

Supporting Information

**Phosphotungstic acid as a novel acidic catalyst for carbohydrate
protection and glycosylation**

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Liao,^b Shen-Shen Wu,^c Hsin-Ru Wu,^d Shun-Yuan Luo^{a*}

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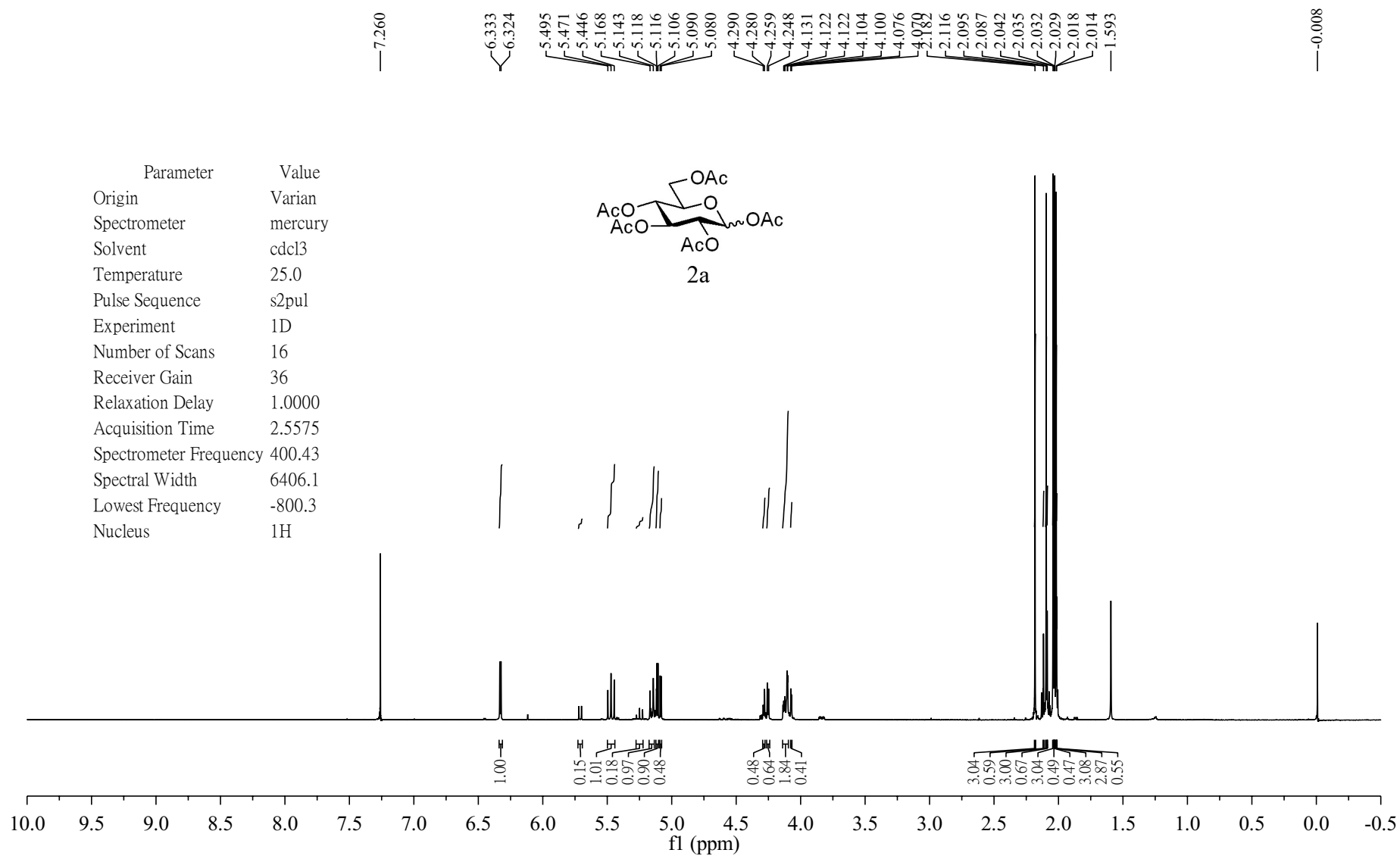
^bTaichung Municipal Feng Yuan Senior High School, Taichung 420, Taiwan

^cNational Hsinchu Girls' Senior High School, Hsinchu 300, Taiwan.

^dInstrumentation Center, MOST, National Tsing Hua University, Hsinchu 300, Taiwan.

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169.348
168.707

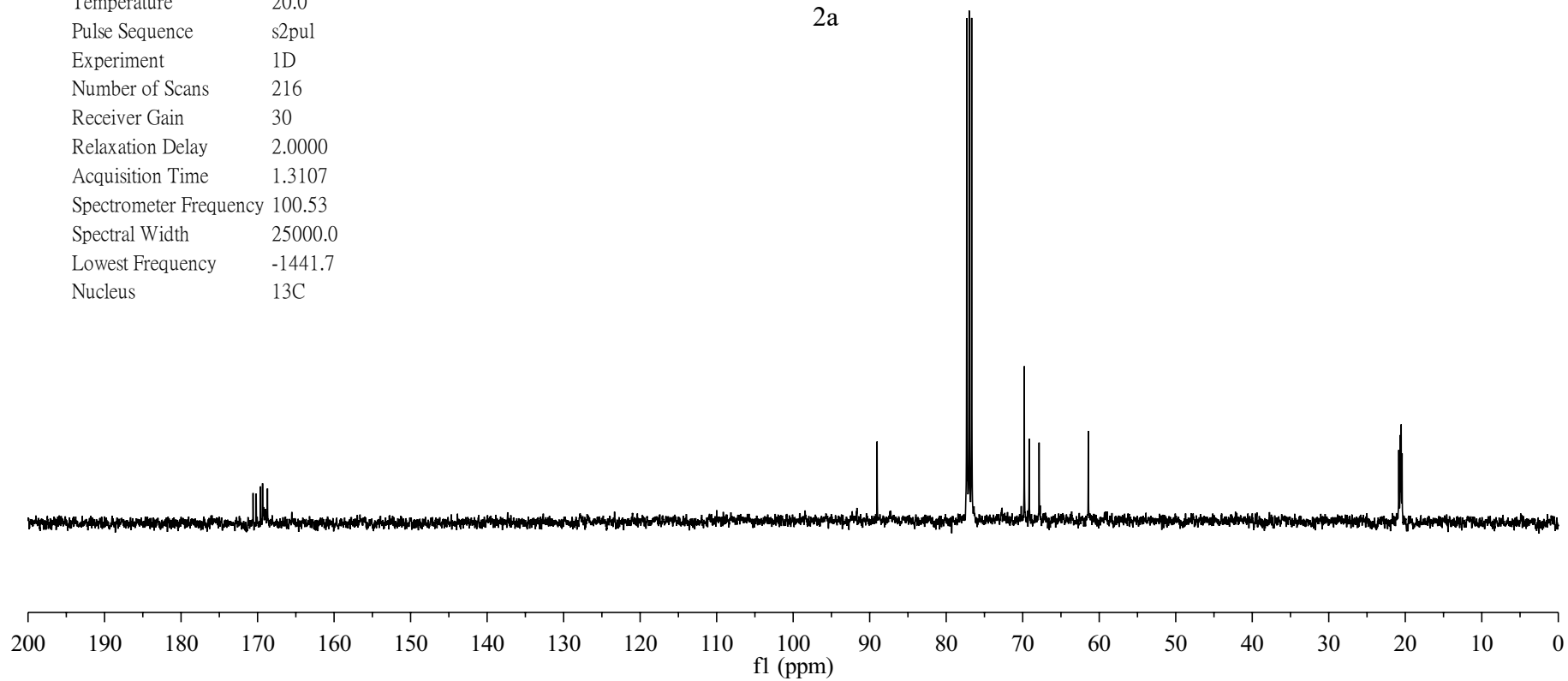
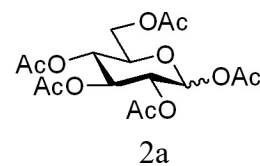
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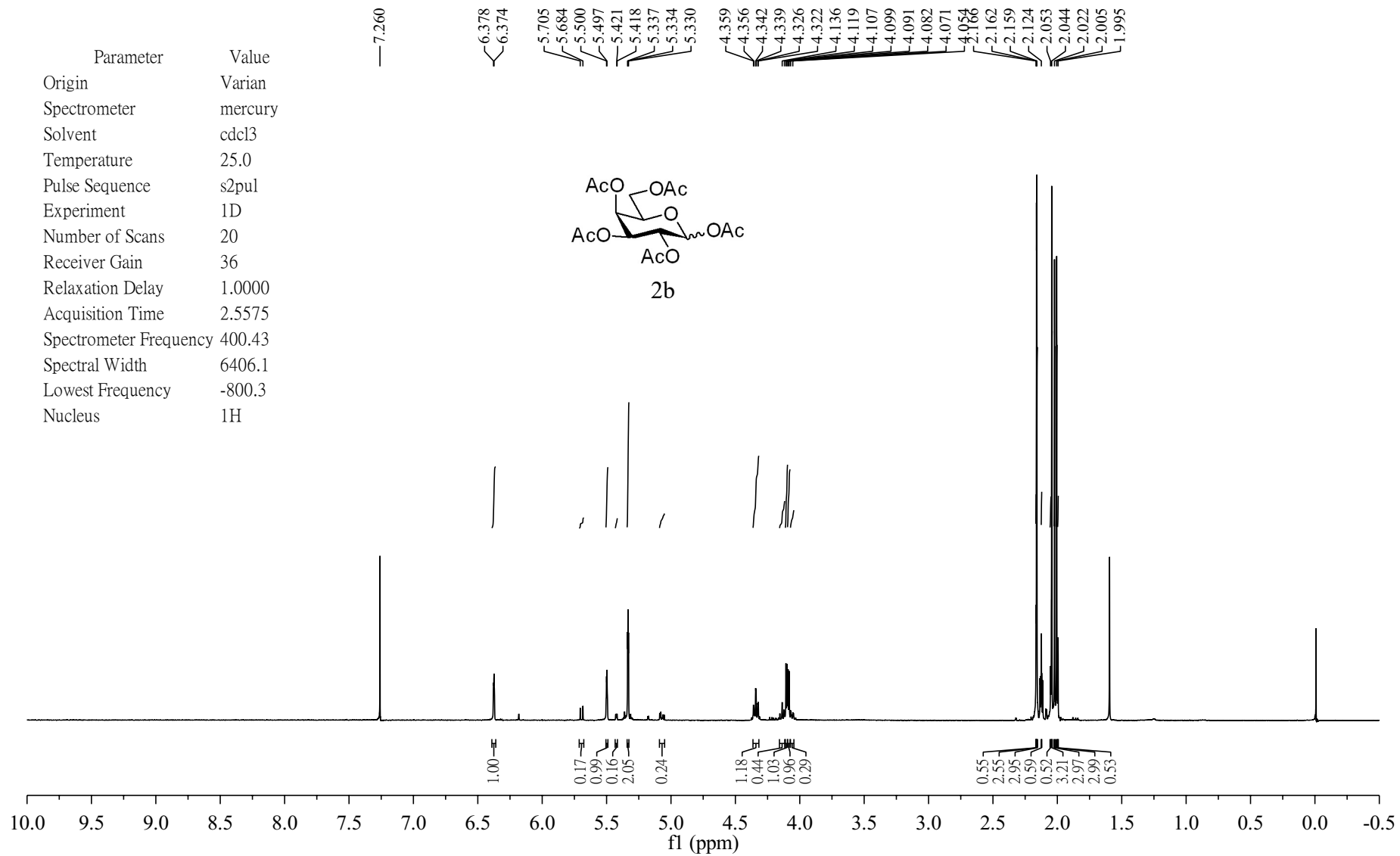
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20.415

Parameter	value
Origin	Varian
Spectrometer	vmrs
Solvent	cdcl3
Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	216
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
Spectrometer Frequency	100.53
Spectral Width	25000.0
Lowest Frequency	-1441.7
Nucleus	13C



Parameter	Value
Origin	Varian
Spectrometer	mercury
Solvent	cdcl3
Temperature	25.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	20
Receiver Gain	36
Relaxation Delay	1.0000
Acquisition Time	2.5575
Spectrometer Frequency	400.43
Spectral Width	6406.1
Lowest Frequency	-800.3
Nucleus	¹ H



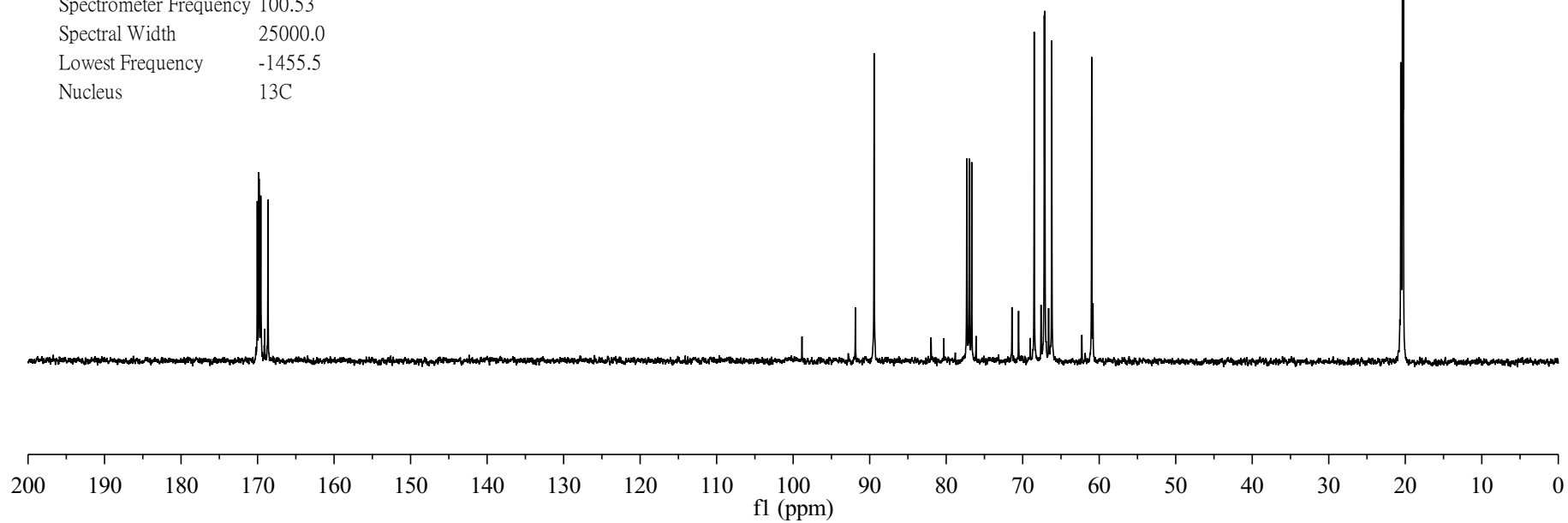
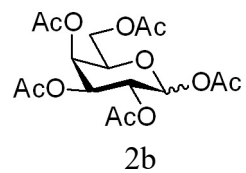
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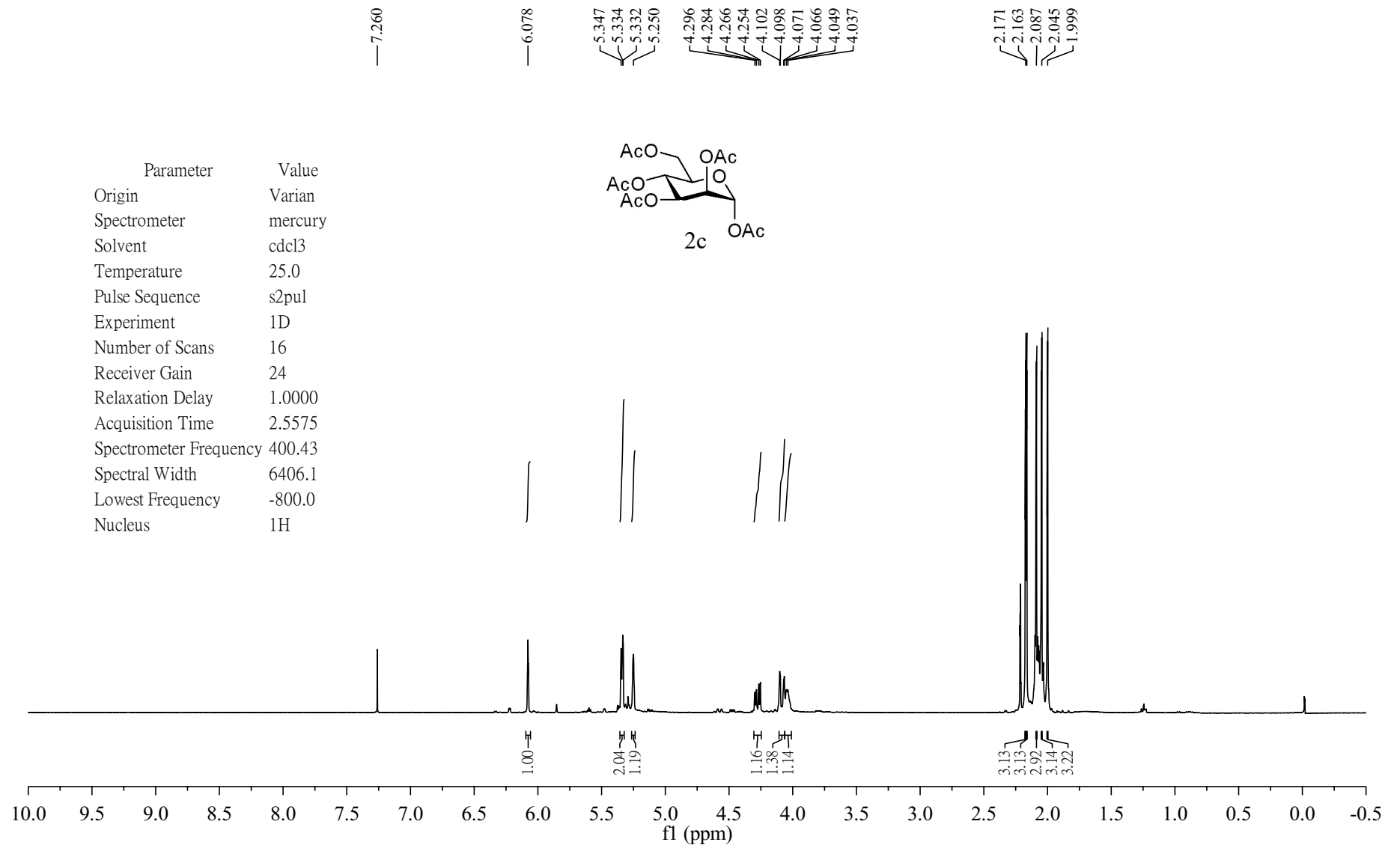
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20.250

Parameter	value
Origin	Varian
Spectrometer	nmrs
Solvent	cdcl3
Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	176
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
Spectrometer Frequency	100.53
Spectral Width	25000.0
Lowest Frequency	-1455.5
Nucleus	13C





Parameter	Value
Origin	Varian
Spectrometer	mercury
Solvent	cdcl3
Temperature	25.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	16
Receiver Gain	24
Relaxation Delay	1.0000
Acquisition Time	2.5575
Spectrometer Frequency	400.43
Spectral Width	6406.1
Lowest Frequency	-800.0
Nucleus	¹ H

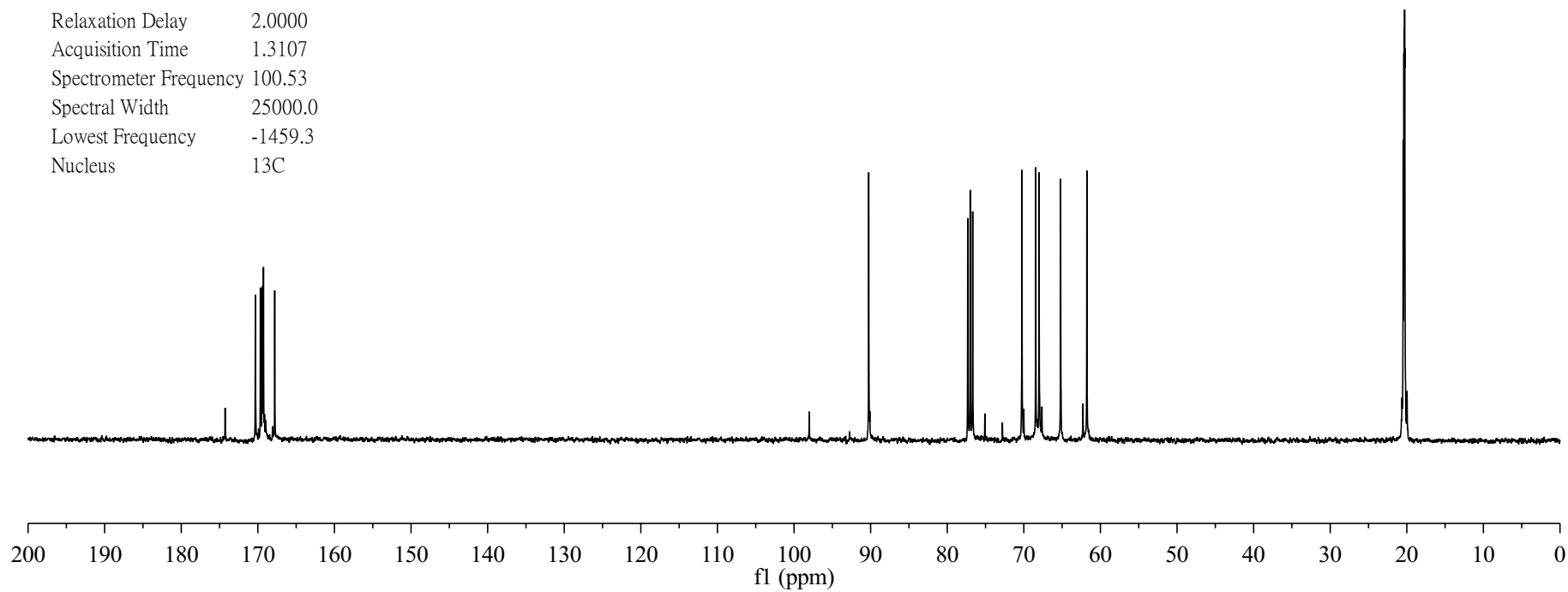
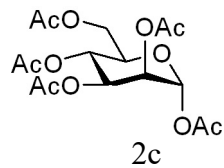
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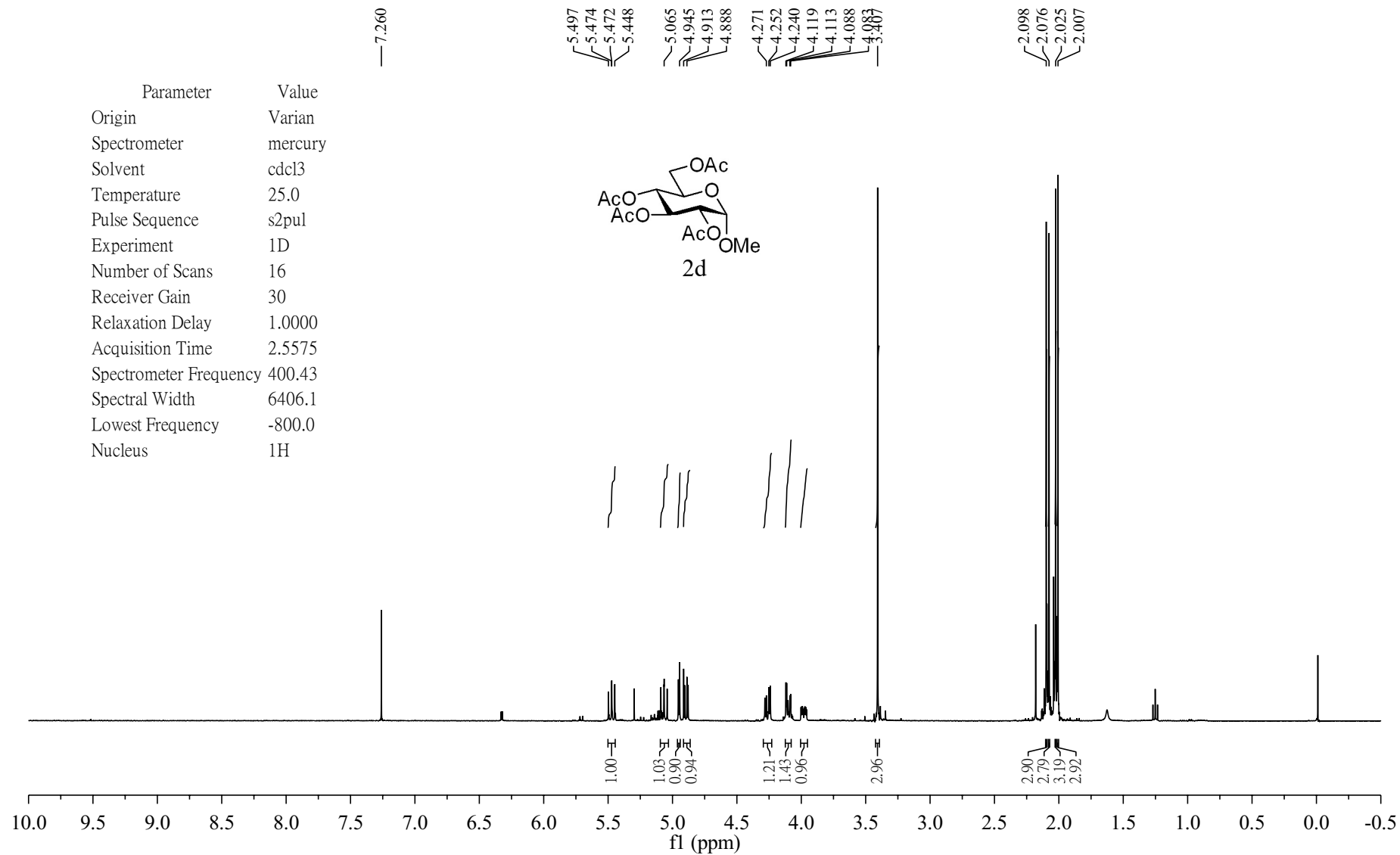
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Parameter	value
Origin	Varian
Spectrometer	vnmrs
Solvent	cdcl3
Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	144
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
Spectrometer Frequency	100.53
Spectral Width	25000.0
Lowest Frequency	-1459.3
Nucleus	13C



Parameter	Value
Origin	Varian
Spectrometer	mercury
Solvent	cdcl3
Temperature	25.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	16
Receiver Gain	30
Relaxation Delay	1.0000
Acquisition Time	2.5575
Spectrometer Frequency	400.43
Spectral Width	6406.1
Lowest Frequency	-800.0
Nucleus	¹ H



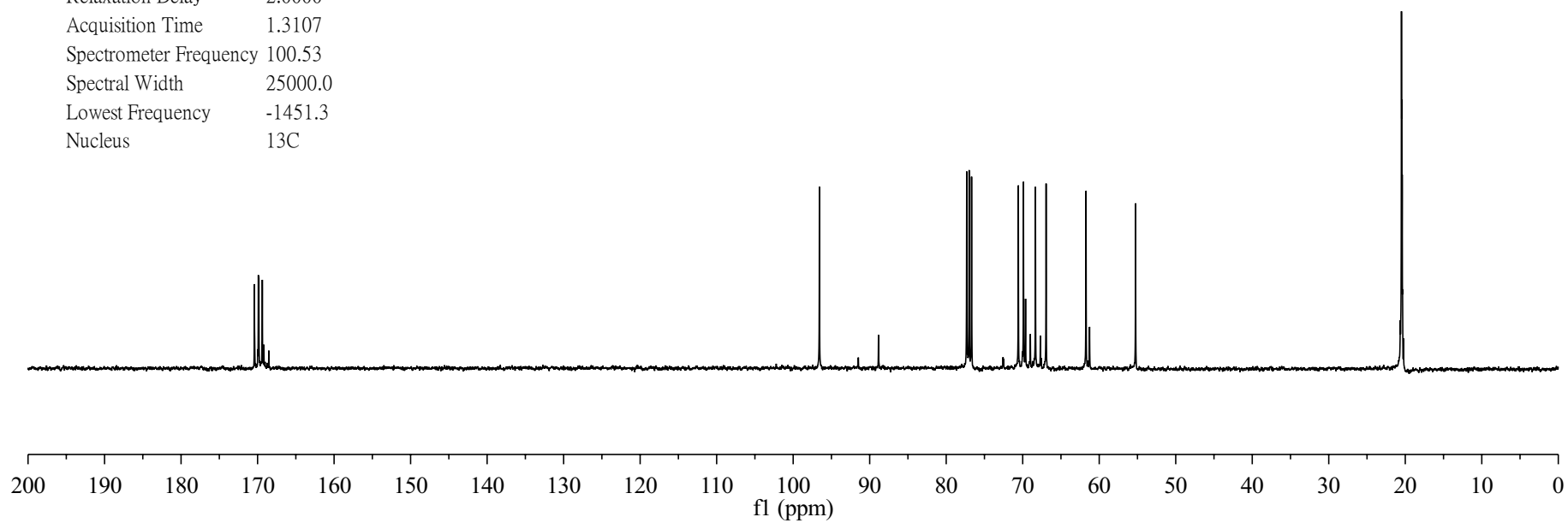
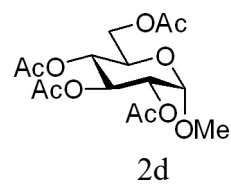
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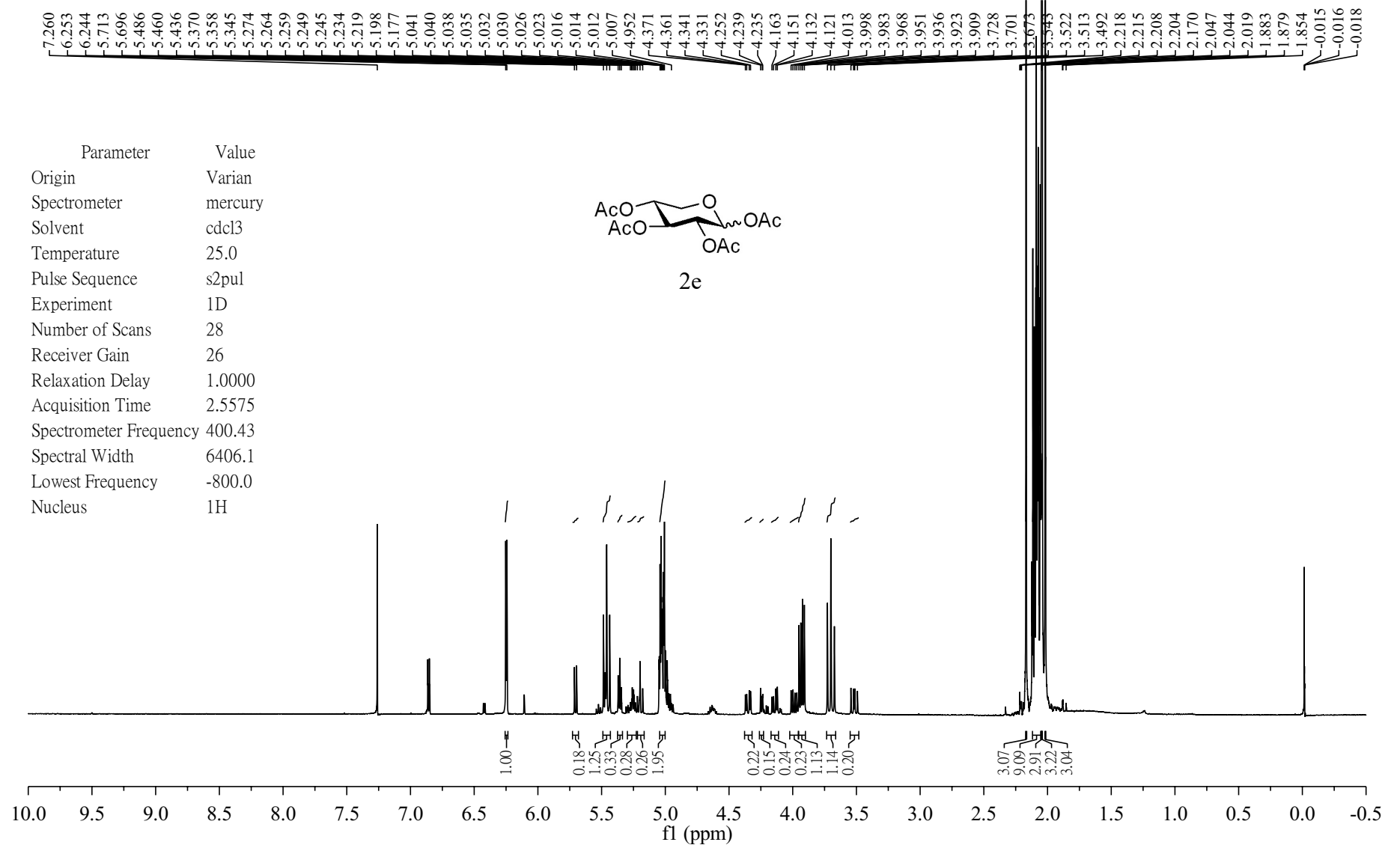
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Parameter	value
Origin	Varian
Spectrometer	vnmrs
Solvent	cdcl3
Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	168
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
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Spectral Width	25000.0
Lowest Frequency	-1451.3
Nucleus	13C





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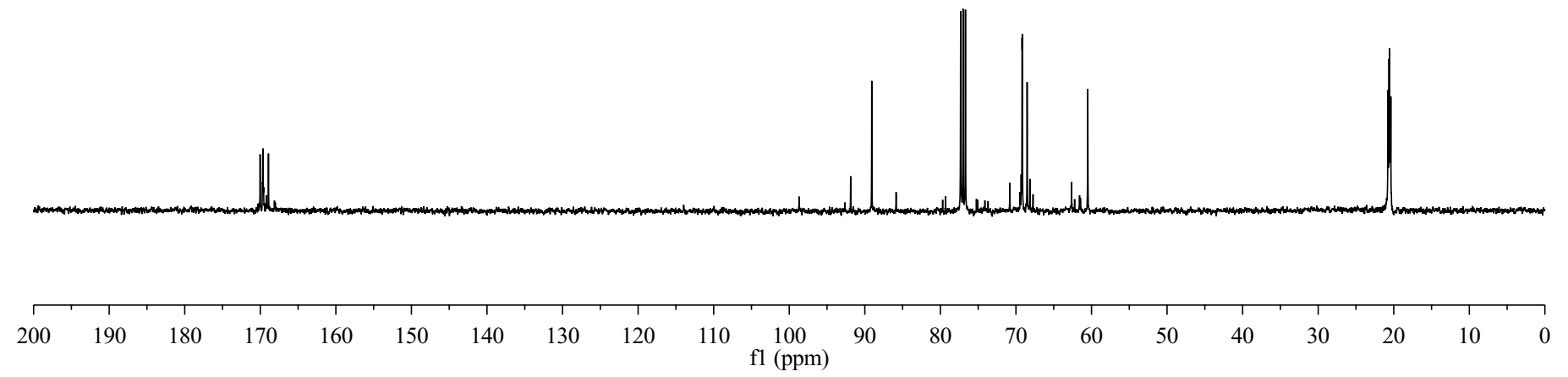
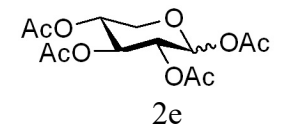
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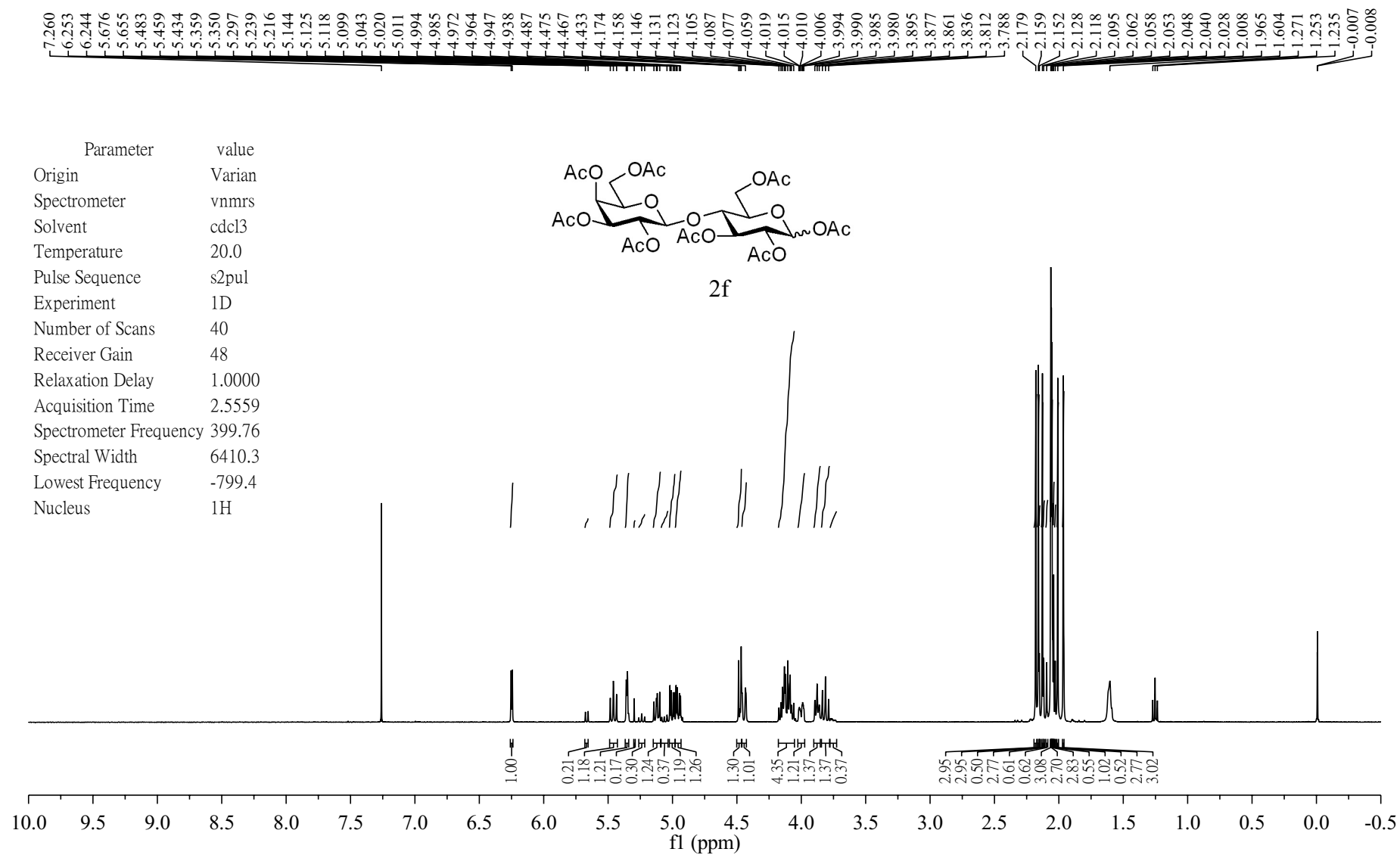
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Parameter	value
Origin	Varian
Spectrometer	vnmrs
Solvent	cdcl3
Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	96
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
Spectrometer Frequency	100.53
Spectral Width	25000.0
Lowest Frequency	-1449.0
Nucleus	¹³ C





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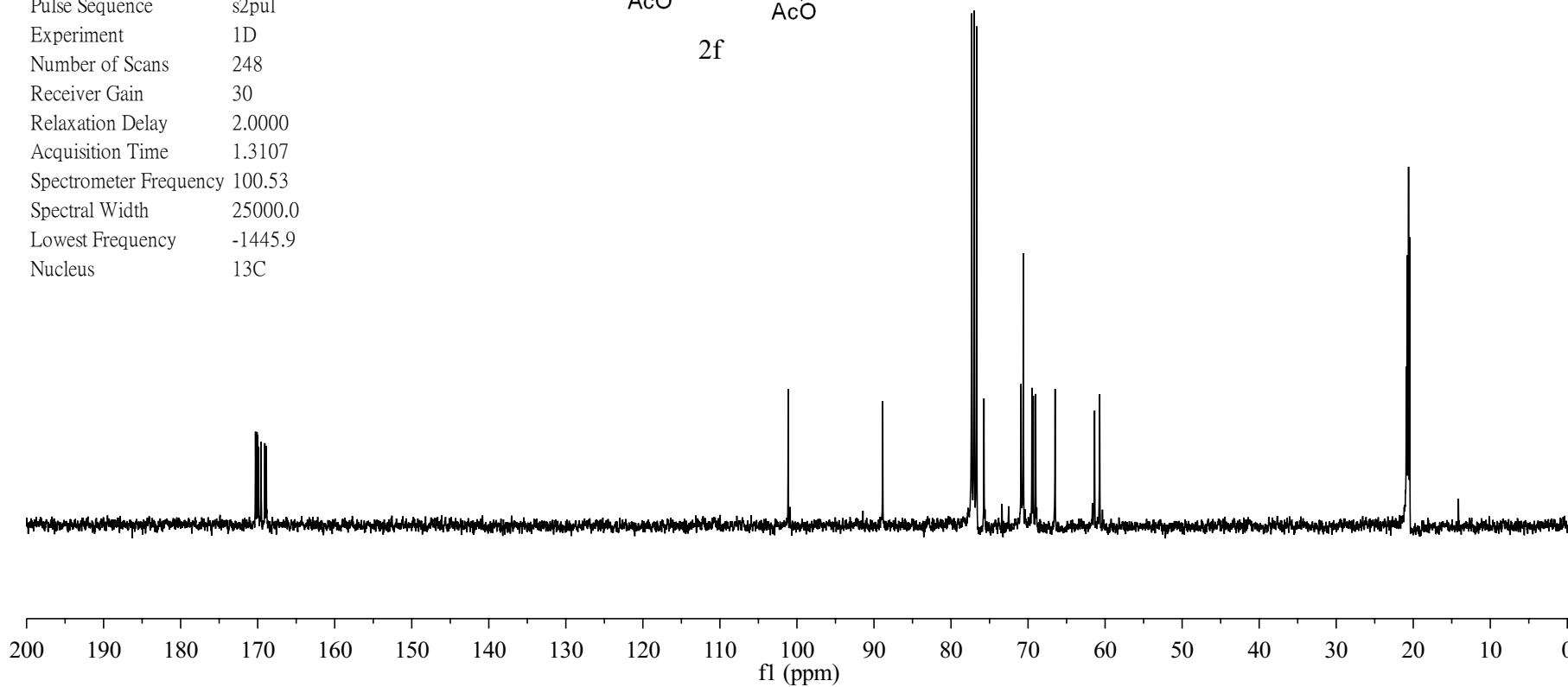
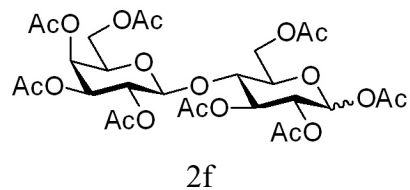
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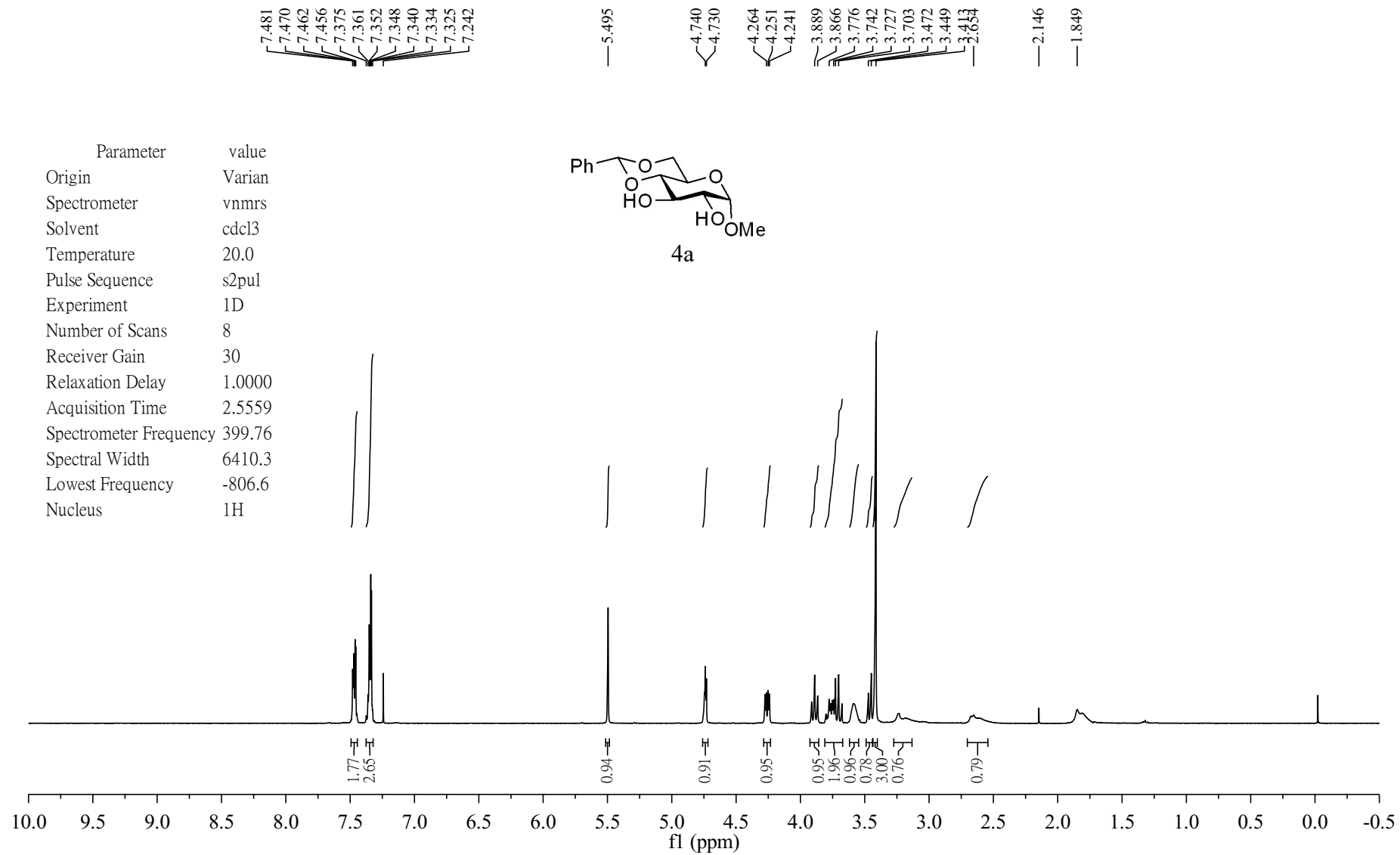
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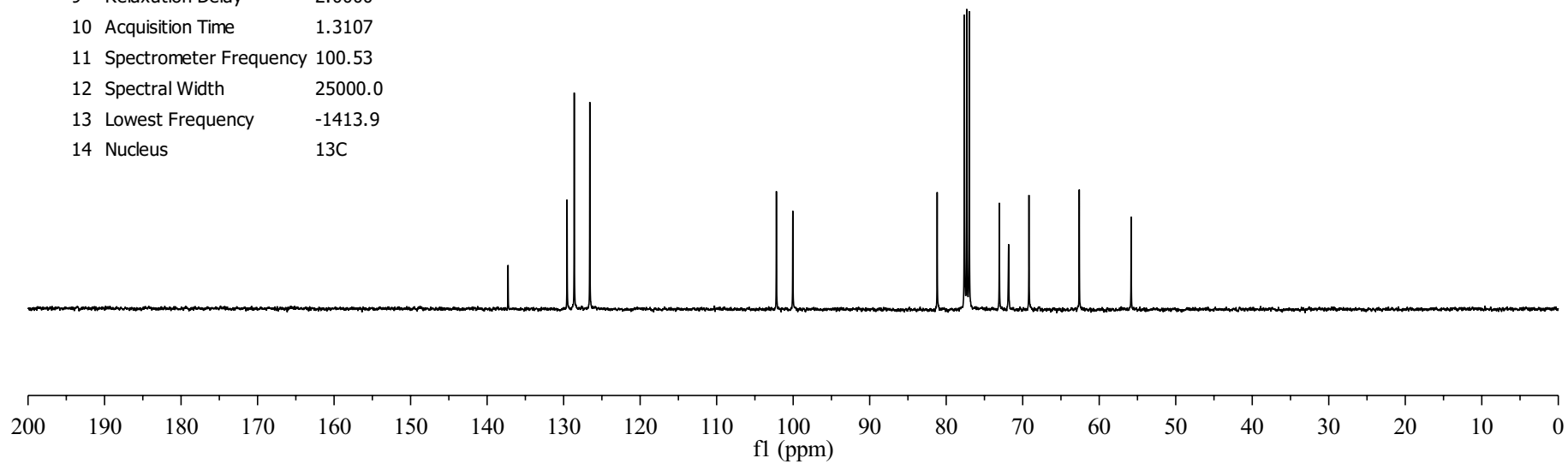
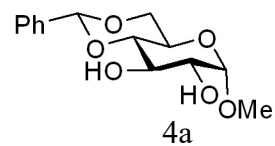
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Spectrometer	nmrs
Solvent	cdcl3
Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	248
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
Spectrometer Frequency	100.53
Spectral Width	25000.0
Lowest Frequency	-1445.9
Nucleus	13C

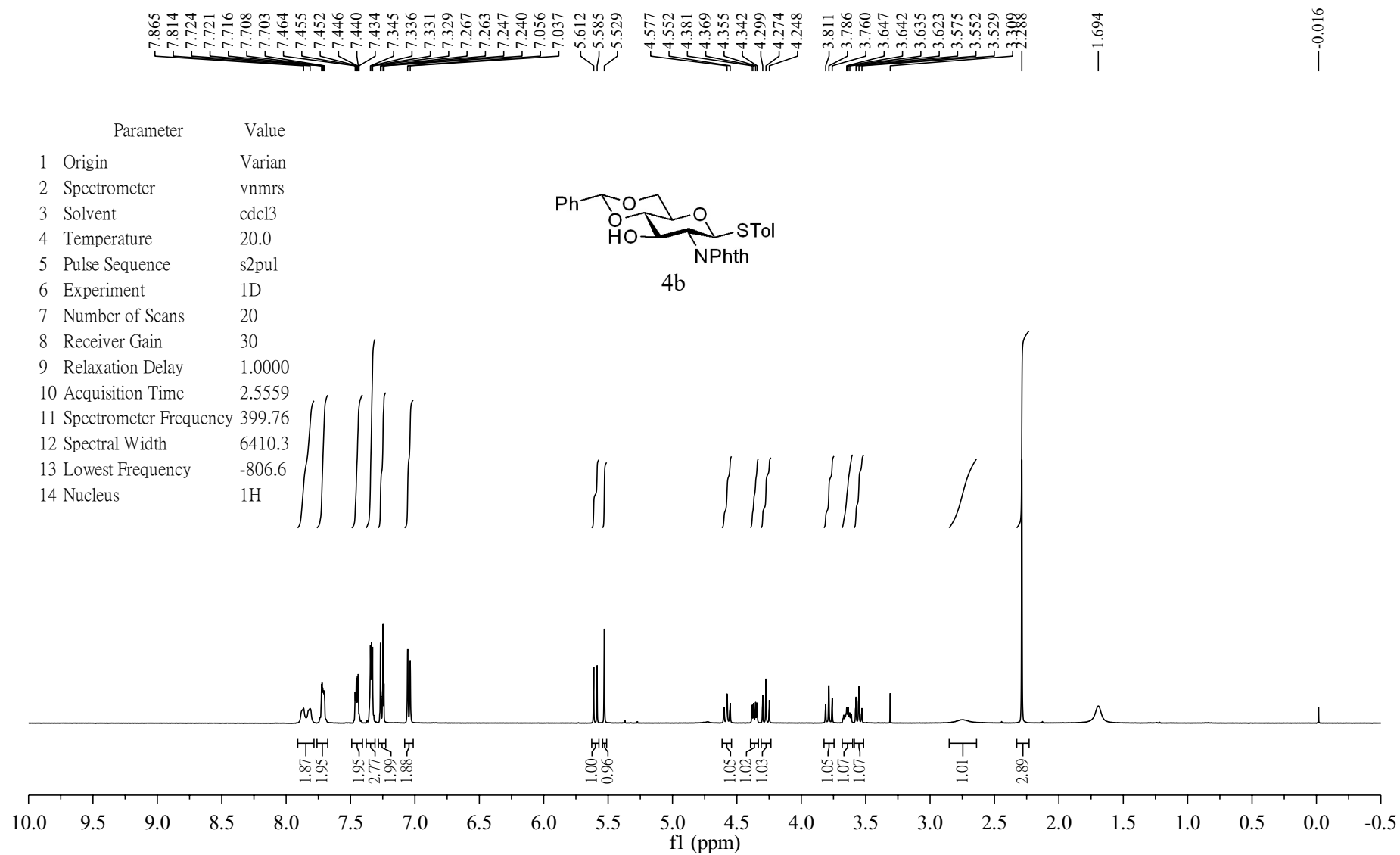


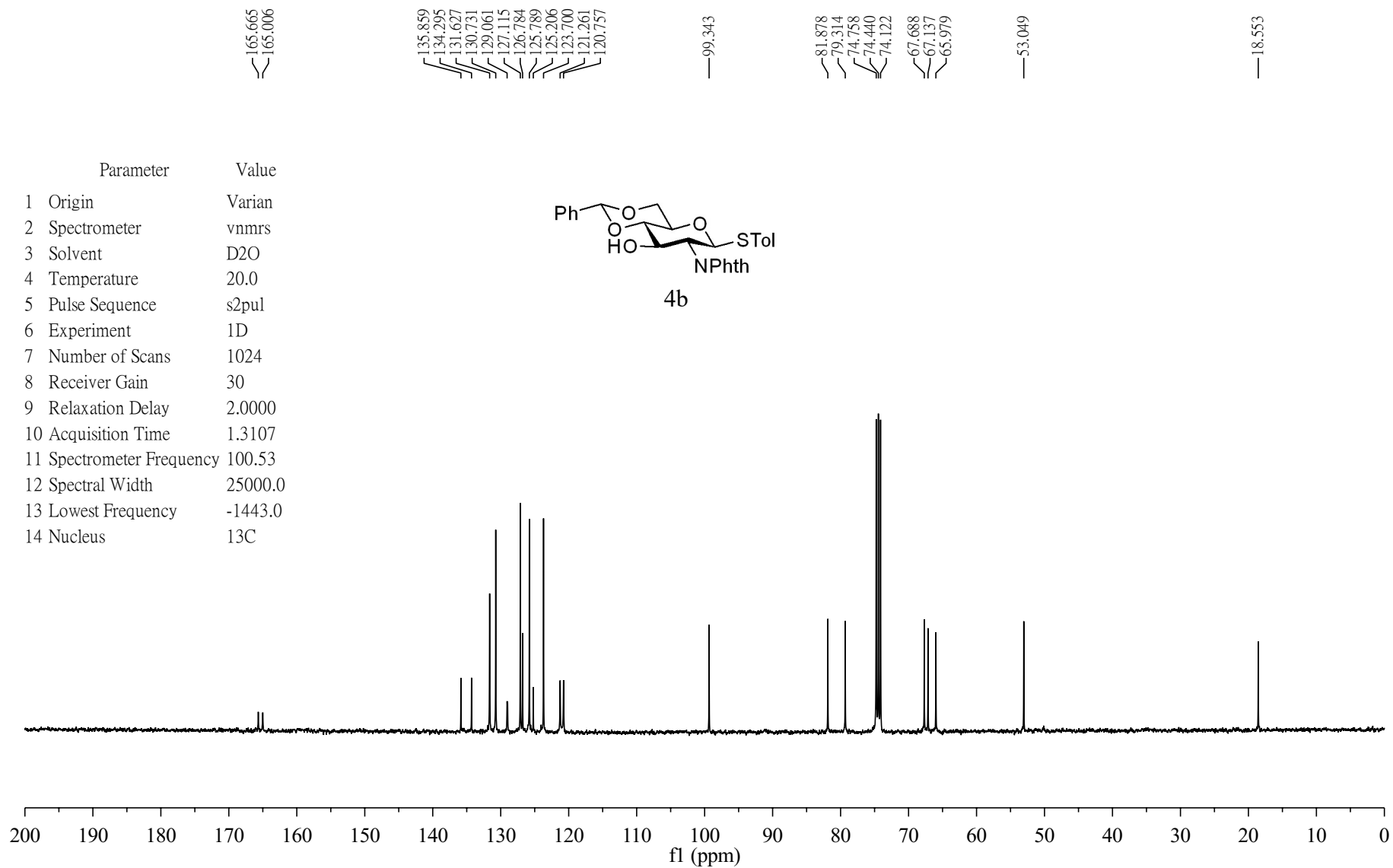


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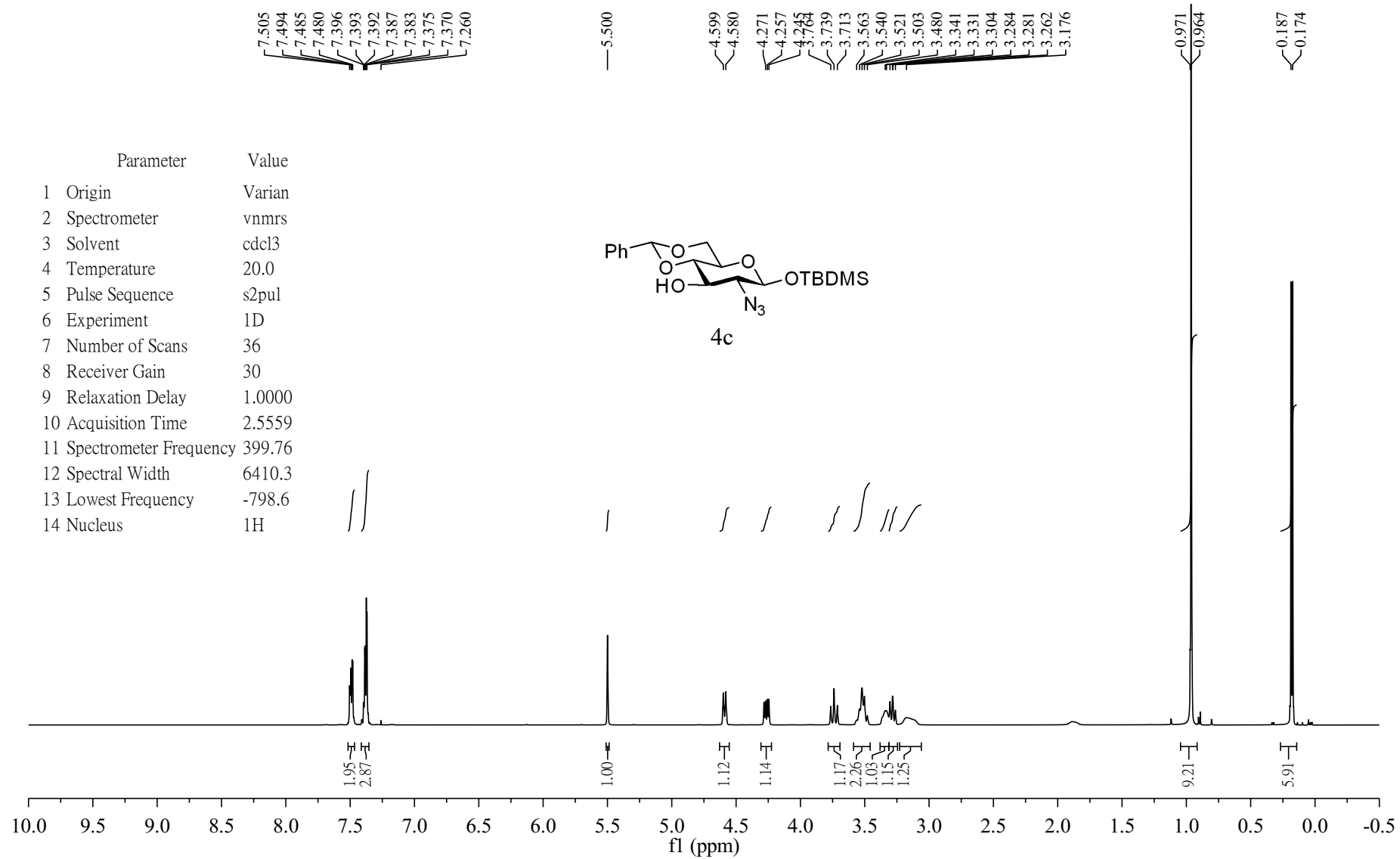
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3 Solvent	cdcl3
4 Temperature	20.0
5 Pulse Sequence	s2pul
6 Experiment	1D
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8 Receiver Gain	30
9 Relaxation Delay	2.0000
10 Acquisition Time	1.3107
11 Spectrometer Frequency	100.53
12 Spectral Width	25000.0
13 Lowest Frequency	-1413.9
14 Nucleus	13C







Parameter	Value
1 Origin	Varian
2 Spectrometer	nmrs
3 Solvent	D2O
4 Temperature	20.0
5 Pulse Sequence	s2pul
6 Experiment	1D
7 Number of Scans	1024
8 Receiver Gain	30
9 Relaxation Delay	2.0000
10 Acquisition Time	1.3107
11 Spectrometer Frequency	100.53
12 Spectral Width	25000.0
13 Lowest Frequency	-1443.0
14 Nucleus	13C



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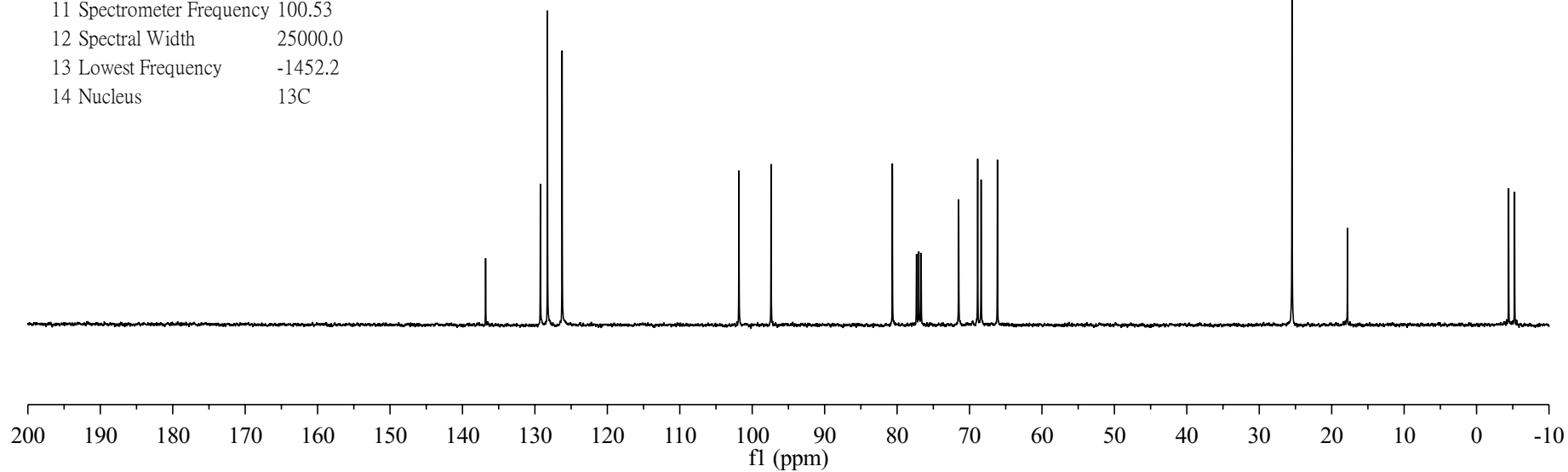
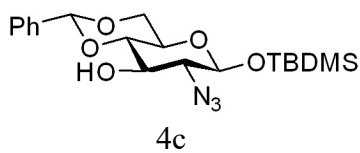
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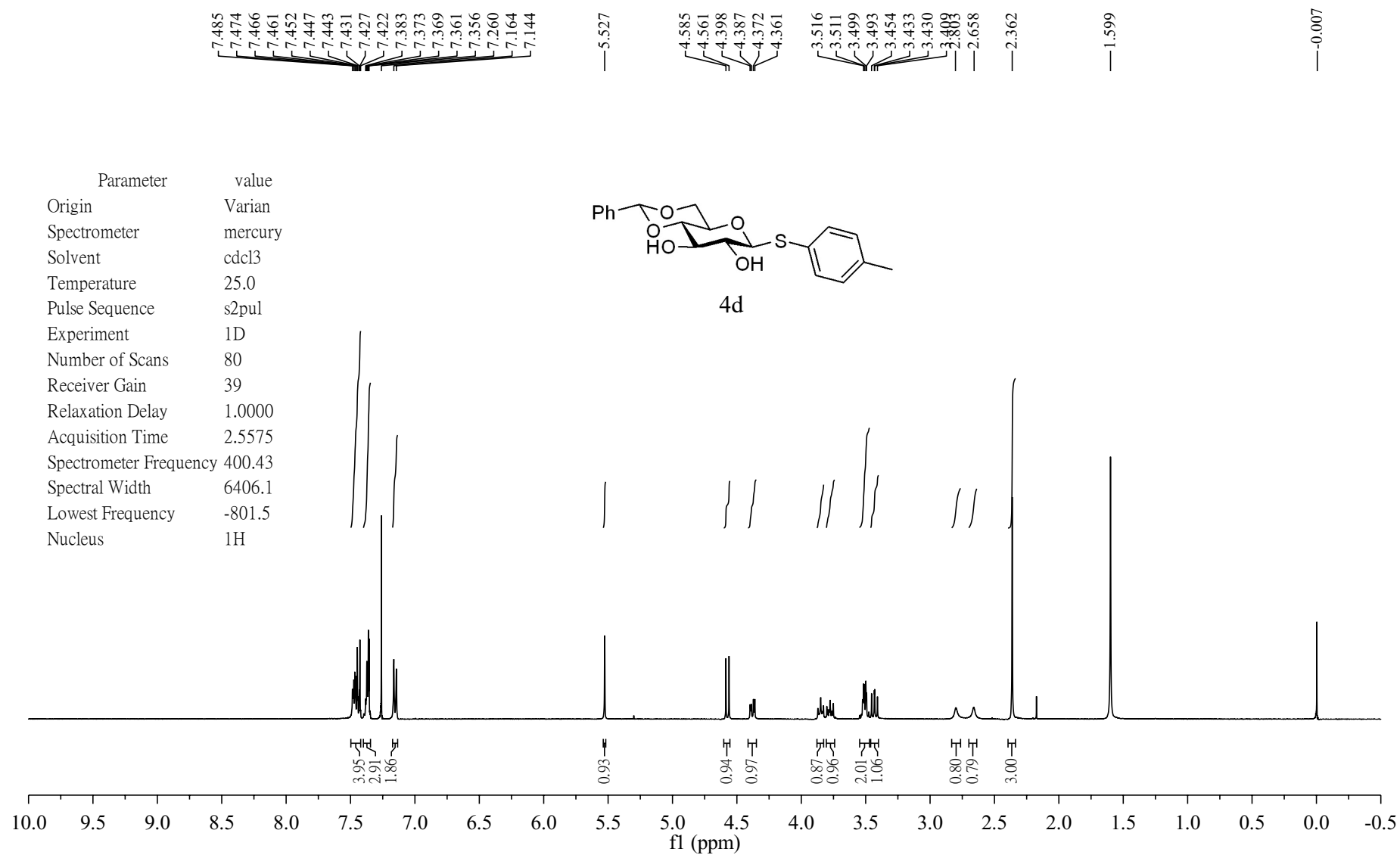
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 — 25.474
 — 17.818

 { -4.431
 { -5.253

Parameter	Value
1 Origin	Varian
2 Spectrometer	vnmrs
3 Solvent	cdcl3
4 Temperature	20.0
5 Pulse Sequence	s2pul
6 Experiment	1D
7 Number of Scans	80
8 Receiver Gain	30
9 Relaxation Delay	2.0000
10 Acquisition Time	1.3107
11 Spectrometer Frequency	100.53
12 Spectral Width	25000.0
13 Lowest Frequency	-1452.2
14 Nucleus	13C





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129.782
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126.248

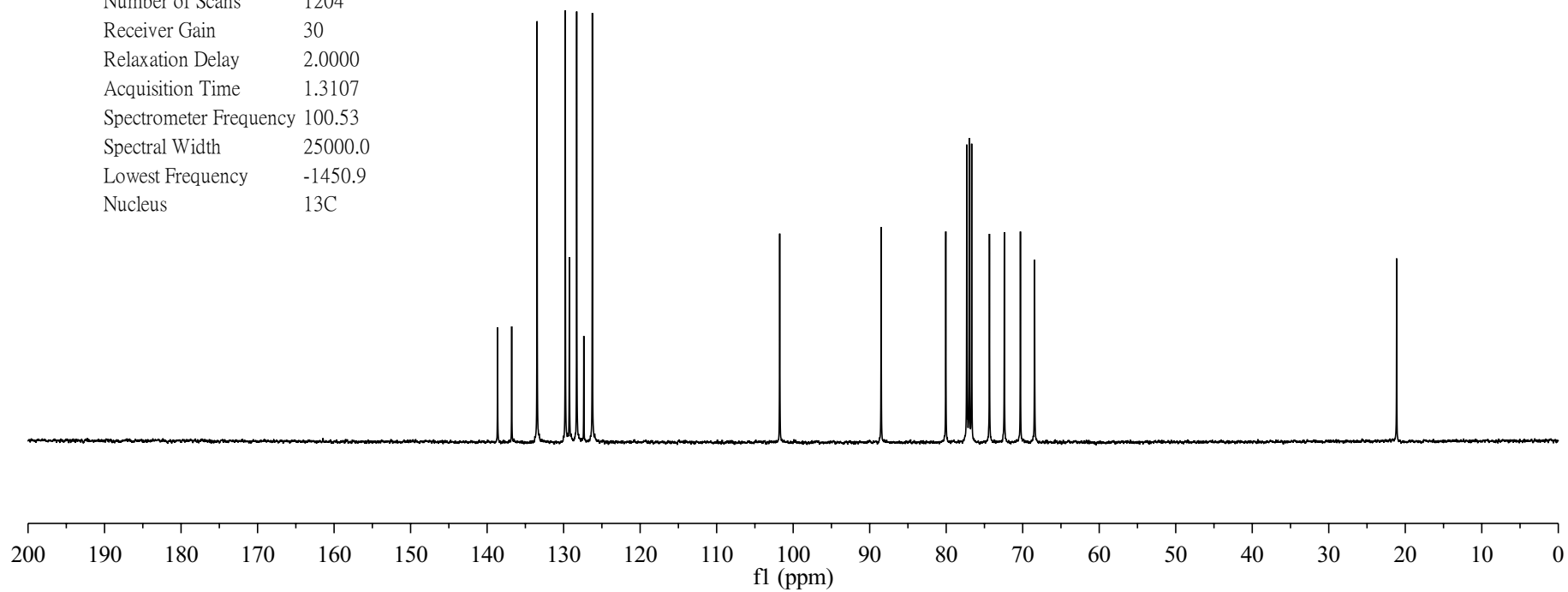
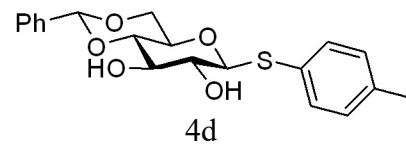
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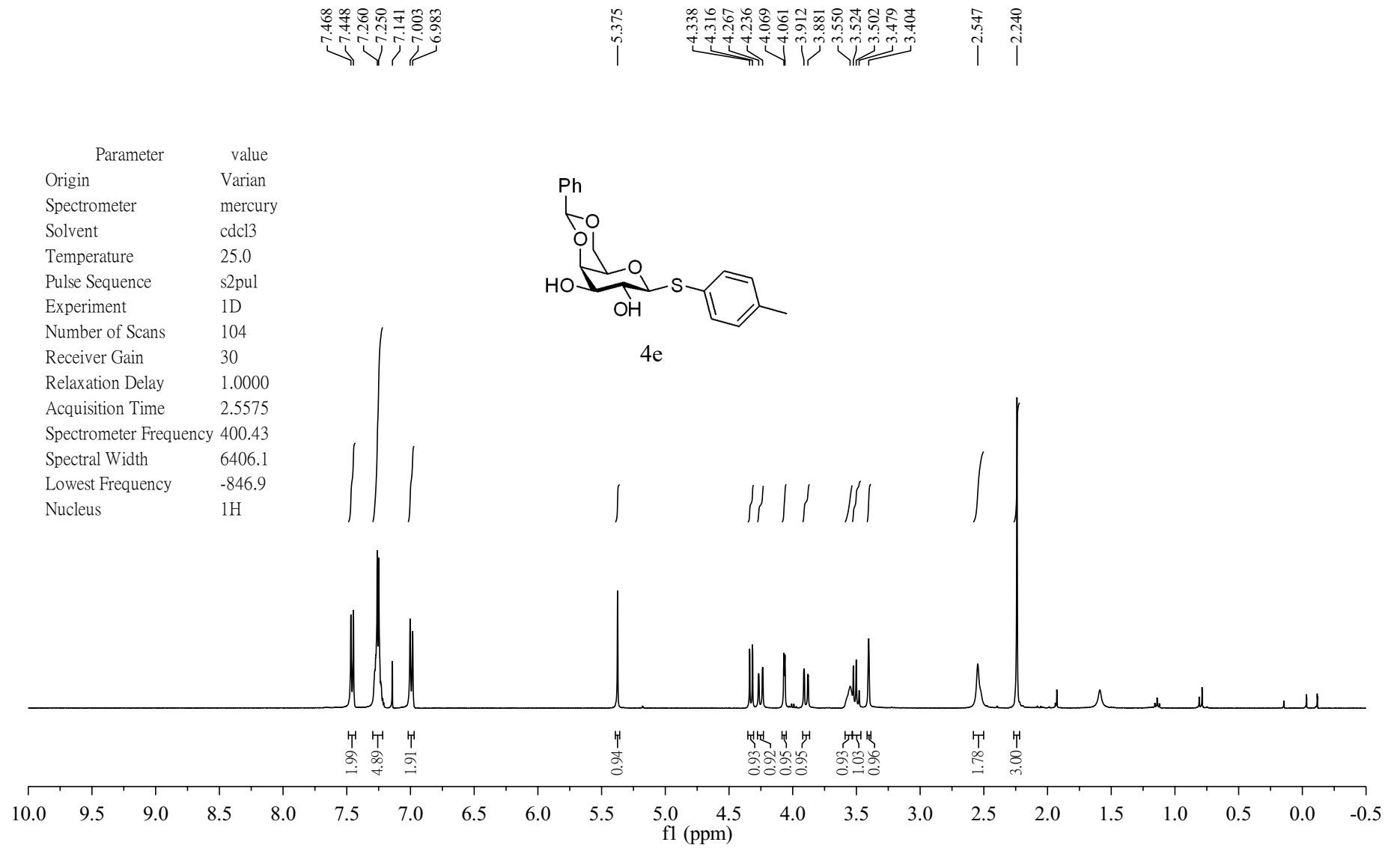
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68.448

21.126

Parameter	value
Origin	Varian
Spectrometer	nmrs
Solvent	cdcl3
Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	1204
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
Spectrometer Frequency	100.53
Spectral Width	25000.0
Lowest Frequency	-1450.9
Nucleus	¹³ C





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129.673
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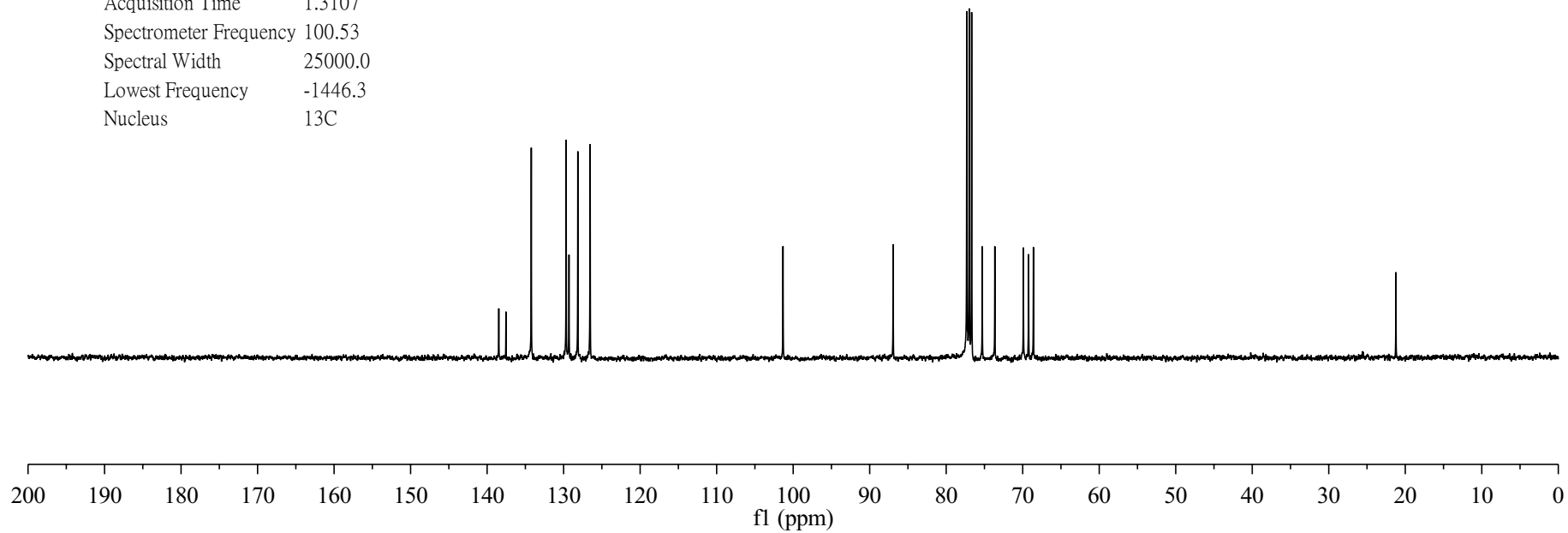
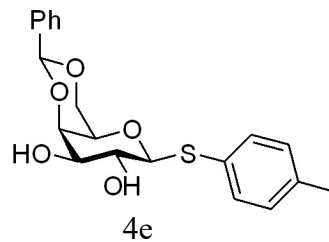
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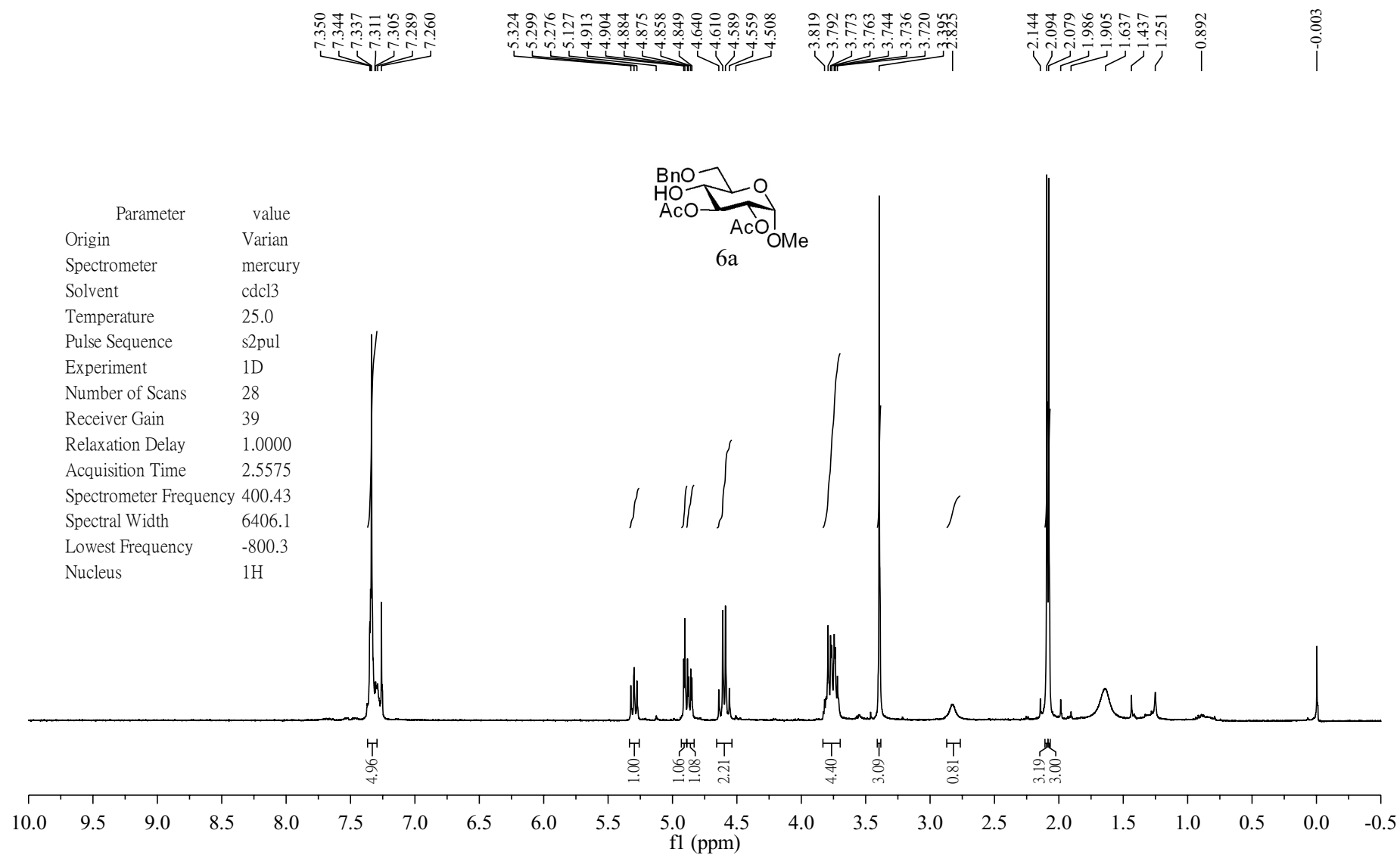
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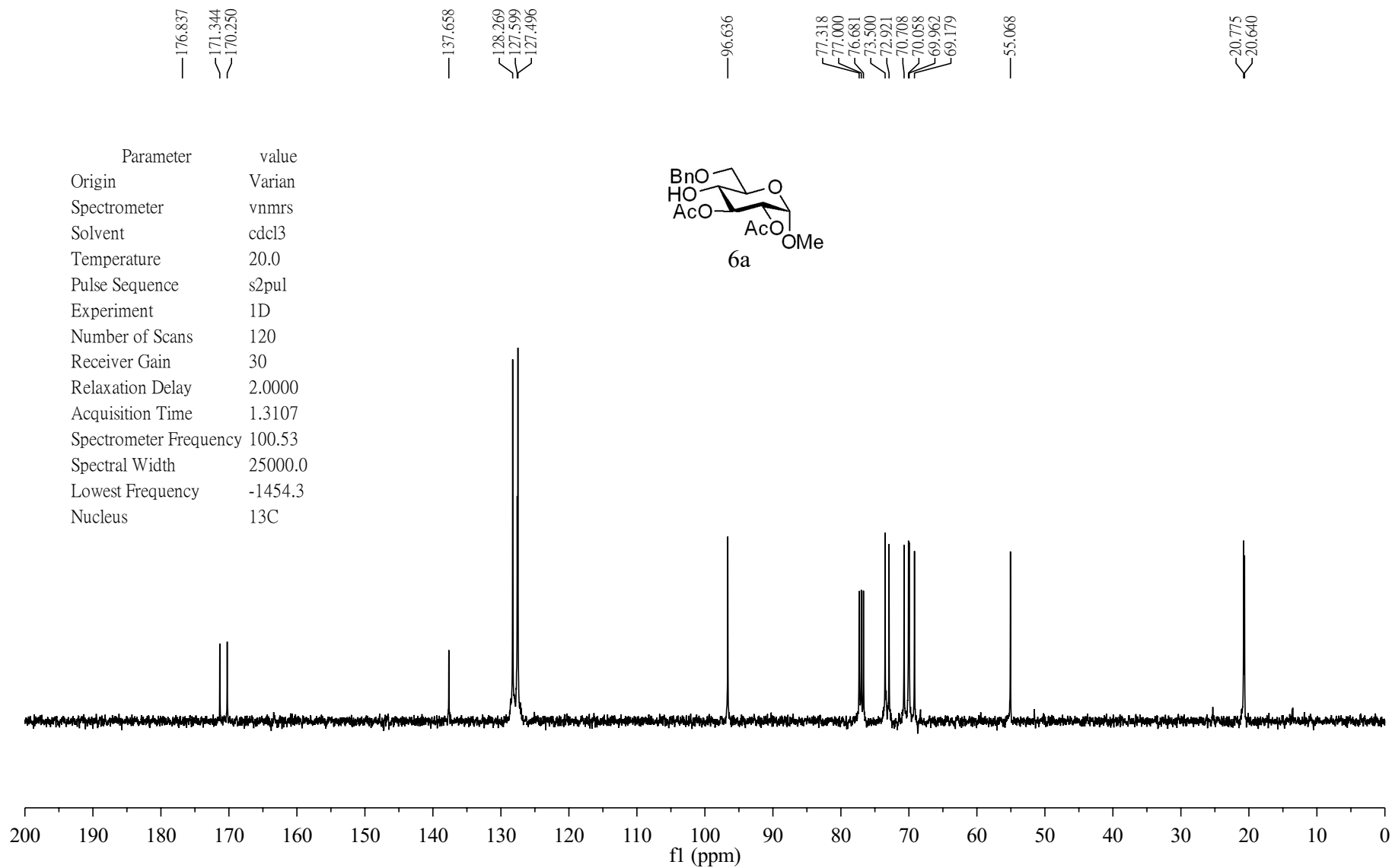
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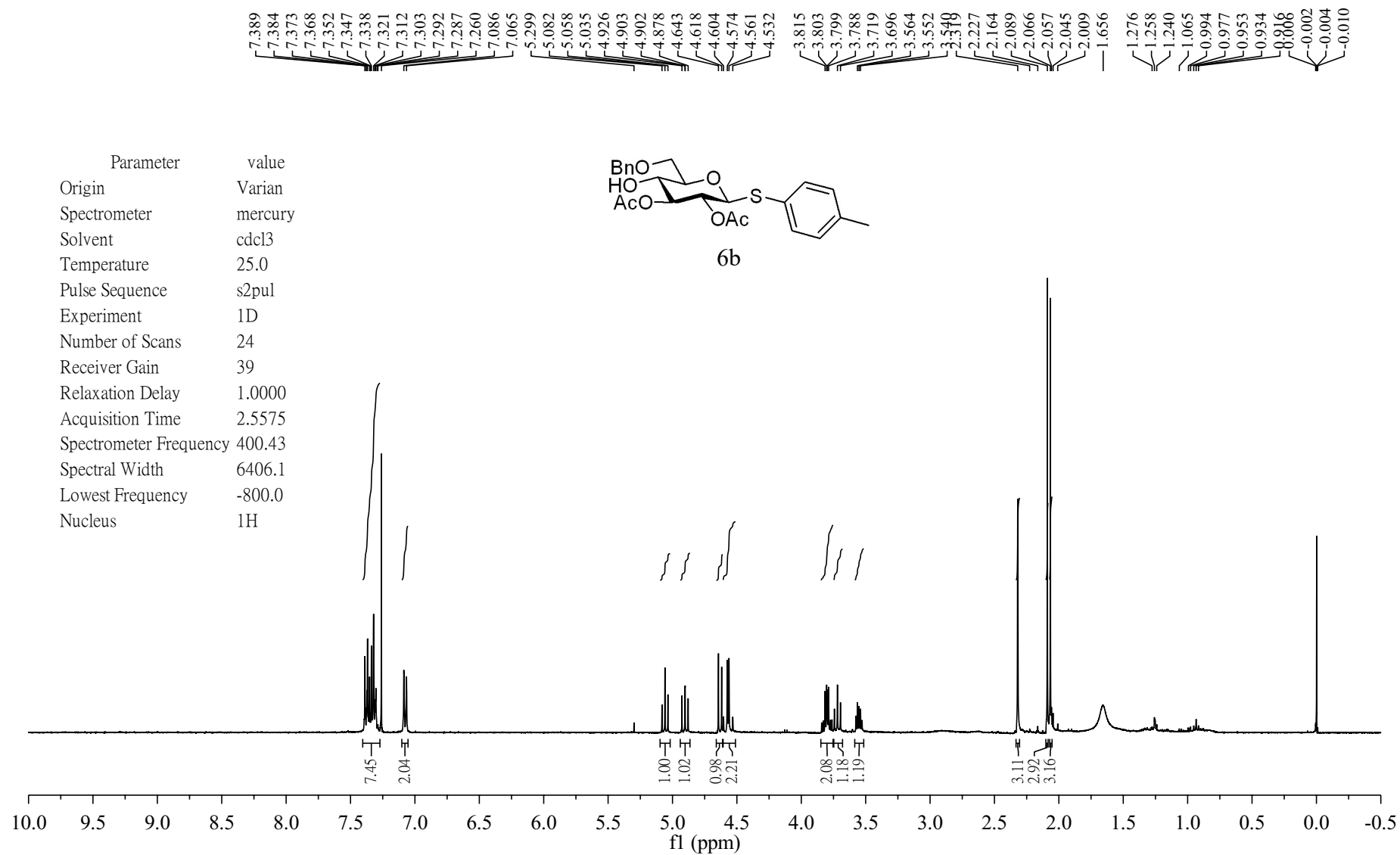
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Spectrometer	nmrs
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Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	732
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
Spectrometer Frequency	100.53
Spectral Width	25000.0
Lowest Frequency	-1446.3
Nucleus	13C







Parameter	value
Origin	Varian
Spectrometer	nmrs
Solvent	cdcl3
Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	120
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
Spectrometer Frequency	100.53
Spectral Width	25000.0
Lowest Frequency	-1454.3
Nucleus	13C



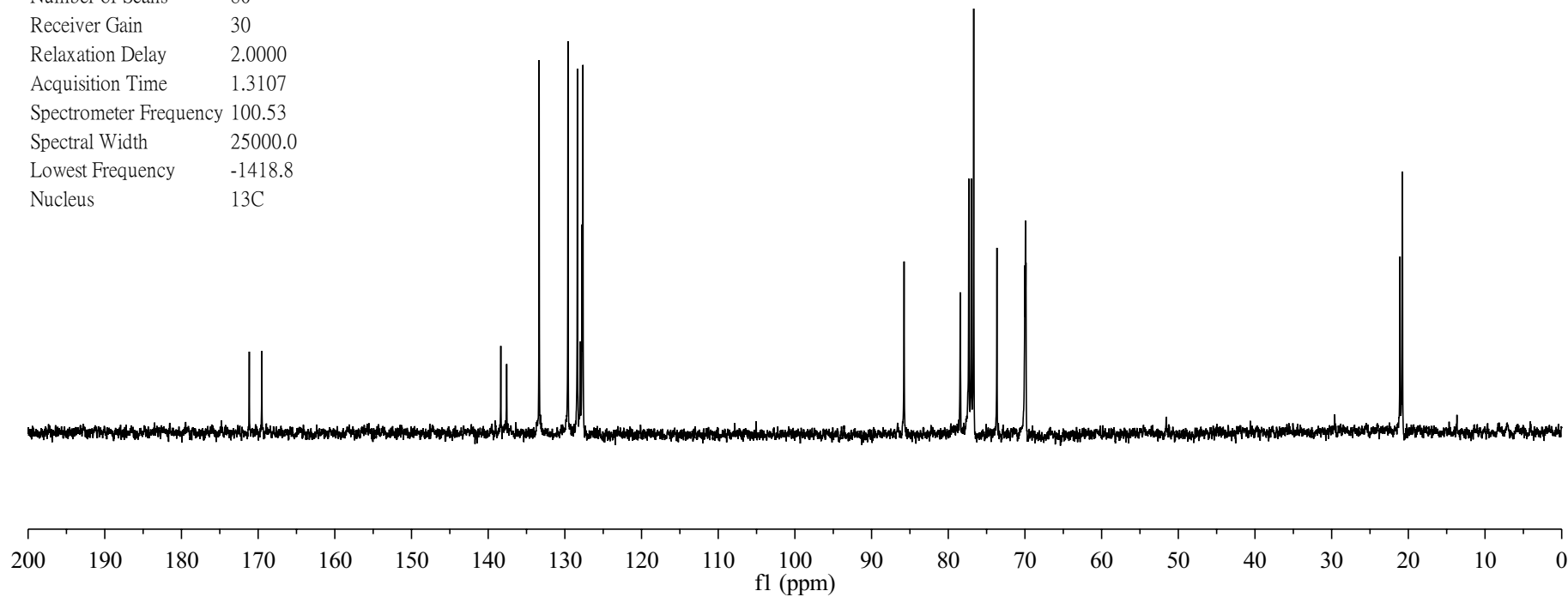
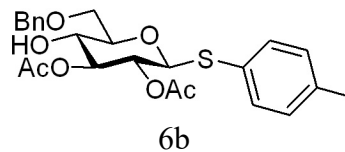
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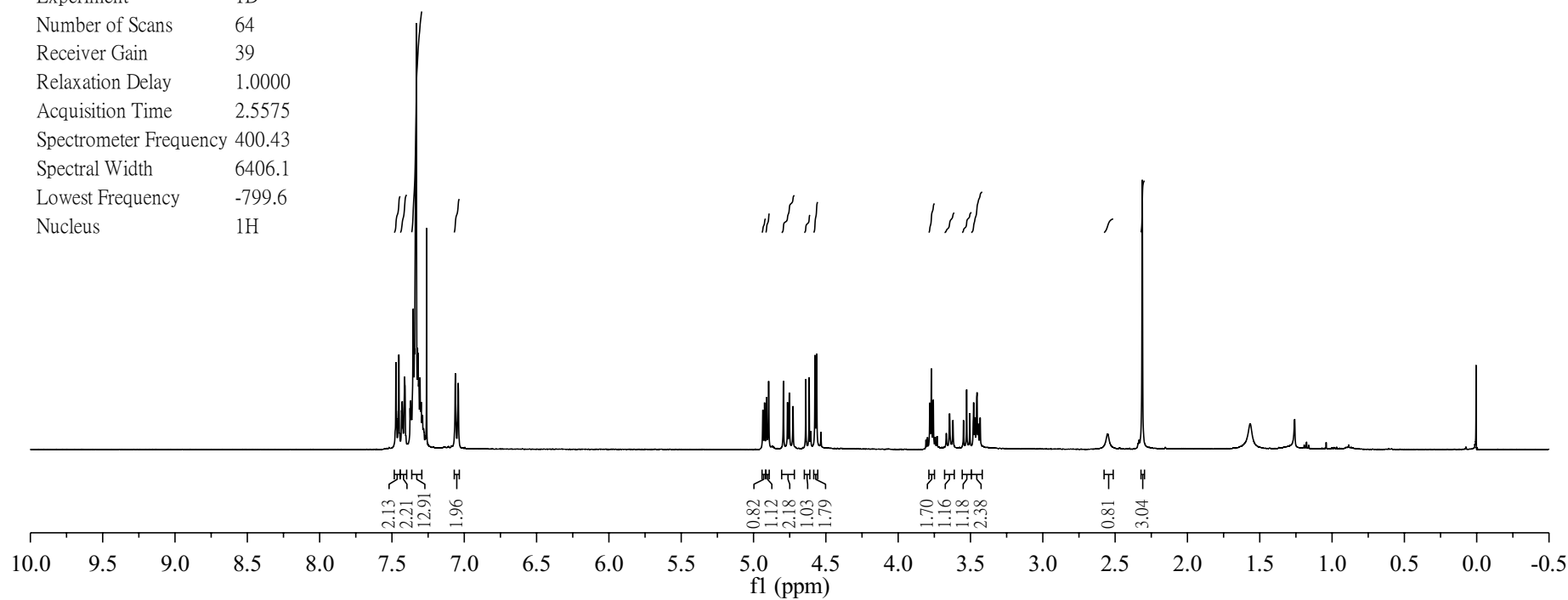
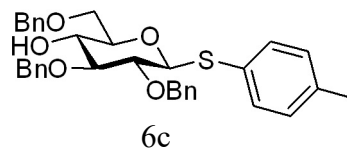
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Parameter	value
Origin	Varian
Spectrometer	vnmrs
Solvent	cdcl3
Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	80
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
Spectrometer Frequency	100.53
Spectral Width	25000.0
Lowest Frequency	-1418.8
Nucleus	13C



7.472
7.452
7.433
7.429
7.413
7.366
7.353
7.350
7.344
7.336
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7.323
7.319
7.314
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3.527
3.505
3.478
3.469
3.455
3.433
2.552
2.334
2.312
2.153

Parameter	value
Origin	Varian
Spectrometer	mercury
Solvent	cdcl3
Temperature	25.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	64
Receiver Gain	39
Relaxation Delay	1.0000
Acquisition Time	2.5575
Spectrometer Frequency	400.43
Spectral Width	6406.1
Lowest Frequency	-799.6
Nucleus	¹ H

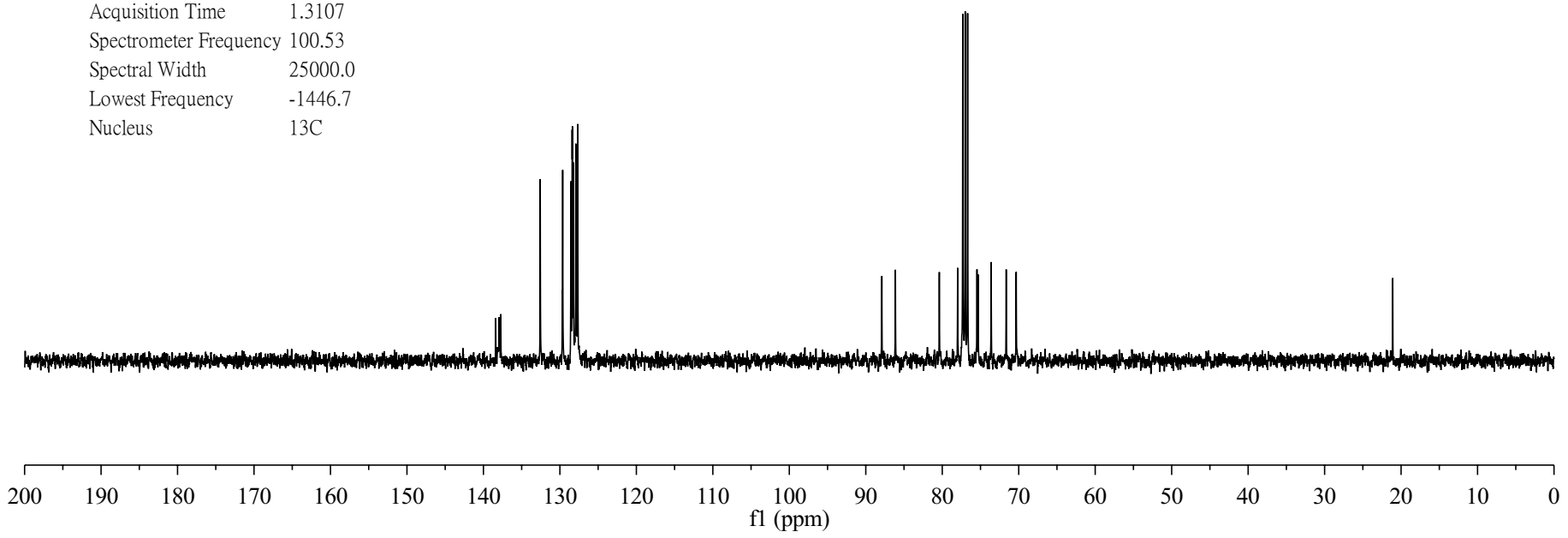
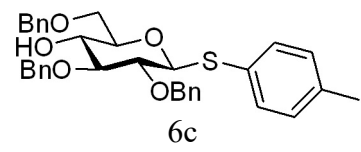


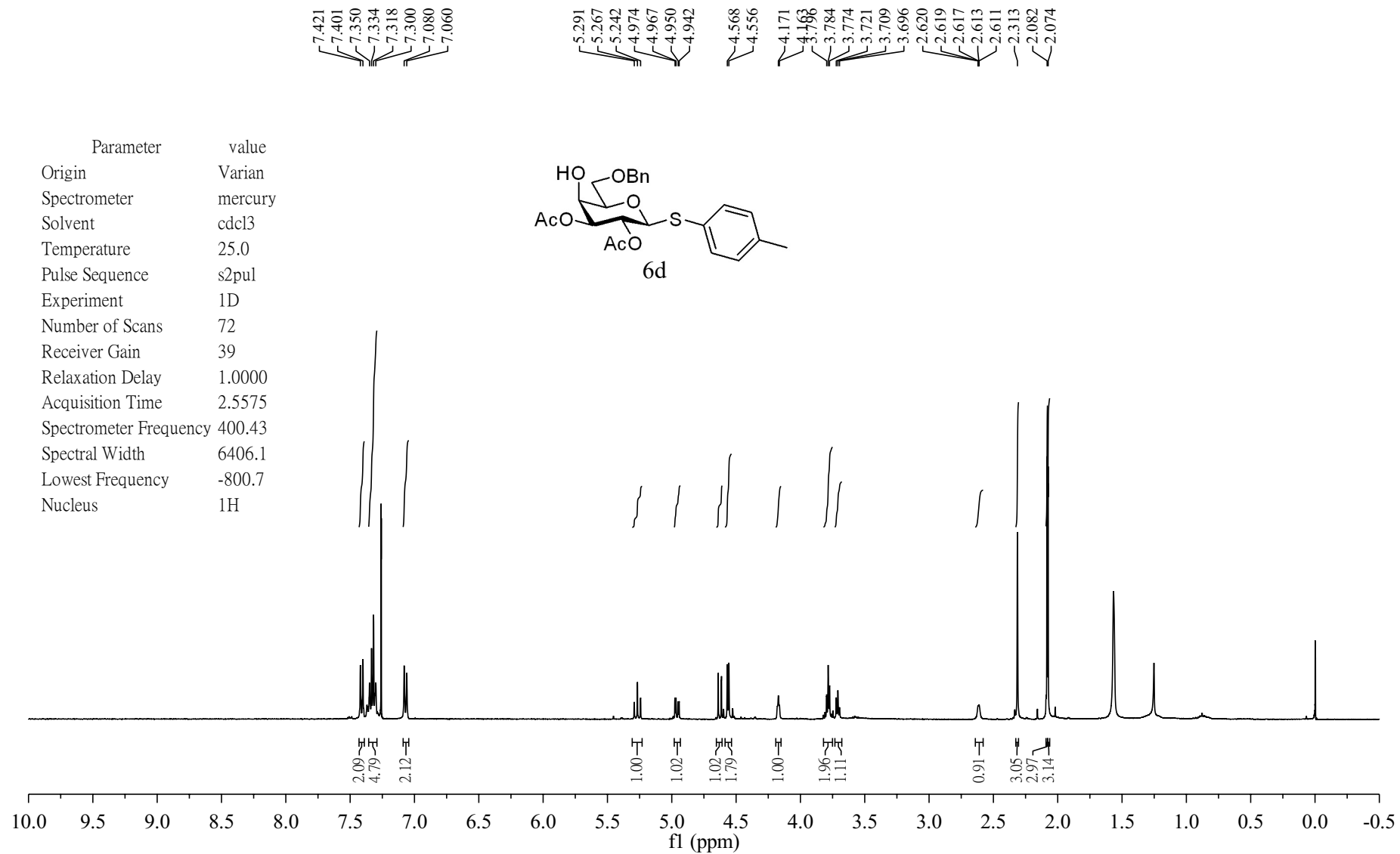
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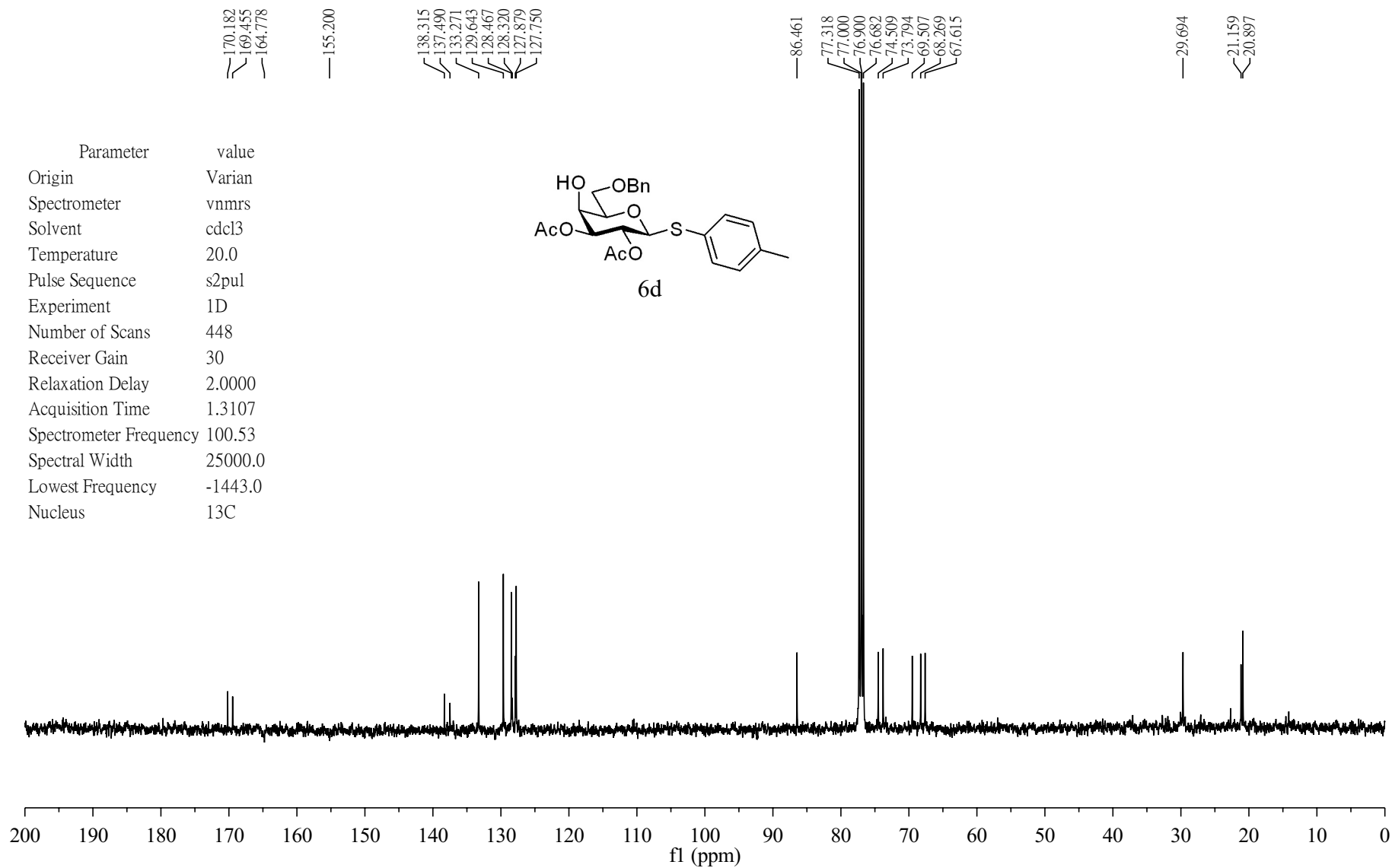
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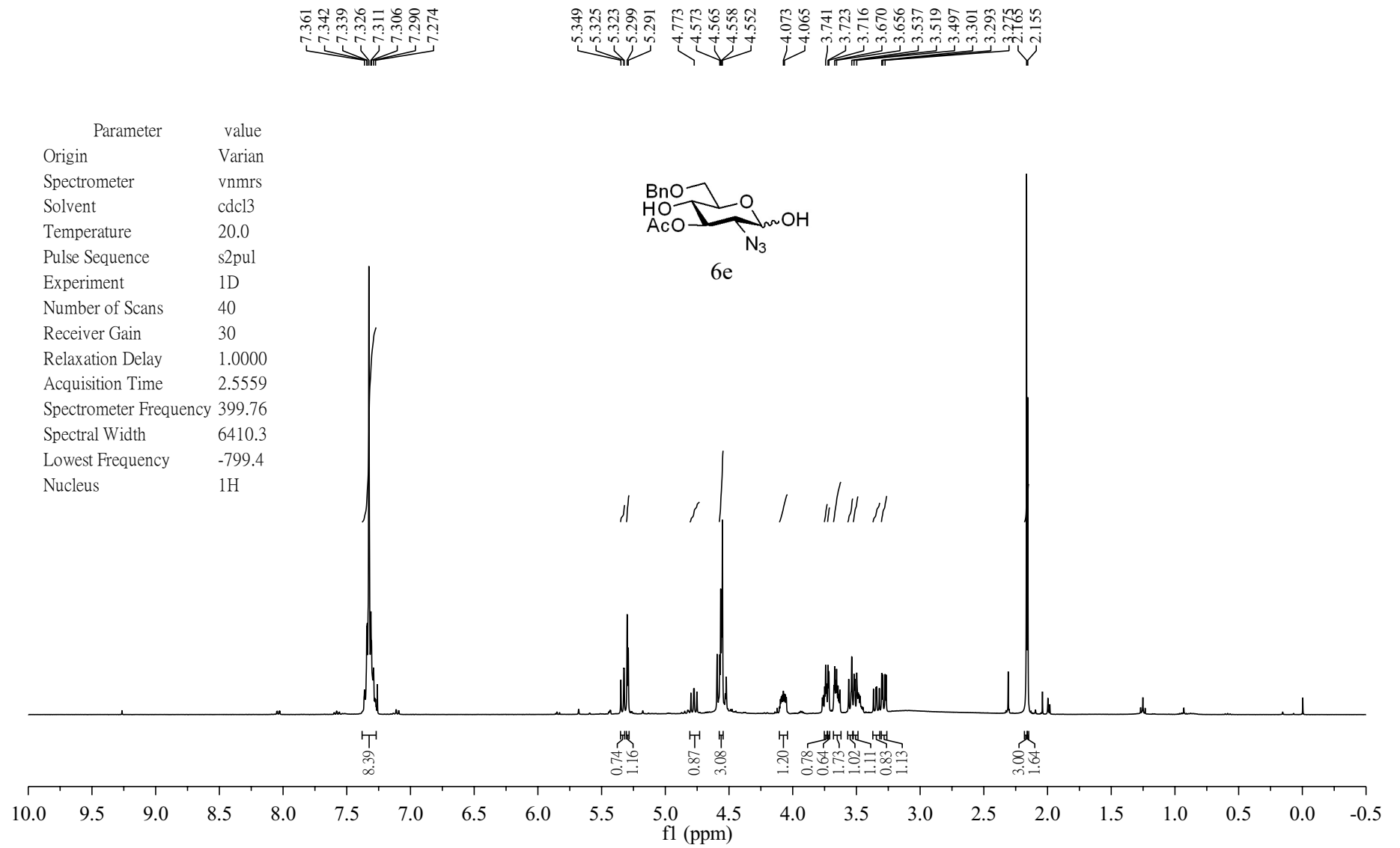
21.090

Parameter	value
Origin	Varian
Spectrometer	nmrs
Solvent	cdcl3
Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	60
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
Spectrometer Frequency	100.53
Spectral Width	25000.0
Lowest Frequency	-1446.7
Nucleus	13C









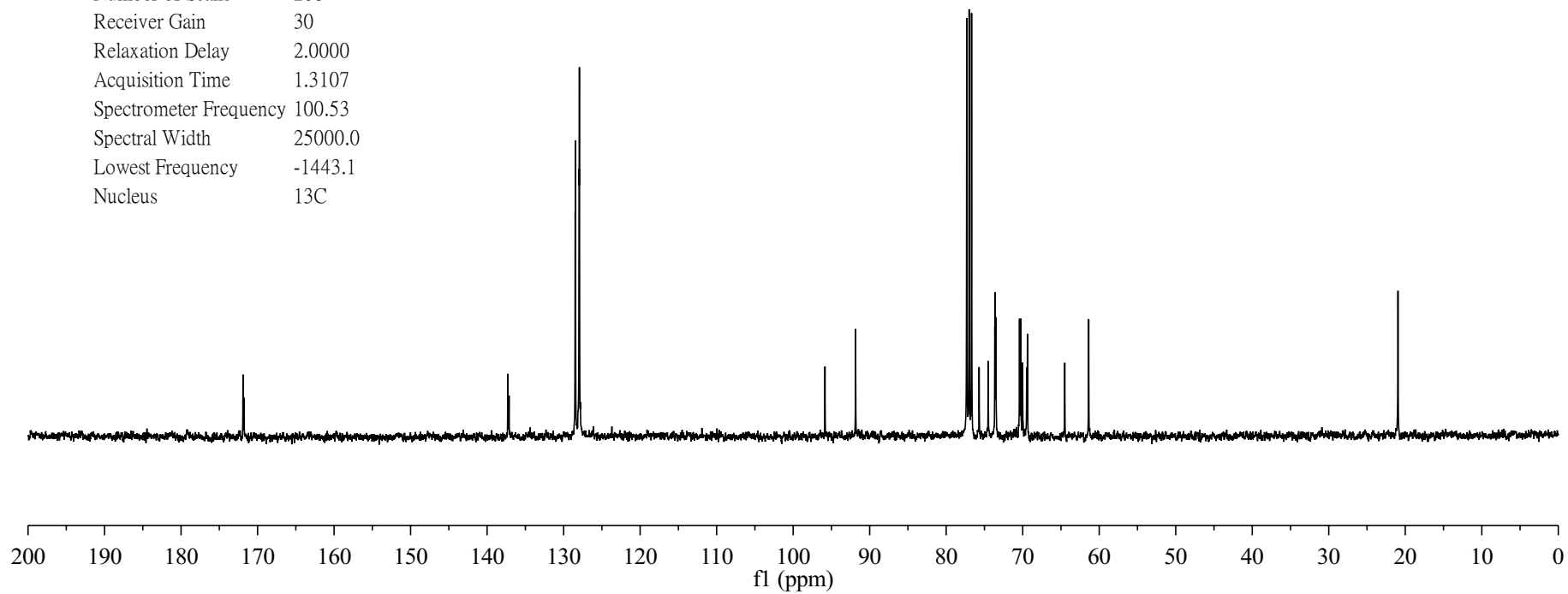
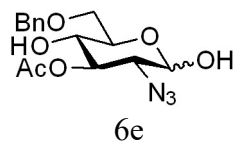
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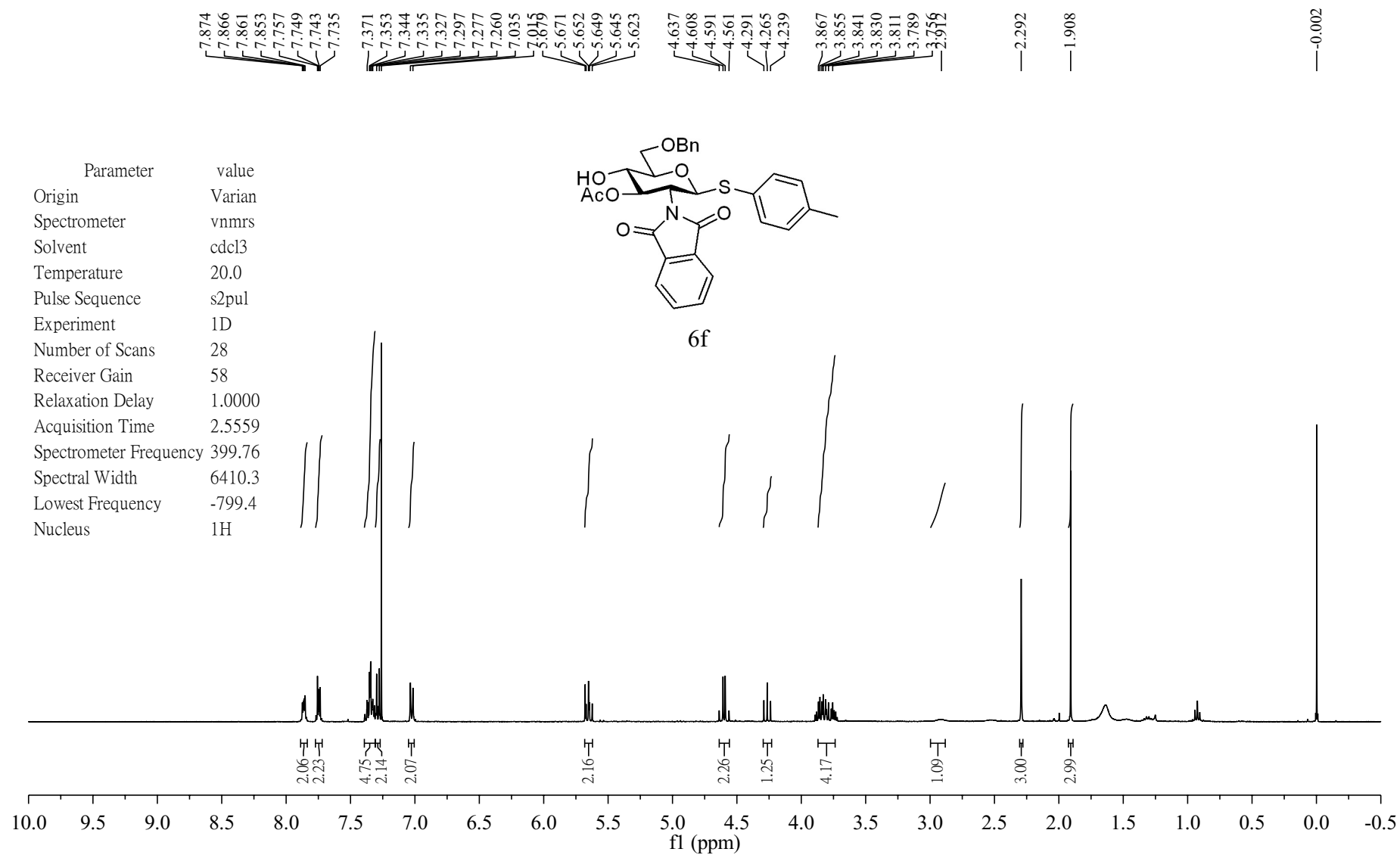
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73.601
73.498
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69.508
61.376

20.953

Parameter	value
Origin	Varian
Spectrometer	nmrs
Solvent	cdcl3
Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	208
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
Spectrometer Frequency	100.53
Spectral Width	25000.0
Lowest Frequency	-1443.1
Nucleus	13C





171.072
167.824
167.245

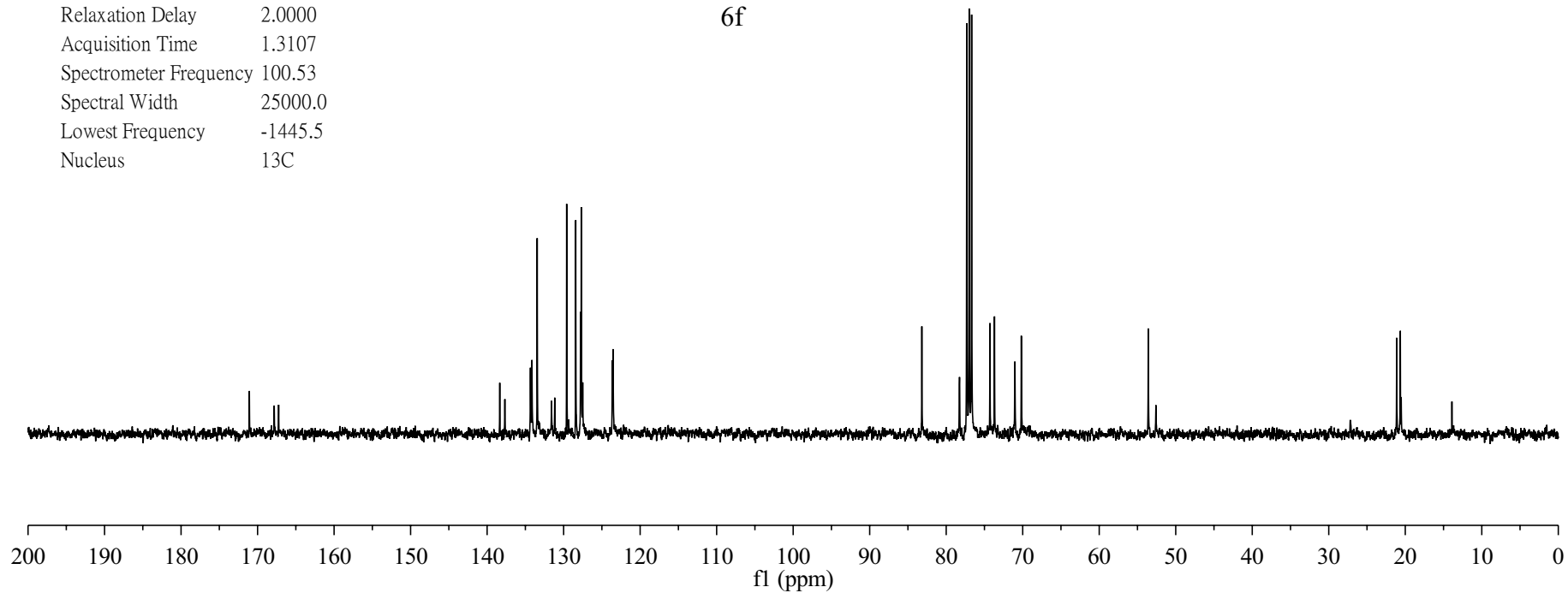
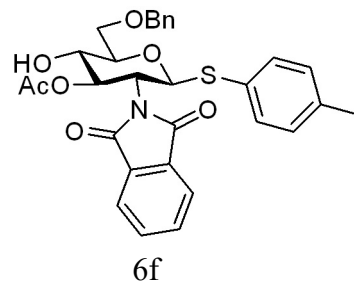
138.348
137.681
134.337
134.143
133.454
131.588
131.164
129.603
128.419
127.790
127.695
127.506
123.640
123.539

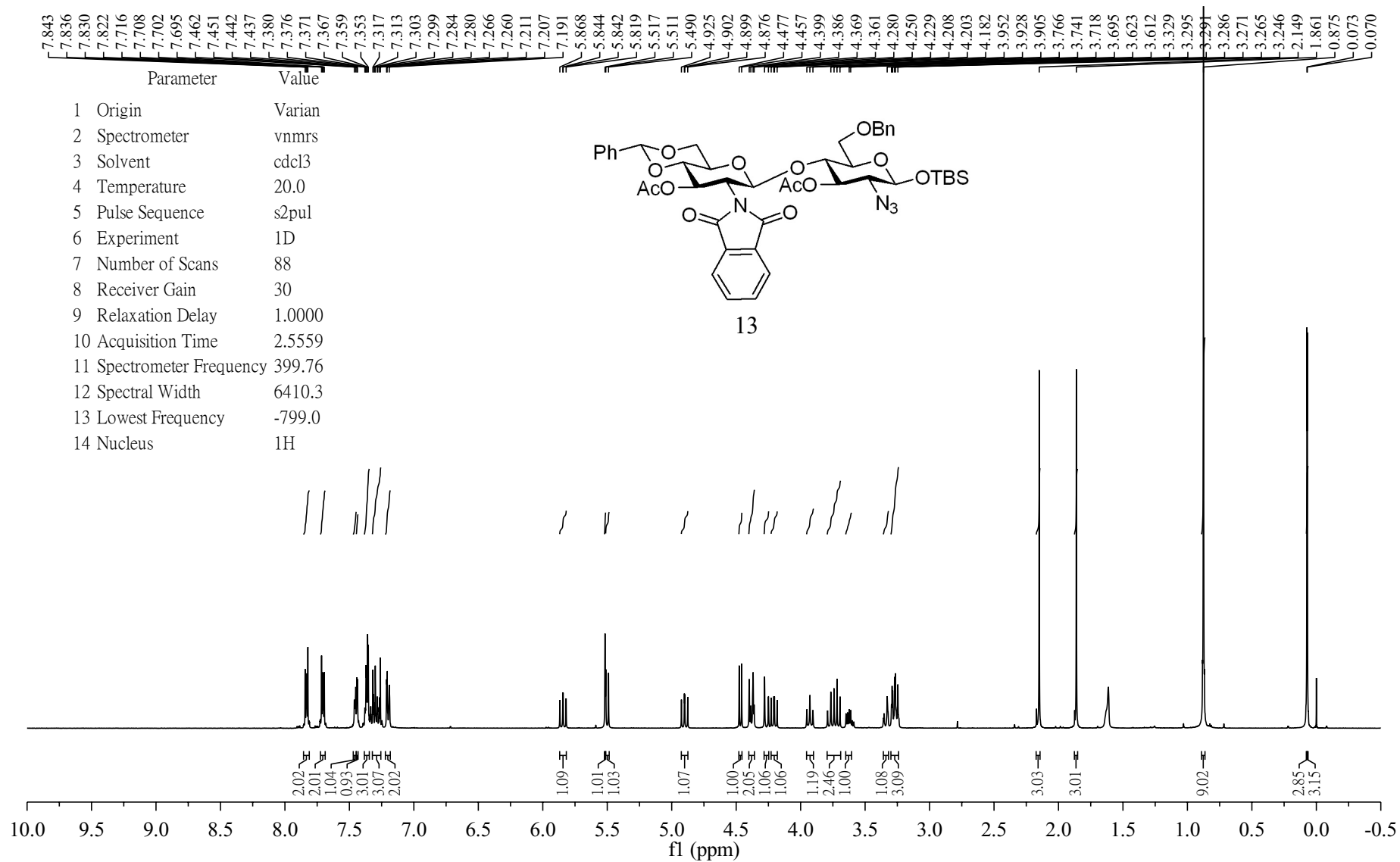
83.179
78.257
77.312
76.994
76.676
74.281
73.687
71.027
70.179

53.585
52.584

21.126
20.646
20.534
13.902

Parameter	value
Origin	Varian
Spectrometer	vnmrs
Solvent	cdcl3
Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	240
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
Spectrometer Frequency	100.53
Spectral Width	25000.0
Lowest Frequency	-1445.5
Nucleus	13C





170.053
169.232

137.787
136.628
134.247
131.206
129.096
128.125
127.395
127.257
126.095
123.435

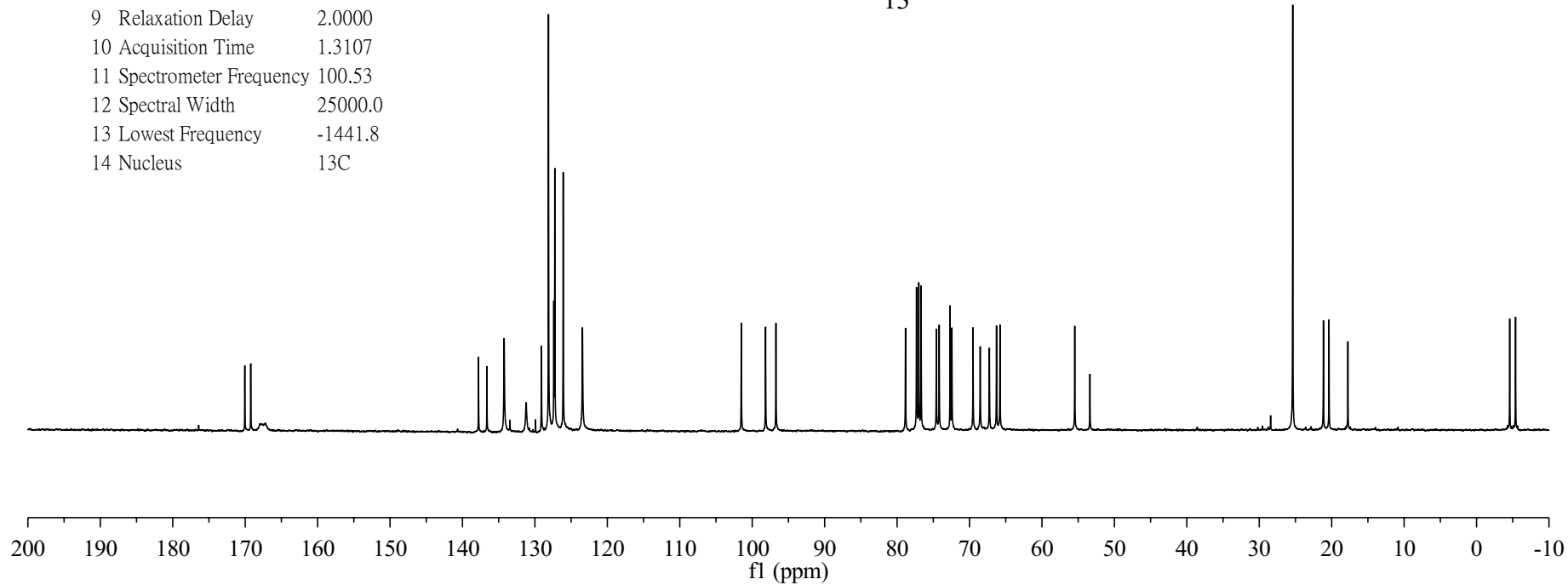
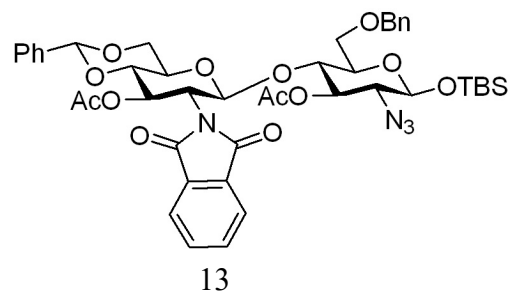
101.503
98.156
96.725
78.840
77.319
77.000
76.682
74.583
74.185
72.683
72.431
69.514
68.524
67.258
66.274
65.795
55.468

25.379
21.142
20.371
17.762

4.580
-5.386

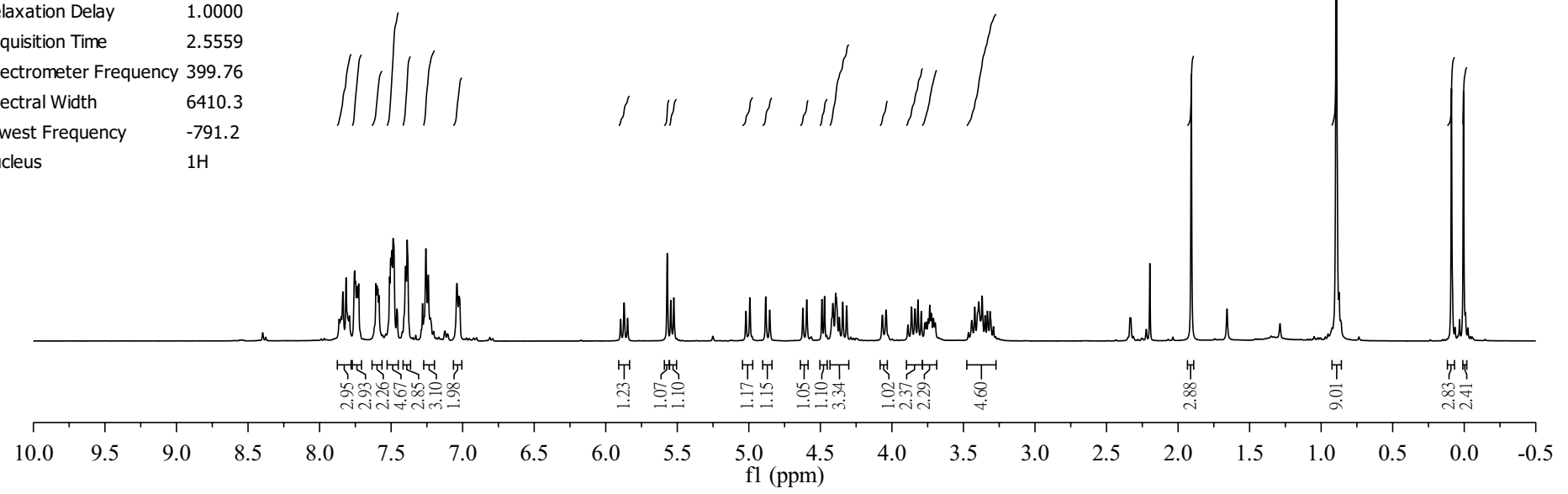
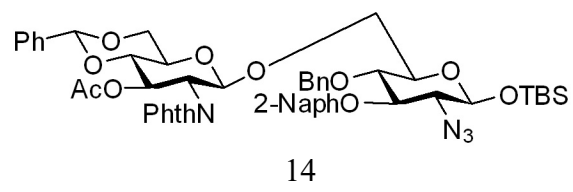
Parameter Value

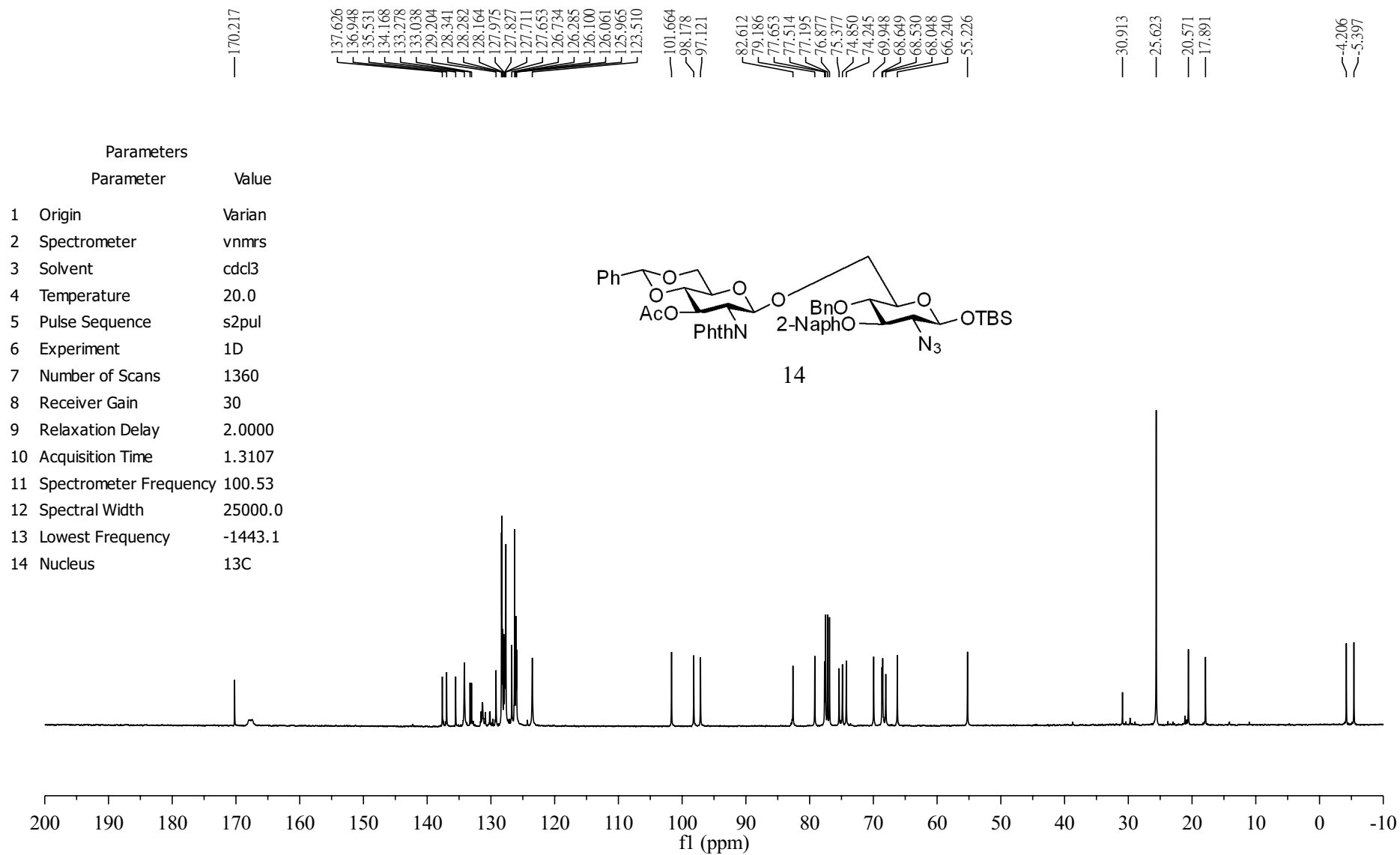
- 1 Origin Varian
- 2 Spectrometer vnmrs
- 3 Solvent cdcl3
- 4 Temperature 20.0
- 5 Pulse Sequence s2pul
- 6 Experiment 1D
- 7 Number of Scans 2016
- 8 Receiver Gain 30
- 9 Relaxation Delay 2.0000
- 10 Acquisition Time 1.3107
- 11 Spectrometer Frequency 100.53
- 12 Spectral Width 25000.0
- 13 Lowest Frequency -1441.8
- 14 Nucleus 13C

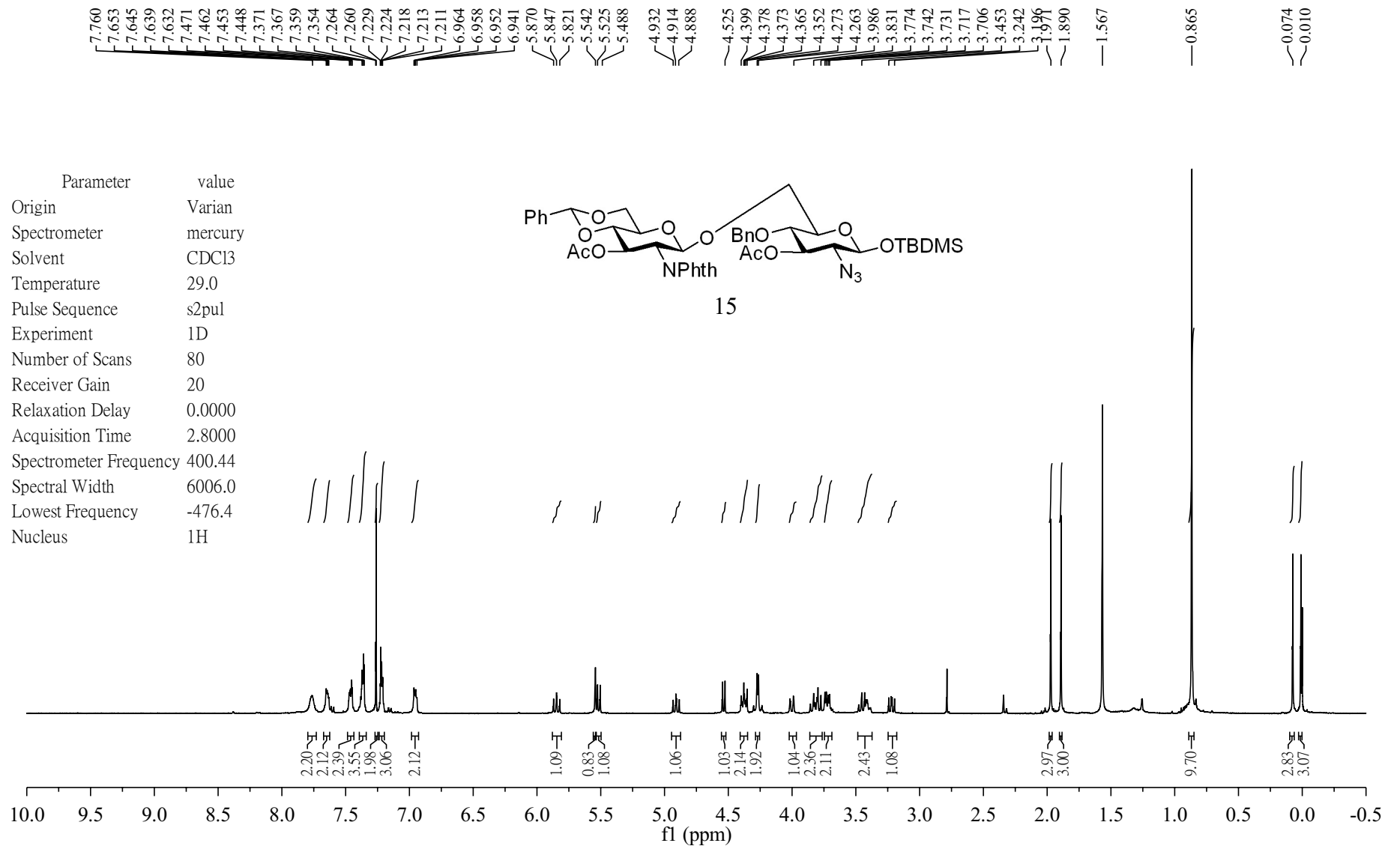


7.863
7.848
7.837
7.815
7.791
7.755
7.748
7.739
7.734
7.727
7.605
7.598
7.592
7.585
7.511
7.503
7.495
7.486
7.481
7.459
7.399
7.388
7.280
7.257
7.240
7.040
7.025
5.896
5.871
5.847
5.570
5.545
5.524
5.020
4.992
4.882
4.854
4.622
4.595
4.489
4.471
4.413
4.393
4.367
4.343
4.316
4.066
4.041
3.888
3.863
3.839
3.818
3.795
3.770
3.759
3.746
3.735
3.723
3.709
3.697
3.465
3.441
3.421
3.393
3.369
3.349
3.332
3.314
3.290

Parameters	
Parameter	Value
1 Origin	Varian
2 Spectrometer	nmrs
3 Solvent	cdcl3
4 Temperature	20.0
5 Pulse Sequence	s2pul
6 Experiment	1D
7 Number of Scans	92
8 Receiver Gain	30
9 Relaxation Delay	1.0000
10 Acquisition Time	2.5559
11 Spectrometer Frequency	399.76
12 Spectral Width	6410.3
13 Lowest Frequency	-791.2
14 Nucleus	1H







170.193
169.711

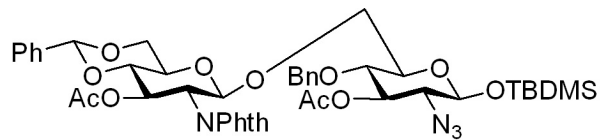
137.124
136.839
134.202
129.159
128.307
128.231
127.839
127.529
126.204
123.523

101.653
98.190
97.023

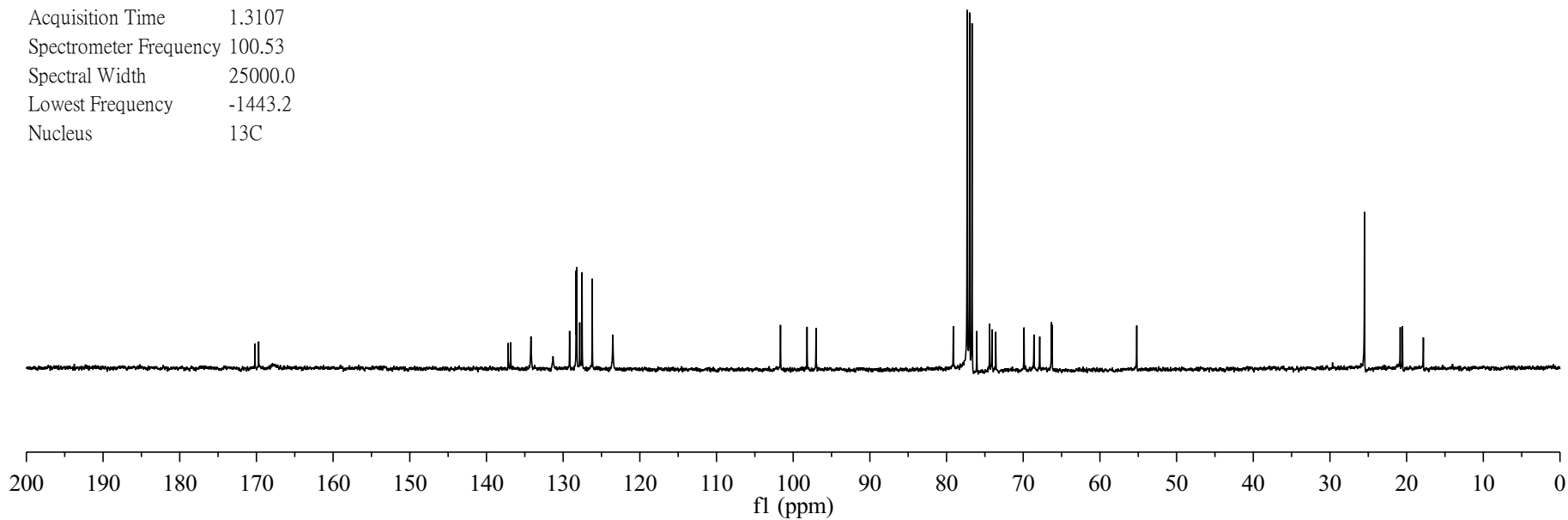
79.118
77.311
76.993
76.675
76.057
74.379
74.072
73.580
69.785
68.602
67.847
66.312
66.231
55.198

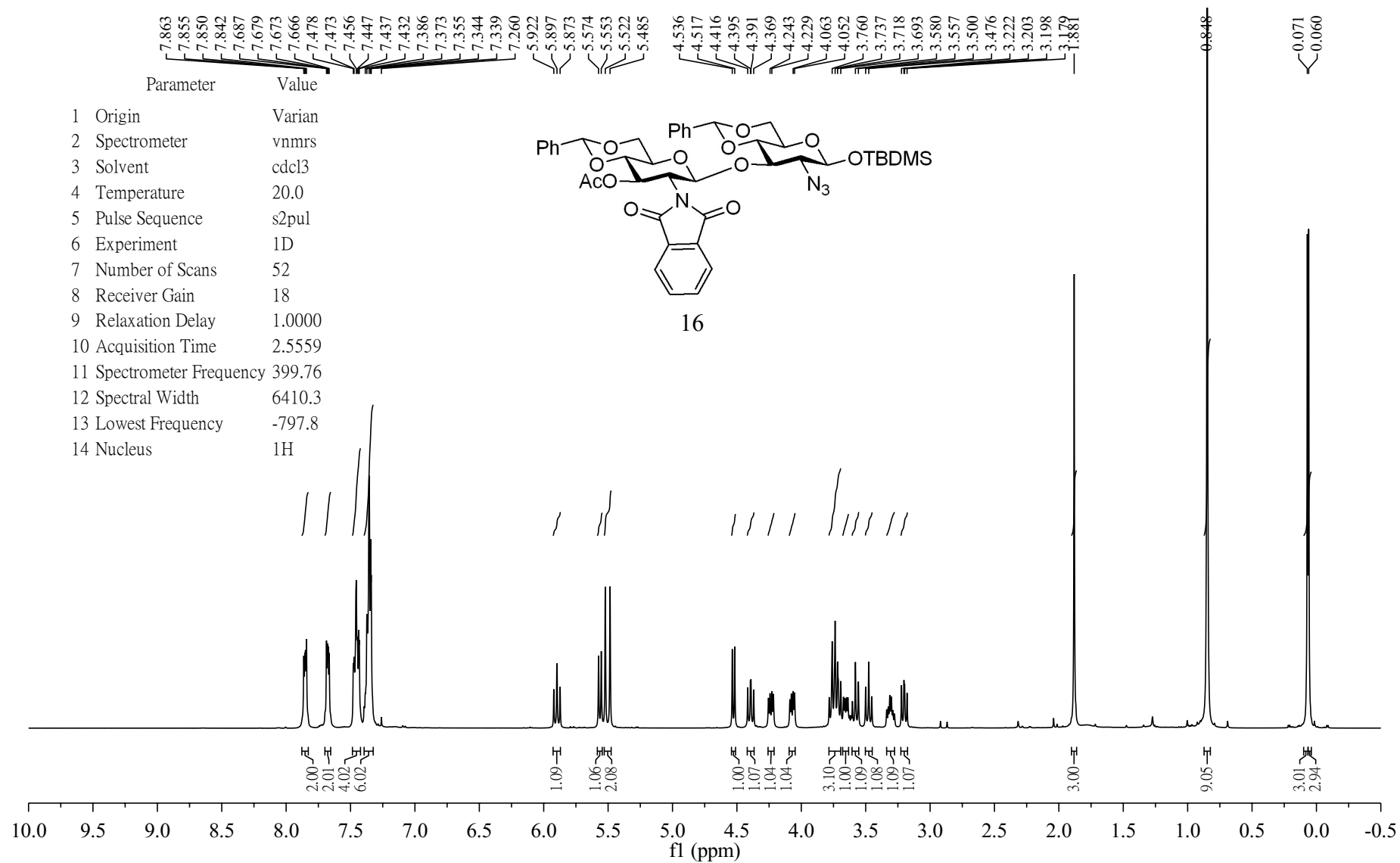
25.498
20.834
20.535
17.741

Parameter	value
Origin	Varian
Spectrometer	nmrs
Solvent	cdcl3
Temperature	20.0
Pulse Sequence	s2pul
Experiment	1D
Number of Scans	612
Receiver Gain	30
Relaxation Delay	2.0000
Acquisition Time	1.3107
Spectrometer Frequency	100.53
Spectral Width	25000.0
Lowest Frequency	-1443.2
Nucleus	13C



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Parameter	Value
1 Origin	Varian
2 Spectrometer	vmrs
3 Solvent	cdcl3
4 Temperature	20.0
5 Pulse Sequence	s2pul
6 Experiment	1D
7 Number of Scans	440
8 Receiver Gain	30
9 Relaxation Delay	2.0000
10 Acquisition Time	1.3107
11 Spectrometer Frequency	100.53
12 Spectral Width	25000.0
13 Lowest Frequency	-1454.3
14 Nucleus	¹³ C

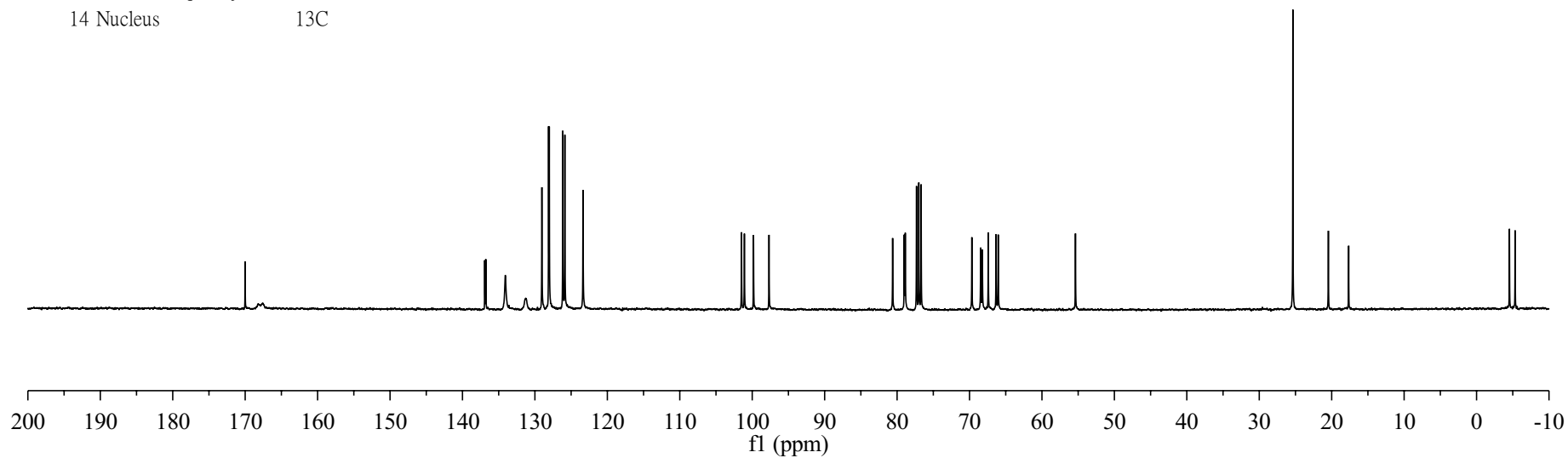
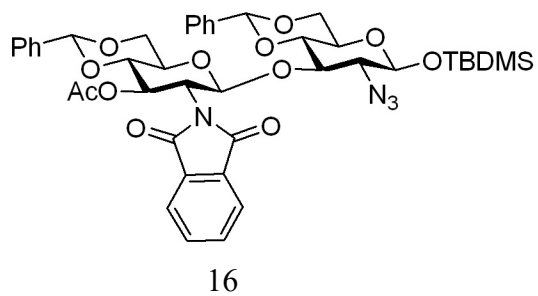
170.010

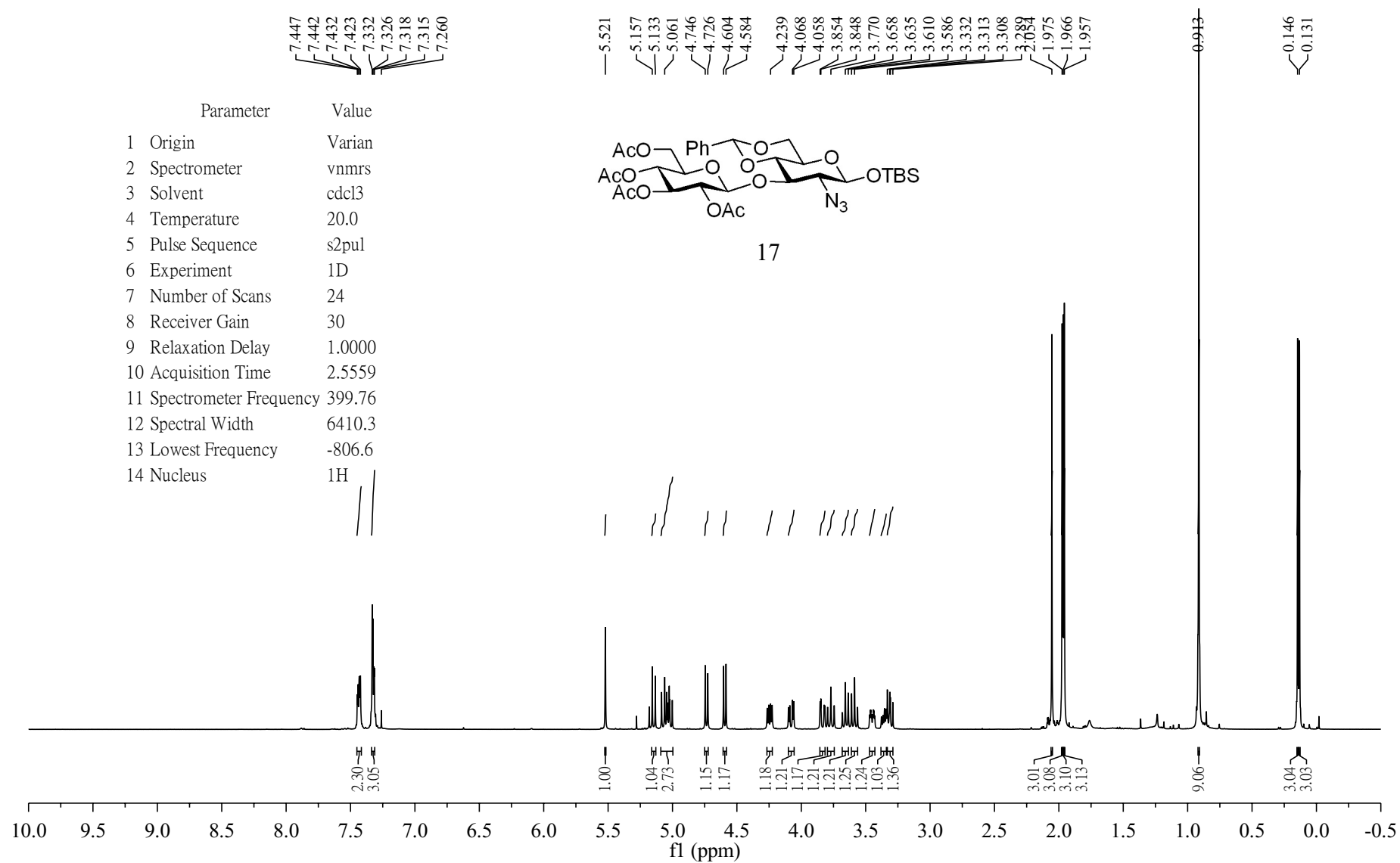
136.930
136.779
134.084
131.249
129.037
128.111
128.014
126.161
125.868
123.359

101.478
101.080
99.821
97.680
80.614
79.012
78.865
77.318
77.000
76.681
69.679
68.459
68.228
67.411
66.340
66.040
55.374

25.361
20.460
17.655

-4.543
-5.324





170.539
170.199
169.299
169.194

136.919
129.100
128.079
125.875

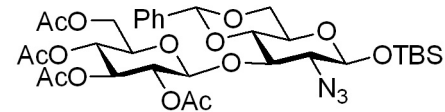
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100.950
97.520

79.418
79.123
77.318
77.000
76.681
72.694
71.645
71.397
68.382
68.346
67.868
66.356
61.434

25.391
20.563
20.492
20.460
17.752

-4.466
-5.335

Parameter	Value
1 Origin	Varian
2 Spectrometer	vnmrs
3 Solvent	cdcl3
4 Temperature	20.0
5 Pulse Sequence	s2pul
6 Experiment	1D
7 Number of Scans	2408
8 Receiver Gain	30
9 Relaxation Delay	2.0000
10 Acquisition Time	1.3107
11 Spectrometer Frequency	100.53
12 Spectral Width	25000.0
13 Lowest Frequency	-1451.3
14 Nucleus	¹³ C



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