Supporting Information for

Copper-Catalysed Addition of α-Alkyl Azaarenes to Ethyl Glyoxylate *via* Direct C(sp^3)-H Activation

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General information:

Melting points were recorded with a micro melting point apparatus and uncorrected. NMR spectra were recorded with a 400 MHz spectrometer for ^{1}H NMR, 100 MHz for $^{13}C\{^1H\}$ NMR. Chemical shifts δ are given in ppm relative to tetramethylsilane as internal standard, residual $CHCl_3$ for ^{1}H or $CDCl_3$ in $^{13}C\{^1H\}$ NMR spectroscopy. Multiplicities are reported as follows: singlet (s), doublet (d), doublet of doublets (dd), triplet (t), quartet (q), multiplet (m). High resolution mass spectra were taken with a 3000 mass spectrometer, using Waters Q-TofMS/MS system. For column chromatography silica gel (200-300 mesh) was used as the stationary phase. All reactions were monitored by thin layer chromatography (TLC). Tetrahydrofuran used in reactions was reagent grade and distilled from sodium. All reagents and solvents were purchased from commercial sources and purified commonly before used. All known quinolines (**1a-1l**) were prepared according to literature proceedures.[1] All pyridines and ethyl glyoxylate are commercially available compounds.

General procedure for the copper-catalysed direct C(sp^3)–H Activation of quinolines.

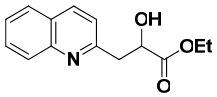
$Cu(OTf)_2$ (7.2 mg, 10 mol%), 1,10-phenanthroline (1.8 mg, 5 mol%), 2-methyl quinoline **1a** (82 μL, 0.6 mmol) and ethyl glyoxylate **2** (40 μL 0.2 mmol) were mixed in a Schlenk tube and then dry THF (0.8 mL) was added. The mixture was stirred at 60 ℃ in a closed reaction vessel. The reaction was monitored by TLC. After completion of the reaction, the solvent was evaporated under reduced pressure and the residue purified by column chromatography on silica gel (eluent: petroleum ether/ ethyl acetate) to give the desired product.

General procedure for the copper-catalysed direct C(sp^3)–H Activation of pyridines.

$Cu(OTf)_2$ (7.2 mg, 10 mol%), 1,10-phenanthroline (1.8 mg, 5 mol%), 2-methyl pyridine **4a** (60 μL , 0.6 mmol) and ethyl glyoxylate **2** (40 μL, 0.2 mmol) were mixed in a Schlenk tube and then dry THF (0.8 mL) was added. The mixture was stirred at 110 ℃ in a closed reaction vessel. The reaction was monitored by TLC. After completion of the reaction, the solvent was evaporated under reduced pressure and the residue purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate) to give the desired product.

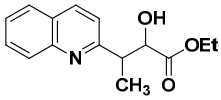
Characterisation of Compounds

Ethyl 2-hydroxy-3-(quinolin-2-yl)propanoate (3a):



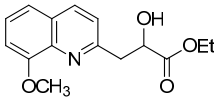
White solid. M.p. 107-109 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.14 (d, *J* = 8.4 Hz, 1H), 8.07-8.05 (m, 1H), 7.81 (d, *J* = 8.4 Hz, 1H), 7.72 (t, *J* = 7.2 Hz, 1H), 7.54 (t, *J* = 7.6 Hz, 1H), 7.34 (d, *J* = 8.4 Hz, 1H), 4.77 (q, *J* = 3.6 Hz, 1H), 4.22 (q, *J* = 7.2 Hz, 2H), 3,56-3.41 (m, 2H), 1.24 (t, *J* = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.6, 158.7, 147.1, 136.7, 129.7, 128.6, 127.5, 126.8, 126.2, 121.9, 70.4, 61.3, 40.9, 14.1; HRMS: calcd for $C_{14}H_{15}NNaO_3$ $[M+Na]^+$ 268.0950, found 268.0952.

Ethyl 2-hydroxy-3-(quinolin-2-yl)butanoate (3b):



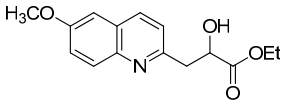
Yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.10 (d, *J* = 8.4 Hz, 1H), 7.99 (d, *J* = 8.8 Hz, 1H), 7.76 (d, *J* = 8.0 Hz, 1H), 7.70-7.66 (m, 1H), 7.52-7.48 (m, 1H), 7.29-7.27 (m, 1H), 4.45 (d, *J* = 2.8 Hz, 1H), 4.08-4.02 (m, 2H), 3.68-3.61 (m, 1H), 1.57 (d, *J* = 7.2 Hz, 3H), 1.04 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.9, 164.0, 146.9, 137.0, 129.7, 128.8, 127.5, 127.0, 126.3, 120.7, 73.6, 61.3, 43.8, 14.7, 14.2; HRMS: calcd for $C_{15}H_{17}NNaO_3$ $[M+Na]^+$ 282.1106, found 282.1109.

Ethyl 2-hydroxy-3-(8-methoxyquinolin-2-yl)propanoate (3c):



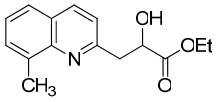
Orange liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.07(d, *J* = 8.4 Hz, 1H), 7.43 (t, *J* = 7.8 Hz, 1H), 7.36-7.33 (m, 2H), 7.03 (d, *J* = 7.6 Hz ,1H), 4.77 (q, *J* =3.6 Hz, 1H), 4.22 (q, *J* = 7.2 Hz, 2H), 4.03 (s, 3H), 3.54-3.35 (m, 2H), 1.24 (t, *J* = 7.2Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.5, 157.5, 154.8, 138.9, 136.6, 127.9, 126.4, 122.3, 119.2, 108.0, 70.6, 61.2, 55.9, 40.7, 14.1; HRMS: calcd for $C_{15}H_{17}NNaO_4$ $[M+Na]^+$ 298.1055, found 298.1057.

Ethyl 2-hydroxy-3-(6-methoxyquinolin-2-yl)propanoate (3d):



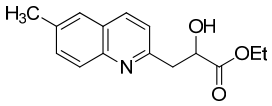
Light yellow solid, M.p. 95-97 °C . ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.00 (d, *J* = 8.4 Hz, 1H), 7.89 (d, *J* = 9.2 Hz, 1H), 7.36-7.33 (m, 1H), 7. 24 (s, 1H), 7.05 (d, *J* = 2.4 Hz ,1H), 4.74 (q, *J* =3.6 Hz, 1H), 4.21 (q, *J* = 7.2 Hz, 2H), 3.92 (s, 3H), 3.48-3.33 (m, 2H), 1.23 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.6, 157.5, 156.0, 143.2, 135.5, 130.1, 127.8, 122.3, 122.2, 105.1, 70.5, 61.2, 55.5, 40.6, 14.1; HRMS: calcd for $C_{15}H_{18}NO_4$ $[M+H]^+$ 276.1236, found 276.1240.

Ethyl 2-hydroxy-3-(8-methylquinolin-2-yl)propanoate (3e):



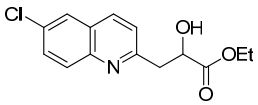
Yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.08 (d, *J* = 8.4 Hz, 1H), 7.63 (d, *J* = 8.0 Hz, 1H), 7.55 (d, *J* = 6.8 Hz, 1H), 7.41 (t, *J* = 7.6 Hz, 1H), 7. 29 (s, 1H), 4.74 (q, *J* = 3.6 Hz, 1H), 4.20 (q, *J* = 7.2 Hz, 2H), 3.54-3.43 (m, 2H), 2.76 (s, 3H), 1.22 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.4, 157.8, 145.9, 137.2, 136.1, 130.1, 126.8, 126.1, 125.6, 121.5, 70.5, 61.1, 40.0, 18.1, 14.1; HRMS: calcd for $C_{15}H_{17}NNaO_3$ $[M+Na]^+$ 282.1106, found 282.1111.

Eethyl 2-hydroxy-3-(6-methylquinolin-2-yl)propanoate (3f):



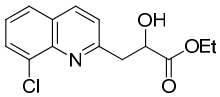
Yellow solid, M.p. 66-68 °C . ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.00 (d, *J* = 8.4 Hz, 1H), 7.87 (d, *J* = 8.4 Hz, 1H), 7.53-7.50 (m, 2H), 7.26-7.24 (m, 1H), 4.75 (q, *J* = 3.6 Hz, 1H), 4.20 (q, *J* = 7.2 Hz, 2H), 3.49-3.40 (m, 2H), 2.51 (s, 3H), 1.22 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.6, 157.7, 145.7, 136.1, 131.9, 128.3, 126.9, 126.4, 121.9, 107.0, 70.5, 61.2, 40.8, 21.5, 14.1; HRMS: calcd for $C_{15}H_{18}NO_3$ $[M+H]^+$ 260.1287, found 260.1283.

Ethyl 3-(6-chloroquinolin-2-yl)-2-hydroxypropanoate (3g):



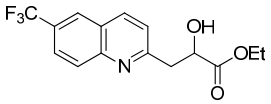
Yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.01 (d, *J* = 8.4 Hz, 1H), 7.93 (d, *J* = 9.2 Hz, 1H), 7.77 (d, *J* = 2.0 Hz, 1H), 7.63-7.61 (m, 1H), 7.33 (d, *J* = 8.4 Hz, 1H), 4.74 (q, *J* = 3.2 Hz, 1H), 4.22 (q, *J* = 7.2 Hz, 2H), 3.51-3.36 (m, 2H), 1.23 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.2, 159.9, 143.1, 137.1, 132.9, 129.7, 128.0, 126.5, 126.2, 122.7, 70.4, 61.3, 40.2, 14.1; HRMS: calcd for $C_{14}H_{14}ClNNaO_3$ $[M+Na]^+$ 302.0560, found 302.0556.

Ethyl 3-(8-chloroquinolin-2-yl)-2-hydroxypropanoate (3h):



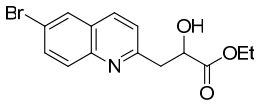
Yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.12 (d, *J* = 8.4 Hz, 1H), 7.80 (d, *J* = 7.6 Hz, 1H), 7.71 (d, *J* = 8.4 Hz, 1H), 7.42 (t, *J* = 8.0 Hz, 1H), 7.36 (d, *J* = 8.4 Hz, 1H), 5.93 (d, *J* = 6.0 Hz, 1H), 4.81 (d, *J* = 4.0 Hz, 1H), 4.21 (q, *J* = 7.2 Hz, 2H), 3.57-3.45 (m, 2H), 1.23 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.6, 159.0, 145.6, 135.7, 131.9, 130.6, 130.3, 127.5, 126.2, 122.9, 70.2, 61.4, 41.2, 14.1; HRMS: calcd for $C_{14}H_{14}ClNNaO_3$ $[M+Na]^+$ 302.0560, found 302.0565.

Ethyl 2-hydroxy-3-(6-(trifluoromethyl)quinolin-2-yl)propanoate(3i):



Yellow solid, M.p. 79-82 °C . ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.19 (d, *J* = 8.4 Hz, 1H), 8.11 (d, *J* = 5.2 Hz, 2H), 7.86 (dd, J_1 = 1.6 Hz, J_2 = 1.6 Hz ,1H), 7.42 (d, *J* = 8.4 Hz, 1H), 4.77 (q, *J* =3.6 Hz, 1H), 4.23 (q, *J* = 7.2 Hz, 2H), 3.56-3.41 (m, 2H), 1.24 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.6, 161.1, 148.2, 137.3, 130.0, 128.3, 127.9, 125.8, 125.5, 125.5, 125.3, 125.3, 123.3 122.6, 70.1, 61.5, 41.5, 14.1; HRMS: calcd for $C_{15}H_{15}F_3NO_3$ $[M+H]^+$ 314.1004, found 314.1000.

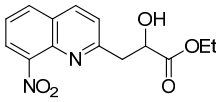
Ethyl 3-(6-bromoquinolin-2-yl)-2-hydroxypropanoate (3j):



Orange liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.00 (d, *J* = 8.4 Hz, 1H), 7.94 (d, *J* = 1.6 Hz, 2H), 7.86 (d, *J* = 8.8 Hz, 1H), 7.75 (dd, J_1 = 2.0 Hz, J_2 = 2.0 Hz, 1H), 7.32 (d, *J* = 8.4 Hz, 1H), 4.77 (q, *J* = 3.6 Hz, 1H), 4.23 (q, *J* = 7.2 Hz, 2H), 3.56-3.41 (m, 2H), 1.24 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.5,

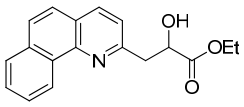
159.1, 135.6, 133.0, 130.0, 130.4, 129.5, 127.9, 122.9, 119.9, 70.1, 61.4, 41.2, 14.1; HRMS: calcd for $C_{14}H_{14}BrNNaO_3$ $[M+Na]^+$ 346.0055, found 346.0059.

Ethyl 2-hydroxy-3-(8-nitroquinolin-2-yl)propanoate (3k):



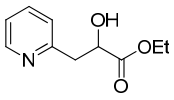
Red solid, M.p. 98-101 °C . ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.20 (d, J = 8.4 Hz, 1H), 8.10 (dd, J_1 = 0.8 Hz, J_2 = 1.2 Hz, 1H), 8.02 (dd, J_1 = 0.8 Hz, J_2 = 0.8 Hz, 1H), 7.59 (t, J = 8.0 Hz, 1H), 7.46 (d, J = 8.4 Hz, 1H), 4.76 (q, J = 5.2 Hz, 1H), 4.65 (d, J = 6.8 Hz, 1H), 4.22 (q, J = 7.2 Hz, 2H), 3.58-3.48 (m, 2H), 1.27 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.4, 161.3, 147.2, 138.5, 136.6, 132.2, 127.7, 124.9, 124.6, 123.9, 69.8, 61.6, 41.2, 14.1; HRMS: calcd for $C_{14}H_{14}N_2NaO_5$ $[M+Na]^+$ 313.0800, found 313.0802.

Ethyl 3-(benzo[h]quinolin-2-yl)-2-hydroxypropanoate (3l):



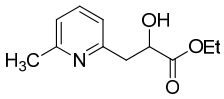
Red-brown liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.16 (d, J = 7.6 Hz, 1H), 8.14 (d, J = 8.4 Hz, 1H), 7.91 (t, J = 7.2 Hz, 1H),7.81-7.66 (m, 4H), 7.42 (d, J = 8.0 Hz, 1H), 4.84 (q, J = 3.2 Hz, 1H), 4.23 (q, J = 7.2 Hz, 2H), 3.64-3.54 (m, 2H), 1.23 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.8, 157.1, 145.5, 136.7, 133.8, 130.8, 128.3, 127.9, 127.5, 127.1, 125.0, 124.9, 124.3, 122.4, 70.3, 61.3, 40.7, 14.1; HRMS: calcd for $C_{18}H_{17}NNaO_5$ $[M+Na]^+$ 318.1106, found 318.1104.

Ethyl 2-hydroxy-3-(pyridin-2-yl)propanoate (5a):



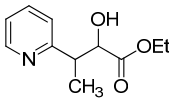
Light yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.51 (d, J = 4.4 Hz, 1H), 7.70-7.65 (m, 1H), 7.24-7.20 (m, 2H), 4.65 (q, J = 3.6 Hz, 1H), 4.21 (q, J = 7.2 Hz, 2H), 3.38-3.19 (m, 2H), 1.24 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.7, 158.0, 148.7, 136.8, 123.9, 121.9, 70.5, 61.3, 40.6, 14.1; HRMS: calcd for $C_{10}H_{14}NO_3$ $[M+H]^+$ 196.0974, found 196.0976.

Ethyl 2-hydroxy-3-(6-methylpyridin-2-yl)propanoate (5b):



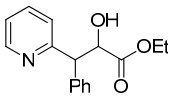
Light yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.51 (t, *J* = 8.0 Hz, 1H), 7.03-6.96 (m, 2H), 4.62 (q, *J* = 3.6 Hz, 1H), 4.19 (q, *J* = 7.2 Hz, 2H), 3.28-3.11 (m, 2H), 2.51 (s, 3H), 1.23 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.9, 162.8, 148.6, 137.1, 123.0, 122.1, 75.5, 61.0, 43.2, 18.7, 14.2; HRMS: calcd for $C_{11}H_{16}NO_3$ $[M+H]^+$ 210.1130, found 210.1134.

Ethyl 2-hydroxy-3-(pyridin-2-yl)butanoate (5c):



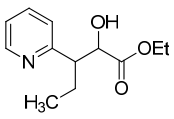
Light yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.51 (d, *J* = 4.0 Hz, 1H), 7.69-7.64 (m, 1H), 7.24-7.16 (m, 2H), 4.65 (d, *J* = 2.8 Hz, 1H), 4.25 (q, *J* = 7.2 Hz, 2H), 3.46-3.39 (m, 1H), 1.33-1.26 (m, 6H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.9, 162.8, 148.6, 137.1, 123.0, 122.1, 75.5, 61.0, 43.2, 18.7, 14.2; HRMS: calcd for $C_{11}H_{16}NO_3$ $[M+H]^+$ 210.1130, found 210.1133.

Ethyl 2-hydroxy-3-phenyl-3-(pyridin-2-yl)propanoate (5d):



Yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.53 (d, *J* = 4.4 Hz, 1H), 7.62-7.58 (m, 1H), 7.34-7.28 (m, 4H), 7.24-7.17 (m, 2H), 7.10 (d, *J* = 7.6 Hz, 1H), 4.74 (d, *J* = 4.0 Hz, 1H), 4.62 (q, *J* = 4.4 Hz, 1H), 4.12-4.03 (m, 2H), 1.07 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.2, 160.8, 148.0, 140.1, 137.1, 128.9, 128.5, 127.1, 124.6, 122.1, 75.6, 61.9, 53.7, 14.0; HRMS: calcd for $C_{16}H_{18}NO_3$ $[M+H]^+$ 272.1287, found 272.1289.

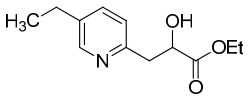
Ethyl 2-hydroxy-3-(pyridin-2-yl)pentanoate (5e):



Light yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.47 (d, *J* = 4.0 Hz, 1H), 7.63-7.58 (m, 1H), 7.18-7.14 (m, 1H), 7.08 (d, *J* = 7.6 Hz, 1H), 4.48 (s, 1H), 4.06-3.98 (m, 2H), 3.11-3.07 (m, 1H), 1.97-1.91 (m, 2H),

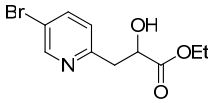
1.05 (t, *J* = 7.2 Hz, 3H) , 0.93 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 174.0, 161.7, 148.6, 136.6, 123.8, 122.0, 73.6, 60.7, 50.1, 26.0, 14.0, 12.0; HRMS: calcd for $C_{12}H_{18}NO_3$ $[M+H]^+$ 224.1287, found 224.1283.

Ethyl 3-(5-ethylpyridin-2-yl)-2-hydroxypropanoate (5f):



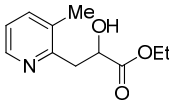
Orange liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.33 (s, 1H), 7.45 (d, *J* = 8.0 Hz, 1H), 7.09 (d, *J* = 8.0 Hz, 1H), 4.61 (q, *J* = 3.6 Hz, 1H), 4.19 (q, *J* = 7.2 Hz, 2H), 3.29-3.10 (m, 2H), 2.61 (q, *J* = 7.6 Hz, 2H), 1.25-1.21 (m, 6H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.7, 155.2, 148.3, 137.4, 136.2, 123.4, 70.7, 61.2, 40.1, 25.7, 15.2, 14.1; HRMS: calcd for $C_{12}H_{18}NO_3$ $[M+H]^+$ 224.1287, found 224.1289.

Ethyl 3-(5-bromopyridin-2-yl)-2-hydroxypropanoate (5g):



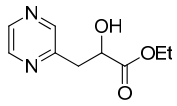
Orange liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.57 (d, *J* = 1.6 Hz ,1H), 7.75 (dd, J_1 = 2.4 Hz, J_1 = 2.0 Hz, 1H), 7.11 (d, *J* = 8.4 Hz, 1H), 4.61 (d, *J* = 3.6 Hz, 1H), 4.22 (q, *J* = 7.2 Hz, 2H), 4.10 (d, *J* = 5.6 Hz, 1H), 3.29-3.10 (m, 2H), 1.28 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.6, 156.2, 150.0, 139.1, 125.3, 118.8, 70.1, 61.6, 40.6, 14.1; HRMS: calcd for $C_{10}H_{12}BrNNaO_3$ $[M+Na]^+$ 295.9898, found 295.9895.

Ethyl 2-hydroxy-3-(3-methylpyridin-2-yl)propanoate (5h):



Orange liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.30 (d, *J* = 4.4 Hz, 1H), 7.44 (d, *J* = 7.2 Hz, 1H), 7.09-7.06 (m, 1H), 4.70 (t, *J* = 5.2 Hz, 1H), 4.22-4.16 (m, 2H), 3.22 (d, *J* = 5.2 Hz, 2H), 2.29 (s, 3H), 1.22 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.8, 156.7, 145.7, 137.9, 131.8, 121.7, 70.2, 61.1, 36.7, 18.6, 14.1; HRMS: calcd for $C_{11}H_{16}NO_3$ $[M+H]^+$ 210.1130, found 210.1135.

Ethyl 2-hydroxy-3-(pyrazin-2-yl)propanoate (5i):



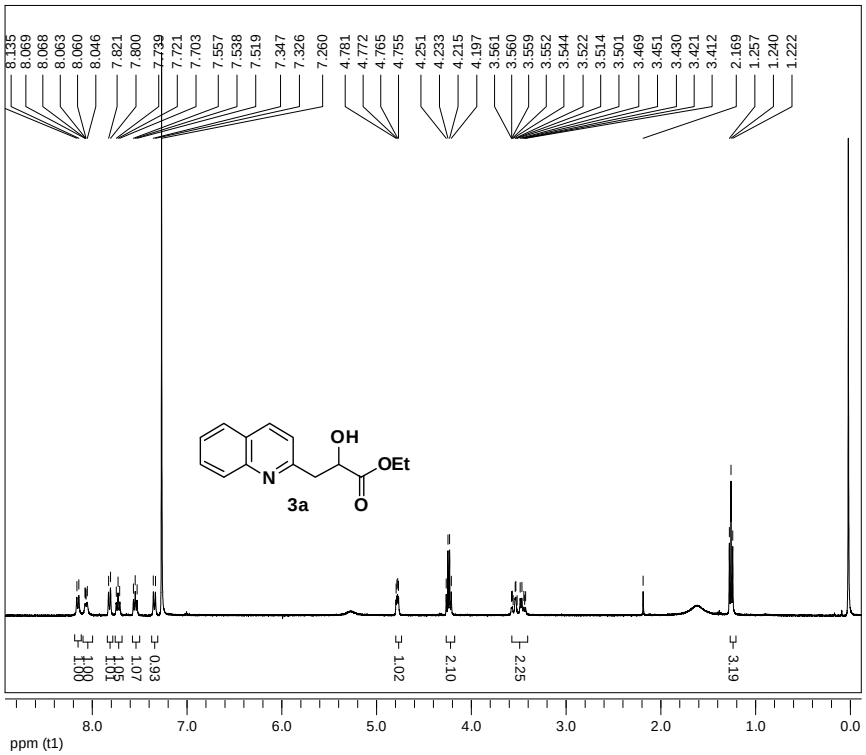
Yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.64-8.44 (m, 3H), 4.65 (s, 1H), 4.24 (q, J = 7.2 Hz, 2H), 3.68 (s, 1H), 3.36-3.18 (m, 2H), 1.26 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.6, 69.7, 61.7, 39.0, 14.0; HRMS: calcd for $C_9H_{12}N_2NaO_3$ $[M+Na]^+$ 219.0746, found 219.0750.

References:

1. M. Matsugi, F. Tabusa and J. Minamikawa, *Tetrahedron Lett*., 2000, **41**, 8523–8525.

Copies of ^{1}H and ^{13}C NMR spectra

^{1}H NMR Spectrum for 3a



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Original Points Count:
(f1) 16384
Actual Points Count:
(f1) 32768
Acquisition Time (sec):
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Spectral Width (ppm):
(f1) 17.951
Pulse Program:
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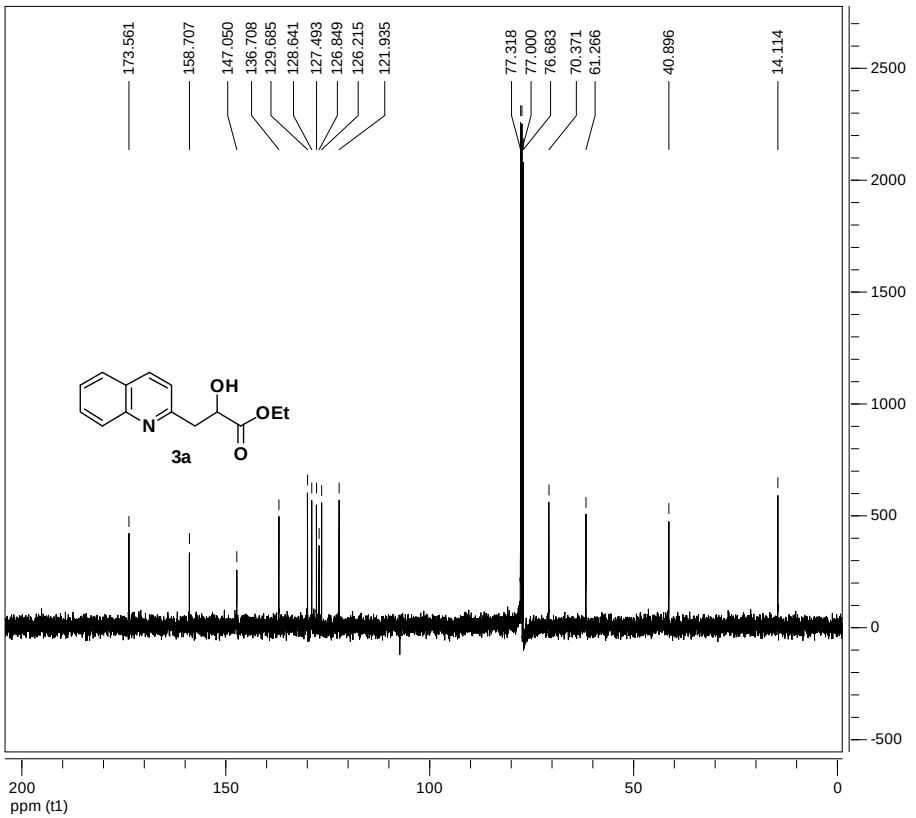
Temperature:
298.96
Number of Scans:
8
Acq. Date:
Fri Jul 08 05:03:18 PM

^{13}C NMR Spectrum for 3a



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Spectral Width (ppm):
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Pulse Program:
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Temperature:
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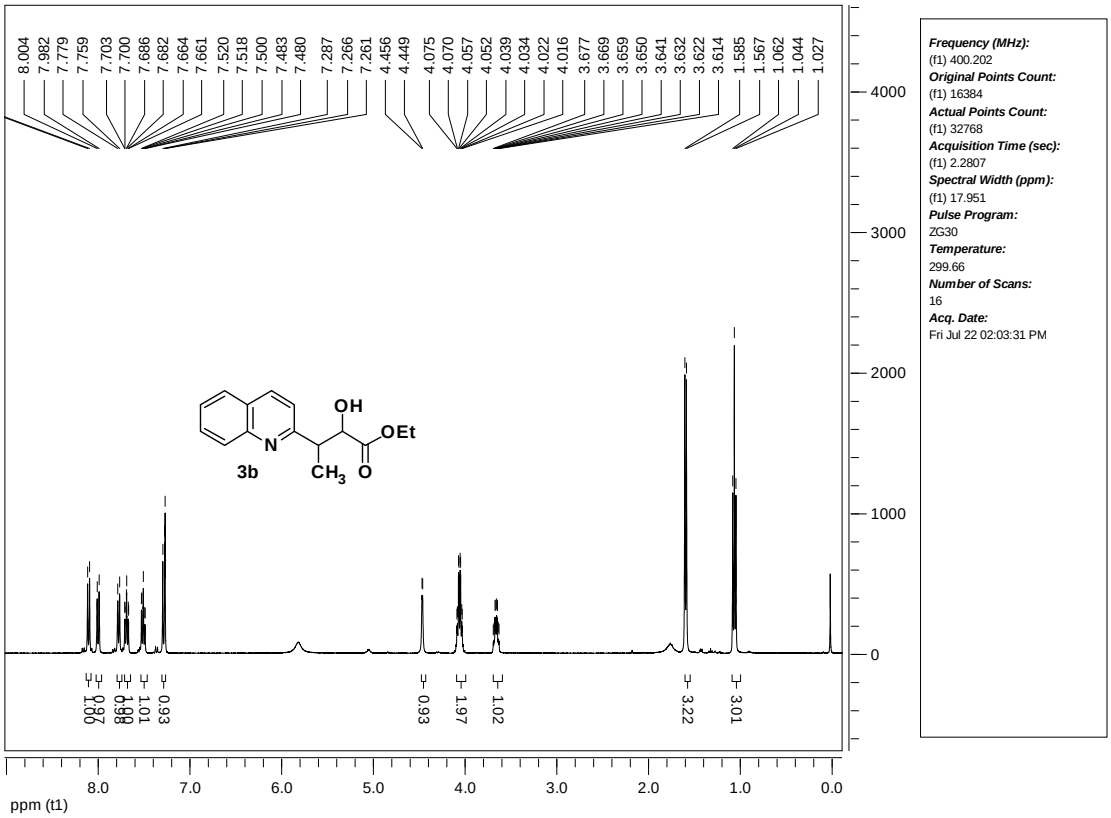
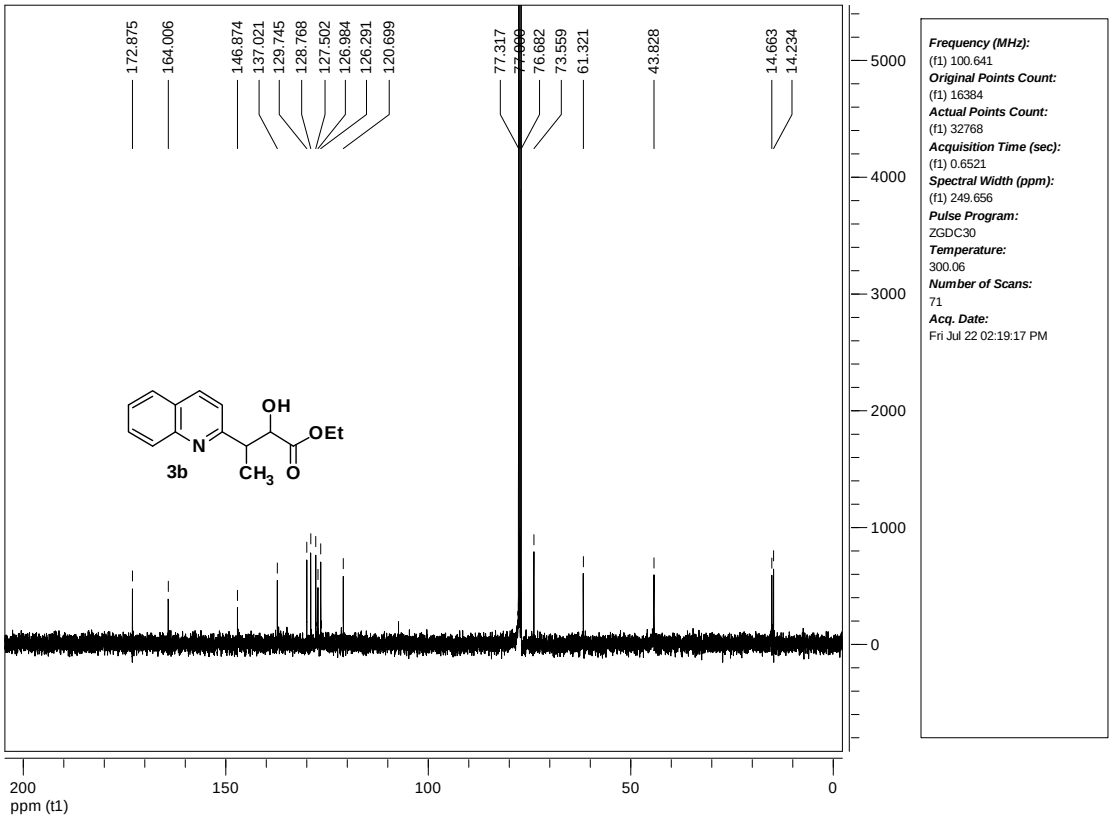
Number of Scans:
21
Acq. Date:
Tue Jul 19 11:21:41 AM

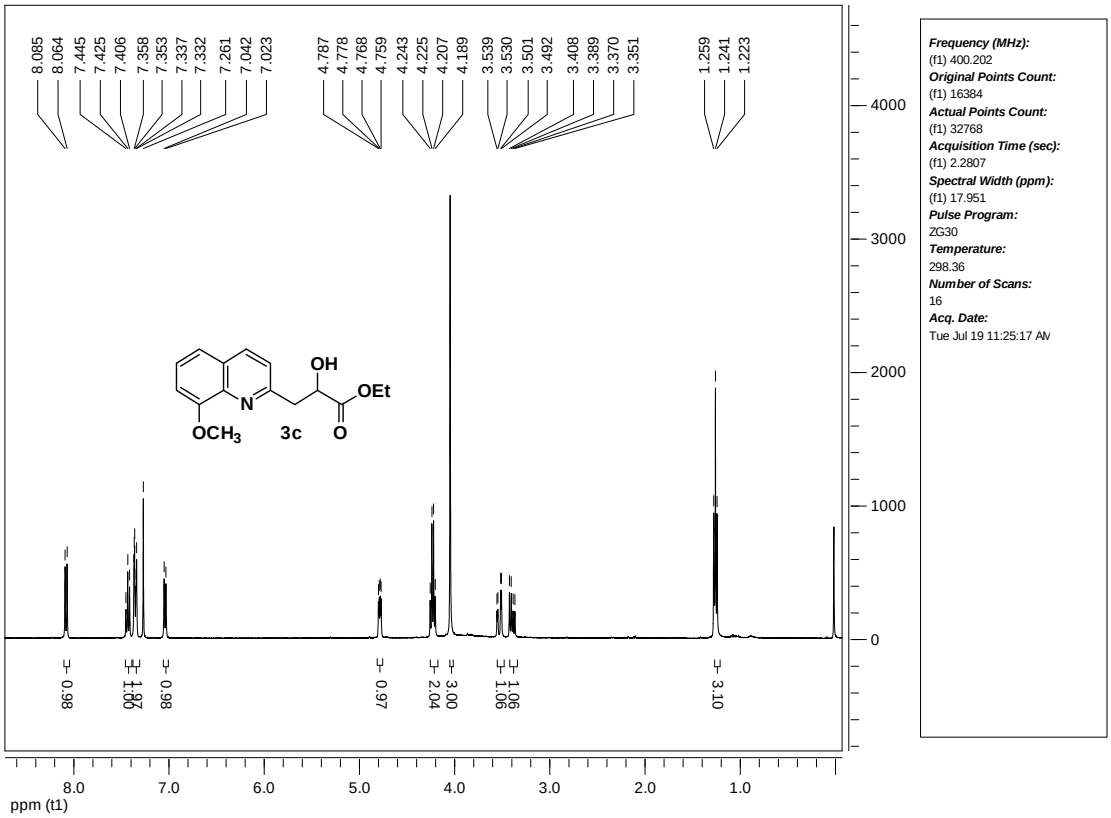
^{1}H NMR Spectrum for 3b



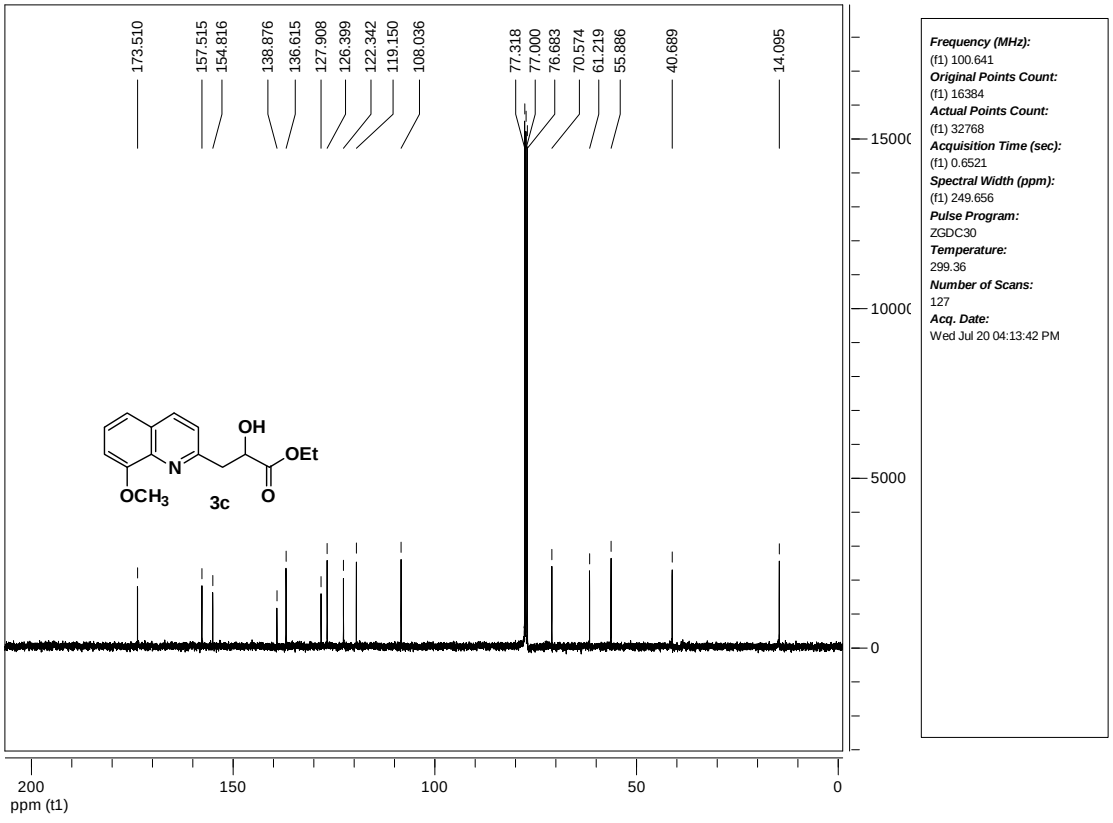
^{13}C NMR Spectrum for 3b



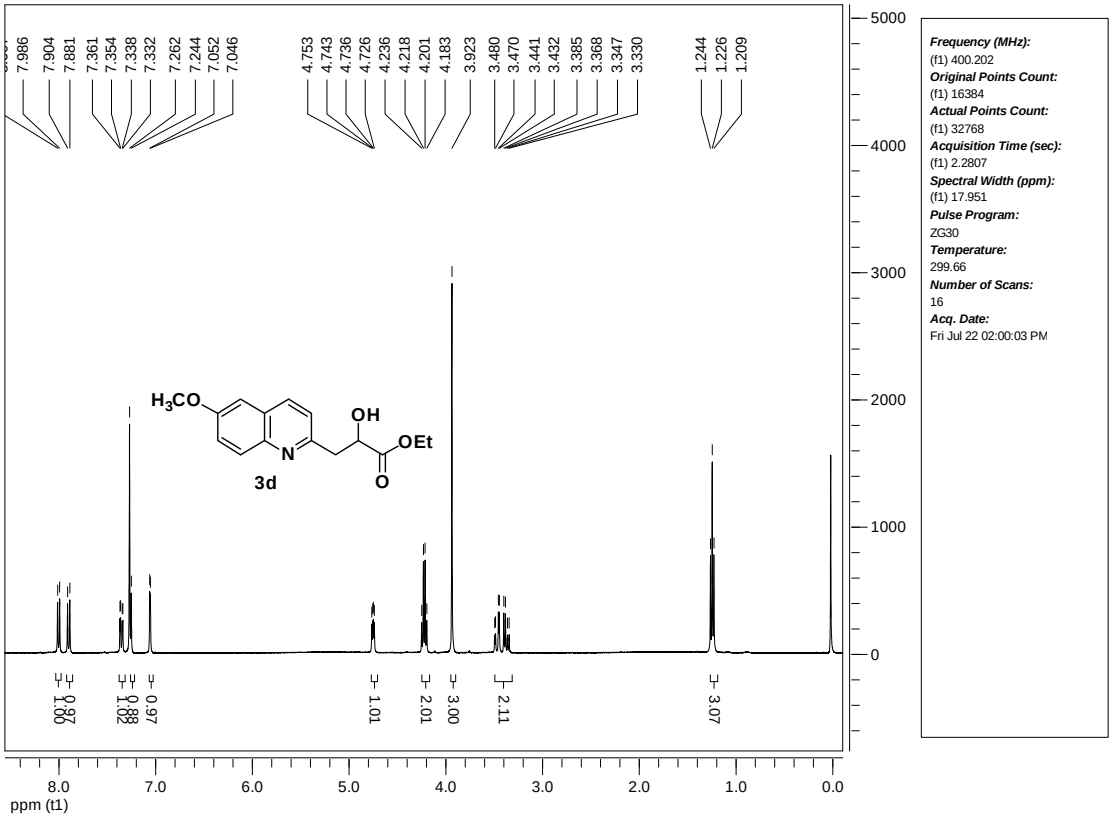
^{1}H NMR Spectrum for 3c



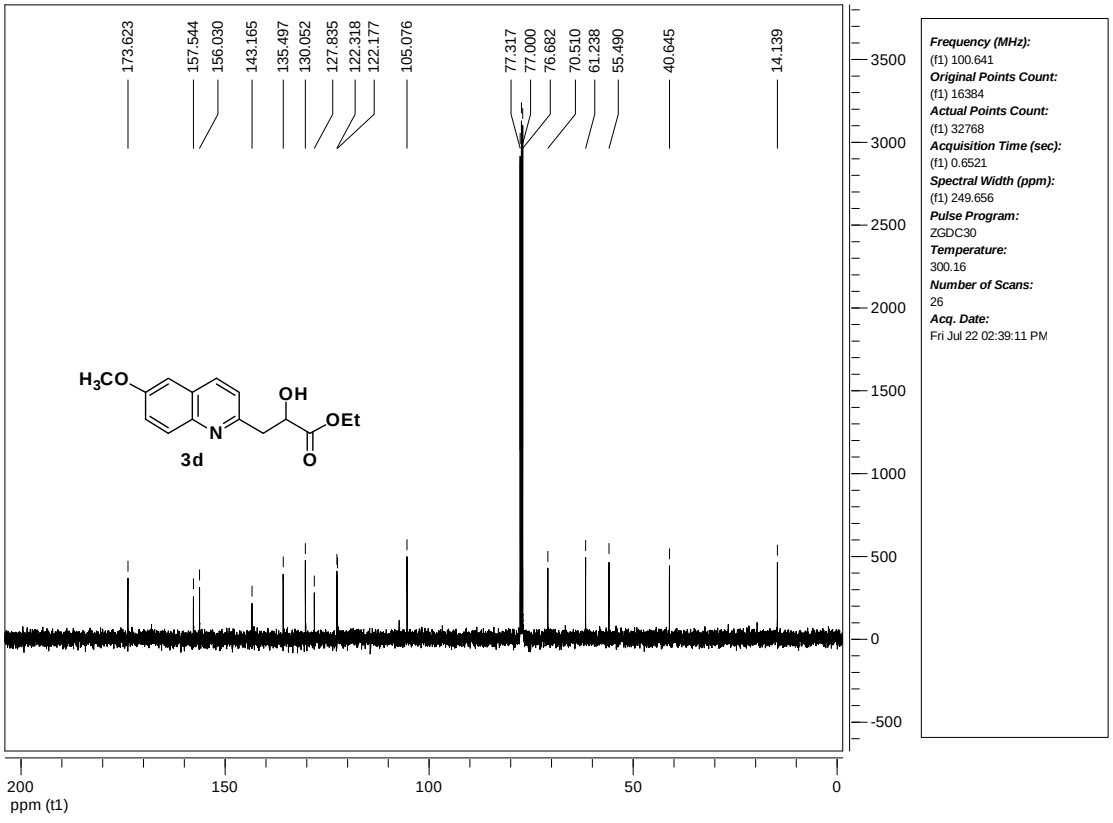
^{13}C NMR Spectrum for 3c



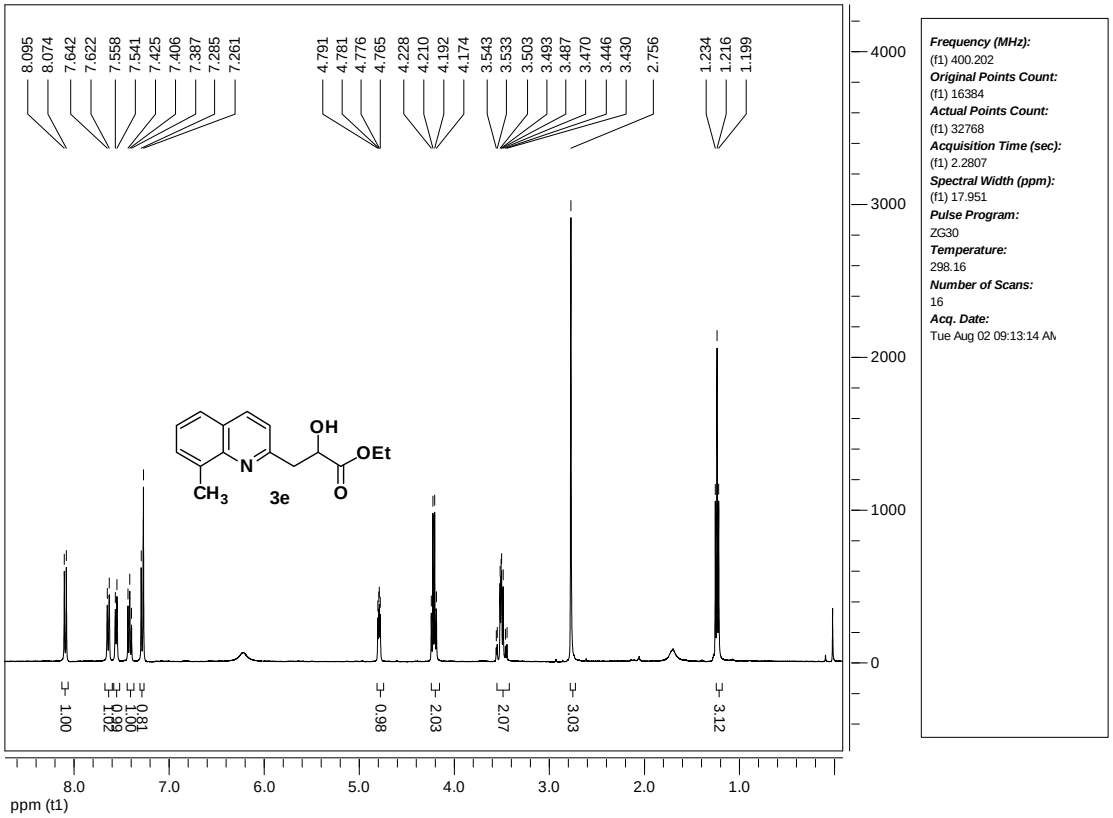
^{1}H NMR Spectrum for 3d



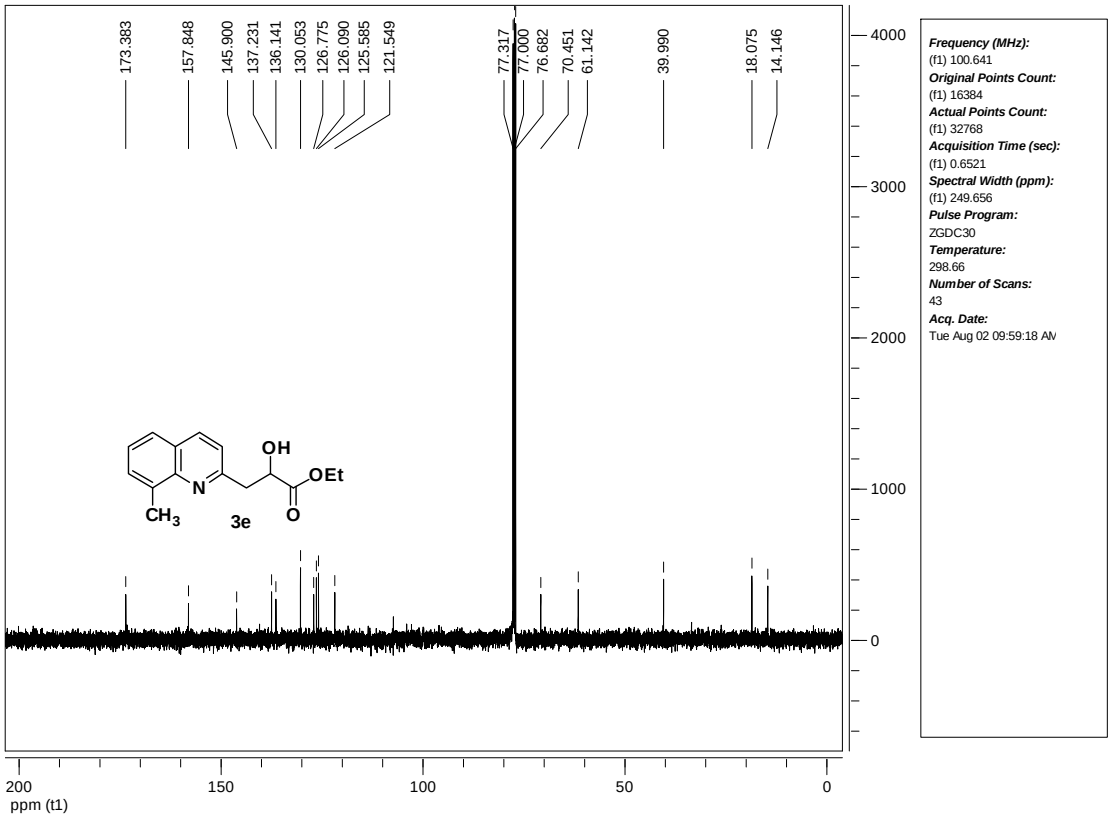
^{13}C NMR Spectrum for 3d



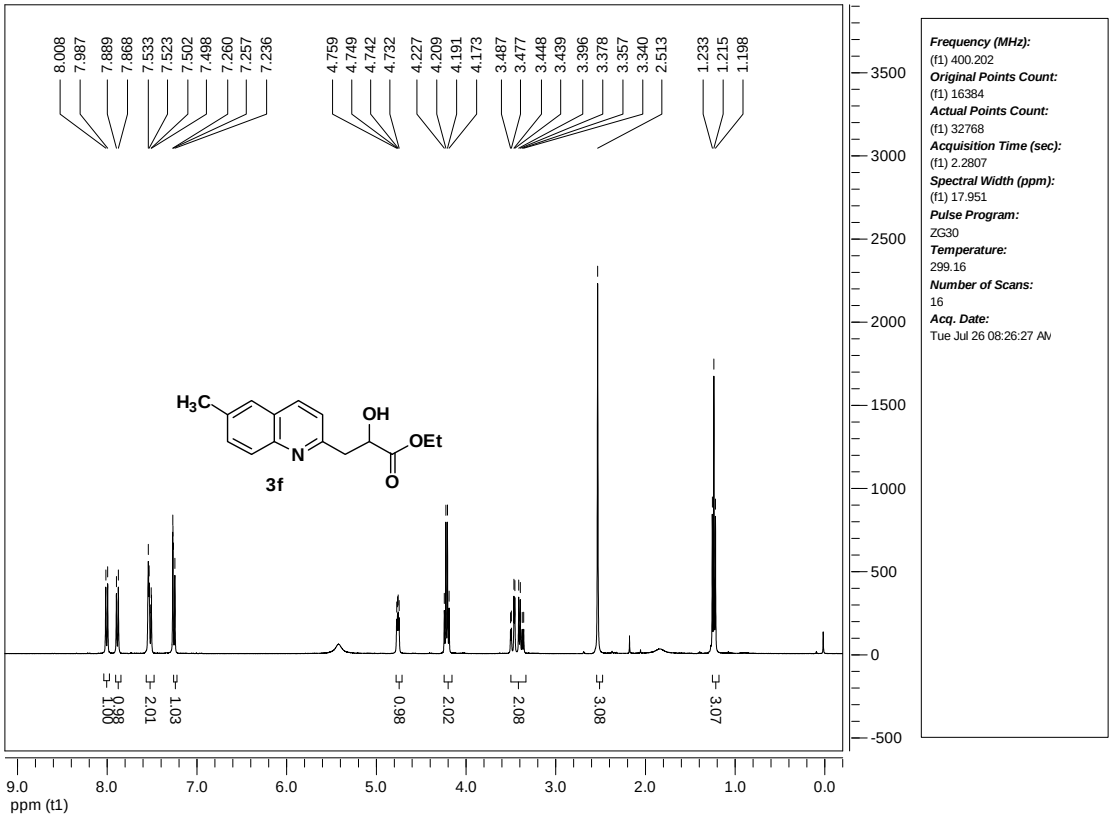
^{1}H NMR Spectrum for 3e



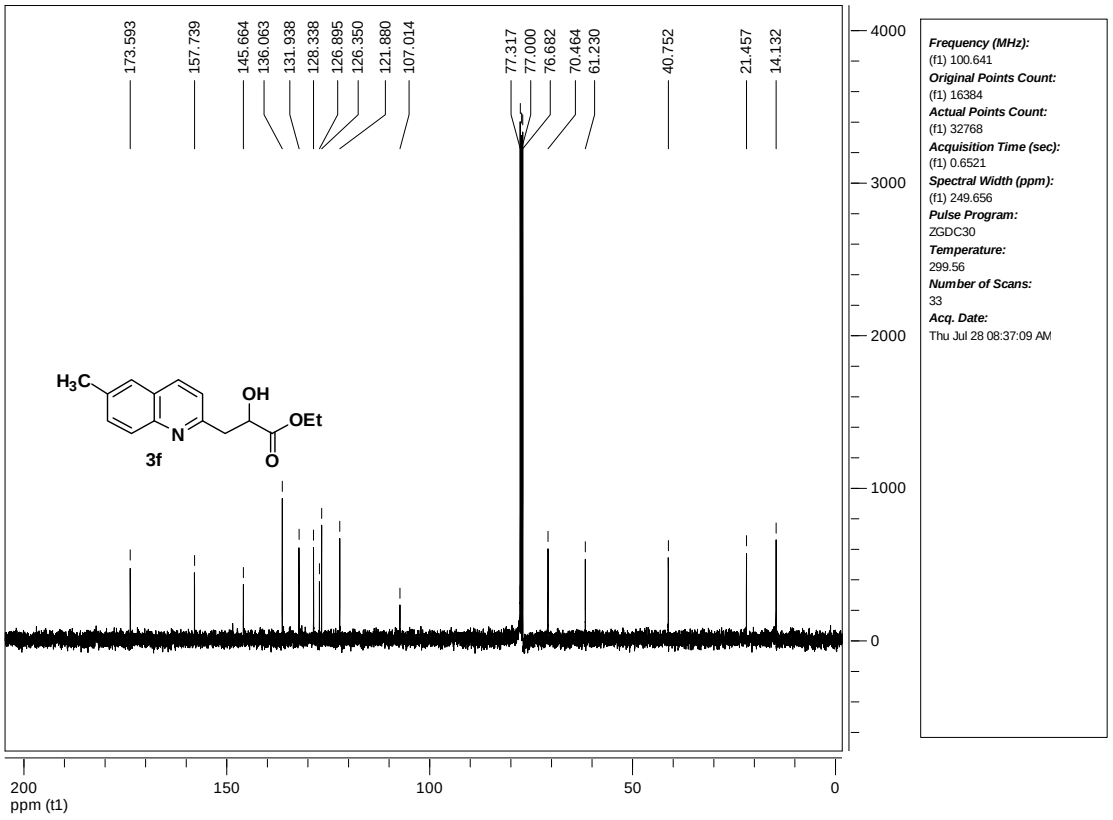
^{13}C NMR Spectrum for 3e



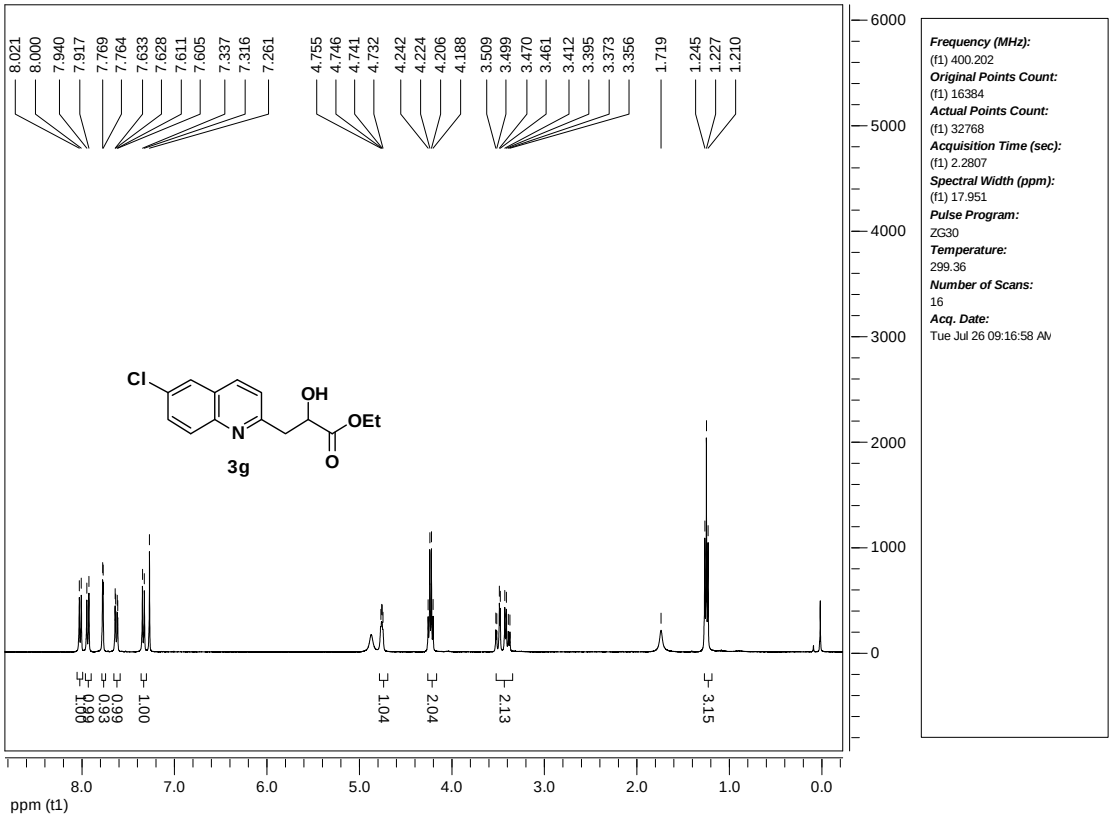
^{1}H NMR Spectrum for 3f



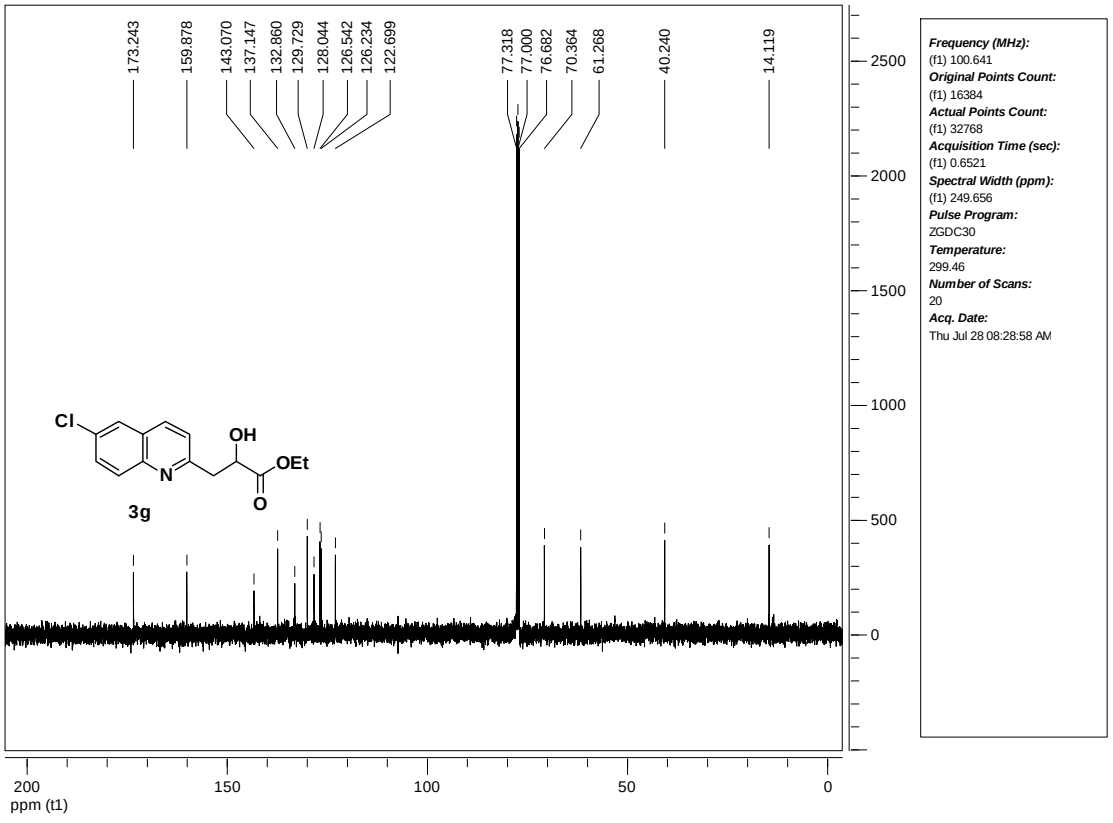
^{13}C NMR Spectrum for 3f



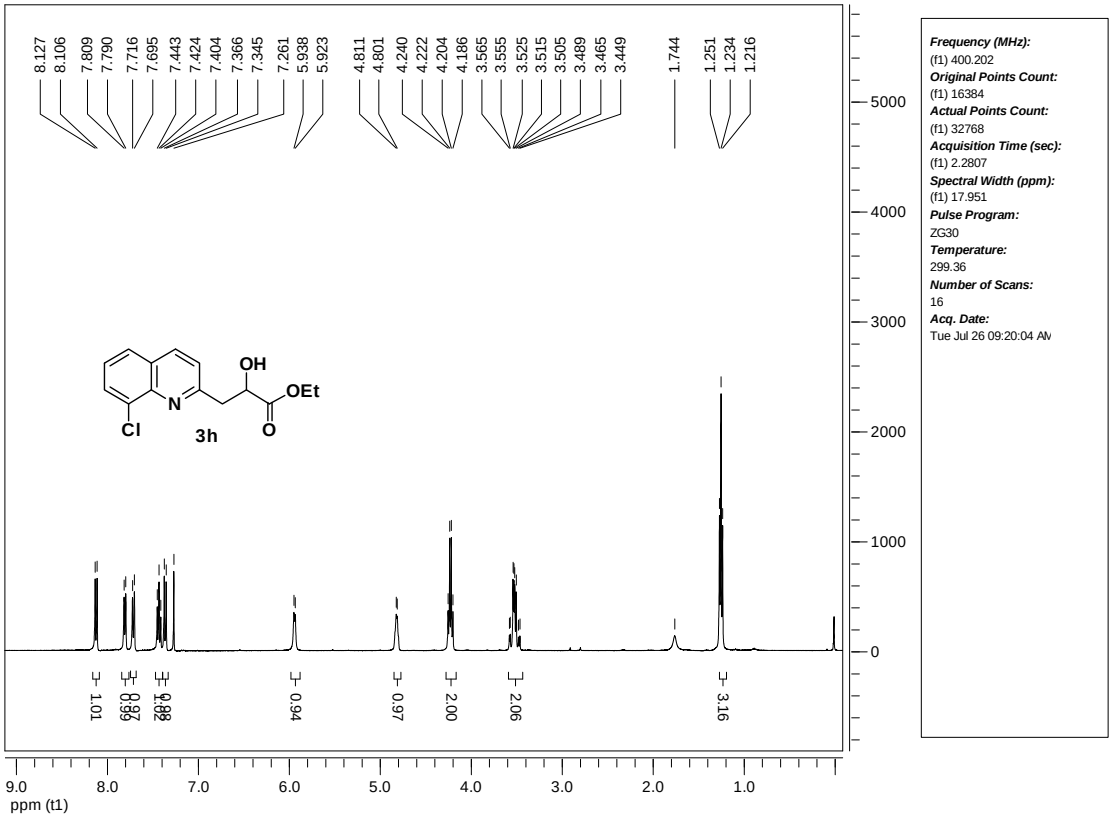
^{1}H NMR Spectrum for 3g



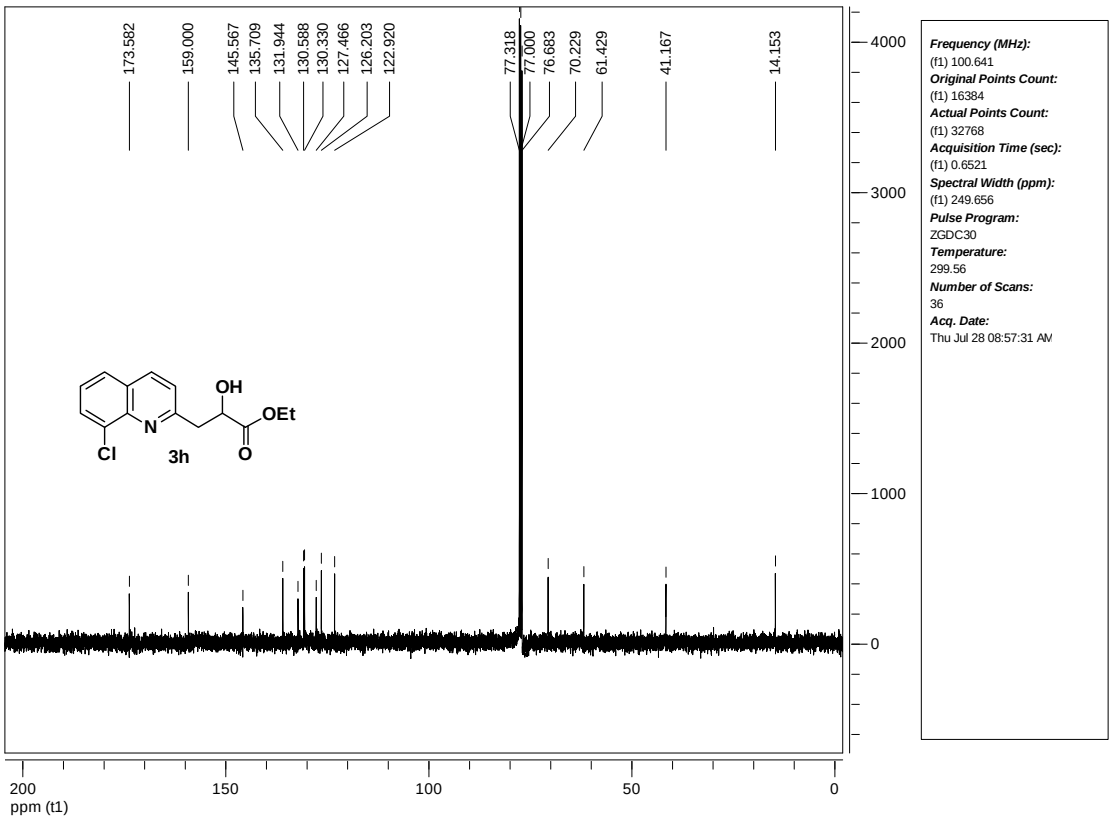
^{13}C NMR Spectrum for 3g



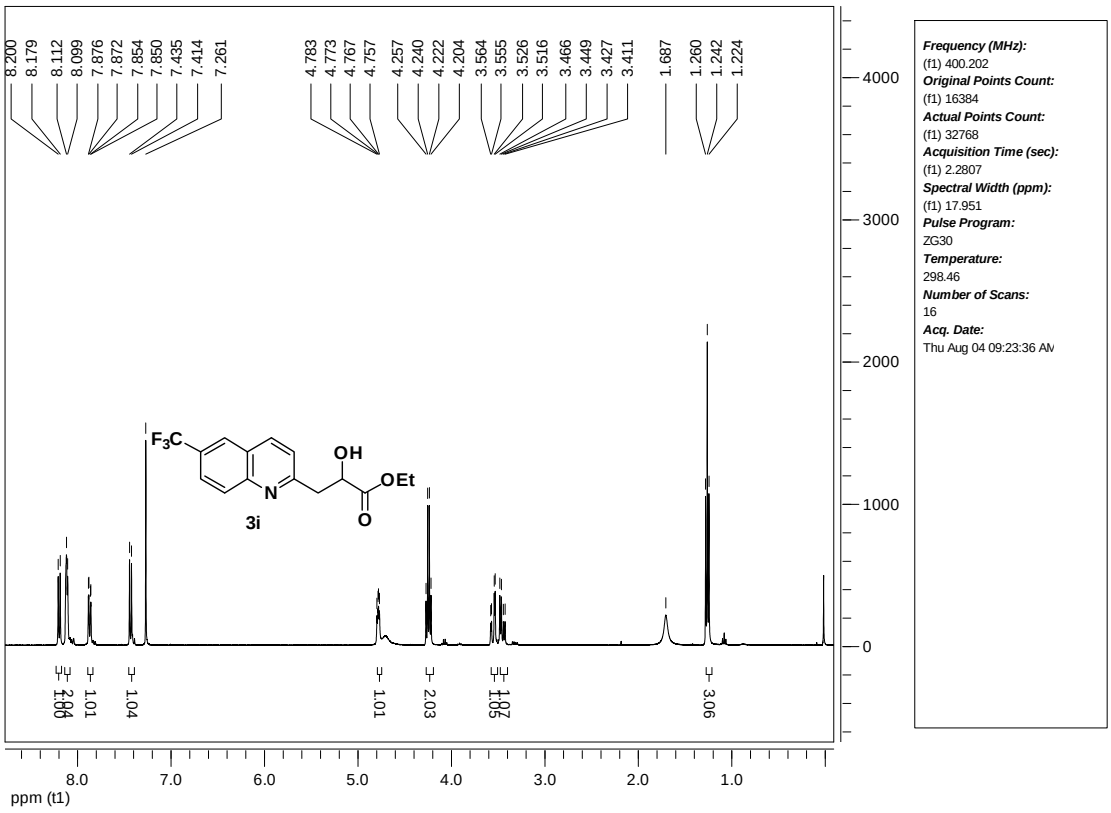
^{1}H NMR Spectrum for 3h



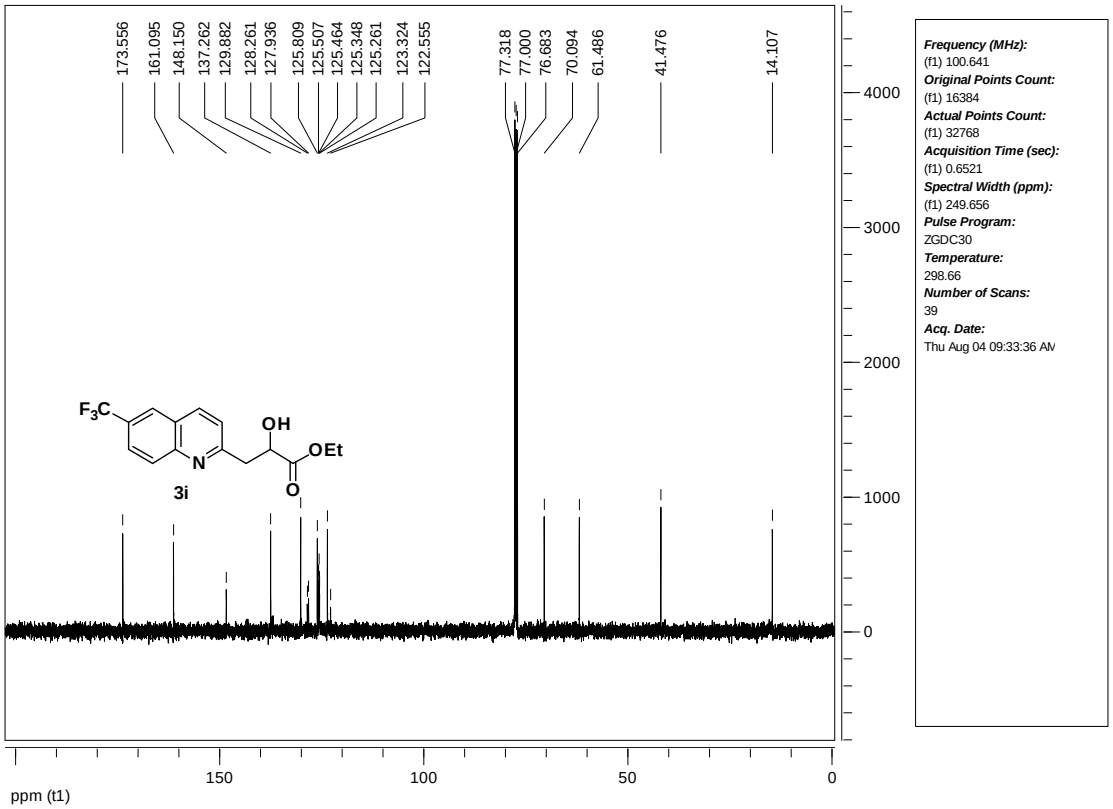
^{13}C NMR Spectrum for 3h



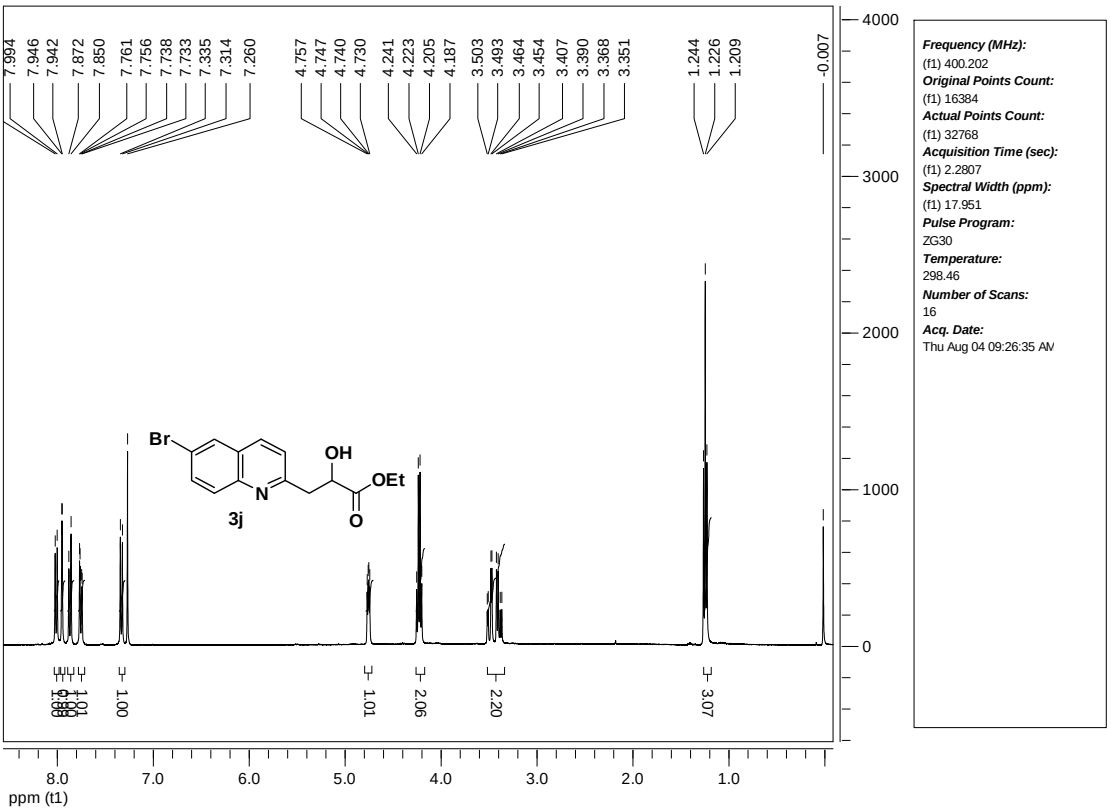
^{1}H NMR Spectrum for 3i



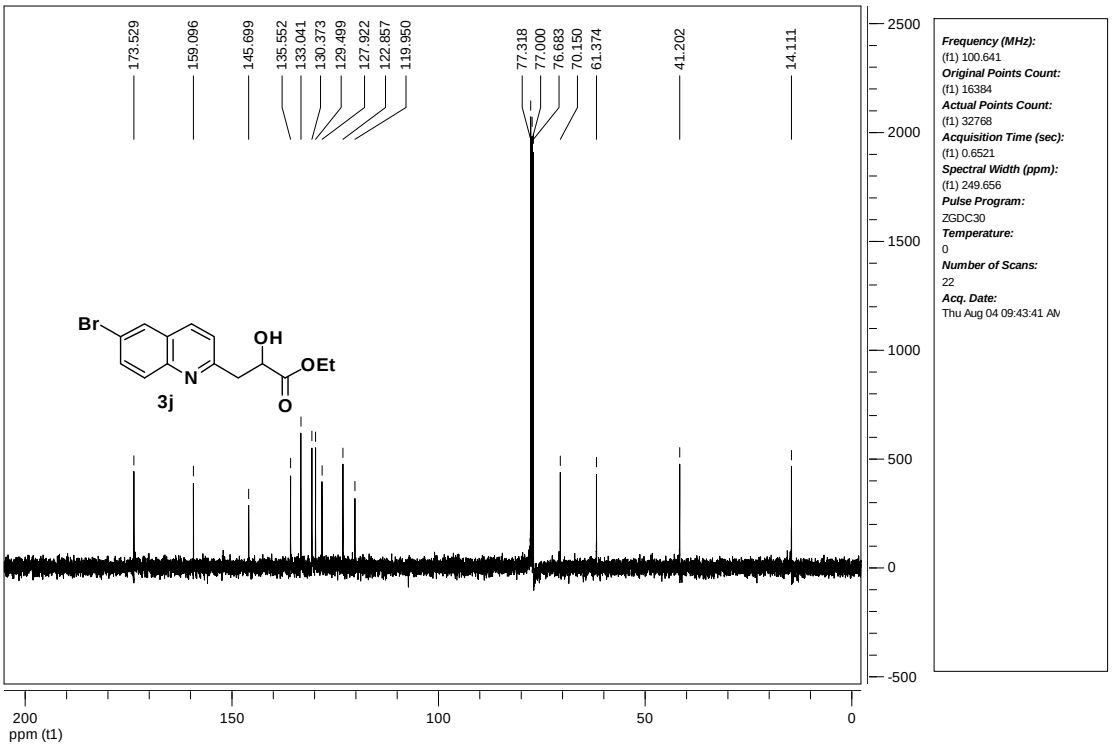
^{13}C NMR Spectrum for 3i



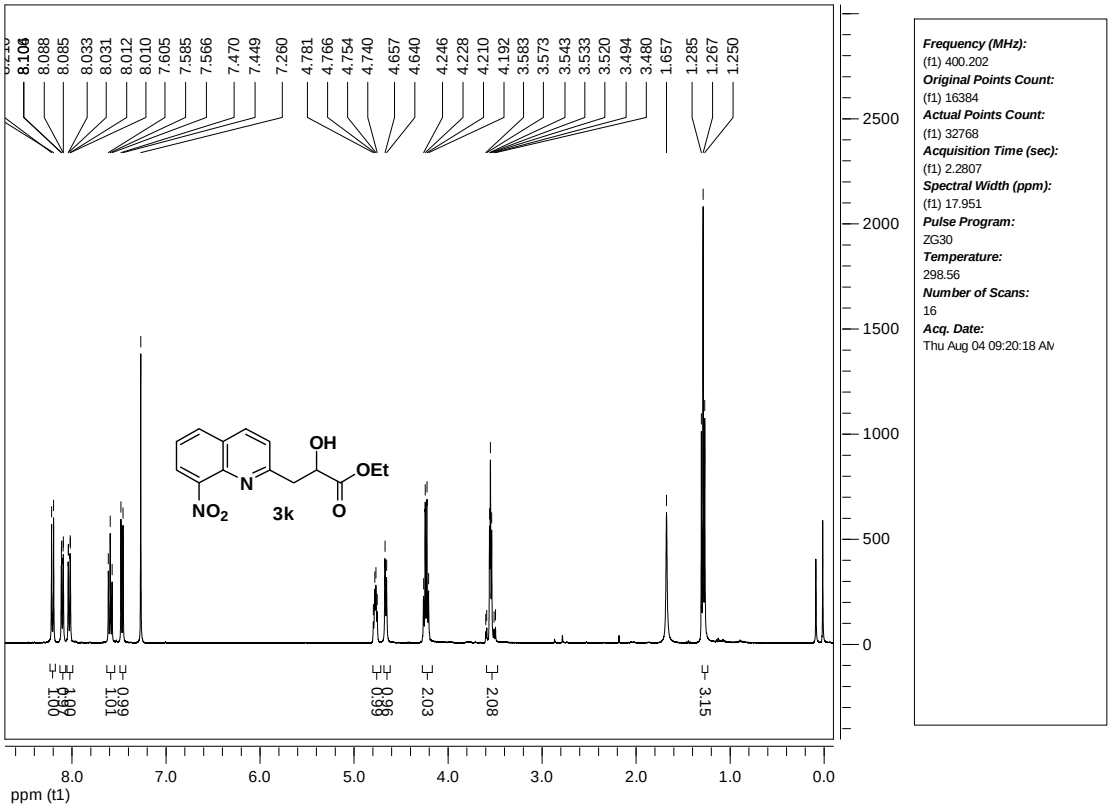
^{1}H NMR Spectrum for 3j



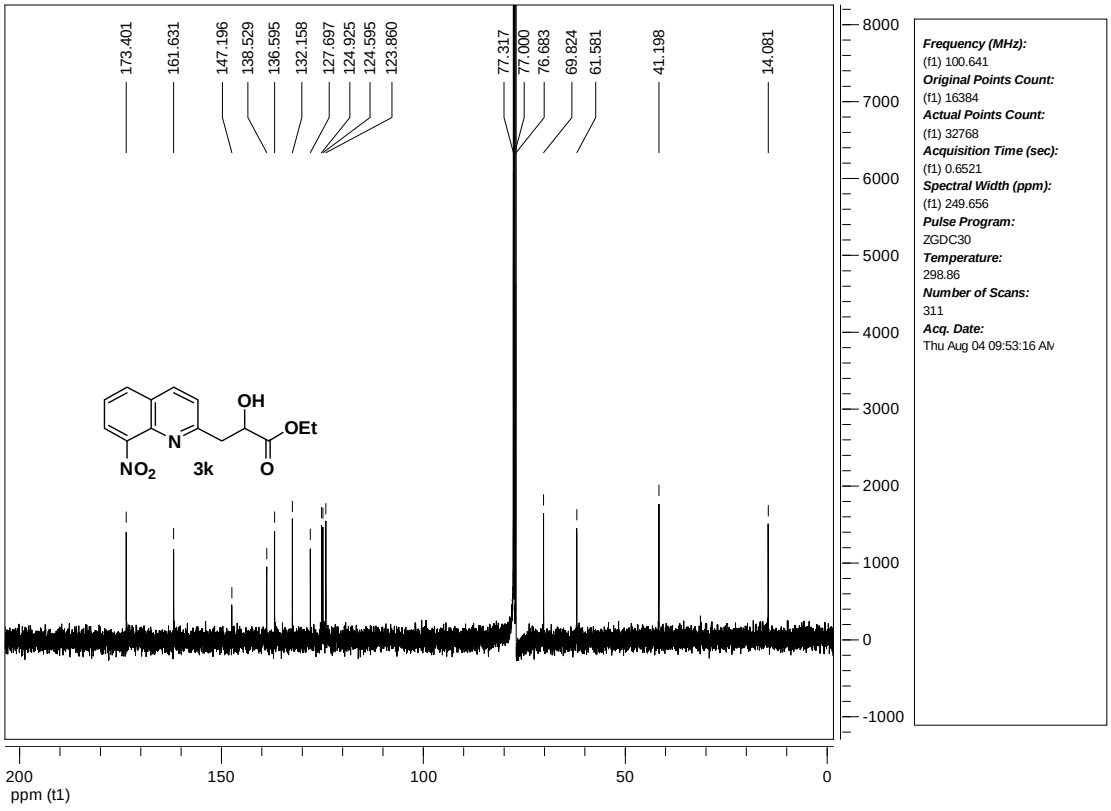
^{13}C NMR Spectrum for 3j



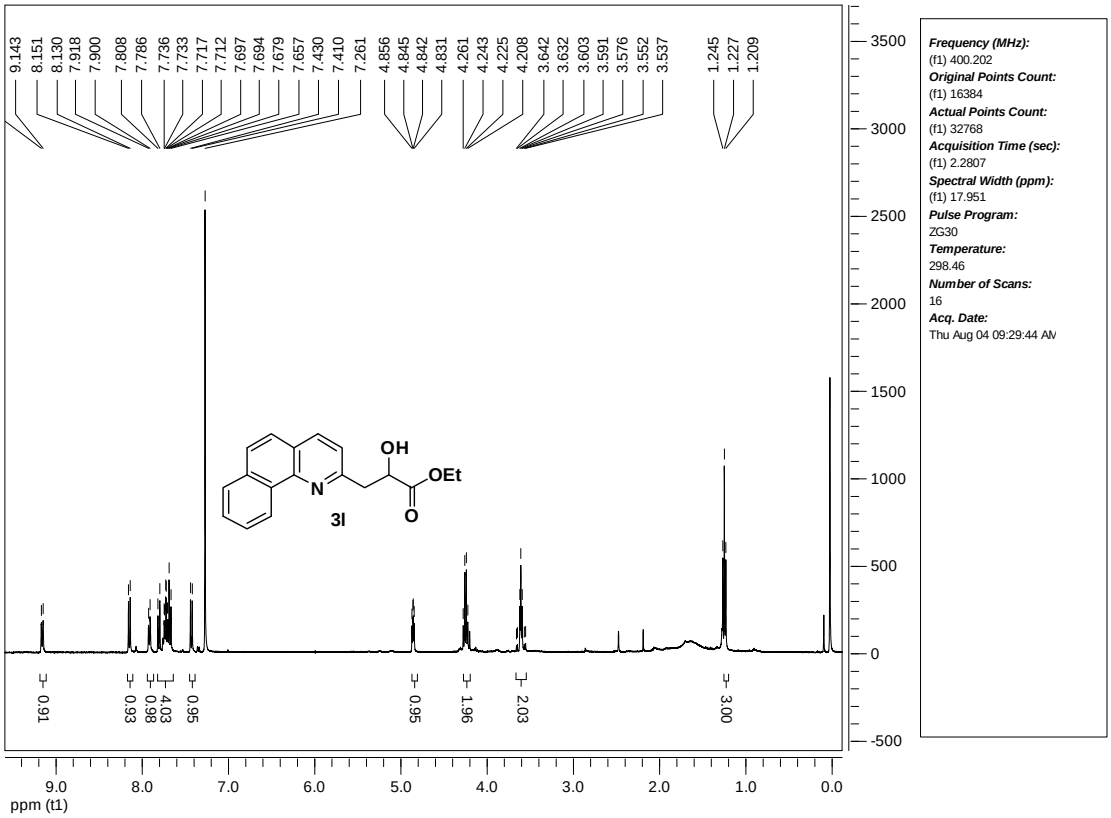
^{1}H NMR Spectrum for 3k



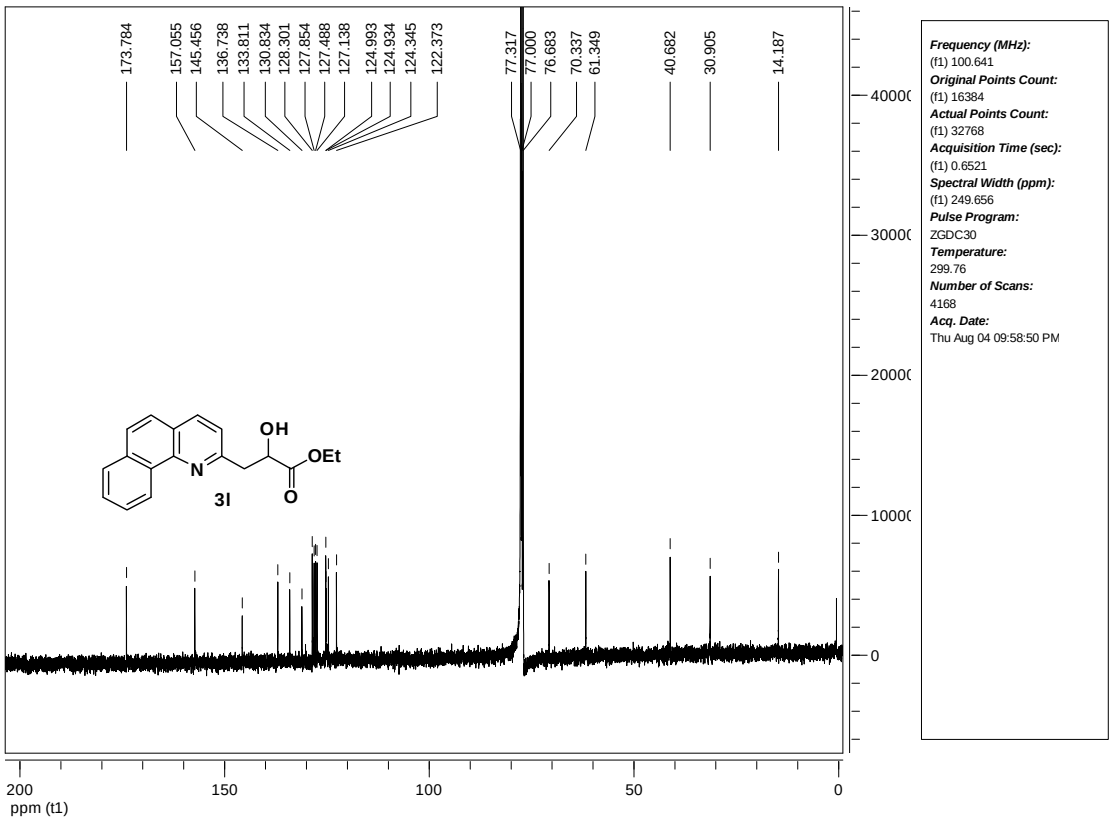
^{13}C NMR Spectrum for 3k



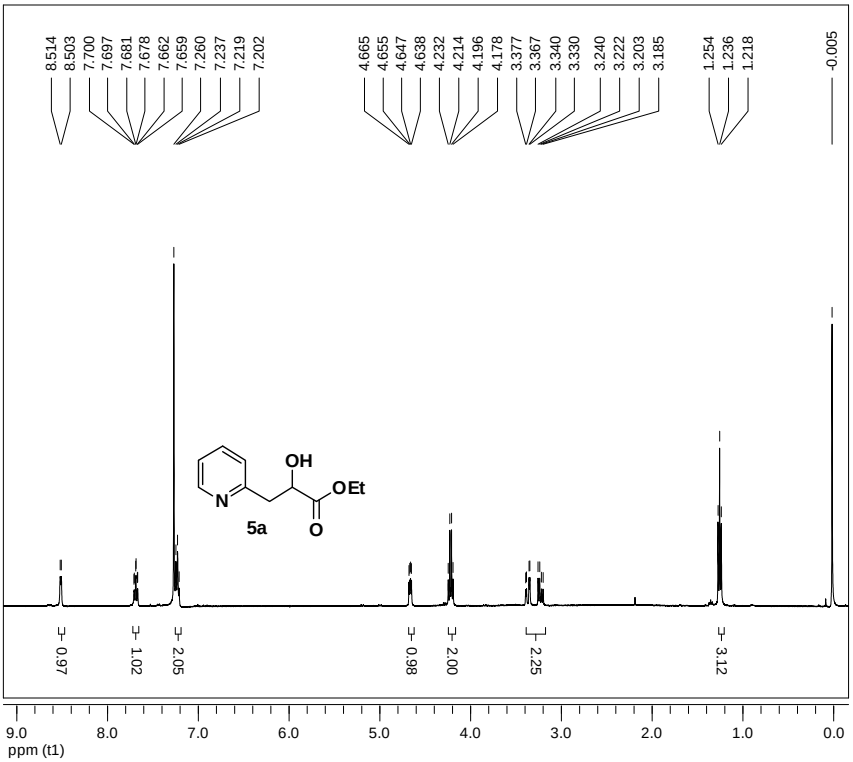
^{1}H NMR Spectrum for 3l



^{13}C NMR Spectrum for 3l



^{1}H NMR Spectrum for 5a



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28 Sep 2011
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Spectrum Title:
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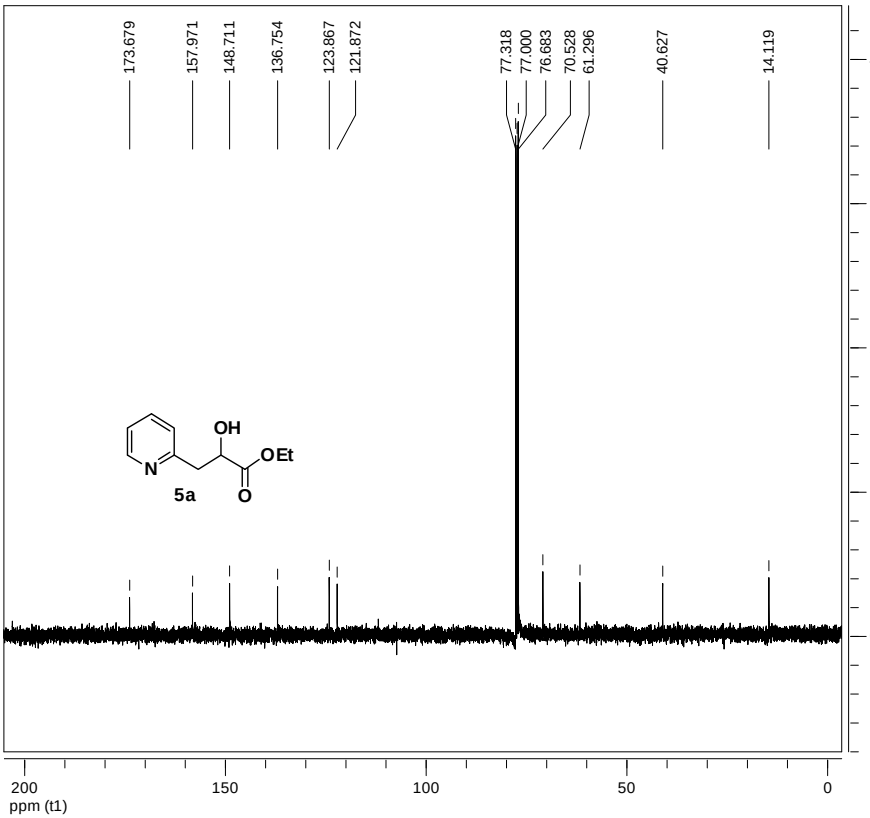
^{13}C NMR Spectrum for 5a



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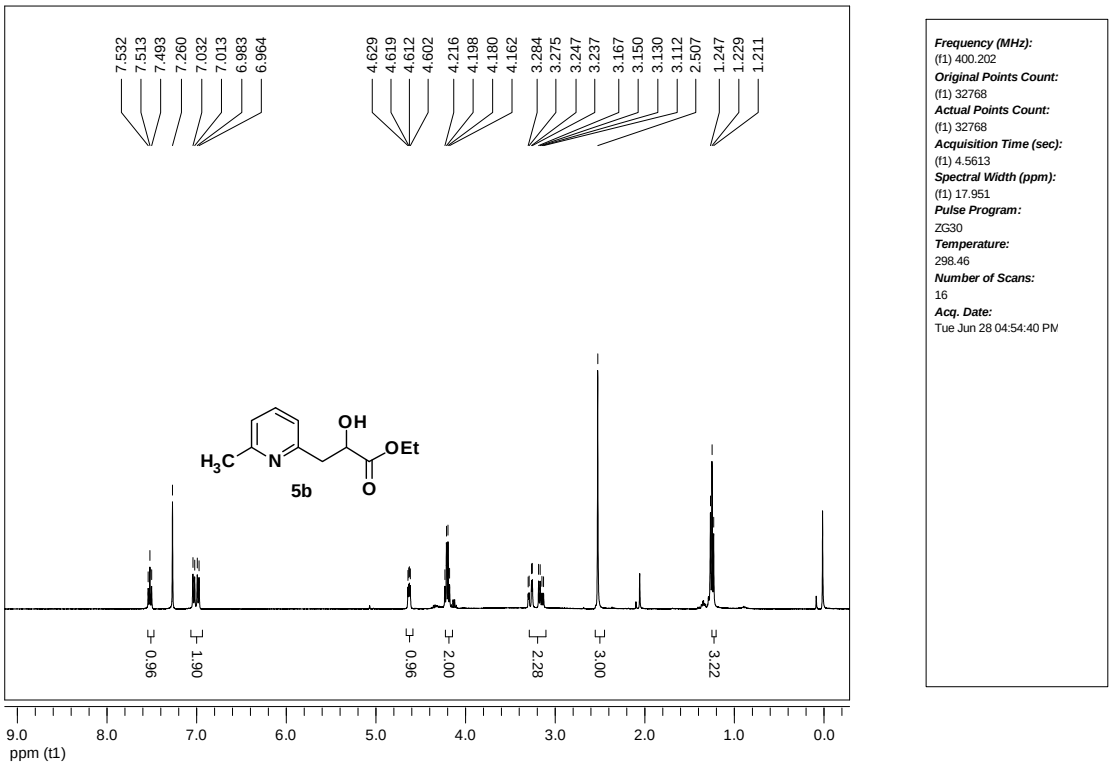
^{1}H NMR Spectrum for 5b



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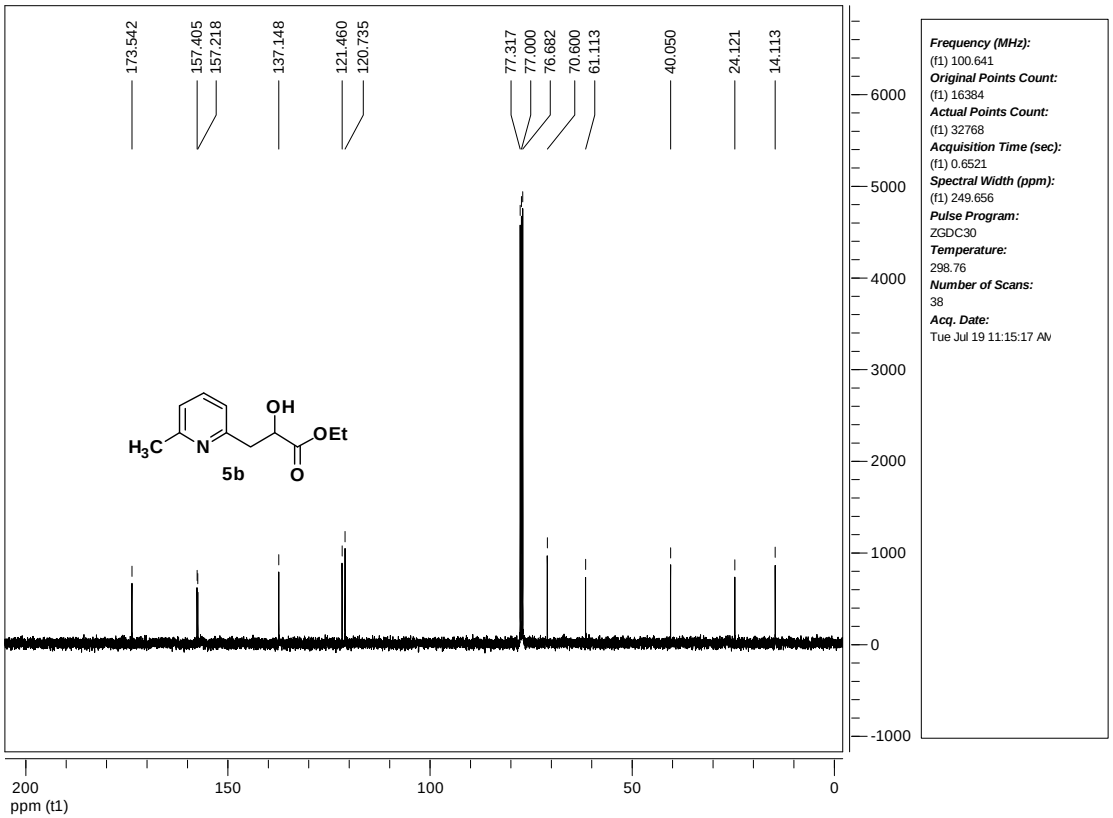
^{13}C NMR Spectrum for 5b



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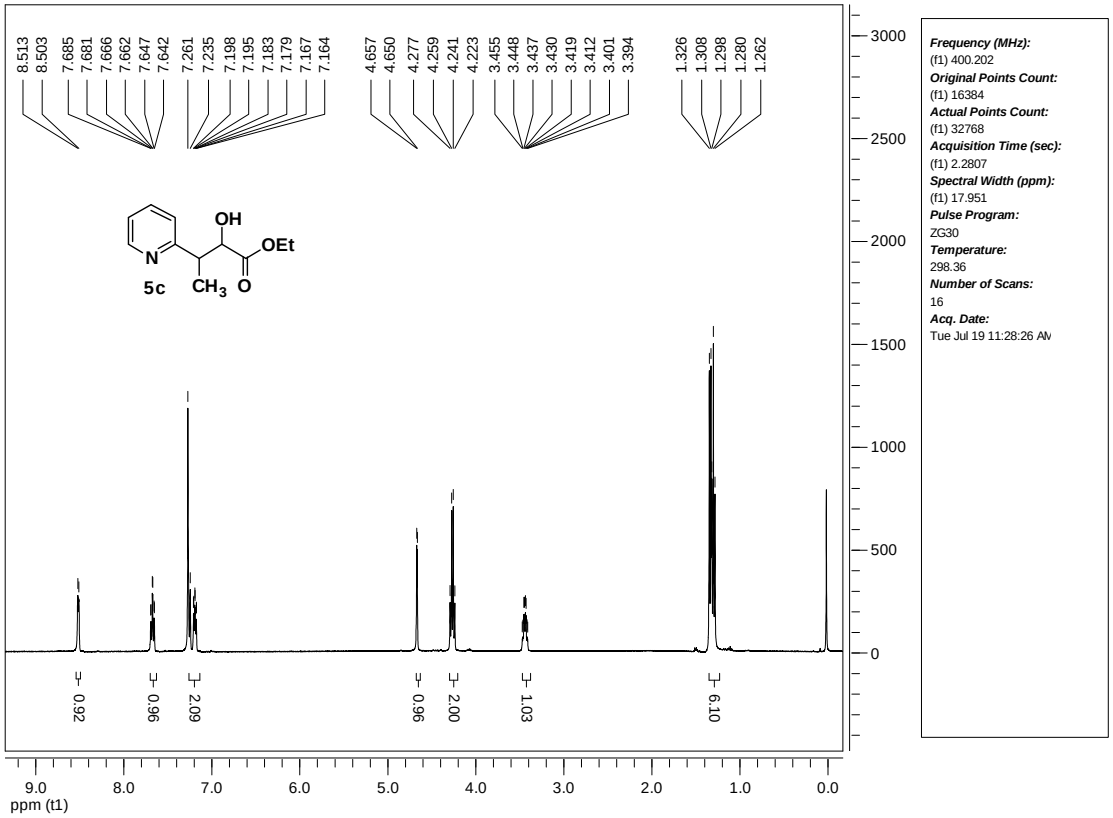
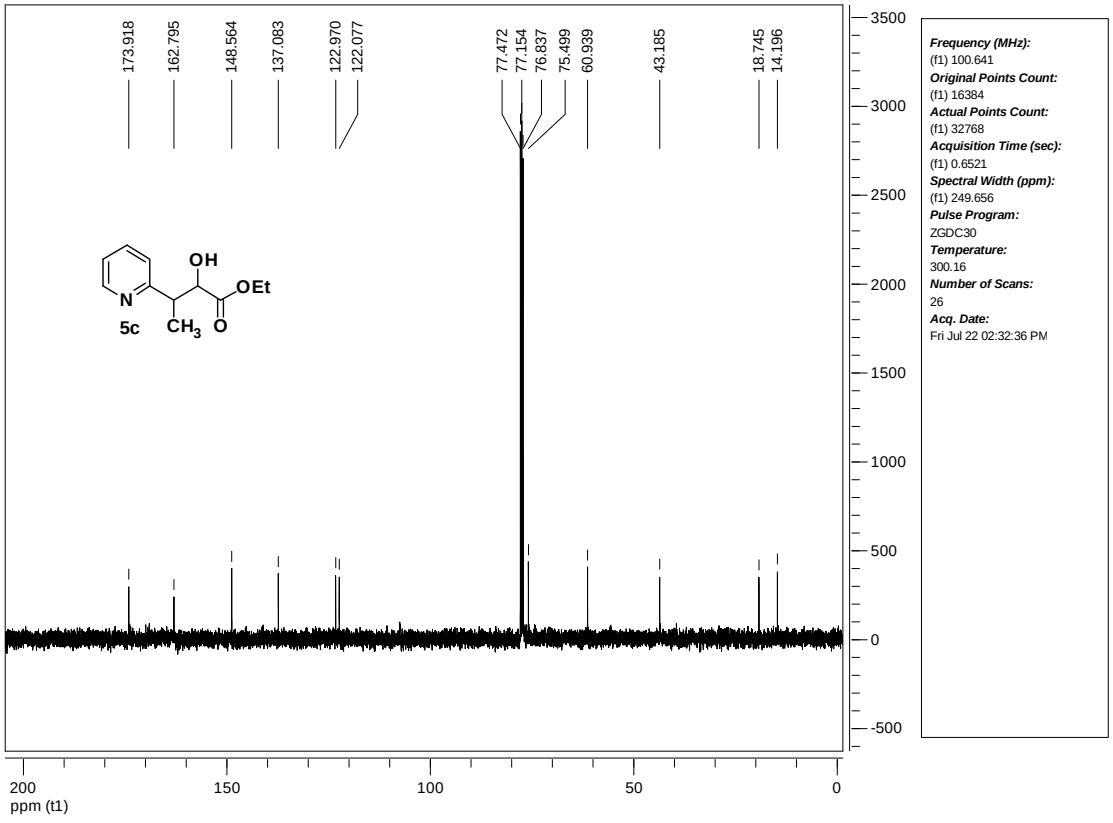
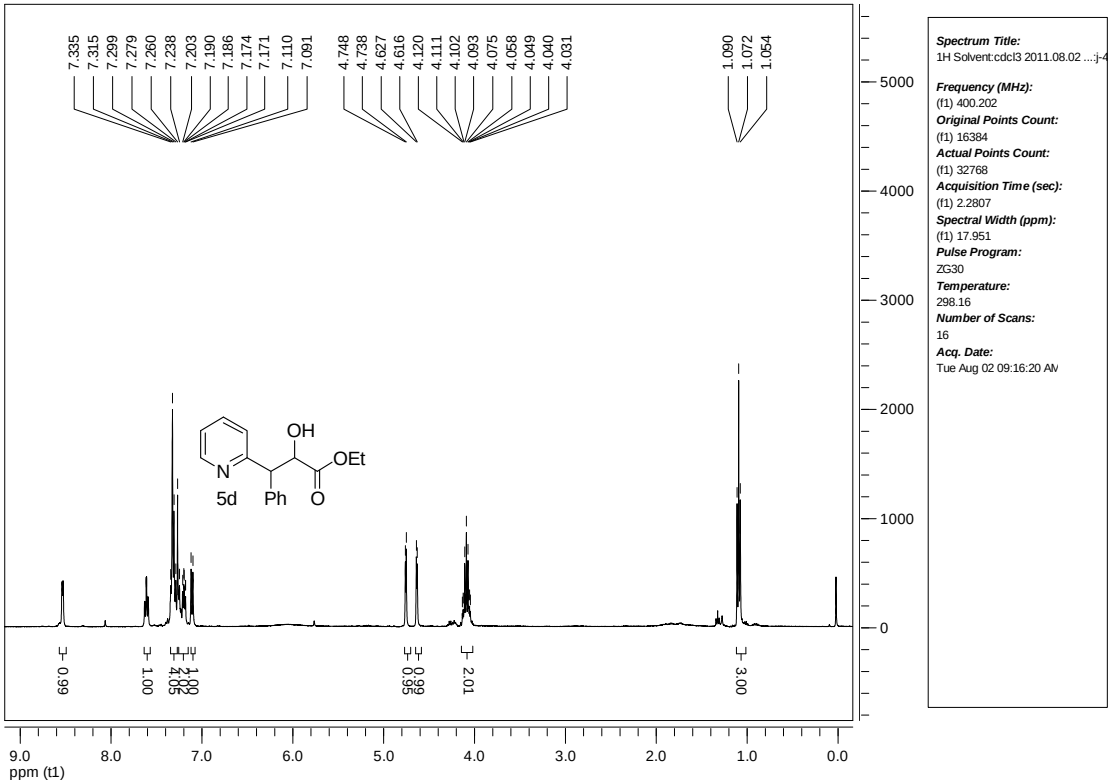
^{1}H NMR Spectrum for 5c



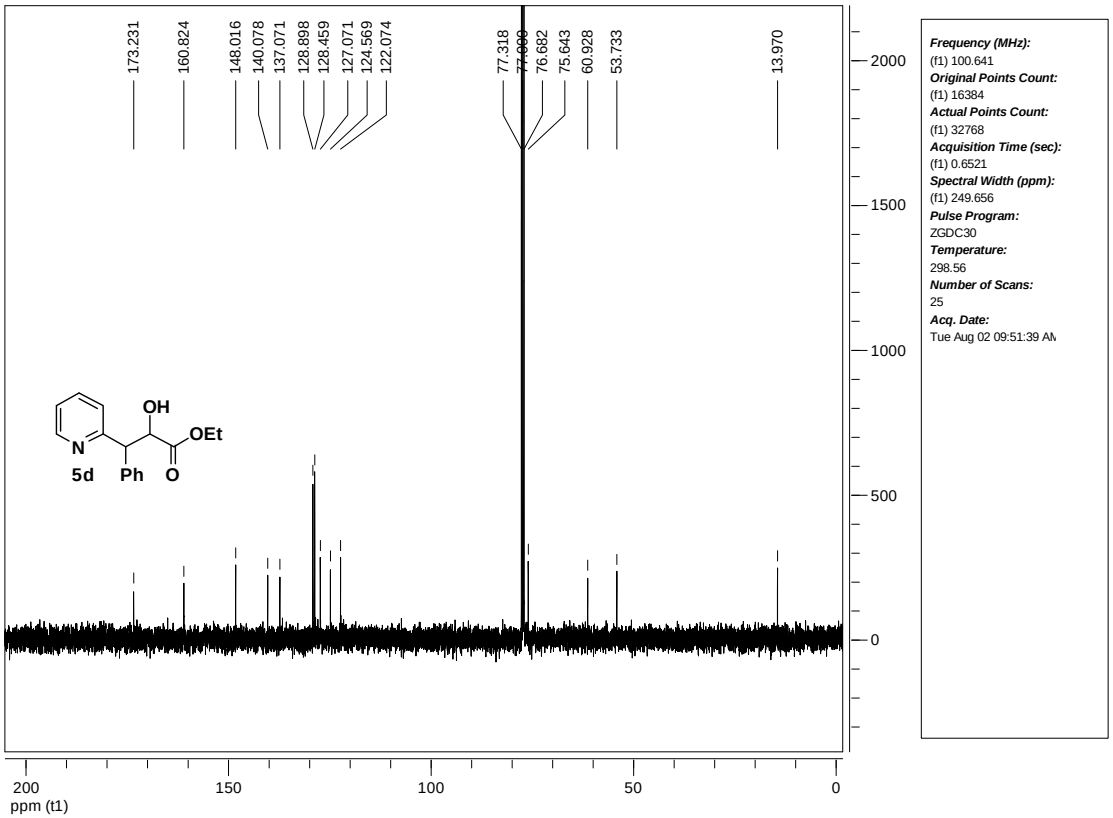
^{13}C NMR Spectrum for 5c



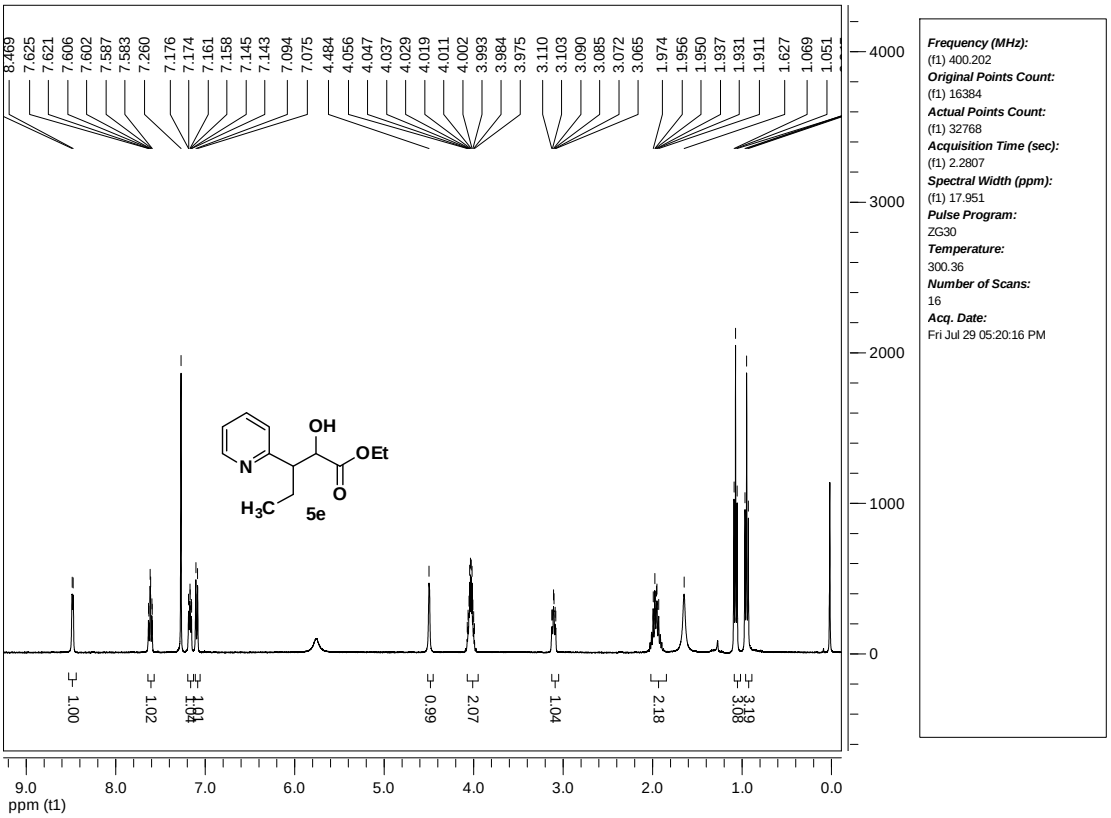
^{1}H NMR Spectrum for 5d



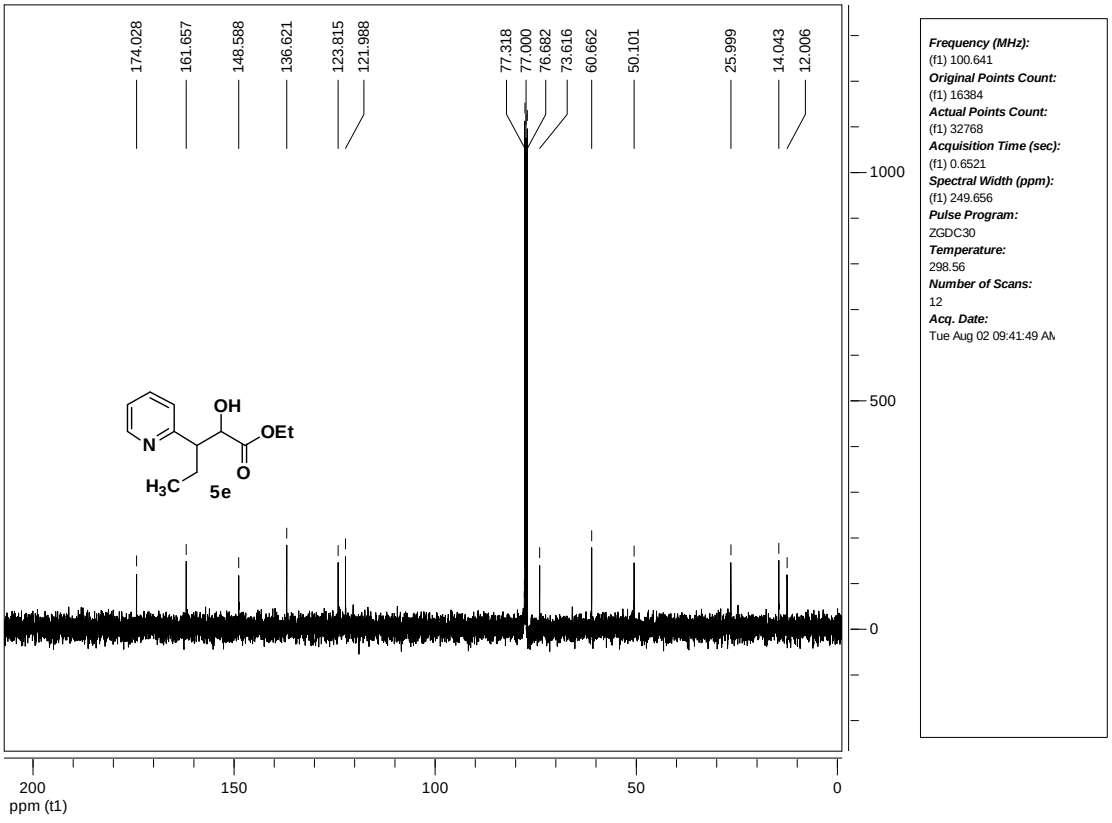
^{13}C NMR Spectrum for 5d



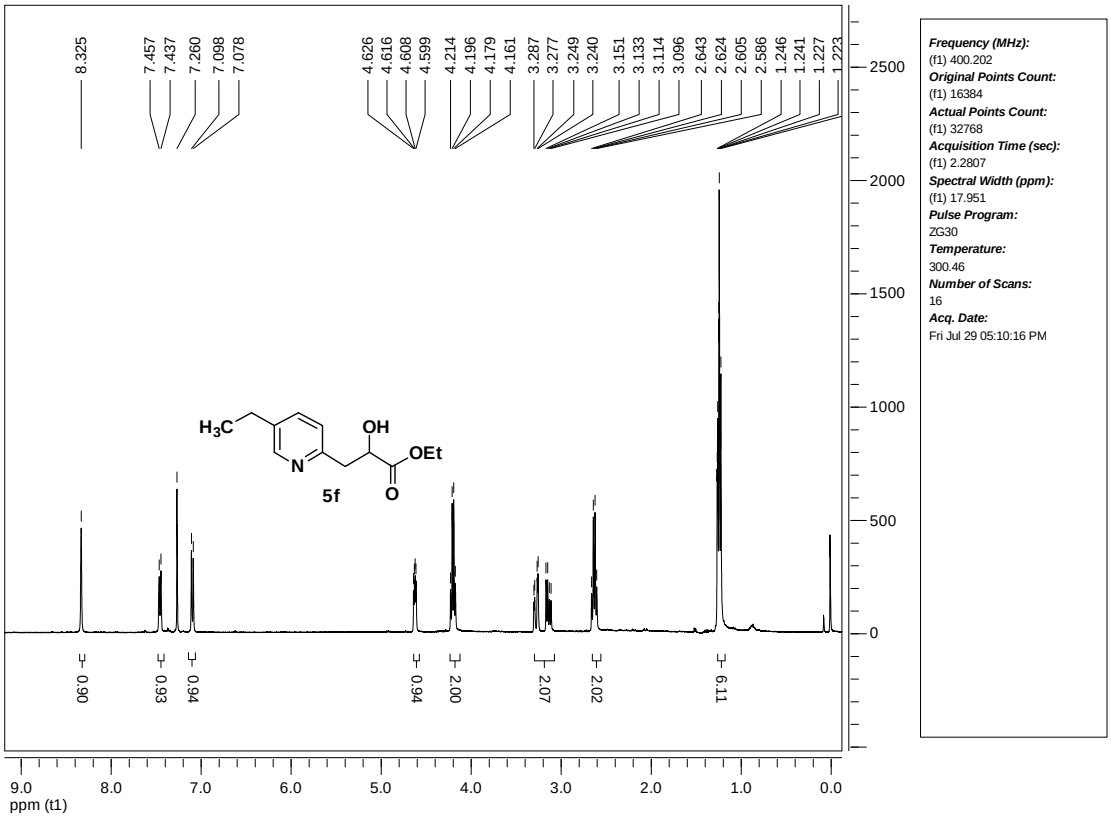
^{1}H NMR Spectrum for 5e



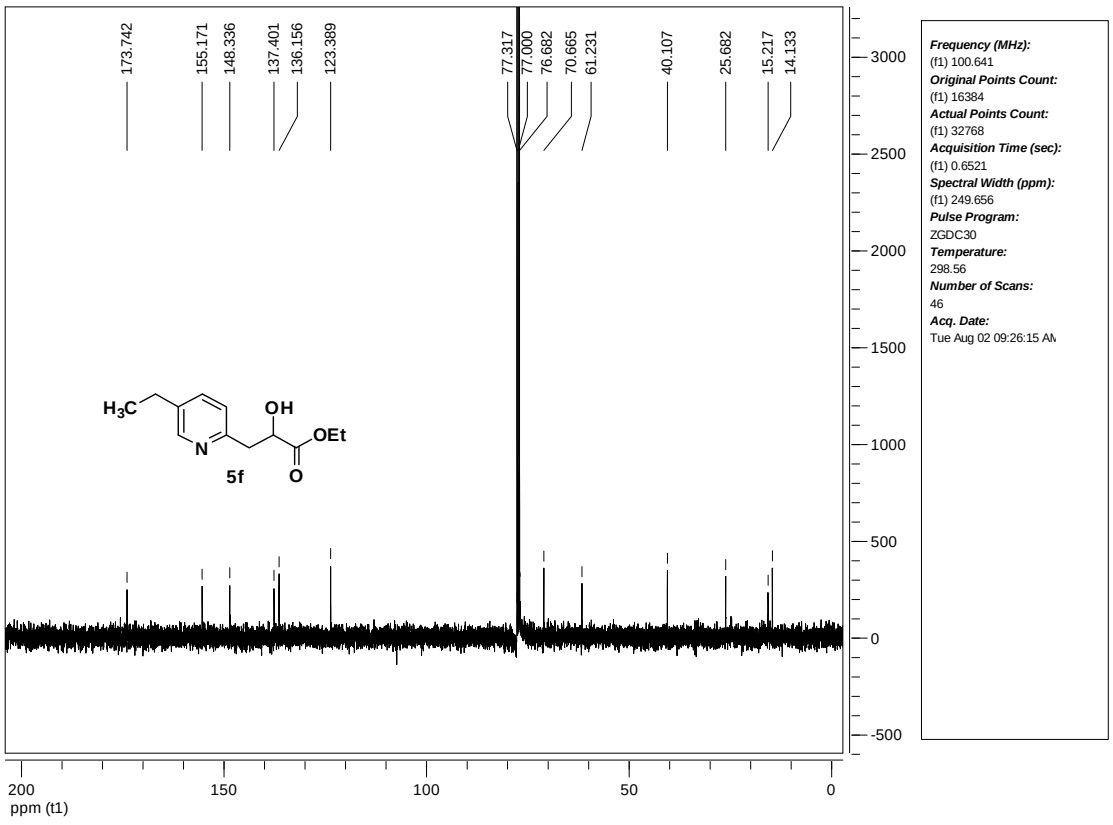
^{13}C NMR Spectrum for 5e



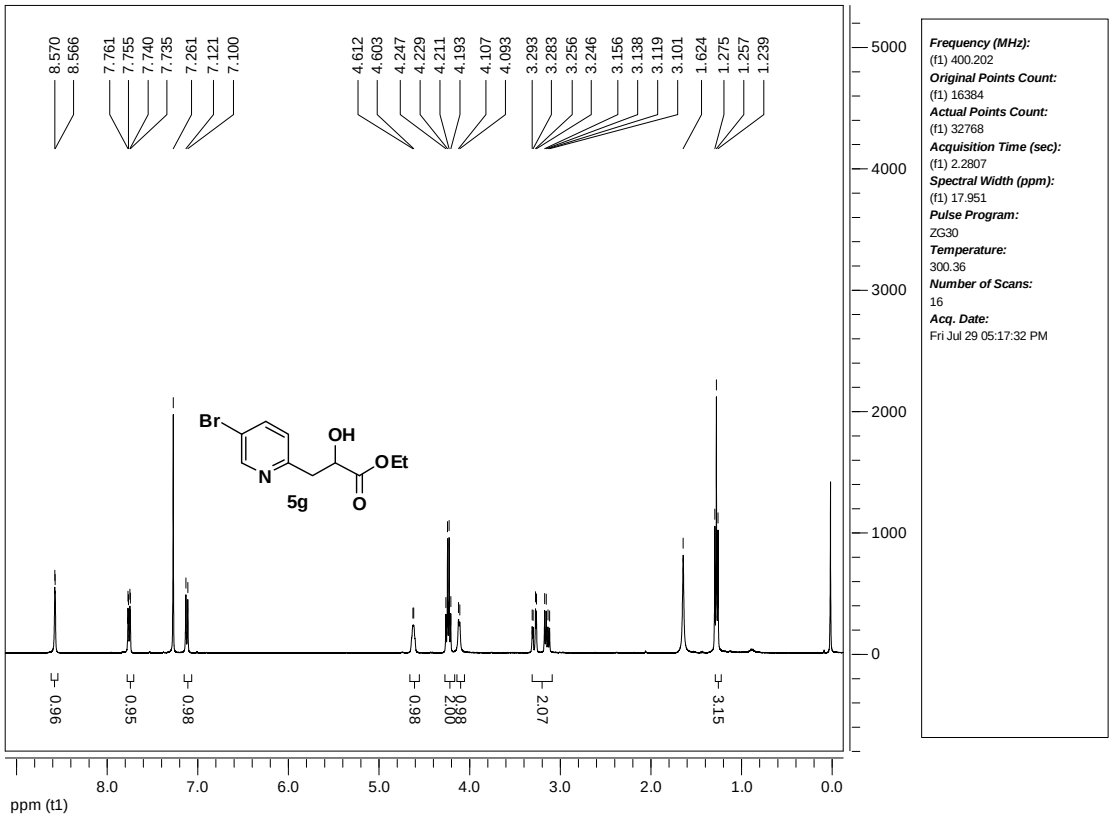
^{1}H NMR Spectrum for 5f



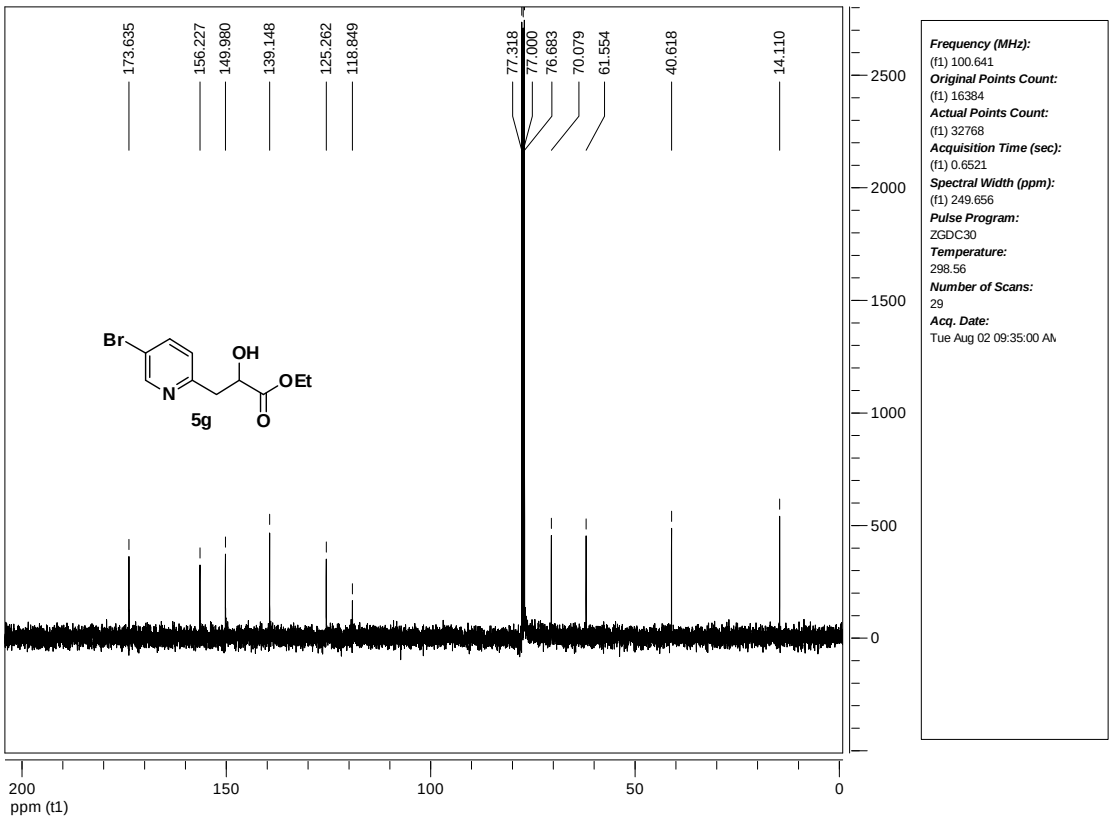
^{13}C NMR Spectrum for 5f



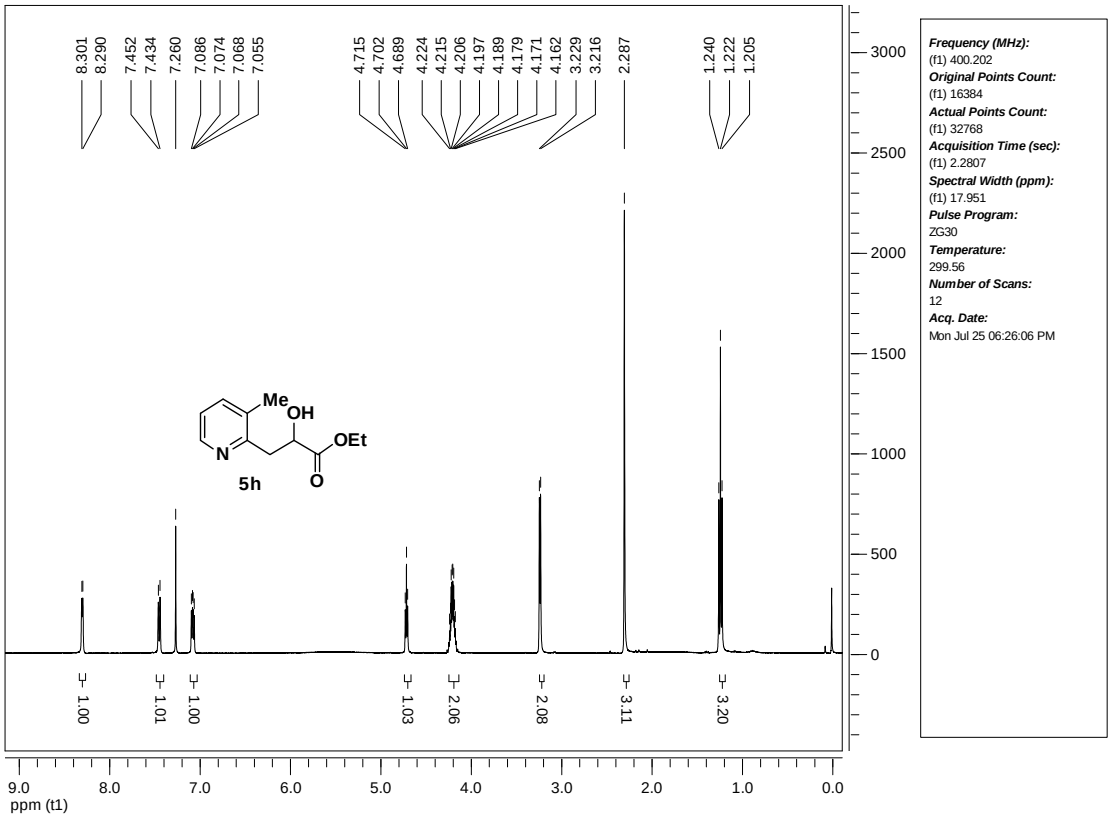
^{1}H NMR Spectrum for 5g



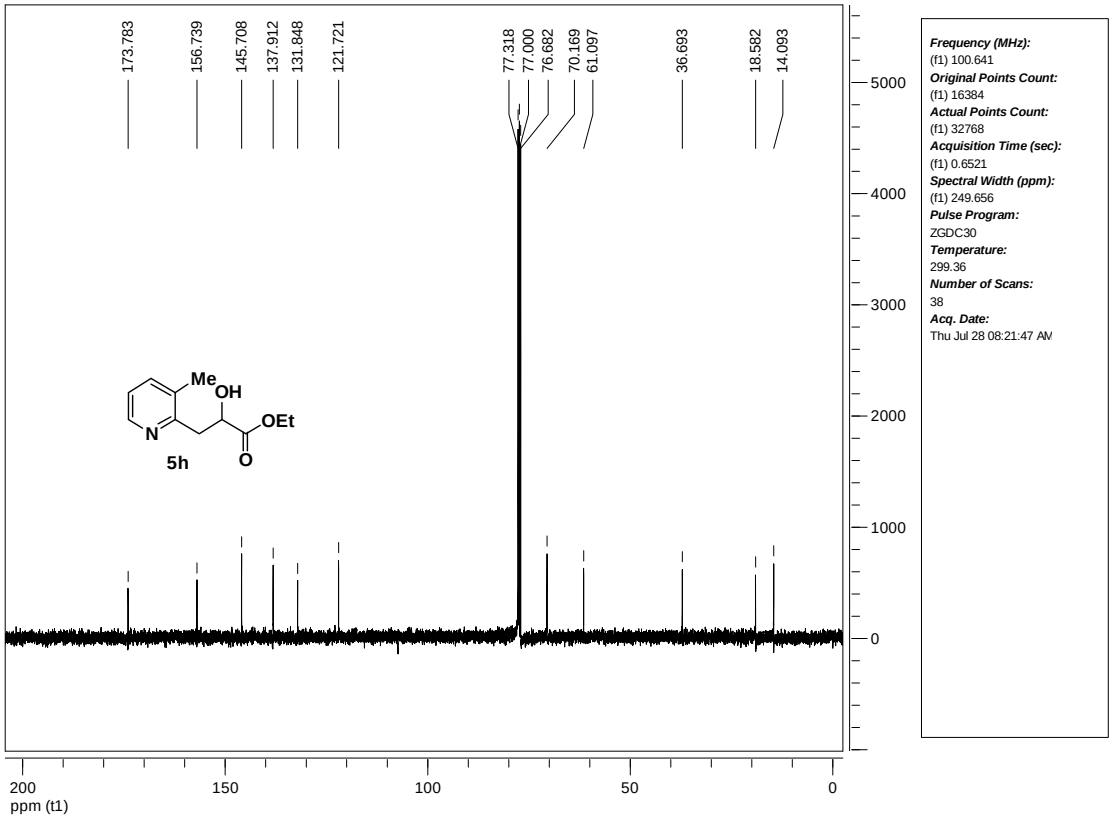
^{13}C NMR Spectrum for 5g



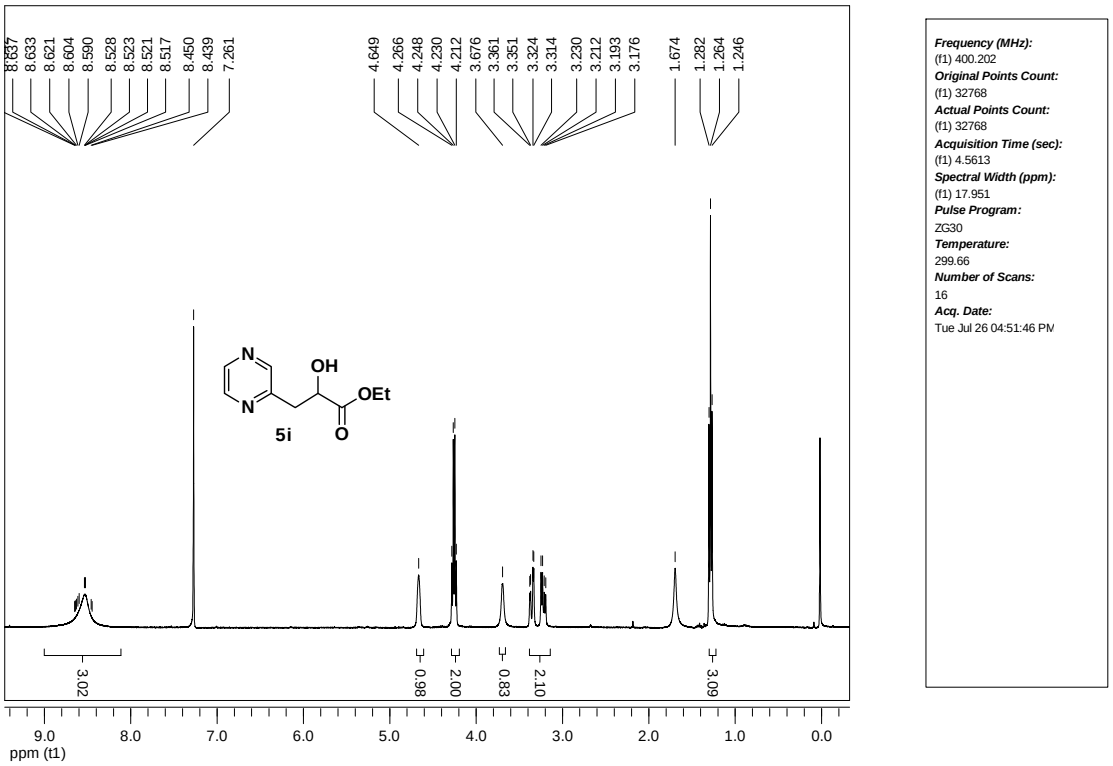
^{1}H NMR Spectrum for 5h



^{13}C NMR Spectrum for 5h



^{1}H NMR Spectrum for 5i



^{13}C NMR Spectrum for 5i