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Supporting Information

Rapid threefold cross-couplings with sterically bulky triarylbismuths under Pd-Cu dual catalysis

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Contents

1. General information

All reactions were carried out in Schlenk tubes under Nitrogen atmosphere conditions. Triarylbismuth reagents have been prepared by following the known procedures.[1] 2-Iodobenzaldehyde,[2] 2-bromo-1-naphthaldehyde[3] were prepared according to standard literature procedures. Solvents were dried according to standard procedures. JEOL-Lambda (500 MHz and 400 MHz) spectrometers were used for NMR measurements using $CDCl_3$ as solvent. Waters CAB155 GCT Premier analyzer was used for HRMS spectral measurments.

2. Representative coupling procedures

2.1. Representative procedure for Tables 2, 3, 4 and 5

An oven-dried Schlenk tube was purged and charged with 1-iodo-4-methylbenzene (0.875 mmol, 191 mg) followed by tri(*o*-anisyl)bismuth, **1a** (0.25 mmol, 133 mg), K_3PO_4 (1.5 mmol, 318 mg), CuI (0.05 mmol, 9.5 mg), PPh_3 (0.1 mmol, 26.2 mg), $Pd(OAc)_2$ (0.025 mmol, 5.6 mg) and DMF (3 mL) under N_2 atmosphere. The reaction mixture was stirred in an oil bath at 90 ^oC for 4 h. After completion of the reaction, contents were cooled, quenched with water (10 mL) and extracted with ethyl acetate (2 x 30 mL). The organic extract was further washed with water (10 mL), brine (10 mL) and dried over anhydrous $MgSO_4$. The crude product was purified by silica gel (100-200 mesh) column chromatography using 0.5% EtOAc/hexane eluent to afford 2-methoxy-4'-methylbiphenyl (**2.1**) as white solid (121 mg, 81%).

2.2. Representative procedure for Table 7

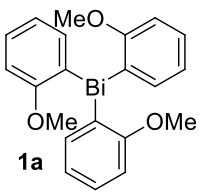
An oven-dried Schlenk tube was purged and charged with 1-bromo-2-methylbenzene (0.875 mmol, 150 mg) followed by tri(*o*-anisyl)bismuth, **1a** (0.25 mmol, 133 mg), K_3PO_4 (1.5 mmol, 318 mg), CuI (0.05 mmol, 9.5 mg), dppf (0.05 mmol, 27.7 mg), $Pd(OAc)_2$ (0.025 mmol, 5.6 mg) and DMF (3 mL) under N_2 atmosphere. The reaction mixture was stirred in an oil bath at 90 ^oC for 4 h. After the completion of the reaction, contents were cooled, quenched with water (10 mL) and extracted with ethyl acetate (2 x 30 mL). The organic extract was washed with water (10 mL), brine (10 mL) and dried over anhydrous $MgSO_4$. The crude product was purified by silica gel (100-200 mesh) column chromatography using 0.1% EtOAc/hexane eluent to afford 2-methoxy-2'-methylbiphenyl (**6.1**) as white solid (116 mg, 78%).

2.3. Representative procedure for Scheme 1

An oven-dried Schlenk tube was purged and charged with 2-bromo-1,3-dimethylbenzene (0.219 mmol, 40 mg) followed by tri(*o*-anisyl)bismuth, **1a** (0.0625 mmol, 33 mg), K_3PO_4 (0.375 mmol, 79.6 mg), CuI (0.0125 mmol, 2.37 mg), XPhos (0.025 mmol, 11.9 mg), $Pd(OAc)_2$ (0.00625 mmol, 1.4 mg) and DMF (1.5 mL) under N_2 atmosphere. The reaction mixture was stirred in an oil bath at 90 ^oC for 10 h. After completion of the reaction, contents were cooled, quenched with water (10 mL) and extracted with ethyl acetate (2 x 20 mL). The organic extract was washed with water (10 mL), brine (10 mL) and dried over anhydrous $MgSO_4$. The crude product was purified by silica gel (100-200 mesh) column chromatography using 0.5% EtOAc/hexane eluent to afford 2'-methoxy-2,6-dimethylbiphenyl (**7.1**) colourless liquid (26 mg, 64%).

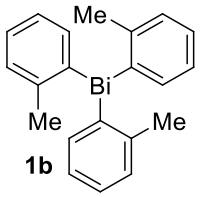
3. Supporting information for triarylbismuth reagents (1a-1f)

Tri(*o*-anisyl)bismuth (1a): White solid, m.p. 145-148 ^{o}C; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.46 (d, J = 6.9 Hz, 3H, Ar-H), 7.33 (t, J = 7.75 Hz, 3H, Ar-H), 7.01 (d, J = 8.0 Hz, 3H, Ar-H), 6.88 (t, J = 7.15 Hz, 3H, Ar-H), 3.76 (s, 9H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 162.15, 142.84, 139.07, 129.12, 124.0, 109.75, 55.51 ppm. IR (KBr, cm^{-1}): 3051, 2992, 2932, 2830, 1568, 1458, 1427, 1296, 1267, 1228, 1174, 1156, 1112, 1049, 1019. CHN data; (Theoretical C:47.56%, H:3.99%; Experimental C:47.4%, H:3.83%)



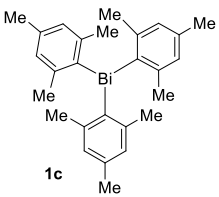
1a

Tri(*o*-tolyl)bismuth (1b): White solid, m.p. 131-132 ^{o}C; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.55 (d, J = 7.3 Hz, 3H, Ar-H), 7.35 (d, J = 7.65 Hz, 3H, Ar-H), 7.29-7.26 (m, 3H, Ar-H), 7.07 (t, J = 7.35 Hz, 3H), 2.44 (s, 9H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 154.25, 143.72, 138.65, 129.90, 128.67, 128.19, 26.37 ppm. IR (KBr, cm^{-1}): 3050, 2989, 2964, 1910, 1576, 1444, 1372, 1265, 1112. CHN data; (Theoretical C:52.29%, H:4.39%; Experimental C:51.62%, H:4.33%)



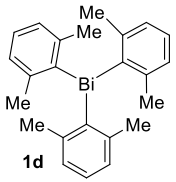
1b

Trimesitylbismuth (1c): White solid, m.p. 132-134 ^{o}C; ^{1}H NMR (500 MHz, $CDCl_3$): δ 6.95 (s, 6H, Ar-H), 2.29 (s, 18H, Me), 2.24 (s, 9H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 154.94, 145.87, 137.20, 129.00, 27.75, 20.90 ppm. IR (KBr, cm^{-1}): 3010, 2956, 2914, 2864, 2722, 1705, 1594, 1555, 1464, 1441, 1369, 1287, 1022, 1001. CHN data; (Theoretical C:57.24%, H:5.87%; Experimental C:57.35%, H:5.84%)

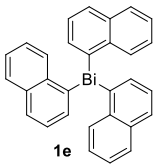


1c

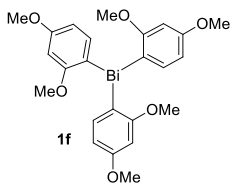
Tri(2,6-dimethylphenyl)bismuth (1d): Yellow crystalline solid, m.p. 118-120 ^{o}C; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.12-7.07 (m, 9H, Ar-H), 2.31 (s, 18H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 159.34, 145.88, 128.14, 127.77, 27.94 ppm. IR (KBr, cm^{-1}): 3046, 2962, 2929, 2861, 2730, 1569, 1451, 1373, 1234, 1162, 1108. CHN data; (Theoretical C:54.96%, H:5.19%; Experimental C:54.8%, H:5.14%)



Tri(naphthalen-1-yl)bismuth (1e): White solid, m.p. 215-218 ^{o}C; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.12 (d, J = 8.0 Hz, 3H, Ar-H), 7.94 (d, J = 9.15 Hz, 3H, Ar-H), 7.89 (d, J = 6.9 Hz, 6H, Ar-H), 7.52-7.46 (m, 6H, Ar-H), 7.28 (d, J = 8.05 Hz, 3H, Ar-H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 154.16, 138.63, 138.60, 134.66, 130.92, 129.14, 128.89, 128.48, 126.16, 125.76 ppm. IR (KBr, cm^{-1}): 3434, 3038, 1549, 1497, 1373, 1251, 1131, 1018, 945. CHN data; (Theoretical C:61.02%, H:3.58%; Experimental C:60.48%, H:3.45%).

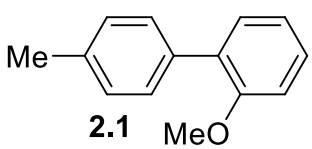


Tri(2,4-dimethoxyphenyl)bismuth (1f): White solid, m.p. 165-168 ^{o}C; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.29 (d, J = 7.95 Hz, 3H, Ar-H), 6.53 (d, J = 2.1 Hz, 3H, Ar-H), 6.40 (dd, J = 8.05 Hz, 2.27 Hz, 3H, Ar-H), 3.78 (s, 9H, OMe), 3.72 (s, 9H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 163.59, 161.29, 139.79, 133.26, 108.28, 98.25, 55.62, 55.32 ppm. IR (KBr, cm^{-1}): 3055, 2997, 2932, 2830, 1568, 1458, 1427, 1296, 1267, 1180, 1156. CHN data; (Theoretical C:46.46%, H:4.39%; Experimental C:46.35%, H:4.15%)



4. Supporting information for cross-coupling products:

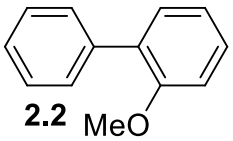
2-Methoxy-4'-methylbiphenyl (2.1):[4] White solid, m.p. 70-72 °C, (121 mg, 81%, with ArI); ^{1}H NMR (500 MHz, $CDCl_3$):



2.1

δ 7.44-7.40 (m, 2H, Ar-H), 7.33-7.30 (m, 2H, Ar-H), 7.23 (d, J = 7.95 Hz, 2H, Ar-H), 7.04-6.97 (m, 2H, Ar-H), 3.81 (s, 3H, OMe), 2.40 (s, 3H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.47, 136.57, 135.56, 130.76, 129.37, 128.71, 128.33, 127.94, 120.76, 111.14, 55.50, 21.18 ppm. IR (KBr, cm^{-1}): 3024, 2937, 2833, 1596, 1582, 1518, 1485, 1462, 1434, 1259, 1235, 1179, 1122, 1055, 1005. HRMS (EI^+): calcd. for $C_{14}H_{14}O$ $[M]^+$ 198.1045; found 198.1043.

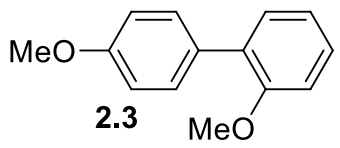
2-Methoxybiphenyl (2.2):[5] Colourless liquid, (115 mg, 83%, with ArI; 85 mg, 62%, with ArBr); ^{1}H NMR (500 MHz,



2.2

$CDCl_3$): δ 7.54 (d, J = 8.0 Hz, 2H, Ar-H), 7.43-7.40 (m, 2H, Ar-H), 7.34-7.32 (m, 3H, Ar-H), 7.04 (d, J = 7.45 Hz, 1H, Ar-H), 7.02-6.98 (m, 1H, Ar-H), 3.82 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.26, 138.63, 130.86, 130.81, 129.51, 128.58, 127.94, 126.89, 120.78, 111.17, 55.51 ppm. IR (neat, cm^{-1}): 3025, 2925, 2853, 1597, 1584, 1504, 1483, 1463, 1430, 1259, 1236, 1180. HRMS (EI^+): calcd. for $C_{13}H_{12}O$ $[M]^+$ 184.0888; found 184.0884.

2,4'-Dimethoxybiphenyl (2.3):[6] White solid, m.p. 64-67 °C, (126 mg, 78%, with ArI; 132 mg, 82%, with ArBr); ^{1}H NMR

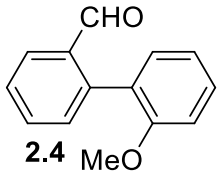


2.3

(500 MHz, $CDCl_3$): δ 7.47 (d, J = 8.85 Hz, 2H, Ar-H), 7.34-7.29 (m, 2H, Ar-H), 7.01-6.99 (m, 1H, Ar-H), 6.97-6.95 (m, 3H, Ar-H), 3.84 (s, 3H, OMe), 3.81 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 158.58, 156.41, 131.43, 130.85, 130.65, 130.57, 128.58, 120.30, 113.44, 111.04, 55.50,

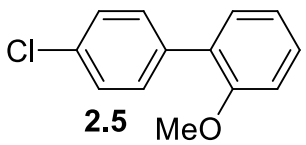
55.24 ppm. IR (KBr, cm^{-1}): 3000, 2957, 2835, 1610, 1517, 1463, 1486, 1463, 1438, 1298, 1245, 1178, 1122, 1038. HRMS (ES^+): calcd. for $C_{14}H_{15}O_2$ $[M+H]^+$ 215.1072; found 215.1074.

2'-Methoxybiphenyl-2-carbaldehyde (2.4):[7] Colourless liquid, (122 mg, 77%, with ArI; 132 mg, 83%, with ArBr); ^1H NMR (500 MHz, $CDCl_3$): δ 9.78 (s, 1H, CHO), 8.0 (d, J = 7.65 Hz, 1H, Ar-H), 7.66-7.62 (m, 1H, Ar-H), 7.49-7.46 (m, 1H, Ar-H), 7.44-7.40 (m, 1H, Ar-H), 7.36 (d, J = 7.6 Hz, 1H, Ar-H), 7.29-7.28 (m, 1H, Ar-H), 7.10-7.07 (m, 1H, Ar-H), 6.98 (d, J = 8.25 Hz, 1H, Ar-H), 3.74 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 192.64, 156.47, 141.79, 133.97, 133.66, 131.39, 131.16, 129.96, 127.71, 126.78, 126.57, 120.98, 110.59, 55.36 ppm. IR (neat, cm^{-1}): 3063, 2937, 2837, 2751, 1695, 1657, 1595, 1497, 1478, 1451. HRMS (ES^+): calcd. for $C_{14}H_{12}NaO_2$ $[M+Na]^+$ 235.0735; found 235.0739.



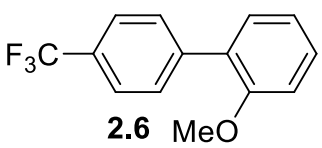
2.4

4'-Chloro-2-methoxybiphenyl (2.5):[8] White solid, m.p. 47-49 ^oC, (141 mg, 85%, with ArI); ^1H NMR (500 MHz, $CDCl_3$): δ 7.46 (d, J = 8.55 Hz, 2H, Ar-H), 7.37 (d, J = 8.25 Hz, 2H, Ar-H), 7.35-7.32 (m, 1H, Ar-H), 7.30-7.28 (m, 1H, Ar-H), 7.05-7.02 (m, 1H, Ar-H), 6.99 (d, J = 8.25 Hz, 1H, Ar-H), 3.81 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.34, 136.91, 132.84, 130.82, 130.64, 129.42, 128.95, 128.14, 120.89, 111.24, 55.52 ppm. IR (KBr, cm^{-1}): 2921, 1592, 1478, 1396, 1235, 1089, 1027, 1004, 828. HRMS (EI^+): calcd. for $C_{13}H_{11}ClO$ $[M]^+$ 218.0498; found 218.0497.



2.5

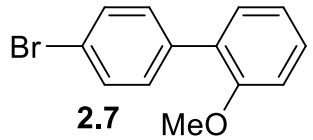
2-Methoxy-4'-(trifluoromethyl)biphenyl (2.6):[8] Colourless liquid, (165 mg, 87%, with ArI; 167 mg, 88%, with ArBr);



2.6

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.67-7.63 (m, 4H, Ar-H), 7.39-7.36 (m, 1H, Ar-H), 7.32 (d, J = 7.6 Hz, 1H, Ar-H), 7.07-7.04 (m, 1H, Ar-H), 7.02 (d, J = 8.2 Hz, 1H, Ar-H), 3.83 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.38, 142.20, 130.75, 129.81, 129.46, 129.18, 128.87 (d, $J_{C\text{-}F}$ = 32.38 Hz), 124.86 (d, $J_{C\text{-}F}$ = 3.6 Hz), 124.36 (d, $J_{C\text{-}F}$ = 269.96 Hz), 120.96, 111.27, 55.52 ppm. IR (neat, cm^{-1}): 2940, 2838, 1617, 1600, 1585, 1523, 1464, 1489, 1405, 1326, 1263, 1240, 1164, 1122, 1108, 1069. HRMS (EI$^+$): calcd. for $C_{14}H_{11}F_3O$ $[M]^+$ 252.0762; found 252.0767.

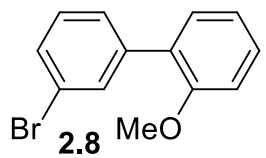
4'-Bromo-2-methoxybiphenyl (2.7): White solid, m.p. 58-59 ^{o}C, (168 mg, 85%, with ArI); ^{1}H NMR (500 MHz, $CDCl_3$): δ



2.7

7.52 (d, J = 8.6 Hz, 2H, Ar-H), 7.40 (d, J = 8.0 Hz, 2H, Ar-H), 7.35-7.32 (m, 1H, Ar-H), 7.28 (dd, J = 1.75 Hz, 7.45 Hz, 1H, Ar-H), 7.03 (d, J = 7.45 Hz, 1H, Ar-H), 7.01-6.97 (m, 1H, Ar-H), 3.81 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.08, 137.40, 131.18, 131.08, 130.57, 129.43, 128.99, 127.93, 120.91, 111.27, 55.53 ppm. IR (KBr, cm^{-1}): 2962, 2834, 1901, 1584, 111477, 1434, 1392, 1261, 1099, 1073, 1026. HRMS (EI$^+$): calcd. for $C_{13}H_{11}BrO$ $[M]^+$ 261.9993; found 261.9990.

3'-Bromo-2-methoxybiphenyl (2.8): Colourless liquid, (150 mg, 76%, with ArI); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.67 (s,

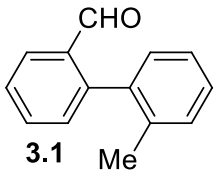


2.8

1H, Ar-H), 7.44 (d, J = 8.0 Hz, 2H, Ar-H), 7.35-7.32 (m, 1H, Ar-H), 7.29-7.26 (m, 2H, Ar-H), 7.02 (d, J = 7.45 Hz, 1H, Ar-H), 6.98 (d, J = 8.6 Hz, 1H, Ar-H), 3.81 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.34, 140.61, 132.46, 130.72, 129.84, 129.44, 129.19, 129.14, 128.18, 122.0, 120.87,

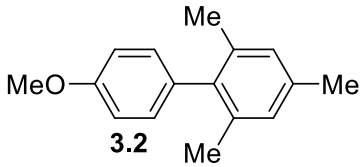
111.23, 55.55 ppm. IR (neat, cm^{-1}): 2962, 2834, 1581, 1555, 1497, 1464, 1406, 1129, 1261, 1234, 1122, 1092, 1074, 1055. HRMS (EI^+): calcd. for $C_{13}H_{11}BrO$ $[M]^+$ 261.9993; found 261.9995.

2'-Methylbiphenyl-2-carbaldehyde (3.1):[9] Colourless liquid, (136 mg, 92%, with ArI; 125 mg, 85%, with ArBr); ^1H NMR (500 MHz, $CDCl_3$): δ 9.75 (s, 1H, CHO), 8.03 (d, J = 7.4 Hz, 1H, Ar-H), 7.65-7.62 (m, 1H, Ar-H), 7.51-7.48 (m, 1H, Ar-H), 7.34-7.27 (m, 4H, Ar-H), 7.19 (d, J = 7.45 Hz, 1H, Ar-H), 2.10 (s, 3H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 192.29, 145.67, 137.48, 136.16, 133.83, 133.70, 130.75, 130.18, 130.08, 128.27, 127.81, 127.07, 125.67, 20.30 ppm. IR (neat, cm^{-1}): 2962, 2841, 2746, 1694, 1595, 1473, 1447, 1390, 1260, 1194, 1095. HRMS (EI^+): calcd. for $C_{14}H_{12}O$ $[M]^+$ 196.0888; found 196.0881.



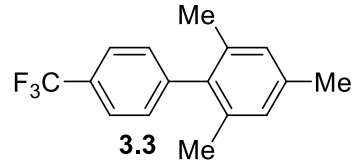
3.1

4'-Methoxy-2,4,6-trimethylbiphenyl (3.2):[10] White solid, m.p. 65-67 ^oC, (125 mg, 73%, with ArI; 116 mg, 67%, with ArBr); ^1H NMR (500 MHz, $CDCl_3$): δ 7.08 (d, J = 8.85 Hz, 2H, Ar-H), 6.98-6.96 (m, 4H, Ar-H), 3.87 (s, 3H, OMe), 2.35 (s, 3H, Me), 2.03 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 158.14, 138.64, 136.39, 133.24, 130.28, 127.98, 113.72, 55.16, 20.99, 20.78 ppm. IR (KBr, cm^{-1}): 3004, 2953, 2834, 1889, 1644, 1609, 1512, 1480, 1455, 1441, 1376, 1286, 1245, 1182, 1174, 1042. HRMS (EI^+): calcd. for $C_{16}H_{18}O$ $[M]^+$ 226.1358; found 226.1355.

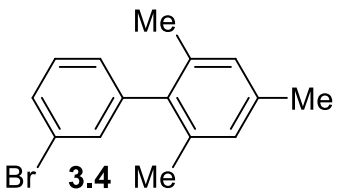


3.2

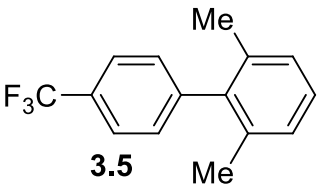
2,4,6-Trimethyl-4'-(trifluoromethyl)biphenyl (3.3):[11] White solid, m.p. 55-57 °C, (141 mg, 71%, with ArI; 128 mg, 65%, with ArBr); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.68 (d, J = 7.9 Hz, 2H, Ar-H), 7.27 (d, J = 7.95 Hz, 2H, Ar-H), 6.96 (s, 2H, Ar-H), 2.34 (s, 3H, Me), 1.99 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 145.01, 137.59, 137.22, 135.60, 129.76, 128.87 (d, $J_{C\text{-}F}$ = 32.38 Hz), 128.22, 125.38 (d, $J_{C\text{-}F}$ = 3.6 Hz), 21.01, 20.64 ppm. IR (KBr, cm^{-1}): 2949, 2923, 2860, 1927, 1684, 1616, 1572, 1479, 1448, 1402, 1323, 1160, 1104, 1067, 1006. HRMS (EI$^+$): calcd. for $C_{16}H_{15}F_3$ $[M]^+$ 264.1126; found 264.1122.



3'-Bromo-2,4,6-trimethylbiphenyl (3.4): Colourless liquid, (157 mg, 76%, with ArI); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.47-7.46 (m, 1H, Ar-H), 7.31-7.27 (m, 2H, Ar-H), 7.08 (d, J = 7.45 Hz, 1H, Ar-H), 6.93 (s, 2H, Ar-H), 2.32 (s, 3H, Me), 2.00 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 143.28, 139.73, 137.03, 135.76, 132.26, 130.81, 129.95, 129.65, 128.13, 128.06, 21.00, 20.66 ppm. IR (neat, cm^{-1}): 2962, 2919, 1612, 1591, 1557, 1465, 1399, 1465, 1261, 1074, 1017. HRMS (EI$^+$): calcd. for $C_{15}H_{15}Br$ $[M]^+$ 274.0357; found 274.0354.

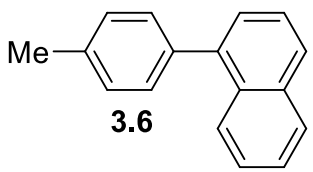


2,6-Dimethyl-4'-(trifluoromethyl)biphenyl (3.5): Colourless liquid, (158 mg, 84%, with ArI); 150 mg, 80%, with ArBr); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.70 (d, J = 8.0 Hz, 2H, Ar-H), 7.28 (d, J = 8.0 Hz, 2H, Ar-H), 7.21-7.18 (m, 1H, Ar-H), 7.13 (d, J = 7.45 Hz, 2H, Ar-H), 2.01 (s, 6H, Me) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 144.94, 140.39, 135.70, 129.49, 128.96 (d, $J_{C\text{-}F}$ = 33.53 Hz), 127.58, 127.45, 125.92, 125.44 (d, $J_{C\text{-}F}$ = 3.83 Hz), 124.30 (d, $J_{C\text{-}F}$ = 248.13 Hz), 20.76 ppm. IR (neat, cm^{-1}): 3049, 2946,



1931, 1615, 1464, 1443, 1403, 1323, 1265, 1164, 1133, 1068, 1025, 1006. HRMS (EI^+): calcd. for $C_{15}H_{13}F_3$ $[M]^+$ 250.0969; found 250.0968.

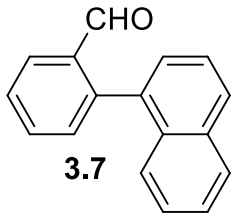
1-(4-Methylphenyl)naphthalene (3.6):[12] White solid, m.p. 50-53 ^oC, (140 mg, 85%, with ArI; 150 mg, 92%, with ArBr);



3.6

^1H NMR (500 MHz, $CDCl_3$): δ 7.94-7.90 (m, 2H, Ar-H), 7.85 (d, J = 8.55 Hz, 1H, Ar-H), 7.54-7.48 (m, 2H, Ar-H), 7.44-7.40 (m, 4H, Ar-H), 7.31 (d, J = 7.9 Hz, 2H, Ar-H), 2.47 (s, 3H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 140.21, 137.78, 136.89, 133.78, 131.69, 129.92, 128.94, 128.21, 127.41, 126.85, 126.07, 125.89, 125.68, 125.37, 21.23 ppm. IR (KBr, cm^{-1}): 3045, 2920, 2864, 1907, 1812, 1591, 1514, 1504, 1394, 1306, 1160, 1109. HRMS (EI^+): calcd. for $C_{17}H_{14}$ $[M]^+$ 218.1096; found 218.1097.

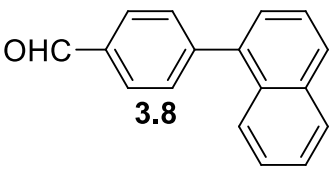
2-(Naphthalen-1-yl)benzaldehyde (3.7):[13] White solid, m.p. 86-87 ^oC, (170 mg, 98%, with ArI; 157 mg, 90%, with ArBr);



3.7

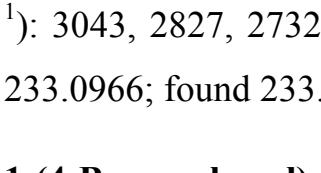
^1H NMR (500 MHz, $CDCl_3$): δ 9.63 (s, 1H, CHO), 8.12 (d, J = 6.85 Hz, 1H, Ar-H), 7.95-7.93 (m, 2H, Ar-H), 7.70 (d, J = 7.45 Hz, 1H, Ar-H), 7.60-7.41 (m, 7H, Ar-H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 192.08, 144.26, 135.43, 134.83, 133.64, 133.40, 132.72, 131.71, 128.65, 128.36, 128.18, 127.09, 126.77, 126.19, 125.78, 125.03 ppm. IR (KBr, cm^{-1}): 3058, 2963, 2843, 2749, 1940, 1819, 1693, 1595, 1506, 1480, 1447, 1390, 1261, 1159, 1090, 1018. HRMS (ES^+): calcd. for $C_{17}H_{13}O$ $[M+H]^+$ 233.0966; found 233.0964.

4-(Naphthalen-1-yl)benzaldehyde (3.8):[14] White solid, m.p. 70-72 °C, (167 mg, 96%, with ArI; 160 mg, 92%, with ArBr); ^{1}H NMR (500 MHz, $CDCl_3$): δ 10.12 (s, 1H, CHO), 8.02 (d, J = 8.25 Hz, 2H, Ar-H), 7.92 (t, J = 9.15 Hz, 2H, Ar-H), 7.83 (d, J = 8.55 Hz, 1H, Ar-H), 7.68 (d, J = 7.9 Hz, 2H, Ar-H), 7.57-7.51 (m, 2H, Ar-H), 7.48-7.43 (m, 2H, Ar-H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 192.01, 147.24, 138.79, 135.30, 133.77, 131.08, 130.76, 129.73, 128.53, 128.45, 126.99, 126.48, 126.05, 125.44, 125.32 ppm. IR (KBr, cm^{-1}): 3043, 2827, 2732, 1707, 1605, 1565, 1501, 1395, 1332, 1303, 1168, 1017. HRMS (ES^+): calcd. for $C_{17}H_{13}O$ $[M+H]^+$ 233.0966; found 233.0966.



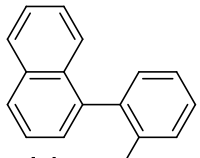
3.8

1-(4-Bromophenyl)naphthalene (3.9):[15] White solid, m.p. 71-72 °C, (180 mg, 85%, with ArI); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.91-7.82 (m, 3H, Ar-H), 7.62 (d, J = 8.6 Hz, 1H, Ar-H), 7.55-7.48 (m, 3H, Ar-H), 7.45-7.41 (m, 1H, Ar-H), 7.39-7.36 (m, 3H, Ar-H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 139.65, 138.92, 133.78, 132.01, 131.69, 131.42, 128.50, 128.35, 128.0, 126.25, 125.90, 125.63, 125.33, 121.47 ppm. IR (KBr, cm^{-1}): 3045, 2963, 1903, 1592, 1507, 1485, 1394, 1261, 1099, 1071, 1011, 198. HRMS (ES^+): calcd. for $C_{16}H_{11}Br$ $[M]^+$ 282.0044; found 282.0042.



3.9

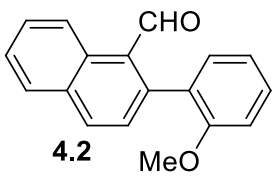
1-(2-Methoxyphenyl)naphthalene (4.1):[16] White solid, m.p. 85-87 °C, (131 mg, 75%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.90-7.86 (m, 2H, Ar-H), 7.59-7.38 (m, 6H, Ar-H), 7.30 (d, J = 7.35 Hz, 1H, Ar-H), 7.10-7.04 (m, 2H, Ar-H), 3.69 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 157.20, 136.93, 133.43, 132.11, 131.91, 129.51, 128.95, 128.09, 127.62, 127.25, 126.40, 125.61, 125.52, 125.32, 120.52, 110.96, 55.52 ppm. IR (KBr, cm^{-1}):



4.1

3056, 2934, 2833, 1600, 1492, 1462, 1433, 1394, 1249, 1236, 1272, 1104, 1047, 962. HRMS (ES^+): calcd. for $C_{17}H_{15}O$ $[M+H]^+$ 235.1123; found 235.1124.

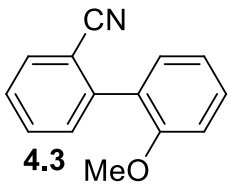
2-(2-Methoxyphenyl)-1-naphthaldehyde (4.2): White solid, m.p. 93-94 ^oC, (178 mg, 90%); ^1H NMR (500 MHz, $CDCl_3$):



4.2

δ 9.86 (s, 1H, Ar-H), 8.06 (d, J = 8.55 Hz, 1H, Ar-H), 7.91 (t, J = 8.25 Hz, 2H, Ar-H), 7.60-7.57 (m, 2H, Ar-H), 7.52-7.49 (m, 1H, Ar-H), 7.44-7.41 (m, 1H, Ar-H), 7.25-7.24 (m, 1H, Ar-H), 7.13-7.10 (m, 1H, Ar-H), 7.08 (d, J = 7.65 Hz, 1H, Ar-H), 3.67 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 193.06, 157.57, 143.21, 136.27, 132.56, 132.49, 131.25, 130.15, 128.58, 128.24, 128.21, 127.34, 126.65, 123.70, 121.99, 120.46, 110.84, 55.53 ppm. IR (KBr, cm^{-1}): 3059, 2936, 2838, 2838, 1688, 1677, 1596, 1579, 1491, 1461, 1433, 1247, 1231, 1161, 1125, 1103, 1048, 1025. HRMS (ES^+): calcd. for $C_{18}H_{15}O_2$ $[M+H]^+$ 263.1072; found 263.1077.

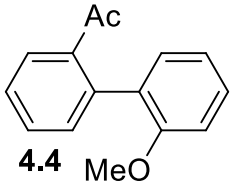
2'-Methoxybiphenyl-2-carbonitrile (4.3):[17] Colourless liquid, (116 mg, 74%); ^1H NMR (500 MHz, $CDCl_3$): δ 7.73 (d, J



4.3

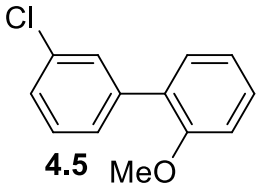
= 7.95 Hz, 1H, Ar-H), 7.64-7.61 (m, 1H, Ar-H), 7.46-7.40 (m, 3H, Ar-H), 7.26-7.25 (m, 1H, Ar-H), 7.07-7.02 (m, 2H, Ar-H), 3.84 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.40, 142.53, 132.75, 132.36, 130.85, 130.32, 127.30, 127.24, 120.75, 118.61, 113.39, 111.27, 55.43 ppm. IR (neat, cm^{-1}): 3065, 2937, 2836, 2226, 1602, 1499, 1462, 1478, 1432, 1280, 1236, 1254, 1125. HRMS (ES^+): calcd. for $C_{14}H_{12}NO$ $[M+H]^+$ 210.0919; found 210.0913.

1-(2'-Methoxybiphenyl-2-yl)ethanone (4.4): White solid, m.p. 80-82 ^{o}C, (105 mg, 62%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.62-7.61 (m, 1H, Ar-H), 7.51 (dt, J = 1.5 Hz, 7.6 Hz, 1H, Ar-H), 7.41-7.33 (m, 3H, Ar-H), 7.27-7.26 (m, 1H, Ar-H), 7.07-7.04 (m, 1H, Ar-H), 6.92 (d, J = 8.25 Hz, 1H, Ar-H), 3.72 (s, 3H, OMe), 2.16 (s, 3H, Ac) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 202.56, 155.76, 140.71, 136.73, 131.21, 130.89, 130.58, 129.89, 129.38, 127.32, 127.27, 121.10, 110.56, 55.04, 28.83 ppm. IR (KBr, cm^{-1}): 3060, 3000, 2982, 2838, 1730, 1694, 1594, 1563, 1496, 1481, 1461, 1246, 1256, 1039. HRMS (ES^{+}): calcd. for $C_{15}H_{15}O_2$ $[M+H]^{+}$ 227.1072; found 227.1078.



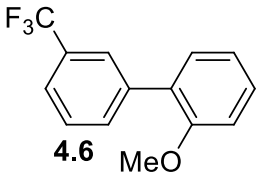
4.4

3'-Chloro-2-methoxybiphenyl (4.5):[18] Colourless liquid, (138 mg, 84%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.54-7.53 (m, 1H, Ar-H), 7.42-7.40 (m, 1H, Ar-H), 7.36-7.29 (m, 4H, Ar-H), 7.05-7.02 (m, 1H, Ar-H), 6.99 (d, J = 8.55 Hz, 1H, Ar-H), 3.82 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.32, 140.29, 133.72, 130.70, 129.60, 129.15, 127.70, 126.93, 120.86, 111.20, 55.52 ppm. IR (neat, cm^{-1}): 3064, 3002, 2937, 2834, 1687, 1600, 1582, 1560, 1407, 1498, 1466, 1253, 1235, 1028. HRMS (ES^{+}): calcd. for $C_{13}H_{11}ClO$ $[M]^{+}$ 218.0498; found 218.0493.



4.5

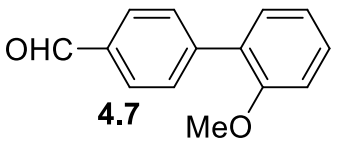
2-Methoxy-3'-(trifluoromethyl)biphenyl (4.6): Colourless liquid, (180 mg, 95%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.79 (s, 1H, Ar-H), 7.72 (d, J = 7.65 Hz, 1H, Ar-H), 7.58 (d, J = 7.95 Hz, 1H, Ar-H), 7.53-7.50 (m, 1H, Ar-H), 7.38-7.35 (m, 1H, Ar-H), 7.33-7.31 (m, 1H, Ar-H), 7.07-7.04 (m, 1H, Ar-H), 7.01 (d, J = 8.25 Hz, 1H, Ar-H), 3.83 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.33, 139.20, 132.84, 130.74, 130.31 (d, $J_{C\text{-}F}$ = 31.18 Hz), 129.36, 129.10, 128.32, 126.32 (d, $J_{C\text{-}F}$ = 3.6 Hz), 124.28 (d, $J_{C\text{-}F}$ = 269.96 Hz), 123.57 (d, $J_{C\text{-}F}$ = 3.6



4.6

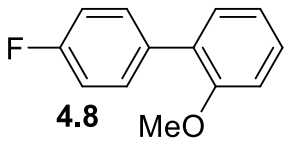
Hz), 120.96, 111.24, 55.52 ppm. IR (neat, cm^{-1}): 2961, 2838, 1600, 1579, 1502, 1466, 1426, 1334, 1255, 1234, 1164, 1122. HRMS (ES^+): calcd. for $C_{14}H_{11}F_3O$ $[M]^+$ 252.0762; found 252.0768.

2'-Methoxybiphenyl-4-carbaldehyde (4.7):[19] White solid, m.p. 54-56 ^oC, (139 mg, 87%); ^1H NMR (500 MHz, $CDCl_3$): δ 10.05 (s, 1H, CHO), 7.92 (d, J = 8.55 Hz, 2H, Ar-H), 7.71 (d, J = 8.25 Hz, 2H, Ar-H), 7.39-7.35 (m, 1H, Ar-H), 7.34 (d, J = 1.85 Hz, 1H, Ar-H), 7.07-7.04 (m, 1H, Ar-H), 7.02 (d, J = 8.2 Hz, 1H, Ar-H), 3.83 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 192.06, 156.45, 145.04, 134.85, 130.74, 130.17, 129.69, 129.42, 129.26, 120.99, 111.37, 55.55 ppm. IR (KBr, cm^{-1}): 2940, 2835, 2734, 1701, 1604, 1563, 1511, 1485, 1462, 1411, 1262, 1212, 1237, 1025. HRMS (ES^+): calcd. for $C_{14}H_{13}O_2$ $[M+H]^+$ 213.0916; found 213.0913.



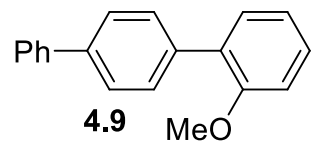
4.7

4'-Fluoro-2-methoxybiphenyl (4.8):[18] Colourless liquid, (101 mg, 67%); ^1H NMR (500 MHz, $CDCl_3$): δ 7.51-7.48 (m, 2H, Ar-H), 7.34-7.31 (m, 1H, Ar-H), 7.30-7.28 (m, 1H, Ar-H), 7.11-7.08 (m, 2H, Ar-H), 7.04-7.01 (m, 1H, Ar-H), 6.99 (d, J = 8.25 Hz, 1H, Ar-H), 3.82 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 161.95 (d, $J_{C\text{-}F}$ = 243.56 Hz), 156.33, 134.39, 131.07 (d, $J_{C\text{-}F}$ = 8.4 Hz), 130.73, 129.62, 128.69, 120.83, 114.83 (d, $J_{C\text{-}F}$ = 20.38 Hz), 111.19, 55.50 ppm. IR (neat, cm^{-1}): 2935, 2835, 1577, 11597, 1486, 1462, 1514, 1259, 1235. HRMS (EI^+): calcd. for $C_{13}H_{11}FO$ $[M]^+$ 202.0794; found 202.0794.



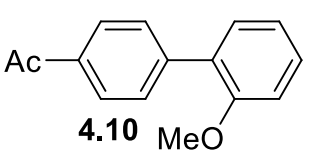
4.8

2-Methoxy-4'-phenylbiphenyl (4.9):[20] White solid, m.p. 112-114 °C, (171 mg, 88%); ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.66-7.61 (m, 6H, Ar-H), 7.46 (t, J = 7.8 Hz, 2H, Ar-H), 7.40-7.32 (m, 3H, Ar-H), 7.06 (td, J = 7.56 Hz, 0.92 Hz, 1H, Ar-H), 7.02 (d, J = 8.28 Hz, 1H, Ar-H), 3.85 (s, 3H, OMe) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 156.51, 141.02, 139.73, 137.51, 130.80, 130.20, 129.89, 128.72, 128.67, 127.16, 127.11, 126.77, 120.87, 111.21, 55.56 ppm. IR (KBr, cm^{-1}): 3024, 2956, 2832, 1597, 1480, 1462, 1238, 1024, 758. HRMS (EI$^+$): calcd. for $C_{19}H_{16}O$ $[M]^+$ 260.1201; found 260.1206.



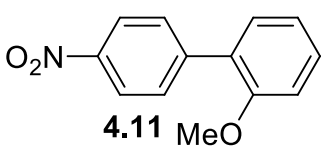
4.9

1-(2'-Methoxybiphenyl-4-yl)ethanone (4.10):[21] White solid, m.p. 100-102 °C, (136 mg, 80%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.0 (d, J = 8.55 Hz, 2H, Ar-H), 7.63 (d, J = 8.55 Hz, 2H, Ar-H), 7.38-7.32 (m, 2H, Ar-H), 7.07-7.04 (m, 1H, Ar-H), 7.01 (d, J = 8.25 Hz, 1H, Ar-H), 3.82 (s, 3H, OMe), 2.63 (s, 3H, Ac) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 197.89, 156.42, 143.56, 135.46, 130.69, 129.70, 129.46, 129.40, 128.05, 120.93, 111.29, 55.53, 26.63 ppm. IR (KBr, cm^{-1}): 3064, 2955, 2833, 1673, 1602, 1555, 1486, 1457, 1427, 1361, 1271, 1186, 1165, 1003. HRMS (ES$^+$): calcd. for $C_{15}H_{15}O_2$ $[M+H]^+$ 227.1072; found 227.1072.



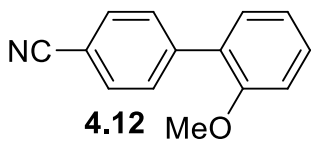
4.10

2-Methoxy-4'-nitrobiphenyl (4.11):[22] White solid, m.p. 45-47 °C, (170 mg, 99%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.25 (d, J = 9.15 Hz, 2H, Ar-H), 7.69 (d, J = 8.85 Hz, 2H, Ar-H), 7.41-7.38 (m, 1H, Ar-H), 7.33-7.32 (m, 1H, Ar-H), 7.08-7.05 (m, 1H, Ar-H), 7.02 (d, J = 8.25 Hz, 1H, Ar-H), 3.83 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.38, 146.61, 145.42, 130.63, 130.31, 130.14, 128.24, 123.18, 121.05, 111.40, 55.40 ppm. IR (KBr, cm^{-1}): 2940, 2838, 1600, 1514, 1481, 1462, 1437, 1402, 1346, 1315, 1263, 1240, 1102. HRMS (ES$^+$): calcd. for $C_{13}H_{12}NO_3$ $[M+H]^+$ 230.0817; found 230.0819.



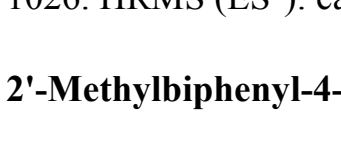
4.11

2'-Methoxybiphenyl-4-carbonitrile (4.12):[23] White solid, m.p. 73-74 °C, (152 mg, 97%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.68 (d, J = 8.55 Hz, 2H, Ar-H), 7.64 (d, J = 8.5 Hz, 2H, Ar-H), 7.40-7.37 (m, 1H, Ar-H), 7.31-7.29 (m, 1H, Ar-H), 7.07-7.04 (m, 1H, Ar-H), 7.01 (d, J = 7.9 Hz, 1H, Ar-H), 3.82 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.29, 143.36, 131.72, 130.58, 130.19, 129.89, 128.60, 121.02, 119.13, 111.32, 110.39, 55.50 ppm. IR (KBr, cm^{-1}): 3070, 3003, 2941, 2226, 1606, 1582, 1510, 1485, 1463, 1436, 1263, 1245, 1026. HRMS (ES$^+$): calcd. for $C_{14}H_{12}NO$ $[M+H]^+$ 210.0919; found 210.0913.



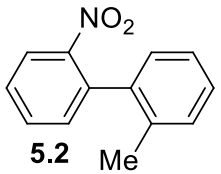
4.12

2'-Methylbiphenyl-4-carbaldehyde (5.1):[24] White solid, m.p. 47-49 °C, (110 mg, 75%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 10.07 (s, 1H, CHO), 7.94 (d, J = 8.25 Hz, 2H, Ar-H), 7.50 (d, J = 8.25 Hz, 2H, Ar-H), 7.31-7.29 (m, 2H, Ar-H), 7.27-7.26 (m, 1H, Ar-H), 7.23-7.22 (m, 1H, Ar-H), 2.28 (s, 3H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 192.0, 148.42, 140.57, 135.11, 134.94, 130.57, 129.91, 129.59, 129.45, 128.06, 125.97, 20.36 ppm. IR (KBr, cm^{-1}): 2950, 2918, 2848, 2562, 1701, 1673, 1607, 1561, 1481, 1422, 1321, 1260, 1104. HRMS (EI$^+$): calcd. for $C_{14}H_{12}O$ $[M]^+$ 196.0888; found 196.0881.



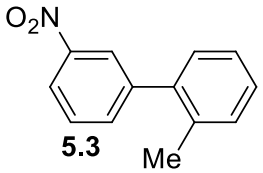
5.1

2-Methyl-2'-nitrobiphenyl (5.2):[25] White solid, m.p. 64-66 °C, (139 mg, 87%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.99 (d, J = 8.25 Hz, 1H, Ar-H), 7.64-7.61 (m, 1H, Ar-H), 7.53-7.50 (m, 1H, Ar-H), 7.34-7.21 (m, 4H, Ar-H), 7.10 (d, J = 7.6 Hz, 1H, Ar-H), 2.10 (s, 3H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 137.43, 136.53, 135.60, 132.49, 132.17, 129.96, 128.26, 128.22, 128.17, 125.72, 125.59, 124.08, 19.85 ppm. IR (KBr, cm^{-1}): 3063, 2924, 1609, 1572, 1525, 1472, 1351, 1287, 1162, 1121. HRMS (ES$^+$): calcd. for $C_{13}H_{12}NO_2$ $[M+H]^+$ 214.0868; found 214.0869.



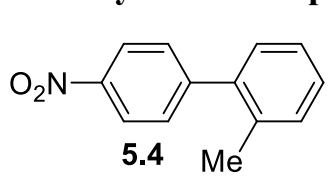
5.2

2-Methyl-3'-nitrobiphenyl (5.3):[26] White solid, m.p. 65-66 °C, (139 mg, 87%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.21-8.20 (m, 2H, Ar-H), 7.66 (d, J = 7.65 Hz, 1H, Ar-H), 7.60-7.57 (m, 1H, Ar-H), 7.34-7.27 (m, 3H, Ar-H), 7.22 (d, J = 7.3 Hz, 1H, Ar-H), 2.27 (s, 3H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 148.09, 143.51, 139.32, 135.32, 135.16, 130.66, 129.60, 129.05, 128.32, 126.15, 124.08, 121.83, 20.31 ppm. IR (KBr, cm^{-1}): 3065, 2921, 1609, 1572, 1472, 1345, 1287. HRMS (ES^+): calcd. for $C_{13}H_{12}NO_2$ $[M+H]^+$ 214.0868; found 214.0869.



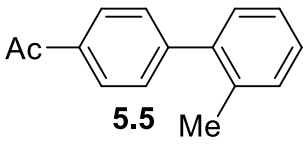
5.3

2-Methyl-4'-nitrobiphenyl (5.4):[27] White solid, m.p. 90-92 °C, (153 mg, 96%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.28 (d, J = 8.55 Hz, 2H, Ar-H), 7.49 (d, J = 8.85 Hz, 2H, Ar-H), 7.33-7.27 (m, 3H, Ar-H), 7.22 (d, J = 7.3 Hz, 1H, Ar-H), 2.27 (s, 3H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 148.90, 146.93, 139.70, 135.16, 130.81, 130.19, 129.50, 128.55, 126.21, 123.51, 20.43 ppm. IR (KBr, cm^{-1}): 3073, 2956, 1939, 1807, 1595, 1513, 1479, 1348, 1315, 1298. HRMS (EI^+): calcd. for $C_{13}H_{11}NO_2$ $[M]^+$ 213.0790; found 213.0797.



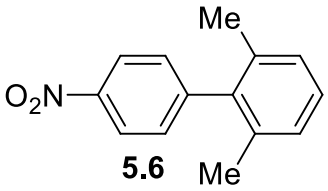
5.4

1-(2'-Methylbiphenyl-4-yl)ethanone (5.5):[28] Colourless liquid, (145 mg, 92%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.01 (d, J = 8.55 Hz, 2H, Ar-H), 7.43 (d, J = 8.55 Hz, 2H, Ar-H), 7.30-7.27 (m, 2H, Ar-H), 7.26-7.25 (m, 1H, Ar-H), 7.22 (d, J = 7.3 Hz, 1H, Ar-H), 2.65 (s, 3H, Me), 2.27 (s, 3H, Ac) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 197.86, 146.95, 140.72, 135.56, 135.14, 130.51, 129.45, 128.19, 127.88, 125.91, 26.66, 20.38 ppm. IR (neat, cm^{-1}): 2933, 1683, 1606, 1483, 1401, 1357, 1266, 1005, 956, 852. HRMS (ES^+): calcd. for $C_{15}H_{15}O$ $[M+H]^+$ 211.1123; found 211.1126.



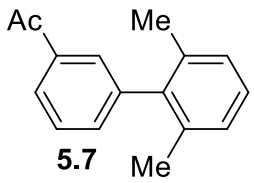
5.5

2,6-Dimethyl-4'-nitrobiphenyl (5.6):[29] White solid, m.p. 110-112 °C, (160 mg, 94%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.31 (d, J = 8.6 Hz, 2H, Ar-H), 7.34 (d, J = 8.6 Hz, 2H, Ar-H), 7.23-7.20 (m, 1H, Ar-H), 7.14 (d, J = 7.45 Hz, 2H, Ar-H), 2.01 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 148.39, 146.90, 139.53, 135.33, 130.18, 127.98, 127.61, 123.81, 20.69 ppm. IR (KBr, cm^{-1}): 3103, 3074, 2919, 1942, 1598, 1515, 1463, 1347, 1310, 1285, 1102. HRMS (EI$^+$): calcd. for $C_{14}H_{13}NO_2$ [M]$^+$ 227.0946; found 227.0943.



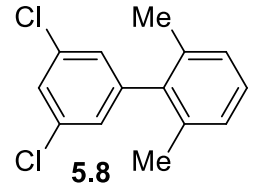
5.6

1-(2',6'-Dimethylbiphenyl-3-yl)ethanone (5.7):[30] Colourless liquid, (140 mg, 83%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.95 (d, J = 7.35 Hz, 1H, Ar-H), 7.76 (s, 1H, Ar-H), 7.55-7.52 (m, 1H, Ar-H), 7.38-7.35 (m, 1H, Ar-H), 7.21-7.18 (m, 1H, Ar-H), 7.13 (d, J = 7.3 Hz, 2H, Ar-H), 2.61 (s, 3H, Ac) 2.02 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 198.18, 141.50, 140.67, 137.37, 135.89, 133.88, 129.04, 128.80, 127.44, 126.66, 26.72, 20.84 ppm. IR (neat, cm^{-1}): 2921, 1686, 1579, 1465, 1420, 1356, 1288, 1248, 1226, 1032. HRMS (ES$^+$): calcd. for $C_{16}H_{17}O$ [M+H]$^+$ 225.1279; found 225.1277.



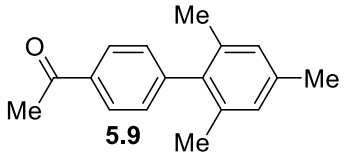
5.7

3',5'-Dichloro-2,6-dimethylbiphenyl (5.8): White solid, m.p. 99-100 °C, (180 mg, 96%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.41 (d, J = 1.75 Hz, 2H, Ar-H), 7.35 (t, J = 2.0 Hz, 1H, Ar-H), 7.19-7.16 (m, 1H, Ar-H), 7.10 (d, J = 7.45 Hz, 2H, Ar-H), 2.03 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 144.13, 141.40, 135.65, 134.99, 128.37, 127.62, 126.97, 125.60, 20.71 ppm. IR (KBr, cm^{-1}): 3076, 1557, 1413, 1095, 845, 800. HRMS (EI$^+$): calcd. for $C_{14}H_{12}Cl_2$ [M]$^+$ 250.0316; found 250.0318.



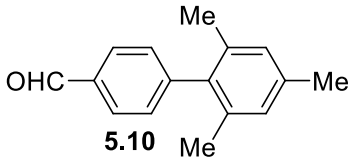
5.8

1-(2',4',6'-Trimethylbiphenyl-4-yl)ethanone (5.9):[31] White solid, m.p. 55-58 °C, (107 mg, 60%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.02 (d, J = 8.2 Hz, 2H, Ar-H), 7.25 (d, J = 7.95 Hz, 2H, Ar-H), 6.95 (s, 2H, Ar-H), 2.65 (s, 3H, Ac), 2.33 (s, 3H, Me), 1.98 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 197.92, 146.56, 137.89, 137.13, 135.57, 135.46, 129.69, 128.52, 128.20, 26.60, 21.01, 20.61 ppm. IR (KBr, cm^{-1}): 2916, 1680, 1604, 1427, 1400, 1358, 1265, 1182, 957. HRMS (EI^+): calcd. for $C_{17}H_{19}O$ $[M+H]^+$ 239.1436; found 239.1432.



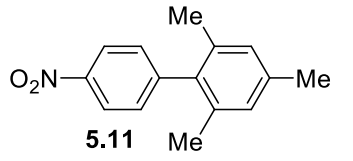
5.9

2',4',6'-Trimethylbiphenyl-4-carbaldehyde (5.10): White solid, m.p. 58-59 °C, (120 mg, 71%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 10.07 (s, 1H, CHO), 7.94 (d, J = 8.25 Hz, 2H, Ar-H), 7.33 (d, J = 8.25 Hz, 2H, Ar-H), 6.96 (s, 2H, Ar-H), 2.34 (s, 3H, Me), 1.99 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 192.07, 148.09, 137.68, 137.29, 135.36, 134.91, 130.18, 129.91, 128.24, 21.02, 20.60 ppm. IR (KBr, cm^{-1}): 2963, 2920, 2853, 2732, 1704, 1604, 1566, 1433, 1380, 1302, 1261, 1206, 1100, 1017, 1005. HRMS (EI^+): calcd. for $C_{16}H_{17}O$ $[M+H]^+$ 225.1279; found 225.1279.



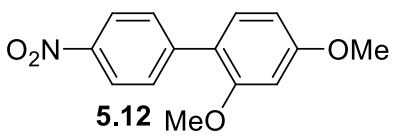
5.10

2,4,6-Trimethyl-4'-nitrobiphenyl (5.11):[32] White solid, m.p. 85-87 °C, (150 mg, 83%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.29 (d, J = 8.55 Hz, 2H, Ar-H), 7.32 (d, J = 8.85 Hz, 2H, Ar-H), 6.96 (s, 2H, Ar-H), 2.34 (s, 3H, Me), 1.98 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 148.52, 146.82, 137.70, 136.73, 135.23, 130.44, 128.37, 123.73, 21.02, 20.59 ppm. IR (KBr, cm^{-1}): 3114, 2946, 2851, 2446, 1928, 1680, 1598, 1519, 1475, 1445, 1397, 1379, 1106, 1097. HRMS (EI^+): calcd. for $C_{15}H_{15}NO_2$ $[M]^+$ 241.1103; found 241.1103.



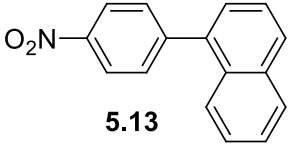
5.11

2,4-Dimethoxy-4'-nitrobiphenyl (5.12):[33] White solid, m.p. 112-114 °C, (186 mg, 96%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.23 (d, J = 8.9 Hz, 2H, Ar-H), 7.66 (d, J = 8.85 Hz, 2H, Ar-H), 7.27 (d, J = 8.3 Hz, 1H, Ar-H), 6.61-6.57 (m, 2H, Ar-H), 3.87 (s, 3H, OMe), 3.82 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 161.50, 157.57, 146.18, 145.35, 131.32, 129.98, 123.22, 121.04, 105.05, 99.05, 55.55, 55.48 ppm. IR (KBr, cm^{-1}): 2943, 2840, 1614, 1597, 1575, 1510, 1485, 1454, 1420, 1341, 1284, 1211, 1165, 1049. HRMS (ES$^+$): calcd. for $C_{14}H_{14}NO_4$ $[M+H]^+$ 260.0923; found 260.0926.



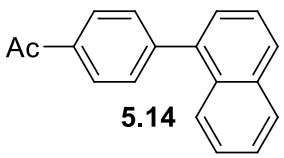
5.12

1-(4-Nitrophenyl) naphthalene (5.13):[34] White solid, m.p. 125-127 °C, (184 mg, 98%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.36 (d, J = 9.15 Hz, 2H, Ar-H), 7.95-7.92 (m, 2H, Ar-H), 7.78 (d, J = 7.95 Hz, 1H, Ar-H), 7.67 (d, J = 9.2 Hz, 2H, Ar-H), 7.59-7.52 (m, 2H, Ar-H), 7.49-7.46 (m, 1H, Ar-H) 7.43-7.42 (m, 1H, Ar-H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 147.67, 147.17, 137.76, 133.77, 130.91, 128.94, 128.56, 127.08, 126.73, 126.21, 125.30, 125.11, 123.58 ppm. IR (KBr, cm^{-1}): 3099, 3058, 2849, 1939, 1597, 1515, 1490, 1396, 1348, 1311, 1348, 1285, 1251, 1106. HRMS (EI$^+$): calcd. for $C_{16}H_{11}NO_2$ $[M]^+$ 249.0790; found 249.0798.



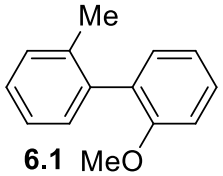
5.13

1-(4-Acetylphenyl)naphthalene (5.14):[34] White solid, m.p. 96-97 °C, (174 mg, 94%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.09 (d, J = 7.95 Hz, 2H, Ar-H), 7.93-7.89 (m, 2H, Ar-H), 7.84 (d, J = 8.55 Hz, 1H, Ar-H), 7.61 (d, J = 7.95 Hz, 2H, Ar-H), 7.56-7.50 (m, 2H, Ar-H), 7.46-7.42 (m, 2H, Ar-H), 2.69 (s, 3H, Ac) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 197.86, 145.78, 138.99, 135.97, 133.76, 131.18, 130.31, 128.41, 128.35, 126.91, 126.36, 125.99, 125.55, 125.32, 26.71 ppm. IR (KBr, cm^{-1}): 3046, 1682, 1605, 1503, 1423, 1396, 1357, 1265, 1180, 1016. HRMS (ES$^+$): calcd. for $C_{18}H_{15}O$ $[M+H]^+$ 247.1123; found 247.1129.



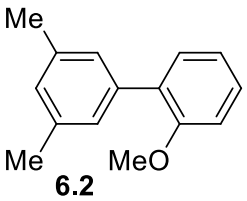
5.14

2-Methoxy-2'-methylbiphenyl (6.1):[35] White solid, m.p. 42-44 °C, (116 mg, 78%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.36-7.33 (m, 1H, Ar-H), 7.26-7.22 (m, 3H, Ar-H), 7.20-7.15 (m, 2H, Ar-H), 7.02 (t, J = 7.3 Hz, 1H, Ar-H), 6.97 (d, J = 8.25 Hz, 1H, Ar-H), 3.77 (s, 3H, OMe), 2.15 (s, 3H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.56, 138.60, 136.80, 130.98, 130.81, 129.97, 129.55, 128.53, 127.27, 125.41, 120.40, 110.60, 55.37, 19.89 ppm. IR (KBr, cm^{-1}): 3061, 3018, 2936, 2834, 1581, 1596, 1499, 1461, 1481, 1433, 1260, 1233, 1028. HRMS (ES$^+$): calcd. for $C_{14}H_{14}O$ $[M]^+$ 198.1045; found 198.1040.



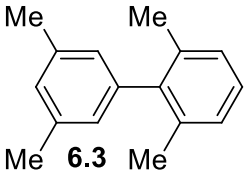
6.1

2-Methoxy-3',5'-dimethylbiphenyl (6.2):[36] Colourless liquid, (145 mg, 91%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.32-7.29 (m, 2H, Ar-H), 7.14 (s, 2H, Ar-H), 7.03-6.97 (m, 3H, Ar-H), 3.81 (s, 3H, OMe), 2.37 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.44, 138.42, 137.36, 130.97, 130.87, 128.66, 128.37, 127.34, 120.66, 111.04, 55.52, 21.39 ppm. IR (neat, cm^{-1}): 3000, 2917, 2833, 1602, 1579, 1463, 1495, 1281, 1241, 1179, 1123, 1049, 1028. HRMS (EI$^+$): calcd. for $C_{15}H_{16}O$ $[M]^+$ 212.1201; found 212.1201.



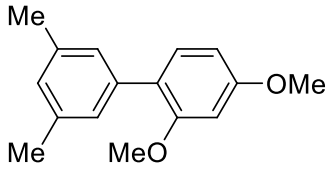
6.2

2,3',5',6-Tetramethylbiphenyl (6.3):[37] Colourless liquid, (130 mg, 82%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.16-7.09 (m, 3H, Ar-H), 6.97 (s, 1H, Ar-H), 6.76 (s, 2H, Ar-H), 2.35 (s, 6H, Me), 2.04 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 142.08, 140.93, 137.71, 136.00, 128.08, 127.13, 126.74, 126.67, 21.36, 20.85 ppm. IR (neat, cm^{-1}): 3018, 2921, 2856, 1601, 1463, 1377, 1199, 1163, 1107, 1035. HRMS (EI$^+$): calcd. for $C_{16}H_{18}$ $[M]^+$ 210.1409; found 210.1404.



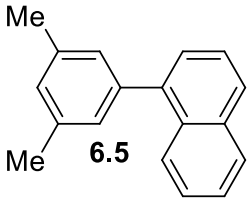
6.3

2,4-Dimethoxy-3',5'-dimethylbiphenyl (6.4): Colourless liquid, (145 mg, 80%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.23-7.20 (m, 1H, Ar-H), 7.10 (s, 2H, Ar-H), 6.95 (s, 1H, Ar-H), 6.56-6.54 (m, 2H, Ar-H), 3.85 (s, 3H, OMe), 3.79 (s, 3H, OMe), 2.36 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 160.09, 157.40, 138.21, 137.33, 131.21, 128.27, 127.29, 123.79, 104.37, 98.85, 55.51, 55.38, 21.38 ppm. IR (neat, cm^{-1}): 3042, 2916, 2860, 1600, 1506, 1458, 1376, 1160, 852, 800. HRMS (EI^+): calcd. for $C_{16}H_{18}O_2$ $[M]^+$ 242.1307; found 242.1308.



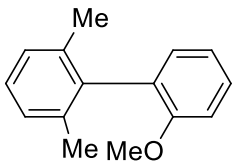
6.4

1-(3,5-Dimethylphenyl)naphthalene (6.5): Colourless liquid, (170 mg, 97%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.94-7.89 (m, 2H, Ar-H), 7.85 (d, J = 7.95 Hz, 1H, Ar-H), 7.53-7.47 (m, 2H, Ar-H), 7.45-7.41 (m, 2H, Ar-H), 7.12 (s, 2H, Ar-H), 7.08 (s, 1H, Ar-H), 2.41 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 140.65, 140.50, 137.70, 133.75, 131.68, 128.81, 128.18, 127.88, 127.39, 126.73, 126.18, 125.85, 125.64, 125.32, 21.37 ppm. IR (neat, cm^{-1}): 3002, 2960, 2936, 1610, 1598, 1575, 1506, 1463, 1437, 1406, 1206, 1158. HRMS (EI^+): calcd. for $C_{18}H_{16}$ $[M]^+$ 232.1252; found 232.1259.



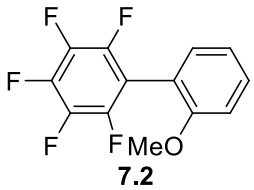
6.5

2'-Methoxy-2,6-dimethylbiphenyl (7.1):[38] Colourless liquid, (26 mg, 64%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.35-7.32 (m, 1H, Ar-H), 7.18-7.15 (m, 1H, Ar-H), 7.11 (d, J = 7.35 Hz, 2H, Ar-H), 7.03-6.98 (m, 3H, Ar-H), 3.74 (s, 3H, OMe), 2.01 (s, 6H, Me) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.53, 139.09, 138.20, 136.58, 130.66, 128.35, 127.03, 127.0, 120.66, 110.88, 55.52, 20.42 ppm. IR (neat, cm^{-1}): 3059, 3017, 2951, 2833, 1600, 1580, 1497, 1462, 1434, 1295, 1243, 1229, 1179, 1161, 1120. HRMS (ES^+): calcd. for $C_{15}H_{16}O$ $[M]^+$ 212.1201; found 212.1204.



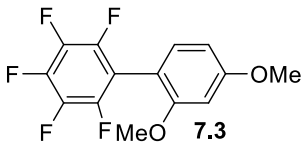
7.1

2,3,4,5,6-Pentafluoro-2'-methoxybiphenyl (7.2):[39] White solid, m.p. 45-46 °C, (34 mg, 66%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.47-7.44 (m, 1H, Ar-H), 7.23 (d, J = 7.45 Hz, 1H, Ar-H), 7.08-7.02 (m, 2H, Ar-H), 3.81 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 157.04, 144.34 (d, $J_{C\text{-}F}$ = 231.15 Hz), 140.42 (d, $J_{C\text{-}F}$ = 260.36 Hz), 137.49 (d, $J_{C\text{-}F}$ = 248.36 Hz), 131.69, 131.10, 120.57, 115.16, 112.67, 111.20, 55.64 ppm. ^{19}F NMR (471 MHz, $CDCl_3$): δ -144.88 (dd, J_F = 22.04 Hz, 7.31 Hz, 2F, Ar-H), -160.78 (t, J_F = 20.18 Hz, 1F, Ar-H), -167.75-(-167.84) (m, 2F, Ar-H) ppm. IR (KBr, cm^{-1}): 3059, 3017, 2951, 2833, 1600, 1580, 1497, 1462, 1434, 1295, 1243, 1229, 1179, 1161, 1120. HRMS (ES$^+$): calcd. for $C_{13}H_7F_5O$ $[M]^+$ 274.0417; found 274.0410.



7.2

2,3,4,5,6-Pentafluoro-2',4'-dimethoxybiphenyl (7.3): White solid, m.p. 59-61 °C, (45 mg, 79%); ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.13 (d, J = 8.24 Hz, 1H, Ar-H), 6.60-6.58 (m, 2H, Ar-H), 3.86 (s, 3H, OMe), 3.78 (s, 3H, OMe) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ 162.14, 158.21, 144.53 (d, $J_{C\text{-}F}$ = 248.13 Hz), 140.25 (d, $J_{C\text{-}F}$ = 248.13 Hz), 137.48 (d, $J_{C\text{-}F}$ = 255.8 Hz), 112.58 (t, $J_{C\text{-}F}$ = 19.16 Hz), 107.53, 104.76, 98.90, 55.64, 55.45 ppm. ^{19}F NMR (471 MHz, $CDCl_3$): δ -140.22 (dd, J_F = 22.70 Hz, 9.09 Hz, 2F, Ar-H), -156.60 (t, J_F = 20.46 Hz, 1F, Ar-H), -163.25-(-163.36) (m, 2F, Ar-H) ppm. IR (KBr, cm^{-1}): 2971, 2847, 1609, 1581, 1508, 1494, 1465, 1443, 1406, 1314, 1280, 1210, 1119, 1062. HRMS (ES$^+$): calcd. for $C_{14}H_{10}F_5O_2$ $[M+H]^+$ 305.0601; found 305.0606.



7.3

5. Crystallographic data for compounds (1a, 1b, 1c, 1d, 1f):

Compound	**1a**	**1b**	**1c**	**1d**	**1f**
Empirical formula	C_{84} H_{85} Bi_4 O_{12}	C_{21} H_{21} Bi	C_{27} H_{33} Bi	C_{24} H_{27} Bi	C_{24} H_{27} Bi O_6
Formula weight	2122.44	482.36	566.51	524.44	620.44
Space group	P-1	P-1	P2(1)/n	P2(1)/c	Pbca
a [Å]	15.515(3)	5.0883(6)	12.295(5)	15.7104(9)	9.309(2)
b [Å]	15.705(3)	10.1508(11)	11.212(5)	8.1516(5)	16.637(4)
c [Å]	15.714(3)	16.5356(18)	16.895(5)	16.0978(9)	29.361(7)
α [°]	94.45(3)	91.151(3)	90.000(5)	90	90
β [°]	94.24(3)	95.535(3)	99.326(5)	103.6390(10)	90
γ [°]	94.35(3)	95.308(3)	90.000(5)	90	90
Volume [$Å^3$]	3794.1(13)	846.08(16)	2298.2(15)	2003.4(2)	4547.1(19)
Z	2	2	4	4	8
$D_{calcd.}$ [Mg/m^3]	1.858	1.893	1.637	1.739	1.813
Absorption coefficient [mm^{-1}]	9.310	10.414	7.681	8.803	7.792
h, k, l max	18, 19, 19	6,13, 22	14, 13, 20	19, 9, 19	11, 20, 35
Temperature [K]	100(2)	273(2)	100(2)	273(2)	100(2)
Reflections collected	20503	9726	12119	14192 / 3923 [R(int) = 0.0338]	24011
Completeness to theta = 25.50°	98.2 %	99.3%	99.4%	100.0%	100.0 %
Goodness-of-fit on F^2	1.099	0.612	1.116	1.030	1.049

Final R indices [I>2sigma(I)]	R1 = 0.1229, wR2 = 0.3105	R1 = 0.0241, wR2 = 0.0701	R1 = 0.0315, wR2 = 0.0736	R1 = 0.0202, wR2 = 0.0491	R1 = 0.0473, wR2 = 0.1137
R indices (all data)	R1 = 0.1777, wR2 = 0.3650	R1 = 0.0284, wR2 = 0.0758	R1 = 0.0424, wR2 = 0.0895	R1 = 0.0223, wR2 = 0.0502	R1 = 0.0703, wR2 = 0.1502
Largest diff. peak and hole	12.856 and -5.149 e.Å^{-3}	1.293 and -1.907 e.Å^{-3}	2.679 and -0.997 e.Å^{-3}	1.209 and -0.905 e.A^-3	4.613 and -1.814 e.Å^{-3}
Data / restraints / parameters	13850 / 0 / 913	4208 / 0 / 202	4244 / 0 / 262	3923 / 0 / 232	4475 / 0 / 286
Independent reflections	--	--	4244 [R(int) = 0.0369]	--	4475 [R(int) = 0.0809]

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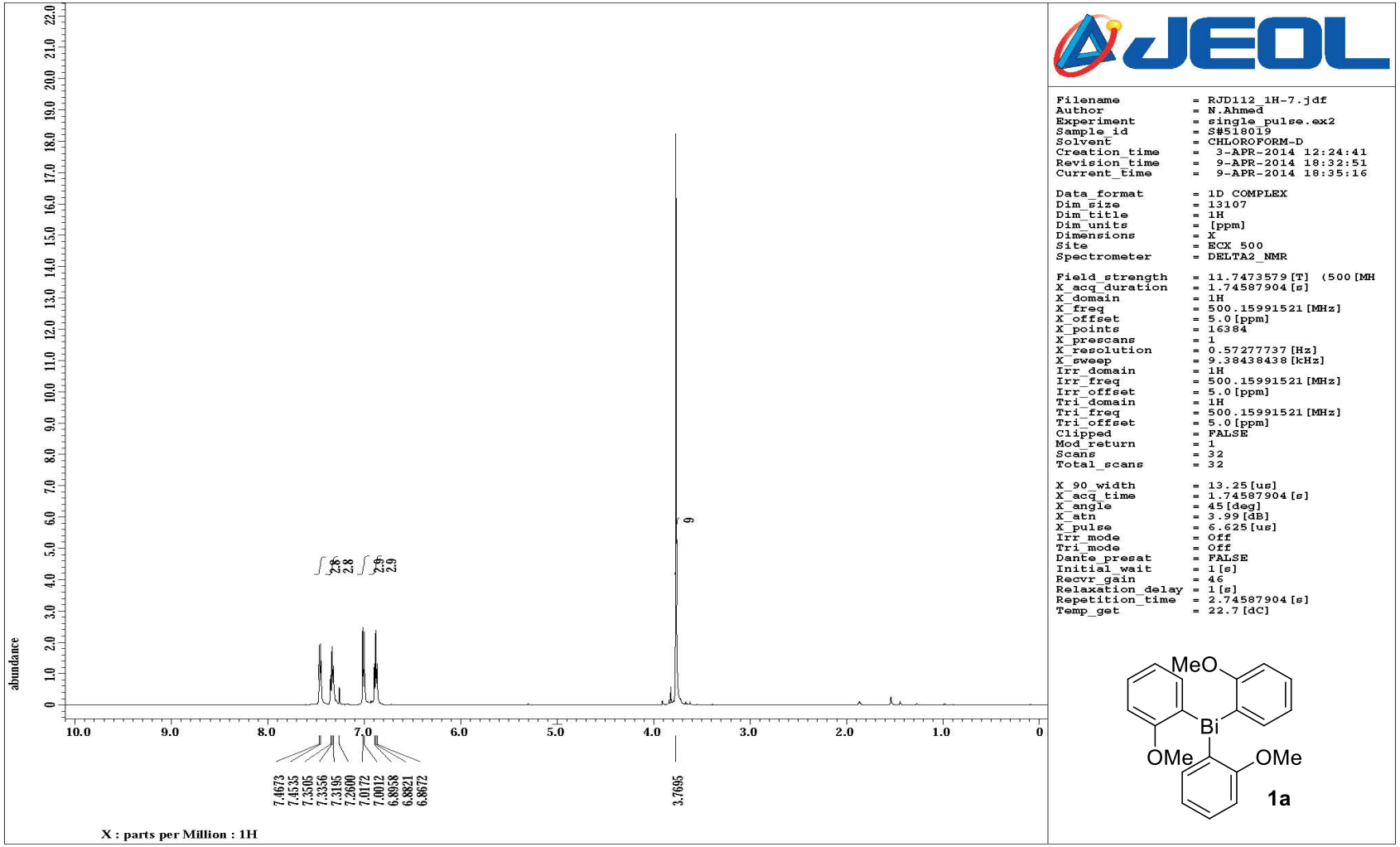
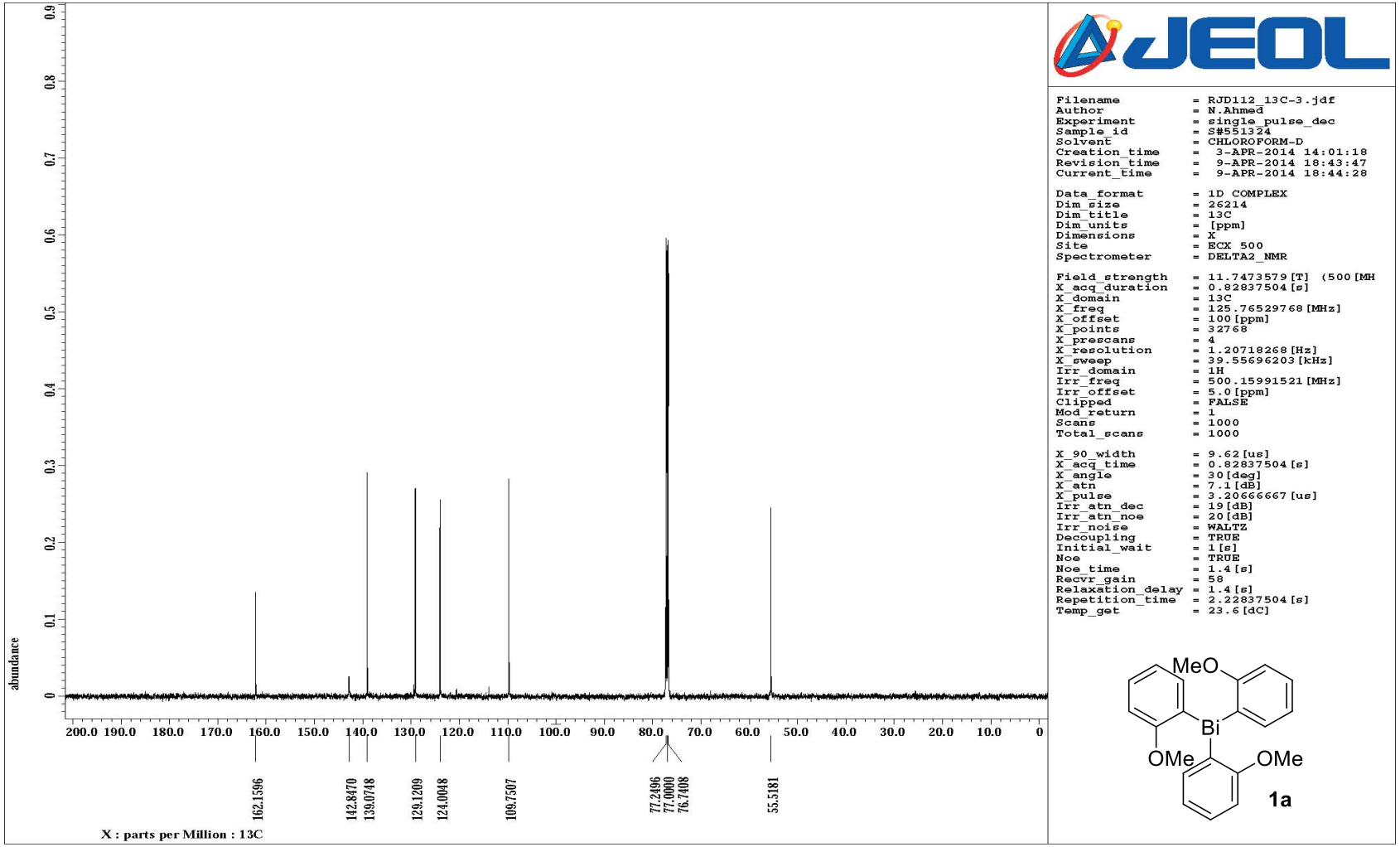
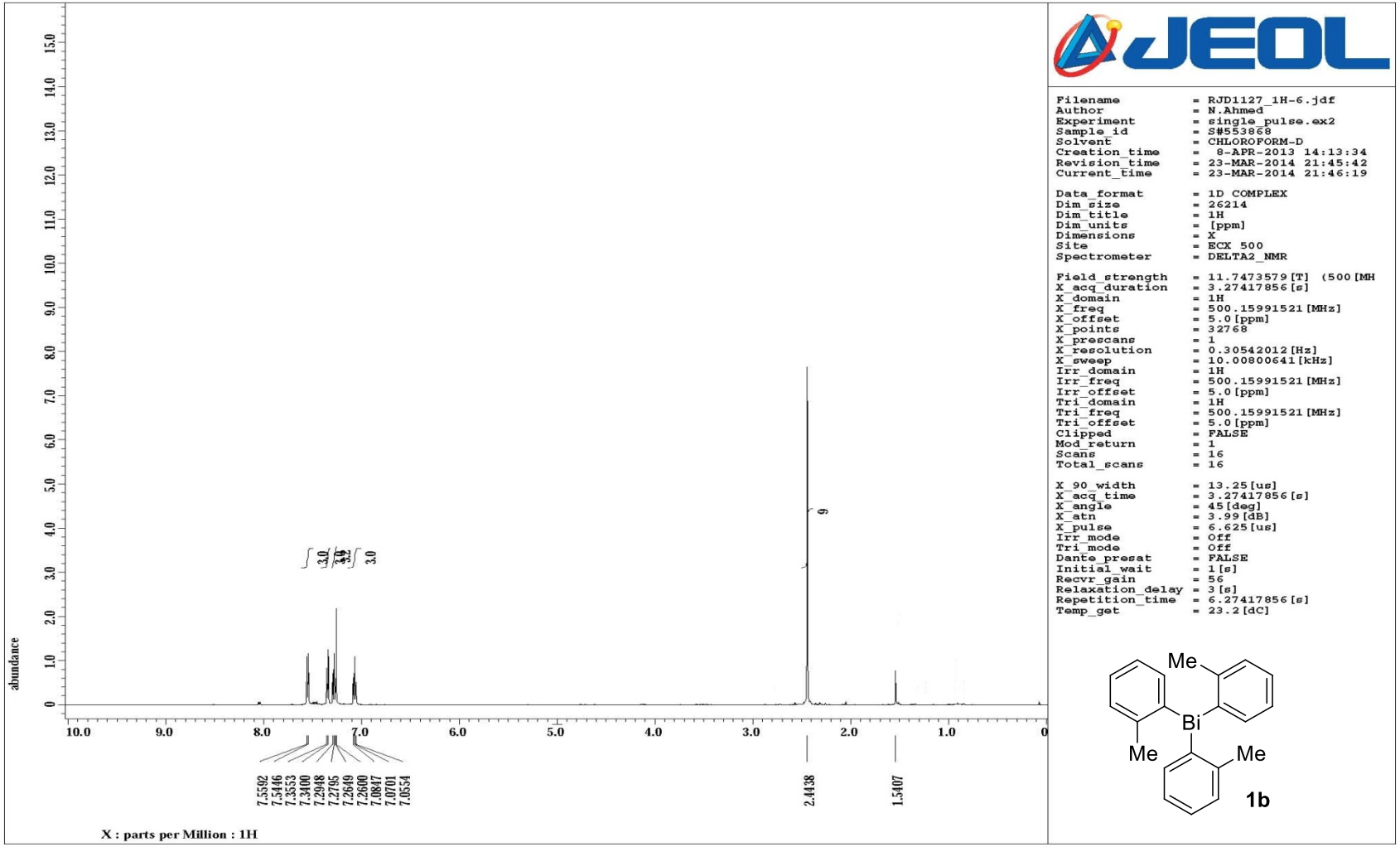


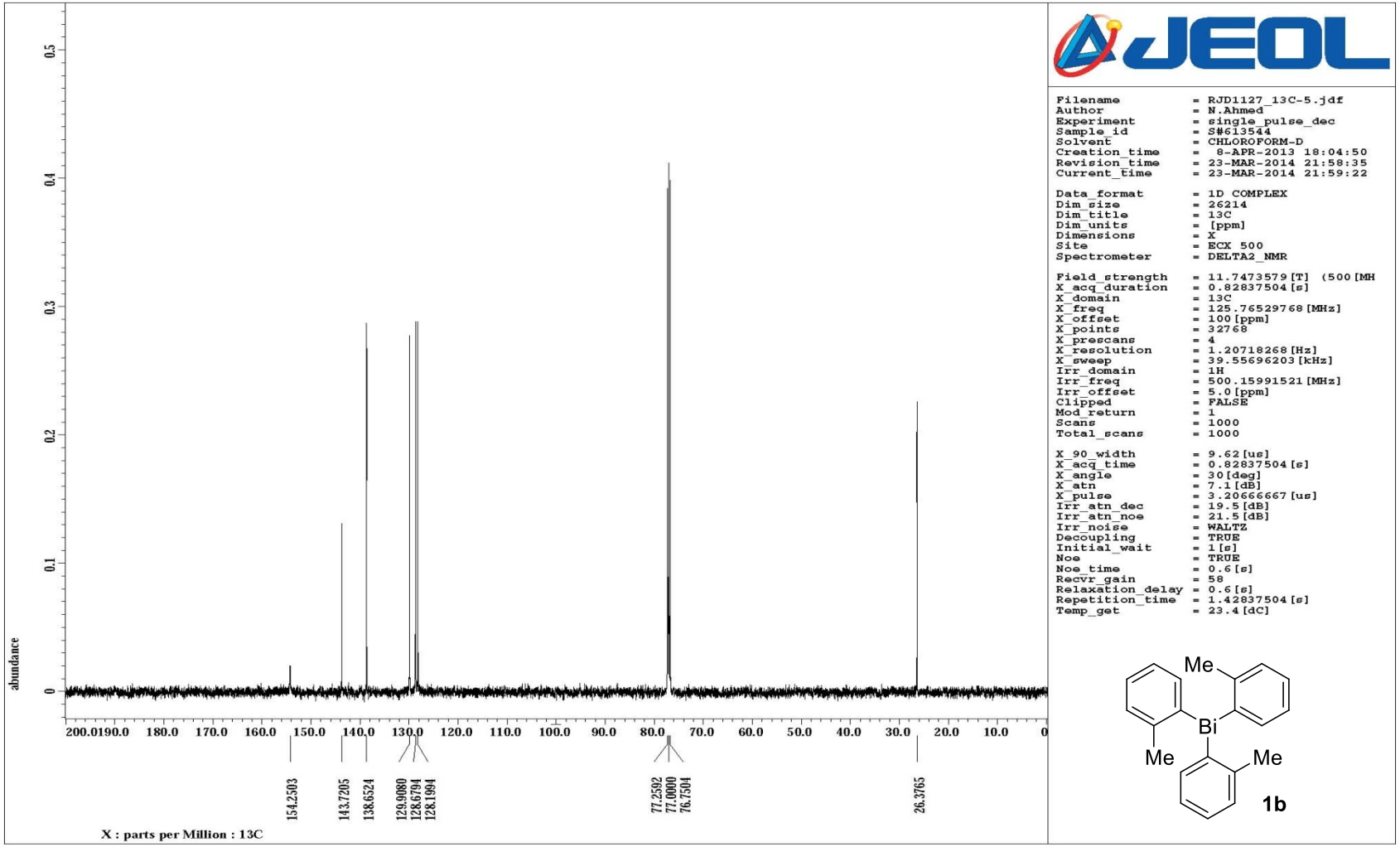
^{1}H NMR spectrum of tri(*o*-anisyl)bismuth (**1a**)



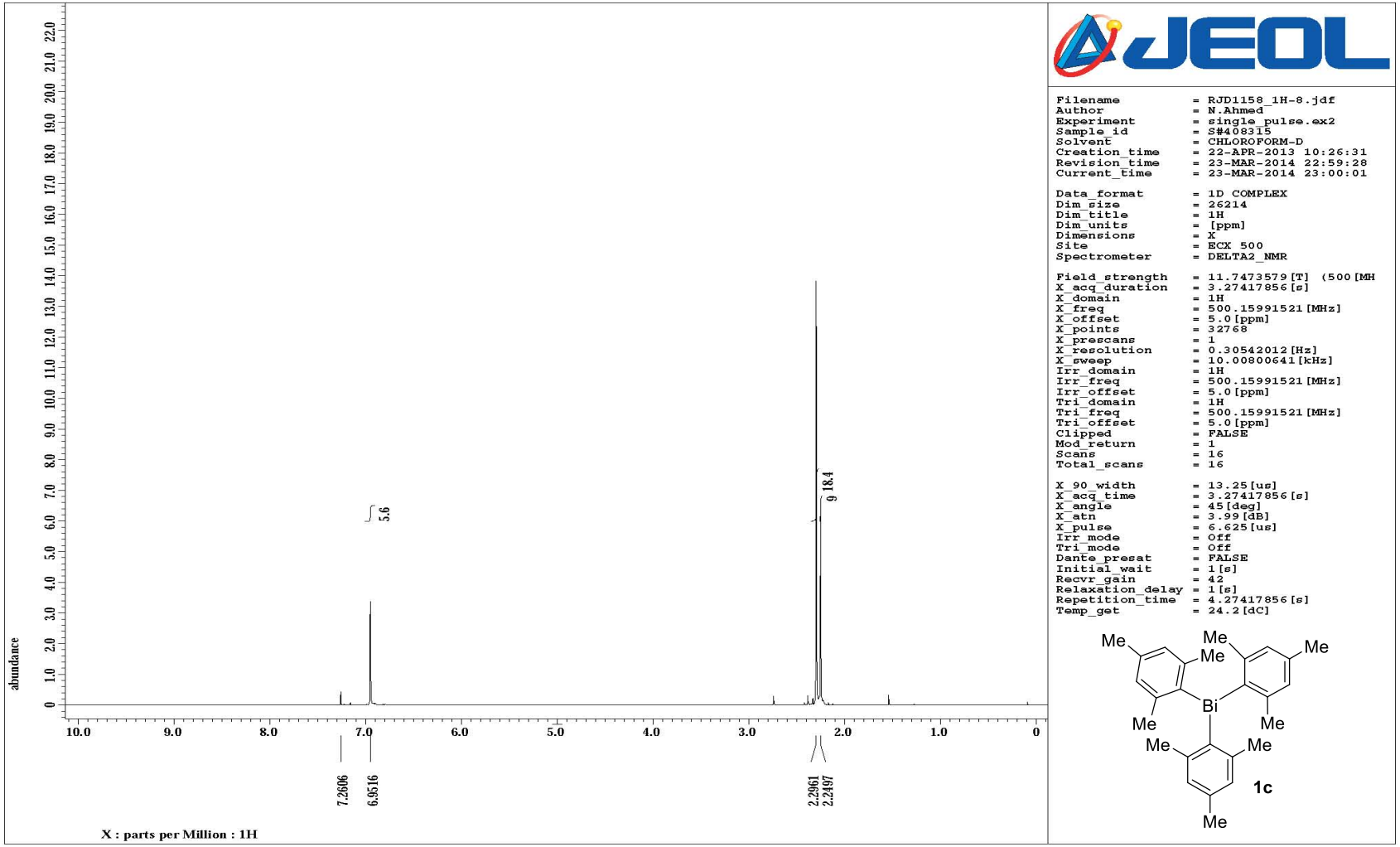
^{13}C NMR spectrum of tri(*o*-anisyl)bismuth (**1a**)



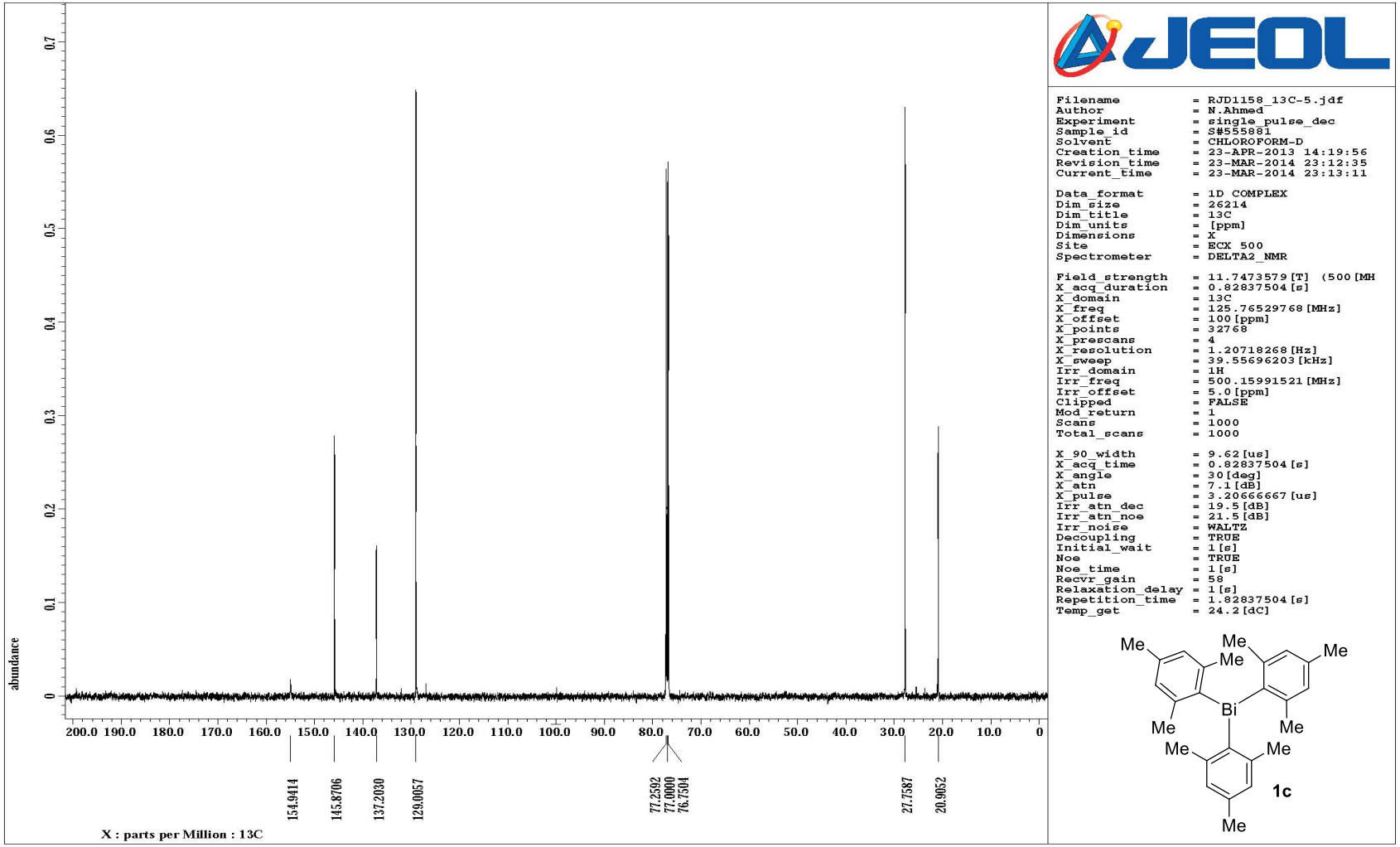
^{1}H NMR spectrum of tri(*o*-tolyl)bismuth (**1b**)



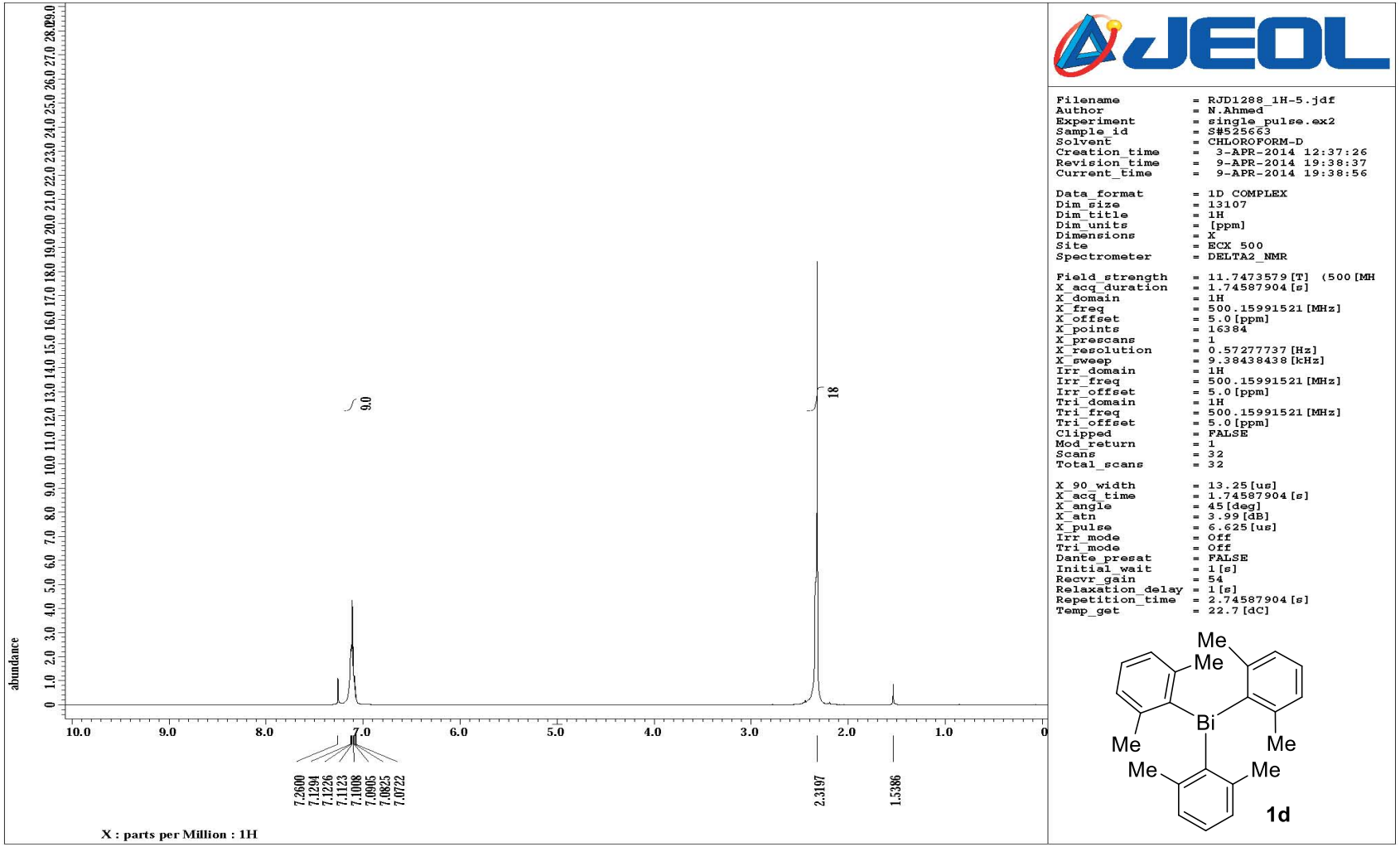
^{13}C NMR spectrum of tri(*o*-tolyl)bismuth (**1b**)



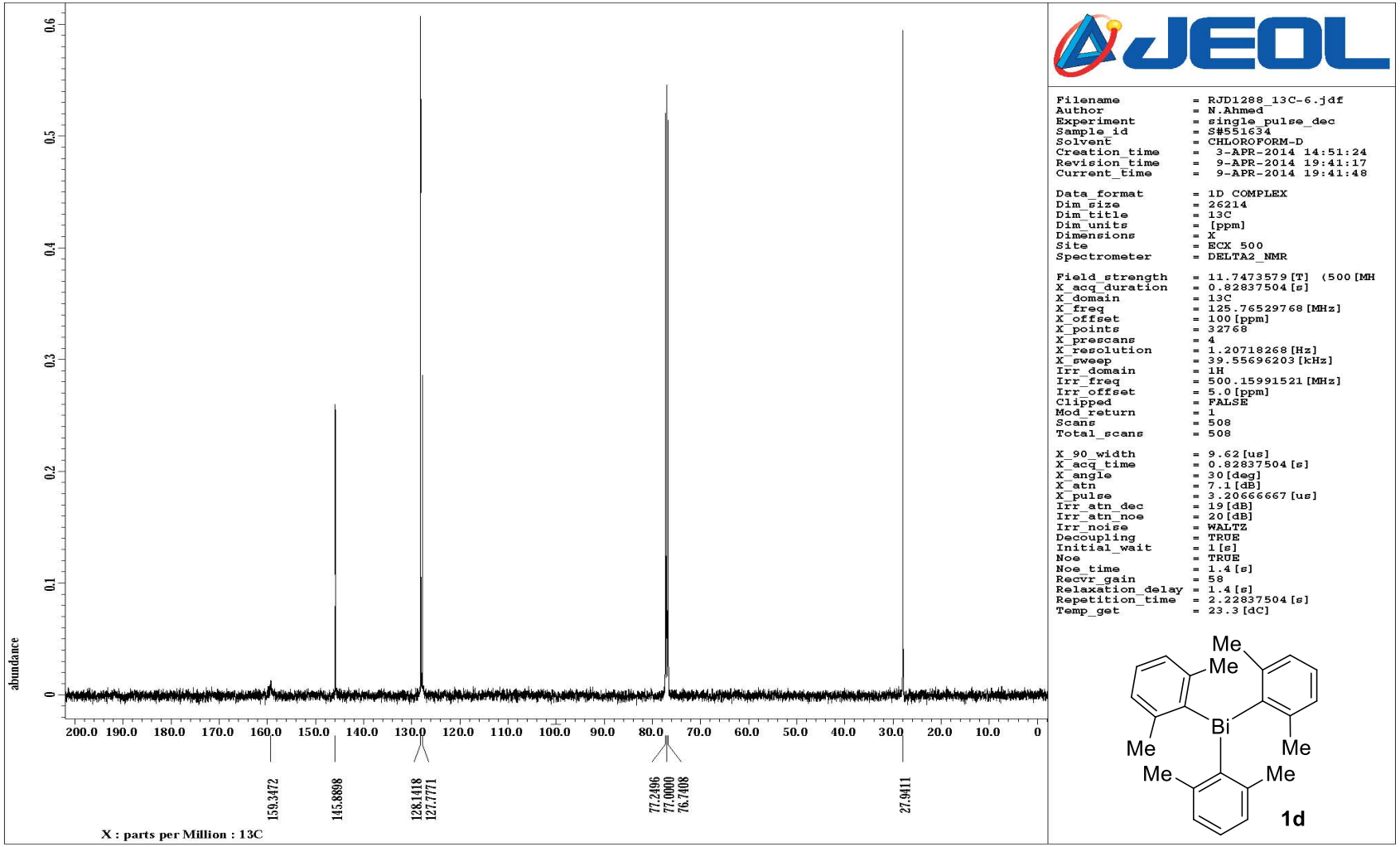
^{1}H NMR spectrum of trimesitylbismuth (**1c**)



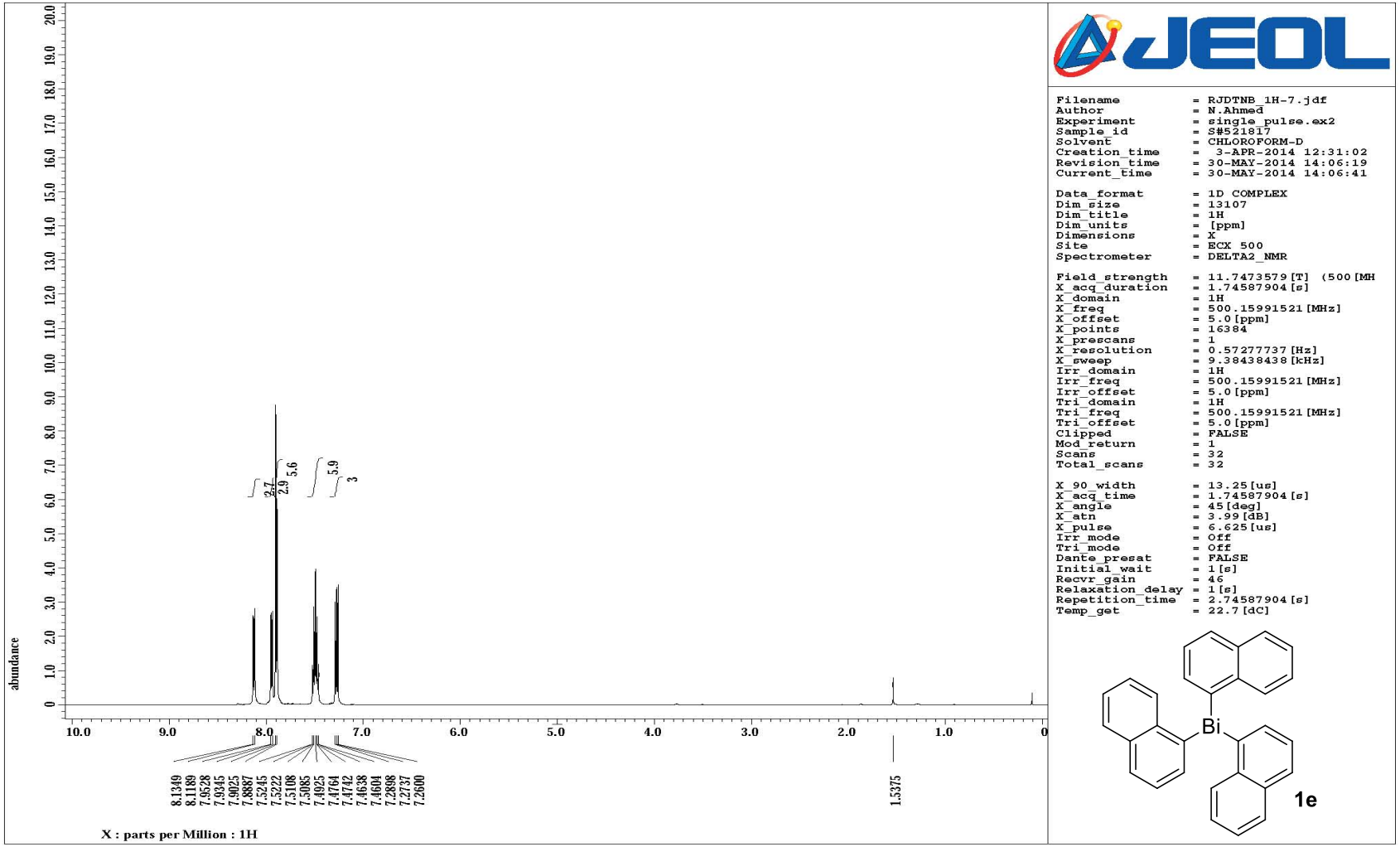
^{13}C NMR spectrum of trimesitylbismuth (**1c**)



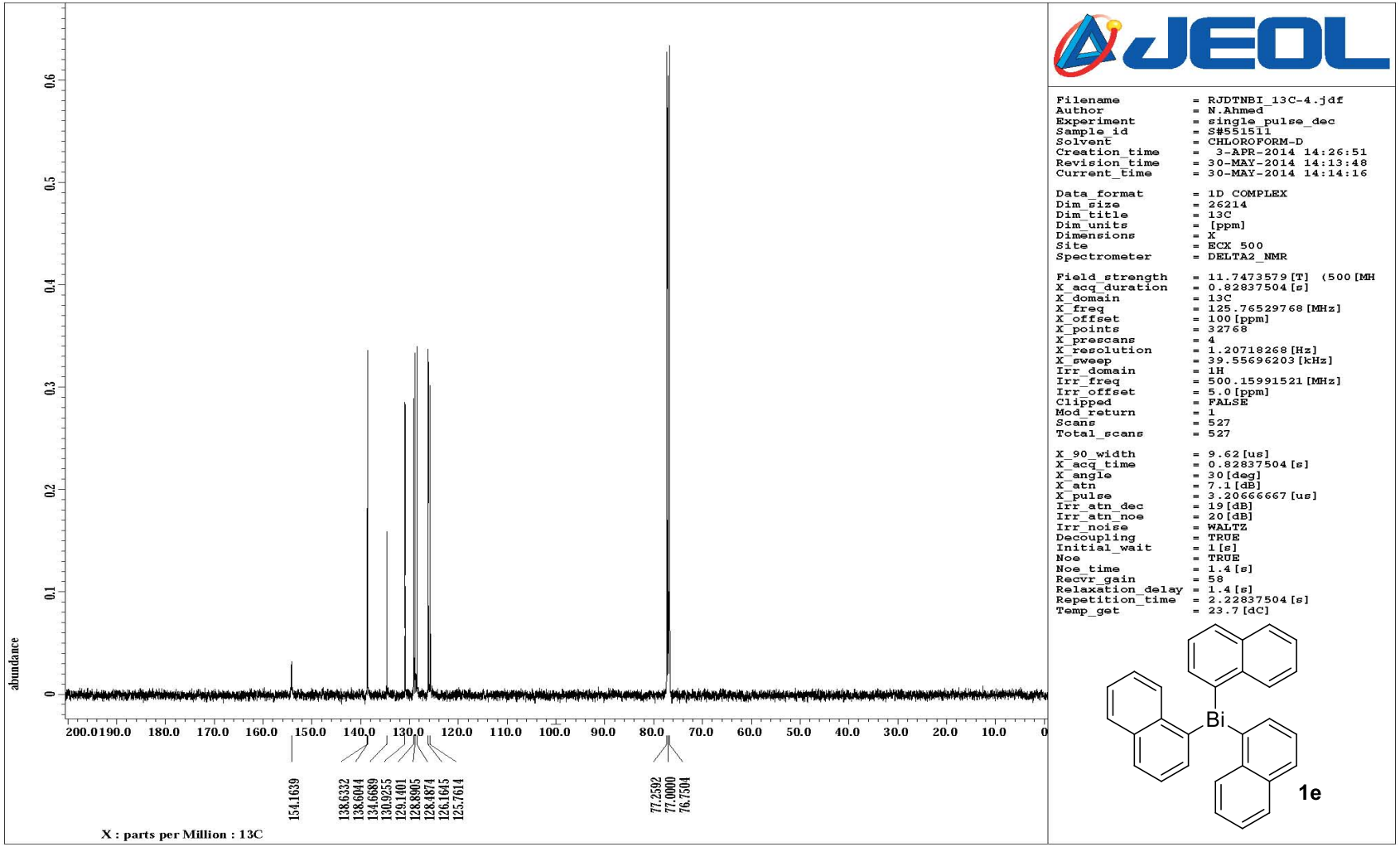
^{1}H NMR spectrum of tris(2,6-dimethylphenyl)bismuth (**1d**)



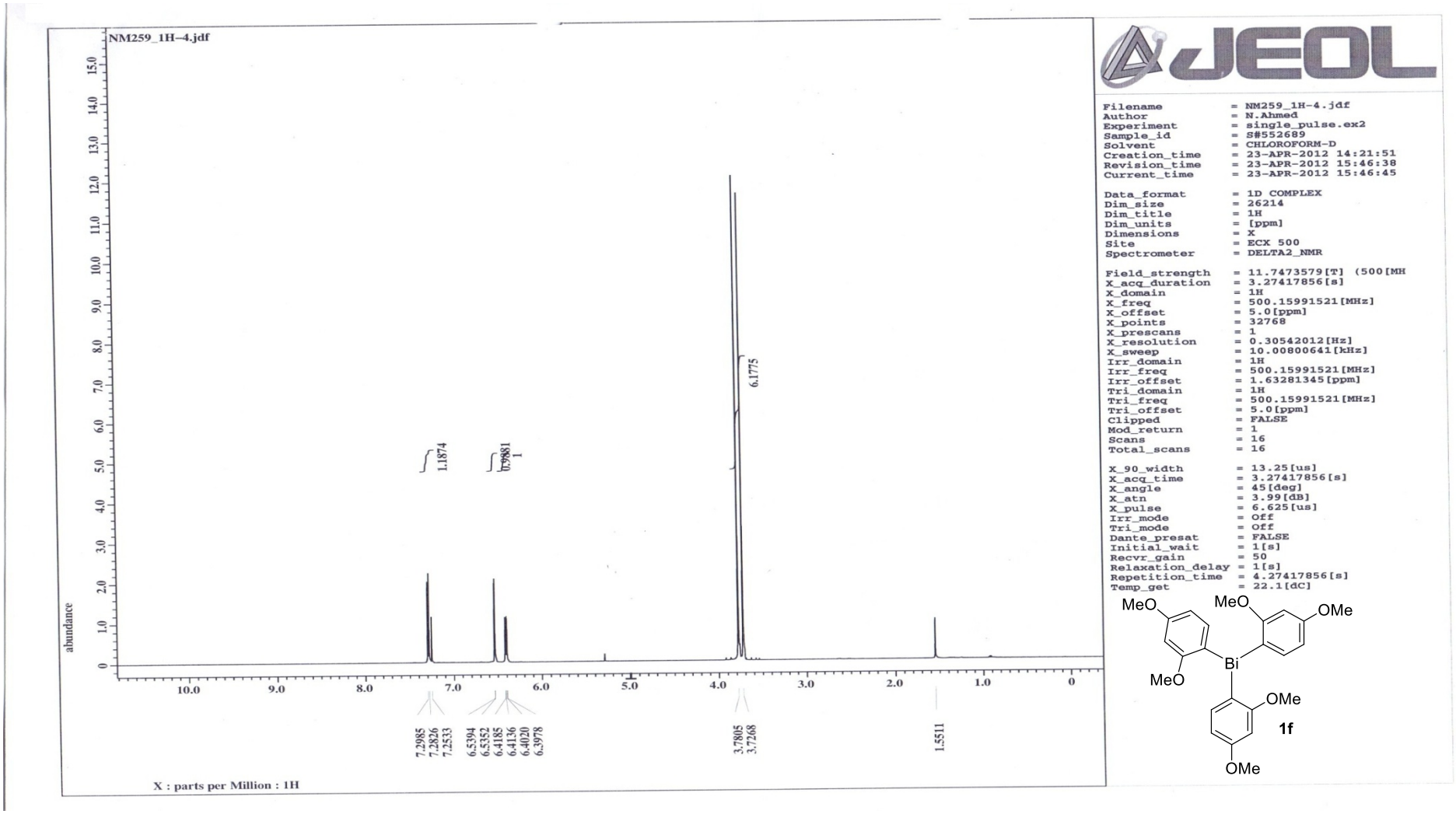
^{13}C NMR spectrum of tris(2,6-dimethylphenyl)bismuth (**1d**)



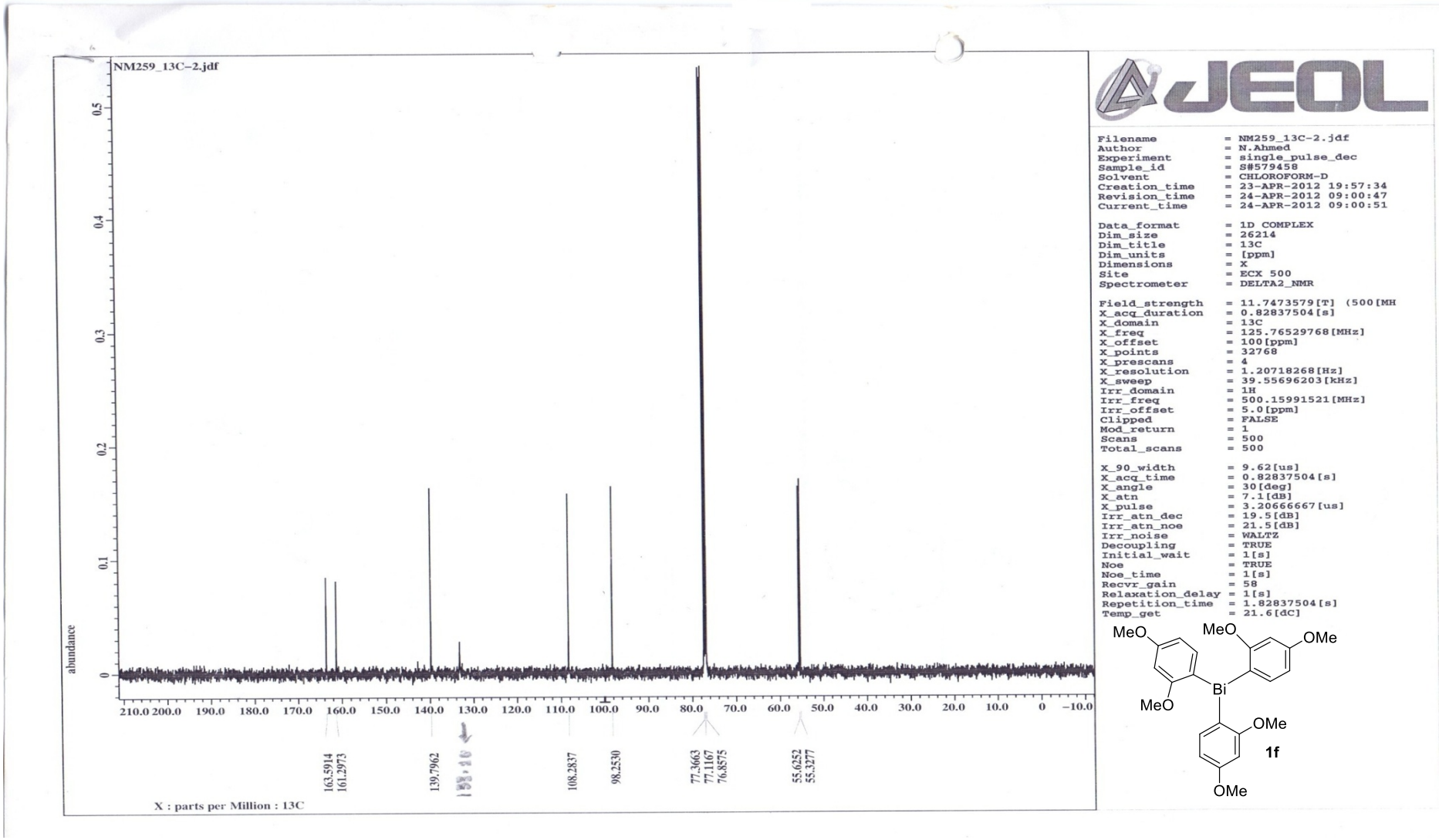
^{1}H NMR spectrum of tri(naphthalen-1-yl)bismuth (**1e**)



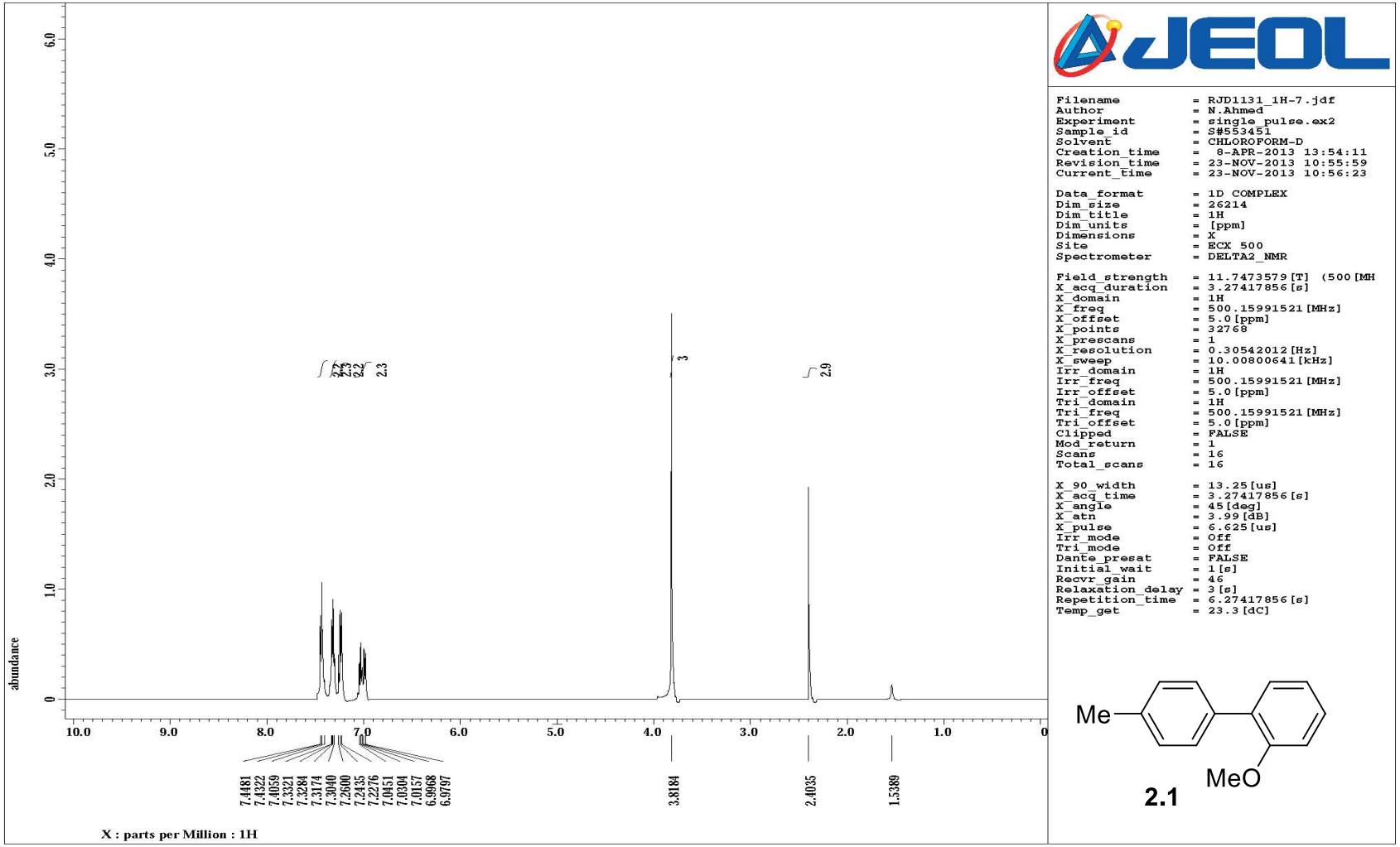
^{13}C NMR spectrum of tri(naphthalen-1-yl)bismuth (**1e**)



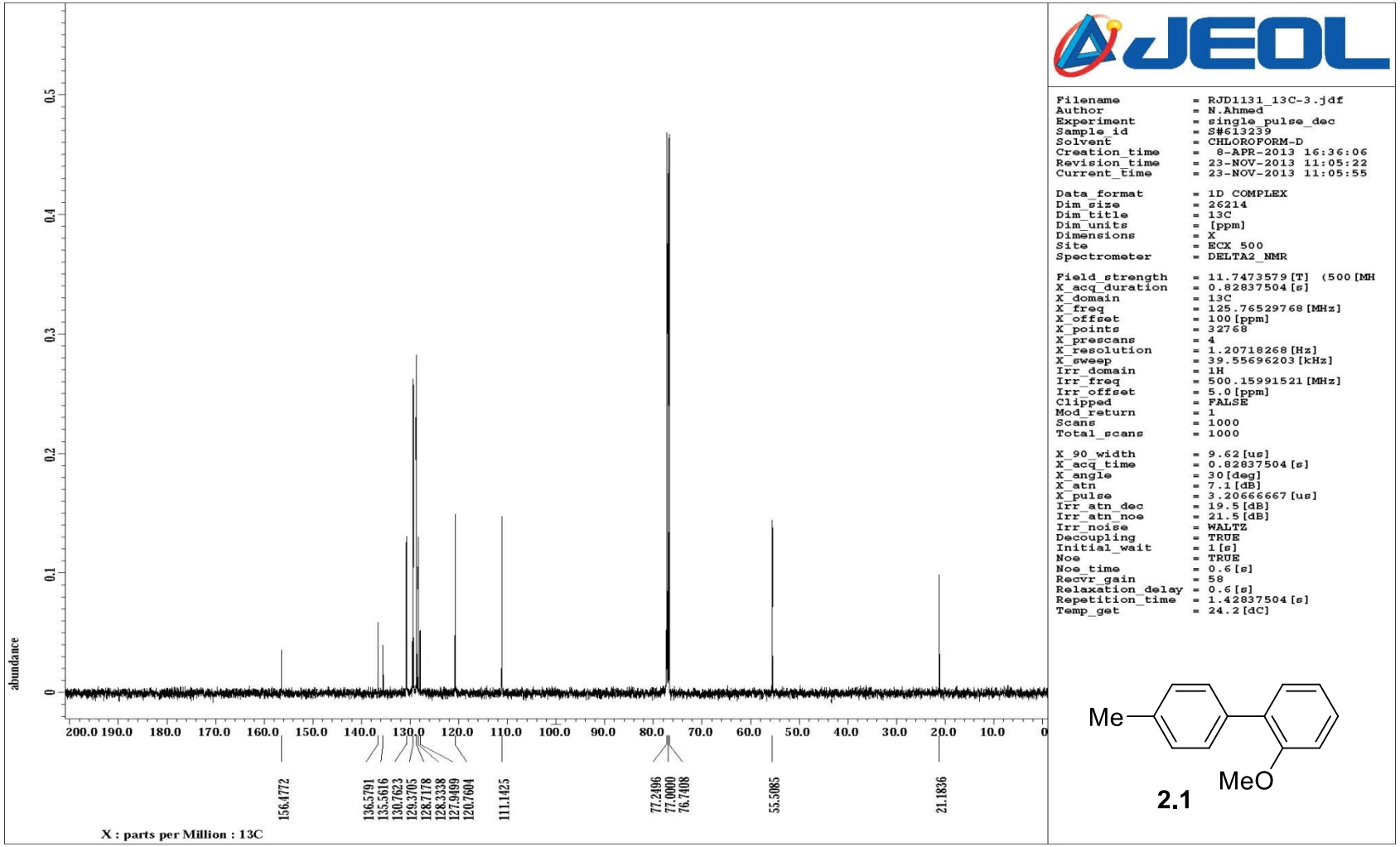
^{1}H NMR spectrum of tri(2,6-dimethoxyphenyl)bismuth (**1f**)



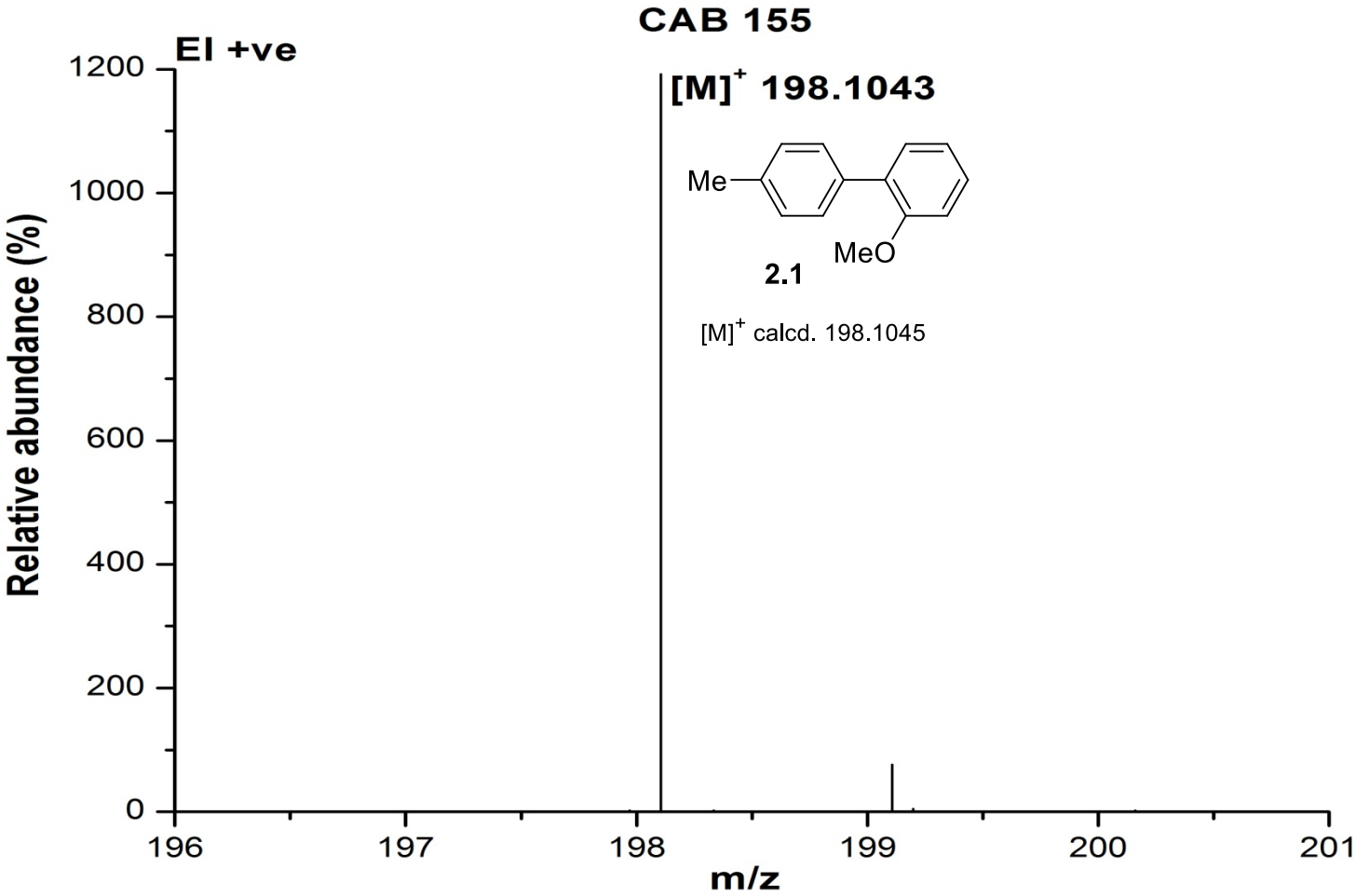
^{13}C NMR spectrum of tris(2,6-dimethoxyphenyl)bismuth (**1f**)



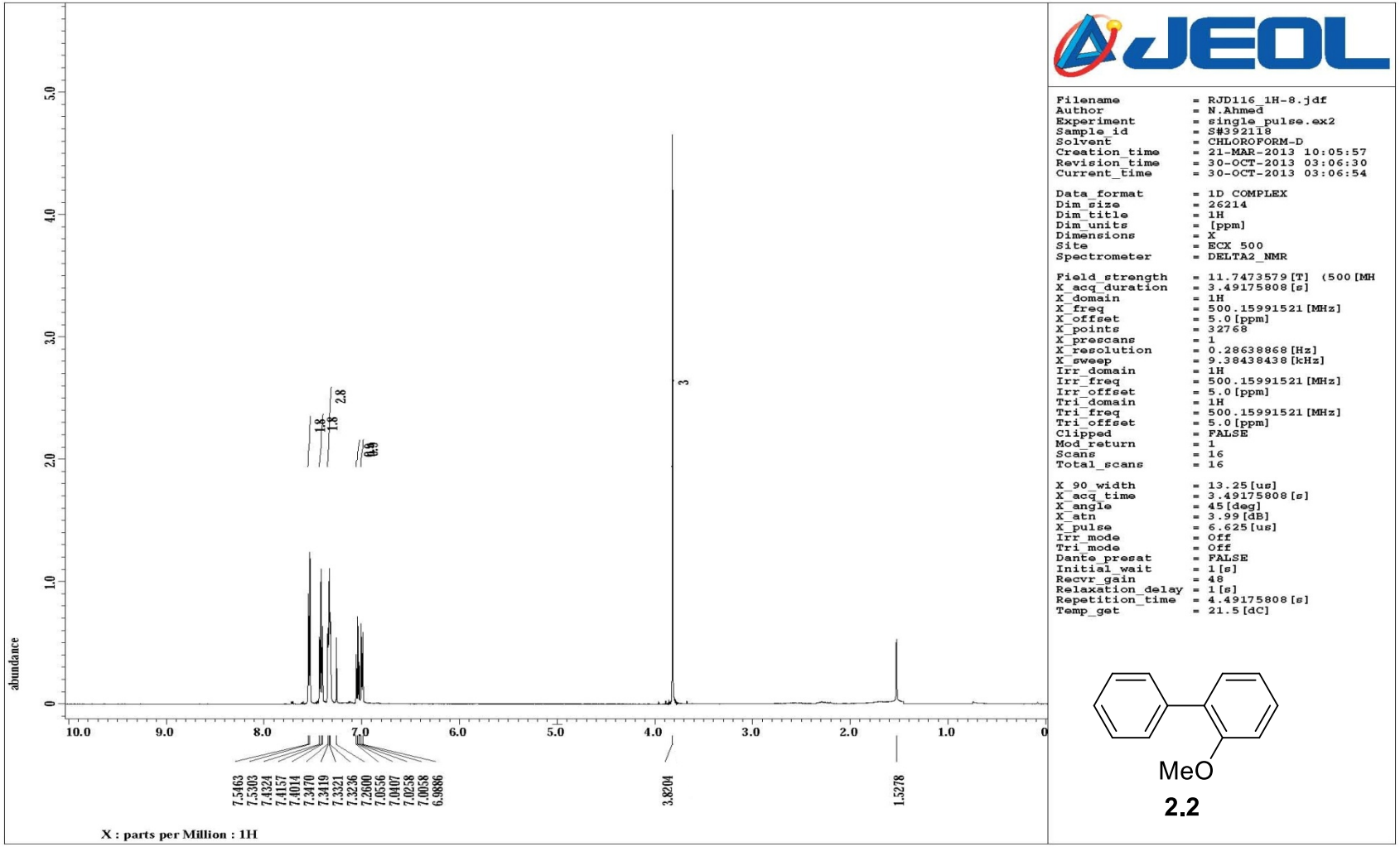
^{1}H NMR spectrum of 2-methoxy-4'-methylbiphenyl (**2.1**)



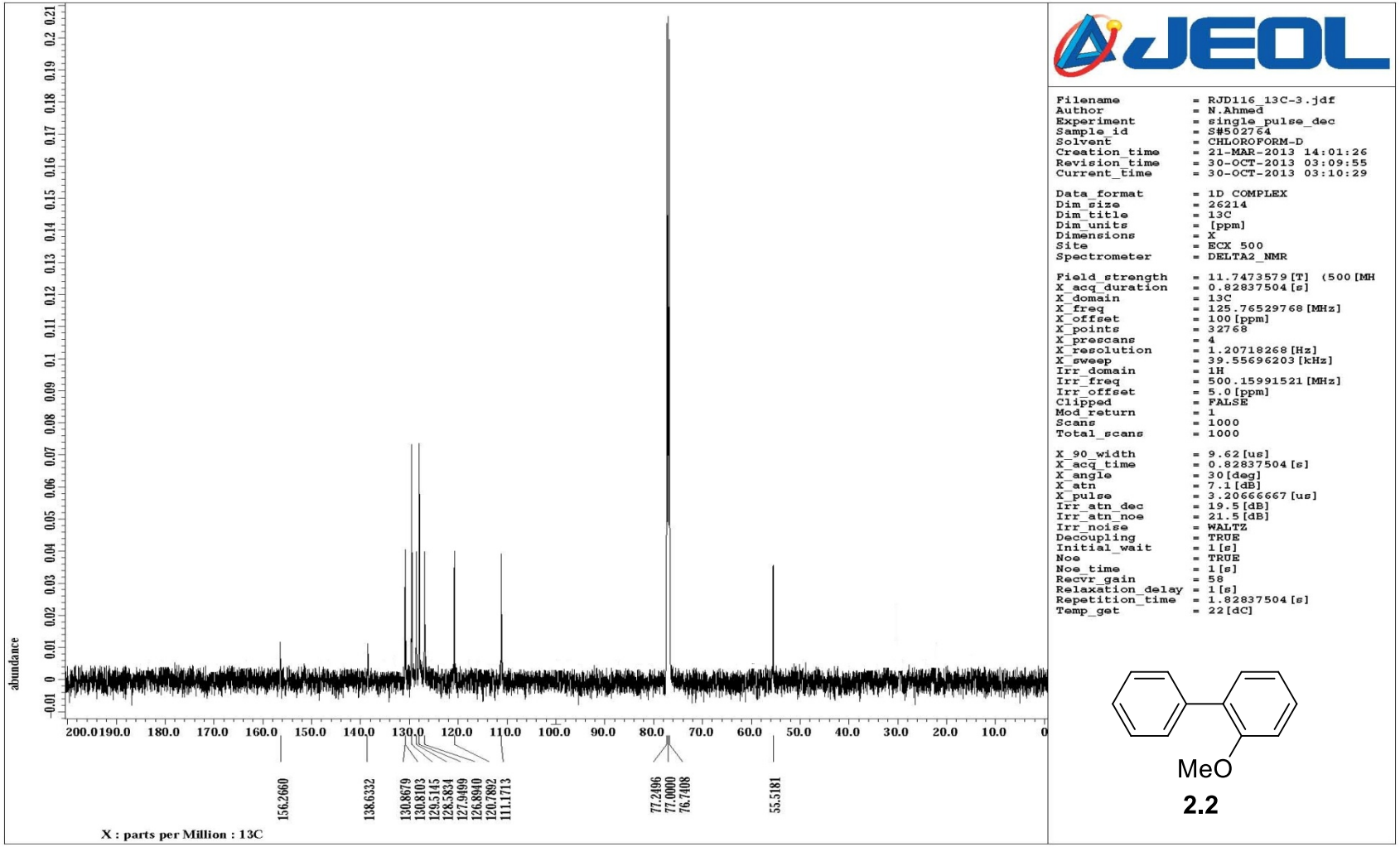
^{13}C NMR spectrum of 2-methoxy-4'-methylbiphenyl (**2.1**)



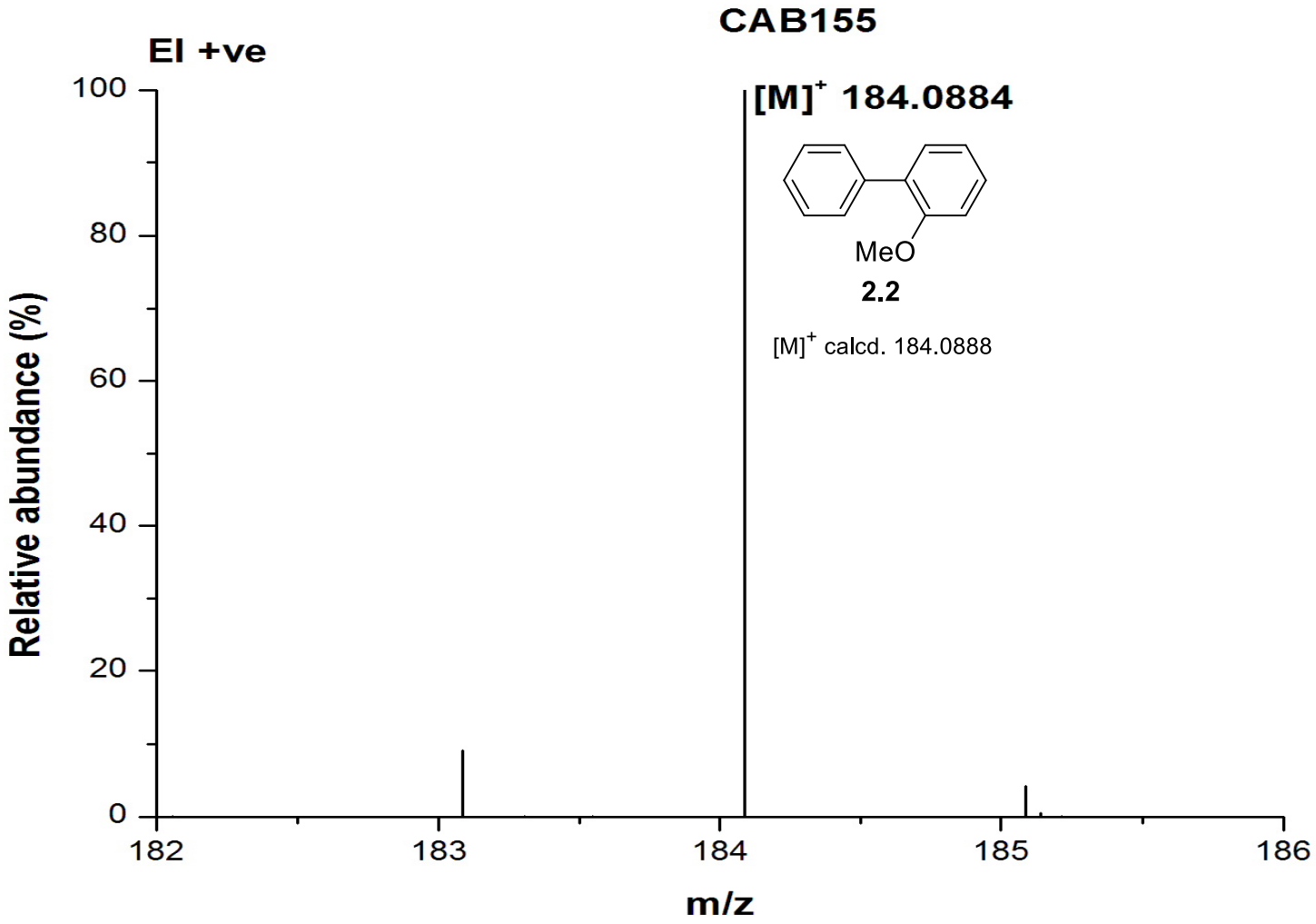
HRMS spectrum of 2-methoxy-4'-methylbiphenyl (**2.1**)



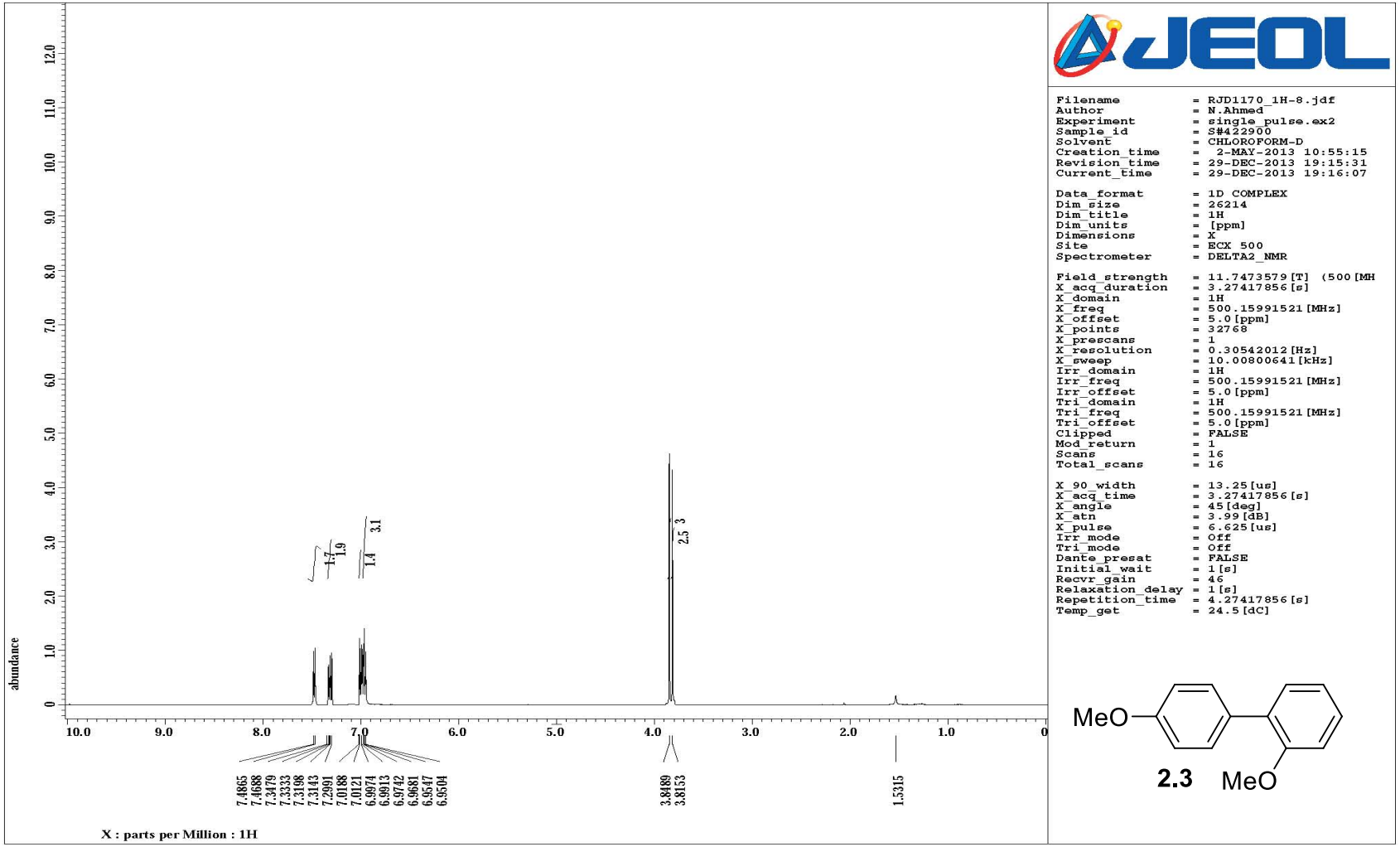
^{1}H NMR spectrum of 2-methoxybiphenyl (**2.2**)



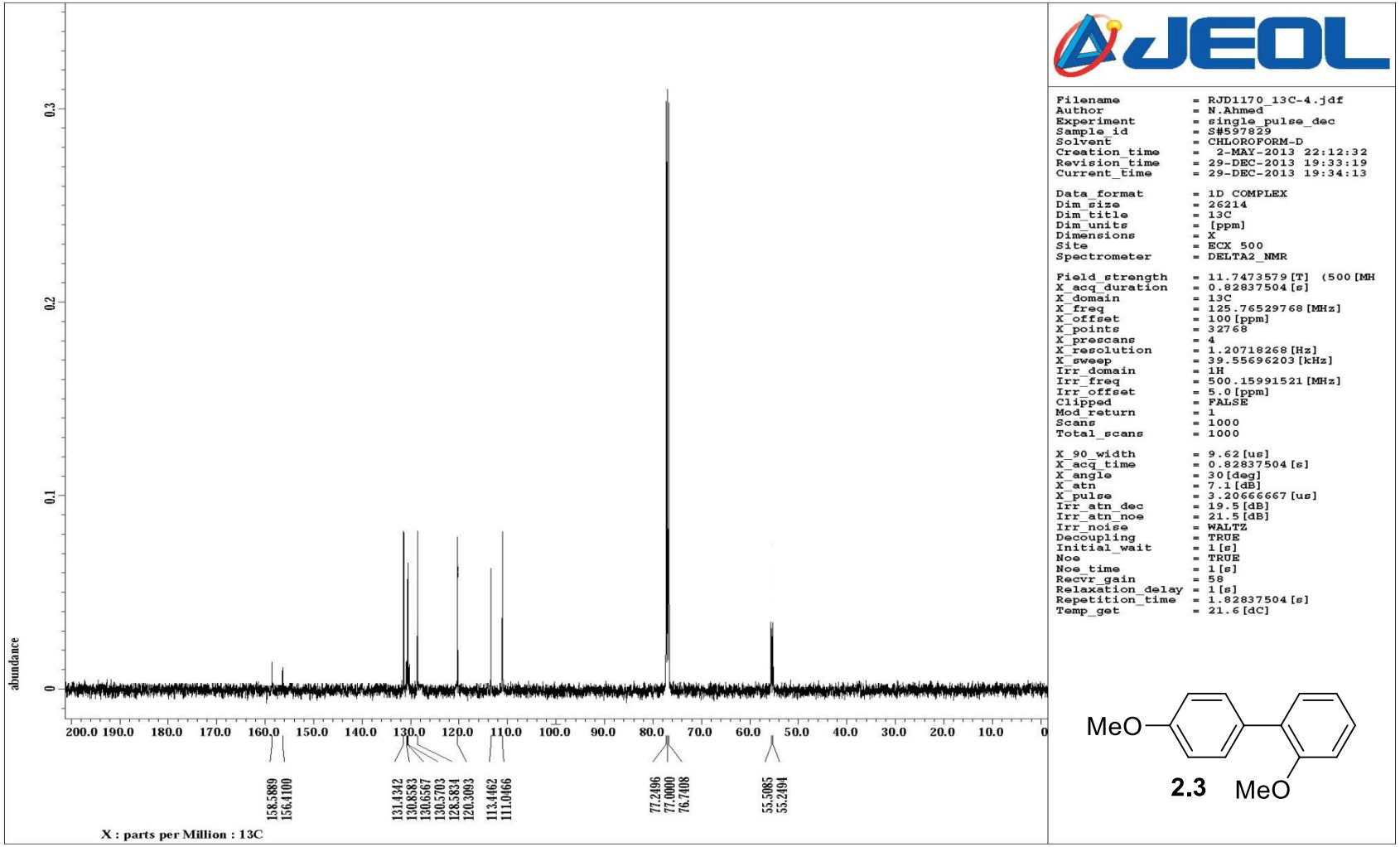
^{13}C NMR spectrum of 2-methoxybiphenyl (**2.2**)



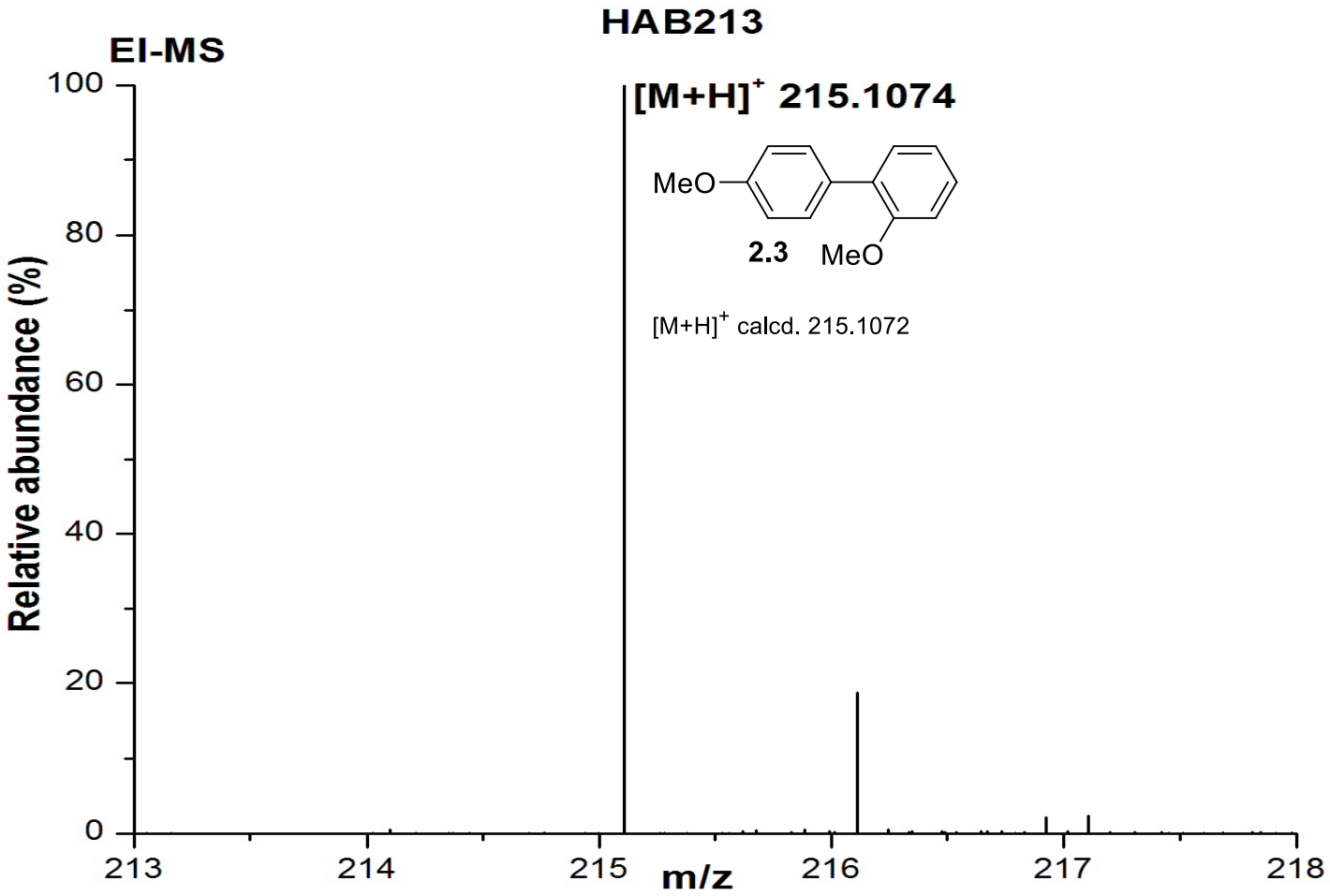
HRMS spectrum of 2-methoxybipheyl (**2.2**)



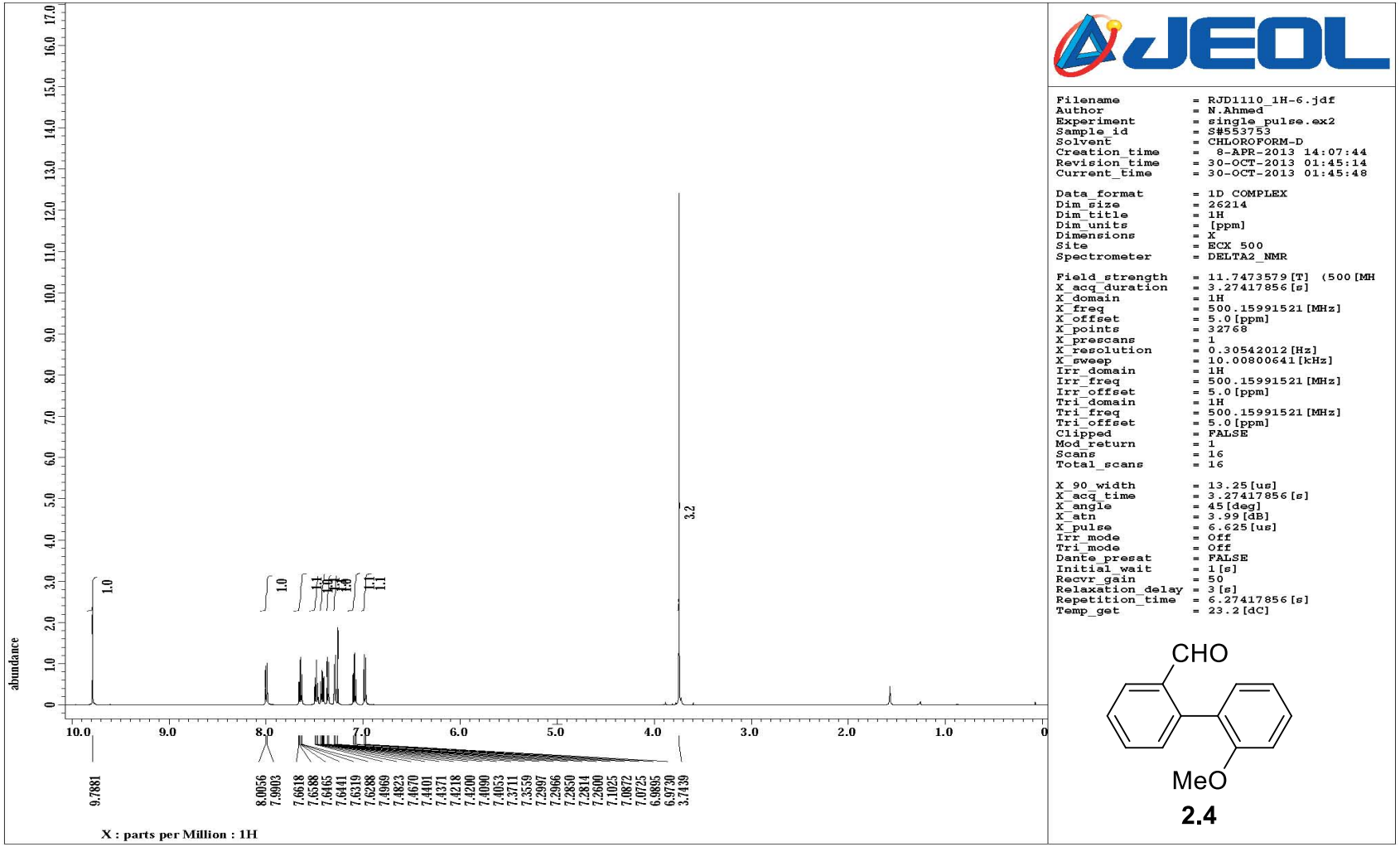
^{1}H NMR spectrum of 2,4'-dimethoxybiphenyl (**2.3**)



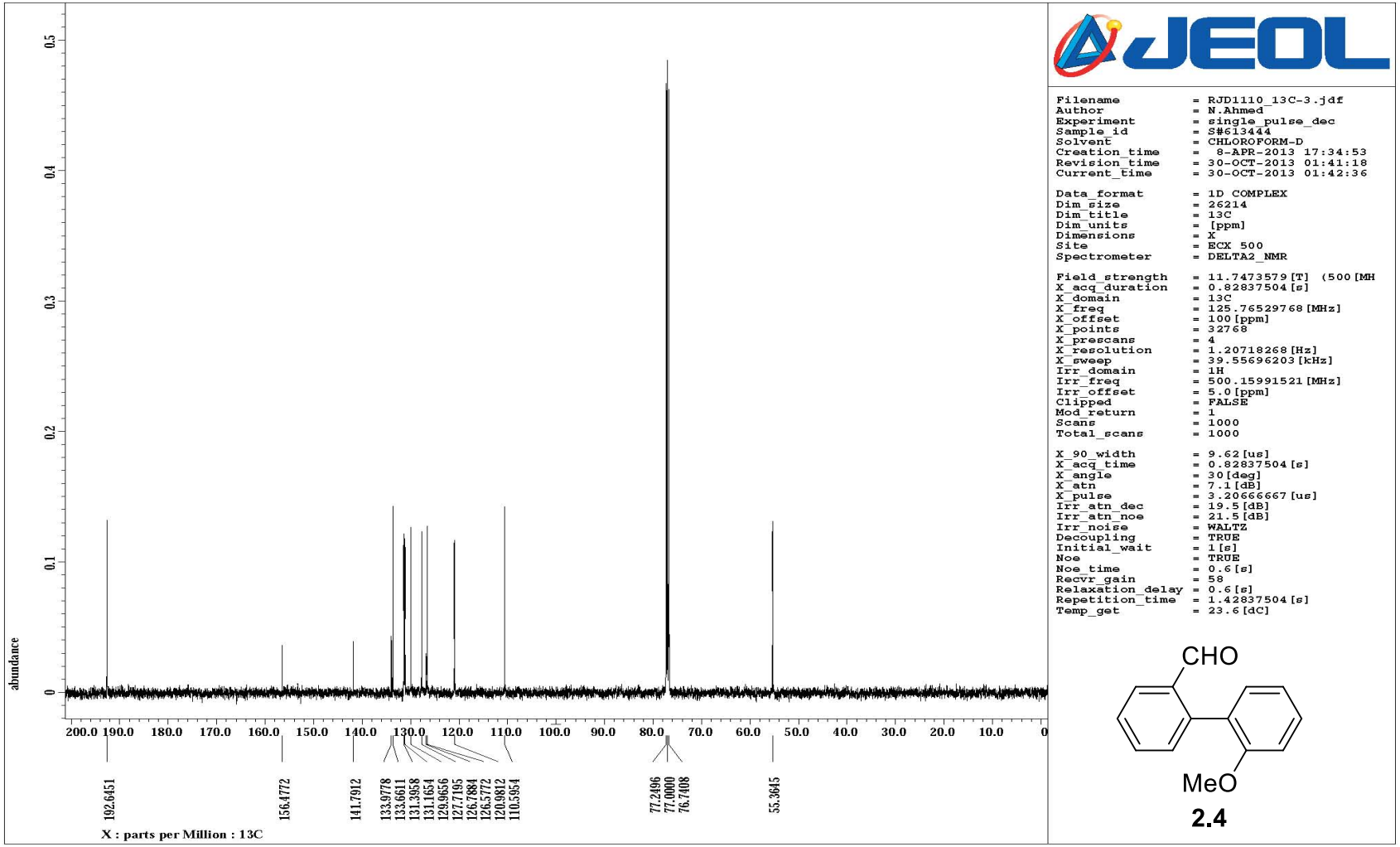
^{13}C NMR spectrum of 2,4'-dimethoxybiphenyl (**2.3**)



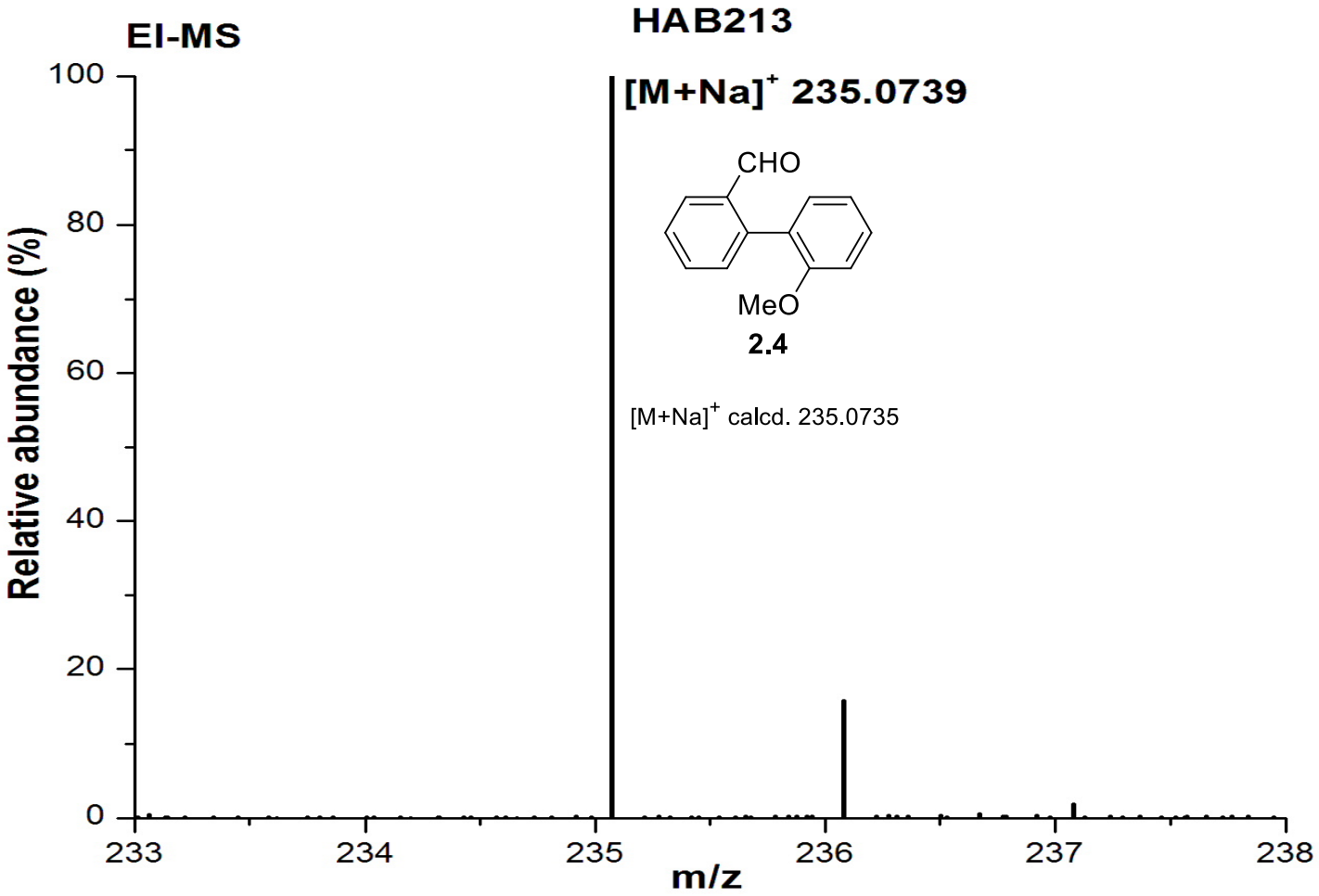
HRMS spectrum of 2,4'-dimethoxybiphenyl (**2.3**)



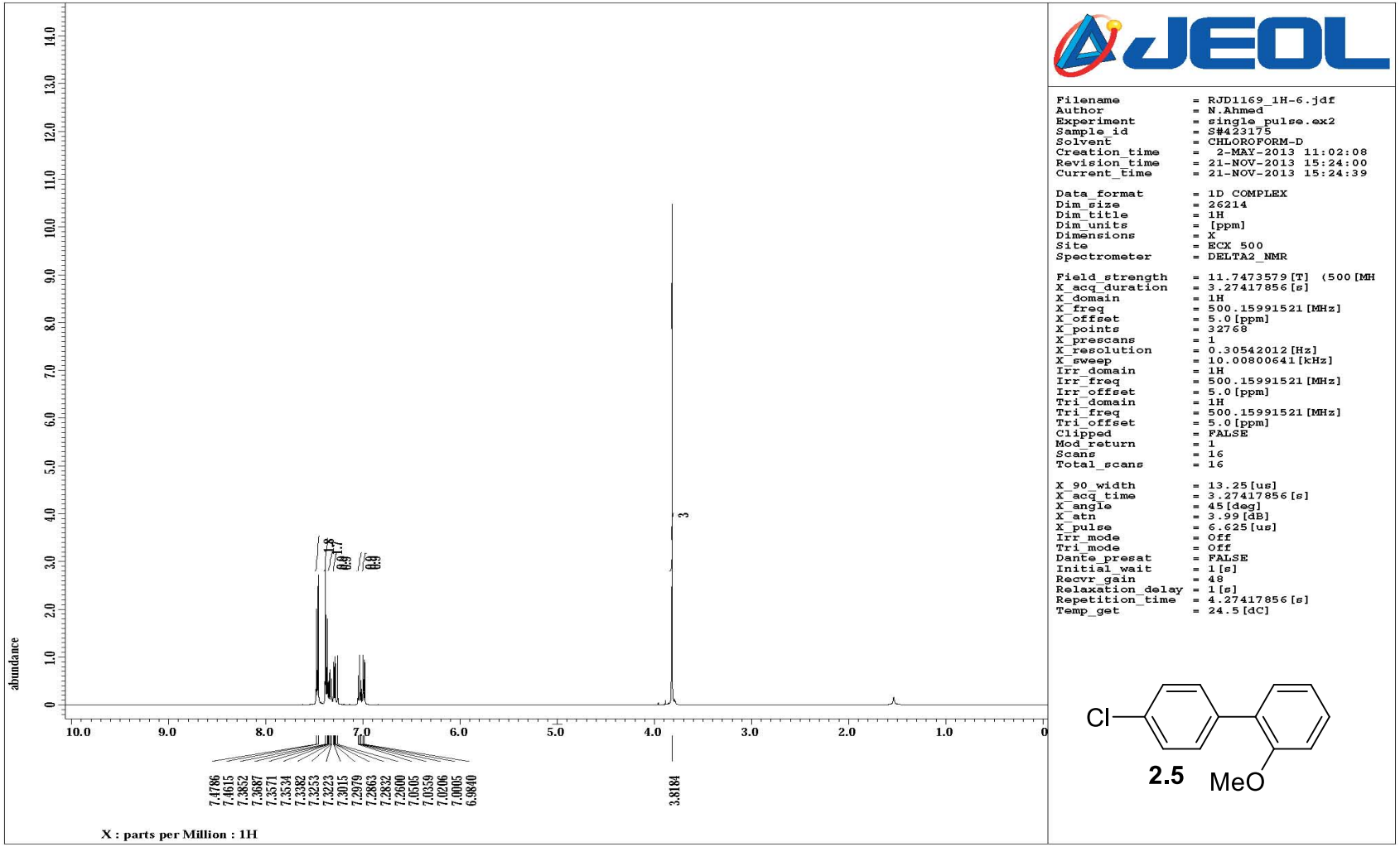
^{1}H NMR spectrum of 2'-methoxybiphenyl-2-carbaldehyde (**2.4**)



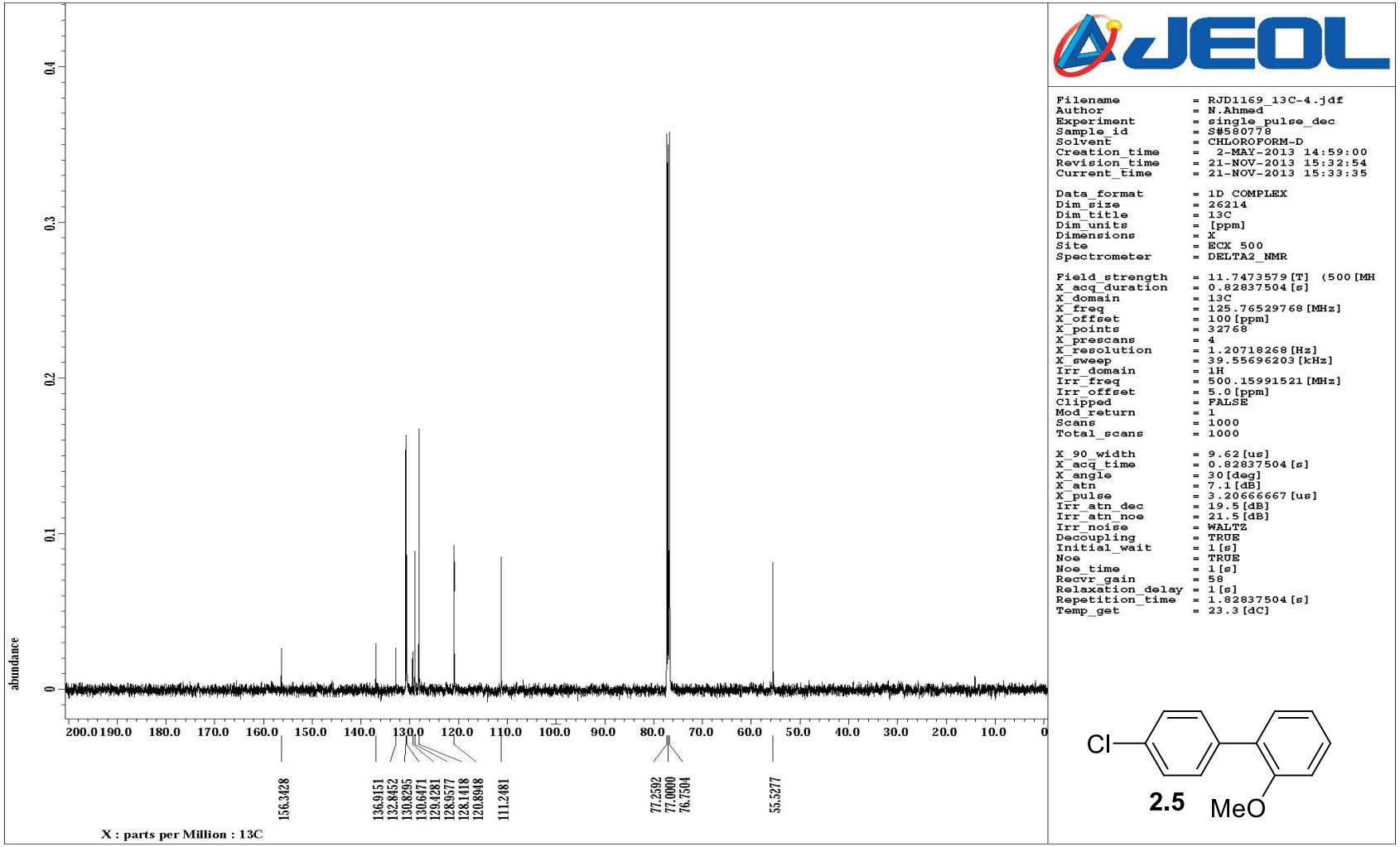
^{13}C NMR spectrum of 2'-methoxybiphenyl-2-carbaldehyde (**2.4**)



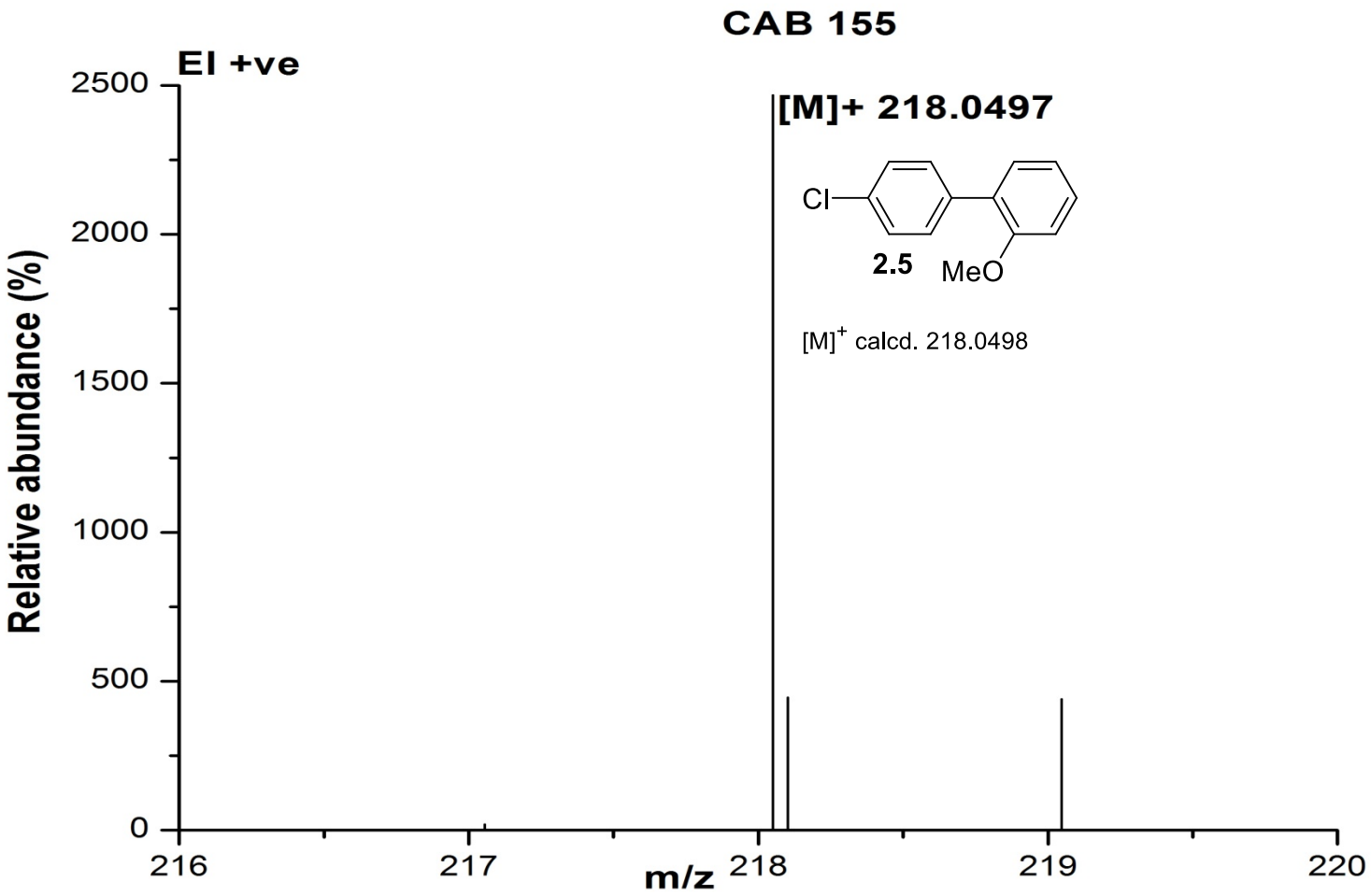
HRMS spectrum of 2'-methoxybiphenyl-2-carbaldehyde (**2.4**)



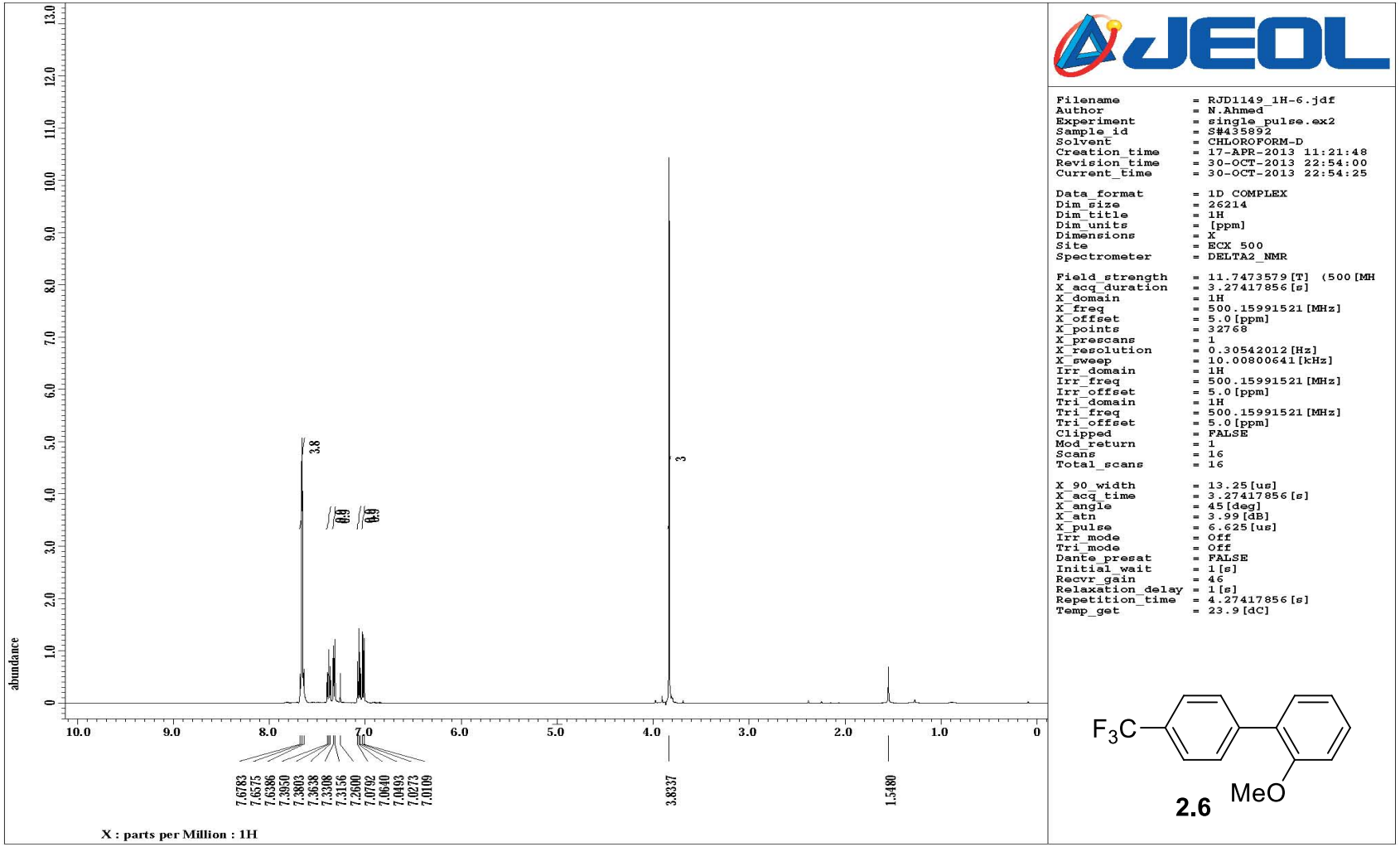
^{1}H NMR spectrum of 4'-chloro-2-methoxybiphenyl (**2.5**)



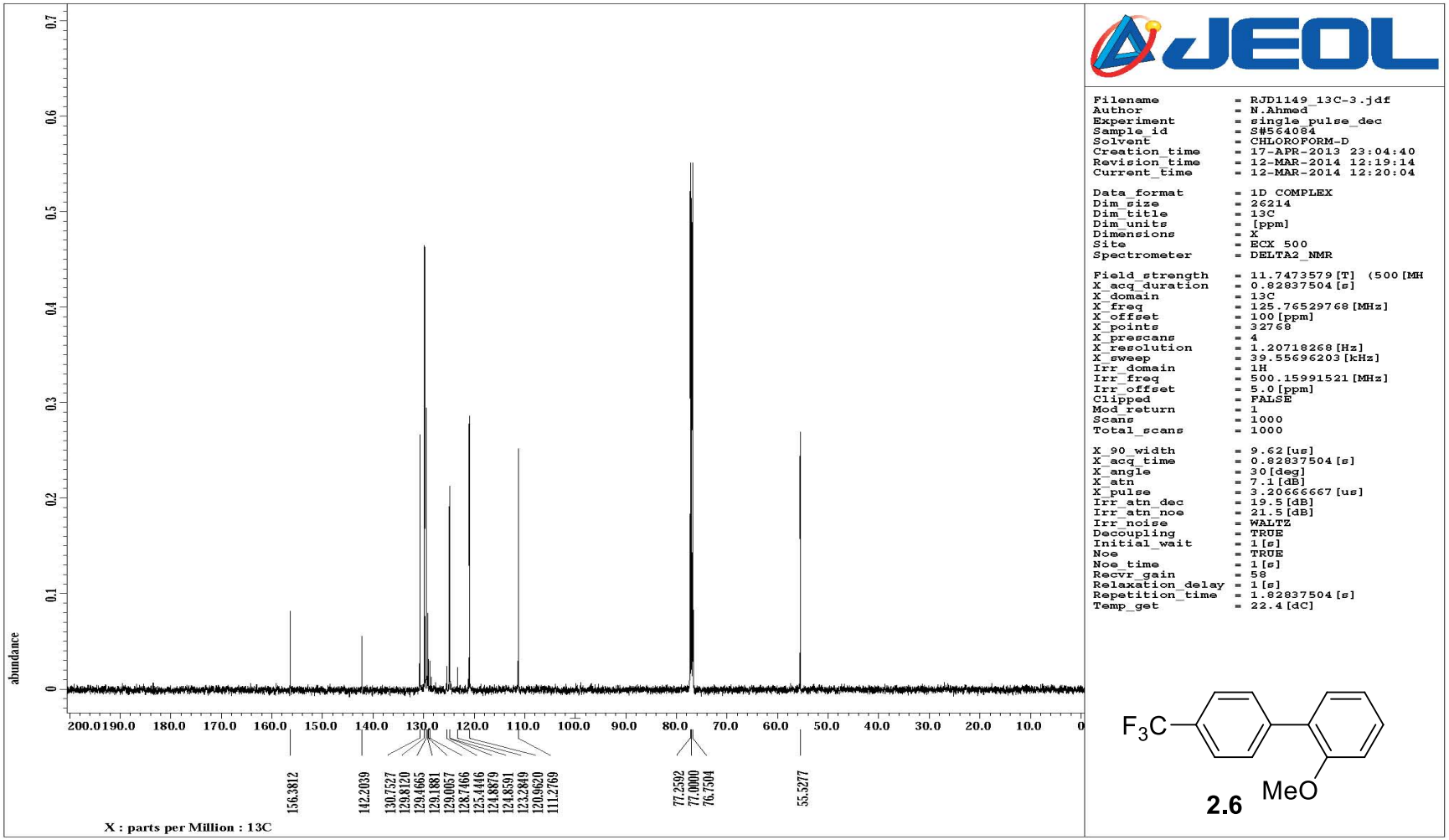
^{13}C NMR spectrum of 4'-chloro-2-methoxybiphenyl (**2.5**)



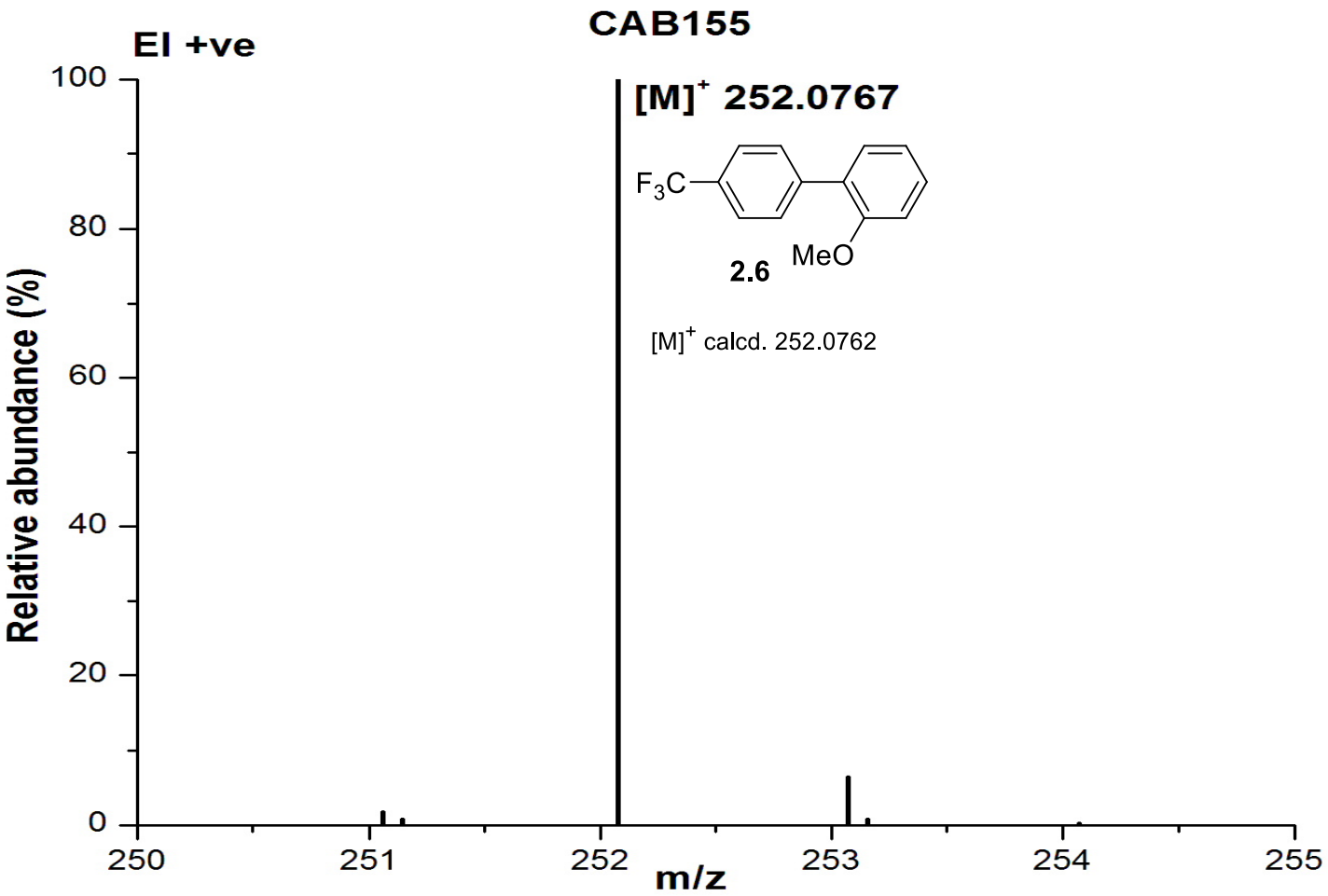
HRMS spectrum of 4'-chloro-2-methoxybiphenyl (**2.5**)



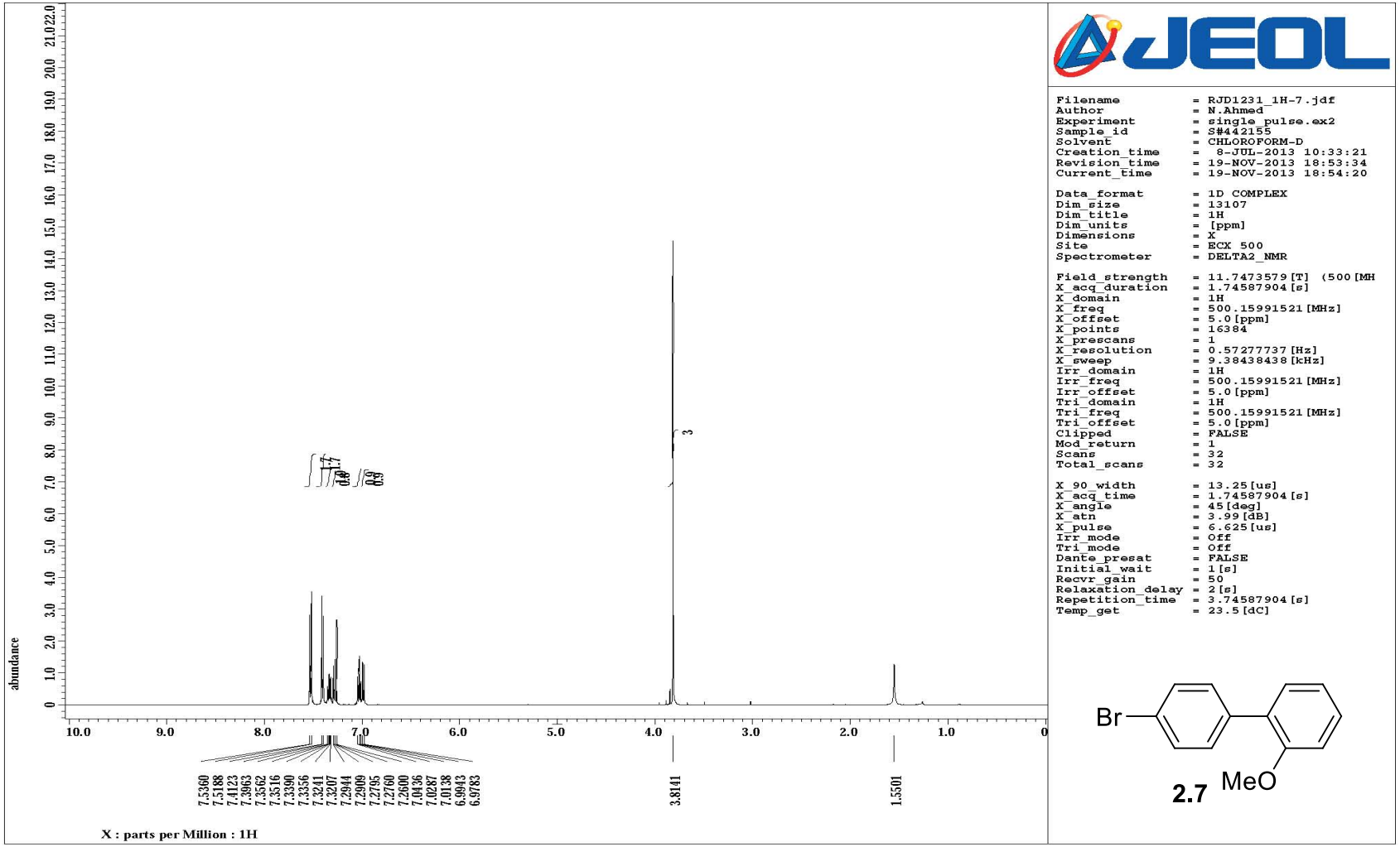
^{1}H NMR spectrum of 2-methoxy-4'-(trifluoromethyl)biphenyl (**2.6**)



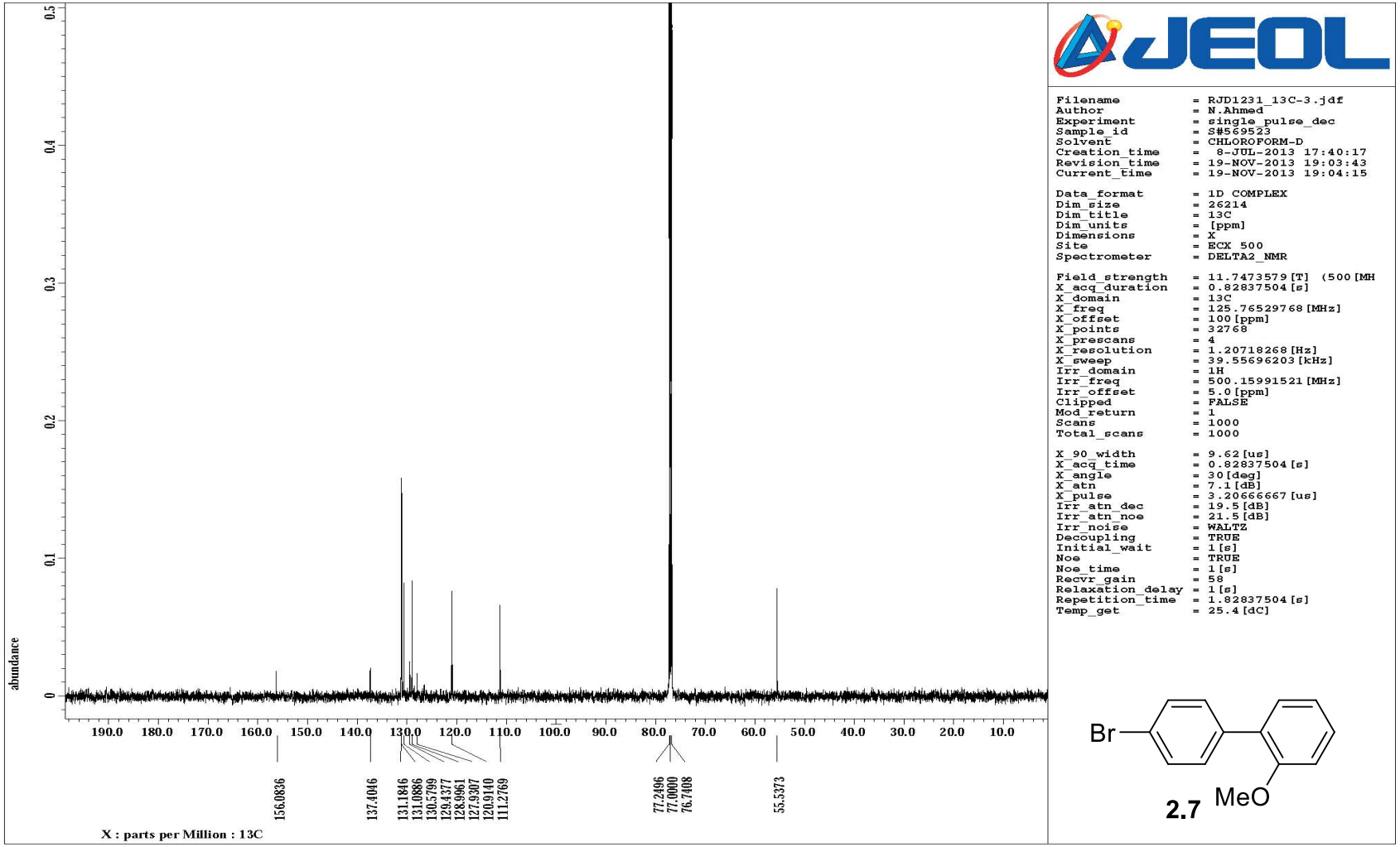
^{13}C NMR spectrum of 2-methoxy-4'-(trifluoromethyl)biphenyl (**2.6**)



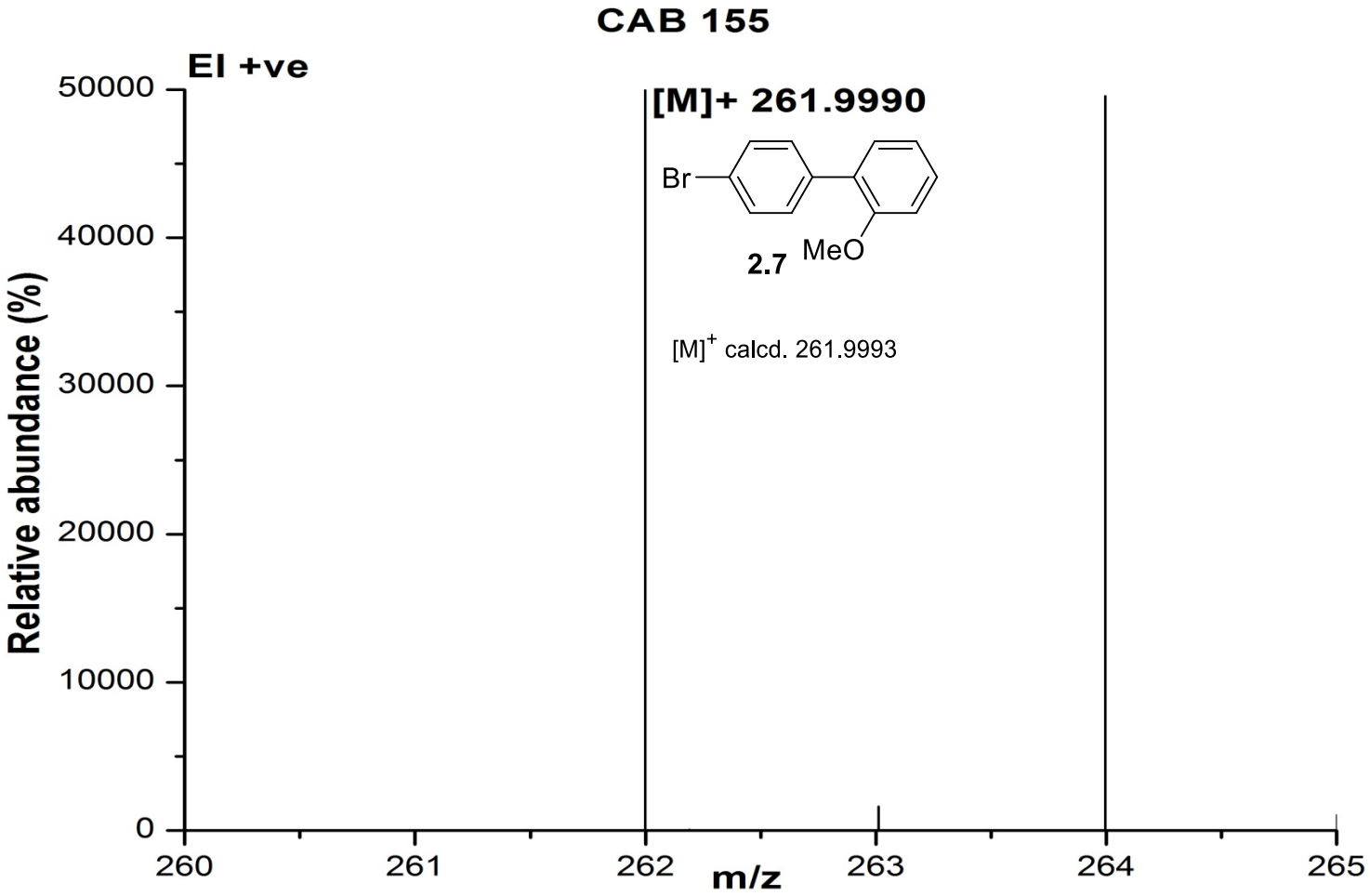
HRMS spectrum of 2-methoxy-4'-(trifluoromethyl)biphenyl (**2.6**)



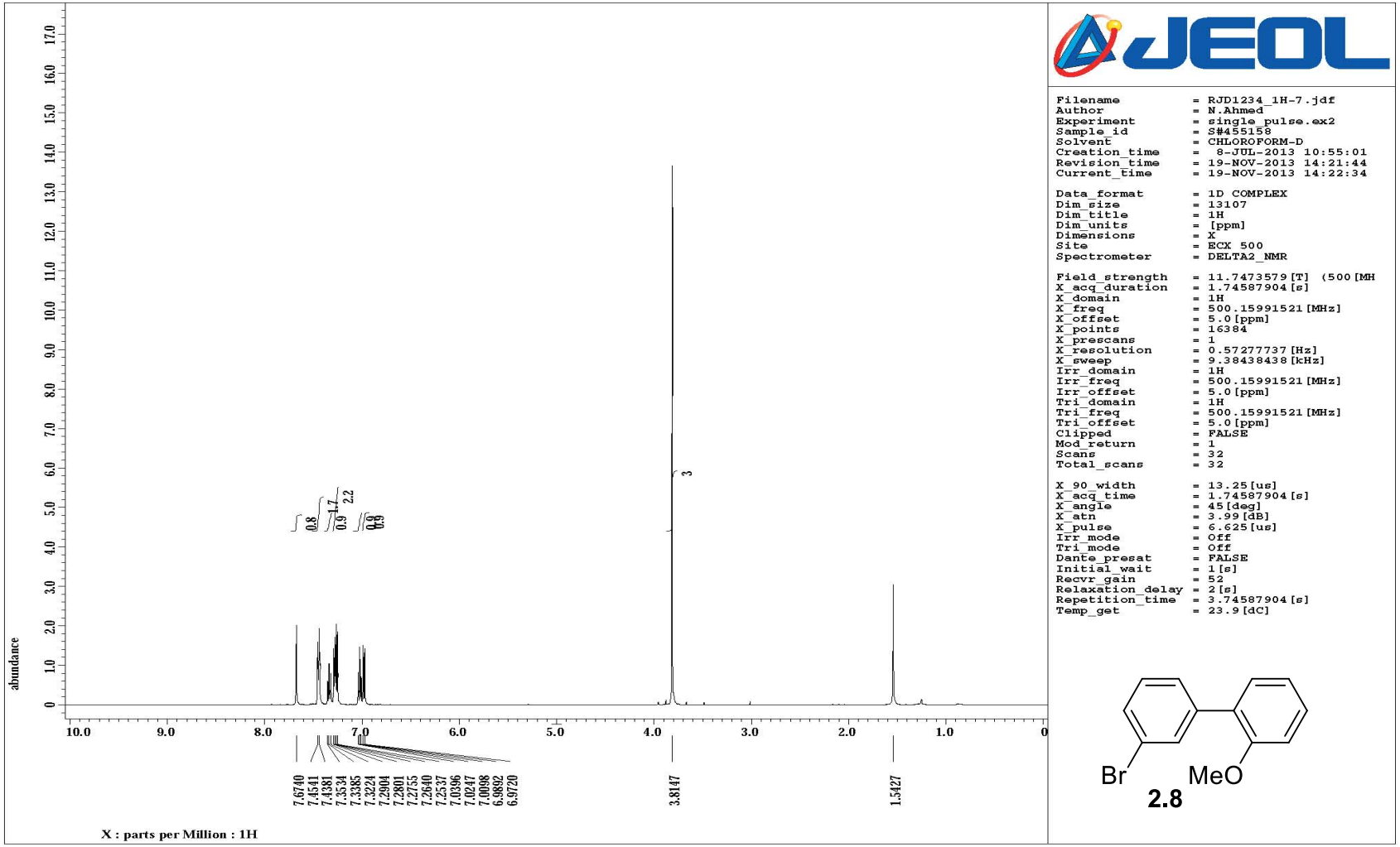
^{1}H NMR spectrum of 4'-bromo-2-methoxybiphenyl (**2.7**)



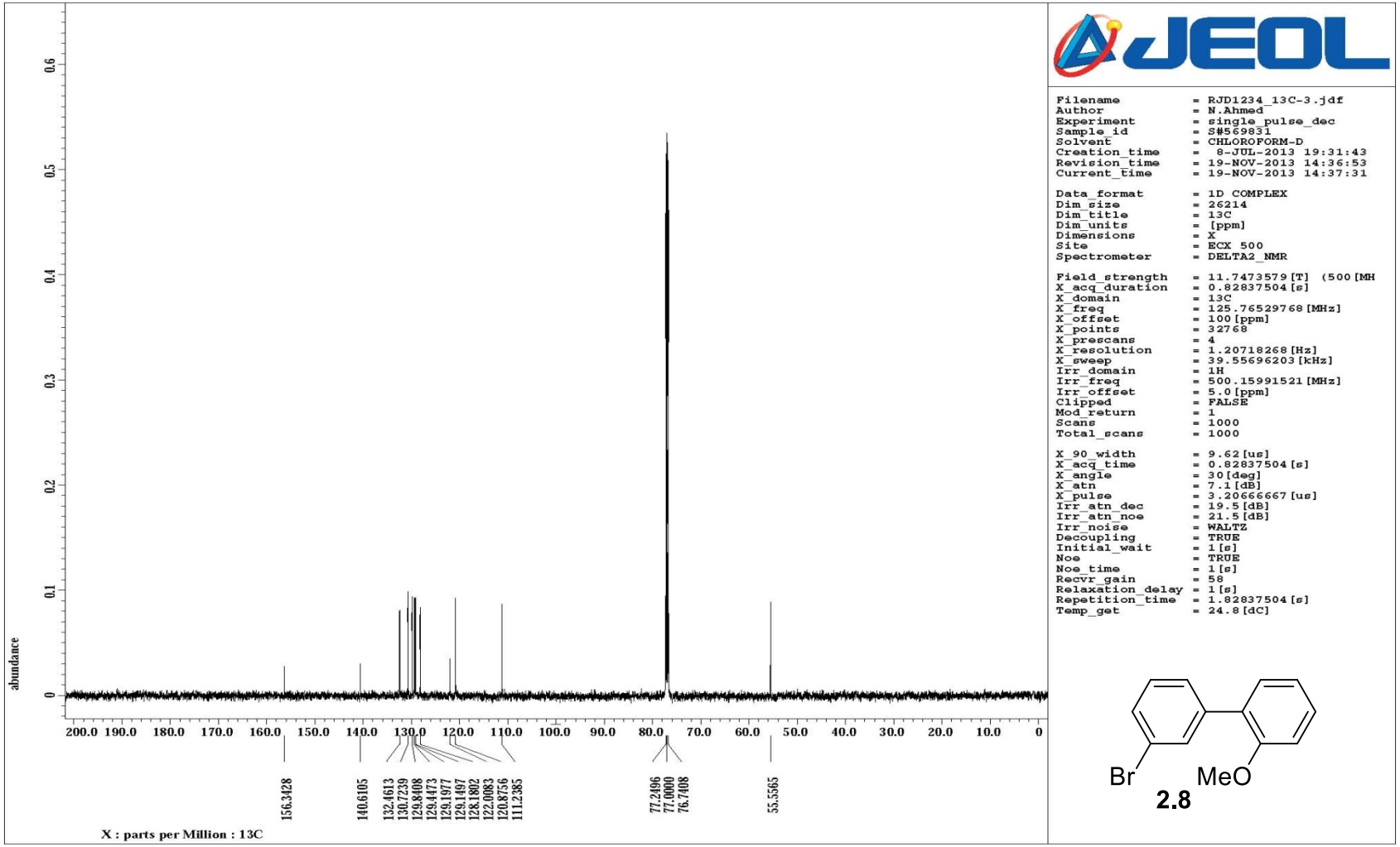
^{13}C NMR spectrum of 4'-bromo-2-methoxybiphenyl (**2.7**)



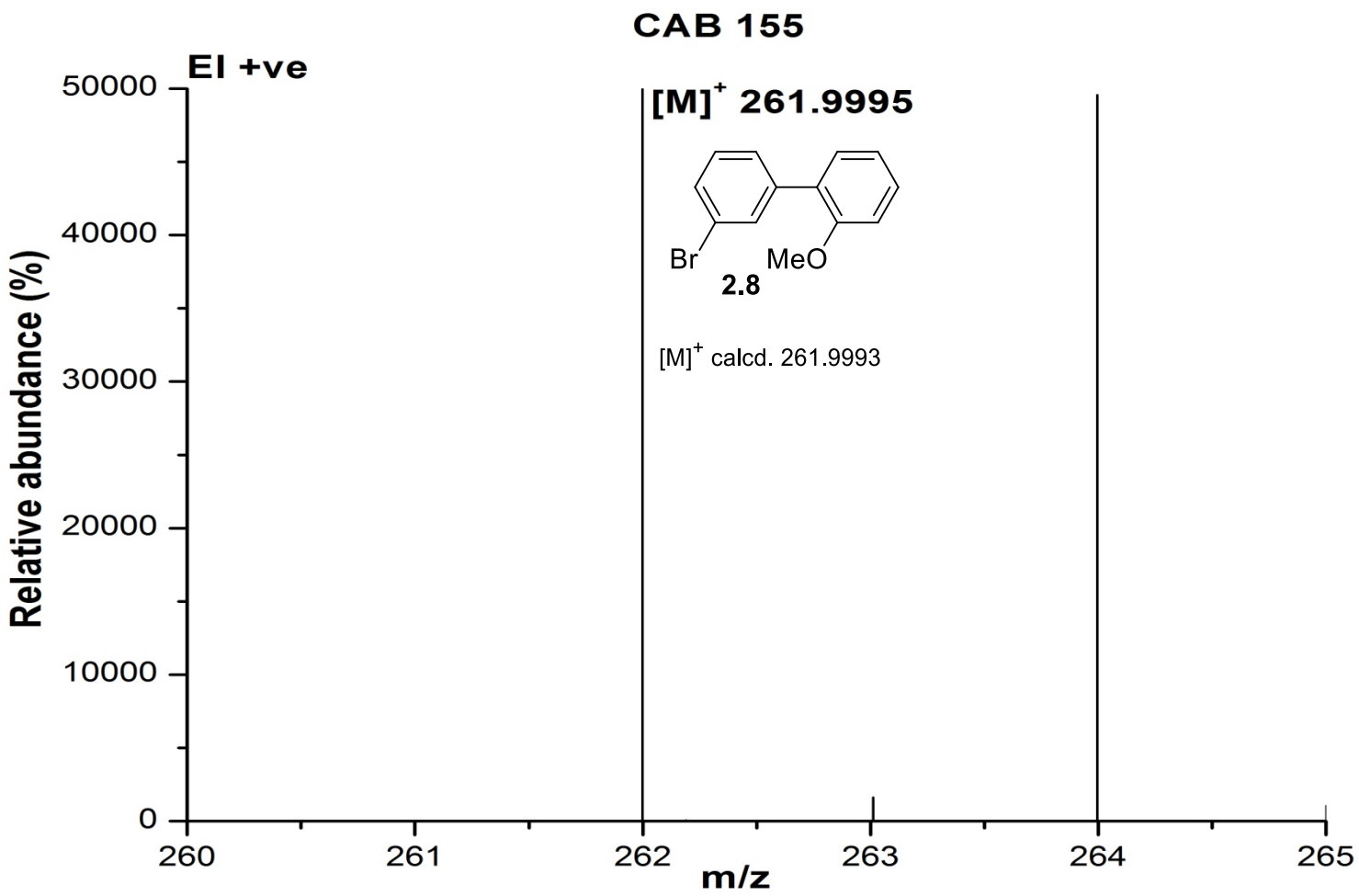
HRMS spectrum of 4'-bromo-2-methoxybiphenyl (**2.7**)



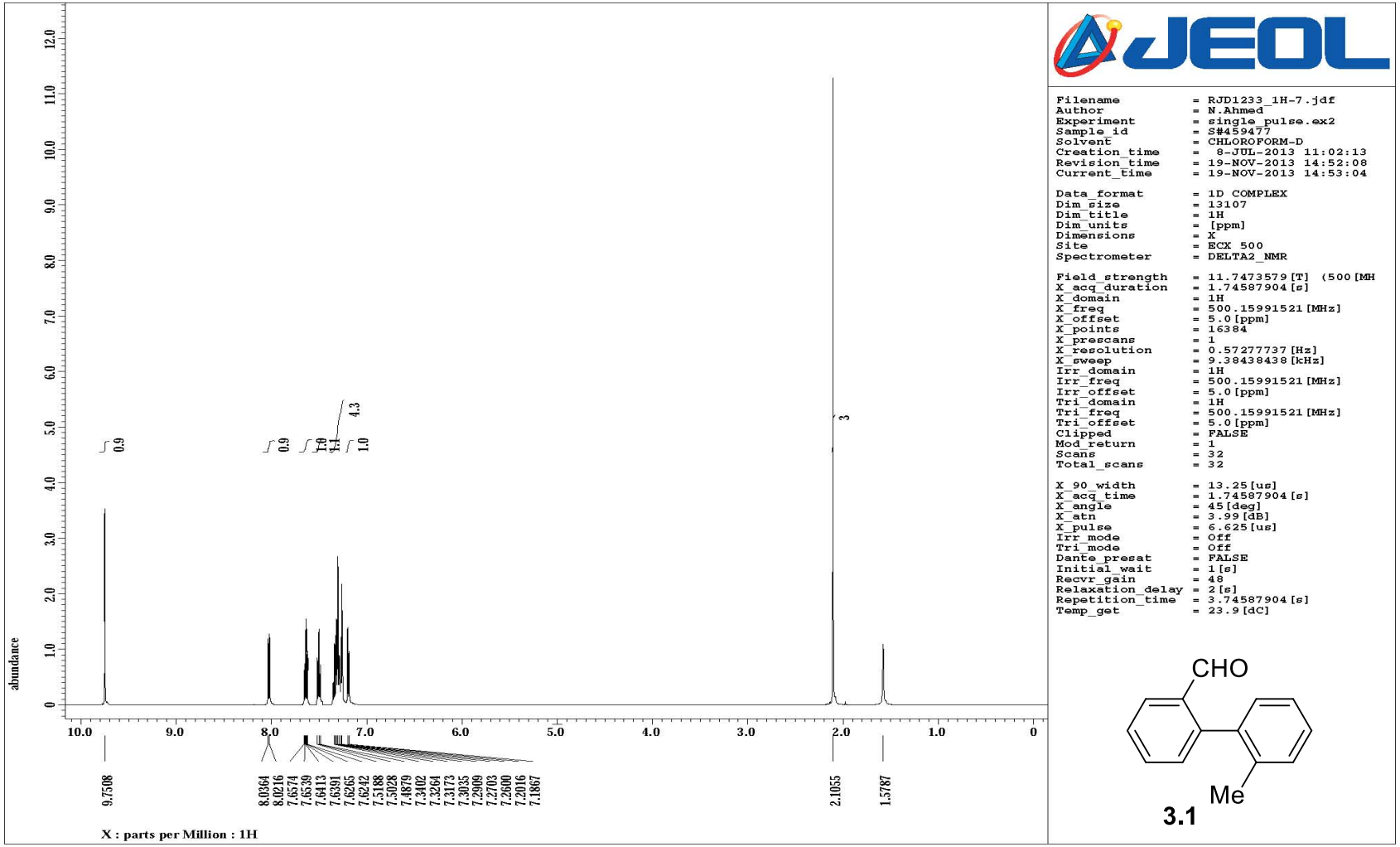
^{1}H NMR spectrum of 3'-bromo-2-methoxybiphenyl (**2.8**)



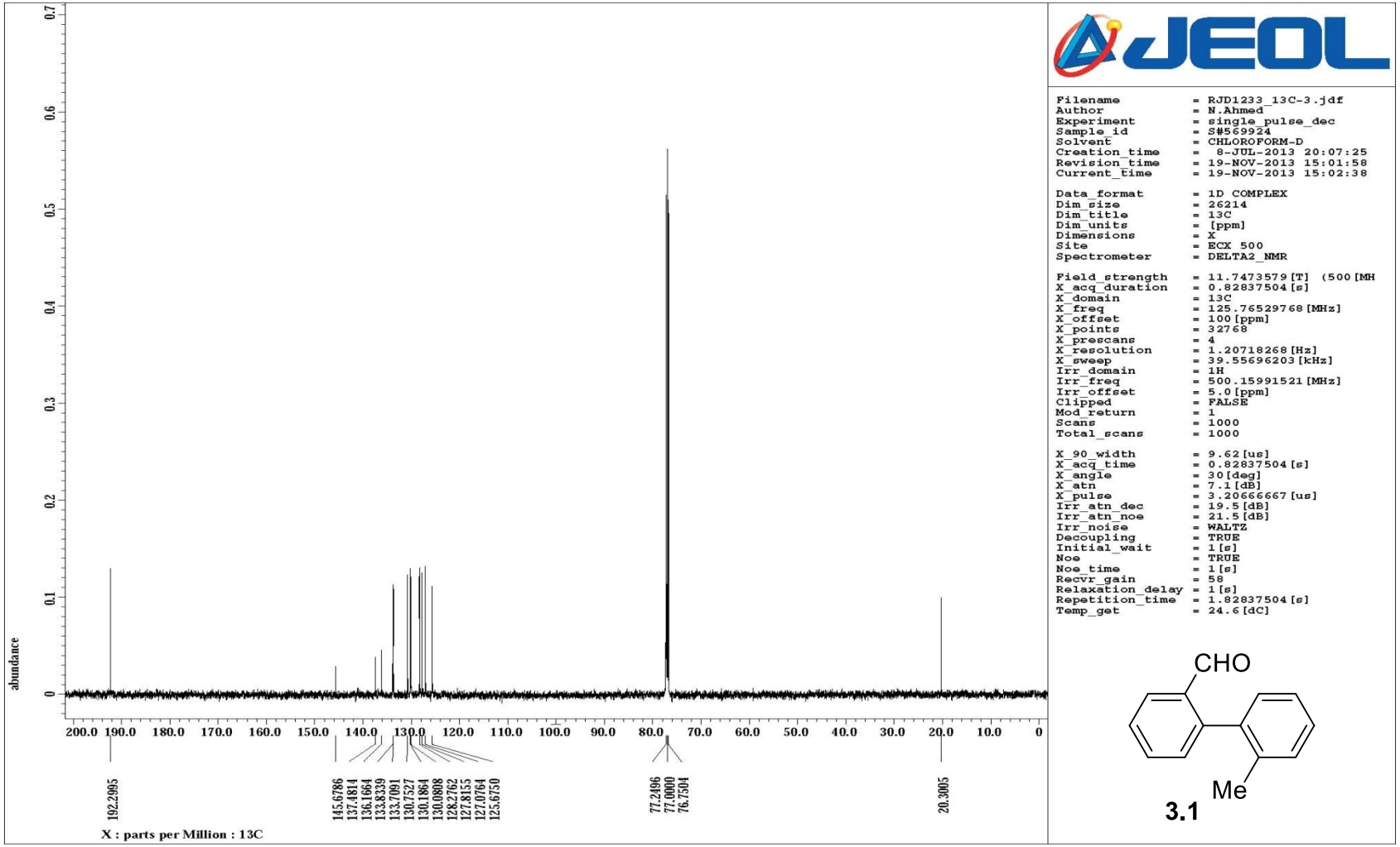
^{13}C NMR spectrum of 3'-bromo-2-methoxybiphenyl (**2.8**)



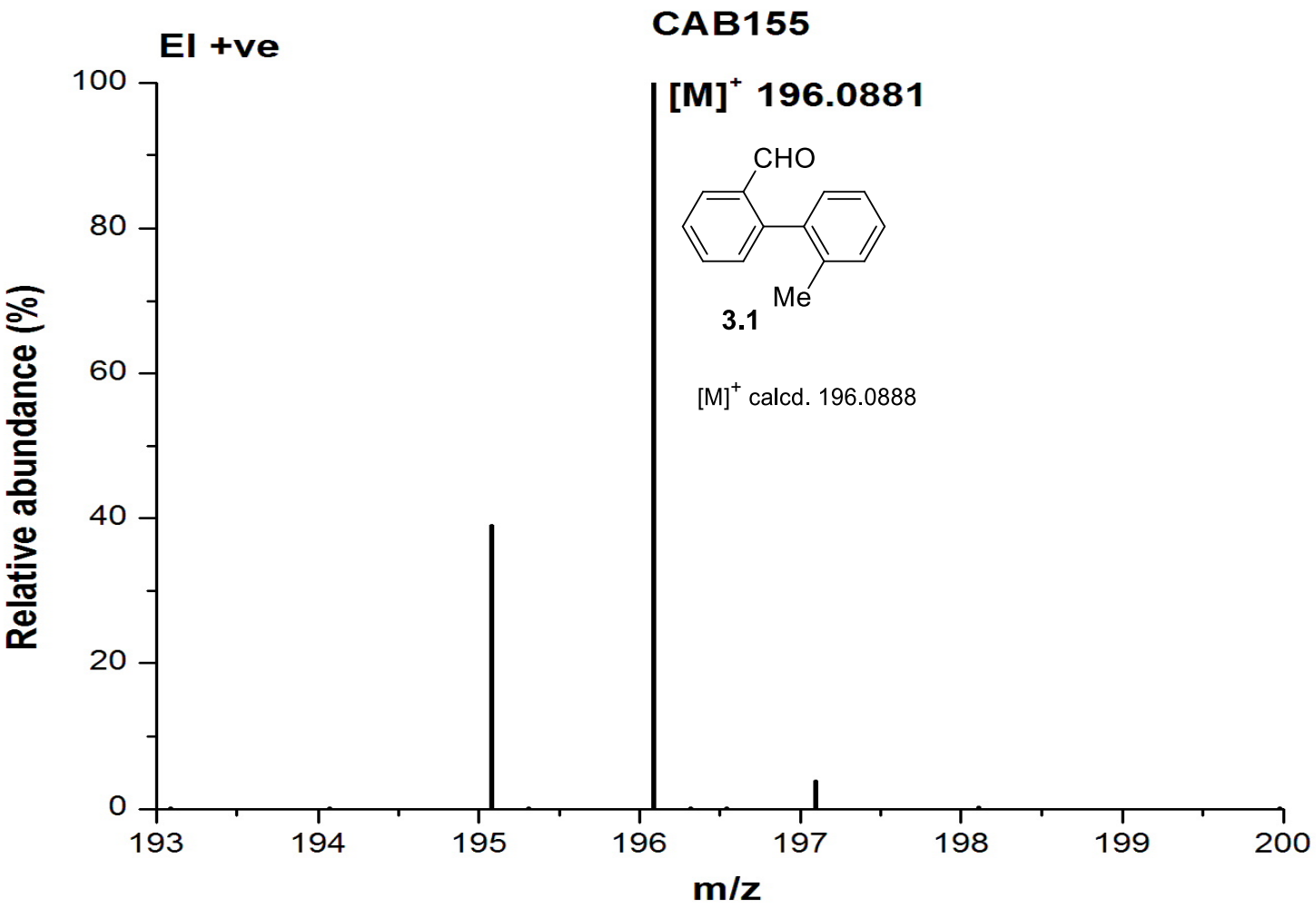
HRMS spectrum of 3'-bromo-2-methoxybiphenyl (**2.8**)



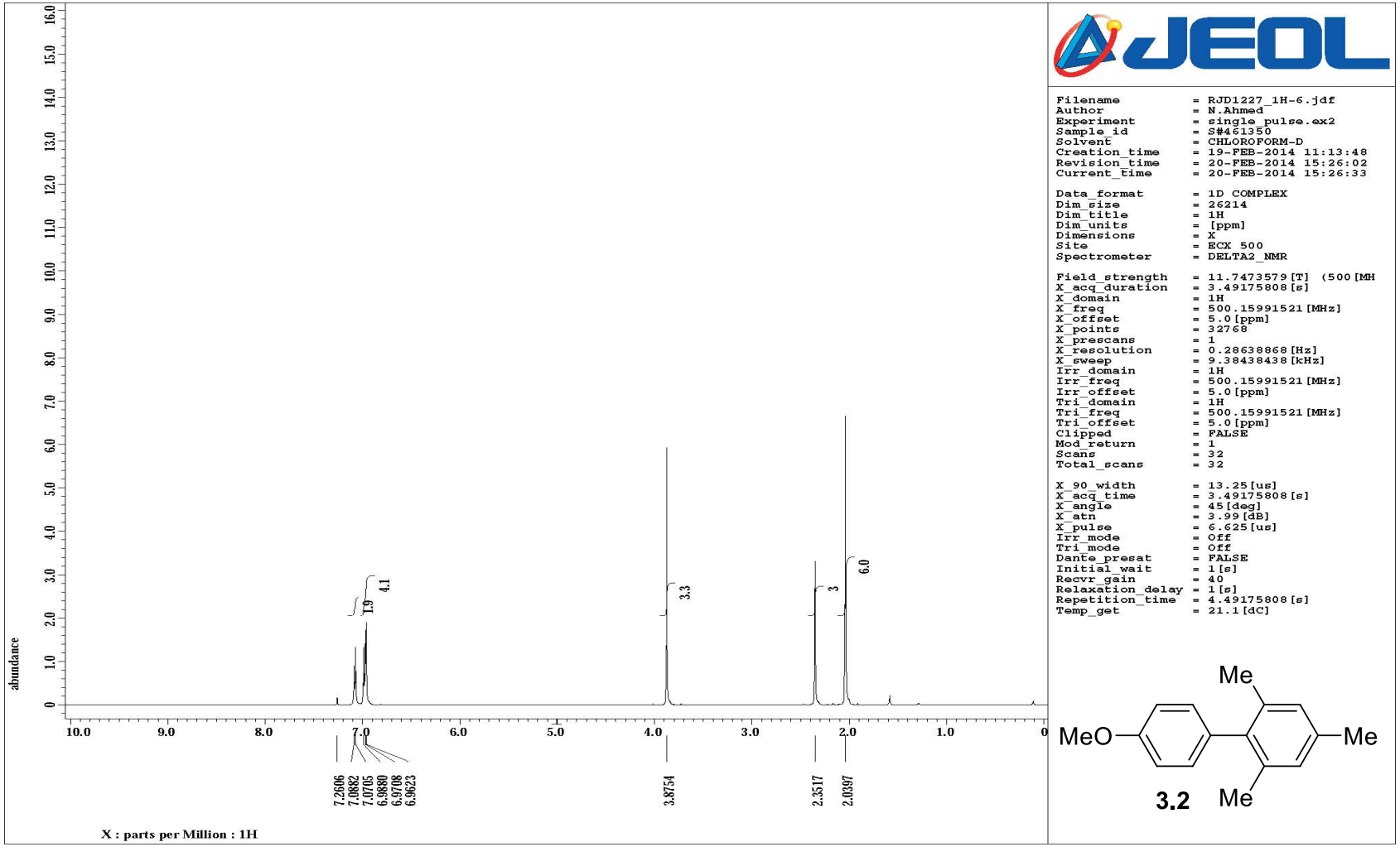
^{1}H NMR spectrum of 2'-methylbiphenyl-2-carbaldehyde (**3.1**)



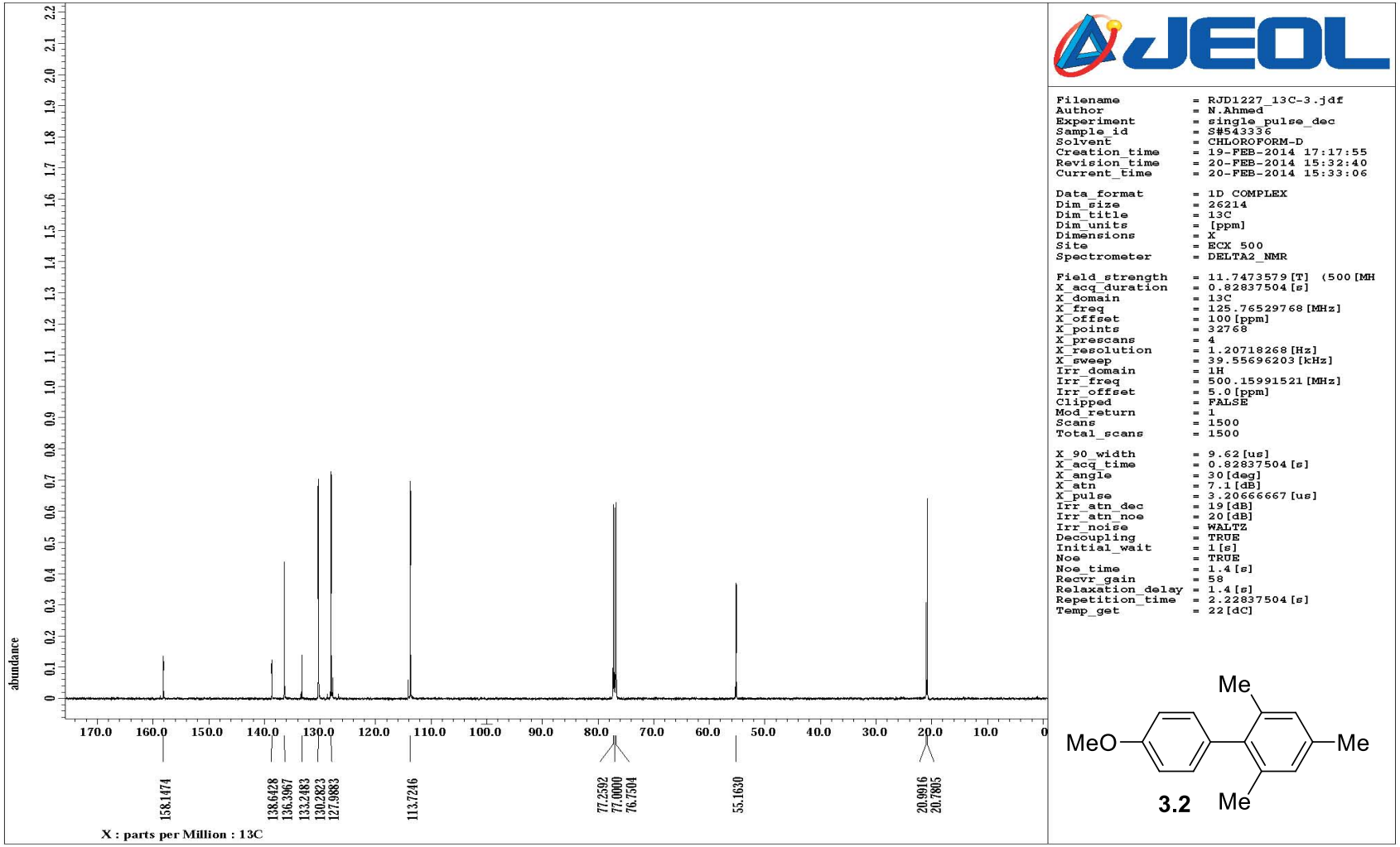
^{13}C NMR spectrum of 2'-methylbiphenyl-2-carbaldehyde (**3.1**)



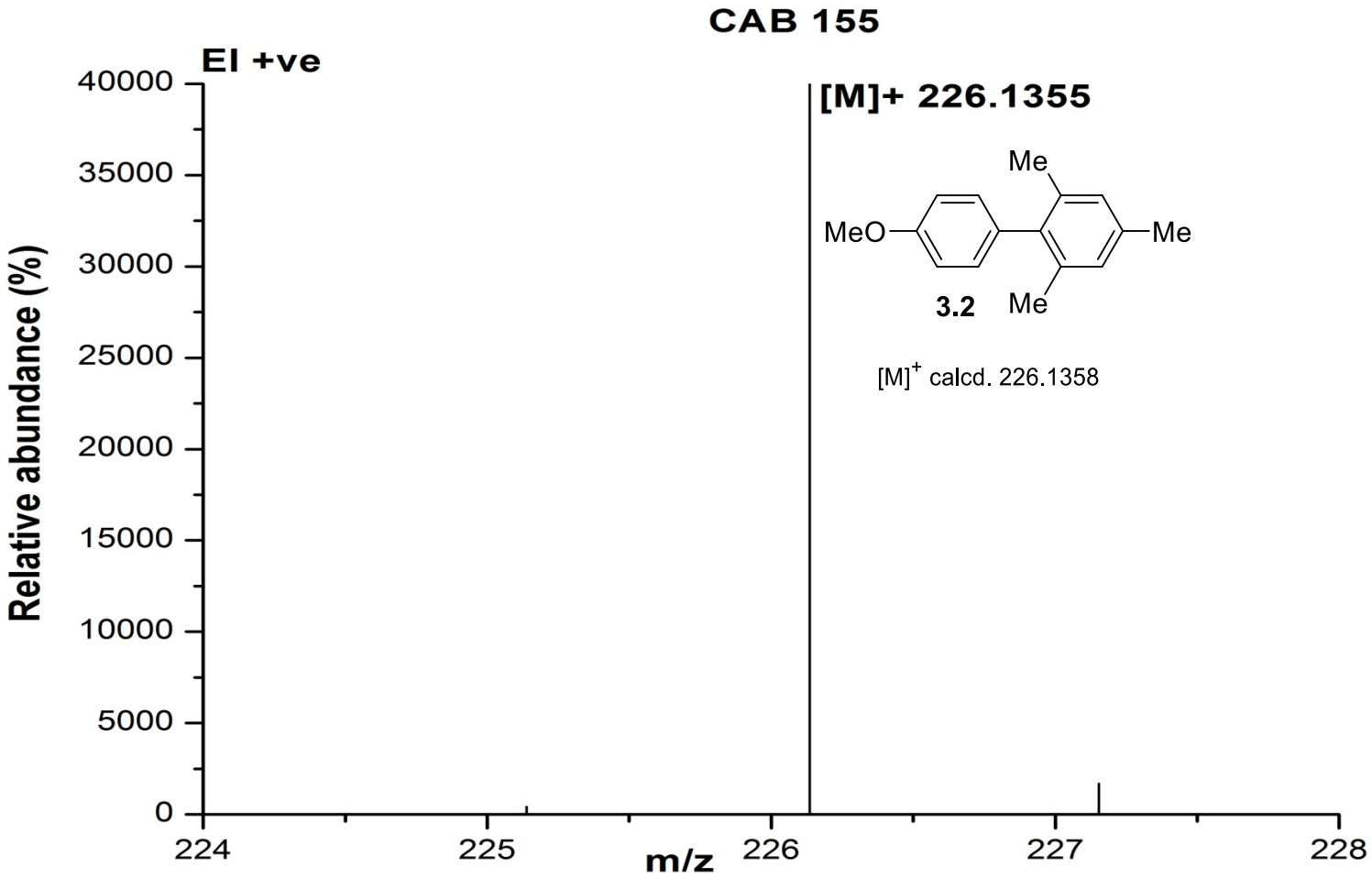
HRMS spectrum of 2'-methylbiphenyl-2-carbaldehyde (**3.1**)



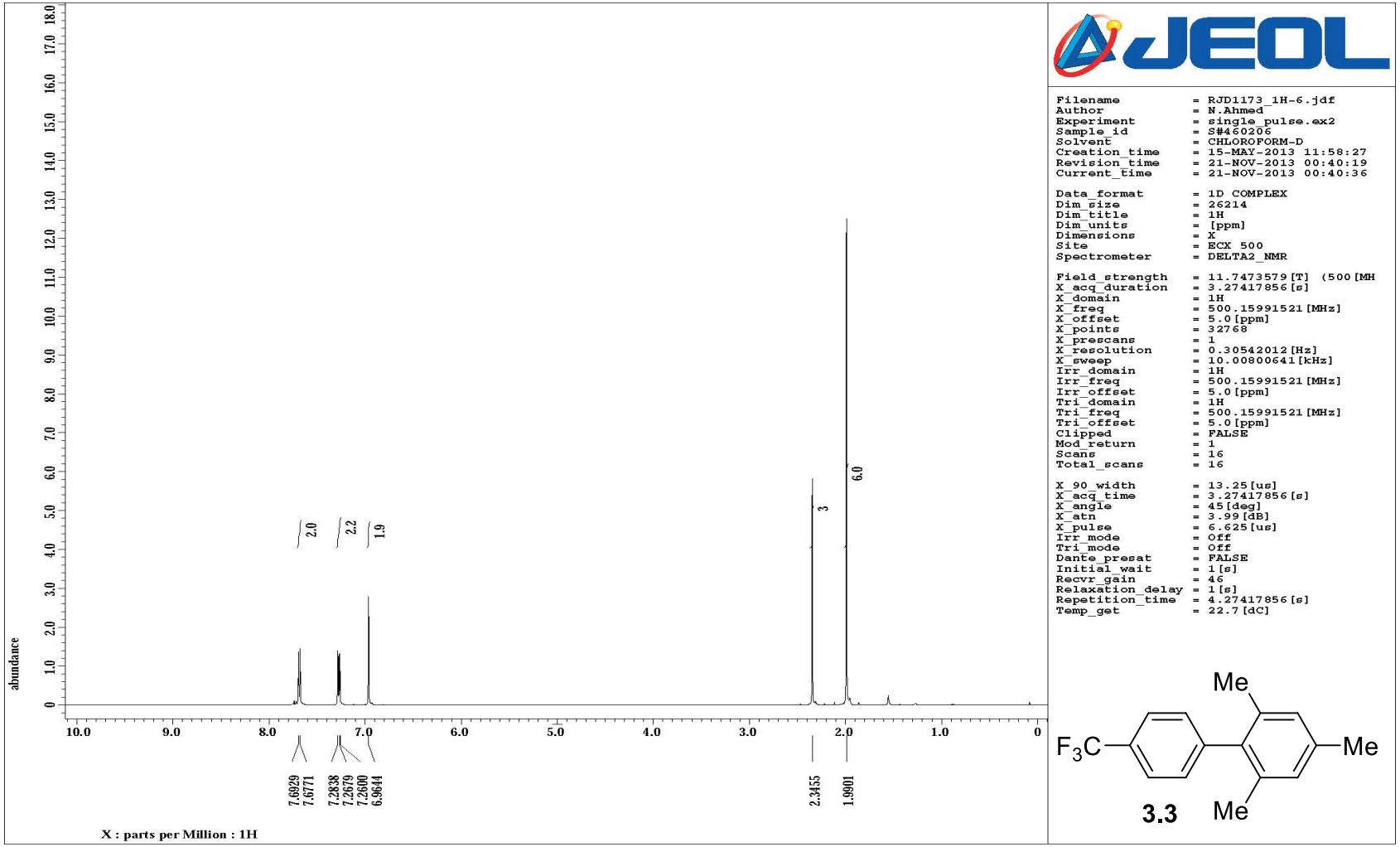
^{1}H NMR spectrum of 4'-methoxy-2,4,6-trimethylbiphenyl (**3.2**)



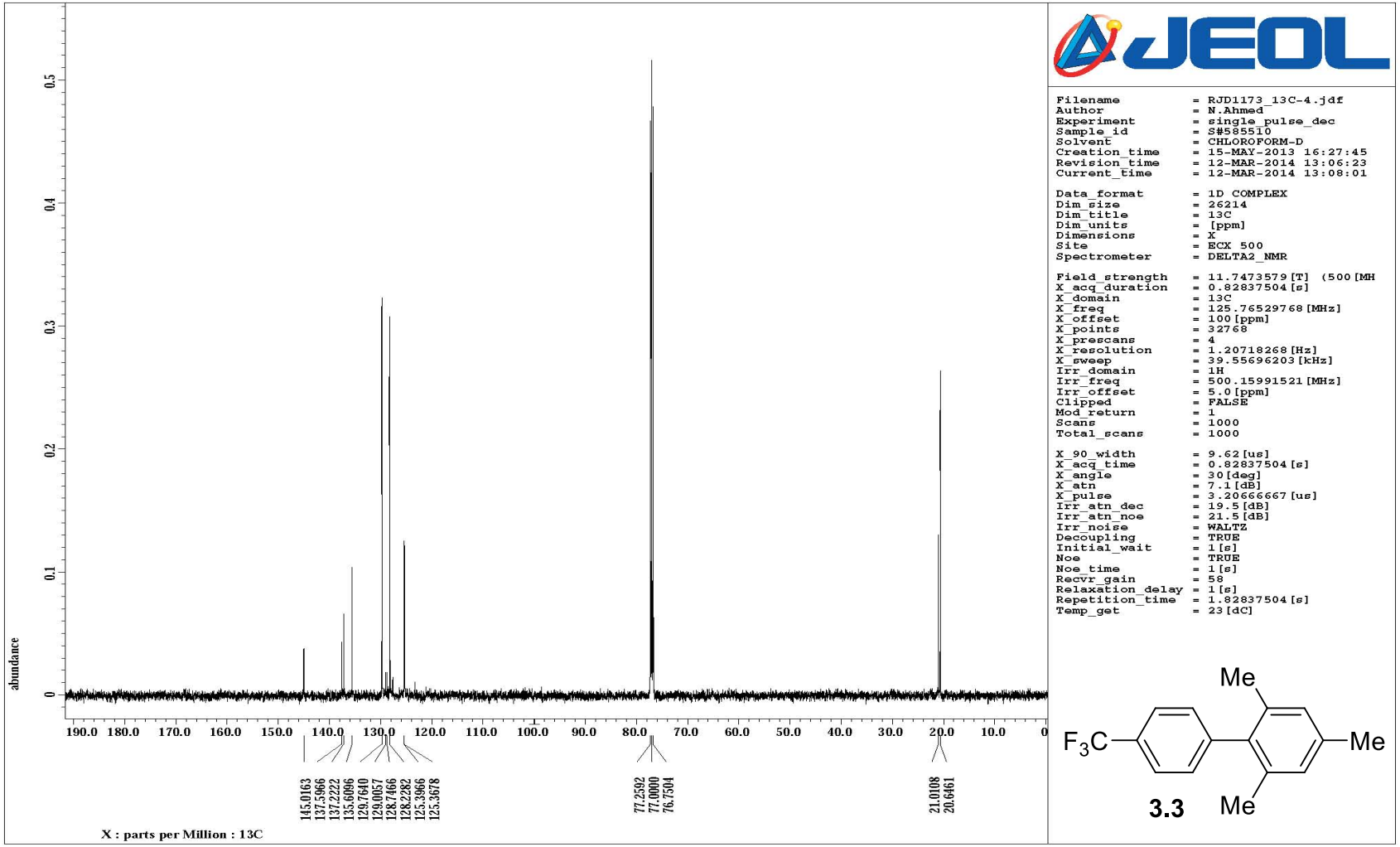
^{13}C NMR spectrum of 4'-methoxy-2,4,6-trimethylbiphenyl (**3.2**)



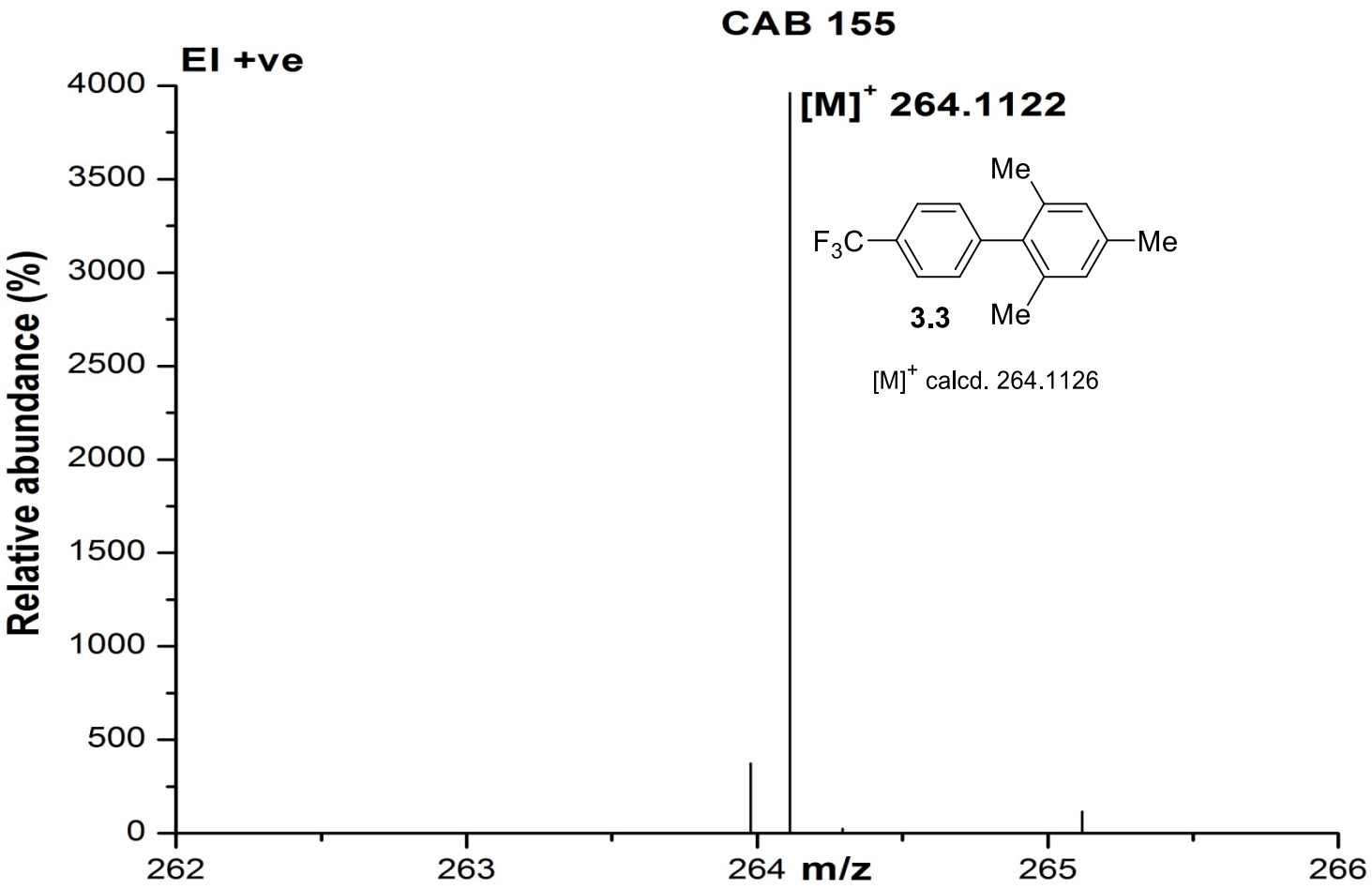
HRMS spectrum of 4'-methoxy-2,4,6-trimethylbiphenyl (**3.2**)



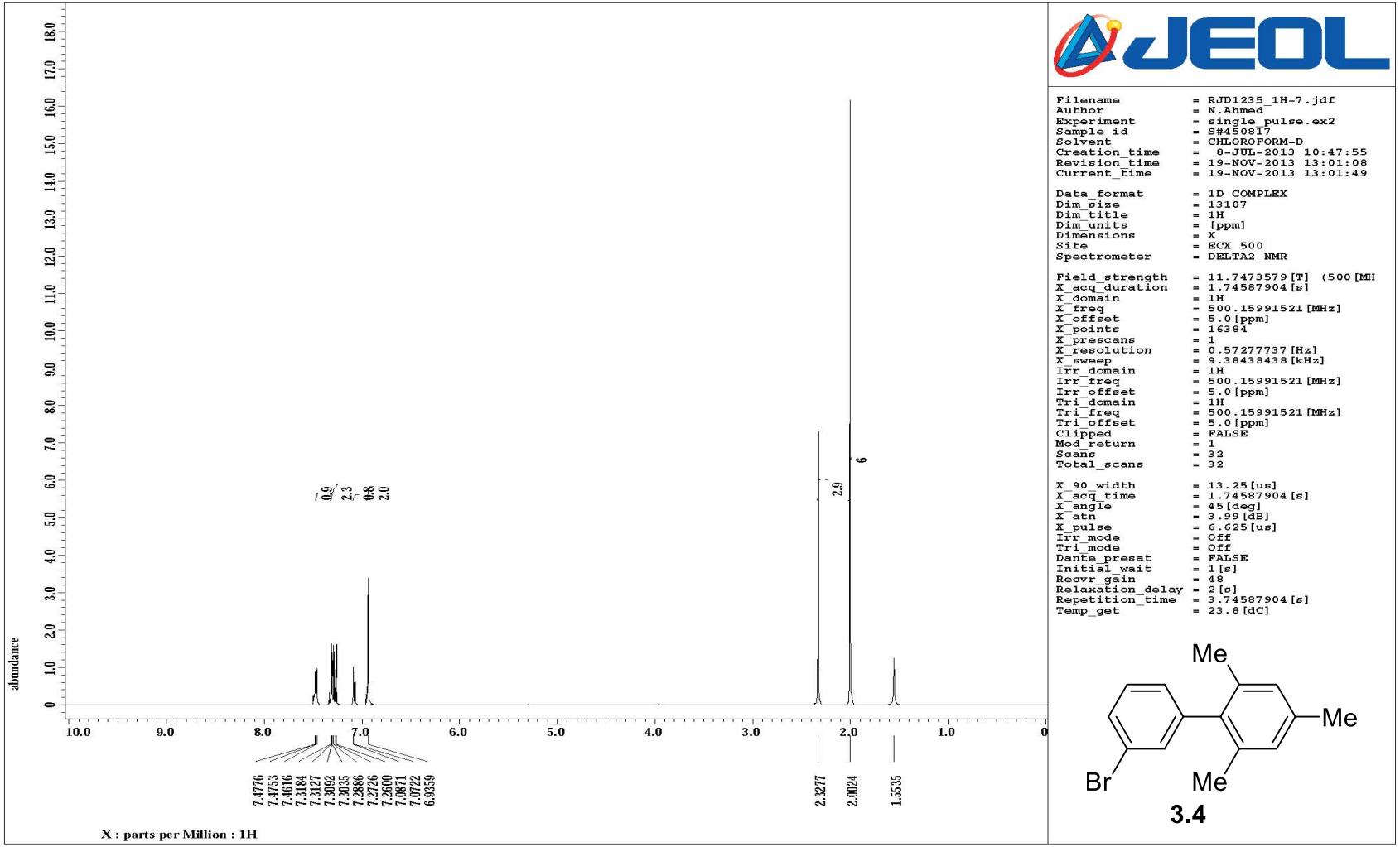
^{1}H NMR spectrum of 2,4,6-trimethyl-4'-(trifluoromethyl)biphenyl (**3.3**)



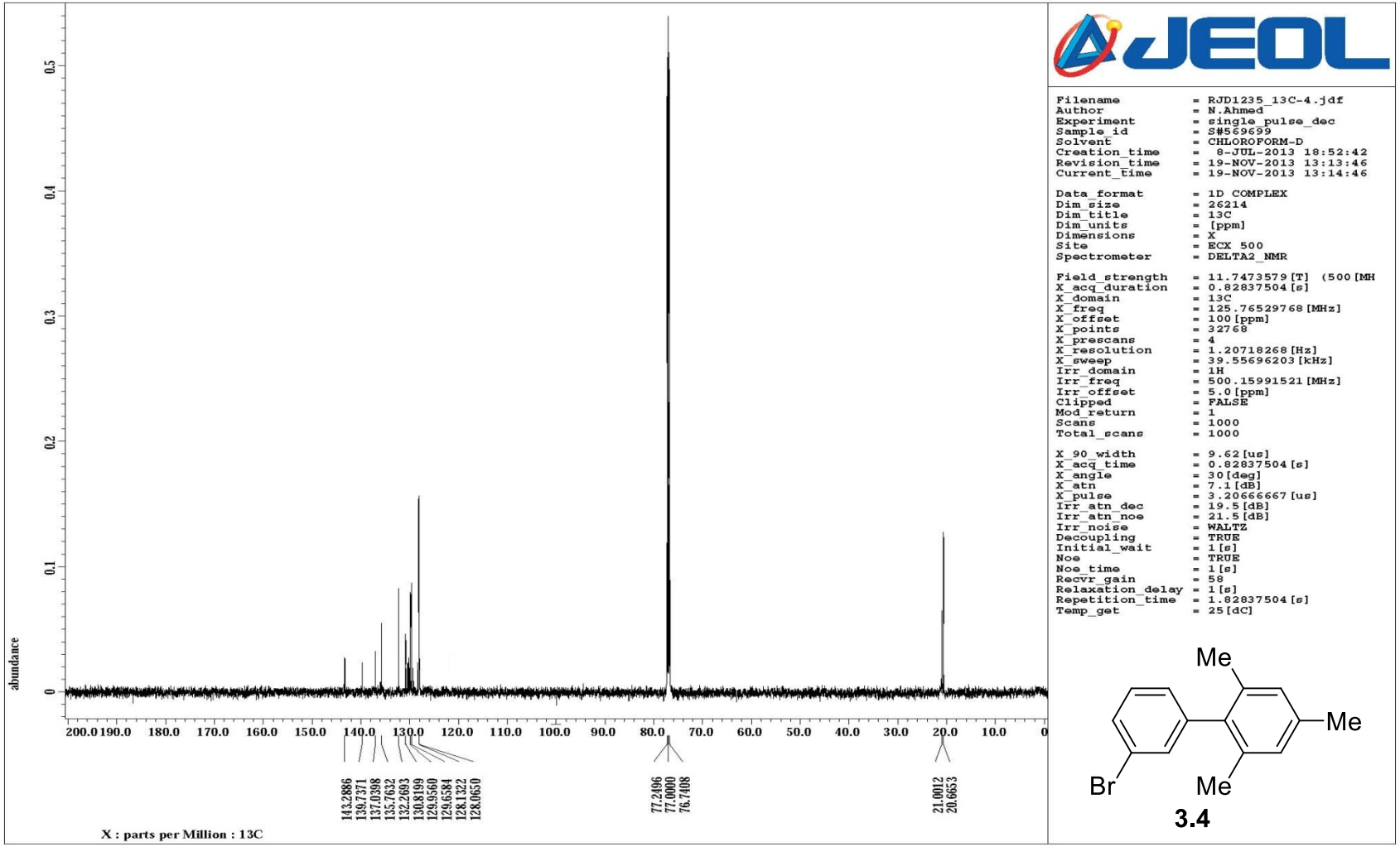
^{13}C NMR spectrum of 2,4,6-trimethyl-4'-(trifluoromethyl)biphenyl (**3.3**)



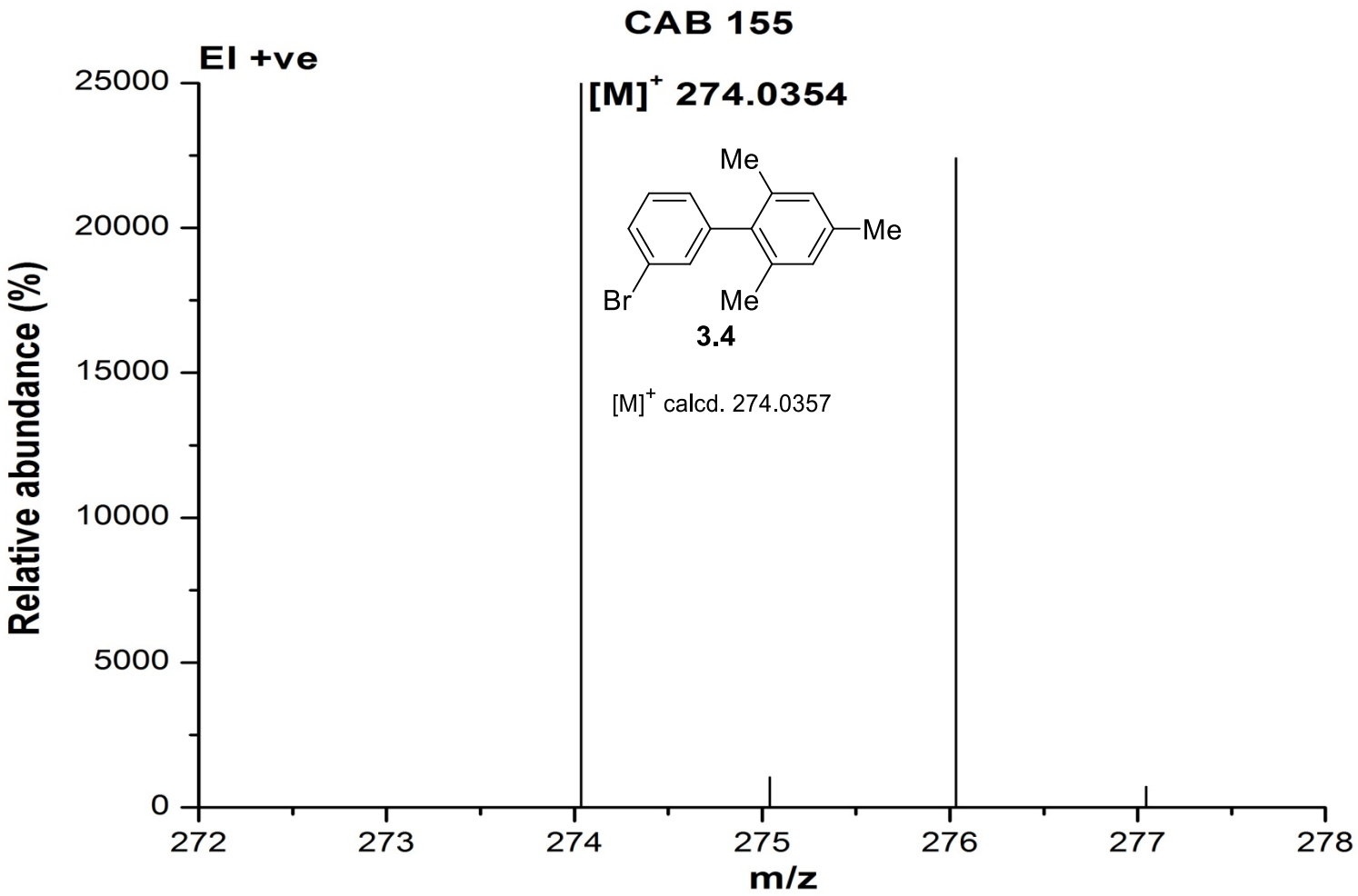
HRMS spectrum of 2,4,6-trimethyl-4'-(trifluoromethyl)biphenyl (**3.3**)



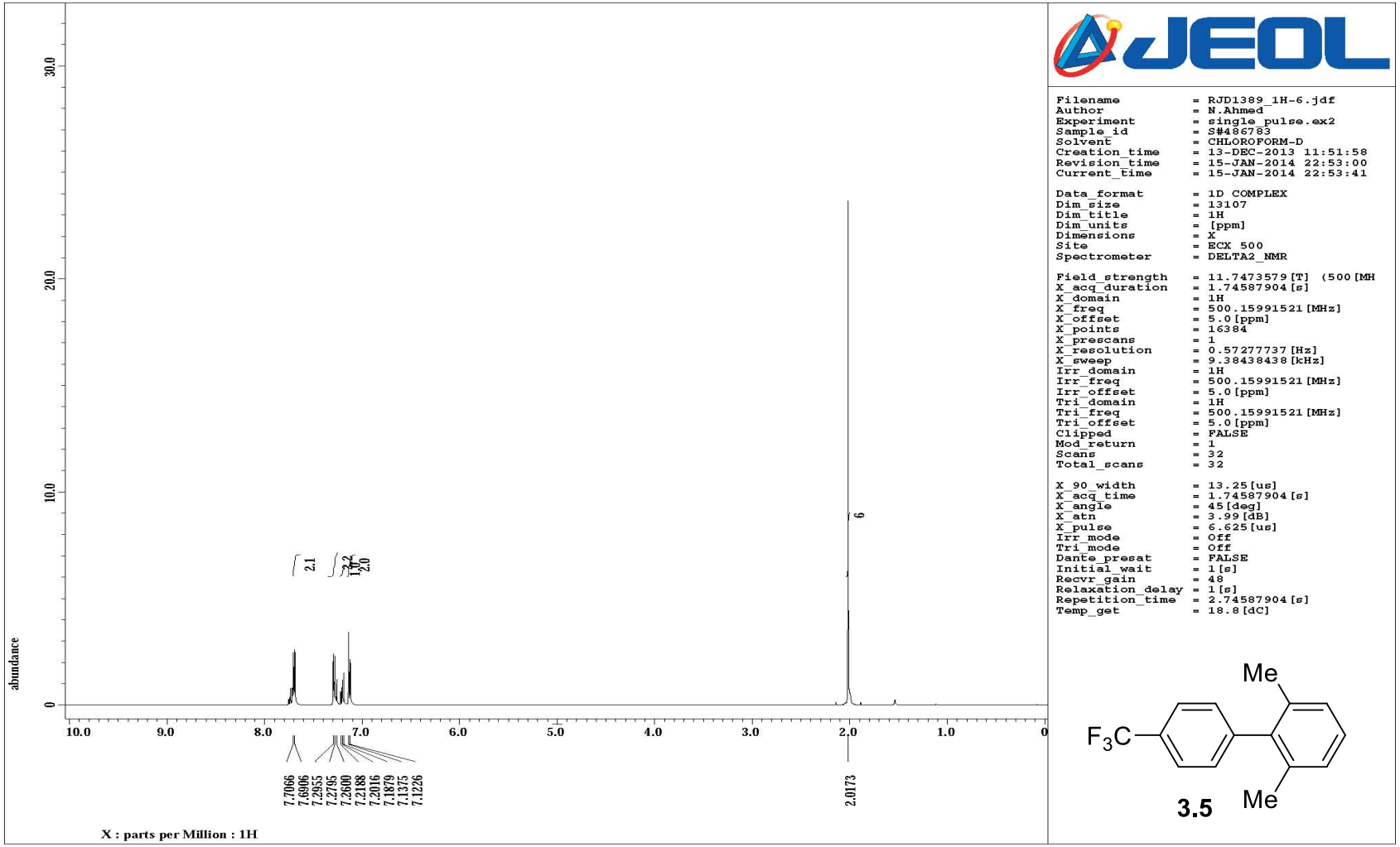
^{1}H NMR spectrum of 3'-bromo-2,4,6-trimethylbiphenyl (**3.4**)



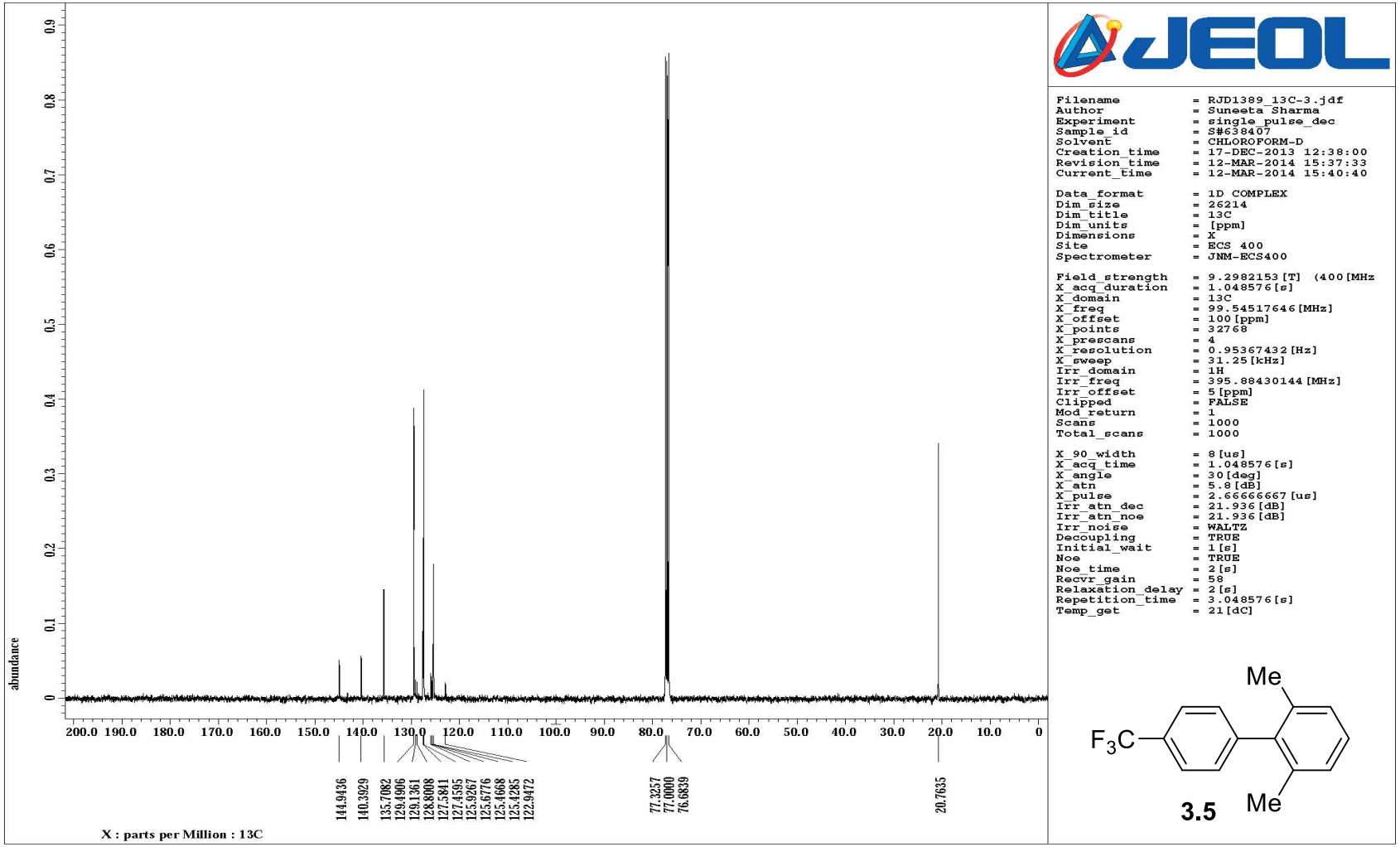
^{13}C NMR spectrum of 3'-bromo-2,4,6-trimethylbiphenyl (**3.4**)



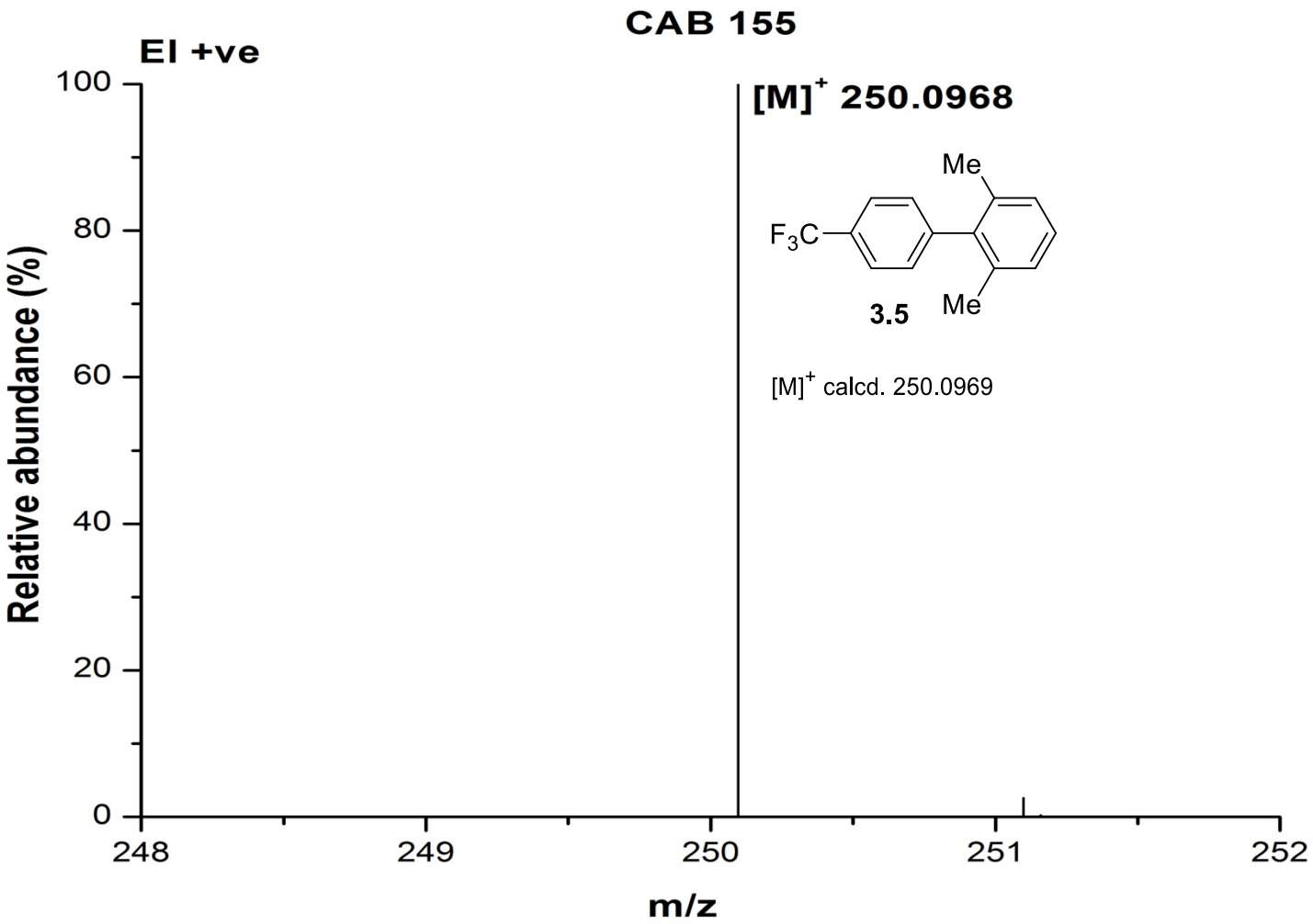
HRMS spectrum of 3'-bromo-2,4,6-trimethylbiphenyl (**3.4**)



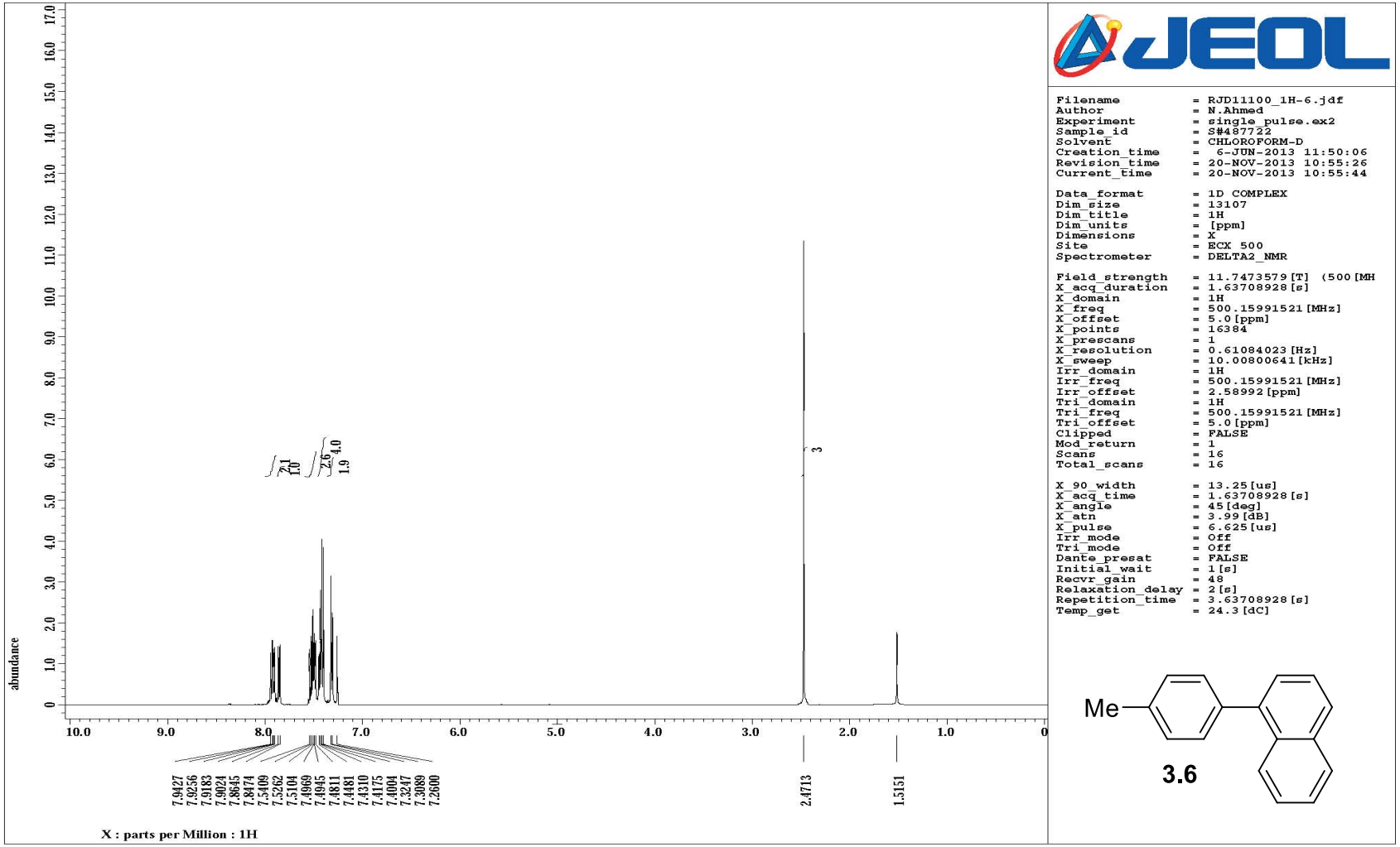
^{1}H NMR spectrum of 2,6-dimethyl-4'-(trifluoromethyl)biphenyl (**3.5**)



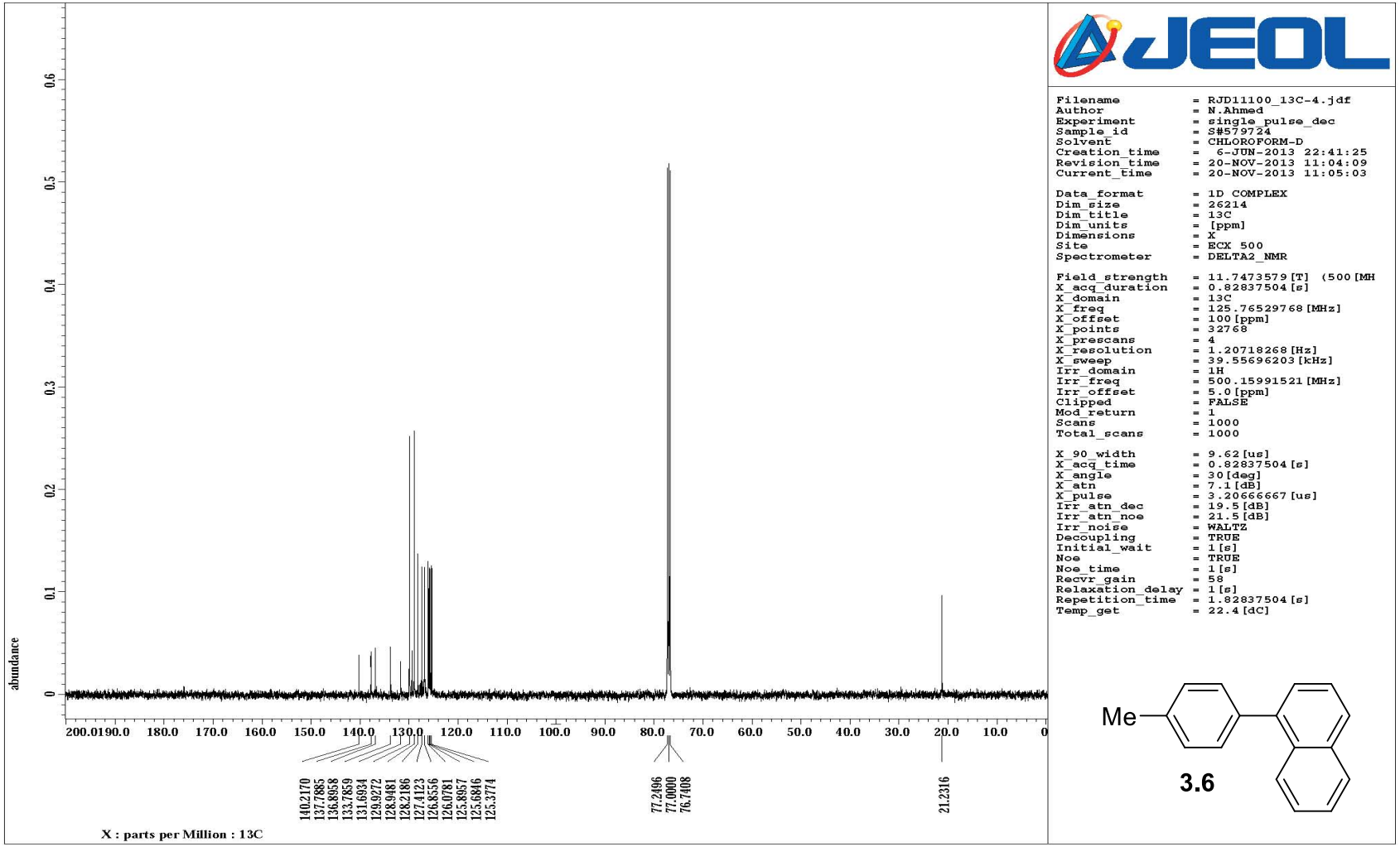
^{13}C NMR spectrum of 2,6-dimethyl-4'-(trifluoromethyl)biphenyl (**3.5**)



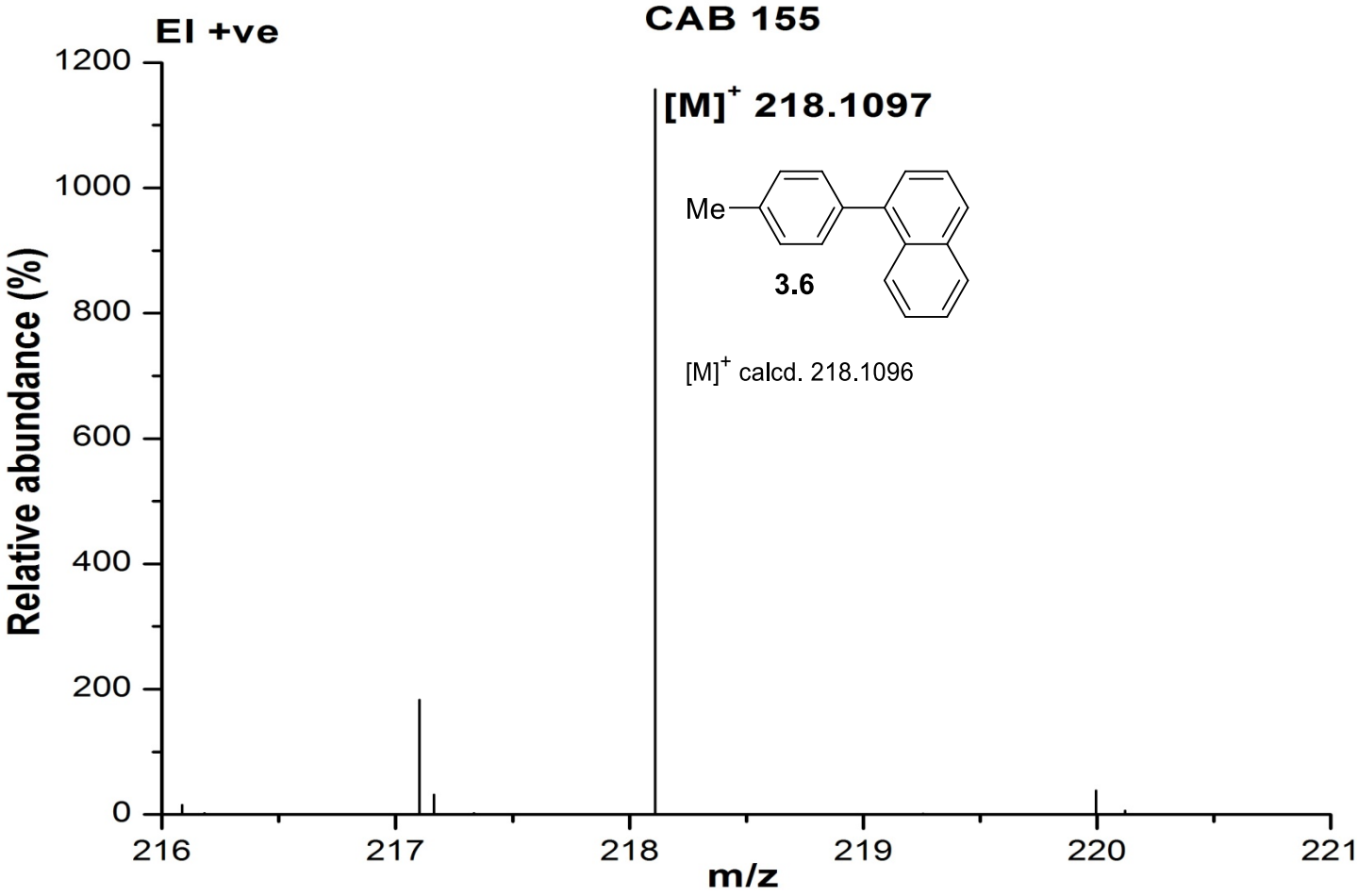
HRMS spectrum of 2,6-dimethyl-4'-(trifluoromethyl)biphenyl (**3.5**)



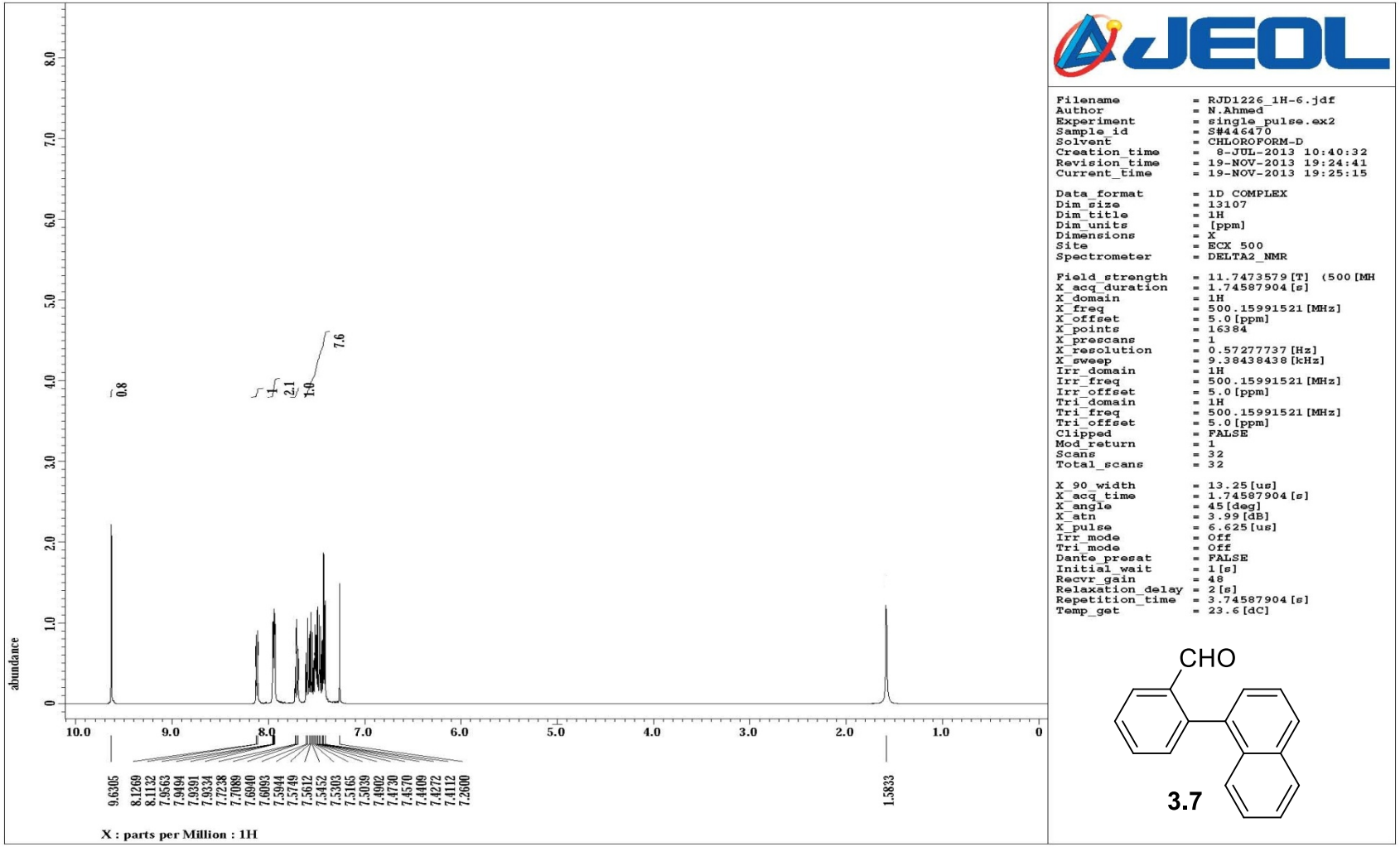
^{1}H NMR spectrum of 1-(4-methylphenyl)naphthalene (**3.6**)



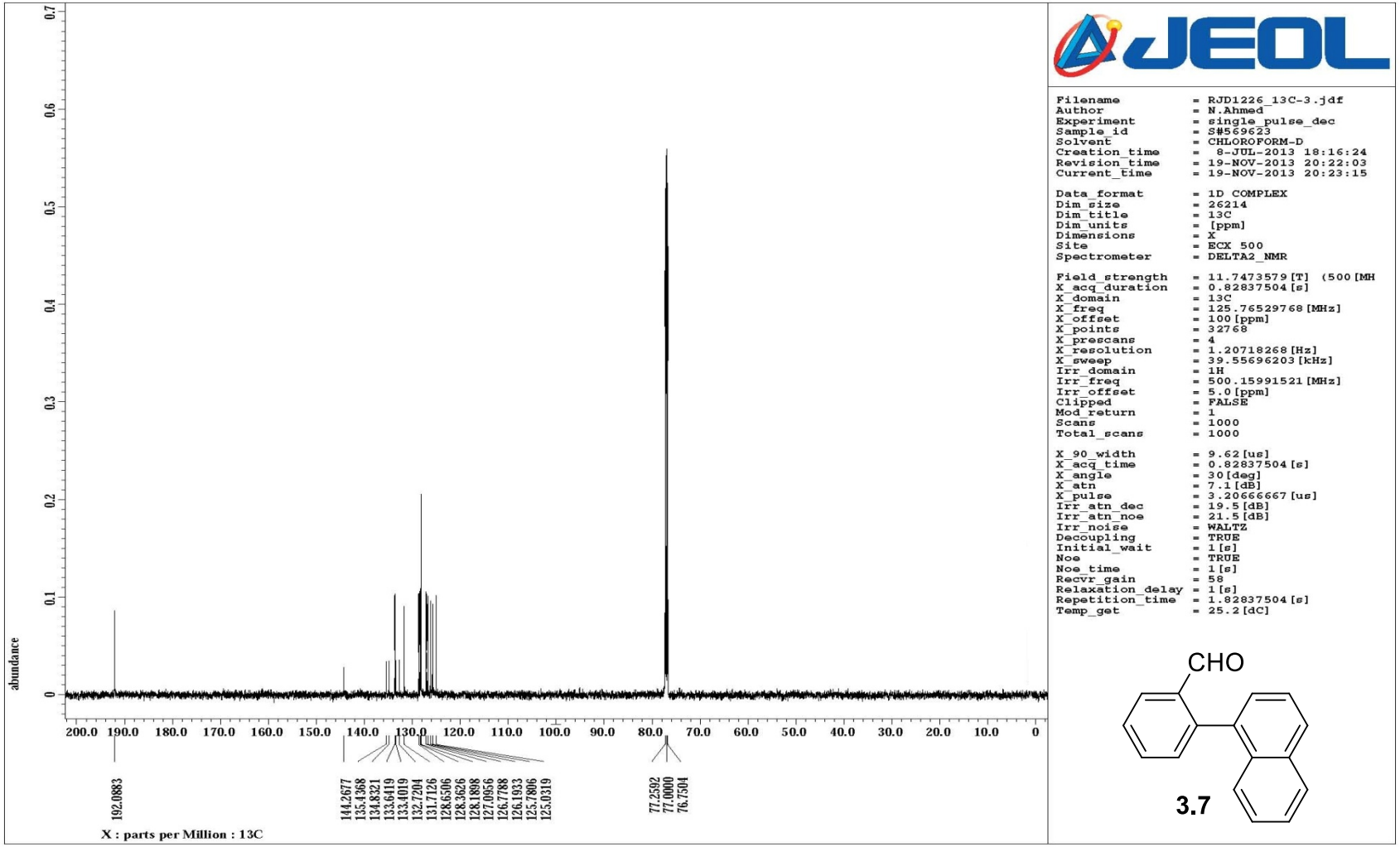
^{13}C NMR spectrum of 1-(4-methylphenyl)naphthalene (**3.6**)



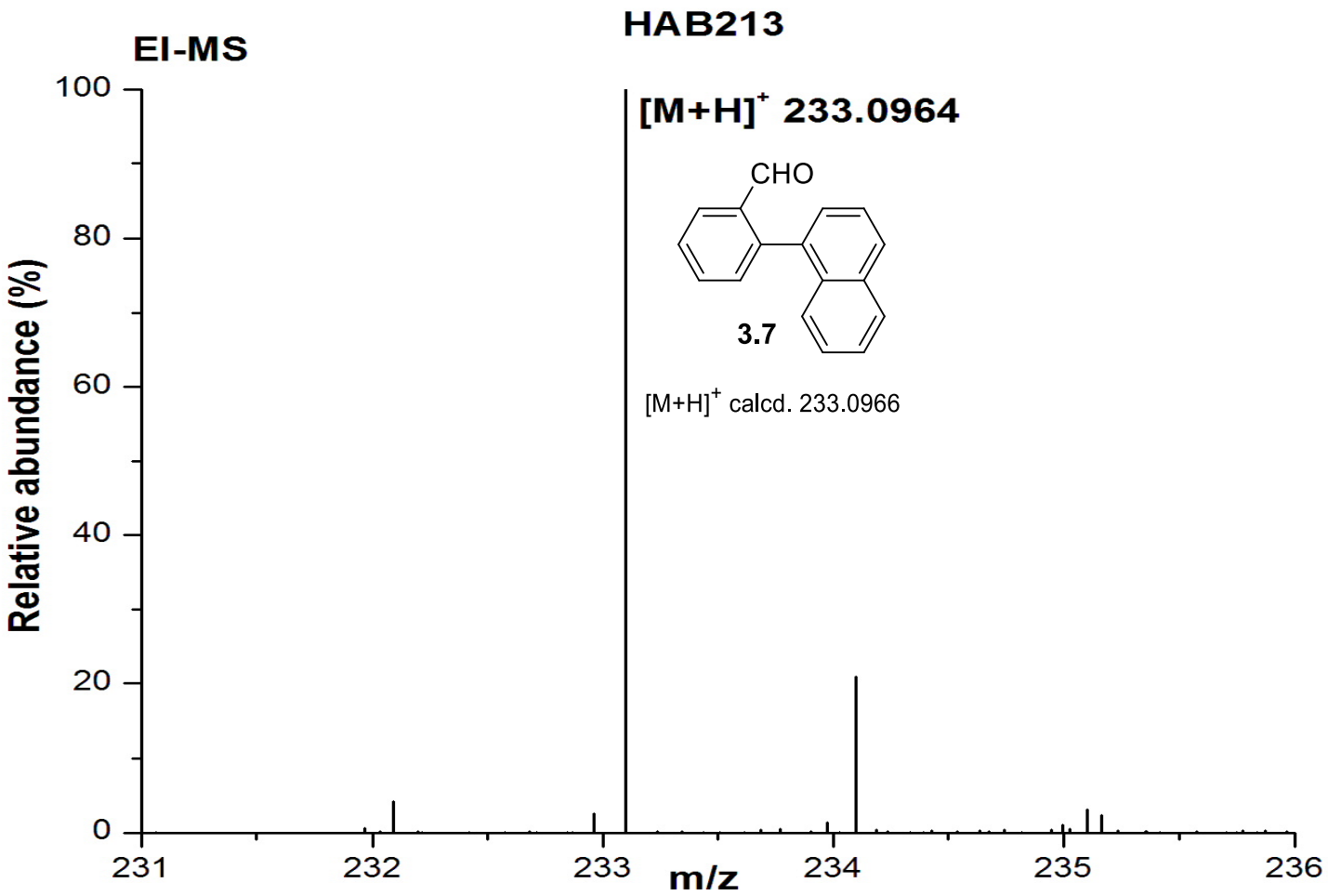
HRMS spectrum of 1-(4-methylphenyl)naphthalene (**3.6**)



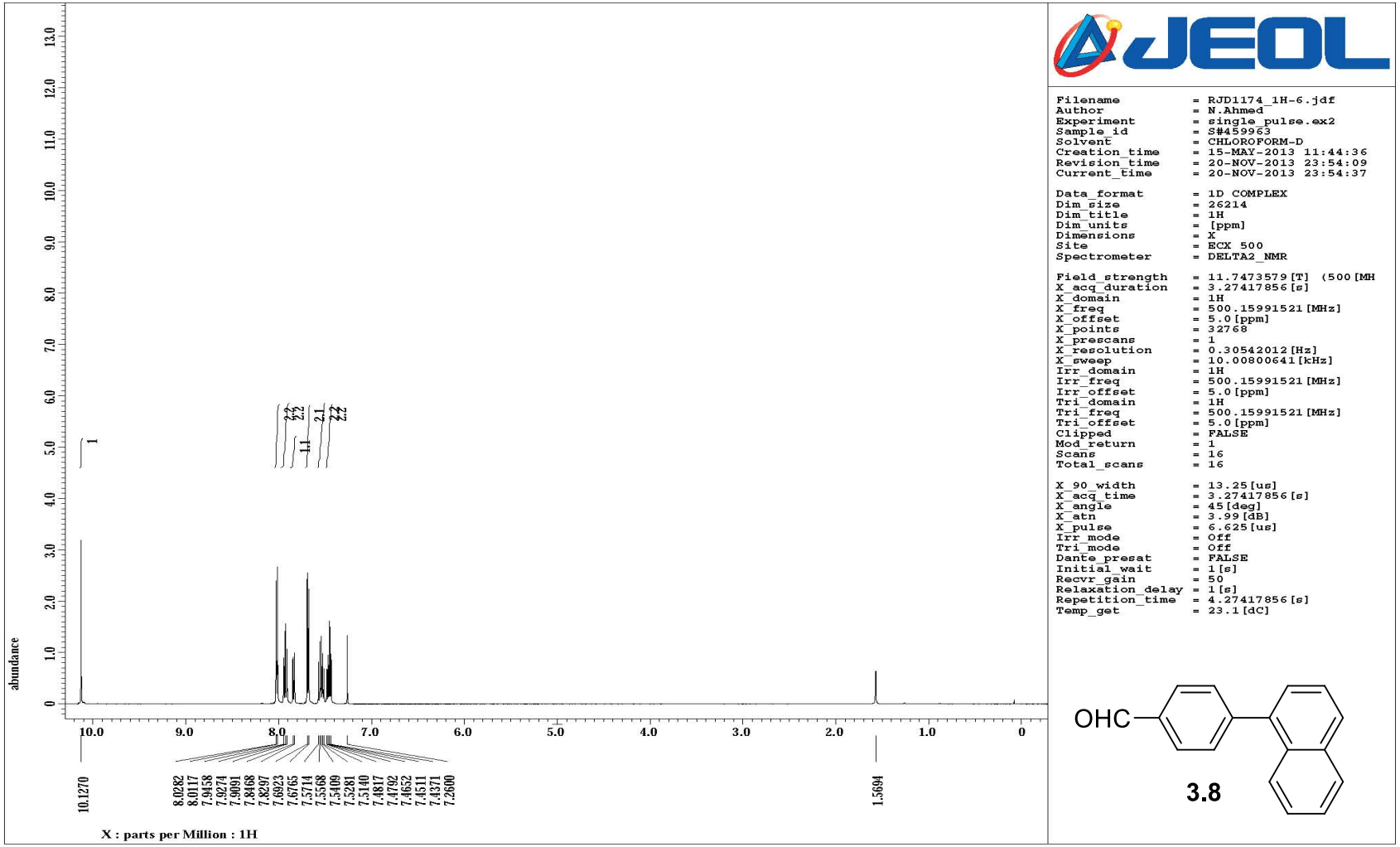
^{1}H NMR spectrum of 2-(naphthalen-1-yl)benzaldehyde (**3.7**)



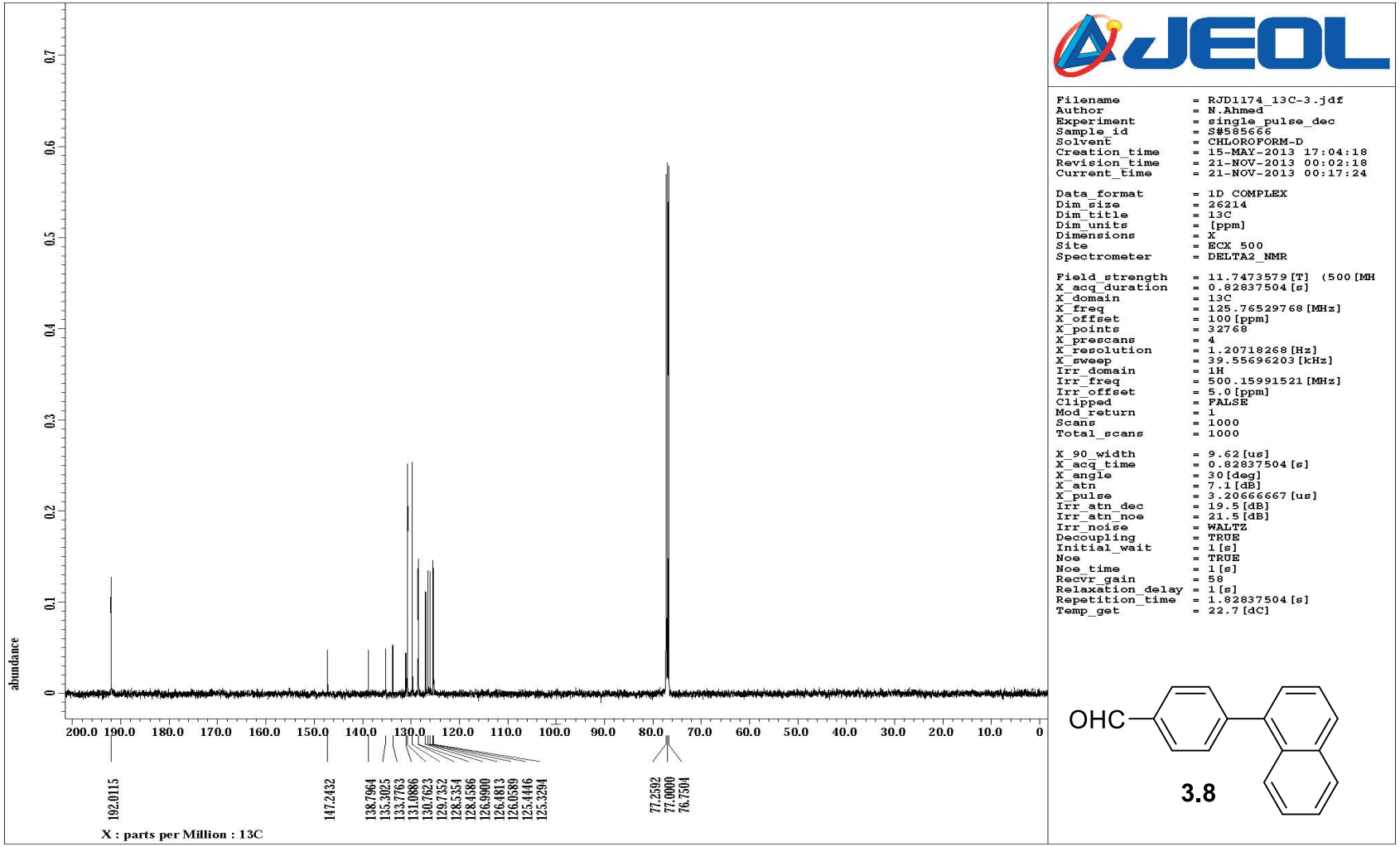
^{13}C NMR spectrum of 2-(naphthalen-1-yl)benzaldehyde (**3.7**)



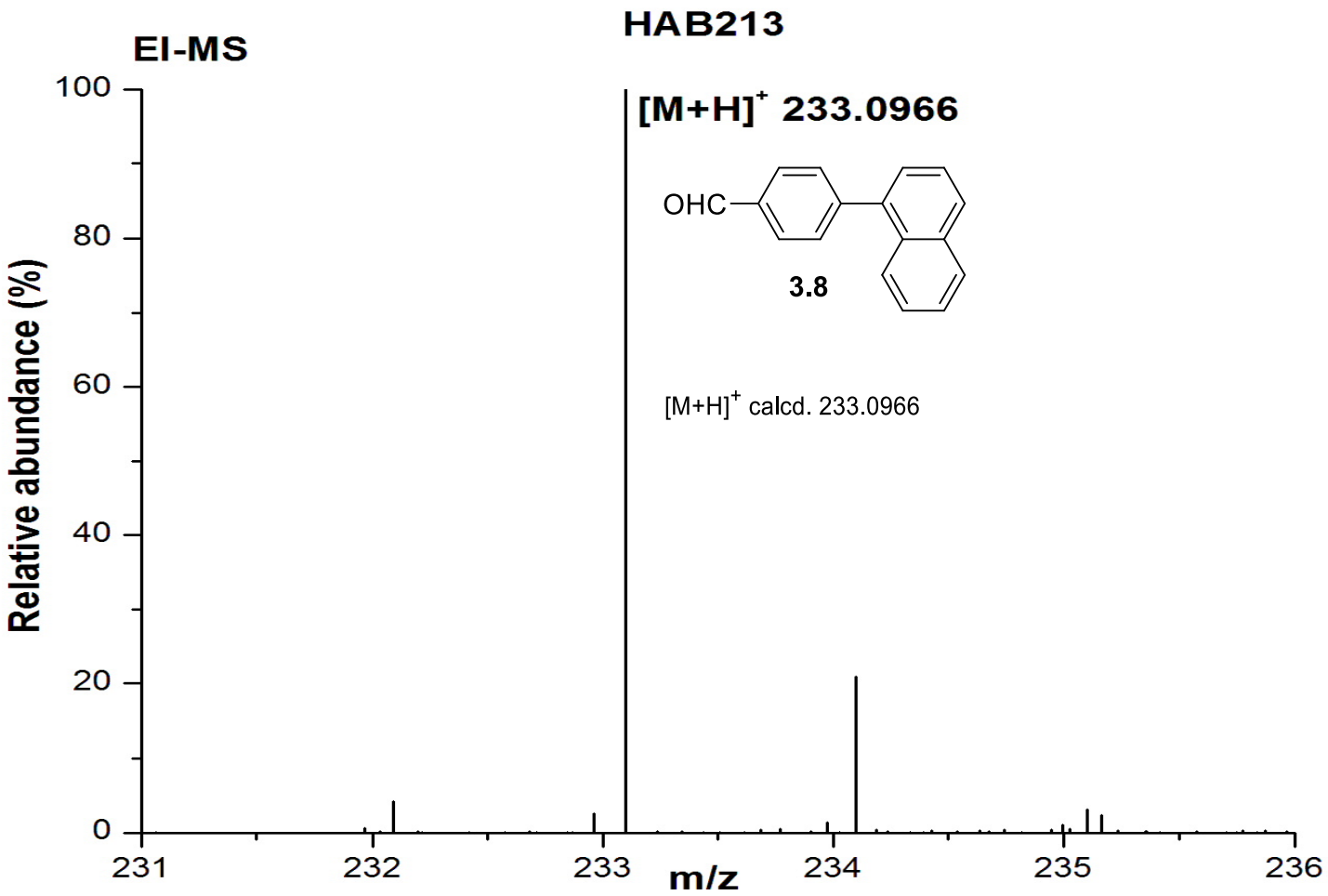
HRMS spectrum of 2-(naphthalen-1-yl)benzaldehyde (**3.7**)



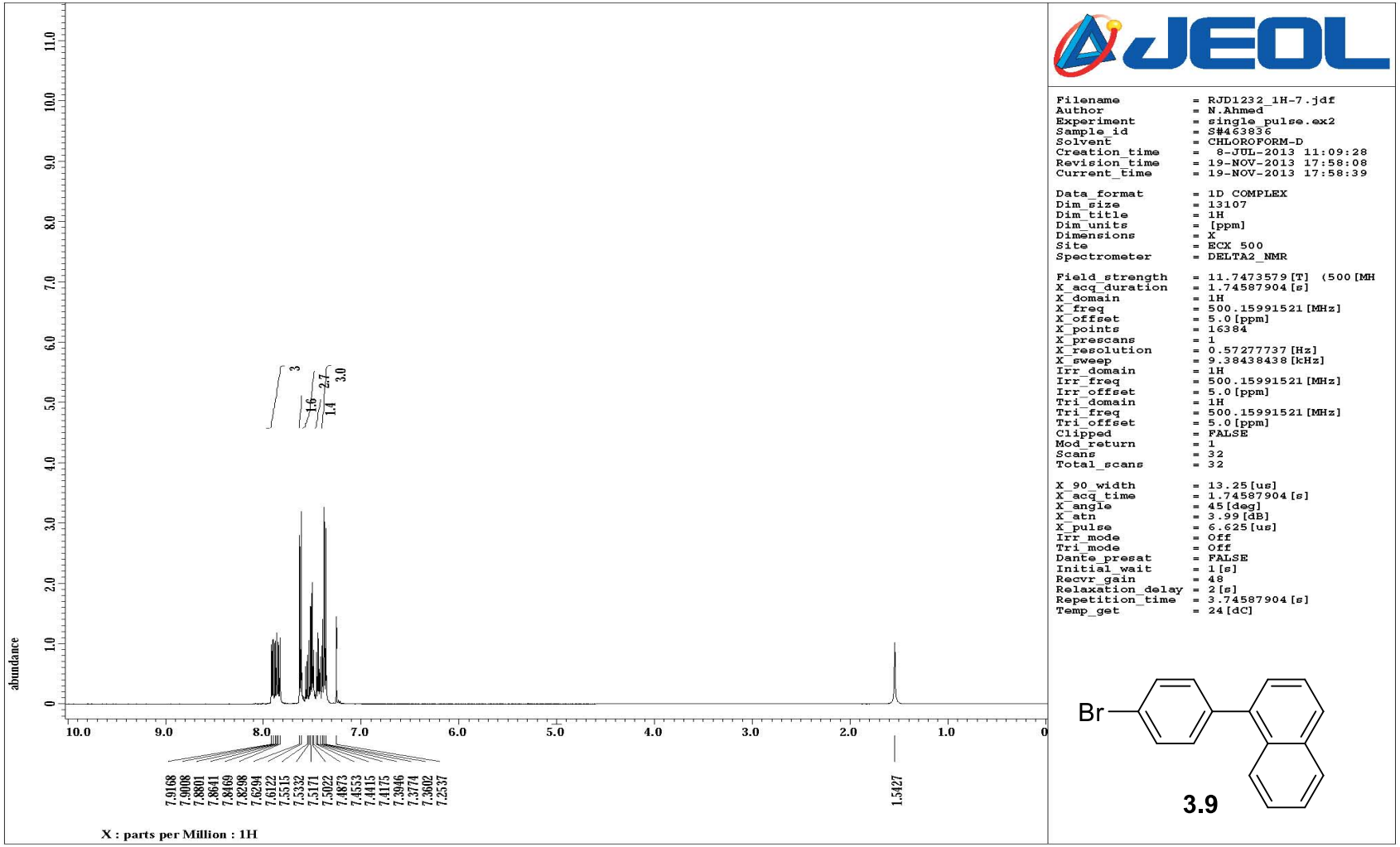
^{1}H NMR spectrum of 4-(naphthalen-1-yl)benzaldehyde (**3.8**)



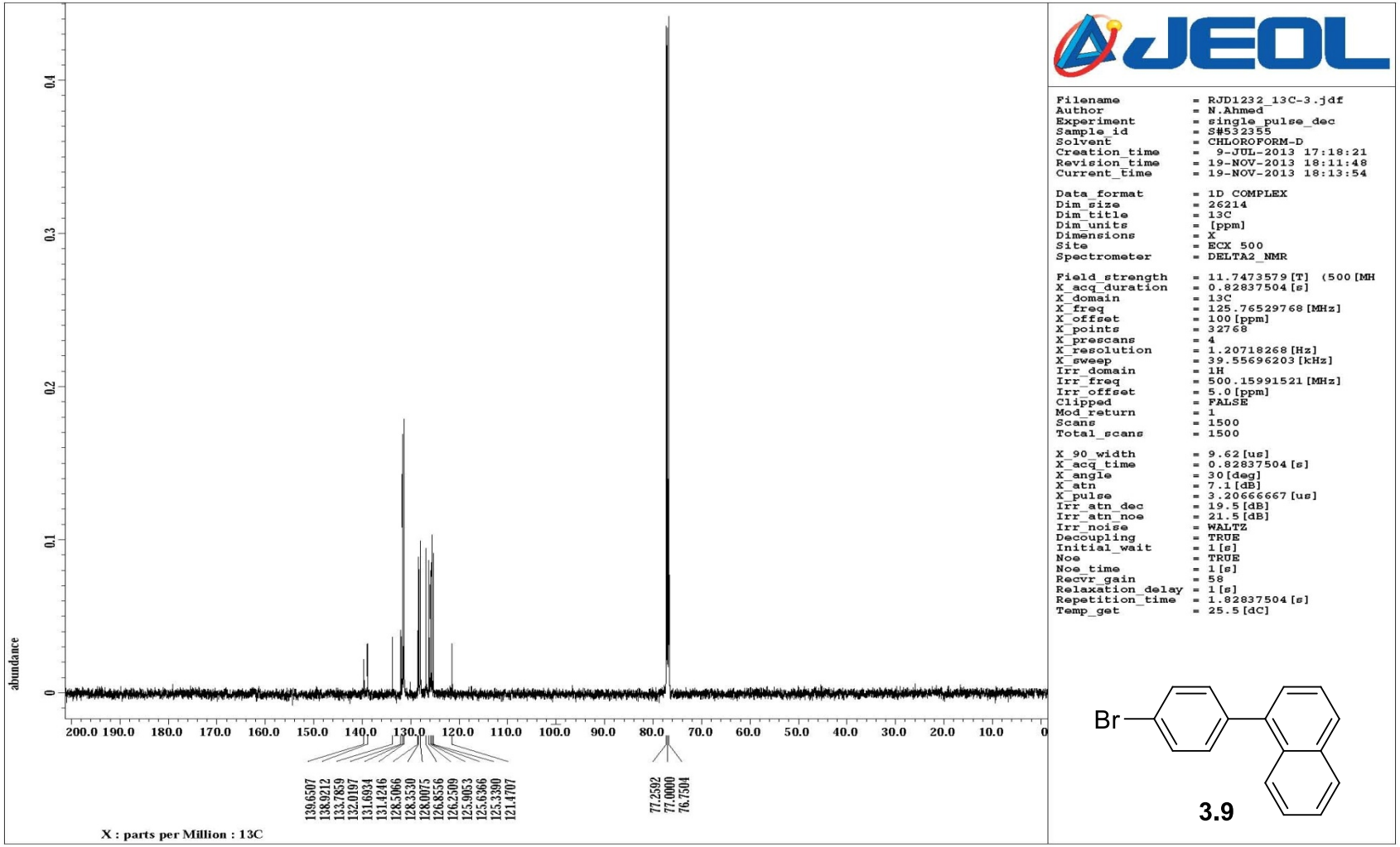
^{13}C NMR spectrum of 4-(naphthalen-1-yl)benzaldehyde (**3.8**)



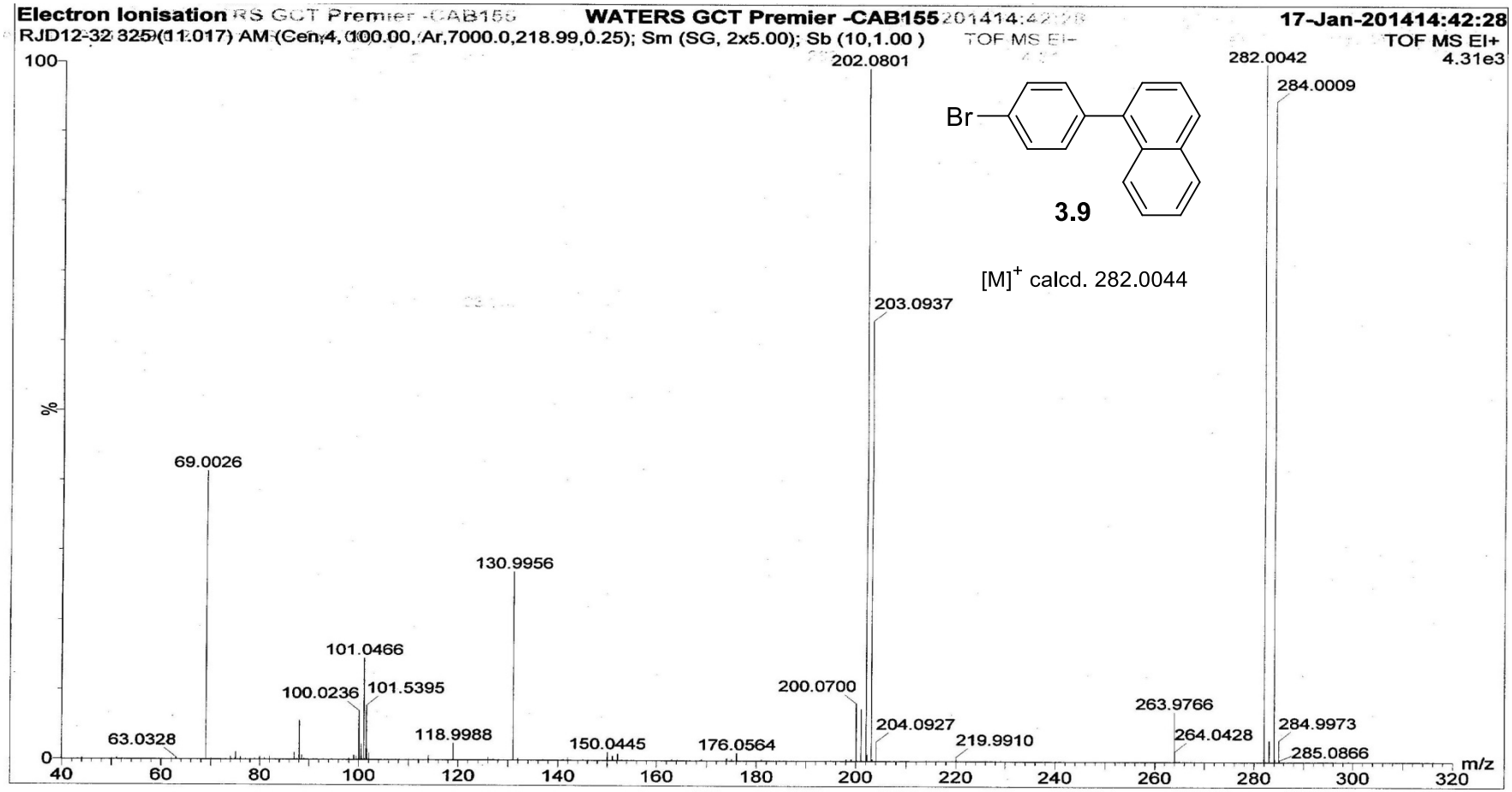
HRMS spectrum of 4-(naphthalen-1-yl)benzaldehyde (**3.8**)



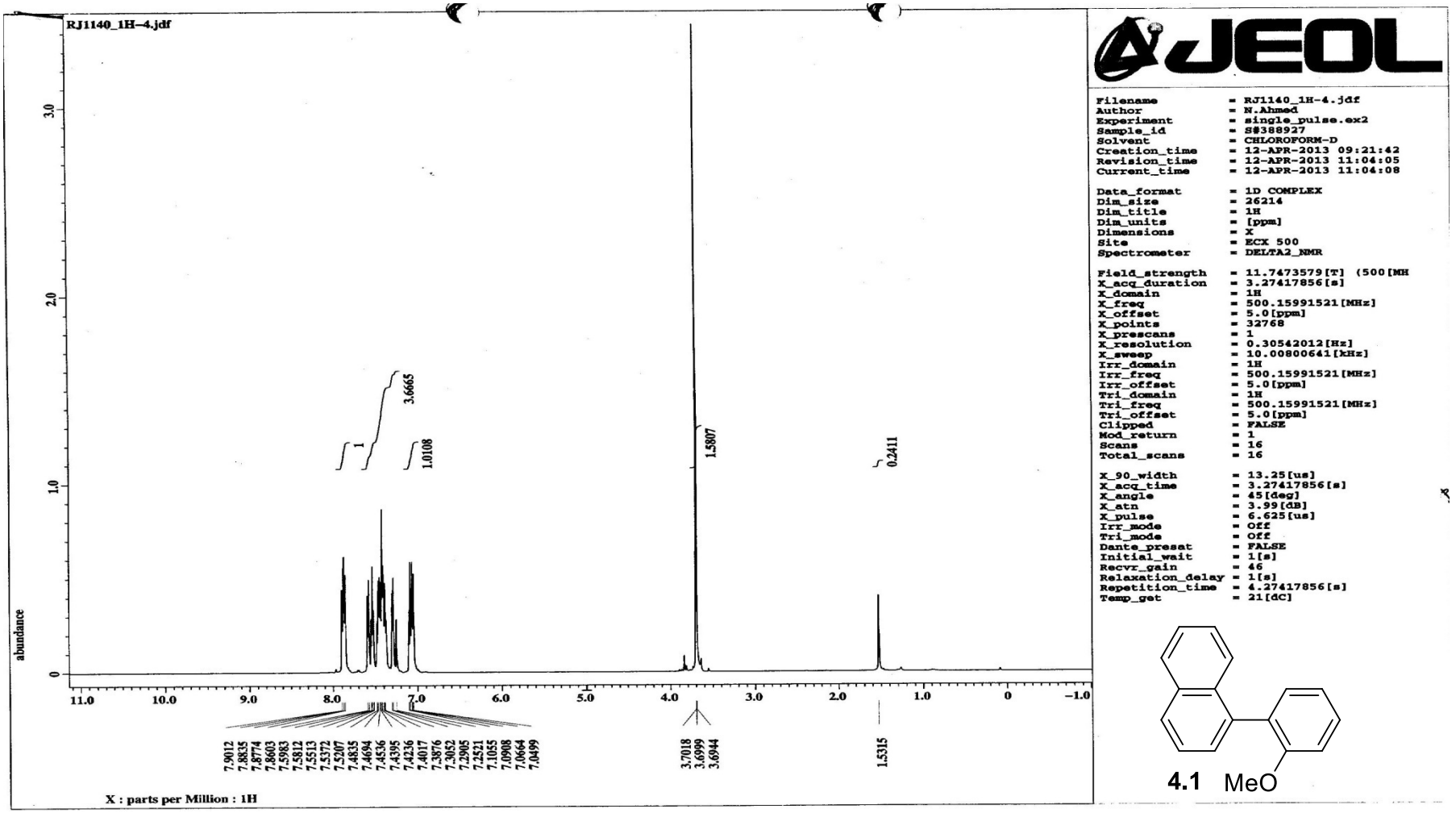
^{1}H NMR spectrum of 1-(4-bromophenyl)naphthalene (**3.9**)



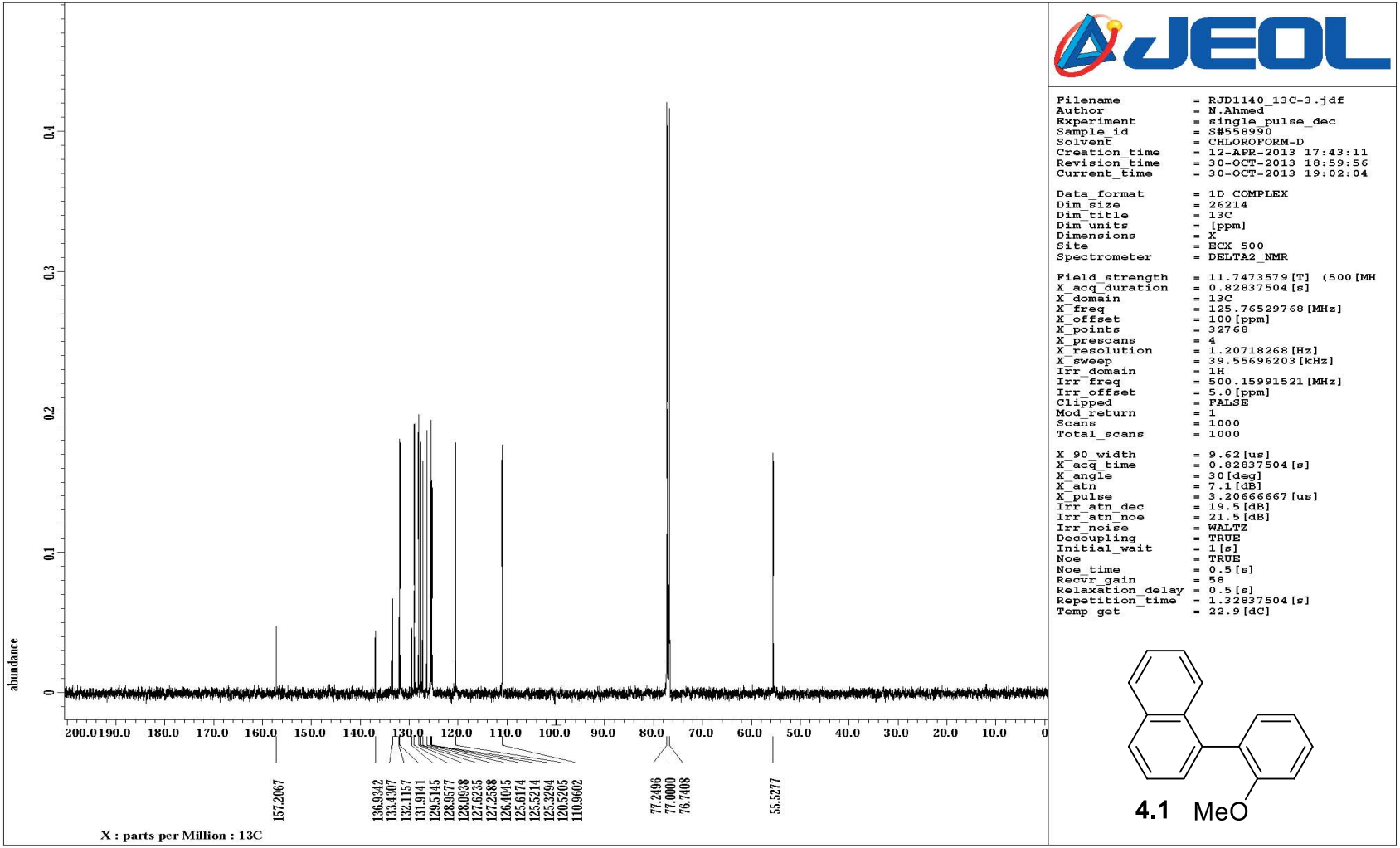
^{13}C NMR spectrum of 1-(4-bromophenyl)naphthalene (**3.9**)



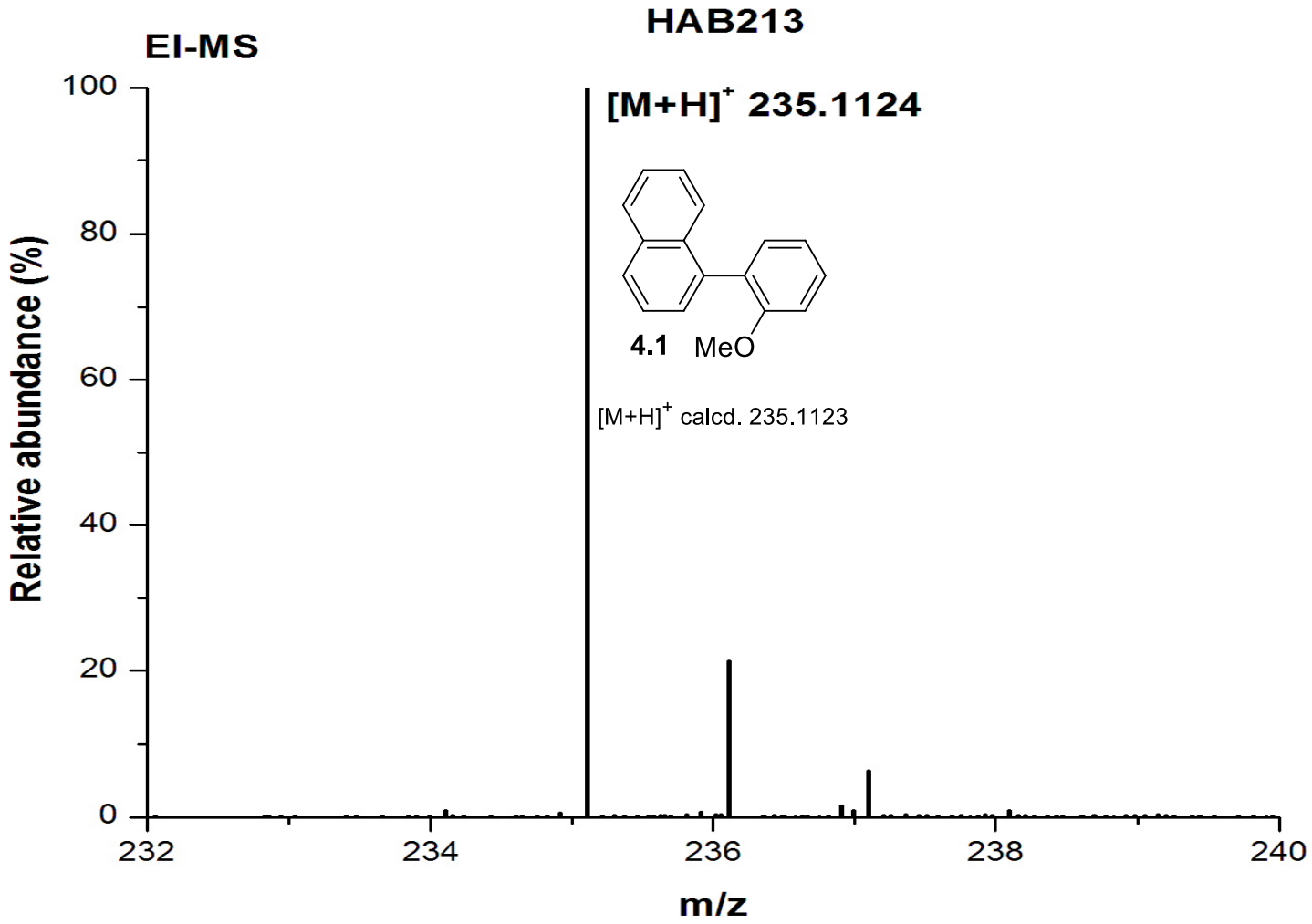
HRMS spectrum of 1-(4-bromophenyl)naphthalene (**3.9**)



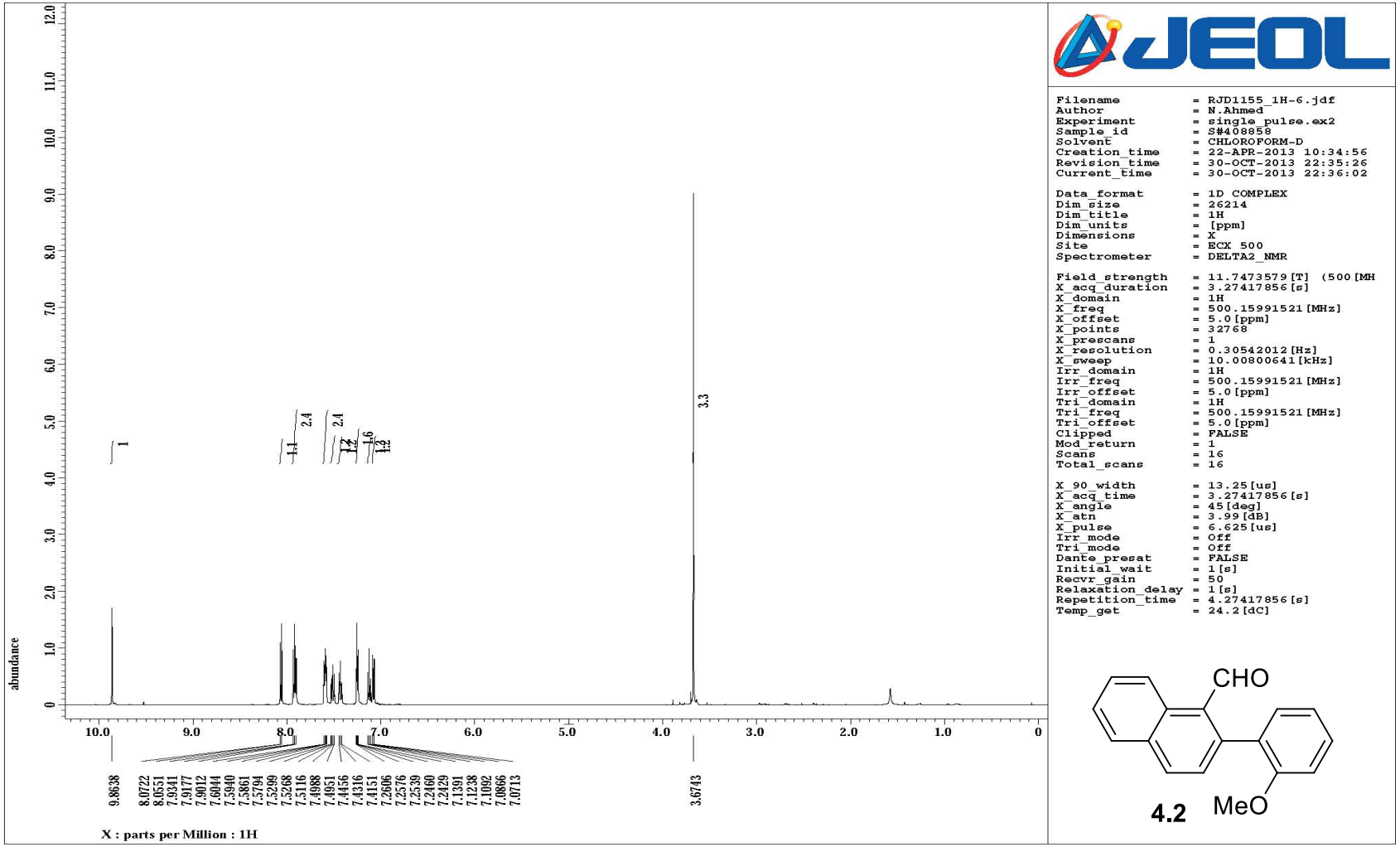
^{1}H NMR spectrum of 1-(2-methoxyphenyl)naphthalene (**4.1**)



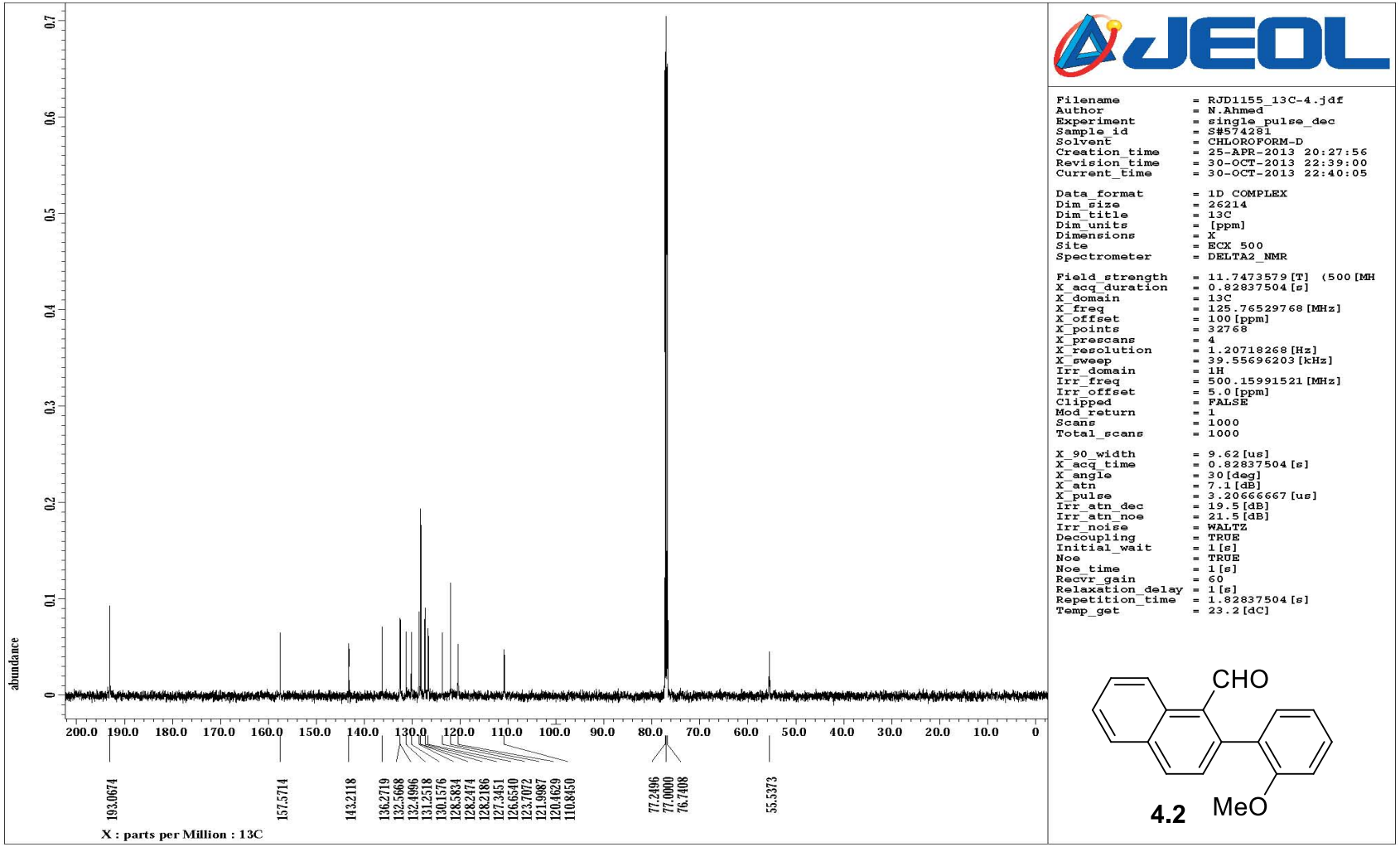
^{13}C NMR spectrum of 1-(2-methoxyphenyl)naphthalene (**4.1**)



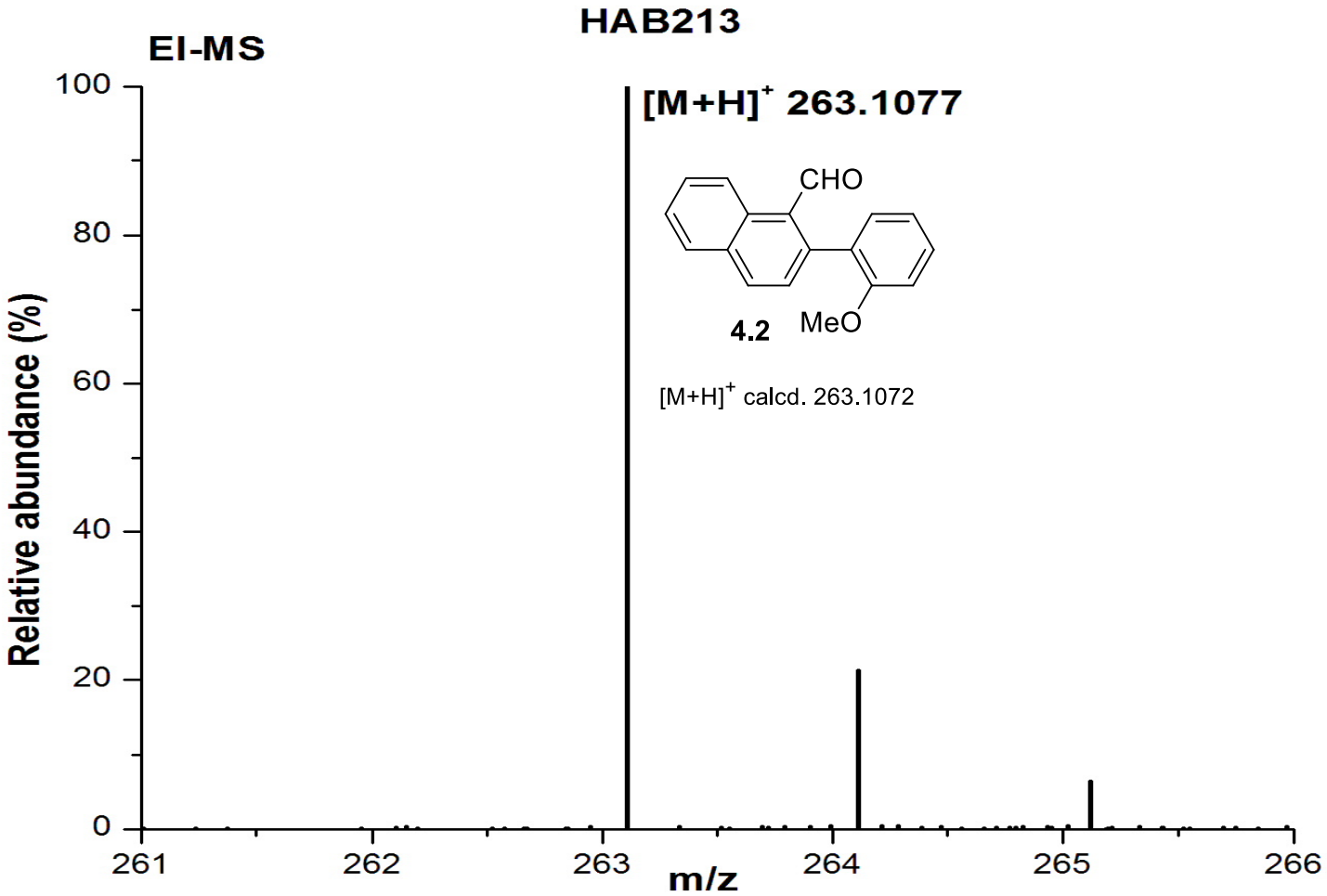
HRMS spectrum of 1-(2-methoxyphenyl)naphthalene (**4.1**)



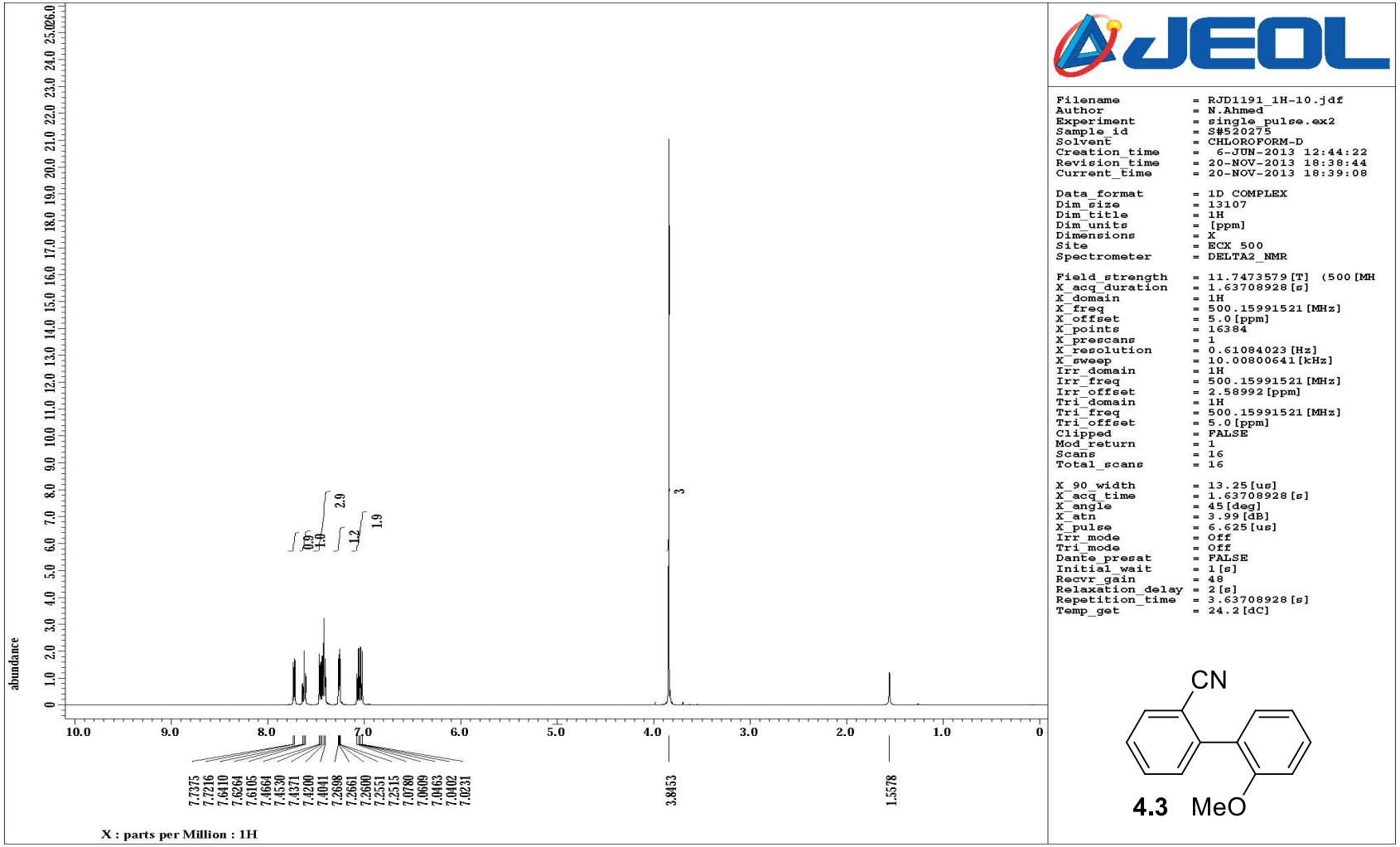
^{1}H NMR spectrum of 2-(2-methoxyphenyl)-1-naphthaldehyde (**4.2**)



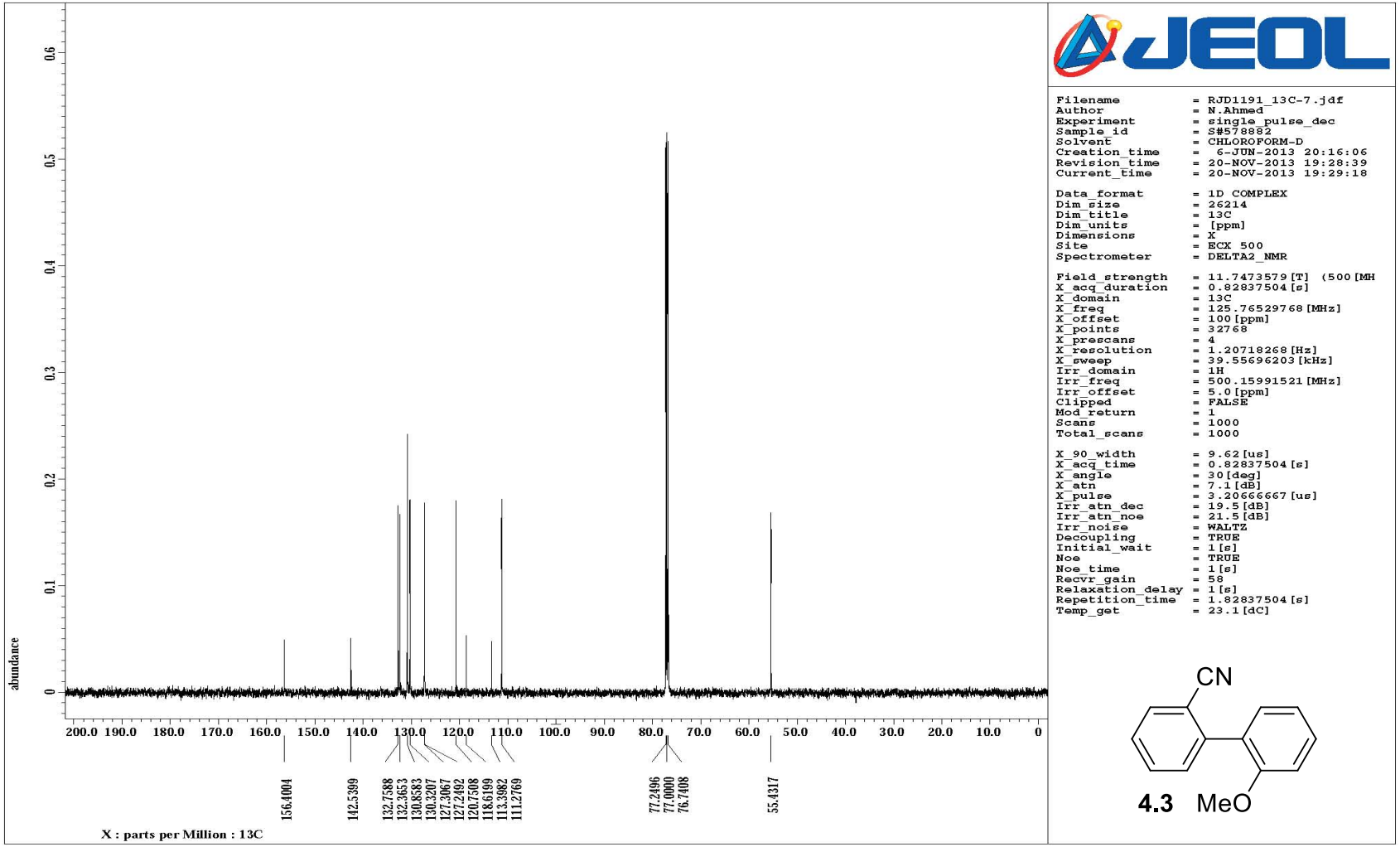
^{13}C NMR spectrum of 2-(2-methoxyphenyl)-1-naphthaldehyde (**4.2**)



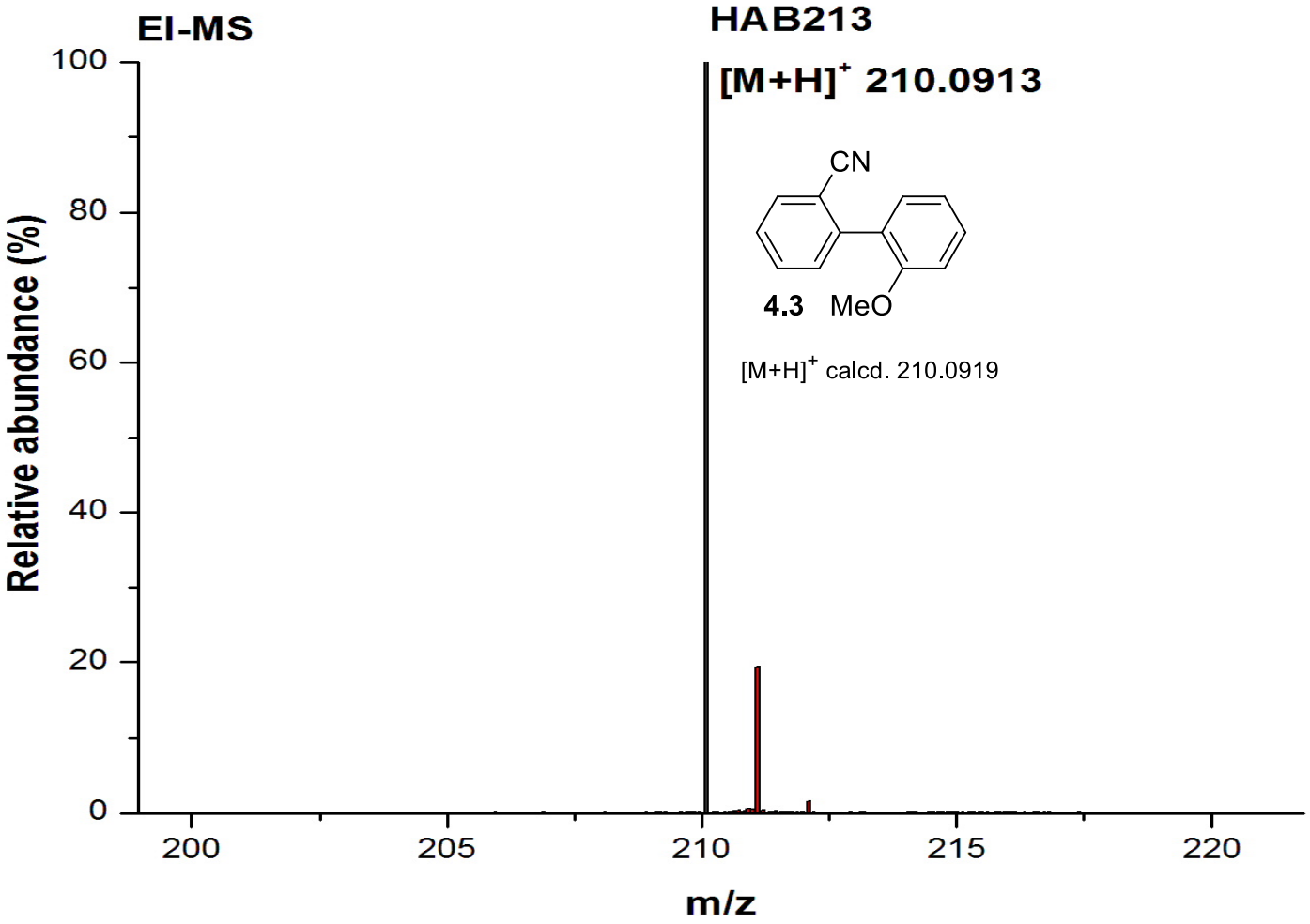
HRMS spectrum of 2-(2-methoxyphenyl)-1-naphthaldehyde (**4.2**)



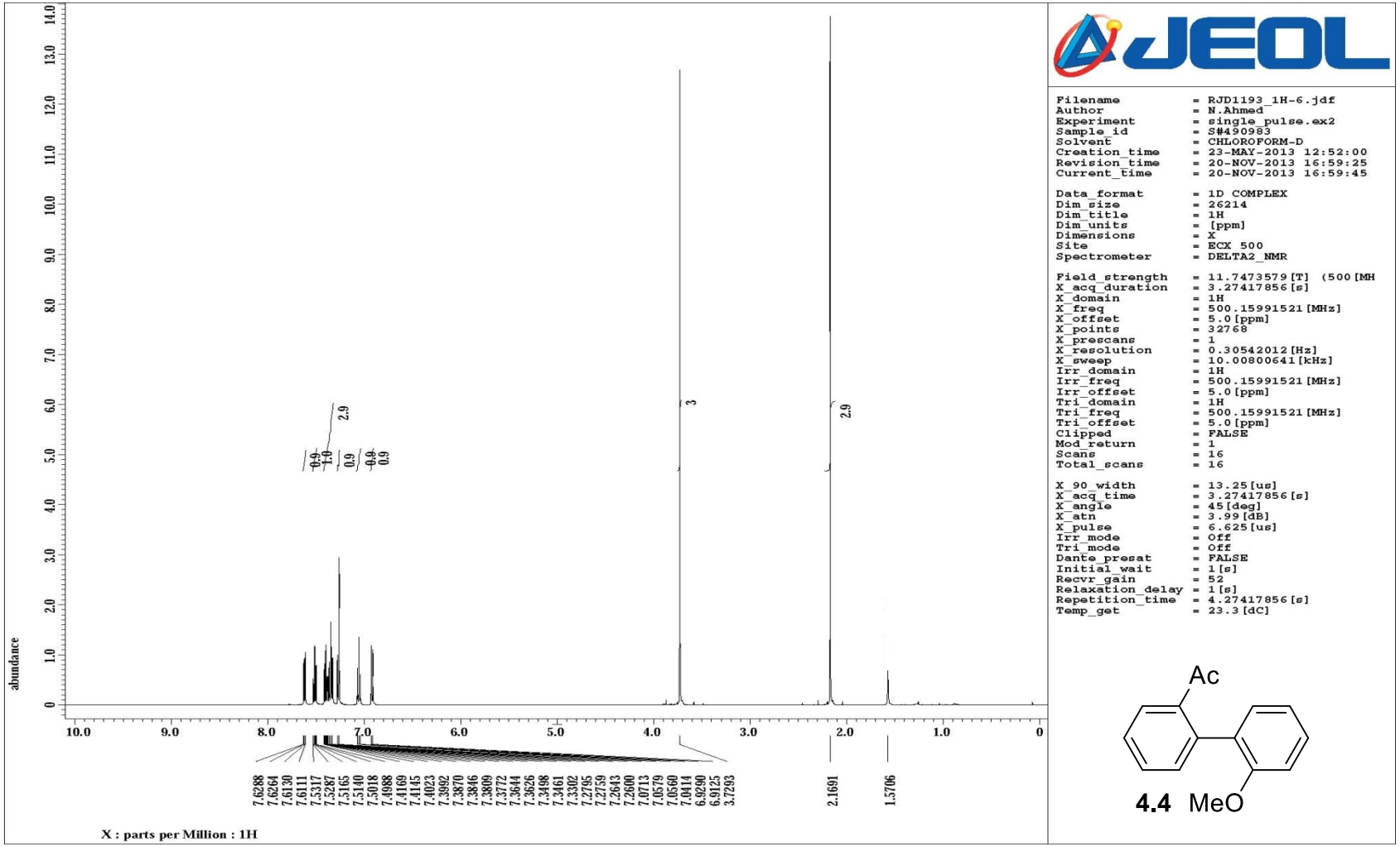
^{1}H NMR spectrum of 2'-methoxybiphenyl-2-carbonitrile (**4.3**)



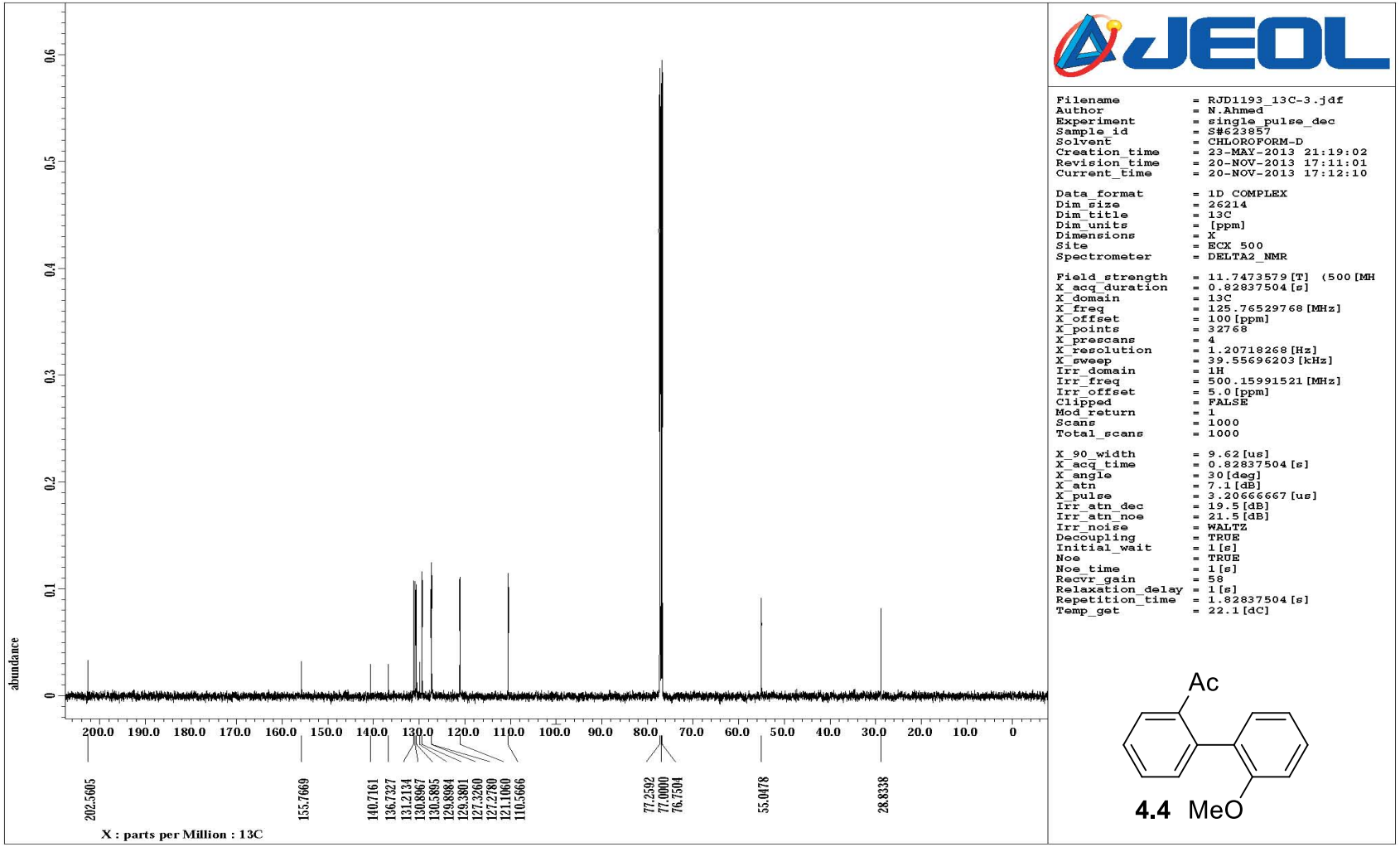
^{13}C NMR spectrum of 2'-methoxybiphenyl-2-carbonitrile (**4.3**)



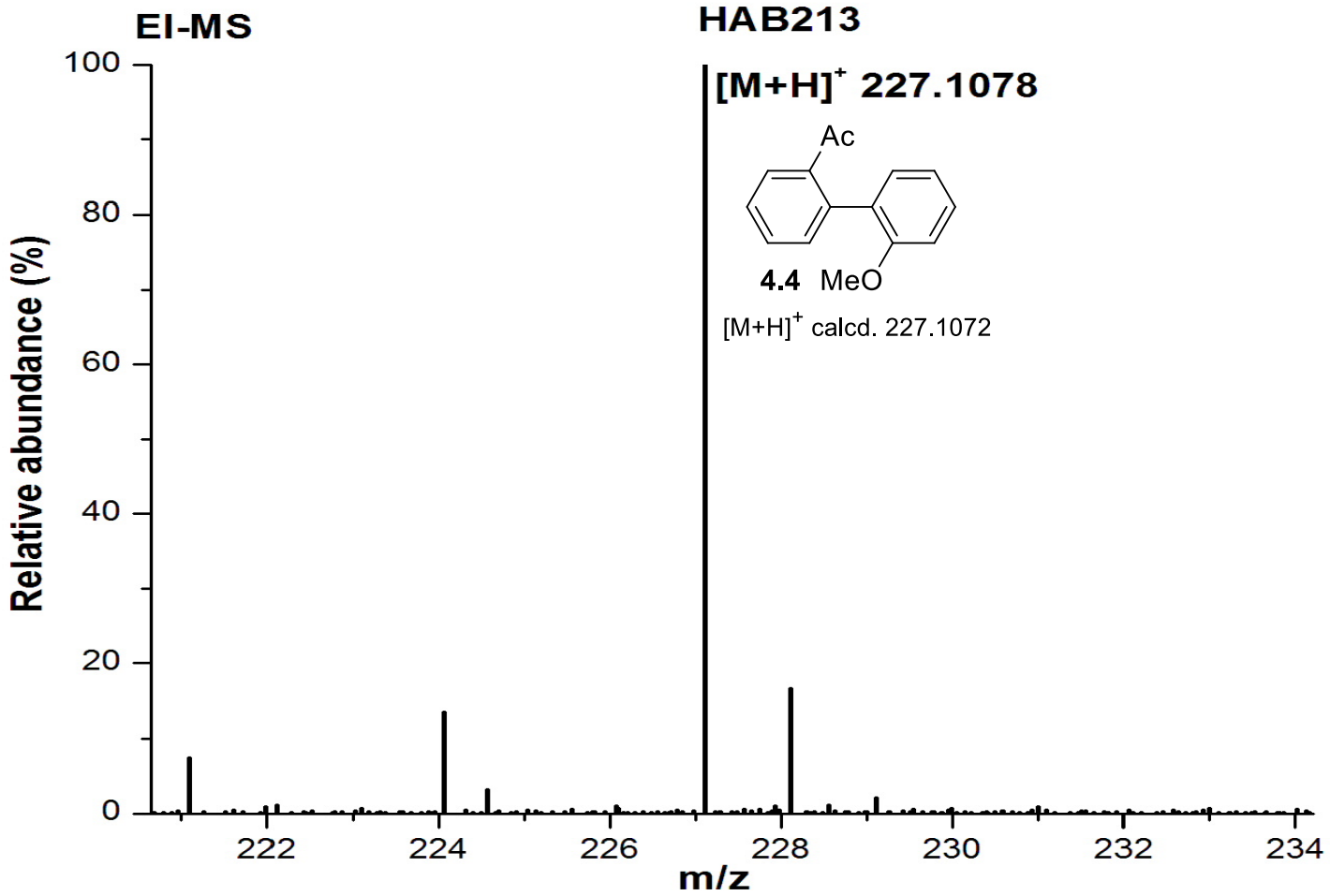
HRMS spectrum of 2'-methoxybiphenyl-2-carbonitrile (**4.3**)



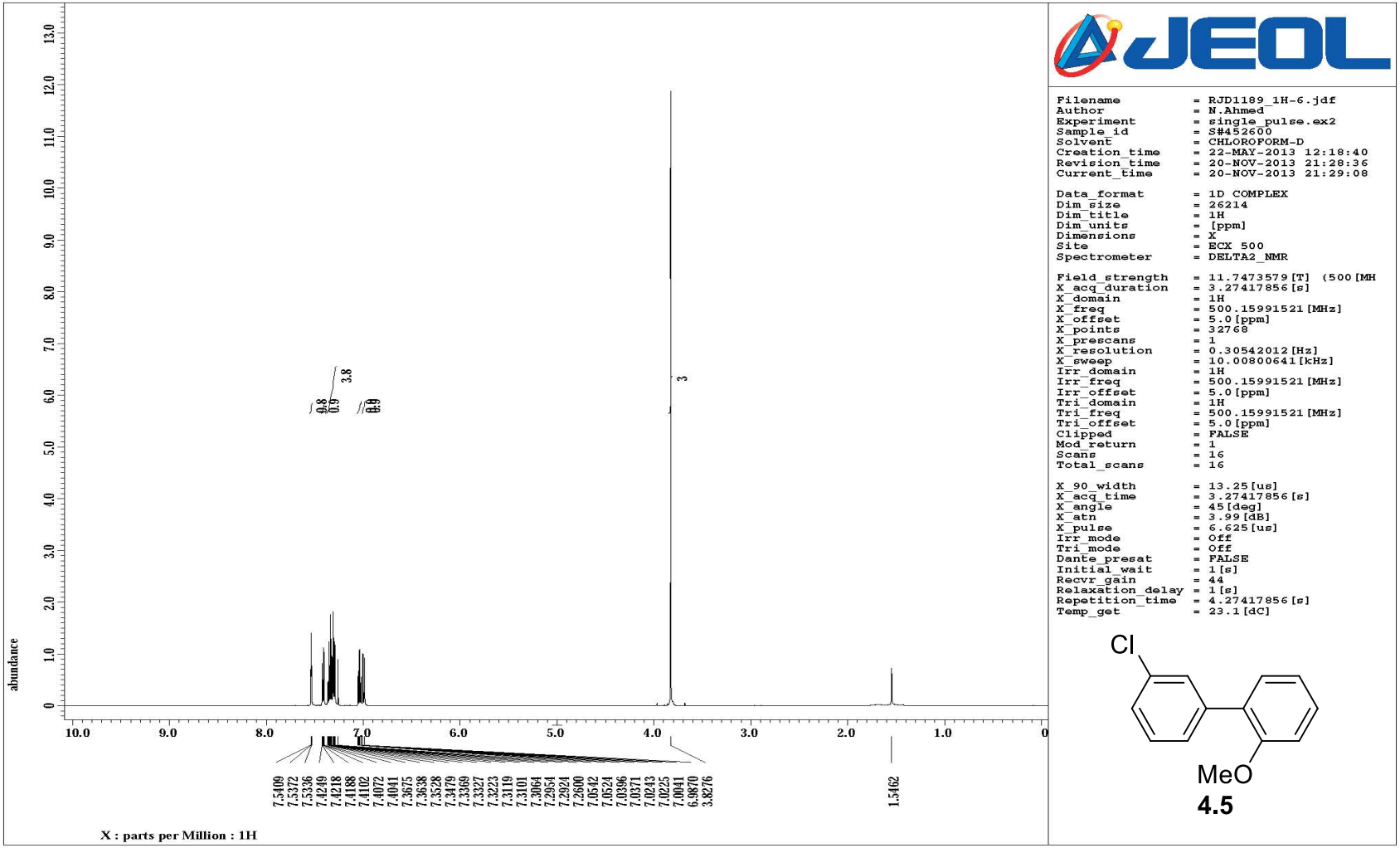
^{1}H NMR spectrum of 1-(2'-methoxybiphenyl-2-yl)ethanone (**4.4**)



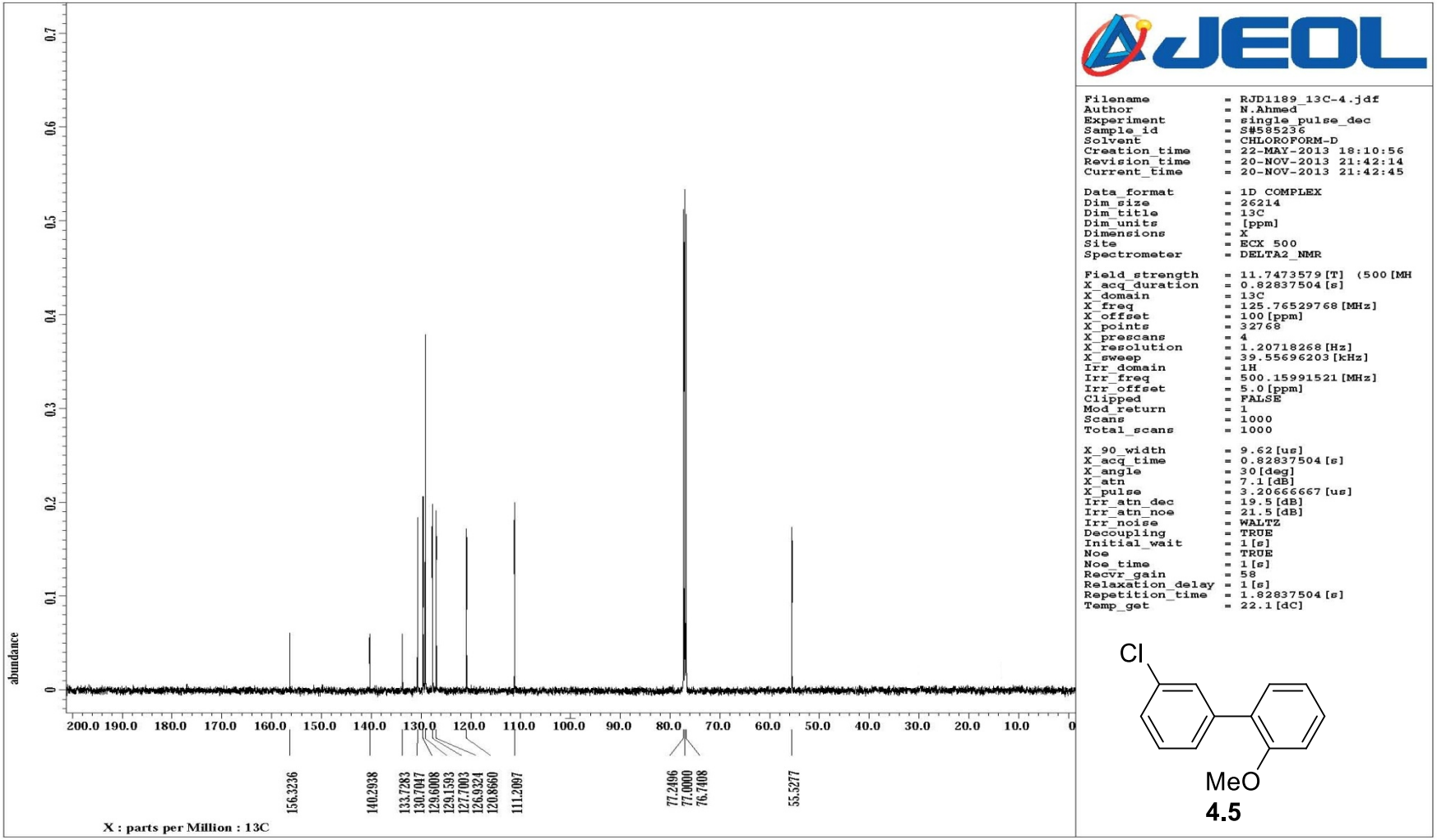
^{13}C NMR spectrum of 1-(2'-methoxybiphenyl-2-yl)ethanone (**4.4**)



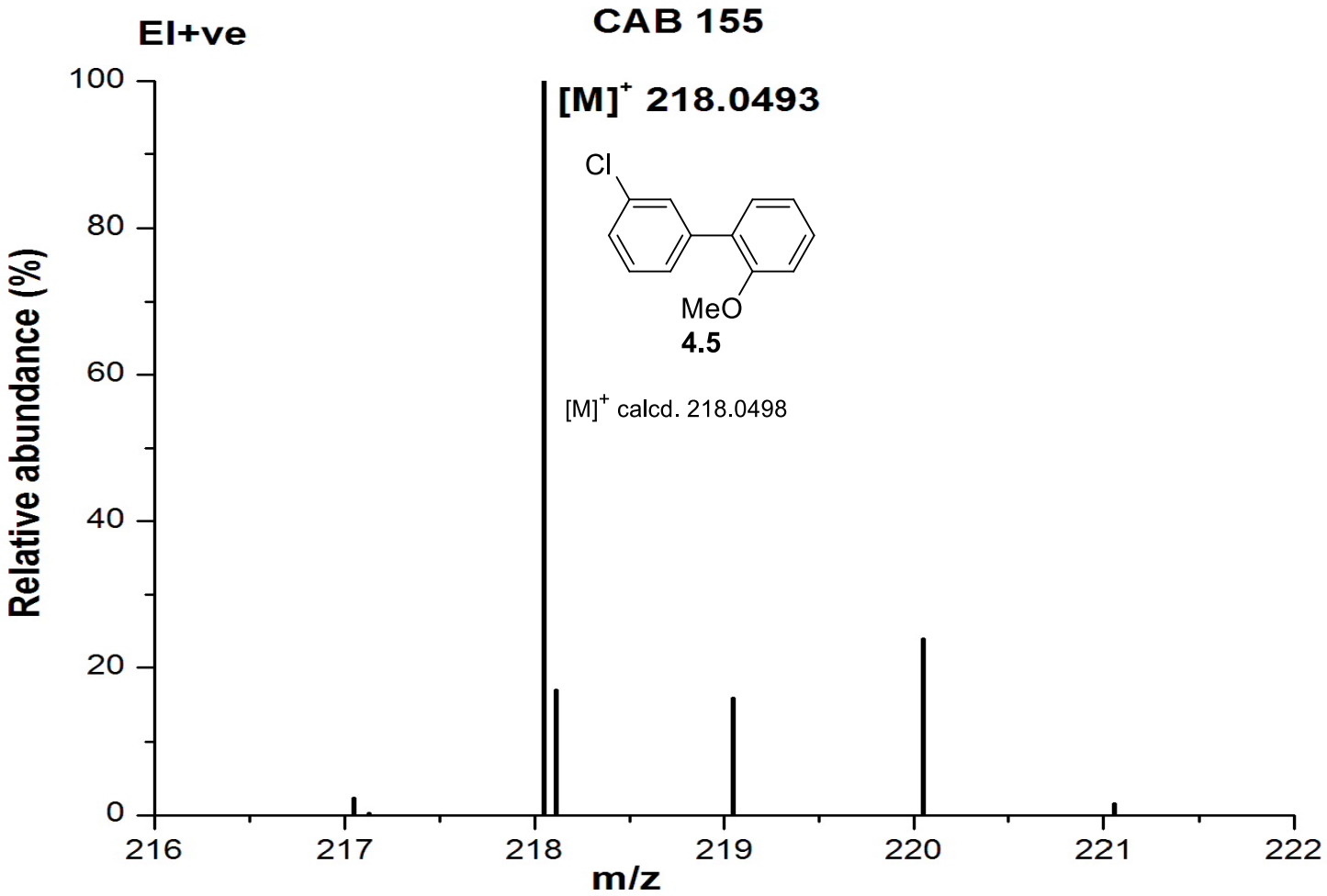
HRMS spectrum of 1-(2'-methoxybiphenyl-2-yl)ethanone (**4.4**)



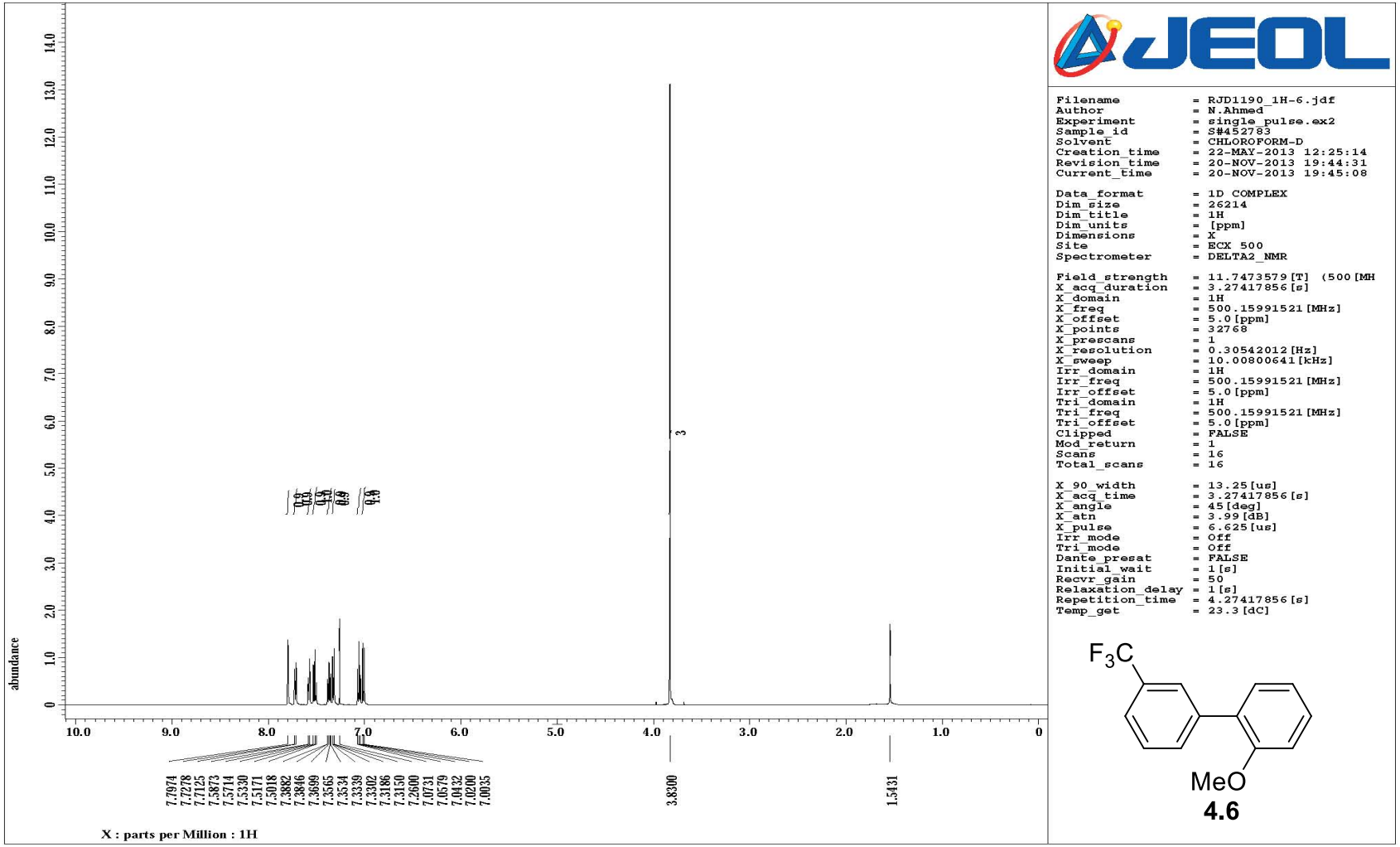
^{1}H NMR spectrum of 3'-chloro-2-methoxybiphenyl (**4.5**)



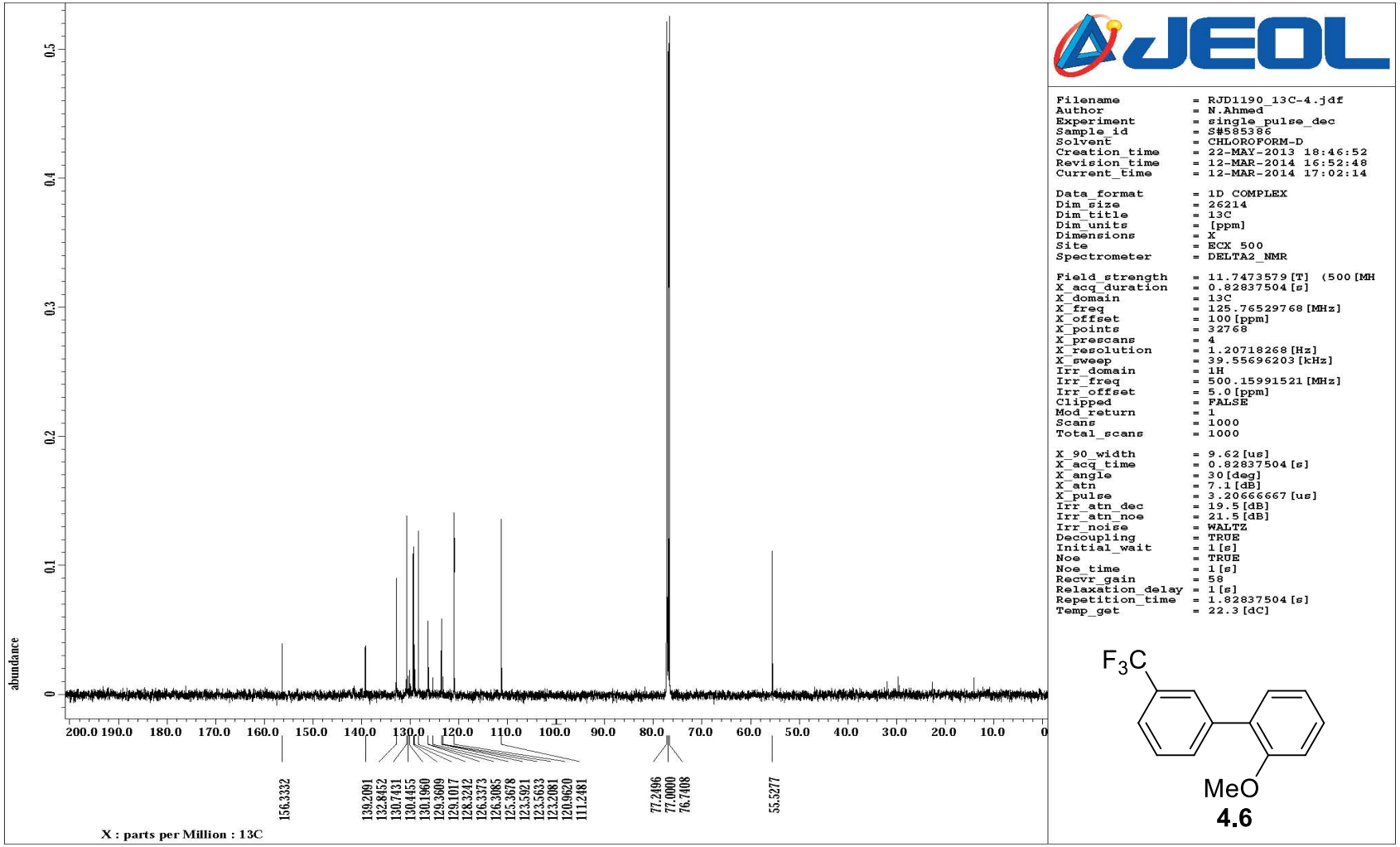
^{13}C NMR spectrum of 3'-chloro-2-methoxybiphenyl (**4.5**)



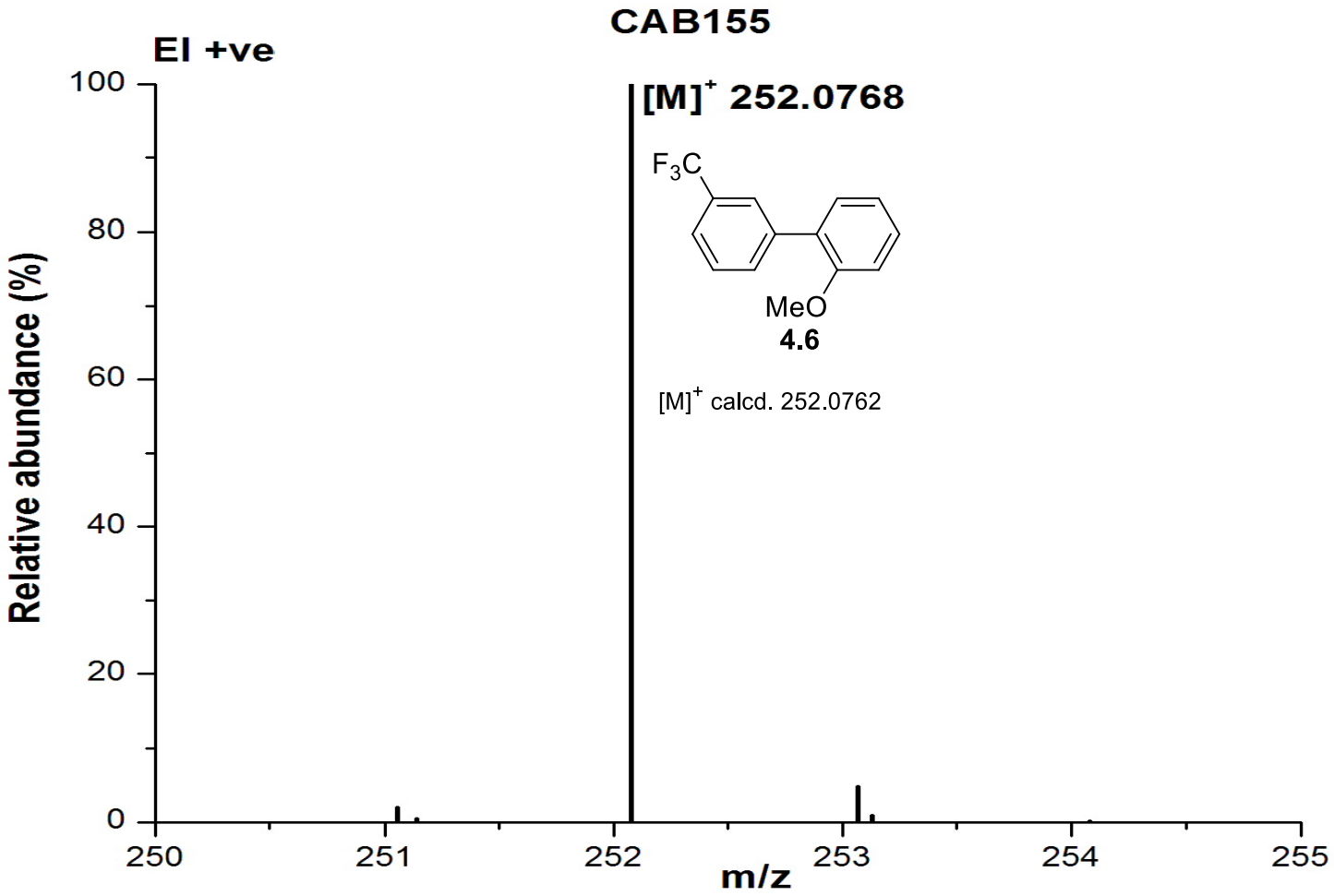
HRMS spectrum of 3'-chloro-2-methoxybiphenyl (**4.5**)



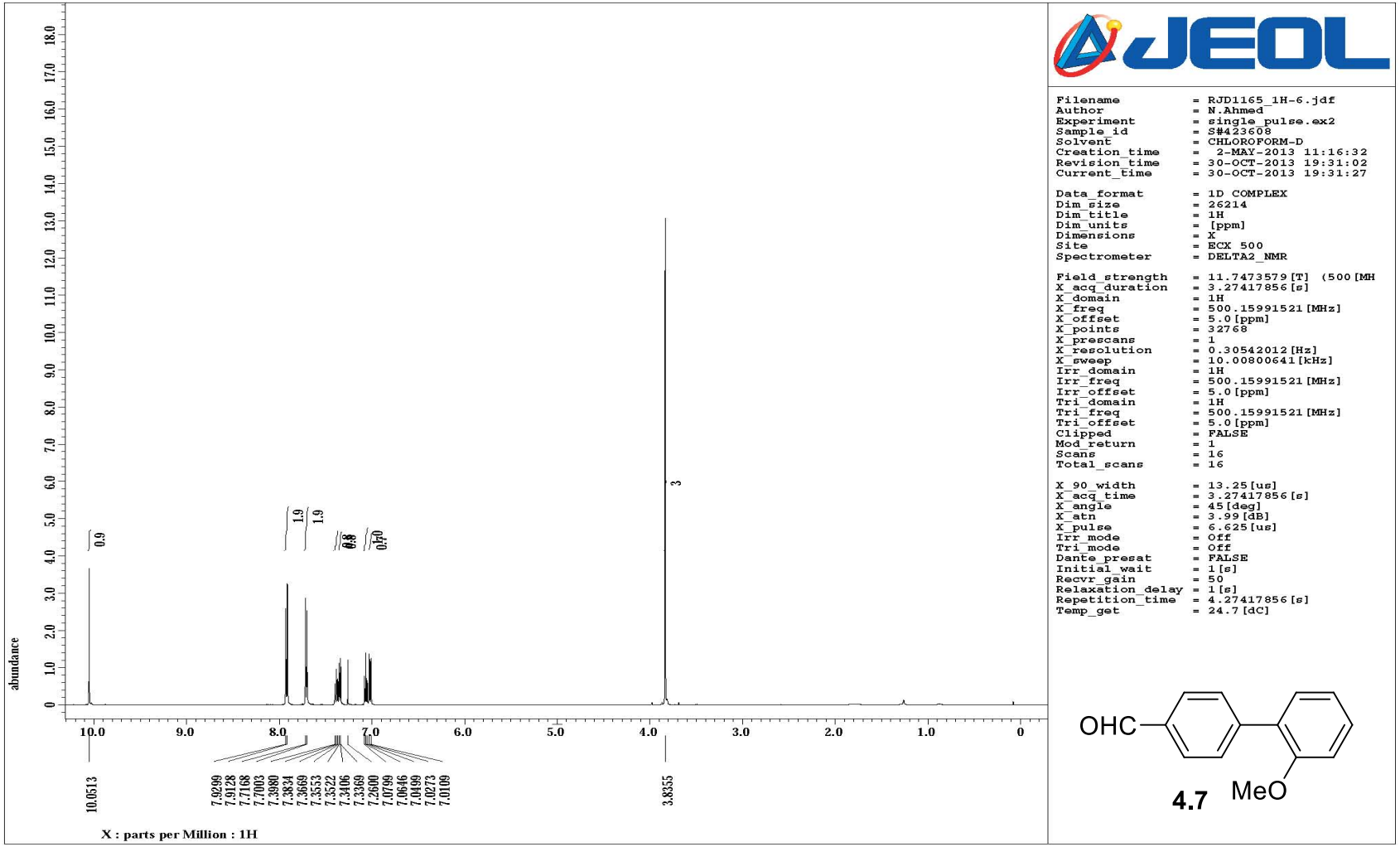
^{1}H NMR spectrum of 2-methoxy-3'-(trifluoromethyl)biphenyl (**4.6**)



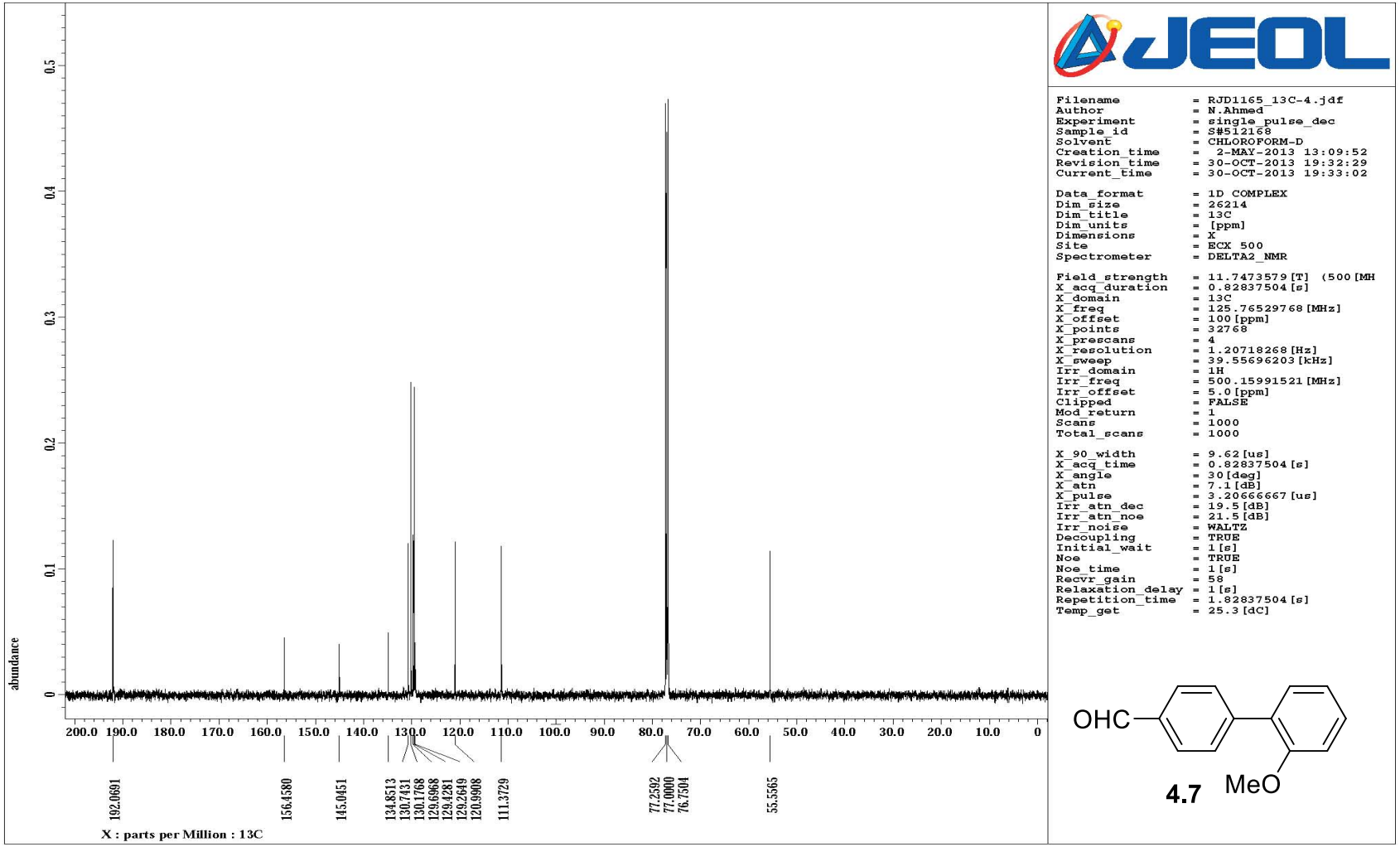
^{13}C NMR spectrum of 2-methoxy-3'-(trifluoromethyl)biphenyl (**4.6**)



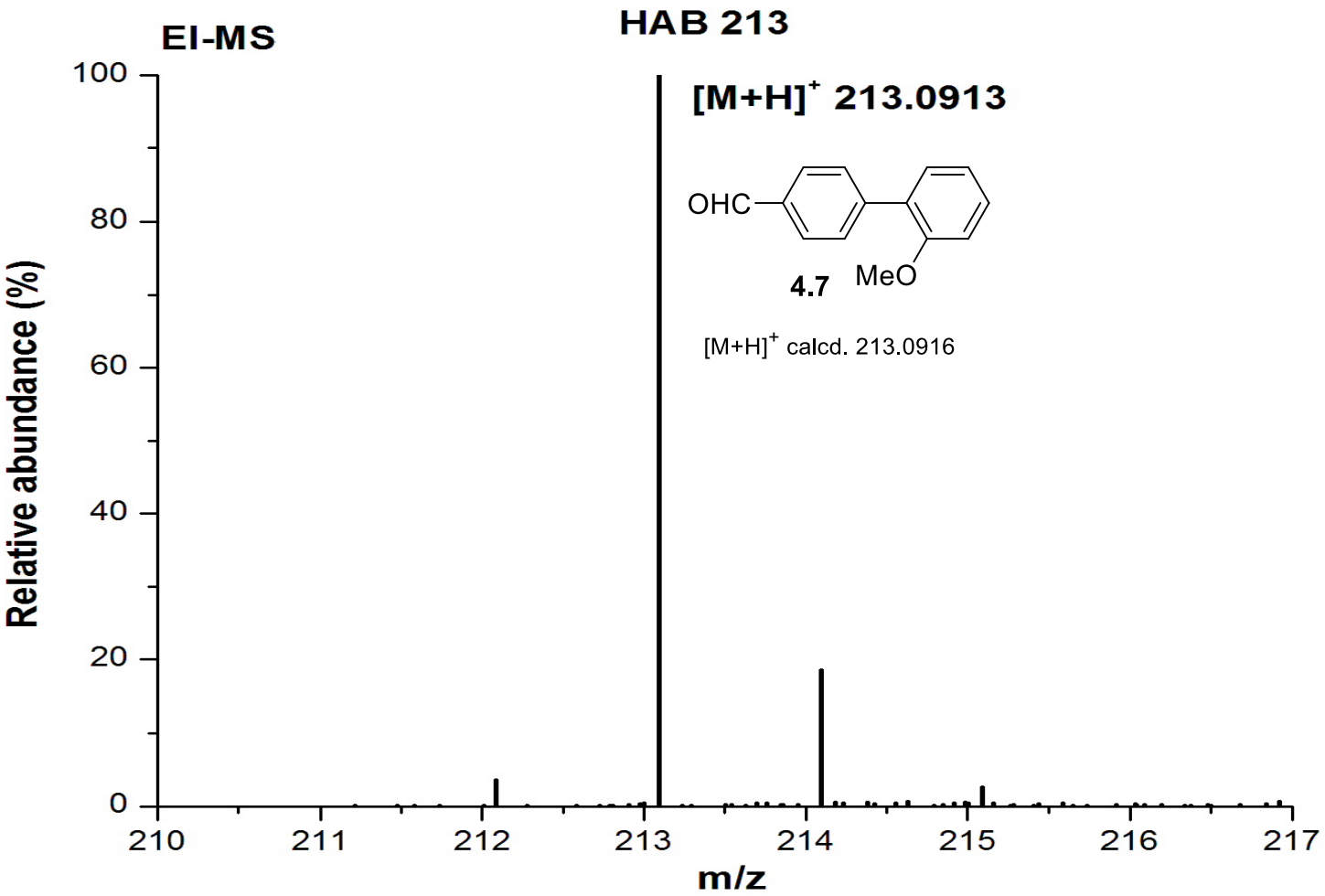
HRMS spectrum of 2-methoxy-3'-(trifluoromethyl)biphenyl (**4.6**)



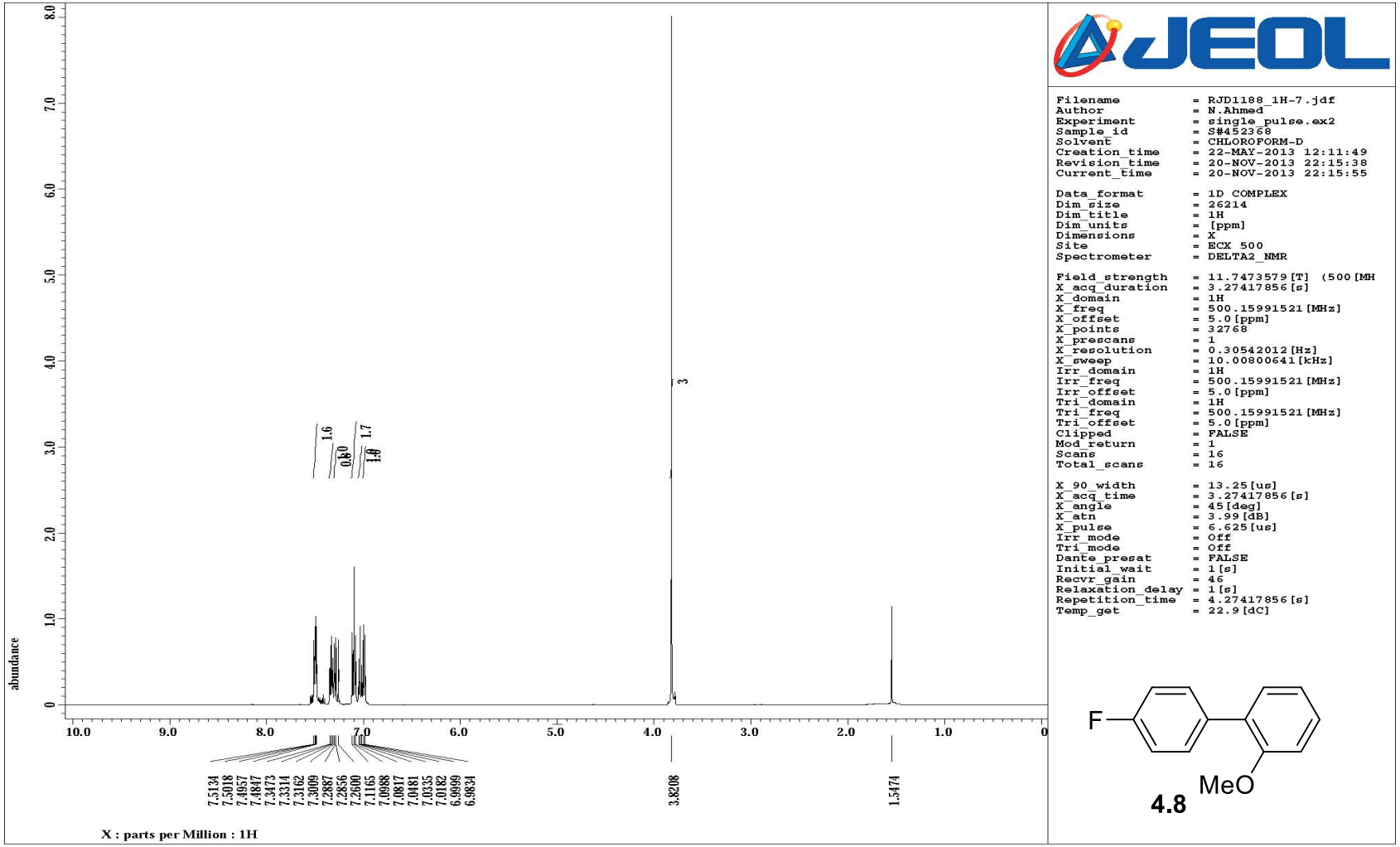
^{1}H NMR spectrum of 2'-methoxybiphenyl-4-carbaldehyde (**4.7**)



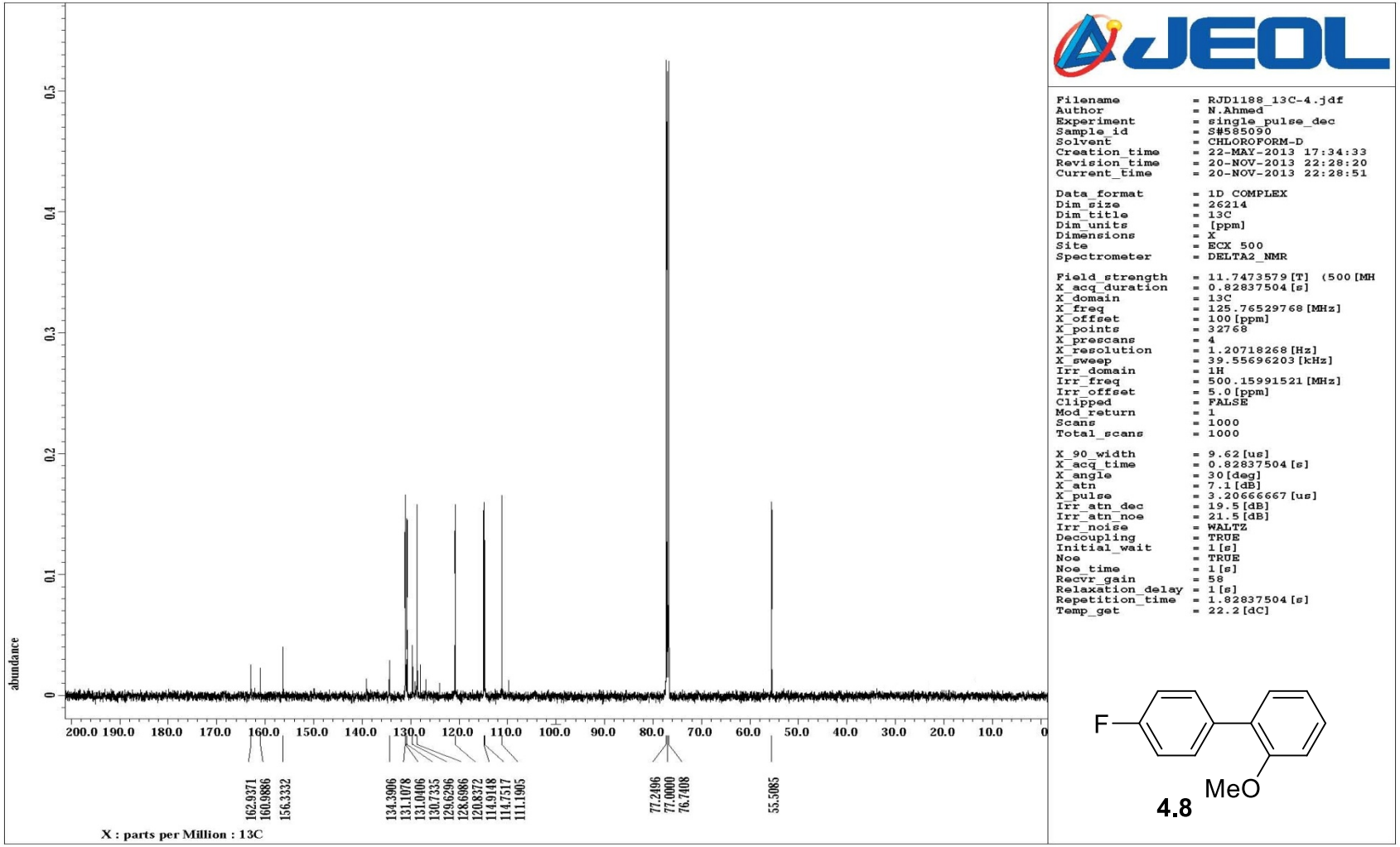
^{13}C NMR spectrum of 2'-methoxybiphenyl-4-carbaldehyde (**4.7**)



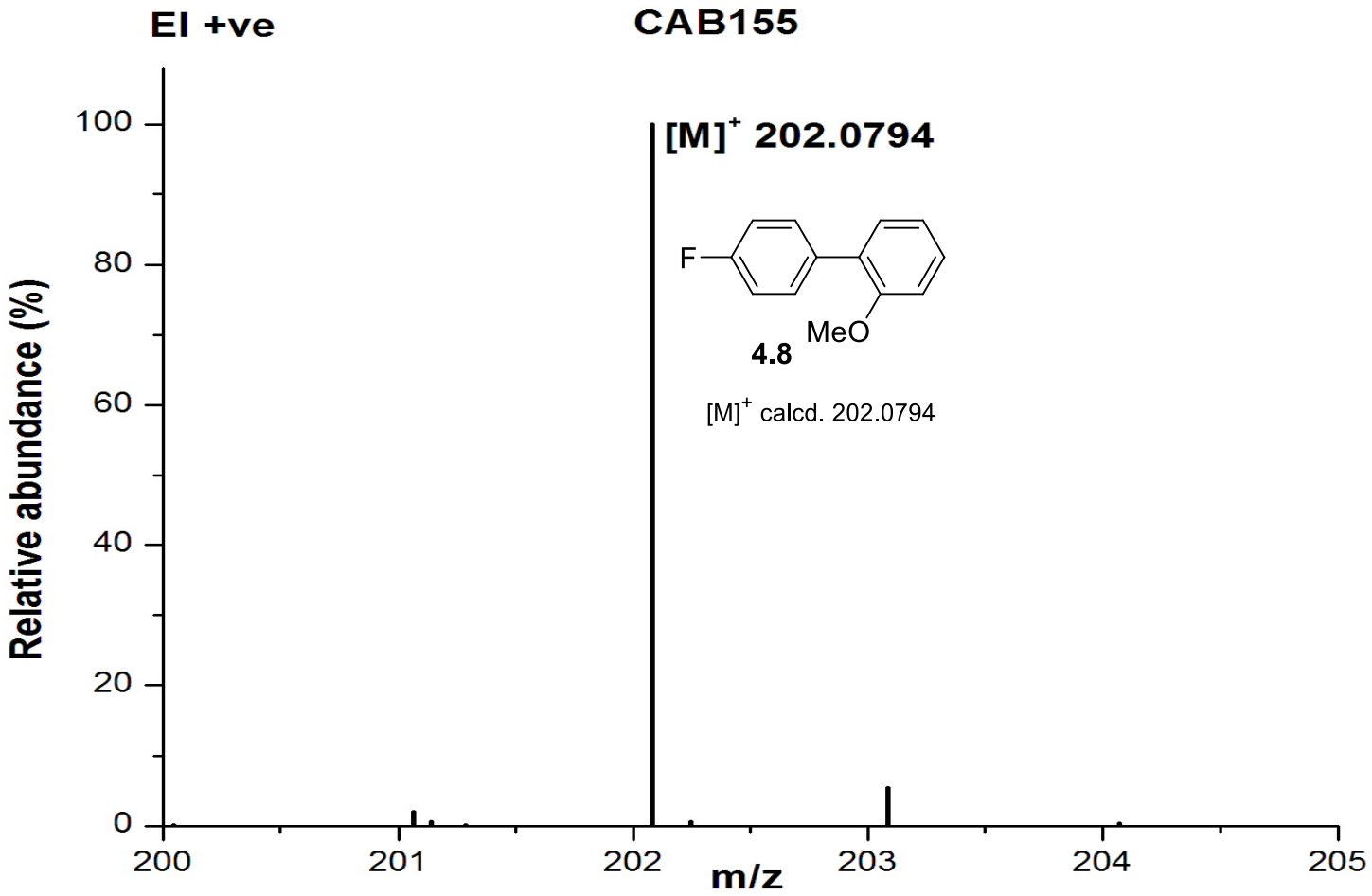
HRMS spectrum of 2'-methoxybiphenyl-4-carbaldehyde (**4.7**)



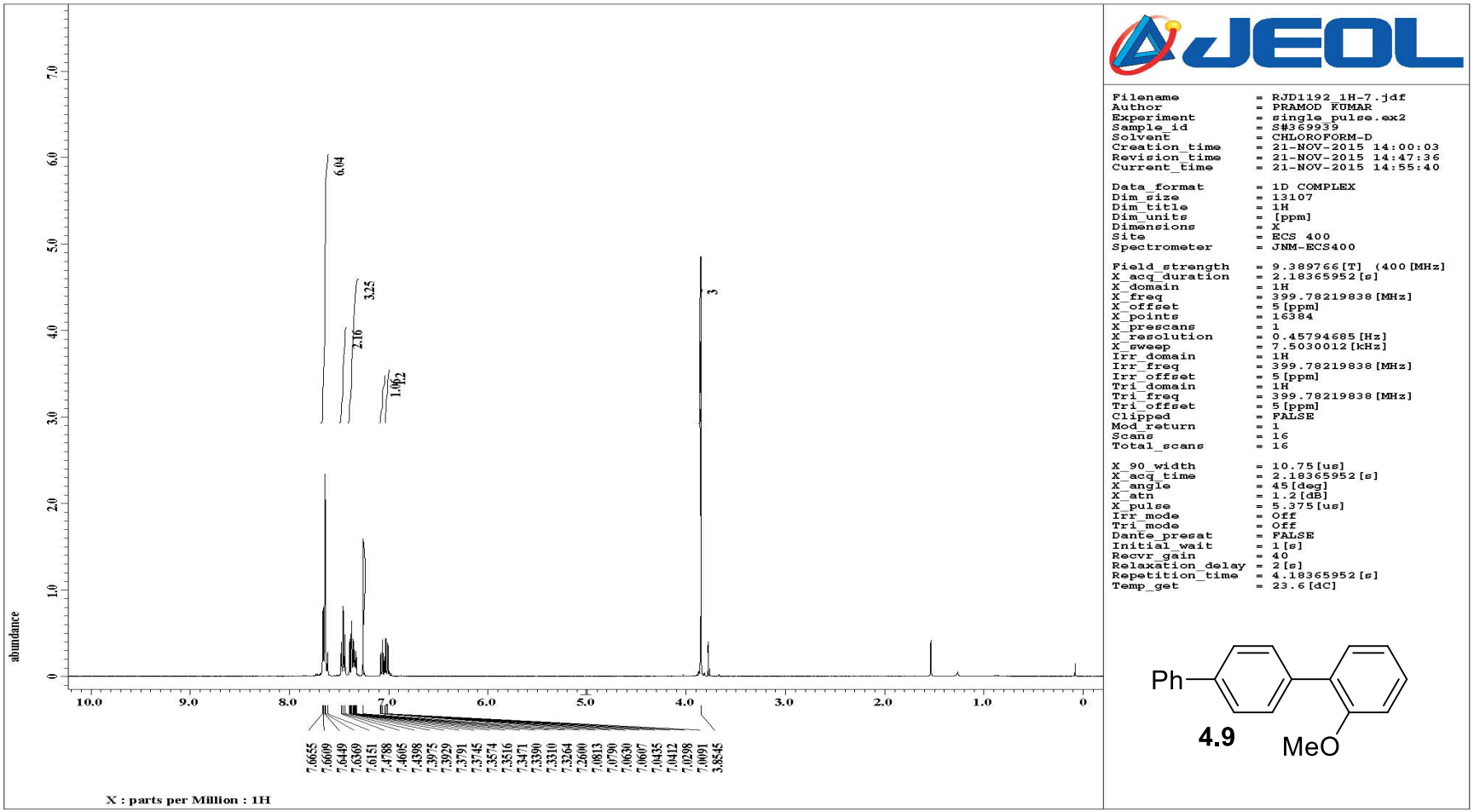
^{1}H NMR spectrum of 4'-fluoro-2-methoxybiphenyl (**4.8**)



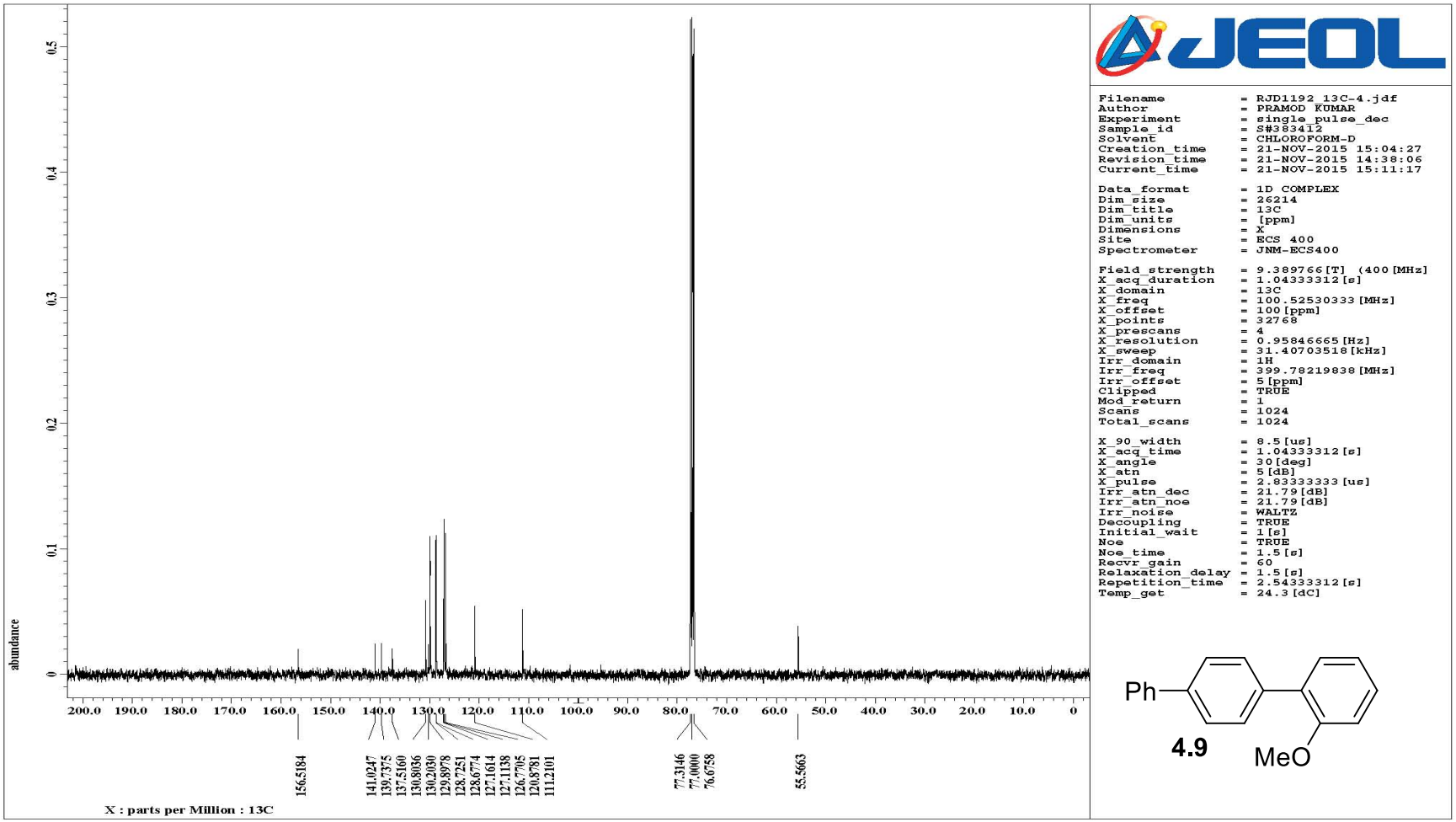
^{13}C NMR spectrum of 4'-fluoro-2-methoxybiphenyl (**4.8**)



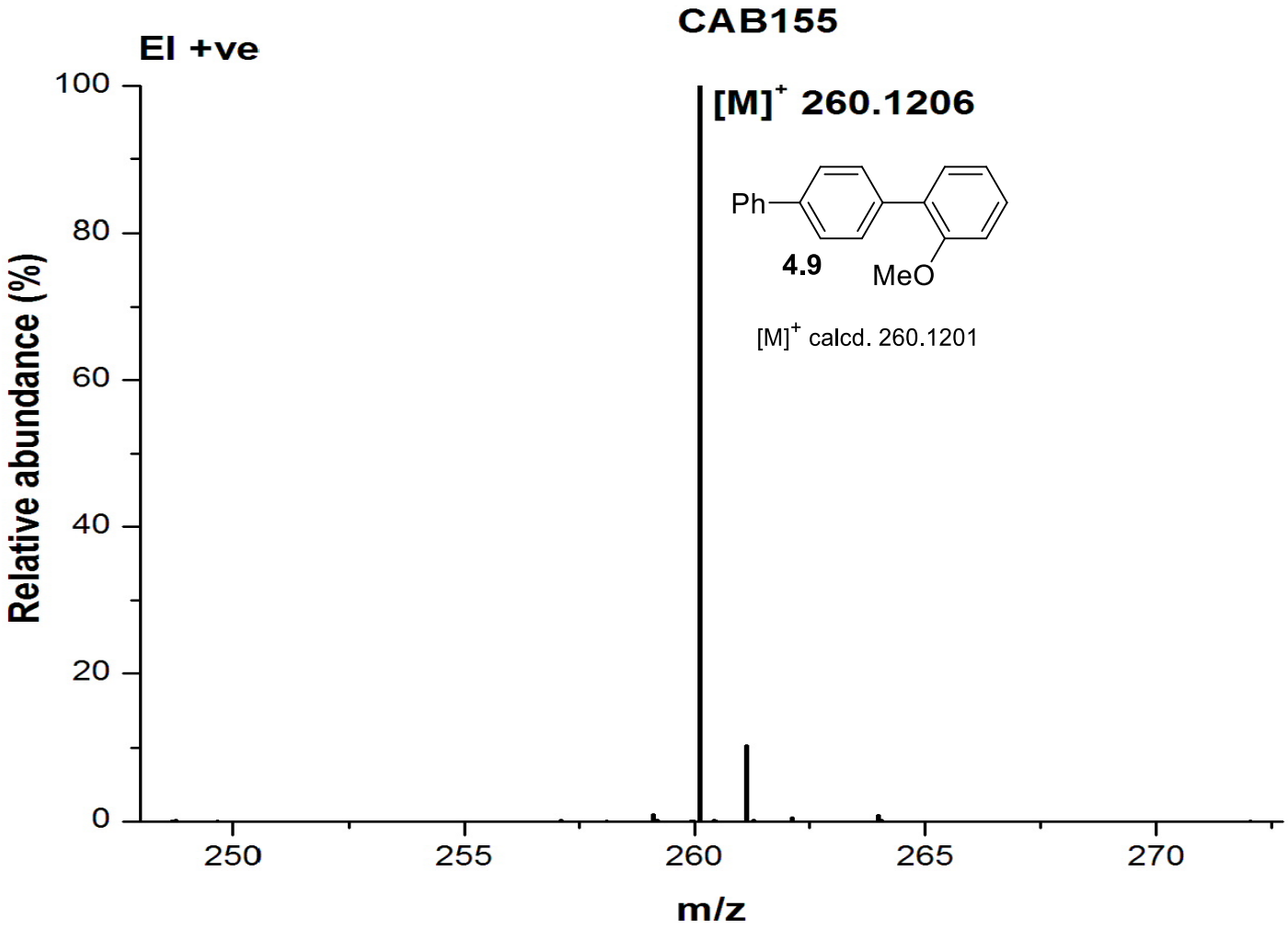
HRMS spectrum of 4'-fluoro-2-methoxybiphenyl (**4.8**)



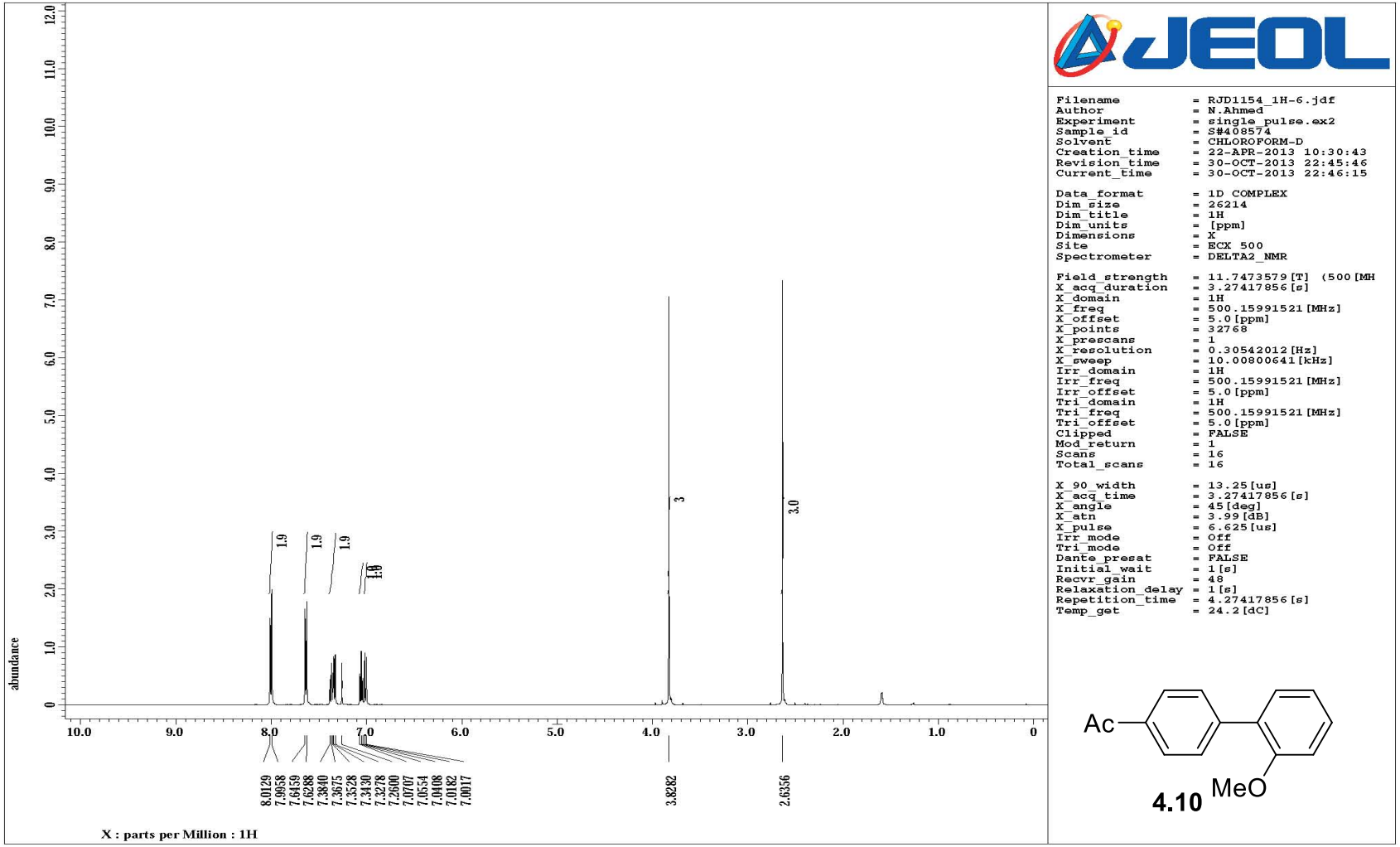
^{1}H NMR spectrum of 2-methoxy-4'-phenylbiphenyl (**4.9**)



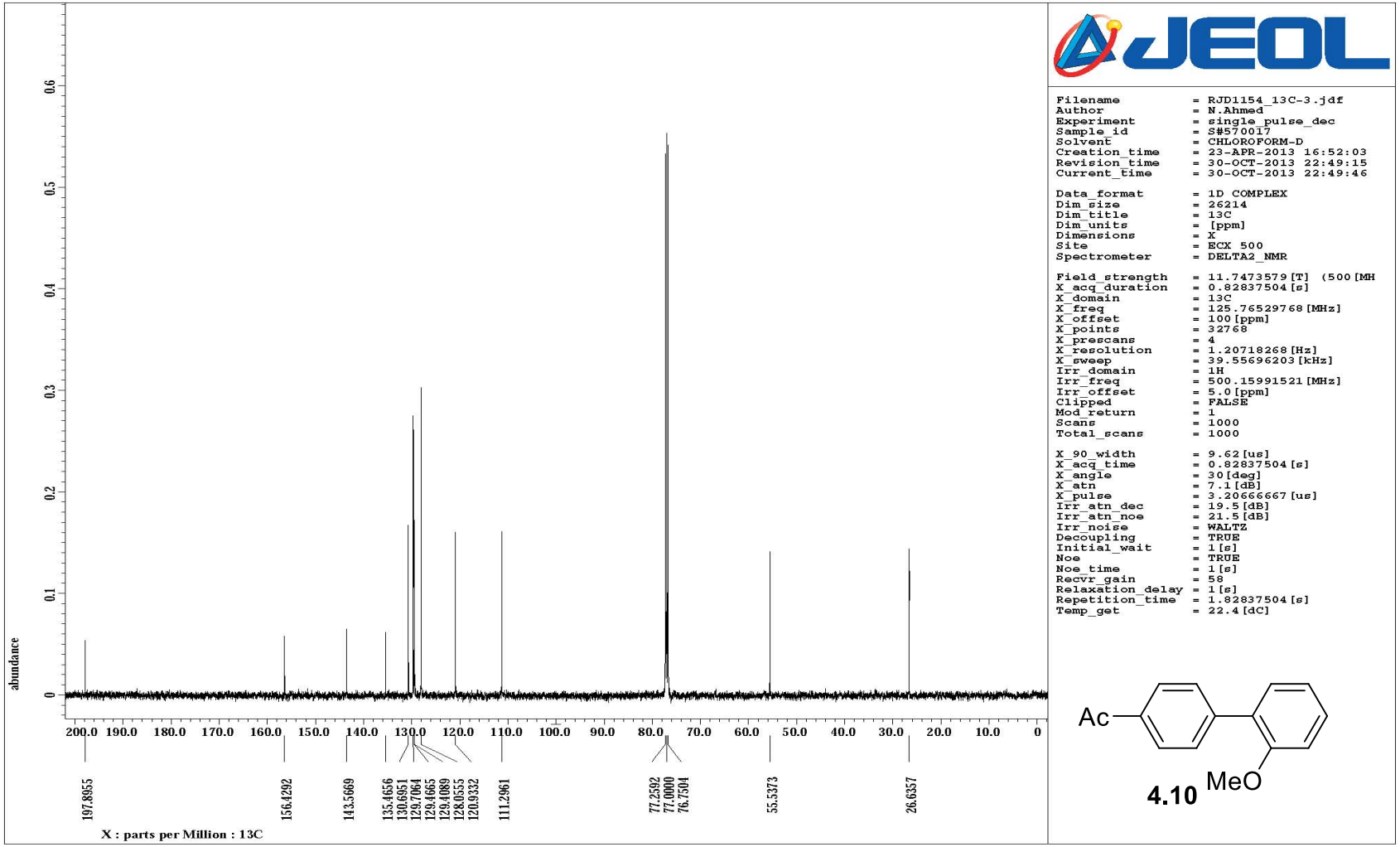
^{13}C NMR spectrum of 2-methoxy-4'-phenylbiphenyl (**4.9**)



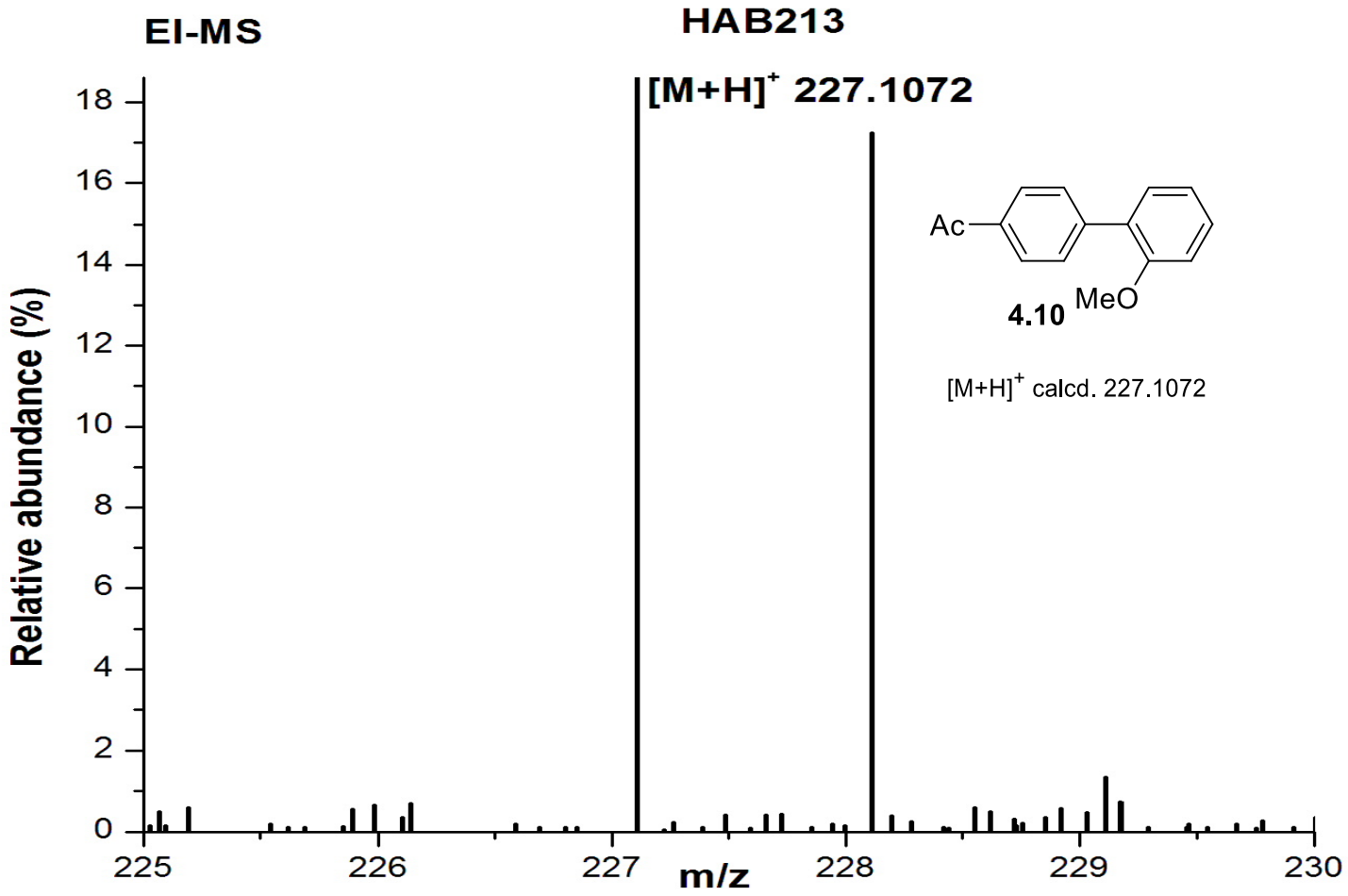
HRMS spectrum of 2-methoxy-4'-phenylbiphenyl (**4.9**)



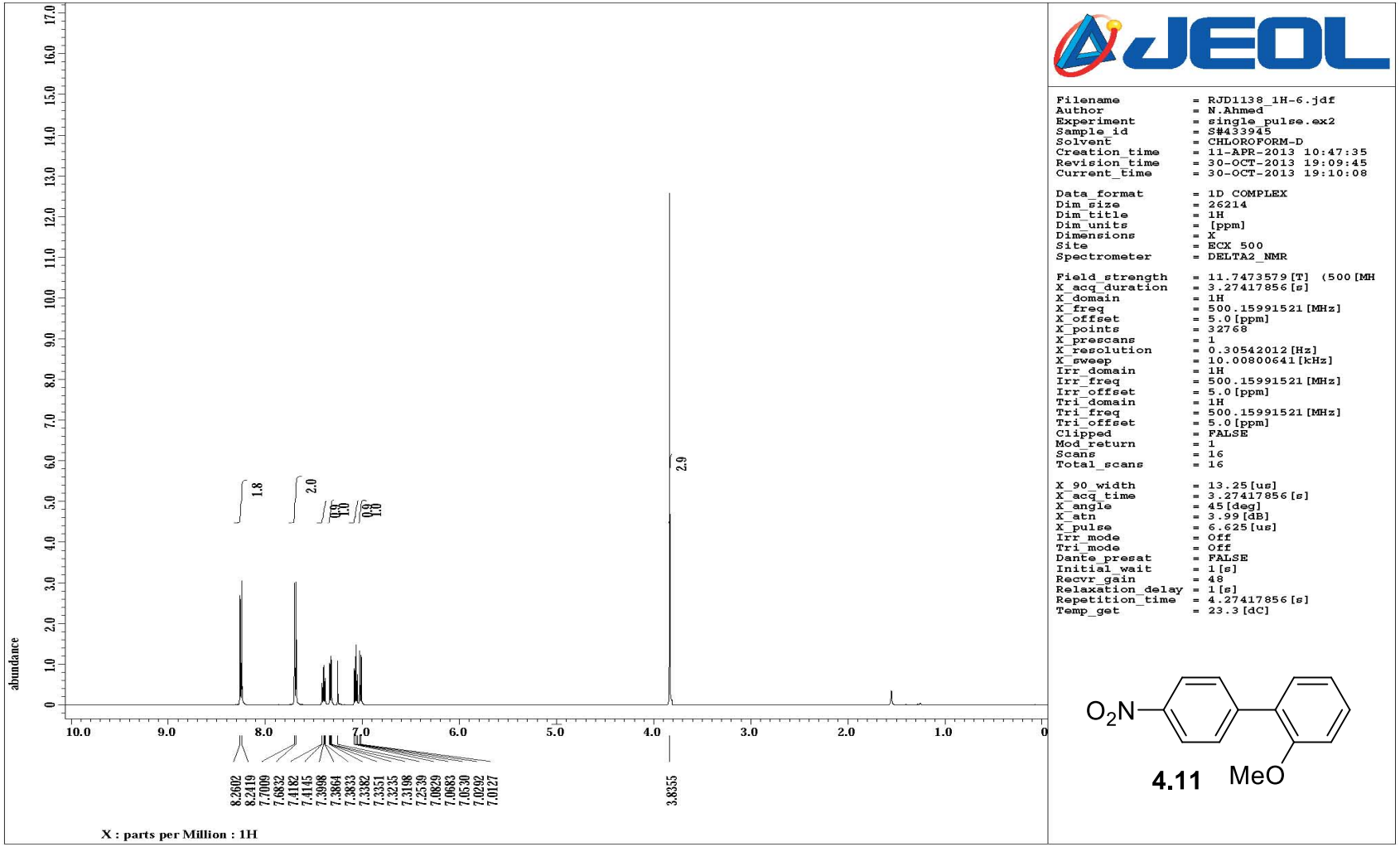
^{1}H NMR spectrum of 1-(2'-methoxybiphenyl-4-yl)ethanone (**4.10**)



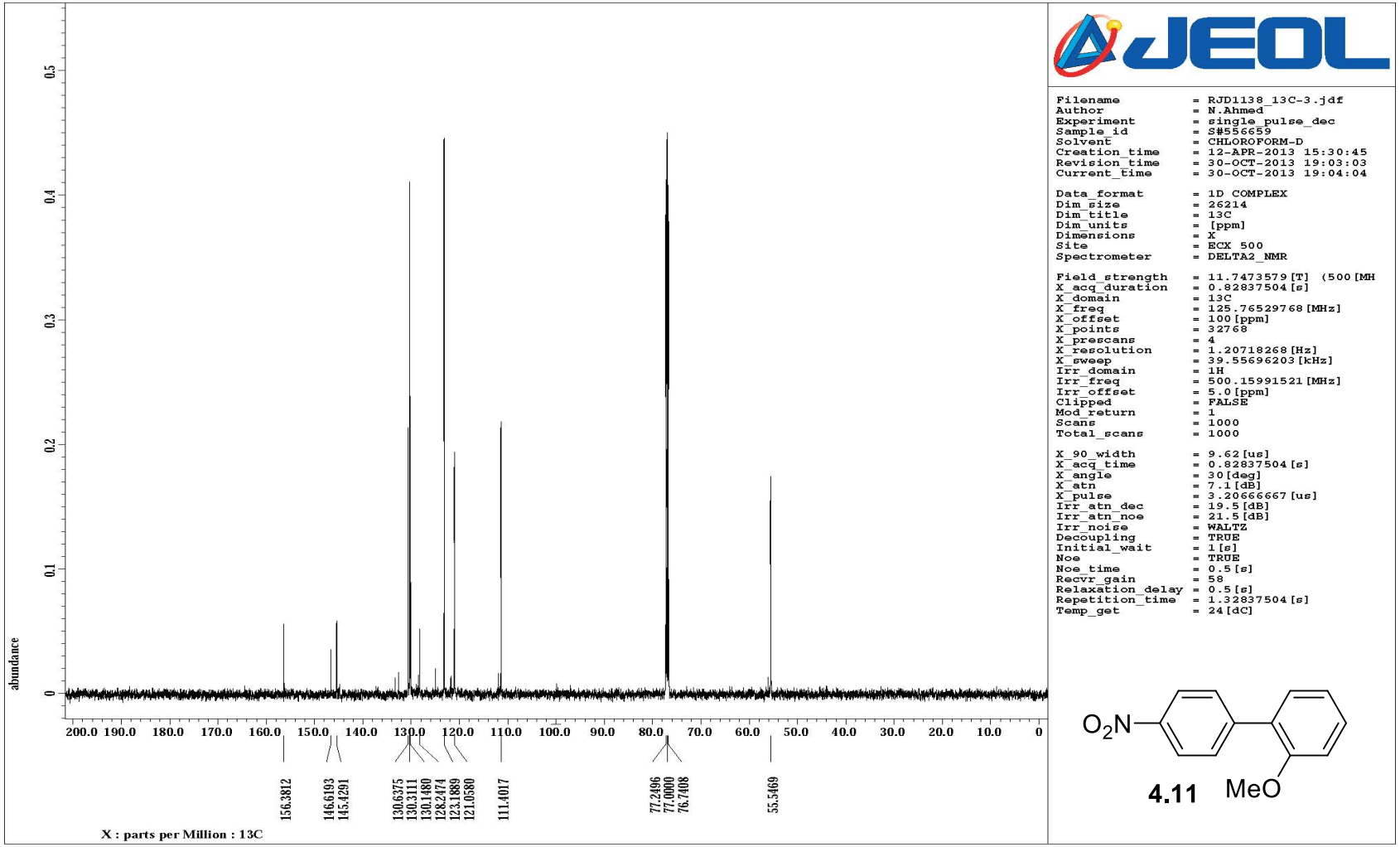
^{13}C NMR spectrum of 1-(2'-methoxybiphenyl-4-yl)ethanone (**4.10**)



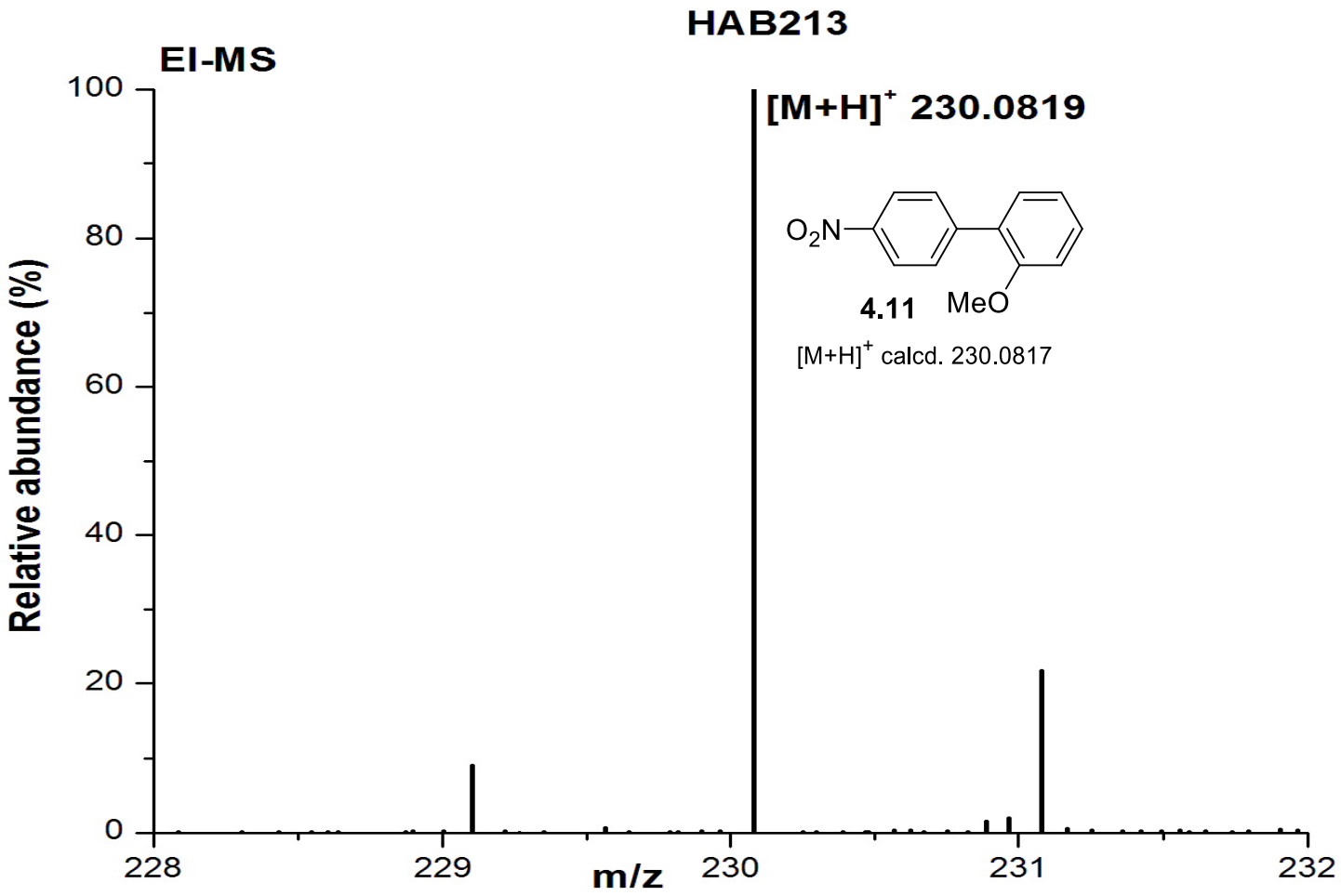
HRMS spectrum of 1-(2'-methoxybiphenyl-4-yl)ethanone (**4.10**)



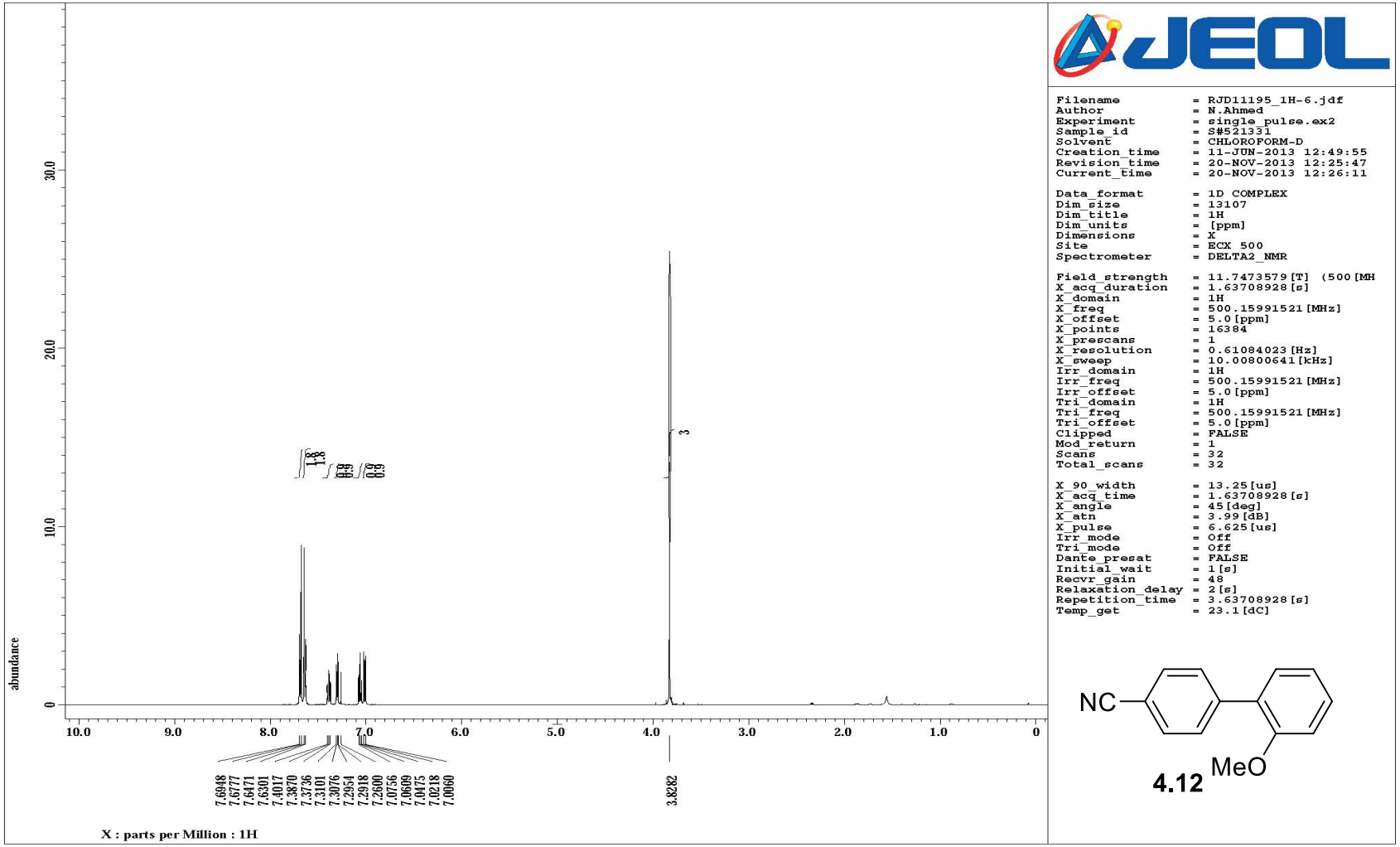
^{1}H NMR spectrum of 2-methoxy-4'-nitrobiphenyl (**4.11**)



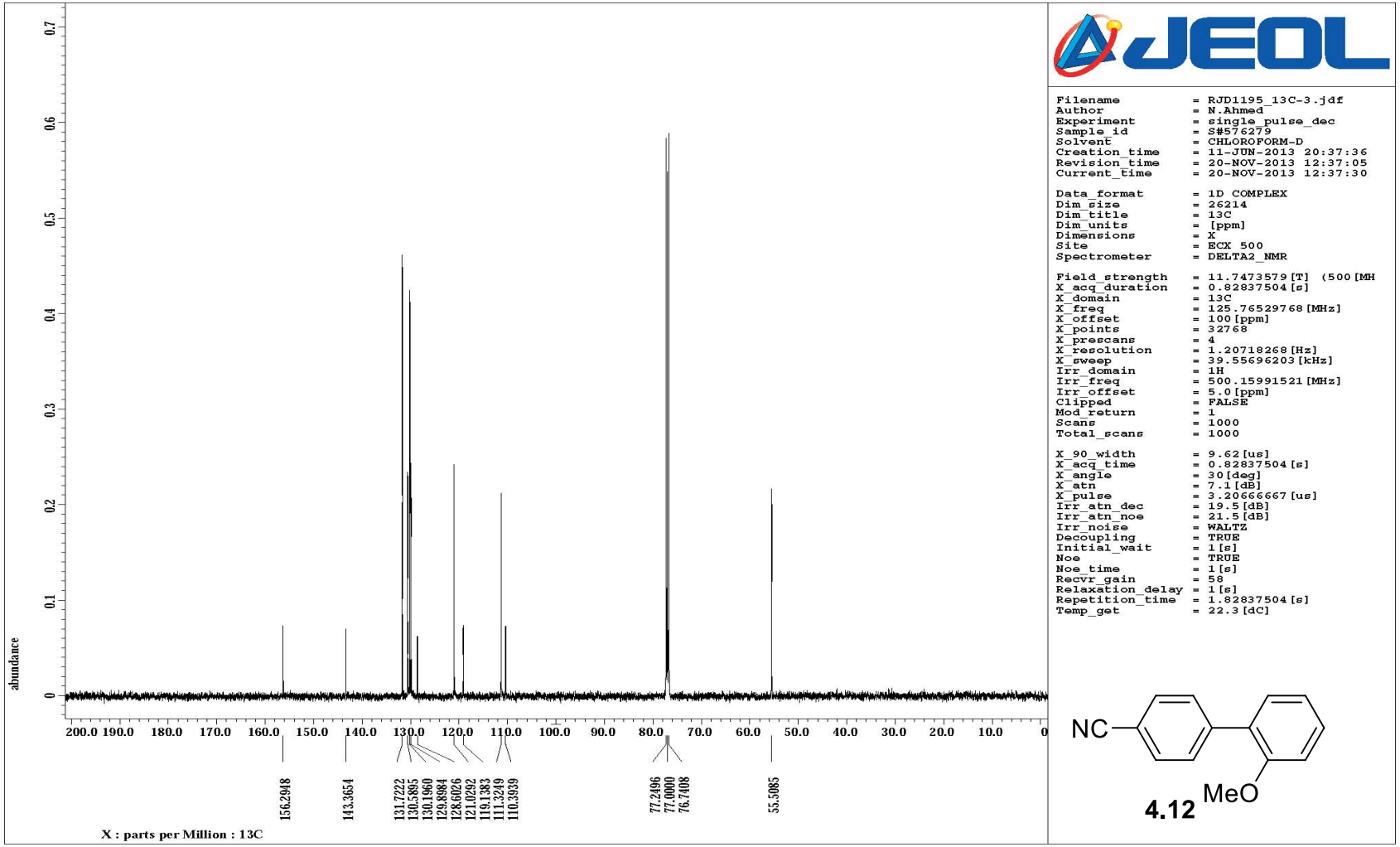
^{13}C NMR spectrum of 2-methoxy-4'-nitrobiphenyl (**4.11**)



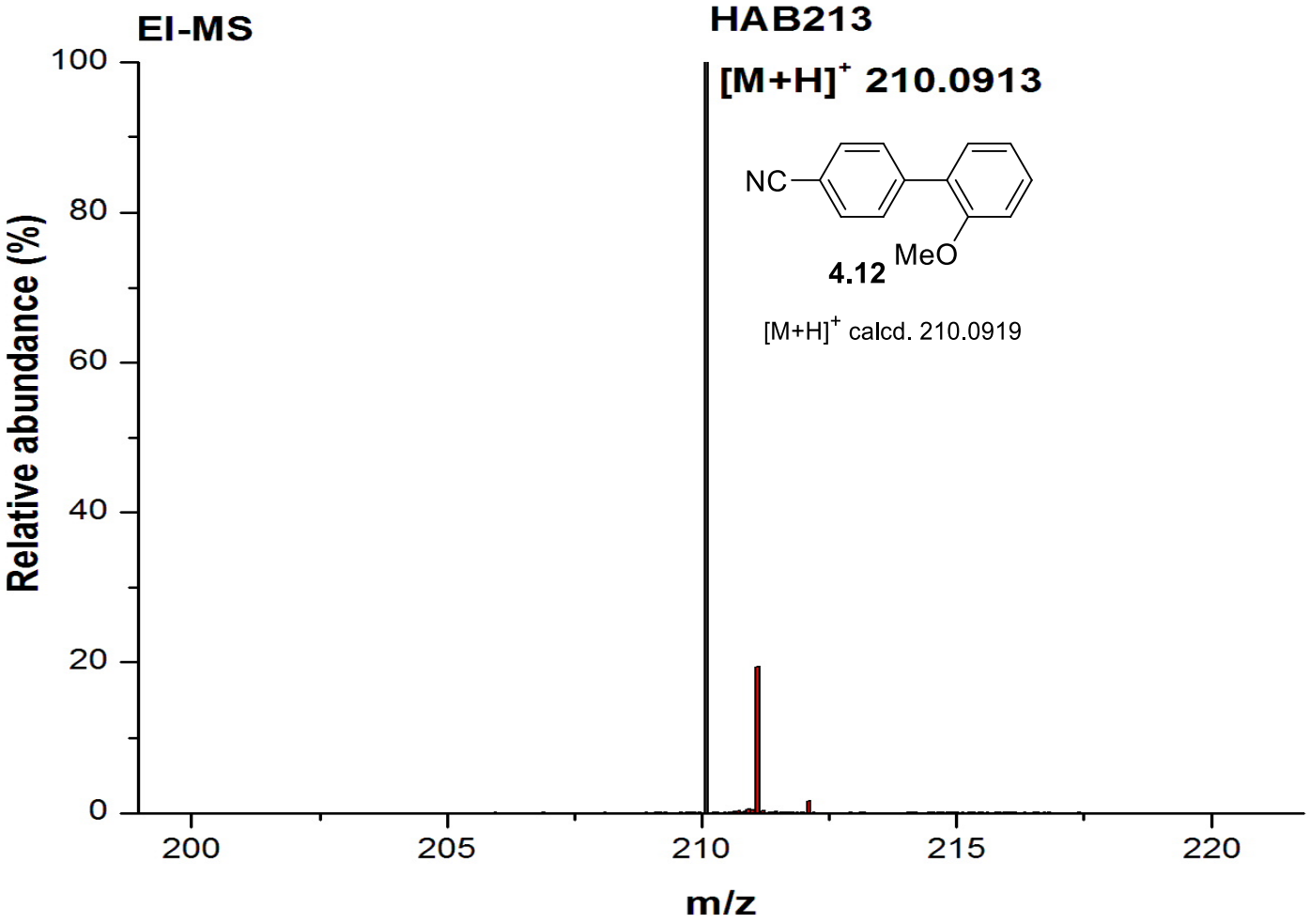
HRMS spectrum of 2-methoxy-4'-nitrobiphenyl (**4.11**)



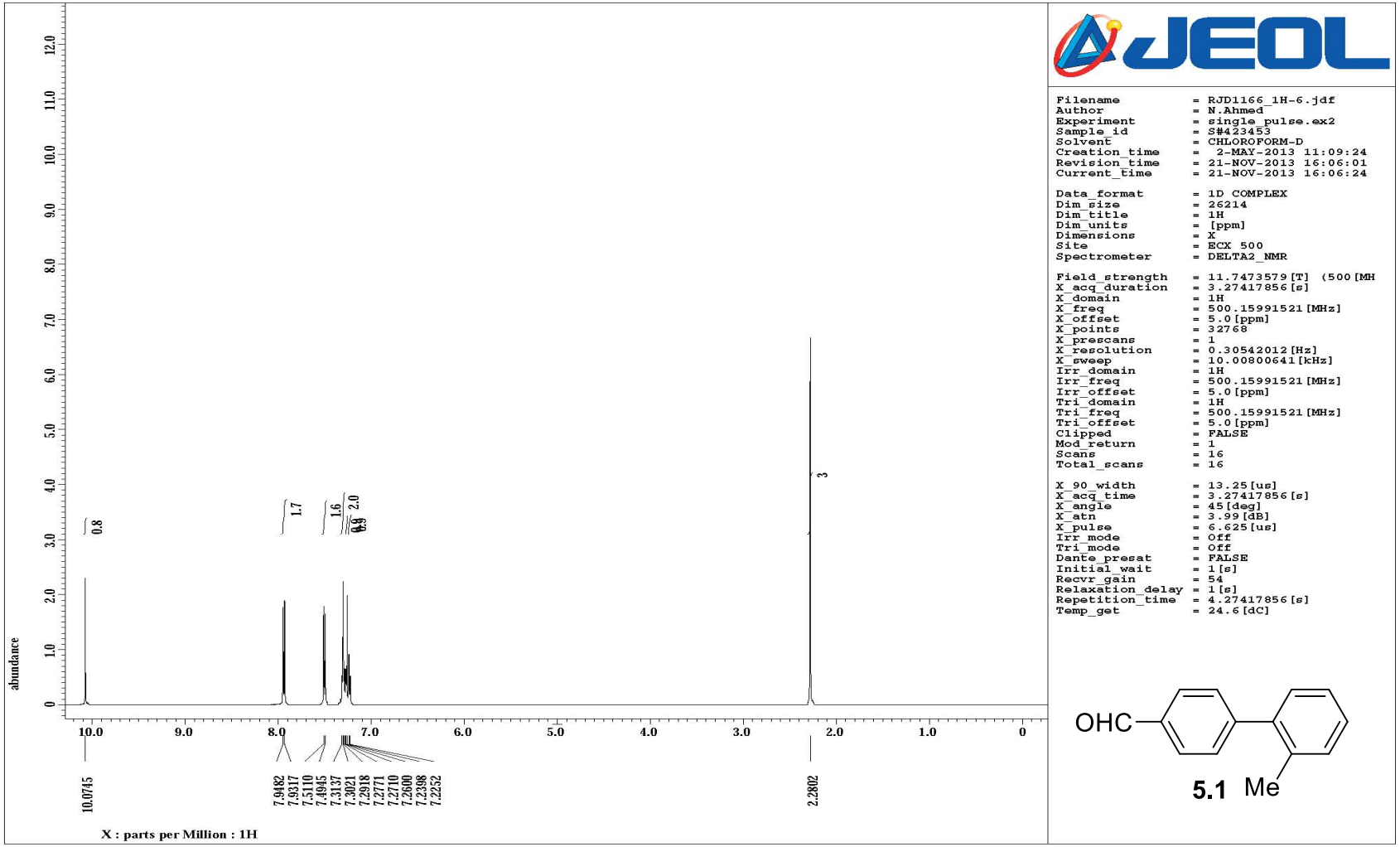
^{1}H NMR spectrum of 2'-methoxybiphenyl-4-carbonitrile (**4.12**)



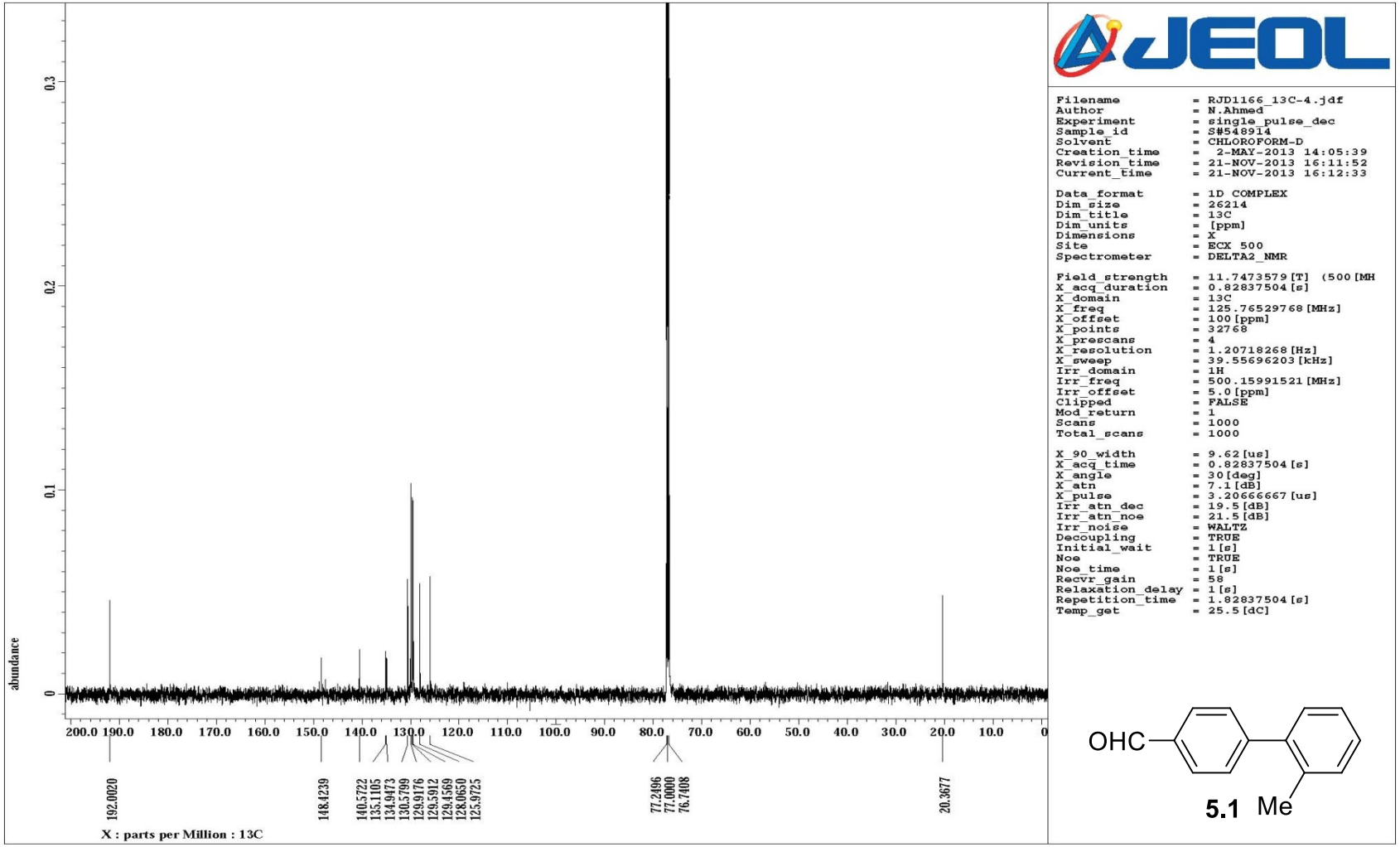
^{13}C NMR spectrum of 2'-methoxybiphenyl-4-carbonitrile (**4.12**)



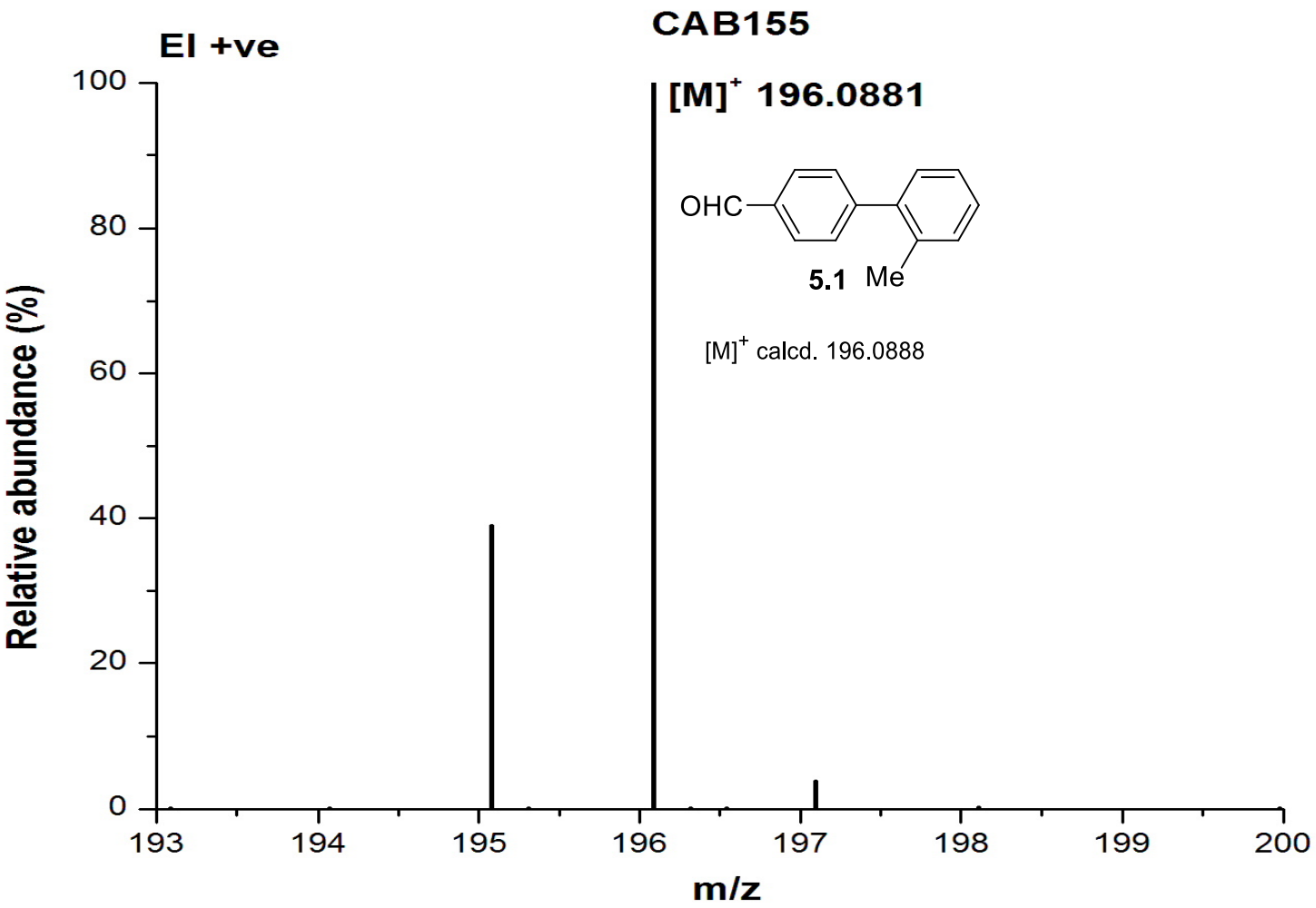
HRMS spectrum of 2'-methoxybiphenyl-4-carbonitrile (**4.12**)



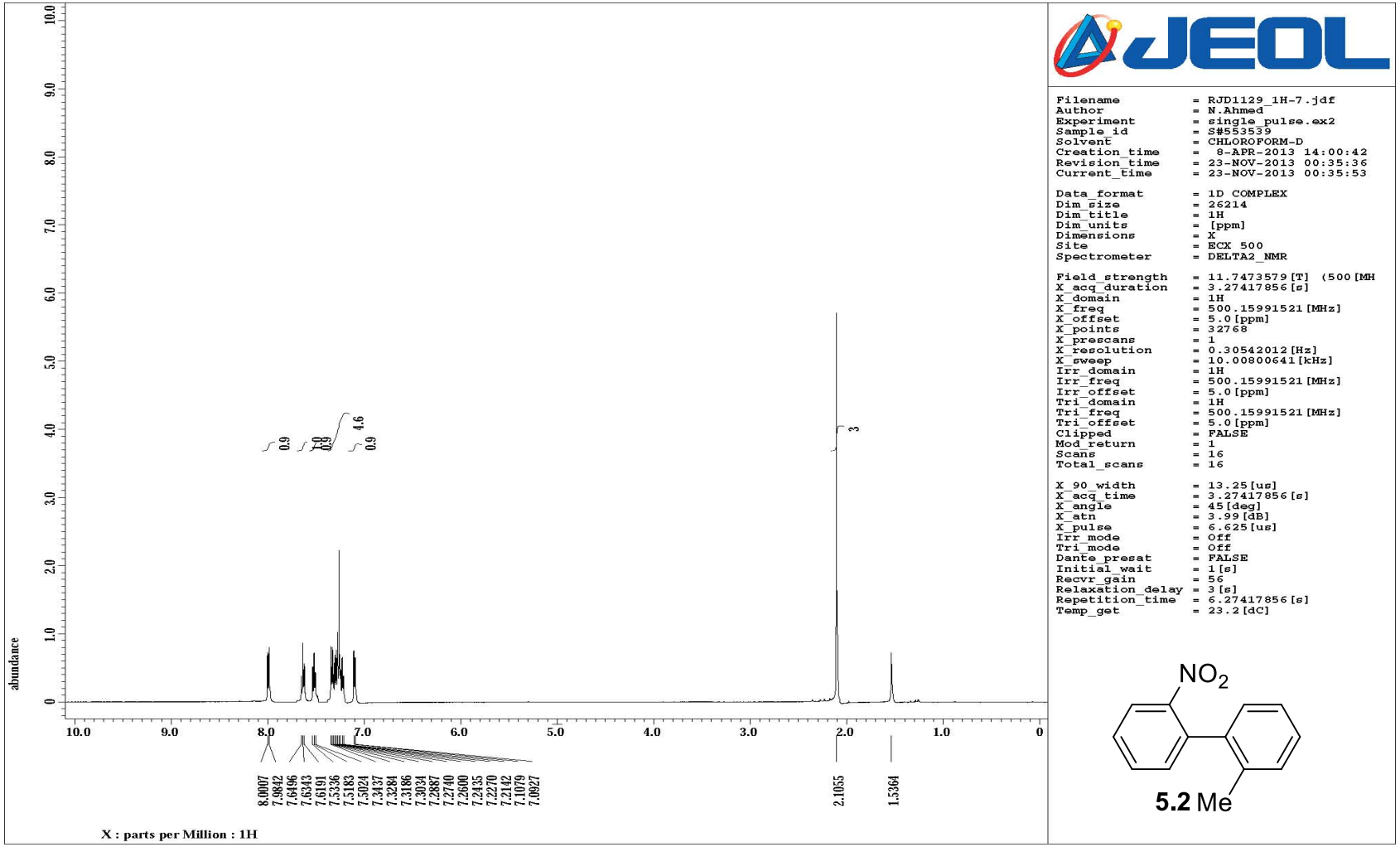
^{1}H NMR spectrum of 2'-methylbiphenyl-4-carbaldehyde (**5.1**)



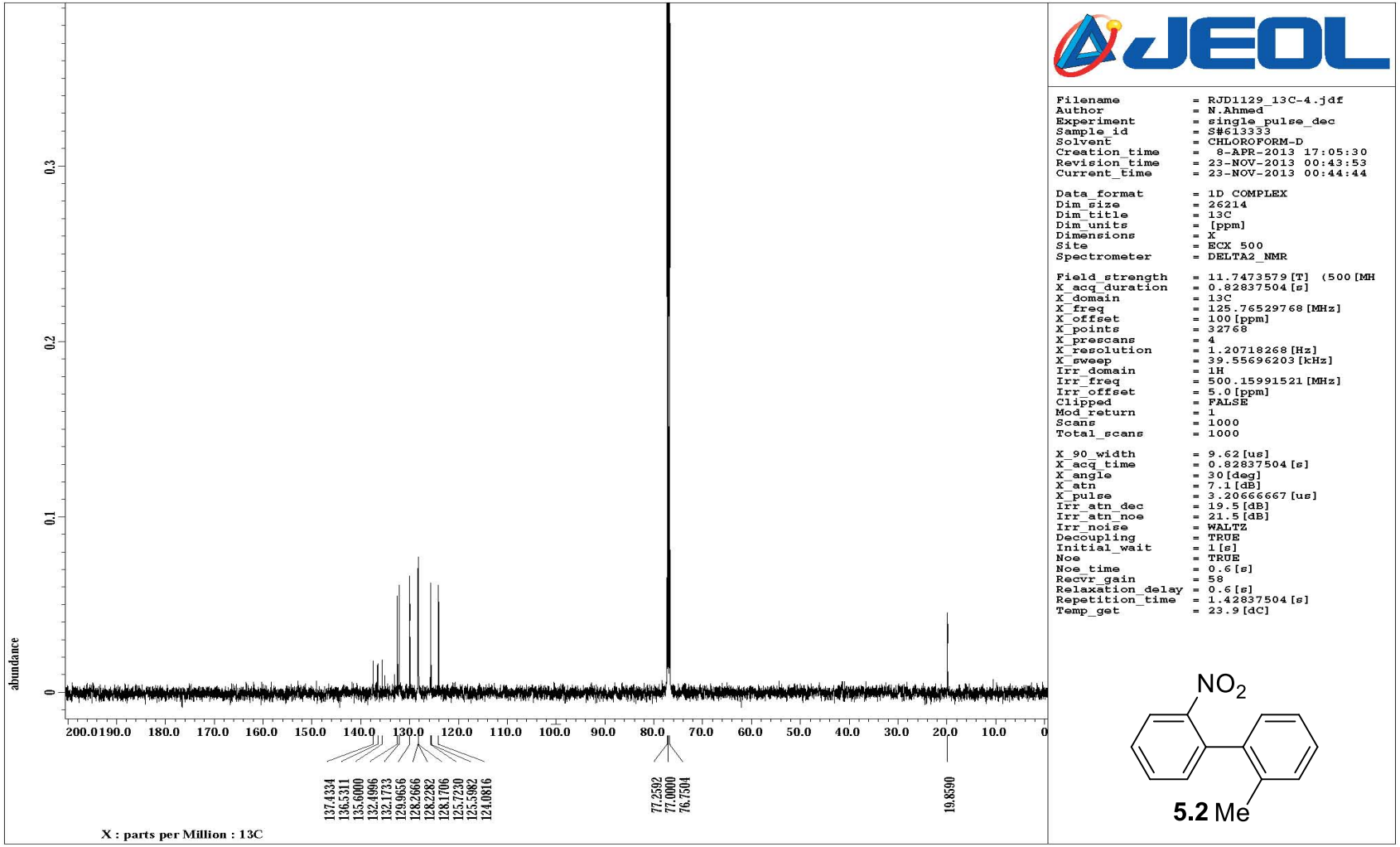
^{13}C NMR spectrum of 2'-methylbiphenyl-4-carbaldehyde (**5.1**)



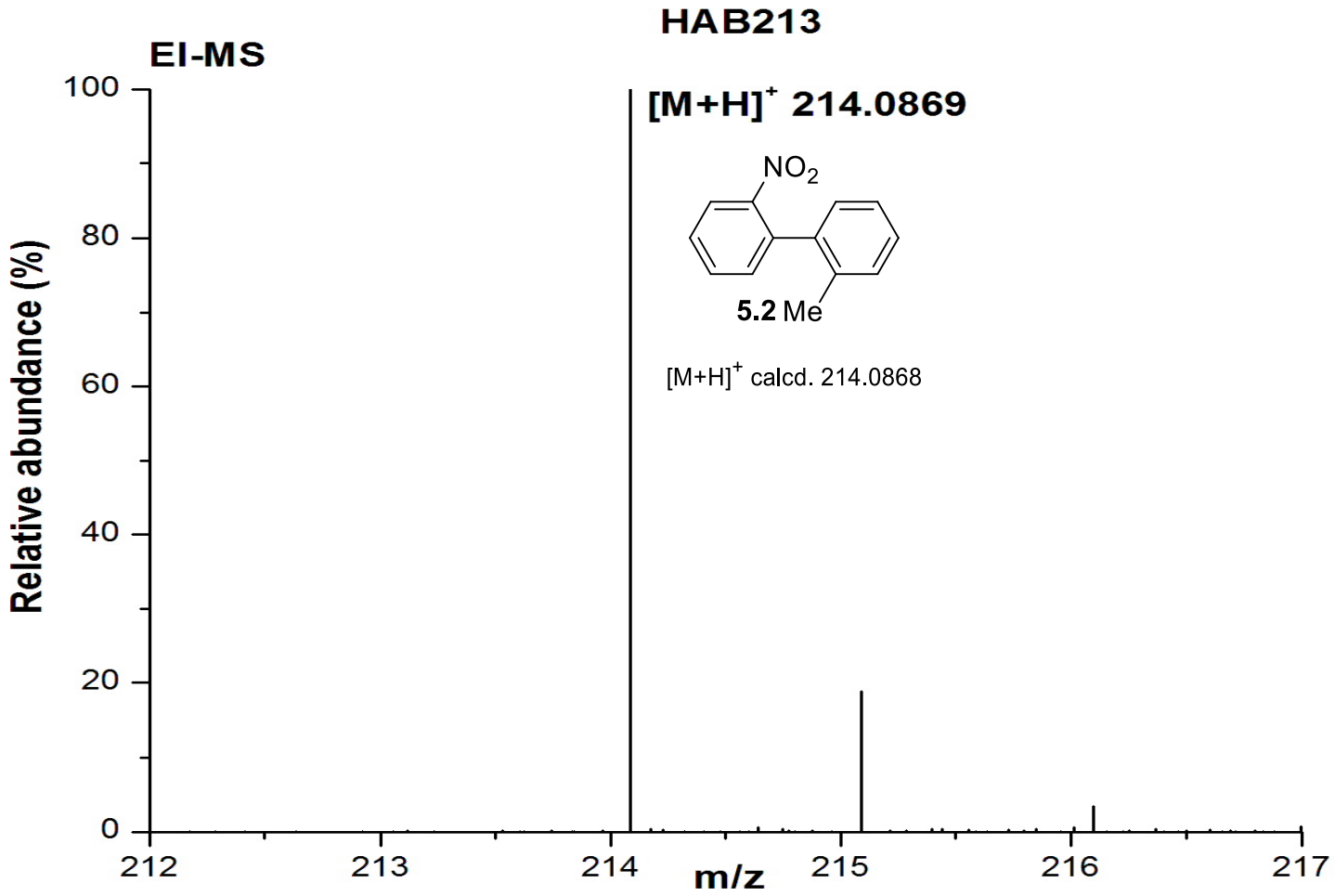
HRMS spectrum of 2'-methylbiphenyl-4-carbaldehyde (**5.1**)



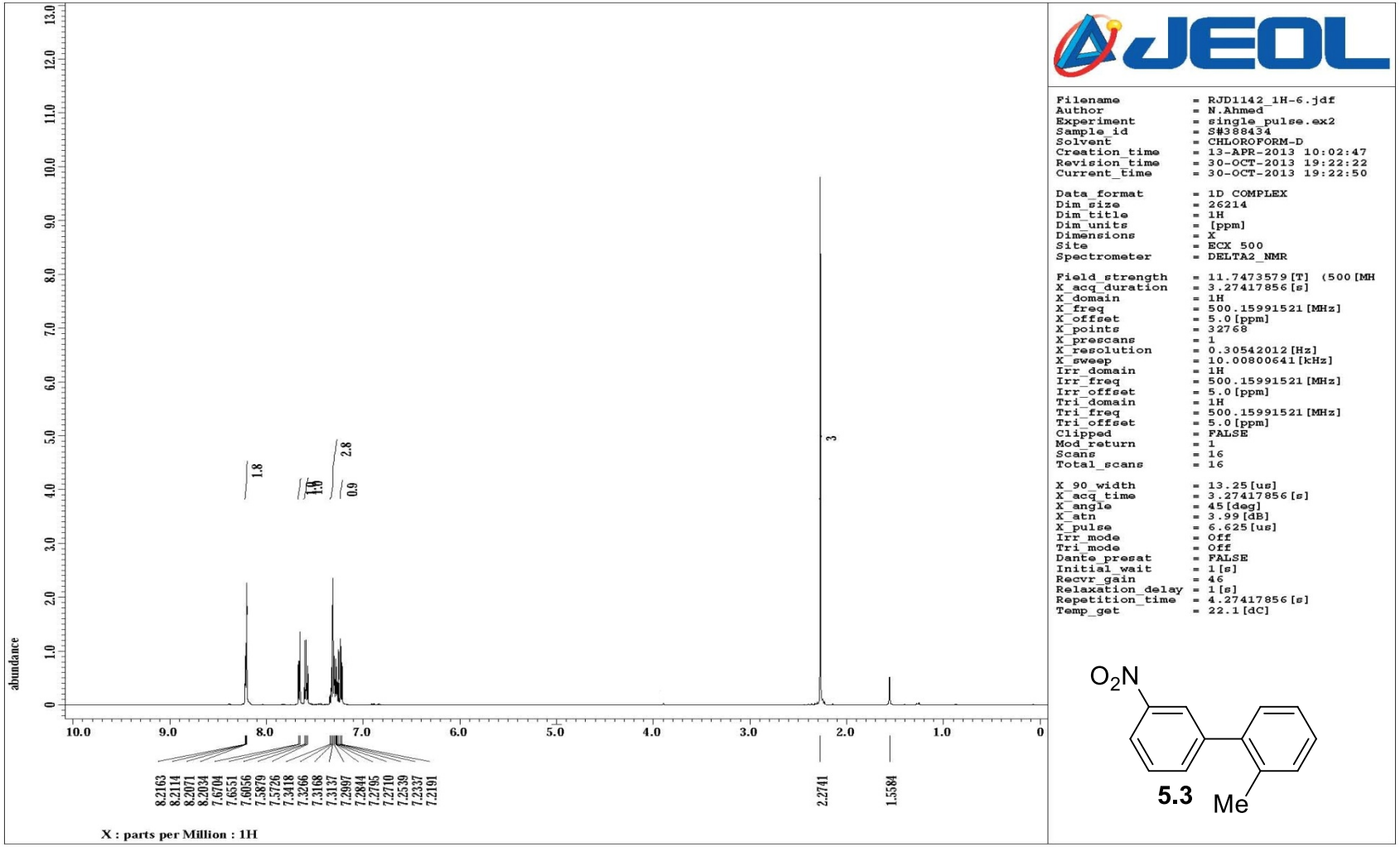
^{1}H NMR spectrum of 2-methyl-2'-nitrobiphenyl (**5.2**)



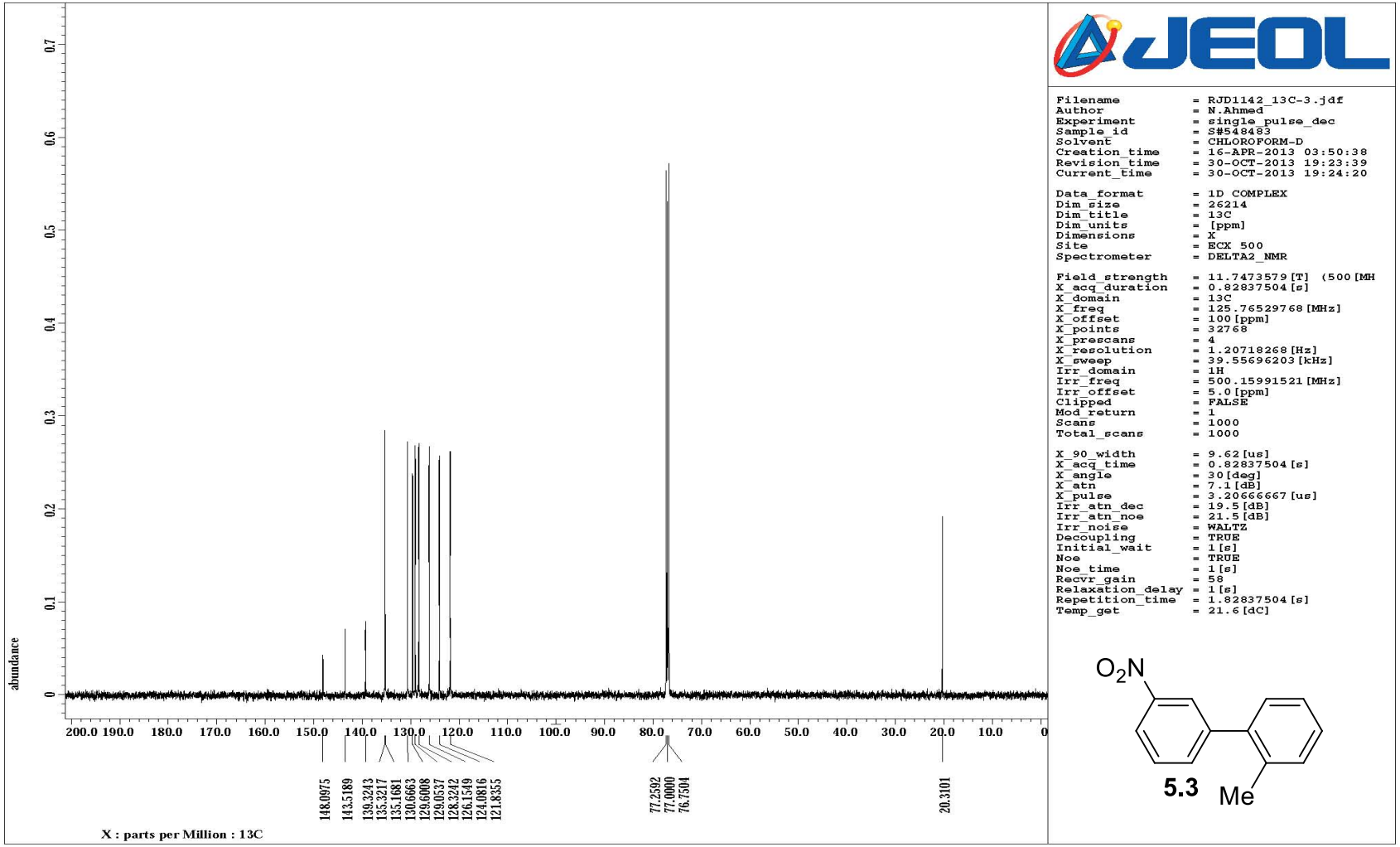
^{13}C NMR spectrum of 2-methyl-2'-nitrobiphenyl (**5.2**)



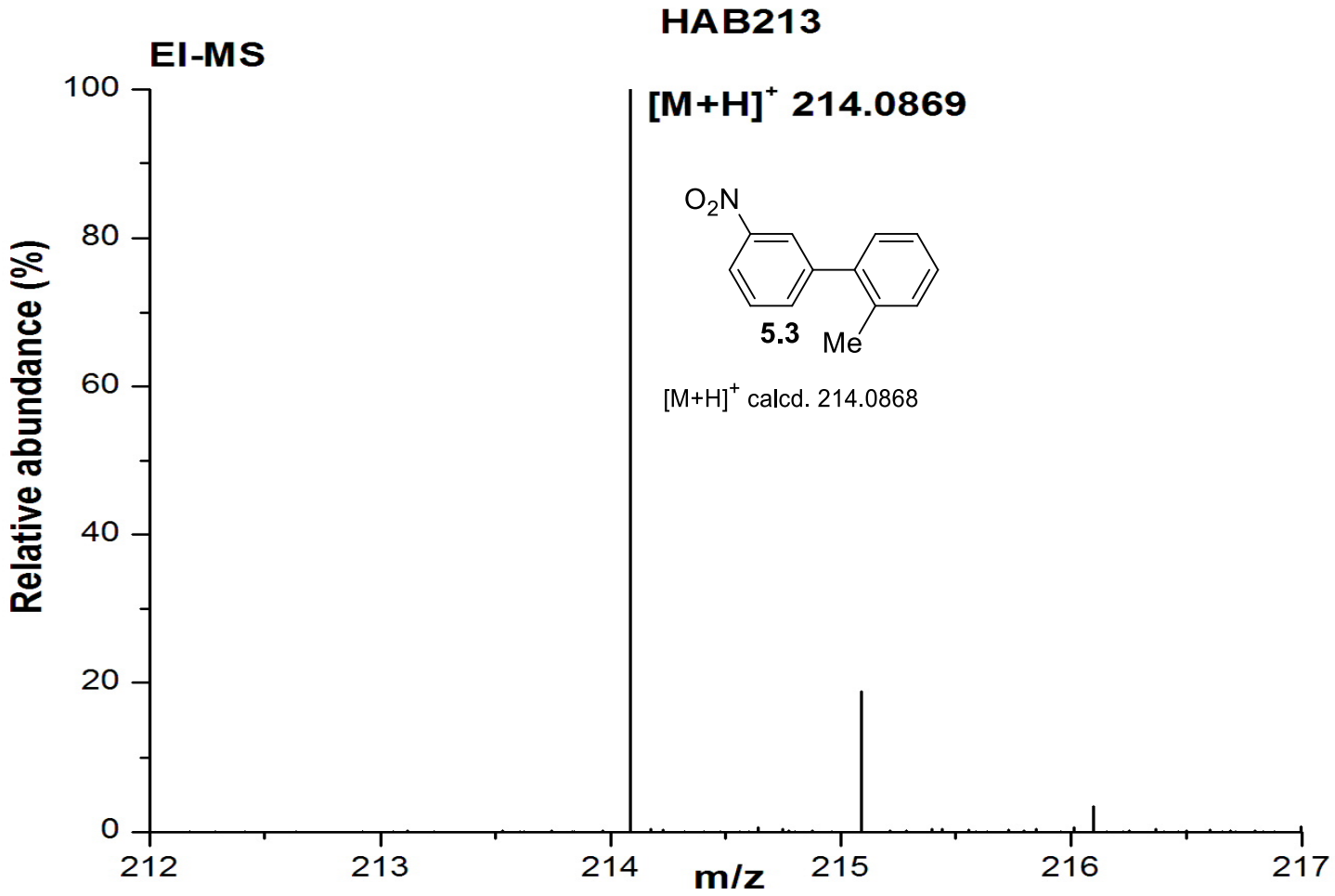
HRMS spectrum of 2-methyl-2'-nitrobiphenyl (**5.2**)



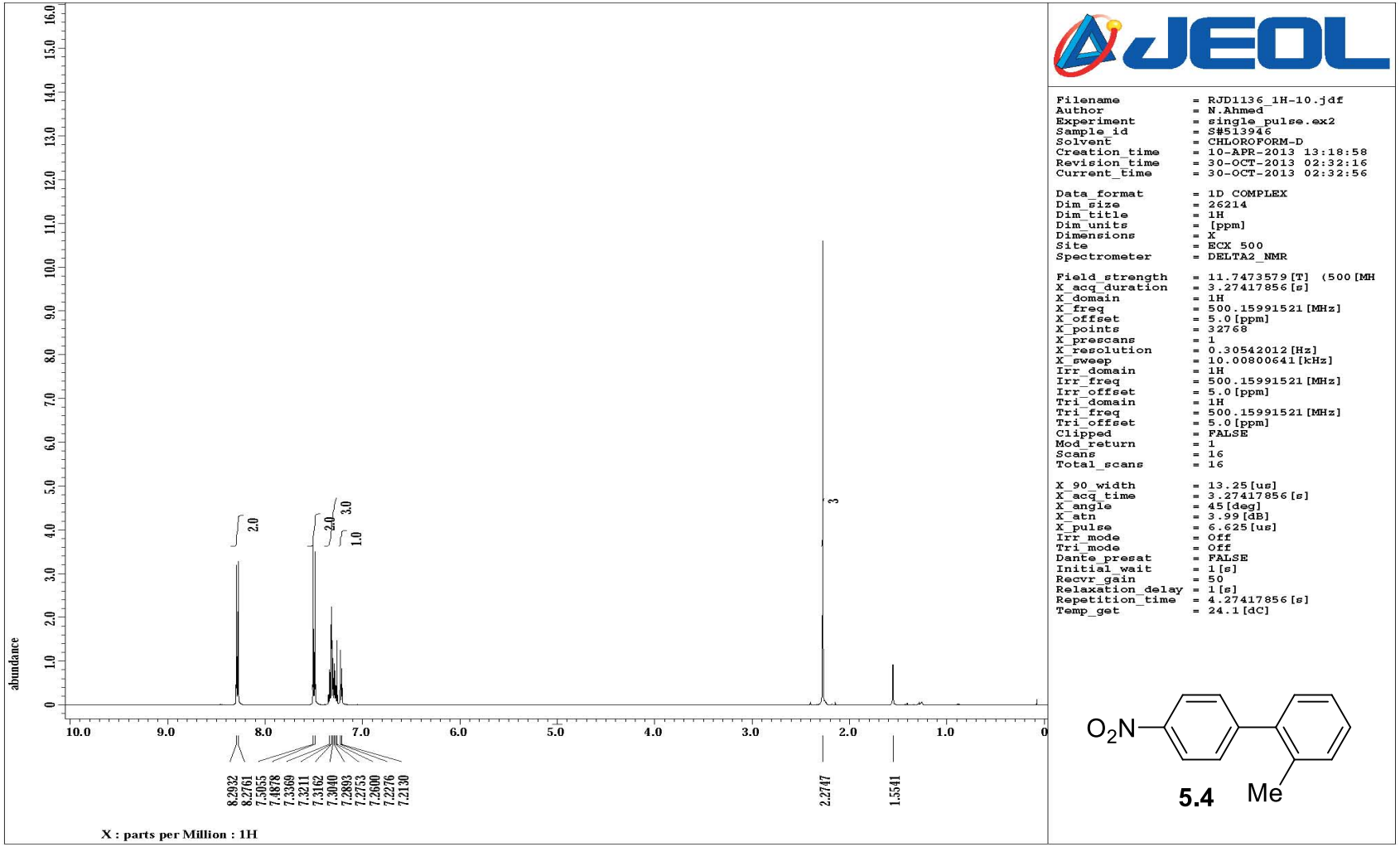
^{1}H NMR spectrum of 2-methyl-3'-nitrobiphenyl (**5.3**)



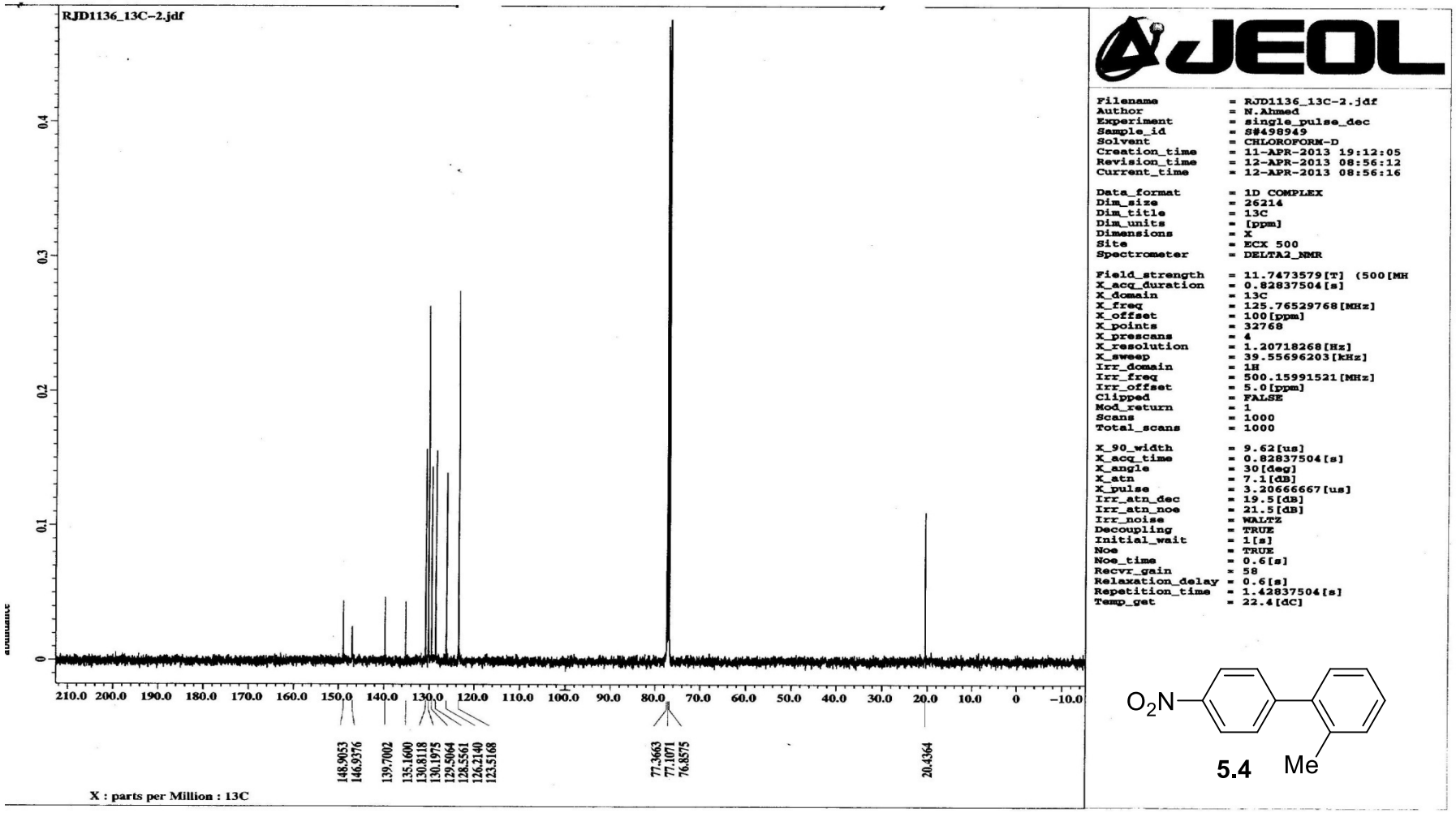
^{13}C NMR spectrum of 2-methyl-3'-nitrobiphenyl (**5.3**)



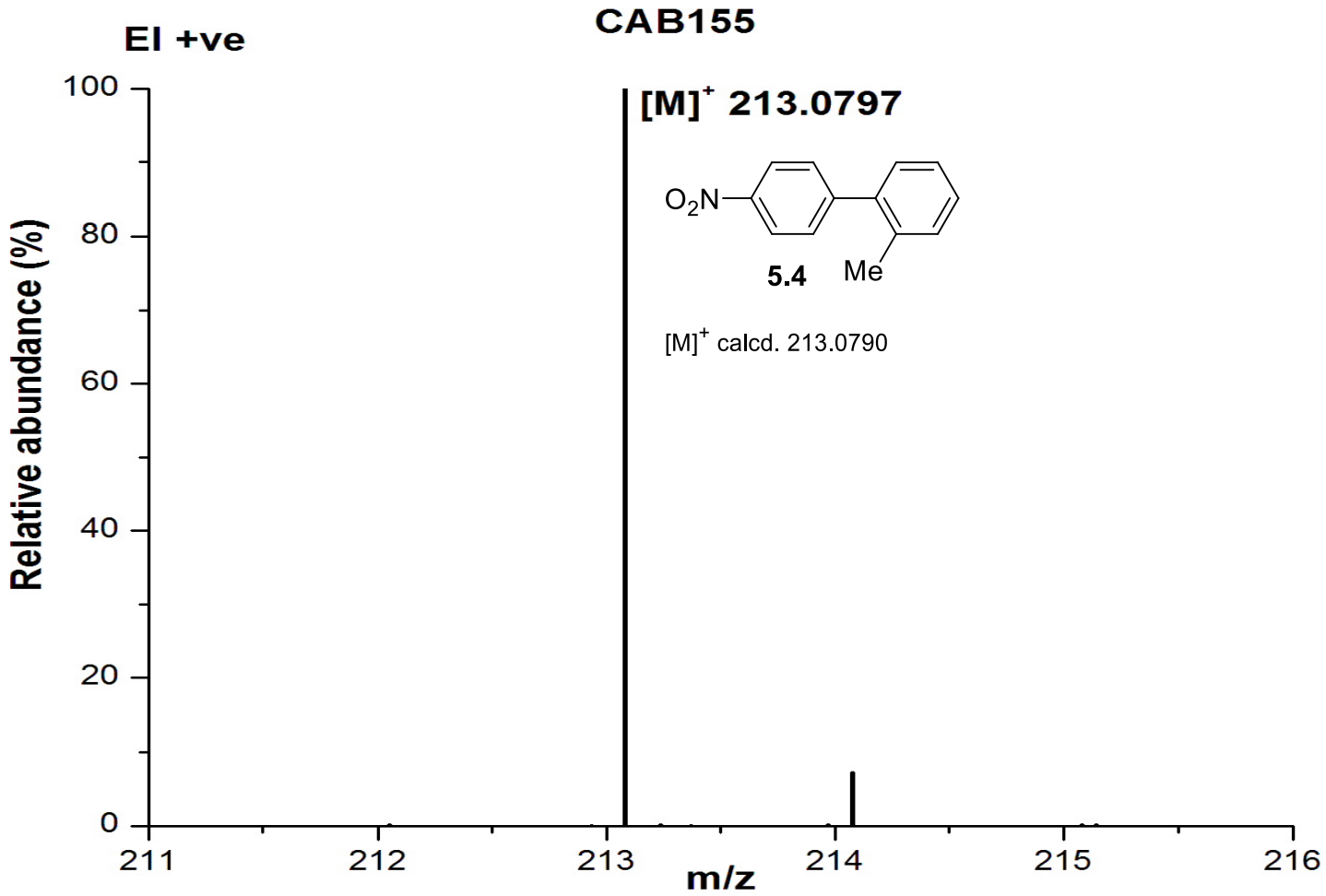
HRMS spectrum of 2-methyl-3'-nitrobiphenyl (**5.3**)



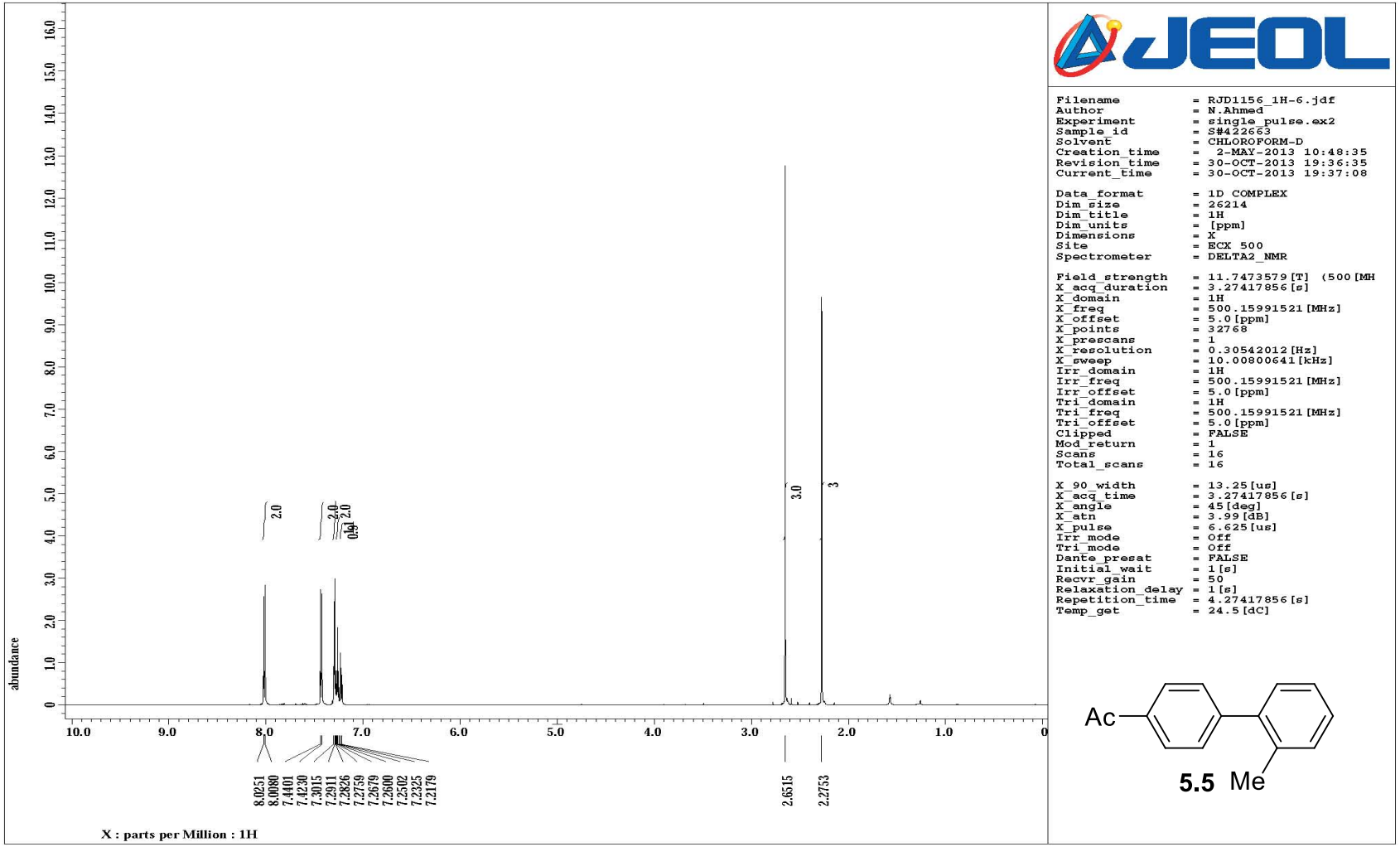
^{1}H NMR spectrum of 2-methyl-4'-nitrobiphenyl (**5.4**)



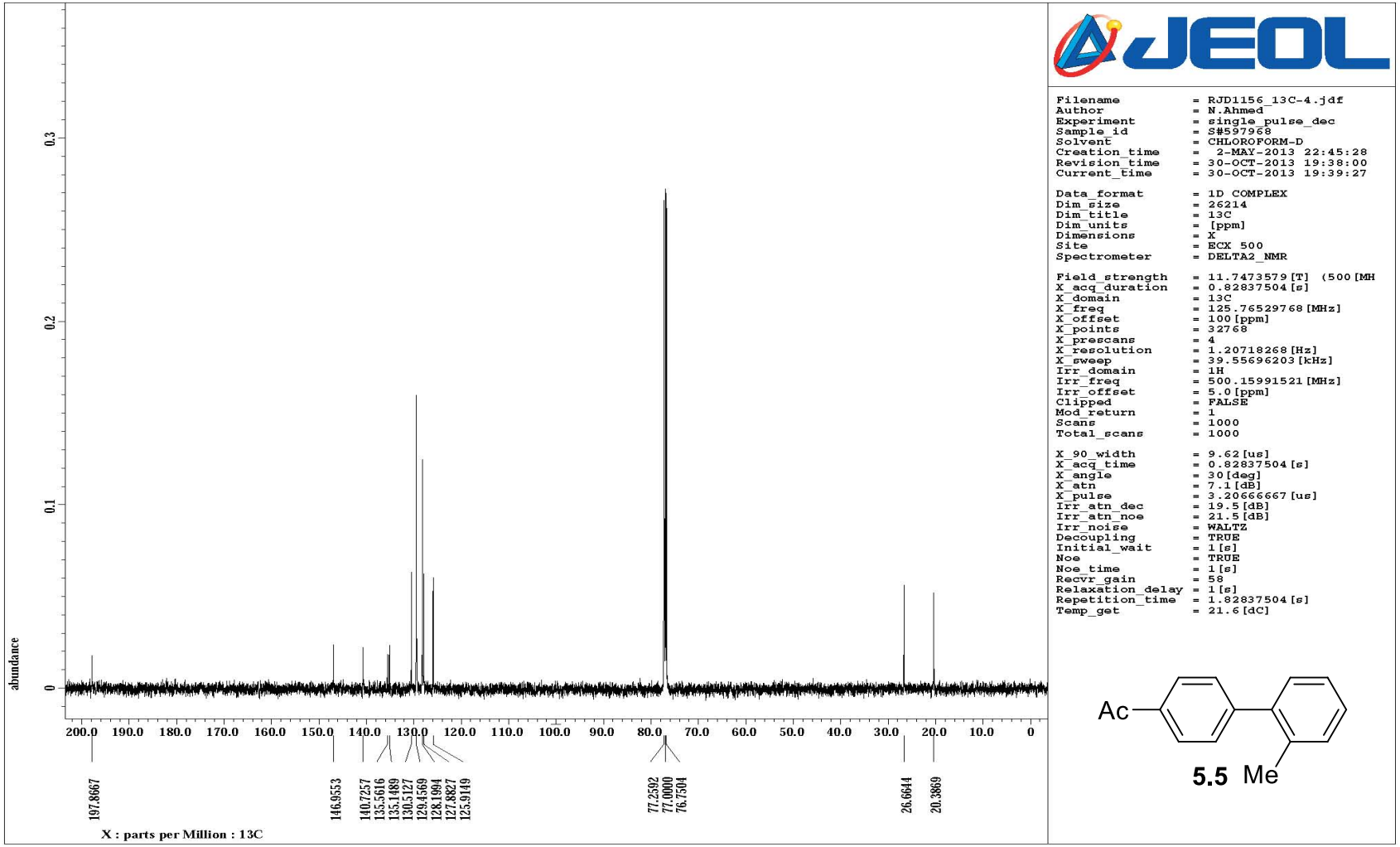
^{13}C NMR spectrum of 2-methyl-4'-nitrobiphenyl (**5.4**)



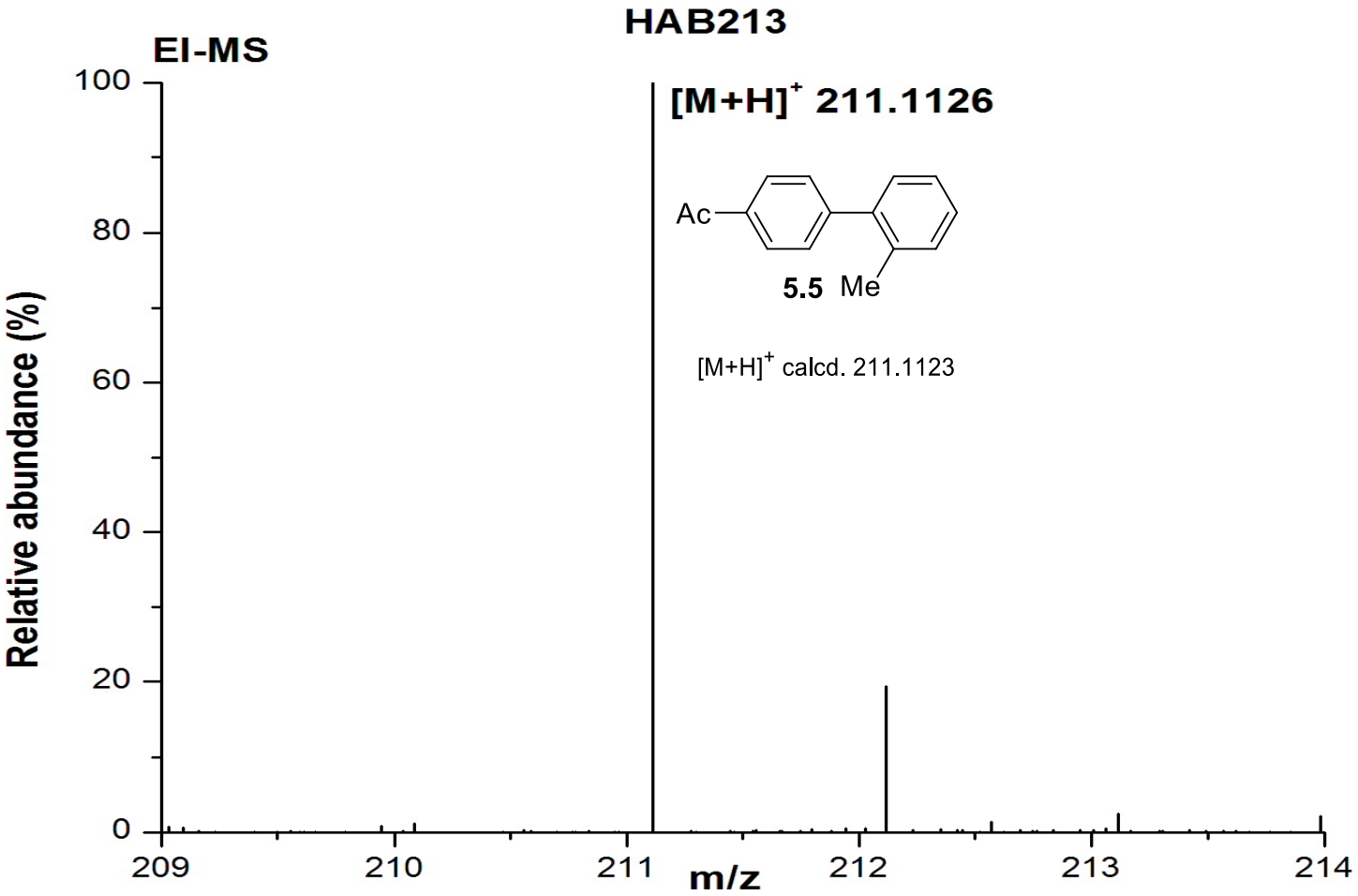
HRMS spectrum of 2-methyl-4'-nitrobiphenyl (**5.4**)



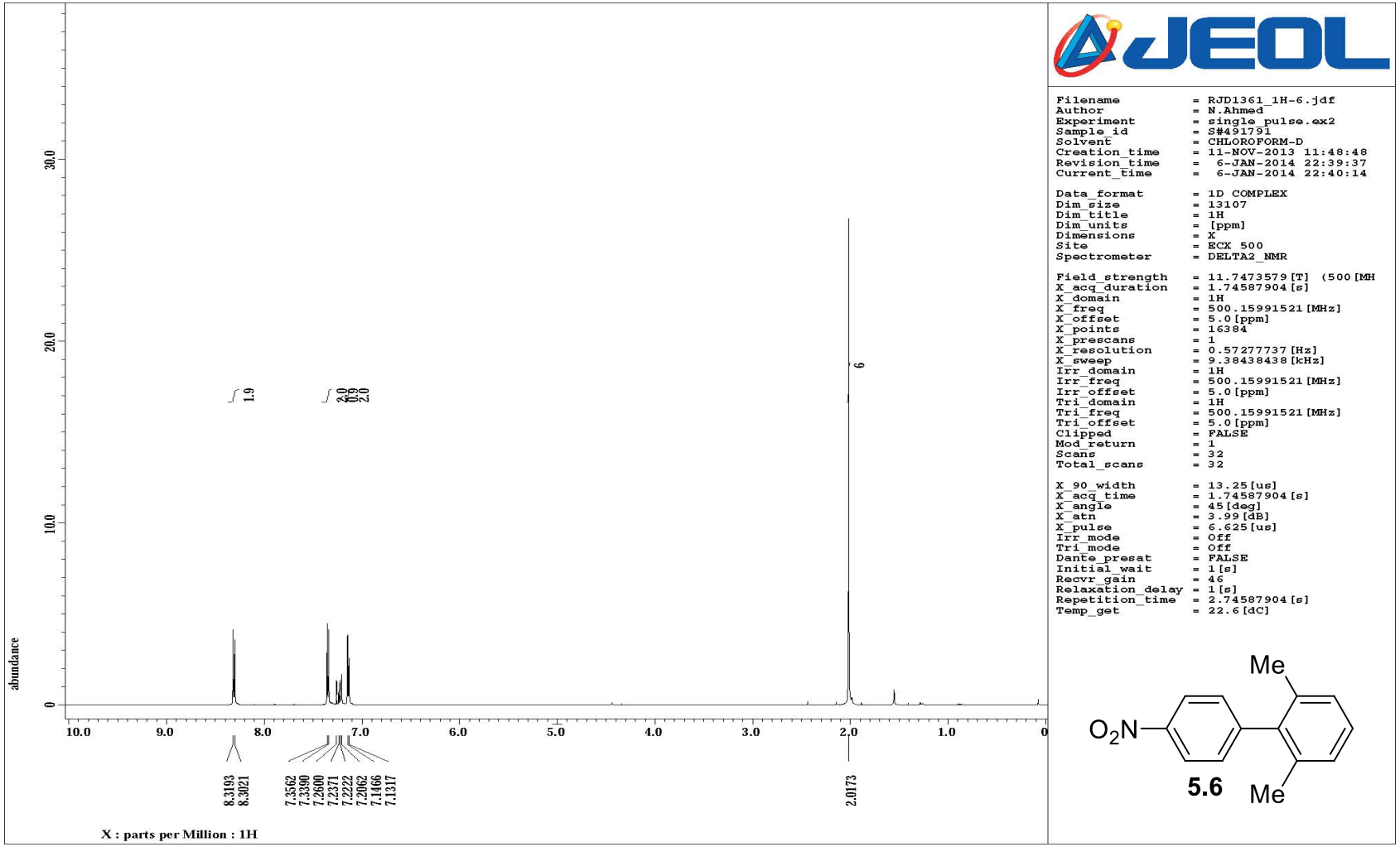
^{1}H NMR spectrum of 1-(2'-methylbiphenyl-4-yl)ethanone (**5.5**)



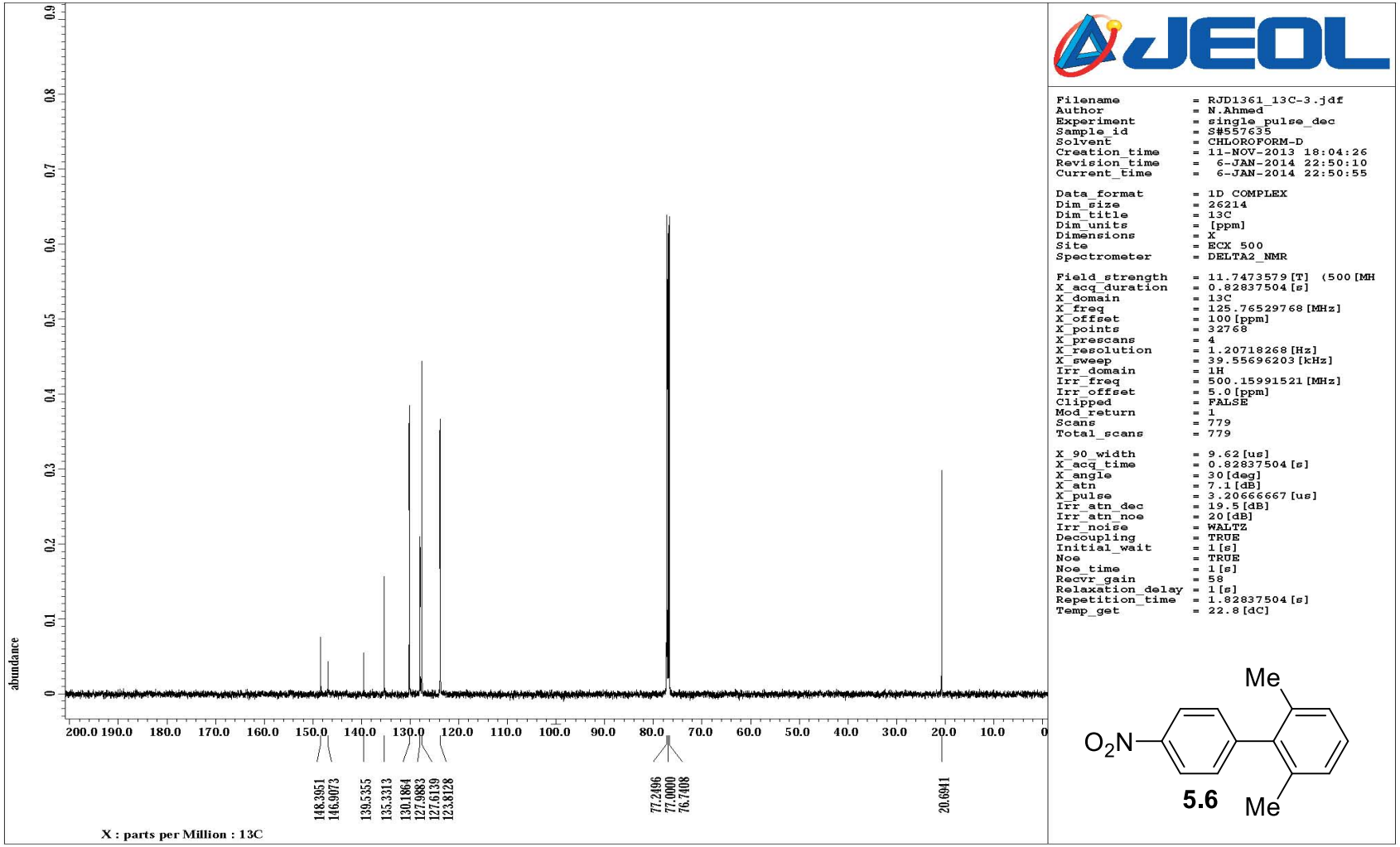
^{13}C NMR spectrum of 1-(2'-methylbiphenyl-4-yl)ethanone (**5.5**)



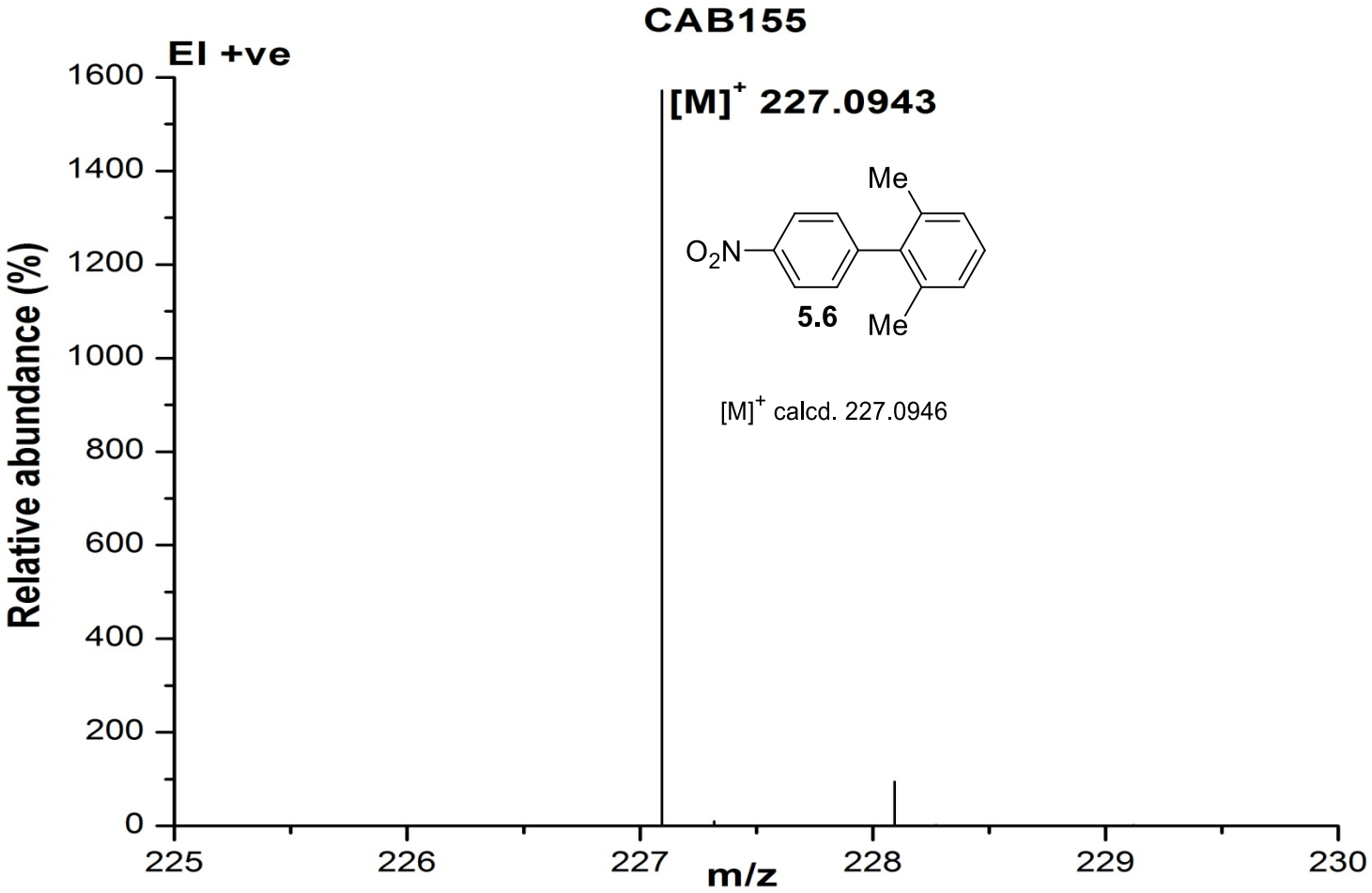
HRMS spectrum of 1-(2'-methylbiphenyl-4-yl)ethanone (**5.5**)



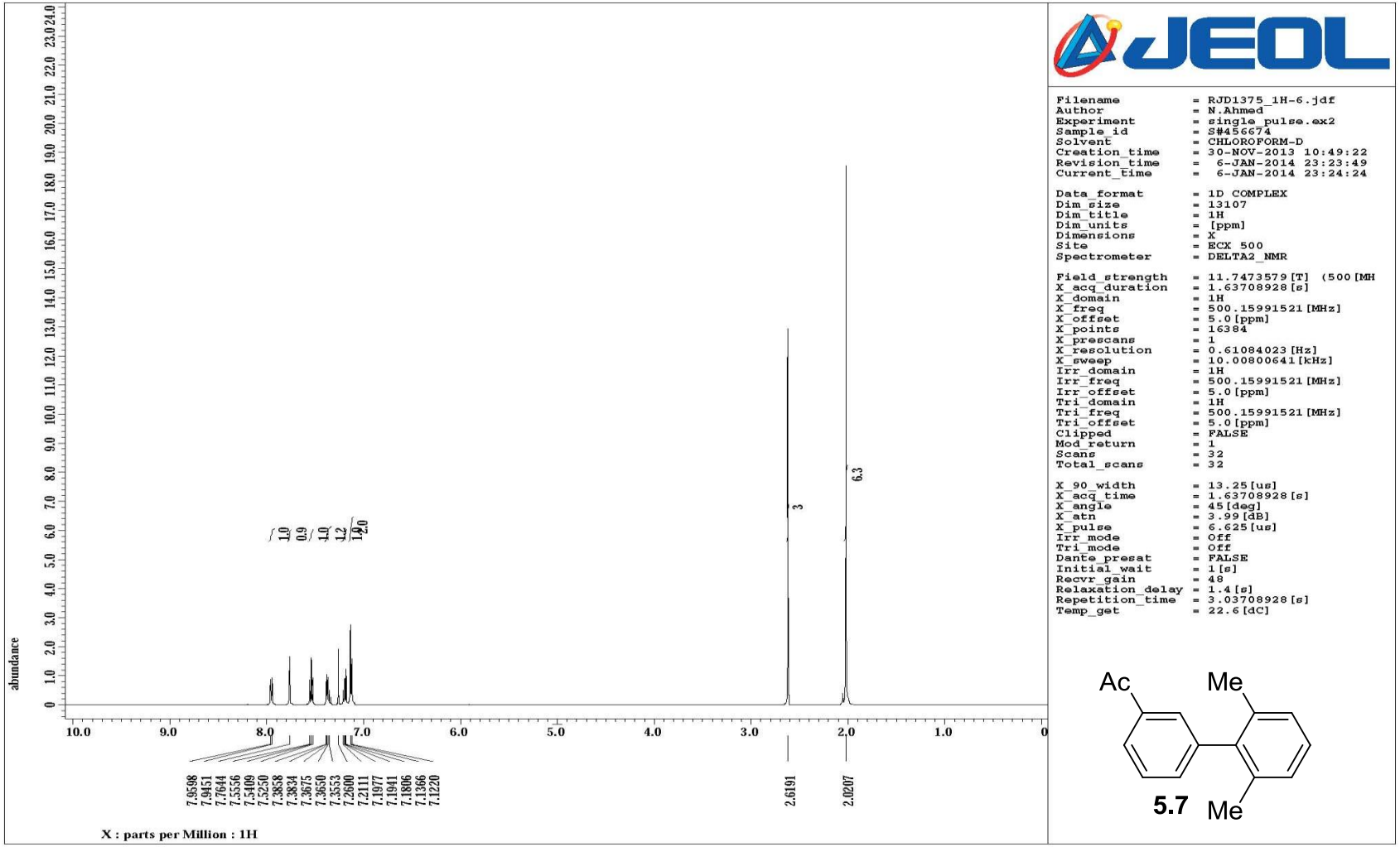
^{1}H NMR spectrum of 2,6-dimethyl-4'-nitrobiphenyl (**5.6**)



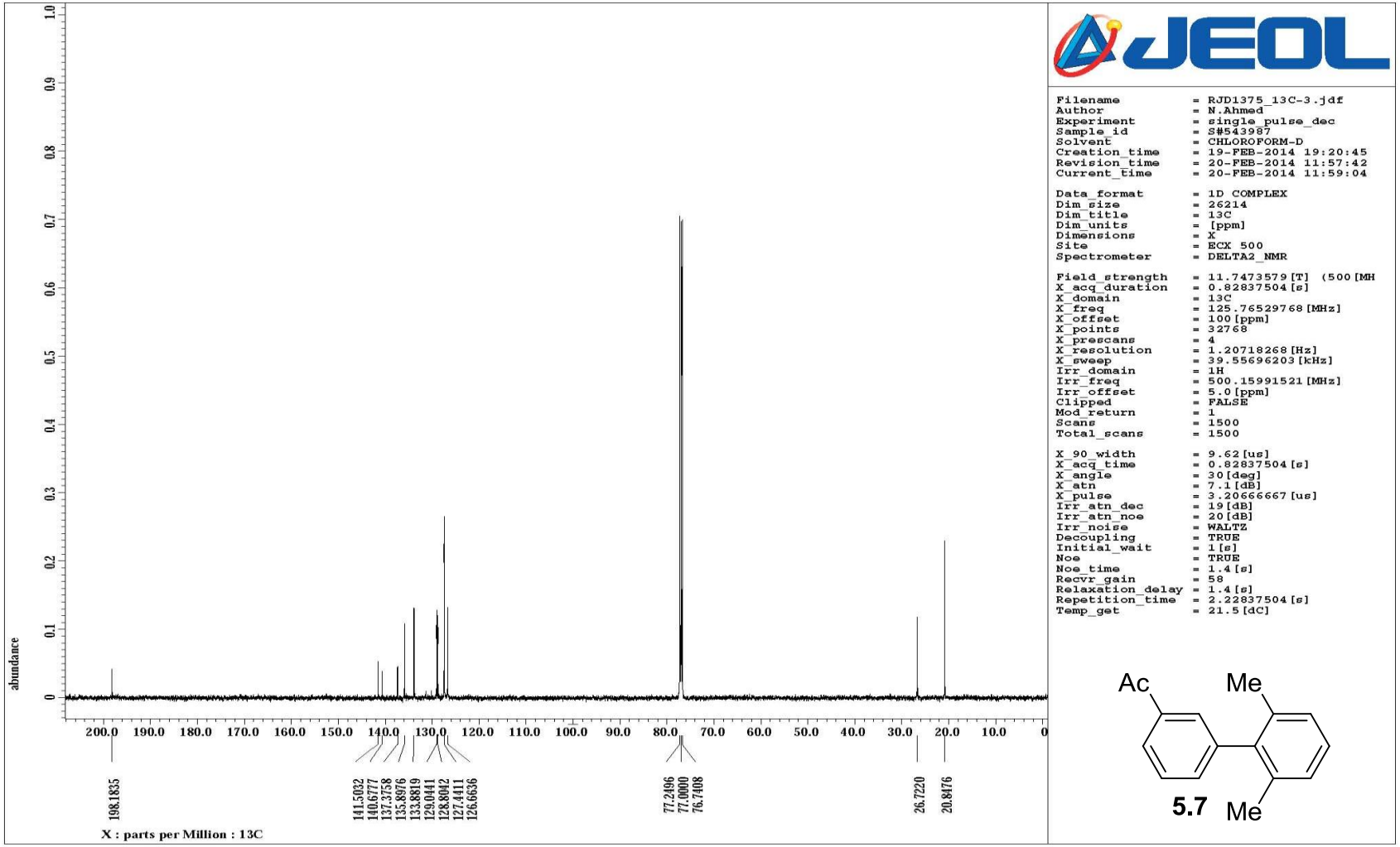
^{13}C NMR spectrum of 2,6-dimethyl-4'-nitrobiphenyl (**5.6**)



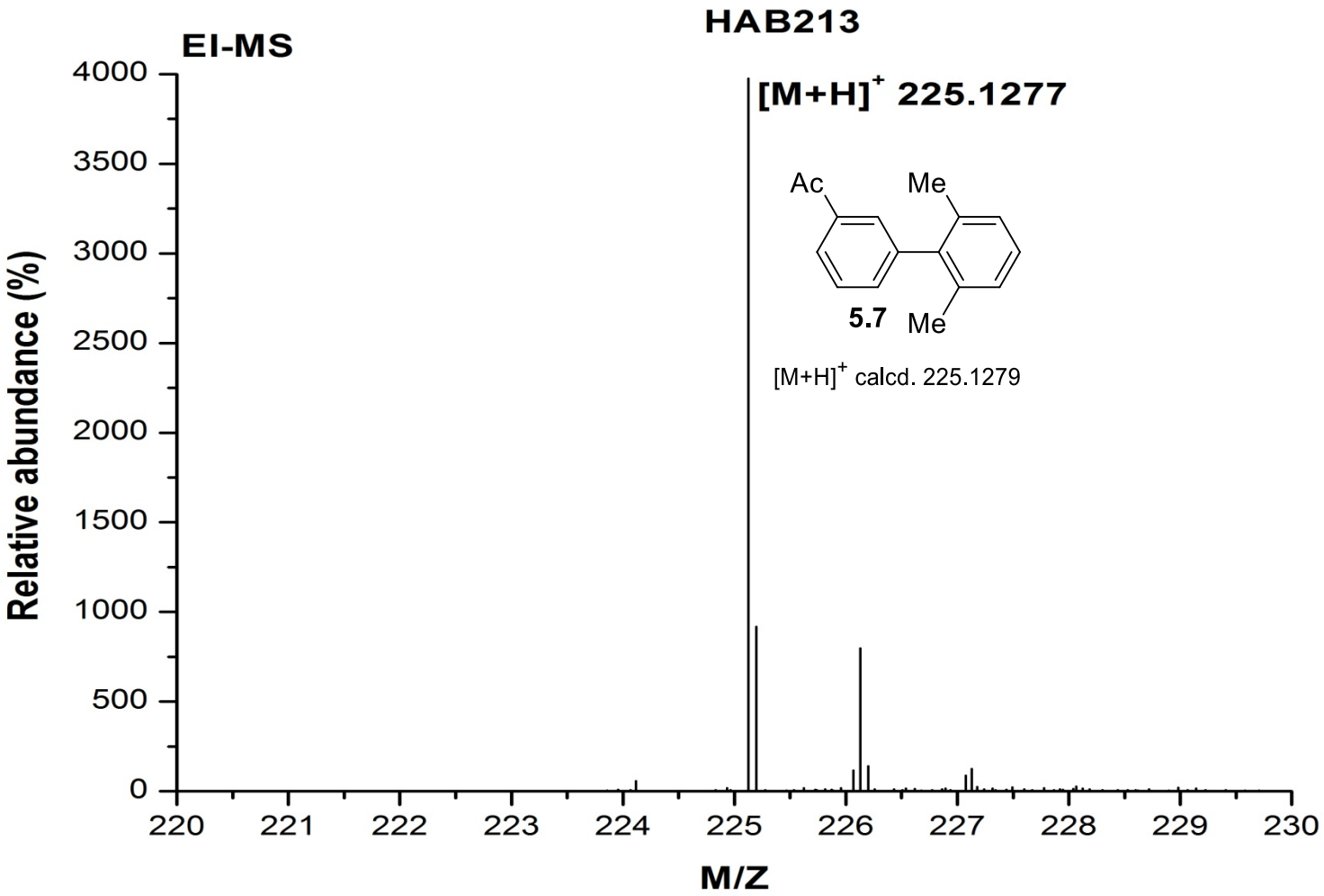
HRMS spectrum of 2,6-dimethyl-4'-nitrobiphenyl (**5.6**)



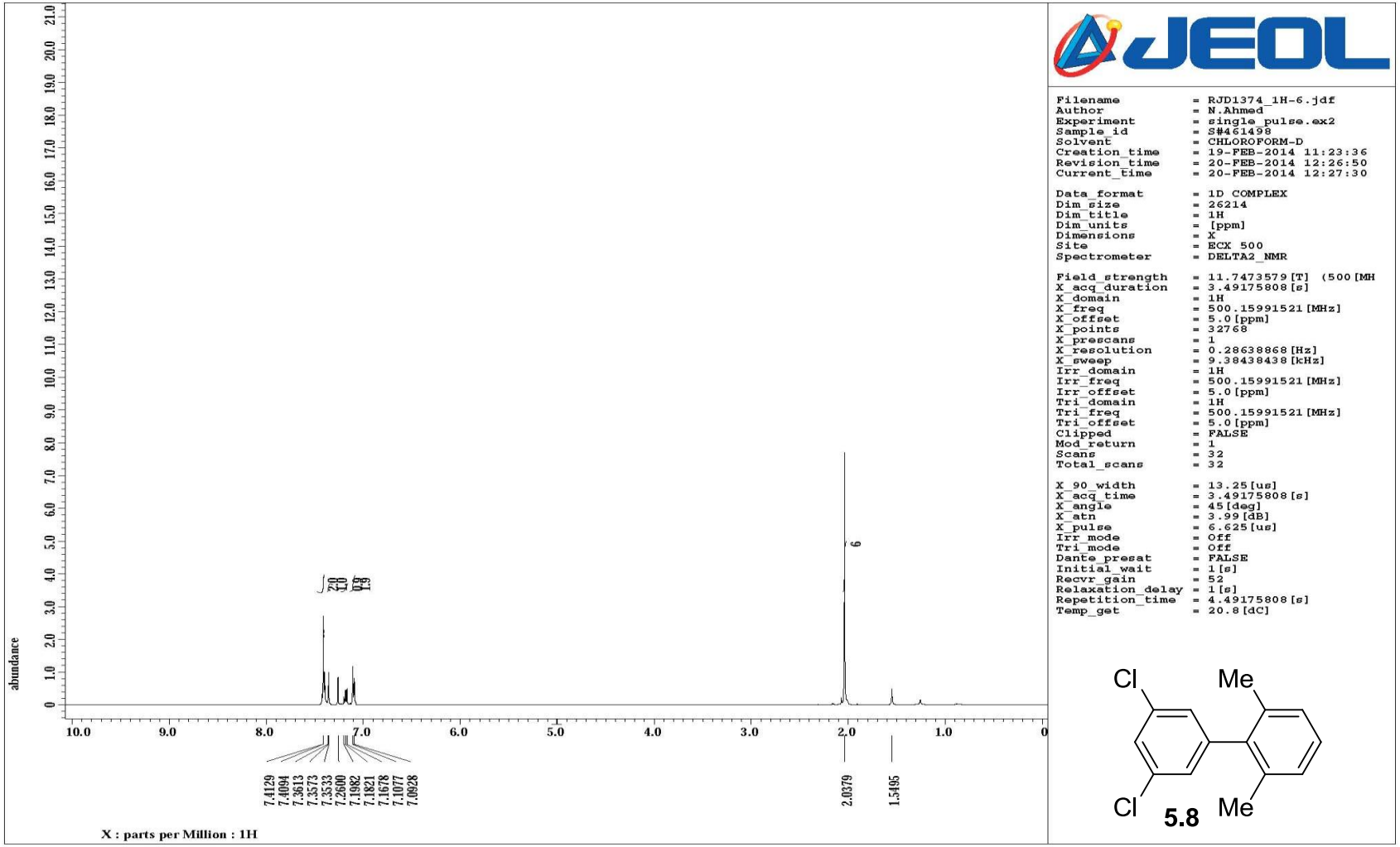
^{1}H NMR spectrum of 1-(2',6'-dimethylbiphenyl-3-yl)ethanone (**5.7**)



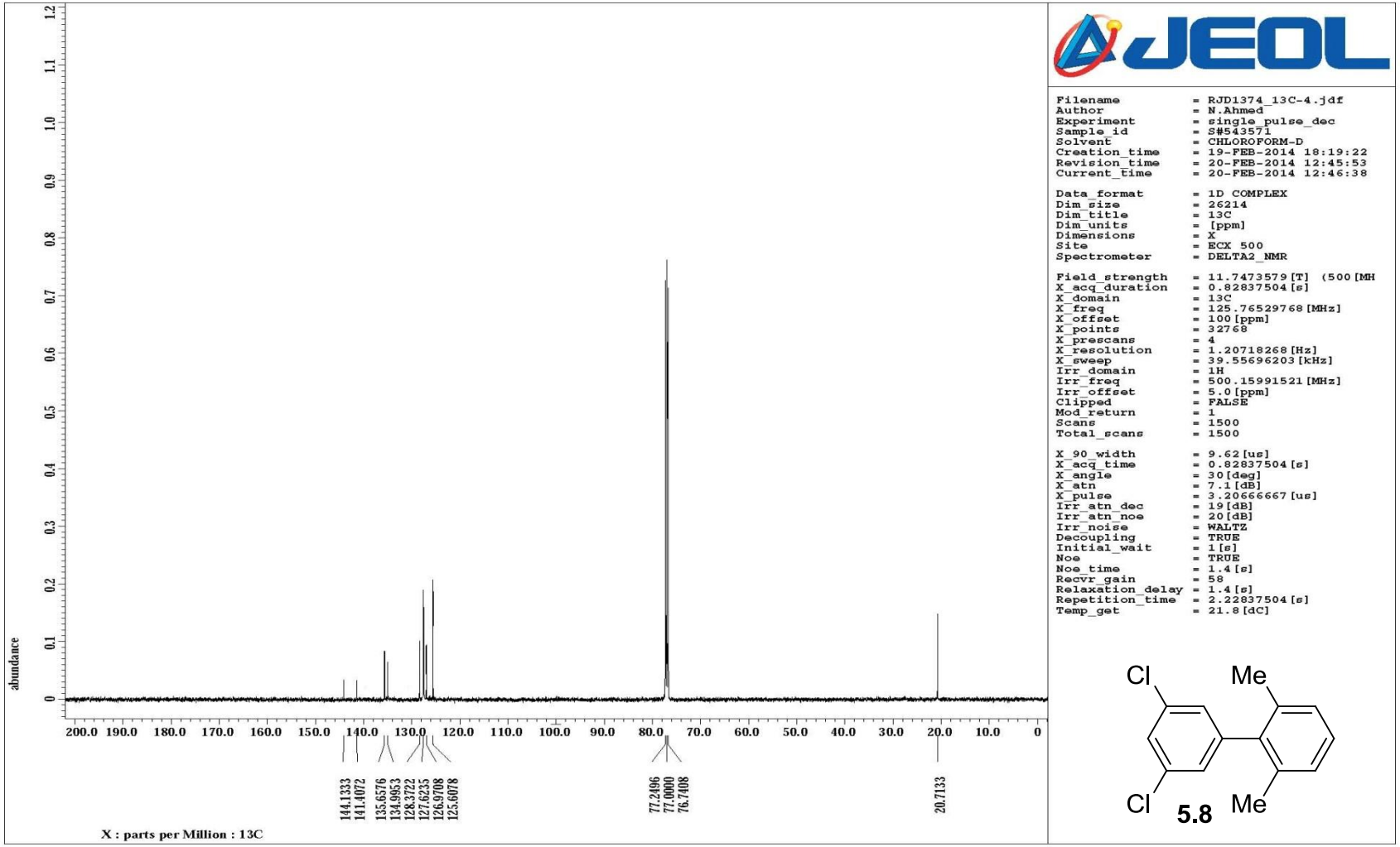
^{13}C NMR spectrum of 1-(2',6'-dimethylbiphenyl-3-yl)ethanone (**5.7**)



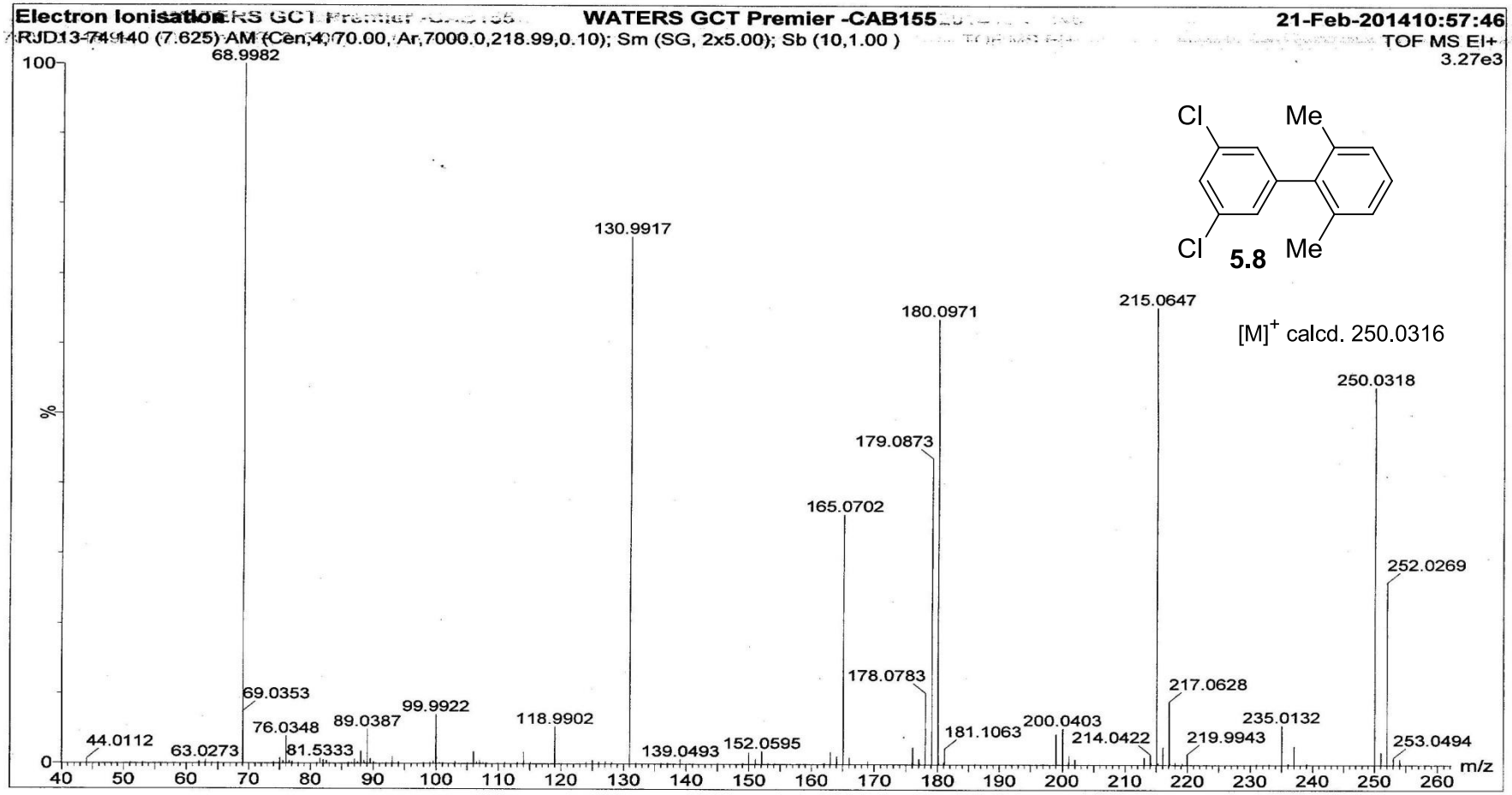
HRMS spectrum of 1-(2',6'-dimethylbiphenyl-3-yl)ethanone (**5.7**)



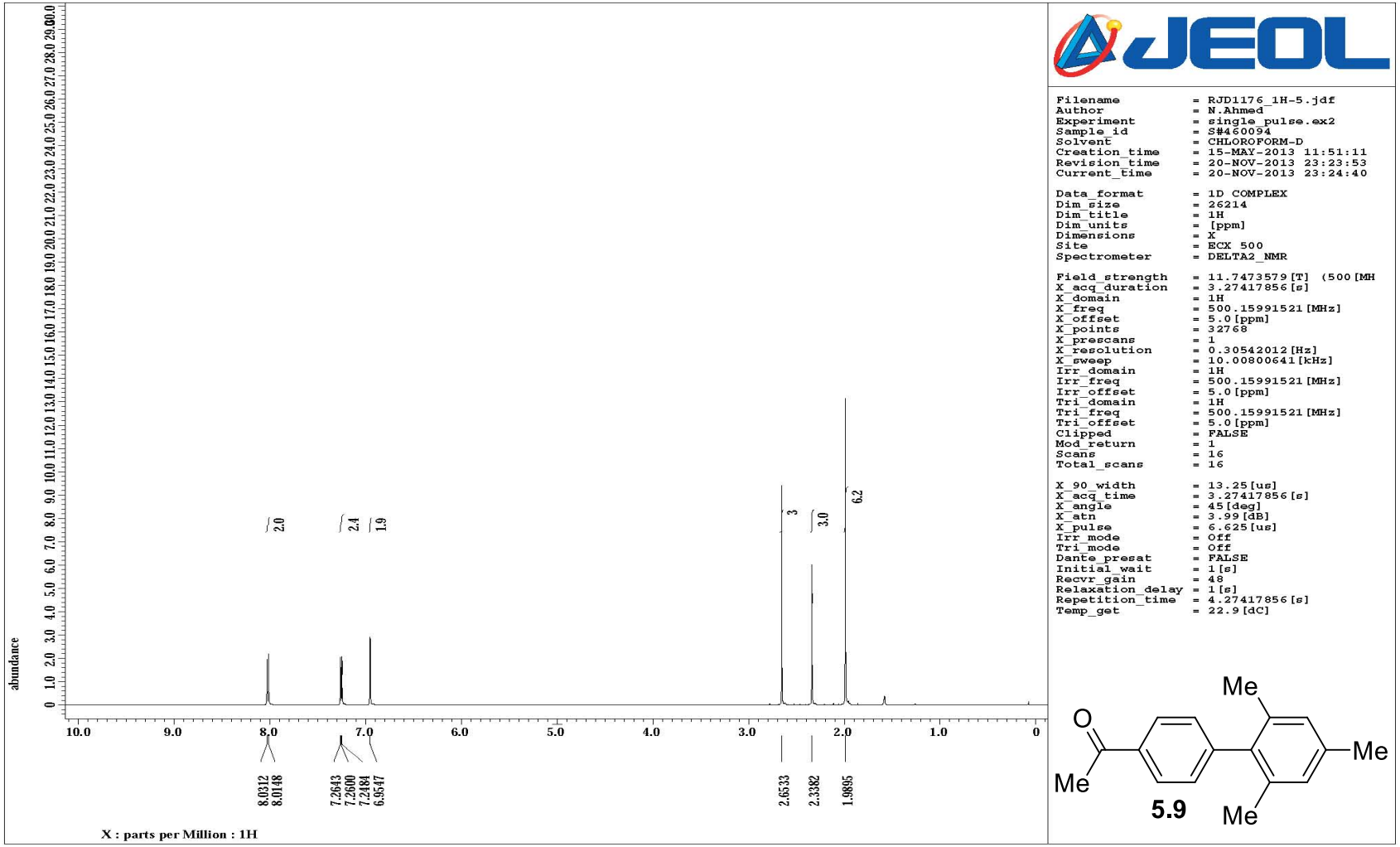
^{1}H NMR spectrum of 3',5'-dichloro-2,6-dimethylbiphenyl (**5.8**)



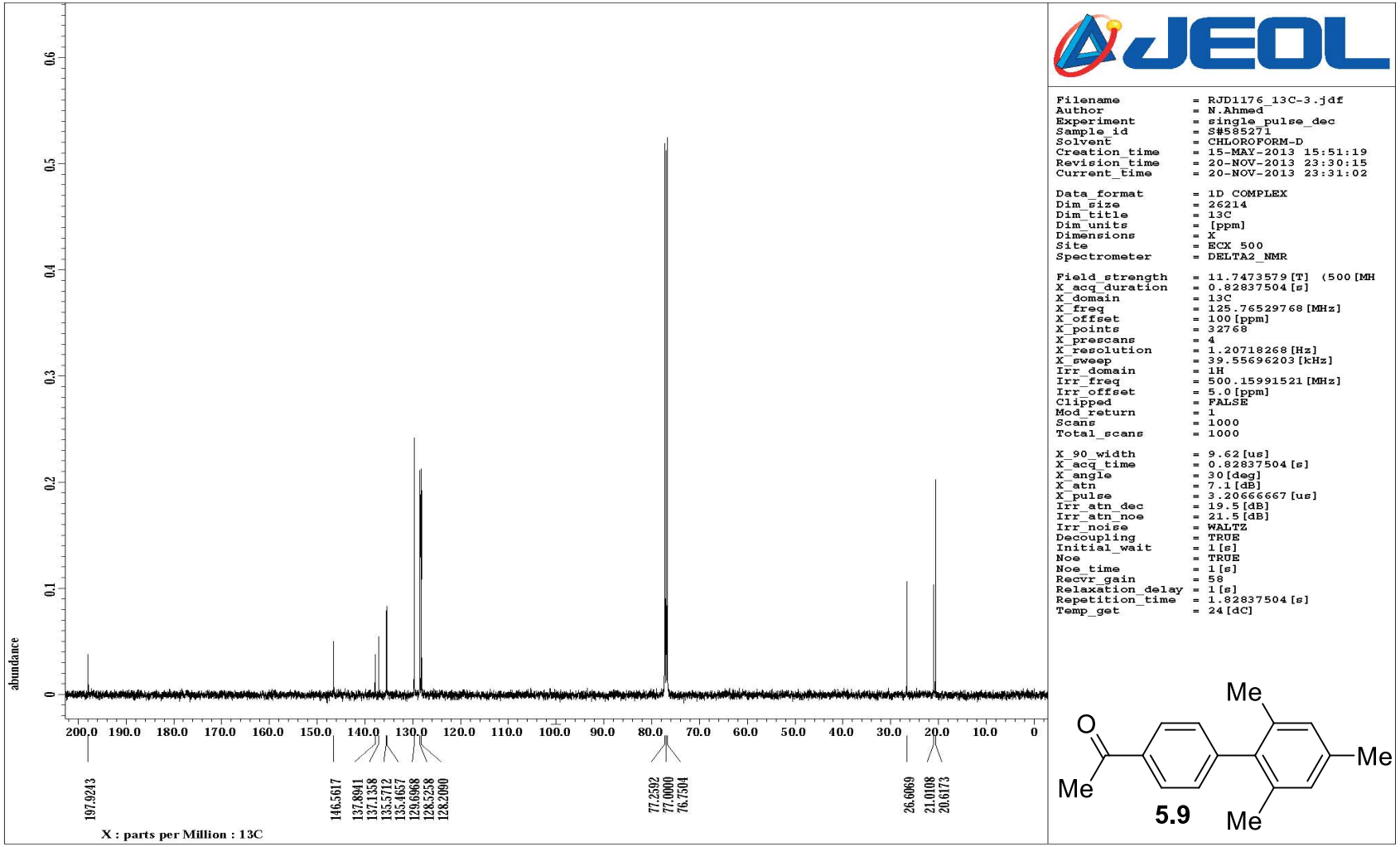
^{13}C NMR spectrum of 3',5'-dichloro-2,6-dimethylbiphenyl (**5.8**)



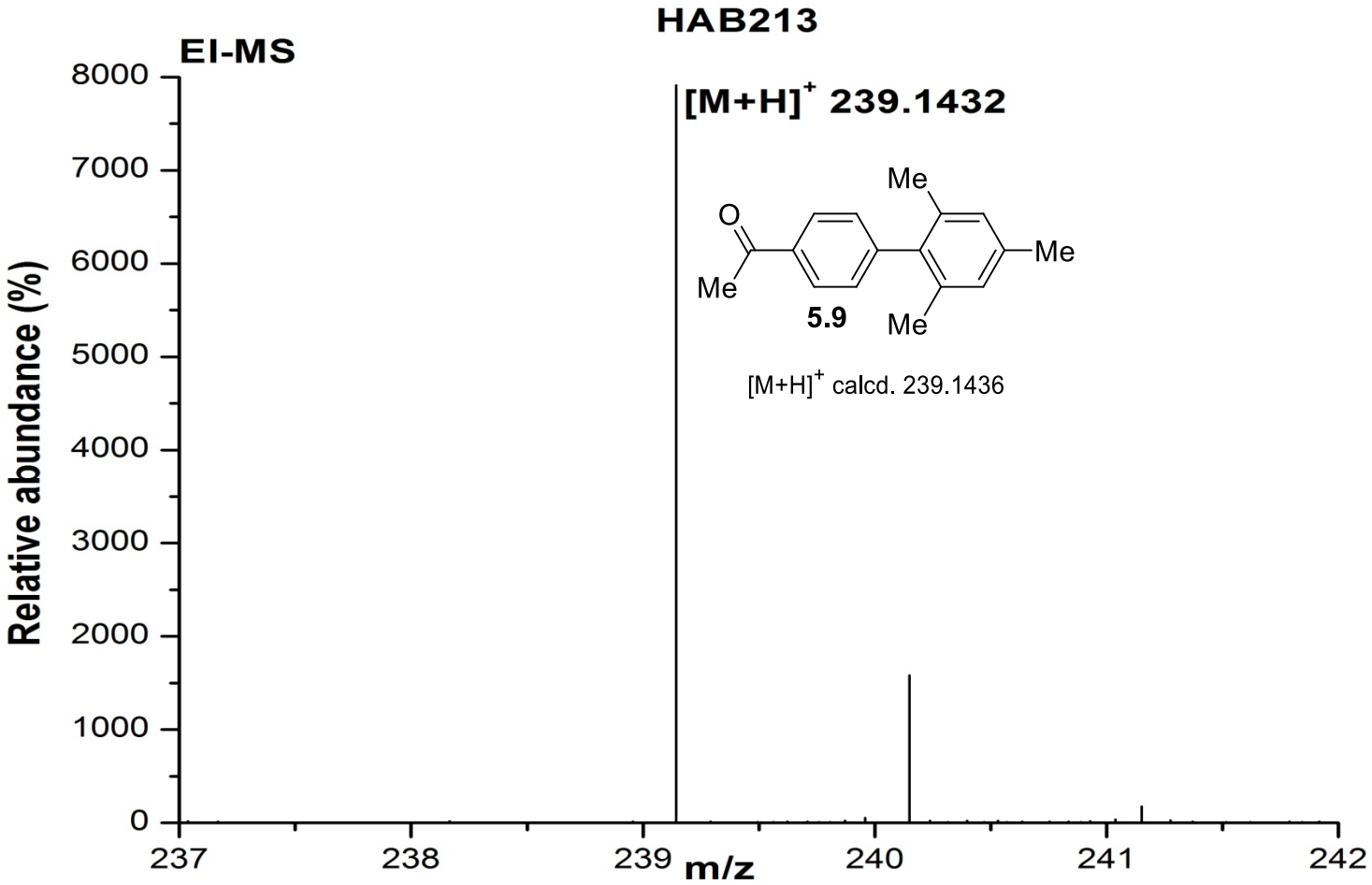
HRMS spectrum of 3',5'-dichloro-2,6-dimethylbiphenyl (**5.8**)



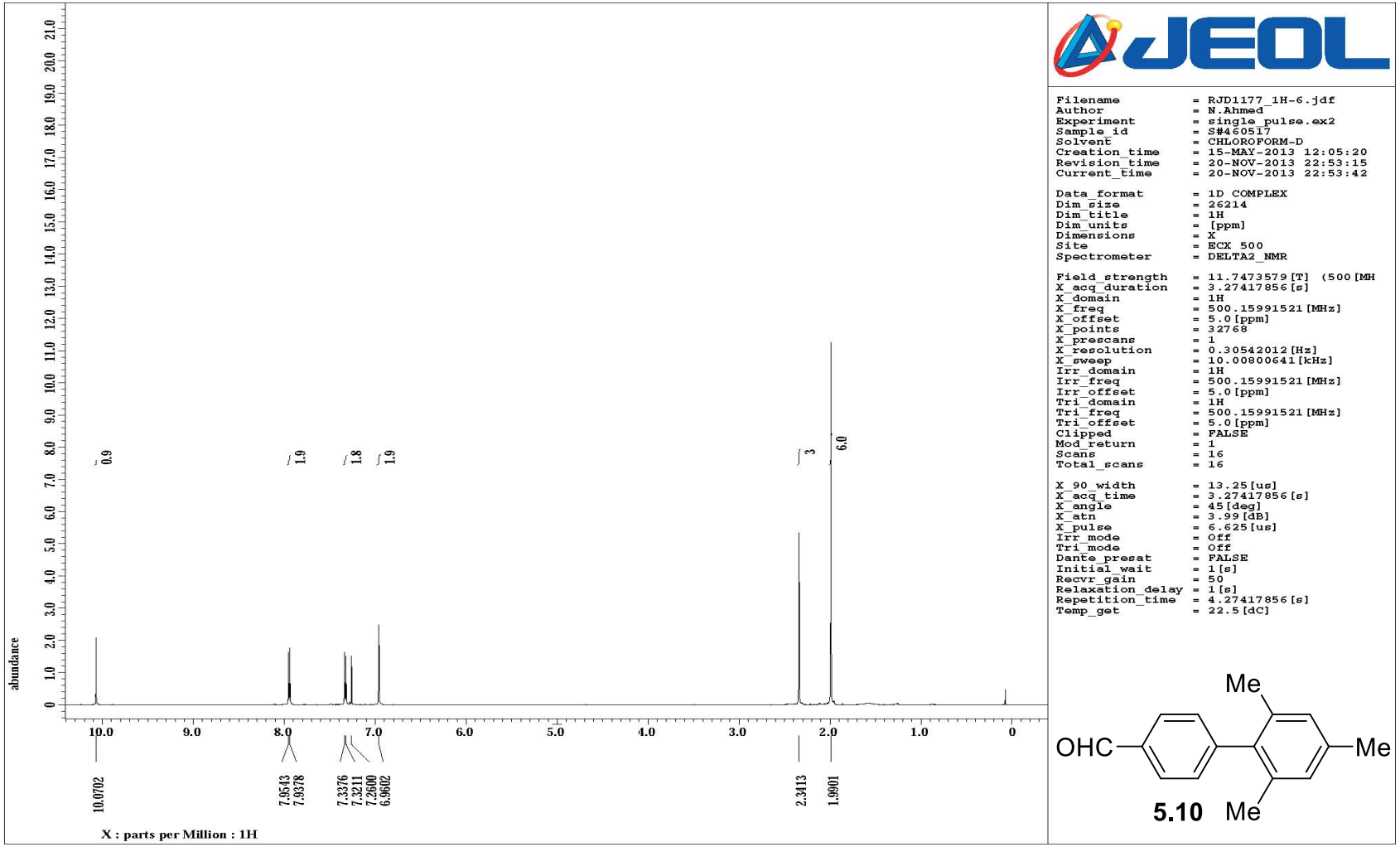
^{1}H NMR spectrum of 1-(2',4',6'-trimethylbiphenyl-4-yl)ethanone (**5.9**)



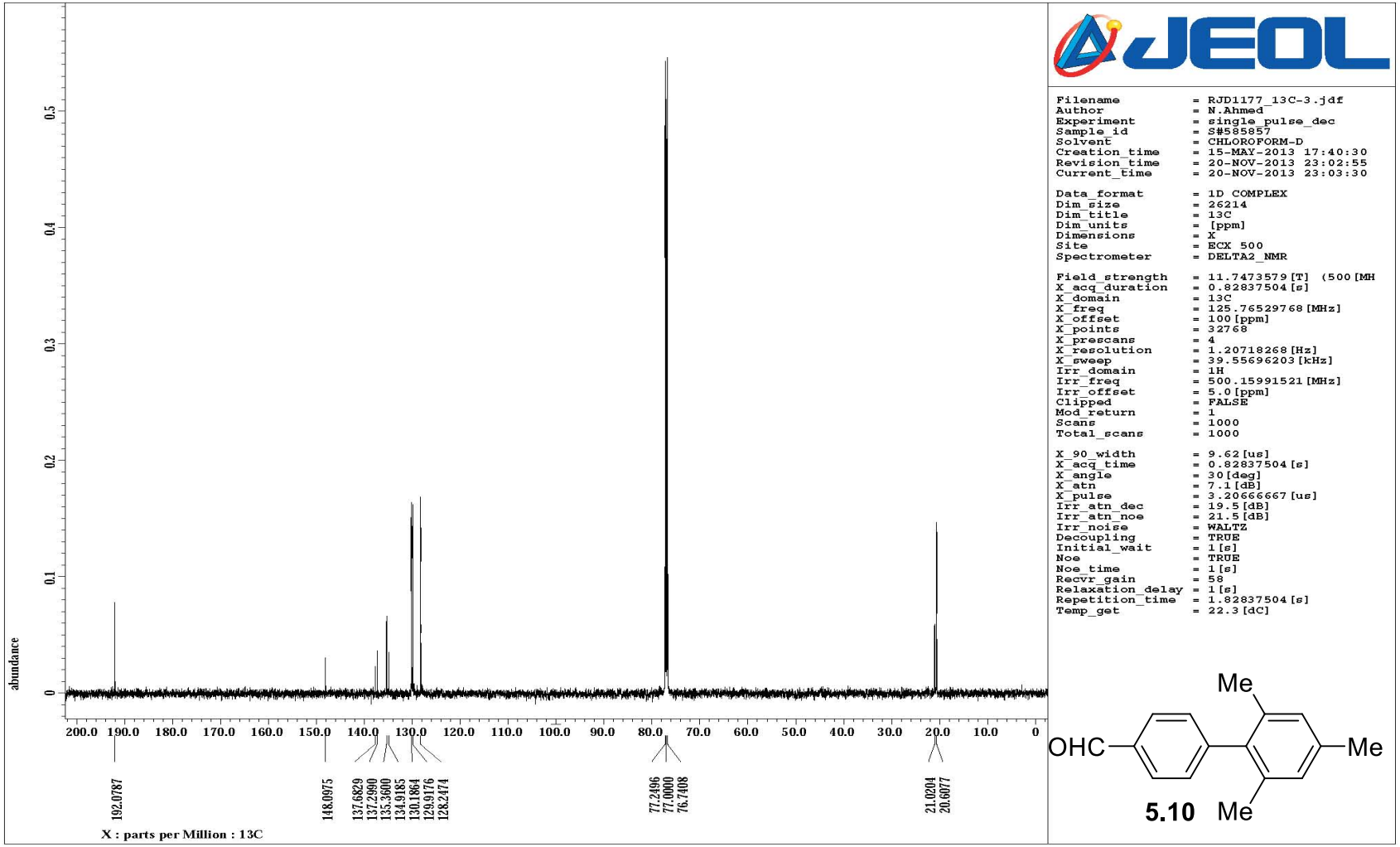
^{13}C NMR spectrum of 1-(2',4',6'-trimethylbiphenyl-4-yl)ethanone (**5.9**)



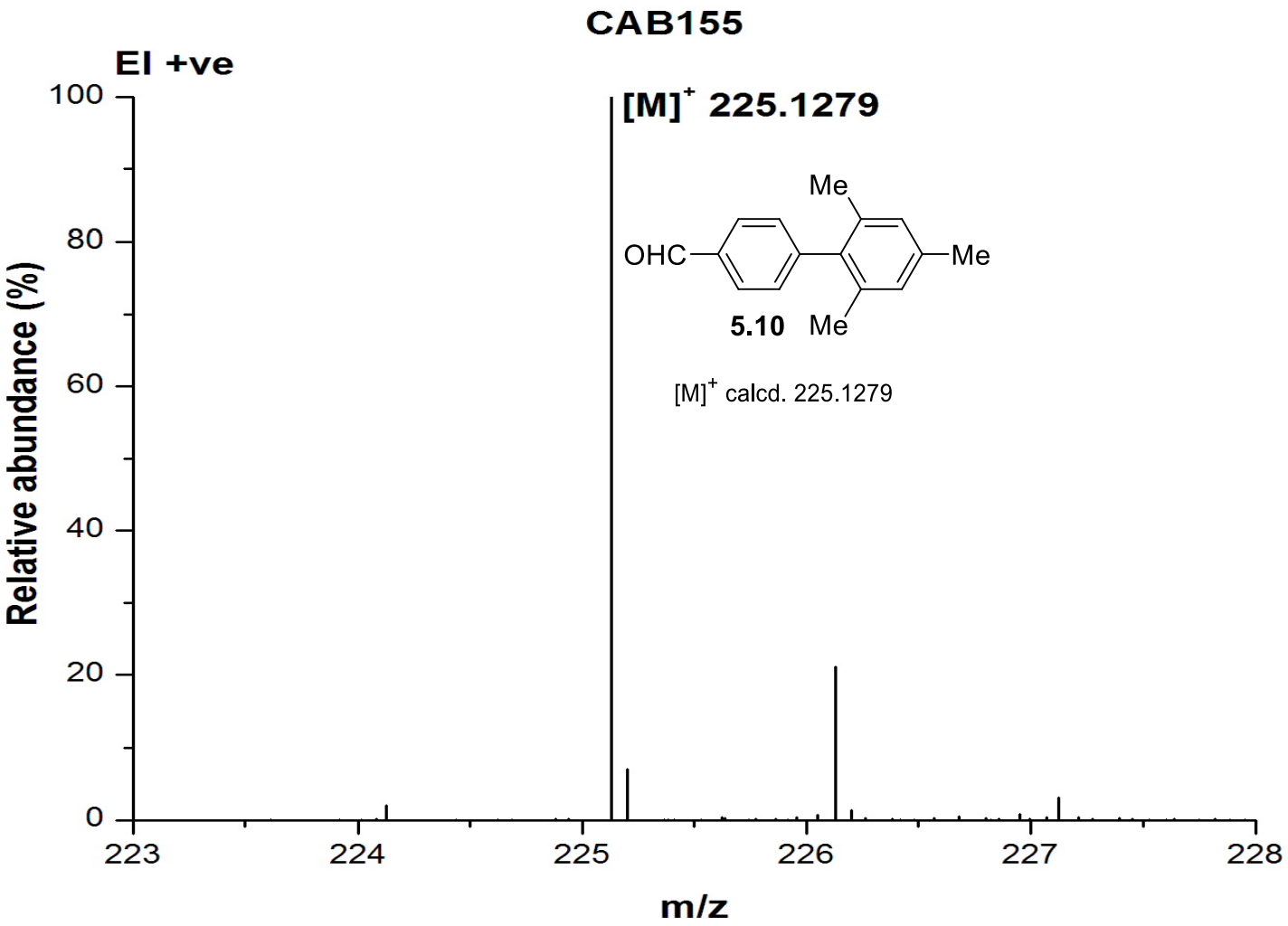
HRMS spectrum of 1-(2',4',6'-trimethylbiphenyl-4-yl)ethanone (**5.9**)



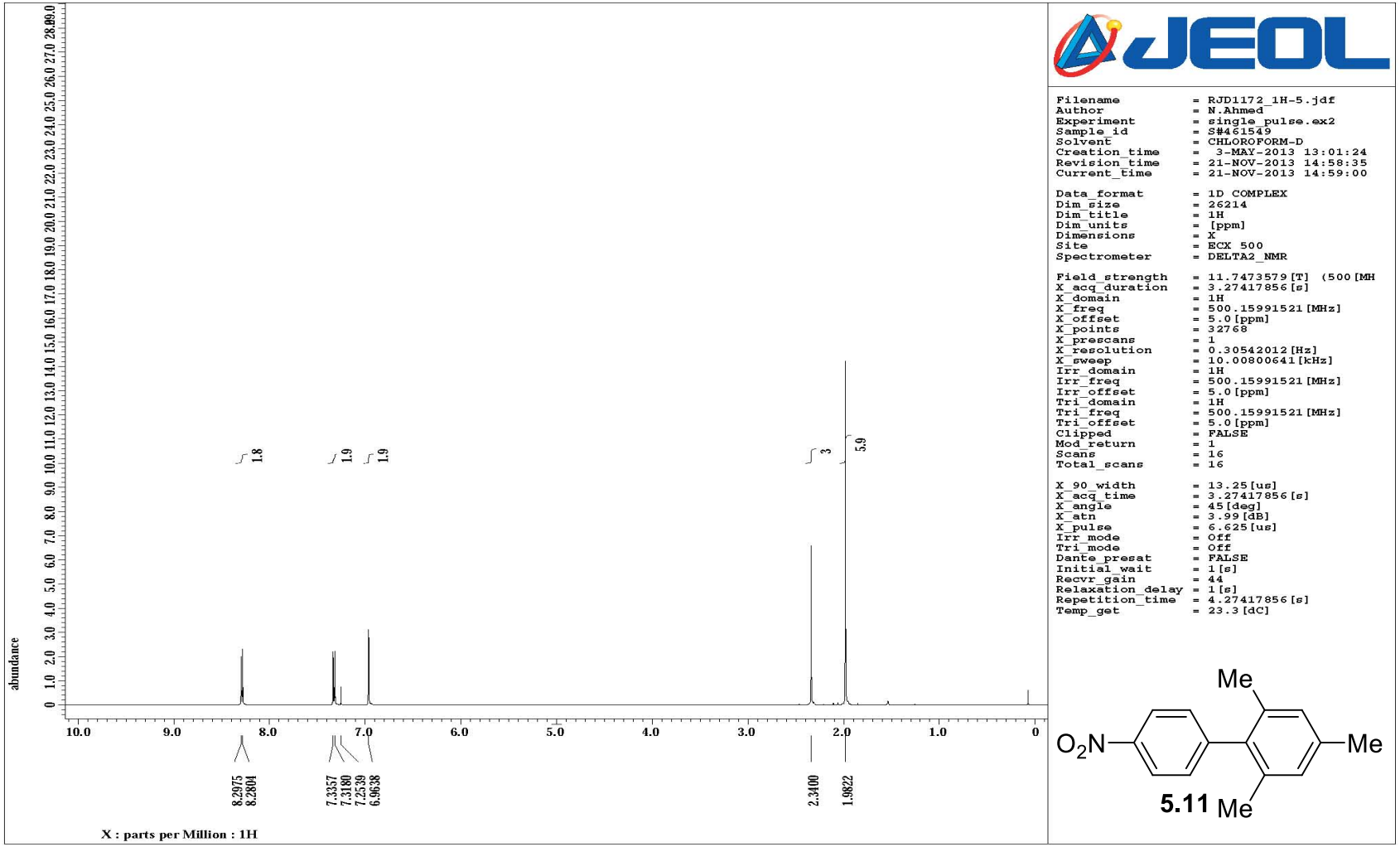
^{1}H NMR spectrum of 2',4',6'-trimethylbiphenyl-4-carbaldehyde (**5.10**)



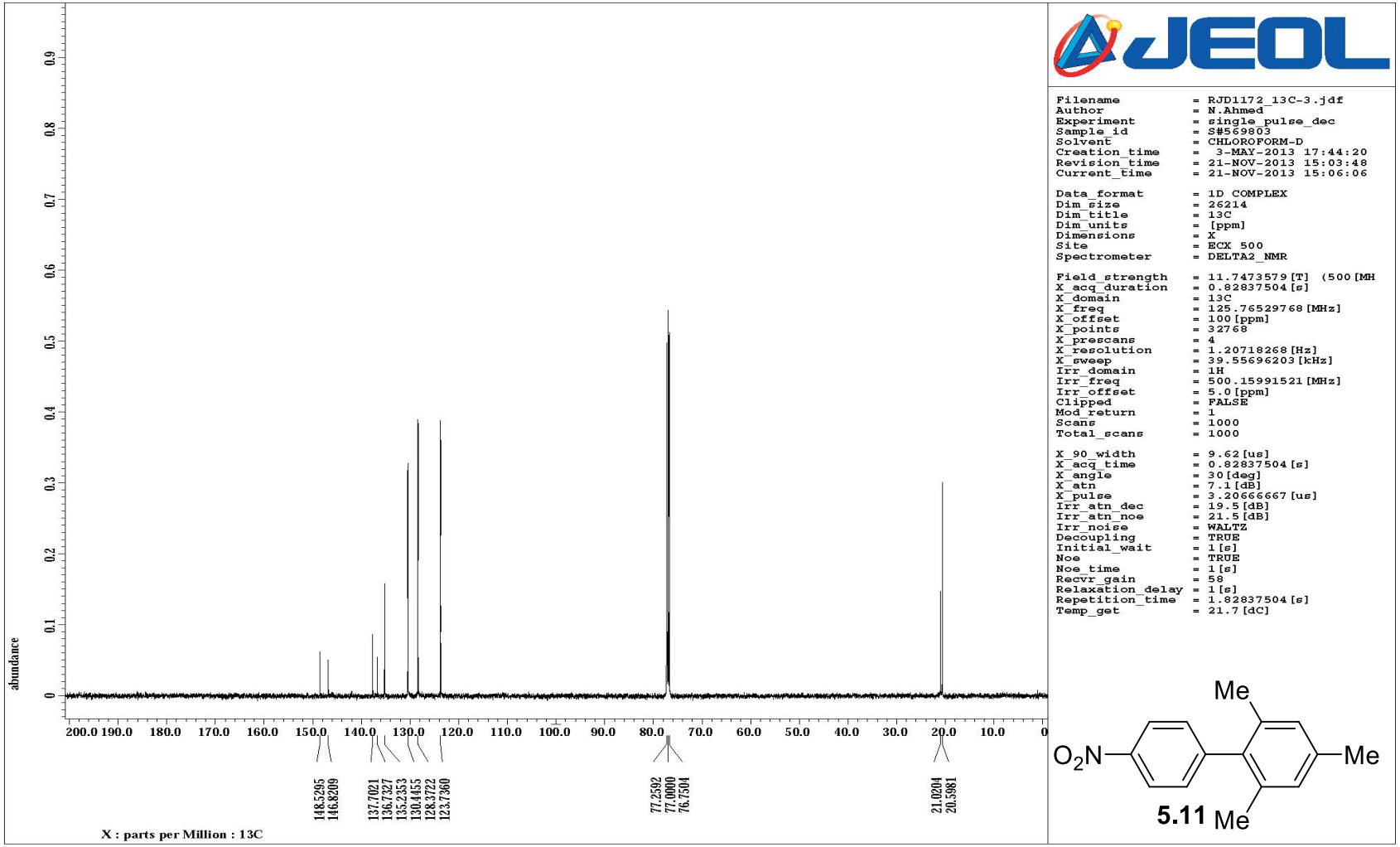
^{13}C NMR spectrum of 2',4',6'-trimethylbiphenyl-4-carbaldehyde (**5.10**)



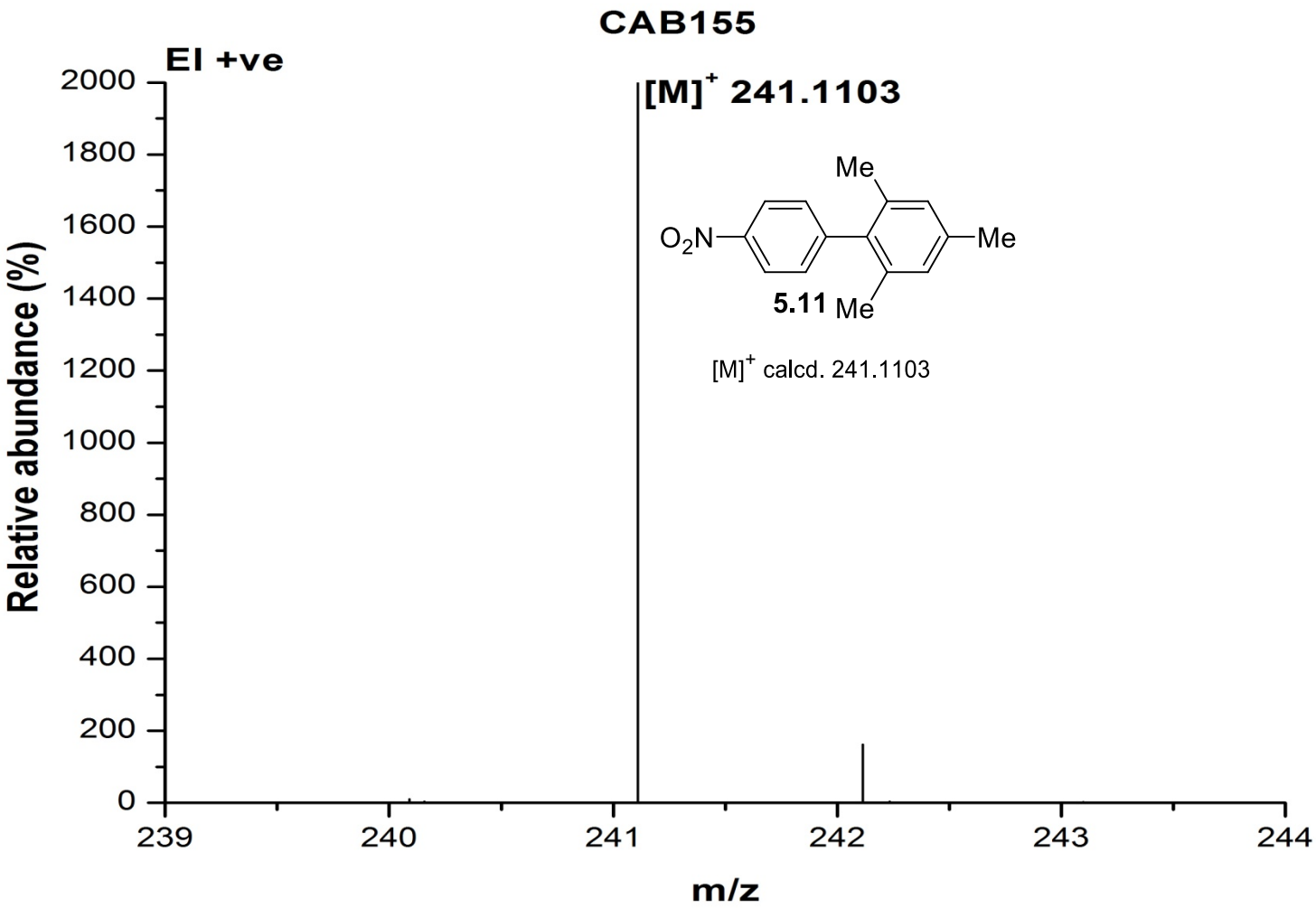
HRMS spectrum of 2',4',6'-trimethylbiphenyl-4-carbaldehyde (**5.10**)



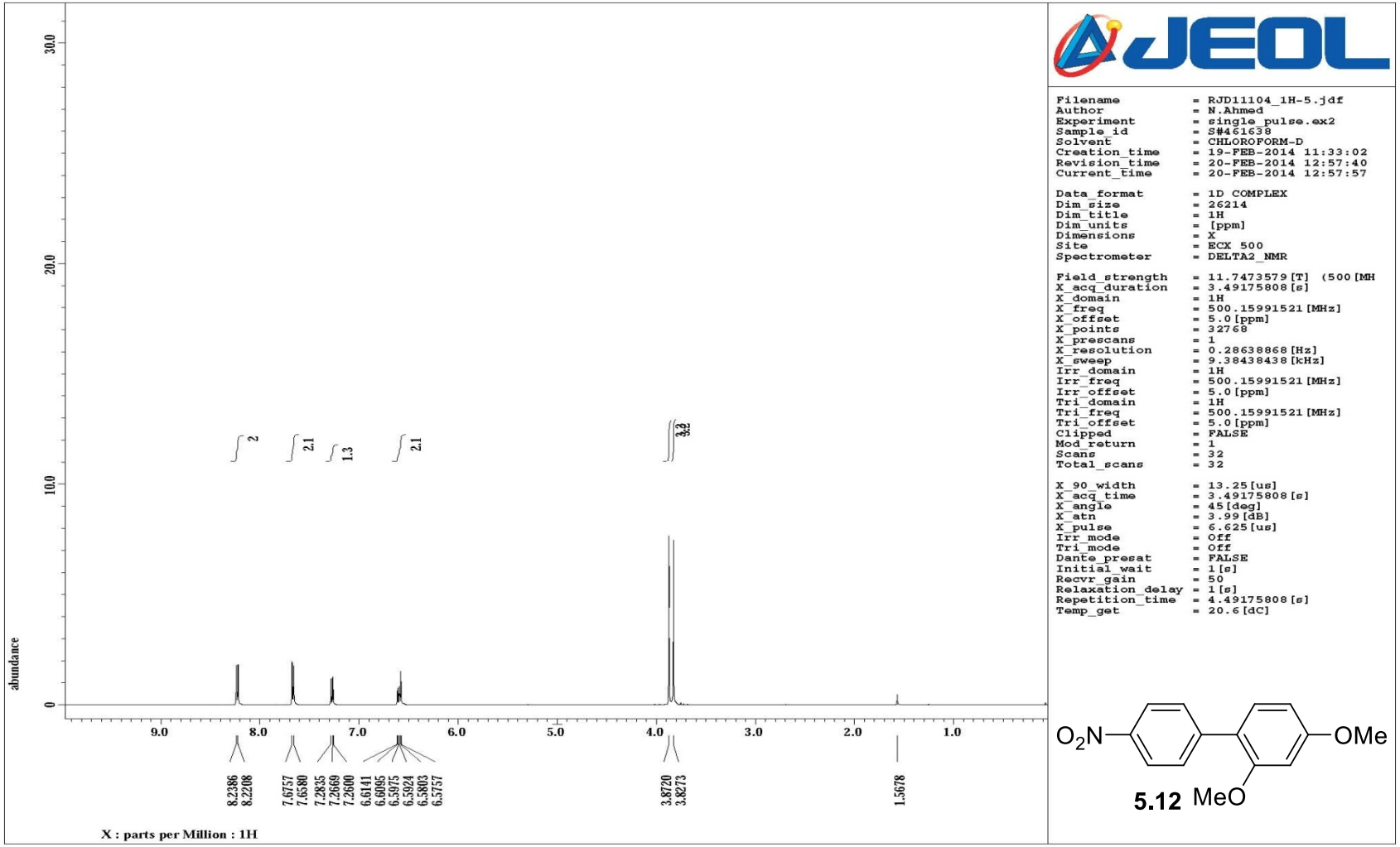
^{1}H NMR spectrum of 2,4,6-trimethyl-4'-nitrobiphenyl (**5.11**)



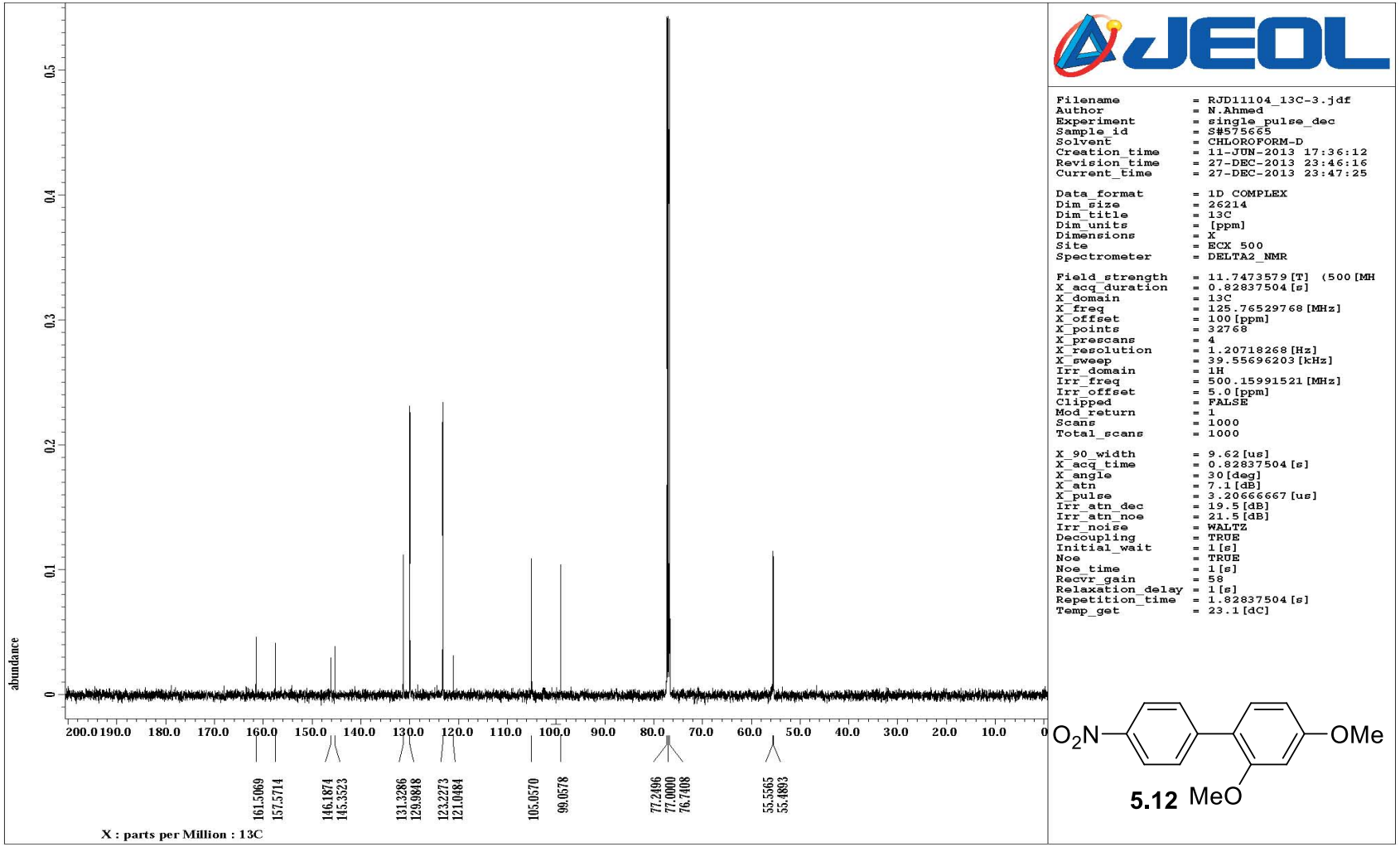
^{13}C NMR spectrum of 2,4,6-trimethyl-4'-nitrobiphenyl (**5.11**)



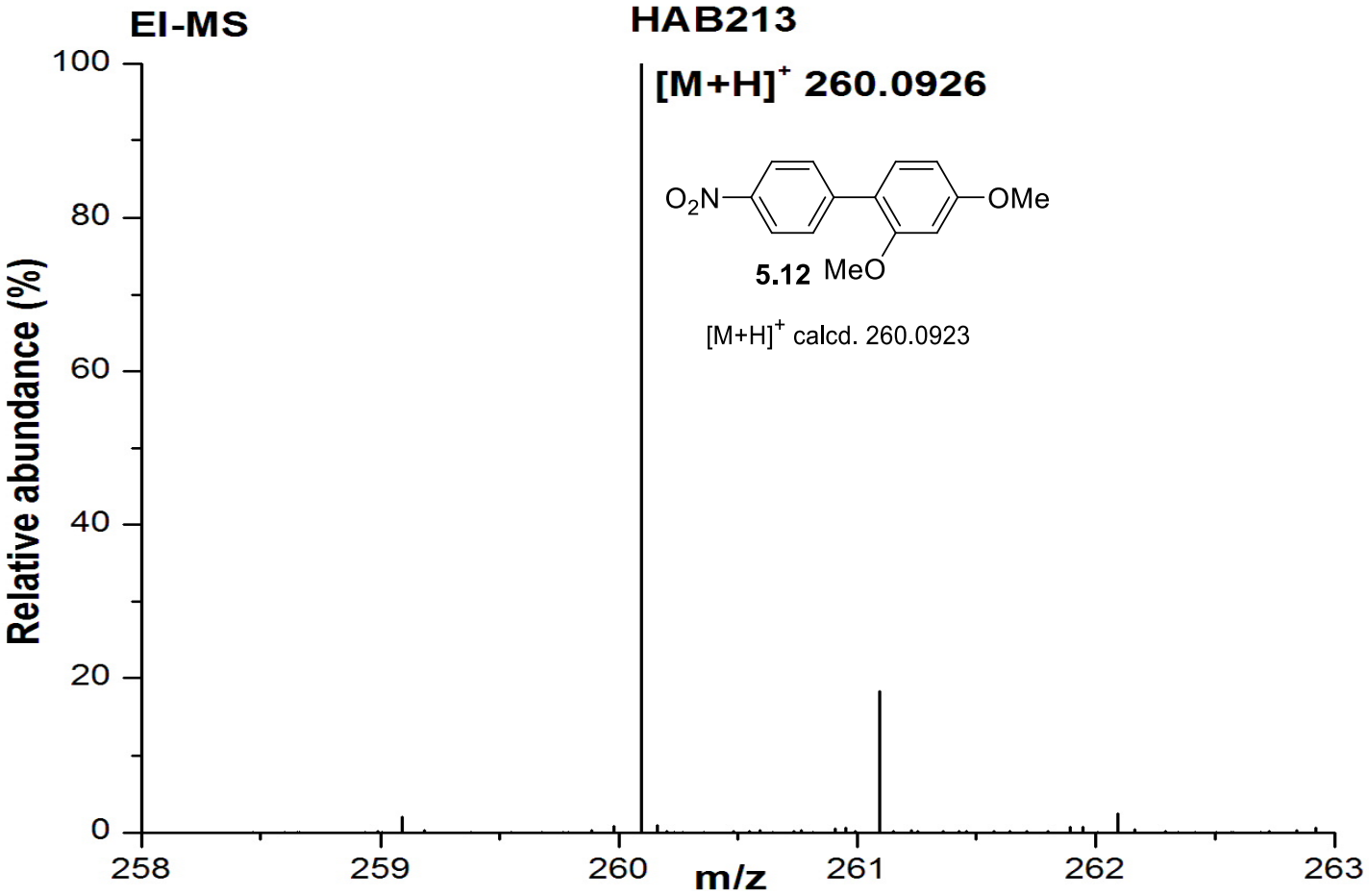
HRMS spectrum of 2,4,6-trimethyl-4'-nitrobiphenyl (**5.11**)



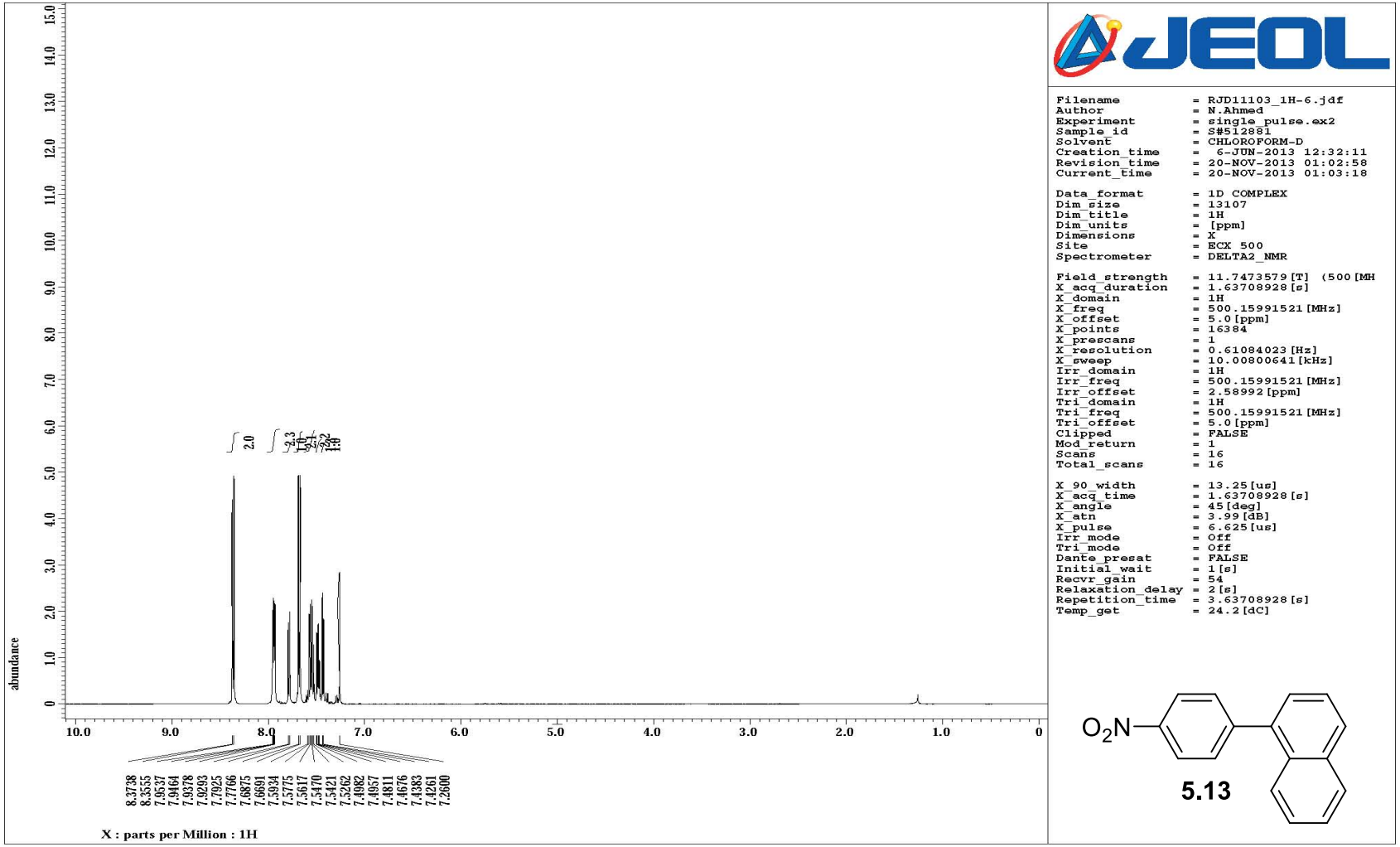
^{1}H NMR spectrum of 2,4-dimethoxy-4'-nitrobiphenyl (**5.12**)



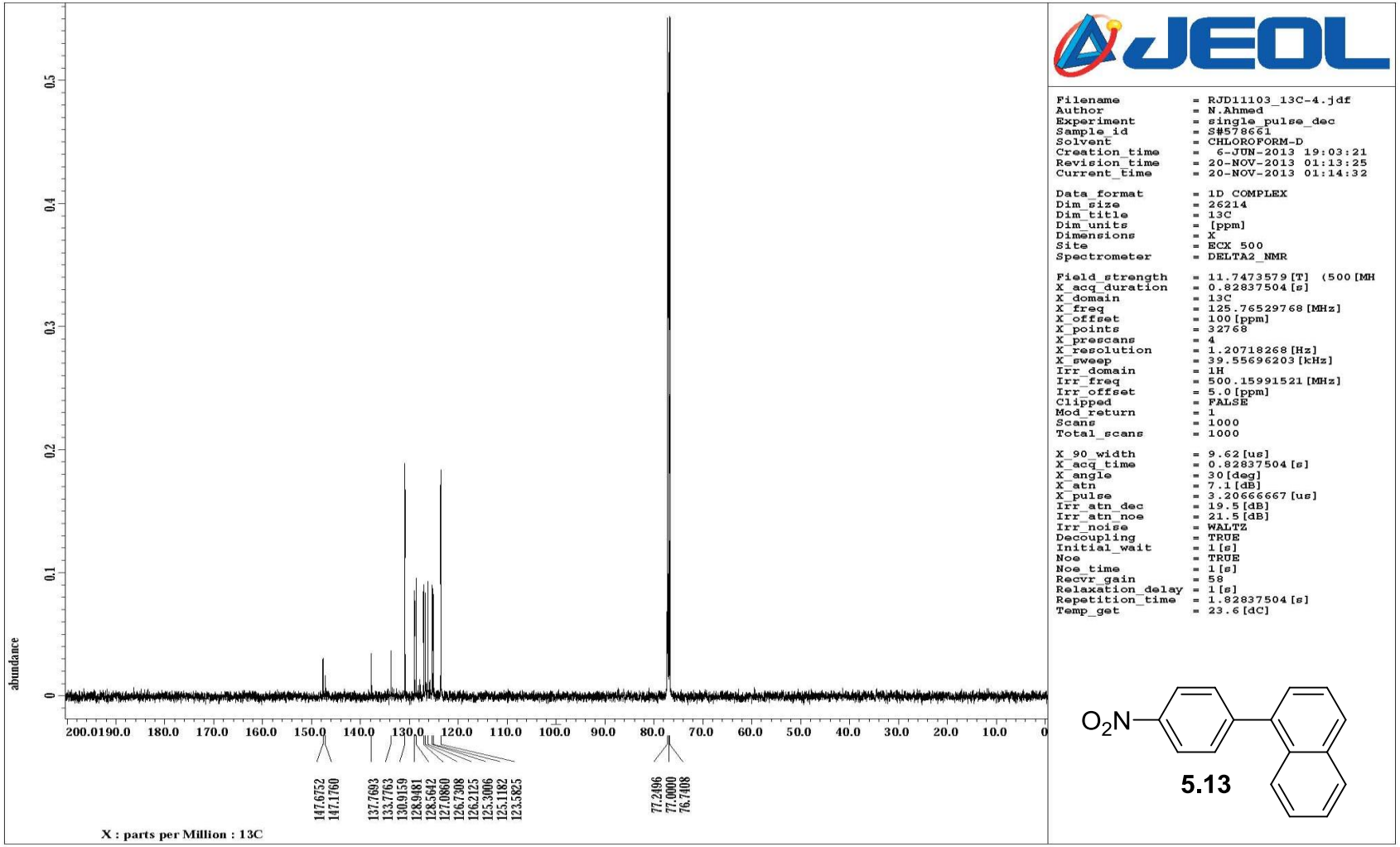
^{13}C NMR spectrum of 2,4-dimethoxy-4'-nitrobiphenyl (**5.12**)



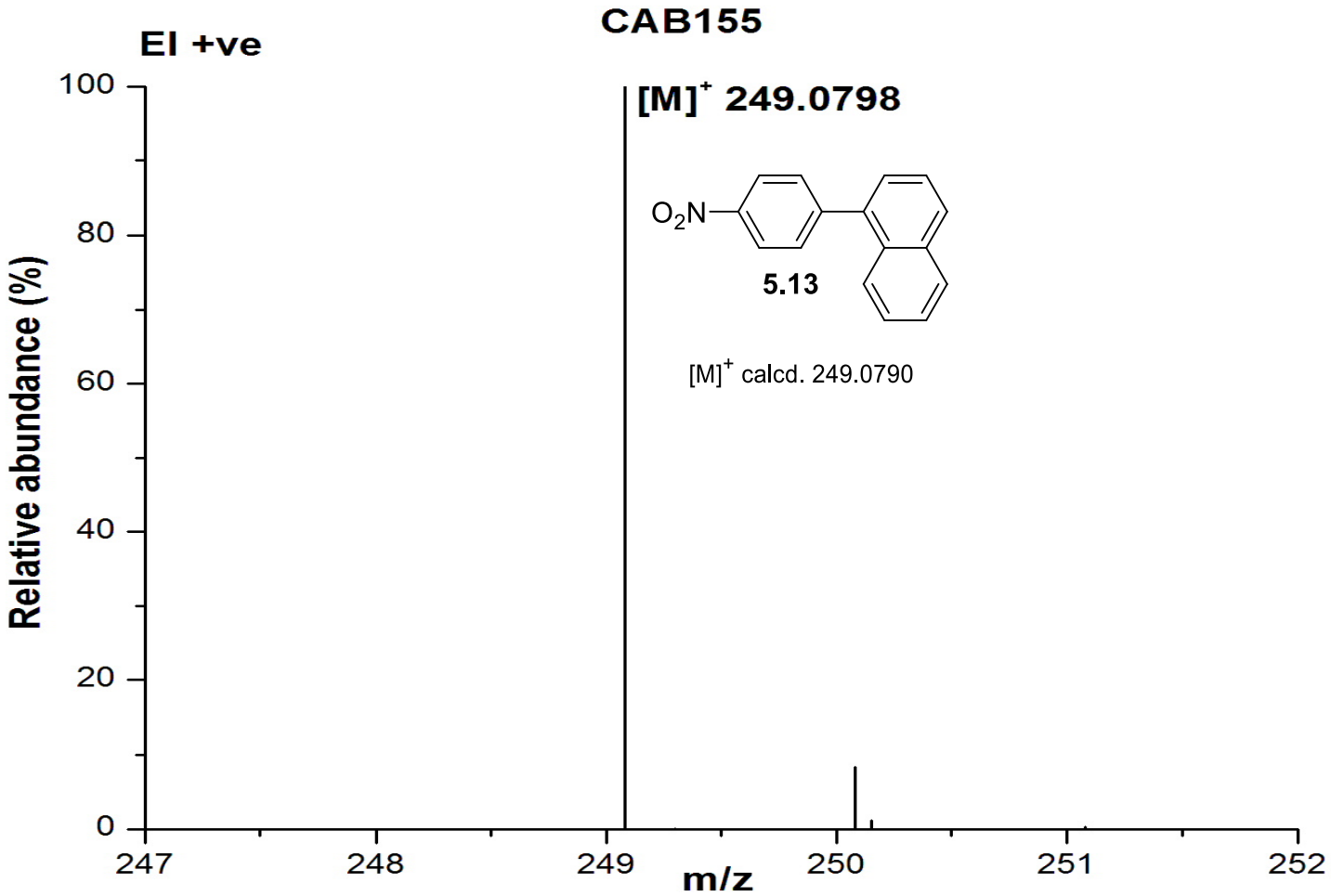
HRMS spectrum of 2,4-dimethoxy-4'-nitrobiphenyl (**5.12**)



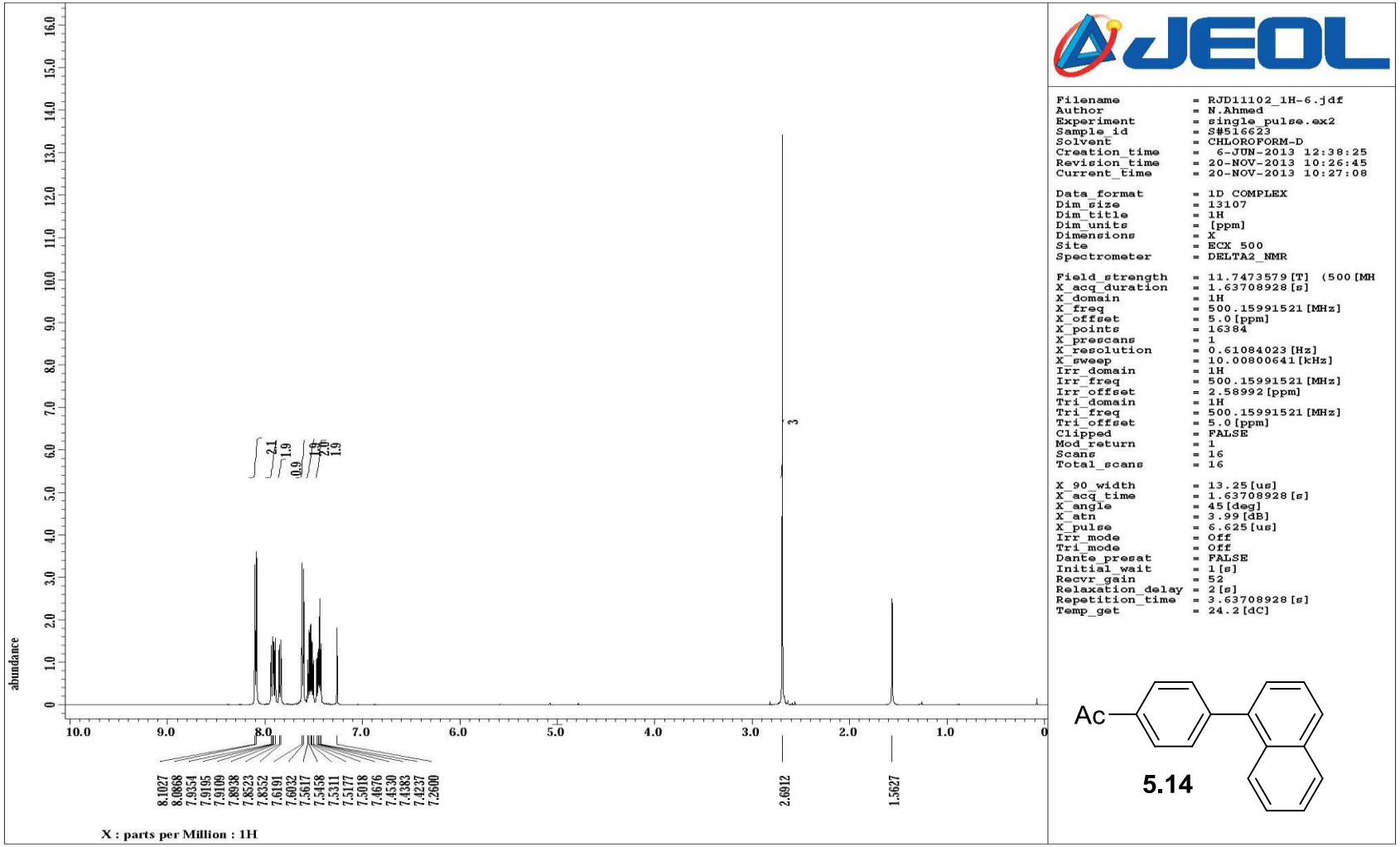
^{1}H NMR spectrum of 1-(4-nitrophenyl)naphthalene (**5.13**)



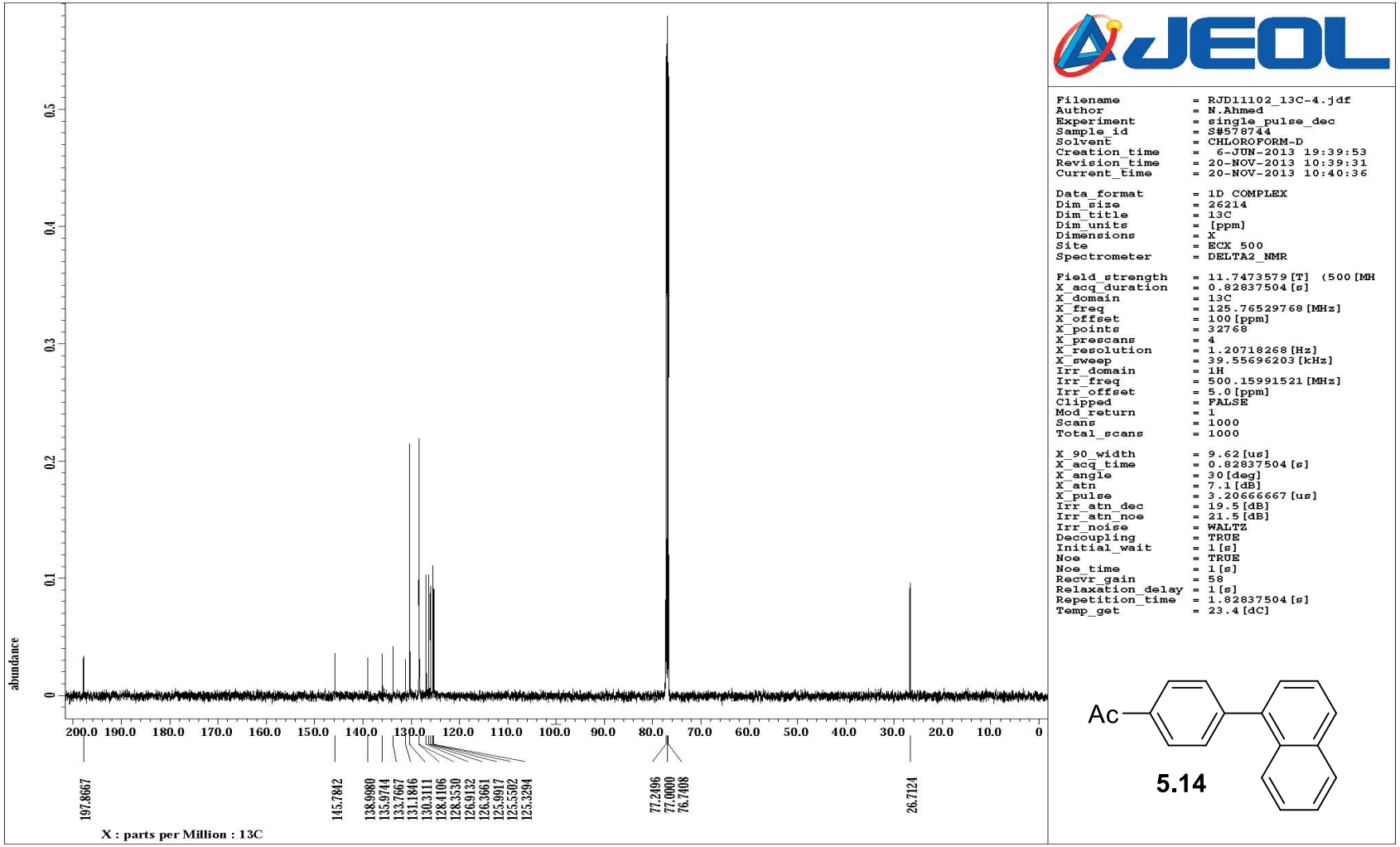
^{13}C NMR spectrum of 1-(4-nitrophenyl)naphthalene (**5.13**)



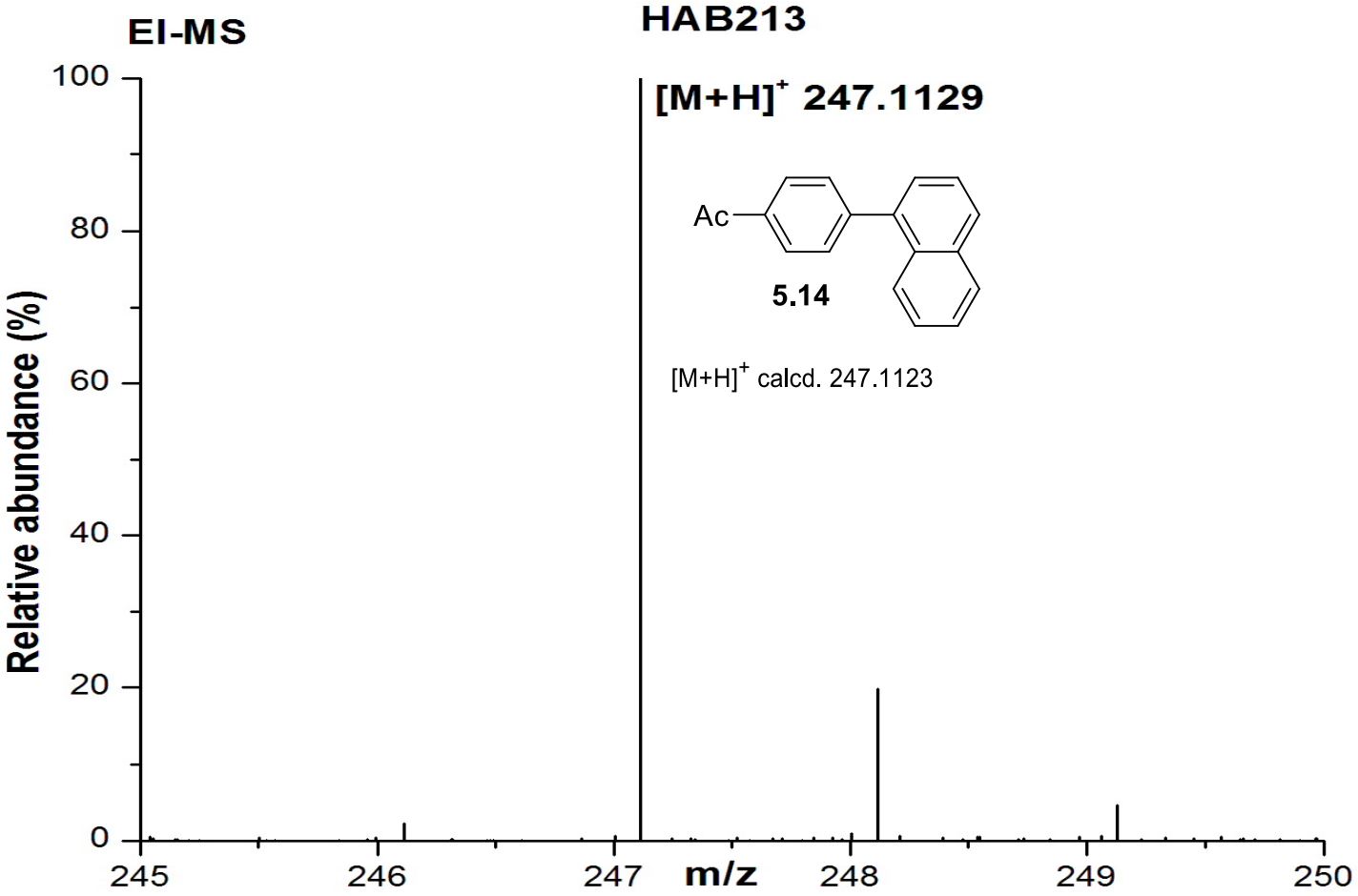
HRMS spectrum of 1-(4-nitrophenyl)naphthalene (**5.13**)



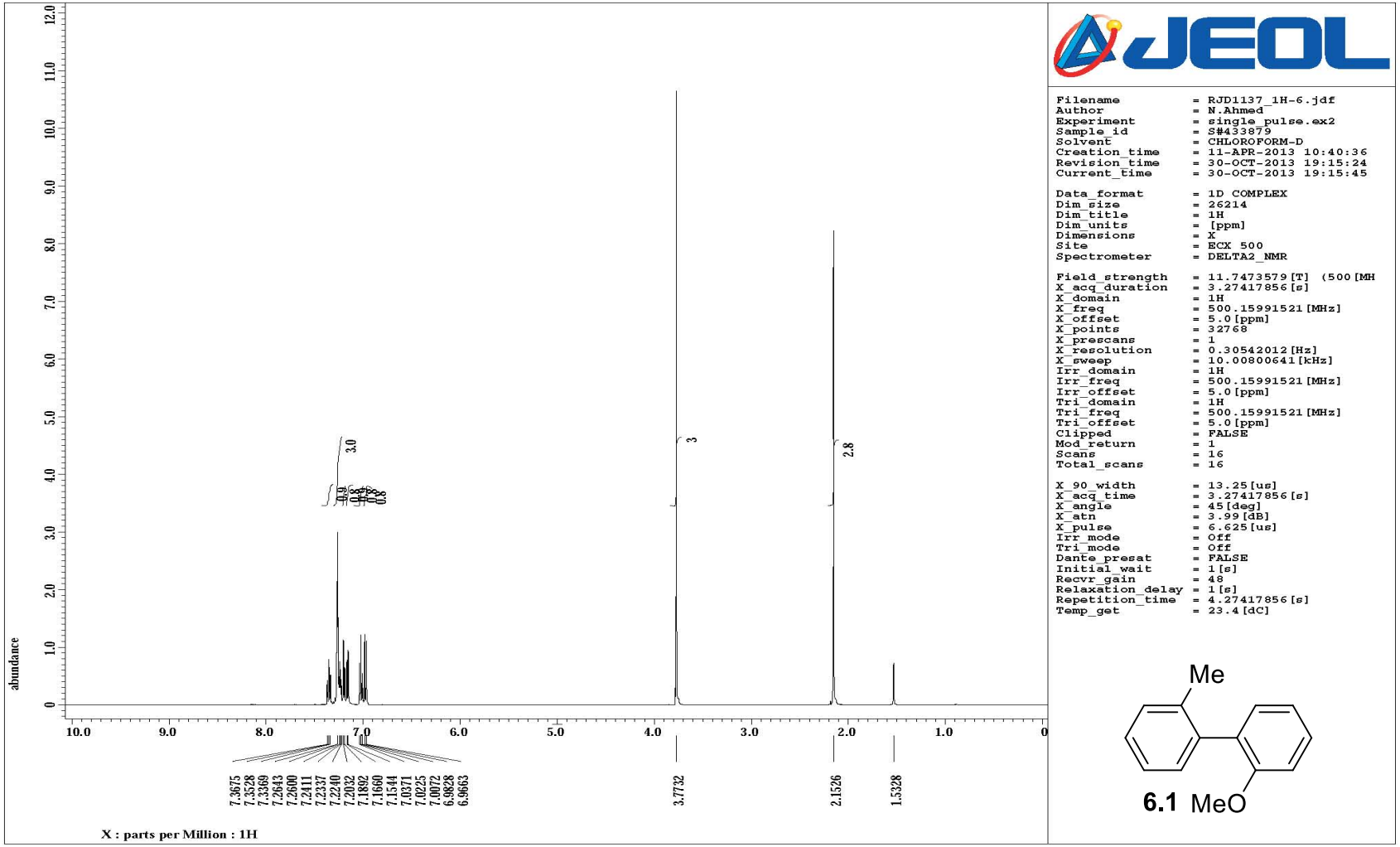
^{1}H NMR spectrum of 1-(4-acetylphenyl)naphthalene (**5.14**)



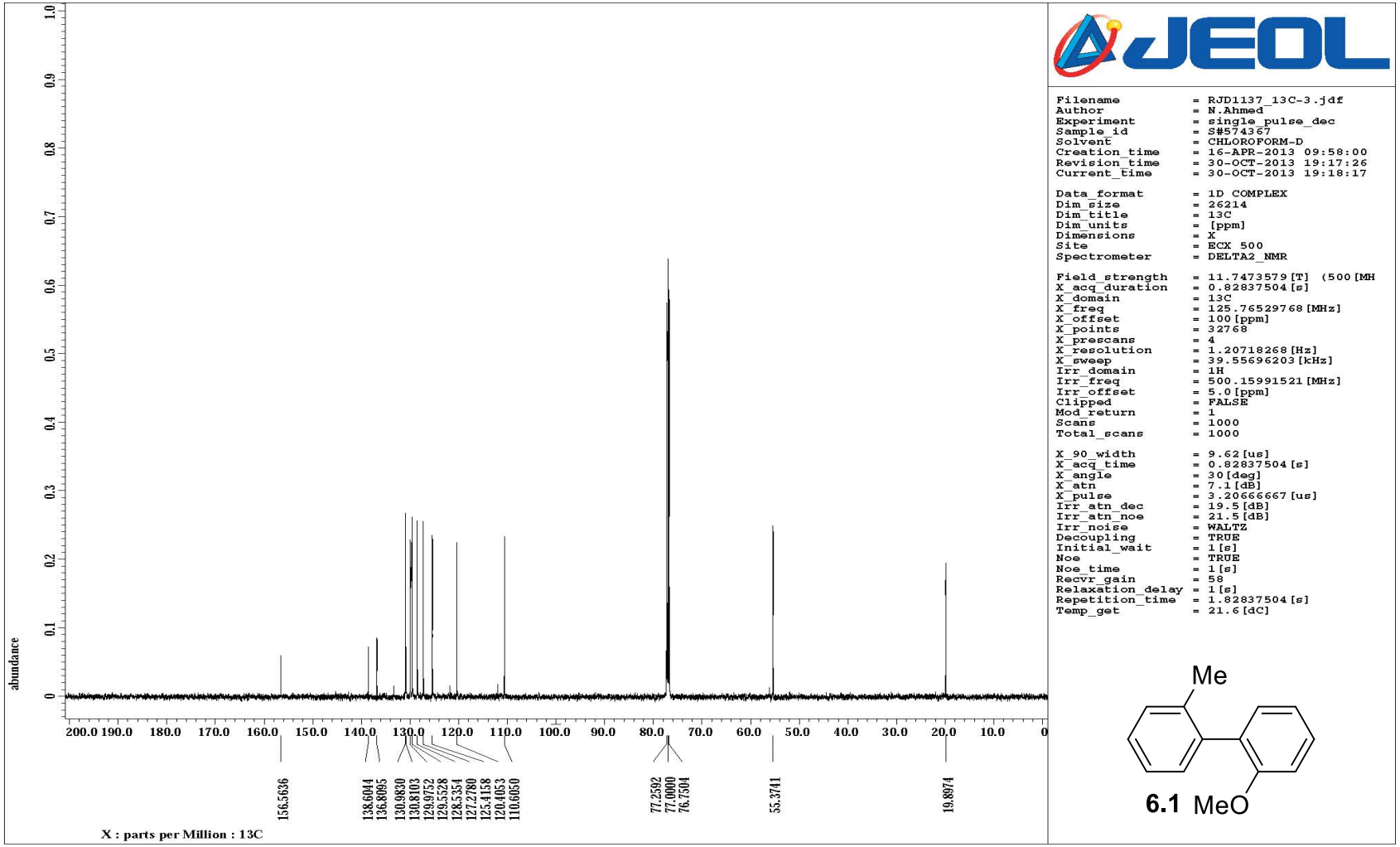
^{13}C NMR spectrum of 1-(4-acetylphenyl)naphthalene (**5.14**)



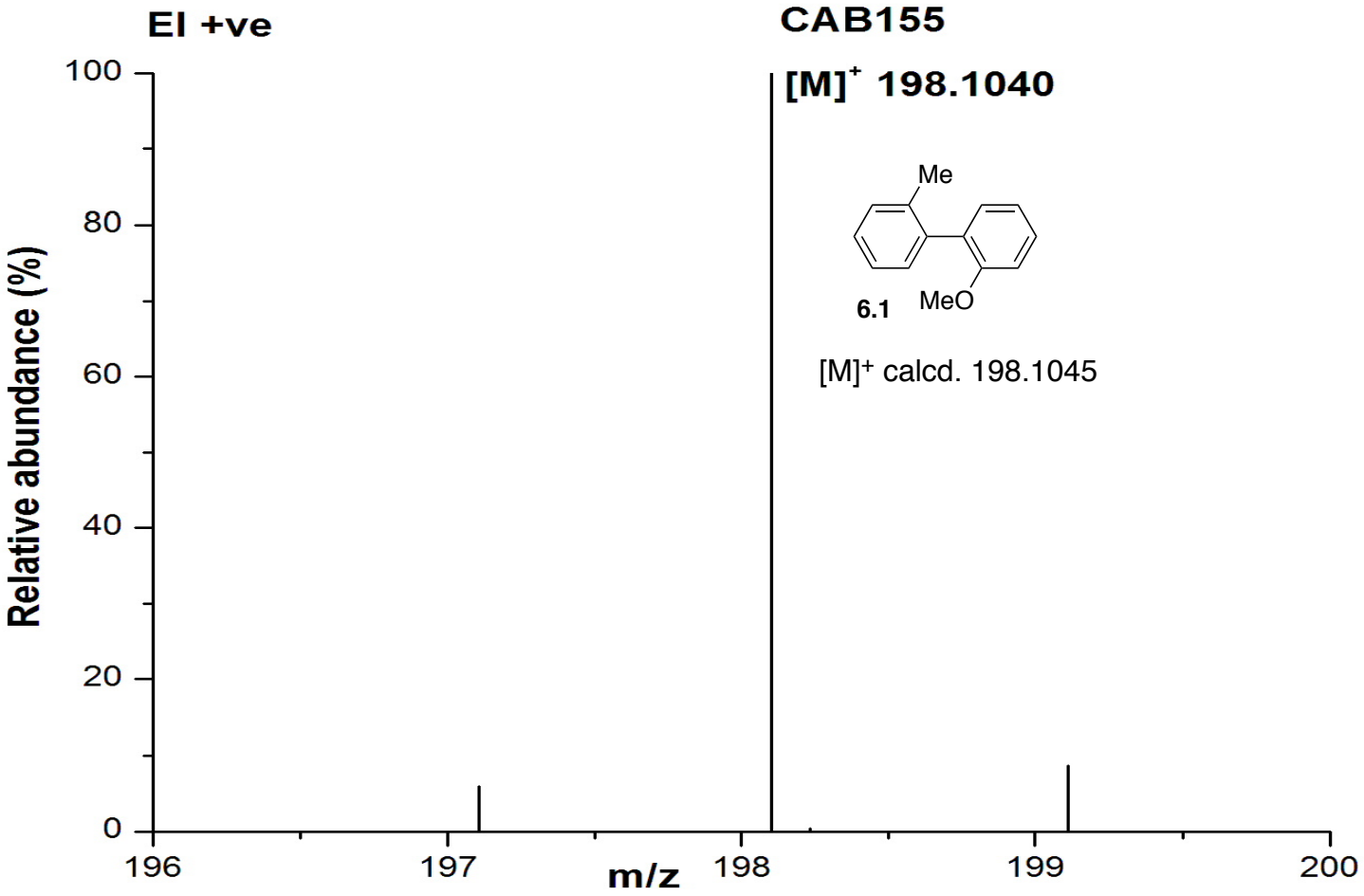
HRMS spectrum of 1-(4-acetylphenyl)naphthalene (**5.14**)



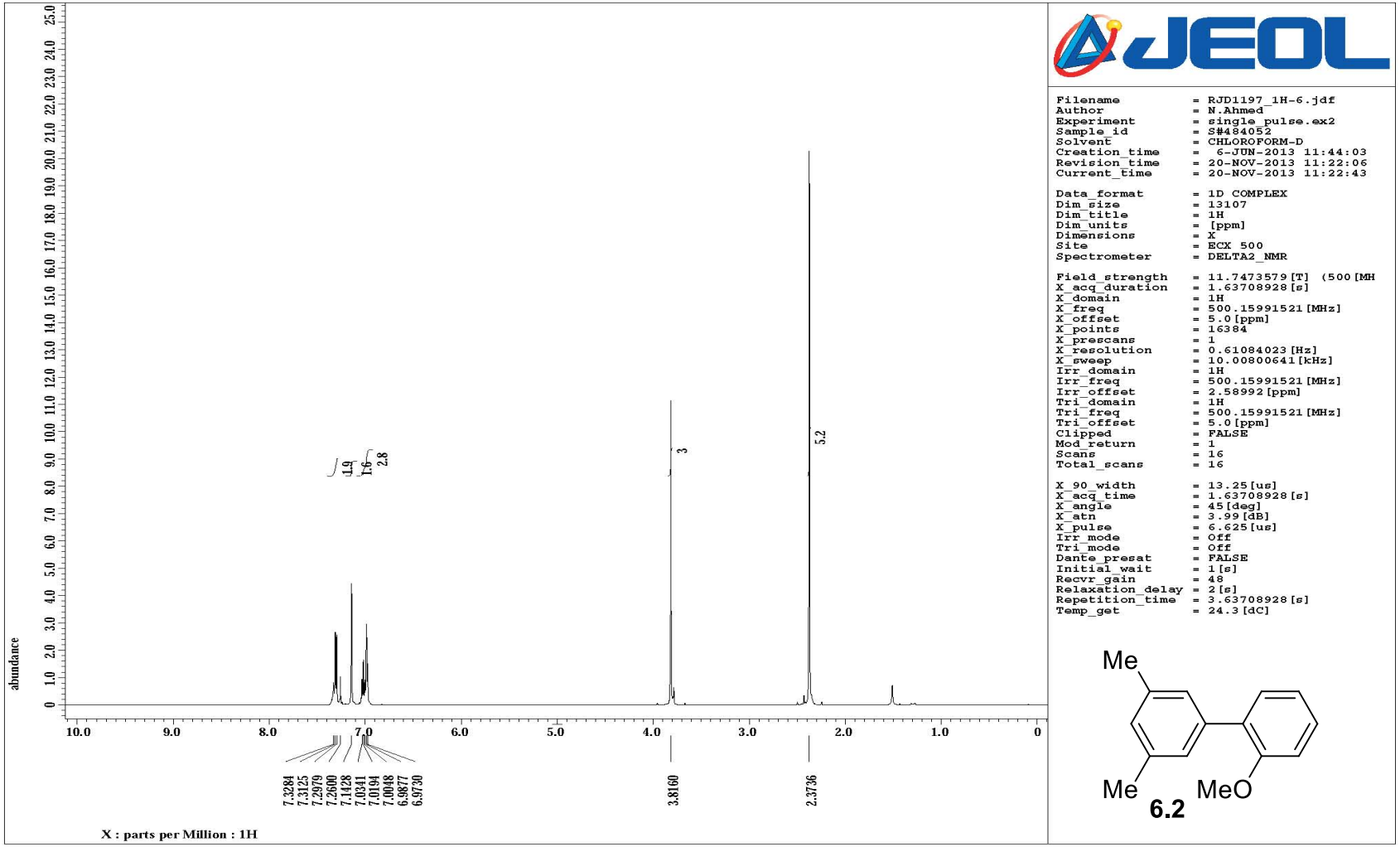
^{1}H NMR spectrum of 2-methoxy-2'-methylbiphenyl (**6.1**)



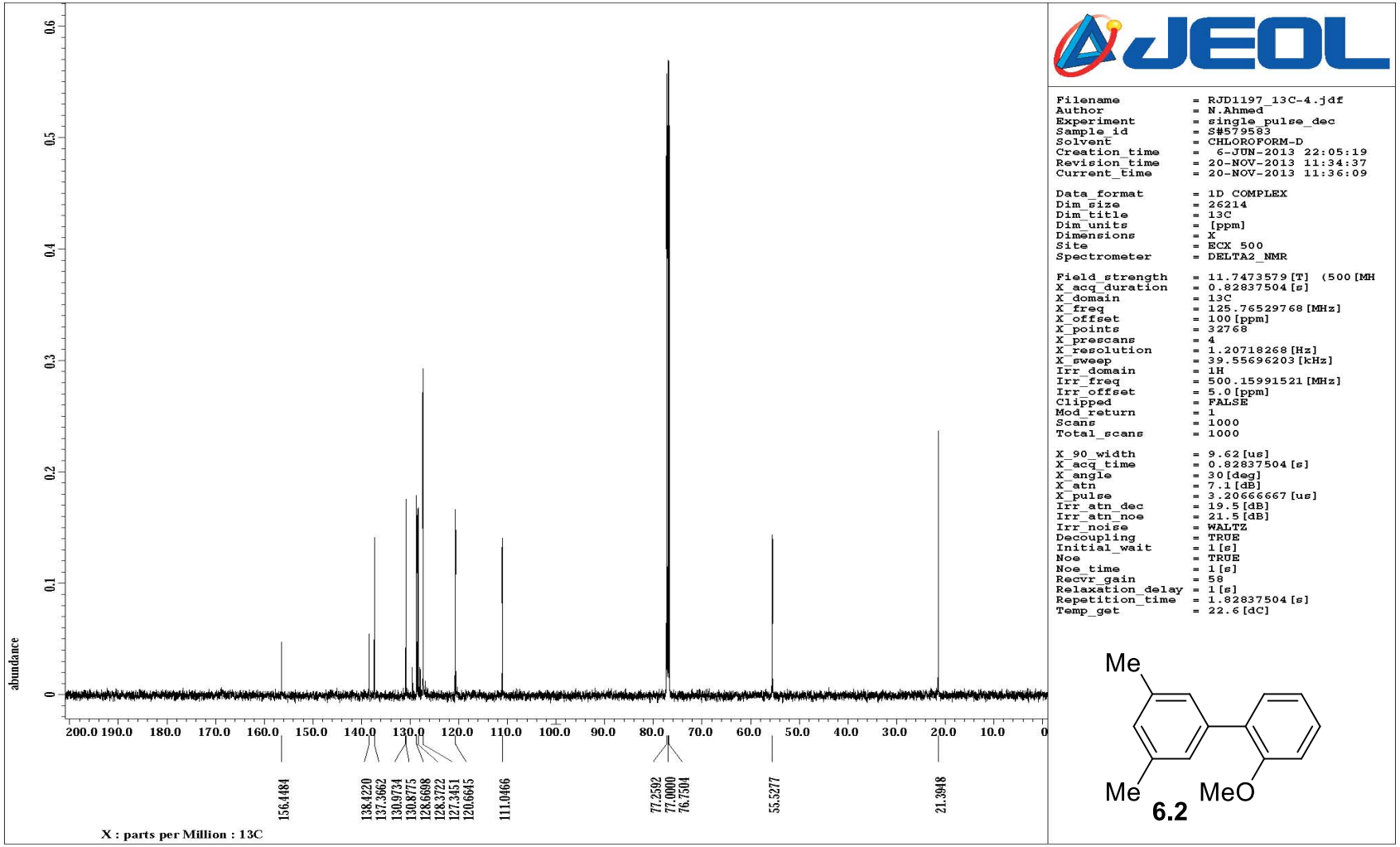
^{13}C NMR spectrum of 2-methoxy-2'-methylbiphenyl (**6.1**)



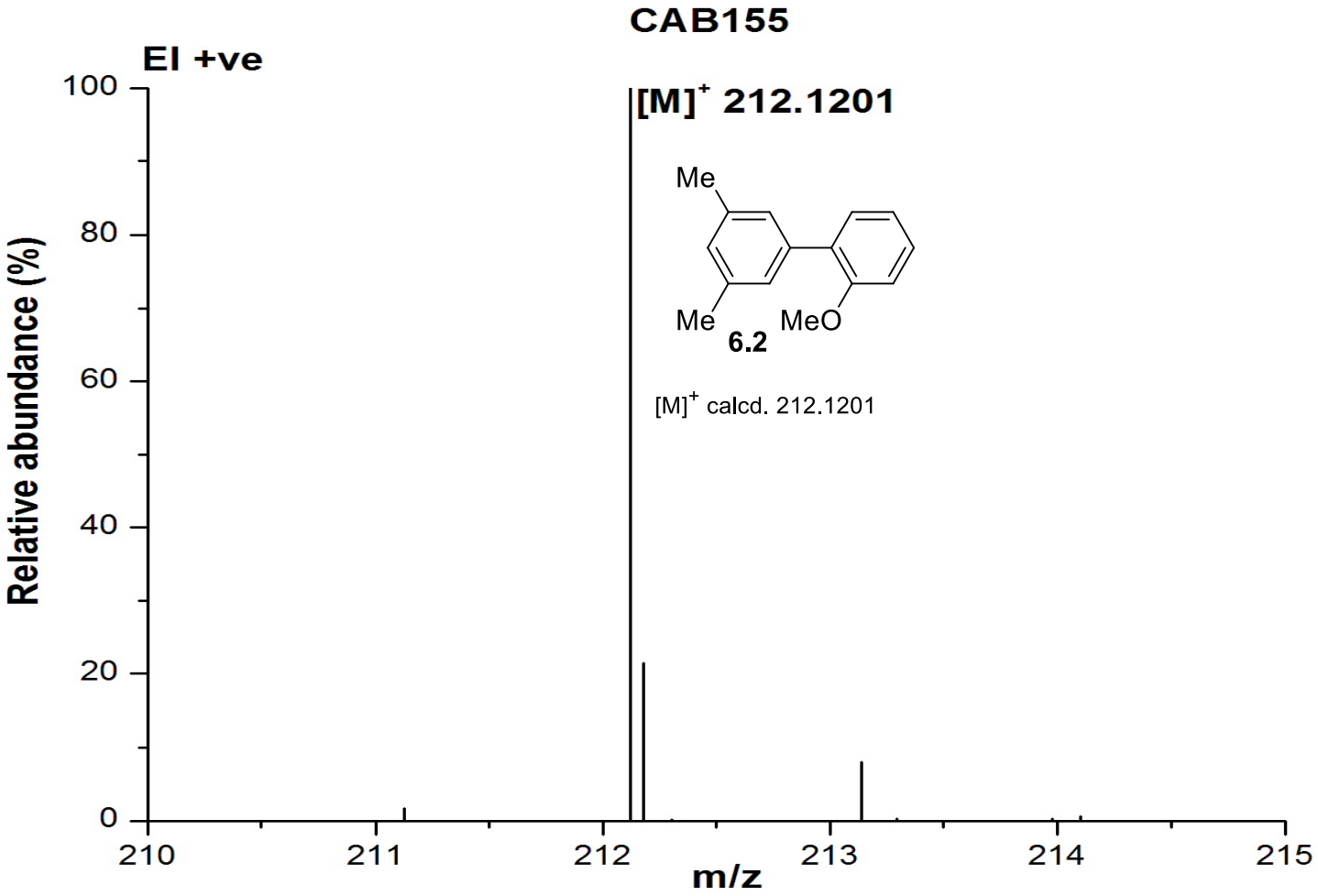
HRMS spectrum of 2-methoxy-2'-methylbiphenyl (**6.1**)



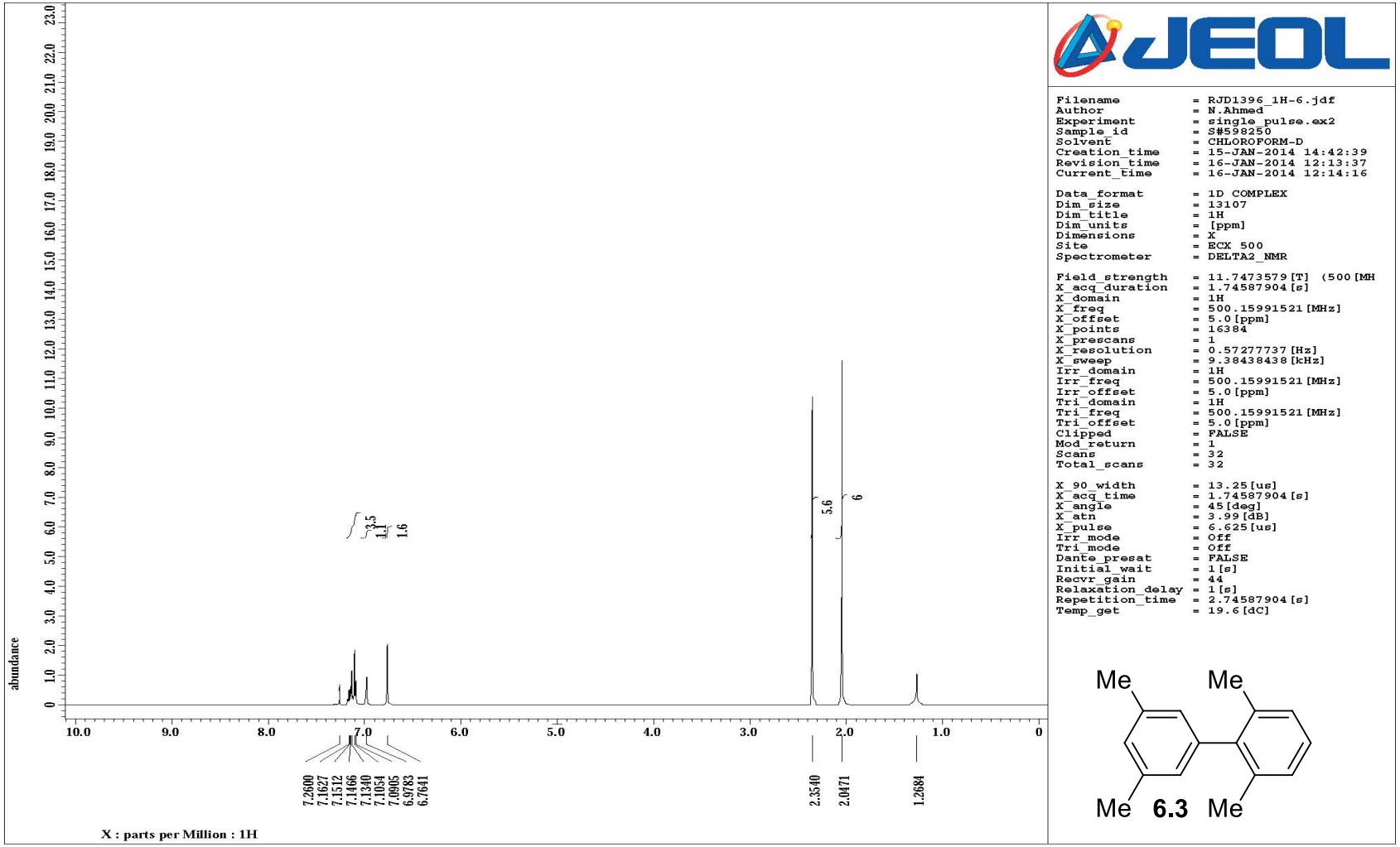
^{1}H NMR spectrum of 2-methoxy-3',5'-dimethylbiphenyl (**6.2**)



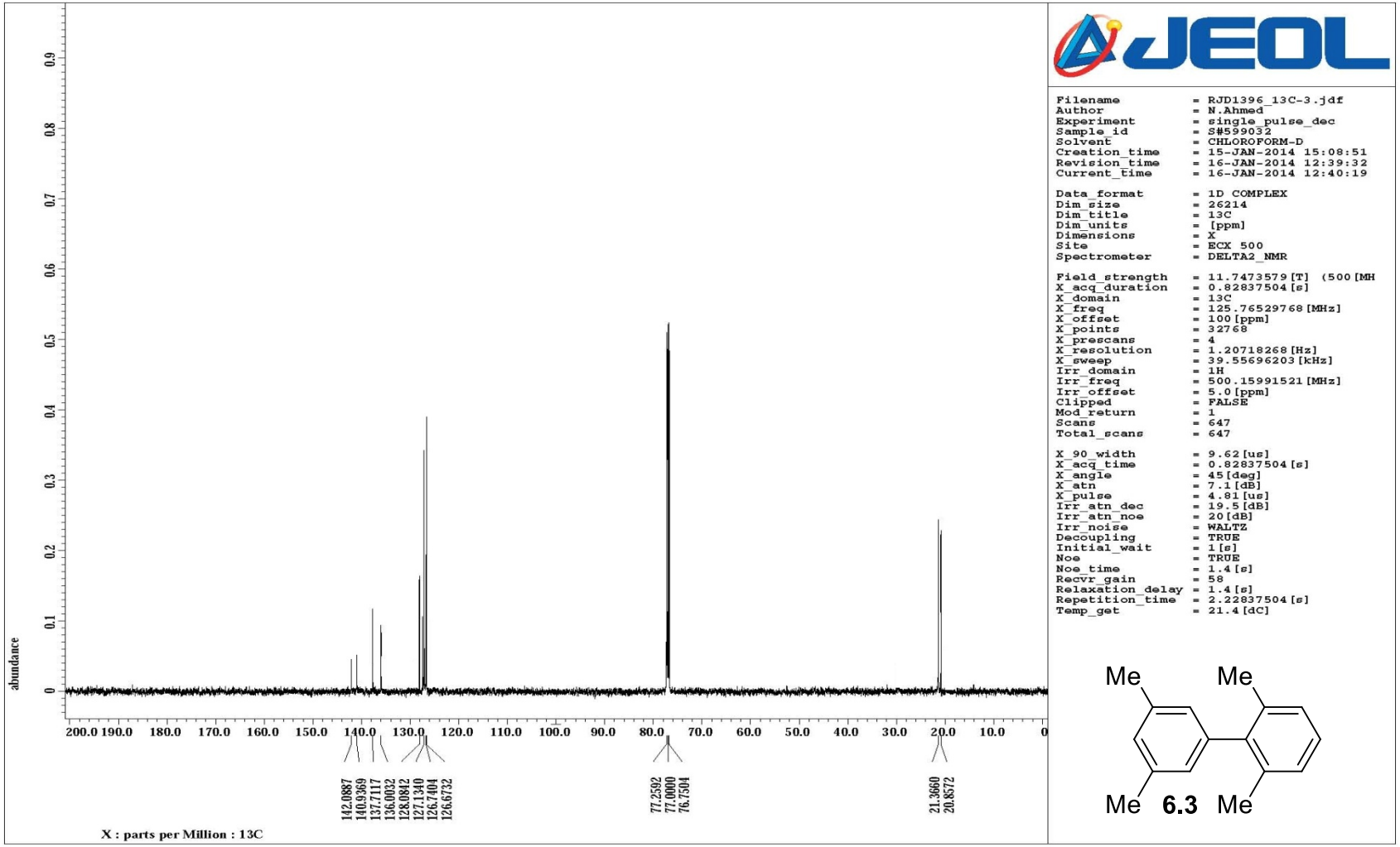
^{13}C NMR spectrum of 2-methoxy-3',5'-dimethylbiphenyl (**6.2**)



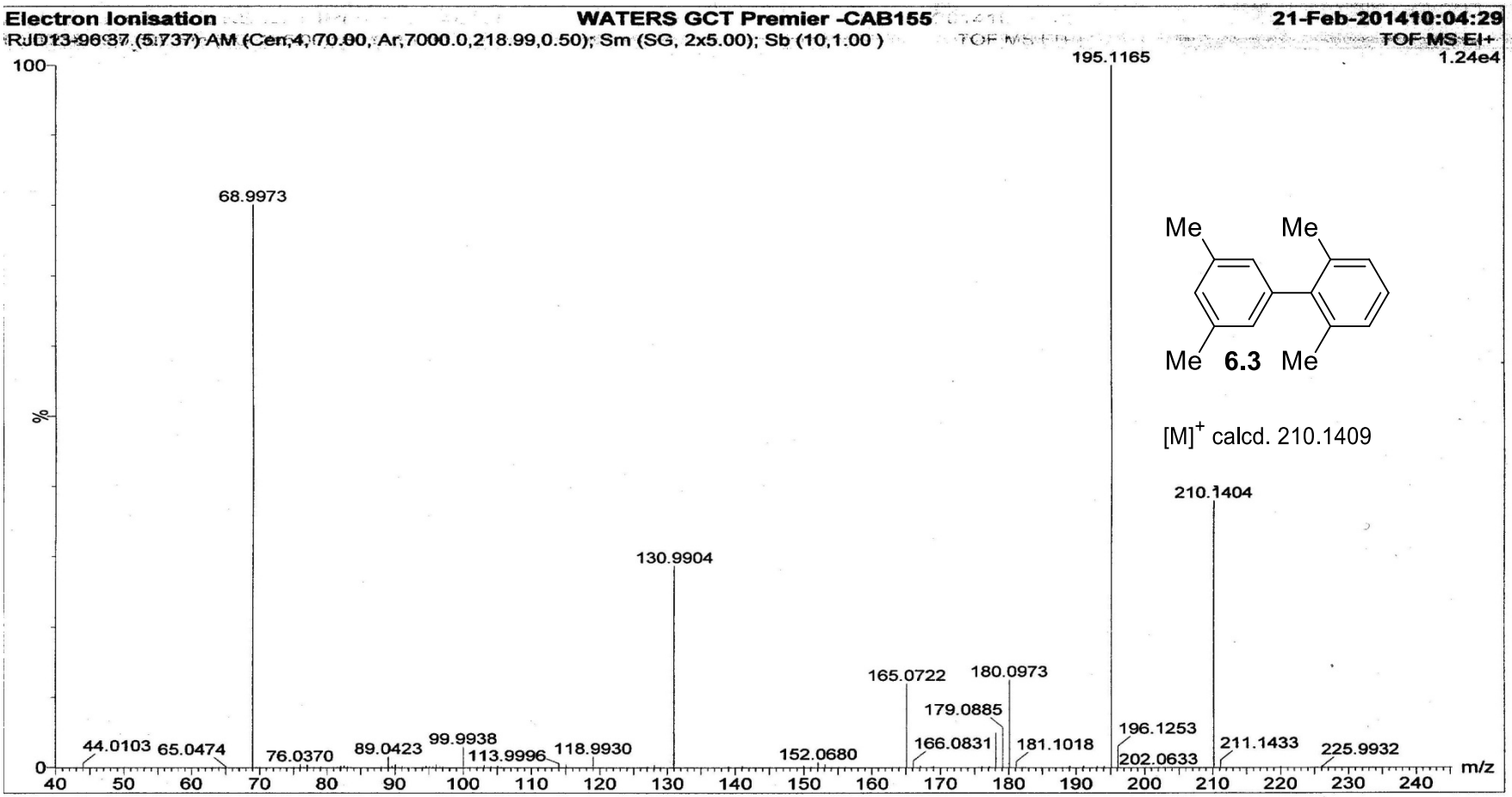
HRMS spectrum of 2-methoxy-3',5'-dimethylbiphenyl (**6.2**)



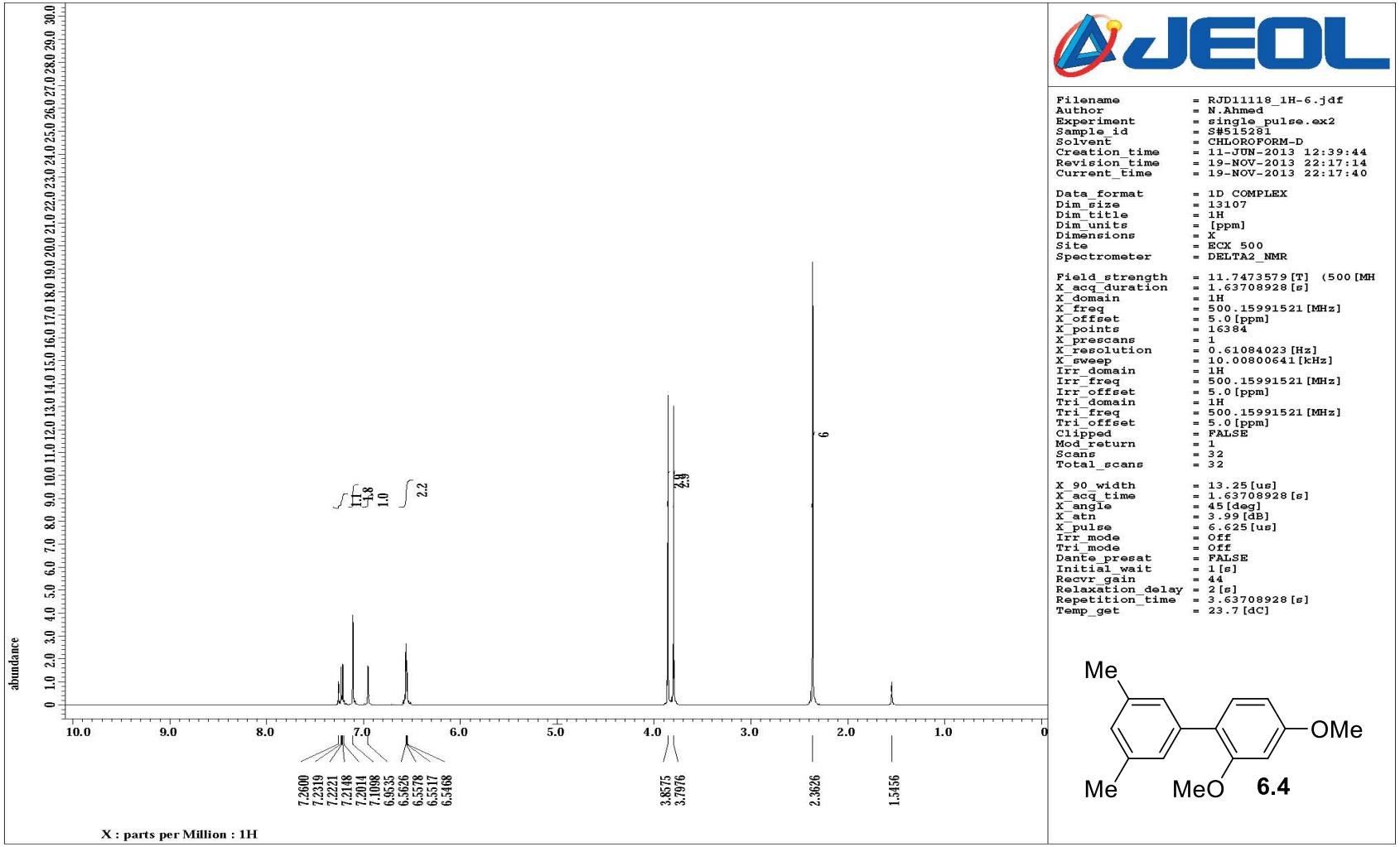
^{1}H NMR spectrum of 2,3',5',6-tetramethylbiphenyl (**6.3**)



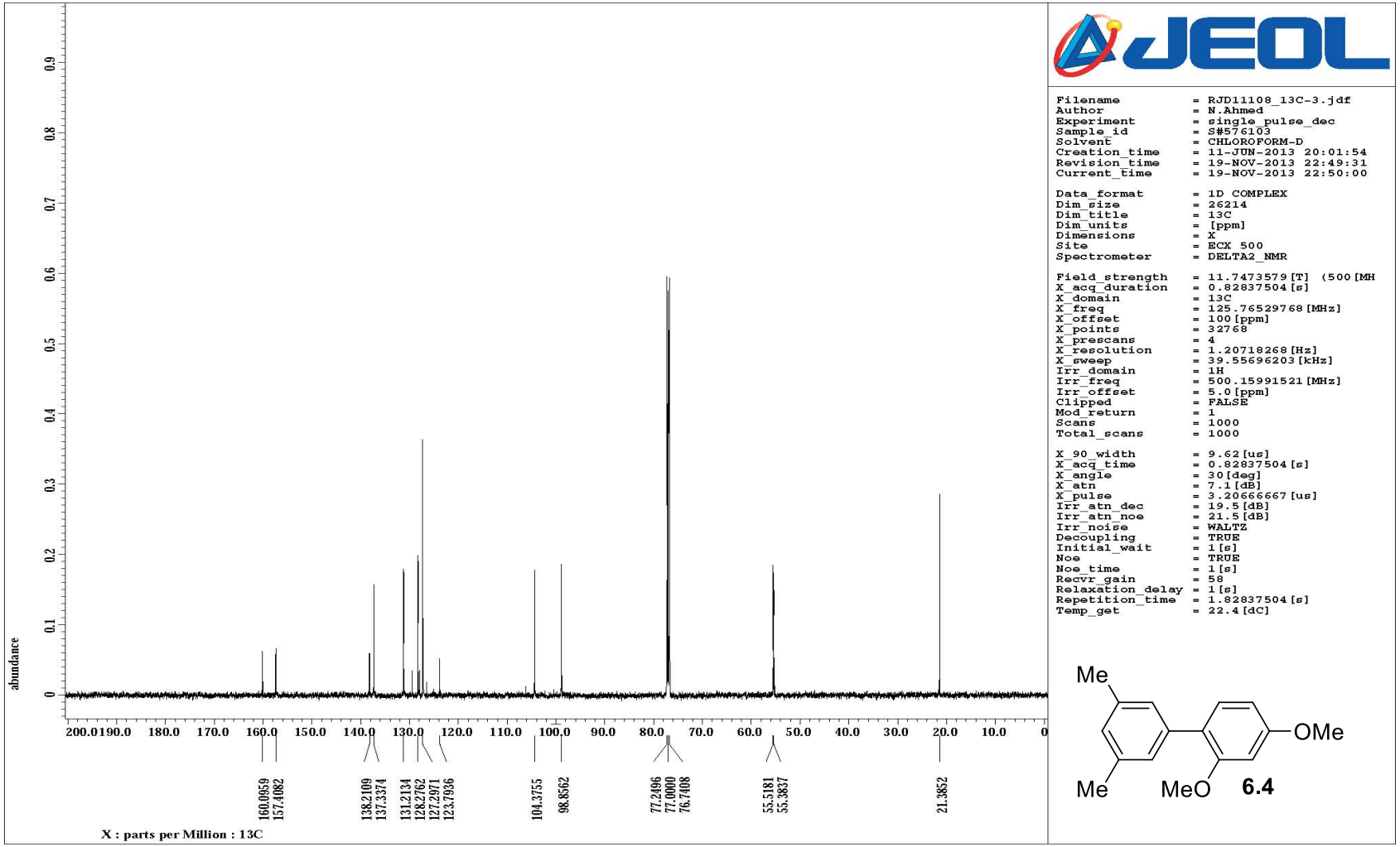
^{13}C NMR spectrum of 2,3',5',6-tetramethylbiphenyl (**6.3**)



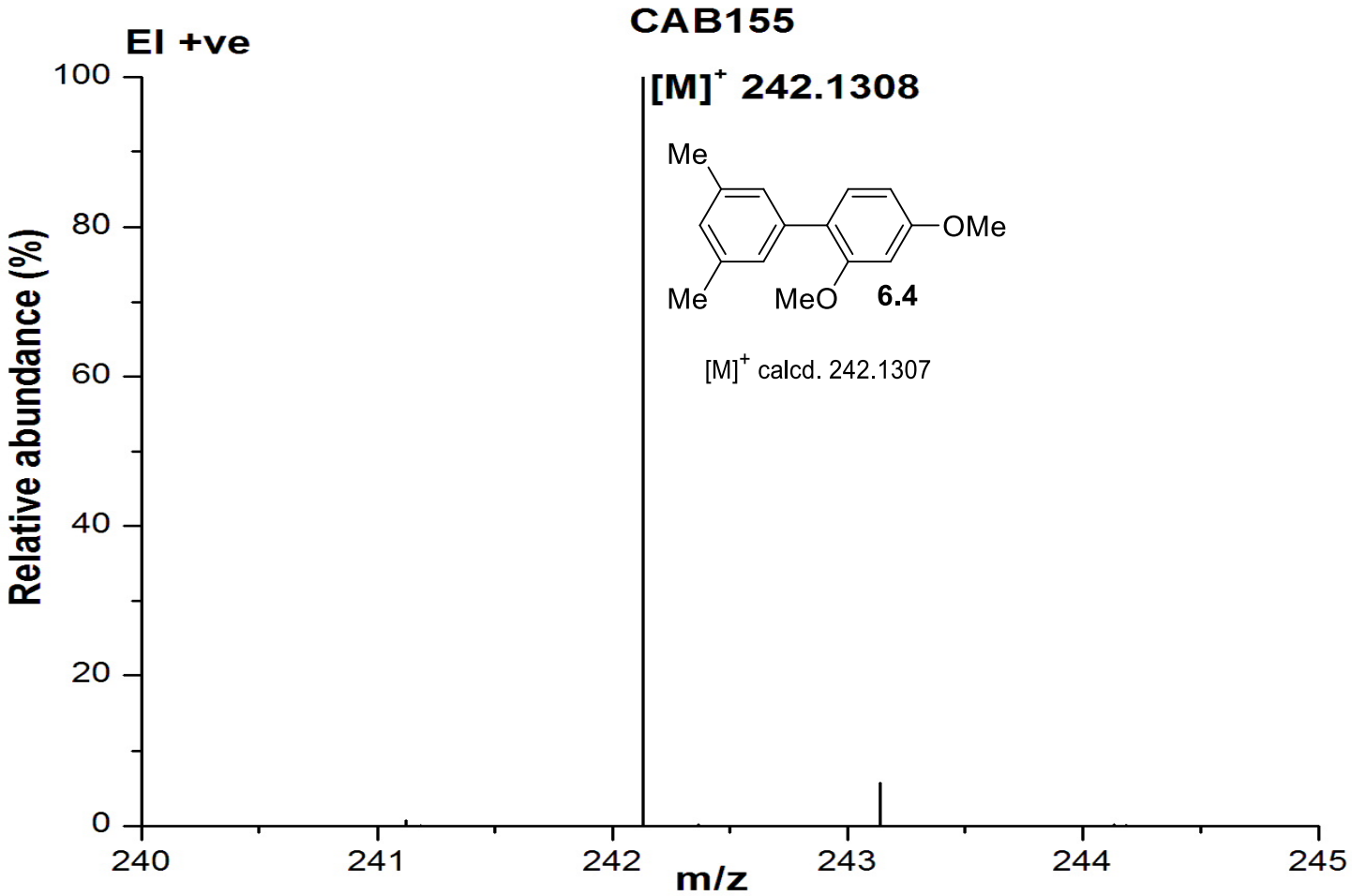
HRMS spectrum of 2,3',5',6-tetramethylbiphenyl (**6.3**)



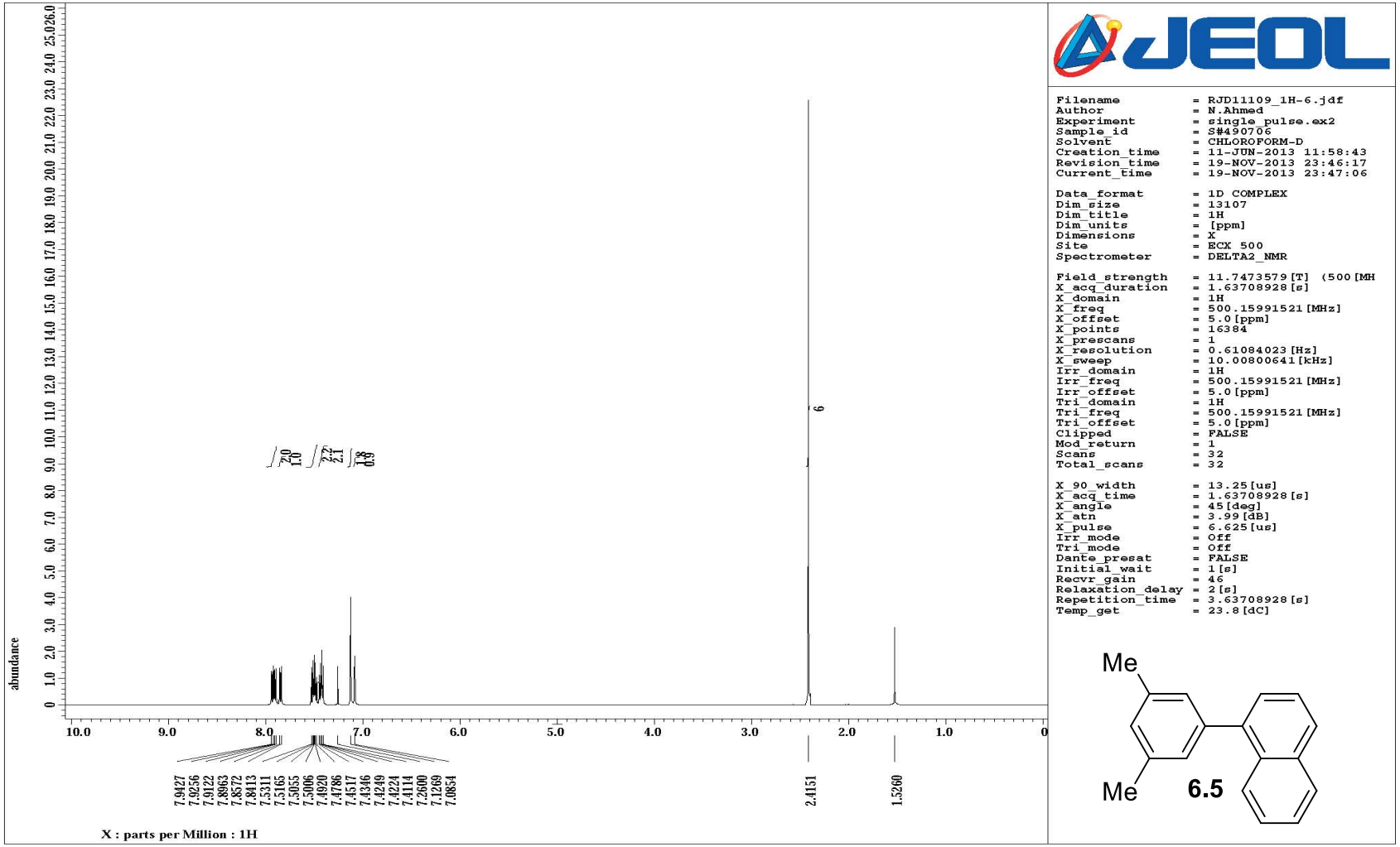
^{1}H NMR spectrum of 2,4-dimethoxy-3',5'-dimethylbiphenyl (**6.4**)



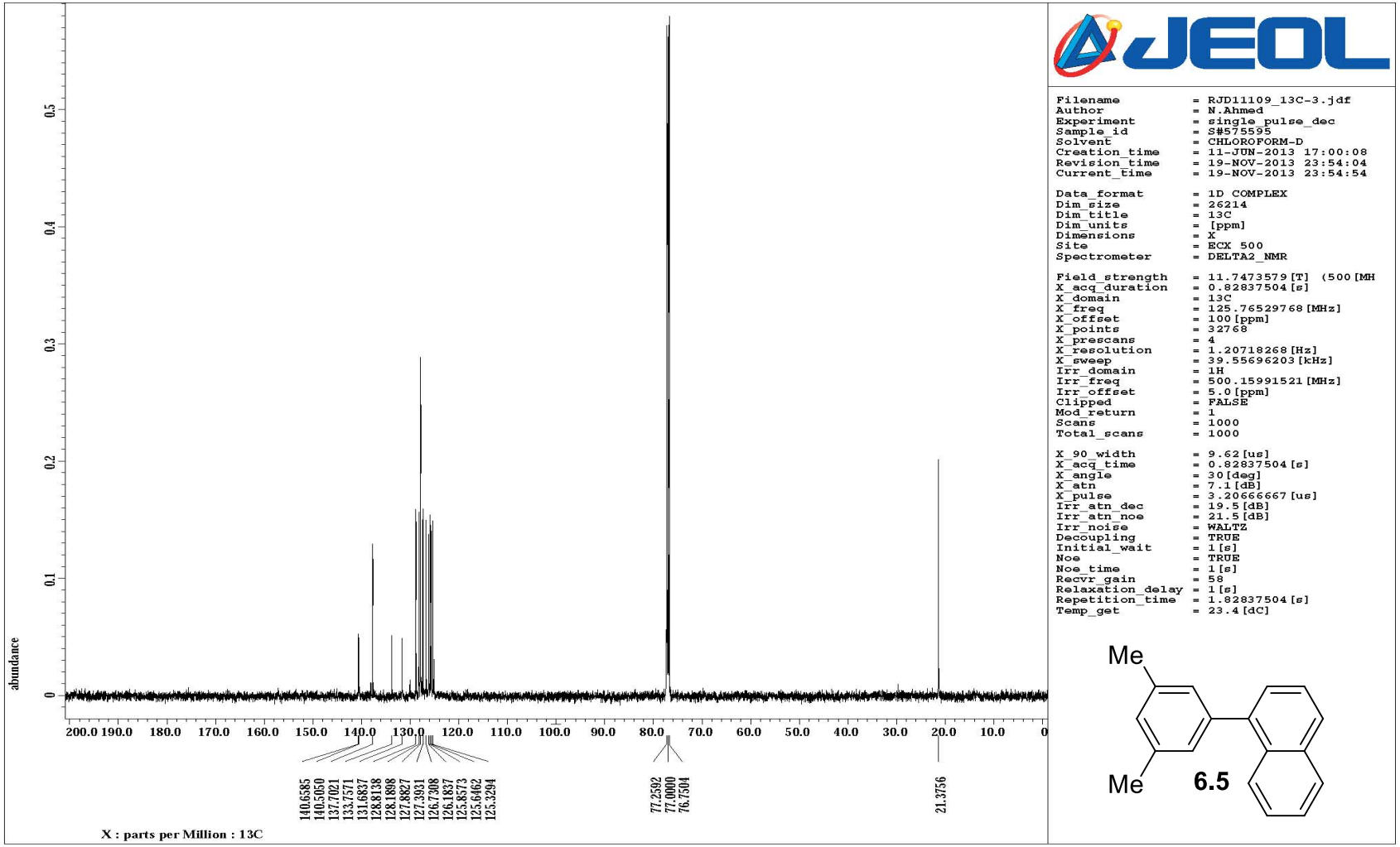
^{13}C NMR spectrum of 2,4-dimethoxy-3',5'-dimethylbiphenyl (**6.4**)



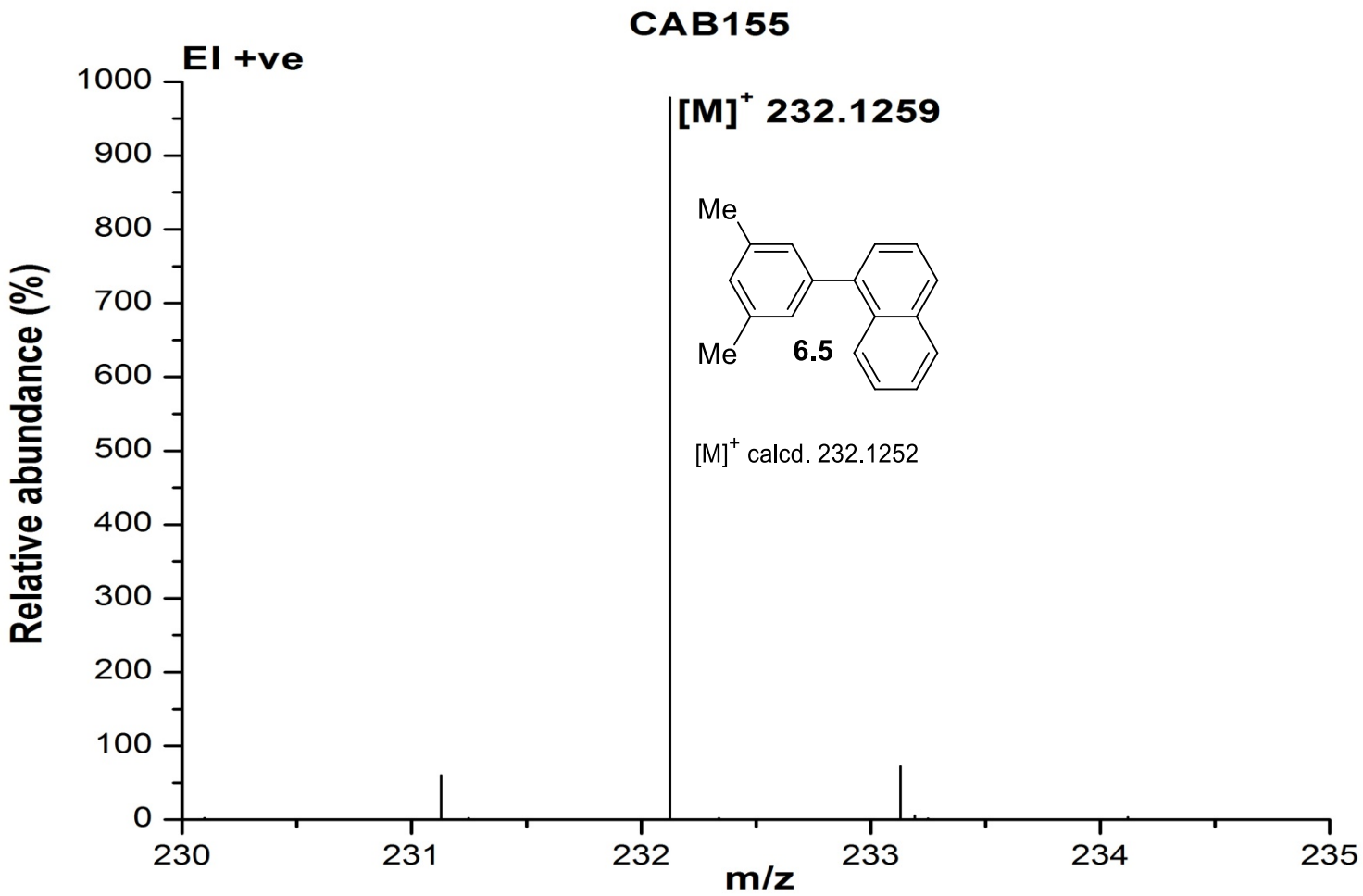
HRMS spectrum of 2,4-dimethoxy-3',5'-dimethylbiphenyl (**6.4**)



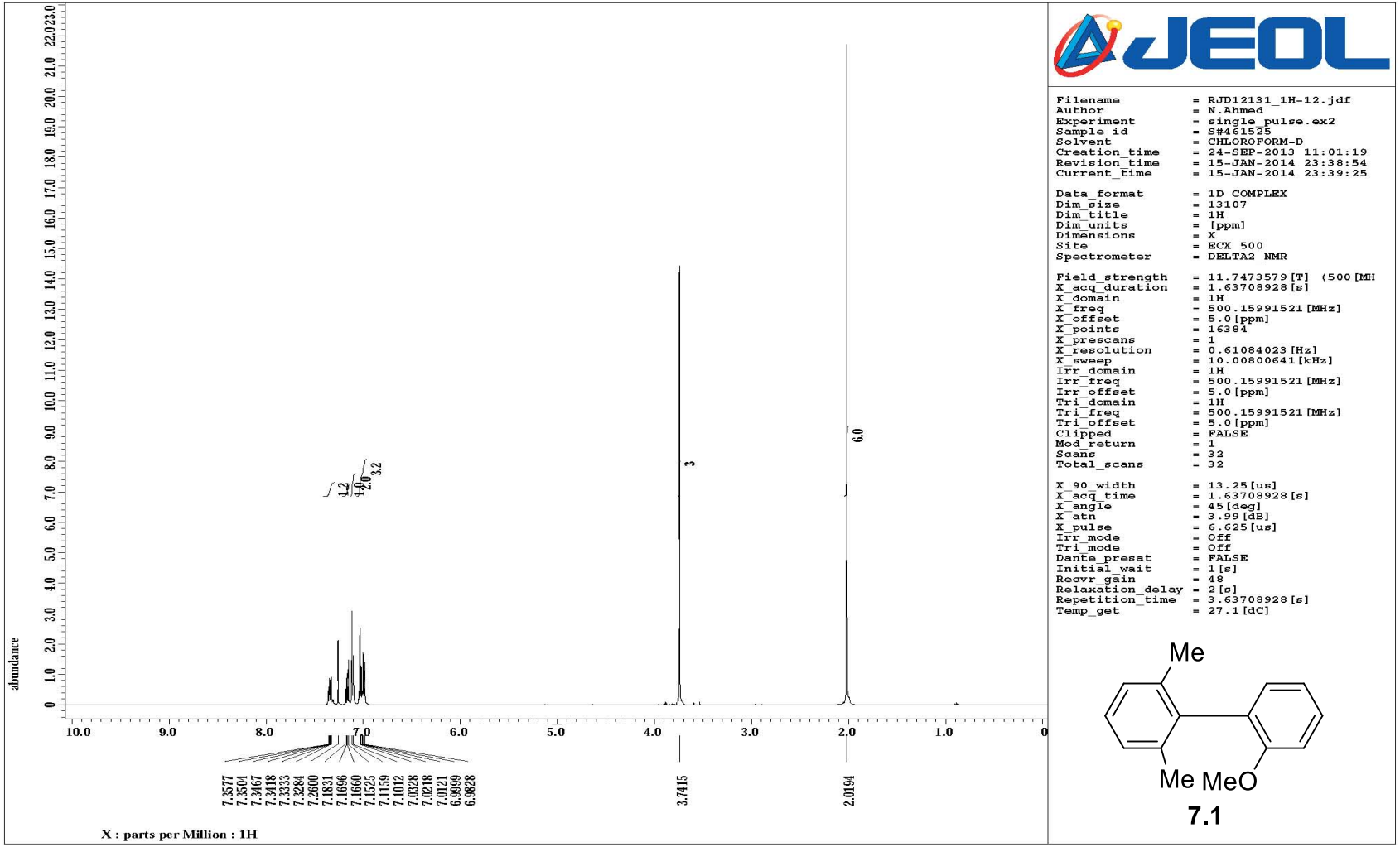
^{1}H NMR spectrum of 1-(3,5-dimethylphenyl)naphthalene (**6.5**)



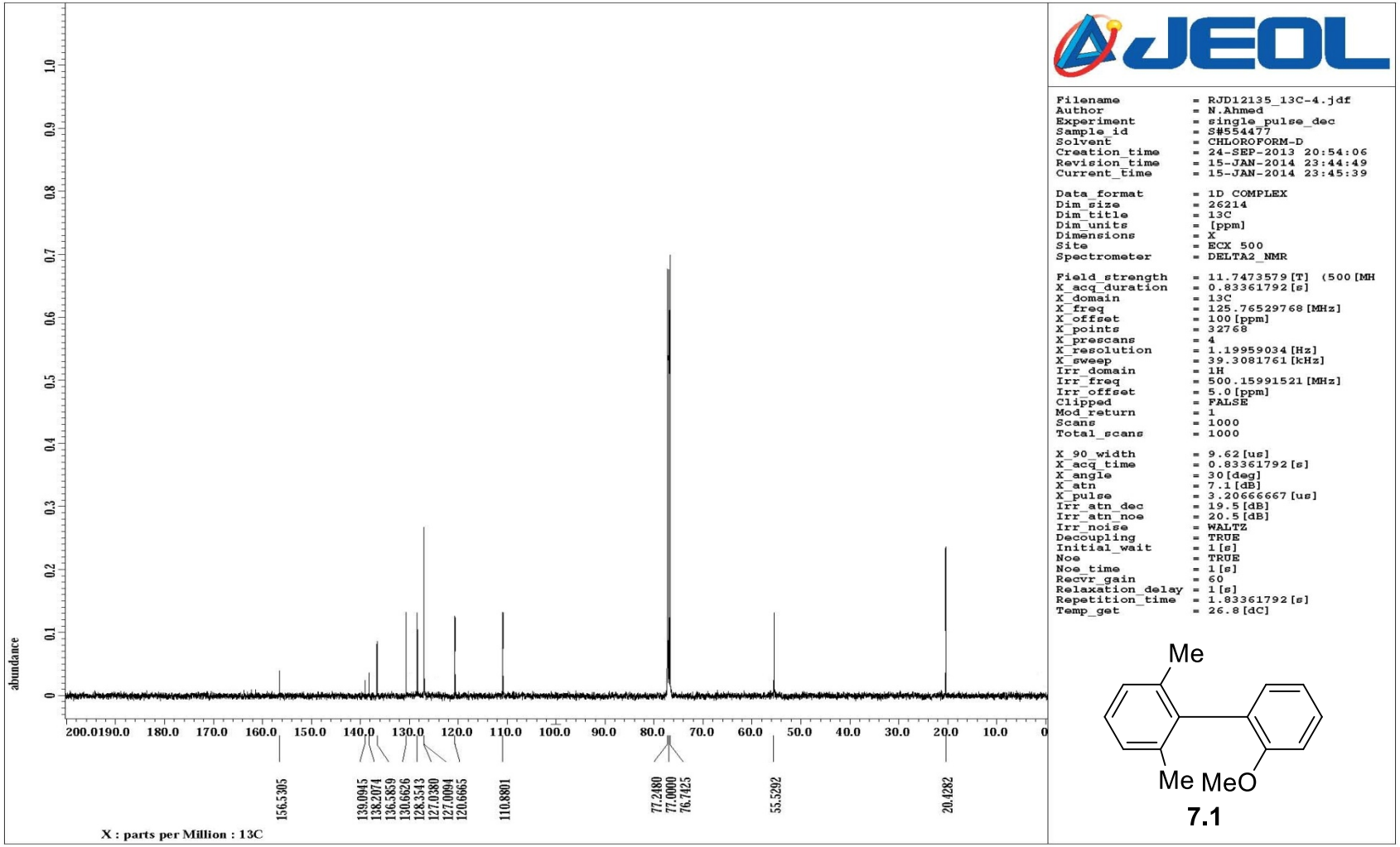
^{13}C NMR spectrum of 1-(3,5-dimethylphenyl)naphthalene (**6.5**)



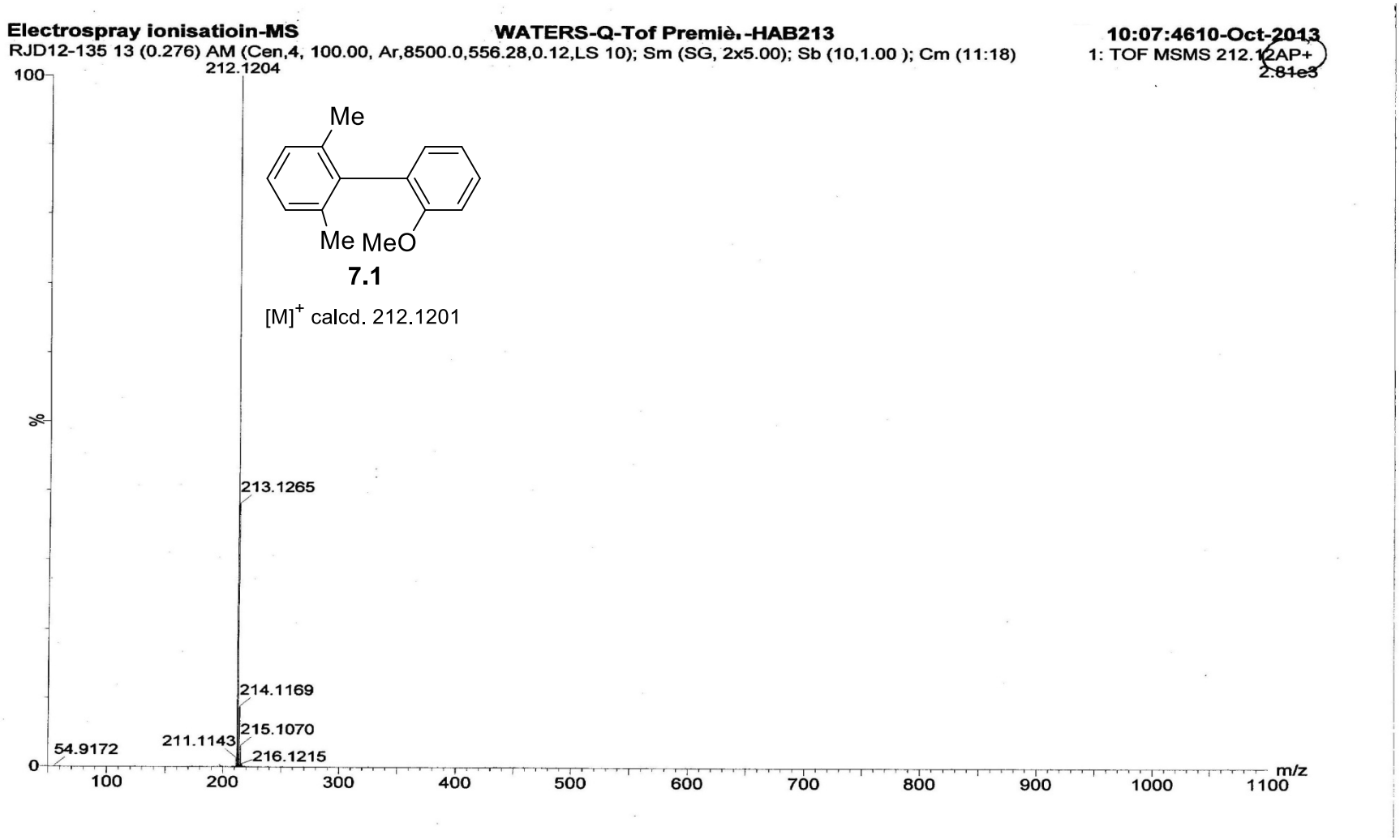
HRMS spectrum of 1-(3,5-dimethylphenyl)naphthalene (**6.5**)



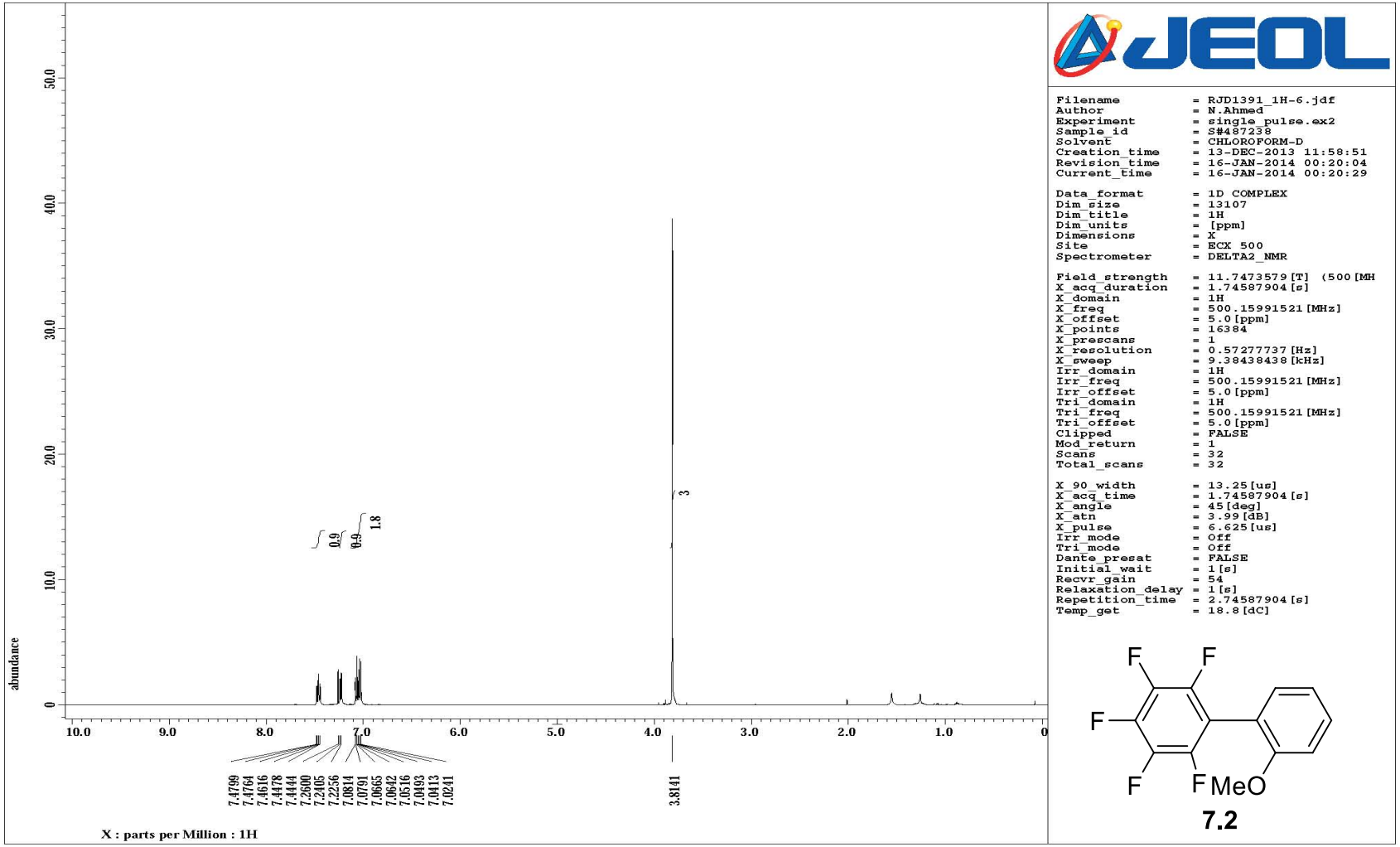
^{1}H NMR spectrum of 2'-methoxy-2,6-dimethylbiphenyl (**7.1**)



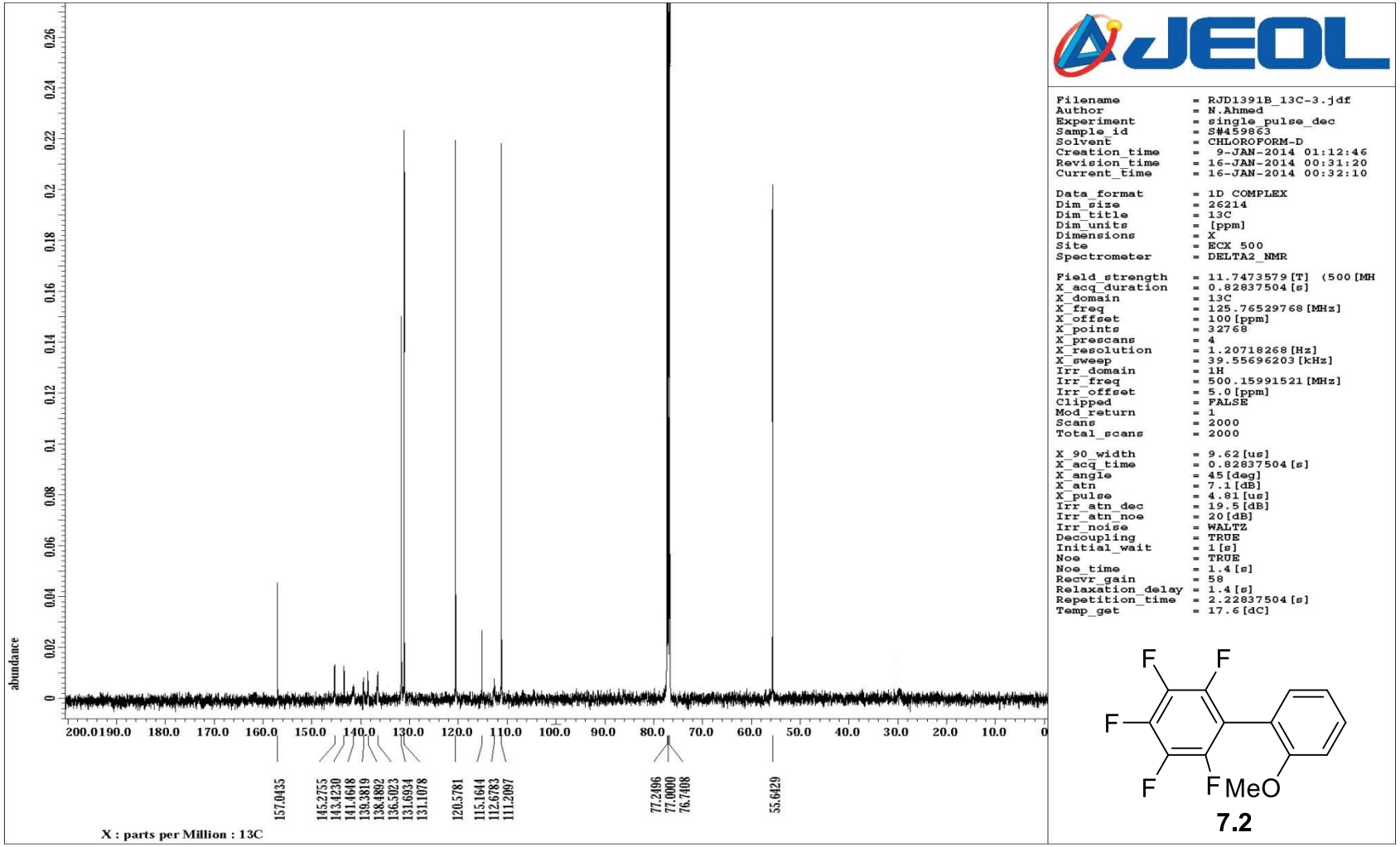
^{13}C NMR spectrum of 2'-methoxy-2,6-dimethylbiphenyl (**7.1**)



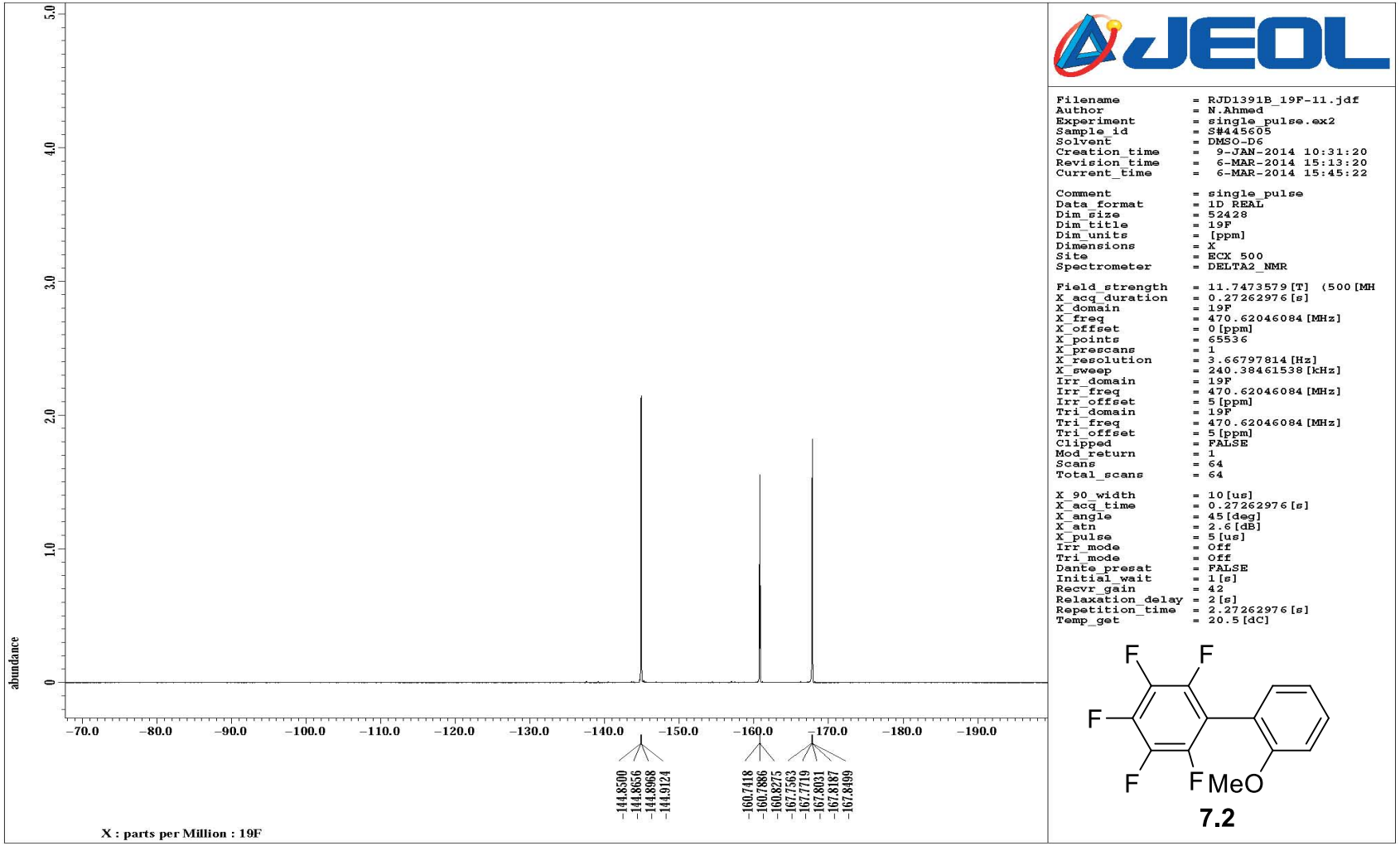
HRMS spectrum of 2'-methoxy-2,6-dimethylbiphenyl (**7.1**)



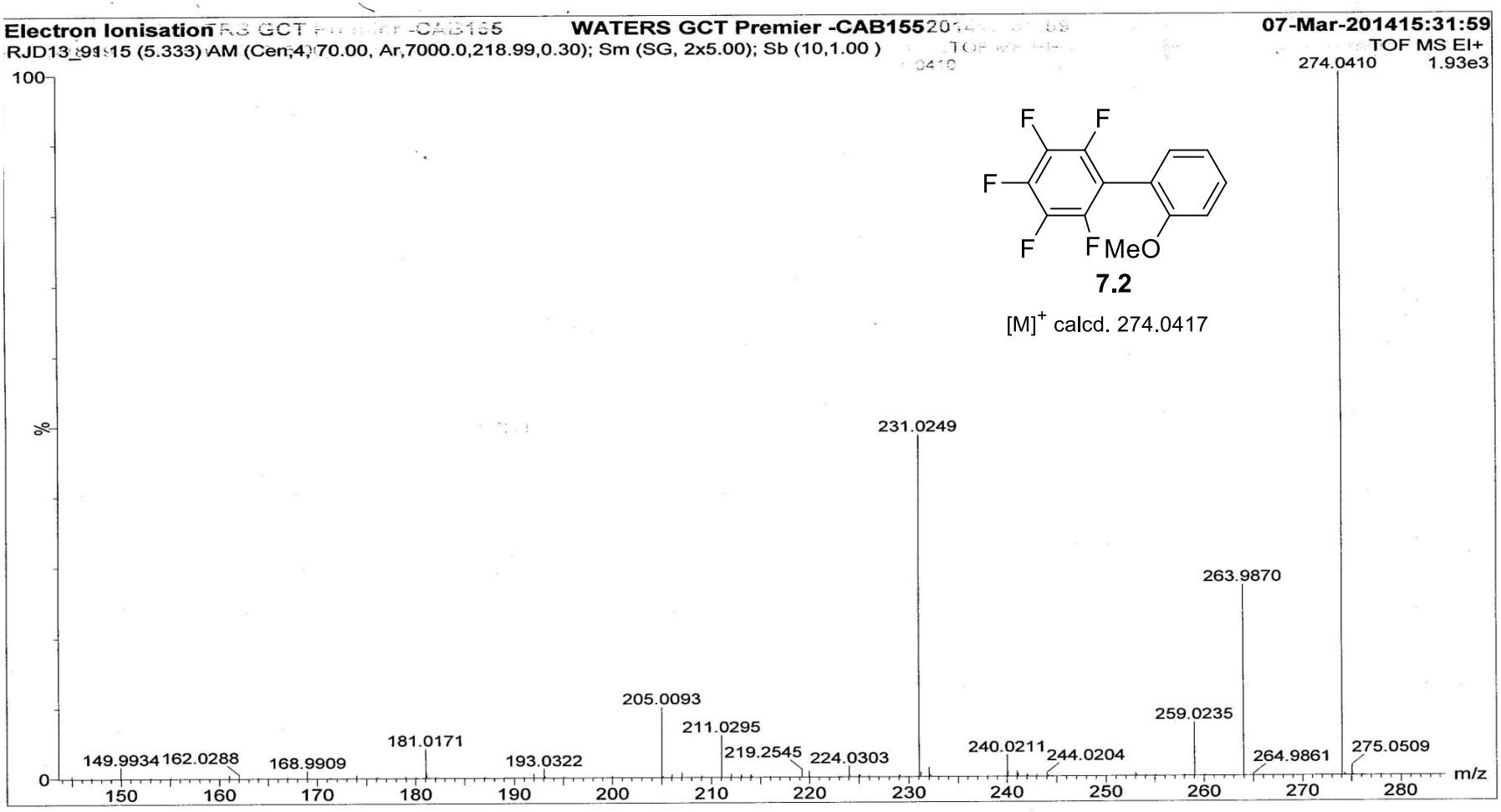
^{1}H NMR spectrum of 2,3,4,5,6-pentafluoro-2'-methoxybiphenyl (**7.2**)



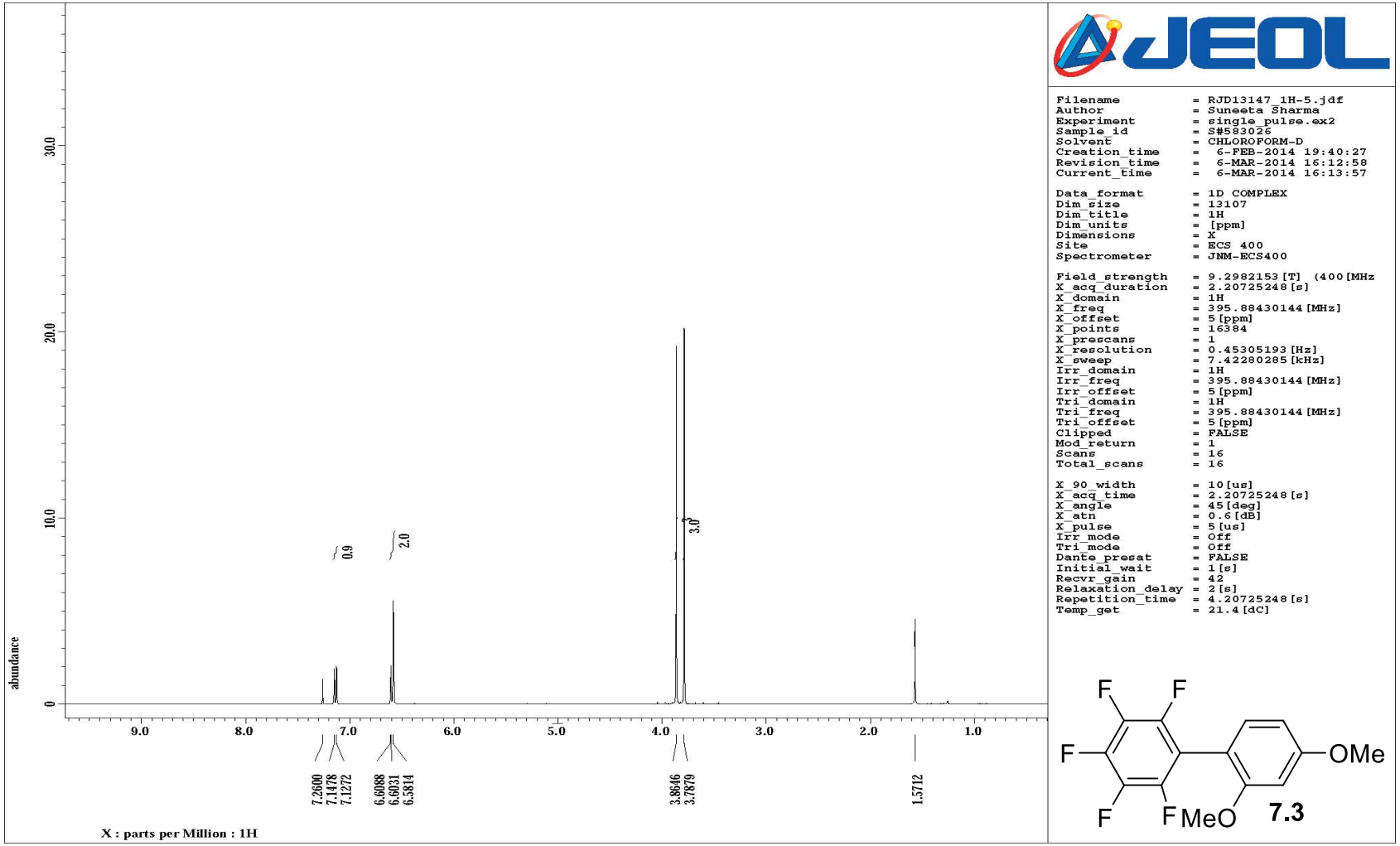
^{13}C NMR spectrum of 2,3,4,5,6-pentafluoro-2'-methoxybiphenyl (**7.2**)



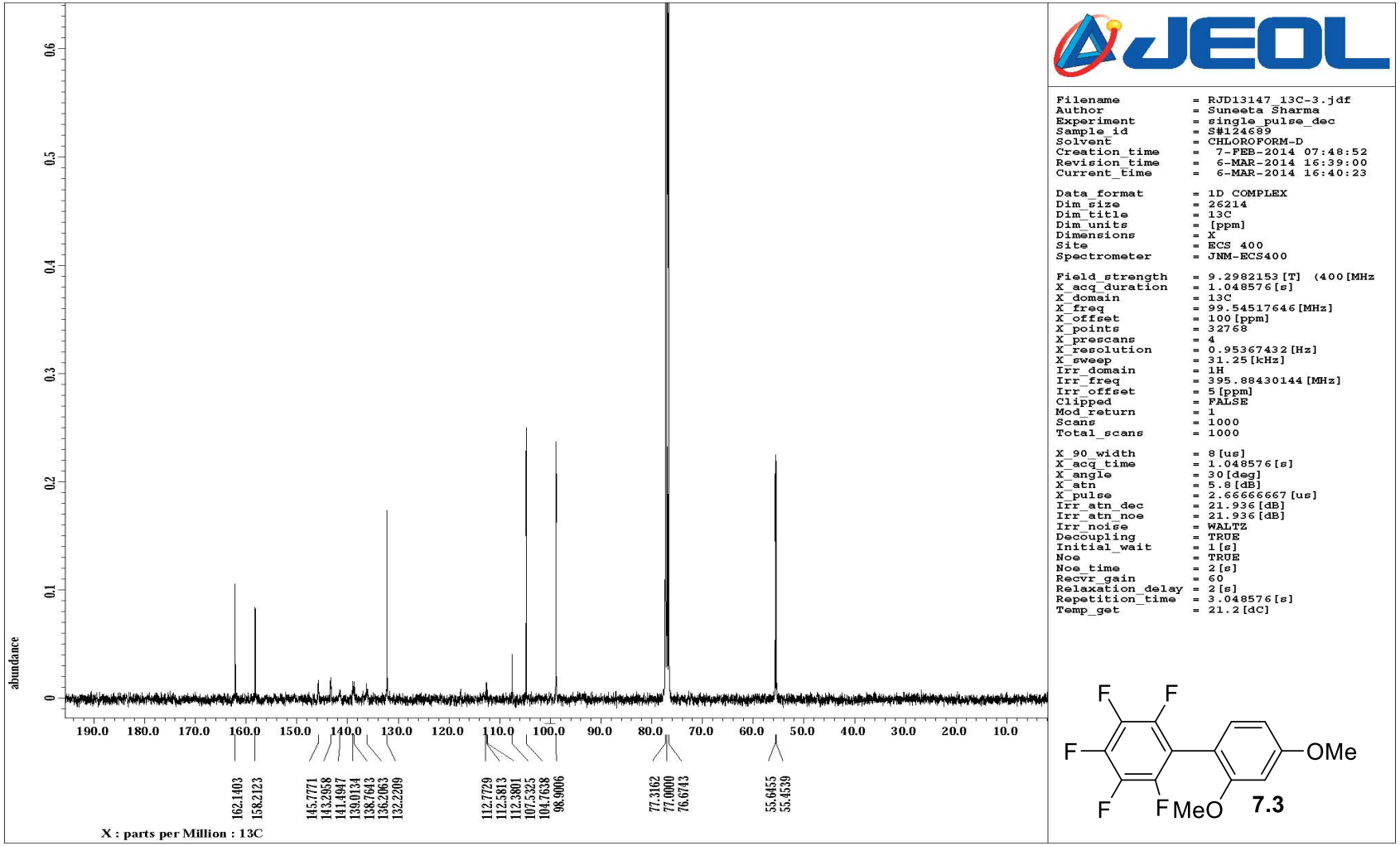
^{19}F NMR spectrum of 2,3,4,5,6-pentafluoro-2'-methoxybiphenyl (**7.2**)



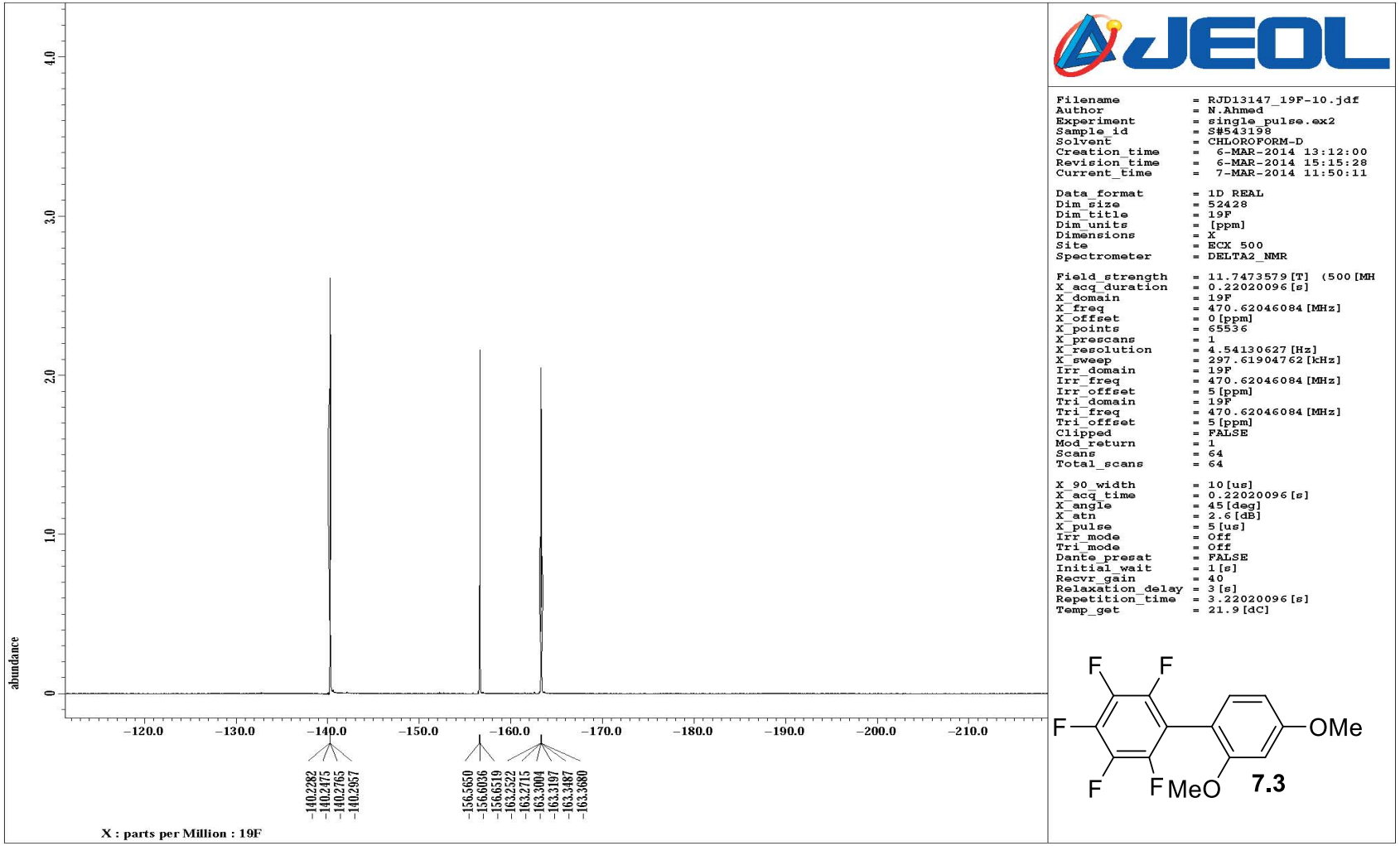
HRMS spectrum of 2,3,4,5,6-pentafluoro-2'-methoxybiphenyl (**7.2**)



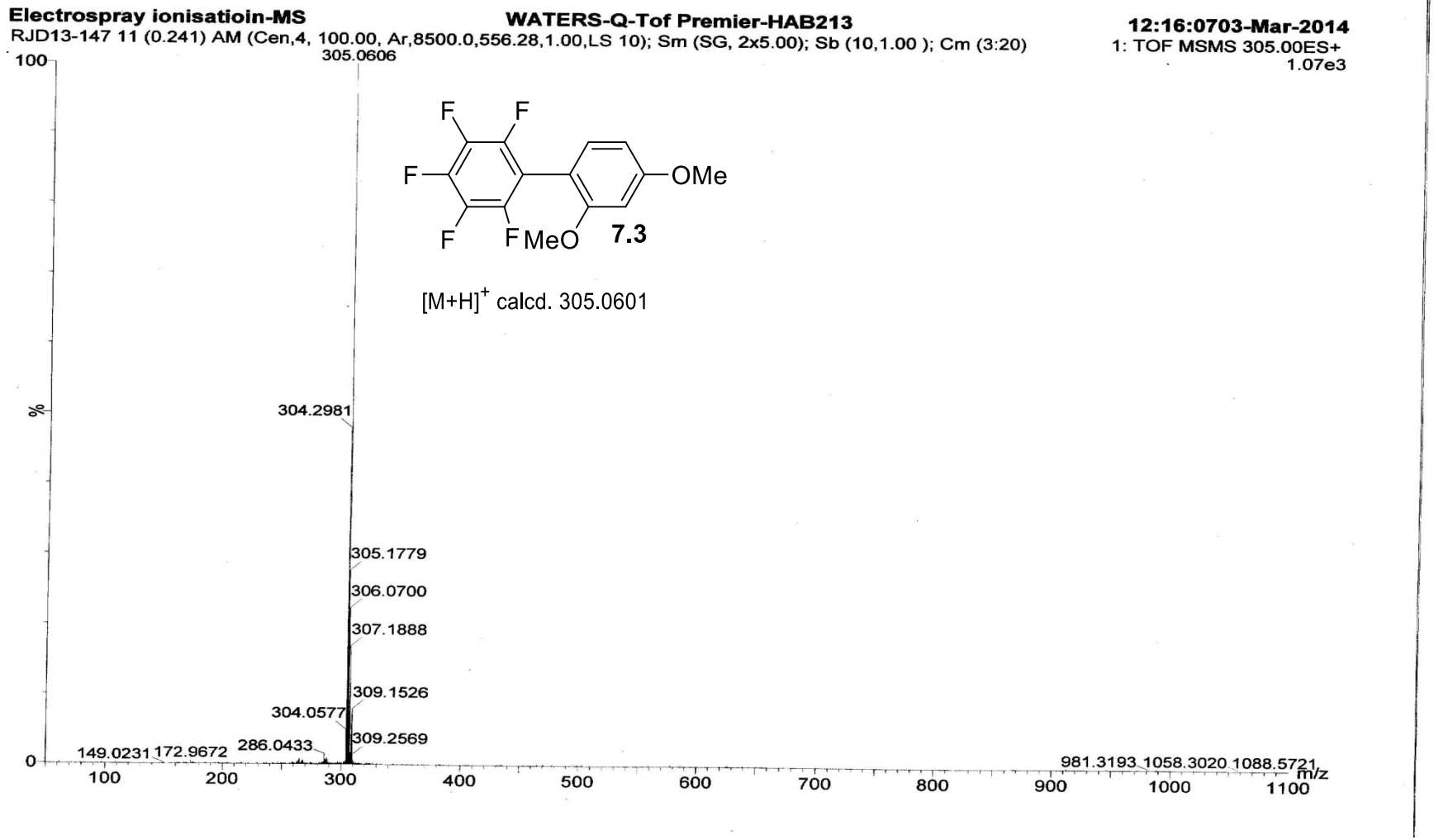
^{1}H NMR spectrum of 2,3,4,5,6-pentafluoro-2',4'-dimethoxybiphenyl (**7.3**)



^{13}C NMR spectrum of 2,3,4,5,6-pentafluoro-2',4'-dimethoxybiphenyl (**7.3**)



^{19}F NMR spectrum of 2,3,4,5,6-pentafluoro-2',4'-dimethoxybiphenyl (**8.3**)



HRMS spectrum of 2,3,4,5,6-pentafluoro-2',4'-dimethoxybiphenyl (**7.3**)