Supporting Information

Synthesis and biological evaluation of lipid A derived from commensal Bacteroides

Enrico C.J.M. Verpalen, Anna M. Ehlers, *Aldo C.A. van Wingaarden, Arwin J. Brouwer,* and Geert-Jan Boons*

Table of contents

	page
1. Supplementary figures	S2
Fig. S1. Capacity of HT-29 to secrete IL-8 and IFN-ß	S2
Fig. S2. Viability of HT-29 cells and human primary monocytes	S3
Fig. S3. Biological activity of lipid A from *B. fragilis* (RAW 264.7 (NO-)	S4
Fig. S4. Gating strategy and purity of human primary monocytes	S5
2. Chemical synthesis	S6
3. Biological studies	S26
4. References	S28
5. Copies of 1D and 2D NMR spectra	S29

1. Supplementary figures

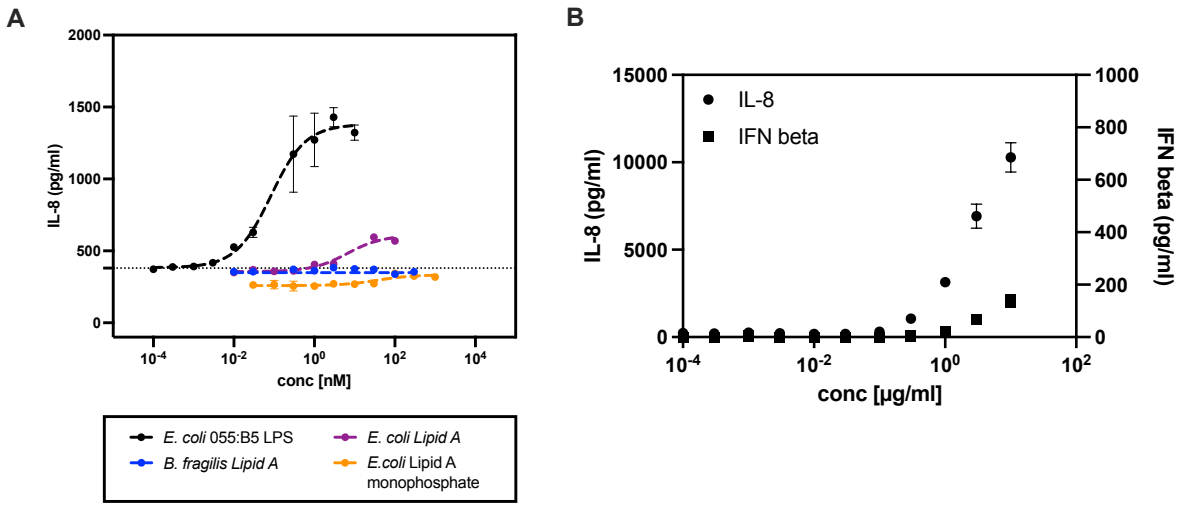


Fig. S1. Capacity of HT-29 to secrete IL-8 and IFN-ß. A HT-29 cells (representative for n = 2) were exposed to a wide concentration range of *E. coli* 055: B5 LPS (0.0001 to 10 nM), *B. fragilis* lipid A (0.01 to 1000 nM), *E. coli* lipid A (0.001 to 100 nM) and *E. coli* monophosphoryl lipid A (0.01 to 1000 nM) and secretion of pro-inflammatory IL-8 was measured by ELISA. **B** The capacity of HT-29 cells (representative for n = 3) to produce and secrete IFN-ß was examined by stimulating HT-29 cells with encapsulated high molecular weight (HMW) poly(I:C) LyoVec, which acts through TLR3. All data are shown as mean and error of biological duplicates.

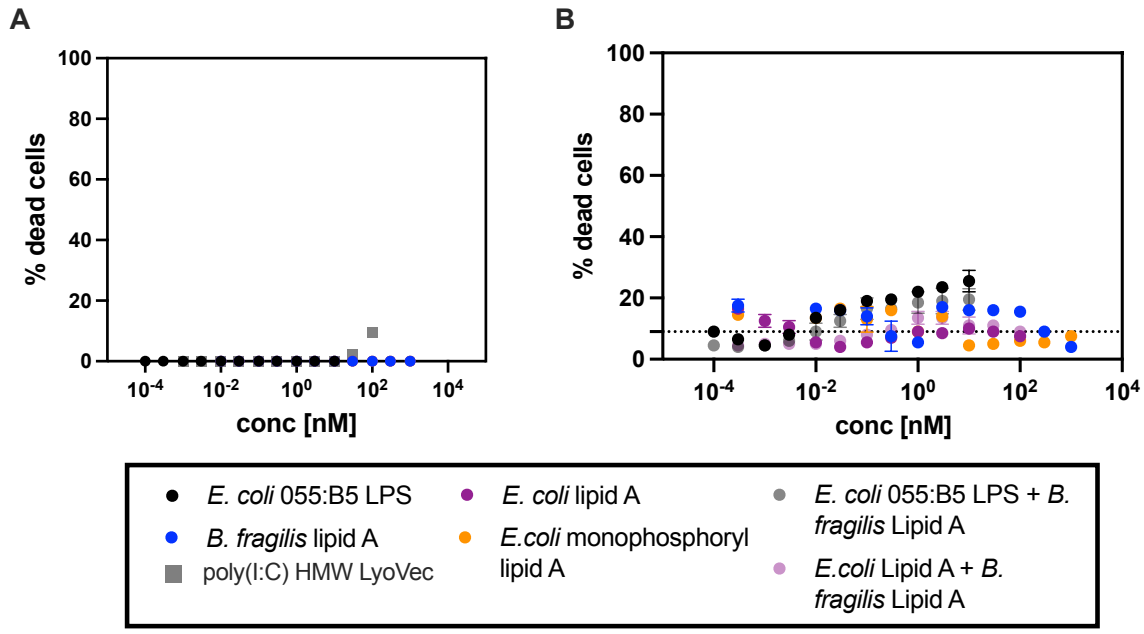


Fig. S2. Viability of HT-29 cells and human primary monocytes upon stimulation. A Viability of HT-29 cells (representative for n = 3) upon stimulation was measured with the lactate dehydrogenase assay (LDH) to measure the percentage of damaged cells. **B** Viability of human primary monocytes was examined with the nucleus stain Hoechst (1:15,000) and propidium iodide (1:10,000) able to penetrate dead cells. All data are shown as mean and error of biological duplicates.

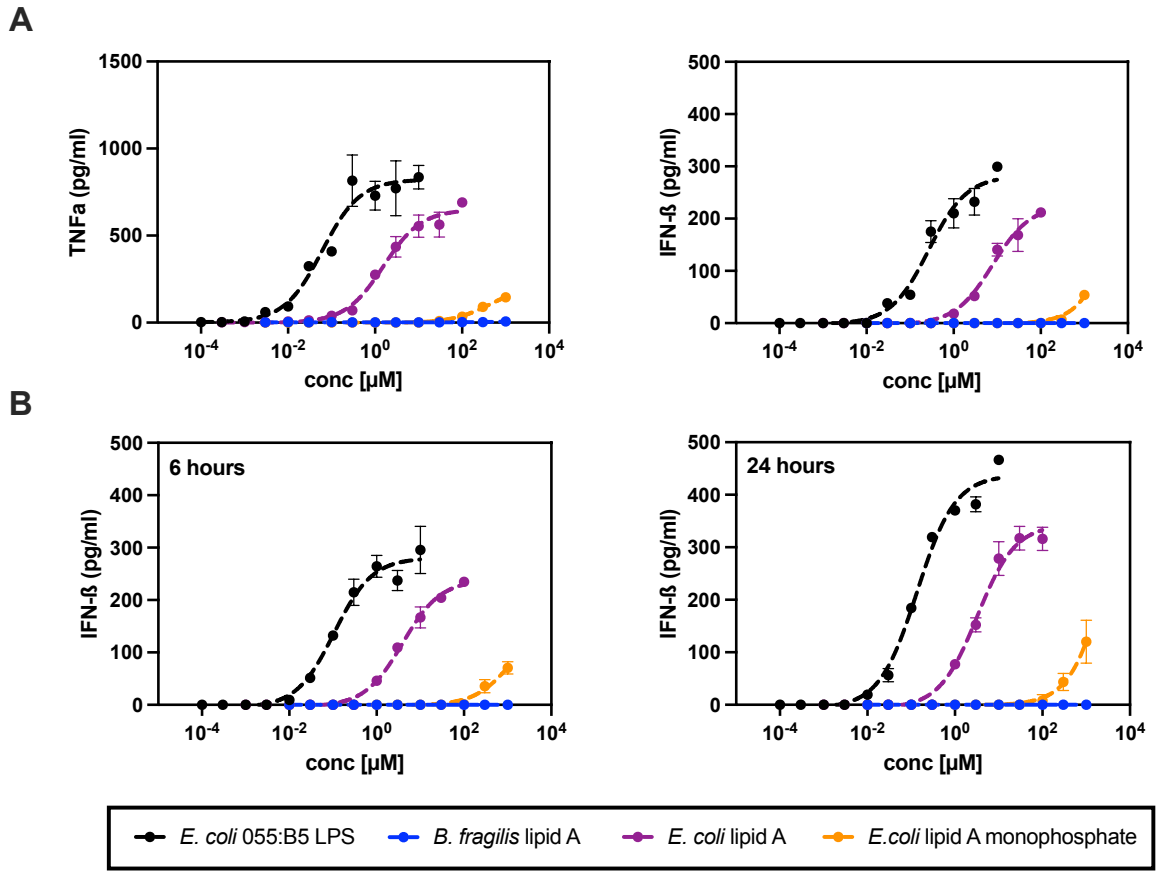


Fig. S3. Biological activity of lipid A from *B. fragilis* to induce pro- and anti-viral cytokine secretion in RAW 264.7 (NO-) cells. RAW 264.7 (NO-) cells (representative for n = 3) were exposed to a wide concentration range of *E. coli* 055: B5 LPS (0.0001 to 10 nM), *B. fragilis* lipid A (0.01 to 1000 nM), *E. coli* lipid A (0.001 to 100 nM) and *E. coli* monophosphoryl lipid A (0.01 to 1000 nM). **A** Secretion of pro-inflammatory mouse TNF- α and anti-viral mouse IFN-ß was measured by ELISA after 6 h. **B** Secretion of anti-viral mouse IFN-ß was detected after 6 and 24 h. All data are shown as mean and error of biological duplicates.

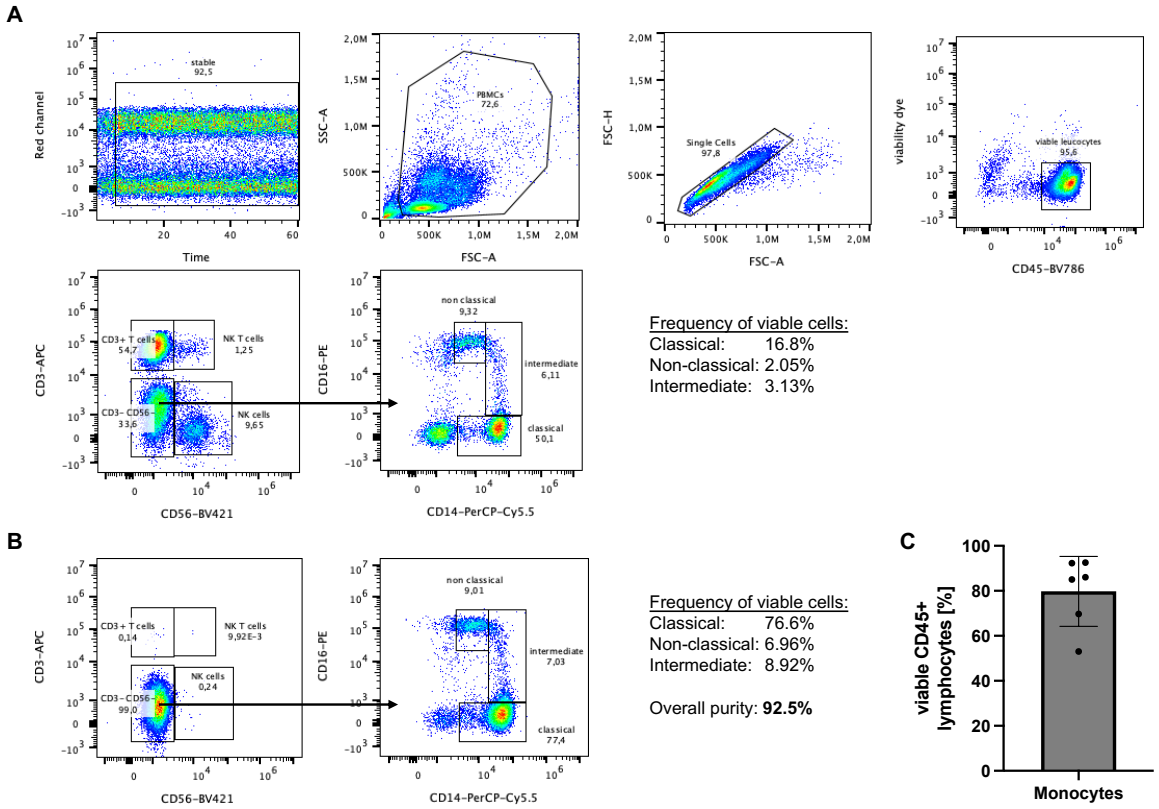


Fig. S4. Gating strategy and purity of human primary monocytes. Human primary monocytes were isolated from peripheral blood mononuclear cells (PBMCs) using magnetic negative isolation. Purity was determined by flow cytometry. **A** Gating strategy to identify classical, non-classical and intermediate monocytes from viable CD45+ leucocytes from PBMCs **B** Purity of classical, non-classical and intermediate monocytes in the negatively selected Pan monocyte fraction **C** Purity of Pan monocytes isolated from different donors (n = 6) in relation to viable CD45+ leucocytes shown as the mean and its error.

2. Chemical synthesis

General synthetic methods. Unless stated otherwise, all reagents were purchased from Sigma-Aldrich and Fischer Scientific. Carbohydrates were purchased from Carbosynth Limited (UK). Petroleum ether (boiling range 40-60 °C) was purchased from Biosolve BV (The Netherlands). Organic solvents for reactions were dried for at least 2 days over molecular sieves (3 or 4 Å). ^{1}H and ^{13}C NMR spectra were recorded on either an Agilent 400 instrument (400 and 101 MHz) or a Bruker Avance Neo 600 spectrometer (600 and 125 MHz). Chemical shifts are reported in parts per million (ppm) relative to TMS (0.00 ppm for ^{1}H NMR), CD_3OD (3.31 ppm for ^{1}H NMR, 49.2 ppm for ^{13}C NMR) or $CDCl_3$ (77.0 ppm for ^{13}C NMR) as the internal standard. NMR data are presented as follows: Chemical shift, multiplicity (s = singlet, d = doublet, 2d = 2 doublets, t = triplet, dd = doublet of doublet, sept = septet, m = multiplet and/or multiple resonances); number of protons, coupling constants are reported in Hertz (Hz) followed by the assignment. All NMR signals were assigned based on 1H NMR, COSY and HSQC experiments. Signals marked with L1 and L2 are of the core lipids of the C-3' and C-2' respectively, the signals marked as and L2' are of the lipid side chain on C-2'. Signals marked with L3 and L4 are of the mono-antennary lipids attached to the C-3 and C-2 respectively. High resolution mass spectra were recorded on an Agilent technologies 6560 Ion mobility Q-TOF spectrometer. Sephadex LH-20 (Sigma Aldrich) column chromatography was performed using a mixture of CH_2Cl_2 and MeOH (1:1, v/v) as the eluent. Silica column chromatography was performed using silica gel SiliaFlash P60 (SiliCycle, Canada, 40-63 μm, 239-400 mesh). TLC analysis was conducted on SiliaPlate TLC Glass Backed TLC F254 (SiliCycle) with examination under UV light (254 nm) where applicable, and with 5% sulfuric acid in ethanol or an aqueous solution of $Ce(NH_4)_2(NO_3)_6$ and $(NH_4)_6Mo_7O_{24}.4H_2O$ (20 g/L and 48 g/L, respectively) with 5% sulfuric acid, followed by heating. All reactions were carried out under nitrogen gas atmosphere unless when water was present in the reaction. All reactions were carried out at room temperature (RT) in glassware with magnetic stirring, unless when stated otherwise. Purities where recorded are percentage by weight as calculated by NMR residual solvent(s) calculator from commonorganicchemstry.com.

Dimethylthexylsilyl 3-allyl-2-azido-2-deoxy-4,6-di-*O*-naphthalen-2-ylmethoxy-ß-D--glucopyranoside (8). To a cooled (0 °C) solution of compound **7** (15.7 g, 40.5 mmol) in DMF (250 mL) were added Nap-Br (21.5 g, 97.3 mmol) and NaH (60% in mineral oil) (3.89 g, 97.3 mmol). After stirring for 2 h at ambient temperature, the reaction mixture was quenched with

sat. aq. NH_4Cl (3 L) and extracted with EtOAc (3x 750 mL). The combined organic phases were dried over $MgSO_4$, filtered and concentrated under reduced pressure. Pure **8** was obtained after purification by silica gel column chromatography (9/1, PE/Et_2O) as a colorless oil (15.7 g, 23.5 mmol, 58%). R*f* = 0.40 (9/1, PE/Et_2O). 1H NMR (400 MHz, $CDCl_3$) δ 7.51 (m, 14H, aromatic 2x Nap), 5.98 (ddt, 1H, *J* = 17.3, 10.4, 5.7 Hz, CH_2=C*H*), 5.30 (dq, 1H, *J* = 17.2, 1.7 Hz, CH_{2a}=CH), 5.18 (dq, 1H, *J* = 10.4, 1.4 Hz, CH_{2b}=CH), 4.96 (d, 1H, *J* = 11.2 Hz, CH_{2a} (Nap)), 4.75 (d, 1H, *J* = 3.6 Hz, CH_{2a} (Nap)), 4.72 (d, 1H, *J* = 2.4 Hz, CH_{2b} (Nap)), 4.65 (dd, 1H, *J* = 12.3, 0.8 Hz, CH_{2b} (Nap)), 4.48 (m, 1H, H-1)), 4.37 (ddt, 1H, *J* = 12.3, 5.6, 1.5 Hz, 1H, CH_{2a}-CH=CH_2), 4.30 (ddt, 1H, *J* = 12.3, 5.8, 1.4 Hz, CH_{2b}-CH=CH_2), 3.71 (d, 2H, *J* = 3.3 Hz, CH_2-6), 3.64 (m, 1H, H-3), 3.42 (dt, 1H, *J* = 9.9, 3.3 Hz, H-5), 3.30 (m, 2H, H-2, H-4), 1.69 (hept, 1H, *J* = 6.9 Hz, CH (TDS)), 0.91 (m, 12H, (4x CH_3 (TDS)), 0.23, 0.20 (2s, 6H, 2x CH_3 (TDS)). ^{13}C NMR (101 MHz, $CDCl_3$) δ 135.7, 135.5 (aromatic (Nap)), 134.8 (CH_2=*C*H), 133.2, 133.2, 133.0, 132.9, 128.1, 128.1, 127.9, 127.8, 127.7, 127.6, 126.6, 126.4, 126.1, 125.9, 125.9, 125.8, 125.7 (aromatic (Nap)), 117.1 (*C*H_2=CH), 97.0 (C-1), 82.7 (C-4), 77.7 (C-3), 75.0 (C-5), 74.9 (CH_2 (Nap)), 74.2 (*C*H_2-CH=CH_2, 73.6 (CH_2 (Nap)), 68.8 (C-6), 68.7 (C-2), 33.9 (CH (TDS)), 24.8 (C (TDS)), 20.0, 19.9, 18.5, 18.4 (4x CH_3 (TDS)), -2.0, -3.3 (2x CH_3 (TDS)). HR MS (*m/z*) calcd for $C_{39}H_{53}N_4O_5Si$ $[M + NH_4]^+$: 685.3780; found: 685.3785.

Dimethylthexylsilyl 3-allyl-2-deoxy-4,6-di-*O*-naphthalen-2-ylmethoxy-2-(2,2,2-trichloroethoxycarbonylamino)-ß-D-glucopyranoside (9). To a solution of compound **8** (15.7 g, 23.5 mmol) in THF/AcOH (4/1) (200 mL) was added Zn (15.7 g, 0.240 mmol). After stirring the suspension for 16 h, the reaction mixture was filtered over a pad of Celite and concentrated under reduced pressure. The crude was partitioned between EtOAc (250 mL) and sat. aq. $NaHCO_3$ (250 mL), the organic phase was dried over $MgSO_4$, filtered and concentrated. To a solution of the crude amine in CH_2Cl_2 (200 mL) was added Troc-Cl (3.88 mL, 28.2 mmol) and DIPEA (8.18 mL, 47.0 mmol). After 2 h the reaction was quenched by washing with 1.0 M HCl (250 mL), the organic layer was dried over $MgSO_4$, filtered and concentrated. Pure **9** was obtained after purification by silica gel column chromatography (19/1, PE/EtOAc) as a colorless oil (11.3 g, 13.8 mmol, 59%) R*f* = 0.80 (9/1, PE/EtOAc). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55 (m, 14H, aromatic (Nap)), 5.90 (dddd, 1H, *J* = 17.1, 10.3, 6.1, 5.4 Hz, CH_2=C*H*), 5.23 (dq, 1H, *J* = 17.2, 1.6 Hz, CH_{2a}=CH), 5.14 (dq, 1H, *J* = 10.4, 1.4 Hz, CH_{2b}=CH), 5.10 (d, 1H, *J* = 8.2 Hz, NH), 4.96 (d, 1H, *J* = 11.2 Hz, CH_{2a} (Nap)), 4.86 (d, 1H, *J* = 7.7 Hz, H-1), 4.72 (m, 5H, CH_{2b} (Nap), CH_2 (Nap), CH_2CCl_3), 4.32 (ddt, 1H, *J* = 12.5, 5.4, 1.4 Hz, CH_{2a}-CH=CH_2), 4.19 (ddt, *J* = 12.5, 6.2, 1.4 Hz, 1H, CH_{2b}-CH=CH_2), 3.78 (m, 1H, H-3), 3.72 (d, 2H, *J* = 3.5

Hz, CH_2-6), 3.67 (dd, 1H *J* = 9.6, 8.6 Hz, H-4), 3.52 (dt, 1H, *J* = 9.8, 3.5 Hz, H-5), 3.32 (q, 1H, *J* = 9.2 Hz, H-2), 1.63 (hept, 1H, *J* = 6.9 Hz, CH (TDS)), 0.87 (m, 12H, 4x CH_3 (TDS)), 0.20, 0.14 (2s, 6H, 2x CH_3 (TDS)). ^{13}C NMR (101 MHz, $CDCl_3$) δ 135.7, 135.6 (aromatic (Nap)), 134.9 (CH_2=*C*H), 133.2, 133.2, 133.0, 132.9, 128.1, 128.1, 127.9, 127.9, 127.7, 127.6, 126.5, 126.4, 126.0, 125.9, 125.8, 125.8, 125.8 (aromatic (Nap)), 117.2 (*C*H_2=CH), 95.2 (C-1), 81.0 (C-3), 78.4 (C-4), 74.9 (C-5), 74.7 (2x CH_2 (Nap)), 73.8 (*C*H_2-CH=CH_2), 73.6 (*C*H_2CCl_3), 69.0 (C-6), 60.0 (C-2), 34.0 (CH (TDS)), 24.8 (C (TDS)), 20.1, 20.0, 18.6, 18.5 (4x CH_3 (TDS)), -1.7, -3.5 (2x CH_3 (TDS)). The signal for C-1 is assigned using HSQC due to low intensity in the ^{13}C spectrum. HR MS (*m/z*) calcd for $C_{42}H_{56}Cl_3N_2O_7Si$ $[M + NH_4]^+$: 833.2917; found: 833.2932.

Dimethylthexylsilyl 2-deoxy-4,6-di-*O*-naphthalen-2-ylmethoxy-2-(2,2,2-trichloroethoxycarbonylamino)-ß-D-glucopyranoside (10). To a solution of compound **9** (11.0 g, 13.5 mmol) in CH_2Cl_2/MeOH (3/2) (150 mL) was added $PdCl_2$ (1.19 g, 6.73 mmol). After stirring the suspension for 5 h, the reaction mixture was filtered over a pad of Celite and concentrated under reduced pressure. Pure **10** was obtained after purification by silica gel column chromatography (0 to 10% EtOAc in PE) as a colorless oil (8.05 g, 10.4 mmol, 77%) R*f* = 0.65 (9/1, PE/EtOAc). Compound **10** contains residual EtOAc (<1%; 2.05 (s, 3H), 4.12 (q, 2H), 1.26 (t, 3H)). ^{1}H NMR (400 MHz, $CDCl_3$). δ 7.55 (m, 14H, aromatic (Nap)), 5.12 (d, 1H, *J* = 7.0 Hz, NH), 4.97 (d, 1H, *J* = 11.5 Hz, CH_{2a} (Nap)), 4.78 (m, 2H, CH_{2b} (Nap), CH_{2a} (Nap)), 4.69 (m, 4H, CH_{2b} (Nap), H-1, CH_2CCl_3) 3.89 (m, 1H, H-3), 3.75 (m, 2H, CH_2-6), 3.62 (dd, 1H *J* = 9.6, 8.3 Hz, H-4), 3.51 (dt, 1H, *J* = 9.8, 3.2 Hz, H-5), 3.38 (q, 1H, *J* = 7.8 Hz, H-2), 3.08 (s, 1H, OH), 1.63 (p, 1H, *J* = 6.9 Hz, CH (TDS)), 0.87 (m, 12H, 4x CH_3 (TDS)), 0.21, 0.15 (2s, 6H, 2x CH_3 (TDS)). ^{13}C NMR (101 MHz, $CDCl_3$) δ 154.9, 135.7, 135.6, 133.2, 133.2, 133.0, 133.0, 128.2, 128.1, 127.9, 127.9, 127.7, 127.6, 126.8, 126.4, 126.2, 126.1, 125.9, 125.9, 125.8, 125.8 (aromatic (Nap)), 95.7 (C-1), 78.2 (C-4), 75.0 (C-5), 74.8 (C-3), 74.8 (CH_2 (Nap)), 74.6 (CH_2 (Nap)), 73.6 (*C*H_2CCl_3), 69.1 (C-6), 60.5 (C-2), 34.0 (CH (TDS)), 24.8 (C (TDS)), 20.1, 20.0, 18.6, 18.5 (4x CH_3 (TDS)), -1.7, -3.5 (2x CH_3 (TDS)).

Dimethylthexylsilyl 2-deoxy-4,6-di-*O*-naphthalen-2-ylmethoxy-2-(2,2,2-trichloroethoxycarbonylamino)-3-*O*-(R)-(naphthalen-2-ylmethoxy)hexadecanoate-ß-D-glucopyranoside (11). To a solution of compound **10** (8.05 g, 10.4 mmol) and lipid **4** (4.70 g, 11.4 mmol) in CH_2Cl_2 (150 mL) were added DCC (3.85 g, 18.6 mmol) and a catalytic amount of DMAP. After stirring for 16 h, the reaction mixture was filtered and concentrated under

reduced pressure. Pure **11** was obtained after purification by silica gel column chromatography (0 to 30% Et_2O in PE) as a colorless oil (9.73 g, 8.30 mmol, 80%) R*f* = 0.6 (7/3, PE/Et_2O). Compound **11** contains residual EtOAc (1%; 2.05 (s, 3H), 4.12 (q, 2H), 1.26 (t, 3H)). ^{1}H NMR (400 MHz, $CDCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53 (m, 21H, aromatic (Nap)), 5.27 (t, 1H, *J* = 9.8 Hz, H-3), 5.02 (d, 1H, *J* = 9.4 Hz, NH), 4.65 (m, 9H, 3x C*H*$_2$ (Nap), H-1, C*H*$_2$$CCl_3$) 3.81 (m, 2H, H-4, C*H*$CH_2COOC$ (L3)), 3.73 (m, 2H, CH_2-6), 3.62 (q, 1H, *J* = 9.6 Hz, H-2), 3.55 (d, 1H, *J* = 10.0 Hz, H-5), 2.53 (dd, 1H, *J* = 15.7, 6.7 Hz, C*H*$_{2a}$COOC (L3)), 2.39 (dd, 1H, *J* = 15.7, 5.5 Hz, C*H*$_{2b}$COOC (L3)), 1.61 (m, 3H, C*H*$_2$$CHCH_2COO$ (L3), CH (TDS)), 1.24 (m, 22H, 11x CH_2), 0.85 (m, 15H, 4x CH_3 (TDS), CH_2-C*H*$_3$), 0.20, 0.13 (2s, 6H, 2x CH_3 (TDS)). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.8 (C=O), 154.0, 135.9, 135.6, 135.1, 133.2, 133.2, 133.1, 133.0, 132.9, 132.9, 128.2, 128.1, 128.0, 127.9, 127.8, 127.7, 127.6, 127.5, 126.4, 126.4, 126.2, 126.1, 126.0, 125.9, 125.8, 125.8, 125.8, 125.7, 125.7 (aromatic (Nap)), 96.4 (C-1), 75.8, 75.5 (C-4, *C*HCH_2COOC (L3)), 75.1 (C-5), 74.6 (CH_2 (Nap)), 74.5 (C-3), 74.4 (CH_2 (Nap)), 73.7 (*C*H_2CCl_3), 71.3 (CH_2 (Nap)), 68.7 (C-6), 58.6 (C-2), 39.5 (*C*H_2COOC (L3)), 34.2 (*C*H_2CHCH_2COOC (L3)), 34.0 (CH (TDS)), 31.9, 29.7, 29.7, 29.6, 29.4, 25.2, 24.8, 22.7 (11x CH_2, C (TDS)), 20.0, 18.5 (4x CH_3 (TDS)), 14.1 (CH_2*C*H_3), -1.8, -3.4 (2x CH_3 (TDS)).

2-deoxy-4,6-di-*O*-naphthalen-2-ylmethoxy-2-(2,2,2-trichloroethoxycarbonylamino)-3-*O*-(R)-(naphthalen-2-ylmethoxy)hexadecanoate-ß-D-glucopyranose (12). To a teflon round-bottom flask containing a solution of compound **11** (4.61 g, 4.47 mmol) in pyridine (80 mL) was added HF·pyridine (3.50 mL, 135 mmol). After stirring for 16 h, the reaction mixture was precipitated from vigorously stirring water (1.35 L) for 2 h. Pure **12** was obtained after filtration as a white solid (3.14 g, 3.05 mmol, 68%). Compound **12** contains residual TDS-F (>1%; two singlets at 0.20 and 0.12 ppm). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47 (m, 21H, aromatic (Nap)), 5.49 (dd, 1H, *J* = 10.8, 9.2 Hz, H-3), 5.42 (d, 1H, *J* = 9.7 Hz, NH), 5.34 (d, 1H, *J* = 2.5 Hz, H-1), 4.61 (m, 8H, 3x C*H*$_2$ (Nap), C*H*$_2$$CCl_3$) 4.14 (m, 1H, H-5), 4.00 (td, 1H, *J* = 10.2, 3.5 Hz, H-2), 3.86 (t, 1H, *J* = 6.0 Hz, C*H*CH_2COOC (L3)), 3.78 (t, 1H, *J* = 9.6 Hz, H-4), 3.71 (dd, 1H, *J* = 10.7, 4.2 Hz, CH_{2a}-6), 3.66 (dd, 1H, *J* = 10.7, 2.3 Hz, CH_{2b}-6), 3.04 (bs, 1H, OH), 2.58 (dd, 1H, *J* = 15.9, 7.1 Hz, C*H*$_{2a}$COOC (L3)), 2.41 (dd, 1H, *J* = 15.9, 5.2 Hz, C*H*$_{2b}$COOC (L3)), 1.57 (bs, 2H, C*H*$_2$$CHCH_2COO$ (L3)), 1.24 (m, 22H, 11x CH_2), 0.88 (t, 3H, *J* = 6.9 Hz, CH_2-C*H*$_3$). ^{13}C NMR (101 MHz, $CDCl_3$) δ 172.0 (C=O), 136.0, 135.1, 135.0, 133.2, 133.0, 132.9, 128.3, 128.1, 128.0, 127.9, 127.8, 127.7, 127.6, 127.5, 126.8, 126.3, 126.3, 126.2, 126.0, 125.9, 125.9, 125.8, 125.7, 125.6 (aromatic (Nap)), 91.9 (C-1), 75.8 (C-4), 75.5 (*C*HCH_2COOC (L3)), 74.7 (CH_2 (Nap)), 74.6 (CH_2 (Nap)), 73.6 (*C*H_2CCl_3), 73.1 (C-3), 71.4 (CH_2 (Nap)), 70.5 (C-5),

68.4 (C-6), 54.8 (C-2), 39.7 (*C*H_2COOC (L3)), 34.3 (*C*H_2CHCH$_2$COOC (L3)), 31.9, 29.7, 29.4, 25.2, 22.7 (11x CH_2), 14.1 (CH_2*C*H_3).

2,2,2-trifluoro-N-phenylacetimidoyl 2-deoxy-4,6-di-*O*-naphthalen-2-ylmethoxy-2-(2,2,2-trichloroethoxycarbonylamino)-3-*O*-(R)-(naphthalen-2-ylmethoxy)hexadecanoate-ß-D-glucopyranoside (2). To a solution of compound **12** (1.62 g, 1.58 mmol) in CH_2Cl_2 (15 mL) were added 2,2,2-trifluoro-*N*-phenyl acetimidoyl chloride (1.24 mL, 7.90 mmol) and cesium carbonate (1.03 g, 3.16 mmol). After stirring for 2 h, the reaction mixture was filtered off. Compound **2** was obtained after flash column chromatography (0 to 20% EtOAc in PE) as a colorless oil (1.83 g, 1.52 mmol, 96%). Compound **2** is recorded at 92.7% purity based on NMR calculations, impurities are residual EtOAc (2.05 (s, 3H), 4.12 (q, 2H), 1.26 (t, 3H)) and TDS-F from the previous step (two singlets at 0.20 and 0.12 ppm). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.51 (m, 21H, aromatic (Nap)), 7.10, 6.77 (m, d, 5H, aromatic (NPh)), 5.46 (t, 1H, *J* = 8.9 Hz, H-3), 5.35 (d, 1H, *J* = 9.0 Hz, NH), 4.65 (m, 9H, 3x C*H*$_2$ (Nap, H-1), C*H*$_2$$CCl_3$) 4.20 (m, 1H, H-2), 3.85 (m, 5H, C*H*CH_2COOC (L3), H-4, H-5, CH_2-6), 2.54 (m, 1H, C*H*$_{2a}$COOC (L3)), 2.40 (ddd, 1H, *J* = 15.5, 10.1, 5.2 Hz, C*H*$_{2b}$COOC (L3)), 1.53 (m, 2H, C*H*$_2$$CHCH_2$COO (L3)), 1.24 (m, 22H, 11x CH_2), 0.88 (t, 3H, *J* = 6.9 Hz, CH_2-C*H*$_3$). ^{13}C NMR (101 MHz, $CDCl_3$) δ 172.4 (C=O), 171.6 (C=N), 135.9, 135.8, 135.1, 134.8, 133.2, 133.2, 133.2, 133.1, 133.0, 132.9, 132.9, 128.8, 128.7, 128.3, 128.3, 128.2, 128.1, 128.0, 128.0, 127.9, 127.9, 127.9, 127.8, 127.8, 127.7, 127.7, 127.6, 127.5, 126.8, 126.5, 126.3, 126.3, 126.2, 126.2, 126.2, 126.0, 126.0, 126.0, 126.0, 125.9, 125.8, 125.8, 125.8, 125.7, 125.7, 125.6, 119.3 (aromatic (Nap) + N(Ph)), 75.8 (C-4), 75.5 (*C*HCH_2COOC (L3)), 74.7 (CH_2 (Nap)), 74.6 (CH_2 (Nap)), 73.6 (*C*$H_2$$CCl_3$), 73.1 (C-3), 71.4 ($CH_2$ (Nap)), 70.5 (C-5), 68.4 (C-6), 54.8 (C-2), 39.7 (*C*H_2COOC (L3)), 34.3 (*C*$H_2$$CHCH_2$COOC (L3)), 31.9, 29.7, 29.4, 25.2, 22.7 (11x CH_2), 14.1 (CH_2*C*H_3).

Dimethylthexylsilyl 2-deoxy-4,6-*O*-(2-methylnaphtylidene)-2-(2,2,2-trichloroethoxycarbonyl amino)-3-*O*-(R)-(naphthalen-2-ylmethoxy)pentadecanoate-ß-D-glucopyranoside (14). To a solution of lipid **5** (3.99 g, 10.0 mmol) and saccharide **13** (3.29 g, 5.18 mmol) in CH_2Cl_2 (50 mL) were added DCC (2.33 g, 11.3 mmol) and DMAP (cat.). After stirring for 16 h, the reaction mixture was filtered and concentrated under reduced pressure. The residue was purified by silica gel column chromatography (PE/EtOAc, 4/1) to give **14** as a viscous colorless oil (4.03 g, 3.97 mmol, 61%) R*f* = 0.80 (PE/EtOAc, 4/1). Compound **14** contains acetone from NMR tube cleaning (1.2%; 2.17 (s, 6H)). ^{1}H NMR (400 MHz, $CDCl_3$). ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.55 (m, 14H, aromatic (2x Nap)), 5.52 (s, 1H, CH (Nap)), 5.40

(t, 1H, *J* = 10.0 Hz, H-3), 5.07 (d, 1H, *J* = 9.2 Hz, NH), 4.88 (d, 1H, *J* = 7.9 Hz, H-1), 4.69 (d, 1H, *J* = 12.0 Hz, CH_{2a}-CCl_3), 4.65 (d, 1H, *J* = 11.8 Hz, CH_{2a} (Nap)), 4.60 (d, 1H, *J* = 12.0 Hz, CH_{2b}-CCl_3), 4.53 (d, 1H, *J* = 11.8 Hz, CH_{2b} (Nap)), 4.33 (dd, 1H, *J* = 10.5, 5.0 Hz, CH_{2a}-6), 3.82 (m, 2H, CH_{2b}-6, C*H*CH_2COOC (L1)), 3.73 (m, 1H, H-4), 3.65 (q, 1H, *J* = 9.2 Hz, H-2), 3.56 (td, 1H, *J* = 9.7, 5.0 Hz, H-5), 2.69 (dd, 1H, *J* = 15.0, 6.2 Hz, CH_{2a}COOC (L1)), 2.51 (dd, 1H, *J* = 14.9, 5.8 Hz, CH_{2b}COOC (L1)), 1.61 (p, 1H, *J* = 6.9 Hz, CH (TDS)), 1.47 (m, 2H, CH_2CHCH_2COO (L1)), 1.22 (m, 20H, 10x CH_2), 0.86 (m, 15H, 4x CH_3 (TDS), CH_2CH_3), 0.17 – 0.14 (2s, 6H, 2x CH_3 (TDS)). ^{13}C NMR (151 MHz, $CDCl_3$) δ 171.5 (C=O), 154.0 (*C*OCH_2CCl_3), 135.9, 134.2, 133.6, 133.2, 132.9, 132.8, 128.3, 128.1, 128.1, 128.0, 127.9, 127.6, 127.6, 126.4, 126.3, 126.1, 126.0, 125.8, 125.7, 125.7, 123.6 (aromatic (Nap)), 101.7 (CH (Nap)), 96.8 (C-1), 78.9 (C-4), 75.5 (*C*HCH_2COOC (L1)), 74.7 (*C*H_2CCl_3), 71.2 (CH_2 (Nap)), 71.0 (C-3), 68.7 (C-6), 66.6 (C-5), 59.1 (C-2), 39.5 (*C*H_2COOC(L1)), 34.5 (*C*H_2CHCH_2COOC (L1)), 33.9 (CH (TDS)), 31.9, 29.7, 29.6, 29.6, 29.5, 29.4, 25.2, 24.8, 22.7 (10x CH_2), 19.9, 19.9, 18.5 (4x CH_3 (TDS)), 14.1 (CH_2*C*H_3), -1.9, -3.4 (2x CH_3 (TDS)). HR MS (*m/z*) calcd for $C_{54}H_{78}Cl_3N_2O_9Si$ $[M + NH_4]^+$: 1031.4537, found: 1031.4529

Dimethylthexylsilyl 2-deoxy-2-(9-fluorenylmethoxycarbonylamino)-4,6-*O*-(2-methylnaphtylidene)-3-*O*-(R)-(naphthalen-2-ylmethoxy)pentadecanoate-ß-D-glucopyranoside (16). To a solution of **14** (3.79 g, 3.73 mmol) in THF/AcOH 4/1 (30 mL) was added Zn (3.65 g, 55.9 mmol). After stirring for 2 h, the reaction mixture was briefly sonicated, filtered over a Celite pad and concentrated under reduced pressure. The crude amine was partitioned between CH_2Cl_2 (30 mL) and sat. aq. NaHCO3 (30 mL). The organic layer was dried over $MgSO_4$, filtered and concentrated to give crude amine **15** as a pale-yellow oil. To a solution of the crude **15** in CH_2Cl_2 (30 mL) were added 9-fluorenylmethyloxy-carbonyl chloride (941 mg, 4.44 mmol) and DIPEA (1.55 mL, 8.90 mmol). After stirring for 16 h, the reaction mixture was washed with 1.0 M HCl (30 mL), the organic phase was dried over MgSO4, filtered and concentrated under reduced pressure. Pure **16** was obtained after purification by silica gel column chromatography (PE/EtOAc, 9/1) as a pale-yellow oil (4.03 g, 3.97 mmol, 61%) R*f* = 0.60 (PE/EtOAc, 9/1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 (m, 22H, aromatic (Nap), (Fmoc)), 5.52 (s, 1H, CH (Nap)), 5.44 (t, 1H, *J* = 9.9 Hz, H-3), 4.96 (d, 1H, *J* = 9.5 Hz, NH), 4.90 (d, 1H, *J* = 7.9 Hz, H-1), 4.63 (d, 1H, *J* = 11.8 Hz, CH_{2a} (Nap)), 4.50 (d, 1H, *J* = 11.8 Hz, CH_{2b} (Nap)), 4.29 (m, 3H, CH_2 (Fmoc), CH_{2a}-6), 4.17 (d, 1H, *J* = 7.7 Hz, CH (Fmoc)), 3.80 (m, 2H, CH_{2b}-6, C*H*CH_2COOC (L1)), 3.70 (m, 2H, H-4, H-2), 3.57 (m, 1H, H-5), 2.69 (dd, 1H, *J* = 14.9, 6.3 Hz, CH_{2a}COOC (L1)), 2.49 (dd, 1H, *J* = 14.9, 5.6 Hz,

C*H*$_{2b}$COOC (L1)), 1.58 (m, 1H, CH (TDS), 1.48 (m, 2H, C*H*$_2$CHCH$_2$COO (L1)), 1.20 (m, 20H, 10*CH$_2$), 0.88 (t, 3H, *J* = 6.8 Hz, CH$_2$C*H*$_3$), 0.82 (m, 12H, 4x CH$_3$ (TDS)), 0.15, 0.11 (2s, 6H, 2*Si-CH3). ^{13}C NMR (101 MHz, CDCl$_3$) δ 155.7 (*C*OCH$_2$CCl$_3$), 143.8, 135.9, 134.3, 133.6, 133.2, 132.9, 132.8, 129.8, 129.0, 128.3, 128.2, 128.1, 128.0, 127.9, 127.8, 127.7, 127.6, 127.0, 126.3, 126.2, 126.0, 125.9, 125.8, 125.7, 125.5, 125.1, 123.6, 119.9 (aromatic (2x Nap), (Fmoc)), 101.6 (CH (Nap)), 97.0 (H-1), 79.0 (C-4), 75.6 (*C*HCH$_2$COOC (L1)), 71.3 (C-3), 71.2 (CH$_2$ (Nap), 68.7 (C-6), 67.2 (CH$_2$ (Fmoc), 66.5 (C-5), 58.9 (C-2), 47.0 (CH (Fmoc)), 39.7 (*C*H$_2$COOC(L1)), 34.5 (*C*H$_2$CHCH$_2$COOC (L1)), 33.9 (CH (TDS)), 31.9, 29.6, 29.6, 29.6, 29.5, 29.5, 29.3, 25.1, 24.8, 22.7 (10x CH$_2$), 19.9, 18.5 (4x CH$_3$ (TDS)), 14.1 (CH$_2$*C*H$_3$), -1.9, -3.4 (2x CH$_3$ (TDS)). HR MS (*m/z*) calcd for C$_{66}$H$_{87}$N$_2$O$_9$Si [M + NH$_4$]$^+$: 1079.6175; found: 1079.6180.

Dimethylthexylsilyl 2-deoxy-2-(9-fluorenylmethoxycarbonylamino)-4-*O*-naphthalen-2-ylmethyl-3-*O*-(R)-(naphthalen-2-ylmethoxy)pentadecanoate-ß-D-glucopyranoside (3). A solution of **16** (2.28 g, 2.12 mmol) in dry CH$_2$Cl$_2$ (20 mL) was dried with 4 Å molecular sieves for 1 h prior to cooling (-78 °C). Triethylsilane (1.01 mL, 6.35 mmol) and dichlorophenylborane (940 µL, 8.90 mmol) were added slowly. After stirring for 30 min at -78 °C, the reaction was quenched with MeOH (1.00 mL, 24.7 mmol) and Et$_3$N (1.33 mL, 9.54 mmol) and then concentrated under reduced pressure. The residue was purified by silica gel column chromatography (PE/Et$_2$O, 3/2) to give **3** as a pale-yellow oil (1.16 g, 1.09 mmol, 51%) R*f* = 0.30 (PE/Et2O, 9/1). ^{1}H NMR (400 MHz, CDCl3) δ 7.52 (m, 22H, aromatic (Nap, (Fmoc)), 5.32 (t, 1H, *J* = 10.0 Hz, H-3), 4.88 (d, 1H, *J* = 9.4 Hz, NH), 4.80 (d, 1H, *J* = 7.8 Hz, H-1), 4.66 (dd, 2H, *J* = 11.6, 8.4 Hz, CH$_2$ (Nap)), 4.56 (q, 2H, *J* = 11.8 Hz, CH$_2$ (Nap)), 4.23 (m, 2H, CH$_2$ (Fmoc)), 4.14 (m, 1H, CH (Fmoc)), 3.84 (m, 2H, CH$_{2a}$-6, C*H*CH$_2$COOC (L1)), 3.70 (m, 2H, H-4, CH$_{2b}$-6), 3.60 (q, 1H, *J* = 9.4 Hz, H-2), 3.48 (m, 1H, H-5), 2.55 (dd, 1H, *J* =15.6, 7.0 Hz, C*H*$_{2a}$COOC (L1)), 2.39 (dd, 1H, *J* = 15.6, 5.3 Hz, C*H*$_{2b}$COOC (L1)), 1.58 (m, 1H, CH (TDS)), 1.45 (m, 2H, C*H*$_2$CHCH$_2$COO (L1)), 1.23 (m, 20H, 10x CH$_2$), 0.88 (t, 3H, *J* = 6.9 Hz, CH$_2$C*H*$_3$), 0.81 (m, 12H, 4x CH$_3$ (TDS)), 0.14, 0.10 (2s, 6H, 2x CH$_3$ (TDS)). ^{13}C NMR (101 MHz, CDCl3) δ 171.9 (C=O), 155.7 (*C*OCH$_2$CCl$_3$), 143.8, 141.2, 135.9, 135.0, 133.2, 133.1, 132.9, 132.9, 128.2, 128.0, 127.9, 127.8, 127.6, 127.6, 127.0, 126.8, 126.6, 126.4, 126.2, 126.1, 125.9, 125.9, 125.8, 125.7, 125.7, 125.2, 119.9 (aromatic (Nap), (Fmoc)), 96.4 (C-1), 75.7 (C-4), 75.6 (*C*HCH$_2$COOC (L1)), 75.2 (C-5), 74.7 (C-3), 74.5 (CH$_2$ (Nap)), 71.4 (CH2 (Nap)), 67.2 (CH$_2$ (Fmoc)), 62.0 (C-6), 58.4 (C-2), 47.0 (CH (Fmoc)), 39.7 (*C*H$_2$COOC(L1)), 34.1 (*C*H$_2$CHCH$_2$COOC (L1)), 33.9 (CH (TDS)), 31.9, 29.6, 29.6, 29.5,

29.3, 25.1, 24.7, 22.7 (10x CH_2), 19.9, 18.4 (4x CH_3 (TDS)), 14.1 (CH_2CH_3), -1.8, -3.4 (2x CH_3 (TDS)).

Methyl (*R*)-3-(naphthalen-2-ylmethoxy)hexadecanoate (19). To a cooled (0 °C) solution of **17** (16.6 g, 58.1 mmol) and 2-naphthaldehyde (27.2 g, 174 mmol) in THF (1.5 L), was added hexamethyldisiloxane (56.6 g, 349 mmol) and this mixture was stirred for 15 min. Next, TMS-TfOH (10.3, 46.5 mmol) was added, after stirring for 15 min, Et_3N (23.7 g, 203 mmol) was added and the resulting mixture was stirred at 0 °C for subsequential 3 h. Then, the crude product was purified by silica gel column chromatography (3/2, toluene/PE) to give **19** as a viscous pale-yellow oil (19.4 g, 47.0 mmol, 81%). R_f = 0.33 (toluene/PE, 3/2). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 – 7.71 (m, 4H, aromatic (Nap)), 7.50 – 7.40 (m, 3H, aromatic, (Nap)), 4.70 (s, 2H, CH_2 (Nap)), 3.98 – 3.88 (m, 1H, C*H*CH_2COOMe), 3.66 (s, 3H, O-CH_3), 2.64 (dd, 1H, *J* = 15.1, 7.4 Hz, CH_{2a}COOMe), 2.50 (dd, 1H, *J* = 15.0, 5.3 Hz, CH_{2b}COOMe), 1.69 – 1.48 (m, 2H, CH_2CHCH_2COOMe), 1.48 – 1.16 (m, 22H, 11x CH_2), 0.93 – 0.83 (m, 3H, CH_3). ^{13}C NMR (101 MHz, $CDCl_3$) δ 172.3 (C=O), 136.0, 133.3, 133.0, 128.0, 127.8, 127.6, 126.3, 126.0, 125.9, 125.7 (aromatic (Nap)), 76.1 (C*H*CH_2COOMe), 71.6 (CH_2 (Nap), 51.6 (O-CH_3), 39.8 (CH_2COOMe), 31.9 (CH_2CHCH_2COOMe), 29.7, 29.7, 29.6, 29.6, 29.6, 29.6, 29.3, 25.2, 22.7 (11x CH_2), 14.1 (CH_3). HR MS (*m/z*) calcd for $C_{28}H_{42}O_3$ $[M + Na]^+$: 449.3026; found: 449.3031.

Methyl (*R*)-3-(naphthalen-2-ylmethoxy)pentadecanoate (20). To a cooled (0 °C) solution of **18** (6.59 g, 24.2 mmol) and 2-naphthaldehyde (11.3 g, 72.6 mmol) in THF (240 mL), was added hexamethyldisiloxane (30.8 mL, 145 mmol) and this mixture was stirred for 15 min. Next, TMS-TfOH (3.51 mL, 19.4 mmol) was added and stirred for 15 min, then Et_3N (13.5 mL, 84.7 mmol) was added and stirred at 0 °C for another 3 h. Then, the crude product was purified by silica gel column chromatography (3/2, toluene/PE) to give **20** as a viscous pale-yellow oil (8.44 g, 20.5 mmol, 85%). R_f = 0.33 (toluene/PE, 3/2) ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 – 7.74 (m, 4H, aromatic (Nap)), 7.50 – 7.39 (m, 3H, aromatic (Nap)), 4.70 (d, *J* = 1.0 Hz, 2H, CH_2 (Nap)), 3.99 – 3.85 (m, 1H, C*H*CH_2COOMe), 3.66 (s, 3H, O-CH_3), 2.64 (ddd, 1H, *J* = 15.0, 7.3, 0.9 Hz, CH_{2a}COOMe), 2.50 (ddd, 1H, *J* = 15.0, 5.3, 0.9 Hz, CH_{2b}COOMe), 1.69 – 1.49 (m, 2H, CH_2CHCH_2COOMe), 1.33 – 1.14 (m, 20H, 10x CH_2), 0.88 (td, 3H, *J* = 6.8, 1.1 Hz, CH_2CH_3). ^{13}C NMR (101 MHz, $CDCl_3$) δ 172.3, (C=O), 136.0, 133.3, 133.0, 128.0, 127.8, 127.63, 126.34, 125.97, 125.88, 125.73 (aromatic (Nap)), 76.11 (C*H*CH_2COOMe), 71.60 (CH_2 (Nap), 51.6 (O-CH_3), 39.8 (CH_2COOMe), 34.4 (CH_2CHCH_2COOMe), 31.9, 29.7, 29.6, 29.6,

29.56, 29.3, 25.2, 22.7 (10x CH_2), 14.1 (CH_3). HR MS (*m/z*) calcd for $C_{27}H_{40}O_3$ $[M + Na]^+$: 435.2869; found: 435.2872.

(*R*)-3-(naphthalen-2-ylmethoxy)hexadecanoic acid (4). To a solution of **19** (19.2 g, 44.9 mmol) in THF (200 mL), was added a solution of LiOH (11.7 g, 279 mmol) in water (200 mL) and this mixture was stirred vigorously at 50 °C for 16 h. Then, THF was evaporated, aq. 1.0 M HCl (250 mL) added and the product was extracted with DCM (3x 200 mL), dried with $MgSO_4$, filtered and concentrated *in vacuo.* The crude product was purified by silica gel column chromatography (4/1, PE/EtOAc with 1% AcOH) to give **4** as a low viscous yellow oil. (16.1 g, 39.0 mmol, 83%). R_f = 0.60 (PE/EtOAc, 4/1 with 1% AcOH). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88 – 7.69 (m, 4H, aromatic (Nap)), 7.51 – 7.28 (m, 3H, aromatic (Nap)), 4.73 (s, 2H, CH_2 (Nap)), 3.98 – 3.83 (m, 1H, C*H*CH_2COOH), 2.66 (dd, 1H, *J* = 15.4, 7.1 Hz, CH_{2a}COOH), 2.57 (dd, 1H, *J* = 15.4, 5.2 Hz, CH_{2b}COOH), 1.78 – 1.51 (m, 2H, CH_2CHCH_2COOH), 1.46 – 1.08 (m, 22H, 11x CH_2), 0.93 – 0.82 (m, 3H, CH_3). ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.8 (C=O), 135.6, 133.3, 133.0, 128.2, 127.9, 127.7, 126.5, 126.1, 125.9, 125.9 (aromatic (Nap)), 75.8 (C*H*CH_2COOH), 71.7 (CH_2 (Nap)), 39.5 (CH_2COOH), 31.9 (CH_2CHCH_2COOH), 29.7, 29.7, 29.7, 29.6, 29.6, 29.6, 29.6, 29.4, 25.1, 22.7 (11x CH_2), 14.1 (CH_3). HR MS (*m/z*) calcd for $C_{27}H_{40}O_3$ $[M + Na]^+$: 435.2869; found: 435.2869.

(*R*)-3-(naphthalen-2-ylmethoxy)pentadecanoic acid (5). To a solution of **20** (8.14 g, 19.7 mmol) in THF (100 mL), was added a solution of LiOH (4.97 g, 118 mmol) in water (100 mL) and this mixture was stirred at 50 °C for 16 h. Then, THF was evaporated, aq. 1.0 M HCl (200 mL) added and the product was extracted with DCM (3x 100 mL), dried with $MgSO_4$, filtered and concentrated *in vacuo.* The crude product was purified by silica gel column chromatography (4/1, PE/EtOAc with 1% AcOH) to give **5** as a low viscous yellow oil. (7.15 g, 17.9 mmol, 91%). R_f = 0.60 (PE/EtOAc, 4/1 with 1% AcOH) ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 – 7.74 (m, 4H, aromatic (Nap)), 7.50 – 7.40 (m, 3H, aromatic (Nap)), 4.72 (s, 2H, CH_2 (Nap)), 3.97 – 3.87 (m, 1H, C*H*CH_2COOH), 2.66 (dd, 1H, *J* = 15.4, 7.1 Hz, CH_{2a}COOH), 2.57 (dd, 1H, *J* = 15.4, 5.2 Hz, CH_{2b}COOH), 1.74 – 1.51 (m, 2H, CH_2CHCH_2COOH), 1.30 – 1.20 (m, 20H, 10x CH_2), 0.92 – 0.83 (m, 3H, CH_3). ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.6 (C=O), 135.6, 133.3, 133.0, 128.2, 127.9, 127.7, 126.5, 126.1, 125.9, 125.9 (aromatic (Nap)), 75.8 (C*H*CH_2COOH), 71.7 (CH_2 (Nap)), 39.5 (CH_2COOH), 34.2 (CH_2CHCH_2COOH), 31.9, 29.7, 29.6, 29.6, 29.6, 29.6, 29.4, 22.7 (11x CH_2), 14.1 (CH_3). HR MS (*m/z*) calcd for $C_{26}H_{38}O_3$ $[M + Na]^+$: 421.2713; found: 421.2721.

Methyl 11-bromoundecanoate (22). To a solution of **21** (24.3 g, 91.7 mmol) in MeOH (240 mL), was added AcCl (32.6 mL, 459 mmol). After stirring for 3 h, the mixture was concentrated *in vacuo*, redissolved in CH_2Cl_2 (500 mL) and then washed with sat. aq. $NaHCO_3$ (2x 500 mL). The organic phase was dried over $MgSO_4$, filtered and concentrated *in vacuo* to yield **22** as a yellow oil that was used without further purification. (25.2 g, 90.2 mmol, 98%). The chemical shifts of the H-NMR spectrum correspond to literature.[1]

Methyl (*Z*)-13-methyltetradec-11-enoate (23). To **22** (24.7 g, 88.6 mmol) was added PPh_3 (23.2 g, 88.6 mmol) and the resulting was heated at 140 °C for 16 h. Then, the mixture cooled to room temperature, dissolved in anhydrous THF (300 mL) and cooled to 0 °C under a nitrogen atmosphere. To this solution was added $NaN(TMS)_2$ (1.0 M in THF) (88.6 mL, 88.6 mmol) and this mixture was stirred for 20 min. Then, the mixture was cooled to -78 °C and isobutyraldehyde (5.33 mL, 58.6 mmol) in THF (95 mL) was added dropwise. After stirring for 30 min at -78 °C, the reaction was allowed to warm to room temperature over 2 h and then stirred for another 2 h. Then, the reaction was quenched by addition of sat. aq. NH_4Cl (300 mL) and extracted with EtOAc (2x 500 mL). The combined organic layers were dried with $MgSO_4$, filtered and concentrated *in vacuo*. The residue was purified by silica gel column chromatography (19/1, PE/Et_2O) to give **23** as a white crystalline solid (12.1 g, 47.4 mmol, 53%). R_f = 0.7 (PE/Et_2O, 19/1). The chemical shifts of the H-NMR spectrum correspond to literature.[2]

Methyl 13-methyltetradecanoate (24). To a solution of **23** (12.1 g, 47.4 mmol) in EtOH (500 mL) under a hydrogen atmosphere, was added $Pd(OH)_2/C$ (1.0 g, 7.12 mmol) and this mixture was stirred for 16 h. Then, the reaction mixture was filtered over celite and washed with EtOH (2x 100 mL). The solvent was removed *in vacuo* to yield **24** as a yellow oil, which was used in the next reaction without further purification (11.4 g, 44.5 mmol, 94%). The chemical shifts of the ^{1}H-NMR spectrum correspond to a literature report.[2]

13-methyltetradecanoic acid (25). To a solution of **24** (11.4 g, 44.5 mmol) in EtOH (450 mL), was added 2.0 M NaOH (1 L) and this mixture was stirred for 4 h. Then, the pH was adjusted to 1 with 10% HCl. The solids were extracted with EtOAc (3x 500 mL) and the combined organic extracts were dried over $MgSO_4$, filtered and concentrated *in vacuo*. Compound **25** was

obtained as greyish solids and was used without further purification (10.8 g, 44.3 mmol, 99.7%). The chemical shifts of the H-NMR spectrum correspond to literature.[3]

Methyl 15-methyl-3-oxohexadecanoate (26). A solution of **25** (6.53 g, 27.0 mmol) in thionyl chloride (6.7 mL, 91 mmol) was refluxed for 2 h and concentrated in vacuo to give an intermediate acid chloride. To a cooled (0 °C) solution of Meldrum's acid (3.54 g, 24.5 mmol) and pyridine (3.96 mL, 49.1 mmol) in CH_2Cl_2 (240 mL) was added the prepared acid chloride and the reaction was warmed to room temperature and stirred for 16 h. Then, the mixture was washed with 10% aq. HCl (3x 200 mL), then dried over $MgSO_4$, filtered and concentrated *in vacuo*. The residue was redissolved in MeOH (240 mL) and heated to reflux for 16 h. After cooling to room temperature, the crude product was purified by silica gel column chromatography (19/1, PE/Et_2O) to give **26** as a white solid (3.08 g, 10.3 mmol, 42%). R_f = 0.20 (PE/Et_2O, 19/1). The chemical shifts of the H-NMR spectrum correspond to literature.[4]

(R)-methyl 3-hydroxyhexadecanoate (27). Ruthenium catalyst was synthesized freshly prior to reduction, DMF (1.0 mL) was degassed with argon for 15 min after which R-BINAP (52 mg, 84 µmol) and benzeneruthenium(II) chloride dimer (21 mg, 42 µmol) were added and this solution was allowed to stir for 15 min under constant argon bubbling. The flask was heated using a preheated oil bath (100 °C) for 10 min after which the mixture was allowed to cool down to room temperature. A solution of **26** (3.00 g, 10.1 mmol) in MeOH (100 mL) was degassed with argon (30 min), after which the catalyst solution was added under argon atmosphere using a cannula. The reaction mixture was flushed three times with H_2-gas, stirred for 16 h under high pressure (32 bar) at 50 °C, and concentrated in vacuo. Silica gel column chromatography (PE/EtOAc, 22/1) afforded **27** as an off-white crystalline solid (2.61 g, 8.69 mmol, 86%). $[\alpha]_D^{25} =$ -14.3 (c = 1.00, $CHCl_3$). The chemical shifts of the H-NMR spectrum correspond to literature and the enantiomeric excess is determined to be >99%.[5]

2-(4-bromophenyl)-2-oxoethyl (R)-3-hydroxy-15-methyl-hexadecanoate (28). To a solution of **27** (2.61 g, 8.69 mmol) in THF (80 mL) was added a solution of lithium hydroxide monohydrate (2.19 g, 52.1 mmol) in water (80 mL). The reaction was stirred vigorously for 4 h and partitioned in Et_2O (150 mL) and 1M HCl (70 mL), the aqueous was extracted with Et_2O (150 mL). The combined organic layers were dried over $MgSO_4$, filtered and concentrated *in vacuo*. The crude acid was dissolved in EtOAc (100 mL) followed by addition of 1,4-dibromoacetophenone (2.90 g, 10.4 mmol) and triethylamine (2.91 mL, 20.8 mmol). The

reaction was stirred using a mechanical stirrer for 16 h. The precipitate was filtered and triturated with hot EtOAc (200 mL). The combined EtOAc was washed with 1M HCl (300 mL) and brine (300 mL), dried over $MgSO_4$, filtered and concentrated *in vacuo*. The residue was crystallized from EtOAc and petroleum ether to give **28** as white crystals (938 mg, 1.94 mmol, 22%). The chemical shifts of the H-NMR spectrum correspond to literature.[6]

2-(4-bromophenyl)-2-oxoethyl (3R)-15-methyl-3-((13-methyltetradecanoyl)oxy)hexadecanoate (29). To a solution of **28** (455 mg, 933 µmol) and **21** (271 mg, 1.12 mmol) in CH_2Cl_2 (10 mL) was added DCC (1.35 g, 6.53 mmol) and DMAP (11 mg, 93.3 µmol). After stirring for 16 h, MeOH (1 mL) was added and stirring continued for 30 min. The mixture was concentrated *in vacuo* and partitioned between EtOAc (50 mL) and 1M HCl (50 mL), the aqueous was extracted with EtOAc (50 mL). The combined organic layers were washed with brine (50 mL), dried over $MgSO_4$, filtered and concentrated *in vacuo*. Pure **29** was obtained after column chromatography (PE/Et_2O, 8/1) as a white solid (477 mg; 673 µmol; 72%). R*f* = 0.63 (PE/Et_2O, 8/1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (m, 2H, aromatic (Ph)), 7.61 (m, 2H, aromatic (Ph)), 5.25 (m, 3H, C*H*CH_2COOCH_2, $COOCH_2CO$), 2.71 (m, 2H, CH_2COOCH_2), 2.28 (t, 2H, *J* = 7.5 Hz, CH_2COOCH'), 1.60 (m, 4H, CH_2CH_2COOCH', CH_2CHCH_2COO), 1.49 (hept, 2H, *J* = 6.7 Hz, 2x C*H*$(CH_3)_2$), 1.24 (m, 38H, 19x CH_2), 0.84 (d, 12H, *J* = 6.7 Hz, 4x CH_3). ^{13}C NMR (101 MHz, $CDCl_3$): δ 190.8 (COPh), 173.3, 169.8 (2x C=O), 132.9, 132.2, 129.2, 129.1 (Ph), 70.1 (*C*HCH_2COOCH_2), 65.9 (OCH_2COPh), 38.9 (*C*H_2COOC), 34.4 (*C*H_2COOC'), 34.0, 29.9, 29.7, 29.7, 29.6, 29.5, 29.5, 29.5, 29.3, 29.3, 29.1, 27.9, 27.4, 25.1, 25.0 (51x CH_2), 27.9 (2x (*C*$H(CH_3)_2$), 22.6 (2x $CH(CH_3)_2$).

(3R)-15-methyl-3-((13-methyltetradecanoyl)oxy)hexadecanoate (6). To a solution of **29** (403 mg, 569 µmol) in acetic acid (5 mL) was added zinc dust (893 mg, 13.7 mmol), after which the mixture stirred at 60 °C for 1 h and sonicated for 30 seconds. The zinc dust was removed by filtration over celite and the filtrate was concentrated *in vacuo*. Silica gel column chromatography (PE/Et_2O, 9/1 with 1% AcOH) afforded compound **6** as a clear colorless oil (223 mg, 473 µmol, 65%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.19 (m, 1H, C*H*CH_2COOH), 2.59 (m, 2H, CH_2COOH), 2.26 (t, 2H, *J* = 7.5 Hz, CH_2COOCH'), 1.57 (m, 4H, CH_2CH_2COOCH', CH_2CHCH_2COOH), 1.49 (m, 2H, 2x C*H*$(CH_3)_2$), 1.25 (m, 38H, 19x CH_2), 0.85 (d, 12H, *J* = 6.6 Hz, 4x CH_3). ^{13}C NMR (101 MHz, $CDCl_3$): δ 70.0 (*C*HCH_2COOCH_2), 39.1 (*C*H_2COOC),

34.5 (*C*H_2COOC'), 34.0, 29.9, 29.7, 29.7, 29.6, 29.5, 29.3, 29.1, 27.4, 25.1, 25.0 (51x CH_2), 28.0 (2x (*C*H(CH_3)$_2$), 22.7 (2x CH(*C*H_3)$_2$).

Dimethylthexylsilyl 6-*O*-[2-deoxy-4,6-di-*O*-naphthalen-2-ylmethoxy-3-*O*-(R)-(naphthalen-2-ylmethoxy)hexadecanoate-2-(2,2,2-trichloroethoxycarbonylamino)-ß-D-glucopyranosyl]-2-deoxy-2-(9-fluorenylmethoxycarbonylamino)-4-*O*-naphthalen-2-ylmethyl-3-*O*-(R)-(naphthalen-2-ylmethoxy)pentadecanoate-ß-D-glucopyranoside (30). To a cooled (-30 °C) solution of *N*-phenyl-trifluoroacetimidate **2** (1.31 g; 1.09 mmol) and acceptor **3** (896 mg; 842 µmol) in dry CH_2Cl_2 (20 mL) containing acid washed molecular sieves 4Å (896 mg) was added a 100-fold diluted solution of TfOH in dry CH_2Cl_2 (1.1 mL, 126 µmol). After stirring at -30 °C for 0.5 h, the reaction mixture was quenched with Et_3N (1 mL) and the reaction mixture was concentrated under reduced pressure. The residue was subjected to column chromatography (PE/EtOAc, 1/0 – 8/2) to obtain disaccharide **30** as a clear yellow oil (1.24 g; 597 µmol; 71%) R*f* = 0.30 (PE/EtOAc, 9/1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 (m, 43H, aromatic (Nap, Fmoc), 5.29 (t, 1H, *J* = 9.7 Hz, H-3'), 5.23 (t, 1H, *J* = 10.0 Hz, H-3), 5.02 (d, 1H, *J* = 9.0 Hz, NH'), 4.84 (d, 1H, *J* = 9.5 Hz, NH), 4.70 (m, 5H, H-1, 2x CH_2 (Nap)), 4.54 (m, 7H, H-1', 3x CH_2 (Nap)), 4.24 (m, 2H, CH_2 (Fmoc)), 4.14 (m, 1H, CH (Fmoc)), 3.84 (d, 1H, *J* = 11.3 Hz, CH_{2a}-6), 3.82 (m, 3H, H-4', C*H*CH_2COOC (L1), C*H*CH_2COOC (L3)), 3.72 (m, 4H, H-4, CH_{2b}-6, CH_2-6'), 3.61 (m, 3H, H-2, H-2', H-5'), 3.45 (d, 1H, *J* = 9.5 Hz, H-5), 2.53 (m, 2H, CH_{2a}COOC (L1), CH_{2a}COOC (L3)), 2.38 (m, 2H, CH_{2b}COOC (L1), CH_{2b}COOC (L3)), 1.51 (m, 5H, CH (TDS), CH_2CHCH_2COO (L1), CH_2CHCH_2COO (L3)), 1.18 (m, 42H, 21x CH_2), 0.88 (t, 6H, *J* = 6.7 Hz, 2x CH_2CH_3), 0.79 (m, 12H, 4x CH_3 (TDS)), 0.17, 0.11 (2s, 6H, 2x CH_3 (TDS)). ^{13}C NMR (101 MHz, $CDCl_3$) δ 143.9, 141.2, 136.0, 135.1, 133.2, 133.1, 133.0, 133.0, 132.9, 128.2, 128.0, 128.0, 127.9, 127.8, 127.7, 127.6, 127.6, 127.5, 127.0, 126.6, 126.4, 126.3, 126.2, 126.1, 125.9, 125.9, 125.8, 125.8, 125.7, 125.2, 119.9 (aromatic (Nap), (Fmoc)), 101.1 (C-1'), 96.3 (C-1), 76.2 (C-4), 75.7, 75.6, 75.7 (*C*HCH_2COOC (L1), *C*HCH_2COOC (L3), C-4'), 75.0 (C-5), 74.9 (C-5'), 74.7 (C-3'), 74.3 (CH_2 (Nap)), 74.2 (C-3, CH_2 (Nap), 73.7 (CH_2 (Nap), 71.4 (2x CH_2 (Nap)), 68.5 (C-6') 68.2 (C-6), 67.2 (CH_2 (Fmoc)), 58.1 (C-2), 56.0 (C-2'), 47.0 (CH (Fmoc)), 39.7 (*C*H_2COOC (L1)), 39.6 (*C*H_2COOC (L3)), 34.2 (*C*H_2CHCH_2COOC (L1), *C*H_2CHCH_2COOC (L3)), 33.9 (CH (TDS)), 31.9, 29.7, 29.6, 29.4, 25.2, 25.1, 24.7, 22.7 (21x CH_2), 19.9, 18.5 (4x CH_3 (TDS)), 14.1 (CH_2*C*H_3), -1.3, -3.7 (2x CH_3 (TDS)).

Dimethylthexylsilyl 6-*O*-[2-deoxy-2-(R)-(13-methyltetradecanoyloxy)15-methylhexadecanamido-4,6-di-*O*-naphthalen-2-ylmethoxy-3-*O*-(R)-(naphthalen-2-ylmethoxy)hexadecanoate-ß-D-glucopyranosyl]-2-deoxy-2-(9-fluorenylmethoxycarbonylamino)-4-*O*-naphthalen-2-ylmethyl-3-*O*-(R)-(naphthalen-2-ylmethoxy)pentadecanoate-ß-D-glucopyranoside (31). To a solution of **30** (303 mg; 146 µmol) in THF/AcOH (4/1; 1.5 mL) was added Zn (303 mg, 4.6 mmol). After stirring for 16 h, the reaction mixture was briefly sonicated, filtered over a pad of celite and concentrated under reduced pressure. The crude was partitioned between EtOAc (30 mL) and sat. aq, $NaHCO_3$ (30 mL), the organic layer was washed with sat. aq. $NaHCO_3$ (2x 30 mL). The combined aqueous layers were extracted with EtOAc (2x 100 mL). Finally, the combined organic layers were washed with brine (50 mL), dried over $MgSO_4$, filtered and concentrated. To the crude amine and DCC (60 mg, 292 µmol) was added a solution of lipid **6** in CH_2Cl_2 (2 mL). After stirring for 16 h, the solids were filtered off and the filtrate was concentrated under reduced pressure. Pure **31** was obtained after column chromatography (PE/EtOAc, 1/0 – 9/1) as a clear pale-yellow oil (132 mg; 55.2 µmol; 38%) R*f* = 0.60 (PE/EtOAc, 8/2). ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.48 (m, 43H, aromatic (Nap, (Fmoc)), 5.82 (d, 1H, *J* = 8.7 Hz, NH'), 5.29 (td, 2H, *J* = 10.0, 4.1 Hz, H-3', H-3), 5.01 (dt, 1H, *J* = 11.4, 5.5 Hz, C*H*CH_2COOC (L2)), 4.89 (d, 1H, *J* = 9.6 Hz, NH), 4.71 (m, 6H, H-1, H-1', 2x CH_2 (Nap)), 4.56 (m, 5H, 2x CH_2 (Nap), CH_{2a} (Nap)), 4.46 (d, 1H, *J* = 11.7 Hz, CH_{2b} (Nap)), 4.23 (m, 2H, CH_2 (Fmoc)), 4.13 (m, 1H, CH (Fmoc)), 4.03 (d, 1H, *J* = 11.7 Hz, CH_{2a}-6), 3.89 (q, 1H, *J* = 7.6 Hz, H-2'), 3.78 (m, 7H, H-4', CH_{2b}-6, C*H*CH_2COOC (L1), C*H*CH_2COOC (L3), H-4, CH_2-6'), 3.68 (q, 1H, *J* = 9.7 Hz, H-2), 3.57 (m, 2H, H-5, H-5'), 2.55 (dd, 1H, *J* = 16.1, 7.2 Hz, C*H*$_{2a}$COOC (L1)), 2.48 (dd, 1H, *J* = 15.7, 6.9 Hz, C*H*$_{2a}$COOC (L3)), 2.42 (dd, 1H, *J* = 15.7, 4.9 Hz, C*H*$_{2b}$COOC (L1)), 2.32 (m, 2H, C*H*$_{2b}$COOC (L3), C*H*$_{2a}$COOC (L2)), 2.26 (dd, 2H, *J* = 15.6, 8.0 Hz, CH_2COOC (L2')), 2.16 (dd, 1H, *J* = 14.9, 5.8 Hz, C*H*$_{2b}$COOC (L2)), 1.50 (m, 11H, CH (TDS), C*H*$_2$CHCH_2COO (L1), C*H*$_2$CHCH_2COO (L2), C*H*$_2$CHCH_2COO (L3), C*H*$_2$$CH_2$COOC (L2), 2x C*H*$(CH_3)_2$), 1.18 (m, 80H, 40x CH_2), 0.86 (m, 18H, 6x CH_2C*H*$_3$), 0.79 (m, 12H, 4x CH_3 (TDS)), 0.17, 0.12 (2s, 6H, 2x CH_3 (TDS)). ^{13}C NMR (151 MHz, $CDCl_3$) δ 173.8, 171.8, 171.6, 169.5 (4x C=O), 155.7 (C=O (Fmoc), 143.9, 141.2, 136.0, 136.0, 135.9, 135.6, 135.3, 135.2, 133.2, 133.2, 133.1, 133.1, 133.0, 133.0, 132.9, 132.9, 132.9, 132.8, 132.8, 132.8, 128.2, 128.1, 128.1, 128.0, 128.0, 127.9, 127.9, 127.8, 127.8, 127.7, 127.6, 127.6, 127.5, 127.0, 126.5, 126.4, 126.3, 126.2, 126.2, 126.2, 126.0, 126.0, 125.9, 125.9, 125.8, 125.8, 125.8, 125.7, 125.7, 125.6, 125.2, 125.2, 119.9 (aromatic (Nap), (Fmoc)), 101.1 (C-1'), 96.4 (C-1), 76.3 (C-4), 75.6, 75.5, 75.5 (*C*HCH_2COOC (L1), *C*HCH_2COOC (L3), C-4'), 75.0, 75.0 (C-5, C-5'), 74.8 (C-3, C-3'), 74.4 (CH_2 (Nap)),

74.2 (CH_2 (Nap)), 73.6 (CH_2 (Nap), 71.3 (2x CH_2 (Nap)), 70.9 (*C*HCH_2COOC (L2)), 68.7 (C-6') 68.4 (C-6), 67.1 (CH_2 (Fmoc)), 58.2 (C-2), 54.8 (C-2'), 47.0 (CH (Fmoc)), 41.8 (*C*H_2COOC (L2)), 39.6 (*C*H_2COOC (L1)), 39.0 (*C*H_2COOC (L3)), 34.5 (*C*H_2CHCH_2COOC (L2)), 34.2 (*C*H_2CHCH_2COOC (L1), *C*H_2CHCH_2COOC (L3)), 33.9 (CH (TDS)), 31.9, 30.0, 29.9, 29.8, 29.7, 29.7, 29.7, 29.7, 29.6, 29.6, 29.6, 29.6, 29.5, 29.4, 29.4, 29.4, 29.3, 29.3, 29.2, 27.4, 27.4, 26.6, 25.2, 25.2 25.1, 25.0, 24.7, 22.7 (40x CH_2), 27.9 (2x (*C*H$(CH_3)_2$), 22.6 (CH(*C*$H_3)_2$), 19.9, 18.5 (4x CH_3 (TDS)), 14.1 (CH_2*C*H_3), -1.5, -3.4 (2x CH_3 (TDS)). MALDI-TOF (*m/z*) calcd for $C_{153}H_{210}KN_2O_{18}Si$ $[M + K]^+$: 2430.4980; found: 2430.3059.

Dimethylthexylsilyl 6-*O*-[2-deoxy-2-(R)-(13-methyltetradecanoyloxy)15-methylhexadecanamido-4,6-di-*O*-naphthalen-2-ylmethoxy-3-*O*-(R)-(naphthalen-2-ylmethoxy)hexadecanoate-ß-D-glucopyranosyl]-2-deoxy-4-*O*-naphthalen-2-ylmethyl-3-*O*-(R)-(naphthalen-2-ylmethoxy)pentadecanoate-2-(R)-(naphthalen-2-ylmethoxy)hexadecanamido-ß-D-glucopyranoside (32). To a solution of **31** (305 mg; 127 µmol) in CH_2Cl_2 (2 mL) was added 1,8-diazabicyclo[5.4.0]undec-7-ene (38 µL, 255 µmol). The reaction mixture was stirred for 1 h. To a solution of lipid **4** (105 mg, 255 µmol) in CH_2Cl_2 (2 mL) were added DCC (53 mg, 255 µmol) and K-OxymaPure (46 mg, 255 µmol). The Fmoc deprotected **31** was added to the pre-activated **4**. After stirring for 16 h, the reaction mixture was filtered and concentrated under reduced pressure. Pure **32** was obtained after column chromatography (PE/EtOAc, 1/0 – 8/2) as a clear pale-yellow oil (236 mg; 92.0 µmol; 72%) R*f* = 0.60 (PE/EtOAc, 8/2). Compound **32** contains residual CH_2Cl_2 (3.4%; 5.30 (s, 2H) and toluene (1.9%; 2.36 (s, 3H), 7.17 (m, 3H), 7.25 (m, 2H)). ^{1}H NMR (400 MHz, $CDCl_3$). ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.56 (m, 42H, aromatic (Nap), 6.19 (d, 1H, *J* = 9.3 Hz, NH), 5.79 (d, 1H, *J* = 8.1 Hz, NH'), 5.30 (t, 1H, *J* = 9.7 Hz, H-3'), 5.17 (t, 1H, *J* = 9.7 Hz, H-3), 5.02 (p, 1H, *J* = 6.3 Hz, C*H*CH_2COOC (L2)), 4.69 (m, 7H, H-1', 3x CH_2 (Nap)), 4.56 (m, 5H, 2x CH_2 (Nap), CH_{2a} (Nap)), 4.47 (d, 1H, *J* = 11.7 Hz, CH_{2b} (Nap)), 4.32 (d, 1H, *J* = 7.8 Hz, H-1), 3.95 (q, 2H, *J* = 9.0 Hz, H-2, CH_{2a}-6), 3.81 (m, 5H, H-2', H-4', C*H*CH_2COOC (L1), C*H*CH_2COOC (L3), C*H*CH_2COOC (L4)), 3.74 (m, 3H, CH_{2b}-6 CH_2-6'), 3.69 (t, 1H, *J* = 9.3 Hz, H-4), 3.54 (dt, 1H, *J* = 9.6, 3.2 Hz, H-5'), 3.32 (ddd, 1H, *J* = 9.6, 5.1, 2.0 Hz, H-5), 2.56 (dd, 1H, *J* = 16.0, 7.2 Hz, CH_{2a}COOC (L1)), 2.51 (dd, 1H, *J* = 15.9, 7.1 Hz, CH_{2a}COOC (L3)), 2.42 (ddd, 2H, *J* = 15.9, 12.5, 5.8 Hz, CH_{2b}COOC (L1), CH_{2a}COOC (L4)), 2.36 (m, 2H, CH_{2b}COOC (L3)), 2.30 (m, 4H, CH_{2a}COOC (L2), CH_{2b}COOC (L4), CH_2COOC (L2')), 2.15 (dd, 1H, *J* = 15.0, 5.6 Hz, CH_{2b}COOC (L2)), 1.52 (m, 13H, CH (TDS), CH_2CHCH_2COO (L1), CH_2CHCH_2COO (L2), CH_2CHCH_2COO (L3), CH_2CHCH_2COO (L4), CH_2CH_2COOC (L2), 2x C*H*$(CH_3)_2$), 1.24

(m, 102H, 51x CH_2), 0.88 (m, 21H, 7x CH_2CH_3), 0.79 (m, 12H, 4x CH_3 (TDS)), 0.09, -0.01 (2s, 6H, 2x CH_3 (TDS)). ^{13}C NMR (151 MHz, $CDCl_3$) δ 173.7, 171.6, 171.5, 170.7, 169.4 (5x C=O), 136.1, 136.0, 136.0, 135.9, 135.8, 135.7, 135.7, 135.4, 135.2, 133.3, 133.2, 133.2, 133.1, 133.1, 133.0, 132.9, 132.8, 132.8, 132.8, 132.4, 130.8, 129.0, 128.8, 128.3, 128.3, 128.2, 128.1, 128.1, 128.0, 128.0, 128.0, 127.9, 127.9, 127.9, 127.8, 127.8, 127.7, 127.6, 127.5, 127.5, 127.5, 126.5, 126.4, 126.3, 126.3, 126.3, 126.2, 126.2, 126.2, 126.1, 126.1, 126.0, 125.9, 125.9, 125.9, 125.8, 125.8, 125.8, 125.8, 125.7, 125.7, 125.7, 125.6, 125.3 (aromatic (Nap)), 100.9 (C-1'), 96.2 (C-1), 76.2 (C-4), 75.7, 75.6, 75.5, 75.4 (*C*HCH$_2$COOC (L1), *C*HCH$_2$COOC (L3), *C*HCH$_2$COOC (L4), C-4'), 74.9 (C-5'), 74.9 (C-3), 74.9 (C-3'), 74.6 (C-5), 74.2 (CH_2 (Nap)), 74.1 (CH_2 (Nap)), 73.5 (CH_2 (Nap), 71.3 (CH_2 (Nap)), 71.2 (CH_2 (Nap)), 70.8 (*C*HCH$_2$COOC (L2)), 70.6 (CH_2 (Nap)), 68.6 (C-6') 68.3 (C-6), 55.8 (C-2), 54.9 (C-2'), 41.7 (*C*H$_2$COOC (L2)), 41.1 (*C*H$_2$COOC (L4)), 39.6 (*C*H$_2$COOC (L1)), 39.6 (*C*H$_2$COOC (L3)), 34.5 (*C*H$_2$CHCH$_2$COOC (L2)), 34.3, 34.2 (*C*H$_2$CHCH$_2$COOC (L1), *C*H$_2$CHCH$_2$COOC (L3)), 33.9 (CH (TDS)), 33.7 (*C*H$_2$CHCH$_2$COOC (L4)), 31.9, 30.3, 30.0, 29.9, 29.8, 29.7, 29.7, 29.7, 29.6, 29.6, 29.6, 29.6, 29.6, 29.4, 29.4, 29.4, 29.2, 28.9, 27.4, 27.4, 25.2, 25.2 25.1, 25.0, 24.6, 23.7, 22.9, 22.7 (51x CH_2), 27.9 (2x (*C*H(CH$_3$)$_2$), 22.6 (CH(*C*H$_3$)$_2$), 20.0, 20.0, 18.5 (4x CH_3 (TDS)), 14.1 (CH_2CH_3), -1.5, -3.4 (2x CH_3 (TDS)). MALDI-TOF (*m/z*) calcd for $C_{165}H_{238}KN_2O_{18}Si$ $[M + K]^+$: 2602.7171; found: 2602.5159.

6-*O*-[2-deoxy-2-(R)-(13-methyltetradecanoyloxy)15-methylhexadecanamido-4,6-di-*O*-naphthalen-2-ylmethoxy-3-*O*-(R)-(naphthalen-2-ylmethoxy)hexadecanoate-ß-D-glucopyranosyl]-2-deoxy-4-*O*-naphthalen-2-ylmethyl-3-*O*-(R)-(naphthalen-2-ylmethoxy)pentadecanoate-2-(R)-(naphthalen-2-ylmethoxy)hexadecanamido-ß-D-glucopyranose (33). To a teflon round bottom flask containing a solution of **32** (236 mg; 92.0 µmol) in THF (10 mL) were added pyridine (3 mL, 37.2 mmol) and HF pyridine (1 mL, 38.5 mmol). After stirring for 16 h, the reaction mixture was diluted with EtOAc (100 mL) and transferred into a separatory funnel. The organic layer was washed with water (2x 100 mL) and the combined aqueous layers were extracted with EtOAc (100 mL). The combined organic layers were washed with brine, dried over $MgSO_4$ and filtered. Concentration *in vacuo* was followed by Sephadex LH-20 column chromatography (CH_2Cl_2/MeOH, 1/1), affording pure **33** as a white solid (178 mg; 73.4 µmol; 80%) R*f* = 0.60 (PE/EtOAc, 6/4). ^1H NMR (600 MHz, $CDCl_3$) δ 7.54 (m, 42H, aromatic (Nap), 6.38 (d, 1H, *J* = 9.3 Hz, NH), 5.91 (d, 1H, *J* = 8.3 Hz, NH'), 5.50 (t, 1H, *J* = 10.1 Hz, H-3), 5.33 (t, 1H, *J* = 9.6 Hz, H-3'), 5.13 (s, 1H, H-1), 5.02 (d, 1H, *J* = 8.1 Hz, H-1), 4.93 (p, 1H, *J* = 6.3 Hz, C*H*CH$_2$COOC (L2)), 4.84 (s, 1H, OH), 4.68 (m,

6H, 3x CH_2 (Nap)), 4.55 (m, 6H, 3x CH_2 (Nap)), 4.25 (td, 1H, *J* = 10.1, 3.5 Hz, H-2), 4.16 (t, 1H, *J* = 9.1 Hz, H-5), 3.98 (d, 1H, *J* = 11.9 Hz, CH_{2a}-6), 3.83 (m, 3H, C*H*CH_2COOC (L1), C*H*CH_2COOC (L3), C*H*CH_2COOC (L4)), 3.69 (m, 4H, H-4', CH_{2b}-6, CH_2-6', H-2'), 3.56 (m, 1H, H-5'), 3.38 (t, 1H, *J* = 9.6 Hz, H-4), 2.58 (dd, 1H, *J* = 16.0, 7.0 Hz, CH_{2a}COOC (L1)), 2.50 (dd, 1H, *J* = 15.6, 6.9 Hz, CH_{2a}COOC (L3)), 2.41 (m, 2H, CH_{2b}COOC (L1), CH_{2a}COOC (L4)), 2.30 (m, 3H, CH_{2b}COOC (L3), CH_{2a}COOC (L2), CH_{2b}COOC (L4),), 2.21 (m, 2H, CH_2COOC (L2')), 2.16 (dd, 1H, *J* = 14.1, 4.5 Hz, CH_{2b}COOC (L2)), 1.50 (m, 12H, CH_2CHCH_2COO (L1), CH_2CHCH_2COO (L2), CH_2CHCH_2COO (L3), CH_2CHCH_2COO (L4), CH_2CH_2COOC (L2), 2x CH(CH_3)$_2$), 1.22 (m, 102H, 51x CH_2), 0.87 (m, 21H, 7x CH_2CH_3). ^{13}C NMR (151 MHz, $CDCl_3$) δ 174.6, 171.9, 171.4, 171.3, 170.1 (5x C=O), 136.0, 136.0, 135.8, 135.3, 135.1, 135.0, 133.3, 133.2, 133.2, 133.1, 133.1, 133.0, 133.0, 133.0, 132.9, 132.9, 132.9, 132.8, 132.8, 128.2, 128.1, 128.1, 128.0, 128.0, 128.0, 128.0, 127.9, 127.8, 127.8, 127.7, 127.7, 127.6, 127.6, 127.6, 127.5, 127.5, 126.6, 126.4, 126.4, 126.3, 126.2, 126.2, 126.2, 126.2, 126.1, 126.1, 126.1, 126.0, 125.9, 125.9, 125.9, 125.9, 125.8, 125.8, 125.8, 125.7, 125.7, 125.6, 125.6, 125.5, 125.5 (aromatic (Nap)), 100.1 (C-1'), 91.4 (C-1), 76.8 (C-4), 76.4, 76.3, 75.9, 75.5 (*C*HCH$_2$COOC (L1), *C*HCH$_2$COOC (L3), *C*HCH$_2$COOC (L4), C-4'), 74.9 (C-5'), 74.5 (C-3'), 74.4 (CH_2 (Nap)), 74.2 (CH_2 (Nap)), 73.7 (C-3), 73.5 (CH_2 (Nap), 71.6 (CH_2 (Nap)), 71.3 (CH_2 (Nap)), 71.2 (*C*HCH$_2$COOC (L2), C-5), 68.5 (C-6') 67.6 (C-6), 55.3 (C-2'), 52.5 (C-2), 42.0 (*C*H$_2$COOC (L2)), 41.8 (*C*H$_2$COOC (L4)), 39.8 (*C*H$_2$COOC (L1)), 39.5 (*C*H$_2$COOC (L3)), 34.4 (*C*H$_2$COOC (L2)'), 34.3, 34.3, 34.2, 34.1 (*C*H$_2$CHCH$_2$COOC (L1), *C*H$_2$CHCH$_2$COOC (L3), *C*H$_2$CHCH$_2$COOC (L2), *C*H$_2$CHCH$_2$COOC (L4)), 31.9, 30.0, 29.8, 29.7, 29.7, 29.7, 29.6, 29.6, 29.5, 29.4, 29.4, 29.3, 29.2, 29.2, 27.4, 25.2, 25.2, 25.2, 25.0, 24.9, 22.7 (51x CH_2), 27.9 (2x (*C*H(CH_3)$_2$), 22.6 (CH(*C*H_3)$_2$), 14.1 (CH_2*C*H_3). MALDI-TOF (*m/z*) calcd for $C_{157}H_{220}KN_2O_{18}$ [M (mono ^{13}C) + K]$^+$: 2461.5993; found: 2461.3853.

Bis(allyloxy)phosphoryl 6-*O*-[2-deoxy-2-(R)-(13-methyltetradecanoyloxy)15-methylhexadecanamido-4,6-di-*O*-naphthalen-2-ylmethoxy-3-*O*-(R)-(naphthalen-2-ylmethoxy)hexadecanoate-ß-D-glucopyranosyl]-2-deoxy-4-*O*-naphthalen-2-ylmethyl-3-*O*-(R)-(naphthalen-2-ylmethoxy)pentadecanoate-2-(R)-(naphthalen-2-ylmethoxy)hexadecanamido-ß-D-glucopyranoside (34). To pyranose **33** (89 mg; 36.7 µmol) was added 1H-tetrazole (0.45 M in MeCN; 409 µL, 184 µmol). After concentration *in vacuo*, the mixture was resuspended in toluene and concentrated for a total of five times after which it was dissolved in CH_2Cl_2 (400 µL). To the cooled (0 °C) reaction mixture diallyl diisopropylphosphoramidite (20 µL, 73.4 µmol) was added. Stirring was continued at 0 °C for

1 h after which the mixture was further cooled to -78 °C, hereto tert-butyl hydroperoxide (5 M in decane; 20 µL, 100 µmol) was added. The resulting mixture was stirred for an additional hour at 0 °C. The reaction mixture was directly transferred onto silica gel and purified using flash chromatography (0 to 40% EtOAc in PE) to afford pure **34** as a colorless oil (39 mg; 15.1 µmol; 41%) R*f* = 0.60 (PE/EtOAc, 6/4). ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.52 (m, 42H, aromatic (Nap), 6.85 (d, 1H, *J* = 8.9 Hz, NH'), 6.40 (d, 1H, *J* = 8.6 Hz, NH), 5.94 (ddt, 1H, *J* = 16.4, 10.8, 5.6 Hz, C*H*=CH_2), 5.81 (dq, 1H, *J* = 16.0, 5.1 Hz, C*H*=CH_2), 5.71 (t, 1H, *J* = 4.1 Hz, H-1), 5.37 (m, 2H, H-3, CH=CH_{2a}), 5.24 (m, 4H, H-3', CH=CH_{2b}, CH=CH_2), 5.09 (p, 1H, *J* = 6.4 Hz, C*H*CH_2COOC (L2)), 4.86 (d, 1H, *J* = 8.4 Hz, H-1'), 4.60 (m, 16H, 6x CH_2 (Nap), 2x CH_2CH=CH_2), 4.35 (td, 1H, *J* = 8.3, 4.3 Hz, H-2), 4.18 (dd, 1H, *J* = 10.4, 6.0 Hz, H-5), 3.98 (m, 2H, H-2', CH_{2a}-6), 3.91 (dd, 1H, *J* = 12.5, 6.0 Hz, CH_{2b}-6) 3.86 (p, 1H, *J* = 6.0 Hz, C*H*CH_2COOC (L4)), 3.81 (m, 2H, C*H*CH_2COOC (L1), C*H*CH_2COOC (L3)), 3.75 (m, 1H, H-4'), 3.70 (m, 2H, CH_2-6'), 3.56 (t, 1H, *J* = 9.7 Hz, H-4), 3.53 (m, 1H, H-5'), 2.62 (dd, 1H, *J* = 15.9, 7.6 Hz, CH_{2a}COOC (L1)), 2.52 (dd, 1H, *J* = 15.8, 7.4 Hz, CH_{2a}COOC (L3)), 2.46 (dd, 1H, *J* = 15.9, 4.6 Hz, CH_{2b}COOC (L1)), 2.40 (dd, 2H, *J* = 15.3, 6.4 Hz, CH_{2b}COOC (L3), CH_{2a}COOC (L4)), 2.35 (m, 2H, CH_2COOC (L2),), 2.27 (dd, 1H, *J* = 15.3, 6.6 Hz, CH_{2b}COOC (L4)), 2.23 (m, 2H, CH_2COOC (L2')), 1.51 (m, 12H, CH_2CH_2COO (L1), CH_2CH_2COO (L2), CH_2CH_2COO (L3), CH_2CH_2COO (L4), CH_2CH_2COOC (L2), 2x C*H*$(CH_3)_2$), 1.21 (m, 102H, 51x CH_2), 0.87 (m, 21H, 7x CH_2CH_3). ^{13}C NMR (151 MHz, $CDCl_3$) δ 173.4, 172.1, 171.5, 171.3, 169.9 (5x C=O), 136.1, 135.9, 135.9, 135.6, 135.2, 134.7, 133.3, 133.2, 133.2, 133.1, 133.0, 132.9, 132.9, 132.9, 132.8, 132.7, 132.4, 132.4, 132.1, 132.1, 128.3, 128.1, 128.1, 128.0, 127.9, 127.9, 127.8, 127.8, 127.7, 127.6, 127.6, 127.5, 127.5, 127.5, 126.5, 126.4, 126.3, 126.3, 126.2, 126.1, 126.1, 126.0, 125.9, 125.9, 125.9, 125.8, 125.8, 125.8, 125.7, 125.6, 125.6, 125.5 (aromatic (Nap) + *C*H=CH_2), 119.0, 118.7 (CH=*C*H_2), 100.1 (C-1'), 96.0 (C-1), 75.9 (C-4'), 75.7, 75.6, 75.6 (*C*HCH_2COOC (L1), *C*HCH_2COOC (L3), *C*HCH_2COOC (L4), C-3'), 75.3 (C-4), 75.1 (C-5'), 75.0 (CH_2 (Nap)), 74.3 (C-5), 74.2 (CH_2 (Nap)), 73.4 (CH_2 (Nap), 72.2 (C-3), 71.3 (CH_2 (Nap)), 71.1 (CH_2 (Nap)), 70.8 (*C*HCH_2COOC (L2)), 68.8, 68.8, 68.7, 68.7 (C-6' + *C*H_2-CH=CH_2), 66.2 (C-6), 54.2 (C-2'), 52.3 (C-2), 41.3 (*C*H_2COOC (L2)), 41.0 (*C*H_2COOC (L4)), 39.8 (*C*H_2COOC (L1)), 39.7 (*C*H_2COOC (L3)), 34.4 (*C*H_2COOC (L2)'), 34.3, 34.2, 34.0, 33.9 (*C*H_2CHCH_2COOC (L1), *C*H_2CHCH_2COOC (L3), *C*H_2CHCH_2COOC (L2), *C*H_2CHCH_2COOC (L4)), 31.9, 30.0, 29.8, 29.7, 29.7, 29.7, 29.6, 29.6, 29.5, 29.4, 29.4, 29.2, 27.4, 25.3, 25.3, 25.2, 25.0, 22.7 (51x CH_2), 27.9 (2x (*C*H$(CH_3)_2$), 22.6 (CH(*C*$H_3)_2$), 14.1 (CH_2*C*H_3). ^{31}P NMR (162 MHz, $CDCl_3$): δ -2.2.

6-*O*-[2-deoxy-2-(R)-(13-methyltetradecanoyloxy)15-methylhexadecanamido-4,6-di-*O*-naphthalen-2-ylmethoxy-3-*O*-(R)-(naphthalen-2-ylmethoxy)hexadecanoate-ß-D-glucopyranosyl]-2-deoxy-4-*O*-naphthalen-2-ylmethyl-3-*O*-(R)-(naphthalen-2-ylmethoxy)pentadecanoate-2-(R)-(naphthalen-2-ylmethoxy)hexadecanamido-ß-D-glucopyranose 1-phosphate (35). To a solution of **34** (39 mg; 15.1 µmol) in CH_2Cl_2/MeOH (3/2, 500 µL) was added $PdCl_2$ (1.3 mg, 7.55 µmol). After stirring for 5 h, the reaction mixture was filtered over a Fisherbrand™ PTFE syringe filter (0.2 µm; 13 mm). Pure **35** was obtained after concentration as a yellow oil (35 mg; 14.0 µmol; 93%). ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.55 (m, 42H, aromatic (Nap), 5.60 (dd, 1H, *J* = 6.2, 3.5 Hz, H-1), 5.44 (t, 1H, *J* = 9.9 Hz, H-3), 5.19 (t, 1H, *J* = 9.9 Hz, H-3'), 5.05 (p, 1H, *J* = 6.1 Hz, C*H*CH_2COOC (L2)), 4.78 (m, 2H, CH_{2a} (Nap), H-1'), 4.59 (m, 11H, 5x CH_2 (Nap), CH_{2b} (Nap)), 4.36 (dt, 1H, *J* = 10.9, 3.2 Hz, H-2), 4.23 (dd, 1H, *J* = 10.2, 6.7 Hz, H-5), 4.01 (d, 1H, *J* = 11.6 Hz, CH_{2a}-6), 3.97 (m, 1H, H-2'), 3.89 (m, 2H, C*H*CH_2COOC (L4), C*H*CH_2COOC (L1)), 3.79 (m, 2H, C*H*CH_2COOC (L3) , CH_{2b}-6), 3.75 (m, 1H, H-4'), 3.68 (m, 2H, CH_2-6'), 3.55 (m, 2H, H-4, H-5'), 2.62 (dd, 1H, *J* = 16.1, 7.6 Hz, CH_{2a}COOC (L1)), 2.52 (m, 1H, CH_{2a}COOC (L3)), 2.46 (m, 2H, CH_{2b}COOC (L1), CH_{2a}COOC (L4)), 2.41 (dd, 1H, *J* = 15.0, 7.3 Hz, CH_{2b}COOC (L3)), 2.34 (m, 3H, CH_2COOC (L2), CH_{2b}COOC (L4)), 2.26 (dt, 2H, *J* = 11.8, 6.0 Hz, CH_2COOC (L2')), 1.47 (m, 12H, CH_2CHCH_2COO (L1), CH_2CHCH_2COO (L2), CH_2CHCH_2COO (L3), CH_2CHCH_2COO (L4), C$H_2$$CH_2$COOC (L2), 2x C*H*$(CH_3)_2$), 1.24 (m, 102H, 51x CH_2), 0.87 (m, 21H, 7x CH_2CH_3). ^{13}C NMR (151 MHz, $CDCl_3$) δ 174.1, 172.0, 171.8, 171.7, 171.3 (5x C=O), 135.8, 135.8, 135.4, 135.2, 134.8, 134.8, 133.1, 133.1, 133.0, 133.0, 132.9, 132.9, 132.8, 132.7, 128.1, 128.0, 128.0, 127.8, 127.8, 127.8, 127.7, 127.7, 127.6, 127.5, 127.5, 127.4, 126.8, 126.5, 126.3, 126.2, 126.2, 126.1, 126.0, 126.0, 125.9, 125.8, 125.8, 125.7, 125.7, 125.7, 125.6, 125.6, 125.5, 125.4 (aromatic (Nap)), 100.2 (C-1'), 94.8 (C-1), 76.0 (C-4), 75.9, 75.4, 75.3 (*C*HCH_2COOC (L1), *C*HCH_2COOC (L3), *C*HCH_2COOC (L4), C-4'), 75.2 (C-3'), 74.7 (C-5'), 74.6 (CH_2 (Nap)), 74.3 (CH_2 (Nap)), 73.4 (CH_2 (Nap), 72.9 (C-5), 72.6 (C-3), 71.6 (CH_2 (Nap)), 71.2, 71.1 (2x CH_2 (Nap)), 71.1 (*C*HCH_2COOC (L2)), 68.4 (C-6'), 66.5 (C-6), 53.9 (C-2'), 52.0 (C-2), 41.0 (*C*H_2COOC (L2)), 40.9 (*C*H_2COOC (L4)), 39.6 (*C*H_2COOC (L1)), 39.5 (*C*H_2COOC (L3)), 34.3 (*C*H_2COOC (L2)'), 34.2, 34.1, 34.0, 33.9 (*C*H_2CHCH_2COOC (L1), *C*H_2CHCH_2COOC (L3), *C*H_2CHCH_2COOC (L2), *C*H_2CHCH_2COOC (L4)), 31.8, 29.9, 29.7, 29.6, 29.6, 29.5, 29.5, 29.5, 29.3, 29.3, 29.2, 29.1, 27.3, 25.2, 25.1, 25.0, 24.9, 22.6 (51x CH_2), 27.8 (2x (*C*H$(CH_3)_2$), 22.5 (CH(*C*$H_3)_2$), 14.0 (CH_2*C*H_3). ^{31}P NMR (162 MHz, $CDCl_3$): δ -2.5.

6-*O*-[2-deoxy-3-*O*-(R)-(3-hydroxy)hexadecanoate--2-(R)-(13-methyltetradecanoyloxy)15-methylhexadecanamido-ß-D-glucopyranosyl]-2-deoxy-2-(R)-(3-hydroxy)hexadecanamido-3-*O*-(R)-(3-hydroxy)pentadecanoate-ß-D-glucopyranose 1-phosphate (1). To a solution of **35** (7.9 mg; 3.16 µmol) in THF (2 mL) in an autoclave beaker was added palladium black (7.9 mg). The suspension was transferred into an autoclave equipped with a hydrogen cylinder (P5 quality). The reaction vessel was flushed five times with hydrogen and finally brought to 50 bar. After stirring for 16 h at 50 °C and 50 bar, the reaction mixture was filtered using a Fisherbrand™ PTFE syringe filter (0.2 µm; 13 mm) and concentrated using a nitrogen flow. Sephadex LH-20 column chromatography ($CHCl_3$/MeOH/H_2O, 4/6/2) followed by trituration with petroleum ether afforded **1** as a white solid (1.6 mg; 0.96 µmol; 30%). ^{1}H NMR (600 MHz, $CDCl_3$/CD_3OD/D_2O 2/3/1) δ 5.47 (s, 1H, H-1), 5.22 (t, 1H, *J* = 9.9 Hz, H-3), 5.16 (t, 1H, *J* = 6.4 Hz, C*H*CH_2COOC (L2)), 5.05 (t, 1H, *J* = 9.4 Hz, H-3'), 4.75 (m, 1H, H-1'), 4.17 (d, 1H, *J* = 10.8 Hz, H-2), 4.10 (m, 1H, H-5), 4.07 (m, 1H, CH_{2a}-6), 4.02 (m, 2H, C*H*CH_2COOC (L4), C*H*CH_2COOC (L1)), 3.85 (m, 1H, H-2'), 3.90 (m, 3H, C*H*CH_2COOC (L3) , CH_{2b}-6, CH_{2a}-6'), 3.75 (dd, 1H, *J* = 12.2, 5.2 Hz, CH_{2b}-6'), 3.58 (t, 2H, *J* = 9.5 Hz, H-4', H-4), 3.42 (m, 1H, H-5'), 2.53 (m, 2H, CH_{2a}COO (L2), CH_{2a}COO (L4)), 2.46 (m, 4H, CH_{2b}COO (L2), CH_{2b}COO (L4), CH_2COOC (L3)), 2.33 (m, 3H, CH_2COOC (L2'), CH_{2a}COOC (L1)), 2.29 (m, 1H, CH_{2b}COOC (L1)), 1.53 (m, 12H, C$H_2$$CH_2$COO (L1), C$H_2$$CH_2$COO (L2), C$H_2$$CH_2$COO (L3), C$H_2$$CH_2$COO (L4), C$H_2$$CH_2$COOC (L2), 2x C*H*$(CH_3)_2$), 1.28 (m, 102H, 51x CH_2), 0.88 (m, 21H, 7x CH_2CH_3). ^{13}C NMR (151 MHz, $CDCl_3$) δ 100.8 (C-1'), 93.4 (C-1), 76.0 (C-5'), 75.6 (C-3'), 73.7 (C-3), 72.1 (C-5), 71.1 (*C*HCH_2COOC (L2)), 68.6 (*C*HCH_2COOC (L3)), 68.2 (C-4, C-4'), 67.9 (*C*HCH_2COOC (L1), *C*HCH_2COOC (L4)), 67.9 (C-6), 60.8 (C-6'), 53.7 (C-2'), 51.8 (C-2), 43.4 (*C*H_2COOC (L1)) 42.1 (*C*H_2COOC (L2), (*C*H_2COOC (L3), *C*H_2COOC (L4)), 34.3 (*C*H_2COOC (L2)'), 38.9, 37.0, 34.1 (*C*$H_2$$CH_2$COOC (L1), *C*$H_2$$CH_2$COOC (L3), *C*$H_2$$CH_2$COOC (L2), *C*$H_2$$CH_2$COOC (L4)), 29.6, 25.4, 25.4, 25.0, 22.5 (51x CH_2), 27.9 (2x (*C*$H(CH_3)_2$), 22.1 ($CH(CH_3)_2$), 13.8 (CH_2CH_3). ^{31}P NMR (162 MHz, $CDCl_3$): δ -1.5. MALDI-TOF (*m/z*) calcd for $C_{91}H_{172}N_2O_{21}P$ $[M - H]^-$: 1660.2196; found: 1660.2230.

3. Biological studies

Biological reagents. The same batch of *E. coli* 055:B5 LPS, obtained from List Biologicals, were used for the generation of all data presented in this study. An average molecular mass was set to 10 kDa in accordance with previous literature.[7-8] Hence, the highest concentration 10 nM corresponds to 100 ng/mL. Synthetically generated *B. fragilis* lipid A, *E. coli* lipid A and *E. coli* lipid A monophosphate were reconstituted in dry THF, and aliquots were stored at −80 °C. To evaluate the purity of monocytes, the following antibodies were used: anti-CD19-fluorescein isothiocyanate (FITC, clone: 4G7, 1:20, BioLegend), anti-CD14-peridinin chlorophyll-Cyanine5.5 (PerCP-Cy5.5, clone: 61D3, 1:50, ThermoFisher Scientific), anti-CD16-phycoerythrin (PE, clone: B73.1, 1:50, BD Biosciences), anti-CD3-allophycocyanin (APC, clone: OKT3, 1:20, BioLegend), anti-CD56-Brilliant Violet 421 (BV421, clone: NCAM16.2, 1:160, BD Biosciences) and anti-CD45-BV785 (clone: HI30, 1:50, BioLegend).

Cells lines. The human colon epithelial cancer HT29 (DSMZ: ACC 299) was cultured in modified McCoy's 5A medium supplemented with 10% heat-inactivated FCS to reach complete confluency before stimulation. The artificial HEKBlue cell line, stably transfected with human TLR4, MD2 and CD14, as well as their control cell line (HEKBlue Null2) were purchased from Invivogen (hkb-htlr4 and hkb-null2) and maintained in Dulbecco's Modified Eagle Medium (DMEM) supplemented with 10% non heat-inactivated FCS and 1% Pen/Strep to allow them to reach a confluency of 70-80% (up to passage 30). Zeocin (ant-zn-05, InvivoGen) and HEKBlue selection antibiotics cocktail (hb-sel, InvivoGen) were used for selection. The mouse macrophage cell line RAW 264.7 was cultured in RPMI-1640 medium supplemented with 10% non heat-inactivated FCS and 1% Pen/Strep.

Isolation primary human monocytes. Peripheral blood mononuclear cells (PBMCs) were isolated from Buffy coats of healthy donors using a Ficoll gradient (1000 x g, 20 min, RT, no brake). Intensively washed PBMCs were subjected to 5 ml of ice-cold ammonium chloride buffer (155 mM NH_4Cl, 12 mM $NaHCO_3$, 0.1 mM EDTA) for 5 min to lyse remaining red blood cells. A single cell preparation (40 µm gaze) was subsequently used for the negative selection of monocytes (classical: CD14+ CD16-, non-classical: CD14dim CD16+, intermediate: CD14+ CD16+) in accordance with manufacturer's instruction of the Pan monocyte isolation kit (130-096-537, Miltenyi Biotec). The purity of the isolated monocytes

was determined by flow cytometry (CytoFlex-S, Beckman Coulter) and ranged from 53 to 92% (Fig. **S3**).

LPS and lipid A stimulation. Overall, the described cell lines were stimulated in a dose-dependent manner reaching from 0.0001 to 10 nM in half-logs for *E. coli* 055:B5 LPS and *E. coli* lipid A and from 0.01 to 1000 nM for *B. fragilis* lipid A and *E. coli* lipid A monophosphate in 96 well plates. RAW 264.7 (NO-) cells (20.000 cells/well) were stimulated for 6 h while human primary monocytes (50.000 cells/well) were stimulated for 18 h and HT-29 (100% confluency) and HEKBlue reporter cells (50.000 cells/well) were exposed to the components for 24 h. Upon stimulation, the supernatant (175 µL) was harvested and stored at -20 °C for up to 4 weeks for cytokine analysis and 20 µL of the SEAP HEKBlue reporter cell line was directly used for quantification with the commercial QuantiBlue solution (rep-qbs, Invivogen). Inhibition curves were determined by pre-incubation with 300 nM *B. fragilis* lipid A for 30 min followed by a concentration range of *E. coli* 055:B5 LPS and *E. coli* lipid A (0.0001 to 100 nM) or by simultaneous stimulation with *B. fragilis* lipid A (300, 30 and 3 nM) and a wide concentration range of *E. coli* 055:B5 LPS (0.0001 to 10 nM). Cytokines secretion was determined by ELISA following manufacturer's instructions of ELISA DuoSet products purchased from R&D systems (IFN-β: DY814, IL-8: DY208, IL-6: DY206). Viability was either checked with the lactate dehydrogenase (LDH) assay (CyQUANT LDH Cytotoxicity assay, C20300, ThermoFisher Scientific) for HT-29 cells or by staining human primary monocytes with Hoechst (1:15000, 62249, ThermoFisher Scientific) and propidium iodide (1:10000, P1304MP, ThermoFisher Scientific) for 20 min in medium (ImageXpress Pico, Molecular Devices).

Data analysis. All data analysis was performed with GraphPad Prism, version 10.0.2 (GraphPad Software Inc., Boston, Massachusetts, US). Curve fitting of concentration range stimulation and inhibition experiments was executed with the sigmoidal dose response function using a constrained hill slope of 1. Efficacy of a component was expressed by E_{max}, which represents the maximum response/cytokine release, and its potency was expressed as EC_{50}, which represents the concentration of the stimulus producing 50% of the maximal cytokine production. Inhibition by *B. fragilis* lipid A was evaluated as its ability to reduce the E_{max} value of *E. coli* 055:B5 LPS and *E. coli* lipid A.

4. References

1 S. Jana, V.A. Sarpe and S.S. Kulkarni, *Org. Lett.,* 2018, **20**, 6938-6942.

2 R. Roy, A. Roseblade and T. Rawling, *Chem. Phys. Lipids,* 2020, **232**, 104952.

3 A. Khan, K. Kodar, M.S.M. Timmer and B.L. Stocker, *Tetrahedron,* 2018, **74**, 1269-1277.

4 O. Labeeuw, P. Phansavath and J.P. Genêt, *Tetrahedron-Asymmetry,* 2004, **15**, 1899-1908.

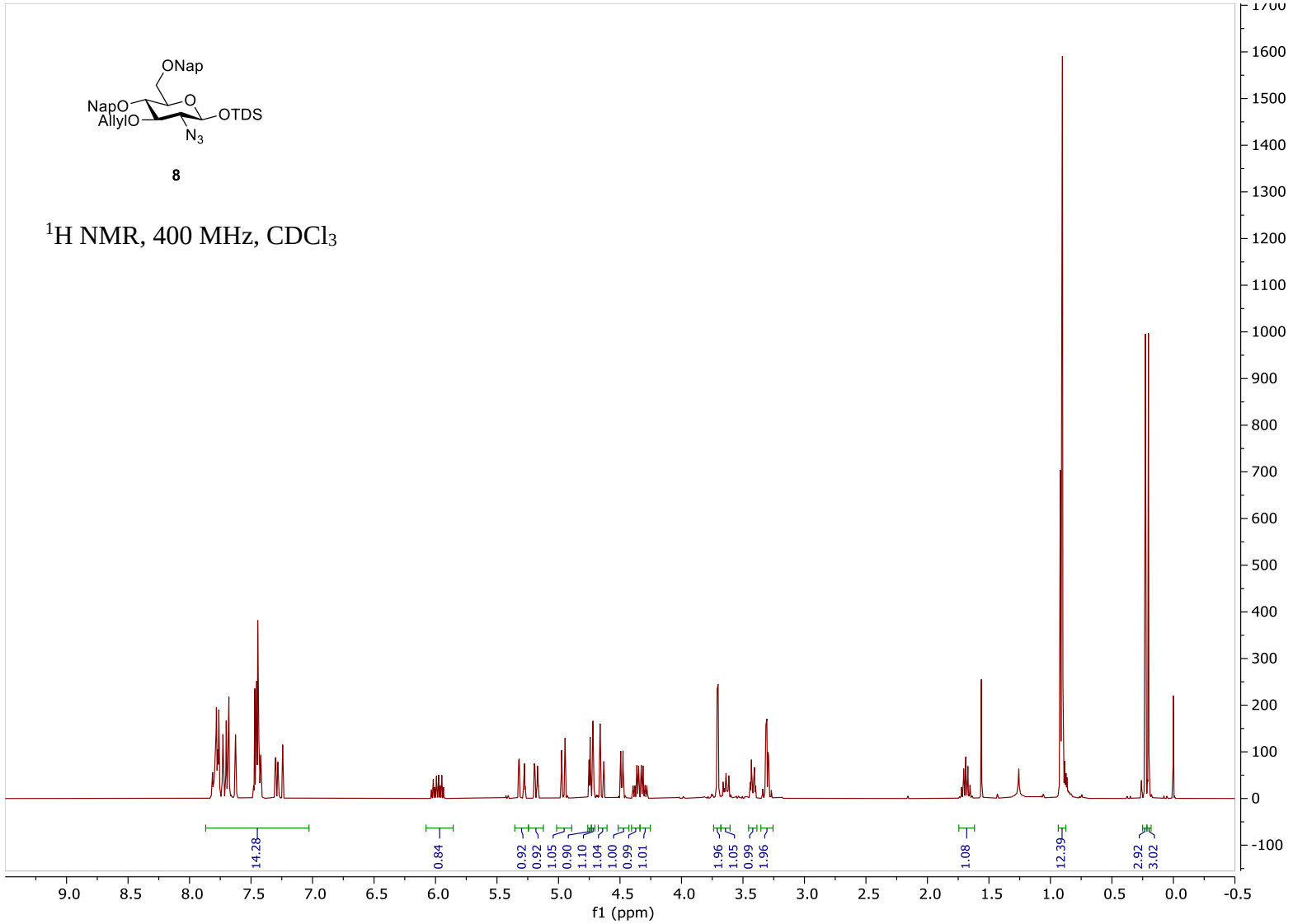
5 O. Labeeuw, P. Phansavath and J.P. Genet, *Tetrahedron Lett.,* 2003, **44**, 6383-6386.

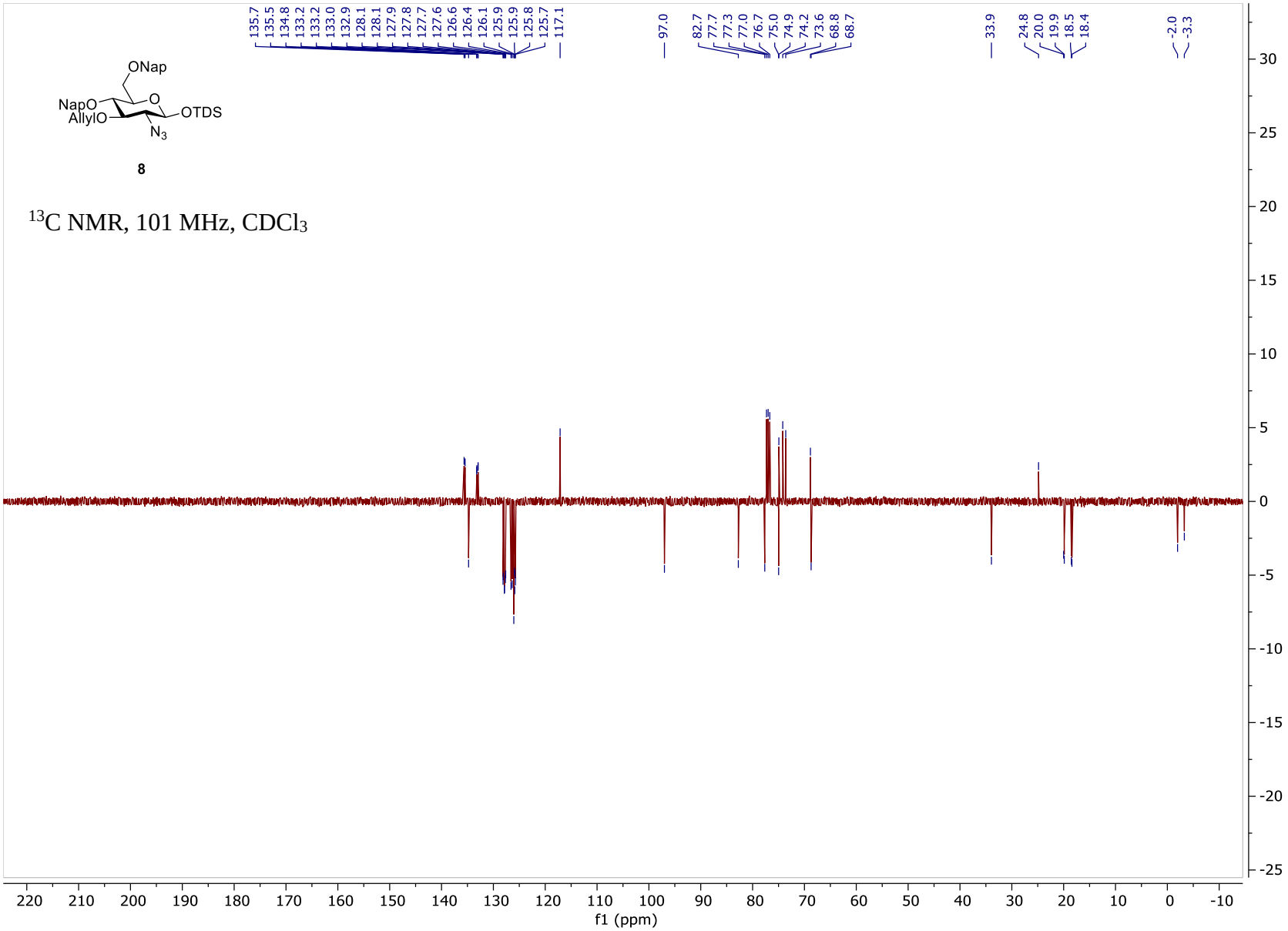
6 Y. Zhang, J. Gaekwad, M.A. Wolfert and G.J. Boons, *Org. Biomol. Chem.,* 2008, **6**, 3371-3381.

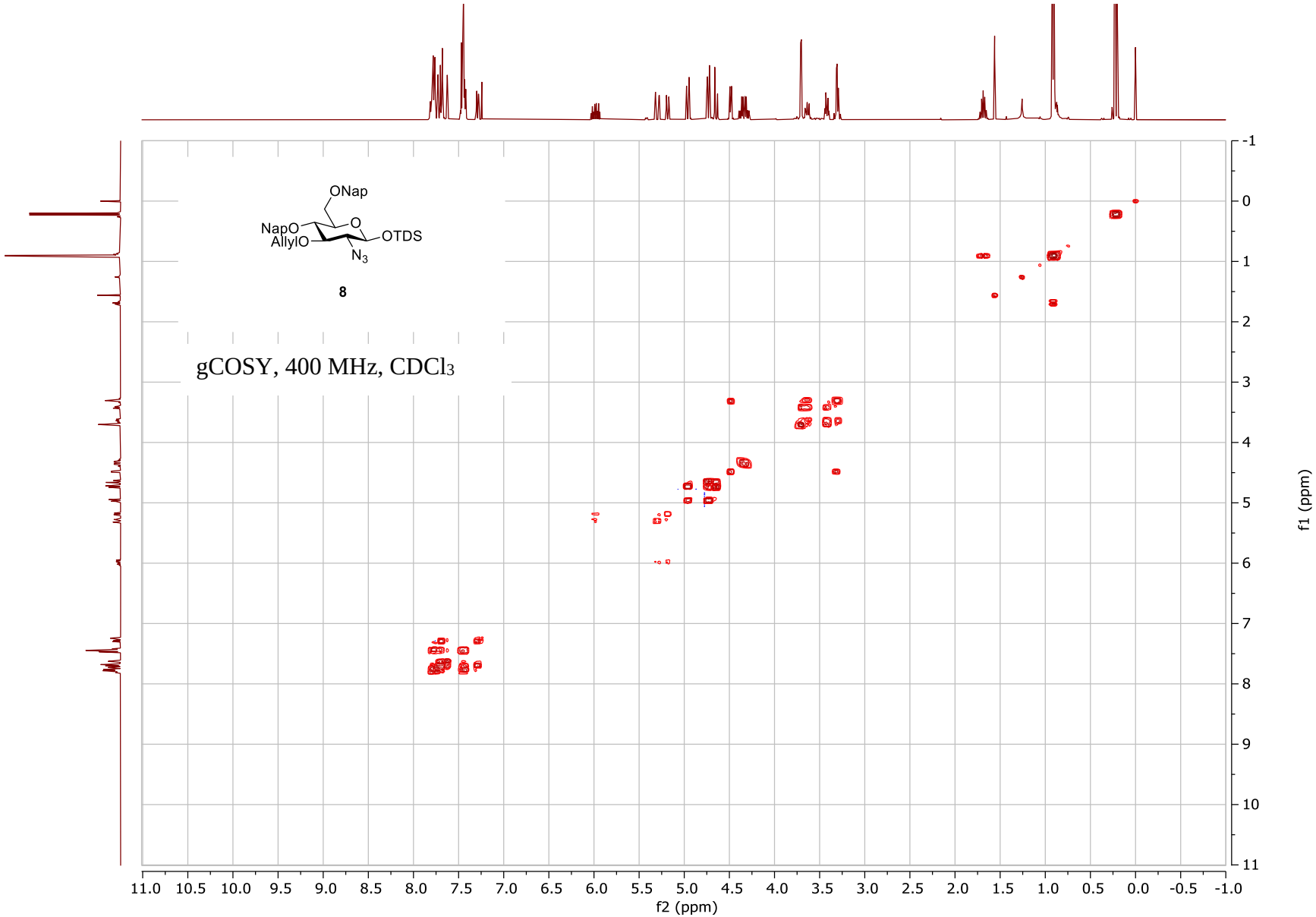
7 D. Petsch and F.B. Anspach, *J. Biotechnol.,* 2000, **76**, 97-119.

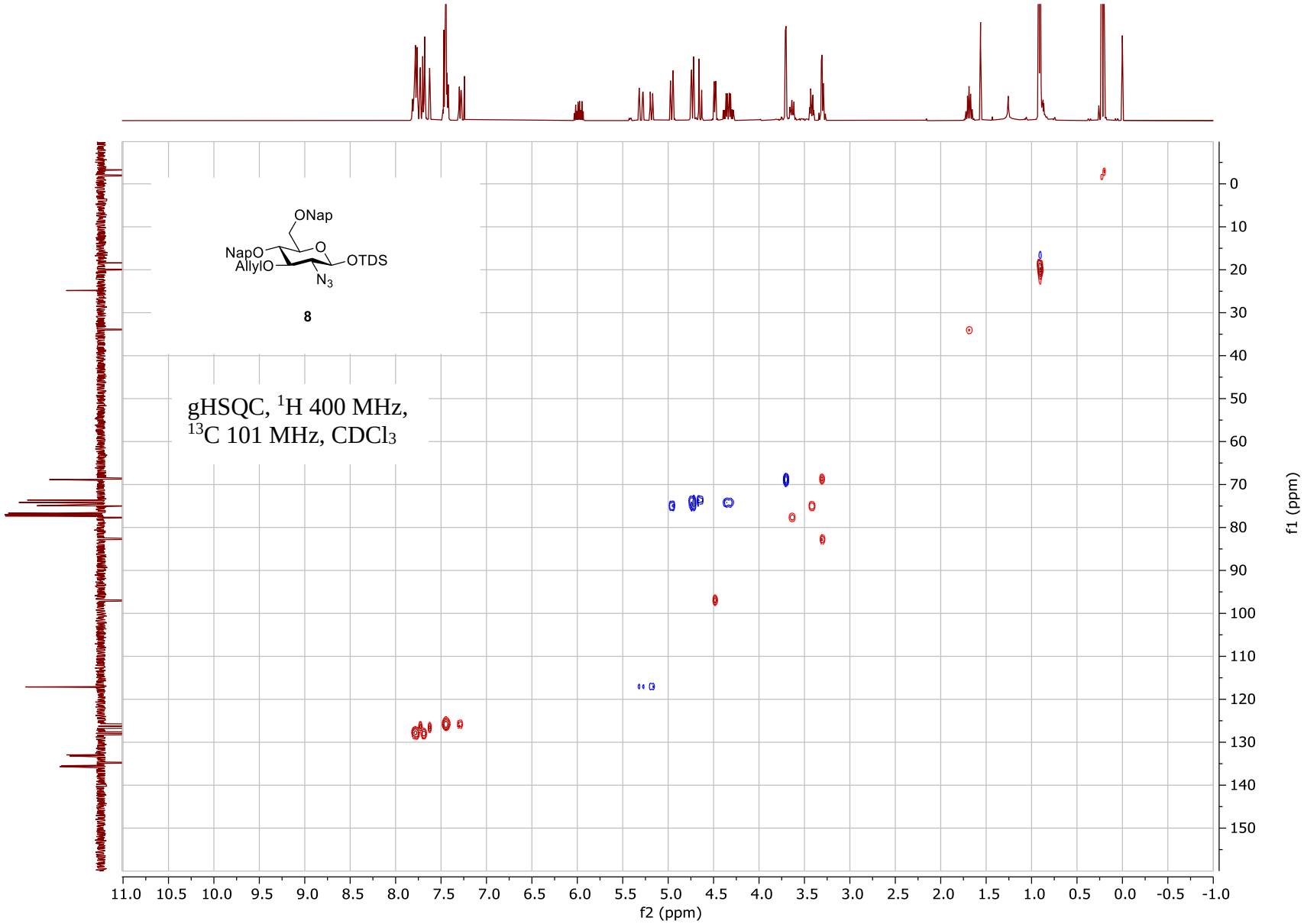
8 A.C. Fux*, et al.*, *Int. J. Mol. Sci.,* 2023, **24**, 8395.

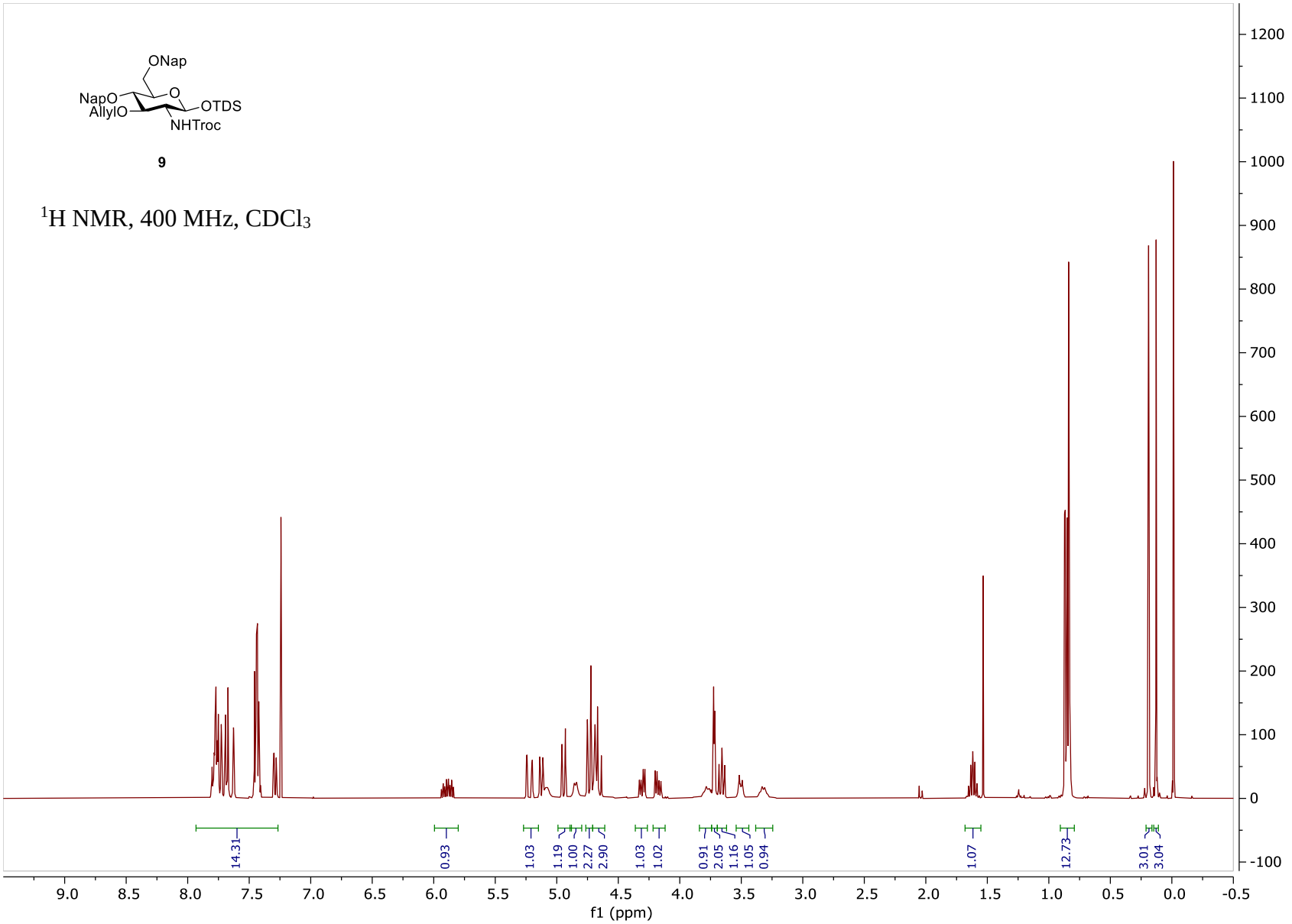
5. NMR spectra

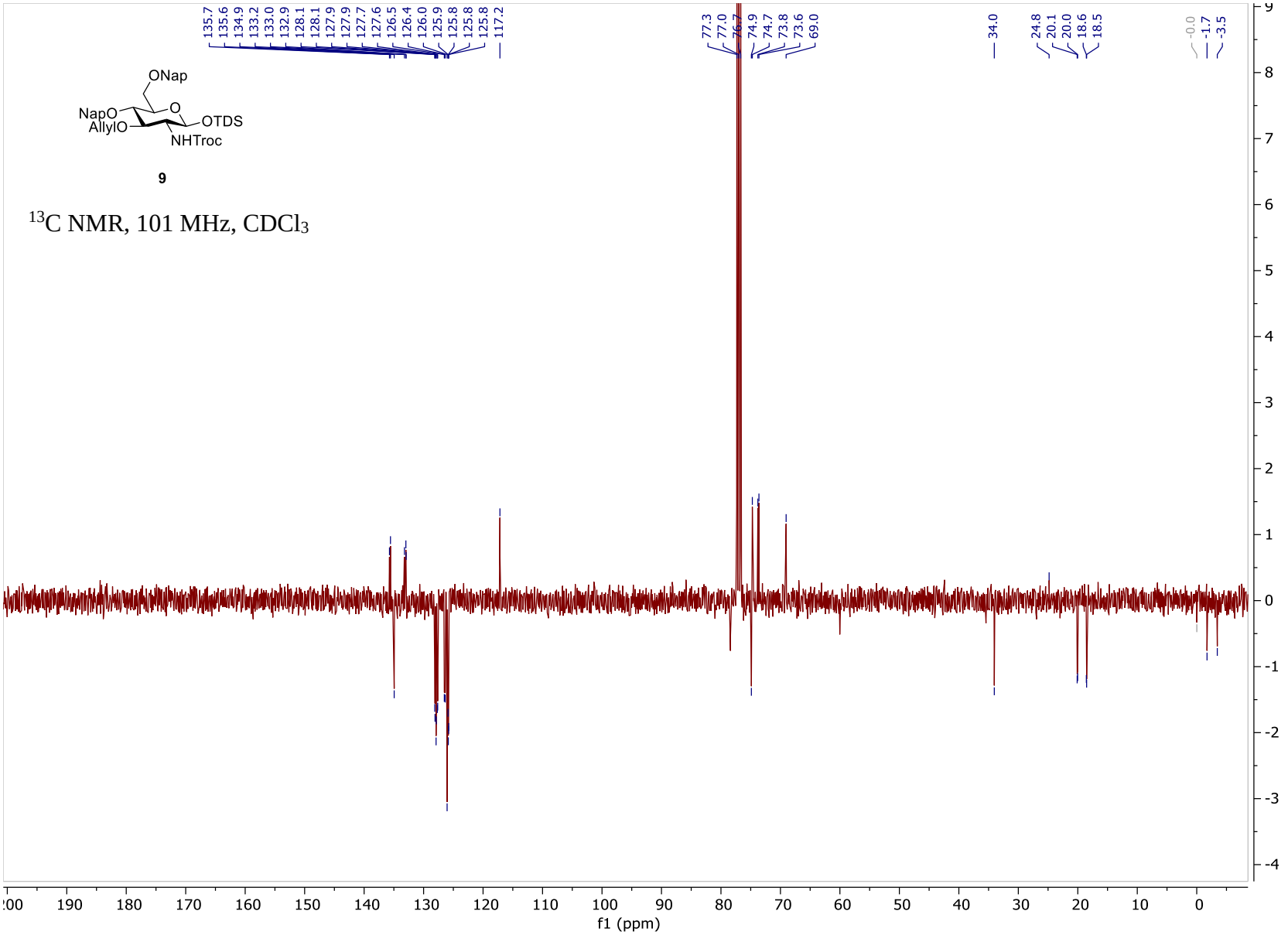

ONap
NapO
AllylO
O
OTDS
N3
8
1H NMR, 400 MHz, CDCl3
14.28
0.84
0.92
0.92
1.05
0.90
1.10
1.04
1.00
0.99
1.01
1.96
1.05
0.99
1.96
1.08
12.39
2.92
3.02
f1 (ppm)

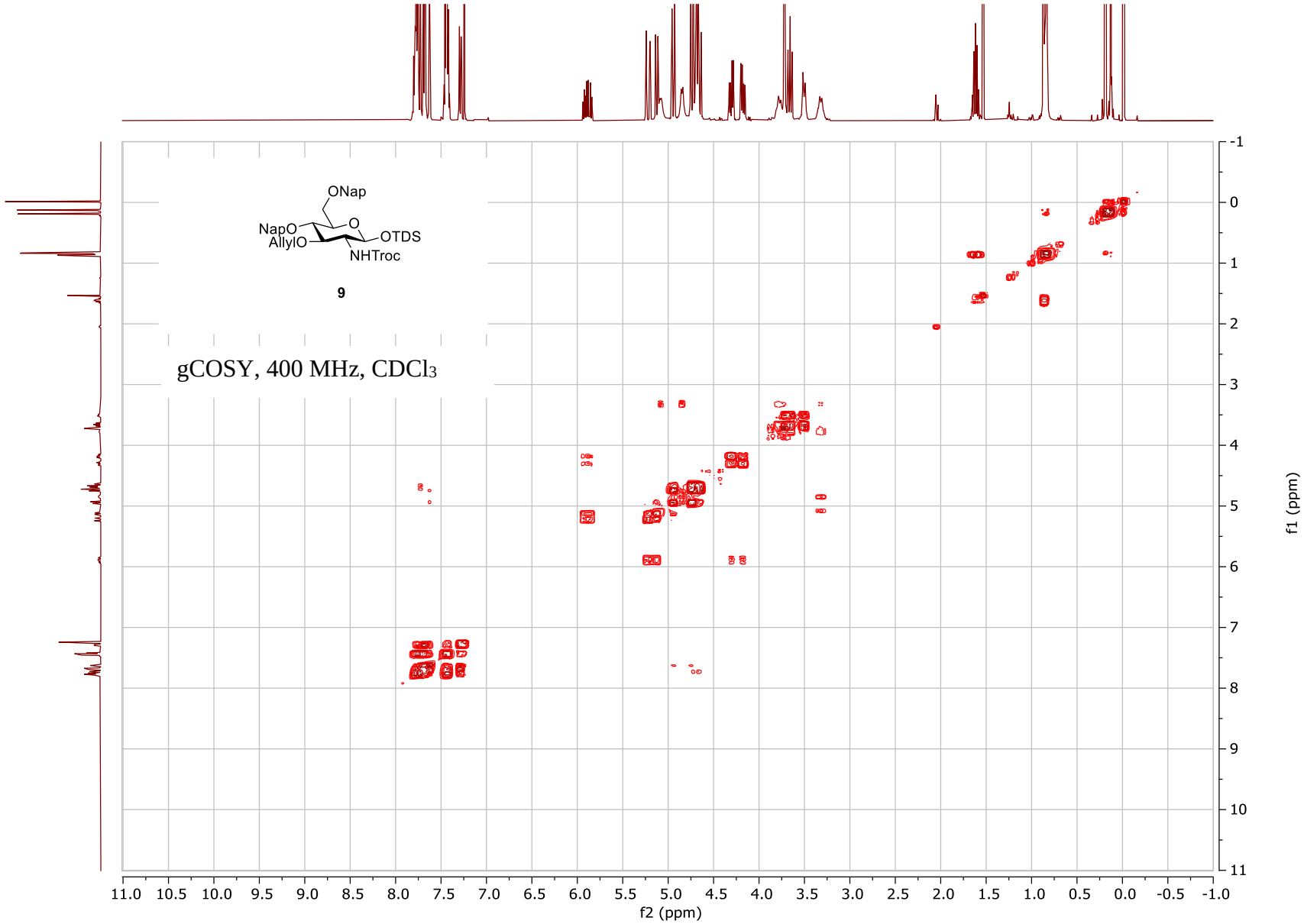

135.7
135.5
134.8
133.2
133.2
133.0
132.9
128.1
128.1
127.9
127.8
127.7
127.6
126.6
126.4
126.1
125.9
125.9
125.8
125.7
117.1
97.0
82.7
77.7
77.3
77.0
76.7
75.0
74.9
74.2
73.6
68.8
68.7
33.9
24.8
20.0
19.9
18.5
18.4
-2.0
-3.3
ONap
NapO
AllylO
O
OTDS
N3
8
13C NMR, 101 MHz, CDCl3
f1 (ppm)

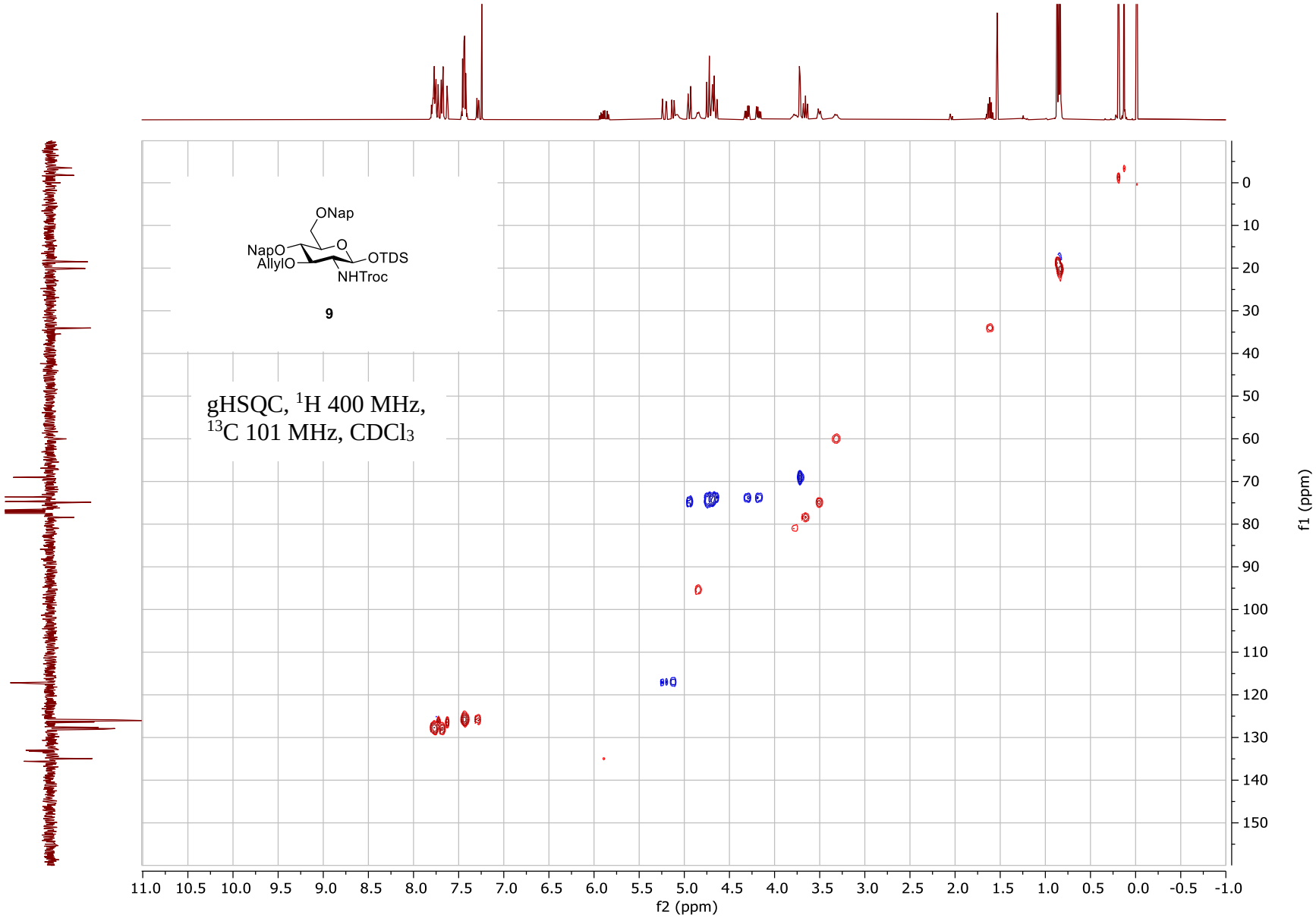

ONap
NapO
AllylO
O
OTDS
N3
8
gCOSY, 400 MHz, CDCl3
f2 (ppm)
f1 (ppm)

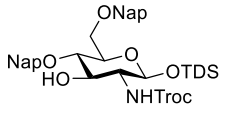

ONap
NapO
AllylO
O
OTDS
N3
8
gHSQC, 1H 400 MHz,
13C 101 MHz, CDCl3
f2 (ppm)
f1 (ppm)


ONap
NapO
AllylO
O
OTDS
NHTroc
9
^{1}H NMR, 400 MHz, CDCl$_3$
14.31
0.93
1.03
1.19
1.00
2.27
2.90
1.03
1.02
0.91
2.05
1.16
1.05
0.94
1.07
12.73
3.01
3.04
f1 (ppm)


135.7
135.6
134.9
133.2
133.0
132.9
128.1
128.1
127.9
127.9
127.7
127.6
126.5
126.4
126.0
125.9
125.8
125.8
125.8
117.2
77.3
77.0
76.7
74.9
74.7
73.8
73.6
69.0
34.0
24.8
20.1
20.0
18.6
18.5
-0.0
-1.7
-3.5
ONap
NapO
AllylO
O
OTDS
NHTroc
9
13C NMR, 101 MHz, CDCl3
f1 (ppm)

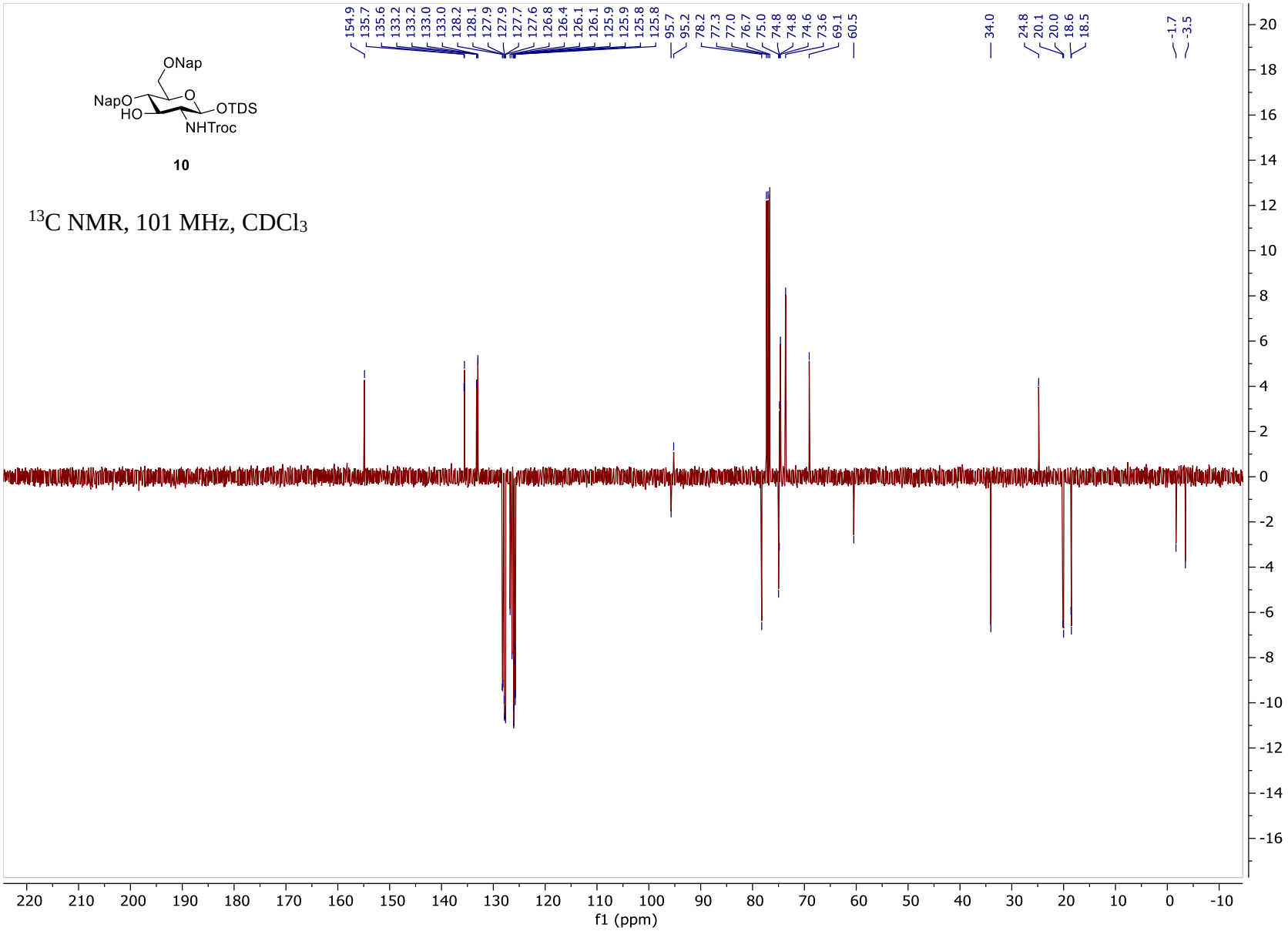

ONap
NapO
AllylO
O
OTDS
NHTroc
9
gCOSY, 400 MHz, CDCl3
f2 (ppm)
f1 (ppm)

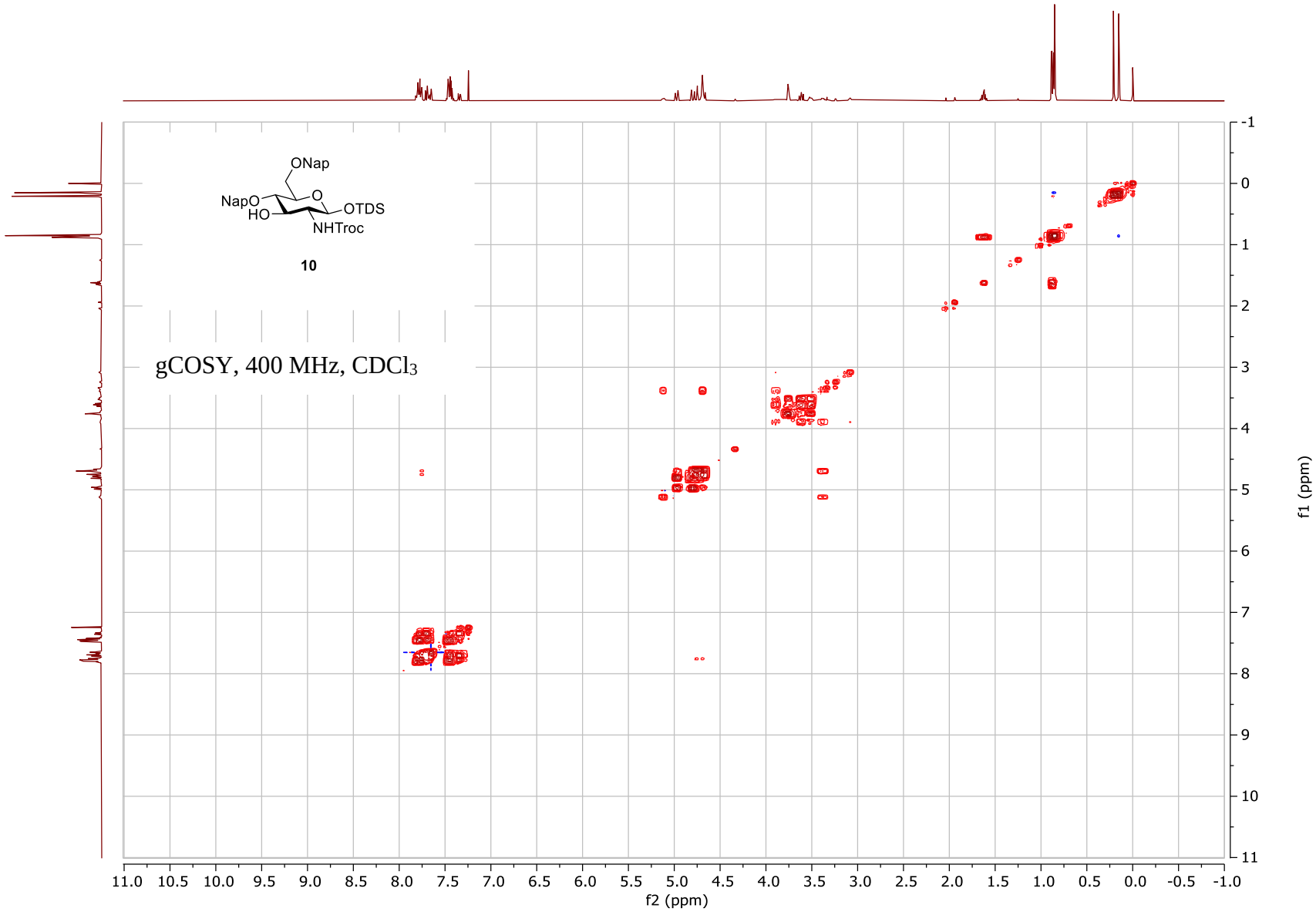

ONap
NapO
AllylO
O
OTDS
NHTroc
9
gHSQC, ^{1}H 400 MHz,
^{13}C 101 MHz, CDCl$_3$
f2 (ppm)
f1 (ppm)

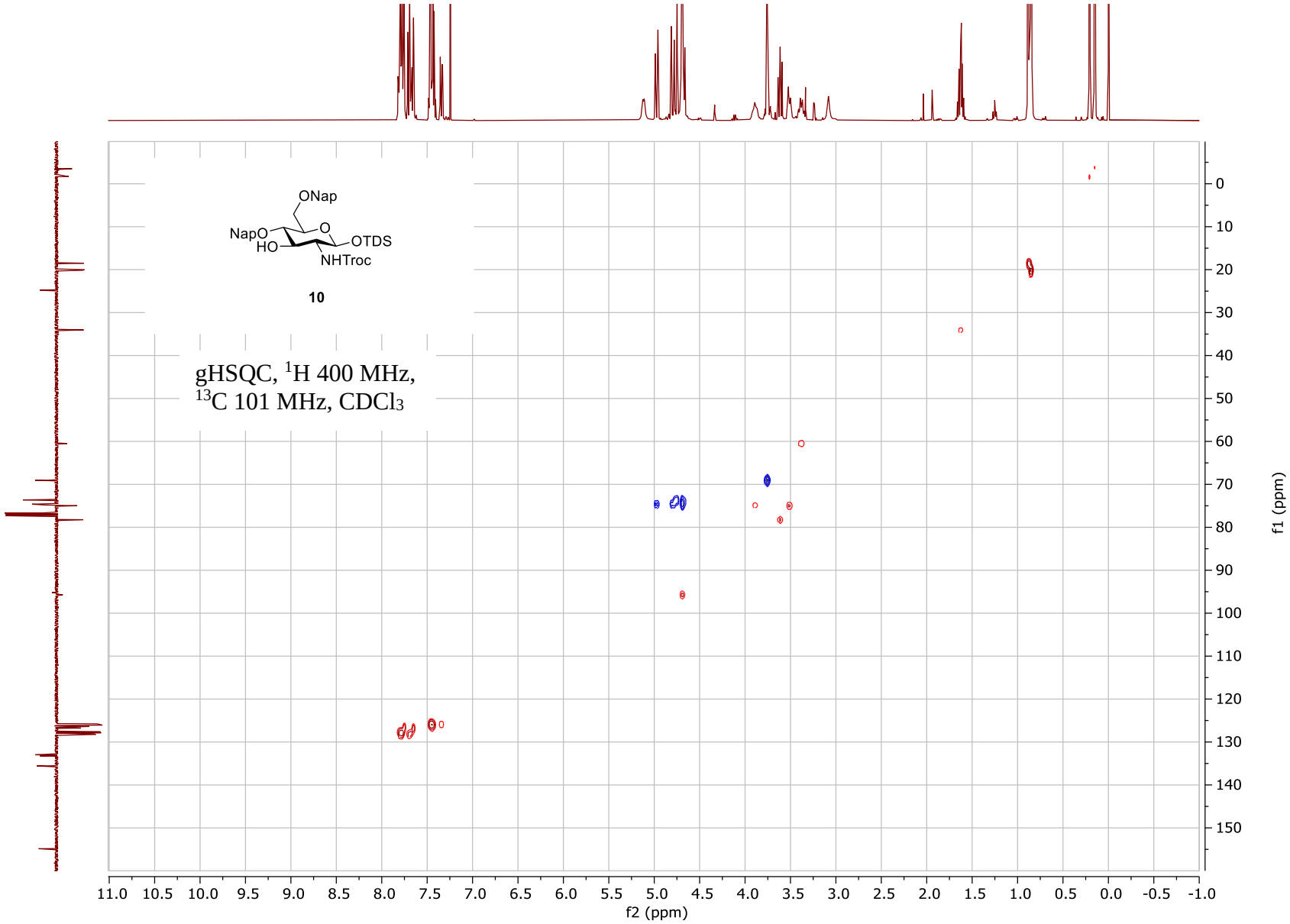


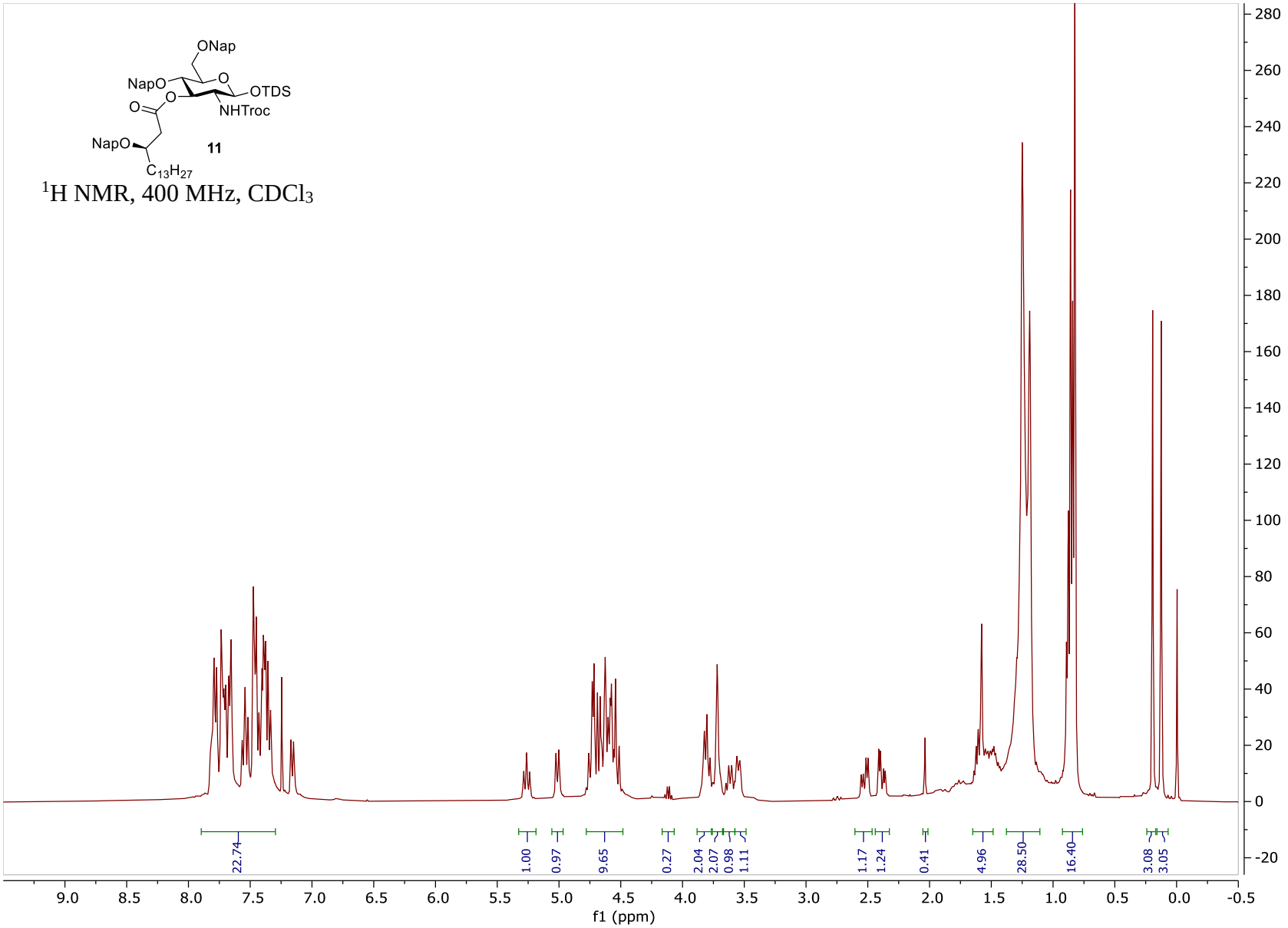
10

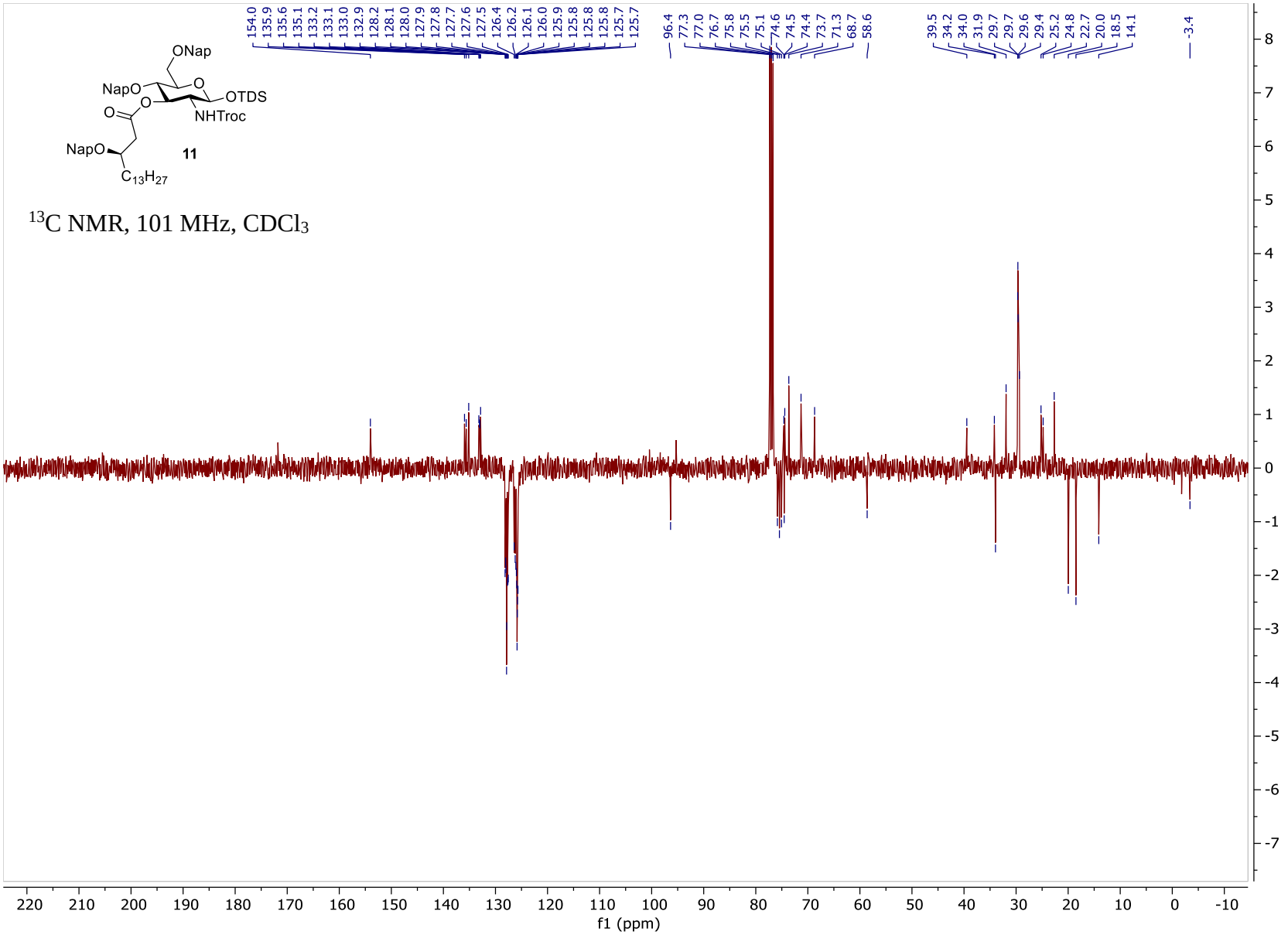
^{1}H NMR, 400 MHz, $CDCl_3$

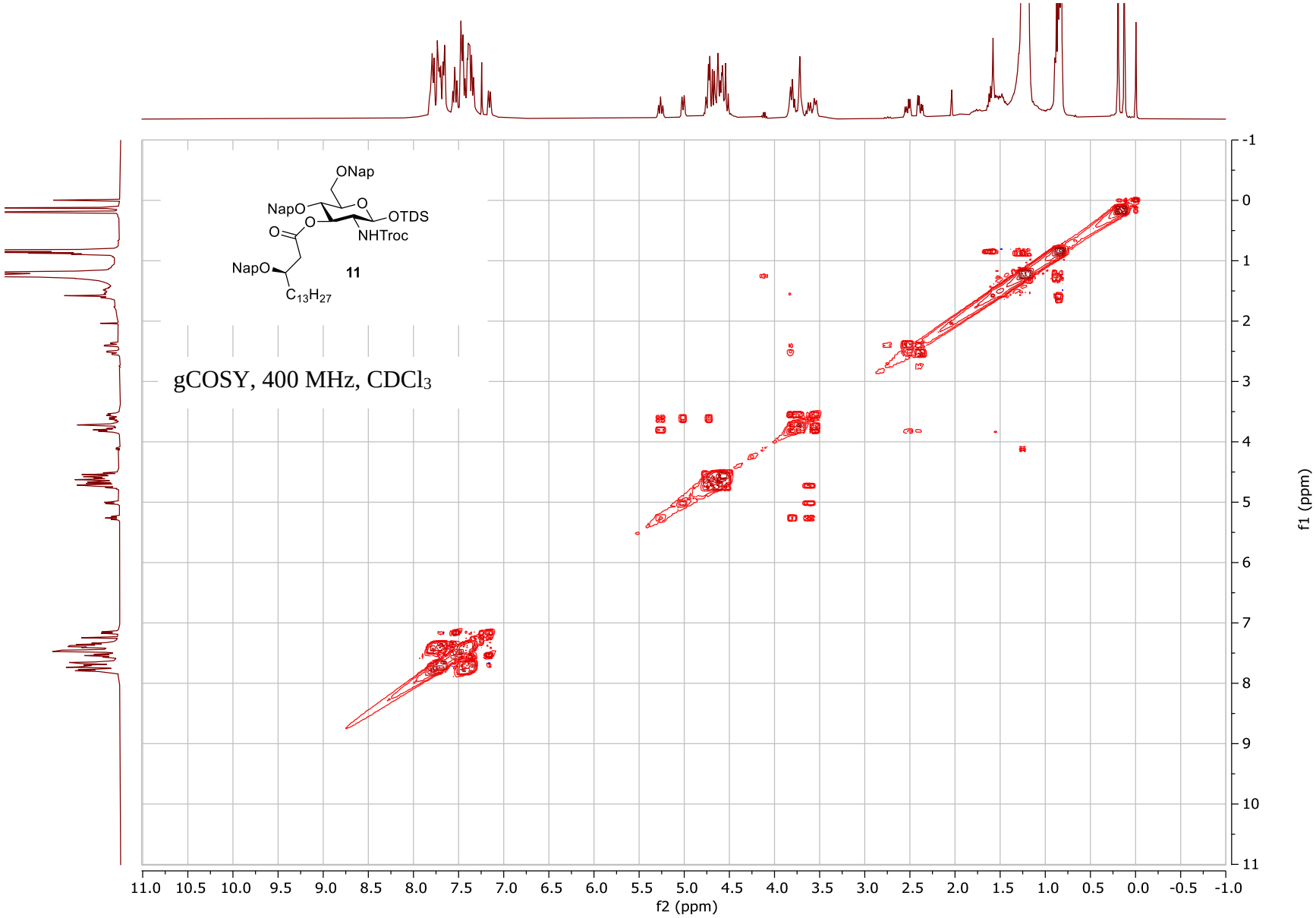

154.9
135.7
135.6
133.2
133.2
133.0
133.0
128.2
128.1
127.9
127.9
127.7
127.6
126.8
126.4
126.1
126.1
125.9
125.9
125.8
125.8
95.7
95.2
78.2
77.3
77.0
76.7
75.0
74.8
74.8
74.6
73.6
69.1
60.5
34.0
24.8
20.1
20.0
18.6
18.5
-1.7
-3.5
ONap
NapO
HO
O
OTDS
NHTroc
10
13C NMR, 101 MHz, CDCl3
f1 (ppm)

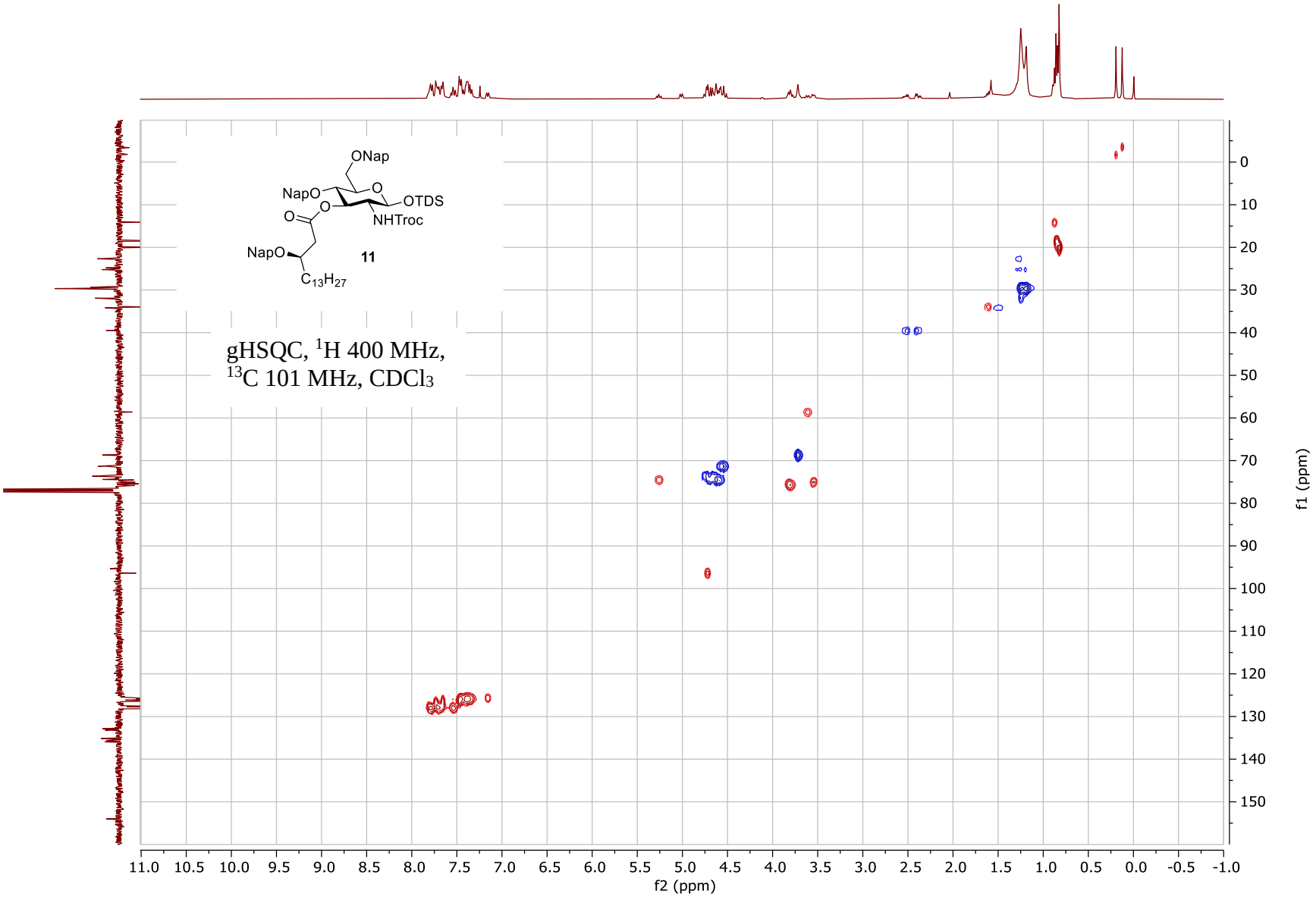

ONap
NapO
HO
O
OTDS
NHTroc
10
gCOSY, 400 MHz, CDCl3
f2 (ppm)
f1 (ppm)

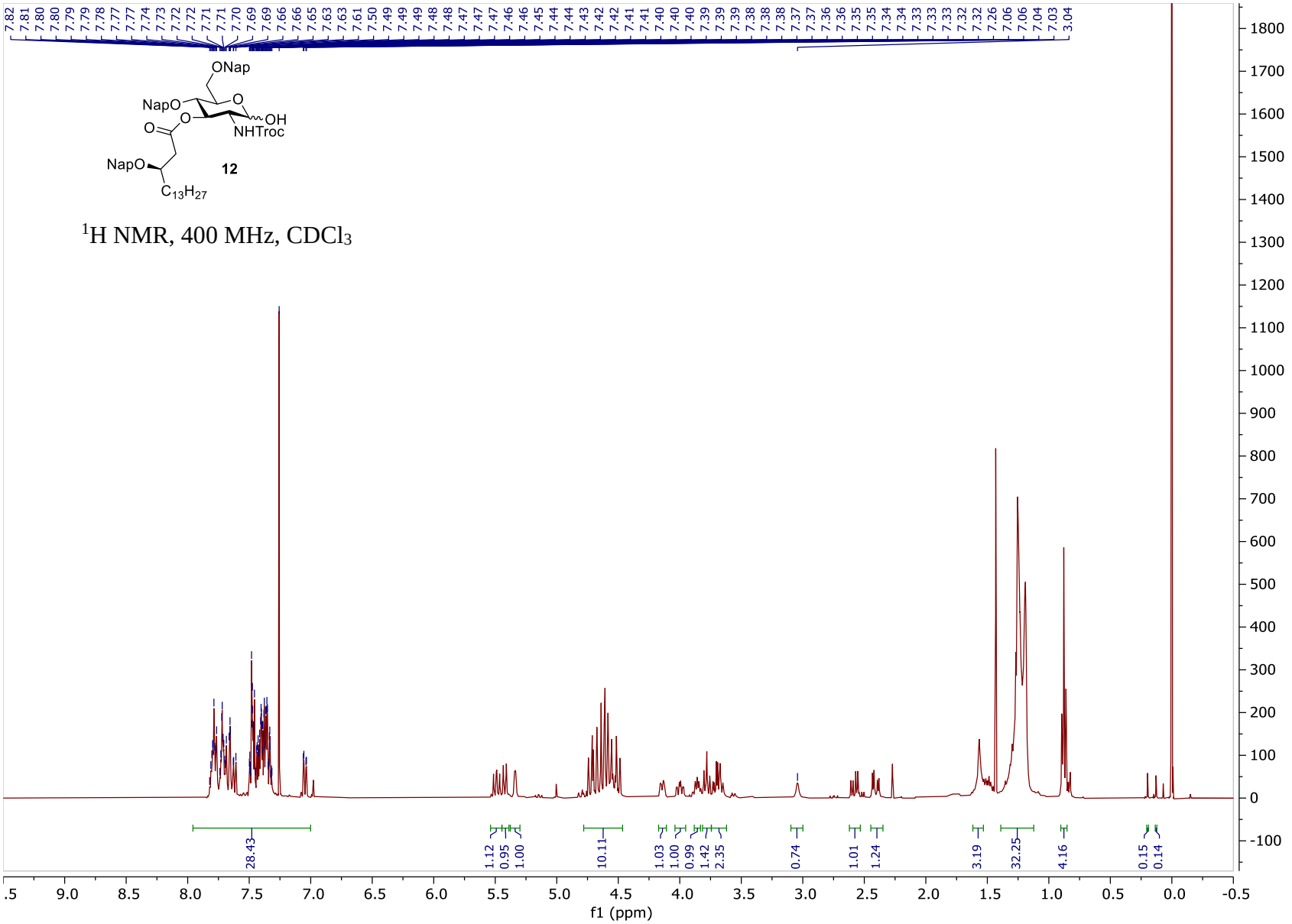

ONap
NapO
O
OTDS
HO
NHTroc
10
gHSQC, ^{1}H 400 MHz,
^{13}C 101 MHz, $CDCl_3$
f2 (ppm)
f1 (ppm)

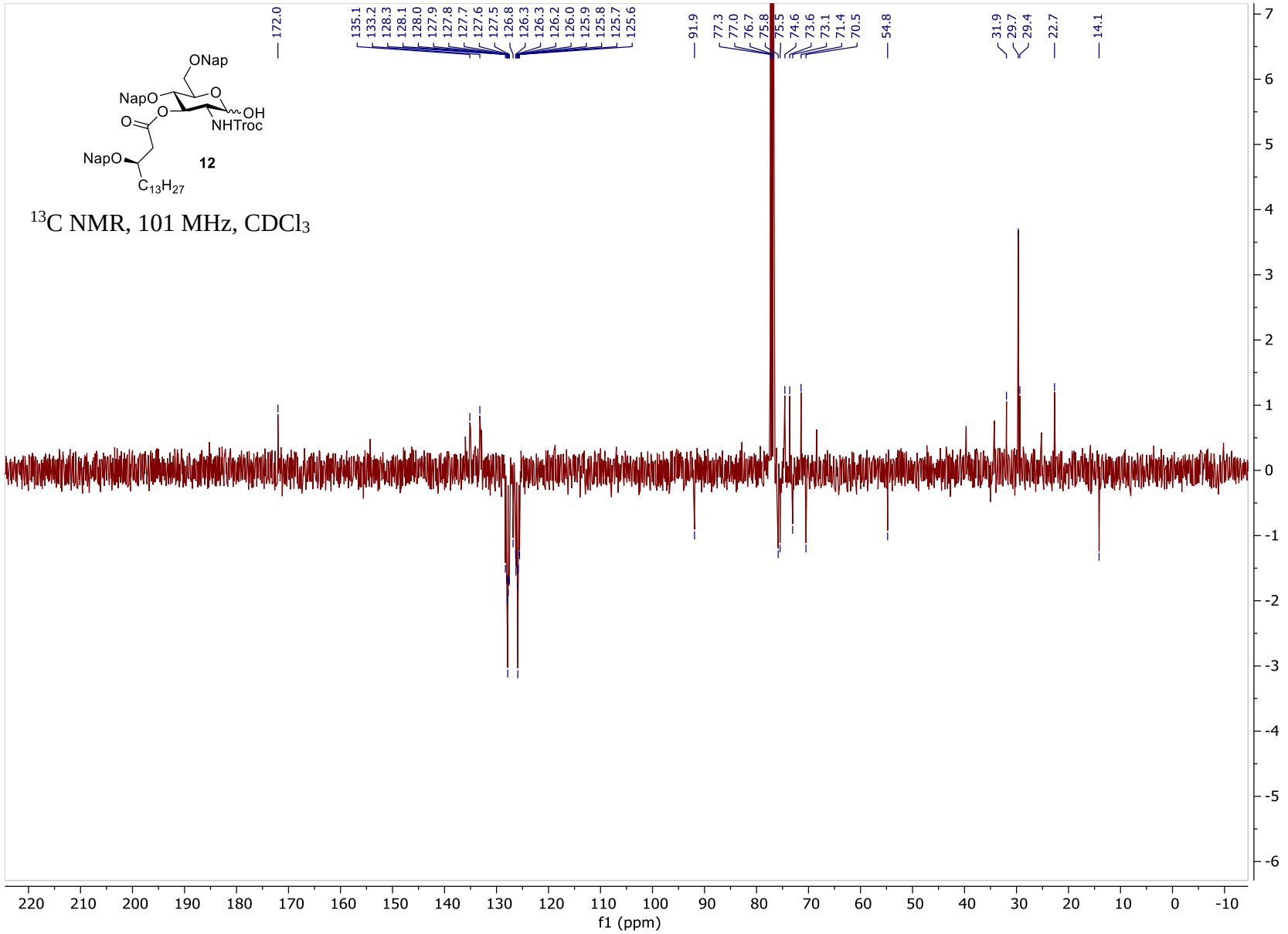

ONap
NapO
O
OTDS
O
O
NHTroc
NapO
11
C13H27
1H NMR, 400 MHz, CDCl3
f1 (ppm)
22.74
1.00
0.97
9.65
0.27
2.04
2.07
0.98
1.11
1.17
1.24
0.41
4.96
28.50
16.40
3.08
3.05

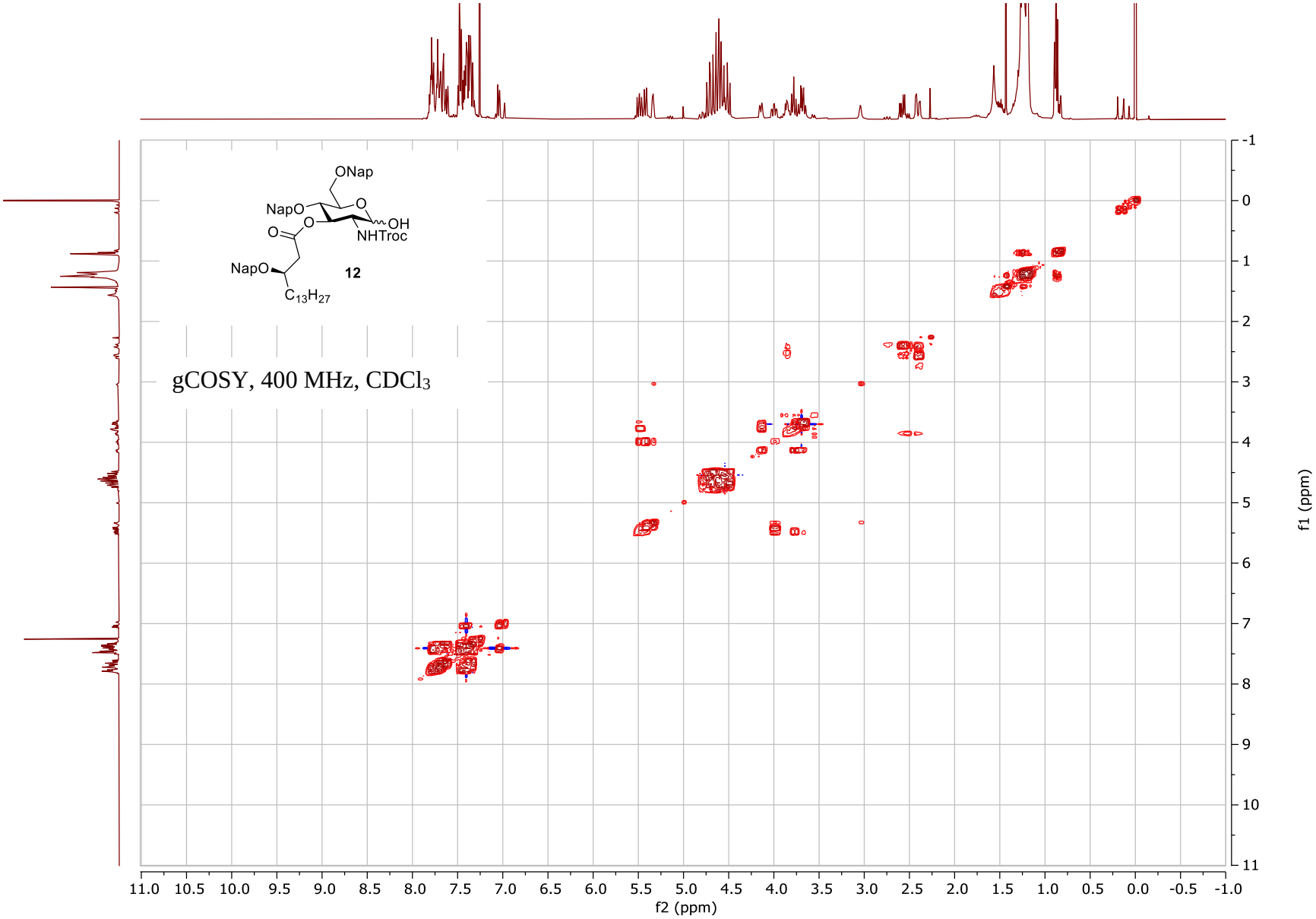

ONap
NapO
O
OTDS
O
O
NHTroc
NapO
11
$C_{13}H_{27}$
^{13}C NMR, 101 MHz, $CDCl_3$
154.0 135.9 135.6 135.1 133.2 133.1 133.0 132.9 128.2 128.1 128.0 127.9 127.8 127.7 127.6 127.5 126.4 126.2 126.1 126.0 125.9 125.8 125.8 125.8 125.7 125.7
96.4 77.3 77.0 76.7 75.8 75.5 75.1 74.6 74.5 74.4 73.7 71.3 68.7 58.6
39.5 34.2 34.0 31.9 29.7 29.7 29.6 29.4 25.2 24.8 22.7 20.0 18.5 14.1
-3.4
f1 (ppm)

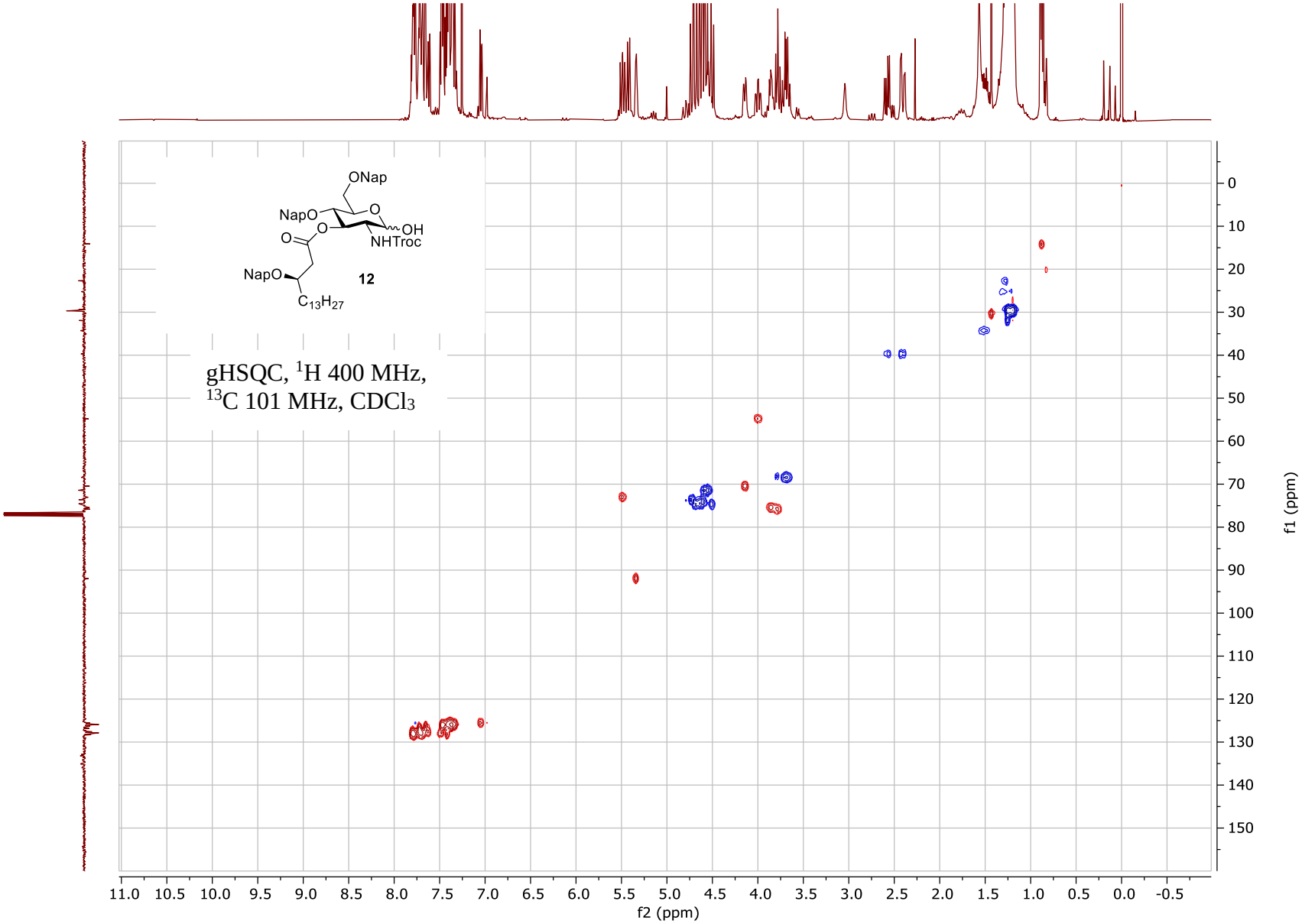

ONap
NapO
O
OTDS
O
O
NHTroc
NapO
11
$C_{13}H_{27}$
gCOSY, 400 MHz, $CDCl_3$
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f2 (ppm)
-1 0 1 2 3 4 5 6 7 8 9 10 11
f1 (ppm)

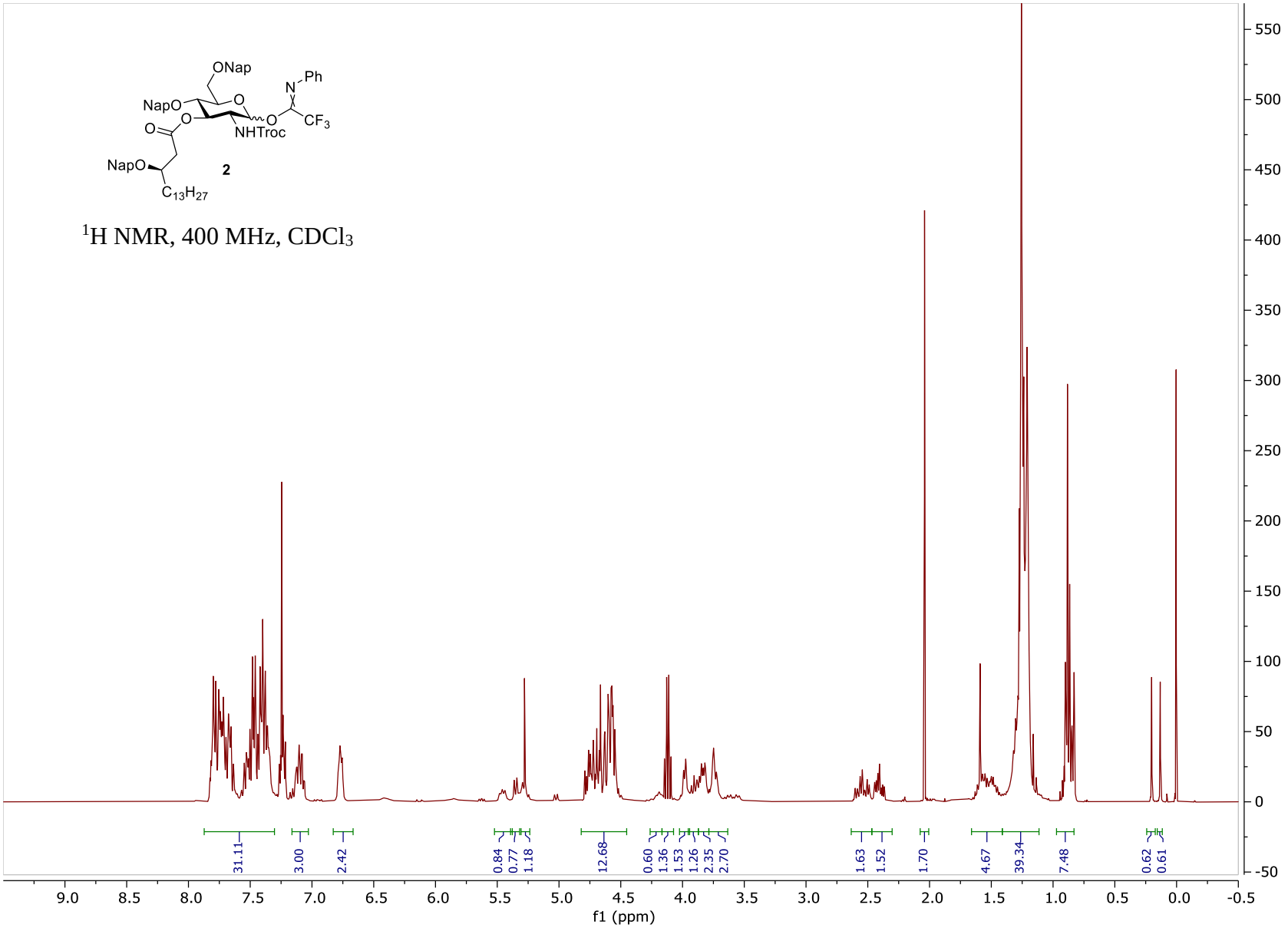

ONap
NapO
O
OTDS
O
NHTroc
NapO
11
C13H27
gHSQC, 1H 400 MHz,
13C 101 MHz, CDCl3
f2 (ppm)
f1 (ppm)

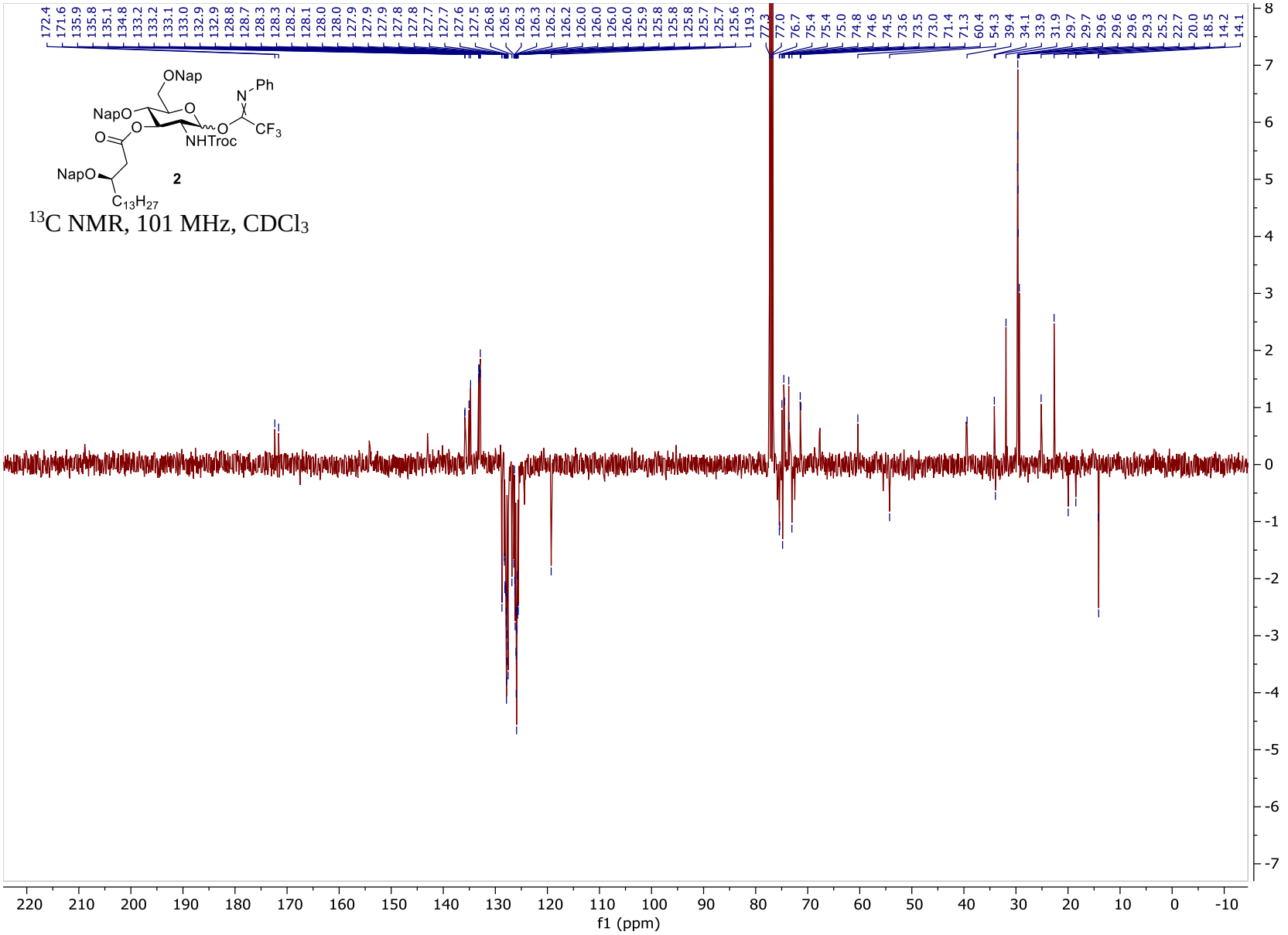

ONap
NapO
O
OH
NHTroc
O
NapO
$C_{13}H_{27}$
12
^{1}H NMR, 400 MHz, $CDCl_3$
f1 (ppm)

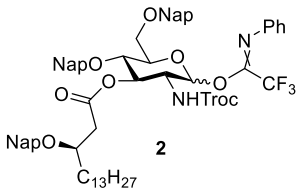

ONap
NapO
O
O
OH
NHTroc
O
NapO
C13H27
12
13C NMR, 101 MHz, CDCl3
172.0
135.1
133.2
128.3
128.1
128.0
127.9
127.8
127.7
127.6
127.5
126.8
126.3
126.3
126.2
126.0
125.9
125.8
125.7
125.6
91.9
77.3
77.0
76.7
75.8
75.5
74.6
73.6
73.1
71.4
70.5
54.8
31.9
29.7
29.4
22.7
14.1
f1 (ppm)


ONap
NapO
O
OH
NHTroc
O
O
NapO
C13H27
12
gCOSY, 400 MHz, CDCl3
f2 (ppm)
f1 (ppm)
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
-1 0 1 2 3 4 5 6 7 8 9 10 11


ONap
NapO
O
O
OH
NHTroc
O
NapO
C13H27
12
gHSQC, 1H 400 MHz,
13C 101 MHz, CDCl3
f2 (ppm)
f1 (ppm)

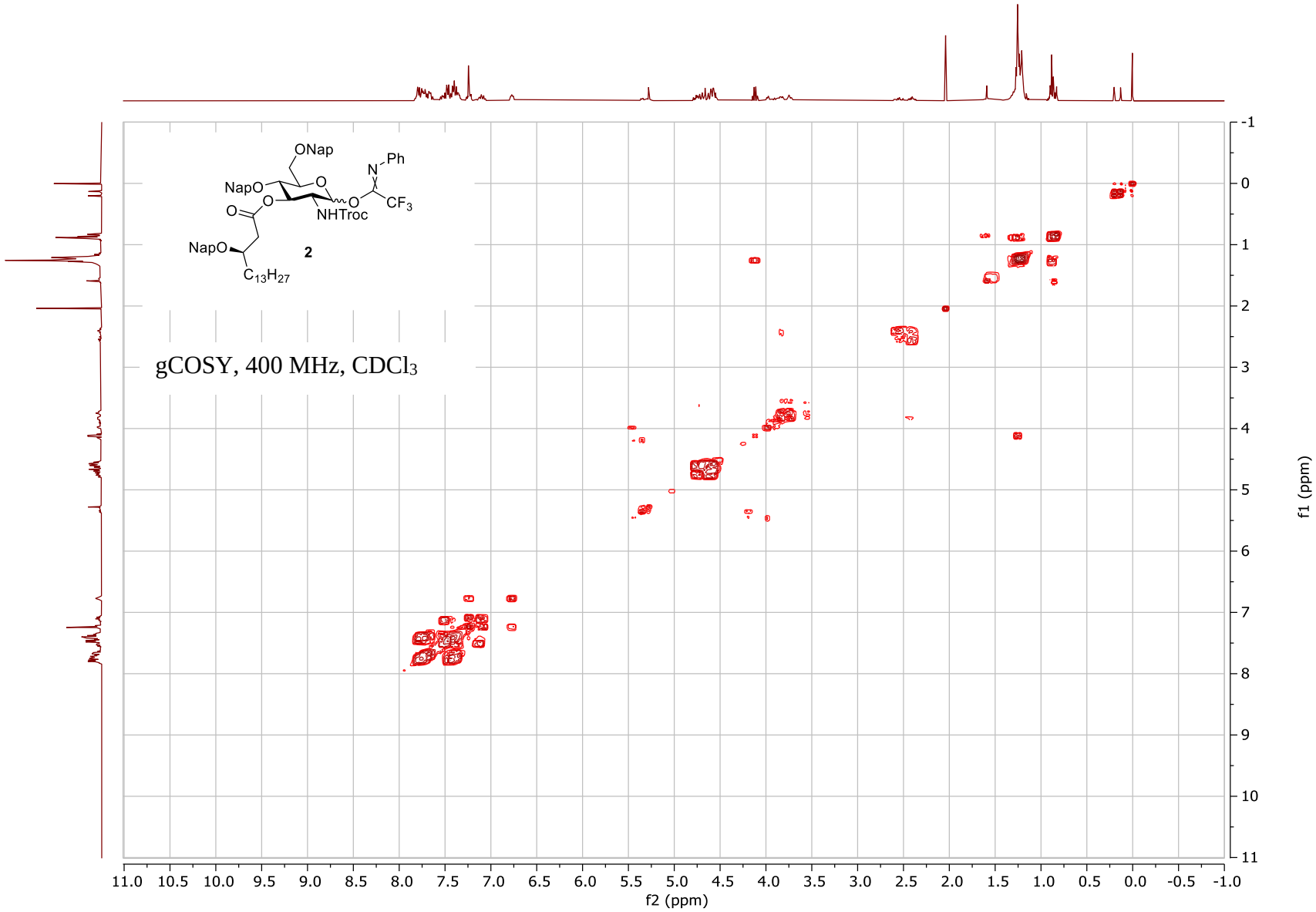

ONap
N
Ph
NapO
O
O
O
O
NHTroc
CF3
O
NapO
C13H27
2
1H NMR, 400 MHz, CDCl3
550
500
450
400
350
300
250
200
150
100
50
0
-50
31.11
3.00
2.42
0.84
0.77
1.18
12.68
0.60
1.36
1.53
1.26
2.35
2.70
1.63
1.52
1.70
4.67
39.34
7.48
0.62
0.61
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

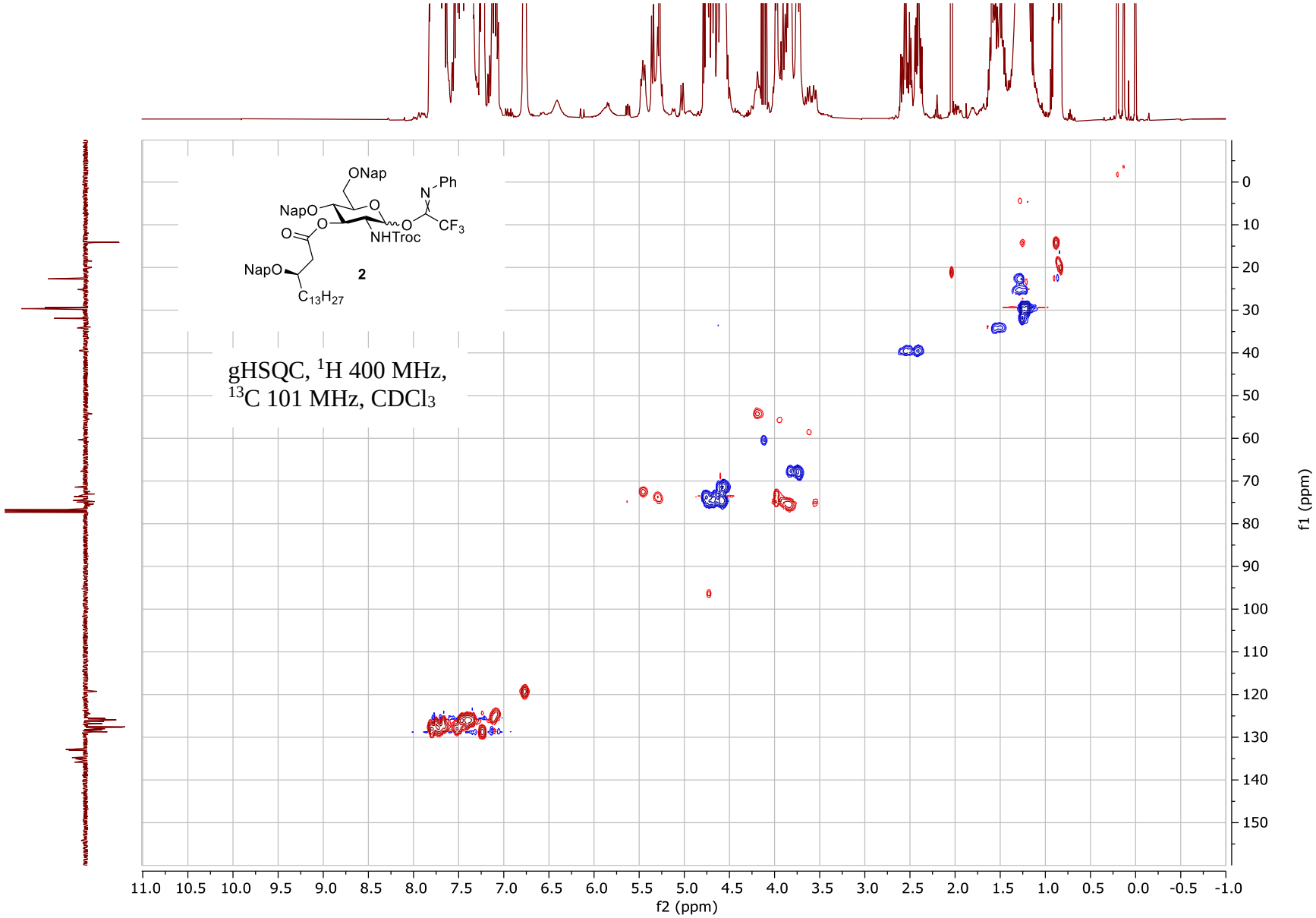

ONap
NapO
O
O
NHTroc
N
Ph
O
CF3
NapO
C13H27
2
13C NMR, 101 MHz, CDCl3
f1 (ppm)

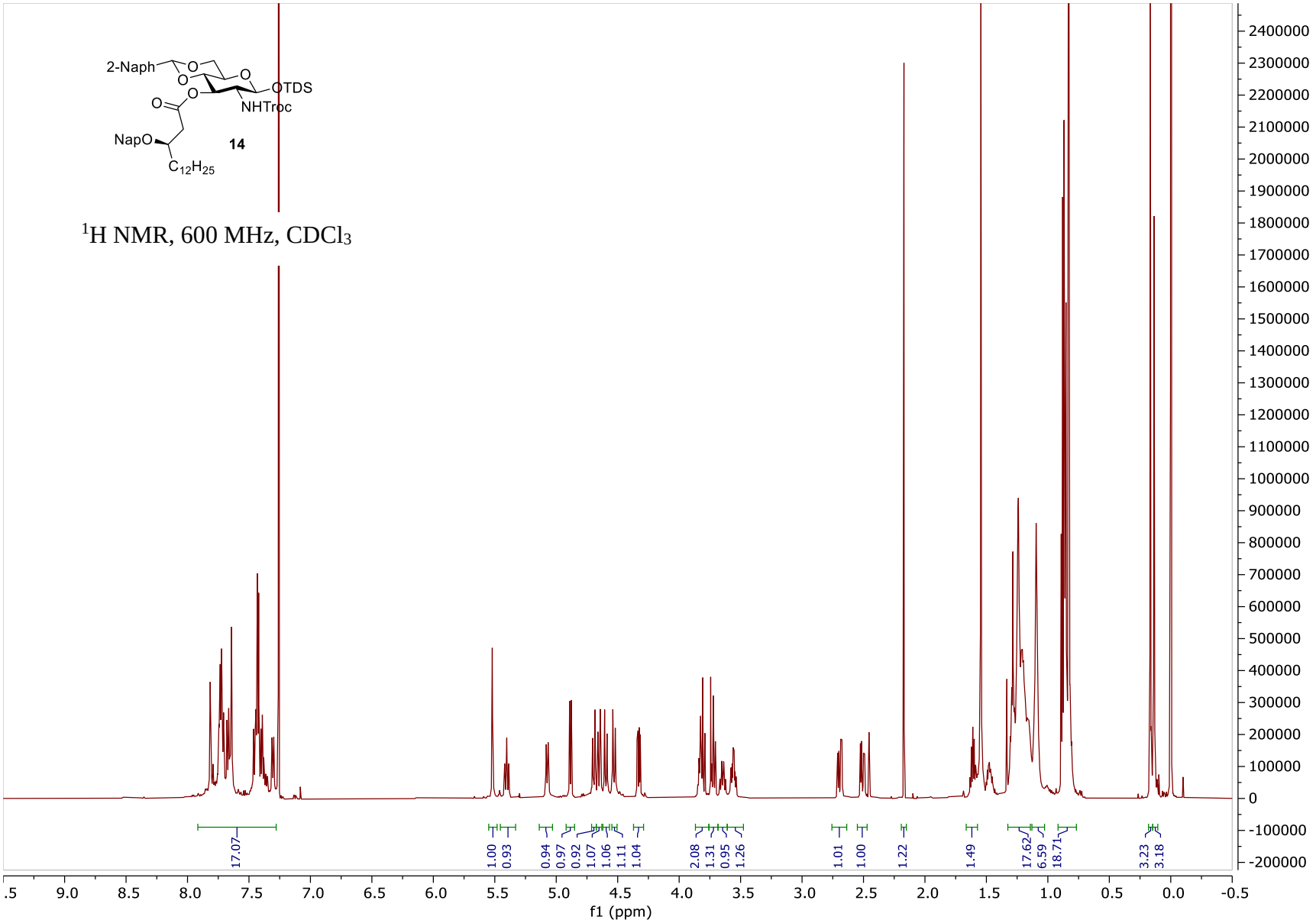


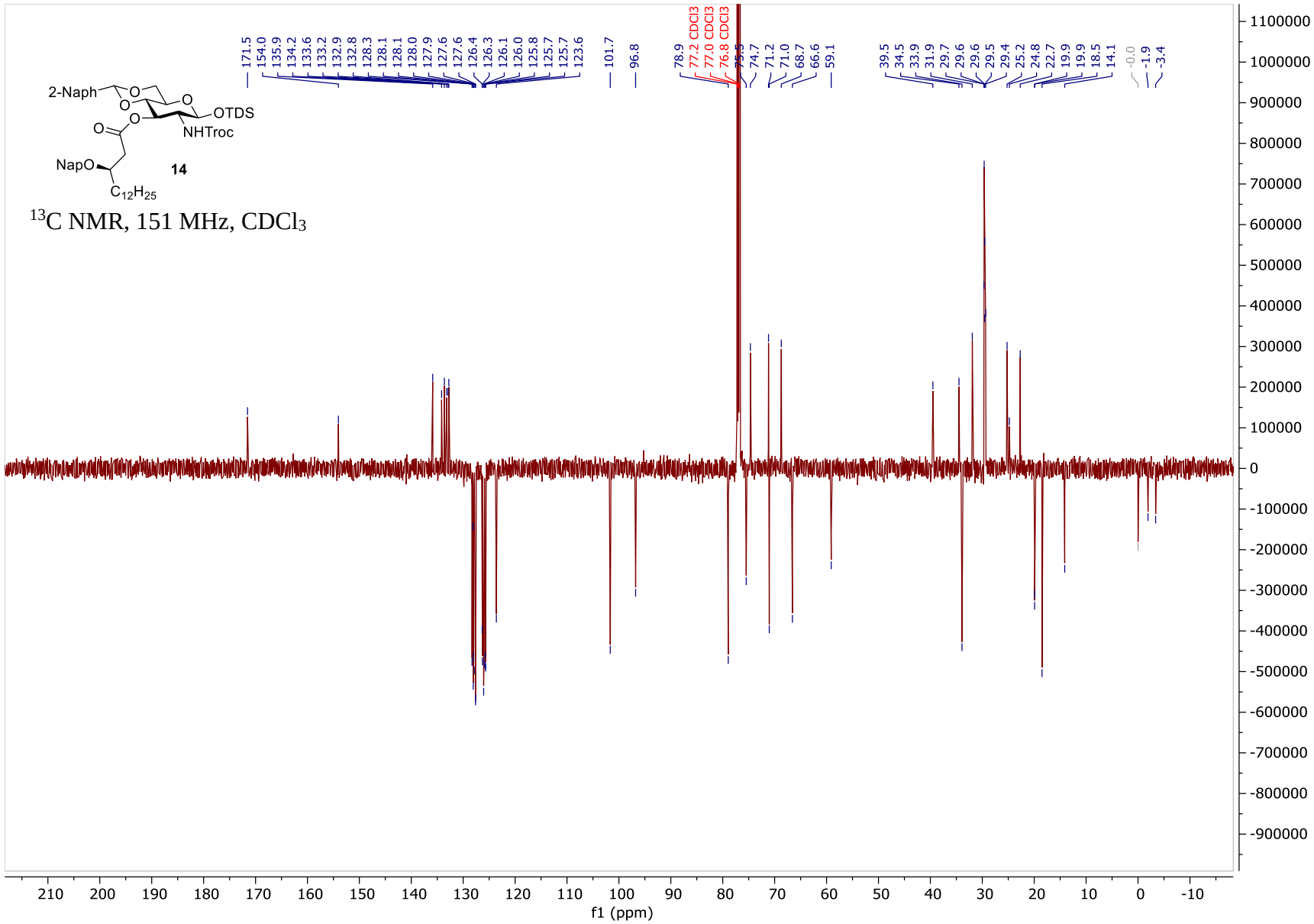
2

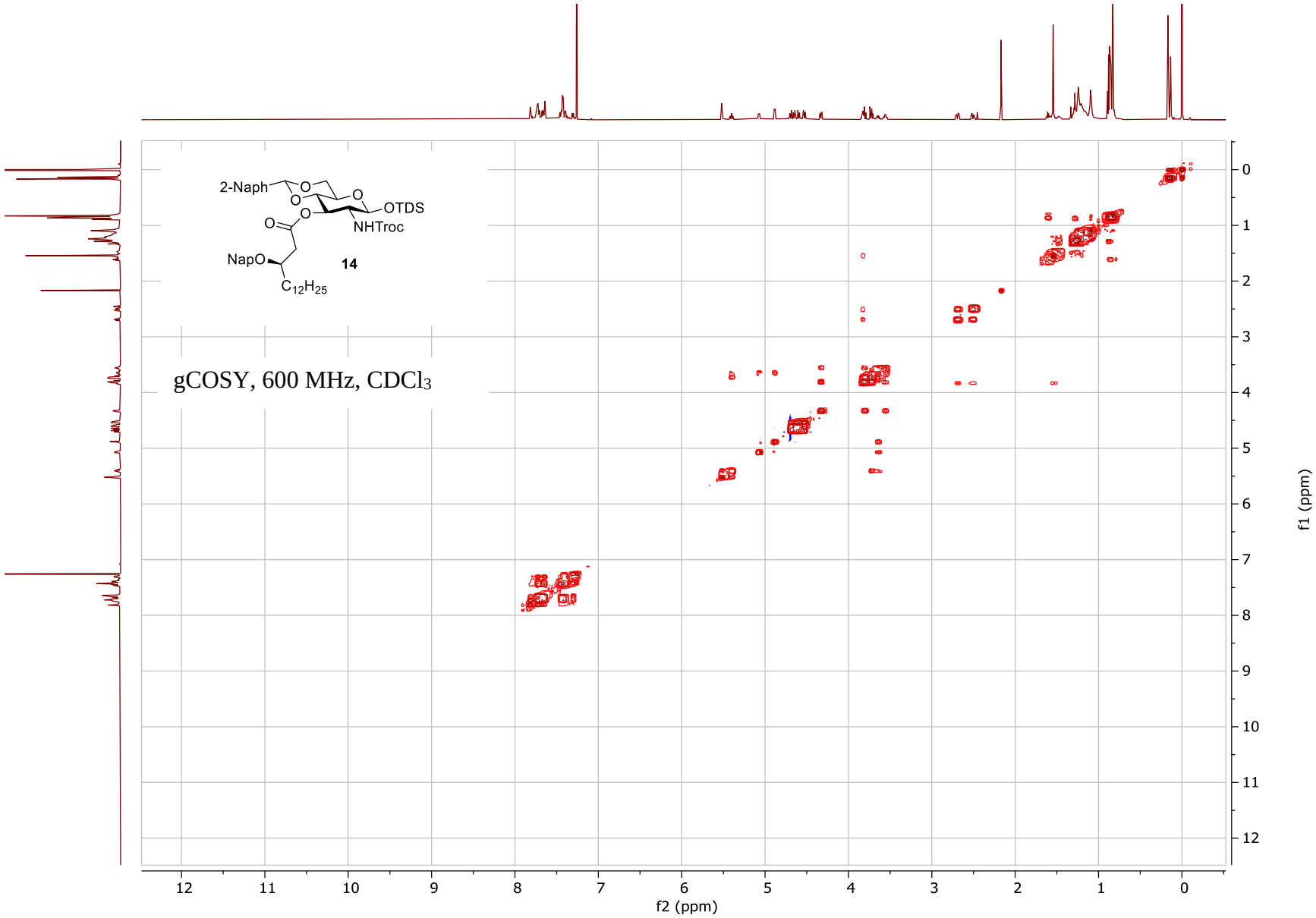
^{19}F NMR, 376 MHz, $CDCl_3$

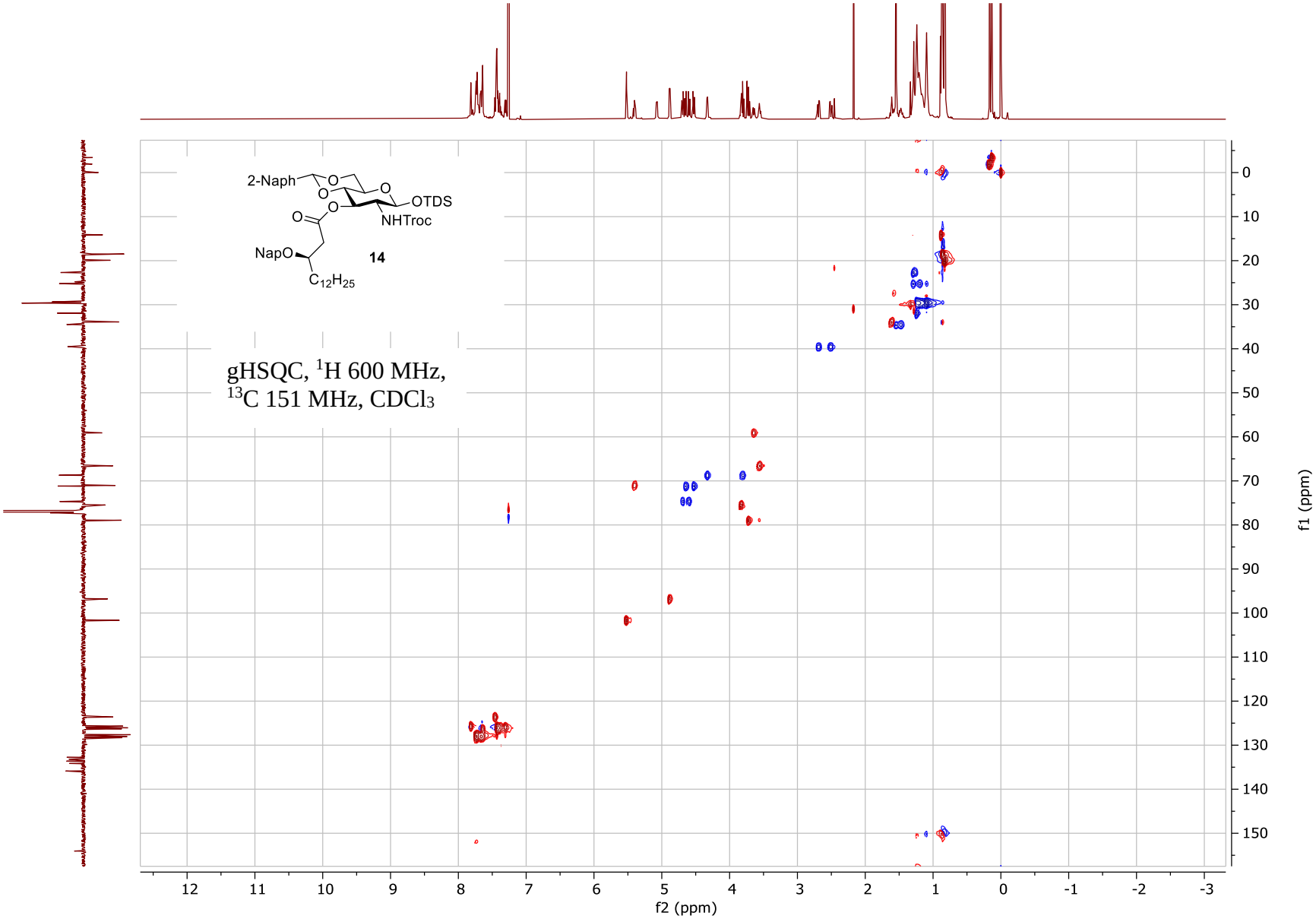

ONap
Ph
N
NapO
O
O
O
NHTroc
CF3
NapO
C13H27
2
gCOSY, 400 MHz, CDCl3
f2 (ppm)
f1 (ppm)

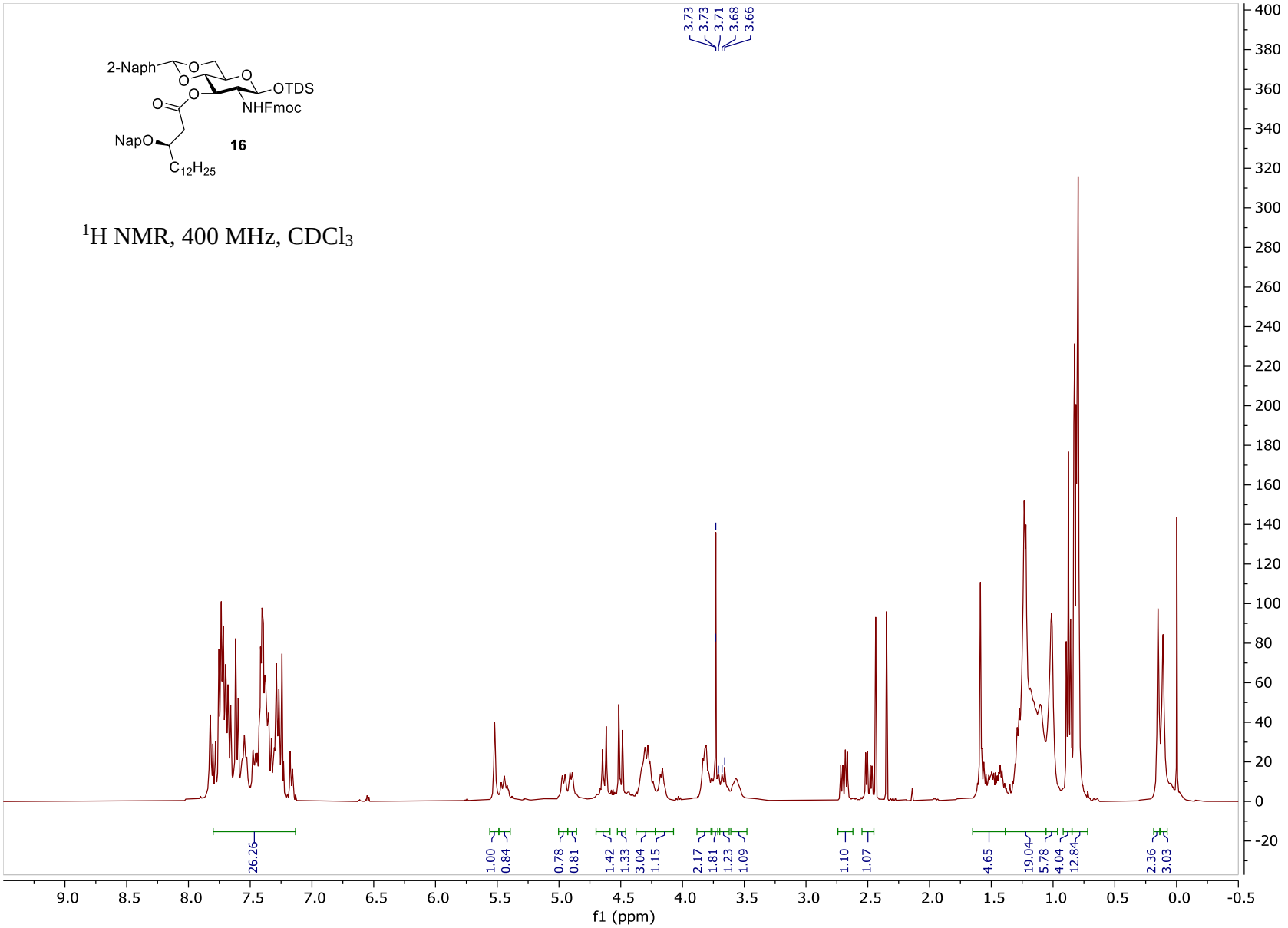

ONap
NapO
O
O
NHTroc
N
Ph
CF3
NapO
C13H27
2
gHSQC, 1H 400 MHz,
13C 101 MHz, CDCl3
f2 (ppm)
f1 (ppm)

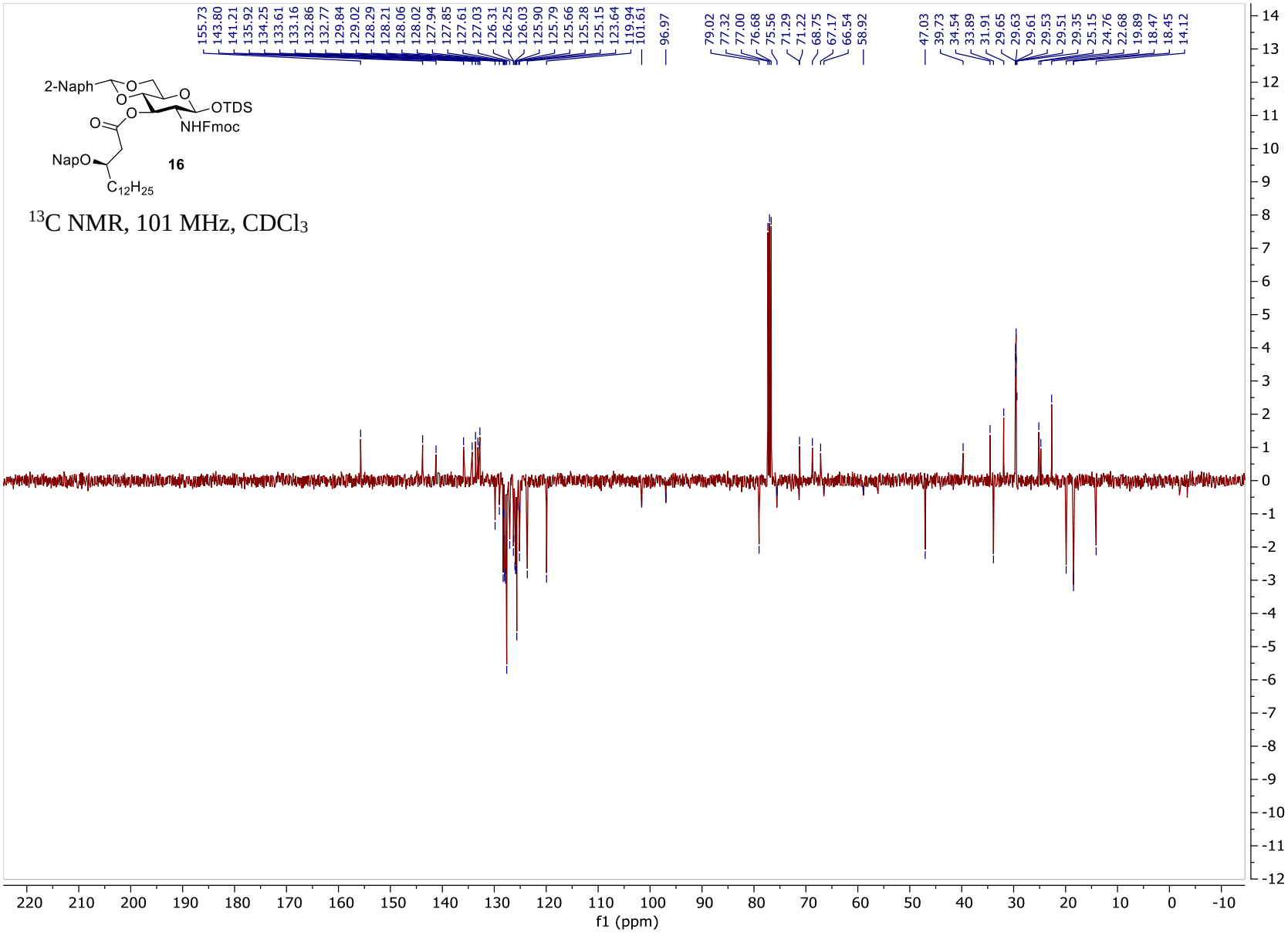

2-Naph
O
O
O
OTDS
O
O
NHTroc
NapO
14
$C_{12}H_{25}$
^{1}H NMR, 600 MHz, $CDCl_3$
2400000
2300000
2200000
2100000
2000000
1900000
1800000
1700000
1600000
1500000
1400000
1300000
1200000
1100000
1000000
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
-100000
-200000
17.07
1.00
0.93
0.94
0.97
0.92
1.07
1.06
1.11
1.04
2.08
1.31
0.95
1.26
1.01
1.00
1.22
1.49
17.62
6.59
18.71
3.23
3.18
.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

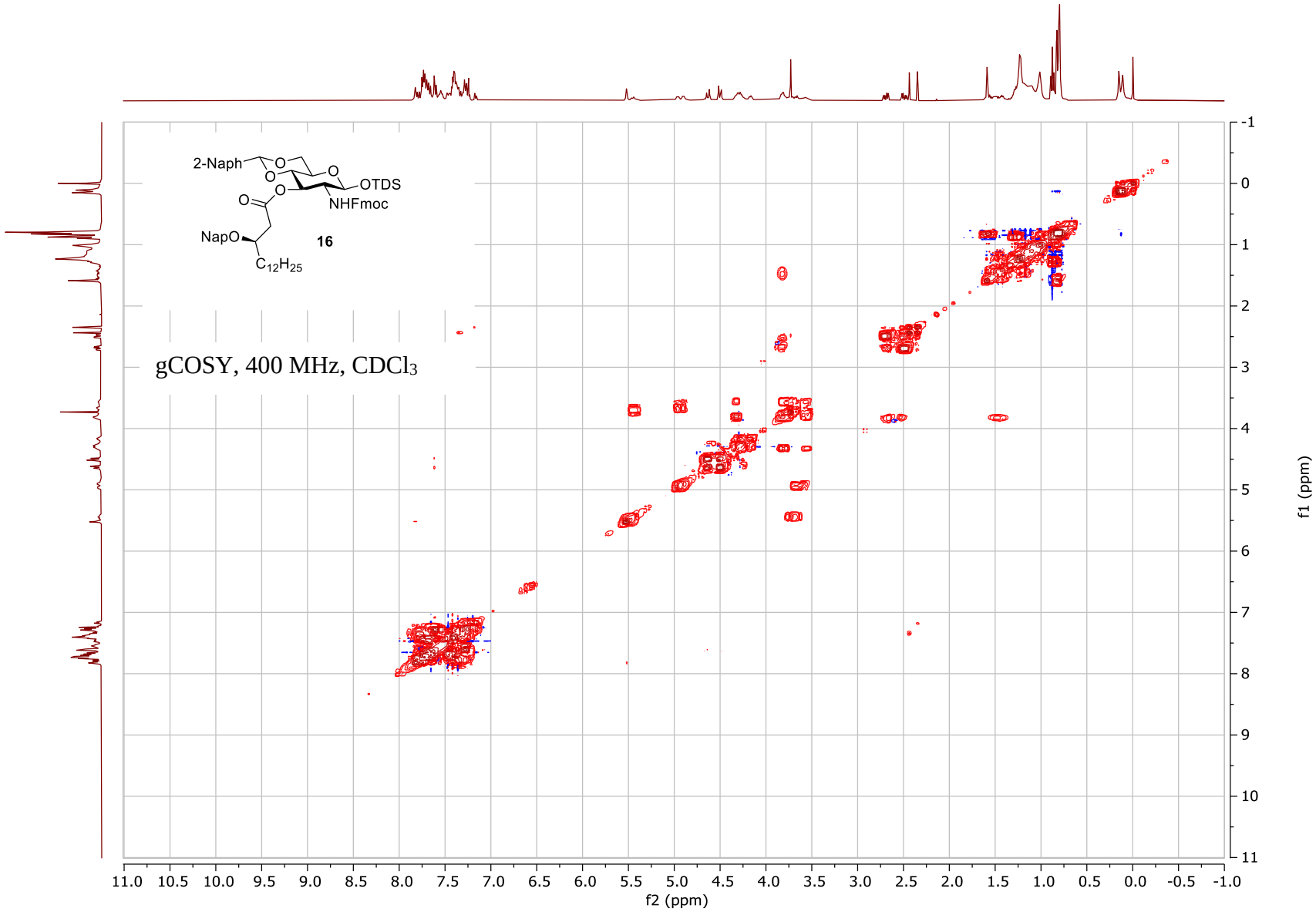

2-Naph
OTDS
NHTroc
NapO
$C_{12}H_{25}$
14
^{13}C NMR, 151 MHz, $CDCl_3$
171.5
154.0
135.9
134.2
133.6
133.2
132.9
132.8
128.3
128.1
128.1
128.0
127.9
127.6
127.6
126.4
126.3
126.1
126.0
125.8
125.7
125.7
123.6
101.7
96.8
78.9
77.2 CDCl3
77.0 CDCl3
76.8 CDCl3
75.5
74.7
71.2
71.0
68.7
66.6
59.1
39.5
34.5
33.9
31.9
29.7
29.6
29.6
29.5
29.4
25.2
24.8
22.7
19.9
19.9
18.5
14.1
-0.0
-1.9
-3.4
f1 (ppm)

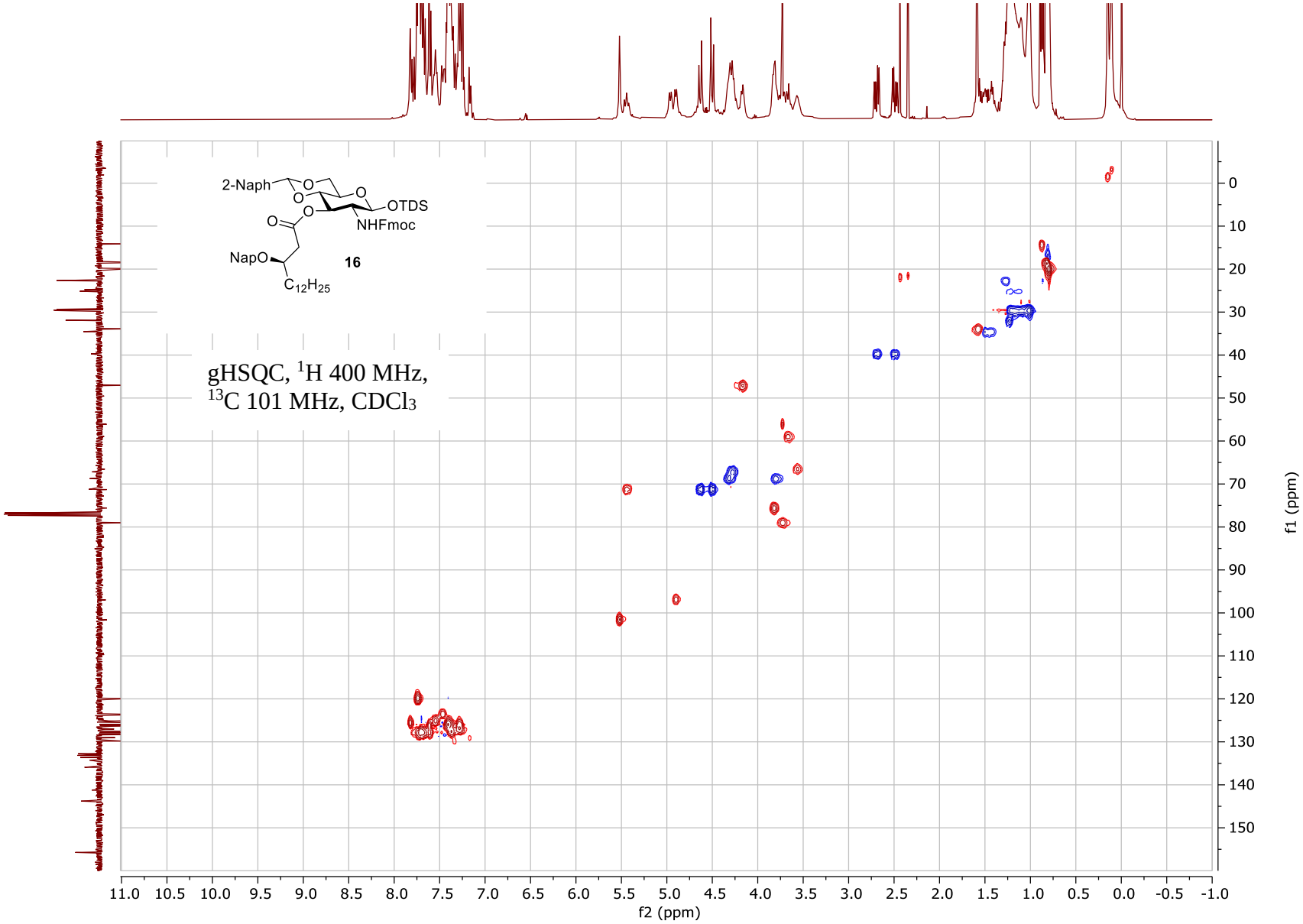

2-Naph
OTDS
NHTroc
NapO
$C_{12}H_{25}$
14
gCOSY, 600 MHz, $CDCl_3$
f2 (ppm)
f1 (ppm)

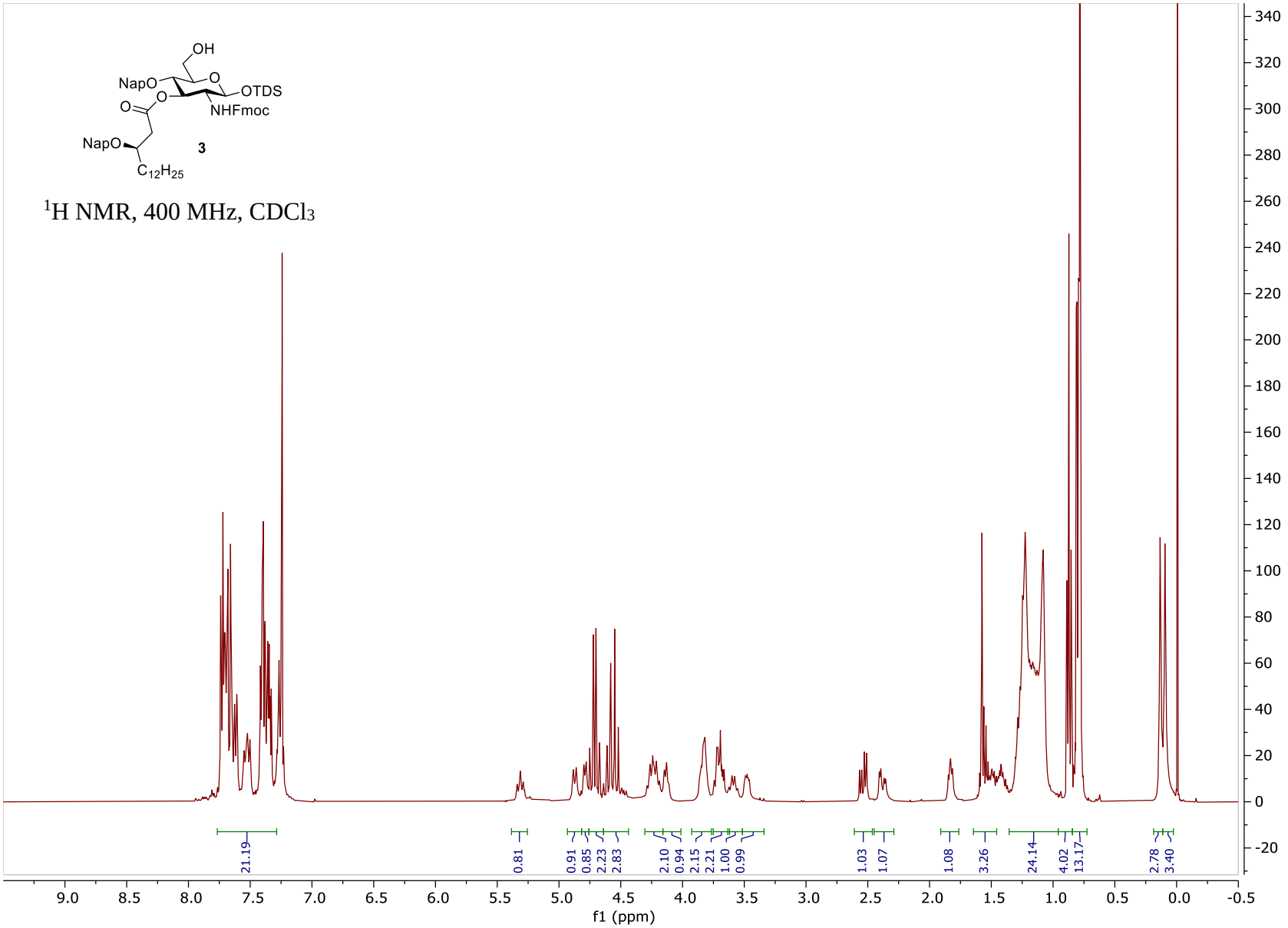

2-Naph
OTDS
NHTroc
NapO
$C_{12}H_{25}$
14
gHSQC, ^{1}H 600 MHz,
^{13}C 151 MHz, $CDCl_3$
f2 (ppm)
f1 (ppm)

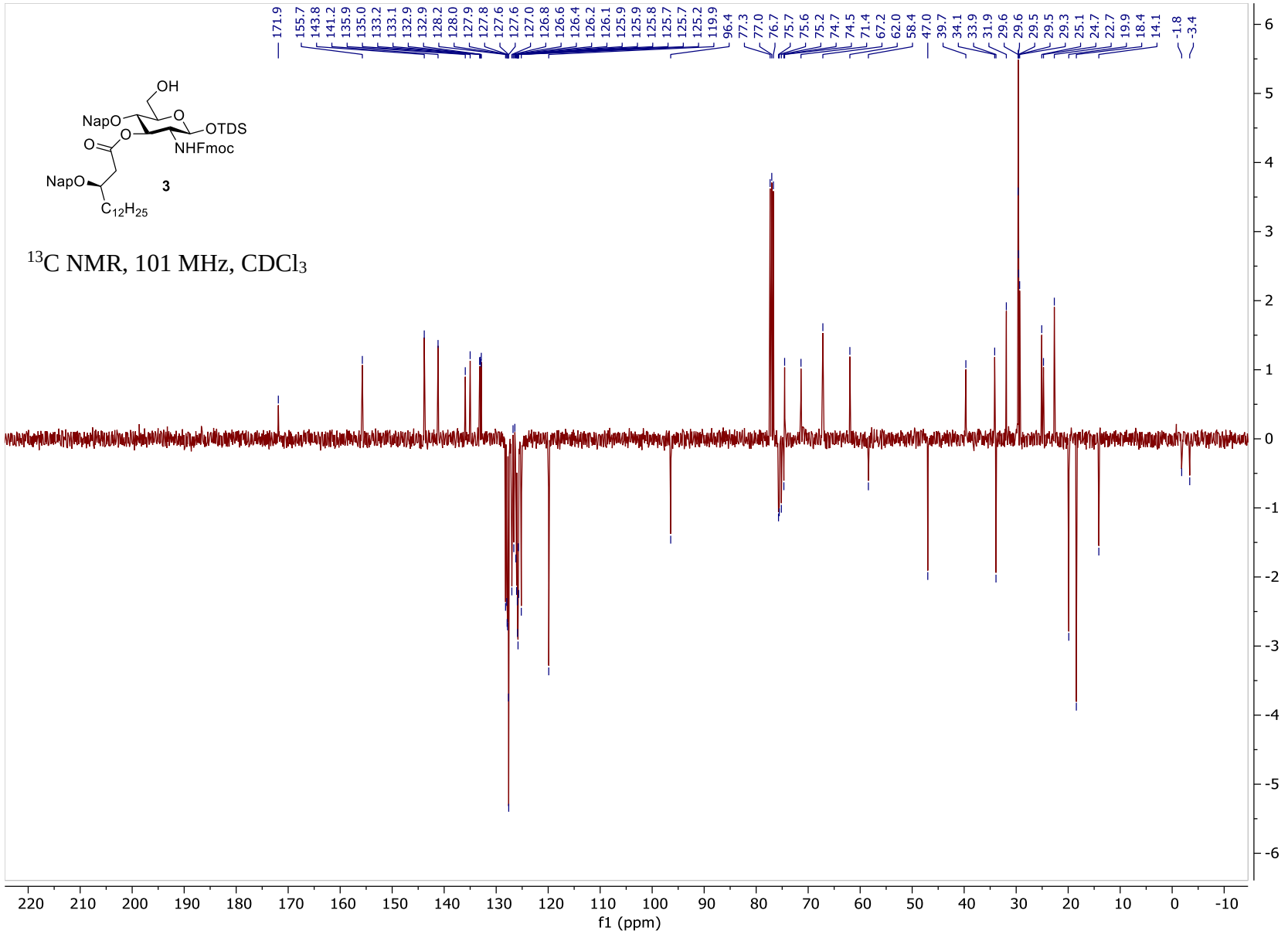

2-Naph
OTDS
NHFmoc
NapO
$C_{12}H_{25}$
16
^{1}H NMR, 400 MHz, $CDCl_3$
3.73
3.73
3.71
3.68
3.66
26.26
1.00
0.84
0.78
0.81
1.42
1.33
3.04
1.15
2.17
1.81
1.23
1.09
1.10
1.07
4.65
19.04
5.78
4.04
12.84
2.36
3.03
f1 (ppm)

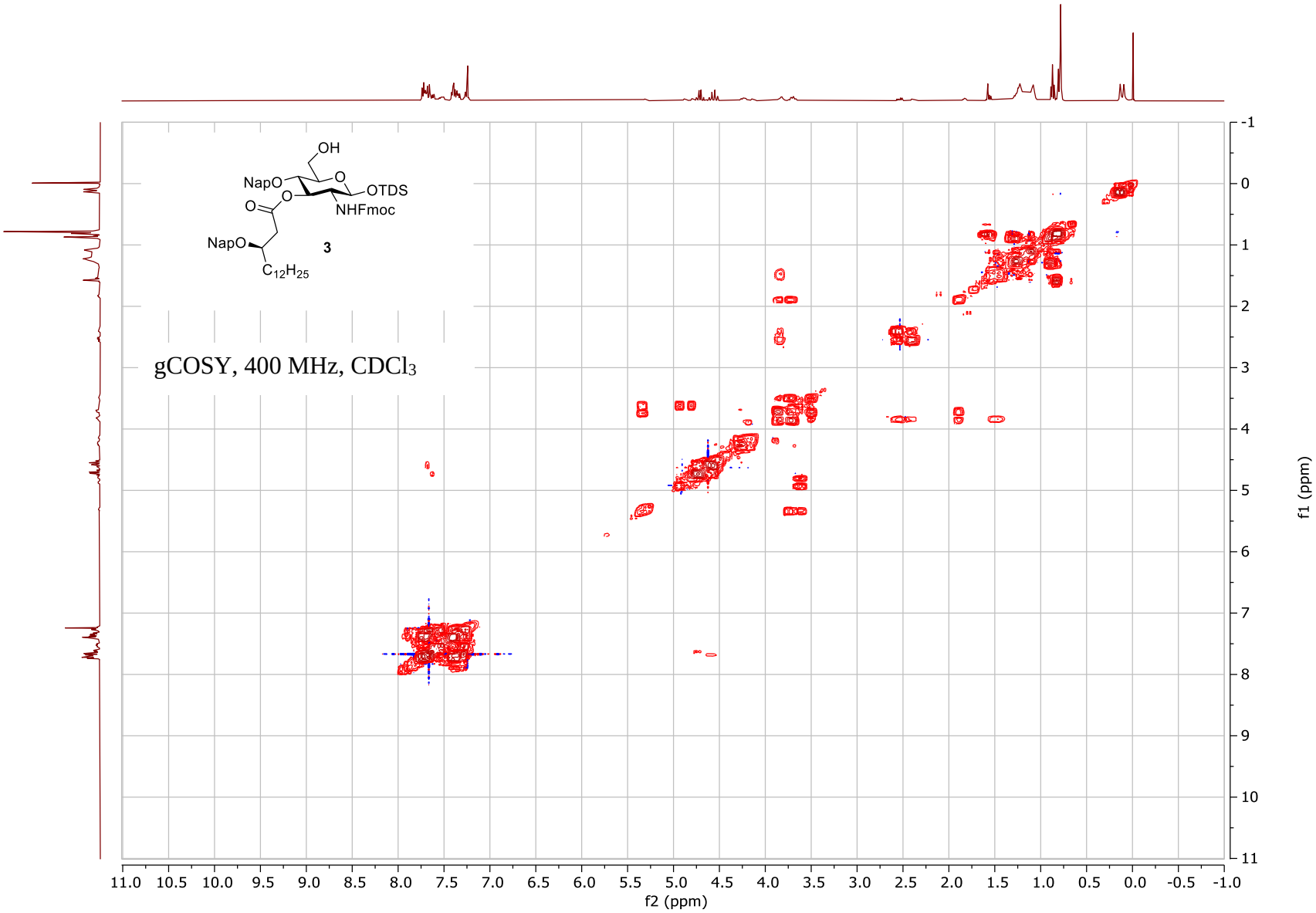

155.73
143.80
141.21
135.92
134.25
133.61
133.16
132.86
132.77
129.84
129.02
128.29
128.21
128.06
128.02
127.94
127.85
127.61
127.03
126.31
126.25
126.03
125.90
125.79
125.66
125.28
125.15
123.64
119.94
101.61
96.97
79.02
77.32
77.00
76.68
75.56
71.29
71.22
68.75
67.17
66.54
58.92
47.03
39.73
34.54
33.89
31.91
29.65
29.63
29.61
29.53
29.51
29.35
25.15
24.76
22.68
19.89
18.47
18.45
14.12
2-Naph
OTDS
NHFmoc
NapO
$C_{12}H_{25}$
16
^{13}C NMR, 101 MHz, $CDCl_3$
f1 (ppm)

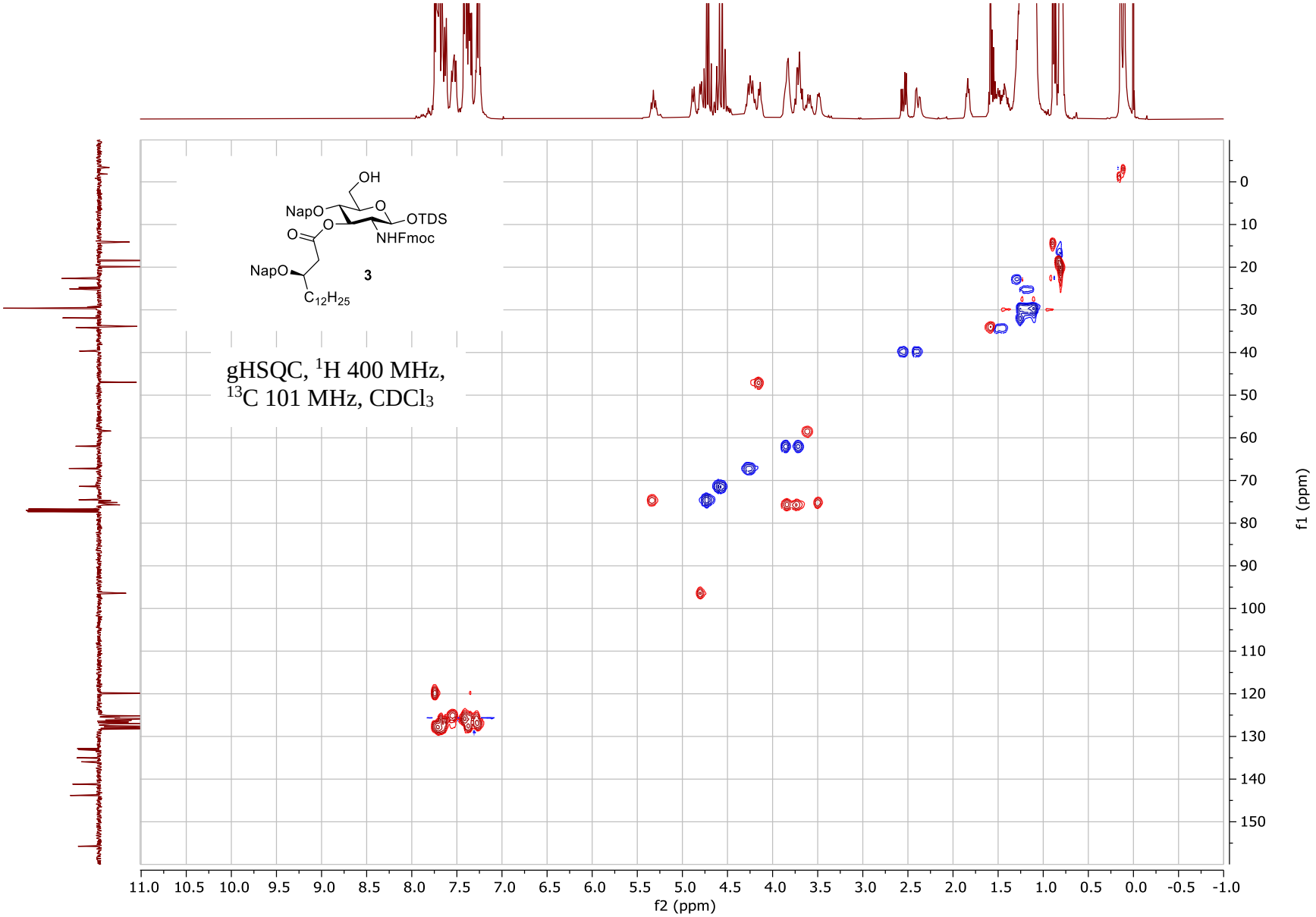

2-Naph
OTDS
NHFmoc
NapO
$C_{12}H_{25}$
16
gCOSY, 400 MHz, $CDCl_3$
f2 (ppm)
f1 (ppm)

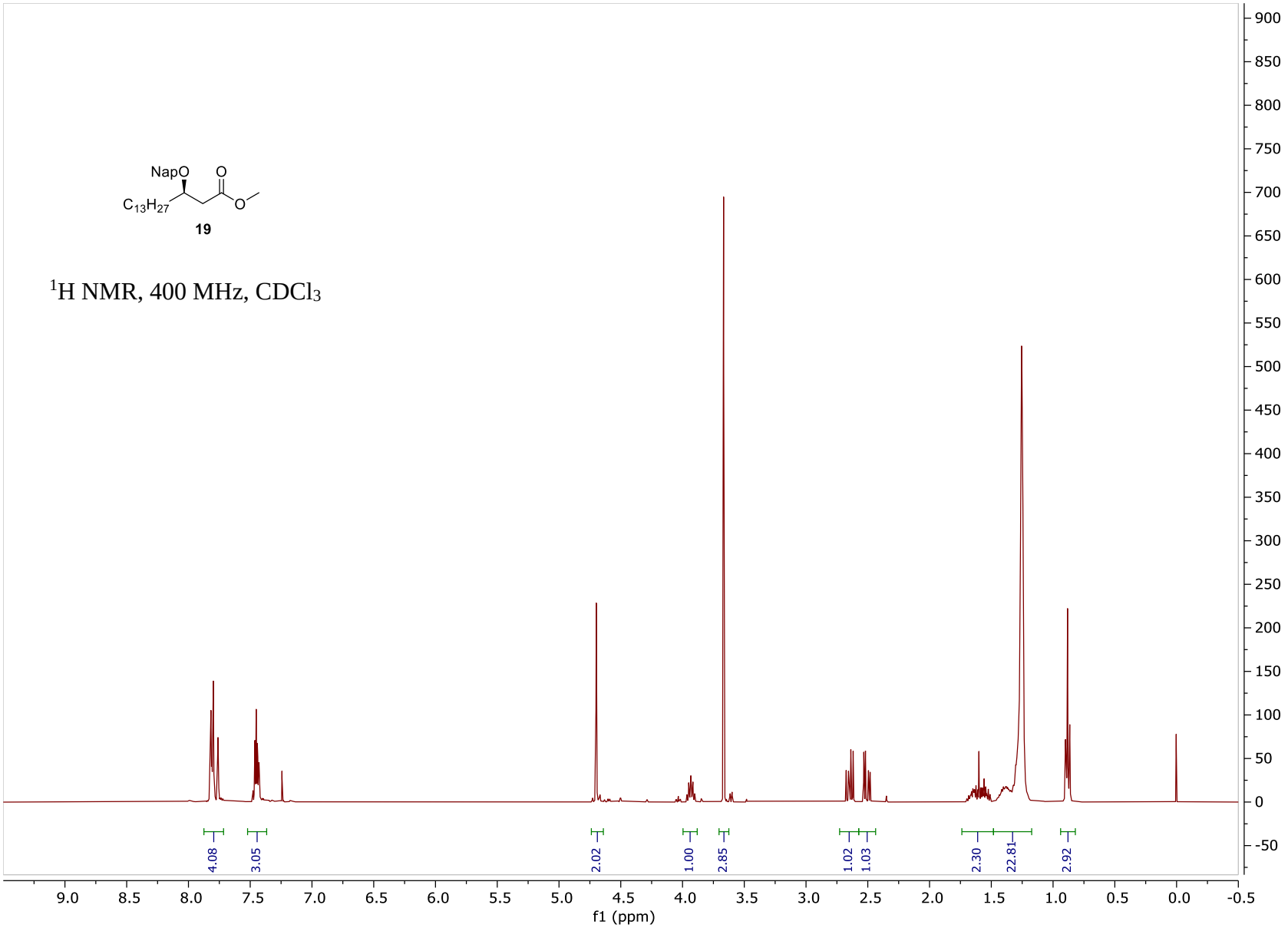

2-Naph
OTDS
NHFmoc
NapO
$C_{12}H_{25}$
16
gHSQC, ^{1}H 400 MHz,
^{13}C 101 MHz, $CDCl_3$
f1 (ppm)
f2 (ppm)

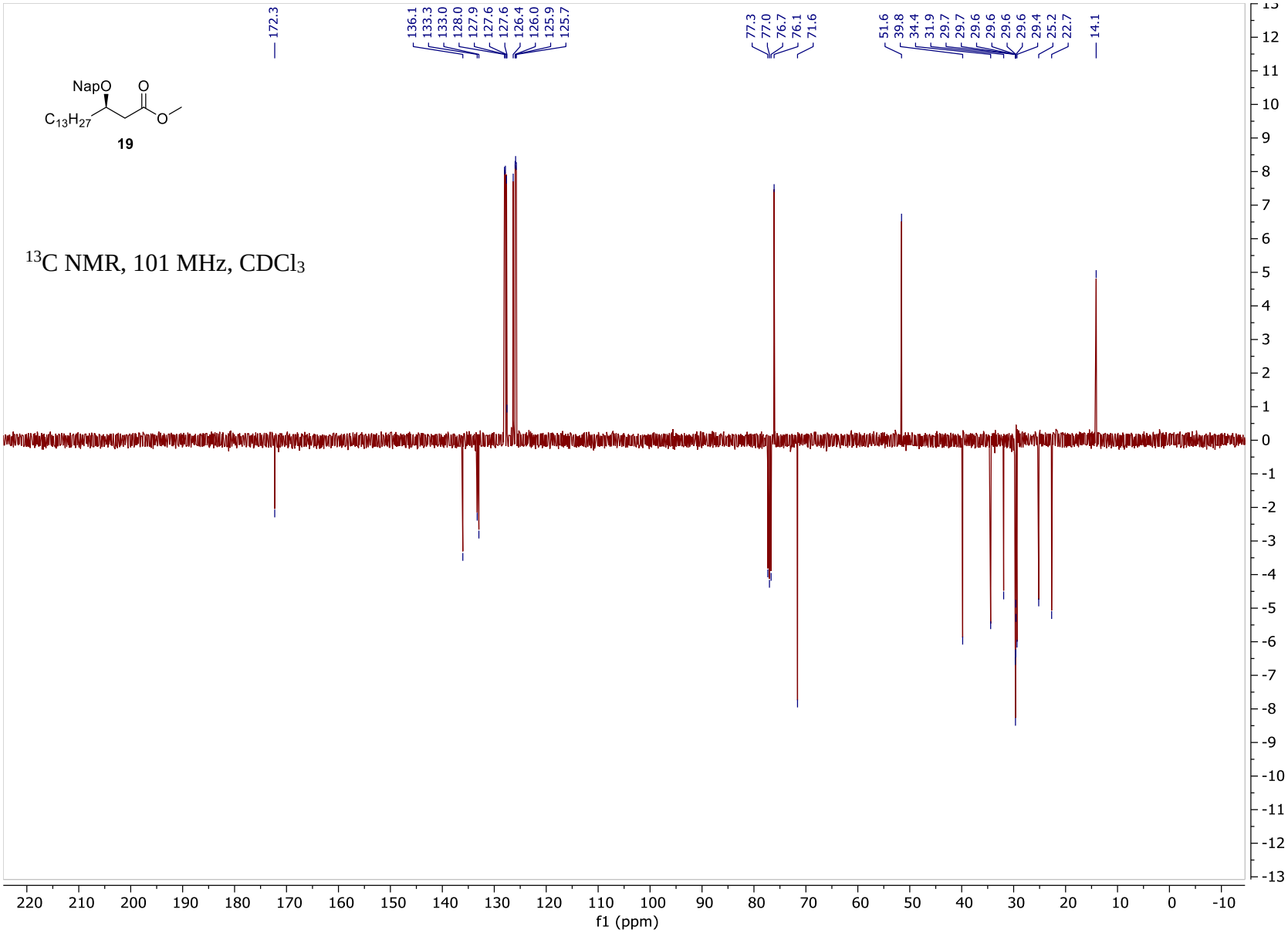

OH
NapO
O
OTDS
O
O
NHFmoc
NapO
3
C12H25
1H NMR, 400 MHz, CDCl3
21.19
0.81
0.91
0.85
2.23
2.83
2.10
0.94
2.15
2.21
1.00
0.99
1.03
1.07
1.08
3.26
24.14
4.02
13.17
2.78
3.40
f1 (ppm)

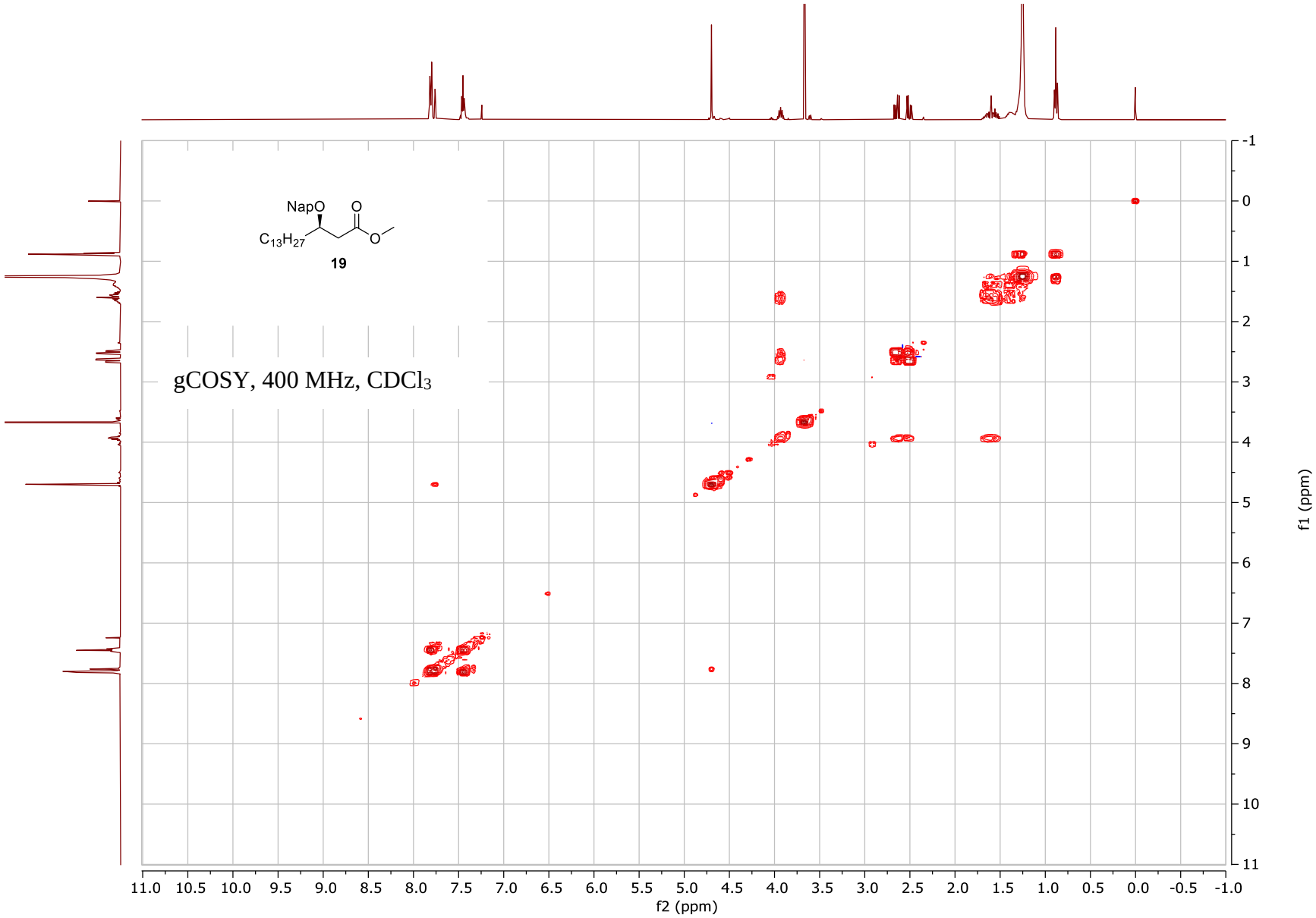

171.9
155.7
143.8
141.2
135.9
135.0
133.2
133.1
132.9
132.9
128.2
128.0
127.9
127.8
127.6
127.6
127.0
126.8
126.6
126.4
126.2
126.1
125.9
125.9
125.8
125.7
125.7
125.2
119.9
96.4
77.3
77.0
76.7
75.7
75.6
75.2
74.7
74.5
71.4
67.2
62.0
58.4
47.0
39.7
34.1
33.9
31.9
29.6
29.6
29.5
29.5
29.3
25.1
24.7
22.7
19.9
18.4
14.1
-1.8
-3.4
OH
NapO
O
O
OTDS
NHFmoc
O
NapO
$C_{12}H_{25}$
3
^{13}C NMR, 101 MHz, $CDCl_3$
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

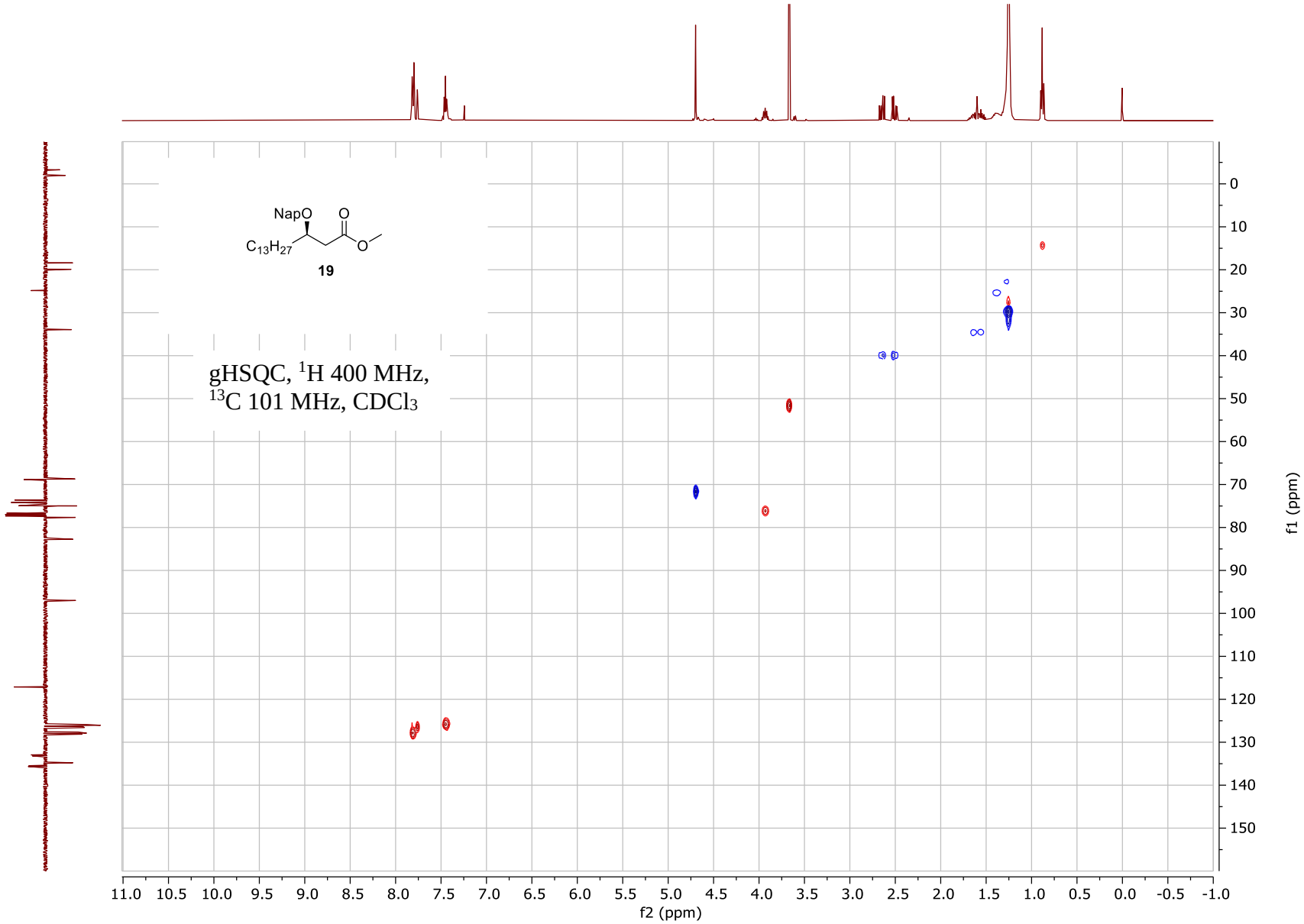

OH
NapO
O
OTDS
O
NHFmoc
NapO
3
$C_{12}H_{25}$
gCOSY, 400 MHz, $CDCl_3$
f2 (ppm)
f1 (ppm)

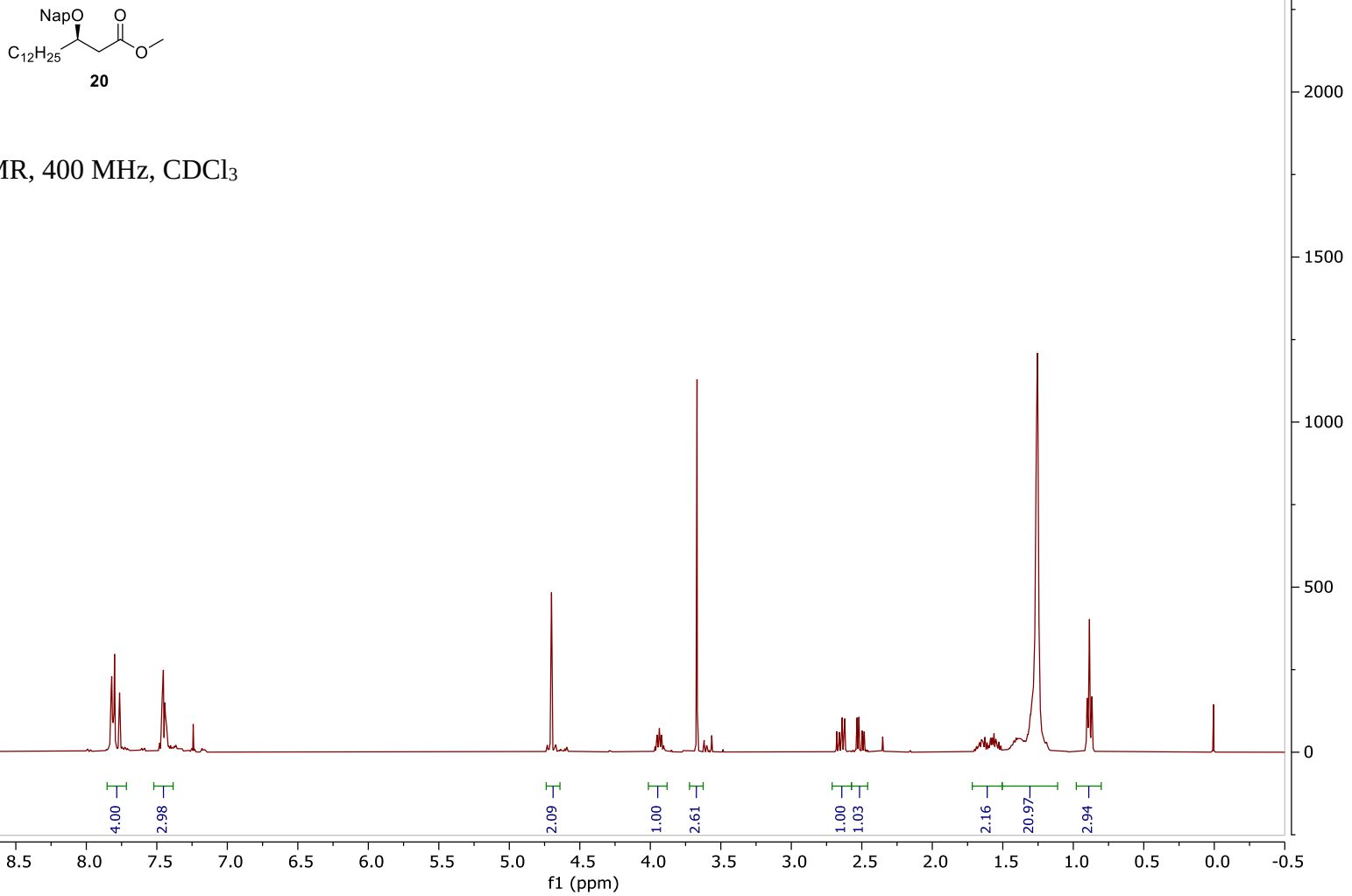

OH
NapO
O
OTDS
O
O
NHFmoc
NapO
3
C12H25
gHSQC, 1H 400 MHz,
13C 101 MHz, CDCl3
f2 (ppm)
f1 (ppm)

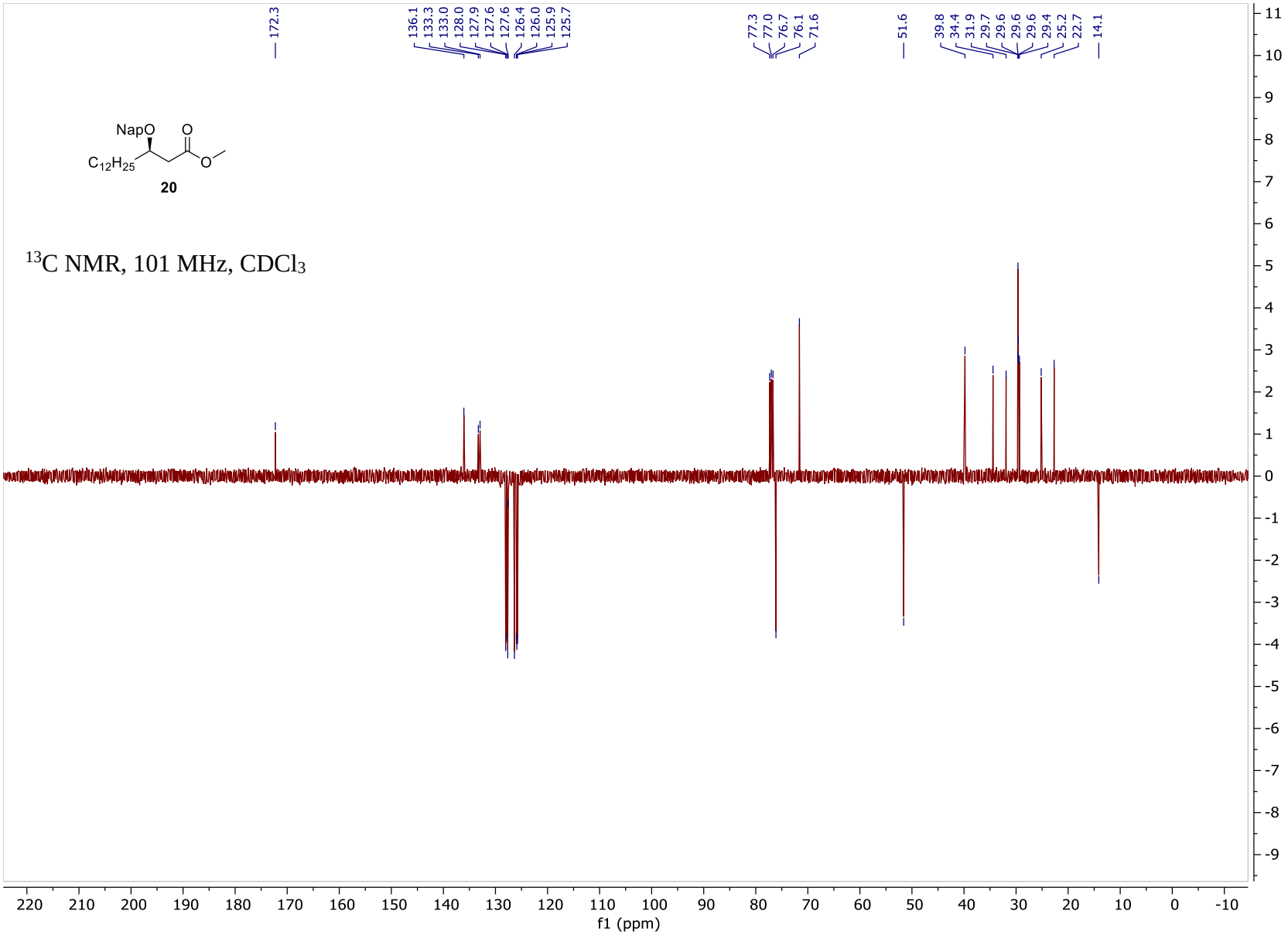

NapO
O
$C_{13}H_{27}$
O
19
^{1}H NMR, 400 MHz, $CDCl_3$
4.08
3.05
2.02
1.00
2.85
1.02
1.03
2.30
22.81
2.92
f1 (ppm)

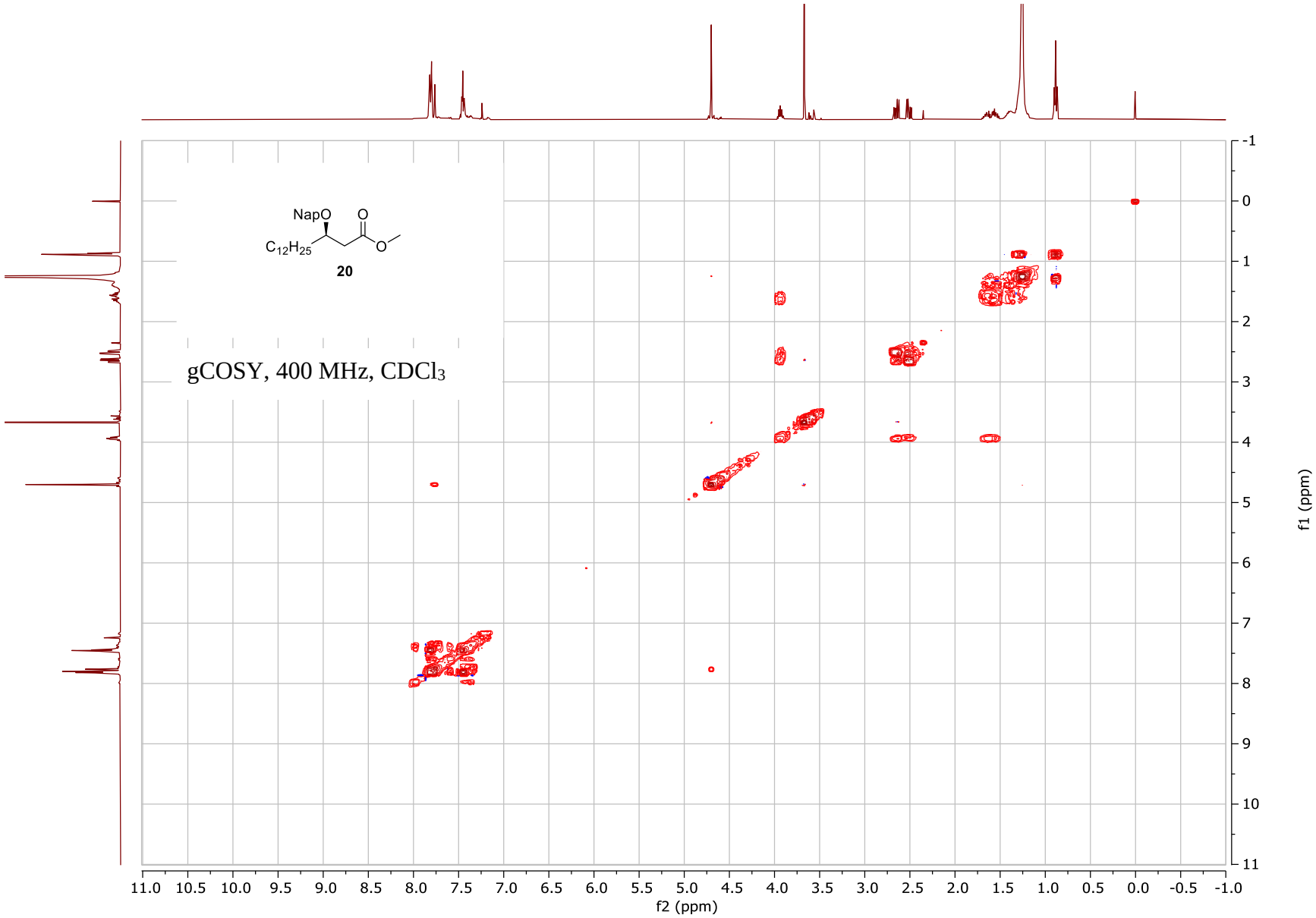

172.3
136.1
133.3
133.0
128.0
127.9
127.6
127.6
126.4
126.0
125.9
125.7
77.3
77.0
76.7
76.1
71.6
51.6
39.8
34.4
31.9
29.7
29.7
29.6
29.6
29.6
29.6
29.4
25.2
22.7
14.1
NapO
O
C13H27
O
19
13C NMR, 101 MHz, CDCl3
f1 (ppm)

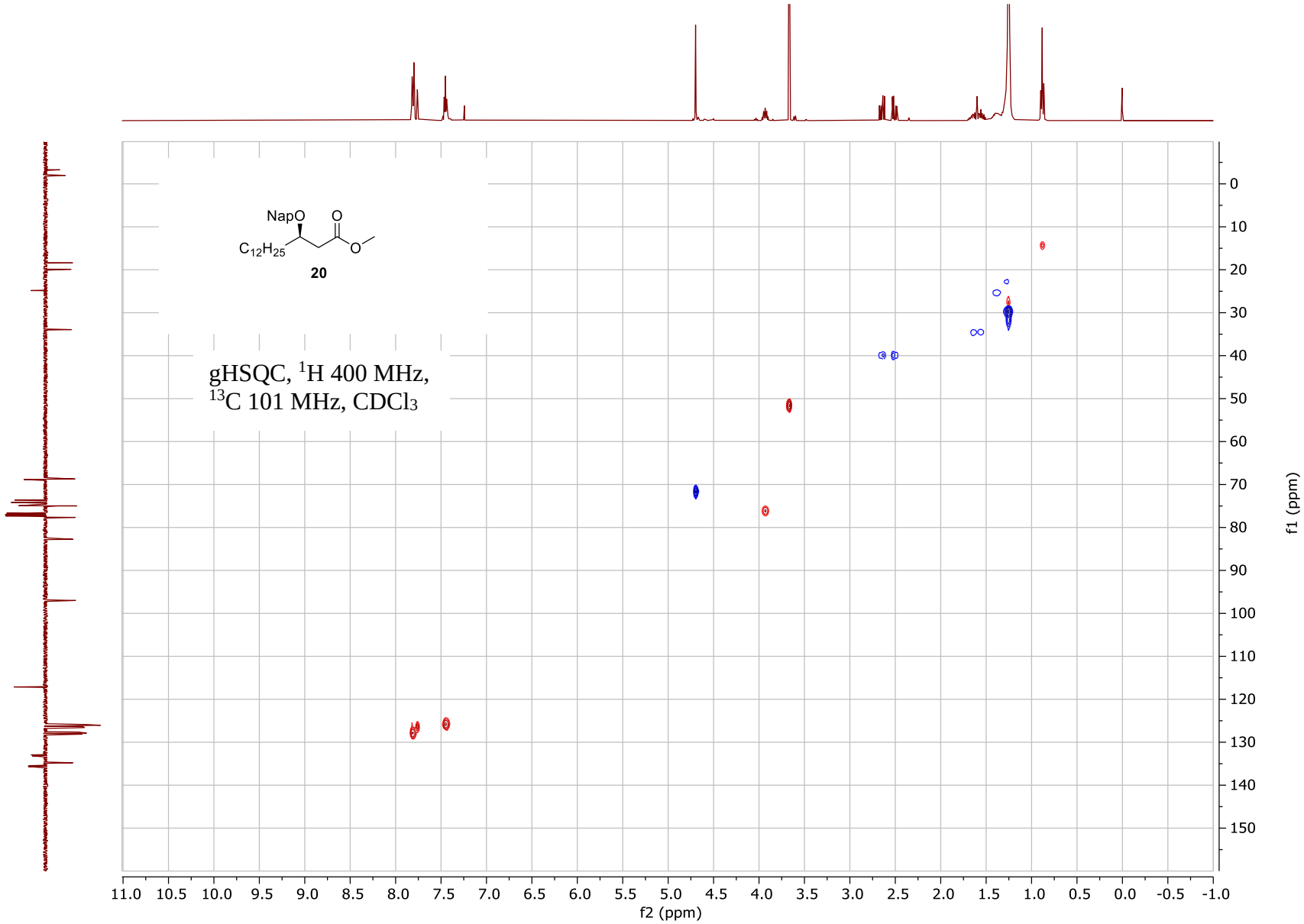

NapO
O
O
$C_{13}H_{27}$
19
gCOSY, 400 MHz, $CDCl_3$
f2 (ppm)
f1 (ppm)

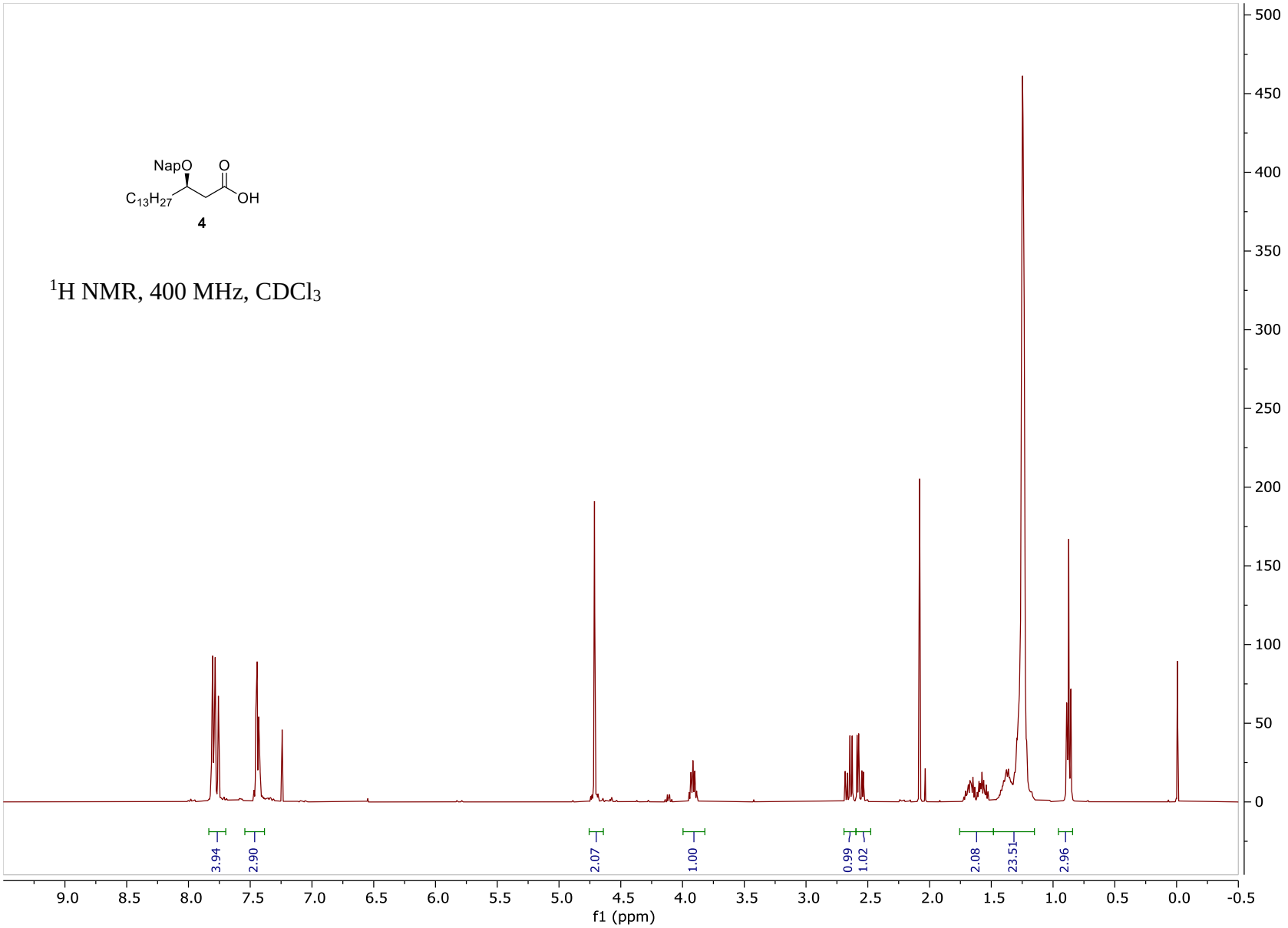

NapO
O
C13H27
O
19
gHSQC, 1H 400 MHz,
13C 101 MHz, CDCl3
f2 (ppm)
f1 (ppm)

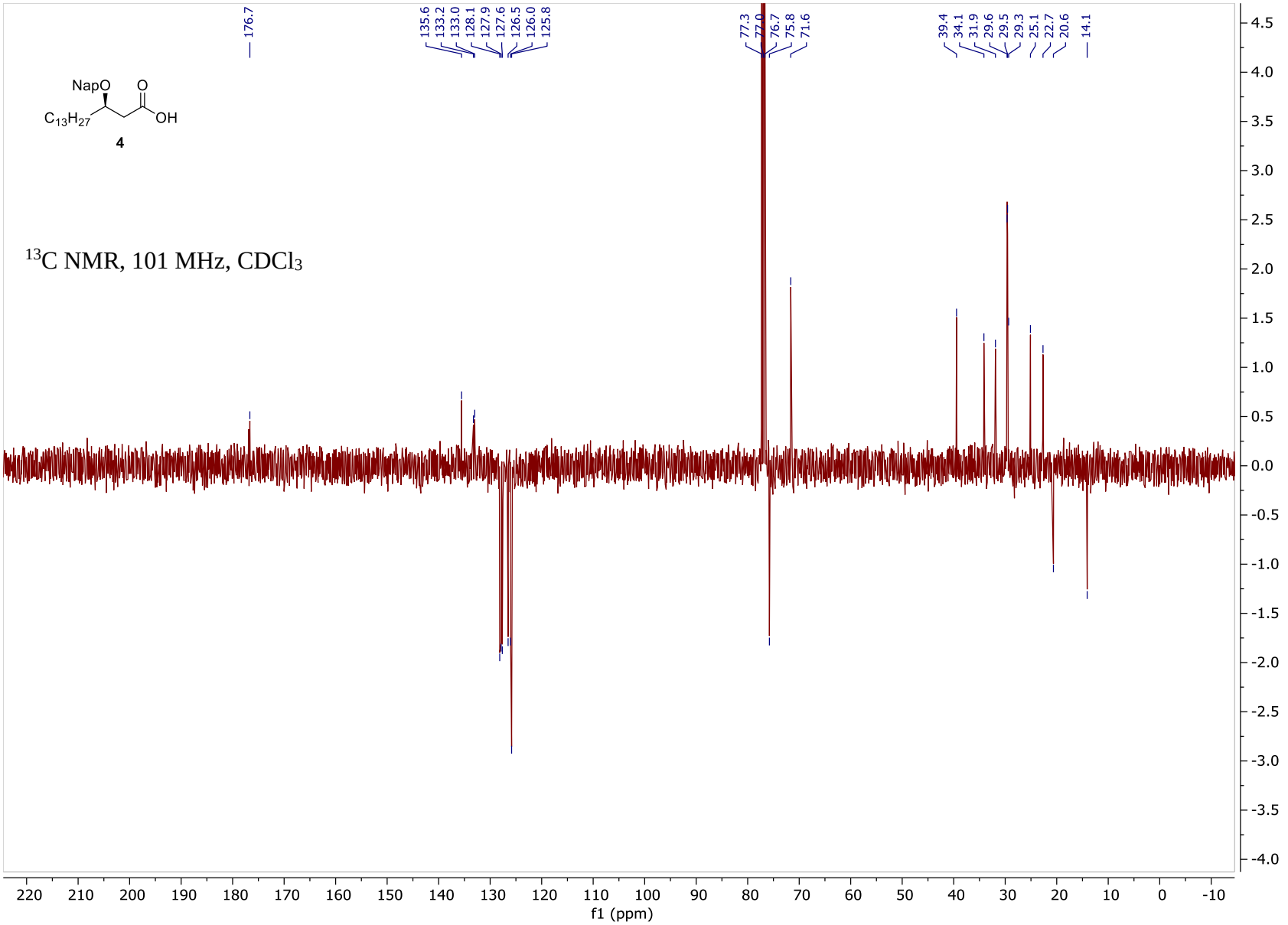

NapO
O
$C_{12}H_{25}$
O
20
^{1}H NMR, 400 MHz, $CDCl_3$
2500
2000
1500
1000
500
0
4.00
2.98
2.09
1.00
2.61
1.00
1.03
2.16
20.97
2.94
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

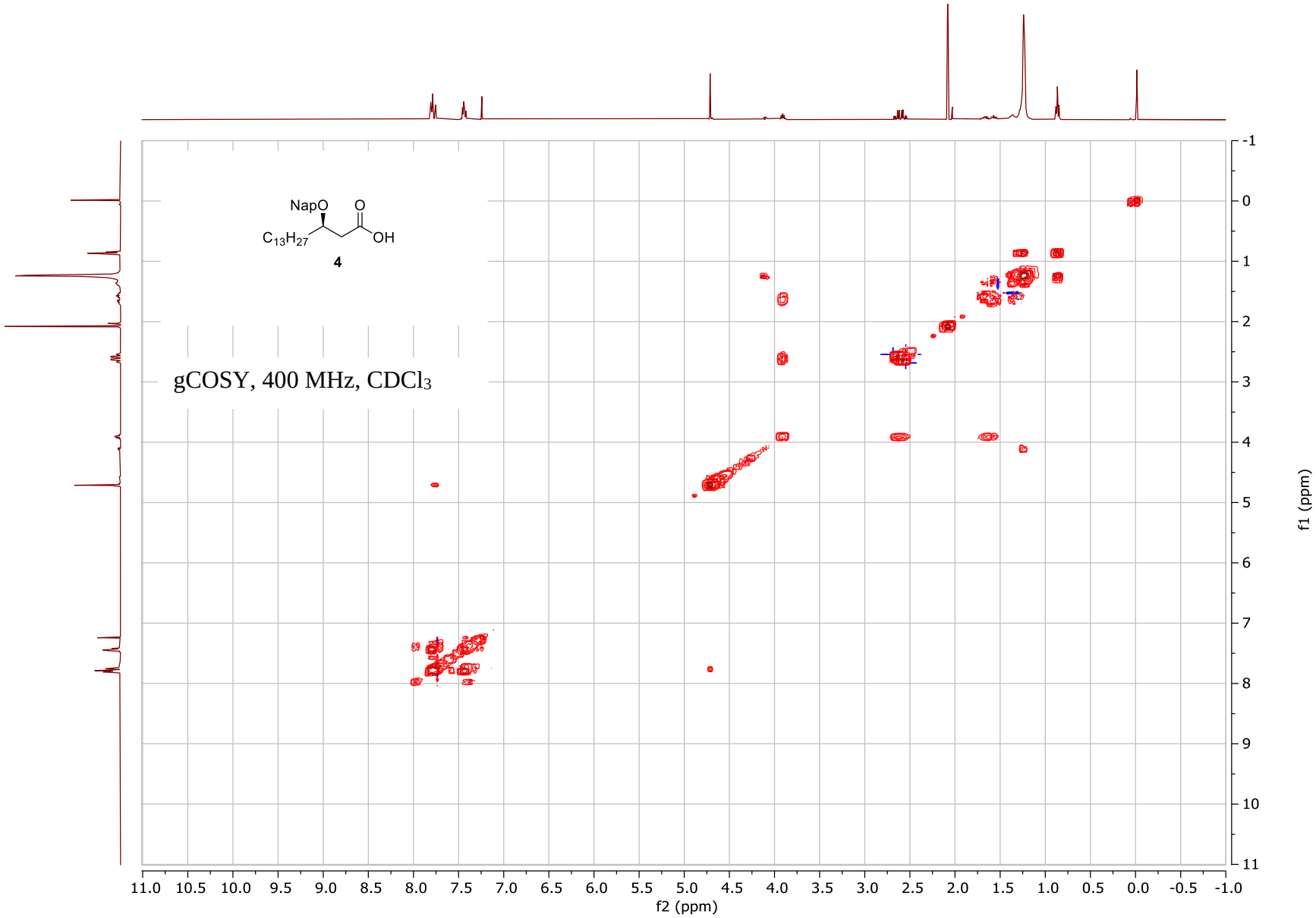

172.3
136.1
133.3
133.0
128.0
127.9
127.6
127.6
126.4
126.0
125.9
125.7
77.3
77.0
76.7
76.1
71.6
51.6
39.8
34.4
31.9
29.7
29.6
29.6
29.6
29.4
25.2
22.7
14.1
NapO
O
$C_{12}H_{25}$
O
20
^{13}C NMR, 101 MHz, $CDCl_3$
f1 (ppm)

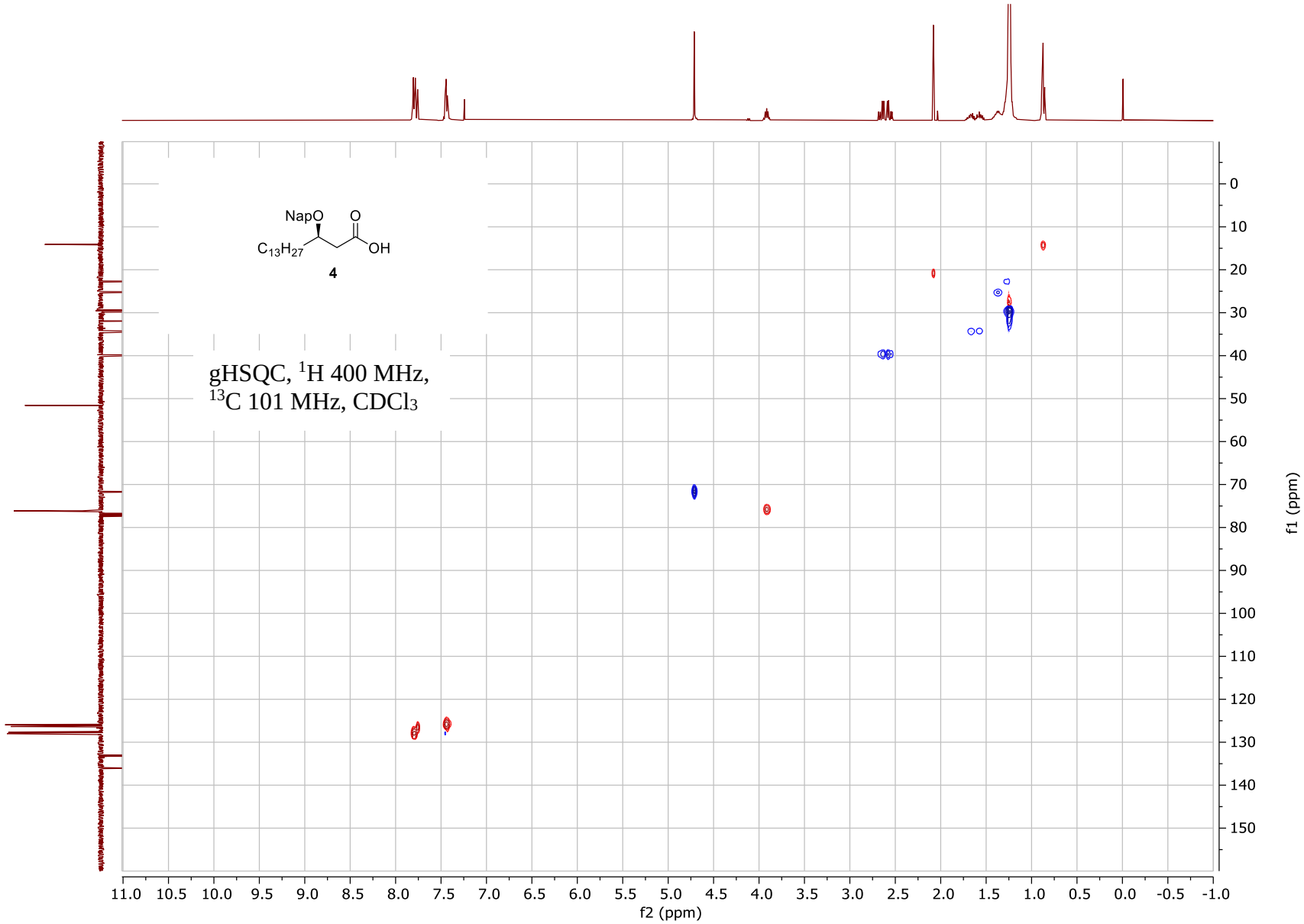

NapO
O
C12H25
O
20
gCOSY, 400 MHz, CDCl3
f2 (ppm)
f1 (ppm)

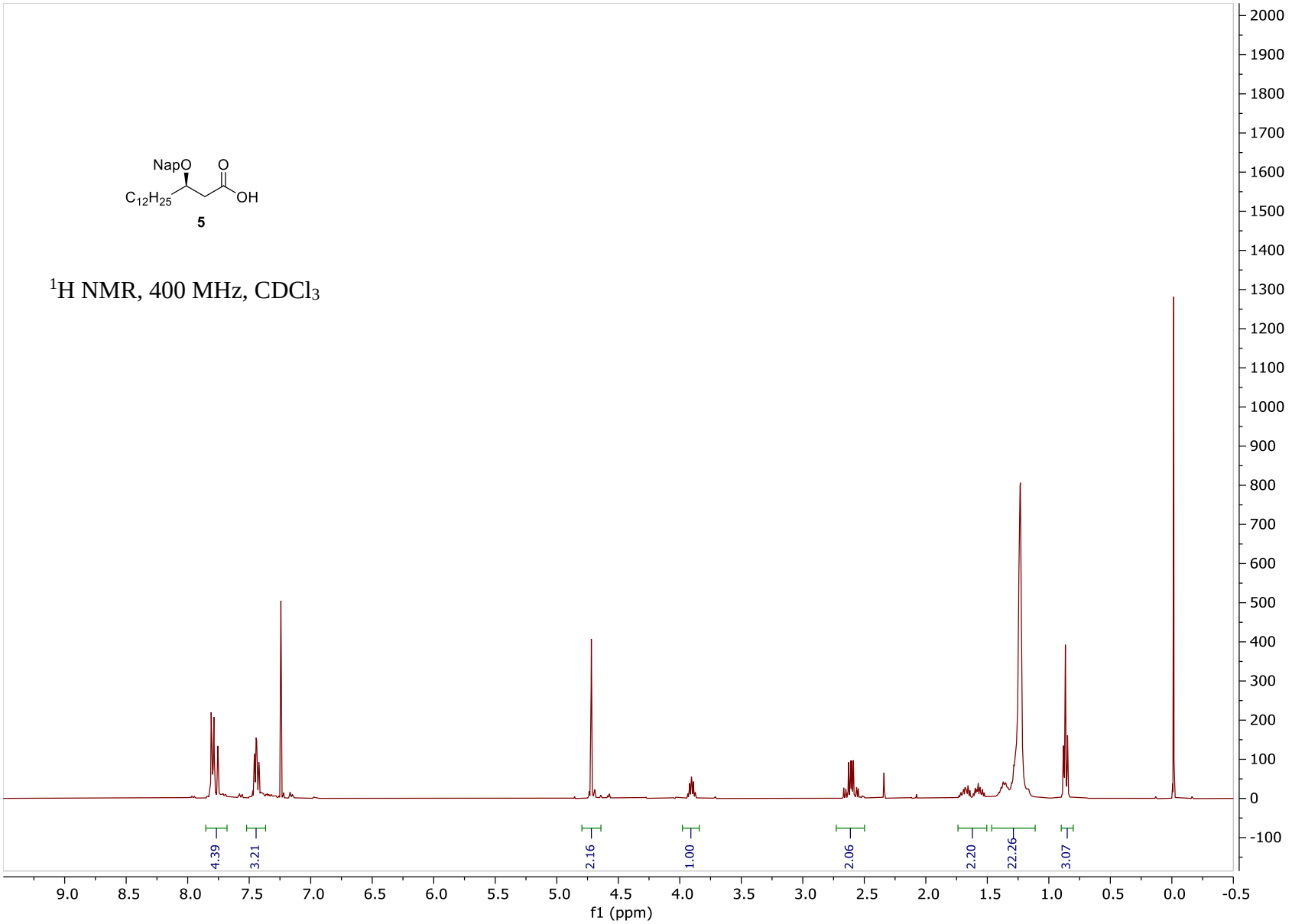

NapO
O
$C_{12}H_{25}$
O
20
gHSQC, ^{1}H 400 MHz,
^{13}C 101 MHz, $CDCl_3$
f2 (ppm)
f1 (ppm)

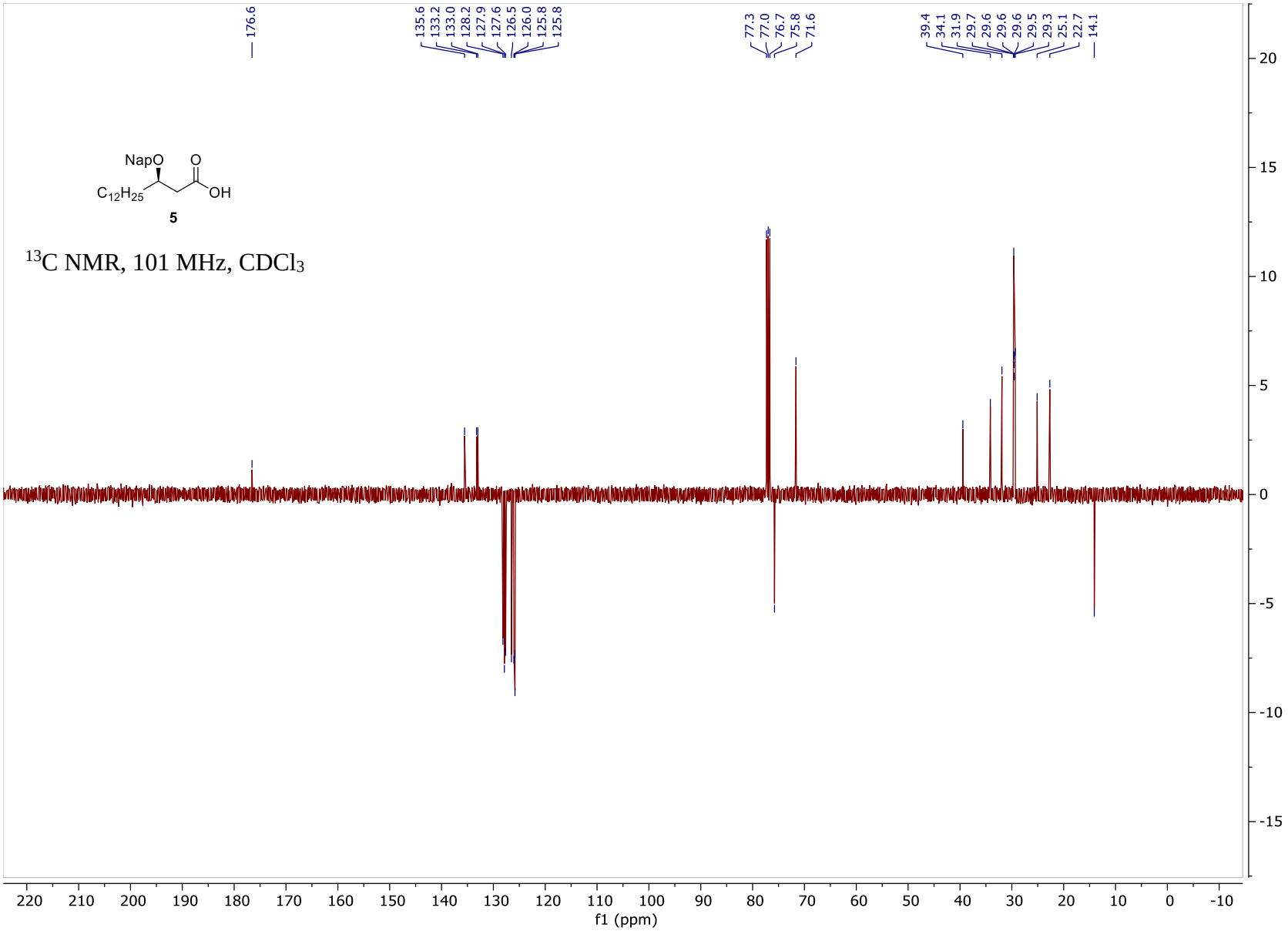

NapO
O
$C_{13}H_{27}$
OH
4
^{1}H NMR, 400 MHz, $CDCl_3$
3.94
2.90
2.07
1.00
0.99
1.02
2.08
23.51
2.96
f1 (ppm)

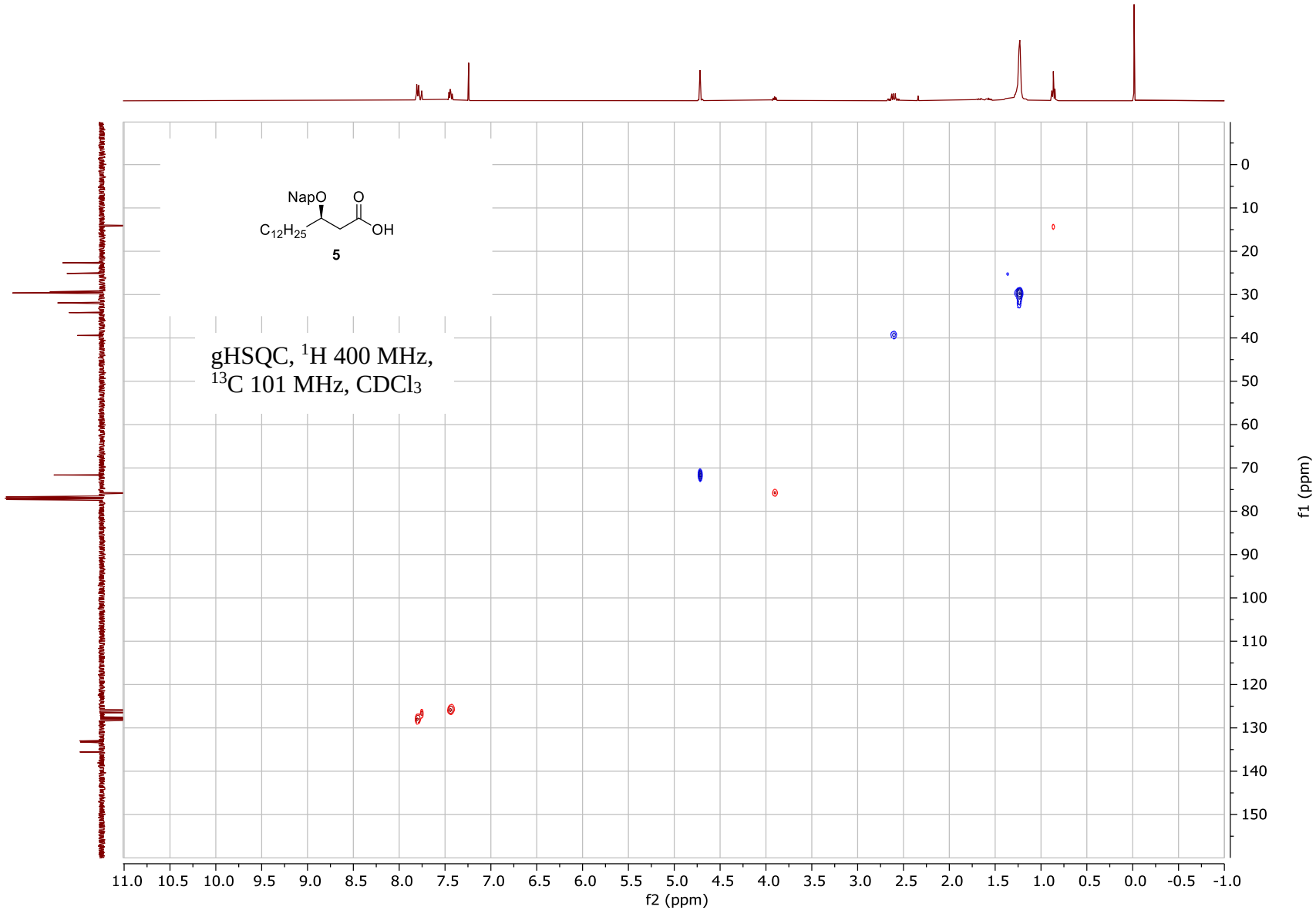

176.7
135.6
133.2
133.0
128.1
127.9
127.6
126.5
126.0
125.8
77.3
77.0
76.7
75.8
71.6
39.4
34.1
31.9
29.6
29.5
29.3
25.1
22.7
20.6
14.1
NapO
O
C13H27
OH
4
13C NMR, 101 MHz, CDCl3
f1 (ppm)

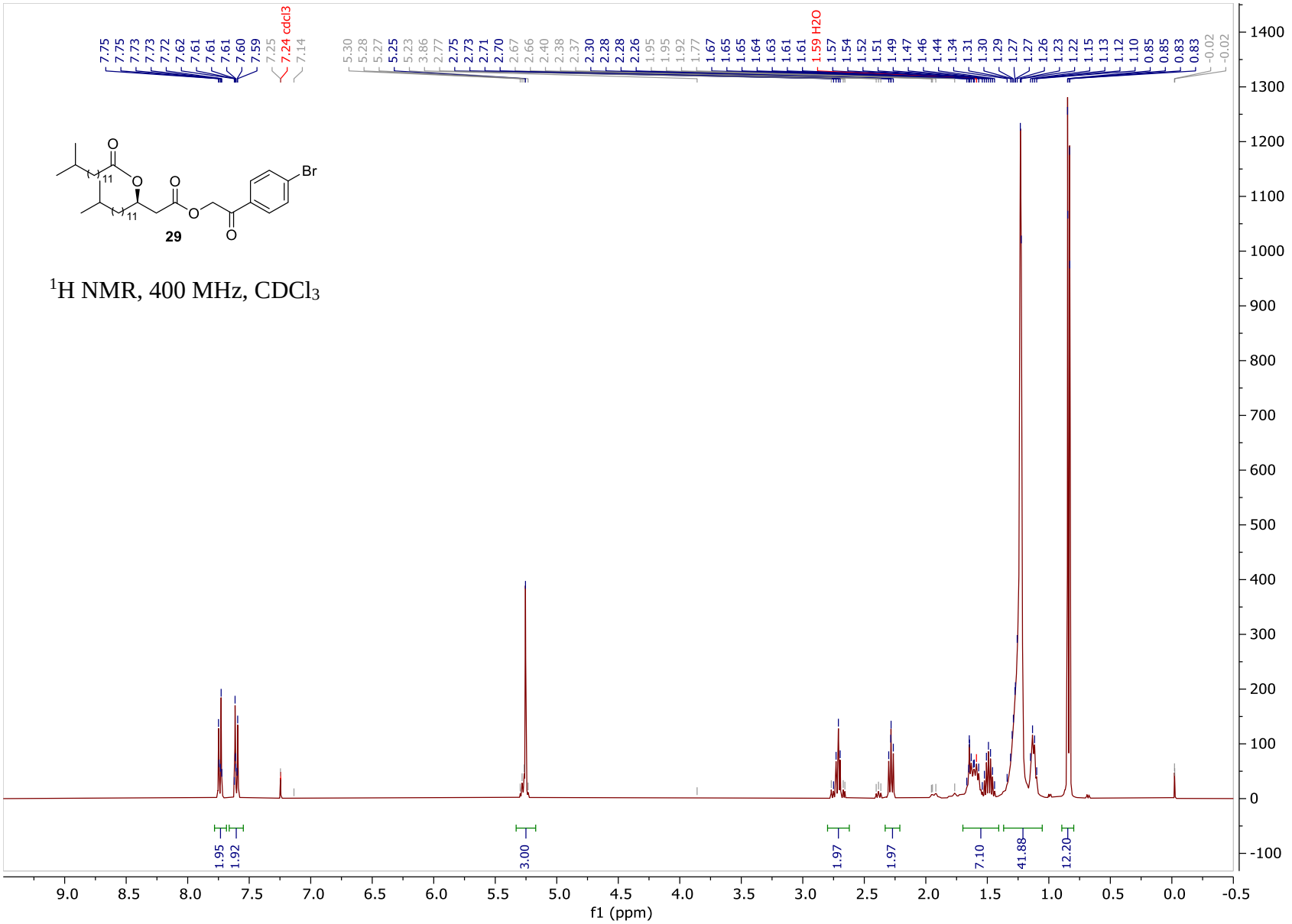

NapO
O
$C_{13}H_{27}$
OH
4
gCOSY, 400 MHz, $CDCl_3$
f2 (ppm)
f1 (ppm)

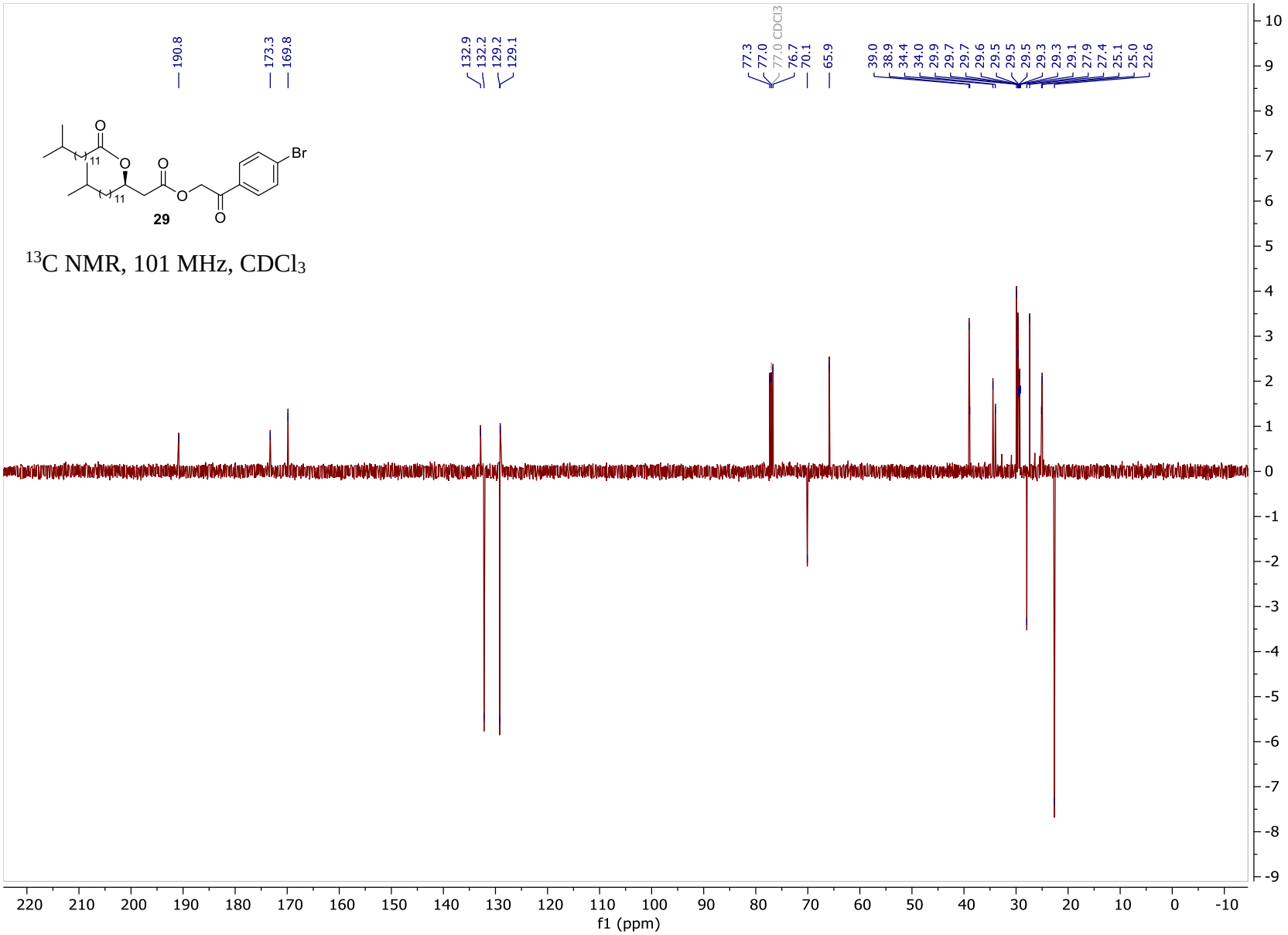

NapO
O
C13H27
OH
4
gHSQC, 1H 400 MHz,
13C 101 MHz, CDCl3
f2 (ppm)
f1 (ppm)

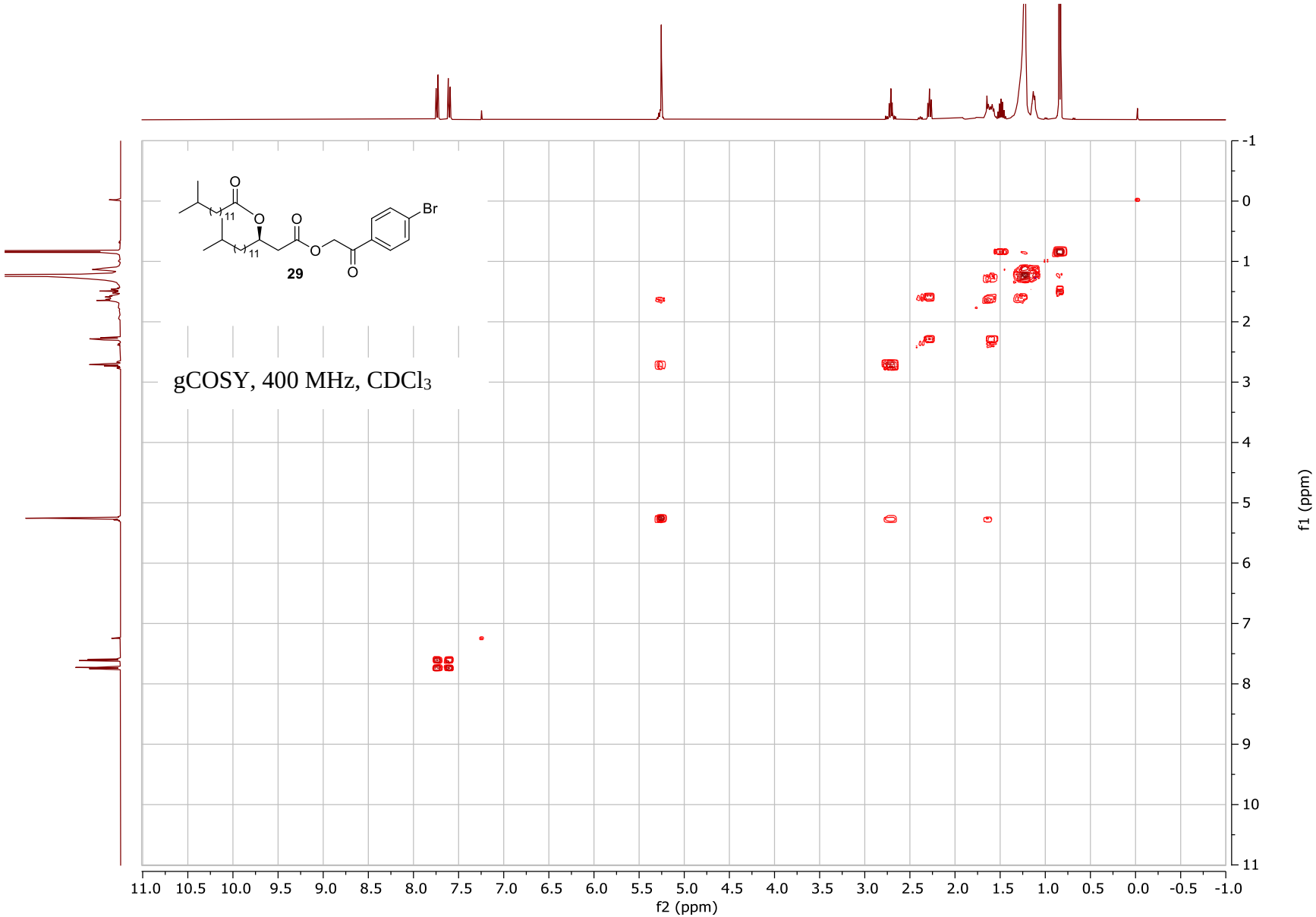

NapO
O
$C_{12}H_{25}$
OH
5
^{1}H NMR, 400 MHz, $CDCl_3$
4.39
3.21
2.16
1.00
2.06
2.20
22.26
3.07
f1 (ppm)

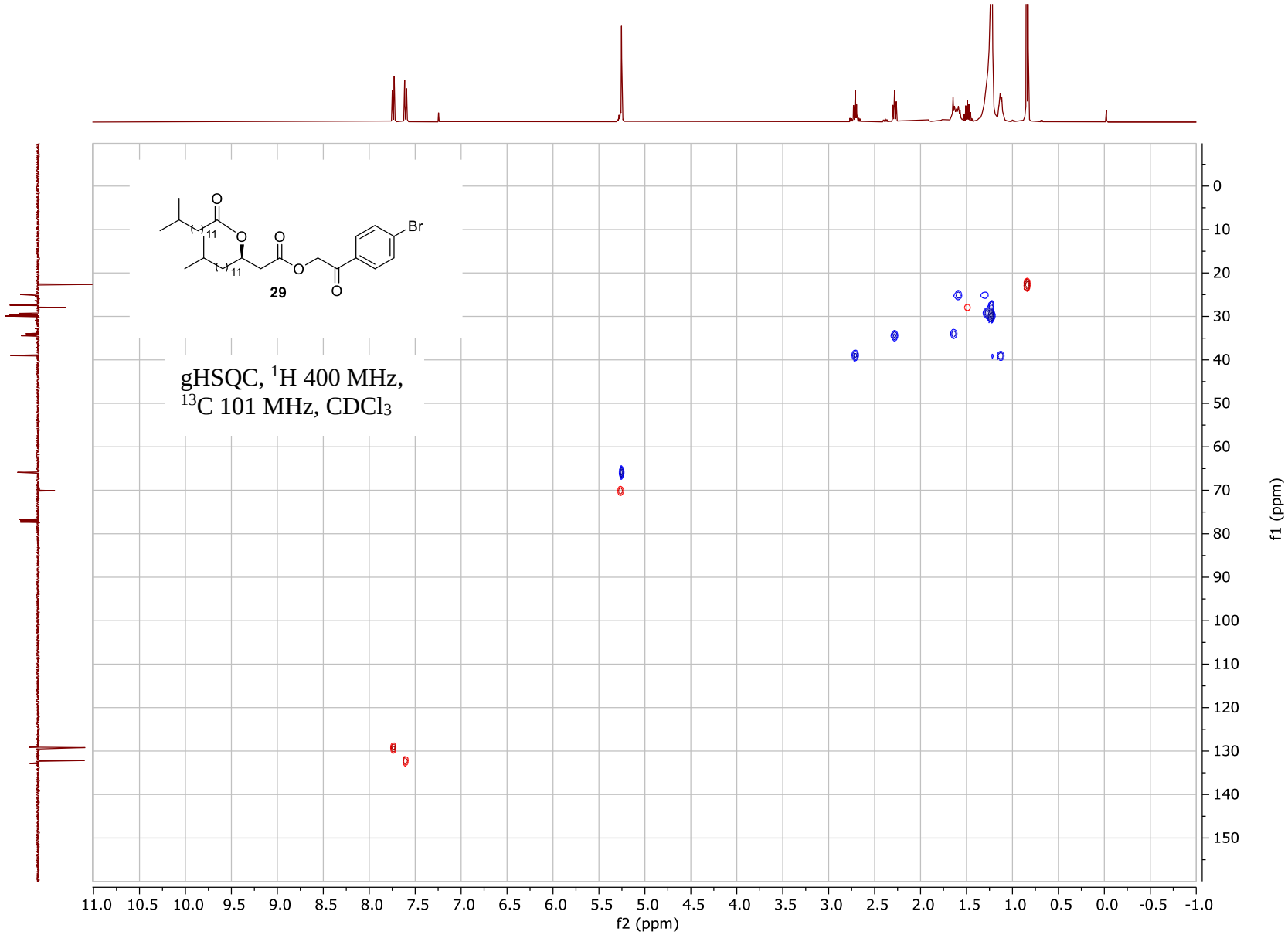

176.6
135.6
133.2
133.0
128.2
127.9
127.6
126.5
126.0
125.8
125.8
77.3
77.0
76.7
75.8
71.6
39.4
34.1
31.9
29.7
29.6
29.6
29.6
29.5
29.3
25.1
22.7
14.1
NapO
O
C12H25
OH
5
13C NMR, 101 MHz, CDCl3
20
15
10
5
0
-5
-10
-15
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

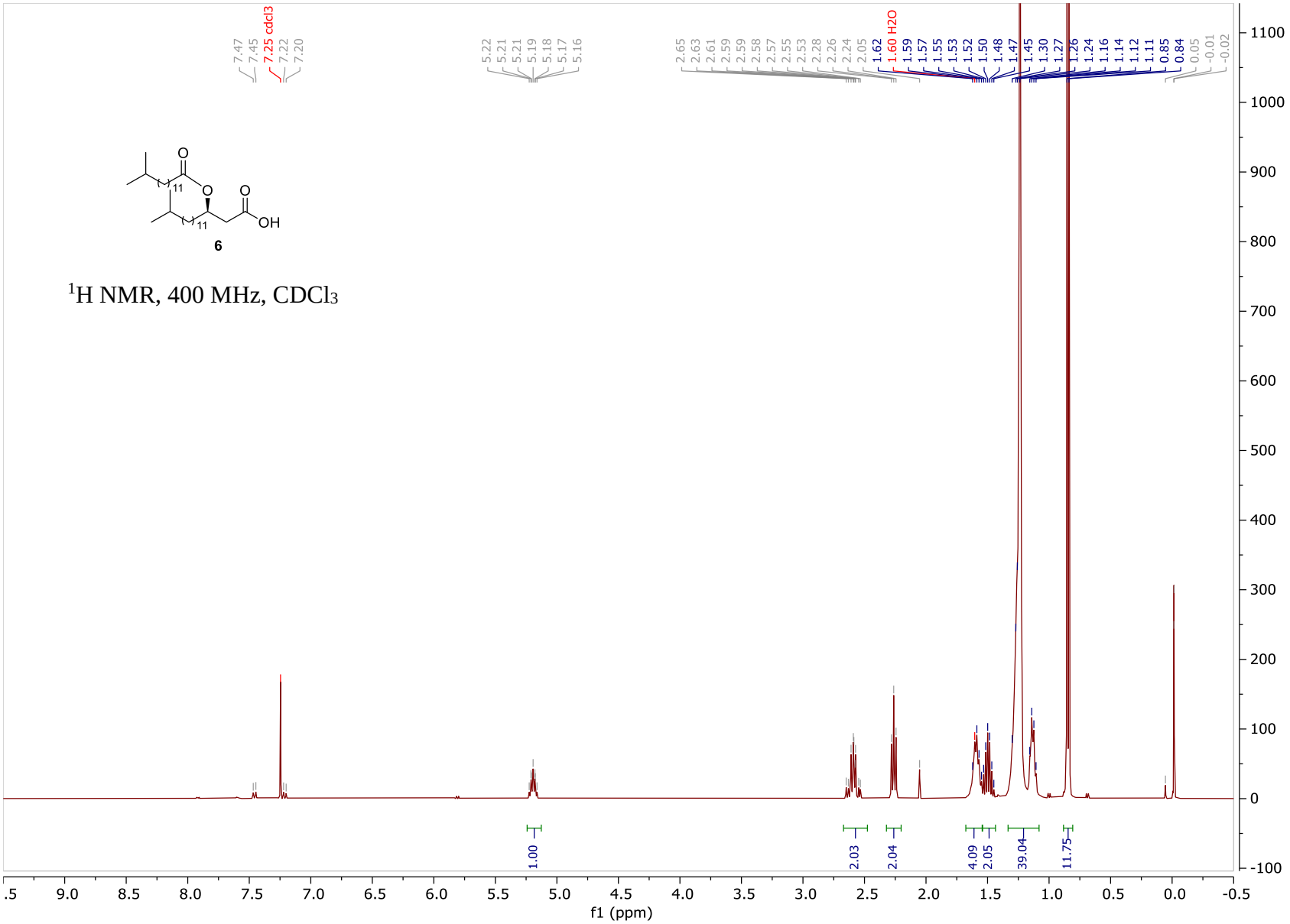

NapO
O
$C_{12}H_{25}$
OH
5
gHSQC, ^{1}H 400 MHz,
^{13}C 101 MHz, $CDCl_3$
f2 (ppm)
f1 (ppm)


7.75 7.75 7.73 7.73 7.72 7.62 7.61 7.61 7.61 7.60 7.59 7.25 7.24 cdcl3 7.14
5.30 5.28 5.27 5.25 5.23 3.86 2.77 2.75 2.73 2.71 2.70 2.67 2.66 2.40 2.38 2.37 2.30 2.28 2.28 2.26 1.95 1.95 1.92 1.77 1.67 1.65 1.65 1.64 1.63 1.61 1.61 1.59 H2O 1.57 1.54 1.52 1.51 1.49 1.47 1.46 1.44 1.34 1.31 1.30 1.29 1.27 1.27 1.26 1.23 1.22 1.15 1.13 1.12 1.10 0.85 0.85 0.83 0.83 -0.02 -0.02
Br
29
1H NMR, 400 MHz, CDCl3
1.95 1.92 3.00 1.97 1.97 7.10 41.88 12.20
f1 (ppm)

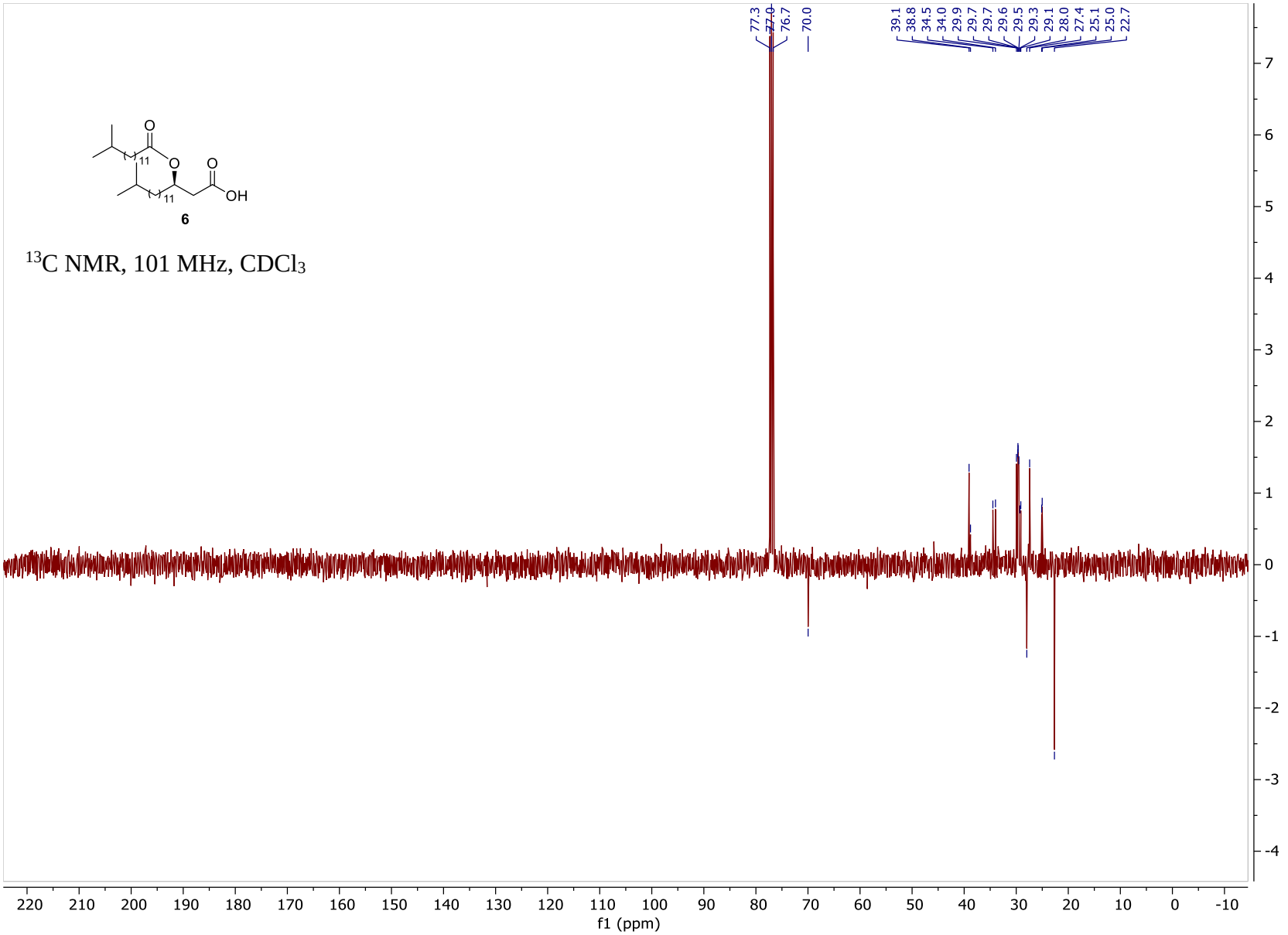

190.8
173.3
169.8
132.9
132.2
129.2
129.1
77.3
77.0
77.0 CDCl3
76.7
70.1
65.9
39.0
38.9
34.4
34.0
29.9
29.7
29.7
29.6
29.5
29.5
29.5
29.3
29.3
29.1
27.9
27.4
25.1
25.0
22.6
Br
29
13C NMR, 101 MHz, CDCl3
f1 (ppm)

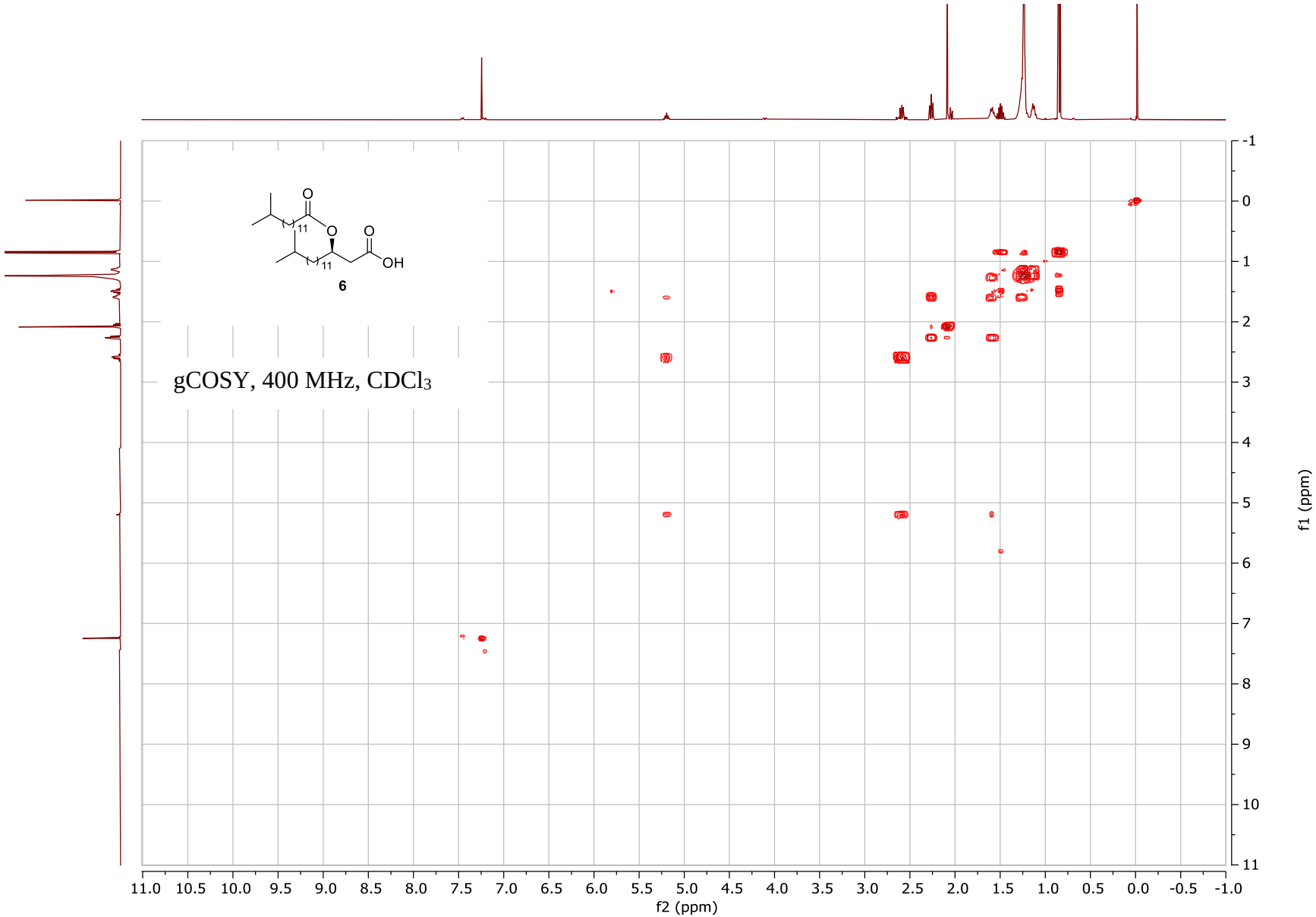

29
gCOSY, 400 MHz, CDCl3
f2 (ppm)
f1 (ppm)

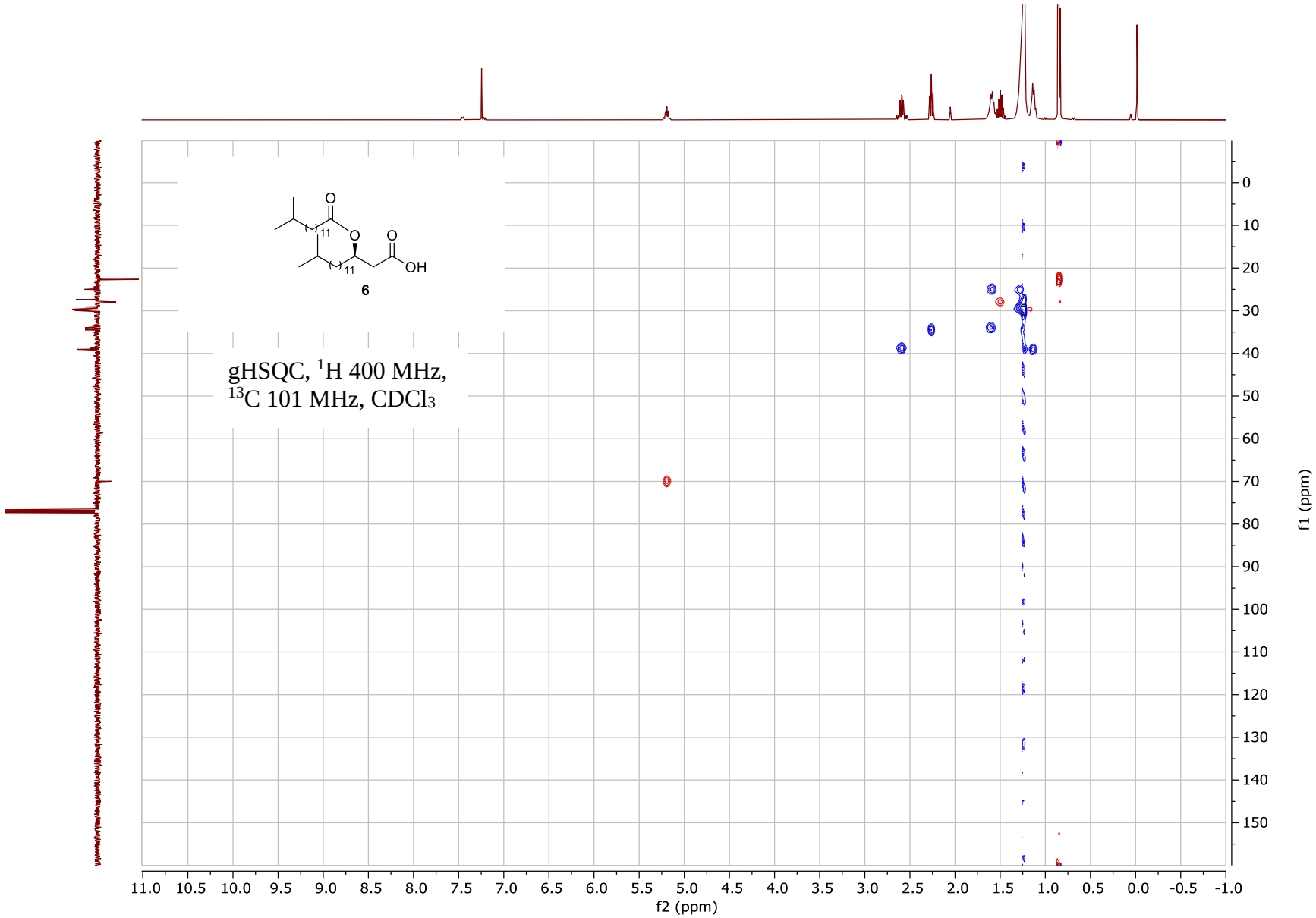

29
gHSQC, ^{1}H 400 MHz,
^{13}C 101 MHz, CDCl$_3$
f2 (ppm)
f1 (ppm)

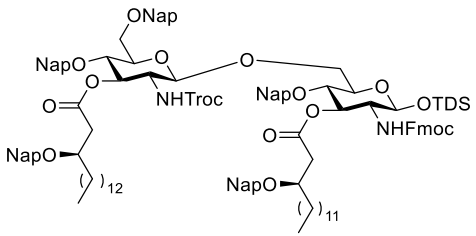


^{1}H NMR, 400 MHz, $CDCl_3$


77.3
77.0
76.7
70.0
39.1
38.8
34.5
34.0
29.9
29.7
29.7
29.6
29.5
29.3
29.1
28.0
27.4
25.1
25.0
22.7
O
O
O
OH
11
11
6
^{13}C NMR, 101 MHz, $CDCl_3$
f1 (ppm)

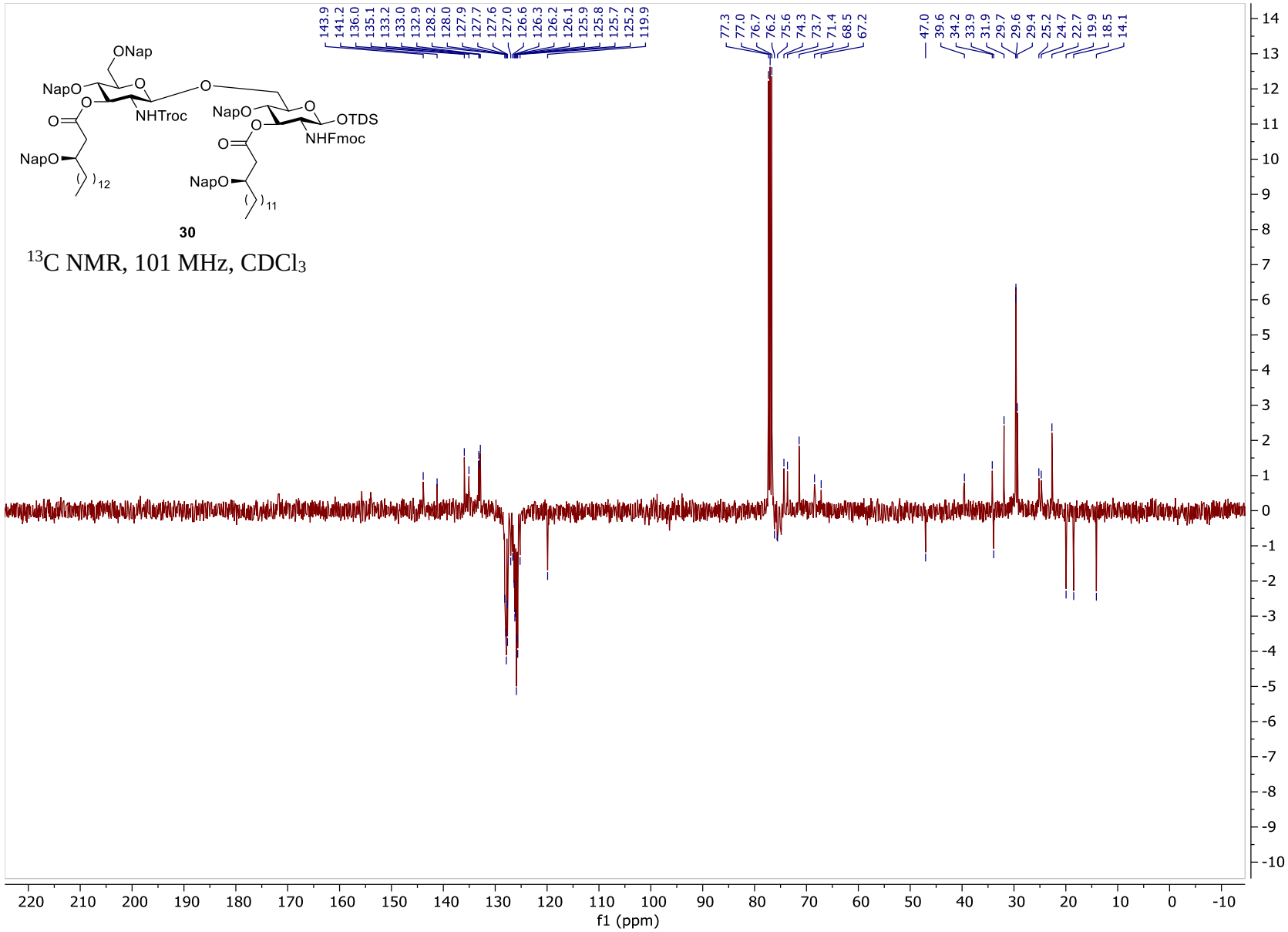

O
11
O
O
OH
11
6
gCOSY, 400 MHz, CDCl3
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f2 (ppm)
-1 0 1 2 3 4 5 6 7 8 9 10 11
f1 (ppm)

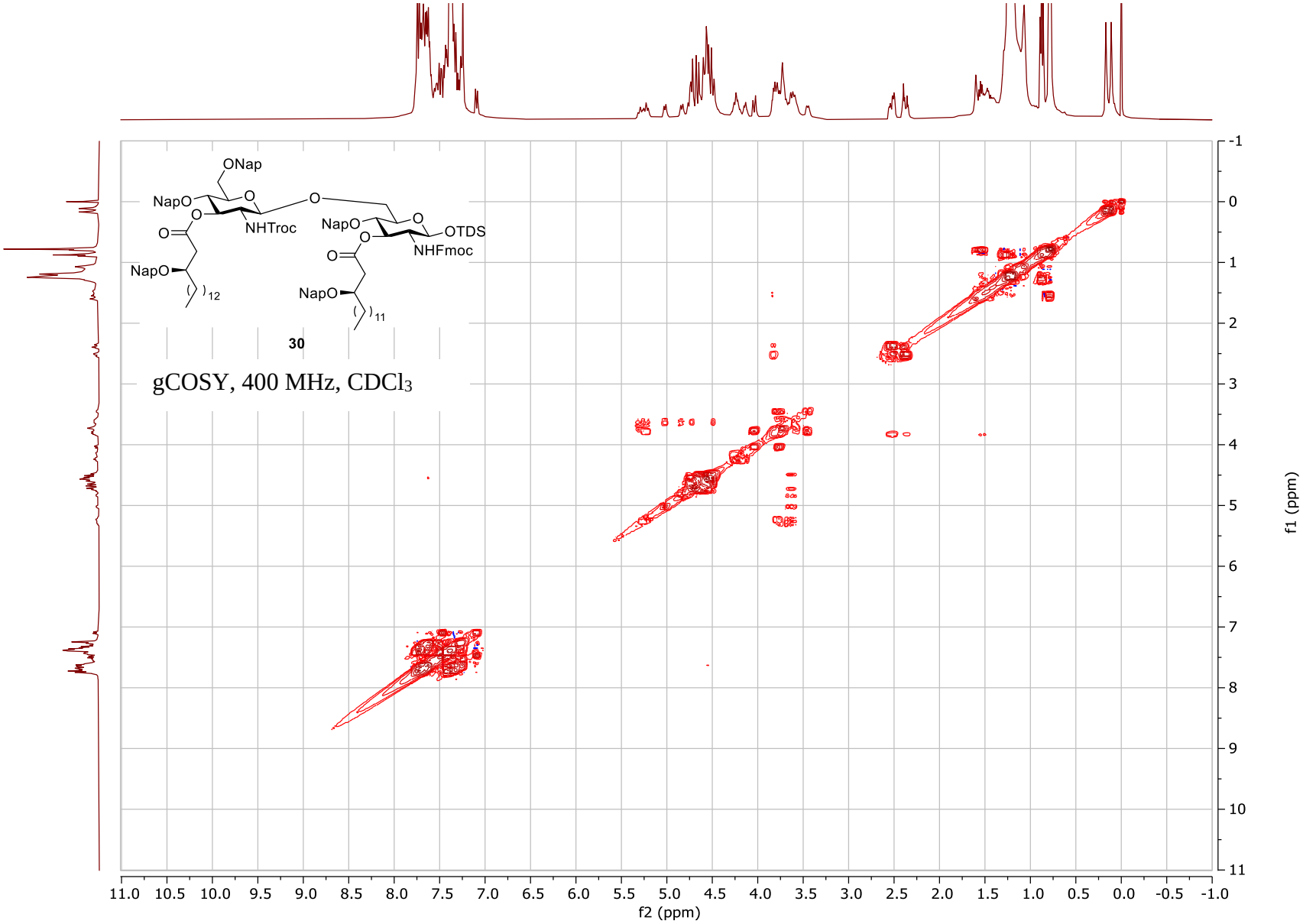

O
O
O
OH
11
11
6
gHSQC, ^{1}H 400 MHz,
^{13}C 101 MHz, $CDCl_3$
f2 (ppm)
f1 (ppm)

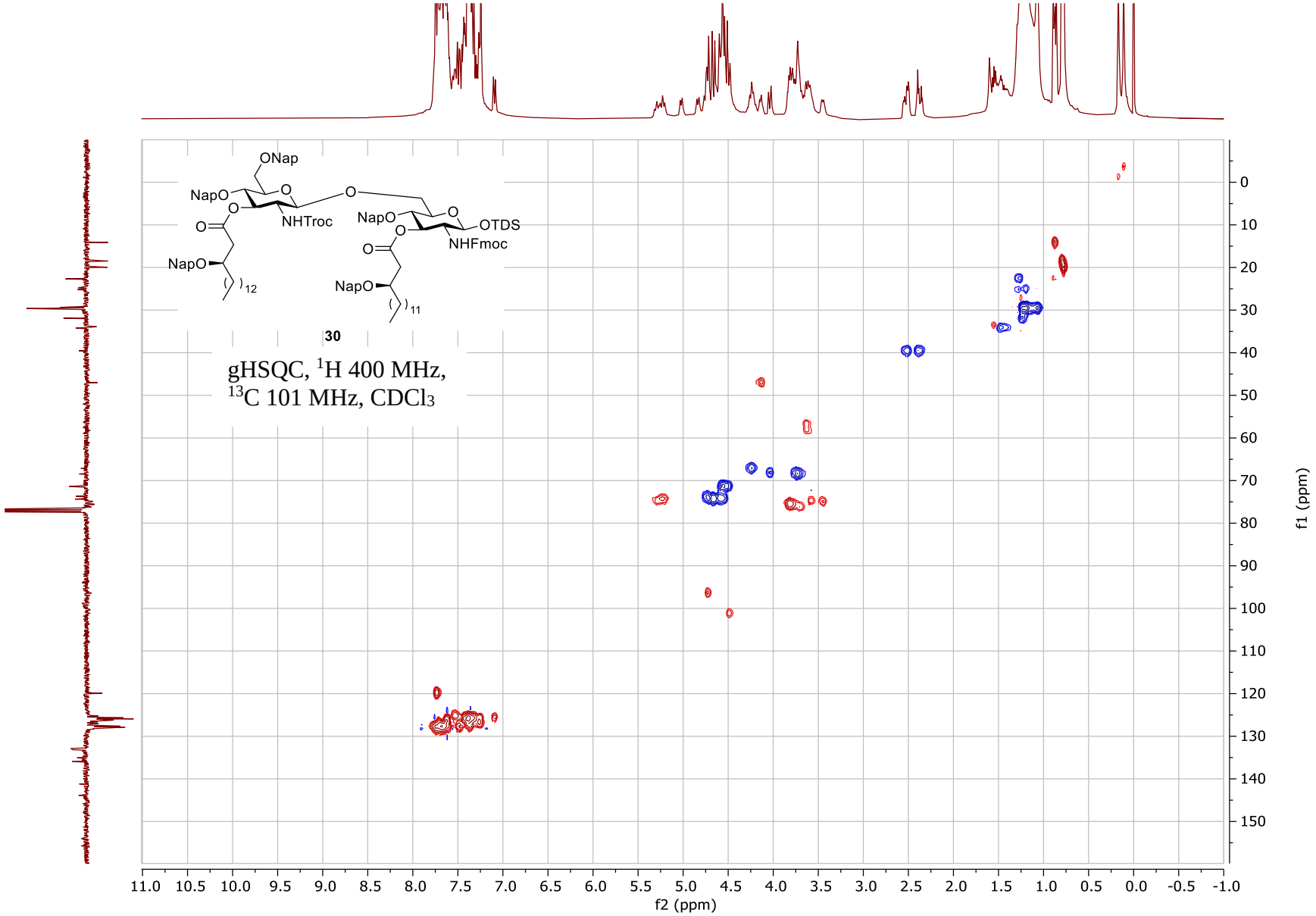


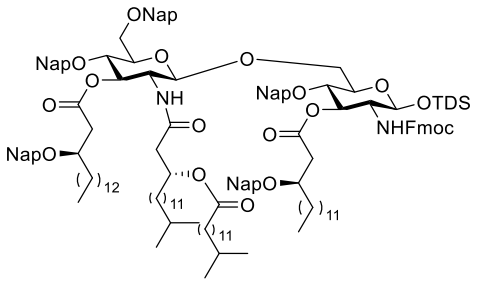
30

^{1}H NMR, 400 MHz, $CDCl_3$


ONap
NapO
O
NHTroc
O
NapO
12
O
NapO
O
OTDS
NHFmoc
O
NapO
11
30
13C NMR, 101 MHz, CDCl3
143.9
141.2
136.0
135.1
133.2
133.0
132.9
128.2
128.0
127.9
127.7
127.6
127.0
126.6
126.3
126.2
126.1
125.9
125.8
125.7
125.2
119.9
77.3
77.0
76.7
76.2
75.6
74.3
73.7
71.4
68.5
67.2
47.0
39.6
34.2
33.9
31.9
29.7
29.6
29.4
25.2
24.7
22.7
19.9
18.5
14.1
f1 (ppm)

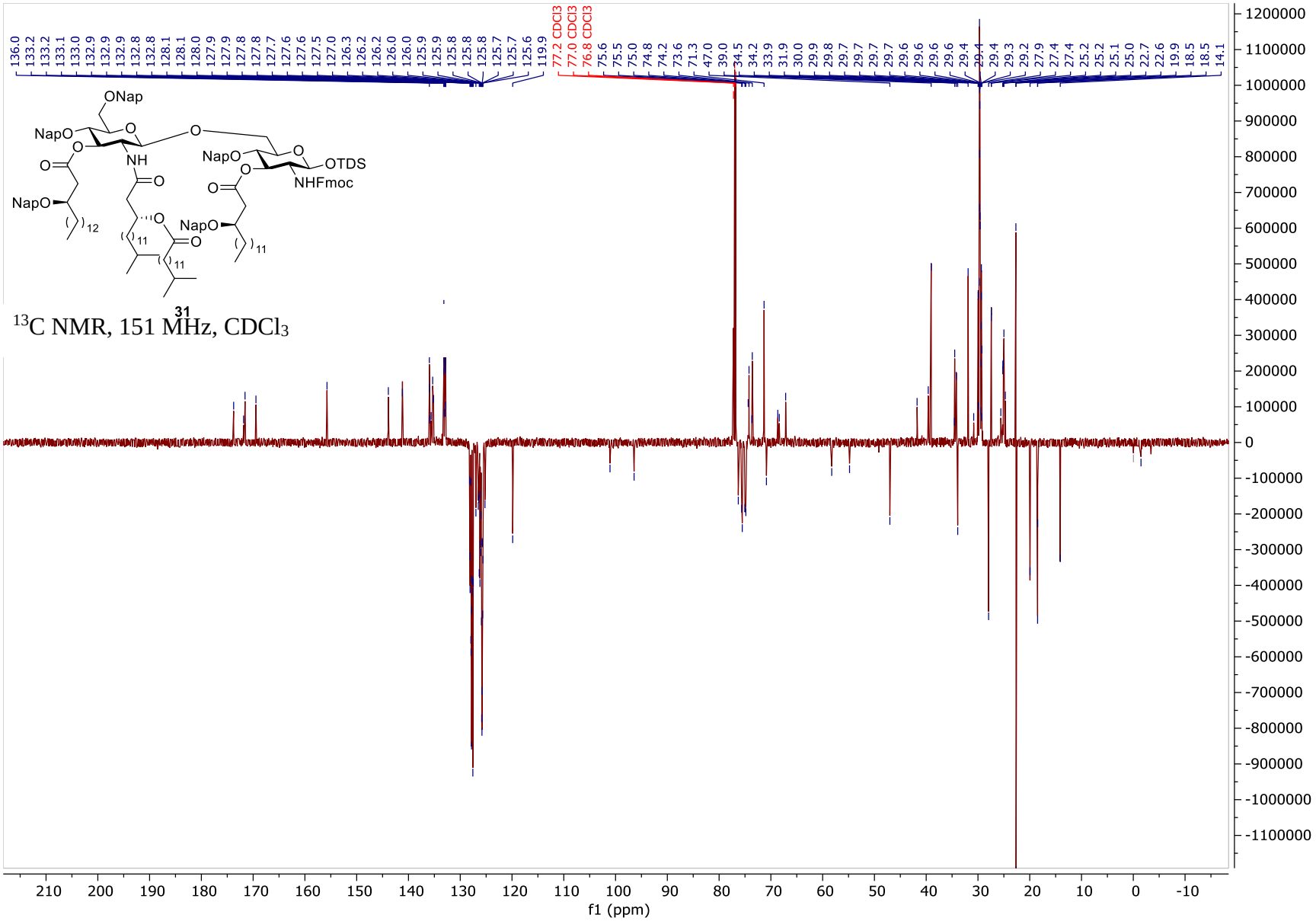

ONap
NapO
O
NHTroc
NapO
O
NapO
12
NapO
O
OTDS
NHFmoc
O
NapO
11
30
gCOSY, 400 MHz, CDCl3
f2 (ppm)
f1 (ppm)


ONap
NapO
O
NHTroc
NapO
O
NapO
12
O
NapO
O
OTDS
NHFmoc
NapO
11
30
gHSQC, ^{1}H 400 MHz,
^{13}C 101 MHz, $CDCl_3$
f2 (ppm)
f1 (ppm)



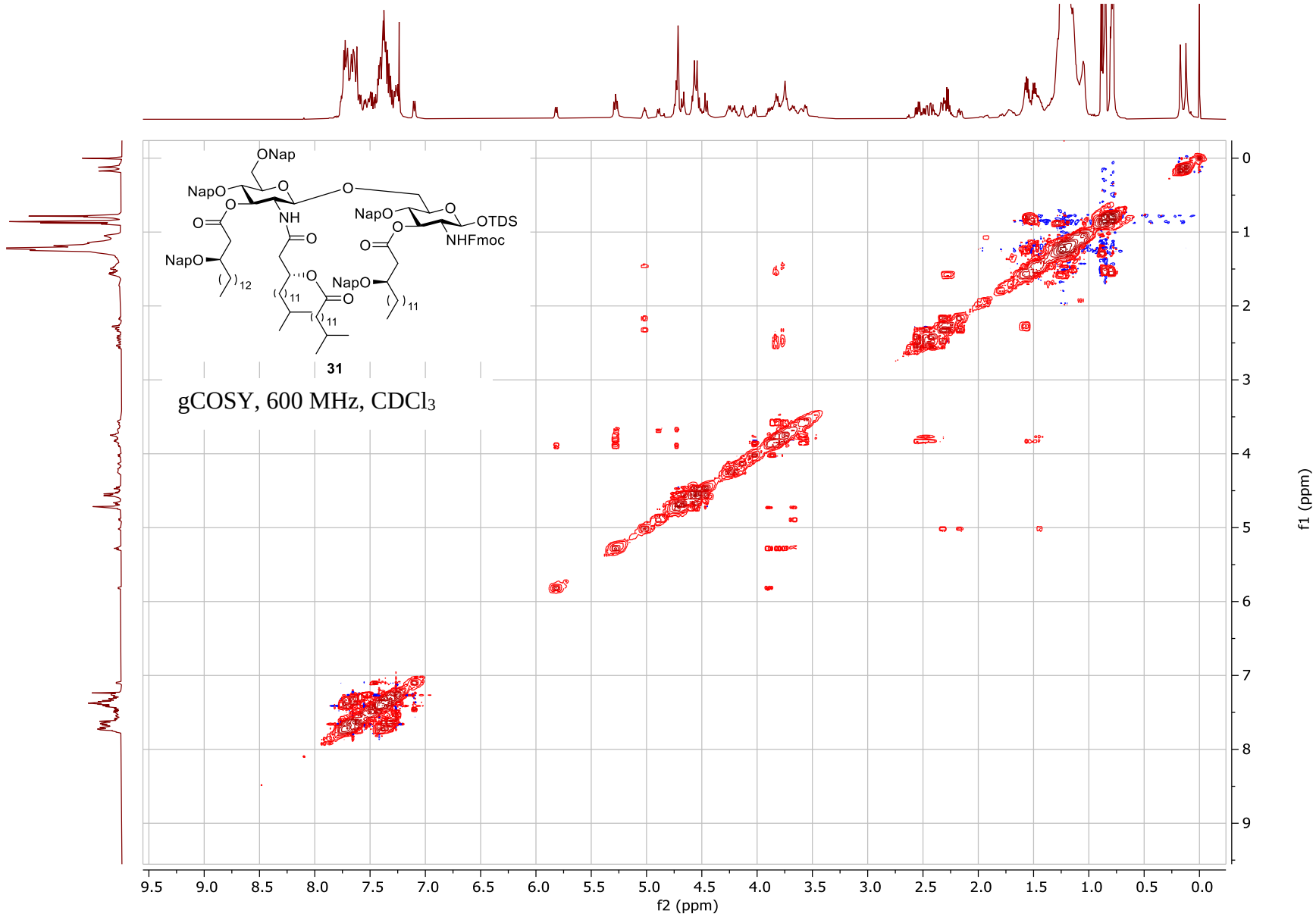
31

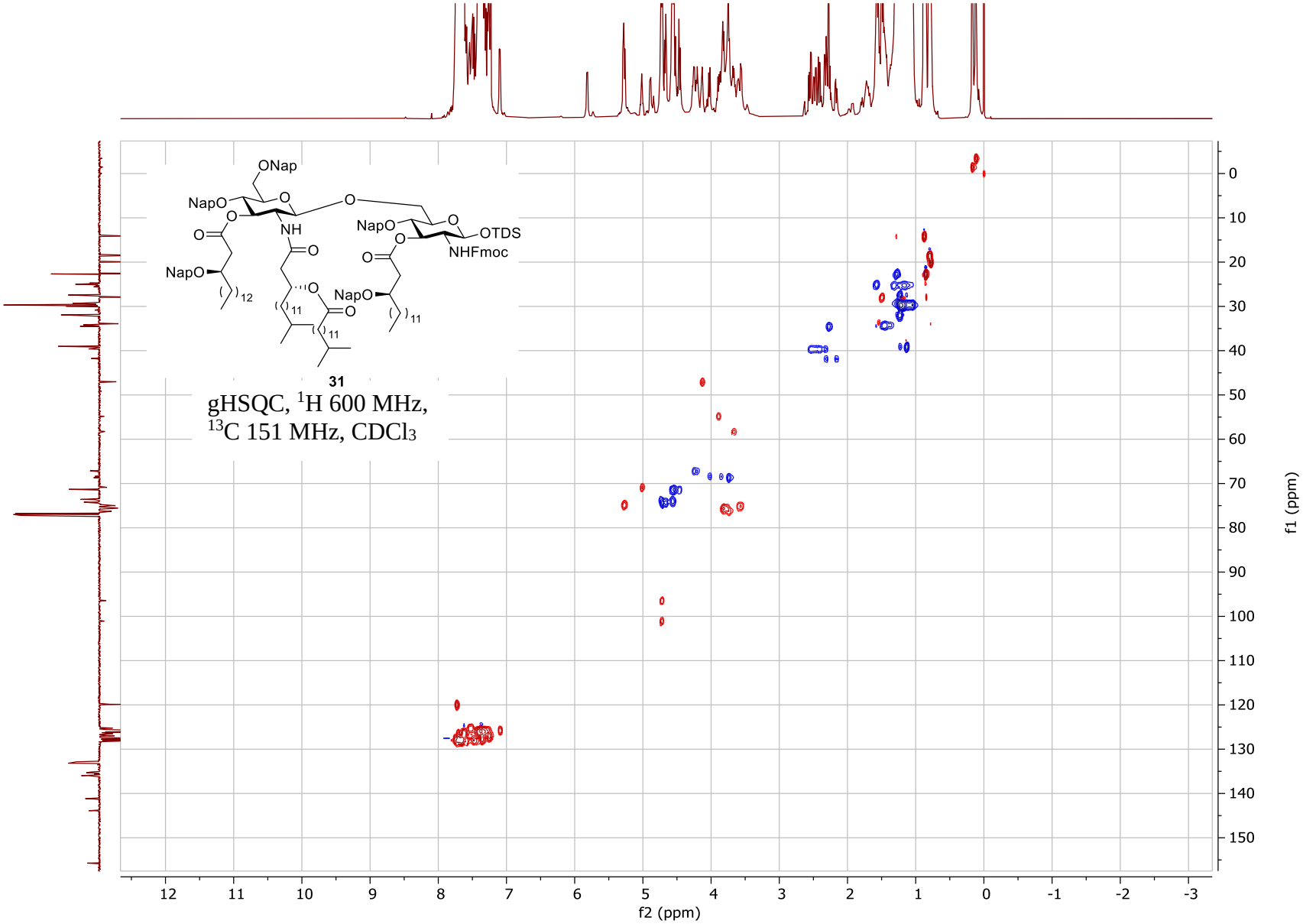
^{1}H NMR, 600 MHz, $CDCl_3$

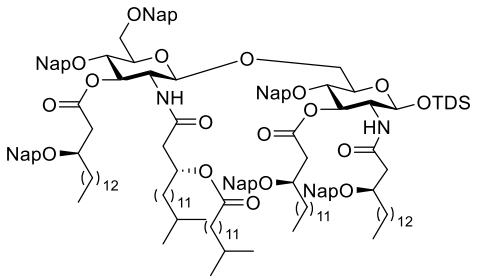


31

^{13}C NMR, 151 MHz, $CDCl_3$

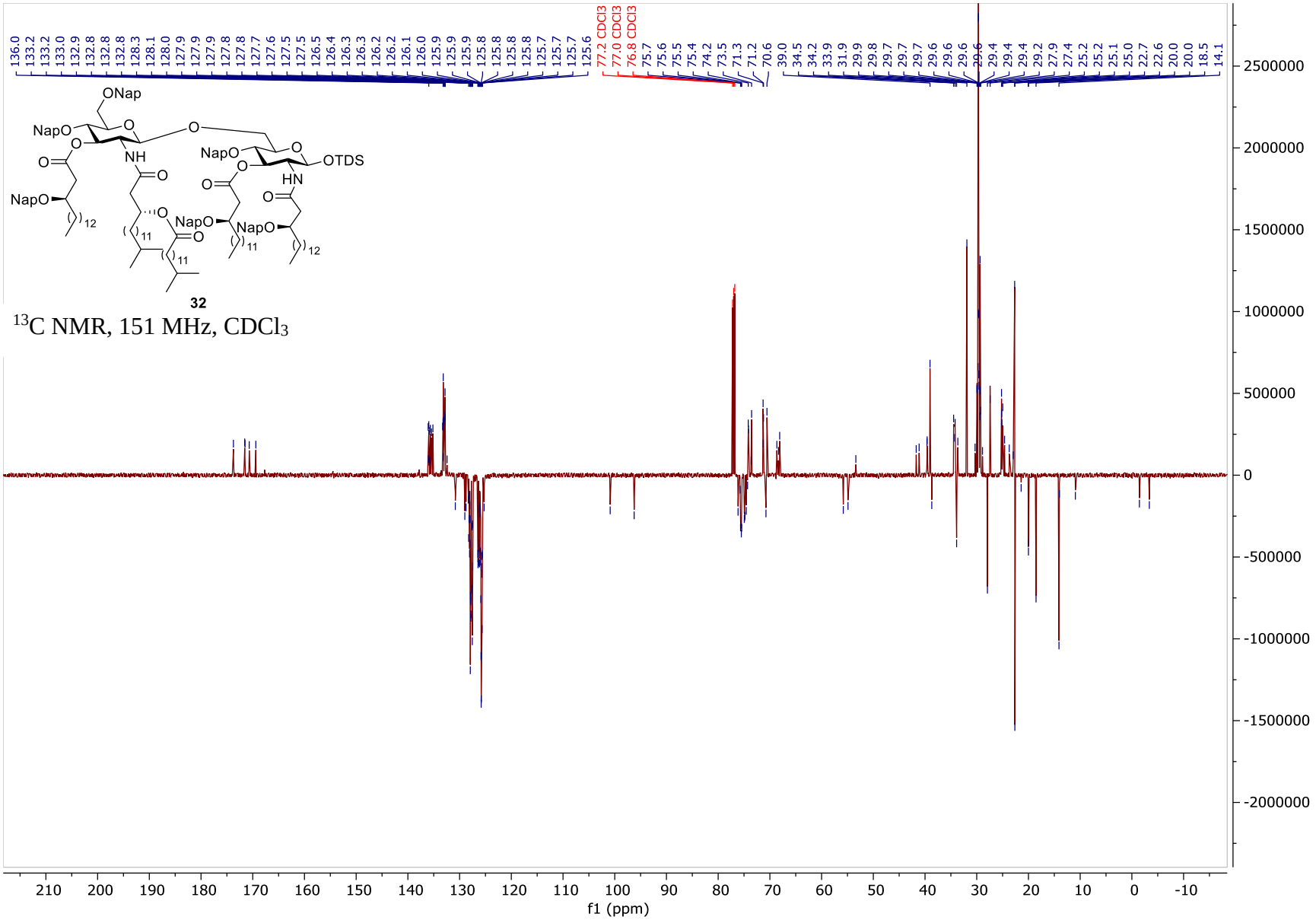

ONap
NapO
O
NH
NapO
OTDS
NHFmoc
NapO
12
11
11
NapO
11
31
gCOSY, 600 MHz, CDCl3
f2 (ppm)
f1 (ppm)

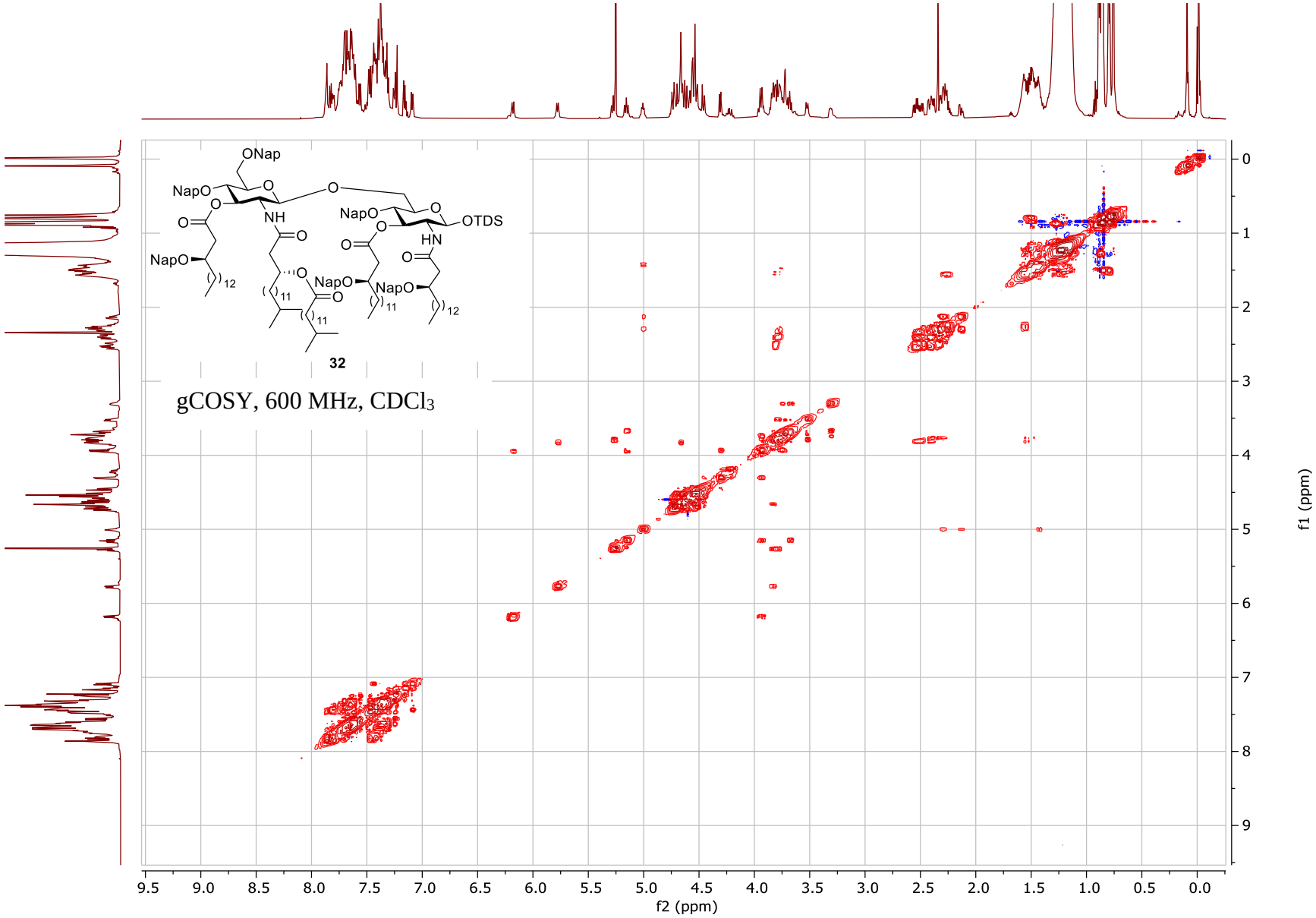

ONap
NapO
O
NH
O
NapO
O
O
NapO
O
O
NapO
O
OTDS
NHFmoc
NapO
12
11
11
11
31
gHSQC, ^{1}H 600 MHz,
^{13}C 151 MHz, $CDCl_3$
f2 (ppm)
f1 (ppm)

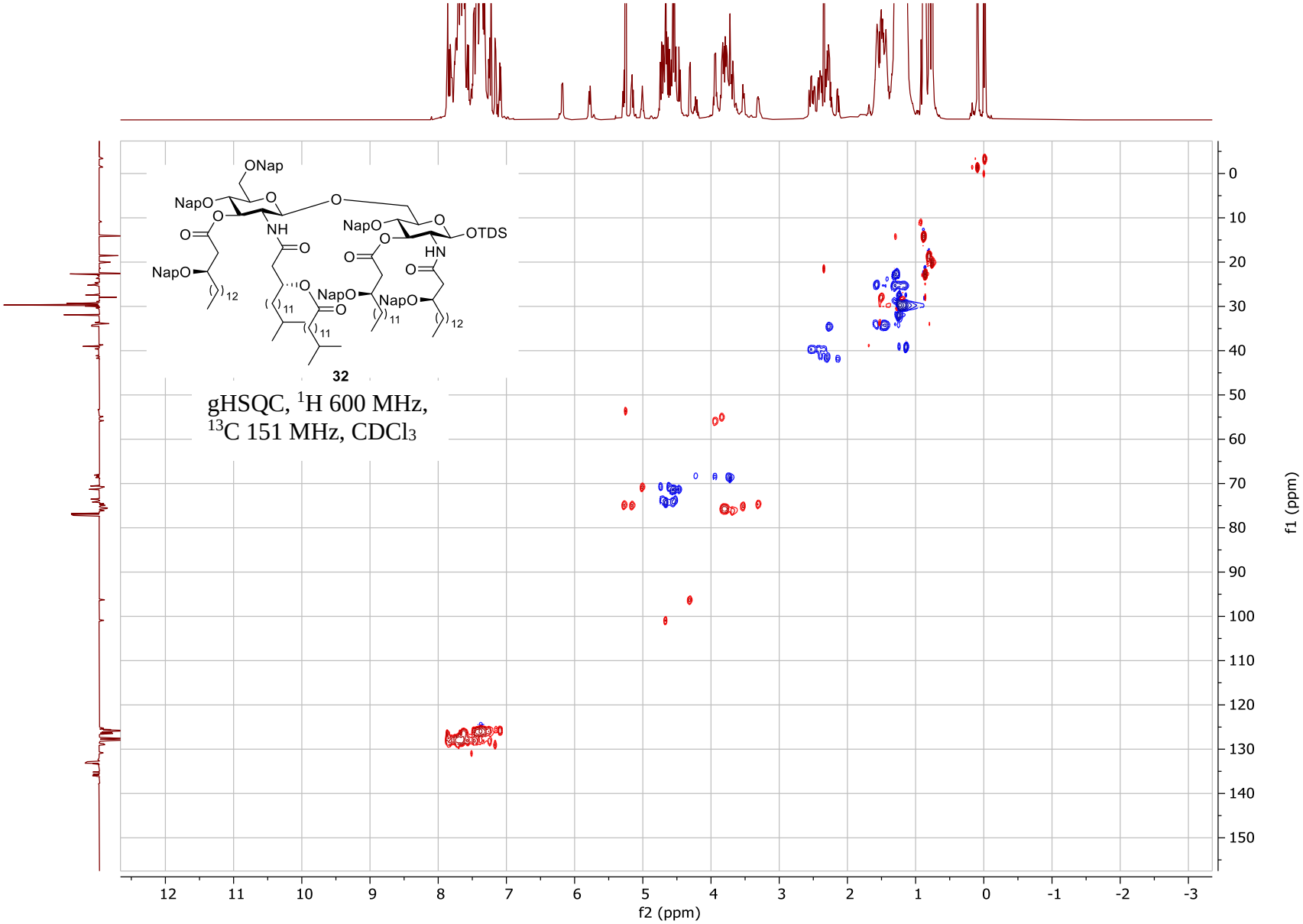


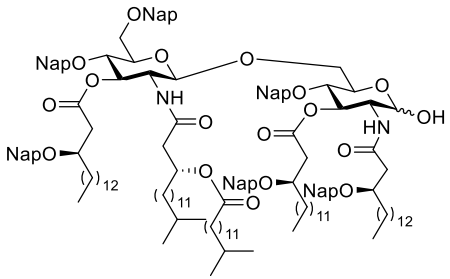
32

^{1}H NMR, 600 MHz, $CDCl_3$


ONap
NapO
O
NH
O
NapO
O
OTDS
HN
NapO
NapO
NapO
11
12
32
13C NMR, 151 MHz, CDCl3
77.2 CDCl3
77.0 CDCl3
76.8 CDCl3
2500000
2000000
1500000
1000000
500000
0
-500000
-1000000
-1500000
-2000000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

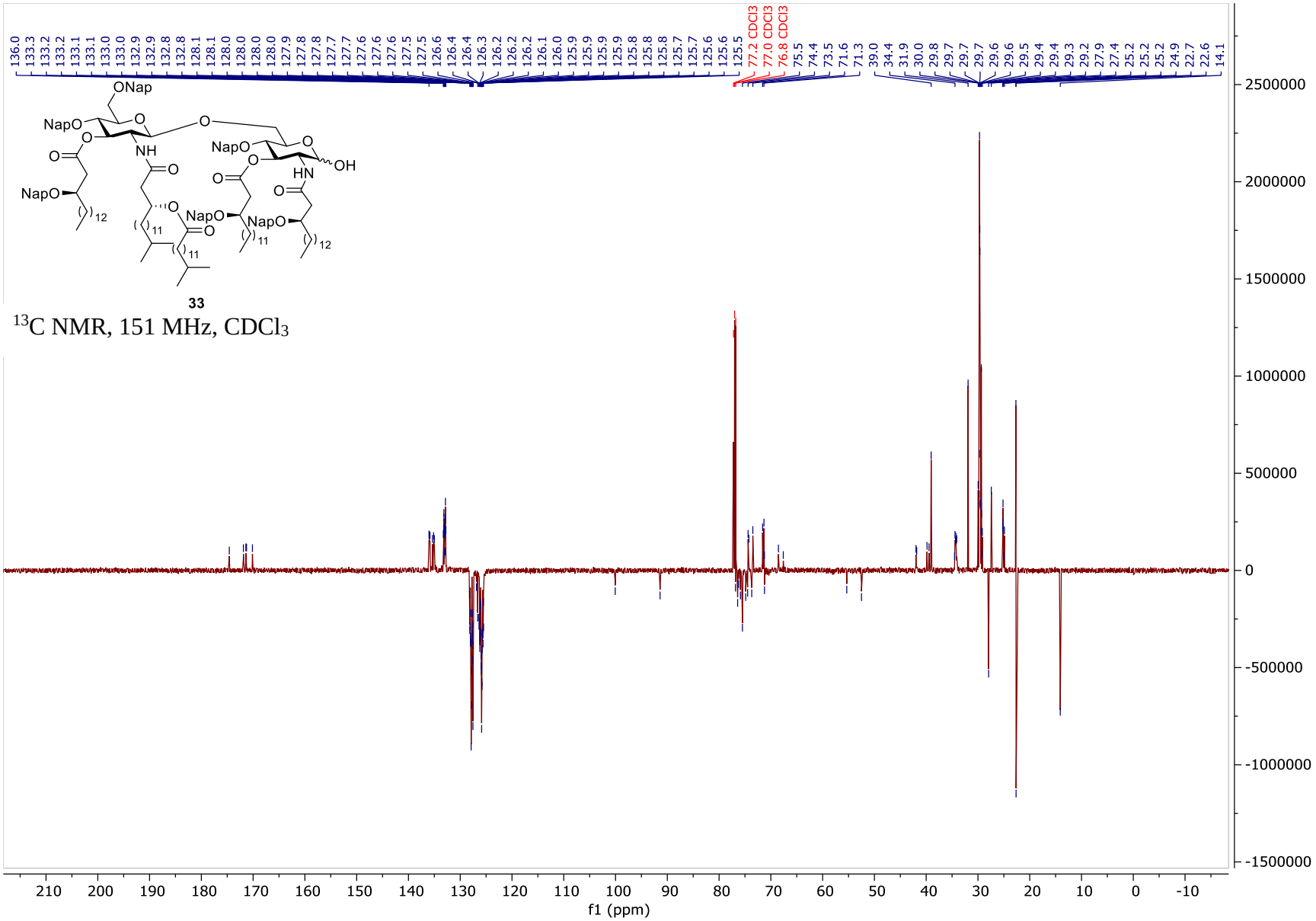

ONap
NapO
O
NH
NapO
12
11
11
NapO
NapO
O
HN
OTDS
NapO
11
12
32
gCOSY, 600 MHz, CDCl3
f2 (ppm)
f1 (ppm)

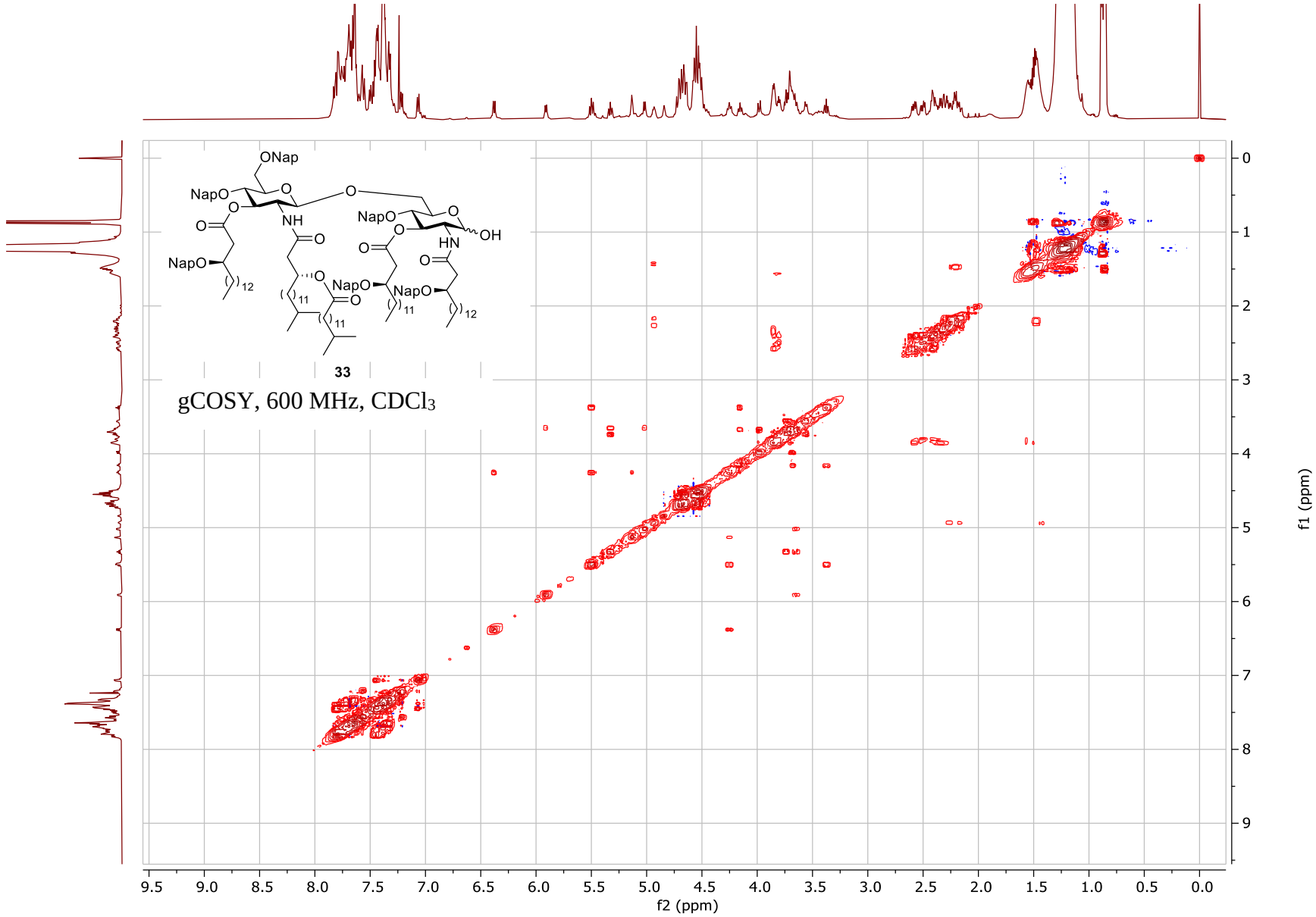

ONap
NapO
O
NH
O
NapO
12
11
NapO
O
11
NapO
O
NapO
O
OTDS
HN
O
NapO
11
12
32
gHSQC, ^{1}H 600 MHz,
^{13}C 151 MHz, CDCl$_3$
f2 (ppm)
f1 (ppm)

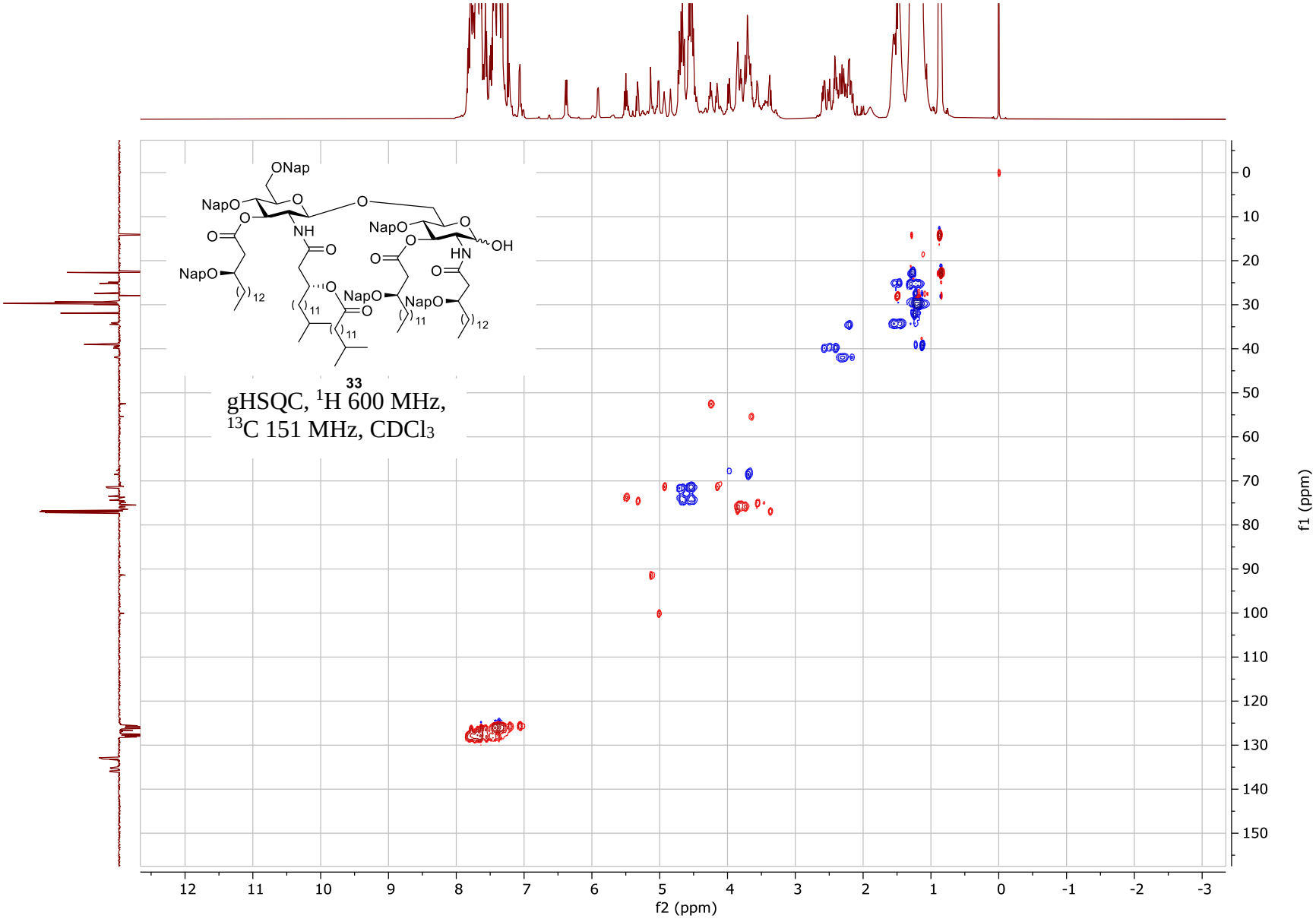


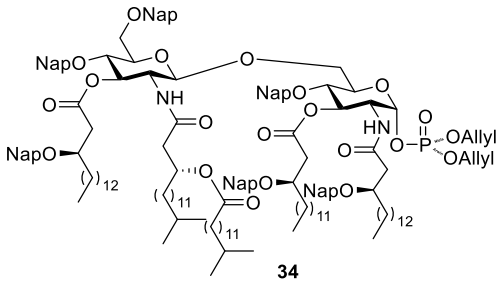
33

^{1}H NMR, 600 MHz, $CDCl_3$

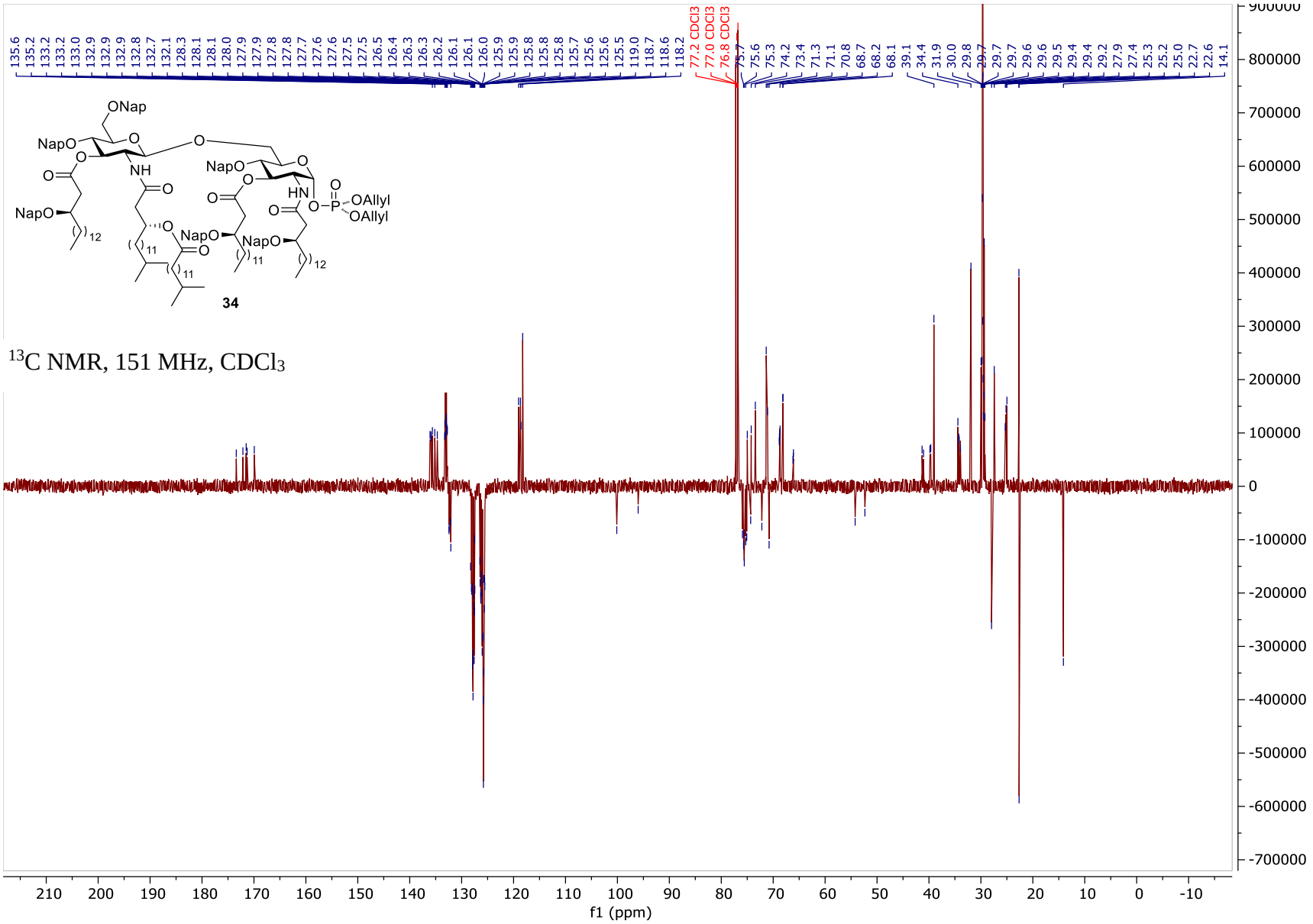

ONap
NapO
NH
NapO
OH
HN
NapO
NapO
NapO
NapO
12
11
11
11
12
33
13C NMR, 151 MHz, CDCl3
f1 (ppm)

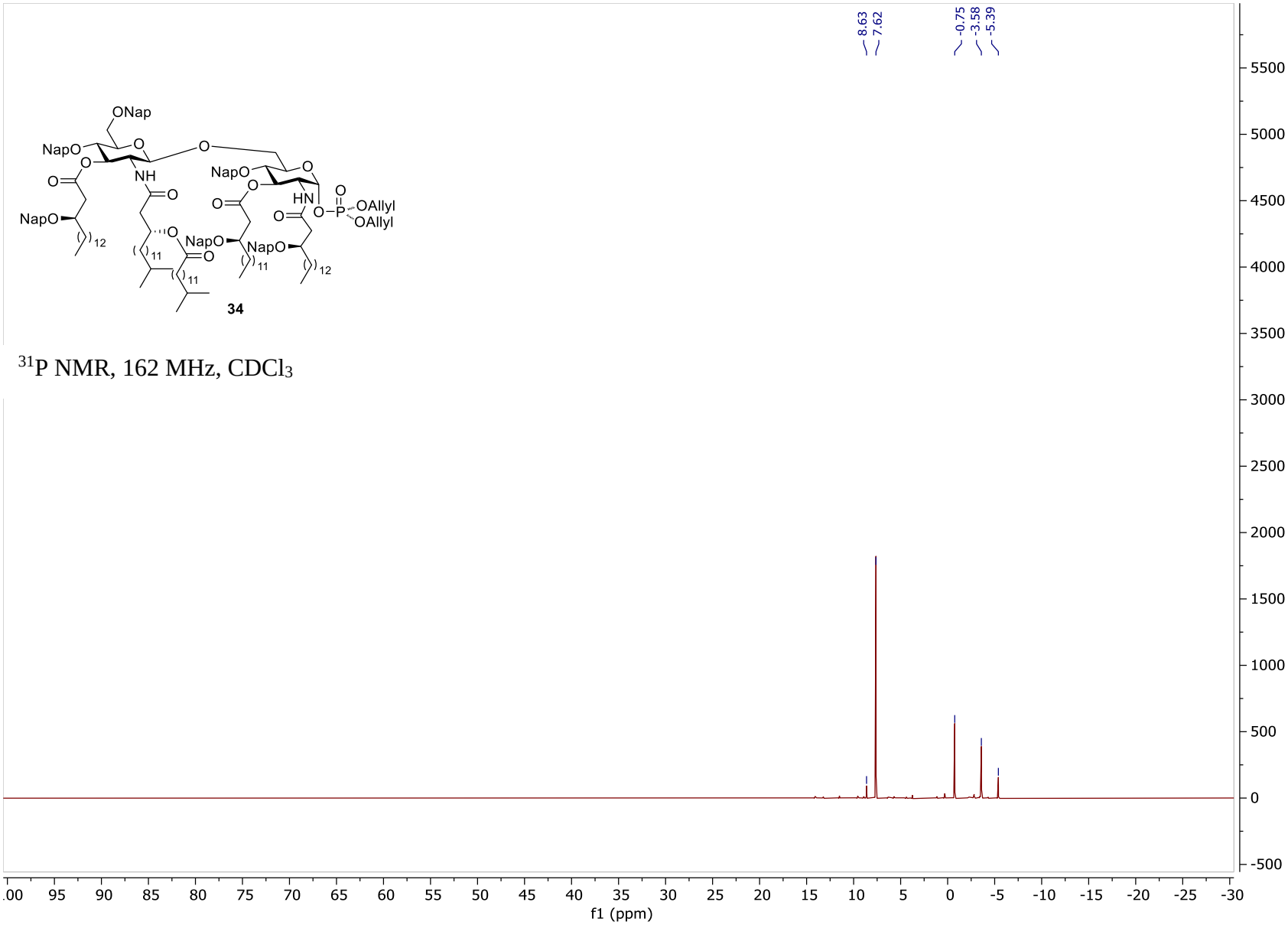

ONap
NapO
O
NH
O
NapO
12
O
11
11
NapO
O
NapO
O
NH
O
NapO
11
12
O
HN
O
OH
33
gCOSY, 600 MHz, CDCl3
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f2 (ppm)
0
1
2
3
4
5
6
7
8
9
f1 (ppm)


ONap
NapO
O
NH
O
NapO
O
HN
OH
NapO
12
11
11
NapO
NapO
11
12
33
gHSQC, ^{1}H 600 MHz,
^{13}C 151 MHz, CDCl$_3$
f2 (ppm)
f1 (ppm)

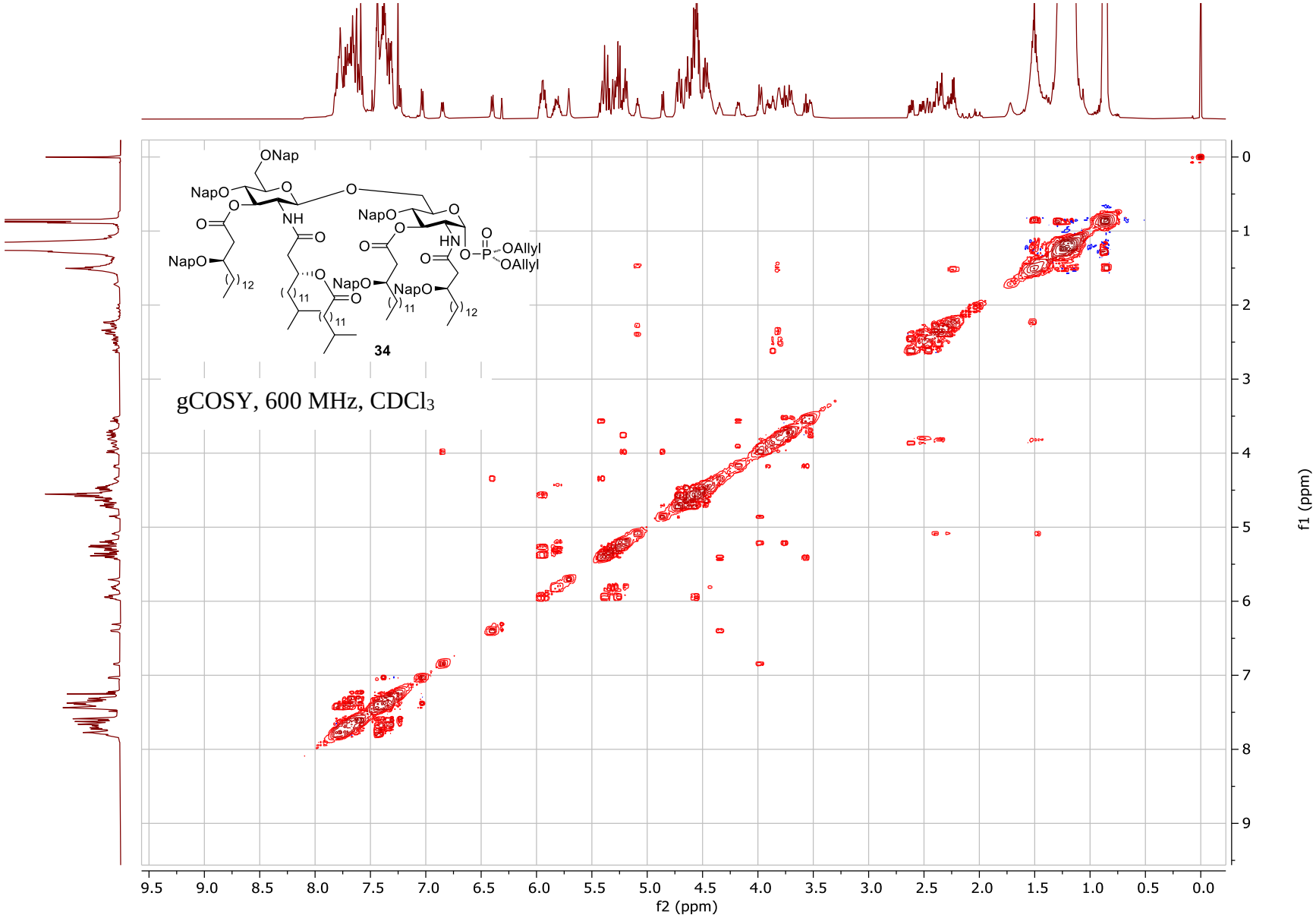


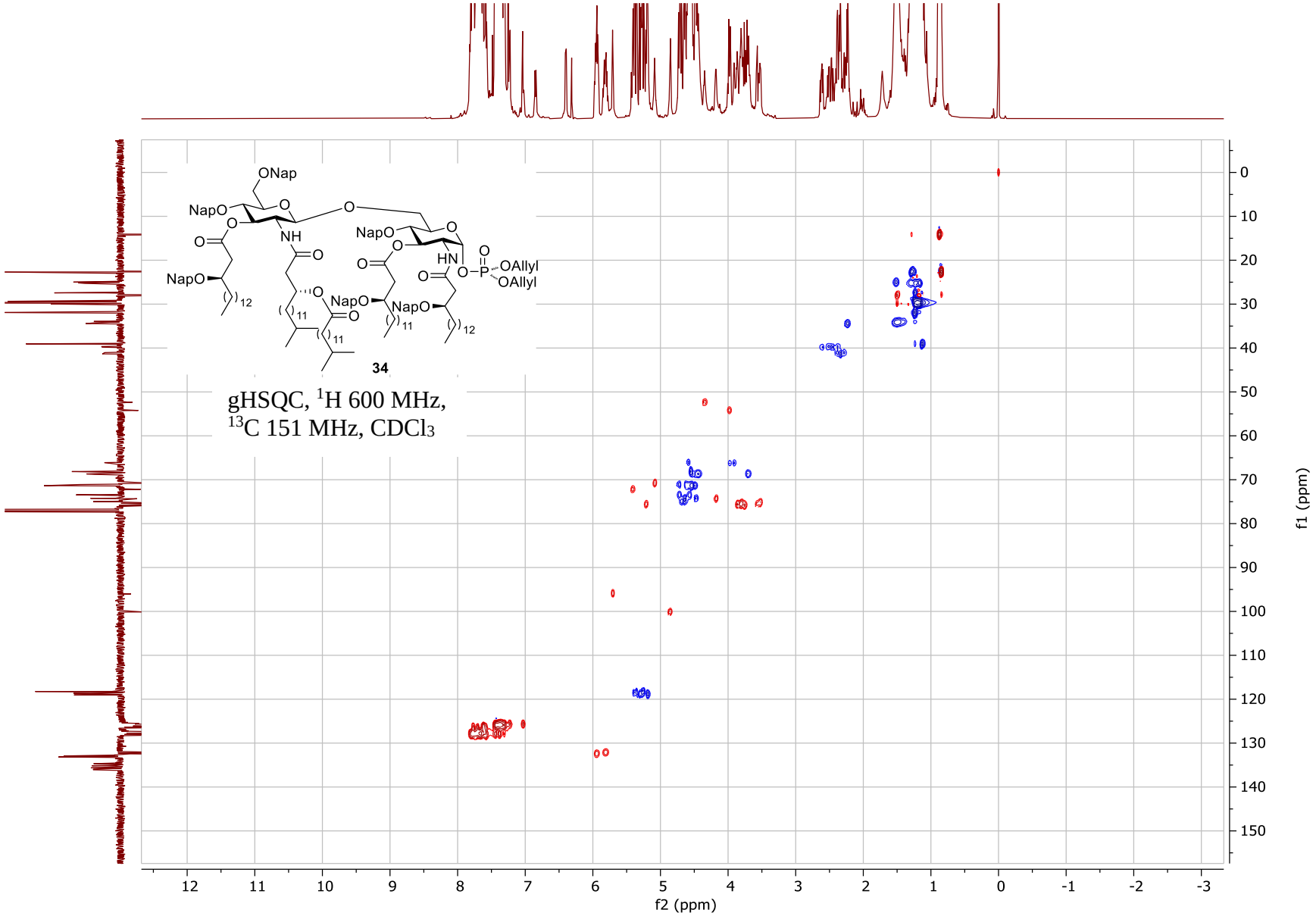
^{1}H NMR, 600 MHz, $CDCl_3$

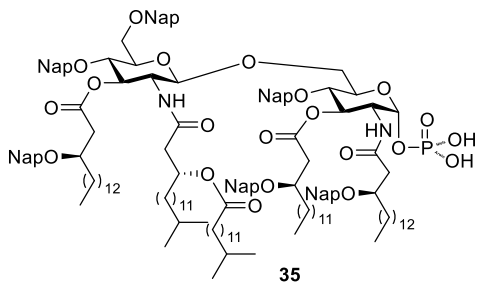

34
^{13}C NMR, 151 MHz, $CDCl_3$
f1 (ppm)



^{31}P NMR, 162 MHz, $CDCl_3$

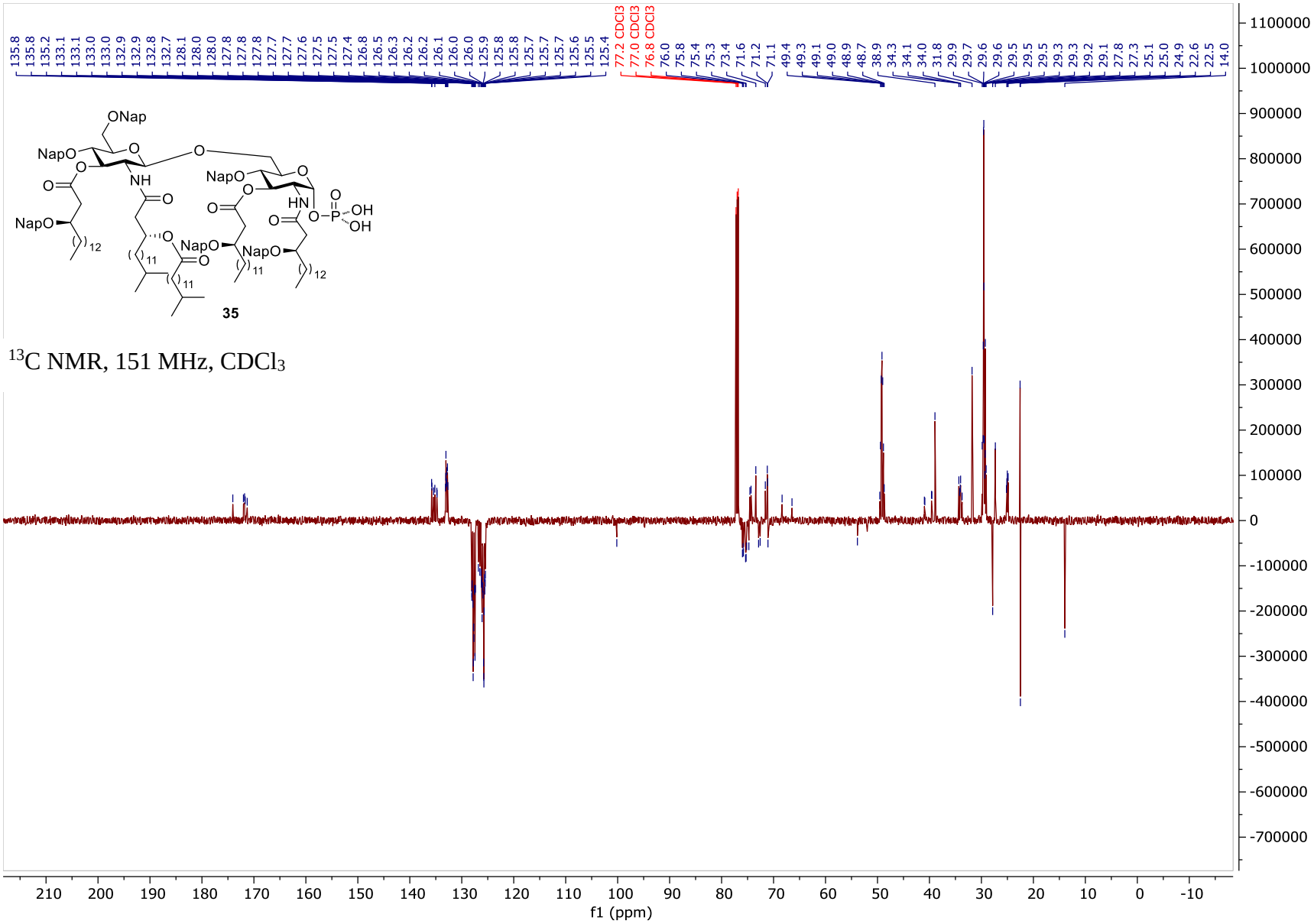

ONap
NapO
NH
HN
OAllyl
OAllyl
34
gCOSY, 600 MHz, CDCl3
f2 (ppm)
f1 (ppm)

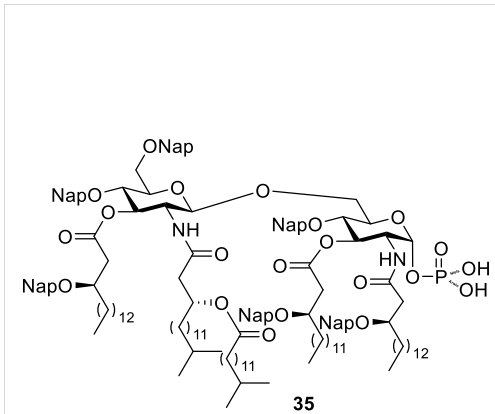

ONap
NapO
NapO
NH
NapO
HN
OAllyl
OAllyl
34
gHSQC, ^{1}H 600 MHz,
^{13}C 151 MHz, CDCl$_3$
f2 (ppm)
f1 (ppm)



35

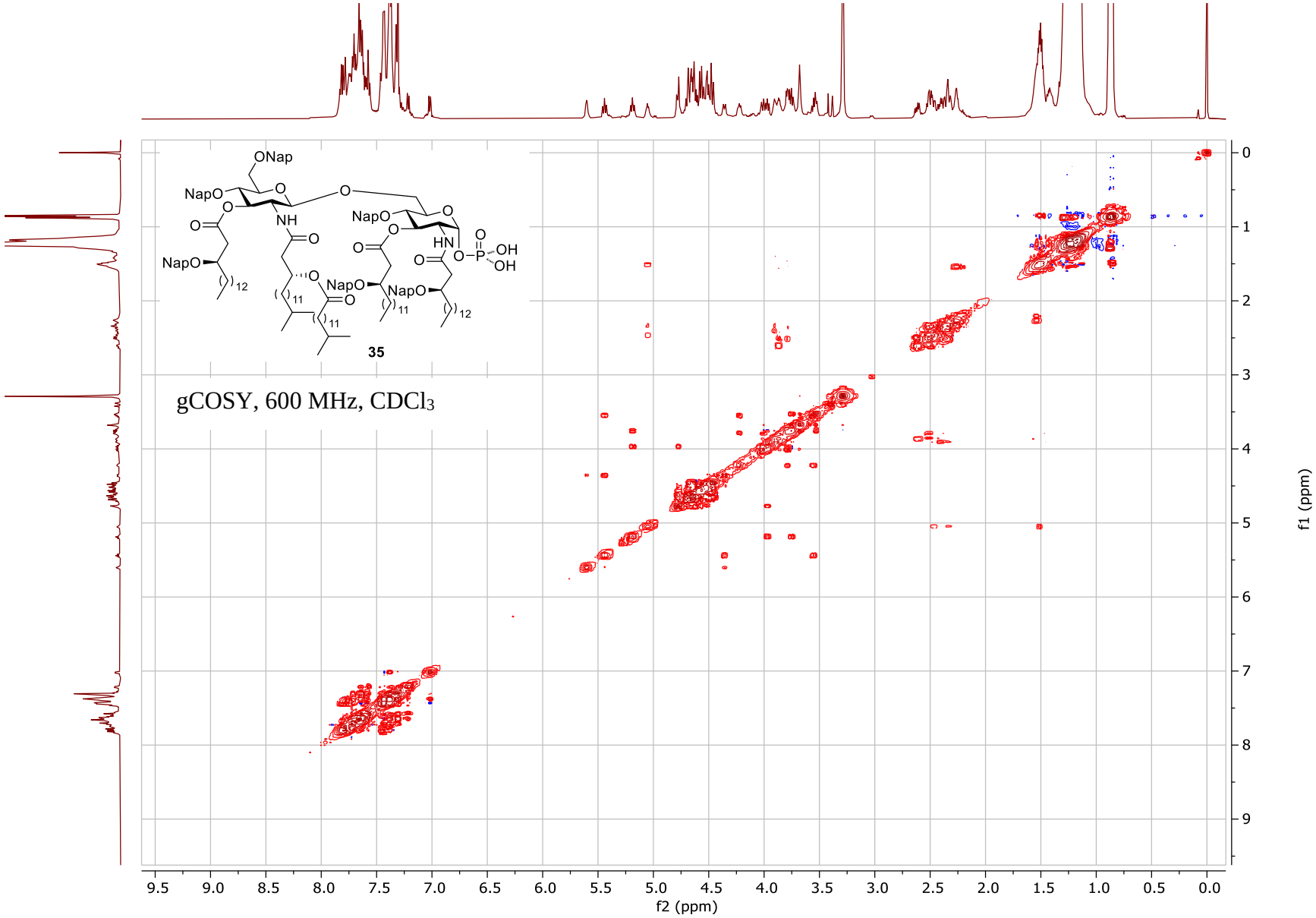
^{1}H NMR, 600 MHz, $CDCl_3$

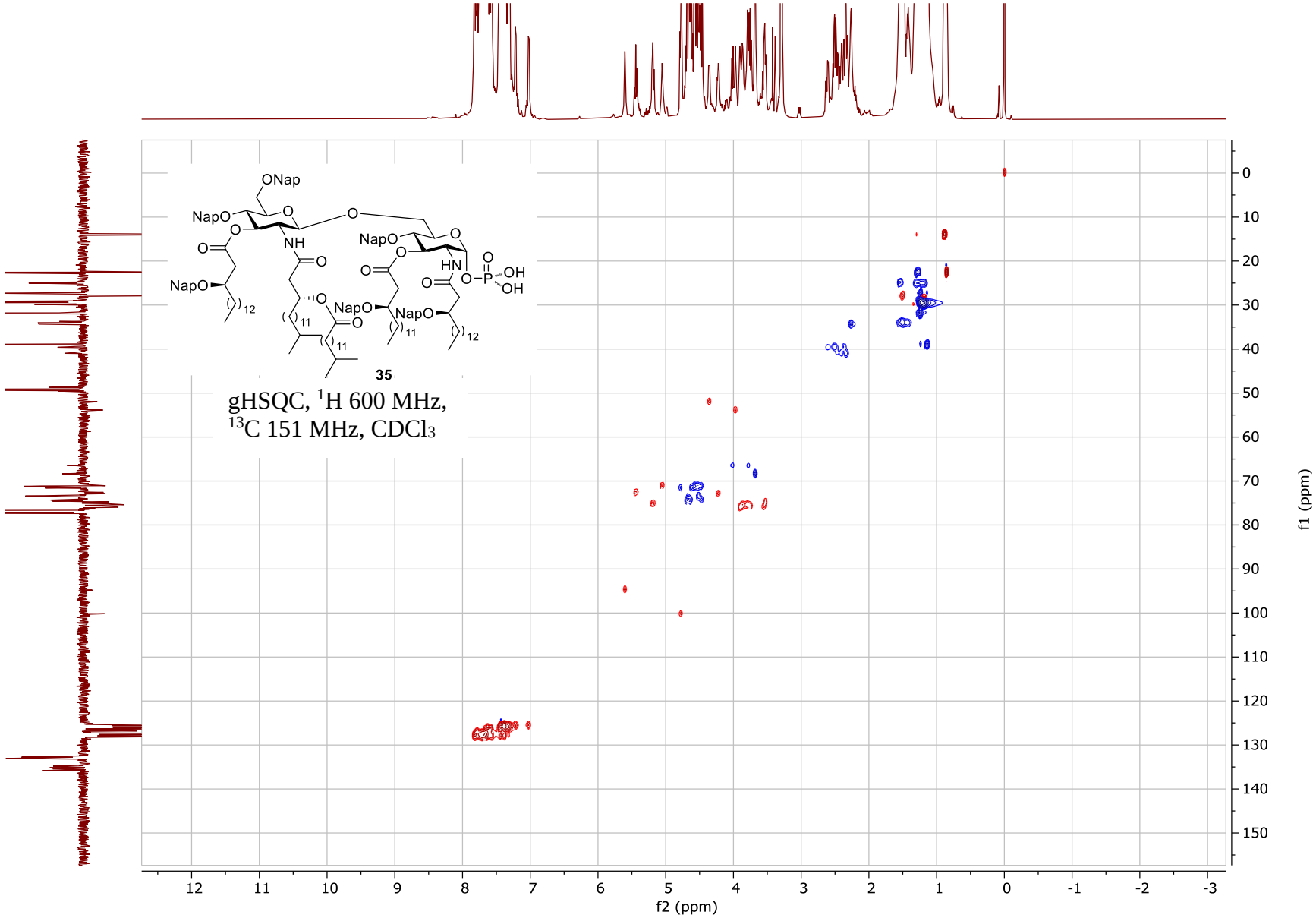

35
^{13}C NMR, 151 MHz, $CDCl_3$
f1 (ppm)

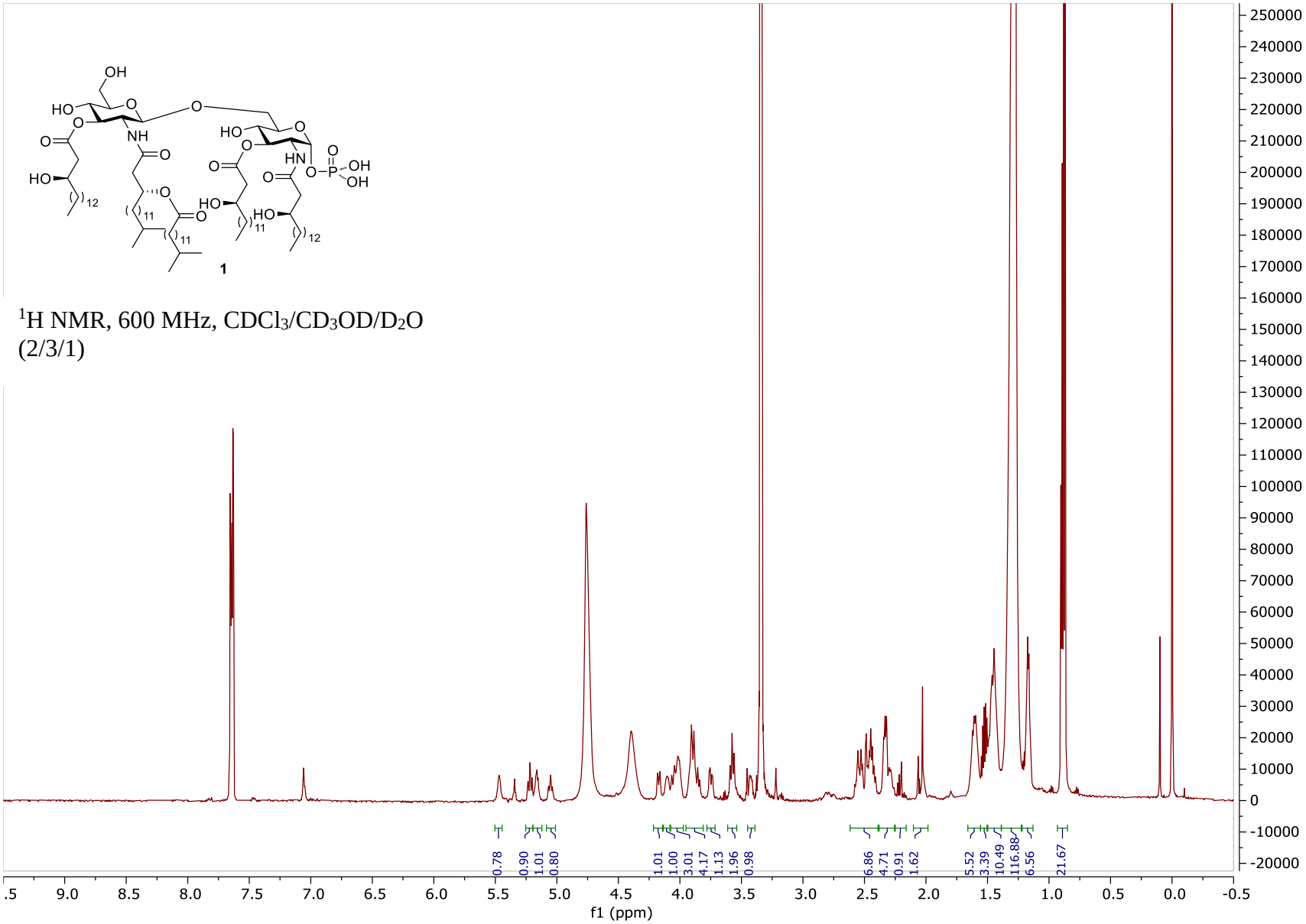


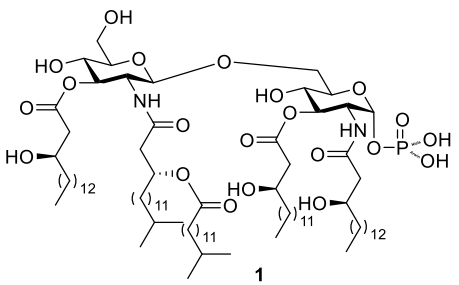
35

^{31}P NMR, 162 MHz, $CDCl_3$

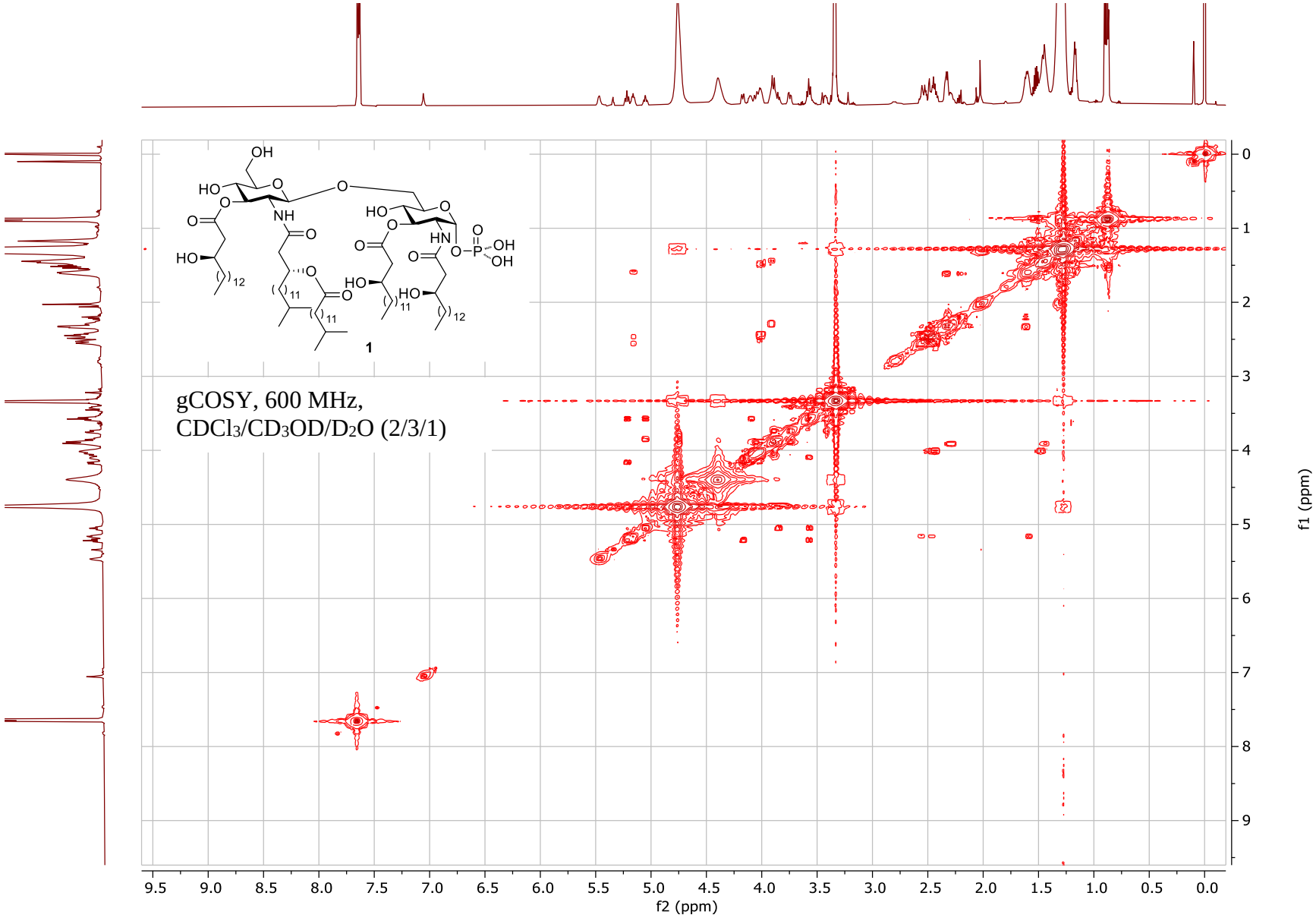

ONap
NapO
NH
NapO
HN
OH
OH
35
gCOSY, 600 MHz, CDCl3
f2 (ppm)
f1 (ppm)

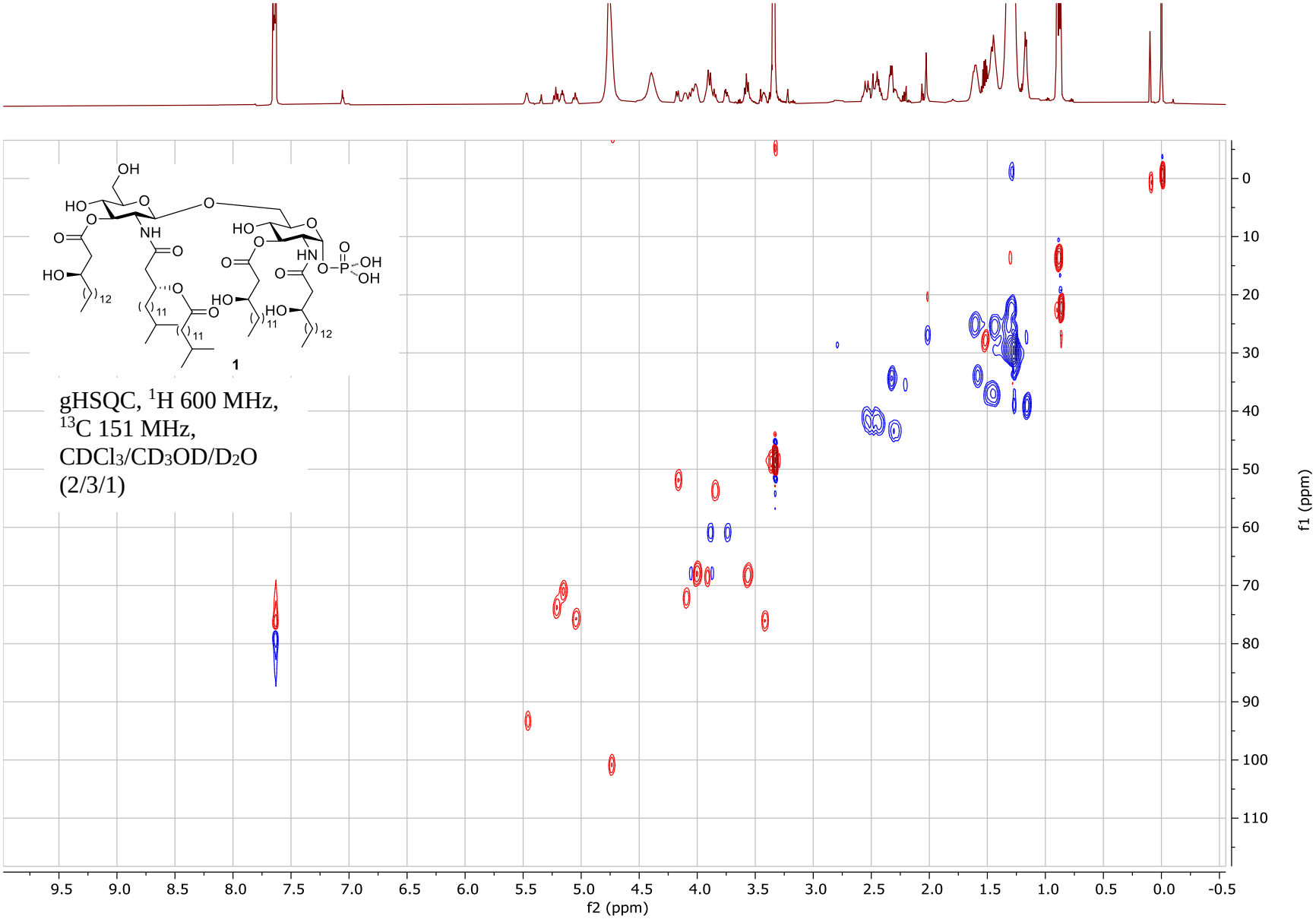

ONap
NapO
O
NH
NapO
HN
O–P
OH
OH
NapO
NapO
NapO
12
11
11
11
12
35
gHSQC, ^{1}H 600 MHz,
^{13}C 151 MHz, CDCl$_3$
f2 (ppm)
f1 (ppm)

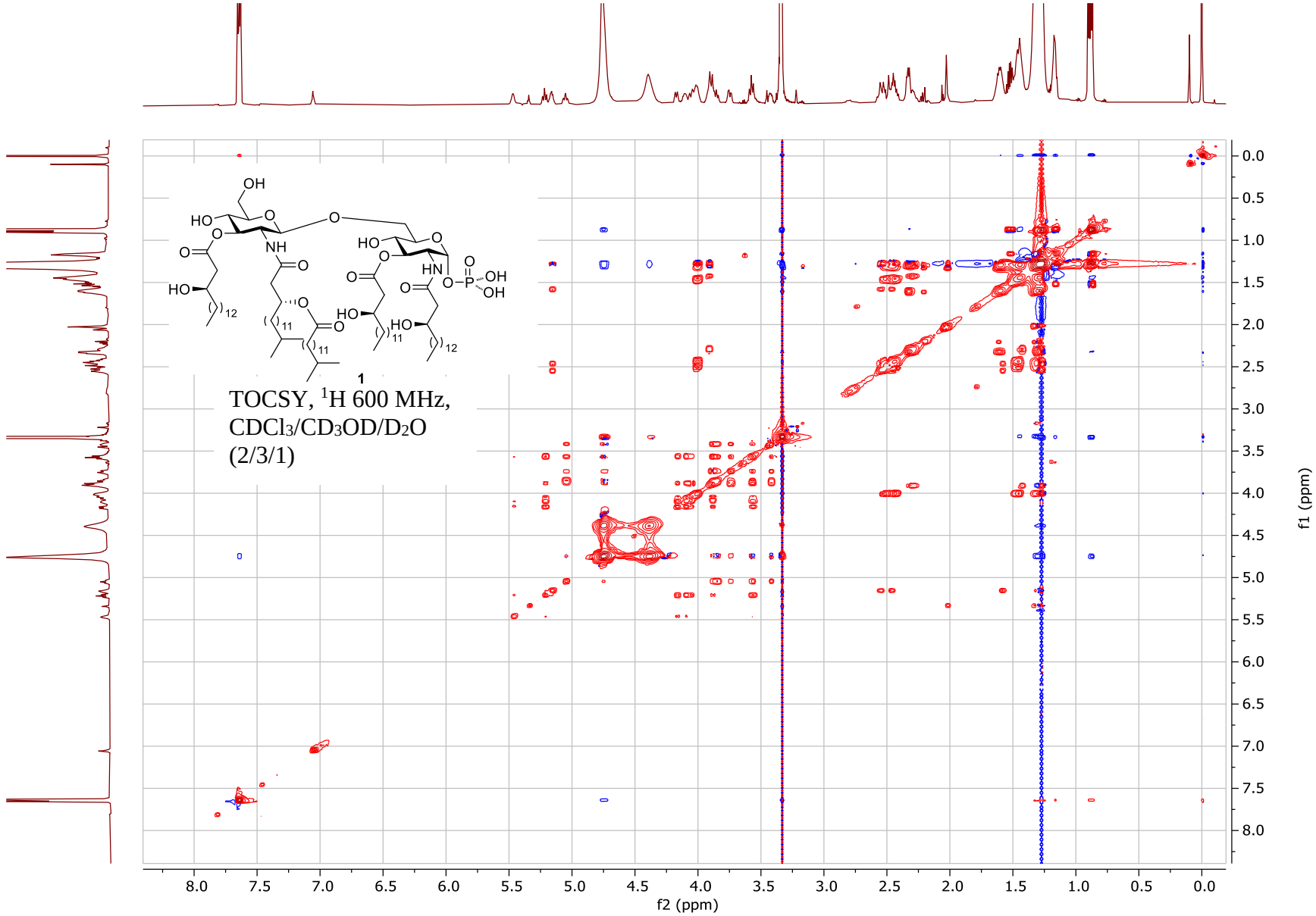

1
1H NMR, 600 MHz, CDCl3/CD3OD/D2O (2/3/1)
f1 (ppm)



^{31}P NMR, 162 MHz, $CDCl_3/CD_3OD/D_2O$ (2/3/1)


gCOSY, 600 MHz,
CDCl3/CD3OD/D2O (2/3/1)
1
f2 (ppm)
f1 (ppm)


gHSQC, ^{1}H 600 MHz,
^{13}C 151 MHz,
$CDCl_3/CD_3OD/D_2O$
(2/3/1)
1
f2 (ppm)
f1 (ppm)


1
TOCSY, ^{1}H 600 MHz,
$CDCl_3/CD_3OD/D_2O$
(2/3/1)
f2 (ppm)
f1 (ppm)