

Synthesis of Unsymmetrical Phosphorus Disulfides

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1. General information

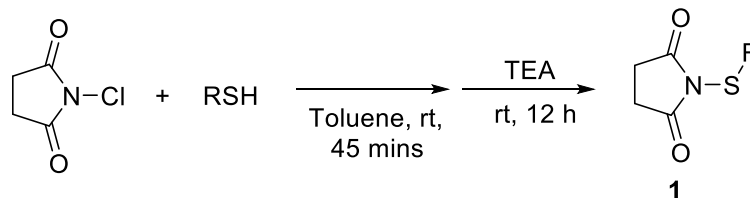
All reactions were carried out under air atmosphere in oven-dried glassware with magnetic stirring bar. Dry solvents (THF, toluene, ACN, diethyl ether, and DCM) were obtained by solvent purification system under argon. All commercially available reagents were used as received without further purification. The tubes used for the reaction were showed in **Figure S1**. Purification of reaction products was carried out by flash column chromatography using silica gel 60 (230-400 mesh). Analytical thin layer chromatography was performed on 0.25 mm aluminum-backed silica gel 60-F plates. Visualization was accompanied with UV light and KMnO₄ solution. Concentration under reduced pressure refers to the removal of volatiles using a rotary evaporator attached to a dry diaphragm pump (10-15 mm Hg) followed by pumping to a constant weight with an oil pump (<300 mTorr). Infrared (IR) spectra were recorded on an IR spectrometer with KBr wafers or a film on KBr plate. High-resolution mass spectra (HRMS) were recorded on LCMS-IT-TOF mass spectrometer using ESI (electrospray ionization) or APCI (Atmospheric Pressure Chemical Ionization). ¹H NMR spectra were recorded in CDCl₃ on 400 MHz NMR spectrometer. The ¹H chemical shifts are referenced to residual solvent signals at δ 7.26 (CHCl₃) or δ 0.00 (TMS). ¹H NMR coupling constants (*J*) are reported in Hertz (Hz) and multiplicities are indicated as follows: s (singlet), bs (broad singlet), d (doublet), t (triplet), q (quartet), m (multiplet), dd (doublet of doublets), dt (doublet of triplets), td (triplet of doublets), tt (triplet of triplets). ¹³C NMR spectra were proton decoupled and recorded in CDCl₃ on 100.5 MHz NMR spectrometer. The ¹³C chemical shifts are referenced to solvent signals at δ 77.16 (CDCl₃). ³¹P NMR spectra were proton decoupled and recorded in CDCl₃ on 162 MHz NMR spectrometer. ³¹P chemical shifts are reported relative to 85% H₃PO₄ (0.00 ppm) as an external standard.



Figure S1. Pictorial description of reaction tubes for the reaction.

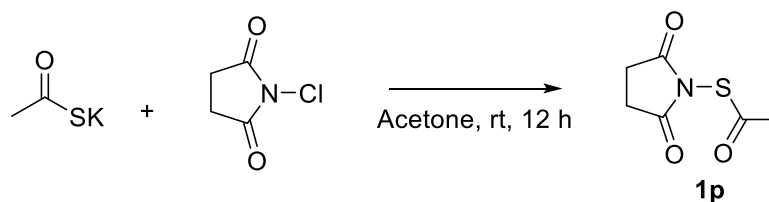
2. General experimental procedure

2.1. General procedure for the synthesis of thiosuccinimide 1



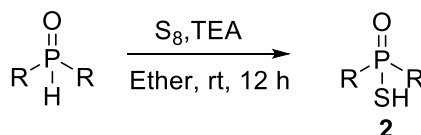
To a solution of thiol (1.0 mmol) in toluene (3.0 mL) was added N-chlorosuccinimide (1.0 mmol) portionwise and was stirred for 45 minutes at room temperature. After 45 min stirring, triethyl amine (1.0 mmol) was added dropwise, and the reaction mixture was stirred for 12 hours. The residue was concentrated under reduced pressure and subjected to column chromatography on silica gel to give the corresponding thiosuccinimides **1**.

2.2. General procedure for the synthesis of acyl thiosuccinimide 1p



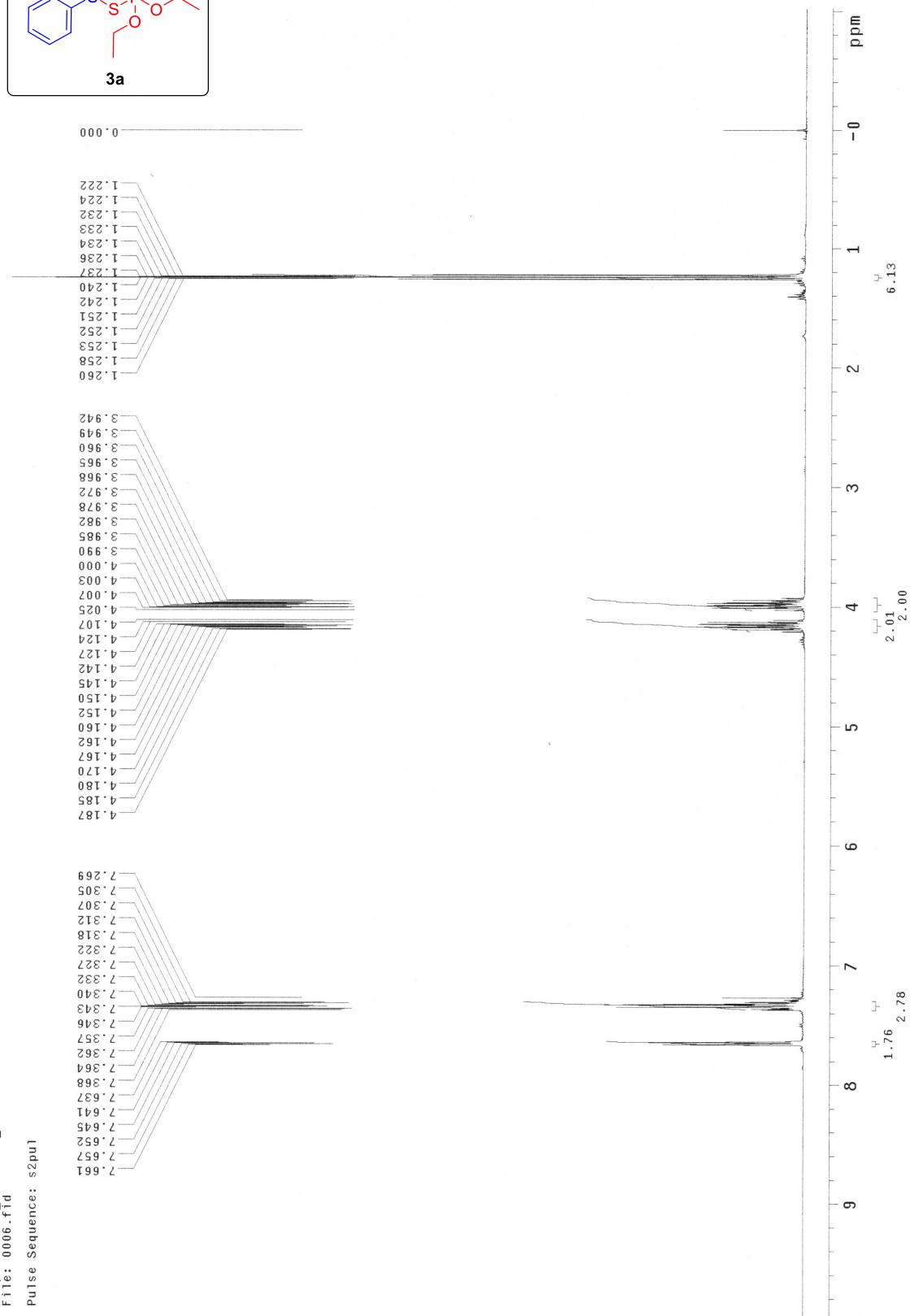
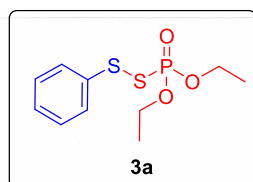
To a solution of potassium thiolate (5.0 mmol) in acetone (25.0 mL) was added N-chlorosuccinimide (5.0 mmol) at room temperature. The reaction mixture was stirred for 12 hours. After stirring for 12 hours at room temperature, the reaction mixture was concentrated under reduced pressure and subjected to column chromatography on silica gel to give the corresponding acyl thio succinimide **1p**.

2.3. General procedure for the synthesis of thiophosphoric acid 2

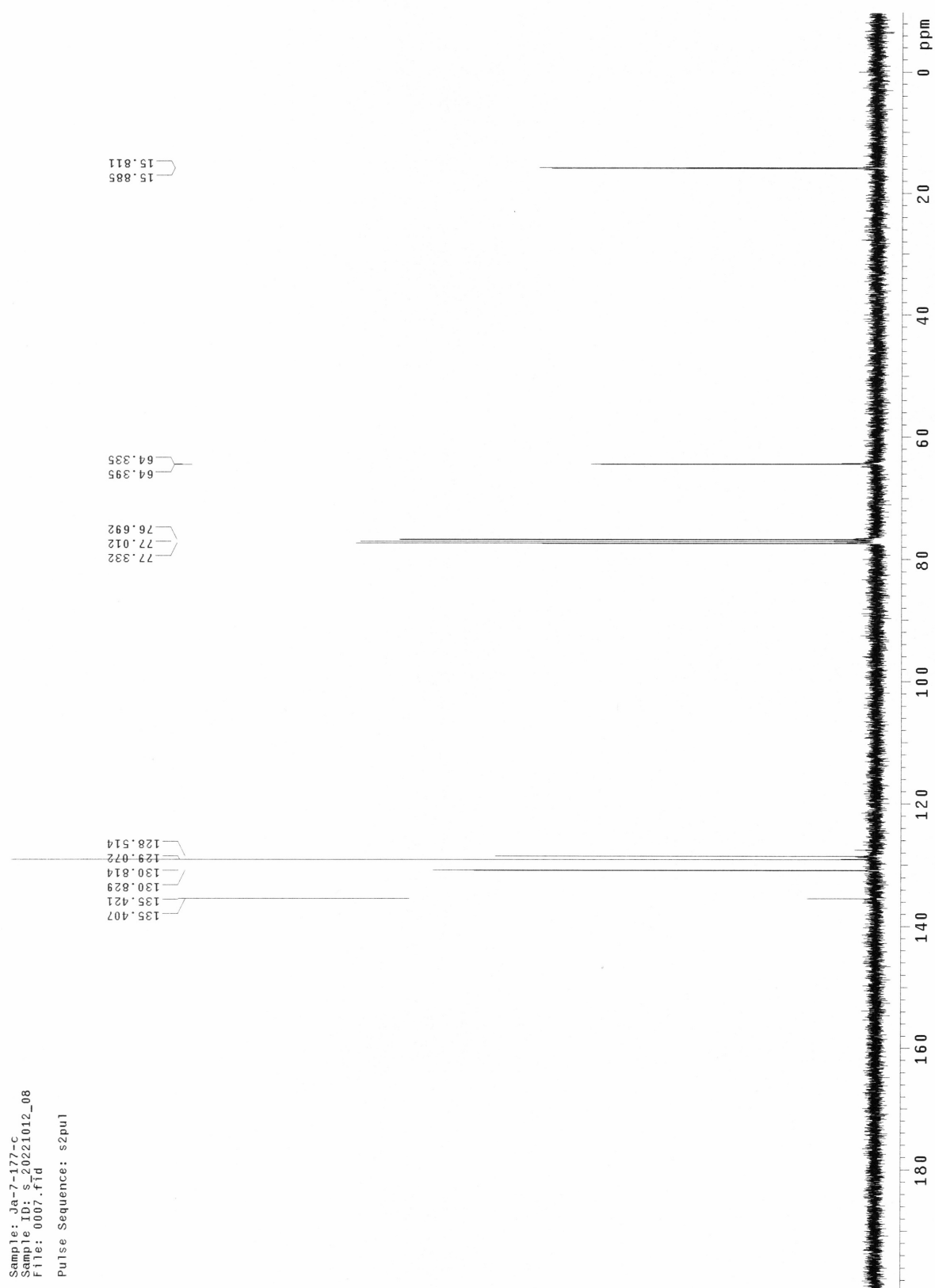


To a solution of H-phosphonate (1.0 mmol) in ether (5.0 mL) was added triethylamine (1.1 mmol), followed by elemental sulfur (1.05 mmol). The reaction was stirred for 12 hours and then washed with 1M HCl (3 X 5.0 mL), followed by washing with brine. The organic extract was dried over sodium sulfate, filtered, and concentrated under reduced pressure to give compound **2**.

3. ¹H, ¹³C, and ³¹P NMR spectra

¹H NMR (400 MHz) in CDCl₃

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Sample ID: s_20221012_07
File: 0006.fid
Pulse Sequence: s2pul

^{13}C NMR (100.5 MHz) in CDCl_3 

^{31}P NMR (162 MHz) in CDCl_3

Sample: Ja-9-177-p
File: exp

Pulse Sequence: s2pul

Solvent: CDCl_3
Temp: 25.0 C / 298.1 K
Operator: Jykang
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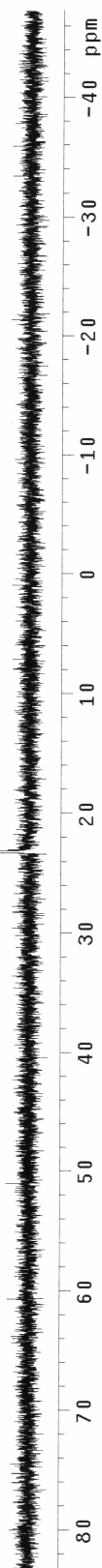
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10 repetitions

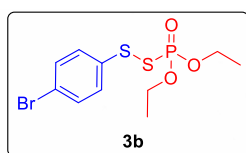
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WALTZ-16 modulated

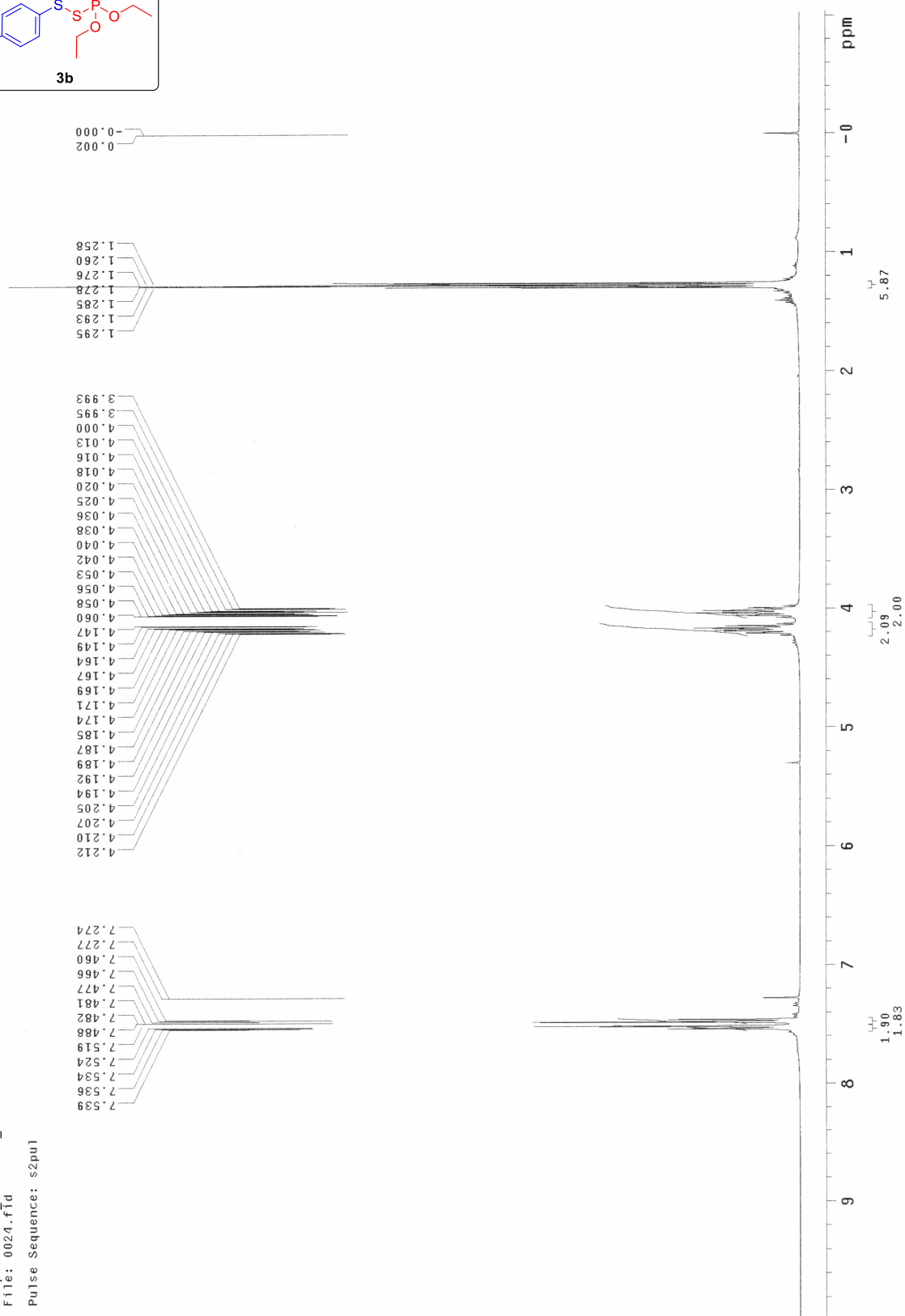
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Total time 0 min, 26 sec

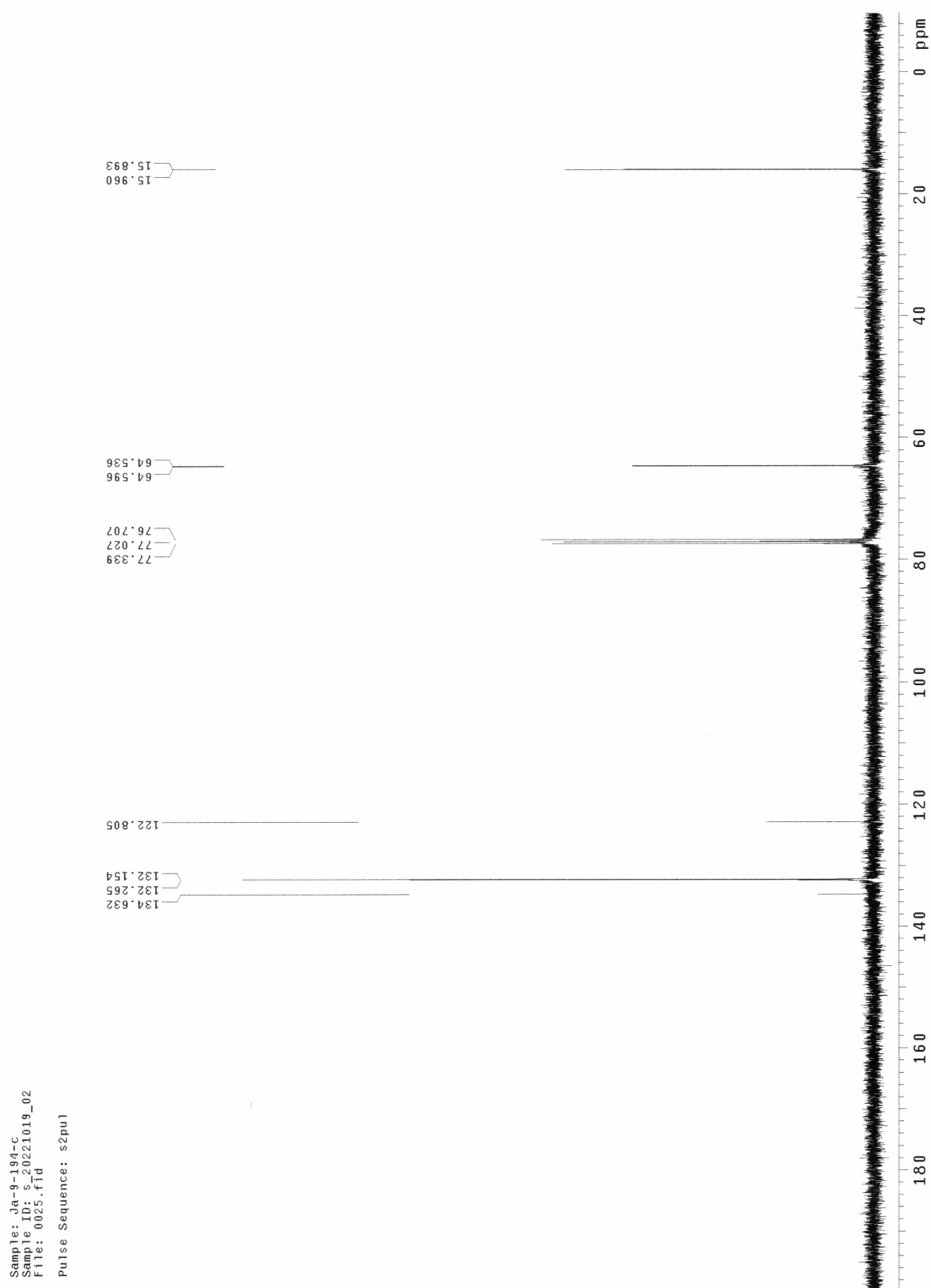
23.156



^1H NMR (400 MHz) in CDCl_3 

Sample: ja-g-194-c
Sample ID: s_20221019_01
File: 0024.f1d
Pulse Sequence: s2pu1



^{13}C NMR (100.5 MHz) in CDCl_3 

^{31}P NMR (162 MHz) in CDCl_3

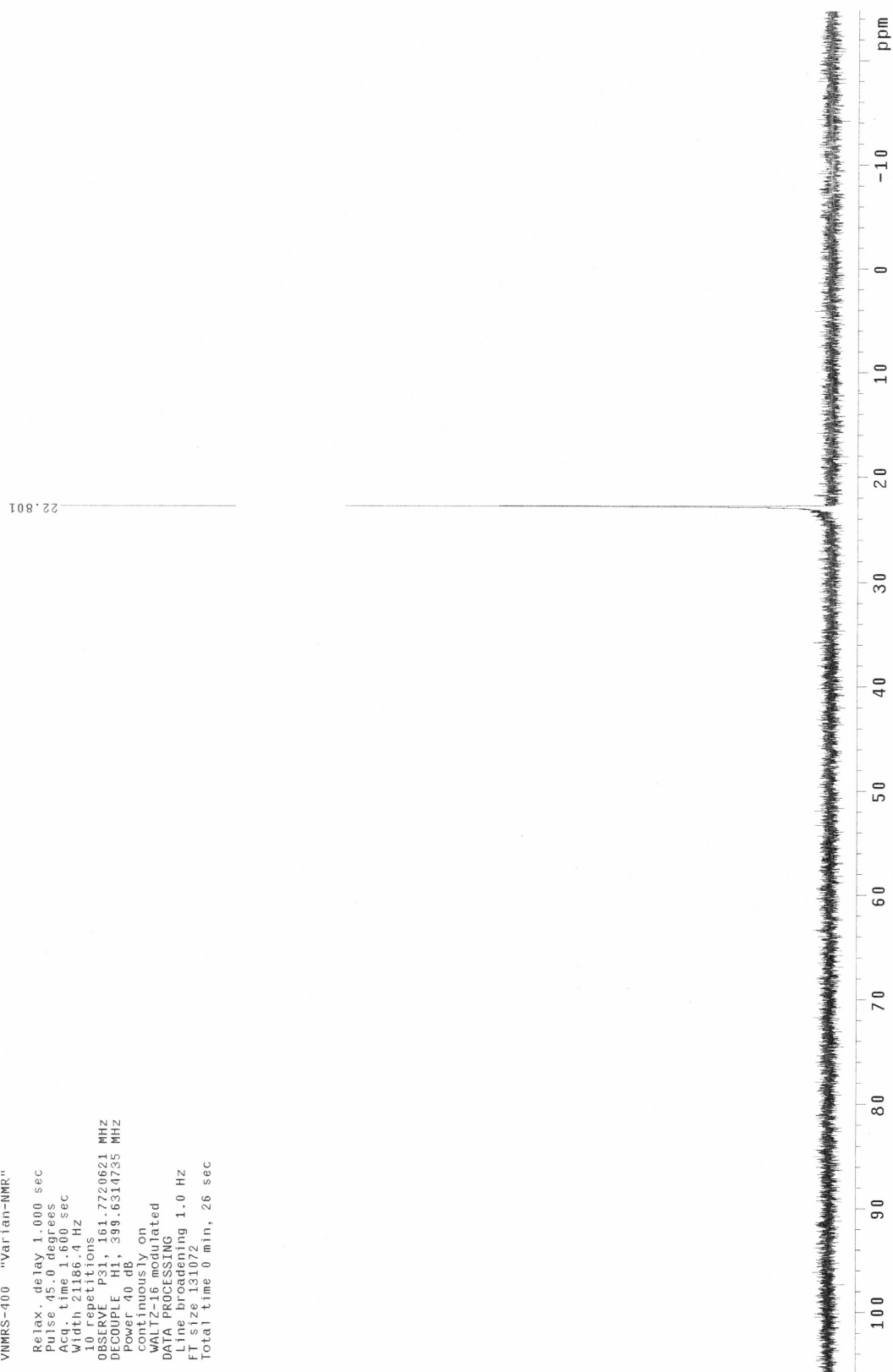
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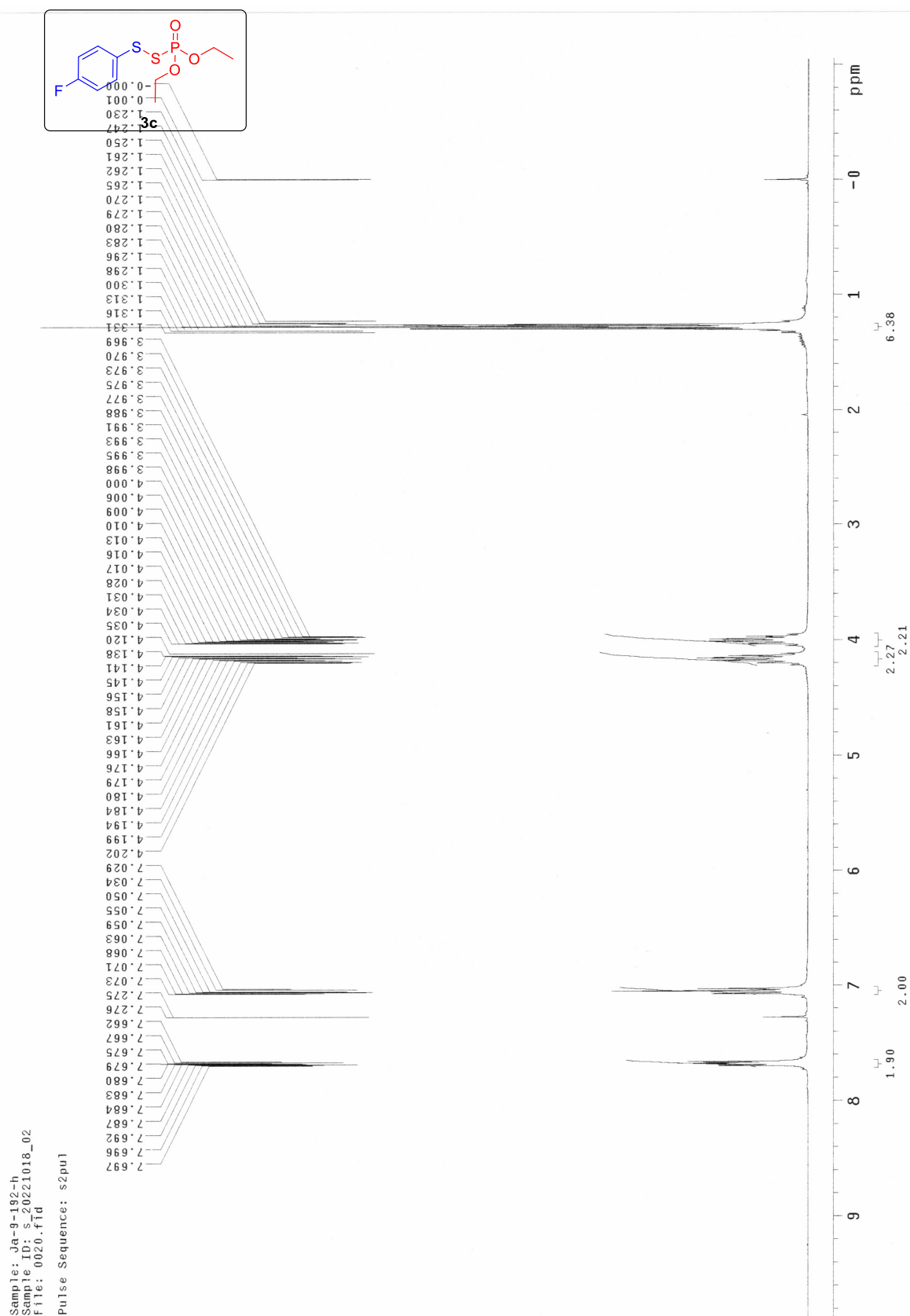
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Solvent: cdcl_3
Temp: 25.0 C / 298.1 K
Operator: JyKang
VNMR-400 "Varian-NMR"

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Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21166.4 Hz

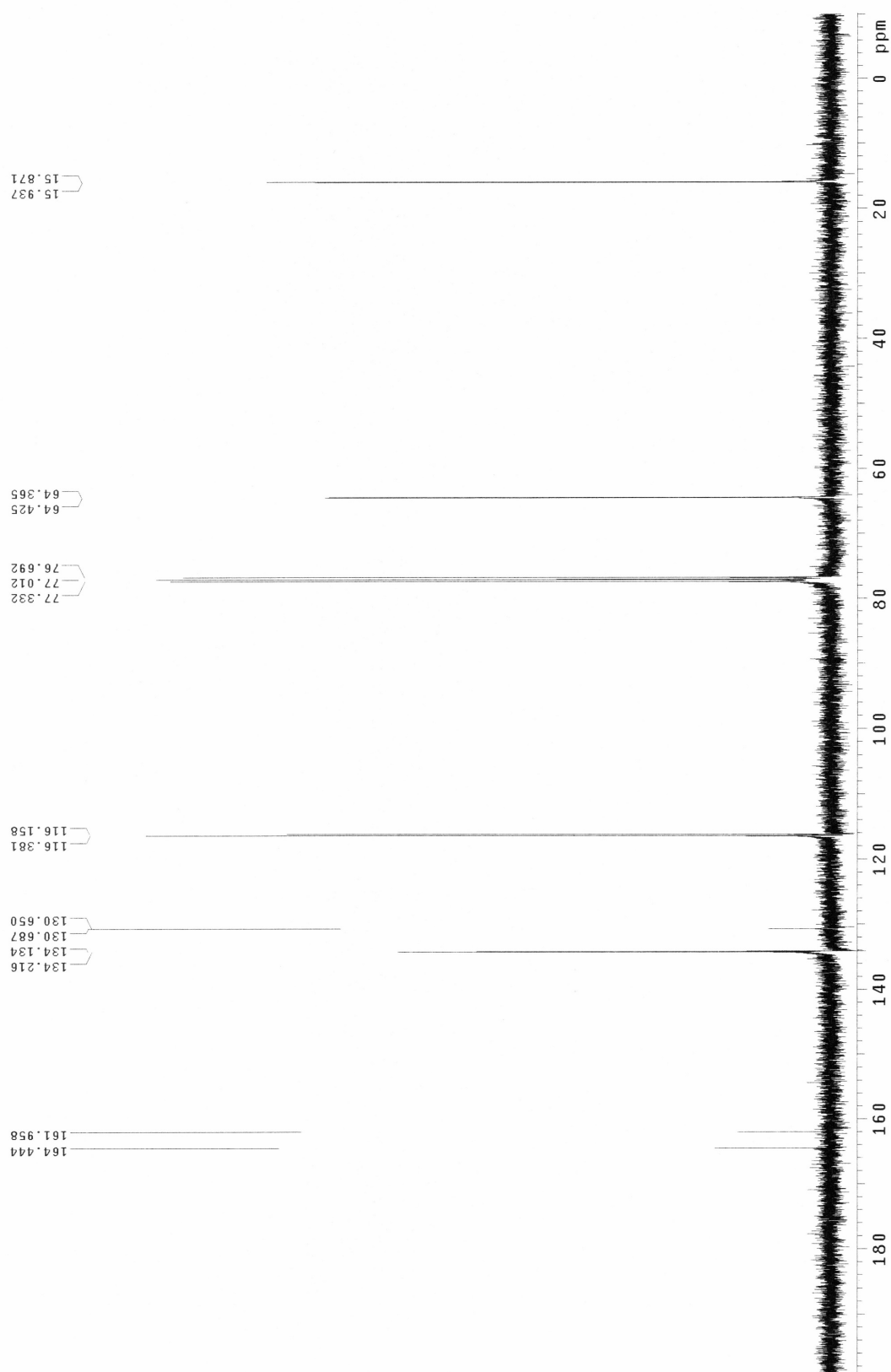
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DECOUPLE H1, 399.6314735 MHz
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continuously on
WALTZ-16 modulated
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Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec



¹H NMR (400 MHz) in CDCl₃

^{13}C NMR (100.5 MHz) in CDCl_3

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Sample ID: s_20221018_03
File: 0021.ftd
Pulse Sequence: s2pul



^{31}P NMR (162 MHz) in CDCl_3

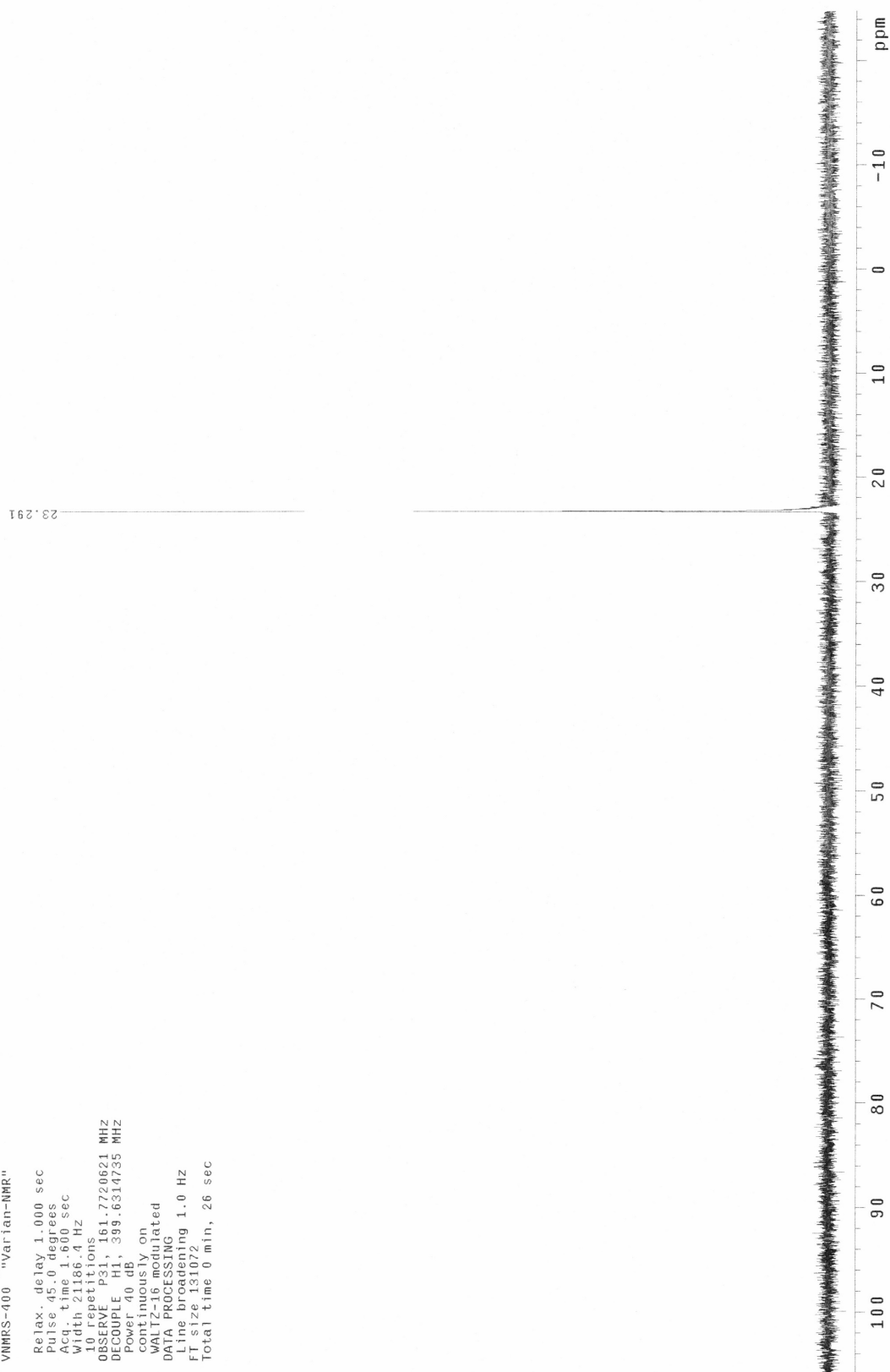
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File: exp

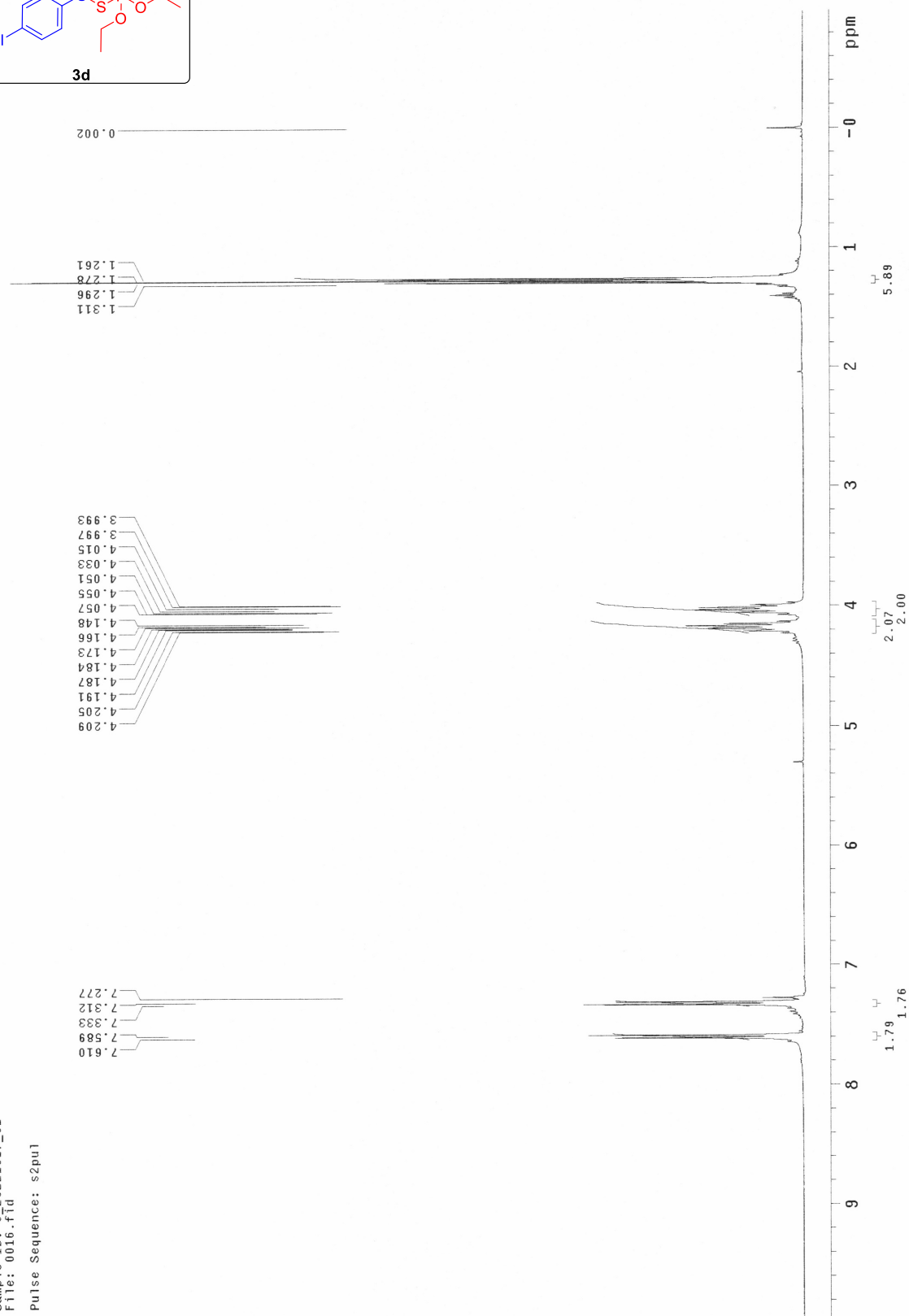
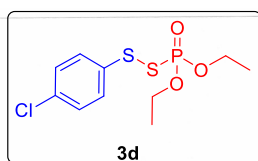
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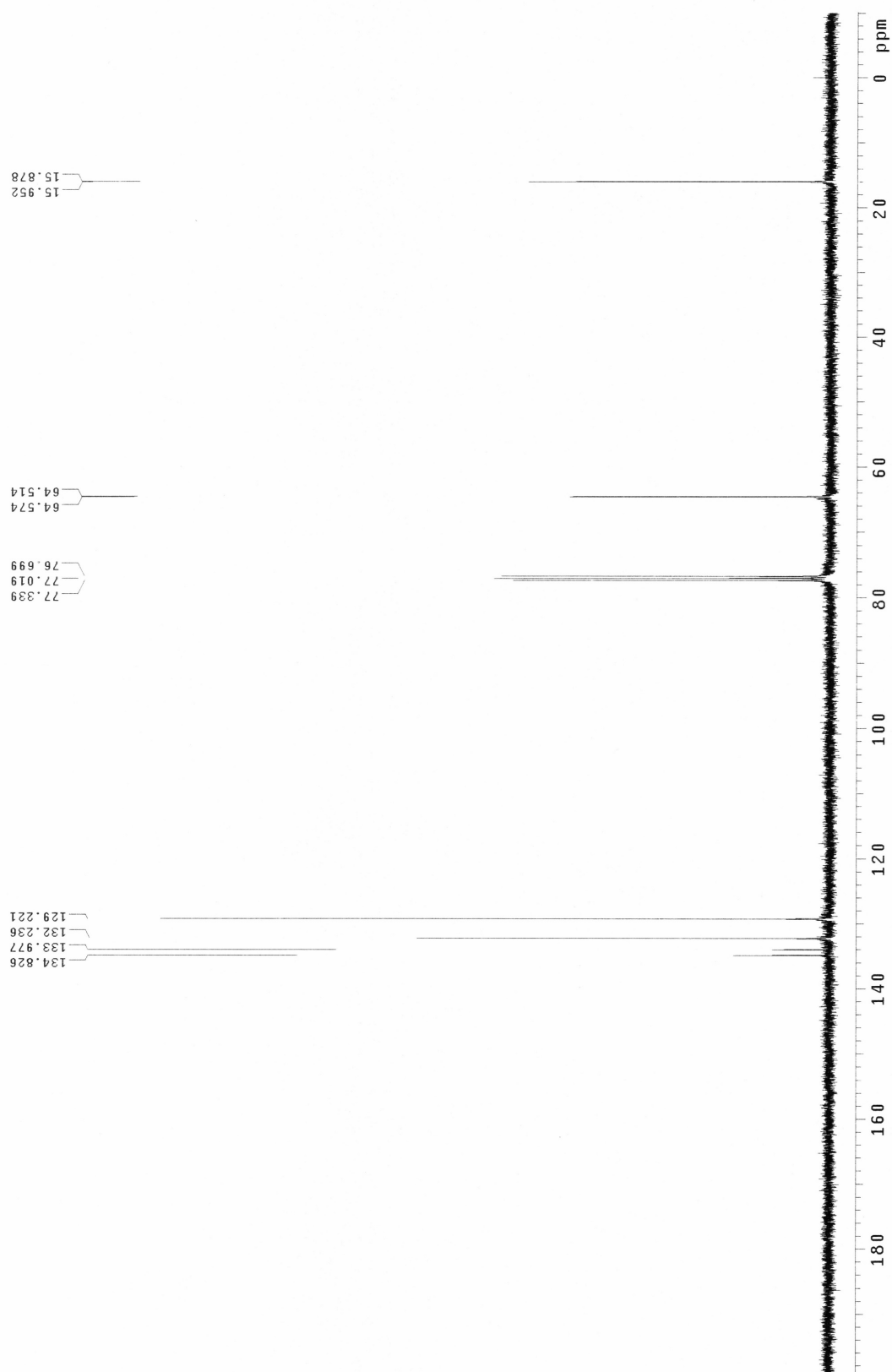
Solvent: cdcl_3
Temp. 25.0 C / 298.1 K
Operator: JyKang
VNMR-400 "Varian-NMR"

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Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz

10 repetitions
OBSERVE P31, 161.7720621 MHz
DECOUPLE H1, 399.6314735 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec



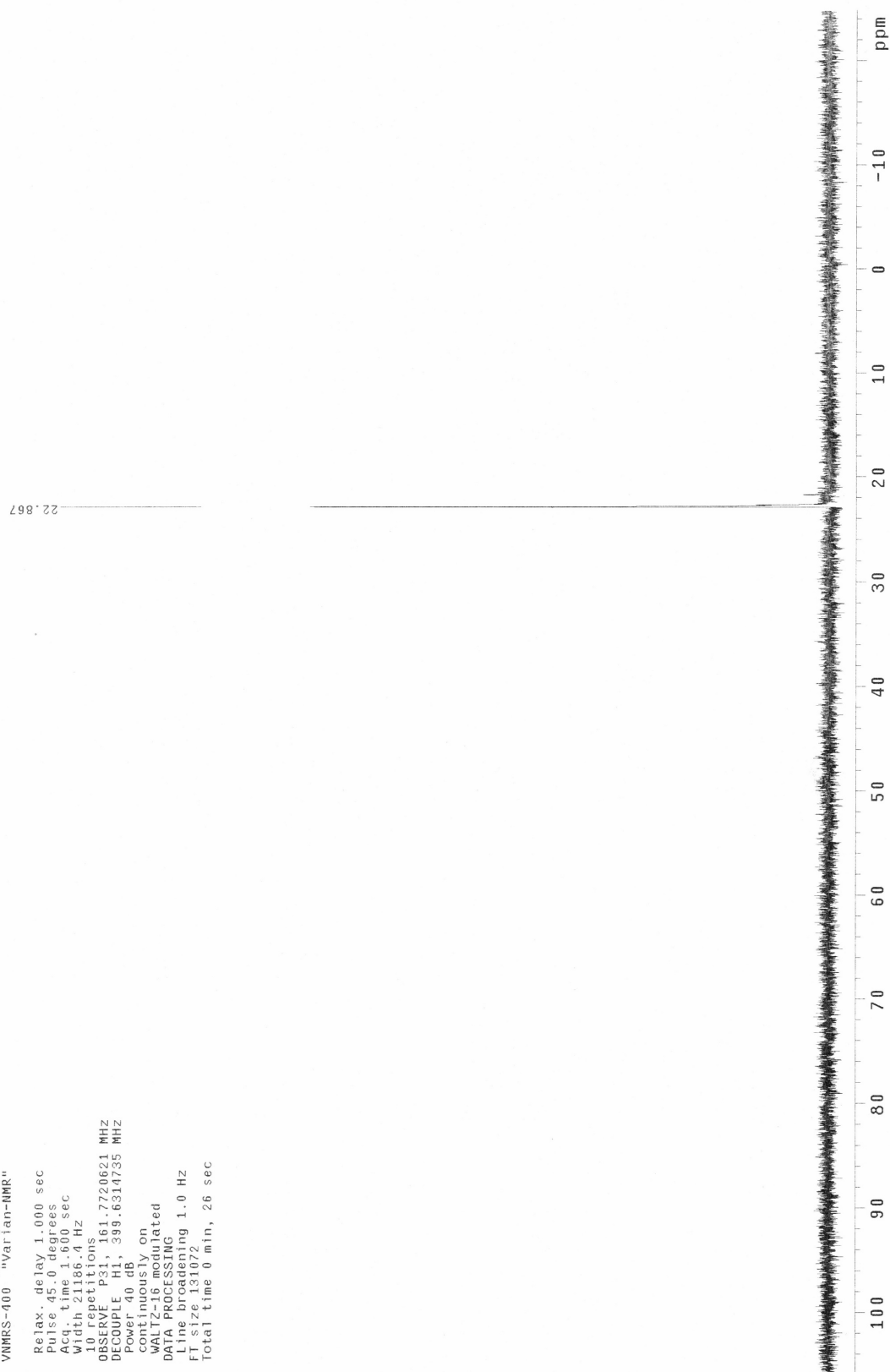
¹H NMR (400 MHz) in CDCl₃

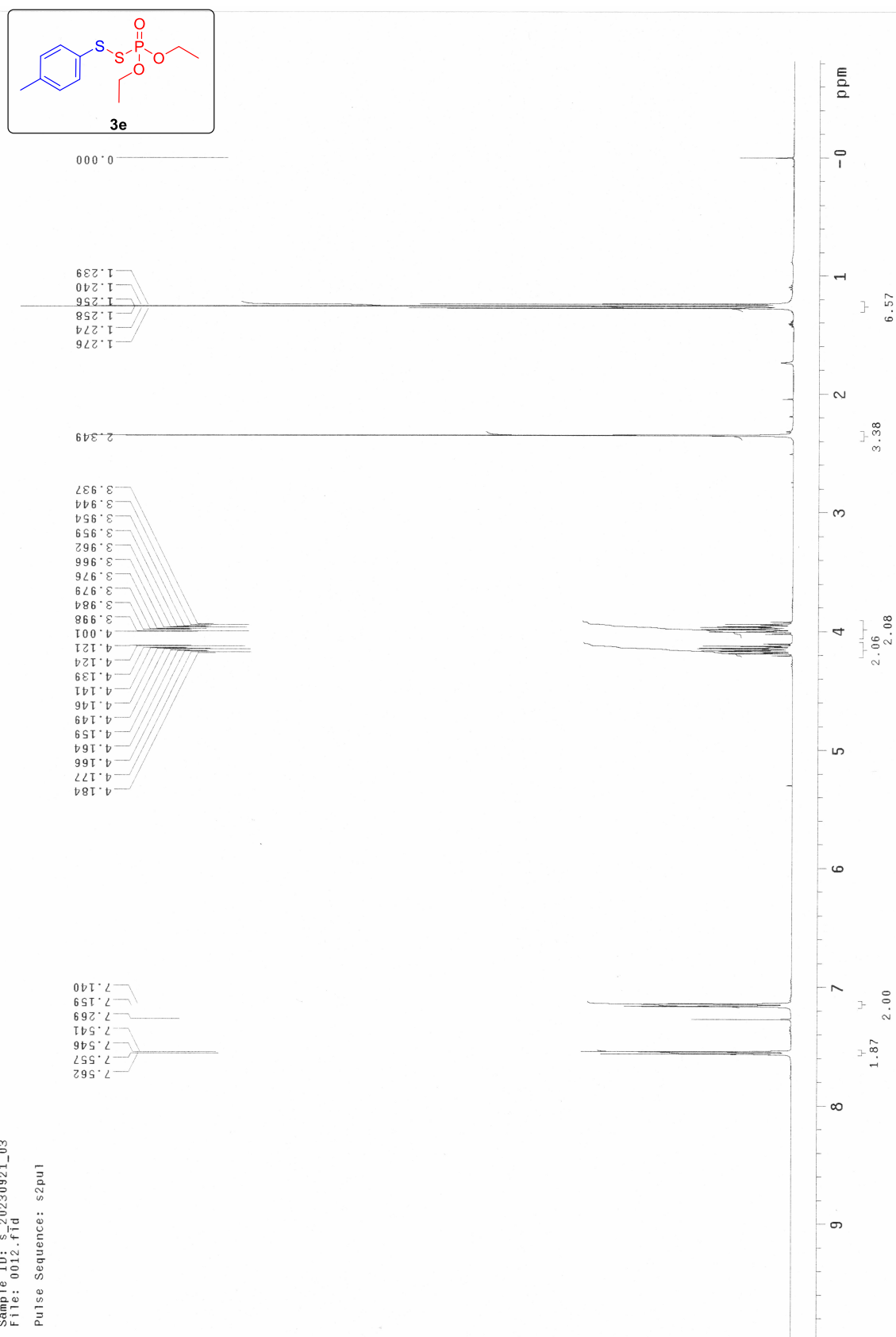
^{13}C NMR (100.5 MHz) in CDCl_3 

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Sample ID: s_20221017_02
File: 0017.fid
Pulse Sequence: szpu1

^{31}P NMR (162 MHz) in CDCl_3

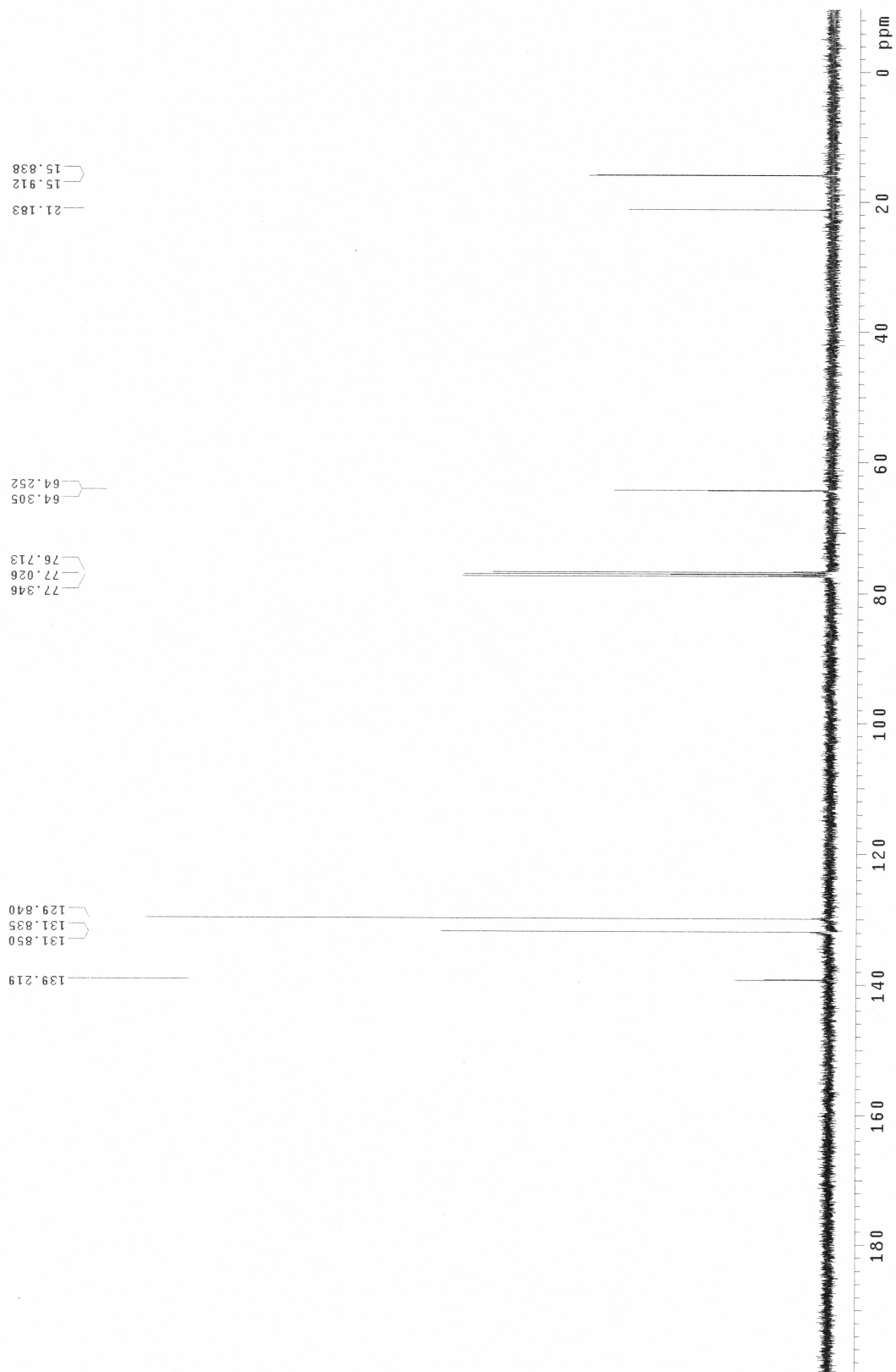
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Pulse Sequence: s2pul
Solvent: cdcl3
Temp: 25.0 C / 298.1 K
Operator: Jykang
VNMR-400 "Varian-NMR"
Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
10 repetitions
OBSERVE P31, 161.7720621 MHz
DECOUPLE H1, 399.6314735 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec



¹H NMR (400 MHz) in CDCl₃

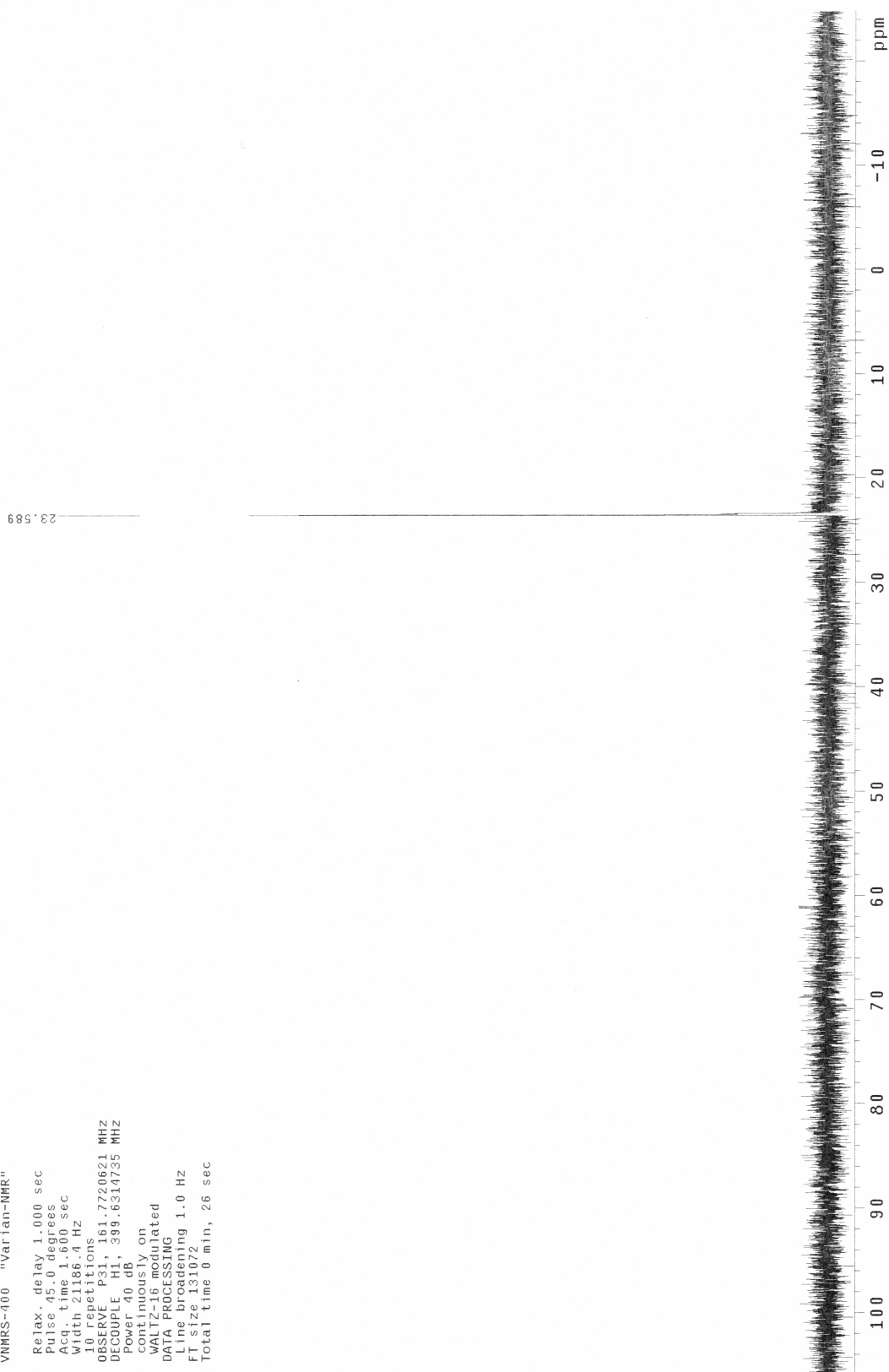
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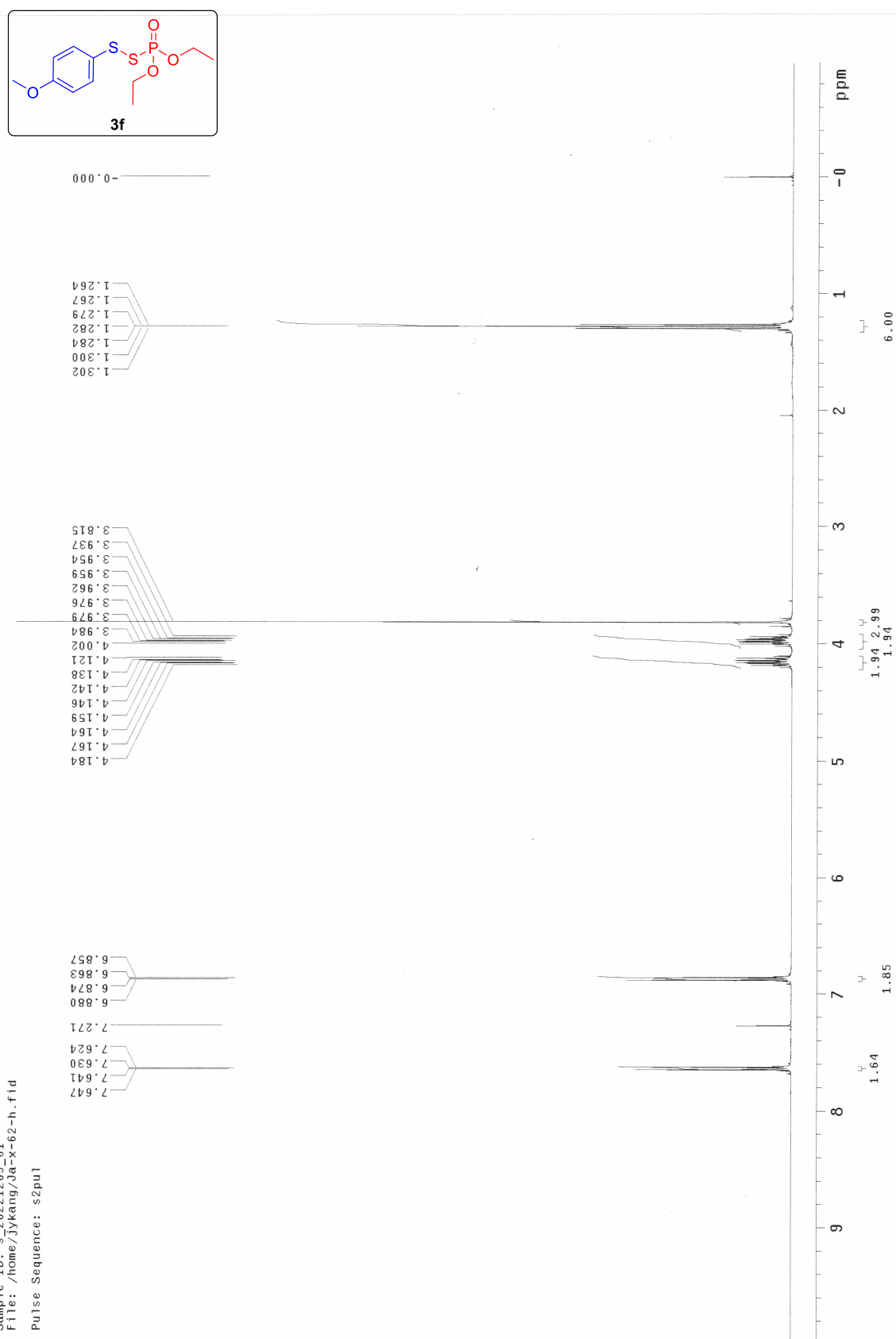
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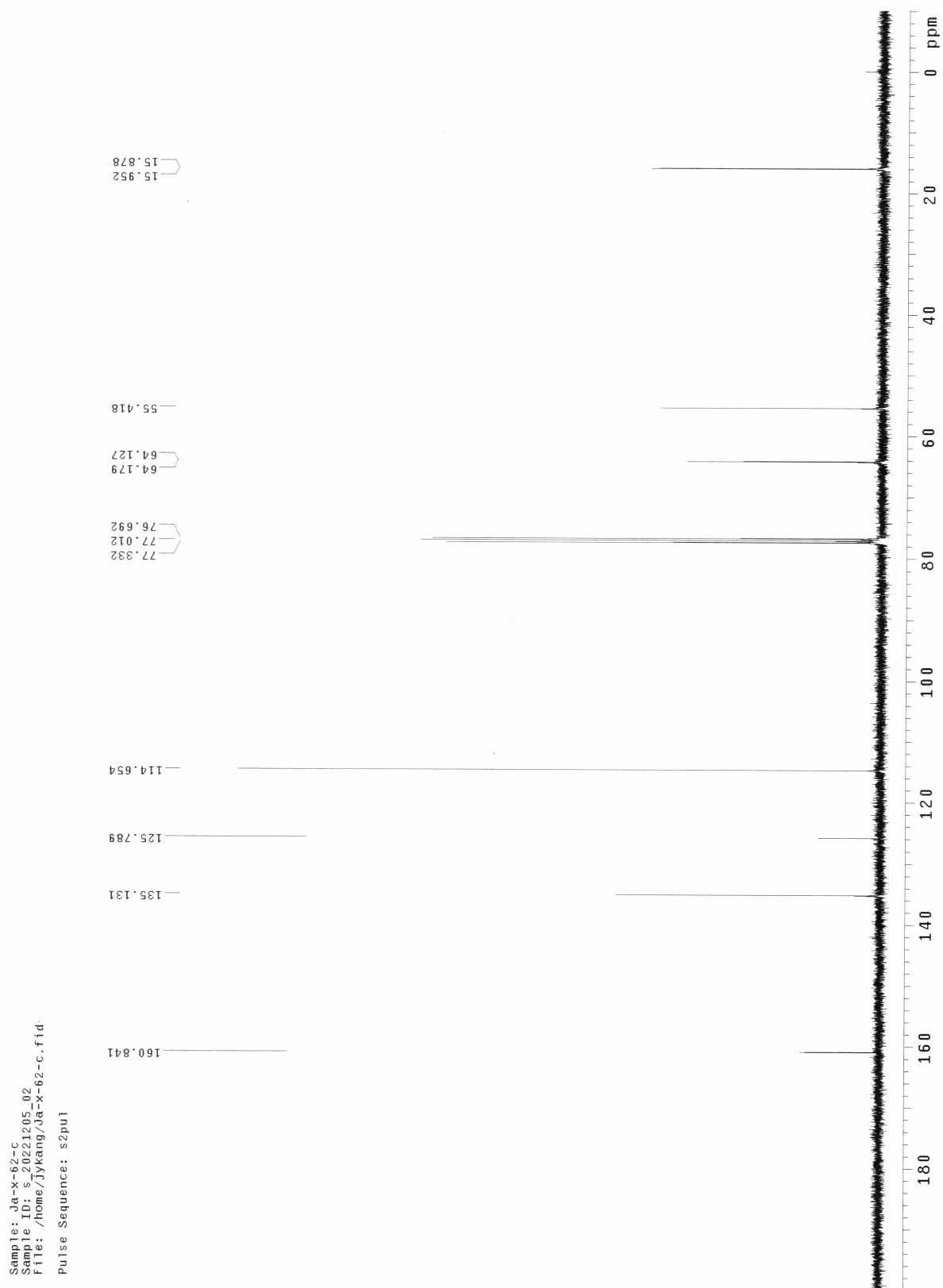


^{31}P NMR (162 MHz) in CDCl_3

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Pulse Sequence: s2pul
Solvent: cdcl3
Temp: 25.0 C, 298.1 K
Operator: J/Kang
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Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
10 repetitions
OBSERVE P31, 161.7720621 MHz
DECOUPLE H1, 399.6314735 MHz
Power 40 dB
continuously on
Z-axis modulated
DATA PROCESSING
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FT size 131072
Total time 0 min, 26 sec

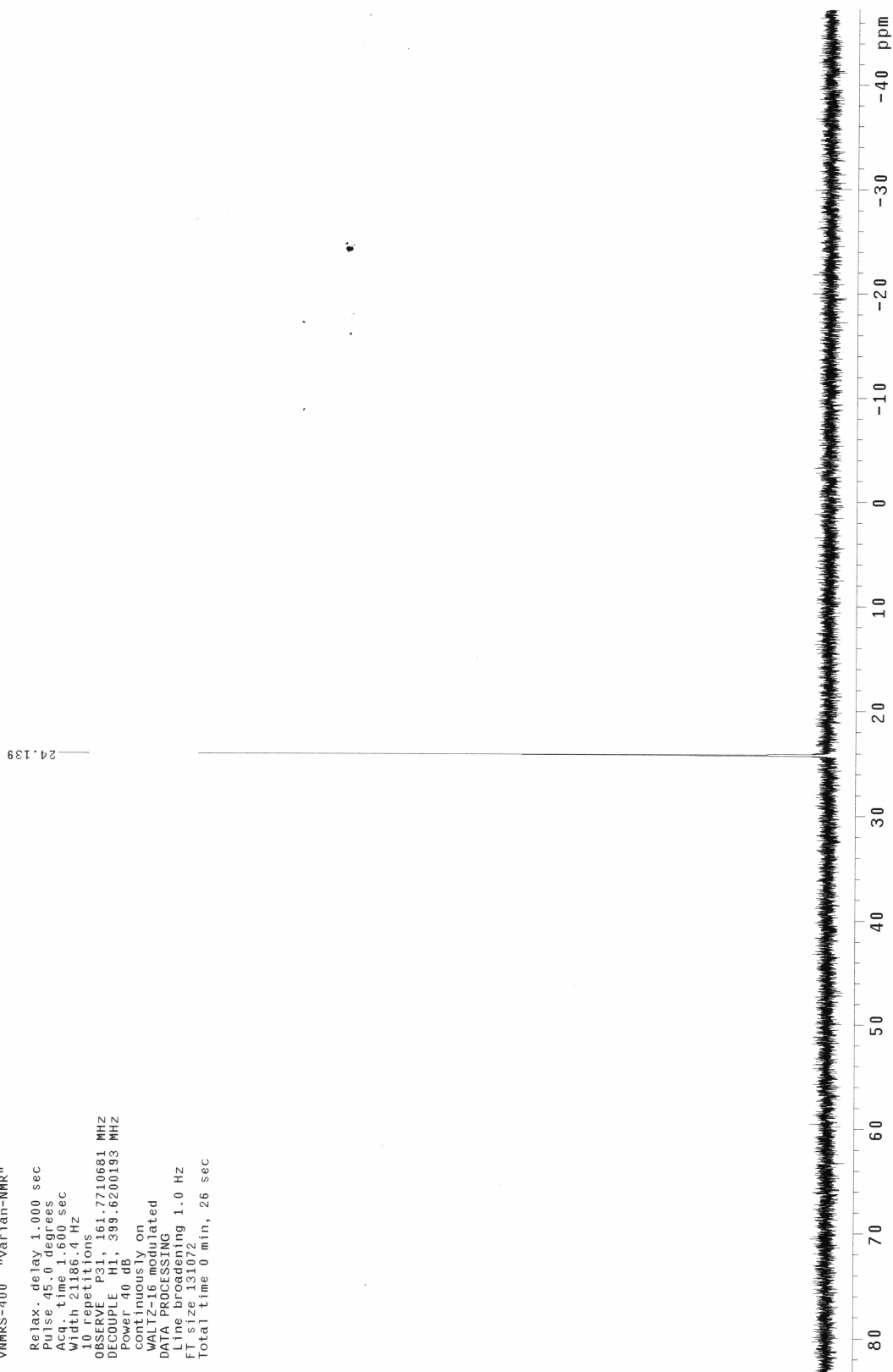


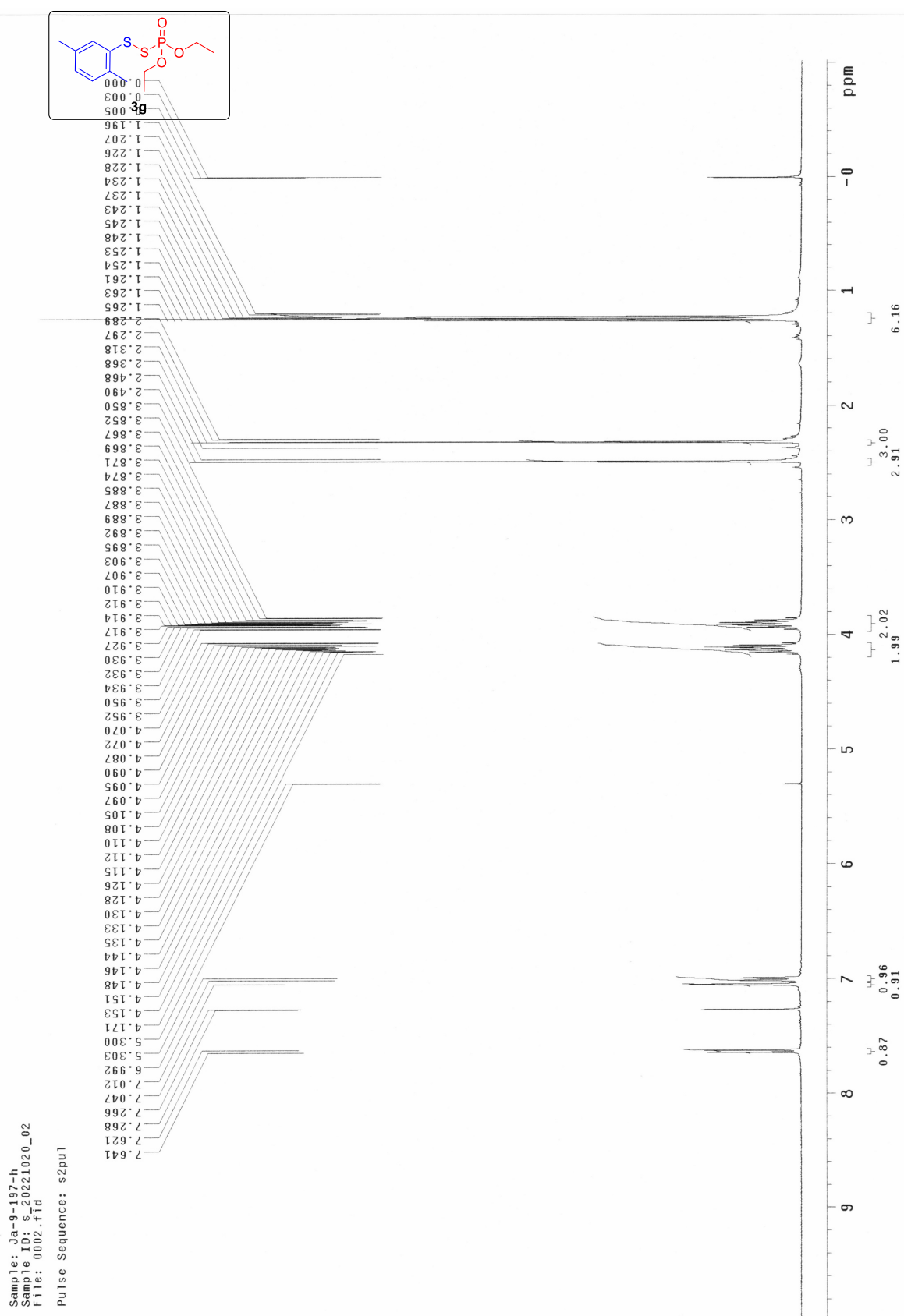
¹H NMR (400 MHz) in CDCl₃

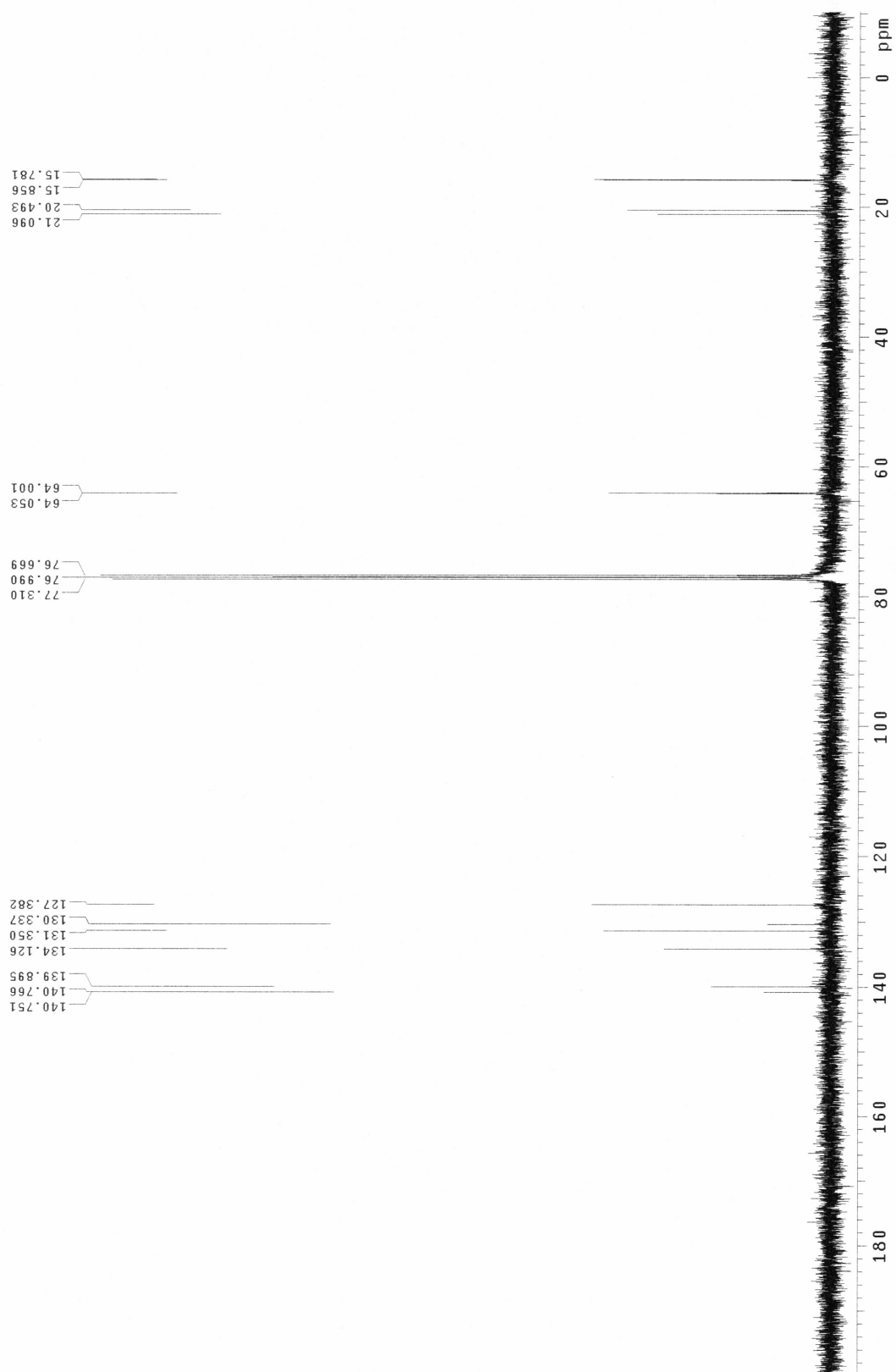
^{13}C NMR (100.5 MHz) in CDCl_3 

^{31}P NMR (162 MHz) in CDCl_3

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File: exp
Pulse Sequence: s2pul
Solvent: cd3od
Temp. 25.0 C / 298.1 K
Operator: Jykang
VNMR-400 "Varian-NMR"
Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
10 repetitions
OBSERVE P31, 161.7710681 MHz
DECOUPLE H1, 399.6200193 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec



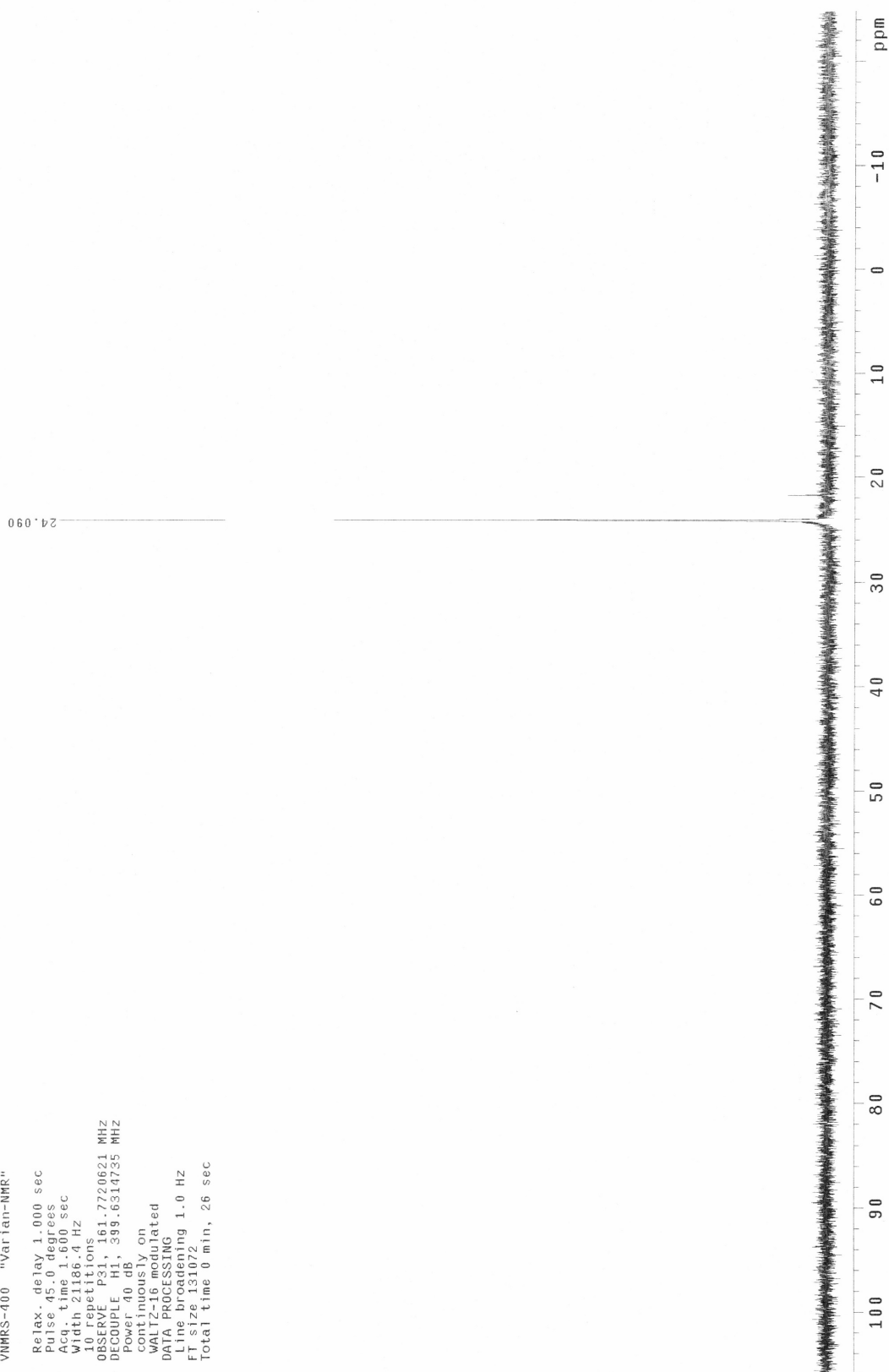
^1H NMR (400 MHz) in CDCl_3 

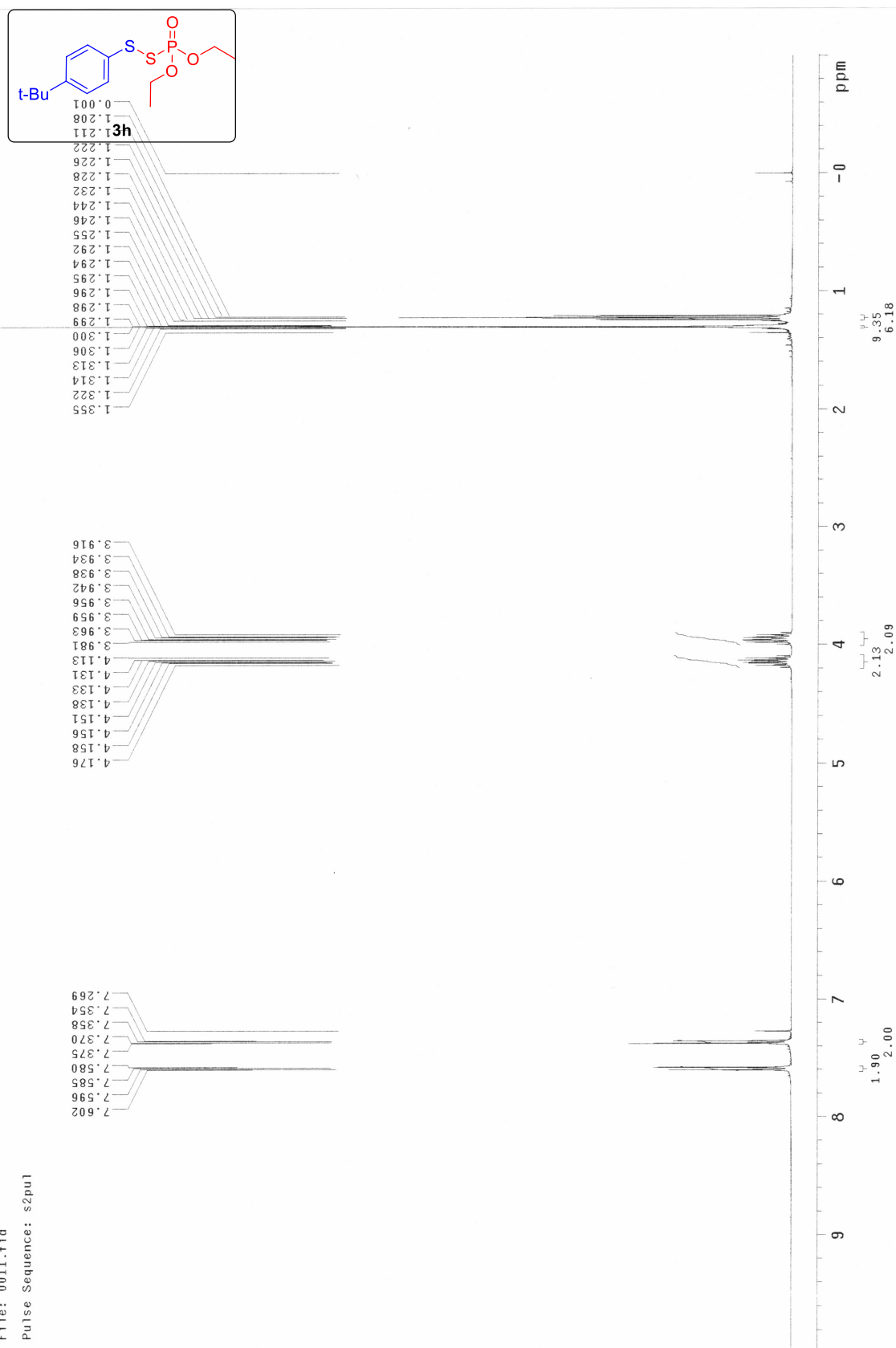
^{13}C NMR (100.5 MHz) in CDCl_3 

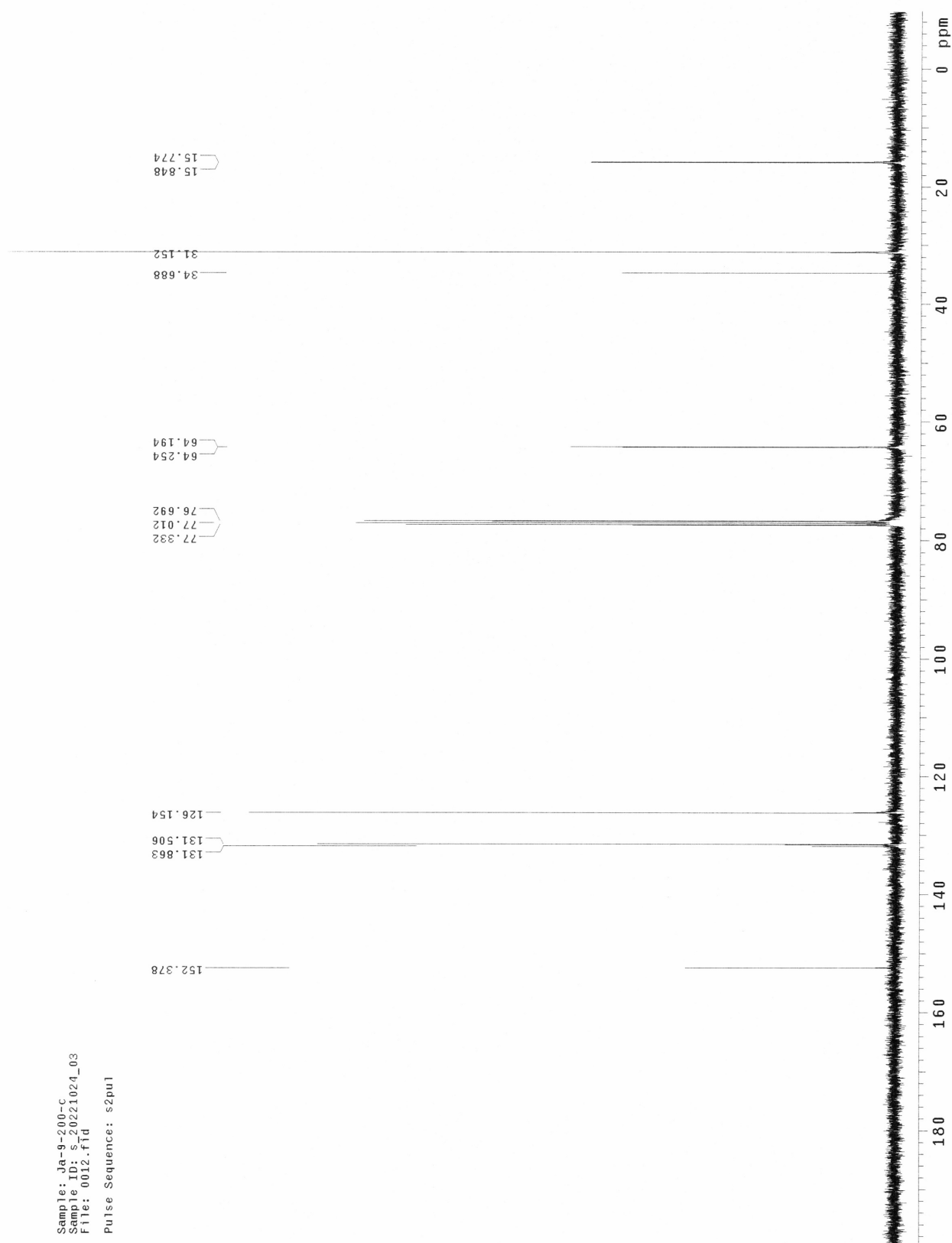
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File: 0003.F1d
Pulse Sequence: s2pul

^{31}P NMR (162 MHz) in CDCl_3

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File: exp
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Solvent: cdCl_3
Temp.: 25.0 C / 298.1 K
Operator: Jykang
VNMR-400 "Varian-NMR"
Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
10 repetitions
OBSERVE P31, 161.7720621 MHz
DECOUPLE H1, 399.6314735 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec

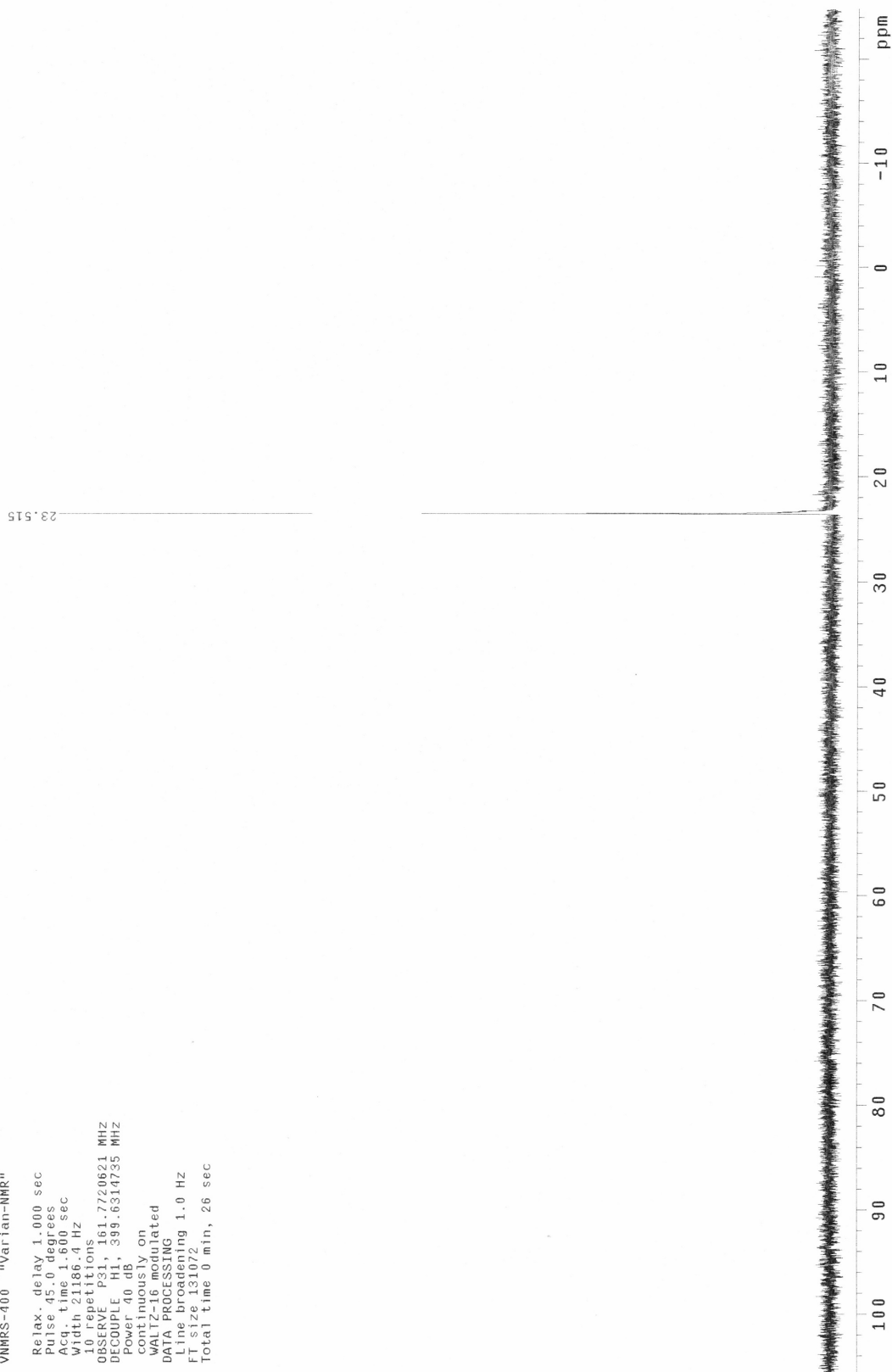


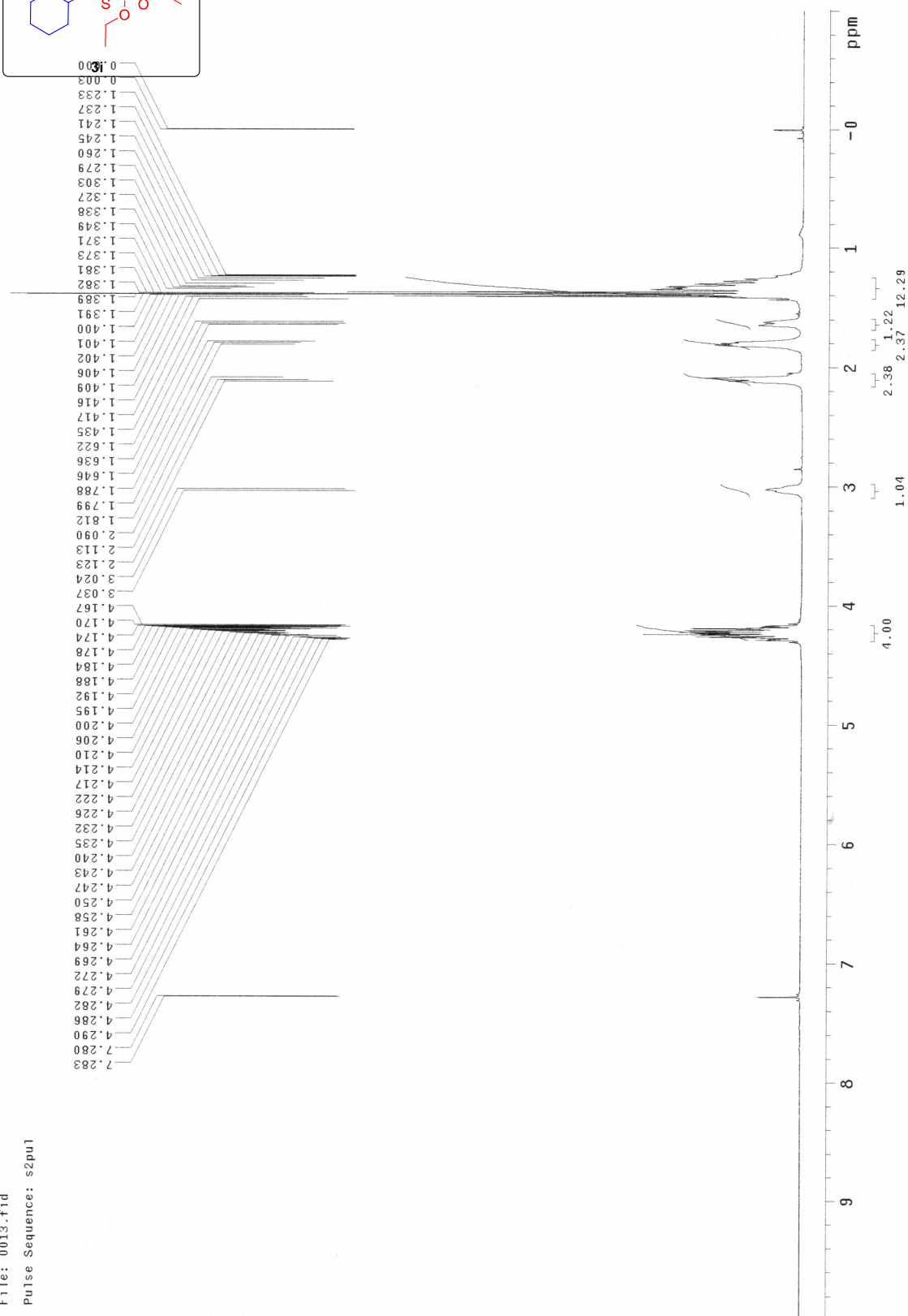
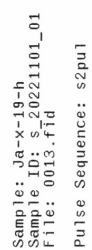
^1H NMR (400 MHz) in CDCl_3 

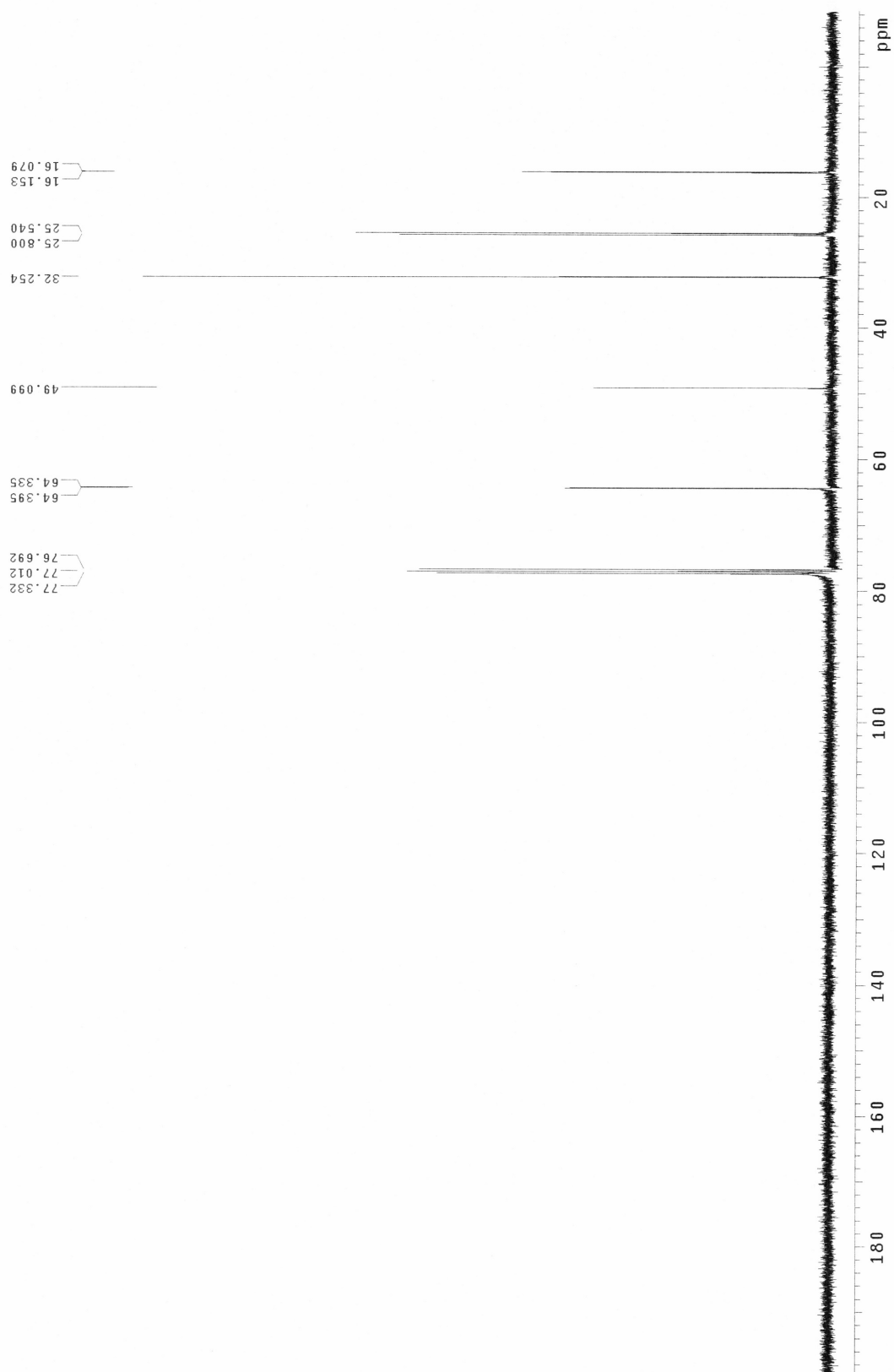
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^{31}P NMR (162 MHz) in CDCl_3

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Solvent: cdc13
Temp: 25.0 C / 298.1 K
Operator: jvkang
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Pulse 45.0 degrees
Acq. time 1.000 sec
F1 24186.4 Hz
10.000000000000000
OBSERVE P1, 161.7720621 MHz
DECOUPLE H1, 399.6314755 MHz
Power 40 dB, continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec



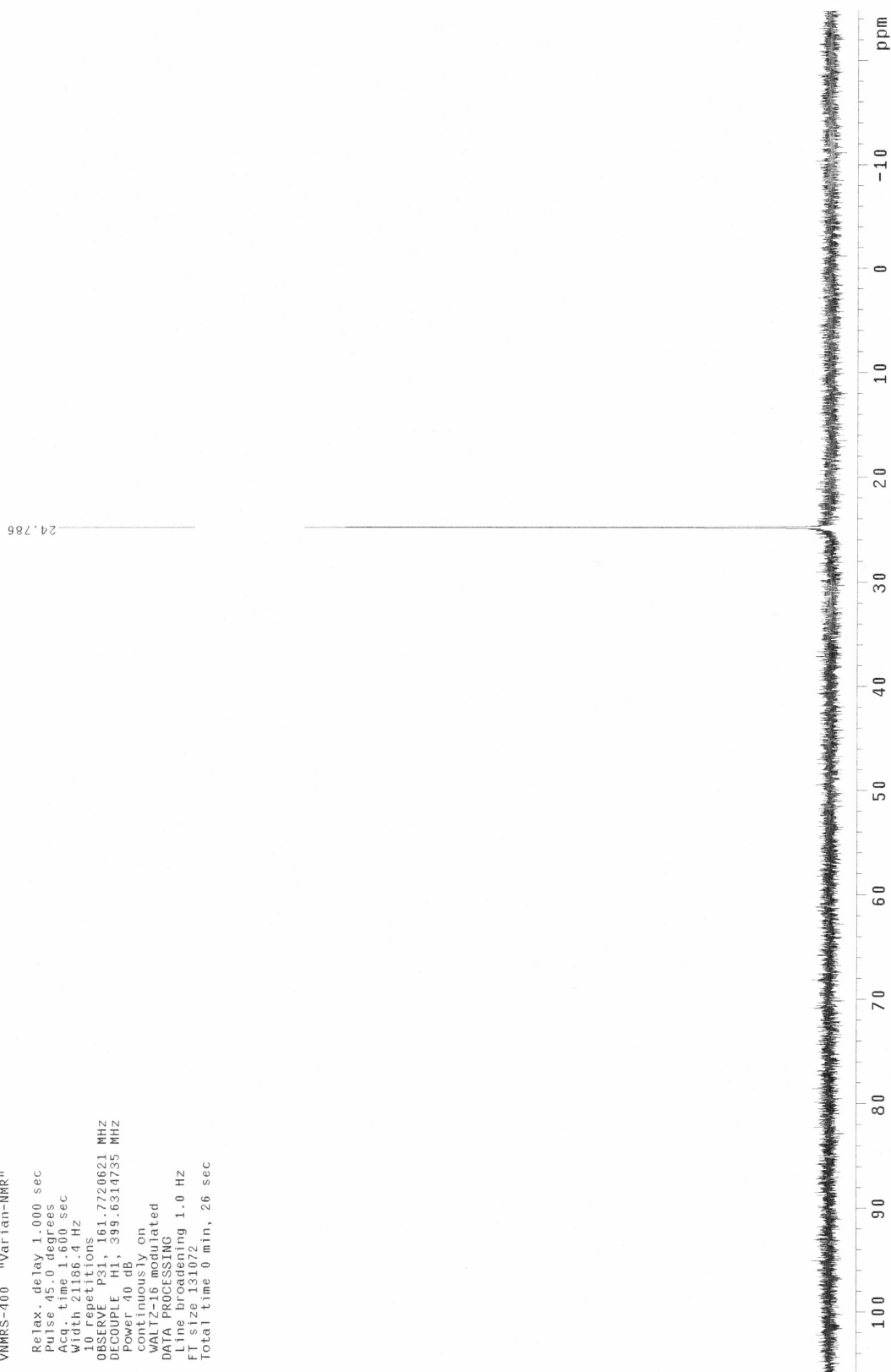
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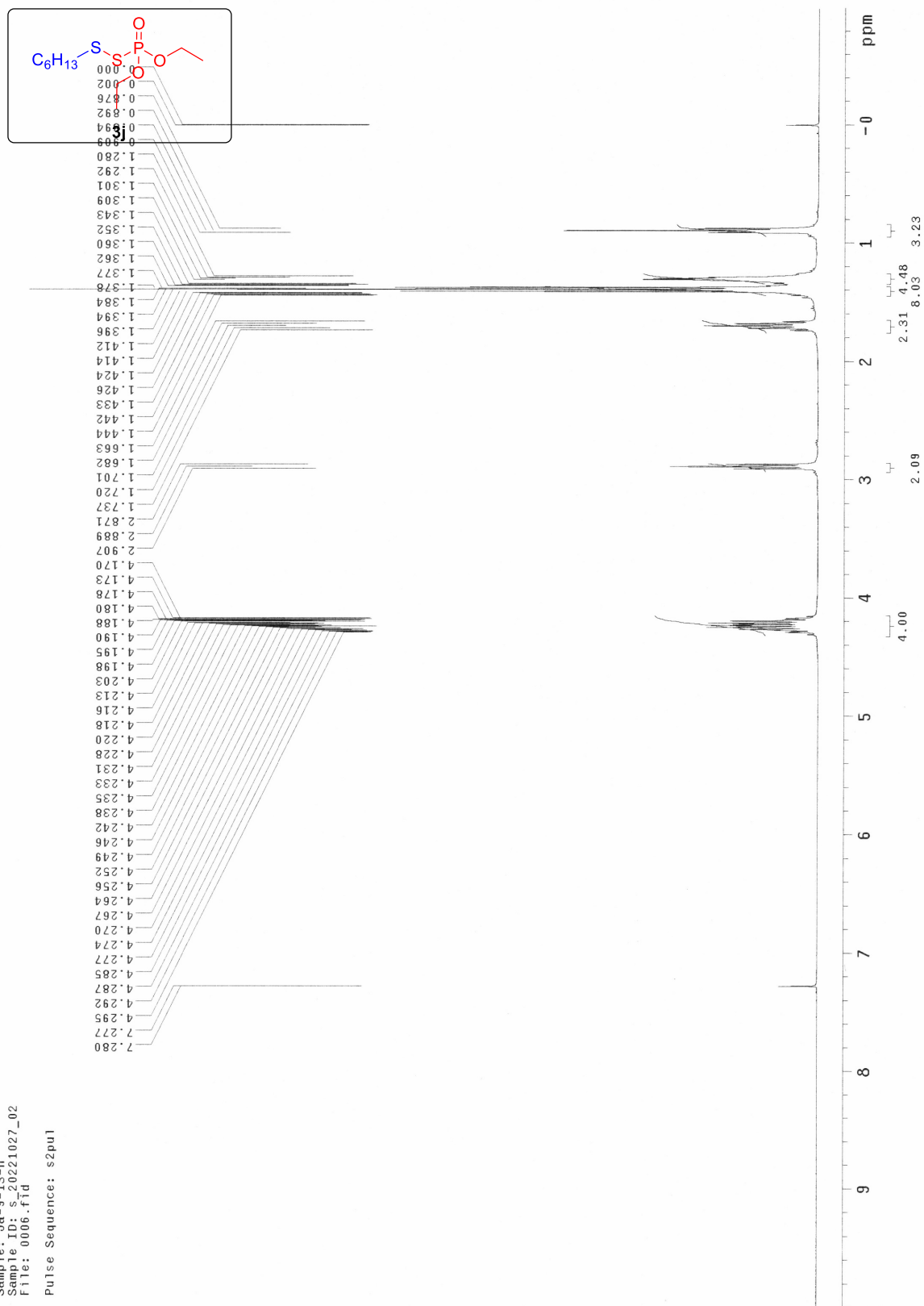
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Pulse Sequence: s2pu1

^{31}P NMR (162 MHz) in CDCl_3

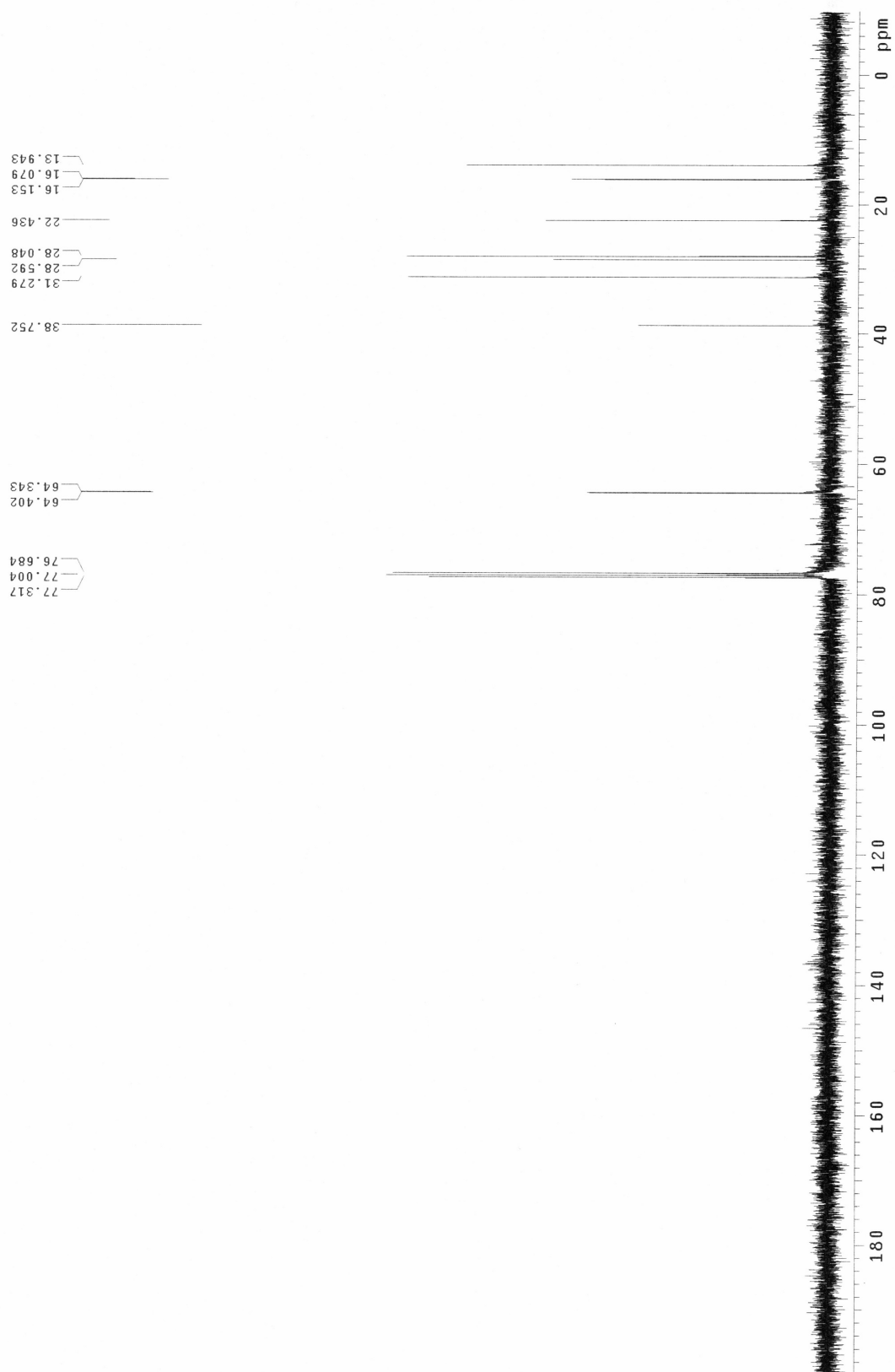
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Solvent: cdc13
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Operator: jwang
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Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
10 repetitions
OBSERVE P31, 161.7720621 MHz
DECOUPLE H1, 399.6314735 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec



^1H NMR (400 MHz) in CDCl_3 

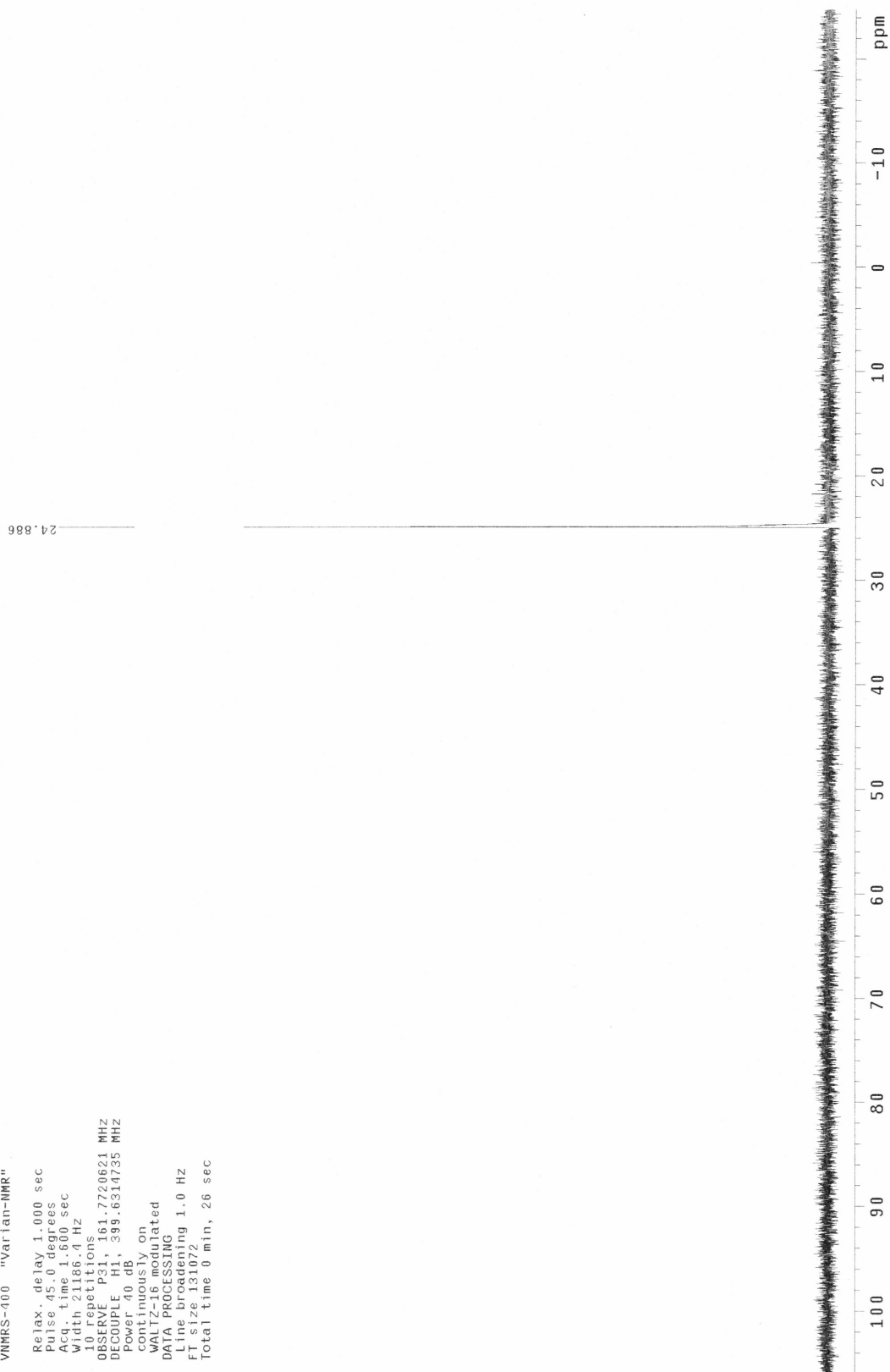
^{13}C NMR (100.5 MHz) in CDCl_3

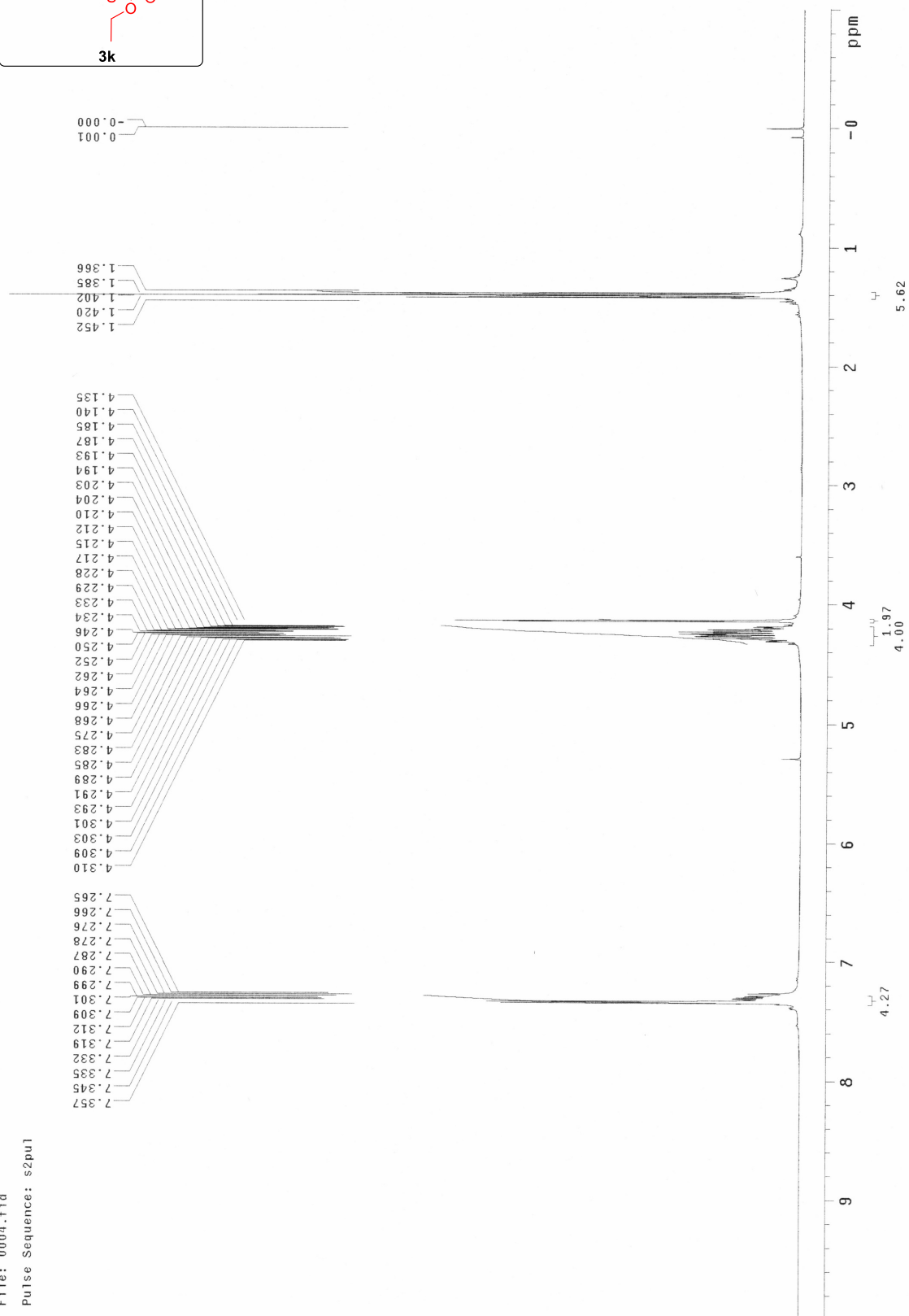
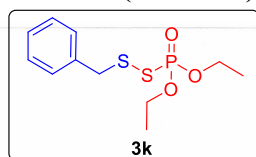
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Sample ID: s_20221027_03
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Pulse Sequence: s2pul

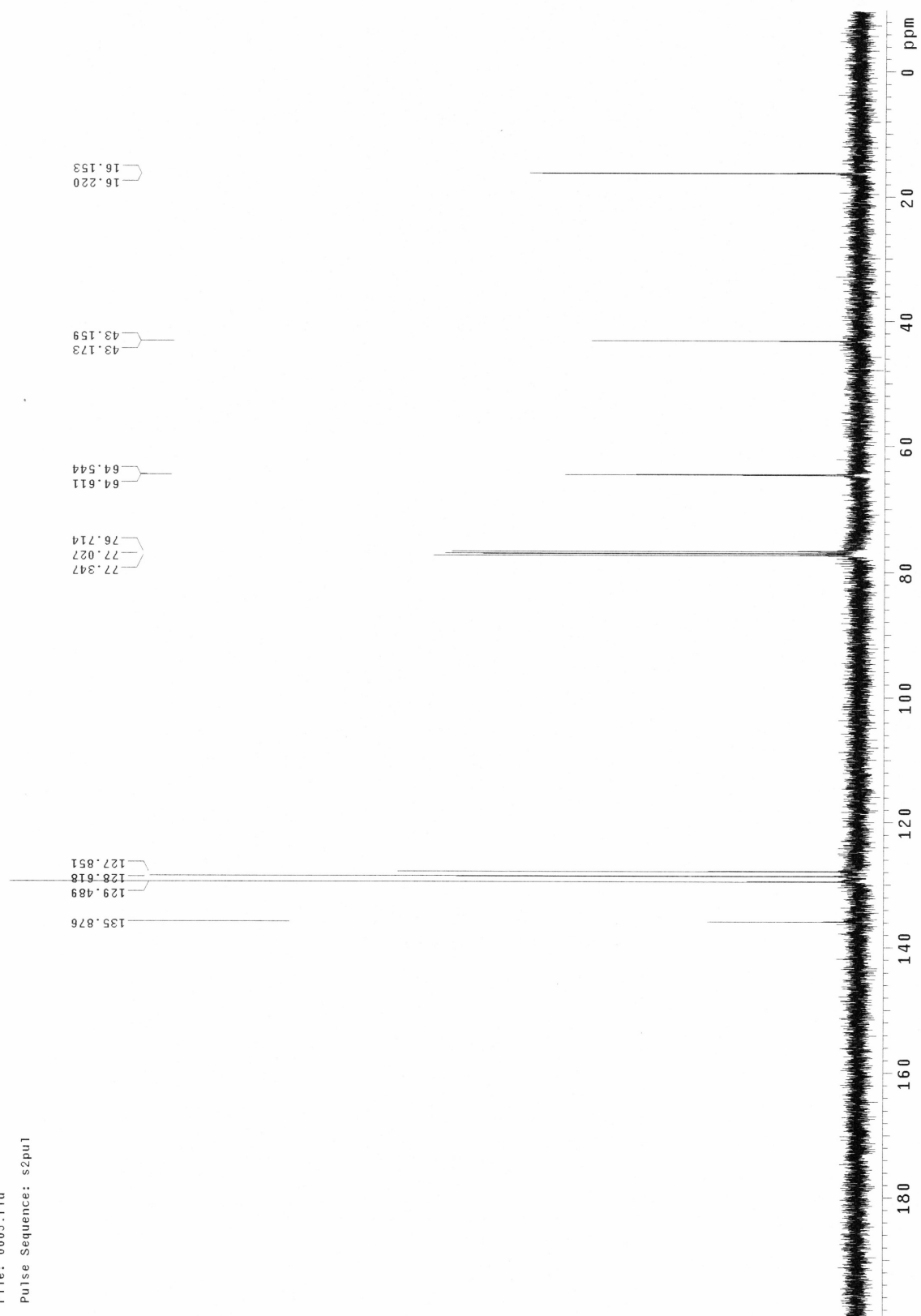


^{31}P NMR (162 MHz) in CDCl_3

Sample: Ja-x-13-p
File: exp
Pulse Sequence: s2pul
Solvent: CDCl_3
Temp. 25.0 C / 298.1 K
Operator: Jykang
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Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
10 repetitions
OBSERVE P31, 161.7720621 MHz
DECOUPLE H1, 399.6314735 MHz
Power 40 dB,
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec



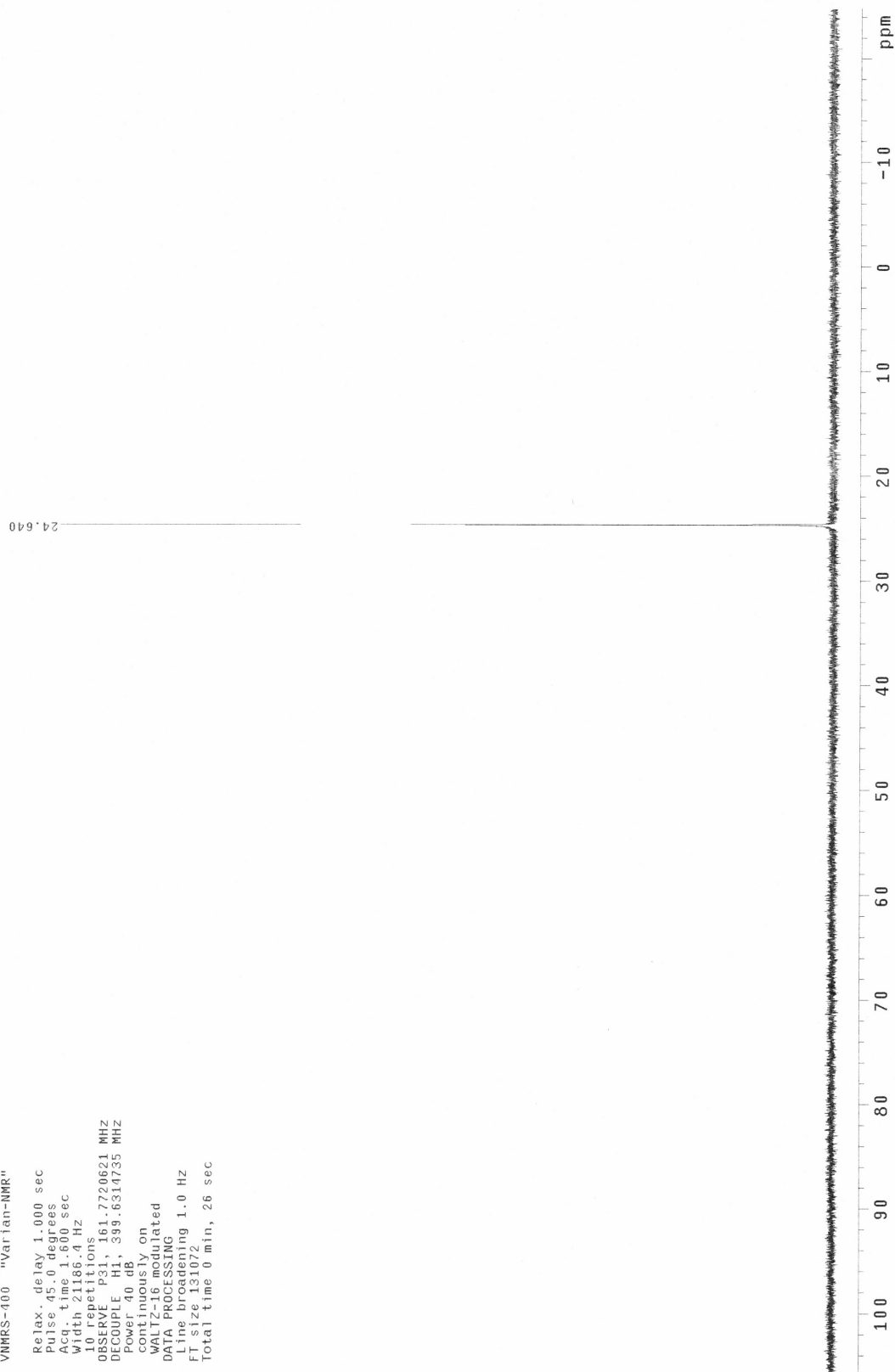
¹H NMR (400 MHz) in CDCl₃

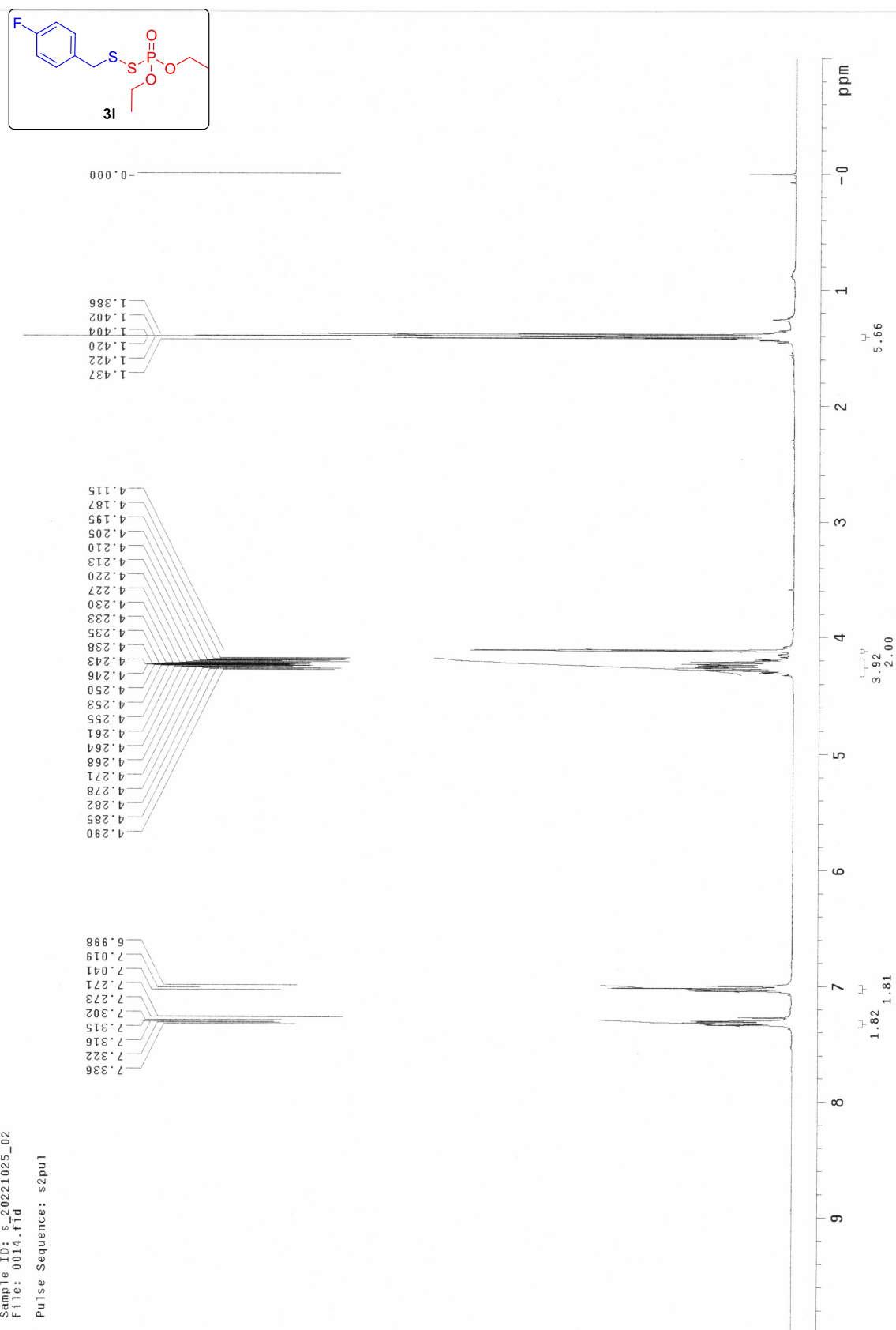
^{13}C NMR (100.5 MHz) in CDCl_3 

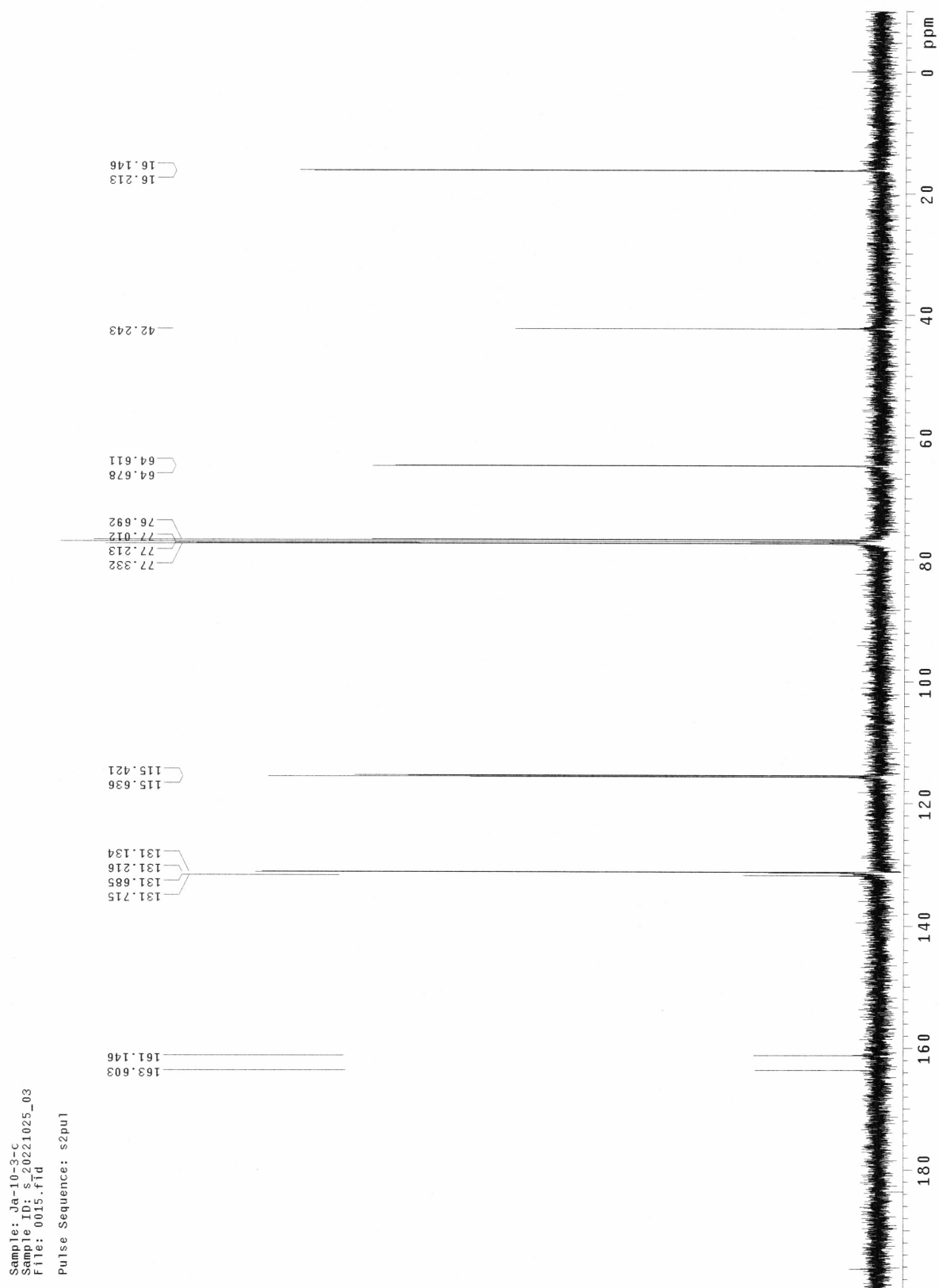
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^{31}P NMR (162 MHz) in CDCl_3

Sample: Ja-9-198-p
File: exp
Pulse Sequence: s2pul
Solvent: cdcl3
Temp: 25.0 C / 298.1 K
Operator: JYKang
VNMR-400 "Varian-NMR"
Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
10 repetitions
OBSERVE P31, 161.7720621 MHz
DECOUPLE H1, 399.6314735 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec

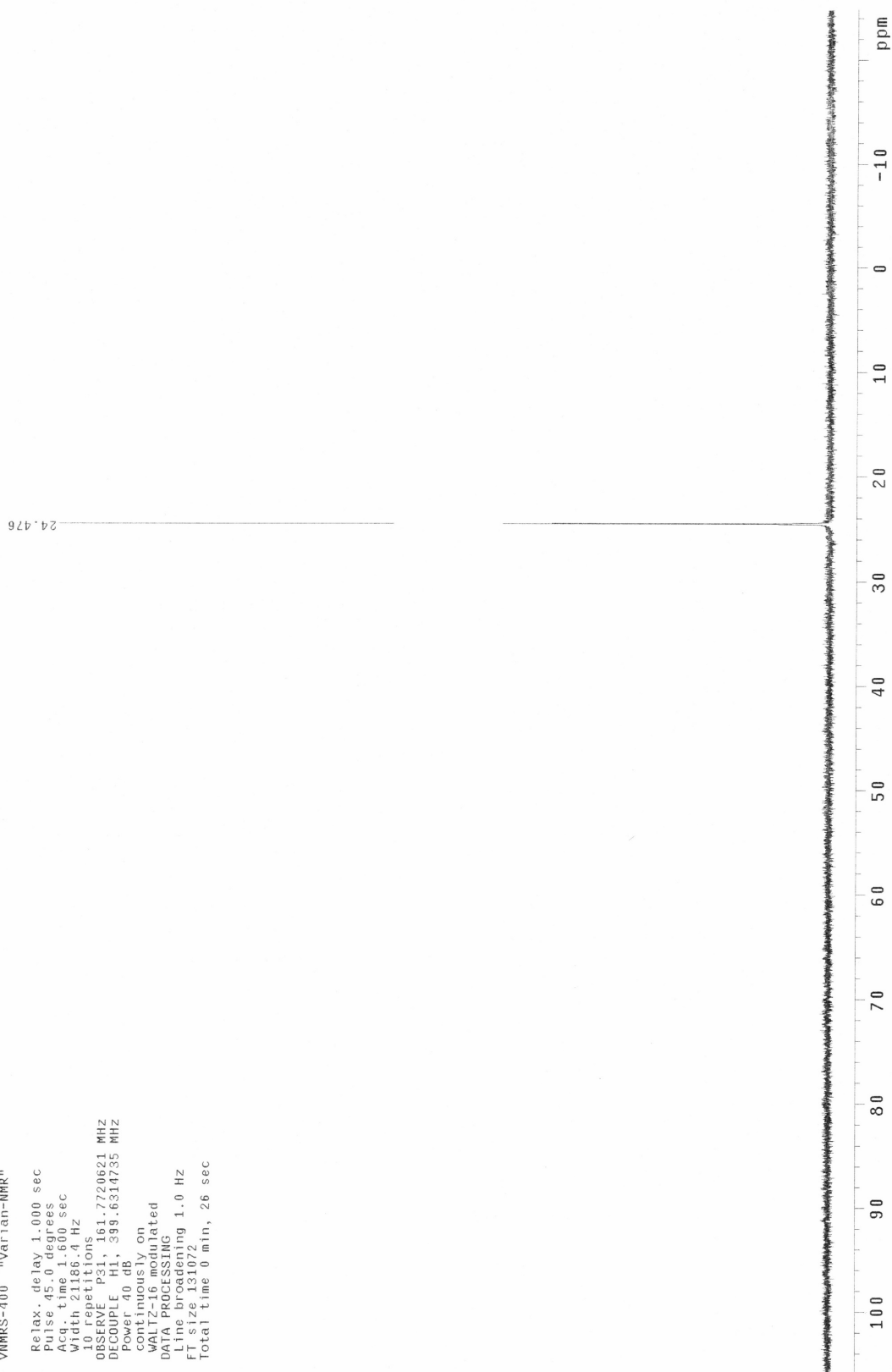


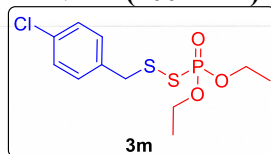
^1H NMR (400 MHz) in CDCl_3 

^{13}C NMR (100.5 MHz) in CDCl_3 

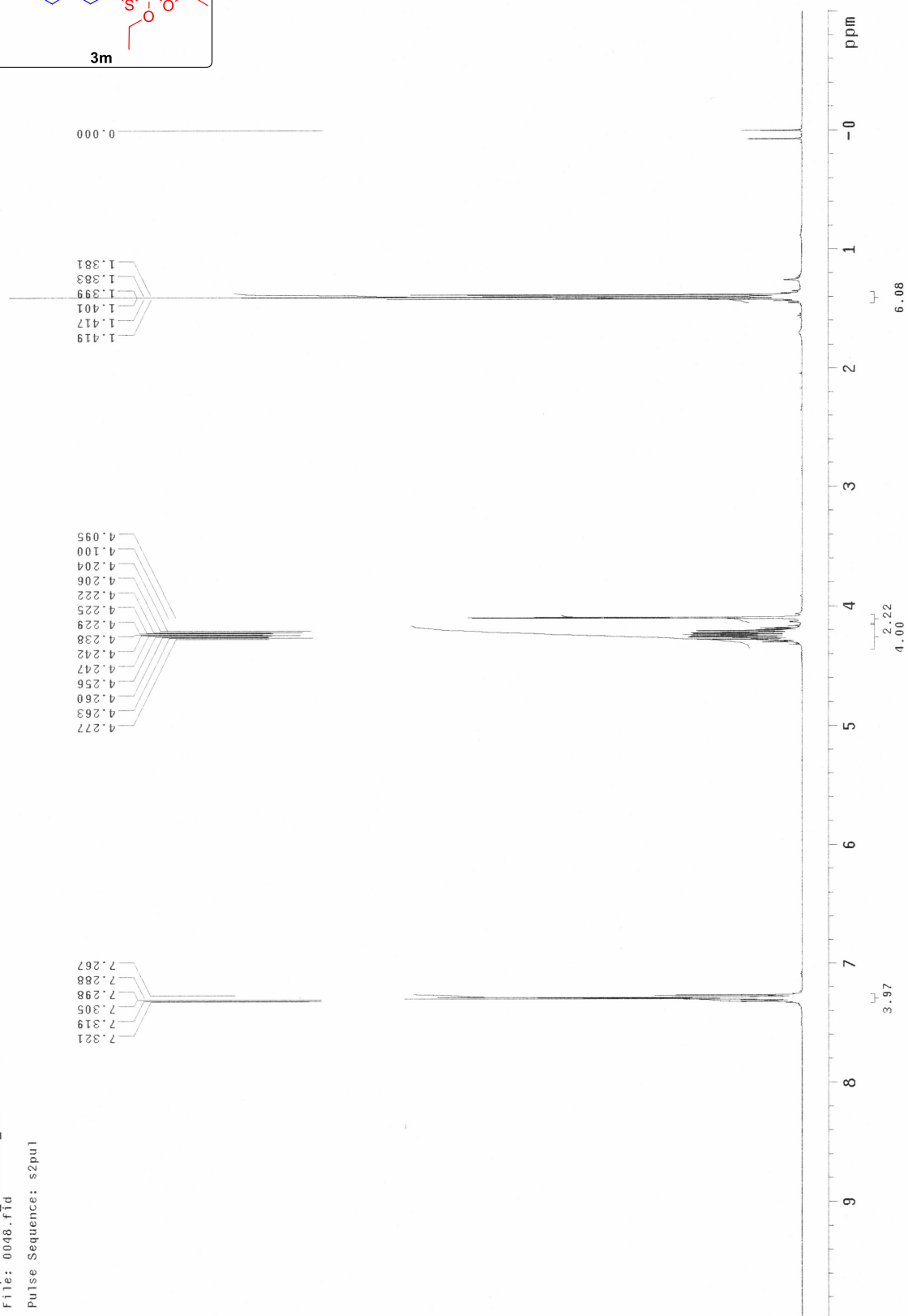
^{31}P NMR (162 MHz) in CDCl_3

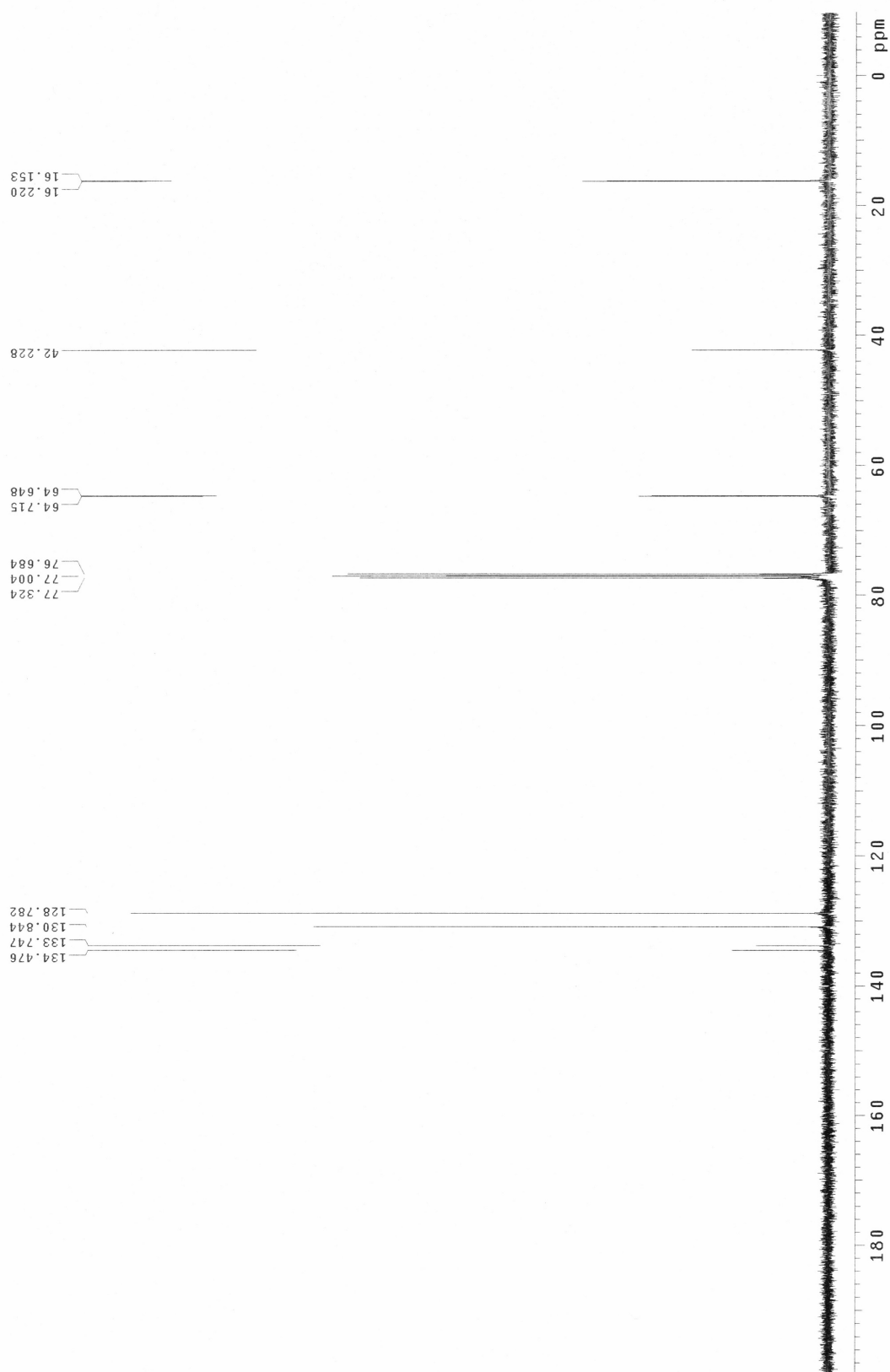
Sample: Ja-x-3-p
File: exp
Pulse Sequence: s2pul
Solvent: cdc13
Temp.: 25.0 C / 298.1 K
Operator: jykang
VNMR-400 "Varian-NMR"
Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
10 repetitions
OBSERVE P31, 161.7720621 MHz
DECOUPLE H1, 399.6314735 MHz
Power 40 dB,
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec



¹H NMR (400 MHz) in CDCl₃

Sample: Ja-x-30-h
Sample ID: s20221107_01
File: 0048.f1d
Pulse Sequence: s2pul



^{13}C NMR (100.5 MHz) in CDCl_3 

Sample: Ja-x-30-c
Sample ID: s_20221107_02
File: 0049.fid
Pulse Sequence: s2pul

^{31}P NMR (162 MHz) in CDCl_3

Sample: Ja-x-30-p
File: exp

Pulse Sequence: s2pul

Solvent: cdcl_3
Temp: 25.0 C, 298.1 K
Operator: jkang
VNMR-400 "Varian-NMR"

Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
10 repetitions

OBSERVE P31, 161.7720621 MHz
DECOUPLE H1, 399.6314735 MHz

Power 40 dB
Continuously on

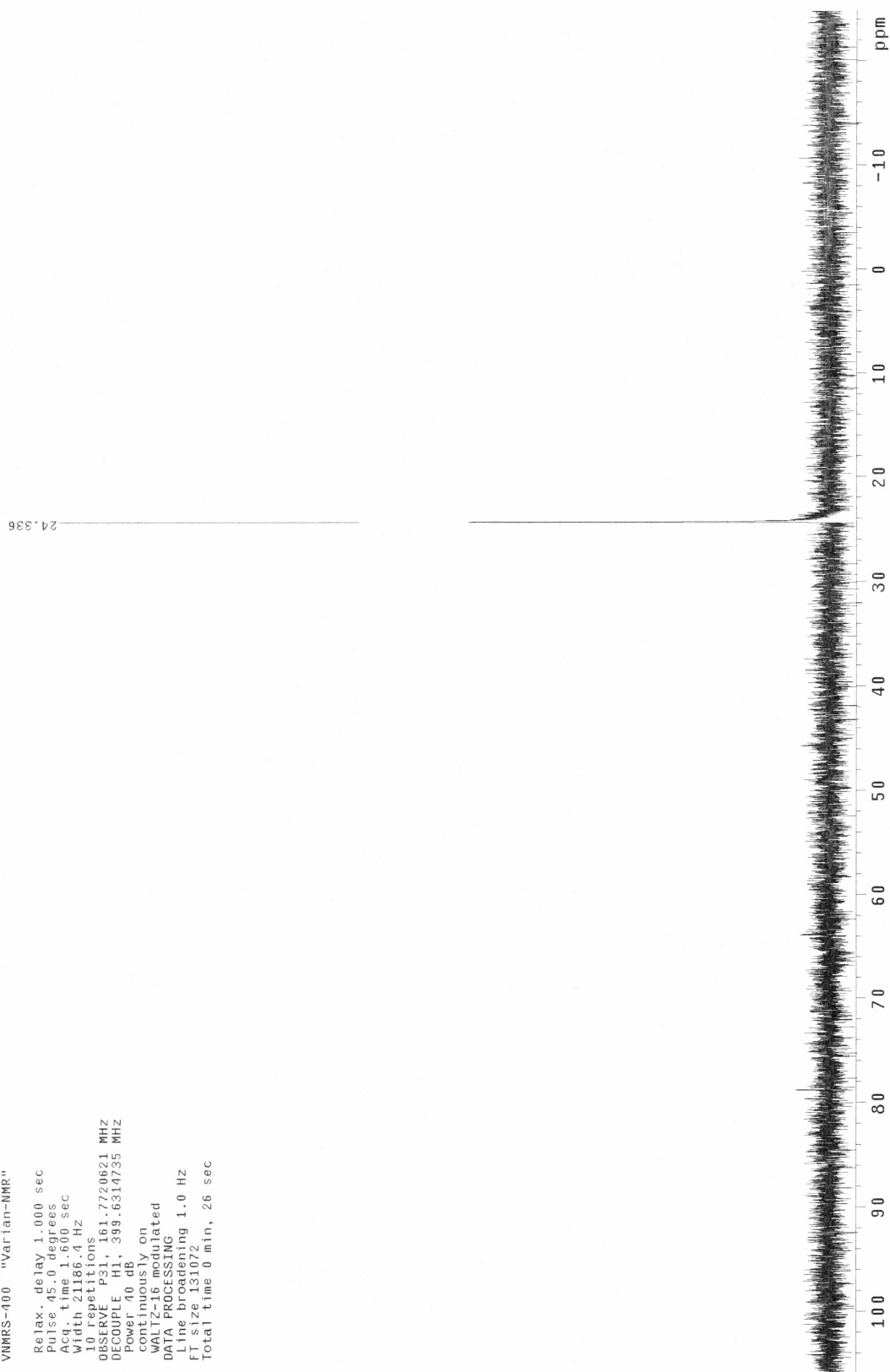
Modulated

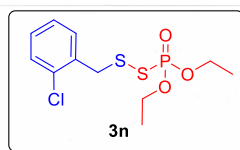
DATA PROCESSING

Time Modulating 1.0 Hz

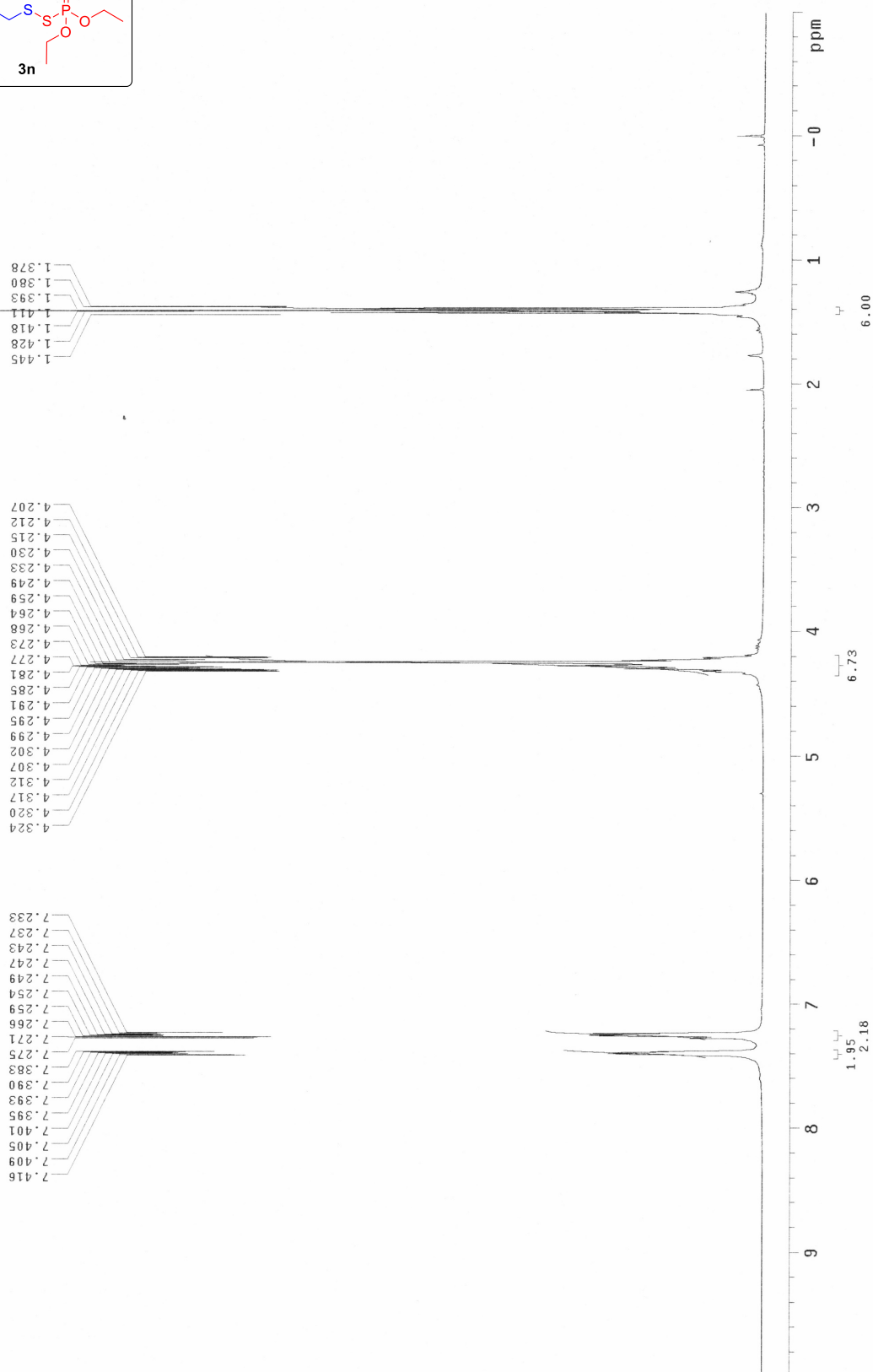
File size 131072

Total time 0 min, 26 sec



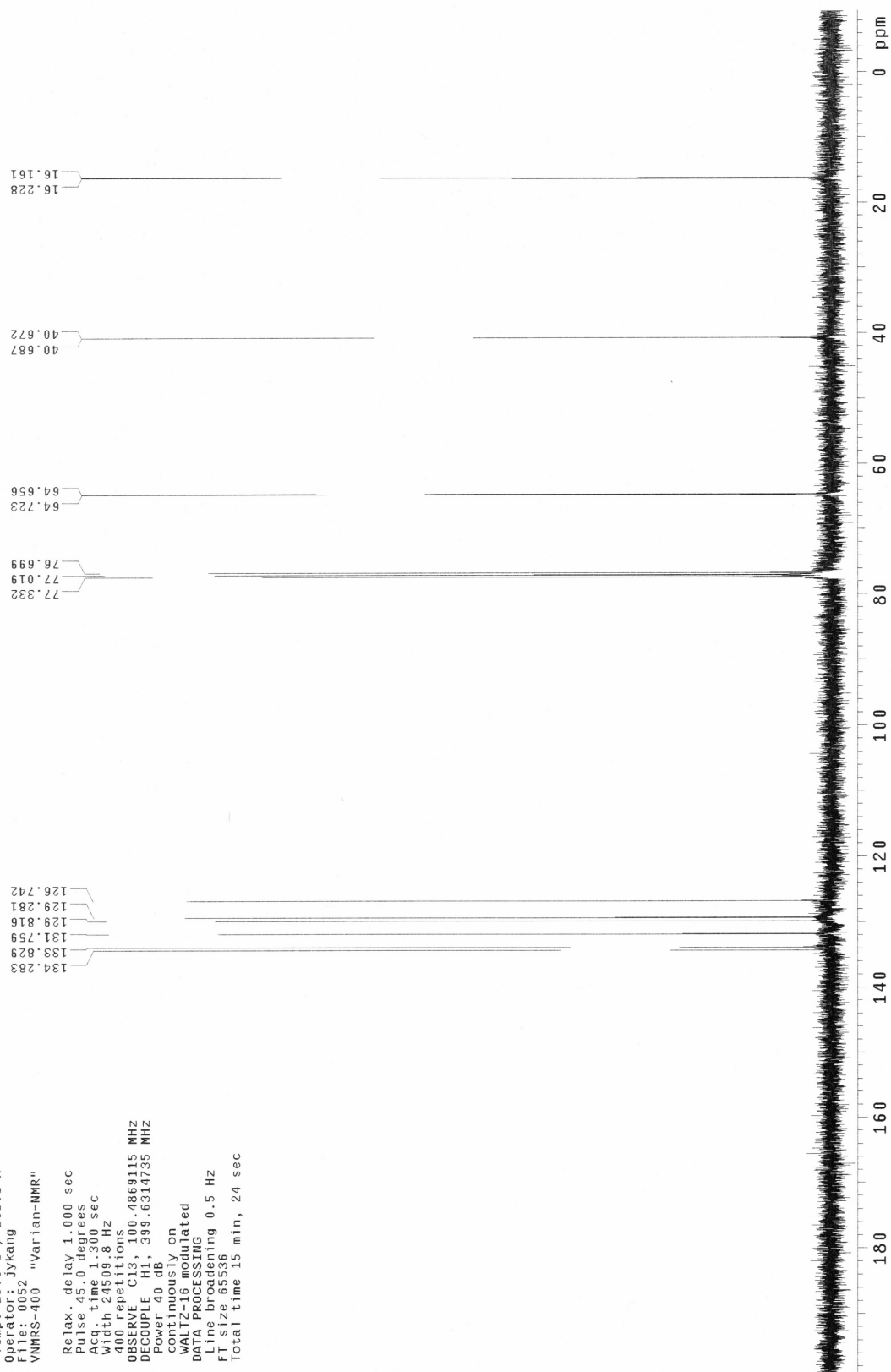
^1H NMR (400 MHz) in CDCl_3 

Sample: Ja-x-32-h
Sample ID: s_20221108_01
File: 0051.fid
Pulse Sequence: s2pul



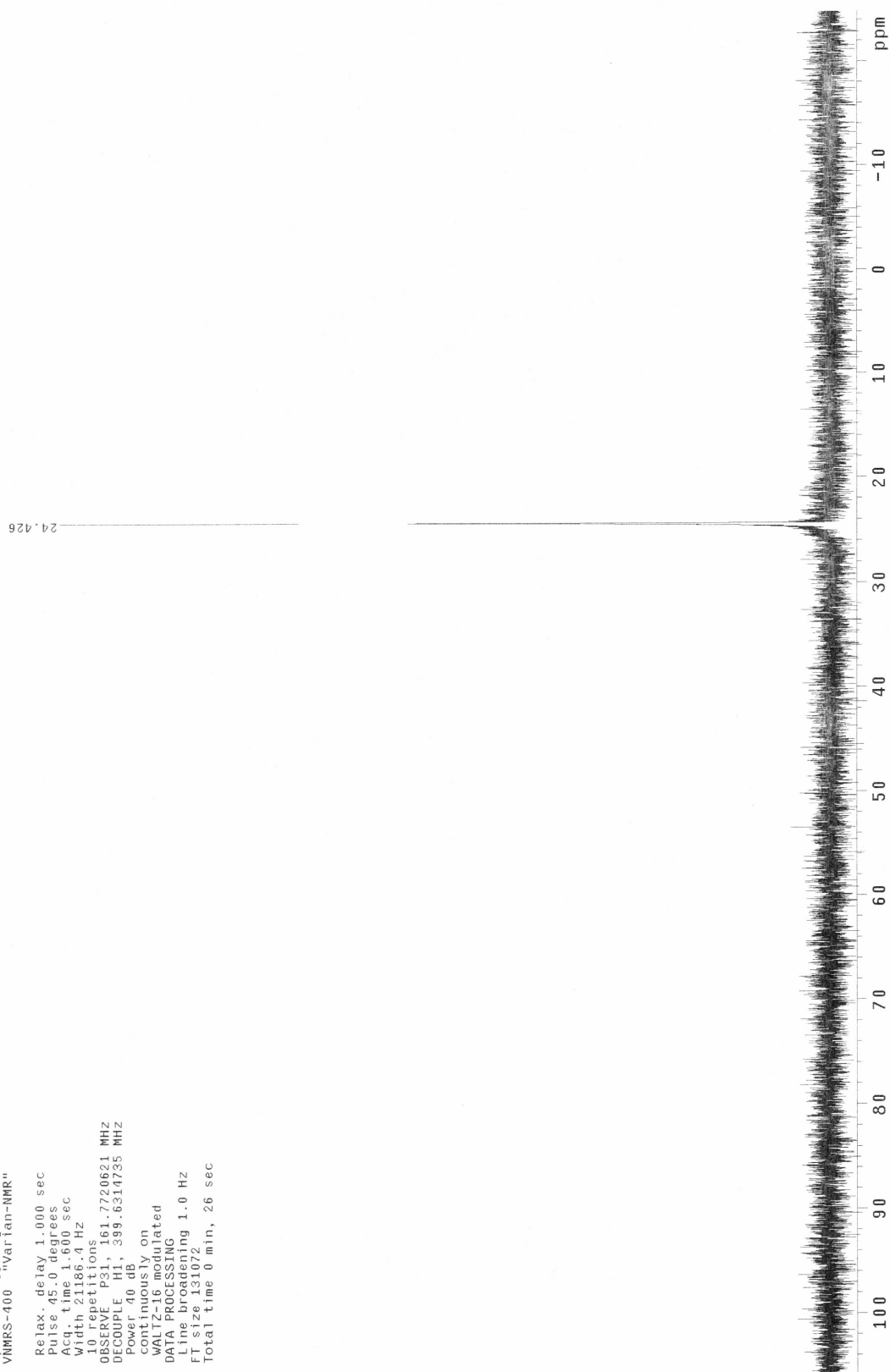
^{13}C NMR (100.5 MHz) in CDCl_3

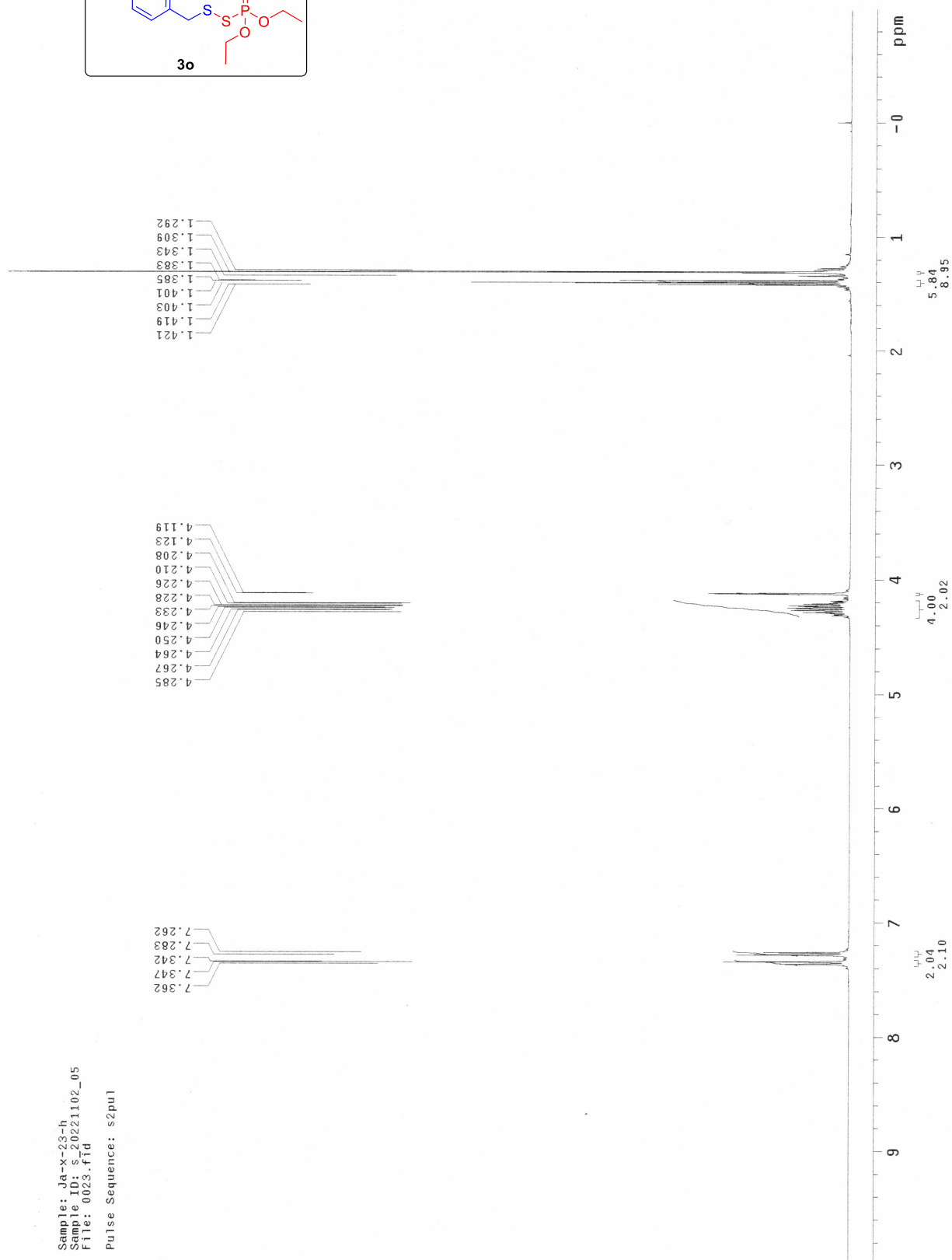
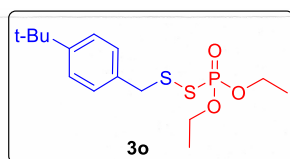
Sample: Ja-x-32-c
Sample ID: s.20221108_02
File: 0052.fid
Pulse Sequence: s2pul
Solvent: cdc13
Temp: 25.0 C / 298.1 K
Operator: jykang
File: 0052
VNMR-400 "Varian-NMR"
Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.300 sec
Width 24509.8 Hz
Sweep rate 100.000 MHz
OBSERVE CH 13, 40.4869115 MHz
DECOUPLE CH 1, 399.6314735 MHz
Power 40 dB
Continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FI size 65536
Total time 15 min, 24 sec



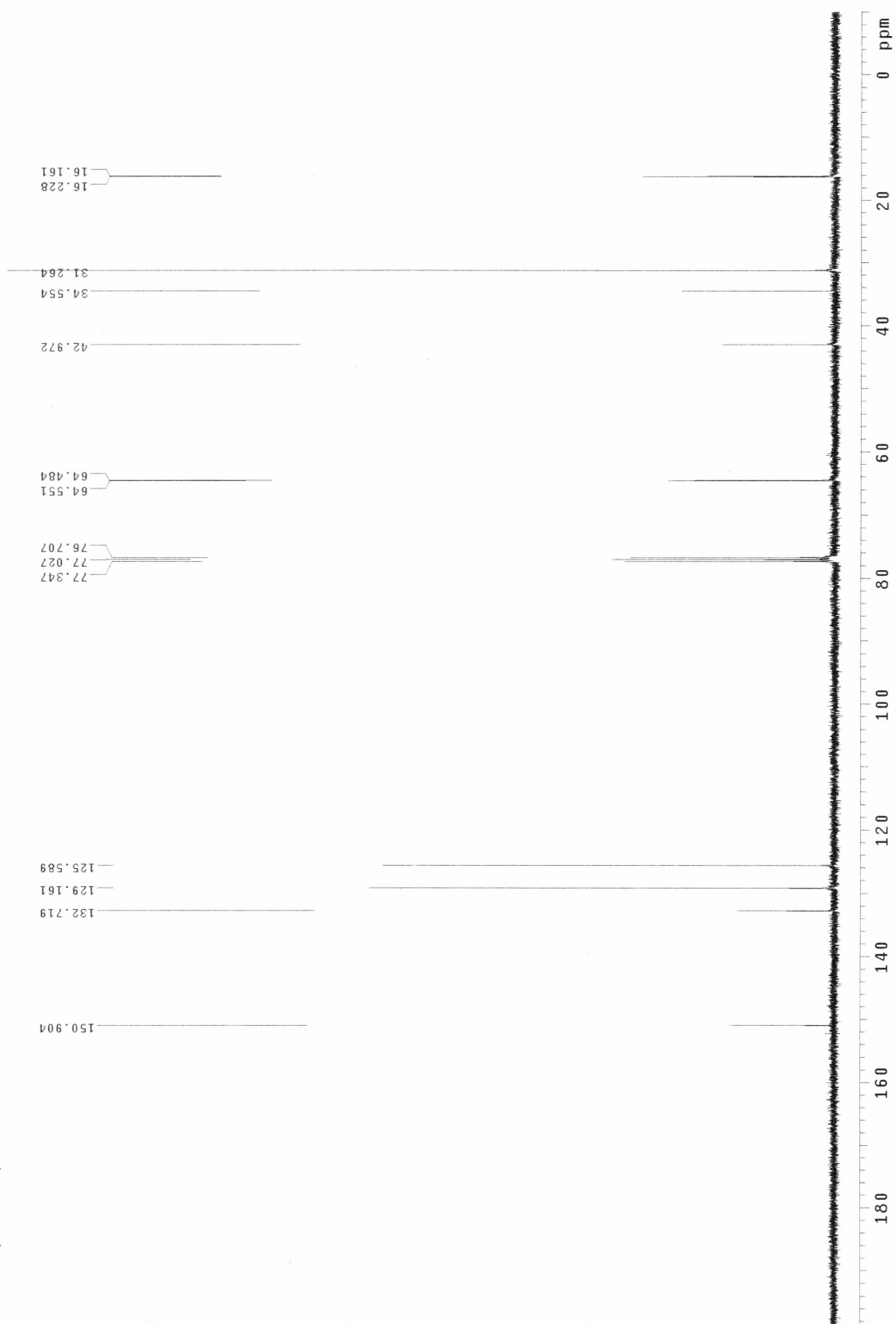
^{31}P NMR (162 MHz) in CDCl_3

Sample: Ja-x-32-p
File: exp
Pulse Sequence: s2pul
Solvent: cdc13
Temp.: 25.0 C / 298.1 K
Operator: Jykang
VNMR-400 "Varian-NMR"
Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
10 repetitions
OBSERVE P31, 161.7720621 MHz
DECOUPLE H1, 399.6314735 MHz
Power 40 dB,
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec



^1H NMR (400 MHz) in CDCl_3 

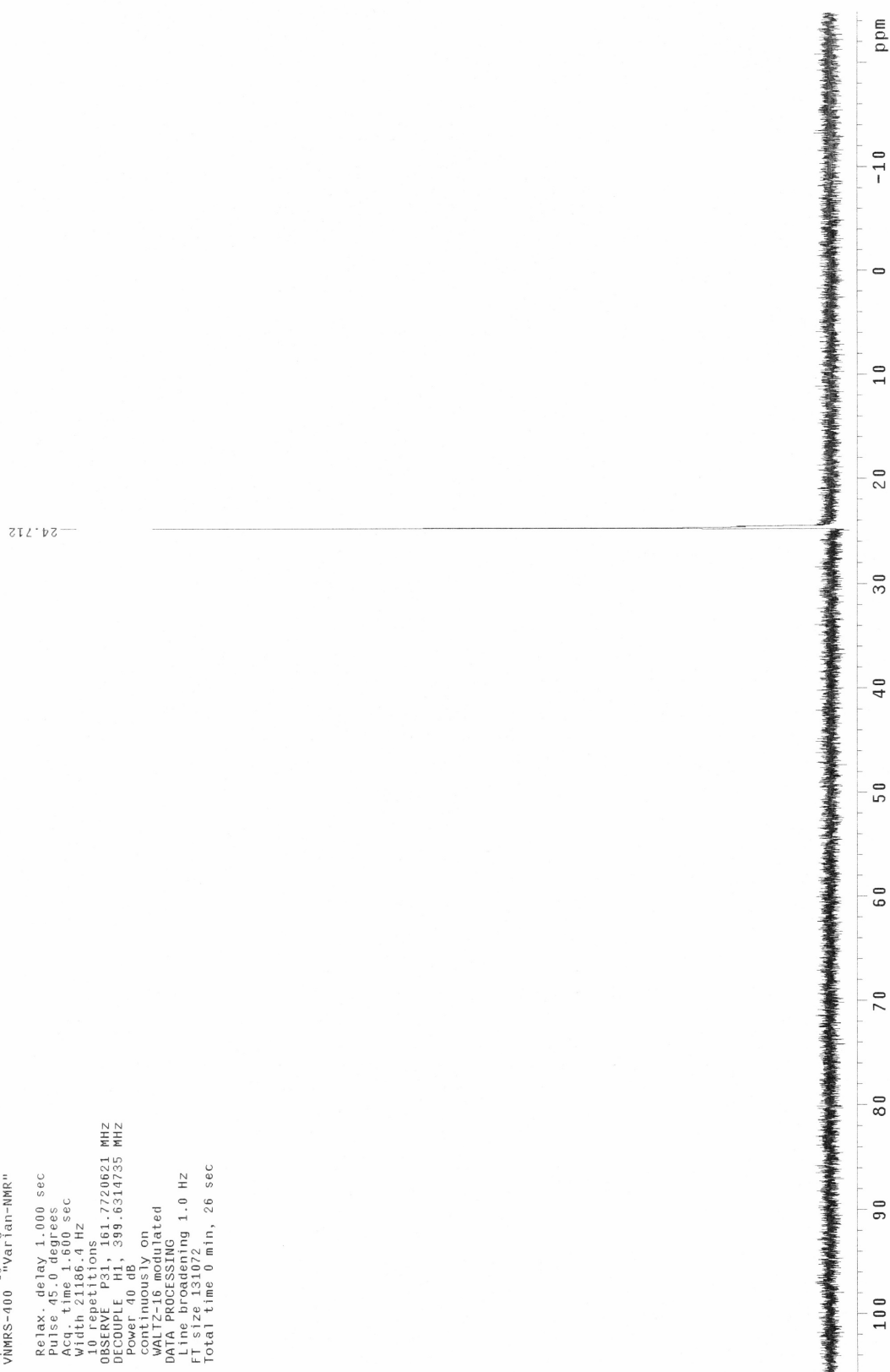
Sample: ja-x-23-h
Sample ID: s_20221102_05
File: 0023.fid
Pulse Sequence: s2pul

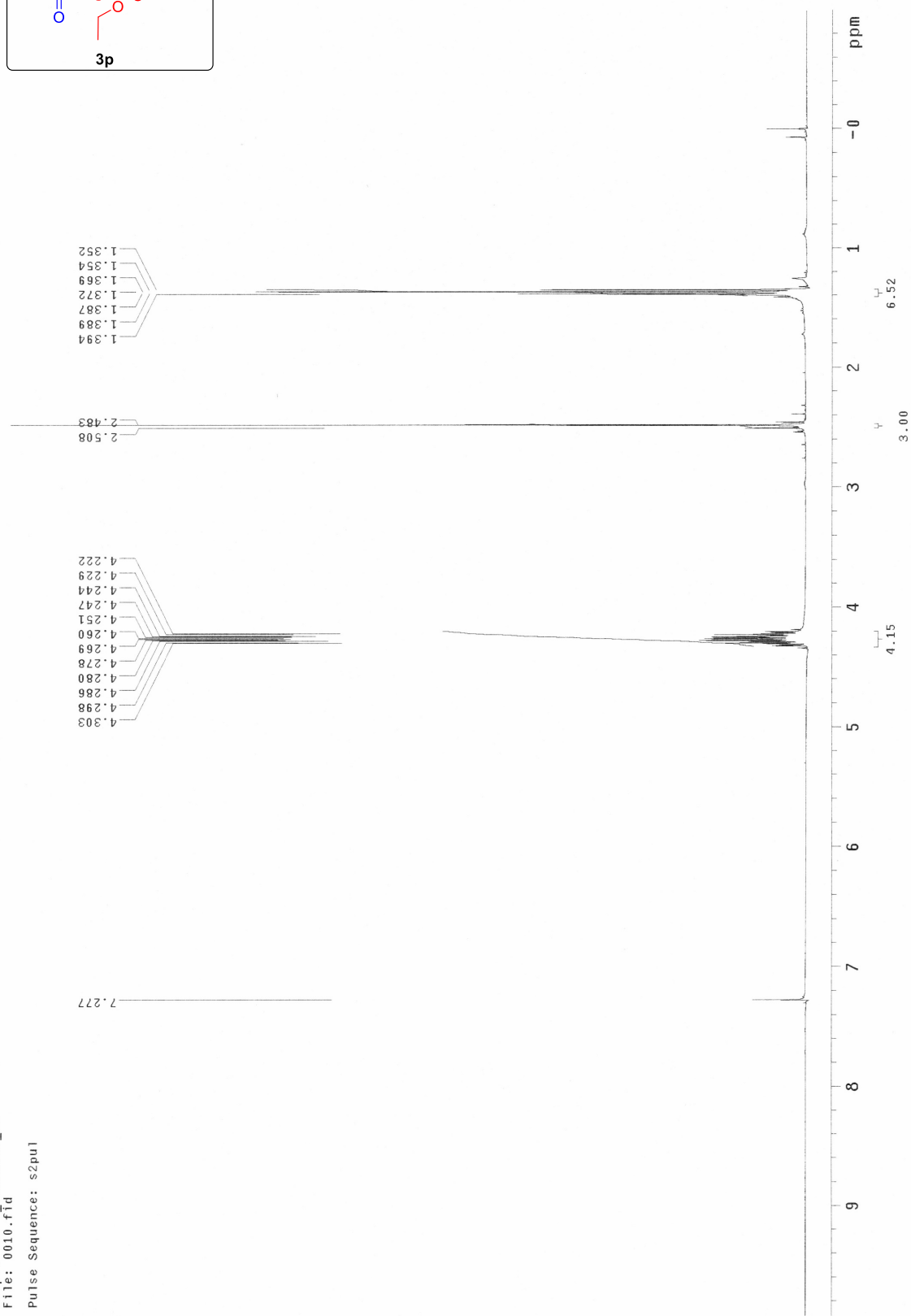
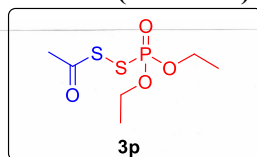
^{13}C NMR (100.5 MHz) in CDCl_3 

Sample: Ja-x-23-c
Sample ID: s_20221102_06
File: 0024.fid
Pulse Sequence: s2pul

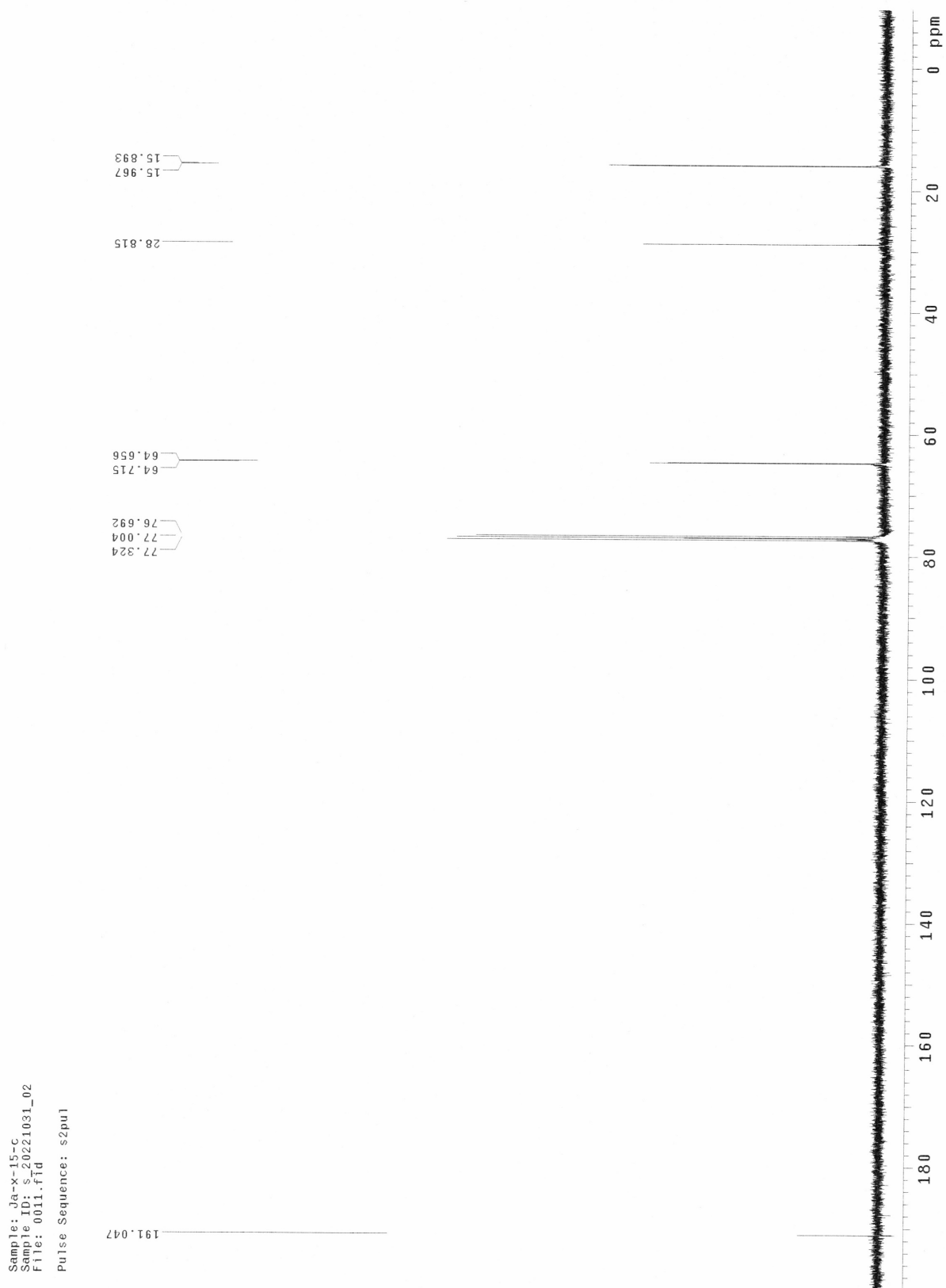
^{31}P NMR (162 MHz) in CDCl_3

Sample: Ja-x-23-p
File: exp
Pulse Sequence: s2pul
Solvent: cdc13
Temp: 25.0 C / 298.1 K
Operator: Jykang
VNMR-400 "Varian-NMR"
Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
10 repetitions
OBSERVE P31, 161.7720621 MHz
DECOUPLE H1, 399.6314735 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec



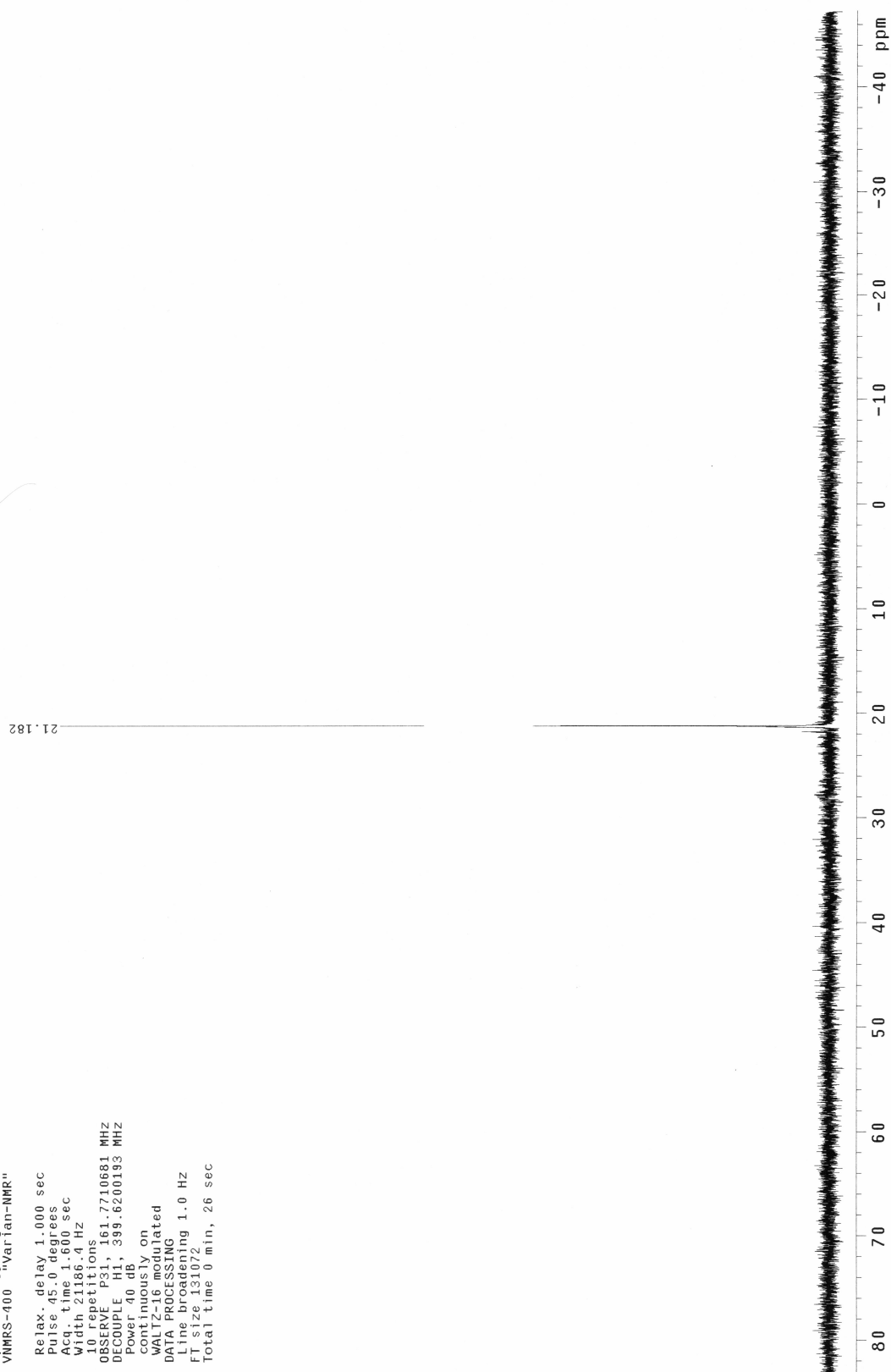
^1H NMR (400 MHz) in CDCl_3 

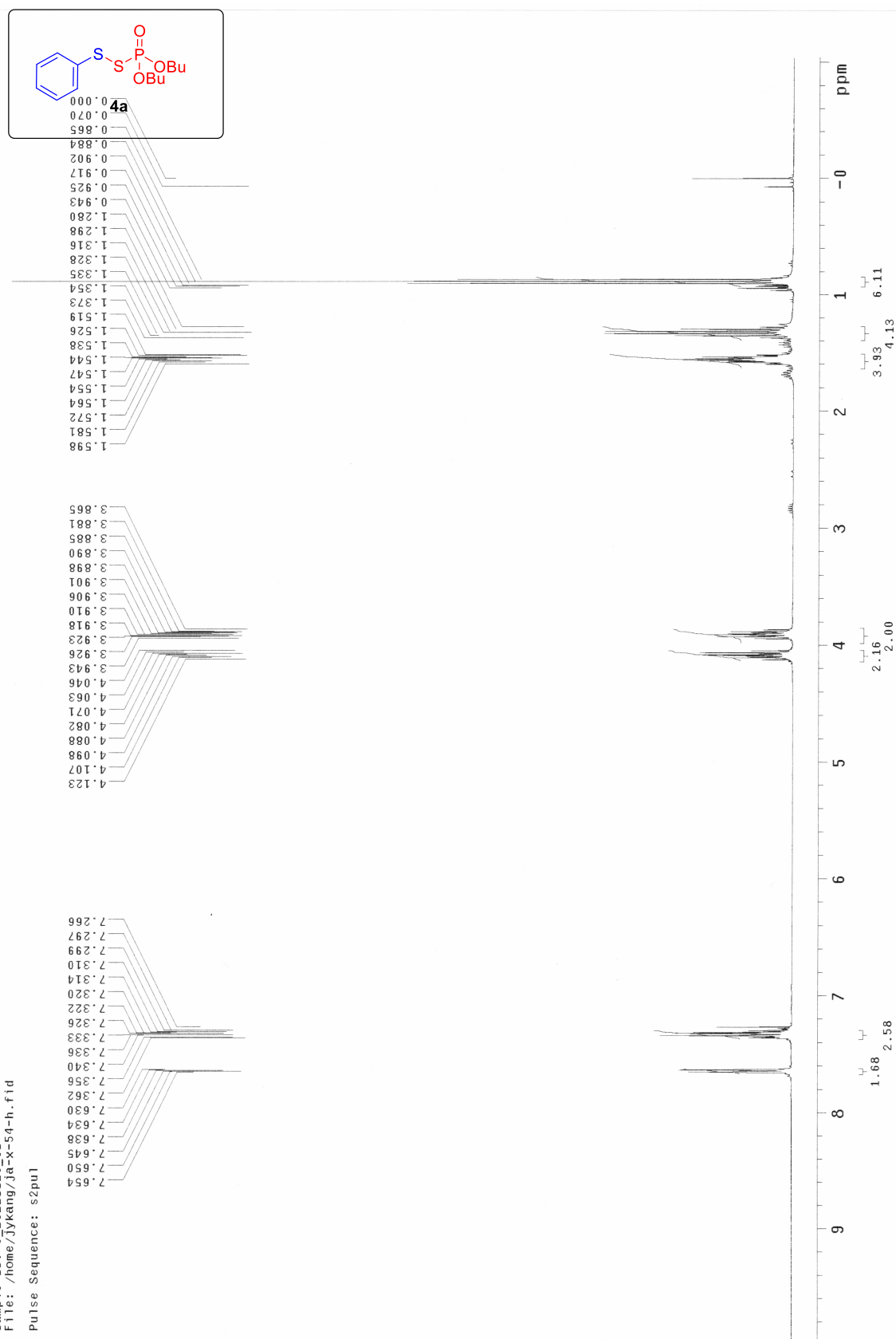
Sample: Ja-x-15-b
Sample ID: S_20221031_01
File: 0010.fid
Pulse Sequence: s2pul

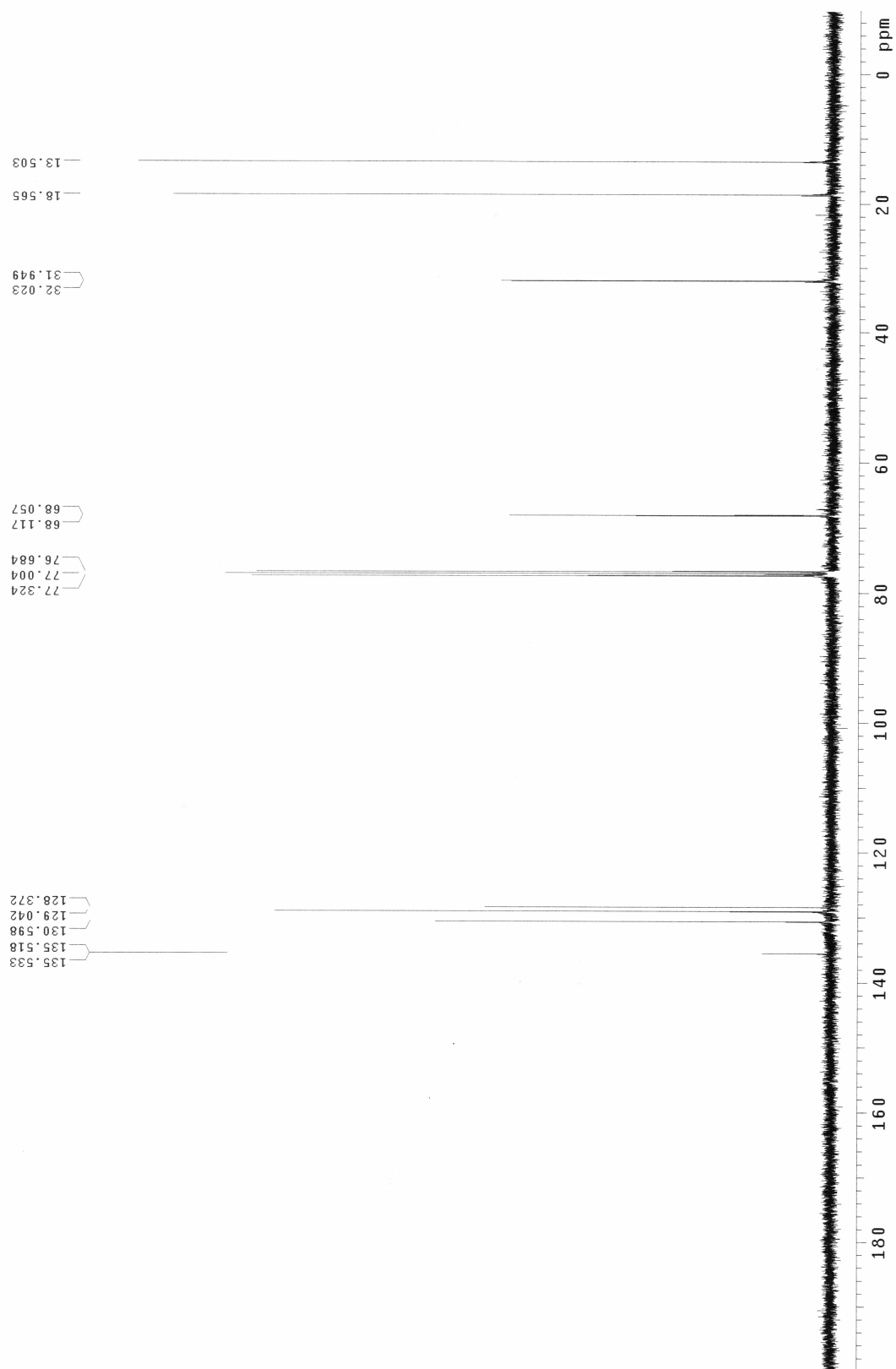
^{13}C NMR (100.5 MHz) in CDCl_3 

^{31}P NMR (162 MHz) in CDCl_3

Sample: Ja-x-15-p
File: exp
Pulse Sequence: s2pul
Solvent: cd3od
Temp. 25.0 C / 298.1 K
Operator: Jykang
VNMR-400 "Varian-NMR"
Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
10 repetitions
OBSERVE P31, 161.7710681 MHz
DECOUPLE H1, 399.6200193 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec



^1H NMR (400 MHz) in CDCl_3 

^{13}C NMR (100.5 MHz) in CDCl_3 

Sample: ja-x-54-c
Sample ID: S_20221129_02
File: /home/jykang/ja-x-54-c.fid
Pulse Sequence: s2pu1

^{31}P NMR (162 MHz) in CDCl_3

Sample: Ja-x-54-p
File: exp

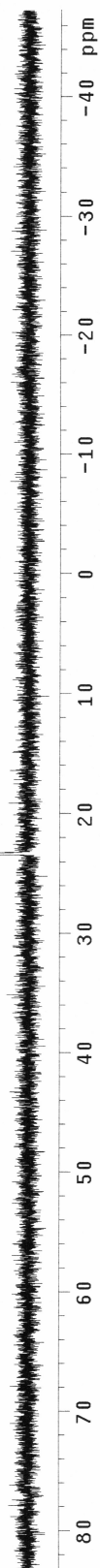
Pulse Sequence: s2pul

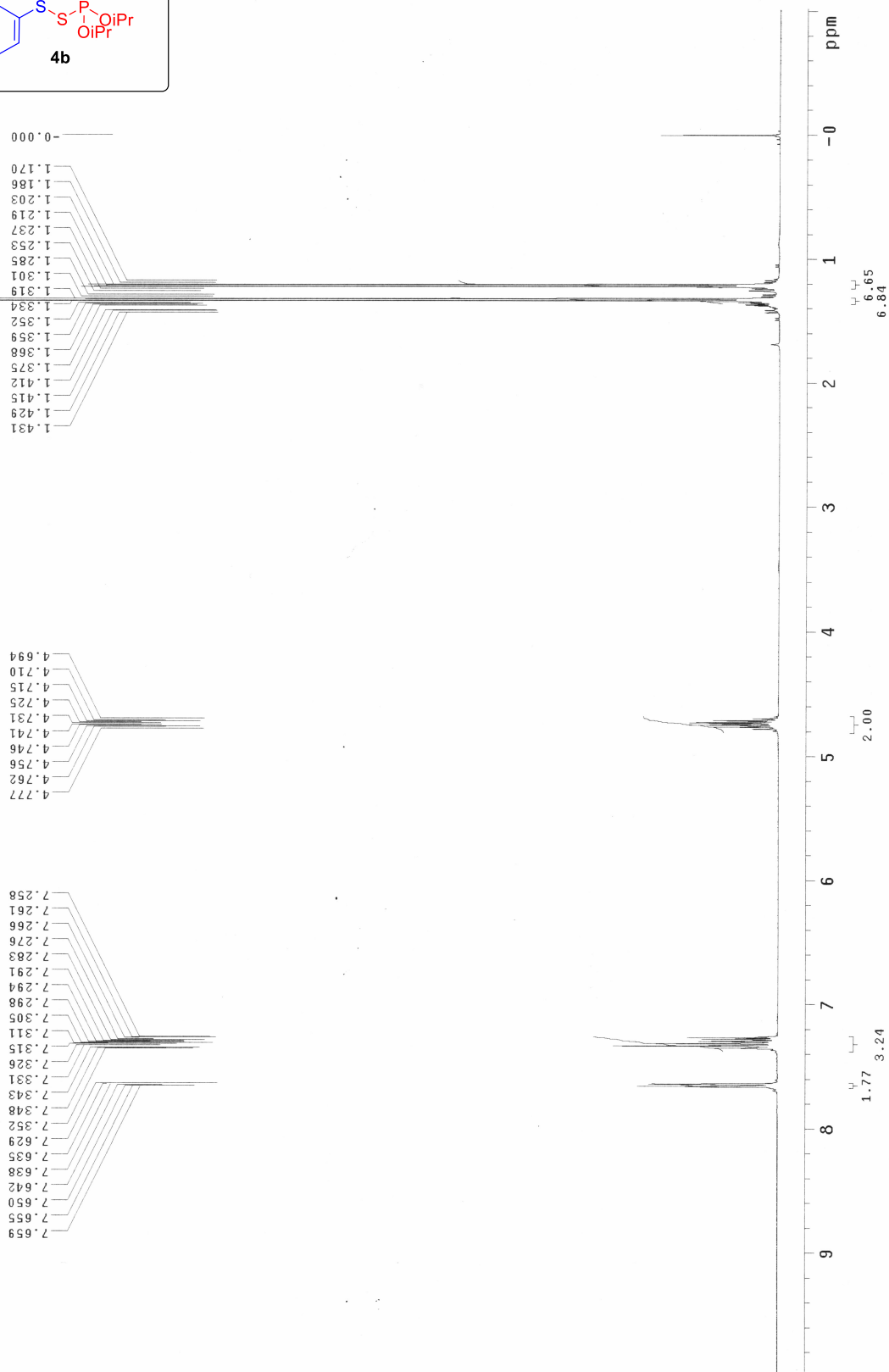
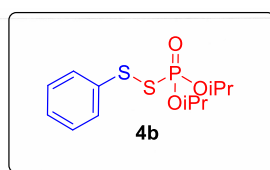
Solvent: cd3od
Temp. 25.0 C / 298.1 K
Operator: Jykang
VNMRK-400 "Varian-NMR"

Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz

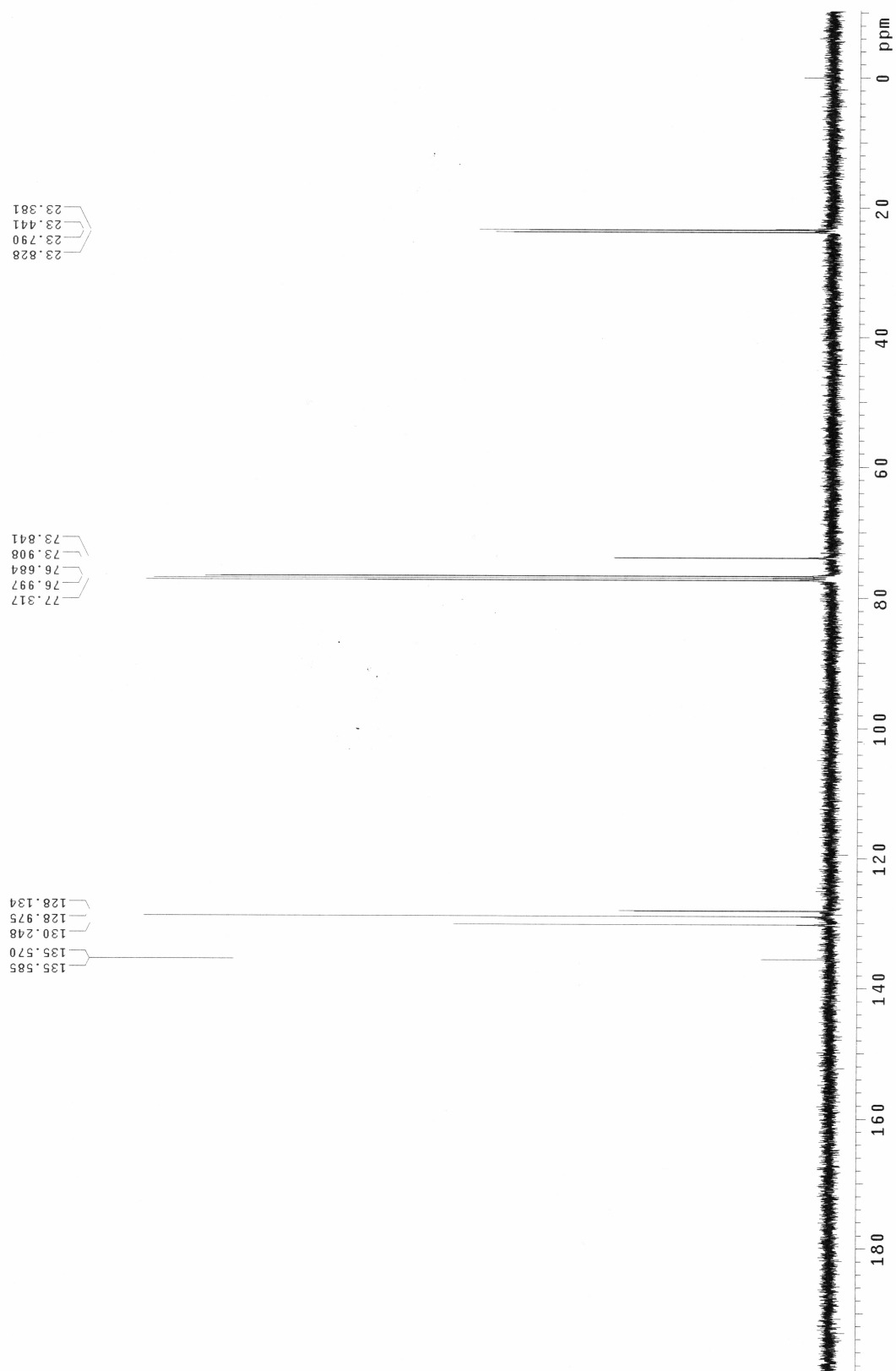
10 repetitions
OBSERVE P31, 161.7710681 MHz
DECOUPLE H1, 399.6200193 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 0 min, 26 sec

23.286



^1H NMR (400 MHz) in CDCl_3 

Sample: ja-x-55-h
Sample ID: s_20221129_03
File: /home/jykang/ja-x-55-h.fid
Pulse Sequence: zgpg30

^{13}C NMR (100.5 MHz) in CDCl_3 

Sample: ja-x-55-c
Sample ID: s_20221129_04
File: /home/jykang/ja-x-55-c.fid
Pulse Sequence: s2pul

^{31}P NMR (162 MHz) in CDCl_3

Sample: Ja-x-55-p
File: exp

Pulse Sequence: s2pul

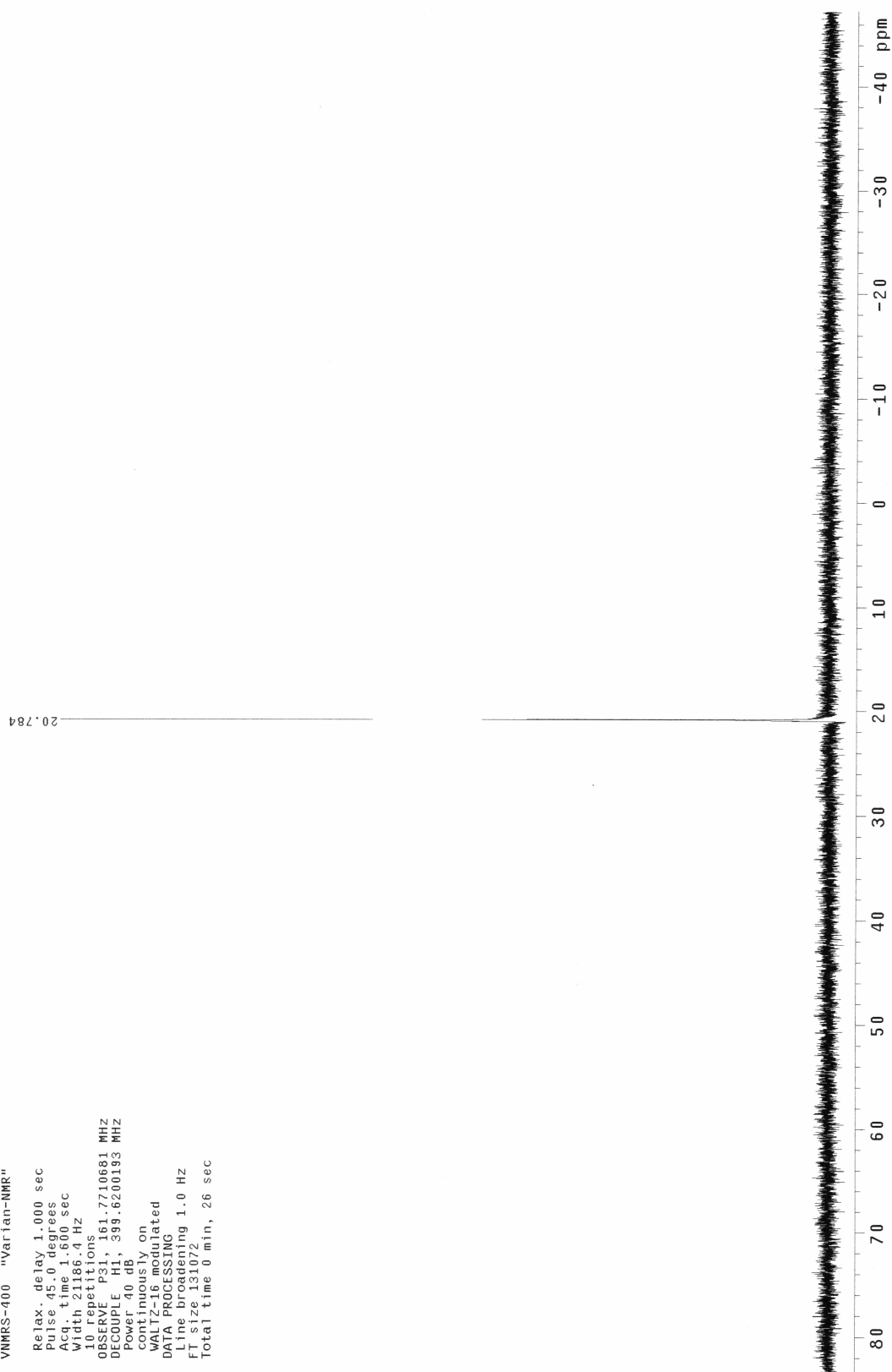
Solvent: cd3od
Temp: 25.0 C / 298.1 K
Operator: jykang
VNMR-400 "Varian-NMR"

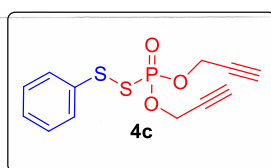
Relax.: delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
10 repetitions

OBSERVE P31, 161.7710681 MHz
DECOUPLE H1, 399.6200193 MHz
Power 40 dB
continuously on

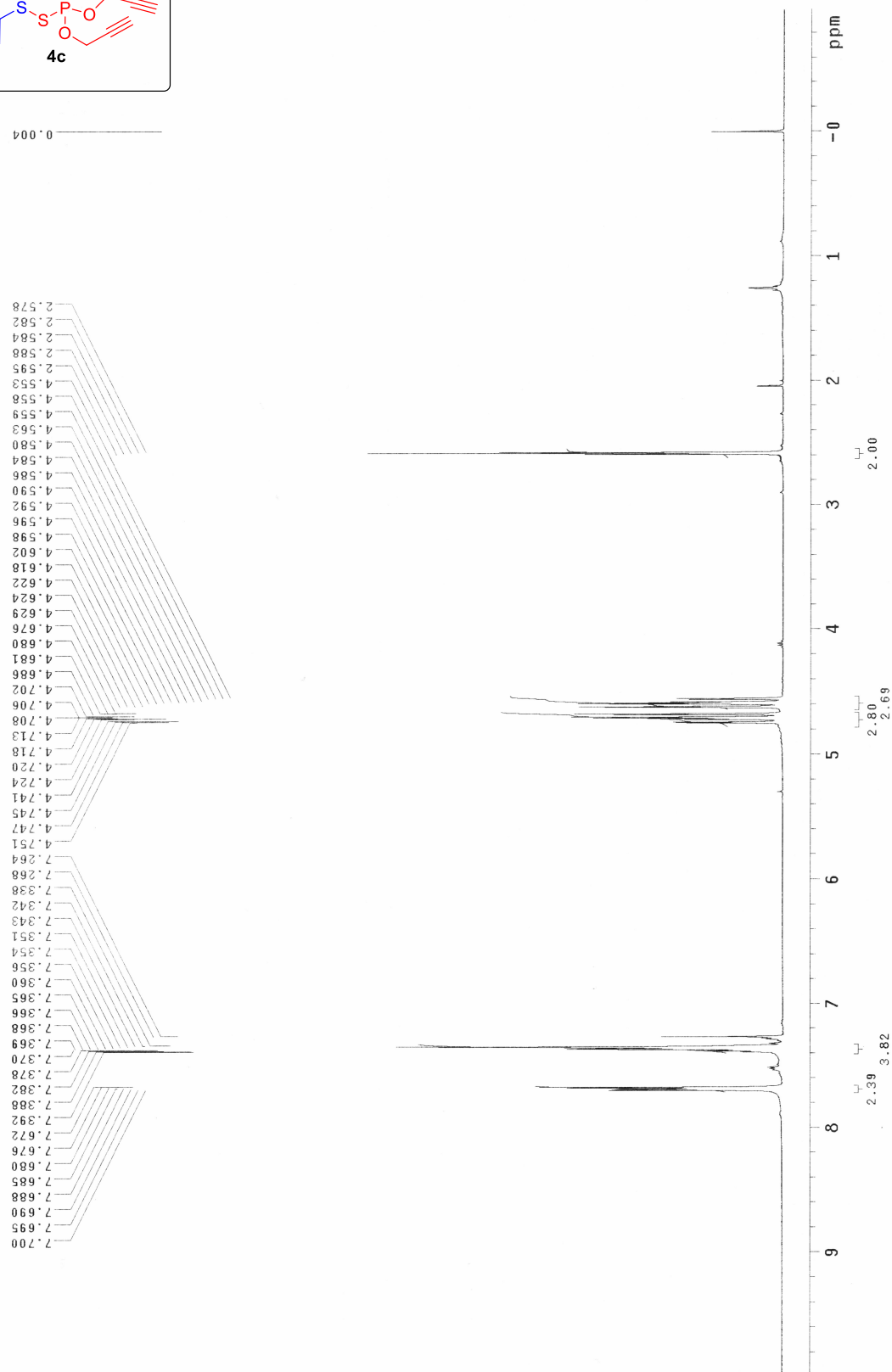
WALTZ-16 modulated
DATA PROCESSING

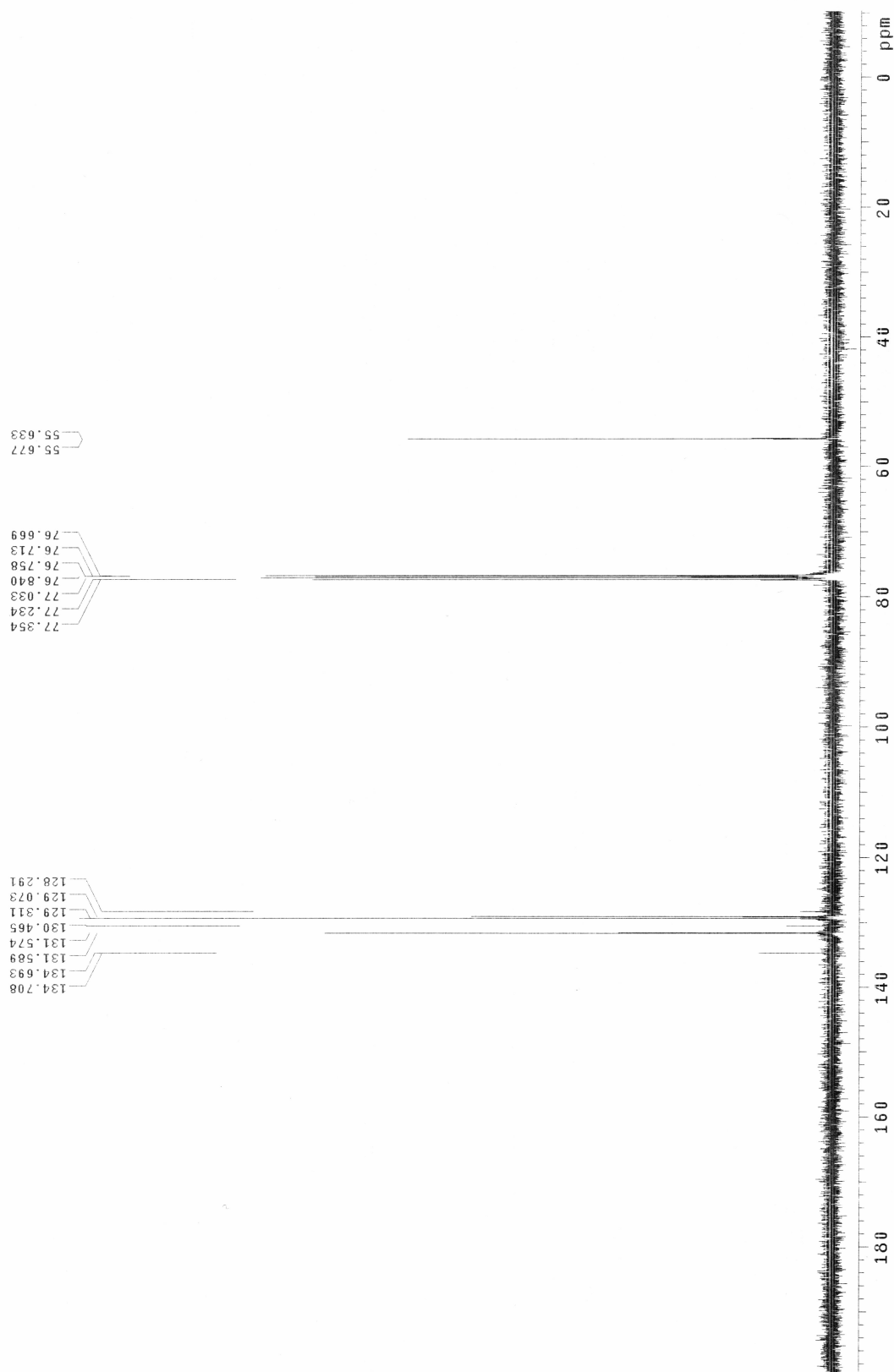
Line broadening 1.0 Hz
F1 size 131072
Total time 0 min, 26 sec



^1H NMR (400 MHz) in CDCl_3 

Sample: ja-xij-30-h
Sample ID: S_20240112_02
File: 0006.f1d
Pulse Sequence: s2pu1



^{13}C NMR (100.5 MHz) in CDCl_3 

Sample: ja-xii-30-c
Sample ID: s_20240112_03
File: 0007.fid
Pulse Sequence: s2bu1

^{31}P NMR (162 MHz) in CDCl_3

Sample: ja-xii-30-p
File: /home/jykang/ja-xii-30-p.fid

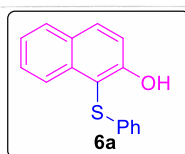
Pulse Sequence: s2pul

Solvent: cdc13
Temp: 25.0 C / 298.1 K
Operator: jykang
File: ja-xii-30-p
VNMRS-400 "Varian-NMR"

Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
16 repetitions
OBSERVE P31, 161.7658777 MHz
DECOUPLE H1, 399.6184448 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FI size 131072
Total time 0 min, 42 sec

25.291

110 100 90 80 70 60 50 40 30 20 10 0 -10 ppm

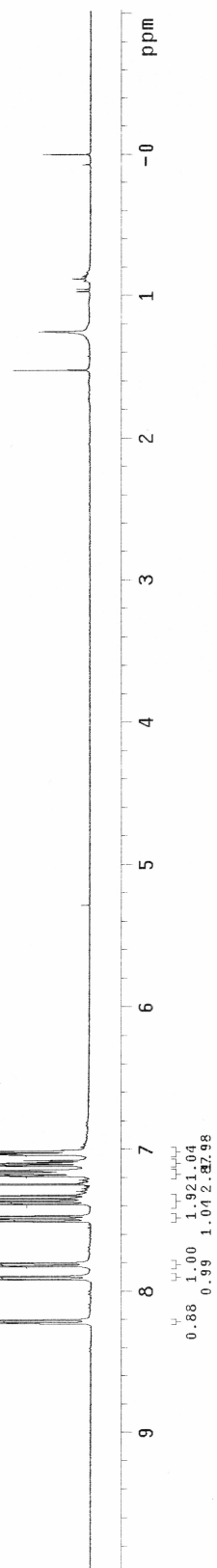
^1H NMR (400 MHz) in CDCl_3 

Sample: ja-xii-42-h
Sample ID: s_20240208_01
File: 0003.fid

Pulse Sequence: s2pu1

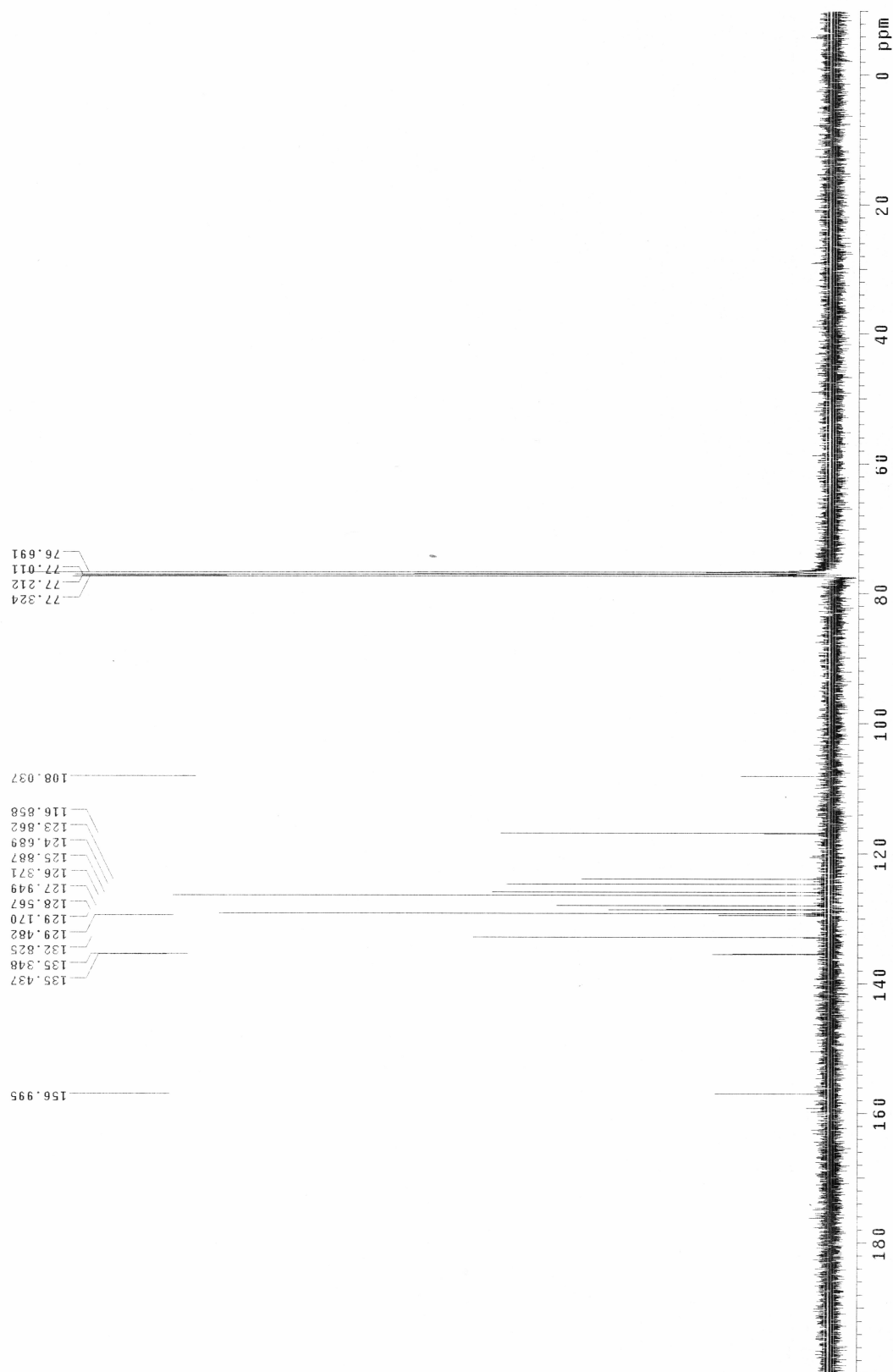
8.224
8.203
7.916
7.894
7.822
7.802
7.510
7.507
7.492
7.489
7.485
7.471
7.468
7.388
7.385
7.370
7.367
7.365
7.349
7.326
7.248
7.190
7.187
7.182
7.167
7.154
7.150
7.144
7.119
7.116
7.113
7.098
7.080
7.037
7.033
7.028
7.018
7.015
7.013

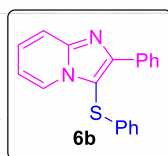
1.525



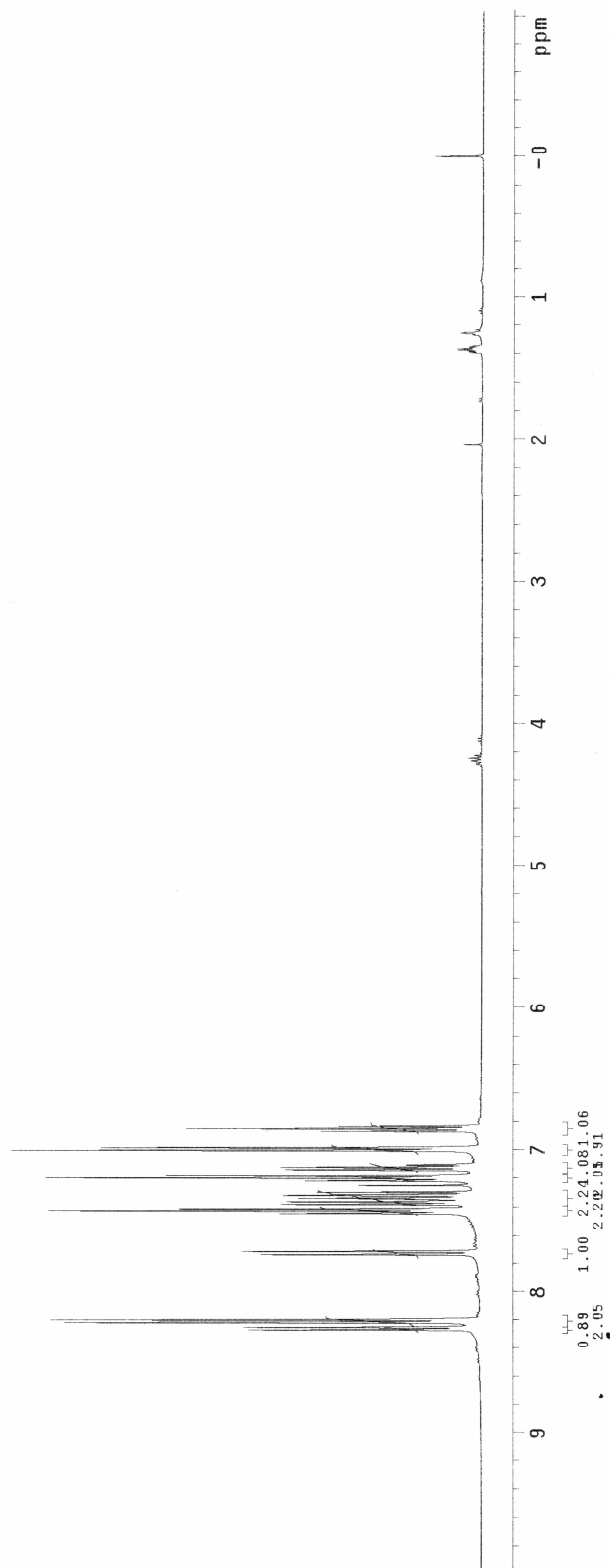
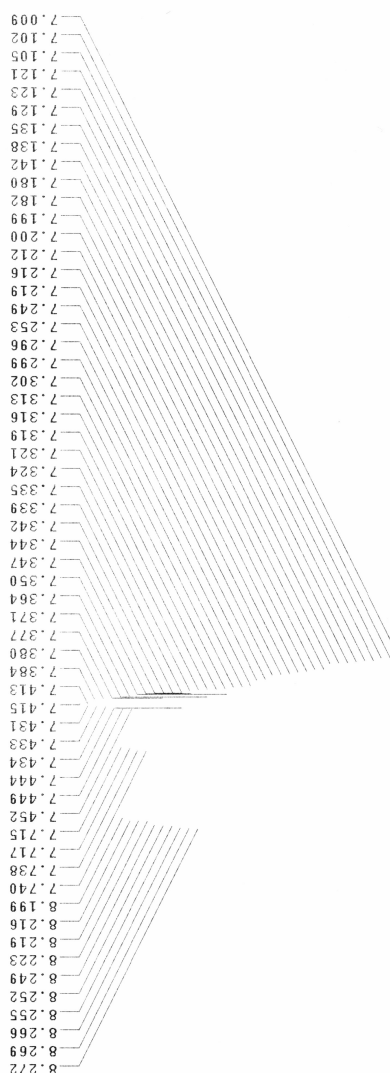
^{13}C NMR (100.5 MHz) in CDCl_3

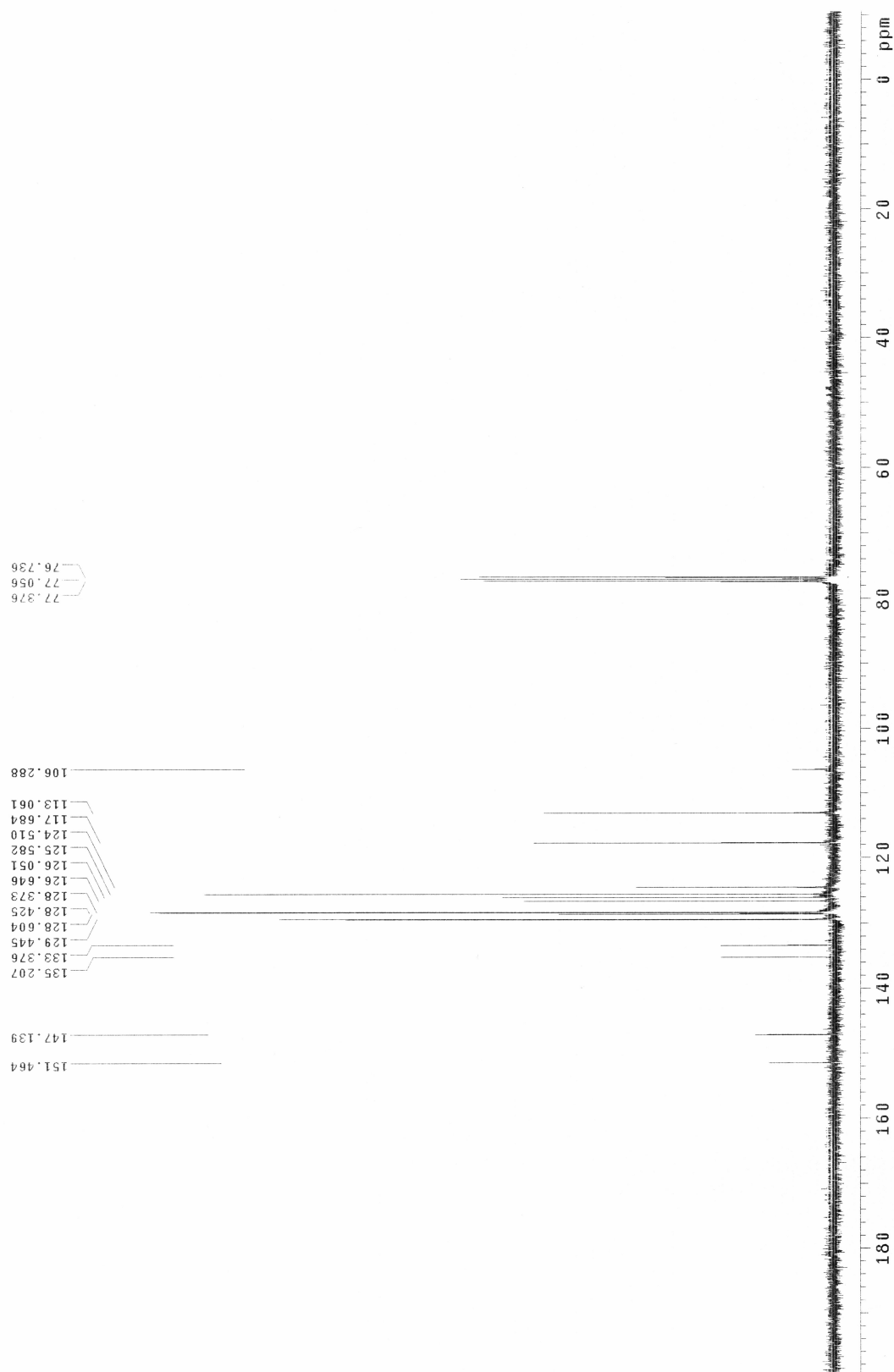
Sample: ja-xji-02-C
Sample ID: S_20240208_02
File: 0004.fid
Pulse Sequence: s2pu1



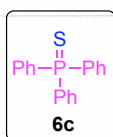
^1H NMR (400 MHz) in CDCl_3 

Sample: Ja-xii-31-h
Sample ID: s_20240119_01
File: 0003.f1d
Pulse Sequence: s2pul



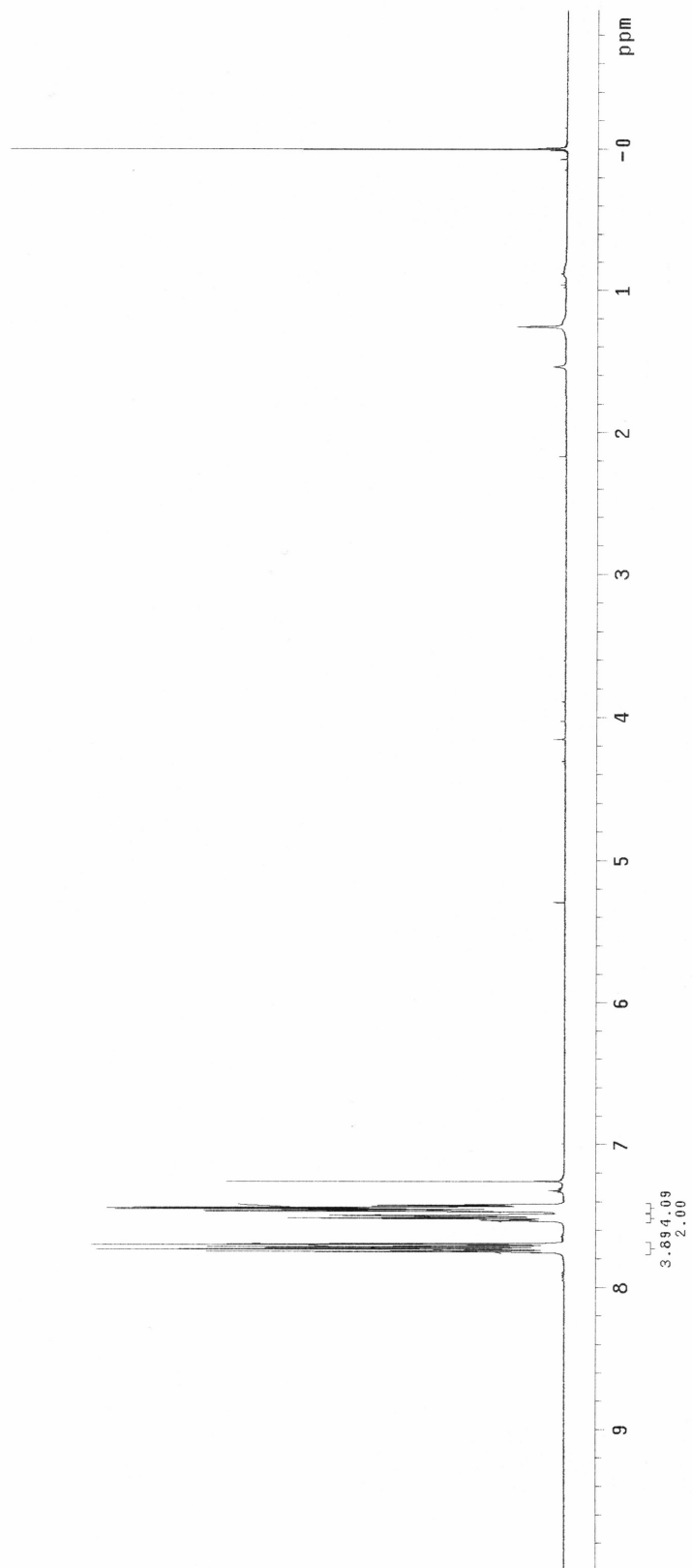
^{13}C NMR (100.5 MHz) in CDCl_3 

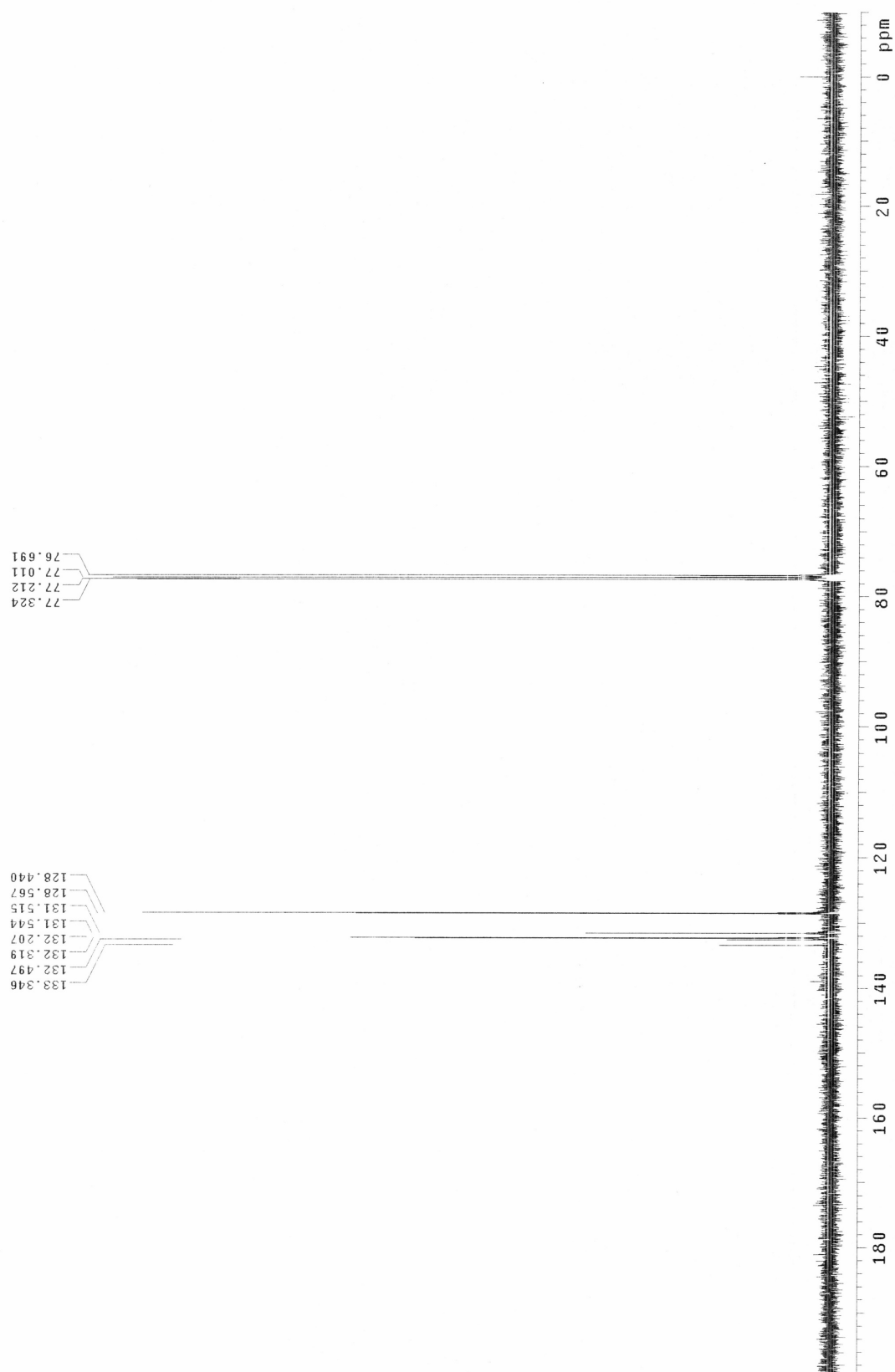
Sample: Je-xii-31-c
Sample ID: s_20240119_02
File: 0004.fId
Pulse Sequence: s2pul

^1H NMR (400 MHz) in CDCl_3 

Sample: ja-xij-50-h
Sample ID: S_20240229_01
File: 0006.fid
Pulse Sequence: s2pu1

7.750
7.747
7.743
7.735
7.730
7.726
7.717
7.714
7.710
7.702
7.696
7.693
7.594
7.529
7.516
7.510
7.505
7.497
7.492
7.489
7.470
7.465
7.462
7.458
7.455
7.450
7.447
7.443
7.439
7.434
7.429
7.426
7.421
7.418
7.258

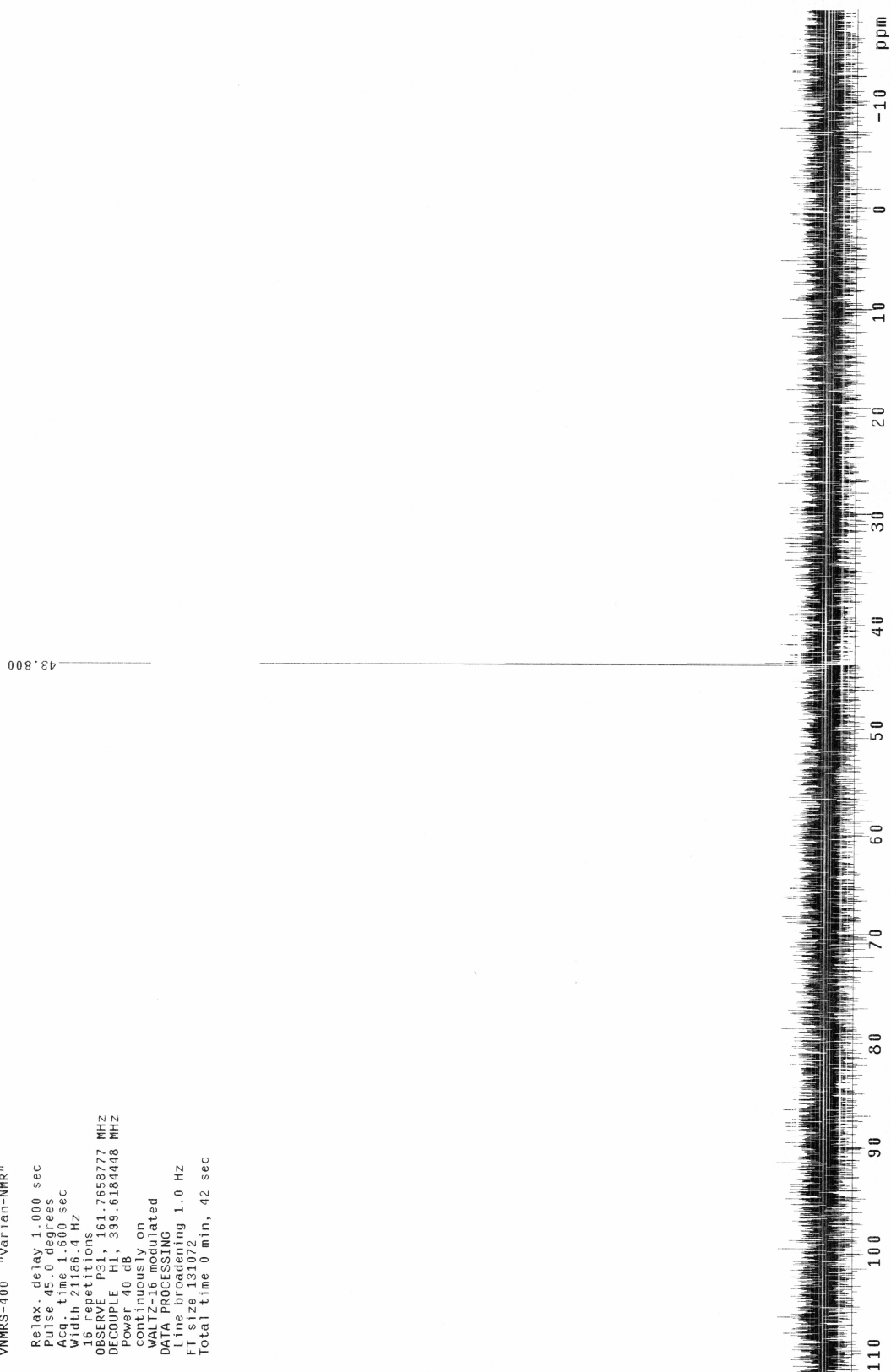


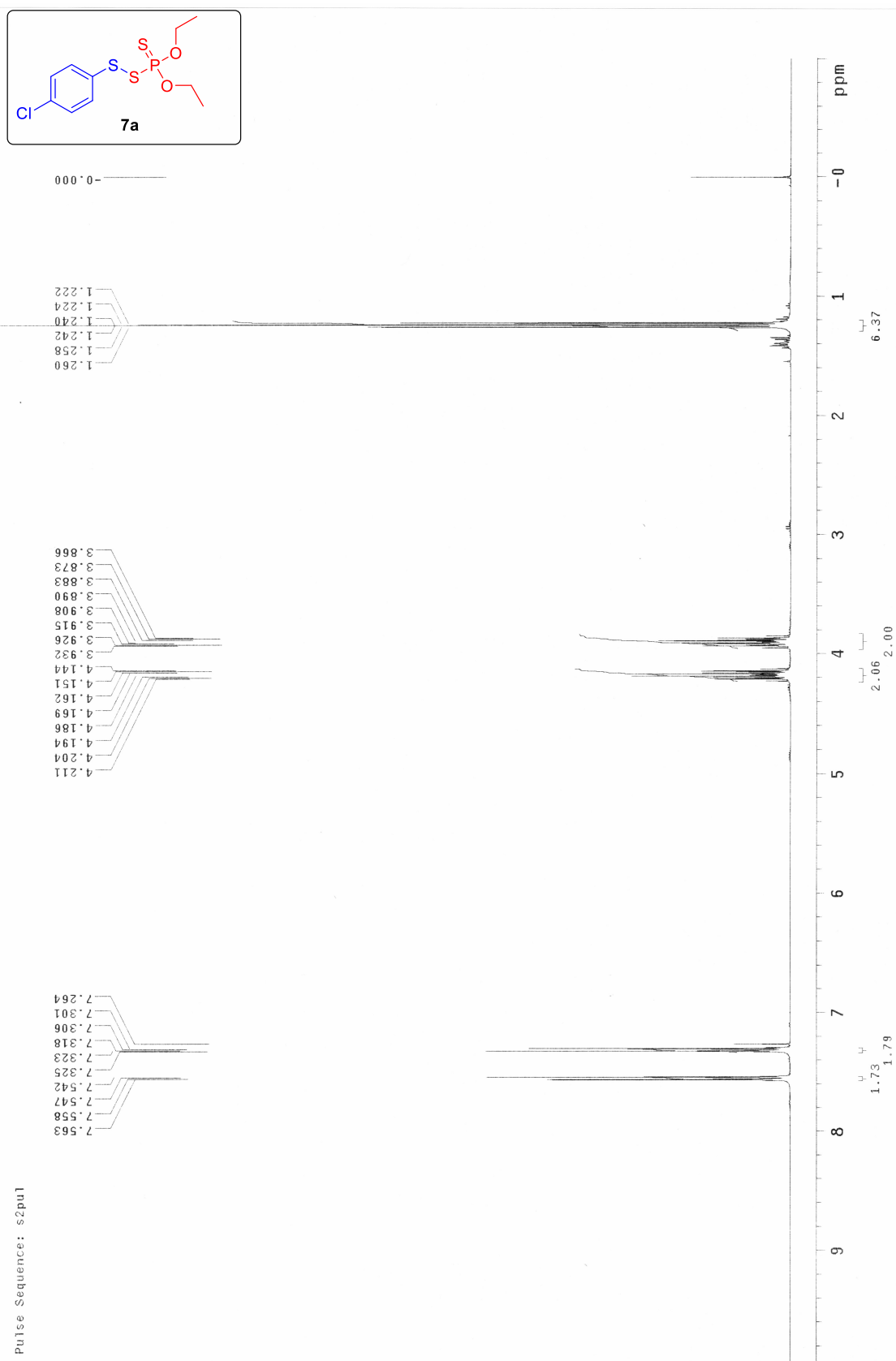
^{13}C NMR (100.5 MHz) in CDCl_3 

Sample: Ja-X11-50-C
Sample ID: s_20240229_02
File: 0007.fid
Pulse Sequence: s2pul1

^{31}P NMR (162 MHz) in CDCl_3

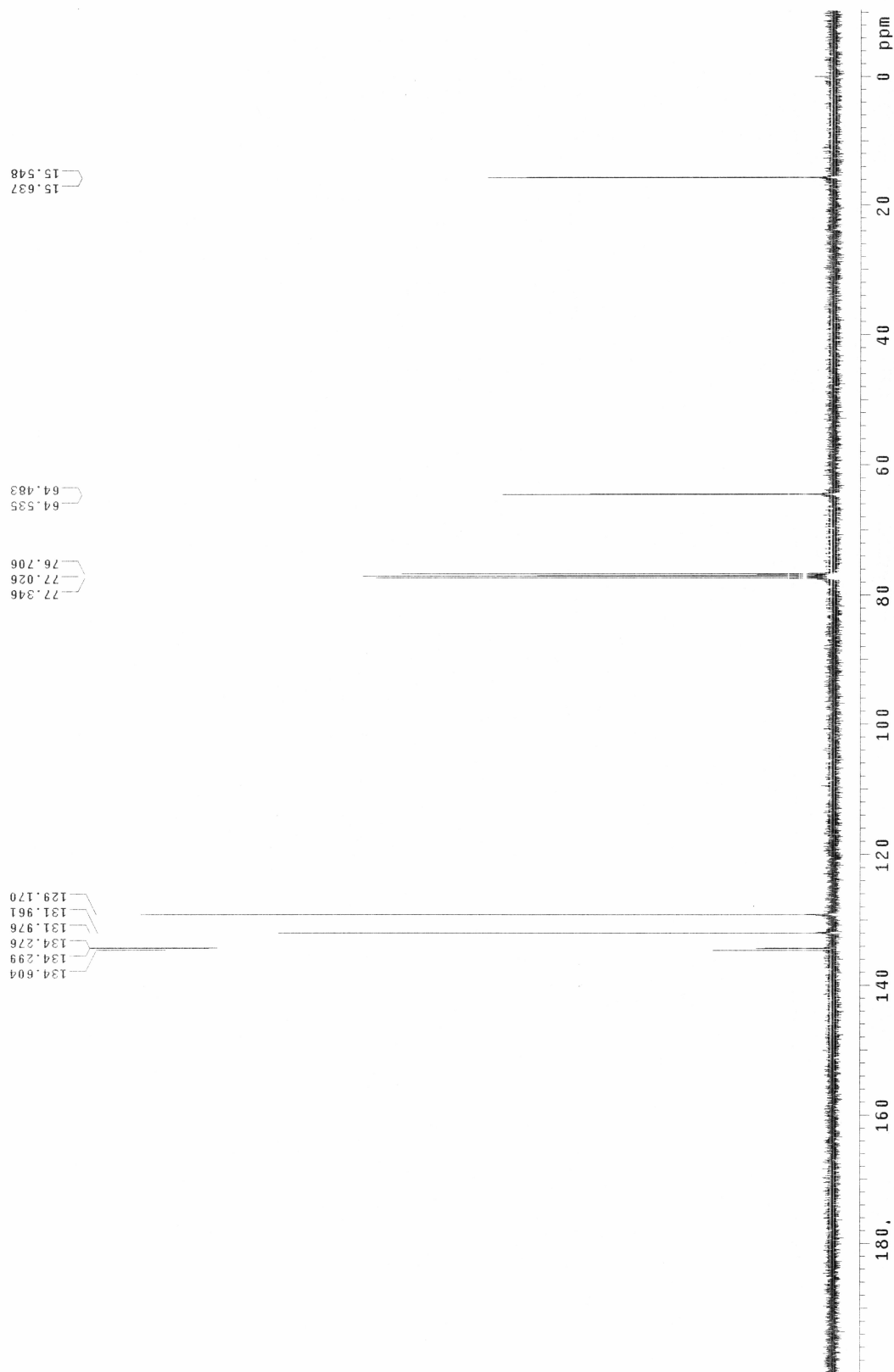
Sample: ja-xii-50-p
File: exp
Pulse Sequence: s2pul
Solvent: cdc13
Temp: 25.0 C / 298.1 K
Operator: JyKang
VNMRK-400 "Varian-NMR"
Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
16 repetitions
OBSERVE P31, 161.7658777 MHz
DECOUPLE H1, 399.6184448 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
F1 size 131072
Total time 0 min, 42 sec



^1H NMR (400 MHz) in CDCl_3 

^{13}C NMR (100.5 MHz) in CDCl_3

Sample: ja-xii-62-c
Sample ID: s_20240228_02
File: 0002.f1d
Pulse Sequence: s2pul



^{31}P NMR (162 MHz) in CDCl_3

Sample: ja-xii-62-p
File: exp

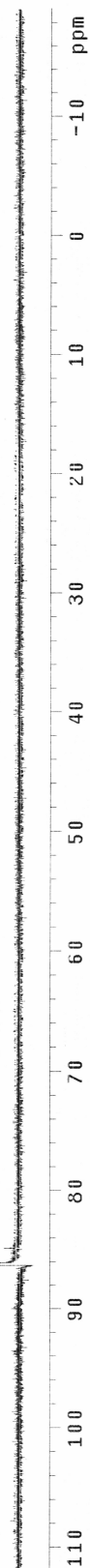
Pulse Sequence: s2pul
Solvent: cdcl3
Temp: 25.0 C / 298.1 K
Operator: Jykang
VNMR-400 "Varian-NMR"

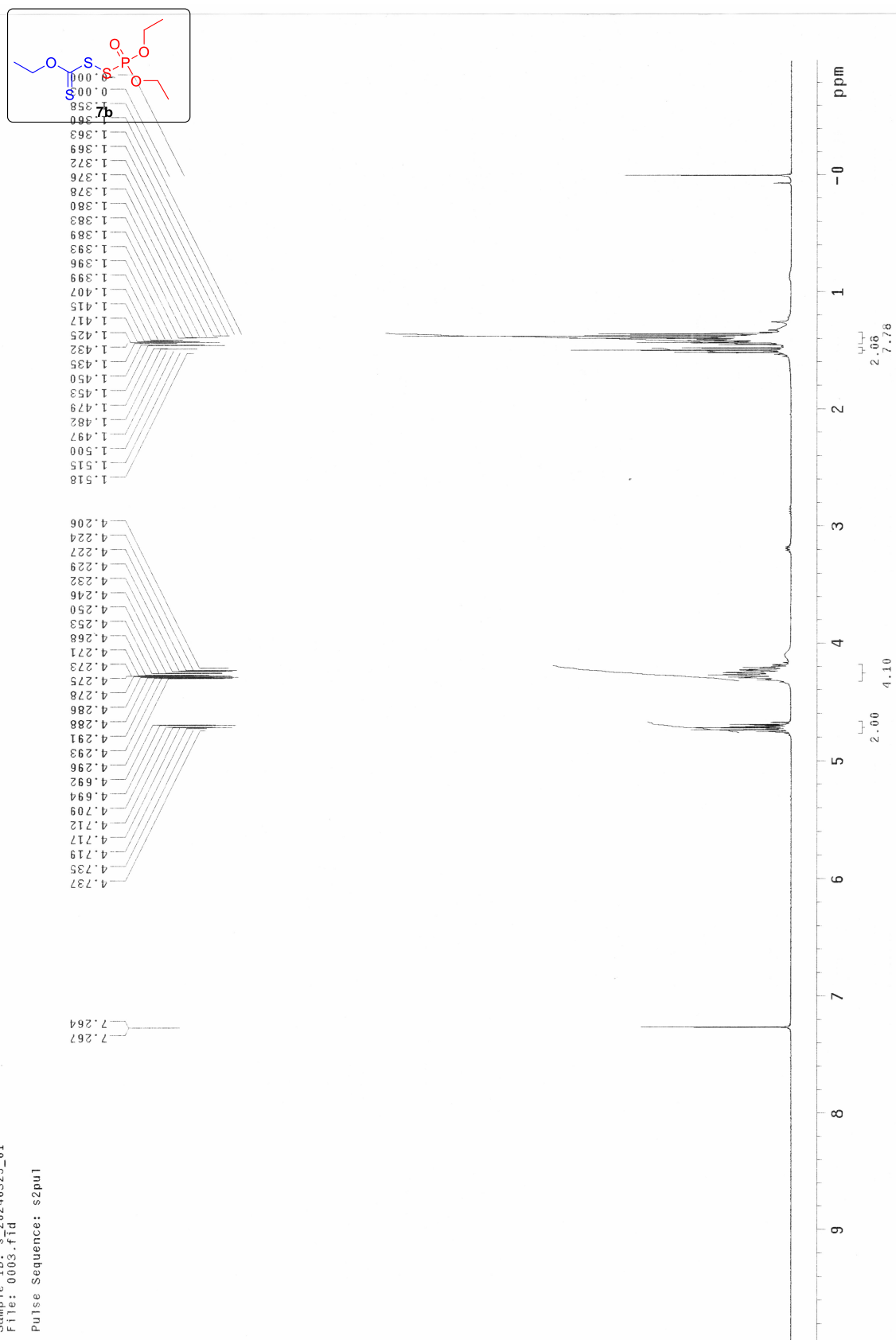
Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
16 repetitions

Observed ^{31}P 161.7658777 MHz
Decouple ^1H 399.018448 MHz

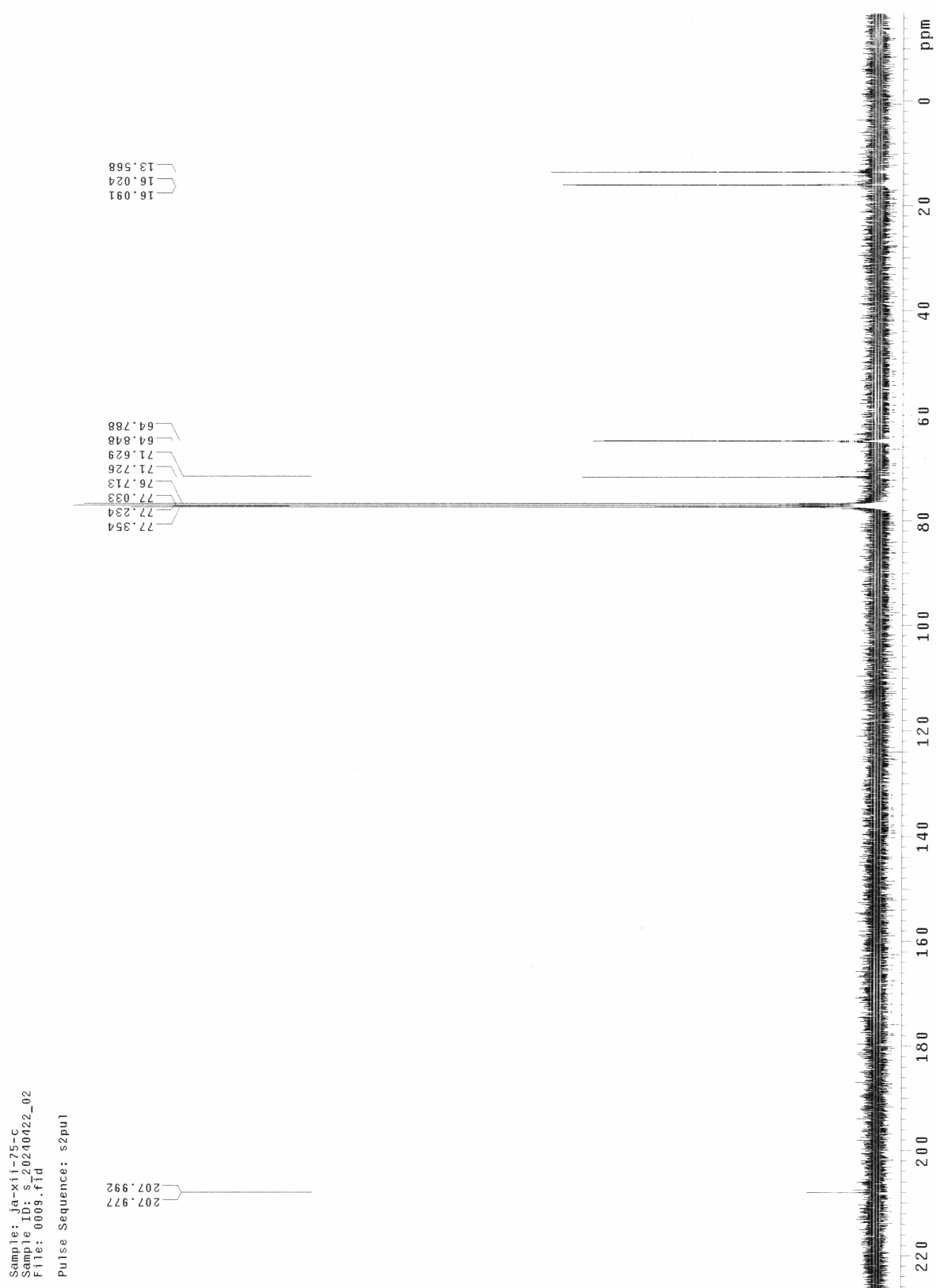
Continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FI size 131072
Total time 0 min, 42 sec

86.247



^1H NMR (400 MHz) in CDCl_3 

Sample: Ja-xii-75-h
Sample ID: S20240325_01
File: 0003.fid
Pulse Sequence: s2pul

^{13}C NMR (100.5 MHz) in CDCl_3 

^{31}P NMR (162 MHz) in CDCl_3

Sample: ja-xii-75-p
File: exp

Pulse Sequence: s2pul

Solvent: cdCl_3
Temp: 25.0 C / 298.1 K
Operator: Jykang
VNMR-400 "Varian-NMR"

Relax. delay 1.000 sec
Pulse 45.0 degrees
Acq. time 1.600 sec
Width 21186.4 Hz
64 repetitions
OBSERVE P31, 161.7652379 MHz
DECOUPLE H1, 399.6184448 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 2 min, 47 sec

