Supporting Information

Fucose-Galactose Polymers Inhibit Cholera Toxin Binding to Fucosylated Structures and Galactose-Dependent Intoxication of Human Enteroids

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Content

Materials

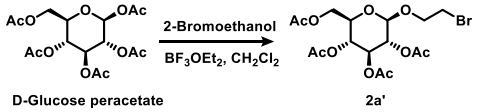
Materials were purchased from Sigma Aldrich, Fisher Scientific, VWR, Santa Cruz Biotechnology, Neta Scientific and used as received unless otherwise specified. Solvents (tetrahydrofuran, methanol, diethyl ether, dimethylformamide, dichloromethane) were purified by Pushstill (Glass Contour System).

General Methods

Analytical thin-layer chromatography was performed on an aluminum backed sheets coated with silica gel 60 F254 as an indicator. For non-UV active compounds, the TLC plates were stained with 10% phosphomolybdic acid in ethanol or Hanessian's stain. LCMS(ESI) were recorded using an Agilent LC-MSD consisting of an 1100 HPLC and a G1956A mass spectrometer. HRMS(ESI) were performed with Agilent LC-UV-TOF consisting of a 1260 UPLC, a UV-Vis diode-array detector (DAD) and a TOF mass analyzer. Flash column chromatography was performed using a flash chromatography system with normal phase silica columns (silica gel 60, 230−400 mesh). HPLC was performed using a Shimadzu HPLC system with a system controller (CBM-20A), a degasser (DGU-20A 3R), binary solvent delivery unit (LC-20AT), a column oven (CTO-20AC), an evaporative light scattering detector (ELSD-LT II). Methanol or acetonitrile and 20 mM ammonium acetate were used as eluents with a reverse-phase column (Phenomenex Jupiter 5u C4 300A). Air and/or moisture sensitive reactions were carried out either using a glovebox under nitrogen atmosphere or a standard Schlenk vacuum technique under argon. *d*-Chloroform and d_2-water were purchased from Cambridge Isotope Laboratories. All NMR spectra were collected in *d*-chloroform unless otherwise specified. NMR spectra were recorded on a Bruker Ascend 700 spectrometer (^{1}H-700 MHz, ^{13}C-176MHz) and a Bruker 500 Advance spectrometer (^{1}H-500 MHz, ^{13}C-125 MHz). Chemical shifts were recorded in ppm relative to the residual solvent peaks; $CDCl_3$ (^{1}H δ7.28; ^{13}C δ77.16), D_2O (^{1}H δ4.79). Purities of each final monomer were assessed using two or more of the following techniques: TLC, ^{1}H-NMR spectroscopy, or HPLC, and the method used for reporting is indicated.

Monomer preparation

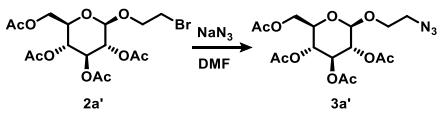
Synthesis of 2,3,4,6-tetra-O-acetyl-β-D-glucopyranoside, 2-bromoethyl (2a')



D-Glucose peracetate 2a'

To a mixture of 1,2,3,4,6-penta-O-acetyl-β-D-glucopyranoside (5.12 mmol, 2.00 g) and 2-bromoethanol (55 mmol, 3.2 mL) in CH_2Cl_2 (20 mL), boron trifluoride dietherate (30 mmol, 3.6 mL) was added dropwise at 0 °C and the temperature was raised to 20 °C upon completion of addition. After 3 h, the reaction was quenched with saturated sodium bicarbonate solution, extracted with 20 mL of EtOAc and concentrated followed by column chromatography (EtOAc:Hexane) to afford **2a'** as a white solid (1.68 mmol, 762 mg, 33%). The NMR spectra matched the literature.[1] ^{1}H NMR (500 MHz, $CDCl_3$) δ 5.24 (t, *J* = 9.5 Hz, 1H), 5.11 (t, *J* = 9.7 Hz, 1H), 5.04 (q, *J* = 5.9 Hz, 1H), 4.60 (d, *J* = 8.0 Hz, 1H), 4.28 (q, *J* = 5.7 Hz, 1H), 4.16 (m, *J* = 3.4 Hz, 2H), 3.84 (m, *J* = 3.6 Hz, 1H), 3.73 (m, *J* = 2.5 Hz, 1H), 3.49 (m, *J* = 2.2 Hz, 2H), 2.12 (s, 3H), 2.10 (s, 3H), 2.05 (s, 3H), 2.03 (s, 3H). ^{13}C NMR (176 MHz, $CDCl_3$) δ 170.67 170.28 169.44 169.42 101.03 72.59 71.93 71.01 69.80 68.30 61.83 29.88 20.76 20.63 20.61. ESI-MS (m/z) calcd for $C_{16}H_{27}BrNO_{10}$; $[M + NH_4]^+$: 472.08, found: 472.1

Synthesis of 2,3,4,6-tetra-O-acetyl-β-D-glucopyranoside, 2-Azidoethyl (3a')

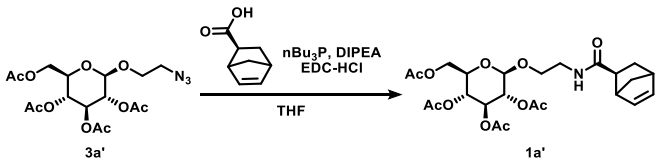


2a' 3a'

Hexose **2a'** (1.68mmol, 762 mg) and sodium azide (5.94mmol, 386 mg) were dissolved in DMF (35 mL). The reaction vessel was maintained at 70 °C for 72 h. The reaction mixture was diluted with acetone (50 mL) and filtered through celite then concentrated. The concentrated solution was diluted with toluene then washed 3 times with water (30 mL) and once with brine. The organic

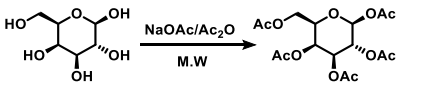
layer was concentrated to provide a brown solid. (1.10 mmol, 455 mg, 66%). The spectra matched the literature.[2] ^{1}H NMR (700 MHz, $CDCl_3$) δ 5.24 (t, *J* = 9.5 Hz, 1H), 5.13 (t, *J* = 9.7 Hz, 1H), 5.05 (q, *J* = 5.9 Hz, 1H), 4.62 (d, *J* = 8.0 Hz, 1H), 4.28 (q, *J* = 5.7 Hz, 1H), 4.19 (q, *J* = 4.9 Hz, 1H), 4.06 (m, *J* = 2.7 Hz, 1H), 3.73 (m, *J* = 2.8 Hz, 2H), 3.52 (m, *J* = 5.5 Hz, 1H), 3.31 (m, *J* = 3.6 Hz, 1H), 2.12 (s, 3H), 2.08 (s, 3H), 2.05 (s, 3H), 2.03 (s, 3H). ^{13}C NMR (176 MHz, $CDCl_3$) δ 170.69 170.31 169.43 169.41 100.67 72.78 71.94 71.05 68.58 68.29 61.82 50.52 20.76 20.70 20.61. ESI-MS (m/z) calcd for $C_{16}H_{27}N_4O_{10}$; $[M + NH_4]^+$: 435.17, found: 435.2

Synthesis of 2,3,4,6-Tetra-O-acetyl-β-D-glucopyranosyl bicyclo[2.2.1]hept-5-ene-exo-2-carboxamide (1a')



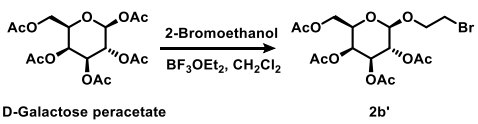
Hexose **3a'** (0.93 mmol, 389 mg), exo-5-norbornene-2-carboxylic acid (1.21 mmol, 170 mg) and EDC-HCl (1.21 mmol, 232 mg) were dissolved in anhydrous THF (20 mL). DIPEA (1.21 mmol, 0.21 mL) was added dropwise and stirred for 10 min with ice-bath cooling. Tributylphosphine (1.21 mmol, 0.30 mL) was added dropwise and the mixture was warmed to ambient temperature and allowed to react for 18 h at room temperature. The reaction mixture was diluted with DCM and subsequently washed 3 times with 1M HCl, once with saturated aq. $NaHCO_3$, and once with brine. After drying over $MgSO_4$ and filtering through Celite, the product was isolated by column chromatography (DCM:Acetone) as a white solid **1a'** (158.5 mg, 33%). The spectra matched the literature.[2] Purity by HPLC: 98.9%. ^{1}H NMR (700 MHz, $CDCl_3$) δ 6.15 (m, *J* = 6.6 Hz, 2H), 5.95 (s, 1H), 5.23 (t, *J* = 9.6 Hz, 1H), 5.11 (m, *J* = 4.5 Hz, 1H), 5.02 (t, *J* = 8.8 Hz, 1H), 4.54 (q, *J* = 3.3 Hz, 1H), 4.29 (m, *J* = 4.4 Hz, 1H), 4.16 (m, *J* = 3.5 Hz, 1H), 3.87 (m, *J* = 3.9 Hz, 1H), 3.74 (m, *J* = 2.9 Hz, 2H), 3.49 (m, *J* = 4.5 Hz, 2H), 2.94 (s, 2H), 2.11 (d, *J* = 2.2 Hz, 3H), 2.08 (d, *J* = 11.5 Hz, 3H), 2.06 (s, 3H), 2.04 (s, 3H), 2.02 (q, *J* = 4.4 Hz, 1H), 1.93 (m, *J* = 3.7 Hz, 1H), 1.73 (t, *J* = 6.8 Hz, 1H), 1.37 (t, *J* = 9.3 Hz, 1H), 1.33 (m, *J* = 3.2 Hz, 1H). ^{13}C NMR (176 MHz, $CDCl_3$) δ 175.70 170.61 170.21 169.46 169.44 138.34 136.00 100.94 72.65 71.95 71.34 69.40 68.25 61.80 47.25 46.35 44.65 41.58 39.25 30.46 20.76 20.74 20.61. ESI-MS (m/z) calcd for $C_{24}H_{34}NO_{11}$; $[M + H]^+$: 512.21, found: 512.2

Synthesis of 1,2,3,4,6-penta-O-acetyl-β-D-galactopyranoside



1,2,3,4,6-penta-O-acetyl-β-D-galactopyranoside was prepared by following the literature.[3] D-galactose (1.00 g, 5.62 mmol), acetic anhydride (3.14 mL, 6 eq.) and sodium acetate (0.92g, 2 eq.) were irradiated under commercial microwave oven until all the solid dissolved in a solution. The solution was directly subject to precipitated in ice-water and the residue was collected by filtration. Multiple recrystallization was performed in ethanol to yield white crystal. (1.21 g, 55 %). ^{1}H NMR (700 MHz, $CDCl_3$) δ 5.72 (d, J = 8.3 Hz, 1H), 5.44 (d, J = 3.4 Hz, 1H), 5.35 (dd, J = 8.4, 10.4 Hz, 1H), 5.09 (dd, J = 3.4, 10.4 Hz, 1H), 4.16 (m, J = 6.4 Hz, 2H), 4.07 (t, J = 6.6 Hz, 1H), 2.18 (s, 3H), 2.14 (s, 3H), 2.06 (s, 6H), 2.01 (s, 3H). ^{13}C NMR (176 MHz, $CDCl_3$) δ 170.36 170.13 169.98 169.39 168.99 92.15 71.69 70.83 67.80 66.78 61.02 31.26 20.83 20.66 20.64 20.55.

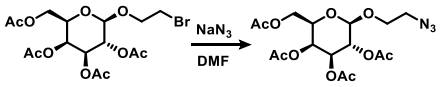
Synthesis of 2,3,4,6-tetra-O-acetyl-β-D-galactopyranoside, 2-bromoethyl (2b')



Hexose **2b'** was prepared by following the same procedure as for the preparation of **2a'**. Yield: 46 %. The NMR spectra of the product matched the literature[1]. ^{1}H NMR (500 MHz, $CDCl_3$) δ 5.42 (d, *J* = 2.9 Hz, 1H), 5.26 (q, *J* = 6.1 Hz, 1H), 5.05 (q, *J* = 4.6 Hz, 1H), 4.56 (d, *J* = 8.0 Hz, 1H), 4.20 (m, *J* = 3.5 Hz, 2H), 3.94 (t, *J* = 6.6 Hz, 1H), 3.84 (m, *J* = 5.0 Hz, 1H), 3.49 (q, *J* = 4.6 Hz, 2H), 2.18

(s, 3H), 2.11 (s, 3H), 2.08 (s, 3H), 2.01 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.40 170.22 170.15 169.55 101.56 70.83 70.75 69.77 68.55 66.96 61.26 29.94 20.88 20.69 20.67 20.60. ESI-MS (m/z) calcd for $C_{16}H_{27}BrNO_{10}$; $[M + NH_4]^+$: 472.08, found: 472.1

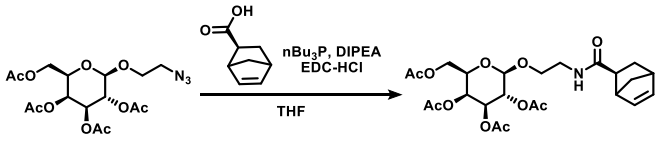
Synthesis of 2,3,4,6-tetra-O-acetyl-β-D-galactopyranoside, 2-azidoethyl (3b')



2b' 3b'

Hexose **3b'** was prepared by following the same procedure as for the preparation of **3a'** and spectra matched the literature[2]. Yield 87%. ^{1}H NMR (700 MHz, $CDCl_3$) δ 5.43 (d, *J* = 3.3 Hz, 1H), 5.27 (q, *J* = 6.1 Hz, 1H), 5.05 (q, *J* = 4.6 Hz, 1H), 4.59 (d, *J* = 8.0 Hz, 1H), 4.18 (m, *J* = 8.4 Hz, 2H), 4.07 (m, *J* = 3.8 Hz, 1H), 3.95 (t, *J* = 6.7 Hz, 1H), 3.72 (m, *J* = 3.8 Hz, 1H), 3.54 (m, *J* = 4.2 Hz, 1H), 3.33 (m, *J* = 4.3 Hz, 1H), 2.18 (s, 3H), 2.09 (s, 3H), 2.08 (s, 3H), 2.01 (s, 3H). ^{13}C NMR (176 MHz, $CDCl_3$) δ 170.40 170.24 170.17 169.49 101.17 70.92 70.84 68.54 68.40 67.02 61.27 50.59 20.79 20.70 20.68 20.59. ESI-MS (m/z) calcd for $C_{16}H_{27}N_4O_{10}$; $[M + NH_4]^+$: 435.17, found: 435.2

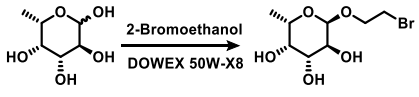
Synthesis of 2,3,4,6-Tetra-O-acetyl-β-D-galactopyranosyl bicyclo[2.2.1]hept-5-ene-exo-2-carboxamide (1b')



3b' 1b'

Peracetylated glycomonomer **1b'** was prepared by by following same the procedure as for the preparation of **1a'** to yield a white solid with spectra matching the literature[2]. Yield: 58 %. Purity by HPLC: 97.5%. ^{1}H NMR (700 MHz, $CDCl_3$) δ 6.15 (m, *J* = 2.9 Hz, 1H), 6.11 (m, *J* = 3.1 Hz, 1H), 5.91 (d, *J* = 3.3 Hz, 1H), 5.40 (d, *J* = 3.2 Hz, 1H), 5.20 (m, *J* = 3.4 Hz, 1H), 5.02 (m, *J* = 2.2 Hz, 1H), 4.48 (q, *J* = 3.7 Hz, 1H), 4.15 (m, *J* = 3.0 Hz, 2H), 3.92 (t, *J* = 6.6 Hz, 1H), 3.89 (m, *J* = 3.4 Hz, 1H), 3.70 (m, *J* = 3.4 Hz, 1H), 3.51 (m, *J* = 3.4 Hz, 1H), 3.45 (q, *J* = 3.1 Hz, 1H), 2.92 (s, 2H), 2.16 (s, 3H), 2.06 (q, *J* = 6.8 Hz, 6H), 1.99 (s, 4H), 1.91 (m, *J* = 3.8 Hz, 1H), 1.71 (t, *J* = 6.5 Hz, 1H), 1.33 (m, *J* = 4.2 Hz, 2H). ^{13}C NMR (176 MHz, $CDCl_3$) δ 175.67 170.40 170.18 170.11 169.63 138.40 136.01 101.42 70.84 70.79 69.29 68.94 66.97 61.31 47.27 46.37 44.71 41.58 39.24 30.49 20.87 20.69 20.59. ESI-MS (m/z) calcd for $C_{24}H_{34}NO_{11}$; $[M + H]^+$: 512.21, found: 512.2

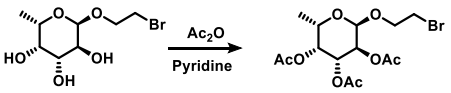
Synthesis of 2'-bromoethyl-α-L-fucopyranoside



L-Fucose c'

To a flask containing L-fucose (4.00 g, 24.41mmol) and DOWEX 50W-X8 (2.86 g) was added 2-Bromoethanol (25 mL). The reaction temperature was maintained at 85 °C for 2 h, followed by filtration through a Celite pad. The resulting filtrate was concentrated under *vacuo*. An α-anomer was exclusively obtained as a white crystal **c'** by recrystallization from ethanol (5.07 g, 51%). NMR spectra matched the literature[4]. ^{1}H NMR (700 MHz, D_2O) δ 4.84 (d, *J* = 4.0 Hz, 1H), 4.10 (q, *J* = 6.6 Hz, 1H), 3.90 (m, *J* = 4.6 Hz, 1H), 3.80 (m, *J* = 4.6 Hz, 1H), 3.71 (d, *J* = 3.3 Hz, 1H), 3.69 (q, *J* = 4.8 Hz, 1H), 3.53 (q, *J* = 3.9 Hz, 2H), 1.12 (d, *J* = 6.6 Hz, 3H). ^{13}C NMR (176 MHz, D_2O) δ 98.47 71.75 69.48 68.30 67.93 66.98 31.21 15.19. ESI-MS (m/z) calcd for $C_8H_{19}NO_5$; $[M + NH_4]^+$: 288.04, found: 288.0

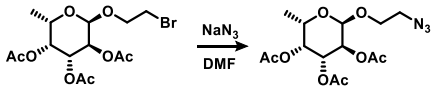
Synthesis of 2,3,4-Tri-O-acetyl-2'-bromoethyl-α-L-fucopyranoside (2c')



Bromoethyl-L-fucose 2c'

2'-bromoethyl-α-L-fucose (255.74 mg, 0.968 mmol) was added to a 1:1 v/v mixture of pyridine and acetic anhydride (5 mL). After 18 h, the organic was subsequently washed 3 times with water, 3 times with aqueous 1M HCl, 3 times with saturated sodium bicarbonate and once with brine, followed by drying over magnesium sulfate and concentration *in vacuo*. Flash chromatography (EtOAc:Hex) was performed to obtain a white solid **2c'** (275.9 mg, 72 %) and the spectrum matched the literature.[5] ^{1}H NMR (500 MHz, $CDCl_3$) δ 5.40 (q, *J* = 4.7 Hz, 1H), 5.34 (t, *J* = 1.6 Hz, 1H), 5.14 (m, *J* = 4.9 Hz, 2H), 4.28 (q, *J* = 6.5 Hz, 1H), 4.01 (m, *J* = 5.8 Hz, 1H), 3.83 (m, *J* = 5.8 Hz, 1H), 3.52 (t, *J* = 5.8 Hz, 2H), 2.19 (s, 3H), 2.11 (s, 3H), 2.02 (s, 3H), 1.17 (d, *J* = 6.6 Hz, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) 170.61 170.06 96.39 71.08 68.42 68.12 67.92 64.86 30.21 20.89 20.73 20.68 15.88. ESI-MS (m/z) calcd for $C_{14}H_{25}BrNO_8$; $[M + NH_4]^+$: 414.07, found: 414.1

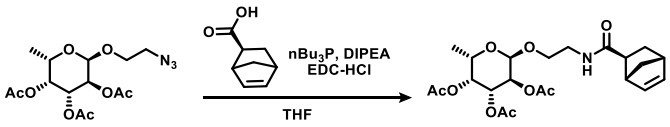
Synthesis of 2,3,4-Tri-O-acetyl-2'-azidoethyl-α-L-fucopyranoside (3c)



2c' 3c'

A solution of **2c'** (3.56 mmol, 1414 mg) and sodium azide (13.4 mmol, 870 mg) in DMF (20 mL) was heated to 80 °C for 18 h. The reaction mixture was diluted with toluene followed by filtered through Celite. The filtrate was subsequently washed 3 times with water and once with brine. The organic layer was dried over anhydrous magnesium sulfate followed by concentration *in vacuo*. The crude product was purified via flash chromatography (EtOAc:Hex) to obtain an orange solid **3c'** (913.7 mg, 71 %). The spectrum matched the literature[6]. ^{1}H NMR (700 MHz, $CDCl_3$) δ 5.40 (q, *J* = 4.7 Hz, 1H), 5.35 (d, *J* = 2.9 Hz, 1H), 5.16 (m, *J* = 5.3 Hz, 2H), 4.21 (q, *J* = 6.5 Hz, 1H), 3.89 (m, *J* = 3.4 Hz, 1H), 3.64 (m, *J* = 3.5 Hz, 1H), 3.49 (m, *J* = 3.4 Hz, 1H), 3.40 (m, *J* = 3.2 Hz, 1H), 2.20 (s, 3H), 2.11 (s, 3H), 2.01 (s, 3H), 1.18 (d, *J* = 6.6 Hz, 3H). ^{13}C NMR (176 MHz, $CDCl_3$) δ 170.69 170.61 170.05 96.48 71.06 67.96 67.90 67.21 64.71 50.47 20.84 20.73 20.69 15.92. ESI-MS (m/z) calcd for $C_{14}H_{25}N_4O_8$; $[M + NH_4]^+$: 377.17, found: 377.2

Synthesis of 2,3,4-Tri-O-acetyl-α-L-fucopyranosyl bicyclo[2.2.1]hept-5-ene-exo-2-carboxamide (1c')



3c' 1c'

Peracetylated glycomonomer 1**c'** was prepared by following the same procedure as for the preparation of **1a'** to yield a white solid (138.4mg, 36 %) and the spectrum matched the literature[2]. Purity by HPLC: 99.5%. ^{1}H NMR (700 MHz, $CDCl_3$) δ 6.18 (t, *J* = 2.6 Hz, 1H), 6.13 (m, *J* = 3.5 Hz, 1H), 5.90 (s, 1H), 5.39 (m, *J* = 3.8 Hz, 1H), 5.32 (t, *J* = 3.4 Hz, 1H), 5.18 (m, *J* = 2.7 Hz, 1H), 5.08 (t, *J* = 3.6 Hz, 1H), 4.16 (t, *J* = 7.0 Hz, 1H), 3.79 (m, *J* = 5.0 Hz, 1H), 3.53 (m, 3H), 2.95 (d, *J* = 9.0 Hz, 2H), 2.20 (s, 3H), 2.09 (d, *J* = 10.0 Hz, 3H), 2.02 (m, 4H), 1.94 (m, *J* = 3.7 Hz, 1H), 1.73 (d, *J* = 8.3 Hz, 1H), 1.38 (m, *J* = 5.2 Hz, 2H), 1.17 (q, *J* = 3.3 Hz, 3H). ^{13}C NMR (176 MHz, $CDCl_3$) δ 175.57 170.63 170.21 138.38 135.93 96.50 71.02 68.16 67.92 67.68 64.68 47.24 46.35 44.81 41.58 39.18 30.96 30.53 20.82 20.75 20.68 15.90. ESI-MS (m/z) calcd for $C_{22}H_{32}NO_9$; $[M + H]^+$: 454.20, found: 454.2

NMR characterization of glycopolymers synthesized.

Polymers ($pGlc_{100}$, $pGal_{100}$, $pFuc_{100}$, Glc_{100}, Gal_{100} and Fuc_{100}) were prepared with matching spectra as literature.[2]

pGal$_5$Fuc$_5$ ^{1}H NMR (700 MHz, $CDCl_3$) δ 7.36 (m), 5.91 (br, s), 5.42 (br, s), 5.35 (br, s), 5.30 (br, s), 5.19 (br, s), 5.16 (br, s), 5.05 (br, s), 4.52 (br, s), 4.16 (br, s), 3.98 (br, s), 3.87 (br, s), 3.77 (m), 3.54 (br, s), 3.35 (br, s), 3.06 (br, s), 2.72 (br, s), 2.47 (br, s), 2.32 (br, s), 2.30 (br, s), 2.19 (br, s), 2.18 (br, s), 2.09 (br, s), 2.07 (br, s), 2.02 (br, s), 1.88 (m), 1.67 (br, s), 1.16 (br, s).

pGal$_{15}$Fuc$_{15}$ ^{1}H NMR (700 MHz, $CDCl_3$) δ 7.36 (m), 5.94 (br, s), 5.42 (br, s), 5.35 (br, s), 5.30 (br, s), 5.19 (br, s), 5.16 (br, s), 5.05 (br, s), 4.54 (br, s), 4.16 (br, s), 3.99 (br, s), 3.87 (br, s), 3.77 (m), 3.54 (br, s), 3.35 (br, s), 3.07 (br, s), 2.73 (br, s), 2.47 (br, s), 2.32 (br, s), 2.30 (br, s), 2.19 (br, s) 2.18 (br, s), 2.09 (br, s), 2.07 (br, s), 2.02 (br, s), 1.88 (m), 1.67 (br, s), 1.16 (br, s).

pGal$_{50}$Fuc$_{50}$ ^{1}H NMR (700 MHz, CD_2Cl_2) δ 7.38 (br, s), 7.31 (br, s), 7.27 (br, s), 5.94 (br, s), 5.42 (br, s), 5.34 (br, s), 5.29 (br, s), 5.23 (br, s), 5.13 (br, s), 5.06 (br, s), 4.56 (br, s), 4.17 (br, s), 4.01 (br, s), 3.86 (br, s), 3.74 (m), 3.70 (br, s), 3.58 (br, s), 3.37 (br, s), 3.06 (br, s), 2.72 (br, s), 2.30 (br, s), 2.18 (s), 2.08 (br, s), 2.06 (s), 2.00 (br, s), 1.88 (m), 1.68 (br, s), 1.15 (br, s). ^{13}C NMR (125 MHz, $CDCl_3$) δ 174.51 170.54 170.29 170.12 169.95 169.51 101.31 96.44 71.04 70.88 68.94 68.10 67.94 67.21 65.64 64.59 61.45 42.17 38.97 36.98 20.72 20.52 20.47 20.44 20.39 15.74 15.09.

Gal$_5$Fuc$_5$ ^{1}H NMR (700 MHz, D_2O) δ 7.35 (br, s), 7.31 (br, s), 7.22 (br, s), 5.31 (br, s), 5.25 (br, s), 5.17 (br, s), 4.76 (br, s), 4.27 (br, s), 3.88 (br, s), 3.83 (s), 3.72 (br, s), 3.67 (s), 3.58 (br, s), 3.54 (br, s), 3.44 (br, s), 3.39 (br, s), 3.31 (br, s), 3.24 (br, s), 2.93 (br, s), 2.83 (br, s), 2.64 (br, s), 2.51 (br, s), 2.40 (br, s), 1.90 (br, s), 1.73 (br, s), 1.56 (br, s), 1.11 (s).

Gal$_{15}$Fuc$_{15}$ ^{1}H NMR (700 MHz, D_2O) δ 7.33 (br, s), 7.30 (br, s), 7.22 (br, s), 5.32 (br, s), 5.25 (br, s), 5.16 (br, s), 4.77 (br, s), 4.27 (br, s), 3.88 (br, s), 3.83 (s), 3.72 (br, s), 3.67 (s), 3.58 (br, s), 3.54 (br, s), 3.44 (br, s), 3.39 (br, s), 3.31 (br, s), 3.24 (br, s), 2.93 (br, s), 2.84 (br, s), 2.64 (br, s), 2.51 (br, s), 2.40 (br, s), 1.90 (br, s), 1.73 (br, s), 1.56 (br, s), 1.11 (s).

Gal$_{50}$Fuc$_{50}$ ^{1}H NMR (700 MHz, D_2O) δ 7.30 (br, s), 7.21 (br, s), 5.31 (br, s), 5.24 (br, s), 5.15 (br, s), 4.77 (br, s), 4.27 (br, s), 3.88 (br, s), 3.83 (s), 3.74 (br, s), 3.67 (s), 3.55 (br, s), 3.54 (br, s), 3.45 (br, s), 3.40 (br, s), 3.31 (br, s), 3.24 (br, s), 2.93 (br, s), 2.84 (br, s), 2.64 (br, s), 2.51 (br, s), 2.40 (br, s), 1.92 (br, s), 1.75 (br, s), 1.57 (br, s), 1.11 (s). ^{13}C NMR (176 MHz, D_2O) δ 177.77 103.11 98.40 75.08 72.72 71.78 70.74 69.59 68.47 68.01 66.57 60.88 51.80 51.56 48.80 43.61 41.75 39.13 36.46 15.65.

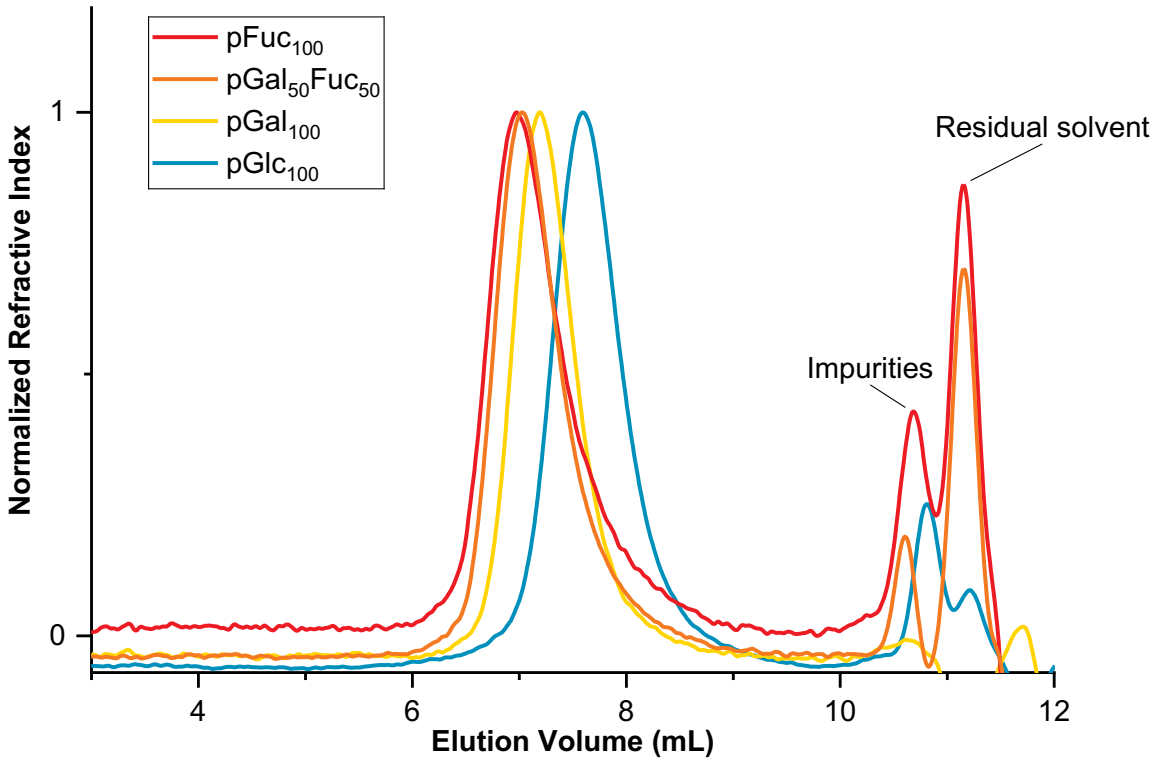


Figure S1. GPC traces of polymers displaying 100 sugar units.

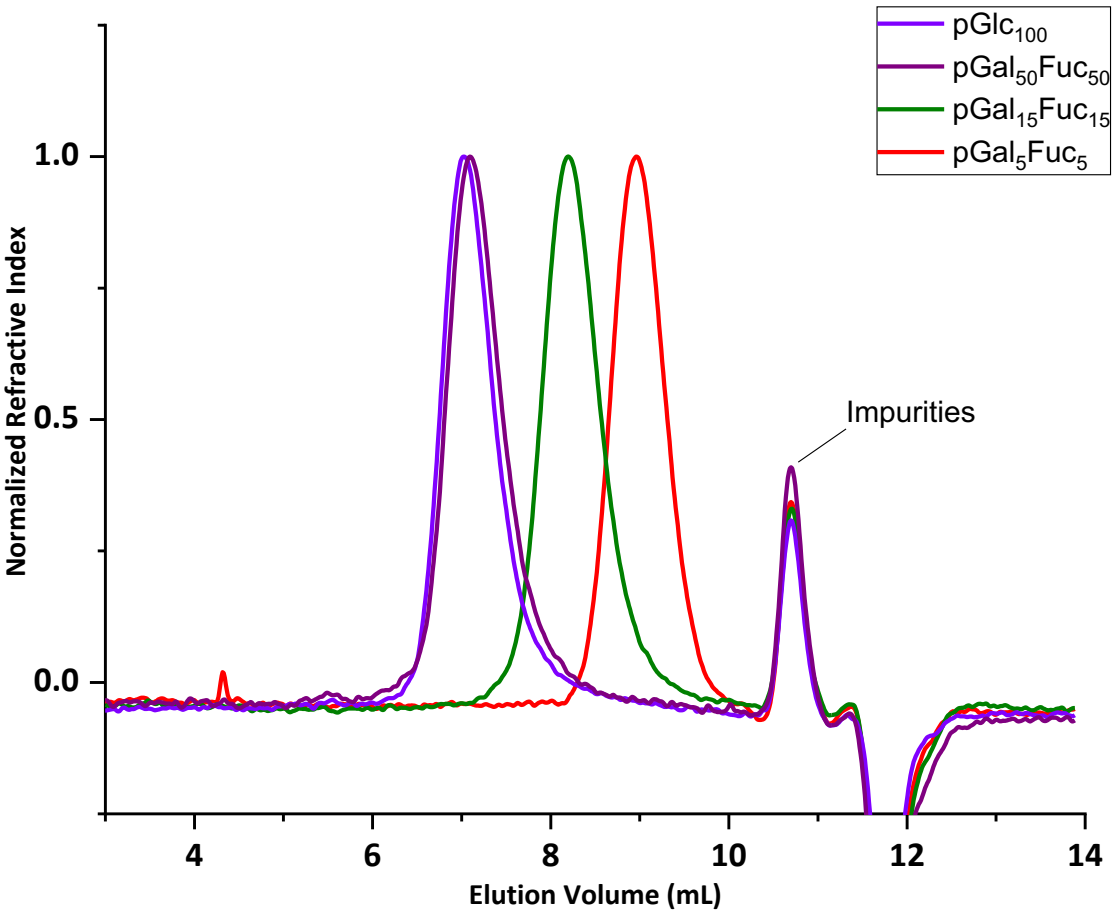


Figure S2. GPC traces of polymers with varying degrees of polymerization.

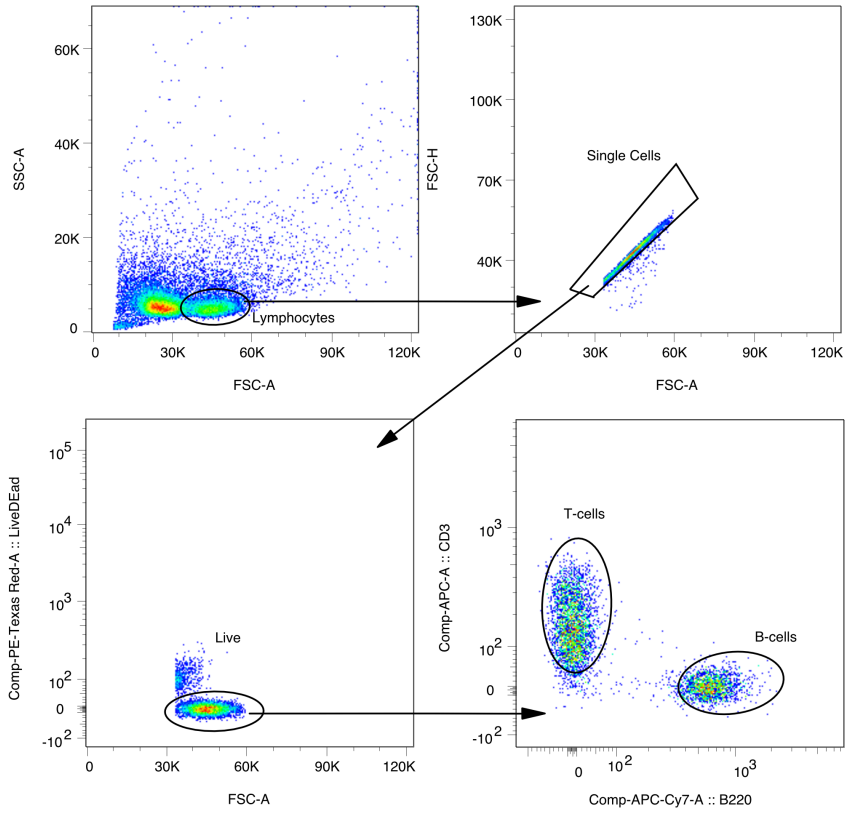


Figure S3. Gating strategy for murine MLN cells.

Only live and single cells were included for further analysis of CTB binding.

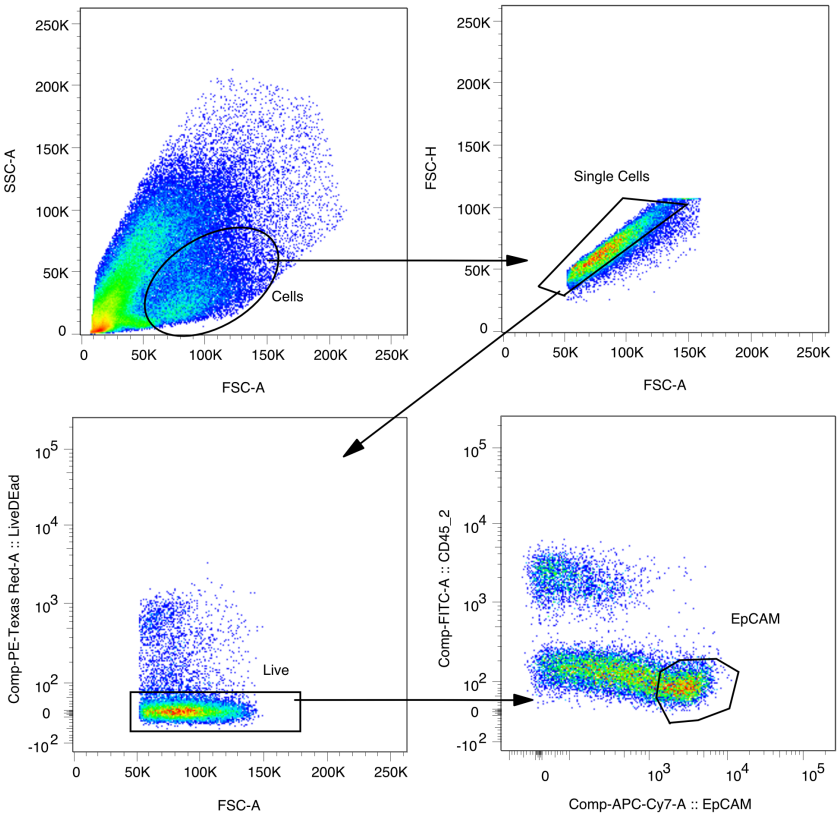


Figure S4. Gating strategy for murine small intestinal cells.

Only live and single EpCAM+ cells were included for further analysis of CTB binding.

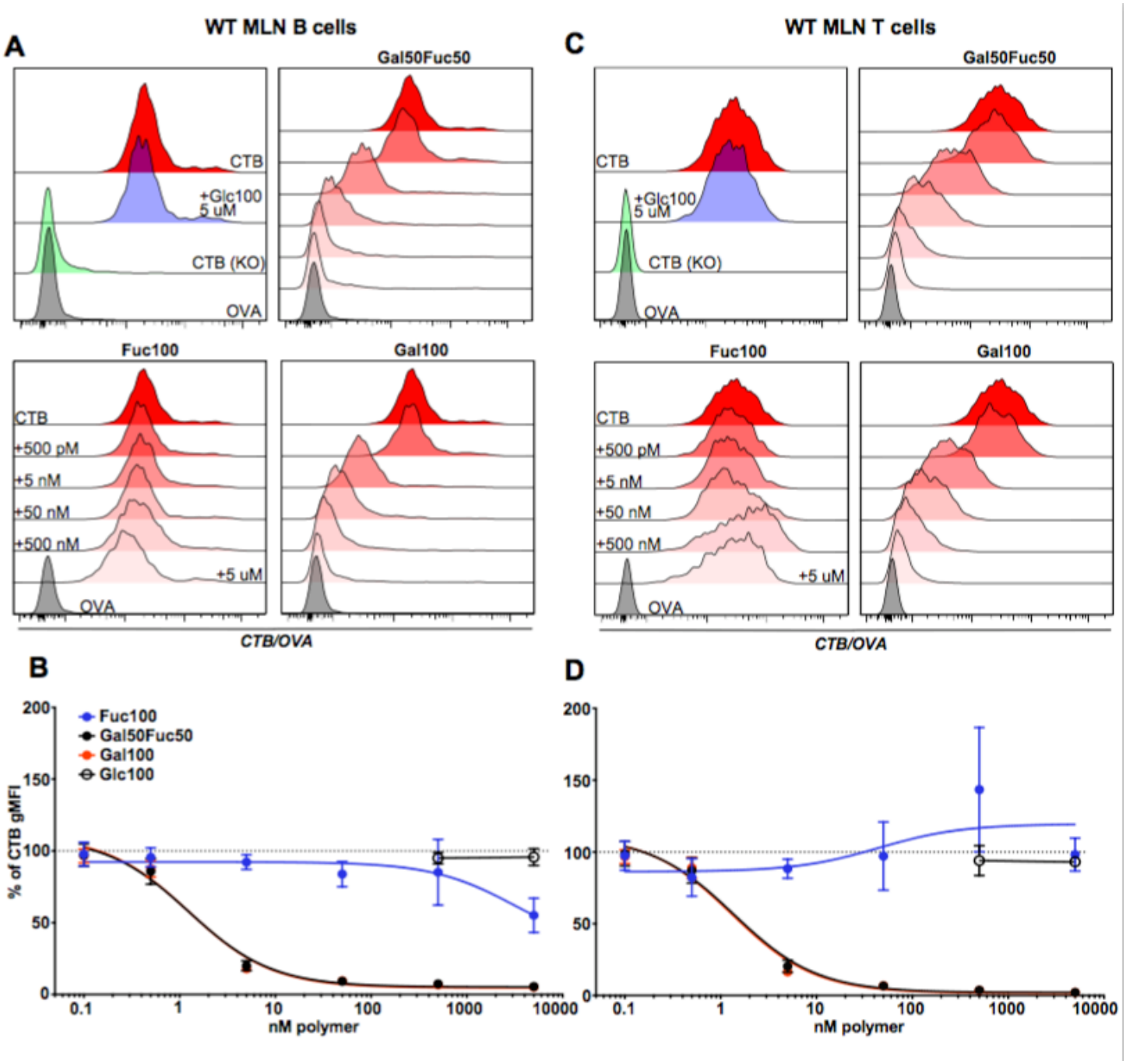


Figure S5. Flow cytometry evaluation of glycol-polymers to block CTB binding to murine lymphocytes.

Cells were isolated from murine MLN, stained with cell markers and stained with CTB-bio to analyze polymer block in flow cytometry. Full gating can be seen in Figure S3. Panel (A) and (C) show representative histograms of CTB binding to B and T cells with or without polymer block. Panel (B) and (D) show graphs of geometric mean fluorescence index (gMFI) for CTB binding after polymer block. The values are normalized to % of unblocked CTB gMFI. Curve fits were made using a three-parameter fit to equation 1. Data pooled from 3 independent experiments with 2-3 mice in each experiment where error bars represent SD.

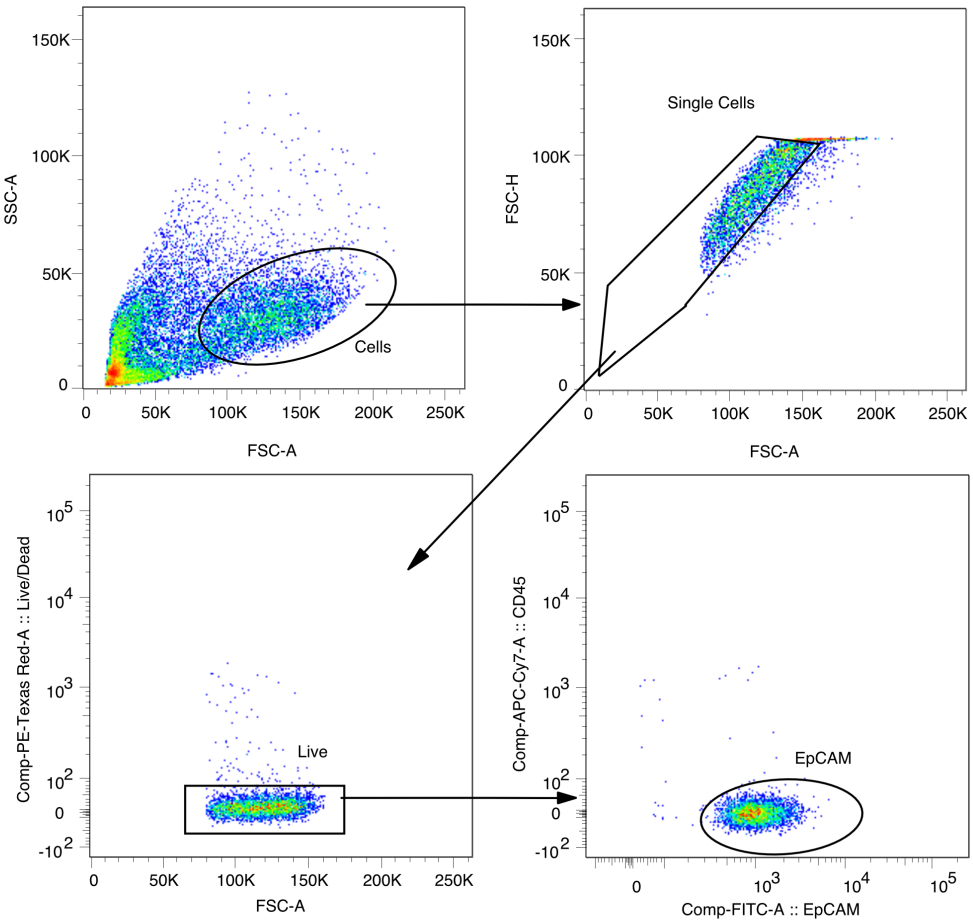


Figure S6. Gating strategy for human small intestinal cells.

Only live and single EpCAM+ cells were included for further analysis of CTB binding.

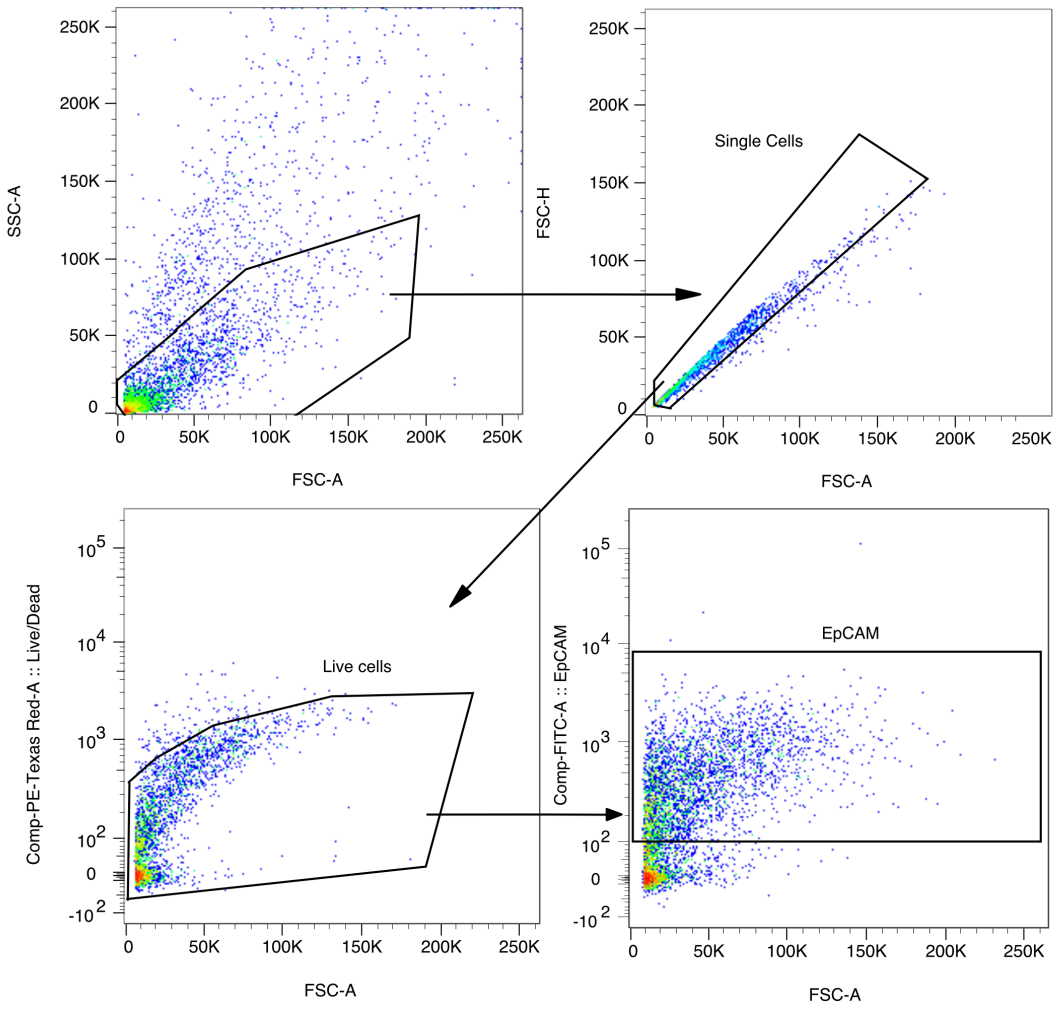
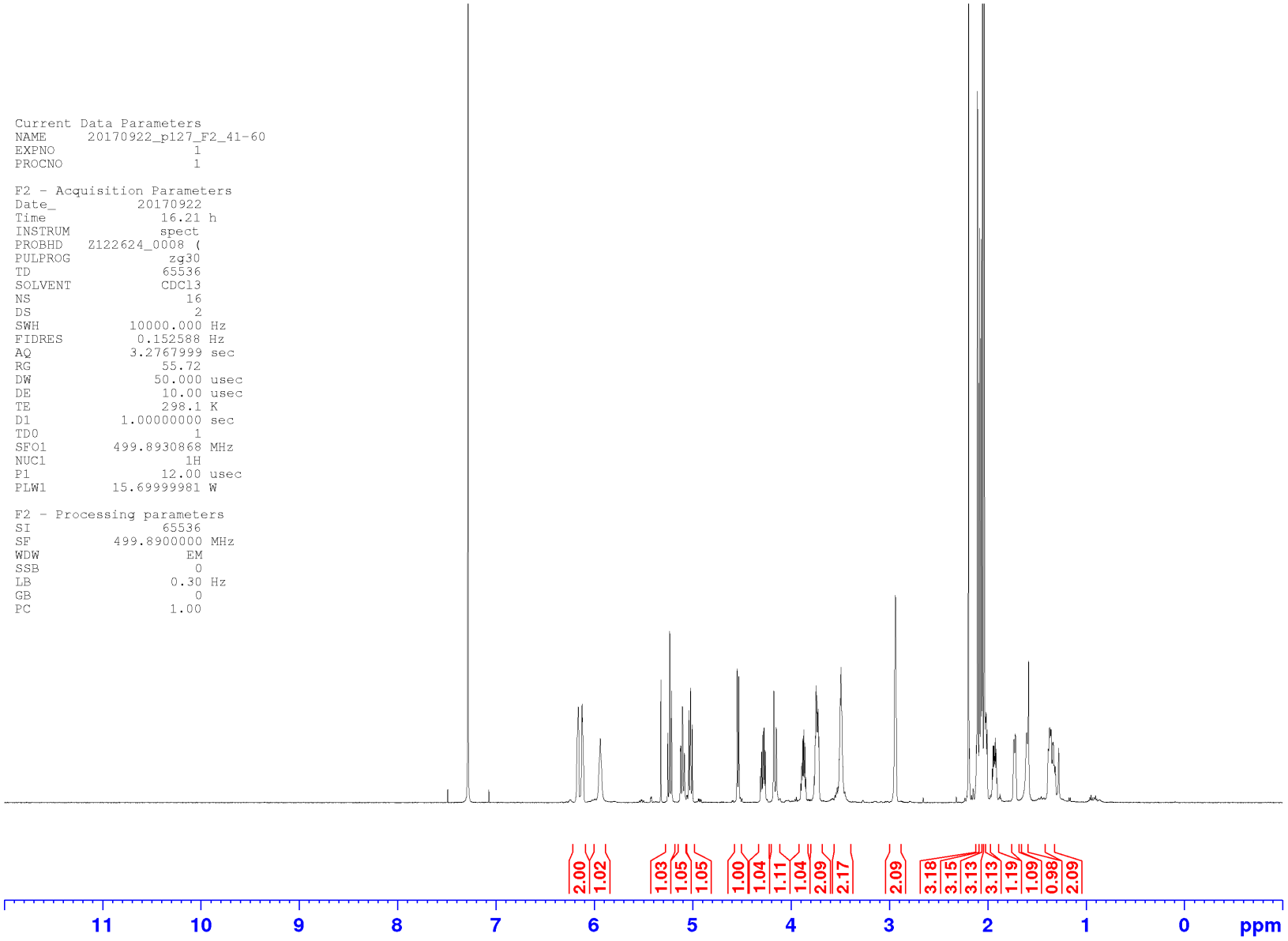
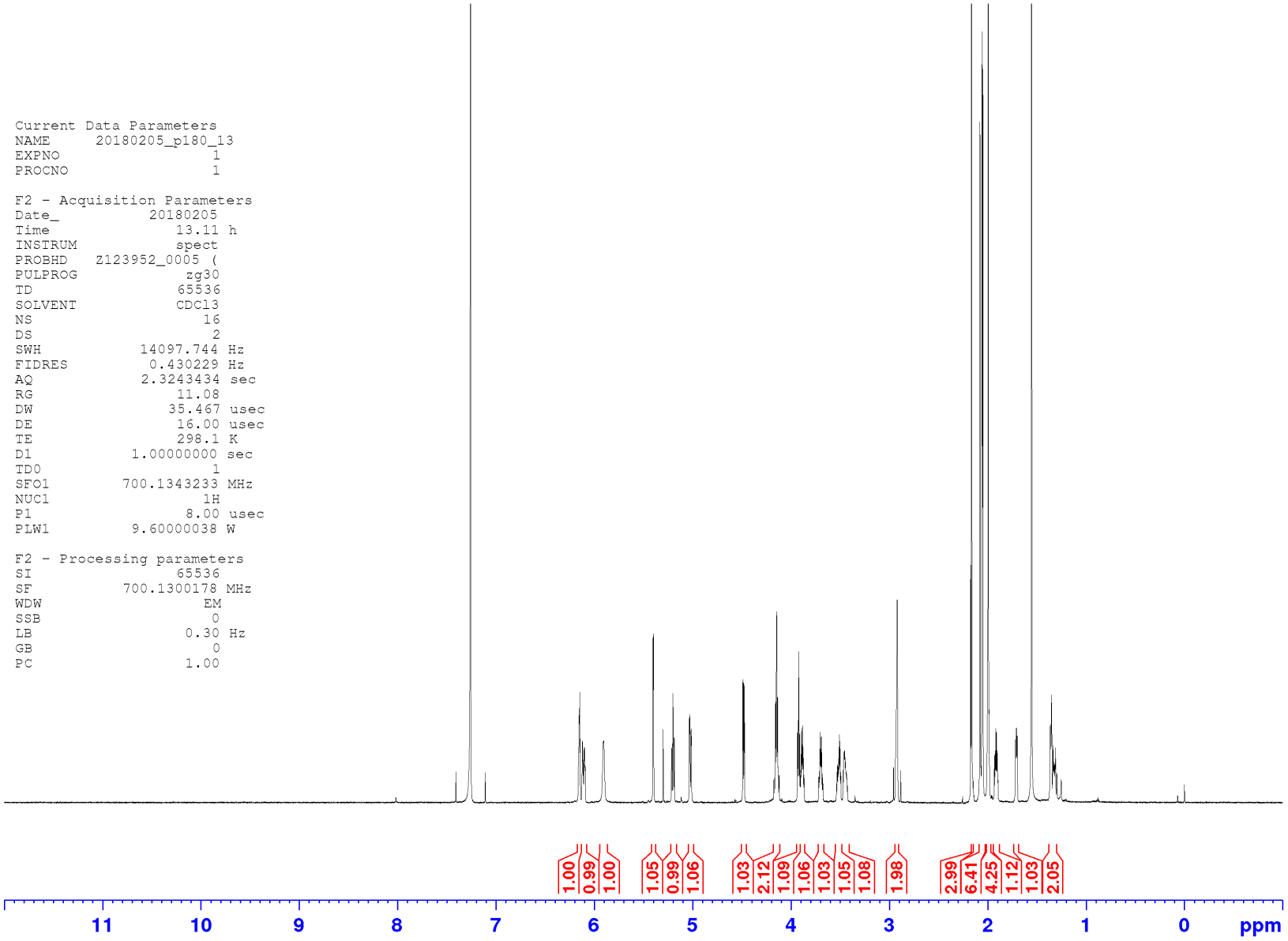


Figure S7. Gating strategy for human enteroid cells.

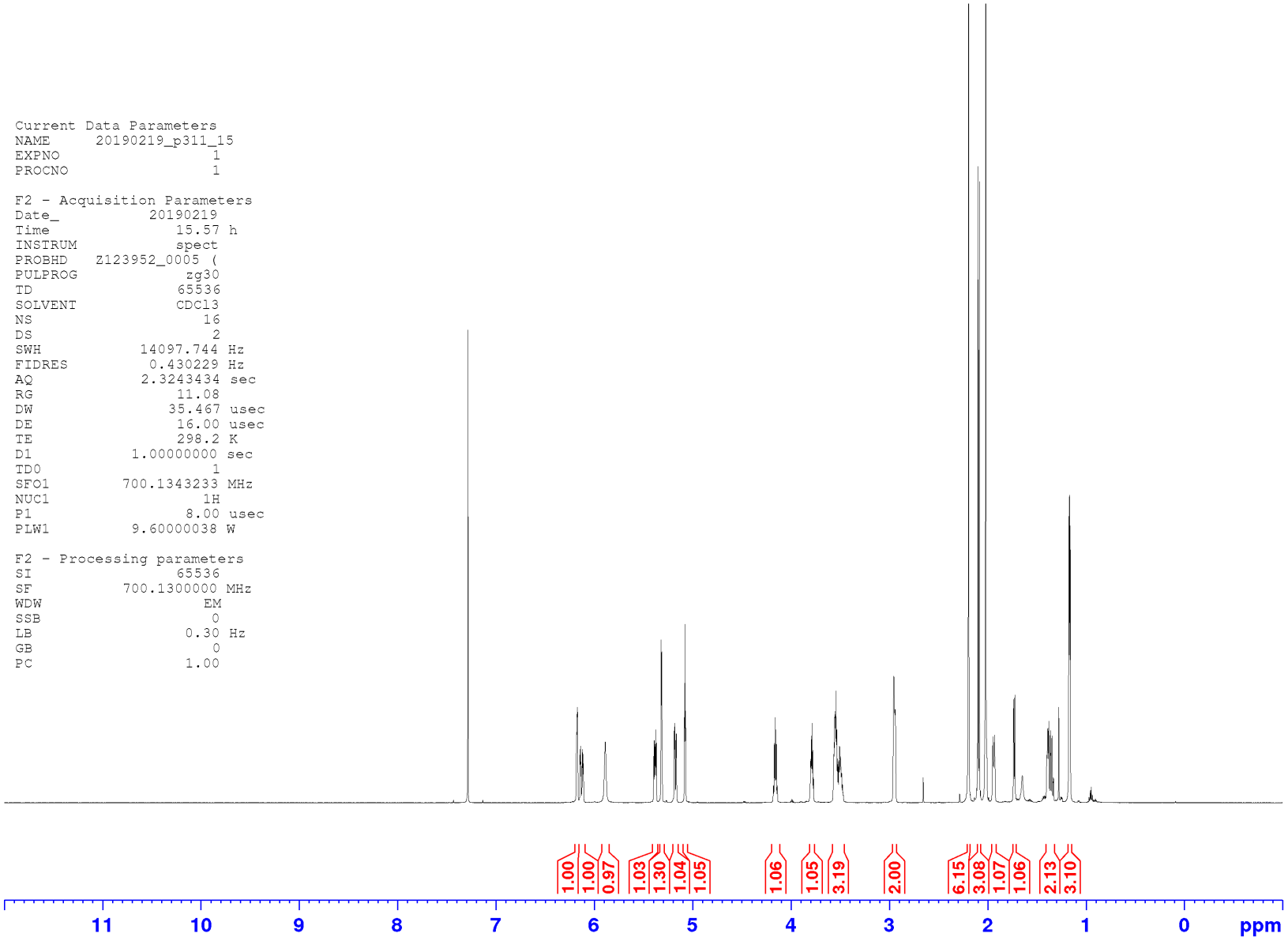
Only live and single EpCAM+ cells were included for further analysis of CTB binding.



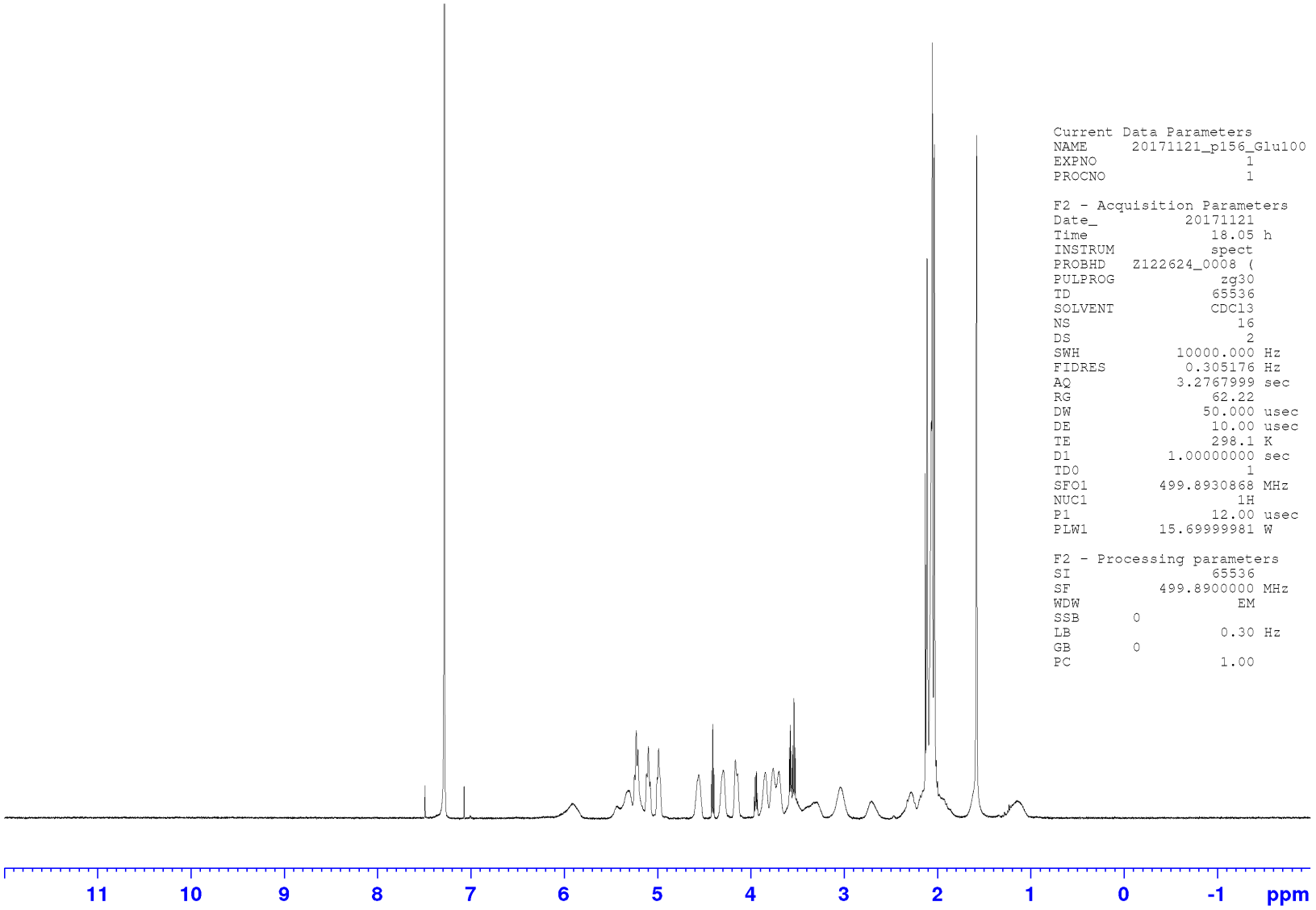
^{1}H-NMR spectrum of monomer **1a'**



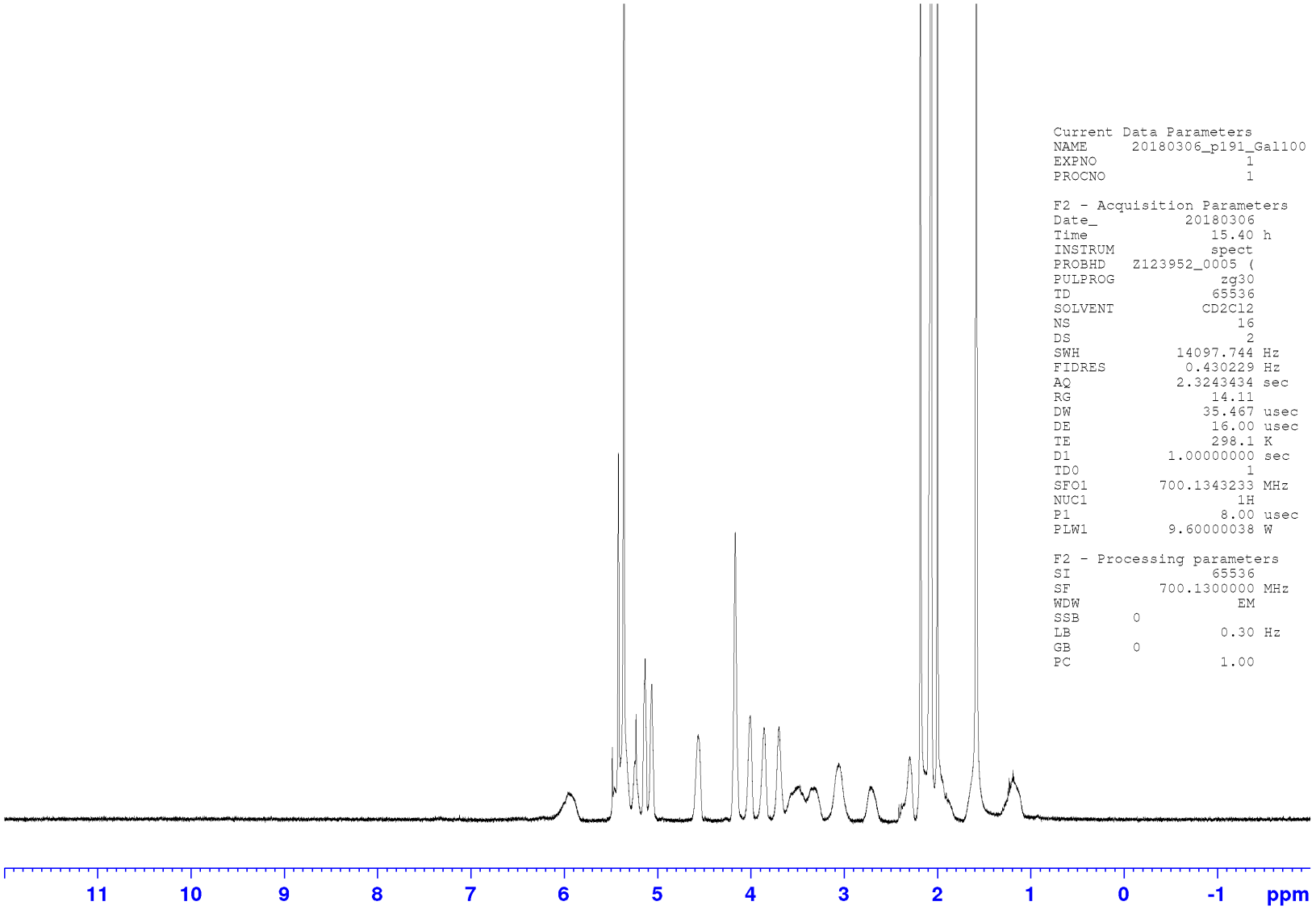
^{1}H-NMR spectrum of monomer **1b'**



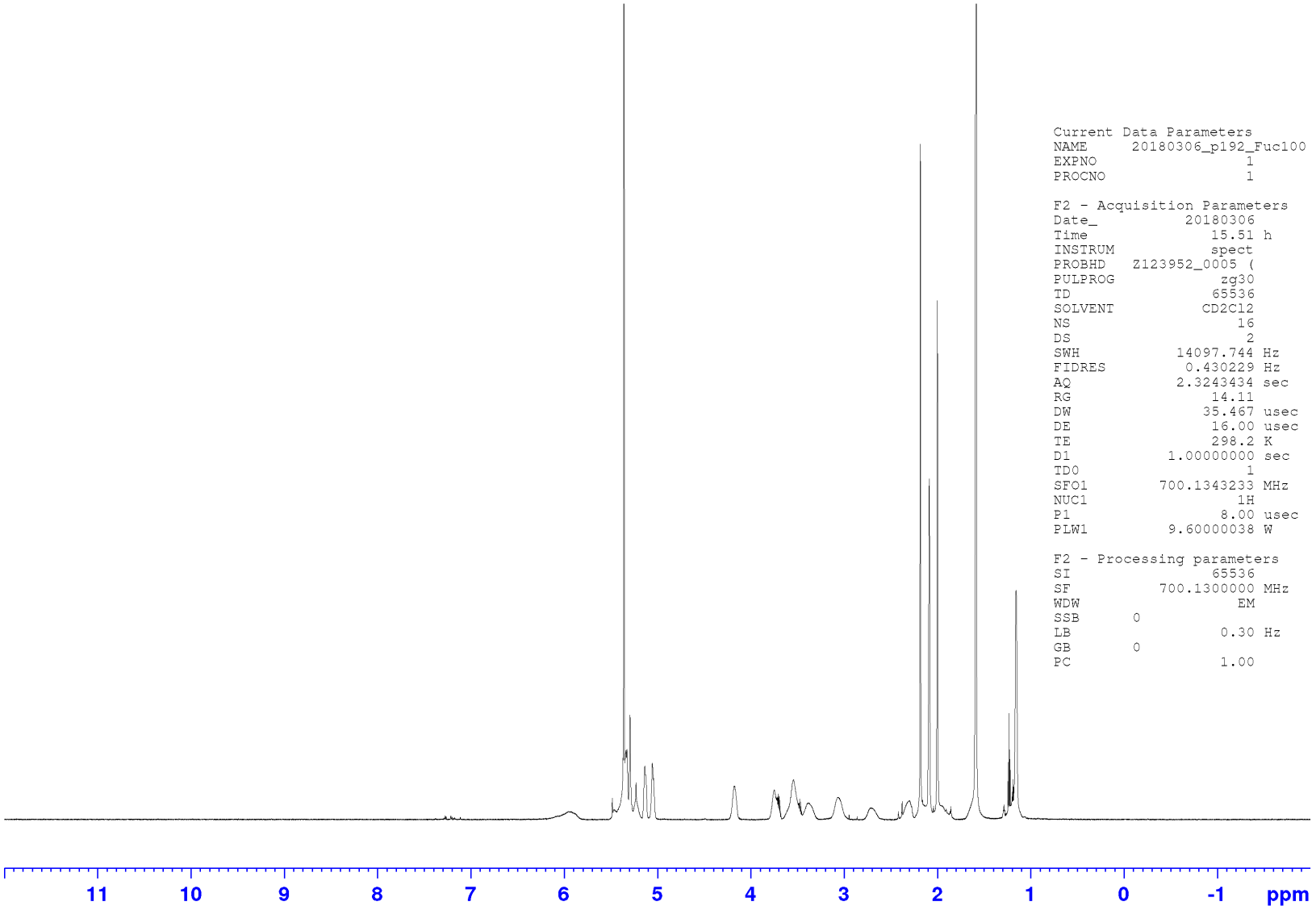
^{1}H-NMR spectrum of monomer **1c'**



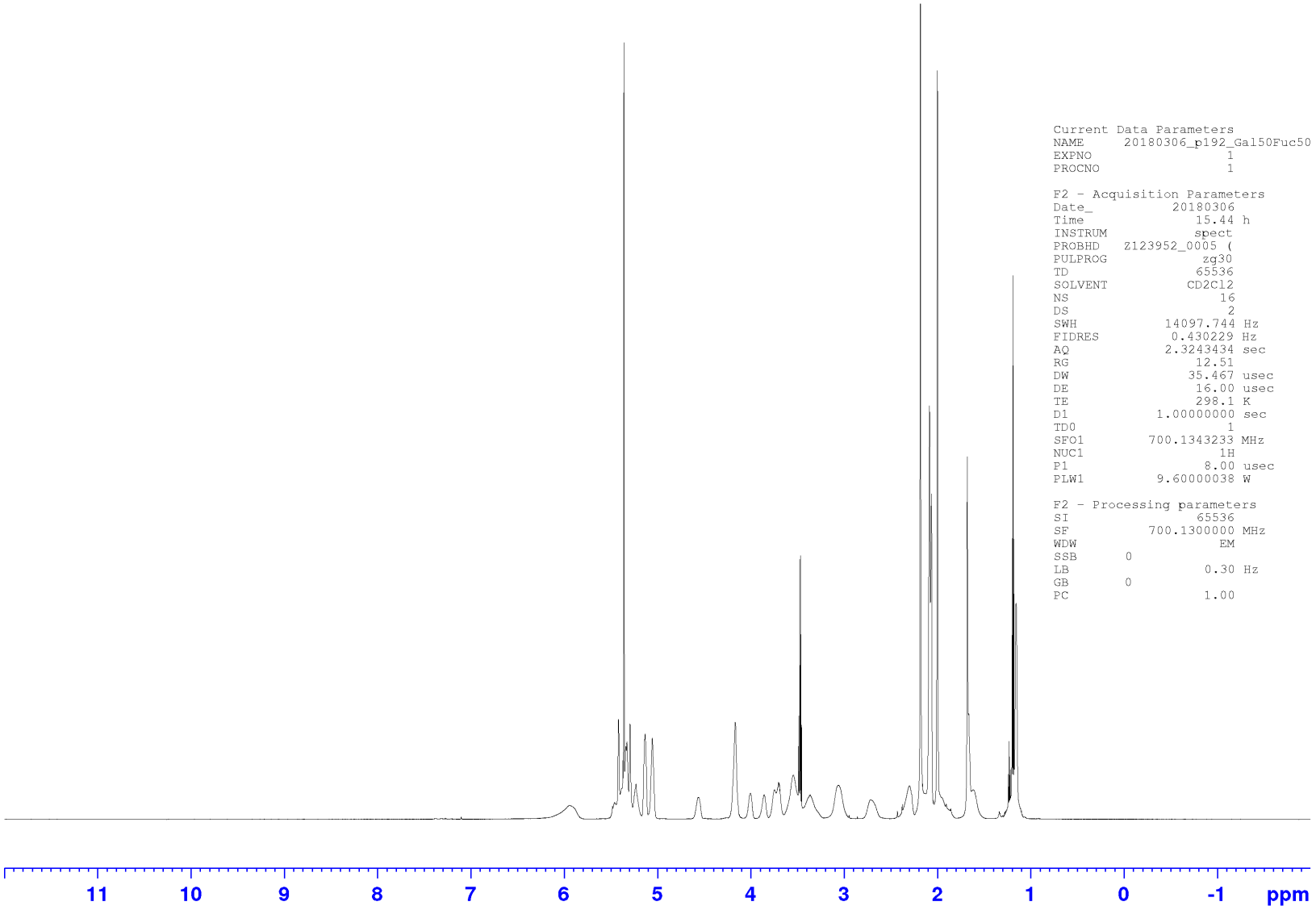
^{1}H-NMR spectrum of $pGlc_{100}$



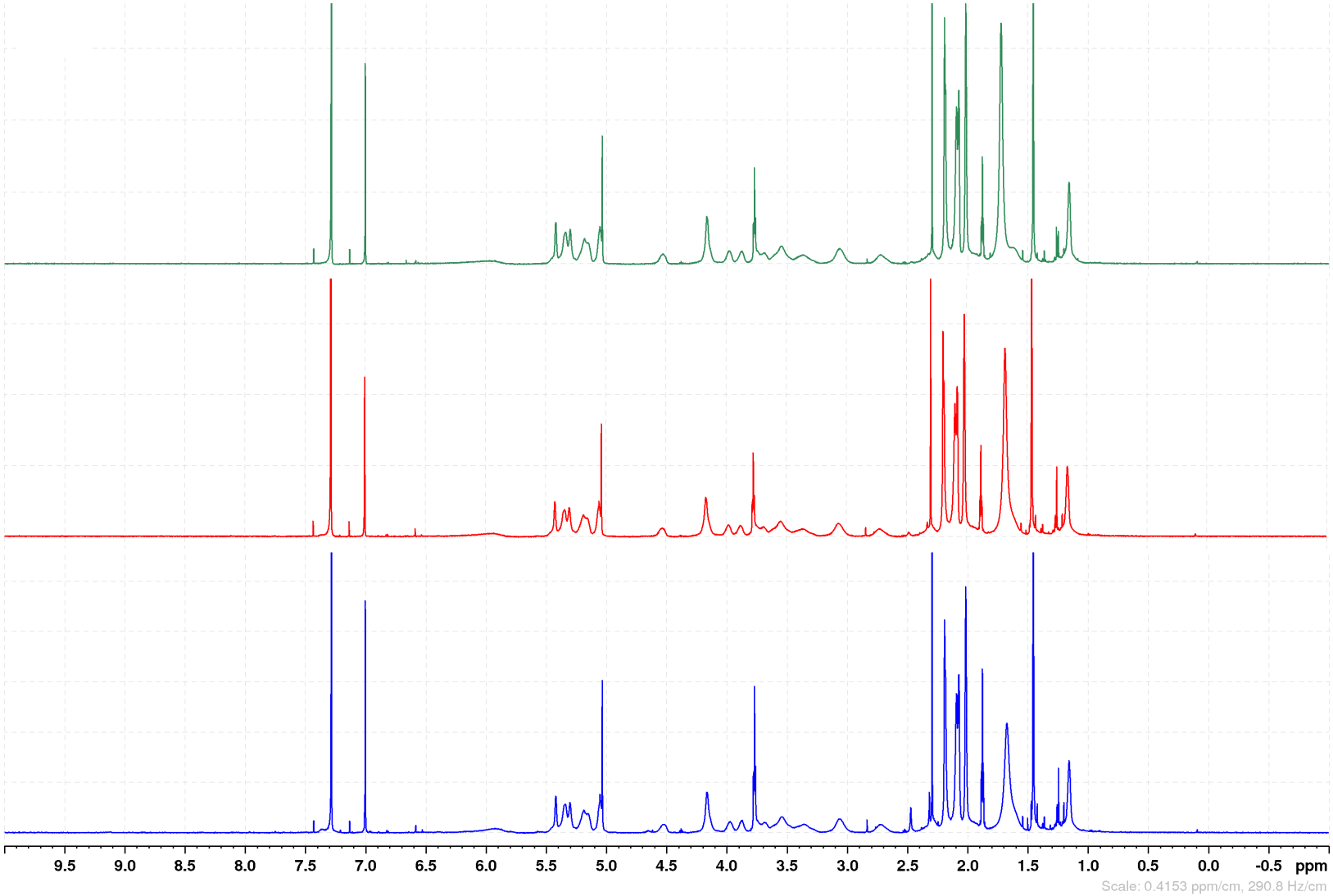
^{1}H-NMR spectrum of $pGal_{100}$



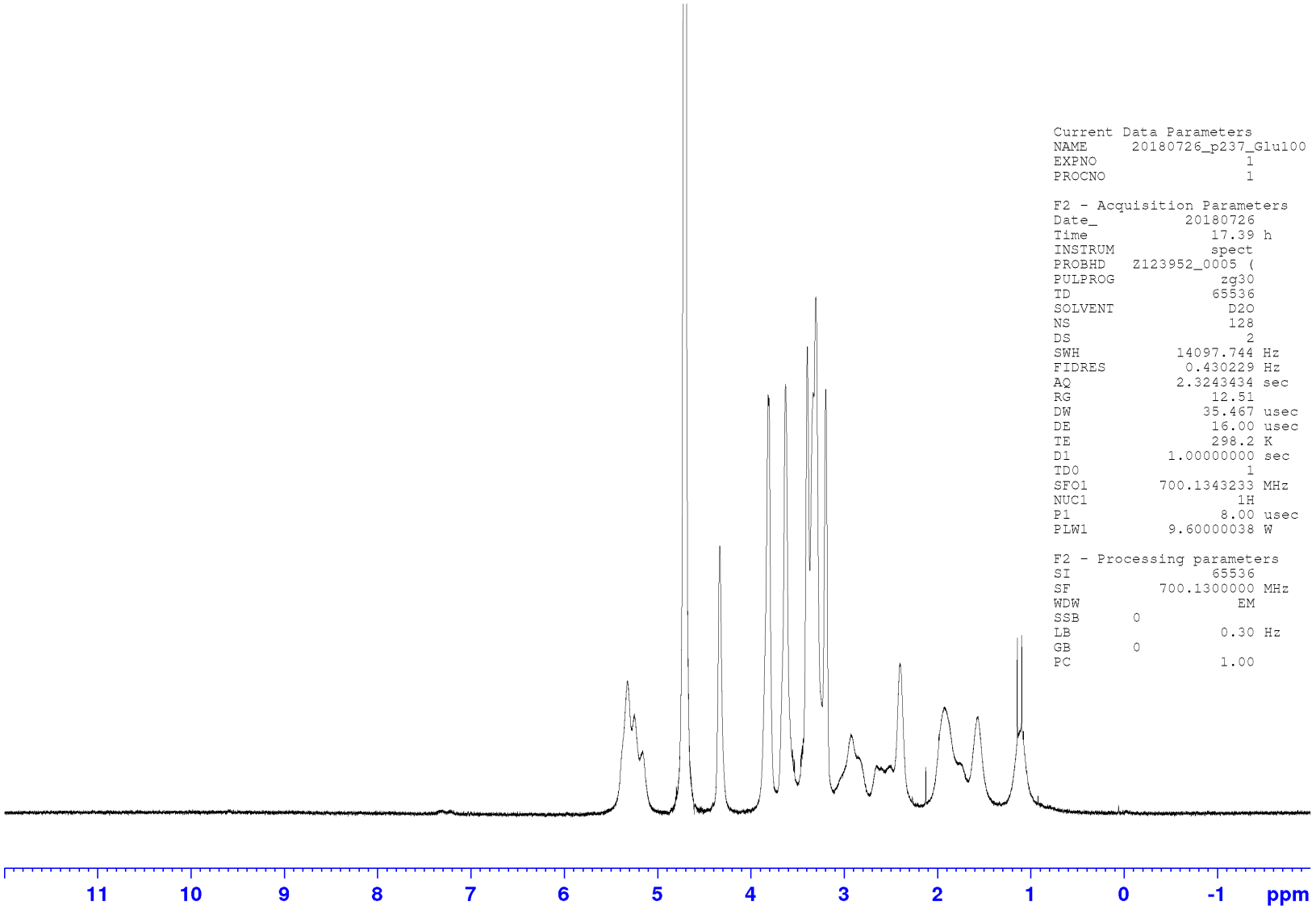
^{1}H-NMR spectrum of $pFuc_{100}$



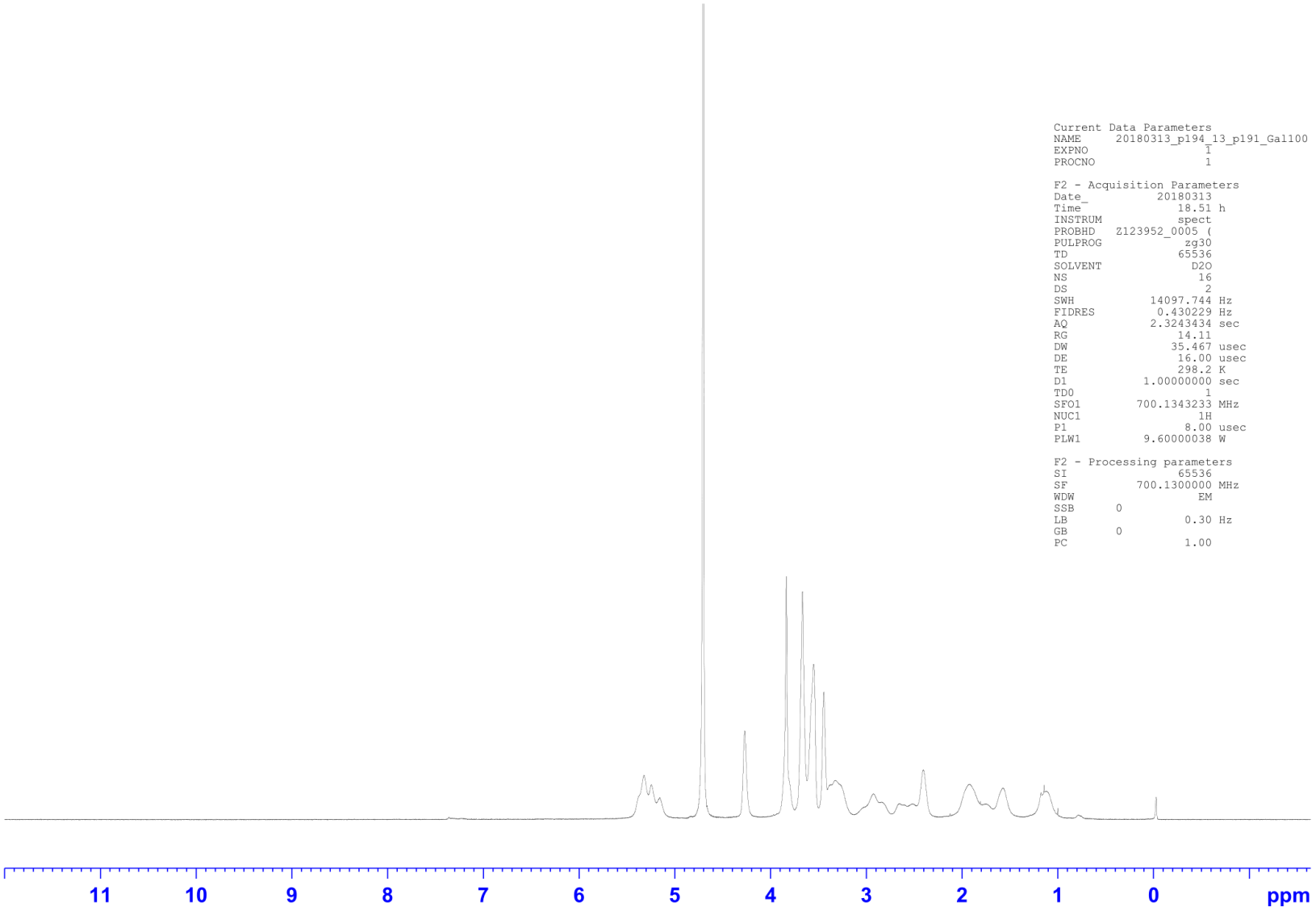
^{1}H-NMR spectrum of pGal$_{50}$Fuc$_{50}$



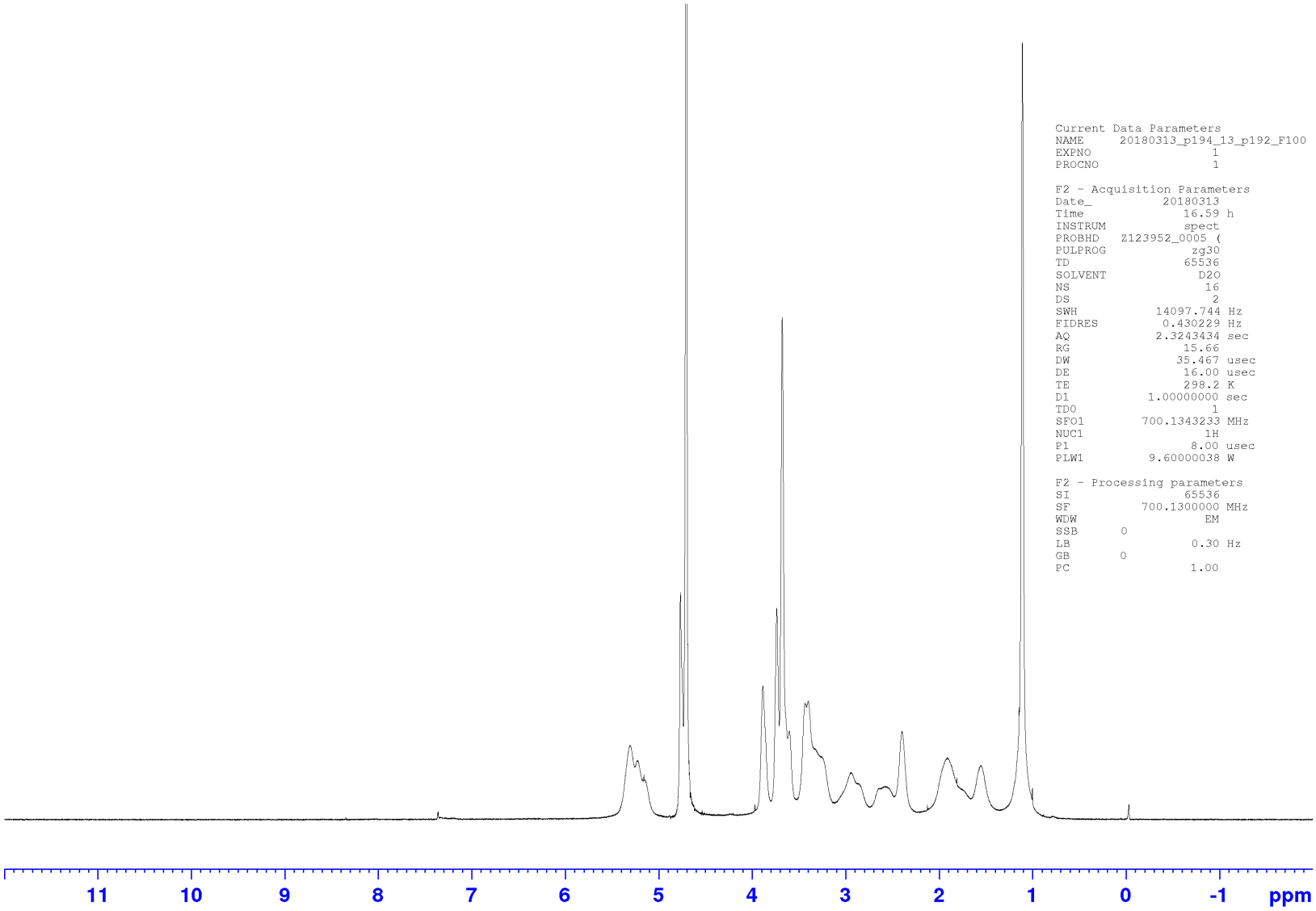
Stacked ^{1}H-NMR spectra of $pGal_5Fuc_5$ (green), $pGal_{15}Fuc_{15}$ (red) and $pGal_{50}Fuc_{50}$ (blue) in $CDCl_3$



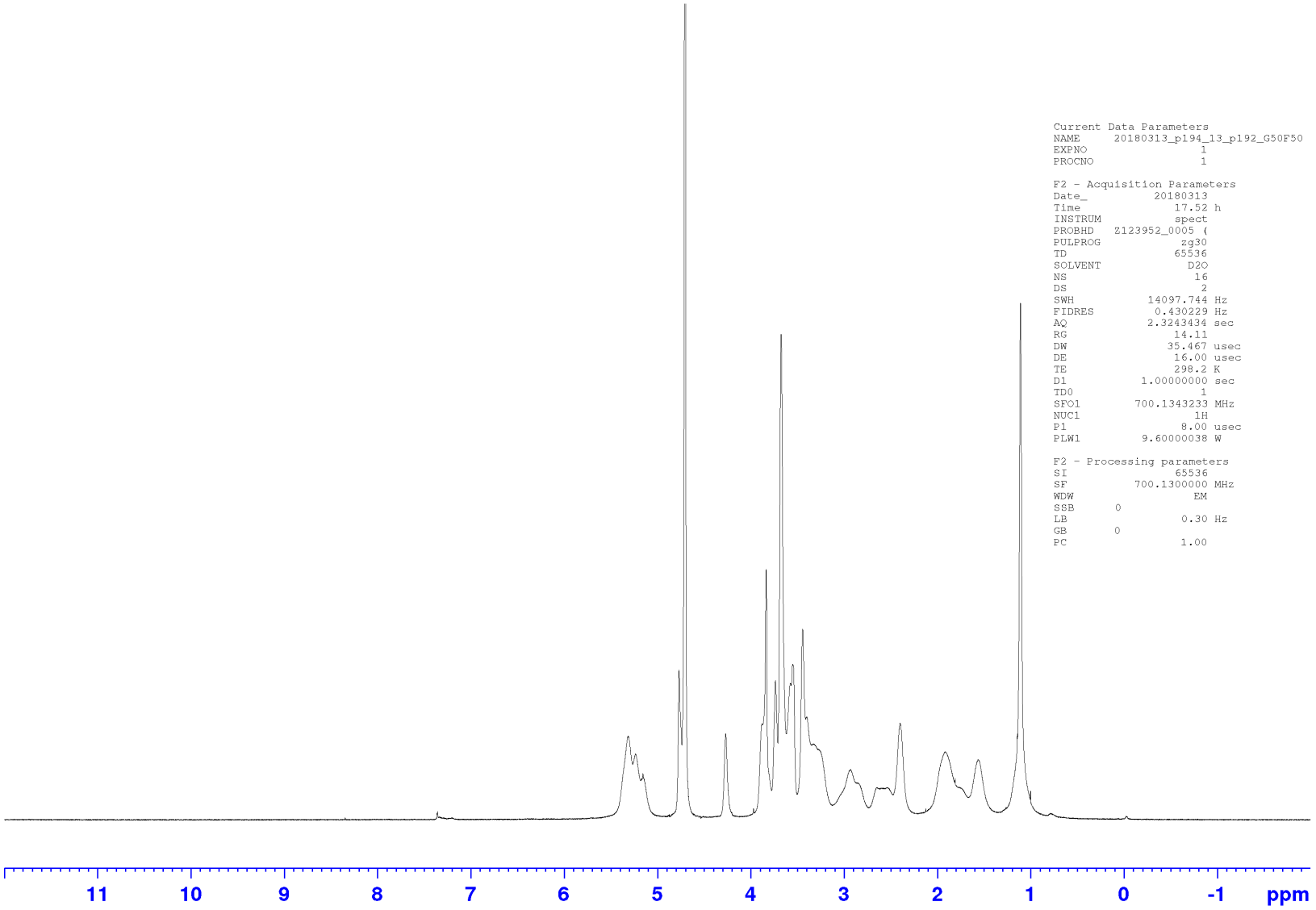
^{1}H-NMR spectrum of Glc_{100}



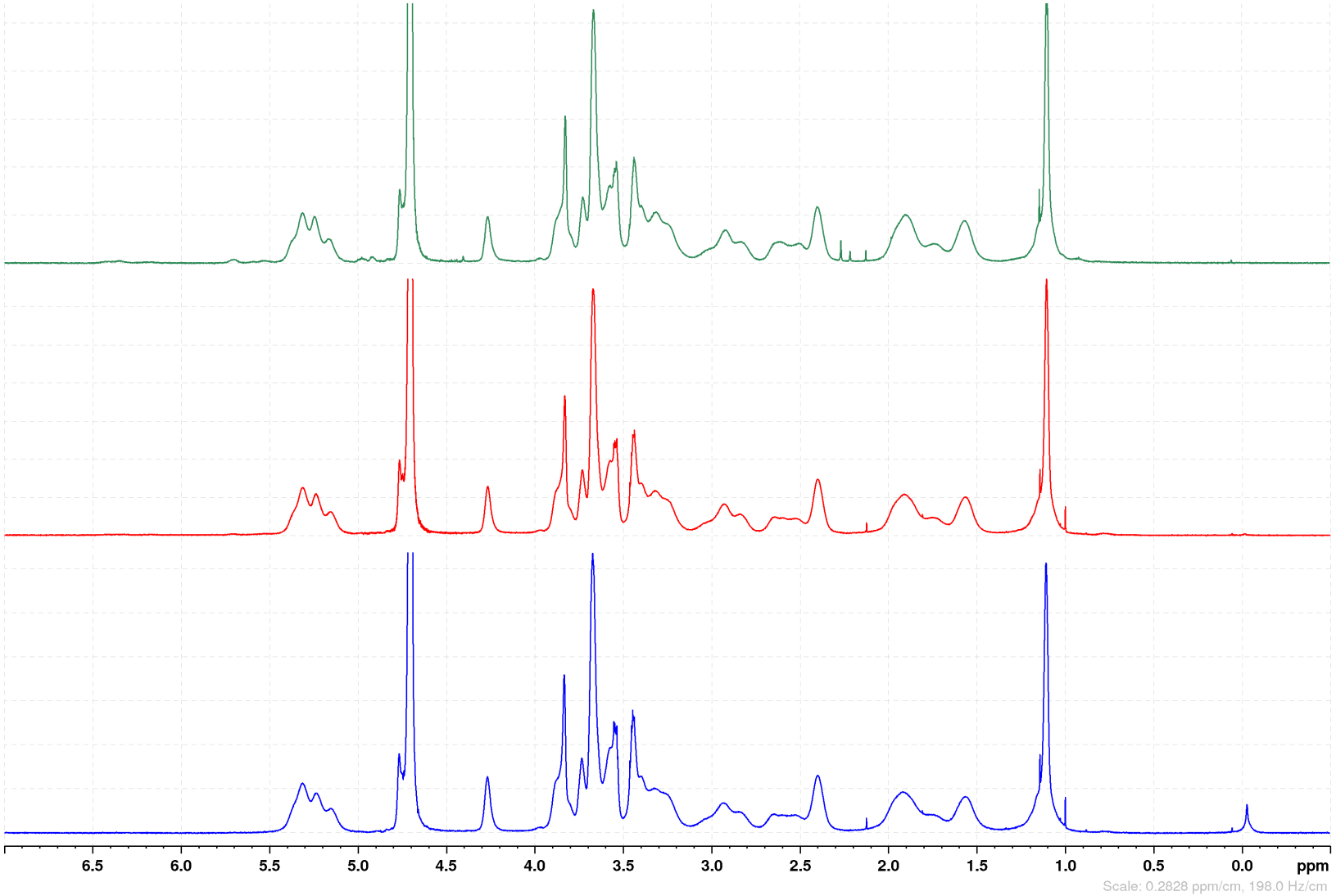
^{1}H-NMR spectrum of Gal_{100}



^{1}H-NMR spectrum of Fuc_{100}



^{1}H-NMR spectrum of $Gal_{50}Fuc_{50}$



Stacked ^{1}H-NMR spectra of Gal_5Fuc_5 (green), $Gal_{15}Fuc_{15}$ (red) and $Gal_{50}Fuc_{50}$ (blue) in D_2O

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