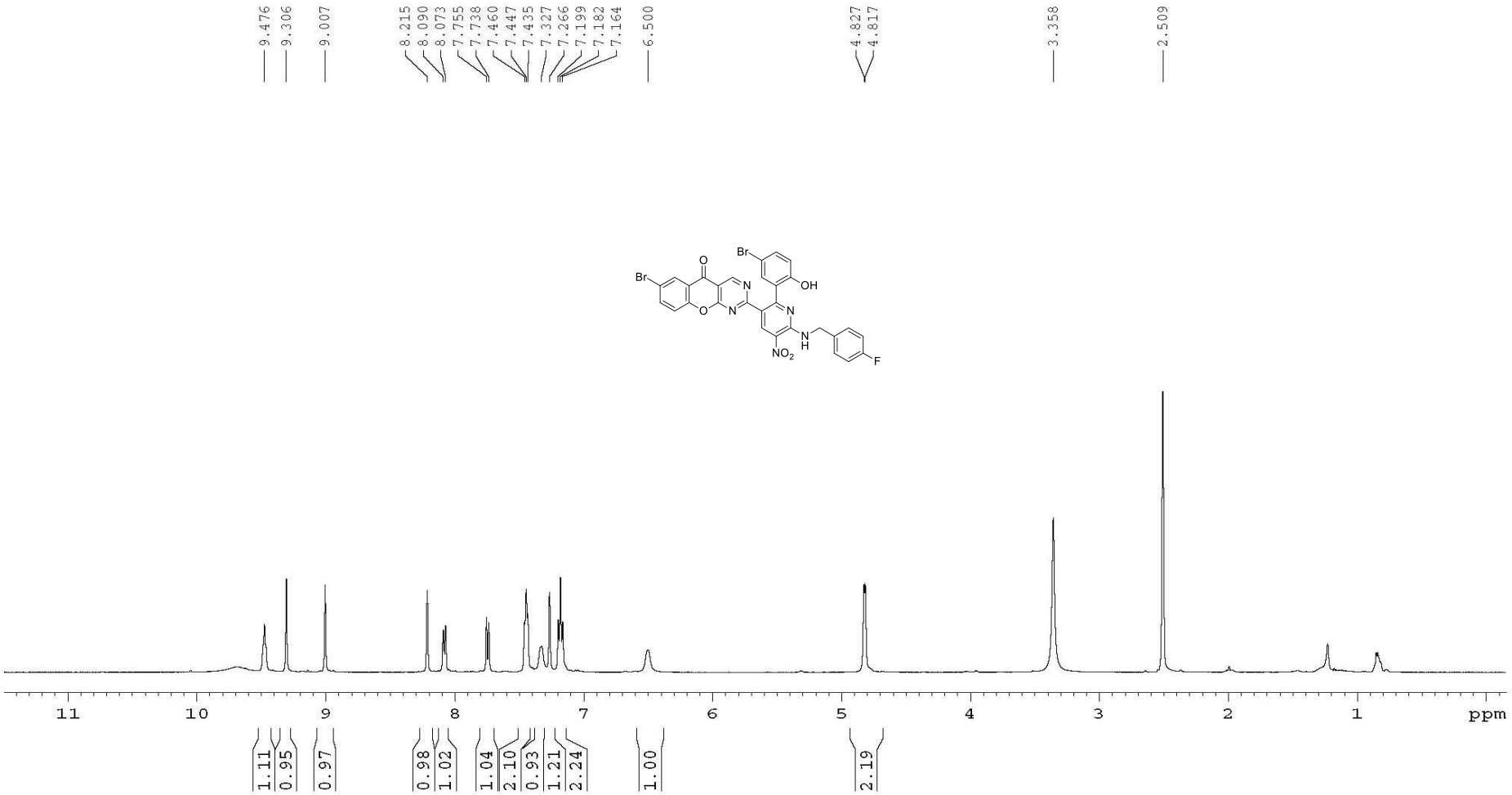


Figure S46. ^{1}H NMR (600 MHz, DMSO-d_6) spectra of compound **3w**

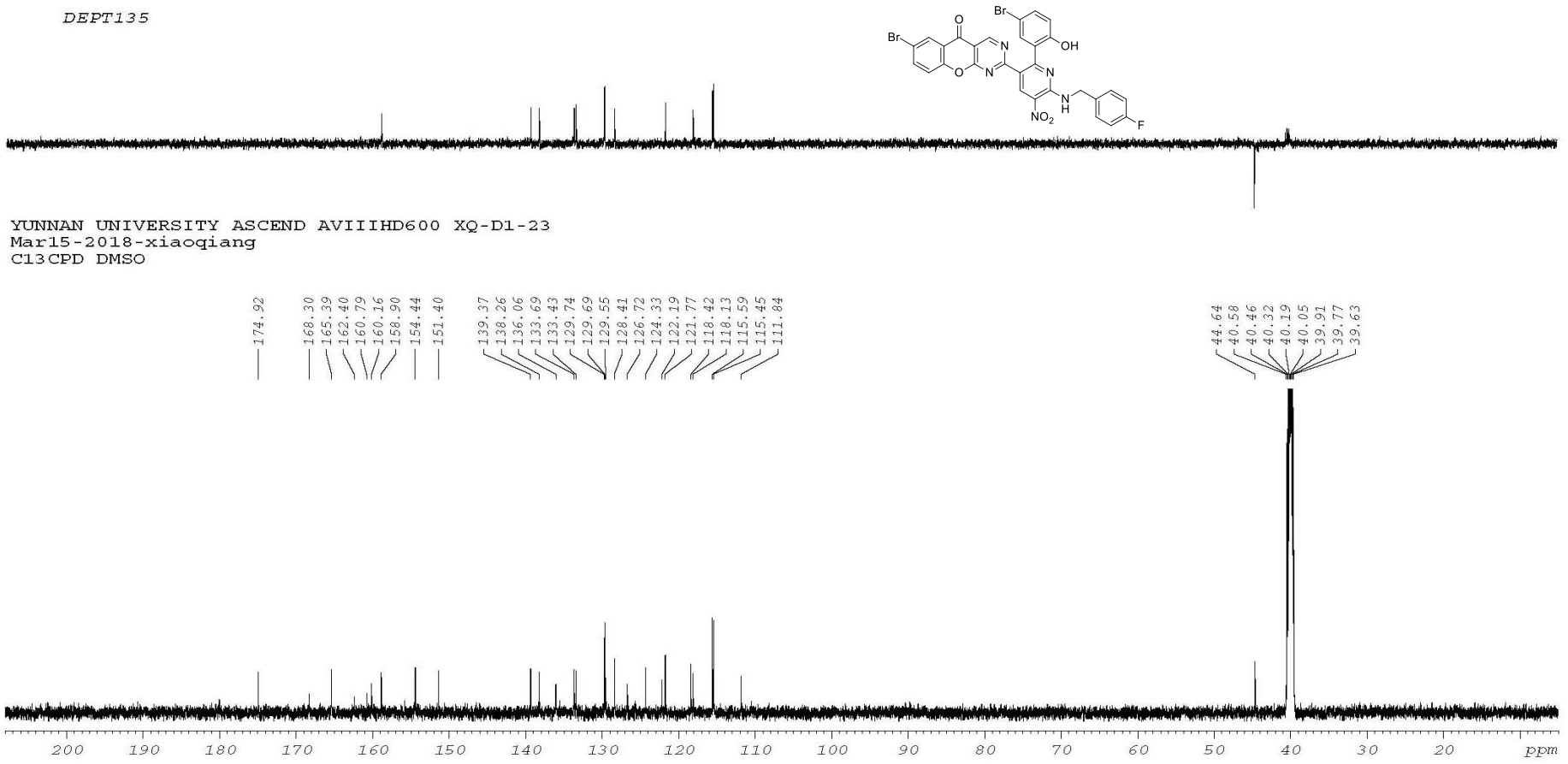


Figure S47. ^{13}C NMR (150 MHz, DMSO-d_6) spectra of compound **3w**

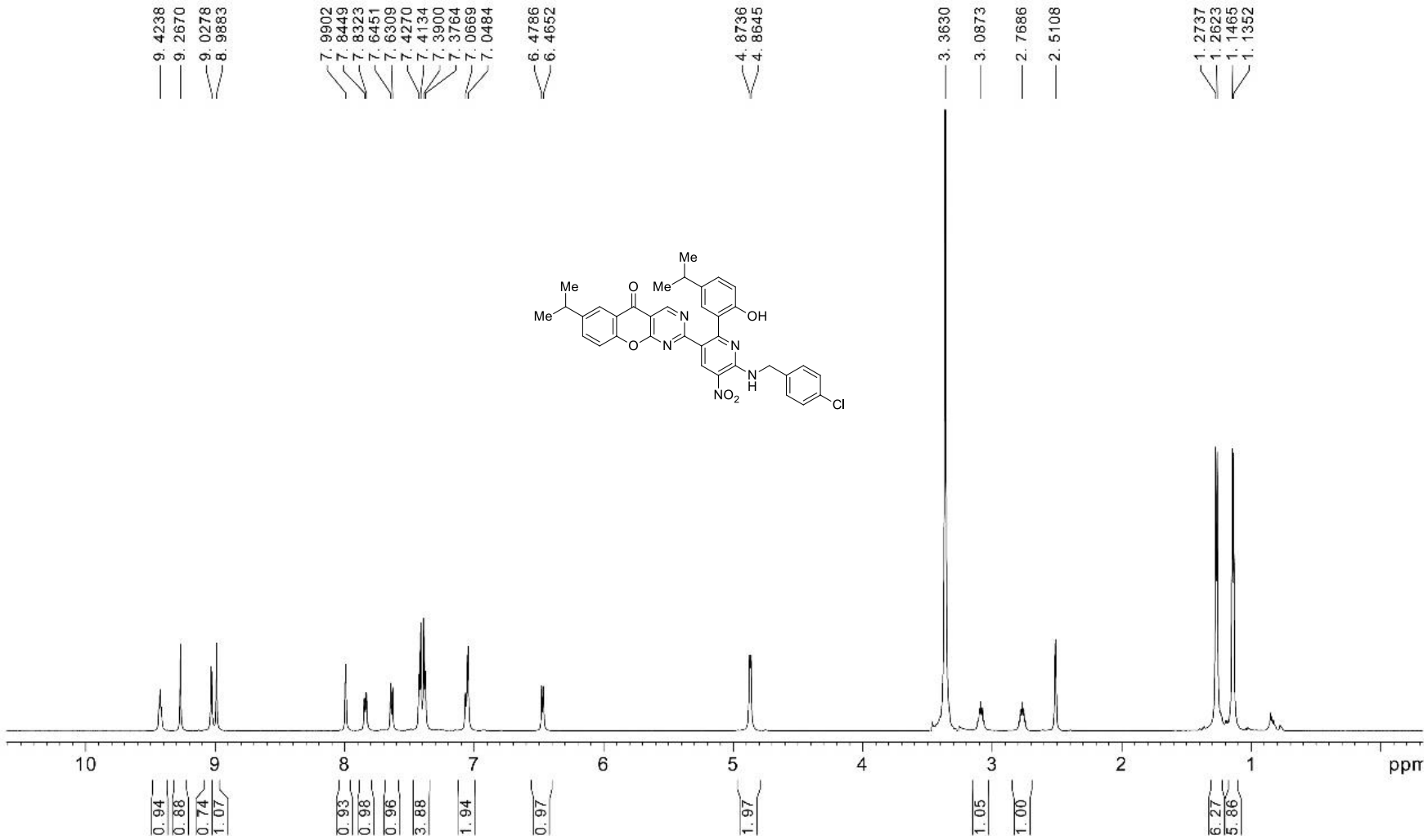


Figure S48. ^{1}H NMR (600 MHz, DMSO-d_6) spectra of compound **3x**

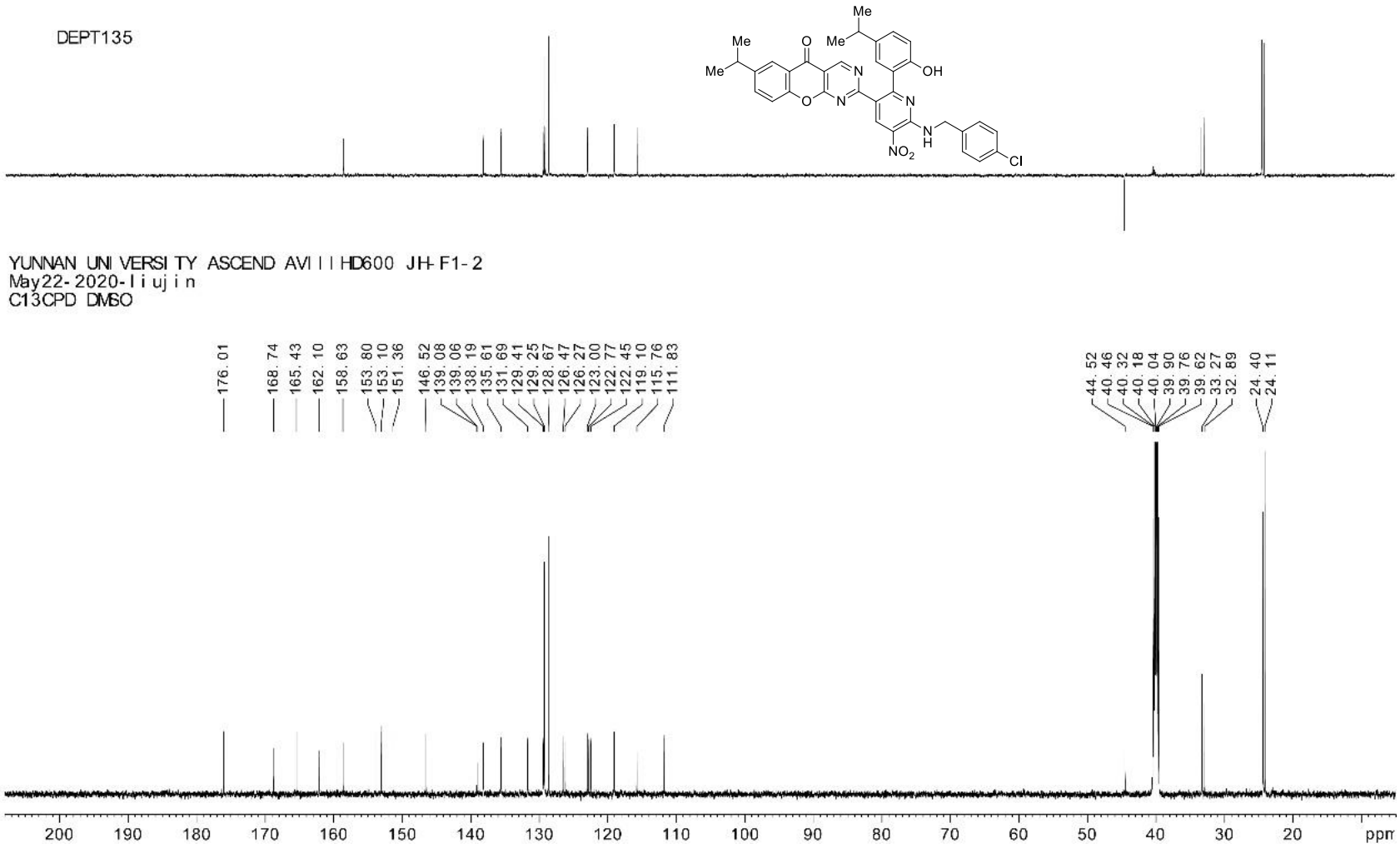


Figure S49. ^{13}C NMR (150 MHz, DMSO-d_6) spectra of compound **3x**

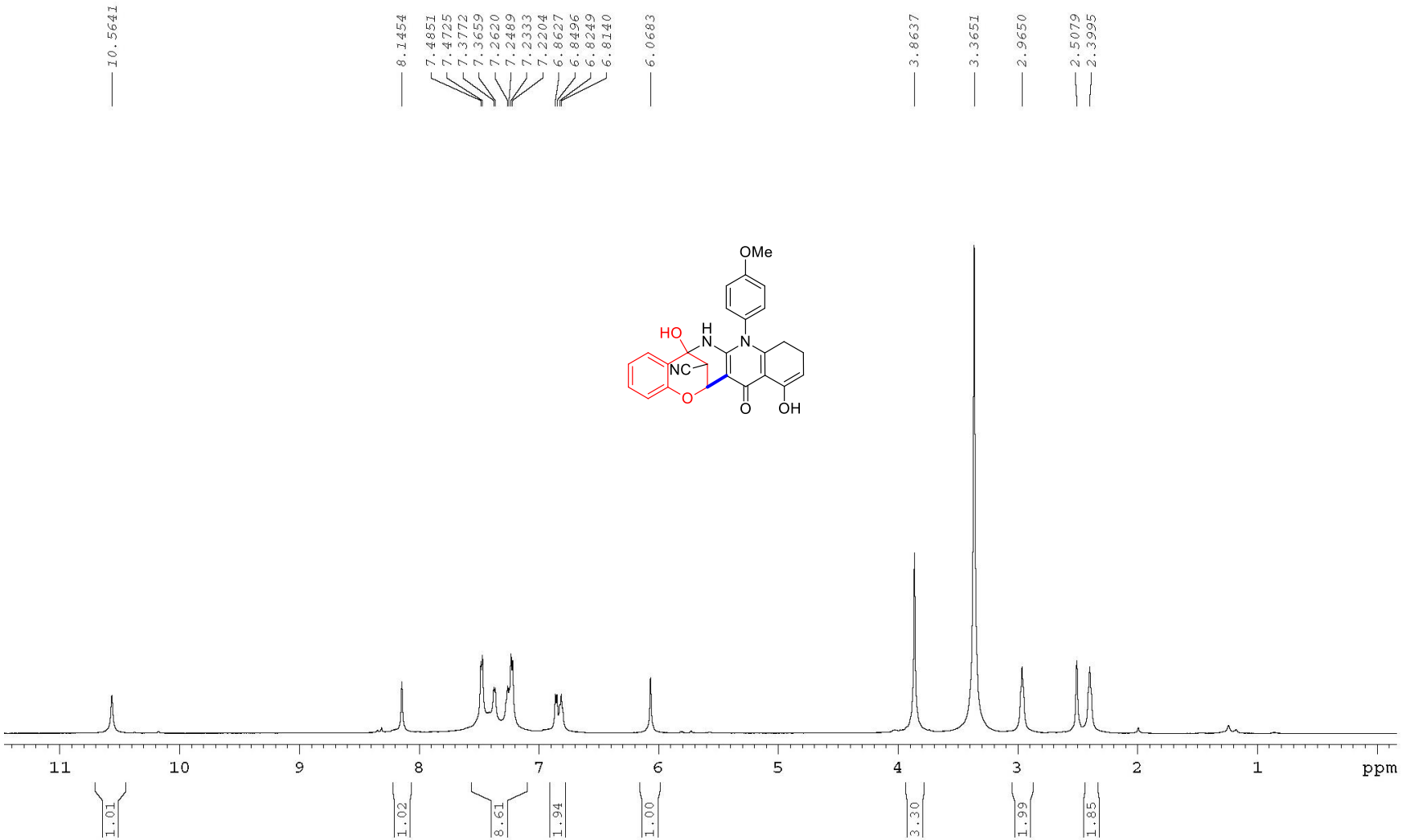


Figure S50. ^{1}H NMR (600 MHz, DMSO-d_6) spectra of intermediate **6**

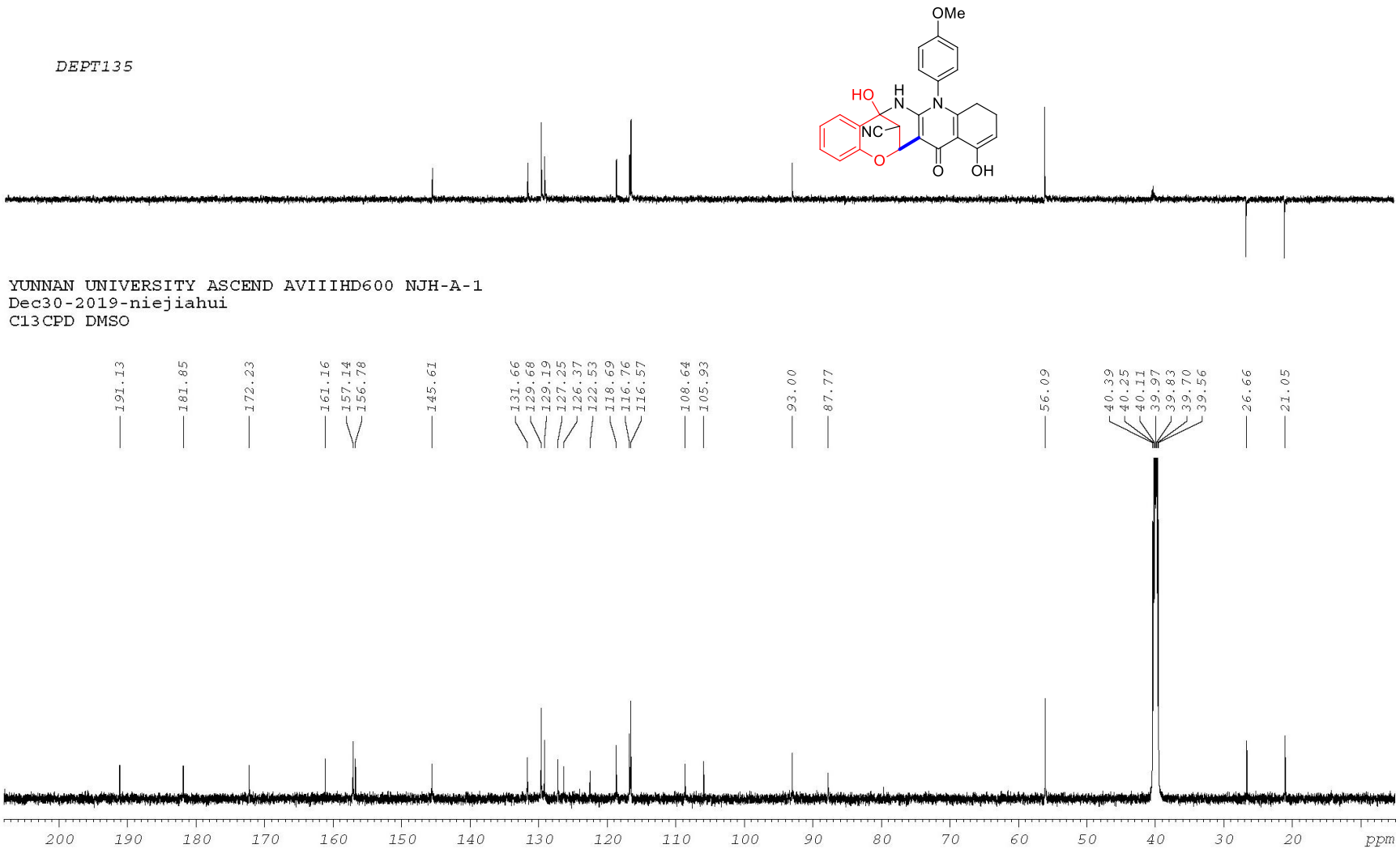


Figure S51. ^{13}C NMR (150 MHz, DMSO-d_6) spectra of intermediate **6**

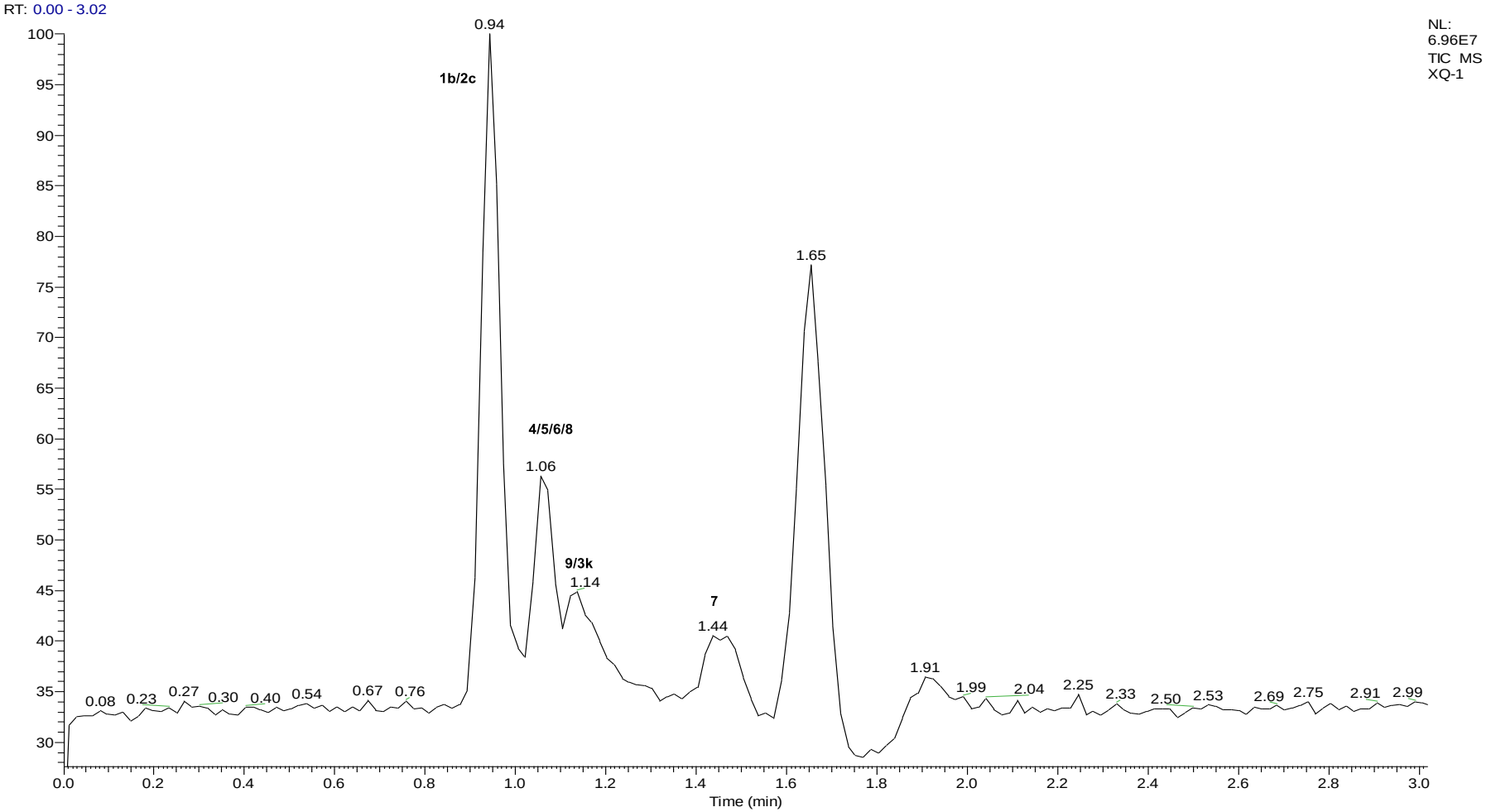


Figure S52. HPLC of the reaction mixture

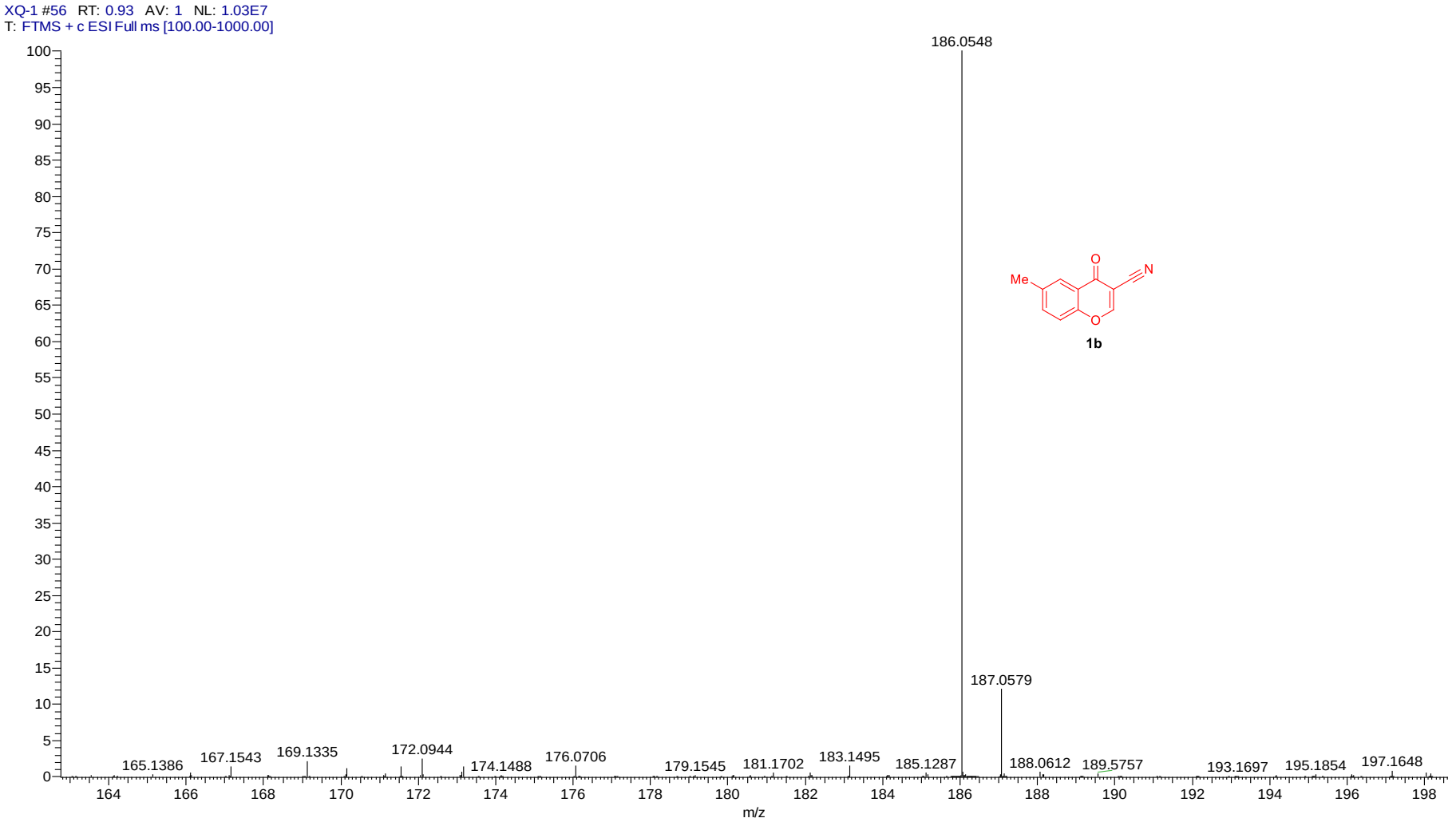


Figure S53. HRMS of compound **1b**

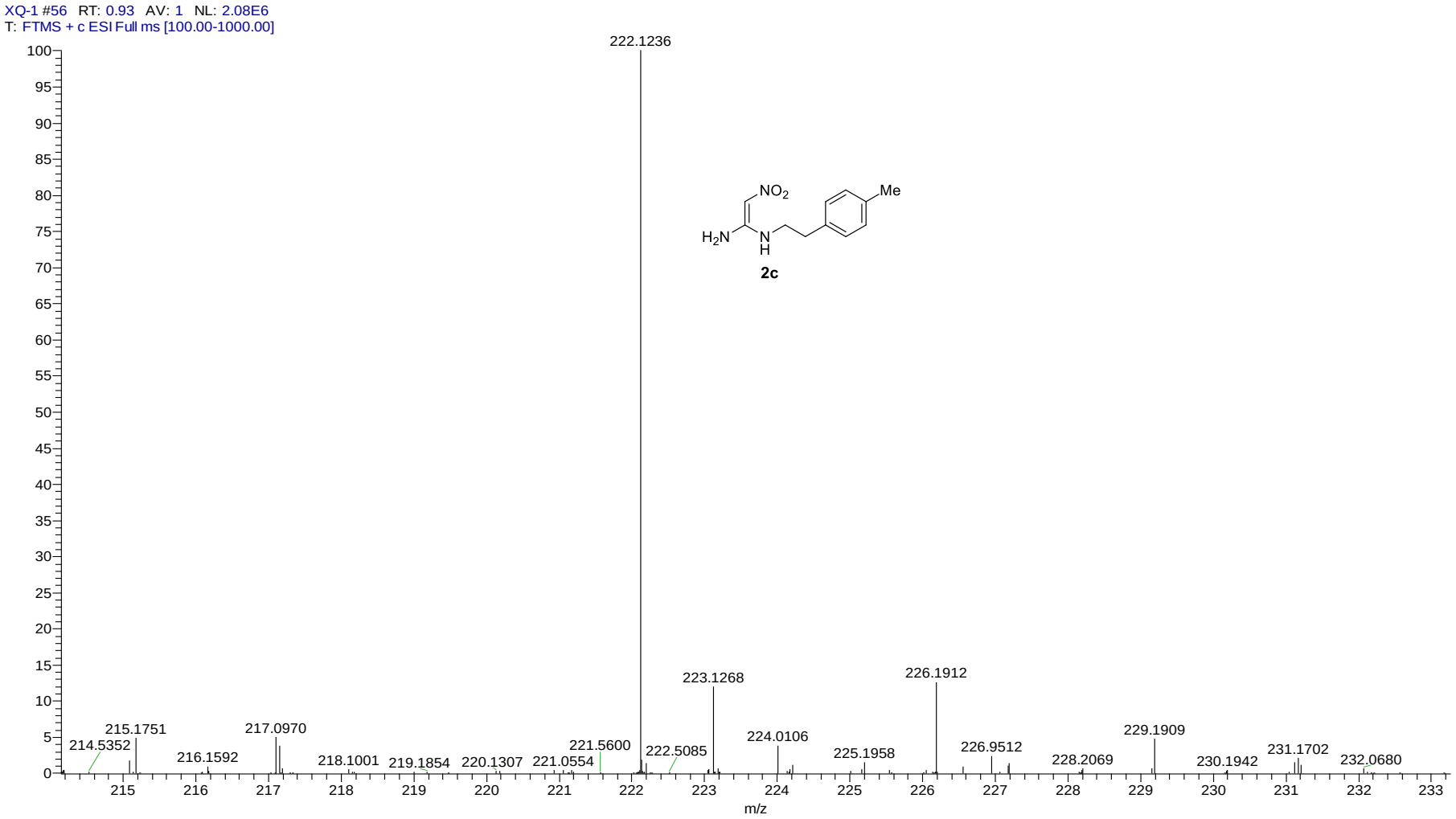


Figure S54. HRMS of compound **2c**

Figure S55. HRMS of intermediate **4/5/6**

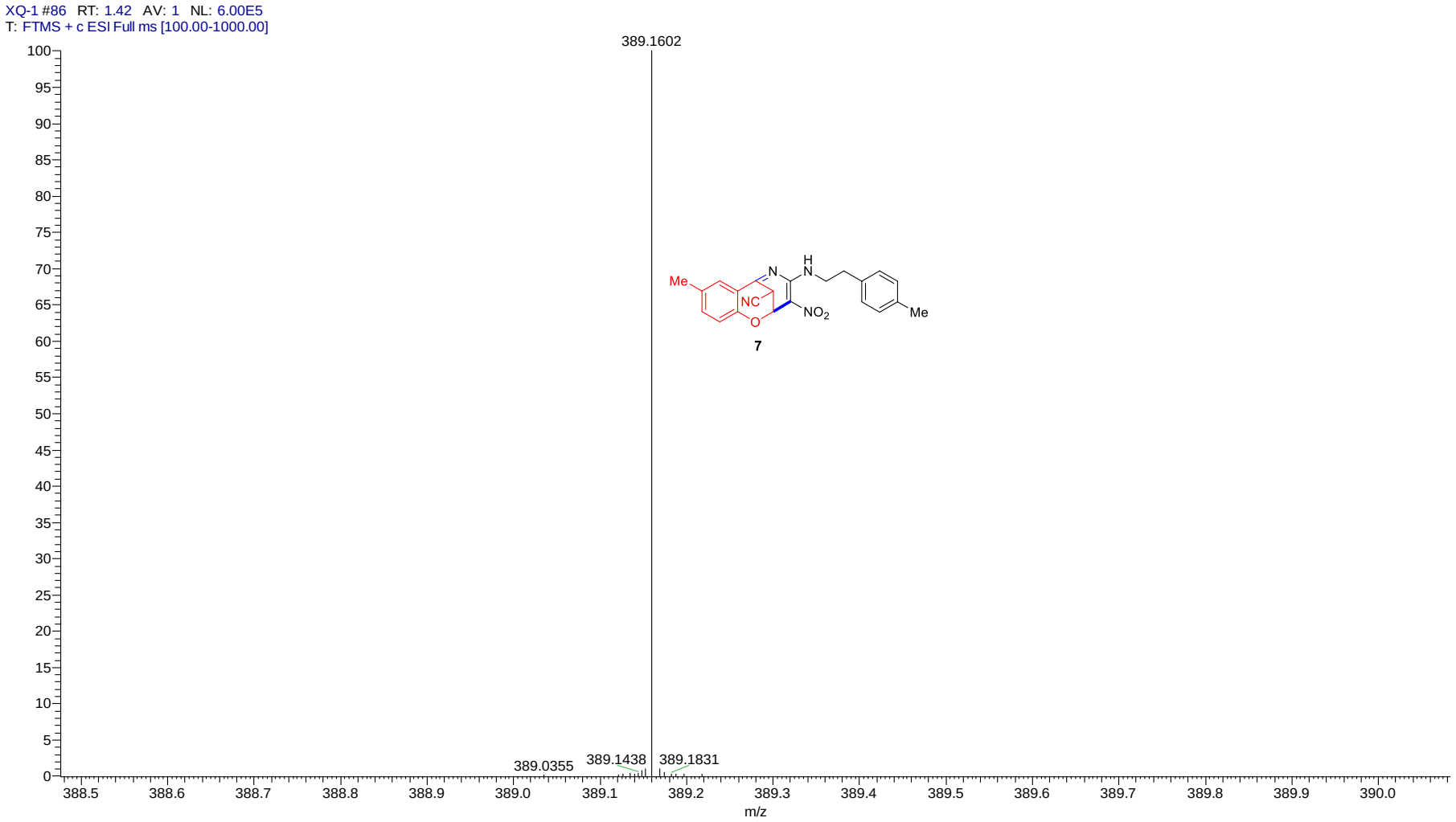


Figure S56. HRMS of intermediate **7**

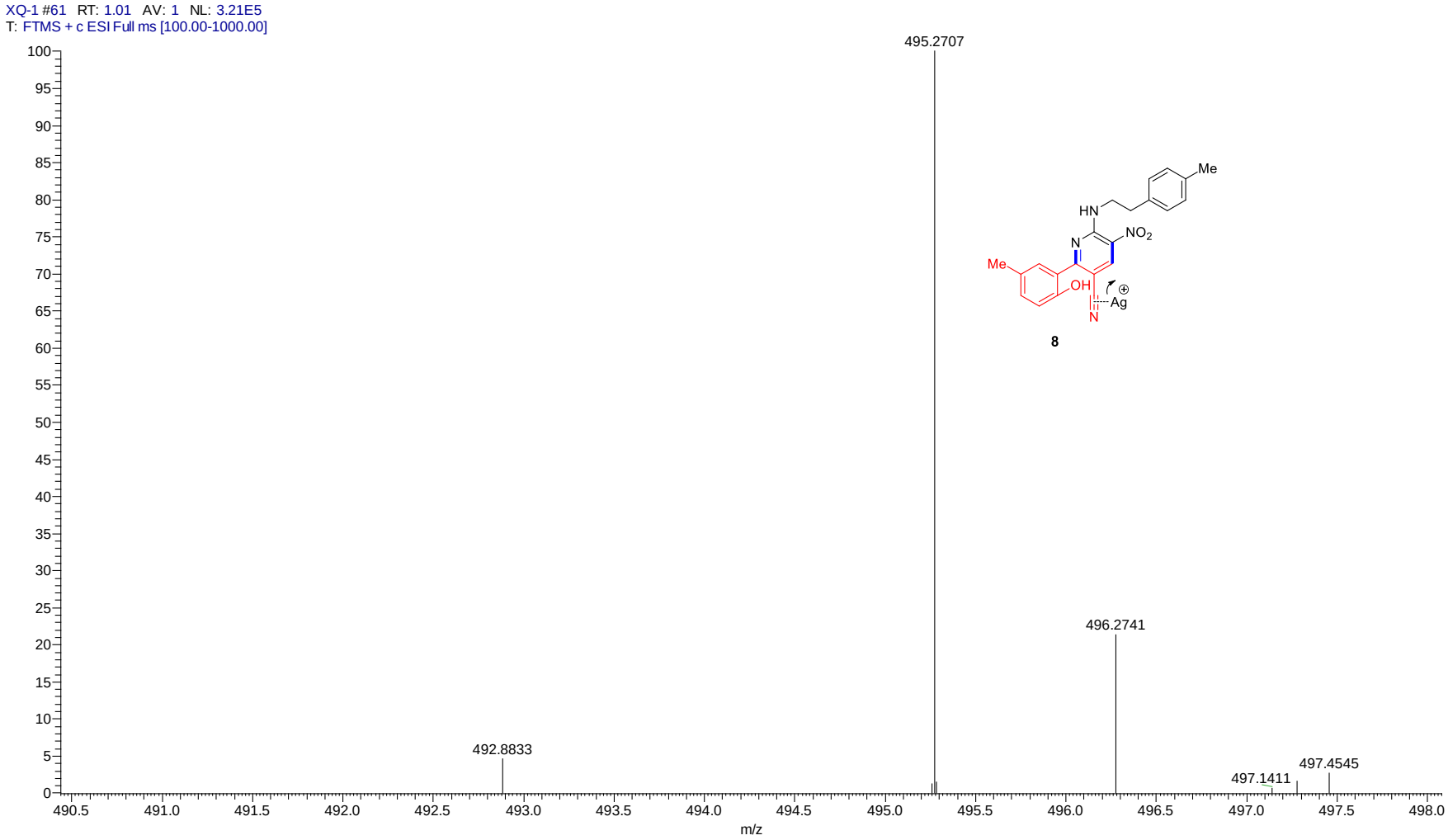


Figure S57. HRMS of intermediate **8**

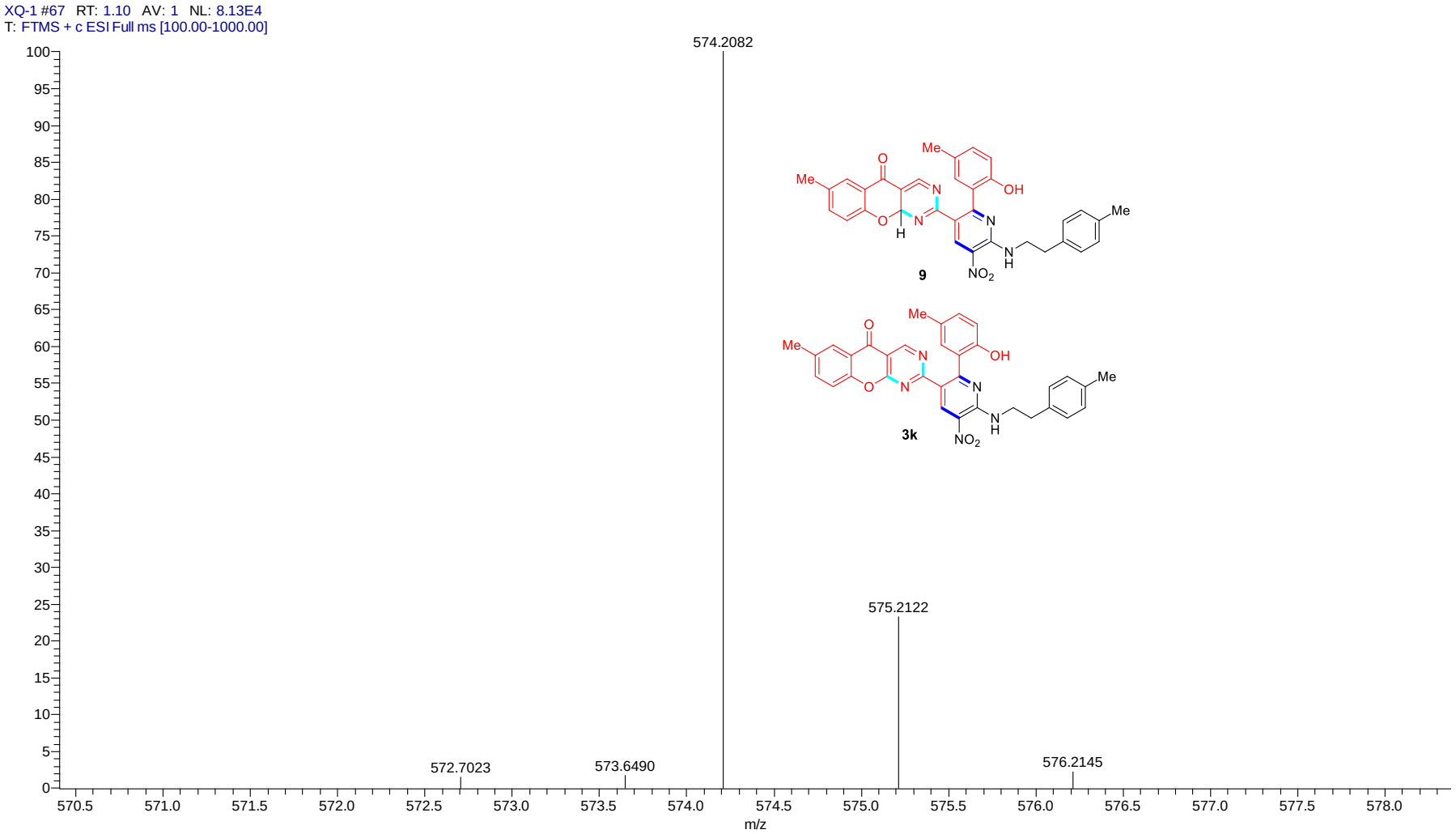


Figure S58. HRMS of intermediate **9** and target compound **3k**

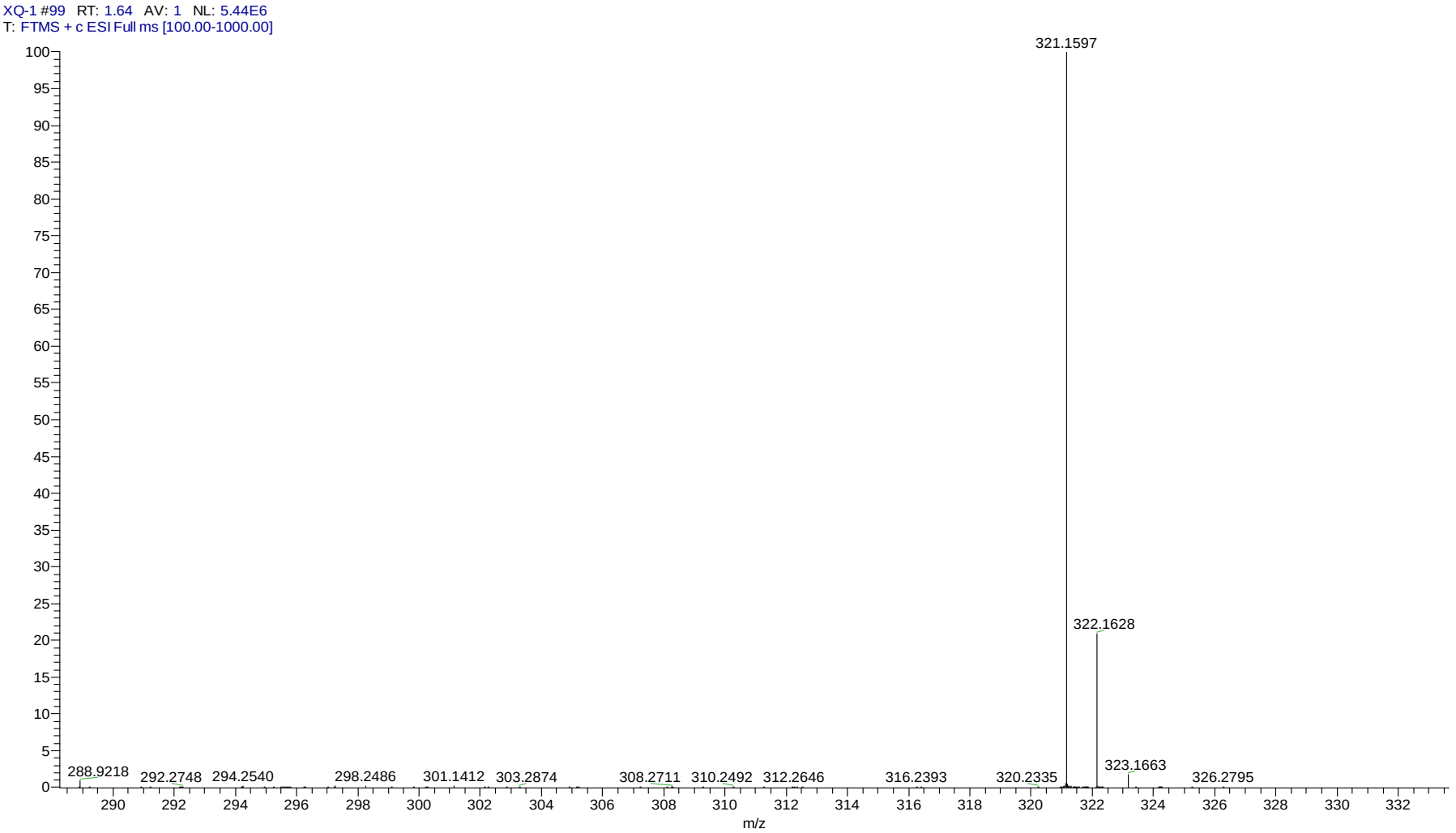


Figure S59. HRMS of plasticizer

References

[1] (a) Mertens, H.; Troschütz, R. Synthese primärer Nitroketenaminale. *Arch. Pharm.* **1986**, *319*, 161−167; (b) Zi, Q.-X.; Yang, C.-L.; Li, K.; Luo, Q.; Lin, J.; Yan, S.-J. Multicomponent Cascade Reaction by Metal-Free Aerobic Oxidation for Synthesis of Highly Functionalized 2-Amino-4-coumarinyl-5-arylpyrroles. *J. Org. Chem.* **2020**, *85*, 327−338.