

Adaptable Synthesis of Chondroitin Sulfate Disaccharide Subtypes Preprogrammed for Regiospecific *O*-Sulfation

Hannah S. Wootton^a, Sian S. Berry^a, Elaine L. Ferguson^b, Clare S. Mahon^c and Gavin J. Miller^{a*}

^aCentre for Glycoscience and School of Chemical and Physical Sciences, Keele University, Keele, Staffordshire, ST5 5BG, United Kingdom.

^bAdvanced Therapies Group, School of Dentistry, College of Biomedical and Life Sciences, Cardiff University, Heath Park, Cardiff, UK

^cDepartment of Chemistry, Durham University, South Road, Durham, United Kingdom.

*Email: g.j.miller@keele.ac.uk

Supporting Information 2

Spectra

Table of Contents

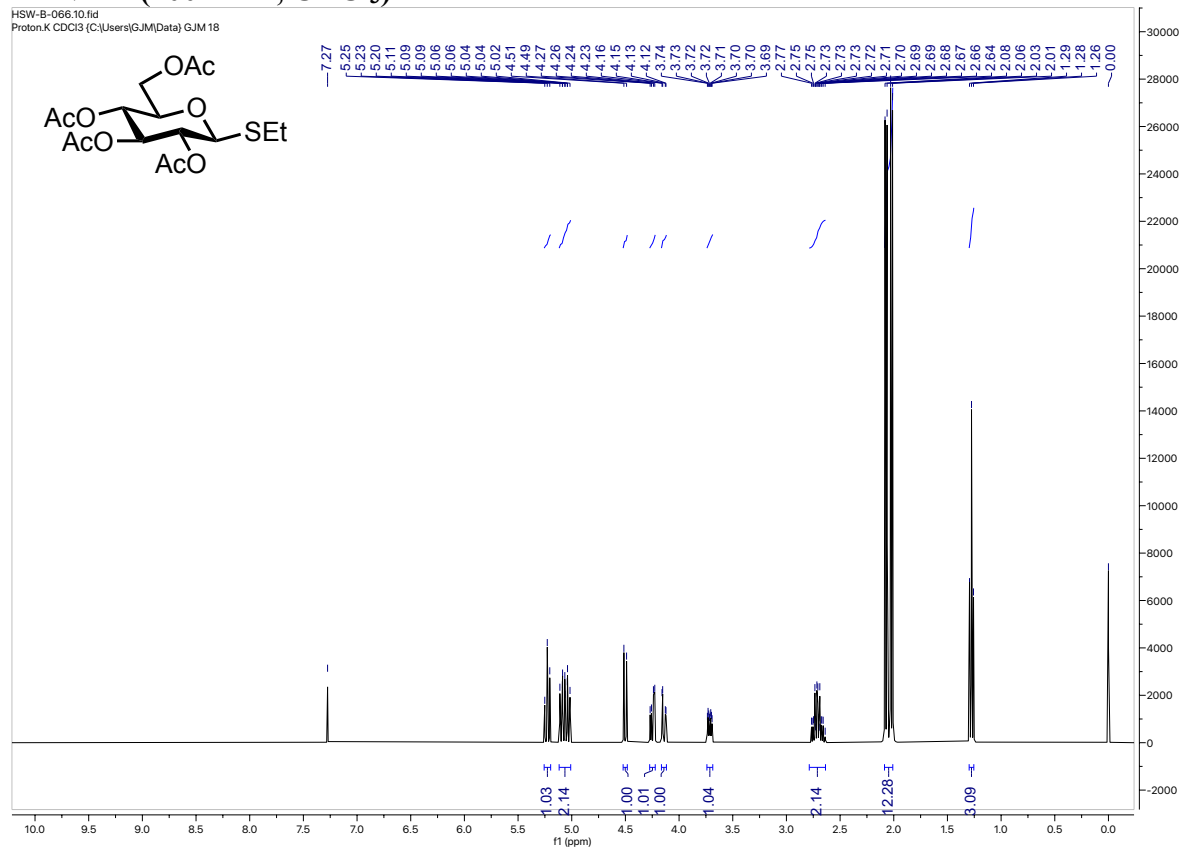
Synthesis of Thioglycoside Donors.....	S3
Compound S1.....	S3
Compound S2.....	S5
Compound S3.....	S7
Compound 3.....	S10
Compound S4.....	S12
Compound 4.....	S15
Compound 5.....	S17
Compound 6.....	S19
Compound 7.....	S22
Compound 8.....	S23
Compound 9.....	S25
Compound 10.....	S27
Galactosamine Acceptor Synthesis.....	S29
Compound S6.....	S29
Compound 12.....	S30
Compound 13.....	S31
Compound 14.....	S33

Compound 15.....	S34
Compound 16.....	S36
Compound 17.....	S37
Compound 18.....	S39
CS Precursor Disaccharide Synthesis.....	S40
Compound 19.....	S40
Compound 20.....	S43
Compound 21.....	S45
Compound 22.....	S47
Compound 23.....	S49
Access to CS Precursor Disaccharide Library.....	S51
Compound S7.....	S51
Compound S8.....	S53
Compound 24.....	S55
Compound 25.....	S57
Compound 26.....	S59
Compound 27.....	S61
Compound 28.....	S64
Compound S9.....	S66
Compound 29.....	S68

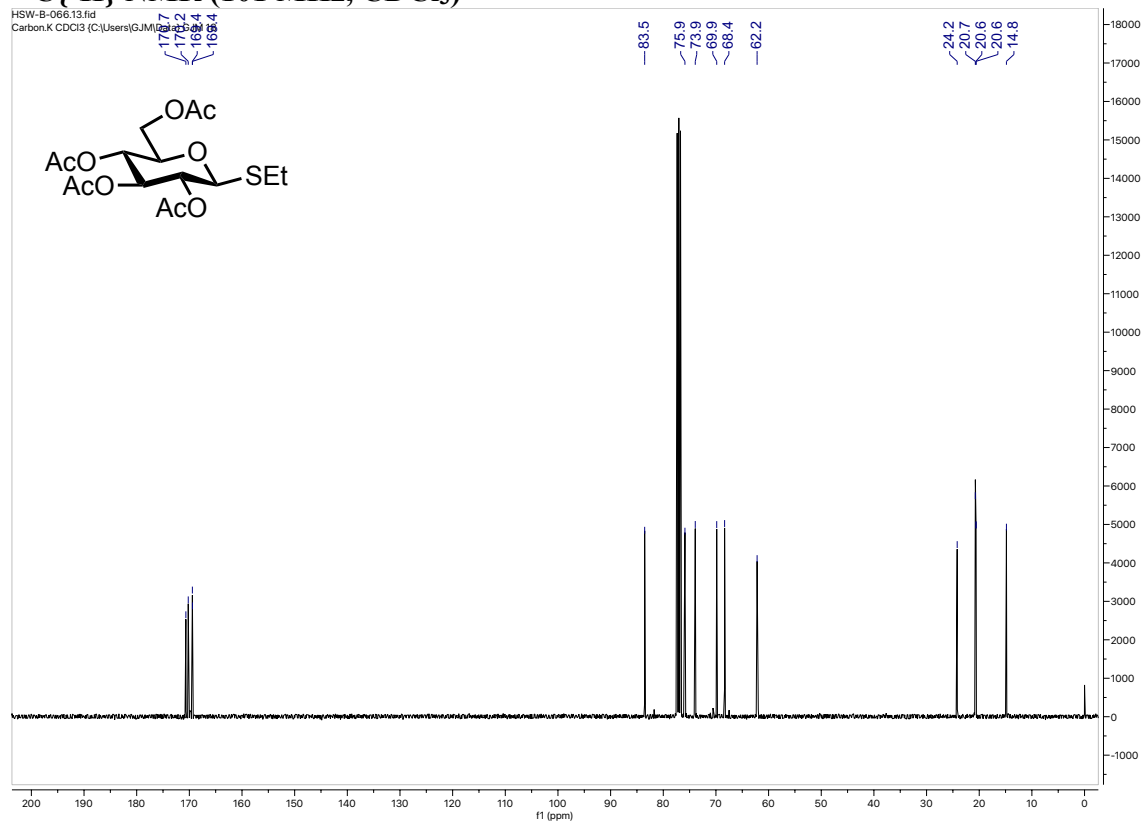
Synthesis of Thioglycoside Donors

Compound S1

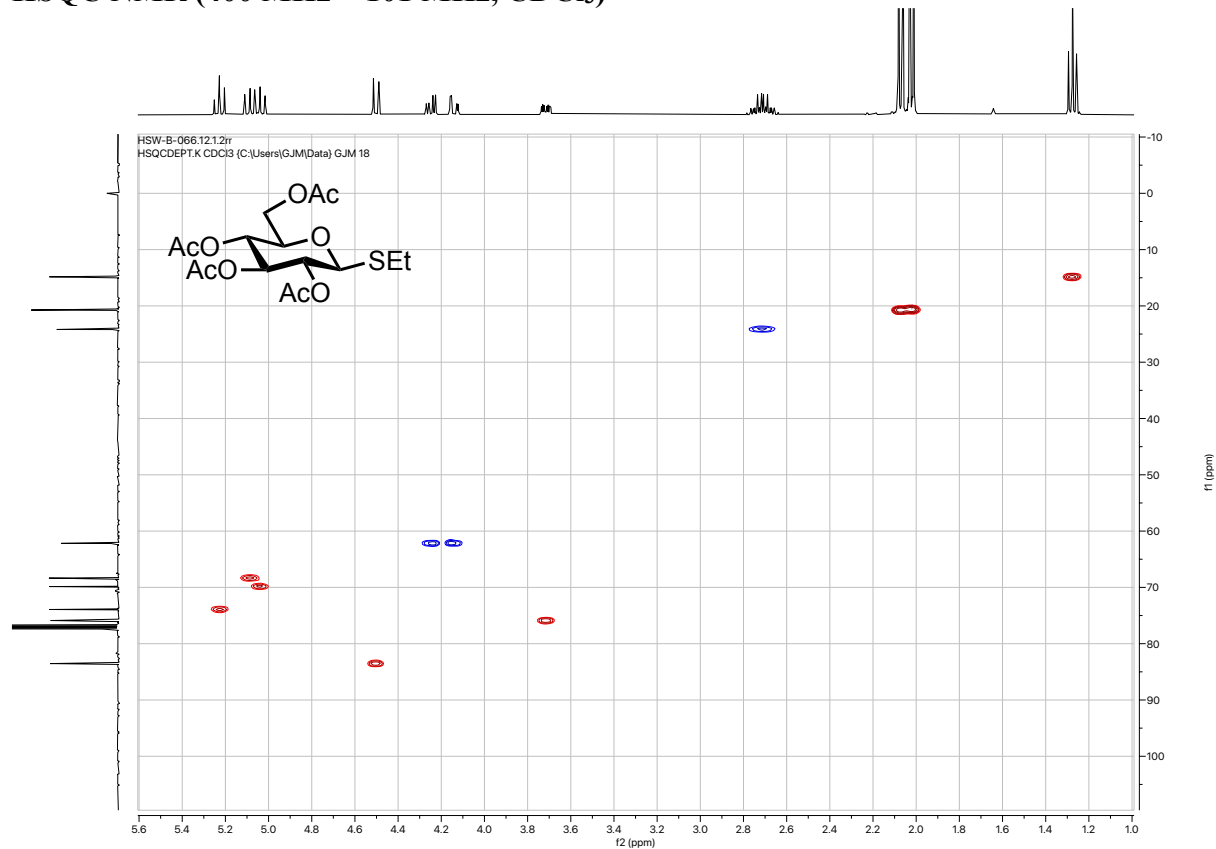
^1H NMR (400 MHz, CDCl_3)



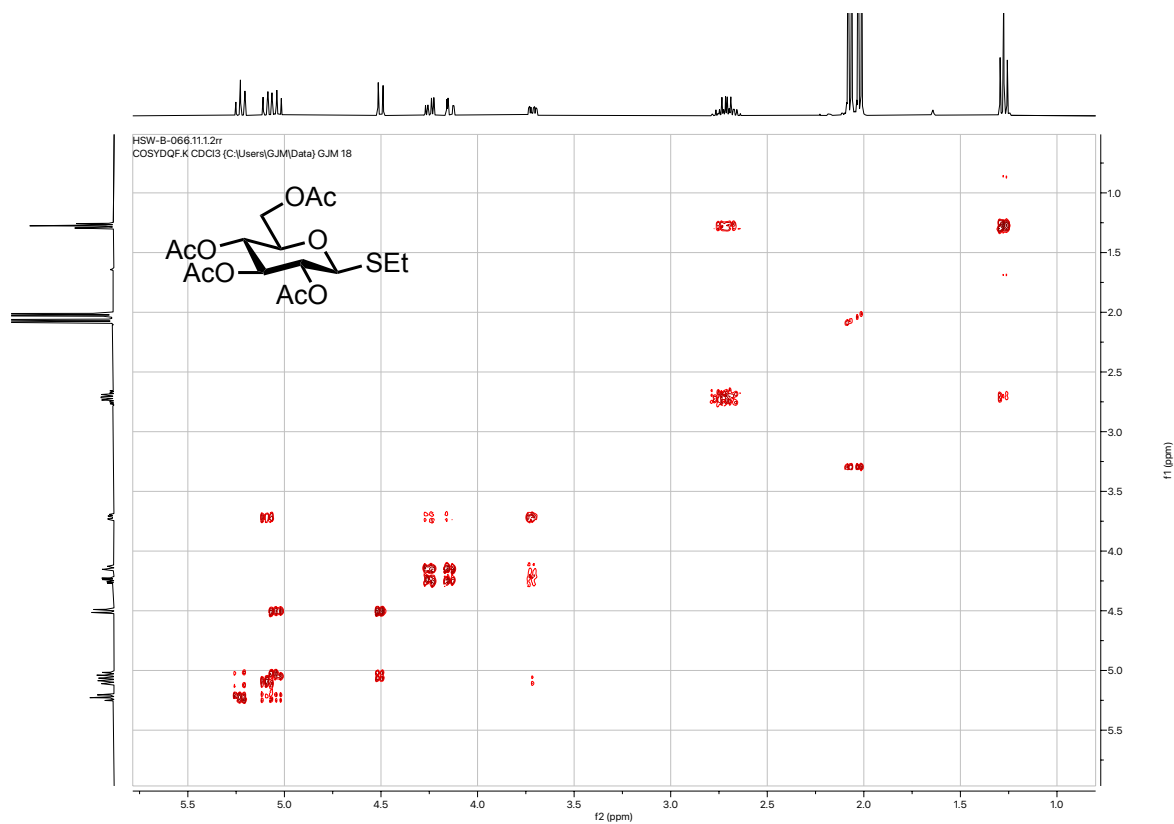
$^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, CDCl_3)



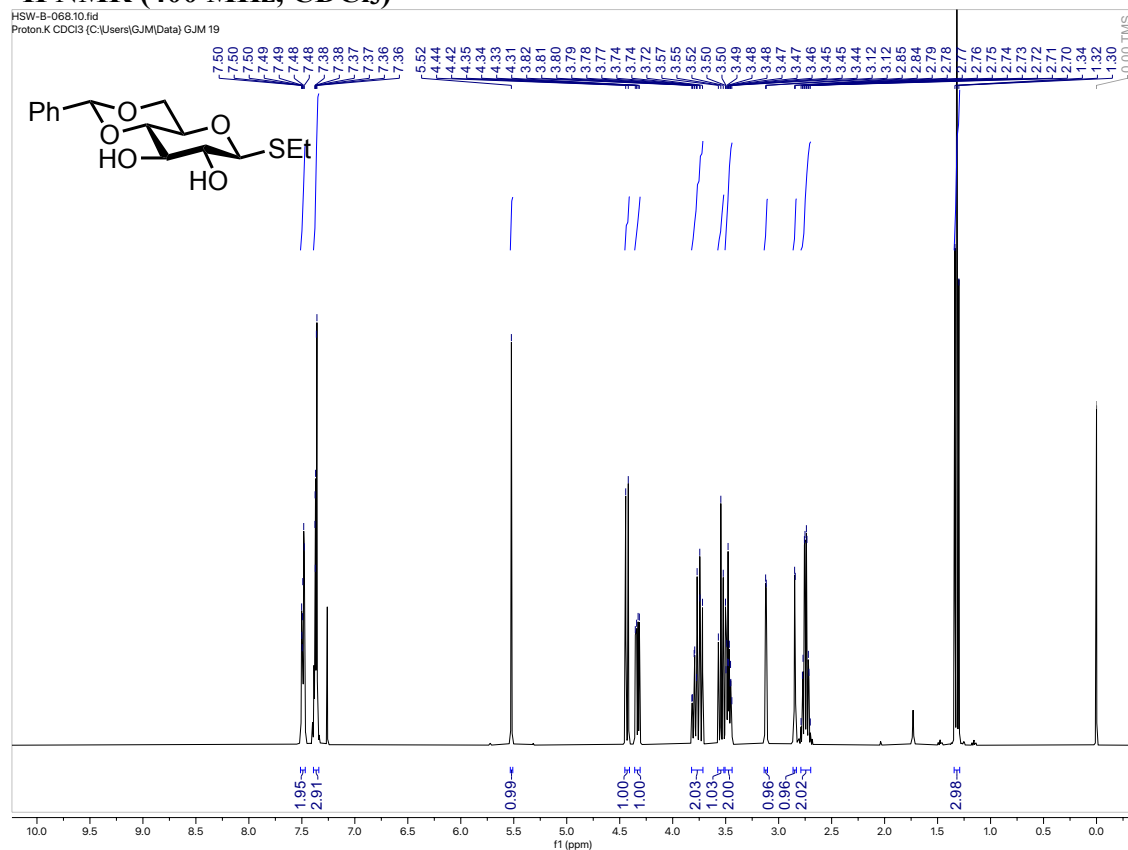
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



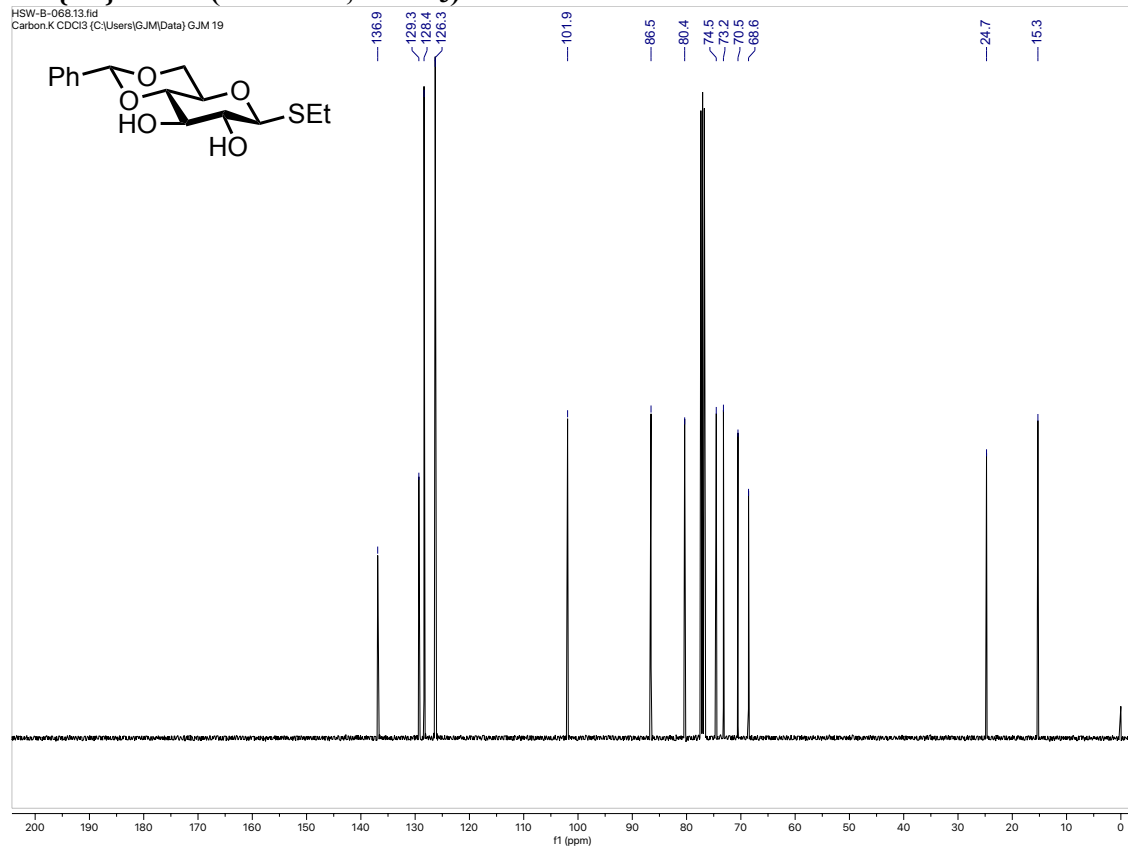
COSY NMR (400 MHz, CDCl₃)



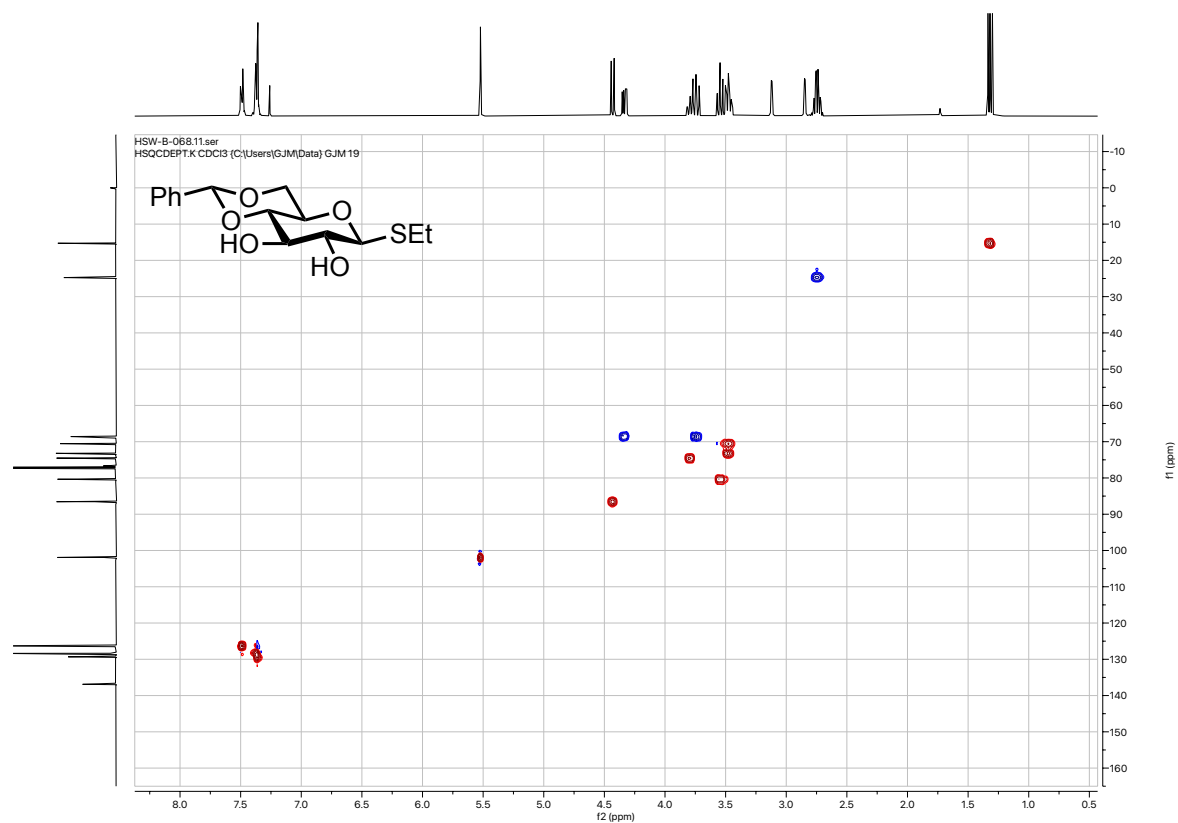
Compound S2
¹H NMR (400 MHz, CDCl₃)



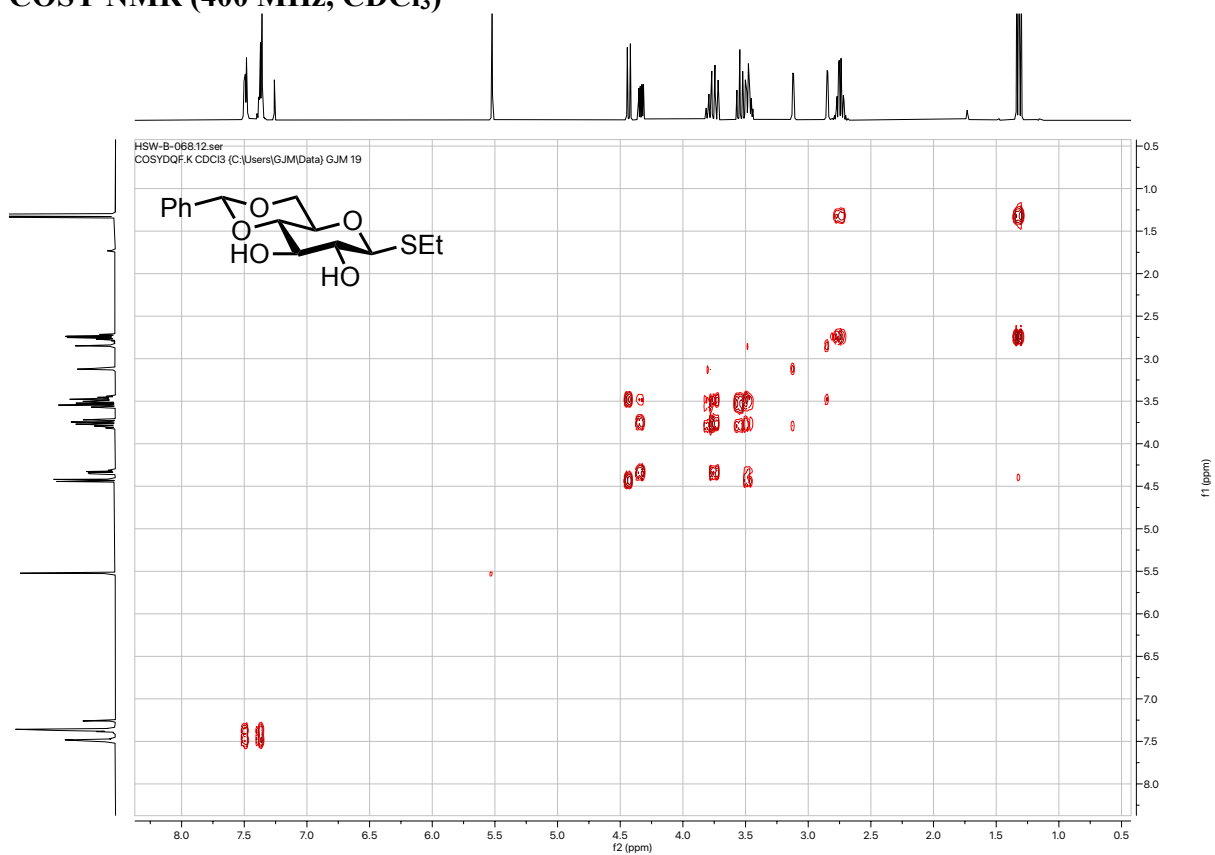
¹³C{¹H} NMR (101 MHz, CDCl₃)



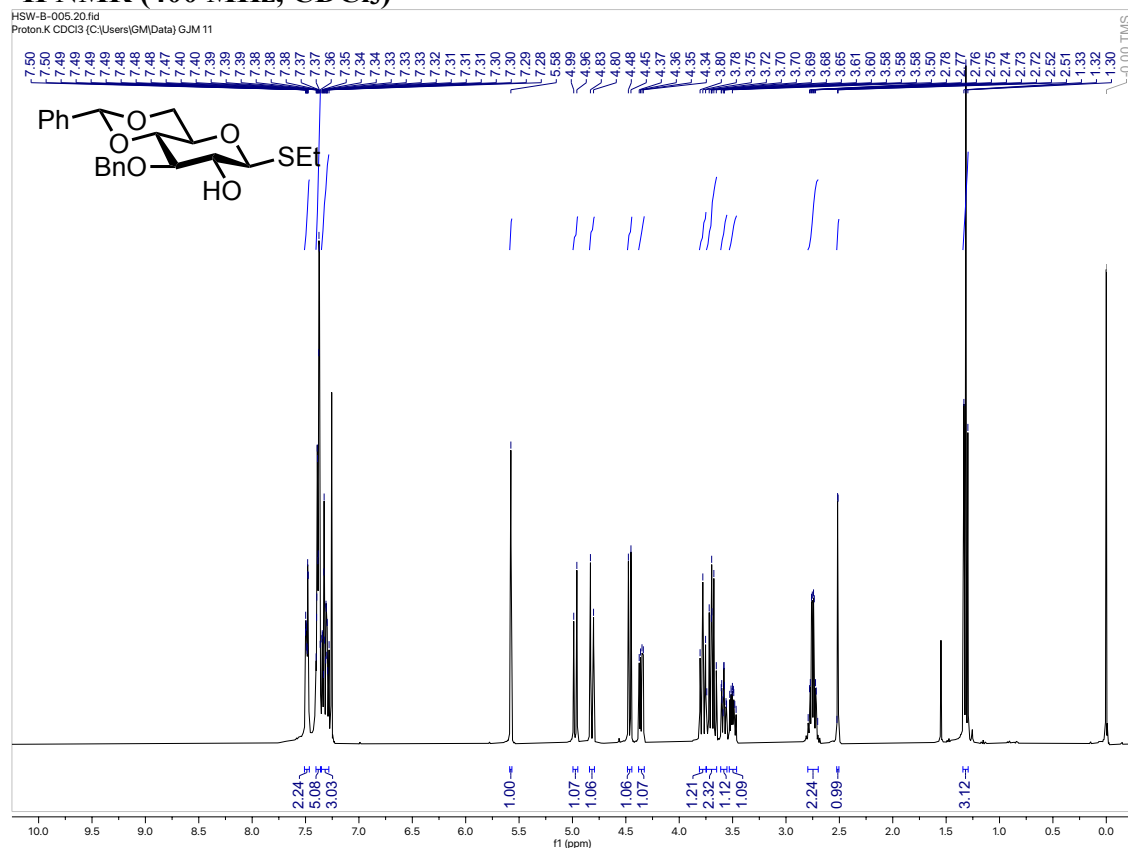
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



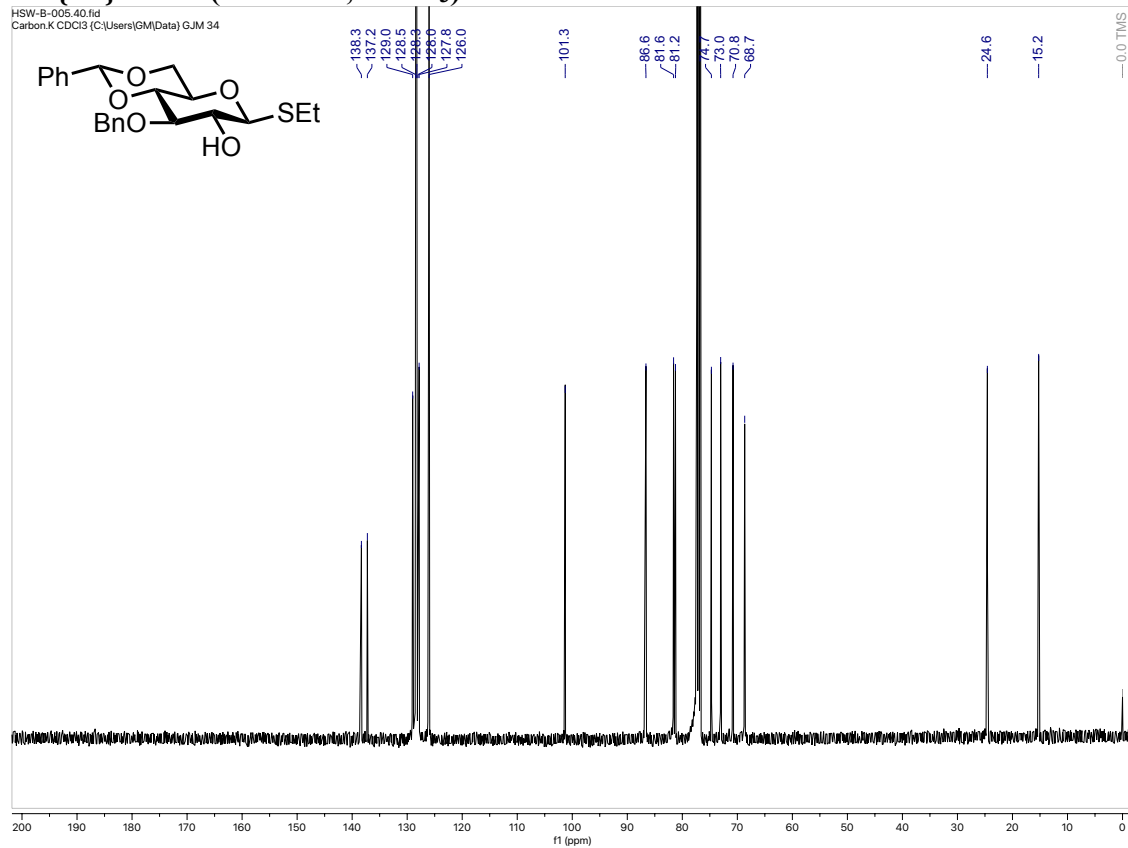
COSY NMR (400 MHz, CDCl₃)



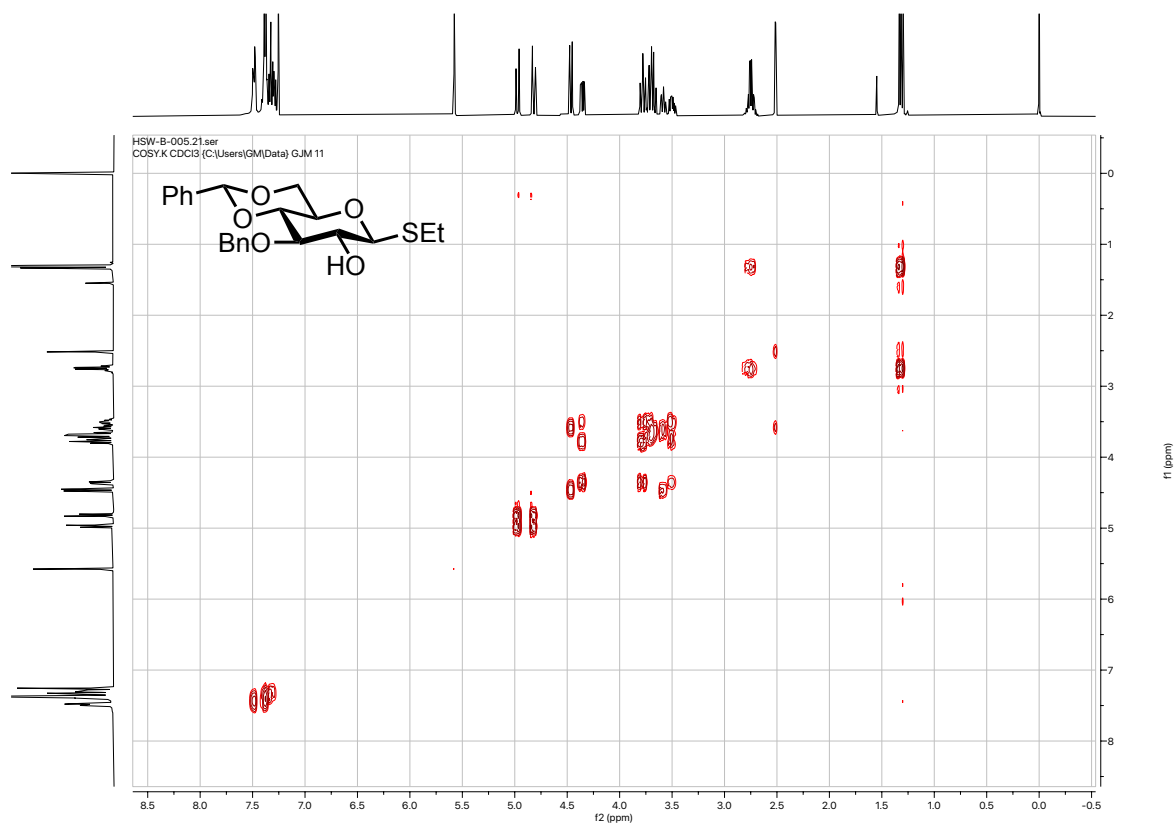
Compound S3
¹H NMR (400 MHz, CDCl₃)



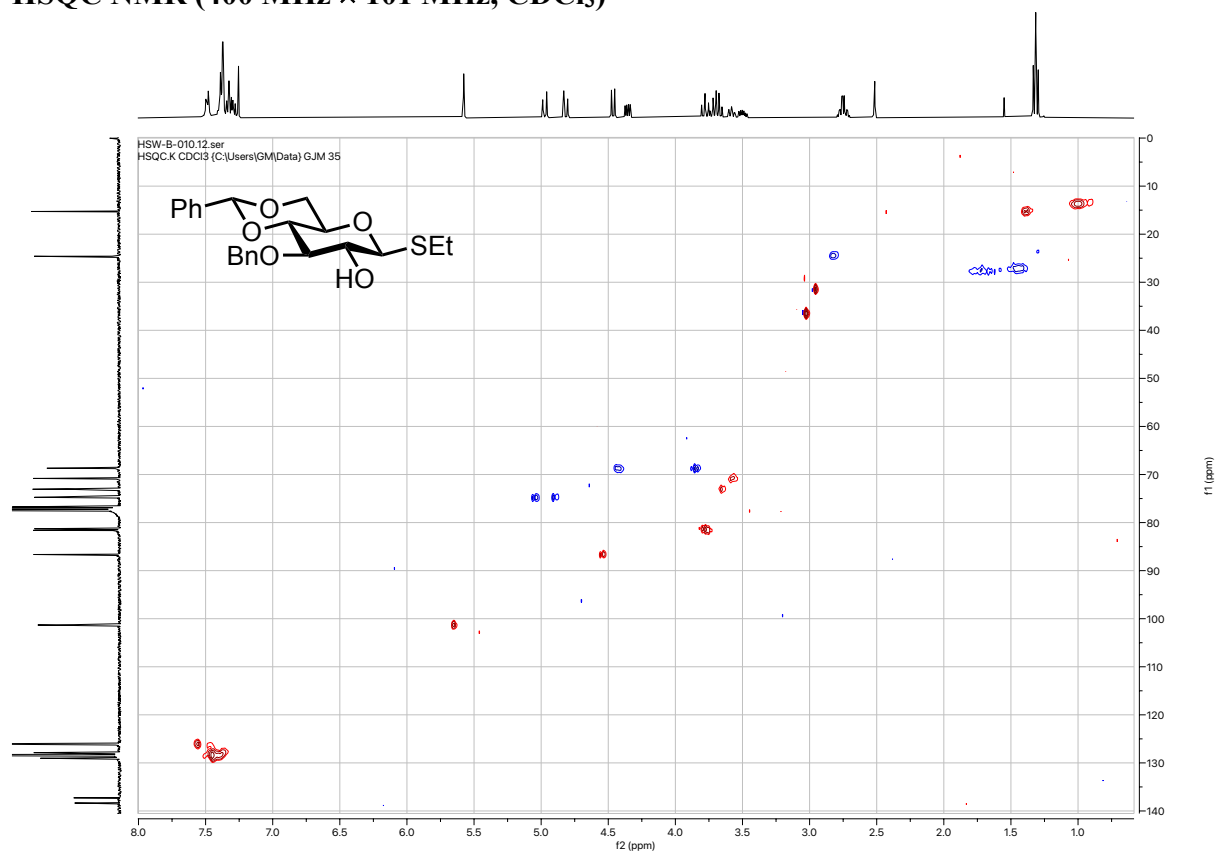
¹³C{¹H} NMR (101 MHz, CDCl₃)



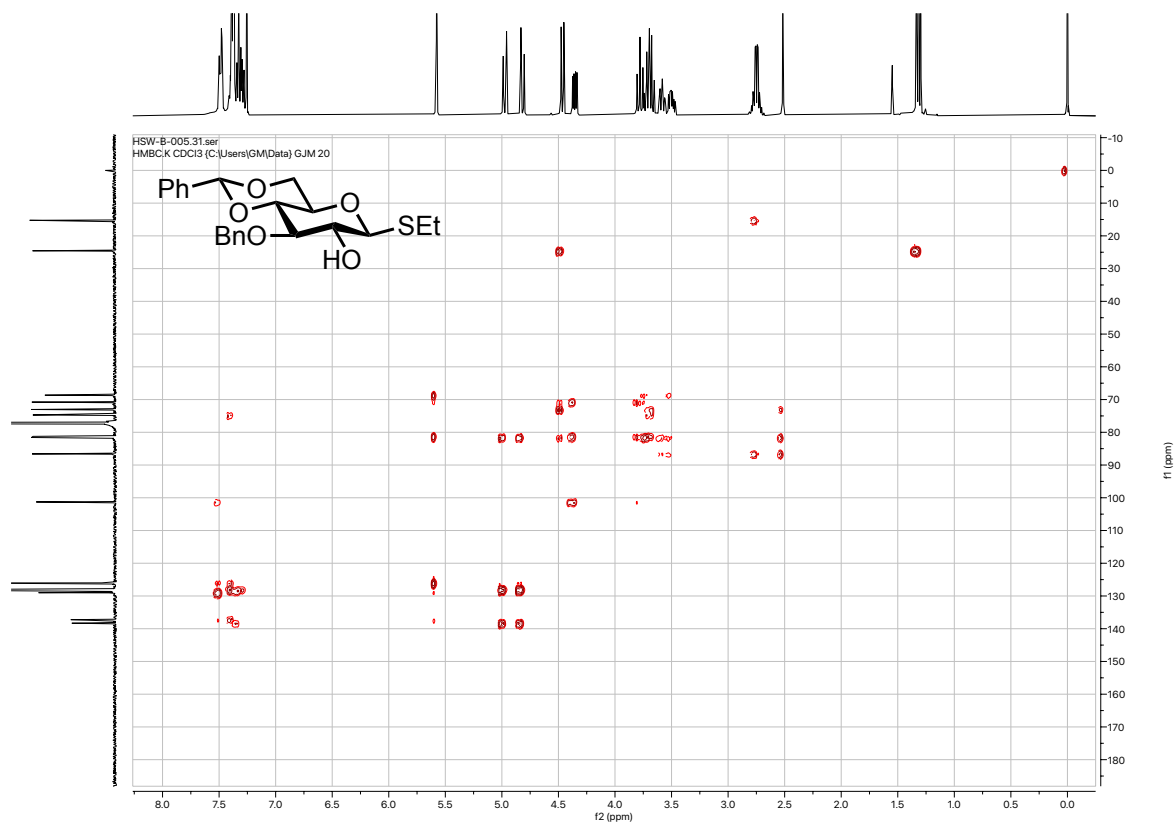
COSY NMR (400 MHz, CDCl₃)



HSQC NMR (400 MHz × 101 MHz, CDCl₃)

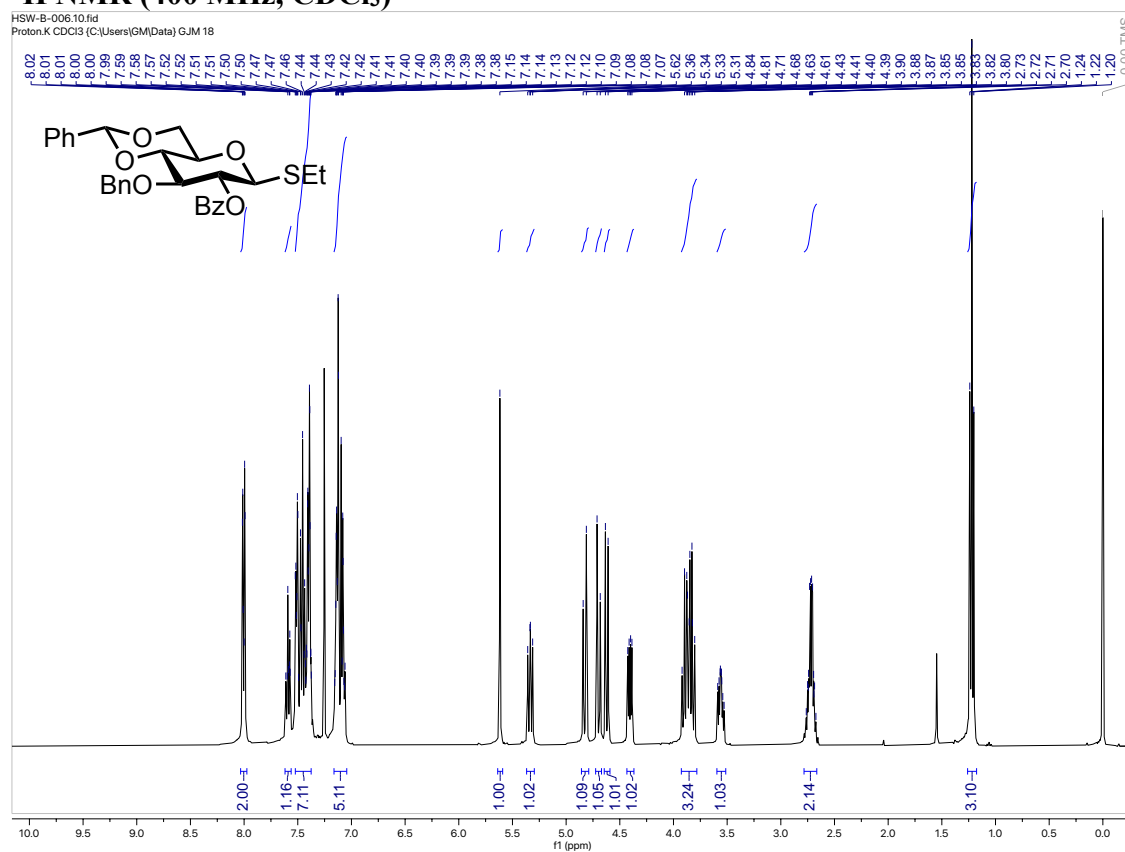


HMBC NMR (400 MHz × 101 MHz, CDCl₃)

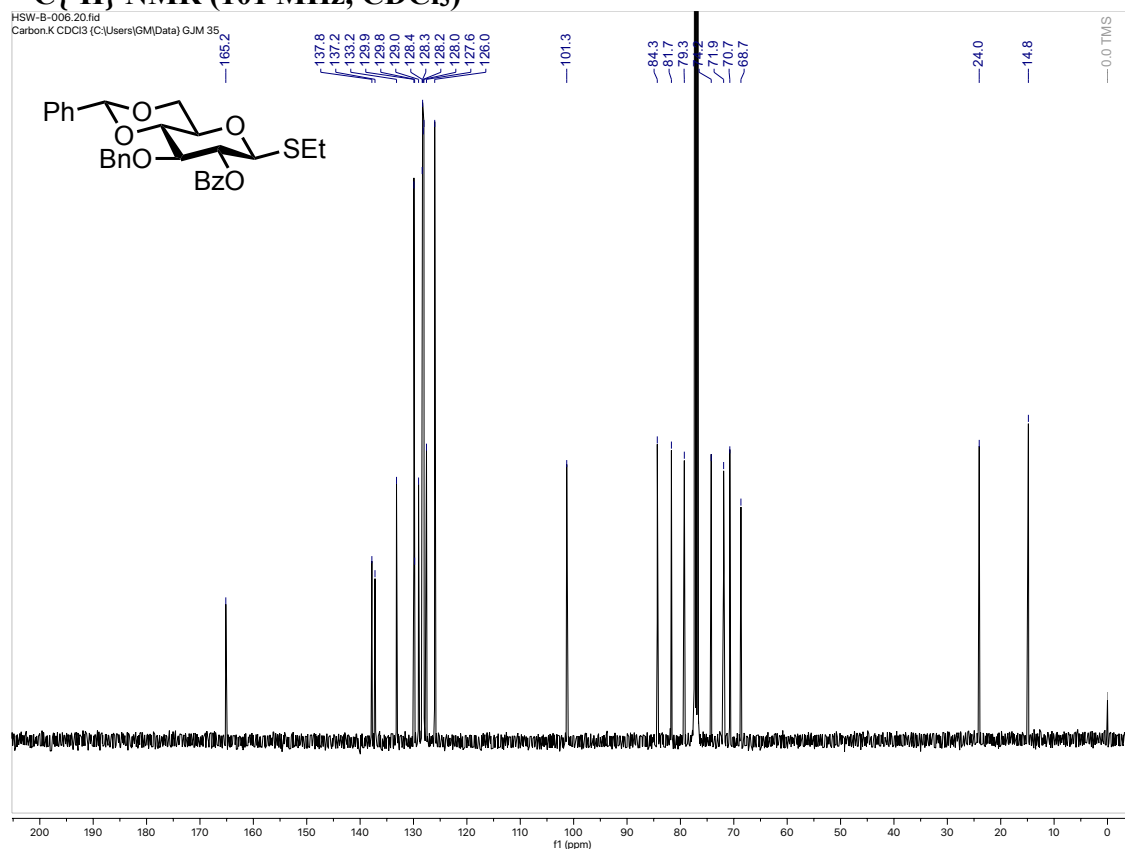


Compound 3

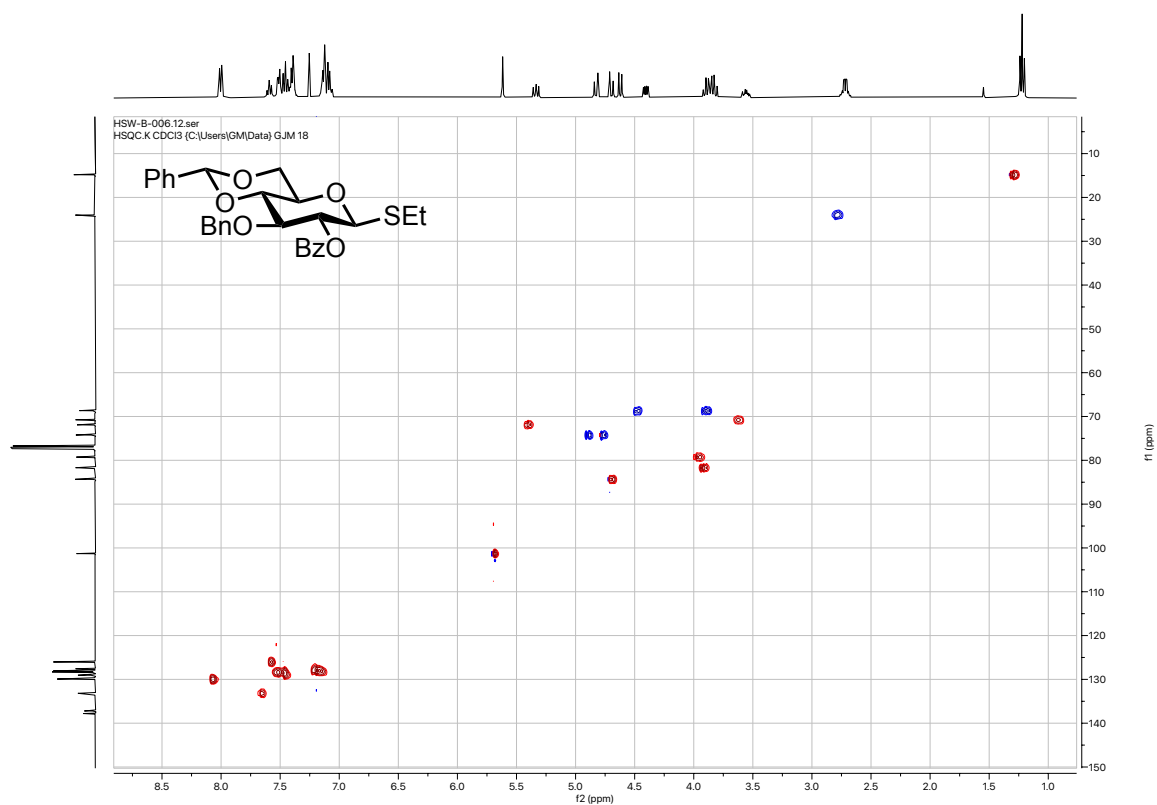
¹H NMR (400 MHz, CDCl₃)



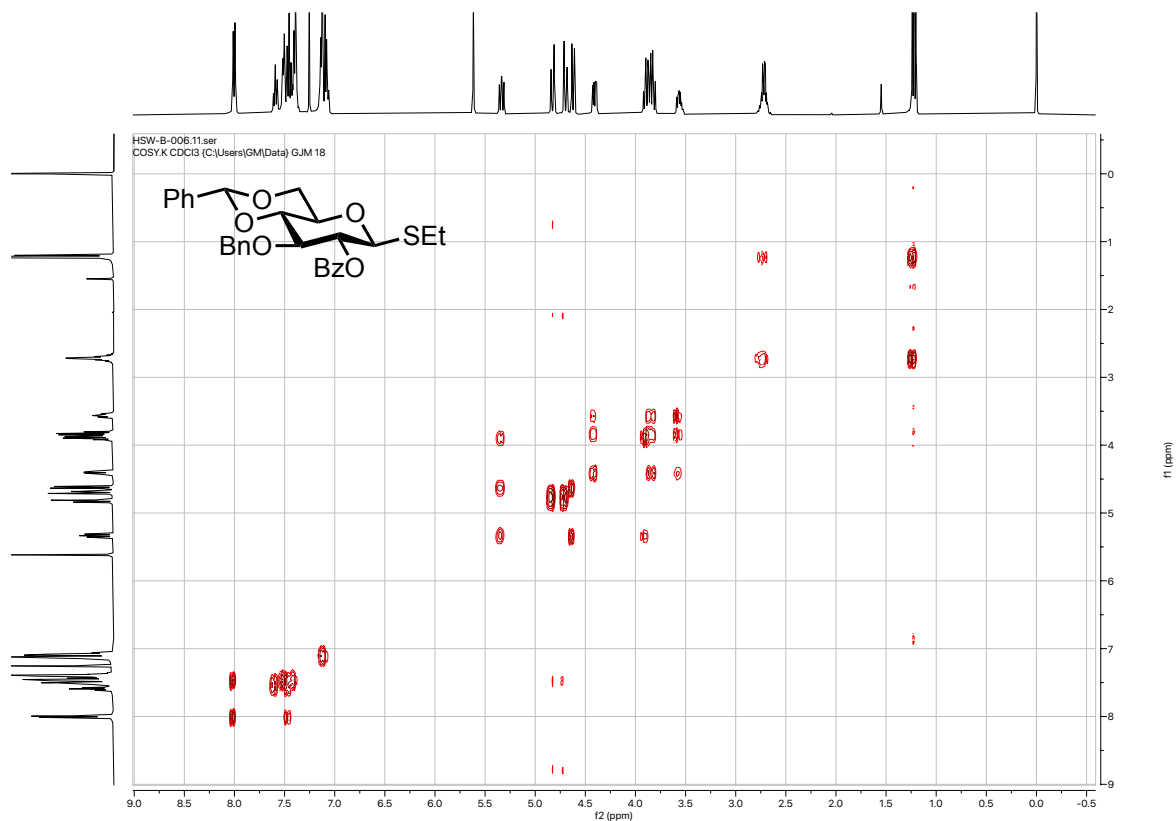
¹³C{¹H} NMR (101 MHz, CDCl₃)



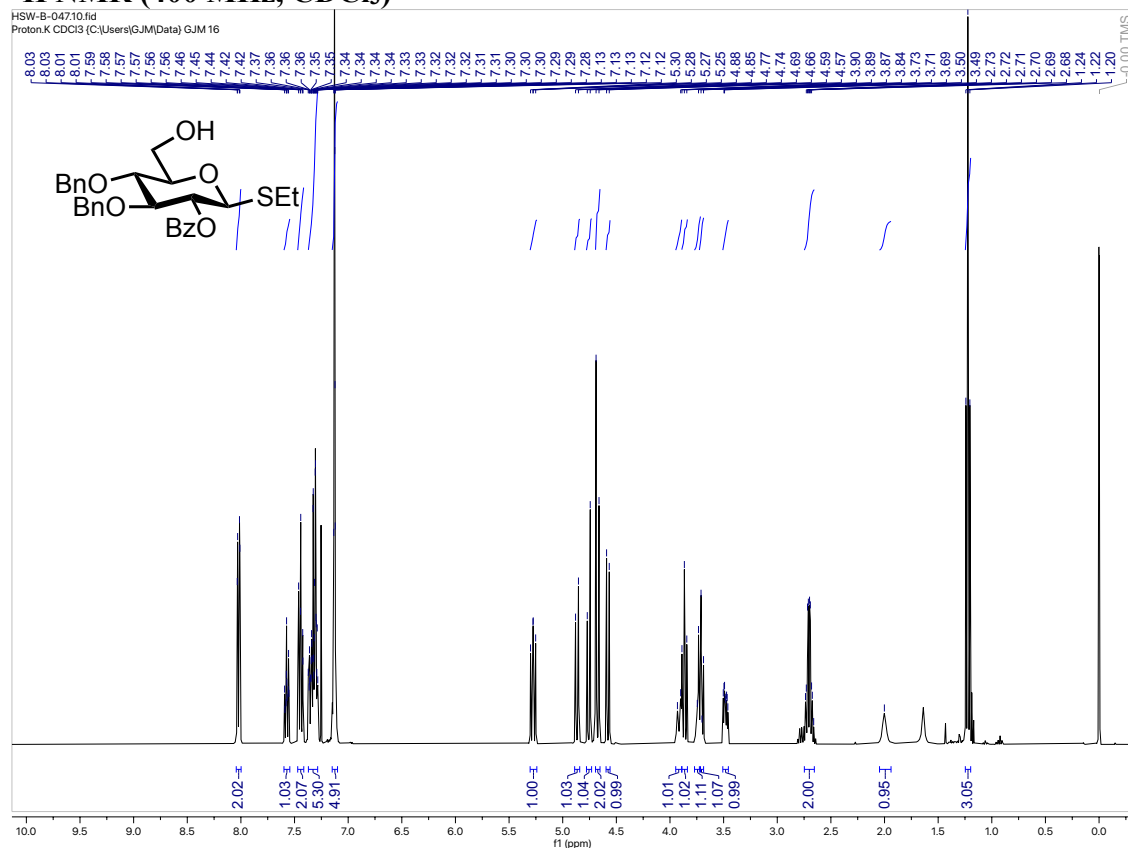
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



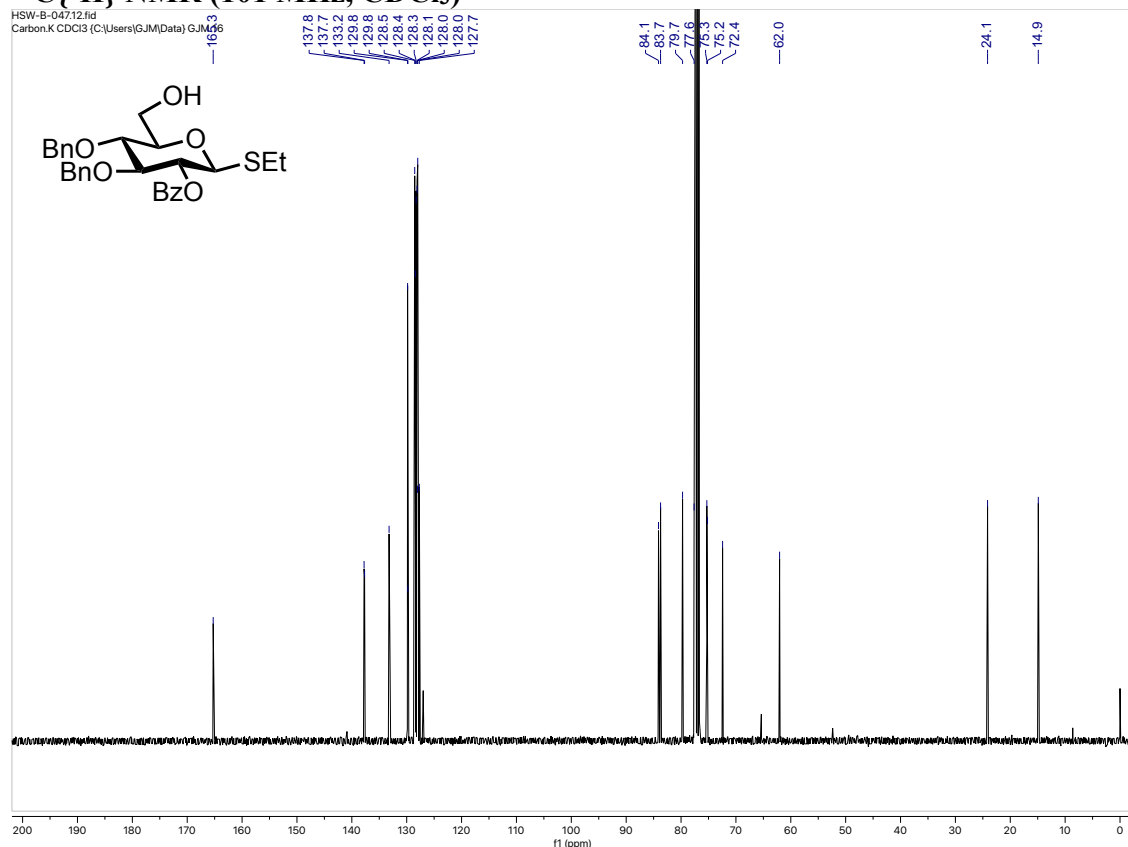
COSY NMR (400 MHz, CDCl₃)



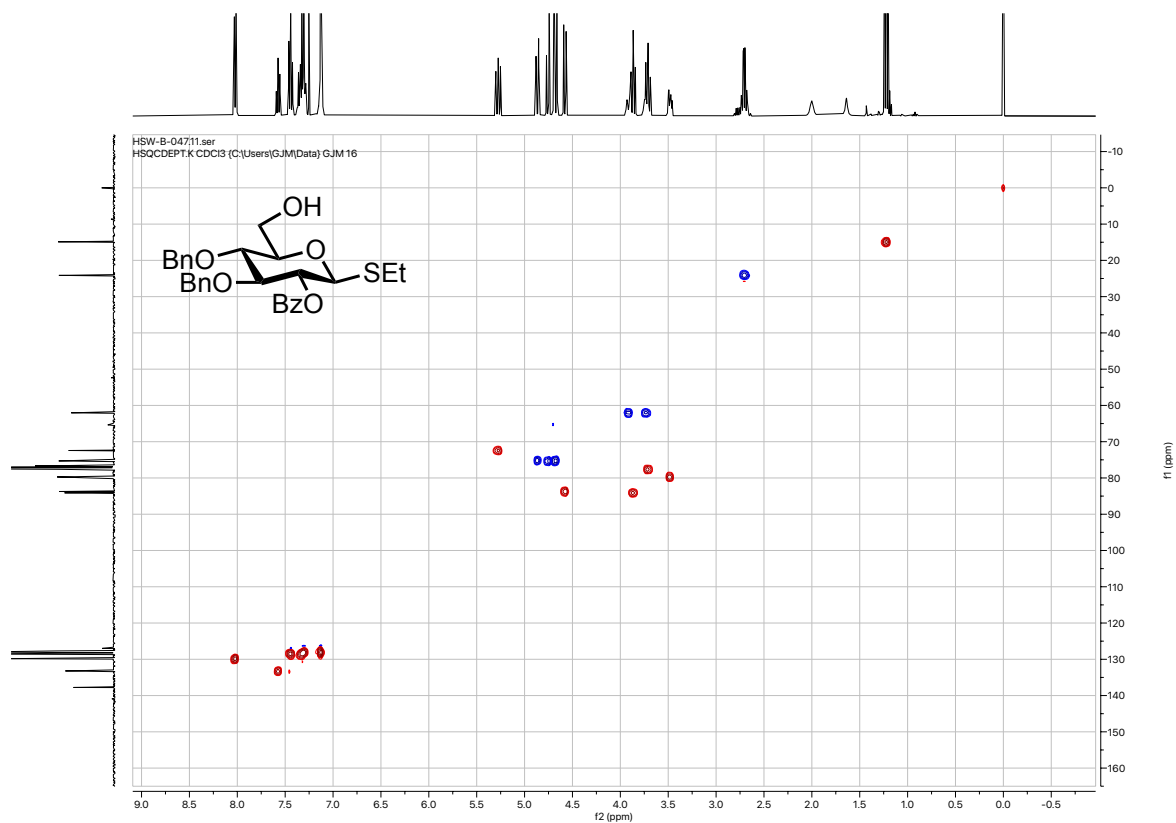
Compound S4
¹H NMR (400 MHz, CDCl₃)



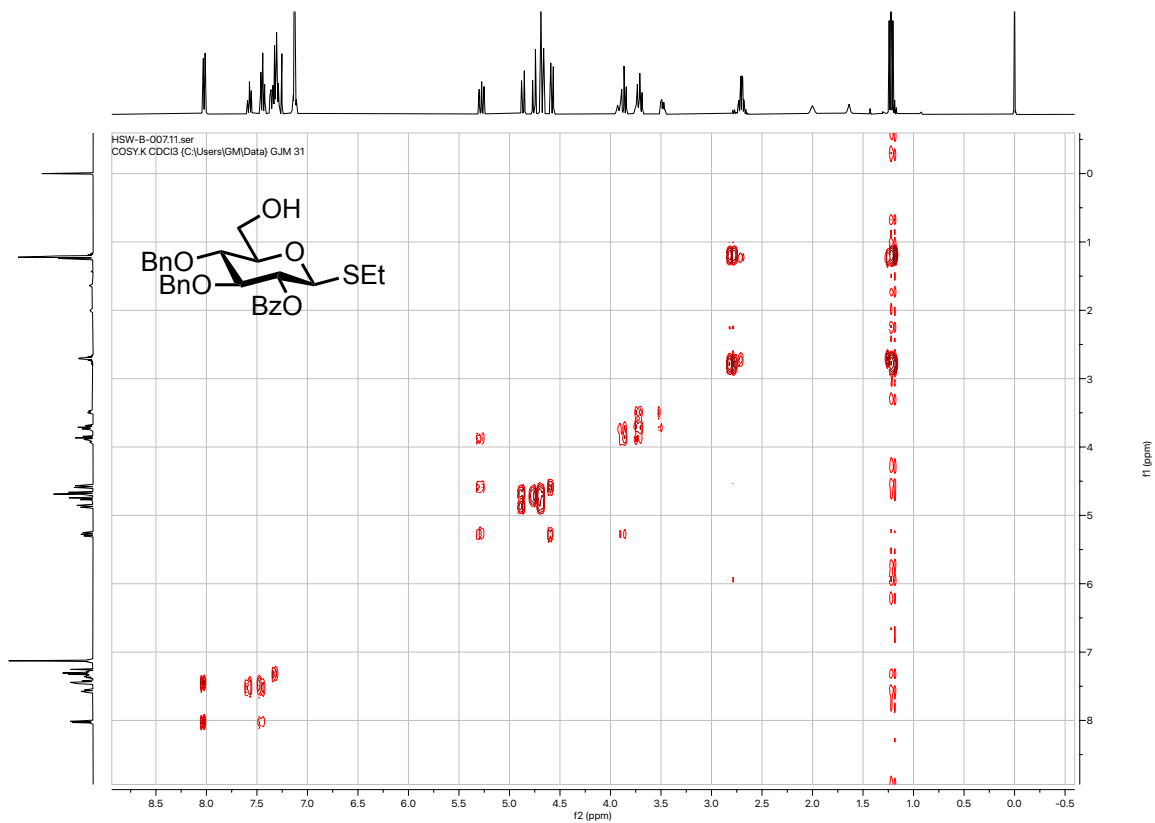
¹³C{¹H} NMR (101 MHz, CDCl₃)



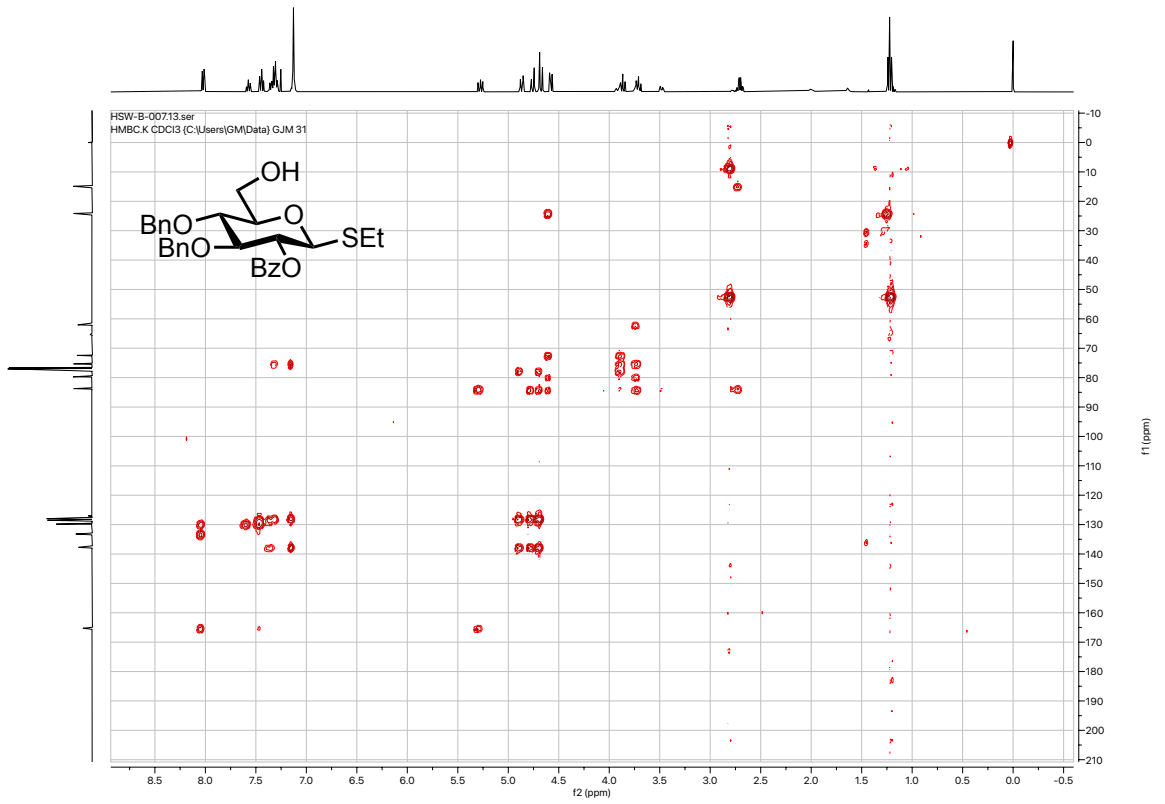
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



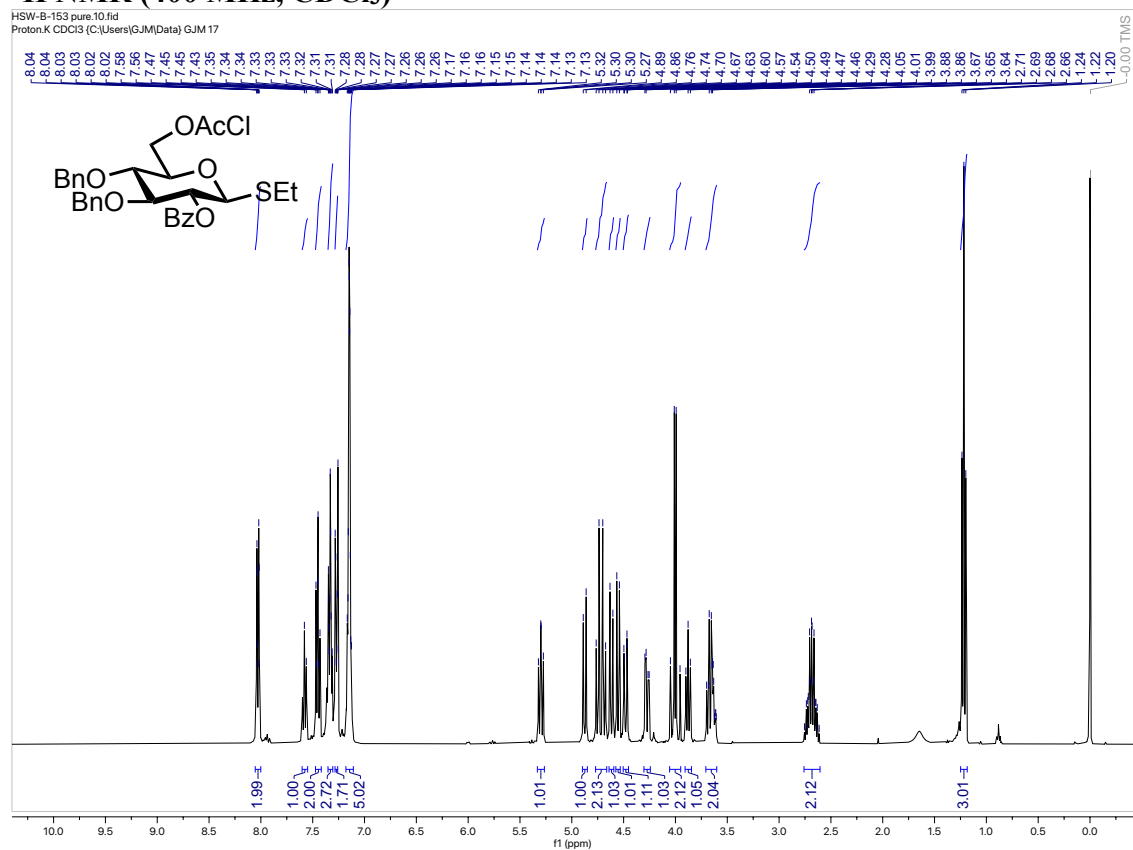
COSY NMR (400 MHz, CDCl₃)



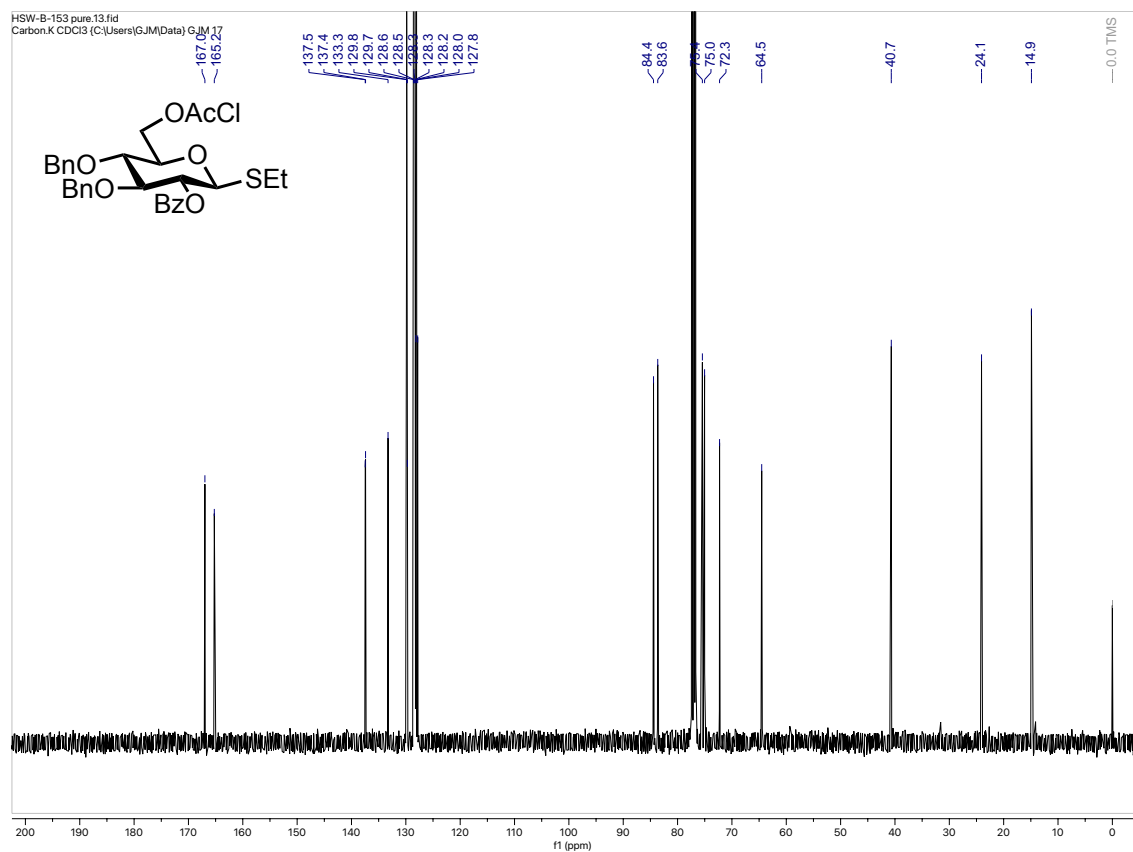
HMBC NMR (400 MHz × 101 MHz, CDCl₃)



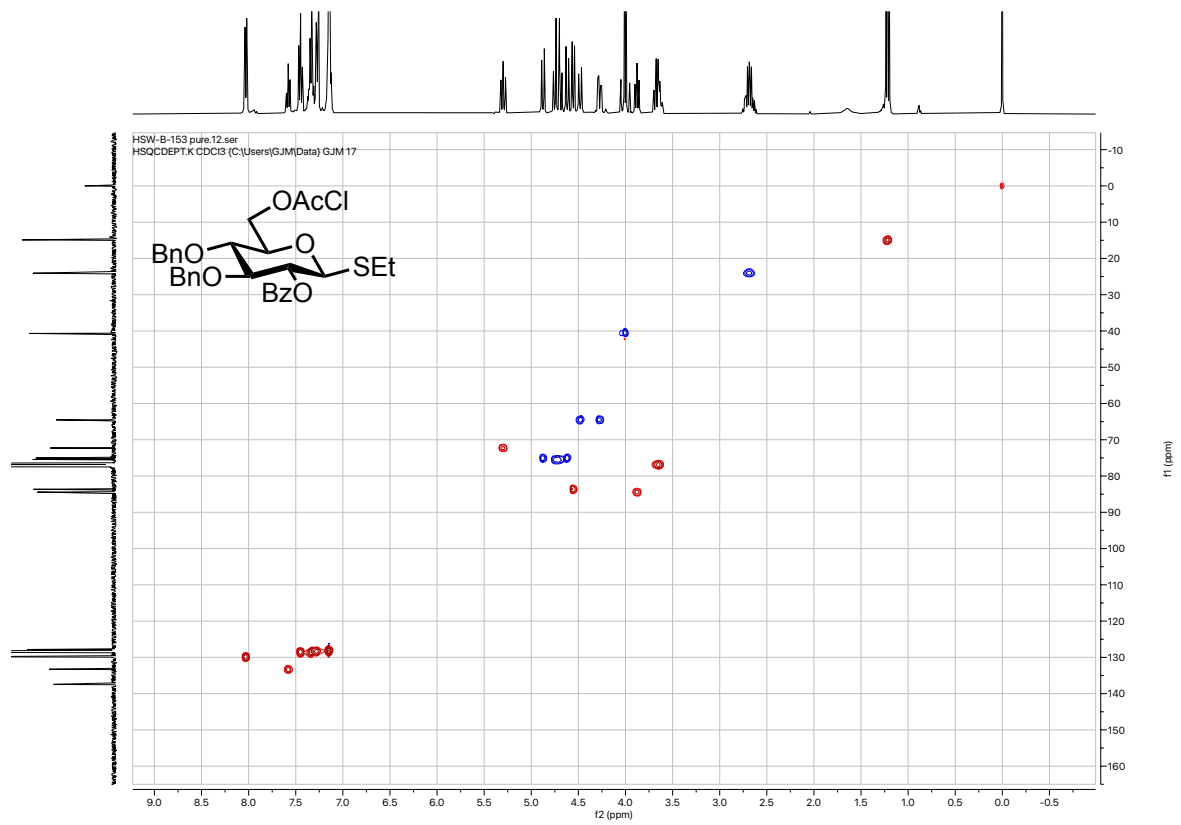
Compound 4
¹H NMR (400 MHz, CDCl₃)



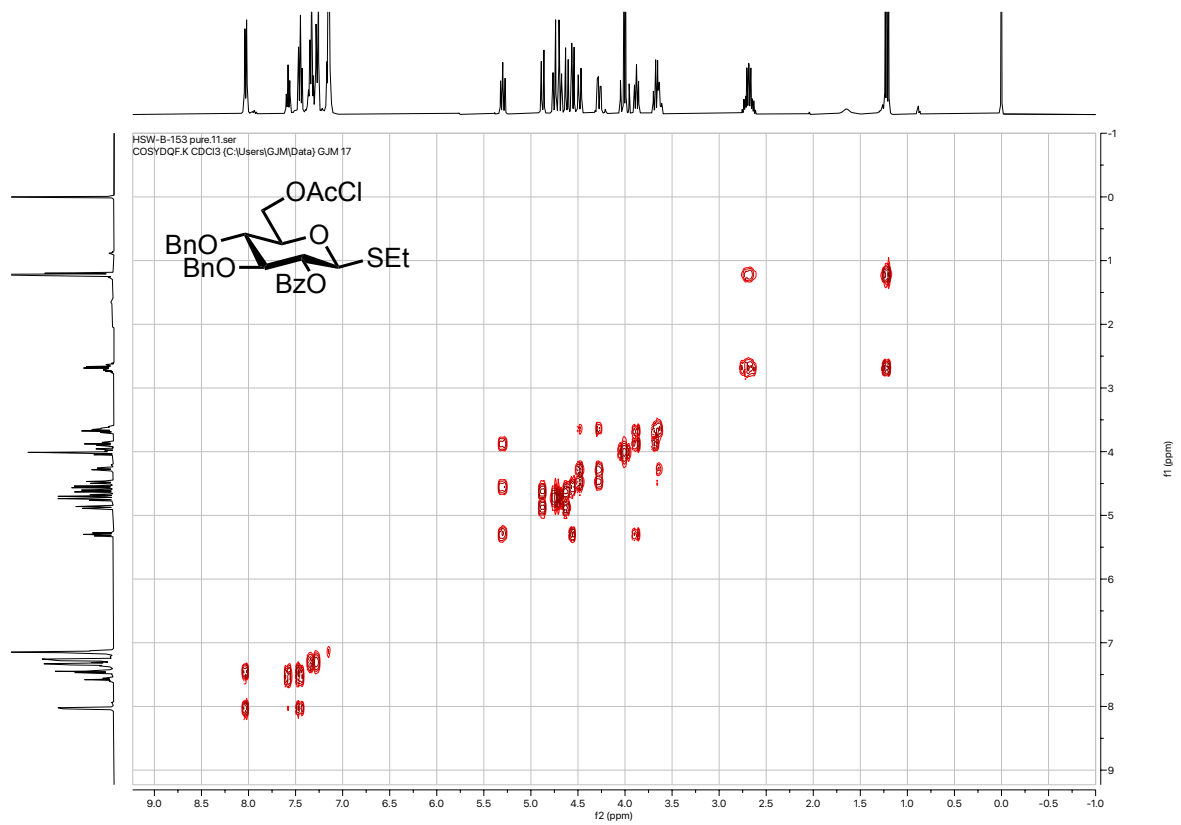
¹³C{¹H} NMR (101 MHz, CDCl₃)



HSQC NMR (400 MHz × 101 MHz, CDCl₃)

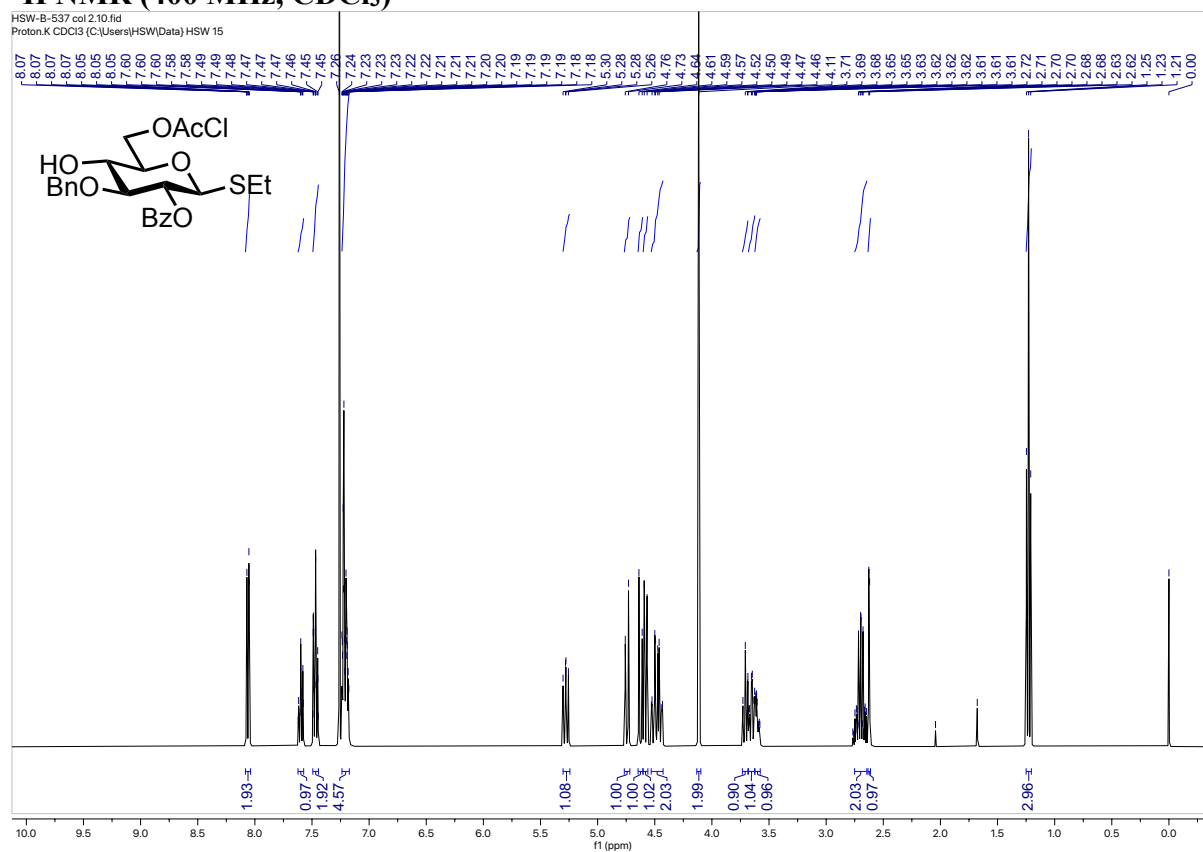


COSY NMR (400 MHz, CDCl₃)

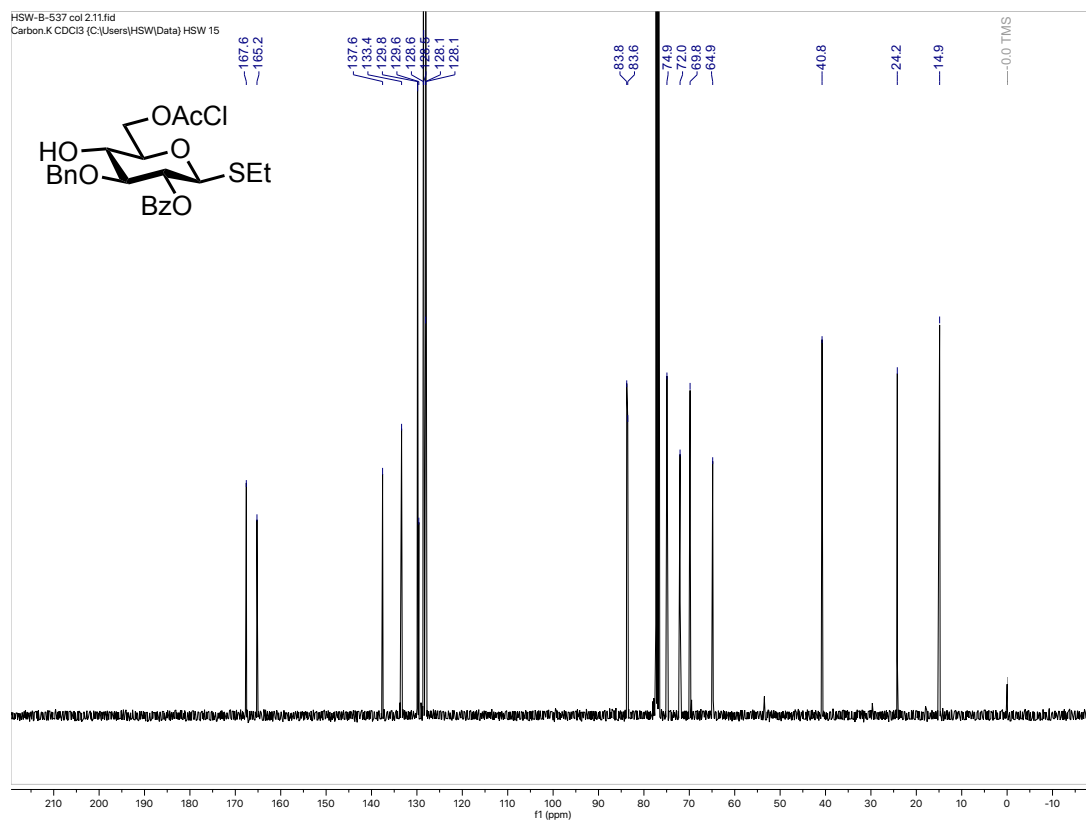


Compound 5

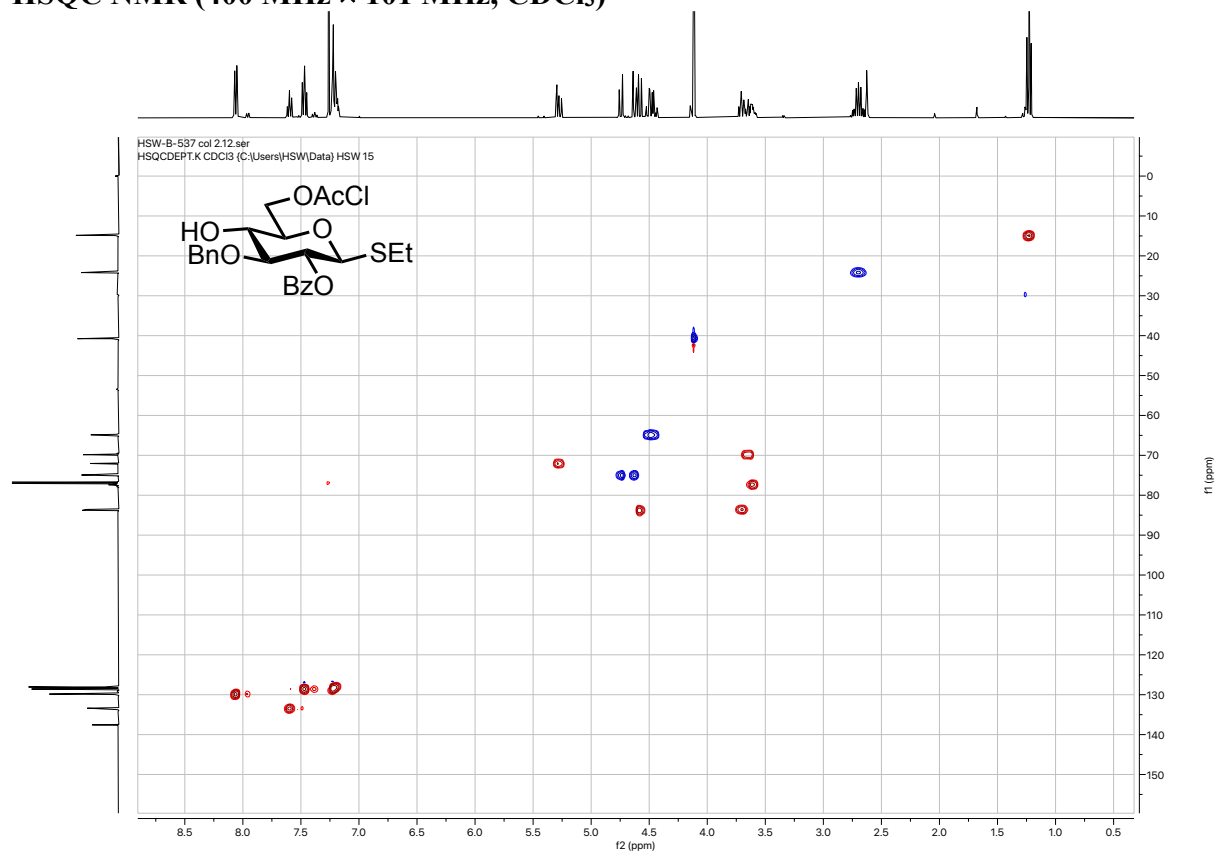
¹H NMR (400 MHz, CDCl₃)



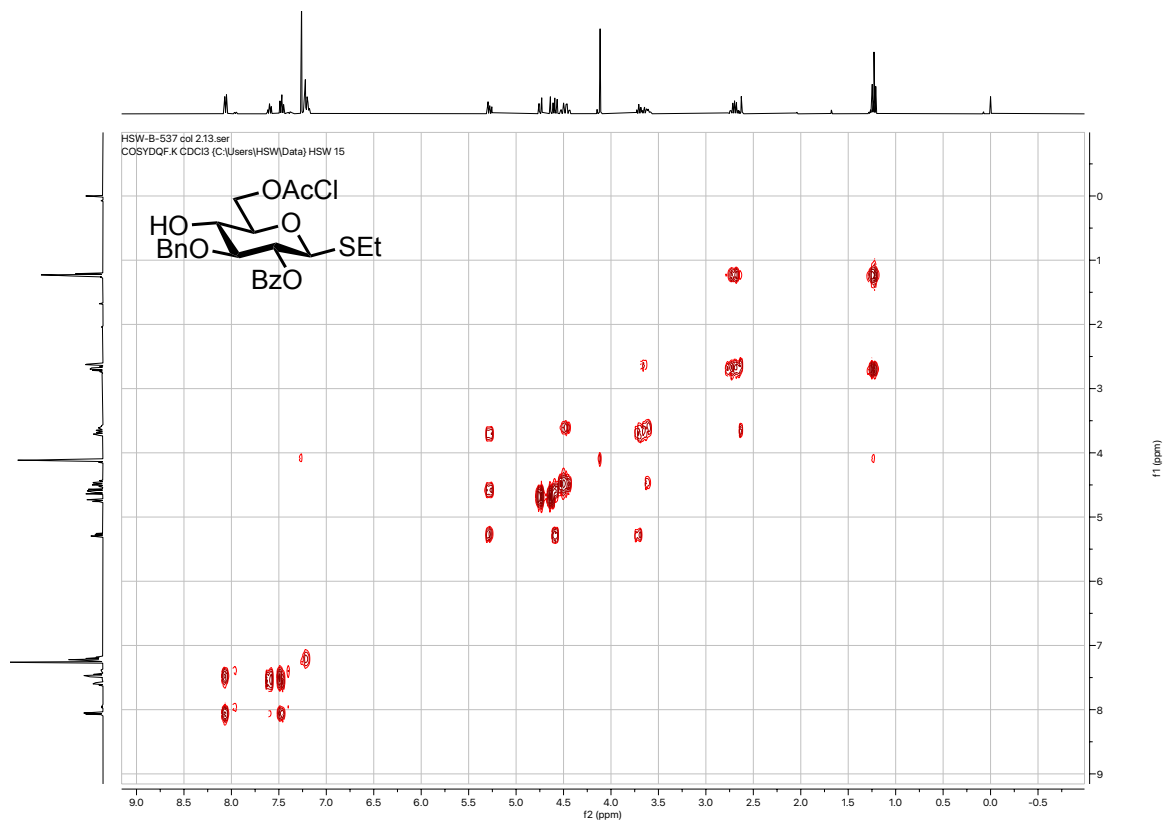
¹³C{¹H} NMR (101 MHz, CDCl₃)



HSQC NMR (400 MHz × 101 MHz, CDCl₃)

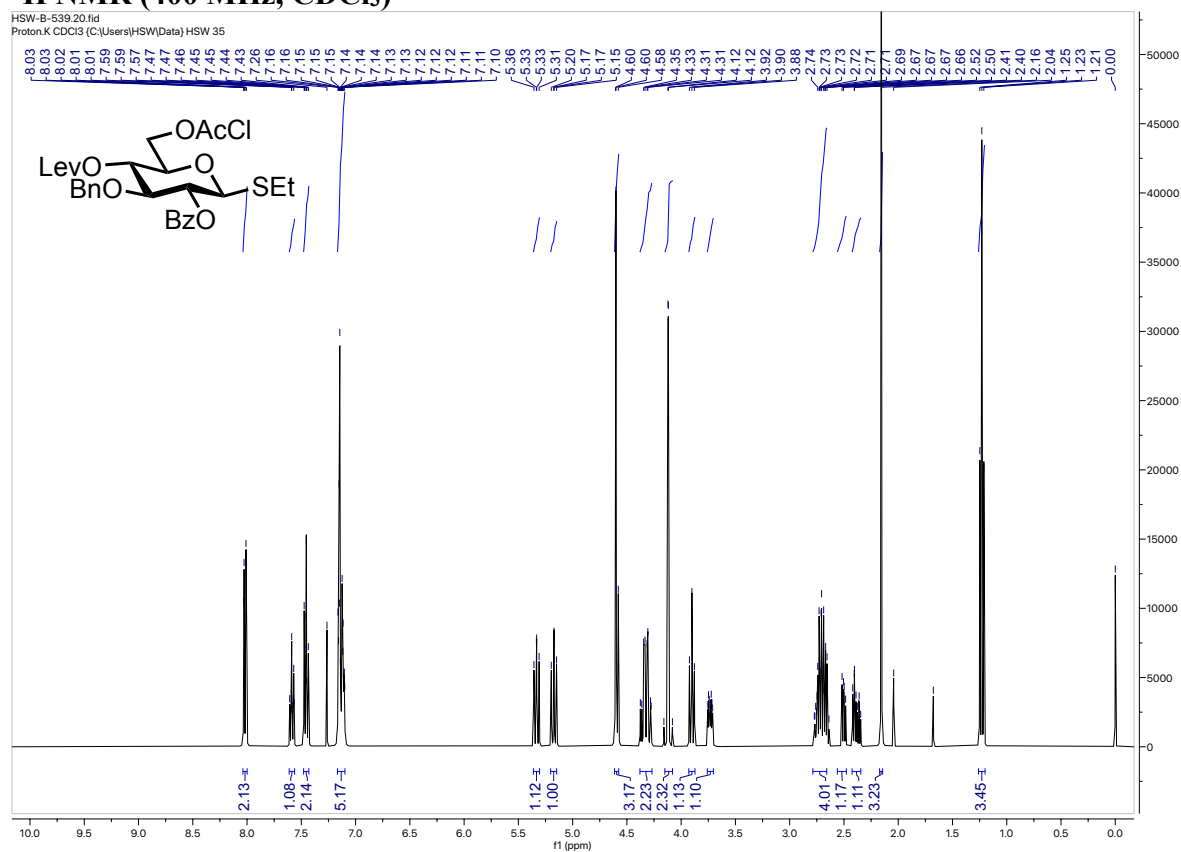


COSY NMR (400 MHz, CDCl₃)

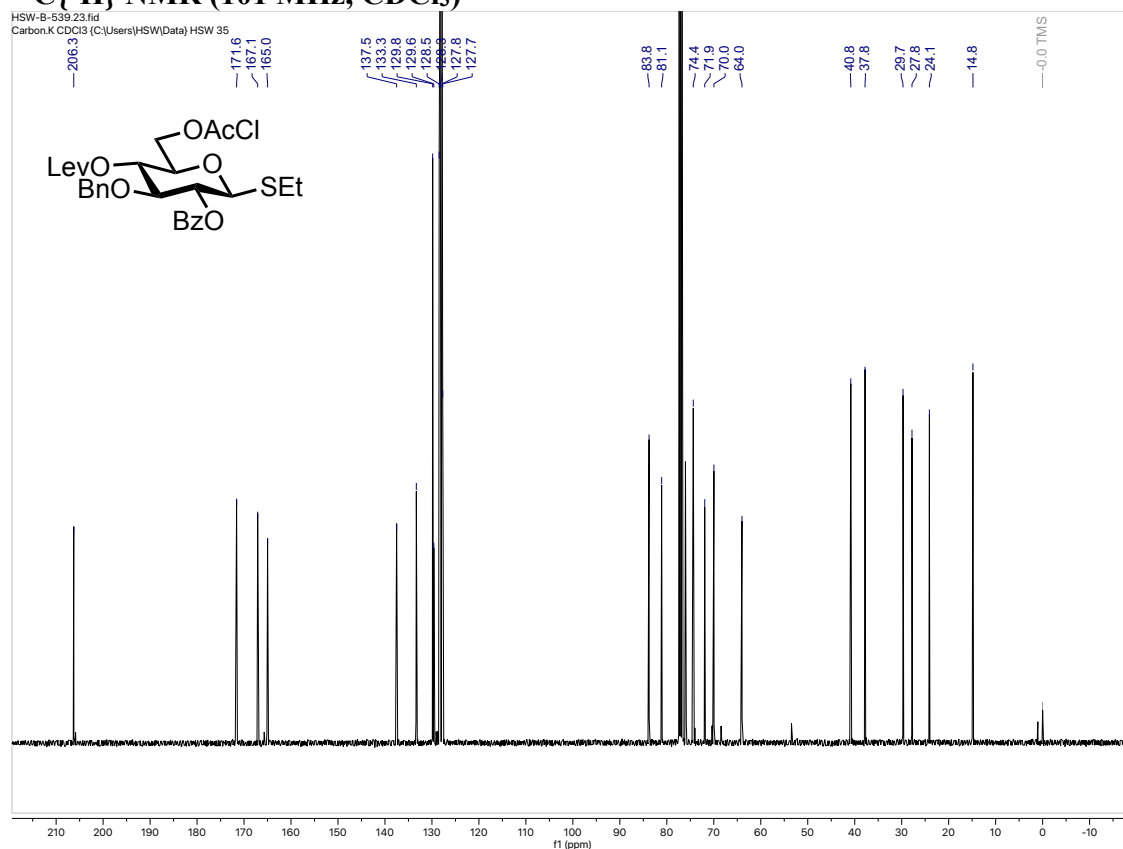


Compound 6

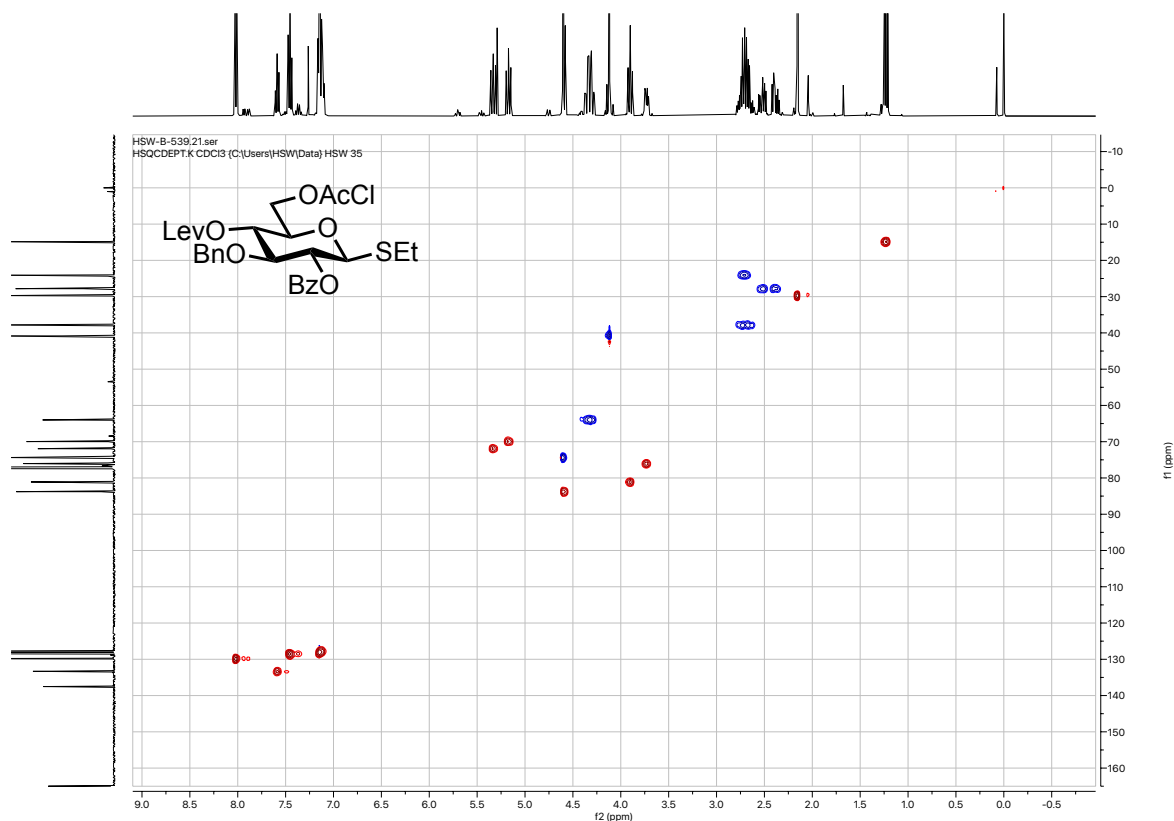
¹H NMR (400 MHz, CDCl₃)



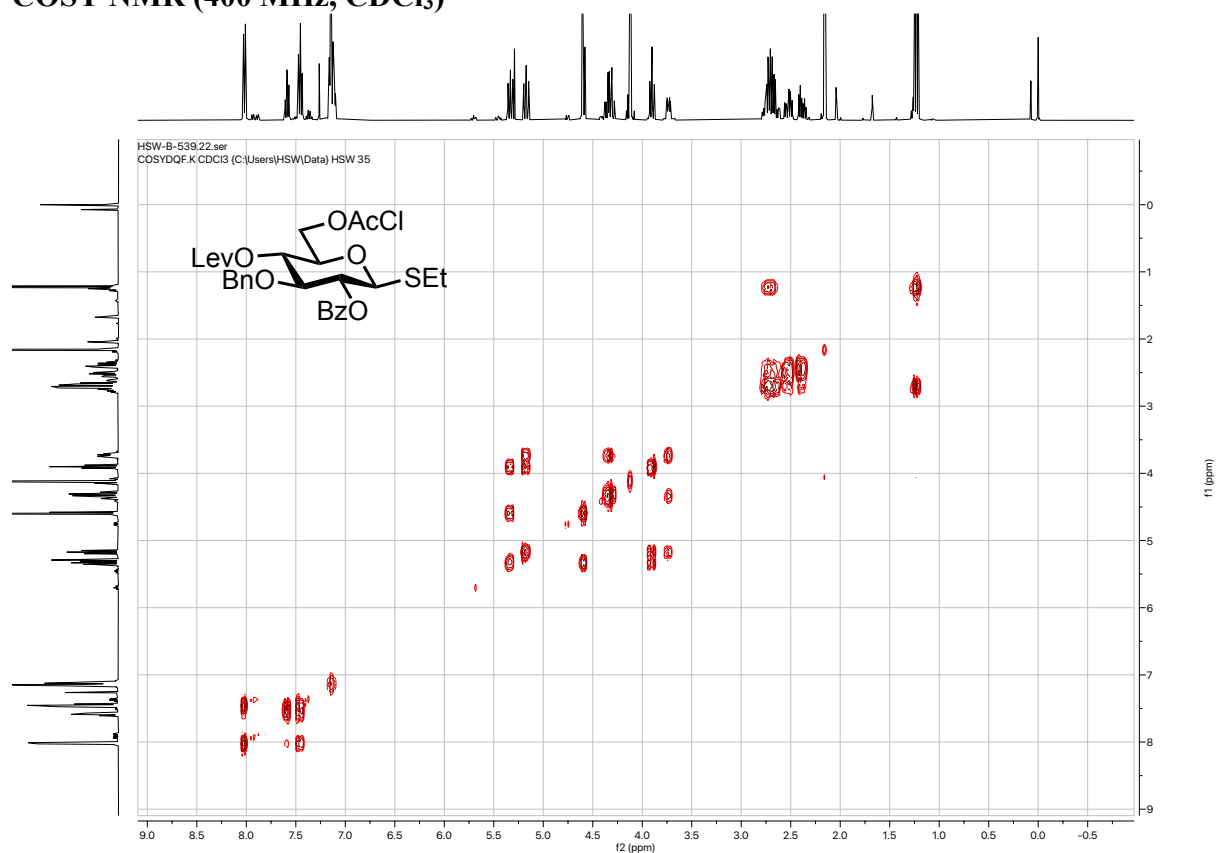
¹³C{¹H} NMR (101 MHz, CDCl₃)



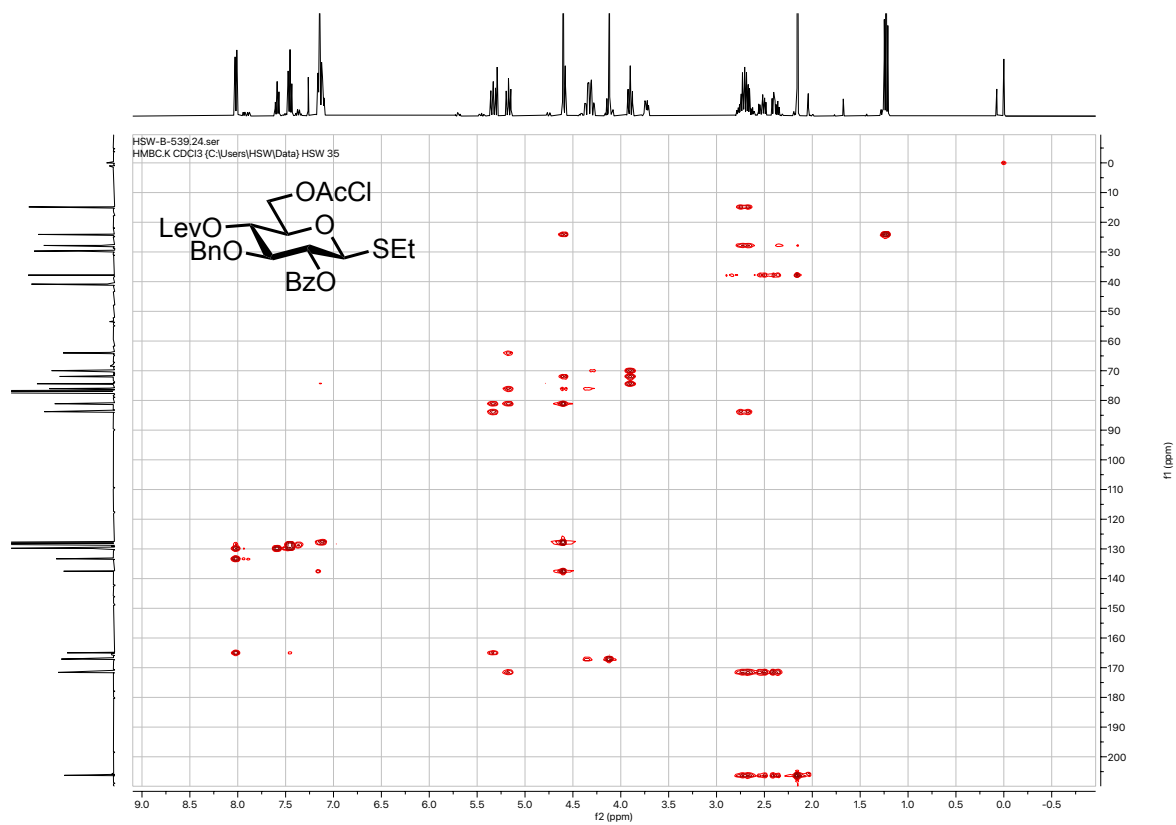
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



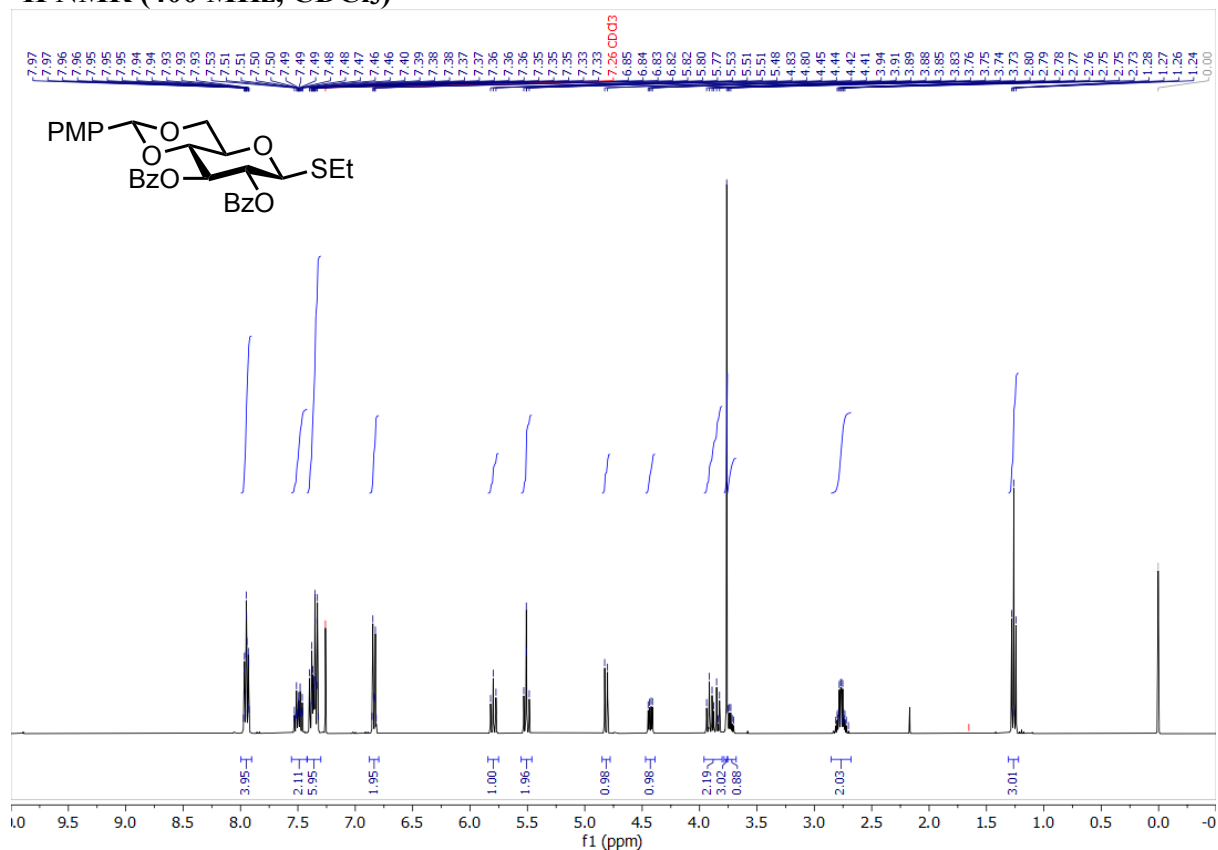
COSY NMR (400 MHz, CDCl₃)



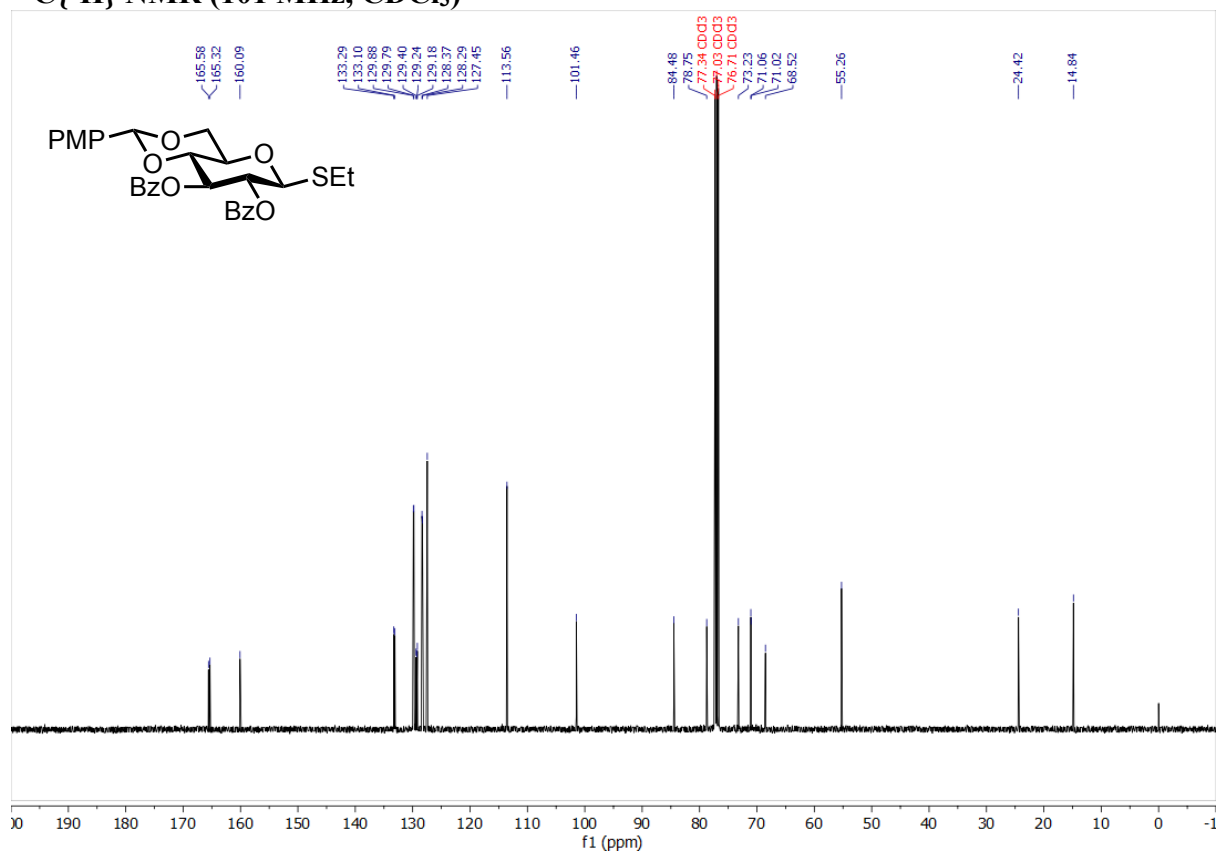
HMBC NMR (400 MHz × 101 MHz, CDCl₃)



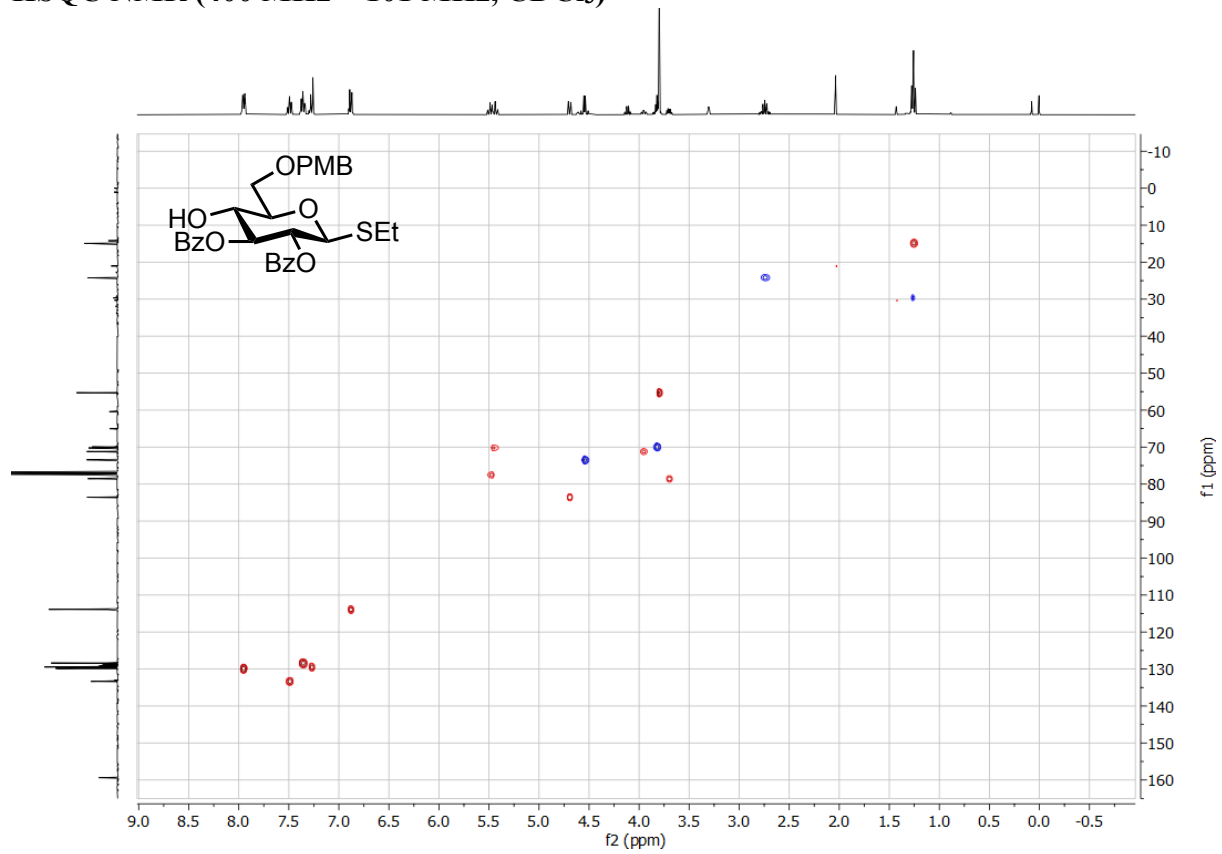
Compound 7
¹H NMR (400 MHz, CDCl₃)



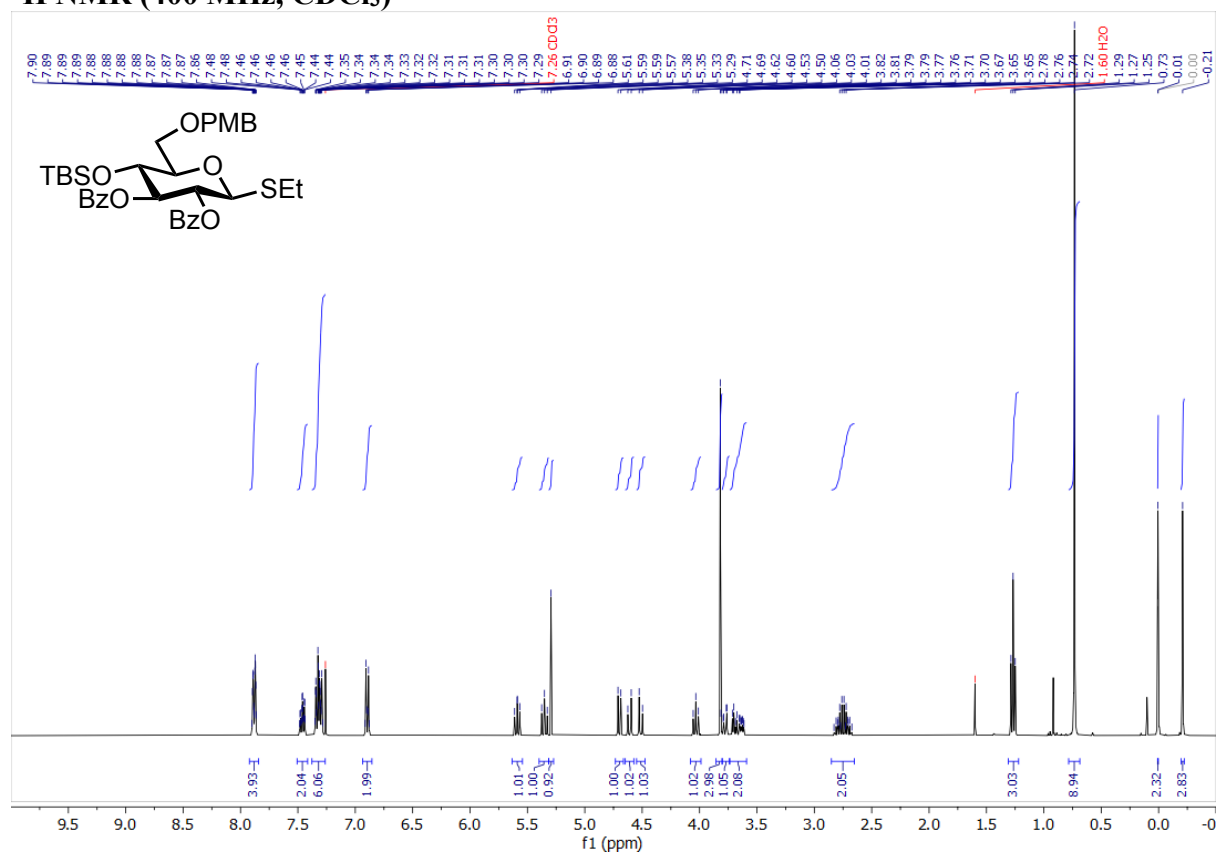
¹³C{¹H} NMR (101 MHz, CDCl₃)



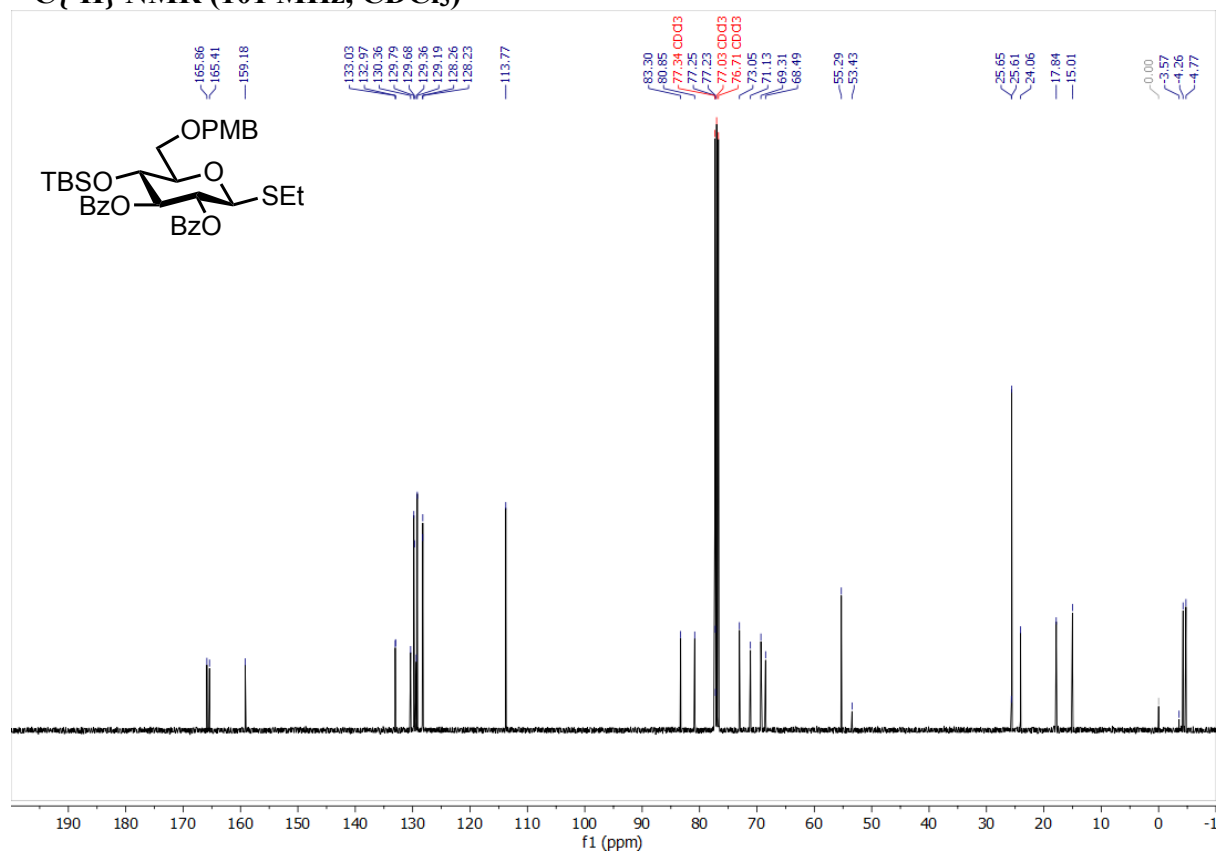
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



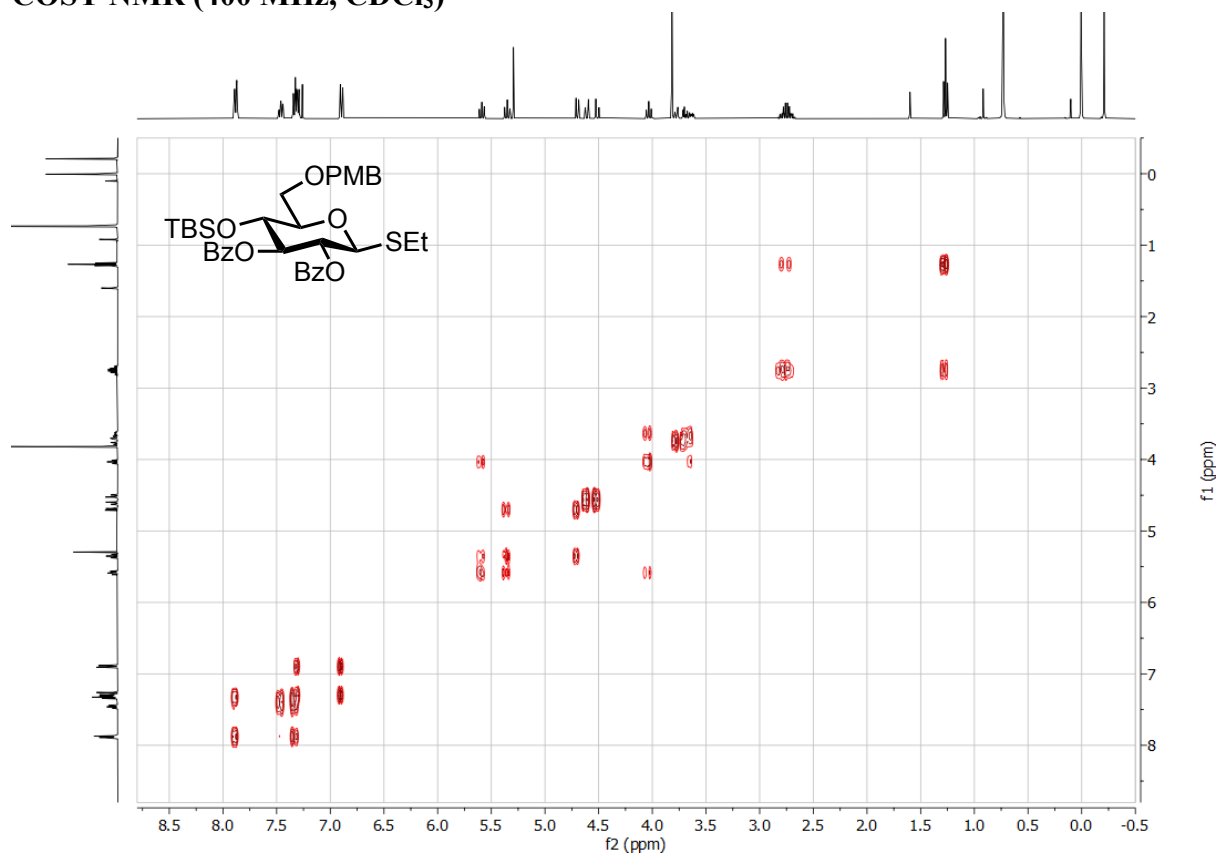
Compound 9 ¹H NMR (400 MHz, CDCl₃)



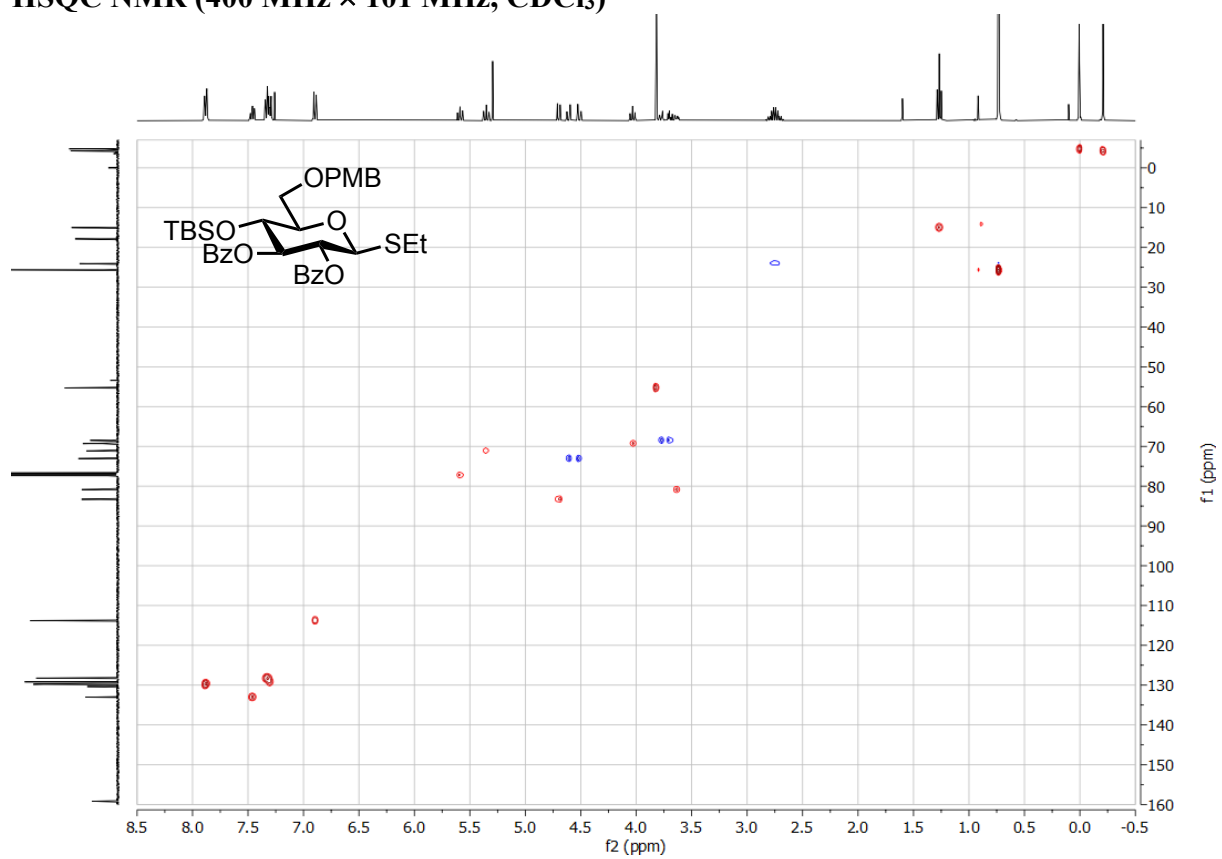
¹³C{¹H} NMR (101 MHz, CDCl₃)



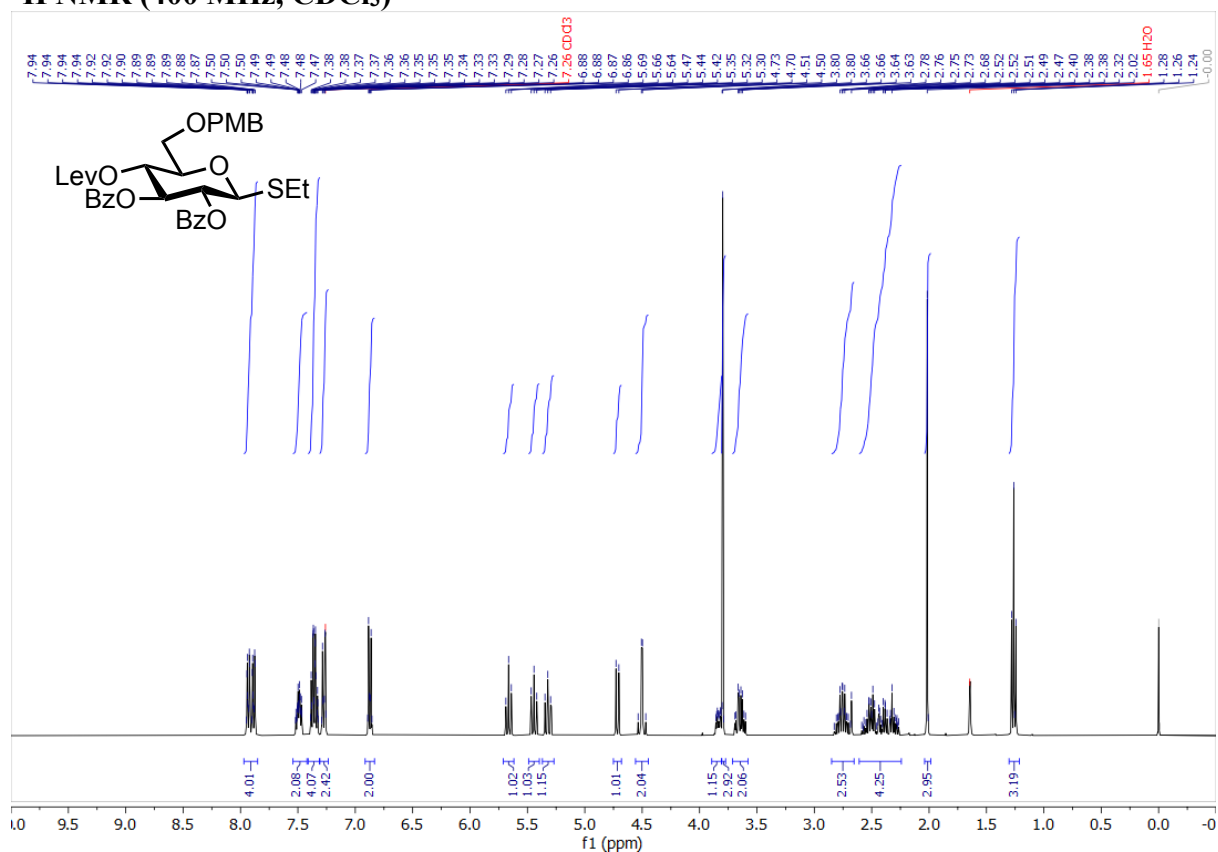
COSY NMR (400 MHz, CDCl₃)



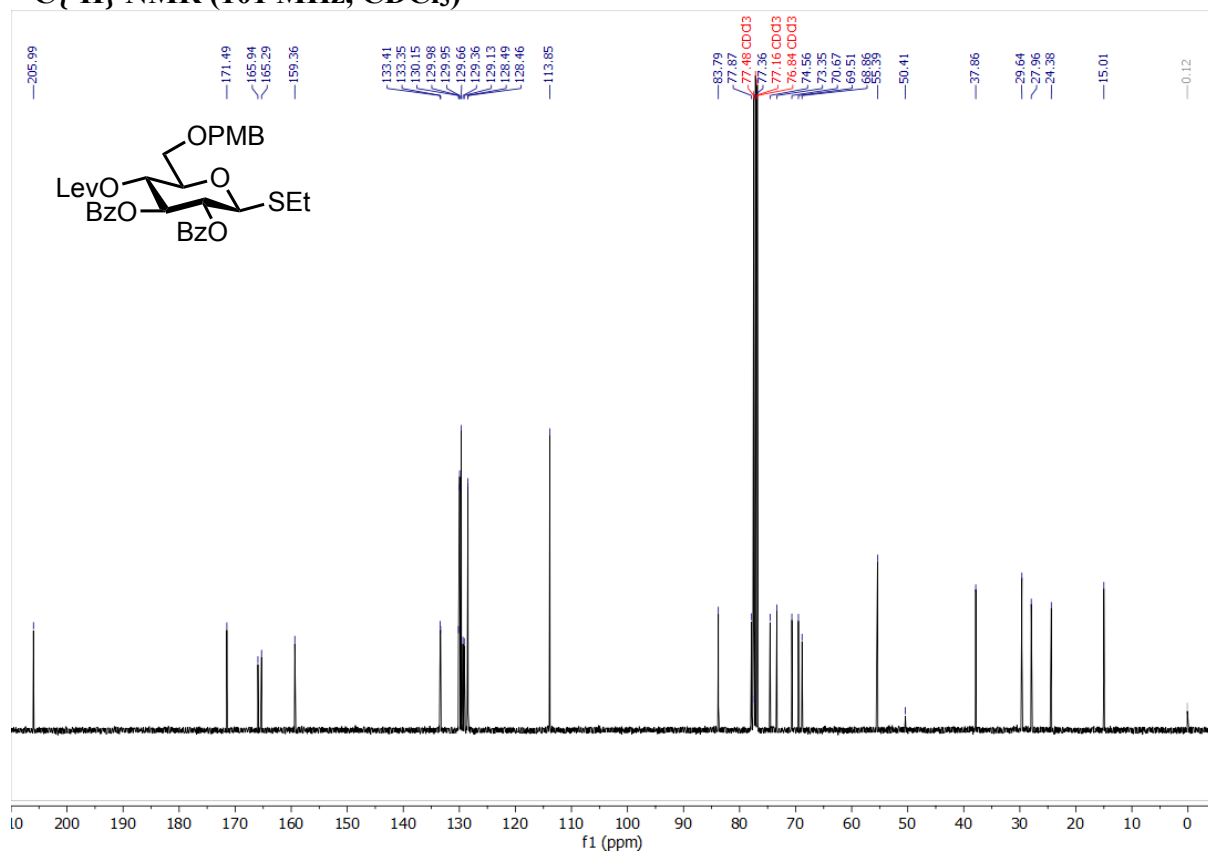
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



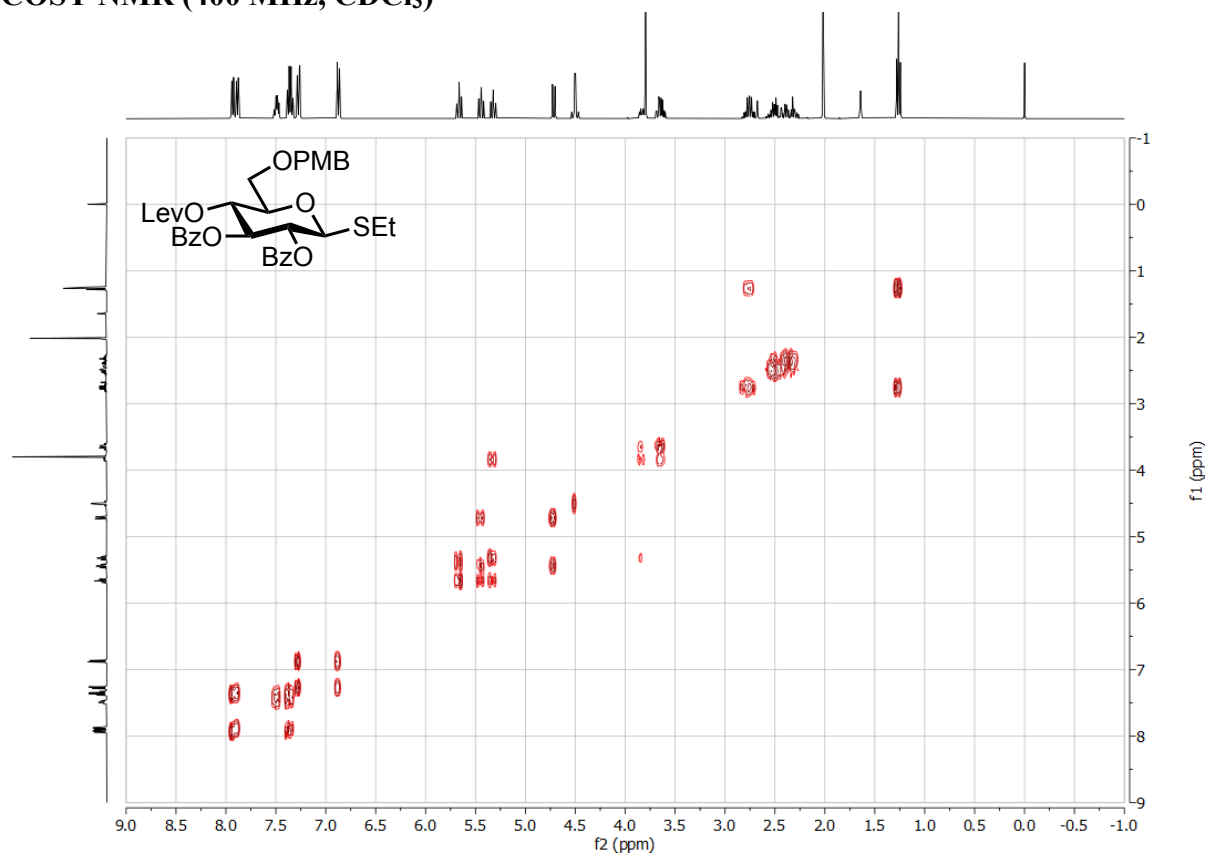
Compound 10
¹H NMR (400 MHz, CDCl₃)



¹³C{¹H} NMR (101 MHz, CDCl₃)



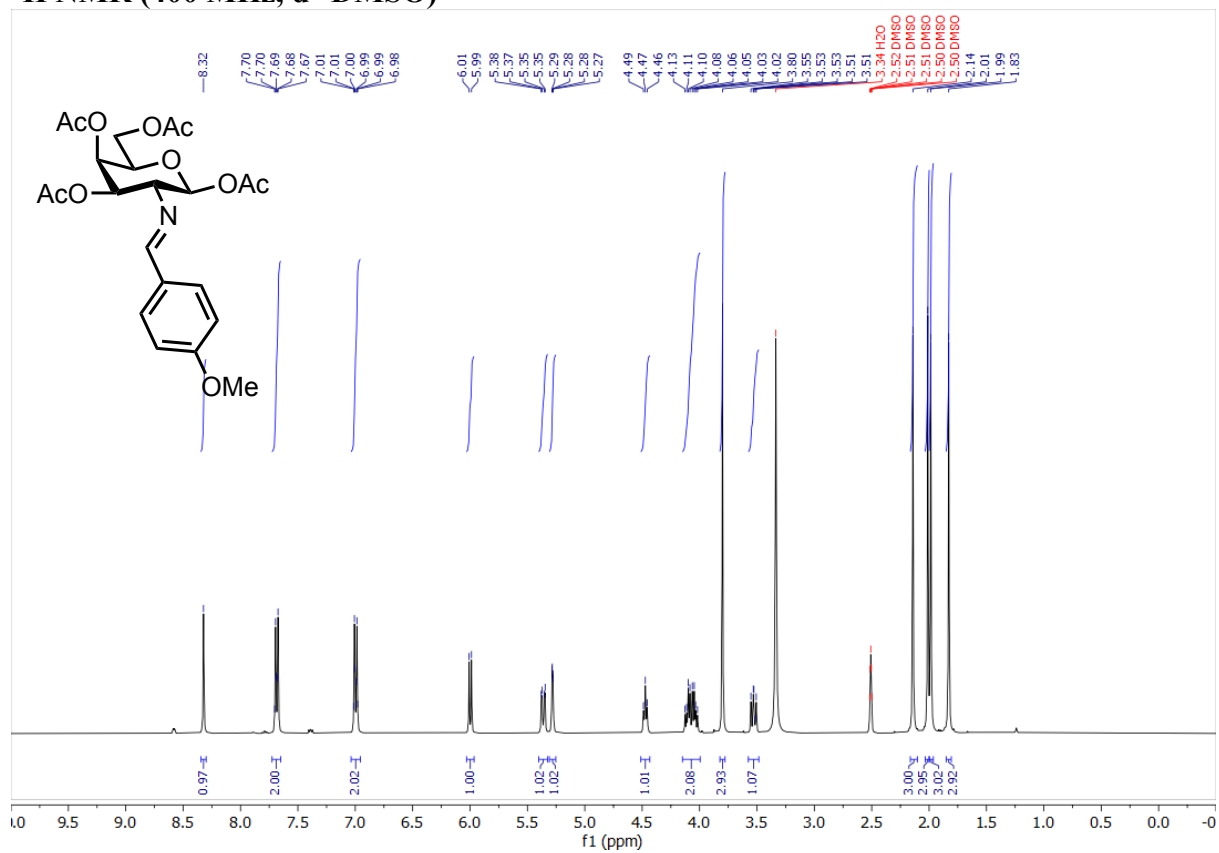
COSY NMR (400 MHz, CDCl₃)



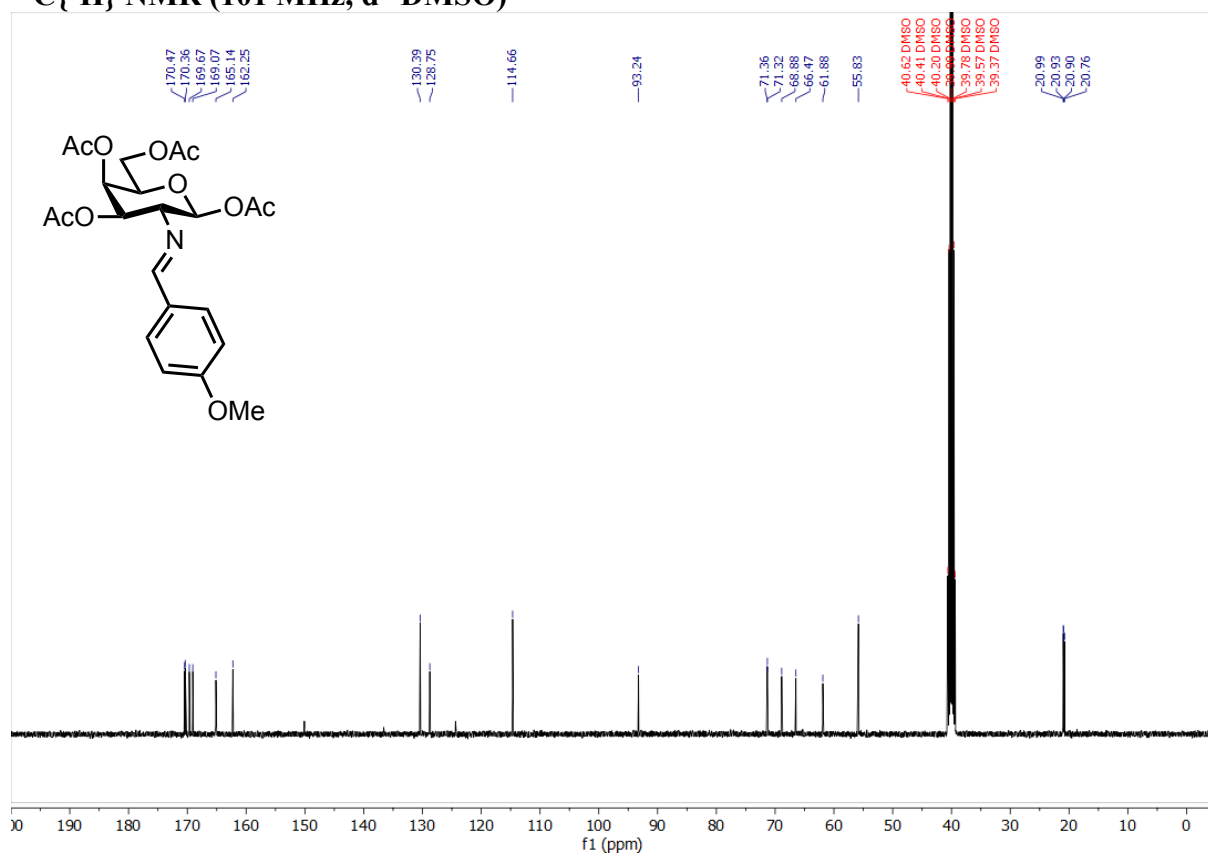
Galactosamine Acceptor Synthesis

Compound S6

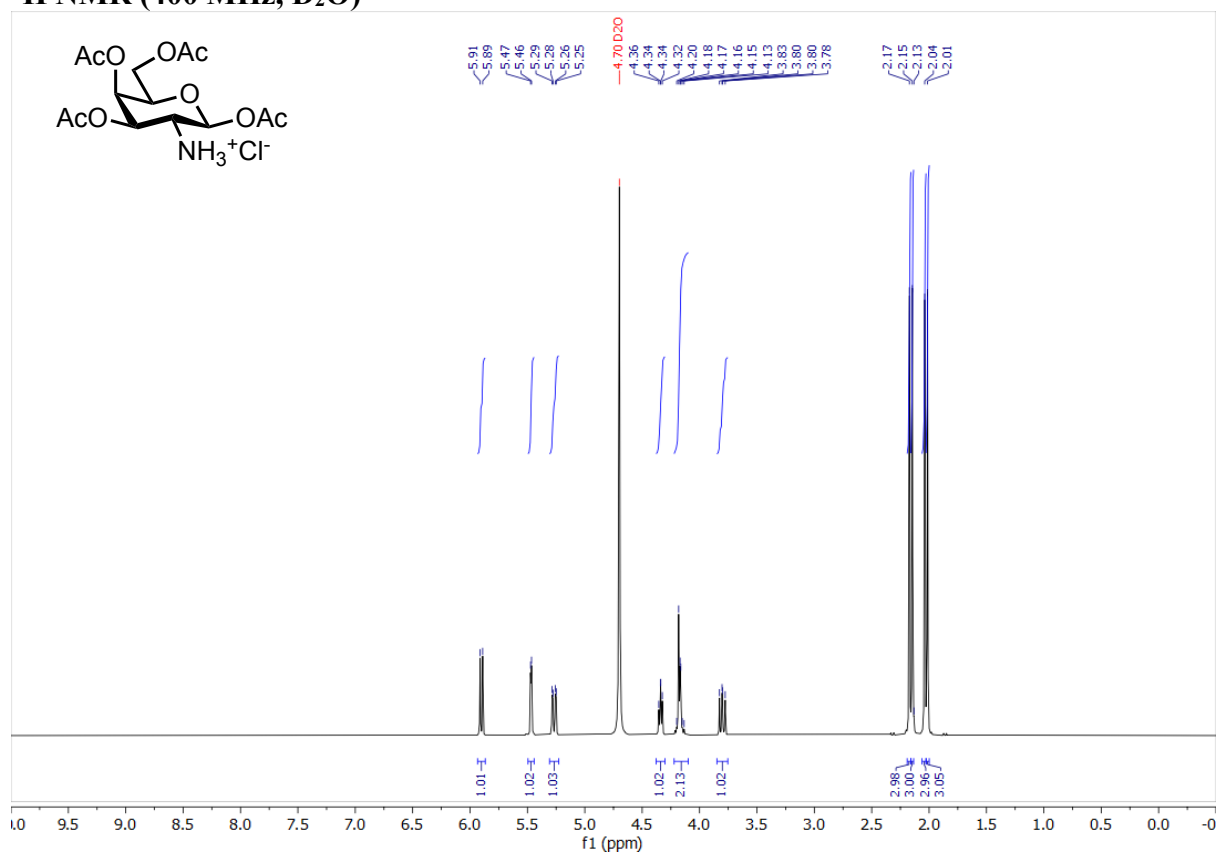
^1H NMR (400 MHz, d^6 -DMSO)



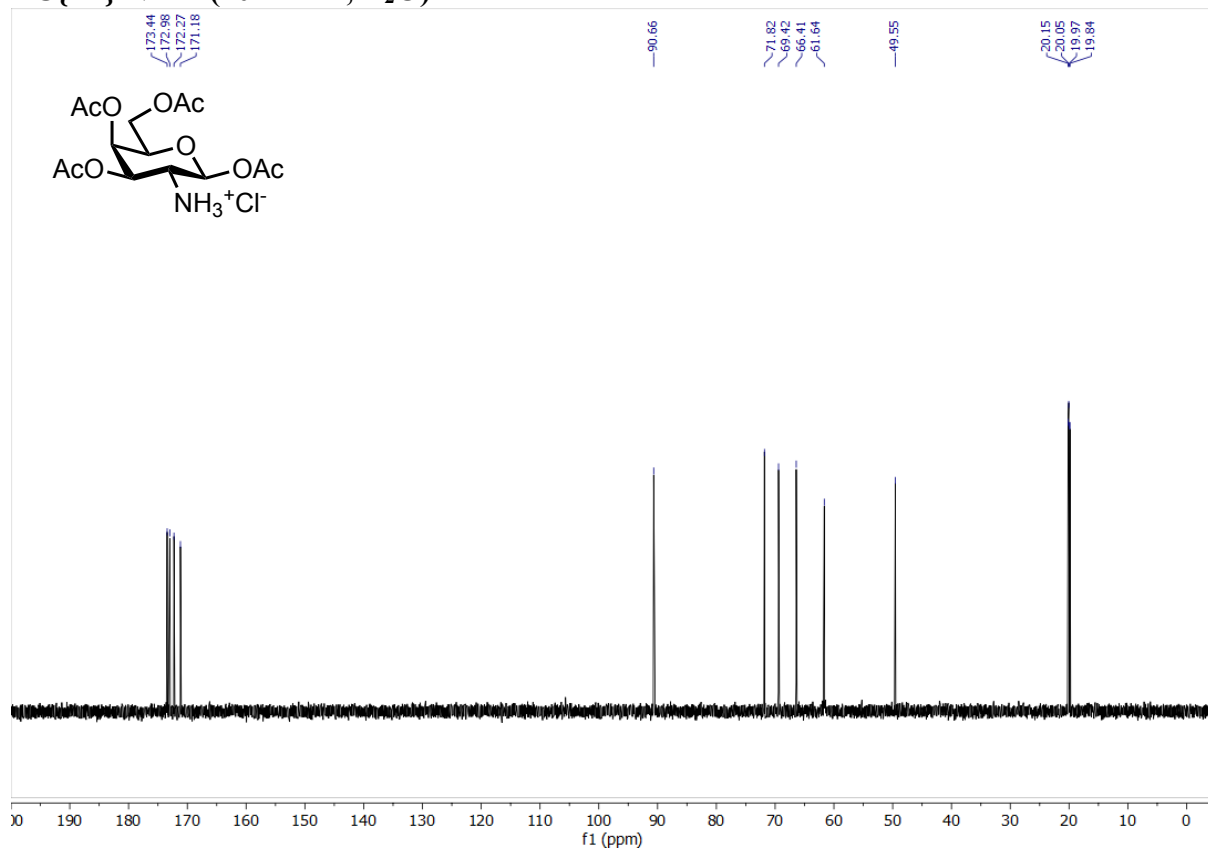
$^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, d^6 -DMSO)



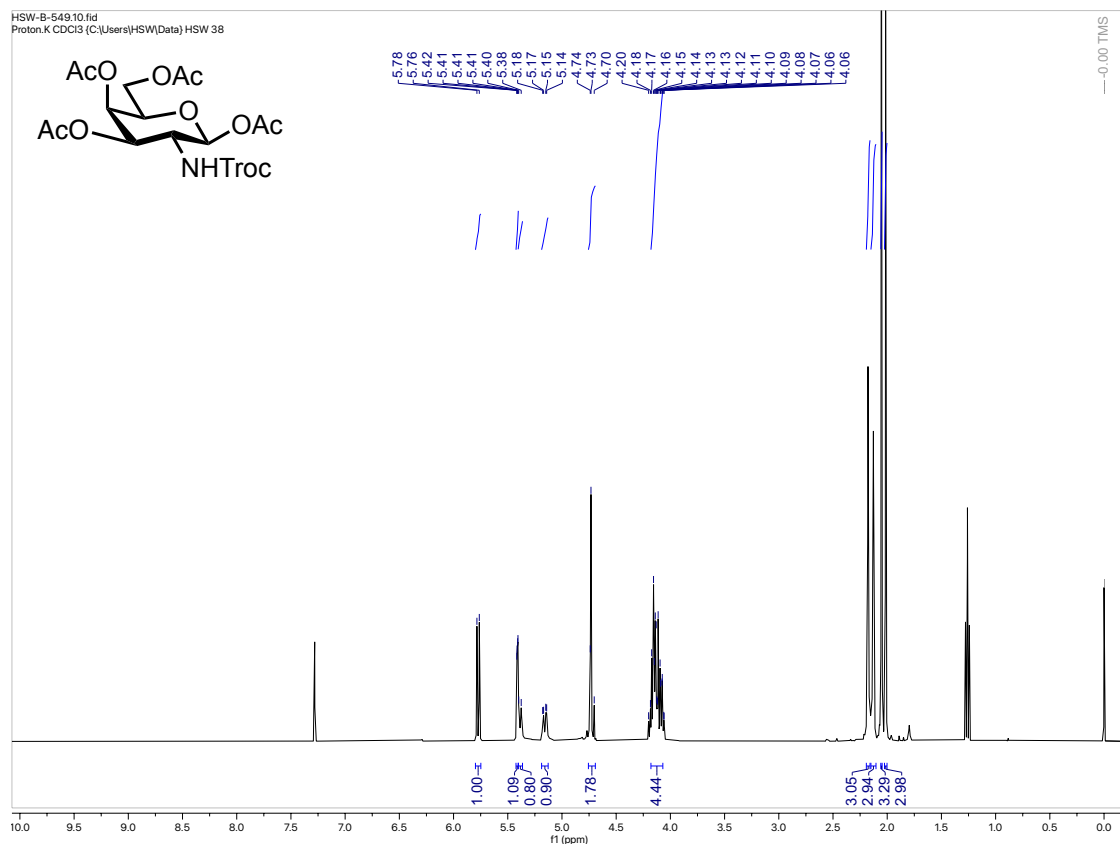
Compound 12
¹H NMR (400 MHz, D₂O)



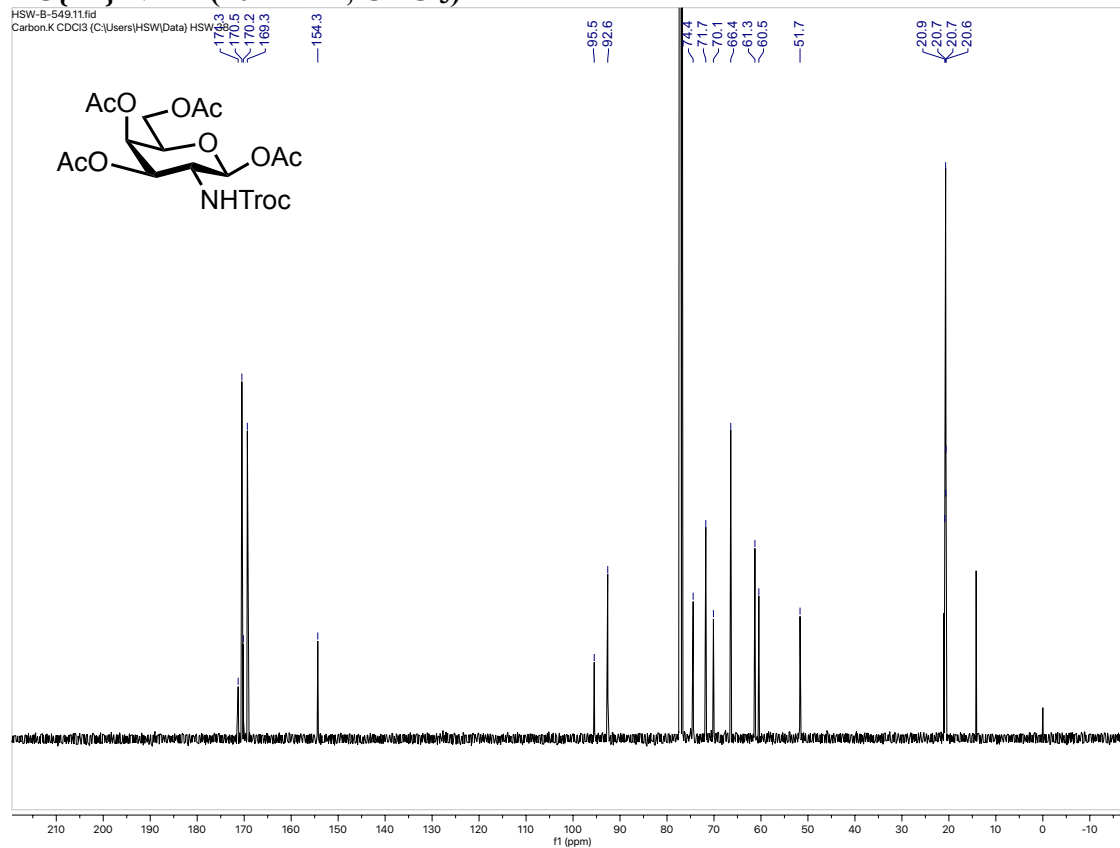
¹³C{¹H} NMR (101 MHz, D₂O)



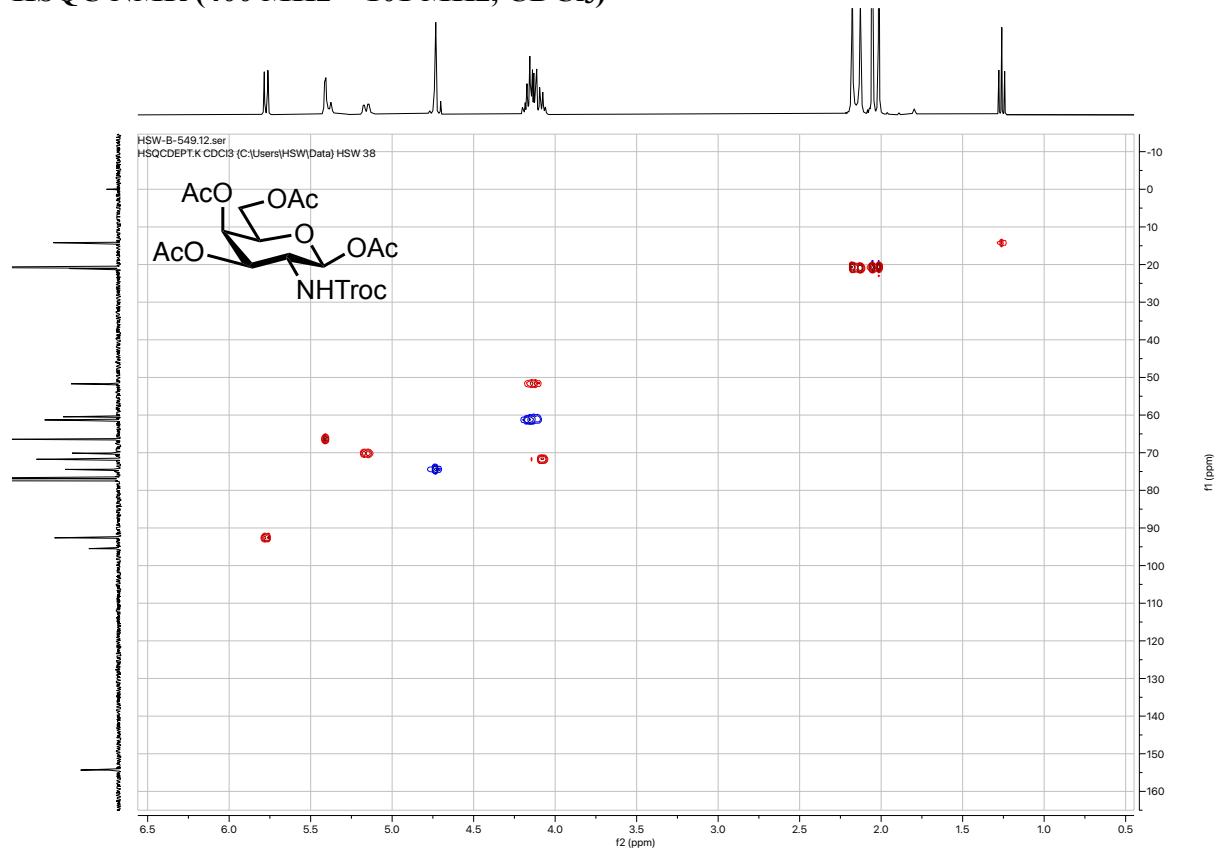
Compound 13
¹H NMR (400 MHz, CDCl₃)



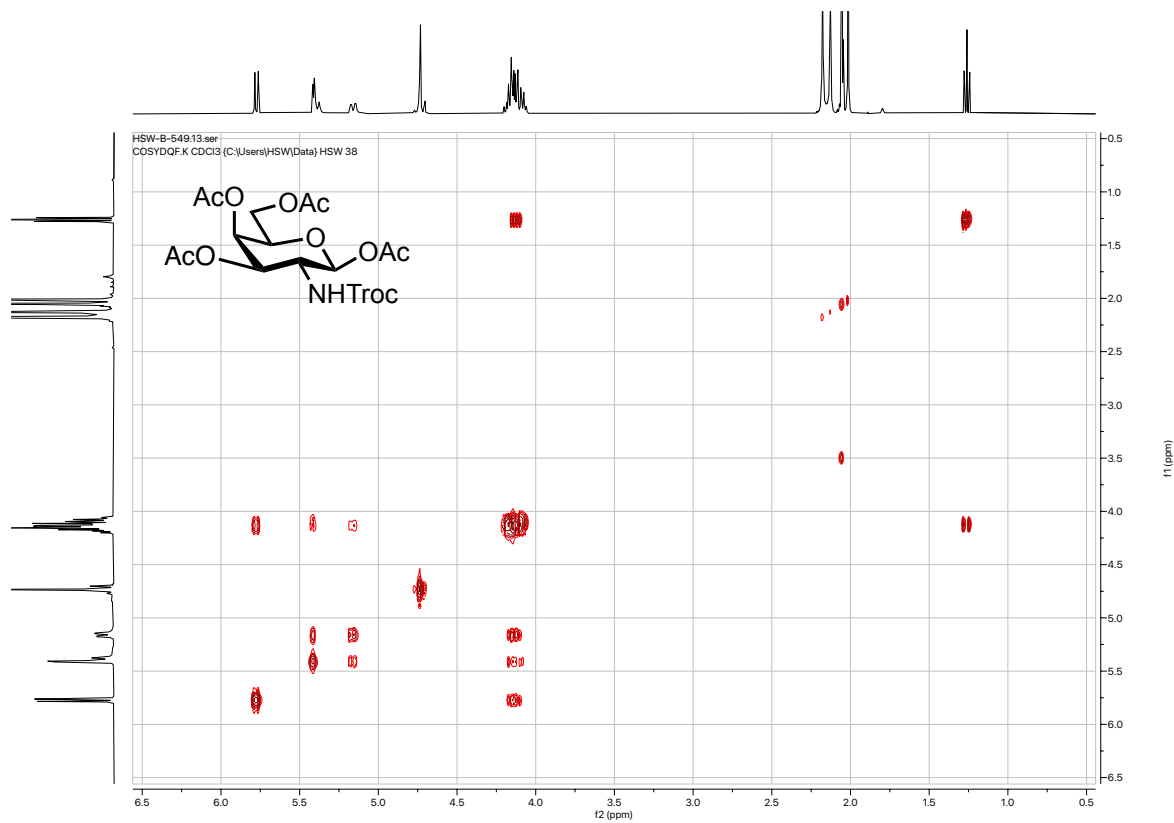
¹³C{¹H} NMR (101 MHz, CDCl₃)



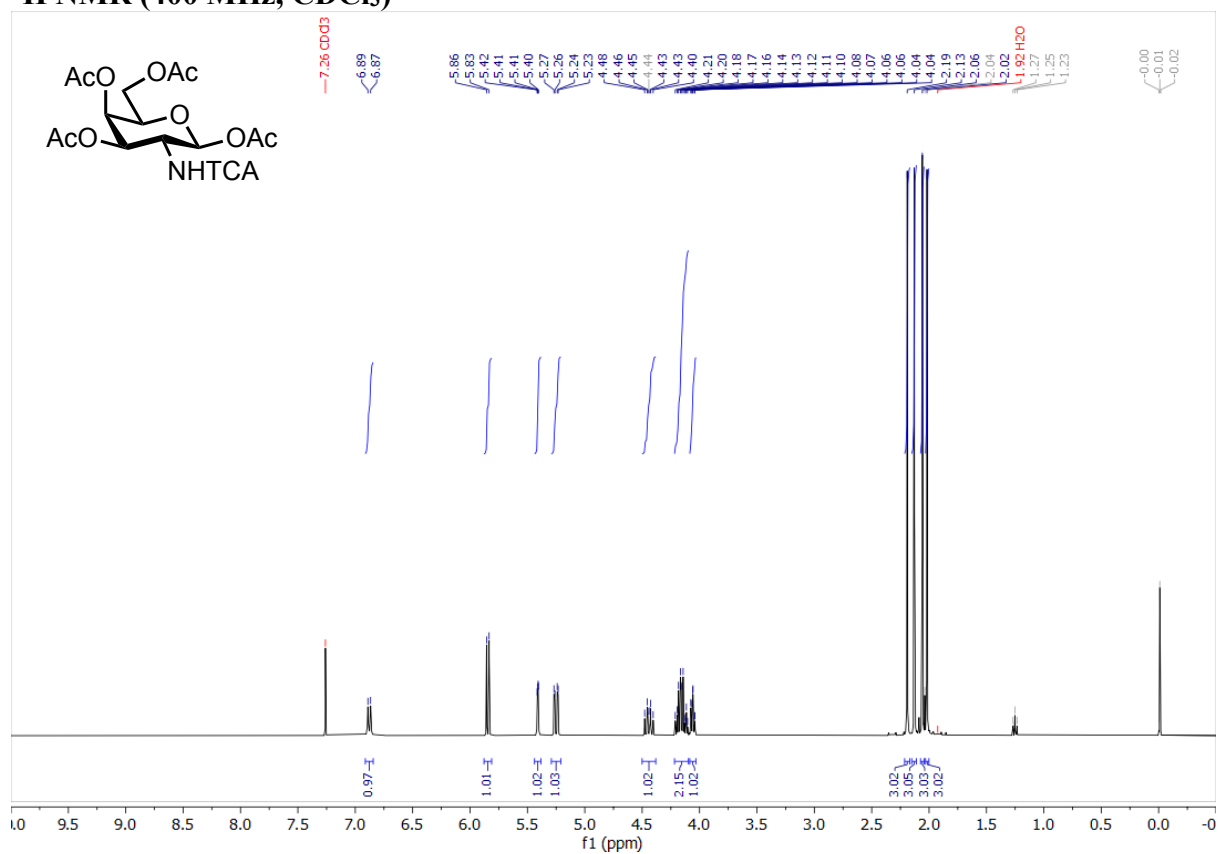
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



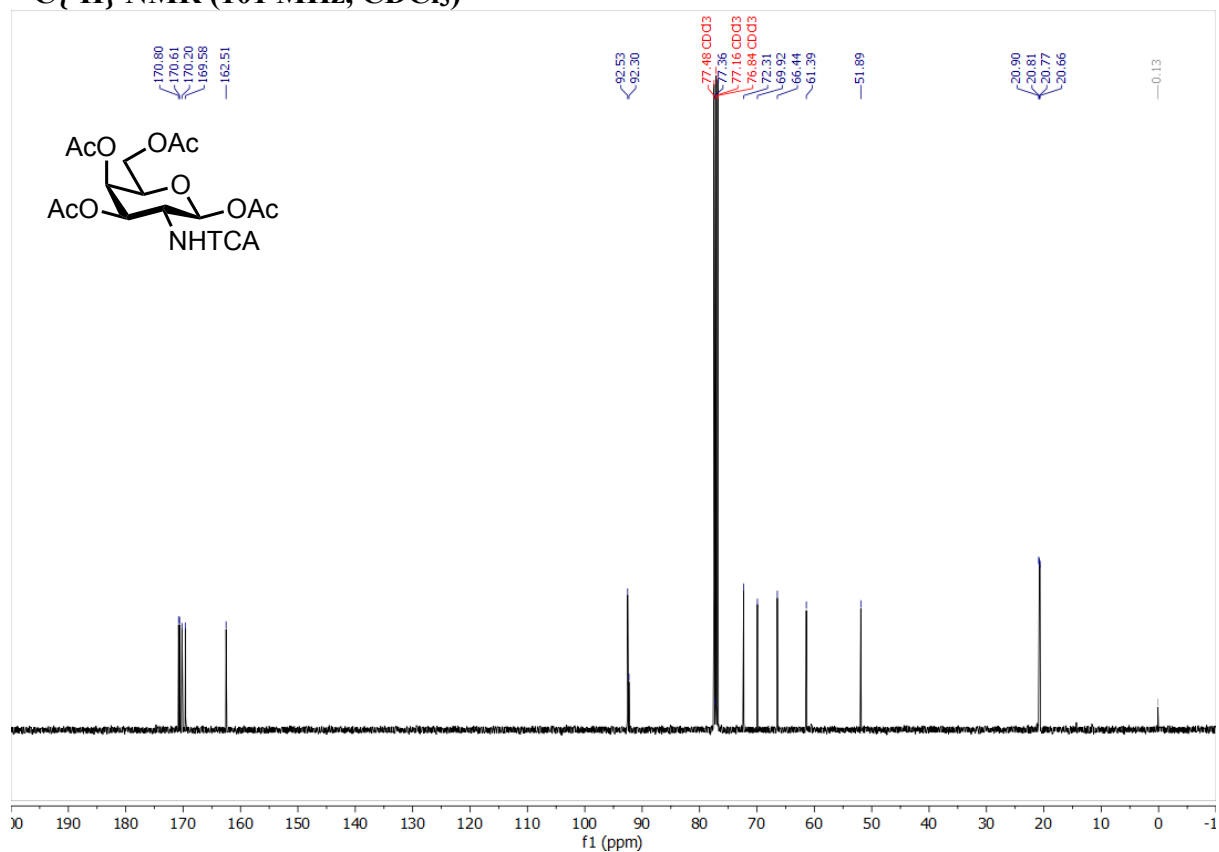
COSY NMR (400 MHz, CDCl₃)



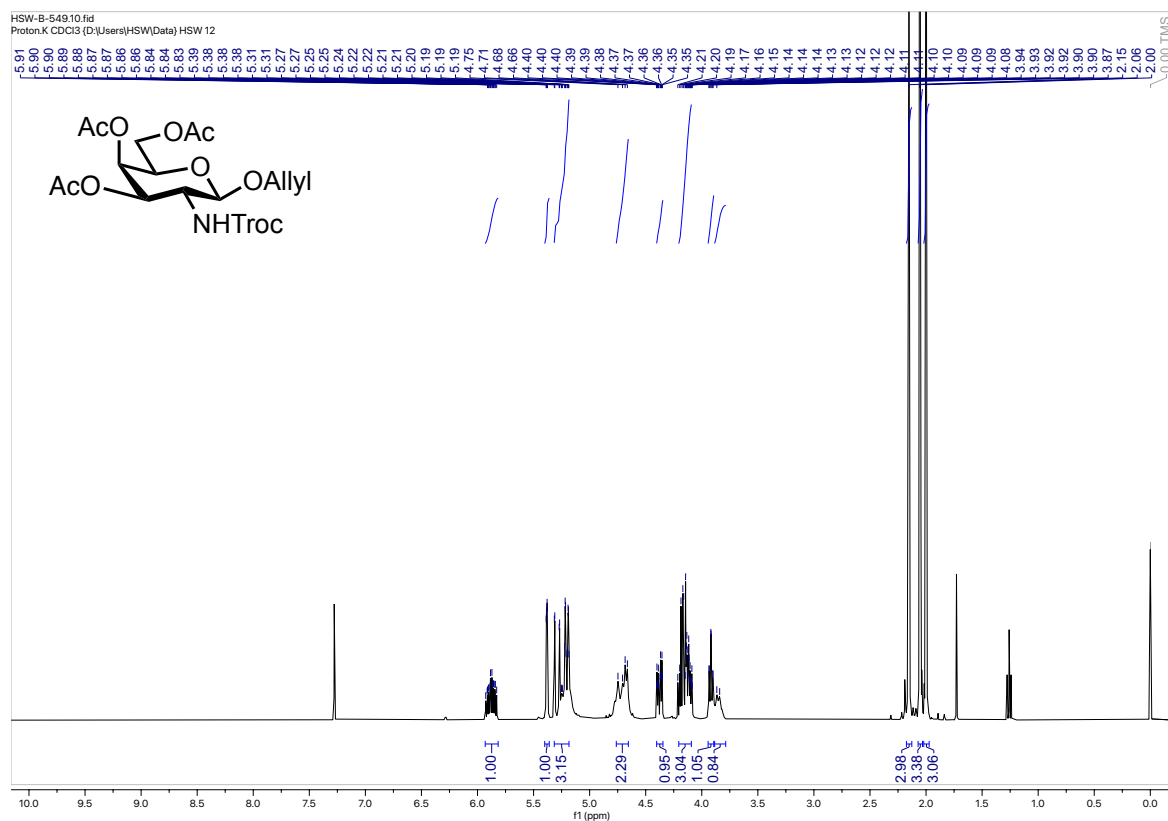
Compound 14
 ^1H NMR (400 MHz, CDCl_3)



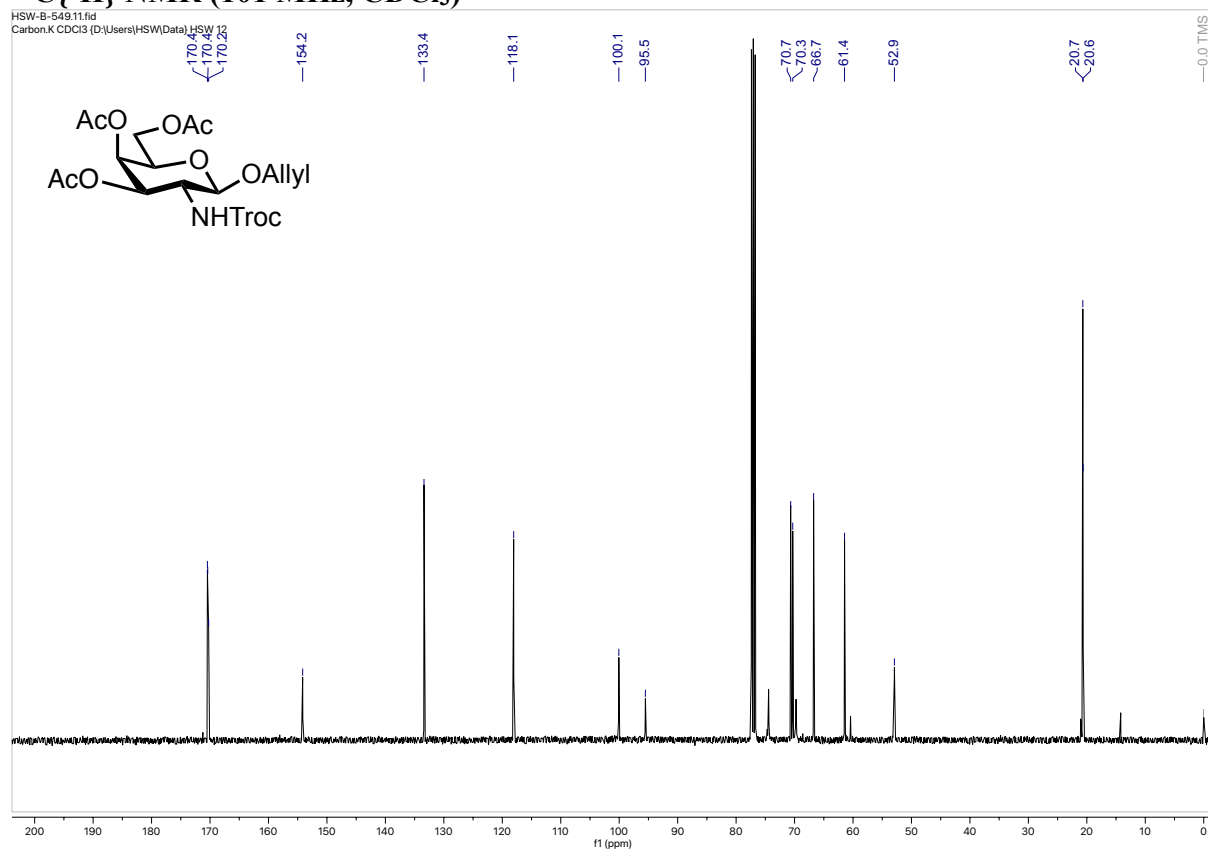
$^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, CDCl_3)



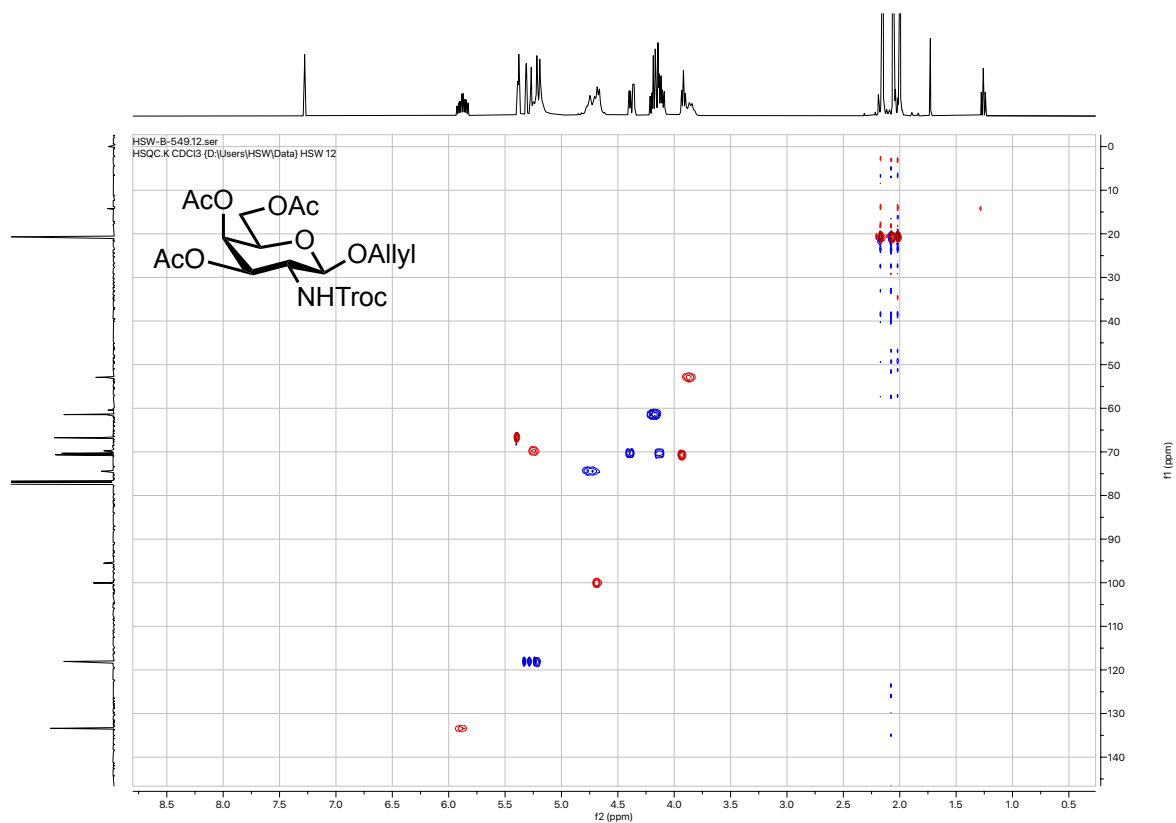
Compound 15
¹H NMR (400 MHz, CDCl₃)



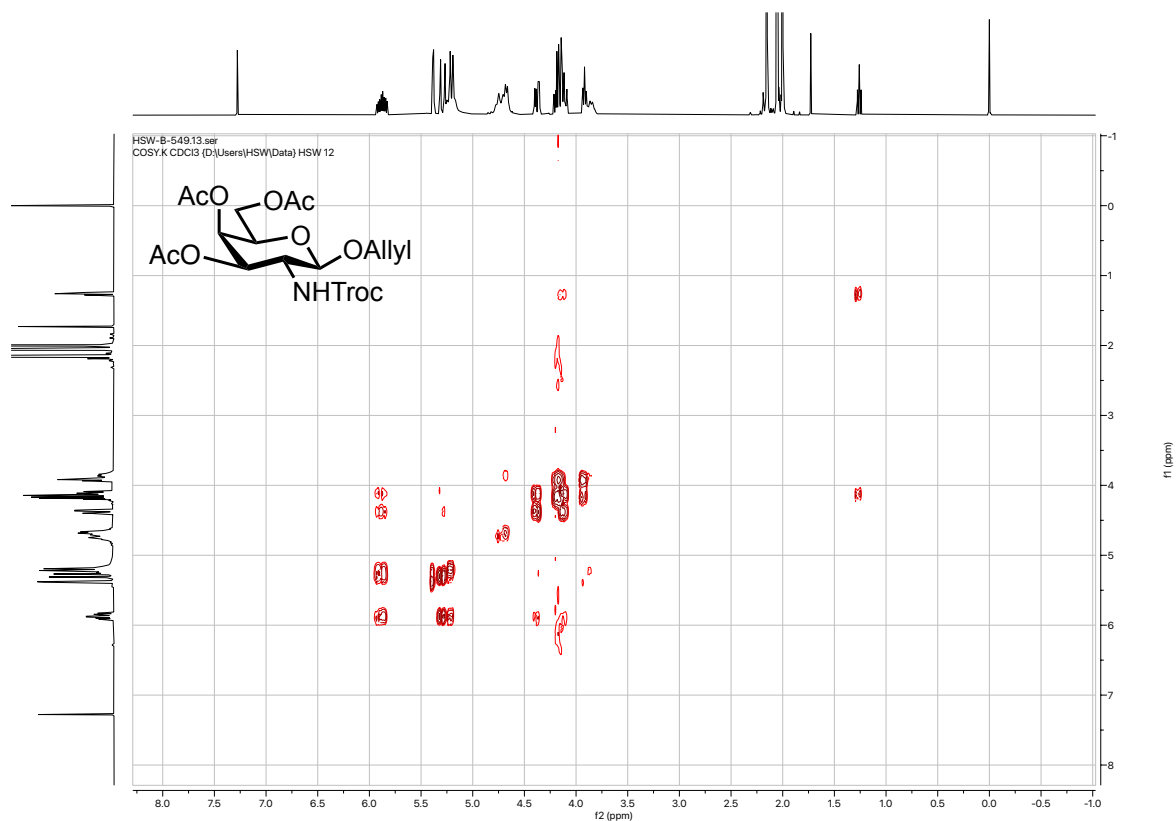
¹³C{¹H} NMR (101 MHz, CDCl₃)



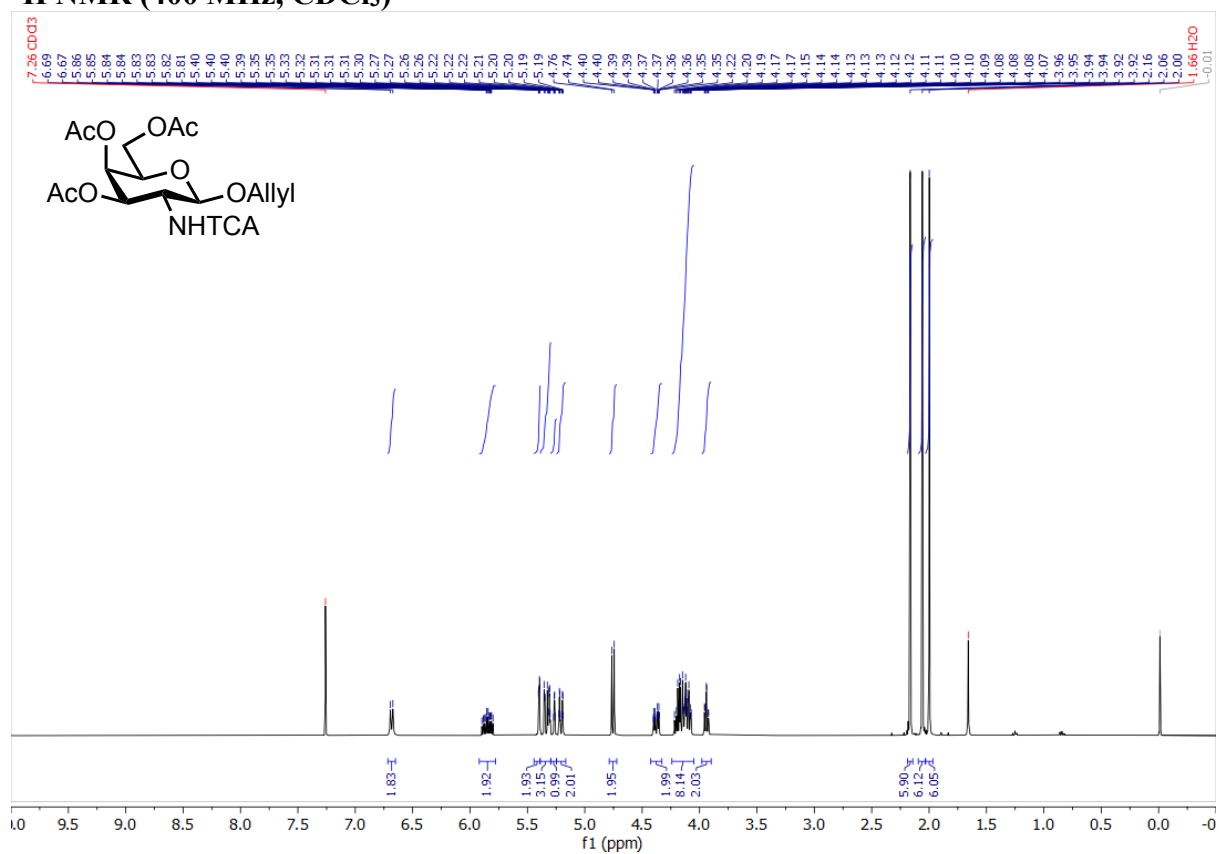
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



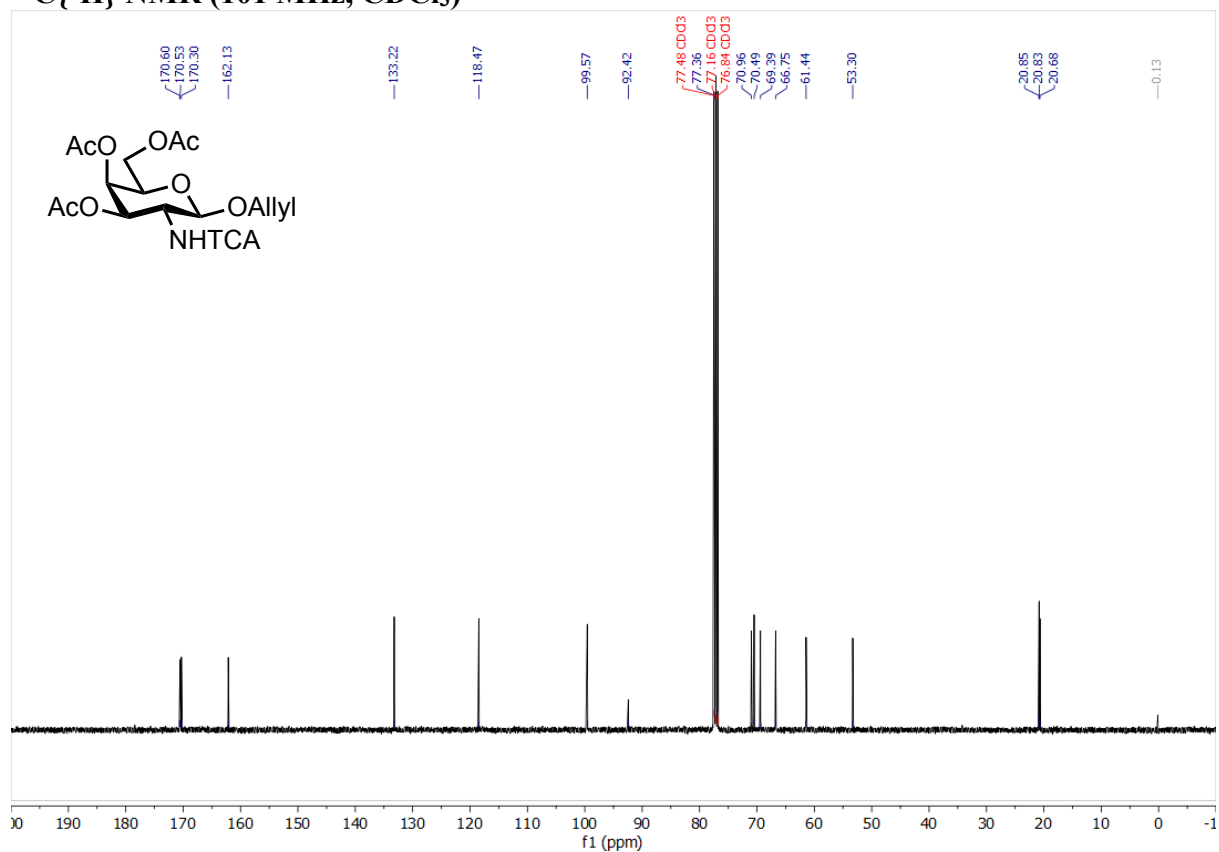
COSY NMR (400 MHz, CDCl₃)



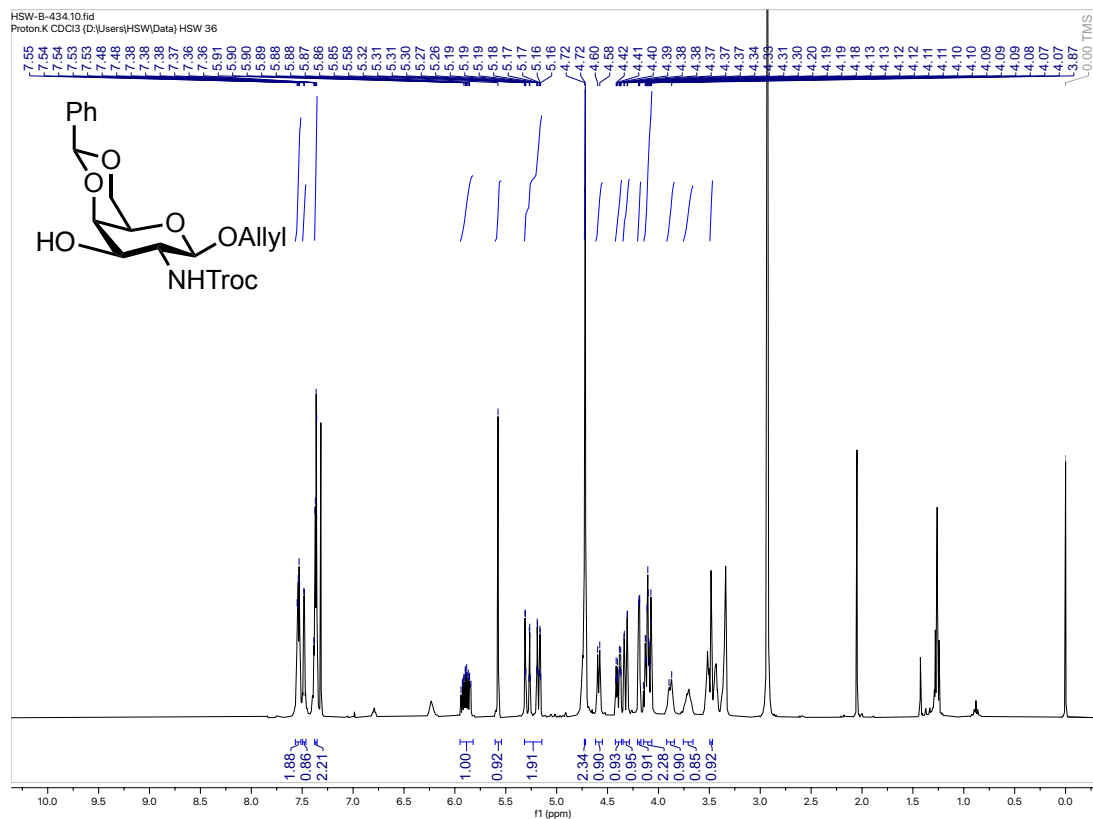
Compound 16
 ^1H NMR (400 MHz, CDCl_3)



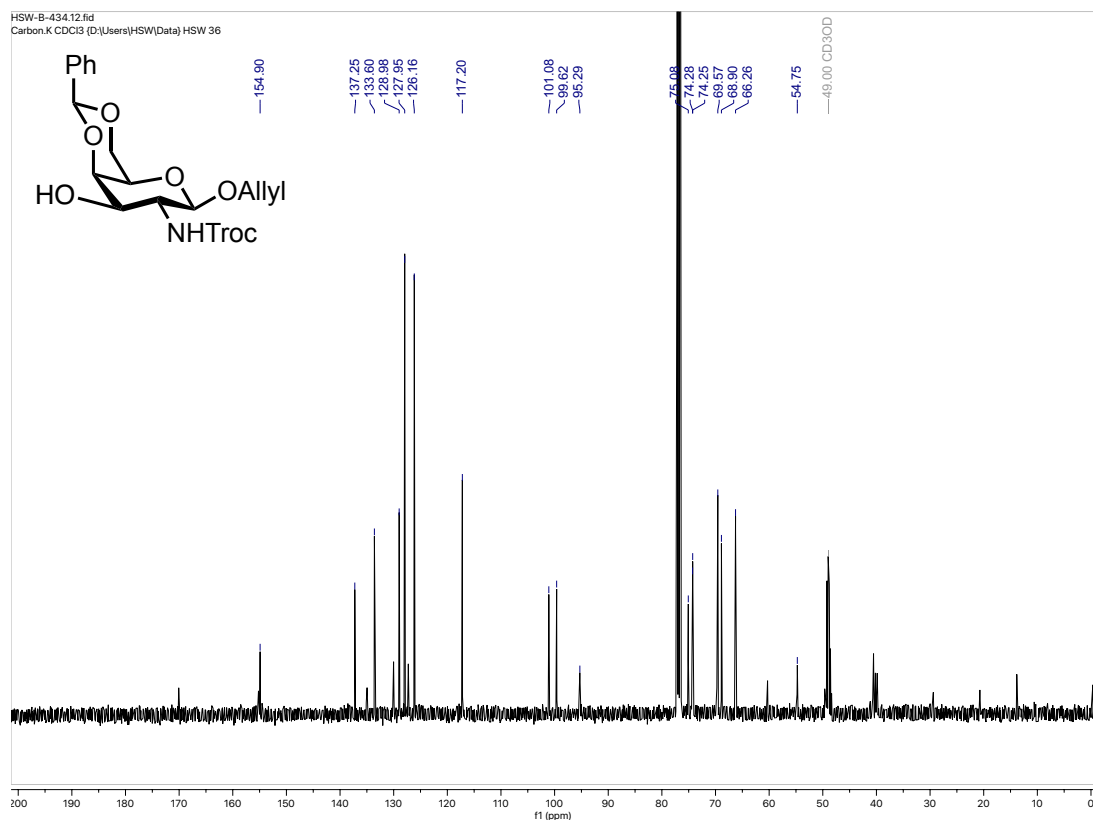
$^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, CDCl_3)



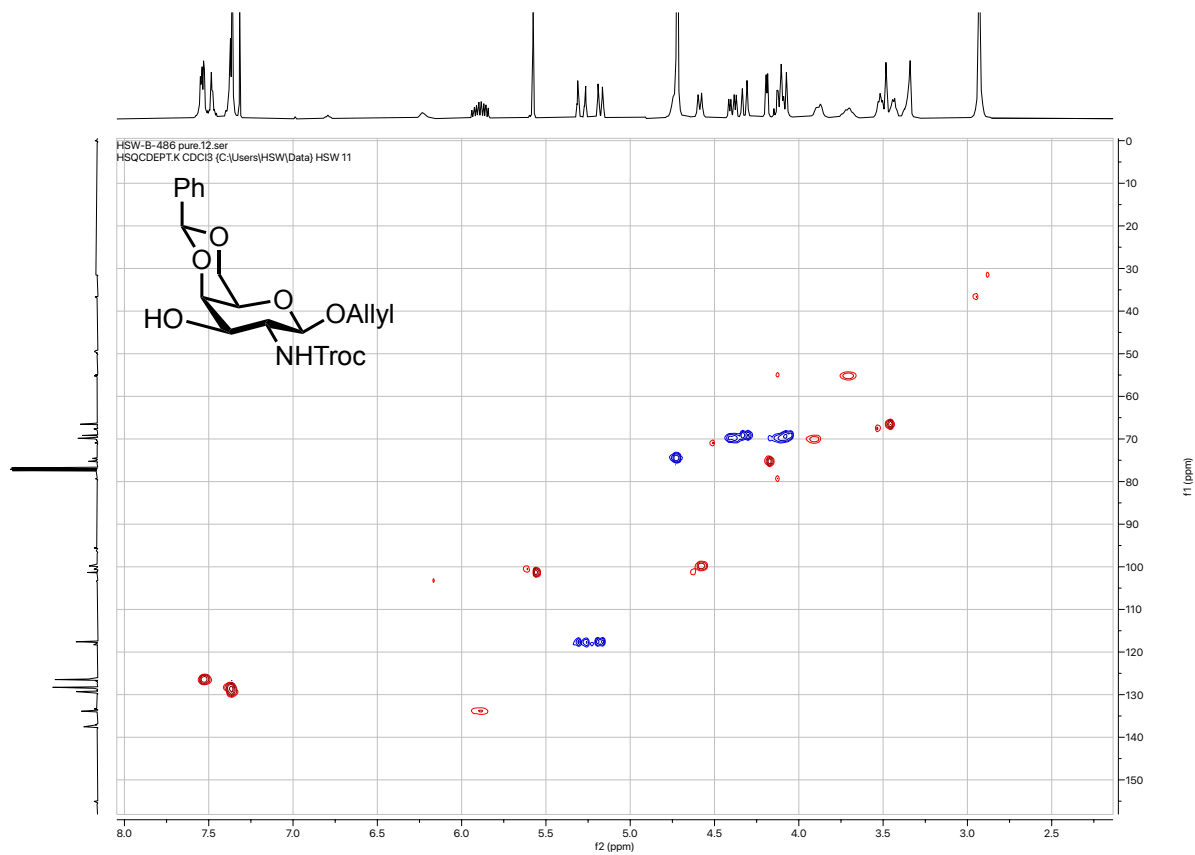
Compound 17
¹H NMR (400 MHz, CDCl₃)



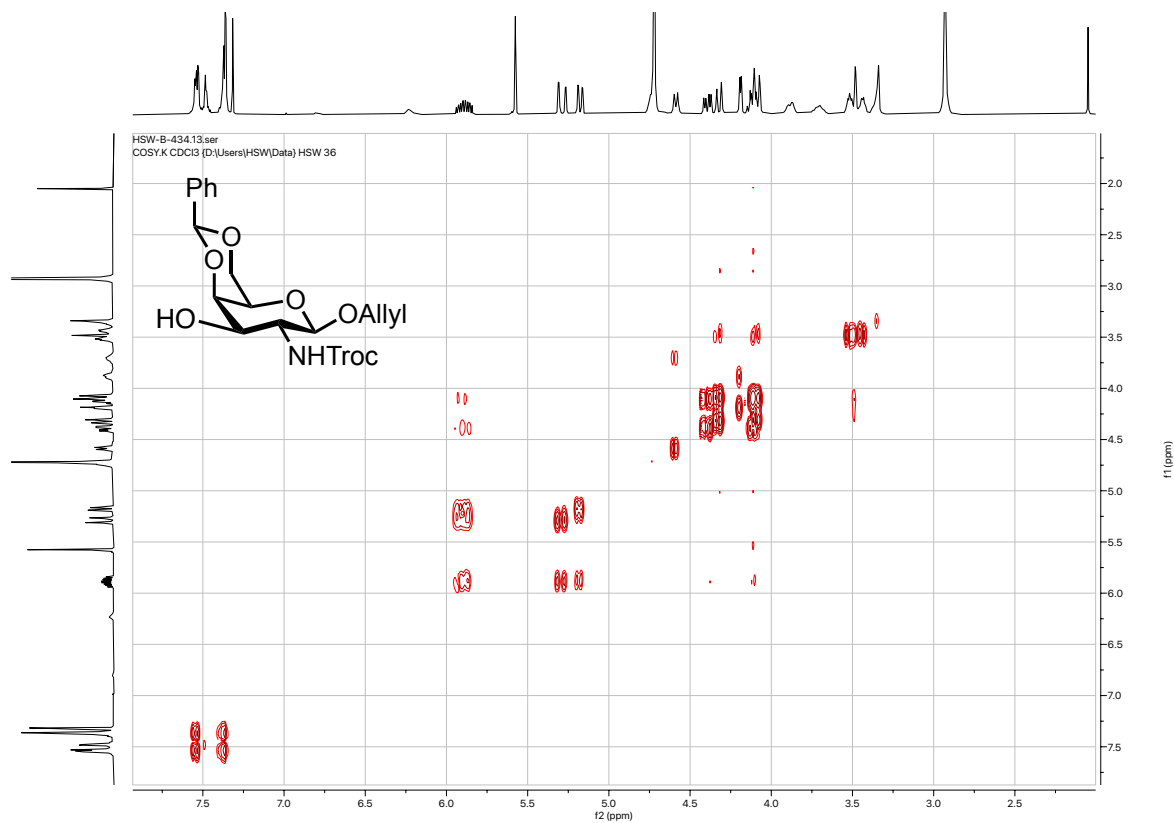
¹³C{¹H} NMR (101 MHz, CDCl₃)



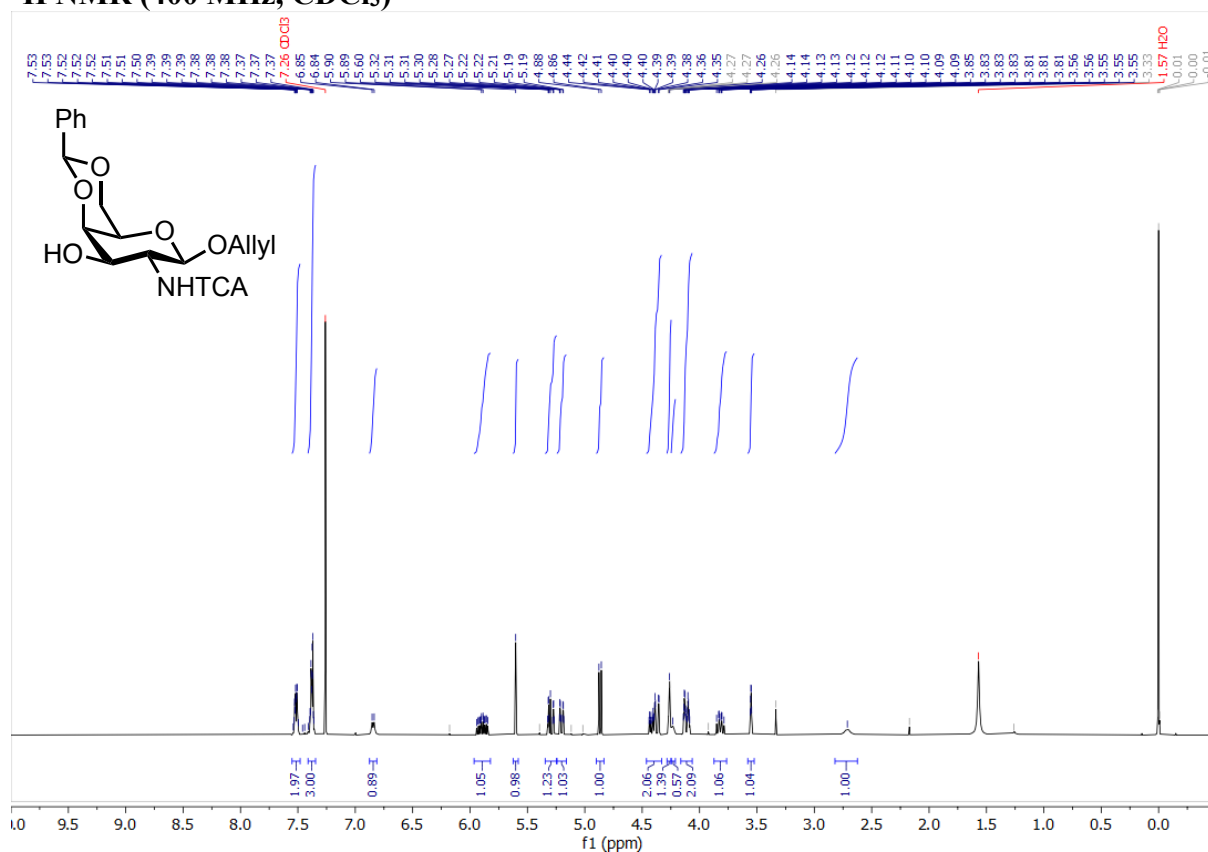
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



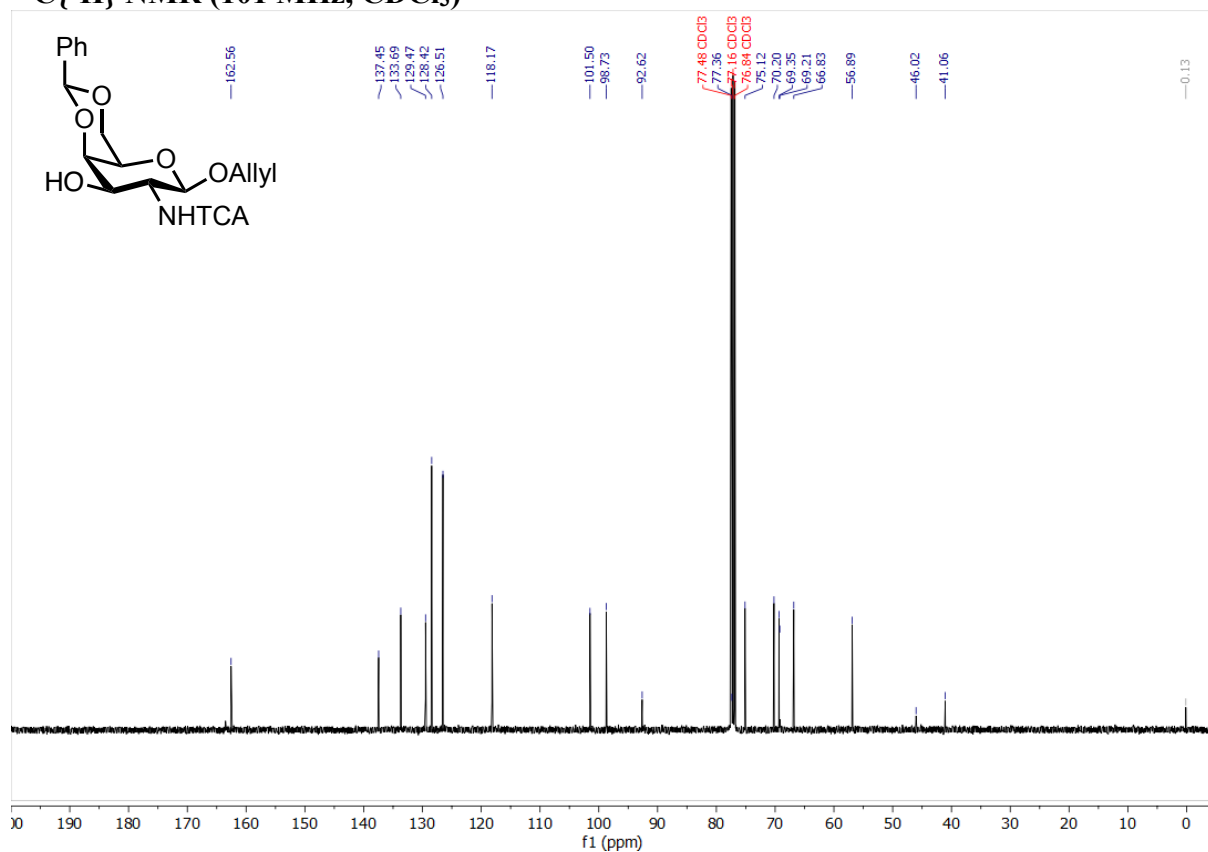
COSY NMR (400 MHz, CDCl₃)



Compound 18
¹H NMR (400 MHz, CDCl₃)



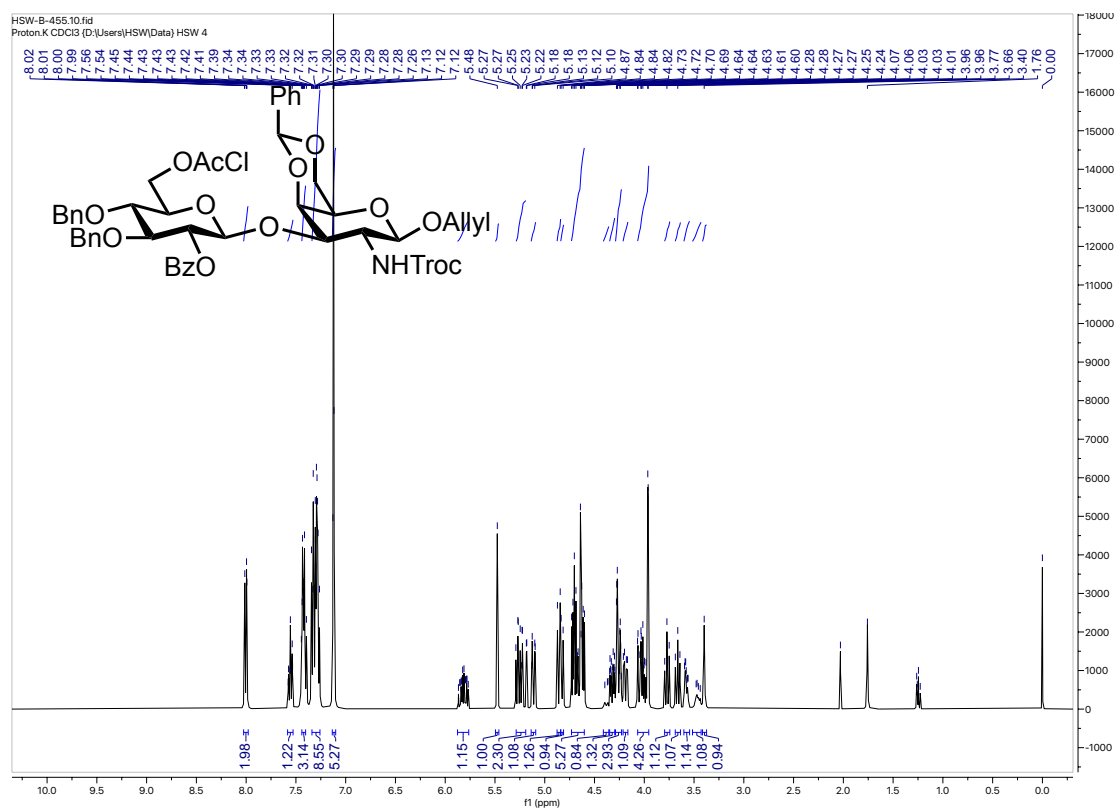
¹³C{¹H} NMR (101 MHz, CDCl₃)



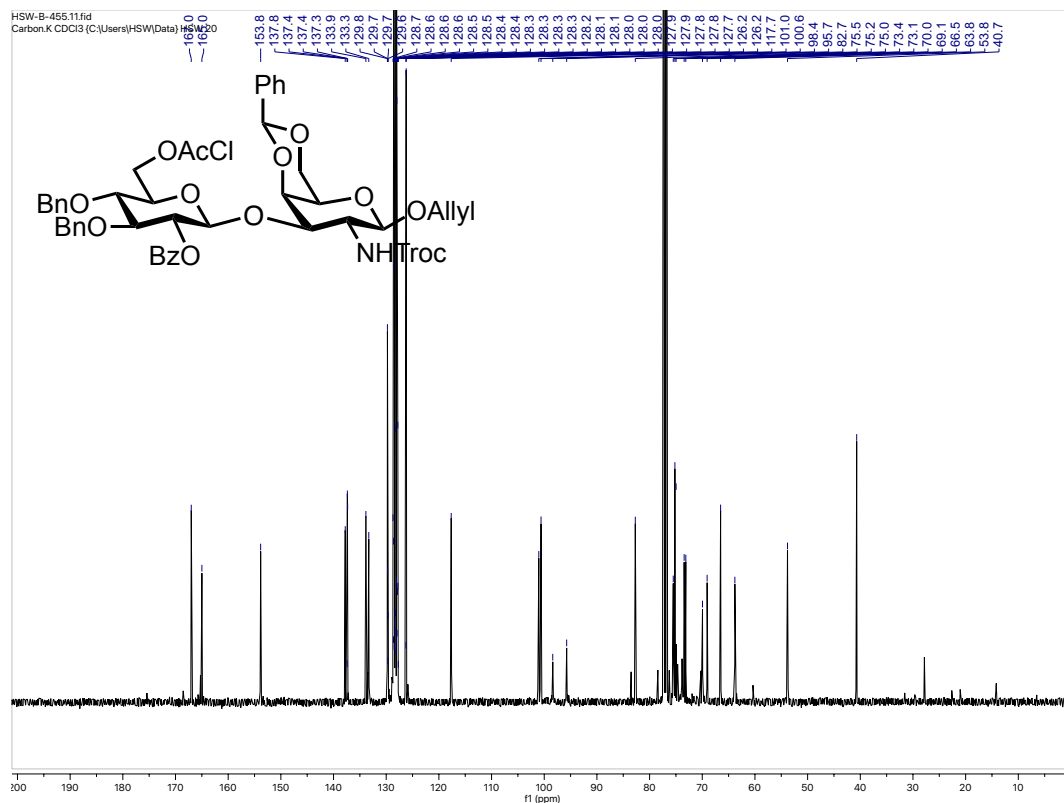
CS Disaccharide Precursor Synthesis

Compound 19

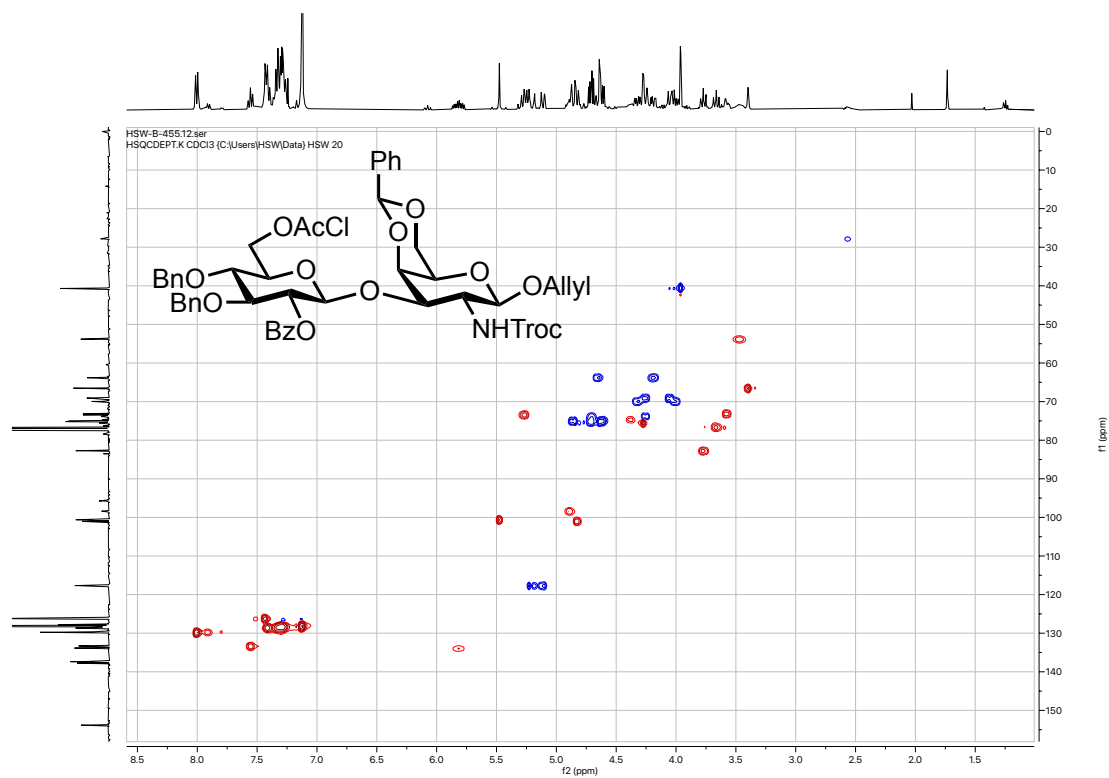
^1H NMR (400 MHz, CDCl_3)



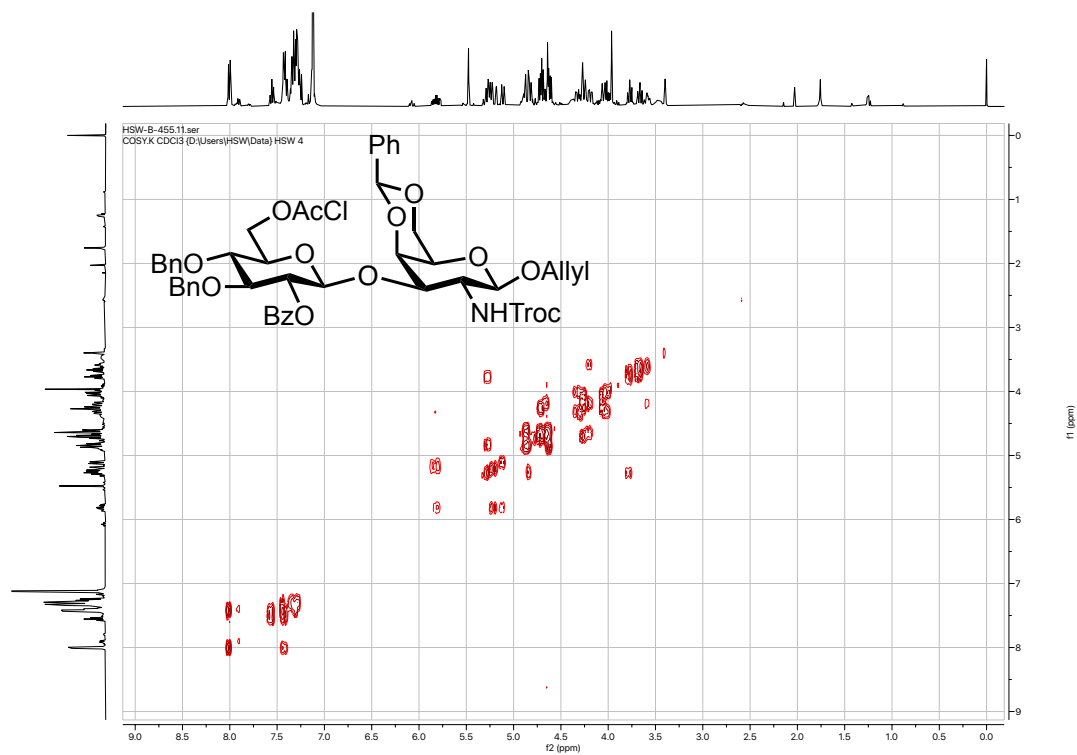
$^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, CDCl_3)



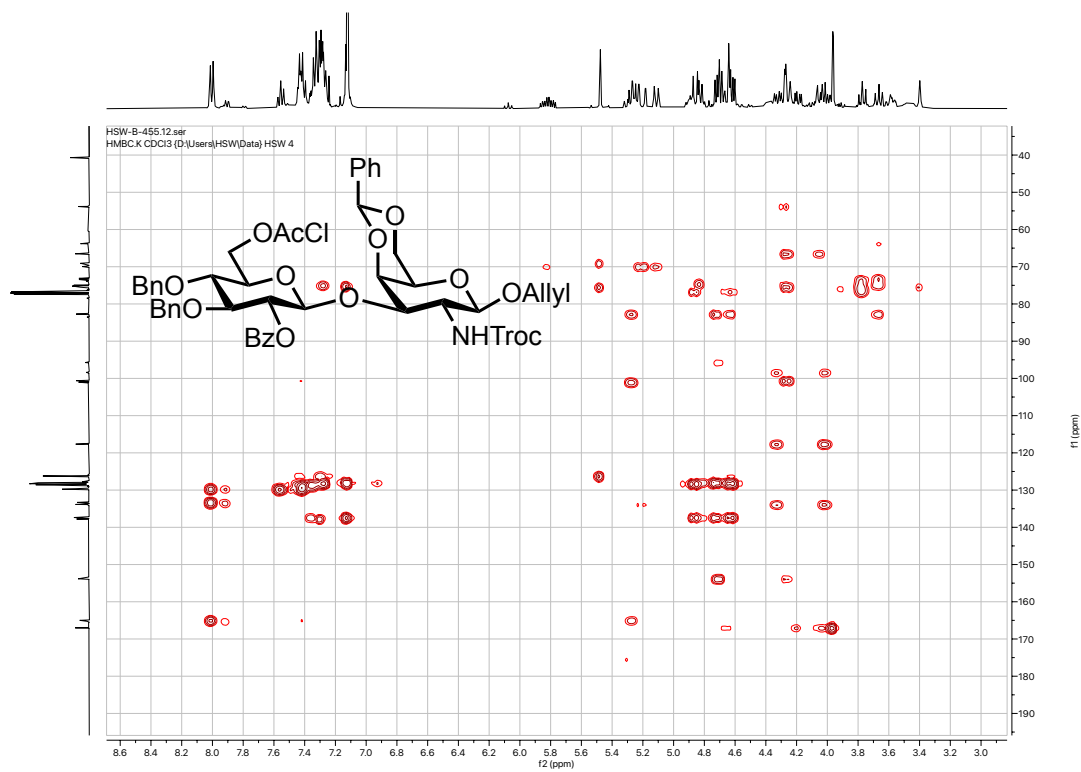
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



COSY NMR (400 MHz, CDCl₃)

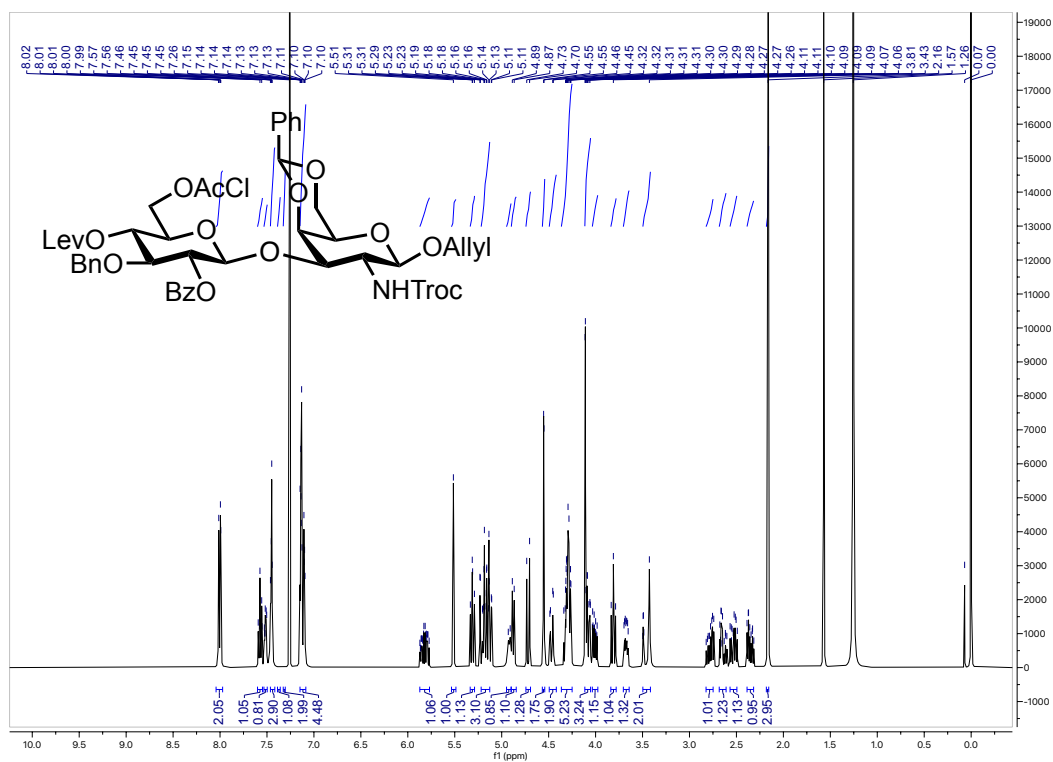


HMBC NMR (400 MHz × 101 MHz, CDCl₃)

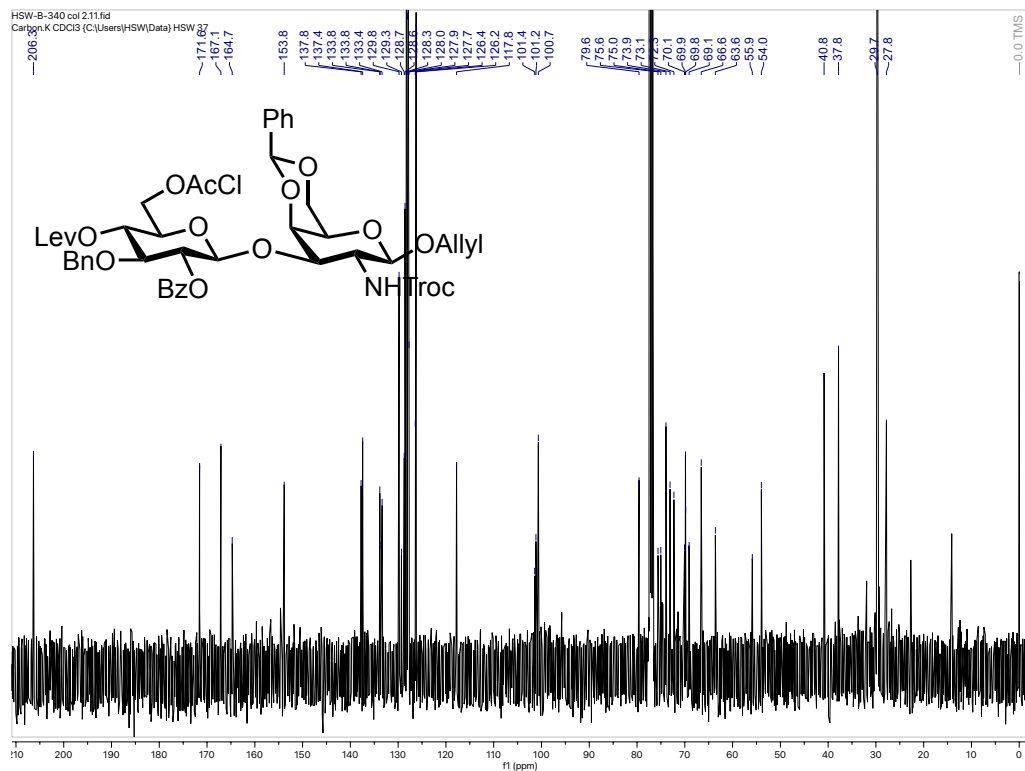


Compound 20

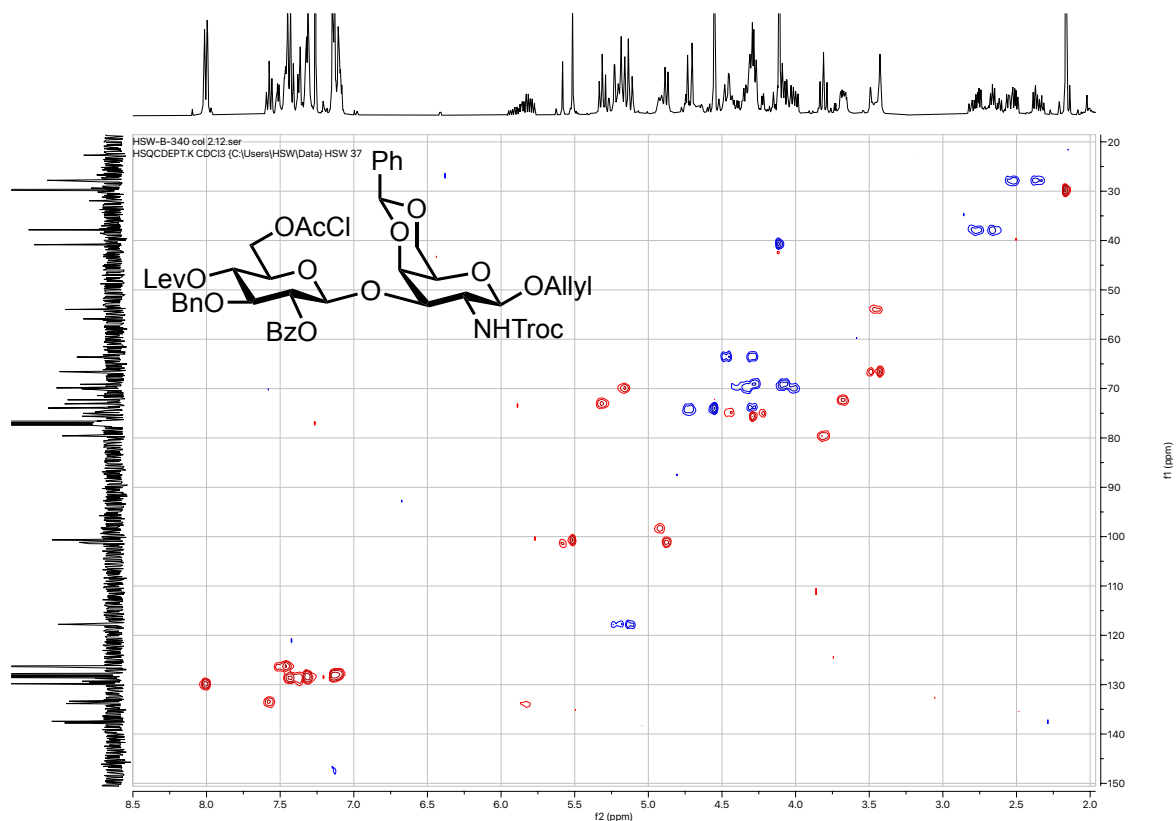
^1H NMR (400 MHz, CDCl_3)



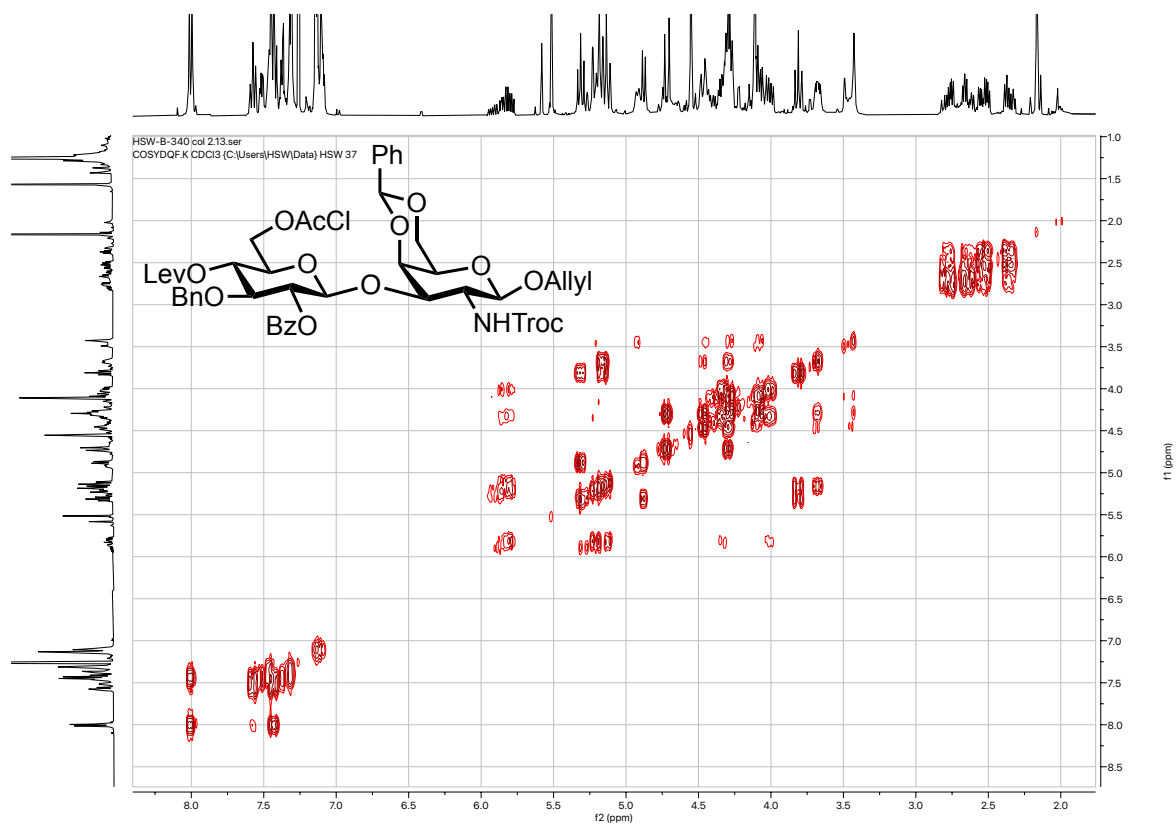
$^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, CDCl_3)



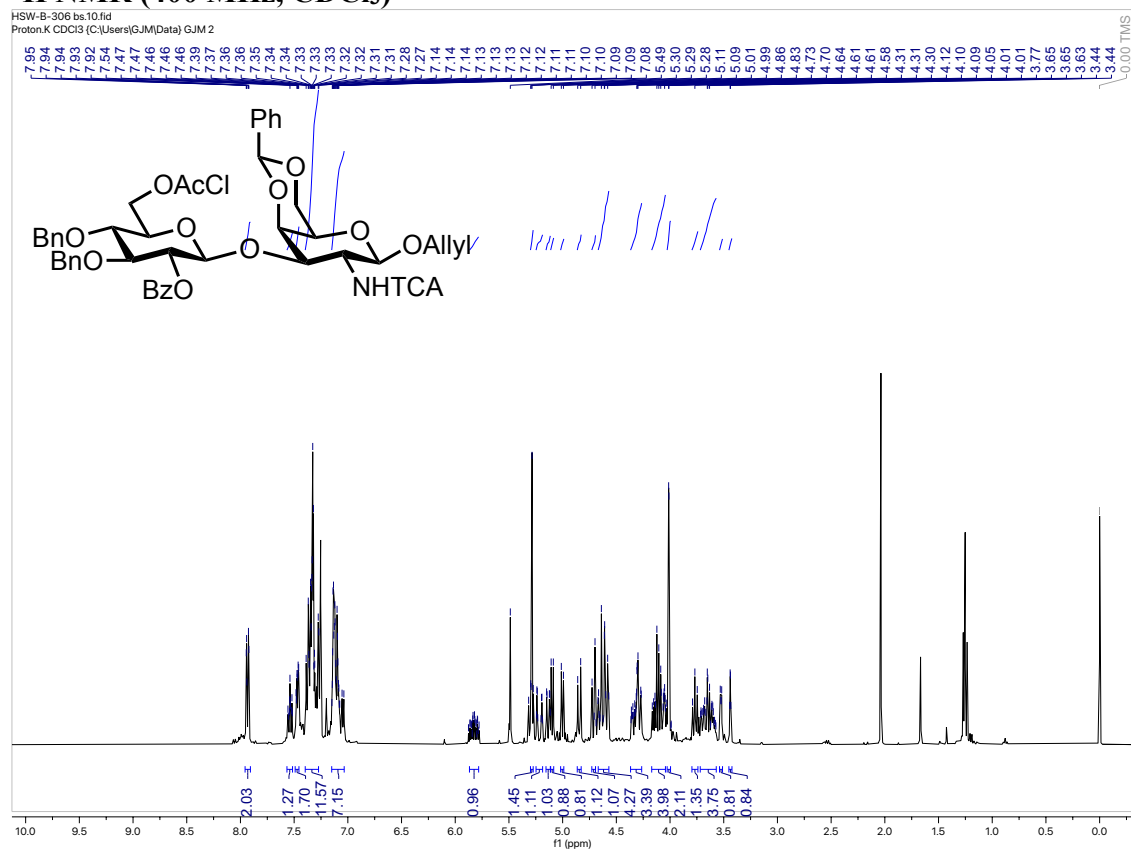
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



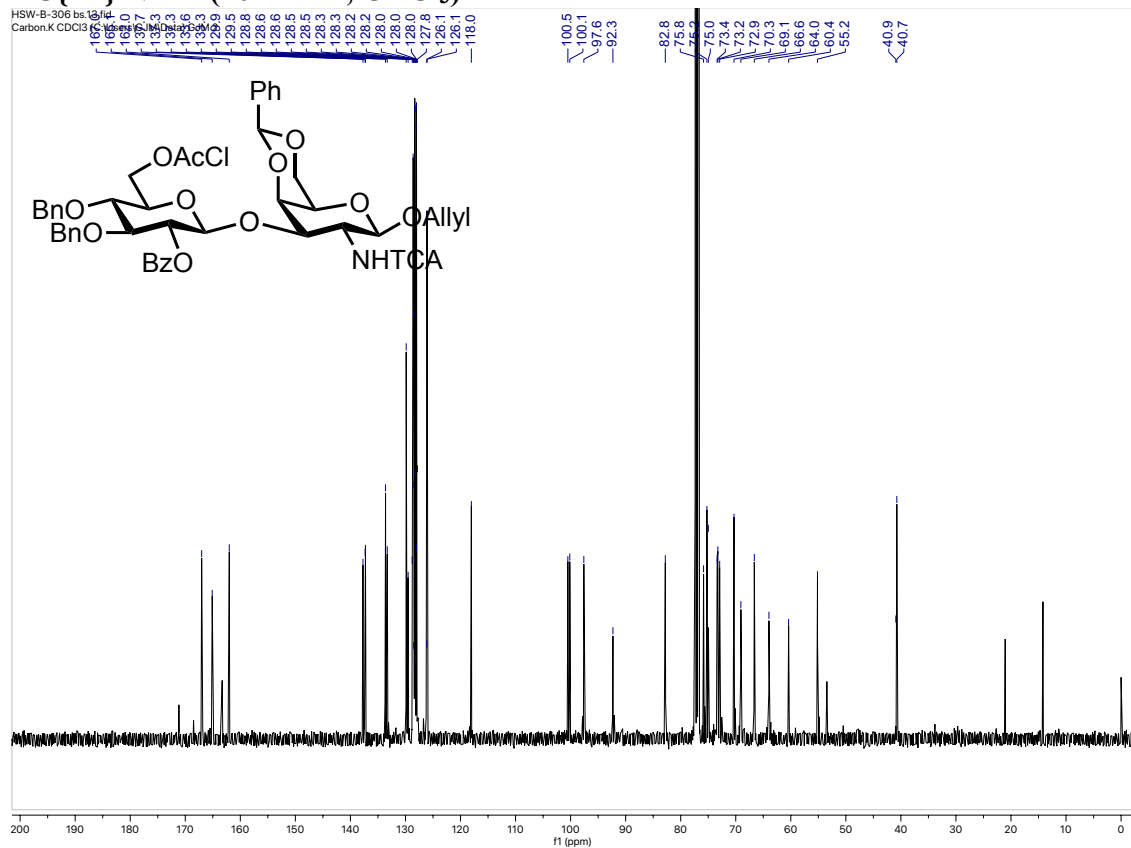
COSY NMR (400 MHz, CDCl₃)



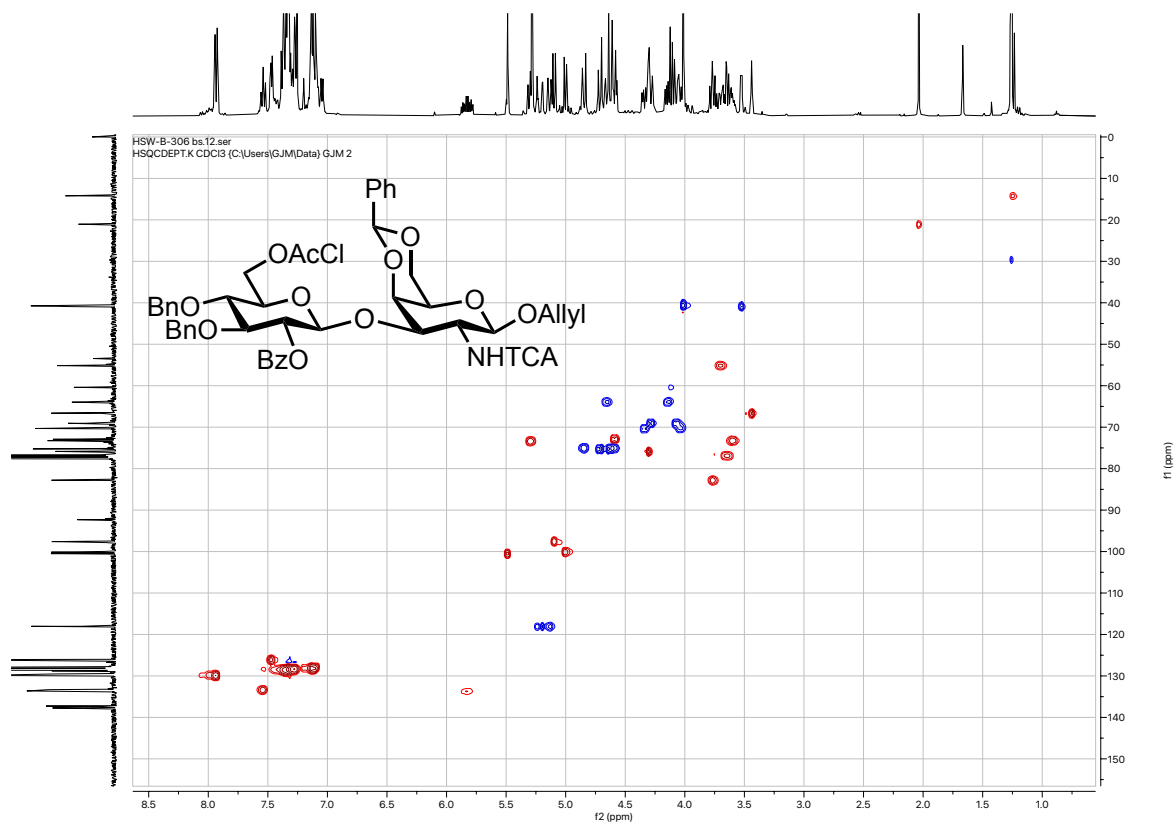
Compound 21
¹H NMR (400 MHz, CDCl₃)



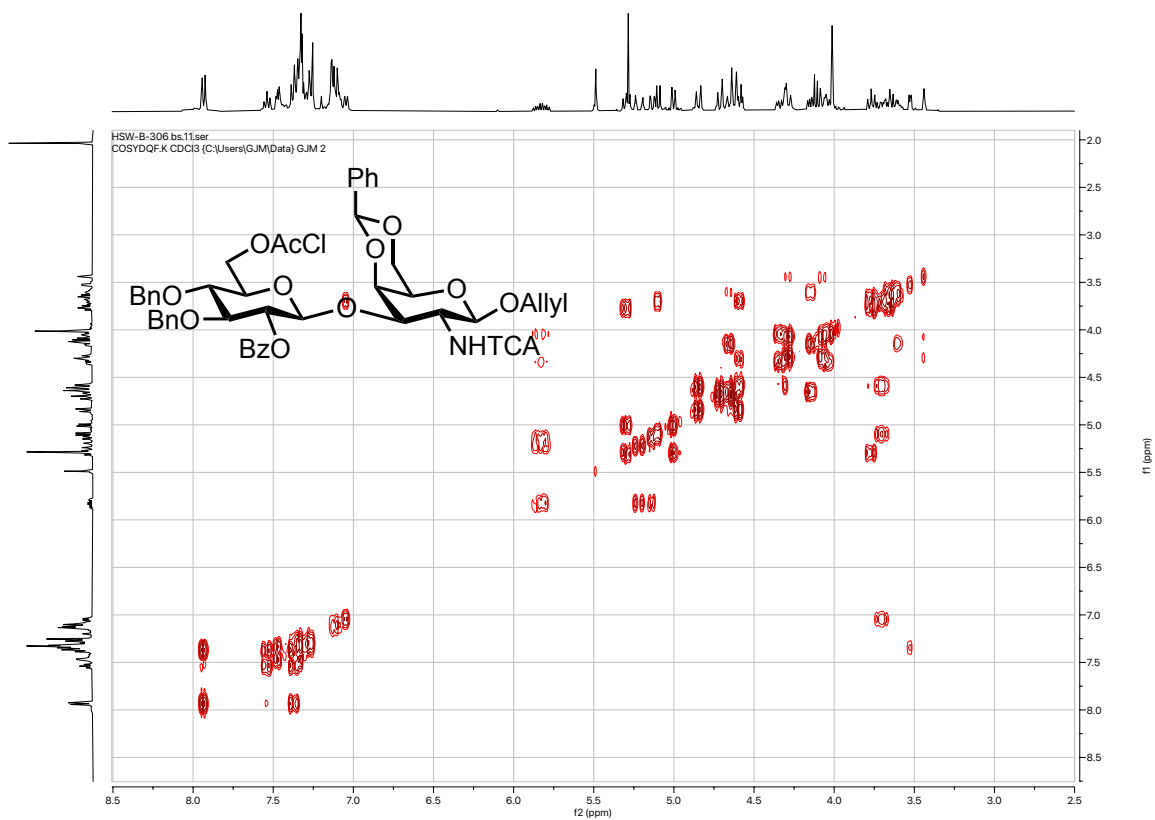
¹³C{¹H} NMR (101 MHz, CDCl₃)



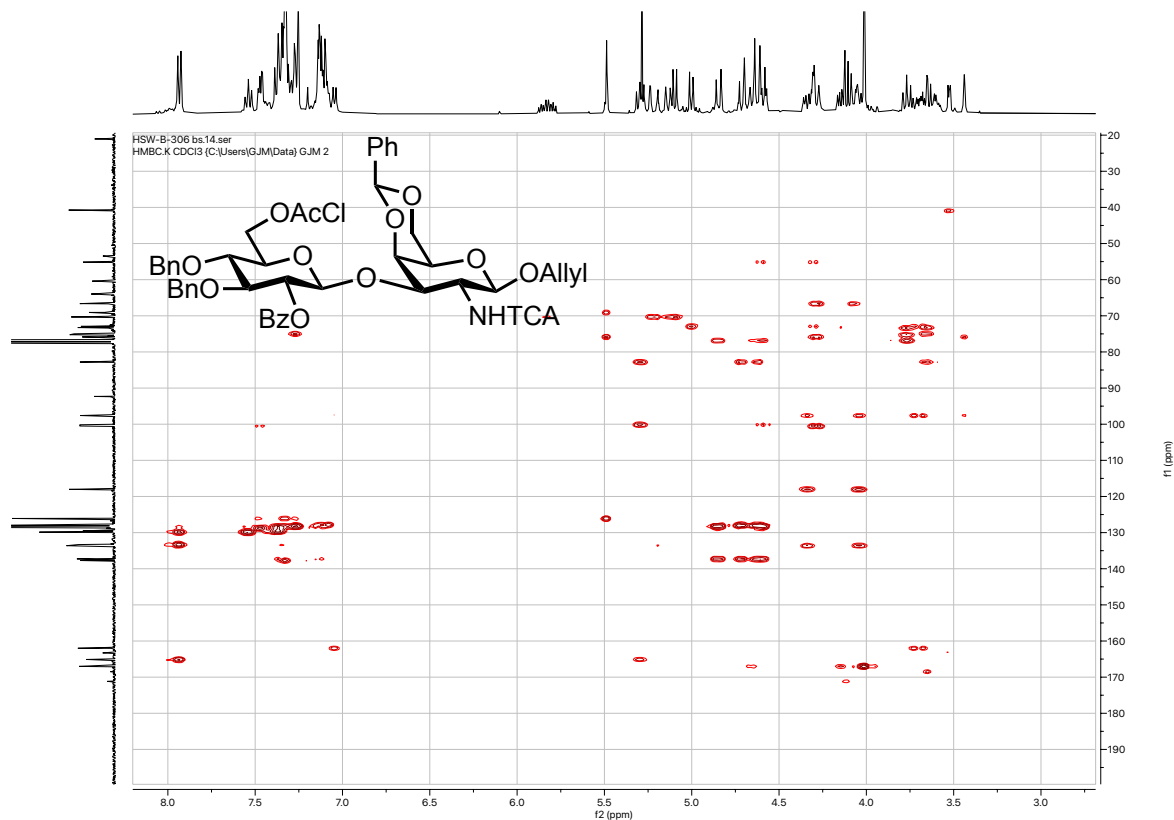
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



COSY NMR (400 MHz, CDCl₃)

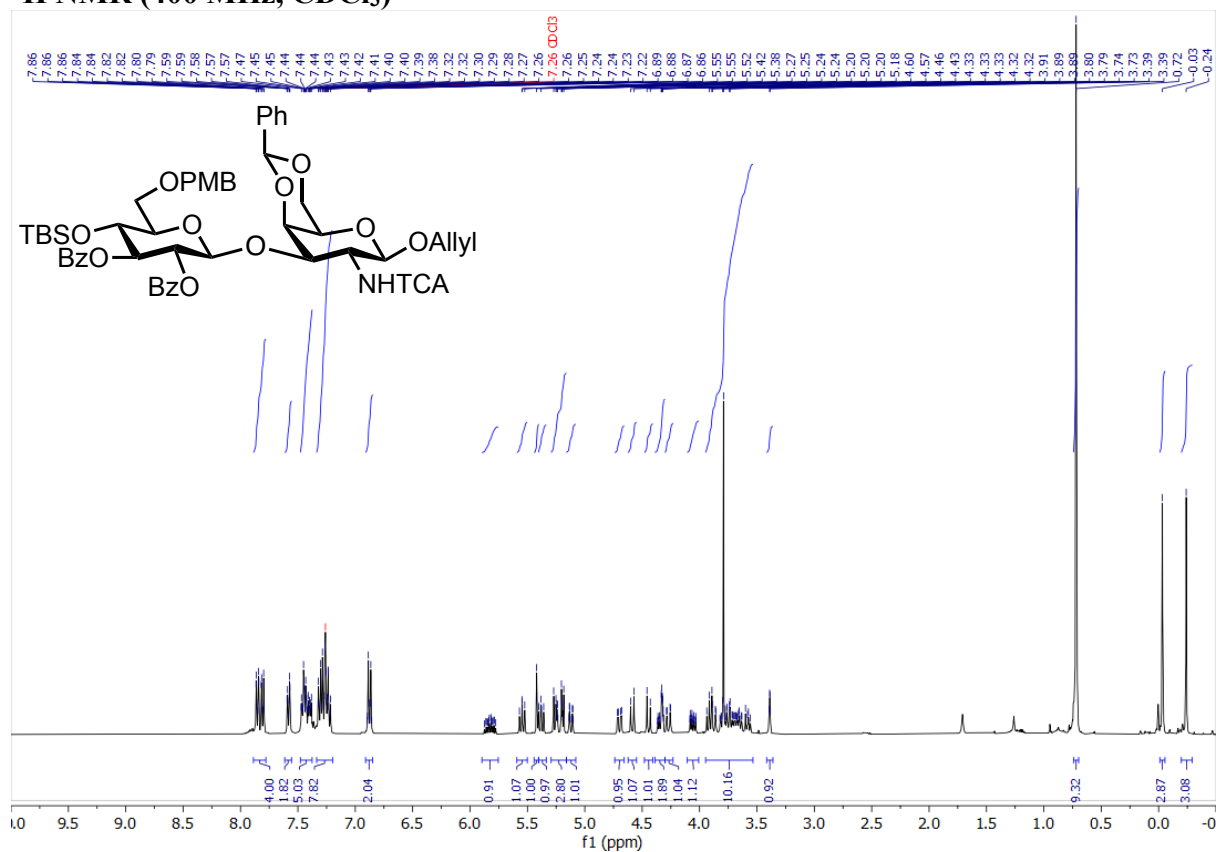


HMBC NMR (400 MHz × 101 MHz, CDCl₃)

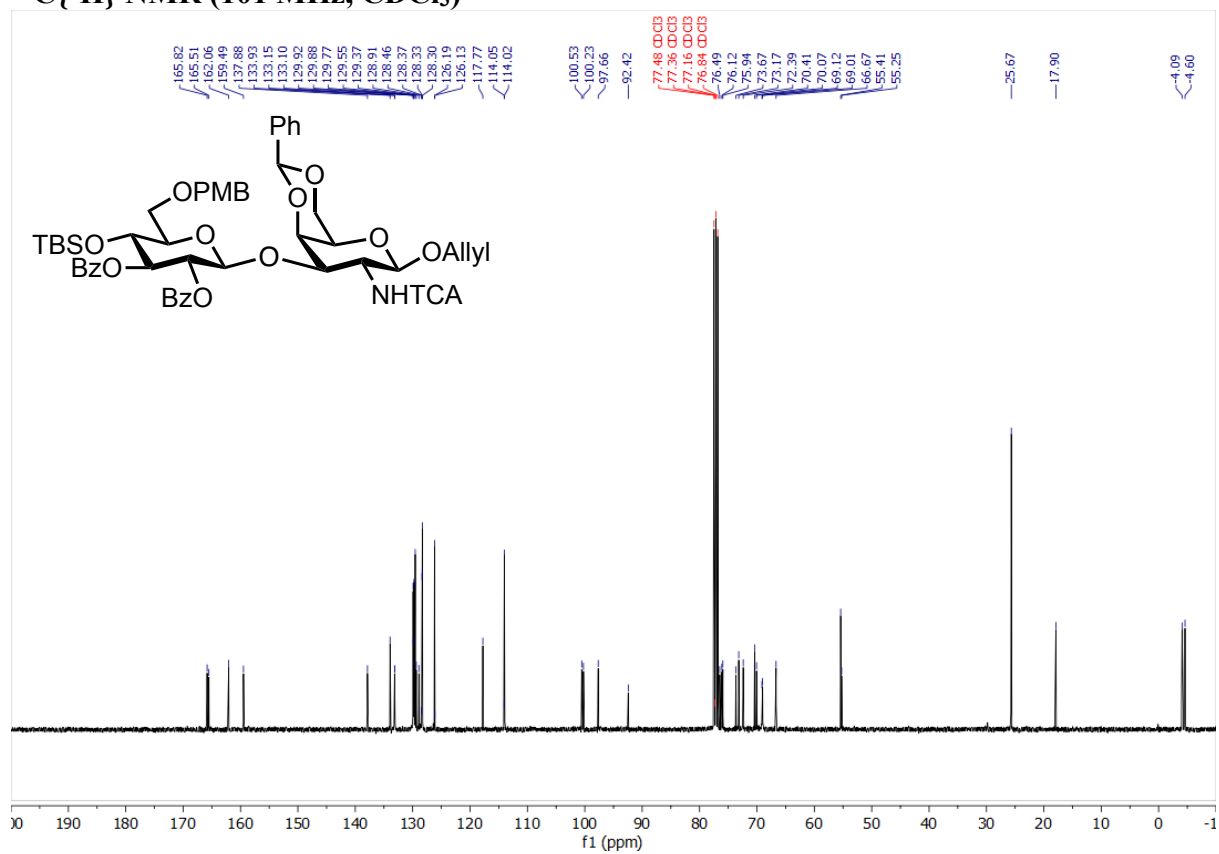


Compound 22

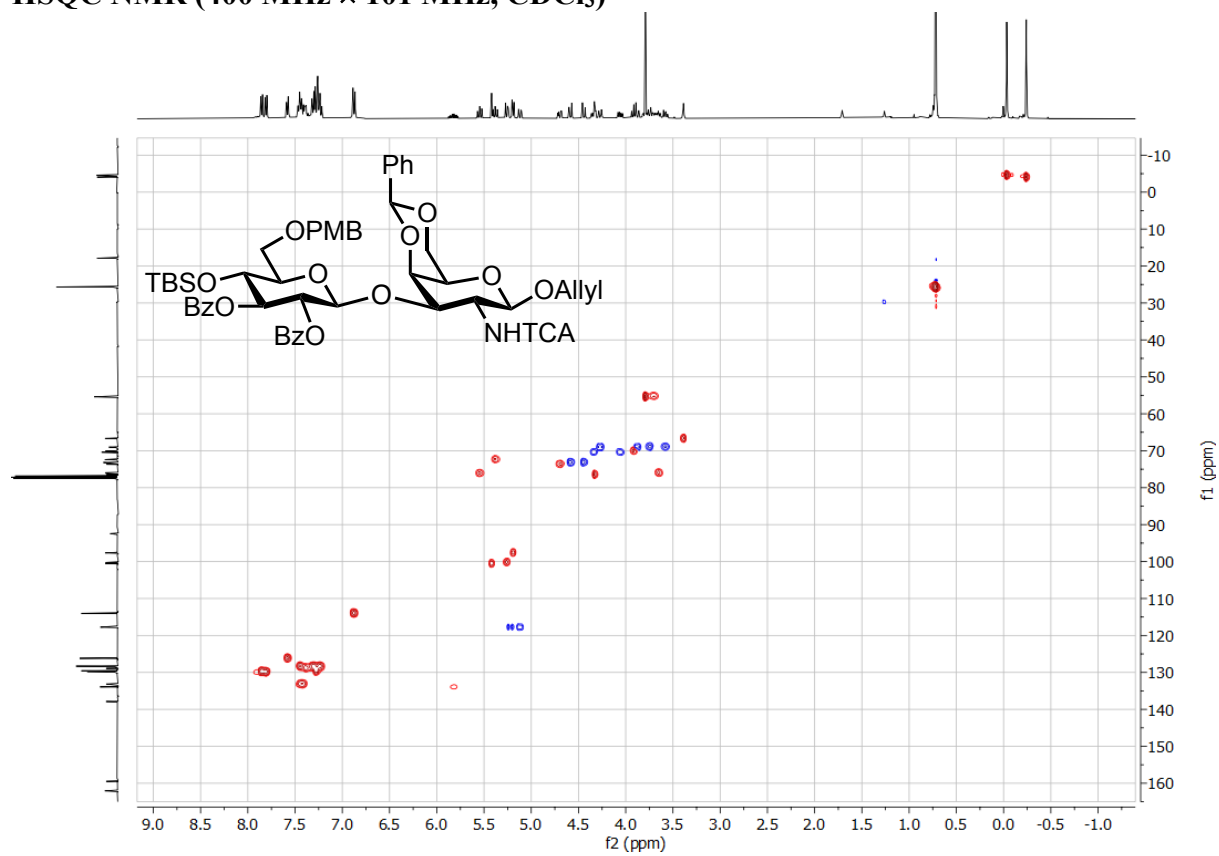
¹H NMR (400 MHz, CDCl₃)



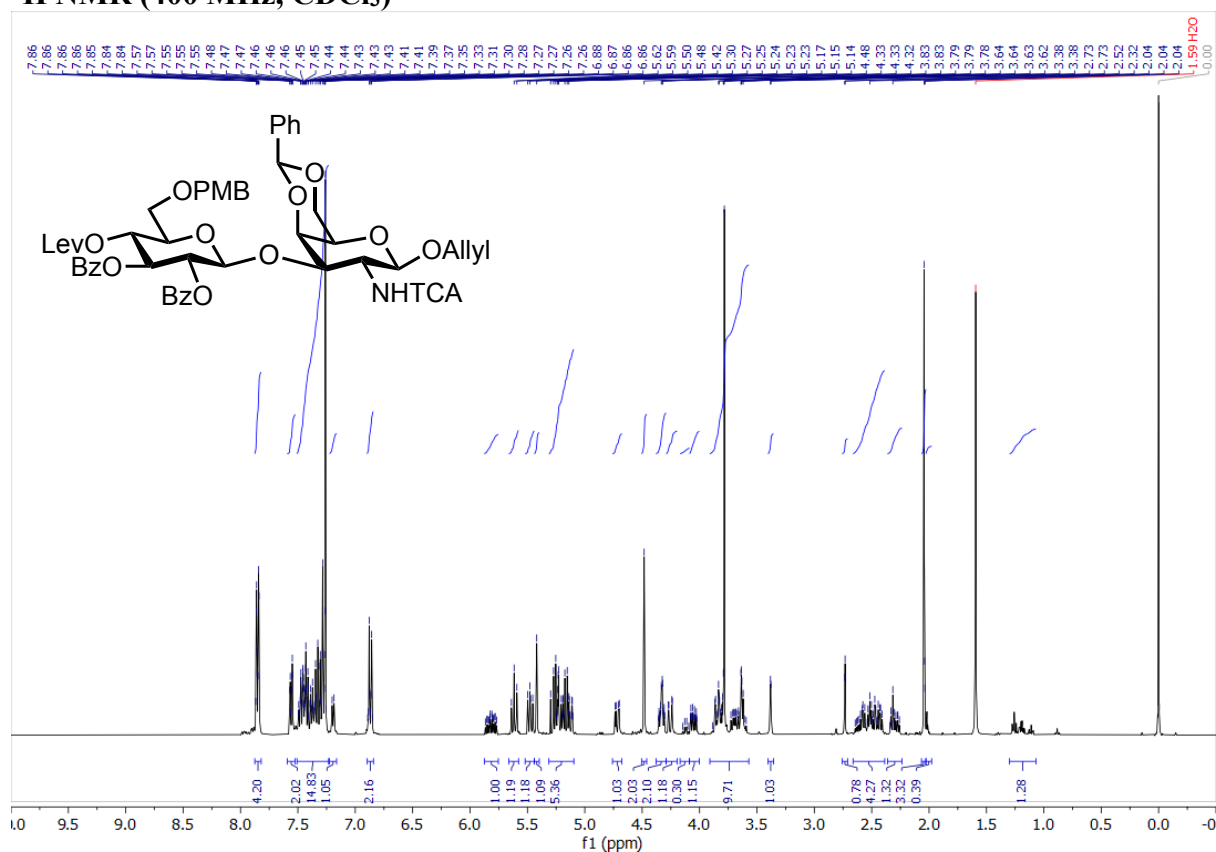
$^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, CDCl_3)



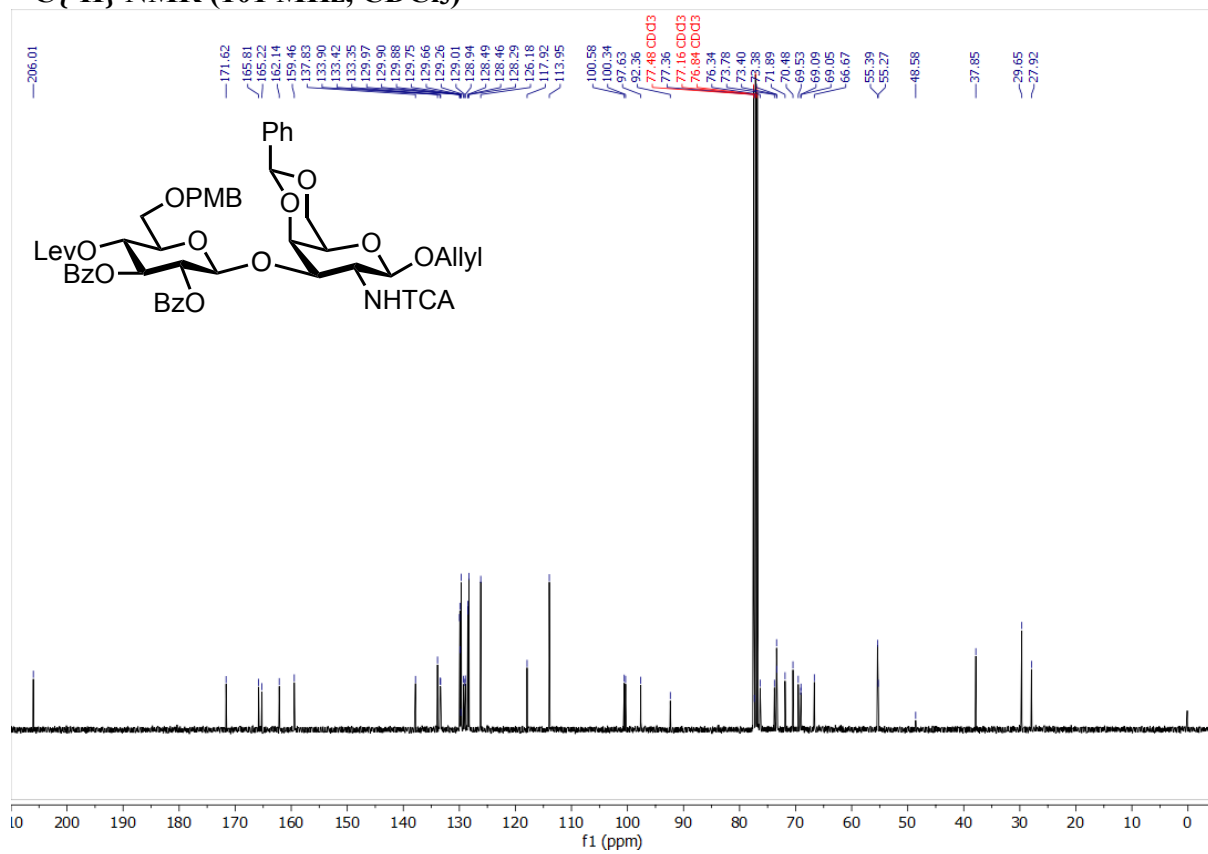
HSQC NMR (400 MHz \times 101 MHz, CDCl_3)



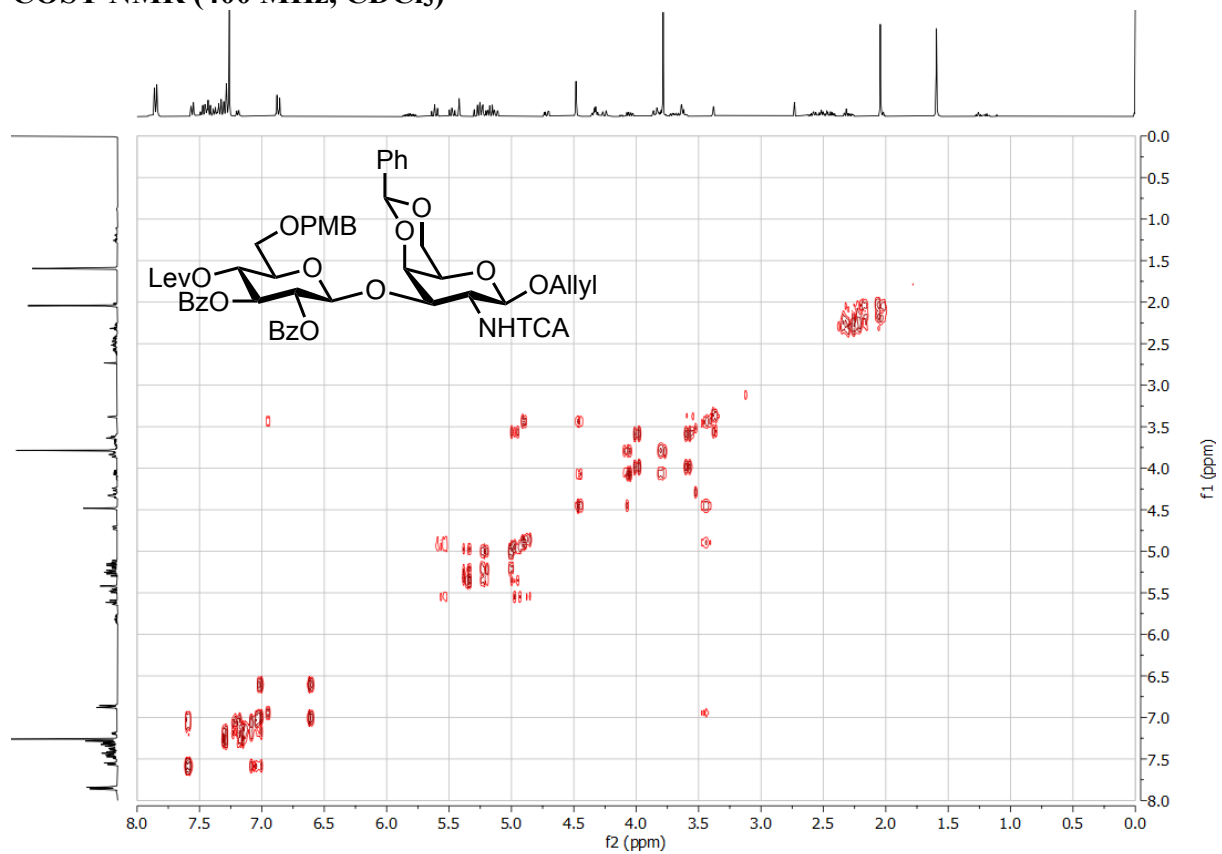
Compound 23
¹H NMR (400 MHz, CDCl₃)



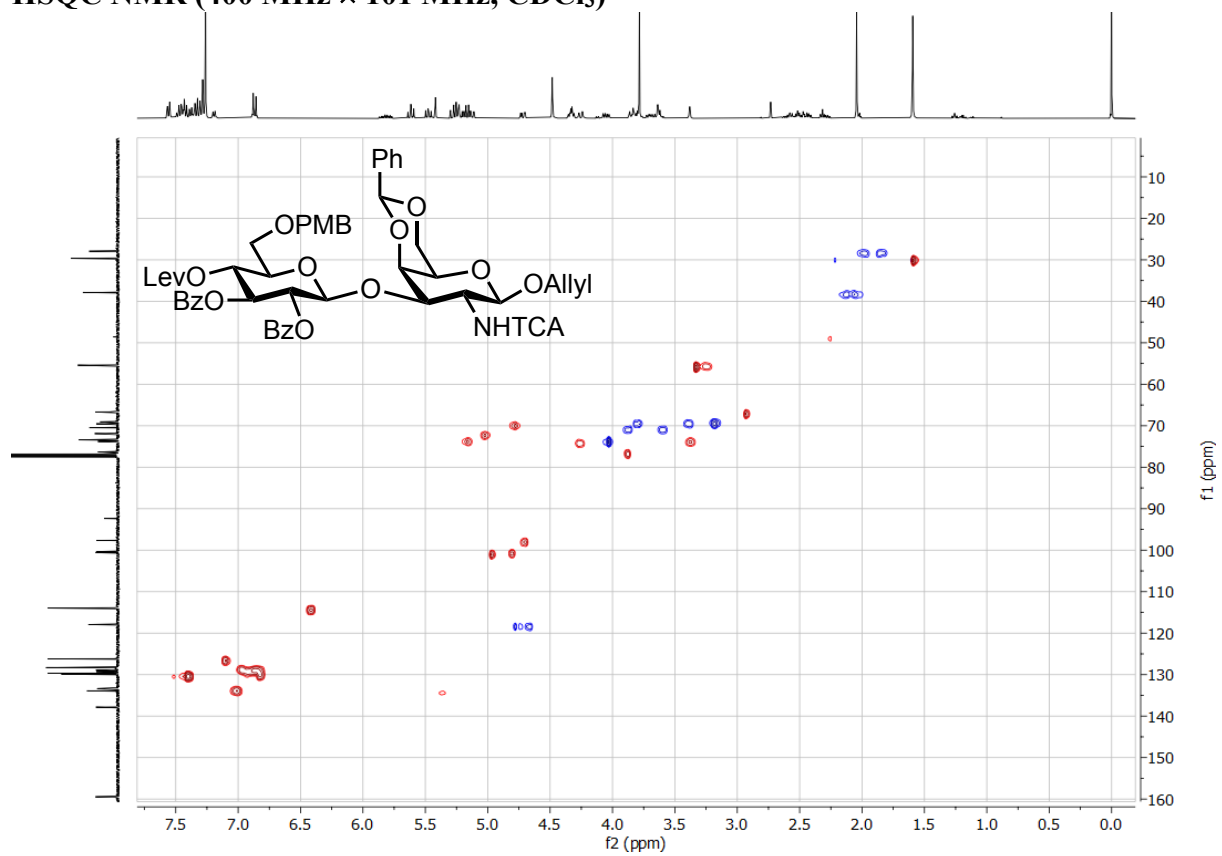
¹³C{¹H} NMR (101 MHz, CDCl₃)



COSY NMR (400 MHz, CDCl₃)



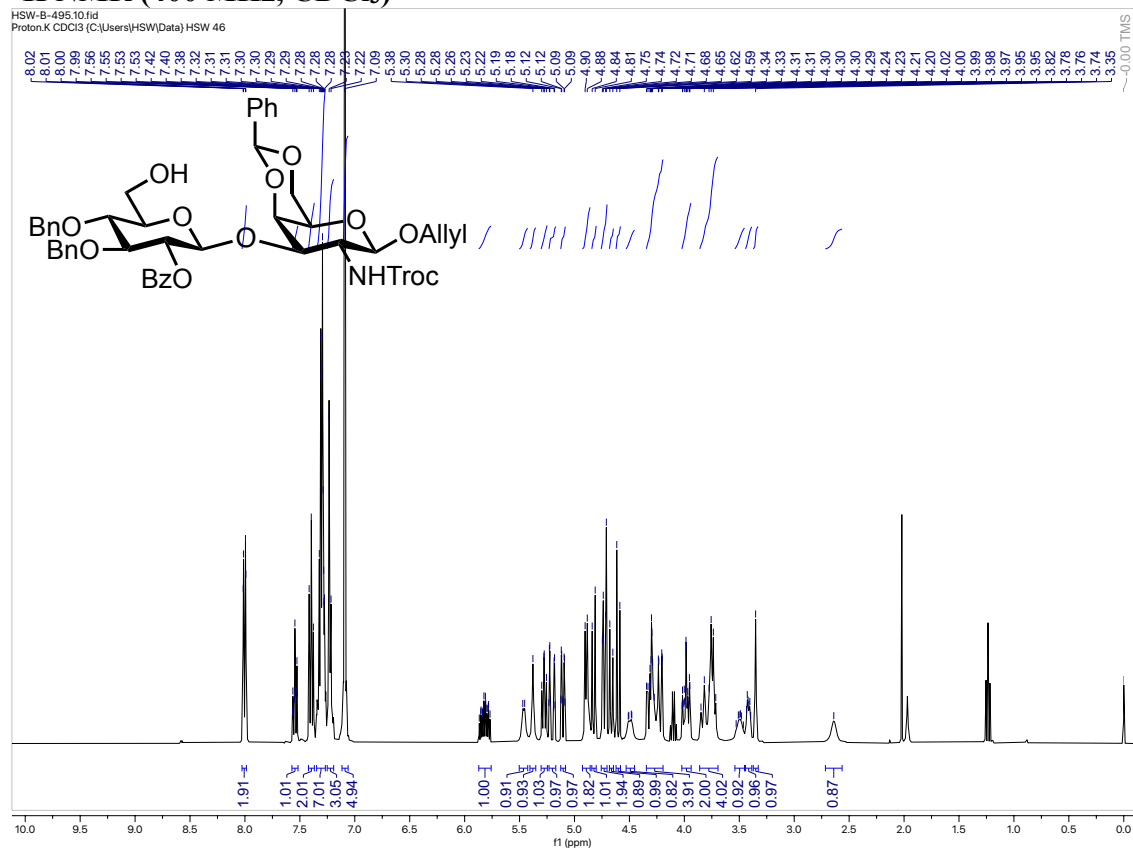
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



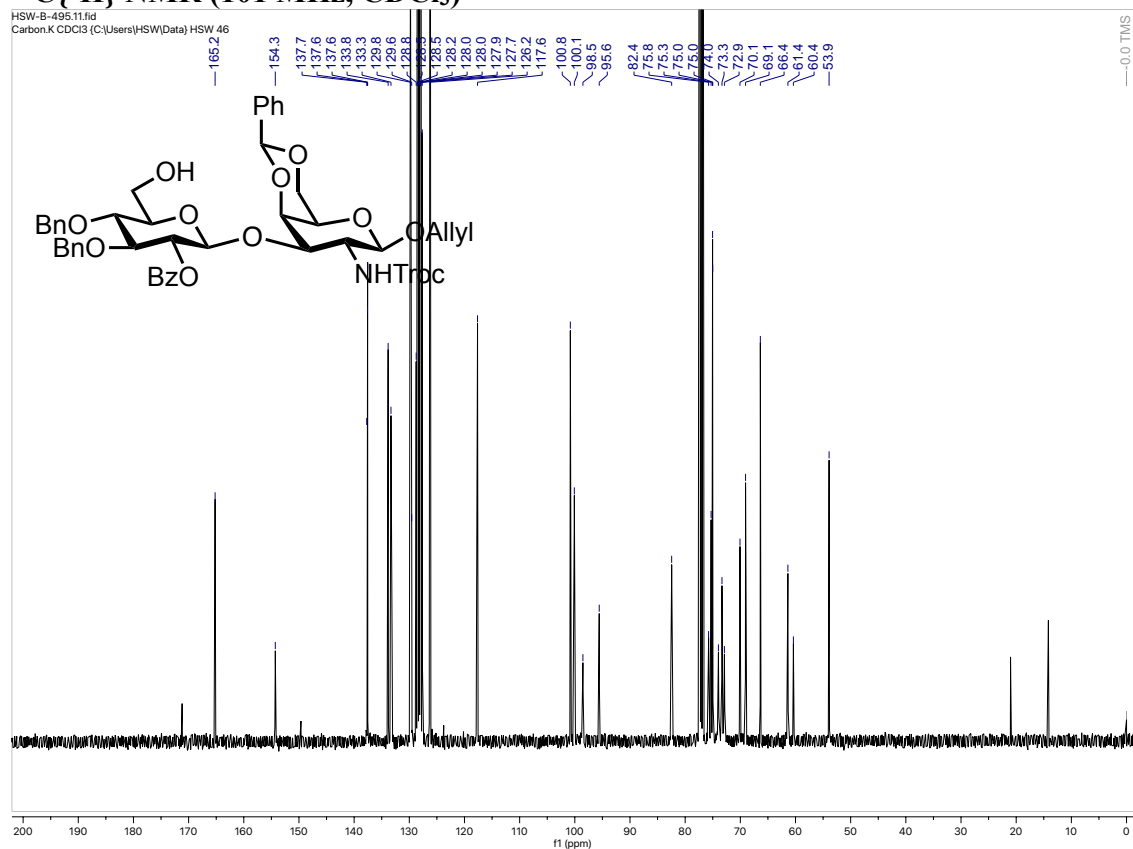
Access to CS precursor disaccharide library

Compound S7

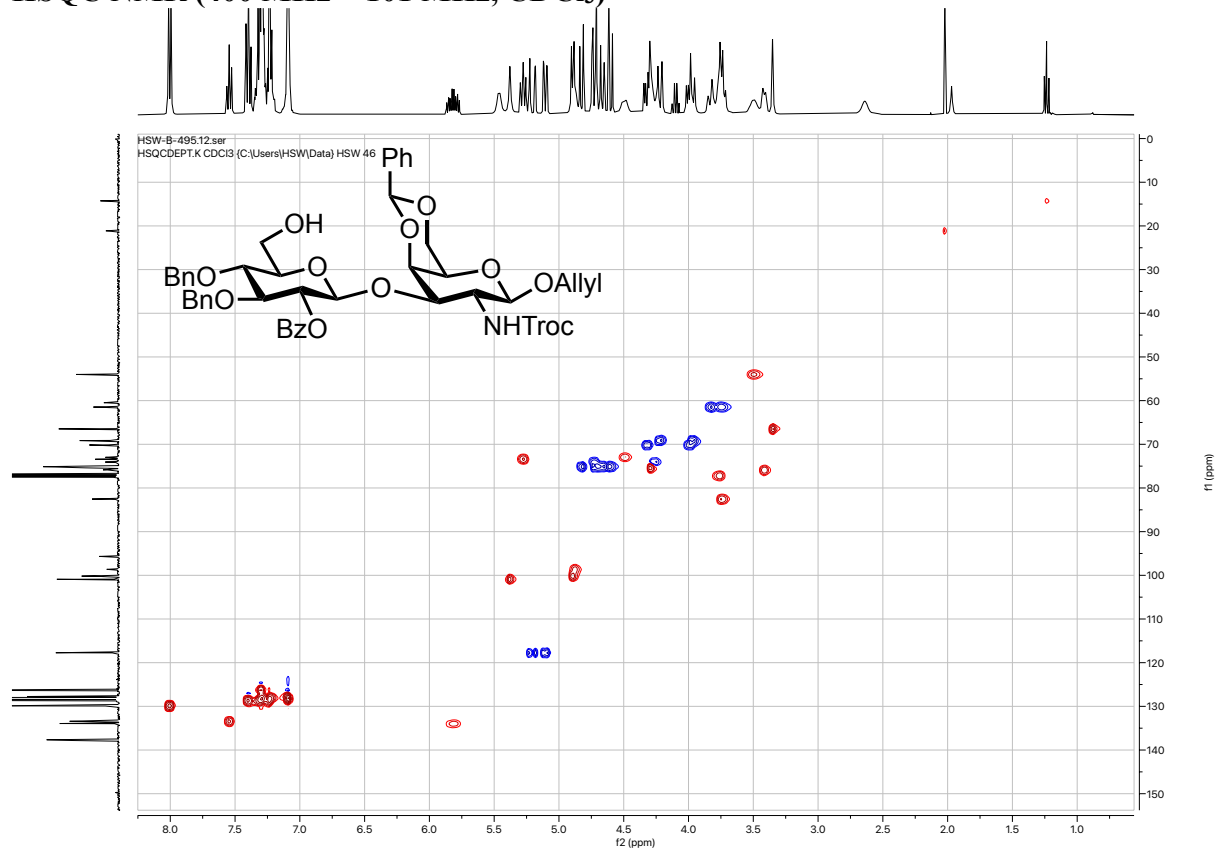
¹H NMR (400 MHz, CDCl₃)



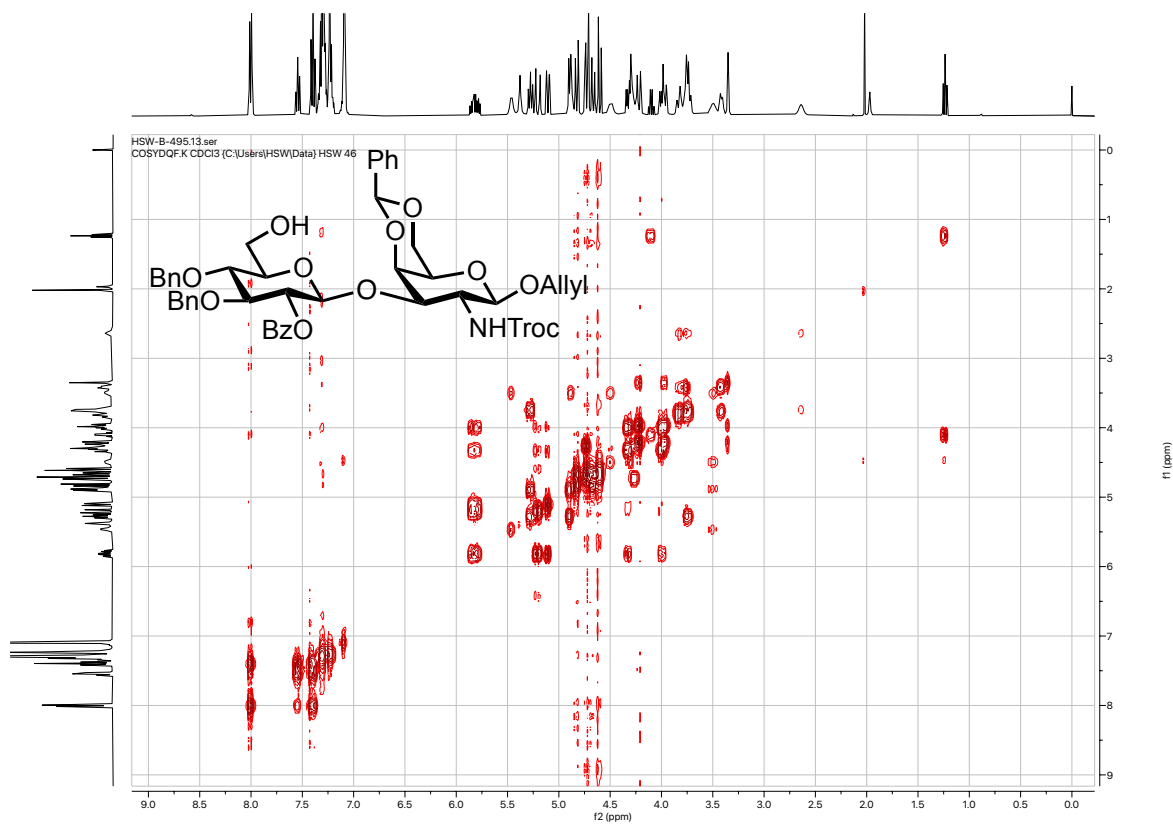
¹³C{¹H} NMR (101 MHz, CDCl₃)



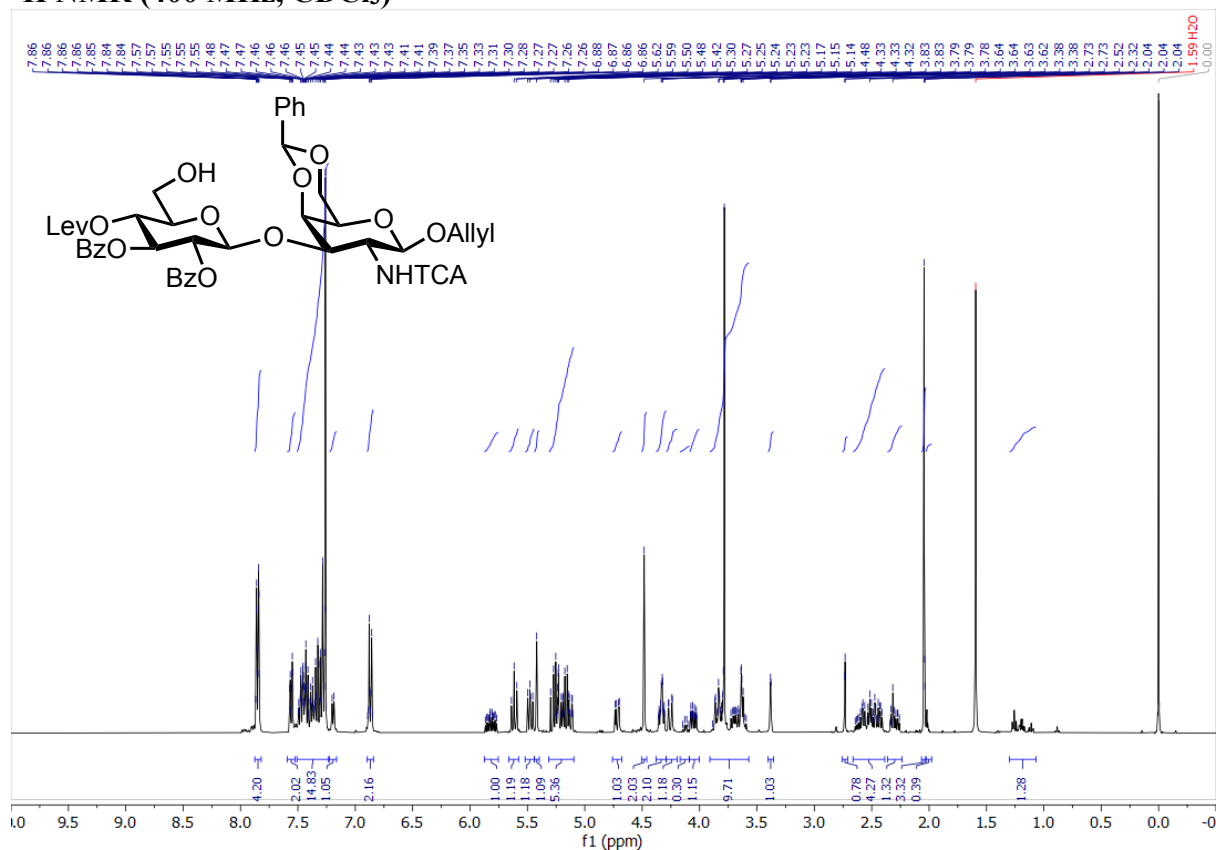
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



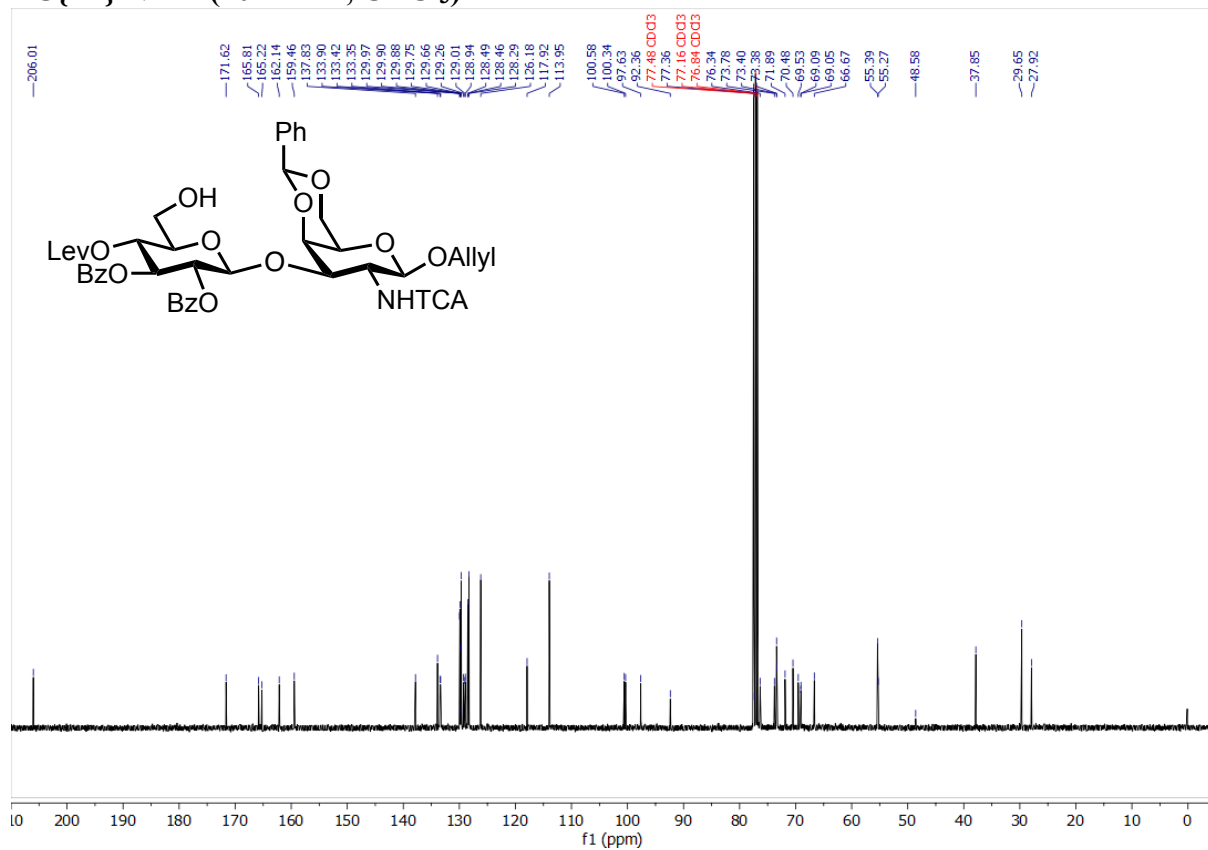
COSY NMR (400 MHz, CDCl₃)



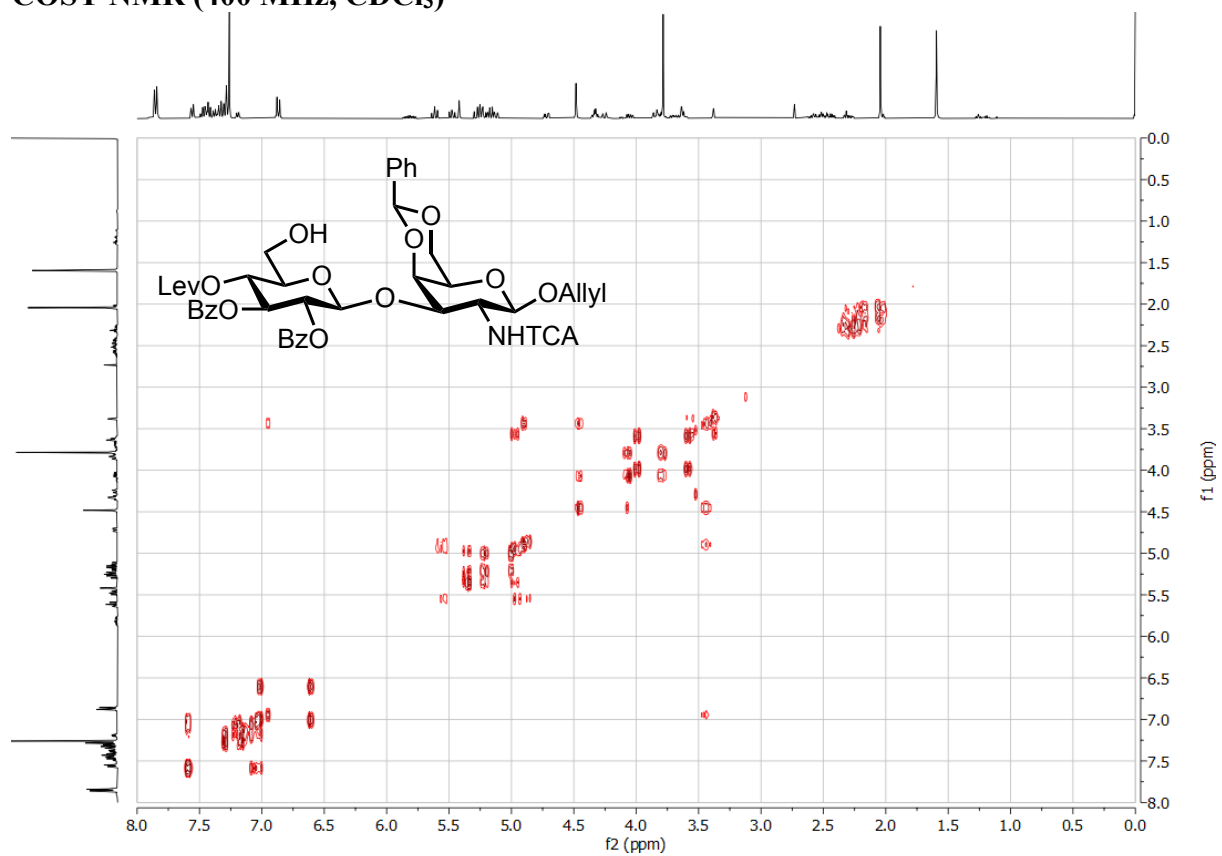
Compound S8
¹H NMR (400 MHz, CDCl₃)



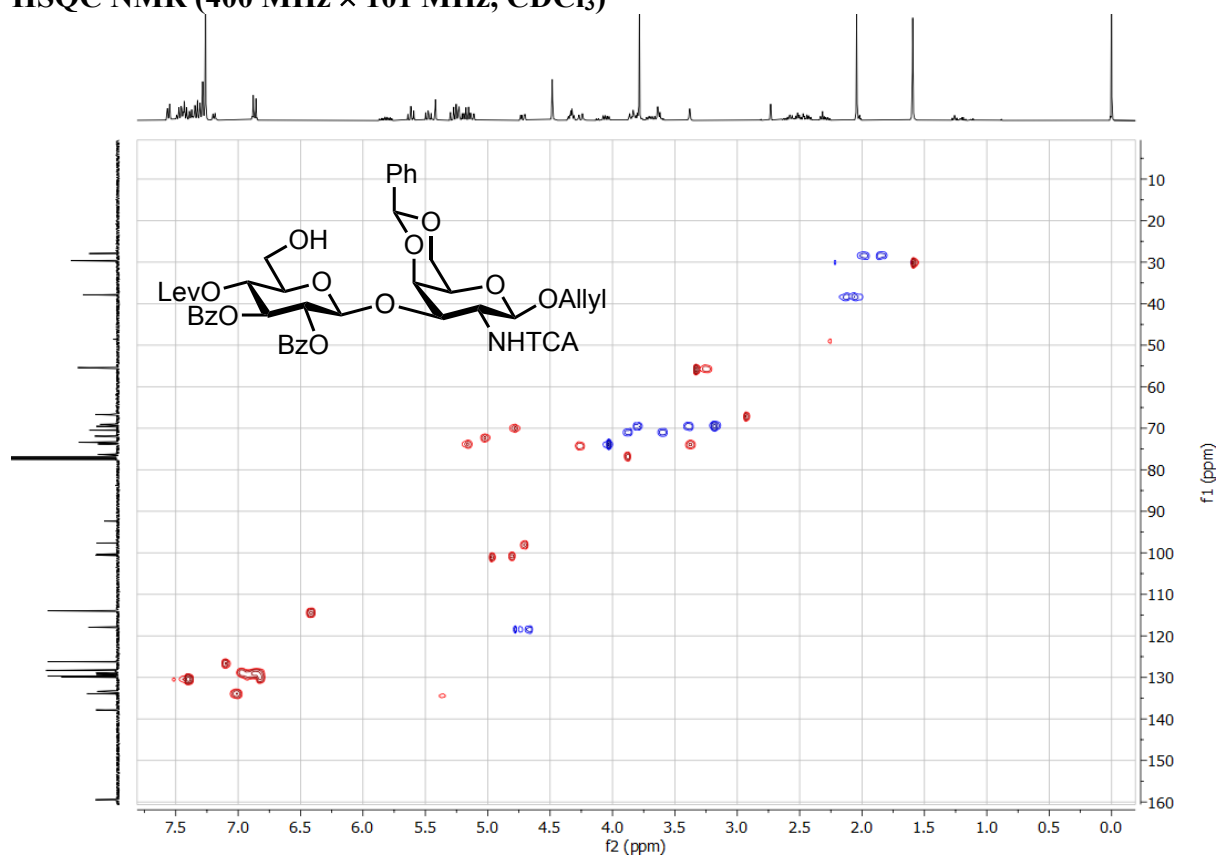
¹³C{¹H} NMR (101 MHz, CDCl₃)



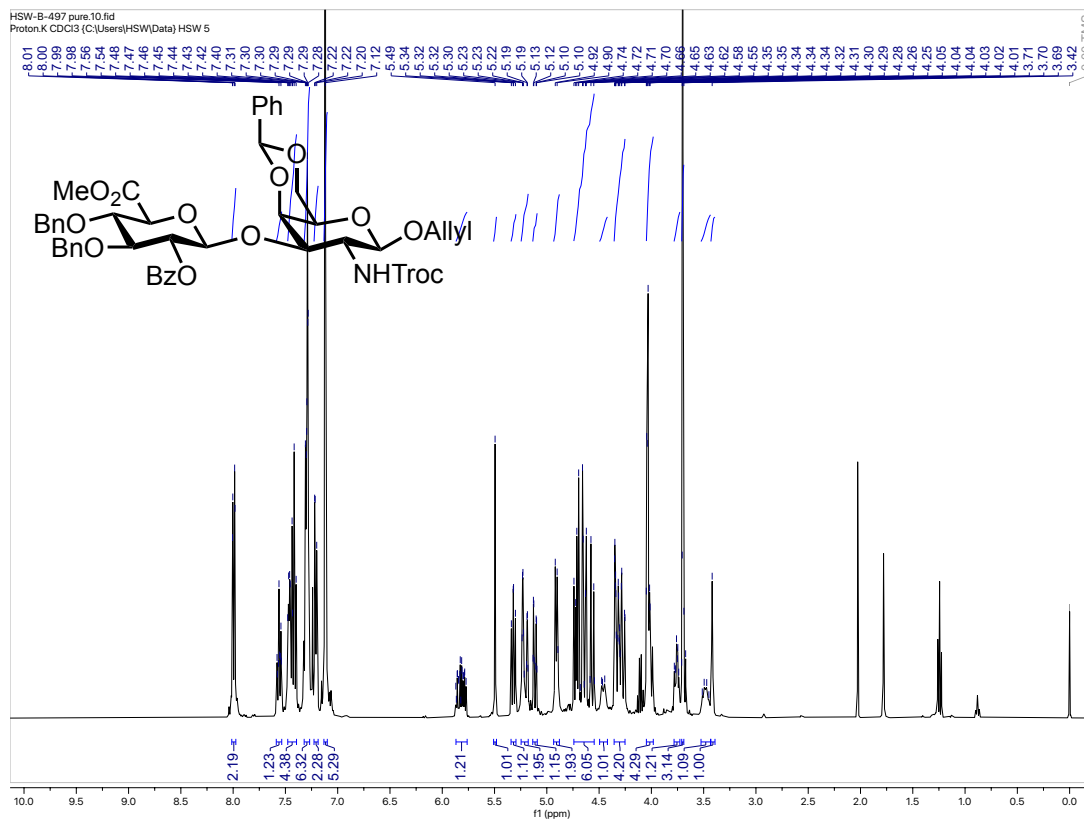
COSY NMR (400 MHz, CDCl₃)



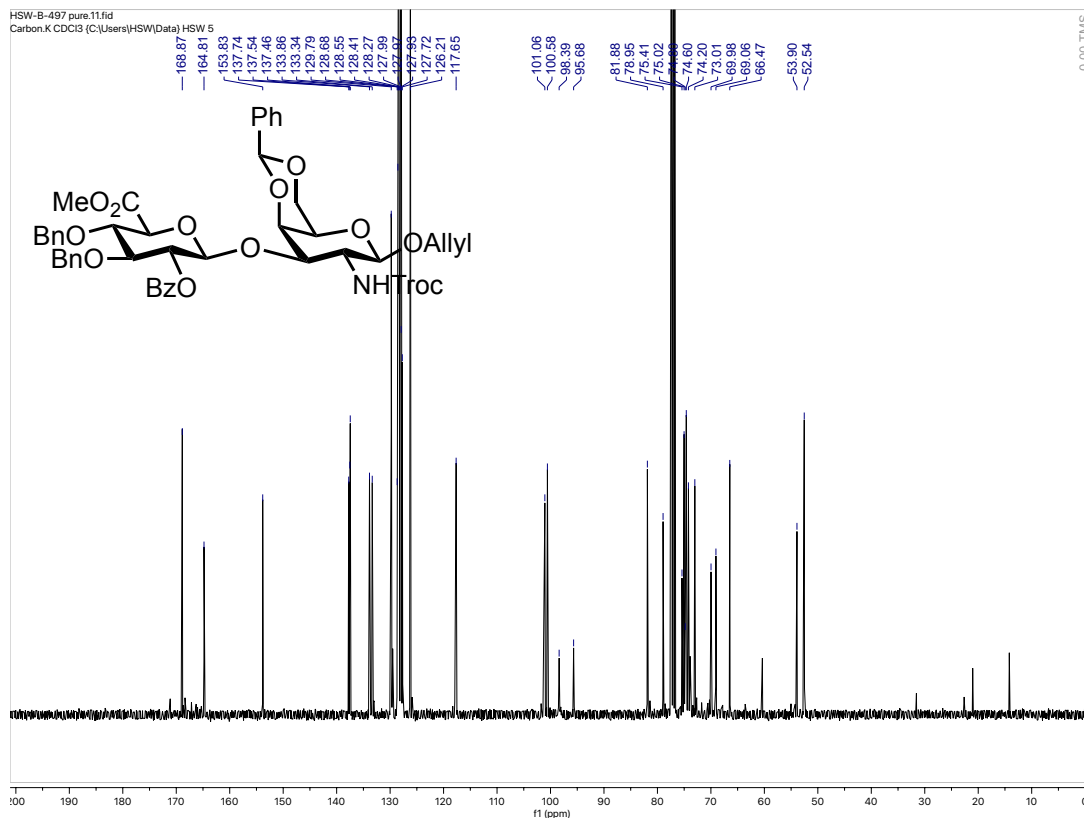
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



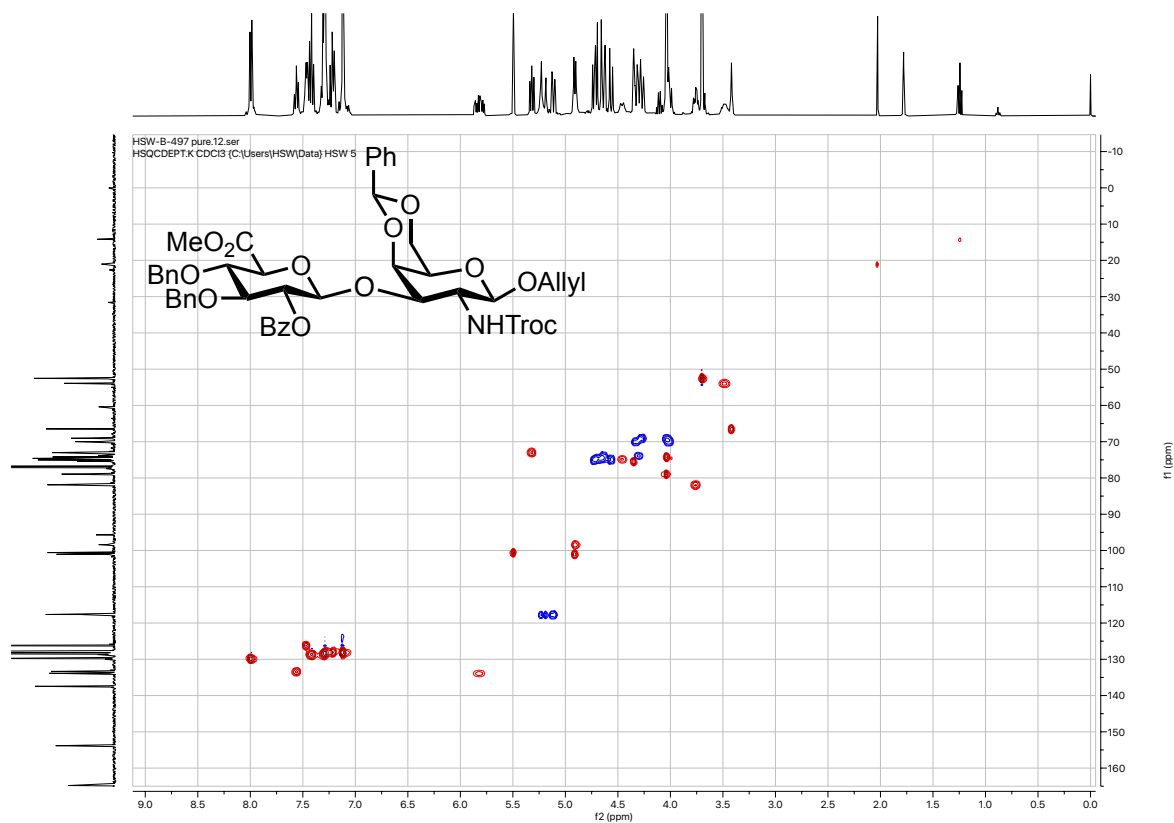
Compound 24
¹H NMR (400 MHz, CDCl₃)



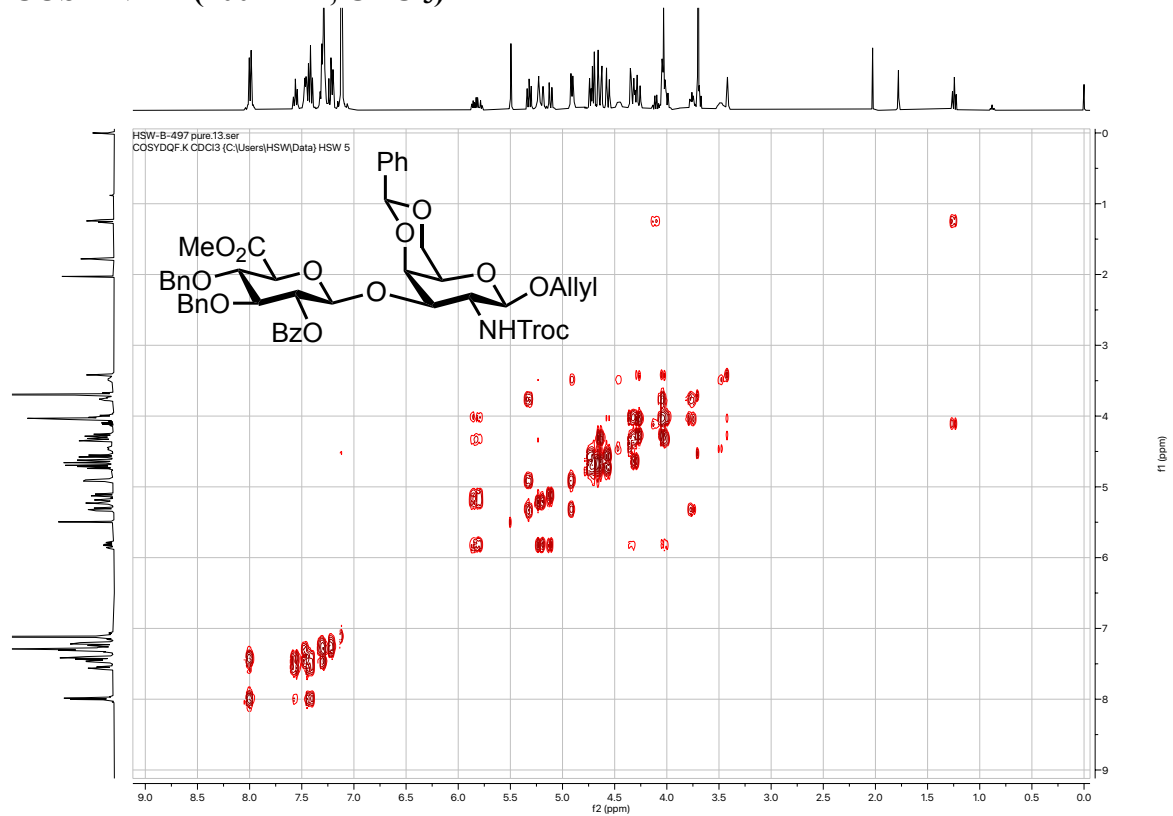
¹³C{¹H} NMR (101 MHz, CDCl₃)



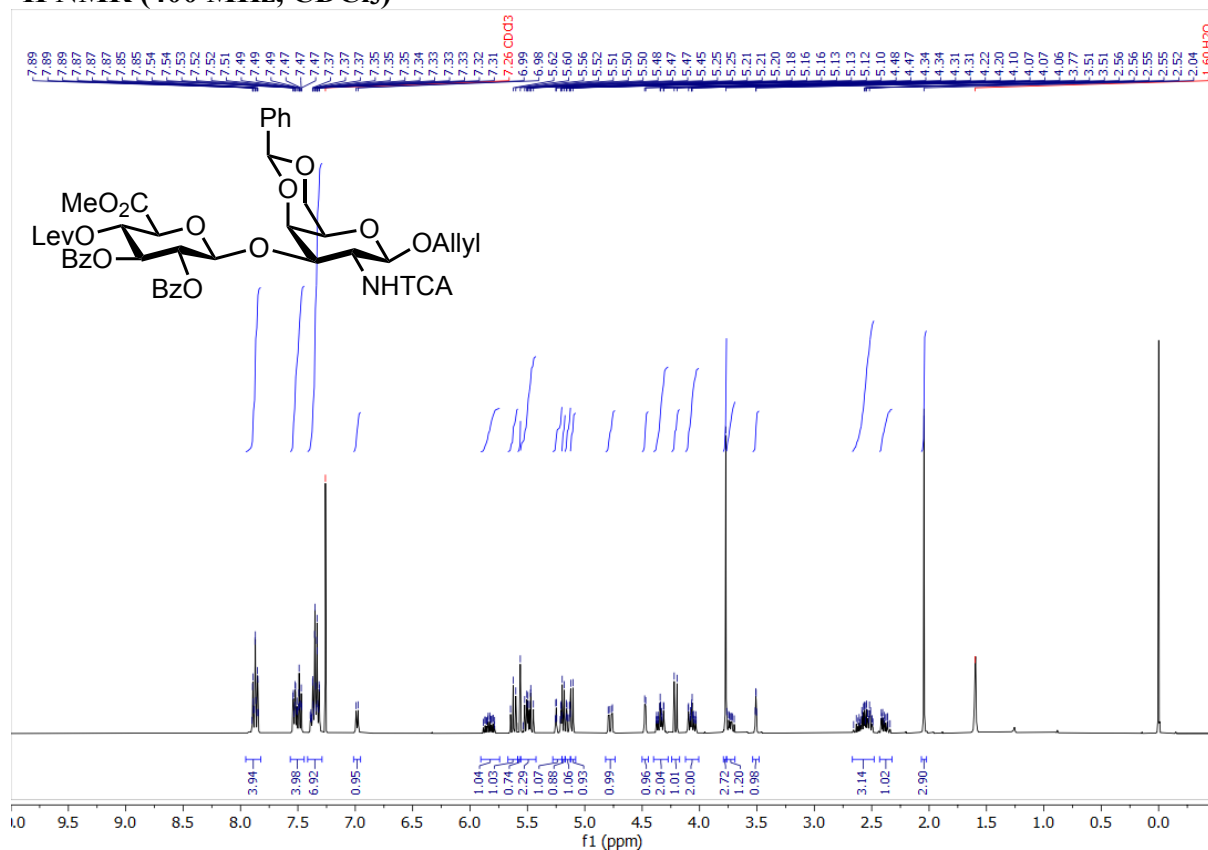
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



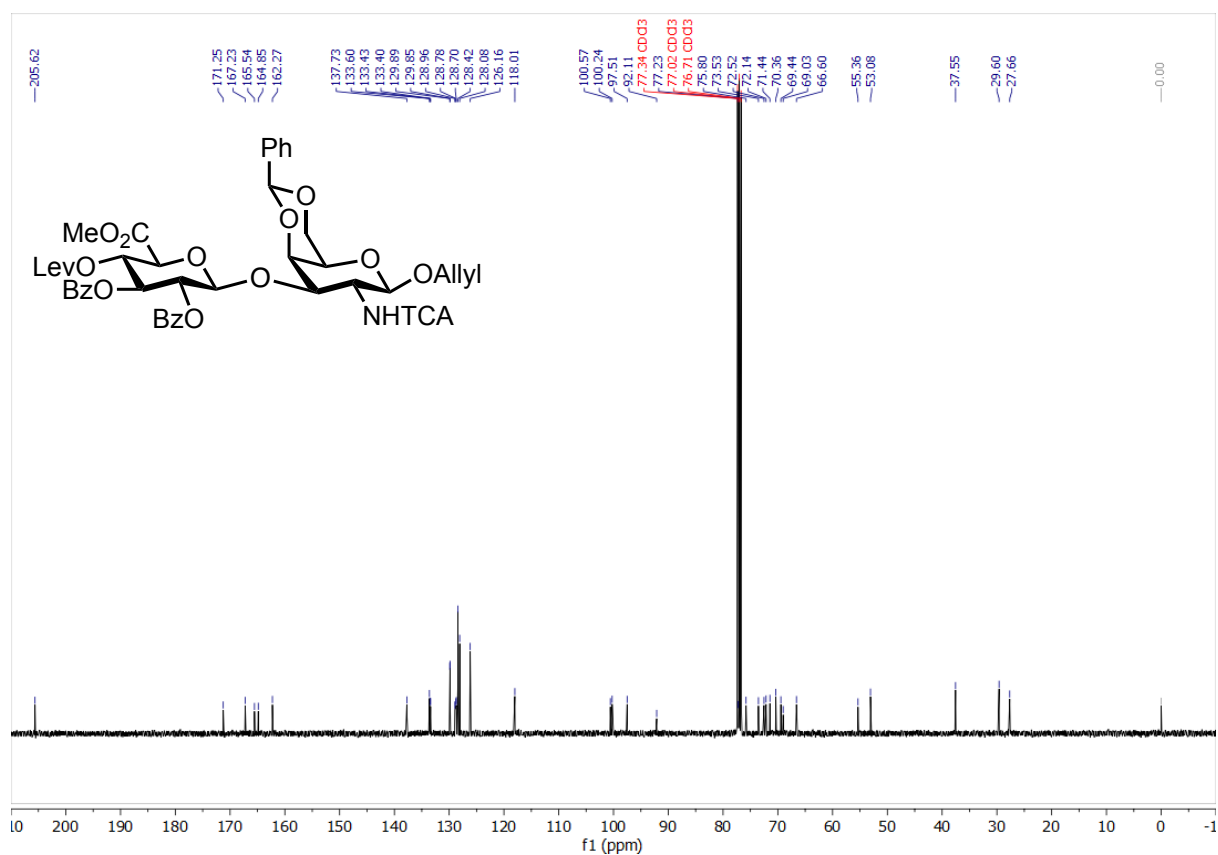
COSY NMR (400 MHz, CDCl₃)



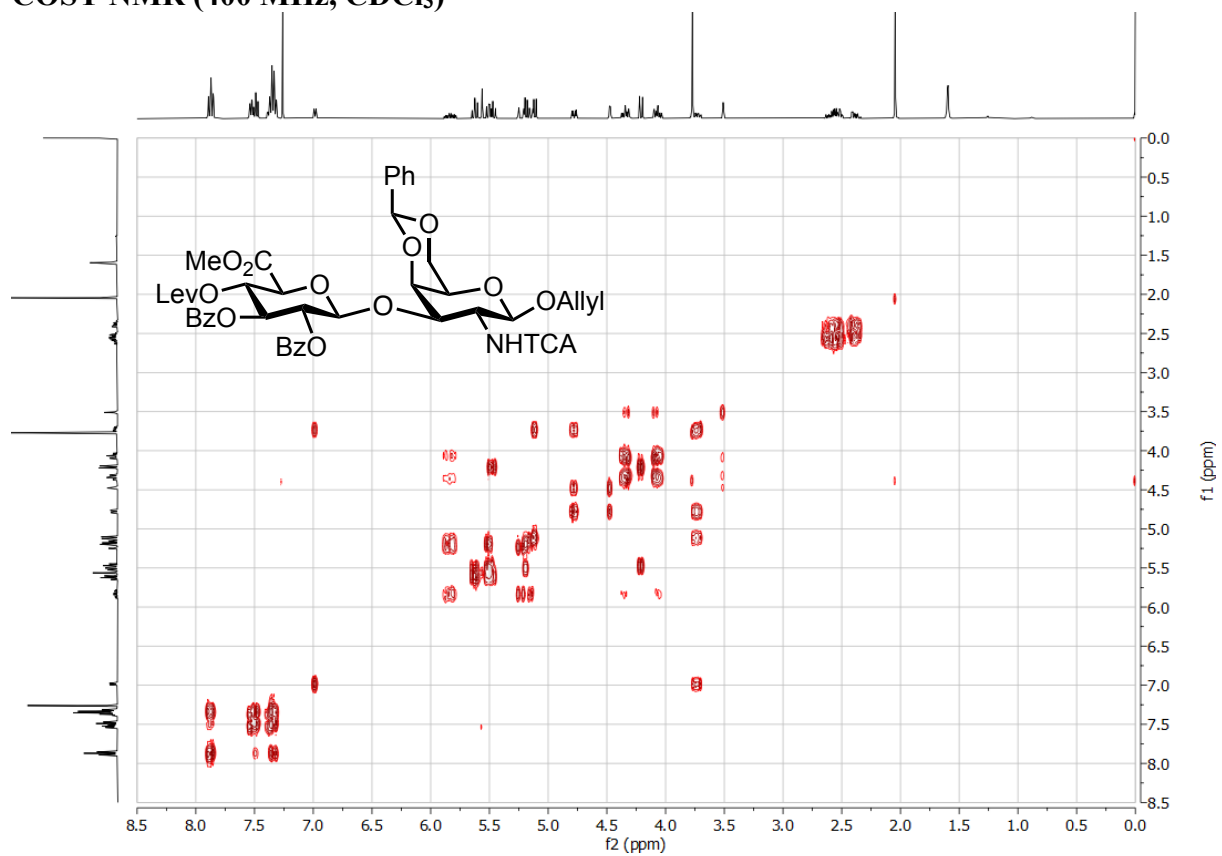
Compound 25
¹H NMR (400 MHz, CDCl₃)



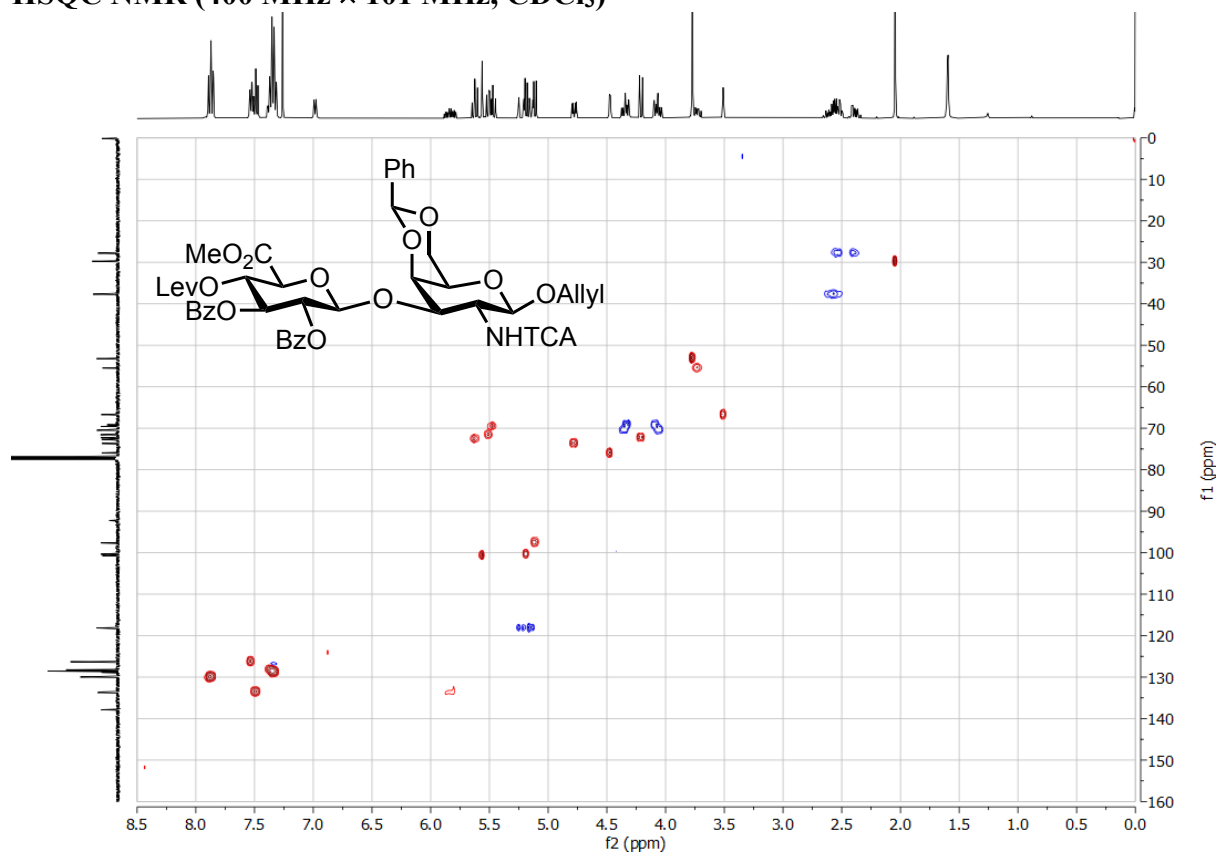
¹³C{¹H} NMR (101 MHz, CDCl₃)



COSY NMR (400 MHz, CDCl₃)

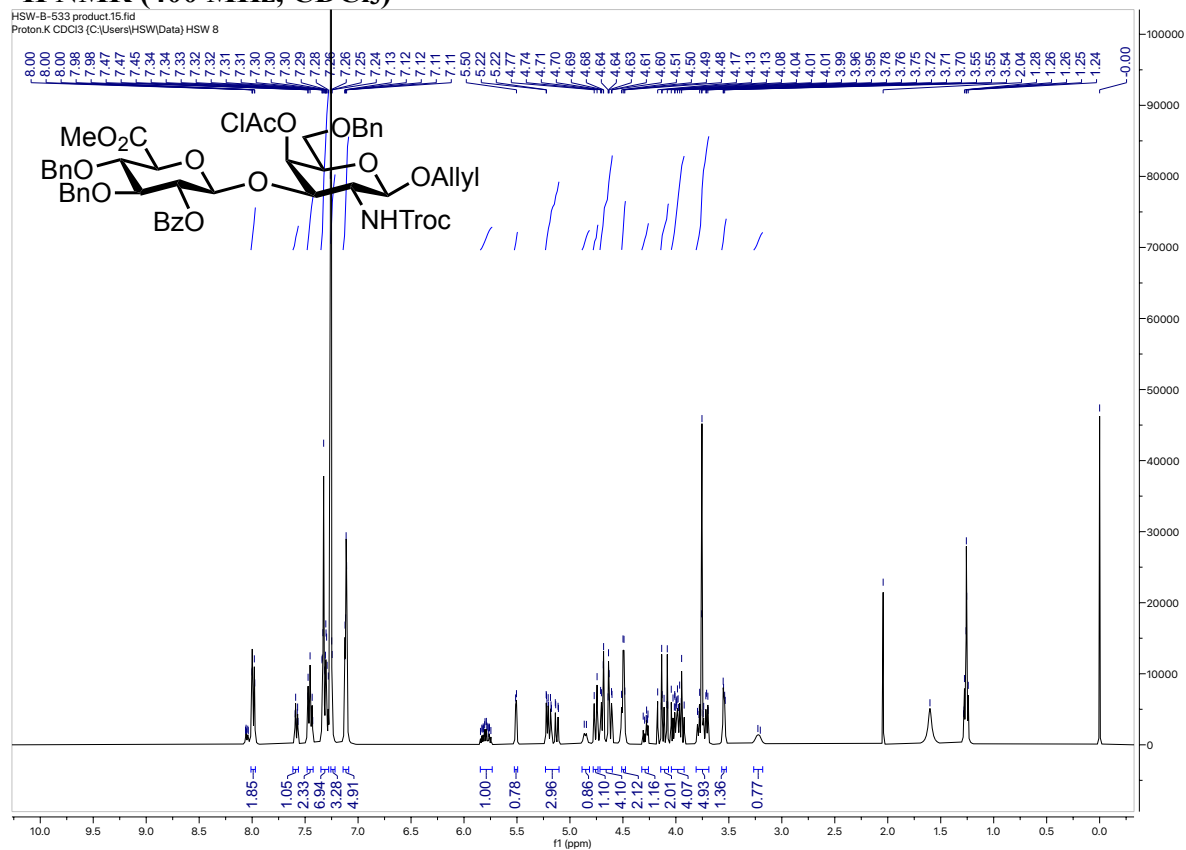


HSQC NMR (400 MHz × 101 MHz, CDCl₃)

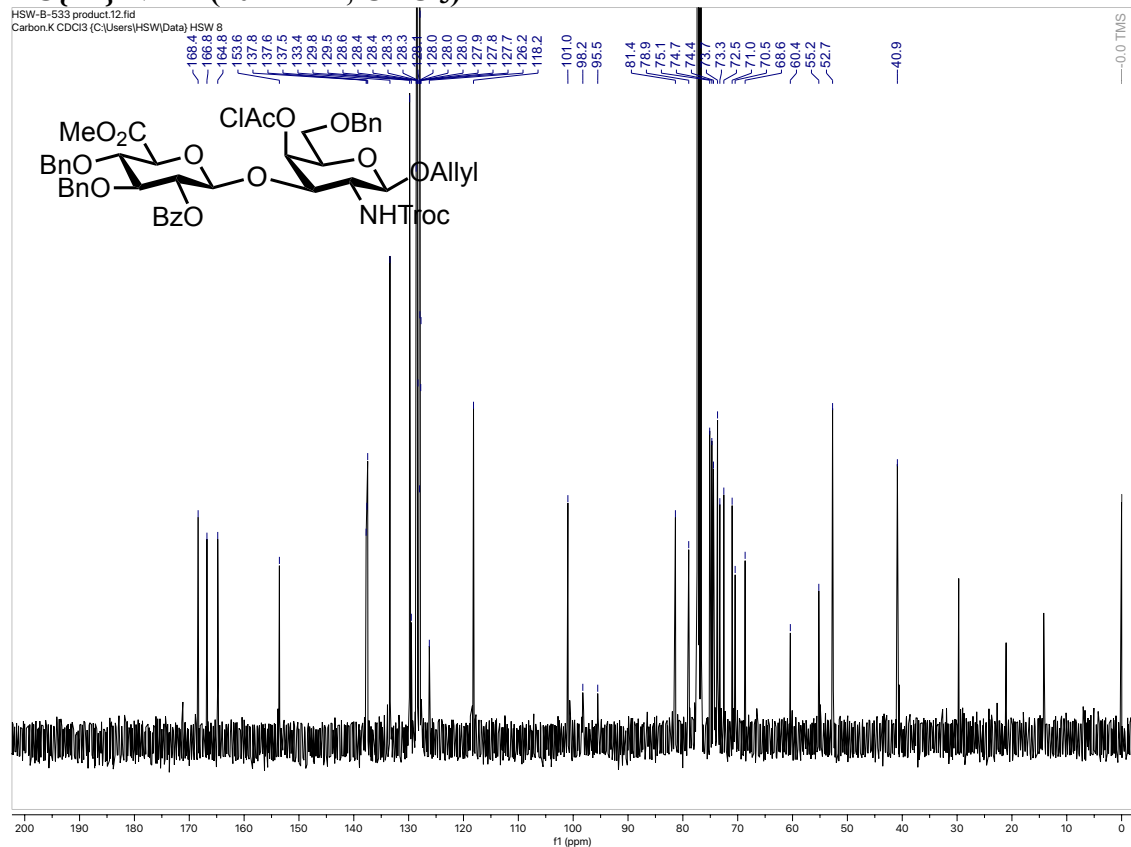


Compound 26

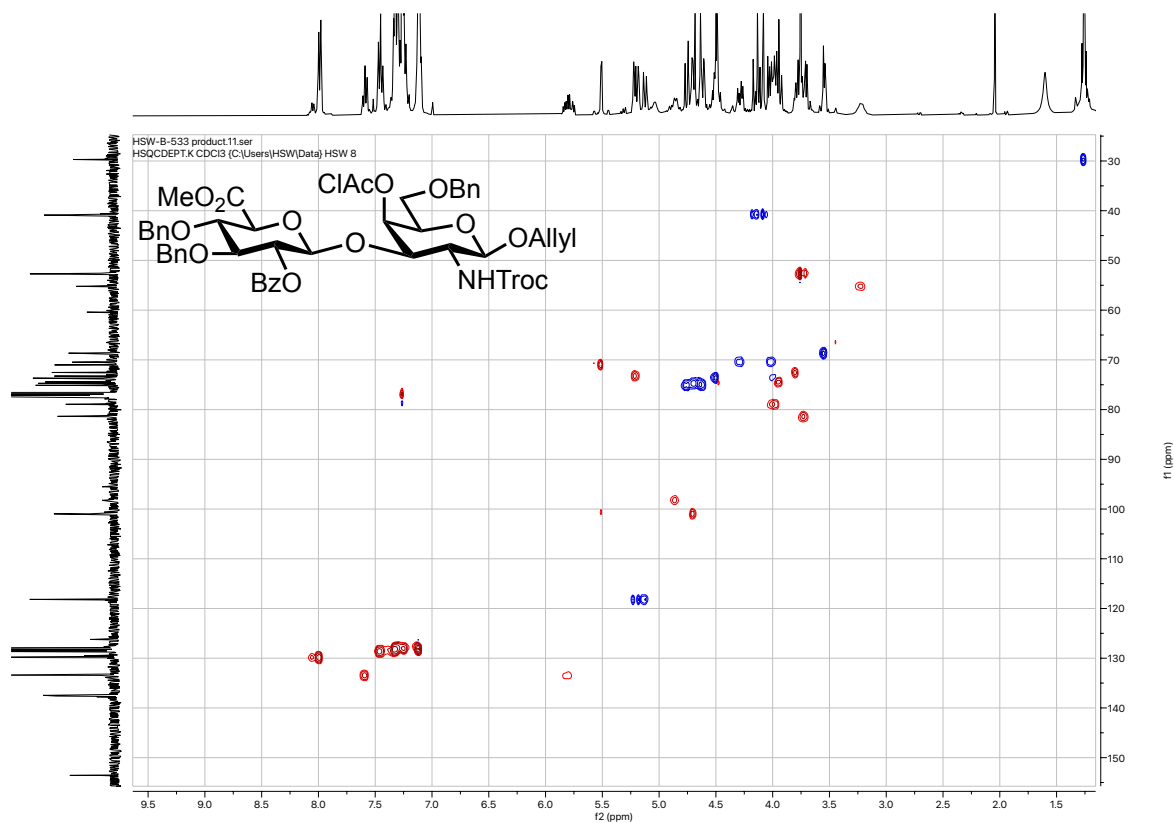
¹H NMR (400 MHz, CDCl₃)



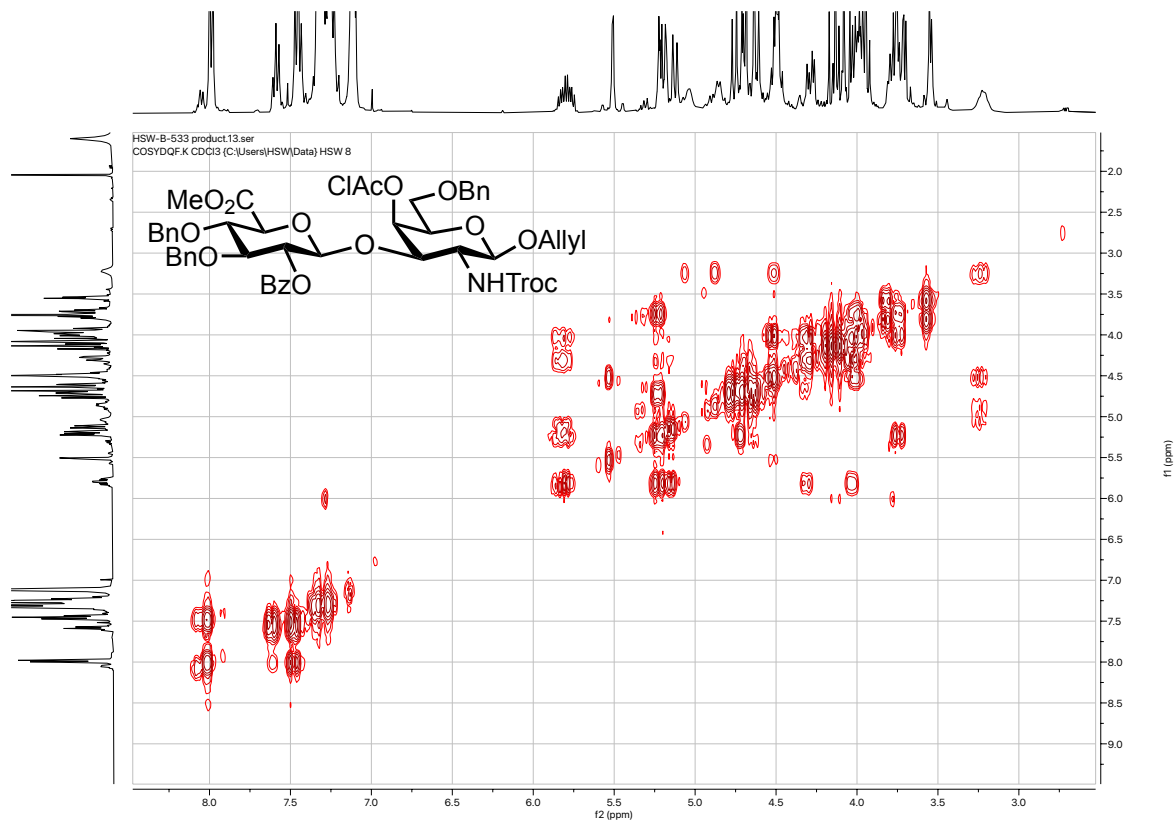
¹³C{¹H} NMR (101 MHz, CDCl₃)



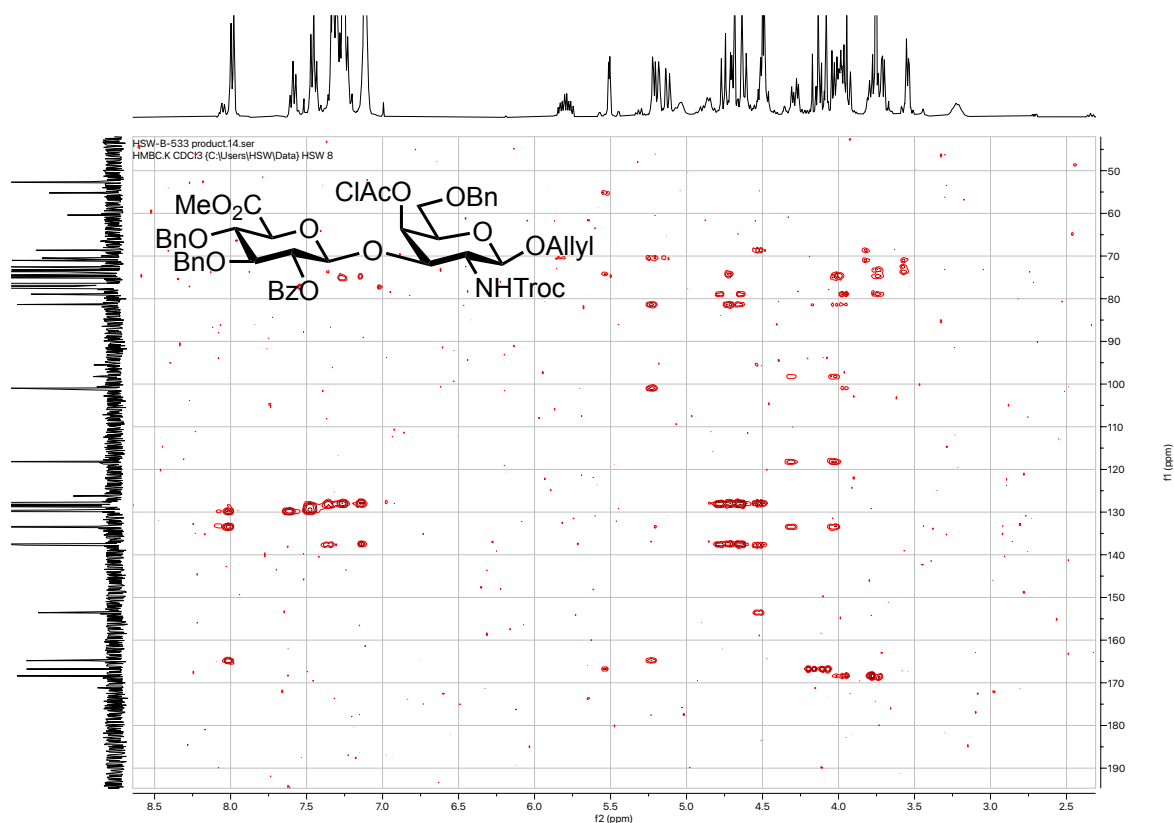
HSQC NMR (400 MHz × 101 MHz, CDCl₃)



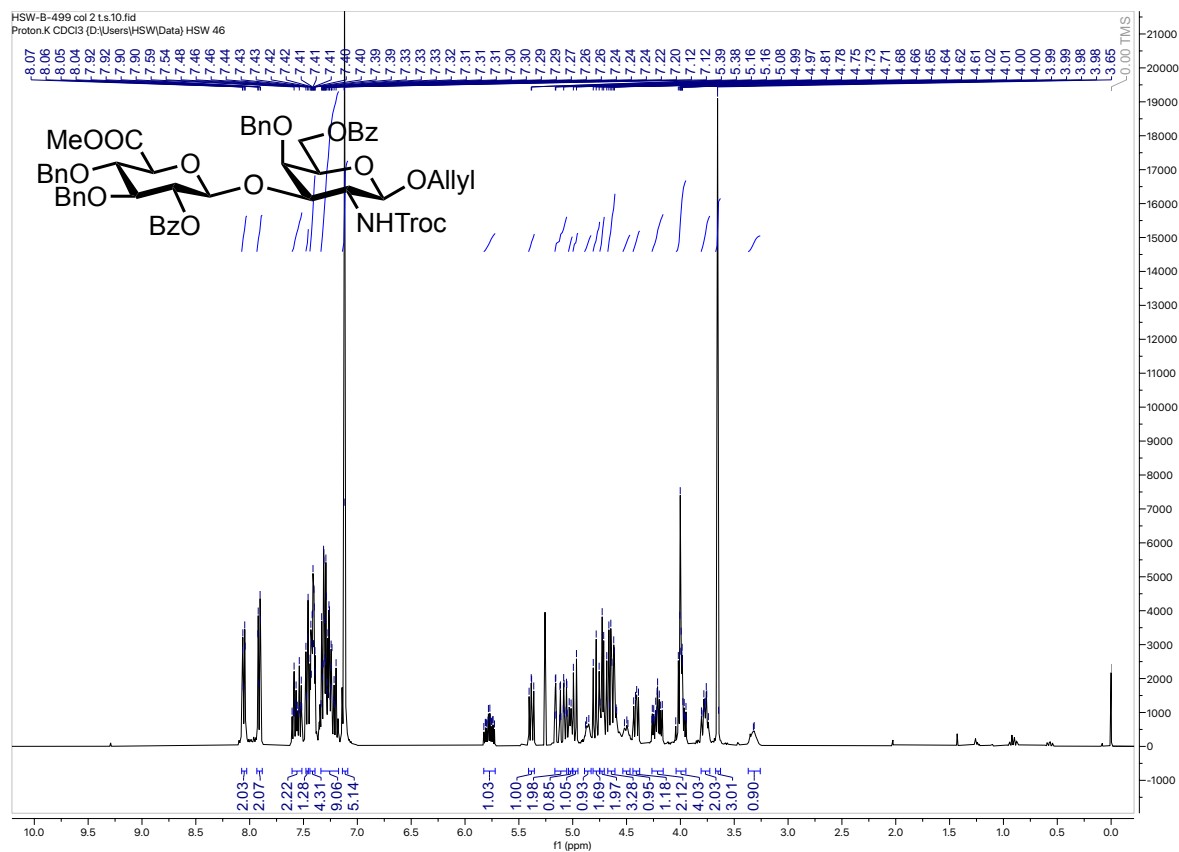
COSY NMR (400 MHz, CDCl₃)



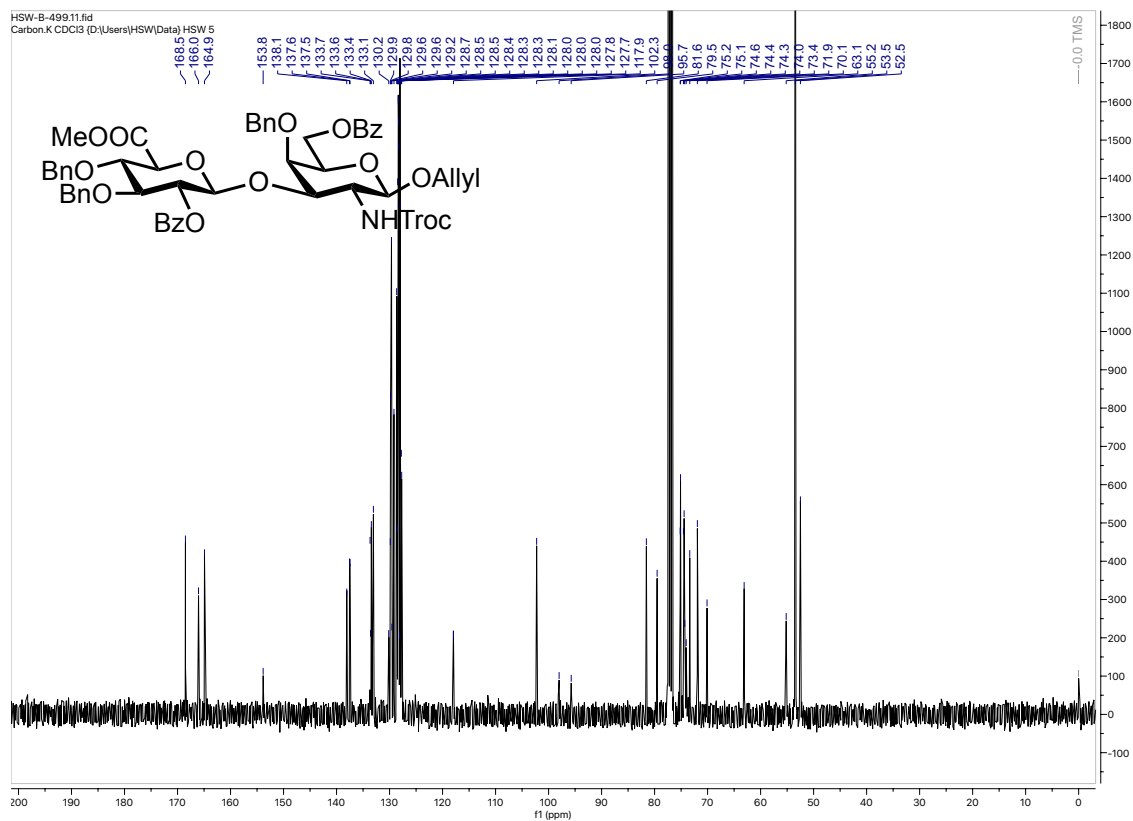
HMBC NMR (400 MHz × 101 MHz, CDCl₃)



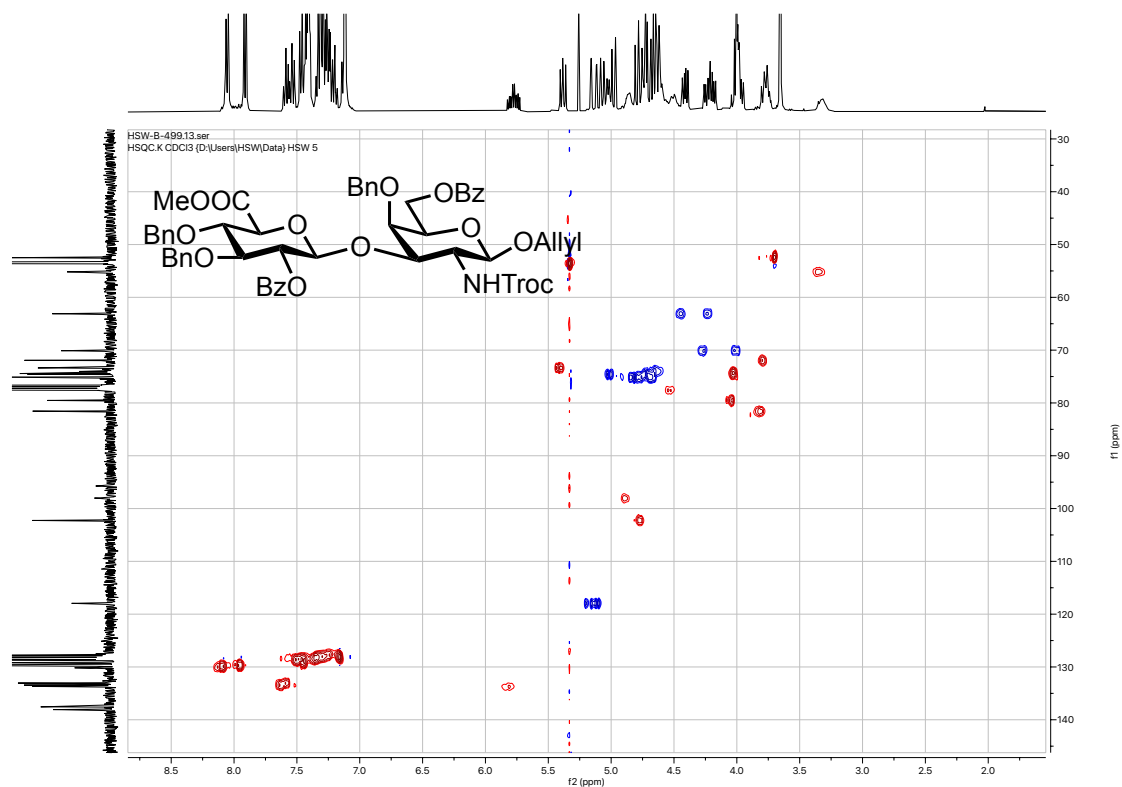
Compound 27 ¹H NMR (400 MHz, CDCl₃)



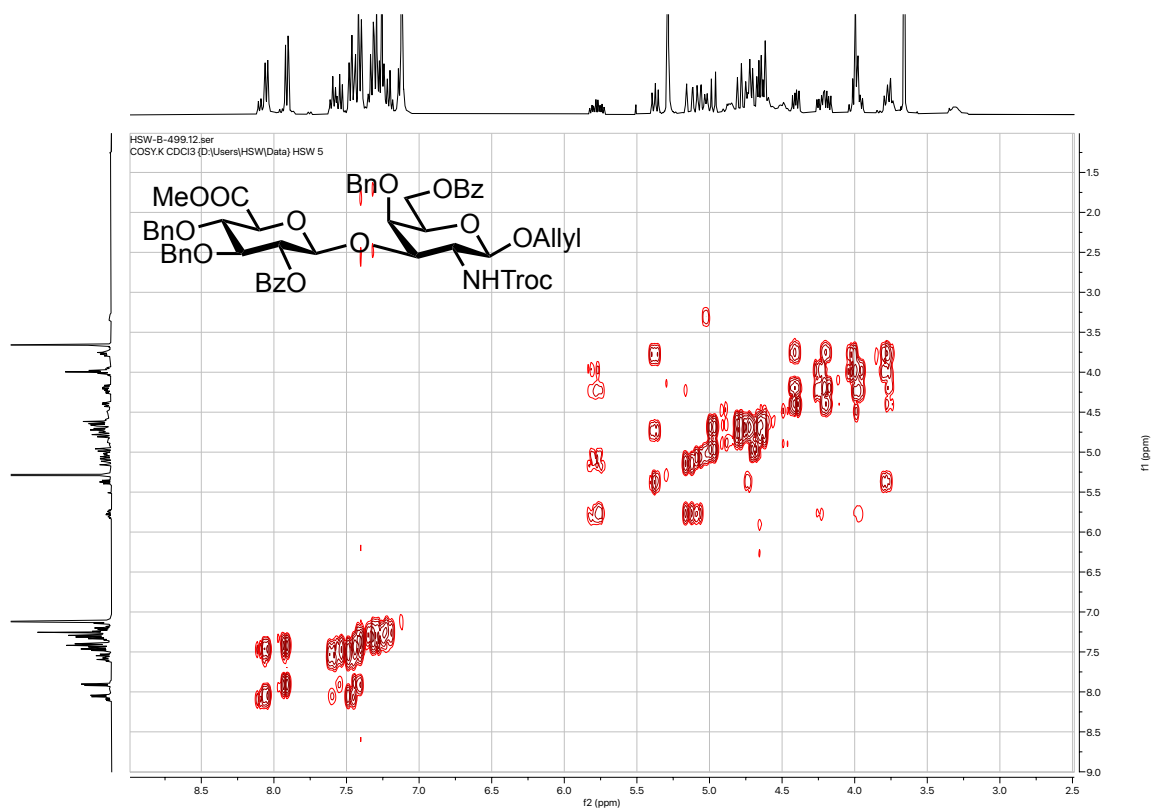
$^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, CDCl_3)



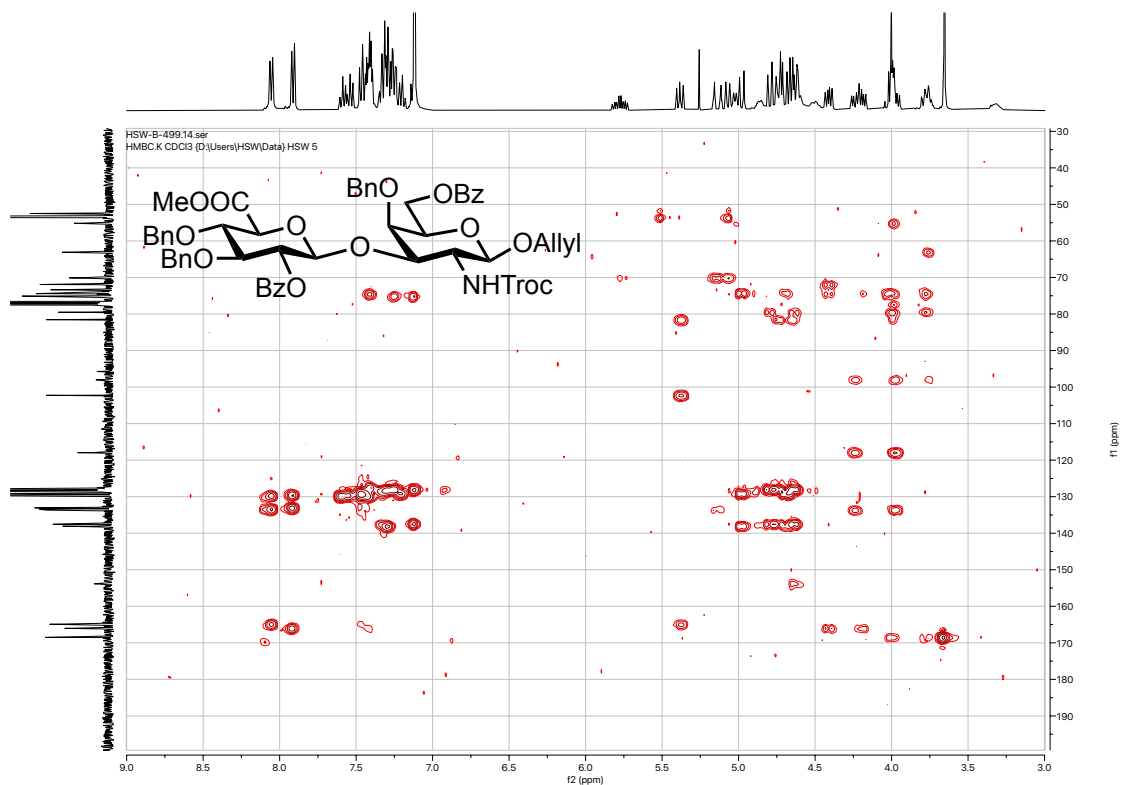
HSQC NMR (400 MHz \times 101 MHz, CDCl_3)



COSY NMR (400 MHz, CDCl₃)



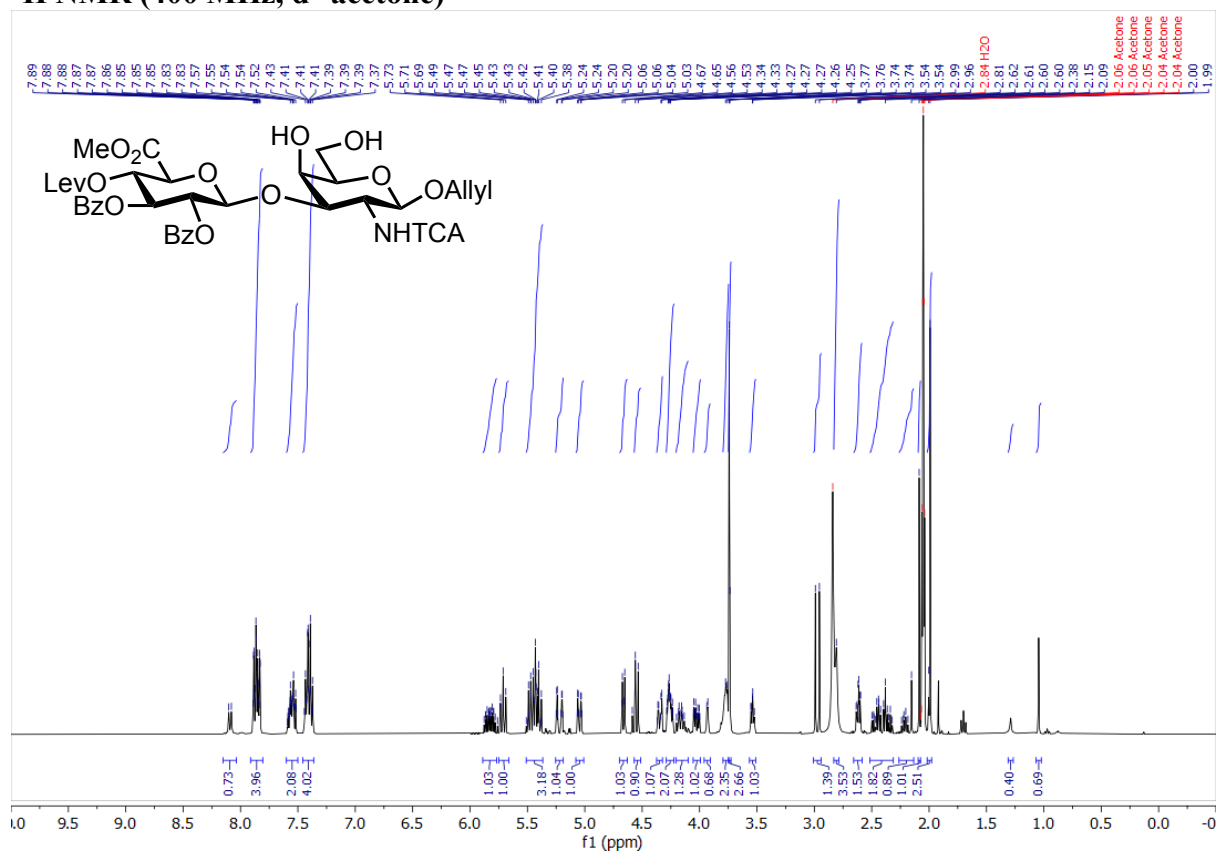
HMBC NMR (400 MHz × 101 MHz, CDCl₃)



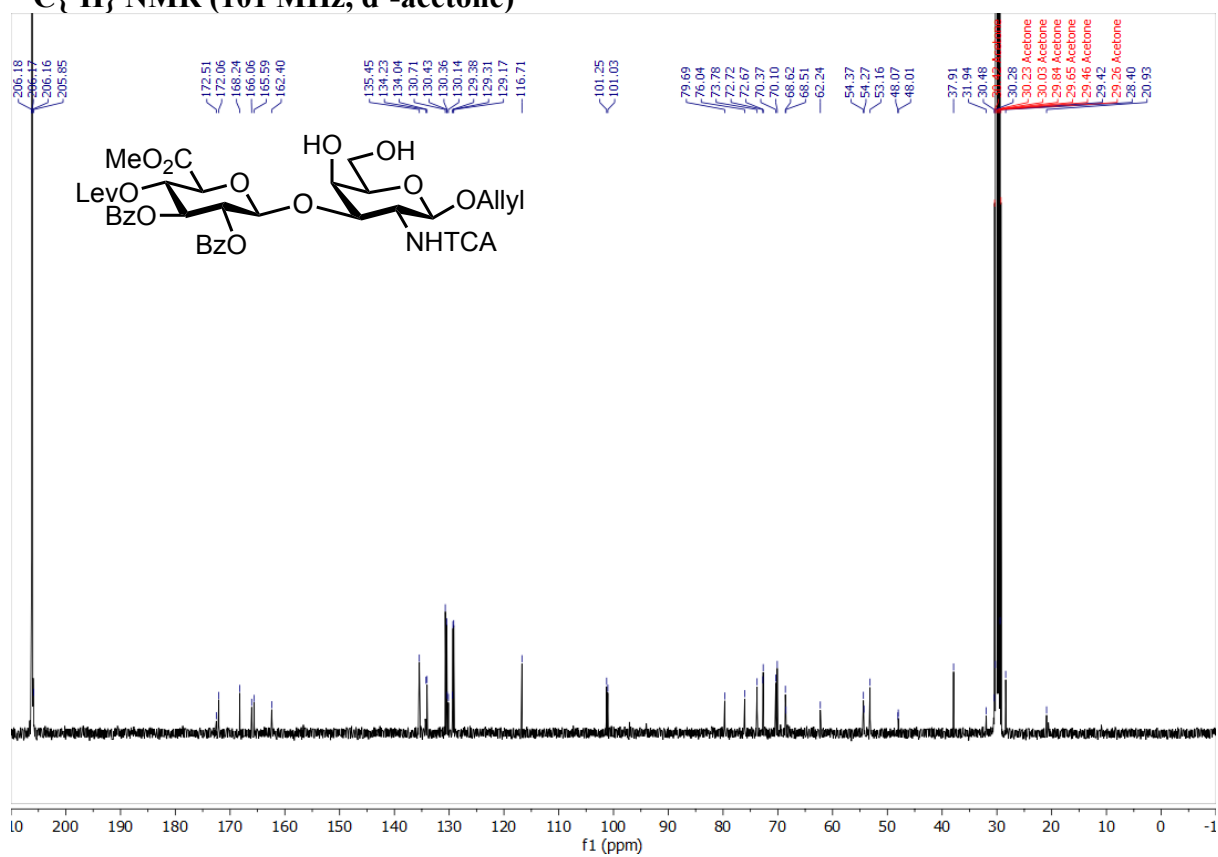
Exemplar synthesis of CS-C

Compound 28

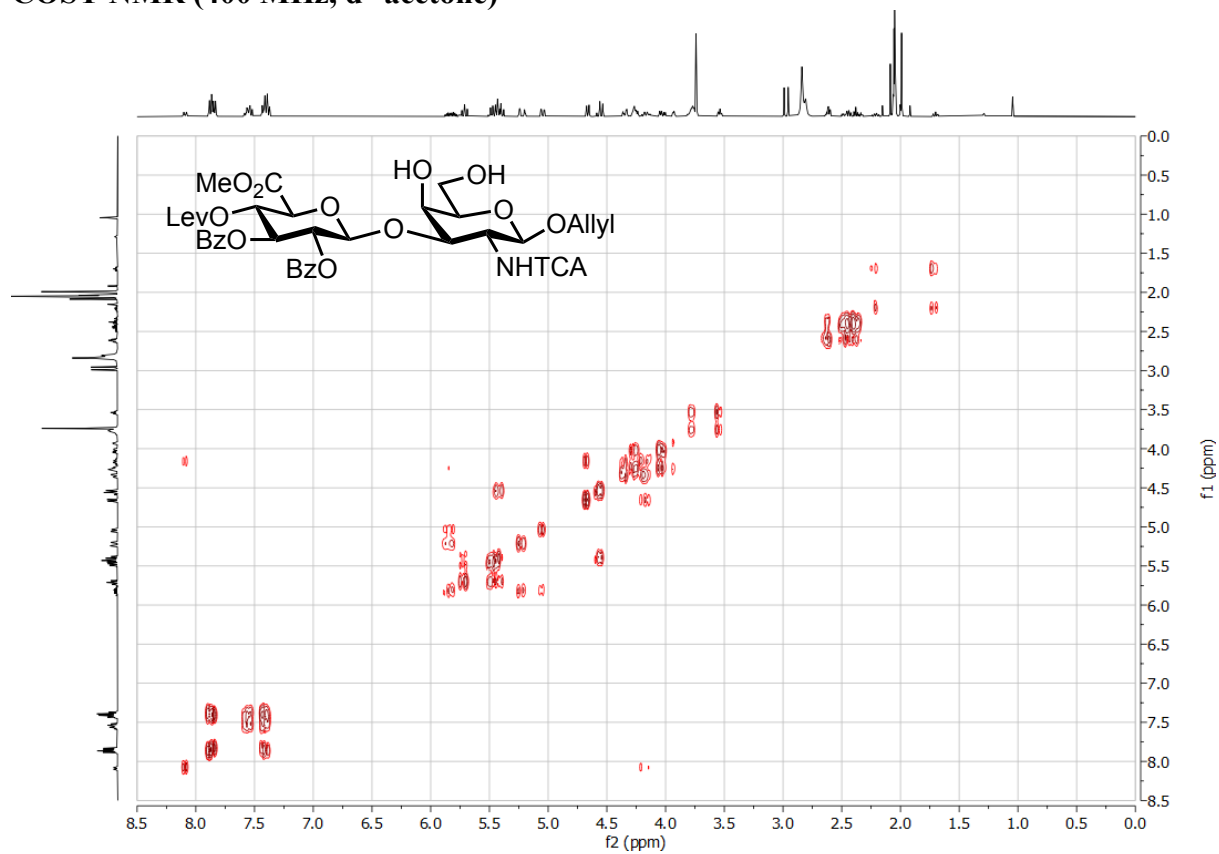
^1H NMR (400 MHz, d^6 -acetone)



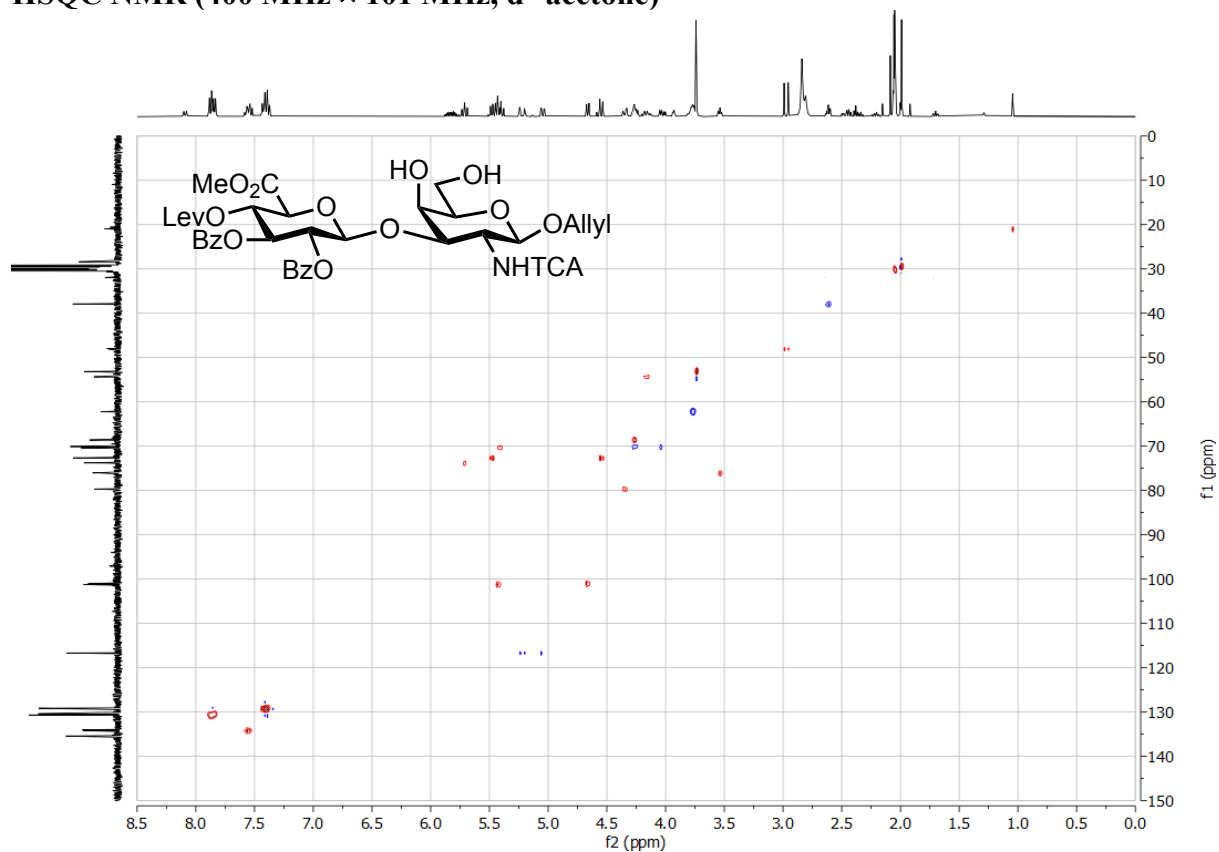
$^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, d^6 -acetone)



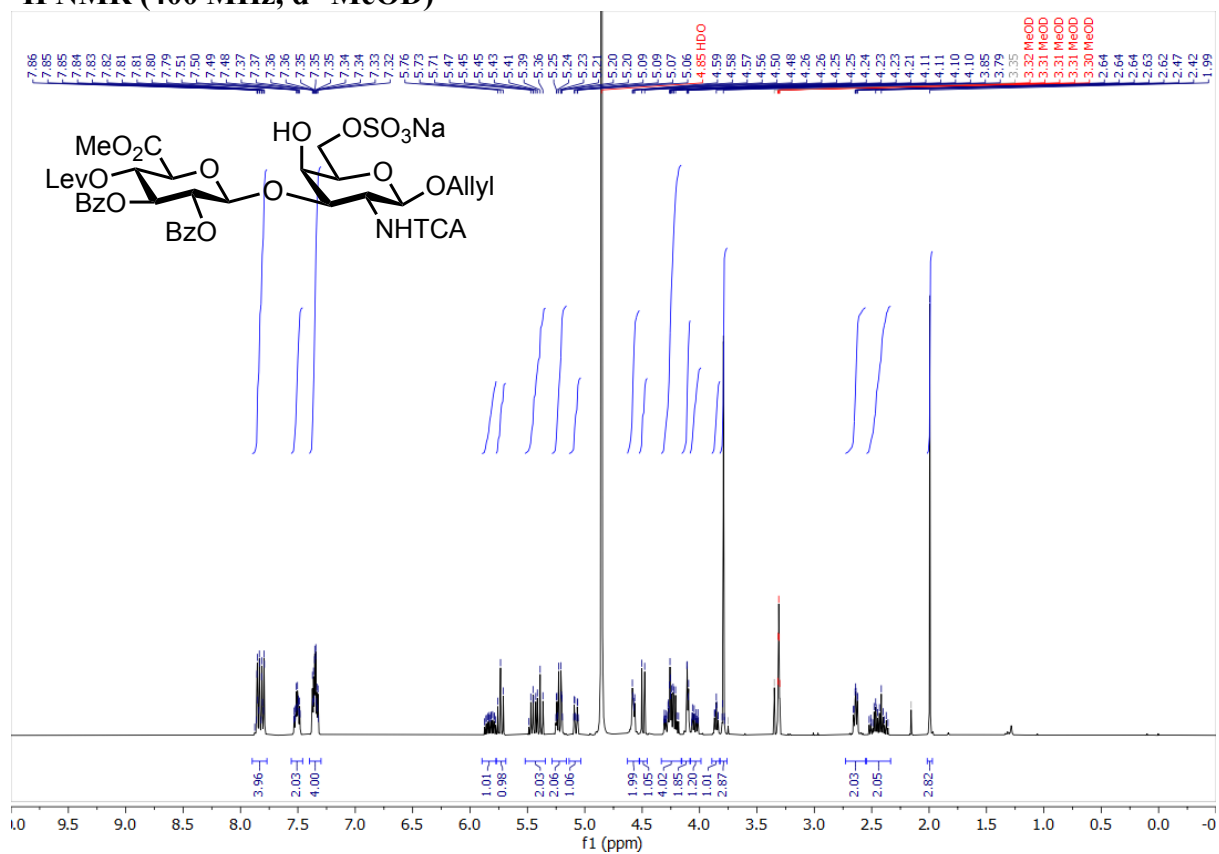
COSY NMR (400 MHz, d⁶-acetone)



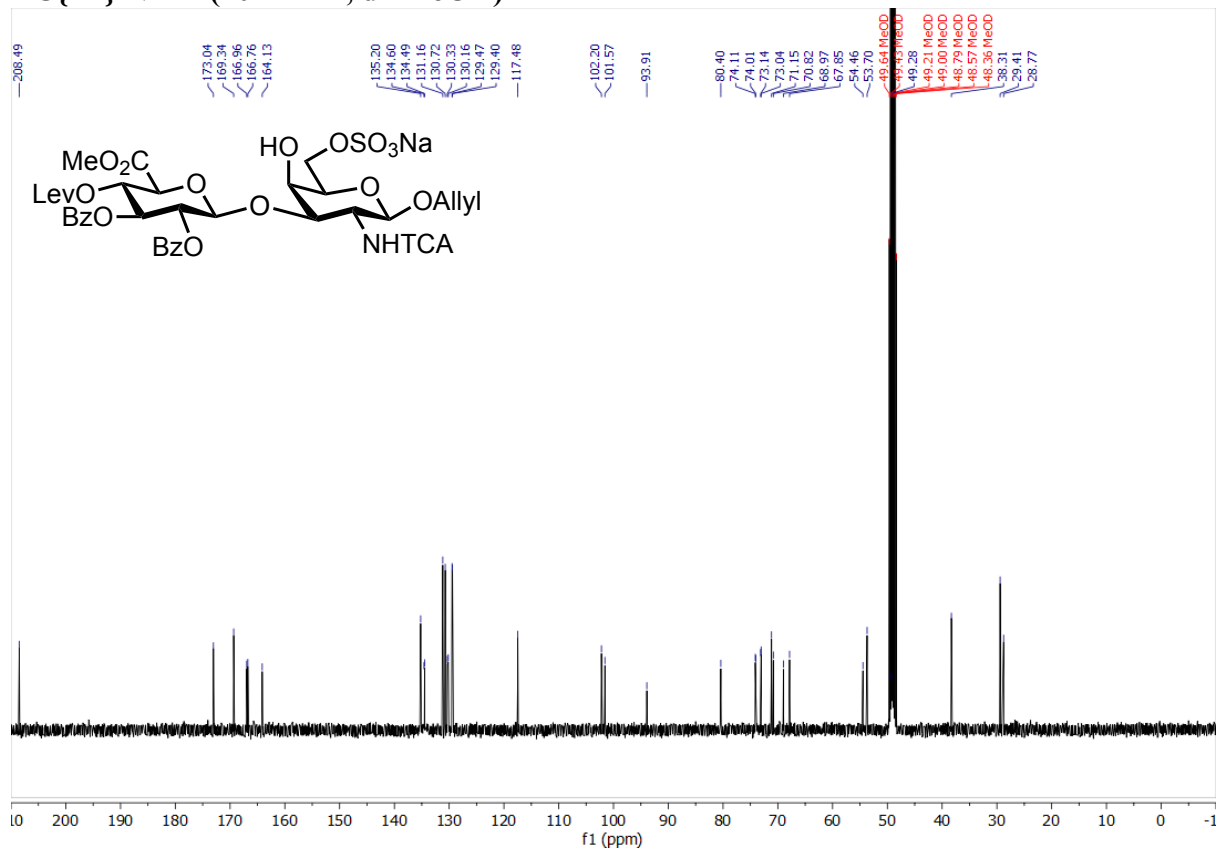
HSQC NMR (400 MHz × 101 MHz, d⁶-acetone)



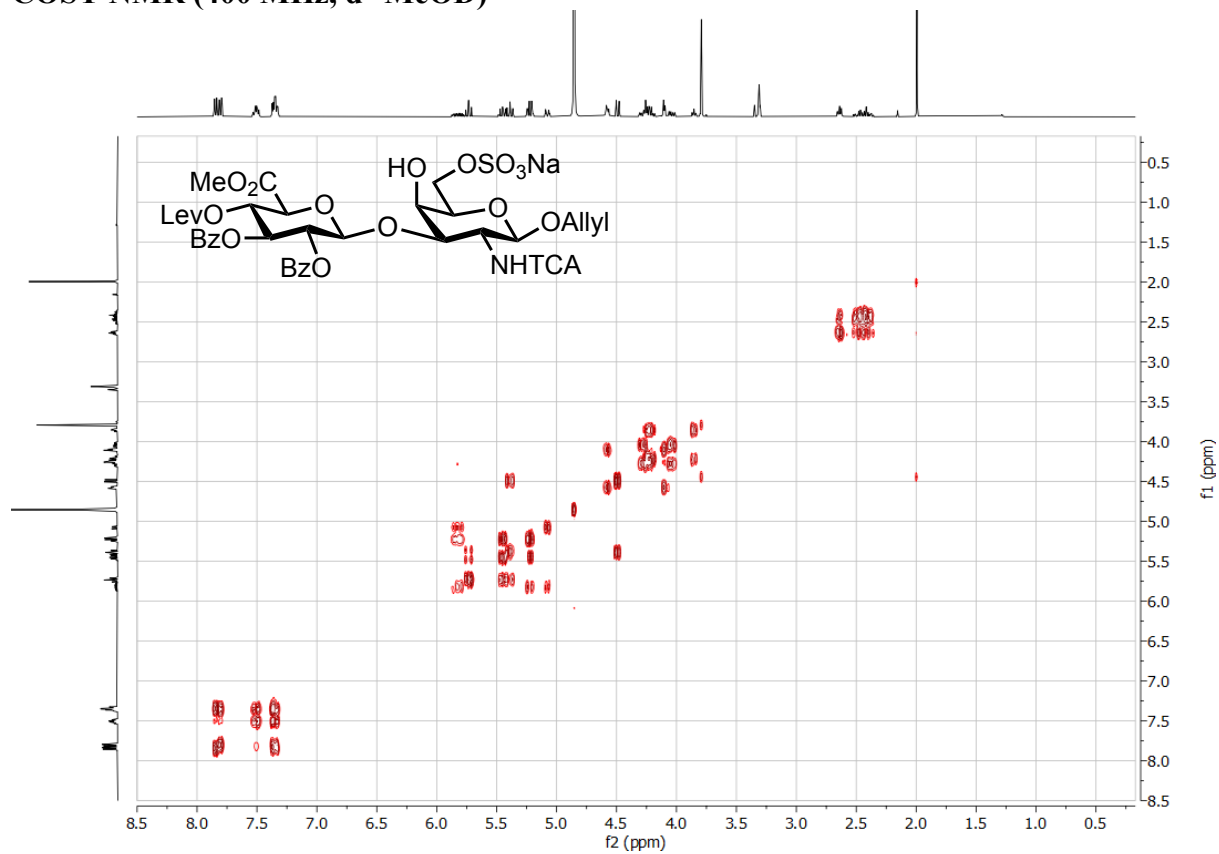
Compound S9
 ^1H NMR (400 MHz, d^4 -MeOD)



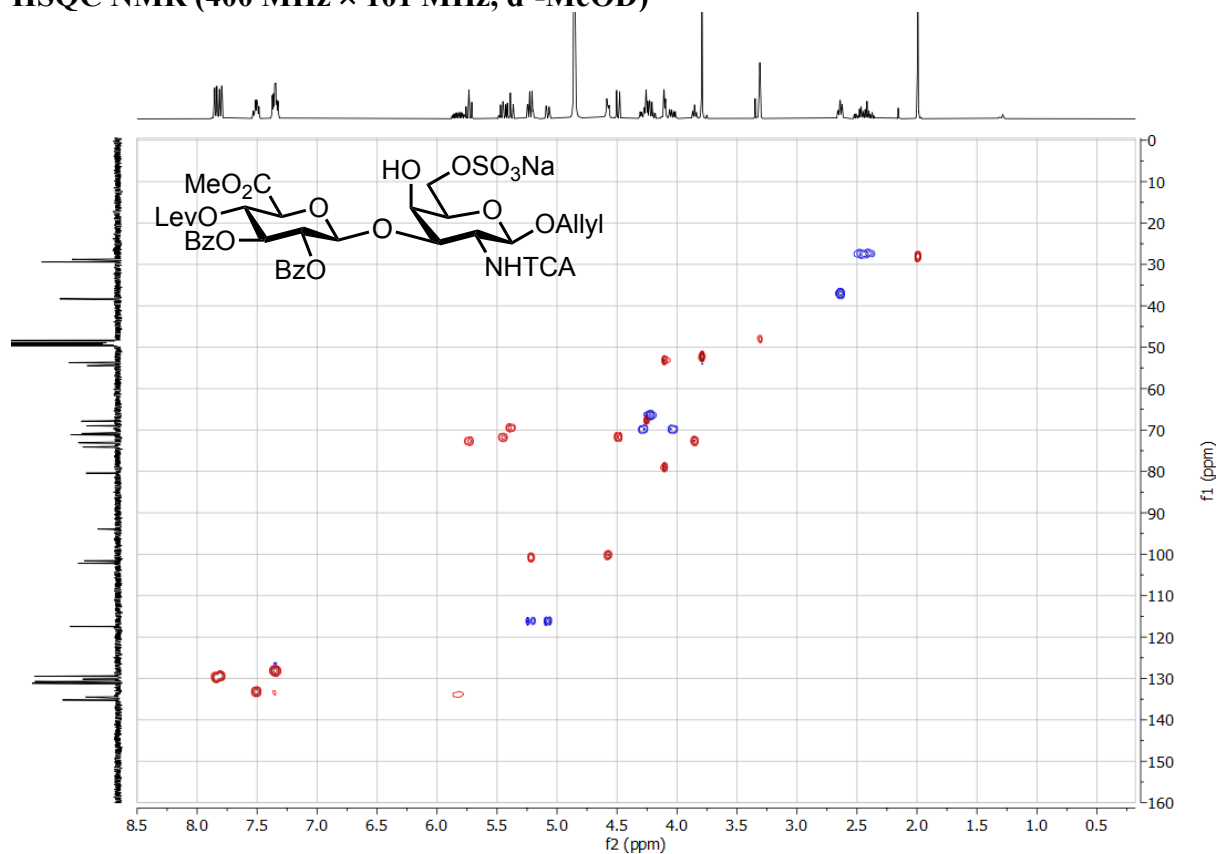
$^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, d^4 -MeOD)



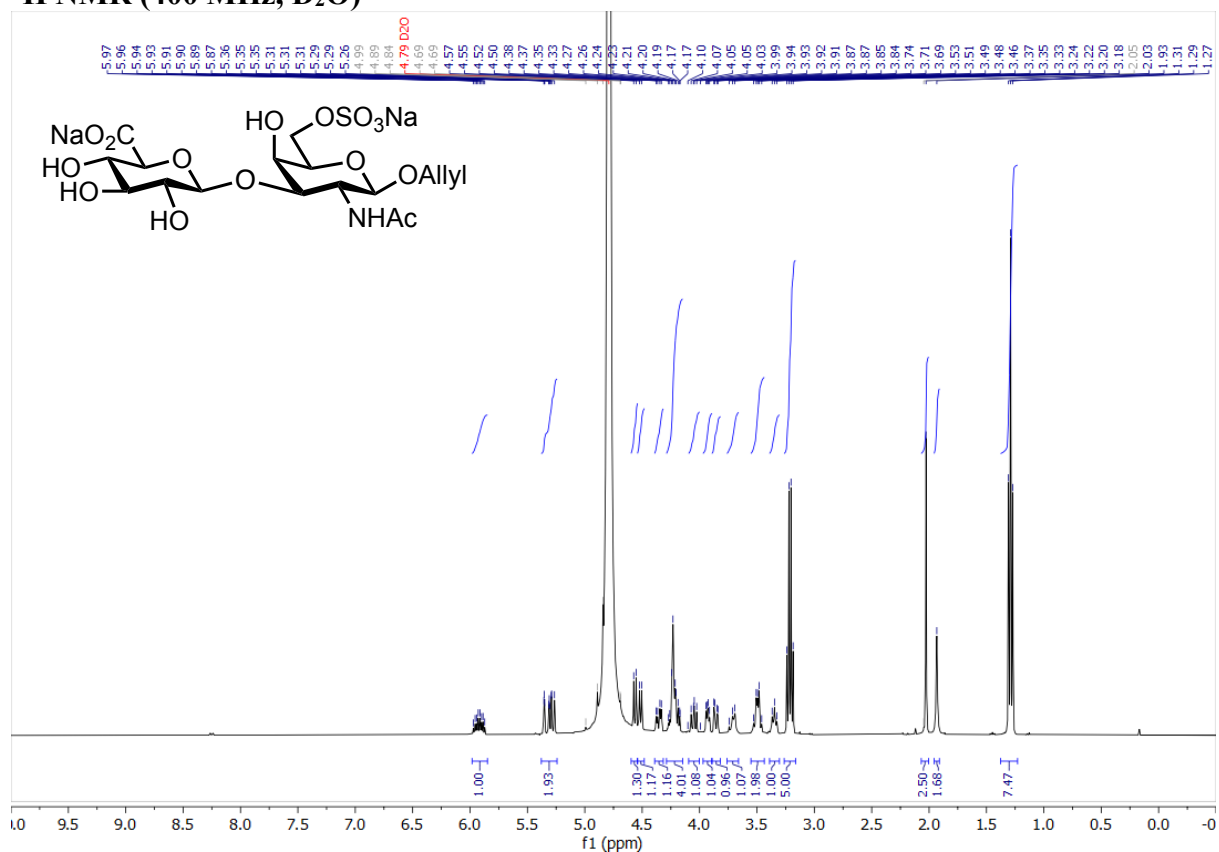
COSY NMR (400 MHz, d⁴-MeOD)



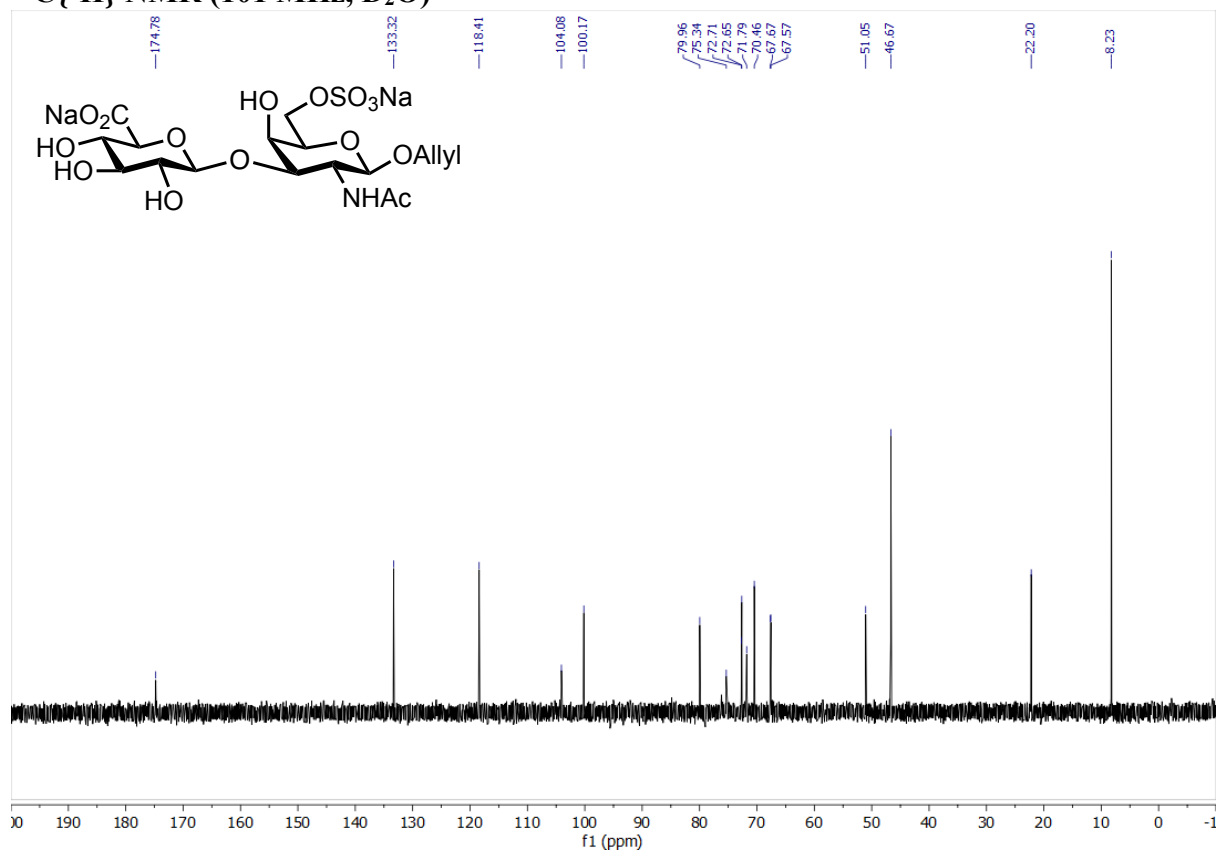
HSQC NMR (400 MHz × 101 MHz, d⁴-MeOD)



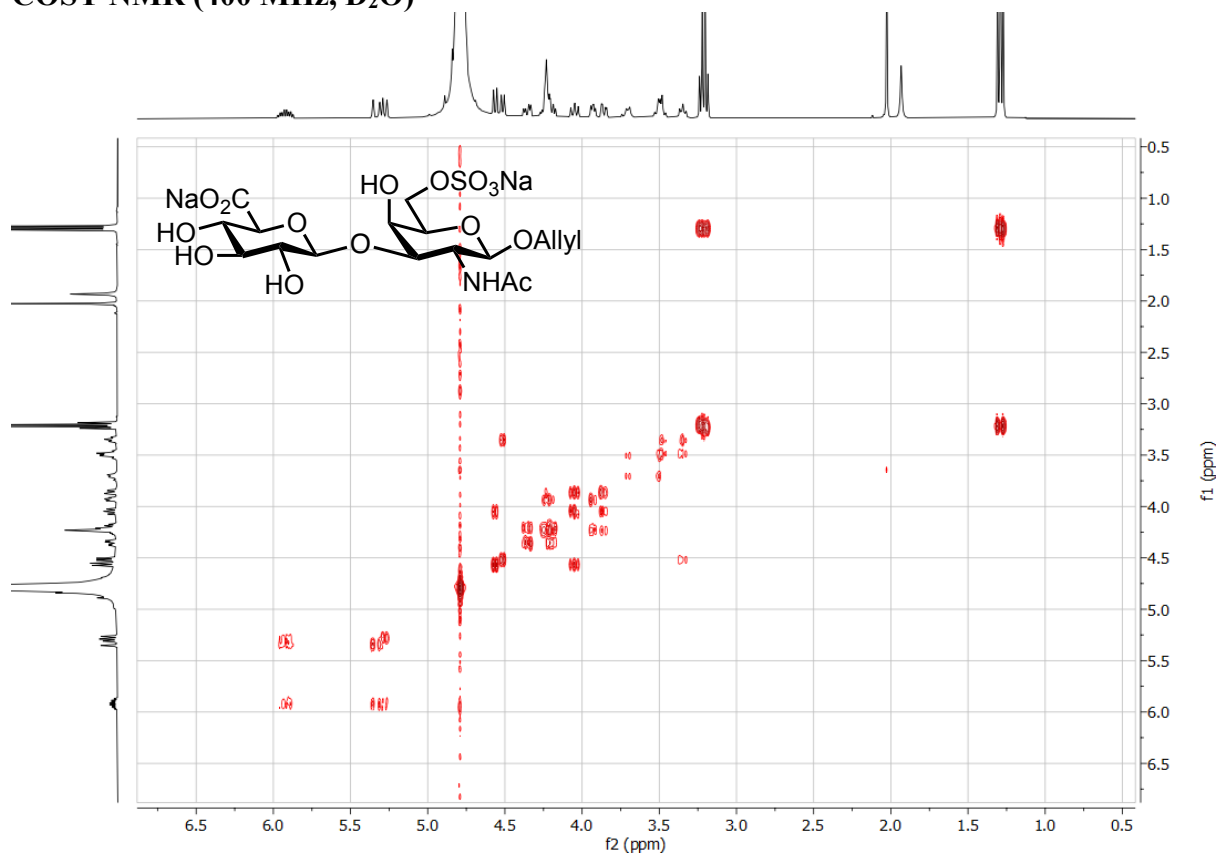
Compound 29
¹H NMR (400 MHz, D₂O)



¹³C{¹H} NMR (101 MHz, D₂O)



COSY NMR (400 MHz, D₂O)



HSQC NMR (400 MHz × 101 MHz, D₂O)

