Supporting Information

Thermal extremophiles: Triarylsulfonium ionic liquids stable in air for 90 days at 300 °C

Benjamin Siu,[a] Cody G. Cassity,[b] Adela Benchea,[b] Taylor Hamby,[b] Jeffrey Hendrich,[b] Katie J. Strickland,[b] Andrzej Wierzbicki,[a] Richard E. Sykora,[b] E. Alan Salter,[a] Richard. A. O'Brien,[b] Kevin N. West,*[a‡] and James H. Davis, Jr.*[b†]

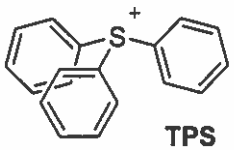
a Department of Chemical & Biomolecular Engineering, University of South Alabama

b Department of Chemistry, University of South Alabama

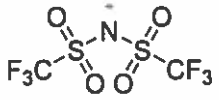
Compound 1

Elemental Analysis

^{1}H-, ^{13}C-, and ^{19}F-NMR Spectra



TPS



Tf_2N

Atlantic Microlab, Inc.

lo. JD-SULFONIUM-1

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s, GA 30071
anticmicrolab.com

Company/School U. SOUTH ALABAMA
Dept. CHEMISTRY
Address CHEM BLDG 223
City, State, Zip MOBILE, AL, 36688

r/Supervisor: JAMES DAVIS
Name JAMES DAVIS Date 10/12/2016
C#
Phone (251) 751-0520

ent	Theory	Found	
	44.20	44.10	
	2.78	2.70	
	2.58	2.64	

Single ☒ Duplicate ☐

Elements Present: CHNOSF

Analyze for: CHN

Hygroscopic ☐ Explosive ☐
M.P. UNK B.P. NONE

To be dried: Yes ☒ No ☐
Temp. 100C Vac. HIGH Time 4H

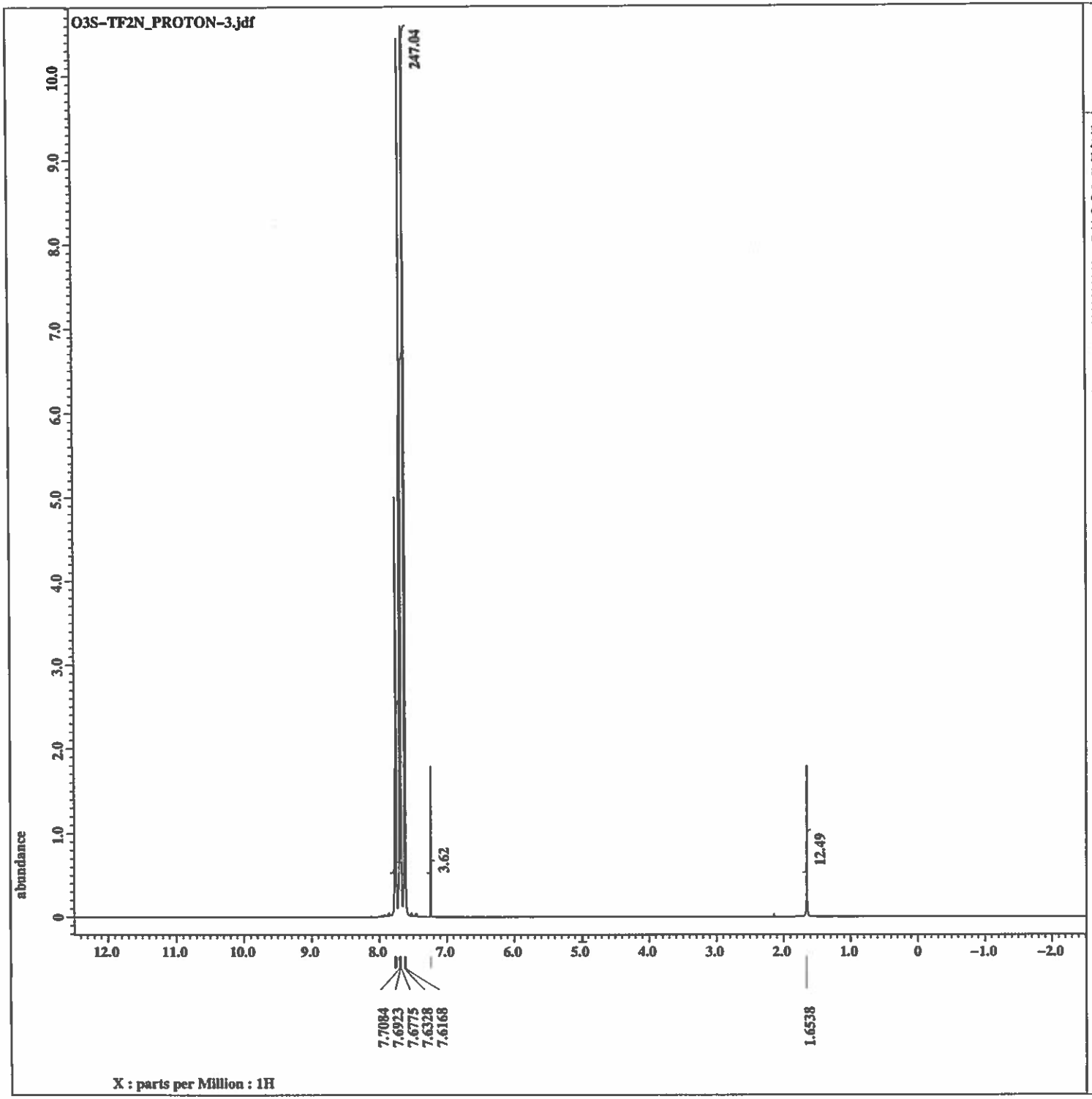
Rush Service ☒ Rush service guarantees analyses will be completed and results available by 5 PM EST on the day the sample is received by 11 AM.

Include Email Address or FAX # Below

jdavis@southalabama.edu

Received OCT 14 2016 Date Completed OCT 14 2016

rks:



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Changer_sample	= 5
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Revision_time	= 16-JUN-2016 10:09:50
Current_time	= 14-OCT-2016 08:12:21
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Dim_units	= [ppm]
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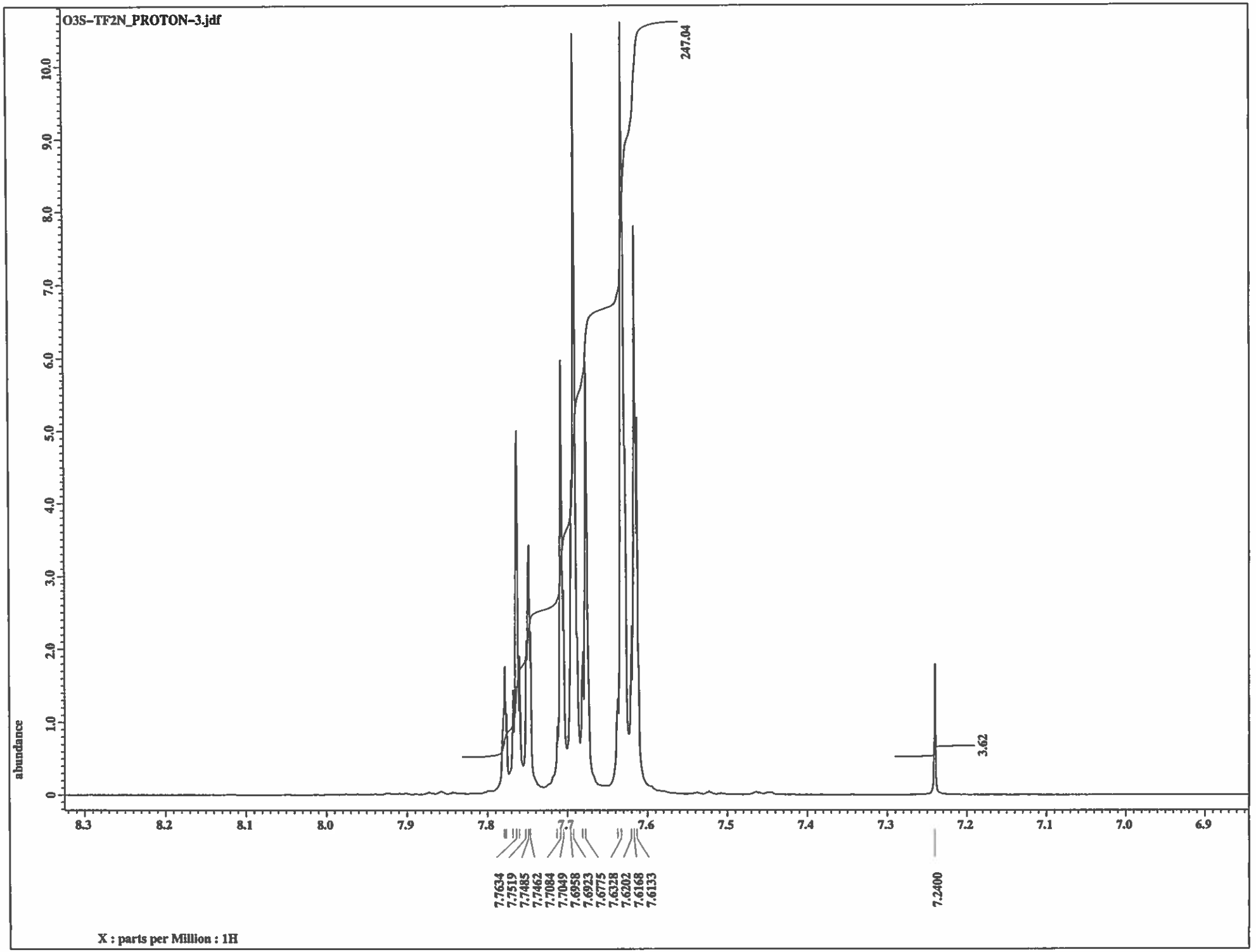
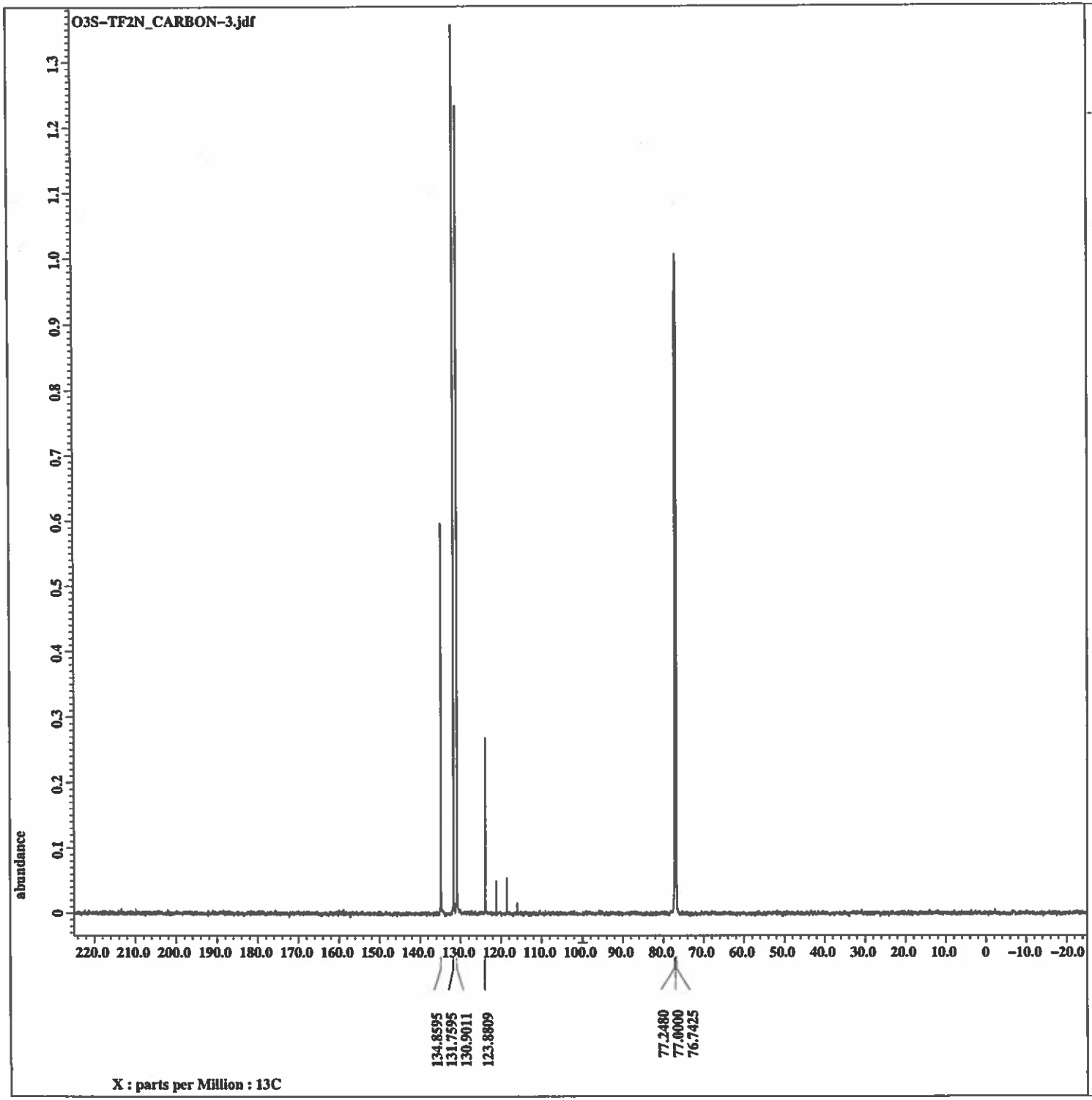
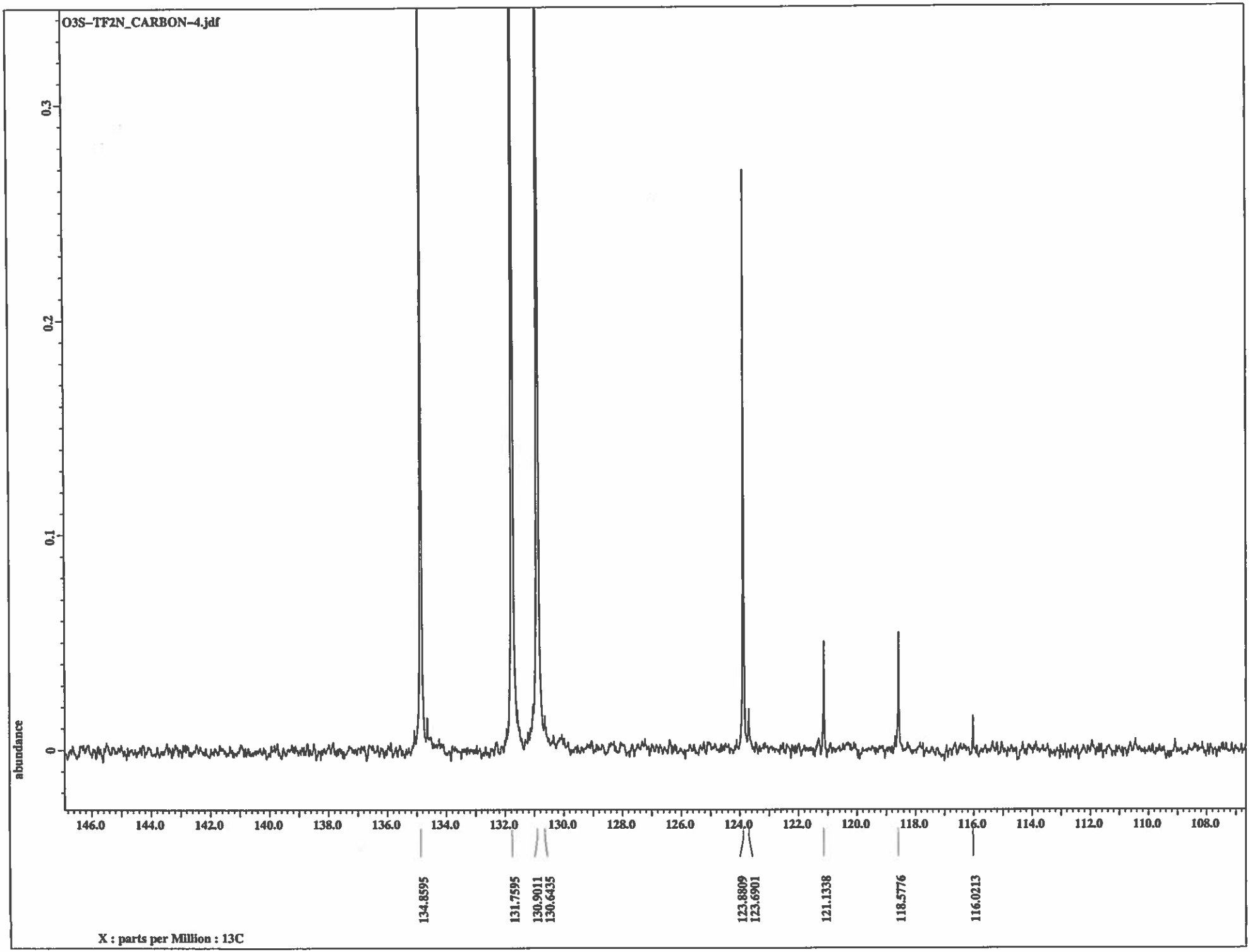
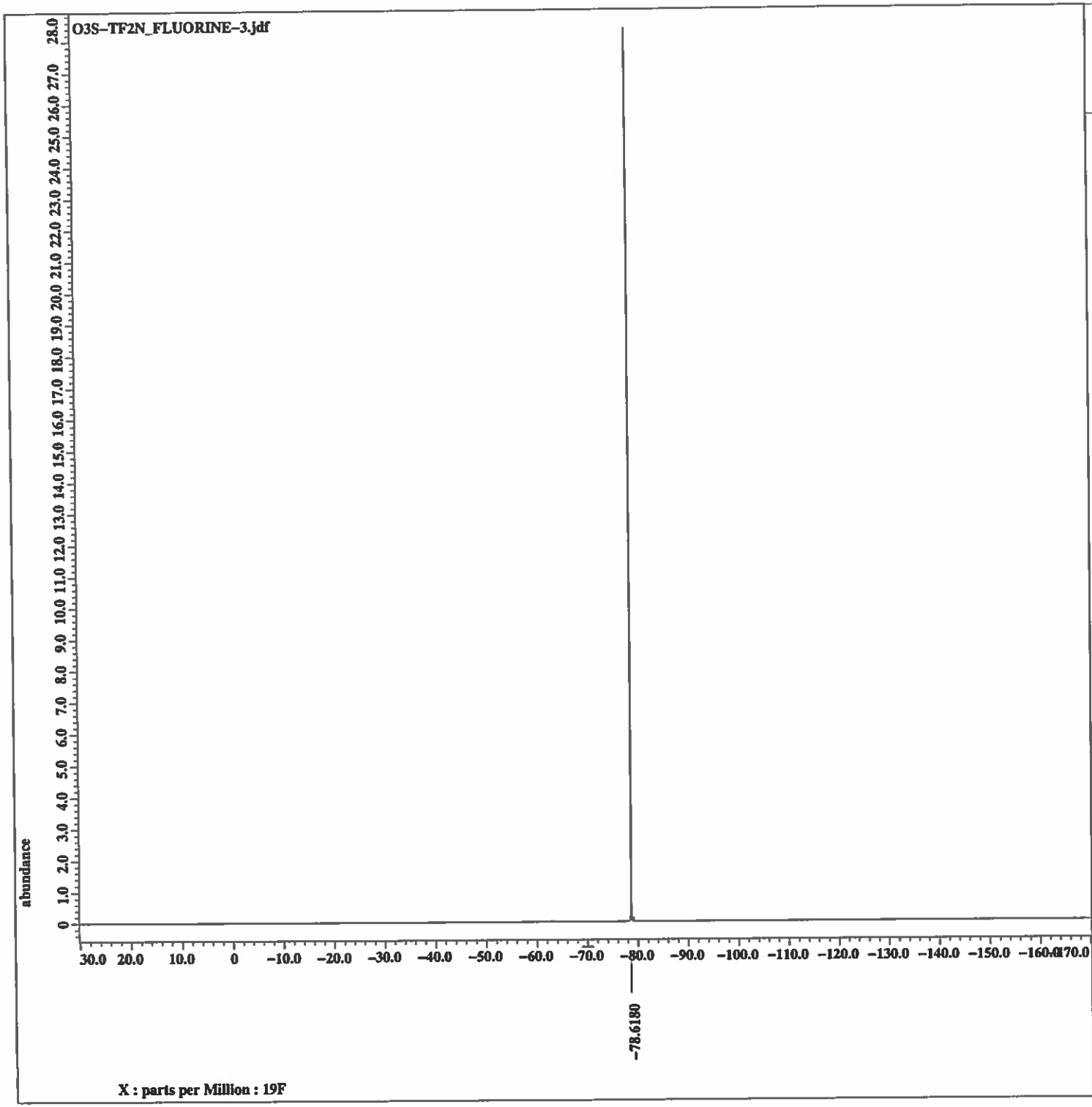
X_domain	= 1H
X_freq	= 500.15991521[MHz]
X_offset	= 5.0[ppm]
X_points	= 16384
X_prescans	= 1
X_resolution	= 0.57277737[Hz]
X_sweep	= 9.38438438[kHz]
Irr_domain	= 1H
Irr_freq	= 500.15991521[MHz]
Irr_offset	= 5.0[ppm]
Tri_domain	= 1H
Tri_freq	= 500.15991521[MHz]
Tri_offset	= 5.0[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 16
Total_scans	= 16
X_90_width	= 13.35[us]
X_acq_time	= 1.74587904[s]
X_angle	= 45[deg]
X_atn	= 4[dB]
X_pulse	= 6.675[us]
Irr_mode	= Off
Tri_mode	= Off
Dante_presat	= FALSE
Initial_wait	= 1[s]
Recvr_gain	= 38
Relaxation_delay	= 4[s]
Repetition_time	= 5.74587904[s]
Temp_get	= 22[dC]


O3S-TF2N_PROTON-3.jdf
247.04
3.62
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
8.3
8.2
8.1
8.0
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
7.0
6.9
7.7634
7.7519
7.7485
7.7462
7.7084
7.7049
7.6958
7.6923
7.6775
7.6328
7.6202
7.6168
7.6133
7.2400
X : parts per Million : 1H



Filename	= O3S-TF2N_CARBON-3.jdf
Author	= Jim Davis
Experiment	= single_pulse_dec
Sample_id	= O3S-TF2N
Solvent	= CHLOROFORM-D
Changer_sample	= 5
Creation_time	= 16-JUN-2016 20:50:25
Revision_time	= 16-JUN-2016 20:33:27
Current_time	= 14-OCT-2016 08:10:41
Data_format	= 1D COMPLEX
Dim_size	= 26214
Dim_title	= 13C
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 0.83361792[s]
X_domain	= 13C
X_freq	= 125.76529768[MHz]
X_offset	= 100[ppm]
X_points	= 32768
X_prescans	= 4
X_resolution	= 1.19959034[Hz]
X_sweep	= 39.3081761[kHz]
Irr_domain	= 1H
Irr_freq	= 500.15991521[MHz]
Irr_offset	= 5.0[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 1024
Total_scans	= 1024
X_90_width	= 12.55[us]
X_acq_time	= 0.83361792[s]
X_angle	= 30[deg]
X_atn	= 6[dB]
X_pulse	= 4.18333333[us]
Irr_atn_dec	= 20.5[dB]
Irr_atn_noe	= 20.5[dB]
Irr_noise	= WALTZ
Decoupling	= TRUE
Initial_wait	= 1[s]
Noe	= TRUE
Noe_time	= 2[s]
Recvr_gain	= 60
Relaxation_delay	= 2[s]
Repetition_time	= 2.83361792[s]
Temp_get	= 22.8[dC]


O3S–TF2N_CARBON–4.jdf
abundance
0.3
0.2
0.1
0
146.0
144.0
142.0
140.0
138.0
136.0
134.0
132.0
130.0
128.0
126.0
124.0
122.0
120.0
118.0
116.0
114.0
112.0
110.0
108.0
134.8595
131.7595
130.9011
130.6435
123.8809
123.6901
121.1338
118.5776
116.0213
X : parts per Million : 13C



Filename	= O3S-TF2N_FLUORINE-3.j
Author	= Jim Davis
Experiment	= single_pulse.ex2
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Solvent	= CHLOROFORM-D
Changer_sample	= 5
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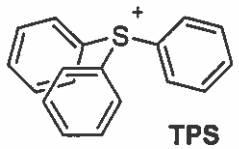
Revision_time	= 16-JUN-2016 10:40:02
Current_time	= 14-OCT-2016 08:09:45
Data_format	= 1D COMPLEX
Dim_size	= 52428
Dim_title	= 19F
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 0.55574528[s]
X_domain	= 19F
X_freq	= 470.62046084[MHz]
X_offset	= -70[ppm]
X_points	= 65536
X_prescans	= 1
X_resolution	= 1.7993855[Hz]
X_sweep	= 117.9245283[kHz]
Irr_domain	= 19F
Irr_freq	= 470.62046084[MHz]
Irr_offset	= 5[ppm]
Tri_domain	= 19F
Tri_freq	= 470.62046084[MHz]
Tri_offset	= 5[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 16
Total_scans	= 16
X_90_width	= 15.7[us]
X_acq_time	= 0.55574528[s]
X_angle	= 45[deg]
X_atn	= 4[dB]
X_pulse	= 7.85[us]
Irr_mode	= Off
Tri_mode	= Off
Dante_presat	= FALSE
Initial_wait	= 1[s]
Recvr_gain	= 44
Relaxation_delay	= 4[s]
Repetition_time	= 4.55574528[s]
Temp_get	= 22[dC]

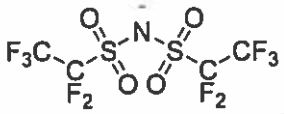
Compound 2

Elemental Analysis

^{1}H-, ^{13}C-, and ^{19}F-NMR Spectra



TPS



BETI

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Dept. CHEMISTRY
Address CHEM BLDG 223
City, State, Zip MOBILE AL 36688
Name JAMES DAVIS Date 10/17/2016
Phone (251) 751-0520

or/Supervisor: DAVIS
C#

ent	Theory	Found	
C	41.06	41.09	
H	2.35	2.31	
N	2.18	2.24	

Single ☒ Duplicate ☐

Elements Present: CHNOSF

Analyze for: CHN

Hygroscopic ☐ Explosive ☐
M.P. UNK B.P. NONE

To be dried: Yes ☒ No ☐
Temp. 60C Vac. HIGH Time 4 H

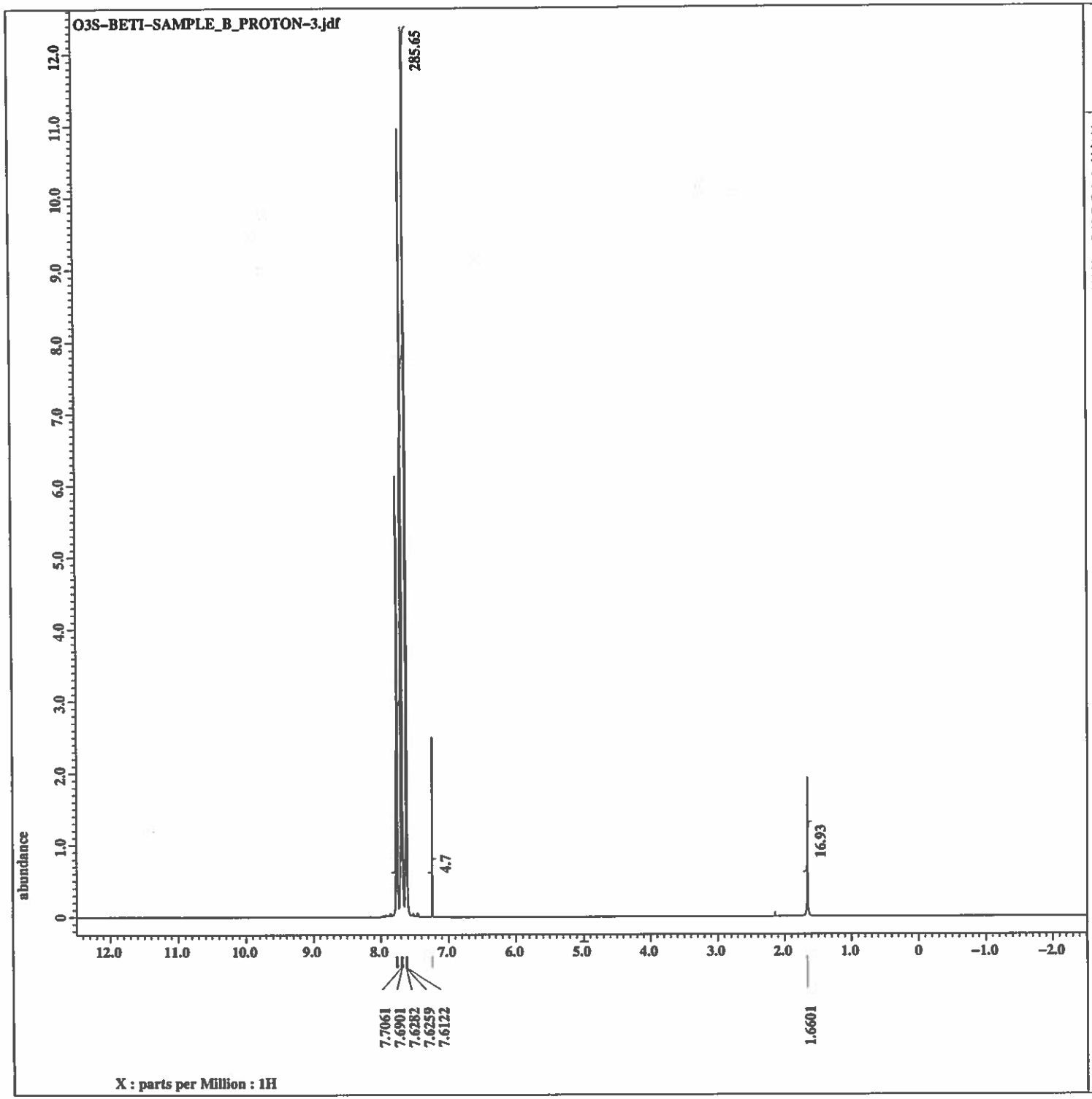
Rush Service ☒ Rush service guarantees analyses will be completed and results available by 5 PM EST on the day the sample is received by 11 AM.

Include Email Address or FAX # Below

jdavis@southalabama.edu

Received OCT 18 2016 Date Completed OCT 18 2016

arks:



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Author	= Jim Davis
Experiment	= single_pulse.ex2
Sample_id	= O3S-BETI-SAMPLE_B
Solvent	= CHLOROFORM-D
Changer_sample	= 6
Creation_time	= 16-JUN-2016 10:32:53
Revision_time	= 16-JUN-2016 10:15:58
Current_time	= 14-OCT-2016 08:06:45
Data_format	= 1D COMPLEX
Dim_size	= 13107
Dim_title	= 1H
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 1.74587904[s]
X_domain	= 1H
X_freq	= 500.15991521[MHz]
X_offset	= 5.0[ppm]
X_points	= 16384
X_prescans	= 1
X_resolution	= 0.57277737[Hz]
X_sweep	= 9.38438438[kHz]
Irr_domain	= 1H
Irr_freq	= 500.15991521[MHz]
Irr_offset	= 5.0[ppm]
Tri_domain	= 1H
Tri_freq	= 500.15991521[MHz]
Tri_offset	= 5.0[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 16
Total_scans	= 16
X_90_width	= 13.35[us]
X_acq_time	= 1.74587904[s]
X_angle	= 45[deg]
X_atn	= 4[dB]
X_pulse	= 6.675[us]
Irr_mode	= Off
Tri_mode	= Off
Dante_presat	= FALSE
Initial_wait	= 1[s]
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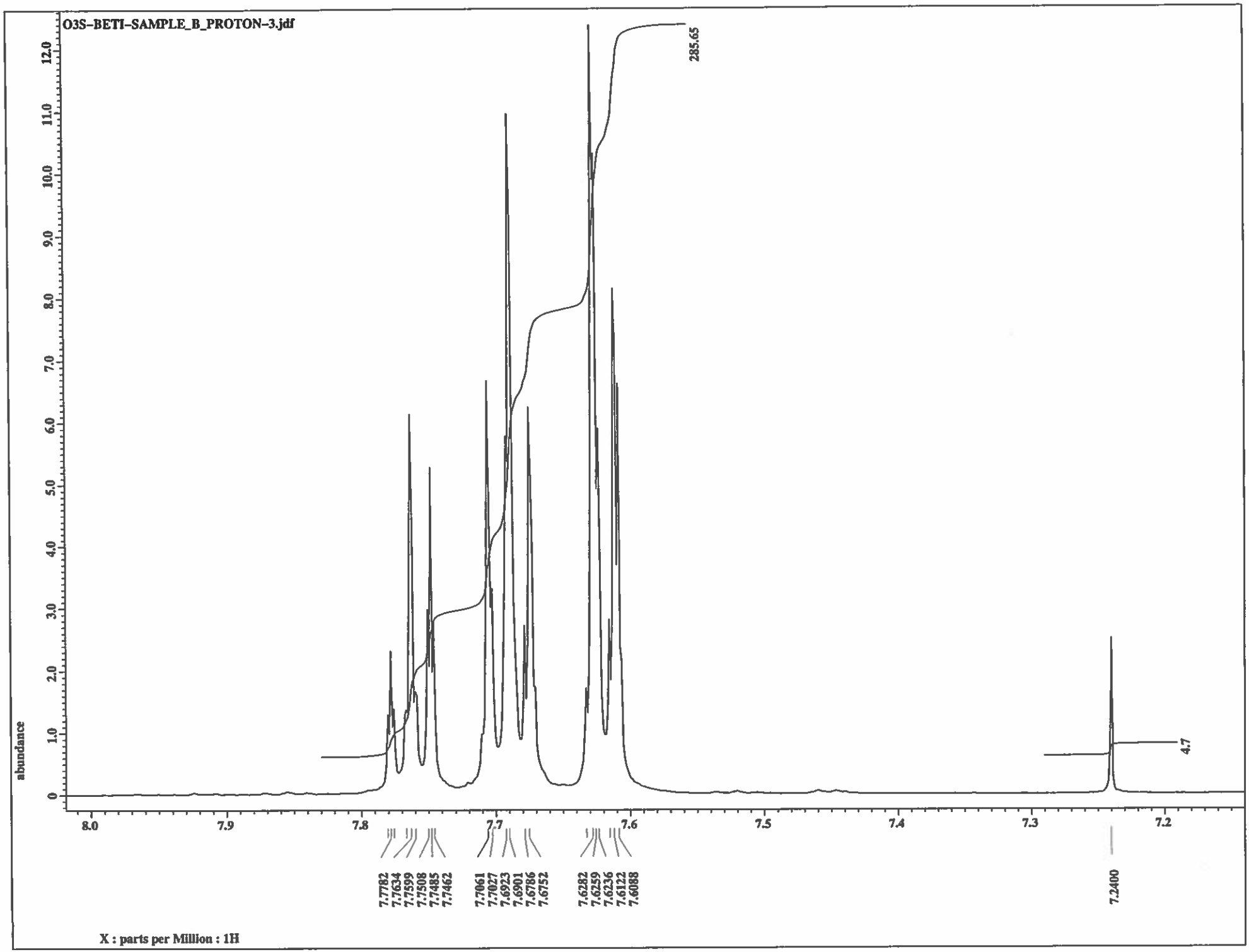
O3S-BETI-SAMPLE_B_PROTON-3.jdf
285.65
4.7
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
8.0
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.7782
7.7634
7.7599
7.7508
7.7485
7.7462
7.7061
7.7027
7.6923
7.6901
7.6786
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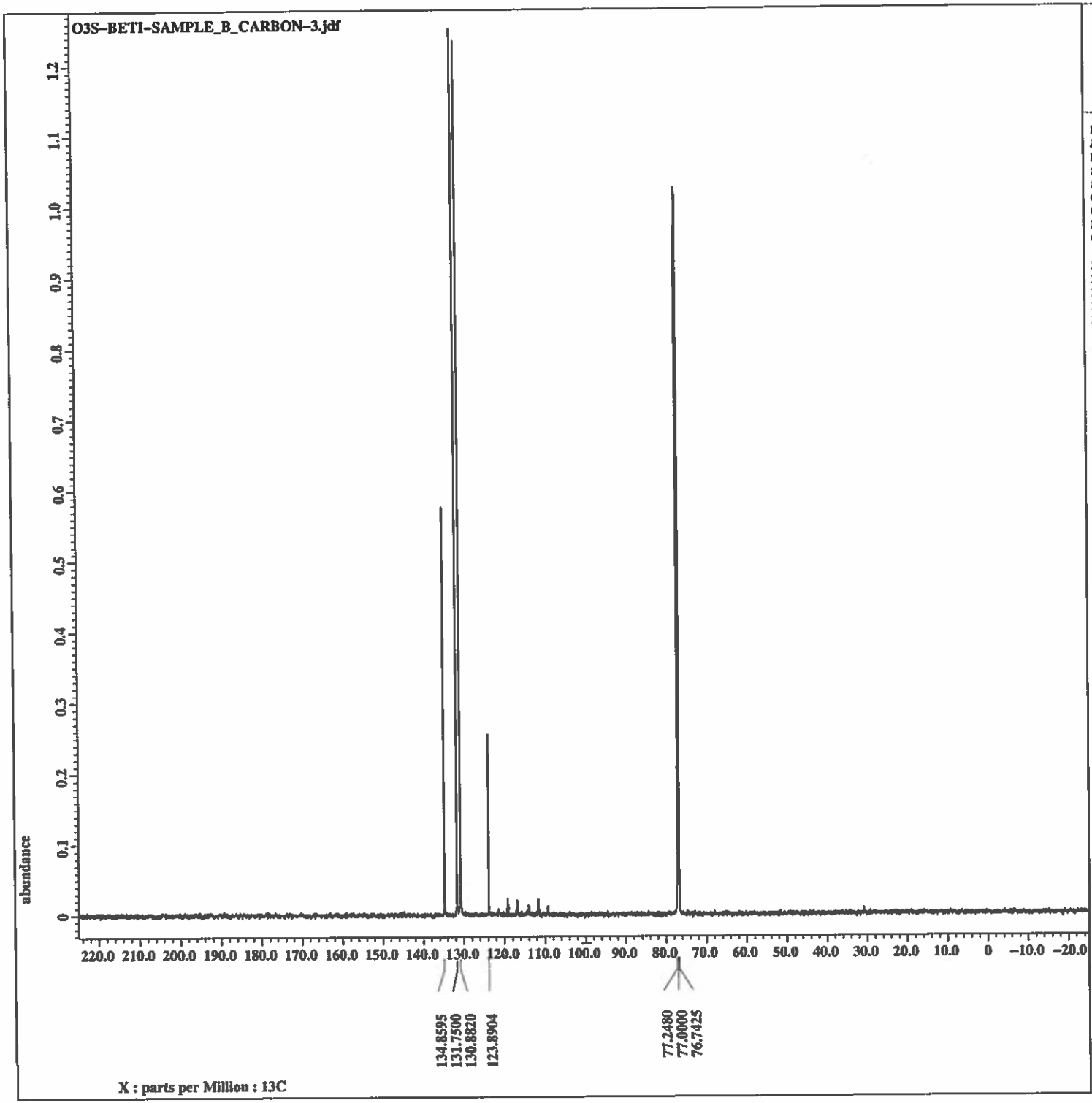
7.6236
7.6122
7.6088
7.2400
X : parts per Million : 1H



SOUTH ALABAMA JAGUARS

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Author	= Jim Davis
Experiment	= single_pulse_dec
Sample_id	= O3S-BETI-SAMPLE_B
Solvent	= CHLOROFORM-D
Changer_sample	= 6
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Revision_time	= 16-JUN-2016 21:26:05
Current_time	= 14-OCT-2016 08:04:30
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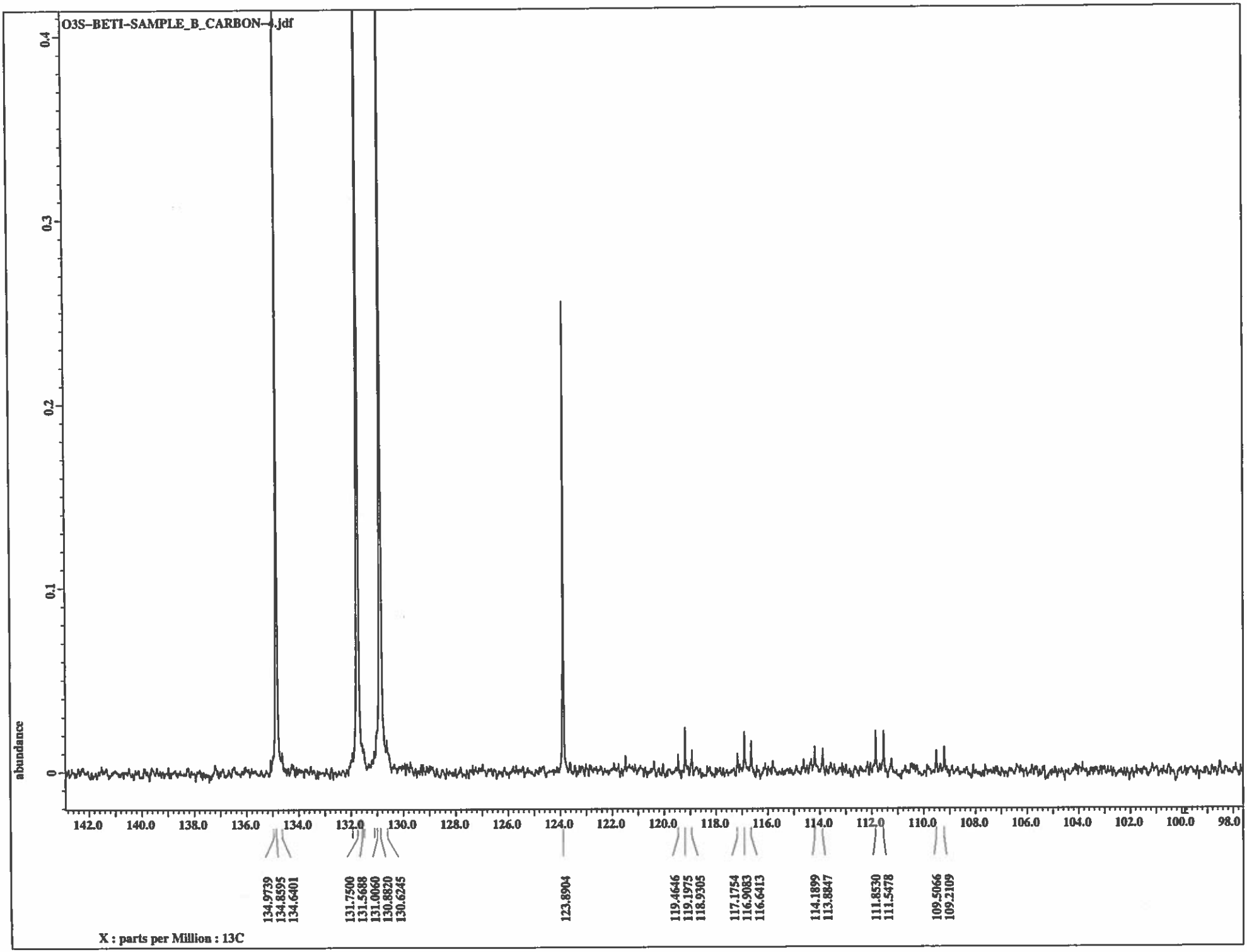
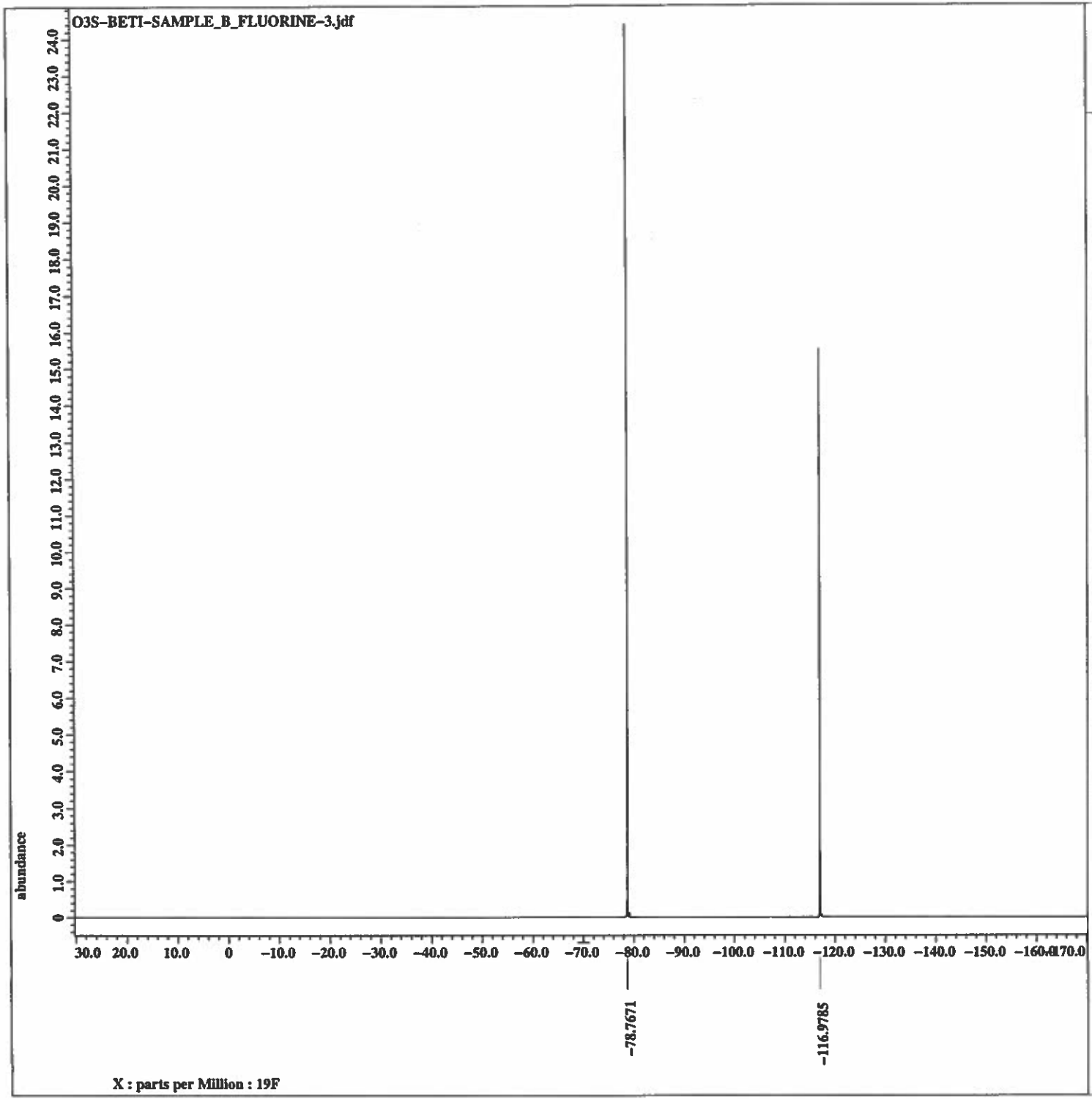
Dim_title	= 13C
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 0.83361792[s]
X_domain	= 13C
X_freq	= 125.76529768[MHz]
X_offset	= 100[ppm]
X_points	= 32768
X_prescans	= 4
X_resolution	= 1.19959034[Hz]
X_sweep	= 39.3081761[kHz]
Irr_domain	= 1H
Irr_freq	= 500.15991521[MHz]
Irr_offset	= 5.0[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 1024
Total_scans	= 1024
X_90_width	= 12.55[us]
X_acq_time	= 0.83361792[s]
X_angle	= 30[deg]
X_atn	= 6[dB]
X_pulse	= 4.18333333[us]
Irr_atn_dec	= 20.5[dB]
Irr_atn_noe	= 20.5[dB]
Irr_noise	= WALTZ
Decoupling	= TRUE
Initial_wait	= 1[s]
Noe	= TRUE
Noe_time	= 2[s]
Recvr_gain	= 60
Relaxation_delay	= 2[s]
Repetition_time	= 2.83361792[s]
Temp_get	= 22.6[dC]


O3S-BETI-SAMPLE_B_CARBON-4.jdf
abundance
0.4
0.3
0.2
0.1
0
142.0
140.0
138.0
136.0
134.0
132.0
130.0
128.0
126.0
124.0
122.0
120.0
118.0
116.0
114.0
112.0
110.0
108.0
106.0
104.0
102.0
100.0
98.0
134.9739
134.8595
134.6401
131.7500
131.5688
131.0060
130.8820
130.6245
123.8904
119.4646
119.1975
118.9305
117.1754
116.9083
116.6413
114.1899
113.8847
111.8530
111.5478
109.5066
109.2109
X : parts per Million : 13C



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Author	= Jim Davis
Experiment	= single_pulse.ex2
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Solvent	= CHLOROFORM-D
Changer_sample	= 6
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Revision_time	= 16-JUN-2016 10:45:38
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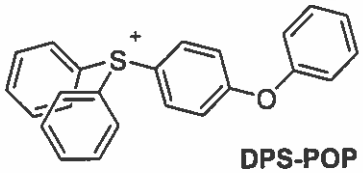
Dim_size	= 52428
Dim_title	= 19F
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 0.55574528[s]
X_domain	= 19F
X_freq	= 470.62046084[MHz]
X_offset	= -70[ppm]
X_points	= 65536
X_prescans	= 1
X_resolution	= 1.7993855[Hz]
X_sweep	= 117.9245283[kHz]
Irr_domain	= 19F
Irr_freq	= 470.62046084[MHz]
Irr_offset	= 5[ppm]
Tri_domain	= 19F
Tri_freq	= 470.62046084[MHz]
Tri_offset	= 5[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 16
Total_scans	= 16
X_90_width	= 15.7[us]
X_acq_time	= 0.55574528[s]
X_angle	= 45[deg]
X_atn	= 4[dB]
X_pulse	= 7.85[us]
Irr_mode	= Off
Tri_mode	= Off
Dante_presat	= FALSE
Initial_wait	= 1[s]
Recvr_gain	= 44
Relaxation_delay	= 4[s]
Repetition_time	= 4.55574528[s]
Temp_get	= 22.1[dC]

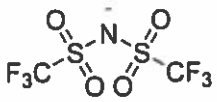
Compound 3

Elemental Analysis

^{1}H-, ^{13}C-, and ^{19}F-NMR Spectra



DPS-POP



Tf_2N

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No. JD-SULFONIUM-3-RECRYSTALLIZED

Company/School U SOUTH ALABAMA

Dept. CHEMISTRY

Address CHEM BLDG 223

City, State, Zip MOBILE AL 36688

Name JAMES DAVIS Date 10/17/2016

Phone (251) 751-0520

tlantic Blvd. Suite M
ss, GA 30071
tlanticmicrolab.com

sor/Supervisor: DAVIS

CC#

nent	Theory	Found	
C	49.13	49.27	
H	3.01	2.98	
N	2.20	2.21	

Single ☒ Duplicate ☐

Elements Present: CHNOSF

Analyze for: CHN

Hygroscopic ☐ Explosive ☐

M.P. UNK B.P. NONE

To be dried: Yes ☒ No ☐

Temp. 60 Vac. HIGH Time 4H

Rush Service ☒ Rush service guarantees analyses will be completed and results available by 5 PM EST on the day the sample is received by 11 AM.

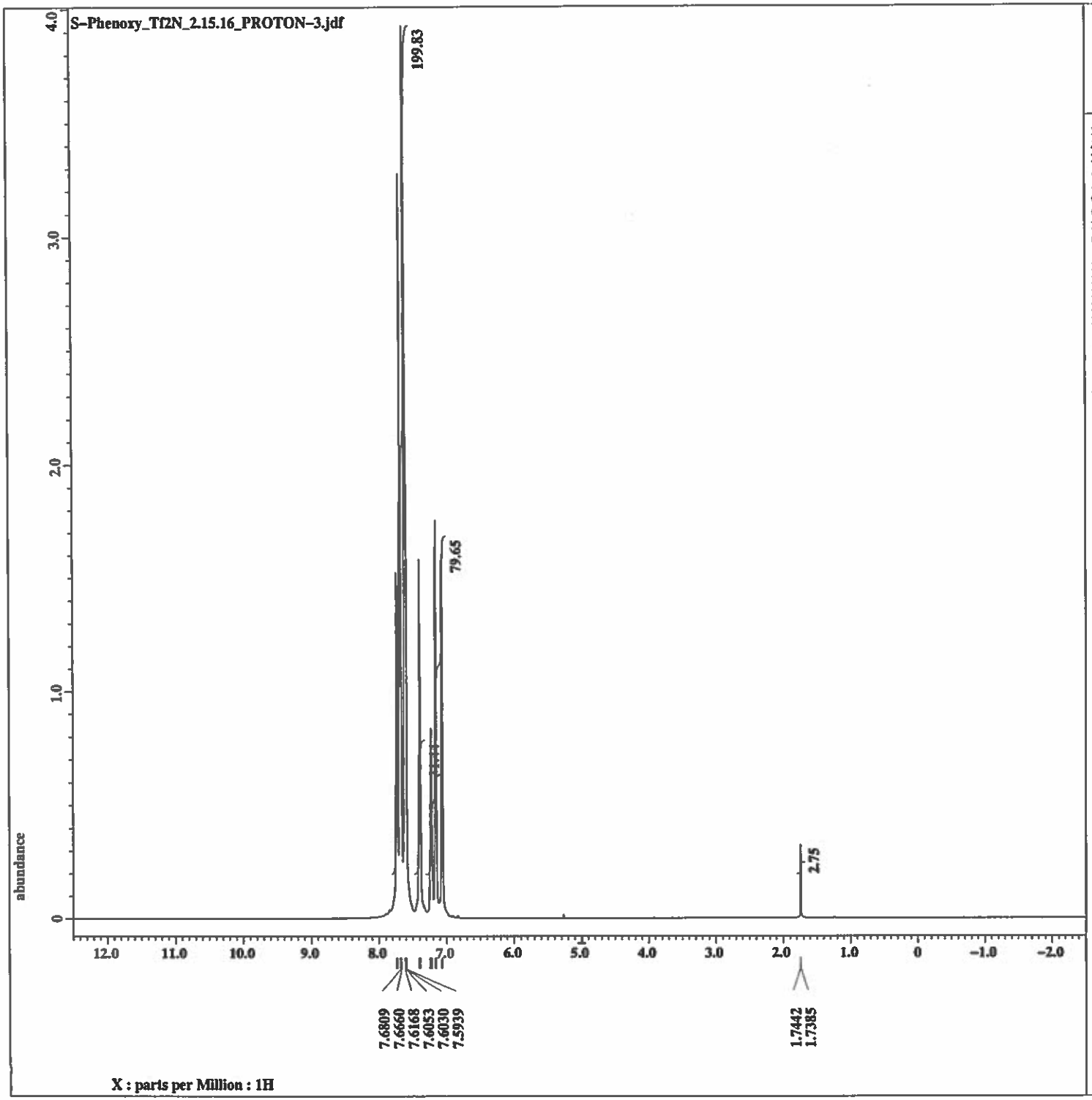
Include Email Address or FAX # Below

jdavis@southalabama.edu

te Received OCT 16 2016 Date Completed OCT 18 2016

marks:

CUT HERE



SOUTH ALABAMA JAGUARS

Filename	= S-Phenoxy_Tf2N_2.15.1
Author	= Jim Davis
Experiment	= single_pulse.ex2
Sample_id	= S-Phenoxy_Tf2N_2.15.1
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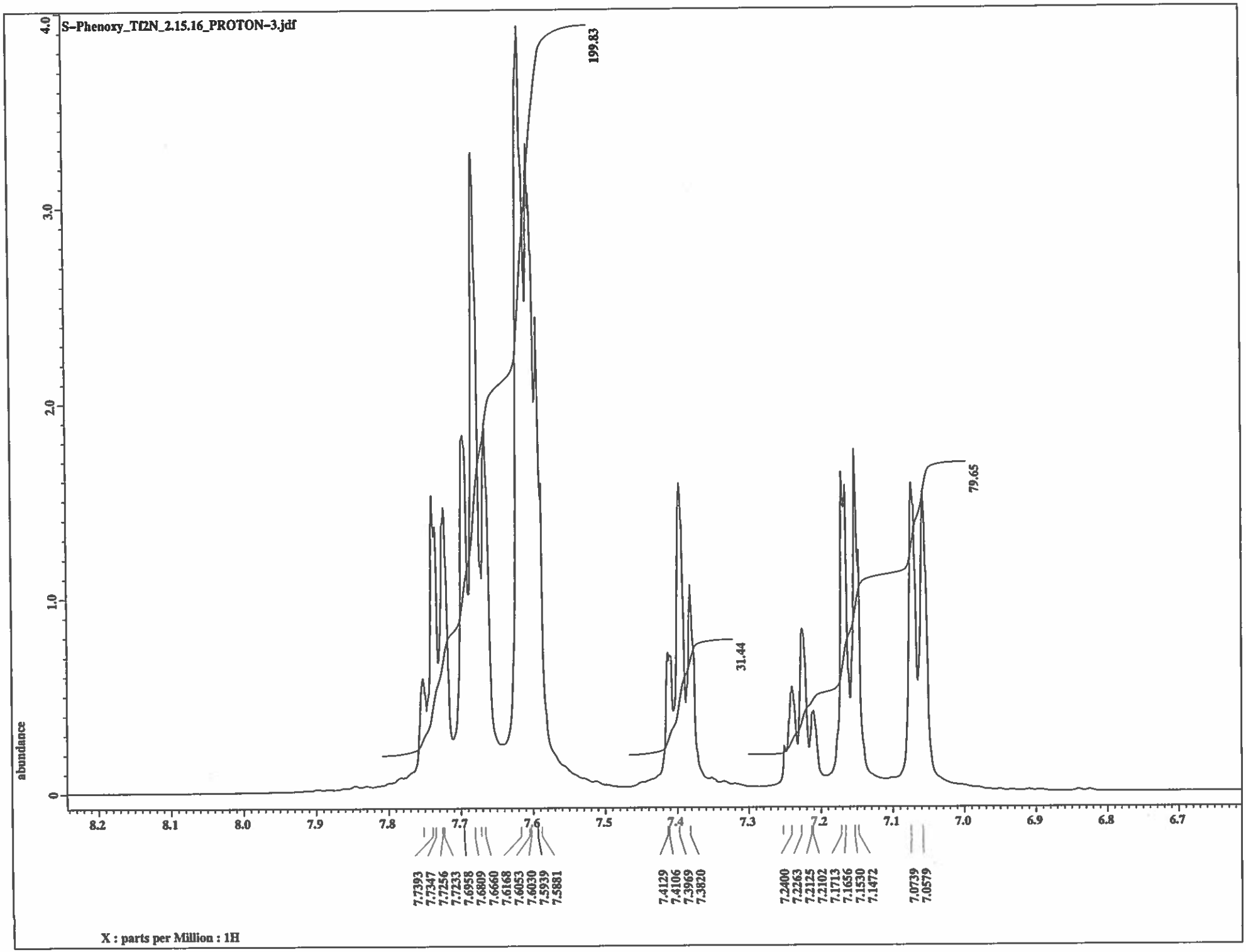
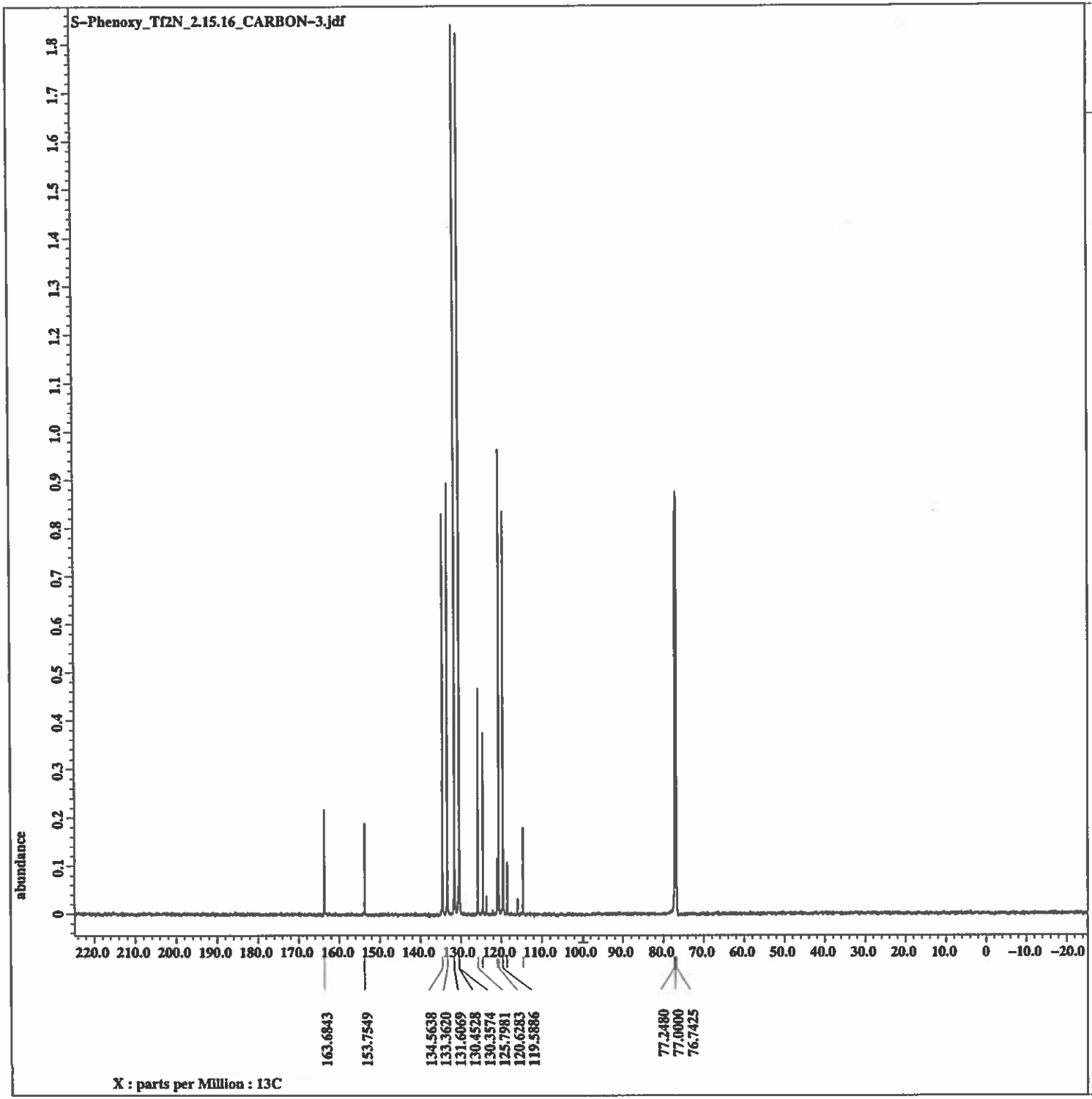
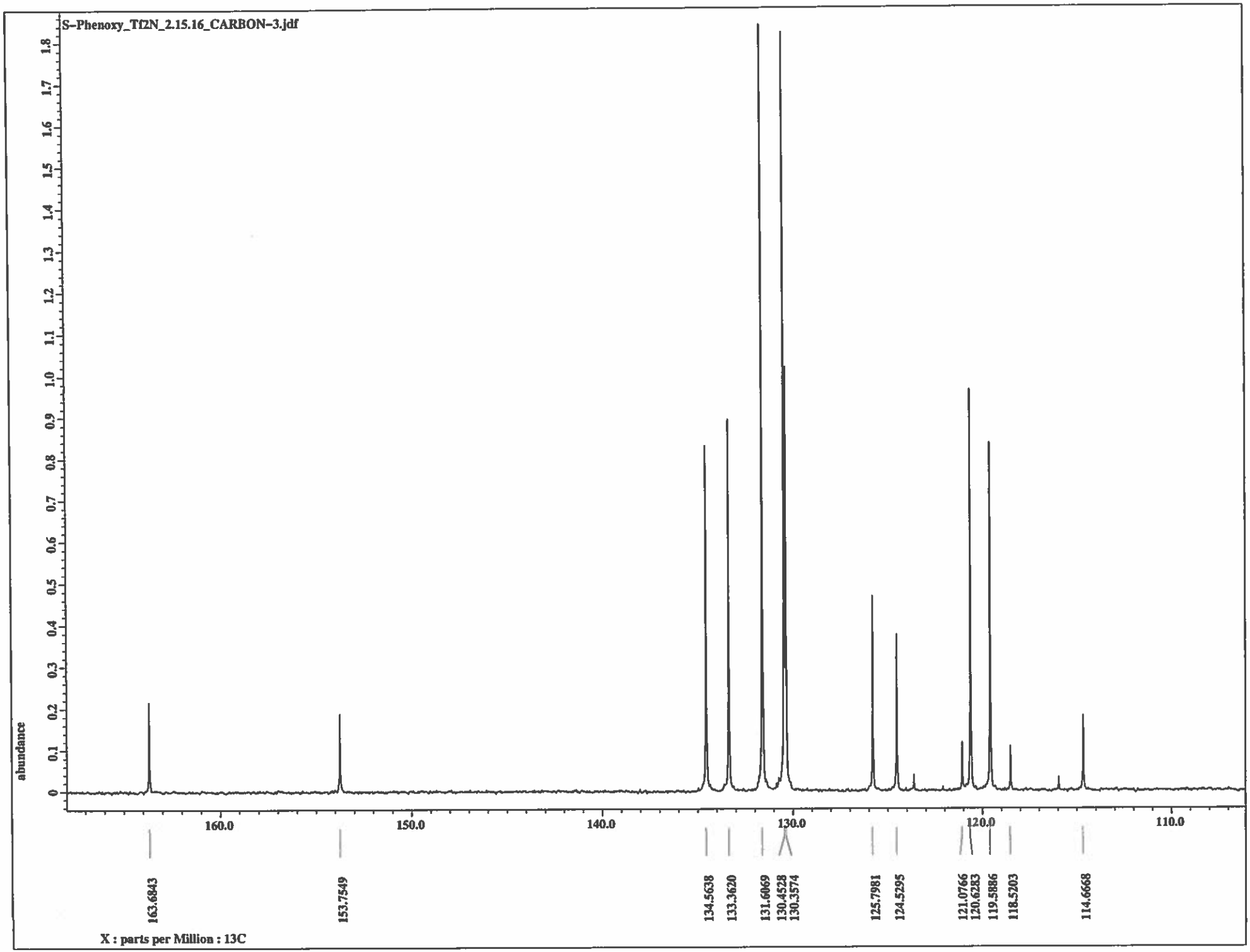
Changer_sample	= 18
Creation_time	= 15-FEB-2016 17:08:16
Revision_time	= 15-FEB-2016 16:54:28
Current_time	= 14-OCT-2016 07:57:05
Data_format	= 1D COMPLEX
Dim_size	= 13107
Dim_title	= 1H
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 1.74587904[s]
X_domain	= 1H
X_freq	= 500.15991521[MHz]
X_offset	= 5.0[ppm]
X_points	= 16384
X_prescans	= 1
X_resolution	= 0.57277737[Hz]
X_sweep	= 9.38438438[kHz]
Irr_domain	= 1H
Irr_freq	= 500.15991521[MHz]
Irr_offset	= 5.0[ppm]
Tri_domain	= 1H
Tri_freq	= 500.15991521[MHz]
Tri_offset	= 5.0[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 16
Total_scans	= 16
X_90_width	= 13.35[us]
X_acq_time	= 1.74587904[s]
X_angle	= 45[deg]
X_atn	= 4[dB]
X_pulse	= 6.675[us]
Irr_mode	= Off
Tri_mode	= Off
Dante_presat	= FALSE
Initial_wait	= 1[s]
Recvr_gain	= 30
Relaxation_delay	= 4[s]
Repetition_time	= 5.74587904[s]
Temp_get	= 19.9[dC]

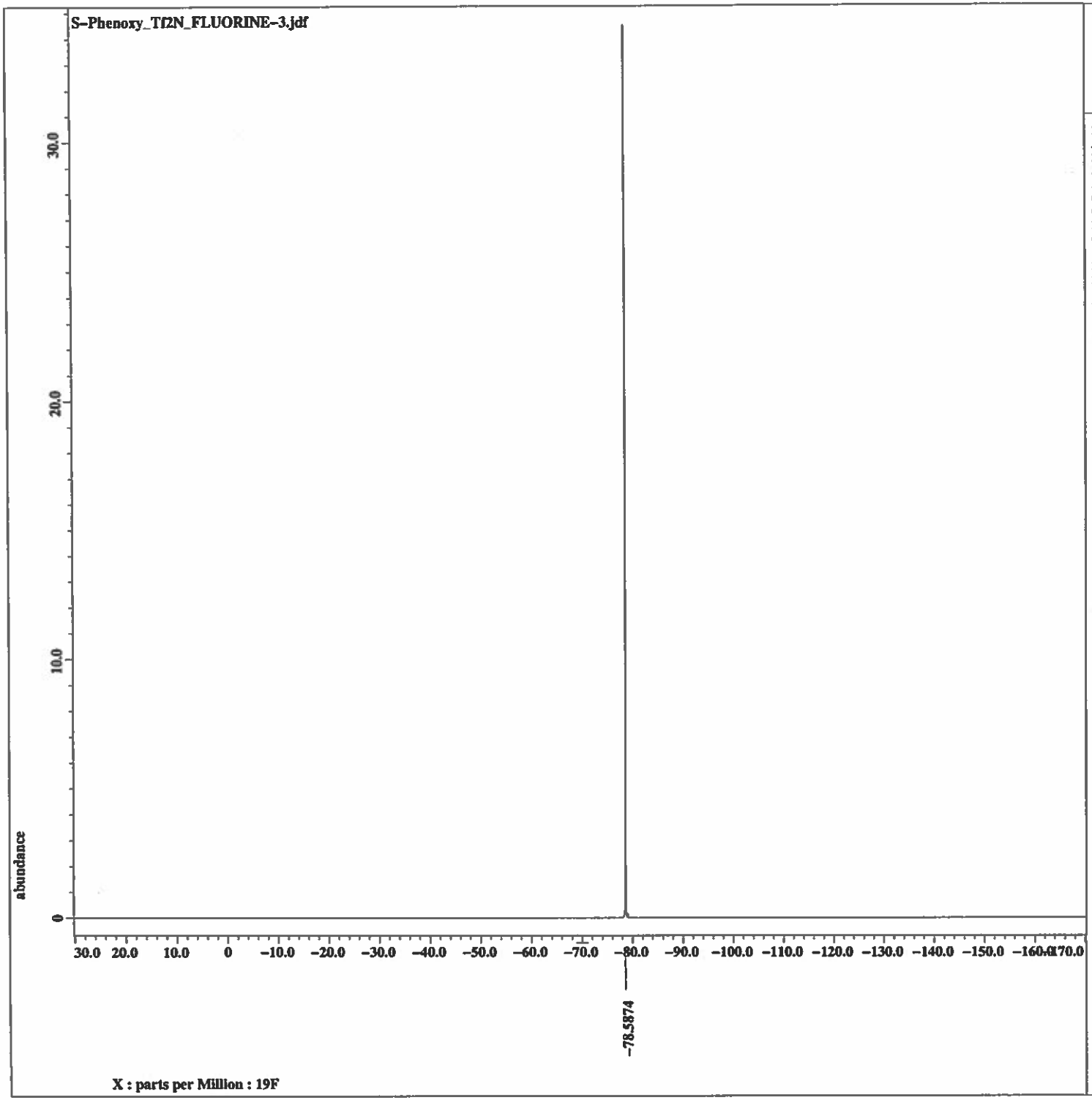

S-Phenoxy_Tf2N_2.15.16_PROTON-3.jdf
abundance
4.0
3.0
2.0
1.0
0
199.83
31.44
79.65
8.2
8.1
8.0
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
7.0
6.9
6.8
6.7
7.7393
7.7347
7.7256
7.7233
7.6958
7.6809
7.6660
7.6168
7.6053
7.6030
7.5939
7.5881
7.4129
7.4106
7.3969
7.3820
7.2400
7.2263
7.2125
7.2102
7.1713
7.1656
7.1530
7.1472
7.0739
7.0579
X : parts per Million : 1H



SOUTH ALABAMA JAGUARS

Filename	= S-Phenoxy_Tf2N_2.15.1
Author	= Jim Davis
Experiment	= single_pulse_dec
Sample_id	= S-Phenoxy_Tf2N_2.15.1
Solvent	= CHLOROFORM-D
Changer_sample	= 18
Creation_time	= 15-FEB-2016 20:49:41
Revision_time	= 15-FEB-2016 20:35:52
Current_time	= 14-OCT-2016 07:54:12
Data_format	= 1D COMPLEX
Dim_size	= 26214
Dim_title	= 13C
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 0.83361792[s]
X_domain	= 13C
X_freq	= 125.76529768[MHz]
X_offset	= 100[ppm]
X_points	= 32768
X_prescans	= 4
X_resolution	= 1.19959034[Hz]
X_sweep	= 39.3081761[kHz]
Irr_domain	= 1H
Irr_freq	= 500.15991521[MHz]
Irr_offset	= 5.0[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 1024
Total_scans	= 1024
X_90_width	= 12.55[us]
X_acq_time	= 0.83361792[s]
X_angle	= 30[deg]
X_atn	= 6[dB]
X_pulse	= 4.18333333[us]
Irr_atn_dec	= 20.5[dB]
Irr_atn_noe	= 20.5[dB]
Irr_noise	= WALTZ
Decoupling	= TRUE
Initial_wait	= 1[s]
Noe	= TRUE
Noe_time	= 2[s]
Recvr_gain	= 60
Relaxation_delay	= 2[s]
Repetition_time	= 2.83361792[s]
Temp_get	= 20.6[dC]


S-Phenoxy_Tf2N_2.15.16_CARBON-3.jdf
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
160.0
150.0
140.0
130.0
120.0
110.0
163.6843
153.7549
134.5638
133.3620
131.6069
130.4528
130.3574
125.7981
124.5295
121.0766
120.6283
119.5886
118.5203
114.6668
X : parts per Million : 13C

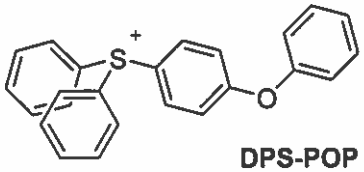


Filename	= S-Phenoxy_Tf2N_FLUORI
Author	= Jim Davis
Experiment	= single_pulse.ex2
Sample_id	= S-Phenoxy_Tf2N
Solvent	= CHLOROFORM-D
Changer_sample	= 18
Creation_time	= 15-FEB-2016 16:34:35
Revision_time	= 15-FEB-2016 16:20:48
Current_time	= 14-OCT-2016 07:52:41
Data_format	= 1D COMPLEX
Dim_size	= 52428
Dim_title	= 19F
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 0.55574528[s]
X_domain	= 19F
X_freq	= 470.62046084[MHz]
X_offset	= -70[ppm]
X_points	= 65536
X_prescans	= 1
X_resolution	= 1.7993855[Hz]
X_sweep	= 117.9245283[kHz]
Irr_domain	= 19F
Irr_freq	= 470.62046084[MHz]
Irr_offset	= 5[ppm]
Tri_domain	= 19F
Tri_freq	= 470.62046084[MHz]
Tri_offset	= 5[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 16
Total_scans	= 16
X_90_width	= 15.7[us]
X_acq_time	= 0.55574528[s]
X_angle	= 45[deg]
X_atn	= 4[dB]
X_pulse	= 7.85[us]
Irr_mode	= Off
Tri_mode	= Off
Dante_presat	= FALSE
Initial_wait	= 1[s]
Recvr_gain	= 40
Relaxation_delay	= 4[s]
Repetition_time	= 4.55574528[s]
Temp_get	= 19.9[dC]

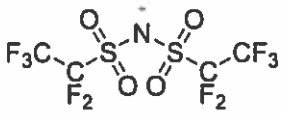
Compound 4

Elemental Analysis

^{1}H-, ^{13}C-, and ^{19}F-NMR Spectra



DPS-POP



BETI

Atlantic Microlab, Inc.

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Norcross, GA 30071
www.atlanticmicrolab.com

Sample No. JD-SULFONIUM-4

Company/School U SOUTH ALABAMA
Dept. CHEMISTRY
Address CHEM BLDG 223
City, State, Zip MOBILE, AL, 36688

Professor/Supervisor: DAVIS
PO# / CC#

Name JAMES DAVIS
Phone (251) 751-0520
Date 10/12/2016

Element	Theory	Found	
C	45.72	45.66	
H	2.60	2.52	
N	1.90	1.94	

Single ☒ Duplicate ☐

Elements Present: CHNOSF

Analyze for: CHN

Hygroscopic ☐ Explosive ☐
M.P. UNK B.P. NONE

To be dried: Yes ☒ No ☐
Temp. 100C Vac. HIGH Time 4H

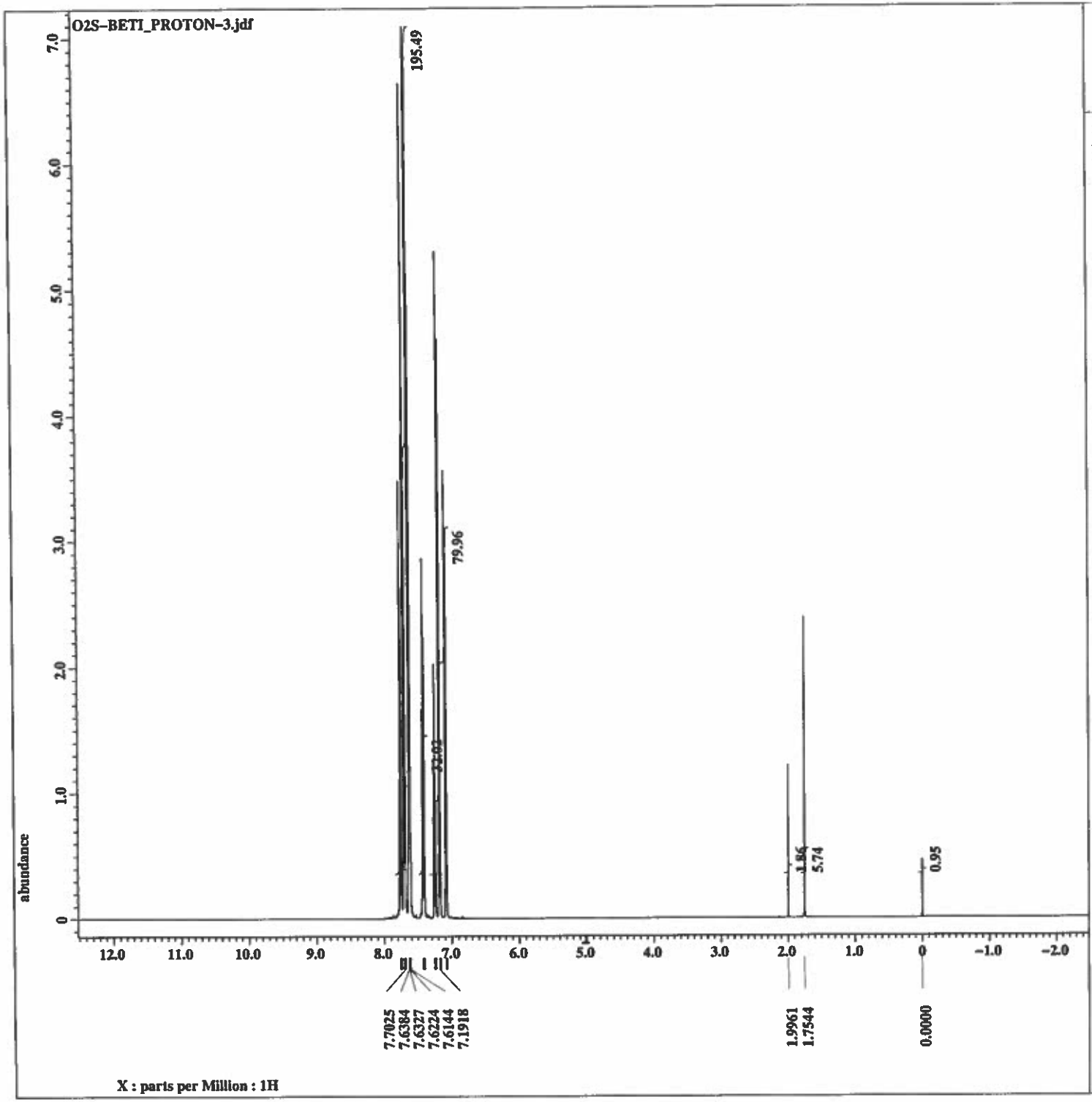
Rush Service ☒ Rush service guarantees analyses will be completed and results available by 5 PM EST on the day the sample is received by 11 AM.

Include Email Address or FAX # Below

jdavis@southalabama.edu

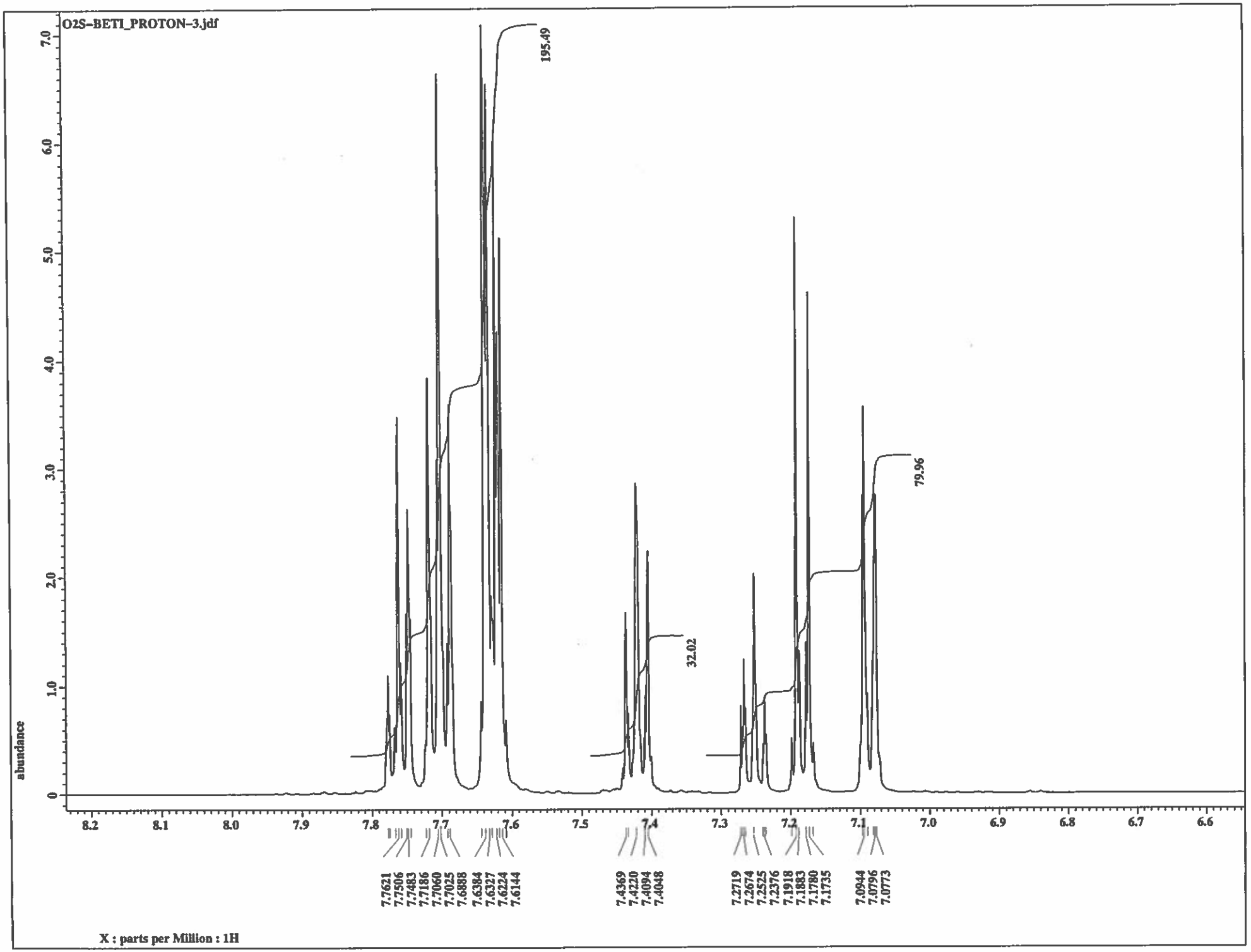
Date Received OCT 14 2016 Date Completed OCT 14 2016

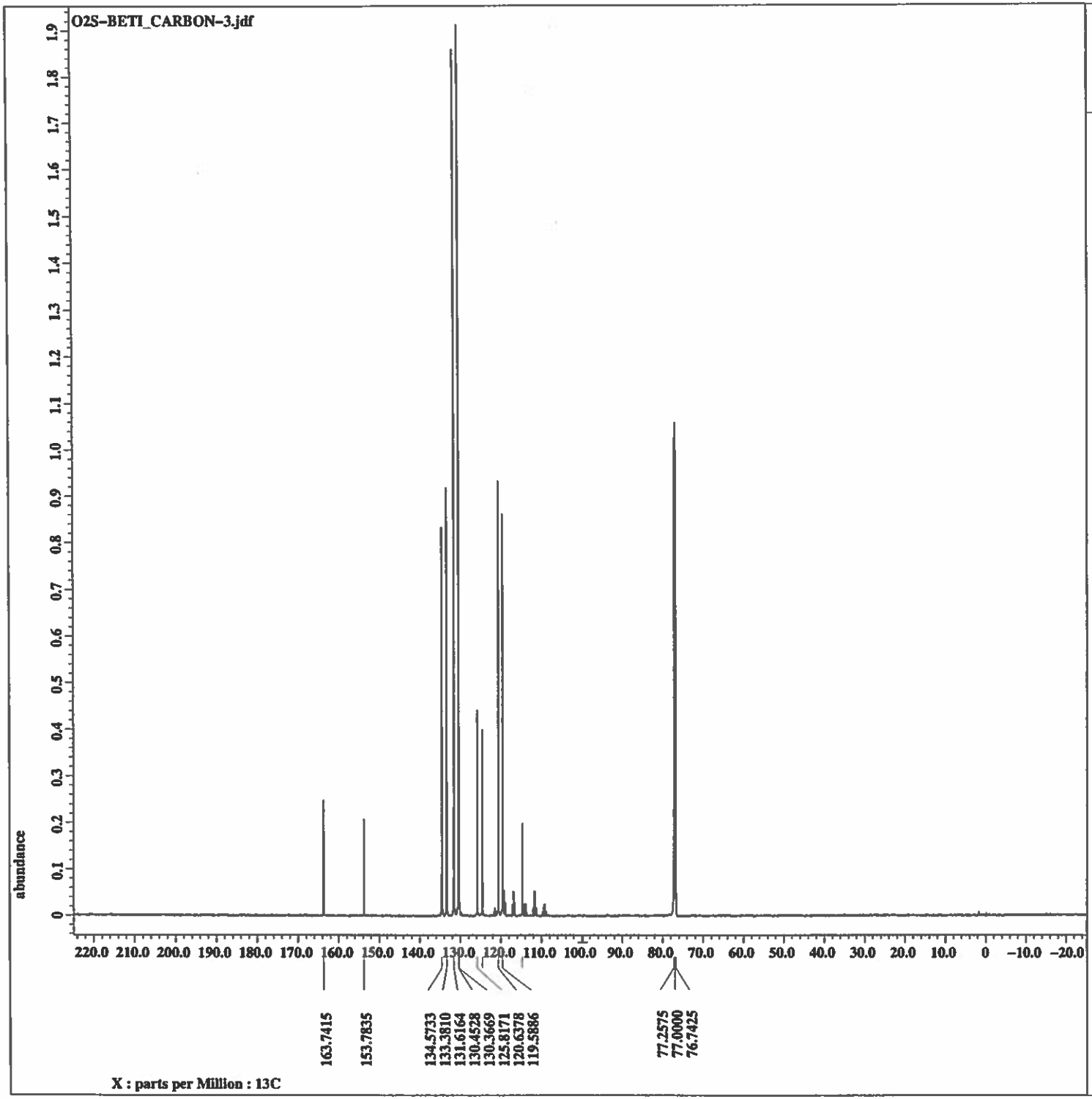
Remarks:



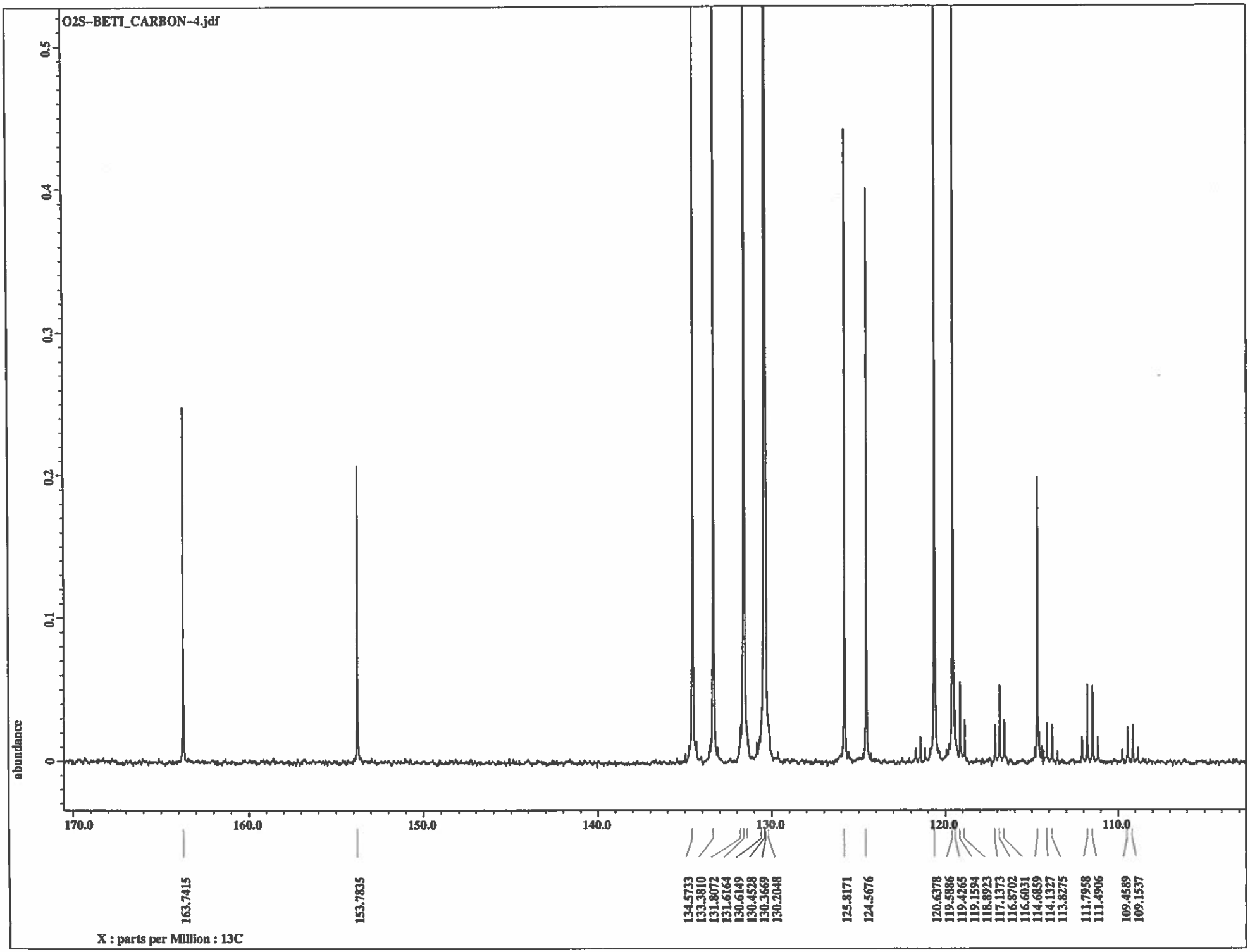
SOUTH ALABAMA JAGUARS

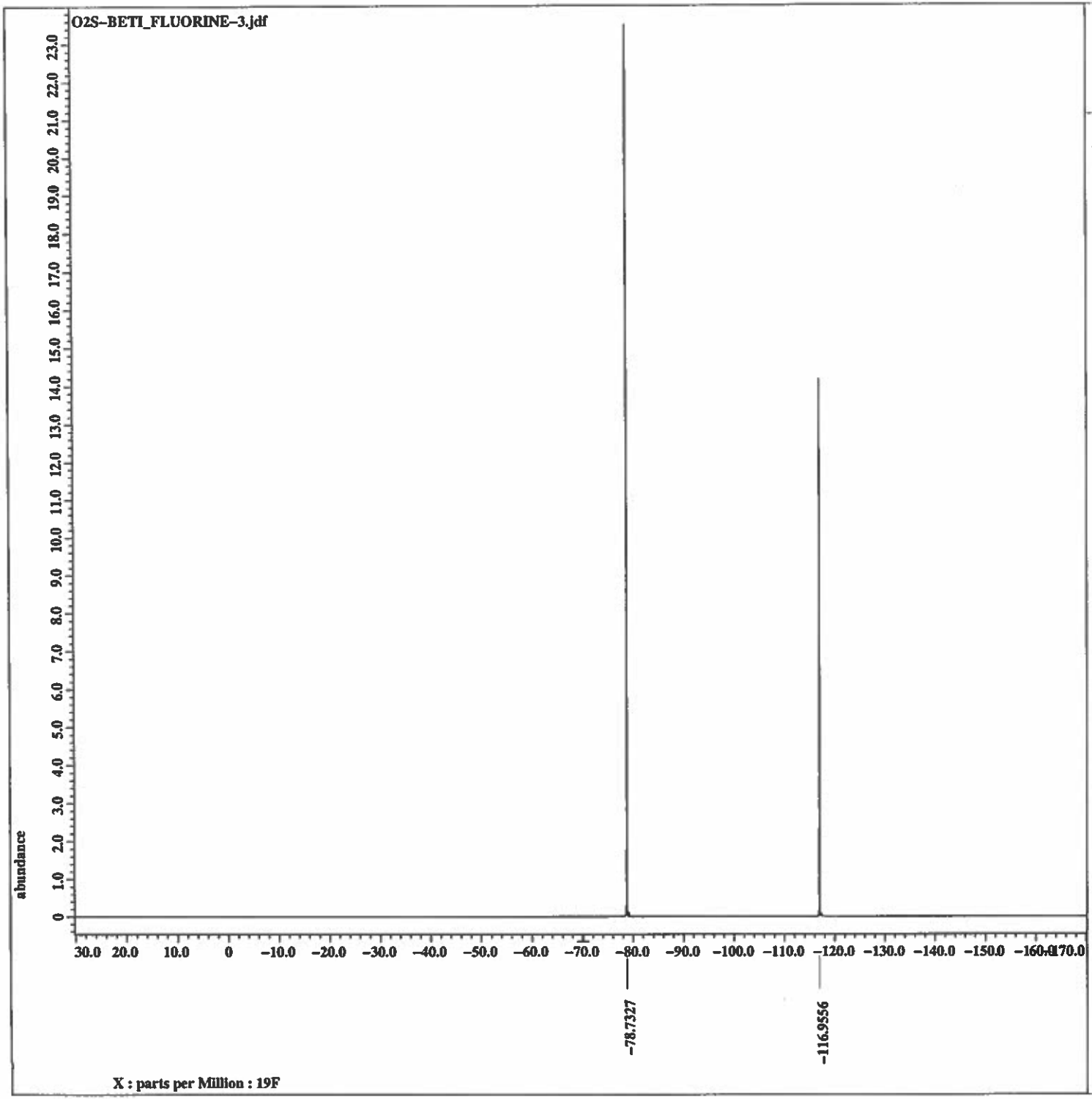
Filename	= O2S-BETI_PROTON-3.jdf
Author	= Jim Davis
Experiment	= single_pulse.ex2
Sample_id	= O2S-BETI
Solvent	= CHLOROFORM-D
Changer_sample	= 3
Creation_time	= 12-OCT-2016 12:22:35
Revision_time	= 12-OCT-2016 12:05:12
Current_time	= 14-OCT-2016 07:48:29
Data_format	= 1D COMPLEX
Dim_size	= 13107
Dim_title	= 1H
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 1.74587904[s]
X_domain	= 1H
X_freq	= 500.15991521[MHz]
X_offset	= 5.0[ppm]
X_points	= 16384
X_prescans	= 1
X_resolution	= 0.57277737[Hz]
X_sweep	= 9.38438438[kHz]
Irr_domain	= 1H
Irr_freq	= 500.15991521[MHz]
Irr_offset	= 5.0[ppm]
Tri_domain	= 1H
Tri_freq	= 500.15991521[MHz]
Tri_offset	= 5.0[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 16
Total_scans	= 16
X_90_width	= 13.35[us]
X_acq_time	= 1.74587904[s]
X_angle	= 45[deg]
X_atn	= 4[dB]
X_pulse	= 6.675[us]
Irr_mode	= Off
Tri_mode	= Off
Dante_presat	= FALSE
Initial_wait	= 1[s]
Recvr_gain	= 30
Relaxation_delay	= 4[s]
Repetition_time	= 5.74587904[s]
Temp_get	= 20.2[dC]


O2S-BETI_PROTON-3.jdf
195.49
32.02
79.96
abundance
X : parts per Million : 1H
7.7621
7.7506
7.7483
7.7186
7.7060
7.7025
7.6888
7.6384
7.6327
7.6224
7.6144
7.4369
7.4220
7.4094
7.4048
7.2719
7.2674
7.2525
7.2376
7.1918
7.1883
7.1780
7.1735
7.0944
7.0796
7.0773



Filename	= O2S-BETI_CARBON-3.jdf
Author	= Jim Davis
Experiment	= single_pulse_dec
Sample_id	= O2S-BETI
Solvent	= CHLOROFORM-D
Changer_sample	= 3
Creation_time	= 12-OCT-2016 19:46:50
Revision_time	= 12-OCT-2016 19:29:23
Current_time	= 14-OCT-2016 07:45:32
Data_format	= 1D COMPLEX
Dim_size	= 26214
Dim_title	= 13C
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 0.83361792[s]
X_domain	= 13C
X_freq	= 125.76529768[MHz]
X_offset	= 100[ppm]
X_points	= 32768
X_prescans	= 4
X_resolution	= 1.19959034[Hz]
X_sweep	= 39.3081761[kHz]
Irr_domain	= 1H
Irr_freq	= 500.15991521[MHz]
Irr_offset	= 5.0[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 3000
Total_scans	= 3000
X_90_width	= 12.55[us]
X_acq_time	= 0.83361792[s]
X_angle	= 30[deg]
X_atn	= 6[dB]
X_pulse	= 4.18333333[us]
Irr_atn_dec	= 20.5[dB]
Irr_atn_noe	= 20.5[dB]
Irr_noise	= WALTZ
Decoupling	= TRUE
Initial_wait	= 1[s]
Noe	= TRUE
Noe_time	= 2[s]
Recvr_gain	= 60
Relaxation_delay	= 2[s]
Repetition_time	= 2.83361792[s]
Temp_get	= 21.3[dC]


O2S--BETI_CARBON--4.jdf
abundance
0.5
0.4
0.3
0.2
0.1
0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
163.7415
153.7835
134.5733
133.3810
131.8072
131.6164
130.6149
130.4528
130.3669
130.2048
125.8171
124.5676
120.6378
119.5886
119.4265
119.1594
118.8923
117.1373
116.8702
116.6031
114.6859
114.1327
113.8275
111.7958
111.4906
109.4589
109.1537
X : parts per Million : 13C

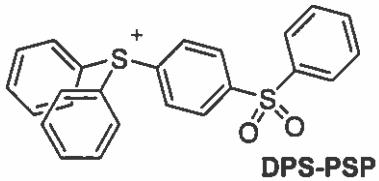


Filename	= O2S-BETI_FLUORINE-3.j
Author	= Jim Davis
Experiment	= single_pulse.ex2
Sample_id	= O2S-BETI
Solvent	= CHLOROFORM-D
Changer_sample	= 3
Creation_time	= 12-OCT-2016 12:25:31
Revision_time	= 12-OCT-2016 12:08:08
Current_time	= 14-OCT-2016 07:44:52
Data_format	= 1D COMPLEX
Dim_size	= 52428
Dim_title	= 19F
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 0.55574528[s]
X_domain	= 19F
X_freq	= 470.62046084[MHz]
X_offset	= -70[ppm]
X_points	= 65536
X_prescans	= 1
X_resolution	= 1.7993855[Hz]
X_sweep	= 117.9245283[kHz]
Irr_domain	= 19F
Irr_freq	= 470.62046084[MHz]
Irr_offset	= 5[ppm]
Tri_domain	= 19F
Tri_freq	= 470.62046084[MHz]
Tri_offset	= 5[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 16
Total_scans	= 16
X_90_width	= 15.7[us]
X_acq_time	= 0.55574528[s]
X_angle	= 45[deg]
X_atn	= 4[dB]
X_pulse	= 7.85[us]
Irr_mode	= Off
Tri_mode	= Off
Dante_presat	= FALSE
Initial_wait	= 1[s]
Recvr_gain	= 36
Relaxation_delay	= 4[s]
Repetition_time	= 4.55574528[s]
Temp_get	= 20.2[dC]

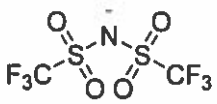
Compound 5

Elemental Analysis

^{1}H-, ^{13}C-, and ^{19}F-NMR Spectra



DPS-PSP



Tf_2N

Atlantic Microlab, Inc.

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www.atlanticmicrolab.com

Sample No. JD-SULFONIUM-5

Company/School U. SOUTH ALABAMA
Dept. CHEMISTRY
Address CHEM BLDG 223
City, State, Zip MOBILE, AL, 36688

Professor/Supervisor: JAMES DAVIS
Name JAMES DAVIS Date 10/12/2016
PO# / CC# _____
Phone (251) 751-0520

Element	Theory	Found	
C	45.68	45.48	
H	2.80	2.82	
N	2.05	2.11	

Single ☒ Duplicate ☐

Elements Present: CHNOSF

Analyze for: CHN

Hygroscopic ☐ Explosive ☐
M.P. UNK B.P. NONE

To be dried: Yes ☒ No ☐
Temp. 100C Vac. HIGH Time 4H

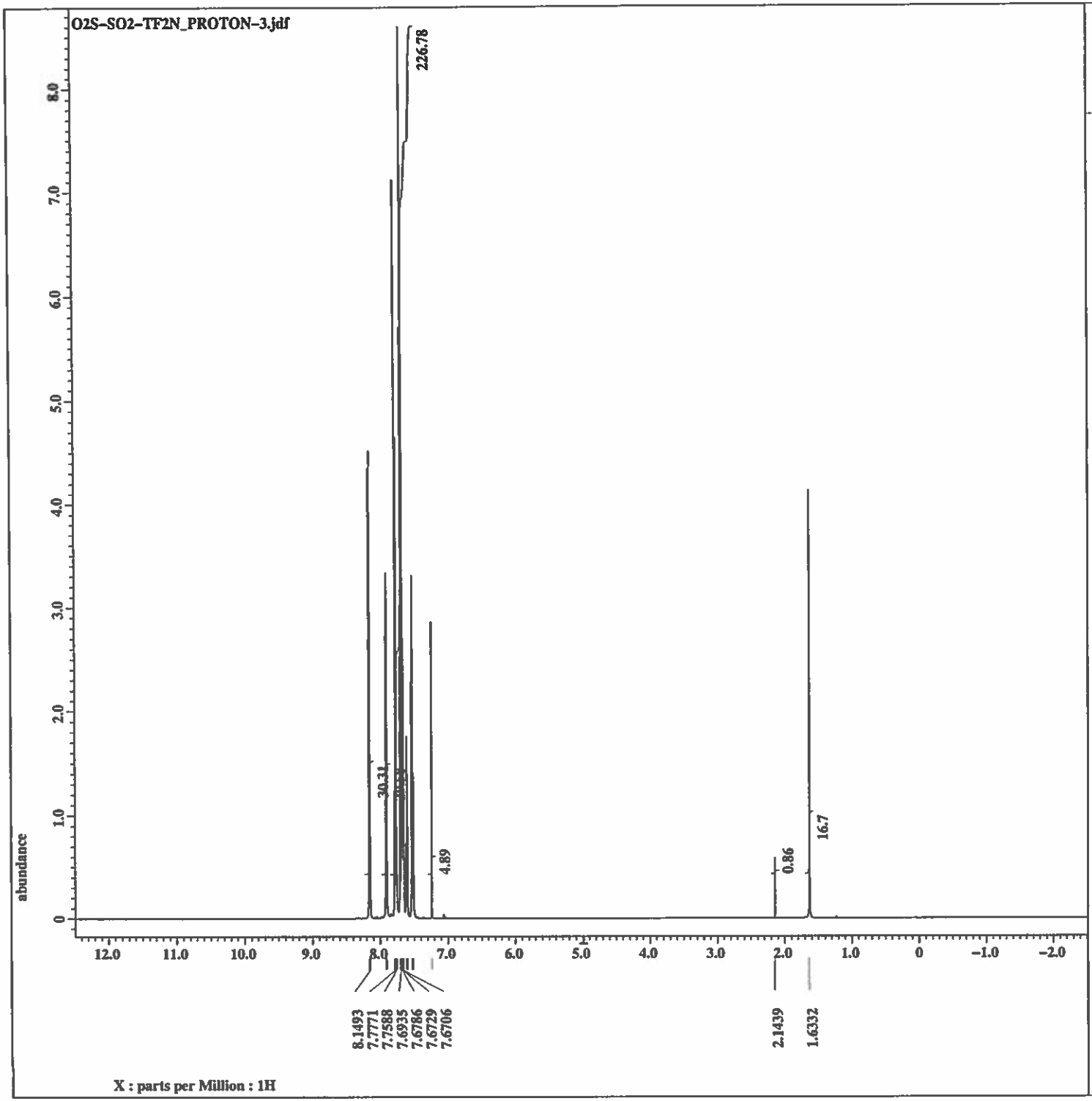
Rush Service ☒ Rush service guarantees analyses will be completed and results available by 5 PM EST on the day the sample is received by 11 AM.

Include Email Address or FAX # Below

jdavis@southalabama.edu

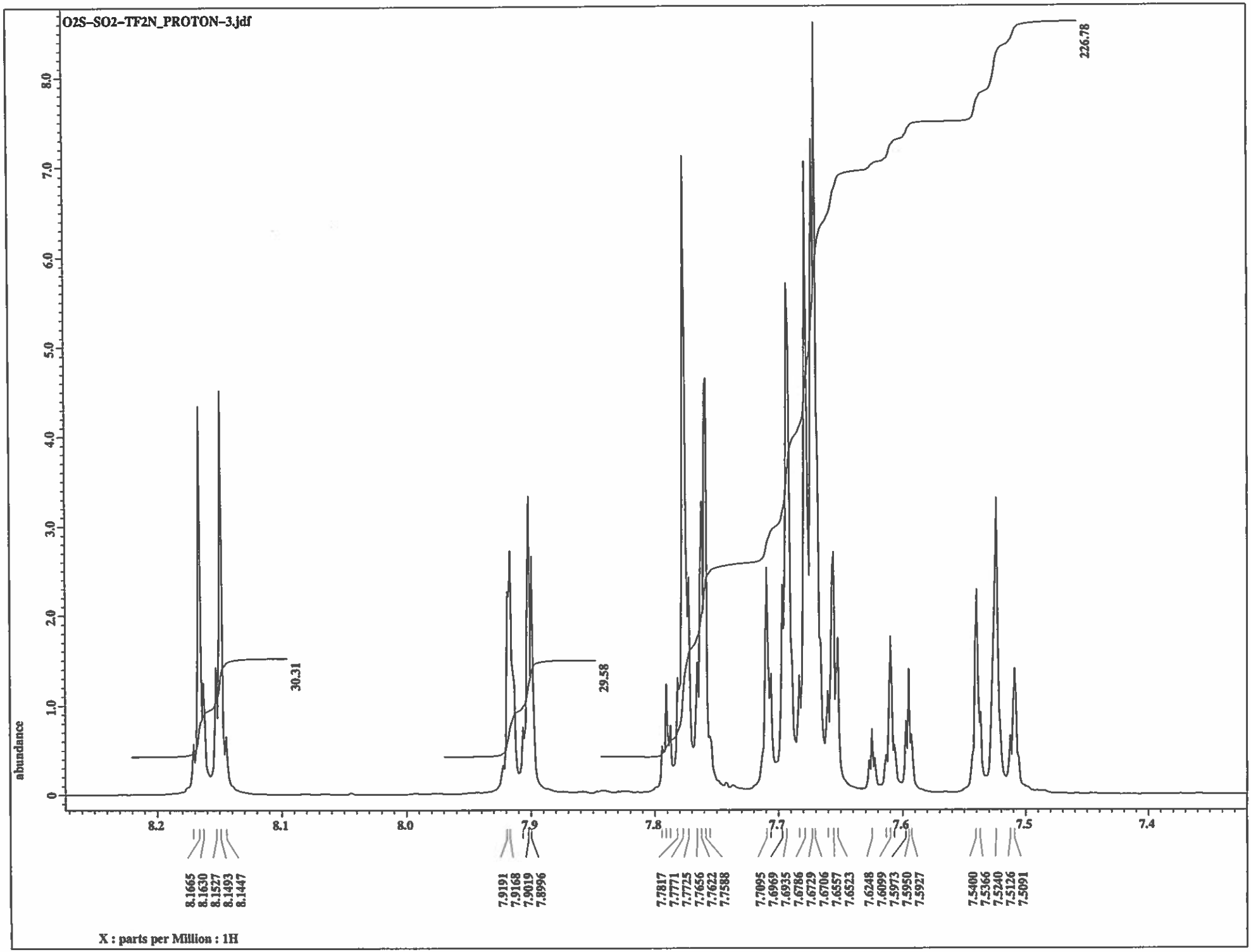
Date Received OCT 14 2016 Date Completed OCT 14 2016

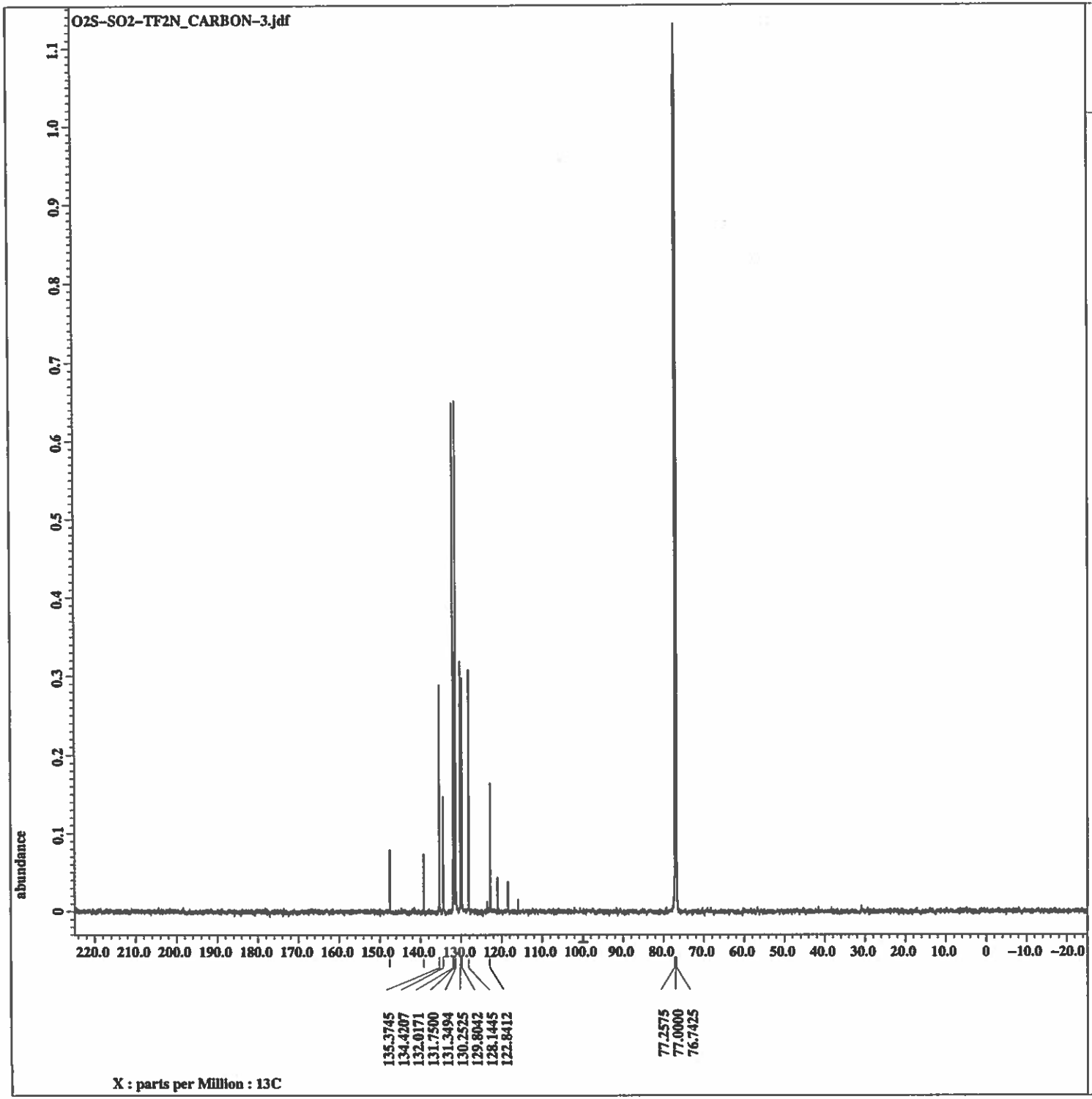
Remarks:



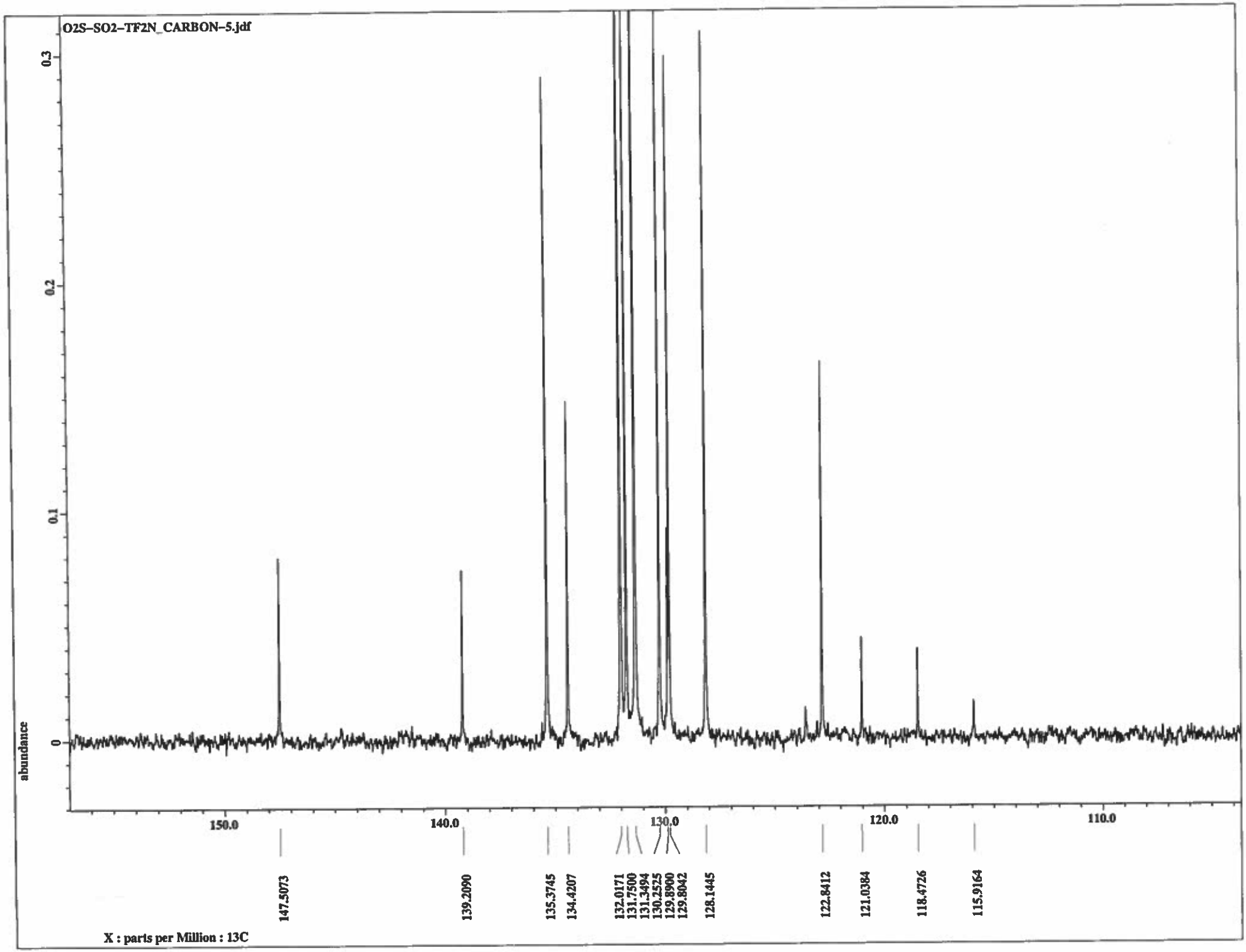
SOUTH ALABAMA JAGUARS

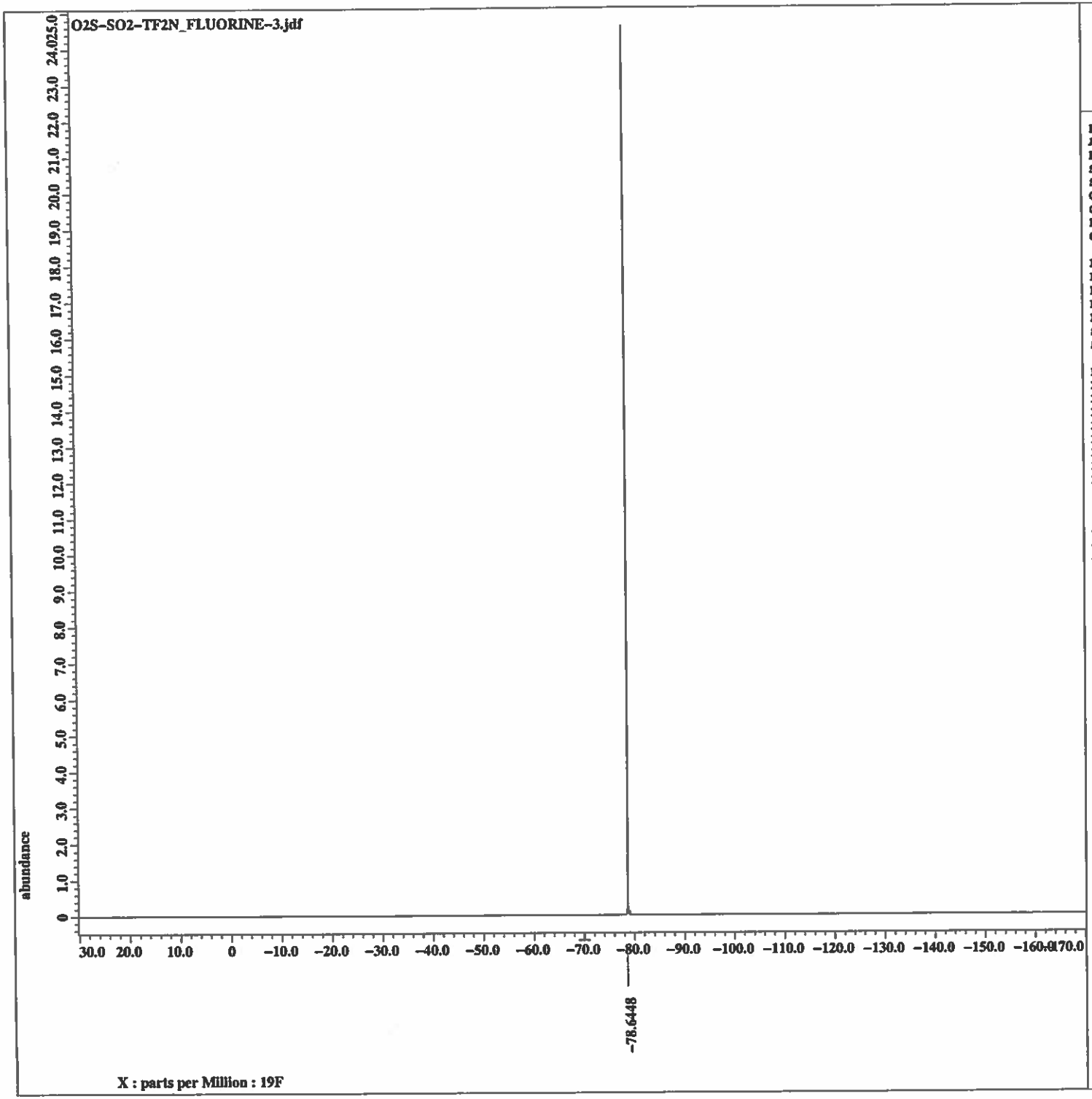
Filename	= O2S-SO2-TF2N_PROTON-3
Author	= Jim Davis
Experiment	= single_pulse.ex2
Sample_id	= O2S-SO2-TF2N
Solvent	= CHLOROFORM-D
Changer_sample	= 4
Creation_time	= 16-JUN-2016 10:20:39
Revision_time	= 16-JUN-2016 10:03:44
Current_time	= 14-OCT-2016 07:40:21
Data_format	= 1D COMPLEX
Dim_size	= 13107
Dim_title	= 1H
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 1.74587904[s]
X_domain	= 1H
X_freq	= 500.15991521[MHz]
X_offset	= 5.0[ppm]
X_points	= 16384
X_prescans	= 1
X_resolution	= 0.57277737[Hz]
X_sweep	= 9.38438438[kHz]
Irr_domain	= 1H
Irr_freq	= 500.15991521[MHz]
Irr_offset	= 5.0[ppm]
Tri_domain	= 1H
Tri_freq	= 500.15991521[MHz]
Tri_offset	= 5.0[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 16
Total_scans	= 16
X_90_width	= 13.35[us]
X_acq_time	= 1.74587904[s]
X_angle	= 45[deg]
X_atn	= 4[dB]
X_pulse	= 6.675[us]
Irr_mode	= Off
Tri_mode	= Off
Dante_presat	= FALSE
Initial_wait	= 1[s]
Recvr_gain	= 40
Relaxation_delay	= 4[s]
Repetition_time	= 5.74587904[s]
Temp_get	= 22.1[dC]


O2S-SO2-TF2N_PROTON-3.jdf
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
30.31
29.58
226.78
8.2
8.1
8.0
7.9
7.8
7.7
7.6
7.5
7.4
8.1665
8.1630
8.1527
8.1493
8.1447
7.9191
7.9168
7.9019
7.8996
7.7817
7.7771
7.7725
7.7656
7.7622
7.7588
7.7095
7.6969
7.6935
7.6786
7.6729
7.6706
7.6557
7.6523
7.6248
7.6099
7.5973
7.5950
7.5927
7.5400
7.5366
7.5240
7.5126
7.5091
X : parts per Million : 1H



Filename	= O2S-SO2-TF2N_CARBON-3
Author	= Jim Davis
Experiment	= single_pulse_dec
Sample_id	= O2S-SO2-TF2N
Solvent	= CHLOROFORM-D
Changer_sample	= 4
Creation_time	= 16-JUN-2016 19:57:49
Revision_time	= 16-JUN-2016 19:40:51
Current_time	= 14-OCT-2016 07:38:08
Data_format	= 1D COMPLEX
Dim_size	= 26214
Dim_title	= 13C
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 0.83361792[s]
X_domain	= 13C
X_freq	= 125.76529768[MHz]
X_offset	= 100[ppm]
X_points	= 32768
X_prescans	= 4
X_resolution	= 1.19959034[Hz]
X_sweep	= 39.3081761[kHz]
Irr_domain	= 1H
Irr_freq	= 500.15991521[MHz]
Irr_offset	= 5.0[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 1024
Total_scans	= 1024
X_90_width	= 12.55[us]
X_acq_time	= 0.83361792[s]
X_angle	= 30[deg]
X_atn	= 6[dB]
X_pulse	= 4.18333333[us]
Irr_atn_dec	= 20.5[dB]
Irr_atn_noe	= 20.5[dB]
Irr_noise	= WALTZ
Decoupling	= TRUE
Initial_wait	= 1[s]
Noe	= TRUE
Noe_time	= 2[s]
Recvr_gain	= 60
Relaxation_delay	= 2[s]
Repetition_time	= 2.83361792[s]
Temp_get	= 22.7[dC]


O2S-SO2-TF2N_CARBON-5.jdf
abundance
0.3
0.2
0.1
0
150.0
140.0
130.0
120.0
110.0
147.5073
139.2090
135.3745
134.4207
132.0171
131.7500
131.3494
130.2525
129.8900
129.8042
128.1445
122.8412
121.0384
118.4726
115.9164
X : parts per Million : 13C

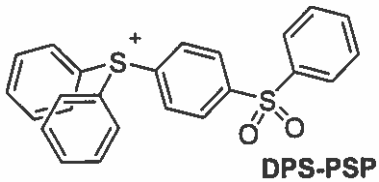


Filename	= O2S-SO2-TF2N_FLUORINE
Author	= Jim Davis
Experiment	= single_pulse.ex2
Sample_id	= O2S-SO2-TF2N
Solvent	= CHLOROFORM-D
Changer_sample	= 4
Creation_time	= 16-JUN-2016 10:51:22
Revision_time	= 16-JUN-2016 10:34:27
Current_time	= 14-OCT-2016 07:36:56
Data_format	= 1D COMPLEX
Dim_size	= 52428
Dim_title	= 19F
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 0.55574528[s]
X_domain	= 19F
X_freq	= 470.62046084[MHz]
X_offset	= -70[ppm]
X_points	= 65536
X_prescans	= 1
X_resolution	= 1.7993855[Hz]
X_sweep	= 117.9245283[kHz]
Irr_domain	= 19F
Irr_freq	= 470.62046084[MHz]
Irr_offset	= 5[ppm]
Tri_domain	= 19F
Tri_freq	= 470.62046084[MHz]
Tri_offset	= 5[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 16
Total_scans	= 16
X_90_width	= 15.7[us]
X_acq_time	= 0.55574528[s]
X_angle	= 45[deg]
X_atn	= 4[dB]
X_pulse	= 7.85[us]
Irr_mode	= Off
Tri_mode	= Off
Dante_presat	= FALSE
Initial_wait	= 1[s]
Recvr_gain	= 46
Relaxation_delay	= 4[s]
Repetition_time	= 4.55574528[s]
Temp_get	= 22.3[dC]

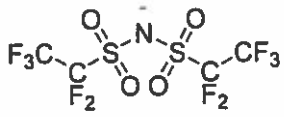
Compound 6

Elemental Analysis

^{1}H-, ^{13}C-, and ^{19}F-NMR Spectra



DPS-PSP



BETI

Atlantic Microlab, Inc.

6180 Atlantic Blvd. Suite M
Norcross, GA 30071
www.atlanticmicrolab.com

Sample No. JD-SULFONIUM-6

Company/School U SOUTH ALABAMA
Dept. CHEMISTRY
Address CHEM BLDG 223
City, State, Zip MOBILE, AL, 36688

Professor/Supervisor: DAVIS
Name JAMES DAVIS Date 10/12/2016
PO# / CC#
Phone (251) 751-0520

Element	Theory	Found	
C	42.91	42.95	
H	2.44	2.44	
N	1.79	1.85	

Single ☒ Duplicate ☐

Elements Present: CHNOSF

Analyze for: CHN

Hygroscopic ☐ Explosive ☐
M.P. UNK B.P. NONE

To be dried: Yes ☒ No ☐
Temp. 100C Vac. HIGH Time 4H

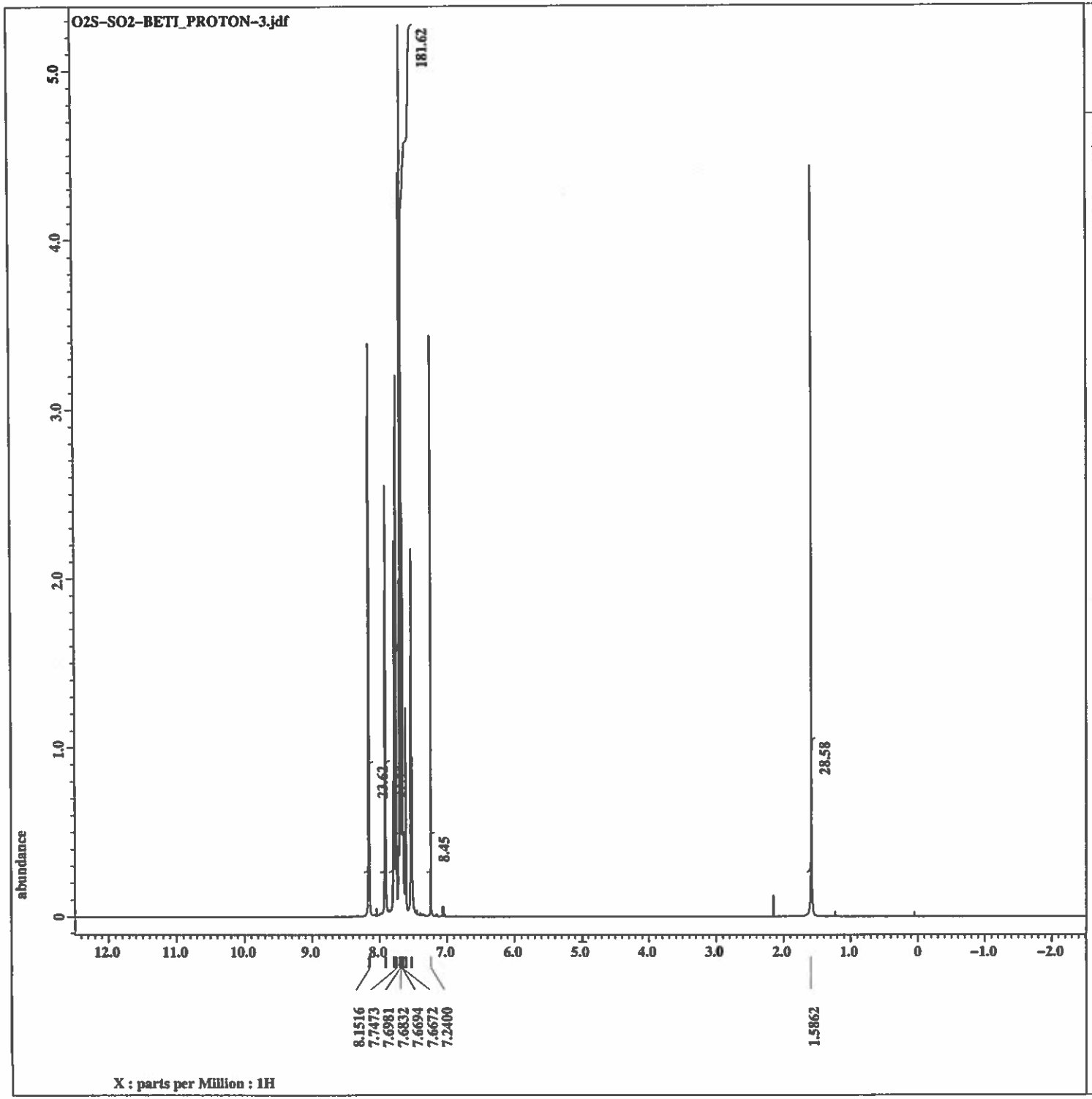
Rush Service ☒ Rush service guarantees analyses will be completed and results available by 5 PM EST on the day the sample is received by 11 AM.

Include Email Address or FAX # Below

jdavis@southalabama.edu

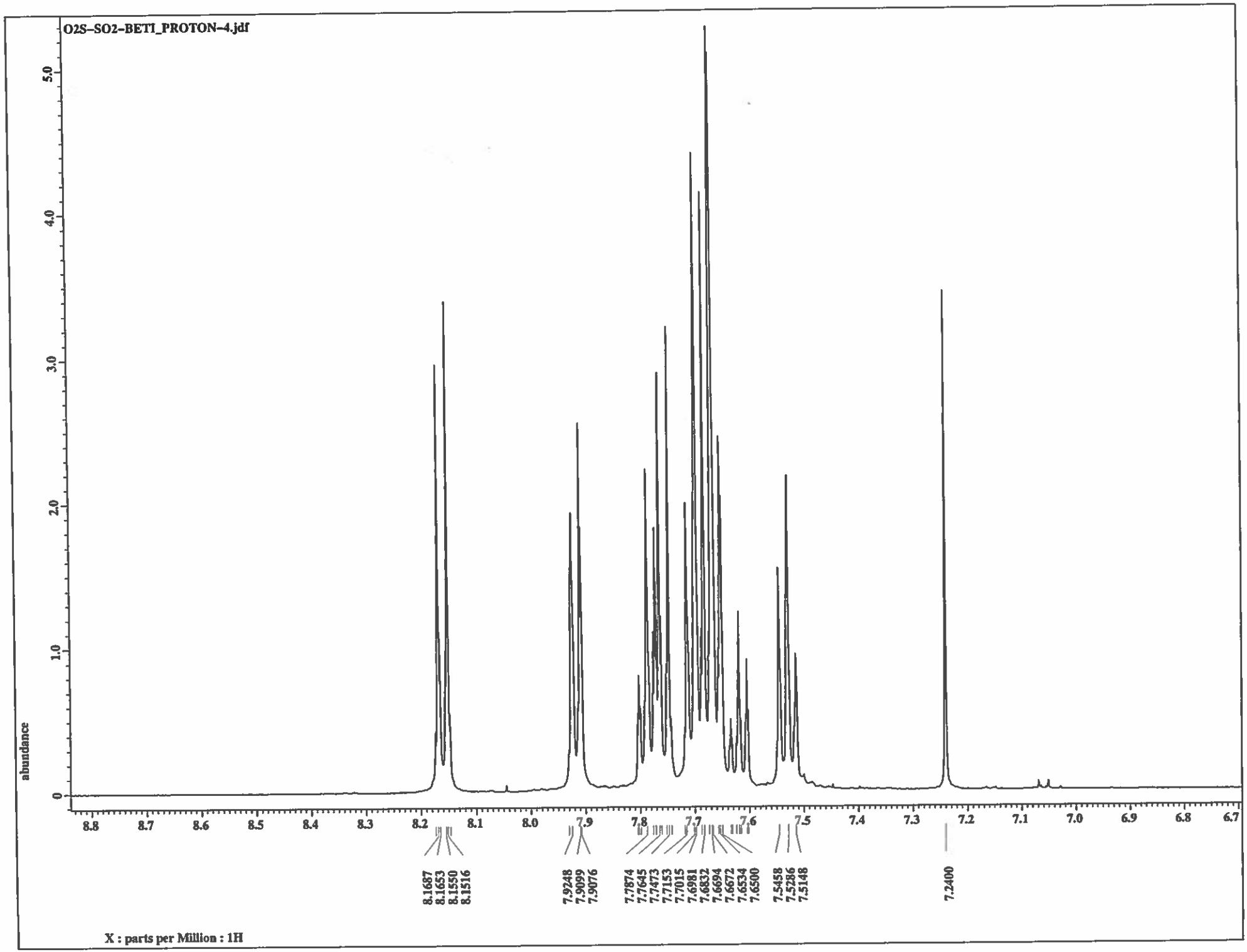
Date Received OCT 14 2016 Date Completed OCT 14 2016

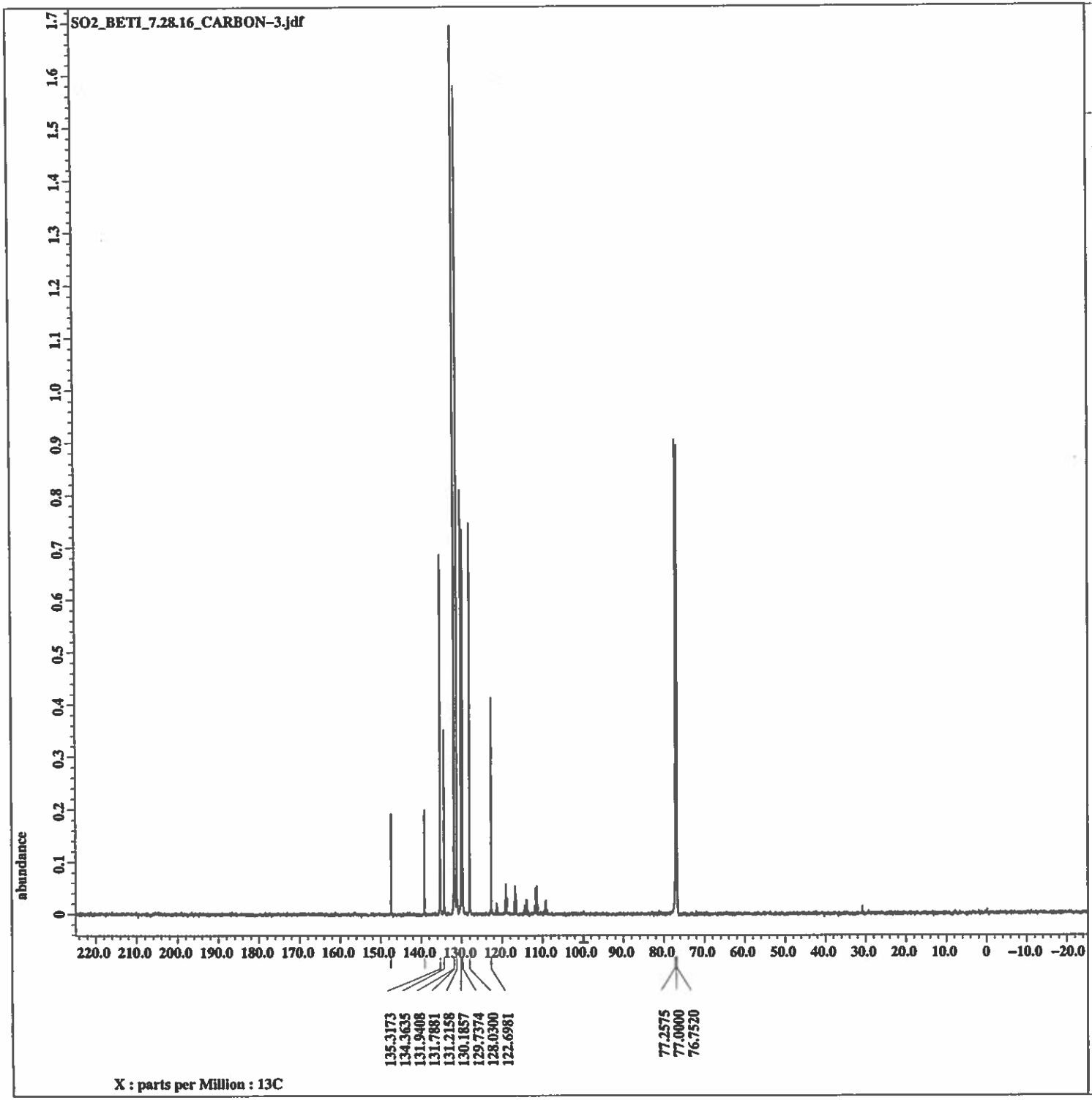
Remarks:



SOUTH ALABAMA JAGUARS

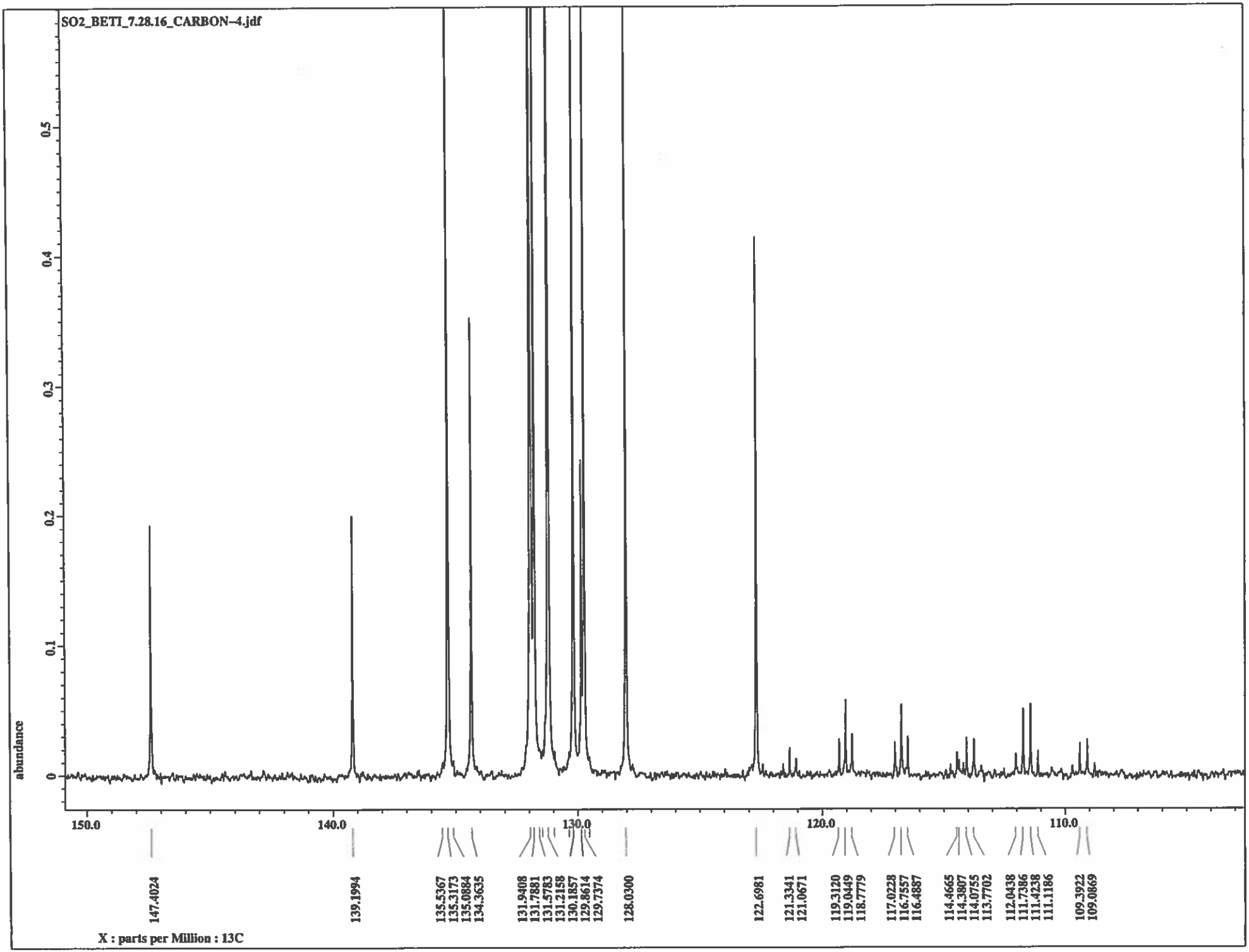
Filename	= O2S-SO2-BETI_PROTON-3
Author	= Jim Davis
Experiment	= single_pulse.ex2
Sample_id	= O2S-SO2-BETI
Solvent	= CHLOROFORM-D
Changer_sample	= 3
Creation_time	= 16-JUN-2016 10:14:38
Revision_time	= 16-JUN-2016 09:57:43
Current_time	= 14-OCT-2016 07:30:18
Data_format	= 1D COMPLEX
Dim_size	= 13107
Dim_title	= 1H
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 1.74587904[s]
X_domain	= 1H
X_freq	= 500.15991521[MHz]
X_offset	= 5.0[ppm]
X_points	= 16384
X_prescans	= 1
X_resolution	= 0.57277737[Hz]
X_sweep	= 9.38438438[kHz]
Irr_domain	= 1H
Irr_freq	= 500.15991521[MHz]
Irr_offset	= 5.0[ppm]
Tri_domain	= 1H
Tri_freq	= 500.15991521[MHz]
Tri_offset	= 5.0[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 16
Total_scans	= 16
X_90_width	= 13.35[us]
X_acq_time	= 1.74587904[s]
X_angle	= 45[deg]
X_atn	= 4[dB]
X_pulse	= 6.675[us]
Irr_mode	= Off
Tri_mode	= Off
Dante_presat	= FALSE
Initial_wait	= 1[s]
Recvr_gain	= 44
Relaxation_delay	= 4[s]
Repetition_time	= 5.74587904[s]
Temp_get	= 22.3[dC]

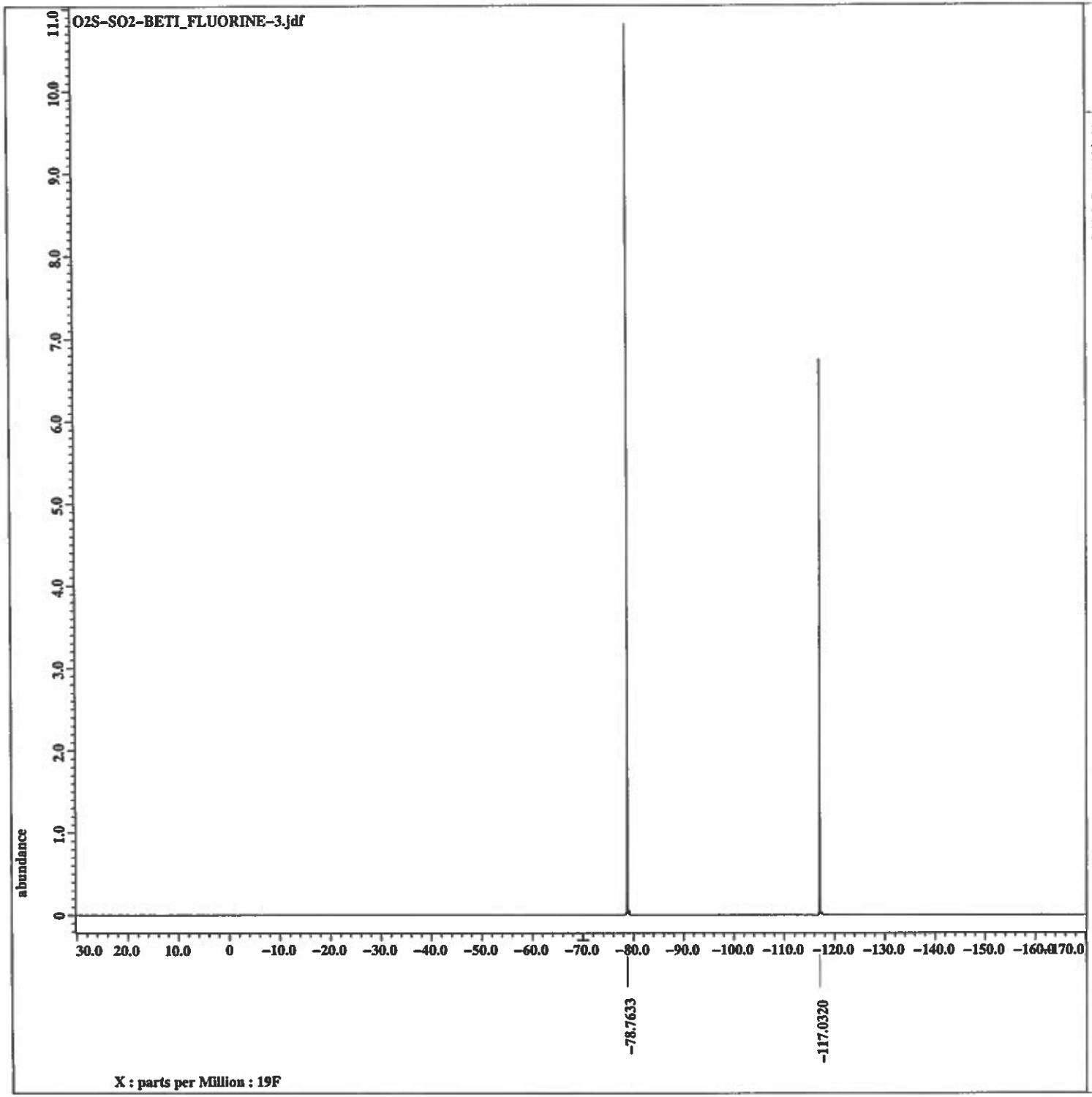

O2S-SO2-BETI_PROTON-4.jdf
abundance
X : parts per Million : 1H
8.1687
8.1653
8.1550
8.1516
7.9248
7.9099
7.9076
7.7874
7.7645
7.7473
7.7153
7.7015
7.6981
7.6832
7.6694
7.6672
7.6534
7.6500
7.5458
7.5286
7.5148
7.2400



SOUTH ALABAMA JAGUARS

Filename	= SO2_BETI_7.28.16_CARB
Author	= Jim Davis
Experiment	= single_pulse_dec
Sample_id	= SO2_BETI_7.28.16
Solvent	= CHLOROFORM-D
Changer_sample	= 16
Creation_time	= 28-JUL-2016 19:10:41
Revision_time	= 28-JUL-2016 18:50:29
Current_time	= 14-OCT-2016 07:32:56
Data_format	= 1D COMPLEX
Dim_size	= 26214
Dim_title	= 13C
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 0.83361792[s]
X_domain	= 13C
X_freq	= 125.76529768[MHz]
X_offset	= 100[ppm]
X_points	= 32768
X_prescans	= 4
X_resolution	= 1.19959034[Hz]
X_sweep	= 39.3081761[kHz]
Irr_domain	= 1H
Irr_freq	= 500.15991521[MHz]
Irr_offset	= 5.0[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 1024
Total_scans	= 1024
X_90_width	= 12.55[us]
X_acq_time	= 0.83361792[s]
X_angle	= 30[deg]
X_atn	= 6[dB]
X_pulse	= 4.18333333[us]
Irr_atn_dec	= 20.5[dB]
Irr_atn_noe	= 20.5[dB]
Irr_noise	= WALTZ
Decoupling	= TRUE
Initial_wait	= 1[s]
Noe	= TRUE
Noe_time	= 2[s]
Recvr_gain	= 60
Relaxation_delay	= 2[s]
Repetition_time	= 2.83361792[s]
Temp_get	= 21.7[dC]


SO2_BETI_7.28.16_CARBON-4.jdf
abundance
0
0.1
0.2
0.3
0.4
0.5
150.0
140.0
130.0
120.0
110.0
147.4024
139.1994
135.5367
135.3173
135.0884
134.3635
131.9408
131.7881
131.5783
131.2158
130.1857
129.8614
129.7374
128.0300
122.6981
121.3341
121.0671
119.3120
119.0449
118.7779
117.0228
116.7557
116.4887
114.4665
114.3807
114.0755
113.7702
112.0438
111.7386
111.4238
111.1186
109.3922
109.0869
X : parts per Million : 13C



Filename	= O2S-SO2-BETI_FLUORINE
Author	= Jim Davis
Experiment	= single_pulse.ex2
Sample_id	= O2S-SO2-BETI
Solvent	= CHLOROFORM-D
Changer_sample	= 3
Creation_time	= 16-JUN-2016 10:45:16
Revision_time	= 16-JUN-2016 10:28:22
Current_time	= 14-OCT-2016 07:29:13
Data_format	= 1D COMPLEX
Dim_size	= 52428
Dim_title	= 19F
Dim_units	= [ppm]
Dimensions	= X
Site	= ECA 500
Spectrometer	= JNM-ECA500
Field_strength	= 11.7473579[T] (500[MH
X_acq_duration	= 0.55574528[s]
X_domain	= 19F
X_freq	= 470.62046084[MHz]
X_offset	= -70[ppm]
X_points	= 65536
X_prescans	= 1
X_resolution	= 1.7993855[Hz]
X_sweep	= 117.9245283[kHz]
Irr_domain	= 19F
Irr_freq	= 470.62046084[MHz]
Irr_offset	= 5[ppm]
Tri_domain	= 19F
Tri_freq	= 470.62046084[MHz]
Tri_offset	= 5[ppm]
Clipped	= FALSE
Mod_return	= 1
Scans	= 16
Total_scans	= 16
X_90_width	= 15.7[us]
X_acq_time	= 0.55574528[s]
X_angle	= 45[deg]
X_atn	= 4[dB]
X_pulse	= 7.85[us]
Irr_mode	= Off
Tri_mode	= Off
Dante_presat	= FALSE
Initial_wait	= 1[s]
Recvr_gain	= 46
Relaxation_delay	= 4[s]
Repetition_time	= 4.55574528[s]
Temp_get	= 22.3[dC]

Compiled NMR Data

*Compound **1** (TPS Tf_2N)*:

^{1}H ($CDCl_3$, 500 MHz): δ 7.35-7.79 (m, 3H), 7.66-7.72 (m, 6H), and 7.60-7.65 (m, 6H) ppm.

^{13}C ($CDCl_3$, 125 MHz): δ 134.86, 131.76, 130.90, 123.98, 123.69, 121.14, 118.58 and 116.02 ppm.

^{19}F ($CDCl_3$, 470 MHz): δ -78.62 ppm.

*Compound **2** (TPS BETI)*:

^{1}H ($CDCl_3$, 500 MHz): δ 7.74-7.78 (m, 3H), 7.66-7.72 (m, 6H), and 7.60-7.64 (m, 6H) ppm.

^{13}C ($CDCl_3$, 125 MHz): δ 134.97, 131.75, 130.88, 123.89, 119.46, 119.20, 118.93, 117.17, 116.91, 116.64, 114.19, 113.88, 111.85, 111.55, 109.51, and 109.21 ppm.

^{19}F ($CDCl_3$, 470 MHz): δ -78.77 and -116.98 ppm.

*Compound **3** (DPS-POP Tf_2N)*:

^{1}H ($CDCl_3$, 500 MHz): δ 7.73-7.79 (m, 2H), 7.67-7.73 (m, 4H), 7.60-7.65 (m, 6H), 7.40-7.44 (tt, 2H), 7.23-7.28 (m, 1H), 7.16-7.21 (m, 2H), and 7.07-7.11 (m, 2H) ppm.

^{13}C ($CDCl_3$, 125 MHz): δ 163.68, 153.75, 134.56, 133.36, 131.61, 130.45, 130.36, 125.80, 124.53, 123.63, 121.08, 120.62, 119.59, 118.52, 115.96, and 114.67 ppm.

^{19}F ($CDCl_3$, 470 MHz): δ - 78.59 ppm.

*Compound **4** (DPS-POP BETI)*:

^{1}H ($CDCl_3$, 500 MHz): δ 7.73-7.79 (m, 2H), 7.67-7.73 (m, 4H), 7.60-7.66 (m, 6H), 7.40-7.45 (tt, 2H), 7.23-7.28 (m, 1H), 7.16-7.20 (m, 2H), and 7.07-7.11 (m, 2H) ppm.

^{13}C ($CDCl_3$, 125 MHz): δ 163.74, 153.78, 134.57, 133.38, 131.62, 130.45, 130.37, 125.82, 124.57, 120.64, 121.70, 121.45, 121.20, 119.79, 119.59, 119.43, 119.16, 118.89, 117.13, 116.87, 116.60, 114.80, 114.69, 114.40, 114.13, 113.83, 112.10, 111.80, 111.49, 111.18, 109.80, 109.46, and 109.45 ppm.

^{19}F ($CDCl_3$, 470 MHz): δ -78.73 and -116.96 ppm.

*Compound **5** (DPS-PSP Tf_2N)*:

^{1}H ($CDCl_3$, 500 MHz): δ 8.14-8.18 (dd, 2H), 7.88-7.92 (dd, 2H), 7.74-7.80 (m, 4H), 7.64-7.72 (m, 8H), 7.58-7.63 (m, 1H), and 7.50-7.55 (m, 2H) ppm.

^{13}C ($CDCl_3$, 125 MHz): δ 147.51, 139.21, 135.37, 134.42, 132.02, 131.75, 131.35, 130.25, 129.89, 129.80, 128.14, 123.20, 122.84, 121.03, 118.47, and 115.92 ppm.

^{19}F ($CDCl_3$, 470 MHz): δ -78.64 ppm.

*Compound **6** (DPS-PSP BETI)*:

^{1}H ($CDCl_3$, 500 MHz): δ 8.14-8.19 (dd, 2H), 7.88-7.92 (dd, 2H), 7.74-7.82 (m, 4H), 7.64-7.72 (m, 8H), 7.58-7.63 (m, 1H), and 7.49-7.54 (m, 2H) ppm.

^{13}C ($CDCl_3$, 125 MHz): δ 147.40, 139.20, 135.20, 134.36, 131.94, 131.79, 131.22, 130.19, 129.86, 129.74, 128.03, 122.70, 121.60, 121.33, 121.07, 119.31, 119.05, 118.78, 117.02, 116.75, 116.49, 114.47, 114.20, 113.77, 112.04, 11.74, 111.42, 111.12, 109.39, and 109.09 ppm.

^{19}F ($CDCl_3$, 470 MHz): δ -78.74 and -117.01 ppm.