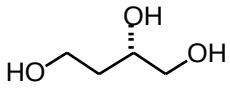
The First Total Synthesis of (–)- and (+)-2-Hydroxy-24-oxooctacosanolide Using an Effective Lactonization

Isamu Shiina,* Takaaki Kikuchi and Akane Sasaki

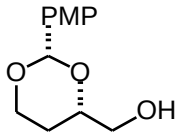
Department of Applied Chemistry, Faculty of Science, Tokyo University of Science, Kagurazaka, Shinjuku-ku, Tokyo 162-8601, Japan

Supporting Information

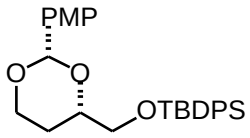
General Information. All reactions were carried out under argon atmosphere in dried glassware, unless otherwise noted. Dichloromethane was distilled from diphosphorus pentoxide, then calcium hydride, and dried over MS 4Å, benzene, toluene and DMF were distilled from diphosphorus pentoxide, and dried over MS 4 Å, and THF was distilled from sodium/benzophenone immediately prior to use. All reagents were purchased from Tokyo Kasei Kogyo Co., Ltd., Kanto Chemical Co., Inc. or Aldrich Chemical Co., Inc., and used without further purification unless otherwise noted.
Column chromatography was performed on Silica gel 60 (Merck) or Wakogel B5F. Thin layer chromatography was performed on Wakogel B5F. ^{1}H and ^{13}C NMR spectra were recorded with tetramethylsilane (TMS), chloroform (in chloroform-*d*) or benzene (in benzene-d_6) as internal standard.



(*S*)-(–)-1,2,4-Butanetriol:[1] To a solution of borane-dimethylsulfide complex (11.4 mL, 120 mmol) at 0 °C was added trimethylborate (12.5 mL, 110 mmol) and THF (25 mL). The reaction mixture was stirred for 15 min at 0 °C and then (*S*)-malic acid (**6**) 5.00 g, 37.3 mmol) was added. After the reaction mixture had been stirred for 23 h at room temperature, methanol was added at 0 °C. The solvent was removed by evaporation and then the residue was filtered through a short pad of silica gel eluting with dichloromethane/methanol=4/1. The filtrate was concentrated, and the residue was filtered again through a short pad of absorbent cotton eluting with dichloromethane/methanol=9/1. Evaporation of the solvent gave (*S*)-(–)-1,2,4-butanetriol (3.84 g, 97%) as a colorless oil. The crude product was instantly used in the following reaction without further purification.

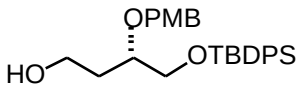


(2*S*)-2,4-[(*S*)-*p*-Methoxybenzylidenedioxy]butanol:[1] To a solution of (*S*)-(–)-1,2,4-butanetriol (3.64 g, 34.3 mmol) and *p*-methoxybenzaldehyde dimethylacetal (11.6 mL, 68.1 mmol) in dichloromethane (36.4 mL) at room temperature was added CSA (799 mg, 3.44 mmol). After the reaction mixture had been stirred for 19 h at room temperature, triethylamine was added. The mixture was concentrated by evaporation of the solvent and then the crude product was purified by column chromatography (eluant; hexane/ethyl acetate=1/1) to afford (2*S*)-2,4-[(*S*)-*p*-methoxybenzylidenedioxy]butanol (6.25 g, 81%) as a colorless oil: ^{1}H NMR (C_6D_6): δ 7.56 (ddd, *J* = 9.0, 3.0, 2.5 Hz, 2H, PMP), 6.82 (ddd, *J* = 9.0, 3.0, 2.5 Hz, 2H, PMP), 5.32 (s, 1H, CHPMP), 3.94 (ddd, *J* = 12.0, 5.0, 1.0 Hz, 1H, 4-H), 3.58 (dddd, *J* = 12.5, 6.0, 4.0, 2.5 Hz, 1H, 2-H), 3.49 (ddd, *J* = 12.0, 11.5, 3.0 Hz, 1H, 4-H), 3.48 (dd, *J* = 11.5, 6.0 Hz, 1H, 1-H), 3.44 (dd, *J* = 11.5, 4.0 Hz, 1H, 1-H), 3.29 (s, 3H, OMe), 2.21 (br s, 1H, OH), 1.62 (dddd, *J* = 13.0, 12.5, 11.5, 5.0 Hz, 1H, 3-H), 0.85 (dddd, *J* = 13.0, 3.0, 2.5, 1.0 Hz, 1H, 3-H); HR MS (ESI TOF): calcd for $C_{12}H_{16}O_4Na$ (M + Na^+) 247.0941, found 247.0941.



7

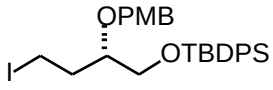
(2*S*)-1-(*t*-Butyldiphenylsiloxy)-2,4-[(*S*)-*p*-methoxybenzylidenedioxy]butane (7):[1] To a solution of imidazole (555 mg, 8.15 mmol) and *t*-butylchlorodiphenylsilane (1.03 mL, 4.01 mmol) in DMF (6.68 mL) at 0 °C was added (2*S*)-2,4-[(*S*)-*p*-methoxybenzylidenedioxy]butanol (754.6 mg, 3.36 mmol) in DMF (6.68 mL). The reaction mixture was stirred for 1.5 h at room temperature and then water was added at 0 °C. The mixture was extracted with ethyl acetate, and the organic layer was washed with water and brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by column chromatography on Silica gel 60N [spherical, neutral, Kanto Chem. Co., Inc.] (eluant; hexane/ethyl acetate=10/1) to afford TBDPS ether **7** (1.29 g, 83%) as a colorless oil: ^{1}H NMR (C_6D_6): δ 7.84-7.80 (m, 4H, TBDPS), 7.68 (ddd, *J* = 9.0, 3.2, 2.1 Hz, 2H, PMP), 7.24-7.19 (m, 6H, TBDPS), 6.82 (ddd, *J* = 9.0, 3.2, 2.1 Hz, 2H, PMP), 5.39 (s, 1H, CHPMP), 3.98 (ddd, *J* = 11.4, 5.4, 1.2 Hz, 1H, 4-H), 3.86 (dd, *J* = 9.9, 5.4 Hz, 1H, 1-H), 3.78 (dddd, *J* = 12.0, 5.4, 4.8, 2.1 Hz, 1H, 2-H), 3.68 (dd, *J* = 9.9, 4.8 Hz, 1H, 1-H), 3.52 (ddd, *J* = 11.4, 11.1, 2.7 Hz, 1H, 4-H), 3.26 (s, 3H, OMe), 1.70 (dddd, *J* = 12.3, 12.0, 11.1, 5.4 Hz, 1H, 3-H), 1.18 (s, 9H, TBDPS), 1.13 (dddd, *J* = 12.3, 2.7, 2.1, 1.2 Hz, 1H, 3-H); HR MS (ESI TOF): calcd for $C_{28}H_{34}O_4SiNa$ (M + Na^+) 485.2119, found 485.2124.



8

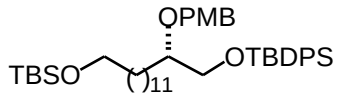
(3*S*)-4-(*t*-Butyldiphenylsiloxy)-3-(*p*-methoxybenzyloxy)butanol (8):[1] To a solution of *p*-methoxybenzylidene acetal **7** (7.05 g, 15.2 mmol) in dichloromethane (75.7 mL) at -78 °C was added DIBAL in dichloromethane (1.0 M, 75.7 mL, 75.7 mmol). After the reaction mixture had been stirred for 4.5 h at -78 °C, methanol was added. The mixture was allowed to warm to room temperature and then saturated aqueous potassium sodium tartrate was added. The mixture was extracted with dichloromethane, and the organic layer was washed with brine, dried over sodium sulfate. After evaporation of the solvent, the crude product was purified by column chromatography (eluant; hexane/ethyl acetate=2/1) to afford alcohol **8** (6.46 g, 92%) as a colorless oil: $[\alpha]_D^{23}$ = –30.4 (c 1.03, benzene); IR (neat): 3436 cm^{-1}; ^{1}H NMR ($CDCl_3$): δ 7.71-7.66 (m, 4H, TBDPS), 7.48-7.36 (m, 6H, TBDPS), 7.23 (d, *J* = 8.4 Hz, 2H, PMP), 6.88 = (d, *J* = 8.6 Hz, 2H, PMP), 4.66 (d, *J* = 11.3 Hz, 1H, PMB), 4.44 (d, *J* = 11.3 Hz, 1H, PMB), 3.80 (s, 3H, OMe), 3.78-3.65 (m, 5H, 1-H, 3-H, 4-H), 2.41 (br s, 1H, OH), 1.92-1.71 (m, 2H, 2-H), 1.08 (s, 9H, TBDPS); ^{13}C NMR ($CDCl_3$): δ 159.2 (PMP), 135.6 (Ar), 135.6 (Ar), 133.3 (Ar), 133.2 (Ar), 130.4 (Ar), 129.8 (Ar), 129.5 (Ar), 129.4 (Ar), 127.7 (Ar), 127.7 (Ar), 113.8 (PMP), 78.4 (3),

71.8 (PMB), 65.9 (4), 60.5 (1), 55.3 (OMe), 34.1 (2), 26.8 (TBDPS), 19.2 (TBDPS); HR MS (ESI TOF): calcd for $C_{28}H_{36}O_4SiNa$ (M + Na^+) 487.2275, found 487.2293.



9

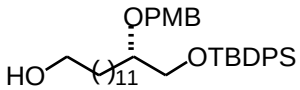
(2*S*)-1-(*t*-Butyldiphenylsiloxy)-4-iodo-2-(*p*-methoxybenzyloxy)butane (9): To a solution of alcohol **8** (5.56 g, 12.0 mmol), imidazole (2.05 g, 30.1 mmol) and triphenylphosphine (7.88 g, 30.1 mmol) in benzene (60 mL) at 0 °C was added iodine (6.07 g, 24.0 mmol). The reaction mixture was stirred for 5 h at room temperature and then saturated aqueous sodium thiosulfate was added. The mixture was extracted with diethyl ether and the organic layer was washed with water and brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by column chromatography (eluant; hexane/ethyl acetate=20/1) to afford iodide **9** (6.66 g, 96%) as a colorless oil: $[\alpha]_D^{21}$ = –10.0 (c 0.313, benzene); IR (neat): 3071, 2928, 2855 cm^{-1}; ^1H NMR ($CDCl_3$): δ 7.68-7.63 (m, 4H, TBDPS), 7.46-7.34 (m, 6H, TBDPS), 7.25-7.23 (m, 2H, PMP), 6.87-6.84 (m, 2H, PMP), 4.57 (d, *J* = 9.7 Hz, 1H, PMB), 4.39 (d, *J* = 9.7 Hz, 1H, PMB), 3.86-3.75 (m, 1H, 1-H), 3.81 (s, 3H, OMe), 3.79-3.54 (m, 1H, 2-H), 3.72 (dd, *J* = 9.3, 4.6 Hz, 1H, 1-H), 3.35 (dd, *J* = 9.5, 4.9 Hz, 1H, 4-H), 3.31 (dd, *J* = 7.7, 3.9 Hz, 1H, 4-H), 1.96-1.71 (m, 2H, 3-H), 1.05 (s, 9H, TBDPS); ^{13}C NMR ($CDCl_3$): δ 159.2 (PMP), 135.6 (Ar), 135.6 (Ar), 133.3 (Ar), 133.3 (Ar), 130.6 (Ar), 129.7 (Ar), 129.5 (Ar), 129.4 (Ar), 127.7 (Ar), 127.7 (Ar), 113.8 (PMP), 78.4 (2), 71.8 (PMB), 65.9 (1), 55.3 (OMe), 34.1 (3), 26.8 (TBDPS), 19.2 (TBDPS), 3.34 (4); HR MS (FAB): calcd for $C_{28}H_{35}O_3ISi$ (M + H^+) 574.1400, found 574.1298.



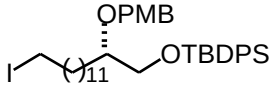
10

(2*S*)-14-(*t*-Butyldimethylsiloxy)-1-(t-butyldiphenylsiloxy)-2-(*p*-methoxybenzyloxy)tetradecane (10): To a solution of cuprous(I) iodide (3.42 mg, 18.0 μmol) and 2,2'-bipyridyl (2.81 mg, 18.0 μmol) in THF (1 mL) at room temperature was added iodide **9** (100 mg, 17.9 mmol) in THF (5 mL). After the reaction mixture had been stirred for 5 min at room temperature, a solution of Grignard reagent **A** (0.90 M, 0.70 mL, 0.63 mmol) was added at -20 °C. The reaction mixture was stirred for 1 h at room temperature and then saturated aqueous ammonium chloride was added. The mixture was extracted with diethyl ether, and the organic layer was washed with brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by thin layer chromatography (eluant;

hexane/ethyl acetate=20/1) to afford 14-carbons unit **10** (116.1 mg, 90%) as a colorless oil: $[\alpha]_D^{23}$ = –14.5 (c 0.800, benzene); IR (neat): 3071, 2928, 2855 cm^{-1}; ^1H NMR ($CDCl_3$): δ 7.70-7.67 (m, 4H, TBDPS), 7.45-7.34 (m, 6H, TBDPS), 7.23 (d, *J* = 8.9 Hz, 2H, PMP), 6.85 (d, *J* = 8.9 Hz, 2H, PMP), 4.60 (d, *J* = 11.3 Hz, 1H, PMB), 4.44 (d, *J* = 11.1 Hz, 1H, PMB), 3.80 (s, 3H, OMe), 3.73 (dd, *J* = 10.5, 5.7 Hz, 1H, 1-H), 3.65-3.53 (m, 1H, 1-H), 3.60 (t, *J* = 4.1 Hz, 2H, 14-H), 3.50-3.42 (m, 1H, 2-H), 1.56-1.48 (m, 5H), 1.39-1.12 (m, 17H), 1.06 (s, TBDPS, 9H), 0.90 (s, 9H, TBS), 0.05 (s, 6H, TBS); ^{13}C NMR ($CDCl_3$): δ 160.9 (PMP), 135.6 (Ar), 133.7 (Ar), 131.0 (Ar), 129.6 (Ar), 129.3 (Ar), 127.6 (Ar), 113.7 (PMP), 79.5 (2), 71.8 (PMB), 66.0 (1), 63.4 (14), 55.3 (OMe), 32.9 (13), 31.7 (3), [29.6 and 29.5] (5 to 11), 26.8 (TBDPS), 26.0 (TBS), 25.8 (12), 25.3 (4), 19.5 (TBDPS), 18.4 (TBS), -5.3 (TBS); HR MS (FAB): calcd for $C_{44}H_{70}O_4Si_2$ ($M + H^+$) 718.4813, found 718.4709.

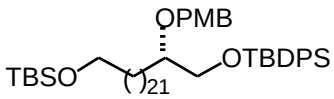


(13*S*)-14-(*t*-Butyldiphenylsiloxy)-13-(*p*-methoxybenzyloxy)tetradecanol:
To a solution of silyl ether **10** (868 mg, 1.21 mmol) in THF (120 mL) at 0 °C was added 1 M hydrochloric acid (60 mL). The reaction mixture was stirred for 6 h at room temperature and then saturated aqueous sodium hydrogencarbonate was added at 0 °C. The mixture was extracted with diethyl ether and the organic layer was washed with brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by column chromatography (eluant; hexane/ethyl acetate=3/1) to afford (13*S*)-14-(*t*-butyldiphenylsiloxy)-13-(*p*-methoxybenzyloxy)tetradecanol (710 mg, 96%) as a colorless oil: $[\alpha]_D^{23}$ = –16.5 (c 1.00, benzene); IR (neat): 3374 cm^{-1}; ^1H NMR ($CDCl_3$): δ 7.72-7.64 (m, 4H, TBDPS), 7.40-7.32 (m, 6H, TBDPS), 7.26-7.17 (m, 2H, PMP), 6.87-6.81 (m, 2H, PMP), 4.60 (d, *J* = 11.3 Hz, 1H, PMB), 4.44 (d, *J* = 11.1 Hz, 1H, PMB), 3.80 (s, 3H, OMe), 3.73 (dd, *J* = 10.5, 5.9 Hz, 1H, 1-H), 3.68-3.60 (m, 3H, 1-H, 14-H), 3.53-3.43 (m, 1H, 2-H), 1.66-1.18 (m, 23H), 1.11 (s, 9H, TBDPS); ^{13}C NMR ($CDCl_3$): δ 160.9 (PMP), 135.6 (Ar), 133.7 (Ar), 131.0 (Ar), 129.6 (Ar), 129.3 (Ar), 127.6 (Ar), 113.7 (PMP), 79.5 (2), 71.8 (PMB), 66.0 (1), 63.1 (14), 55.3 (OMe), 32.8 (13), 31.7 (3), [29.7, 29.6 and 29.4] (5 to 11), 26.8 (TBDPS), 25.7 (12), 25.4 (4), 19.4 (TBDPS); HR MS (FAB): calcd for $C_{38}H_{56}O_4Si$ ($M + H^+$) 604.3948, found 604.3848.



11

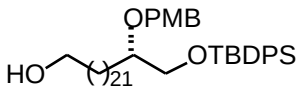
(2*S*)-1-(*t*-Butyldiphenylsiloxy)-14-iodo-2-(*p*-methoxybenzyloxy)tetradecane (11): To a solution of (13*S*)-14-(*t*-butyldiphenylsiloxy)-13-(*p*-methoxybenzyloxy)tetradecanol (710 mg, 1.17 mmol), imidazole (200 mg, 2.93 mmol) and triphenylphosphine (770 mg, 2.93 mmol) in benzene (9.4 mL) at 0 °C was added iodine (595 mg, 2.35 mmol). The reaction mixture was stirred for 30 min at room temperature and then saturated aqueous sodium thiosulfate was added. The mixture was extracted with diethyl ether and the organic layer was washed with water and brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by column chromatography (eluant; hexane/ethyl acetate=30/1) to afford iodide **11** (770 mg, 92%) as a colorless oil: $[\alpha]_D^{21}$ = –6.61 (c 0.947, benzene); IR (neat): 3070, 3048, 2998, 2927, 2854 cm^{-1}; ^1H NMR ($CDCl_3$): δ 7.71-7.63 (m, 4H, TBDPS), 7.46-7.33 (m, 6H, TBDPS), 7.26-7.23 (m, 2H, PMP), 6.88-6.84 (m, 2H, PMP), 4.61 (d, *J* = 11.3 Hz, 1H, PMB), 4.44 (d, *J* = 11.1 Hz, 1H, PMB), 3.80 (s, 3H, OMe), 3.73 (dd, *J* = 10.5, 5.9 Hz, 1H, 1-H), 3.63 (dd, *J* = 10.5, 4.6 Hz, 1H, 1-H), 3.53-3.43 (m, 1H, 2-H), 3.19 (t, *J* = 7.0 Hz, 2H, 14-H), 1.82 (d, t, *J* = 14.3, 7.0 Hz, 2H), 1.60-1.18 (m, 20H), 1.07 (s, 9H, TBS); ^{13}C NMR ($CDCl_3$): δ 160.9 (PMP), 135.6 (Ar), 133.6 (Ar), 131.2 (Ar), 129.6 (Ar), 129.3 (Ar), 127.6 (Ar), 113.6 (PMP), 79.4 (2), 71.8 (PMB), 66.4 (1), 55.3 (OMe), 33.6 (13), 31.6 (3), 30.5 (12), [29.7, 29.6 and 29.4] (5 to 10), 28.5 (11), 26.8 (TBDPS), 25.4 (4), 19.2 (TBDPS), 7.4 (14); HR MS (FAB): calcd for $C_{38}H_{55}O_3Si$ ($M + H^+$) 714.2965, found 714.2864.



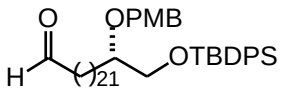
12

(2*S*)-24-(*t*-Butyldimethylsiloxy)-1-(t-butyldiphenylsiloxy)-2-(*p*-methoxybenzyloxy)tetracosane (12): To a solution of cuprous(I) iodide (285 mg, 1.50 mmol) and 2,2'-bipyridyl (235 mg, 1.50 mmol) in THF (1.1 mL) at room temperature was added iodide **11** (3.57 g, 5.00 mmol) in THF (10 mL). After the reaction mixture had been stirred for 5 min at room temperature, a solution of Grignard reagent **A** (0.555 M, 1.84 mL, 10.2 mmol) was added at -17 °C. The reaction mixture was stirred for 1 h at room temperature and then saturated aqueous ammonium chloride was added. The mixture was filtered through a short pad of Celite, and the filtrate was extracted with diethyl ether. The organic layer was washed with brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by thin layer chromatography (eluant; hexane/ethyl acetate=10/1) to afford 24-carbons unit **12** (4.10 g, 96%) as a colorless oil: $[\alpha]_D^{21}$ = –12.1 (c 1.01, benzene); IR (neat): 3071, 3049, 2999, 2926, 2854 cm^{-1}; ^1H NMR ($CDCl_3$): δ 7.72-

7.65 (m, 4H, TBDPS), 7.46-7.35 (m, 6H, TBDPS), 7.26-7.23 (m, 2H, PMP), 6.88-6.84 (m, 2H, PMP), 4.61 (d, *J* = 11.3 Hz, 1H, PMB), 4.45 (d, *J* = 11.3 Hz, 1H, PMB), 3.81 (s, 3H, OMe), 3.74 (dd, *J* = 10.5, 5.9 Hz, 1H, 1-H), 3.63 (dd, *J* = 10.5, 4.6 Hz, 1H, 1-H), 3.61 (t, *J* = 6.8 Hz, 2H, 24-H), 3.54-3.43 (m, 1H, 2-H), 1.63-1.49 (m, 4H), 1.37-1.19 (m, 38H), 1.08 (s, 9H, TBDPS), 0.91 (s, 9H, TBS), 0.06 (s, 6H, TBS); ^{13}C NMR ($CDCl_3$): δ 159.0 (PMP), 135.6 (Ar), 133.6 (Ar), 131.2 (Ar), 129.6 (Ar), 129.3 (Ar), 127.6 (Ar), 113.6 (PMP), 79.4 (2), 71.8 (PMB), 66.3 (1), 63.3 (24), 55.2 (OMe), 32.8 (23), 31.6 (3), [29.7, 29.6 and 29.4] (5 to 21), 26.8 (TBDPS), 26.0 (TBS), 25.8 (22), 25.4 (4), 19.2 (TBDPS), 18.4 (TBS), -5.3 (TBS); HR MS (ESI TOF): calcd for $C_{54}H_{90}O_4Si_2Na$ (M + Na^+) 881.6270, found 881.6249.



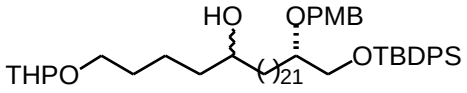
(23*S*)-24-(*t*-Butyldiphenylsiloxy)-23-(*p*-methoxybenzyloxy)tetradecanol: To a solution of silyl ether **12** (254 mg, 0.296 mmol) in THF (30 mL) at 0 °C was added 1 M hydrochloric acid (14.8 mL). The reaction mixture was stirred for 6 h at room temperature and then and then saturated aqueous sodium hydrogencarbonate was added at 0 °C. The mixture was extracted with diethyl ether and the organic layer was washed with brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by thin layer chromatography (eluant; hexane/ethyl acetate=5/1) to afford alcohol (23*S*)-24-(*t*-butyldiphenylsiloxy)-23-(*p*-methoxybenzyloxy)tetradecanol (216 mg, 99%) as a colorless oil: $[\alpha]_D^{27}$ = –9.90 (c 1.03, benzene); IR (neat): 3357 cm^{-1}; ^{1}H NMR ($CDCl_3$): δ 7.75-7.72 (m, 4H), 7.51-7.35 (m, 6H), 7.29-7.26 (m, 2H), 6.90-6.87 (m, 2H), 4.64 (d, *J* = 11.3 Hz, 1H), 4.48 (d, *J* = 11.3 Hz, 1H), 3.82 (s, 3H), 3.81-3.61 (m, 2H, 1-H), 3.65 (t, *J* = 6.6 Hz, 2H, 24-H), 3.56-3.46 (m, 1H, 2-H), 1.65-1.18 (m, 42H), 1.11 (s, 9H); ^{13}C NMR ($CDCl_3$): δ 159.0 (PMP), 135.6 (Ar), 133.6 (Ar), 131.1 (Ar), 129.6 (Ar), 129.3 (Ar), 127.6 (Ar), 113.6 (PMP), 79.4 (2), 71.7 (PMB), 66.3 (1), 63.0 (24), 55.2 (OMe), 32.7 (23), 31.6 (3), [29.7, 29.6 and 29.4] (5 to 21), 26.8 (TBDPS), 25.7 (22), 25.3 (4), 19.2 (TBDPS); HR MS (ESI TOF): calcd for $C_{48}H_{76}O_4SiNa$ (M + Na^+) 767.5405, found 767.5406.



13

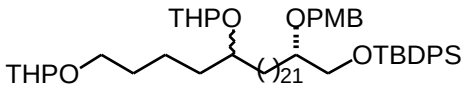
(23*S*)-24-(*t*-Butyldiphenylsiloxy)-23-(*p*-methoxybenzyloxy)tetradecanal (13): To a solution of (23*S*)-24-(*t*-butyldiphenylsiloxy)-23-(*p*-methoxybenzyloxy)tetradecanol (100 mg, 0.134 mmol) in dichloromethane (1.5 mL)

was added PCC (43.3 mg, 0.201 mmol). The reaction mixture was stirred for 22 h at room temperature and then it was diluted with diethyl ether. After filtration of the mixture through a short pad of Celite and evaporation of the solvent, the crude product was purified by thin layer chromatography (eluant; hexane/ethyl acetate=3/1) to afford aldehyde **13** (85.0 mg, 85%) as a colorless oil: $[\alpha]_D^{22}$ = –14.3 (c 1.03, benzene); IR (neat): 1727 cm^{-1}; ^1H NMR ($CDCl_3$): δ 9.76 (s, 1H, CHO), 7.70-7.67 (m, 4H, TBDPS), 7.45-7.34 (m, 6H, TBDPS), 7.23 (d, *J* = 8.7 Hz, 2H, PMP), 6.85 (d, *J* = 9.0 Hz, 2H, PMP), 4.60 (d, *J* = 11.4 Hz, 1H, PMB), 4.44 (d, *J* = 11.4 Hz, 1H), 3.80 (s, 3H, PMB), 3.73 (dd, *J* = 11.9, 5.9 Hz, 1H, 1-H), 3.62 (dd, *J* = 10.8, 4.8 Hz, 1H, 1-H), 3.50-3.44 (m, 1H, 2-H), 2.42 (t, d, *J* = 7.4, 1.8 Hz, 2H, 23-H), 1.65-1.44 (m, 4H, 3-H, 22-H), 1.35-1.18 (m, 38H, 4-H to 21-H), 1.06 (s, 9H, TBDPS); ^{13}C NMR ($CDCl_3$): δ 203.0 (24), 159.0 (PMP), 135.6 (Ar), 133.6 (Ar), 131.2 (Ar), 129.6 (Ar), 129.3 (Ar), 127.6 (Ar), 113.6 (PMP), 79.4 (2), 71.7 (PMB), 66.4 (1), 55.2 (OMe), 43.9 (23), 31.6 (3), [29.70, 29.63, 29.59, 29.41, 29.34 and 29.14] (5 to 21), 26.8 (TBDPS), 25.4 (4), 22.1 (22), 19.2 (TBDPS); HR MS (ESI TOF): calcd for $C_{48}H_{74}O_4SiNa$ (M + Na^+) 765.5249, found 765.5270.



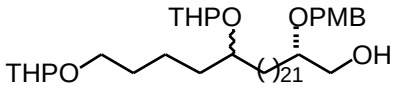
14

(2*S*)-1-(*t*-Butyldiphenylsiloxy)-2-(*p*-methoxybenzyloxy)-28-(tetrahydro-2*H*-pyran-2-yloxy)octacosane-24-ol (14): To a solution of aldehyde **13** (565 mg, 0.760 mmol) in THF (2.5 mL) at 0 °C was added a solution of Grignard reagent **B** (0.556 M, 3.0 mL, 16.7 mmol). The reaction mixture was stirred for 1.5 h at 0 °C and then saturated aqueous ammonium chloride was added. The mixture was extracted with diethyl ether and the organic layer was washed with brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by column chromatography (eluant; hexane/ethyl acetate=10/1) to afford alcohol **14** (557 mg, 81%) as a colorless oil: IR (neat): 3448 cm^{-1}; ^1H NMR ($CDCl_3$): δ 7.78-7.64 (m, 4H, TBDPS), 7.47-7.33 (m, 6H, TBDPS), 7.28-7.20 (m, 2H, PMP), 6.89-6.81 (m, 2H, PMP), 4.61 (d, *J* =11.1 Hz, 1H, PMB), 4.59 (s, 1H, THP), 4.45 (d, *J* =11.1 Hz, 1H, PMB), 3.93-3.36 (m, 8H, 1-H, 2-H, 24-H, 28-H, THP), 3.80 (s, 3H, OMe), 1.89-1.15 (m, 54H); ^{13}C NMR ($CDCl_3$): δ 159.0 (PMP), 135.6 (Ar), 133.6 (Ar), 131.2 (Ar), 129.6 (Ar), 129.3 (Ar), 127.6 (Ar), 113.6 (PMP), 98.9 (THP), 79.4 (2), 71.7 (PMB), 67.5 (24), 66.4 (1), 64.3 (28), 62.3 (THP), 55.2 (OMe), 37.5 (23), 37.1 (25), 31.6 (3), 30.7 (27), [29.7 and 29.6] (5 to 21), 26.8 (TBDPS), [25.6 and 25.3] (4, 26), 22.3 (22), 19.6 (TBDPS), 19.2 (THP); HR MS (ESI TOF): calcd for $C_{57}H_{92}O_6SiNa$ (M + Na^+) 923.6555, found 923.6554.



15

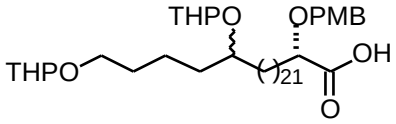
(2*S*)-1-(*t*-Butyldiphenylsiloxy)-2-(*p*-methoxybenzyloxy)-24,28-di(tetrahydro-2*H*-pyran-2-yloxy)octacosane (15): To a solution of alcohol **14** (1.38 mg, 1.53 mmol) and 3,4-dihydro-2*H*-pyran (0.200 mL, 2.19 mmol) in dichloromethane (6 mL) at 0 °C was added *p*-toluenesulfonic acid monohydrate (32.7 mg, 0.190 mmol). The reaction mixture had been stirred for 2 h at room temperature and then saturated aqueous sodium hydrogencarbonate was added. The mixture was extracted with dichloromethane and the organic layer was washed with brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by column chromatography (eluant; hexane/ethyl acetate=15/1) to afford THP ether **15** (1.30 g, 86%) as a colorless oil: IR (neat): 3070, 3044, 2924, 2853 cm^{-1}; ^1H NMR ($CDCl_3$): δ 7.71-7.67 (m, 4H, TBDPS), 7.47-7.35 (m, 6H, TBDPS), 7.26-7.17 (m, 2H, PMP), 6.88-6.80 (m, 2H, PMP), 4.60 (d, *J* = 11.1 Hz, 1H, PMB), 4.58 (s, 1H, THP), 4.44 (d, *J* = 11.3 Hz, 1H, PMB), 3.92-3.32 (m, 8H, 1-H, 2-H, 24-H, 28-H, THP), 3.80 (s, 3H, OMe), 1.88-1.11 (m, 54H), 1.07 (s, 9H, TBDPS); ^{13}C NMR ($CDCl_3$): δ 158.9 (PMP), 135.6 (Ar), 133.6 (Ar), 131.1 (Ar), 129.6 (Ar), 129.3 (Ar), 127.6 (Ar), 113.6 (PMP), 100.5 (THP), 95.4 (THP), 79.4 (2), 71.8 (PMB), 67.5 (24), 66.4 (1), 62.7 (28), 62.2 (THP), 62.1 (THP), 55.3 (OMe), 35.0 (23), 34.8 (25), 30.8 (3), 30.7 (27), [29.9 and 29.5] (5 to 21), 26.8 (TBDPS), [25.5 and 25.0] (4, 26), 22.3 (22), 20.0 (TBDPS), 19.7 (THP), 19.6 (THP); HR MS (ESI TOF): calcd for $C_{62}H_{100}O_7SiNa$ ($M + Na^+$) 1007.7131, found 1007.7123.



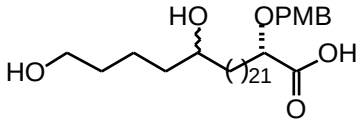
16

(2*S*)-2-(*p*-Methoxybenzyloxy)-24,28-di(tetrahydro-2*H*-pyran-2-yloxy)octacosanol (16): To a solution of TBDPS ether **15** (655 mg, 0.664 mmol) in THF (7.2 mL) at 0 °C were added acetic acid (0.12 mL, 2.10 mmol) and a solution of TBAF in THF (1.0 M, 2.00 mL, 2.00 mmol). After the reaction mixture had been stirred for 22.5 h at room temperature, saturated aqueous sodium hydrogencarbonate was added. The mixture was extracted with ethyl acetate, and the organic layer was washed with water and brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by column chromatography (eluant; hexane/ethyl acetate=3/1) to afford alcohol **16** (474 mg, 96%) as a colorless oil: IR (neat): 3466 cm^{-1}; ^1H NMR ($CDCl_3$): δ 7.27 (d, *J* = 8.4 Hz, 2H, PMP), 6.91-6.86 (m, 2H, PMP), 4.67-4.62 (m, 1H, THP), 4.60-4.55 (m, 1H, THP), 4.56 (d, *J* = 11.3

Hz, 1H, PMB), 4.46 (d, *J* = 11.1 Hz, 1H, PMB), 3.95-3.34 (m, 10H, 1-H, 2-H, 24-H, 28-H, THP), 3.81 (s, 3H, OMe), 1.86-1.38 (m, 20H, 3-H, 23-H, 25-H, 27-H, THP), 1.38-1.16 (m, 40H); ^{13}C NMR ($CDCl_3$): δ 159.2 (PMP), 130.6 (PMP), 129.3 (PMP), 113.8 (PMP), 98.8 (THP), 97.6 (THP), 79.4 (2), 71.1 (PMB), 67.5 (24), 64.3 (1), 62.7 (28), 62.3 (THP), 62.2 (THP), 55.3 (OMe), 35.0 (23), 34.8 (25), 30.8 (3), 30.7 (27), [29.9 and 29.5] (5 to 21), [25.5 and 25.0] (4, 26), 22.3 (22), 20.0 (THP), 19.6 (THP); HR MS (ESI TOF): calcd for $C_{46}H_{82}O_7Na$ (M + Na^+) 769.5953, found 769.5953.

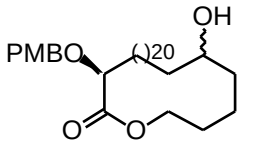


(2*S*)-2-(*p*-Methoxybenzyloxy)-24,28-di(tetrahydro-2*H*-pyran-2-yloxy)octacosanoic acid: To a solution of alcohol **16** (588.1 mg, 0.787 mmol) in acetonitrile (3.9 mL) at room temperature were added TEMPO (18.0 mg, 0.110 mmol) and phosphate buffer (pH=7, 2.95 mL). After the reaction mixture had been warmed up to 35 °C, a solution of sodium chlorite in water (2.0 M, 0.394 mL, 3.15 mmol) and a solution of sodium hypochlorite in water (available chlorine >0.25%, 0.414 mL, 31.5 μmol) were added. The mixture was stirred for 8.5 h at 35 °C and then water (5.9 mL) was added at room temperature. A solution of 6% sodium sulfite in water was added to the reaction mixture at 0 °C, and the solution was acidified to pH=6 by addition of 1 M hydrochloric acid. The mixture was extracted with diethyl ether, and the organic layer was filtered through a short pad of silica eluting with chloroform/methanol=10/1. Evaporation of the solvent gave (2*S*)-2-(*p*-methoxybenzyloxy)-24,28-di(tetrahydro-2*H*-pyran-2-yloxy)octacosanoic acid (604 mg, quant.) as a colorless oil. The crude product was instantly used in the following reaction without further purification. For the analysis, the carboxylic acid was purified by column chromatography (eluant; CH_2Cl_2 => 5% MeOH in CH_2Cl_2) on Silica gel 60N (spherical, neutral, Kanto Chem. Co., Inc.) and the resulted salt was washed with hexane under argon atmosphere to give pure (2*S*)-2-(*p*-methoxybenzyloxy)-24,28-di(tetrahydro-2*H*-pyran-2-yloxy)octacosanoic acid as a colorless oil: IR (neat): 3446, 1700 cm^{-1}; ^{1}H NMR ($CDCl_3$): δ 7.27 (d, *J* = 8.7 Hz, 2H, PMP), 6.89 (d, *J* = 8.7 Hz, 2H, PMP), 4.58 (s, 2H, THP), 4.55 (d, *J* = 11.3 Hz, 1H, PMB), 4.47 (d, *J* = 11.1 Hz, 1H, PMB), 3.93-3.34 (m, 8H, 2-H, 24-H, 28-H, THP), 3.80 (s, 3H, OMe), 1.95-1.16 (m, 60H); HR MS (ESI TOF): calcd for $C_{46}H_{80}O_8Na$ (M + Na^+) 783.5745, found 783.5739.



17

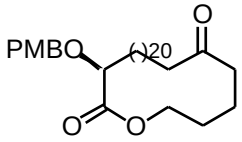
(2*S*)-24,28-Dihydroxy-2-(*p*-methoxybenzyloxy)octacosanoic acid (17): To a solution of crude (2*S*)-2-(*p*-methoxybenzyloxy)-24,28-di(tetrahydro-2*H*-pyran-2-yloxy)octacosanoic acid (604 mg, 0.793 mmol) in THF (40 mL) at 0 °C was added 1 M hydrochloric acid (4 mL). The reaction mixture was stirred for 71 h at room temperature. The mixture was extracted with ethyl acetate and the organic layer was washed with brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by thin layer chromatography (eluant; dichloromethane/methanol=10/1) to afford ω-hydroxycarboxylic acid **17** (262.3 mg, 56% for 2 steps) as a white solid: Mp. 62-63 °C; IR (neat): 3416, 1716 cm^{-1}; ^1H NMR ($CDCl_3$): δ 7.29-7.26 (m, 2H, PMP), 6.92-6.87 (m, 2H, PMP), 4.60 (d, *J* = 11.4 Hz, 1H, PMB), 4.46 (d, *J* = 11.4 Hz, 1H, PMB), 3.98 (t, *J* = 5.9 Hz, 1H, 2-H), 3.81 (s, 3H, OMe), 3.67 (t, *J* = 6.3 Hz, 2H, 28-H), 3.61 (m, 1H, 24-H), 1.82-1.72 (m, 2H), 1.61-1.25 (m, 48H); ^{13}C NMR ($CDCl_3$): δ 174.7 (1), 159.3 (PMP), 129.8 (PMP), 129.0 (PMP), 113.9 (PMP), 72.3 (2), 72.0 (PMB), 70.0 (24), 62.8 (28), 55.3 (OMe), 37.5 (23), 36.9 (25), 32.5 (26), 32.3 (3), [29.6 and 29.4] (5 to 21), 29.2 (27), [25.6 and 24.8] (4, 26), 21.8 (22); HR MS (ESI TOF): calcd for $C_{36}H_{64}O_6Na$ ($M + Na^+$) 615.4595, found 615.4597.



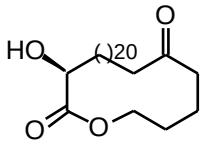
18

(2*S*)-24-Hydroxy-2-(*p*-methoxybenzyloxy)octacosanolide (18): To a solution of MNBA (24.8 mg, 72.0 μmol), DMAPO (1.7 mg, 12.3 μmol) and triethylamine (0.02 mL, 0.161 mmol) in dichloromethane (9.6 mL) at 50 °C was slowly added a solution of seco-acid **17** (31.8 mg, 53.6 μmol) in THF (16.3 mL) with a mechanically driven syringe over a 12 h period. After the reaction mixture had been stirred for 1 h at room temperature, saturated aqueous sodium hydrogencarbonate was added at 0 °C. The mixture was extracted with dichloromethane, and the organic layer was washed with water and brine, and dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by thin layer chromatography (eluant; hexane/ethyl acetate=3/1) to afford lactone **18** (23.6 mg, 77%) as a colorless oil: IR (neat): 3446, 1636 cm^{-1}; ^1H NMR ($CDCl_3$): δ 7.28 (d, *J* = 8.5 Hz, 2H, PMP), 6.88 (d, *J* = 8.5 Hz, 2H, PMP), 4.63 (d, *J* = 11.0 Hz, 1H, PMB), 4.34 (d, *J* = 11.0 Hz, 1H, PMB), 4.22-4.18 (m, 1H, 28-H), 4.16-4.09 (m, 1H, 28-H), 3.90 (t,

J = 6.5 Hz, 1H, 2-H), 3.80 (s, 3H, OMe), 3.66-3.55 (m, 1H, 24-H), 1.76-1.26 (m, 48H); ^{13}C NMR ($CDCl_3$): δ 174.0 (1), 159.3 (PMP), 131.9 (PMP), 129.7 (PMP), 113.7 (PMP), 77.4 (2), 71.8 (24), 71.6 (PMB), 64.7 (28), 55.3 (OMe), 37.3 (23), 36.8 (25), 33.0 (3), [29.35, 29.25, 29.17, 29.10, 29.03, 28.90, 28.86, 28.75, 28.66, 28.61 and 28.56] (5 to 21), 25.4 (26), 25.3 (4), 25.0 (22), 22.1 (27); HR MS (ESI TOF): calcd for $C_{36}H_{62}O_5Na$ (M + Na^+) 597.4489, found 597.4489.



(2*S*)-2-(*p*-Methoxybenzyloxy)-24-oxooctacosanolide: To a mixture of MS 4Å (3.1 mg) and alcohol **18** (3.20 mg, 5.57 μmol) in dichloromethane (0.5 mL) at room temperature was added NMO (1.84 mg, 15.7 μmol). After the reaction mixture had been stirred for 5 min at room temperature, TPAP (0.37 mg, 1.05 μmol) was added at 0 °C. The reaction mixture was stirred for 30 min at 0 °C and then it was filtered through a pre-cooled short pad of silica gel eluting with ethyl acetate. The mixture and evaporation of the solvent, the crude product was purified by thin layer chromatography (eluant; benzene/diethyl ether=3/1) to afford (2*S*)-2-(*p*-methoxybenzyloxy)-24-oxooctacosanolide (3.0 mg, 94%) as a colorless oil: $[\alpha]_D^{22}$ = –34.4 (c 0.753, benzene); IR (neat): 1737, 1712 cm^{-1}; ^{1}H NMR ($CDCl_3$): δ 7.30-7.26 (m, 2H, PMP), 6.90-6.84 (m, 2H, PMP), 4.62 (d, *J* = 11.1 Hz, 1H, PMB), 4.33 (d, *J* = 11.3 Hz, 1H, PMB), 4.20-4.07 (m, 2H, 28-H), 3.89 (t, *J* = 6.5 Hz, 1H, 2-H), 3.80 (s, 3H, OMe), 2.45 (t, *J* = 7.0 Hz, 2H, 25-H), 2.38 (t, *J* = 7.4 Hz, 2H, 23-H), 1.78-1.50 (m, 10H), 1.45-1.18 (m, 34H); ^{13}C NMR ($CDCl_3$): δ 210.8 (24), 173.0 (1), 159.3 (PMP), 132.7 (PMP), 129.7 (PMP), 113.3 (PMP), 71.9 (2), 64.4 (28), 55.3 (OMe), 42.8 (23), 42.0 (25), 33.0 (3), [29.32, 29.23, 29.18, 29.09, 28.98, 28.78, 28.72, 28.64 and 28.59] (5 to 21), 28.2 (26), 25.2 (4), 23.8 (22), 20.3 (27); HR MS (ESI TOF): calcd for $C_{36}H_{60}O_5Na$ (M + Na^+) 595.4333, found 595.4333.



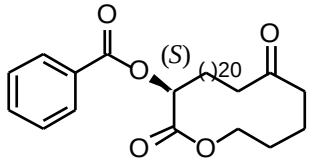
(–)-5

(2*S*)-2-Hydroxy-24-oxooctacosanolide ((–)-5): To a suspension of (2*S*)-2-(*p*-methoxybenzyloxy)-24-oxooctacosanolide (3.00 mg, 5.20 μmol) in dichloromethane (0.47 mL) and water (0.05 mL) at 0 °C was added DDQ (1.43 mg, 6.30 μmol). The reaction mixture was stirred for 2.5 h at room temperature and then phosphate buffer (pH=7) was added. The mixture was extracted with dichloromethane, and the organic

layer was washed with water and brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by thin layer chromatography (eluant; benzene/diethyl ether=3/1) to afford (2*S*)-2-hydroxy-24-oxooctacosanolide (**(–)-5**) (1.9 mg, 80%) as a white solid: Mp. 67-68 °C; $[\alpha]_D^{21}$ = –9.6 (c 0.96, benzene); IR (neat): 3445, 1739, 1713 cm^{-1}; ^1H NMR ($CDCl_3$): δ 4.28-4.24 (m, 1H, 28-H), 4.18-4.16 (m, 1H, 2-H), 4.13-4.09 (m, 1H, 28-H), 2.45 (t, *J* = 7.0 Hz, 2H, 25-H), 2.40 (t, *J* = 7.5 Hz, 2H, 23-H), 1.81-1.75 (m, 2H, 3-H), 1.69-1.63 (m, 2H, 27-H), 1.67-1.61 (m, 2H, 26-H), 1.61-1.56 (m, 2H, 22-H), 1.56-1.45 (m, 2H, 4-H), 1.45-1.17 (m, 34H, 5-H to 21-H); ^{13}C NMR ($CDCl_3$): δ 210.7 (24), 175.6 (1), 70.4 (2), 65.4 (28), 42.8 (23), 42.0 (25), 34.4 (3), [29.40, 29.29, 29.27, 29.20, 29.12, 28.98, 28.92, 28.89, 28.81, 28.74, 28.72, 28.67, 28.60, 28.58, 28.50] (5 to 21), 28.1 (26), 24.7 (4), 23.7 (22), 20.2 (27); HR MS (ESI TOF): calcd for $C_{28}H_{52}O_4Na$ (M + Na^+) 475.3758, found 475.3758.

(Natural Product **5**)[2]

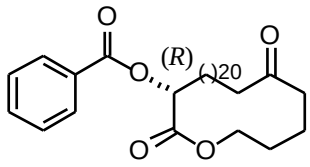
Amorphous solid; ^1H NMR ($CDCl_3$): δ 4.24 and 4.10 (m, 2H, 28-H), 4.15 (m, 1H, 2-H), 2.73 (d, *J* = 5 Hz, 1H, OH), 2.44 (t, *J* = 6.5 Hz, 2H, 25-H), 2.38 (t, *J* = 7 Hz, 2H, 23-H), 1.76 and 1.63 (m, 2H, 3-H), 1.65 (m, 2H, 27-H), 1.63 (m, 2H, 26-H), 1.58 (m, 2H, 22-H), 1.45-1.30 (m, 2H, 4-H), 1.25 (m, 34H, 5-H to 21-H); ^{13}C NMR ($CDCl_3$): δ 210.4 (24), 176.2 (1), 71.1 (2), 66.0 (28), 43.5 (23), 42.7 (25), 35.1 (3), 29.0 (5 to 21), 28.8 (26), 25.3 (4), 24.4 (22), 20.8 (27); M^+ at m/z 452.3867 (calcd for $C_{28}H_5O_4$ 452.3865).



19

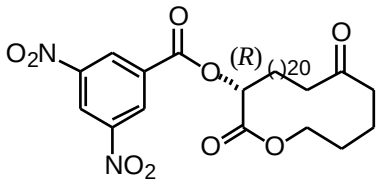
(2*S*)-2-Benzoyloxy-24-oxooctacosanolide (19): To a solution of (2*S*)-2-hydroxy-24-oxooctacosanolide (**(–)-5**) (1.00 mg, 2.21 μmol) in dichloromethane (0.2 mL) at 0 °C were added DMAP (0.60 mg, 5.3 μmol) and benzoic anhydride (1.43 mg, 6.30 μmol). The reaction mixture was stirred for 21 h at room temperature and then saturated aqueous sodium hydrogencarbonate was added. The mixture was extracted with dichloromethane, and the organic layer was washed with water and brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by thin layer chromatography (eluant; hexane/ethyl acetate=5/1) to afford benzoate **19** (1.2 mg, quant.) as a colorless oil: IR (neat): 1757, 1726 cm^{-1}; ^1H NMR ($CDCl_3$): δ 8.10-8.07 (m, 2H, Bz), 7.65-7.55 (m, 1H, Bz), 7.48-7.31 (m, 2H, Bz), 5.21 (t, *J* = 6.8 Hz, 1H, 2-H), 4.23-4.16 (m, 2H, 28-H), 2.43 (t, *J*

= 6.8 Hz, 2H, 25-H), 2.38 (t, *J* = 7.3 Hz, 2H, 23-H), 1.82-1.48 (m, 2H, 3-H), 1.70-1.62 (m, 2H, 26-H), 1.70-1.62 (m, 2H, 27-H), 1.62-1.48 (m, 2H, 22-H), 1.62-1.48 (m, 2H, 4-H), 1.27-1.25 (m, 34H, 5-H to 21-H); HPLC (CHIRALCEL OD-H*2, *i*-PrOH/hexane = 1/20, flow rate = 0.3 mL/min): t_R = 46.6 min (<1%), t_R = 47.6 min (>99%); HR MS (ESI TOF): calcd for $C_{35}H_{56}O_5Na$ (M + Na^+) 579.4020, found 579.4020.



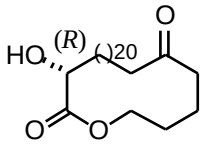
***ent*-19**

(2*R*)-2-Benzoyloxy-24-oxooctacosanolide (*ent*-19): To a solution of (2*S*)-2-hydroxy-24-oxooctacosanolide (**(–)-5**) (1.40 mg, 1.89 μmol), benzoic acid (1.40 mg, 11.4 μmol) and triphenylphosphine (2.30 mg, 8.70 μmol) in THF (0.1 mL) at 0 °C was added DEAD (5.00 mg, 28.3 μmol). The reaction mixture was stirred for 9 h at room temperature and then saturated aqueous sodium hydrogencarbonate was added. The mixture was extracted with diethyl ether, and the organic layer was washed with water and brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by thin layer chromatography (eluant; hexane/ethyl acetate=5/1) to afford benzoate ***ent*-19** (1.7 mg, quant.) as a colorless oil: IR (neat): 1752, 1730 cm^{-1}; ^1H NMR ($CDCl_3$): δ 8.10-8.07 (m, 2H, Bz), 7.65-7.55 (m, 1H, Bz), 7.48-7.31 (m, 2H, Bz), 5.21 (t, *J* = 6.8 Hz, 1H, 2-H), 4.23-4.16 (m, 2H, 28-H), 2.43 (t, *J* = 6.8 Hz, 2H, 25-H), 2.38 (t, *J* = 7.3 Hz, 2H, 23-H), 1.82-1.48 (m, 2H, 3-H), 1.70-1.62 (m, 2H, 26-H), 1.70-1.62 (m, 2H, 27-H), 1.62-1.48 (m, 2H, 22-H), 1.62-1.48 (m, 2H, 4-H), 1.27-1.25 (m, 34H, 5-H to 21-H); HPLC (CHIRALCEL OD-H*2, *i*-PrOH/hexane = 1/20, flow rate = 0.3 mL/min): t_R = 46.6 min (>99%), t_R = 47.6 min (<1%); HR MS (ESI TOF): calcd for $C_{35}H_{56}O_5Na$ (M + Na^+) 579.4020, found 579.4020.



(2*R*)-2-(3,5-Dinitrobenzoyloxy)-24-oxooctacosanolide: To a solution of (2*S*)-2-hydroxy-24-oxooctacosanolide (**(–)-5**) (5.40 mg, 11.9 μmol), triphenylphosphine (6.50 mg, 24.8 μmol) and 3,5-dinitrobenzoic (6.50 mg, 30.6 μmol) acid in THF (0.12 mL) at room temperature was added diisopropyl azodicarboxylate (4.80 mg, 23.9 μmol). The reaction mixture was stirred for 2 h at room temperature and then saturated aqueous sodium hydrogencarbonate was added. The mixture was extracted with hexane and the organic layer was washed with water and brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by thin layer chromatography (eluant; hexane/ethyl acetate=3/1) to afford dinitrobenzoate (2*R*)-2-(3,5-dinitrobenzoyloxy)-24-oxooctacosanolide (6.0 mg, 78%) and recovered **(–)-5** (1.2 mg, 22%) as colorless oils.

(2*R*)-2-(3,5-Dinitrobenzoyloxy)-24-oxooctacosanolide:
IR (neat): 1736, 1714, 1547 cm^{-1};
^1H NMR ($CDCl_3$): δ 9.26 (t, *J* = 2.0 Hz, 1H, Ar), 9.19 (t, *J* = 2.0 Hz, 2H, Ar), 5.32 (dd, *J* = 12.5, 5.0 Hz, 1H, 2-H), 4.24-4.21 (m, 1H, 28-H), 4.18-4.15 (m, 1H, 28-H), 2.45 (t, *J* = 6.0 Hz, 2H, 25-H), 2.40 (t, *J* = 7.0 Hz, 2H, 23-H), 2.08-2.03 (m, 2H, 3-H), 1.67-1.66 (m, 2H, 27-H), 1.67-1.66 (m, 2H, 26-H), 1.55-1.49 (m, 2H, 4-H), 1.48-1.39 (m, 2H, 22-H), 1.35-1.25 (m, 34H, 5-H to 21-H);
HR MS (ESI TOF): calcd for $C_{35}H_{54}N_2O_9Na$ ($M + Na^+$) 669.3722, found 669.3722.



(+)-5

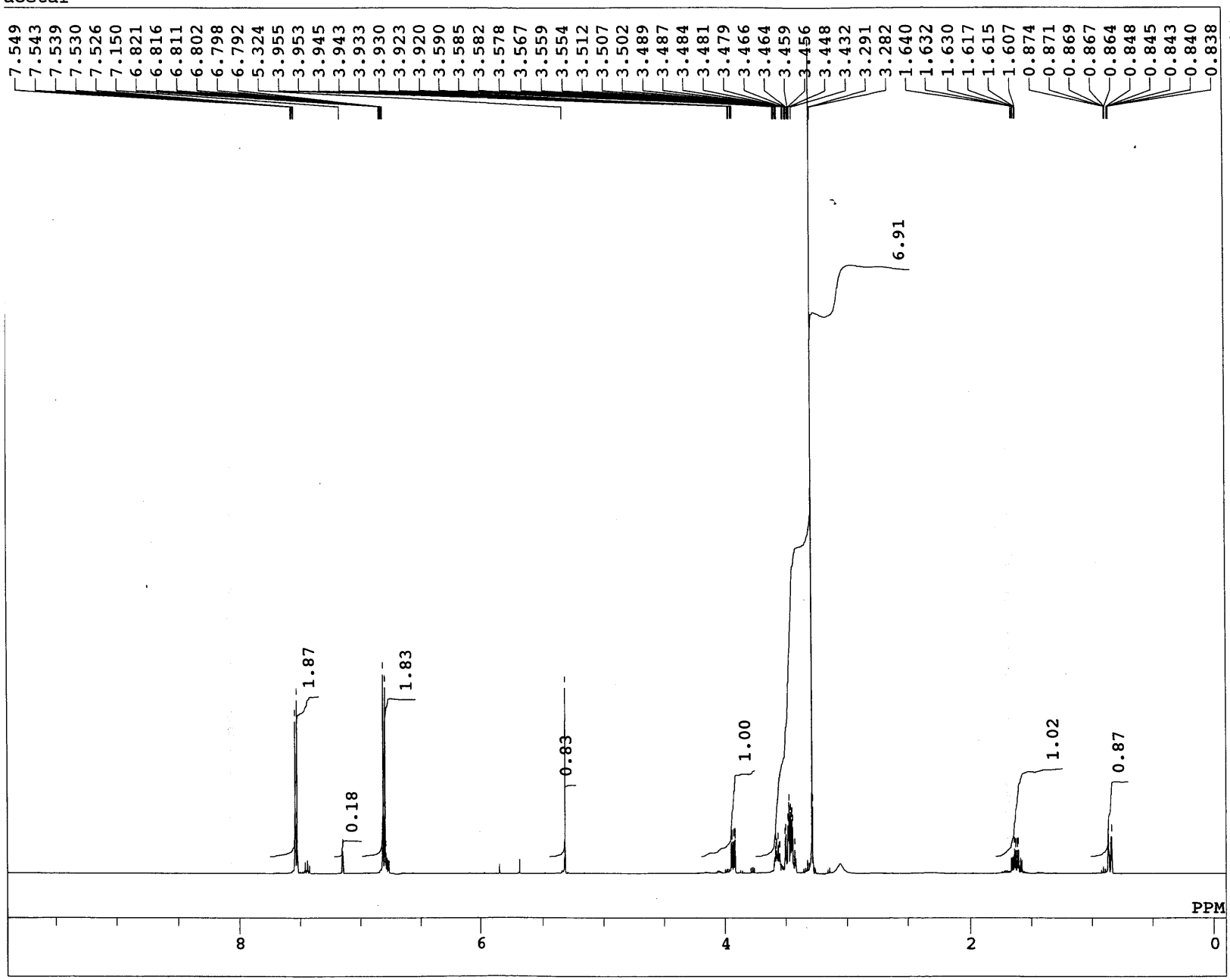
(2*R*)-2-Hydroxy-24-oxooctacosanolide ((+)-5): To a solution of dinitrobenzoate **(2*R*)-2-(3,5-dinitrobenzoyloxy)-24-oxooctacosanolide** (6.00 mg, 9.28 μmol) in methanol (0.1 mL) at room temperature was added triethylamine (6.5 μL). The reaction mixture was stirred for 30 min at room temperature and then saturated aqueous sodium hydrogencarbonate was added at 0 °C. The mixture was extracted with ethyl acetate and the organic layer was washed with brine, dried over sodium sulfate. After filtration of the mixture and evaporation of the solvent, the crude product was purified by thin layer chromatography (eluant; hexane/ethyl acetate=3/1) to afford (2*R*)-2-hydroxy-24-oxooctacosanolide (**(+)-5**) (3.5 mg, 83%) as a colorless oil:

Mp. 69-70 °C;
$[\alpha]_D^{22}$ = +9.54° (c 0.44, benzene);
HR MS (ESI TOF): calcd for $C_{28}H_{52}O_4Na$ ($M + Na^+$) 475.3758, found 475.3758.

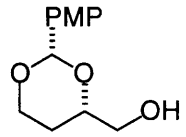
(1) Toshima, H.; Maru, K.; Saito, M.; Ichikawa, A. *Tetrahedron* **1999**, *55*, 5793-5808.

(2) Plasman, V.; Daloze, D.; Braekman, J.-C.; Connétable, S.: Robert, A.; Bordereau, C. *Tetrahedron Lett.* **1999**, *40*, 9229-9232.

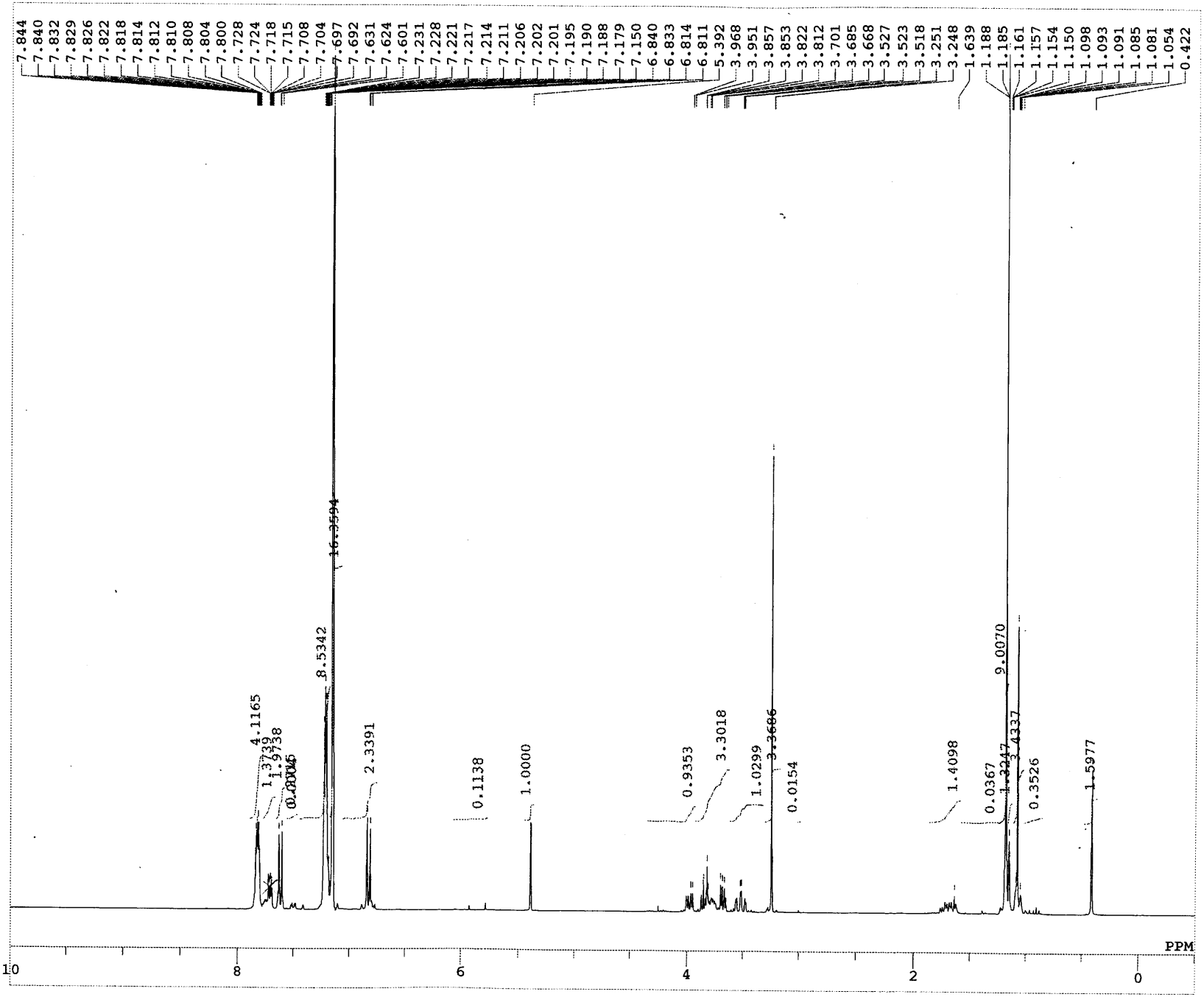
acetal



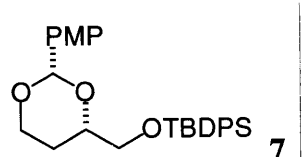
DFILE	C:\WinLambda\TEMPDATA\Auto1non_E1
OBNUC	1H
EXMOD	non
OFR	500.00 MHz
OBSET	0.00 KHz
OBFIN	162160.00 Hz
POINT	32768
FREQU	10000.00 Hz
SCANS	8
ACQTM	3.2768 sec
PD	3.7232 sec
PW1	6.38 usec
IRN	
CTEMP	25.0 c
SLVNT	C6D6
EXREF	7.15 ppm
BF	0.12 Hz
RGAIN	10



18-TM

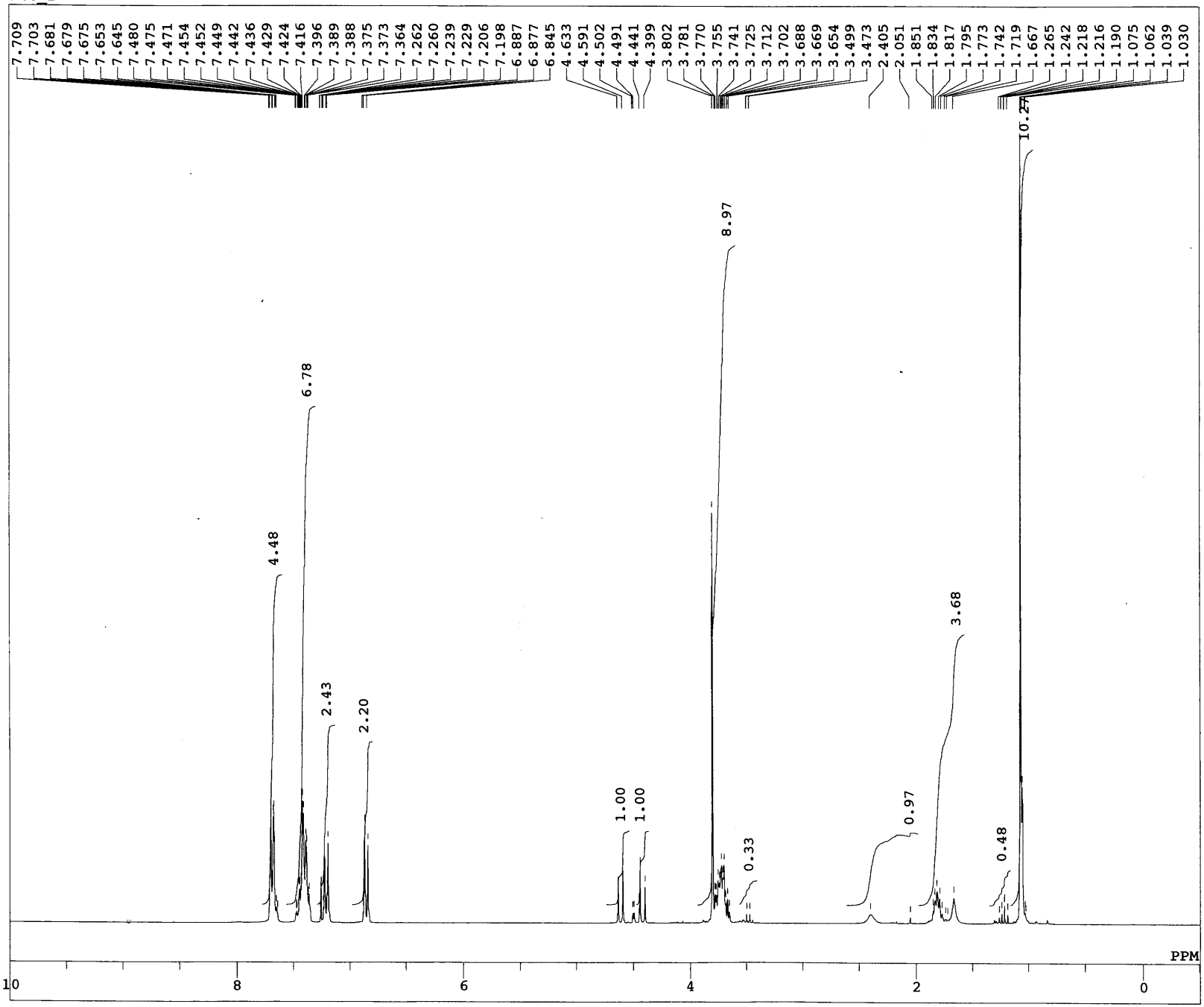


DFILE	C:\WINNMR95\DATA\Auto1NON_E1_FT.al
COMNT	18-TM
DATIM	Wed Jun 01 10:52:25 2005
OBNUC	1H
EXMOD	NON
OBFRQ	300.40 MHz
OBSET	130.00 KHz
OBFIN	1150.0 Hz
POINT	32768
FREQU	6020.4 Hz
SCANS	64
ACQTM	5.443 sec
PD	1.554 sec
PW1	5.4 us
IRNUC	1H
CTEMP	21.0 c
SLVNT	C6D6
EXREF	7.15 ppm
BF	0.12 Hz
RGAIN	18

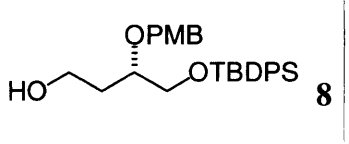


7

C:\WINNMR98\DATA\Auto1NON_E1_FT.als
R44_2

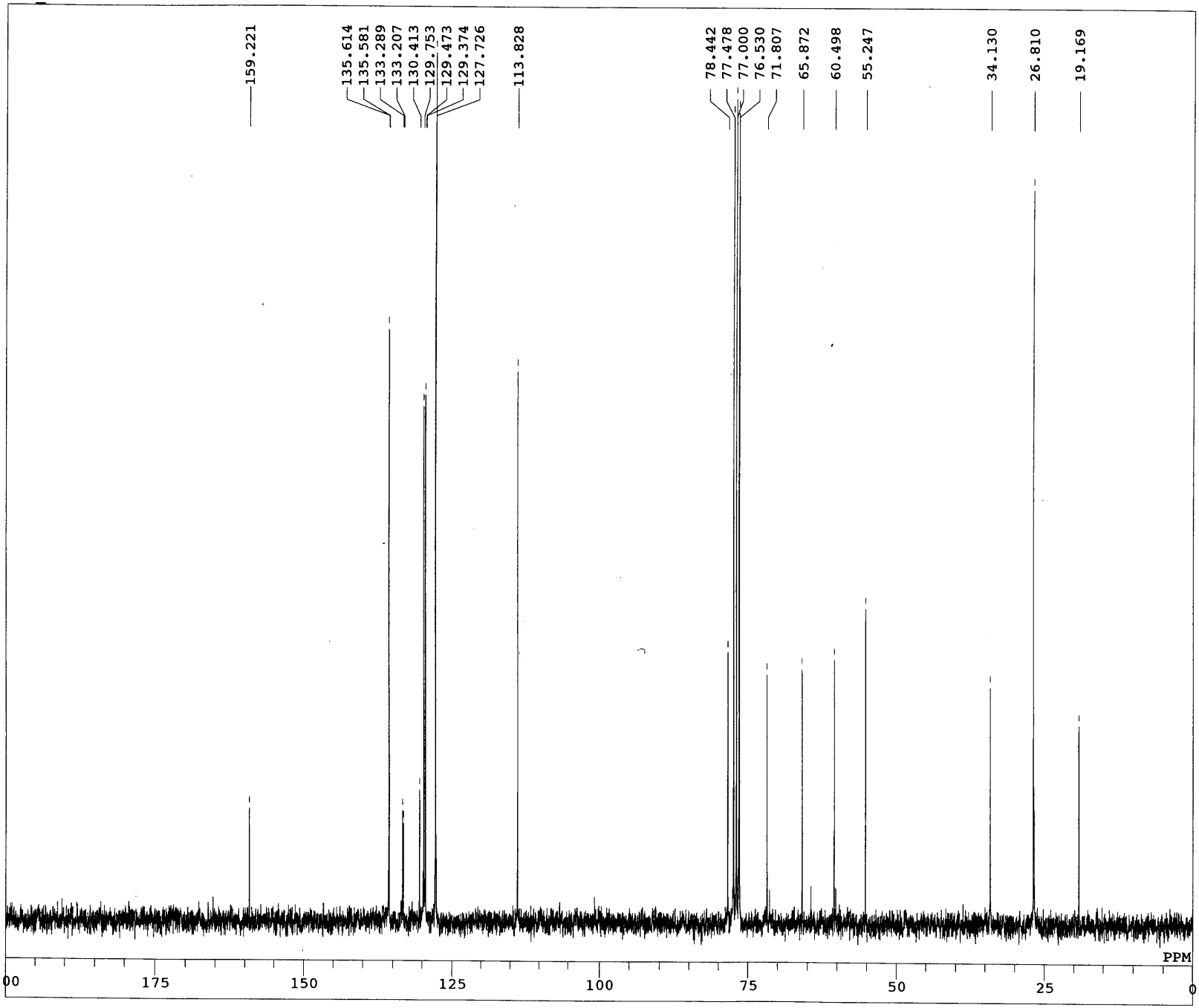


DFILE	C:\WINNMR98\DATA\Auto1NON_E1_FT.a
COMNT	R44_2
DATIM	Sun Aug 28 17:16:38 2005
EXMOD	NON
OBNUC	1H
OBFRQ	270.05 MHz
OBSET	112.00 KHz
OBFIN	5800.0 Hz
POINT	32768
FREQU	5405.4 Hz
CLPNT	1
TODAT	1
CLFRQ	100.0 Hz
SCANS	8
ACQTM	6.062 sec
PD	0.935 sec
PW1	6.0 us
PW2	10.0 us
PW3	10.0 us
PI1	1.000 ms
PI2	1.000 ms
PI3	1.00 ms
IRNUC	1H
CTEMP	21.7 c
SLVNT	CDCL3
EXREF	7.26 ppm
CLEXR	0.00
RGAIN	17
OBATN	511
LOOP1	1

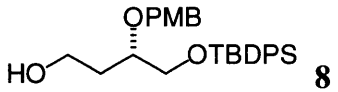


8

C:\WINNMR98\TEMPDATA\Auto2BCM_E1_FT.als
R44_2

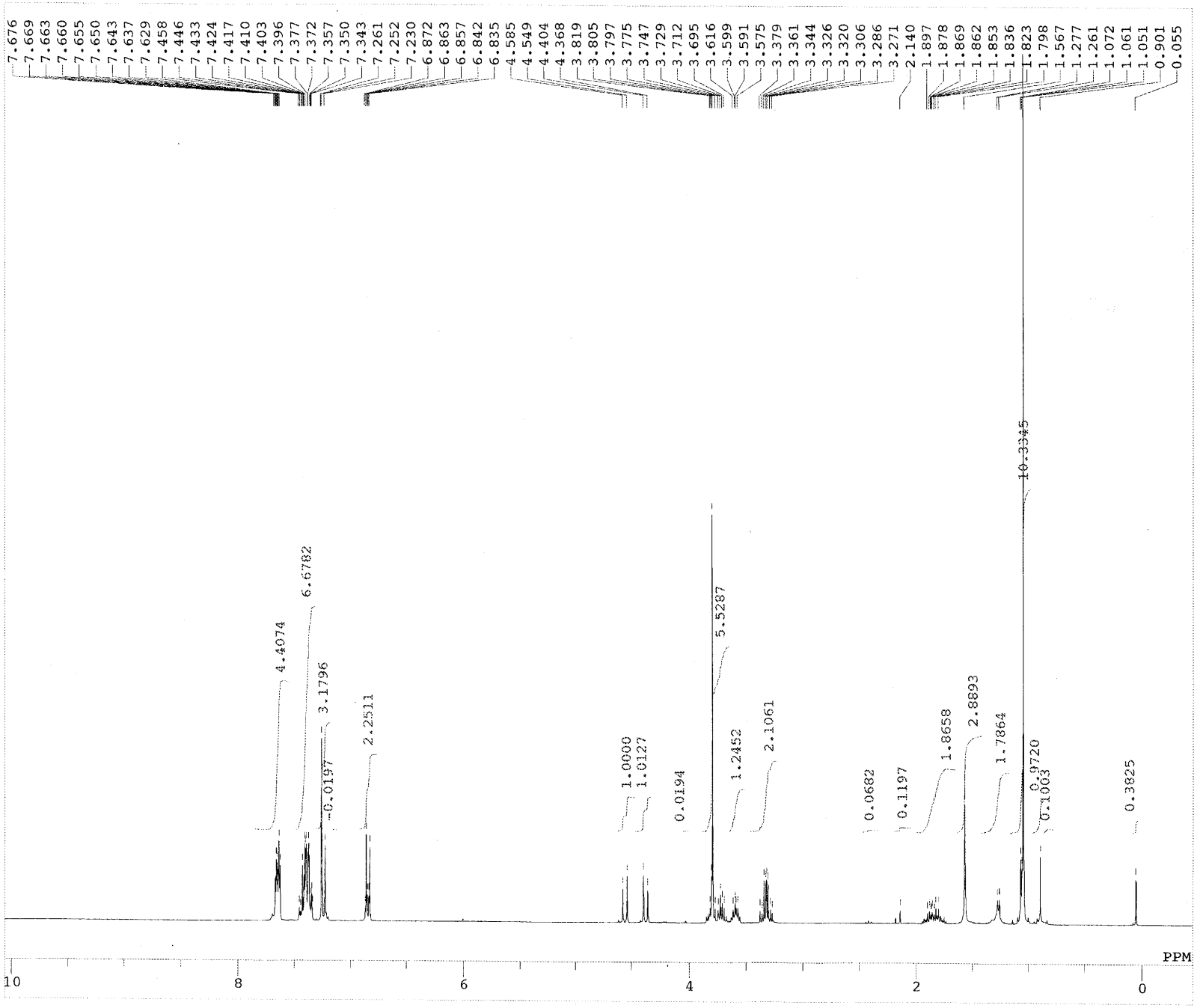


DFILE	C:\WINNMR98\TEMPDATA\Auto2BCM_E1_	
COMNT	R44_2	
DATIM	Sun Aug 28 17:42:37 2005	
EXMOD	BCM	
OBNUC	13C	
OBFRQ	67.80	MHz
OBSET	135.00	KHz
OBFIN	5200.0	Hz
POINT	32768	
FREQU	18348.6	Hz
CLPNT	1	
TODAT	1	
CLFRQ	500.0	Hz
SCANS	512	
ACQTM	1.786	sec
PD	1.211	sec
PW1	3.8	us
PW2	10.0	us
PW3	10.0	us
PI1	1.000	ms
PI2	1.000	ms
PI3	1.00	ms
IRNUC	1H	
CTEMP	20.9	c
SLVNT	CDCL3	
EXREF	77.00	ppm
CLEXR	0.00	
RGAIN	30	
OBATN	511	
LOOP1	1	

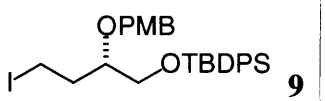


8

I-OTBDPS

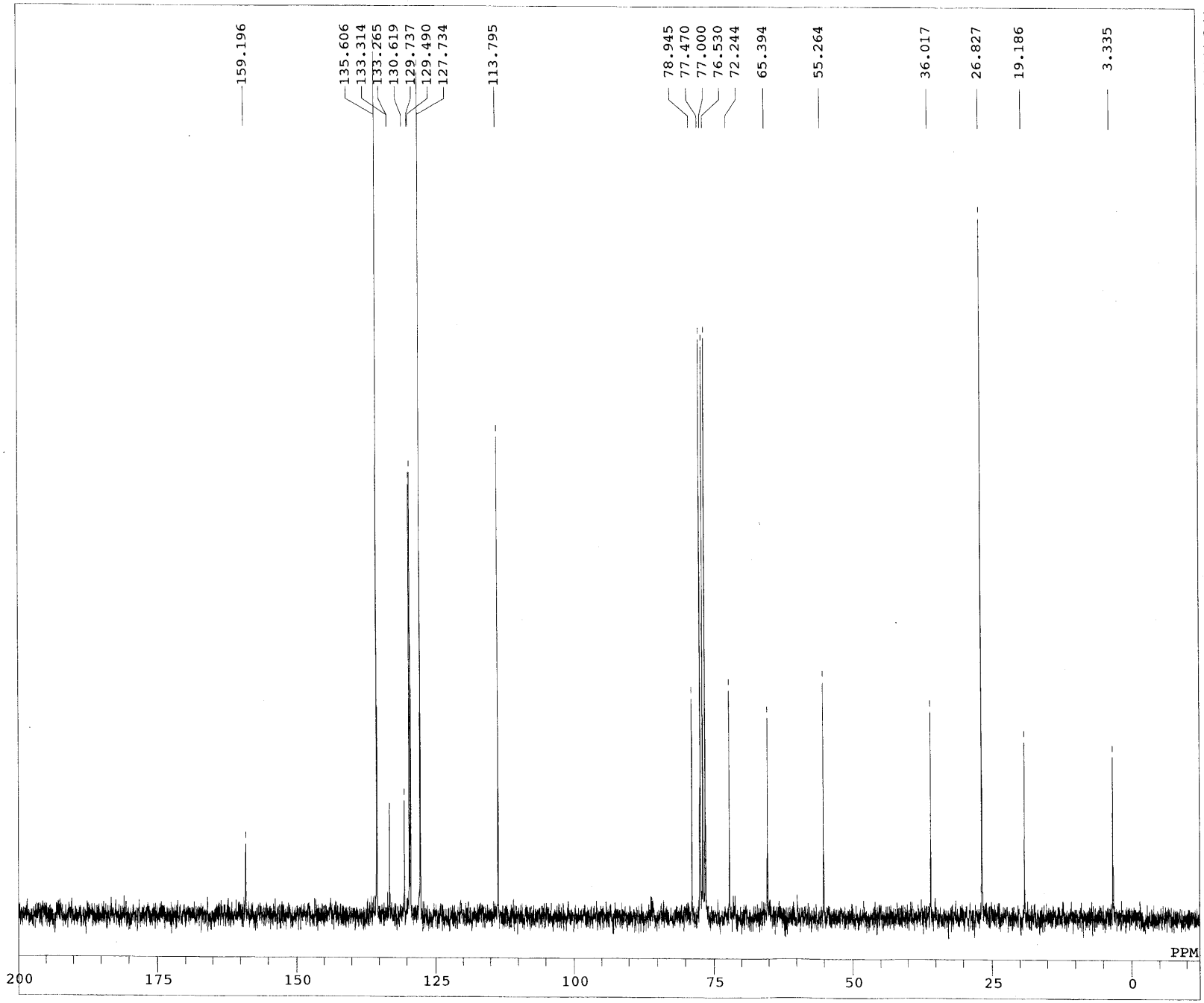


DFILE C:\WINNMR95\DATA\Auto1NON_E1_FT.a
COMNT I-OTBDPS
DATIM Sat Aug 27 16:53:51 2005
OBNUC 1H
EXMOD NON
OBFRQ 300.40 MHz
OBSET 130.00 KHz
OBFIN 1150.0 Hz
POINT 32768
FREQU 6020.4 Hz
SCANS 32
ACQTM 5.443 sec
PD 1.554 sec
PW1 5.4 us
IRNUC 1H
CTEMP 22.0 c
SLVNT CDCL3
EXREF 7.26 ppm
BF 0.12 Hz
RGAIN 22

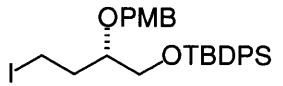


9

C:\WINNMR98\TEMPDATA\Auto2BCM_E1_FT.als
Term-6

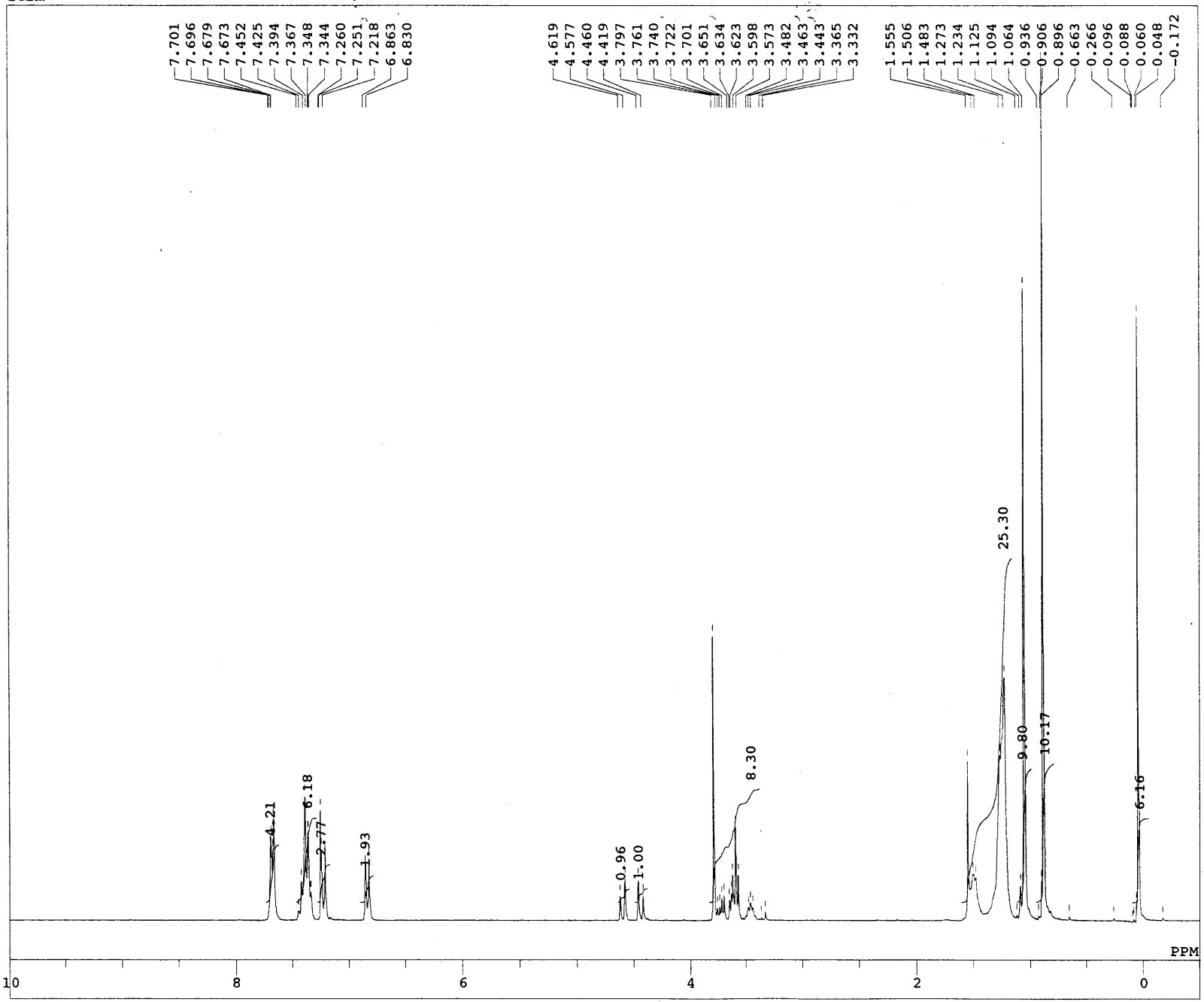


DFILE	C:\WINNMR98\TEMPDATA\Auto2BCM_E1_F
COMNT	Term-6
DATIM	Sun Sep 04 14:31:51 2005
EXMOD	BCM
OBNUC	13C
OBFRQ	67.80 MHz
OBSET	135.00 KHz
OBFIN	5200.0 Hz
POINT	32768
FREQU	18348.6 Hz
CLPNT	1
TODAT	1
CLFRQ	500.0 Hz
SCANS	512
ACQTM	1.786 sec
PD	1.211 sec
PW1	3.8 us
PW2	10.0 us
PW3	10.0 us
PI1	1.000 ms
PI2	1.000 ms
PI3	1.00 ms
IRNUC	1H
CTEMP	21.1 c
SLVNT	CDCL3
EXREF	77.00 ppm
CLEXR	0.00
RGAIN	30
OBATN	511
LOOP1	1

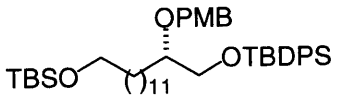


9

C:\WINNMR98\DATA\Autol NON_E1_FT.als
Term

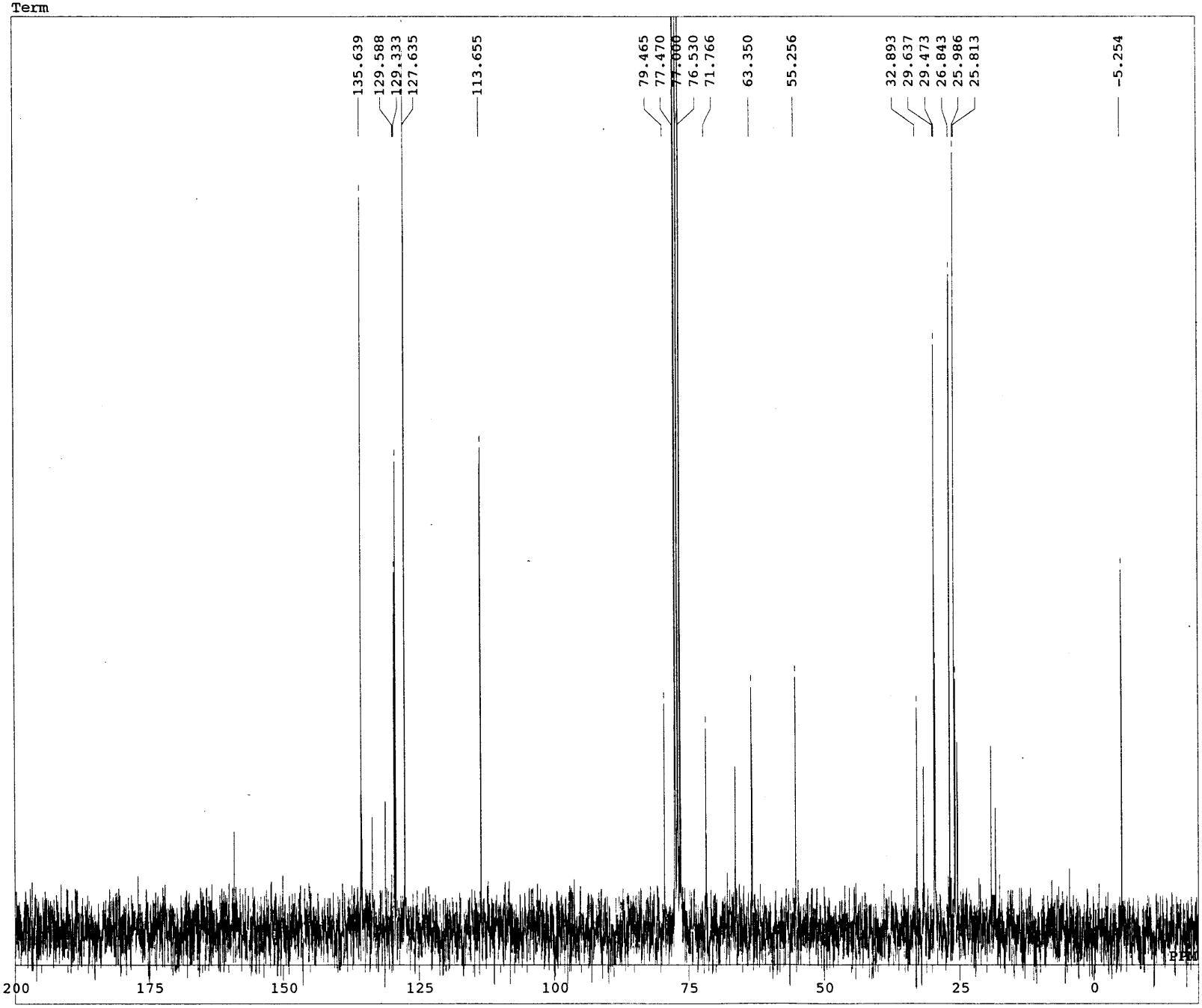


DFILE	C:\WINNMR98\DATA\Autol NON_E1_FT.al	
COMNT	Term	
DATIM	Tue Sep 27 19:31:05 2005	
EXMOD	NON	
OBNUC	1H	
OBFRQ	270.05	MHz
OBSET	112.00	KHz
OBFIN	5800.0	Hz
POINT	32768	
FREQU	5405.4	Hz
CLPNT	1	
TODAT	1	
CLFRQ	100.0	Hz
SCANS	64	
ACQTM	6.062	sec
PD	0.935	sec
PW1	6.0	us
PW2	10.0	us
PW3	10.0	us
PI1	1.000	ms
PI2	1.000	ms
PI3	1.00	ms
IRNUC	1H	
CTEMP	24.0	c
SLVNT	CDCL3	
EXREF	7.26	ppm
CLEXR	0.00	
RGAIN	18	
OBATN	511	
LOOP1	1	

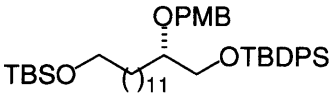


10

C:\WINNMR98\TEMPDATA\Auto2BCM_E1_FT.als
Term

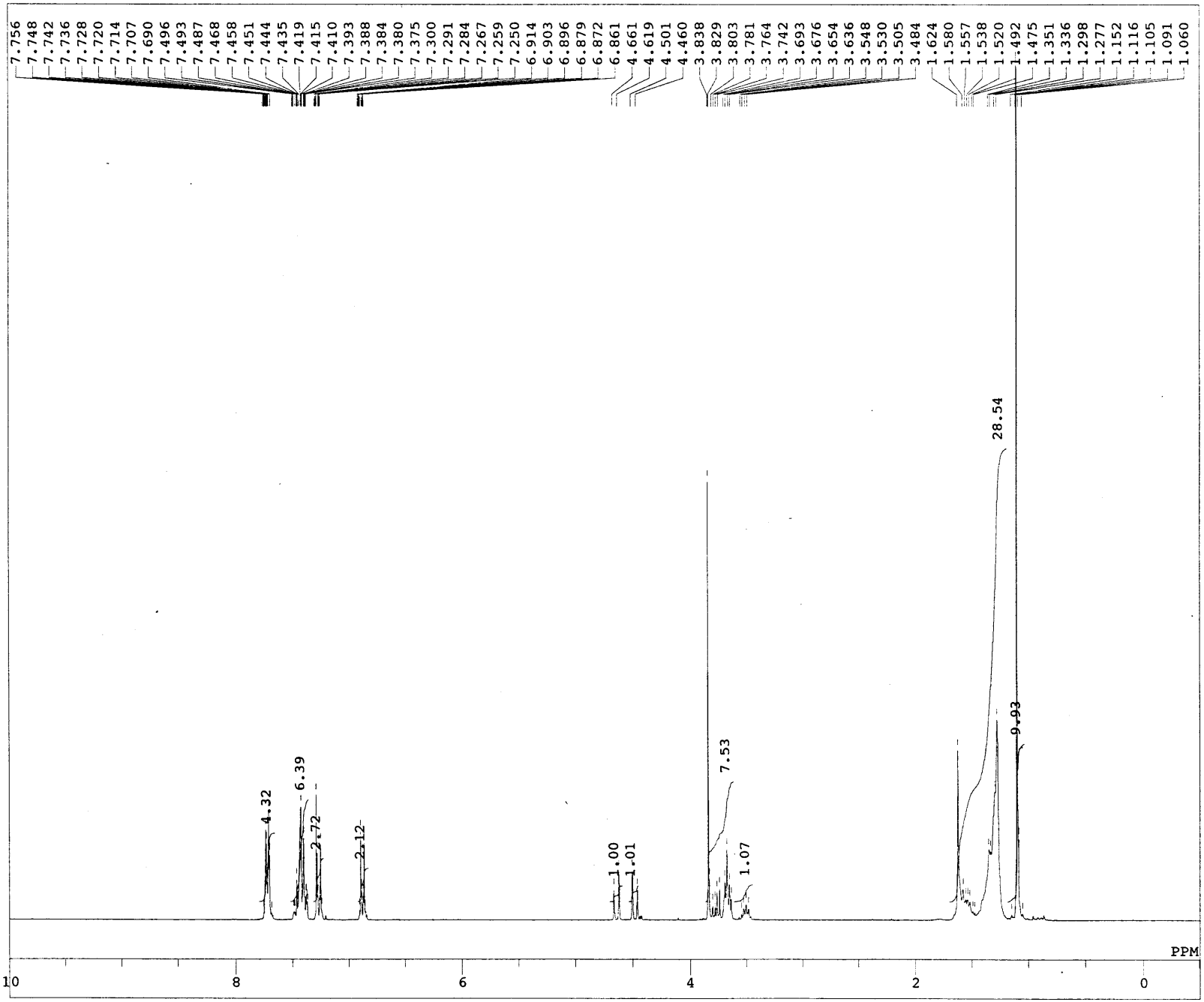


DFILE	C:\WINNMR98\TEMPDATA\Auto2BCM_E1_F	
COMNT	Term	
DATIM	Tue Sep 27 19:57:04 2005	
EXMOD	BCM	
OBNUC	13C	
OBFRQ	67.80	MHz
OBSET	135.00	KHz
OBFIN	5200.0	Hz
POINT	32768	
FREQU	18348.6	Hz
CLPNT	1	
TODAT	1	
CLFRQ	500.0	Hz
SCANS	512	
ACQTM	1.786	sec
PD	1.211	sec
PW1	3.8	us
PW2	10.0	us
PW3	10.0	us
PI1	1.000	ms
PI2	1.000	ms
PI3	1.00	ms
IRNUC	1H	
CTEMP	23.7	c
SLVNT	CDCL3	
EXREF	77.00	ppm
CLEXR	0.00	
RGAIN	30	
OBATN	511	
LOOP1	1	

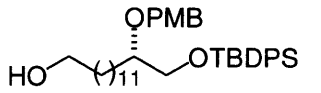


10

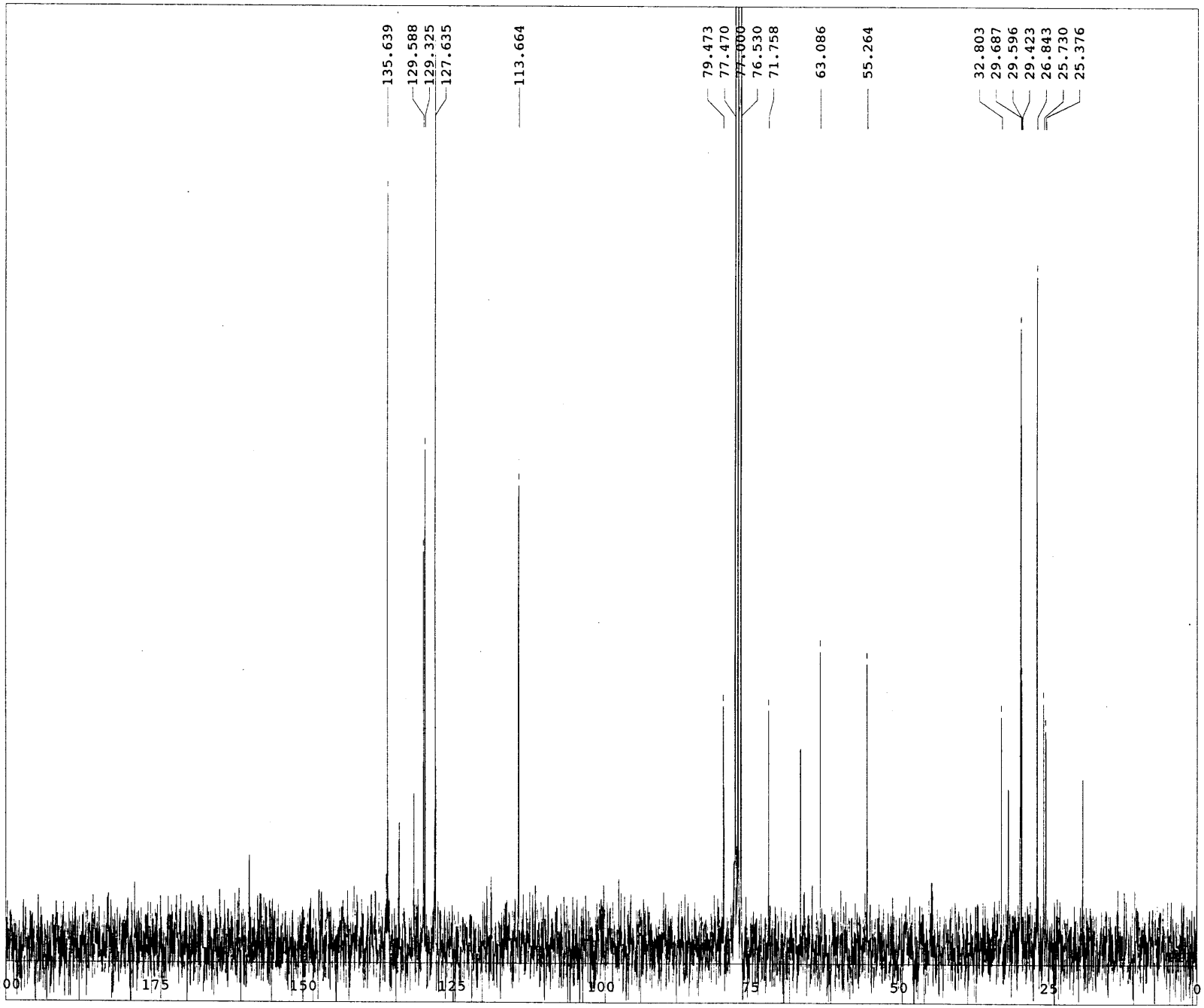
C:\Winnmr98\DATA\Autol1NON_E1_FT.als



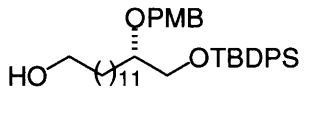
DFILE	C:\Winnmr98\DATA\Autol1NON_E1_FT.al	
COMNT		
DATIM	Mon Nov 28 10:15:22 2005	
EXMOD	NON	
OBNUC	1H	
OBFRQ	270.05	MHz
OBSET	112.00	KHz
OBFIN	5800.0	Hz
POINT	32768	
FREQU	5405.4	Hz
CLPNT	1	
TODAT	1	
CLFRQ	100.0	Hz
SCANS	32	
ACQTM	6.062	sec
PD	0.935	sec
PW1	6.0	us
PW2	10.0	us
PW3	10.0	us
PI1	1.000	ms
PI2	1.000	ms
PI3	1.00	ms
IRNUC	1H	
CTEMP	24.2	c
SLVNT	CDCL3	
EXREF	7.26	ppm
CLEXR	0.00	
RGAIN	18	
OBATN	511	
LOOP1	1	



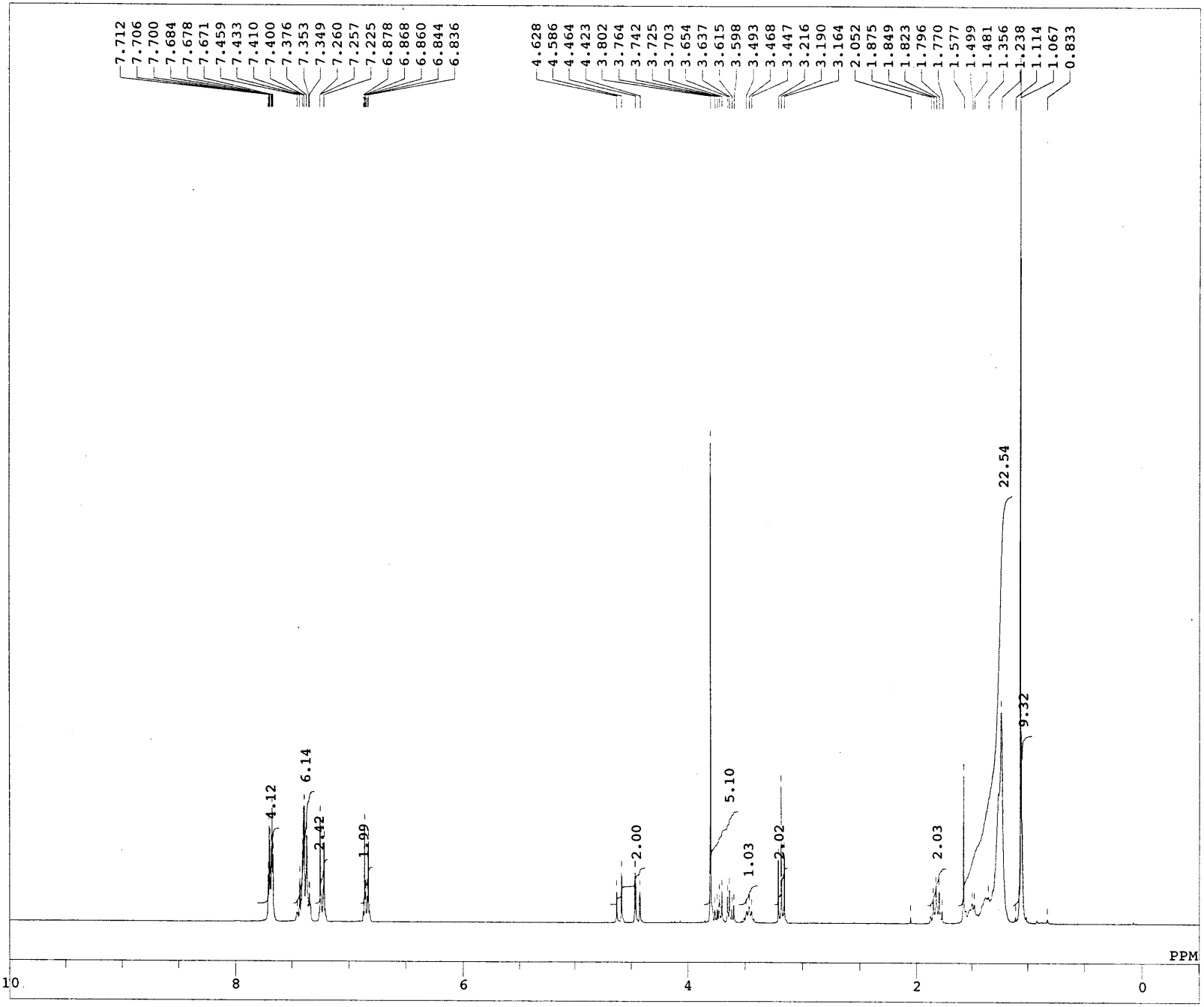
C:\WINNMR98\TEMPDATA\Auto2BCM_E1_FT.als



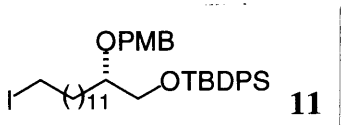
DFILE	C:\WINNMR98\TEMPDATA\Auto2BCM_E1_F	
COMNT		
DATIM	Mon Nov 28 10:30:48 2005	
EXMOD	BCM	
OBNUC	13C	
OBFRQ	67.80	MHz
OBSET	135.00	KHz
OBFIN	5200.0	Hz
POINT	32768	
FREQU	18348.6	Hz
CLPNT	1	
TODAT	1	
CLFRQ	500.0	Hz
SCANS	300	
ACQTM	1.786	sec
PD	1.211	sec
PW1	3.8	us
PW2	10.0	us
PW3	10.0	us
PI1	1.000	ms
PI2	1.000	ms
PI3	1.00	ms
IRNUC	1H	
CTEMP	23.5	c
SLVNT	CDCL3	
EXREF	77.00	ppm
CLEXR	0.00	
RGAIN	31	
OBATN	511	
LOOP1	1	



C:\Winnmr98\DATA\Auto1NON_E1_FT.als

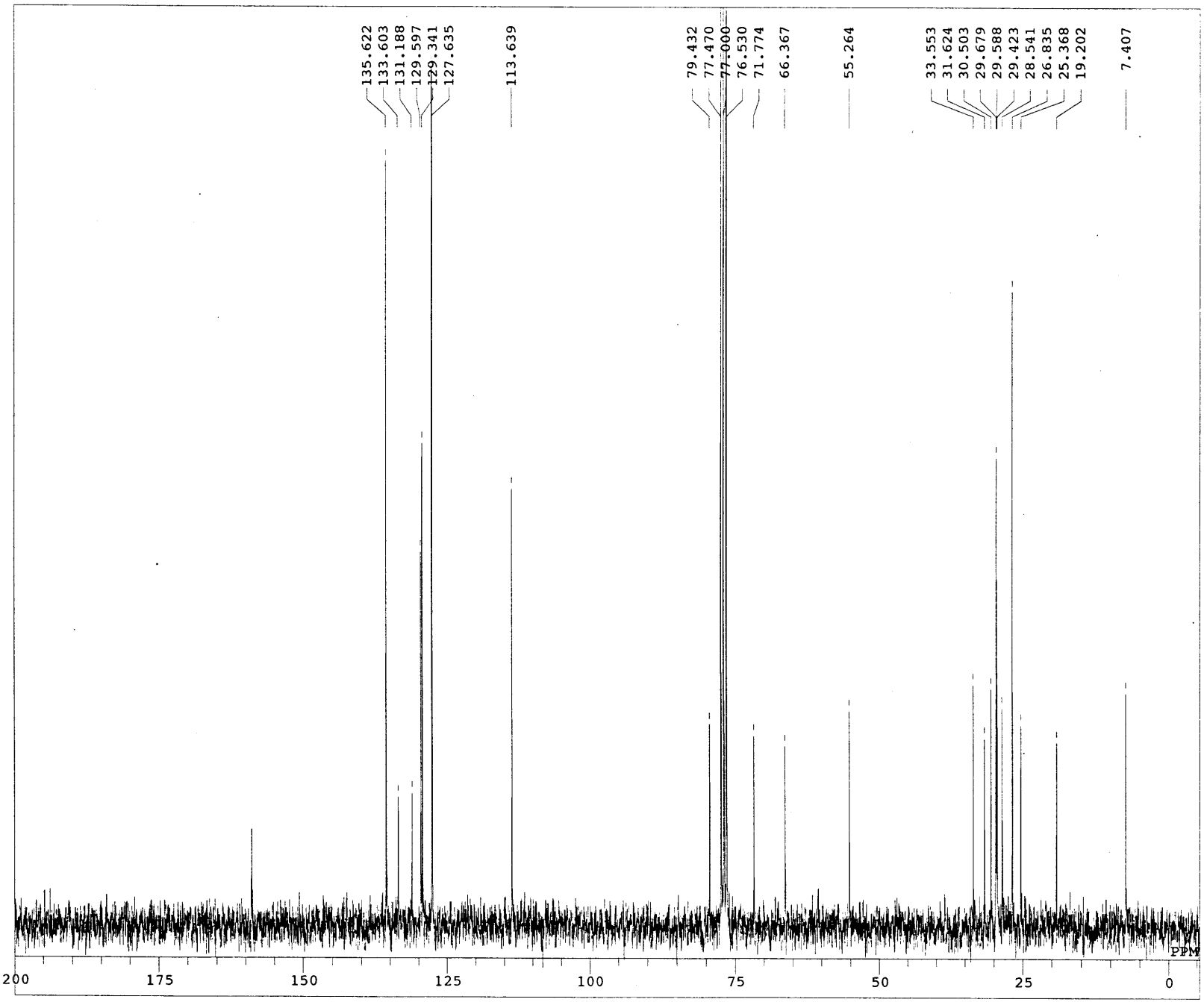


DFILE	C:\Winnmr98\DATA\Auto1NON_E1_FT.al	
COMNT		
DATIM	Sun Dec 25 14:34:37 2005	
EXMOD	NON	
OBNUC	1H	
OBFRQ	270.05	MHz
OBSET	112.00	KHz
OBFIN	5800.0	Hz
POINT	32768	
FREQU	5405.4	Hz
CLPNT	1	
TODAT	1	
CLFRQ	100.0	Hz
SCANS	128	
ACQTM	6.062	sec
PD	0.935	sec
PW1	6.0	us
PW2	10.0	us
PW3	10.0	us
PI1	1.000	ms
PI2	1.000	ms
PI3	1.00	ms
IRNUC	1H	
CTEMP	18.9	c
SLVNT	CDCL3	
EXREF	7.26	ppm
CLEXR	0.00	
RGAIN	17	
OBATN	511	
LOOP1	1	

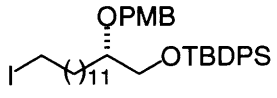


11

C:\WINNMR98\TEMPDATA\Auto2BCM_E1_FT.als

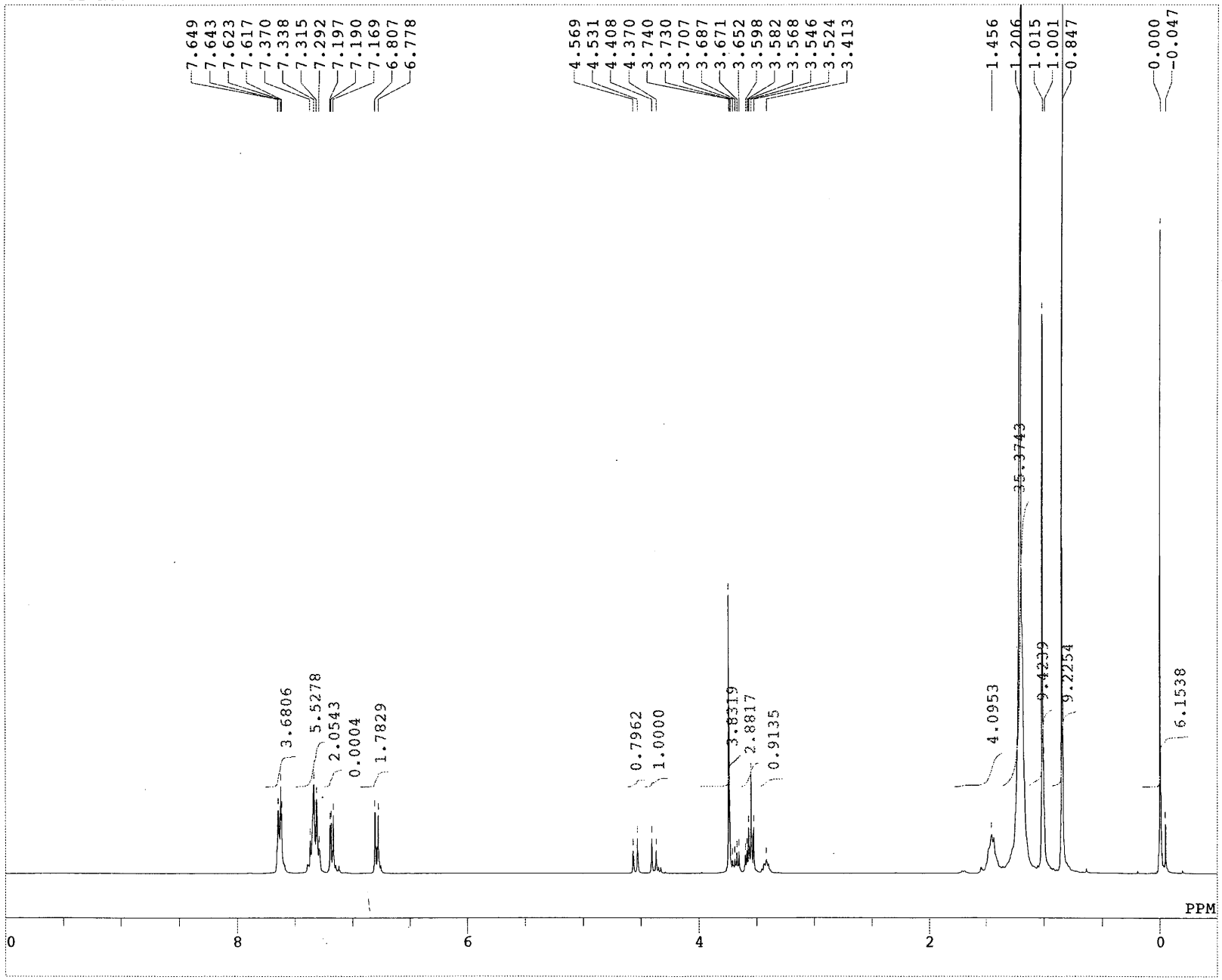


DFILE	C:\WINNMR98\TEMPDATA\Auto2BCM_E1_F
COMNT	
DATIM	Sun Dec 25 14:55:04 2005
EXMOD	BCM
OBNUC	13C
OBFRQ	67.80 MHz
OBSET	135.00 KHz
OBFIN	5200.0 Hz
POINT	32768
FREQU	18348.6 Hz
CLPNT	1
TODAT	1
CLFRQ	500.0 Hz
SCANS	400
ACQTM	1.786 sec
PD	1.211 sec
PW1	3.8 us
PW2	10.0 us
PW3	10.0 us
PI1	1.000 ms
PI2	1.000 ms
PI3	1.00 ms
IRNUC	1H
CTEMP	19.6 c
SLVNT	CDCL3
EXREF	77.00 ppm
CLEXR	0.00
RGAIN	30
OBATN	511
LOOP1	1

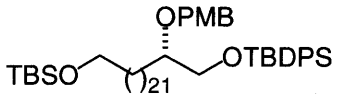


11

04.02.21 No.

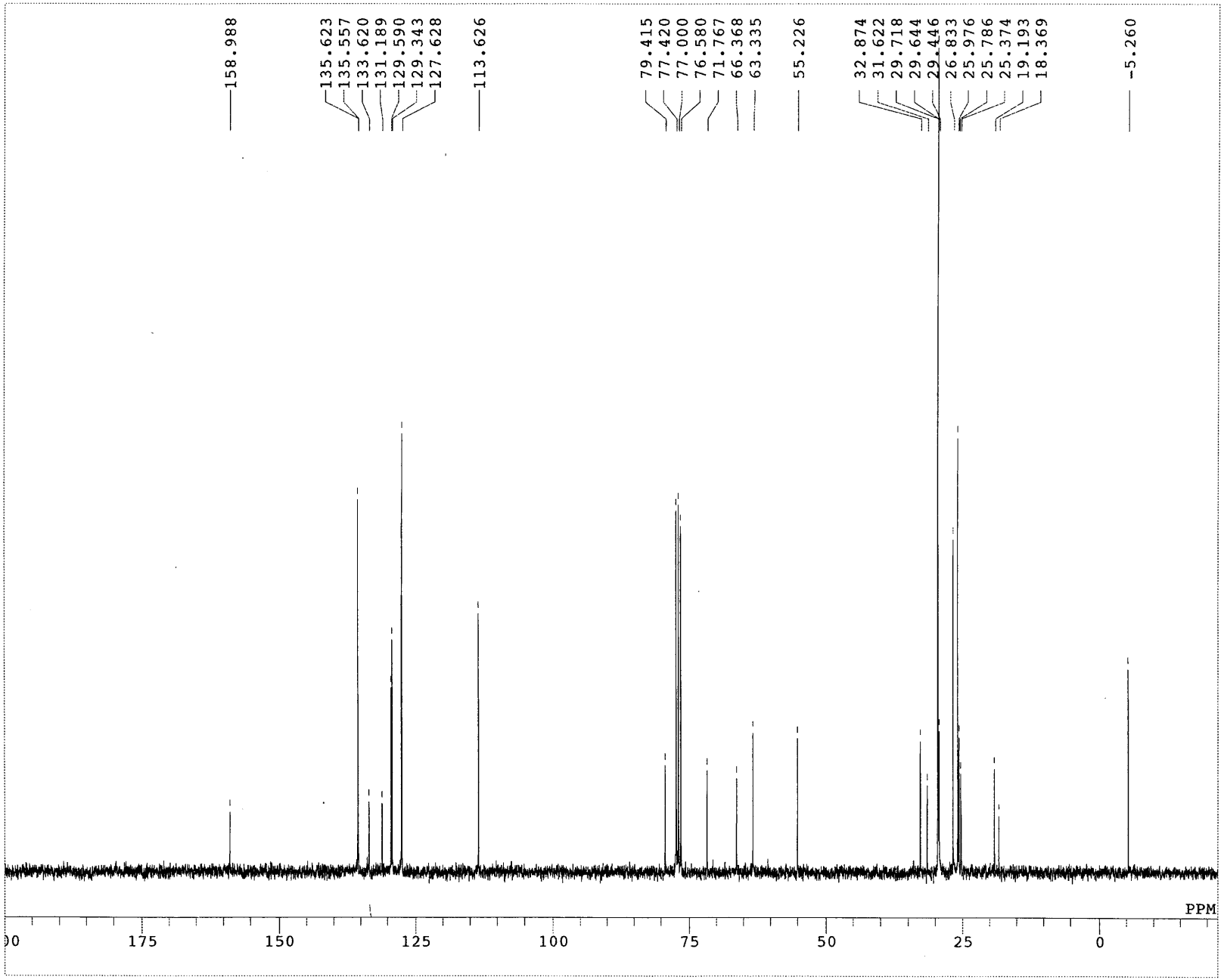


DFILE C:\WINNMR95\DATA\Auto1NON_E1_FT.als
COMNT 04.02.21 No.
DATIM Sat Feb 21 10:35:14 2004
OBNUC 1H
EXMOD NON
OBFRQ 300.40 MHz
OBSET 130.00 KHz
OBFIN 1150.0 Hz
POINT 32768
FREQU 6020.4 Hz
SCANS 16
ACQTM 5.443 sec
PD 1.554 sec
PW1 5.5 us
IRNUC 1H
CTEMP 20.2 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 11

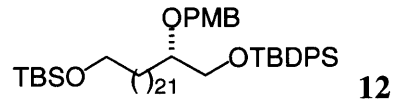


12

04.02.21 No.

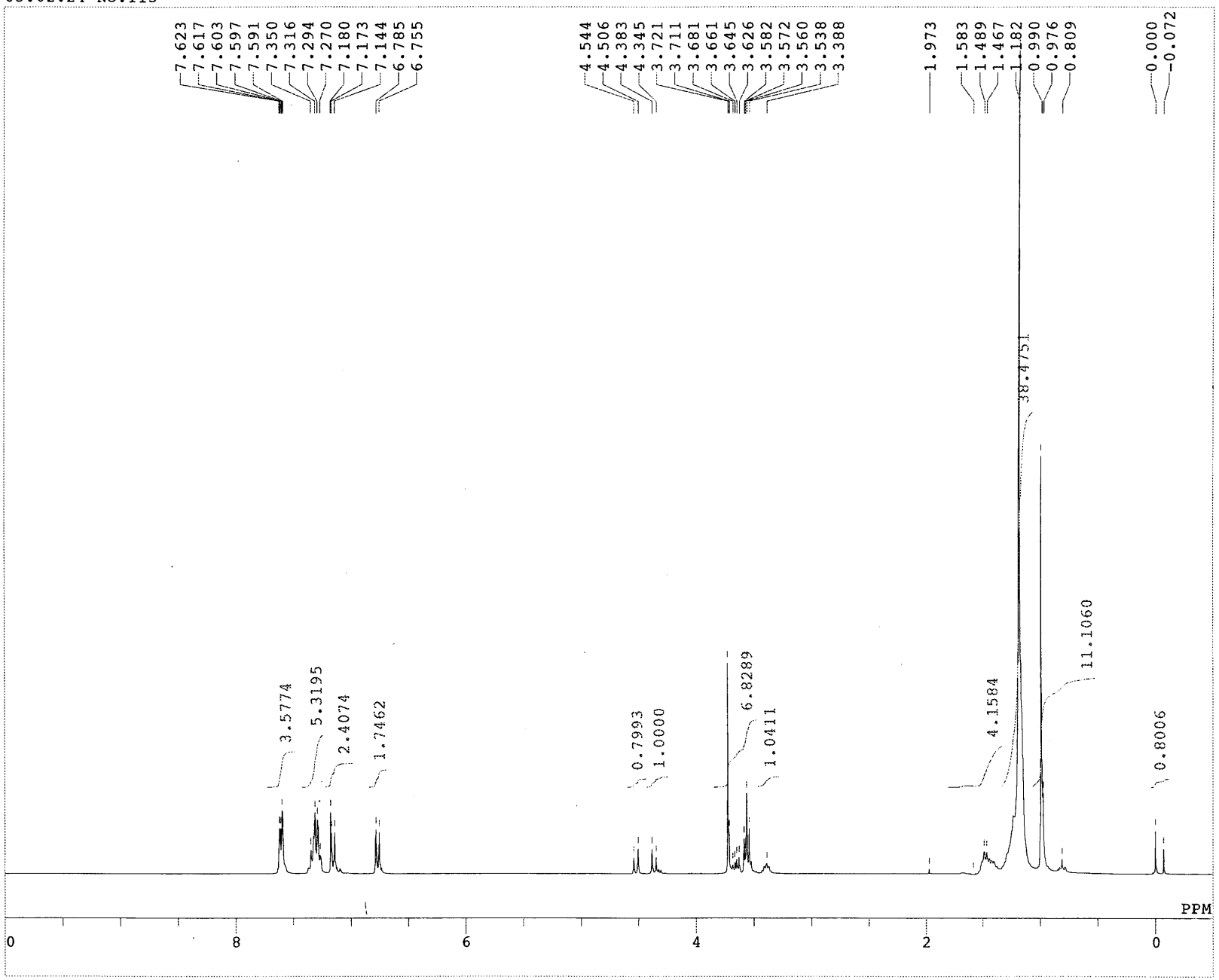



```
DFILE  C:\WINNMR95\TEMPDATA\AUTO2BCM_E1_FT
COMNT  04.02.21 No.
DATIM  Sat Feb 21 10:48:32 2004
OBNUC  13C
EXMOD  BCM
OBFRQ        75.45 MHz
OBSET       124.00 KHz
OBFIN       1840.0 Hz
POINT         32768
FREQU      20408.1 Hz
SCANS           256
ACQTM         1.606 sec
PD            1.394 sec
PW1             4.2 us
IRNUC  1H
CTEMP          20.2 c
SLVNT  CDCL3
EXREF         77.00 ppm
BF             1.20 Hz
RGAIN            25
```

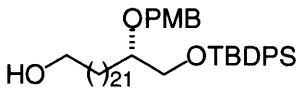


12

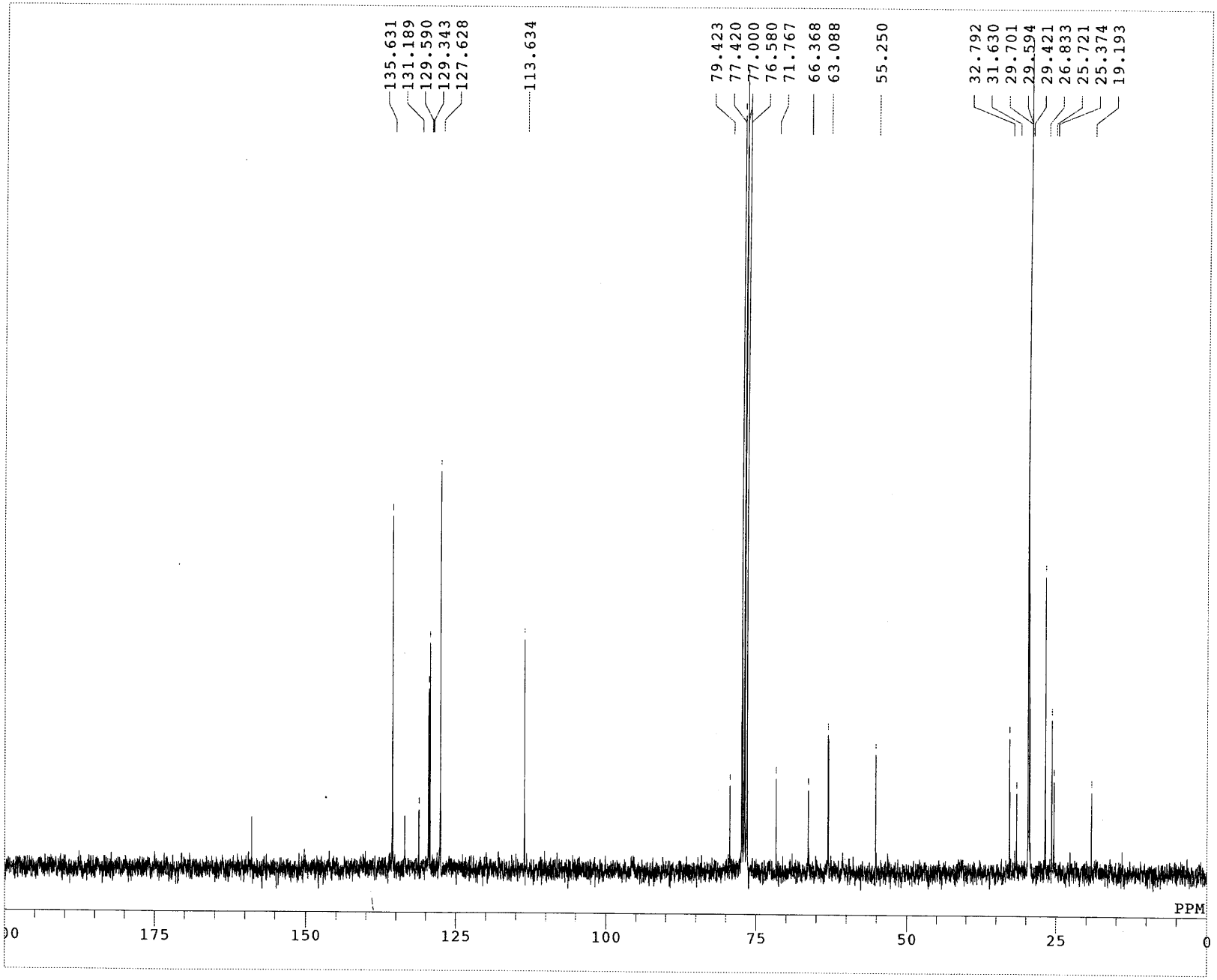
03.02.24 No.113



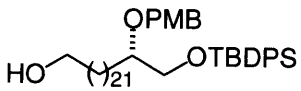
DFILE C:\WINNMR95\DATA\Auto1NON_E1_FT.als
COMNT 03.02.24 No.113
DATIM Wed Feb 25 14:23:46 2004
OBNUC 1H
EXMOD NON
OBFRQ 300.40 MHz
OBSET 130.00 KHz
OBFIN 1150.0 Hz
POINT 32768
FREQU 6020.4 Hz
SCANS 32
ACQTM 5.443 sec
PD 1.554 sec
PW1 5.5 us
IRNUC 1H
CTEMP 21.3 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 14



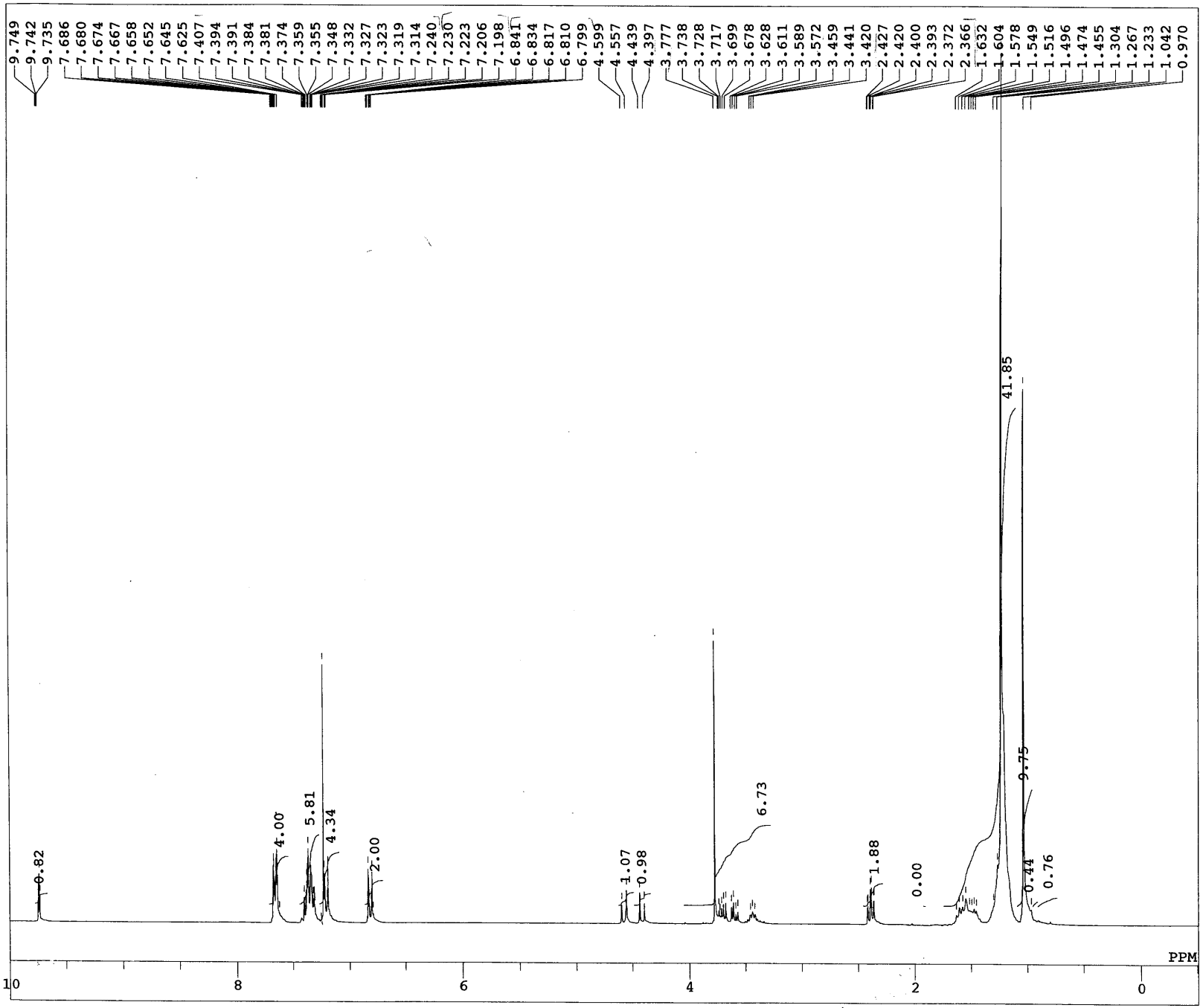
03.02.24 No.113



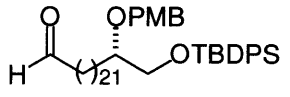

```
DFILE  C:\WINNMR95\TEMPDATA\AUTO2BCM_E1_FT
COMNT  03.02.24 No.113
DATIM  Wed Feb 25 14:49:52 2004
OBNUC  13C
EXMOD  BCM
OBFRQ        75.45 MHz
OBSET       124.00 KHz
OBFIN       1840.0 Hz
POINT        32768
FREQU      20408.1 Hz
SCANS          512
ACQTM        1.606 sec
PD           1.394 sec
PW1            4.2 us
IRNUC  1H
CTEMP         21.0 c
SLVNT  CDCL3
EXREF        77.00 ppm
BF            1.20 Hz
RGAIN           25
```



C:\WINNMR98\DATA\Autol NON_E1_FT.als
04.04.02

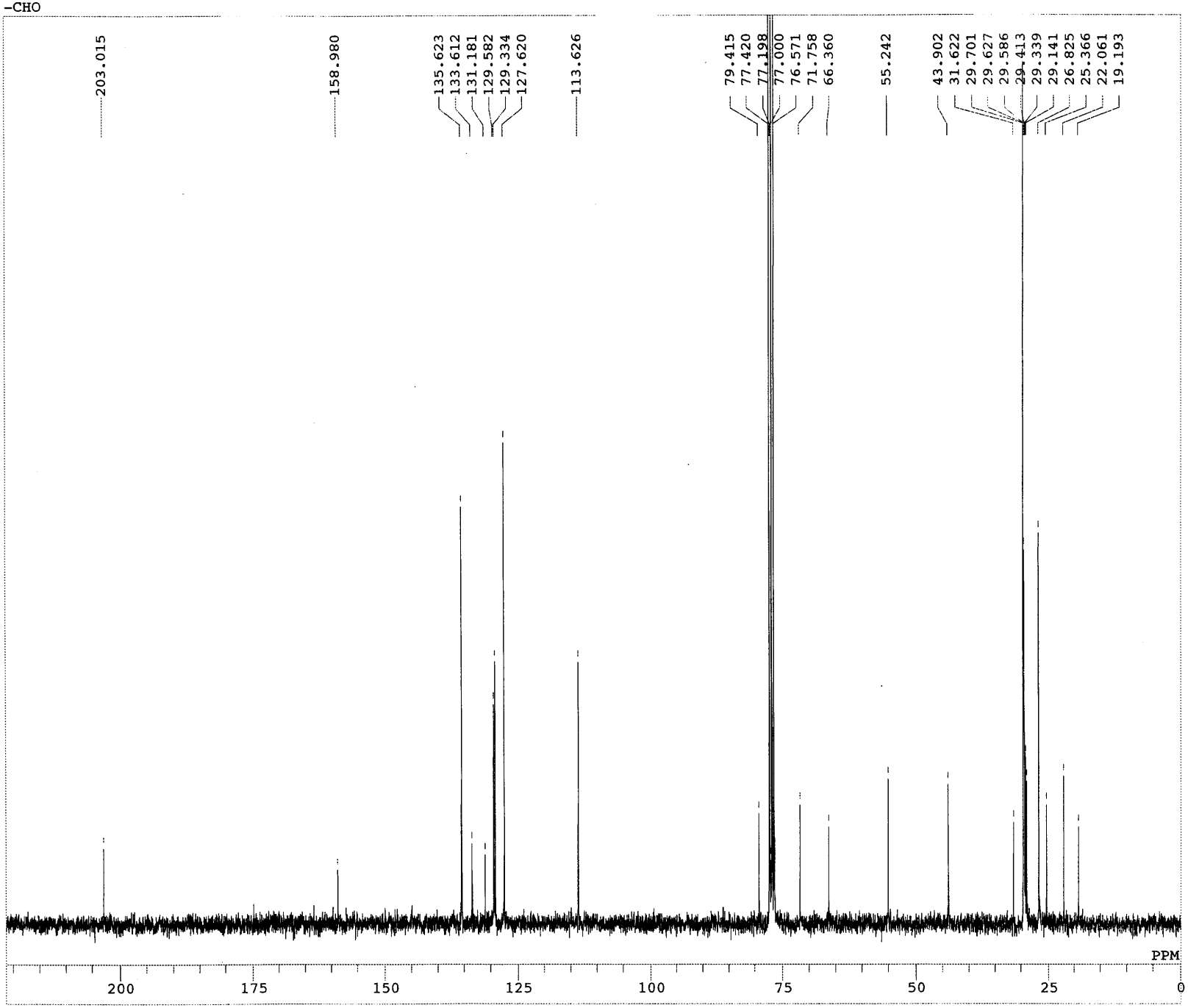


DFILE C:\WINNMR98\DATA\Autol NON_E1_FT.a]
COMNT 04.04.02
DATIM Fri Apr 02 18:32:54 2004
OBNUC 1H
EXMOD NON
OBFRQ 270.05 MHz
OBSET 112.00 KHz
OBFIN 5800.0 Hz
POINT 32768
FREQU 5405.4 Hz
SCANS 64
ACQTM 6.062 sec
PD 0.935 sec
PW1 5.5 us
IRNUC 1H
CTEMP 20.9 c
SLVNT CDCL3
EXREF 7.24 ppm
BF 0.12 Hz
RGAIN 19

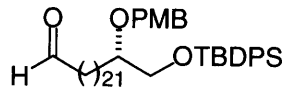


13

-CHO

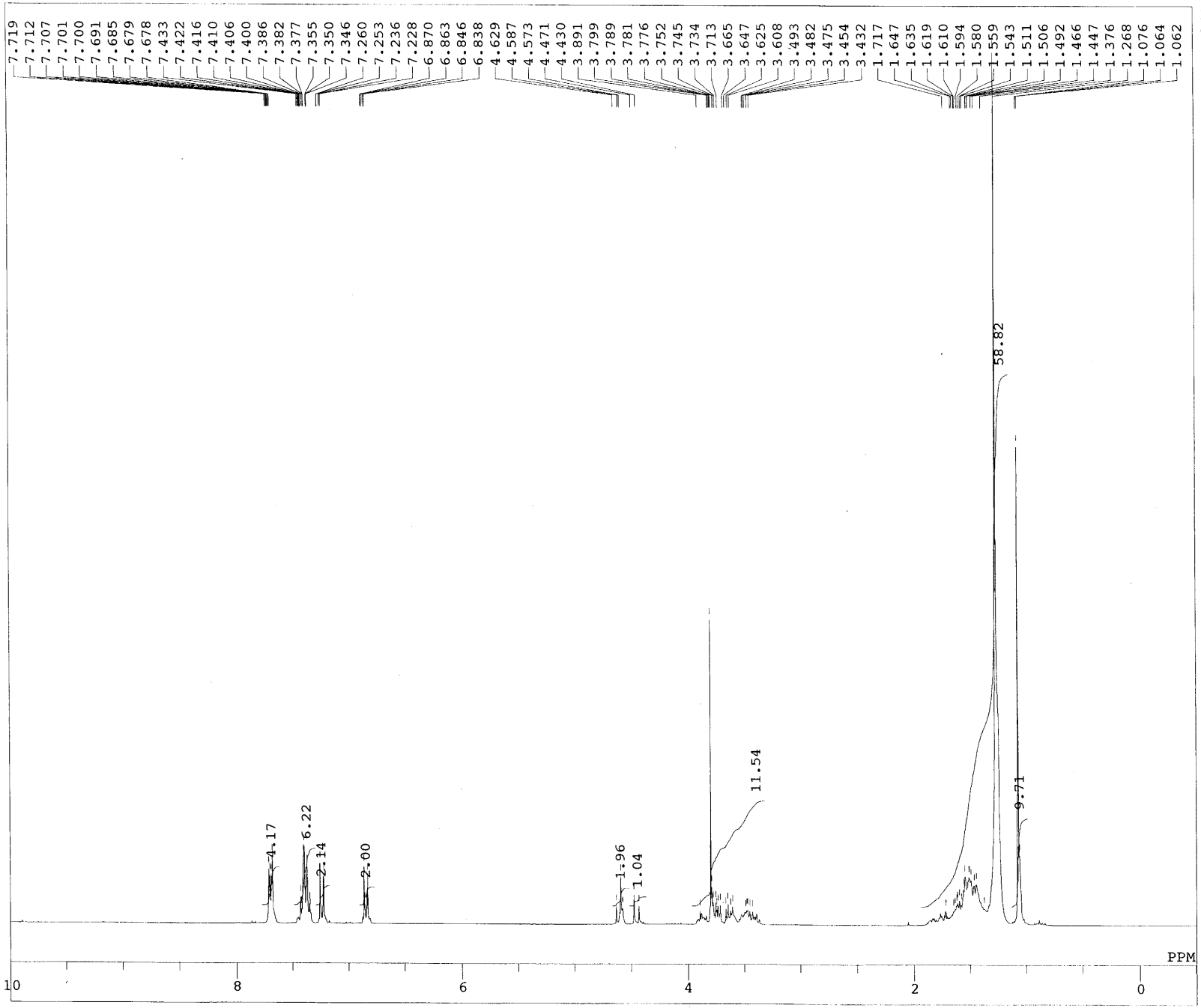



```
DFILE   C:\WINNMR95\TEMPDATA\AUTO2BCM_E1_F
COMNT   -CHO
DATIM   Sat Feb 11 13:18:22 2006
OBNUC   13C
EXMOD   BCM
OBFRQ        75.45 MHz
OBSET       124.00 KHz
OBFIN       1840.0 Hz
POINT        32768
FREQU      20408.1 Hz
SCANS          960
ACQTM        1.606 sec
PD           1.394 sec
PW1            4.1 us
IRNUC   1H
CTEMP         20.5 c
SLVNT   CDCL3
EXREF        77.00 ppm
BF            1.20 Hz
RGAIN           22
```

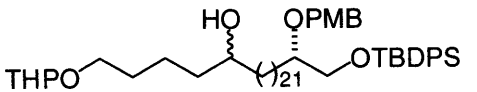


13

C:\Winnmr98\DATA\Auto1NON_E1_FT.als

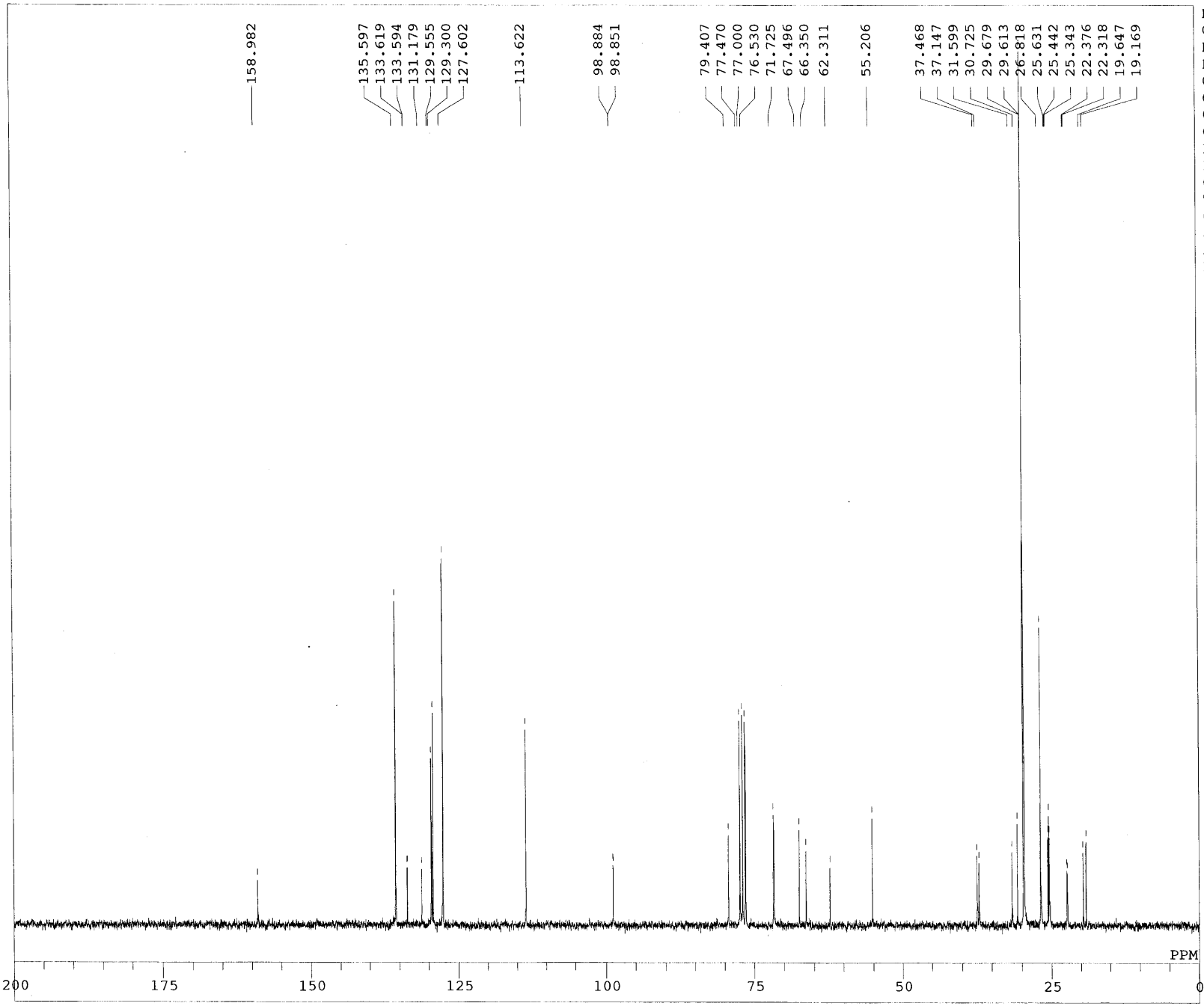


DFILE	C:\Winnmr98\DATA\Auto1NON_E1_FT.al	
COMNT		
DATIM	Sun Dec 11 17:22:22 2005	
EXMOD	NON	
OBNUC	1H	
OBFRQ	270.05	MHz
OBSET	112.00	KHz
OBFIN	5800.0	Hz
POINT	32768	
FREQU	5405.4	Hz
CLPNT	1	
TODAT	1	
CLFRQ	100.0	Hz
SCANS	128	
ACQTM	6.062	sec
PD	0.935	sec
PW1	6.0	us
PW2	10.0	us
PW3	10.0	us
PI1	1.000	ms
PI2	1.000	ms
PI3	1.00	ms
IRNUC	1H	
CTEMP	22.6	c
SLVNT	CDCL3	
EXREF	7.26	ppm
CLEXR	0.00	
RGAIN	11	
OBATN	511	
LOOP1	1	

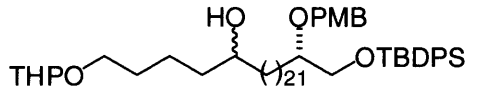


14

C:\WINNMR98\TEMPDATA\Auto2BCM_E1_FT.als

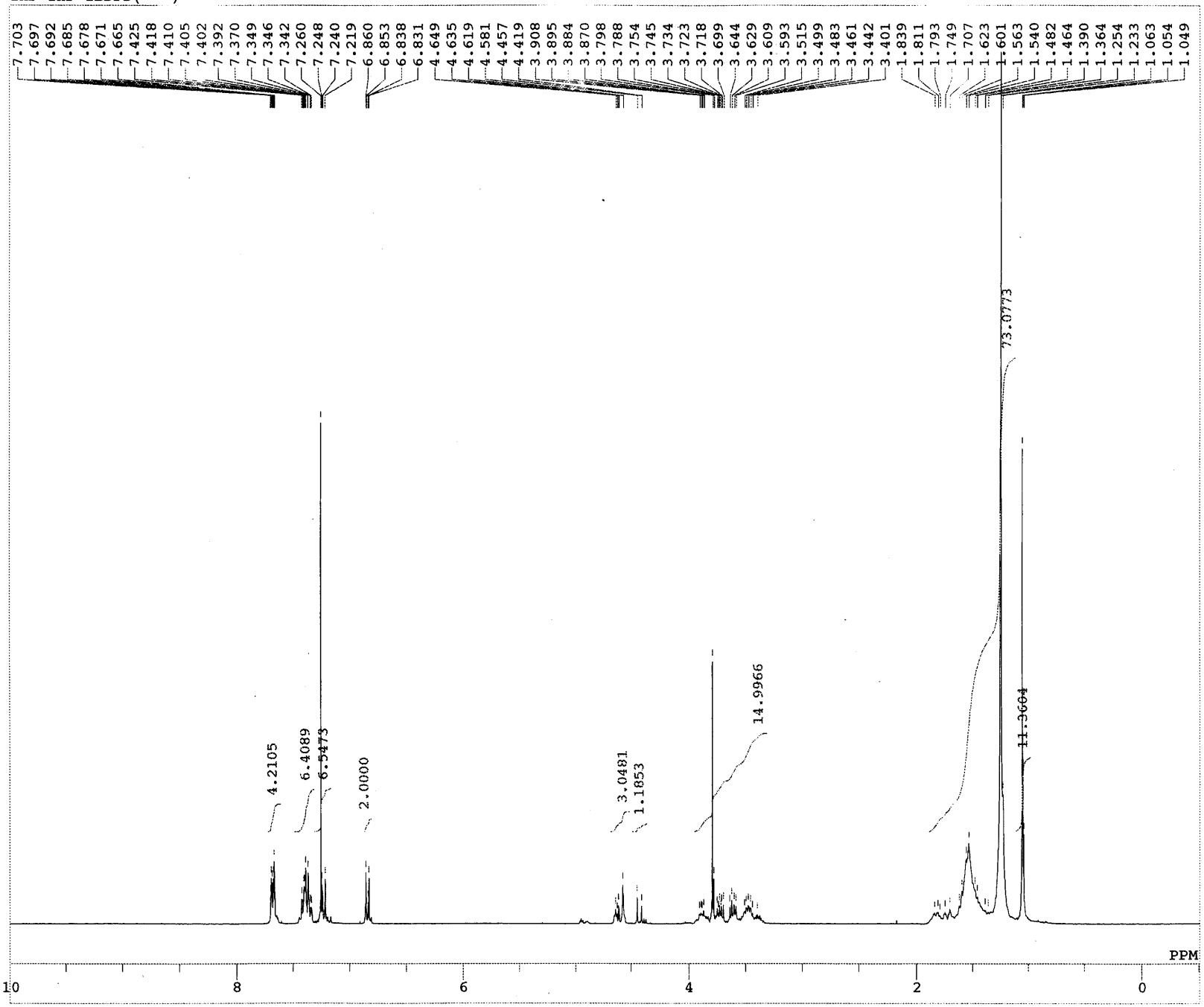


DFILE	C:\WINNMR98\TEMPDATA\Auto2BCM_E1_F
COMNT	
DATIM	Sun Dec 11 17:37:50 2005
EXMOD	BCM
OBNUC	13C
OBFRQ	67.80 MHz
OBSET	135.00 KHz
OBFIN	5200.0 Hz
POINT	32768
FREQU	18348.6 Hz
CLPNT	1
TODAT	1
CLFRQ	500.0 Hz
SCANS	300
ACQTM	1.786 sec
PD	1.211 sec
PW1	3.8 us
PW2	10.0 us
PW3	10.0 us
PI1	1.000 ms
PI2	1.000 ms
PI3	1.00 ms
IRNUC	1H
CTEMP	22.7 c
SLVNT	CDCL3
EXREF	77.00 ppm
CLEXR	0.00
RGAIN	30
OBATN	511
LOOP1	1

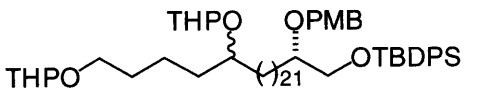


14

THP-THP-TBDPS(^-^)

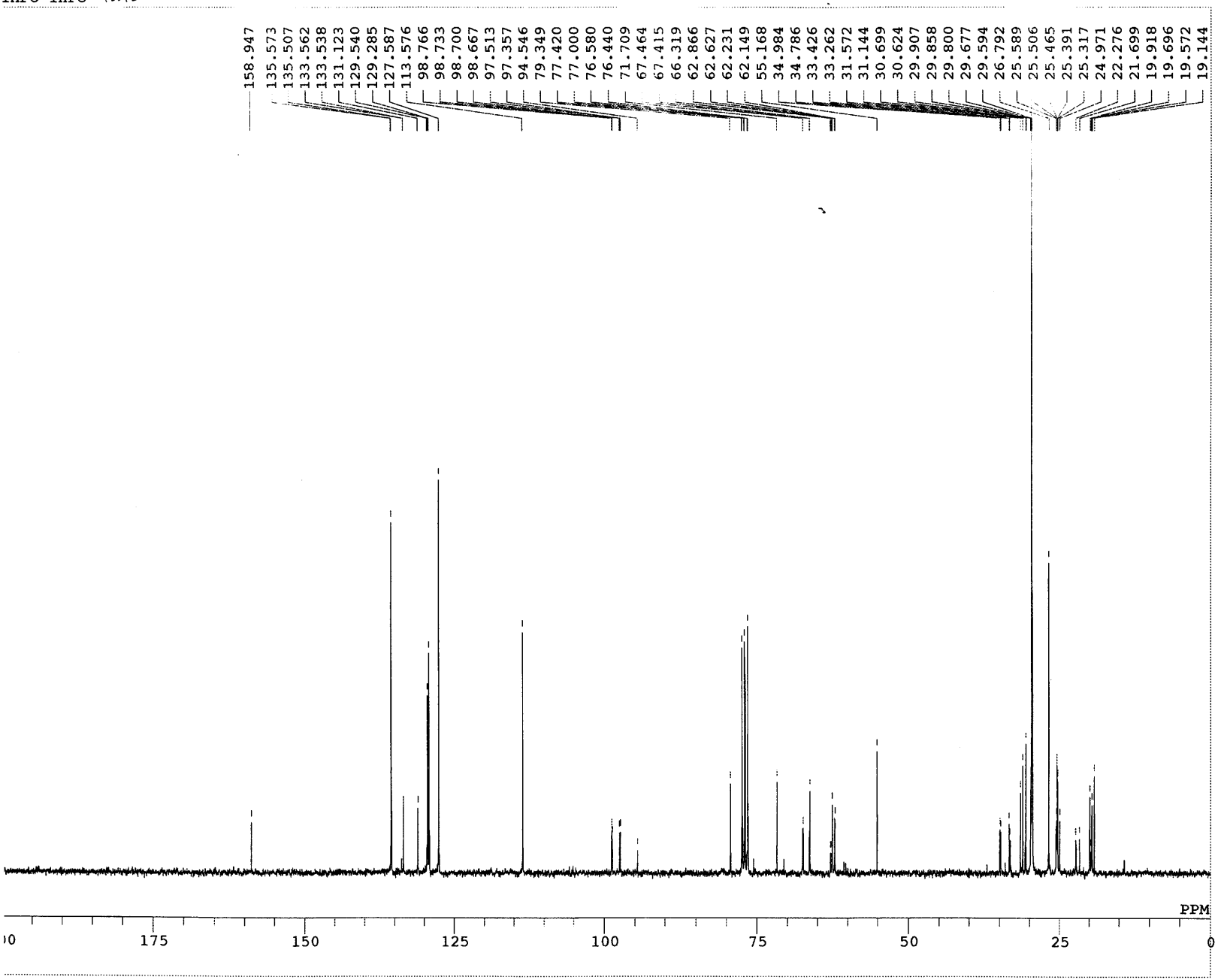



```
DFILE   C:\WINNMR95\DATA\Auto1NON_E1_FT.al
COMNT   THP-THP-TBDPS(^-^)
DATIM   Wed Feb 08 21:07:50 2006
OBNUC   1H
EXMOD   NON
OBFRQ         300.40 MHz
OBSET         130.00 KHz
OBFIN         1150.0 Hz
POINT          32768
FREQU         6020.4 Hz
SCANS              8
ACQTM          5.443 sec
PD             1.554 sec
PW1              5.4 us
IRNUC   1H
CTEMP           19.6 c
SLVNT   CDCL3
EXREF          7.26 ppm
BF             0.12 Hz
RGAIN            17
```

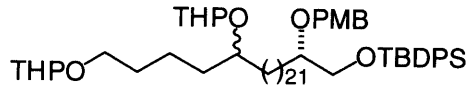


15

THPO-THPO- TBDPS

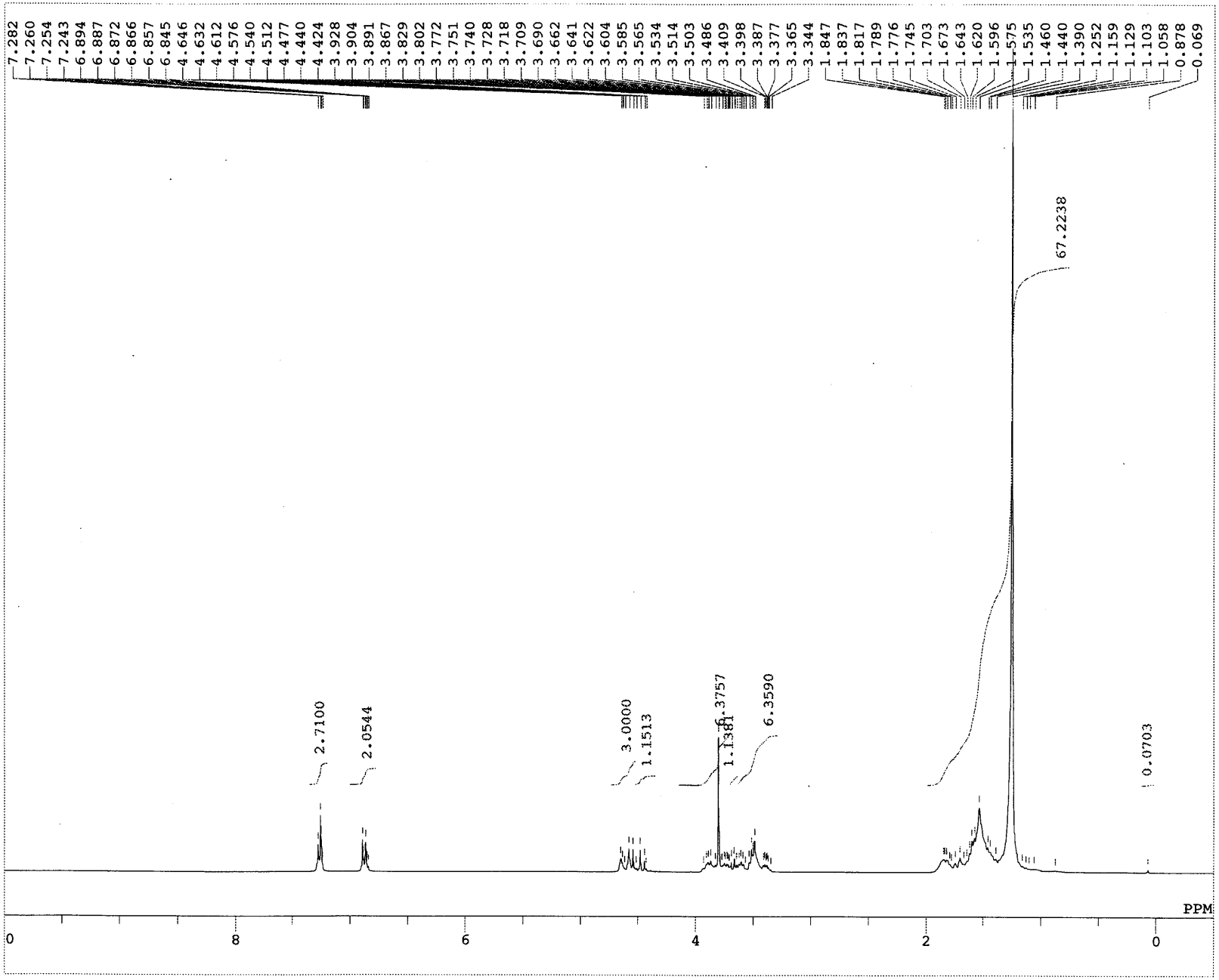


DFILE	C:\WINNMR95\TEMPDATA\AUTO2BCM_E1_FT.AL
COMNT	THPO-THPO-COOH
DATIM	Tue Mar 14 21:10:51 2006
OBNUC	13C
EXMOD	BCM
OBFRQ	75.45 MHz
OBSET	124.00 KHz
OBFIN	1840.0 Hz
POINT	32768
FREQU	20408.1 Hz
SCANS	320
ACQTM	1.606 sec
PD	1.394 sec
PW1	4.1 us
IRNUC	1H
CTEMP	20.7 c
SLVNT	CDCL3
EXREF	77.00 ppm
BF	1.20 Hz
RGAIN	22

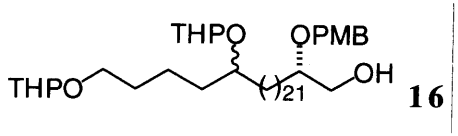


15

-OH

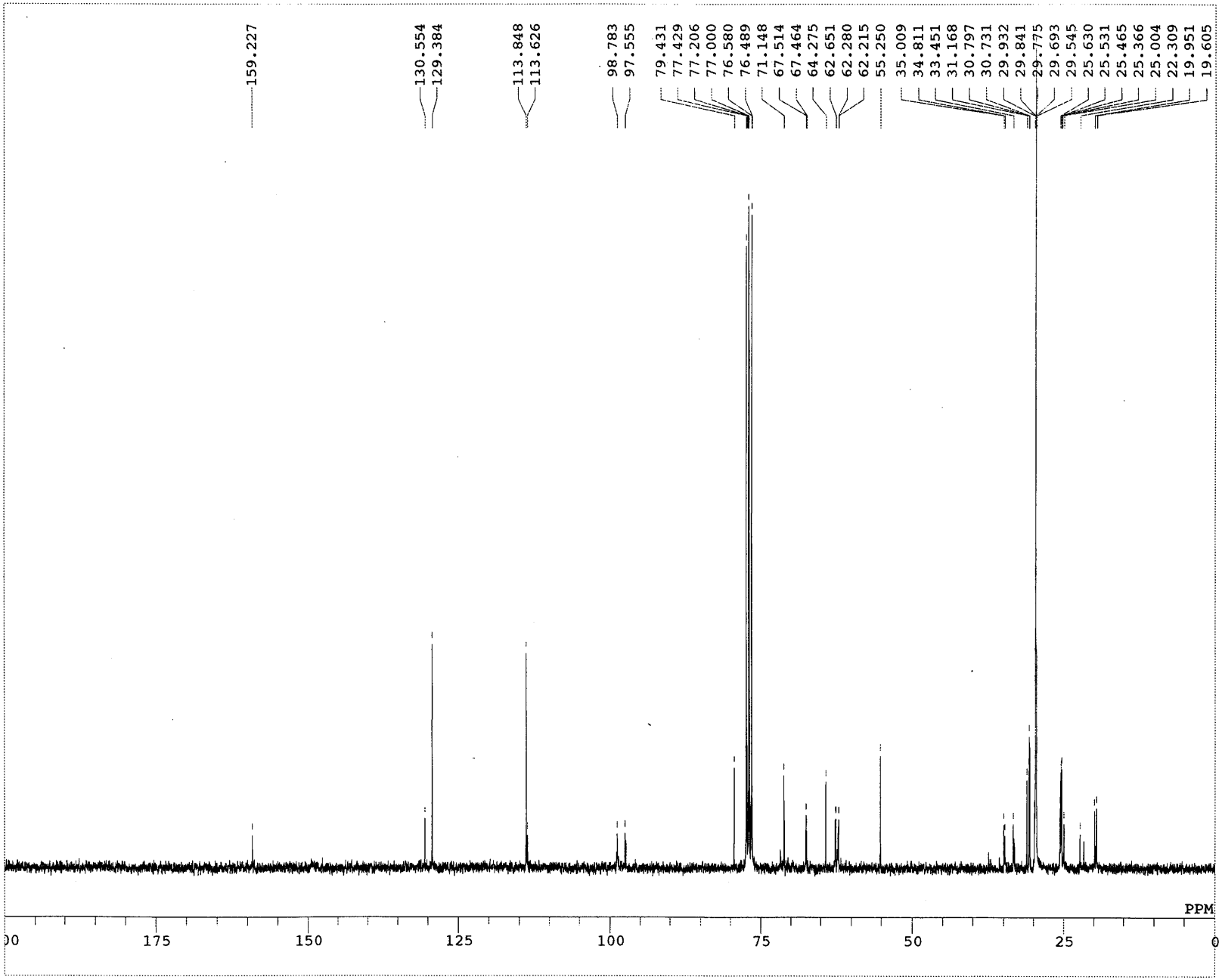


DFILE C:\WINNMR95\DATA\Autol NON_E1_FT.als
COMNT -OH
DATIM Sat Feb 11 16:59:31 2006
OBNUC 1H
EXMOD NON
OBFRQ 300.40 MHz
OBSET 130.00 KHz
OBFIN 1150.0 Hz
POINT 32768
FREQU 6020.4 Hz
SCANS 8
ACQTM 5.443 sec
PD 1.554 sec
PW1 5.4 us
IRNUC 1H
CTEMP 20.8 c
SLVNT CDCL3
EXREF 7.26 ppm
BF 0.12 Hz
RGAIN 11

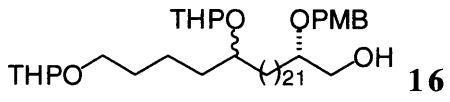


16

-OH

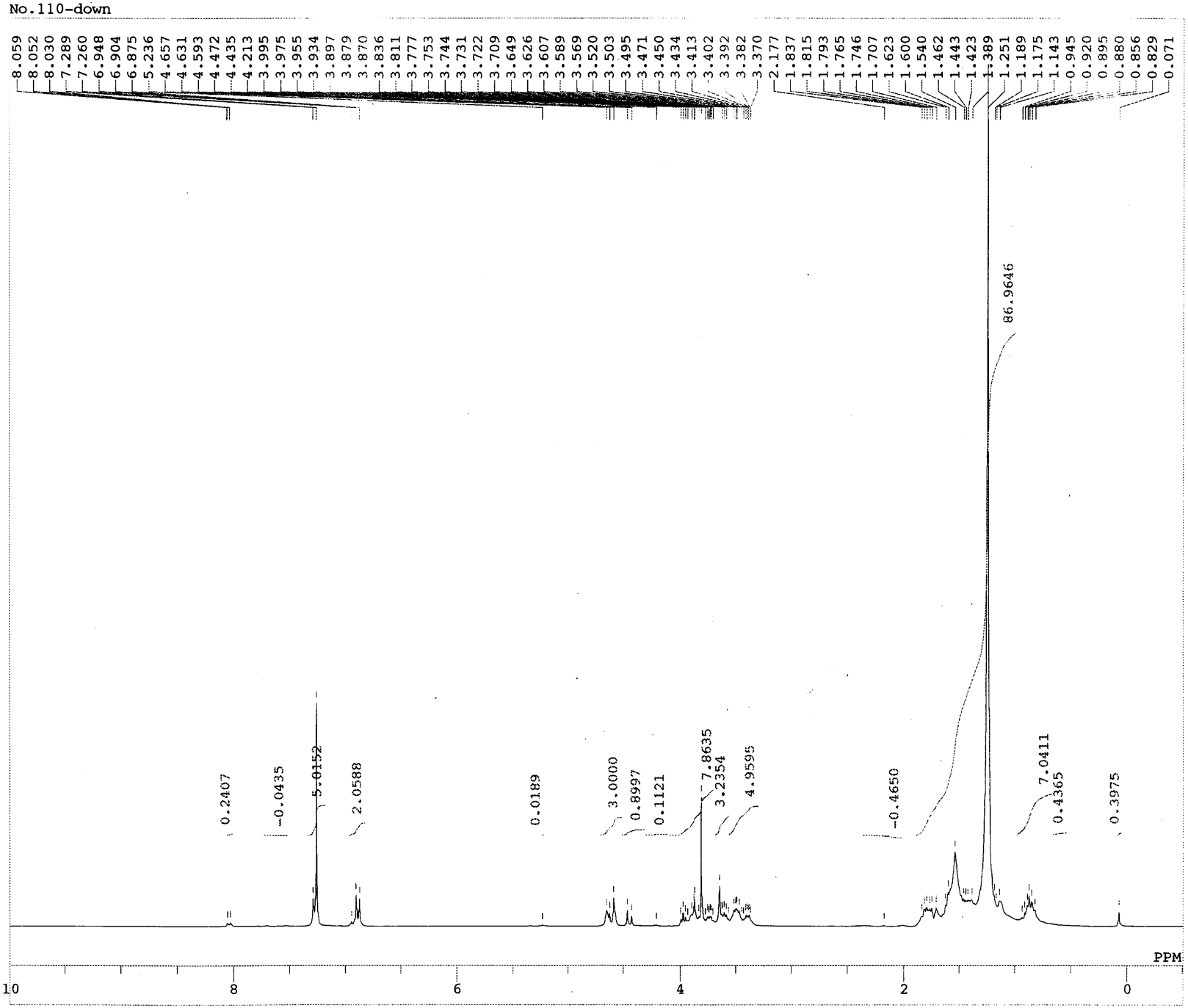


DFILE C:\WINNMR95\DATA\Auto2BCM_E1_FT.als
COMNT -OH
DATIM Sat Feb 11 17:48:02 2006
OBNUC 13C
EXMOD BCM
OBFRQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 960
ACQTM 1.606 sec
PD 1.394 sec
PW1 4.1 us
IRNUC 1H
CTEMP 20.4 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 22

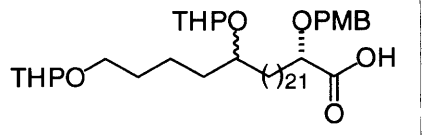


16

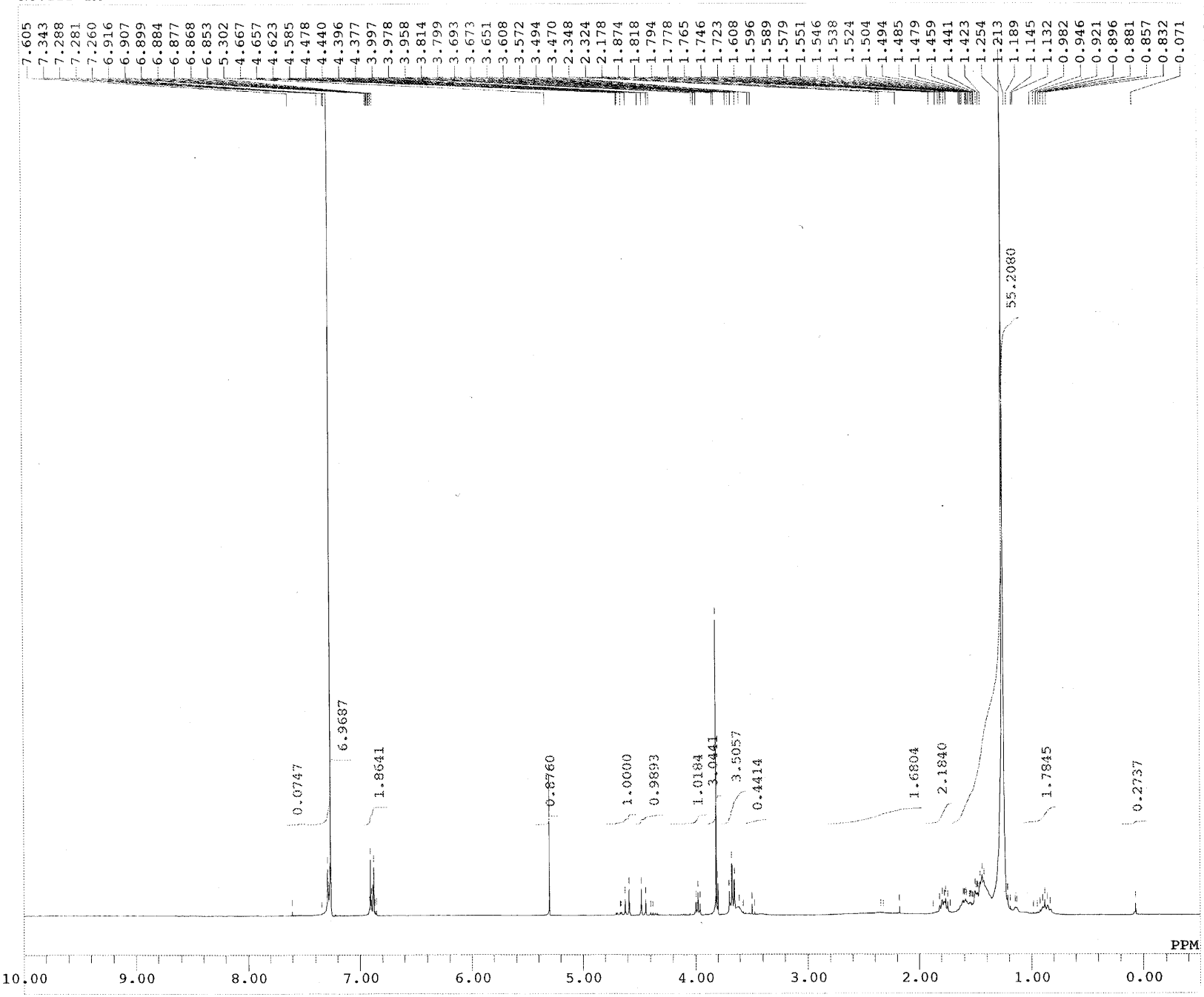
No.110-down



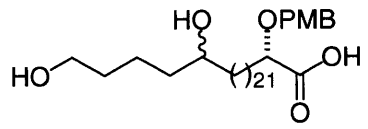
DFILE C:\WINNMR95\DATA\Auto1NON_E1_FT.al
COMNT No.110-down
DATIM Thu Feb 09 13:54:43 2006
OBNUC 1H
EXMOD NON
OBFRQ 300.40 MHz
OBSET 130.00 KHz
OBFIN 1150.0 Hz
POINT 32768
FREQU 6020.4 Hz
SCANS 64
ACQTM 5.443 sec
PD 1.554 sec
PW1 5.4 us
IRNUC 1H
CTEMP 18.8 c
SLVNT CDCL3
EXREF 7.26 ppm
BF 0.12 Hz
RGAIN 16



No.111-TM

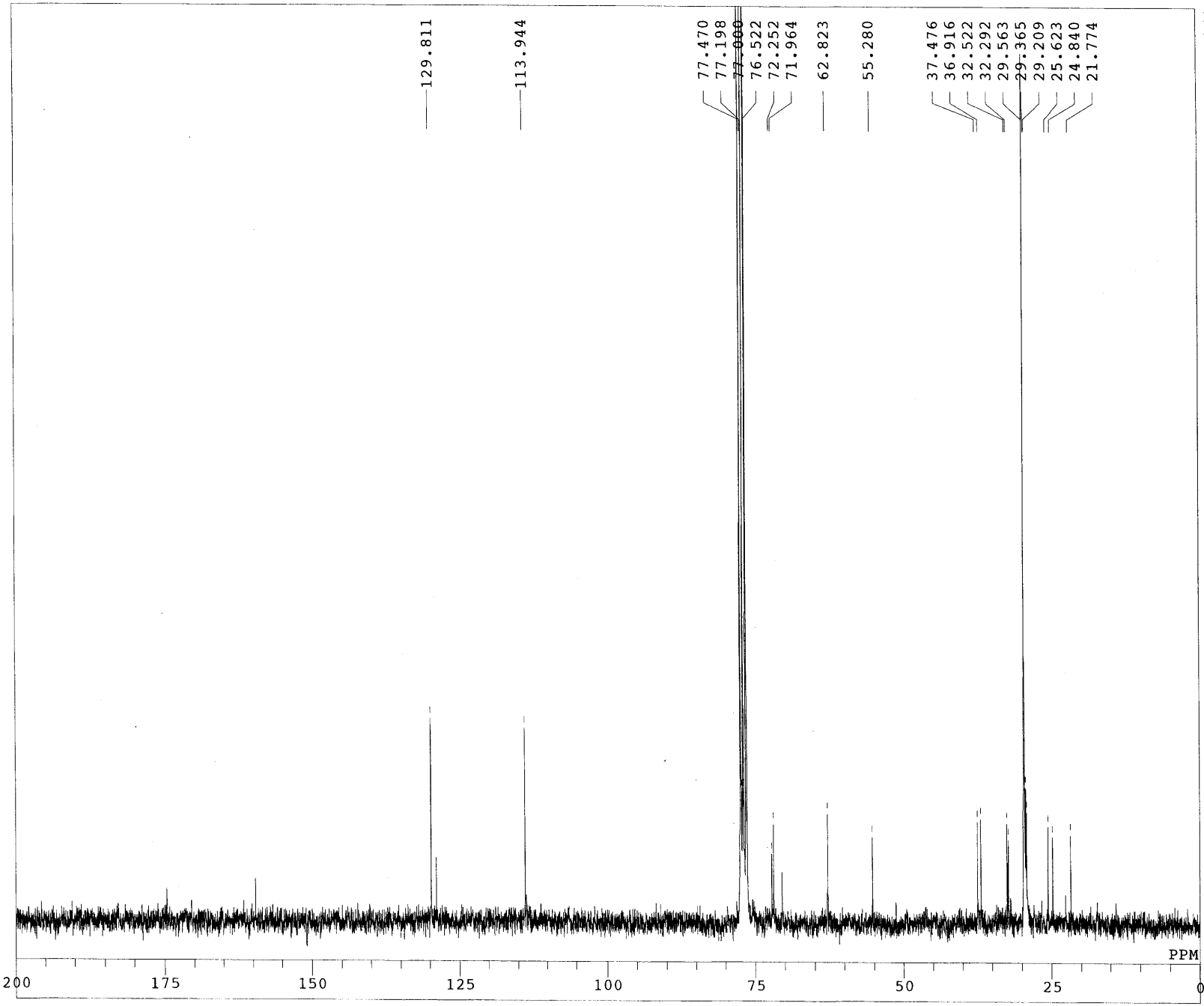



```
DFILE   C:\WINNMR95\DATA\AutolNON_E1_FT.a
COMNT   No.111-TM
DATIM   Tue Feb 07 18:15:34 2006
OBNUC   1H
EXMOD   NON
OBFRQ        300.40 MHz
OBSET        130.00 KHz
OBFIN        1150.0 Hz
POINT         32768
FREQU        6020.4 Hz
SCANS            64
ACQTM         5.443 sec
PD            1.554 sec
PW1             5.4 us
IRNUC   1H
CTEMP          19.0 c
SLVNT   CDCL3
EXREF          7.26 ppm
BF             0.12 Hz
RGAIN            18
```

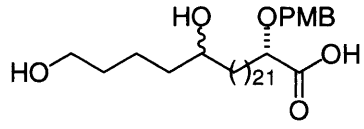


17

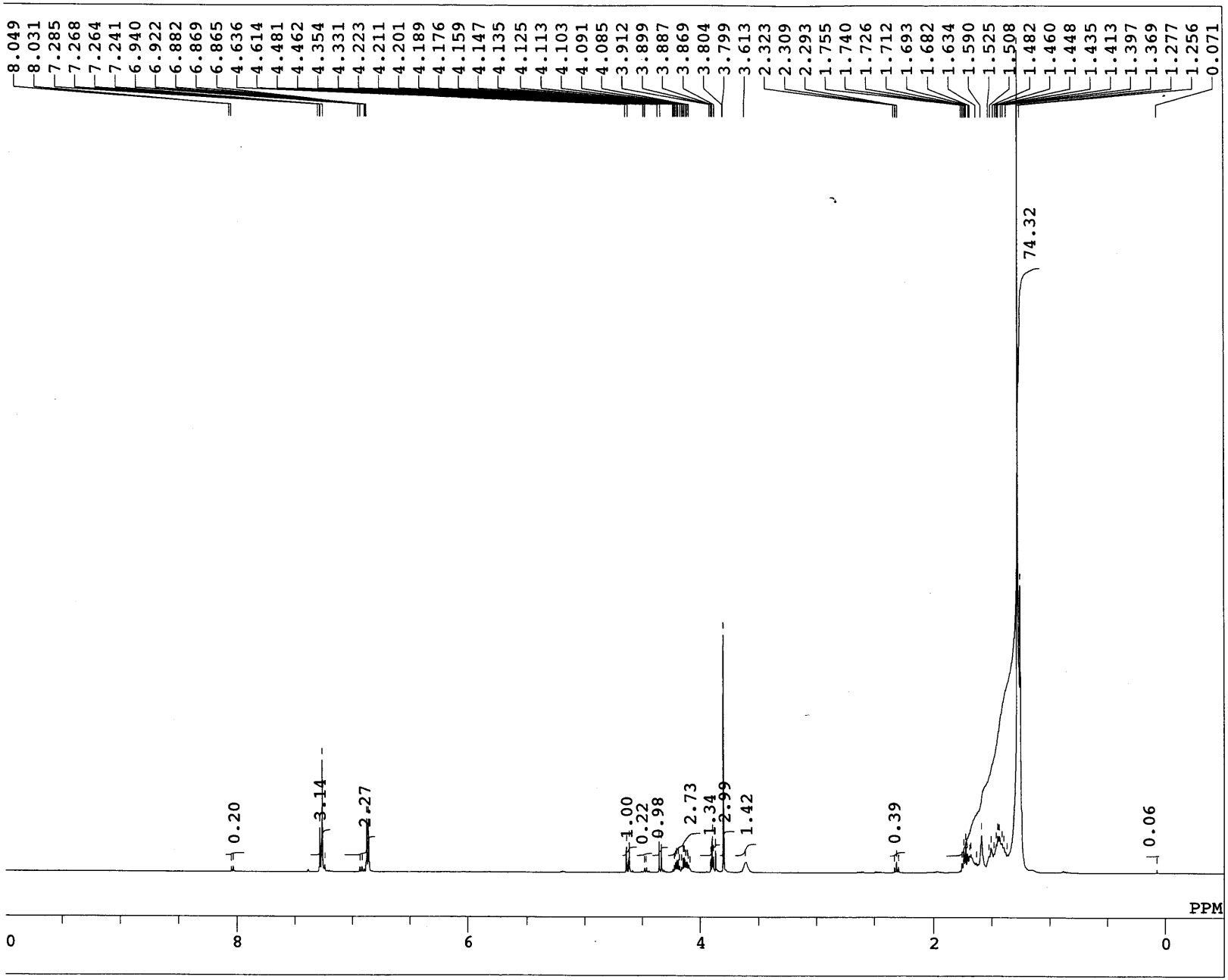
C:\WINNMR98\TEMPDATA\Auto2BCM_E1_FT.als
diOH-COOH



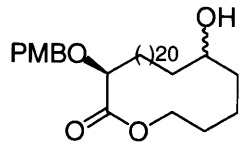

```
DFILE  C:\WINNMR98\TEMPDATA\Auto2BCM_E
COMNT  diOH-COOH
DATIM  Fri Aug 06 08:31:57 2004
OBNUC  13C
EXMOD  BCM
OBFRQ        67.80 MHz
OBSET       135.00 KHz
OBFIN      5200.0 Hz
POINT        32768
FREQU      18348.6 Hz
SCANS        10000
ACQTM        1.786 sec
PD           1.211 sec
PW1            3.7 us
IRNUC  1H
CTEMP         20.9 c
SLVNT  CDCL3
EXREF        77.00 ppm
BF            1.20 Hz
RGAIN           30
```



17

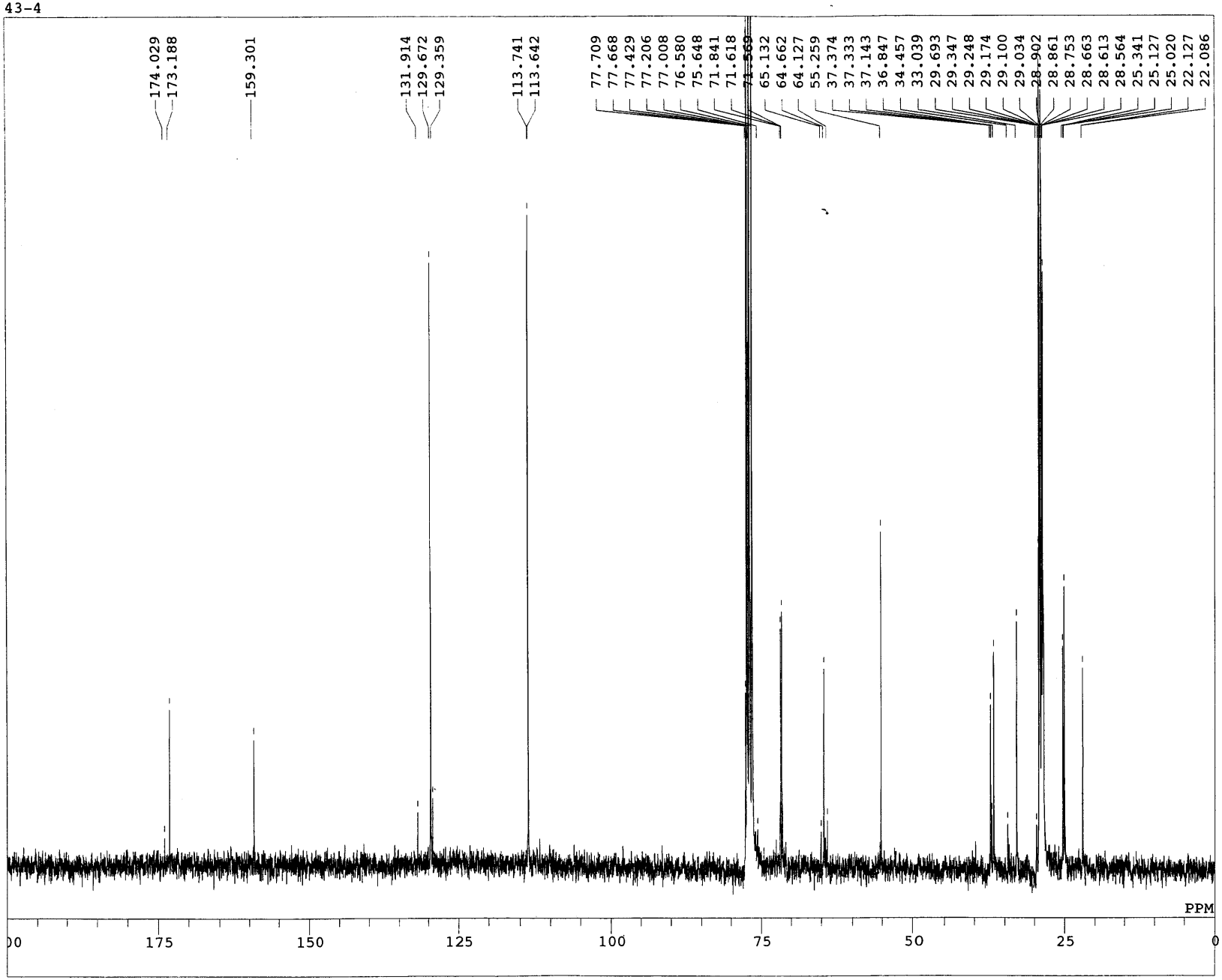


DFILE	C:\WinLambda\AutoData\Auto1non_E1
OBNUC	1H
EXMOD	non
OFR	500.00 MHz
OBSET	0.00 KHz
OBFIN	162160.00 Hz
POINT	32768
FREQU	10000.00 Hz
SCANS	32
ACQTM	3.2768 sec
PD	3.7232 sec
PW1	6.38 usec
IRN	
CTEMP	24.4 c
SLVNT	CDCL3
EXREF	7.26 ppm
BF	0.12 Hz
RGAIN	15

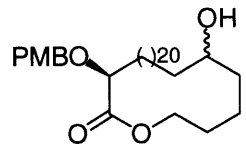


18

43-4

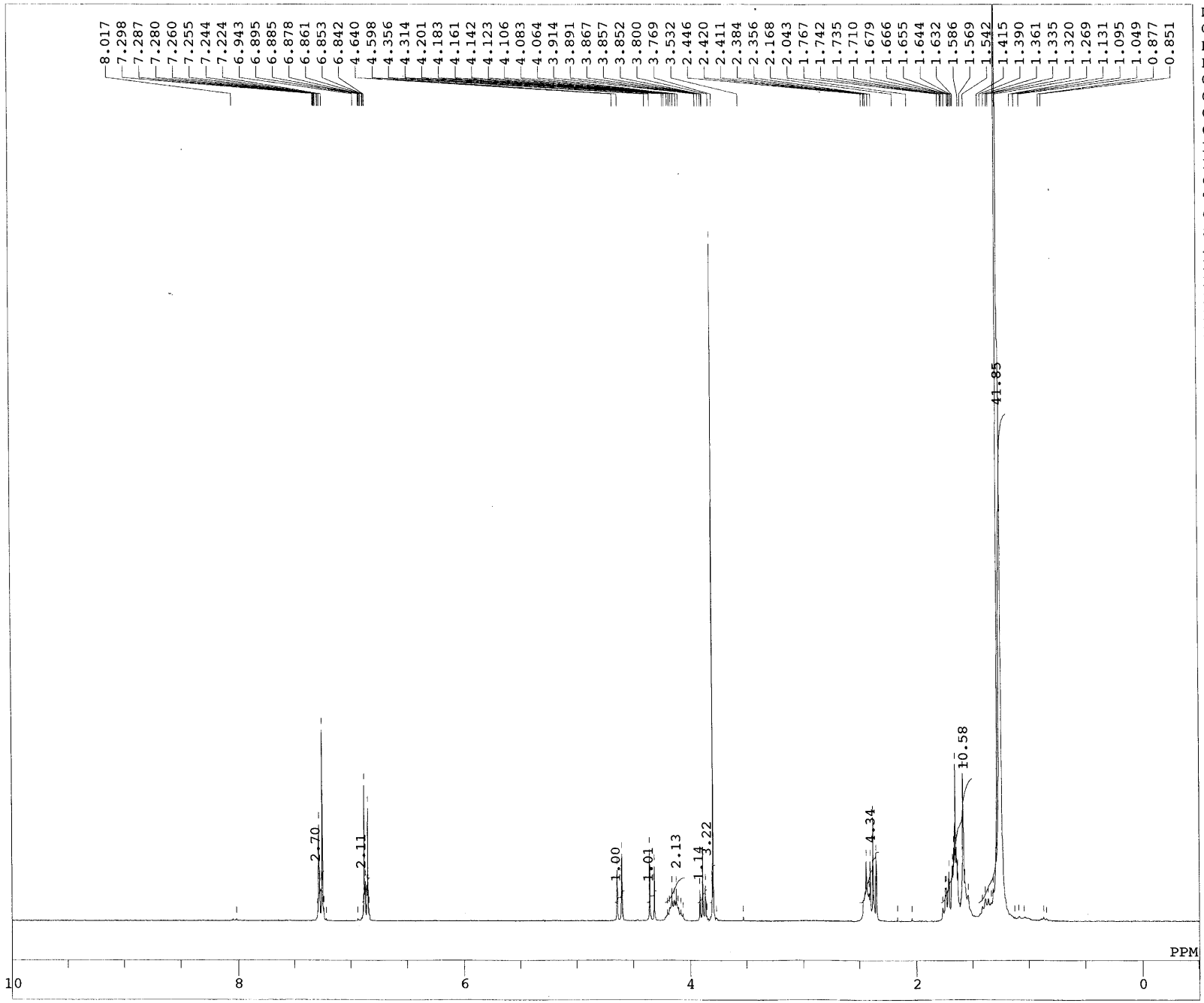


DFILE C:\WINNMR95\DATA\Shiina_Lab\akane\19 C
COMNT 43-4
DATIM Wed Jun 28 05:27:09 2006
OBNUC 13C
EXMOD BCM
OBFRQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 8000
ACQTM 1.606 sec
PD 1.394 sec
PW1 4.1 us
IRNUC 1H
CTEMP 21.5 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 22

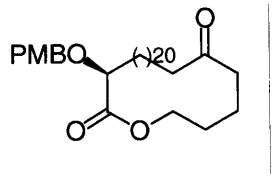


18

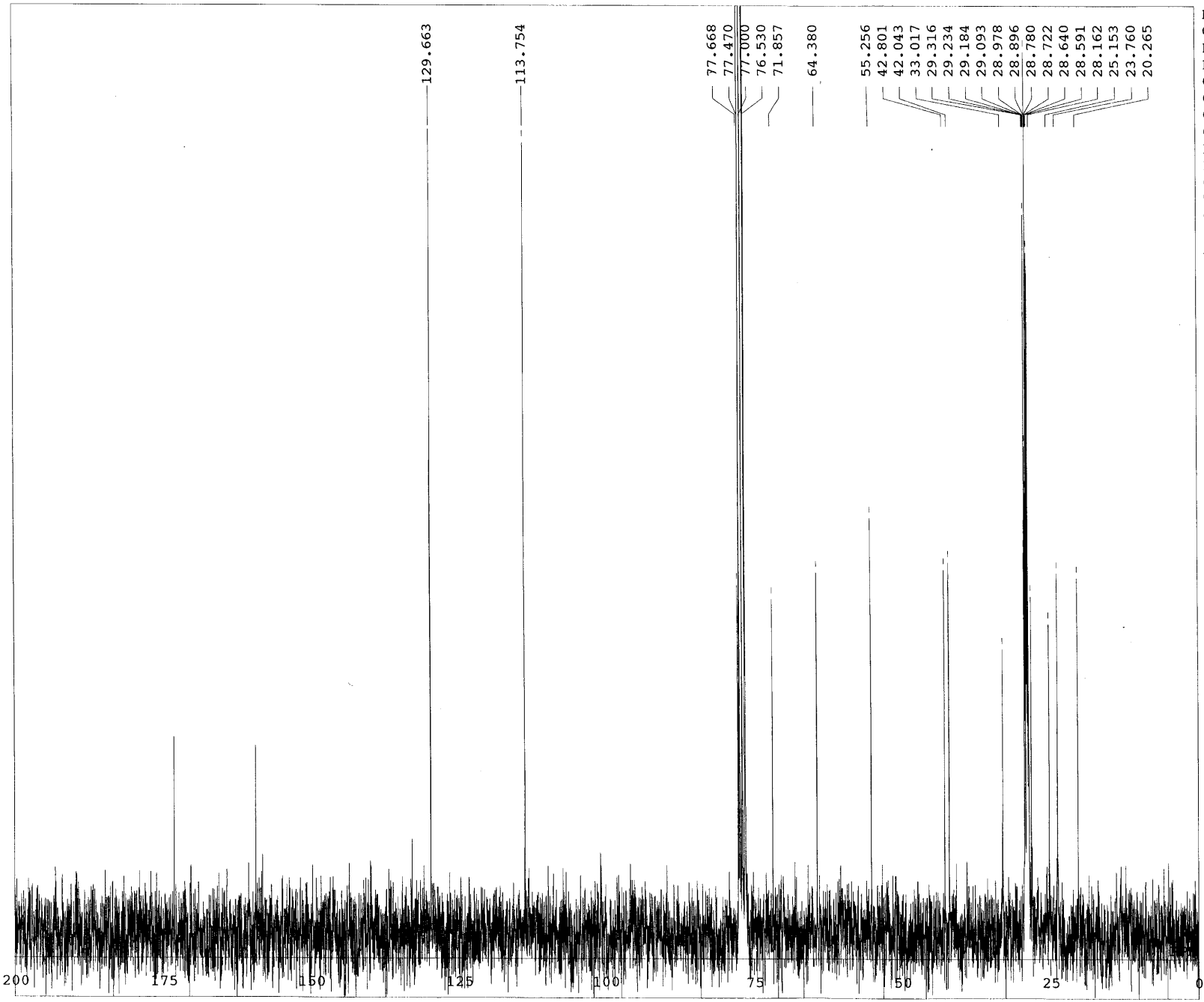
C:\WINNMR98\DATA\Auto1NON_E1_FT.als
Term



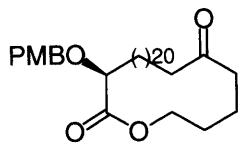
DFILE	C:\WINNMR98\DATA\Auto1NON_E1_FT.al
COMNT	Term
DATIM	Wed Sep 28 10:13:02 2005
EXMOD	NON
OBNUC	1H
OBFRQ	270.05 MHz
OBSET	112.00 KHz
OBFIN	5800.0 Hz
POINT	32768
FREQU	5405.4 Hz
CLPNT	1
TODAT	1
CLFRQ	100.0 Hz
SCANS	8
ACQTM	6.062 sec
PD	0.935 sec
PW1	6.0 us
PW2	10.0 us
PW3	10.0 us
PI1	1.000 ms
PI2	1.000 ms
PI3	1.00 ms
IRNUC	1H
CTEMP	24.1 c
SLVNT	CDCL3
EXREF	7.26 ppm
CLEXR	0.00
RGAIN	17
OBATN	511
LOOP1	1

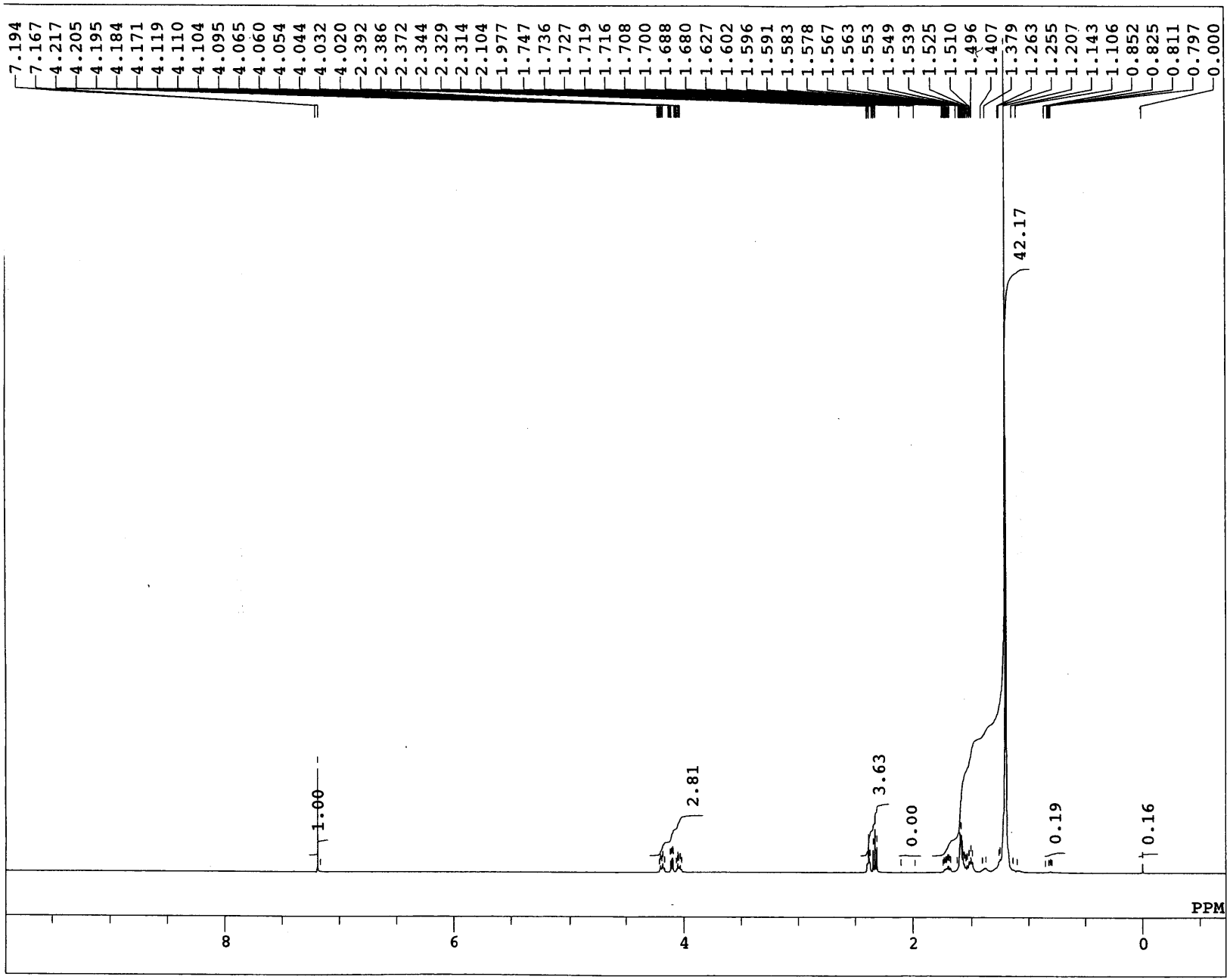


C:\WINNMR98\TEMPDATA\Auto2BCM_E1_FT.als
Term

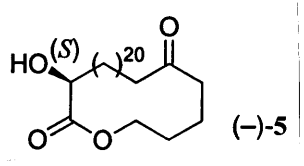


DFILE	C:\WINNMR98\TEMPDATA\Auto2BCM_E1_F
COMNT	Term
DATIM	Wed Sep 28 10:31:25 2005
EXMOD	BCM
OBNUC	13C
OBFRQ	67.80 MHz
OBSET	135.00 KHz
OBFIN	5200.0 Hz
POINT	32768
FREQU	18348.6 Hz
CLPNT	1
TODAT	1
CLFRQ	500.0 Hz
SCANS	360
ACQTM	1.786 sec
PD	1.211 sec
PW1	3.8 us
PW2	10.0 us
PW3	10.0 us
PI1	1.000 ms
PI2	1.000 ms
PI3	1.00 ms
IRNUC	1H
CTEMP	23.7 c
SLVNT	CDCL3
EXREF	77.00 ppm
CLEXR	0.00
RGAIN	30
OBATN	511
LOOP1	1



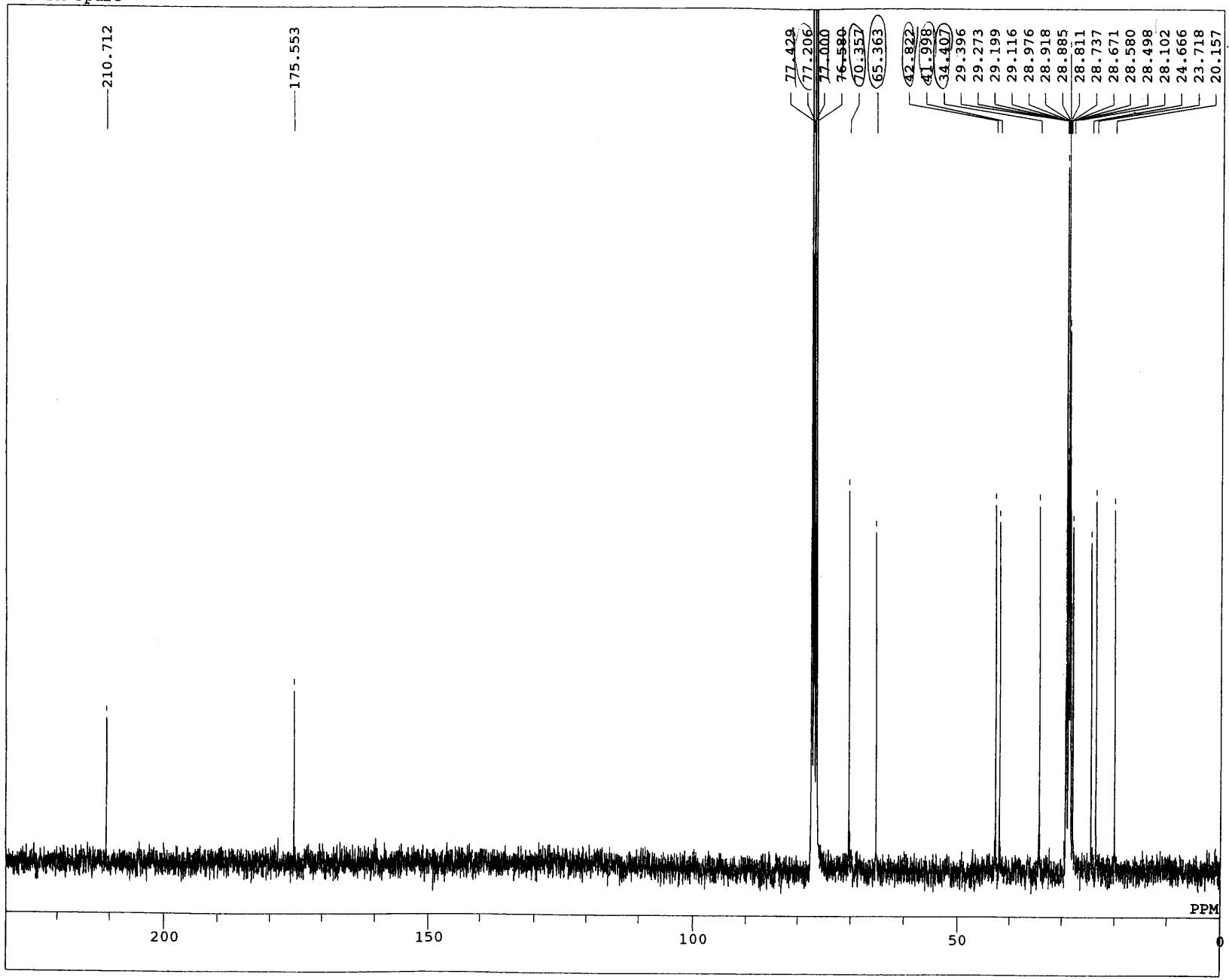


DFILE	C:\WinLambda\TEMPDATA\Auto1non_
OBNUC	1H
EXMOD	non
OFR	500.00 MHz
OBSET	0.00 KHz
OBFIN	162160.00 Hz
POINT	32768
FREQU	10000.00 Hz
SCANS	8
ACQTM	3.2768 sec
PD	3.7232 sec
PW1	6.38 usec
IRN	
CTEMP	24.3 c
SLVNT	CDCL3
EXREF	0.00 ppm
BF	0.12 Hz
RGAIN	17

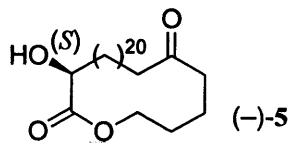


(–)-5

E24-SM Spure

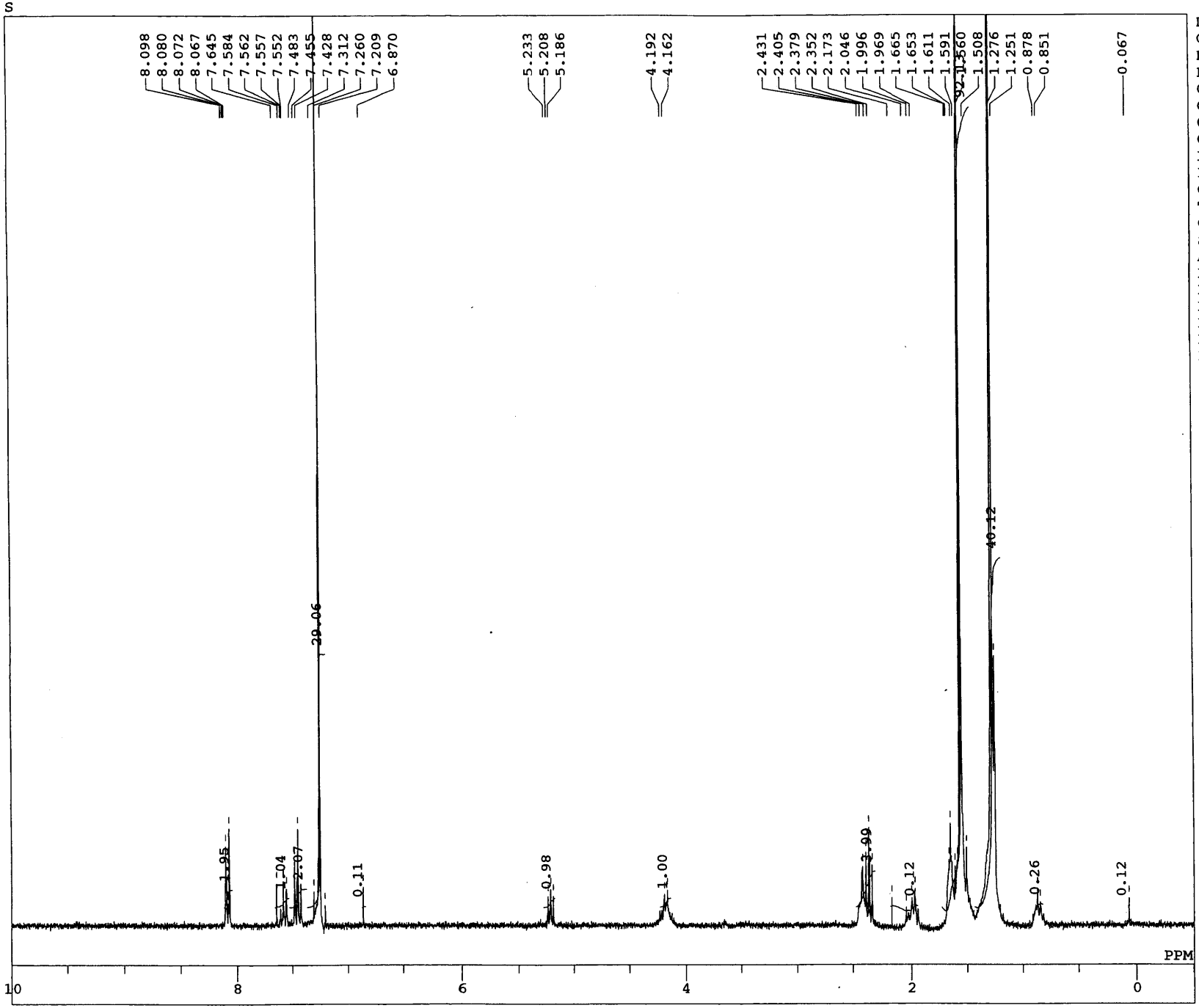



```
DFILE   C:\WINNMR95\TEMPDATA\AUTO2BCM_E1_FT
COMNT   E24-SM Spure
DATIM   Thu Jun 29 04:52:20 2006
OBNUC   13C
EXMOD   BCM
OBFRQ         75.45 MHz
OBSET        124.00 KHz
OBFIN       1840.0 Hz
POINT         32768
FREQU       20408.1 Hz
SCANS          8000
ACQTM         1.606 sec
PD            1.394 sec
PW1             4.1 us
IRNUC   1H
CTEMP          21.6 c
SLVNT   CDCL3
EXREF         77.00 ppm
BF             1.20 Hz
RGAIN            22
```

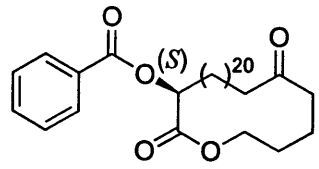


(−)-5

C:\Winnmr98\DATA\Autol NON_E1_FT.als
S

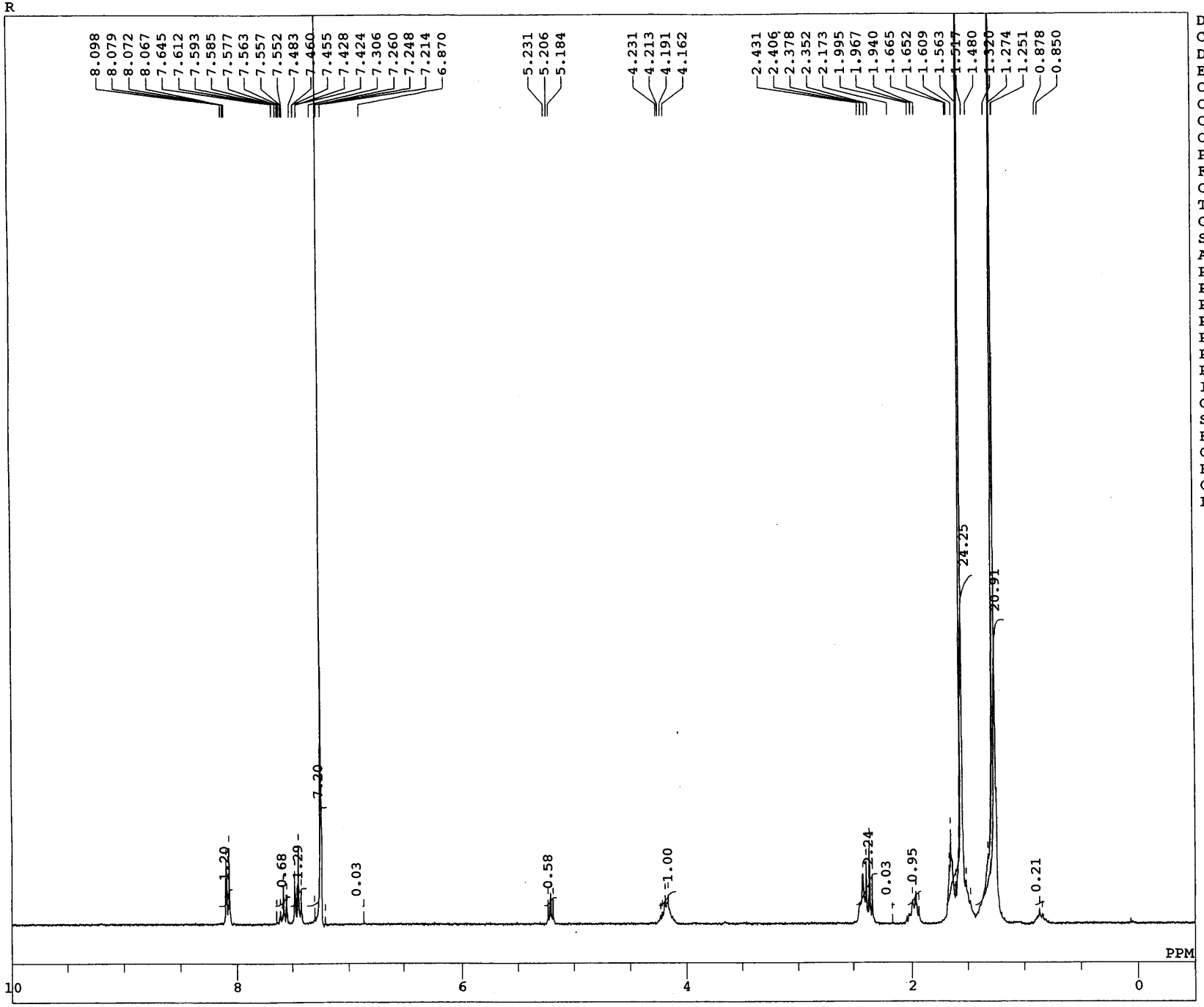


DFILE C:\Winnmr98\DATA\Autol NON_E1_FT.al
COMNT S
DATIM Wed Dec 21 14:59:52 2005
EXMOD NON
OBNUC 1H
OBFRQ 270.05 MHz
OBSET 112.00 KHz
OBFIN 5800.0 Hz
POINT 32768
FREQU 5405.4 Hz
CLPNT 1
TODAT 1
CLFRQ 100.0 Hz
SCANS 180
ACQTM 6.062 sec
PD 0.935 sec
PW1 6.0 us
PW2 10.0 us
PW3 10.0 us
PI1 1.000 ms
PI2 1.000 ms
PI3 1.00 ms
IRNUC 1H
CTEMP 19.6 c
SLVNT CDCL3
EXREF 7.26 ppm
CLEXR 0.00
RGAIN 26
OBATN 511
LOOP1 1

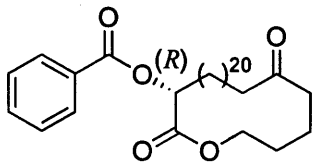


19

C:\Winnmr98\DATA\Autol NON_E1_FT.als
R

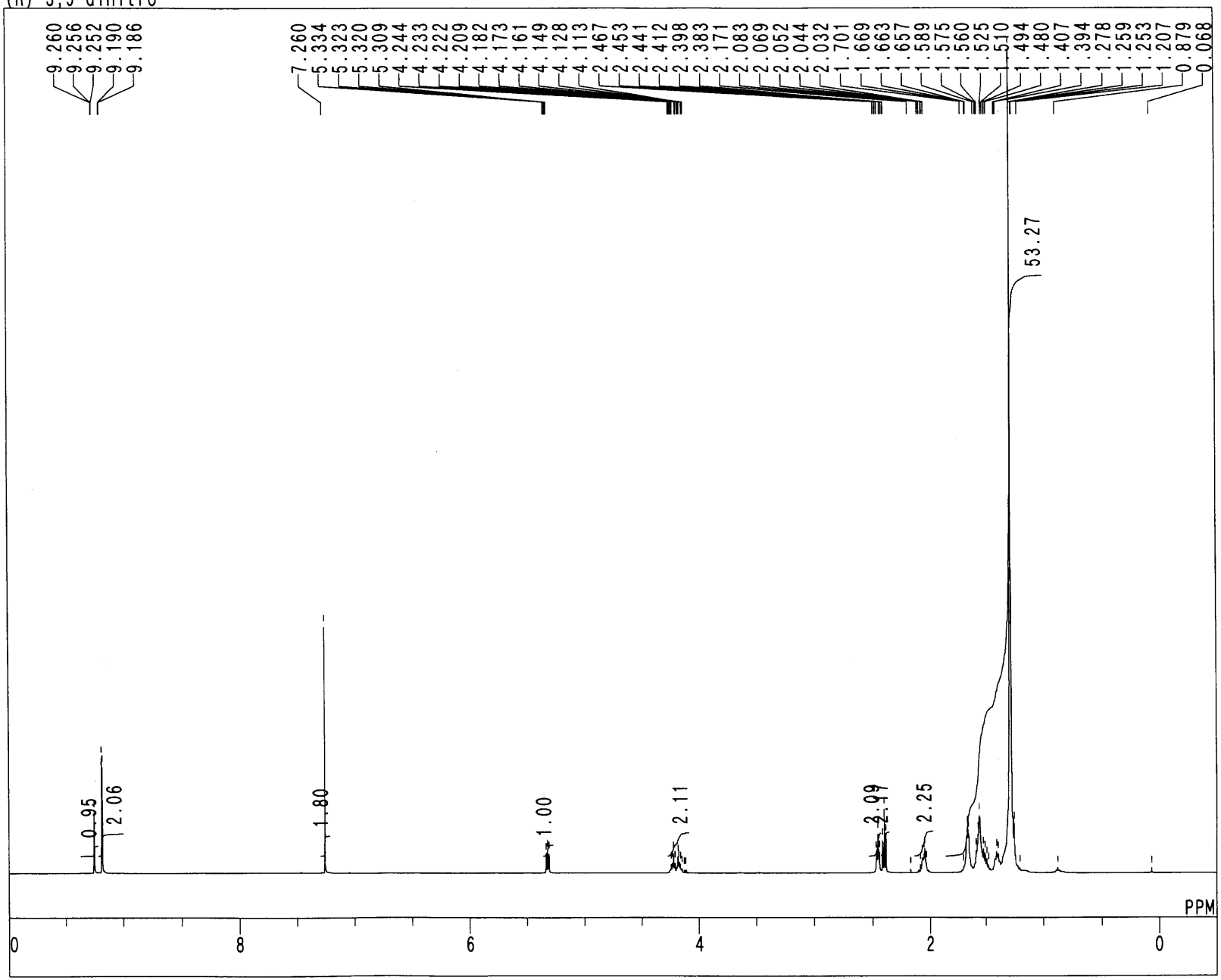


DFILE	C:\Winnmr98\DATA\Autol NON_E1_FT.al
COMNT	R
DATIM	Wed Dec 21 15:27:12 2005
EXMOD	NON
OBNUC	1H
OBFRQ	270.05 MHz
OBSET	112.00 KHz
OBFIN	5800.0 Hz
POINT	32768
FREQU	5405.4 Hz
CLPNT	1
TODAT	1
CLFRQ	100.0 Hz
SCANS	180
ACQTM	6.062 sec
PD	0.935 sec
PW1	6.0 us
PW2	10.0 us
PW3	10.0 us
PI1	1.000 ms
PI2	1.000 ms
PI3	1.00 ms
IRNUC	1H
CTEMP	18.8 c
SLVNT	CDCL3
EXREF	7.26 ppm
CLEXR	0.00
RGAIN	25
OBATN	511
LOOP1	1

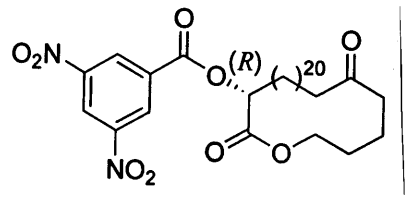


ent-19

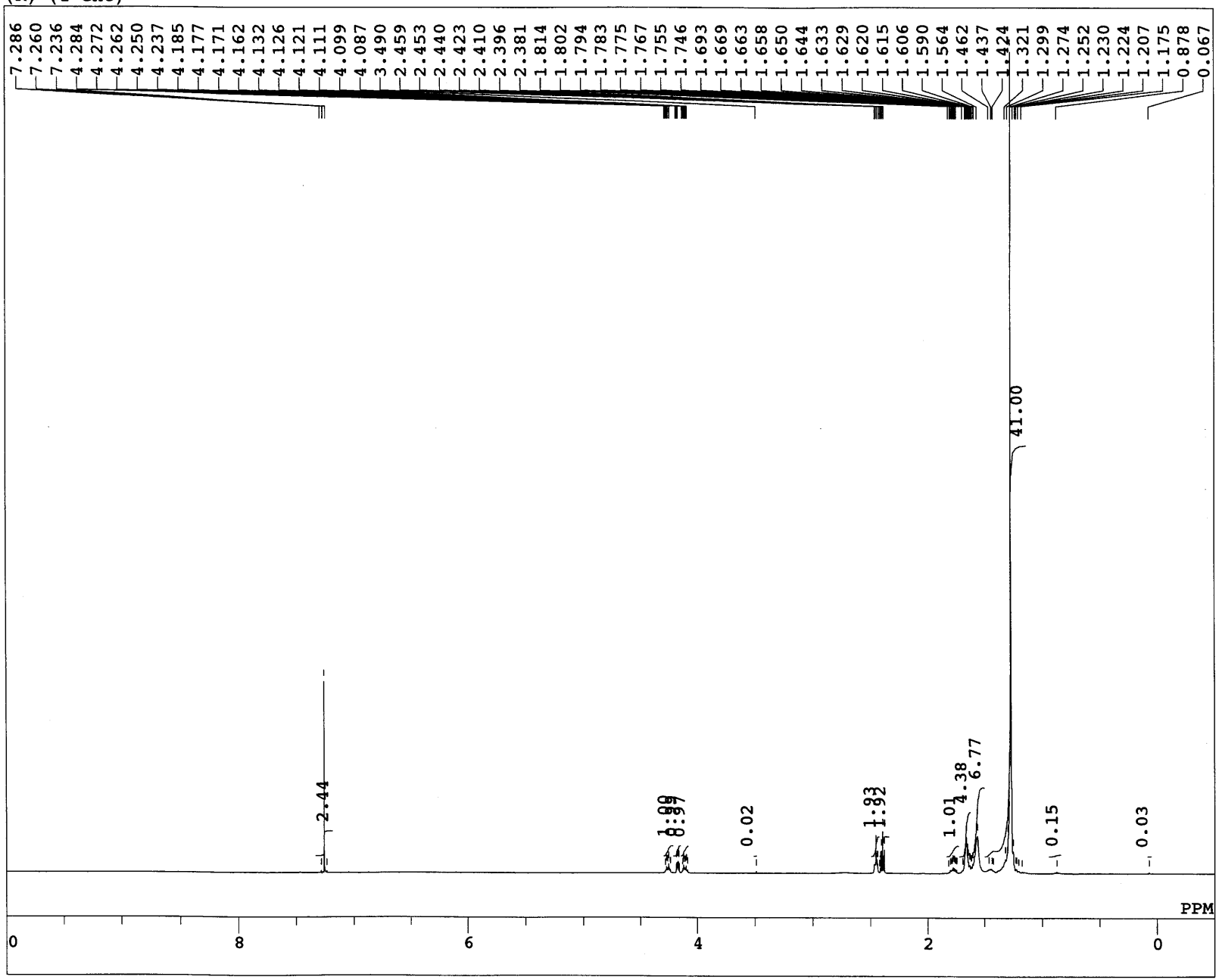
(R)-3,5-dinitro



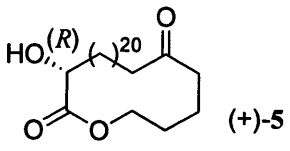
DFILE C:\WinLambda\DATA\shiina\akane\(R)-3
COMNT (R)-3,5-dinitro
DATIM Tue Sep 05 12:12:57 2006
OBNUC 1H
EXMOD non
OBFRQ 500.00 MHz
OBSET 0.00 KHz
OBFIN 162160.00 Hz
POINT 32768
FREQU 10000.00 Hz
SCANS 128
ACQTM 3.2768 sec
PD 3.7232 sec
PW1 6.40 usec
IRNUC 1H
CTEMP 25.0 c
SLVNT CDCL3
EXREF 7.26 ppm
BF 0.12 Hz
RGAIN 18



(R)-(1-ent)



DFILE	C:\WinLambda\AutoData\Auto1non_E1
OBNUC	1H
EXMOD	non
OFR	500.00 MHz
OBSET	0.00 KHz
OBFIN	162160.00 Hz
POINT	32768
FREQU	10000.00 Hz
SCANS	8
ACQTM	3.2768 sec
PD	3.7232 sec
PW1	6.38 usec
IRN	
CTEMP	23.7 c
SLVNT	CDCL3
EXREF	7.26 ppm
BF	0.12 Hz
RGAIN	18



(+)-5