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Fluorinated Hexasaccharides

Synthesis of a Fluorinated Sialophorin Hexasaccharide–Threonine Conjugate for Fmoc Solid-Phase Glycopeptide Synthesis

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Dedicated to Professor Horst Kunz on the occasion of his 75th birthday

Abstract: The decoding of the mechanisms underlying glycan-mediated recognition in disease and health requires access to structurally well-defined oligosaccharides as molecular probes. Owing to their often favourable properties, deoxyfluorosugars have emerged as a promising class of selectively modified carbohydrates for biological and immunological studies. In particular the enhanced metabolic stability and intrinsic immunogenicity of fluorinated carbohydrates has spurred research on their use for vaccine design. Herein, a first total synthesis of an orthogonally protected and fluorinated hexasaccharide–threonine conjugate of the natural sialophorin antigen has been accomplished. Starting from readily available monosaccharide building blocks, the targeted glycosyl amino acid **1** was assembled by a [3+3′]-block glycosylation strategy. Together with its (1→4)-linked regioisomer the glycan mimic can be applied to solid-phase glycopeptide synthesis to access novel sialophorin-derived molecular tools for functional and biomedical studies.

Introduction

Regarding the eminent role of carbohydrates in many physiological and pathophysiological processes, a detailed understanding of the molecular recognition processes between glycans and their specific binding partners, such as lectins, antibodies, and enzymes is indispensable. Functional studies rely on structurally well-defined glycans, which typically requires profound expertise in chemical oligosaccharide synthesis. This holds particularly true when analogues are used to mimic the bioactive function of carbohydrates.[1] In recent years, selectively fluorinated carbohydrates have emerged as valuable tools for structural, functional and mechanistic studies, e.g. to map antibody–antigen interactions,[2] to probe lectin binding[3] and to elucidate enzyme mechanisms.[4] Moreover, fluorinated glycoconjugates are increasingly investigated as promising building blocks for the development of synthetic vaccines with improved metabolic stabilities and immunogenicities.[5] This, however, requires further expansion of synthetic methodology to allow the preparation of diverse fluorinated glycans and fluoroglycopeptides.

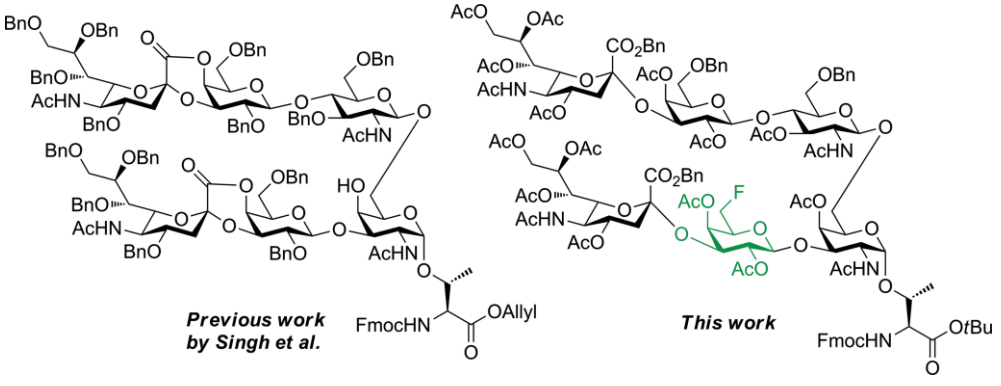

Figure 1. Disialylated hexasaccharide building block for naturally occurring sialophorin and its novel fluorinated analogue.

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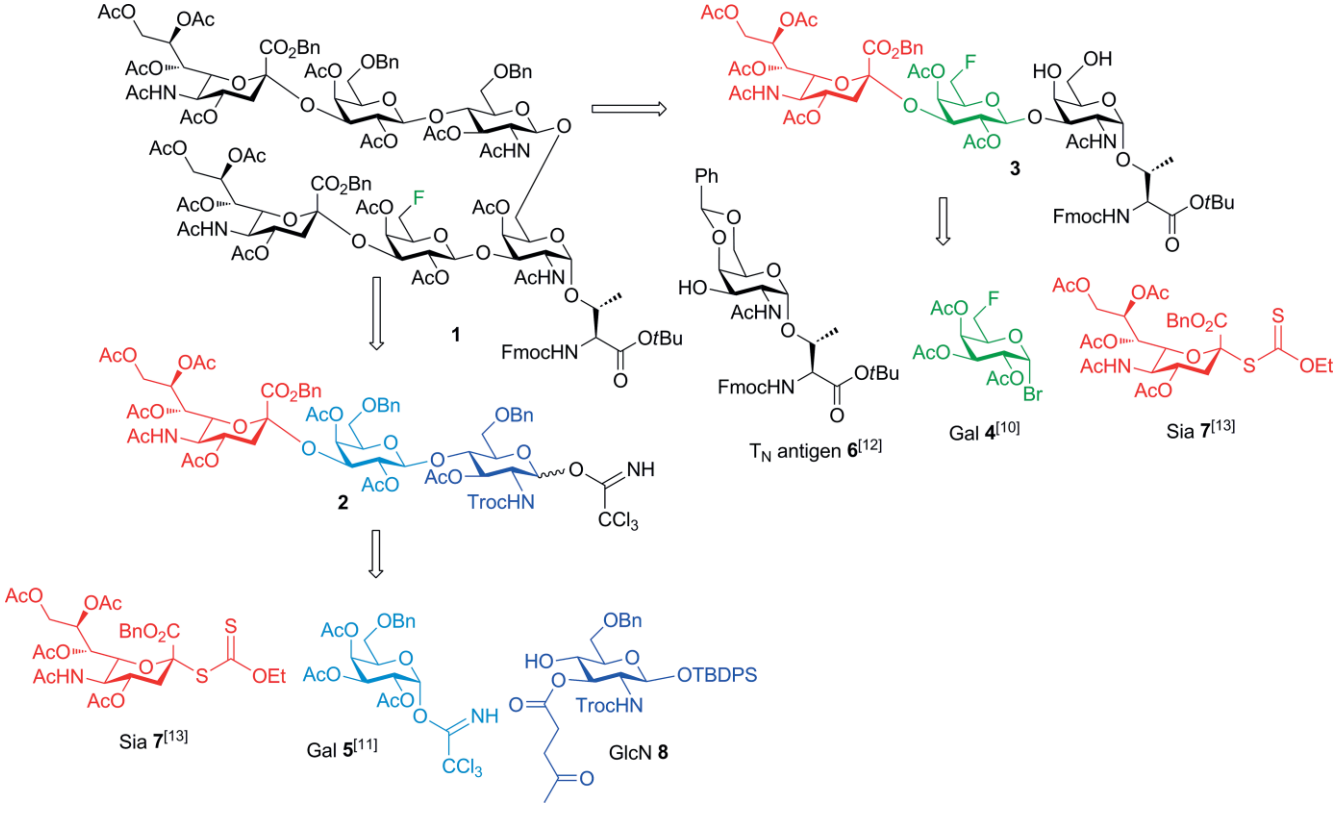
The highly glycosylated mucin-like glycoprotein sialophorin (leukosialin, CD 43)[6] is presented on the surface of hematopoietic cells and participates in many important events during immune response. For instance, sialophorin is involved in activation, differentiation, adhesion and migration of T-cells.[7] Moreover, overexpression of sialophorin has been associated with certain pathologies including rheumatoid arthritis, leukemia, the Wiskott-Aldrich syndrome, and acquired immune deficiency syndrome.[8] The low abundance and heterogeneity of naturally occurring sialophorin glycoforms, however, has hampered investigations on the exact role of its glycans. Although chemical synthesis of the sialophorin hexasaccharide was accomplished by Singh et al. in 1999,[9] functional studies using synthetic glycopeptide antigens have not yet been reported. With regard to the general advantages of carbohydrate analogues in biomedical studies and in order to provide access to novel sialophorin-based mimetics and antigen analogues, the first fluorinated hexasaccharide–threonine conjugate is now devised bearing a fluorine substituent at C6′ of the lower branch galactose residue (Figure 1). Previous work on structurally related antigens[5e,5h,10] has indicated this position to be readily addressable and suitable for enhancement of both immunogenicity and hydrolytic stability.

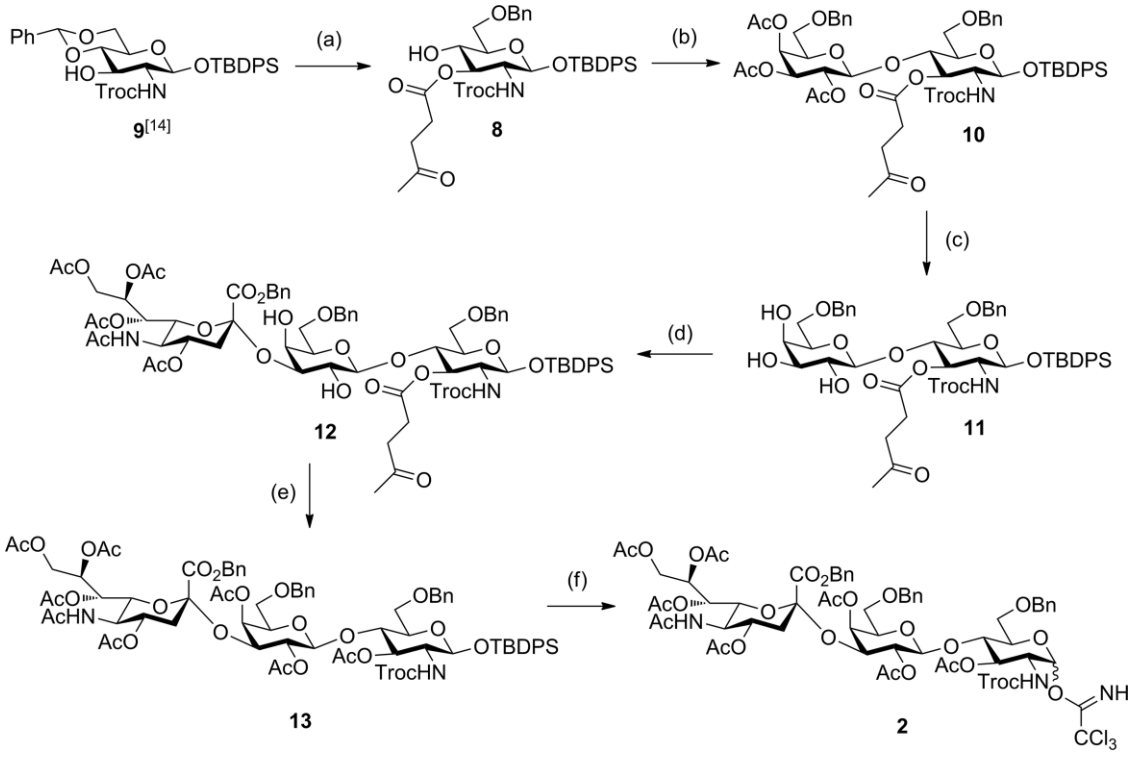
Results and Discussion

Retrosynthetic analysis indicated a strategy towards fully protected fluorinated antigen analogue **1** for solid-phase glycopeptide synthesis (Fmoc-SPPS) based on a convergent [3+3′]-block glycosylation, i.e. by coupling of glycosyl donor **2** with fluorinated glycosyl acceptor **3**. The final trisaccharide coupling partners in turn were accessed from the following monosaccharides: galactose-derived glycosyl donors **4**[10] and **5**,[11] the T_N antigen derivative **6**,[12] sialic acid xanthate **7**,[13] as well as glucosamine derivative **8** (Scheme 1). Thereby, and in contrast to previous work by Singh et al.,[9] a modified synthetic route was followed abstaining from the use of participating groups at C3 of the sialic acid donors, which were also introduced at a later stage of the synthesis.

Key building block **2** was assembled in a stepwise manner by starting from protected glucosamine precursor **9**[14] as the central building block (Scheme 2). Introduction of a levulinoyl ester to orthogonally block the 3-OH group was followed by regioselective ring-opening of the benzylidene acetal under well-established conditions[15] to afford the desired glucosaminyl acceptor **8** in 48 % yield (2 steps) after column chromatography. Subsequent β-galactosylation with trichloroacetimidate **5**[11] activated by trimethylsilyl trifluoromethanesulfonate (TMSOTf) proceeded smoothly to furnish disaccharide **10** in 79 % yield. Notably, formation of the corresponding orthoester of **10**[16] was not observed. Cleavage of the acetate protecting groups under mild Zemplén conditions[17] furnished glycosyl acceptor **11**, which was regio- and stereoselectively sialylated at the more reactive 3-OH group under kinetically controlled reaction conditions. Thus, activation of sialic acid xanthate **7** (2 equiv.) with methylsulfenyl triflate[12b,18] (MeSOTf), generated in situ from methylsulfenyl bromide (MeSBr) and silver(I) triflate (AgOTf) at –45 °C in a mixture of acetonitrile (MeCN) and di-



Scheme 1. Retrosynthetic analysis of the sialophorin–threonine building block **1**.

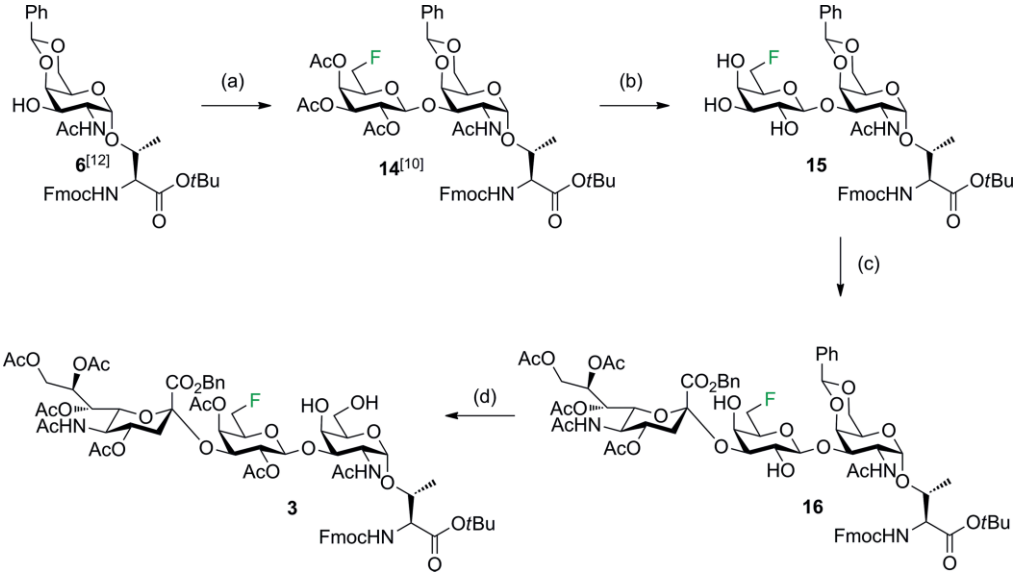


Scheme 2. Reagents and conditions: (a) (i) levulinic acid, DCC, 4-DMAP, CH_2Cl_2, room temp., 2.5 h; (ii) Et_3SiH, TfOH, CH_2Cl_2, Et_2O, –78 °C, 4 h, 48 % (2 steps); (b) **5**,[11] TMSOTf, CH_2Cl_2, molecular sieves (MS) (4 Å), –78 °C, 2.5 h, 79 %; (c) NaOMe, MeOH, pH 8.5–9.0, room temp., 18 h, 92 %; (d) **7**,[13] AgOTf, MeSBr, MeCN/CH_2Cl_2 (2:1), MS (4 Å), –45 °C, 24 h; (e) (i) hydrazine acetate, toluene/EtOH (2:1), room temp., 4 h; (ii) pyridine/Ac_2O (2:1), 4-DMAP, room temp., 20 h, 55 % (3 steps); (f) (i) TBAF, AcOH, THF, 0 °C to room temp., 48 h; (ii) Cl_3CCN, DBU, MS (4 Å), CH_2Cl_2, 0 °C to room temp., 6 h, 51 % (2 steps).

chloromethane (CH_2Cl_2),[19] provided α-sialoside **12**. In this reaction, attachment of the sialic acid moiety occurred exclusively at 3-OH, which was unambiguously proven by heteronuclear 2D shift correlations on the basis of a cross-peak between C2–Sia (δ = 96.9 ppm) and H3–Gal (δ = 4.63 ppm) in an HMBC experiment (see Supporting Information). Similarly, the strong coupling of $H3_{ax}$–Sia (δ = 1.69 ppm) and C1–Sia (δ = 167.2 ppm) confirmed the required α-stereochemistry of the newly formed glycosidic bond. However, owing to difficulties in the purification of **12**, the latter was directly subjected to hydrazinolysis to liberate the 3-OH group.[20] Subsequent global acetylation with Ac_2O in pyridine then allowed isolation of trisaccharide **13** by flash chromatography in high purity and with an excellent yield of 55 % over three steps. Cleavage of the anomeric silyl ether with tetrabutylammonium fluoride (TBAF) in the presence of acetic acid in tetrahydrofuran furnished the reducing trisaccharide derivative, which was readily converted into key trichloroacetimidate donor **2** (51 % yield over two steps) by employing 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) and trichloroacetonitrile.[21]

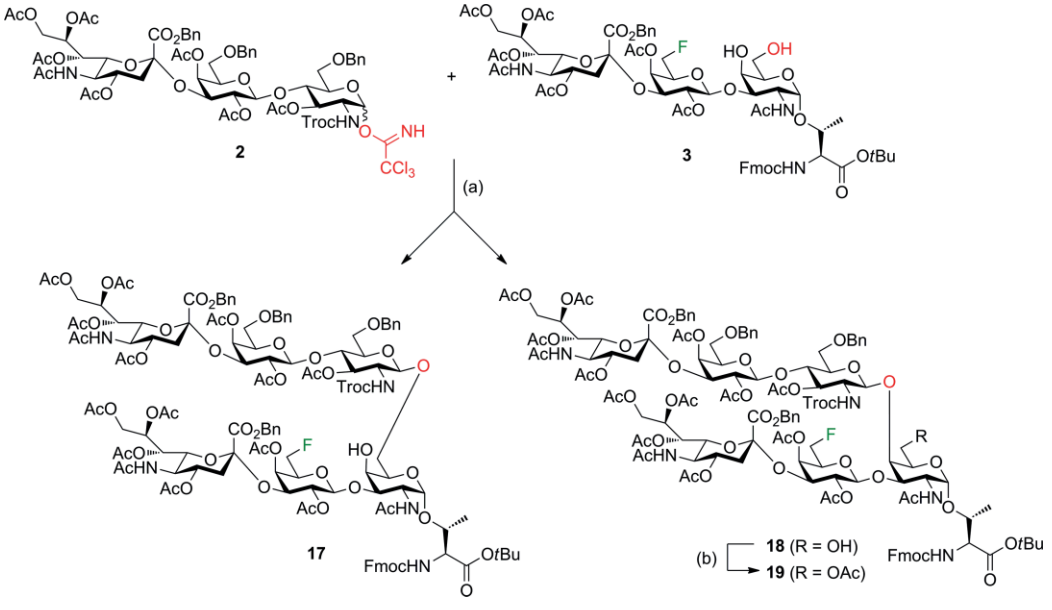
The synthesis of the second trisaccharide building block **3** commenced with the stereoselective coupling of known T_N antigen derivative **6** with 6F-galactosyl bromide **4** (Scheme 3).[10] Subsequent Zemplén transesterification of compound **14** at pH 8.5[22] provided disaccharide–threonine conjugate **15** in 74 % yield, which was regio- and stereoselectively sialylated at 3-OH, as before. Thus, MeSOTf-promoted α-sialylation with xanthate **7** in MeCN/CH_2Cl_2 under kinetic control led to the exclusive formation of the trisaccharide **16**. Again, 2D NMR spectroscopy confirmed the presence of the desired C3′-linked α-sialoside, which was obtained in 26 % yield after column flash chromatography. Unfortunately, all attempts to improve the sialylation reaction by using a recently published activated *N*-acetyloxazolidinone-functionalized phosphate donor of Wang et al.[23] failed, disclosing the intrinsic low reactivity of disaccharide acceptor **11** to be mainly responsible for the insufficient yield of this step. Standard protecting-group manipulations (acetylation and benzylidene acetal cleavage) then converted **16** into the targeted acceptor building block **3** in 73 % yield over two steps.

The final glycosylation reaction of trichloroacetimidate donor **2** and the fluorinated trisaccharide acceptor **3** was performed with promotion of TMSOTf at –50 °C → –40 °C in CH_2Cl_2 to yield the desired hexasaccharide backbone (Scheme 4). With a view to previous findings,[18,24] this reaction was again expected to occur regioselectively at the more reactive primary hydroxy group of C6. Moreover, the neighboring-group participation of the *N*-(2,2,2-trichloroethoxycarbonyl) group (Troc) at C2 of the glucosamine moiety should lead to stereoselective formation of the desired β-configured product. It should be noted that deviating from standard procedure, the precious glycosyl acceptor **3** was used in slight excess (1.2 equiv.) in this reaction providing two regioisomeric products **17** and **18** with the same

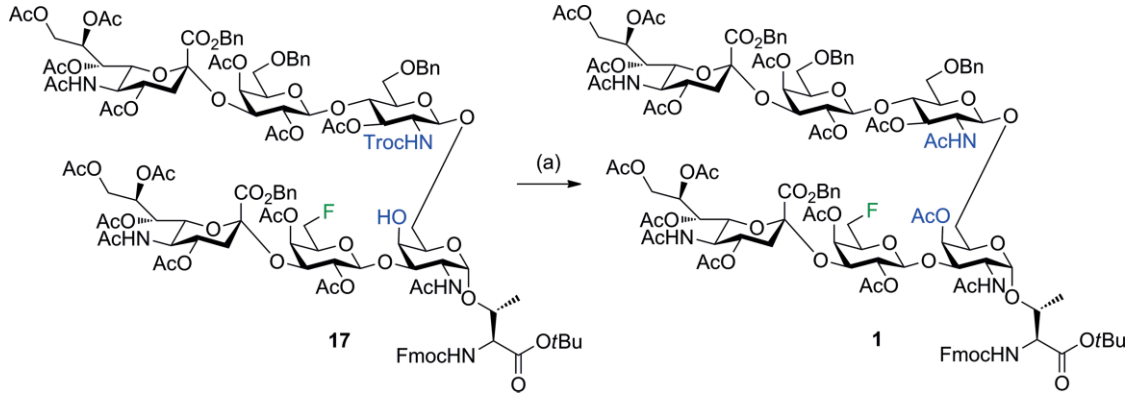


Scheme 3. Reagents and conditions: (a) **4**,[10] $Hg(CN)_2$, $CH_2Cl_2/MeNO_2$ (3:2), MS (4 Å), 100 W, 80 °C, 2 h, 85 %; (b) (i) NaOMe, MeOH, pH 8.5, room temp., 18 h; (ii) FmocOSu, DIPEA, CH_2Cl_2, room temp., 15 h, 74 % (2 steps); (c) **7**,[13] AgOTf, MeSBr, $MeCN/CH_2Cl_2$ (2:1), MS (4 Å), –45 °C, 24 h, 26 %; (d) (i) pyridine/Ac_2O (2:1), room temp., 16 h; (ii) AcOH, 80 °C, 1 h, 73 % (2 steps).

molecular mass. Isolation of both products succeeded efficiently by column chromatography on silica gel with the major product **18** (55 %) eluting first, followed by the minor compound **17** (45 %) and remaining acceptor **3**. Whereas β-stereoselectivity was again unambiguously proven by the large coupling constant between H1 and H2 of the glucosamine residue after acetylation (7.7 Hz, see Supporting Information), the regioisomeric assignments were less clear-cut. Owing to signal overlap, cross-peaks between C1 of the glucosamine moiety and either H4 or H6a/b of the galactosamine were not detectable in the HMBC spectrum of **18**. Similarly, no cross-peaks between glucosamine H1 and either C4 or C6 of the galactosamine moiety were observed. However, high-field shift of the signal of the methylene group at C6 of the latter (δ = 70.5 ppm → 56.2 ppm, Figure 2) suggested the presence of a (1→4)-linked product, which was later confirmed again through acetylation (**19**, see



Scheme 4. Reagents and conditions: (a) TMSOTf, CH_2Cl_2, MS (4 Å), –50 °C to –40 °C, 4 h, 45 % (for **17**), 55 % (for **18**); (b) pyridine/Ac_2O (2:1), room temp., 16 h, 89 %.



Scheme 5. Reagents and conditions: (a) (i) Zn, AcOH, room temp., 20 h; (ii) pyridine/Ac_2O (2:1), room temp., 2 d, 89 % (2 steps).

Supporting Information). Although unexpected at first, a comparable lack of regioselectivity has been reported for slow glycosylation reactions of complex coupling partners before.[14,25]

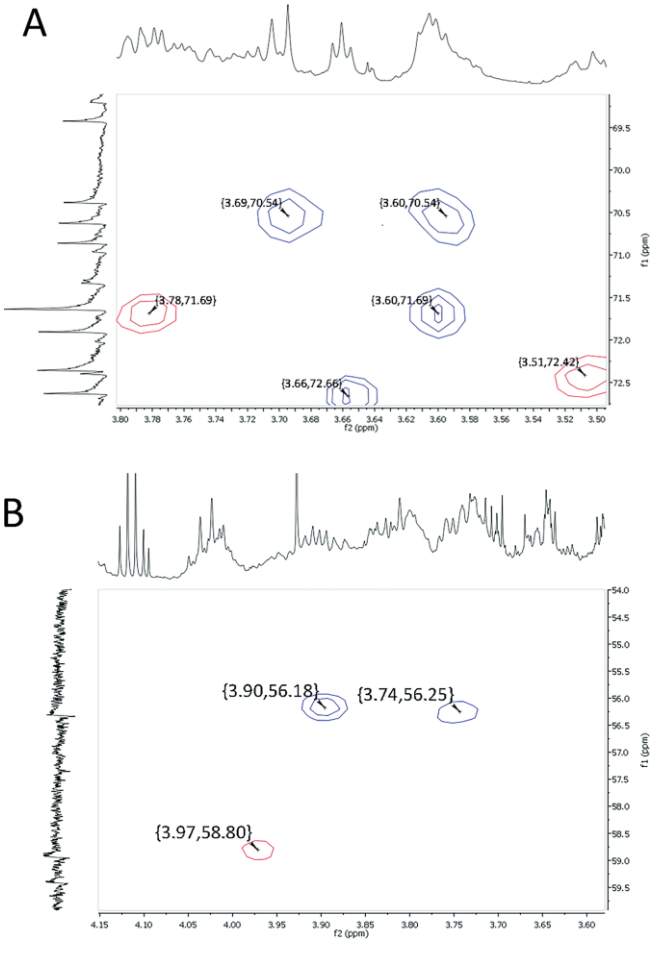


Figure 2. (A) Extract of the $^1H,^{13}C$ HSQC NMR spectrum of **17** in $CDCl_3$ for assignment of C6-GalNAc. (B) Extract of the $^1H,^{13}C$ HSQC NMR spectrum of **18** in $CDCl_3$ for assignment of C6-GalNAc.

The desired (1→6)-linkage of target compound **17** was finally confirmed by NMR analysis after protecting-group manipulations. Thus, removal of the Troc group under mild reductive conditions by treatment with activated zinc dust in acetic acid[26] and subsequent acetylation (Ac_2O/pyridine) furnished the targeted sialophorin analogue **1** in 89 % over two steps after column chromatography (Scheme 5). In the corresponding HMBC spectrum of this compound a distinct cross-peak between H4–GalNAc (δ = 5.25 ppm) and 4-OAc–GalNAc (δ = 169.7 ppm) suggests that position C6 of the galactosamine residue is glycosylated. This was further confirmed by the NOESY spectrum displaying cross-peaks from H1–GalNAc (δ = 4.76 ppm) and H6a/b–GalNAc (δ = 3.67 ppm and 3.61 ppm), respectively.

Conclusions

The synthesis of fluorinated analogue **1** of the sialophorin hexasaccharide–threonine epitope, as well as of its (1→4)-linked regioisomer **18**, both compatible to Fmoc-SPPS, was accomplished for the first time and by means of a convergent [3+3′]-glycosylation strategy. The requisite trisaccharide building blocks are accessible from readily available monosaccharides including sialyl xanthate **7** and T_N threonine conjugate **6**. In principle, the synthetic route disclosed herein is well suited for the preparation of novel fluorinated sialophorin-derived glycopeptides for biological and medical studies, including the development of improved glycoconjugate vaccines for cancer immunotherapy.

Experimental Section

General Remarks: Solvents for moisture-sensitive reactions (toluene, acetonitrile, dichloromethane, nitromethane and 1,2-dichloroethane) were distilled and dried according to standard procedures. Glycosylations were carried out under argon in flame-dried glassware. Commercially available reagents and solvents were used without further purification. Reactions were monitored by TLC with precoated silica gel 60 F_{254} aluminium plates (Merck KGaA, Darmstadt) using UV light as the visualizing agent and by dipping the plate into a 1:1 mixture of 1 M H_2SO_4 in EtOH and 3 % 4-methoxyphenol solution in EtOH followed by heating. The crude products were purified by standard column chromatography using silica gel (35–70 μm) from Acros Organics. Analytical RP-HPLC was carried out with a JASCO system using a Phenomenex Luna C18 column (5 μm, 250 × 4.6 mm) and Phenomenex Jupiter C18 column (5 μm, 250 × 4.6 mm). Semipreparative RP-HPLC was carried out with a JASCO system using a Phenomenex Luna C18 column (10 μm,

250 × 30 mm) and a Phenomenex Jupiter C18 column (10 µm, 250 × 30 mm). In all cases mixtures of water and acetonitrile were used as solvents; if required 0.1 % trifluoroacetic acid was added. Low-resolution (ESI) and high-resolution (HR-ESI) mass spectra were recorded with a Thermo Finnigan LTQ FT instrument. ^{1}H, ^{13}C, ^{19}F and 2D NMR spectra were recorded with a Varian 400 MHz and 600 MHz spectrometer or with a Bruker Avance III 800 MHz spectrometer. The chemical shifts are reported relative to the signal of the deuterated solvent. Multiplicities are given as: s (singlet), br. s (broad singlet), d (doublet), t (triplet), and m (multiplet). Assignments of proton and carbon signals were achieved by additional COSY, TOCSY, NOESY, HSQC, and HMBC experiments when noted. The signals of molecule-fragments were denoted as follows: *N*-acetyl-D-galactosamine (GalN), D-glucosamine (GlcN), D-galactose (Gal), D-galactose linked to GalN (Gal′) link to GalN, *N*-acetyl-D-neuraminic acid (Sia), *N*-acetyl-D-neuraminic acid linked to Gal′ (Sia′) and glycosylated threonine (Thr). Optical rotations were measured at 598 nm with a Perkin–Elmer polarimeter 241.

Typical Procedure for the Synthesis of Sialylated Compounds (TP1): A solution of sialic acid xanthate **7**[13] (2.5 equiv.) in a mixture of dry acetonitrile/dichloromethane (2:1, 20 mL) was stirred with activated, powdered molecular sieves (4 Å) under argon at room temperature for 24 h. Then glycosyl acceptor (1.0 equiv.), dissolved in dry acetonitrile/dichloromethane (2:1, 20 mL) was added, and the reaction mixture was stirred at room temperature for 1 h. The suspension was cooled to –45 °C, and silver trifluoromethanesulfonate (AgOTf) (2.5 equiv.) in dry acetonitrile/dichloromethane (2:1, 6 mL) was added. After stirring for 30 min, a precooled solution of methylsulfenyl bromide (2.5 equiv., TP2) was added. The reaction mixture was stirred under argon with protection from light at –45 °C for 24 h, neutralized with DIPEA, stirred at –45 °C for 1 h, warmed to room temperature, and filtered through a pad of Celite. The solvents were evaporated, and the crude product was purified by flash chromatography (SiO_2).

Typical Procedure for the Preparation of Methylsulfenyl Bromide Solution (1.6 M) (TP2): A dry and argon-flushed 25 mL flask equipped with a magnetic stirrer and a septum was charged under argon with a solution of dimethyl disulfide (709 µL, 4.99 mmol, 1.0 equiv.) in dry 1,2-dichloroethane (10 mL). Then bromine (410 µL, 4.99 mmol, 1.0 equiv.) was added at room temperature, and the reaction mixture was stirred with protection from light for 20 h.

***tert*-Butyldiphenylsilyl 6-*O*-Benzyl-2-deoxy-3-*O*-levulinoyl-2-(*N*-2,2,2-trichloroethoxycarbonylamino)-β-D-glucopyranoside (8):** According to ref.[27] a mixture of 14.0 g (18.0 mmol, 1.0 equiv.) of compound **20**[28] and 15.0 g of powdered molecular sieves (4 Å) in 250 mL of dry dichloromethane were stirred under argon at room temperature for 1 h. The mixture was cooled to –78 °C; sequentially were added 4.31 mL (27.0 mmol, 1.5 equiv.) of triethylsilane (Et_3SiH) and within 15 min a cooled solution of 2.37 mL (27.0 mmol, 1.5 equiv.) of trifluoromethanesulfonic acid (TfOH) in diethyl ether. It was stirred at –78 °C for 4 h; after 2 h, additional 1.5 equiv. of TfOH in diethyl ether were added. The reaction was quenched by addition of 15 mL of methanol, the mixture neutralized with DIPEA in dichloromethane at –78 °C, and filtered through a pad of Celite. The filtrate was then washed three times with 100 mL of dichloromethane, two times with 50 mL of aqueous sodium hydrogen carbonate ($NaHCO_3$) and brine. The aqueous layer was extracted with dichloromethane (2 × 100 mL), and the combined organic layers were dried with $MgSO_4$, filtered, and concentrated in vacuo. The crude product was purified by column chromatography on silica (cyclohexane/ethyl acetate, 2:1) to yield compound **8** as a colorless, amorphous solid (8.29 g, 10.6 mmol, 59 %). R_f = 0.30 (cyclohexane/ethyl acetate, 2:1). HPLC (Luna, MeCN/H_2O, 90:10 → 100:0, 20 min, flow 1 mL/min): t_R = 7.05 min, λ = 214 nm. $[\alpha]_D^{21}$ = –5.9 (*c* = 1.00, $CHCl_3$). ^{1}H NMR (600 MHz, $CDCl_3$, COSY, HSQC): δ = 7.71 (d, $J_{CH,CH}$ = 7.3 Hz, 2 H, H_{Ar}-Ph, -Bn), 7.64 (d, $J_{CH,CH}$ = 7.4 Hz, 2 H, H_{Ar}-Ph, -Bn), 7.44–7.36 (m, 1 H, H_{Ar}-Ph), 7.35–7.22 (m, 10 H, H_{Ar}-Ph, -Bn), 4.86 (d, $J_{NH,H2}$ = 9.9 Hz, 1 H, NH-GlcN), 4.79 (t, $J_{H4,H3} \approx J_{H4,H5}$ = 9.5 Hz, 1 H, H4-GlcN), 4.75 (d, $J_{CH,CH}$ = 12.1 Hz, 1 H, CH_{2a}-Troc), 4.62 (d, $J_{CH,CH}$ = 11.9 Hz, 1 H, CH_{2b}-Troc), 4.52–4.43 (m, 3 H, CH_2-Bn {4.48, 4.44, 2 × d, $J_{CH,CH}$ = 12.1 Hz, $J_{CH,CH}$ = 11.8 Hz}, H1-GlcN {4.46, d, $J_{H1,H2}$ = 8.1 Hz}), 3.85 (dd, $J_{H2,H1}$ = 9.8 Hz, $J_{H2,H3}$ = 9.5 Hz, 1 H, H2-GlcN), 3.75 (t, $J_{H3,H2} \approx J_{H3,H4}$ = 9.5 Hz, 1 H, H3-GlcN), 3.64–3.57 (m, 2 H, H6a-GlcN {dd, $J_{H6a,H6b}$ = 10.6 Hz, $J_{H6a,H5}$ = 5.0 Hz}, H6b-GlcN {dd, $J_{H6b,H6a}$ = 10.5 Hz, $J_{H6b,H5}$ = 4.1 Hz}), 3.18 (m_c, 1 H, H5-GlcN), 2.75 (t, $J_{CH,CH}$ = 6.4 Hz, 2 H, CH_2-Lev), 2.53 (d, $J_{CH,CH}$ = 6.3 Hz, 2 H, CH_2-Lev), 2.15 (s, 3 H, CH_3-Lev), 1.07 (s, 9 H, CH_3-*t*Bu-Si) ppm. ^{13}C NMR (150 MHz, $CDCl_3$, HSQC, HMBC): δ = 207.4 (C=O-Lev), 173.4 (C=O-Lev), 154.4 (C=O-Troc), 138.0 (C_q-Bn), 136.1, 136.0 (C_{Ar}-Ph, -Bn), 133.1, 132.7 (C_q-Ph), 130.2, 130.0, 128.5, 127.8, 127.6 (C_{Ar}-Ph, -Bn), 96.5 (C1-GlcN), 95.6 (CCl_3), 75.9 (C4-GlcN), 74.8 (CH_2-Troc), 74.4 (C5-GlcN), 73.8 (CH_2-Bn), 70.4 (C3-GlcN), 69.8 (C6-GlcN), 57.7 (C2-GlcN), 38.4 (CH_2-Lev), 29.9 (CH_3-Lev), 28.3 (CH_2-Lev), 26.9 (CH_3-*t*Bu-Si), 19.3 (C_q-*t*Bu-Si) ppm. MS (ESI^+): *m/z* calcd. for $C_{37}H_{48}Cl_3N_2O_9Si$ [M + NH_4]$^+$ 797.21, found 797.21. HR-MS (ESI^+): *m/z* calcd. for $C_{37}H_{44}Cl_3NO_9SiK$ [M + K]$^+$ 818.1482, found 818.1493.

***tert*-Butyldiphenylsilyl 4-*O*-(2,3,4-Tri-*O*-acetyl-6-*O*-benzyl-β-D-galactopyranosyl)-6-*O*-benzyl-2-deoxy-3-*O*-levulinoyl-2-(*N*-2,2,2-trichloroethoxycarbonylamino)-β-D-glucopyranoside (10):** A mixture of compound **8** (2.00 g, 2.56 mmol), compound **5** (2.08 g, 3.84 mmol, 1.5 equiv.) and 5.0 g of powdered molecular sieves (4 Å) in 100 mL of dry dichloromethane was stirred under argon at room temperature for 1 h. The mixture was cooled to –78 °C and treated with 69 µL (0.38 mmol, 0.1 equiv. based on **5**) of trimethylsilyl trifluoromethanesulfonate (TMSOTf) in 1.0 mL of dry dichloromethane. The solution was warmed up to room temperature within 2.5 h, diluted with 50 mL of dichloromethane, and filtered through a pad of Celite. The filtrate was washed twice with 50 mL of $NaHCO_3$ and brine, dried ($MgSO_4$) and concentrated in vacuo. The residue was purified by column chromatography on silica (cyclohexane/ethyl acetate, 2:1) to provide **10** as a colorless, amorphous solid (2.33 g, 2.10 mmol, 79 %). R_f = 0.33 (cyclohexane/ethyl acetate, 2:1). HPLC (Luna, MeCN/H_2O, 90:10 → 100:0, 20 min, flow 1 mL/min): t_R = 10.5 min, λ = 214 nm. $[\alpha]_D^{20}$ = –7.5 (*c* = 1.00, $CHCl_3$). ^{1}H NMR (600 MHz, $CDCl_3$, COSY, HSQC): δ = 7.74–7.70 (m, 2 H, H_{Ar}-Ph, -Bn), 7.65–7.60 (m, 2 H, H_{Ar}-Ph, -Bn), 7.43–7.39 (m, 2 H, H_{Ar}-Ph, -Bn), 7.37–7.24 (m, 14 H, H_{Ar}-Ph, -Bn), 5.38 (dd, $J_{H4,H3}$ = 3.5 Hz, $J_{H4,H5}$ = 1.2 Hz, 1 H, H4–Gal), 4.93 (dd, $J_{H2,H3}$ = 10.4 Hz, $J_{H2,H1}$ = 7.9 Hz, 1 H, H2-Gal), 4.85 (dd, $J_{H3,H2}$ = 10.2 Hz, $J_{H3,H4}$ = 3.5 Hz, 1 H, H3–Gal), 4.82 (dd, $J_{H3,H2}$ = 10.2 Hz, $J_{H3,H4}$ = 9.5 Hz, 1 H, H3-GlcN), 4.60 (d, $J_{CH,CH}$ = 12.2 Hz, 1 H, CH_{2a}-Troc), 4.53 (d, $J_{CH,CH}$ = 12.0 Hz, 2 H, CH_2-Bn), 4.44 (d, $J_{H1,H2}$ = 7.9 Hz, 1 H, H1–Gal), 4.41 (d, $J_{H1,H2}$ = 10.1 Hz, 1 H, H1-GlcN), 4.41 (d, $J_{CH,CH}$ = 11.9 Hz, 2 H, CH_2-Bn), 4.37 (d, $J_{CH,CH}$ = 12.2 Hz, 1 H, CH_{2b}-Troc), 3.94 (t, $J_{H4,H3} = J_{H4,H5}$ = 9.4 Hz, 1 H, H4-GlcN), 3.87 (dd, $J_{H2,H3}$ = 10.2 Hz, $J_{H2,H1}$ = 10.1 Hz, 1 H, H2-GlcN), 3.68 (ddd, $J_{H5,H6a}$ = 7.5 Hz, $J_{H5,H6b}$ = 5.7 Hz, $J_{H5,H4}$ = 1.3 Hz, 1 H, H5-Gal), 3.56 (dd, $J_{H6a,H6b}$ = 11.1 Hz, $J_{H6a,H5}$ = 3.3 Hz, 1 H, H6a-GlcN), 3.51 (dd, $J_{H6a,H6b}$ = 9.3 Hz, $J_{H6a,H5}$ = 5.6 Hz, 1 H, H6a-Gal), 3.41–3.36 (m, 2 H, H6b-Gal, H6b-GlcN), 3.04 (ddd, $J_{H5,H4}$ = 9.8 Hz, $J_{H5,H6a}$ = 3.3 Hz, $J_{H5,H6b}$ = 1.8 Hz, 1 H, H5-GlcN), 2.65–2.57 (m, 2 H, CH_2-Lev), 2.51–2.46 (m, 2 H, CH_2-Lev), 2.11 (s, 3 H, CH_3-Lev), 2.01, 1.94, 1.88 (3 × s, 9 H, CH_3-OAc), 1.07 (s, 9 H, CH_3-*t*Bu-Si) ppm. ^{13}C NMR (150 MHz, $CDCl_3$, HSQC, HMBC): δ = 206.0 (C=O-Lev), 172.5, 170.2, 170.1 (C=O-Ac), 169.1 (C=O-Lev), 154.3 (C=O-Troc), 138.0, 137.6 (C_q-Bn, -Ph), 136.1, 136.0 (C_{Ar}-Bn, -Ph), 133.1, 132.6, 130.2, 130.0, 128.6, 128.0,

128.0, 127.8, 127.6 (C_{Ar}-Bn, -Ph), 100.5 (C1–Gal), 96.5 (C1-GlcN), 95.6 (CCl_3), 74.9 (C5-GlcN), 74.8 (C4-GlcN), 73.9 (CH_2-Troc), 73.5, 73.4 (CH_2-Bn), 73.0 (C3-GlcN), 71.8 (C5-Gal), 71.5 (C3-Gal), 69.6 (C2–Gal), 67.4 (C4-Gal), 67.2 (C6-Gal), 67.2 (C6-GlcN), 58.1 (C2-GlcN), 38.0 (CH_2-Lev), 29.8 (CH_3-Lev), 28.1 (CH_2-Lev), 26.7 (CH_3-*t*Bu-Si), 20.7, 20.7, 20.6 (CH_3-OAc), 19.3 (C_q-*t*Bu-Si) ppm. HR-MS (ESI$^+$): *m/z* calcd. for $C_{56}H_{70}Cl_3N_2O_{17}Si$ $[M + NH_4]^+$ 1175.3504, found 1175.3493.

***tert*-Butyldiphenylsilyl 4-*O*-(6-*O*-Benzyl-β-D-galactopyranosyl)-6-*O*-benzyl-2-deoxy-3-*O*-levulinoyl-2-(*N*-2,2,2-trichloroethoxycarbonylamino)-β-D-glucopyranoside (11):** A solution of 2.33 g (2.01 mmol) of compound **10** in 25 mL of methanol was treated with a freshly prepared solution of sodium methoxide (NaOMe) in methanol, and the reaction mixture was adjusted to pH = 8.5. The solution was readjusted at regular intervals and stirred at room temperature for 4 h. It was neutralized with Amberlyst® 15, filtered, and washed with methanol (50 mL). The solution was concentrated in vacuo, the residue was co-evaporated twice with 10 mL of dichloromethane and purified by column chromatography on silica (cyclohexane/ethyl acetate, 1:4) to give compound **11** as a colorless, amorphous solid (1.91 g, 1.85 mmol, 92 %). R_f = 0.49 (cyclohexane/ethyl acetate, 1:4). HPLC (Luna, MeCN/H_2O, 90:10 → 100:0, 20 min, flow 1 mL/min): t_R = 8.63 min, λ = 214 nm. $[\alpha]_D^{22}$ = –1.1 (*c* = 1.00, $CHCl_3$). MS (ESI$^+$): *m/z* calcd. for $C_{50}H_{64}Cl_3N_2O_{14}Si$ $[M + NH_4]^+$ 1049.32, found 1049.32. HR-MS (ESI$^+$): *m/z* calcd. for $C_{50}H_{60}Cl_3NO_{14}SiNa$ $[M + Na]^+$ 1054.2746, found 1054.2728.

***tert*-Butyldiphenylsilyl 4-*O*-(6-*O*-Benzyl-β-D-galactopyranosyl)-3-*O*-[benzyl (5-acetamido-4,7,8,9-tetra-*O*-acetyl-3,5-dideoxy-α-D-*glycero*-D-*galacto*-non-2-ulopyranosyl)onate]-6-*O*-benzyl-2-deoxy-3-*O*-levulinoyl-2-(*N*-2,2,2-trichloroethoxycarbonylamino)-β-D-glucopyranoside (12):** Sialylated compound **12** was prepared according to TP1. Sialic acid xanthate **7** (3.11 g, 4.63 mmol), molecular sieves (6.0 g), glycosyl acceptor **11** (1.91 g, 1.85 mmol), AgOTf (1.19 g, 4.63 mmol), and methylsulfenyl bromide (2.89 mL, 4.63 mmol, TP2) were allowed to react. The product was purified twice by column chromatography on silica (dichloromethane/methanol, 25:1 → ethyl acetate) to provide **12** as a colorless, amorphous solid (3.73 g, slightly contaminated). For further decontamination, compound **12** was purified by preparative reversed-phase HPLC [Luna, MeCN/H_2O (90:10) → (100:0) in 20 min]. R_f = 0.46 (ethyl acetate), 0.23 (dichloromethane/methanol, 25:1). $[\alpha]_D^{22}$ = –1.3 (*c* = 1.00, $CHCl_3$). ^{1}H NMR (600 MHz, $CDCl_3$, COSY, HSQC): δ = 7.73–7.67 (m, 2 H, H_{Ar}-Ph, -Bn), 7.65–7.59 (m, 2 H, H_{Ar}-Ph, -Bn), 7.40–7.21 (m, 21 H, H_{Ar}-Ph, -Bn), 5.40–5.35 (m, 2 H, H8-Sia {5.36}, NH-GlcN), 5.30 (dd, $J_{H7,H8}$ = 8.6 Hz, $J_{H7,H6}$ = 1.6 Hz, 1 H, H7-Sia), 5.19–5.15 (m, 1 H, NH-Sia), 4.91 (td, $J_{H4,H5/H3ax}$ = 10.2 Hz, $J_{H4,H3eq}$ = 4.3 Hz, 1 H, H4–Sia), 4.86 (dd, $J_{H3,H2}$ = 10.2 Hz, $J_{H3,H4}$ = 9.6 Hz, 1 H, H3-GlcN), 4.74 (d, $J_{CH,CH}$ = 12.0 Hz, 1 H, CH_{2a}-Troc), 4.65 (d, $J_{CH,CH}$ = 12.0 Hz, 1 H, CH_{2b}-Troc), 4.54–4.50 (m, 2 H, CH_2-Bn {d, $J_{CH,CH}$ = 11.9 Hz}), 4.49 (d, $J_{CH,CH}$ = 12.3 Hz, 2 H, CH_2-Bn), 4.45 (d, $J_{CH,CH}$ = 12.4 Hz, 2 H, CH_2-Bn), 4.42 (d, $J_{H1,H2}$ = 7.7 Hz, 1 H, H1–Gal), 4.39 (d, $J_{H1,H2}$ = 8.1 Hz, 1 H, H1-GlcN), 4.22 (dd, $J_{H9a,H9b}$ = 12.4 Hz, $J_{H9a,H8}$ = 2.5 Hz, 1 H, H9a-Sia), 4.07 (dd, $J_{H6,H5}$ = 10.8 Hz, $J_{H6,H7}$ = 1.8 Hz, 1 H, H6-Sia), 4.04–4.00 (m, 2 H, H9b-Sia {4.00}, H4-GlcN {4.00}), 3.99–3.95 (m, 1 H, H5-Sia), 3.92–3.86 (m, 2 H, H3–Gal {3.89}, H2-GlcN {3.87}), 3.75 (dd, $J_{H6a,H6b}$ = 11.4 Hz, $J_{H6a,H5}$ = 3.7 Hz, 1 H, H6a-GlcN), 3.57–3.52 (m, 3 H, H6b-GlcN {3.53}, H6a-Gal {3.53}, H6b-Gal {3.52}), 3.51–3.47 (m, 1 H, H2-Gal), 3.44 (d, $J_{H4,H3}$ = 3.3 Hz, 1 H, H4–Gal), 3.42 (t, $J_{H5,H6a/b}$ = 6.1 Hz, 1 H, H5-Gal), 3.20–3.15 (m, 1 H, H5-GlcN), 2.75 (dd, $J_{H3eq,H3ax}$ = 13.0 Hz, $J_{H3eq,H4}$ = 4.6 Hz, 1 H, $H3_{eq}$-Sia), 2.63–2.36 (m, 4 H, CH_2-Lev), 2.15 (s, 3 H, CH_3-Lev), 2.09, 2.04, 2.00, 1.93 (4 × s, 12 H, CH_3-OAc), 2.03–1.99 (m, 1 H, $H3_{ax}$–Sia), 1.87 (s, 3 H, CH_3-NHAc), 1.05 (s, 9 H, CH_3-*t*Bu-Si) ppm. ^{13}C NMR (150 MHz, $CDCl_3$, HSQC, HMBC): δ = 207.0 (C=O-Lev), 172.9 (C=O-Lev), 170.9, 170.6, 170.5, 170.0 (5 × C=O-Ac, -NHAc), 167.6 (C1–Sia), 154.4 (C=O-Troc), 138.6, 138.1 (3 × C_q-Bn), 136.1, 136.0 (C_q-Ph), 134.4, 133.2, 132.7, 130.1, 129.9, 129.1, 128.9, 128.8, 128.6, 128.5, 128.3, 127.9, 127.7, 127.5, 127.4 (C_{Ar}-Bn, -Ph), 102.3 (C1–Gal), 97.9 (C2–Sia), 96.6 (C1-GlcN), 95.6 (CCl_3), 77.4 (C3-Gal), 75.1 (C5-GlcN), 74.8 (CH_2-Troc), 74.0 (C4-GlcN), 73.2 (C3-GlcN), 73.1, 73.1 (CH_2-Bn), 72.8 (C5-Gal), 72.8 (C6-Sia), 69.7 (C2–Gal), 69.3 (C6-Gal), 68.6 (C4-Sia), 68.5 (C8-Sia), 68.4 (CH_2-Bn), 68.4 (C4-Gal), 67.7 (C6-GlcN), 66.9 (C7-Sia), 62.2 (C9-Sia), 57.9 (C2-GlcN), 49.6 (C5-Sia), 37.9 (C3-Sia), 37.8 (CH_2-Lev), 29.9 (CH_3-Lev), 28.1 (CH_2-Lev), 26.9 (CH_3-*t*Bu-Si), 23.3 (CH_3-NHAc), 21.3, 20.9, 20.8, 20.7 (CH_3-OAc), 19.2 (C_q-*t*Bu-Si) ppm. HR-MS (ESI$^+$): *m/z* calcd. for $C_{76}H_{95}Cl_3N_3O_{26}Si$ $[M + NH_4]^+$ 1598.5033, found 1598.5030.

***tert*-Butyldiphenylsilyl 4-*O*-(2,4-Di-*O*-acetyl-6-*O*-benzyl-β-D-galactopyranosyl)-3-*O*-[benzyl (5-acetamido-4,7,8,9-tetra-*O*-acetyl-3,5-dideoxy-α-D-*glycero*-D-*galacto*-non-2-ulopyranosyl)onate]-3-*O*-acetyl-6-*O*-benzyl-2-deoxy-2-(*N*-2,2,2-trichloroethoxycarbonylamino)-β-D-glucopyranoside (13):** Cleavage of levulinic acid: A solution of 3.73 g (max. 1.85 mmol) of slightly contaminated compound **12** in 60 mL of a mixture of toluene/ethanol (2:1) was treated with 204 mg (2.22 mmol, 1.2 equiv.) of hydrazine acetate and stirred at room temperature for 4 h; 10 mL of acetone and 50 mL of water were added, and the solution was extracted with ethyl acetate (3 × 80 mL). The organic phase was dried ($MgSO_4$), filtered, and the solvent was removed under reduced pressure. The residue was co-evaporated with dichloromethane (30 mL) and used without further purification in the next step. HPLC (Luna, MeCN/H_2O, 90:10 → 100:0, 20 min, flow 1 mL/min): t_R = 8.66 min, λ = 214 nm. HR-MS (ESI$^+$): *m/z* calcd. for $C_{71}H_{89}Cl_3N_3O_{24}Si$ $[M + NH_4]^+$ 1500.4665, found 1500.4659. The residue was dissolved in 40 mL of pyridine and 20 mL of acetic anhydride, and 226 mg (1.85 mmol, 1.0 equiv.) of 4-DMAP was added. The solution was stirred at room temperature for 20 h, before it was concentrated in vacuo. The residue was co-evaporated with toluene (3 × 50 mL) and dichloromethane (3 × 50 mL). The crude product was purified by column chromatography on silica (dichloromethane/methanol, 25:1) to provide **13** as a colorless, amorphous solid (1.63 g, 1.01 mmol, 55 %, based on **11**). R_f = 0.39 (dichloromethane/methanol, 25:1). HPLC (Luna, MeCN/H_2O, 90:10 → 100:0, 20 min, flow 1 mL/min): t_R = 11.7 min, λ = 214 nm. $[\alpha]_D^{22}$ = +5.2 (*c* = 1.00, $CHCl_3$). ^{1}H NMR (800 MHz, $CDCl_3$, COSY, HSQC): δ = 7.71–7.67 (m, 2 H, H_{Ar}-Ph, -Bn), 7.63–7.59 (m, 2 H, H_{Ar}-Ph, -Bn), 7.43–7.23 (m, 21 H, H_{Ar}-Ph, -Bn), 5.47 (dd, $J_{H8,H7}$ = 7.5 Hz, $J_{H8,H9}$ = 2.9 Hz, 1 H, H8-Sia), 5.43–5.34 (m, 2 H, NH-GlcN {5.42}, H7-Sia {5.36}), 5.19–5.13 (m, 1 H, NH-Sia {5.14}), 5.12 (d, $J_{H4,H3}$ = 3.3 Hz, 1 H, H4–Gal), 4.92–4.82 (m, 2 H, H2-Gal {4.87}, H4–Sia {4.82}), 4.81 (d, $J_{CH,CH}$ = 12.0 Hz, 1 H, CH_{2a}-Troc), 4.74 (d, $J_{H1,H2}$ = 8.2 Hz, 1 H, H1–Gal), 4.54 (dd, $J_{H3,H2}$ = 12.3 Hz, $J_{H3,H4}$ = 3.3 Hz, 1 H, H3–Gal), 4.53 (d, $J_{CH,CH}$ = 12.0 Hz, 1 H, CH_{2b}-Troc), 4.52 (d, $J_{CH,CH}$ = 11.9 Hz, 2 H, CH_2-Bn), 4.46–4.41 (m, 4 H, CH_2-Bn {4.44, 4.41}), 4.38–4.35 (m, 1 H, H1-GlcN {4.36}), 4.29 (dd, $J_{H9a,H9b}$ = 12.5 Hz, $J_{H9a,H8}$ = 2.9 Hz, 1 H, H9a-Sia), 4.12–4.06 (m, 3 H, H6-Sia {4.09}, H9b-Sia {4.08}, H5-Sia {4.07}), 4.04–3.85 (m, 3 H, H3-GlcN {4.03}, H4-GlcN {3.96}, H2-GlcN {3.87}), 3.77 (m_c, 1 H, H5-Gal), 3.58 (dd, $J_{H6a,H6b}$ = 11.2 Hz, $J_{H6a,H5}$ = 4.3 Hz, 1 H, H6a-GlcN), 3.49–3.42 (m, 2 H, H6b-GlcN {3.46}, H6a-Gal {3.54}), 3.33 (dd, $J_{H6b,H6a}$ = 9.7 Hz, $J_{H6b,H5}$ = 7.6 Hz, 1 H, H6b-Gal), 3.14–3.11 (m, 1 H, H5-GlcN), 2.62 (dd, $J_{H3eq,H3ax}$ = 12.7 Hz, $J_{H3eq,H4}$ = 4.6 Hz, 1 H, $H3_{eq}$-Sia), 2.12, 2.11, 2.10, 2.06, 2.02, 1.97, 1.89 (7 × s, 21 H, CH_3-OAc), 1.95–1.91 (m, 1 H, $H3_{ax}$–Sia), 1.86 (s, 3 H, CH_3-NHAc), 1.05 (s, 9 H, CH_3-*t*Bu-Si) ppm. ^{13}C NMR (200 MHz, $CDCl_3$, HSQC, HMBC): δ = 170.8, 170.6, 170.3, 170.2, 170.2, 170.1 (8 × C=O-NHAc, -OAc), 168.1 (C1–Sia), 154.2 (C=O-Troc), 138.6, 137.9 (C_q-Bn, -Ph), 136.1, 136.0, 135.2, 135.1, 134.9, 129.0, 128.8, 128.8, 128.7, 128.7, 128.7, 128.6, 128.4, 128.3, 127.9, 127.8, 127.6, 127.4 (C_{Ar}-Bn, -Ph), 100.7 (C1–Gal), 98.9 (C2–Sia), 97.2 (C1-

GlcN), 95.5 (CCl_3), 75.0 (C4-GlcN), 74.9 (C5-GlcN), 74.6 (CH_2-Troc), 73.9 (C2–Gal), 73.7 (C3-GlcN), 73.5, 73.4 (CH_2-Bn), 72.5 (C6-Sia), 71.8 (C3-Gal), 71.6 (C5-Gal), 69.2 (C4-Sia), 68.4 (CH_2-Bn), 67.9 (C6-GlcN), 67.7 (C4-Gal), 67.7 (C8-Sia), 67.6 (C6-Gal), 67.4 (C7-Sia), 62.4 (C9-Sia), 58.1 (C2-GlcN), 49.4 (C5-Sia), 38.3 (C3-Sia), 26.8 (CH_3-*t*Bu-Si), 23.3 (CH_3-NHAc), 21.2, 21.0, 21.0, 20.9, 20.9, 20.8, 20.7 (CH_3-OAc), 19.2 (C_q-*t*Bu-Si) ppm. HR-MS (ESI^+): *m/z* calcd. for $C_{77}H_{95}Cl_3N_3O_{27}Si$ [M + NH_4]$^+$ 1626.4982, found 1626.4985.

4-*O*-(2,4-Di-*O*-acetyl-6-*O*-benzyl-β-D-galactopyranosyl)-3-*O*-[benzyl (5-acetamido-4,7,8,9-tetra-*O*-acetyl-3,5-dideoxy-α-D-*glycero*-D-*galacto*-non-2-ulopyranosyl)onate]-3-*O*-acetyl-6-*O*-benzyl-2-deoxy-2-(*N*-2,2,2-trichloroethoxycarbonylamino)-α/β-D-glucopyranosyl Trichloroacetimidate (2): A mixture of 1.63 g (1.01 mmol) of compound **13** in 100 mL of tetrahydrofurane (THF) was cooled to 0 °C, followed by simultaneous addition of 15.2 mL (397 mg, 1.52 mmol, 1.5 equiv.) of a solution of tetrabutylammonium fluoride (TBAF) in THF (0.1 M) and 15.0 mL (3.03 mmol, 3.0 equiv.) of a solution of 0.17 mL of glacial acetic acid and 14.8 mL of THF within 15 min. The reaction mixture was stirred at 0 °C for 30 min, warmed up to room temperature, and stirred for 48 h. The solution was diluted with dichloromethane (100 mL) and washed with $NaHCO_3$ and brine (3 × 50 mL). The aqueous phase was extracted with dichloromethane (3 × 50 mL), the combined organic layers were dried ($MgSO_4$) and concentrated in vacuo. Purification of the crude product by column chromatography on silica (dichloromethane/methanol, 25:1) provided the desired compound as a colorless, amorphous solid (1.21 g, 0.88 mmol, 87 %). R_f = 0.22/0.29 (dichloromethane/methanol, 25:1). HPLC (Luna, MeCN/H_2O, 90:10 → 100:0, 20 min, flow 1 mL/min): t_R = 3.83 min/4.12 min, λ = 214 nm. HR-MS (ESI^+): *m/z* calcd. for $C_{61}H_{77}Cl_3N_3O_{27}$ [M + NH_4]$^+$ 1388.3805, found 1388.3795. HR-MS (ESI^-): *m/z* calcd. for $C_{62}H_{74}Cl_3N_2O_{29}$ [M + HCO_2]$^-$ 1415.3448, found 1415.3438. A solution of 700 mg (0.51 mmol) of crude product in 60 mL of dry dichloromethane was added to 1.0 g of powdered molecular sieves (4 Å) under argon and stirred at room temperature for 30 min. The reaction mixture was cooled to 0 °C and treated with 511 µL (5.10 mmol, 10.0 equiv.) of trichloroacetonitrile and four drops of DBU. The mixture was warmed up to room temperature while being stirred for 6 h, during which after 3 h one drop of DBU was added. It was diluted with dichloromethane (20 mL), filtered through a pad of Celite, and concentrated in vacuo. The crude product was purified by column chromatography on silica (cyclohexane/ethyl acetate, 1:9) to obtain **2** as a colorless, amorphous solid (460 mg, 0.30 mmol, 51 % over 2 steps) in an anomeric mixture (α/β, 1:1.8, determined by analytic reversed-phase HPLC). R_f = 0.41/0.52 (cyclohexane/ethyl acetate, 1:9). $[\alpha]_D^{22}$ = +34.4 (*c* = 0.50, $CHCl_3$, α-anomer). ^{1}H NMR (800 MHz, $CDCl_3$, COSY, HSQC): α-anomer: δ = 8.70 (s, 1 H, NH-TCI), 7.44–7.41 (m, 2 H, H_{Ar}-Bn), 7.40–7.35 (m, 3 H, H_{Ar}-Bn), 7.35–7.30 (m, 10 H, H_{Ar}-Bn), 6.41 (d, $J_{H1,H2}$ = 3.7 Hz, 1 H, H1-GlcN), 5.49 (ddd, $J_{H8,H7}$ = 8.8 Hz, $J_{H8,H9b}$ = 6.0 Hz, $J_{H8,H9a}$ = 2.8 Hz, 1 H, H8-Sia), 5.43 (d, $J_{CH,CH}$ = 12.0 Hz, 1 H, CH_2-Bn), 5.37 (dd, $J_{H3,H2}$ = 11.0 Hz, $J_{H3,H4}$ = 9.2 Hz, 1 H, H3-GlcN), 5.30 (dd, $J_{H7,H8}$ = 8.7 Hz, $J_{H7,H6}$ = 2.8 Hz, 1 H, H7-Sia), 5.26 (d, $J_{NH,H2}$ = 9.2 Hz, 1 H, NH-GlcN), 5.15 (dd, $J_{H4,H3}$ = 3.4 Hz, $J_{H4,H5}$ = 1.1 Hz, 1 H, H4–Gal), 5.09 (d, $J_{CH,CH}$ = 12.0 Hz, 1 H, CH_2-Bn), 4.96 (dd, $J_{H2,H3}$ = 9.8 Hz, $J_{H2,H1}$ = 7.9 Hz, 1 H, H2-Gal), 4.94 (d, $J_{NH,H5}$ = 9.5 Hz, 1 H, NH-Sia), 4.87 (d, $J_{H1,H2}$ = 7.9 Hz, 1 H, H1–Gal), 4.84 (ddd, $J_{H4,H3ax}$ = 12.1 Hz, $J_{H4,H5}$ = 10.3 Hz, $J_{H4,H3eq}$ = 4.6 Hz, 1 H, H4–Sia), 4.71 (d, $J_{CH,CH}$ = 12.0 Hz, 1 H, CH_{2a}-Troc), 4.69 (d, $J_{CH,CH}$ = 12.0 Hz, 1 H, CH_{2b}-Troc), 4.64 (d, $J_{CH,CH}$ = 11.8 Hz, 1 H, CH_2-Bn), 4.61 (dd, $J_{H3,H2}$ = 10.0 Hz, $J_{H3,H4}$ = 3.4 Hz, 1 H, H3–Gal), 4.56 (d, $J_{CH,CH}$ = 11.8 Hz, 1 H, CH_2-Bn), 4.53 (d, $J_{CH,CH}$ = 11.8 Hz, 1 H, CH_2-Bn), 4.44 (d, $J_{CH,CH}$ = 11.8 Hz, 1 H, CH_2-Bn), 4.29 (dd, $J_{H9a,H9b}$ = 12.4 Hz, $J_{H9a,H8}$ = 2.8 Hz, 1 H, H9a-Sia), 4.18 (t, $J_{H4,H3}$ = $J_{H4,H5}$ = 9.6 Hz, 1 H, H4-GlcN), 4.14 (ddd, $J_{H2,H3}$ = 11.0 Hz, $J_{H2,NH}$ = 9.2 Hz, $J_{H2,H1}$ = 3.7 Hz, 1 H, H2-GlcN), 4.04–3.99 (m, 2 H, H5-Sia {4.03}, H5-GlcN {4.02}), 3.90 (dd, $J_{H9b,H9a}$ = 12.4 Hz, $J_{H9b,H8}$ = 6.0 Hz, 1 H, H9b-Sia), 3.84 (ddd, $J_{H5,H6a}$ = 6.9 Hz, $J_{H5,H6b}$ = 5.5 Hz, $J_{H5,H4}$ = 1.1 Hz, 1 H, H5-Gal), 3.81 (dd, $J_{H6a,H6b}$ = 11.5 Hz, $J_{H6a,H5}$ = 3.8 Hz, 1 H, H6a-GlcN), 3.72 (dd, $J_{H6b,H6a}$ = 11.6 Hz, $J_{H6b,H5}$ = 1.8 Hz, 1 H, H6b-GlcN), 3.50 (dd, $J_{H6a,H6b}$ = 9.6 Hz, $J_{H6a,H5}$ = 5.4 Hz, 1 H, H6a-Gal), 3.46 (dd, $J_{H6,H5}$ = 10.8 Hz, $J_{H6,H7}$ = 2.7 Hz, 1 H, H6-Sia), 3.39 (dd, $J_{H6b,H6a}$ = 9.6 Hz, $J_{H6b,H5}$ = 7.3 Hz, 1 H, H6b-Gal), 2.61 (dd, $J_{H3eq,H3ax}$ = 12.6 Hz, $J_{H3eq,H4}$ = 4.7 Hz, 1 H, $H3_{eq}$-Sia), 2.11, 2.11, 2.03, 2.02, 1.99, 1.98, 1.97 (7 × s, 21 H, CH_3-OAc), 1.84 (s, 3 H, CH_3-NHAc), 1.67 (t, $J_{H3ax,H3eq}$ = $J_{H3ax,H4}$ = 12.4 Hz, 1 H, $H3_{ax}$–Sia) ppm. ^{13}C NMR (200 MHz, $CDCl_3$, HSQC, HMBC): δ = 171.1, 170.7, 170.5, 170.4, 170.2, 169.8, 169.7 (8 × C=O-NHAc, -OAc), 167.4 (C1–Sia), 161.0 (C=NH-TCI), 154.4 (C=O-Troc), 138.4, 137.9 (3 × C_q-Bn), 135.0, 129.1, 128.8, 128.5, 128.4, 127.9, 127.9, 127.6, 127.6 (C_{Ar}-Bn), 100.5 (C1–Gal), 97.1 (C2–Sia), 95.5 (CCl_3), 94.8 (C1-GlcN), 91.0 (CCl_3-TCI), 74.5 (CH_2-Troc), 74.2 (C4-GlcN), 73.5, 73.4 (CH_2-Bn), 73.2 (C5-GlcN), 72.2 (C6-Sia), 71.9 (C3-Gal), 71.7 (C5-Gal), 71.3 (C3-GlcN), 70.7 (C2–Gal), 69.2 (C4-Sia), 68.5 (CH_2-Bn), 67.9 (C8-Sia), 67.8 (C4-Gal), 67.7 (C6-Gal), 67.6 (C6-GlcN), 67.1 (C7-Sia), 62.2 (C9-Sia), 54.3 (C2-GlcN), 48.9 (C5-Sia), 37.5 (C3-Sia), 23.2 (CH_3-NHAc), 21.6, 21.3, 20.9, 20.8, 20.8, 20.7, 20.7 (CH_3-OAc) ppm. HR-MS (ESI^+): *m/z* calcd. for $C_{63}H_{77}Cl_6N_4O_{27}$ [M + NH_4]$^+$ 1531.2885, found 1531.2901.

***N*-(9*H*-Fluoren-9-yl)methoxycarbonyl-*O*-(2-acetamido)-2-deoxy-4,6-*O*-benzylidene-3-*O*-[6-deoxy-6-fluoro-β-D-galactopyranosyl]-α-D-galactopyranosyl-L-threonine *tert*-Buyl Ester (15):** 2.54 g (2.59 mmol) of compound **14** in 50 mL of methanol was treated with a freshly prepared solution of NaOMe in MeOH. The reaction mixture was adjusted to a pH value of 8.5, and it was readjusted at regular intervals. The solution was stirred at room temperature for 18 h before it was neutralized with AcOH. The solvent was removed under reduced pressure, and the residue was co-evaporated with toluene (3 × 50 mL) and dichloromethane (2 × 50 mL). The crude product was dissolved in 100 mL of dry dichloromethane and 847 mg (2.59 mmol, 1.0 equiv.) of Fmoc-OSu was added. The pH value was adjusted to 9.5 with DIPEA, and the reaction mixture was stirred under argon at room temperature for 15 h. The solution was neutralized with Amberlite IR120 and filtered. The solvent was removed under reduced pressure, and the crude product was purified by column chromatography on silica (cyclohexane/ethyl acetate → ethyl acetate → ethyl acetate/ethanol, 20:1) to give compound **15** as a colorless, amorphous solid (1.63 g, 1.92 mmol, 74 %). R_f = 0.26 (ethyl acetate/ethanol, 20:1). HPLC (Luna, MeCN/H_2O, 30:70 → 77:23 in 30 min → 100:0 in 60 min, flow 1 mL/min): t_R = 21.6 min, λ = 214 nm. $[\alpha]_D^{22}$ = +77.3 (*c* = 1.00, $CHCl_3$). ^{1}H NMR (800 MHz, $CDCl_3$, COSY, HSQC): δ = 7.81–7.73 (m, 2 H, H4-, H5-Fmoc), 7.64 (d, $J_{H1/H8,H2/H7}$ = 7.3 Hz, 2 H, H1-, H8-Fmoc), 7.52 (d, $J_{CH,CH}$ = 6.9 Hz, 2 H, H_{Ar}-Bzn), 7.45–7.27 (m, 7 H, H2-, H3-, H6-, H7-Fmoc, H_{Ar}-Bzn), 6.33 (d, $J_{NH,H2}$ = 8.9 Hz, 1 H, NH-GalN), 5.55 (d, $J_{NH,T\alpha}$ = 8.5 Hz, 1 H, NH-urethane), 5.51 (s, 1 H, CH-Bzn), 4.96 (d, $J_{H1,H2}$ = 4.9 Hz, 1 H, H1-GalN), 4.67–4.54 (m, 2 H, H2-GalN, H6a-Gal'), 4.53–4.45 (m, 4 H, H2-Gal', H6b-Gal', CH_2-Fmoc), 4.43–4.36 (m, 1 H, H4-GalN), 4.30–4.22 (m, 3 H, T^{α}, H1-Gal', H9-Fmoc), 4.22–4.15 (m, 2 H, H6a-GalN, T^{β}), 4.08–4.02 (m, 1 H, H6b-GalN), 3.77–3.73 (m, 1 H, H3-GalN), 3.72–3.68 (m, 1 H, H5-GalN), 3.62–3.58 (m, 1 H, H4-Gal'), 3.57–3.52 (m, 1 H, H5-Gal'), 3.31–3.24 (m, 1 H, H3-Gal'), 2.04 (s, 3 H, CH_3-NHAc), 1.46 (s, 9 H, CH_3-*t*Bu), 1.28 (d, $J_{T\gamma,T\beta}$ = 6.2 Hz, 3 H, T^{γ}) ppm. ^{13}C NMR (200 MHz, $CDCl_3$, HSQC, HMBC): δ = 172.3, 170.4 (2 × C=O-NHAc, -ester), 156.5 (C=O-urethane), 143.8, 143.7 (C1a-, C8a-Fmoc), 141.4, 141.4 (C4a-, C5a-Fmoc), 136.7 (C_q-Bzn), 128.9, 128.8 (C2-, C7-Fmoc), 128.3, 128.3, 127.9 (C_{Ar}-Bzn), 127.2 (C3-, C6-Fmoc), 126.4, 126.2 (C_{Ar}-Bzn), 125.1, 125.0 (C1-, C8-Fmoc), 120.2, 120.2

(C4-, C5-Fmoc), 105.3 (C1-Gal'), 101.4 (CH-Bzn), 100.6 (C1-GalN), 83.4 (C_q-*t*Bu), 83.4 (d, $J_{C6,F}$ = 168.1 Hz, C6-Gal'), 77.8 (C3-GalN), 76.9 (T^{β}), 75.8 (C4-GalN), 73.4 (d, $J_{C5,F}$ = 20.2 Hz, C5-Gal'), 73.3 (C3-Gal'), 69.1 (C6-GalN), 68.4 (d, $J_{C4,F}$ = 7.3 Hz, C4-Gal'), 67.2, 67.2 (C2-Gal', CH_2-Fmoc), 63.7 (C5-GalN), 59.1 (T^{α}), 48.2 (C2-GalN), 47.3 (C9-Fmoc), 28.1 (CH_3-*t*Bu), 21.4 (CH_3-NHAc), 19.0 (T^{γ}) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –228.8 (dd, $J_{F,H6}$ = 47.1 Hz, $J_{F,H5}$ = 15.0 Hz, F6-Gal') ppm. HR-MS (ESI^+): *m/z* calcd. for $C_{44}H_{57}FN_3O_{14}$ $[M + NH_4]^+$ 870.3819, found 870.3819.

***N*-(9*H*-Fluoren-9-yl)methoxycarbonyl-*O*-{2-acetamido-4,6-*O*-benzylidene-2-deoxy-3-*O*-(6-deoxy-6-fluoro-β-D-galactopyranosyl)-3-*O*-[benzyl (5-acetamido-4,7,8,9-tetra-*O*-acetyl-3,5-dideoxy-α-D-*glycero*-D-*galacto*-non-2-ulopyranosyl)onate]}-α-D-galactopyranosyl-L-threonine *tert*-Buyl Ester (16):** Sialylated compound **16** was prepared according to TP1. Sialic acid xanthate **7** (1.93 g, 2.87 mmol), molecular sieves (3.0 g), glycosyl acceptor **15** (1.22 g, 1.44 mmol), AgOTf (740 mg, 2.87 mmol), and methylsulfenyl bromide (1.80 mL, 2.88 mmol, TP2) were allowed to react. The product was purified by column chromatography on silica (1 × dichloromethane/ethanol, 20:1, 1 × cyclohexane/ethyl acetate, 1:4) to provide **16** as a colorless, amorphous solid (534 mg, 0.38 mmol, 26 %). R_f = 0.16 (dichloromethane/ethanol, 20:1). HPLC (Luna, MeCN/H_2O, 30:70 → 77:23 in 30 min → 100:0 in 60 min, flow 1 mL/min): t_R = 22.4 min, λ = 214 nm. $[\alpha]_D^{22}$ = +46.0 (*c* = 1.00, $CHCl_3$). ^{1}H NMR (800 MHz, $CDCl_3$, COSY, HSQC): δ = 7.81–7.78 (m, 2 H, H4-, H5-Fmoc), 7.64, 7.61 (2 × d, $J_{H1/H8,H2/H7}$ = 7.5 Hz, 2 H, H1-, H8-Fmoc), 7.58–7.53 (m, 4 H, H_{Ar}-Bn, -Bzn), 7.43 (t, $J_{H3/H6,H2/H7}$ = $J_{H3/H6,H4/H5}$ = 7.5 Hz, 2 H, H3-, H6-Fmoc), 7.41–7.30 (m, 8 H, H2-, H7-Fmoc, H_{Ar}-Bn, -Bzn), 6.52 (d, $J_{NH,H2}$ = 8.9 Hz, 1 H, NH-GalN), 6.04 (d, $J_{NH,T\alpha}$ = 9.9 Hz, 1 H, NH-urethane), 5.56 (s, 1 H, CH-Bzn), 5.46–5.43 (m, 1 H, H7-Sia'), 5.27–5.19 (m, 4 H, H8-Sia', NH-Sia', CH_2-Bn), 5.03 (d, $J_{H1,H2}$ = 3.9 Hz, 1 H, H1-GalN), 4.93–4.88 (m, 1 H, H4-Sia'), 4.75 (dt, $J_{H2,NH}$ = $J_{H2,H3}$ = 9.6 Hz, $J_{H2,H1}$ = 3.8 Hz, 1 H, H2-GalN), 4.59–4.48 (m, 2 H, H6a-Gal', H9a-Sia'), 4.48–4.40 (m, 2 H, CH_2-Fmoc), 4.38–4.29 (m, 4 H, T^{α}, T^{β}, H4-GalN, H6b-Gal'), 4.26 (t, $J_{H9,CH2}$ = 7.3 Hz, 1 H, H9-Fmoc), 4.25–4.21 (m, 1 H, H6a-GalN), 4.19 (d, $J_{H1,H2}$ = 7.7 Hz, 1 H, H1-Gal'), 4.16–4.11 (m, 1 H, H5-Sia'), 4.10–4.06 (m, 1 H, H6b-GalN), 4.02–3.95 (m, 3 H, H6-Sia', H9b-Sia', H3-Gal'), 3.76–3.68 (m, 2 H, H5-GalN, H3-GalN), 3.66–3.59 (m, 1 H, H2-Gal'), 3.53–3.49 (m, 1 H, H5-Gal'), 3.23 (br. s, 1 H, H4-Gal'), 2.86 (br. s, 1 H, 2-OH-Gal'), 2.72 (dd, $J_{H3eq,H3ax}$ = 12.8 Hz, $J_{H3eq,H4}$ = 4.7 Hz, 1 H, $H3_{eq}$-Sia'), 2.13 (s, 3 H, CH_3-OAc), 2.07–2.05 (m, 4 H, CH_3-NHAc, $H3_{ax}$-Sia' {2.05}), 2.04, 1.99, 1.87 (4 × s, CH_3-NHAc, -OAc), 1.48 (s, 9 H, CH_3-*t*Bu), 1.31 (d, $J_{T\gamma,T\beta}$ = 6.4 Hz, 3 H, T^{γ}) ppm. ^{13}C NMR (200 MHz, $CDCl_3$, HSQC, HMBC): δ = 170.8, 170.4, 169.9, 169.8, 169.2, 169.2, 168.8 (7 × C=O-NHAc, -OAc, -ester), 166.7 (C1-Sia'), 155.8 (C=O-urethane), 142.7, 142.7 (C1a-, C8a-Fmoc), 140.3 (C4a-, C5a-Fmoc), 140.2, 136.6 (C_q-Bn, -Bzn), 127.9, 127.1 (C2-, C7-Fmoc, C_{Ar}-Bn, -Bzn), 126.1 (C3-, C6-Fmoc), 125.5 (C_{Ar}-Bn, -Bzn), 124.2, 124.0 (C1-, C8-Fmoc), 119.0 (C4-, C5-Fmoc), 105.3 (C1-Gal'), 100.0 (CH-Bzn), 99.5 (C1-GalN), 96.6 (C2-Sia'), 82.2 (C_q-*t*Bu), 81.9 (d, $J_{C6,F}$ = 168.6 Hz, C6-Gal'), 77.2 (C3-GalN), 75.0 (T^{β}), 74.8 (C4-GalN), 74.2 (C3-Gal'), 72.5 (C6-Sia'), 72.0 (d, $J_{C5,F}$ = 21.2 Hz, C5-Gal'), 68.7 (C7-Sia'), 68.1 (C6-GalN), 67.7 (C4-Sia'), 67.2, 67.2 (C8-Sia', CH_2-Bn, C2-Gal'), 66.7 (d, $J_{C4,F}$ = 7.5 Hz, C4-Gal'), 66.3 (CH_2-Fmoc), 62.7 (C9-Sia'), 62.6 (C5-GalN), 58.2 (T^{α}), 48.1 (C5-Sia'), 46.8 (C2-GalN), 46.1 (C9-Fmoc), 36.3 (C3-Sia'), 28.1 (CH_3-*t*Bu), 23.2, 21.4 (CH_3-NHAc), 20.2, 20.1, 19.8, 19.7 (CH_3-OAc), 18.4 (T^{γ}) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –229.0 (dt, $J_{F,H6}$ = 47.1 Hz, $J_{F,H5}$ = 15.0 Hz, F6-Gal') ppm. HR-MS (ESI^+): *m/z* calcd. for $C_{70}H_{88}FN_4O_{26}$ $[M + NH_4]^+$ 1419.5665, found 1419.5657.

***N*-(9*H*-Fluoren-9-yl)methoxycarbonyl-*O*-{2-acetamido-2-deoxy-3-*O*-(2,4-di-*O*-acetyl-6-deoxy-6-fluoro-β-D-galactopyranosyl)-3-*O*-[benzyl (5-acetamido-4,7,8,9-tetra-*O*-acetyl-3,5-dideoxy-α-D-*glycero*-D-*galacto*-non-2-ulopyranosyl)onate]}-α-D-galactopyranosyl-L-threonine *tert*-Buyl Ester (3):** 541 mg (0.38 mmol) of compound **16** was dissolved in 20 mL of pyridine, and 10 mL of acetic anhydride was added dropwise. The solution was stirred at room temperature for 16 h before it was concentrated in vacuo. The residue was co-evaporated with toluene (3 × 20 mL) and dichloromethane (2 × 20 mL); 20 mL of aqueous acetic acid (80 %) was added, and the reaction mixture was stirred at 80 °C for 1 h. After cooling to room temperature, the solution was concentrated in vacuo, and the residue was co-evaporated with toluene (3 × 20 mL) and dichloromethane (2 × 20 mL). The crude product was purified by column chromatography on silica (dichloromethane/ethanol, 20:1 → dichloromethane/ethanol, 10:1) to provide compound **3** as a colorless, amorphous solid (395 mg, 0.28 mmol, 73 %). R_f = 0.18 (dichloromethane/ethanol, 20:1). HPLC (Luna, MeCN/H_2O, 30:70 → 77:23 in 30 min → 100:0 in 60 min, flow 1 mL/min): t_R = 23.6 min, λ = 214 nm. $[\alpha]_D^{22}$ = +39.5 (*c* = 1.00, $CHCl_3$). ^{1}H NMR (800 MHz, $CDCl_3$, COSY, HSQC): δ = 7.76 (d, $J_{H4/H5,H3/H6}$ = 7.5 Hz, 2 H, H4-, H5-Fmoc), 7.62–7.56 (m, 2 H, H1-, H8-Fmoc), 7.45–7.34 (m, 7 H, H_{Ar}-Bn, H3-, H6-Fmoc), 7.32–7.27 (m, 2 H, H2-, H7-Fmoc), 6.35 (d, $J_{NH,H2}$ = 9.6 Hz, 1 H, NH-GalN), 5.75 (d, $J_{NH,T\alpha}$ = 9.7 Hz, 1 H, NH-urethane), 5.59 (dt, $J_{H8,H7}$ = $J_{H8,H9a}$ = 8.3 Hz, $J_{H8,H9b}$ = 2.6 Hz, 1 H, H8-Sia'), 5.44 (d, $J_{CH,CH}$ = 11.9 Hz, 1 H, CH_2-Bn), 5.21 (dd, $J_{H7,H8}$ = 8.6 Hz, $J_{H7,H6}$ = 2.8 Hz, 1 H, H7-Sia'), 5.11–5.03 (m, 2 H, H2-Gal', CH_2-Bn), 5.01–4.99 (m, 1 H, H4-Gal'), 4.97 (d, $J_{NH,H5}$ = 10.2 Hz, 1 H, NH-Sia'), 4.98 (d, $J_{H1,H2}$ = 3.8 Hz, 1 H, H1-GalN), 4.83 (dt, $J_{H4,H3ax}$ = $J_{H4,H5}$ = 10.3 Hz, $J_{H4,H3eq}$ = 4.5 Hz, 1 H, H4-Sia'), 4.65 (d, $J_{H1,H2}$ = 8.0 Hz, 1 H, H1-Gal'), 4.59 (dt, $J_{H2,NH}$ = $J_{H2,H3}$ = 10.5 Hz, $J_{H2,H1}$ = 3.2 Hz, 1 H, H2-GalN), 4.53 (dd, $J_{H3,H2}$ = 10.3 Hz, $J_{H3,H4}$ = 3.3 Hz, 1 H, H3-Gal'), 4.44–4.35 (m, 4 H, CH_2-Fmoc, H6a-Gal', H9a-Sia'), 4.34–4.19 (m, 4 H, H6b-Gal', T^{α}, T^{β}, H9-Fmoc), 4.18–4.13 (m, 1 H, H4-GalN), 4.04 (q, $J_{H5,H4}$ = $J_{H5,H6}$ = $J_{H5,NH}$ = 10.4 Hz, 1 H, H5-Sia'), 3.92–3.85 (m, 3 H, H5-Gal', H5-GalN, H6a-GalN), 3.84–3.77 (m, 2 H, H9b-Sia', H6b-GalN), 3.76–3.72 (m, 1 H, H3-GalN), 3.54–3.50 (m, 1 H, H6-Sia'), 2.61 (dd, $J_{H3eq,H3ax}$ = 12.6 Hz, $J_{H3eq,H4}$ = 4.6 Hz, 1 H, $H3_{eq}$-Sia'), 2.28, 2.13, 2.08, 2.06, 2.04, 2.00, 1.98, 1.82 (8 × s, 24 H, CH_3-NHAc, -OAc), 1.65 (t, $J_{H3ax,H3eq}$ = $J_{H3ax,H4}$ = 12.4 Hz, 1 H, $H3_{ax}$-Sia'), 1.48 (s, 9 H, CH_3-*t*Bu), 1.31 (d, $J_{T\gamma,T\beta}$ = 6.3 Hz, 3 H, T^{γ}) ppm. ^{13}C NMR (200 MHz, $CDCl_3$, HSQC, HMBC): δ = 171.7, 171.2, 170.7, 170.4, 170.0, 170.0, 169.9, 169.9, 168.8 (9 × C=O-NHAc, -OAc, -ester), 167.5 (C1-Sia'), 156.8 (C=O-urethane), 143.9, 143.7 (C1a-, C8a-Fmoc), 141.5, 141.4 (C4a-, C5a-Fmoc), 134.7 (C_q-Bn), 129.1, 128.9, 128.8, 127.9 (C2-, C7-Fmoc, C_{Ar}-Bn), 127.1 (C3-, C6-Fmoc), 125.2, 125.1 (C1-, C8-Fmoc), 120.2 (C4-, C5-Fmoc), 102.3 (C1-Gal'), 99.9 (C1-GalN), 96.9 (C2-Sia'), 83.3 (C_q-*t*Bu), 81.5 (d, $J_{C6,F}$ = 172.1 Hz, C6-Gal'), 78.5 (C3-GalN), 76.0 (T^{β}), 72.5 (C6-Sia'), 72.1 (d, $J_{C5,F}$ = 21.8 Hz, C5-Gal'), 71.2 (C3-Gal'), 69.9 (C5-GalN), 69.8 (C4-GalN), 69.2 (C7-Sia'), 69.0 (C2-Gal'), 68.7 (CH_2-Bn), 67.9 (C8-Sia'), 67.7 (C4-Sia', C4-Gal'), 67.4 (CH_2-Fmoc), 63.4 (C9-Sia'), 63.1 (C6-GalN), 59.3 (T^{α}), 48.9 (C5-Sia'), 47.4 (C2-GalN), 47.3 (C9-Fmoc), 37.3 (C3-Sia'), 28.3 (CH_3-*t*Bu), 23.5, 23.4 (CH_3-NHAc), 21.6, 21.3, 21.1, 20.9, 20.9, 20.8 (6 × CH_3-OAc), 19.4 (T^{γ}) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –230.3 (dt, $J_{F,H6}$ = 46.9 Hz, $J_{F,H5}$ = 13.6 Hz, F6-Gal') ppm. HR-MS (ESI^+): *m/z* calcd. for $C_{67}H_{84}FN_3O_{28}Na$ $[M + Na]^+$ 1420.5118, found 1420.5111.

***N*-(9*H*-Fluoren-9-yl)methoxycarbonyl-*O*-[2-acetamido-6-*O*-(4-*O*-{2,4-di-*O*-acetyl-6-*O*-benzyl-β-D-galactopyranosyl-3-*O*-[benzyl (5-acetamido-4,7,8,9-tetra-*O*-acetyl-3,5-dideoxy-α-D-*glycero*-D-*galacto*-non-2-ulopyranosyl)onate]-β-D-galactopyranosyl}-3-*O*-acetyl-6-*O*-benzyl-2-deoxy-2-(*N*-2,2,2-trichloroethoxycarbonylamino)-β-D-glucopyranosyl)-3-*O*-(2,4-di-*O*-acetyl-6-deoxy-6-fluoro-β-D-galactopyranosyl)-3-*O*-[benzyl (5-acetamido-4,7,8,9-tetra-*O*-acetyl-3,5-dideoxy-α-D-*glycero*-D-*galacto*-non-2-ulopyranosyl)onate]-β-D-galacto-**

pyranosyl]-2-deoxy-α-D-galactopyranosyl]-L-threonine *tert*-Buyl Ester (17): A solution of 91 mg (0.060 mmol) of compound **2** and 100 mg (0.072 mmol, 1.2 equiv.) of compound **3** in 20 mL of dry dichloromethane was added to 250 mg of powdered molecular sieves (4 Å), and the mixture was stirred under argon at room temperature for 1 h. The mixture was cooled to –50 °C before sequential addition of a solution of 5 µL (0.030 mmol, 0.5 equiv.) of trimethylsilyl trifluoromethanesulfonate (TMSOTf) in 500 µL of dry dichloromethane within 5 min. The solution was warmed up to –40 °C over a period of 4 h during which additional 250 µL (0.015 mmol, 0.25 equiv.) of TMSOTf in dry dichloromethane after 2 h was added. It was neutralized with DIPEA in dichloromethane at –40 °C before the mixture was diluted with dichloromethane (50 mL), filtered through a pad of Celite, and washed with dichloromethane (4 × 80 mL). The filtrate was washed with $NaHCO_3$ and brine (2 × 50 mL), the aqueous layer was extracted with dichloromethane (3 × 50 mL). The combined organic layers were dried ($MgSO_4$), concentrated in vacuo, and purified by column chromatography (cyclohexane/ethyl acetate, 1:9) to provide compound **17** as a colorless, amorphous solid (75 mg, 0.027 mmol, 45 %). R_f = 0.08 (cyclohexane/ethyl acetate, 1:9). HPLC (Luna, MeCN/H_2O, 50:50 → 90:10 in 20 min → 100:0 in 40 min, flow 1 mL/min): t_R = 23.1 min, λ = 214 nm. $[\alpha]_D^{22}$ = +5.2 (*c* = 0.10, $CHCl_3$). ^{1}H NMR (800 MHz, $CDCl_3$, COSY, TOCSY, HSQC): δ = 7.78–7.74 (m, 2 H, H4-, H5-Fmoc), 7.62–7.58 (m, 2 H, H1-, H8-Fmoc), 7.44–7.27 (m, 22 H, H_{Ar}-Bn, H3-, H6-Fmoc), 7.28–7.23 (m, 2 H, H2-, H7-Fmoc), 6.54 (d, $J_{NH,H2}$ = 9.7 Hz, 1 H, NH-GlcN), 6.47 (d, $J_{NH,H2}$ = 9.5 Hz, 1 H, NH-GalN), 5.84 (d, $J_{NH,T\alpha}$ = 9.9 Hz, 1 H, NH-Fmoc), 5.57 (td, $J_{H8,H7}$ = $J_{H8,H9b}$ = 8.1 Hz, $J_{H8,H9a}$ = 2.8 Hz, 1 H, H8-Sia′), 5.48 (ddd, $J_{H8,H7}$ = 8.8 Hz, $J_{H8,H9b}$ = 6.3 Hz, $J_{H8,H9a}$ = 2.8 Hz, 1 H, H8-Sia), 5.45 (d, $J_{CH,CH}$ = 12.0 Hz, 1 H, CH_2-Bn), 5.42 (d, $J_{CH,CH}$ = 12.0 Hz, 1 H, CH_2-Bn), 5.29 (dd, $J_{H7,H8}$ = 8.4 Hz, $J_{H7,H6}$ = 2.7 Hz, 1 H, H7-Sia), 5.21 (dd, $J_{H7,H8}$ = 8.5 Hz, $J_{H7,H6}$ = 2.7 Hz, 1 H, H7-Sia′), 5.14 (dd, $J_{H4,H3}$ = 3.2 Hz, $J_{H4,H5}$ = 1.1 Hz, 1 H, H4-Gal), 5.10–5.00 (m, 7 H, H3-GlcN {5.08}, CH_2-Bn {5.08, 5.06, d, $J_{CH,CH}$ = 12.2 Hz}, H2-Gal′ {5.07}, NH-Sia {5.02}, NH-Sia′ {5.01}, H4-Gal′ {5.00}), 4.91 (dd, $J_{H2,H3}$ = 10.1 Hz, $J_{H2,H1}$ = 7.9 Hz, 1 H, H2-Gal), 4.86–4.81 (m, 3 H, H4-Sia, H4-Sia′ {4.84}, H1-GalN {4.82}), 4.77–4.69 (m, 4 H, CH_{2a}-Troc {4.74, d, $J_{CH,CH}$ = 12.1 Hz}, H1-Gal {4.74}, CH_{2b}-Troc {4.71, d, $J_{CH,CH}$ = 12.1 Hz}, H1-GlcN {4.69}), 4.67–4.62 (m, 2 H, H1-Gal′ {4.65, d, $J_{CH,CH}$ = 8.6 Hz}, CH_2-Bn {4.64, d, $J_{CH,CH}$ = 12.2 Hz}), 4.60–4.56 (m, 3 H, H3-Gal {4.58}, CH_2-Bn {4.58}, H2-GalN {4.57}), 4.54–4.49 (m, 2 H, H3-Gal′ {4.52}, CH_2-Bn {4.51}), 4.48–4.39 (m, 3 H, CH_2-Fmoc {4.47, 4.40}, CH_2-Bn {4.42}), 4.39–4.28 (m, 4 H, H9a-Sia′ {4.37}, H6a-Gal′ {4.37}, H9a-Sia {4.33}, H6b-Gal′ {4.31}), 4.27–4.20 (m, 3 H, T^β {4.25}, T^α {4.23}, H9-Fmoc {4.23}), 4.11 (m_c, 1 H, H4-GalN), 4.06–4.00 (m, 2 H, H5-Sia′ {4.03}, H5-Sia {4.01}), 3.94–3.89 (m, 2 H, H9b-Sia {3.91}, H4-GlcN {3.90}), 3.89–3.64 (m, 9 H, H5-Gal′ {3.87}, H5-GalN {3.85}, H6a-GlcN {3.81}, H9b-Sia′ {3.81}, H5-Gal {3.79}, H2-GlcN {3.74}, H3-GalN {3.73}, H6b-GlcN {3.71}, H6a-GalN {3.70}), 3.63–3.56 (m, 2 H, H6b-GalN {3.59}, H5-GlcN {3.58}), 3.53–3.48 (m, 2 H, H6-Sia′ {3.51}, H6a-Gal {3.49}), 3.46 (dd, $J_{H6,H5}$ = 10.7 Hz, $J_{H6,H7}$ = 2.7 Hz, 1 H, H6-Sia), 3.39–3.35 (m, 1 H, H6b-Gal), 2.60 (dd, $J_{H3eq,H3ax}$ = 12.6 Hz, $J_{H3eq,H4}$ = 4.9 Hz, 2 H, $H3_{eq}$-Sia, $H3_{eq}$-Sia′), 2.12, 2.10, 2.10, 2.07, 2.05, 2.03, 2.00, 1.98, 1.97 (13 × s, 39 H, CH_3-OAc), 2.05 (s, 3 H, CH_3-NHAc-GalN), 1.81 (2 × s, 6 H, CH_3-NHAc-Sia, -Sia′), 1.66 (m_c, 2 H, $H3_{ax}$-Sia, $H3_{ax}$-Sia′), 1.44 (s, 9 H, CH_3-*t*Bu), 1.34 (d, $J_{T\gamma,T\beta}$ = 6.4 Hz, 3 H, T^γ) ppm. ^{13}C NMR (200 MHz, $CDCl_3$, HSQC, HMBC): δ = 170.9, 170.8, 170.8, 170.6, 170.5, 170.5, 170.4, 170.4, 170.2, 170.2, 169.8, 169.7 (17 × C=O-NHAc, -OAc, -ester), 167.5, 167.4 (C1-Sia, C1-Sia′), 156.8 (C=O-urethane), 155.1 (C=O-Troc), 143.9, 143.8 (C1a-, C8a-Fmoc), 141.4, 141.4 (C4a-, C5a-Fmoc), 138.5, 137.9, 137.9 (4 × C_q-Bn), 135.0, 134.7, 129.1, 129.1, 128.9, 128.8, 128.8, 128.5, 128.5, 128.4, 127.9, 127.9, 127.9, 127.9, 127.6, 127.6, 127.2, 127.1 (20 × C_{Ar}, C2-, C3-, C6-, C7-Fmoc), 125.2, 125.1 (C1-, C8-Fmoc), 120.2, 120.2 (C4-, C5-Fmoc), 102.3 (C1-Gal′), 102.0 (C1-GlcN), 100.5 (C1-Gal), 100.2 (C1-GalN), 97.1 (C2-Sia, C2-Sia′), 96.9 (CCl_3), 83.2 (C_q-*t*Bu), 81.4 (d, $J_{F,C6}$ = 172.1 Hz, C6-Gal′), 78.8 (C3-GalN), 76.2 (T^β), 75.5 (C4-GlcN), 74.9 (C5-GlcN), 74.6 (CH_2-Troc), 74.5 (C3-GlcN), 73.5, 73.5 (CH_2-Bn), 72.4, 72.4 (C6-Sia′, C6-Sia), 71.9 (C3-Gal), 71.9 (d, $J_{F,C5}$ = 21.9 Hz, C5-Gal′), 71.6 (C5-Gal), 71.3 (C3-Gal′), 70.9 (C2-Gal), 70.5 (C6-GalN), 69.4 (C4-Sia, C4-Sia′), 69.1 (C2-Gal′), 68.7 (C6-GlcN), 68.6, 68.6 (CH_2-Bn), 68.8 (C5-GalN), 68.3 (C4-GalN), 68.2 (C8-Sia), 68.0 (C8-Sia′), 67.9 (C4-Gal), 67.7 (C4-Gal′), 67.7 (C6-Gal), 67.6 (C7-Sia′), 67.4 (C7-Sia), 67.4 (CH_2-Fmoc), 63.3 (C9-Sia′), 62.4 (C9-Sia), 59.4 (T^α), 56.4 (C2-GlcN), 49.0 (C5-Sia, C5-Sia′), 47.9 (C2-GalN), 47.3 (C9-Fmoc), 37.6 (C3-Sia, C3-Sia′), 28.2 (CH_3-*t*Bu), 23.4 (CH_3-NHAc-GalN), 23.2 (CH_3-NHAc-Sia, -Sia′), 21.5, 21.5, 21.2, 21.2, 21.1, 20.9, 20.9, 20.9, 20.9, 20.8, 20.8, 20.7 (13 × CH_3-OAc), 19.4 (T^γ) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –230.2 (dt, $J_{F,H6a/b}$ = 46.9 Hz, $J_{F,H5}$ = 13.6 Hz, F6-Gal′) ppm. HR-MS (ESI^+): *m/z* calcd. for $C_{128}H_{160}Cl_3FN_6O_{54}$ $[M + H + NH_4]^{2+}$ 1384.4498, found 1384.4498.

***N*-(9*H*-Fluoren-9-yl)methoxycarbonyl-*O*-[2-acetamido-6-*O*-(2-acetamido-4-*O*-{2,4-di-*O*-acetyl-6-*O*-benzyl-β-D-galactopyranosyl-3-*O*-[benzyl (5-acetamido-4,7,8,9-tetra-*O*-acetyl-3,5-dideoxy-α-D-*glycero*-D-*galacto*-non-2-ulopyranosyl)onate]-β-D-galactopyranosyl}-3-*O*-acetyl-6-*O*-benzyl-2-deoxy-β-D-glucopyranosyl)-3-*O*-(2,4-di-*O*-acetyl-6-deoxy-6-fluoro-β-D-galactopyranosyl)-3-*O*-[benzyl (5-acetamido-4,7,8,9-tetra-*O*-acetyl-3,5-dideoxy-α-D-*glycero*-D-*galacto*-non-2-ulopyranosyl)onate]-β-D-galactopyranosyl])-4-*O*-acetyl-2-deoxy-α-D-galactopyranosyl]-L-threonine *tert*-Buyl Ester (1):** Cleavage of the Troc protection group: 75 mg (0.027 mmol) of compound **17** was dissolved in 20 mL of glacial acetic acid, and 1.0 g of activated zinc was added [washed with aqueous HCl (1 M) and water (2 × 10 mL), dried with methanol and diethyl ether]. The reaction mixture was stirred at room temperature for 20 h, filtered through a pad of Celite, and washed with acetic acid (4 × 50 mL). The filtrate was concentrated in vacuo, and the residue was co-evaporated with toluene (3 × 50 mL) before the crude compound was subjected to the final acetylation step. R_f = 0.27 (ethyl acetate/ethanol, 10:1). HPLC (Luna, MeCN/H_2O, 50:50 → 90:10 in 20 min → 100:0 in 40 min, flow 1 mL/min): t_R = 2.93 min, λ = 214 nm. The crude compound was dissolved in 30 mL of a mixture of pyridine/acetic anhydride and stirred at room temperature for 2 d. The solvents were removed under reduced pressure before the residue was dissolved in dichloromethane (50 mL) and washed with water and brine (4 × 50 mL). The aqueous phase was extracted with dichloromethane (50 mL), and the combined organic layers were dried ($MgSO_4$), filtered, and concentrated in vacuo. Purification by column chromatography on silica (ethyl acetate/ethanol, 10:1) provided the desired compound **1**. Final purification was accomplished by preparative reversed-phase HPLC [R_t = 21.8 min, Jupiter, MeCN/H_2O + 0.1 % TFA (50:50) → (90:10) 20 min, → (100:0) in 40 min] to yield **1** as a colorless, amorphous solid after lyophilization (63 mg, 0.024 mmol, 89 % over 2 steps based on **17**). R_f = 0.63 (ethyl acetate/ethanol, 10:1). HPLC (Luna, MeCN/H_2O, 50:50 → 90:10 in 20 min → 100:0 in 40 min, flow 1 mL/min): t_R = 15.7 min, λ = 214 nm. $[\alpha]_D^{20}$ = +20.0 (*c* = 0.10, $CHCl_3$). ^{1}H NMR (800 MHz, $CDCl_3$, TOCSY, NOESY, HSQC): δ = 7.77 (d, $J_{H4,H3}$ = $J_{H5,H6}$ = 7.9 Hz, 2 H, H4-, H5-Fmoc), 7.60 (d, $J_{H1,H2}$ = $J_{H8,H7}$ = 7.5 Hz, 2 H, H1-, H8-Fmoc), 7.45–7.26 (m, 24 H, H_{Ar}-Bn, H2-, H3-, H6-, H7-Fmoc), 6.68 (d, $J_{NH,H2}$ = 9.1 Hz, 1 H, NH-GalN), 5.81 (d, $J_{NH,T\alpha}$ = 9.7 Hz, 1 H, NH-Fmoc), 5.61 (td, $J_{H8,H7}$ = $J_{H8,H9b}$ = 7.5 Hz, $J_{H8,H9a}$ = 2.8 Hz, 1 H, H8-Sia′), 5.53 (td, $J_{H8,H7}$ = $J_{H8,H9b}$ = 7.6 Hz, $J_{H8,H9a}$ = 2.7 Hz, 1 H, H8-Sia), 5.45 (d, $J_{CH,CH}$ = 12.2 Hz, 2 H, CH_2-Bn), 5.31–5.23 (m, 2 H, H4-GalN {5.25}, H7-Sia {5.24}), 5.24 (dd, $J_{H7,H8}$ = 8.3 Hz, $J_{H7,H6}$ = 2.6 Hz, 1 H, H7-Sia′), 5.14 (d, $J_{H4,H3}$ = 3.2 Hz, 1 H, H4-Gal), 5.09–5.04 (m, 4 H, NH-Sia, NH-Sia′ {5.09, 5.08, d, $J_{NH,H5}$ = 9.7 Hz}, CH_2-Bn {5.06, d, $J_{CH,CH}$ =

12.1 Hz}), 5.01–4.97 (m, 2 H, H4-Gal′ {5.00}, H2-Gal′ {4.99}), 4.93–4.90 (m, 2 H, H2-Gal {4.92}, H1-GalN {4.91, d, $J_{H1,H2}$ = 3.5 Hz}), 4.84 (td, $J_{H4,H3ax}$ = $J_{H4,H5}$ = 11.1 Hz, $J_{H4,H3eq}$ = 4.7 Hz, 2 H, H4-Sia, H4-Sia′), 4.81–4.75 (m, 2 H, H1-Gal {4.80}, H1-GlcN {4.76, d, $J_{H1,H2}$ = 7.7 Hz }), 4.65–4.60 (m, 2 H, CH_2-Bn {4.64}, H1-Gal′ {4.62, d, $J_{H1,H2}$ = 7.9 Hz}), 4.57–4.45 (m, 6 H, CH_2-Bn {4.59}, H3-Gal {4.58}, H2-GalN {4.54}, CH_2-Bn {4.52}, H3-Gal′ {4.51}, CH_2-Fmoc {4.49}), 4.44–4.38 (m, 4 H, H6a-Gal′ {4.43}, CH_2-Bn {4.43}, CH_2-Fmoc {4.41}, H9a-Sia′ {4.37}), 4.38–4.33 (m, 1 H, H6b-Gal′), 4.30–4.21 (m, 3 H, T^{β} {4.25}, H9-Fmoc {4.24}, T^{α} {4.24}), 4.21–4.13 (m, 2 H, H9a-Sia {4.19}, H5-GalN {4.18}), 4.06–3.95 (m, 4 H, H5-Sia, H5-Sia′ {4.03}, H9b-Sia {3.99}, H3-GlcN {3.97}), 3.92 (dd, $J_{H3,H2}$ = 11.1 Hz, $J_{H3,H4}$ = 3.2 Hz, 1 H, H3-GalN), 3.91–3.83 (m, 4 H, H4-GlcN {3.91}, H9b-Sia′ {3.86}, H2-GlcN {3.84}, H5-Gal′ {3.84}), 3.80–3.59 (m, 6 H, H6a-GlcN {3.80}, H5-Gal {3.79}, H6b-GlcN {3.71}, H6a-GalN {3.67}, H6b-GalN {3.61}, H5-GlcN {3.60}), 3.50 (dd, $J_{H6,H5}$ = 10.6 Hz, $J_{H6,H7}$ = 2.7 Hz, 2 H, H6-Sia, H6-Sia′), 3.47 (dd, $J_{H6a,H6b}$ = 10.7 Hz, $J_{H6a,H5}$ = 2.7 Hz, 1 H, H6a-Gal), 3.38–3.35 (m, 1 H, H6b-Gal), 2.60 (dd, $J_{H3eq,H3ax}$ = 12.6 Hz, $J_{H3eq,H4}$ = 4.6 Hz, 2 H, $H3_{eq}$-Sia, $H3_{eq}$-Sia′), 2.27, 2.19, 2.13, 2.10, 2.07, 2.05, 1.98 (7 × s, 42 H, CH_3-OAc), 2.13 (s, 6 H, CH_3-NHAc-GalN, -GlcN), 1.83 (s, 6 H, CH_3-NHAc-Sia, -Sia′), 1.65 (t, $J_{H3ax,H3eq}$ = $J_{H3ax,H4}$ = 12.1 Hz, 2 H, $H3_{ax}$-Sia, $H3_{ax}$-Sia′), 1.45 (s, 9 H, CH_3-*t*Bu), 1.33 (d, $J_{T\gamma,T\beta}$ = 6.3 Hz, 3 H, T^{γ}) ppm. ^{13}C NMR (200 MHz, $CDCl_3$, HSQC, HMBC): δ = 171.7, 171.4, 170.9, 170.9, 170.8, 170.7, 170.5, 170.4, 170.1, 170.0, 169.9 (19 × C=O-NHAc, -OAc, -ester), 167.5 (C1-Sia, C1-Sia′), 156.8 (C=O-urethane), 143.9, 143.7 (C1a-, C8a-Fmoc), 141.5, 141.4 (C4a-, C5a-Fmoc), 138.2, 137.7 (4 × C_q-Bn), 134.7, 129.1, 128.9, 128.8, 128.0, 127.9, 127.2, 127.2 (20 × C_{Ar}, C2-, C3-, C6-, C7-Fmoc), 125.2, 125.1 (C1-, C8-Fmoc), 120.2, 120.2 (C4-, C5-Fmoc), 101.1 (C1-Gal′), 100.7 (C1-GlcN), 100.1 (C1-Gal), 99.8 (C1-GalN), 96.9 (C2-Sia, C2-Sia′), 83.3 (C_q-*t*Bu), 81.3 (d, $J_{F,C6}$ = 172.1 Hz, C6-Gal′), 76.5 (T^{β}), 73.7 (C3-GlcN), 73.6 (C3-GalN), 73.6 (C4-GlcN), 73.5, 73.4 (CH_2-Bn), 72.4 (C5-GlcN), 72.3 (C6-Sia, C6-Sia′), 71.8 (d, $J_{F,C5}$ = 23.1 Hz, C5-Gal′), 71.8 (C3-Gal), 71.7 (C5-Gal), 71.4 (C3-Gal′), 70.8 (C2-Gal), 70.5 (C6-GalN), 69.9 (C4-GalN), 69.2 (C4-Sia, C4-Sia′), 69.0 (C2-Gal′), 69.0 (C4-Gal′), 68.7, 68.7 (CH_2-Bn), 68.7 (C6-GlcN), 68.1 (C5-GalN), 68.0 (C8-Sia, C8-Sia′), 67.7 (C6-Gal), 67.7 (C4-Gal), 67.6 (C7-Sia, C7-Sia′), 67.5 (CH_2-Fmoc), 63.1 (C9-Sia, C9-Sia′), 59.8 (C2-GlcN), 59.2 (T^{α}), 49.0 (C5-Sia, C5-Sia′), 48.9 (C2-GalN), 47.2 (C9-Fmoc), 37.5 (C3-Sia, C3-Sia′), 28.2 (CH_3-*t*Bu), 23.2 (CH_3-NHAc-Sia, -NHAc-Sia′), 23.1 (CH_3-NHAc-GalN, -NHAc-GlcN), 21.6, 21.5, 21.1, 20.9, 20.8, 20.8, 20.8 (14 × CH_3-OAc), 19.2 (T^{γ}) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –230.3 (dt, $J_{F,H6a/b}$ = 46.8 Hz, $J_{F,H5}$ = 13.7 Hz, F6-Gal′) ppm. HR-MS (ESI^+): *m/z* calcd. for $C_{129}H_{158}FN_5Na_2O_{54}$ $[M + 2Na]^{2+}$ 1353.4787, found 1353.4779.

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[28] For the experimental procedure for the preparation of compound **20**, see the Supporting Information.

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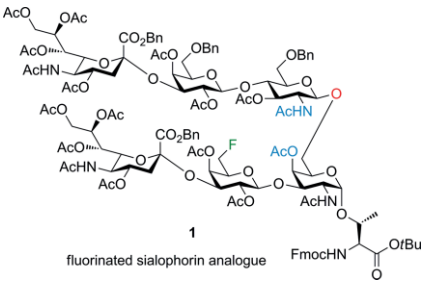
Fluorinated Hexasaccharides



1
fluorinated sialophorin analogue

A first total synthesis of a fluorinated hexasaccharide–threonine antigen mimic has been accomplished using a [3+3′]-block glycosylation strategy to access novel sialophorin-derived molecular tools for biomedical and immunological studies.

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