Supporting Information For

Tandem reactions of cis-2-acyl-1-alkynyl-1-aryl cyclopropanes tuned by gold(I) and silver(I) catalysts: Efficient synthesis of pyran-fused indene cores and 2,4,6-trisubstitutedphenols

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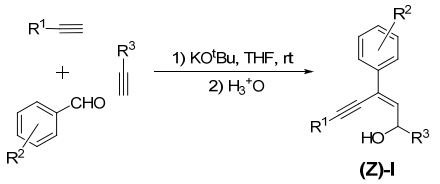
Contents

General: All chemicals were used as received, and the solvent dichloromethane was refluxed with CaH_2 and freshly distilled prior to use. All reactions under standard conditions were monitored by thin-layer chromatography (TLC) on gel F254 plates. The silica gel (200-300 meshes) is used for column chromatography, and the distillation range of petroleum is 60-90°C. ^1H and ^{13}C NMR spectra were recorded in $CDCl_3$ solution on Bruker AM-400 MHz instruments. The MS data were obtained with EI (70 eV), and the relative intensity (%) is given in brackets. High-resolution mass spectral analysis (HRMS) data were measured on the Bruker Apex II by means of the ESI, APCI and ESI negative techniques.

1. Typical Experimental Procedures

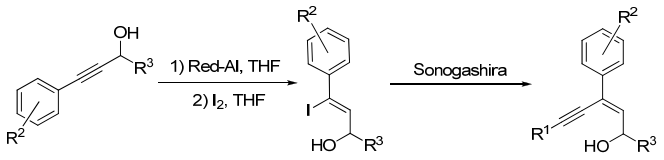
1.1 Typical experimental procedures to synthesize (Z)-2-en-4-yn-1-ols



(Z)-I

(Z)-2-en-4-yn-1-ols **Ia** to **Ie** and **Ij** were prepared through a one-pot three-component coupling which was reported by our group.[1]

Aldehyde (2 mmol) was added to the mixture of alkyne (4.4 mmol) and KO^tBu (3.6 mmol) in freshly distilled solvent at rt under argon atmosphere. After the reaction was stirred for 3 min, it was cooled to 0℃ and neutralized with H_2SO_4 (10% in water) to acidity. After the product formed in the first step disappeared by TLC, the organic layer was separated followed by the extraction of the aqueous layer with Et_2O. The combined organic extracts were washed with a saturated solution of $NaHCO_3$ and brine and dried over anhydrous Na_2SO_4. After removal of the solvent, the residue was purified by the column chromatography on silica gel (petroleum/ethyl acetate = 16/1) to furnish the expected product.



(Z)-I

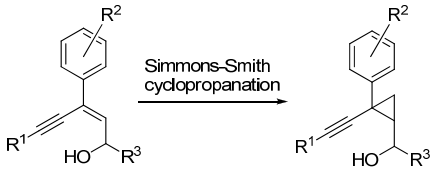
(Z)-2-en-4-yn-1-ols **If** to **Ii** were prepared by the Sonogashira coupling reaction of iodinated allylic alcohols with terminal alkynes. The iodide precursors were conveniently synthesized from the corresponding propargylic alcohols by their reaction with Red-Al (Red-Al = sodium bis(2-methoxyethoxy)aluminumhydride) followed by iodination of the organoaluminum intermediate.[2]

Under an argon atmosphere, to a solution of propargylic alcohols (5 mmol) in dry THF (15 ml) was added Red-Al (8 mmol, 65% w/w in toluene) at 0℃, then the mixture was warmed to room temperature and stirred for 3 h. A solution of I_2 in THF (40 mmol) was added dropwise at -78℃.Then the mixture was warmed up to room temperature and stirred for 1

h. The mixture was treated with saturated $Na_2S_2O_3$ and extracted with ethyl acetate. The extract was washed with saturated $Na_2S_2O_3$, brine, dried over anhydrous Na_2SO_4 and evaporated. Chromatography on silica gel (petroleum ether/ethyl acetate = 15/1) afforded the iodide precursor.

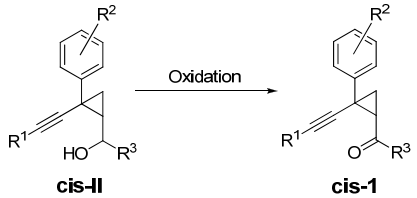
To a solution of the iodide precursor (3 mmol) in THF (12 ml) was added alkyne (3 mmol), $PdCl_2(PPh_3)_2$ (0.03 mmol), CuI (0.06 mmol) and $(^iPr)_2NH$ (9 mmol) at room temperature. Then the mixture was stirred at rt for 3h. The reaction was quenched with 5M HCl solution The residue was extracted with ethyl acetate, washed with brine, dried over anhydrous Na_2SO_4. Chromatography on silica gel (petroleum ether/ethyl acetate = 16/1) afforded the expected product.

1.2 Typical experimental procedures to synthesize compounds cis-II



A 25 mL round-bottom flask that contained 3 mL of CH_2Cl_2 was cooled to -30℃, and 4.3mL (2.2 equiv, 3.72 mmol) of a 15w/w% solution of diethyl zinc in hexane was added under argon atmosphere. This solution was treated with 0.61 mL (4.4 equiv, 7.44 mmol) of methylene iodide, and the reaction was stirred for 30 min at -30℃. To this solution was added 2 mL of a methylene chloride solution that contained 577 mg (1 equiv, 1.86 mmol) 2-en-4-yn-1-ols **Ia**. The reaction mixture was allowed to stir at -30℃ for 1 day, then -20℃ for 1 day. The reaction was quenched with saturated NH_4Cl solution, and the aqueous portion was extracted with Et_2O:CH_2Cl_2 = 5:1. The combined organic solutions were dried over Na_2SO_4, concentrated to give a crude oil, which was purified on silica gel (petroleum: ethyl acetate 16:1 to 8:1) to give **IIa** (422 mg 70%).

1.3 Typical experimental procedures to synthesize compounds cis-1



A solution of **IIa** (434 mg, 1.34 mmol) in dry CH_2Cl_2 (3 mL) was added the PCC (434 mg, 2.01 mmol) and silica gel (434 mg) mixtures at 0℃. After stirring at room temperature for 5 hours, the reaction mixture was purified through column chromatography first on Al_2O_3 (ethyl acetate) then on silica gel (petroleum: ethyl acetate 40:1) to afford **1a** (280 mg 65%).

1.4 Typical experimental procedures of gold(I) catalyzed reaction

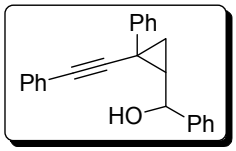
A solution of **1a** (33 mg, 0.10 mmol) in dry CH_2Cl_2 (1 mL) was added a solution of Ph_3AuOTf (generated by mixing equal equivalents of PPh_3AuCl and AgOTf, with AgCl filtered off) in CH_2Cl_2 (0.02 M, 0.5 mL, 0.01 mmol) under argon atmosphere. The mixture was stirred for 2h at room temperature. After evaporation of the solvent, the residue was purified by column chromatography on silica gel (petroleum: ethyl acetate 100:1) to afford **2a** (28 mg 85%).

1.5 Typical experimental procedures of silver(I) catalyzed reaction

A solution of **1a** (33 mg, 0.10 mmol) in dry CH_2Cl_2 (1 mL) was added $NaHCO_3$ (9 mg, 0.10 mmol), then AgOTf (5 mg, 0.02mmol) under argon atmosphere. The mixture was stirred for 50 min at room temperature. After evaporation of the solvent, the residue was purified by column chromatography on silica gel (petroleum: ethyl acetate 60:1) to afford **3a** (26.5 mg, 80%).

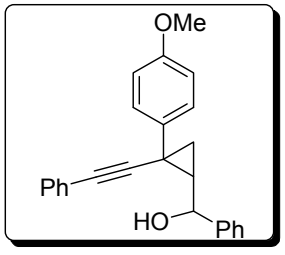
2. Spectroscopic and Analytical Data of the Products

2.1 Spectroscopic and analytical data of the products cis-IIa to cis-IIj



IIa

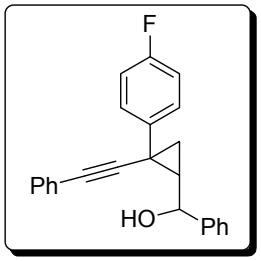
^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.52-7.60 (d, 2H, *J* = 7.2 Hz), 7.39-7.45 (m, 2H), 7.31-7.38 (dd, 2H, *J* = 7.2 Hz and 7.2 Hz), 7.20-7.31 (m, 8H), 7.14-7.20 (dd, 1H, *J* = 6.8 Hz and 6.8 Hz), 4.88-4.94 (d, 1H, *J* = 8.0 Hz), 2.24 (s, b, 1H), 1.83-1.92 (ddd, 1H, *J* = 8.8 Hz, 8.0 Hz and 6.4 Hz), 1.71-1.77 (dd, 1H, *J* = 6.4 Hz and 5.2 Hz), 1.65-1.71 ppm(dd, 1H, *J* = 8.8 Hz and 5.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 143.5, 141.2, 131.7, 128.5, 128.4, 128.3, 128.0, 127.6, 126.4, 126.0, 125.9, 123.2, 90.9, 82.2, 74.8, 37.6, 23.3, 22.1 ppm; **EI MS** (70 eV): m/z (%): 324 (1) $[M]^+$, 228 (2), 122 (76), 120 (100), 91 (56), 77 (56).



IIb

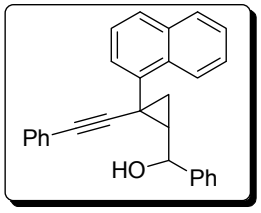
^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.54-7.60 (d, 2H, *J* = 7.6 Hz), 7.38-7.44 (m, 2H), 7.30-7.38 (dd, 2H, *J* = 7.6 Hz and 7.6 Hz), 7.23-7.30 (m, 4H), 7.16-7.23 (d, 2H, *J* = 8.4 Hz), 6.75-6.81 (d, 2H, *J* = 8.4 Hz), 4.84-4.90 (d, 1H, *J* = 8.4 Hz), 3.73 (s, 3H), 2.30 (s, b, 1H),

1.76-1.85 (ddd, 1H, *J* = 8.4 Hz, 8.4 Hz and 6.8 Hz), 1.64-1.70 (dd, 1H, *J* = 6.8 Hz and 5.2 Hz), 1.57-1.64 ppm(dd, 1H, *J* = 8.4 Hz and 5.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 158.2, 143.6, 133.4, 131.6, 128.5, 128.2, 127.9, 127.6, 127.4, 126.0, 123.3, 113.8, 91.4, 81.7, 74.9, 55.2, 37.0, 22.8, 21.6 ppm; **EI MS** (70 eV): m/z (%): 354 (0.09) $[M]^+$, 236 (3), 247 (35), 234 (100), 91 (48), 77 (57).



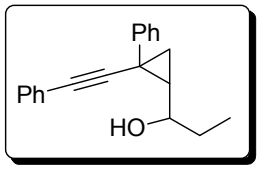
IId

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.53-7.60 (d, 2H, *J* = 7.2 Hz), 7.38-7.45 (m, 2H), 7.32-7.38 (dd, 2H, *J* = 7.2 Hz and 7.2 Hz), 7.25-7.32 (m, 4H), 7.19-7.25 (dd, 2H, *J* = 7.6 Hz and 6.4 Hz), 6.90-6.99 (dd, 2H, *J* = 8.4 Hz and 8.4 Hz), 4.85-4.92 (d, 1H, *J* = 8.0 Hz), 2.27 (s, b, 1H), 1.77-1.86 (ddd, 1H, *J* = 8.4 Hz, 8.0 Hz and 6.8 Hz), 1.68-1.75 (dd, 1H, *J* = 6.8 Hz and 5.2 Hz), 1.60-1.68 ppm(dd, 1H, *J* = 8.4 Hz and 5.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 162.7, 160.3, 143.5, 137.0, 137.0, 131.6, 128.5, 128.3, 128.1, 127.8, 127.7, 125.9, 123.1, 115.3, 115.1, 90.8, 82.1, 74.8, 37.4, 23.1, 21.6 ppm; **EI MS** (70 eV): m/z (%): 342 (0.34) $[M]^+$, 251 (3), 222 (31), 120 (100), 91 (39), 77 (43).



IIe

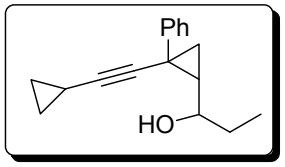
^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.90-7.98 (d, 1H, *J* = 8.4 Hz), 7.75-7.80 (d, 1H, *J* = 8.0 Hz), 7.65-7.72 (m, 3H), 7.36-7.46 (m, 5H), 7.25-7.36 (m, 3H), 7.18-7.25 (m, 4H), 4.95-5.05 (d, 1H, *J* = 8.4 Hz), 2.33 (s, b, 1H), 1.87-1.95 (ddd, 1H, *J* = 8.4 Hz, 8.4 Hz and 5.2 Hz), 1.76-1.82 (dd, 1H, *J* = 5.2 Hz and 4.8 Hz), 1.66-1.73 ppm(dd, 1H, *J* = 8.4 Hz and 4.8 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 143.5, 137.5, 133.8, 132.0, 131.6, 128.7, 128.3, 128.2, 128.1, 128.0, 127.8, 126.6, 126.3, 125.8, 125.6, 125.2, 125.1, 123.3, 91.9, 80.4, 75.8, 34.8, 21.5, 21.1 ppm; **EI MS** (70 eV): m/z (%): 356 (2), 270 (13), 254 (92), 120 (100), 91 (75), 77 (73).



IIh

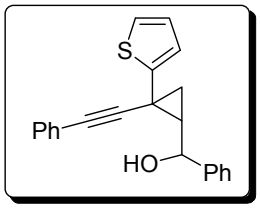
^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.41-7.46 (m, 2H), 7.35-7.41 (m, 2H), 7.26-7.35 (m, 5H), 7.18-7.25 (dd, 1H, *J* = 7.6 Hz and 7.6 Hz), 3.68-3.78 (m, 1H), 1.80-1.90 (m, 2H), 1.67-1.80

(m, 1H), 1.50-1.63 (m, 3H), 1.03-1.11 ppm(t, 3H, *J* = 7.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 141.6, 131.6, 128.4, 128.3, 127.9, 126.3, 125.7, 123.3, 90.6, 81.6, 74.7, 36.3, 30.1, 23.2, 21.4, 10.0 ppm; **EI MS** (70 eV): m/z (%): 276 (3) $[M]^+$, 247 (22), 217 (54), 204 (100), 189 (33), 115 (24).



IIi

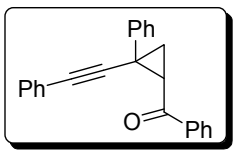
^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.25-7.32 (m, 4H), 7.14-7.21 (m, 1H), 3.57-3.67 (m, 1H), 1.93 (s, b, 1H), 1.69-1.80 (m, 1H), 1.60-1.69 (m, 1H), 1.32-1.44 (m, 3H), 1.21-1.31 (m, 1H), 0.98-1.08 (t, 3H, *J* = 7.2 Hz), 0.71-0.79 (m, 2H), 0.61-0.67 ppm(m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 142.3, 128.3, 126.0, 125.5, 85.1, 75.9, 74.2, 35.7, 30.0, 22.5, 20.7, 9.9, 8.3, 8.2, 0.0 ppm; **EI MS** (70 eV): m/z (%): 240 (0.36) $[M]^+$, 211 (15), 182 (24), 167 (100), 153 (74), 115 (50).



IIj

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.55-7.60 (d, 2H, *J* = 7.6 Hz), 7.39-7.45 (m, 2H), 7.33-7.39 (dd, 2H, *J* = 7.6 Hz and 7.6 Hz), 7.26-7.33 (m, 4H), 7.05-7.10 (dd, 1H, *J* = 3.2 Hz and 3.2 Hz), 6.85-6.90 (d, 2H, *J* = 3.2 Hz), 4.83-4.90 (d, 1H, *J* = 7.6 Hz), 2.24 (s, b, 1H), 1.91-2.00 (ddd, 1H, *J* = 8.8 Hz, 7.6 Hz and 6.8 Hz), 1.79-1.85 (dd, 1H, *J* = 6.8 Hz and 5.2 Hz), 1.66-1.74 ppm(dd, 1H, *J* = 8.8 Hz and 5.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 146.9, 143.2, 131.7, 128.5, 128.3, 128.2, 127.7, 126.8, 126.0, 123.2, 123.0, 122.9, 90.0, 81.9, 74.4, 39.0, 25.2, 19.0 ppm; **EI MS** (70 eV): m/z (%): 255 (11), 223 (14), 192 (18), 84 (65), 64 (95), 41 (100).

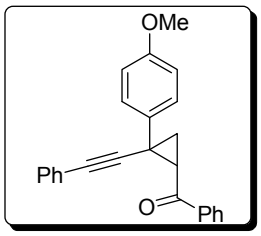
2.2 Spectroscopic and analytical data of the products cis-1a to cis-1j



1a

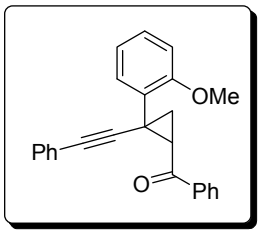
Following the typical experimental procedures **1a** was prepared in 52% yield over two steps from (Z)-2-en-4-yn-1-ol **Ia**. **^{1}H NMR** (400 MHz, $CDCl_3$): δ = 7.92-8.00 (d, 2H, *J* = 7.6 Hz), 7.50-7.58 (m, 3H), 7.38-7.48 (m, 4H), 7.25-7.35 (m, 3H), 7.16-7.24 (m, 3H), 3.14-3.22 (dd, 1H, *J* = 7.6 Hz and 7.2 Hz), 2.47-2.54 (dd, 1H, *J* = 7.2 Hz and 5.2 Hz), 1.92-2.00 ppm(dd, 1H, *J* = 7.6 Hz and 5.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 193.7, 140.2, 137.9, 132.9, 131.8, 128.8, 128.6, 128.3, 128.0, 127.8, 127.1, 125.8, 123.0, 88.0,

82.2, 38.3, 27.6, 22.6 ppm; **EI MS** (70 eV): m/z (%): 322 (19) $[M]^+$, 217 (20), 189 (26), 105 (78), 77 (100), 51 (39); **HRMS** (ESI): m/z calcd for $C_{24}H_{18}O$ $[M+H]^+$: 323.1430; found: 323.1423.



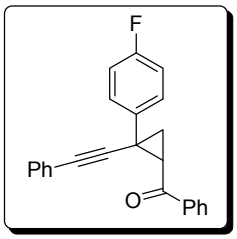
1b

Following the typical experimental procedures **1b** was prepared in 50% yield over two steps from (Z)-2-en-4-yn-1-ol **Ib**. **^{1}H NMR** (400 MHz, Acetone-d6): δ = 7.98-8.05 (d, 2H, *J* = 7.6 Hz), 7.58-7.65 (m, 1H), 7.49-7.57 (m, 4H), 7.25-7.30 (m, 5H), 6.97-7.02 (dd, 2H, *J* = 6.8 Hz and 2.0 Hz), 3.83 (s, 3H), 3.37-3.43 (dd, 1H, *J* = 7.6 Hz and 7.2 Hz), 2.32-2.37 (dd, 1H, *J* = 7.2 Hz and 4.8 Hz), 1.98-2.03 ppm(dd, 1H, *J* = 7.6 Hz and 4.8 Hz); **^{13}C NMR** (100 MHz, Acetone-d6): δ = 194.0, 160.0, 139.0, 133.9, 133.0, 132.4, 129.6, 129.2, 129.0, 128.9, 128.1, 124.2, 115.0, 90.0, 82.3, 55.7, 38.6, 27.6, 22.8 ppm; **EI MS** (70 eV): m/z (%): 352 (1) $[M]^+$, 247 (4), 236 (75), 208 (78), 129 (100), 77 (55). **HRMS** (APCI): m/z calcd for $C_{25}H_{20}O_2$ $[M+H]^+$: 353.1536; found: 353.1539.



1c

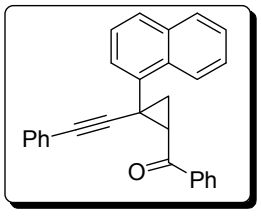
Following the typical experimental procedures **1c** was prepared in 45% yield over two steps from (Z)-2-en-4-yn-1-ol **Ic**. **^{1}H NMR** (400 MHz, $CDCl_3$): δ = 8.15-8.20 (d, 2H, *J* = 8.0 Hz), 7.52-7.60 (dd, 1H, *J* = 7.2 Hz and 7.2 Hz), 7.40-7.52 (m, 3H), 7.20-7.32 (m, 3H), 7.12-7.18 (m, 3H), 6.90-7.00 (m, 2H), 3.80 (s, 3H), 3.16-3.22 (dd, 1H, *J* = 7.6 Hz and 6.4 Hz), 2.36-2.43 (dd, 1H, *J* = 6.4 Hz and 4.8 Hz), 1.80-2.87 ppm(dd, 1H, *J* = 7.6 Hz and 4.8 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 194.8, 158.3, 138.5, 132.5, 131.8, 129.9, 129.3, 129.0, 128.5, 128.3, 127.8, 127.4, 123.7, 120.6, 111.3, 89.4, 79.6, 55.2, 34.2, 26.1, 21.7 ppm; **EI MS** (70 eV): m/z (%): 352 (6) $[M]^+$, 247 (28), 135 (46), 105 (100), 77 (64), 51 (24); **HRMS** (ESI): m/z calcd for $C_{25}H_{20}O_2$ $[M+H]^+$: 353.1536; found: 353.1534.



1d

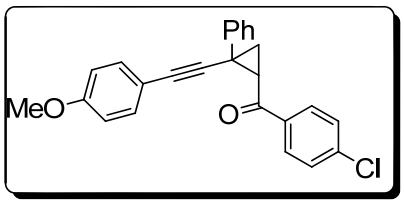
Following the typical experimental procedures **1d** was prepared in 53% yield over two steps from (Z)-2-en-4-yn-1-ol **Id**. **^{1}H NMR** (400 MHz, $CDCl_3$): δ = 7.92-8.00 (d, 2H, *J* =

7.2 Hz), 7.46-7.56 (m, 3H), 7.40-7.46 (m, 2H), 7.23-7.30 (m, 2H), 7.15-7.23 (m, 3H), 7.04-7.12 (dd, 2H, *J* = 8.4 Hz and 8.4 Hz), 3.09-3.15 (dd, 1H, *J* = 8.0 Hz and 6.8 Hz), 2.47-2.54 (dd, 1H, *J* = 6.8 Hz and 5.2 Hz), 1.88-1.94 ppm(dd, 1H, *J* = 8.0 Hz and 5.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 193.4, 163.1, 160.7, 137.7, 136.0, 135.9, 132.9, 131.7, 128.6, 128.2, 128.0, 127.9, 127.6, 127.5, 122.8, 115.7, 115.5, 87.8, 82.3, 38.1, 27.0, 22.5 ppm; **EI MS** (70 eV): m/z (%): 340 (6) $[M]^+$, 233 (9), 207 (13), 105 (100), 77 (32), 51 (11); **HRMS** (ESI): m/z calcd for $C_{24}H_{17}FO$ $[M+H]^+$: 341.1336; found: 341.1336.



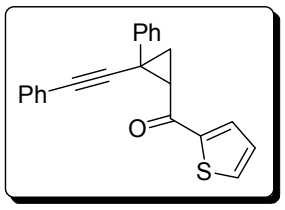
1e

Following the typical experimental procedures **1e** was prepared in 50% yield over two steps from (Z)-2-en-4-yn-1-ol **Ie**. **^{1}H NMR** (400 MHz, $CDCl_3$): δ = 8.35-8.44 (d, 1H, *J* = 8.0 Hz), 8.05-8.14 (d, 2H, *J* = 8.0 Hz), 7.81-7.88 (d, 1H, *J* = 8.0 Hz), 7.76-7.81 (d, 1H, *J* = 8.0 Hz), 7.52-7.61 (m, 2H), 7.35-7.52 (m, 6H), 7.20-7.25 (m, 2H), 7.05-7.13 (m, 2H), 3.28-3.34 (m, 1H), 2.54-2.62 (m, 1H), 1.90-2.00 ppm(m, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 194.1, 138.0, 137.0, 134.0, 133.0, 131.9, 131.7, 128.6, 128.6, 128.5, 128.5, 127.9, 127.6, 126.2, 126.0, 125.7, 125.4, 125.3, 123.2, 89.1, 81.6, 34.0, 28.2, 22.4 ppm; **EI MS** (70 eV): m/z (%): 372 (6) $[M]^+$, 267 (0.2), 239 (13), 105 (100), 77 (64), 51 (19); **HRMS** (ESI): m/z calcd for $C_{28}H_{20}O$ $[M+H]^+$: 373.1587; found: 373.1580.



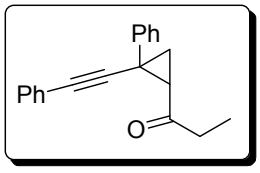
1f

Following the typical experimental procedures **1f** was prepared in 27% yield over two steps from (Z)-2-en-4-yn-1-ol **If**. **^{1}H NMR** (400 MHz, $CDCl_3$): δ = 7.87-7.92 (d, 2H, *J* = 8.4 Hz), 7.50-7.56 (d, 2H, *J* = 7.2 Hz), 7.38-7.46 (m, 4H), 7.30-7.36 (dd, 1H, *J* = 7.2 Hz and 7.2 Hz), 7.18-7.23 (d, 2H, *J* = 8.8 Hz), 6.72-6.78 (d, 2H, *J* = 8.8 Hz), 3.76 (s, 3H), 3.08-3.14 (dd, 1H, *J* = 7.6 Hz and 6.8 Hz), 2.46-2.54 (dd, 1H, *J* = 6.8 Hz and 5.2 Hz), 1.94-2.00 ppm(dd, 1H, *J* = 7.6 Hz and 5.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 192.7, 159.4, 140.2, 139.3, 136.2, 133.2, 129.7, 128.9, 128.8, 127.2, 125.7, 115.0, 113.7, 86.1, 82.2, 55.2, 38.3, 27.7, 22.6 ppm; **EI MS** (70 eV): m/z (%): 386 (7) $[M]^+$, 254 (12), 247 (73), 139 (100), 111 (77), 75 (36); **HRMS** (ESI): m/z calcd for $C_{25}H_{19}ClO_2$ $[M+H]^+$: 387.1146; found: 387.1145.



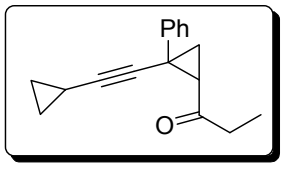
1g

Following the typical experimental procedures **1g** was prepared in 17% yield over two steps from (Z)-2-en-4-yn-1-ol **Ig**. **^{1}H NMR** (400 MHz, $CDCl_3$): δ = 7.67-7.73 (d, 1H, *J* = 3.2 Hz), 7.58-7.65 (d, 1H, *J* = 4.8 Hz), 7.48-7.55 (d, 2H, *J* = 7.6 Hz), 7.36-7.43 (m, 2H), 7.26-7.36 (m, 3H), 7.18-7.26 (m, 3H), 7.08-7.14 (dd, 1H, *J* = 4.4 Hz and 4.4 Hz), 3.06-3.14 (dd, 1H, *J* = 7.6 Hz and 6.8 Hz), 2.43-2.50 (dd, 1H, *J* = 6.8 Hz and 5.2 Hz), 1.92-1.98 ppm(dd, 1H, *J* = 7.6 Hz and 5.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 186.0, 145.1, 140.2, 133.4, 131.9, 131.8, 128.7, 128.1, 128.0, 127.8, 127.1, 126.0, 123.0, 88.0, 82.3, 38.4, 27.7, 22.3 ppm; **EI MS** (70 eV): m/z (%): 328 (10) $[M]^+$, 226 (7), 215 (18), 202 (15), 189 (19), 111 (100); **HRMS** (ESI): m/z calcd for $C_{22}H_{16}OS$ $[M+H]^+$: 329.0995; found: 329.0991.



1h

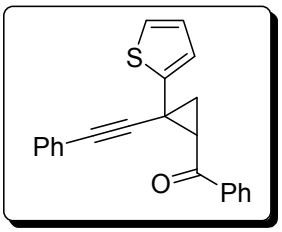
Following the typical experimental procedures **1h** was prepared in 61% yield over two steps from (Z)-2-en-4-yn-1-ol **Ih**. **^{1}H NMR** (400 MHz, $CDCl_3$): δ = 7.46-7.51 (m, 2H), 7.41-7.46 (m, 2H), 7.35-7.41 (m, 2H), 7.26-7.32 (m, 4H), 2.63-2.71 (q, 2H, *J* = 7.2 Hz), 2.57-2.63 (dd, 1H, *J* = 8.0 Hz and 7.2 Hz), 2.27-2.32 (dd, 1H, *J* = 7.2 Hz and 5.2 Hz), 1.77-1.83 (dd, 1H, *J* = 8.0 Hz and 5.2 Hz), 1.15-1.20 ppm(t, 3H, *J* = 7.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 204.1, 140.4, 131.7, 128.6, 128.1, 127.9, 127.0, 125.9, 123.1, 88.2, 82.0, 40.2, 37.2, 26.8, 22.5, 7.9 ppm; **EI MS** (70 eV): m/z (%): 274 (12) $[M]^+$, 245 (12), 217 (100), 202 (58), 189 (34), 57 (68); **HRMS** (ESI): m/z calcd for $C_{20}H_{18}O$ $[M+H]^+$: 275.1430; found: 275.1438.



1i

Following the typical experimental procedures **1i** was prepared in 64% yield over two steps from (Z)-2-en-4-yn-1-ol **Ii**. **^{1}H NMR** (400 MHz, $CDCl_3$): δ = 7.34-7.39 (m, 2H), 7.29-7.39 (m, 2H), 7.20-7.26 (m, 1H), 2.53-2.61 (q, 2H, *J* = 7.2 Hz), 2.37-2.44 (dd, 1H, *J* = 7.6 Hz and 7.6 Hz), 2.05-2.10 (dd, 1H, *J* = 7.6 Hz and 5.2 Hz), 1.58-1.64 (dd, 1H, *J* = 7.6 Hz and 5.2 Hz), 1.18-1.26 (m, 1H), 1.09-1.15 (t, 3H, *J* = 7.2 Hz), 0.70-0.75 (m, 2H), 0.60-0.66 ppm(m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 204.4, 141.1, 128.4, 126.7, 125.8, 85.6, 73.5, 39.9, 37.1, 26.4, 22.3, 8.4, 8.3, 7.8, 0.0 ppm; **EI MS** (70 eV): m/z (%):

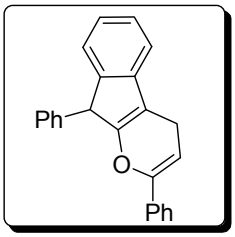
238 (11) $[M]^+$, 237 (12), 209 (22), 181 (78), 165 (89), 57 (100); **HRMS** (ESI): m/z calcd for $C_{17}H_{18}O$ $[M+H]^+$: 239.1430; found: 239.1434.



1j

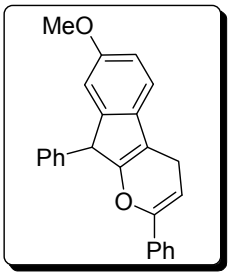
Following the typical experimental procedures **1j** was prepared in 54% yield over two steps from (Z)-2-en-4-yn-1-ol **Ij**. **^{1}H NMR** (400 MHz, $CDCl_3$): δ = 7.98-8.03 (d, 2H, *J* = 7.6 Hz), 7.54-7.60 (m, 1H), 7.44-7.52 (m, 3H), 7.30-7.35 (m, 2H), 7.24-7.30 (m, 3H), 7.17-7.24 (m, 1H), 7.11-7.15 (m, 1H), 3.23-3.30 (dd, 1H, *J* = 7.6 Hz and 7.6 Hz), 2.54-2.60 (dd, 1H, *J* = 7.6 Hz and 5.2 Hz), 1.91-1.97 ppm(dd, 1H, *J* = 7.6 Hz and 5.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 193.2, 146.0, 137.7, 133.0, 131.8, 128.6, 128.4, 128.3, 128.0, 127.2, 123.9, 123.8, 122.7, 87.4, 81.7, 39.7, 24.6, 24.5 ppm; **EI MS** (70 eV): m/z (%): 328 (2) $[M]^+$, 255 (21), 223 (8), 192 (12), 160 (30), 43 (100); **HRMS** (ESI): m/z calcd for $C_{22}H_{16}OS$ $[M+H]^+$: 329.0995; found: 329.0989.

2.3 Spectroscopic and analytical data of the products 2a to 2i, 4a, 4i



2a

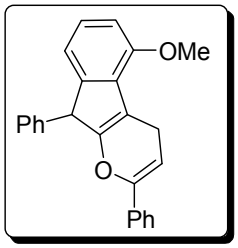
^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.48-7.55 (m, 2H), 7.22-7.36 (m, 9H), 7.17-7.22 (d, 1H, *J* = 7.2 Hz), 7.13-7.17 (d, 1H, *J* = 7.2 Hz), 7.08-7.13 (dd, 1H, *J* = 7.2 Hz and 7.2 Hz), 5.57-5.63 (dd, 1H, *J* = 3.2 Hz and 3.2 Hz), 4.66 (s, 1H), 3.33-3.39 ppm(dd, 2H, *J* = 5.6 Hz and 3.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 157.6, 149.9, 142.7, 141.7, 137.8, 134.3, 128.7, 128.3, 128.2, 128.1, 127.1, 127.0, 124.5, 124.1, 123.5, 117.7, 110.9, 97.3, 52.8, 20.2 ppm; **EI MS** (70 eV): m/z (%): 322 (18) $[M]^+$, 217 (14), 191 (18), 149 (70), 105 (100), 77 (49); **HRMS** (APCI): m/z calcd for $C_{24}H_{18}O$ $[M+H]^+$: 323.1430; found: 323.1431.



2b

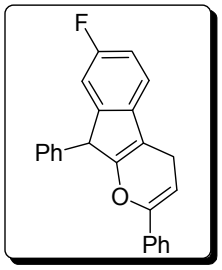
^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.47-7.52 (d, 2H, *J* = 6.4 Hz), 7.20-7.34 (m, 8H), 7.00-7.05 (d, 1H, *J* = 8.8 Hz), 6.78-6.83 (m, 2H), 5.53-5.58 (dd, 1H, *J* = 3.2 Hz and 3.2 Hz),

4.62 (s, 1H), 3.75 (s, 3H), 3.30-3.35 ppm(dd, 2H, *J* = 5.6 Hz and 3.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 157.5, 155.7, 149.8, 143.4, 138.0, 135.5, 134.4, 128.7, 128.2, 128.1, 127.0, 124.5, 117.9, 111.7, 111.3, 110.5, 97.1, 55.6, 52.8, 20.3 ppm; **EI MS** (70 eV): m/z (%): 352 (27) $[M]^+$, 247 (17), 222 (11), 179 (18), 149 (50), 105 (100); **HRMS** (APCI): m/z calcd for $C_{25}H_{20}O_2$ $[M+H]^+$: 353.1536; found: 353.1542.



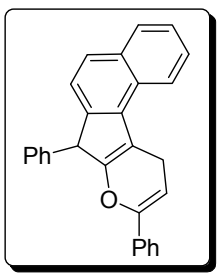
2c

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.46-7.50 (d, 2H, *J* = 7.2 Hz), 7.20-7.33 (m, 8H), 6.98-7.04 (dd, 1H, *J* = 8.4 Hz and 7.2 Hz), 6.76-6.83 (dd, 2H, *J* = 8.4 Hz and 7.2 Hz), 5.48-5.55 (dd, 1H, *J* = 3.6 Hz and 3.6 Hz), 4.56 (s, 1H), 3.83 (s, 3H), 3.59-3.63 ppm(m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 155.9, 153.5, 149.3, 143.3, 138.0, 134.4, 130.5, 128.7, 128.2, 128.1, 127.0, 125.0, 124.4, 116.8, 110.5, 110.0, 98.2, 55.6, 53.1, 20.8 ppm; **EI MS** (70 eV): m/z (%): 352 (17) $[M]^+$, 247 (17), 207 (26), 133 (24), 105 (100), 77 (38); **HRMS** (APCI): m/z calcd for $C_{25}H_{20}O_2$ $[M+H]^+$: 353.1536; found: 353.1540.



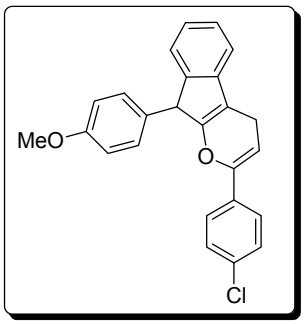
2d

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.46-7.51 (m, 2H), 7.25-7.35 (m, 4H), 7.18-7.25 (m, 4H), 7.00-7.05 (m, 1H), 6.95-7.00 (m, 1H), 6.88-6.95 (m, 1H), 5.53-5.58 (dd, 1H, *J* = 3.2 Hz and 3.2 Hz), 4.61 (s, 1H), 3.29-3.34 ppm(dd, 2H, *J* = 6.0 Hz and 3.2 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 162.1, 159.7, 156.9, 156.8, 149.8, 143.7, 143.6, 138.4, 138.4, 137.2, 134.2, 128.8, 128.3, 128.2, 128.1, 127.3, 124.5, 118.1, 118.0, 113.6, 113.4, 112.0, 111.7, 110.4, 97.1, 52.9, 52.8, 20.2 ppm; **EI MS** (70 eV): m/z (%): 340 (40) $[M]^+$, 233 (16), 209 (37), 133 (23), 105 (100), 77 (72); **HRMS** (APCI): m/z calcd for $C_{24}H_{17}FO$ $[M+H]^+$: 341.1336; found: 341.1340.



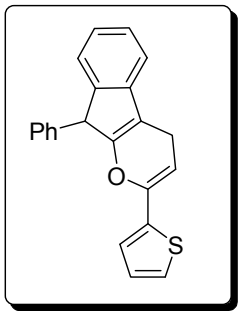
2e

^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.25-8.30 (d, 1H, *J* = 7.6 Hz), 7.80-7.88 (d, 1H, *J* = 8.0 Hz), 7.58-7.63 (d, 1H, *J* = 7.6 Hz), 7.49-7.58 (m, 3H), 7.39-7.49 (m, 3H), 7.20-7.39 (m, 7H), 5.59-5.64 (dd, 1H, *J* = 3.2 Hz and 3.2 Hz), 4.70 (s, 1H), 4.00-4.06 ppm(m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 158.7, 149.4, 138.4, 138.3, 137.3, 134.1, 133.7, 128.9, 128.7, 128.6, 128.3, 128.2, 127.1, 126.7, 125.3, 125.0, 124.5, 124.2, 123.8, 122.0, 111.6, 97.3, 53.3, 24.3 ppm; **EI MS** (70 eV): m/z (%): 372 (9) $[M]^+$, 241 (15), 180 (15), 165 (20), 105 (100), 77 (73); **HRMS** (APCI): m/z calcd for $C_{28}H_{20}O$ $[M+H]^+$: 373.1587; found: 373.1586.



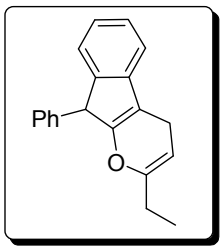
2f

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.40-7.46 (d, 2H, *J* = 8.4 Hz), 7.23-7.30 (m, 2H), 7.08-7.20 (m, 6H), 6.82-6.88 (d, 2H, *J* = 8.4 Hz), 5.53-5.58 (dd, 1H, *J* = 3.2 Hz and 3.2 Hz), 4.59 (s, 1H), 3.78 (s, 3H), 3.27-3.35 ppm(m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 158.7, 157.6, 149.0, 142.5, 141.9, 134.0, 132.8, 129.5, 129.1, 128.4, 127.1, 125.8, 124.2, 123.5, 117.7, 114.1, 110.6, 97.8, 55.2, 52.0, 20.1 ppm; **EI MS** (70 eV): m/z (%): 386 (29) $[M]^+$, 276 (4), 247 (100), 178 (56), 136 (66); **HRMS** (APCI): m/z calcd for $C_{25}H_{19}ClO_2$ $[M+H]^+$: 387.1146; found: 387.1150.



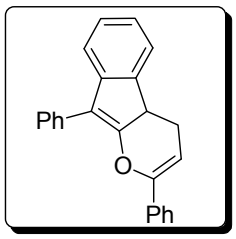
2g

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.28-7.35 (m, 3H), 7.19-7.28 (m, 3H), 7.08-7.19 (m, 5H), 6.91-6.97 (dd, 1H, *J* = 4.0 Hz and 4.0 Hz), 5.42-5.52 (dd, 1H, *J* = 3.2 Hz and 3.2 Hz), 4.64 (s, 1H), 3.26-3.37 ppm(m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 157.2, 145.8, 142.6, 141.5, 137.9, 137.6, 128.6, 128.1, 127.2, 127.1, 127.1, 124.6, 124.2, 123.6, 123.4, 117.7, 110.9, 96.7, 52.6, 20.0 ppm; **EI MS** (70 eV): m/z (%): 328 (81) $[M]^+$, 217 (31), 191 (69), 165 (21), 111 (100); **HRMS** (APCI): m/z calcd for $C_{22}H_{16}OS$ $[M+H]^+$: 329.0995; found: 329.0993.



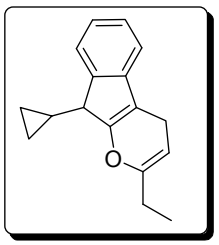
2h

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.20-7.31 (m, 4H), 7.14-7.20 (m, 2H), 7.10-7.14 (m, 1H), 7.01-7.09 (m, 2H), 4.74-4.80 (m, 1H), 4.51 (s, 1H), 3.11-3.19 (m, 2H), 2.07-2.15 (q, 2H, *J* = 7.6 Hz), 0.99-1.05 ppm(t, 3H, *J* = 7.6 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 157.6, 154.0, 142.9, 141.7, 138.0, 128.6, 128.1, 127.0, 126.9, 123.8, 123.3, 117.4, 111.1, 94.7, 52.6, 26.3, 19.7, 11.3 ppm; **EI MS** (70 eV): m/z (%): 274 (69) $[M]^+$, 217 (100), 202 (31), 189 (21), 57 (87); **HRMS** (APCI): m/z calcd for $C_{20}H_{18}O$ $[M+H]^+$: 275.1430; found: 275.1428.

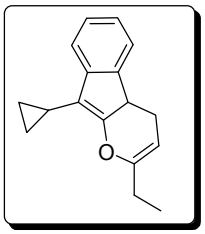


4a

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.77-7.82 (d, 2H, *J* = 8.0 Hz), 7.64-7.70 (d, 2H, *J* = 7.2 Hz), 7.55-7.60 (d, 1H, *J* = 7.6 Hz), 7.47-7.55 (dd, 2H, *J* = 7.6 Hz and 7.6 Hz), 7.42-7.47 (d, 1H, *J* = 7.6 Hz), 7.28-7.42 (m, 4H), 7.18-7.24 (dd, 1H, *J* = 7.6 Hz and 7.6 Hz), 5.62-5.68 (dd, 1H, *J* = 6.8 Hz and 2.4 Hz), 3.47-3.55 (dd, 1H, *J* = 12.8 Hz and 8.0 Hz), 2.97-3.08 (ddd, 1H, *J* = 16.8 Hz, 8.0 Hz and 6.8 Hz), 2.18-2.28 ppm(ddd, 1H, *J* = 16.8 Hz, 12.8 Hz and 2.4 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 156.3, 150.9, 143.2, 140.4, 134.1, 132.8, 128.6, 128.5, 128.4, 128.4, 127.2, 126.9, 124.6, 123.7, 122.9, 119.5, 116.8, 95.8, 39.6, 23.8 ppm; **EI MS** (70 eV): m/z (%): 322 (27) $[M]^+$, 217 (13), 178 (17), 115 (25), 105 (100), 77 (45).



2i and

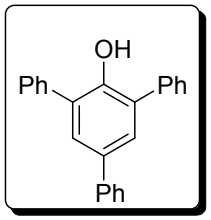


4i

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.20-7.45 (m, 7H), 7.06-7.18 (m, 2H), 6.98-7.06 (d, 1H, *J* = 7.6 Hz), 4.72-4.77 (m, 1H), 4.66-4.72 (m, 1H), 3.10-3.19 (dd, 1H, *J* = 12.4 Hz and 8.0 Hz), 3.03-3.10 (m, 2H), 2.78-2.83 (d, 1H, *J* = 8.4 Hz), 2.60-2.70 (m, 1H), 2.13-2.35 (m, 5H), 1.80-1.90 (m, 1H), 1.58-1.68 (m, 1H), 1.10-1.20 (m, 6H), 0.80-1.00 (m, 4H), 0.48-0.65 ppm(m, 4H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 158.5, 155.6, 154.8, 153.7, 145.1, 142.9, 141.1, 140.3, 126.9, 126.9, 123.3, 123.0, 122.6, 122.2, 118.5, 117.1, 115.8, 109.6, 94.7,

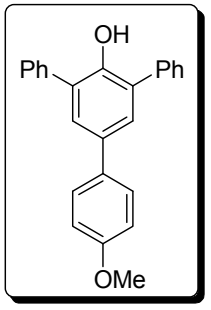
92.8, 49.9, 39.4, 26.5, 26.4, 23.2, 19.5, 11.6, 11.6, 11.4, 5.5, 4.8, 4.7, 2.3, 2.3 ppm; **EI MS** (70 eV): m/z (%): 238 (82) $[M]^+$, 181 (53), 165 (24), 153 (20), 141 (29), 128 (14), 115 (26), 57 (100), 41 (64). **HRMS** (APCI): m/z calcd for $C_{17}H_{18}O$ $[M+H]^+$: 239.1430; found: 239.1425.

2.4 Spectroscopic and analytical data of the products 3a to 3j, 5i



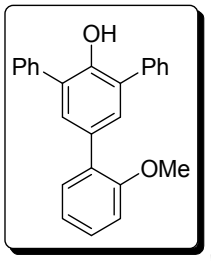
3a

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.60-7.65 (m, 6H), 7.52-7.56 (m, 2H), 7.48-7.52 (m, 4H), 7.39-7.46 (m, 4H), 7.30-7.36 (dd, 1H, *J* = 7.2 Hz and 7.2 Hz), 5.45 ppm(s, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 148.9, 140.5, 137.5, 133.8, 129.4, 129.1, 128.9, 128.8, 128.6, 127.8, 126.9, 126.8 ppm; **EI MS** (70 eV): m/z (%): 322 (100) $[M]^+$, 215 (16), 149 (39), 129 (20), 105 (46), 57 (35); **HRMS** (ESI negative): m/z calcd for $C_{24}H_{18}O$ $[M-H]^+$: 321.1285; found: 321.1287. This known compound has been reported in reference 3.



3b

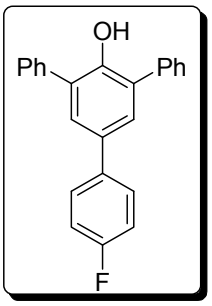
^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.59-7.64 (d, 4H, *J* = 7.2 Hz), 7.53-7.58 (d, 2H, *J* = 8.8 Hz), 7.46-7.53 (m, 6H), 7.38-7.46 (dd, 2H, *J* = 7.6 Hz and 7.6 Hz), 6.95-7.00 (d, 2H, *J* = 8.4 Hz), 5.39 (s, 1H), 3.85 ppm(s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 158.9, 148.5, 137.6, 133.5, 133.2, 129.4, 129.1, 128.9, 128.2, 127.8, 127.7, 114.2, 55.4 ppm; **EI MS** (70 eV): m/z (%): 352 (21) $[M]^+$, 236 (31), 208 (39), 193 (31), 129 (47), 41 (100); **HRMS** (ESI negative): m/z calcd for $C_{25}H_{20}O_2$ $[M-H]^+$: 351.1391; found: 351.1385. This known compound has been reported in reference 4.



3c

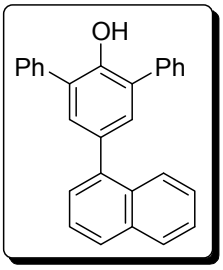
^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.60-7.65 (d, 4H, *J* = 7.2 Hz), 7.46-7.52 (m, 6H),

7.37-7.43 (m, 3H), 7.28-7.34 (m, 1H), 6.97-7.06 (m, 2H), 5.46 (s, 1H), 3.84 ppm(s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 156.4, 148.5, 137.7, 131.1, 130.9, 130.7, 129.9, 129.4, 128.8, 128.4, 128.3, 127.6, 120.8, 111.1, 55.6 ppm; **EI MS** (70 eV): m/z (%): 352 (52) $[M]^+$, 149 (100), 135 (76), 77 (51), 57 (83), 43 (75); **HRMS** (ESI negative): m/z calcd for $C_{25}H_{20}O_2$ $[M-H]^+$: 351.1391; found: 351.1384.



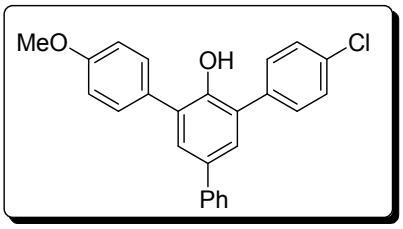
3d

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.60-7.65 (d, 4H, *J* = 7.6 Hz), 7.54-7.60 (m, 2H), 7.47-7.54 (m, 6H), 7.40-7.47 (m, 2H), 7.09-7.15 (dd, 2H, *J* = 8.8 Hz and 8.8 Hz), 5.45 ppm(s, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 163.4, 161.0, 148.9, 137.4, 136.7, 136.6, 132.9, 129.3, 129.2, 128.9, 128.5, 128.3, 128.2, 127.9, 115.7, 115.5 ppm; **EI MS** (70 eV): m/z (%): 340 (100) $[M]^+$, 149 (29), 133 (39), 105 (75), 77 (62), 41 (82); **HRMS** (ESI negative): m/z calcd for $C_{24}H_{17}FO$ $[M-H]^+$: 339.1191; found: 339.1186.



3e

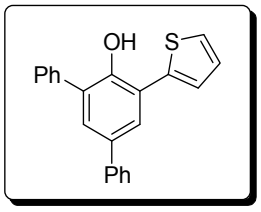
^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.09-8.14 (d, 1H, *J* = 8.0 Hz), 7.90-7.94 (m, 1H), 7.84-7.88 (m, 1H), 7.63-7.69 (m, 4H), 7.44-7.56 (m, 10H), 7.38-7.44 (m, 2H), 5.56 ppm(s, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 148.7, 139.5, 137.4, 133.9, 133.2, 131.7, 131.5, 129.4, 128.9, 128.6, 128.3, 127.8, 127.5, 127.0, 126.1, 126.0, 125.7, 125.4 ppm; **EI MS** (70 eV): m/z (%): 372 (32) $[M]^+$, 322 (21), 105 (92), 91 (32), 77 (53), 43 (100); **HRMS** (ESI negative): m/z calcd for $C_{28}H_{20}O$ $[M-H]^+$: 371.1441; found: 371.1437.



3f

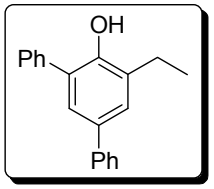
^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.55-7.63 (m, 4H), 7.39-7.53 (m, 8H), 7.29-7.35 (m, 1H), 7.03-7.08 (d, 2H, *J* = 8.8 Hz), 5.38 (s, 1H), 3.88 ppm(s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 159.5, 148.9, 140.4, 136.3, 134.0, 133.5, 130.8, 130.5, 129.1, 129.0, 128.8, 128.8,

128.7, 128.3, 127.8, 127.0, 126.8, 114.7, 55.4 ppm; **EI MS** (70 eV): m/z (%): 386 (8) $[M]^+$, 223 (5), 205 (4), 149 (100), 69 (48), 57 (64); **HRMS** (ESI negative): m/z calcd for $C_{25}H_{19}ClO_2$ $[M-H]^+$: 385.1001; found: 385.0996.



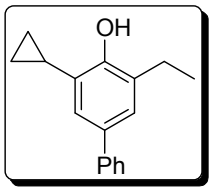
3g

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.64-7.68 (d, 1H, *J* = 8.0 Hz), 7.54-7.58 (dd, 1H, *J* = 3.6 Hz and 1.2 Hz), 7.29-7.38 (m, 4H), 7.20-7.23 (m, 2H), 7.12-7.18 (m, 4H), 7.05-7.11 (m, 3H), 5.64 ppm(s, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 149.1, 141.3, 140.7, 139.4, 134.9, 131.1, 129.6, 129.1, 128.1, 128.0, 127.7, 127.5, 127.3, 126.5, 125.8, 125.5, 122.4, 120.3 ppm; **EI MS** (70 eV): m/z (%): 328 (100) $[M]^+$, 215 (15), 191 (14), 111 (27), 45 (25); **HRMS** (ESI negative): m/z calcd for $C_{22}H_{16}OS$ $[M-H]^+$: 327.0849; found: 327.0853.



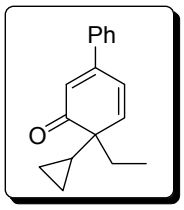
3h

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.57-7.63 (d, 2H, *J* = 7.6 Hz), 7.50-7.57 (m, 4H), 7.39-7.47 (m, 4H), 7.29-7.37 (m, 2H), 5.30 (s, 1H), 2.76-2.83 (q, 2H, *J* = 7.6 Hz), 1.30-1.40 ppm(t, 3H, *J* = 7.6 Hz); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 149.8, 141.0, 137.3, 133.5, 131.0, 129.4, 129.2, 128.7, 128.1, 128.0, 127.6, 126.8, 126.6, 126.4, 23.6, 14.1 ppm; **EI MS** (70 eV): m/z (%): 274 (100) $[M]^+$, 259 (37), 244 (16), 215 (16), 152 (9), 77 (13); **HRMS** (ESI negative): m/z calcd for $C_{20}H_{18}O$ $[M-H]^+$: 273.1285; found: 273.1288.



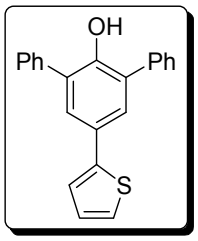
3i

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.51-7.56 (d, 2H, *J* = 7.2 Hz), 7.38-7.44 (dd, 2H, *J* = 8.0 Hz and 7.2 Hz), 7.27-7.32 (m, 2H), 7.19-7.24 (m, 1H), 5.62 (s, 1H), 2.70-2.78 (q, 2H, *J* = 7.6 Hz), 1.80-1.89 (m, 1H), 1.25-1.32 (t, 3H, *J* = 7.6 Hz), 0.98-1.04 (m, 2H), 0.69-0.74 ppm(m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 153.0, 141.4, 133.1, 129.9, 128.6, 126.9, 126.8, 126.5, 125.5, 23.3, 14.1, 9.6, 5.2 ppm; **EI MS** (70 eV): m/z (%): 238 (17) $[M]^+$, 203 (18), 159 (22), 145 (21), 133 (100), 105 (74); **HRMS** (ESI negative): m/z calcd for $C_{17}H_{18}O$ $[M-H]^+$: 237.1285; found: 237.1292.



5i

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.38-7.43 (m, 4H), 7.30-7.38 (m, 2H), 6.14-6.18 (m, 2H), 2.12-2.23 (m, 1H), 1.68-1.78 (m, 1H), 1.09-1.18 (m, 1H), 0.74-0.80 (t, 3H, *J* = 7.6 Hz), 0.38-0.46 (m, 2H), 0.28-0.38 (m, 1H), 0.13-0.20 ppm(m, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 205.4, 142.6, 139.0, 138.6, 135.9, 128.8, 127.9, 127.0, 125.7, 54.1, 32.3, 20.2, 9.6, 0.5, 0.1 ppm; **EI MS** (70 eV): m/z (%): 238 (40) $[M]^+$, 223 (32), 209 (36), 181 (48), 165 (59), 39 (100). **HRMS** (APCI): m/z calcd for $C_{17}H_{18}O$ $[M+H]^+$: 239.1430; found: 239.1434.



3j

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.60-7.67 (d, 4H, *J* = 7.6 Hz), 7.50-7.60 (m, 6H), 7.42-7.50 (m, 2H), 7.25-7.30 (m, 2H), 7.07-7.13 (dd, 1H, *J* = 4.0 Hz and 4.0 Hz), 5.46 ppm(s, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$): δ = 149.0, 143.9, 137.2, 129.3, 129.2, 128.9, 128.0, 127.9, 127.6, 127.4, 124.1, 122.4 ppm; **EI MS** (70 eV): m/z (%): 328 (8) $[M]^+$, 255 (11), 212 (17), 184 (25), 160 (15), 43 (100); **HRMS** (ESI negative): m/z calcd for $C_{22}H_{16}OS$ $[M-H]^+$: 327.0849; found: 327.0854.

References

1 S.-H. Wang, Y.-Q. Tu, P. Chen, X.-D. Hu, F.-M. Zhang and A.-X. Wang, *J. Org. Chem*. **2006**, *71*, 4343.

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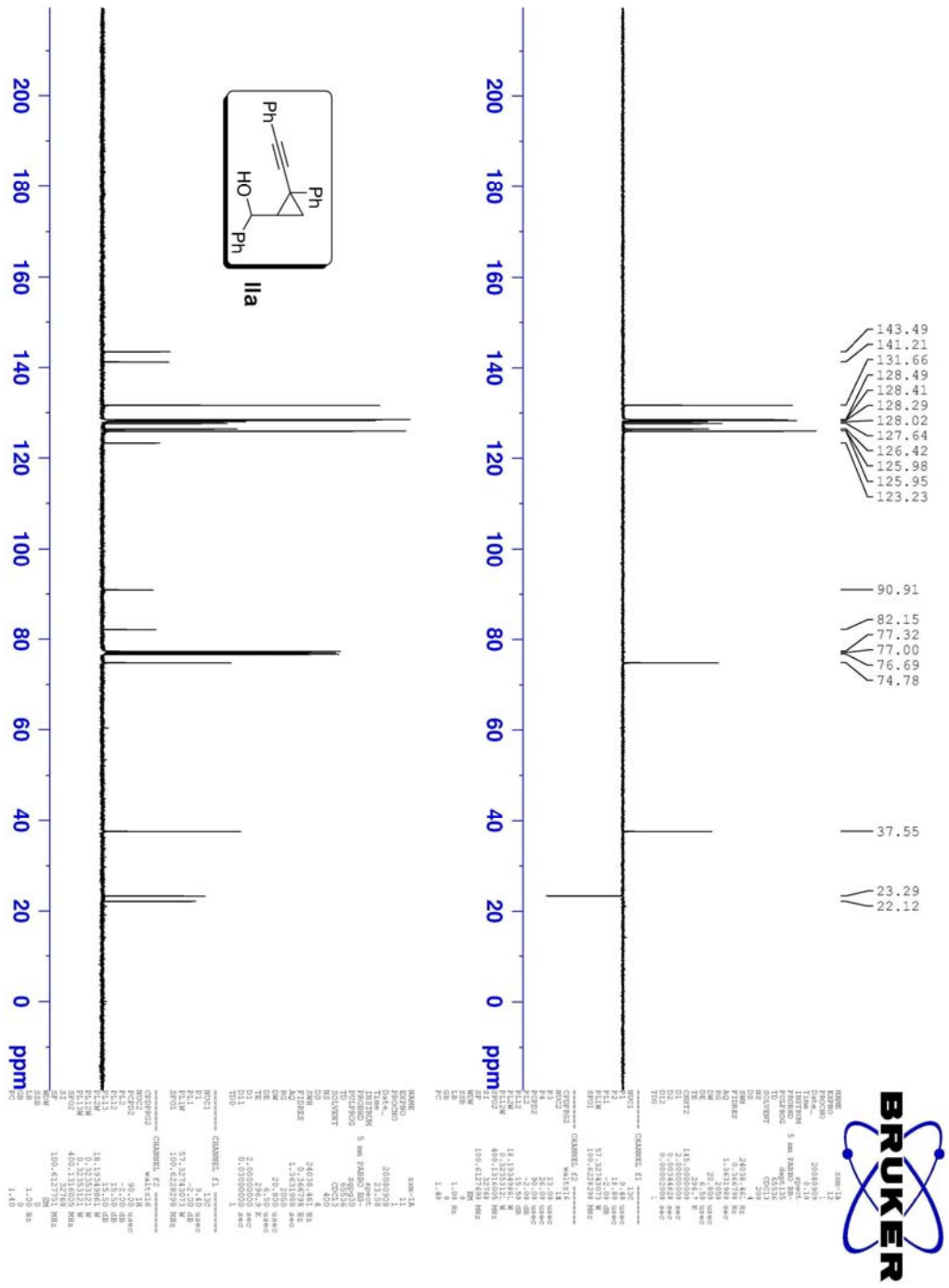
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125.95
123.23
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77.32
77.00
76.69
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22.12
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180
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120
100
80
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40
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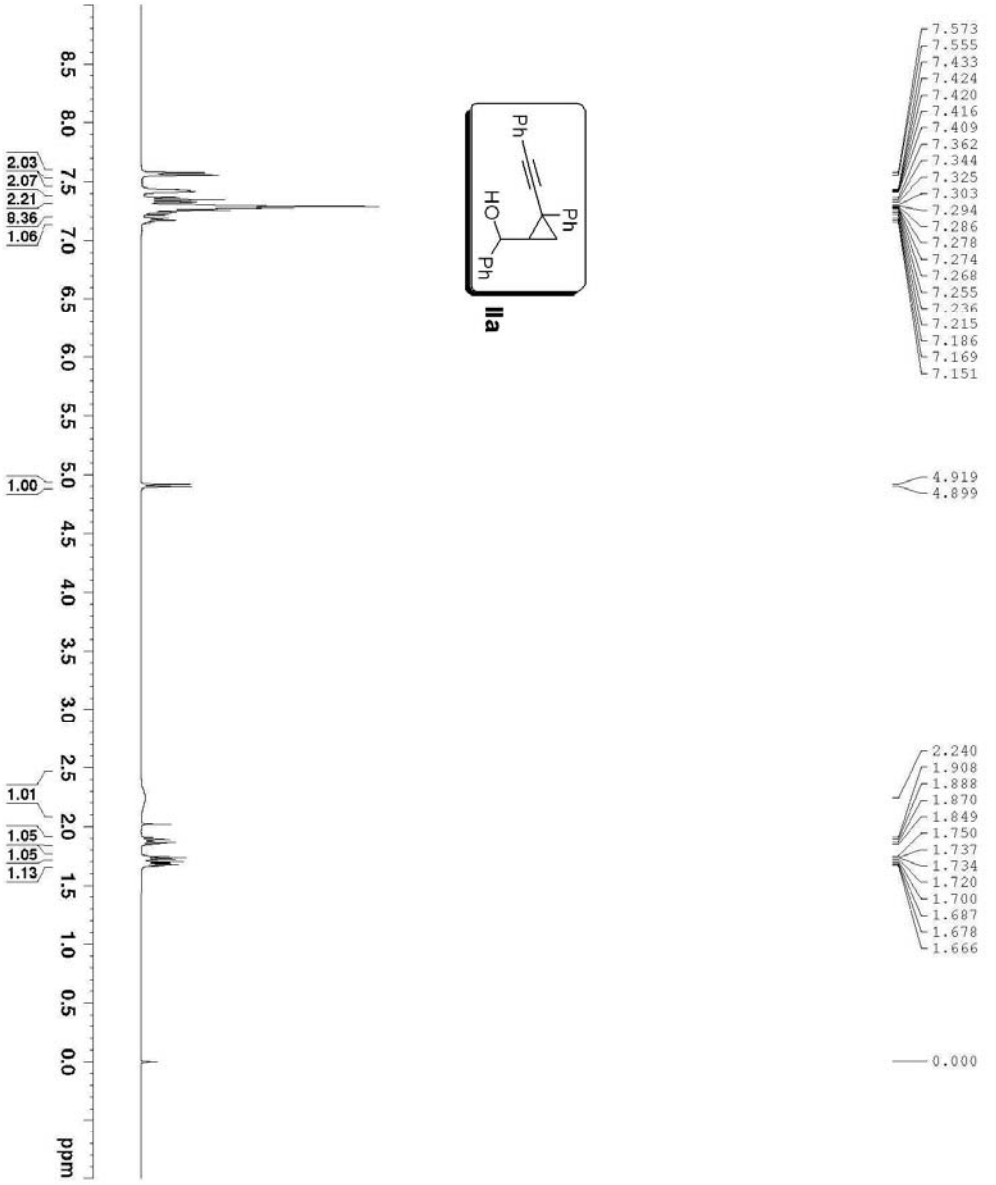
ppm
BRUKER

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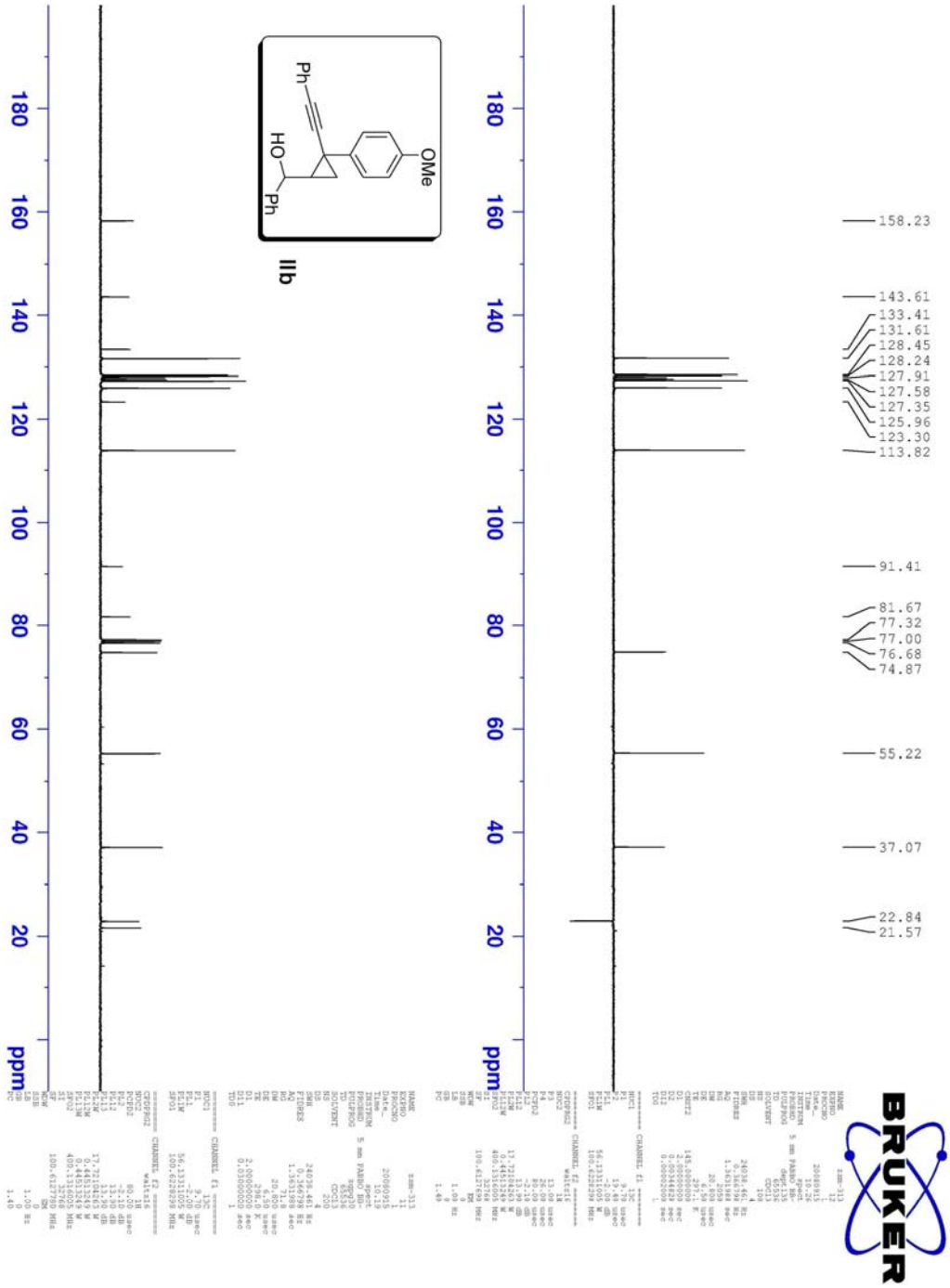
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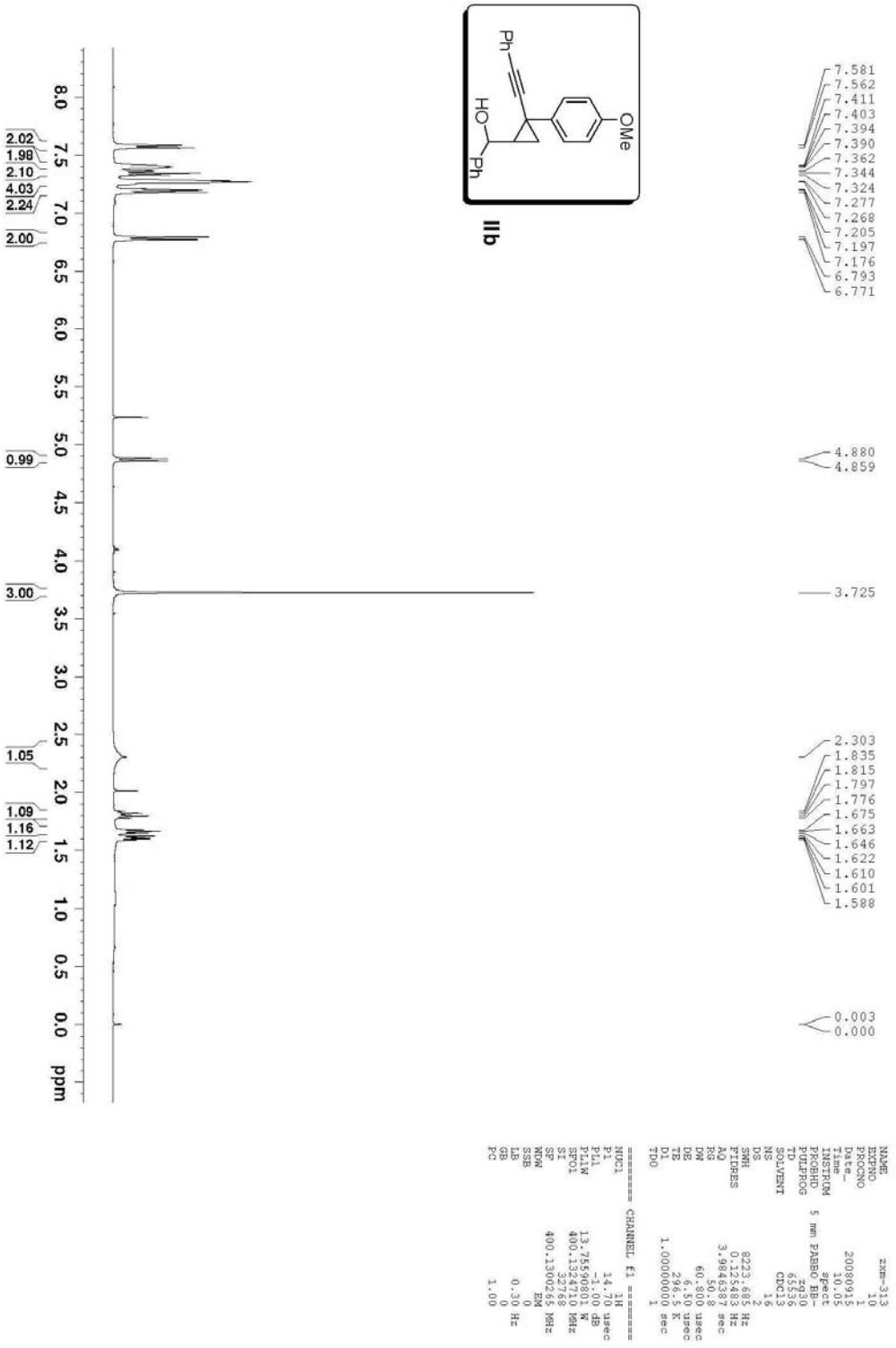
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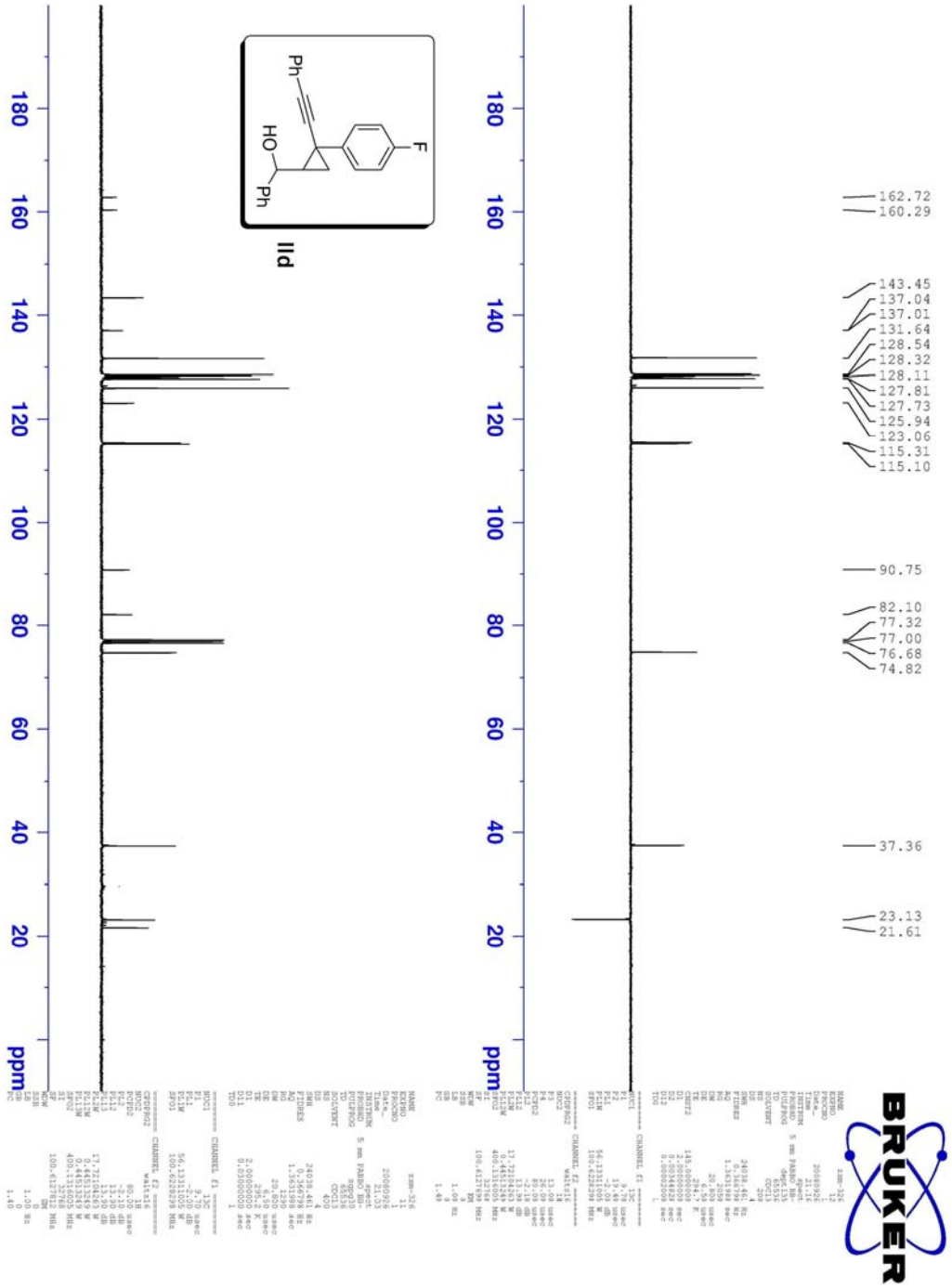
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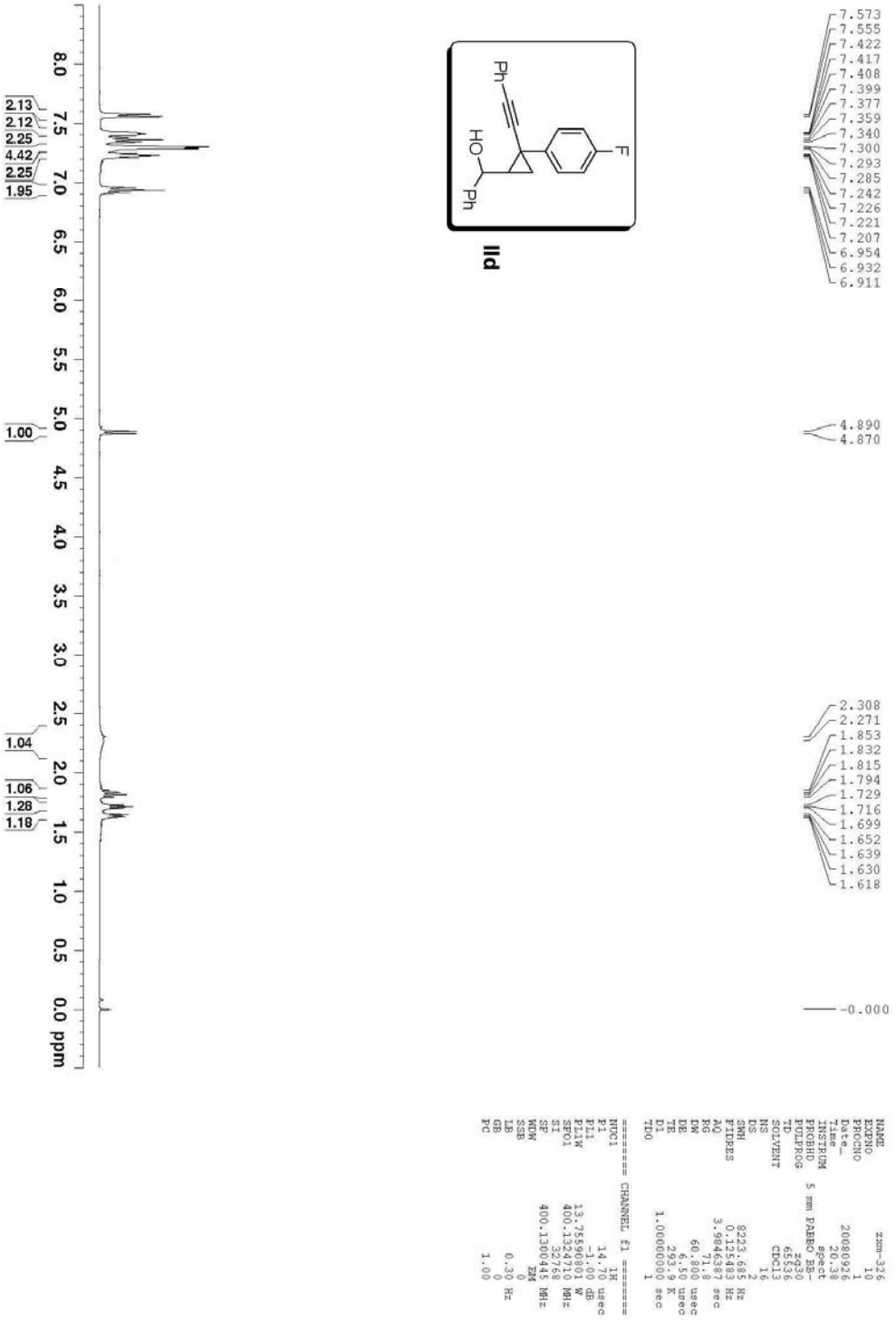
BRUKER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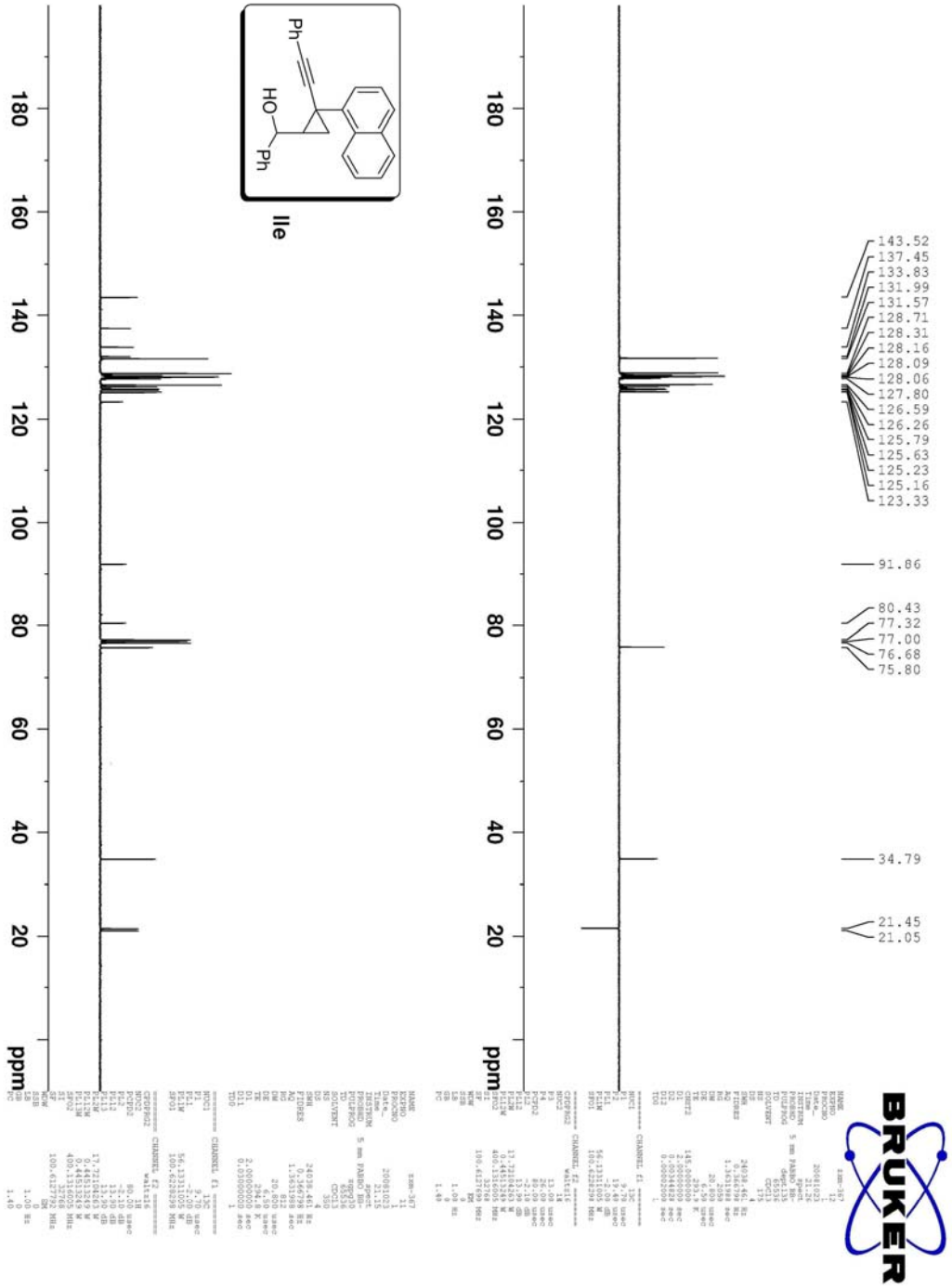
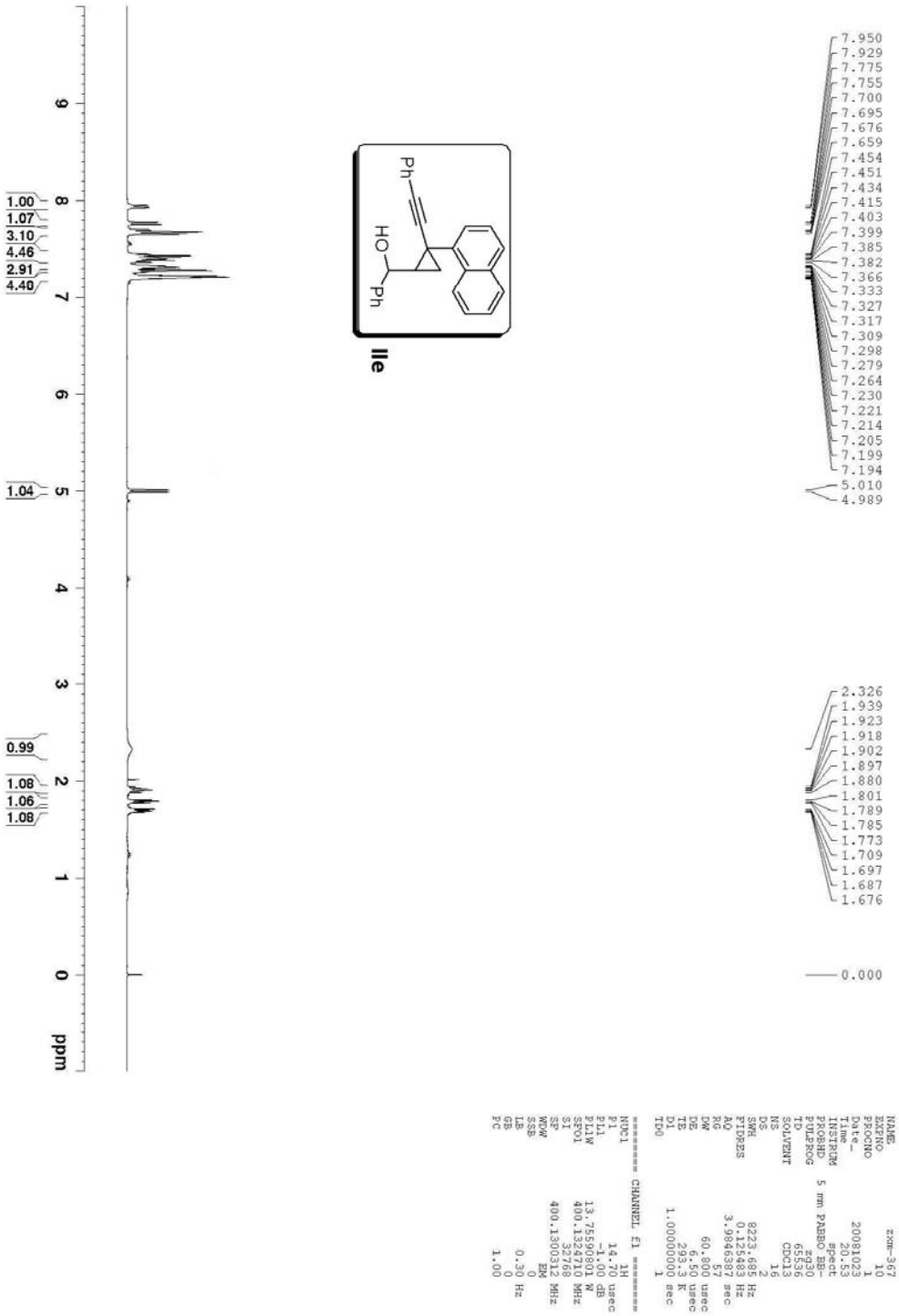
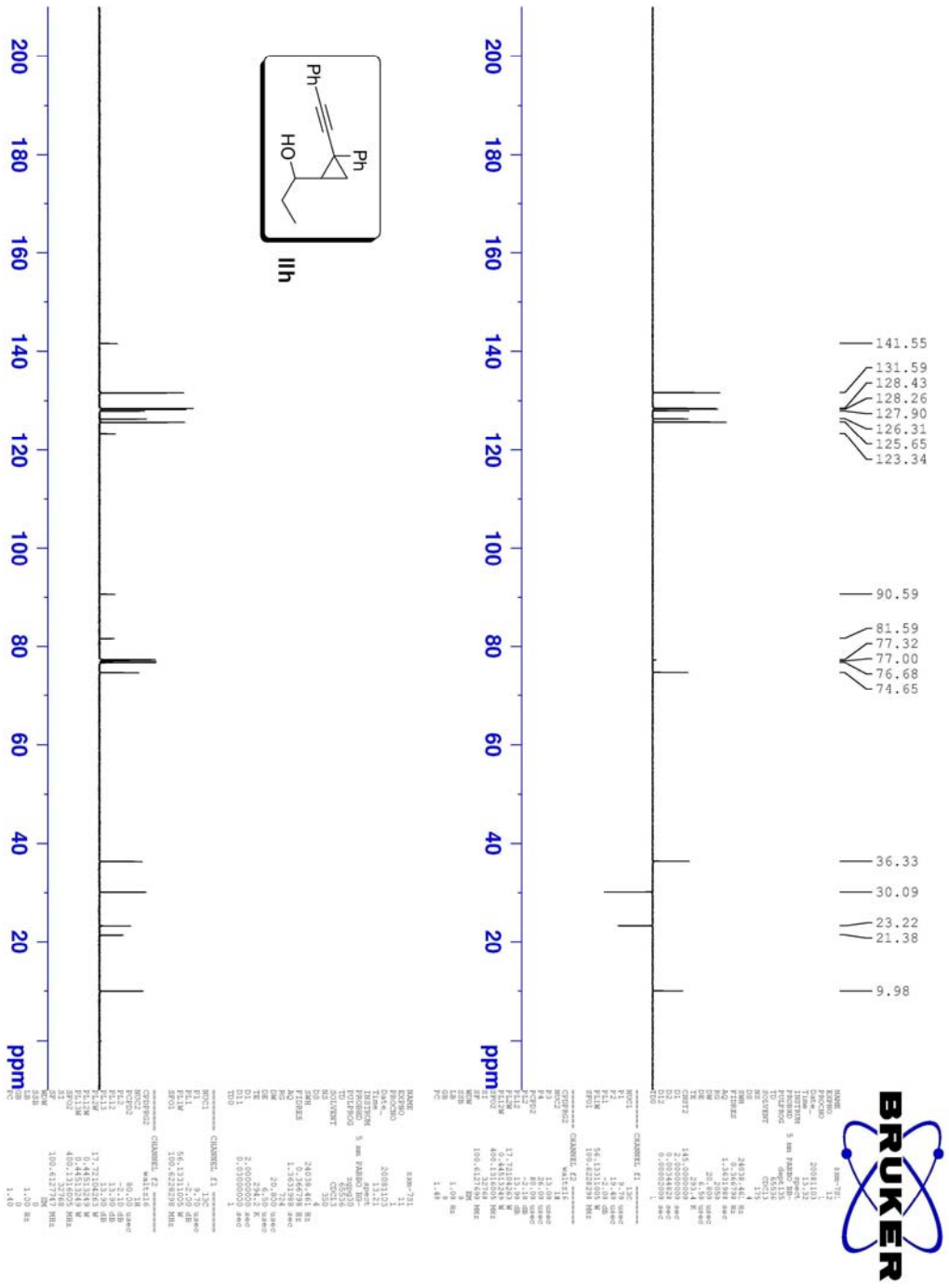
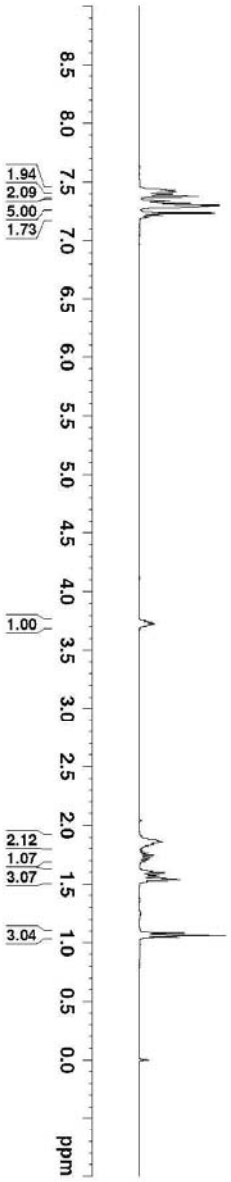
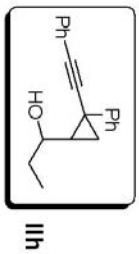
DW 60.800 usec
DE 6.50 usec
TE 293.9 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 -1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300445 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00


Ph
HO
Ph
IIe
ppm
143.52
137.45
133.83
131.99
131.57
128.71
128.31
128.16
128.09
128.06
127.80
126.59
126.26
125.79
125.63
125.23
125.16
123.33
91.86
80.43
77.32
77.00
76.68
75.80
34.79
21.45
21.05
BRUKER

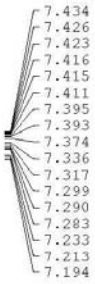

7.950
7.929
7.775
7.755
7.700
7.695
7.676
7.659
7.454
7.451
7.434
7.415
7.403
7.399
7.385
7.382
7.366
7.333
7.327
7.317
7.309
7.298
7.279
7.264
7.230
7.221
7.214
7.205
7.199
7.194
5.010
4.989
2.326
1.939
1.923
1.918
1.902
1.897
1.880
1.801
1.789
1.785
1.773
1.709
1.697
1.687
1.676
0.000
1.00
1.07
3.10
4.46
2.91
4.40
1.04
0.99
1.08
1.06
1.08
ppm
Ph
HO
Ph
IIe
NAME zxm-367
EXPNO 10
PROCNO 1
Date_ 20081023
Time 20.53
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 57
DW 60.800 usec
DE 6.50 usec
TE 293.3 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.20 usec
PL1 -1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 32768
SP 400.1300312 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

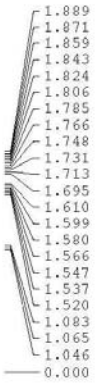

Ph
Ph
HO
IIh
141.55
131.59
128.43
128.26
127.90
126.31
125.65
123.34
90.59
81.59
77.32
77.00
76.68
74.65
36.33
30.09
23.22
21.38
9.98
ppm
BRUKER



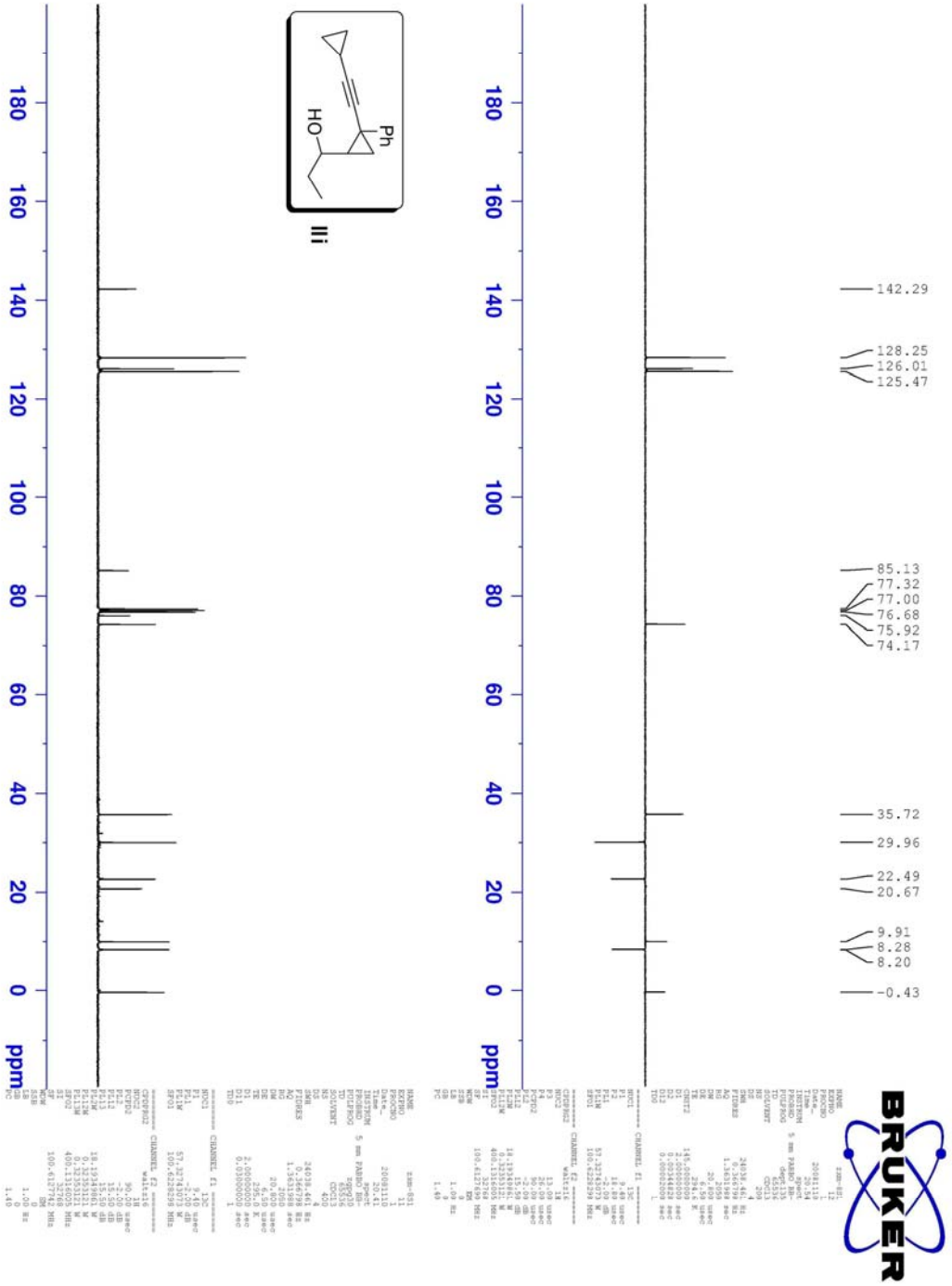


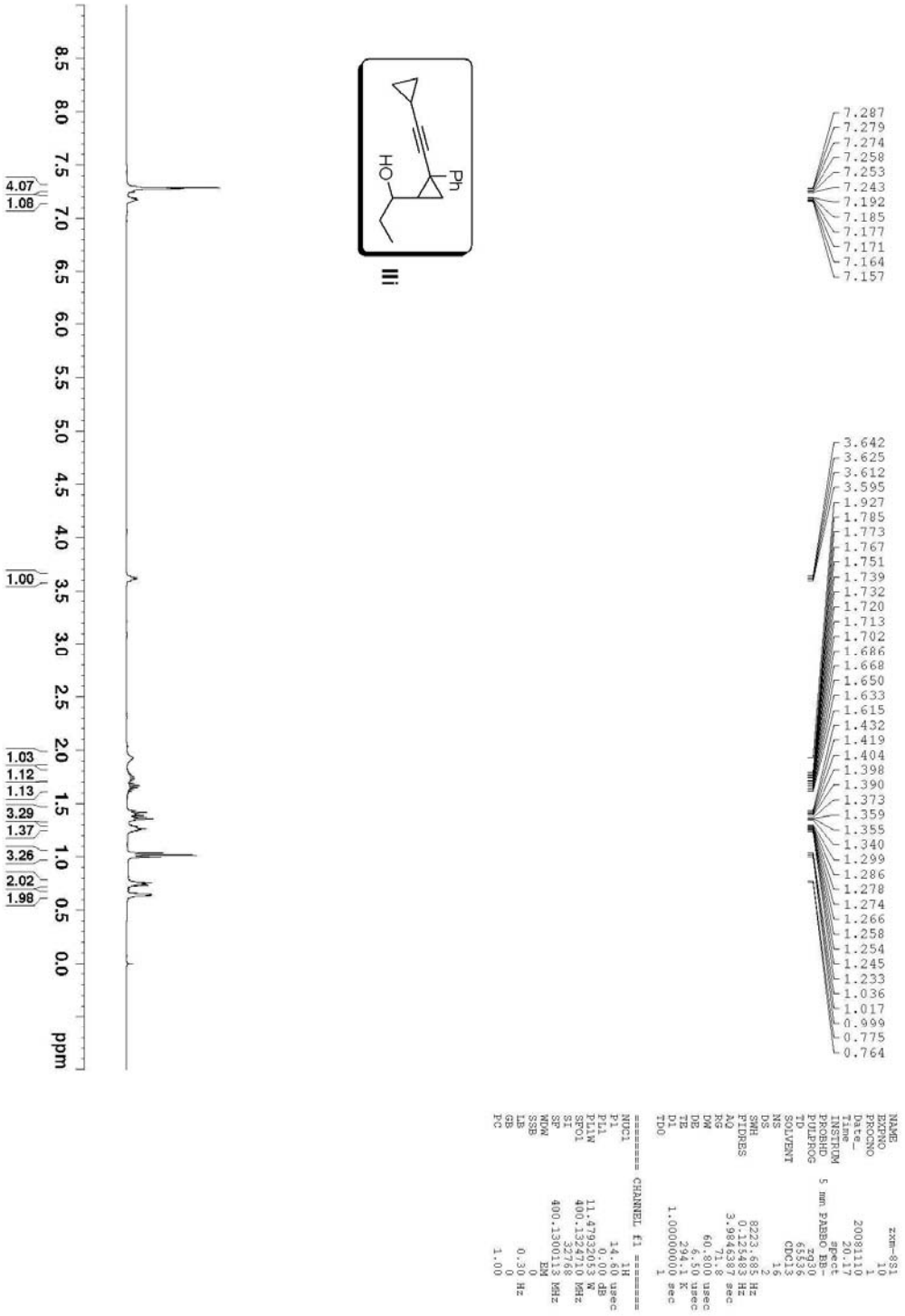
IIh

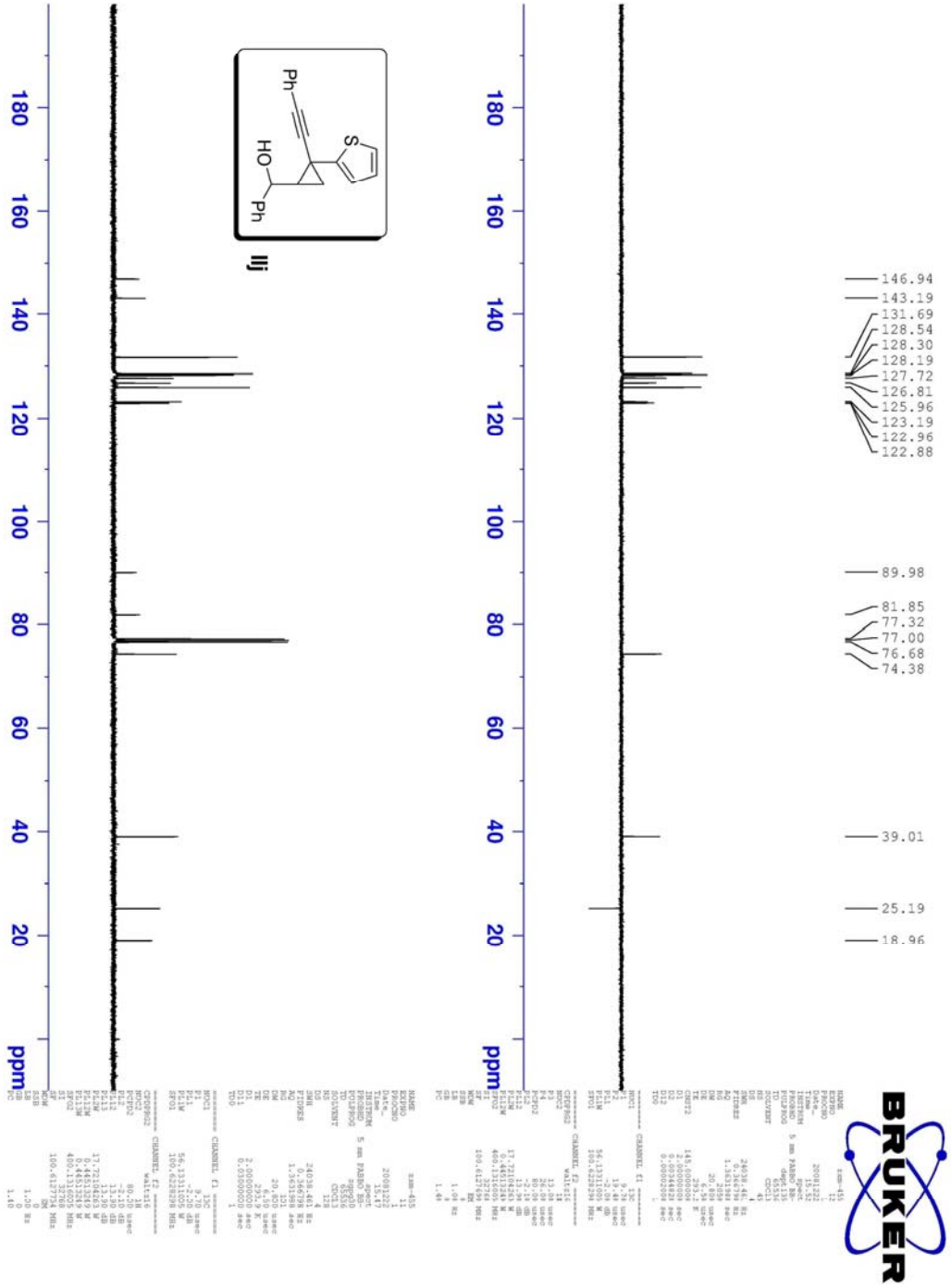


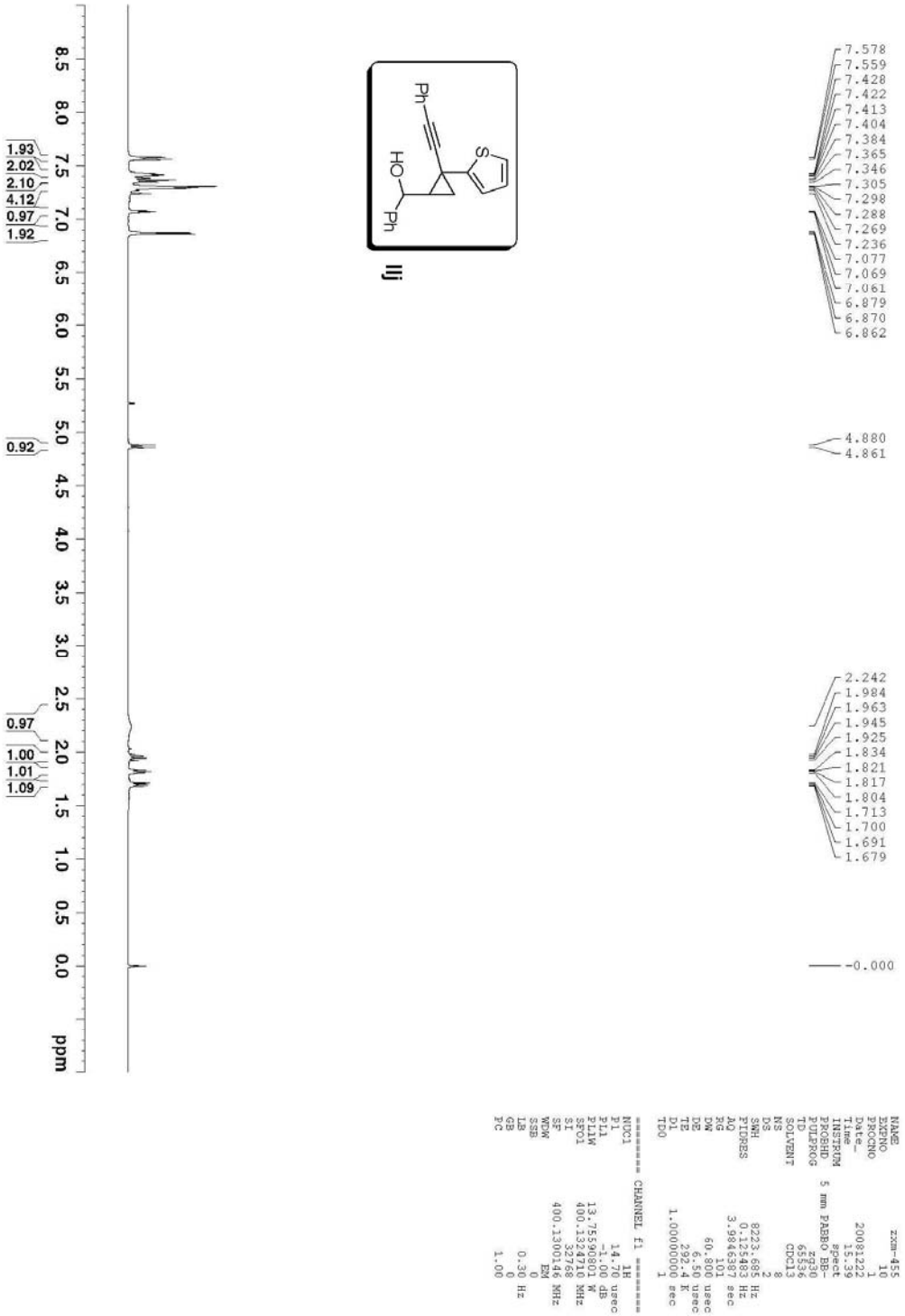


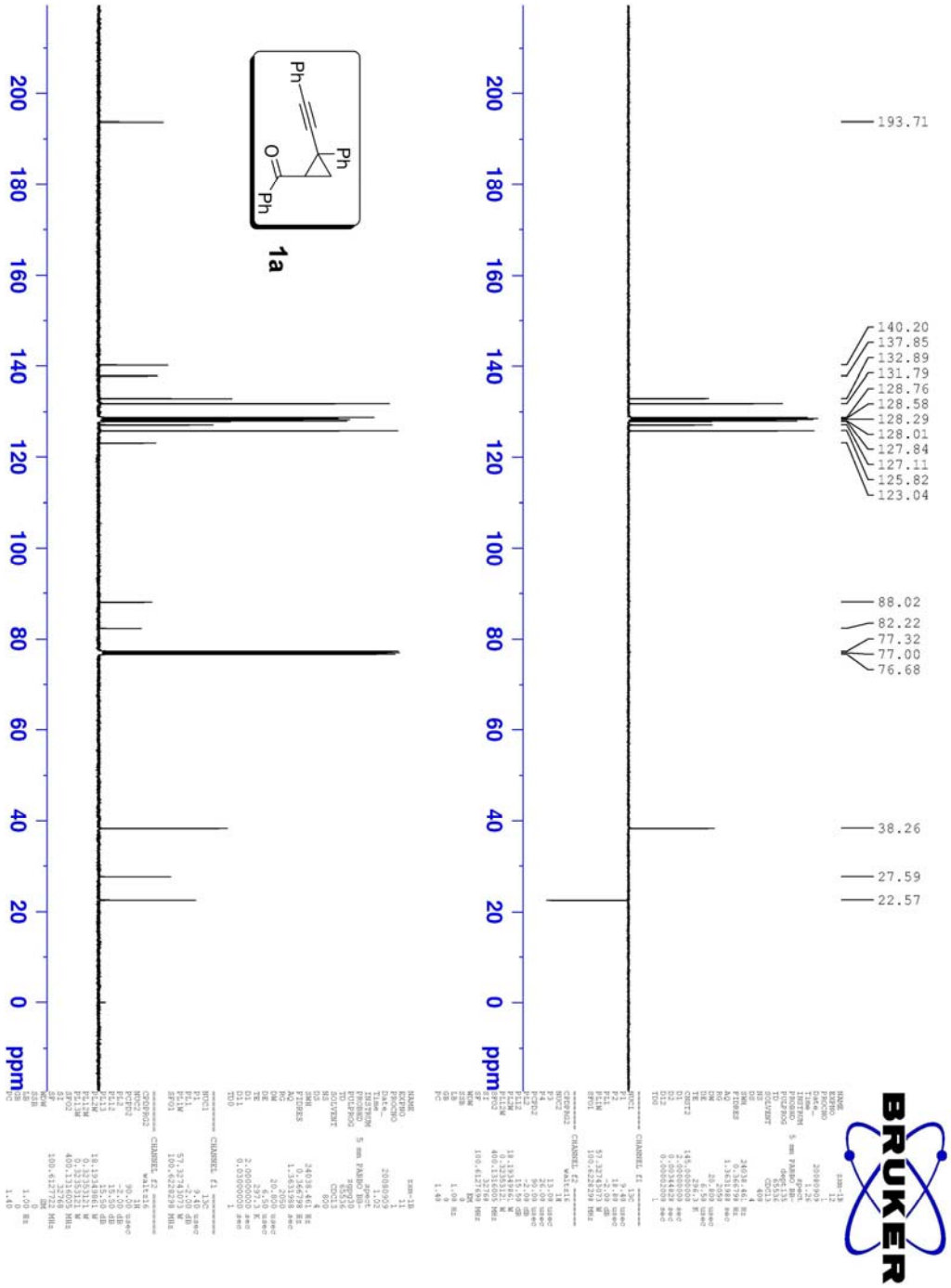

```
NAME                                    zxw-781
EXPNO                                        10
PROCNO                                        1
Date_                               20081103
Time                                    12.59
INSTRUM                                 spect
PROBHD                   5 mm PABBO BB-
PULPROG                                 zg30
TD                                      65536
SOLVENT                                 CDCl3
NS                                          2
DS                                          2
SWH                                 8223.685 Hz
FIDRES                              0.125483 Hz
AQ                                  3.9846387 sec
RG                                       71.8
DW                                  60.800 usec
DE                                   6.50 usec
TE                                      292.8 K
D1                                  1.00000000 sec
TD0                                         1

======== CHANNEL f1 ========
NUC1                                      1H
P1                                     14.70 usec
PL1                                    -1.00 dB
PL1W                            13.75590801 W
SFO1                            400.1324710 MHz
SI                                      32768
SF                              400.1300161 MHz
WDW                                       EM
SSB                                        0
LB                                      0.30 Hz
GB                                         0
PC                                      1.00
```

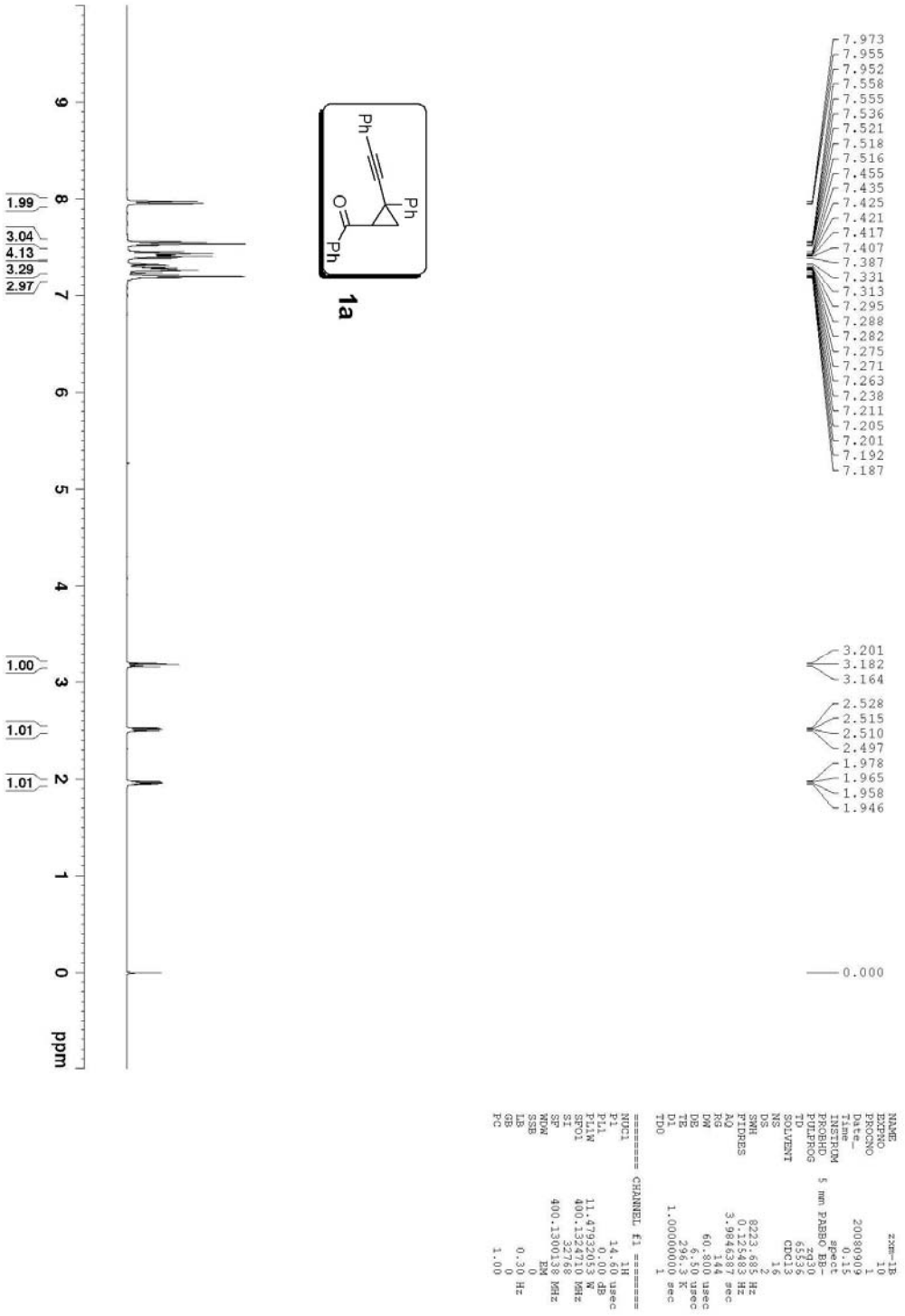

142.29
128.25
126.01
125.47
85.13
77.32
77.00
76.68
75.92
74.17
35.72
29.96
22.49
20.67
9.91
8.28
8.20
-0.43
ppm
HO
Ph
IIi

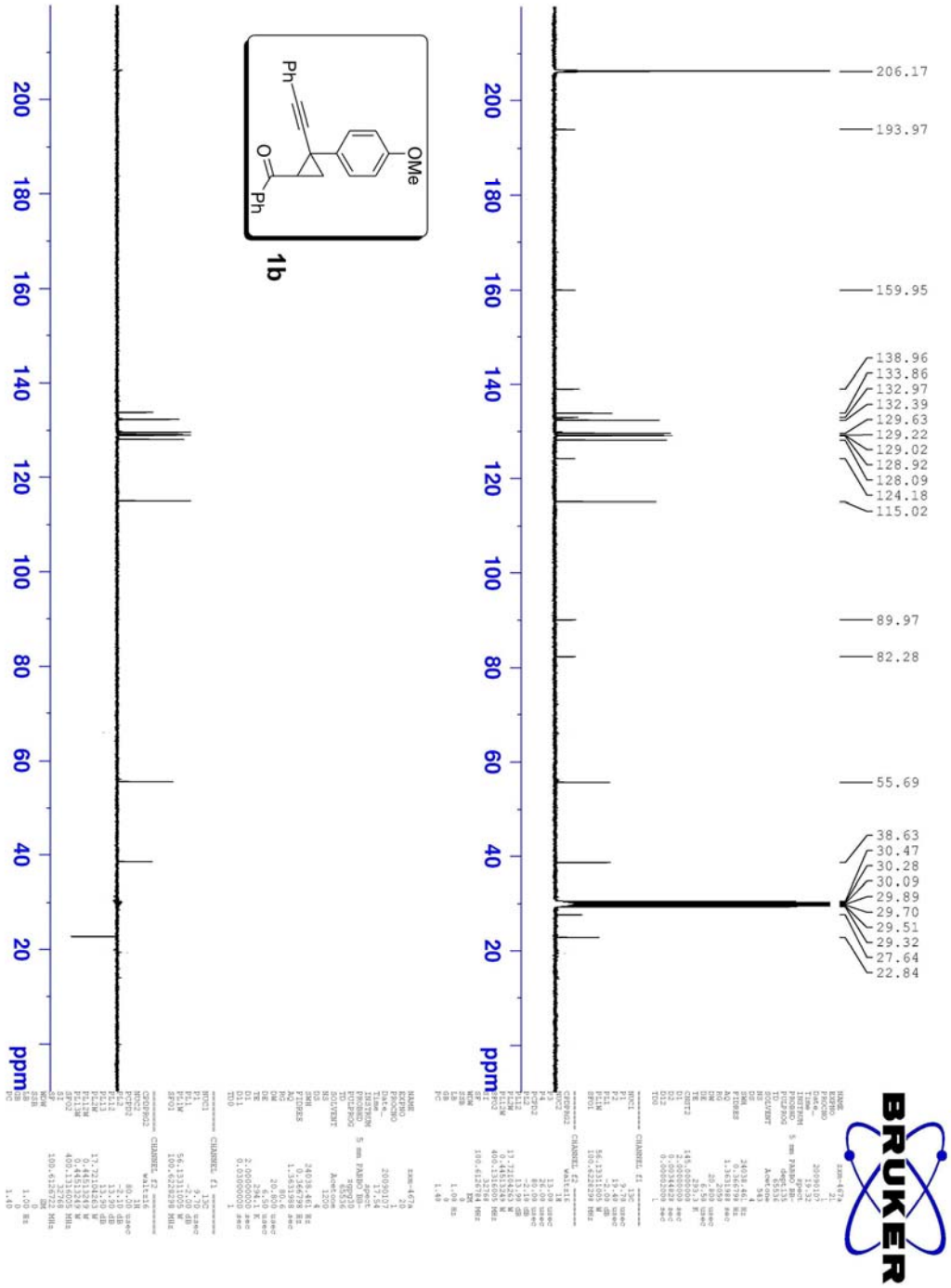

4.07
1.08
1.00
1.03
1.12
1.13
3.29
1.37
3.26
2.02
1.98
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
HO
Ph
IIIi
7.287
7.279
7.274
7.258
7.253
7.243
7.192
7.185
7.177
7.171
7.164
7.157
3.642
3.625
3.612
3.595
1.927
1.785
1.773
1.767
1.751
1.739
1.732
1.720
1.713
1.702
1.686
1.668
1.650
1.633
1.615
1.432
1.419
1.404
1.398
1.390
1.373
1.359
1.355
1.340
1.299
1.286
1.278
1.274
1.266
1.258
1.254
1.245
1.233
1.036
1.017
0.999
0.775
0.764
NAME zxm-8S1
EXPNO 10
PROCNO 1
Date_ 20081110
Time 20.17
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 71.8
DW 60.800 usec
DE 6.50 usec
TE 294.3 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300113 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

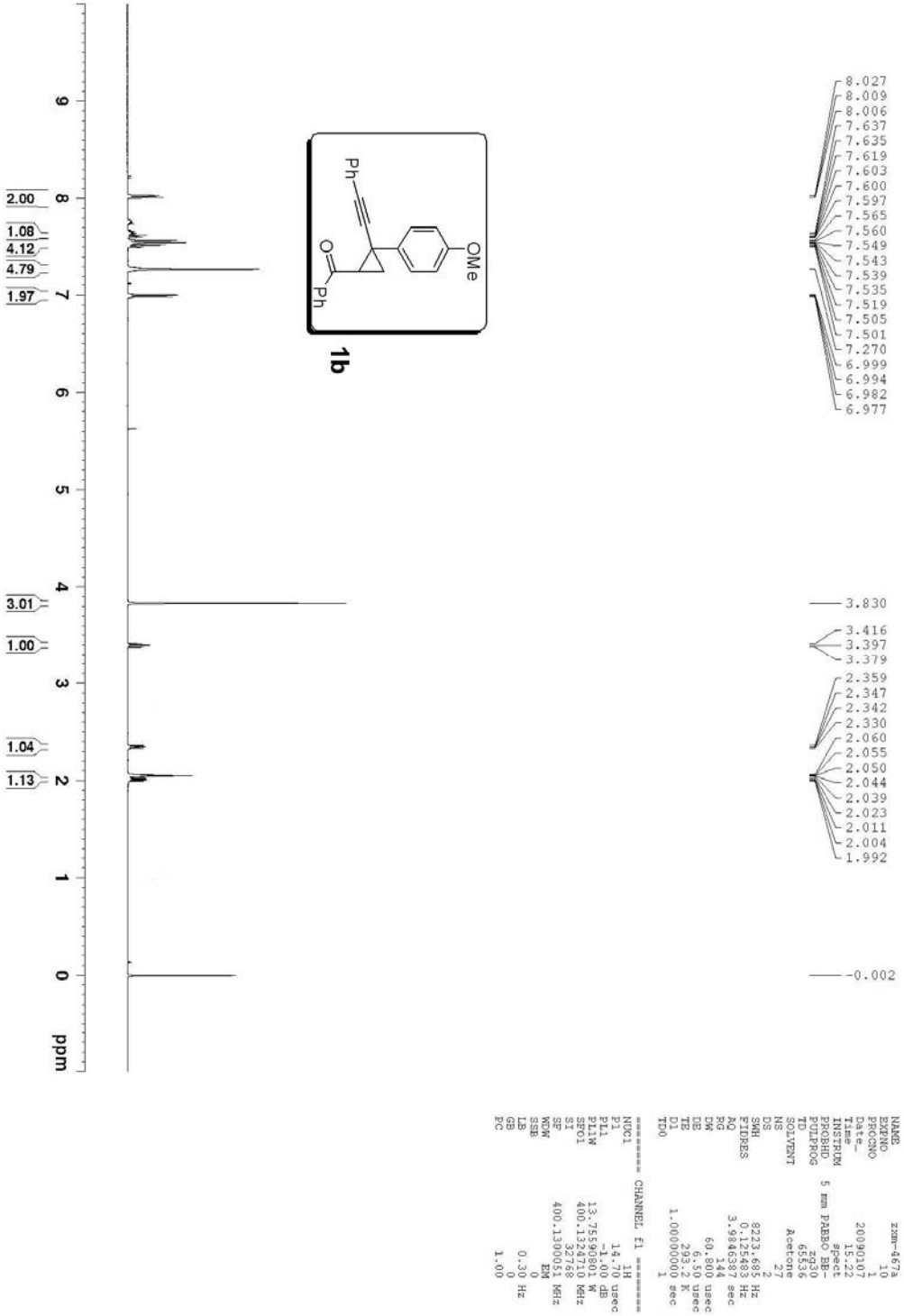

Ph
HO
Ph
S
IIij
146.94
143.19
131.69
128.54
128.30
128.19
127.72
126.81
125.96
123.19
122.96
122.88
89.98
81.85
77.32
77.00
76.68
74.38
39.01
25.19
18.96
ppm
BRUKER

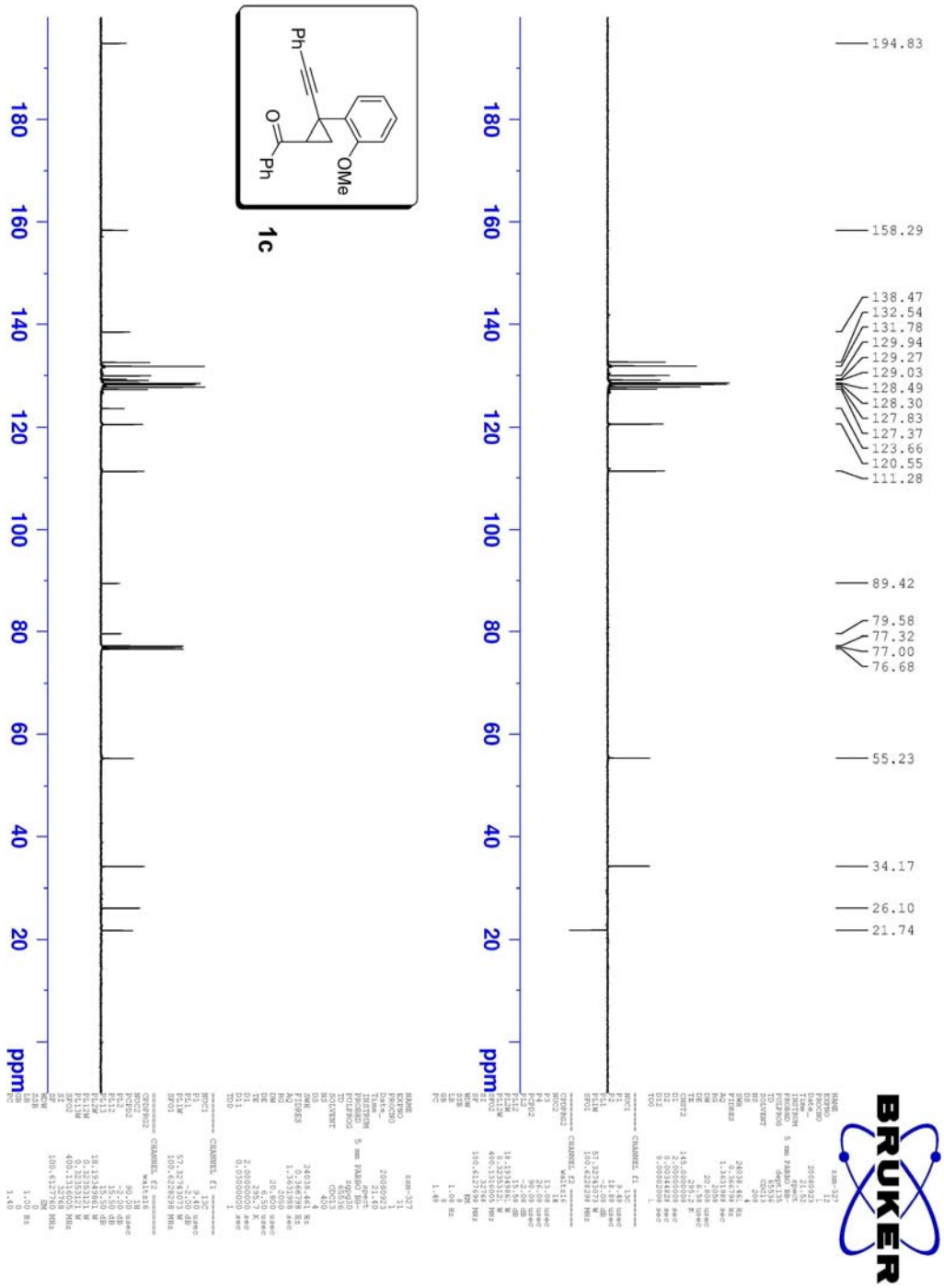

Ph
HO
Ph
S
IIj
1.93
2.02
2.10
4.12
0.97
1.92
0.92
0.97
1.00
1.01
1.09
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
7.578
7.559
7.428
7.422
7.413
7.404
7.384
7.365
7.346
7.305
7.298
7.288
7.269
7.236
7.077
7.069
7.061
6.879
6.870
6.862
4.880
4.861
2.242
1.984
1.963
1.945
1.925
1.834
1.821
1.817
1.804
1.713
1.700
1.691
1.679
-0.000
NAME zxm-455
EXPNO 10
PROCNO 1
Date_ 20081222
Time 15:39
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 8
DS 8
SWH 8223.685 Hz
FIDRES 0.125460 Hz
AQ 3.9845107 sec
RG 60.800
DW 60.800 usec
DE 6.50 usec
TE 292.4 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 1.00 dB
PL1W 13.75590010 W
SFO1 400.1332760 MHz
SI 32768
SF 400.1300146 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

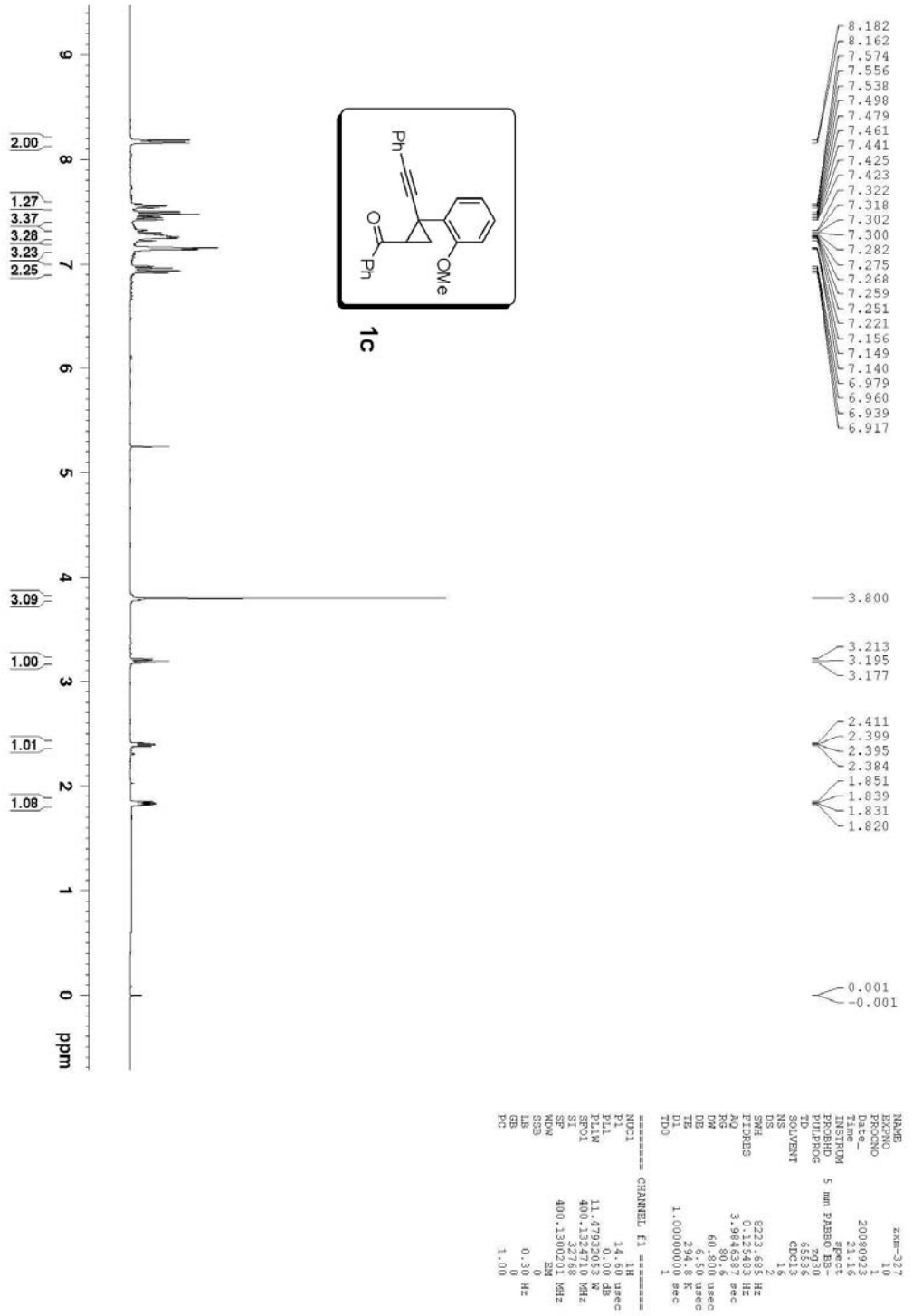

Ph
Ph
O
Ph
1a
193.71
140.20
137.85
132.89
131.79
128.76
128.58
128.29
128.01
127.84
127.11
125.82
123.04
88.02
82.22
77.32
77.00
76.68
38.26
27.59
22.57
ppm
BRUKER

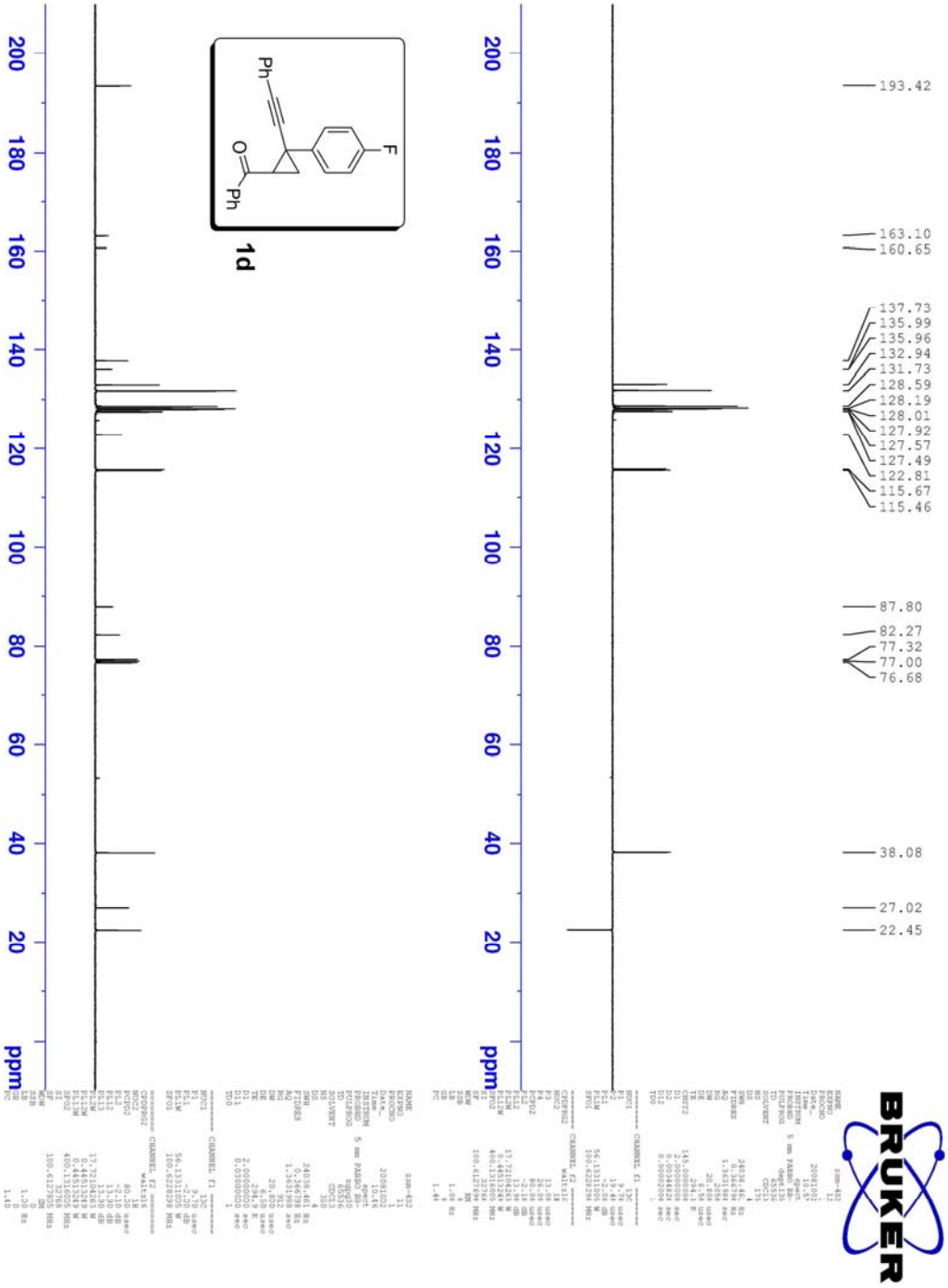

1.99
3.04
4.13
3.29
2.97
1.00
1.01
1.01
9
8
7
6
5
4
3
2
1
0
ppm
Ph
Ph
O
Ph
1a
7.973
7.955
7.952
7.558
7.555
7.536
7.521
7.518
7.516
7.455
7.435
7.425
7.421
7.417
7.407
7.387
7.331
7.313
7.295
7.288
7.282
7.275
7.271
7.263
7.238
7.211
7.205
7.201
7.192
7.187
3.201
3.182
3.164
2.528
2.515
2.510
2.497
1.978
1.965
1.958
1.946
0.000
NAME zsm-1b
EXPNO 10
PROCNO 1
Date_ 20080909
Time 9pec
INSTRUM 0.15
PROBHD 5 mm PABBO BB
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 144
DW 60.800 usec
DE 6.50 usec
TE 298.3 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300139 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

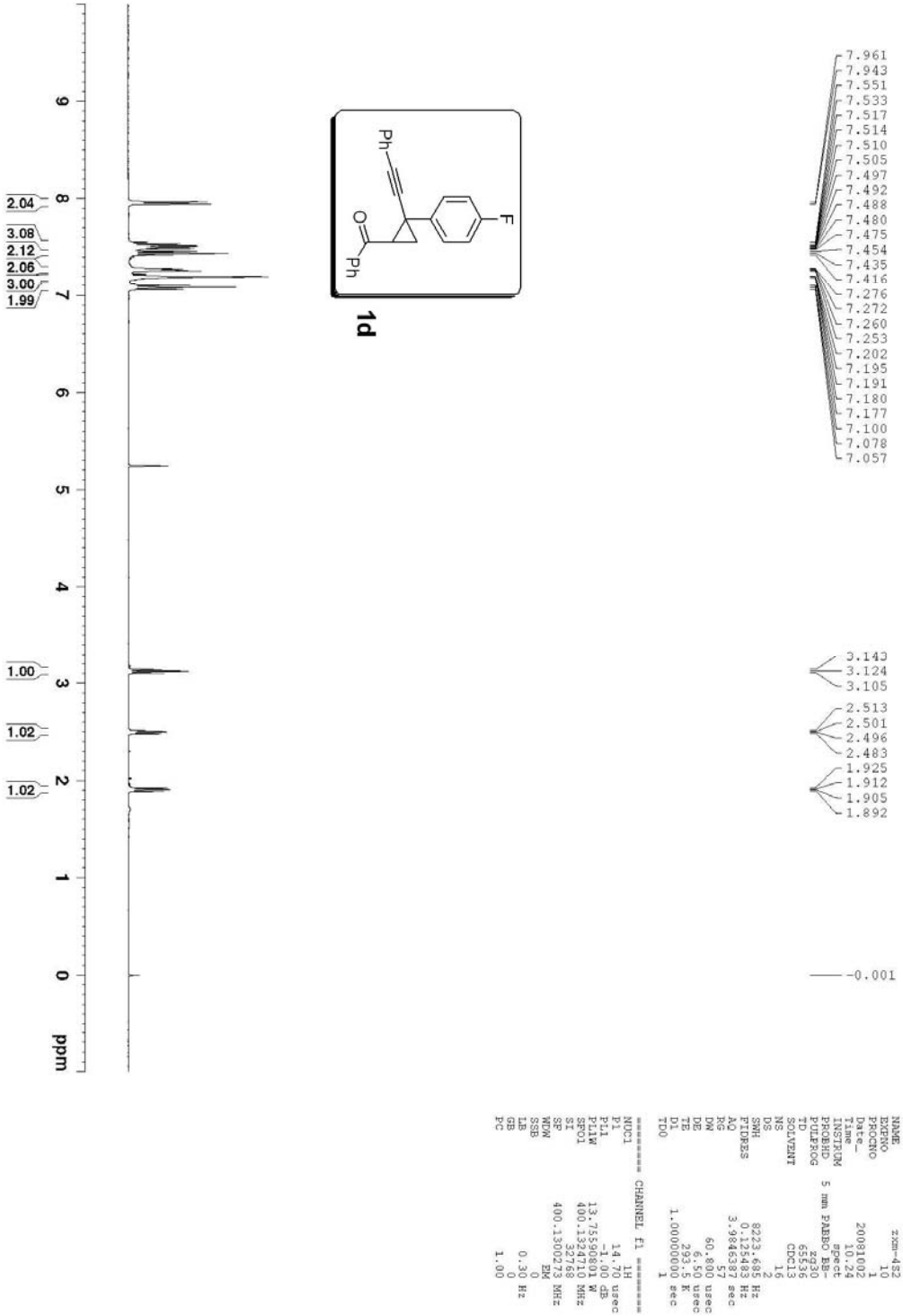

206.17
193.97
159.95
138.96
133.86
132.97
132.39
129.63
129.22
129.02
128.92
128.09
124.18
115.02
89.97
82.28
55.69
38.63
30.47
30.28
30.09
29.89
29.70
29.51
29.32
27.64
22.84
ppm
Ph
OMe
O
Ph
1b
BRUKER

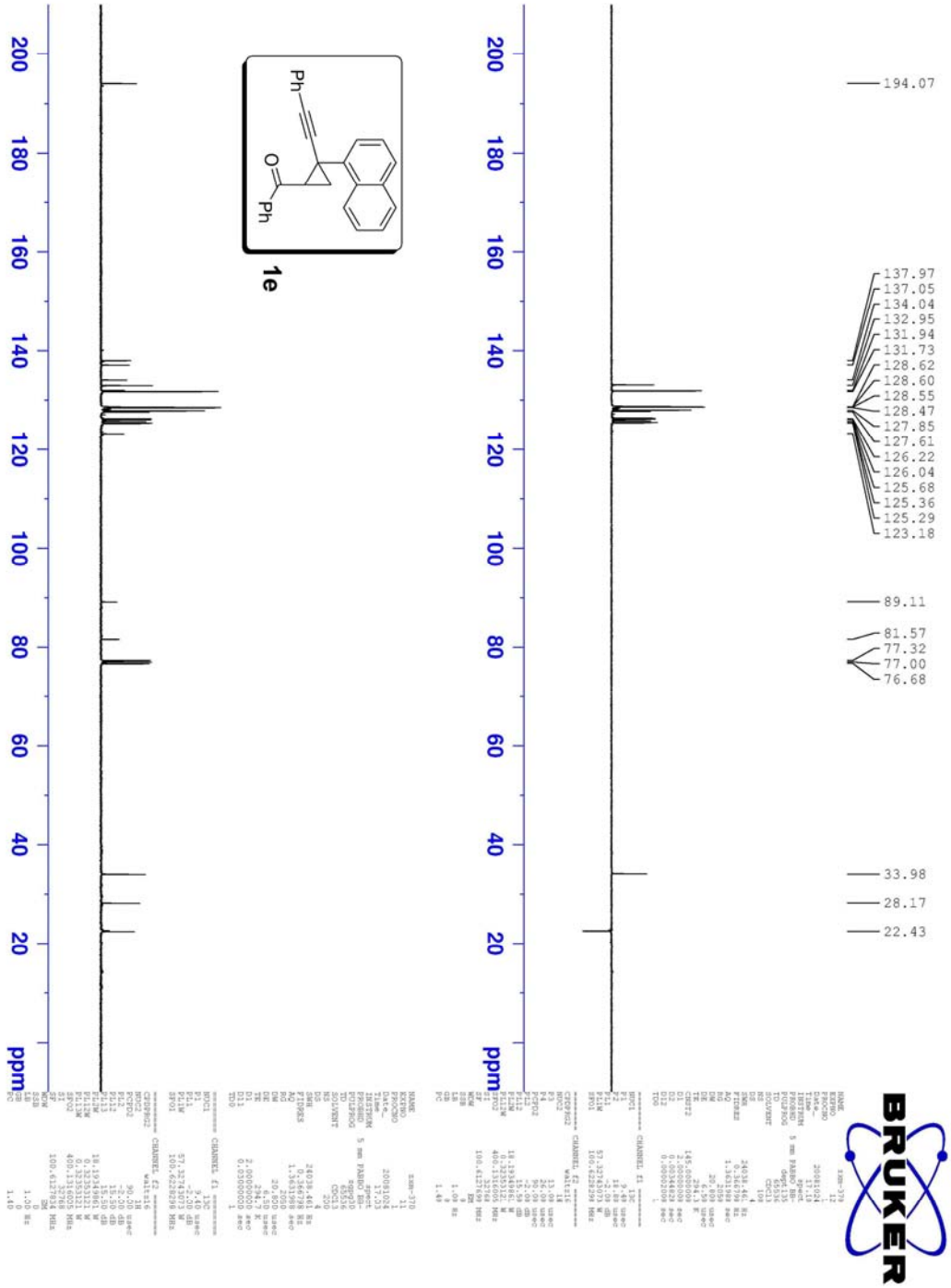

8.027
8.009
8.006
7.637
7.635
7.619
7.603
7.600
7.597
7.565
7.560
7.549
7.543
7.539
7.535
7.519
7.505
7.501
7.270
6.999
6.994
6.982
6.977
3.830
3.416
3.397
3.379
2.359
2.347
2.342
2.330
2.060
2.055
2.050
2.044
2.039
2.023
2.011
2.004
1.992
-0.002
2.00
1.08
4.12
4.79
1.97
3.01
1.00
1.04
1.13
ppm
Ph
OMe
O
Ph
1b
NAME zxm-467a
EXPNO 10
PROCNO 1
Date_ 20090107
Time 15.22
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT Acetone
NS 27
DS 2
SWH 8223.685 Hz
FIDRES 0.125493 Hz
AQ 3.9846307 sec
RG 144
DW 60.800 usec
DE 6.50 usec
TE 293.2 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300051 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

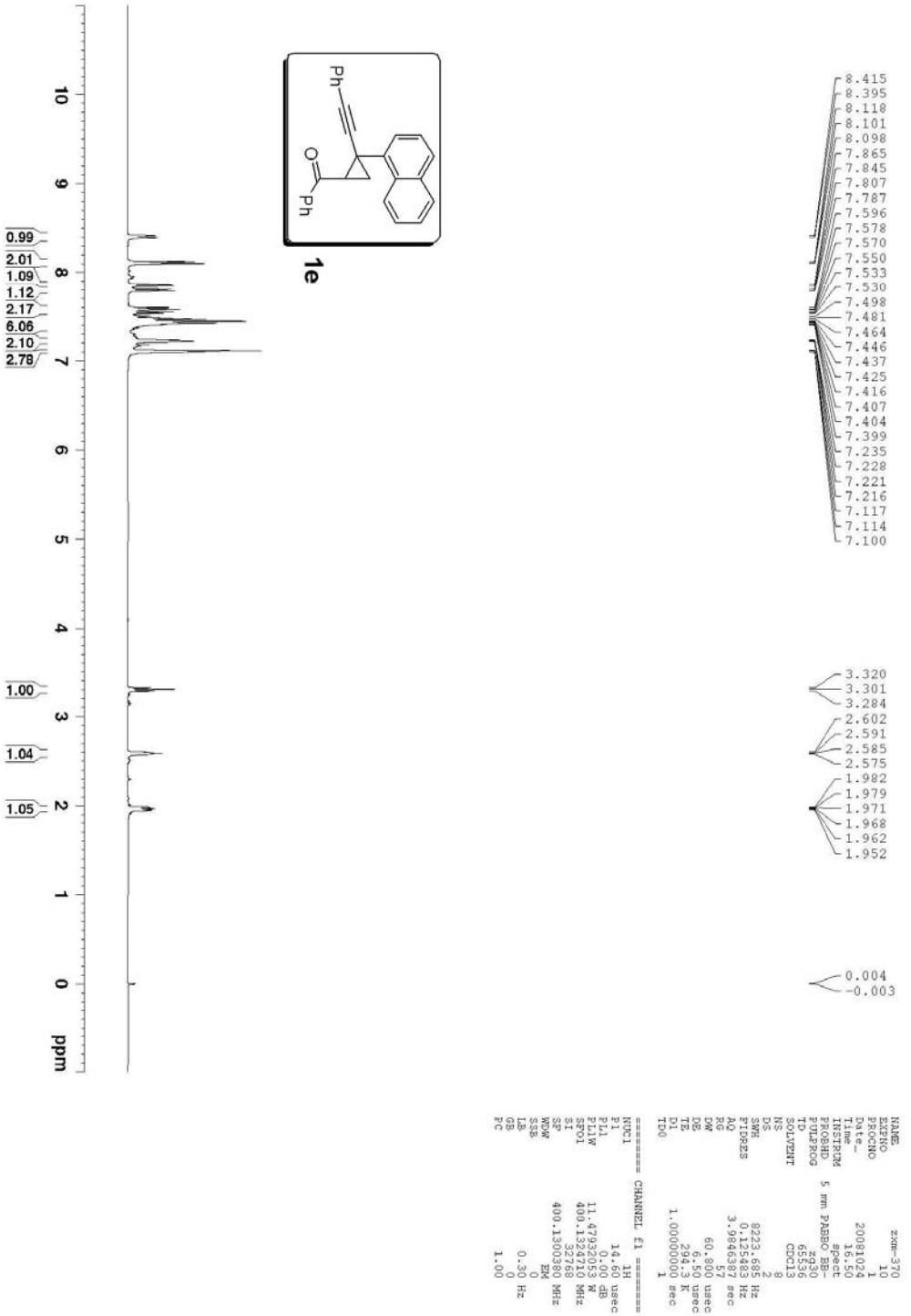

Ph
O
Ph
OMe
1c
194.83
158.29
138.47
132.54
131.78
129.94
129.27
129.03
128.49
128.30
127.83
127.37
123.66
120.55
111.28
89.42
79.58
77.32
77.00
76.68
55.23
34.17
26.10
21.74
ppm
BRUKER

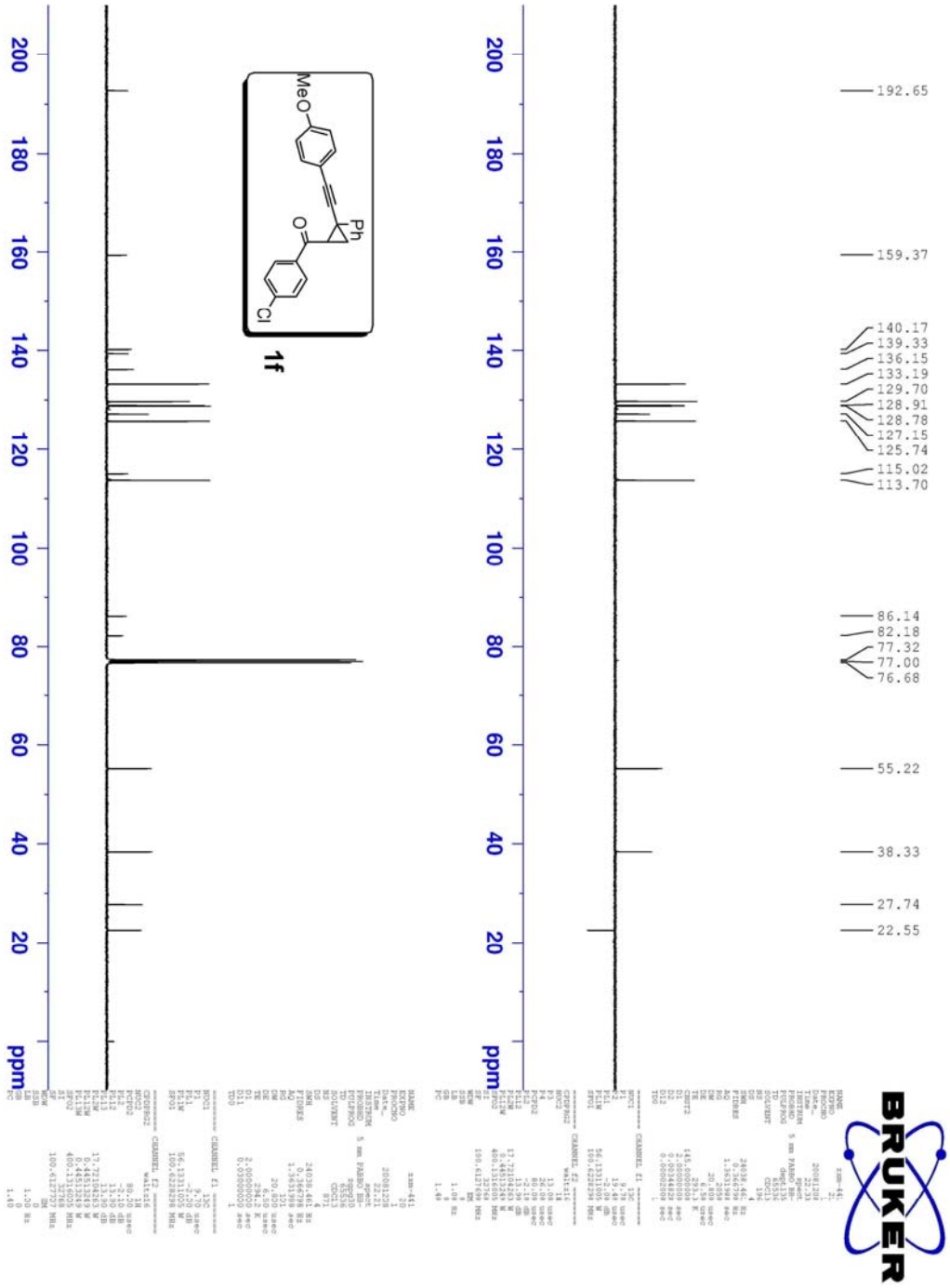

8.182
8.162
7.574
7.556
7.538
7.498
7.479
7.461
7.441
7.425
7.423
7.322
7.318
7.302
7.300
7.282
7.275
7.268
7.259
7.251
7.221
7.156
7.149
7.140
6.979
6.960
6.939
6.917
3.800
3.213
3.195
3.177
2.411
2.399
2.395
2.384
1.851
1.839
1.831
1.820
0.001
-0.001
2.00
1.27
3.37
3.28
3.23
2.25
3.09
1.00
1.01
1.08
ppm
Ph
OMe
O
Ph
1c
NAME zxm-327
EXPNO 10
PROCNO 1
Date_ 20080923
Time 21.16
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 80.6
DW 60.800 usec
DE 6.50 usec
TE 294.8 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300201 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

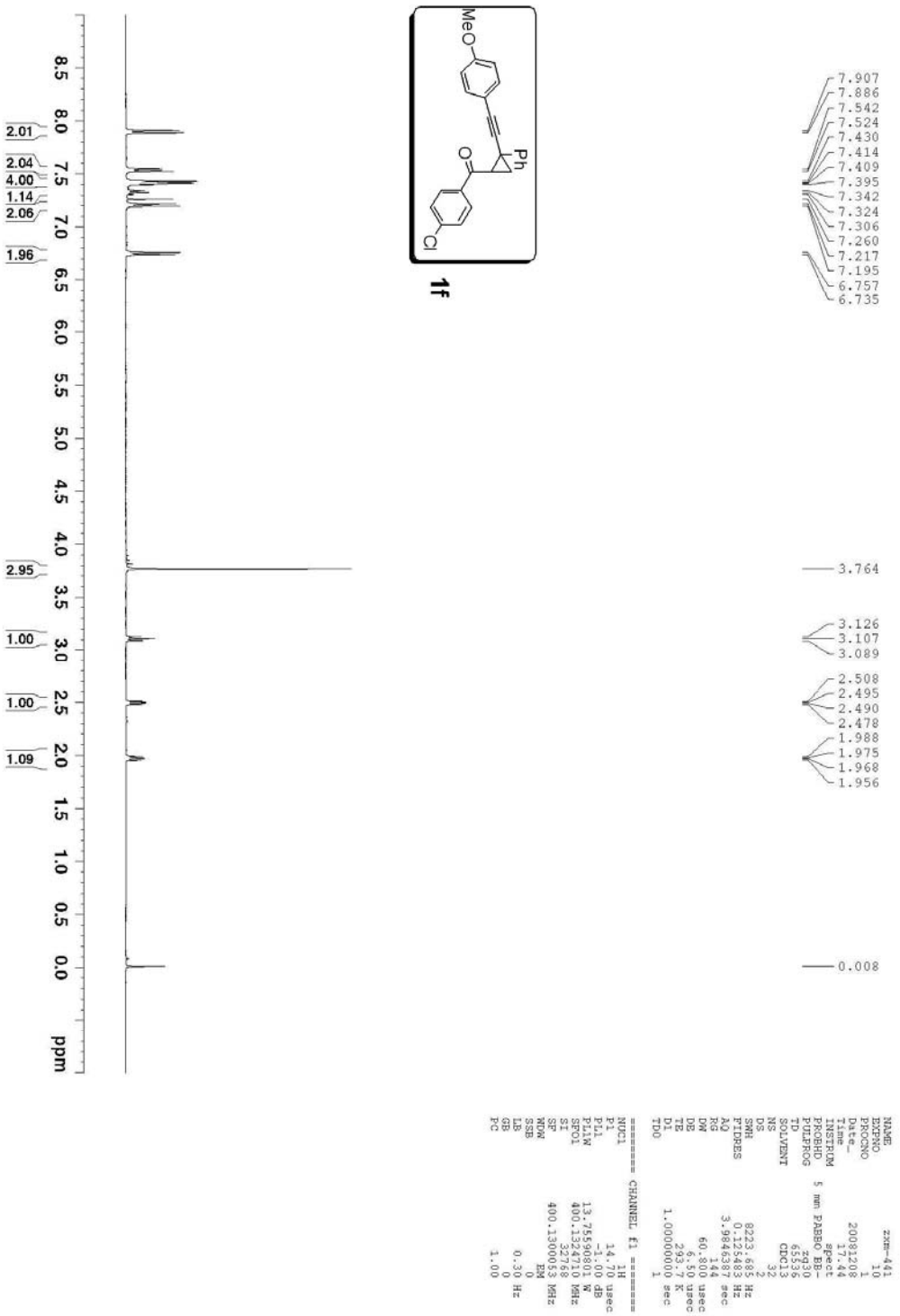

193.42
163.10
160.65
137.73
135.99
135.96
132.94
131.73
128.59
128.19
128.01
127.92
127.57
127.49
122.81
115.67
115.46
87.80
82.27
77.32
77.00
76.68
38.08
27.02
22.45
Ph
O
Ph
F
1d
ppm
BRUKER

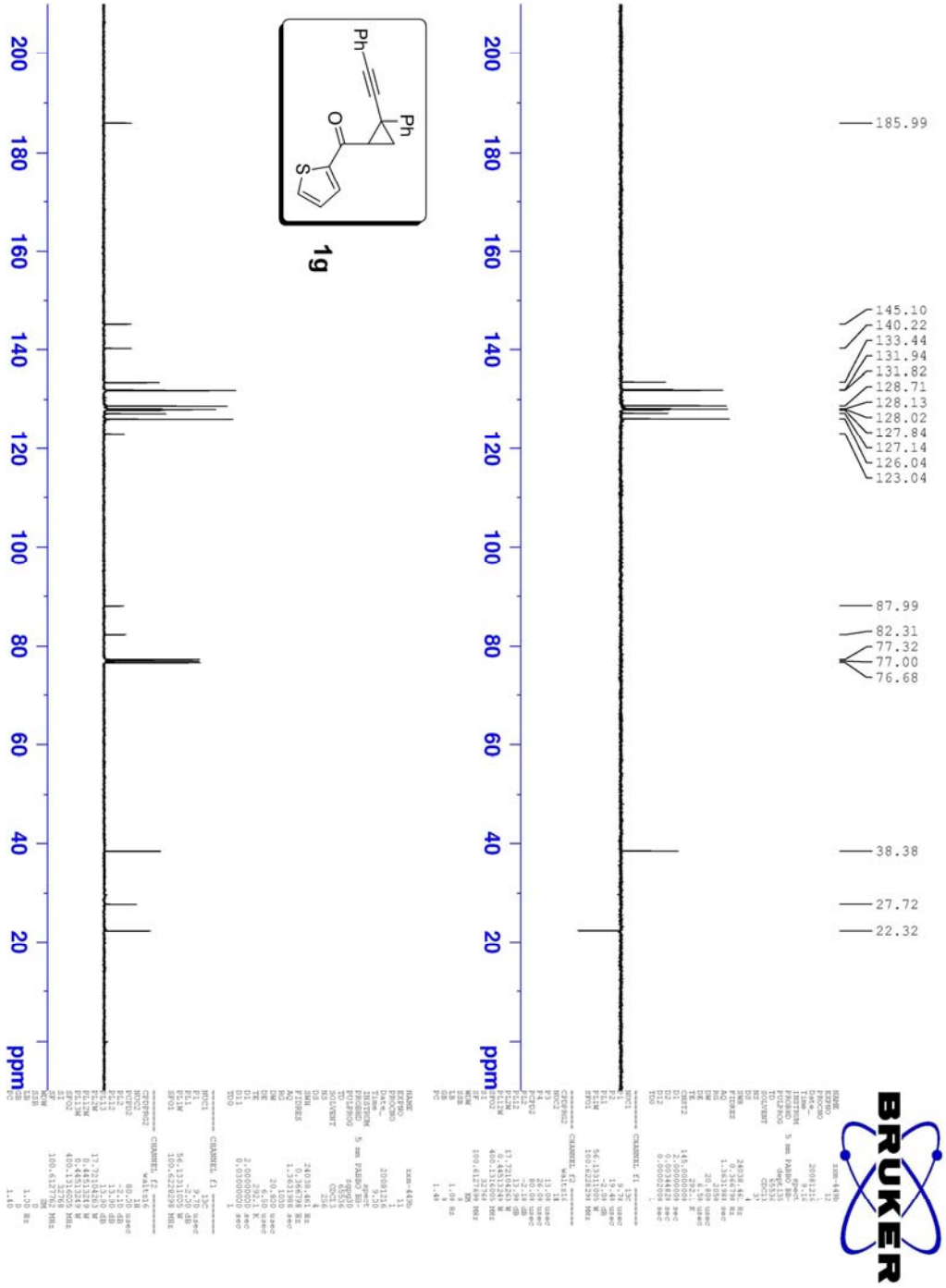

7.961
7.943
7.551
7.533
7.517
7.514
7.510
7.505
7.497
7.492
7.488
7.480
7.475
7.454
7.435
7.416
7.276
7.272
7.260
7.253
7.202
7.195
7.191
7.180
7.177
7.100
7.078
7.057
3.143
3.124
3.105
2.513
2.501
2.496
2.483
1.925
1.912
1.905
1.892
-0.001
2.04
3.08
2.12
2.06
3.00
1.99
1.00
1.02
1.02
ppm
Ph
F
O
Ph
1d
NAME zxm-432
EXPNO 10
PROCNO 1
Date_ 20081002
Time 10.24
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 57
DW 60.800 usec
DE 6.50 usec
TE 293.5 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 -1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300273 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

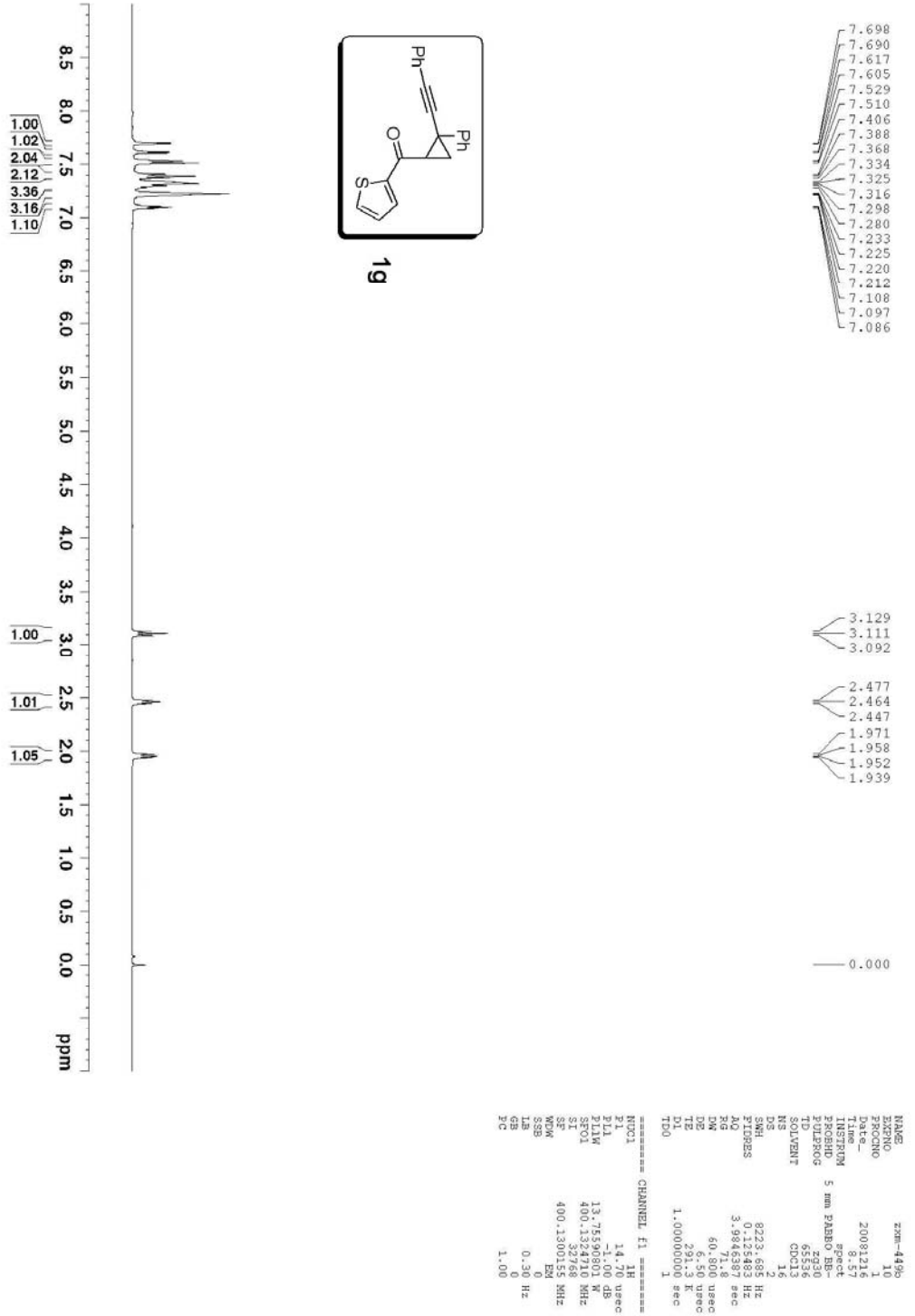

Ph
O
Ph
1e
194.07
137.97
137.05
134.04
132.95
131.94
131.73
128.62
128.60
128.55
128.47
127.85
127.61
126.22
126.04
125.68
125.36
125.29
123.18
89.11
81.57
77.32
77.00
76.68
33.98
28.17
22.43
ppm
BRUKER

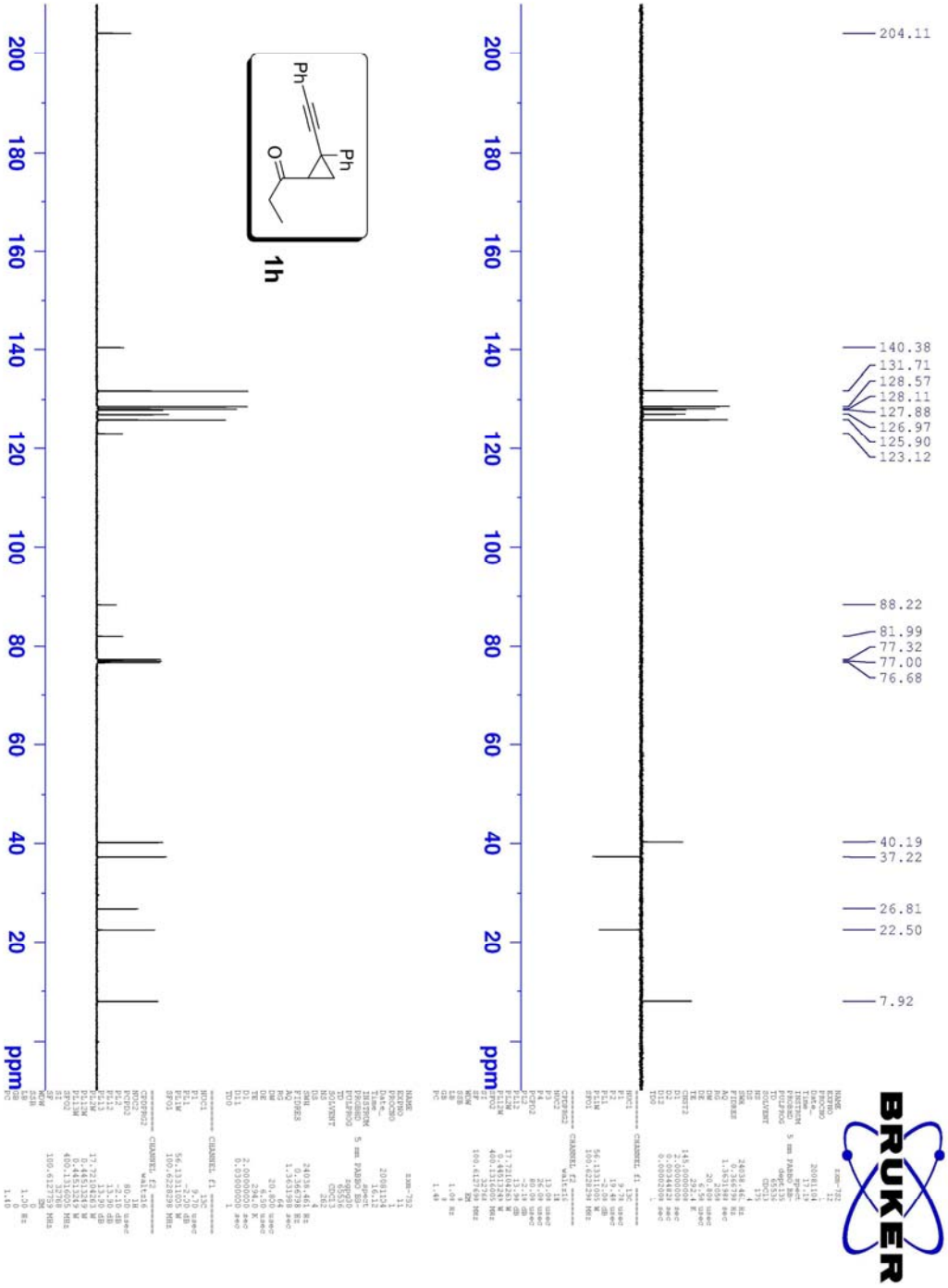

Ph
O
Ph
1e
0.99
2.01
1.09
1.12
2.17
6.06
2.10
2.78
1.00
1.04
1.05
10
9
8
7
6
5
4
3
2
1
0
ppm
8.415
8.395
8.118
8.101
8.098
7.865
7.845
7.807
7.787
7.596
7.578
7.570
7.550
7.533
7.530
7.498
7.481
7.464
7.446
7.437
7.425
7.416
7.407
7.404
7.399
7.235
7.228
7.221
7.216
7.117
7.114
7.100
3.320
3.301
3.284
2.602
2.591
2.585
2.575
1.982
1.979
1.971
1.968
1.962
1.952
0.004
-0.003
NAME zxm-370
EXPNO 10
PROCNO 1
Date_ 20081024
Time 16.50
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 8
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 57
DW 60.800 usec
DE 6.50 usec
TE 294.3 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300380 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

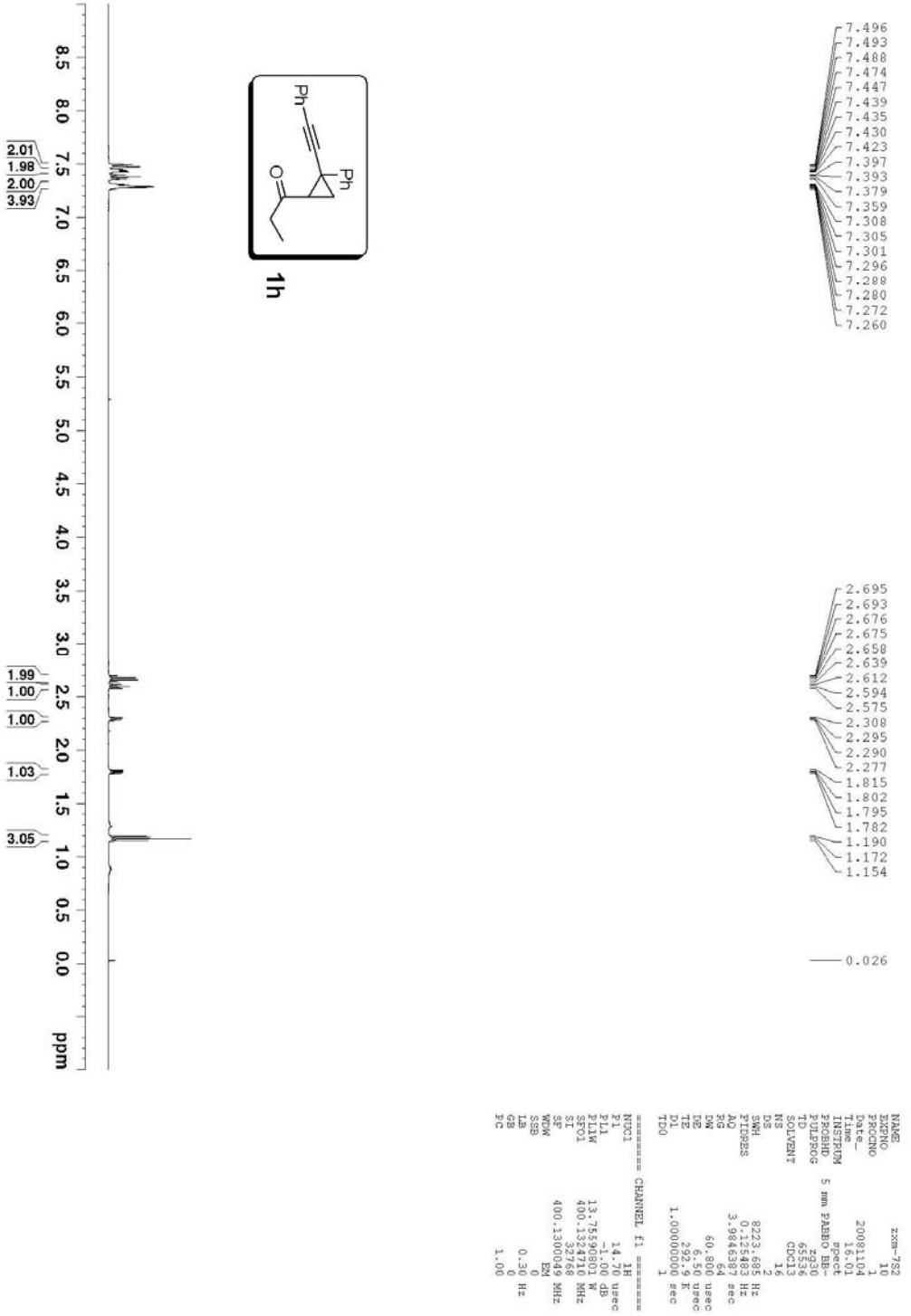

MeO
Ph
O
Cl
1f
192.65
159.37
140.17
139.33
136.15
133.19
129.70
128.91
128.78
127.15
125.74
115.02
113.70
86.14
82.18
77.32
77.00
76.68
55.22
38.33
27.74
22.55
ppm
BRUKER

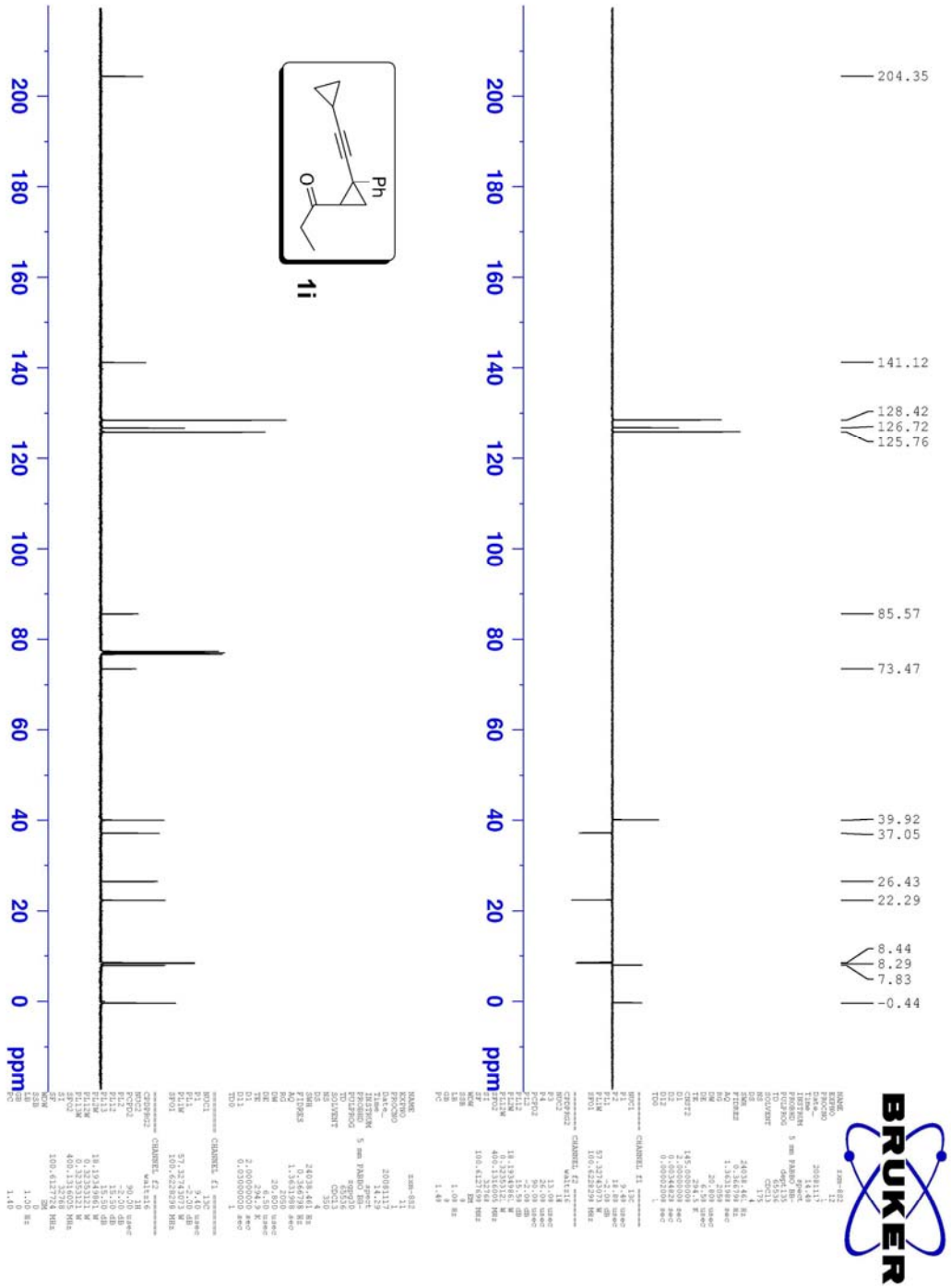

MeO
Ph
O
Cl
1f
7.907
7.886
7.542
7.524
7.430
7.414
7.409
7.395
7.342
7.324
7.306
7.260
7.217
7.195
6.757
6.735
3.764
3.126
3.107
3.089
2.508
2.495
2.490
2.478
1.988
1.975
1.968
1.956
0.008
2.01
2.04
4.00
1.14
2.06
1.96
2.95
1.00
1.00
1.09
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
NAME zxm-441
EXPNO 10
PROCNO 1
Date_ 20091208
Time 17.44
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 32
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 144
DW 60.800 usec
DE 6.50 usec
TE 295.7 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 -1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300053 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

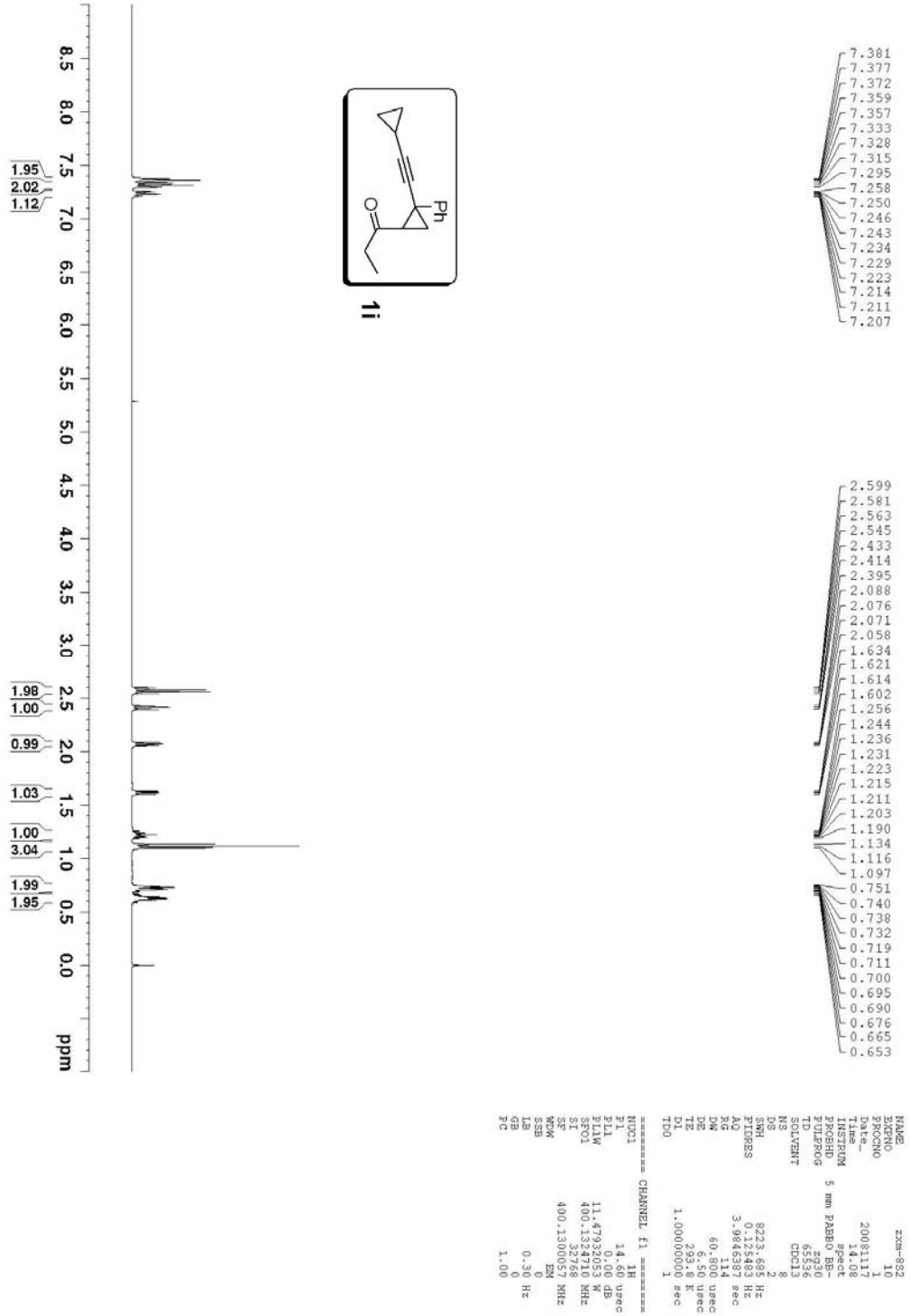

Ph
Ph
O
S
1g
185.99
145.10
140.22
133.44
131.94
131.82
128.71
128.13
128.02
127.84
127.14
126.04
123.04
87.99
82.31
77.32
77.00
76.68
38.38
27.72
22.32
ppm
BRUKER

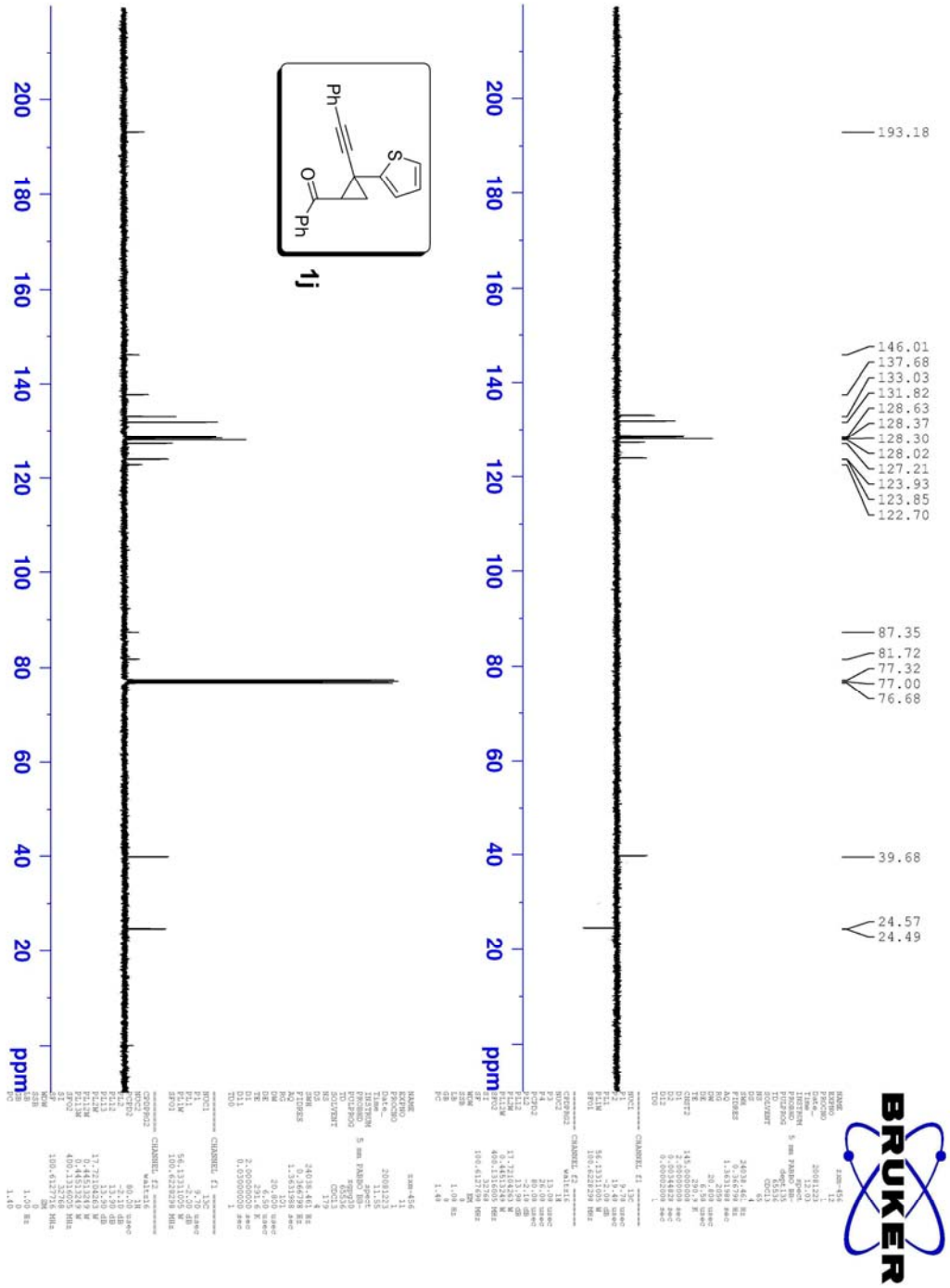

1g
Ph
Ph
O
S
7.698
7.690
7.617
7.605
7.529
7.510
7.406
7.388
7.368
7.334
7.325
7.316
7.298
7.280
7.233
7.225
7.220
7.212
7.108
7.097
7.086
3.129
3.111
3.092
2.477
2.464
2.447
1.971
1.958
1.952
1.939
0.000
1.00
1.02
2.04
2.12
3.36
3.16
1.10
1.00
1.01
1.05
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
NAME zxm-449b
EXPNO 10
PROCNO 1
Date_ 20081216
Time 8.57
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 71.0
DW 60.900 usec
DE 6.50 usec
TE 291.3 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 -1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300155 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

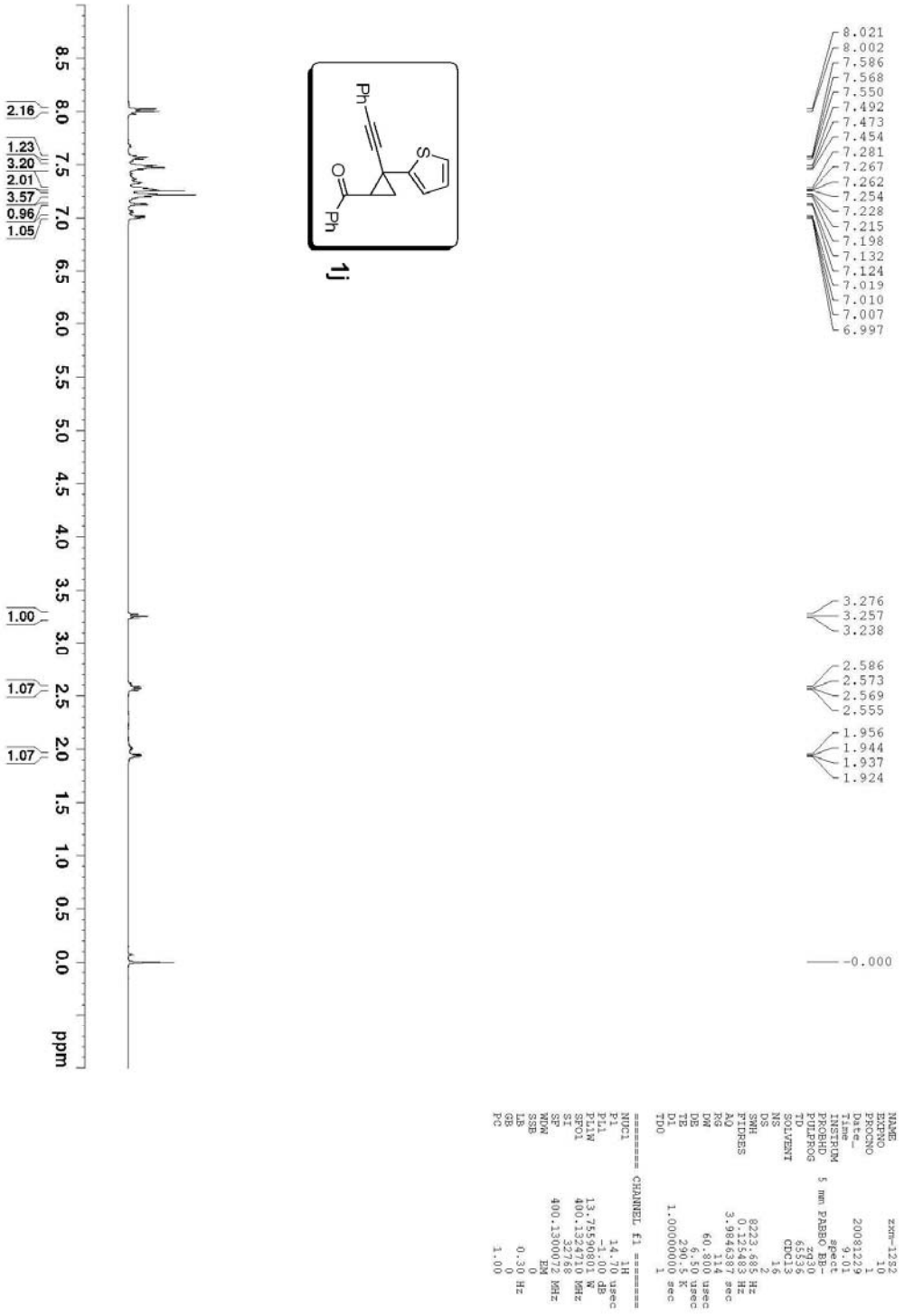

1h
Ph
Ph
O
204.11
140.38
131.71
128.57
128.11
127.88
126.97
125.90
123.12
88.22
81.99
77.32
77.00
76.68
40.19
37.22
26.81
22.50
7.92
ppm
BRUKER

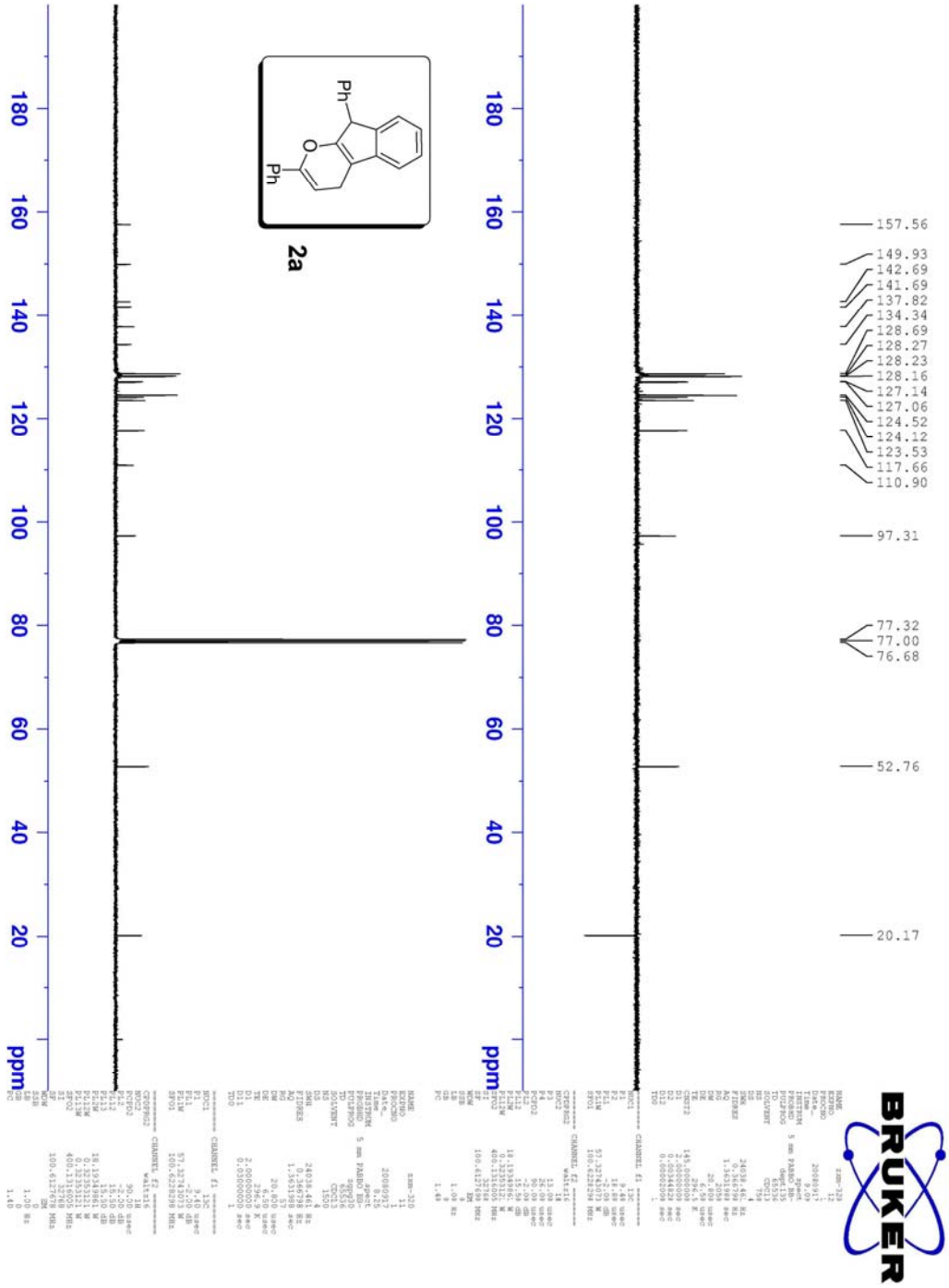

7.496
7.493
7.488
7.474
7.447
7.439
7.435
7.430
7.423
7.397
7.393
7.379
7.359
7.308
7.305
7.301
7.296
7.288
7.280
7.272
7.260
2.695
2.693
2.676
2.675
2.658
2.639
2.612
2.594
2.575
2.308
2.295
2.290
2.277
1.815
1.802
1.795
1.782
1.190
1.172
1.154
0.026
2.01
1.98
2.00
3.93
1.99
1.00
1.00
1.03
3.05
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
Ph
Ph
O
1h
NAME zxm-7S2
EXPNO 10
PROCNO 1
Date_ 20081104
Time 16.01
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 64
DW 60.800 usec
DE 6.50 usec
TE 292.9 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 -1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300049 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

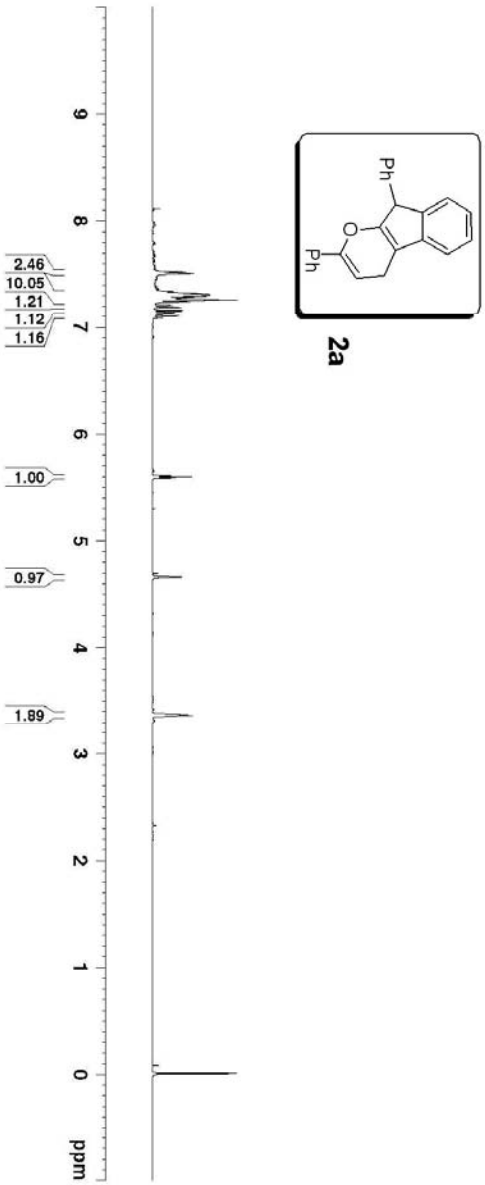

Ph
O
1i
204.35
141.12
128.42
126.72
125.76
85.57
73.47
39.92
37.05
26.43
22.29
8.44
8.29
7.83
-0.44
ppm
BRUKER


1i
Ph
1.95
2.02
1.12
1.98
1.00
0.99
1.03
1.00
3.04
1.99
1.95
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
7.381 7.377 7.372 7.359 7.357 7.333 7.328 7.315 7.295 7.258 7.250 7.246 7.243 7.234 7.229 7.223 7.214 7.211 7.207
2.599 2.581 2.563 2.545 2.433 2.414 2.395 2.088 2.076 2.071 2.058 1.634 1.621 1.614 1.602 1.256 1.244 1.236 1.231 1.223 1.215 1.211 1.203 1.190 1.134 1.116 1.097 0.751 0.740 0.738 0.732 0.719 0.711 0.700 0.695 0.690 0.676 0.665 0.653
NAME zxm-8S2
EXPNO 10
PROCNO 1
Date_ 20091117
Time 8.47
INSTRM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 8
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 514
DW 60.800 usec
DE 6.50 usec
TE 293.0 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300057 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00


Ph
S
O
Ph
1j
193.18
146.01
137.68
133.03
131.82
128.63
128.37
128.30
128.02
127.21
123.93
123.85
122.70
87.35
81.72
77.32
77.00
76.68
39.68
24.57
24.49
ppm
BRUKER


8.021
8.002
7.586
7.568
7.550
7.492
7.473
7.454
7.281
7.267
7.262
7.254
7.228
7.215
7.198
7.132
7.124
7.019
7.010
7.007
6.997
3.276
3.257
3.238
2.586
2.573
2.569
2.555
1.956
1.944
1.937
1.924
-0.000
Ph
O
Ph
S
1j
2.16
1.23
3.20
2.01
3.57
0.96
1.05
1.00
1.07
1.07
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
NAME zxm-1282
EXPNO 10
PROCNO 1
Date_ 20081229
Time 9.01
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 114
DW 60.800 usec
DE 6.50 usec
TE 290.5 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 -1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300072 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

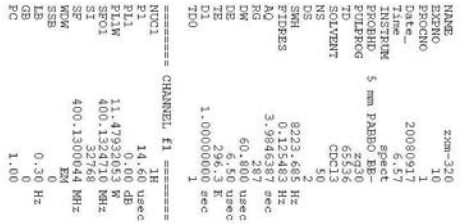

Ph
O
Ph
2a
157.56
149.93
142.69
141.69
137.82
134.34
128.69
128.27
128.23
128.16
127.14
127.06
124.52
124.12
123.53
117.66
110.90
97.31
77.32
77.00
76.68
52.76
20.17
ppm
BRUKER

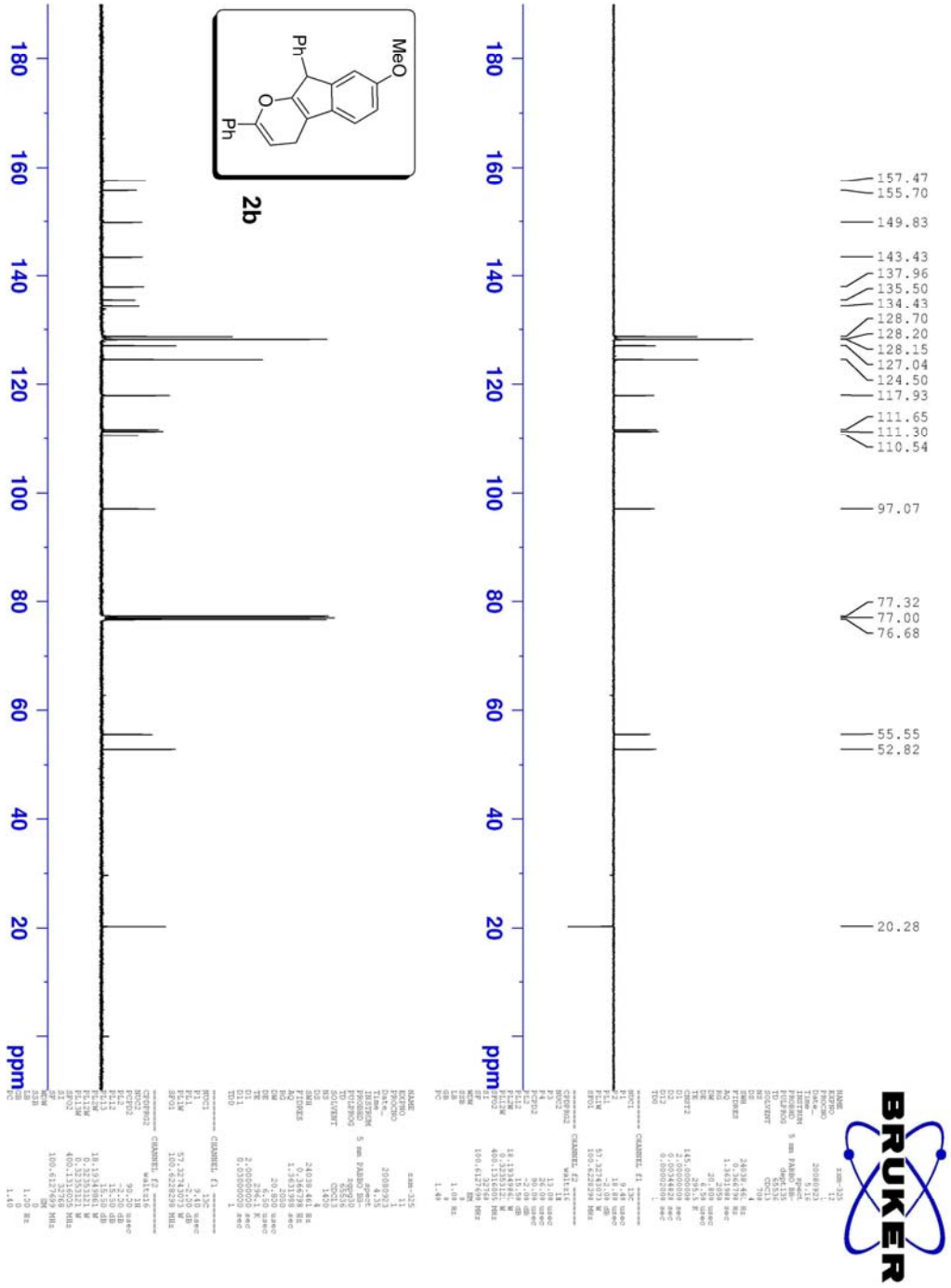

2.46
10.05
1.21
1.12
1.16
1.00
0.97
1.89
9
8
7
6
5
4
3
2
1
0
ppm

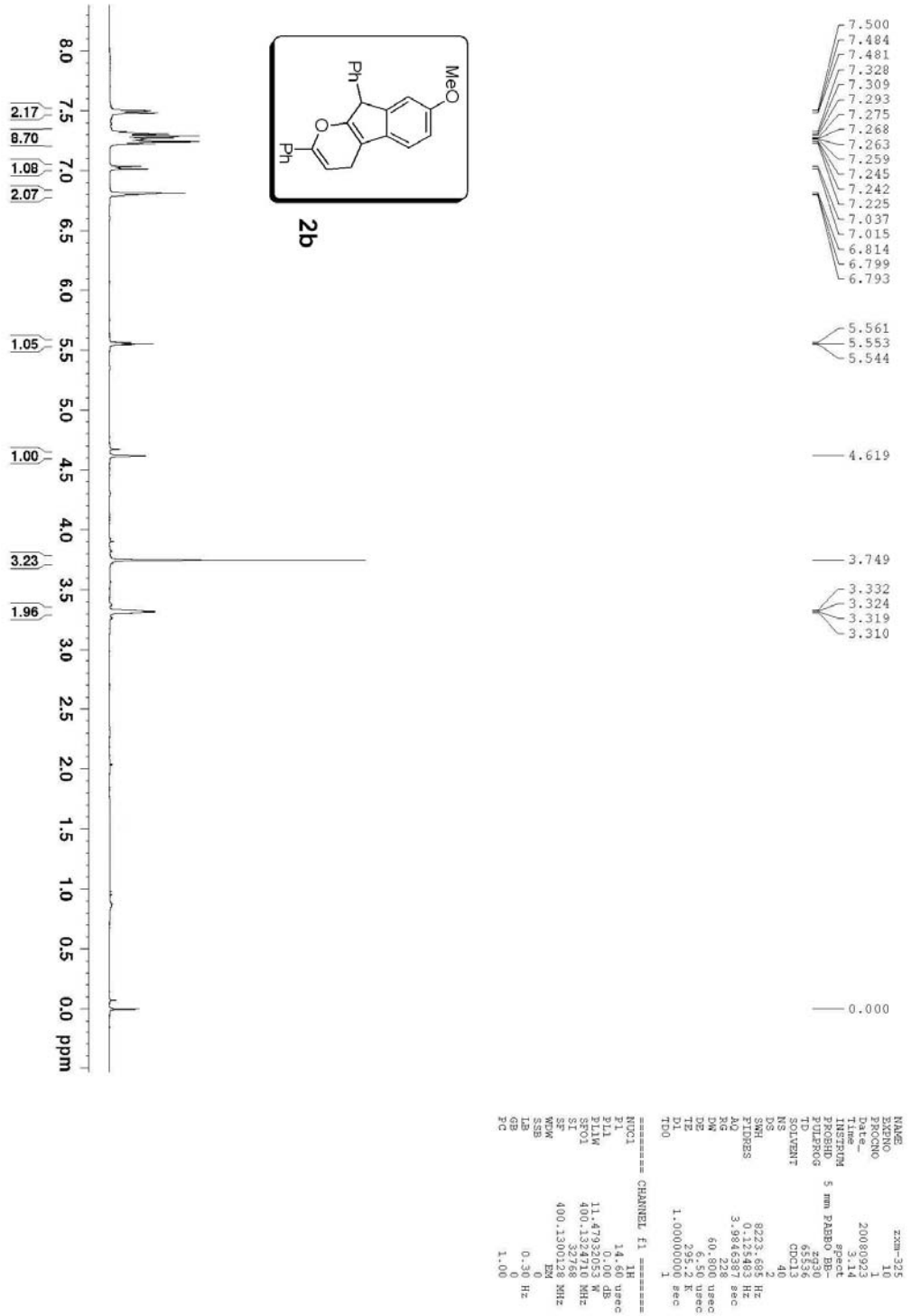
Ph
O
Ph

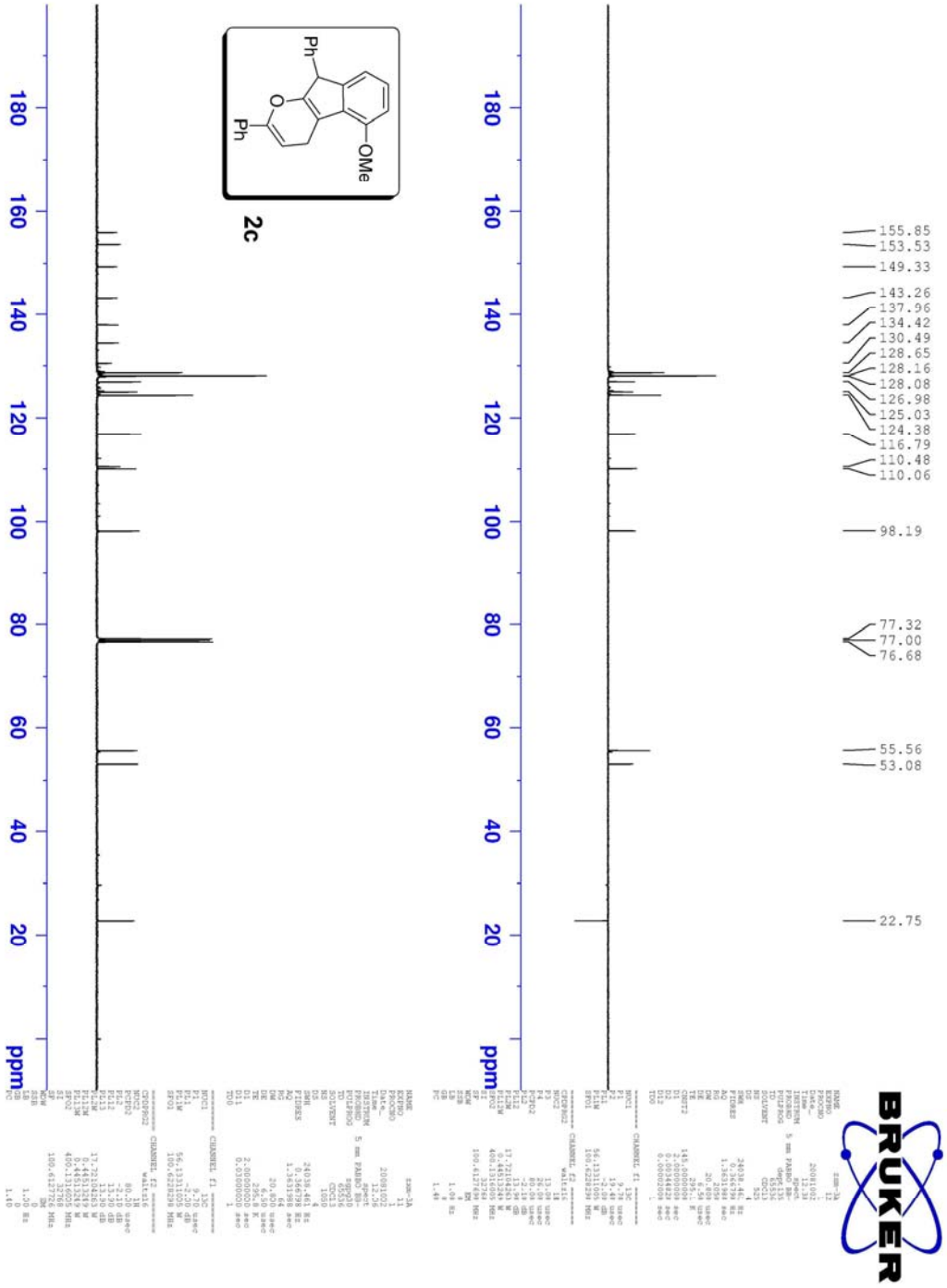
2a

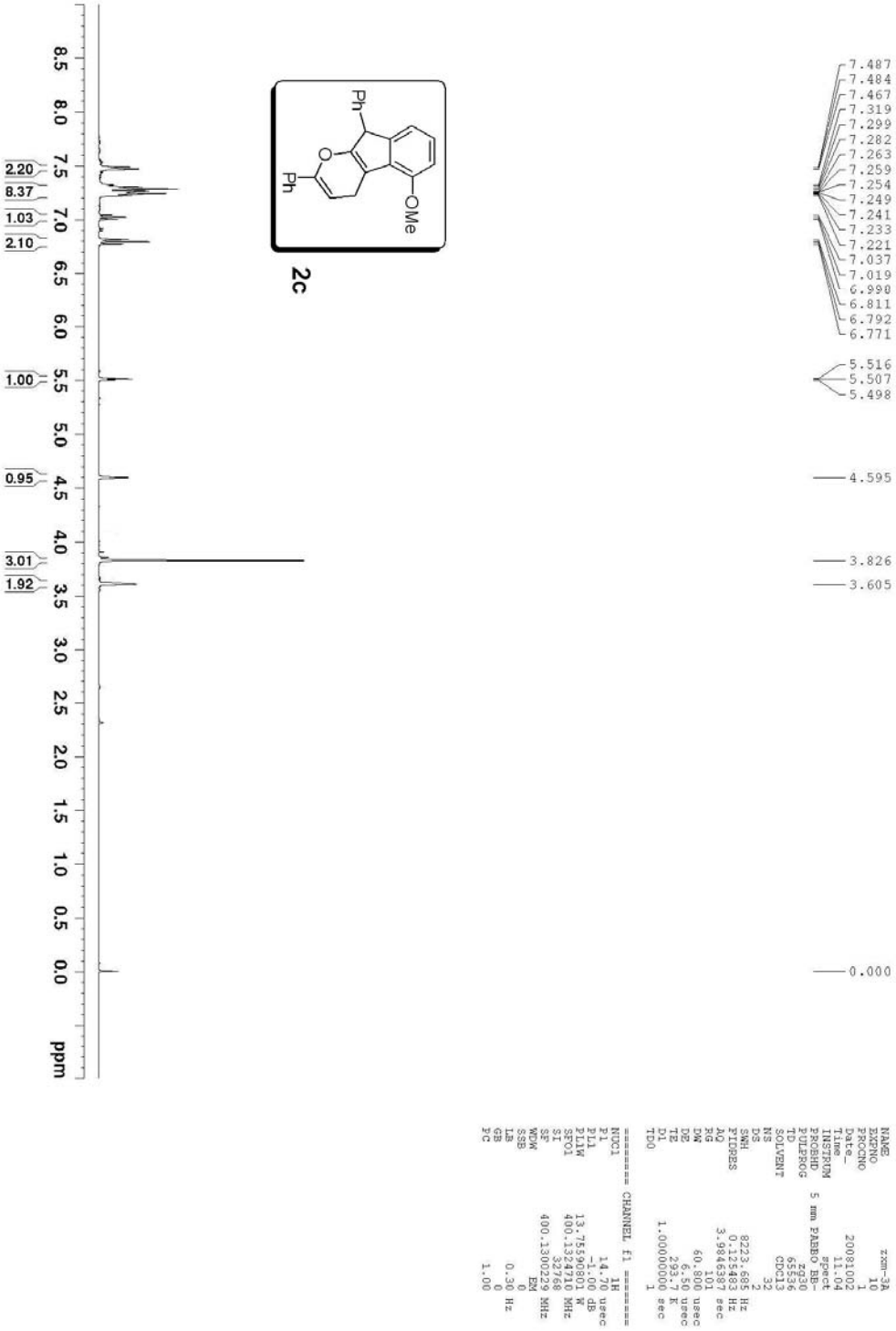

7.526
7.522
7.506
7.503
7.337
7.322
7.316
7.305
7.297
7.289
7.277
7.274
7.267
7.260
7.255
7.239
7.206
7.188
7.157
7.139
7.125
7.107
7.105
7.088
5.604
5.596
5.587
4.661
3.376
3.368
3.363
3.354
0.011

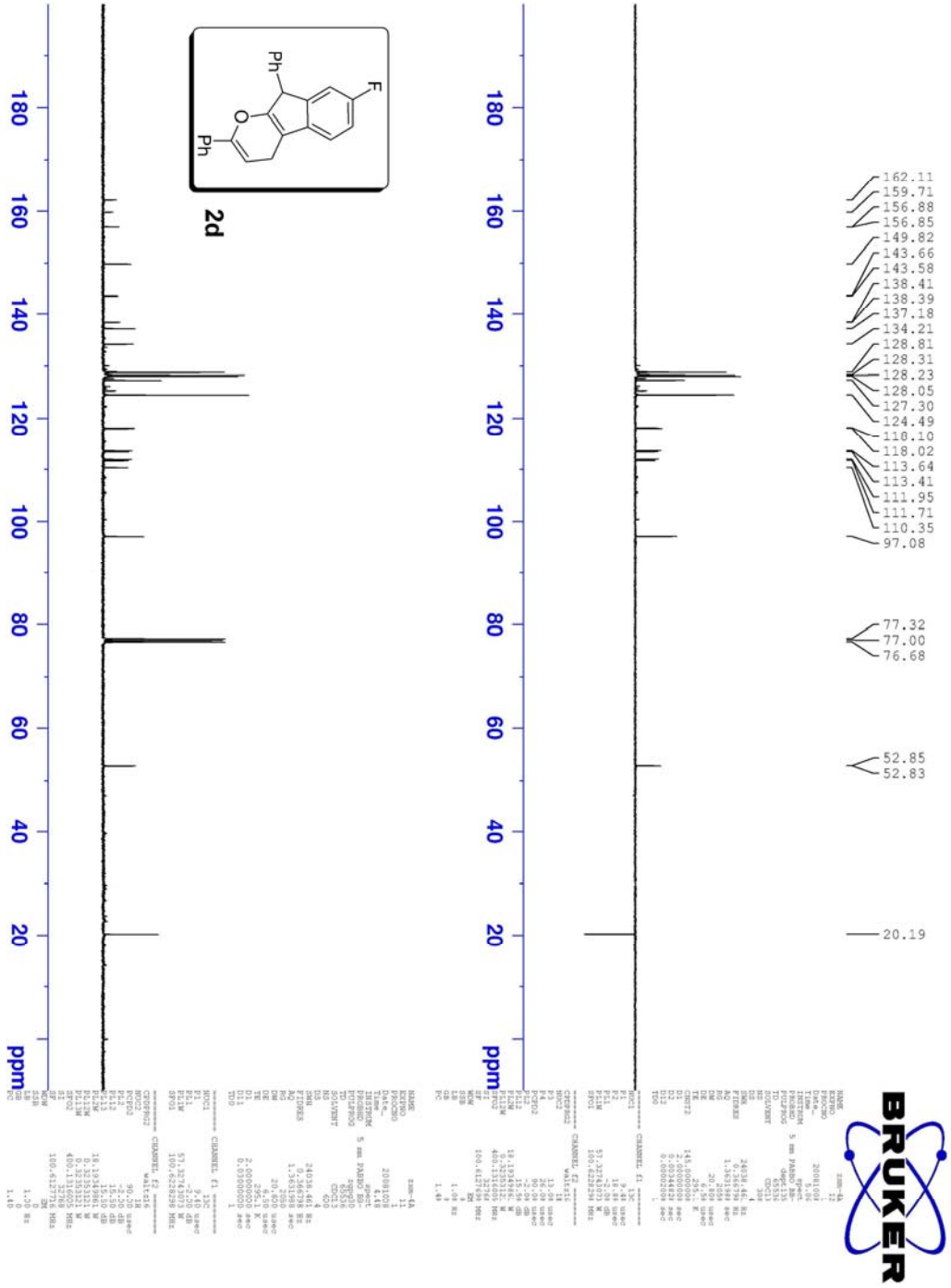

NAME zxm-320
EXPNO 10
PROCNO 1
Date_ 20080917
Time 6.57
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 287
DW 60.800 usec
DE 6.50 usec
TE 296.3 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300044 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

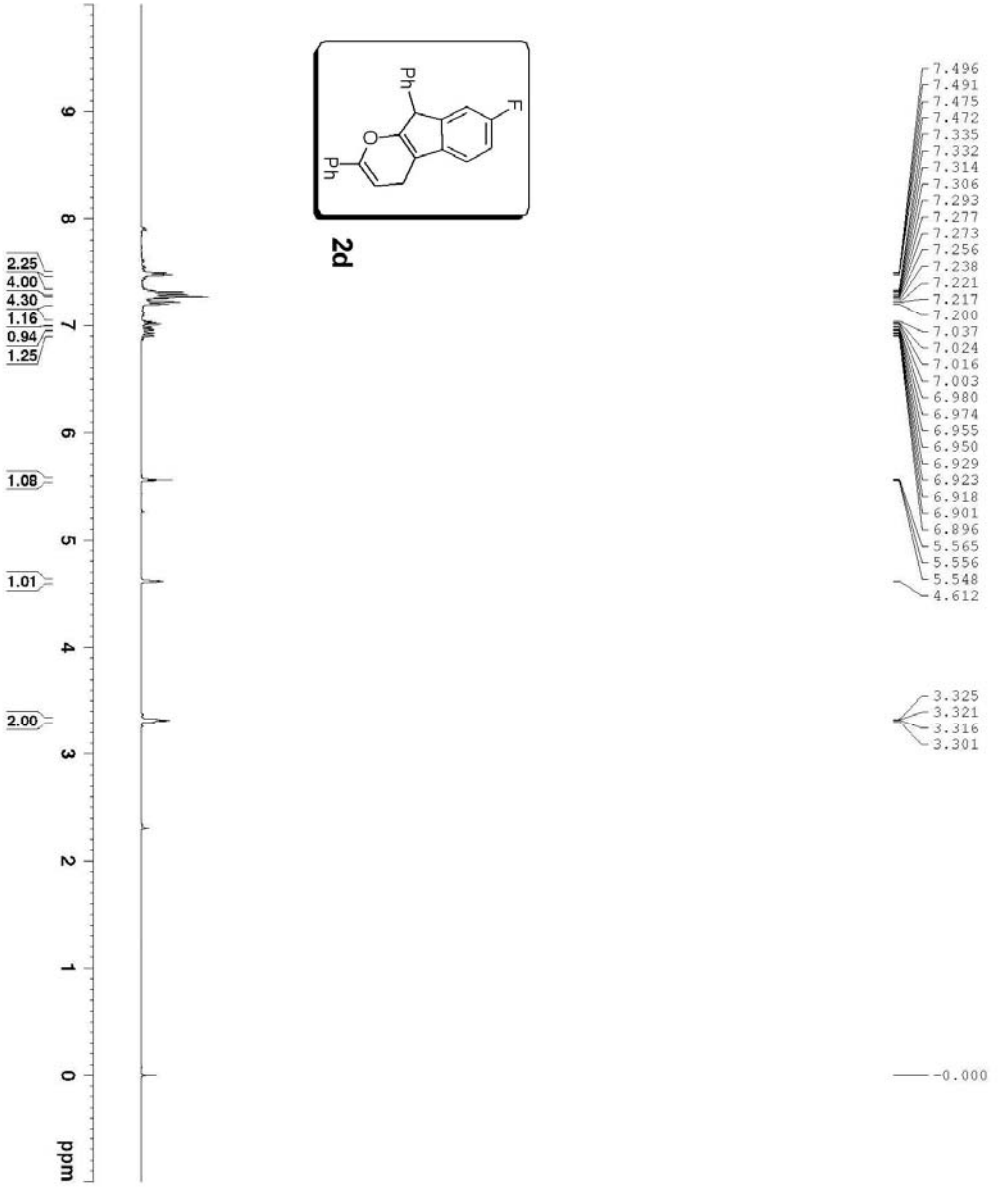

MeO
Ph
O
Ph
2b
157.47
155.70
149.83
143.43
137.96
135.50
134.43
128.70
128.20
128.15
127.04
124.50
117.93
111.65
111.30
110.54
97.07
77.32
77.00
76.68
55.55
52.82
20.28
ppm
BRUKER

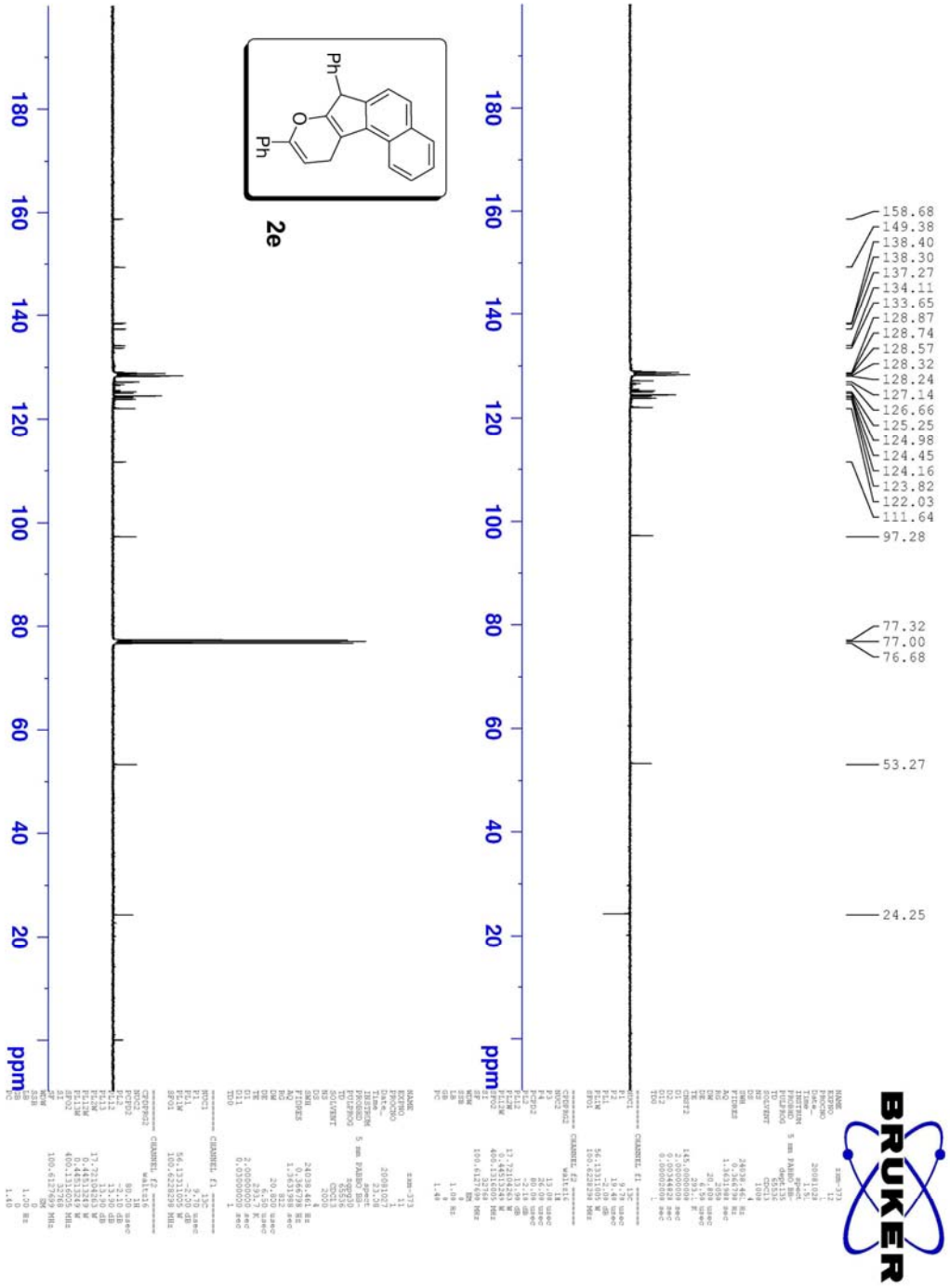

MeO
Ph
Ph
O
2b
2.17
8.70
1.08
2.07
1.05
1.00
3.23
1.96
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
7.500
7.484
7.481
7.328
7.309
7.293
7.275
7.268
7.263
7.259
7.245
7.242
7.225
7.037
7.015
6.814
6.799
6.793
5.561
5.553
5.544
4.619
3.749
3.332
3.324
3.319
3.310
0.000
NAME zxm-325
EXPNO 10
PROCNO 1
Date_ 20080923
Time 3.14
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 40
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 228
DW 60.900 usec
DE 6.50 usec
TE 295.2 K
D1 1.0000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300128 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

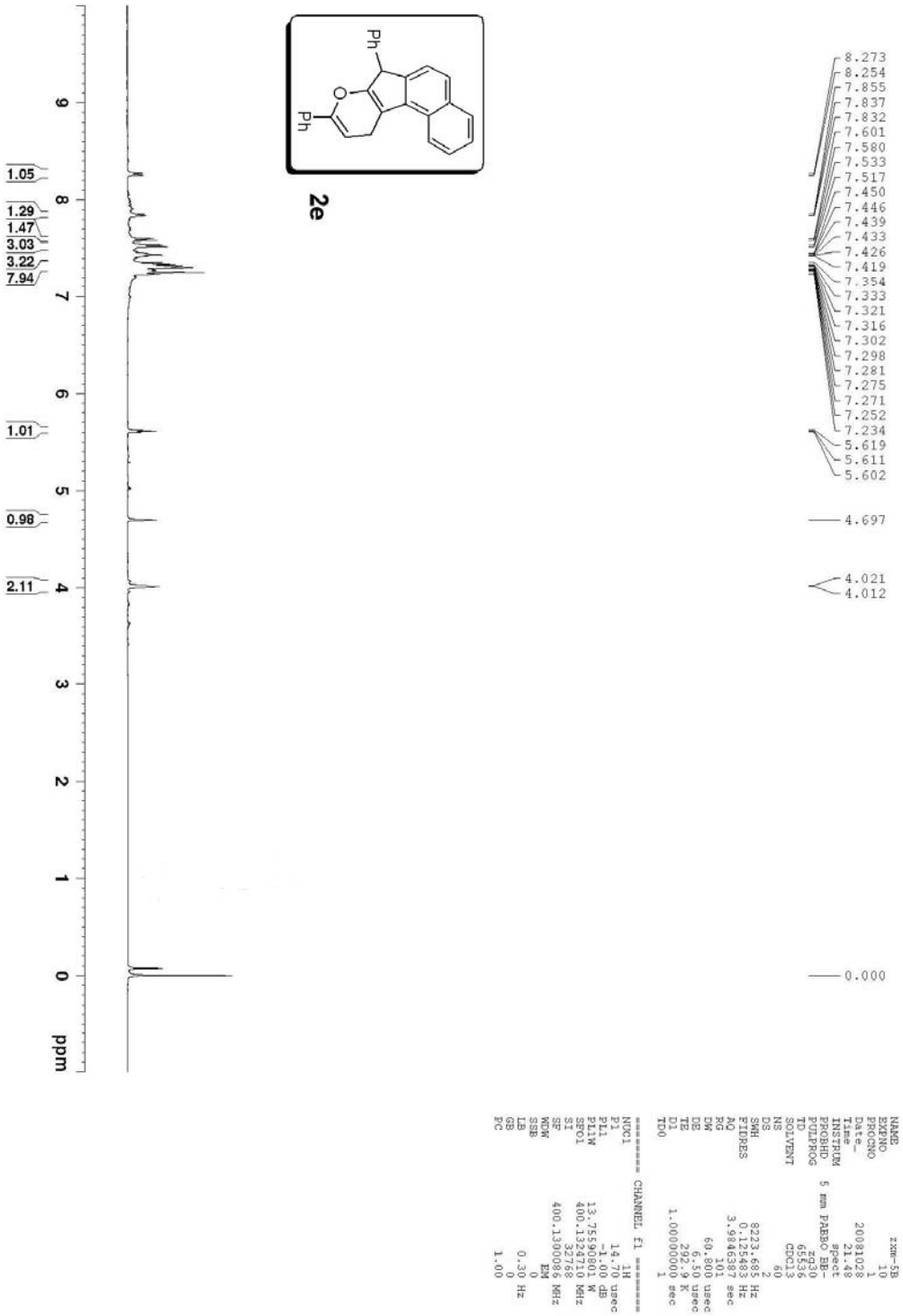

Ph
O
Ph
OMe
2c
ppm
155.85
153.53
149.33
143.26
137.96
134.42
130.49
128.65
128.16
128.08
126.98
125.03
124.38
116.79
110.48
110.06
98.19
77.32
77.00
76.68
55.56
53.08
22.75
BRUKER

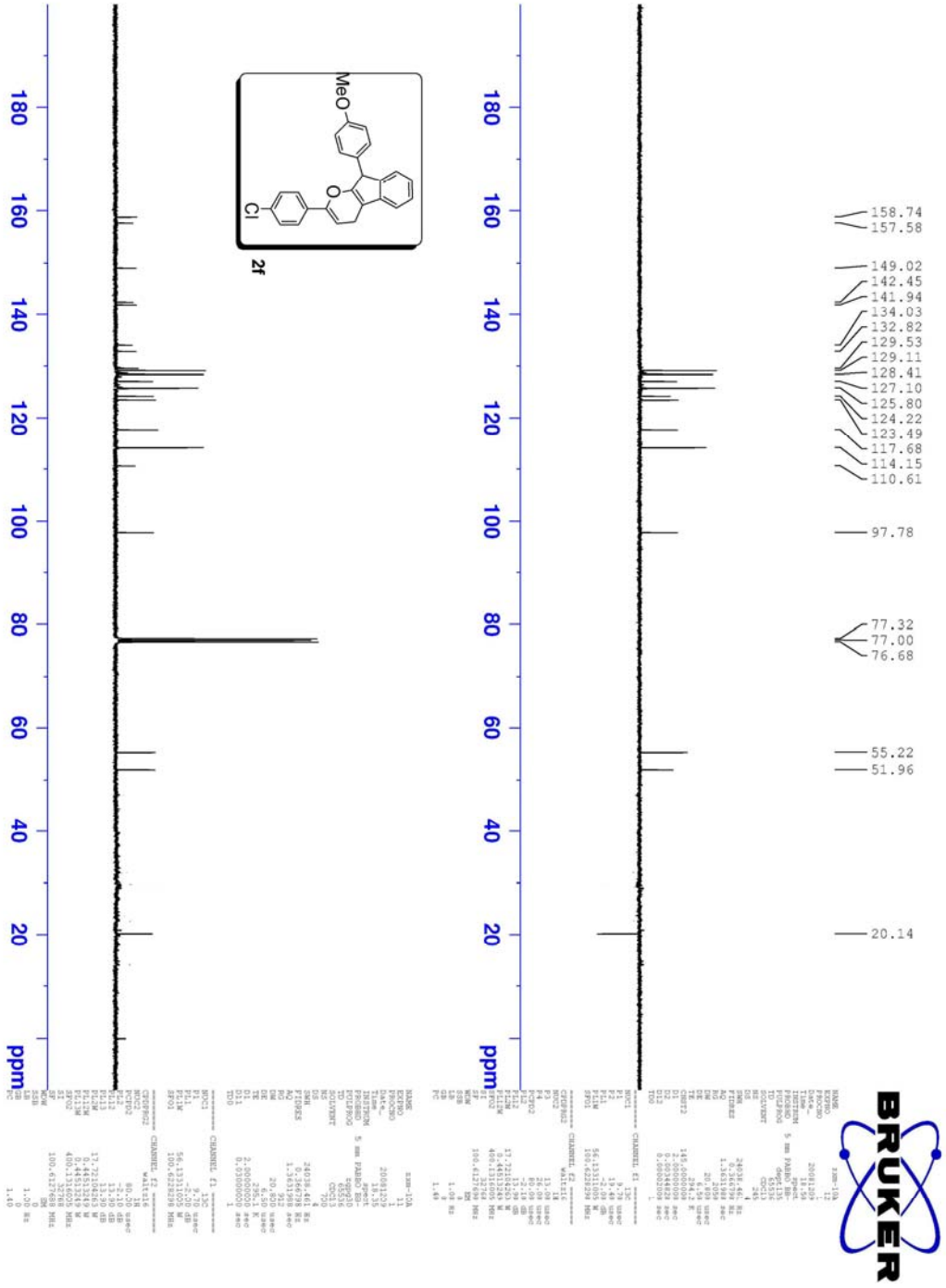

7.487
7.484
7.467
7.319
7.299
7.282
7.263
7.259
7.254
7.249
7.241
7.233
7.221
7.037
7.019
6.998
6.811
6.792
6.771
5.516
5.507
5.498
4.595
3.826
3.605
0.000
2.20
8.37
1.03
2.10
1.00
0.95
3.01
1.92
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
Ph
O
Ph
OMe
2c
NAME zzm-3A
EXPNO 10
PROCNO 1
Date_ 20081002
Time 11.04
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 32
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 101
DW 60.800 usec
DE 6.50 usec
TE 293.7 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 -1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300229 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

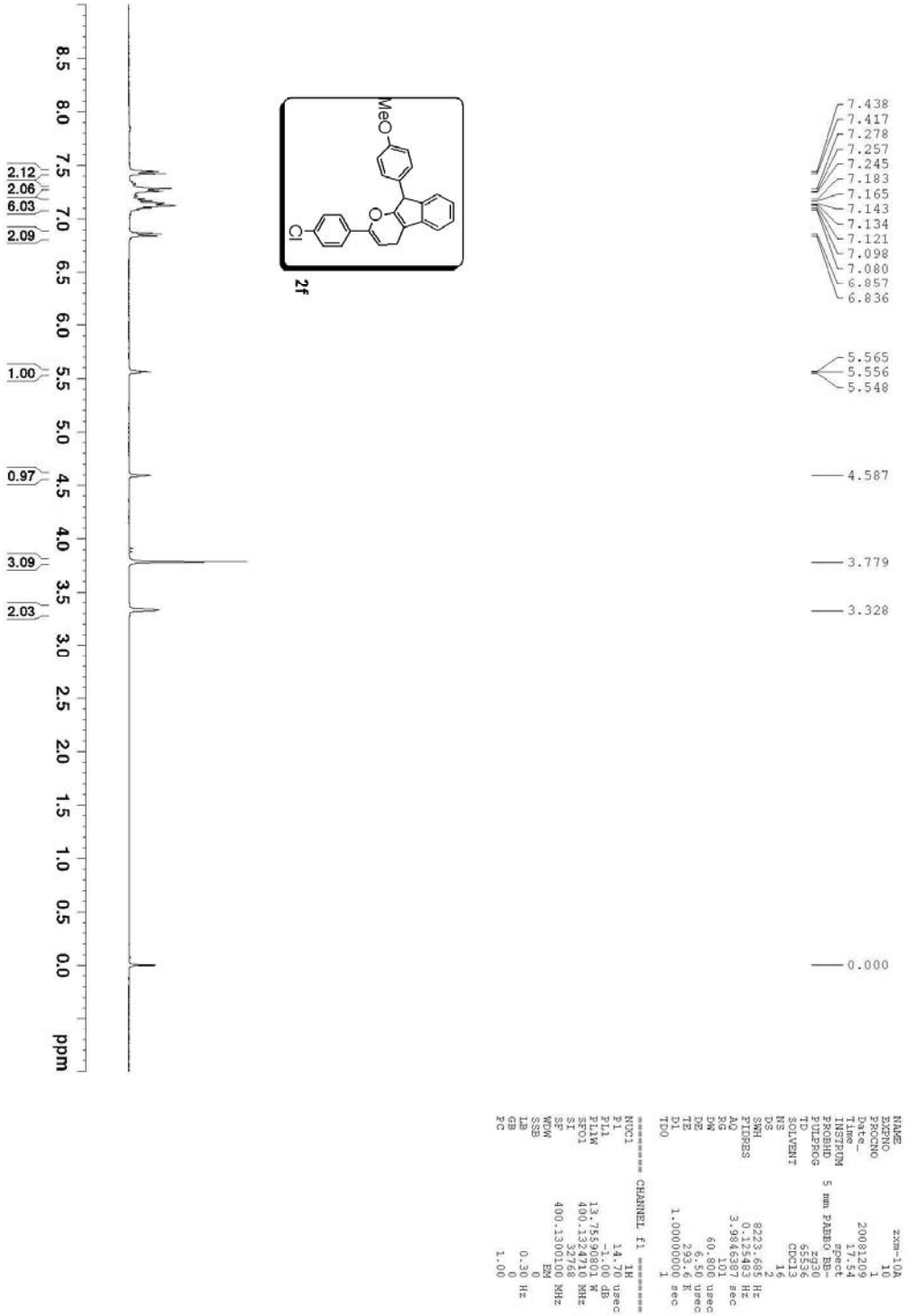

2d
Ph
F
O
Ph
ppm
162.11
159.71
156.88
156.85
149.82
143.66
143.58
138.41
138.39
137.18
134.21
128.81
128.31
128.23
128.05
127.30
124.49
118.10
118.02
113.64
113.41
111.95
111.71
110.35
97.08
77.32
77.00
76.68
52.85
52.83
20.19
BRUKER

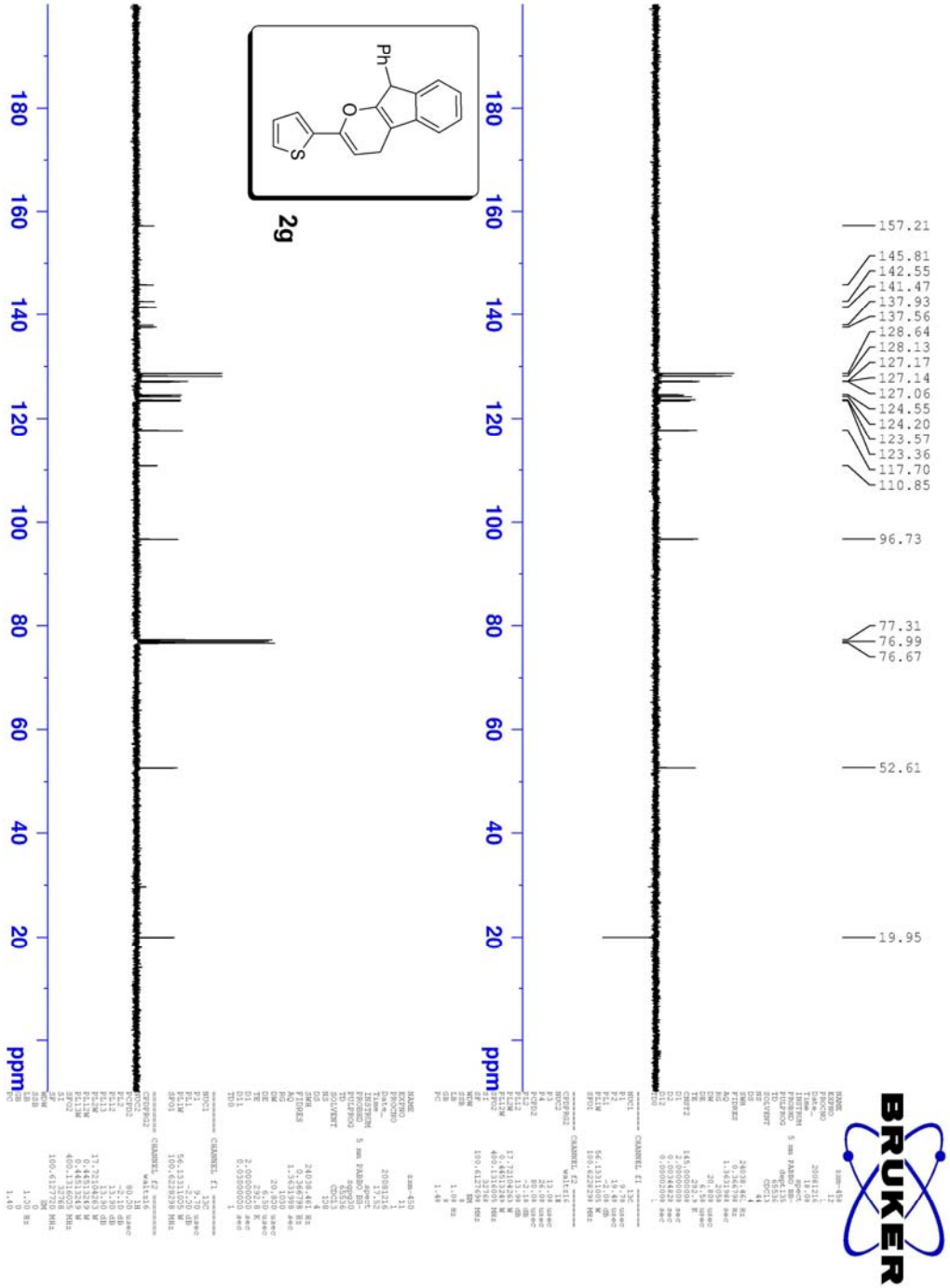

2d
Ph
F
O
Ph
2.25
4.00
4.30
1.16
0.94
1.25
1.08
1.01
2.00
ppm
7.496
7.491
7.475
7.472
7.335
7.332
7.314
7.306
7.293
7.277
7.273
7.256
7.238
7.221
7.217
7.200
7.037
7.024
7.016
7.003
6.980
6.974
6.955
6.950
6.929
6.923
6.918
6.901
6.896
5.565
5.556
5.548
4.612
3.325
3.321
3.316
3.301
-0.000
NAME z:\zm-4A
EXPNO 10
PROCNO 1
Date_ 20081007
Time 20.24
INSTRUM
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846397 sec
RG 71.8
DW 60.800 usec
DE 6.00 usec
TE 294.5 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 -1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 65536
SF 400.1300000 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

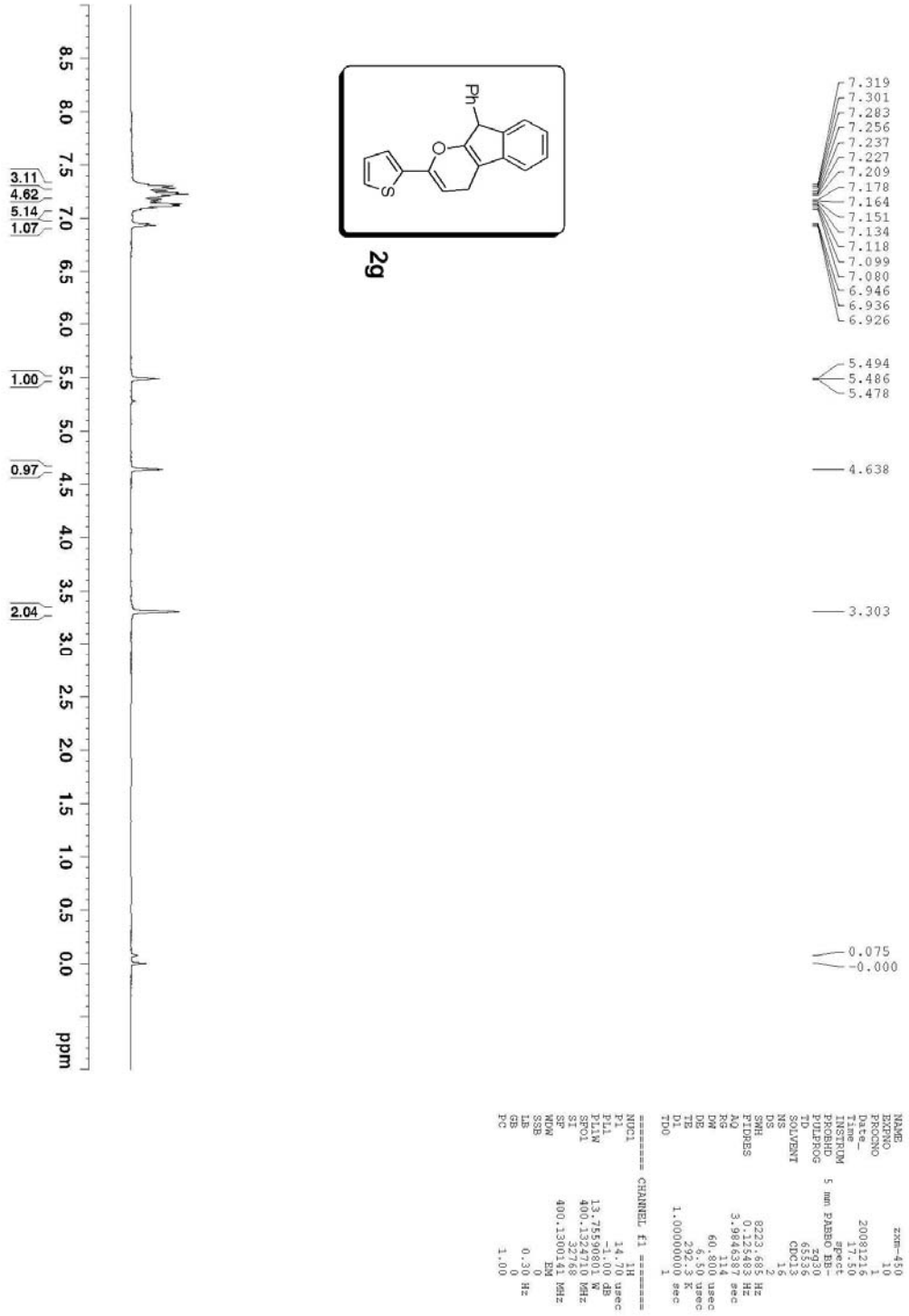

Ph
O
Ph
2e
158.68
149.38
138.40
138.30
137.27
134.11
133.65
128.87
128.74
128.57
128.32
128.24
127.14
126.66
125.25
124.98
124.45
124.16
123.82
122.03
111.64
97.28
77.32
77.00
76.68
53.27
24.25
ppm
BRUKER

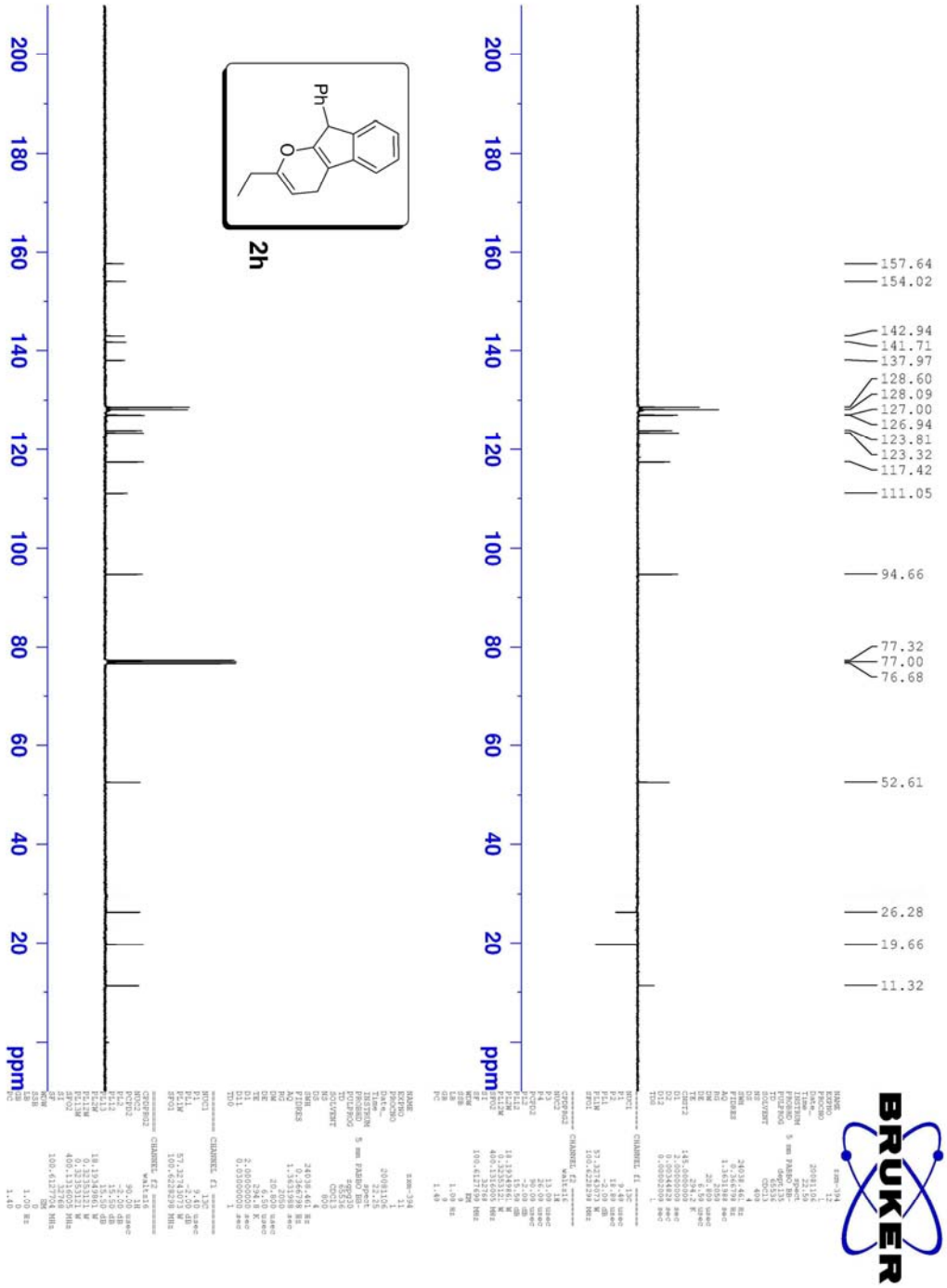

Ph
Ph
O
2e
1.05
1.29
1.47
3.03
3.22
7.94
1.01
0.98
2.11
ppm
8.273
8.254
7.855
7.837
7.832
7.601
7.580
7.533
7.517
7.450
7.446
7.439
7.433
7.426
7.419
7.354
7.333
7.321
7.316
7.302
7.298
7.281
7.275
7.271
7.252
7.234
5.619
5.611
5.602
4.697
4.021
4.012
0.000
NAME zxw-5B
EXPNO 10
PROCNO 1
Date_ 20081028
Time 21.48
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 60
DS 8
SWH 8223.685 Hz
FIDRES 0.125493 Hz
AQ 3.9846387 sec
RG 101
DW 60.800 usec
DE 6.50 usec
TE 292.9 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300086 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

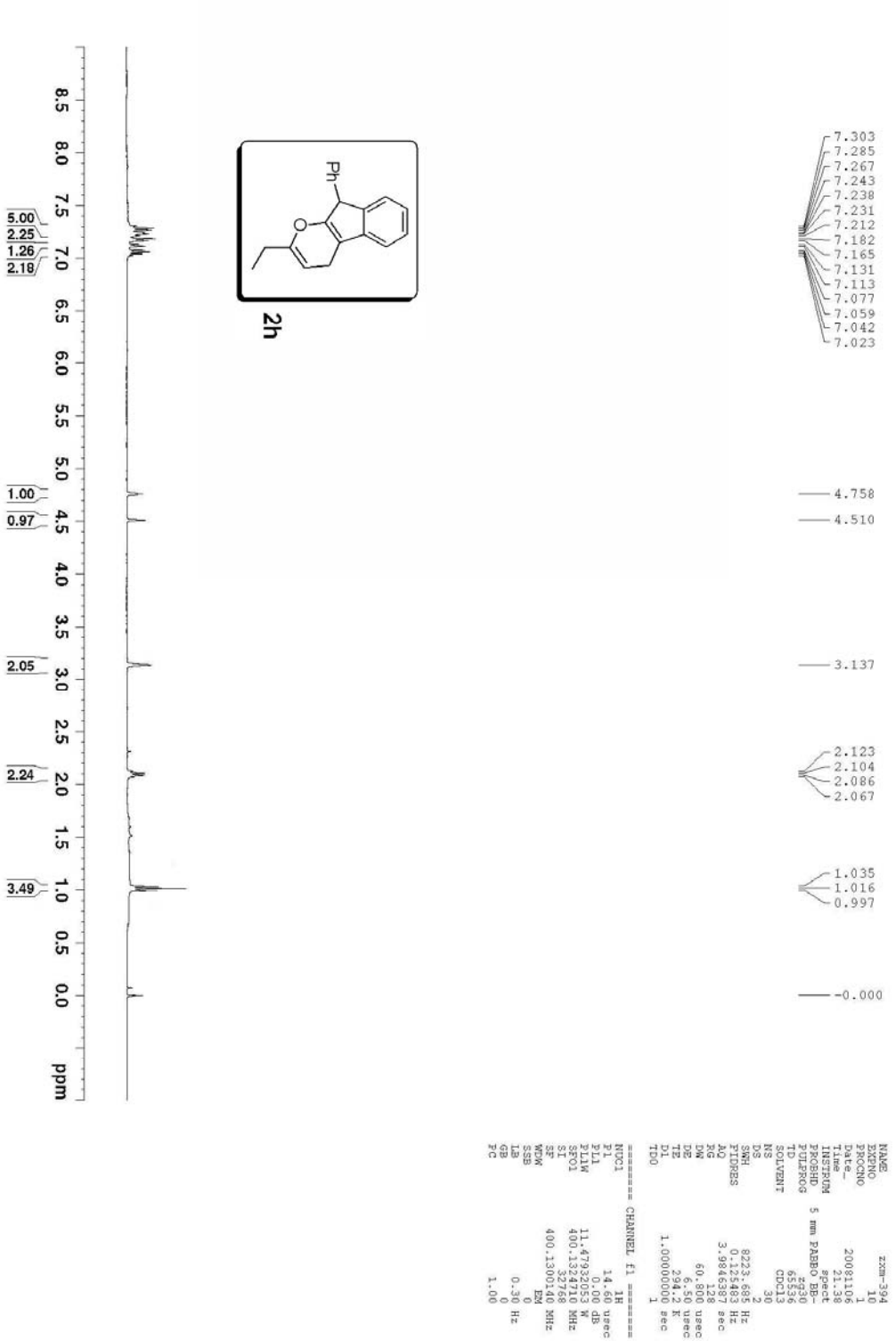

MeO
Cl
O
2f
158.74
157.58
149.02
142.45
141.94
134.03
132.82
129.53
129.11
128.41
127.10
125.80
124.22
123.49
117.68
114.15
110.61
97.78
77.32
77.00
76.68
55.22
51.96
20.14
ppm
BRUKER

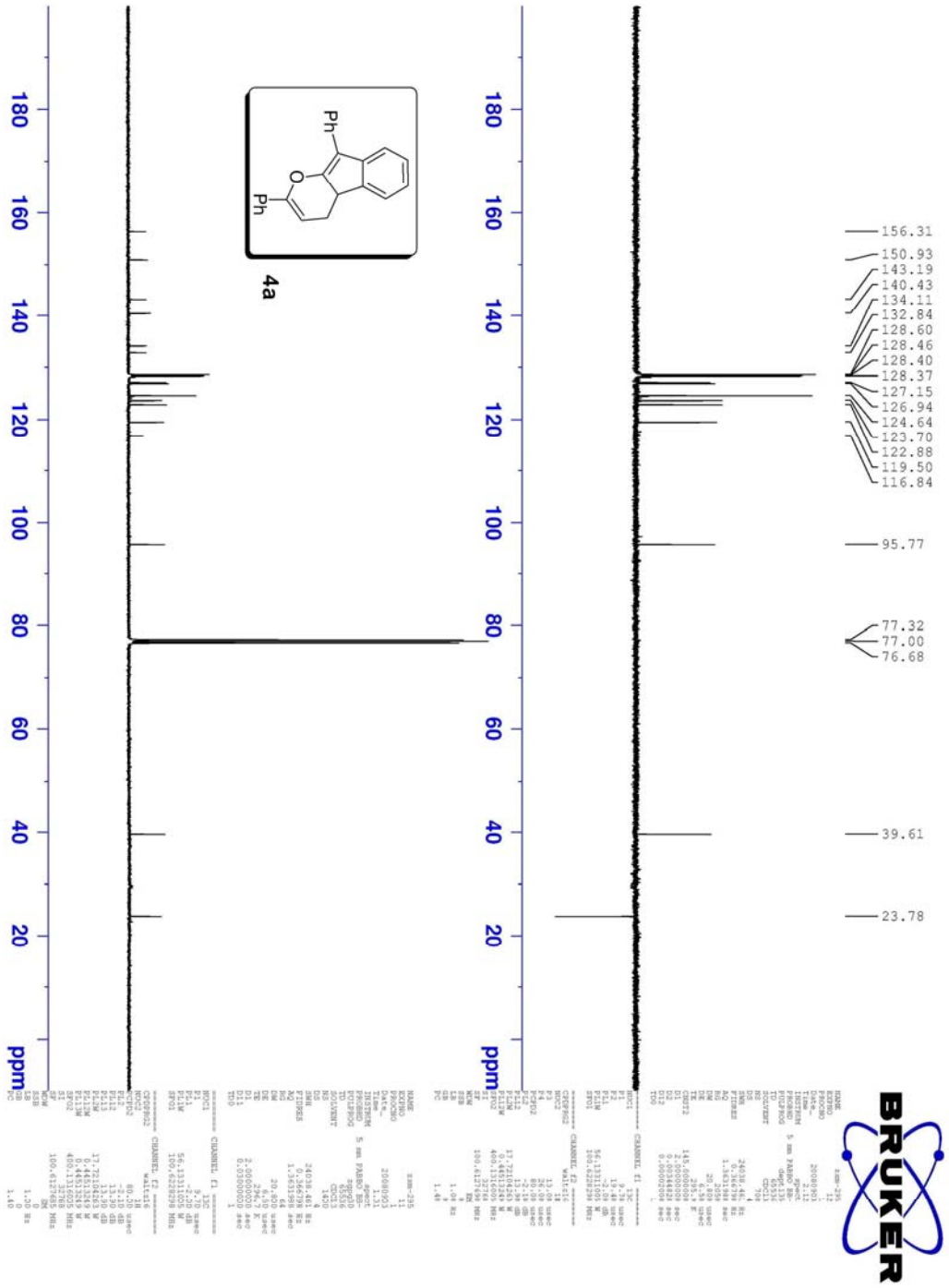

MeO
Cl
2f
2.12
2.06
6.03
2.09
1.00
0.97
3.09
2.03
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
7.438
7.417
7.278
7.257
7.245
7.183
7.165
7.143
7.134
7.121
7.098
7.080
6.857
6.836
5.565
5.556
5.548
4.587
3.779
3.328
0.000
NAME zxm-10A
EXPNO 10
PROCNO 1
Date_ 20081209
Time 17.54
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 101
DW 60.800 usec
DE 6.50 usec
TE 293.6 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 -1.00 dB
PL1W 13.75908801 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300108 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

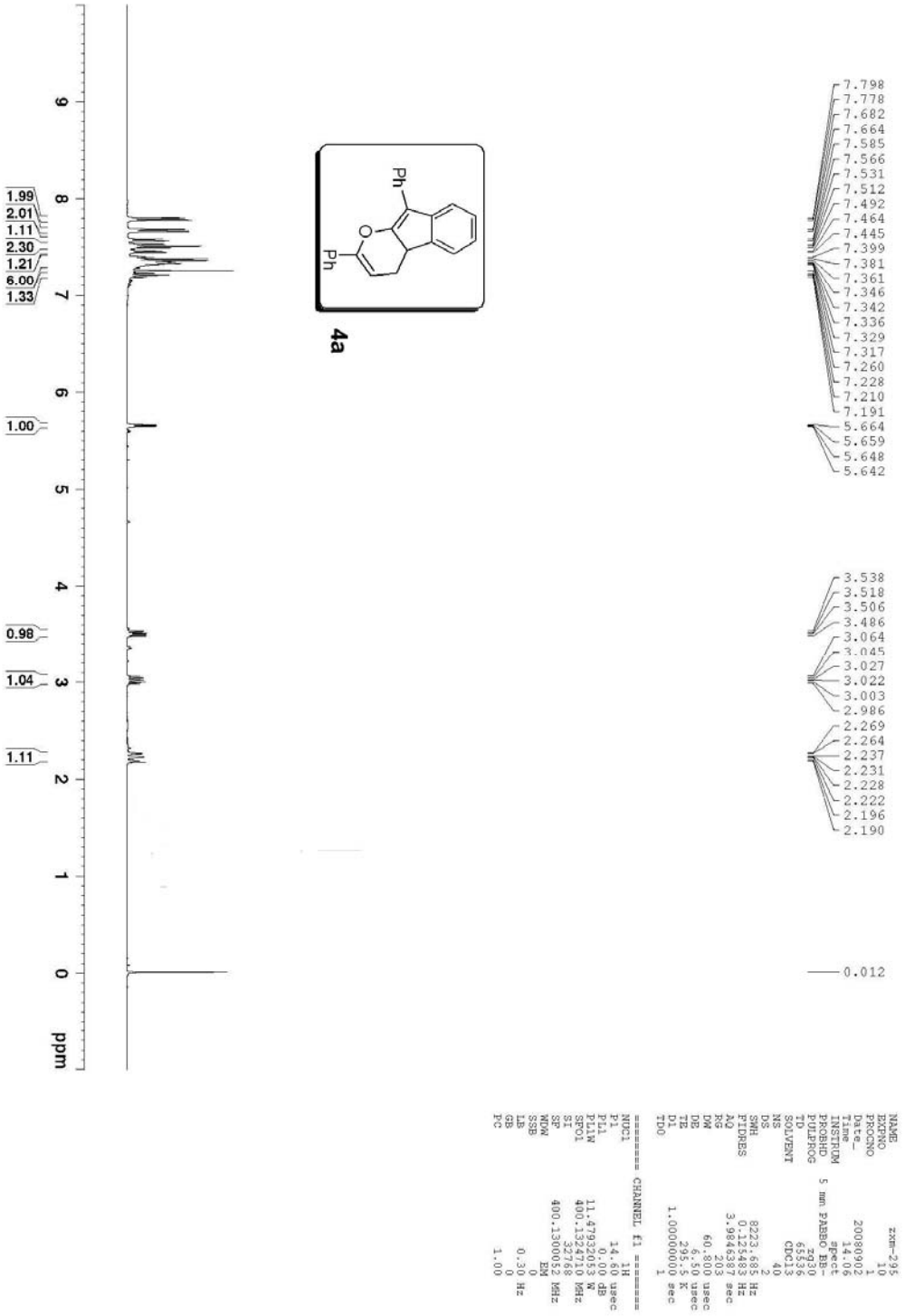

Ph
O
S
2g
157.21
145.81
142.55
141.47
137.93
137.56
128.64
128.13
127.17
127.14
127.06
124.55
124.20
123.57
123.36
117.70
110.85
96.73
77.31
76.99
76.67
52.61
19.95
ppm
BRUKER

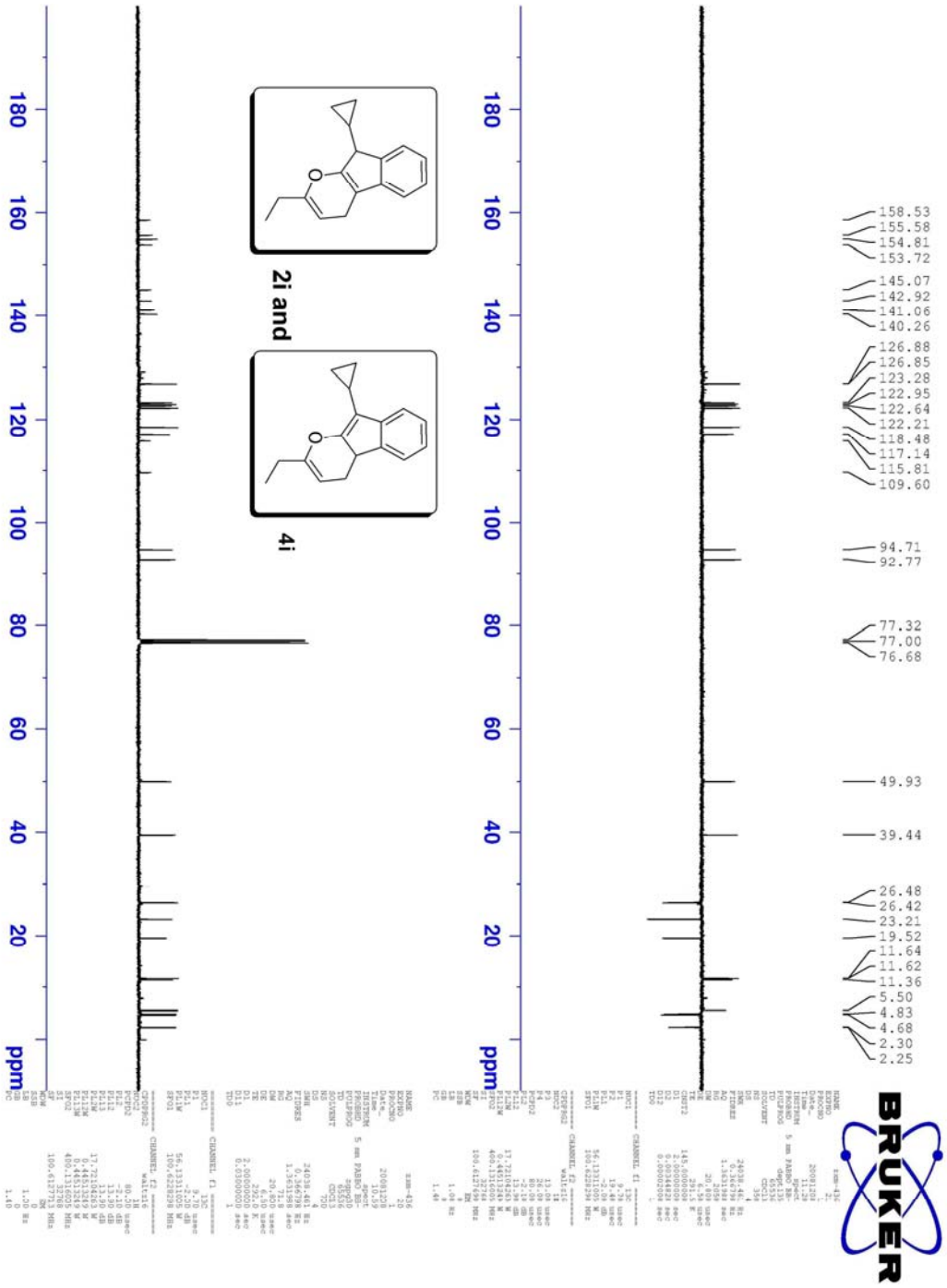

Ph
O
S
2g
7.319
7.301
7.283
7.256
7.237
7.227
7.209
7.178
7.164
7.151
7.134
7.118
7.099
7.080
6.946
6.936
6.926
5.494
5.486
5.478
4.638
3.303
0.075
-0.000
3.11
4.62
5.14
1.07
1.00
0.97
2.04
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
NAME zxm-450
EXPNO 10
PROCNO 1
Date_ 20081216
Time 17.50
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 114
DW 60.800 usec
DE 6.50 usec
TE 292.3 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 -1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300141 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00


Ph
O
2h
157.64
154.02
142.94
141.71
137.97
128.60
128.09
127.00
126.94
123.81
123.32
117.42
111.05
94.66
77.32
77.00
76.68
52.61
26.28
19.66
11.32
ppm
BRUKER


Ph
2h
5.00
2.25
1.26
2.18
1.00
0.97
2.05
2.24
3.49
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
7.303
7.285
7.267
7.243
7.238
7.231
7.212
7.182
7.165
7.131
7.113
7.077
7.059
7.042
7.023
4.758
4.510
3.137
2.123
2.104
2.086
2.067
1.035
1.016
0.997
-0.000
NAME zxm-394
EXPNO 10
PROCNO 1
Date_ 20091106
Time 21.38
INSTRUM
PROBHD 5 mm PABBO BB/
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 30
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 128
DW 60.800 usec
DE 6.50 usec
TE 294.0 K
D1 1.0000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300140 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00


Ph
O
Ph
4a
156.31
150.93
143.19
140.43
134.11
132.84
128.60
128.46
128.40
128.37
127.15
126.94
124.64
123.70
122.88
119.50
116.84
95.77
77.32
77.00
76.68
39.61
23.78
ppm
BRUKER


1.99
2.01
1.11
2.30
1.21
6.00
1.33
1.00
0.98
1.04
1.11
9
8
7
6
5
4
3
2
1
0
ppm
Ph
O
Ph
4a
7.798
7.778
7.682
7.664
7.585
7.566
7.531
7.512
7.492
7.464
7.445
7.399
7.381
7.361
7.346
7.342
7.336
7.329
7.317
7.260
7.228
7.210
7.191
5.664
5.659
5.648
5.642
3.538
3.518
3.506
3.486
3.064
3.045
3.027
3.022
3.003
2.986
2.269
2.264
2.237
2.231
2.228
2.222
2.196
2.190
0.012
NAME zxm-295
EXPNO 10
PROCNO 1
Date_ 20080902
Time 14.06
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 40
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 203
DW 60.800 usec
DE 6.50 usec
TE 295.3 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PLW1 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300054 MHz
WDW no
SSB 0
LB 0.30 Hz
GB 0
PC 1.00


2i and
4i
ppm
158.53
155.58
154.81
153.72
145.07
142.92
141.06
140.26
126.88
126.85
123.28
122.95
122.64
122.21
118.48
117.14
115.81
109.60
94.71
92.77
77.32
77.00
76.68
49.93
39.44
26.48
26.42
23.21
19.52
11.64
11.62
11.36
5.50
4.83
4.68
2.30
2.25
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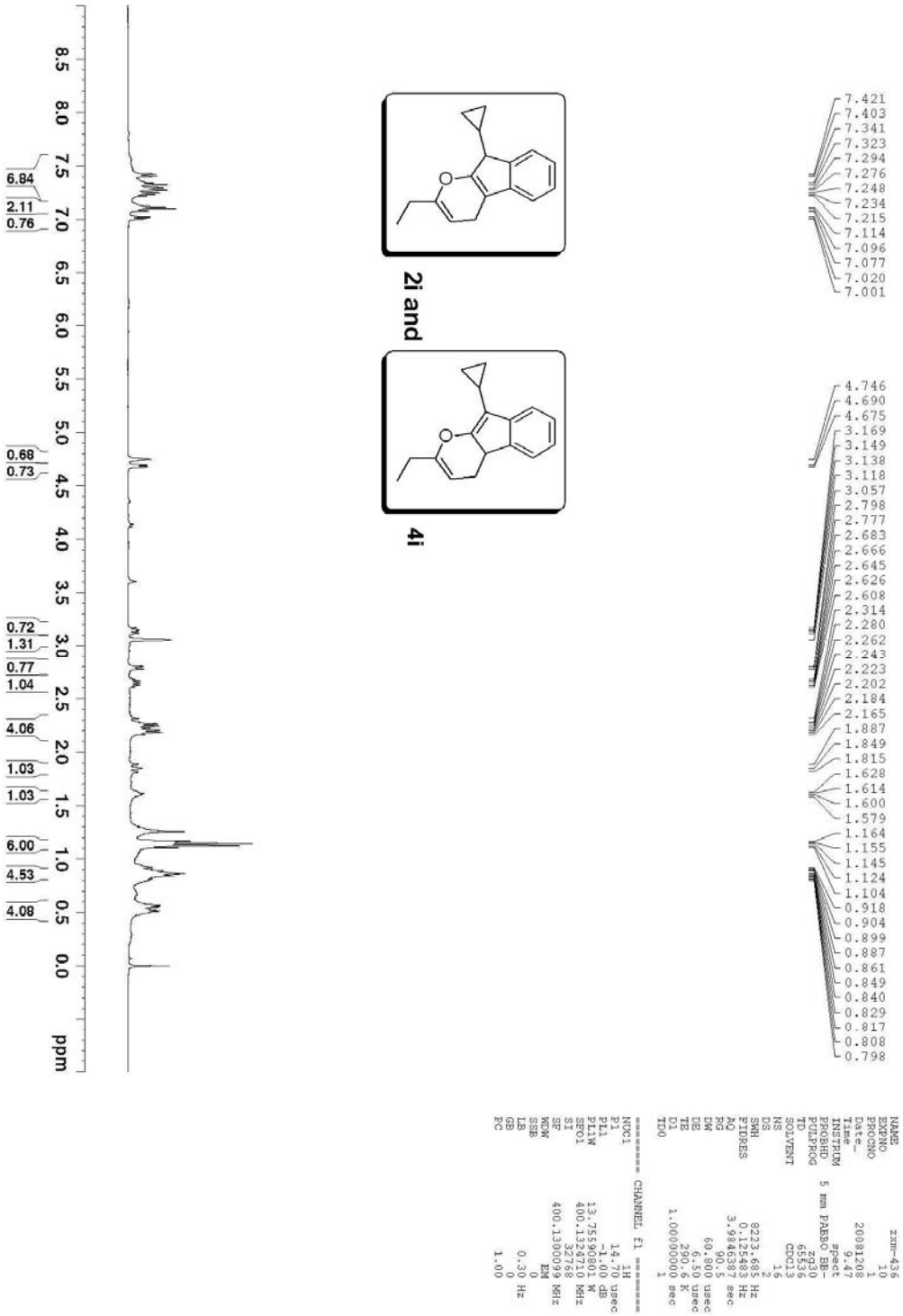
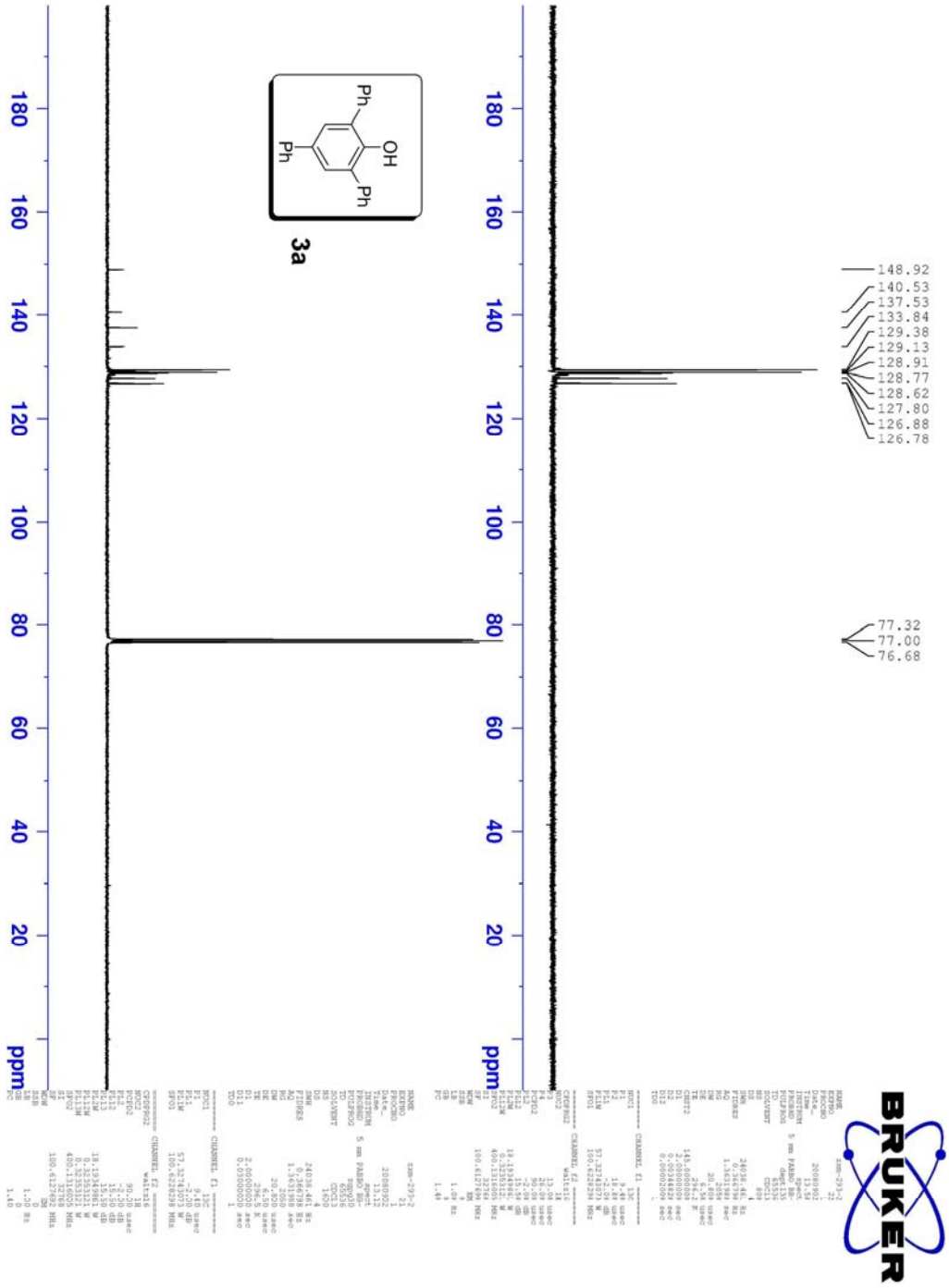
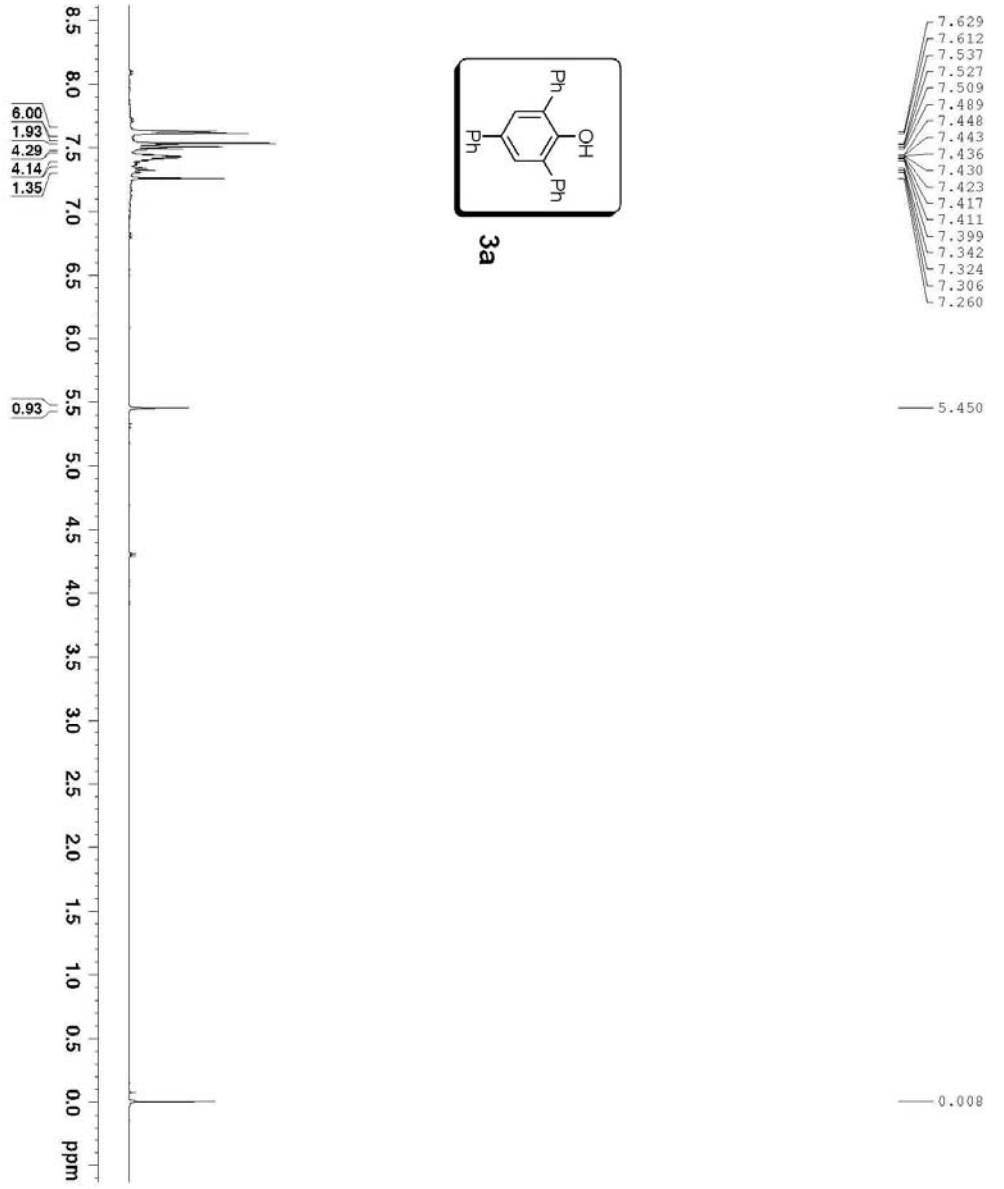
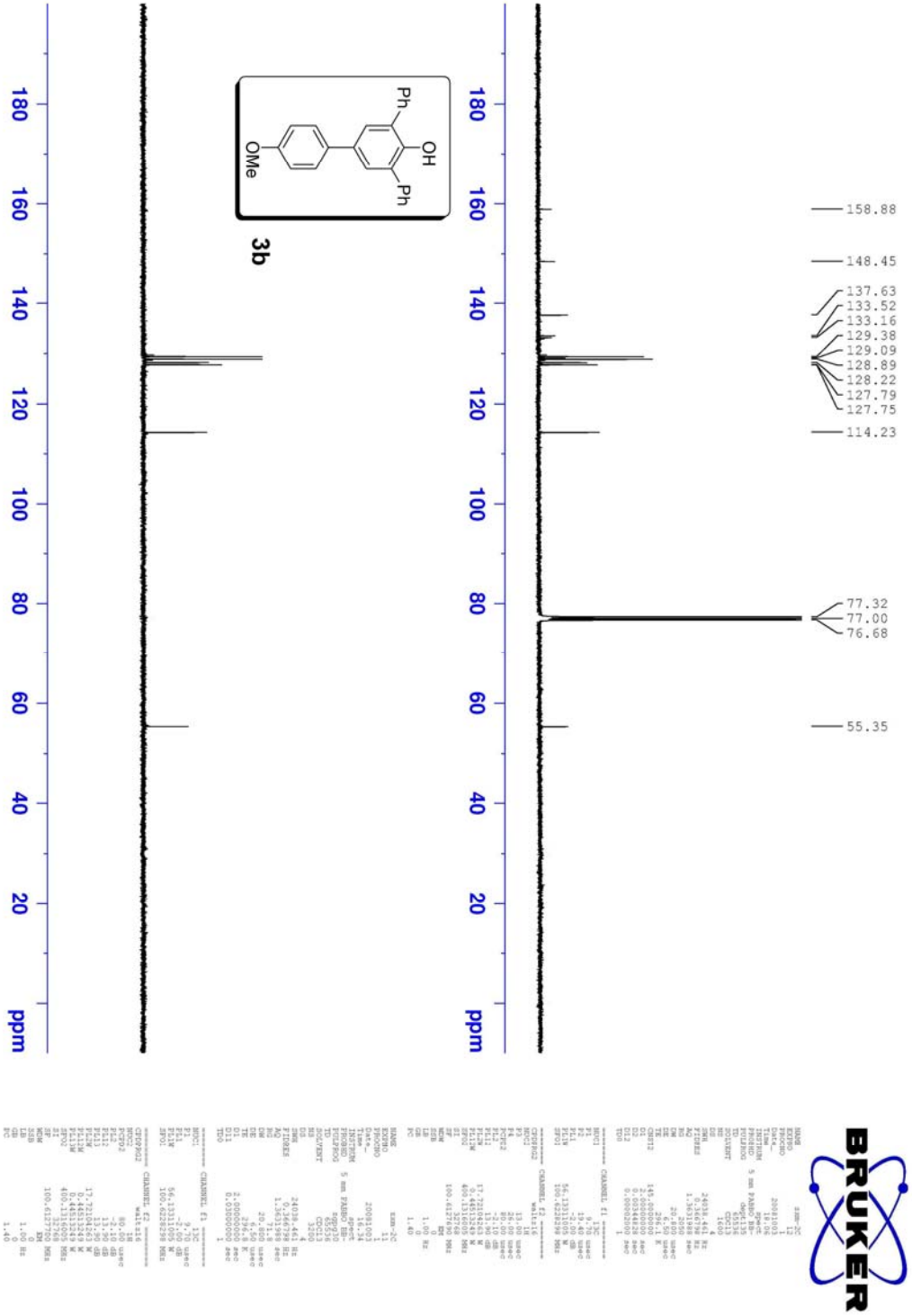

2i and
4i
6.84
2.11
0.76
0.68
0.73
0.72
1.31
0.77
1.04
4.06
1.03
1.03
6.00
4.53
4.08
ppm
7.421
7.403
7.341
7.323
7.294
7.276
7.248
7.234
7.215
7.114
7.096
7.077
7.020
7.001
4.746
4.690
4.675
3.169
3.149
3.138
3.118
3.057
2.798
2.777
2.683
2.666
2.645
2.626
2.608
2.314
2.280
2.262
2.243
2.223
2.202
2.184
2.165
1.887
1.849
1.815
1.628
1.614
1.600
1.579
1.164
1.155
1.145
1.124
1.104
0.918
0.904
0.899
0.887
0.861
0.849
0.840
0.829
0.817
0.808
0.798
NAME zxm-436
EXPNO 10
PROCNO 1
Date_ 20081208
Time 9.47
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125493 Hz
AQ 3.9846387 sec
RG 90.5
DW 60.800 usec
DE 6.50 usec
TE 290.6 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300099 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

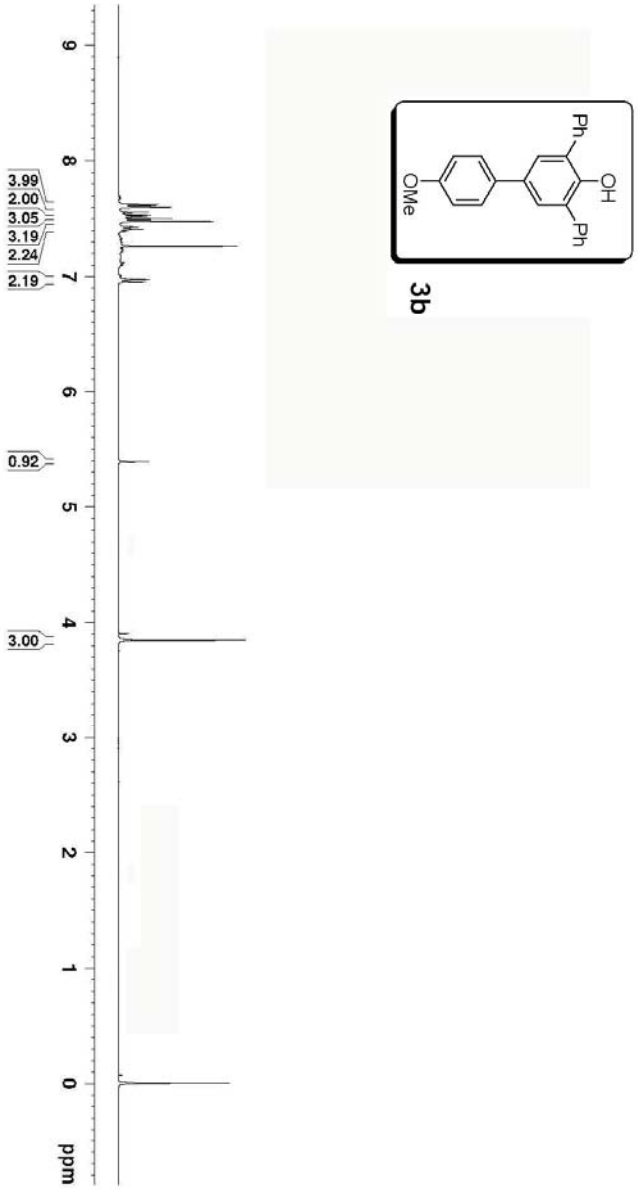

Ph
OH
Ph
Ph
3a
148.92
140.53
137.53
133.84
129.38
129.13
128.91
128.77
128.62
127.80
126.88
126.78
77.32
77.00
76.68
ppm
BRUKER



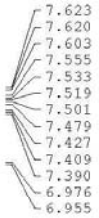
NAME zxm-293-2
EXPNO 20
PROCNO 1
Date_ 20080902
Time 11.39
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 50
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 287
DW 60.800 usec
DE 6.50 usec
TE 294.4 K
D1 1.00000000 sec
TD0 1

======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300048 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00


158.88
148.45
137.63
133.52
133.16
129.38
129.09
128.89
128.22
127.79
127.75
114.23
77.32
77.00
76.68
55.35
ppm
OMe
OH
Ph
Ph
3b

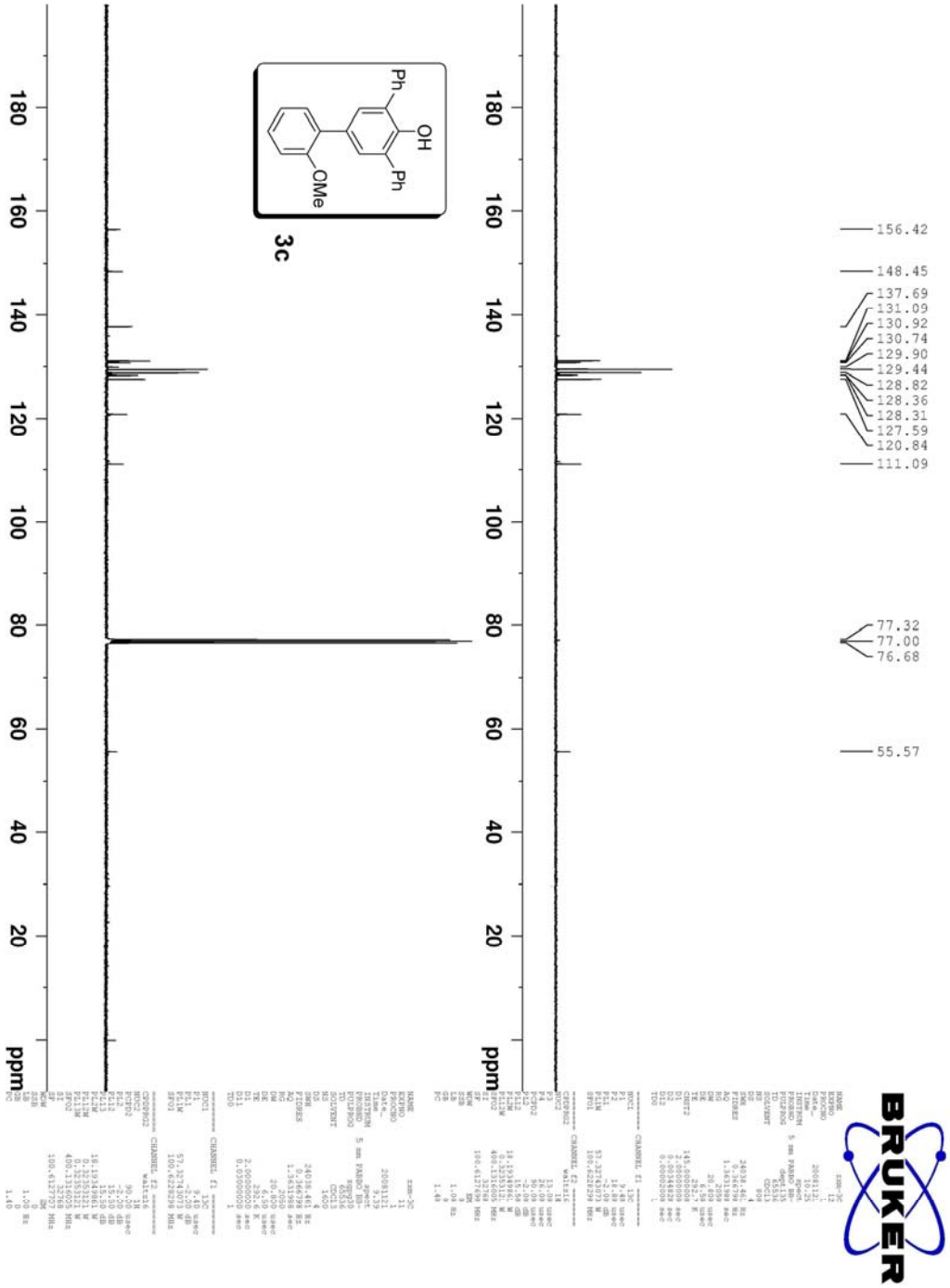


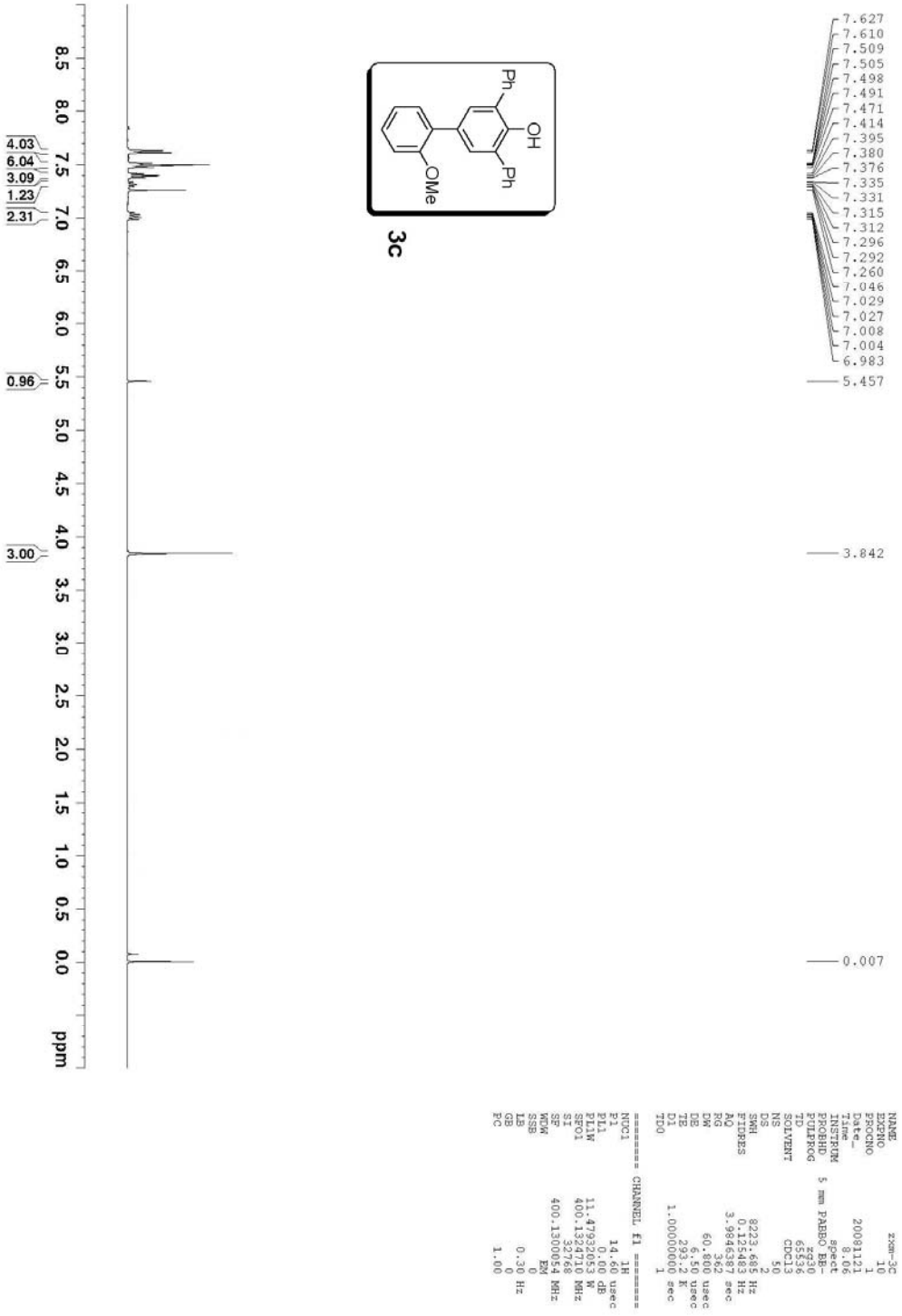
3b

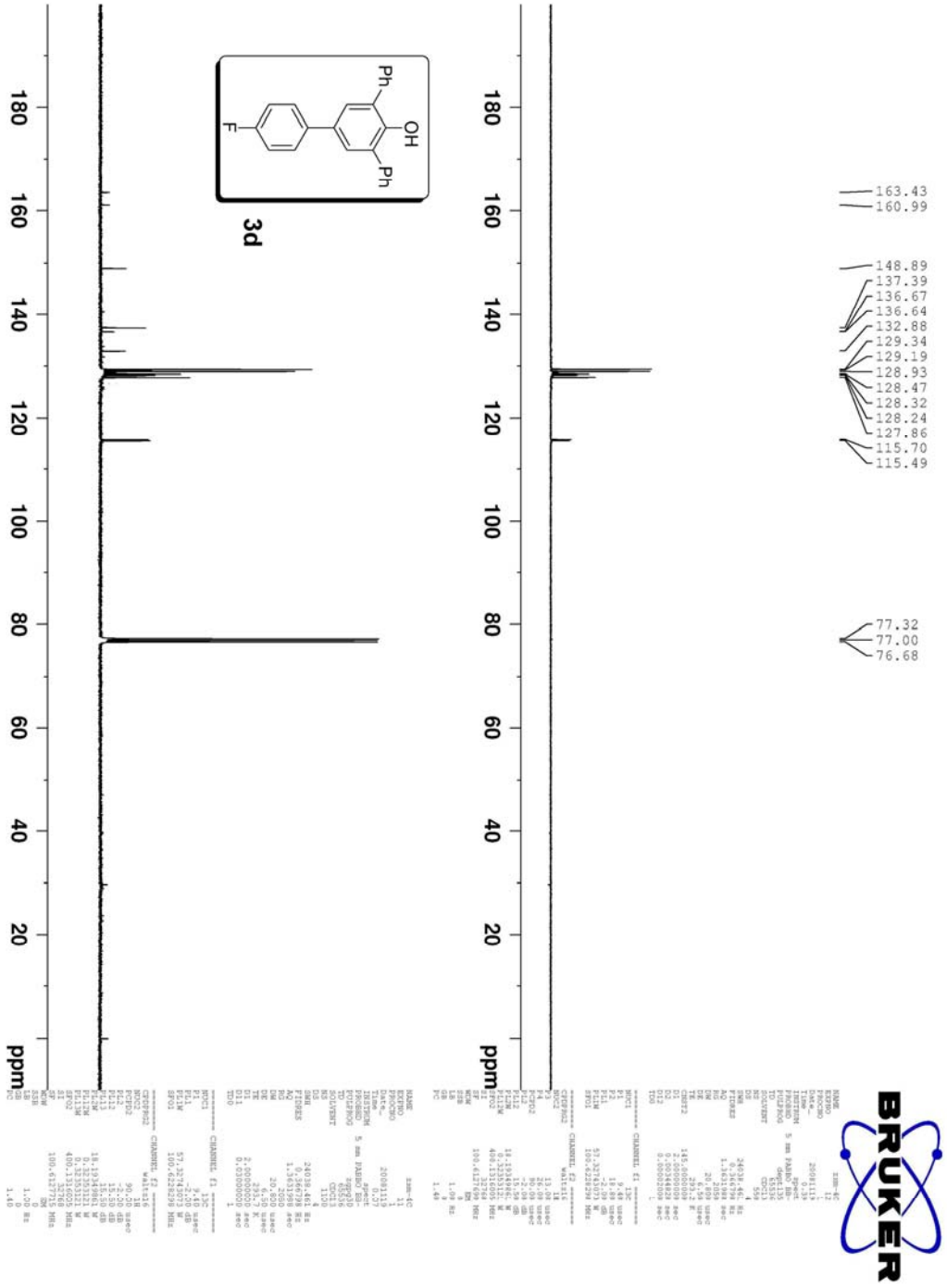


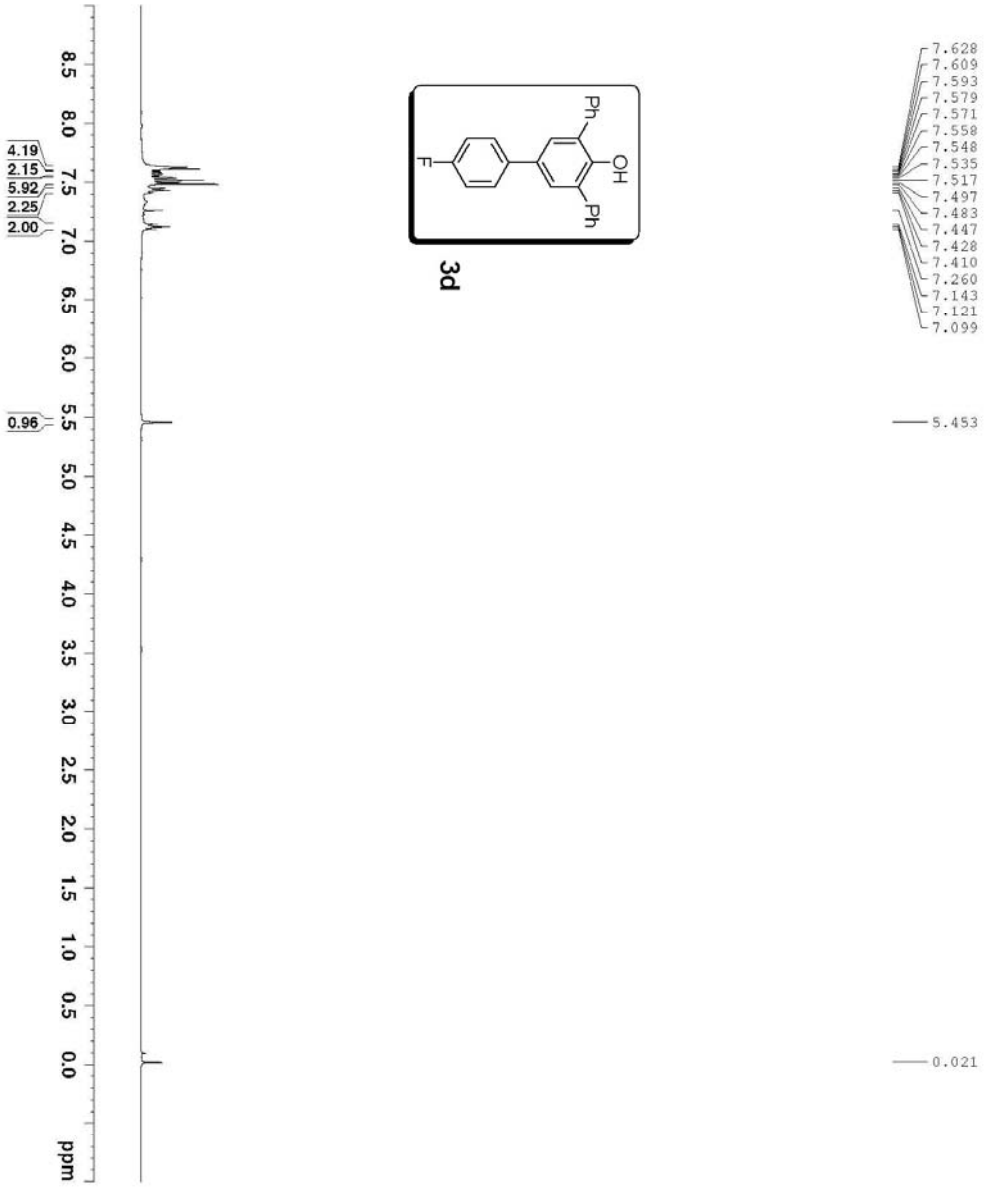

```
NAME                                    zzm-317
EXPNO                                        10
PROCNO                                        1
Date_                               20080916
Time                                    15.18
INSTRUM                                 spect
PROBHD                     5 mm PABBO BB/
PULPROG                                 zg30
TD                                     65536
SOLVENT                                CDCl3
NS                                        56
DS                                         2
SWH                                 8223.685 Hz
FIDRES                              0.125483 Hz
AQ                                  3.9846387 sec
RG                                       322
DW                                  60.800 usec
DE                                   6.50 usec
TE                                       295 K
D1                                  1.0000000 sec
TD0                                         1

======== CHANNEL f1 ========
NUC1                                      1H
P1                                     14.70 usec
PL1                                    -1.00 dB
PL1W                                13.75590801 W
SFO1                                400.1324710 MHz
SI                                      32768
SF                                  400.1300048 MHz
WDW                                        EM
SSB                                         0
LB                                       0.30 Hz
GB                                          0
PC                                       1.00
```


Ph
OH
Ph
OMe
3c
156.42
148.45
137.69
131.09
130.92
130.74
129.90
129.44
128.82
128.36
128.31
127.59
120.84
111.09
77.32
77.00
76.68
55.57
ppm
BRUKER

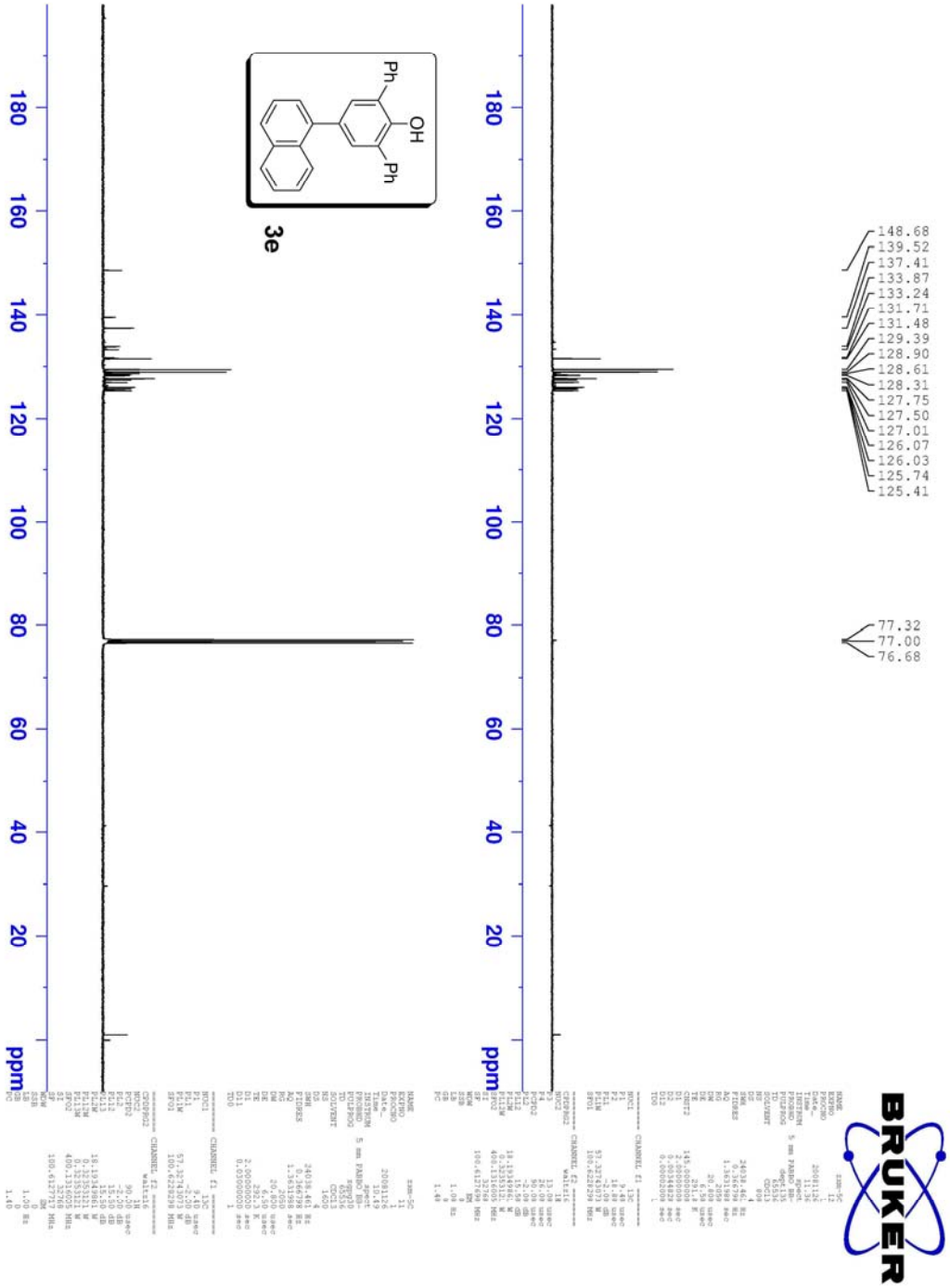

7.627
7.610
7.509
7.505
7.498
7.491
7.471
7.414
7.395
7.380
7.376
7.335
7.331
7.315
7.312
7.296
7.292
7.260
7.046
7.029
7.027
7.008
7.004
6.983
5.457
3.842
0.007
4.03
6.04
3.09
1.23
2.31
0.96
3.00
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
Ph
OH
Ph
OMe
3c
NAME zsm-3c
EXPNO 10
PROCNO 1
Date_ 20081121
Time 8.06
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 50
DS 2
SWH 8223.686 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 362
DW 60.800 usec
DE 6.50 usec
TE 293.2 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300054 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

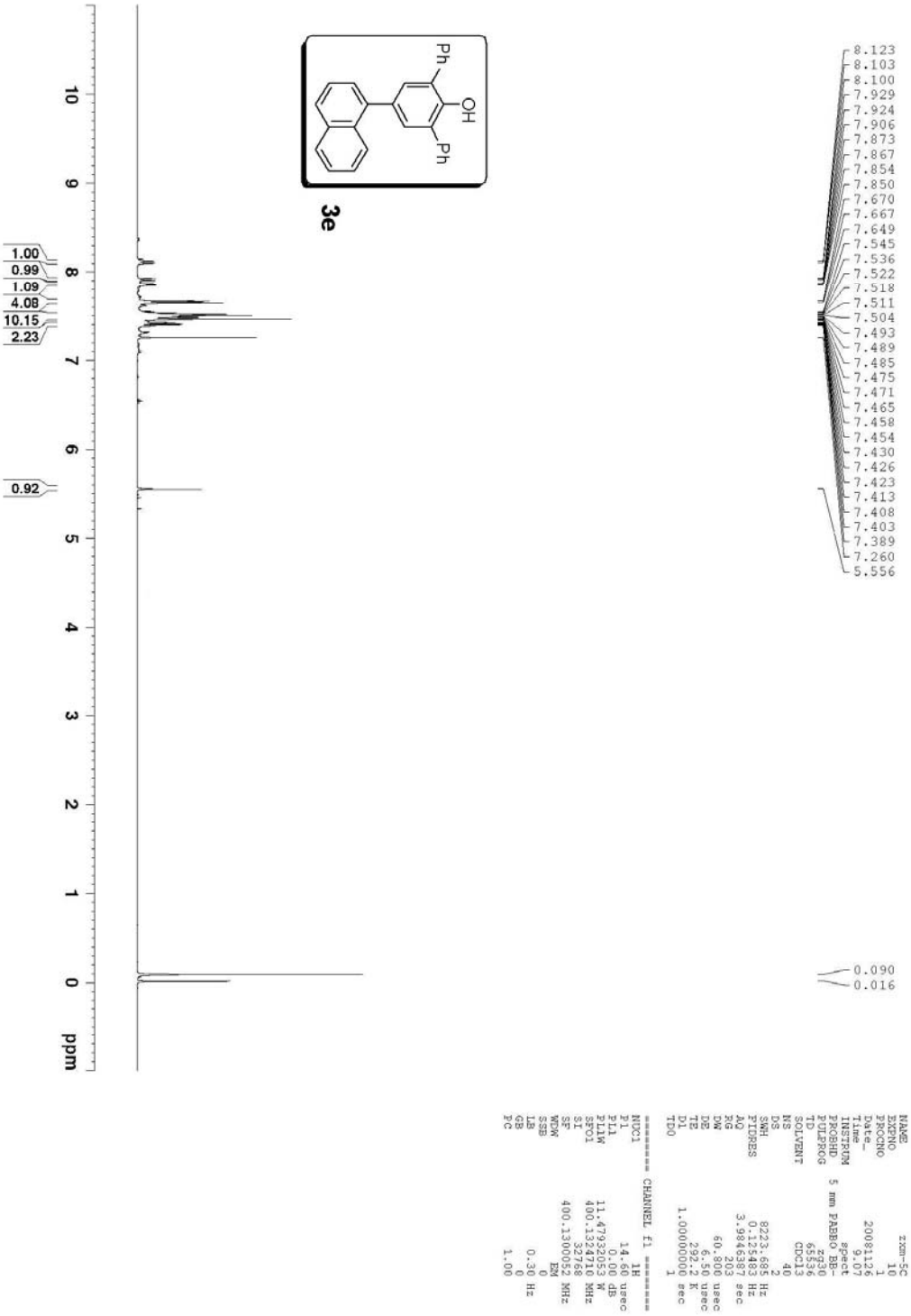

3d
Ph
OH
Ph
F
ppm
163.43
160.99
148.89
137.39
136.67
136.64
132.88
129.34
129.19
128.93
128.47
128.32
128.24
127.86
115.70
115.49
77.32
77.00
76.68
BRUKER

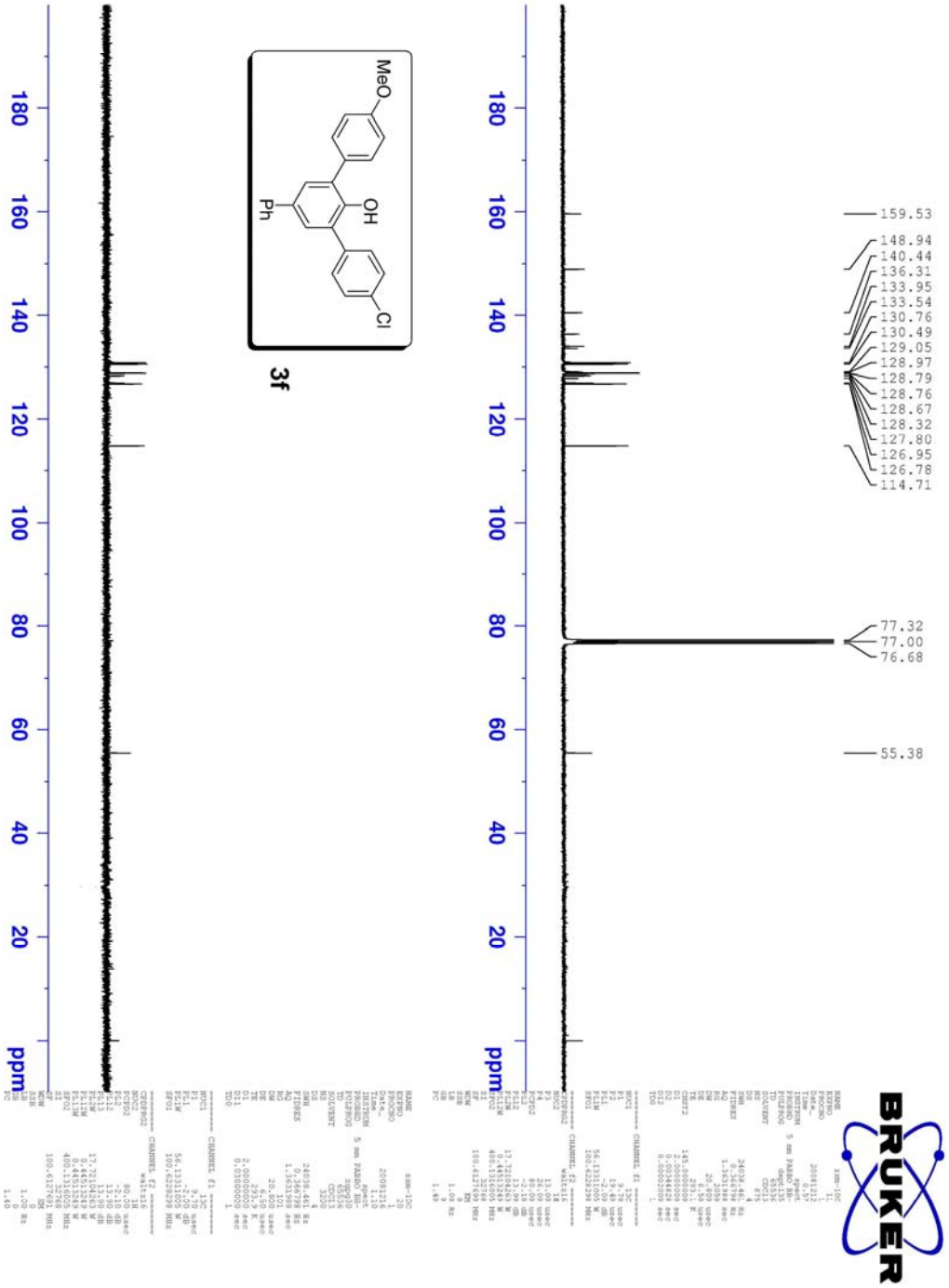


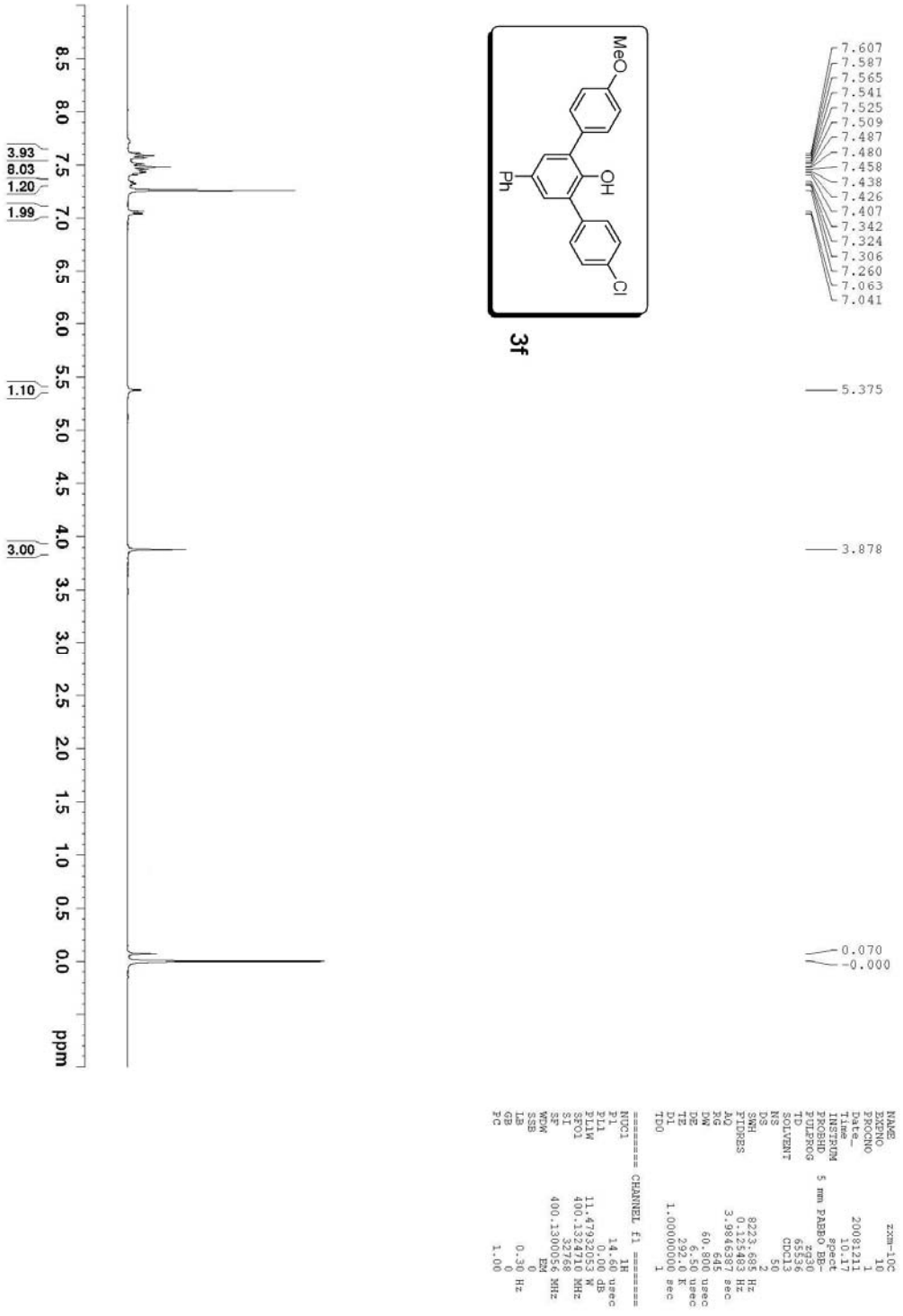
NAME zzm-4C
EXPNO 10
PROCNO 1
Date_ 20081118
Time 23.03
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 32
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 161
DW 60.800 usec
DE 6.50 usec
TE 293.3 K
D1 1.00000000 sec
TD0 1

======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300054 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

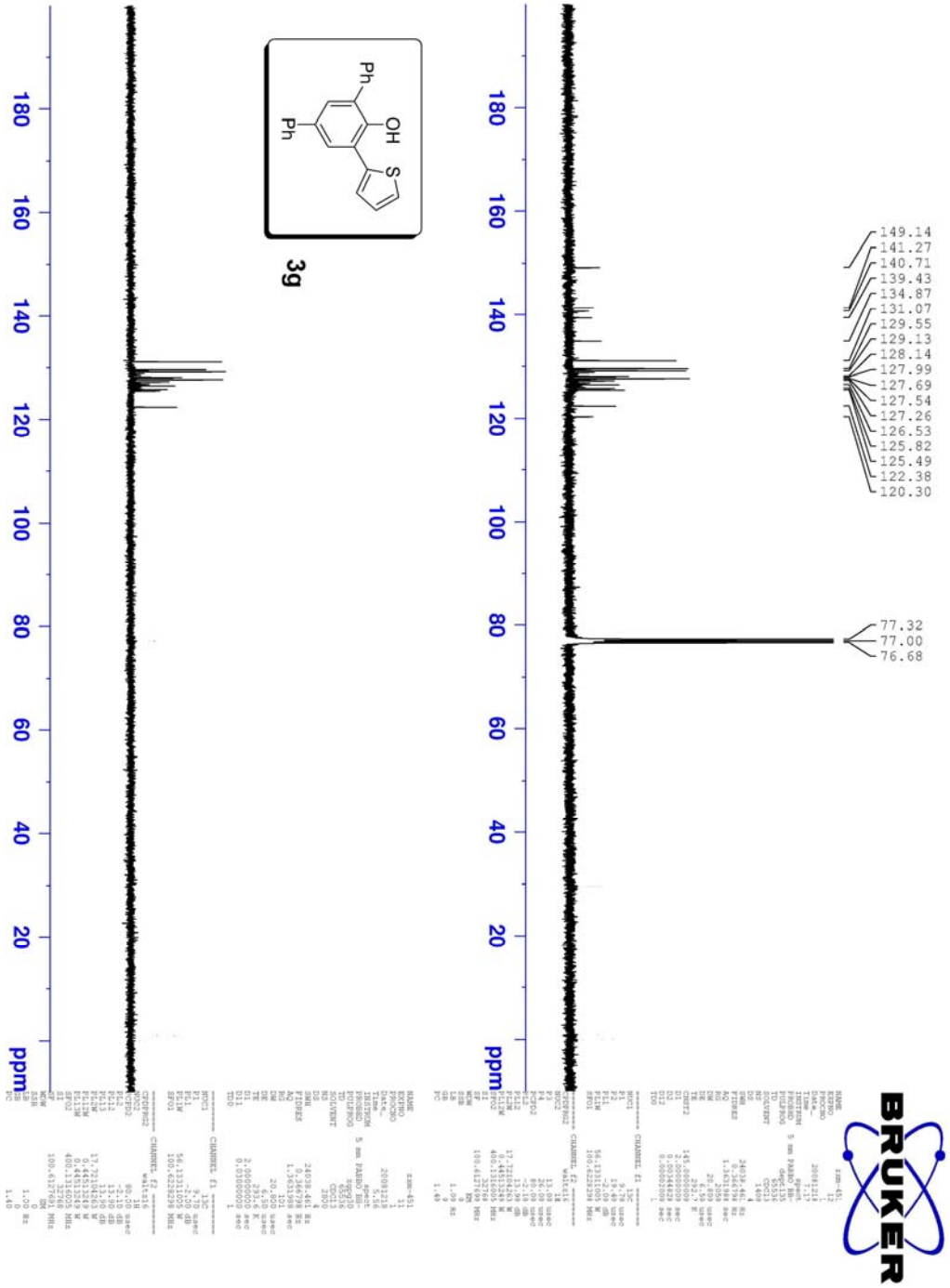

Ph
OH
Ph
3e
148.68
139.52
137.41
133.87
133.24
131.71
131.48
129.39
128.90
128.61
128.31
127.75
127.50
127.01
126.07
126.03
125.74
125.41
77.32
77.00
76.68
ppm
BRUKER

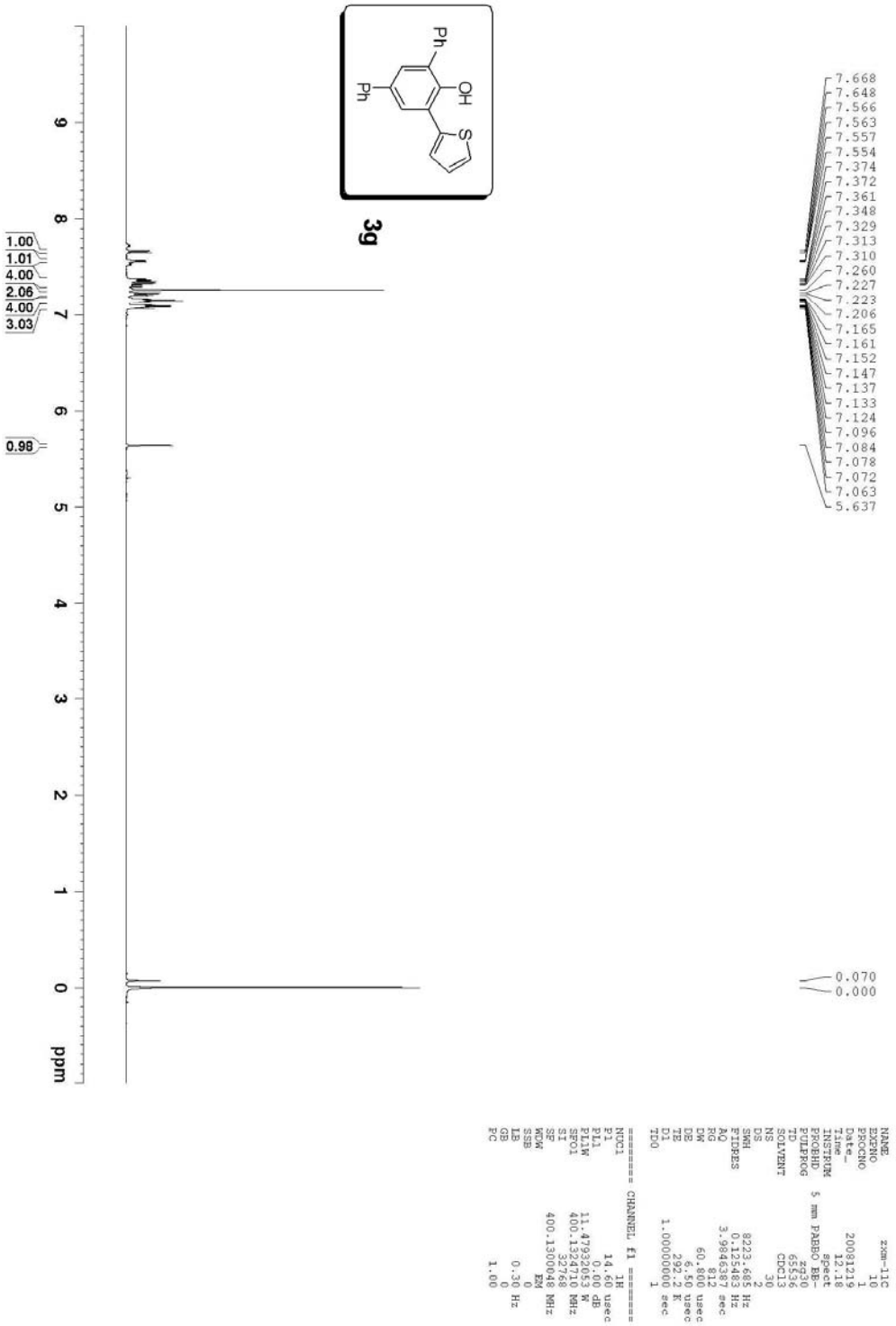

Ph
OH
Ph
3e
1.00
0.99
1.09
4.08
10.15
2.23
0.92
10
9
8
7
6
5
4
3
2
1
0
ppm
8.123
8.103
8.100
7.929
7.924
7.906
7.873
7.867
7.854
7.850
7.670
7.667
7.649
7.545
7.536
7.522
7.518
7.511
7.504
7.493
7.489
7.485
7.475
7.471
7.465
7.458
7.454
7.430
7.426
7.423
7.413
7.408
7.403
7.389
7.260
5.556
0.090
0.016
NAME zxm-5c
EXPNO 10
PROCNO 1
Date_ 20081126
Time 9.07
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 40
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9845203 sec
RG 60.800
DW 60.800 usec
DE 6.50 usec
TE 292.2 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47923851 W
SFO1 400.1332510 MHz
SI 32768
SF 400.1300052 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

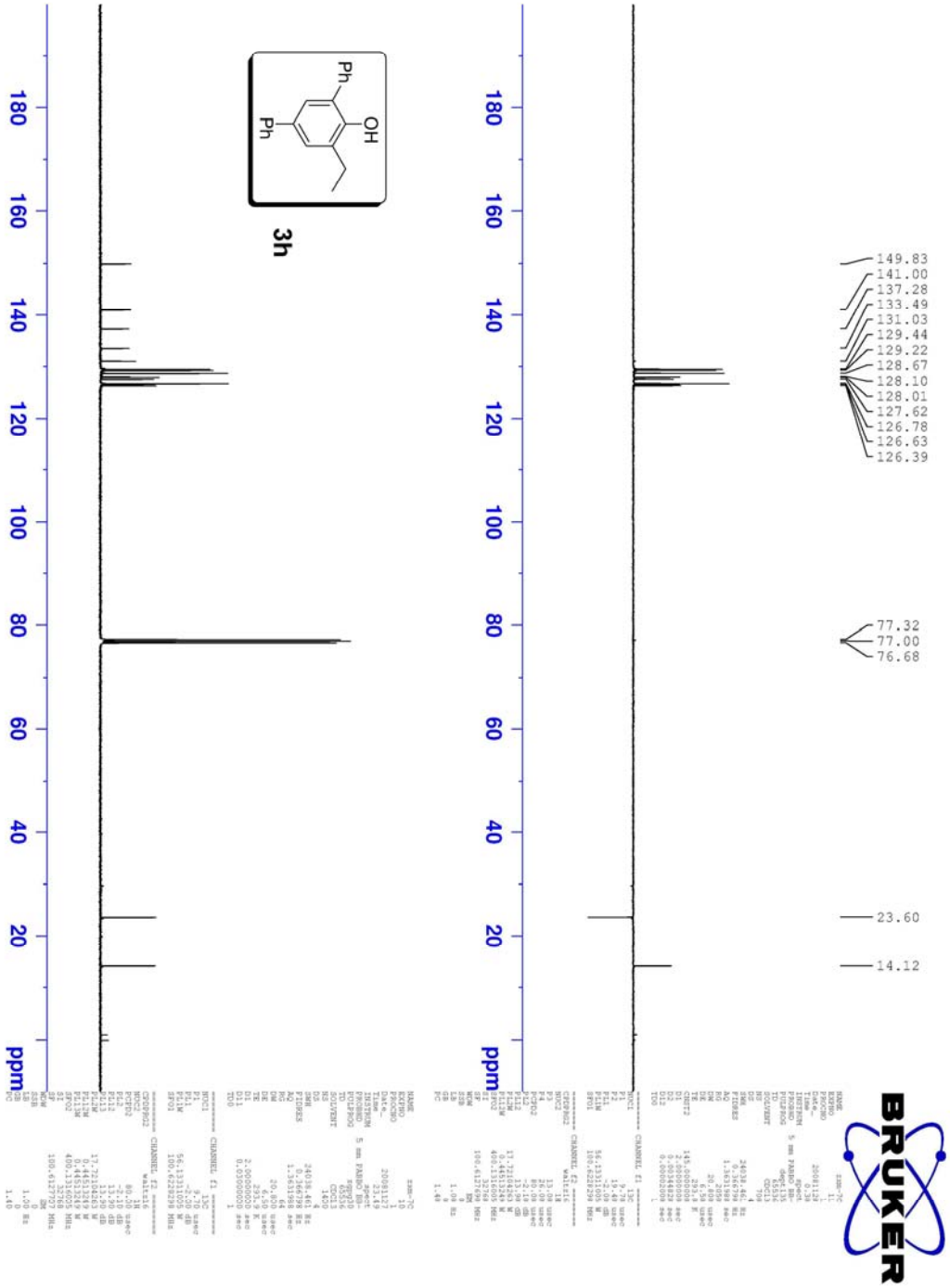

MeO
OH
Cl
Ph
3f
159.53
148.94
140.44
136.31
133.95
133.54
130.76
130.49
129.05
128.97
128.79
128.76
128.67
128.32
127.80
126.95
126.78
114.71
77.32
77.00
76.68
55.38
ppm
BRUKER

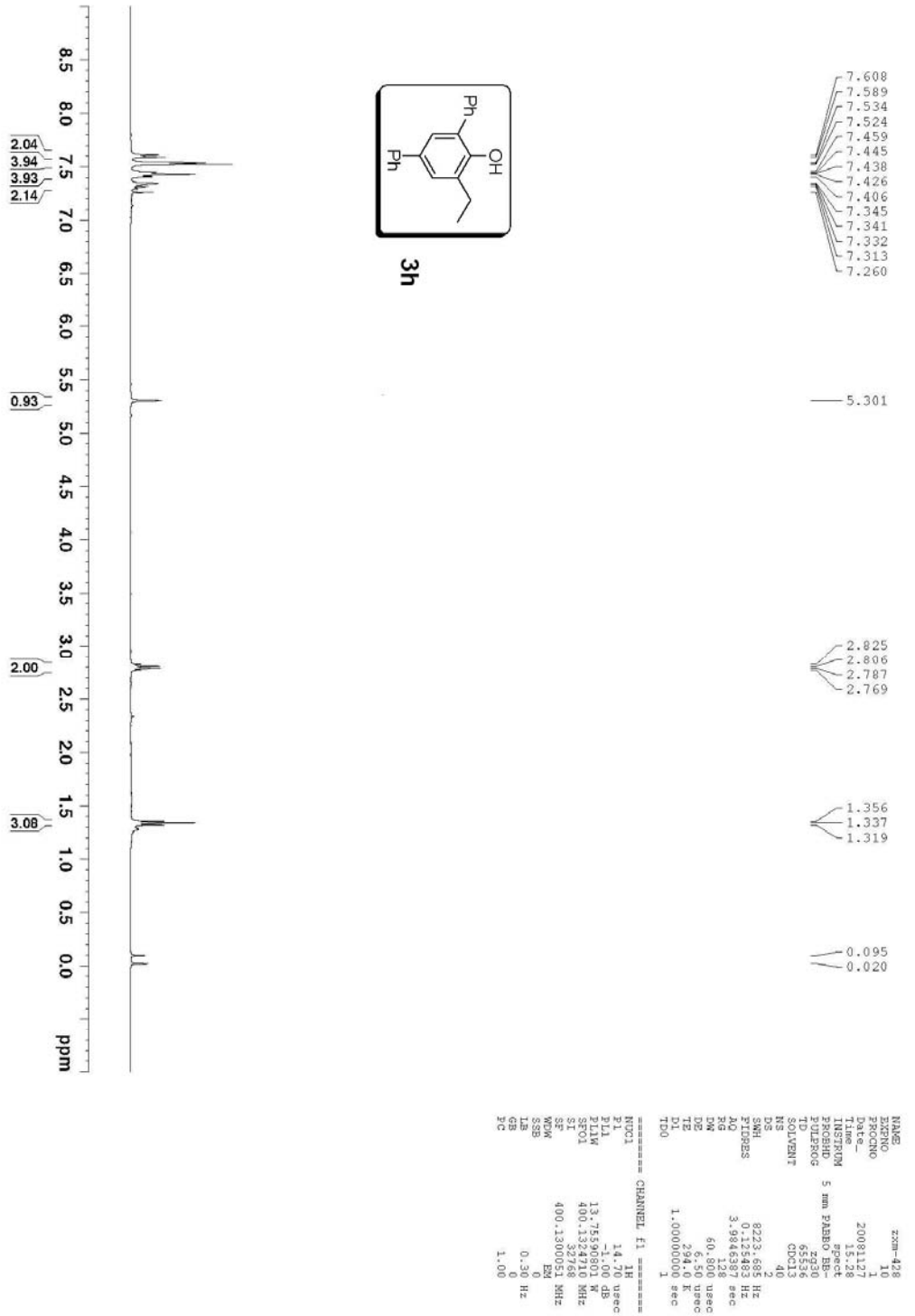


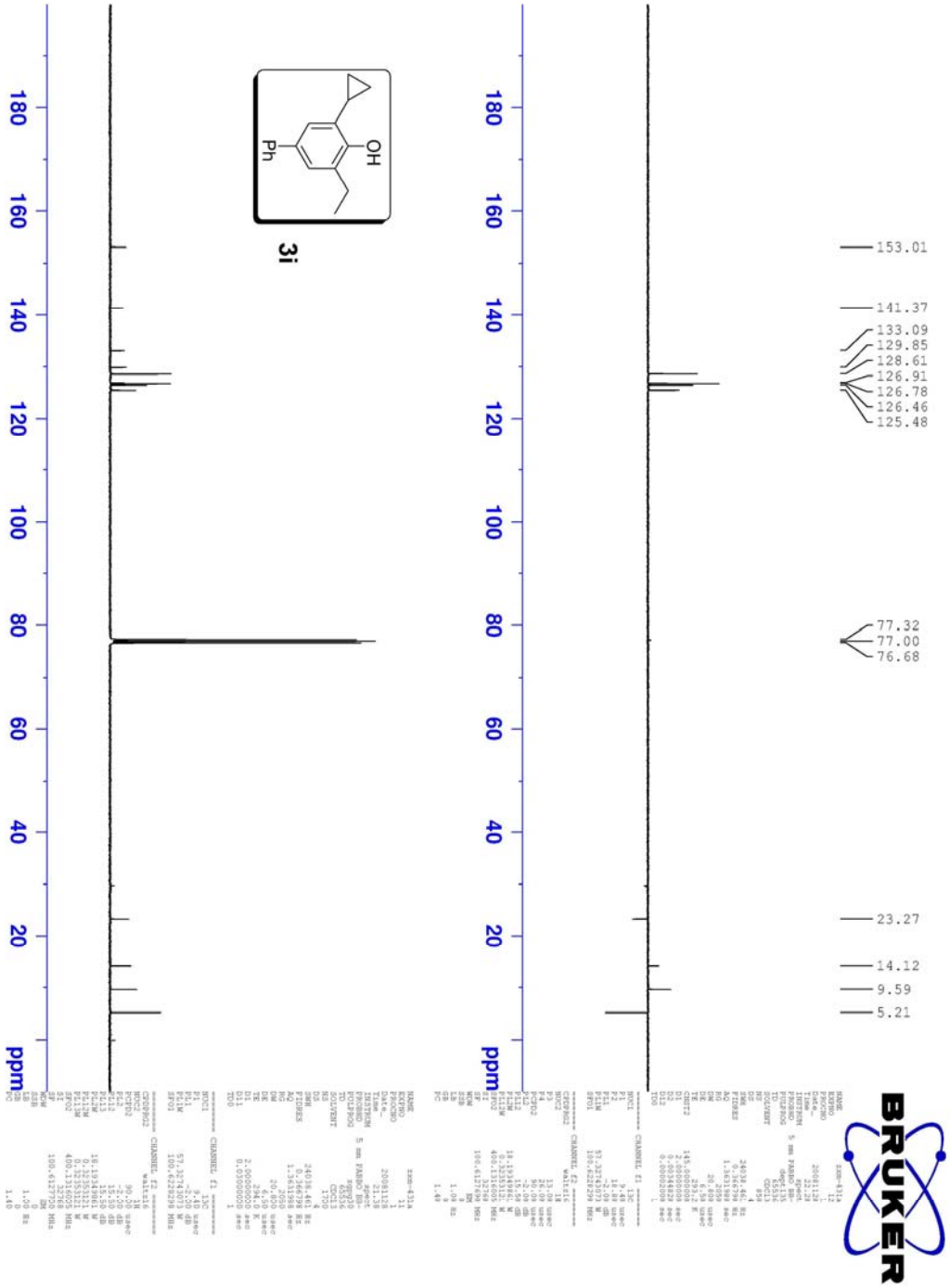
NAME zxm-10C
EXPNO 10
PROCNO 1
Date_ 20091211
Time 10.17
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 50
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 645
DW 60.800 usec
DE 6.50 usec
TE 295.0 K
D1 1.0000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300056 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

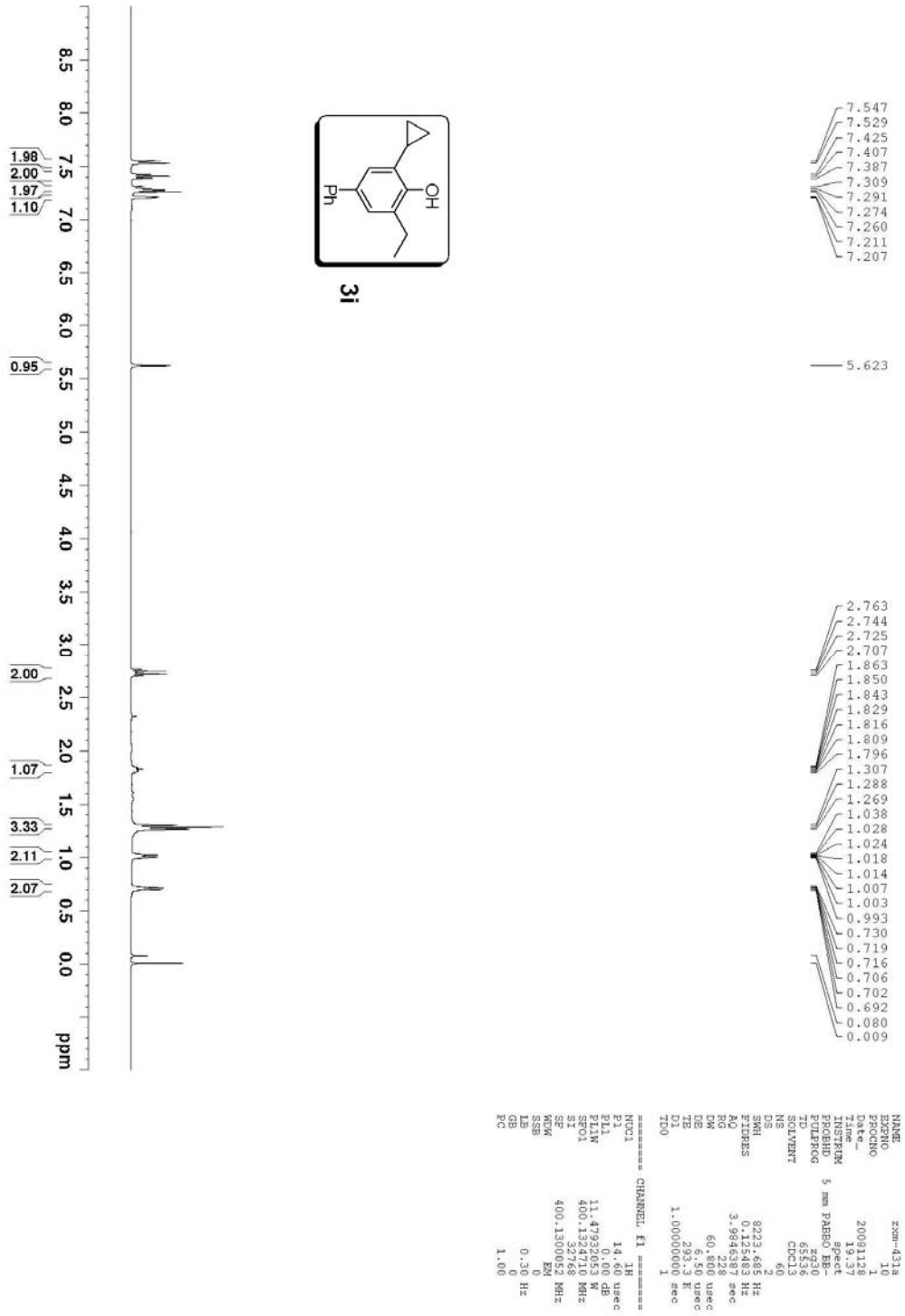

149.14
141.27
140.71
139.43
134.87
131.07
129.55
129.13
128.14
127.99
127.69
127.54
127.26
126.53
125.82
125.49
122.38
120.30
77.32
77.00
76.68
ppm
3g
Ph
OH
S
Ph
BRUKER

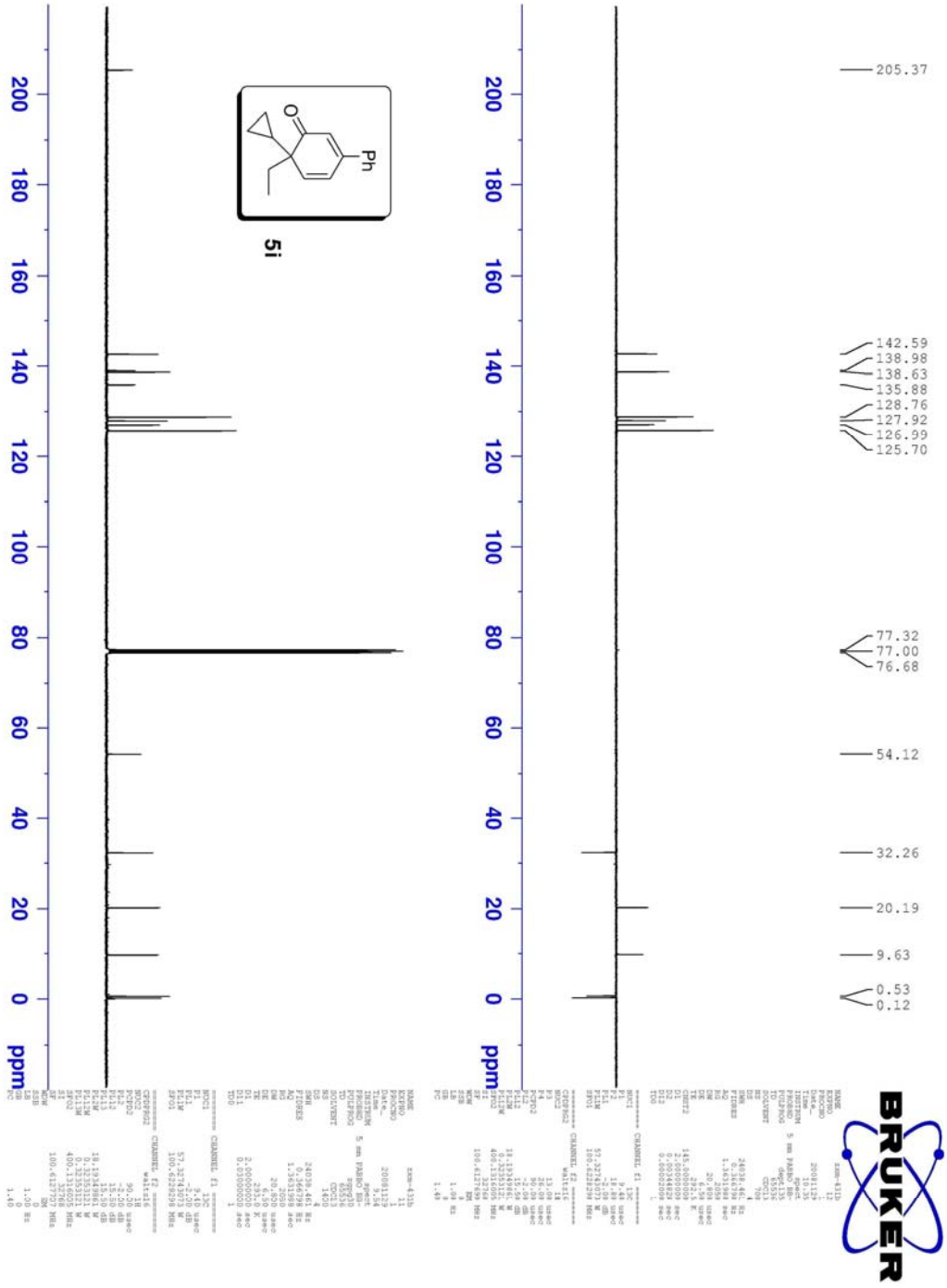

Ph
OH
Ph
S
3g
1.00
1.01
4.00
2.06
4.00
3.03
0.98
9
8
7
6
5
4
3
2
1
0
ppm
7.668
7.648
7.566
7.563
7.557
7.554
7.374
7.372
7.361
7.348
7.329
7.313
7.310
7.260
7.227
7.223
7.206
7.165
7.161
7.152
7.147
7.137
7.133
7.124
7.096
7.084
7.078
7.072
7.063
5.637
0.070
0.000
NAME zxm-11C
EXPNO 10
PROCNO 1
Date_ 20081219
Time 12.18
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 30
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 812
DW 60.800 usec
DE 6.50 usec
TE 292.2 K
D1 1.0000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300048 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

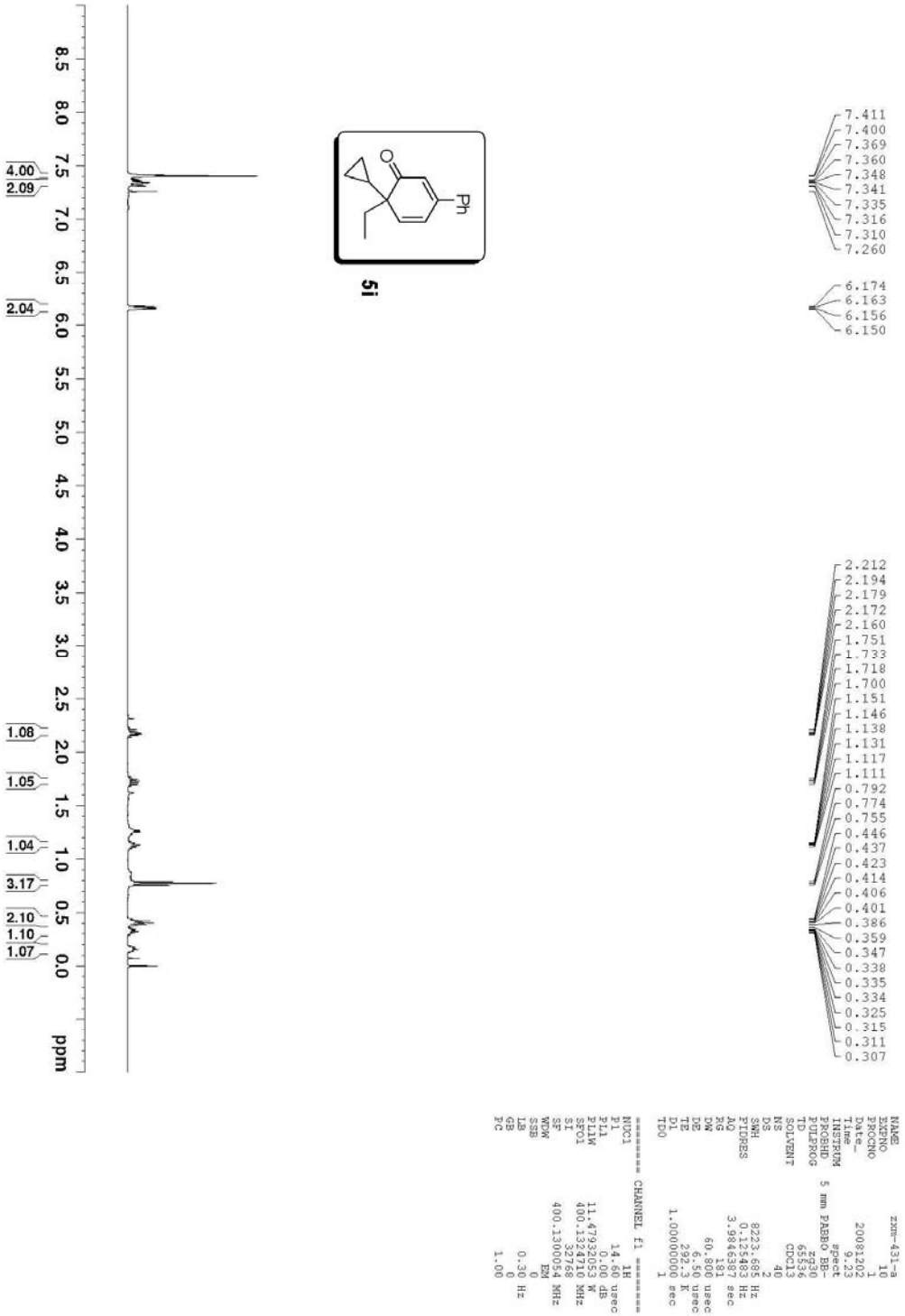

Ph
Ph
OH
3h
149.83
141.00
137.28
133.49
131.03
129.44
129.22
128.67
128.10
128.01
127.62
126.78
126.63
126.39
77.32
77.00
76.68
23.60
14.12
ppm
BRUKER

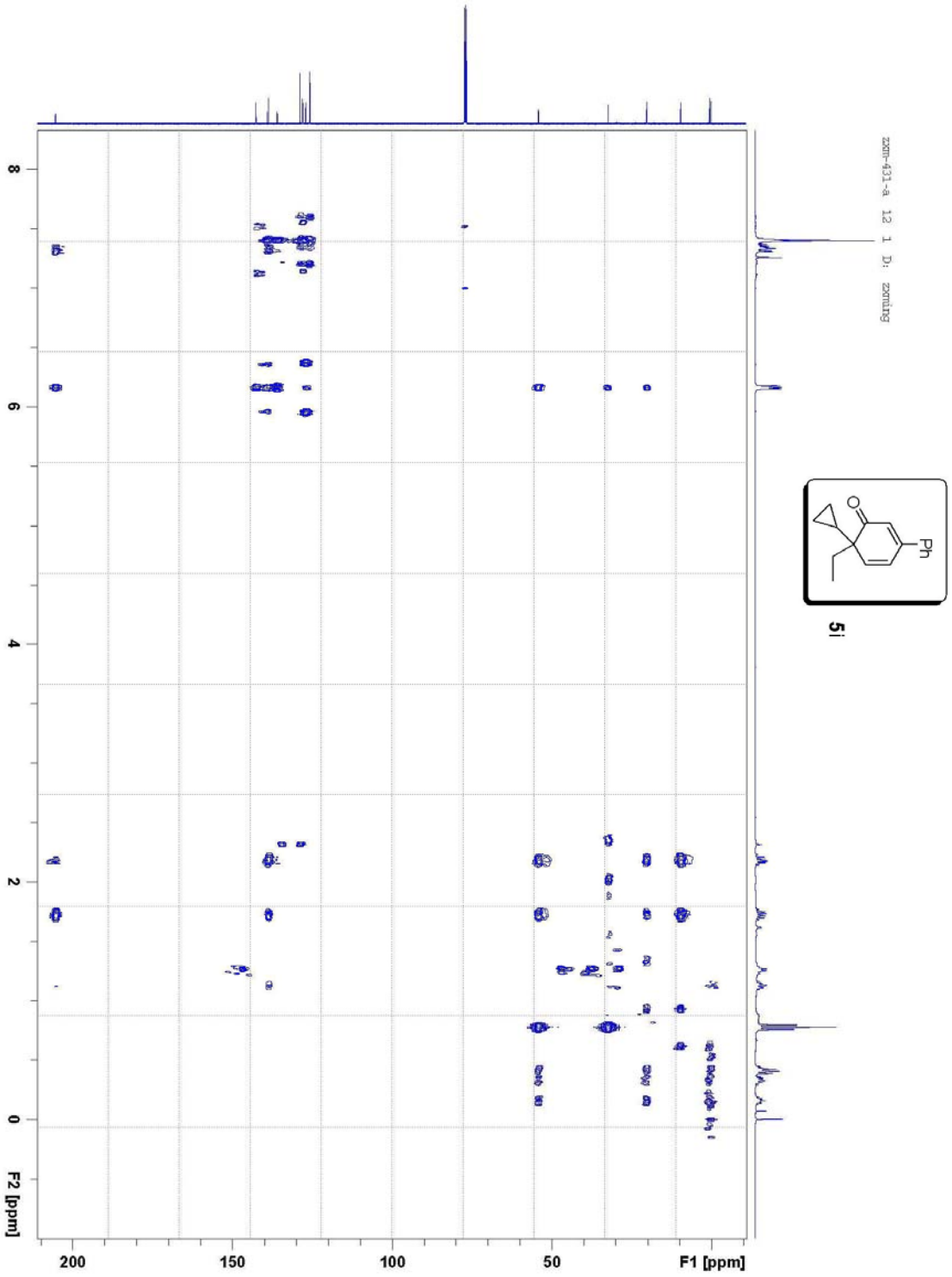

7.608
7.589
7.534
7.524
7.459
7.445
7.438
7.426
7.406
7.345
7.341
7.332
7.313
7.260
5.301
2.825
2.806
2.787
2.769
1.356
1.337
1.319
0.095
0.020
2.04
3.94
3.93
2.14
0.93
2.00
3.08
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
Ph
OH
Ph
3h
NAME zxm-428
EXPNO 10
PROCNO 1
Date_ 20081127
Time 15.28
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 40
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 128
DW 60.800 usec
DE 6.50 usec
TE 294.0 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.70 usec
PL1 -1.00 dB
PL1W 13.75590801 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300051 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

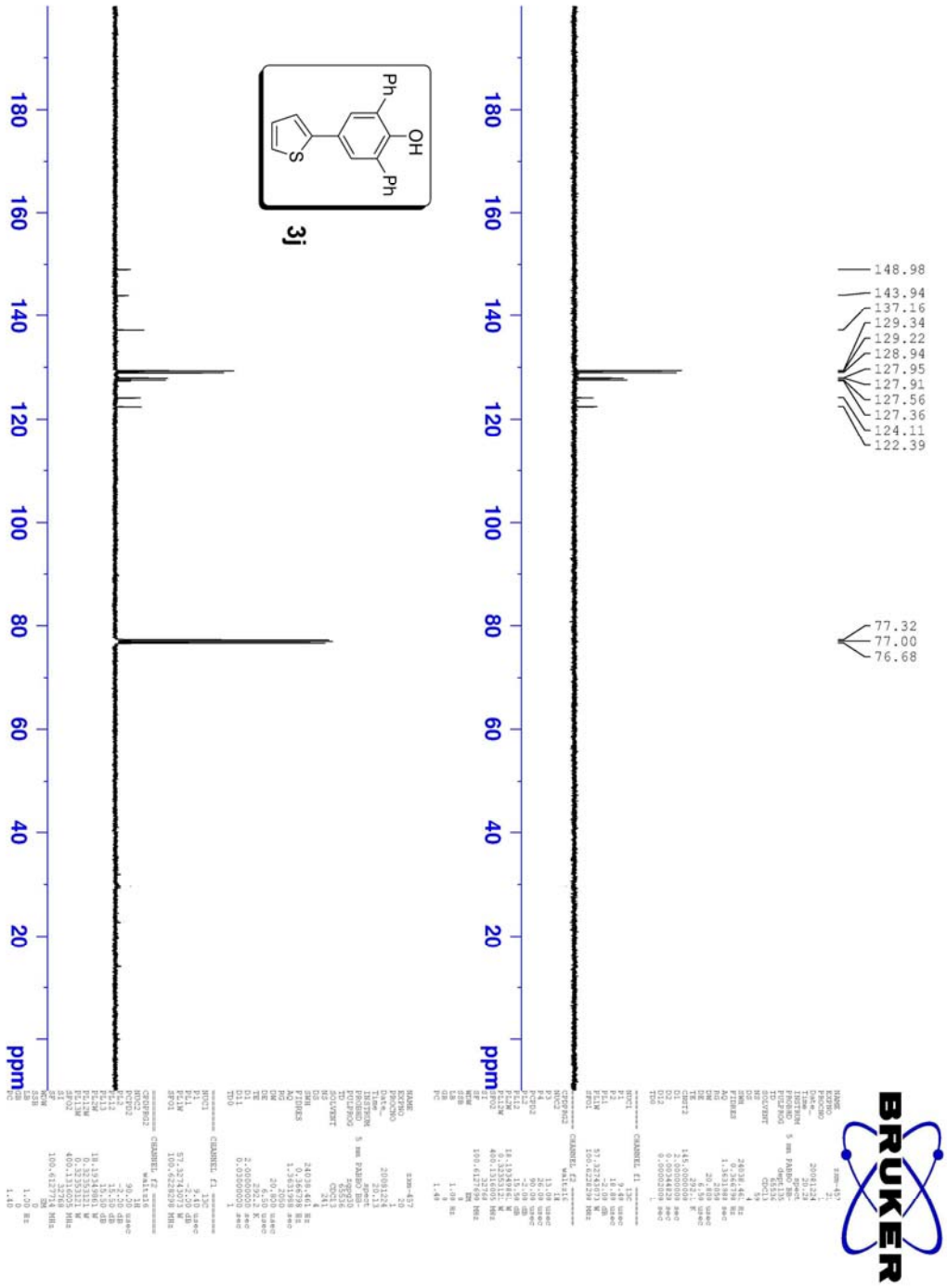

OH
Ph
3i
153.01
141.37
133.09
129.85
128.61
126.91
126.78
126.46
125.48
77.32
77.00
76.68
23.27
14.12
9.59
5.21
ppm
BRUKER

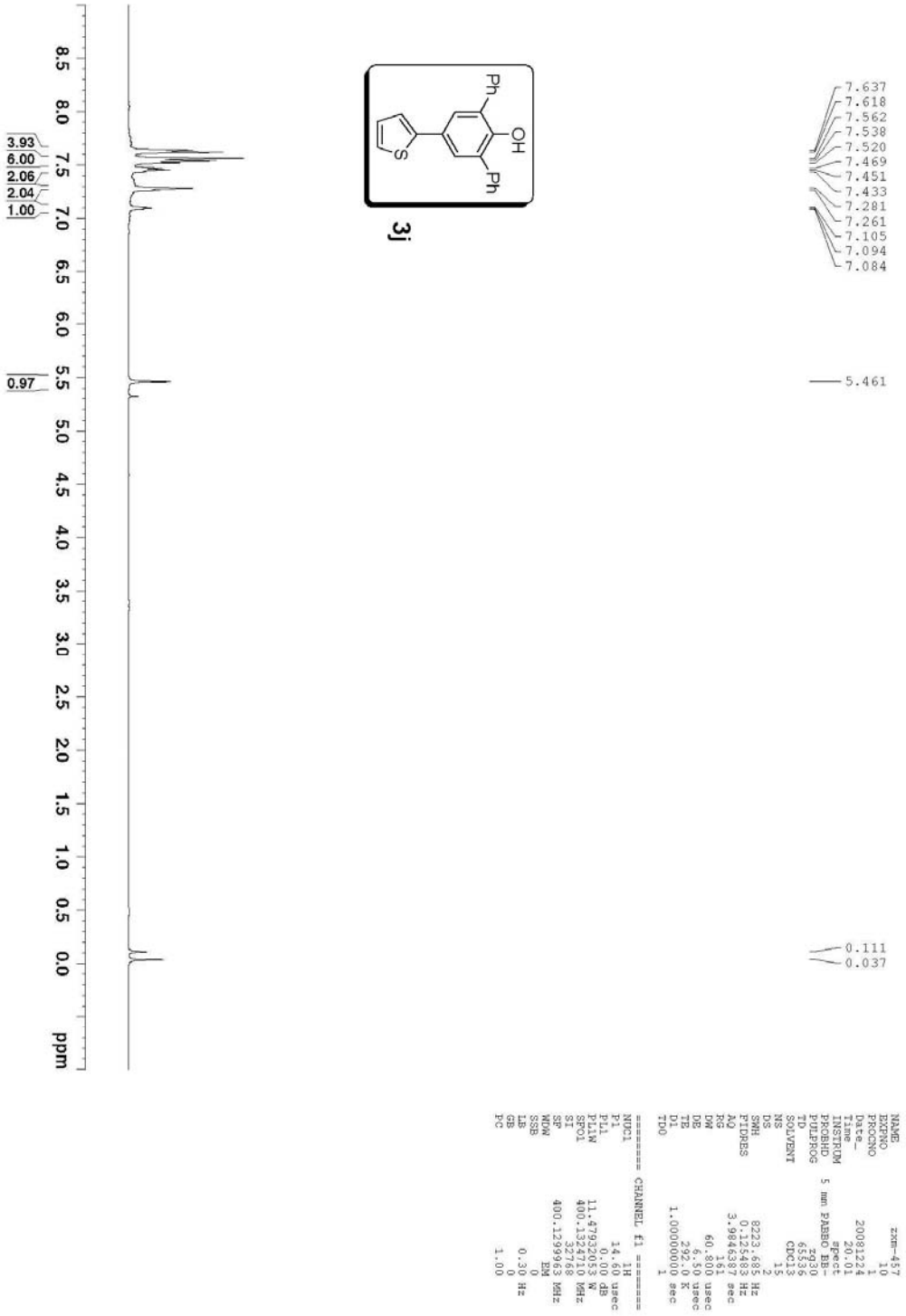

7.547
7.529
7.425
7.407
7.387
7.309
7.291
7.274
7.260
7.211
7.207
5.623
2.763
2.744
2.725
2.707
1.863
1.850
1.843
1.829
1.816
1.809
1.796
1.307
1.288
1.269
1.038
1.028
1.024
1.018
1.014
1.007
1.003
0.993
0.730
0.719
0.716
0.706
0.702
0.692
0.080
0.009
OH
Ph
3i
1.98
2.00
1.97
1.10
0.95
2.00
1.07
3.33
2.11
2.07
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
ppm
NAME zxm-431a
EXPNO 10
PROCNO 1
Date_ 20081128
Time 19.37
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 228
DW 60.800 usec
DE 6.50 usec
TE 293.3 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1300052 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00


Ph
O
5i
205.37
142.59
138.98
138.63
135.88
128.76
127.92
126.99
125.70
77.32
77.00
76.68
54.12
32.26
20.19
9.63
0.53
0.12
200
180
160
140
120
100
80
60
40
20
0
ppm
BRUKER


4.00
2.09
2.04
1.08
1.05
1.04
3.17
2.10
1.10
1.07
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
Ph
5i
7.411
7.400
7.369
7.360
7.348
7.341
7.335
7.316
7.310
7.260
6.174
6.163
6.156
6.150
2.212
2.194
2.179
2.172
2.160
1.751
1.733
1.718
1.700
1.151
1.146
1.138
1.131
1.117
1.111
0.792
0.774
0.755
0.446
0.437
0.423
0.414
0.406
0.401
0.386
0.359
0.347
0.338
0.335
0.334
0.325
0.315
0.311
0.307
NAME zxm-431-a
EXPNO 1
PROCNO 1
Date_ 20081202
Time 9.23
INSTRM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 40
DS 2
SWH 8223.685 Hz
FIDRES 0.125460 Hz
AQ 3.9845887 sec
RG 60.800
DW 60.800 usec
DE 6.50 usec
TE 292.3 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47929115 W
SFO1 400.1332760 MHz
SI 32768
SF 400.1300054 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00


zxm-431-a 12 1 D: zxmulq
Ph
5i
F2 [ppm]
F1 [ppm]
200
150
100
50
0
2
4
6
8


148.98
143.94
137.16
129.34
129.22
128.94
127.95
127.91
127.56
127.36
124.11
122.39
77.32
77.00
76.68
Ph
OH
Ph
S
3j
ppm
180
160
140
120
100
80
60
40
20
BRUKER


7.637
7.618
7.562
7.538
7.520
7.469
7.451
7.433
7.281
7.261
7.105
7.094
7.084
5.461
0.111
0.037
3.93
6.00
2.06
2.04
1.00
0.97
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
Ph
OH
Ph
S
3j
NAME zxm-457
EXPNO 10
PROCNO 1
Date_ 20081224
Time 20.01
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 161
DW 60.800 usec
DE 6.50 usec
TE 292.0 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 14.60 usec
PL1 0.00 dB
PL1W 11.47932053 W
SFO1 400.1324710 MHz
SI 32768
SF 400.1299963 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00