Supporting Information for –

Probing the lactose•GM3 carbohydrate-carbohydrate interaction with glycodendrimers

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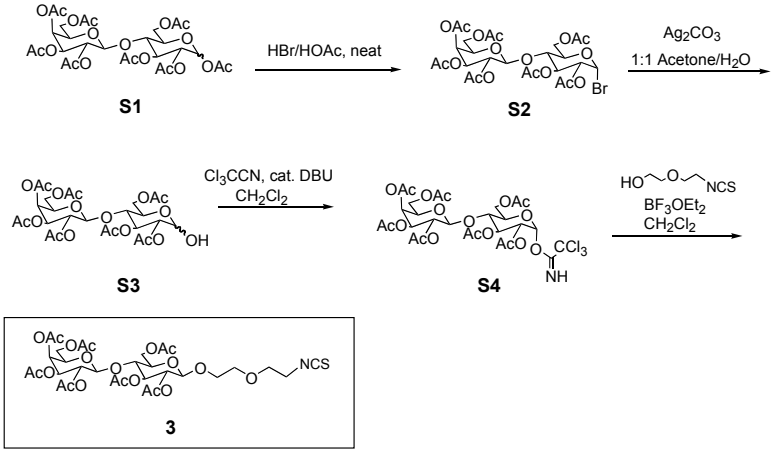
Table of Contents

General Experimental Protocols

Dry solvents (THF/CH_2Cl_2/MeOH) were obtained using a commercially available solvent purification system based on purification principles reported by Grubbs.[1] DBU was distilled under reduced pressure (1.0 mm Hg, 95 °C). NMR spectra were recorded on a Bruker instrument at 300 or 400 MHz for ^1H and 75 or 100 MHz for ^{13}C. ^1H chemical shifts were referenced to TMS at 0 ppm or to residual solvent peaks. ^{13}C chemical shifts were referenced to the solvent peak, typically $CDCl_3$ at 77 ppm.

The synthesis of lactose ligand **3** is summarized in scheme S1 below. The same synthetic route was employed for maltose and cellobiose ligands **5** and **6**.



Scheme S1. Synthesis of glycosyl ligands

Lactosyl-glycol isothiocyanate 3

Lactose octaacetate (10 g, 9.7 mmol) was dissolved in neat 33% HBr/HOAc (30 mL). The viscous red solution was stirred under N_2 atmosphere for 2 hours, after which it was poured over ice in a separatory funnel and diluted with CH_2Cl_2. The organic layer was washed twice with ice-cold water, four times with dilute $NaHCO_3$ solution, thrice more with water and once with brine. The organic layer was then dried over $MgSO_4$ and concentrated to provide the anomeric bromide as a white solid (6.37 g, 96% yield).

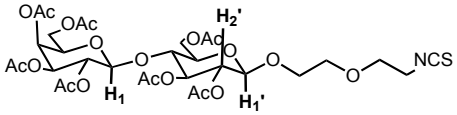
The crude anomeric bromide (6.37 g, 9.3 mmols) was converted to the lactol by treatment with Ag_2CO_3 (8 g, 14.6 mmol) in 100 mL of 1:1 acetone/water overnight. The grey suspension was diluted with CH_2Cl_2 and filtered into a separatory funnel. The organic layer was washed once with water and then brine, dried over $MgSO_4$, then concentrated to provide an off white solid (5.78 g, quantitative yield).

The lactol was converted into the α-imidate without further purification.[2] Special care was taken to dry the lactol by dissolving it in distilled CH_2Cl_2, removing the solvent under reduced pressure

[1] Pangborn, A.B.; Giardello, M.A.; Grubbs, R.H.; Rosen, R.K.; Timmers, F.J. *Organometallics* **1996** *15*, 1518-1520.

[2] Procedure adapted from Upreti, M.; Ruhela, D.; Vishwakarma, R. A. *Tetrahedron* **2000**, *56*, 6577 – 6884.

(repeated 2-3 times) followed by drying the final white solid under high vacuum for several hours. The dried lactol (5.78 g, 9.32 mmol) was dissolved in CH_2Cl_2 (90 mL) under a N_2 atmosphere. The solution was cooled to 0 °C, followed by the addition of trichloroacetonitrile (24 mL, 23.2 mmol). After 10 minutes a catalytic amount of distilled DBU (140 µL, 0.93 mmol) was added and the solution was stirred for 30 minutes. The solution was concentrated under reduced pressure to provide brown viscous oil/gum which was used immediately. The crude glycosyl α-imidate (~9.32 mmols) and 2-(2-isothiocyano-ethoxy)-ethanol (**4**)[3] (2.06 g, 13.98 mmols), both dried under high vaccum, were dissolved in dry CH_2Cl_2 (100 mL). The solution was cooled to 0 °C, followed by the drop-wise addition of BF_3•OEt_2 (3.54 mL, 2.80 mmols). After 10 minutes, the reaction flask was gradually warmed to room temperature. The solution was stirred overnight and was quenched by the addition of K_2CO_3 (0.5 g) followed by stirring for 30 minutes. The mixture was filtered, diluted with CH_2Cl_2, and washed twice with water, once with brine, dried over Na_2SO_4 and concentrated under reduced pressure. The crude product was then purified via column chromatography with 40% EtOAc/Toluene to provide **3** as a white solid (4.63 g, 65% yield).



^{1}H-NMR ($CDCl_3$, 400 MHz) δ ppm: 5.33 (d, 1H, $J_{4,3}$ = 3.1 Hz, H4), 5.19 (t, 1H, $J_{3',2'}$ = 9.3 Hz, H3`), 5.09 (dd, 1H, $J_{2,1}$ = 8.1 Hz, $J_{2,3}$ = 10.1 Hz, H2), 4.95 (dd, 1H, $J_{3,4}$ = 3.3 Hz, $J_{3,2}$ = 10.4 Hz, H3), 4.89 (t, 1H, $J_{2',1'}$ = 8.7 Hz, H2`), 4.55 (d, 1H, $J_{1',2'}$ = 7.9 Hz, H1`), 4.50 (d, 1H, $J$ = 12.0 Hz, H6`), 4.49 (d, 1H, $J_{1,2}$ = 7.7 Hz, *H1*), 4.09 (m, 3H, H6, H6, H6`), 3.92 (dd, 1H, $J$ = 3.1 Hz, $J$ = 7.8 Hz, *H5/H5`*), 3.88 (dd, 1H, J = 5.4 Hz, J = 12.5 Hz, *H5/H5`*), 3.80 (t, 1H, $J$ = 9.4 Hz, H4`), 3.80-3.58 (m, 8H, glycol-C*H*$_2$), 2.14 (s, 3H, -CO_2C*H*$_3$), 2.11 (s, 3H, -CO_2C*H*$_3$), 2.05 (s, 3H, -CO_2C*H*$_3$), 2.04 (s, 3H, -CO_2C*H*$_3$), 1.95 (s, 3H, -CO_2C*H*$_3$)

^{13}C-NMR ($CDCl_3$, 100 MHz) δ ppm, 170.4 (acetate-*C*=*O*), 170.2 (acetate-*C*=*O*), 170.1 (acetate-*C*=*O*), 169.8 (acetate-*C*=*O*), 169.7 (acetate-*C*=*O*), 169.1 (acetate-*C*=*O*), 101.1 (*C1`*), 100.6 (*C1*), 72.8 (*C5/C5`*), 72.8 (*C3`, C4`*), 71.7 (*C5/C5`*), 71.0 (*C2`*), 70.7 (*C3*), 70.4 (glycol-*C*H$_2$), 69.4 (glycol-*C*H$_2$), 69.2 (glycol-*C*H$_2$), 69.1 (*C2`*), 66.6 (*C4*), 61.9 (*C6/C6`*), 60.8 (*C6/C6`*), 45.3 (glycol-*C*H$_2$), 20.9 (-CO_2CH$_3$), 20.8 (-CO_2CH$_3$), 20.8 (-CO_2CH$_3$), 20.7 (-CO_2CH$_3$), 20.5 (-CO_2CH$_3$)

HRMS-FAB$^+$ (*m/z*) [$C_{31}H_{43}NO_{19}S$ + Na]$^+$ calcd: 788.2048 found 788.2040
IR ν cm^{-1}: 2116.49 (NCS *stretch*)

Cellobiosyl-glycol isothiocyanate 5

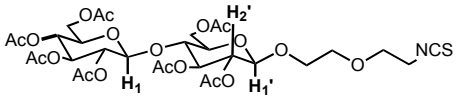
Cellobiose octaacetate (3.18 g, 4.80 mmols) was dissolved in neat 33% HBr/HOAc (10 mL). The viscous red solution was stirred under N_2 atmosphere for 2 hours, after which it was poured over ice in a separatory funnel and diluted with CH_2Cl_2. The organic layer was washed twice

[3] Woller, E.; Cloninger, M. *Org. Lett.* **2002**, *4*, 7 – 10.

with ice-cold water, four times with dilute $NaHCO_3$ solution, thrice more with water and once with brine. The organic layer was then dried over $MgSO_4$ and concentrated to provide the anomeric bromide as a white solid (3.26 g, ~quantitative crude yield).

The crude anomeric bromide (3.26 g, 4.80 mmol) was converted to the lactol by treatment with Ag_2CO_3 (2.65 g, 9.60 mmol) in 30 mL of 1:1 acetone/water overnight. The grey suspension was diluted with CH_2Cl_2 and filtered into a separatory funnel. The organic layer was washed once with water and then brine, dried over $MgSO_4$, then concentrated to provide an off white solid (2.98 g, 96% crude yield).

The lactol was converted into the α-imidate without further purification.[2] Special care was taken to dry the lactol by dissolving it in distilled CH_2Cl_2, removing the solvent under reduced pressure (repeated 2-3 times) followed by drying the final white solid under high vacuum for several hours. The dried lactol (2.2 g, 3.31 mmols) was dissolved in CH_2Cl_2 (25 mL) under a N_2 atmosphere. The solution was cooled to 0 °C, followed by the addition of trichloroacetonitrile (8.3 mL, 82.8 mmol). After 10 minutes a catalytic amount of distilled DBU (50 μL, 0.33 mmol) was added and the solution was stirred for 30 minutes. The solution was concentrated under reduced pressure to provide a brown viscous oil/gum (2.05g, 80% yield) which was used immediately. The crude glycosyl *α*-imidate (1 g, 1.28 mmols) and 2-(2-isothiocyano-ethoxy)-ethanol (**4**)[3] (0.282 g, 1.92 mmols), both dried under high vacuum, were dissolved in dry CH_2Cl_2 (15 mL). The solution was cooled to 0 °C, followed by the drop-wise addition of BF_3•OEt_2 (48.3 μL, 0.384 mmols). After 10 minutes, the reaction flask was gradually warmed to room temperature. The solution was stirred overnight and was quenched by the addition of K_2CO_3 (0.5 g) followed by stirring for 30 minutes. The mixture was filtered, diluted with CH_2Cl_2, and washed twice with water, once with brine, dried over Na_2SO_4 and concentrated under reduced pressure. The crude product was then purified via column chromatography with 40% EtOAc/Toluene to provide **5** as a white solid (0.661 g, ~62.5% yield).



^{1}H-NMR ($CDCl_3$, 300 MHz) δ ppm: 5.16 (t, 1H, $J_{3',2'}$ = 7.2 Hz, H3`), 5.09 (dd, 1H, $J_{3,4}$ = 4.9Hz, $J_{3,2}$ = 14.0 Hz, H3), 5.01 (d, 1H, *J* = 9.5 Hz, H4), 4.90 (dd, 1H, *J* = 3.6 Hz, $J_{2,1}$ = 8.0 Hz, H2), 4.87 (dd, 1H, *J* = 4.0 Hz, *J* = 9.2 Hz, *H2`*), 4.51 (d, 1H, $J_{1,2}$ = 7.9 Hz, *H1*), 4.49 (dd, 1H, *J* = 7.9 Hz, *J* = 12.1 Hz, *H6`*), 4.47 (d, 1H, $J_{1',2'}$ = 7.9 Hz, *H1`*), 4.34 (dd, 1H, *J* = 4.3 Hz, *J* = 12.4 Hz, *H6*), 4.06 (dd, 1H, *J* = 5.0 Hz, *J* = 12.2 Hz, H6/H6`), 4.00 (dd, 1H, *J* = 2.0 Hz, *J* = 12.7 Hz, H6/H6`), 3.89 (td, 1H, *J* = 4.0 Hz, *J* = 10.6 Hz, H5`), 3.80-3.50 (m, 10H, H5, H4`, glycol-C*H*$_2$), 2.09 (s, 3H, -CO_2CH_3), 2.05 (s, 3H, -CO_2CH_3), 2.01 (s, 3H, -CO_2CH_3), 1.99 (s, 3H, -CO_2CH_3), 1.98 (s, 3H, -CO_2CH_3), 1.97 (s, 3H, -CO_2CH_3), 1.95 (s, 3H, -CO_2CH_3)

^{13}C-NMR ($CDCl_3$, 60 MHz) δ ppm, 170.5 (acetate-*C*=*O*), 170.3 (acetate-*C*=*O*), 170.2 (acetate-*C*=*O*), 169.8 (acetate-*C*=*O*), 169.6 (acetate-*C*=*O*), 169.3 (acetate-*C*=*O*), 169.0 (acetate-*C*=*O*), 100.7 (*C1*), 100.7 (*C1`*), 72.9, 72.7, 72.4, 71.9, 71.6, 71.5, 70.4, 69.3, 69.2, 67.8, 61.8, 61.7, 61.5, 45.297, 20.9 (-CO_2CH_3), 20.7 (-CO_2CH_3), 20.7 (-CO_2CH_3), 20.6 (-CO_2CH_3)

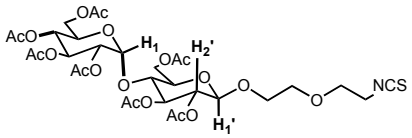
HRMS-FAB$^+$ (*m/z*) $[C_{31}H_{43}NO_{19}S + Na]^+$ calcd: 788.2048 found 788.2073
IR ν cm^{-1}: 2117.46 (NCS)

Maltosyl-glycol isothiocyanate 6

Maltose octaacetate (4.2 g, 6.34 mmols) was dissolved in neat 33% HBr/HOAc (10 mL). The viscous red solution was stirred under N_2 atmosphere for 2 hours, after which it was poured over ice in a separatory funnel and diluted with CH_2Cl_2. The organic layer was washed twice with ice-cold water, four times with dilute $NaHCO_3$ solution, thrice more with water and once with brine. The organic layer was then dried over $MgSO_4$ and concentrated to provide the anomeric bromide as a white solid (4.31 g, ~quantitative crude yield).

The crude anomeric bromide (4.31 g, 6.34 mmols) was converted to the lactol by treatment with Ag_2CO_3 (3.5 g, 12.68 mmols) in 40 mL of 1:1 acetone/water overnight. The grey suspension was diluted with CH_2Cl_2 and filtered into a separatory funnel. The organic layer was washed once with water and then brine, dried over $MgSO_4$, then concentrated to provide an off white solid (3.54 g, ~90% crude yield).

The lactol was converted into the α-imidate without further purification.[2] Special care was taken to dry the lactol by dissolving it in distilled CH_2Cl_2, removing the solvent under reduced pressure (repeated 2-3 times) followed by drying the final white solid under high vacuum for several hours. The dried lactol (3.4 g, 5.28 mmols) was dissolved in CH_2Cl_2 (40 mL) under a N_2 atmosphere. The solution was cooled to 0 °C, followed by the addition of trichloroacetonitrile (13.2 mL, 0.132 mols). After 10 minutes a catalytic amount of distilled DBU (79 μL, 0.528 mmols) was added and the solution was stirred for 30 minutes. The solution was concentrated under reduced pressure to provide brown viscous oil/gum which was used immediately. The crude glycosyl α-imidate (1 g, 1.28 mmols) and 2-(2-isothiocyano-ethoxy)-ethanol (**4**)[3] (0.282 g, 1.92 mmols), both dried under high vaccum, were dissolved in dry CH_2Cl_2 (100 mL). The solution was cooled to 0 °C, followed by the drop-wise addition of BF_3•OEt_2 (48.3 μL, 0.384 mmols). After 10 minutes, the reaction flask was gradually warmed to room temperature. The solution was stired overnight and was quenched by the addition of K_2CO_3 (0.5 g) followed by stirring for 30 minutes. The mixture was filtered, diluted with CH_2Cl_2, and washed twice with water, once with brine, dried over Na_2SO_4 and concentrated under reduced pressure. The crude product was then purified via column chromatography with 40% EtOAc/Toluene to provide **6** as a white solid (0.558 g, ~57% yield).



^{1}H-NMR ($CDCl_3$, 400 MHz) δ ppm: 5.44 (d, 1H, $J_{1,2}$ = 4.0 Hz, H1), 5.38 (dd, 1H, $J_{3,4}$ = 9.7Hz, $J_{3,2}$ = 10.4 Hz, H3), 5.29 (dd, 1H, J = 6.0 Hz, J = 15.0 Hz, H3`), 5.08 (t, 1H, $J_{4,3}$ = 9.9 Hz, H4),

4.88 (dd, 1H, $J_{2,1}$ = 3.7 Hz, $J_{2,3}$ = 6.9 Hz, H2), 4.85 (dd, 1H, $J_{2,3}$ = 6.1 Hz, $J_{2,1}$ = 7.8 Hz, H2`), 4.65 (d, 1H, $J_{1,2}$ = 7.9 Hz, H1`), 4.53 (dd, 1H, *J* = 2.7 Hz, *J* = 12.1 Hz, H6`), 4.28 (dd, 1H, *J* = 3.4 Hz, *J* = 9.1Hz, H6/ H6`), 4.25 (dd, 1H, *J* = 3.4 Hz, *J* = 8.9 Hz, H6/H6`), 4.07 (dd, 2H, J = 2 Hz, *J* = 12.4 Hz, H6/H6` and H5), 4.04 (m, 2H, H5` and H4`), 3.83-3.71 (m, 8H, glycol-CH_2), 2.17 (s, 3H, -CO_2CH_3), 2.13 (s, 3H, -CO_2CH_3), 2.07 (s, 3H, -CO_2CH_3), 2.05, 2.05 (d, 3H, -CO_2CH_3), 2.03, 2.02 (d, 3H, -CO_2CH_3)

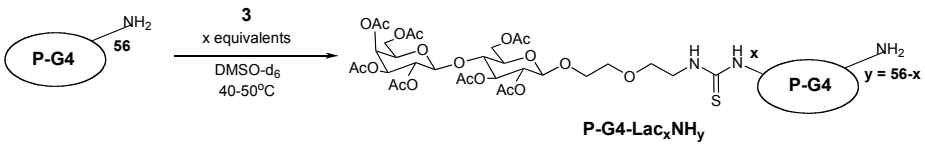
^{13}C-NMR ($CDCl_3$, 100 MHz) δ ppm, 170.6 (acetate-*C*=*O*), 170.5 (acetate-*C*=*O*), 170.2 (acetate-*C*=*O*), 169.9 (acetate-*C*=*O*), 169.7 (acetate-*C*=*O*), 169.4 (acetate-*C*=*O*), 129.0, 128.2, 100.3 (*C1`*), 95.5 (*C1*), 75.4, 72.7, 72.3, 72.2, 70.4, 70.0, 69.4, 69.2, 68.5, 68.0, 62.8, 61.5, 45.3, 20.9 (-CO_2CH_3), 20.8 (-CO_2CH_3), 20.8 (-CO_2CH_3), 20.7 (-CO_2CH_3), 20.5 (-CO_2CH_3)

HRMS-FAB$^+$ (*m/z*) $[C_{31}H_{43}NO_{19}S + Na]^+$ calcd: 788.2048 found: 788.2065
IR ν cm^{-1}: 2114.56 (NCS)

General procedure for synthesizing PAMAM glycodendrimers –

The synthesis of glycodendrimers was carried out following procedures reported by Cloninger and coworkers.[4] General protocols are described below.

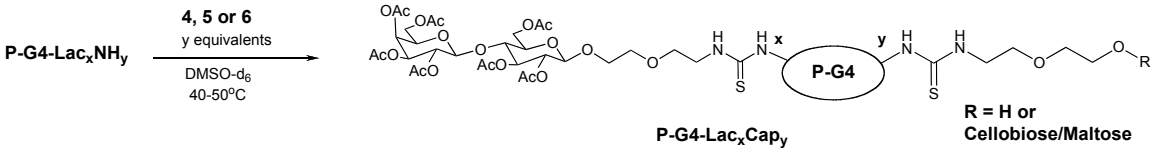
*i) Functionalizing terminal amines with glycol ligands (**3, 4, 5 and 6**)*



P-G4-Lac$_x$NH$_y$

A methanolic solution of G4 PAMAM (Aldrich) was transferred to a 1 or 4 dram vial followed by removal of the solvent under reduced pressure. This sample was left under under high vaccum for several hours. The necessary equivalents of glycosyl ligand (**4**, **5** or **6**) were dispensed as DMSO-d_6 solutions; the final volume of DMSO-d_6 was adjusted to achieve dendrimer concentrations of ≤1M. The vials were capped, sealed with Teflon tape, and incubated at 40 °C overnight in an aluminium heating block. Reactions were typically complete within 24 hours and functionalization was confirmed by ^{1}H-NMR and MALDI-TOF/MS. Glycodendrimers that were not subjected to capping (step ii) were purified by dialysis (SpectraPor60 regenerated cellulose membrane, MWCO 1000) in ethyl acetate for 8 hours. The solvent reservoir was renewed thrice.

ii) Capping unreacted amines:

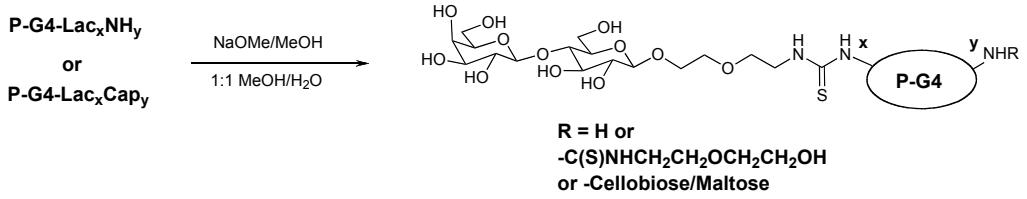


P-G4-Lac$_x$Cap$_y$

Without purification, the crude reaction mixtures from step i) were treated with excess ligands **4, 5** or **6** to "cap" the unreacted amines on the dendrimer. Reaction vials were re-sealed with Teflon tape and returned to the aluminium block for 48 hours. Purification was carried out as described in step i) followed by analysis by ^{1}H-NMR and MALDI-TOF/MS.

[4] Woller, E. K.; Walter, E. D.; Morgan, J. R.; Singel, D. J.; Cloninger, M. J. *J. Am. Chem. Soc.* **2003**, *125*, 8820-8826.

iii) Deacetylation of glycodendrimers:



Acetyl-group deprotection was carried out using NaOMe in MeOH/H_2O (1:1). The reaction was neutralized with Amberlite IR-120 resin, filtered, then dialyzed with water overnight; the reservoir was renewed thrice. The final solution was filtered through a 0.45 μm nylon syringe filter into a preweighed vial and lyophilized.

MALDI-TOF/MS

Glycodendrimers were diluted to a concentration of 0.1-0.3 mM for analysis; higher or lower concentrations provided poor or no signals. Protected glycodendrimers in DMSO-d_6 were diluted with THF or MeOH, while deprotected dendrimers were analyzed in water. 2,5-dihydroxybenzene (**DHB**) or ***super DHB*** (DHB doped with 5-10% 5-methoxysalicylic acid) was employed as the matrix for all analyses. 20-30 mg of matrix was dissolved in 300-400 μL of 0.1% aqueous TFA and 150-200 μL of CH_3CN (i.e. 0.1%TFA/CH_3CN ratio = 2:1). 1 μL of matrix was deposited followed by deposition of 0.5-0.6 μL of analyte in the same well. The mixture was allowed to dry and crystallize (~10 mins) in air and then subjected to analysis. Mass analyses of the dendrimers and glycodendrimers were carried out on Voyager-DE Pro BioSpectrometry Workstation, in the linear mode at 25kV accelerating voltage with an extraction delay time of 700 nsec. An average of 50 laser shots was sufficient to obtain a representative mass value. 4 to 8 spectra per sample were collected to assess reproducibility of the mass value. The average molecular mass values, M_n, M_w, and the associated polydispersity indices, PDI, were calculated by the polymer analysis macros provided by the Applied Biosystems Voyager System 6375 software (see spectra for values). M_w values of the glycodendrimers were employed to determine the number of terminal amines that were functionalized on each dendrimer (Table S1).

Table S1. Characterization of glycodendrimers via MALDI-TOF/MS

a) Glycodendrimers with free unreacted amines

Entry	P-G4-carb$_x$NH$_x$	M_w (OAc_7)	PDI	M_w (OH_7)	PDI	%Lac
1	P-G4-Lac$_0$NH$_{56}$	n.a.	n.a.	13400	1.06	0
2	P-G4-Lac$_7$NH$_{49}$	17600	1.04	16700	1.06	13
3	P-G4-Lac$_{24}$NH$_{32}$	29600	1.05	24700	1.05	44

(b) Glycodendrimers with glycol-capped amines

Entry	P-G4-carb$_x$Gly$_x$	M_w (OAc_7) P-carb-NH	PDI	%Lac	M_w (OAc_7) P-carb-cap	PDI	%Cap	M_w (OH_7)	PDI
1	P-G4-Lac$_0$Gly$_{56}$	n.a.	n.a.	0	n.a.	n.a.	100	22700	1.05
2	P-G4-Lac$_7$Gly$_{48}$	17600	1.04	13	25900	1.04	<90	23800[d]	-
3	P-G4-Lac$_{17}$Gly$_{27}$	25900	1.04	31	29900	1.05	49	26700	1.04
4	P-G4-Lac$_{25}$Gly$_{30}$	32600	1.02	45	37200	1.03	55	26300	1.03
5	P-G4-Lac$_{35}$Gly$_9$	41200	1.04	64	42600	1.05	17	31300	1.04
6	P-G4-Lac$_{42}$Gly$_2$	45200	1.05	75	45600	1.04	3	33600	1.05
7	P-G4-Lac$_{25}$ Cell$_{22}$Gly$_5$	50100	1.02	45	50800	1.02	47[b]	35300	1.03
8	P-G4-Lac$_{25}$ Malt$_{21}$Gly$_2$	49200	1.03	45	49600	1.02	42[c]	33700	1.03
9	P-G4-Cell$_{26}$Gly$_{21}$	34600	1.04	48[b]	37300	1.03	32	27500	1.03
10	P-G4-Malt$_{23}$Gly$_{30}$	31700	1.03	42[c]	35300	1.03	42	28000	1.03

a) data not available; b) functionalized with cellobiose; c) functionalized with maltose; d) estimated from M_w of the corresponding acetylated adduct.

^{1}H-NMR

Spectra were acquired on a 300 MHz Bruker instrument using DMSO-d_6 as the solvent. Thiourea bridges formed from the reaction of terminal amines on the dendrimer with isothiocyanates of the glycol ligands produced proton resonances (δ ~7.5ppm) distinct from the proton resonances of the internal amides of the dendrimer (δ ~8.2-7.7ppm). A rough estimate of the number of functionalized amines (Table S2, %Lac and %Cap) was obtained by first integrating the thiourea resonances against the latter, and subsequently by multiplying this integral value (Table S2, $\int_{thiourea}$) by the ratio of internal amide protons to thiourea protons (124:128). We found that the derived molecular weights often overestimated the number of functionalized amines.[5] Consequently, MALDI-TOF/MS data was used as the primary source for determining the degree of functionalization.

Table S2. Characterization of glycodendrimers via ^{1}H NMR

a) Glycodendrimers with free unreacted amines

Entry	P-G4-carb$_x$NH$_x$	$\int_{thiourea}$	%Lac
1	P-G4-Lac$_0$NH$_{56}$	-	0
2	P-G4-Lac$_7$NH$_{49}$	0.1	10
3	P-G4-Lac$_{24}$NH$_{32}$	0.27	30

(b) Glycodendrimers with glycol-capped amines

Entry	P-G4-carb$_x$Gly$_x$	$\int_{thiourea}$ P-carb-NH	%Lac	$\int_{thiourea}$ P-carb-cap	%Cap
1	P-G4-Lac$_0$Gly$_{56}$	n.a.	n.a.	0.7	68
2	P-G4-Lac$_7$Gly$_{48}$	0.1	10	0.7	58
3	P-G4-Lac$_{17}$Gly$_{27}$	0.35	33	0.63	29
4	P-G4-Lac$_{25}$Gly$_{30}$	0.47	45	1.04	55
5	P-G4-Lac$_{35}$Gly$_9$	0.81	78	0.90	9
6	P-G4-Lac$_{42}$Gly$_2$	0.81	78	0.98	17
7	P-G4-Lac$_{25}$Cell$_{22}$Gly$_5$	0.87[b]	84[b]	0.90	6
8	P-G4-Lac$_{25}$Malt$_{21}$Gly$_2$	0.91[c]	88[c]	0.93	2
9	P-G4-Cell$_{26}$Gly$_{21}$	0.72	70	[a]	-
10	P-G4-Malt$_{23}$Gly$_{30}$	0.67	65	[a]	-

a) data not available; b) functionalized with both lactose and cellobiose; c) functionalized with both lactose and maltose

Langmuir Monolayer Assays

The Langmuir monolayer assays were designed to measure the interaction between the glycolipids in the monolayer and the glycodendrimers in the aqueous subphase under the monolayer. The resulting perturbations at the air-water interface were manifested as changes in

[5] Woller and Cloninger have reported a similar observation. See Reference 3 in Supporting Information.

surface pressure (Δπ) and monitored by the Wilhelmy plate or pin that sits at the surface of the aqueous subphase. The magnitude of Δπ was measured by the microbalance. These assays were performed on the *Kibron* μtrough Langmuir film balance and all data were computed via the Fimlware 2.1.4 software.

All aqueous solutions were prepared using nanopure water (18.2-18.3 mΩ) obtained from a Millipore filtration system. Monolayer solutions were prepared daily from stock solutions of GM3 and DPPC. The monolayer solution was deposited at the surface of the subphase using a glass syringe until a surface pressure of 30-32mN/m was achieved. A "holding" period of ~500 s followed to assess the stability of the monolayer. The glycodendrimer analyte was then injected under the monolayer into the subphase. and allowed to interact with the monolayer for 2500 s. The Δπ value for each assay was calculated by subtracting the initial surface pressure from the final surface pressure (Figure S1). The reported Δπ values are an average of at least 3 trials (Table S3).

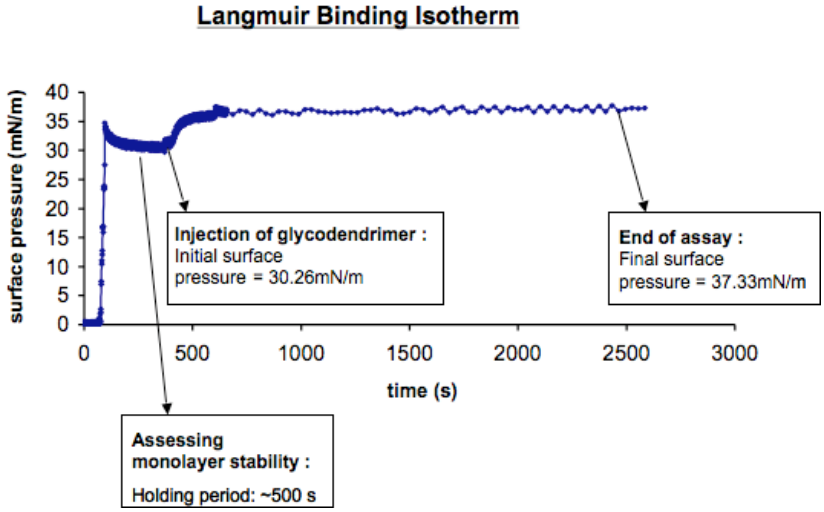
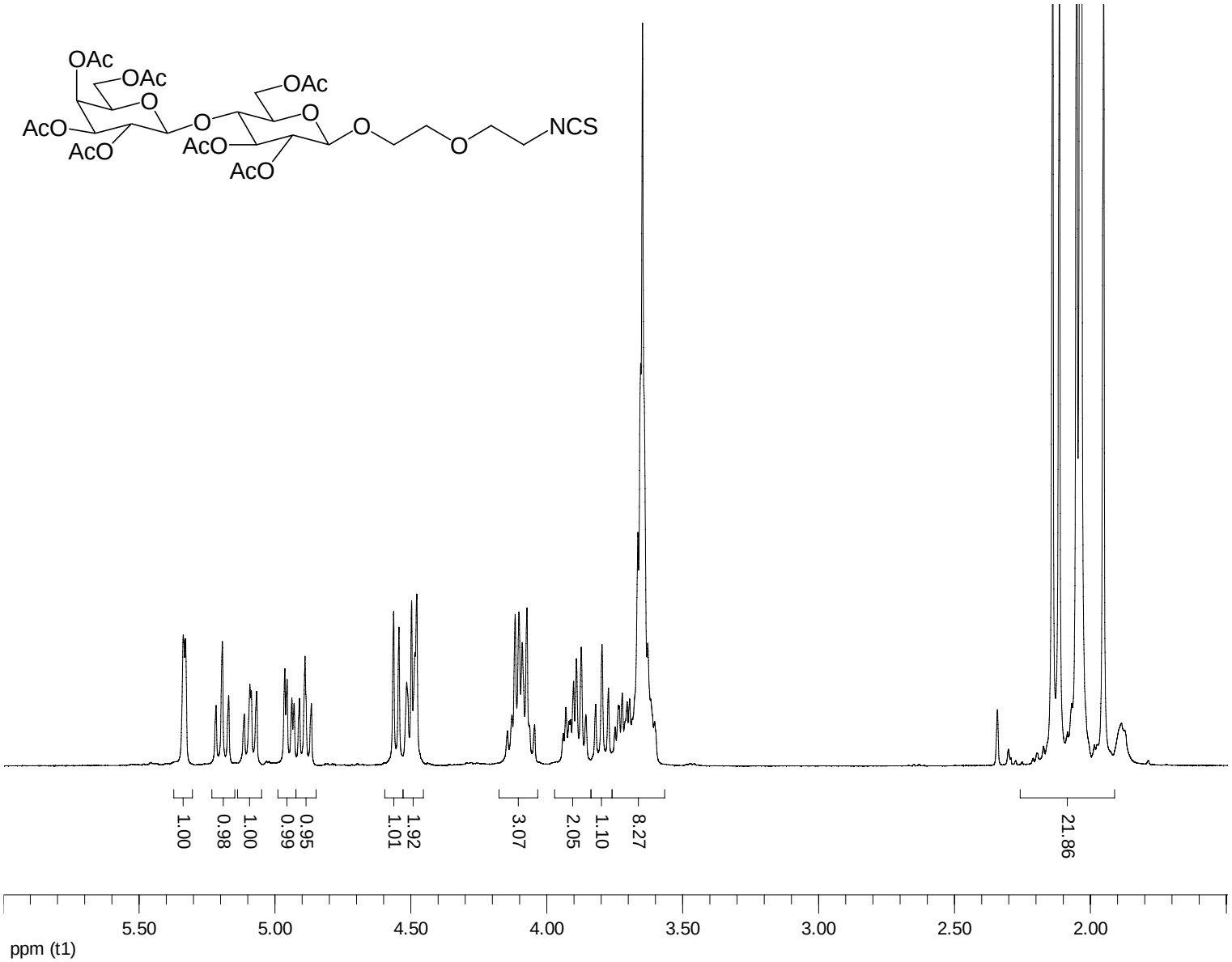


Figure S1. An example of a Langmuir binding isotherm

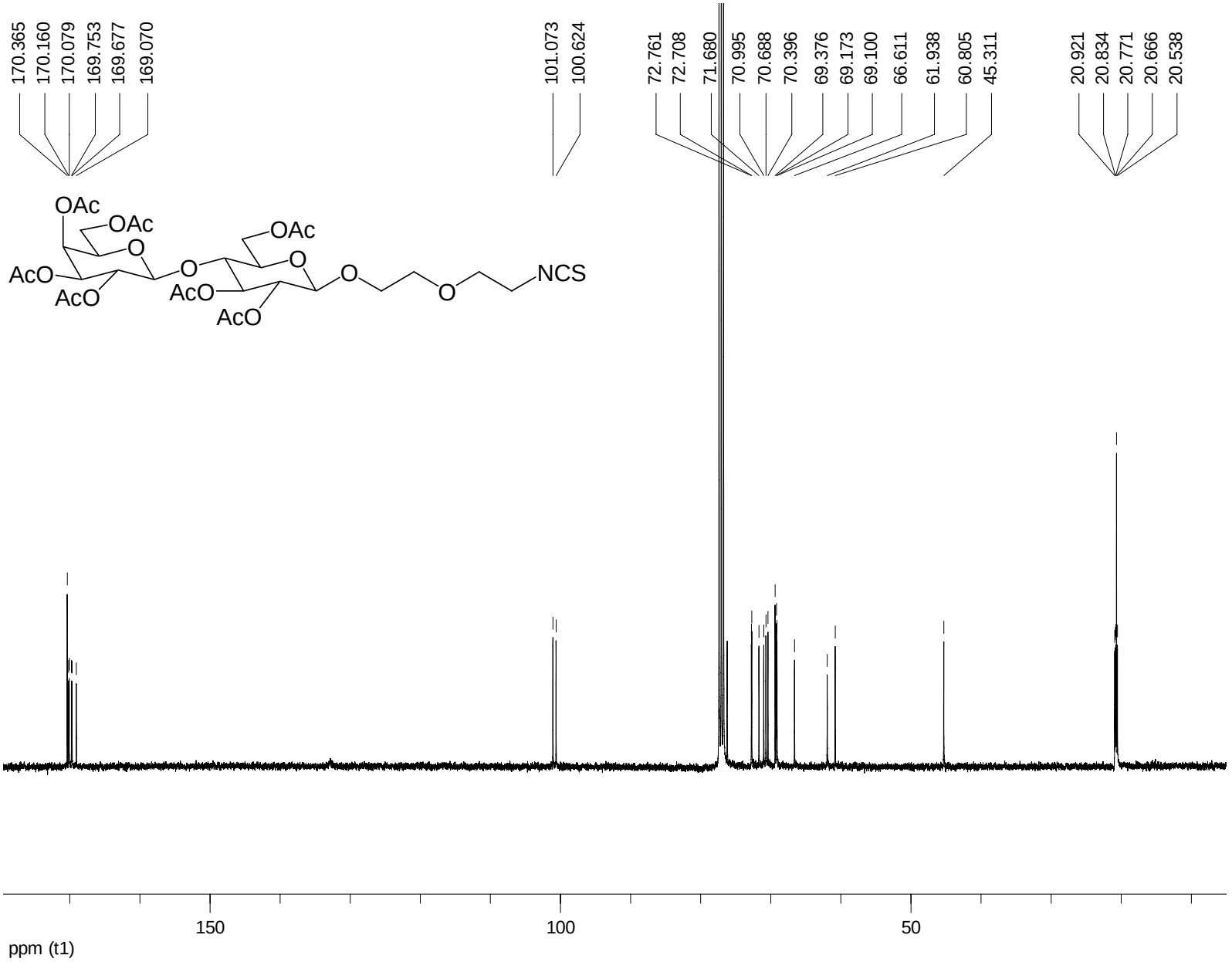
Table S3. Results for P-G4-$Lac_{25}Gly_{30}$

Entry	Δπ (mN/m)
1	10.28
2	7.02
3	10.74
4	7.06
Average	***8.77***
Std. Dev.	***2.01***

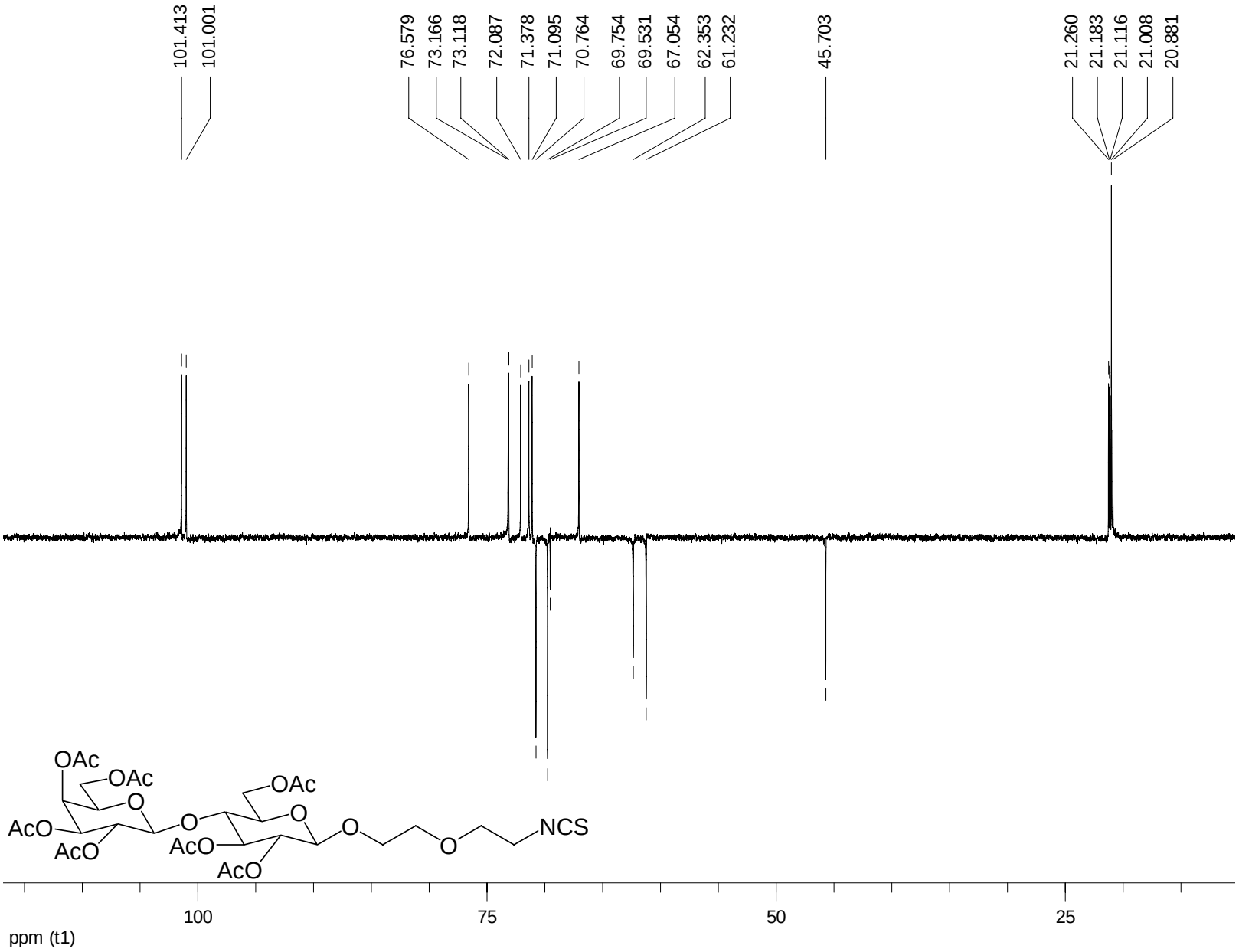
Lactosyl Ligand 3 – ^{1}H



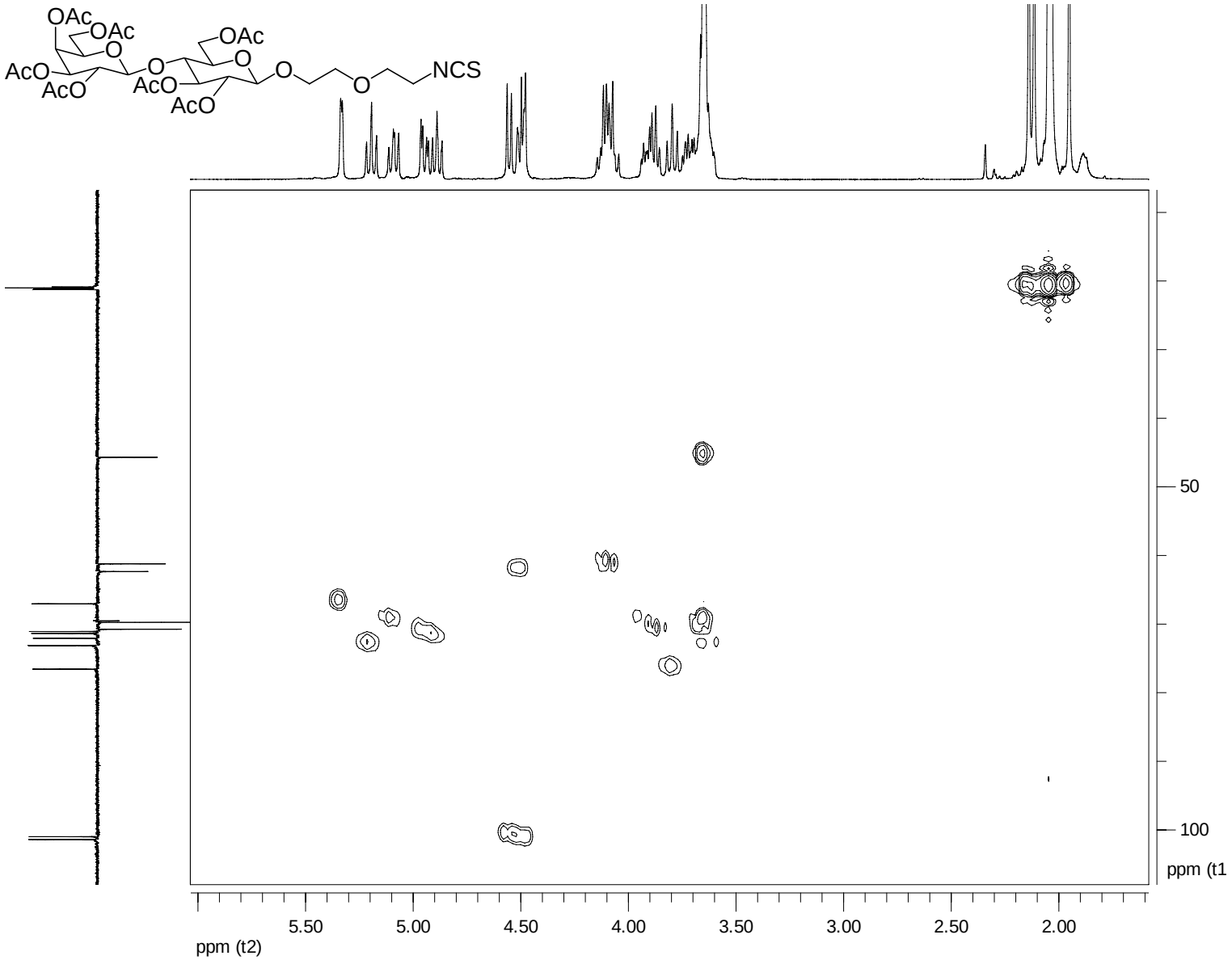
Lactosyl Ligand 3 – ^{13}C



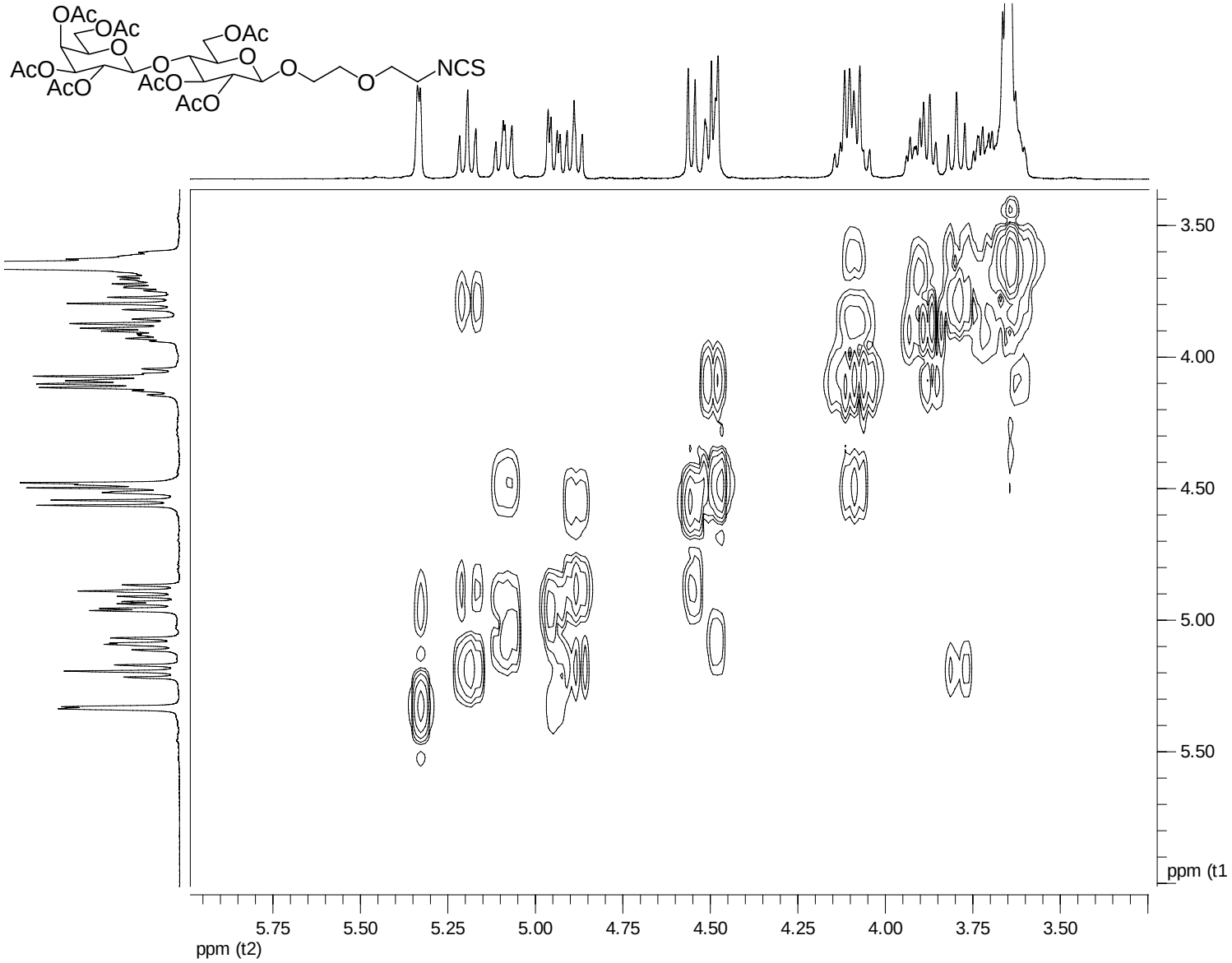
Lactosyl Ligand 3 – ^{13}C DEPT



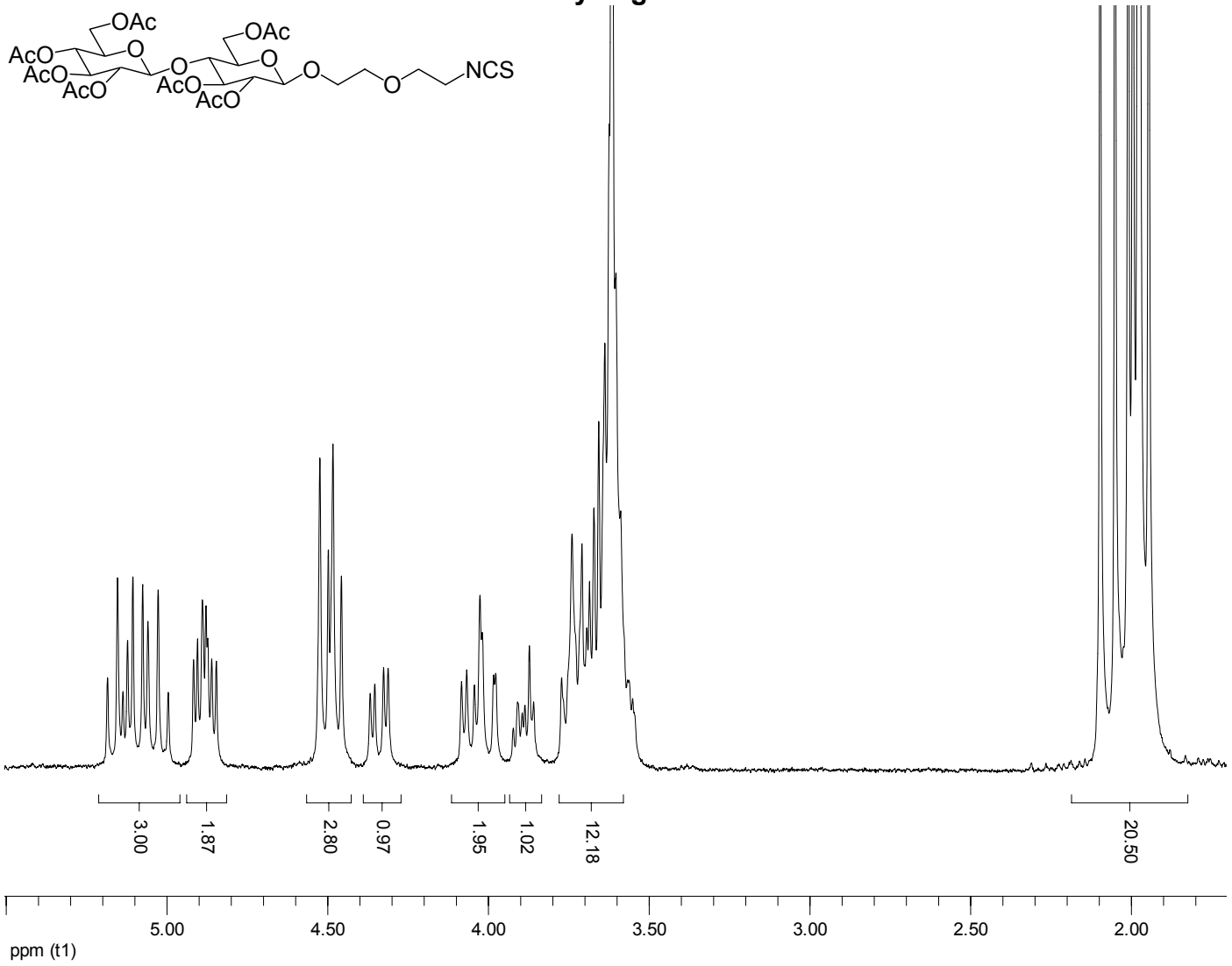
Lactosyl Ligand 3 – $^{1}H,^{13}C$-HSQC



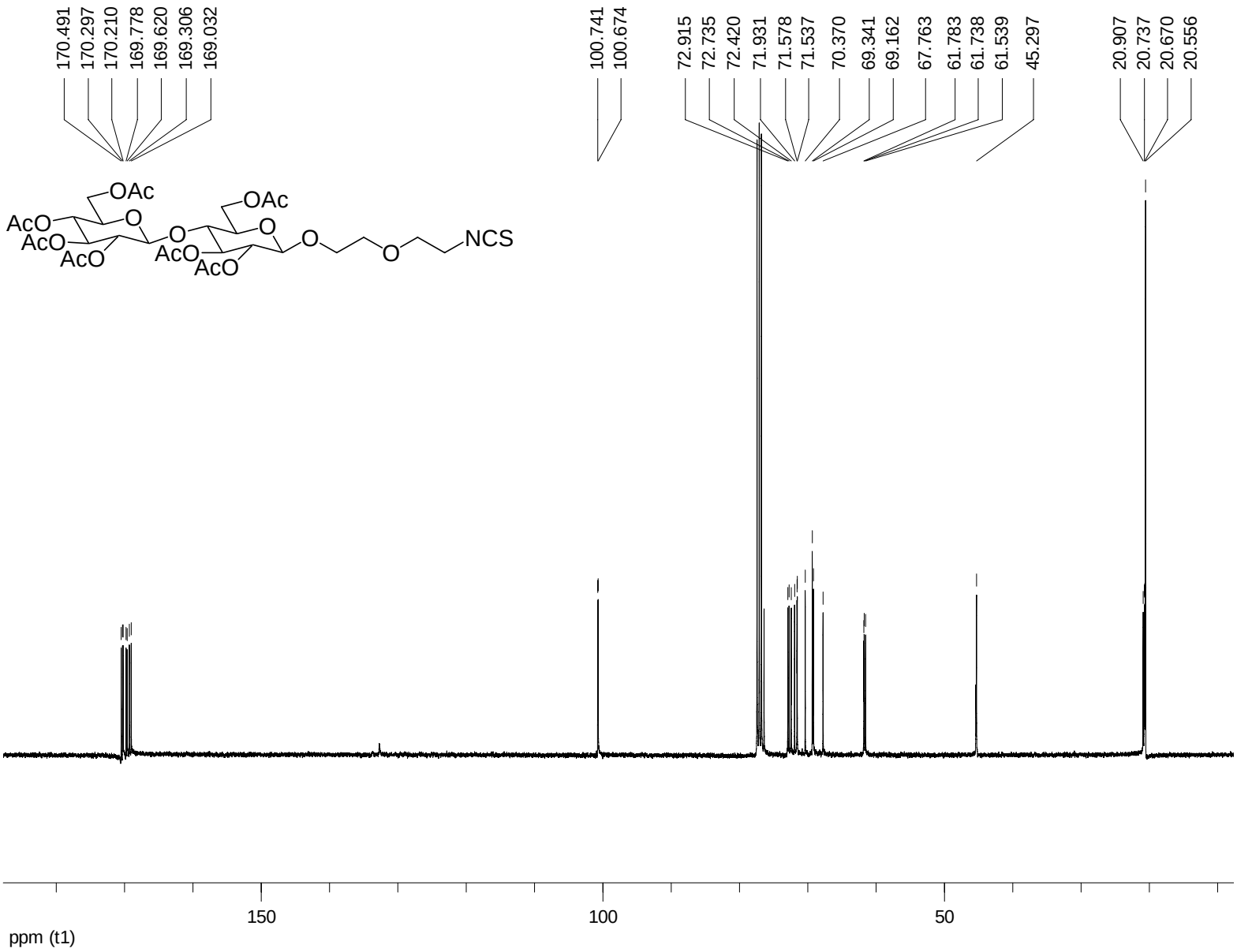
Lactosy Ligand 3 – $^{1}H,^{1}H$-COSY



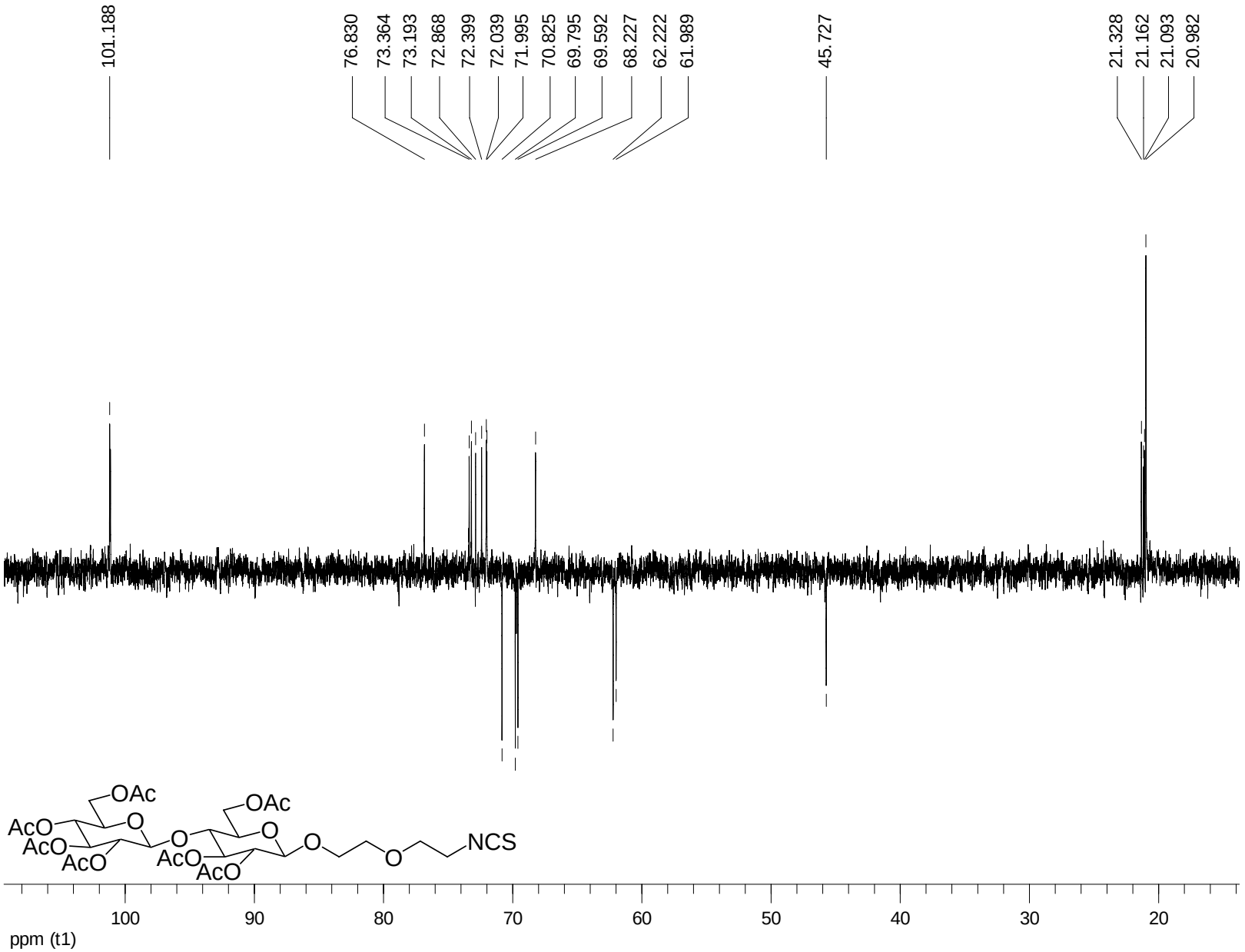
Cellobiosyl Ligand 5 – ^{1}H



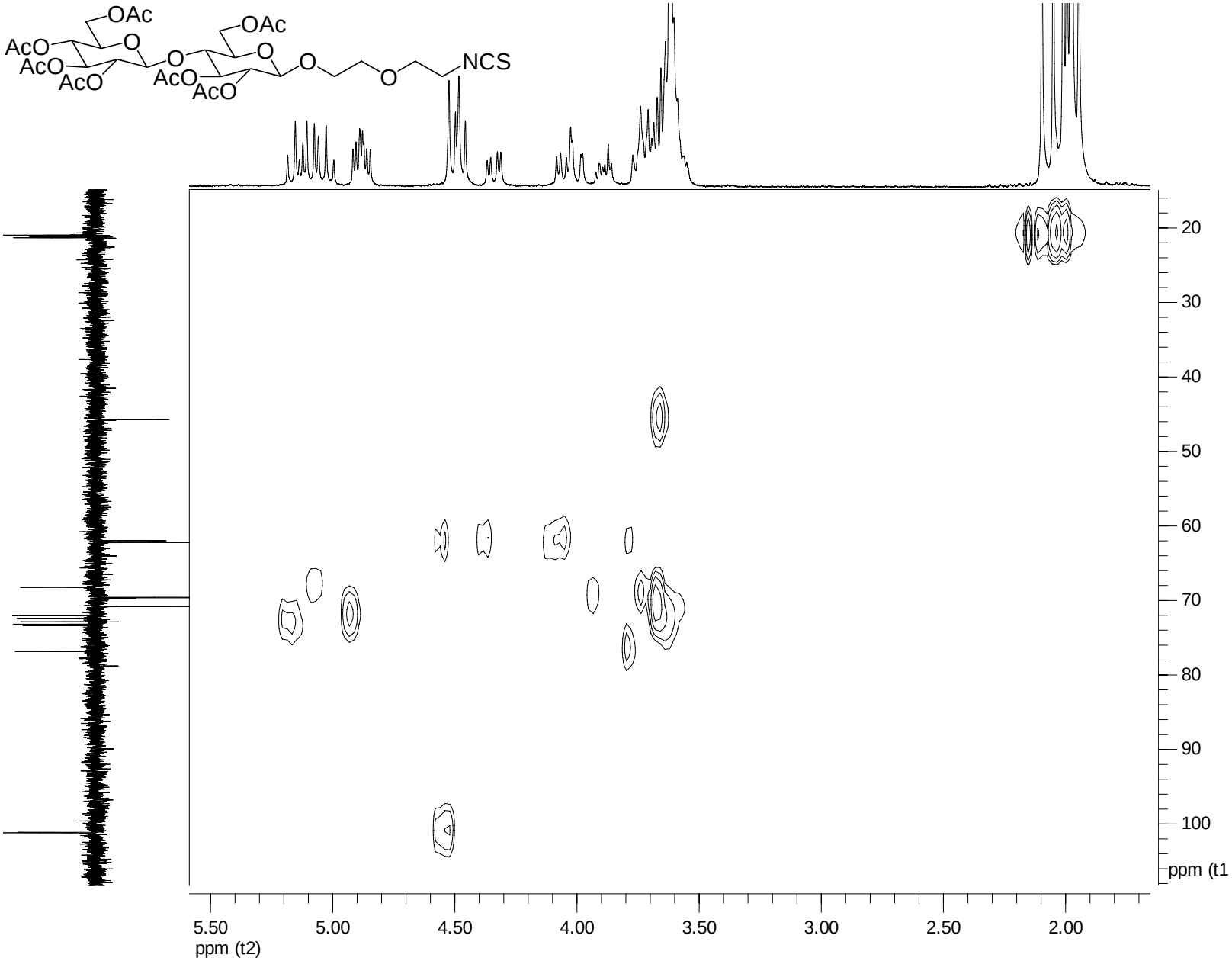
Cellobiosyl Ligand 5 – ^{13}C



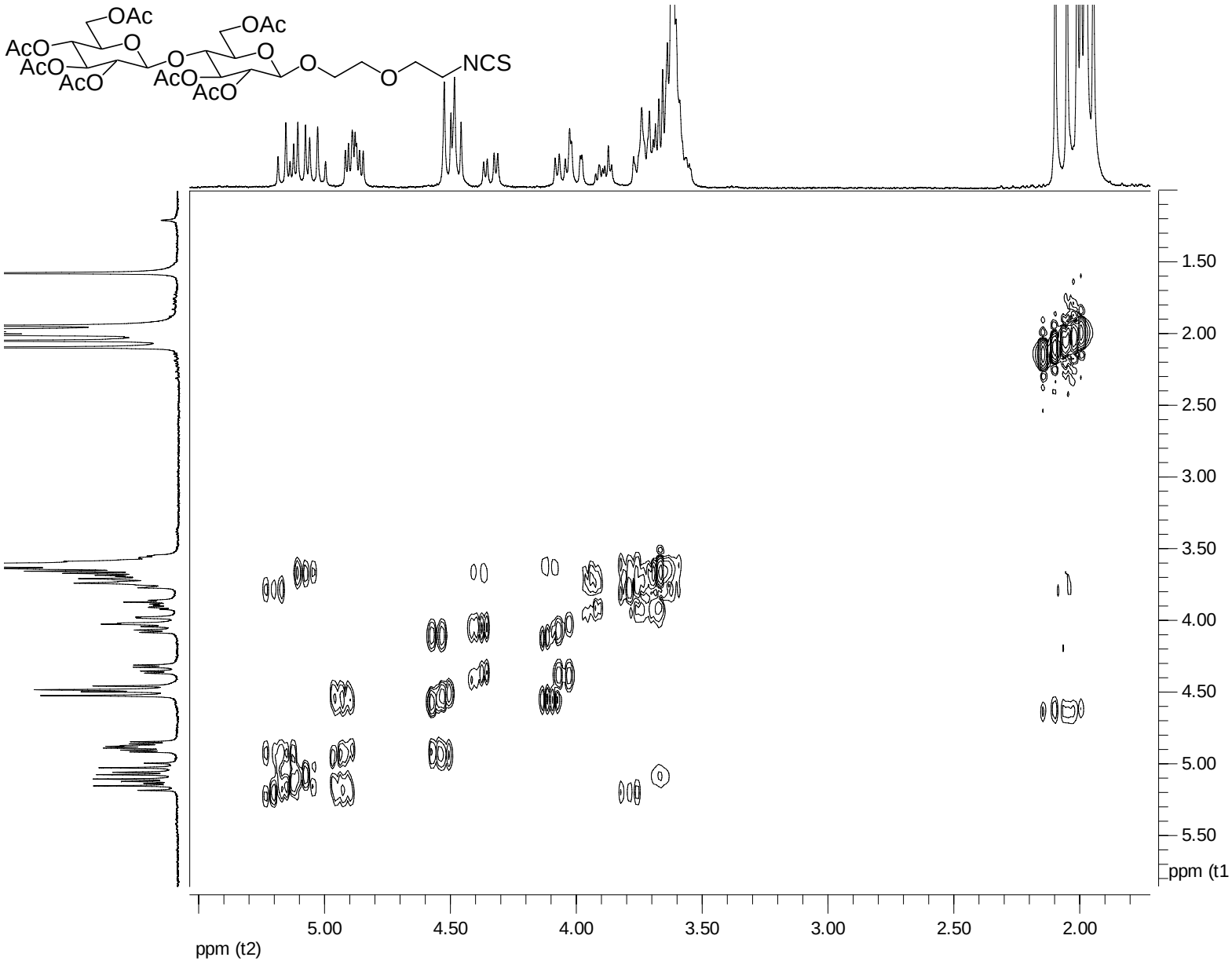
Cellobiosyl Ligand 5 – ^{13}C DEPT



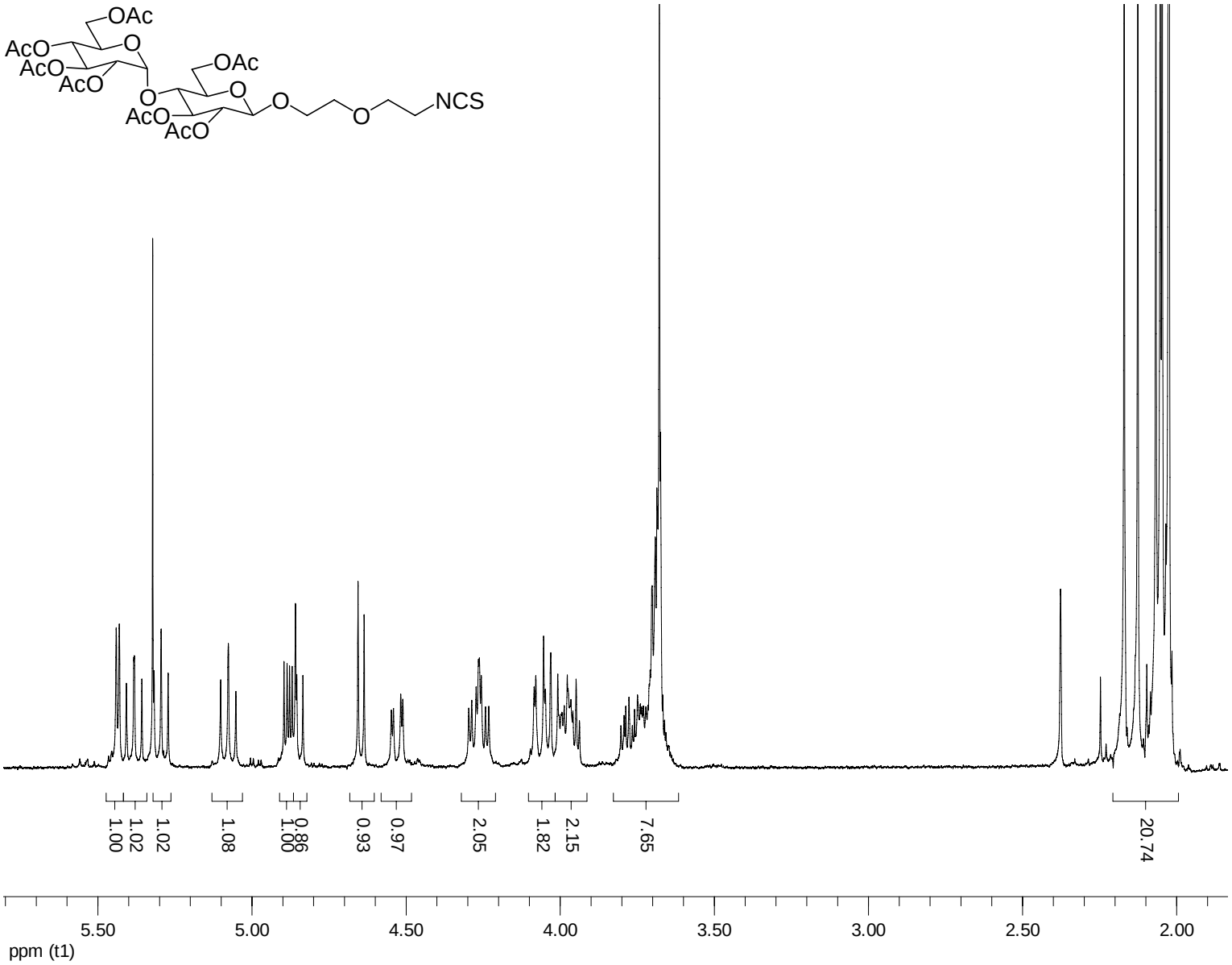
Cellobiosyl Ligand 5 – $^{1}H,^{13}C$-HSQC



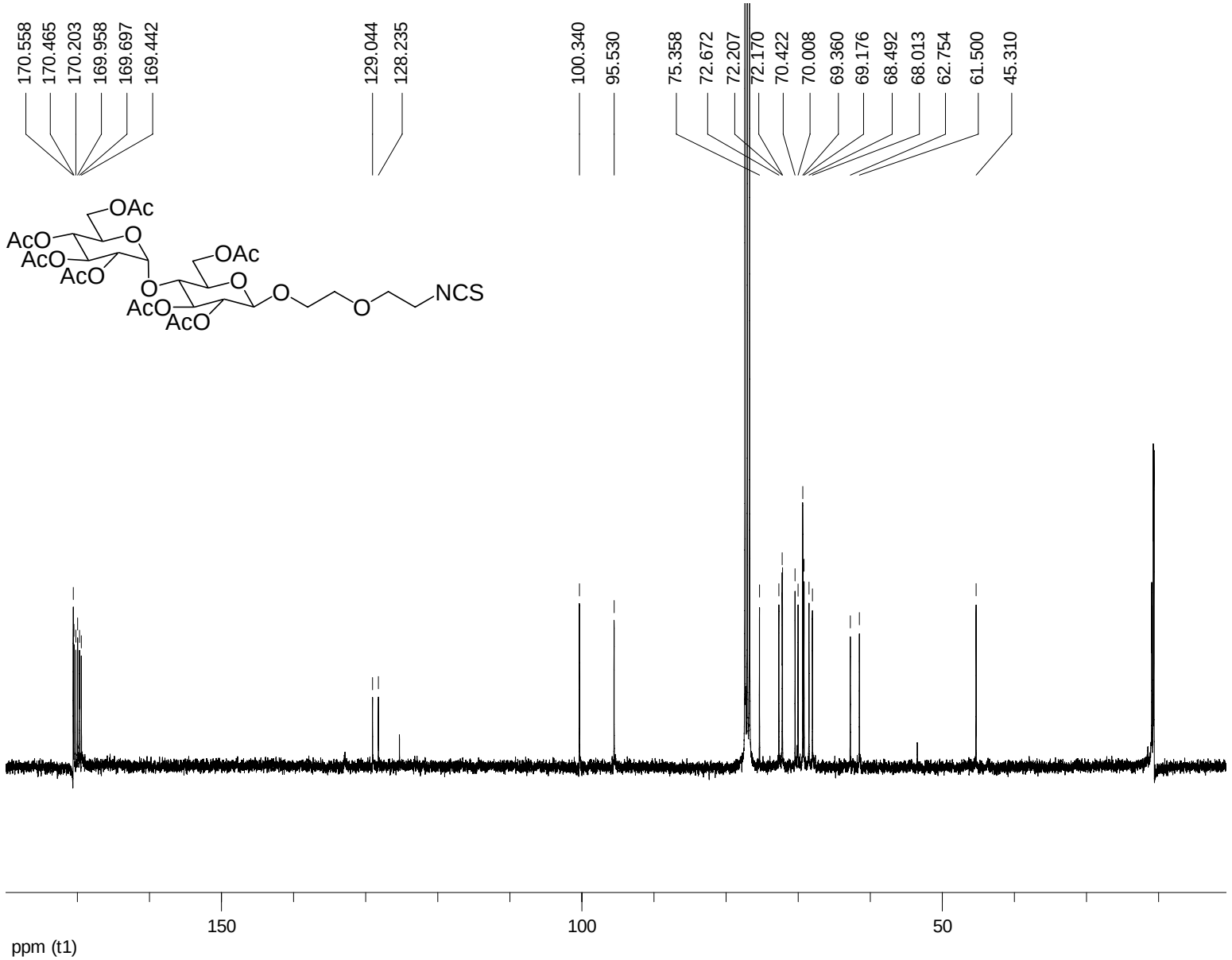
Cellobiosyl Ligand 5 – $^{1}H,^{1}H$-COSY



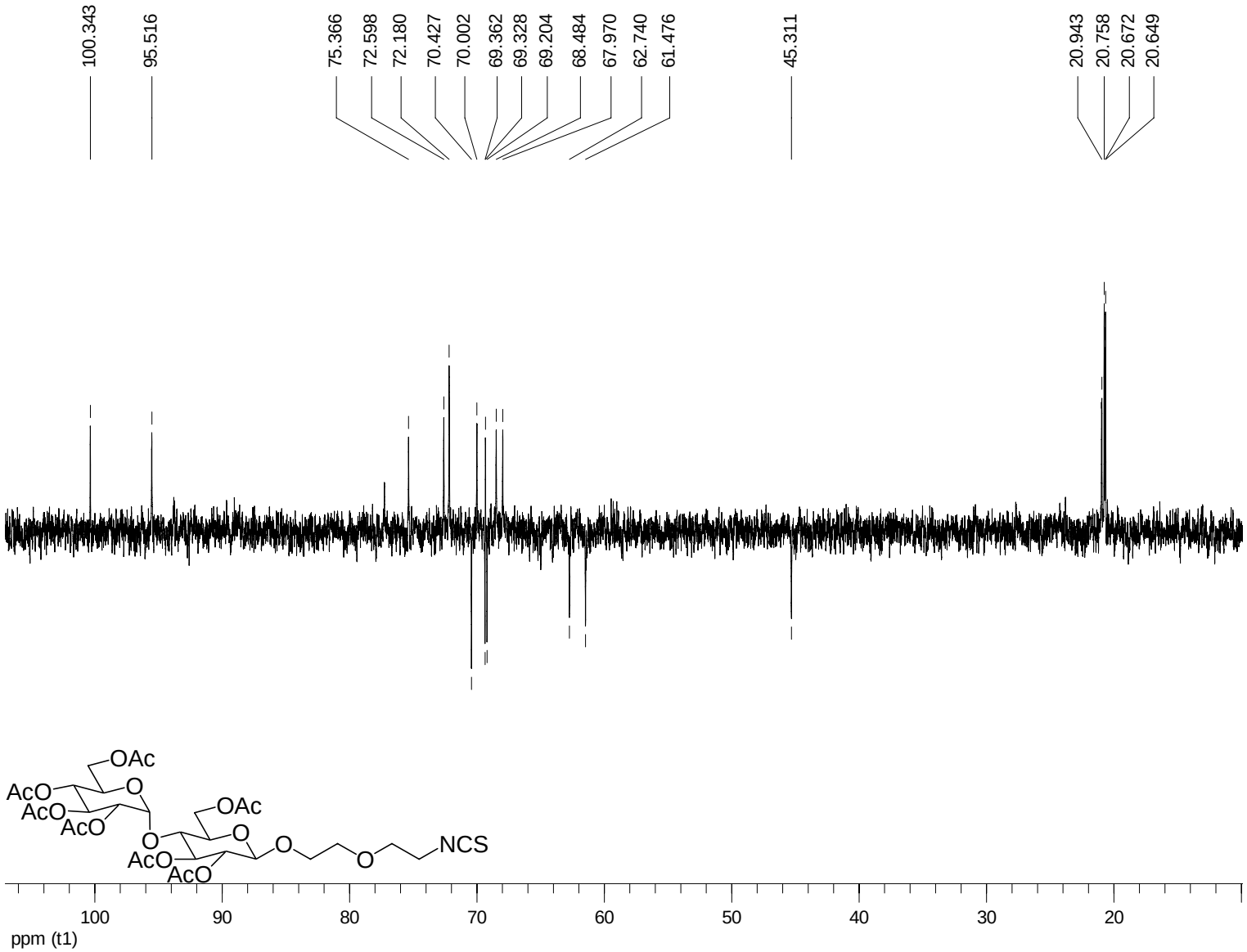
Maltosyl Ligand 6 – ^{1}H



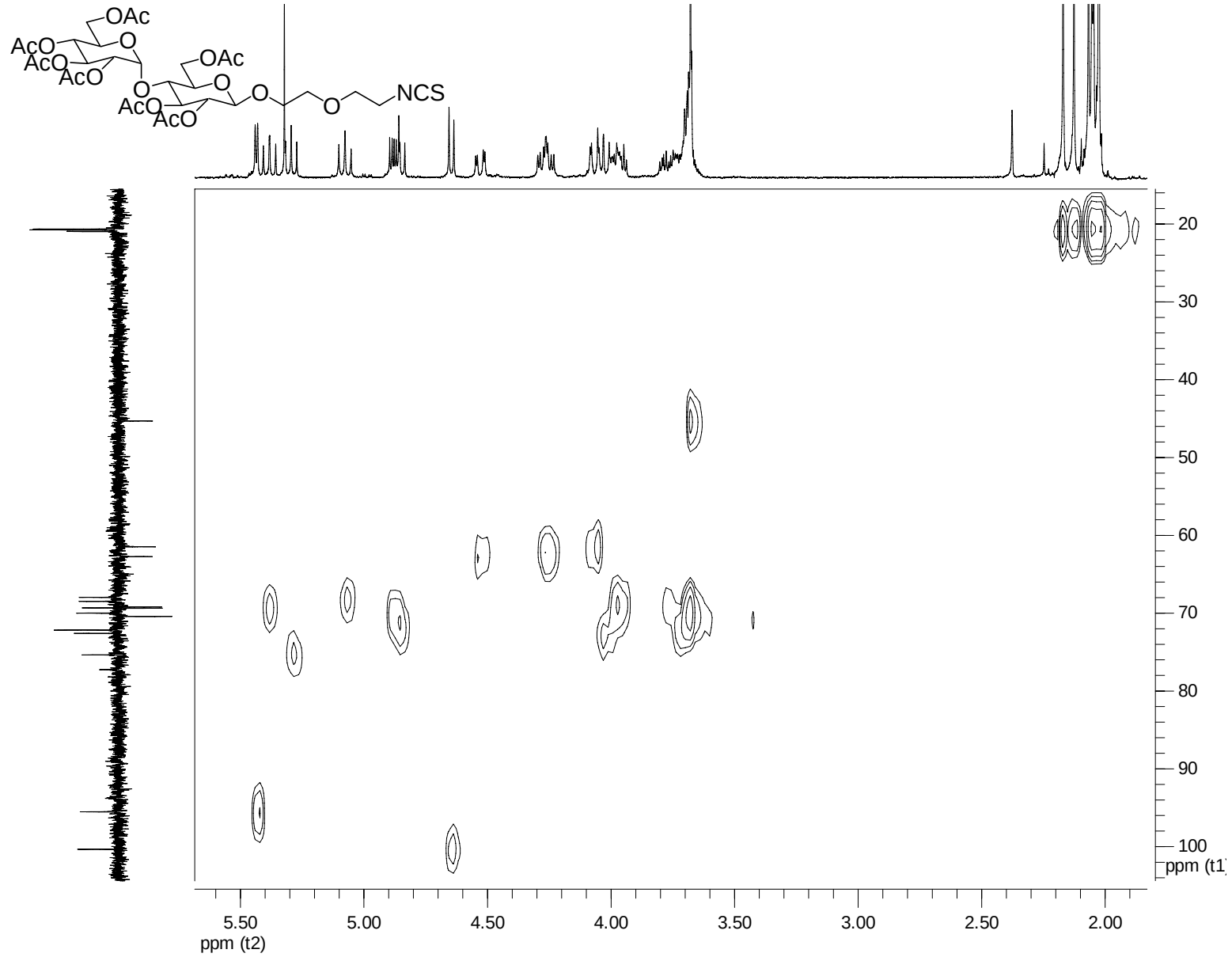
Maltosyl Ligand 6 – ^{13}C



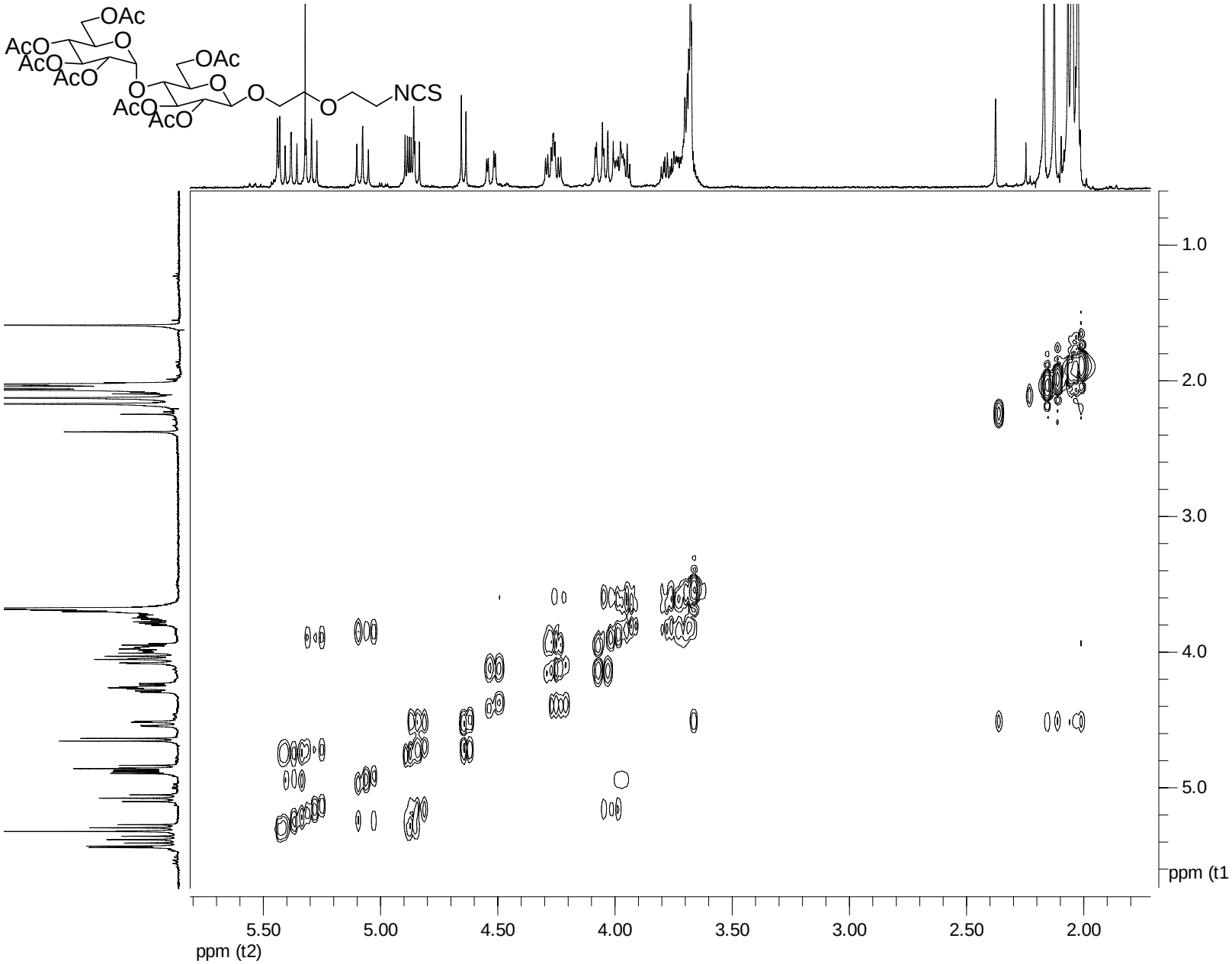
Maltosyl Ligand 6 – ^{13}C DEPT



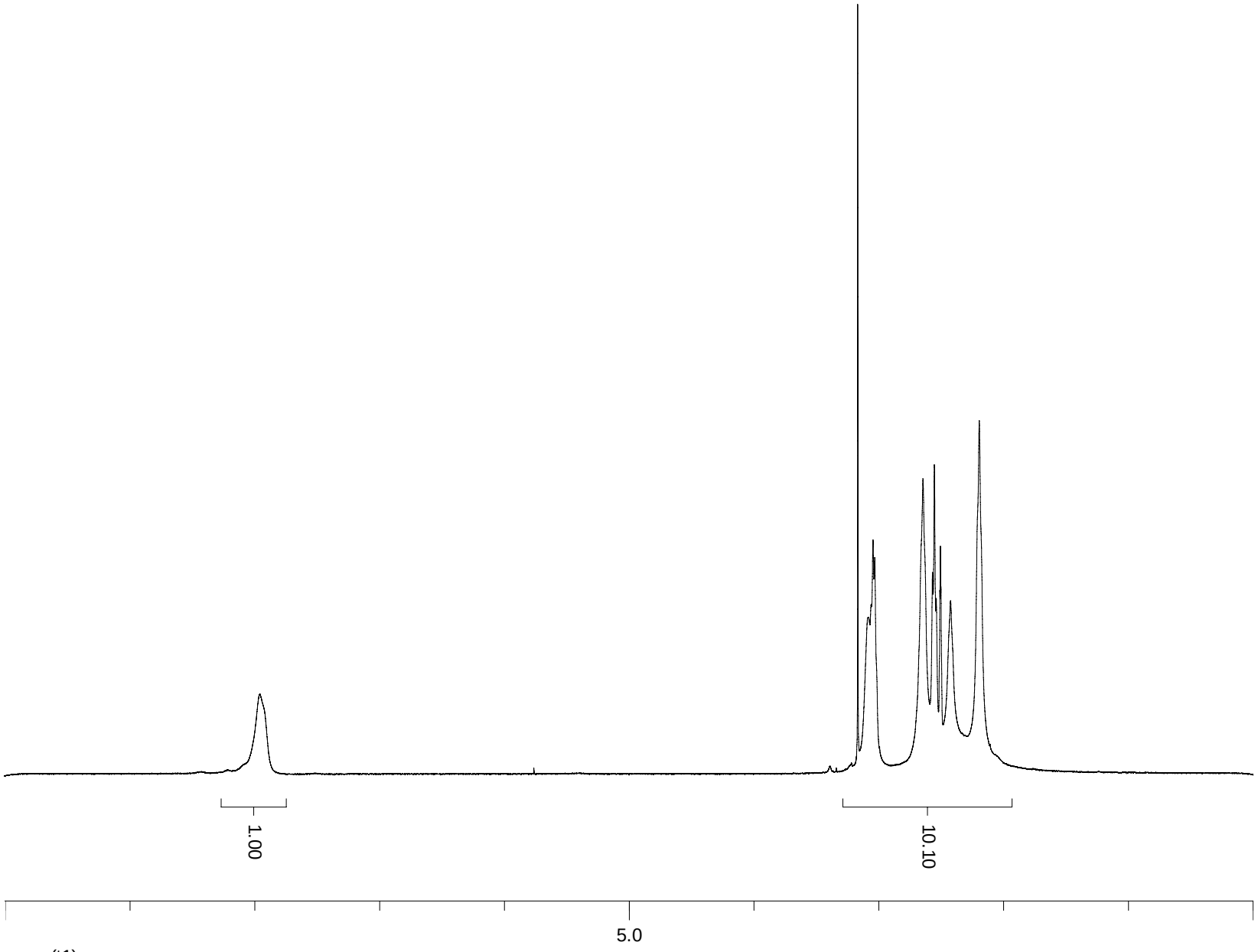
Maltosyl Ligand 6– ^{1}H,^{13}C-HSQC



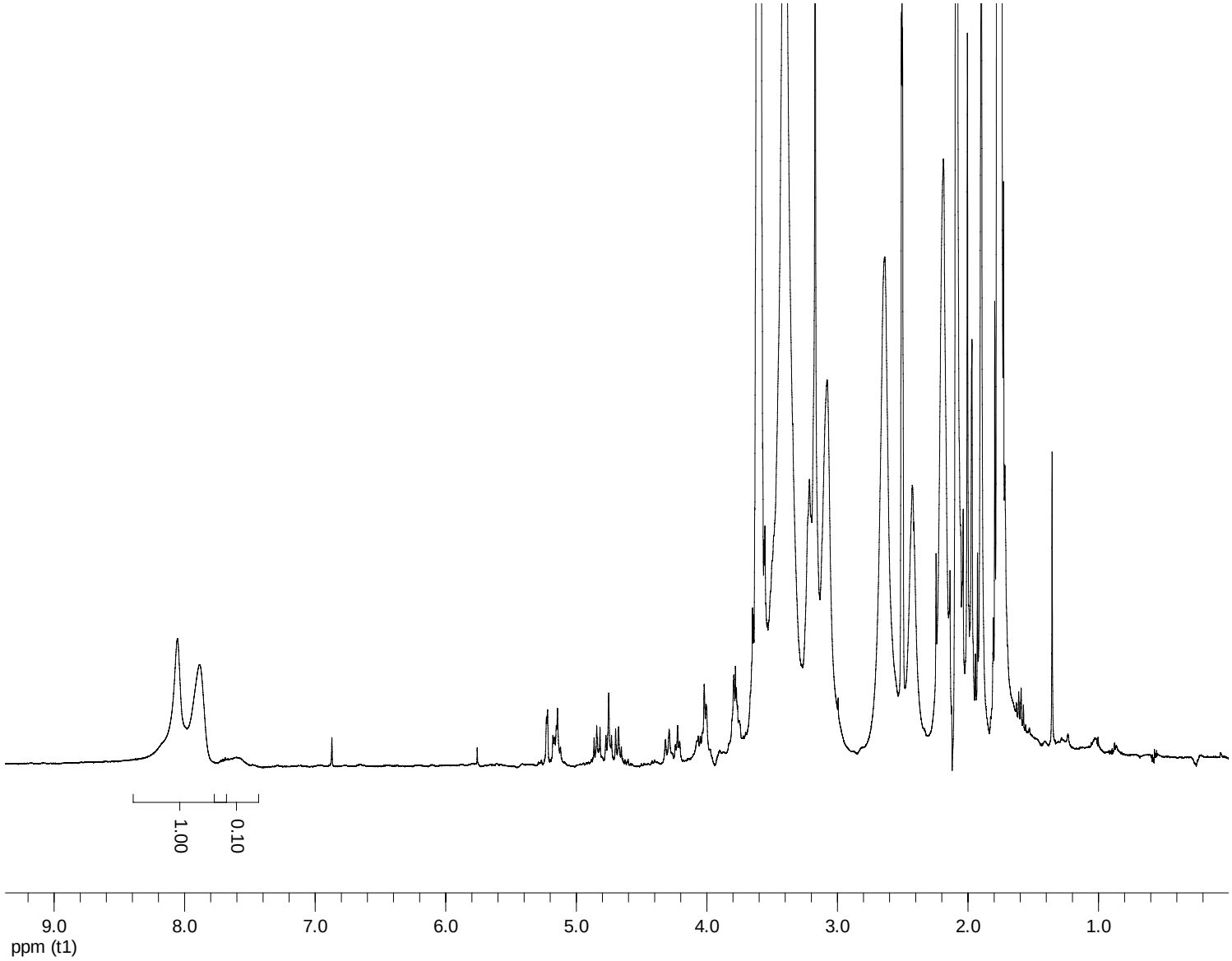
Maltosyl Ligand 6– ^{1}H,^{1}H-COSY


OAc
AcO
O
AcO
AcO
AcO
OAc
O
O
O
AcO
AcO
O
NCS
1.0
2.0
3.0
4.0
5.0
ppm (t1
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
ppm (t2)

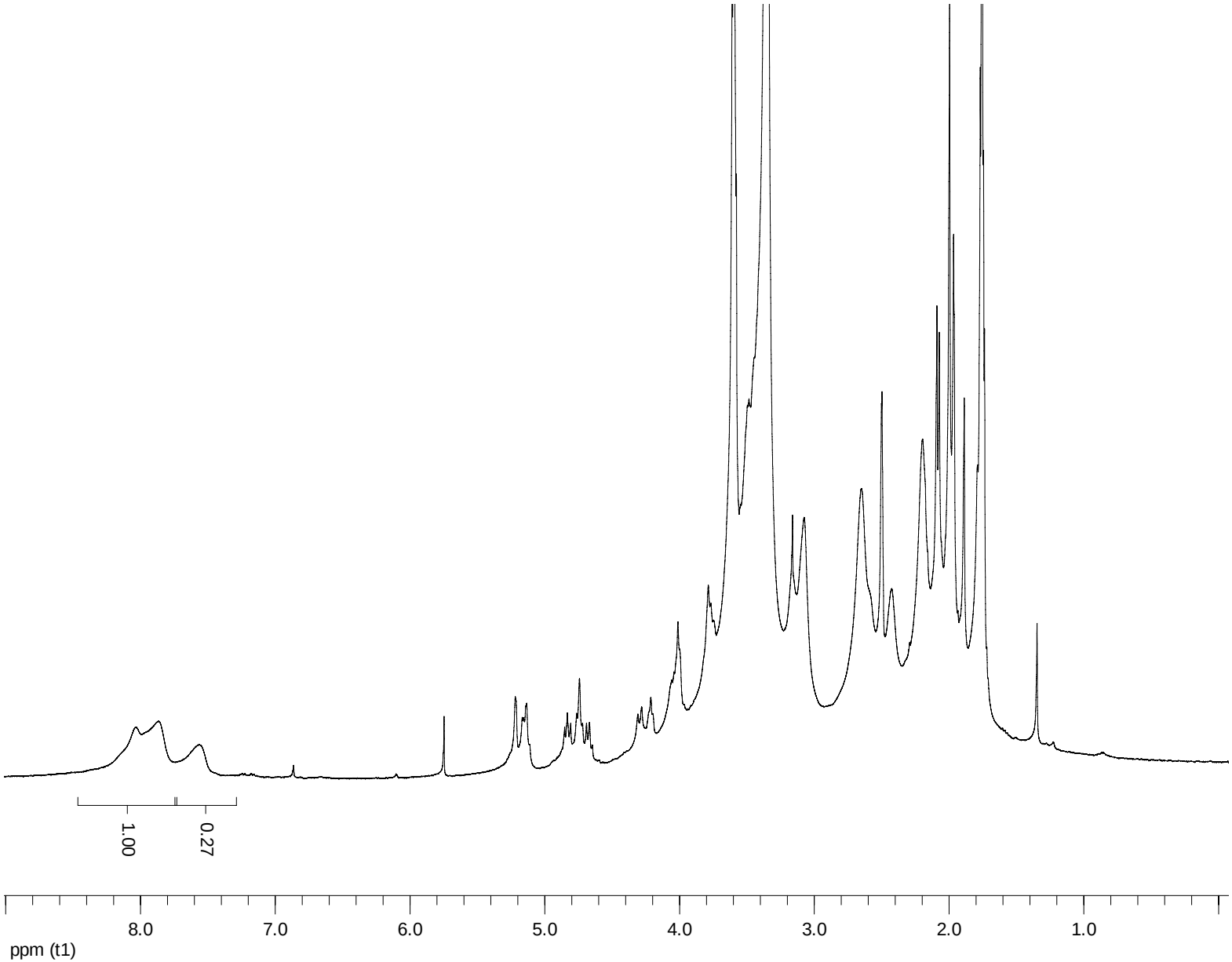
P-G4-Lac_0NH_{56} – G4 PAMAM Dendrimer



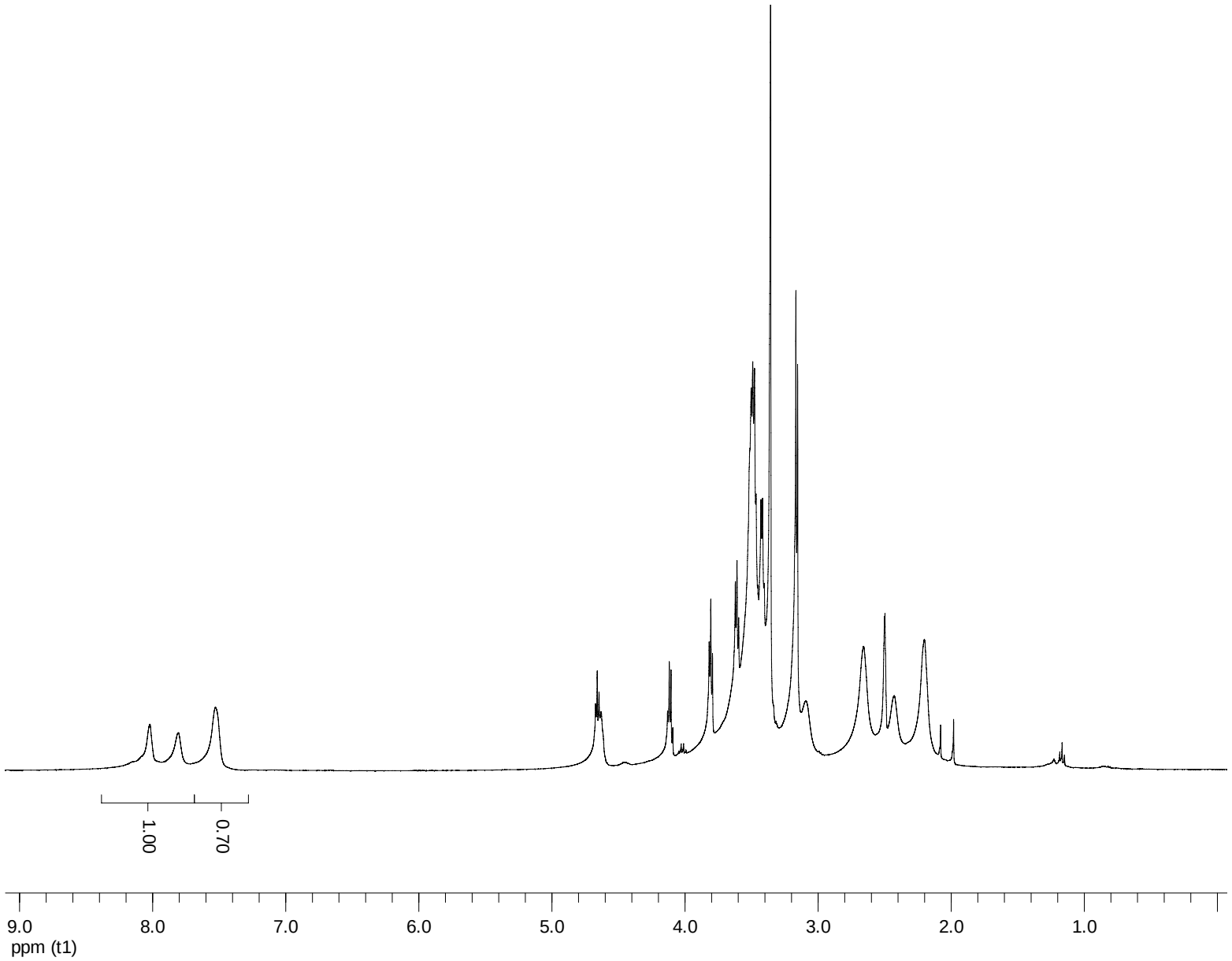
P-G4-Lac$_7$NH$_{49}$ – 13% Lactosyl_OAc$_7$ –Glycodendrimer



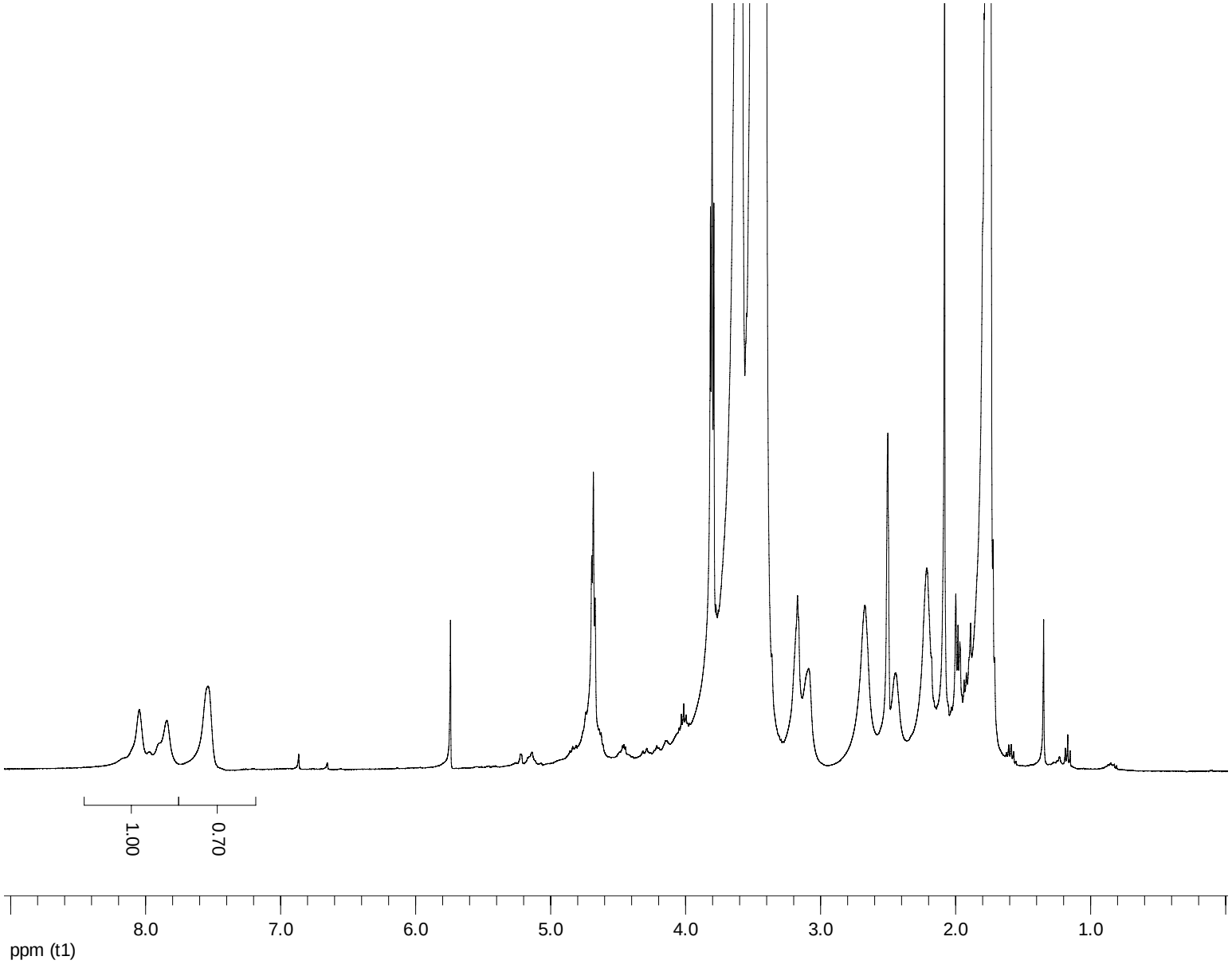
P-G4-$Lac_{24}NH_{32}$ – 44% Lactosyl_OAc_7 Glycodendrimer



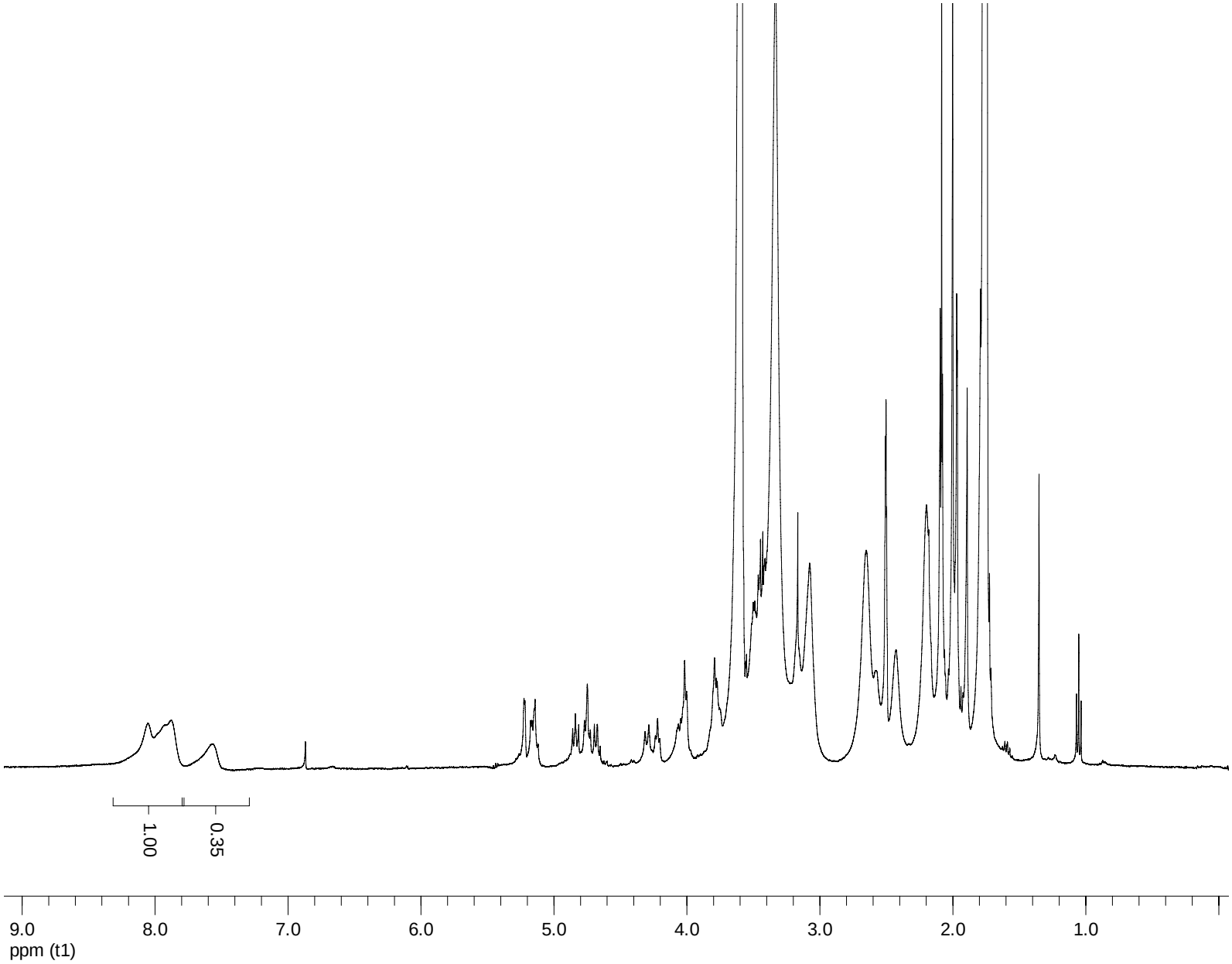
P-G4-Lac$_0$Gly$_{56}$ – Glycol Dendrimer



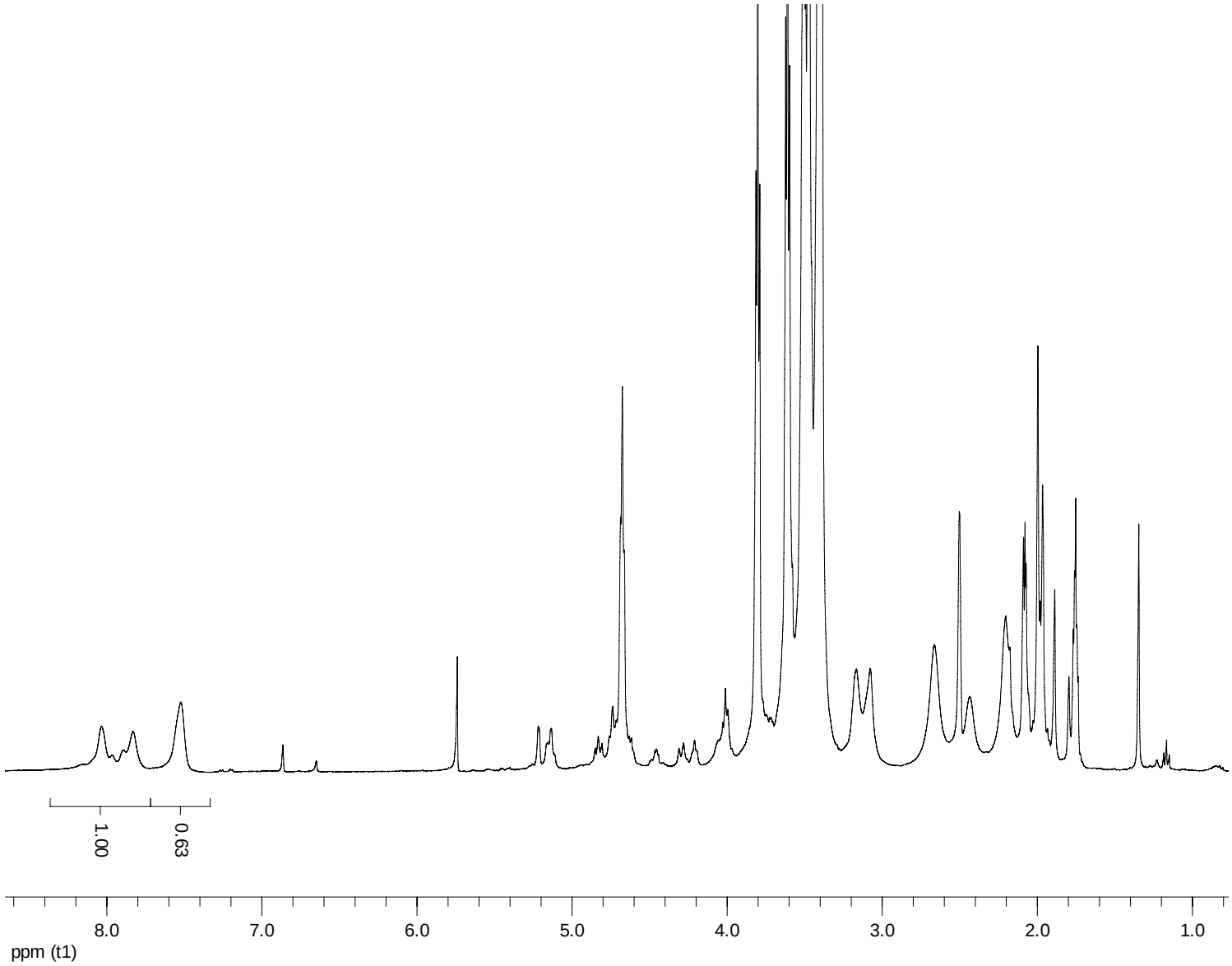
P-G4-$Lac_{13}Gly_{48}$ – 13%Lactosyl_OAc_7, Glycol Capped Glycodendrimer



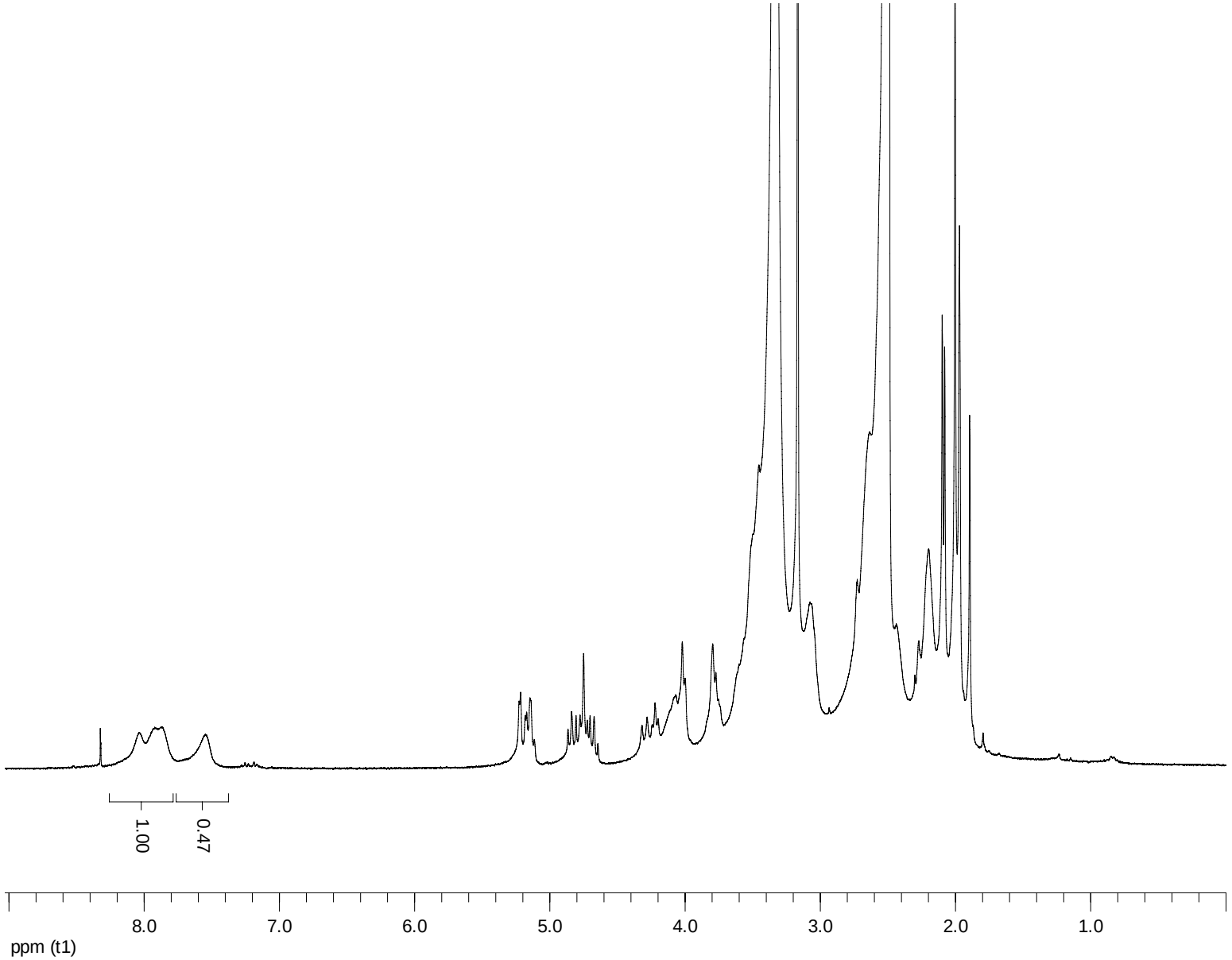
P-G4-Lac$_{17}$Gly$_{27}$ – 31% Lactosyl_OAc$_7$, uncapped Glycodendrimer



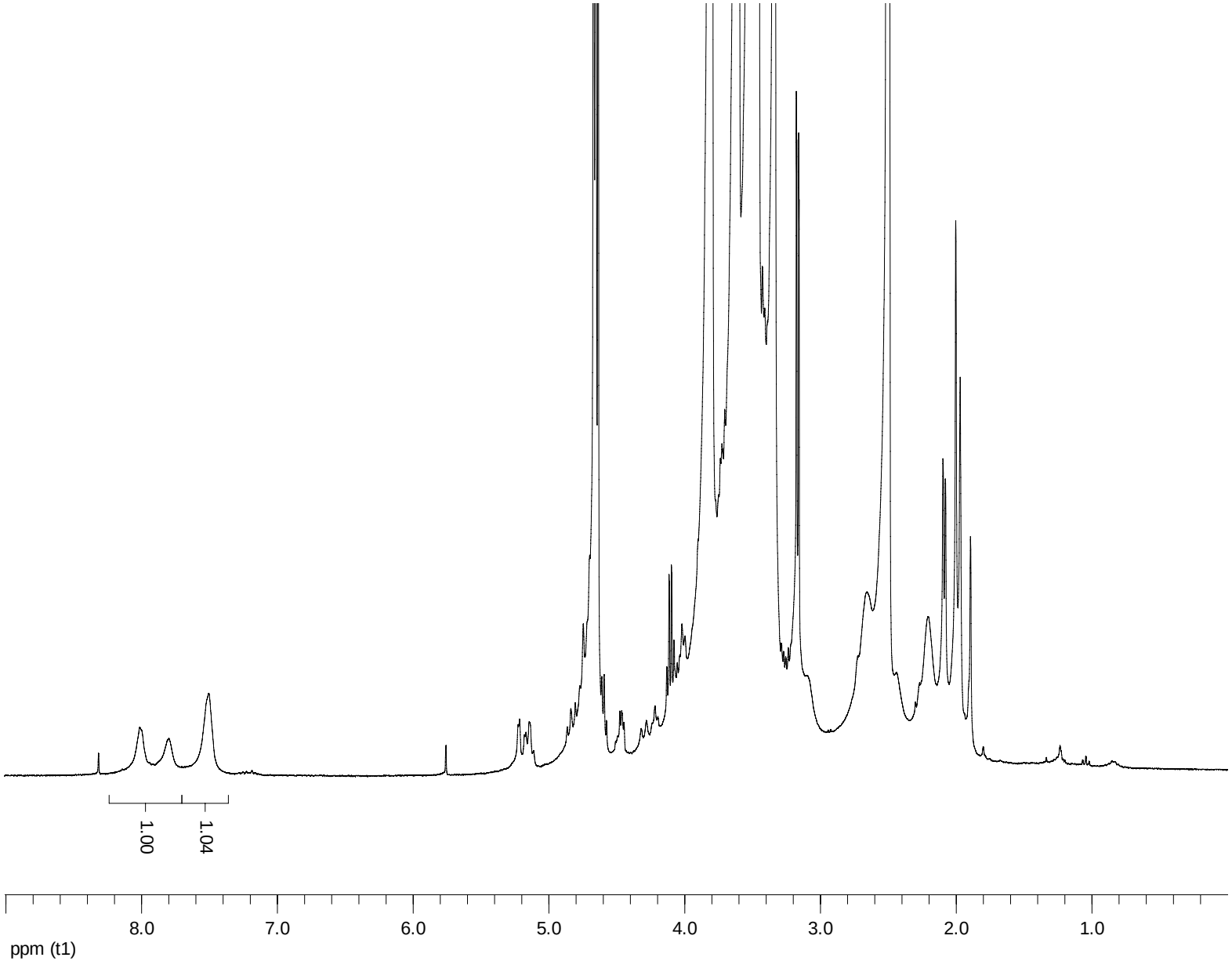
P-G4-$Lac_{17}Gly_{27}$ – 31% Lactosyl_OAc_7, Glycol capped Glycodendrimer



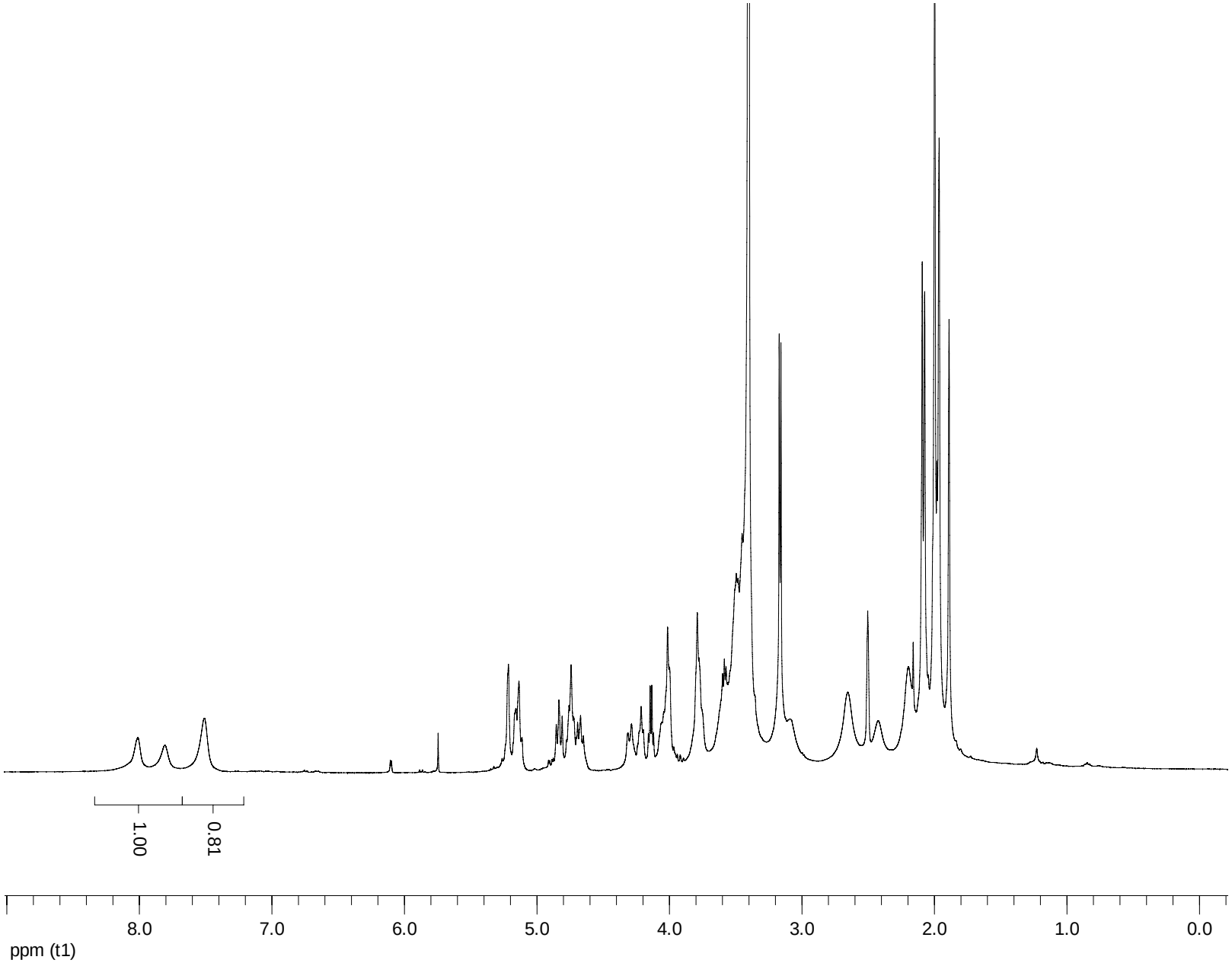
P-G4-$Lac_{25}Gly_{30}$ – 45%Lactosyl_OAc_7, uncapped Glycodendrimer



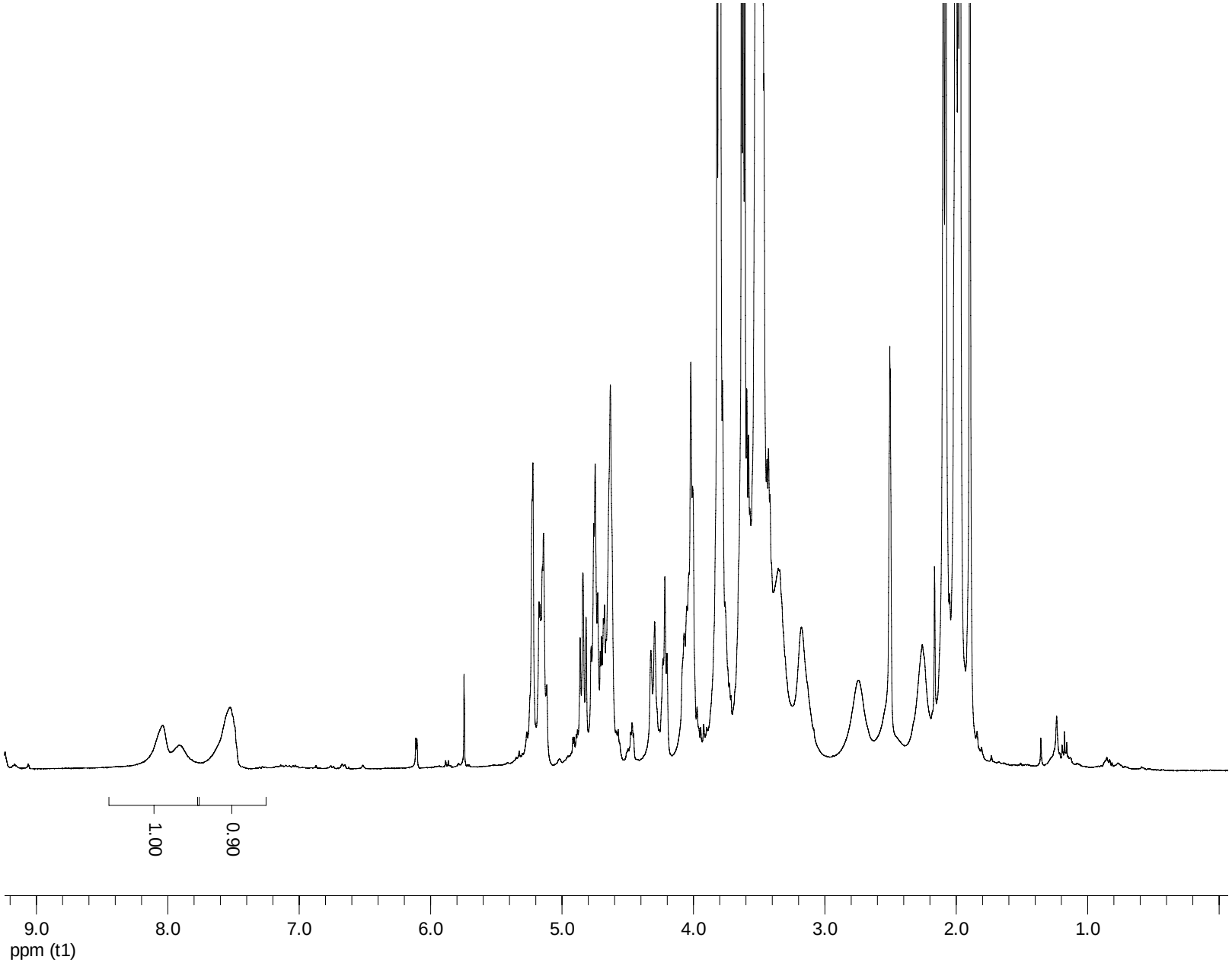
P-G4-$Lac_{25}Gly_{30}$ – 45% Lactosyl_OAc_7, Glycol capped Glycodendrimer



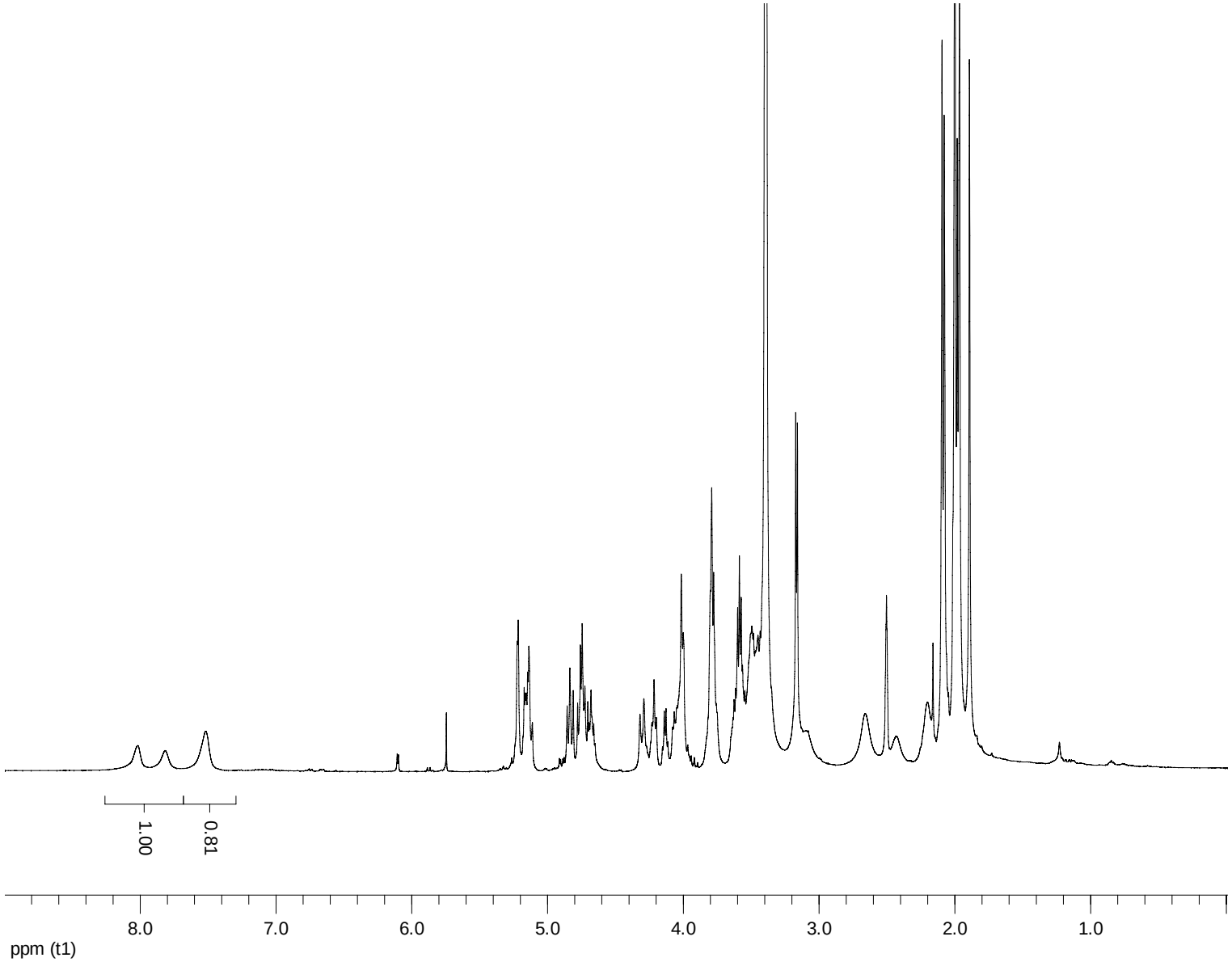
P-G4-$Lac_{35}Gly_9$ – 64% Lactosyl_OAc_7, uncapped Glycodendrimer



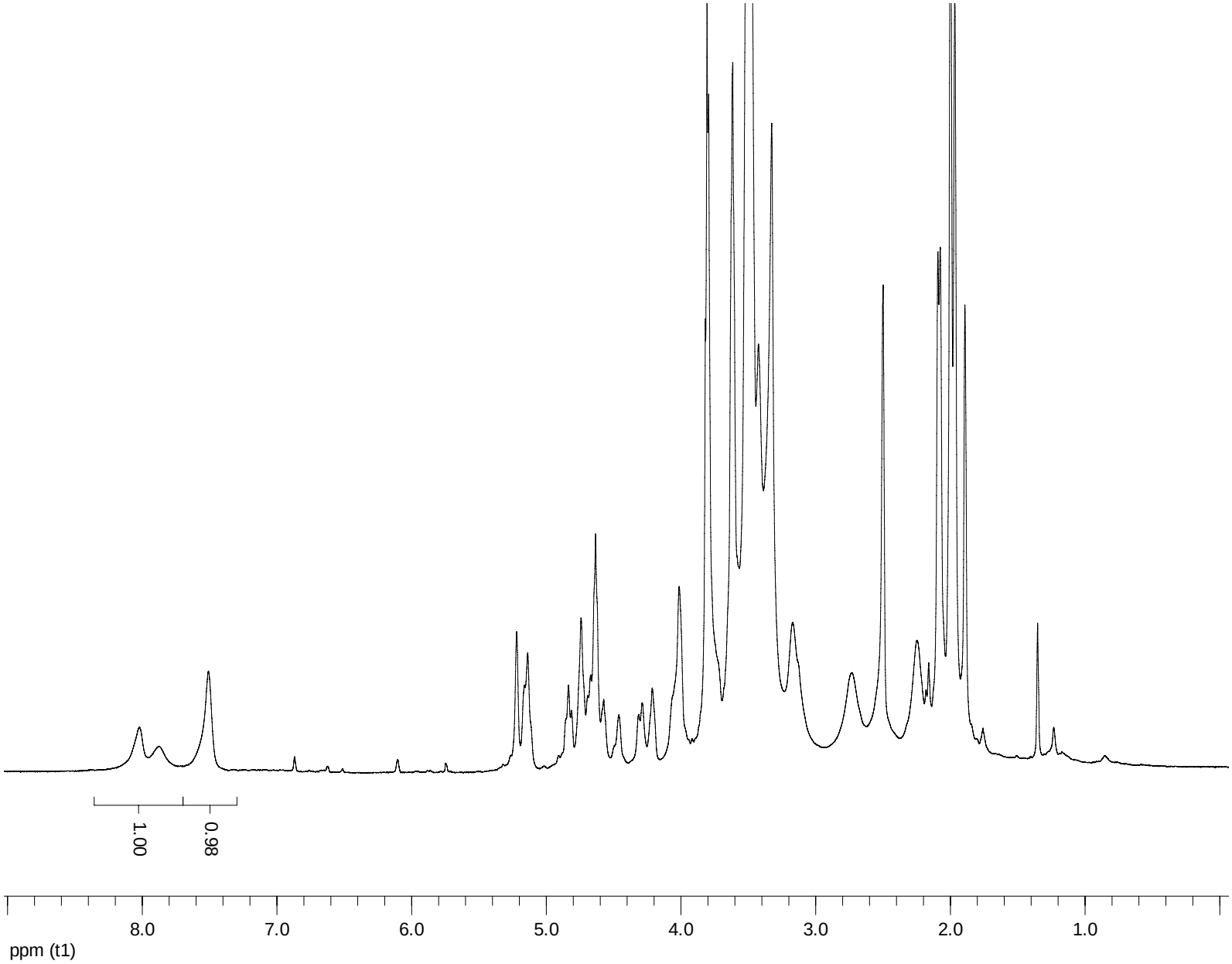
P-G4-$Lac_{35}Gly_9$ – 64% Lactosyl_OAc_7, Glycol capped Glycodendrimer



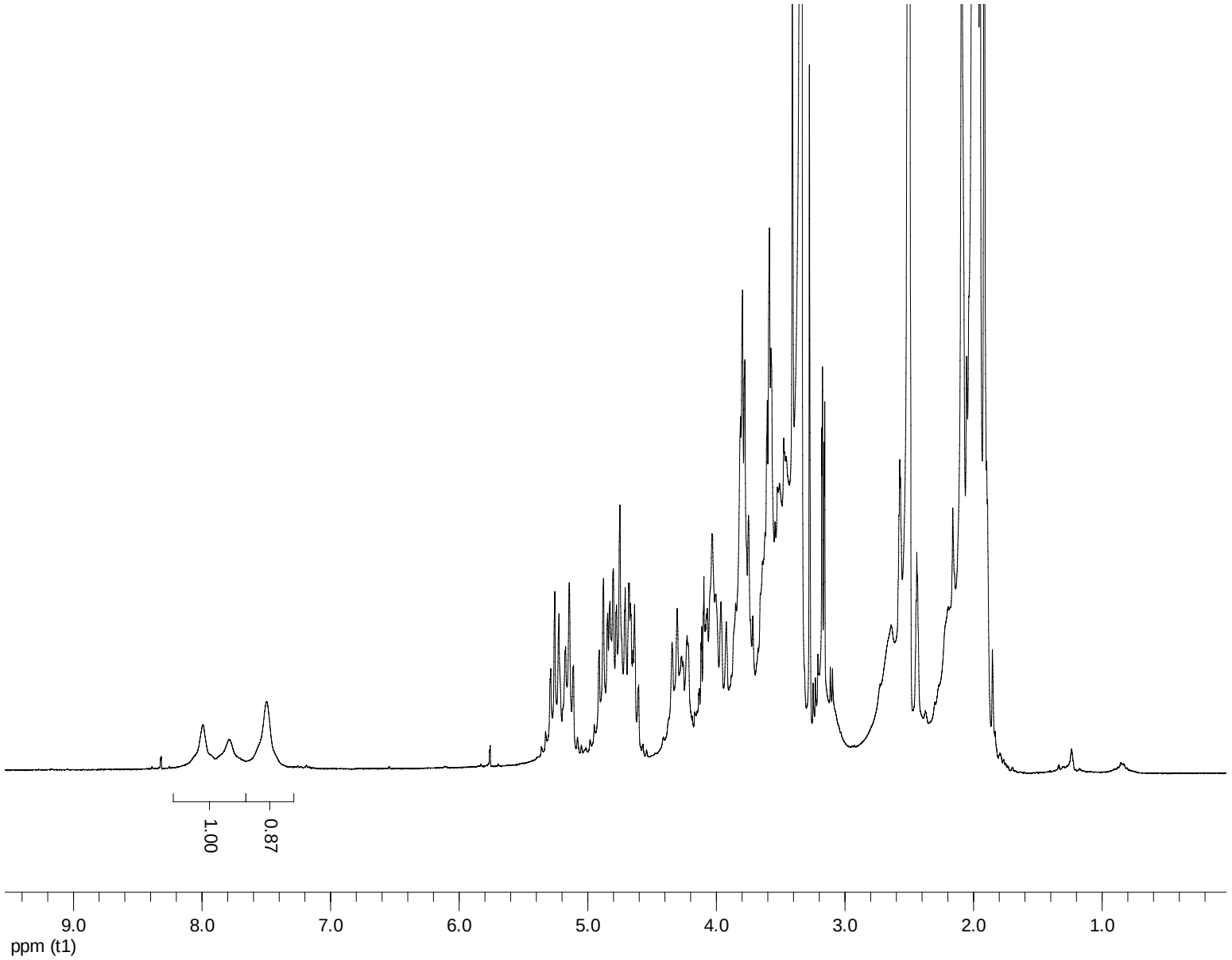
P-G4-$Lac_{42}Gly_2$ – 75% Lactosyl_OAc, uncapped Glycodendrimer



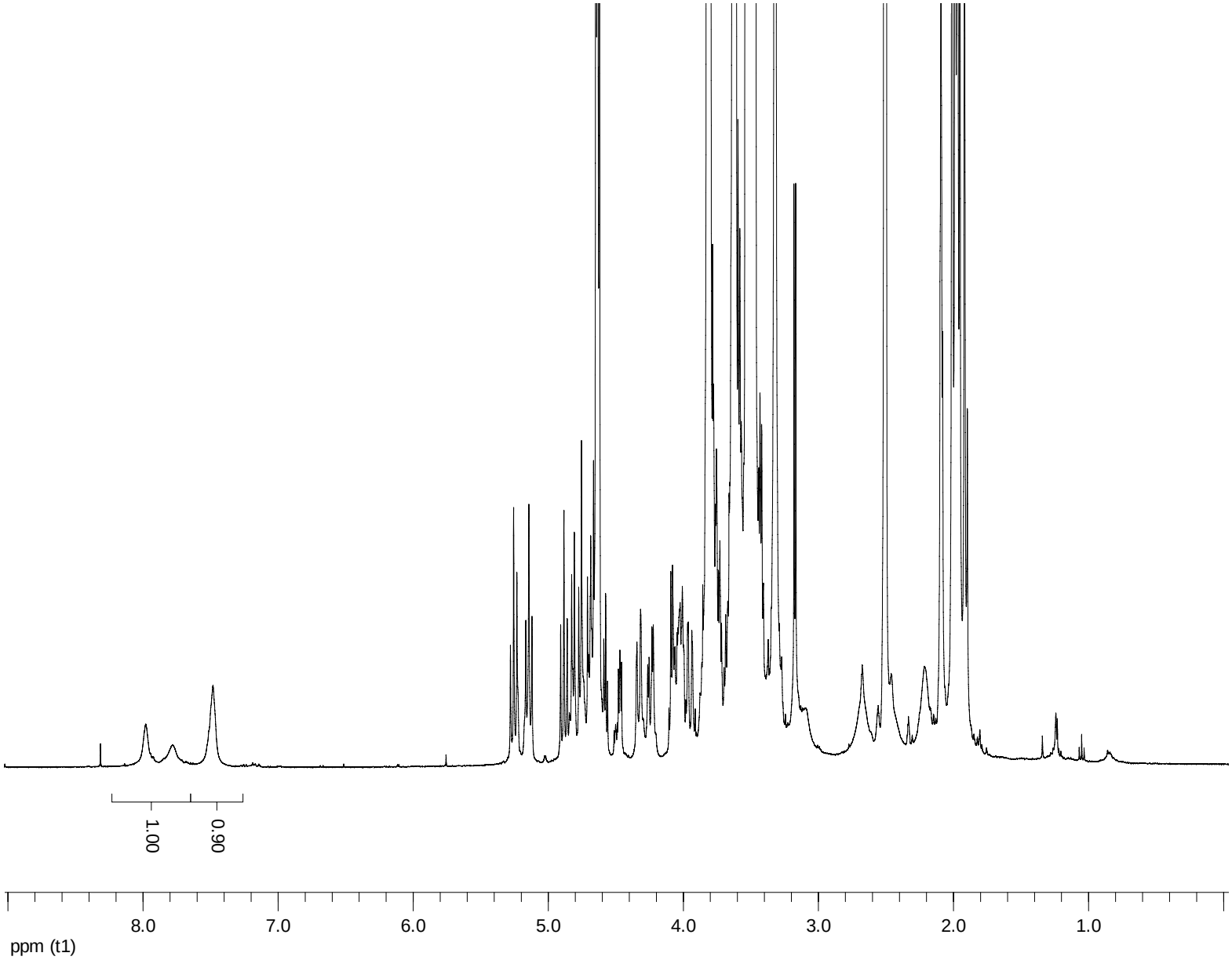
P-G4-Lac$_{42}$Gly$_2$ – 75% Lactosyl_OAc, Glycol capped Glycodendrimer



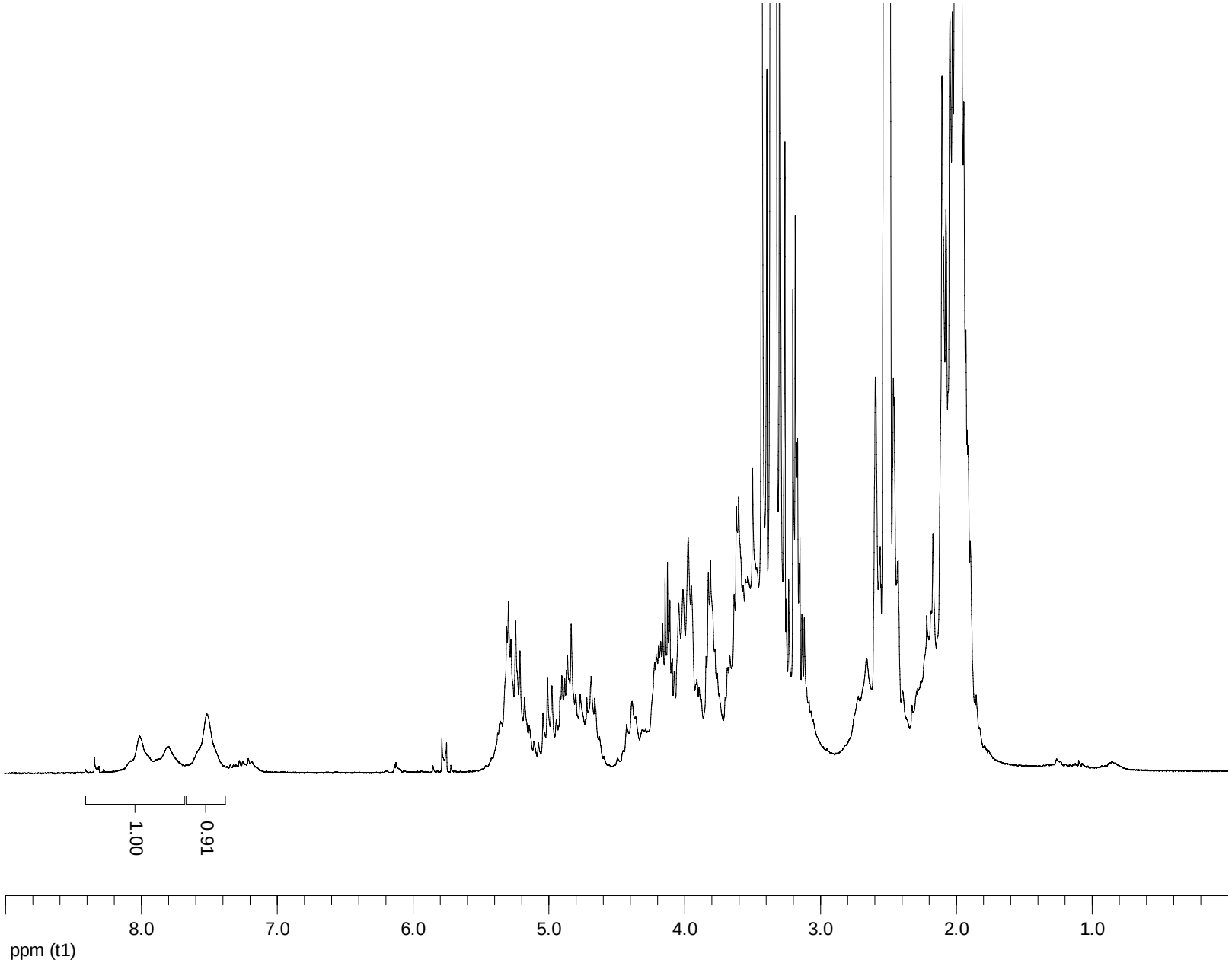
P-G4-Lac$_{25}$Cell$_{22}$Gly$_5$ – 45% Lactosyl_OAc$_7$, 41%Cellobiosyl_OAc$_7$ capped Glycodendrimer



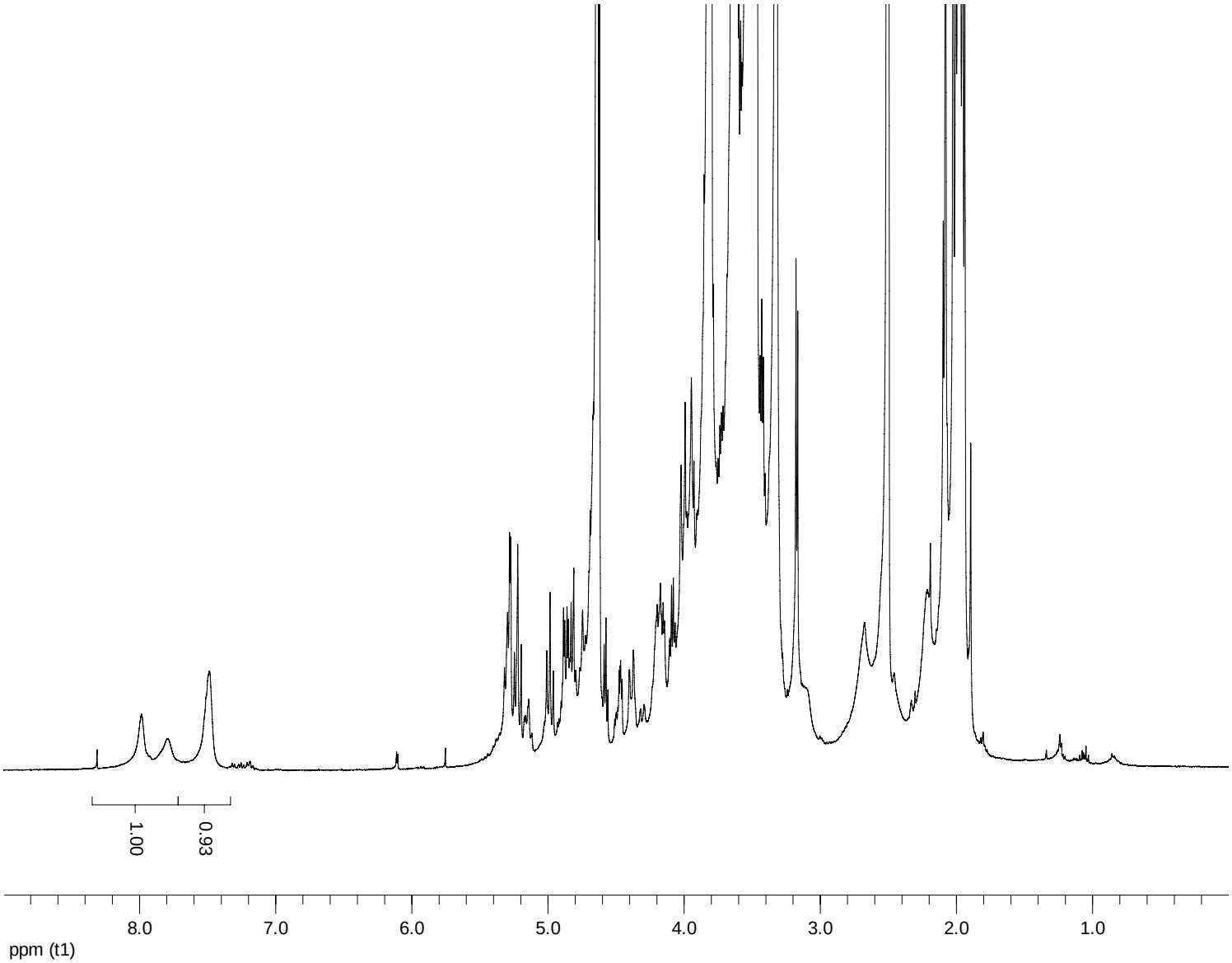
P-G4-$Lac_{25}Cell_{22}Gly_5$ – 45% Lactosyl_OAc_7, 41%Cellobiosyl_OAc_7 and Glycol capped Glycodendrimer



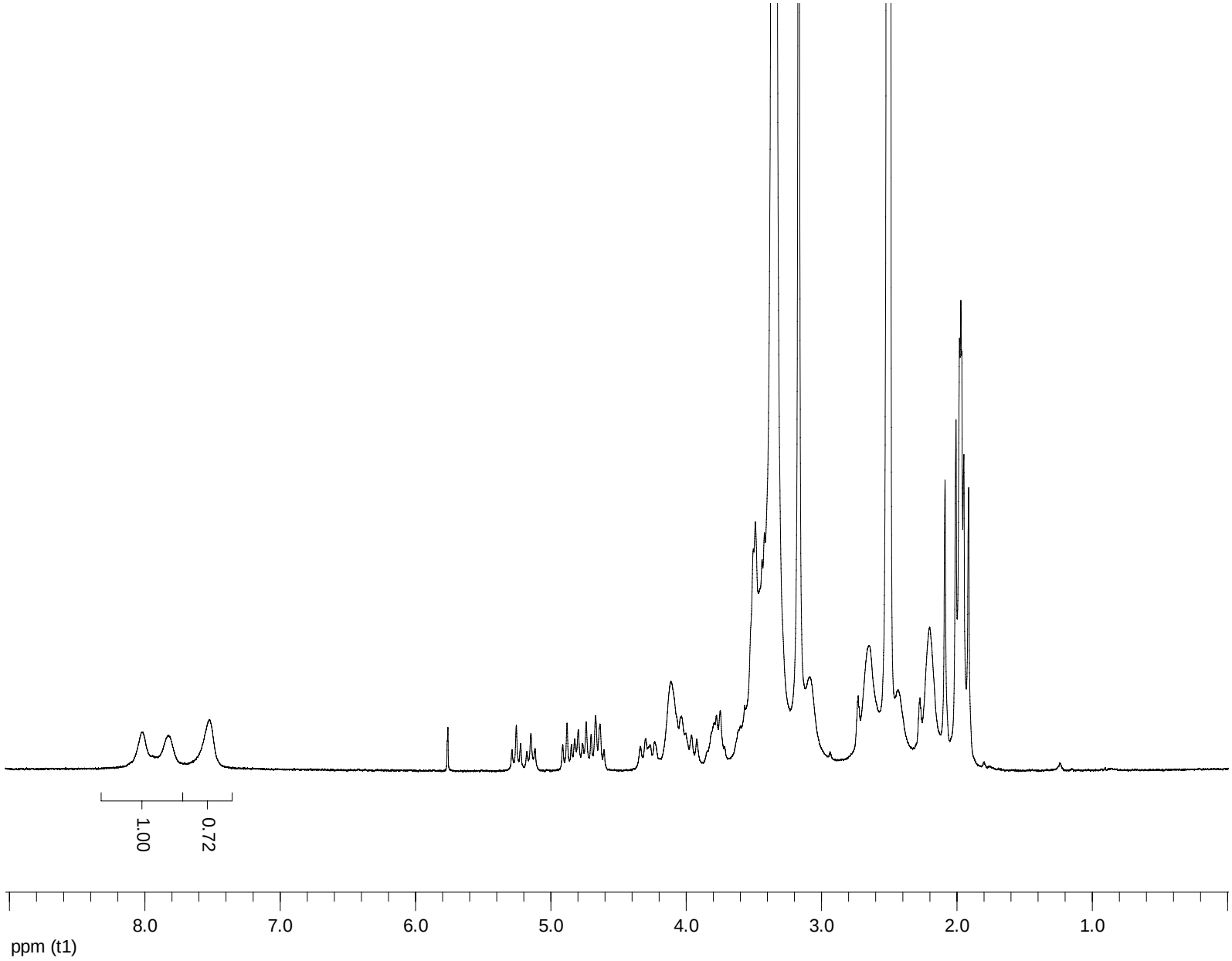
P-G4-$Lac_{25}Malt_{21}Gly_2$ – 45%Lactosyl_OAc_7, 39% Maltosyl capped Glycodendrimer



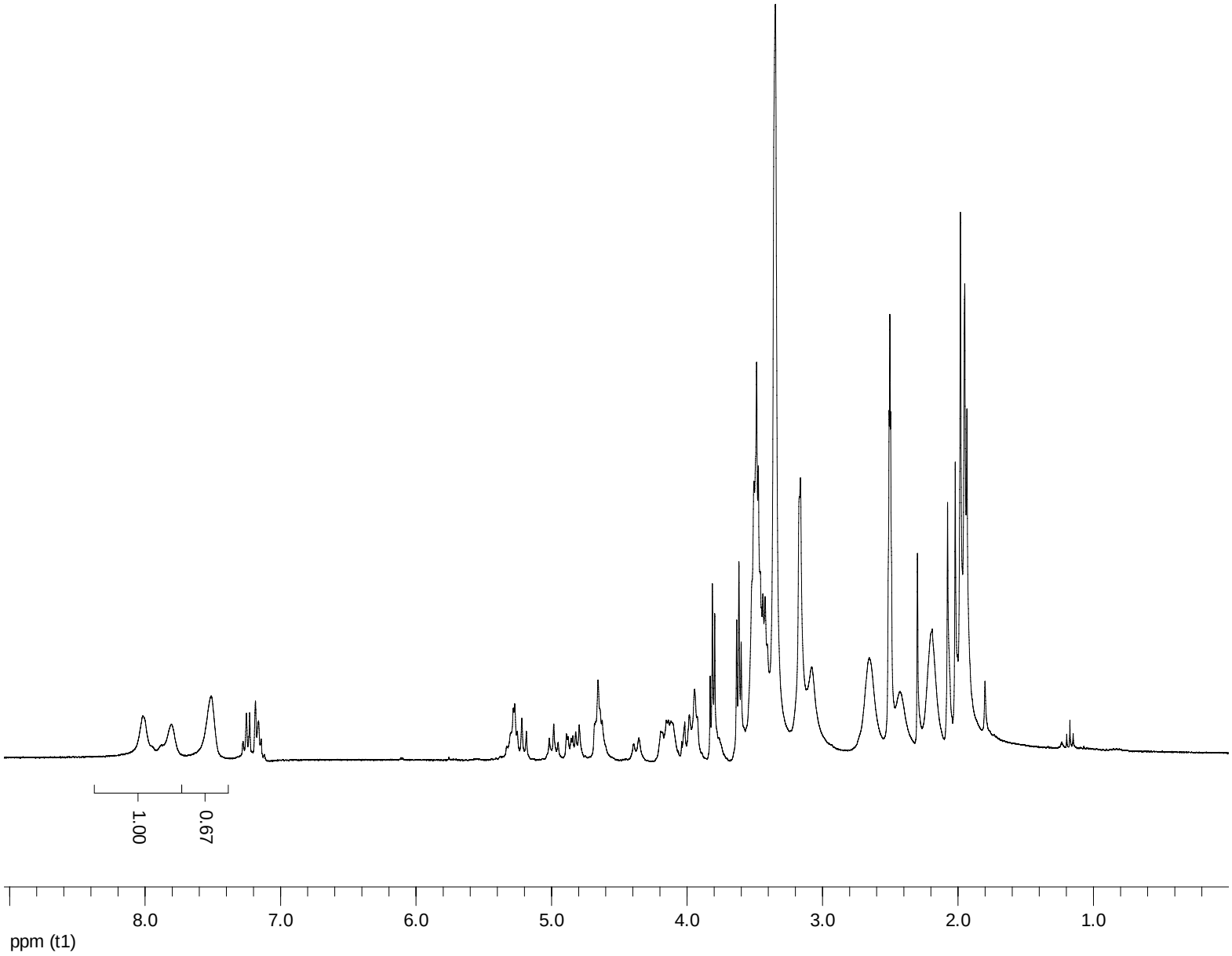
P-G4-$Lac_{25}Malt_{21}Gly_2$ – 45%Lactosyl_OAc_7, 39% Maltosyl and Glycol capped Glycodendrimer



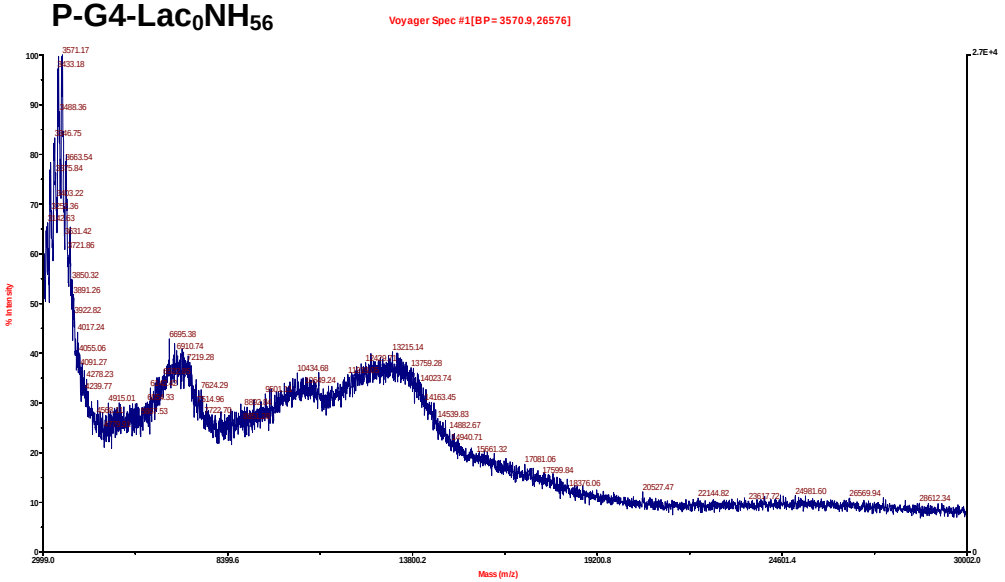
P-G4-Cell$_{26}$Gly$_{21}$ – 48% Cellobiosyl_OAc$_7$ uncapped Glycodendrimer



P-G4-Malt$_{21}$Gly$_{30}$ – 42% Maltosyl_OAc$_7$ uncapped Glycodendrimer

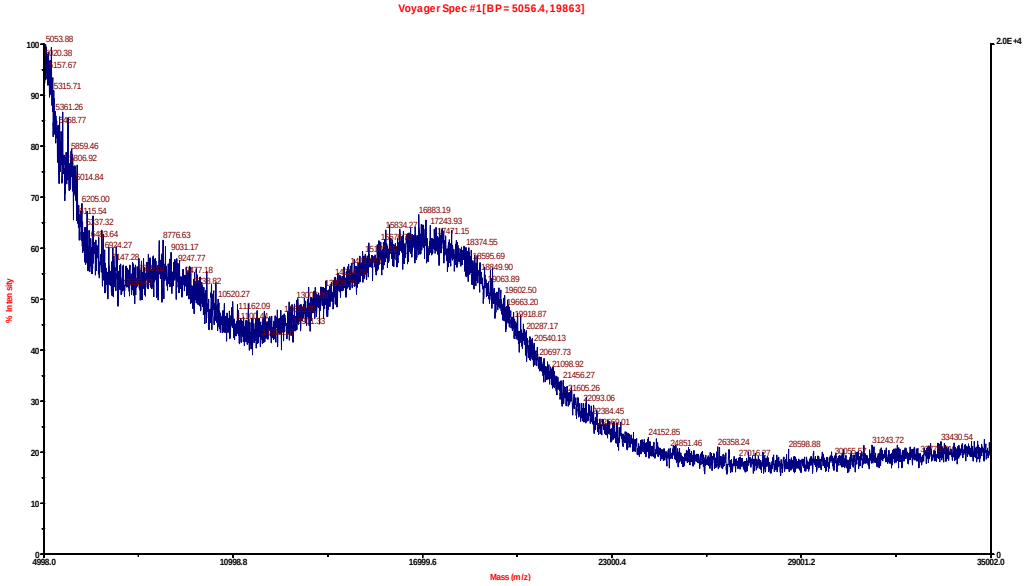


P-G4-Lac$_0$NH$_{56}$



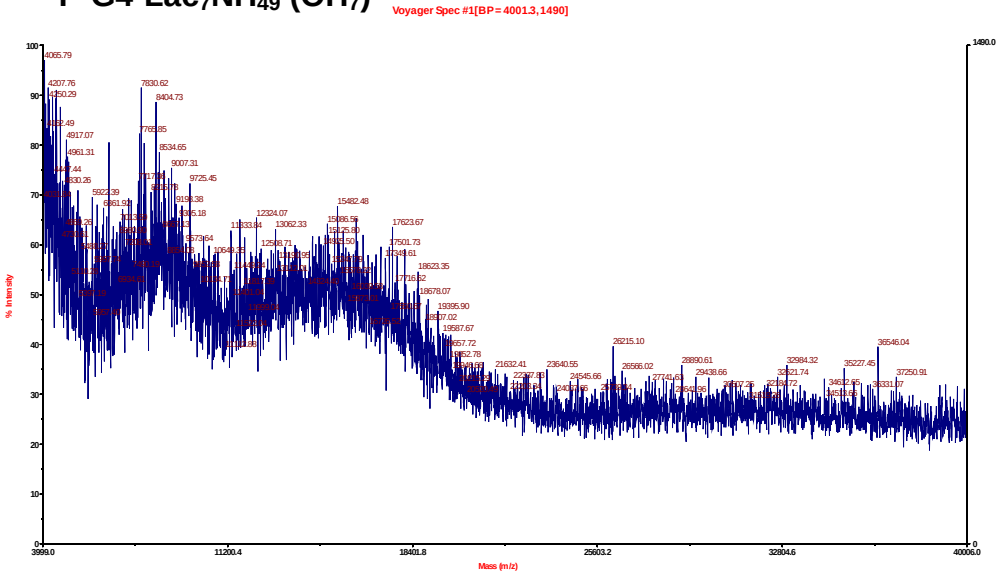
Range evaluated: 7919 to 20210
Mn: 12686.48
Mz: 14150.68
Mw: 13417.47
Polymer Dispersion Index: 1.06

P-G4-Lac$_7$NH$_{49}$ (OAc$_7$)



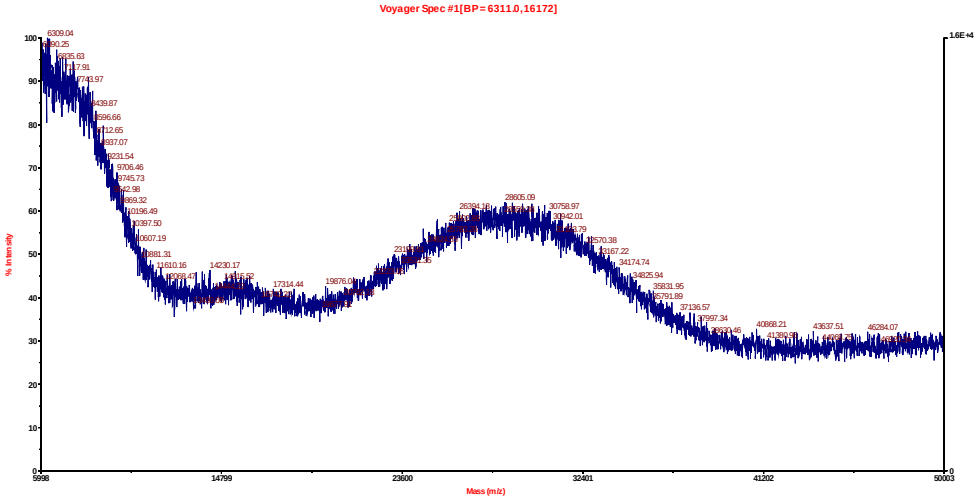
Range evaluated: 11483 to 24564
Mn: 16932.58
Mz: 18216.04
Mw: 17578.72
Polymer Dispersion Index: 1.04

P-G4-Lac$_7$NH$_{49}$ (OH$_7$)



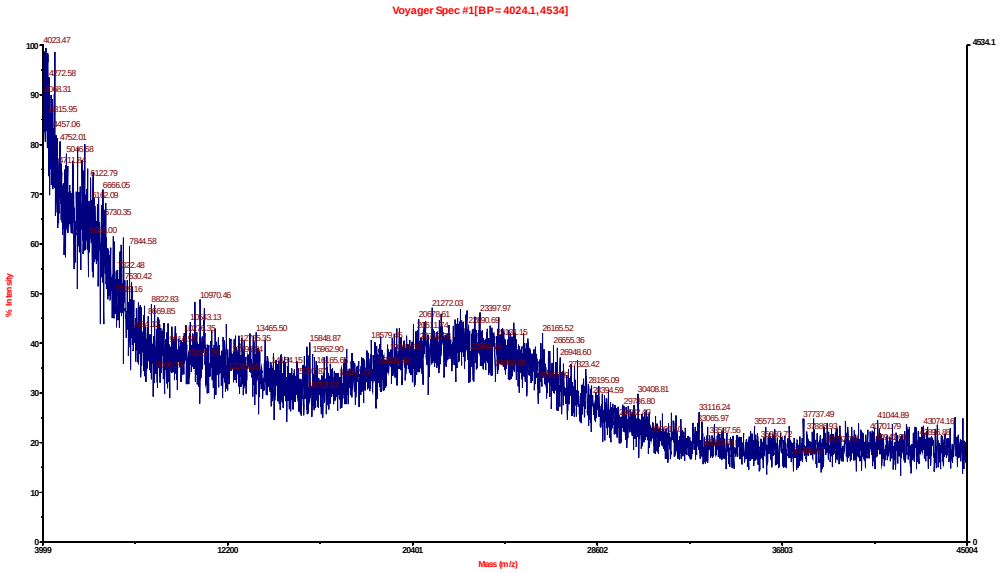
Range evaluated: 9898 to 24089
Mn: 15814.45
Mz: 17627.21
Mw: 16734.20
Polymer Dispersion Index: 1.06

P-G4-Lac$_{24}$NH$_{32}$ (OAc$_7$)



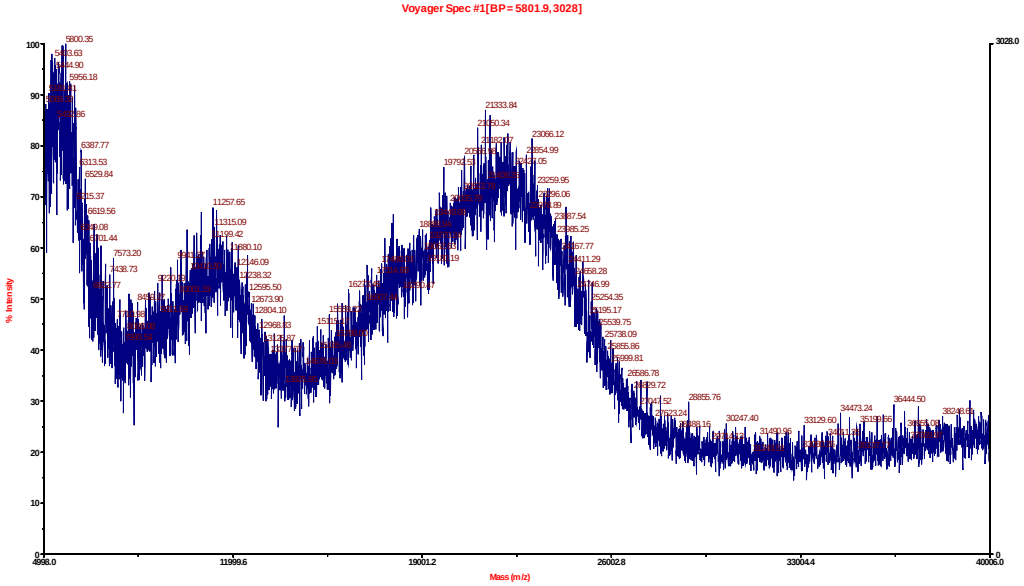
Range evaluated: 17422 to 41340
Mn: 28163.84
Mz: 30873.60
Mw: 29556.79
Polymer Dispersion Index: 1.05

P-G4-Lac$_{24}$NH$_{32}$ (OH$_7$)



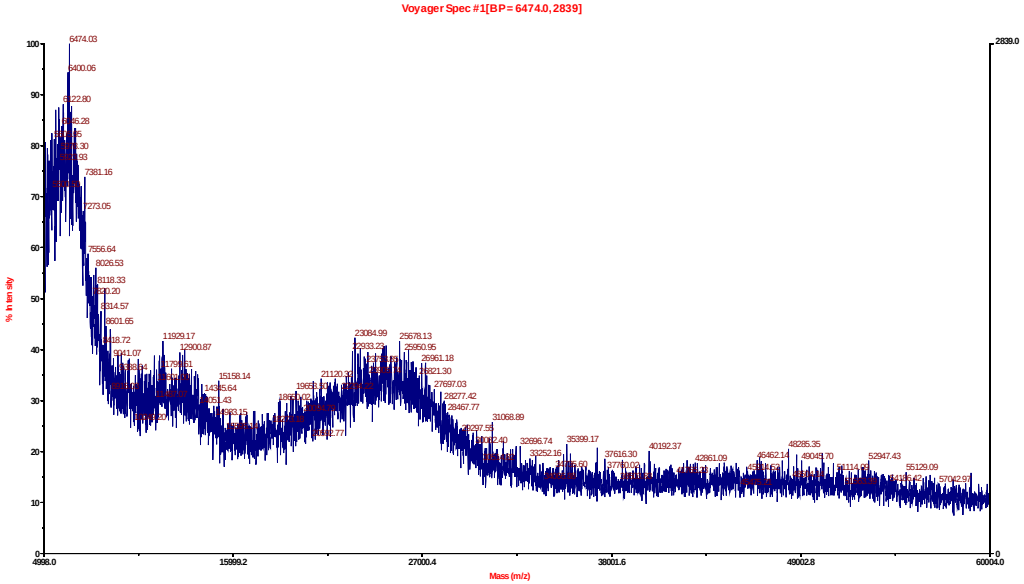
Range evaluated: 14688 to 35566
Mn: 23451.02
Mz: 25989.53
Mw: 24737.04
Polymer Dispersion Index: 1.05

P-G4-Lac$_0$Gly$_{56}$



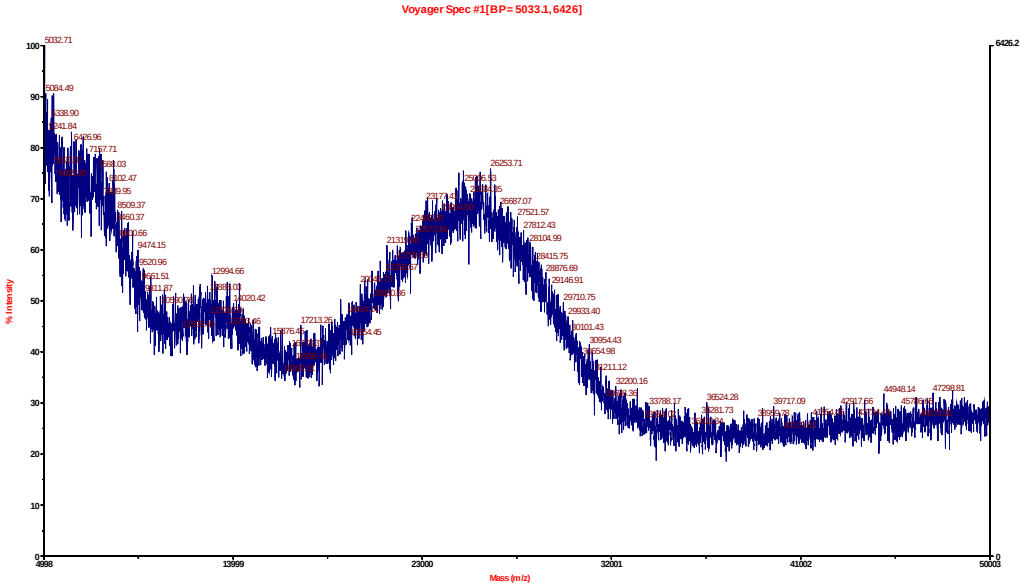
Range evaluated: 13604 to 33628
Mn: 21638.11
Mz: 23726.12
Mw: 22677.70
Polymer Dispersion Index: 1.05

P-G4-Lac$_7$Gly$_{48}$ (OAc$_7$)



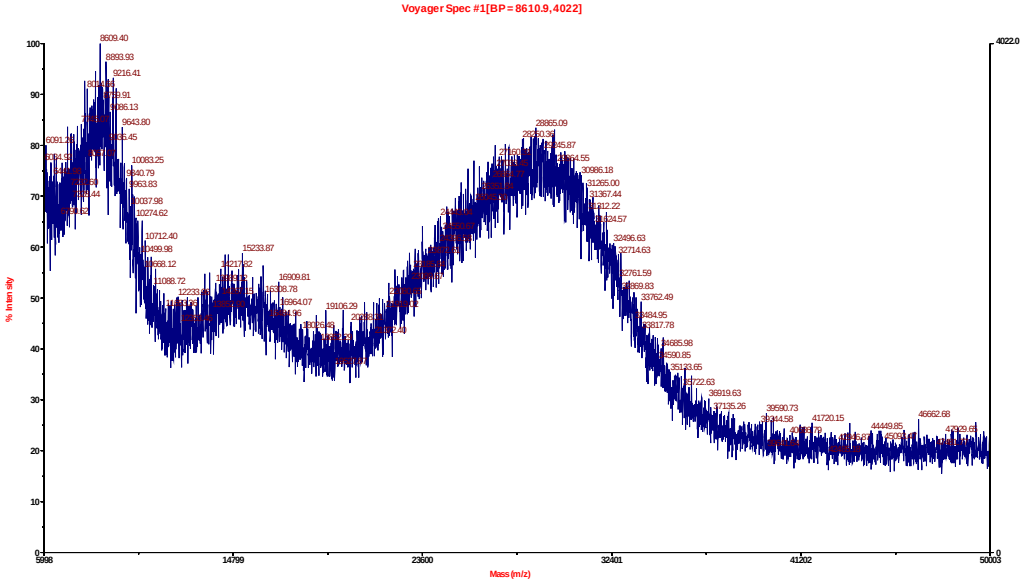
Range evaluated: 16556 to 36219
Mn: 24922.94
Mz: 26960.32
Mw: 25948.73
Polymer Dispersion Index: 1.04
*could not obtain corresponding (OH$_7$) spectrum

P-G4-Lac$_{17}$NH (OAc$_7$)



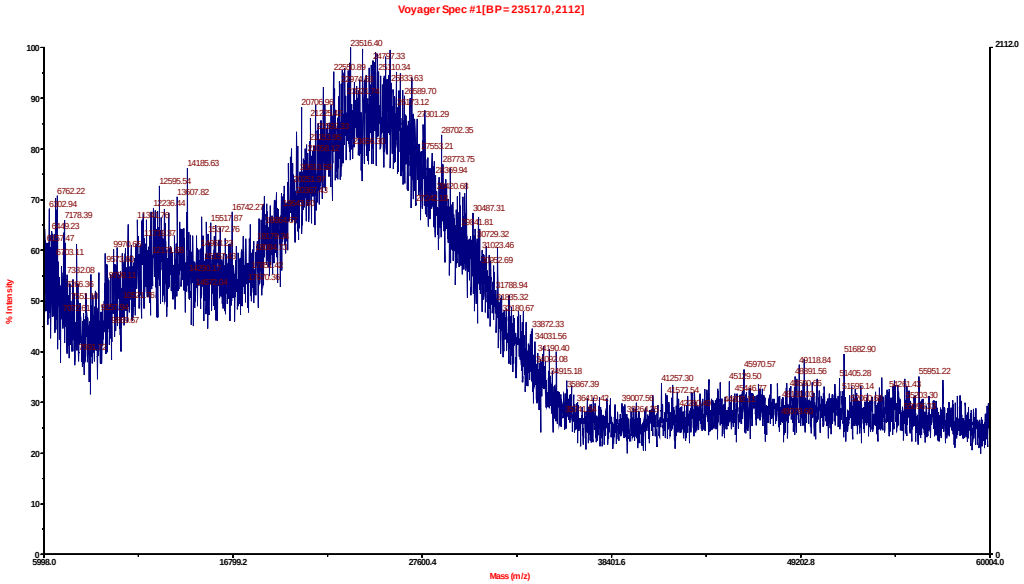
Range evaluated: 16534 to 36033
Mn: 24990.58
Mz: 26863.75
Mw: 25938.14
Polymer Dispersion Index: 1.04

P-G4-Lac$_{17}$Gly$_{27}$ (OAc$_7$)



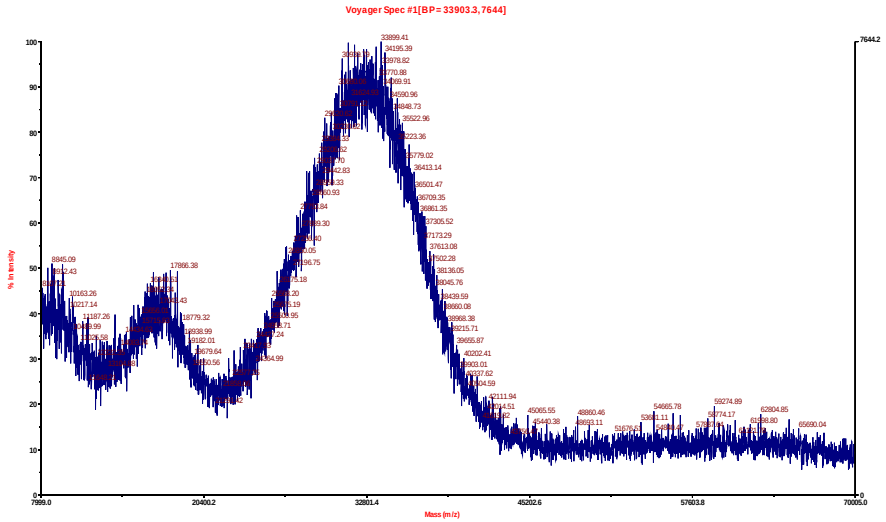
Range evaluated: 18263 to 44085
Mn: 28615.14
Mz: 31262.17
Mw: 29933.96
Polymer Dispersion Index: 1.05

P-G4-Lac$_{17}$Gly$_{27}$ (OH$_7$)



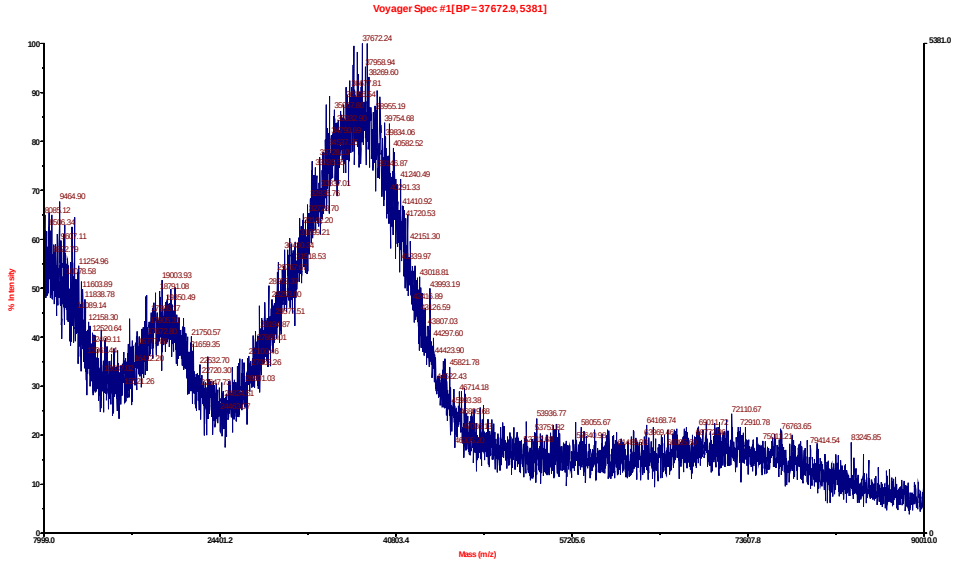
Range evaluated: 16875 to 38345
Mn: 25559.85
Mz: 27756.97
Mw: 26659.72
Polymer Dispersion Index: 1.04

P-G4-Lac$_{25}$NH (OAc$_7$)



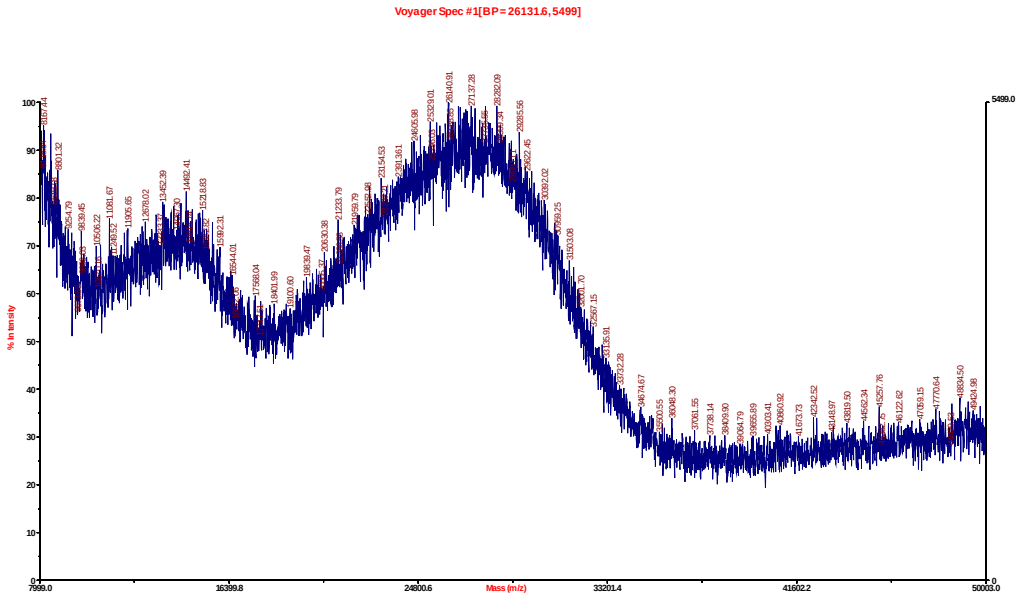
Range evaluated: 22432 to 42704
Mn: 31926.25
Mz: 33206.76
Mw: 32577.56
Polymer Dispersion Index: 1.02

P-G4-Lac$_{25}$Gly$_{30}$ (OAc$_7$)



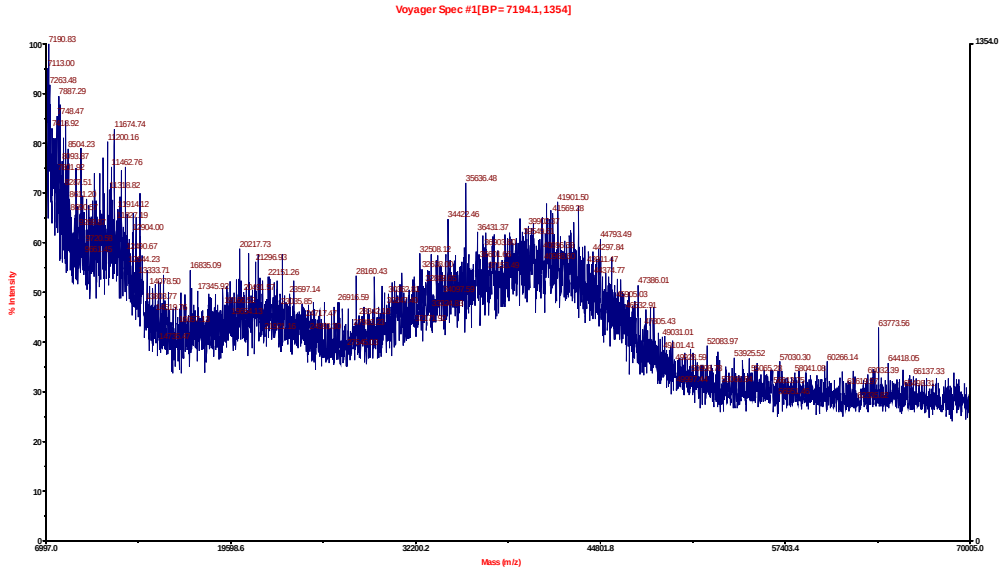
Range evaluated: 23732 to 51294
Mn: 36188.04
Mz: 38249.32
Mw: 37236.67
Polymer Dispersion Index: 1.03

P-G4-Lac$_{25}$Gly$_{30}$ (OH$_7$)



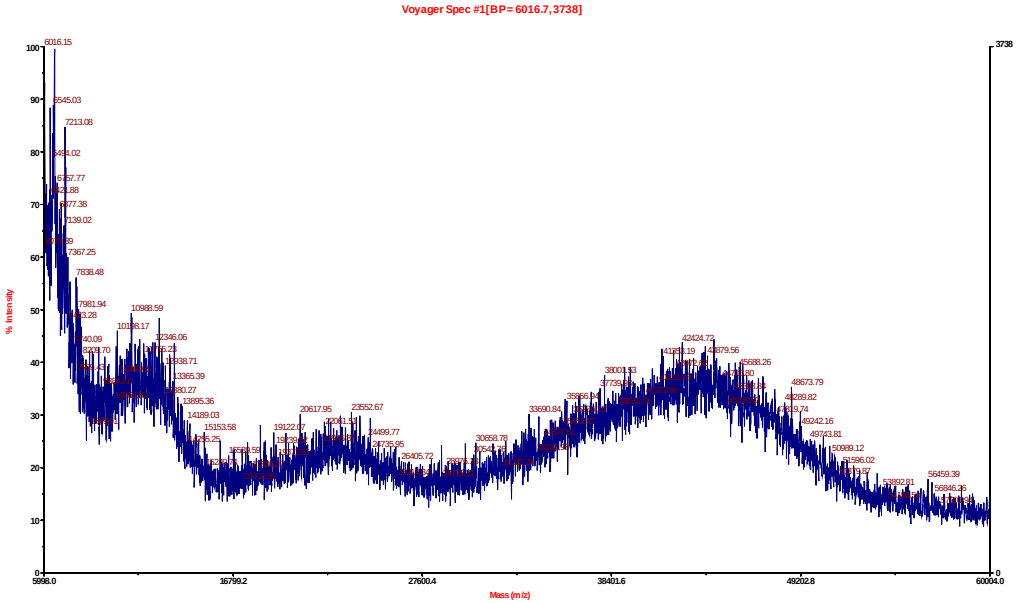
Range evaluated: 18107 to 33855
Mn: 25631.13
Mz: 26914.89
Mw: 26288.08
Polymer Dispersion Index: 1.03

P-G4-Lac$_{35}$NH (OAc$_7$)



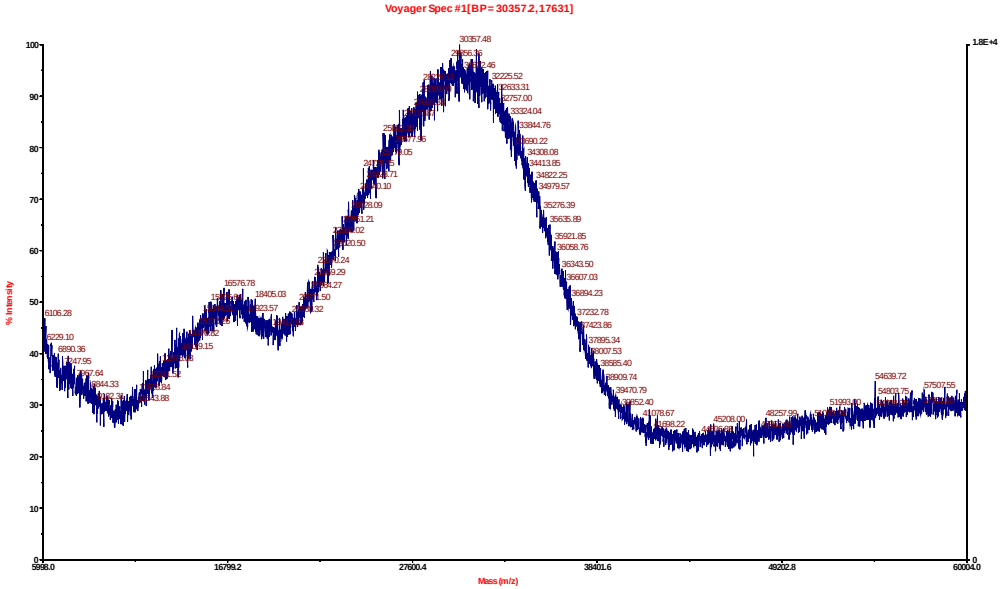
Range evaluated: 26497 to 56052
Mn: 39665.22
Mz: 42731.06
Mw: 41223.55
Polymer Dispersion Index: 1.04

P-G4-Lac$_{35}$Gly$_9$ (OAc$_7$)



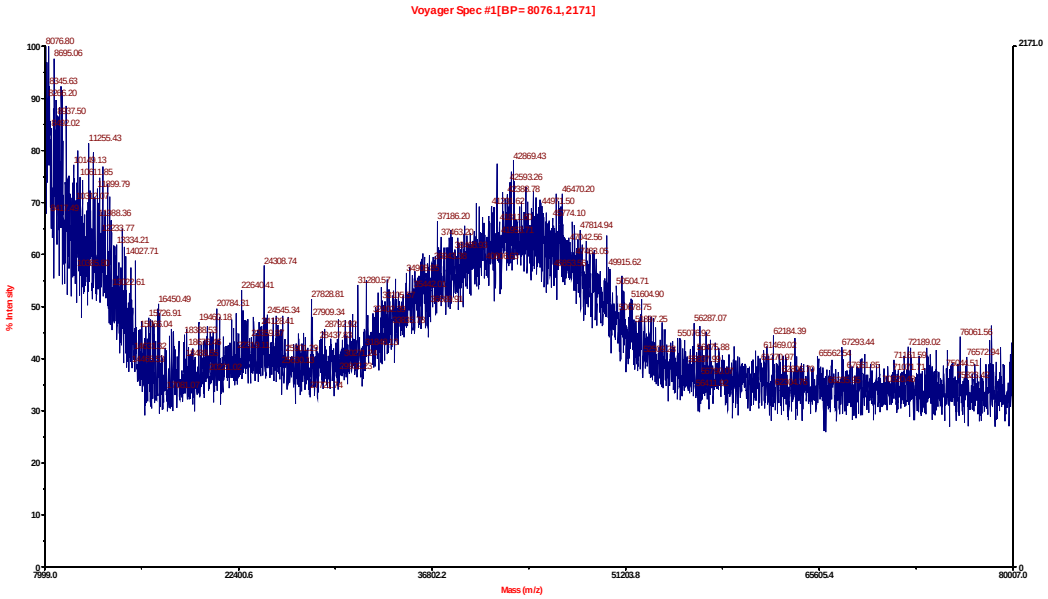
Range evaluated: 27562 to 57319
Mn: 41307.28
Mz: 43892.78
Mw: 42629.96
Polymer Dispersion Index: 1.03

P-G4-Lac$_{35}$Gly$_9$ (OH$_7$)



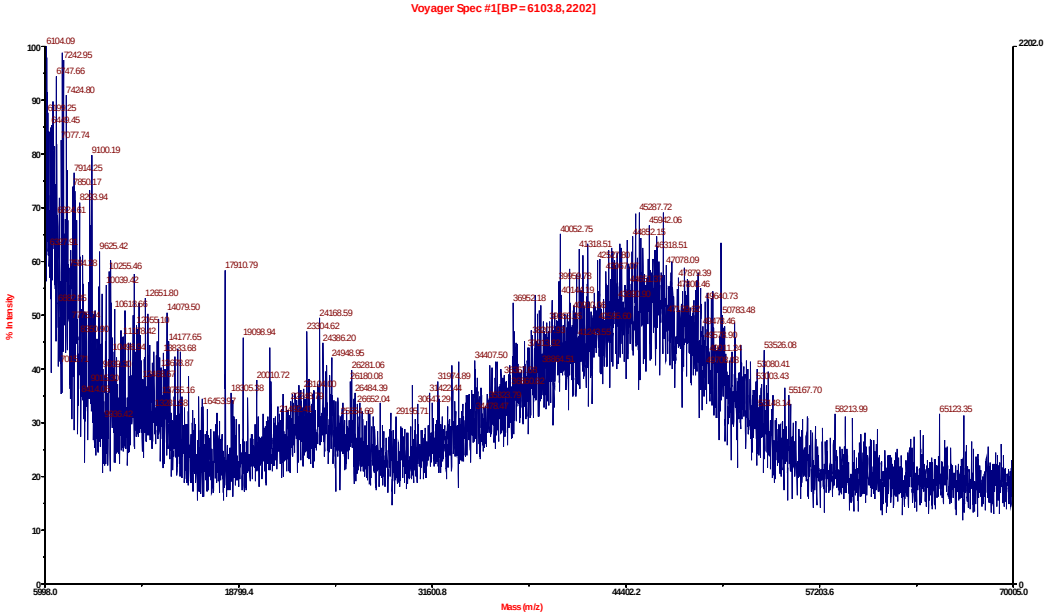
Range evaluated: 18804 to 45595
Mn: 29801.43
Mz: 32415.24
Mw: 31116.68
Polymer Dispersion Index: 1.04

P-G4-Lac$_{42}$NH (OAc$_7$)



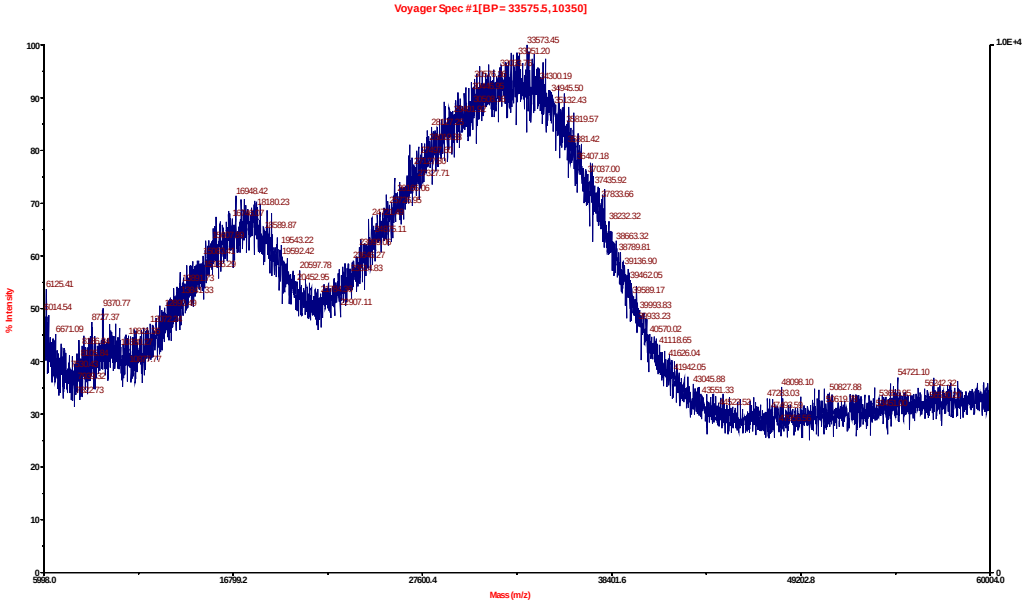
Range evaluated: 26831 to 62552
Mn: 43096.06
Mz: 47111.52
Mw: 45153.32
Polymer Dispersion Index: 1.05

P-G4-Lac$_{42}$Gly$_2$ (OAc$_7$)



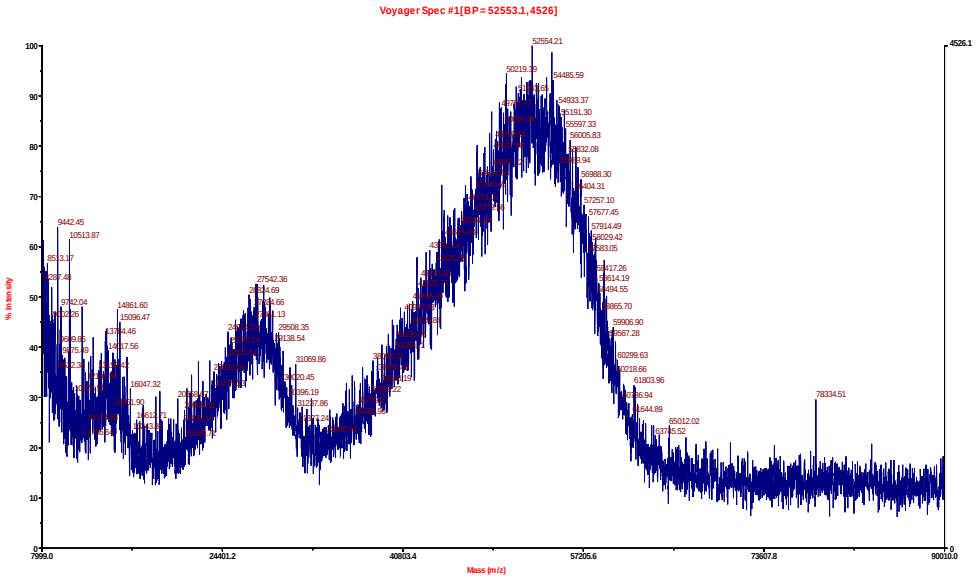
Range evaluated: 27702 to 63087
Mn: 43895.00
Mz: 47308.66
Mw: 45643.04
Polymer Dispersion Index: 1.04

P-G4-Lac$_{42}$Gly$_2$ (OH$_7$)



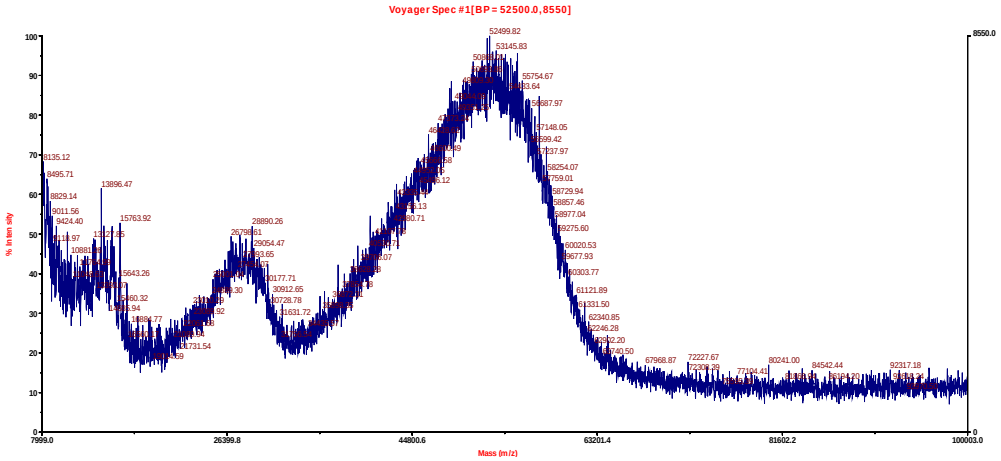
Range evaluated: 19981 to 49222
Mn: 32076.91
Mz: 35194.70
Mw: 33649.25
Polymer Dispersion Index: 1.05

P-G4-Lac$_{25}$Cell$_{22}$NH (OAc$_7$)



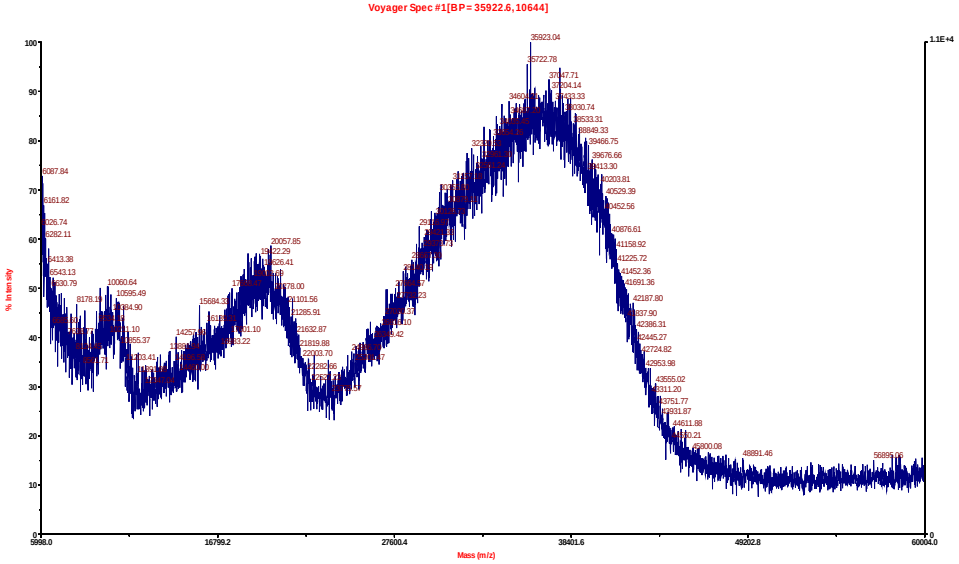
Range evaluated: 33311 to 63412
Mn: 49048.82
Mz: 51022.84
Mw: 50074.64
Polymer Dispersion Index: 1.02

P-G4-Lac$_{25}$Cell$_{22}$Gly$_5$ (OAc$_7$)



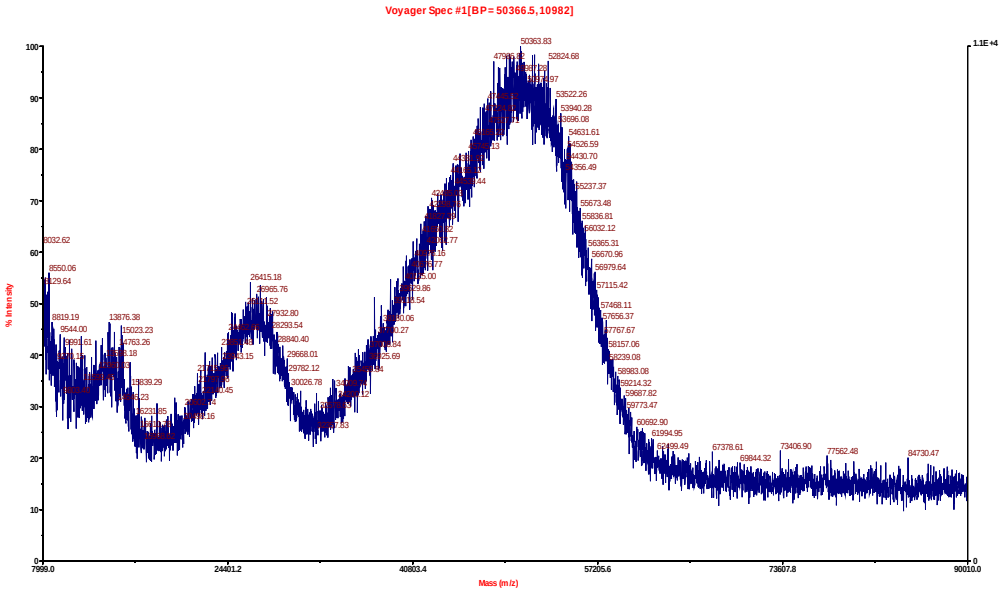
Range evaluated: 33059 to 67962
Mn: 49532.60
Mz: 51901.11
Mw: 50751.84
Polymer Dispersion Index: 1.02

P-G4-Lac$_{25}$Cell$_{22}$Gly$_5$ (OH$_7$)



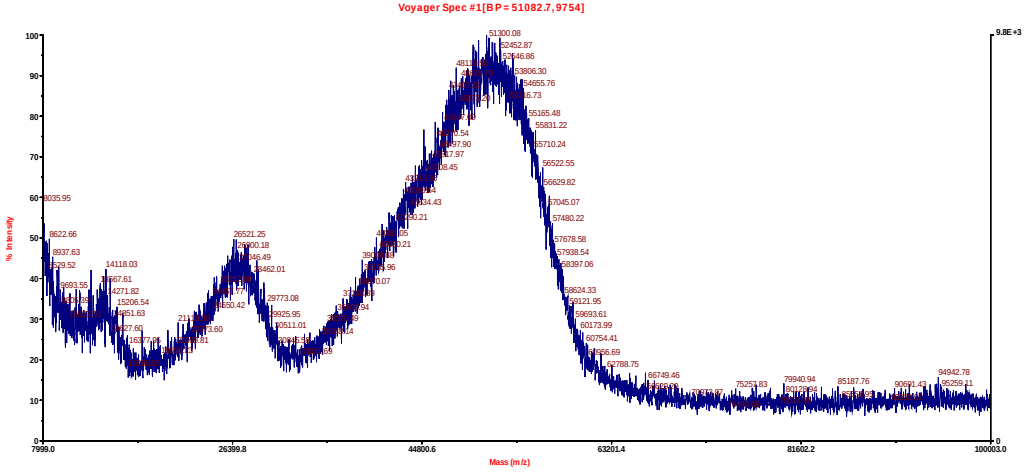
Range evaluated: 23243 to 47887
Mn: 34373.86
Mz: 36144.89
Mw: 35280.36
Polymer Dispersion Index: 1.03

P-G4-$Lac_{25}Malt_{21}NH$ (OAc_7)



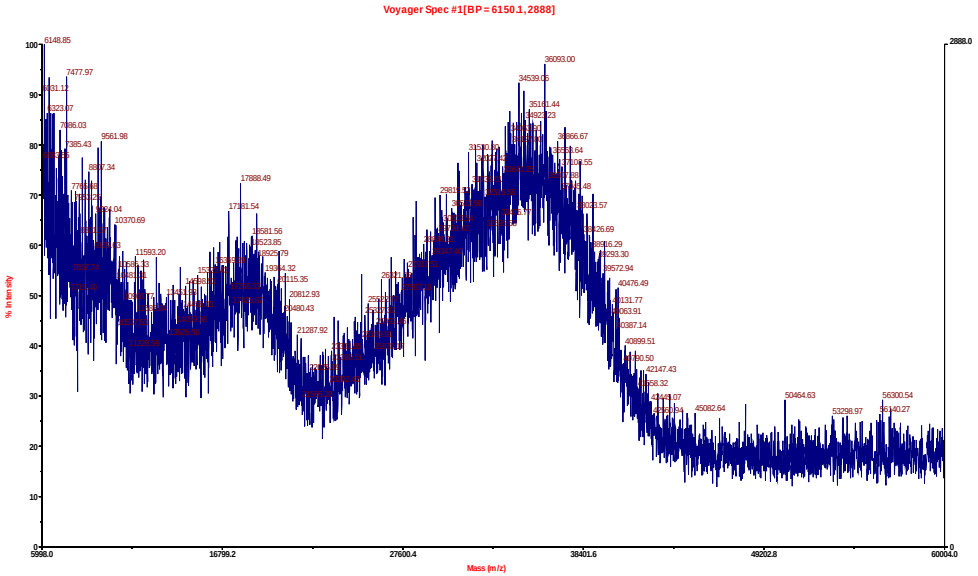
Range evaluated: 32019 to 68060
Mn: 47918.56
Mz: 50514.02
Mw: 49237.51
Polymer Dispersion Index: 1.03

P-G4-$Lac_{25}Malt_{21}Gly_2$ (OAc_7)



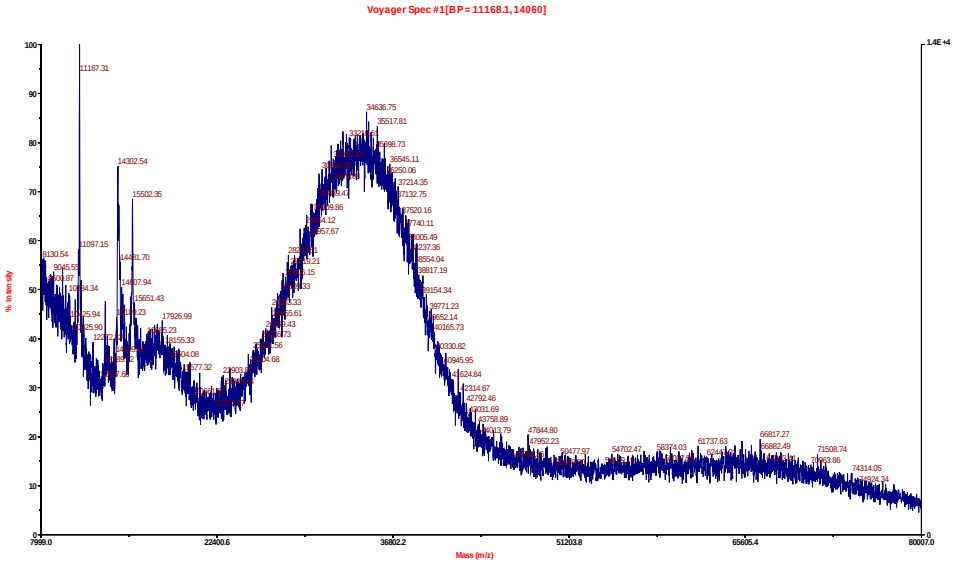
Range evaluated: 32158 to 66840
Mn: 48420.43
Mz: 50637.88
Mw: 49561.56
Polymer Dispersion Index: 1.02

P-G4-$Lac_{25}Malt_{21}Gly_2$ (OH_7)



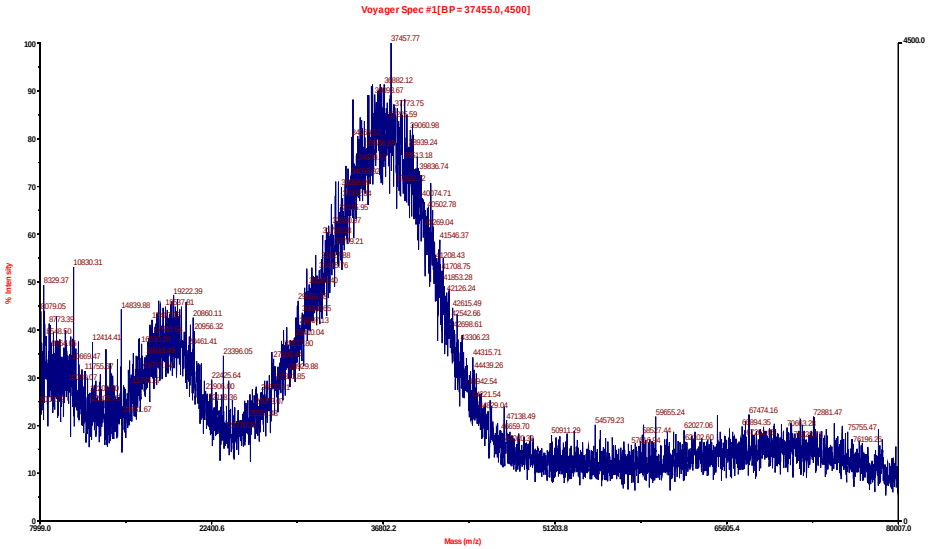
Range evaluated: 22101 to 44653
Mn: 32765.51
Mz: 34561.06
Mw: 33689.00
Polymer Dispersion Index: 1.03

P-G4-$Cell_{26}NH$ (OAc_7)



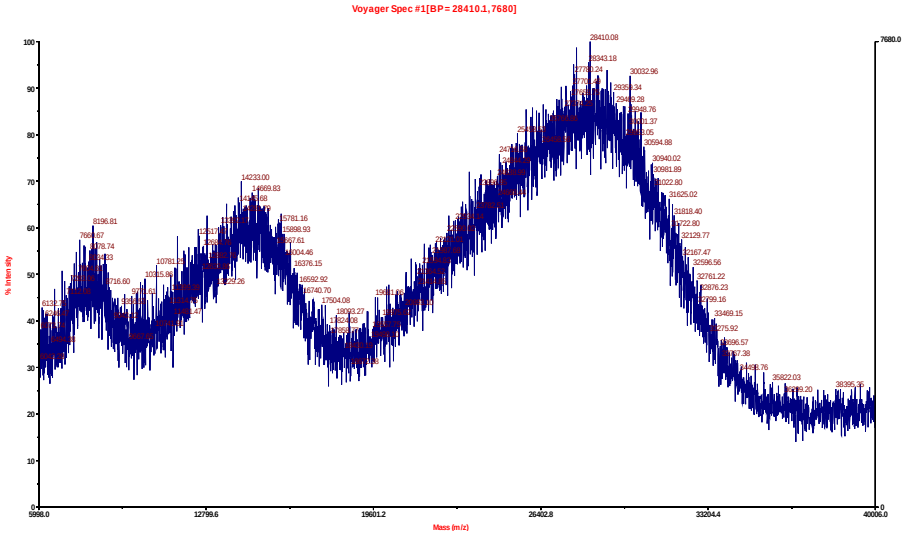
Range evaluated: 21246 to 49999
Mn: 33405.93
Mz: 35782.92
Mw: 34604.74
Polymer Dispersion Index: 1.04

P-G4-Cell$_{26}$Gly$_{21}$ (OAc$_7$)



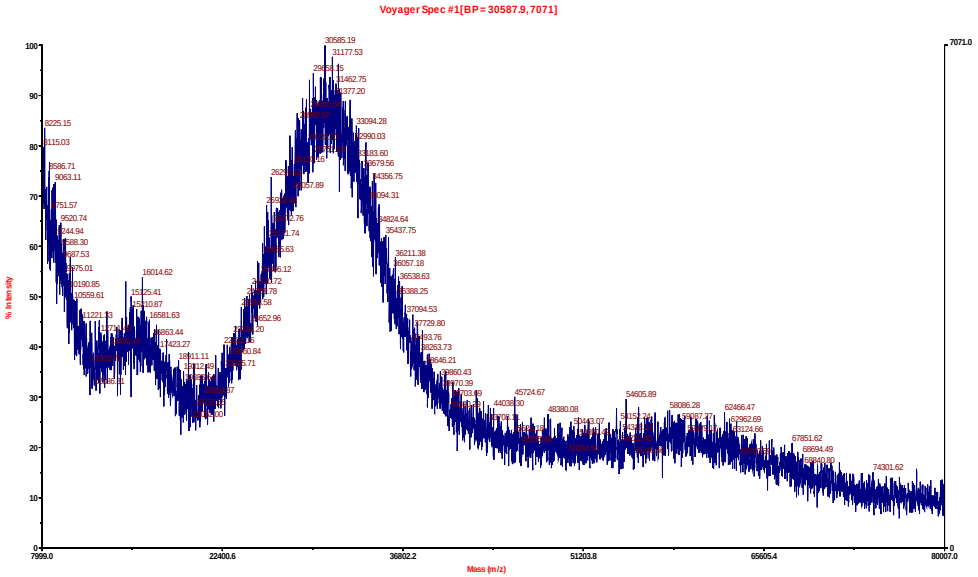
Range evaluated: 22689 to 53827
Mn: 36121.21
Mz: 38404.36
Mw: 37272.12
Polymer Dispersion Index: 1.03

P-G4-Cell$_{26}$Gly$_{21}$ (OH$_7$)



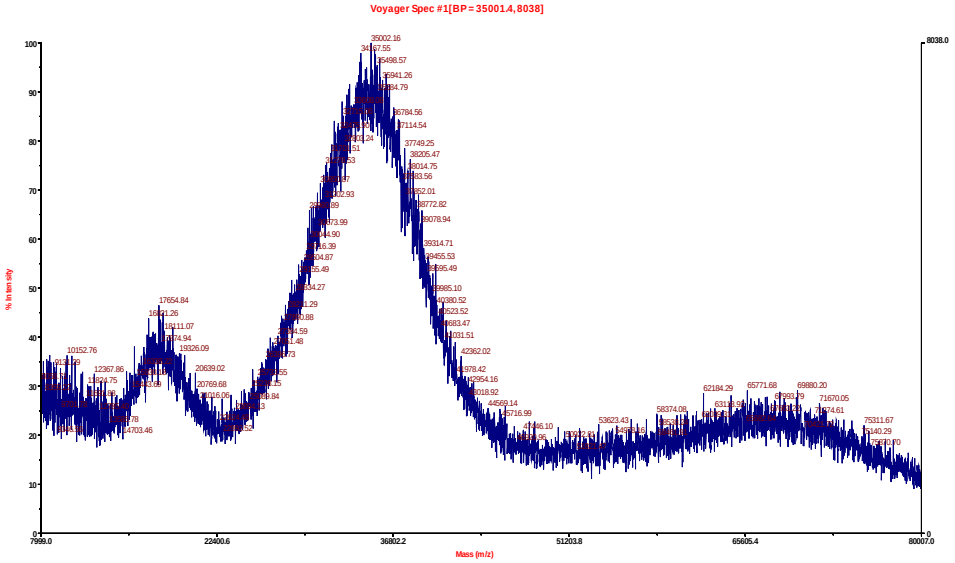
Range evaluated: 17886 to 37221
Mn: 26756.23
Mz: 28290.56
Mw: 27541.77
Polymer Dispersion Index: 1.03

P-G4-Malt$_{21}$NH (OAc$_7$)



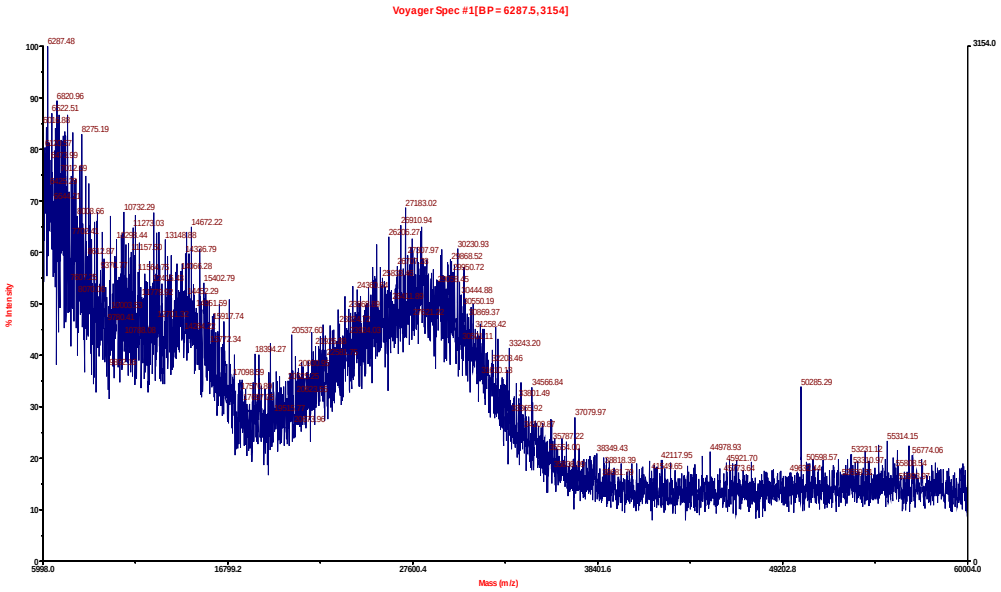
Range evaluated: 20177 to 43345
Mn: 30693.92
Mz: 32594.57
Mw: 31657.05
Polymer Dispersion Index: 1.03

P-G4-Malt$_{21}$Gly$_{30}$ (OAc$_7$)



Range evaluated: 23003 to 48055
Mn: 34378.75
Mz: 36134.10
Mw: 35266.48
Polymer Dispersion Index: 1.03

P-G4-Malt$_{21}$Gly$_{30}$ (OH$_7$)



Range evaluated: 18759 to 37684
Mn: 27229.07
Mz: 28823.21
Mw: 28038.47
Polymer Dispersion Index: 1.03