Supporting Information

Stereoselective synthesis of fully substituted ethylenes via an Ag-catalyzed 1,6-nucleophilic addition/annulation cascade

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General Information

^{1}H NMR (^{13}C NMR) spectra were measured on a Bruker DPX 400 MHz spectrometer in $CDCl_3$ (DMSO-*d6*) with chemical shift (δ) given in ppm relative to TMS as internal standard [(s = singlet, d = doublet, t = triplet, brs = broad singlet, m = multiplet), coupling constant (Hz)]. HRMS (ESI) was determined by using microTOF-QII HRMS/MS instrument (BRUKER). X-Ray crystallographic analysis was performed with a Siemens SMART CCD and a Siemens P4 diffractometer.

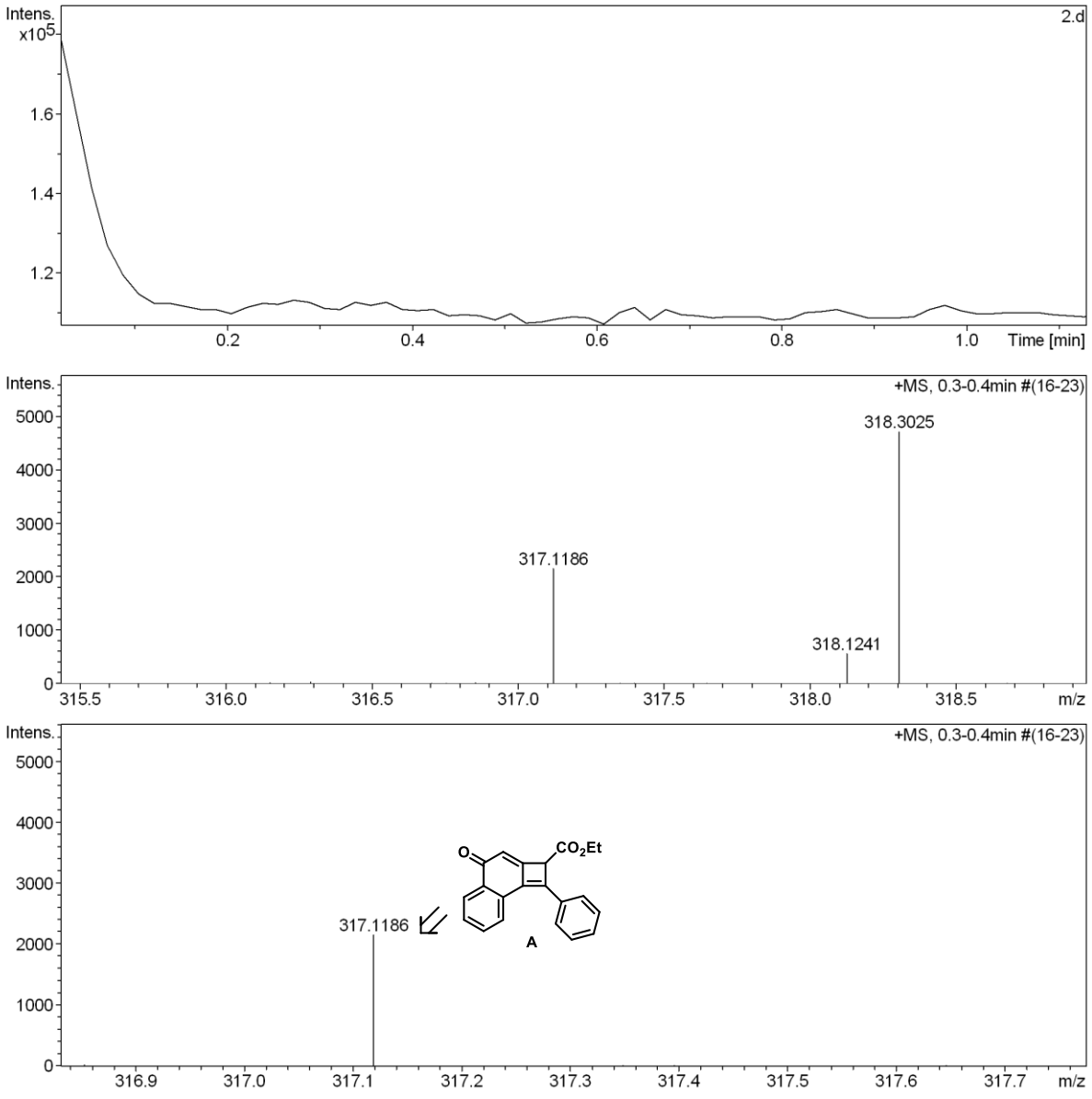


Figure S1 Copy of HRMS Spectra of Intermediate A $[M+H]^+$

[M+H]$^+$

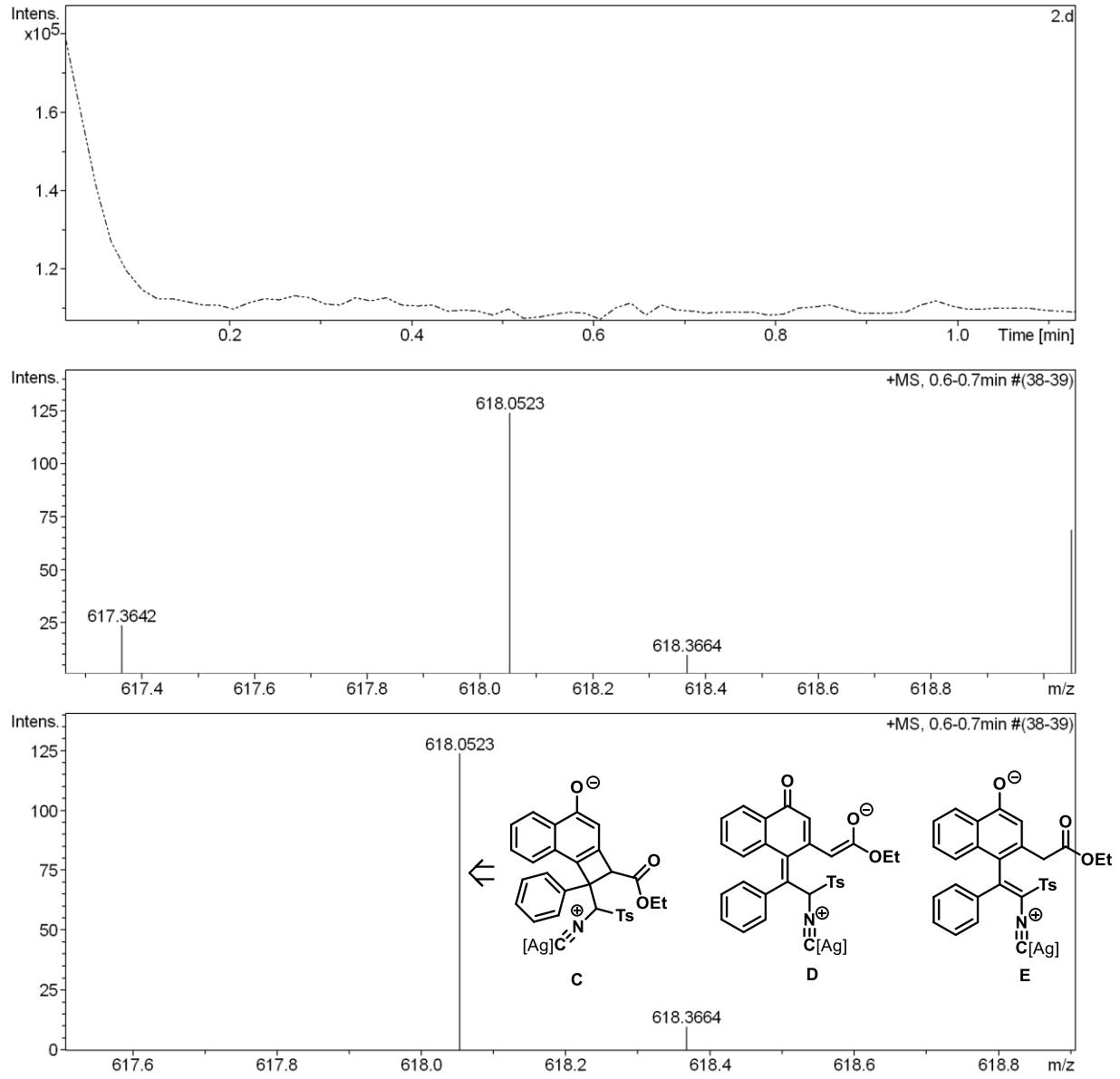


Figure S2 Copy of HRMS Spectra of Intermediate **C**, **D** or **E** [M+H]$^+$

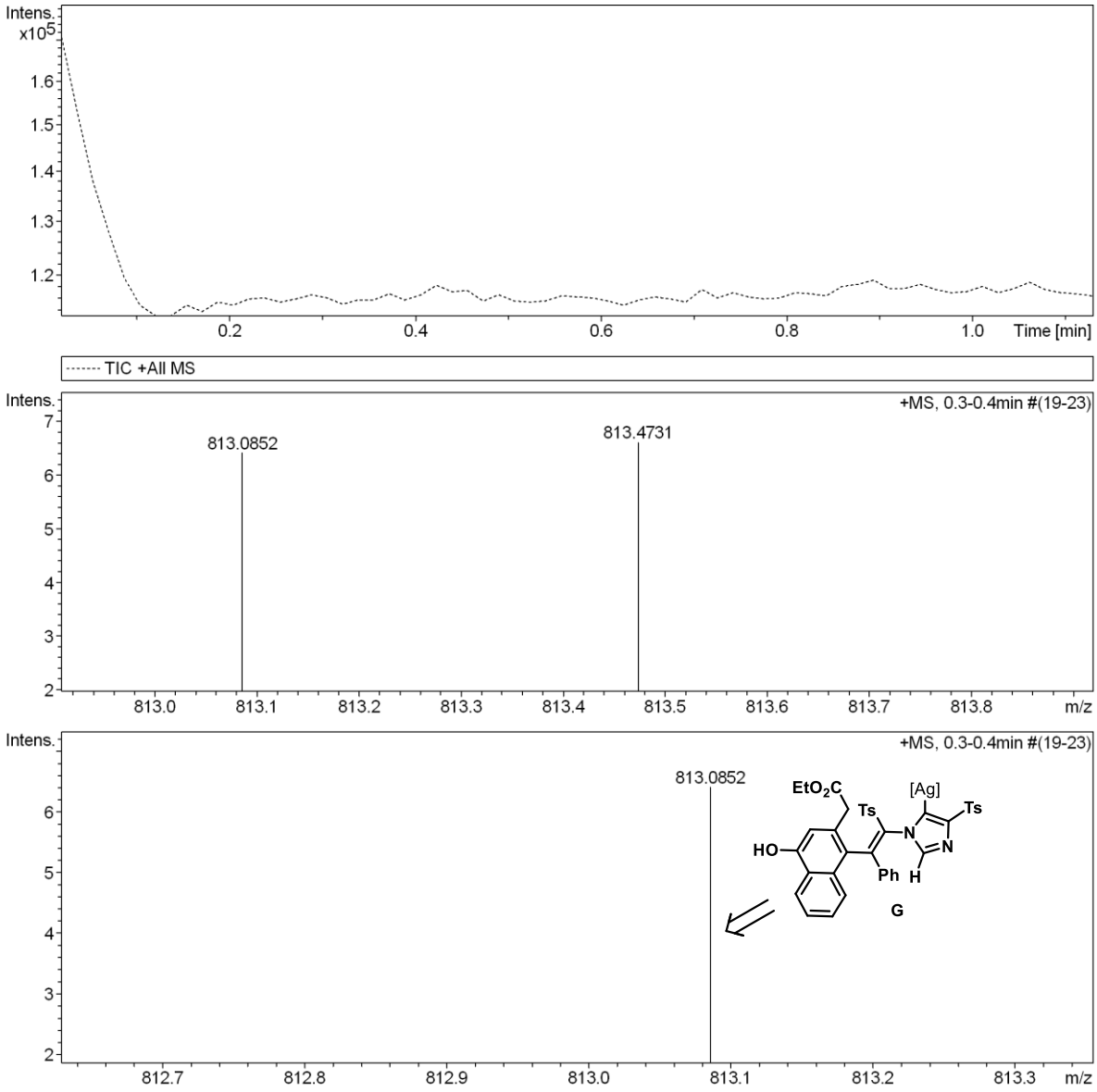


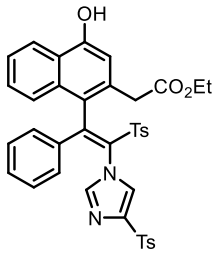
Figure S3 Copy of HRMS Spectra of Intermediate **G** $[M+H]^+$

General Procedure for the Synthesis of Compounds **3**

Example for the synthesis of 3a

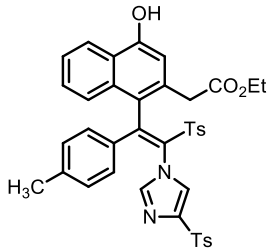
A mixture of ethyl 5-oxo-5-(2-(phenylethynyl)phenyl)penta-2,3-dienoate (**1a**, 0.3 mmol, 94.8 mg), tosylmethyl isocyanide (**2a**, 0.6 mmol, 117.0 mg), pyridine (0.3 mmol, 23.7 mg), Ag_2O (10 mol%, 7 mg) and 4A (100 mg)were sequentially added in a 25-mL Schlenk tube. Then, 1,4-dioxane (3.0 mL) was added into this reaction system. The reaction vial was sealed at 80 °C until TLC (petroleum ether ethyl acetate=11) revealed that conversion of the starting material 1a was completed. Next, the reaction mixture was concentrated by vacuum distillation and was purified by flash column chromatography (silica gel, mixtures of petroleum ether / acetic ester, 21, v/v) to afford the desired pure products (**3a**, 144.2 mg, 68% yield) as yellow solid.

(Z)-ethyl 2-(4-hydroxy-1-(1-phenyl-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)naphthalen-2-yl)acetate (3a)



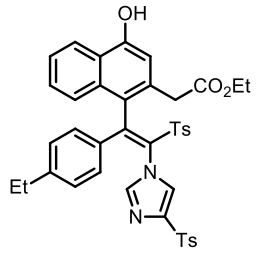
Yellow solid, 144.2mg, 68% yield; mp 129-130 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.10-7.84(m, 5H), 7.39-7.33 (m, 3H), 7.23-7.14 (m, 3H), 7.02-6.95 (m, 3H), 6.87-6.77 (m, 6H), 4.07-3.91 (m, 2H), 3.78-3.69 (m, 2H), 2.45 (s, 3H), 2.22 (s, 3H), 1.15-1.12 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.5, 153.7, 149.5, 145.4, 144.5, 142.8, 137.7, 135.6, 134.4, 133.6, 132.1, 131.6, 130.5, 129.9, 129.4, 128.9, 128.4, 128.2, 128.1, 127.6, 125.0, 124.7, 124.0, 123.6, 122.7, 110.9, 61.6, 39.9, 21.8, 21.6, 14.1. IR (KBr, ν, cm^{-1}) 3400, 3125, 3062, 1728, 1624, 1595, 1322, 1082, 813. HR-MS (ESI) m/z calcd for $C_{39}H_{33}N_2O_7S_2$, 705.1729, $[M-H]^-$, found 705.1760.

(Z)-ethyl 2-(4-hydroxy-1-(1-(p-tolyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)naphthalen-2-yl)acetate (3b)



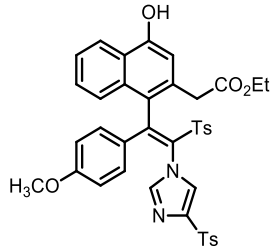
Yellow solid, 153.5mg, 71% yield; mp 127-128 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.07 (d, *J* = 8.0 Hz, 1H), 7.88 (d, *J* = 8.0 Hz, 3H), 7.35 (d, *J* = 8.0 Hz, 3H), 7.21-6.69 (m, 12H), 4.06-3.94 (m, 2H), 3.77-3.68 (m, 2H), 2.45 (s, 3H), 2.19 (d, *J* = 8.0 Hz, 6H), 1.15-1.11 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.6, 153.7, 149.6, 145.3, 144.5, 142.7, 141.2, 137.7, 133.8, 133.6, 132.6, 132.1, 131.6, 129.9, 129.6, 129.4, 128.5, 128.1, 128.1, 127.5, 124.9, 124.8, 124.0, 123.6, 122.7, 110.9, 61.6, 39.8, 21.7, 21.6, 21.3, 14.0. IR (KBr, ν, cm^{-1}) 3401, 3125, 3062, 1728, 1595, 1510, 1323, 1044, 971. HR-MS (ESI) m/z calcd for $C_{40}H_{35}N_2O_7S_2$, 719.1886, $[M-H]^-$, found 719.1910.

(Z)-ethyl 2-(1-(1-(4-ethylphenyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)-4-hydroxynaphthalen-2-yl)acetate (3c)



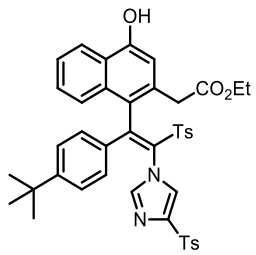
Yellow solid, 152.1mg, 69% yield; mp 129-130 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.08 (d, *J* = 8.0 Hz, 1H), 7.90 (d, *J* = 8.0 Hz, 3H), 7.38-7.34 (m, 3H), 7.20-6.71 (m, 12H), 4.04-3.92 (m, 2H), 3.77-3.68 (m, 2H), 2.51-2.45 (m, 5H), 2.21 (s, 3H), 1.14-1.07 (m, 6H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.6, 153.6, 149.5, 147.3, 145.3, 144.5, 142.7, 137.8, 133.8, 133.5, 132.7, 132.2, 131.6, 129.9, 129.4, 128.7, 128.4, 128.1, 128.1, 127.5, 124.9, 124.8, 123.95, 123.7, 122.7, 110.9, 61.5, 39.8, 28.5, 21.8, 21.6, 14.8, 14.0. IR (KBr, ν, cm^{-1}) 3400, 3126, 3062, 1728, 1670, 1541, 1348, 1093, 900. HR-MS (ESI) m/z calcd for $C_{41}H_{37}N_2O_7S_2$, 733.2042, $[M-H]^-$, found 733.2062.

(Z)-ethyl 2-(4-hydroxy-1-(1-(4-methoxyphenyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)naphthalen-2-yl)acetate (3d)



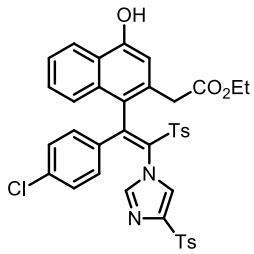
Yellow solid, 168.0mg, 76% yield; mp 128-129 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.06 (d, *J* = 8.0 Hz, 1H), 7.88 (d, *J* = 8.0 Hz, 3H), 7.35 (d, *J* = 8.0 Hz, 3H), 7.20-6.70 (m, 10H), 6.49 (d, *J* = 8.0 Hz, 2H), 4.05-3.92 (m, 2H), 3.77-3.71 (m, 2H), 3.67 (s, 3H), 2.44 (s, 3H), 2.20 (s, 3H), 1.14-1.11 (m 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.7, 161.3, 153.8, 149.1, 145.2, 144.5, 142.9, 137.8, 134.0, 132.4, 132.2, 131.8, 130.6, 129.9, 129.4, 128.1, 128.0, 127.5, 127.4, 124.8, 124.7, 124.0, 123.6, 122.7, 114.4, 110.9, 61.6, 55.4, 39.8, 21.8, 21.6, 14.0. IR (KBr, ν, cm^{-1}) 3412, 3127, 2980, 1728, 1623, 1596, 1303, 1102, 836. HR-MS (ESI) m/z calcd for $C_{40}H_{35}N_2O_8S_2$, 735.1835, $[M-H]^-$, found 735.1875.

(Z)-ethyl 2-(1-(1-(4-(tert-butyl)phenyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)-4-hydroxynaphthalen-2-yl)acetate (3e)



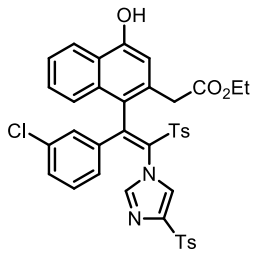
Yellow solid, 171.2mg, 75% yield; mp 122-123 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.10-7.92 (m , 4H), 7.35 (d, *J* = 8.0 Hz, 3H), 7.20-6.72 (m, 12H), 4.01-3.87 (m, 2H), 3.78-3.68 (m, 2H), 2.44 (s, 3H), 2.20 (s, 3H), 1.14 (s, 9H), 1.11-1.08 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.7, 154.3, 153.8, 149.4, 145.3, 144.5, 142.8, 137.8, 133.8, 133.5, 132.2, 132.2, 131.6, 129.9, 129.4, 128.6, 128.1, 128.1, 127.5, 125.8, 124.9, 124.8, 124.0, 123.6, 122.7, 110.9, 61.5, 39.9, 34.8, 34.8, 34.8, 34.8, 30.9, 30.9, 30.8, 21.8, 21.6, 21.6, 21.6, 21.6, 14.0. IR (KBr, ν, cm^{-1}) 3420, 3136, 2964, 1729, 1624, 1595, 1323, 1154, 813. HR-MS (ESI) m/z calcd for $C_{43}H_{41}N_2O_7S_2$, 761.2355, $[M-H]^-$, found 761.2381.

(Z)-ethyl 2-(1-(1-(4-chlorophenyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)-4-hydroxynaphthalen-2-yl)acetate (3f)



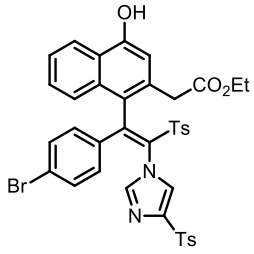
Yellow solid, 140.1mg, 63% yield; mp 124-125 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.06-7.86 (m, 4H), 7.38-7.33 (m, 3H), 7.23-6.78 (m, 12H), 4.11-3.98 (m, 2H), 3.80-3.71 (m, 2H), 2.44 (s, 3H), 2.21 (s, 3H), 1.19-1.15 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.6, 154.1, 147.9, 145.7, 144.6, 143.2, 137.5, 135.6, 135.0, 133.3, 131.9, 131.7, 130.5, 130.1, 130.0, 129.5, 128.4, 128.3, 128.1, 127.8, 126.3, 125.1, 124.4, 124.1, 122.9, 122.8, 110.8, 61.8, 40.0, 21.8, 21.6, 14.1. IR (KBr, ν, cm^{-1}) 3412, 3126, 2981, 1728, 1624, 1595, 1322, 1082, 813. HR-MS (ESI) m/z calcd for $C_{39}H_{32}ClN_2O_7S_2$, 739.1339, $[M-H]^-$, found 739.1372.

(Z)-ethyl 2-(1-(1-(3-chlorophenyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)-4-hydroxynaphthalen-2-yl)acetate (3g)



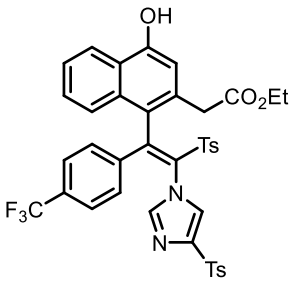
Yellow solid, 144.6mg, 65% yield; mp 126-127 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.07-7.86 (m, 5H), 7.34 (d, *J* = 8.0 Hz, 3H), 7.13 (s, 4H), 6.94-6.80 (m, 7H), 4.10-3.98 (m, 2H), 3.79-3.70 (m, 2H), 2.45 (s, 3H), 2.22 (s, 3H), 1.19-1.15 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.2, 153.8, 147.7, 145.7, 144.5, 137.5, 137.5, 135.6, 135.0, 133.4, 131.9, 131.7, 130.5, 130.1, 129.9, 129.5, 128.3, 128.3, 128.1, 127.8, 126.3, 125.2, 124.5, 124.0, 123.1, 122.8, 110.9, 100.0, 61.7, 40.0, 21.8, 21.7, 14.1. IR (KBr, ν, cm^{-1}) 3423, 3180, 1725, 1624, 1595, 1321, 1129, 1044, 866. HR-MS (ESI) m/z calcd for $C_{39}H_{32}ClN_2O_7S_2$, 739.1339, $[M-H]^-$, found 739.1358.

(Z)-ethyl 2-(1-(1-(4-bromophenyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)-4-hydroxynaphthalen-2-yl)acetate (3h)



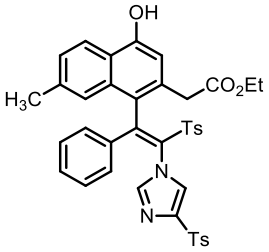
Yellow solid, 150.8mg, 64% yield; mp 132-133 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.06 (d, *J* = 8.0 Hz, 1H), 7.84 (d, *J* = 8.0 Hz, 3H), 7.40-7.34 (m, 3H), 7.23-6.66 (m, 12H), 4.04-3.94 (m, 2H), 3.74-3.66 (m, 2H), 2.47 (s, 3H), 2.22 (s, 3H), 1.16-1.12 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.5, 153.9, 148.1, 145.6, 144.6, 143.2, 137.5, 134.7, 134.5, 133.4, 132.1, 131.9, 131.7, 129.9, 129.9, 129.5, 128.2, 128.0, 127.7, 125.2, 125.0, 124.3, 124.0, 123.0, 122.8, 110.9, 61.7, 39.9, 21.8, 21.6, 14.0. IR (KBr, ν, cm^{-1}) 3404, 3123, 3063, 1728, 1623, 1595, 1380, 1043, 841. HR-MS (ESI) m/z calcd for $C_{39}H_{32}BrN_2O_7S_2$, 783.0834, $[M-H]^-$, found 783.0848.

(Z)-ethyl 2-(4-hydroxy-1-(2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)-1-(4-(trifluoromethyl)phenyl)vinyl)naphthalen-2-yl)acetate (3i)



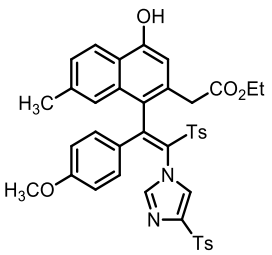
Yellow solid, 146.4 mg, 63% yield; mp 126-127 °C;^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.07 (d, *J* = 8.4 Hz, 1H), 7.86 (d, *J* = 7.2 Hz, 2H), 7.51-7.29 (m, 5H), 7.24-7.12 (m, 4H), 7.01-6.78 (m, 7H), 4.04-3.91 (m, 2H), 3.77-3.69 (m, 2H), 2.43 (s, 3H), 2.20 (s, 3H), 1.12-1.08 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.6, 154.3, 147.8, 145.8, 144.8, 143.2, 141.5 (q, *J* = 4.6 Hz), 139.2, 137.4, 136.0, 133.1, 131.8 (q, *J* = 32.8 Hz), 131.7, 129.9, 129.5, 128.8, 128.2, 128.0, 127.8, 126.5 (q, *J* = 2.3 Hz), 125.7, 125.7 (q, *J* = 3.6 Hz), 125.0, 124.6, 124.2, 124.1, 122.9, 122.5, 121.9, 110.8, 61.7, 39.9, 21.6, 21.6, 13.9. IR (KBr, ν, cm^{-1}) 3400, 3122, 3060, 1728, 1625, 1592, 1341, 1064, 894. HR-MS (ESI) m/z calcd for $C_{40}H_{32}F_3N_2O_7S_2$, 773.1603, $[M-H]^-$, found 773.1594.

(Z)-ethyl 2-(4-hydroxy-7-methyl-1-(1-phenyl-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)naphthalen-2-yl)acetate (3k)



Yellow solid, 151.4mg, 70% yield; mp 131-132 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.00 (d, *J* = 8.0 Hz, 1H), 7.86 (d, *J* = 8.0 Hz, 2H), 7.34 (d, *J* = 8.0 Hz, 2H), 7.19-6.77 (m, 14H), 4.04-3.91 (m, 2H), 3.74-3.65 (m, 2H), 2.45 (s, 3H), 2.23 (d, *J* = 4.0 Hz, 6H), 1.14-1.11 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.4, 153.6, 149.8, 145.2, 144.4, 142.9, 137.7, 137.1, 135.7, 134.1, 133.8, 132.2, 131.7, 130.4, 129.8, 129.3, 128.9, 128.3, 128.1, 127.0, 123.7, 123.0, 122.6, 122.0, 110.3, 61.5, 39.8, 22.0, 21.7, 21.6, 14.0. IR (KBr, ν, cm^{-1}) 3412, 3123, 2981, 1728, 1640, 1516, 1104, 976, 863. HR-MS (ESI) m/z calcd for $C_{40}H_{35}N_2O_7S_2$, 719.1886, $[M-H]^-$, found 719.1914.

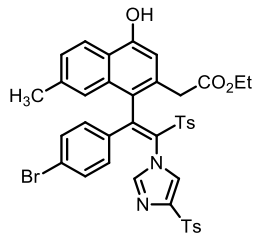
(Z)-ethyl 2-(4-hydroxy-1-(1-(4-methoxyphenyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)-7-methylnaphthalen-2-yl)acetate (3l)



Yellow solid, 144.2mg, 64% yield; mp 135-136 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 7.99-7.89 (m, 3H), 7.35 (d, *J* = 8.0 Hz, 2H), 7.17-6.49 (m, 13H), 4.04-3.91 (m, 2H), 3.73-3.64 (m, 5H), 2.45 (s, 3H), 2.21 (d, *J* = 12.0 Hz, 6H), 1.14-1.11 (m, 3H). ^{13}C NMR (100 MHz, CDCl3; δ, ppm) 171.5, 161.3, 145.0, 144.5, 137.8, 137.1, 134.2, 132.4, 132.1, 131.9, 130.6, 129.9, 129.8, 129.2, 128.1, 128.0, 127.5, 127.0, 123.8, 122.6, 122.6, 122.0, 114.4, 110.4, 100.0, 61.5, 55.3, 39.8, 22.0, 21.8,

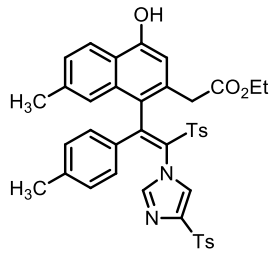
21.6, 14.1. IR (KBr, ν, cm^{-1}) 3400, 3165, 2981, 1725, 1606, 1543, 1225, 1029, 850. HR-MS (ESI) m/z calcd for $C_{41}H_{37}N_2O_8S_2$, 749.1991, $[M-H]^-$, found 749.2012.

(Z)-ethyl 2-(1-(1-(4-bromophenyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)-4-hydroxy-7-methylnaphthalen-2-yl)acetate (3m)



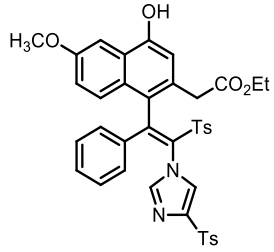
Yellow solid, 148.8mg, 62% yield; mp 134-135 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.00 (d, *J* = 8.0 Hz, 1H), 7.85 (s, 2H), 7.48 (d, *J* = 8.0 Hz, 2H), 7.40-7.33 (m, 3H), 7.19-7.07 (m, 3H), 6.91-6.73 (m, 7H), 4.07-3.94 (m, 2H), 3.74-3.65 (m, 2H), 2.40 (s, 3H), 2.22 (d, *J* = 8.0 Hz, 6H), 1.17-1.13 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.4, 148.8, 145.4, 144.5, 143.2, 137.3, 135.5, 134.5, 133.8, 133.2, 133.1, 133.1, 132.3, 132.2, 132.0, 131.9, 131.9, 130.0, 129.9, 129.4, 128.4, 128.2, 128.1, 128.1, 127.1, 125.3, 123.6, 123.3, 122.7, 122.1, 121.5, 110.3, 100.0, 91.3, 89.5, 61.6, 40.0, 22.1, 21.8, 21.8, 21.6, 14.1, 14.1. IR (KBr, ν, cm^{-1}) 3420, 3159, 2986, 1728, 1602, 1513, 1219, 1069, 857. HR-MS (ESI) m/z calcd for $C_{40}H_{34}BrN_2O_7S_2$, 797.0991, $[M-H]^-$, found 797.1025.

(Z)-ethyl 2-(4-hydroxy-7-methyl-1-(1-(p-tolyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)naphthalen-2-yl)acetate (3n)



Yellow solid, 147.7mg, 67% yield; mp 126-127 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 7.98-7.89 (m, 4H), 7.35 (d, *J* = 8.0 Hz, 2H), 7.15-6.67 (m, 12H), 4.05-3.90 (m, 2H), 3.74-3.65 (m, 2H), 2.45 (s, 3H), 2.19 (d, *J* = 8.0 Hz, 9H), 1.14-1.10 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.8, 153.8, 150.0, 145.1, 144.4, 142.8, 141.5, 141.1, 137.8, 136.9, 134.0, 133.3, 132.7, 132.3, 131.8, 129.8, 129.6, 129.2, 128.5, 128.1, 128.0, 126.9, 123.8, 122.7, 122.1, 110.3, 61.5, 39.9, 22.0, 21.8, 21.6, 21.3, 14.0. IR (KBr, ν, cm^{-1}) 3423, 3125, 2981, 1729, 1670, 1371, 1219, 1102, 811. HR-MS (ESI) m/z calcd for $C_{41}H_{37}N_2O_7S_2$, 733.2042, $[M-H]^-$, found 733.2061.

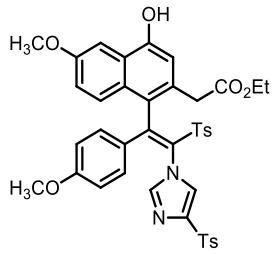
(Z)-ethyl 2-(4-hydroxy-6-methoxy-1-(1-phenyl-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)naphthalen-2-yl)acetate (3o)



Yellow solid, 161.4mg, 73% yield; mp 123-124 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 7.89-7.82 (m, 4H), 7.45-7.32 (m, 9H), 7.29 (d, *J* = 4.0 Hz, 3H), 7.23-7.14 (m, 3H), 7.07-6.99 (m, 3H), 6.89-6.79 (m, 8H), 4.04-3.89 (m, 2H), 3.89-3.80 (m,

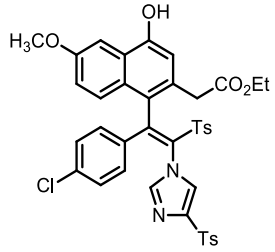
3H), 3.74-3.65 (m, 2H), 2.45 (s, 3H), 2.43 (s, 6H), 2.23 (s, 3H), 1.15-1.11 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.6, 157.1, 152.6, 149.4, 147.0, 145.4, 144.6, 144.4, 143.4, 139.6, 137.7, 137.4, 135.6, 134.3, 133.7, 131.3, 130.6, 130.5, 129.8, 129.8, 129.4, 128.9, 128.8, 128.7, 128.3, 128.1, 128.0, 128.0, 127.3, 126.3, 125.1, 123.8, 123.6, 120.1, 111.5, 100.7, 66.5, 61.4, 55.3, 39.5, 21.9, 21.7, 21.5, 14.0. IR (KBr, ν, cm^{-1}) 3408, 3126, 2981, 1726, 1648, 1528, 1136, 1040, 891. HR-MS (ESI) m/z calcd for $C_{40}H_{35}N_2O_8S_2$, 735.1835, $[M-H]^-$, found 735.1862.

(Z)-ethyl 2-(4-hydroxy-6-methoxy-1-(1-(4-methoxyphenyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)naphthalen-2-yl)acetate (3p)



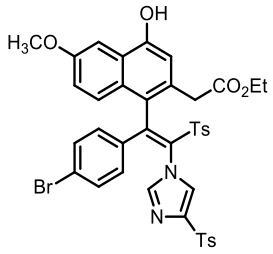
Yellow solid, 154.1mg, 67% yield; mp 125-126 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 7.89-7.87 (m, 3H), 7.35 (d, *J* = 8.0 Hz, 3H), 7.21 (d, *J* = 4.0 Hz, 1H), 6.99-6.71 (m, 9H), 6.51 (d, *J* = 12.0 Hz, 2H), 4.05-3.91 (m, 2H), 3.81 (s, 3H), 3.75-3.64 (m, 5H), 2.45 (s, 3H), 2.21 (s, 3H), 1.15-1.11 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 172.1, 161.3, 157.0, 152.8, 149.1, 145.1, 144.5, 142.9, 137.8, 134.1, 132.3, 130.6, 130.6, 129.9, 129.9, 129.4, 129.1, 128.8, 128.1, 128.1, 128.0, 127.5, 127.4, 126.3, 125.1, 123.6, 120.0, 114.3, 111.5, 100.7, 100.0, 61.5, 55.4, 55.3, 39.5, 21.9, 21.75, 21.7, 21.5, 14.1. IR (KBr, ν, cm^{-1}) 3404, 3125, 3013, 1736, 1649, 1502, 1153, 1002, 706. HR-MS (ESI) m/z calcd for $C_{41}H_{37}N_2O_9S_2$, 765.1940, $[M-H]^-$, found 765.1969.

(Z)-ethyl 2-(1-(1-(4-chlorophenyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)-4-hydroxy-6-methoxynaphthalen-2-yl)acetate (3q)



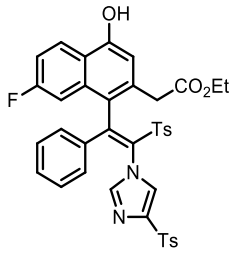
Yellow solid, 145.8mg, 63% yield; mp 121-122 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 7.84 (d, *J* = 8.0 Hz, 3H), 7.37 (d, *J* = 8.0 Hz, 2H), 7.18-6.74 (m, 13H), 4.07-3.94 (m, 2H), 3.80 (s, 3H), 3.74-3.65 (m, 2H), 2.46 (s, 3H), 2.21 (s, 3H), 1.16-1.13 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 172.1, 157.1, 153.1, 148.2, 145.6, 144.7, 1432, 137.6, 136.7, 134.8, 134.1, 133.6, 130.2, 130.0, 129.9, 129.9, 129.8, 129.5, 129.1, 129.1, 128.2, 128.0, 127.9, 127.9, 127.2, 125.9, 125.2, 122.9, 120.3, 111.4, 100.8, 100.0, 61.7, 55.3, 39.6, 21.8, 21.6, 14.0. IR (KBr, ν, cm^{-1}) 3432, 3120, 2988, 1728, 1601, 1462, 1219, 1013, 871. HR-MS (ESI) m/z calcd for $C_{40}H_{34}ClN_2O_8S_2$, 769.1445, $[M-H]^-$, found 769.1472.

(Z)-ethyl 2-(1-(1-(4-bromophenyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)-4-hydroxy-6-methoxynaphthalen-2-yl)acetate (3r)



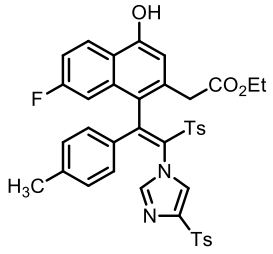
Yellow solid, 159.1mg, 65% yield; mp 130-131 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 7.84 (d, *J* = 8.0 Hz, 3H), 7.38 (d, *J* = 8.0 Hz, 2H), 7.19-7.08 (m, 3H), 6.97-6.79 (m, 8H), 6.67 (d, *J* = 8.0 Hz, 2H), 4.05-3.95 (m, 2H), 3.81 (s, 3H), 3.73-3.64 (m, 2H), 2.47 (s, 3H), 2.22 (s, 3H), 1.17-1.13 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 157.2, 148.1, 145.6, 144.6, 143.3, 137.6, 134.7, 134.6, 133.6, 133.1, 132.1, 131.9, 130.0, 129.9, 129.5, 129.0, 128.2, 128.1, 128.0, 127.2, 125.9, 125.2, 125.1, 123.0, 120.3, 111.4, 100.8, 61.7, 55.4, 39.6, 21.8, 21.6, 14.1. IR (KBr, ν, cm^{-1}) 3392, 3128, 2931, 1726, 1540, 1326, 1192, 1026, 891. HR-MS (ESI) m/z calcd for $C_{40}H_{34}BrN_2O_8S_2$, 813.0940, $[M-H]^-$, found 813.0963.

(Z)-ethyl 2-(7-fluoro-4-hydroxy-1-(1-phenyl-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)naphthalen-2-yl)acetate (3s)



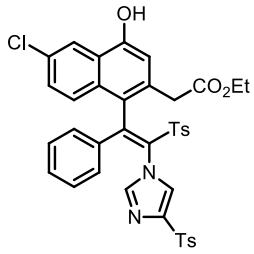
Yellow solid, 147.9mg, 68% yield; mp 125-126 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.03-7.99 (m,1H), 7.87 (d, *J* = 8.0 Hz, 3H), 7.34 (d, *J* = 8.0 Hz, 2H), 7.21-6.61 (m, 13H), 4.07-3.93 (m, 2H), 3.81-3.71 (m, 2H), 2.45 (s, 3H), 2.22 (s, 3H), 1.17-1.13 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.7, 161.5($^{1}J_{CF}$ = 246.7), 154.1, 148.8, 145.6, 144.5, 143.0, 141.3, 137.6, 135.2, 134.7, 133.7, 133.4, 133.2($^{4}J_{CF}$ = 8.6), 130.7, 129.8, 129.5, 129.0, 128.3, 128.1($^{5}J_{CF}$ = 12.4), 126.5, 125.7, 122.7($^{6}J_{CF}$ = 5.0), 120.9, 114.9, 114.7, 110.4, 108.3($^{2}J_{CF}$ = 22.0), 61.7, 39.9, 21.7($^{3}J_{CF}$ = 16.7), 14.0. IR (KBr, ν, cm^{-1}) 3396, 3125, 2981, 1728, 1632, 1475, 1323, 1082, 855. HR-MS (ESI) m/z calcd for $C_{39}H_{32}FN_2O_7S_2$, 723.1635, $[M-H]^-$, found 723.1661.

(Z)-ethyl 2-(7-fluoro-4-hydroxy-1-(1-(p-tolyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)naphthalen-2-yl)acetate (3t)



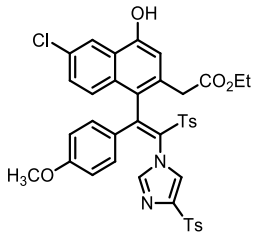
Yellow solid, 137.5mg, 62% yield; mp 127-128 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 7.90-7.79 (m, 4H), 7.57 (d, *J* = 12.0 Hz, 1H), 7.35 (d, *J* = 8.0 Hz, 2H), 7.12-7.09 (m, 1H), 6.96-6.78 (m, 8H), 6.68 (d, *J* = 8.0 Hz, 2H), 4.07-3.91 (m, 2H), 3.78-3.68 (m, 2H), 2.45 (s, 3H), 2.22 (d, *J* = 12.0 Hz, 6H), 1.16-1.12 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.9, 160.1($^{1}J_{CF}$ = 245.1), 153.4, 153.3, 149.2, 145.5, 144.5, 142.9, 141.4, 137.7, 133.9, 133.8, 132.4, 131.0($^{6}J_{CF}$ = 2.7), 130.4, 130.2, 129.9, 129.7, 129.5, 129.1, 129.1, 129.0, 128.5, 128.1, 128.1, 127.2($^{5}J_{CF}$ = 8.9), 126.7, 125.1($^{4}J_{CF}$ = 8.9), 123.5, 117.5($^{3}J_{CF}$ = 24.5), 111.7, 106.6($^{2}J_{CF}$ = 21.9), 61.7, 39.7, 21.8, 21.8, 21.6, 21.4, 14.0. IR (KBr, ν, cm^{-1}) 3431, 3129, 2980, 1728, 1406, 1323, 1108, 972, 861. HR-MS (ESI) m/z calcd for $C_{40}H_{34}FN_2O_7S_2$, 737.1791, $[M-H]^-$, found 737.1798.

(Z)-ethyl 2-(6-chloro-4-hydroxy-1-(1-phenyl-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)naphthalen-2-yl)acetate (3u)



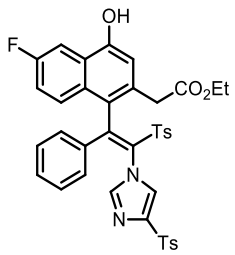
Yellow solid, 146.8mg, 66% yield; mp 130-131 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 7.87-7.81 (m, 4H), 7.59 (s, 1H), 7.34 (d, *J* = 8.0 Hz, 2H), 7.22-7.18 (m, 1H), 7.09-7.02 (m, 4H), 6.93-6.79 (m, 7H), 4.06-3.90 (m, 2H), 3.80-3.70 (m, 2H), 2.45 (s, 3H), 2.26 (s, 3H), 1.16-1.13 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.9, 153.2, 149.0, 145.7, 144.5, 143.0, 141.3, 137.5, 135.3, 134.8, 133.8, 132.0, 131.0, 130.7, 130.2, 129.8, 129.5, 129.0, 128.3, 128.2, 128.1, 128.0, 126.6, 126.1, 124.7, 123.1, 121.8, 112.0, 61.8, 39.7, 21.7, 21.6, 14.0. IR (KBr, ν, cm^{-1}) 3386, 2923, 2853, 1728, 1593, 1476, 1154, 1082, 853. HR-MS (ESI) m/z calcd for $C_{39}H_{32}ClN_2O_7S_2$, 739.1339, $[M-H]^-$, found 739.1367.

(Z)-ethyl 2-(6-chloro-4-hydroxy-1-(1-(4-methoxyphenyl)-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)naphthalen-2-yl)acetate (3v)



Yellow solid, 145.8mg, 63% yield; mp 110-111 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 7.94-7.91 (m, 5H), 7.36 (d, *J* = 8.0 Hz, 2H), 7.22-7.19 (m, 1H), 6.96-6.52 (m, 10H), 4.08-3.90 (m, 2H), 3.79-3.69 (m, 5H), 2.45 (s, 3H), 2.23 (s, 3H), 1.16-1.12 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.9, 161.5, 161.5, 154.0, 148.4, 148.4, 145.4, 144.5, 143.2, 137.7, 134.0, 133.6, 133.5, 133.5, 132.9, 132.6, 130.6, 129.9, 129.6, 128.1, 127.7, 127.0, 125.5, 124.6, 123.4, 122.6, 122.1, 122.1, 114.6, 111.5, 100.0, 61.8, 55.4, 39.9, 21.8, 21.6, 14.0. IR (KBr, ν, cm^{-1}) 3409, 3129, 3051, 1729, 1605, 1341, 12349, 1088, 801. HR-MS (ESI) m/z calcd for $C_{40}H_{34}ClN_2O_8S_2$, 769.1445, $[M-H]^-$, found 769.1460.

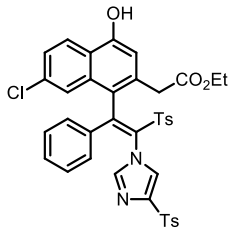
(Z)-ethyl 2-(6-fluoro-4-hydroxy-1-(1-phenyl-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)naphthalen-2-yl)acetate (3w)



Yellow solid, 141.3mg, 65% yield; mp 130-131 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 7.85 (d, *J* = 8.0 Hz, 3H), 7.58-7.54 (m, 1H), 7.34 (d, *J* = 8.0 Hz, 2H), 7.20-6.80 (m, 13H), 4.06-3.92 (m, 2H), 3.79-3.69 (m, 2H), 2.45 (s, 3H), 2.24 (s, 3H), 1.16-1.12 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.8, 160.0($^{1}J_{CF}$ = 244.9), 153.4, 149.1, 145.6, 144.5, 142.9, 141.4, 137.5, 135.3, 134.6, 133.7, 130.8($^{6}J_{CF}$ = 2.3), 130.7, 129.8, 129.5, 129.0, 128.3, 128.1, 127.1($^{4}J_{CF}$ = 8.6), 126.6, 125.1($^{5}J_{CF}$ = 8.9), 123.3, 117.6, 117.3, 111.7, 106.6($^{3}J_{CF}$ = 21.8), 61.7, 39.7, 21.6($^{2}J_{CF}$ = 18.8), 14.0. IR (KBr, ν, cm^{-1}) 3405,

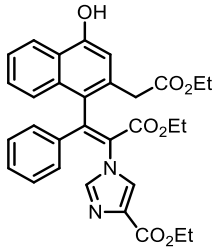
3126, 2981, 1728, 1607, 1400, 1082, 1044, 872. HR-MS (ESI) m/z calcd for $C_{39}H_{32}FN_2O_7S_2$, 723.1635, $[M-H]^-$, found 723.1664.

(Z)-ethyl 2-(7-chloro-4-hydroxy-1-(1-phenyl-2-tosyl-2-(4-tosyl-1H-imidazol-1-yl)vinyl)naphthalen-2-yl)acetate (3x)



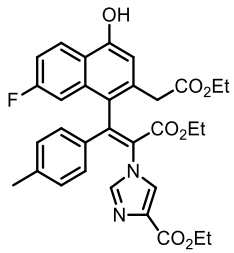
Yellow solid, 155.7mg, 70% yield; mp 134-135 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 7.95-7.87 (m, 4H), 7.34 (d, *J* = 8.0 Hz, 2H), 7.24-6.81 (m, 13H), 4.08-3.90 (m, 2H), 3.80-3.70 (m, 2H), 2.45 (s, 3H), 2.24 (s, 3H), 1.16-1.12 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.7, 154.1, 148.8, 145.7, 144.5, 143.0, 141.3, 137.6, 135.3, 134.7, 133.6, 133.3, 132.7, 130.7, 129.8, 129.6, 129.0, 128.3, 128.1, 127.8, 126.5, 125.5, 124.7, 123.3, 122.4, 122.2, 111.4, 61.8, 39.9, 21.7, 21.6, 14.0. IR (KBr, ν, cm^{-1}) 3412, 3143, 2981, 1728, 1620, 1511, 1323, 1185, 813. HR-MS (ESI) m/z calcd for $C_{39}H_{32}ClN_2O_7S_2$, 739.1339, $[M-H]^-$, found 739.1349.

(*E*)-ethyl 1-(3-ethoxy-1-(2-(2-ethoxy-2-oxoethyl)-4-hydroxynaphthalen-1-yl)-3-oxo-1-phenylprop-1-en-2-yl)-1H-imidazole-4-carboxylate (3y)



Yellow solid, 104.2mg, 64% yield; mp 101-102 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.20 (d, *J* = 8.0 Hz, 1H), 7.76 (d, *J* = 8.0 Hz, 2H), 7.64 (s, 1H), 7.47-7.40 (m, 2H), 7.21-7.12 (m, 3H), 6.97-6.94 (m, 3H), 4.39-4.34 (m, 2H), 4.01-3.92 (m, 2H), 3.74-3.69 (m, 2H), 3.67-3.58 (m, 2H), 1.38-1.34 (m, 3H), 1.14-1.11 (m, 3H), 0.47-0.44 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.3, 163.6, 162.5, 153.3, 147.2, 139.3, 136.4, 134.0, 132.9, 129.8, 129.6, 128.9, 128.9, 128.5, 127.6, 127.1, 126.7, 126.5, 125.1, 124.6, 124.2, 122.5, 110.7, 61.8, 61.3, 60.9, 39.6, 14.3, 14.0, 13.0. IR (KBr, ν, cm^{-1}) 3123, 2981, 2930, 1716, 1623, 1594, 1382, 1133, 982. HR-MS (ESI) m/z calcd for $C_{31}H_{29}N_2O_7$, 541.1975, $[M-H]^-$, found 541.1988.

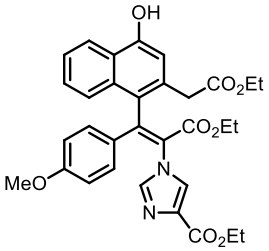
(*E*)-ethyl 1-(3-ethoxy-1-(2-(2-ethoxy-2-oxoethyl)-7-fluoro-4-hydroxynaphthalen-1-yl)-3-oxo-1-(p-tolyl)prop-1-en-2-yl)-1H-imidazole-4-carboxylate (3z)



Yellow solid, 103.4mg, 60% yield; mp 101-102 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 7.77-7.69 (m, 4H), 7.22-7.17 (m, 1H), 6.96 (d, *J* = 8.0 Hz, 3H), 6.81 (d, *J* = 8.0 Hz, 2H), 4.38-4.33 (m, 2H), 4.01-3.92 (m, 2H), 3.76-3.70 (m, 2H), 3.67-3.57 (m, 2H), 2.22 (s, 3H), 1.37-1.33 (m, 3H), 1.15-1.11 (m, 3H), 0.51-0.48 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm)

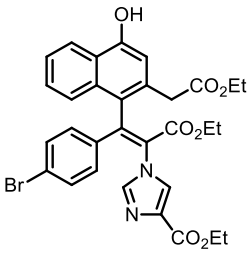
171.5, 162.5($^1J_{CF}$ = 221.4), 159.0, 153.0, 153.0, 140.7, 133.2, 130.0($^2J_{CF}$ = 17.1), 129.8, 128.9, 128.8, 128.8, 128.7($^6J_{CF}$ = 1.8), 127.3($^4J_{CF}$ = 8.5), 127.1, 126.8, 125.8, 125.4($^5J_{CF}$ = 8.9), 117.8, 117.5, 111.6, 106.5($^3J_{CF}$ = 23.8), 61.9, 61.4, 61.1, 39.4, 31.7, 22.7, 21.3, 14.4, 14.2, 14.0, 13.1. IR (KBr, ν, cm^{-1}) 3126, 2990, 2946, 1716, 1621, 1531, 1219, 1015, 987. HR-MS (ESI) m/z calcd for $C_{32}H_{30}FN_2O_7$, 573.2037, $[M-H]^-$, found 573.2041.

(*E*)-ethyl 1-(3-ethoxy-1-(2-(2-ethoxy-2-oxoethyl)-4-hydroxynaphthalen-1-yl)-1-(4-methoxyphenyl)-3-oxoprop-1-en-2-yl)-1H-imidazole-4-carboxylate (3aa)



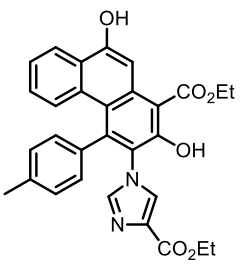
Yellow solid, 110.0mg, 64% yield; mp 103-104 °C; ^{1}H NMR (400 MHz, $CDCl_3$;δ, ppm) 8.20-8.17 (m, 1H), 8.01 (s, 1H), 7.77-7.69 (m, 2H), 7.47-7.41 (m, 2H), 6.94 (s, 1H), 6.85 (d, *J* = 8.0 Hz, 2H), 6.67 (d, *J* = 8.0 Hz, 2H), 4.37-4.31 (m, 2H), 4.03-3.95 (m, 2H), 3.73-3.68 (m, 5H), 3.67-3.57 (m, 2H), 1.36-1.33 (m, 3H), 1.17-1.14 (m, 3H), 0.478-0.45 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.3, 163.6, 161.0, 152.8, 133.0, 130.9, 129.5, 128.1, 127.7, 127.7, 127.0, 125.2, 124.8, 124.1, 122.3, 114.6, 110.8, 100.0, 61.8, 61.4, 61.1, 55.4, 39.5, 14.4, 14.1, 13.0. IR (KBr, ν, cm^{-1}) 3125, 2981, 2940, 1718, 1619, 1596, 1210, 1149, 945. HR-MS (ESI) m/z calcd for $C_{32}H_{31}N_2O_8$, 571.2080, $[M-H]^-$, found 571.2096.

(*E*)-ethyl 1-(1-(4-bromophenyl)-3-ethoxy-1-(2-(2-ethoxy-2-oxoethyl)-4-hydroxynaphthalen-1-yl)-3-oxoprop-1-en-2-yl)-1H-imidazole-4-carboxylate (3bb)



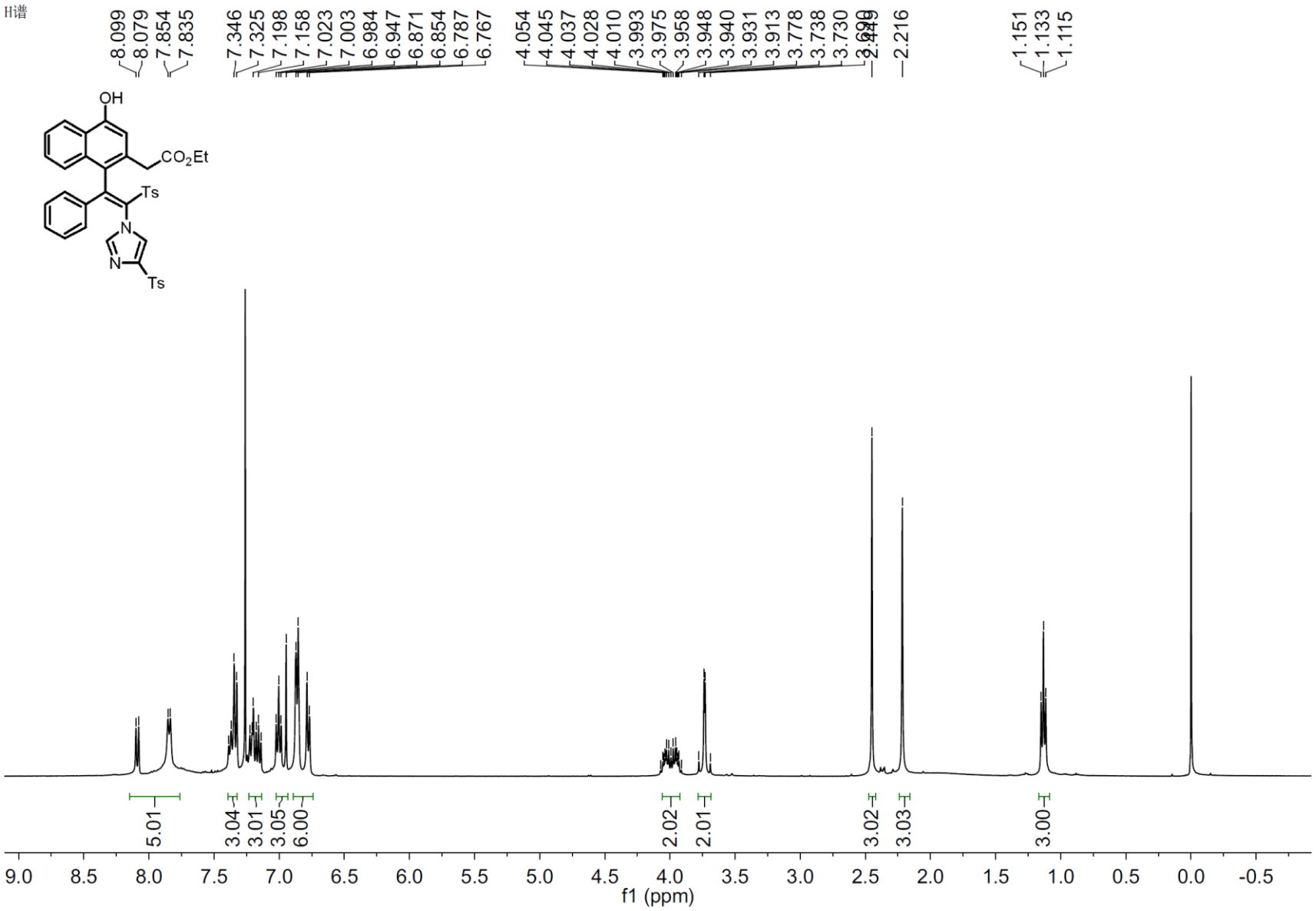
Yellow solid, 117.5mg, 63% yield; mp 115-116 °C; ^{1}H NMR (400 MHz, $CDCl_3$; δ, ppm) 8.18 (d, *J* = 8.0 Hz, 1H), 7.76-7.68 (m, 3H), 7.48-7.40 (m, 2H), 7.29 (d, *J* = 8.0 Hz, 2H), 6.94 (s, 1H), 6.83 (d, *J* = 12.0 Hz, 2H), 4.40-4.35 (m, 2H), 4.02-3.92 (m, 2H), 3.74-3.69 (m, 2H), 3.66-3.55 (m, 2H), 1.39-1.35 (m, 3H), 1.16-1.12 (m, 3H), 0.48-0.44 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$; δ, ppm) 171.3, 163.4, 153.6, 135.3, 132.9, 132.3, 130.5, 129.8, 127.9, 126.8, 126.5, 126.5, 125.3, 124.6, 124.4, 124.3, 122.6, 110.8, 62.1, 61.5, 61.1, 39.6, 14.4, 14.1, 13.0. IR (KBr, ν, cm^{-1}) 3129, 2980, 2956, 1718, 1540, 1419, 1103, 961, 854. HR-MS (ESI) m/z calcd for $C_{31}H_{28}BrN_2O_7$, 619.1080, $[M-H]^-$, found 619.1109.

ethyl 1-(1-(ethoxycarbonyl)-2,9-dihydroxy-4-(p-tolyl)phenanthren-3-yl)-1H-imidazole-4-carboxylate (5a)

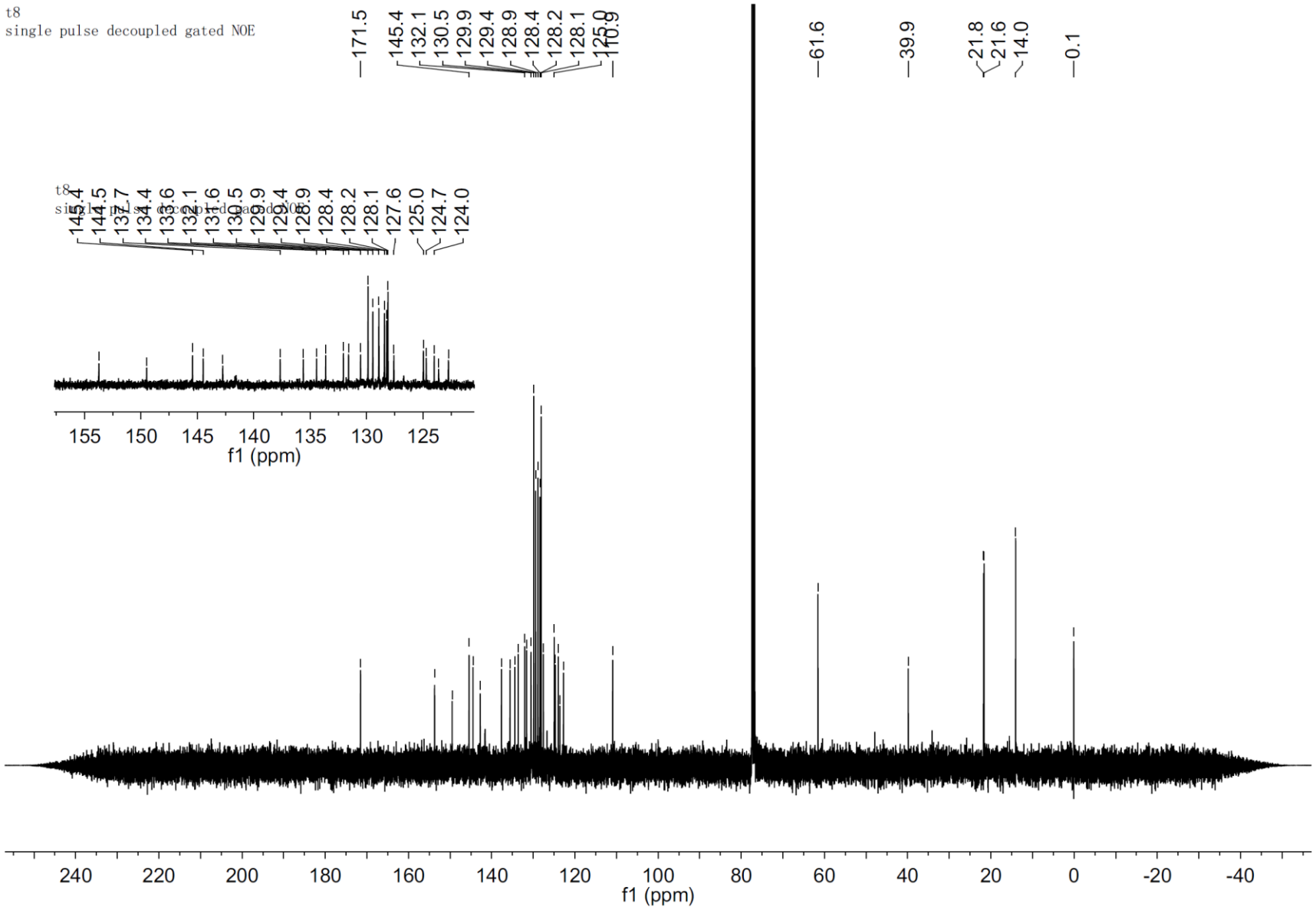


Yellow solid, 116.4mg, 76% yield; mp 125-126 °C; ^{1}H NMR (400 MHz, DMSO-d_6; δ, ppm) 10.80 (s, 1H), 10.13 (s, 1H),

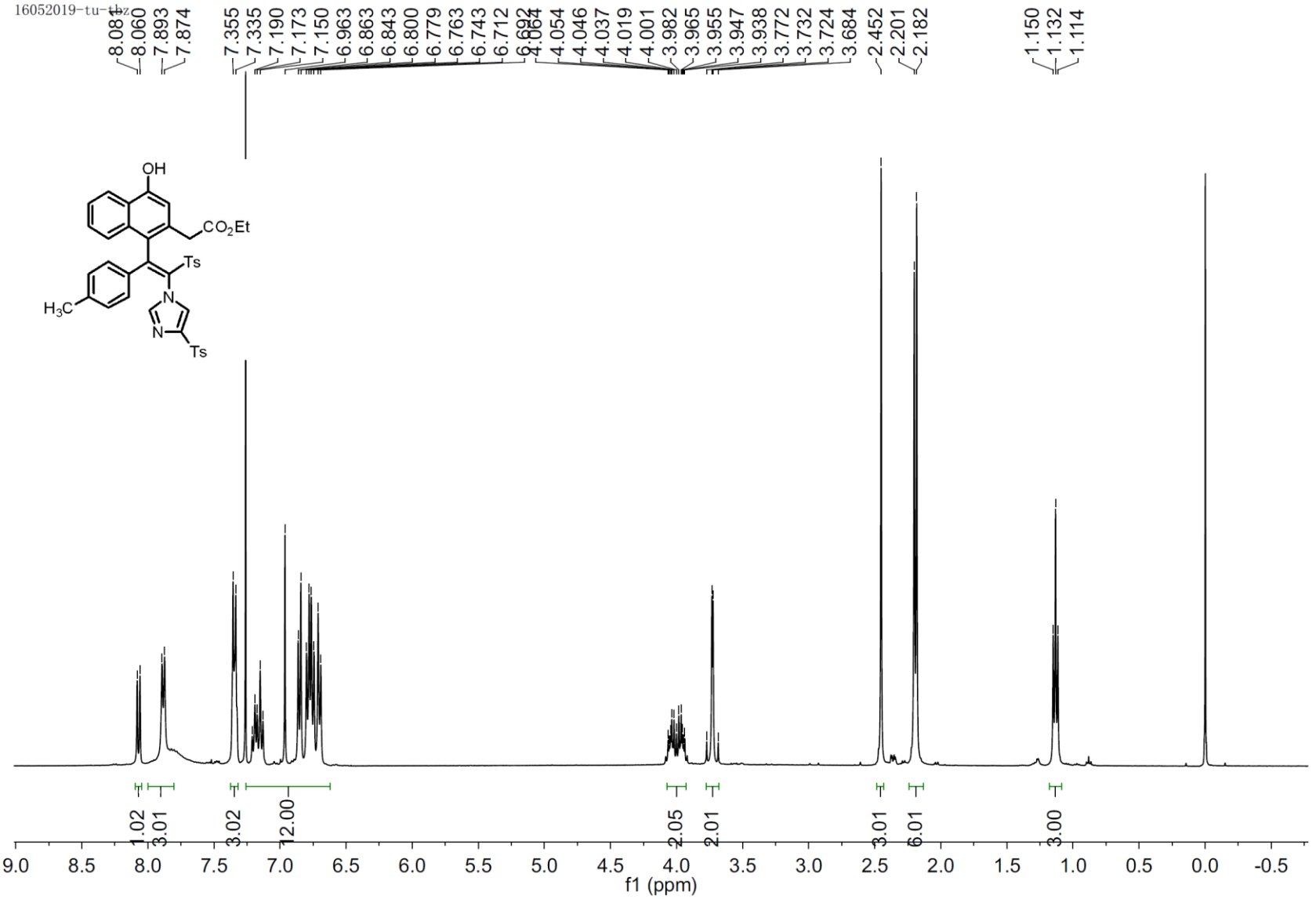
8.24-8.21 (m, 1H), 7.79 (d, J = 0.8 Hz, 1H), 7.53 (d, J = 1.2 Hz, 1H), 7.43-7.40 (m, 1H), 7.19-7.16 (m, 4H), 7.10-7.02 (m, 3H), 4.50-4.45 (m, 2H), 4.21-4.16 (m, 2H), 2.34 (s, 3H), 1.41 (m, 3H), 1.24 (m, 3H). ^{13}C NMR (100 MHz, DMSO-d_6; δ, ppm) 168.0, 162.7, 153.8, 149.2, 141.3, 141.0, 137.4, 136.1, 133.4, 132.3, 131.9, 129.9, 129.7, 129.2, 126.9, 126.5, 126.5, 125.8, 123.4, 122.8, 118.0, 116.6, 101.9, 62.0, 59.9, 21.4, 14.8, 14.6. IR (KBr, ν, cm^{-1}) 3412, 3120, 3055, 1729, 1689, 1603, 1408, 1090, 816. HR-MS (ESI) m/z calcd for $C_{30}H_{25}N_2O_6$, 509.1713, $[M-H]^-$, found 509.1710.



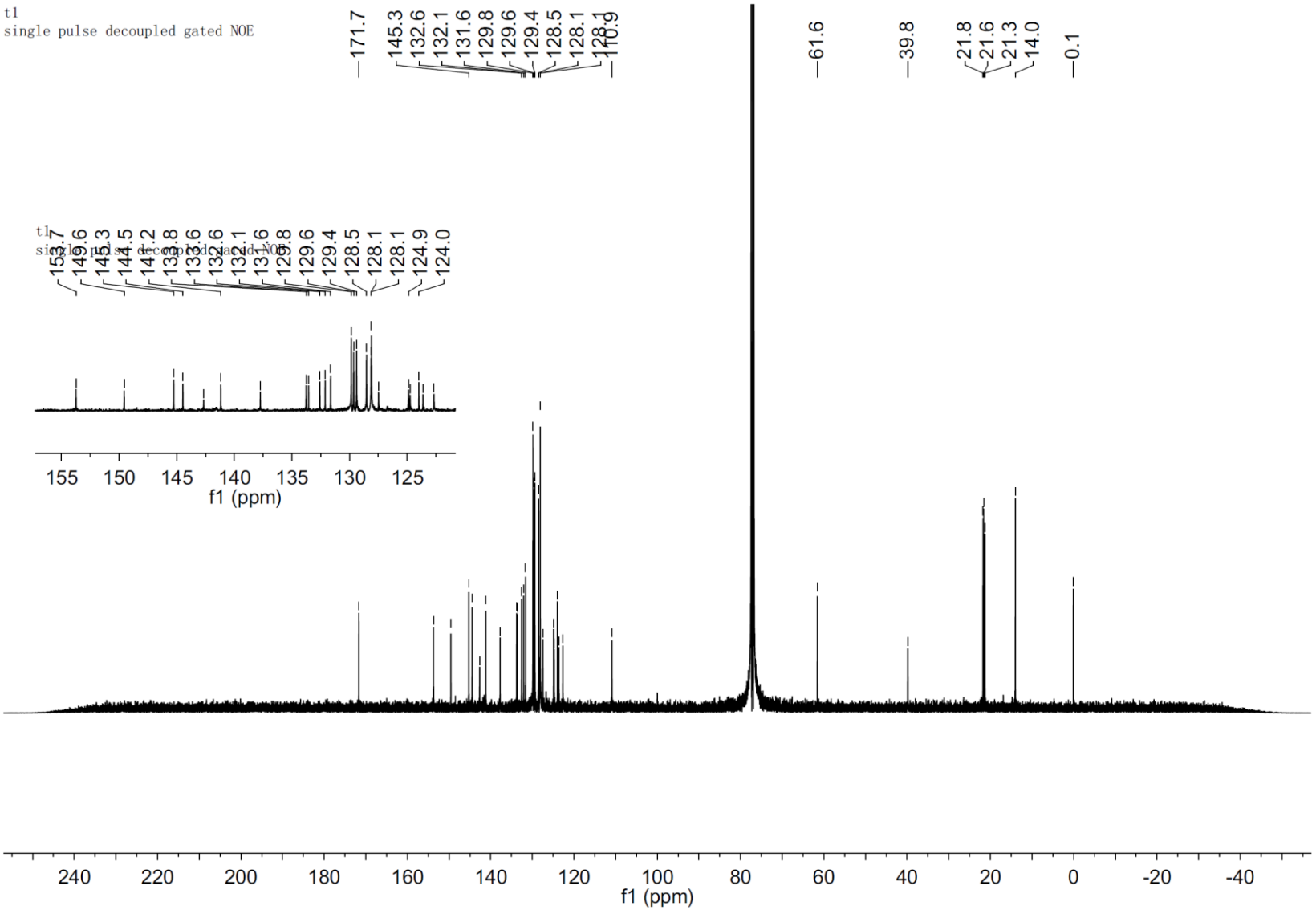
^{1}H NMR Spectrum of Compound 3a



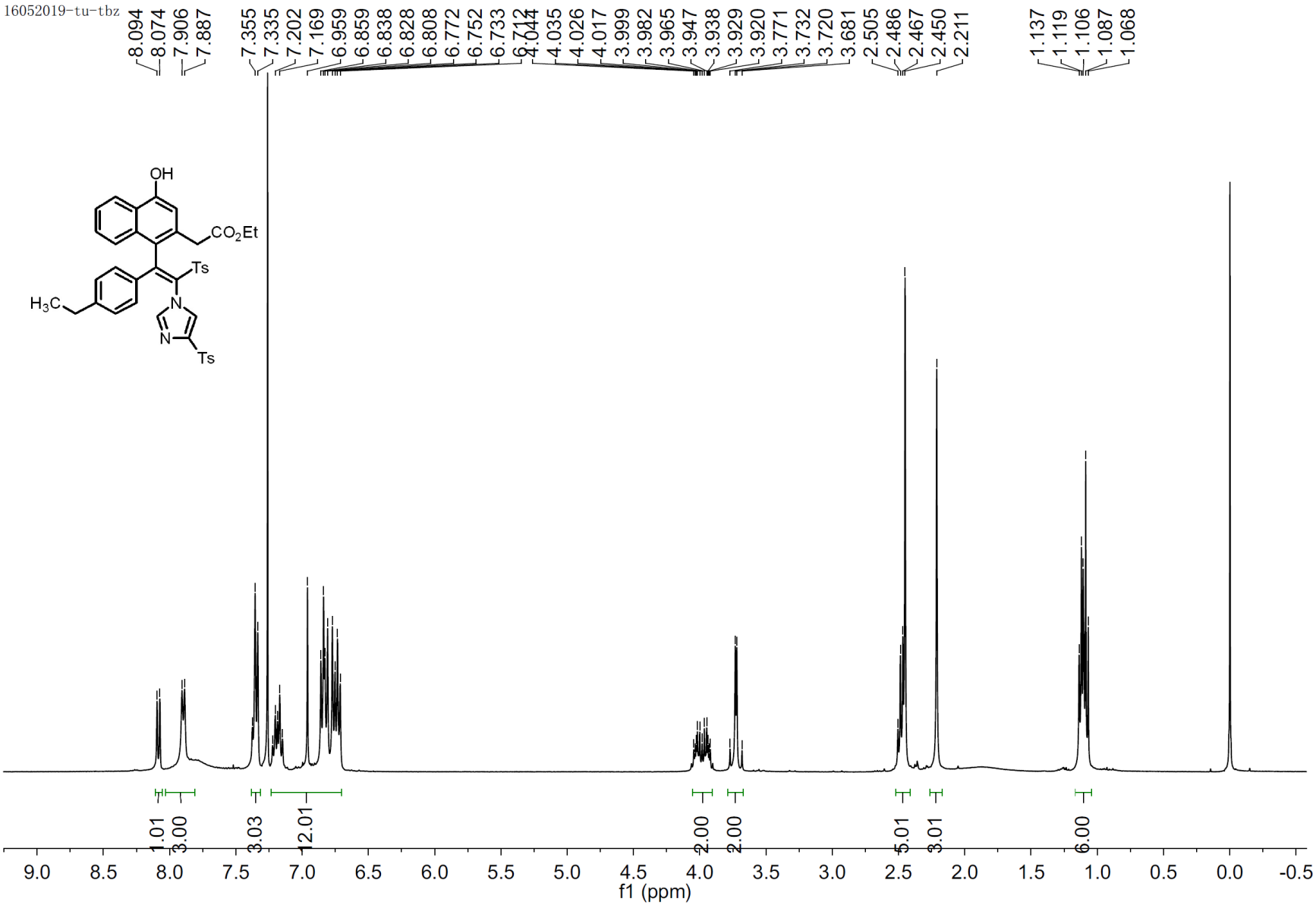
^{13}C NMR Spectrum of Compound 3a



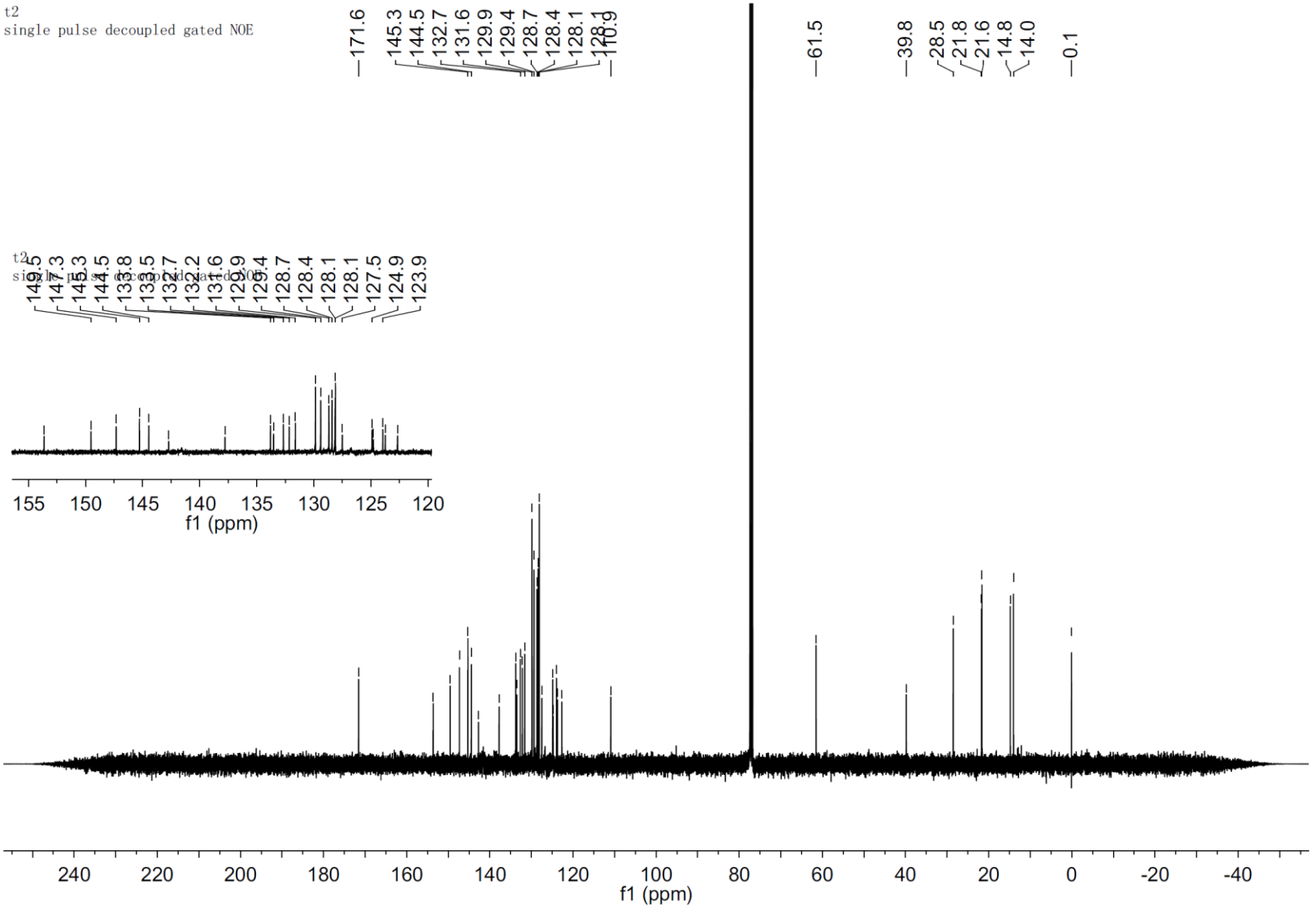
^{1}H NMR Spectrum of Compound 3b



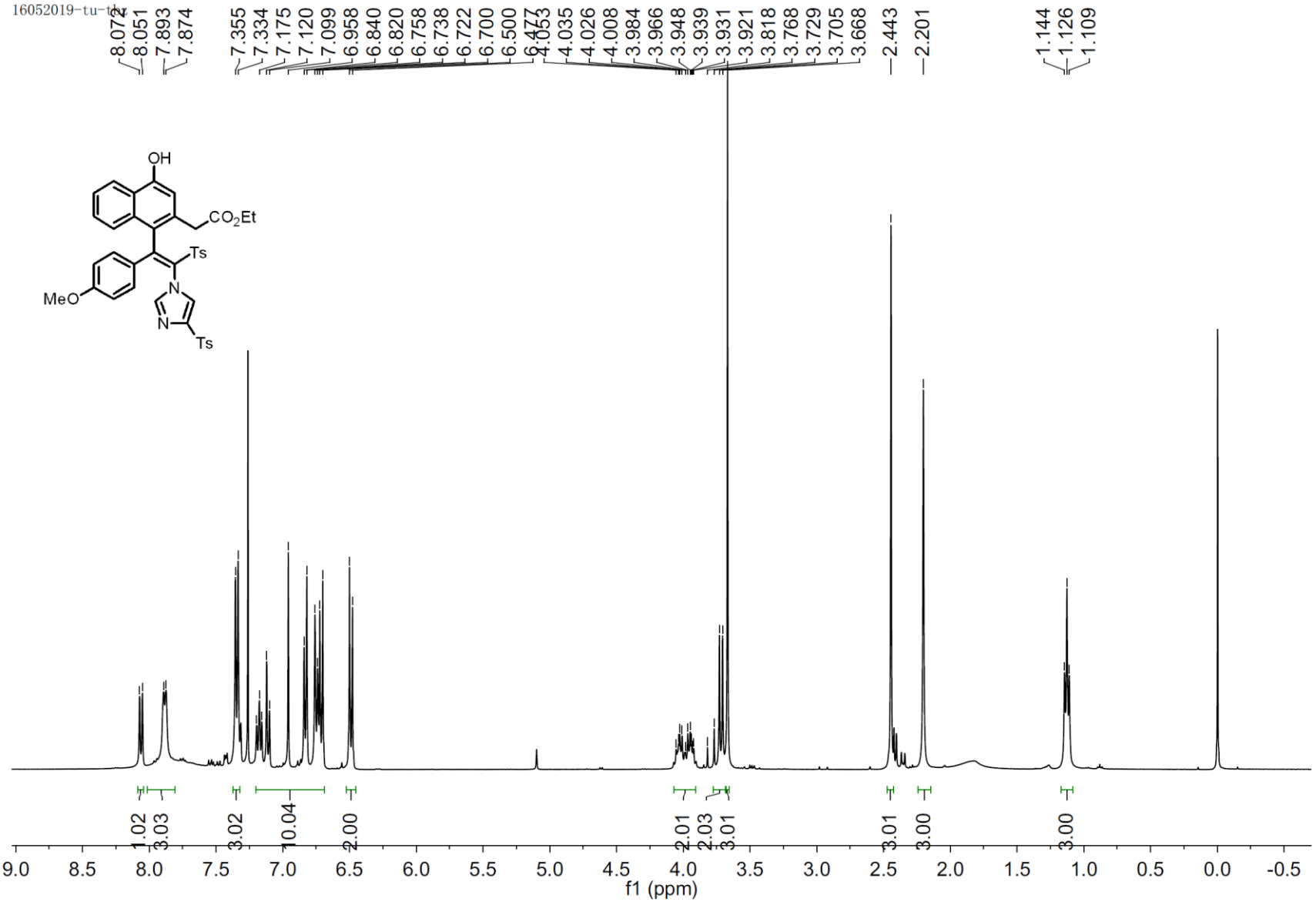
^{13}C NMR Spectrum of Compound 3b



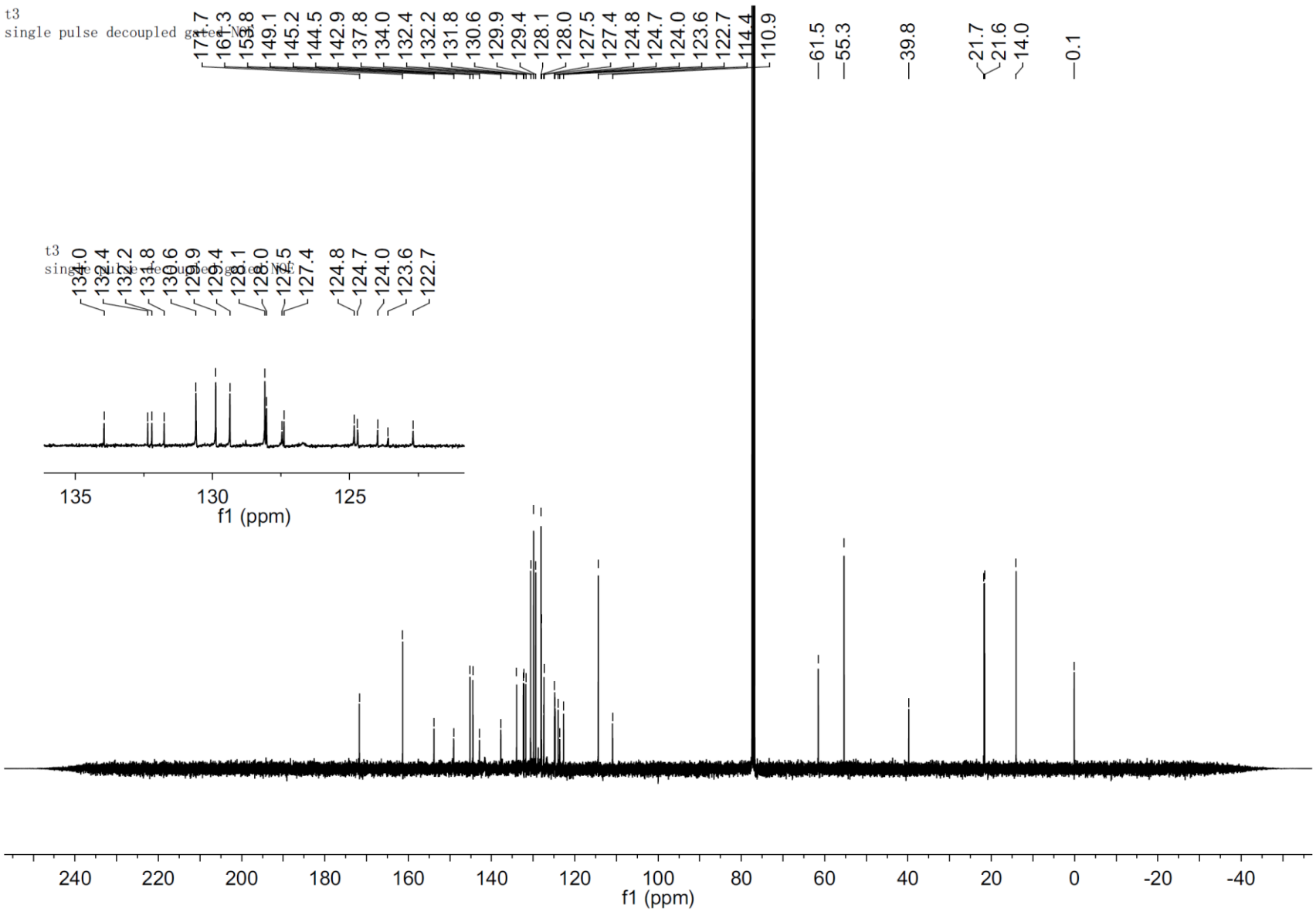
^{1}H NMR Spectrum of Compound 3c



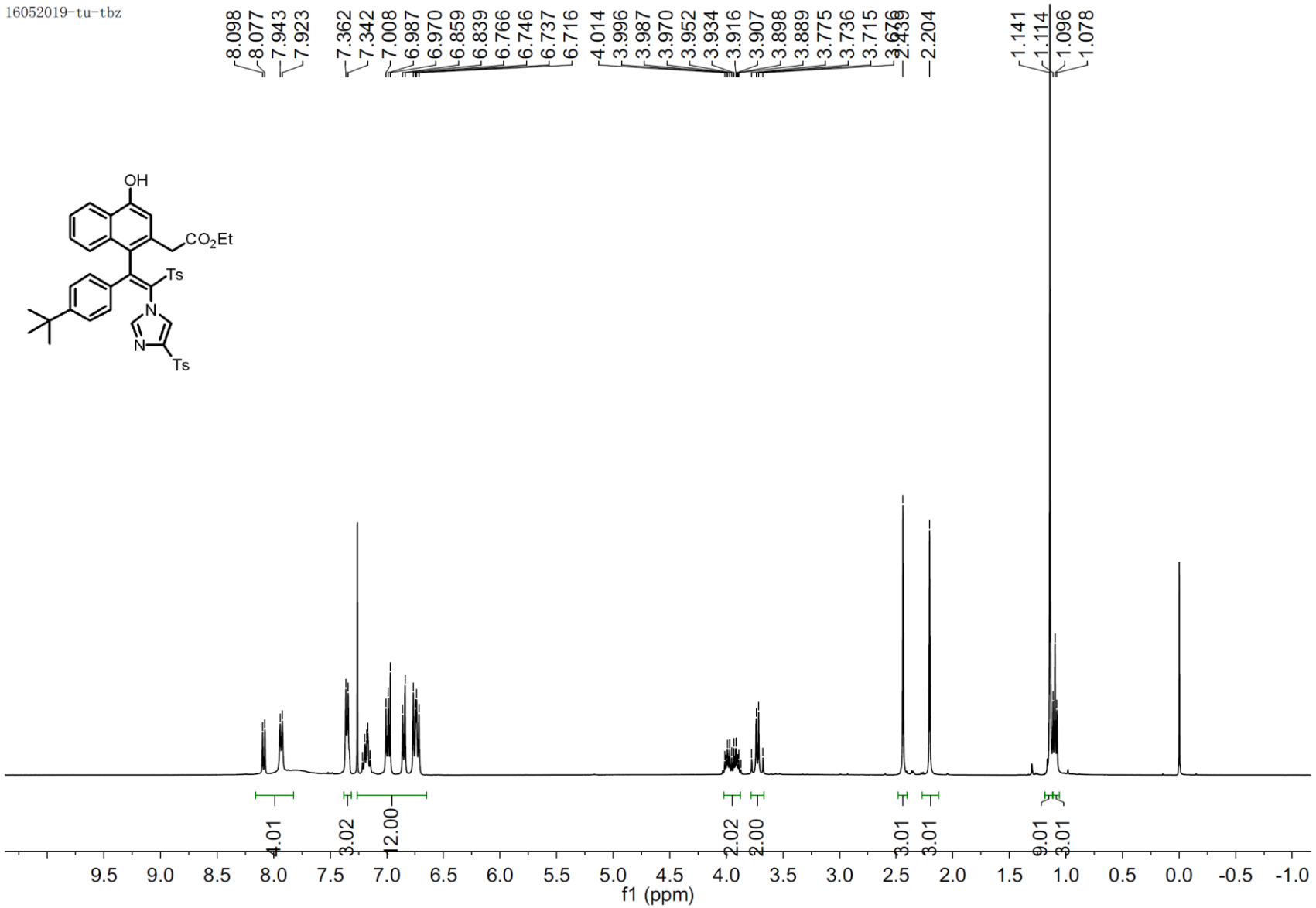
^{13}C NMR Spectrum of Compound 3c



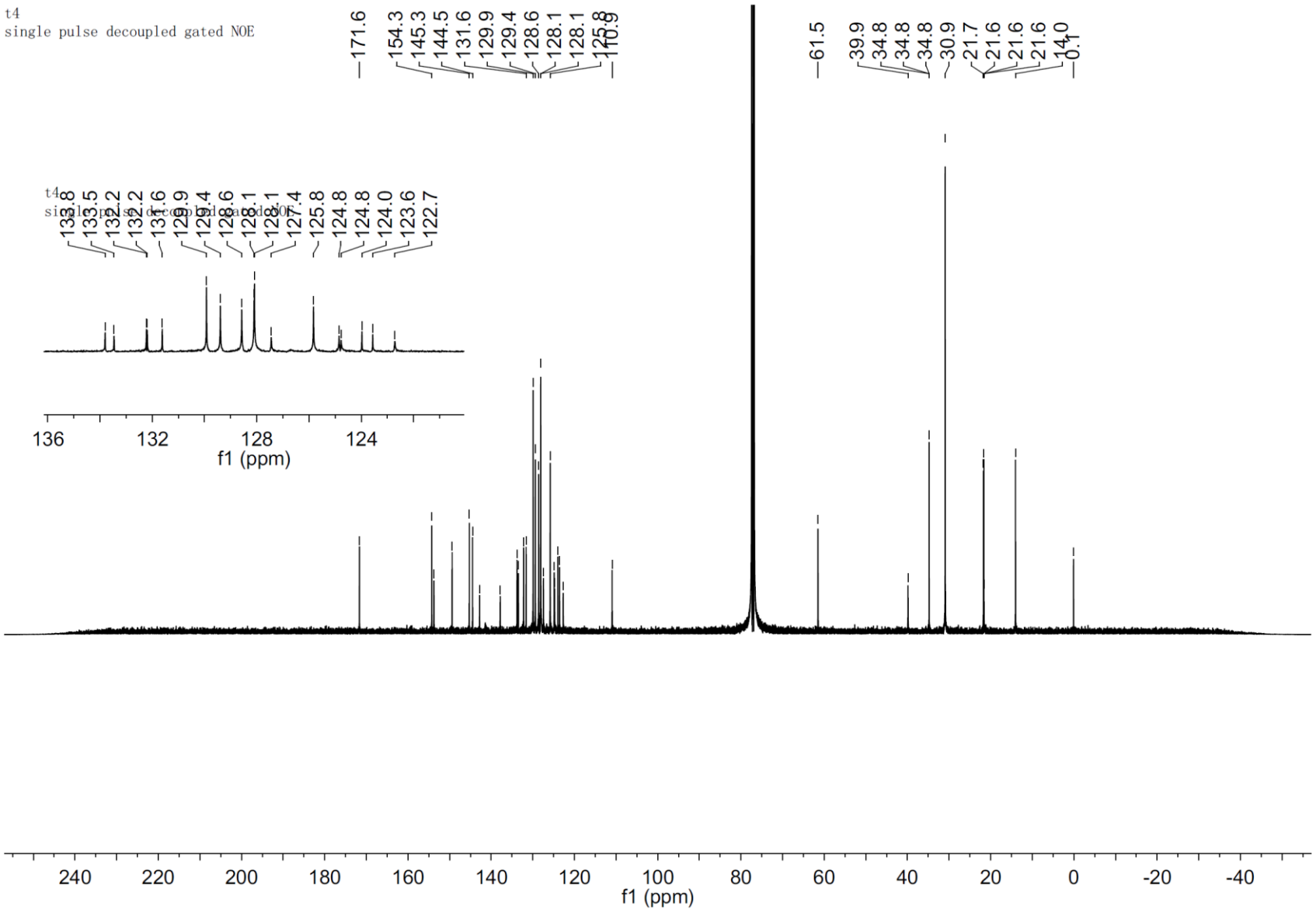
^{1}H NMR Spectrum of Compound 3d



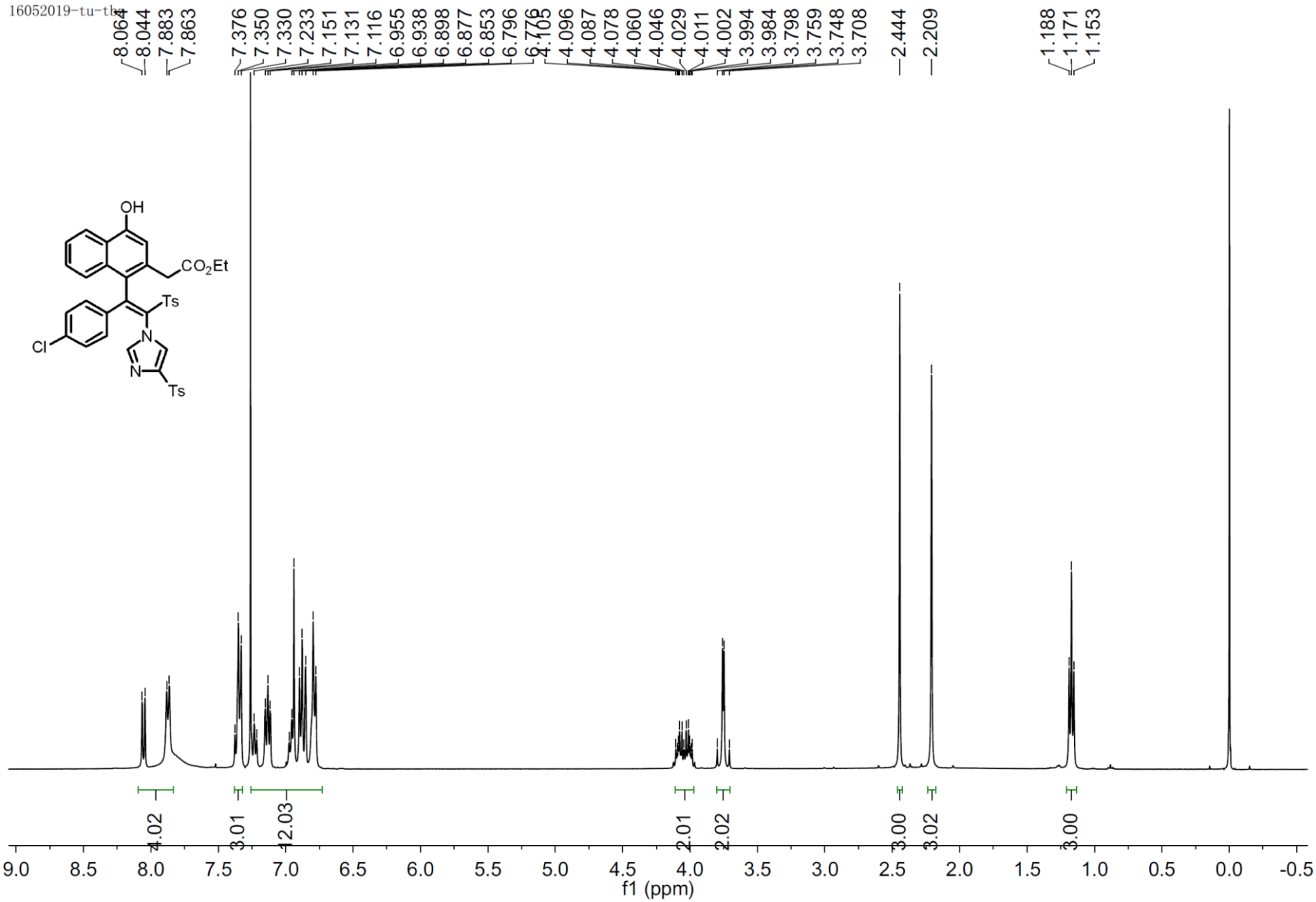
^{13}C NMR Spectrum of Compound 3d



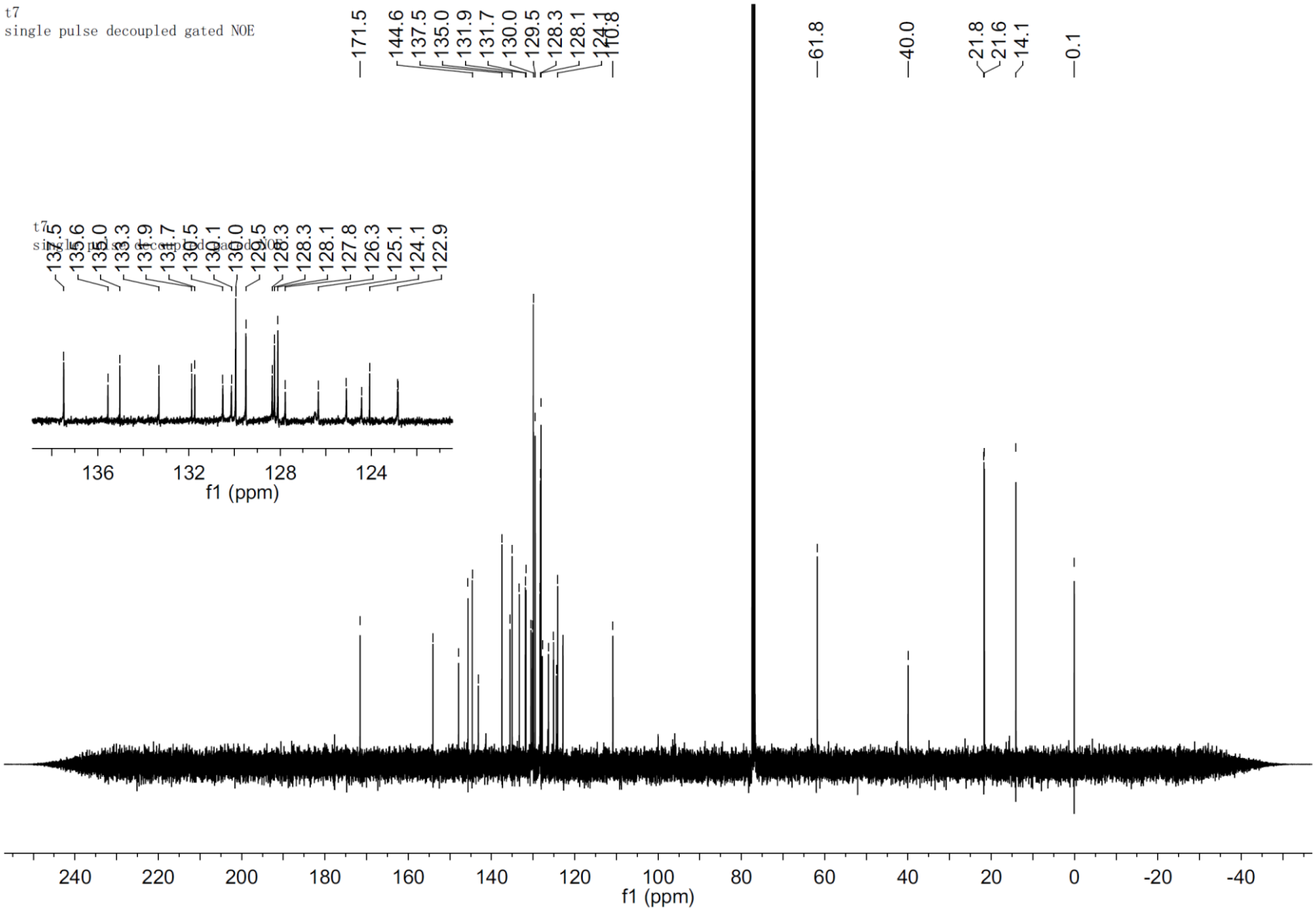
^{1}H NMR Spectrum of Compound 3e



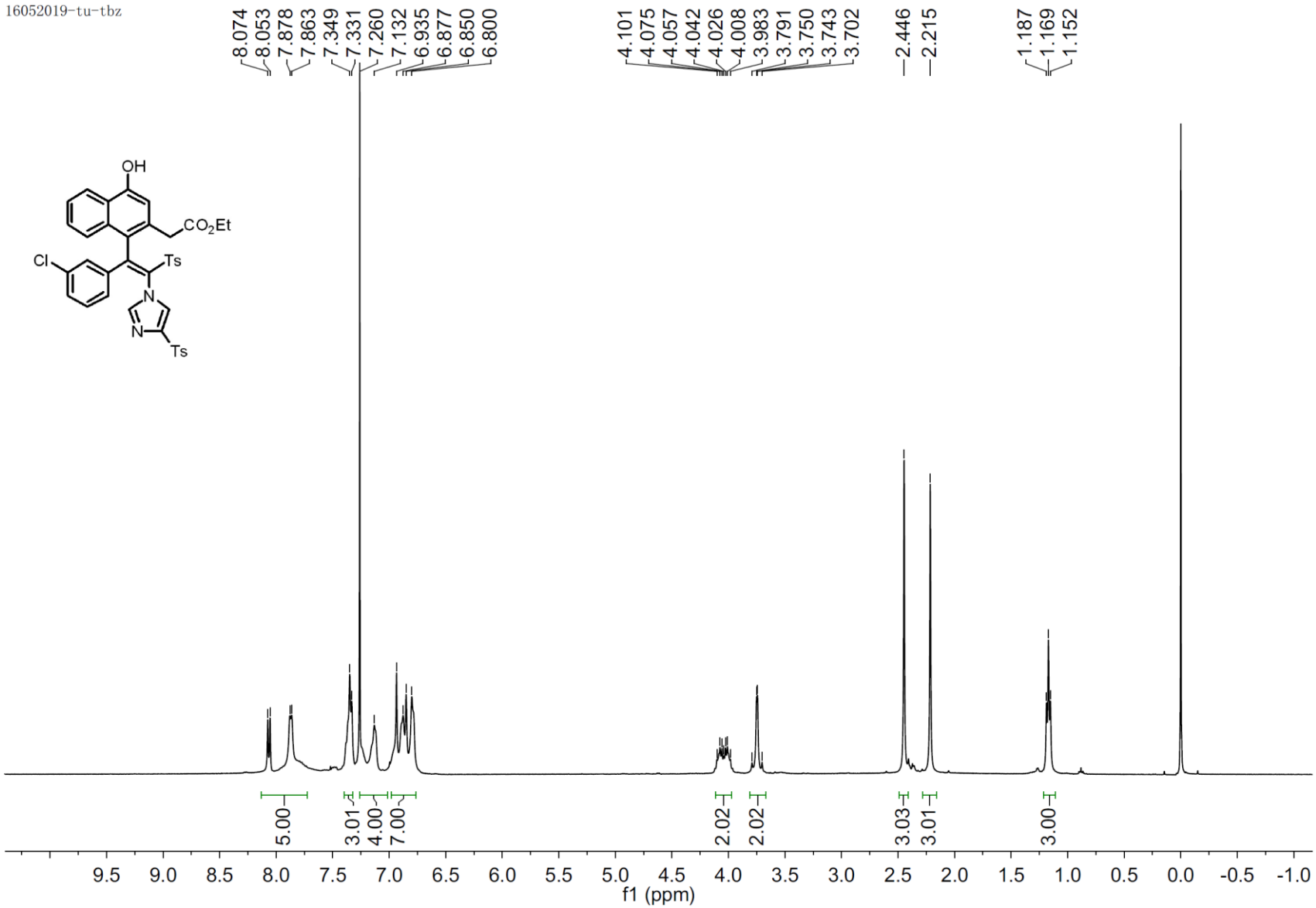
^{13}C NMR Spectrum of Compound 3e



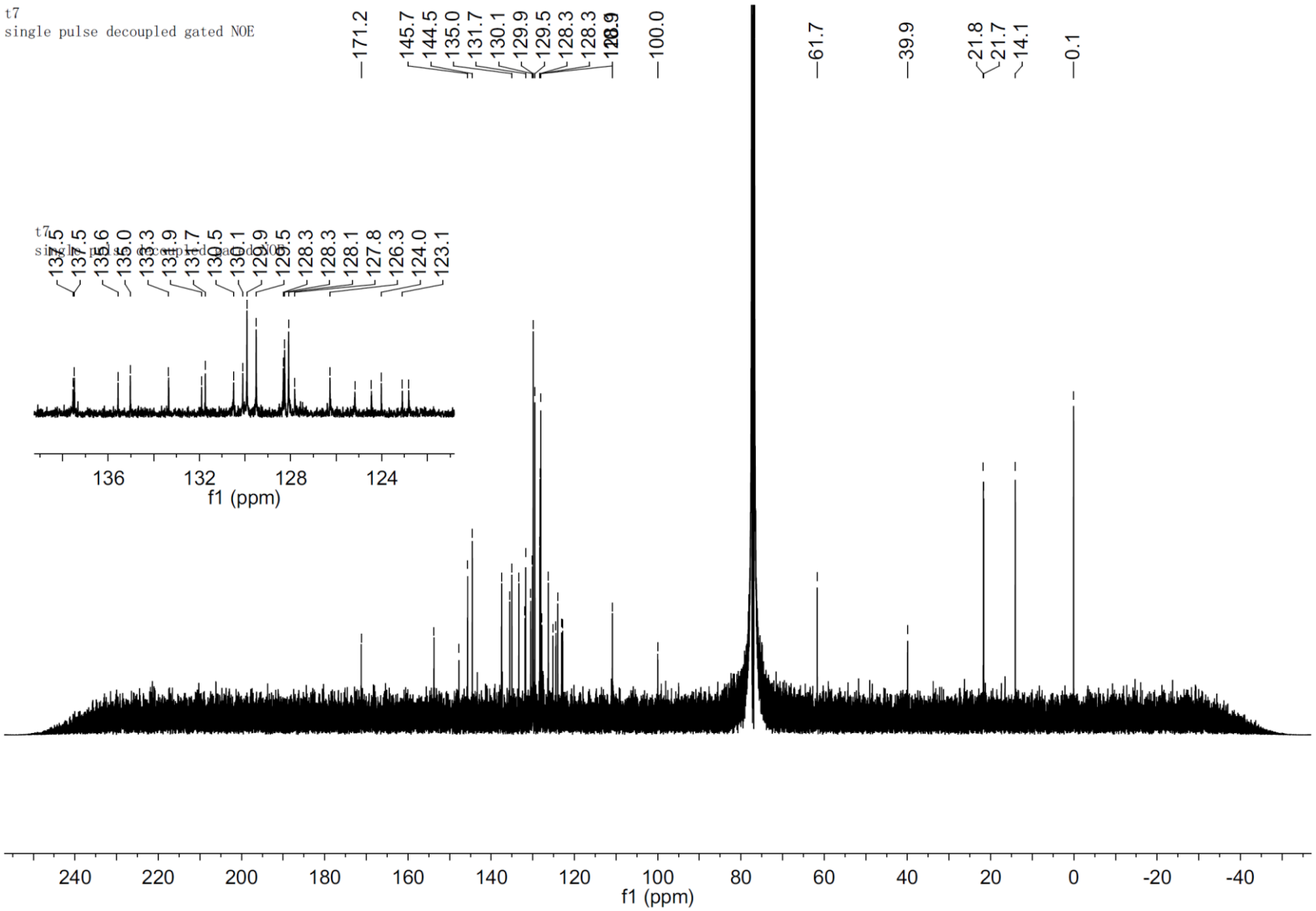
^{1}H NMR Spectrum of Compound 3f



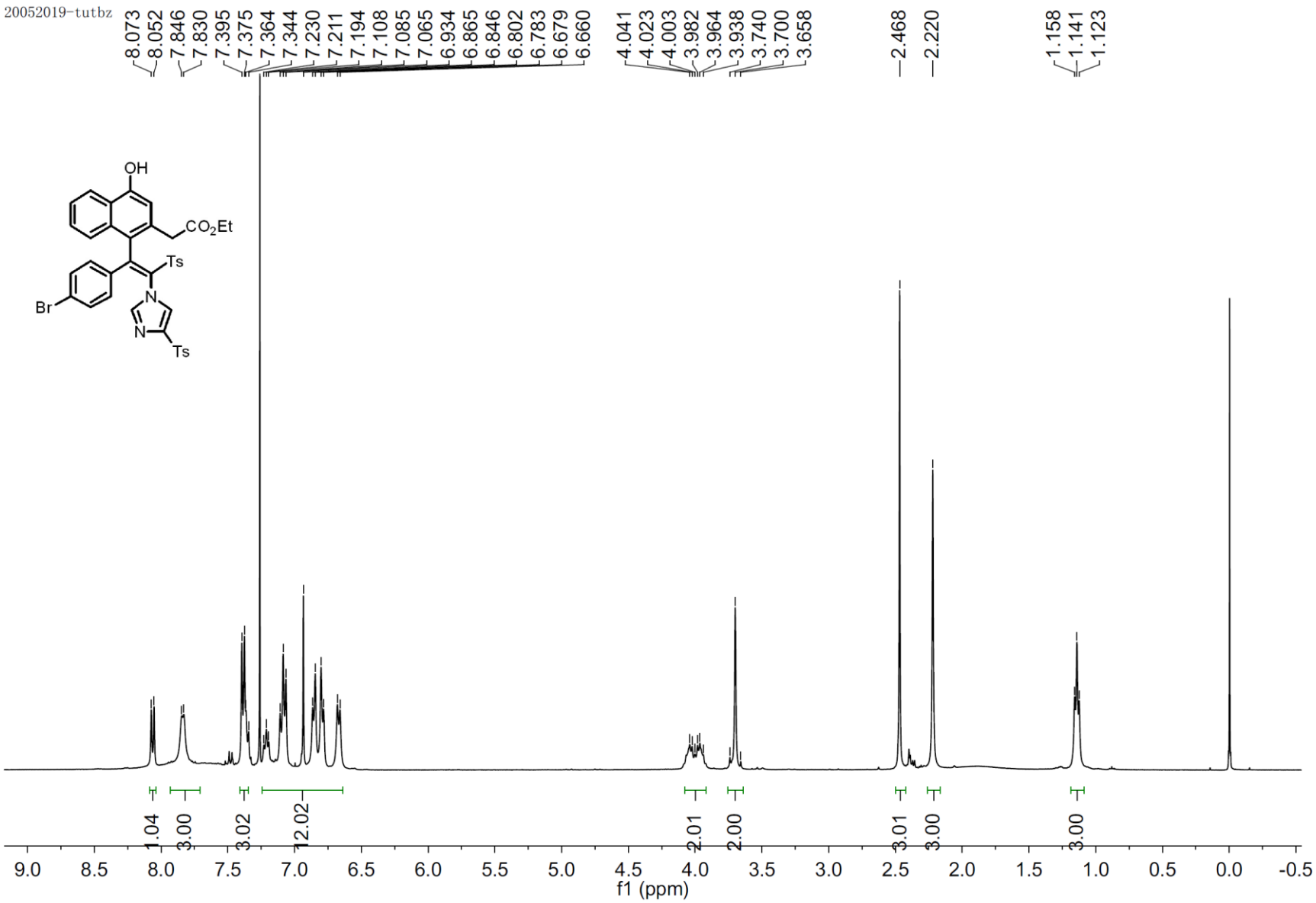
^{13}C NMR Spectrum of Compound 3f



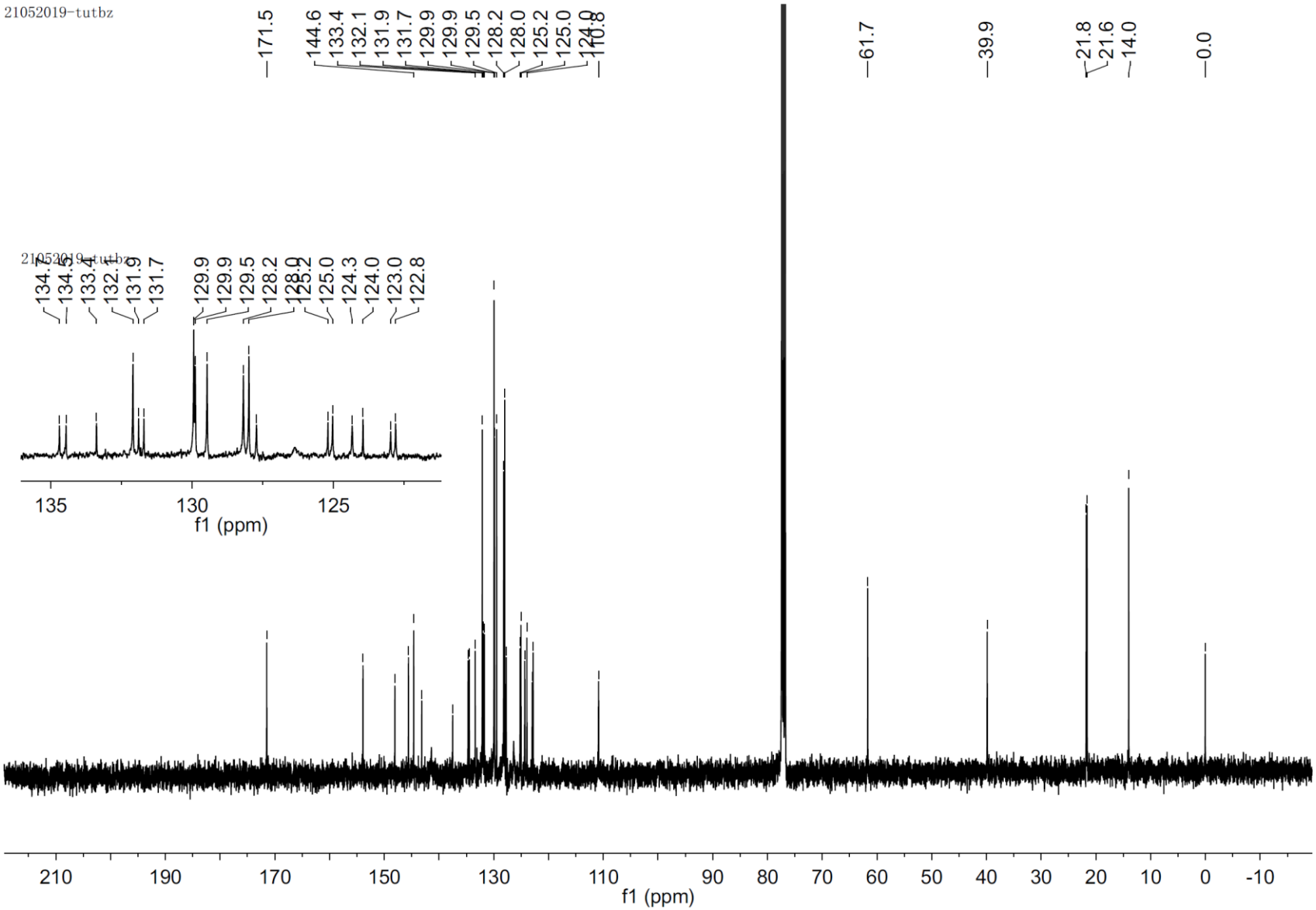
^{1}H NMR Spectrum of Compound 3g



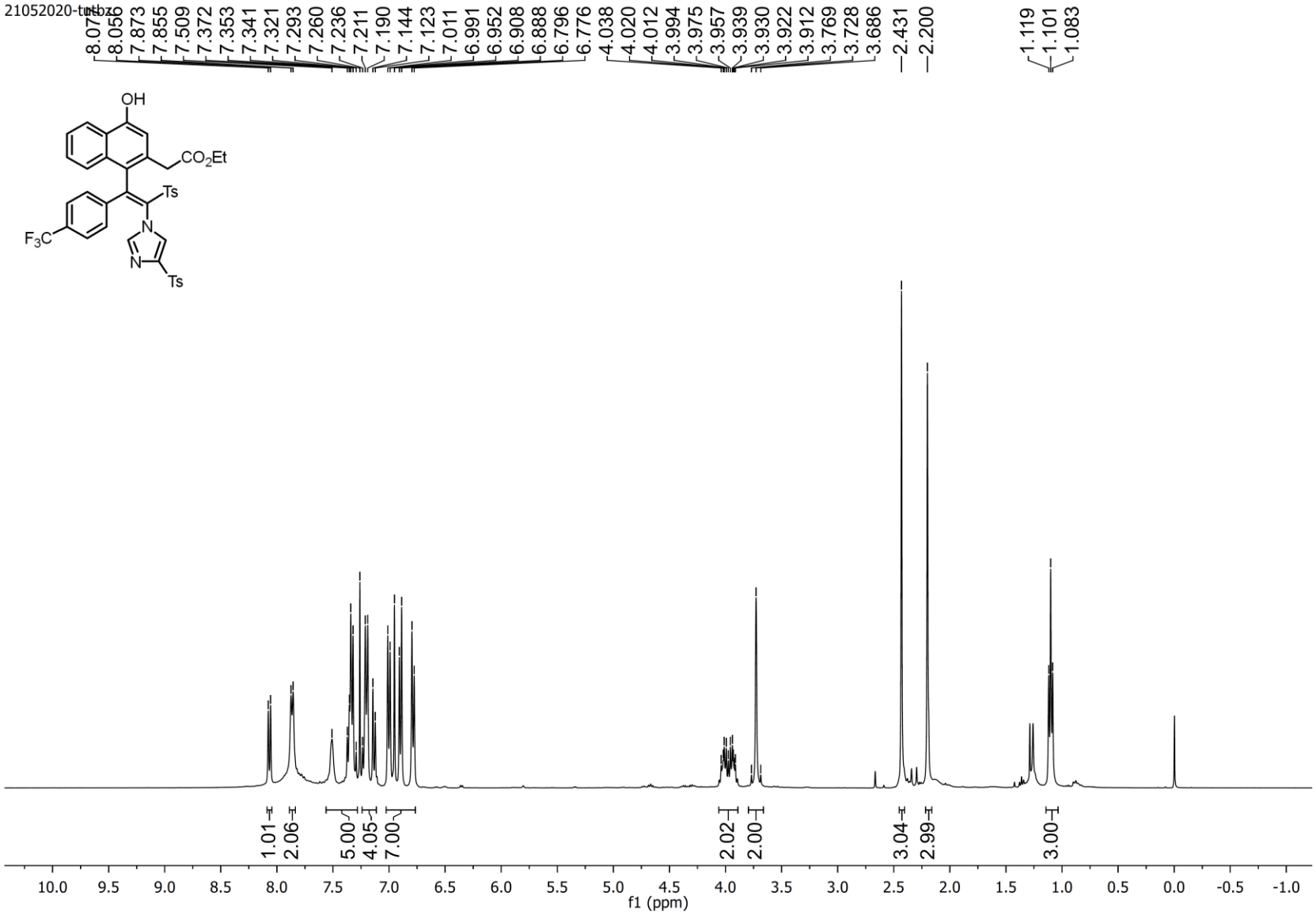
^{13}C NMR Spectrum of Compound 3g



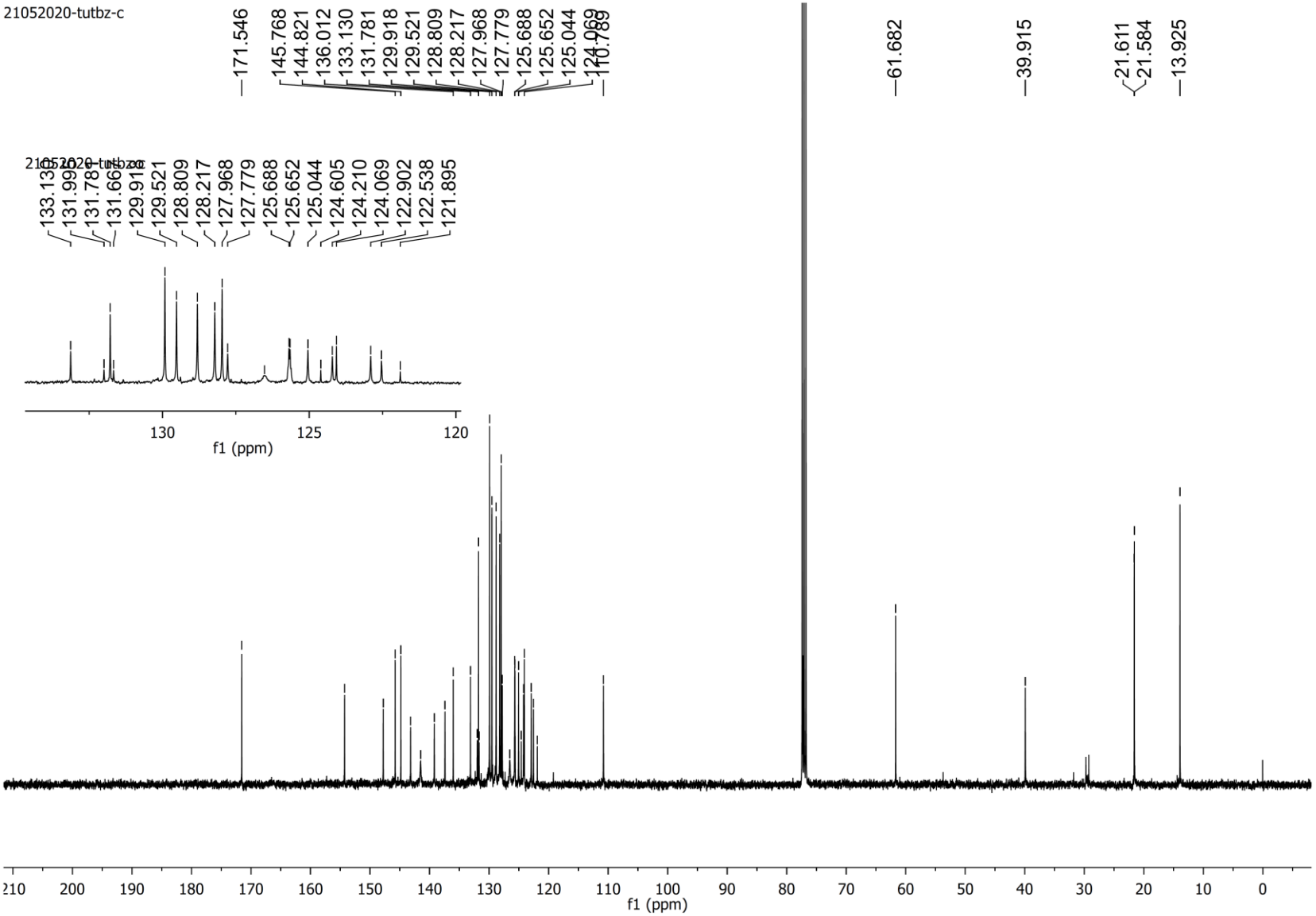
^{1}H NMR Spectrum of Compound 3h



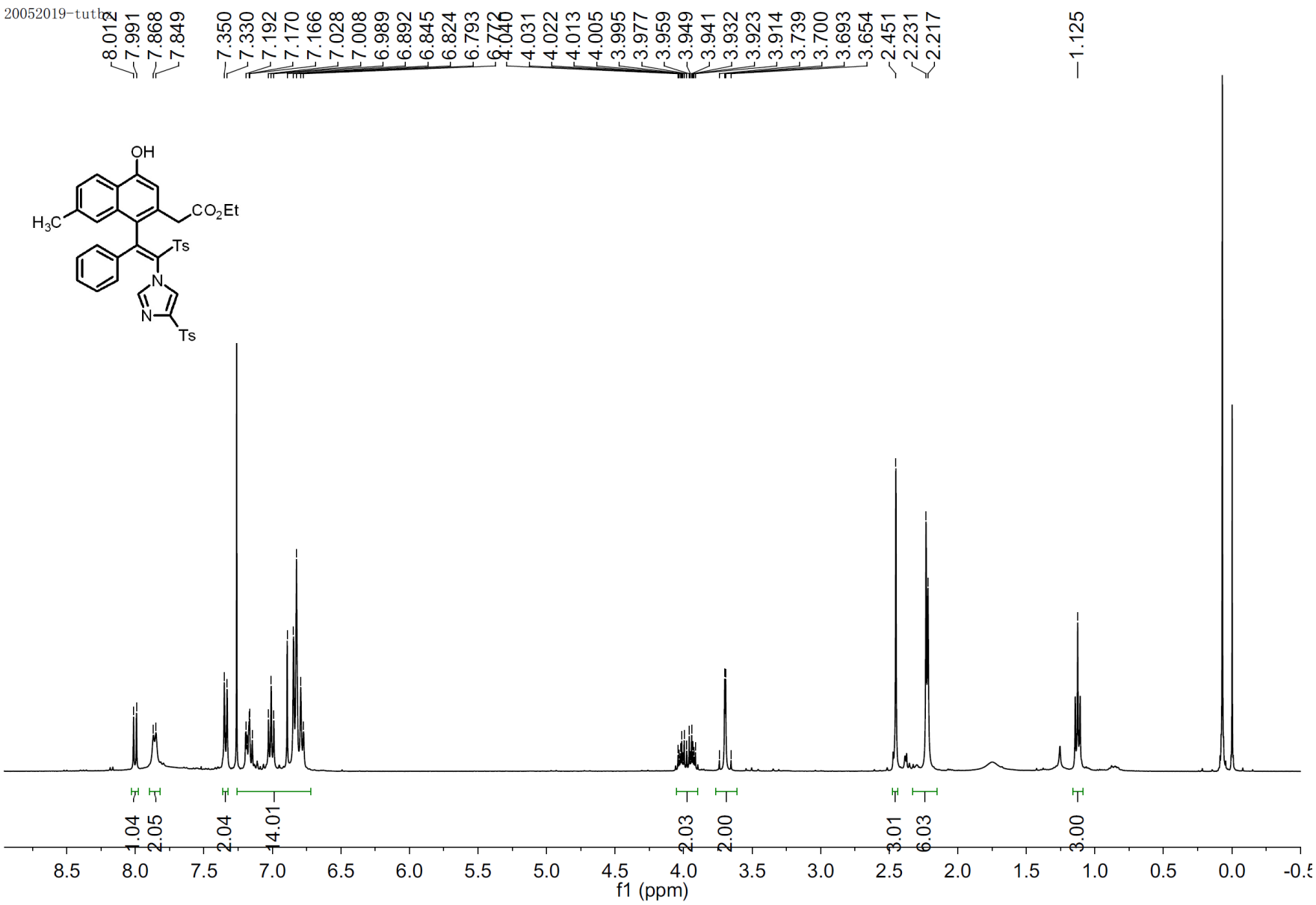
^{13}C NMR Spectrum of Compound 3h



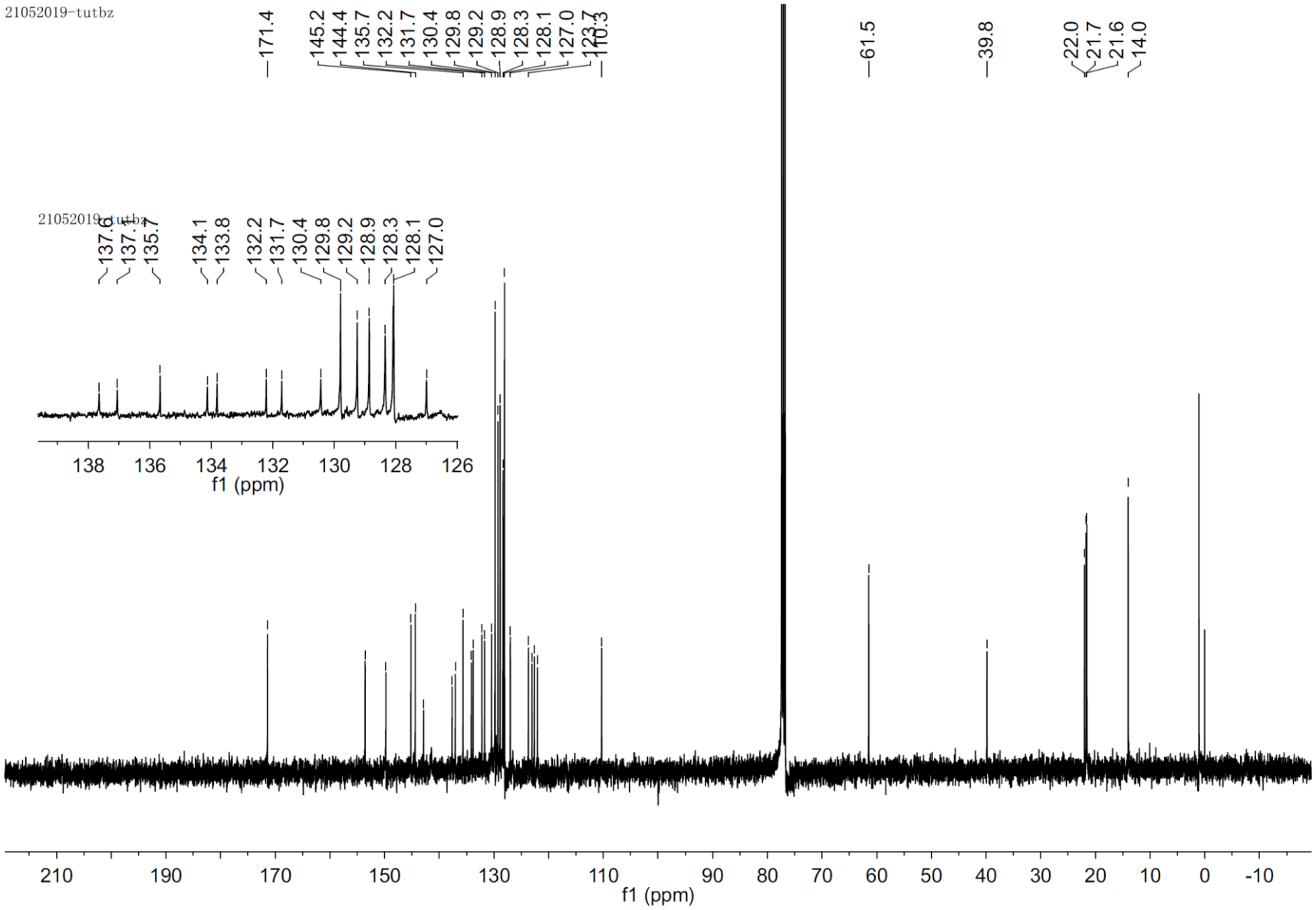
^{1}H NMR Spectrum of Compound 3i



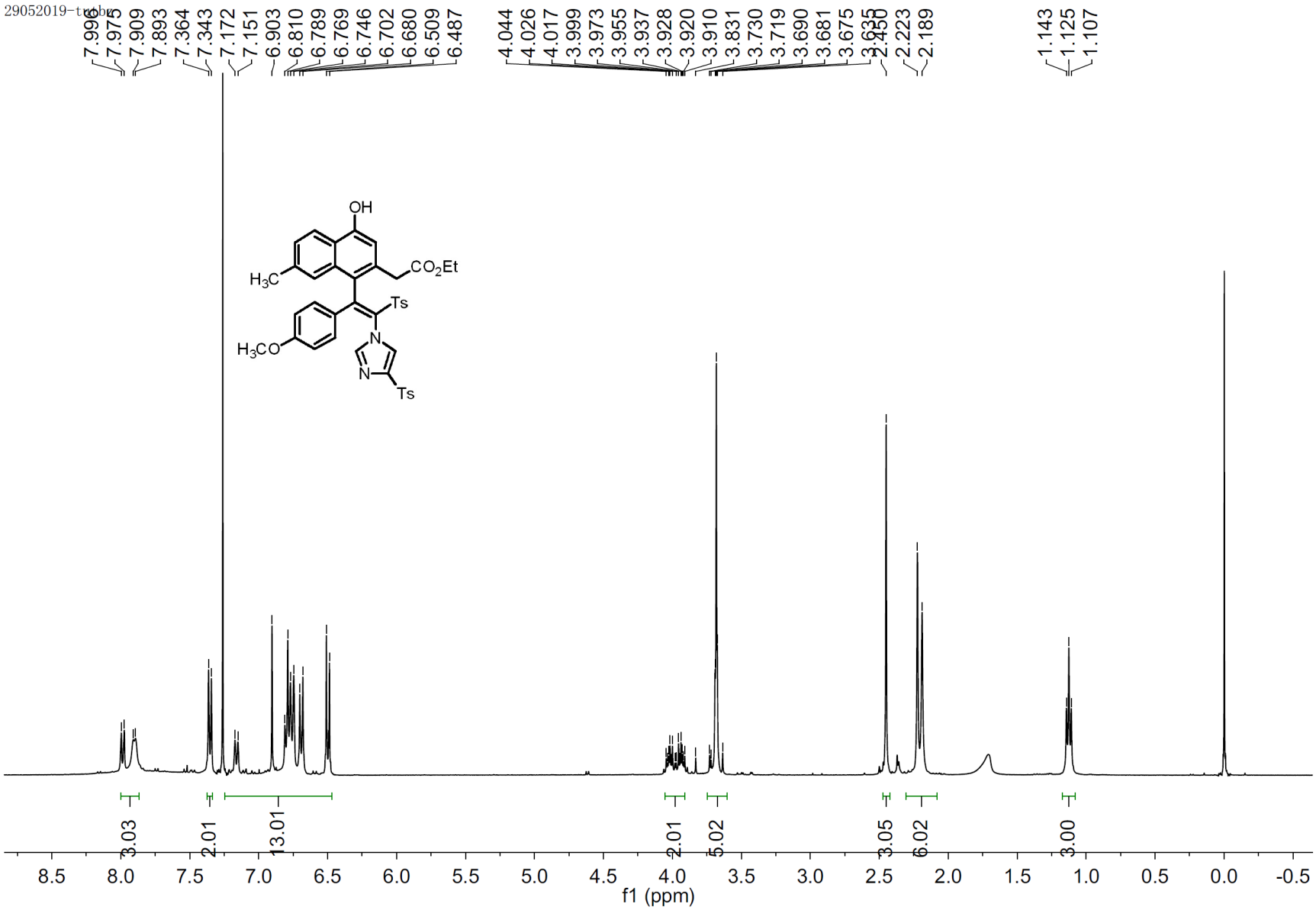
^{13}C NMR Spectrum of Compound 3i



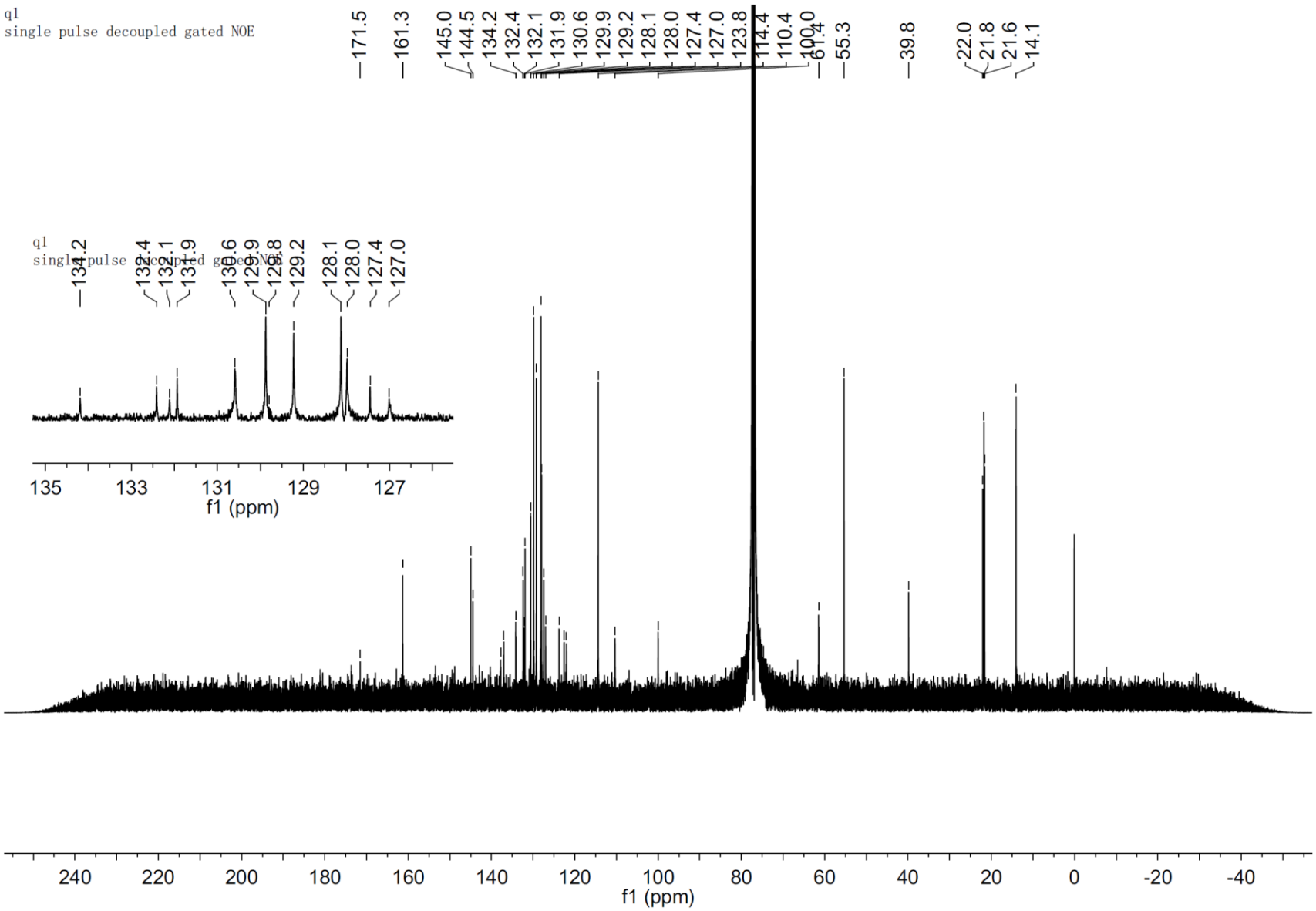
^{1}H NMR Spectrum of Compound 3k



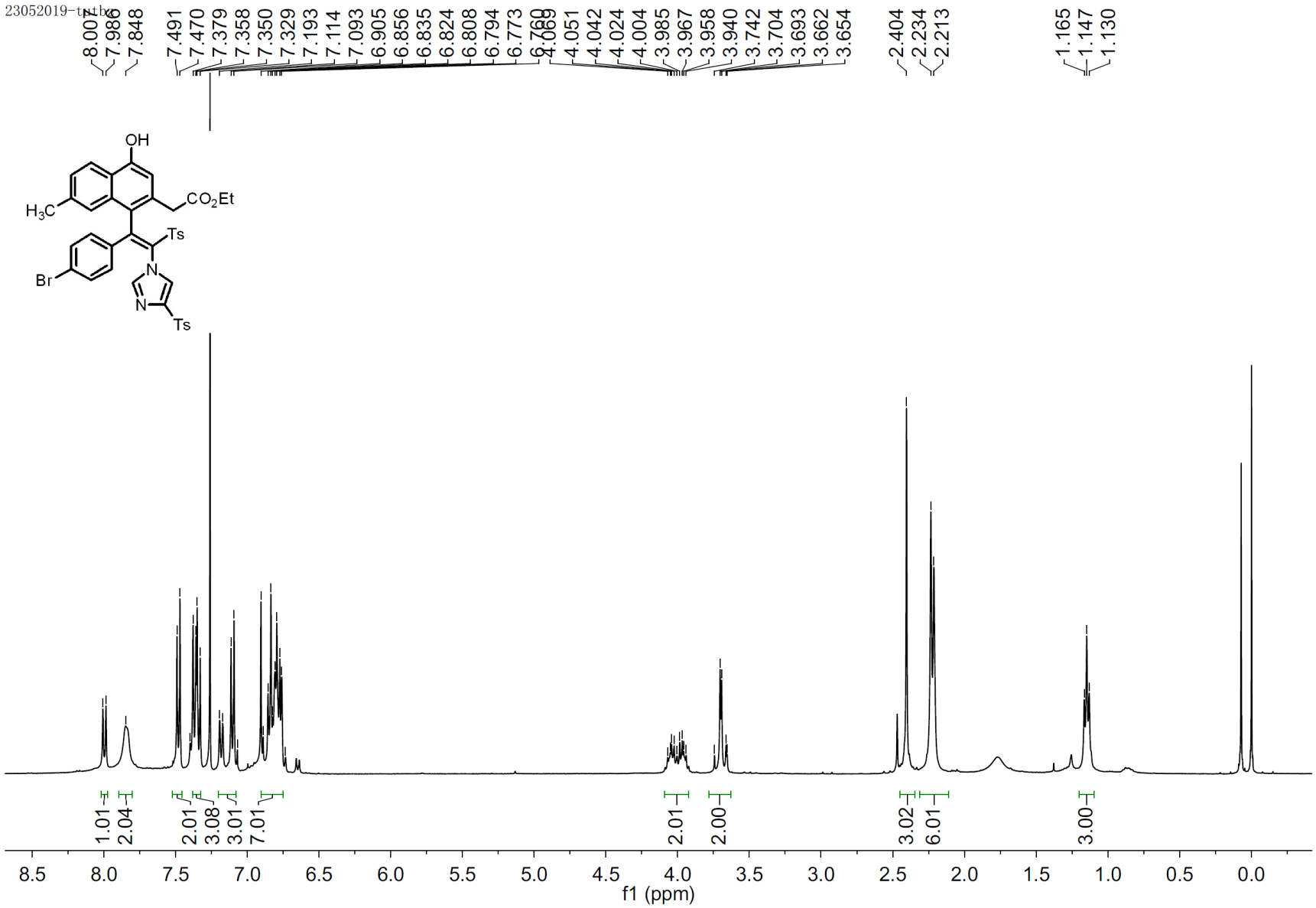
^{13}C NMR Spectrum of Compound 3k



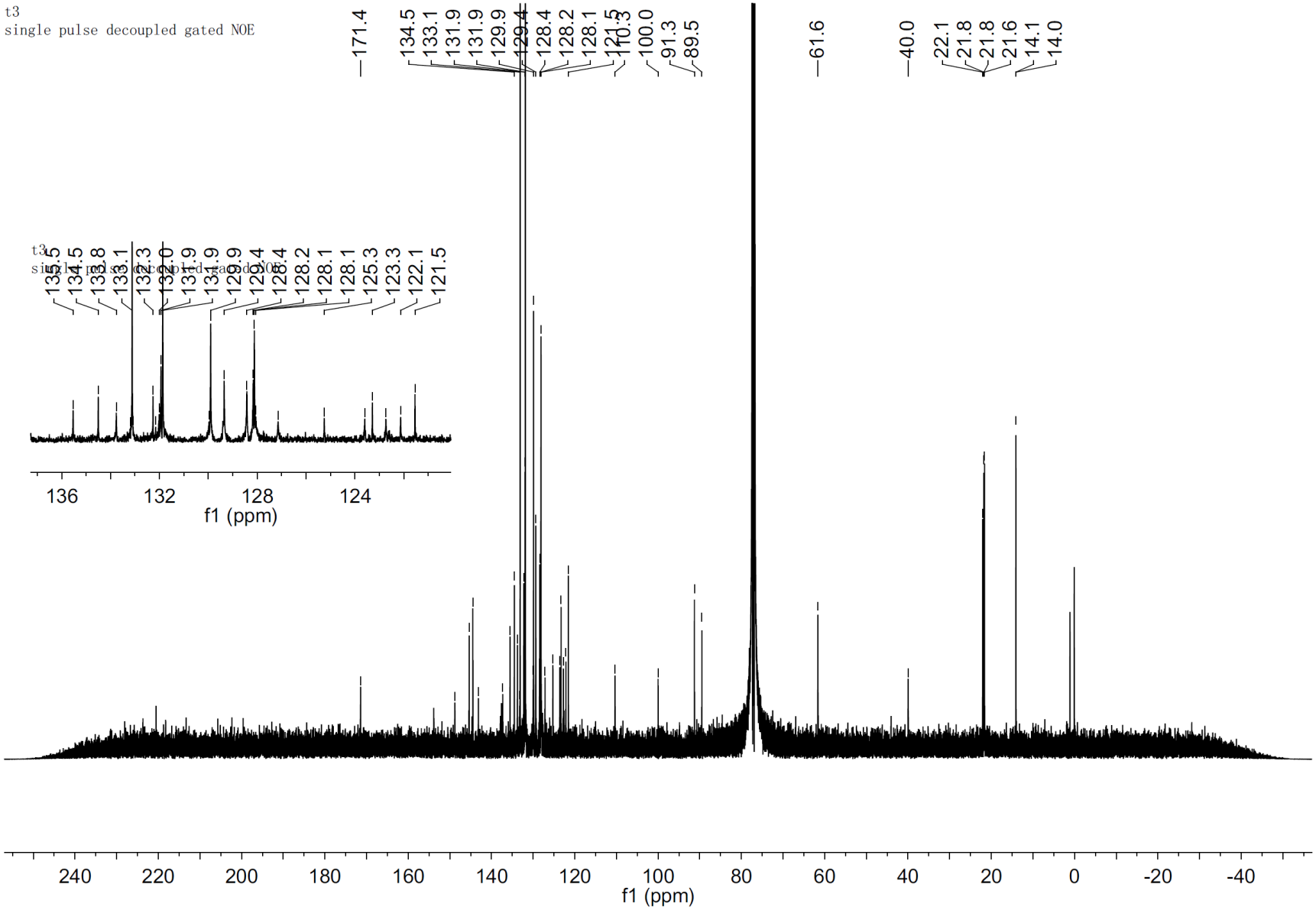
^{1}H NMR Spectrum of Compound 3l



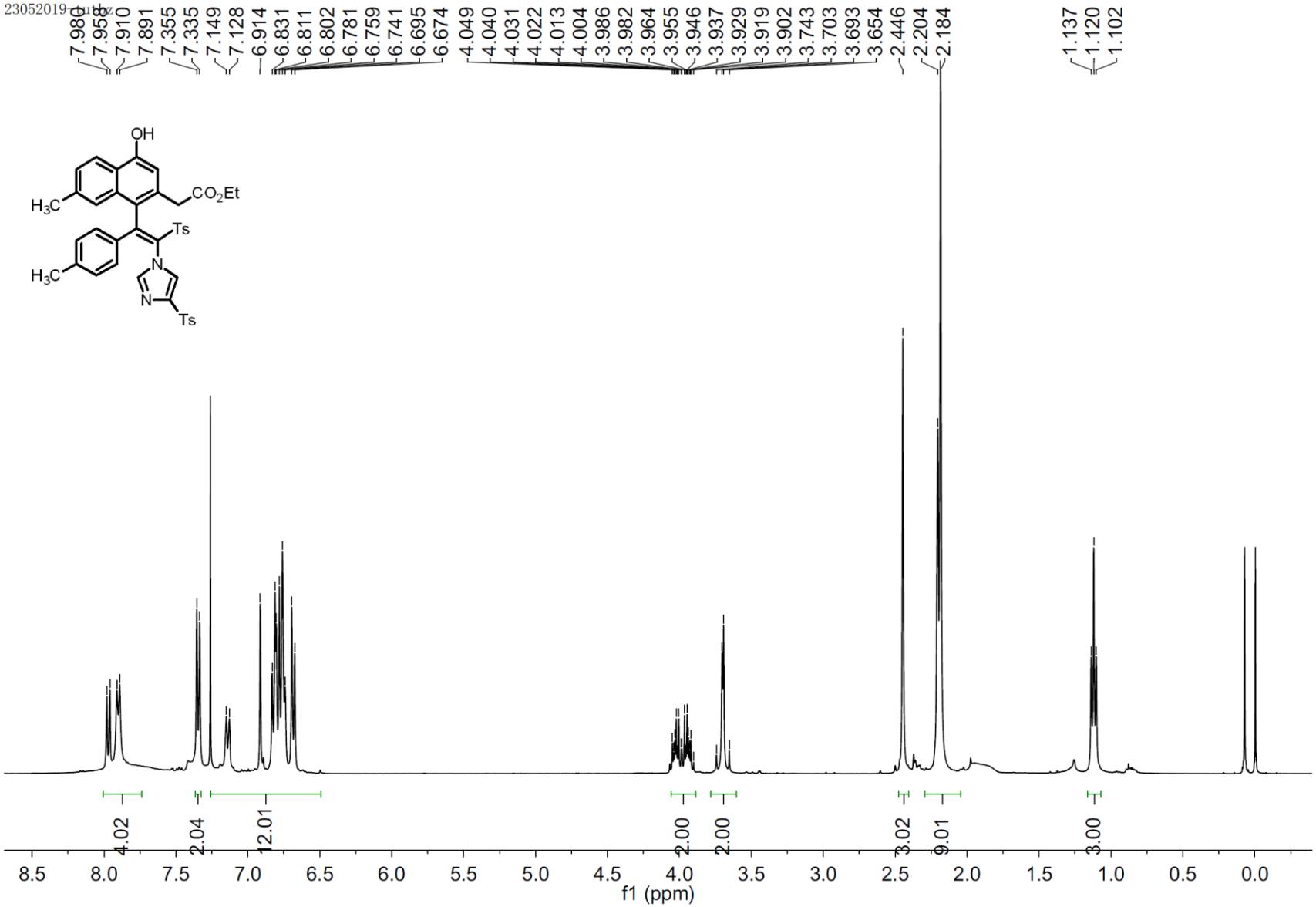
^{13}C NMR Spectrum of Compound 3l



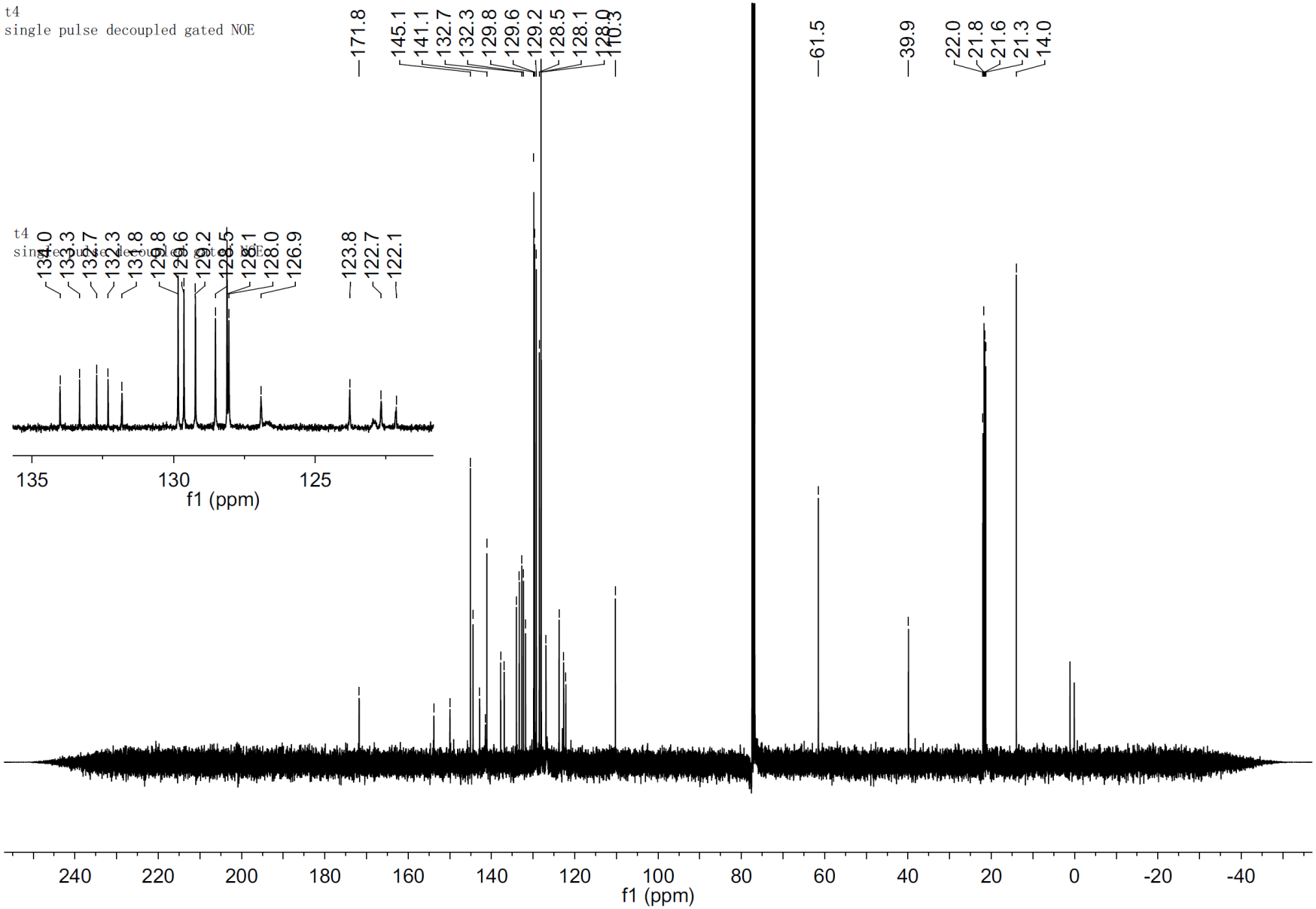
^{1}H NMR Spectrum of Compound 3m



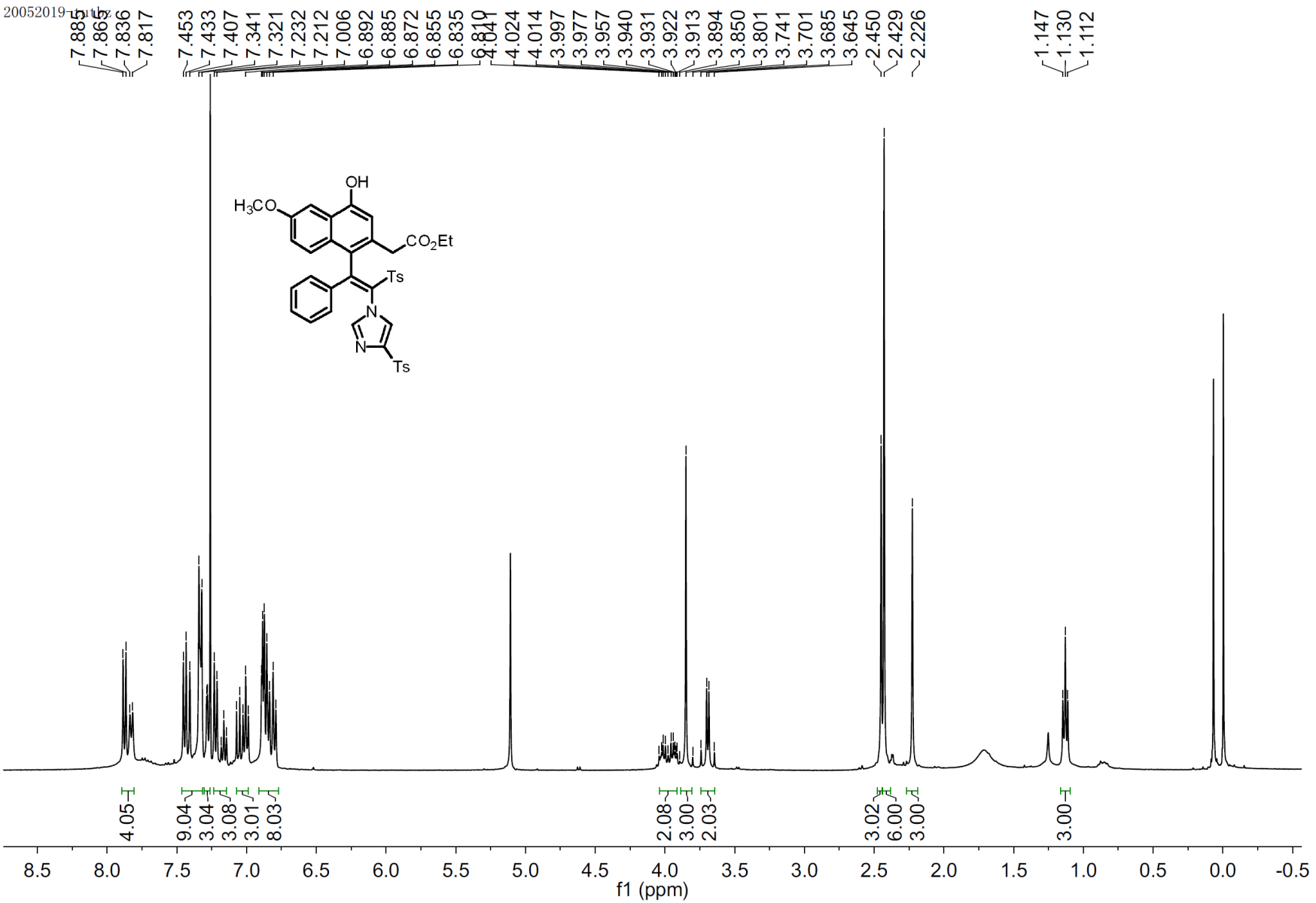
^{13}C NMR Spectrum of Compound 3m



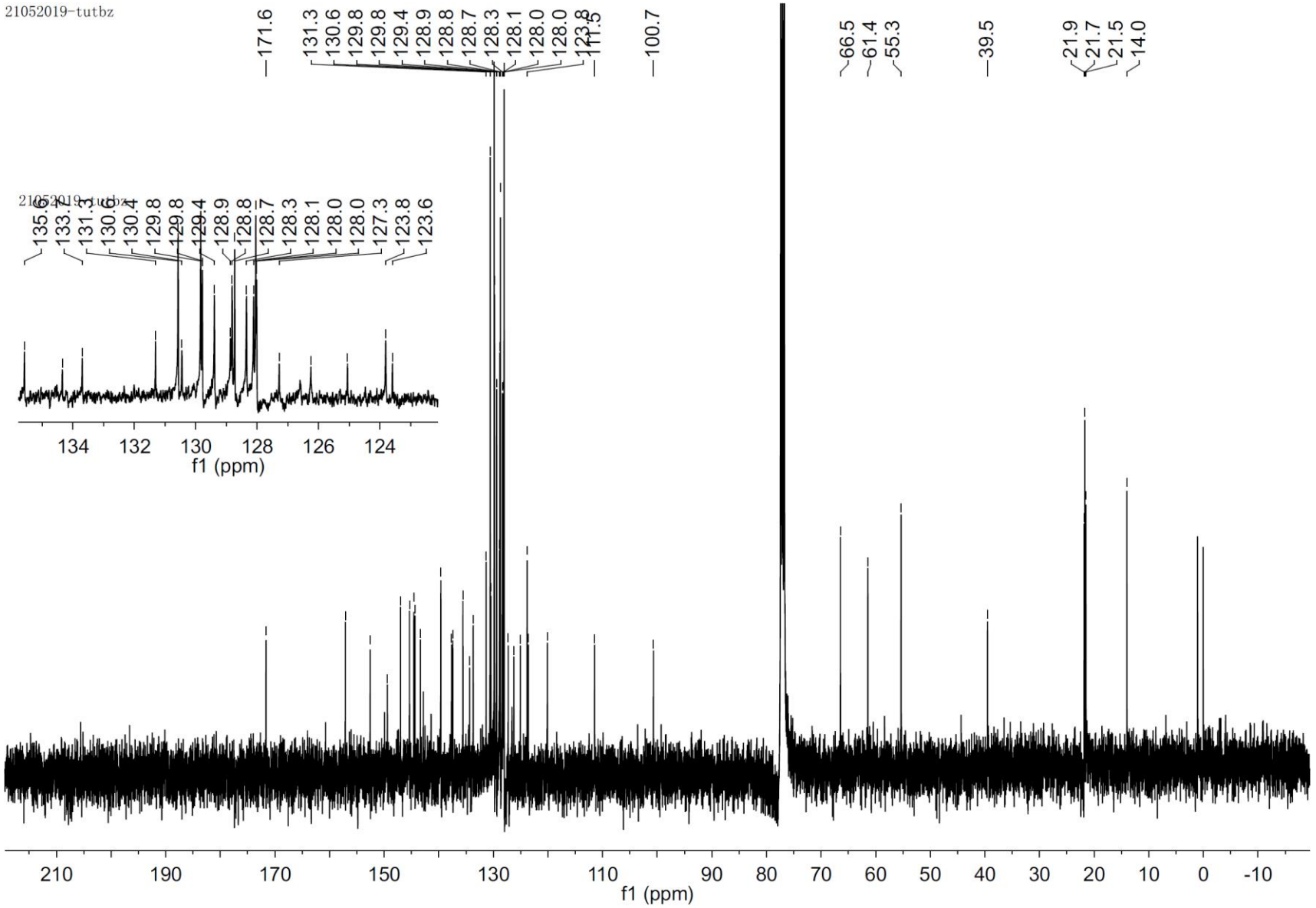
^{1}H NMR Spectrum of Compound 3n



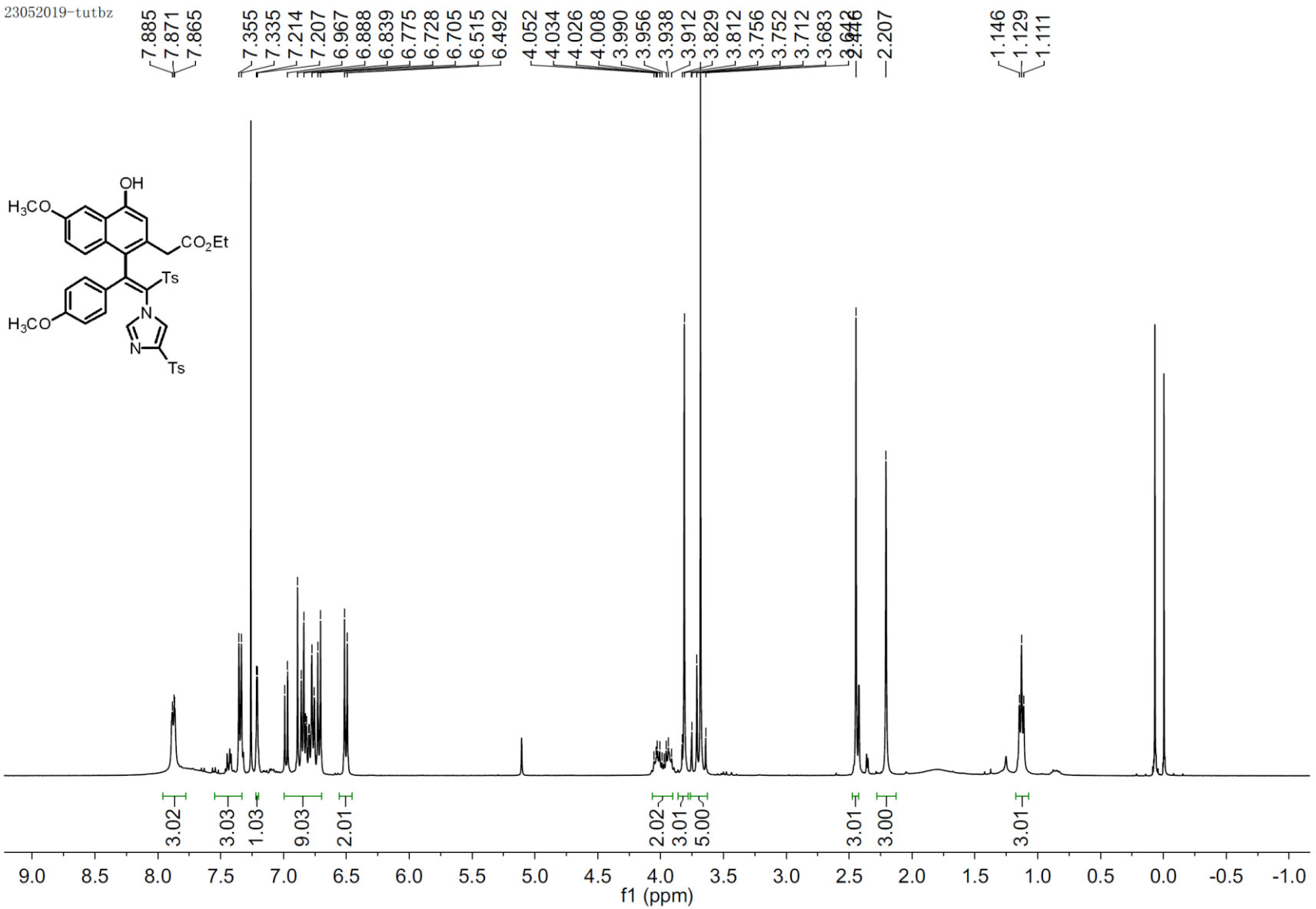
^{13}C NMR Spectrum of Compound 3n



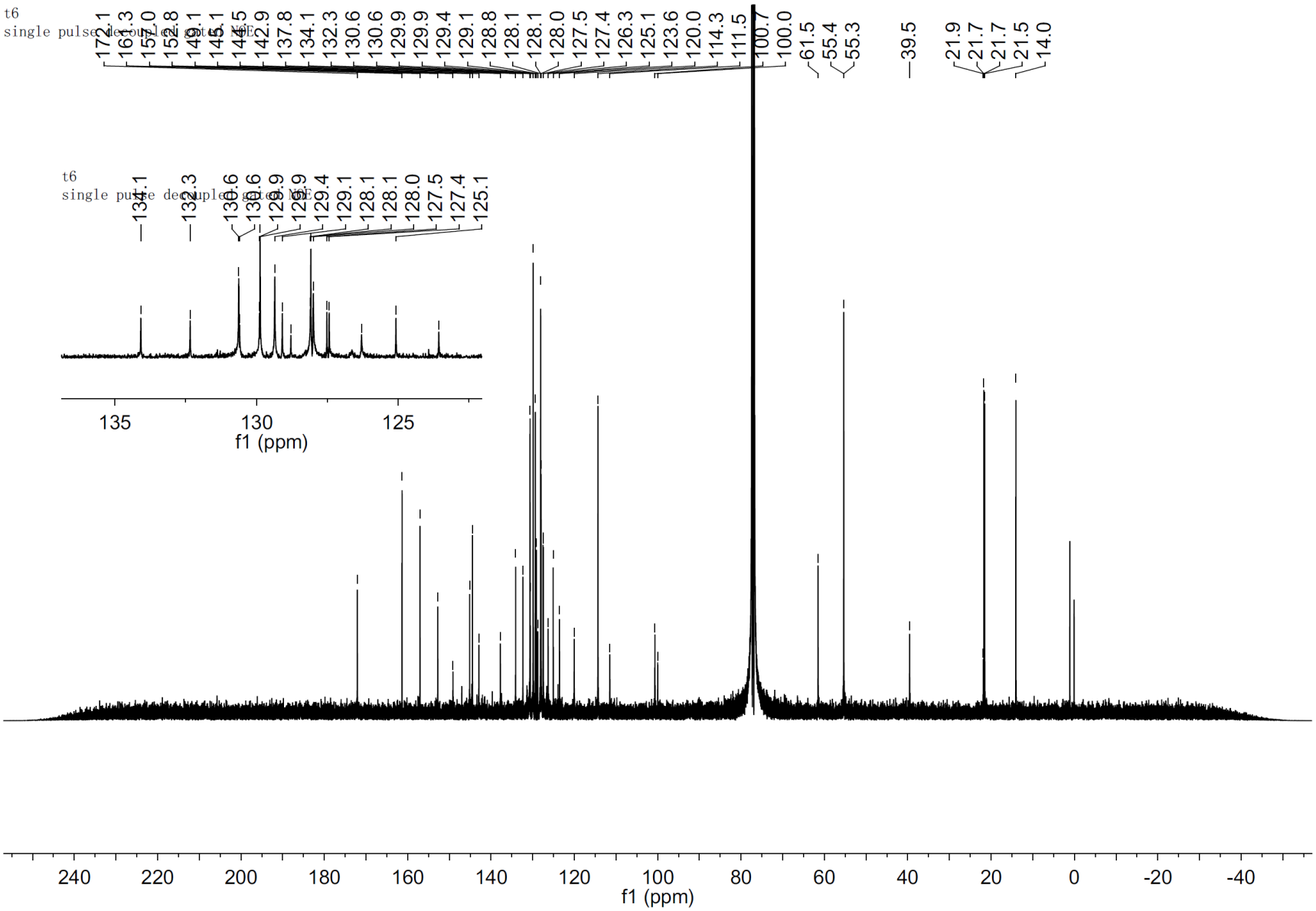
^{1}H NMR Spectrum of Compound 3o



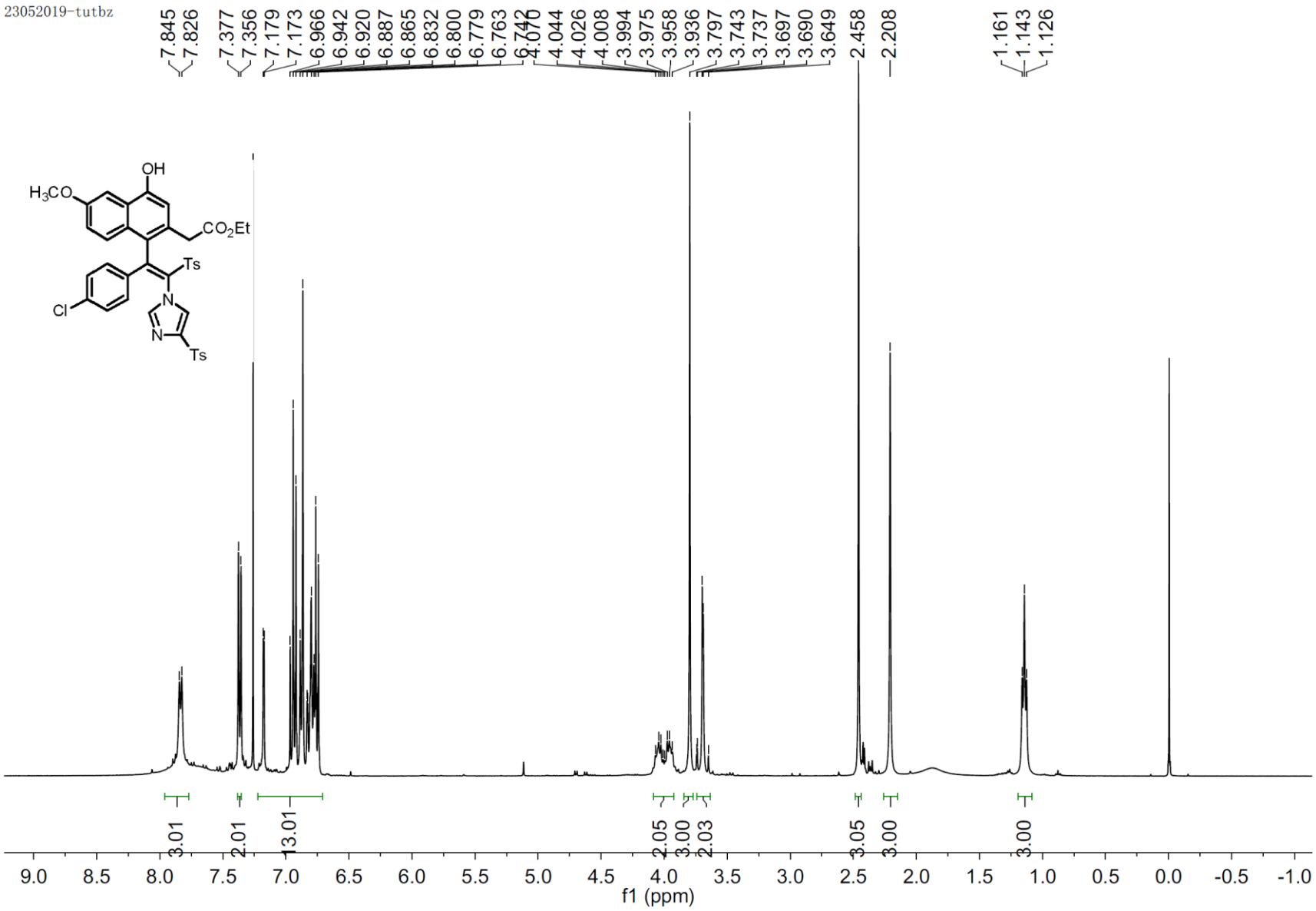
^{13}C NMR Spectrum of Compound 3o



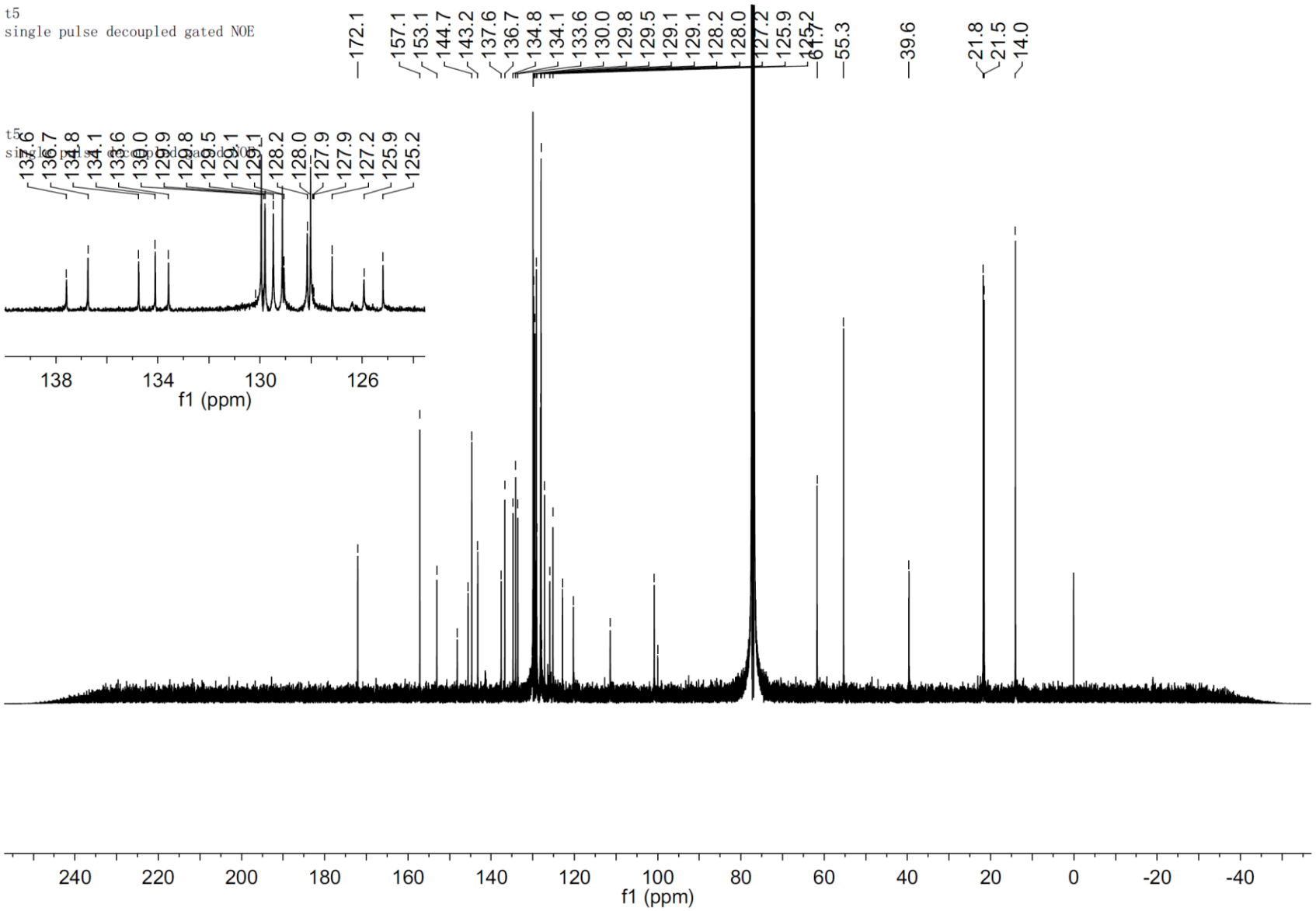
^{1}H NMR Spectrum of Compound 3p



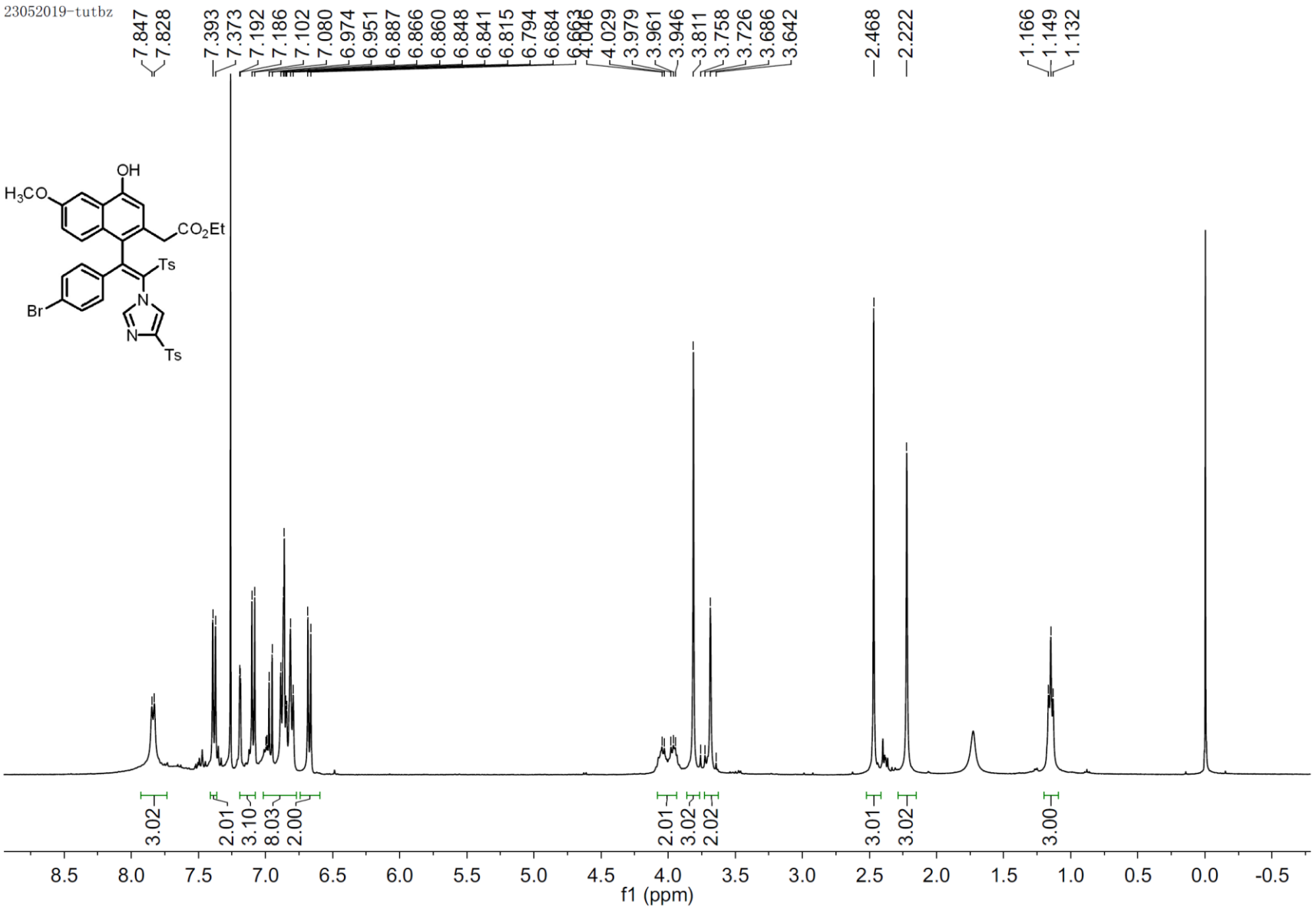
^{13}C NMR Spectrum of Compound 3p



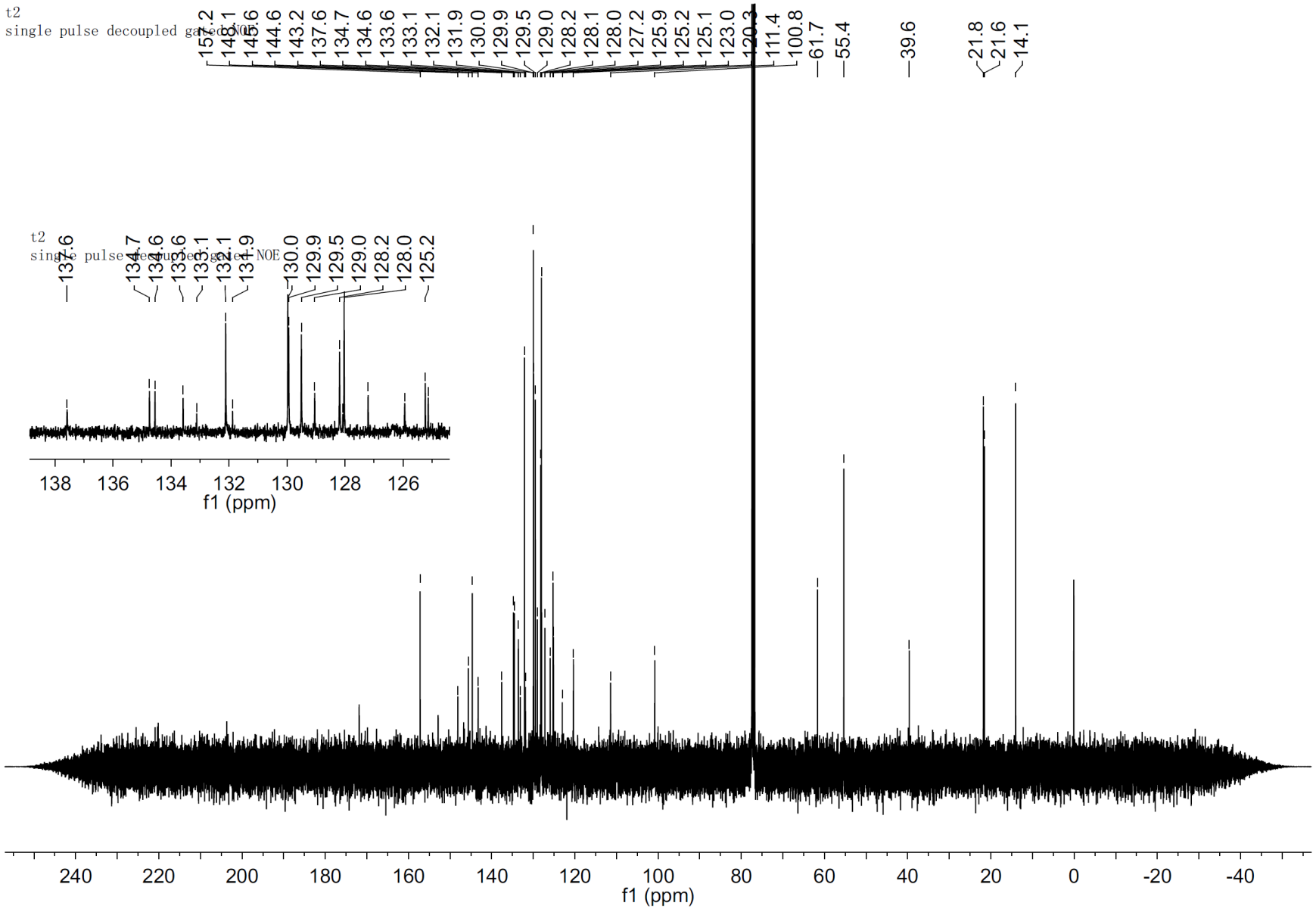
^{1}H NMR Spectrum of Compound 3q



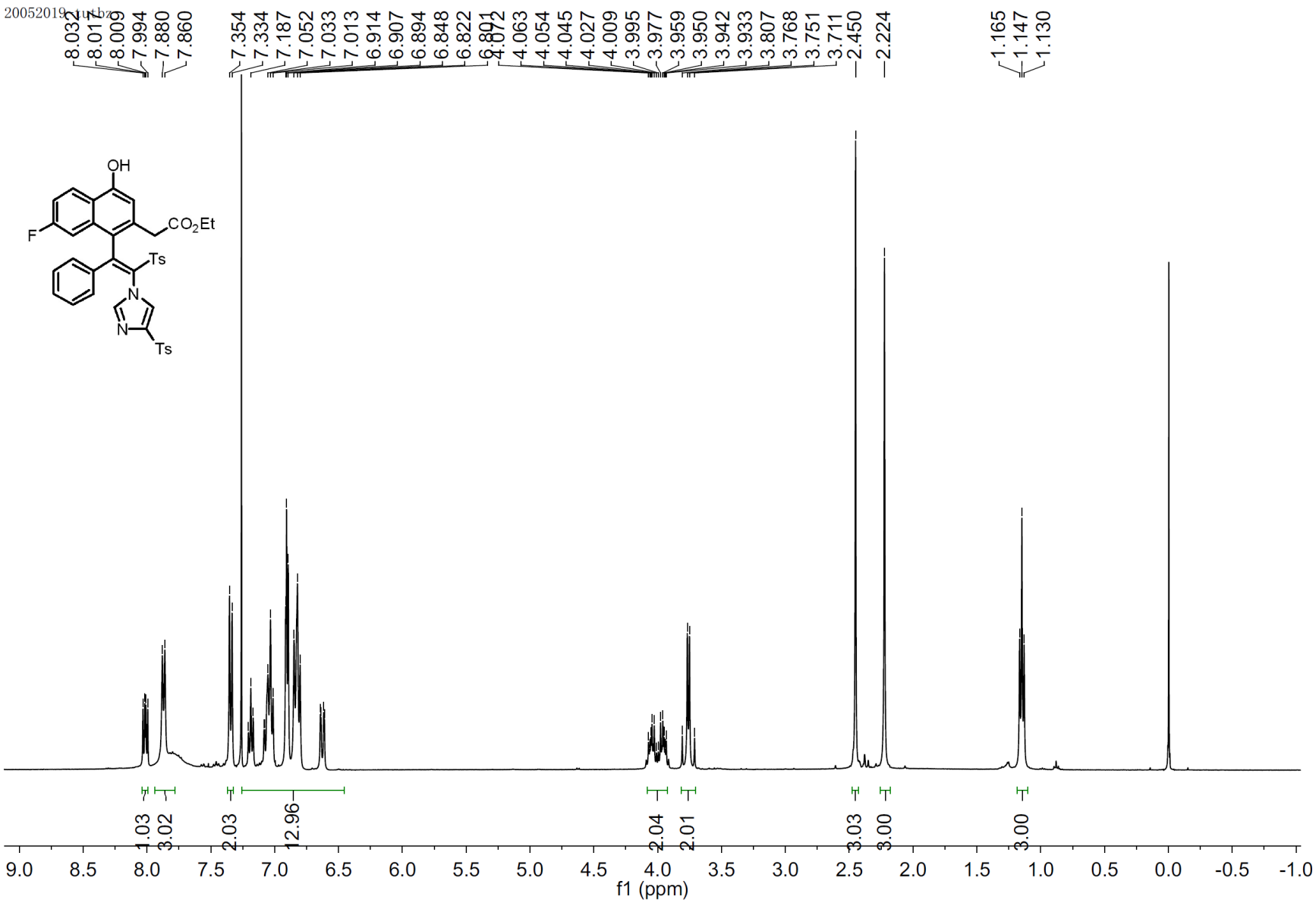
^{13}C NMR Spectrum of Compound 3q



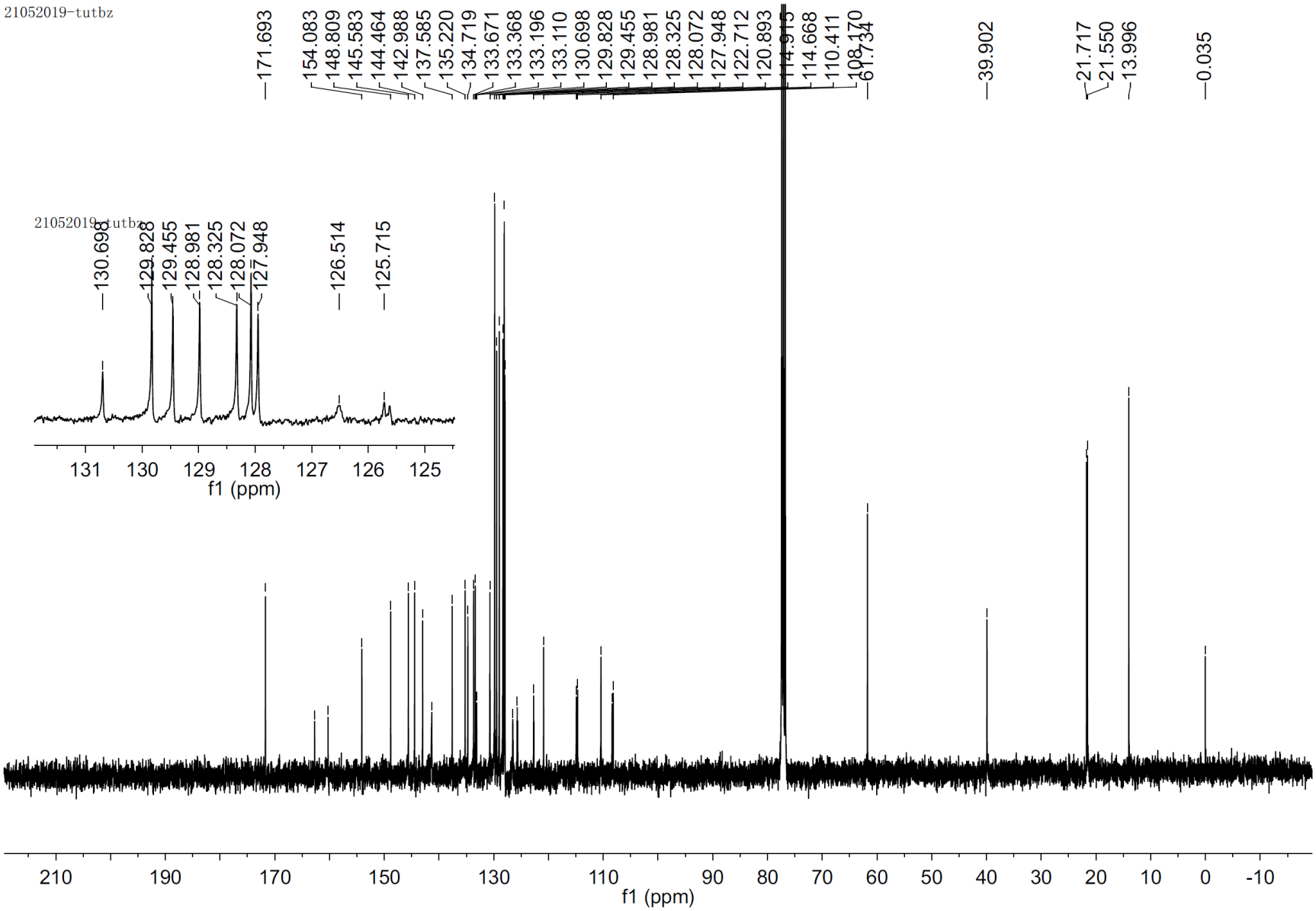
^{1}H NMR Spectrum of Compound 3r



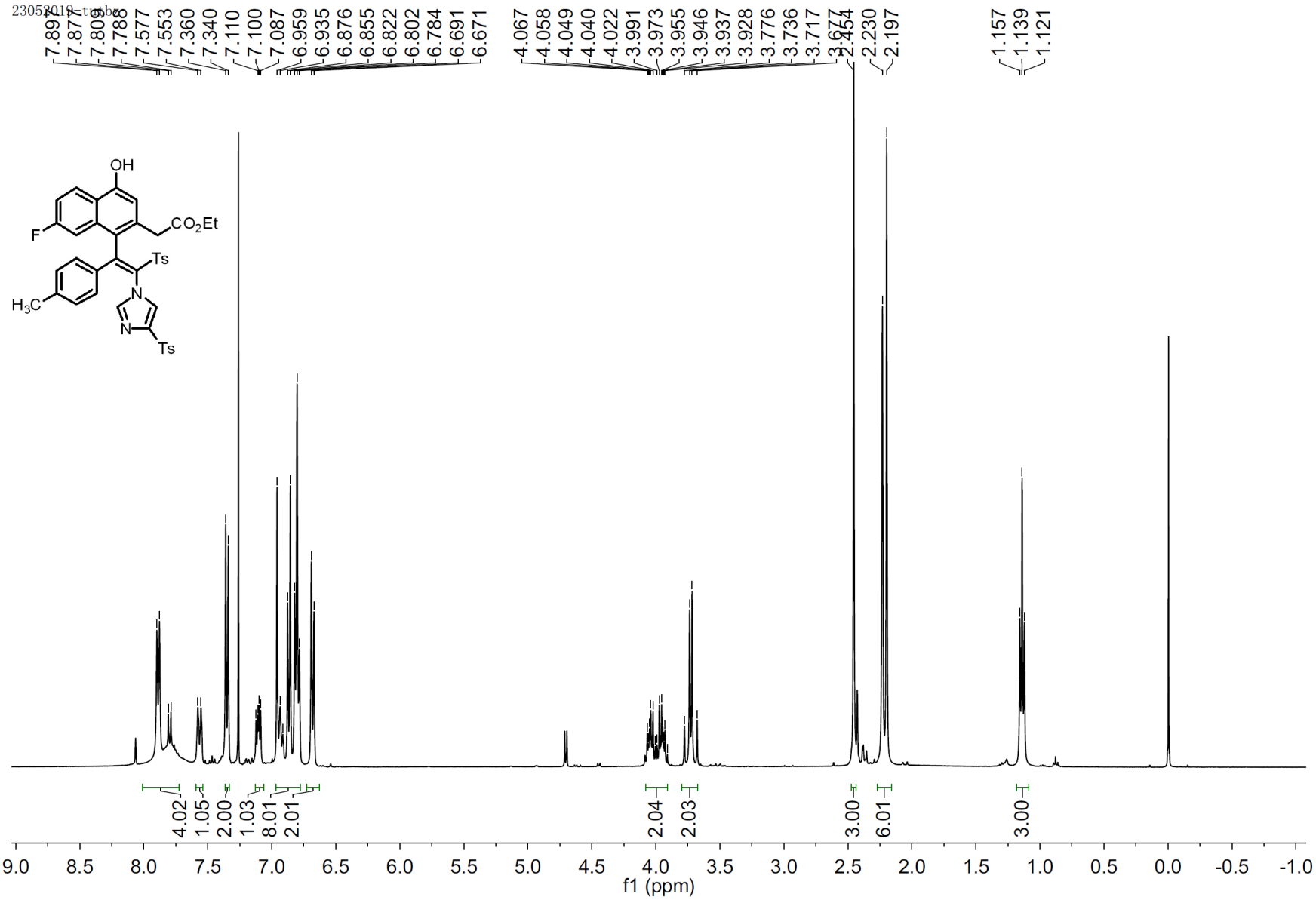
^{13}C NMR Spectrum of Compound 3r



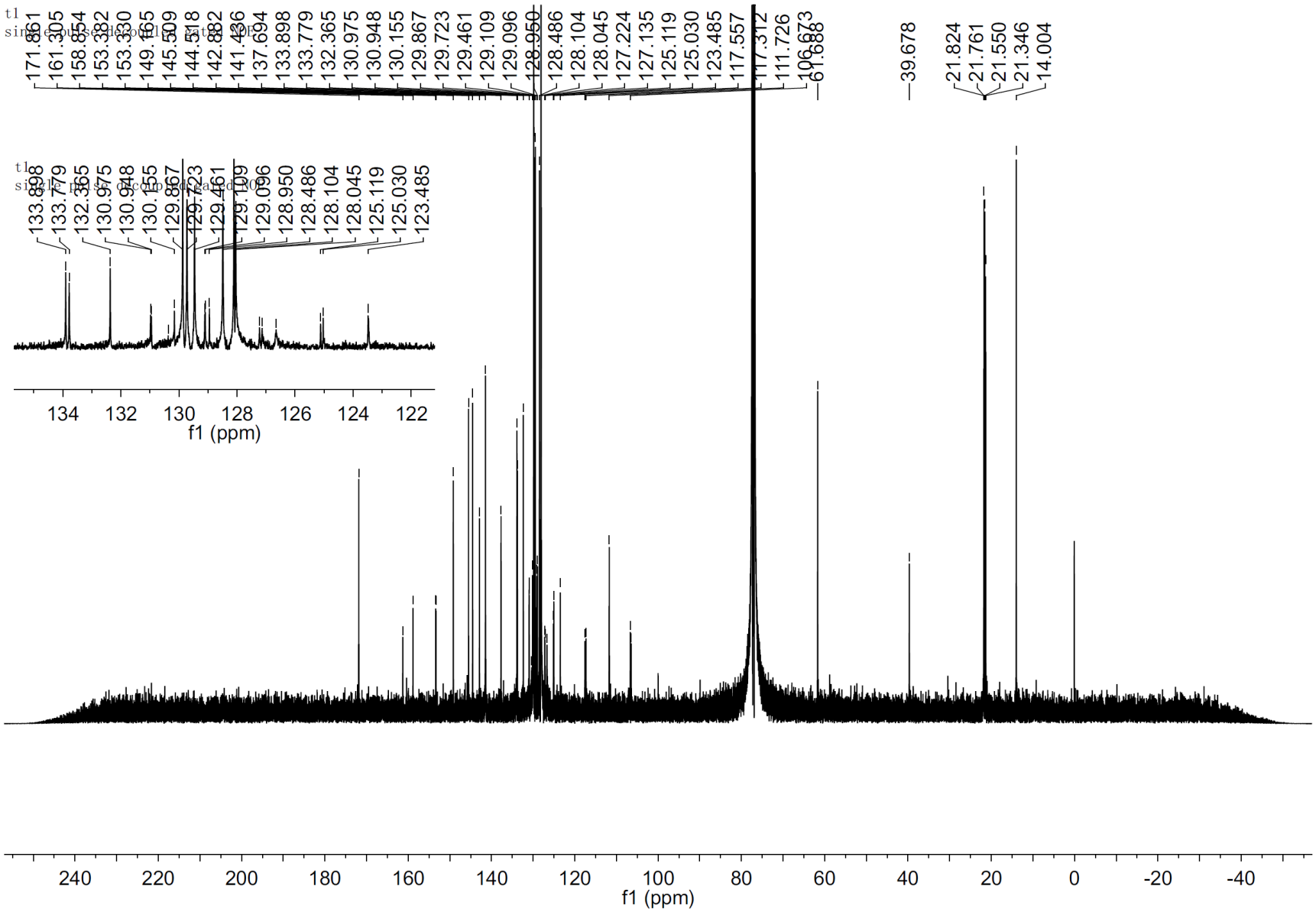
^{1}H NMR Spectrum of Compound 3s



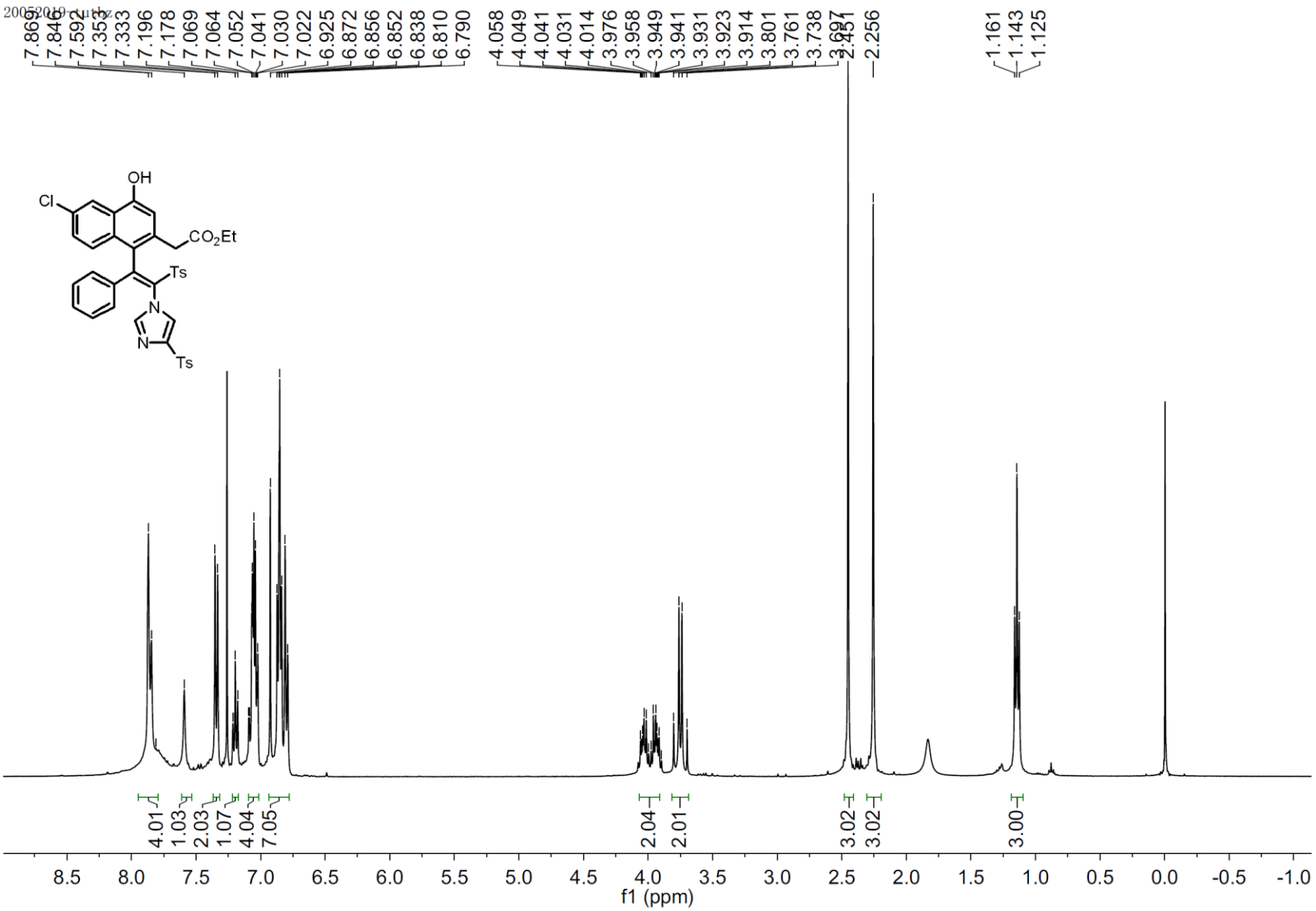
^{13}C NMR Spectrum of Compound 3s



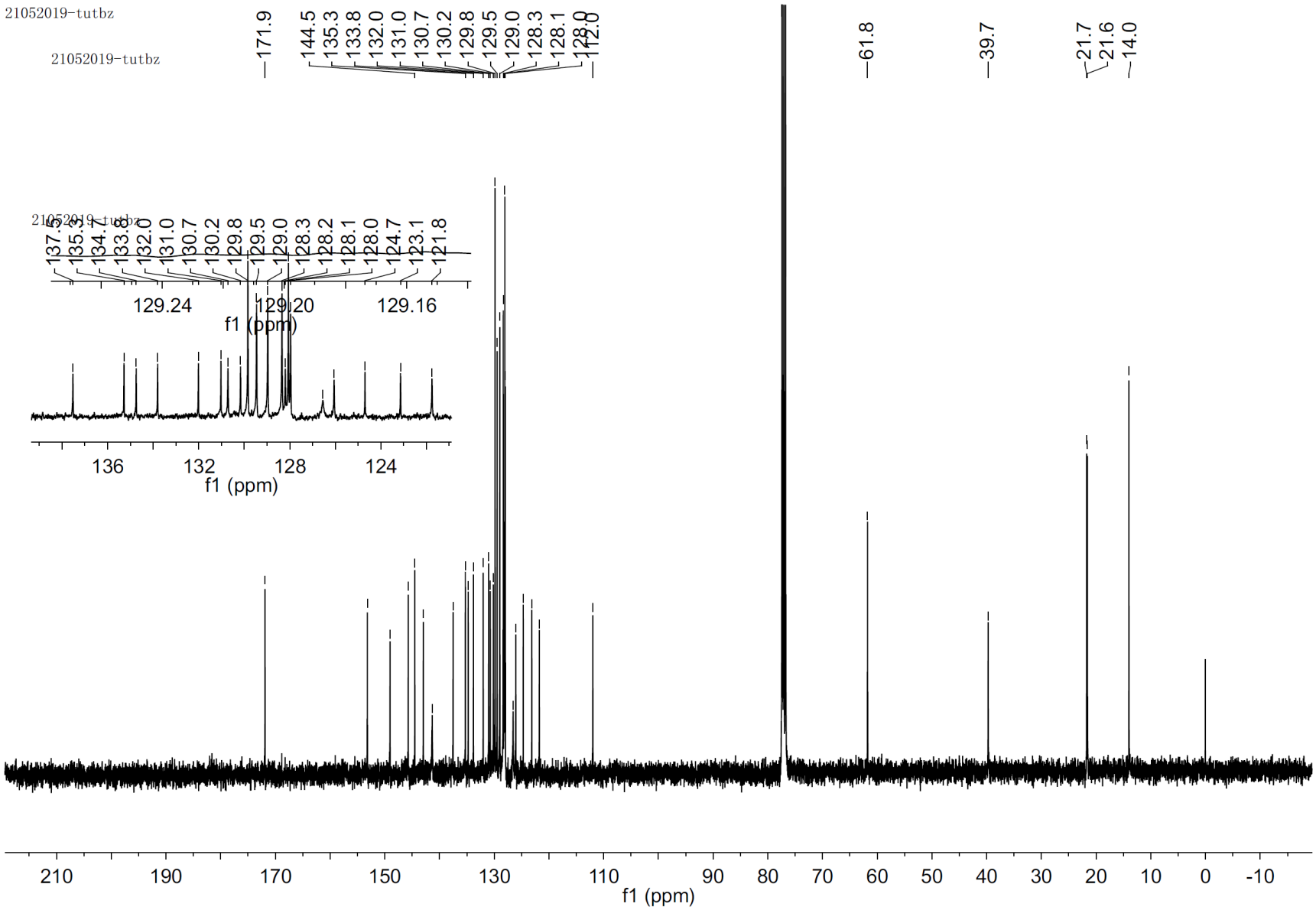
^{1}H NMR Spectrum of Compound 3t



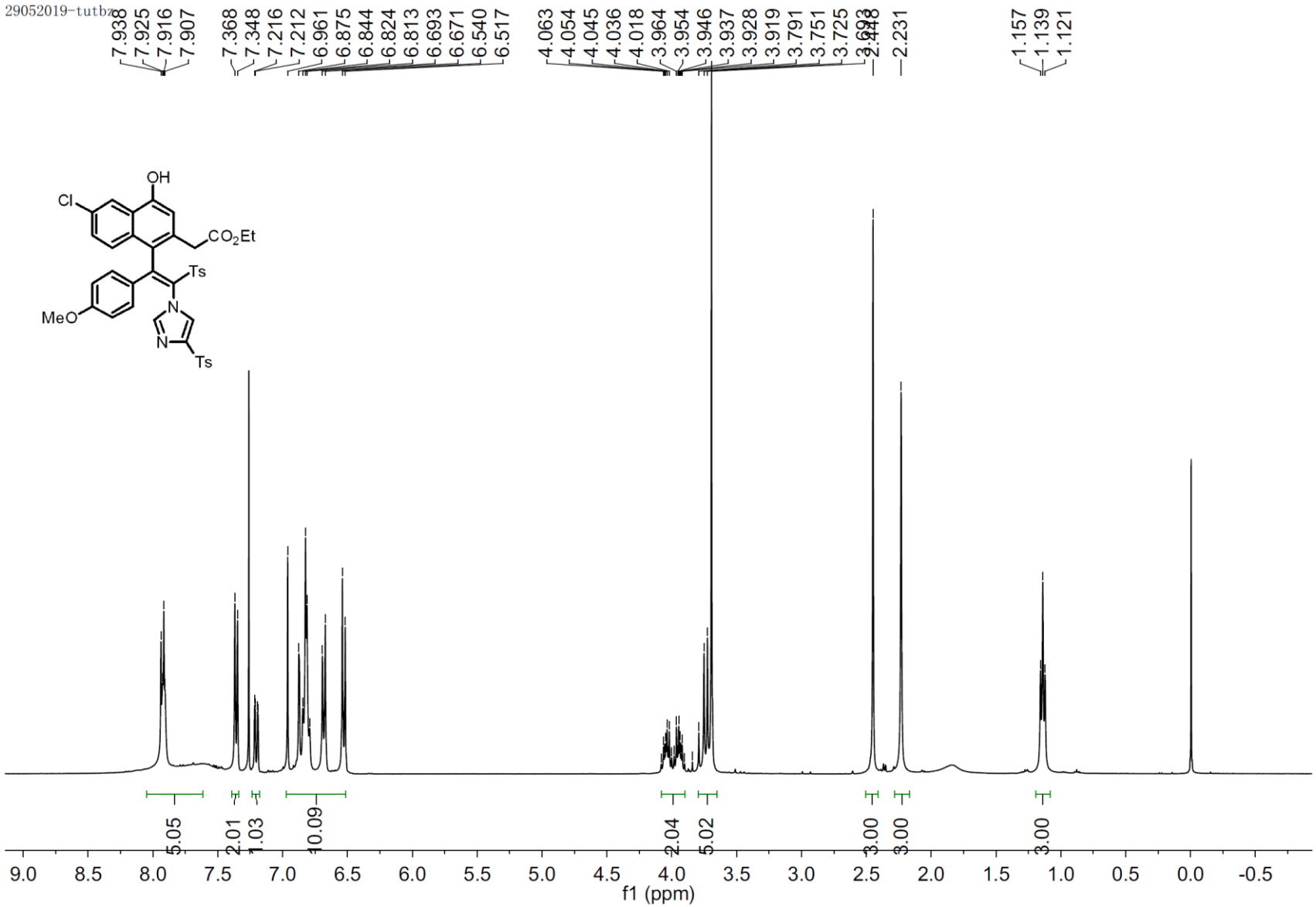
^{13}C NMR Spectrum of Compound 3t



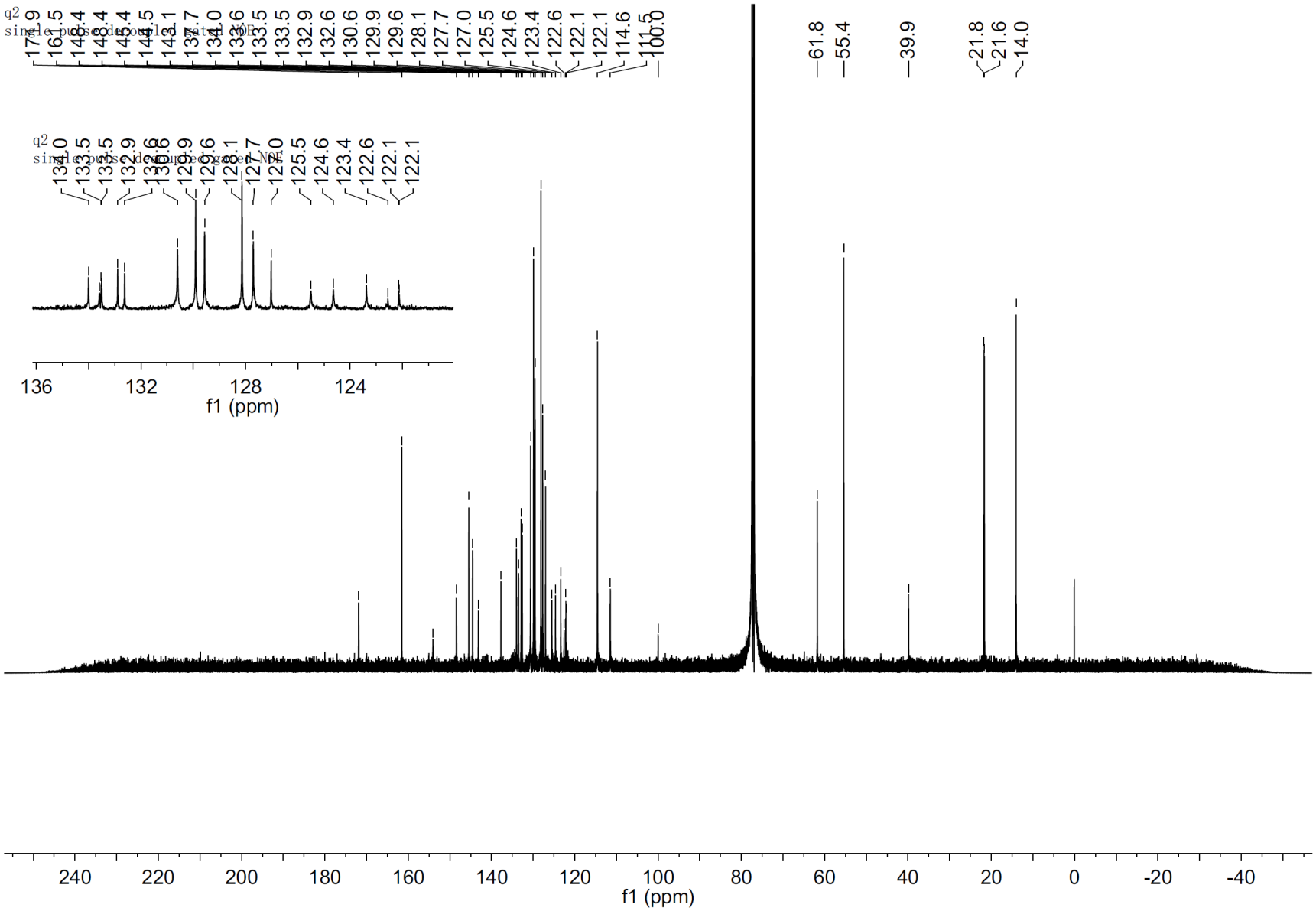
^{1}H NMR Spectrum of Compound 3u



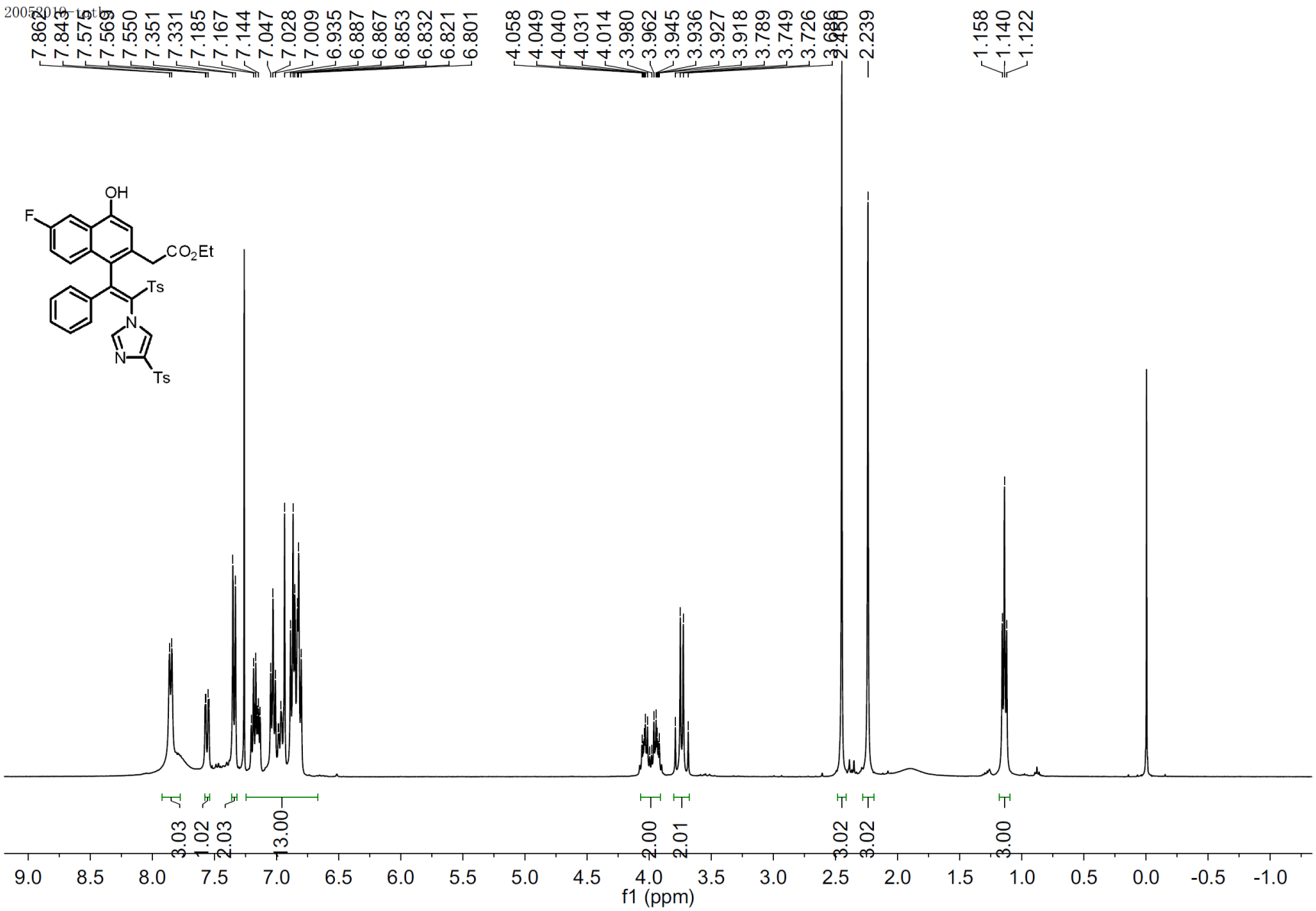
^{13}C NMR Spectrum of Compound 3u



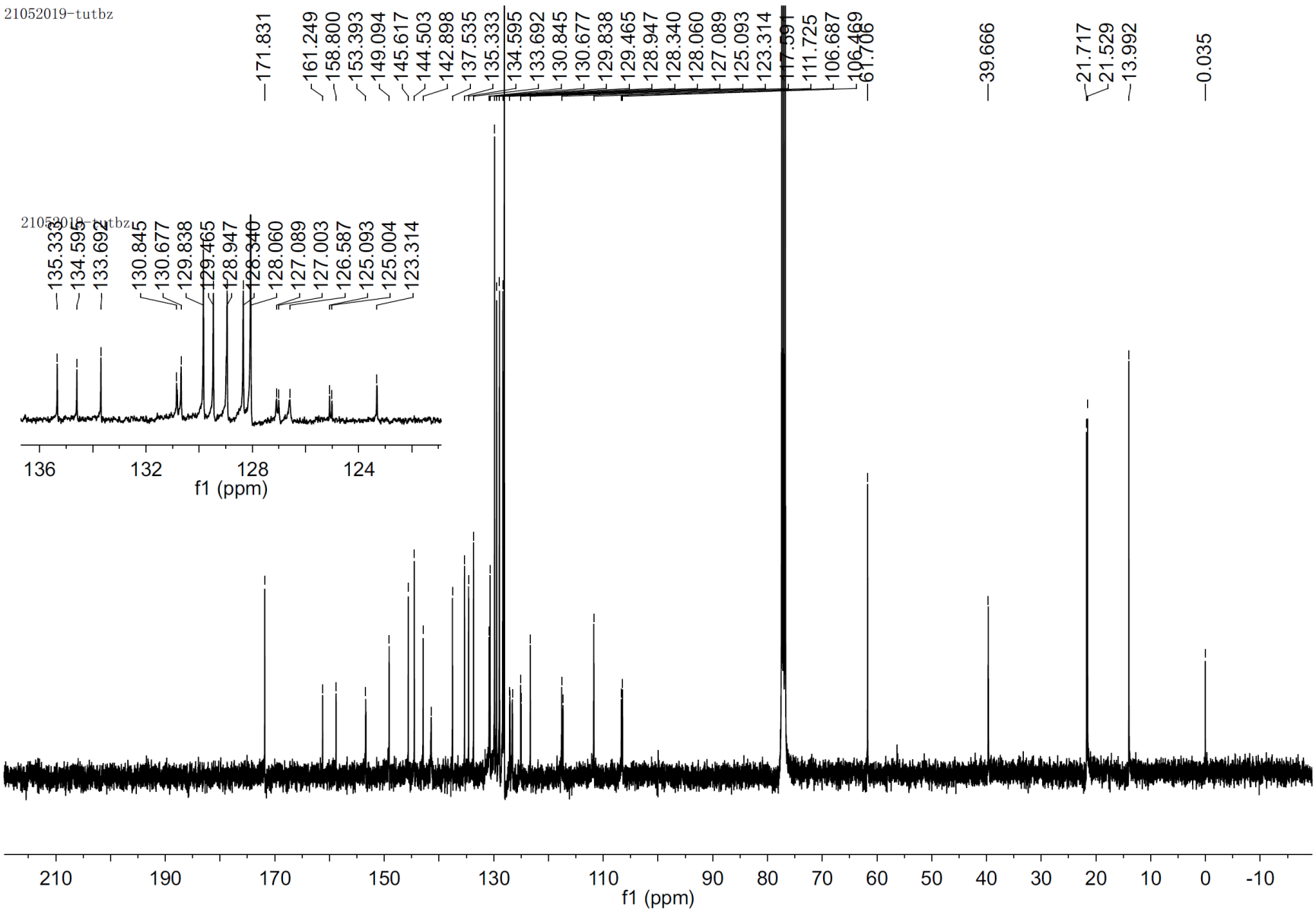
^{1}H NMR Spectrum of Compound 3v



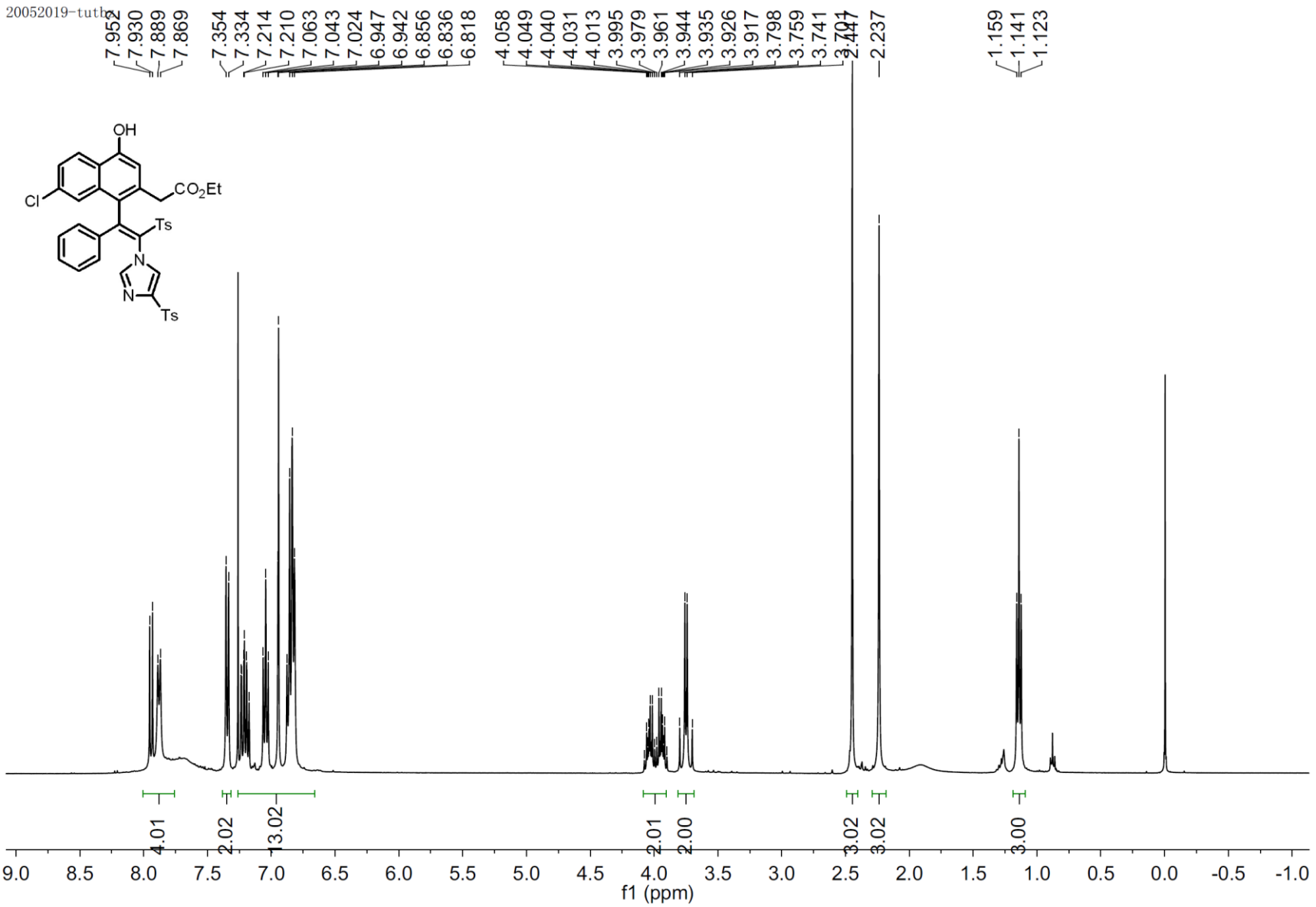
^{13}C NMR Spectrum of Compound 3v



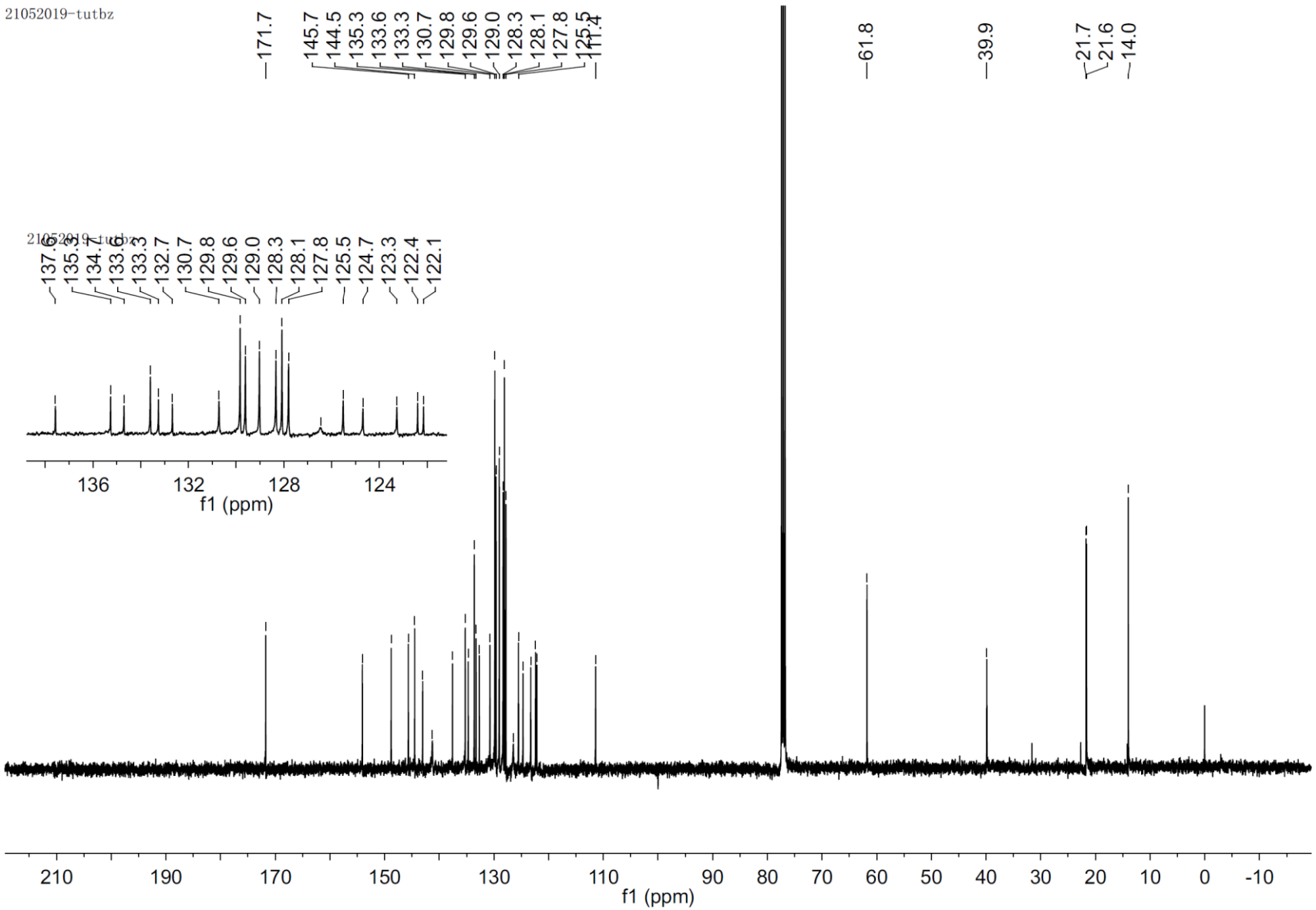
^{1}H NMR Spectrum of Compound 3w



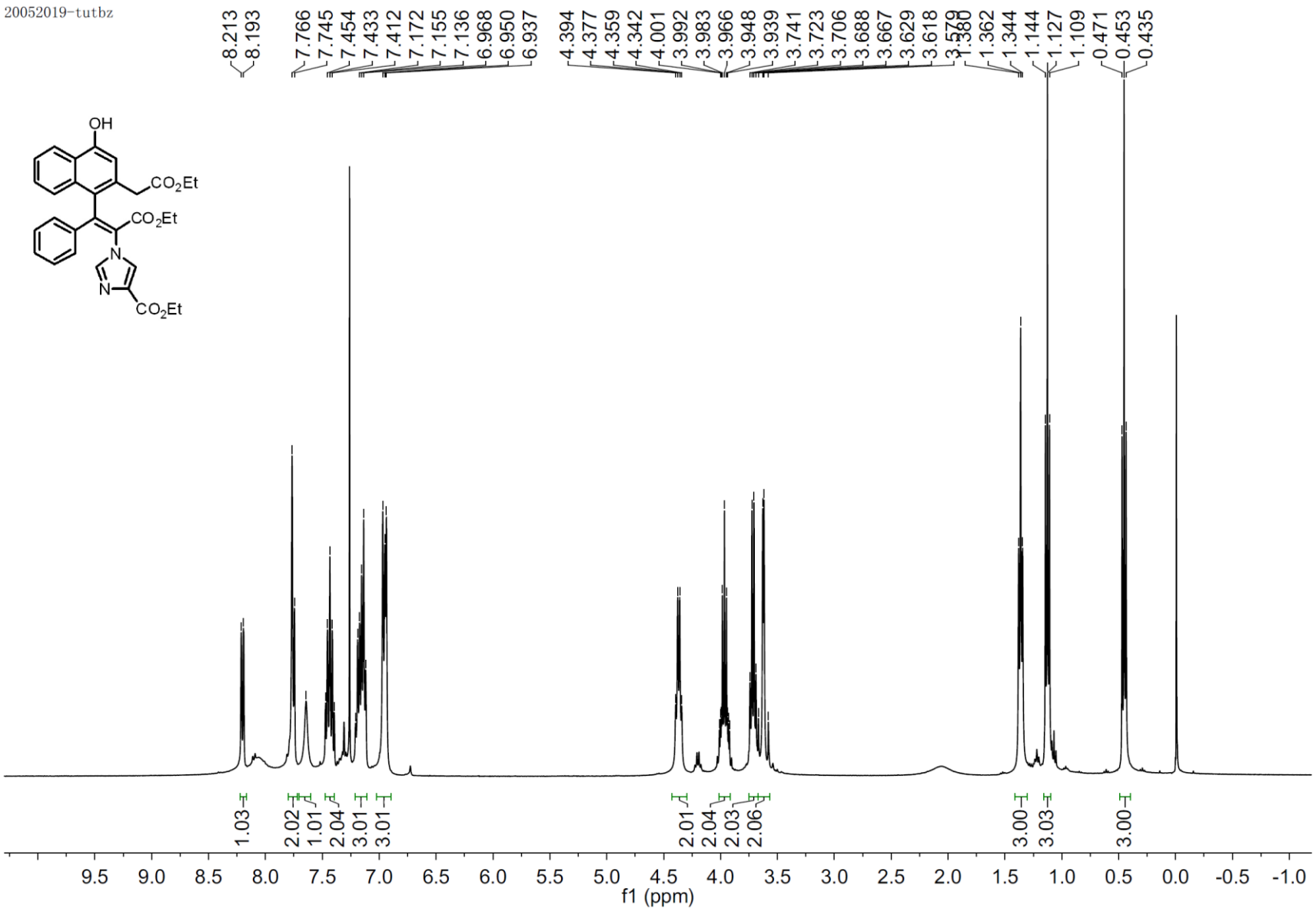
^{13}C NMR Spectrum of Compound 3w



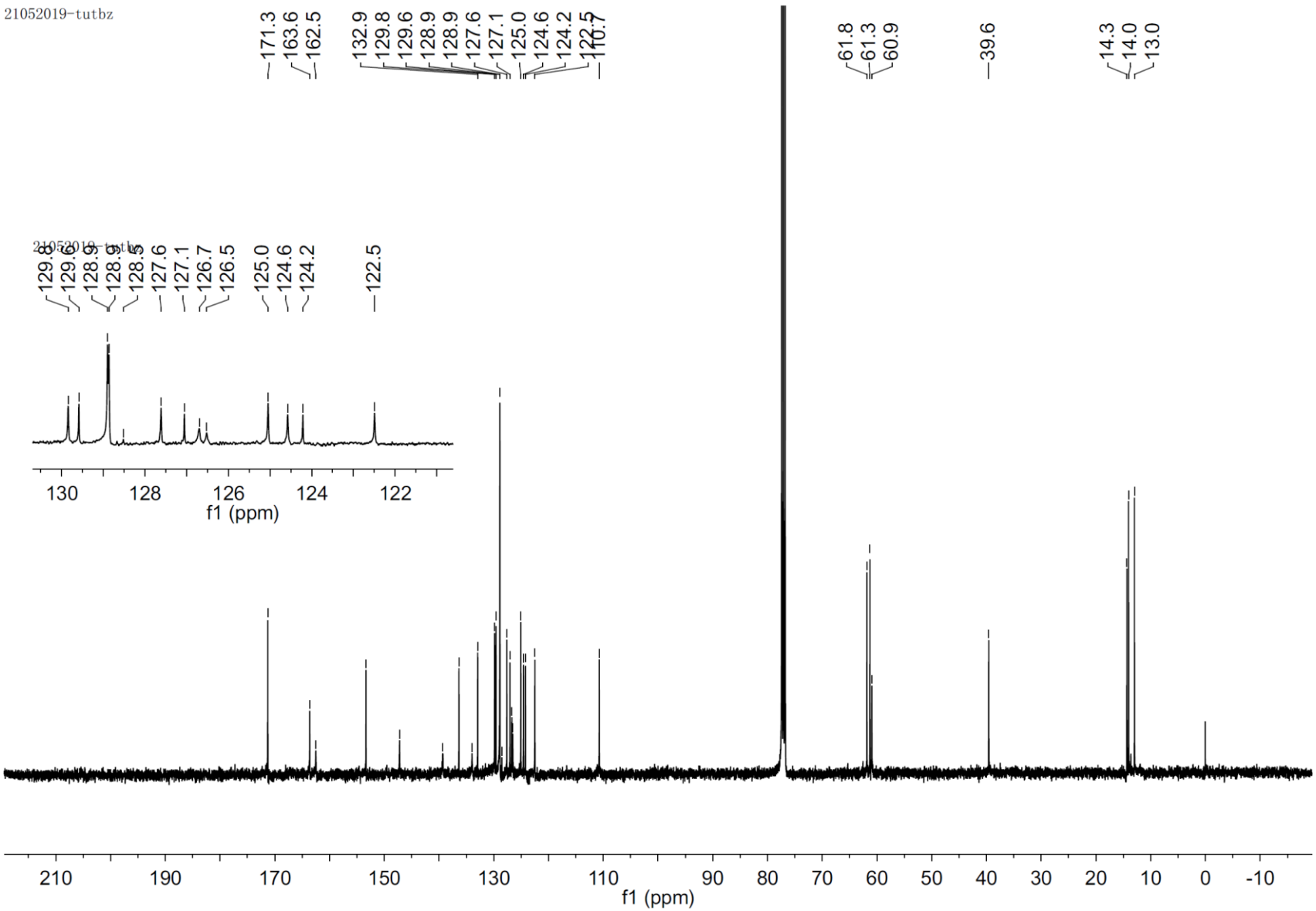
^{1}H NMR Spectrum of Compound 3x



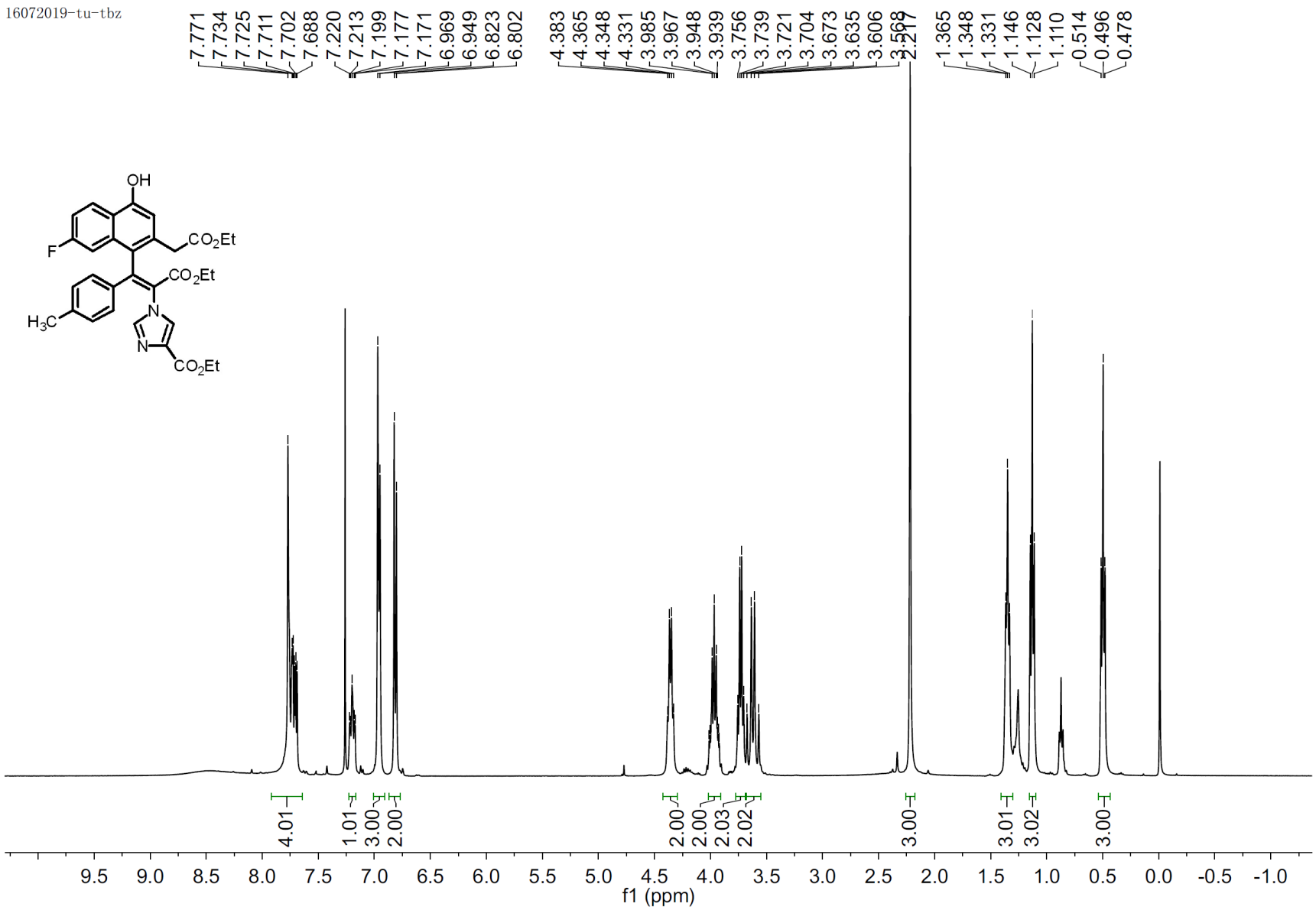
^{13}C NMR Spectrum of Compound 3x



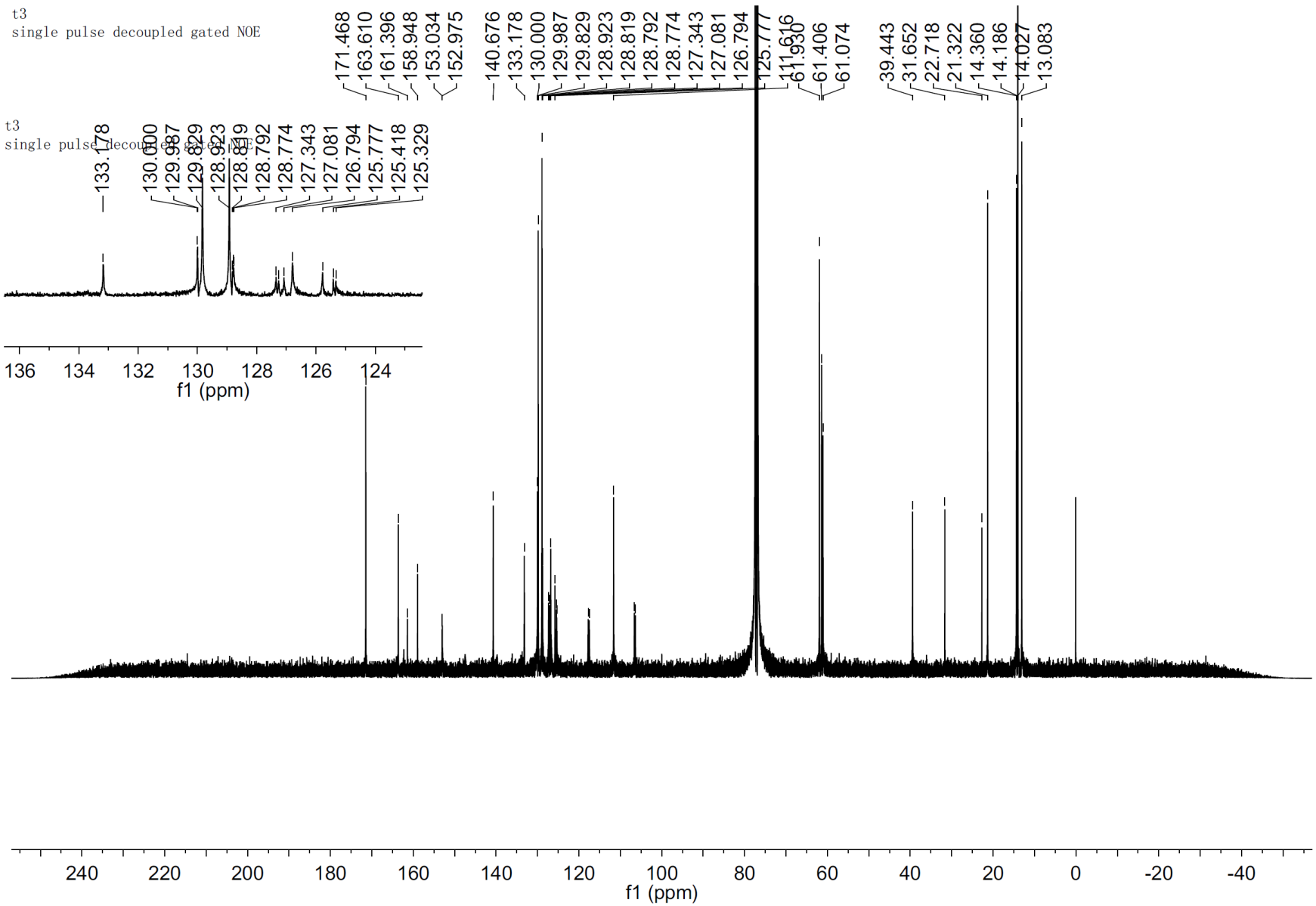
^{1}H NMR Spectrum of Compound 3y



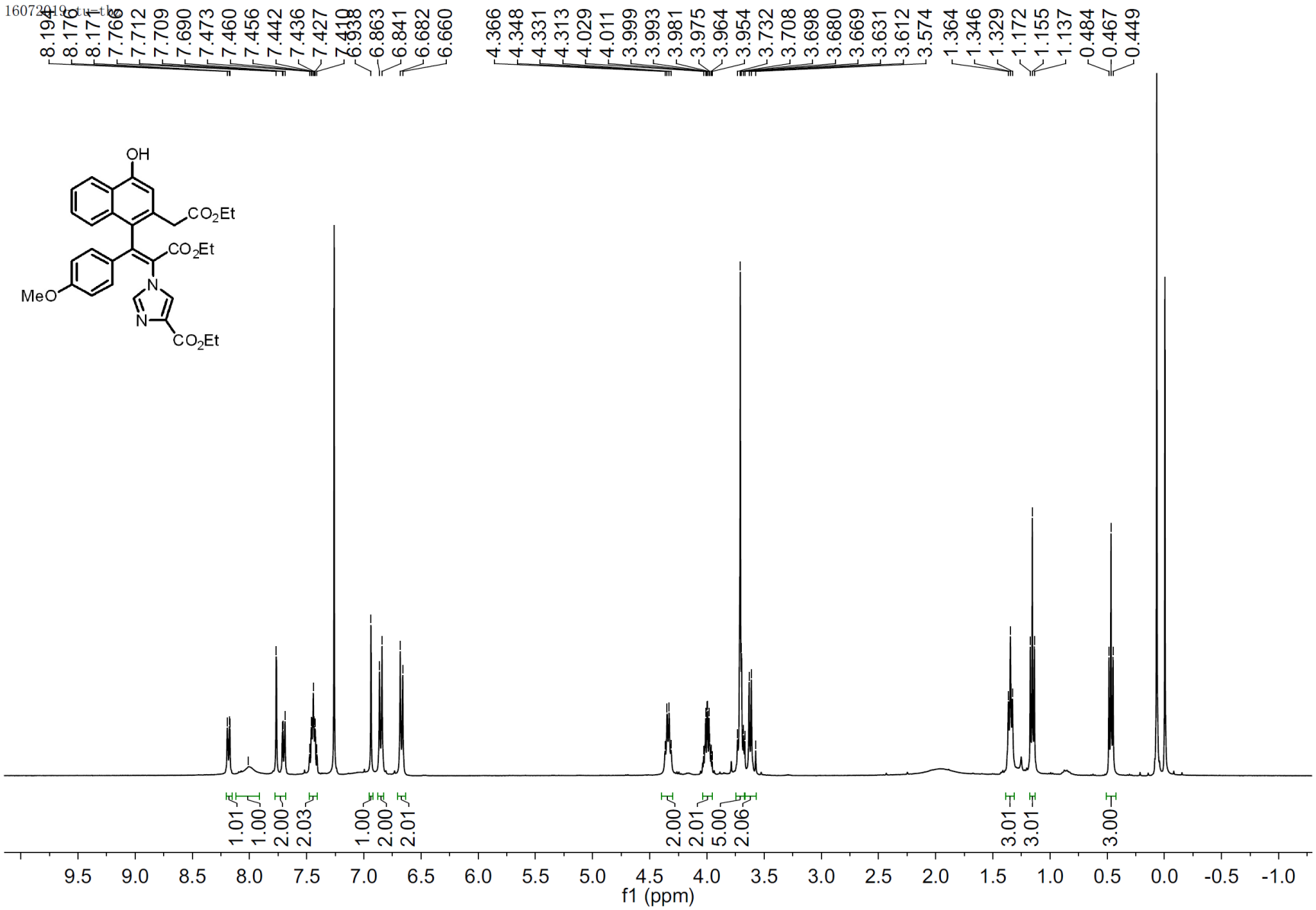
^{13}C NMR Spectrum of Compound 3y



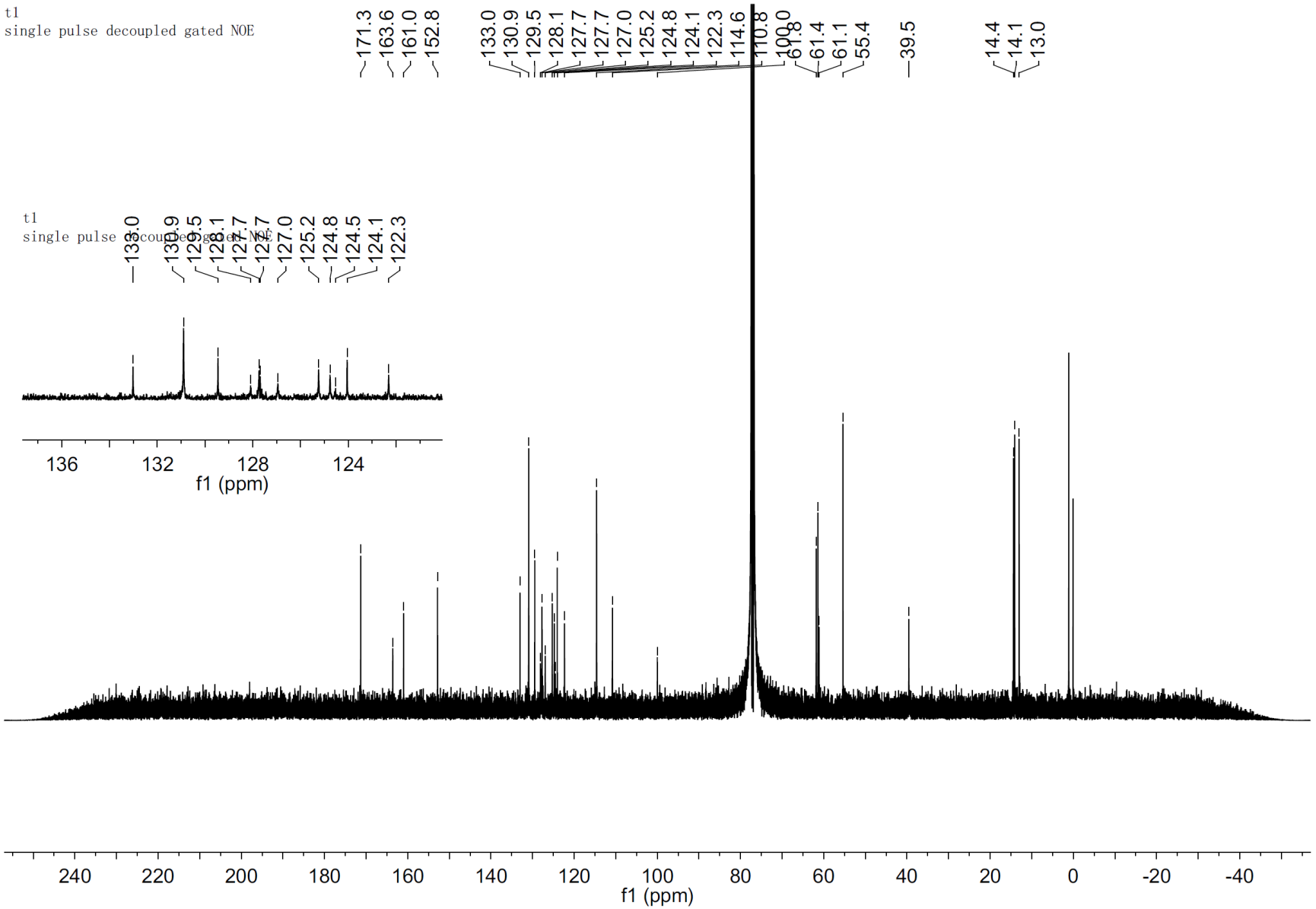
^{1}H NMR Spectrum of Compound 3z



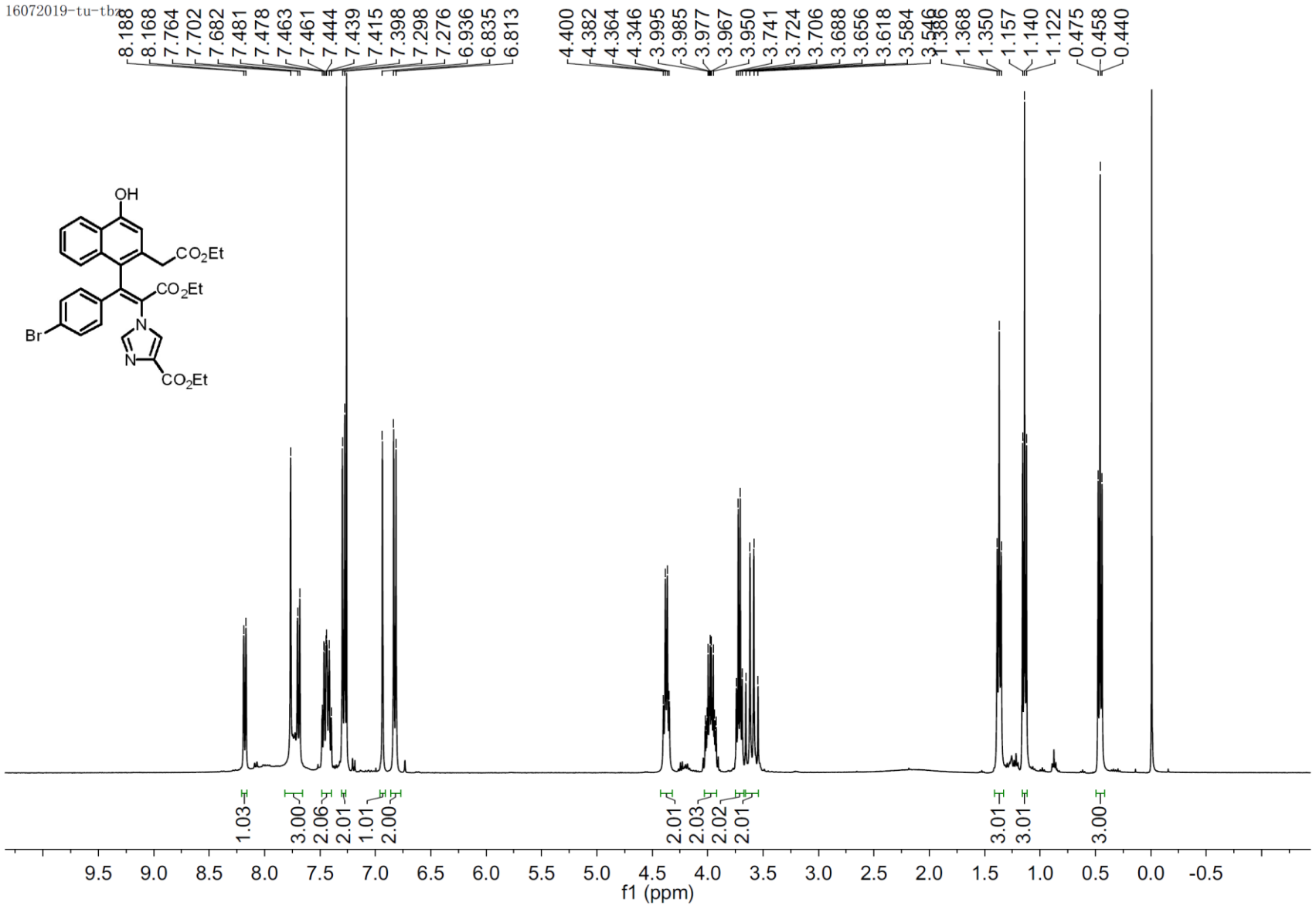
^{13}C NMR Spectrum of Compound 3z



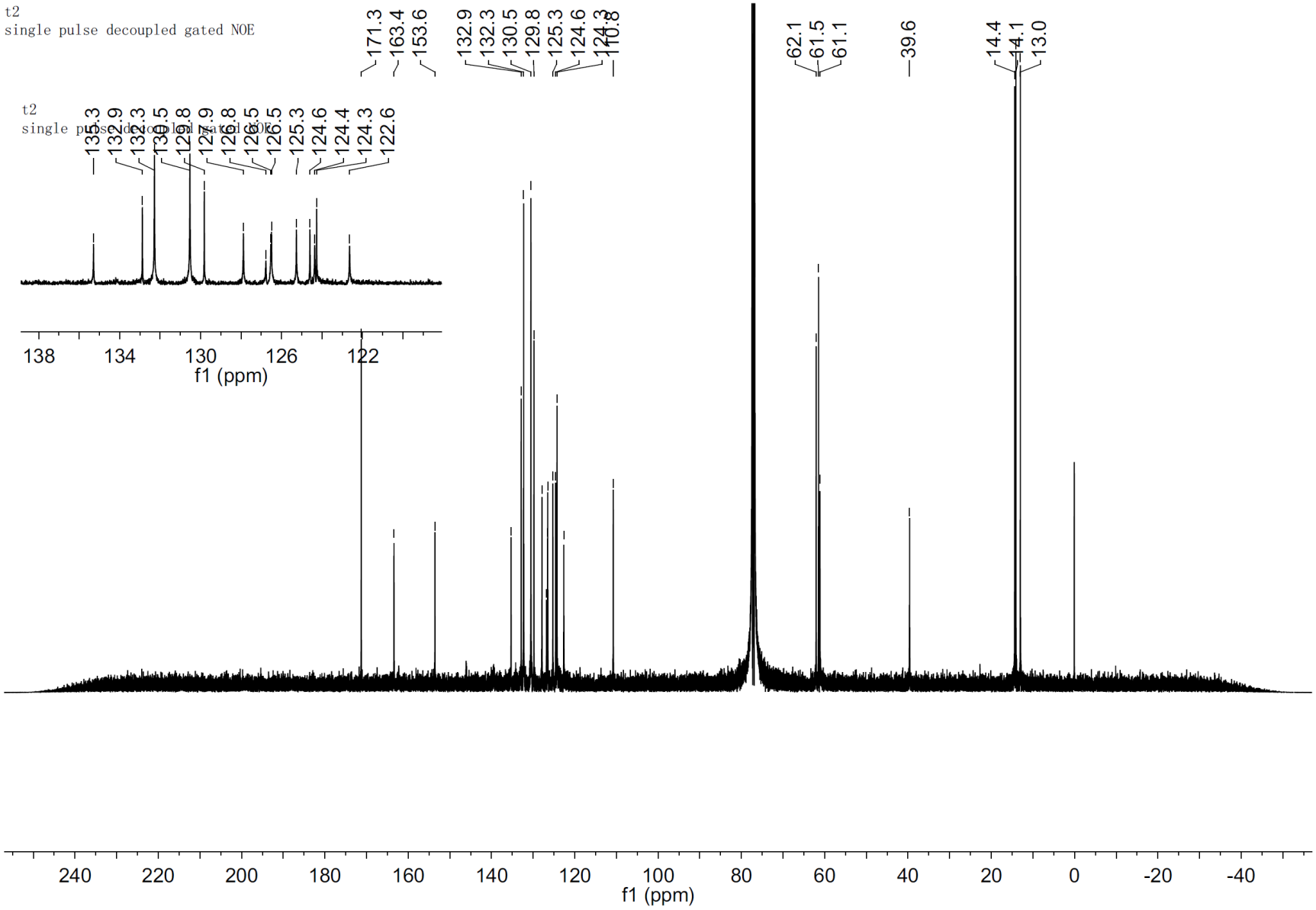
^{1}H NMR Spectrum of Compound 3aa



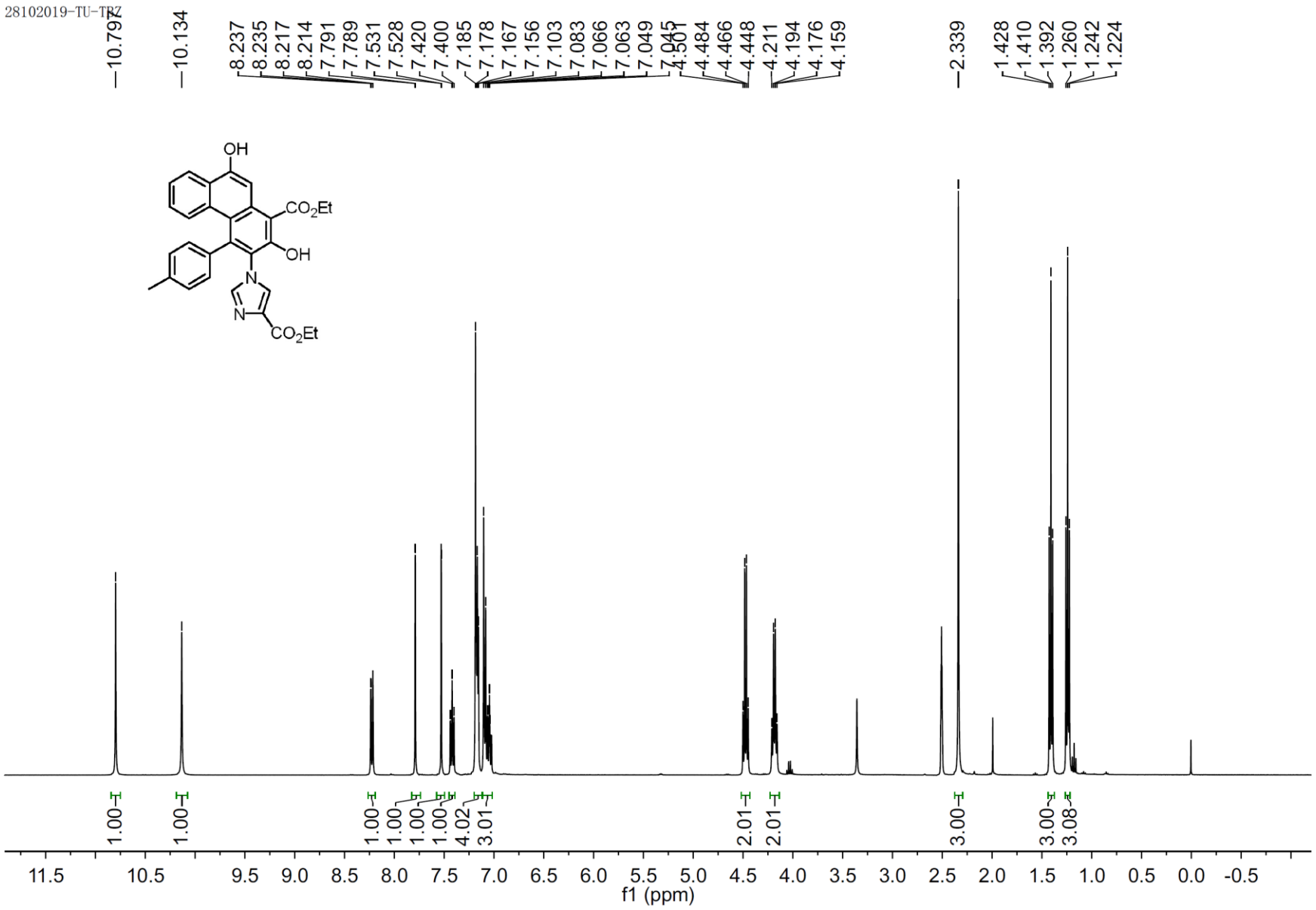
^{13}C NMR Spectrum of Compound 3aa



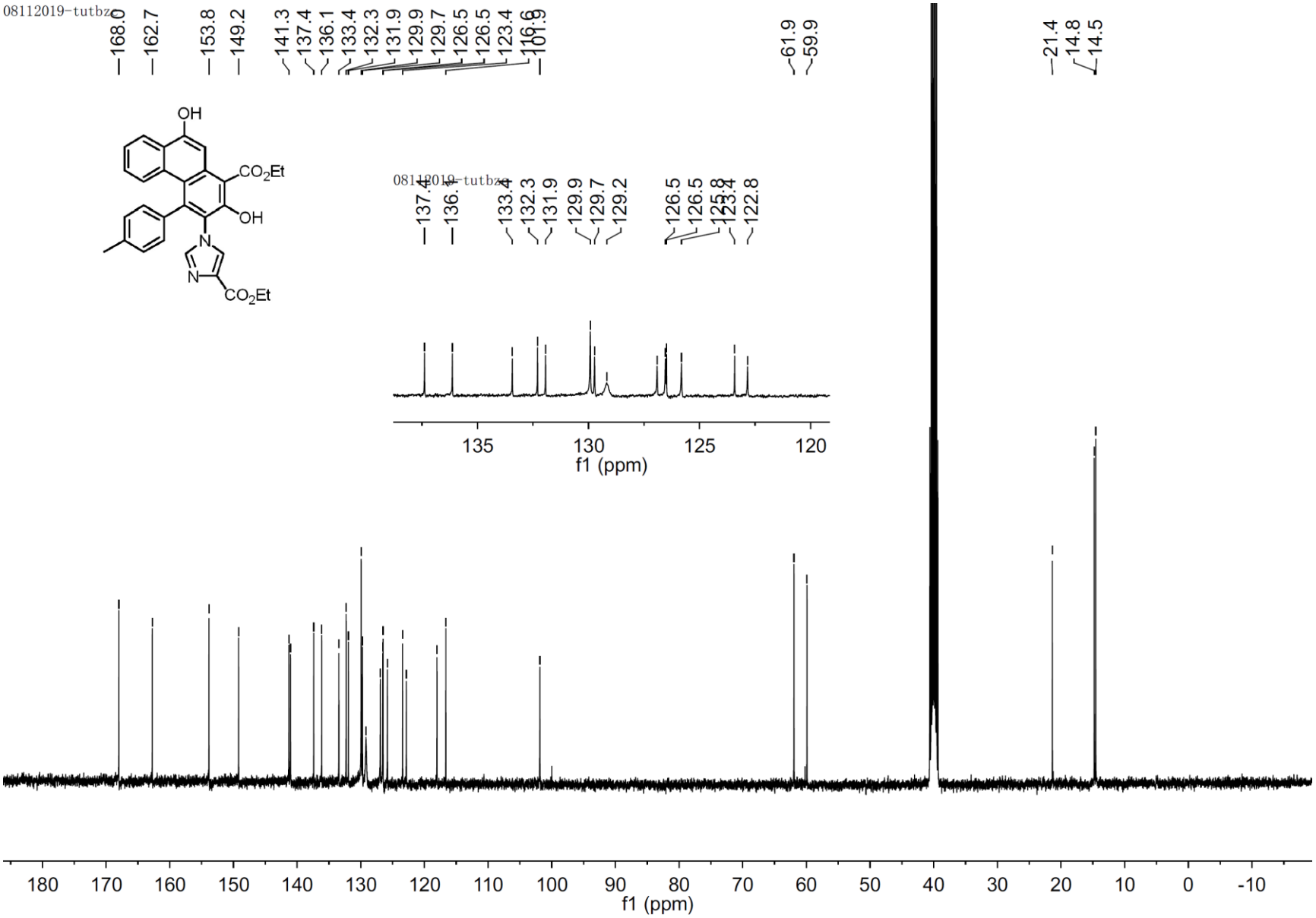
^{1}H NMR Spectrum of Compound 3bb



^{13}C NMR Spectrum of Compound 3bb



^{1}H NMR Spectrum of Compound 5a



^{13}C NMR Spectrum of Compound 5a