

# Supplementary Materials

## Synthesis and Cytotoxic Activity of a New Family of $\alpha$ -Hydroxyphosphonates with the Benzothiophene Scaffold

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**1. Geometrical data for 7-chlorobenzothiophenyl- $\alpha$ -hydroxy-methylphosphonate (2f) obtained from the X-ray measurements**

**SI Table 1.** Selected bond lengths (Å) of hydroxy-methylphosphonate **2f**.

S1 – C9	1.730(2)	C1A – O4B	1.392(3)
S1 – C2	1.742(2)	C5 – C6	1.386(3)
C3 – C2	1.352(3)	P1A – O3A	1.480(6)
C3 – C4	1.436(2)	P1A – O2A	1.534(4)
Cl1 – C8	1.732(2)	P1A – O1A	1.569(4)
C7 – C8	1.374(3)	P1A – C1A	1.824(3)
C7 – C6	1.403(3)	O2A – C12A	1.421(1)
C9 – C8	1.396(2)	C12A – C13A	1.540(1)
C9 – C4	1.405(2)	O1A – C10A	1.433(5)
C4 – C5	1.401(2)	C10A – C11A	1.496(6)
C2 – C1A	1.506(2)		

**SI Table 2.** Selected bond angles (°) of hydroxy-methylphosphonate **2f**.

C9 – S1 – C2	90.6(1)	C5 – C6 – C7	121.3(2)
C2 – C3 – C4	113.3(2)	O4B – C1A – C2	111.1(2)
C8 – C7 – C6	119.8(2)	O4B – C1A – P1A	110.3(2)
C8 – C9 – C4	120.4(2)	C2 – C1A – P1A	114.9(1)
C8 – C9 – S1	127.1(1)	O3A – P1A – O2A	113.8(2)
C4 – C9 – S1	112.5(1)	O3A – P1A – O1A	113.6(2)
C5 – C4 – C9	119.7(2)	O2A – P1A – O1A	105.5(2)
C5 – C4 – C3	129.6(2)	O3A – P1A – C1A	113.4(3)
C9 – C4 – C3	110.7(2)	O2A – P1A – C1A	105.9(2)
C3 – C2 – C1A	129.3(2)	O1A – P1A – C1A	103.7(2)
C3 – C2 – S1	112.9(1)	C12A – O2A – P1A	125.1(3)
C1A – C2 – S1	117.8(1)	O2A – C12A – C13A	107.7(5)
C6 – C5 – C4	118.9(2)	C10A – O1A – P1A	122.8(3)
C7 – C8 – C9	119.9(2)	O1A – C10A – C11A	109.5(4)
C7 – C8 – Cl1	120.9(1)	C9 – C8 – Cl1	119.2(1)

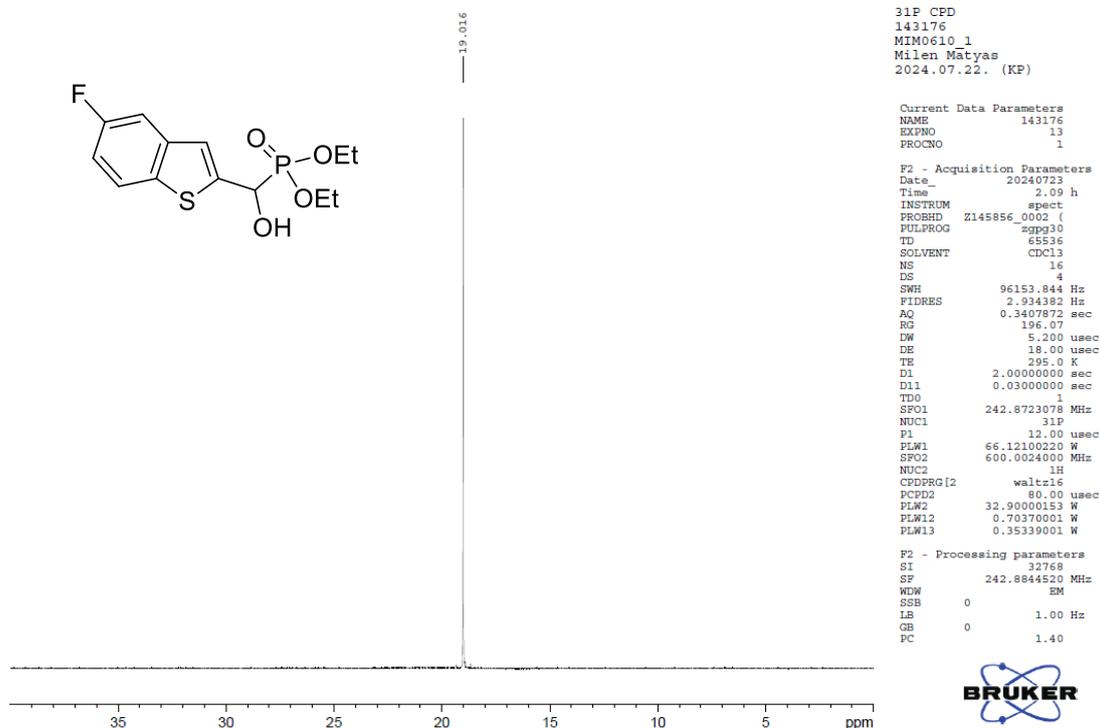
**SI Table 3.** Selected torsion angles (°) of hydroxy-methylphosphonate **2f**.

C2 – S1 – C9 – C8	178.4(2)	C4 – C5 – C6 – C7	-0.1(3)
C2 – S1 – C9 – C4	-0.7(1)	C8 – C7 – C6 – C5	0.3(3)
C8 – C9 – C4 – C5	1.2(2)	C3 – C2 – C1A – O4B	170.6(2)
S1 – C9 – C4 – C5	-179.6(1)	S1 – C2 – C1A – O4B	-8.2(2)
C8 – C9 – C4 – C3	-178.5(2)	C3 – C2 – C1A – P1A	-63.4(2)
S1 – C9 – C4 – C3	0.7(2)	S1 – C2 – C1A – P1A	117.8(2)
C2 – C3 – C4 – C5	-180.0(2)	O3A – P1A – C1A – O4B	-53.5(2)
C2 – C3 – C4 – C9	-0.4(2)	O2A – P1A – C1A – O4B	72.0(2)
C4 – C3 – C2 – C1A	-179.0(2)	O1A – P1A – C1A – O4B	-177.2(2)
C4 – C3 – C2 – S1	-0.2(2)	O3A – P1A – C1A – C2	-179.9(2)
C9 – S1 – C2 – C3	0.5(1)	O2A – P1A – C1A – C2	-54.4(2)
C9 – S1 – C2 – C1A	179.5(1)	O1A – P1A – C1A – C2	56.4(2)
C9 – C4 – C5 – C6	-0.6(2)	O1A – P1A – O2A – C12A	160.1(5)
C3 – C4 – C5 – C6	178.9(2)	C1A – P1A – O2A – C12A	-90.3(5)
C6 – C7 – C8 – C9	0.2(3)	P1A – O2A – C12A – C13A	-138.2(6)
C6 – C7 – C8 – C11	-178.1(1)	O3A – P1A – O1A – C10A	43.1(5)
C4 – C9 – C8 – C7	-1.0(3)	O2A – P1A – O1A – C10A	-82.2(4)
S1 – C9 – C8 – C7	180.0(1)	C1A – P1A – O1A – C10A	166.7(3)
C4 – C9 – C8 – C11	177.3(1)	P1A – O1A – C10A – C11A	121.7(5)
S1 – C9 – C8 – C11	-1.7(2)	O3A – P1A – O2A – C12A	34.9(6)

## 2. $^{31}\text{P}$ , $^{13}\text{C}$ , $^1\text{H}$ NMR and IR spectra for the hydroxy-methylphosphonates 2a-w synthesized

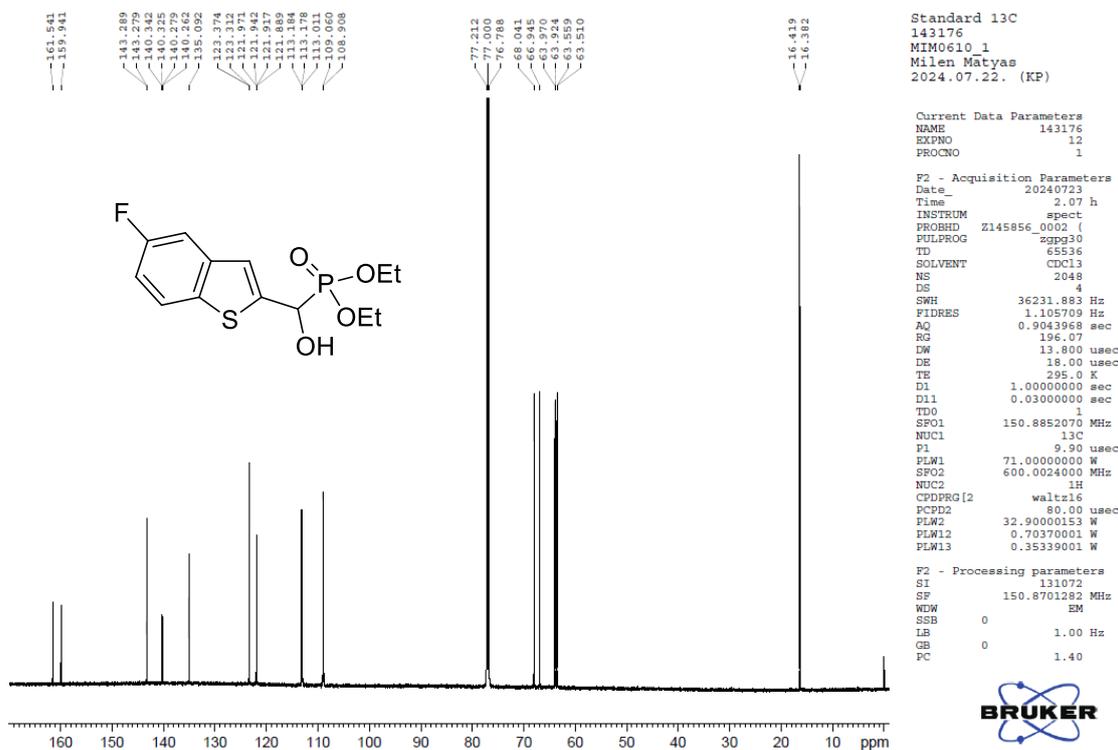
### $^{31}\text{P}$ NMR (242 MHz, $\text{CDCl}_3$ ) spectra for compound 2a

2a



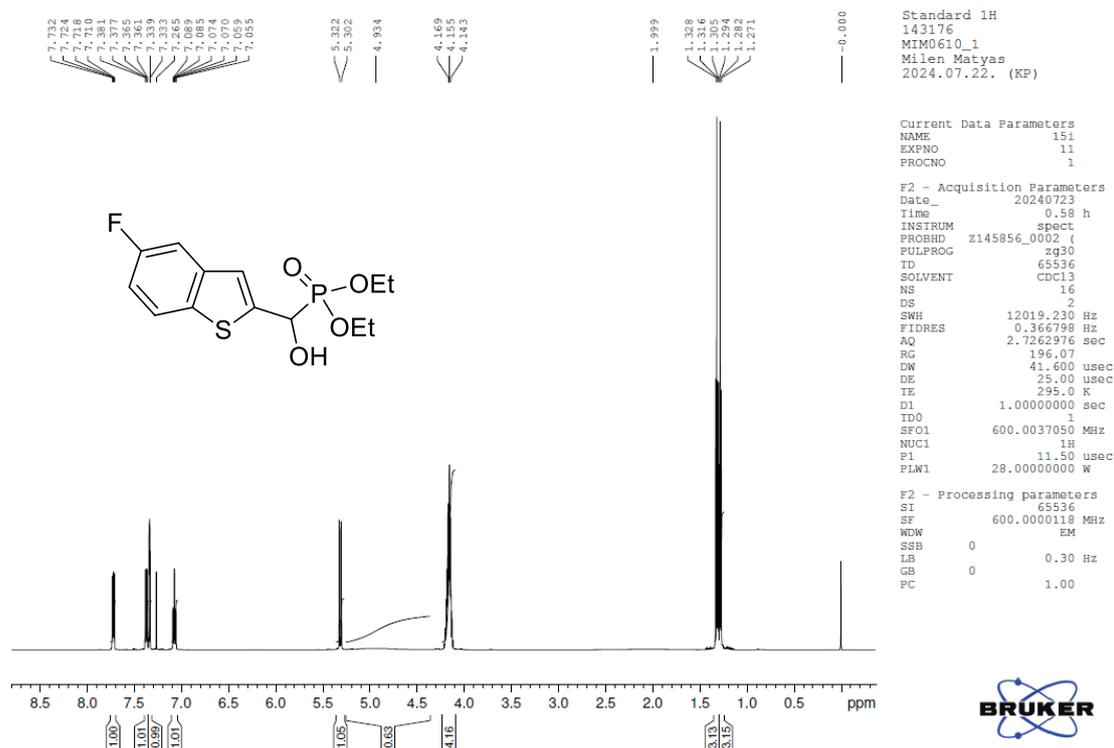
### $^{13}\text{C}$ NMR (150 MHz, $\text{CDCl}_3$ ) spectra for compound 2a

2a



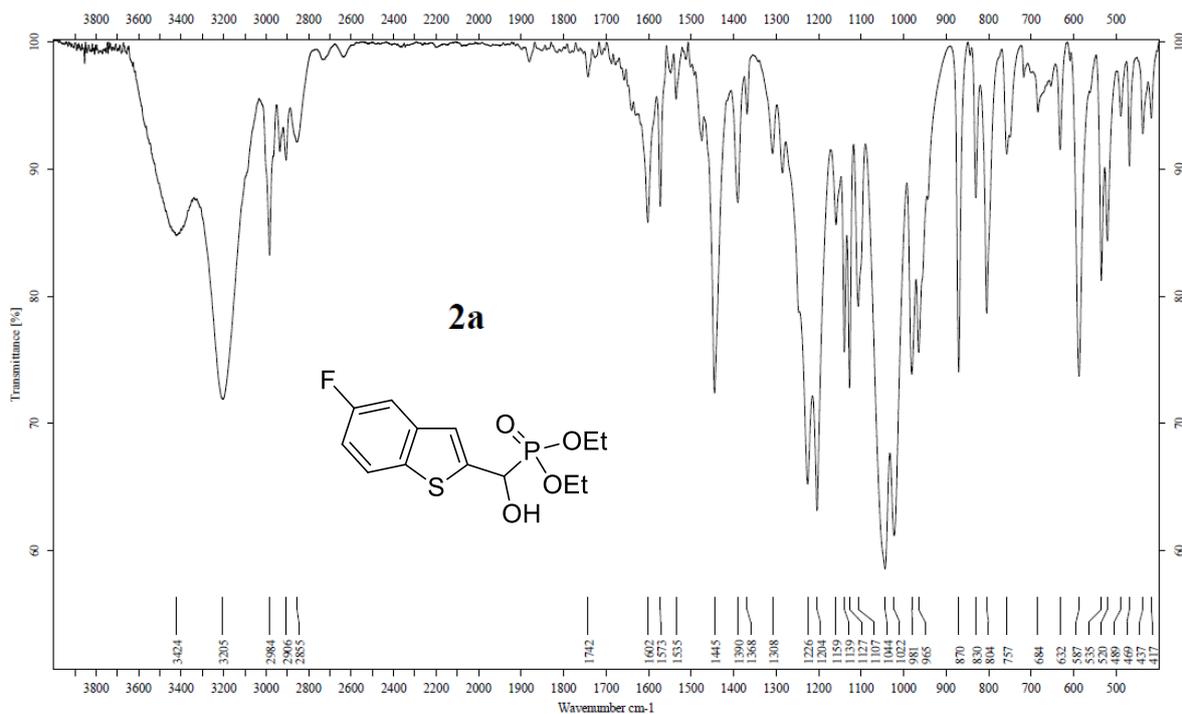
# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2a

2a

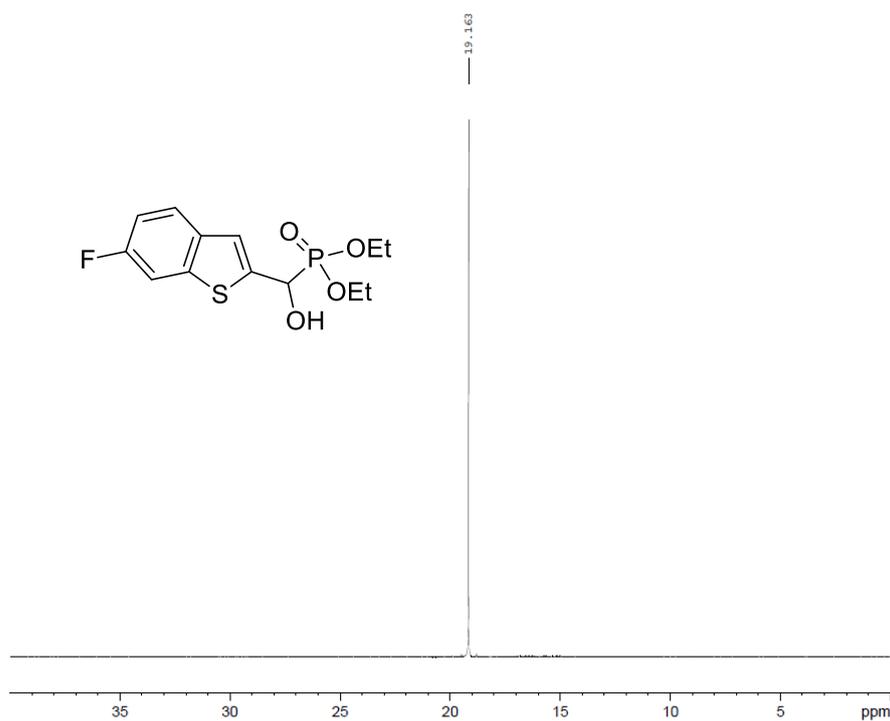


# IR (KBr) spectra for compound 2a

143176	Milen Matyas	PZ	BRUKER Alpha
MIM0610_1	KBr	7/22/2024	Resolution: 2 cm-1
			Number of Scans: 16



**<sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2b**



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143469  
MIM0631\_1  
Milen Matyas  
2024.09.09. (KP)

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PROCNO 1

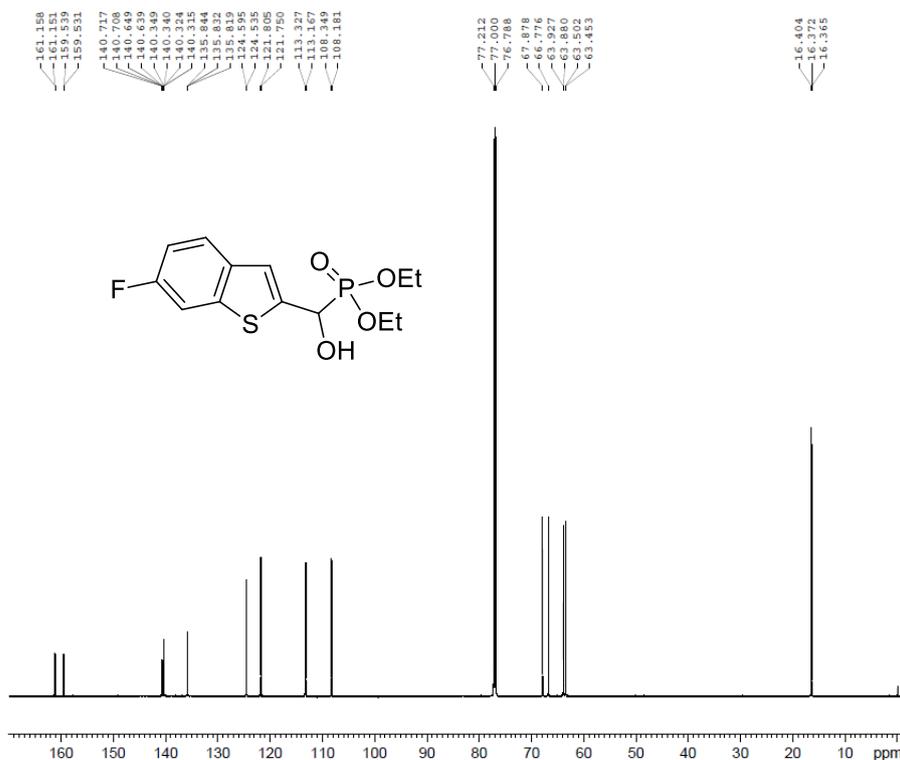
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SFO2 600.0024000 MHz  
NUC2 1H  
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F2 - Processing parameters  
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**<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2b**

**2b**



Standard 13C  
143469  
MIM0631\_1  
Milen Matyas  
2024.09.09. (KP)

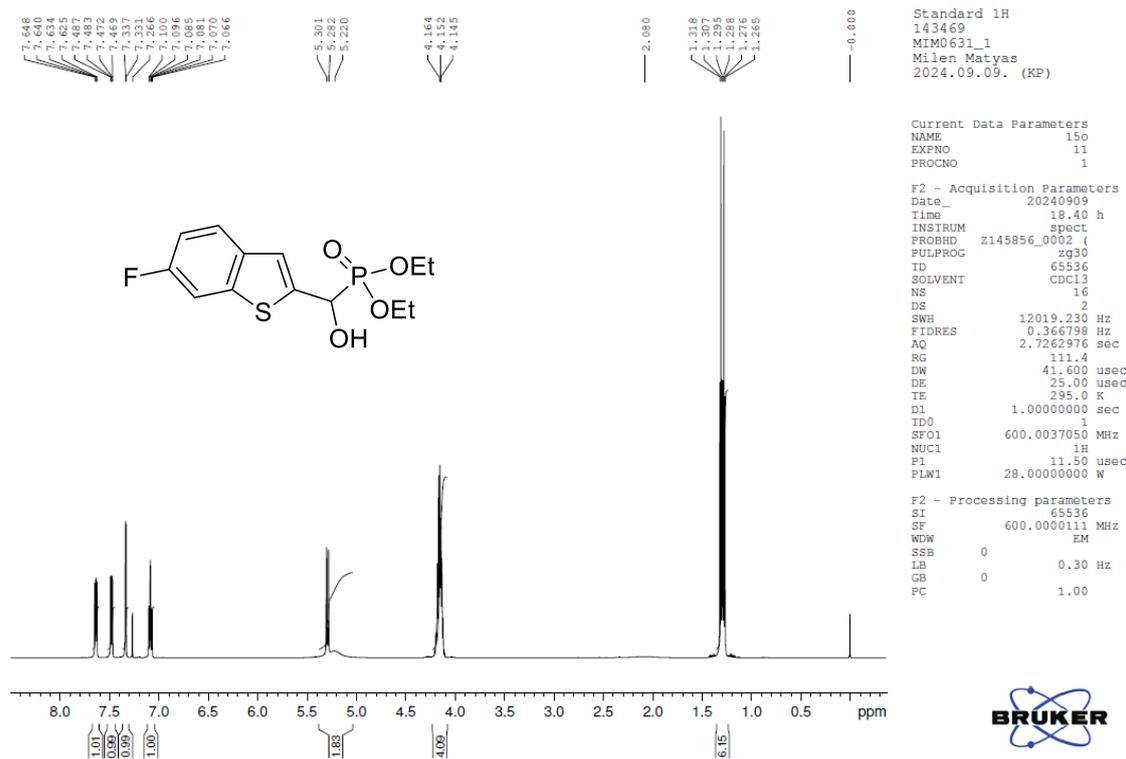
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FIDRES 1.105709 Hz  
AQ 0.9043968 sec  
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P1 9.90 usec  
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SFO2 600.0024000 MHz  
NUC2 1H  
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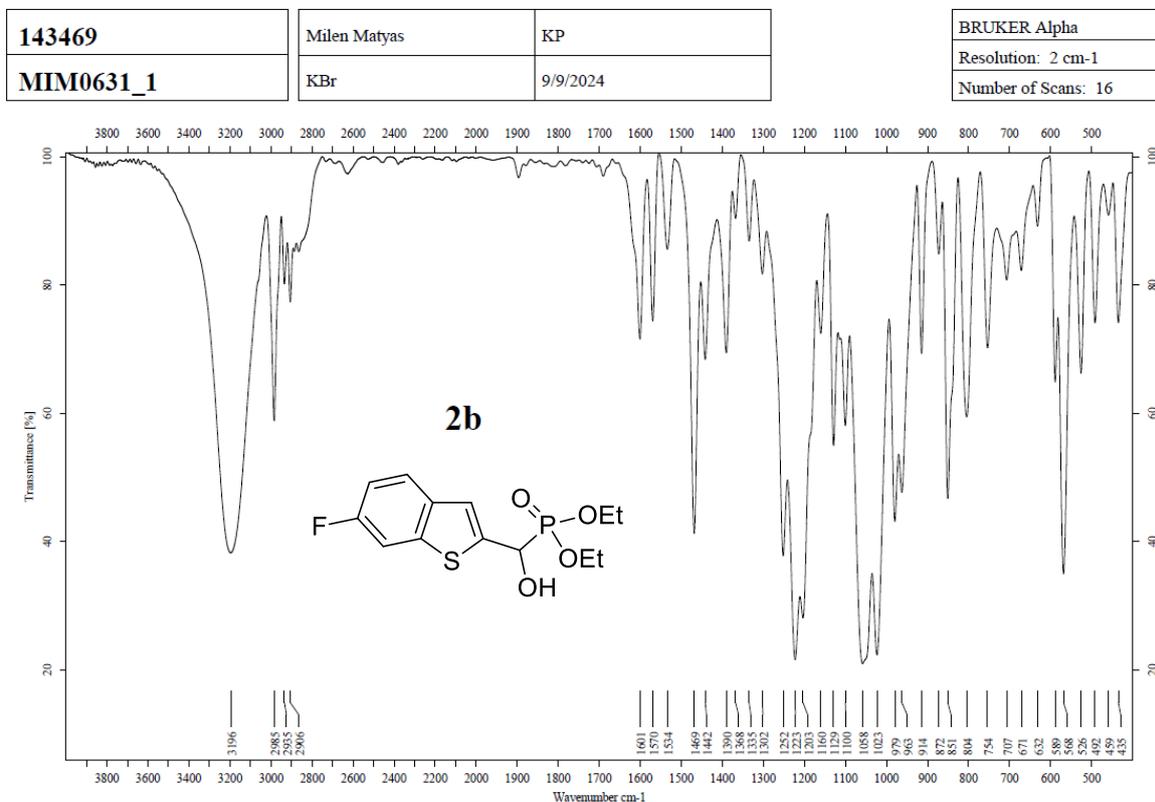
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# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2b

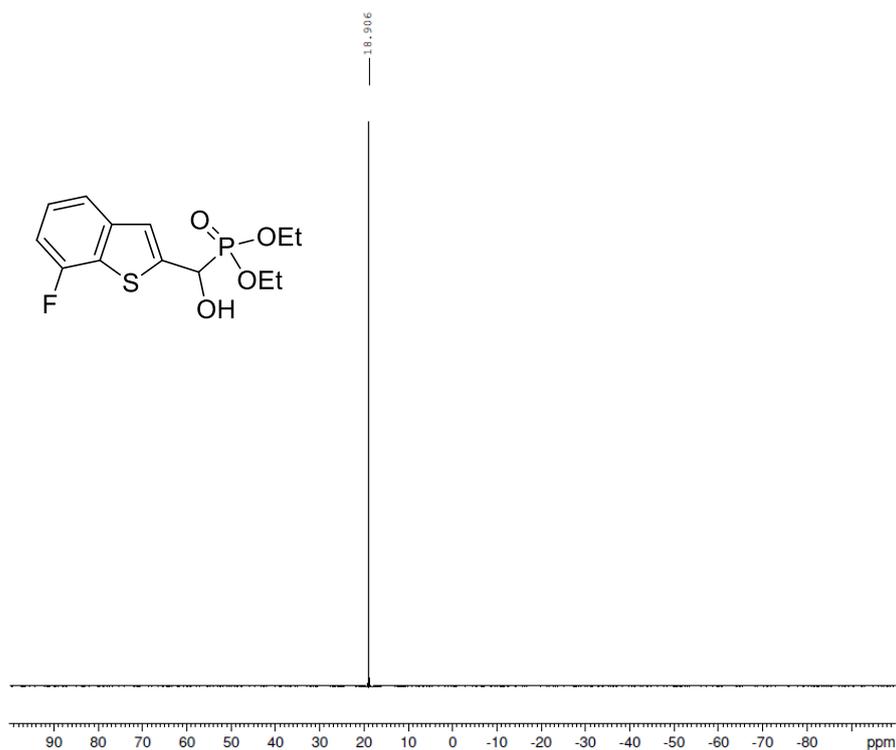


# IR (KBr) spectra for compound 2b



# <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2c

2c



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MIM0609\_1  
Milen Matyas  
2024.07.22. (KP)

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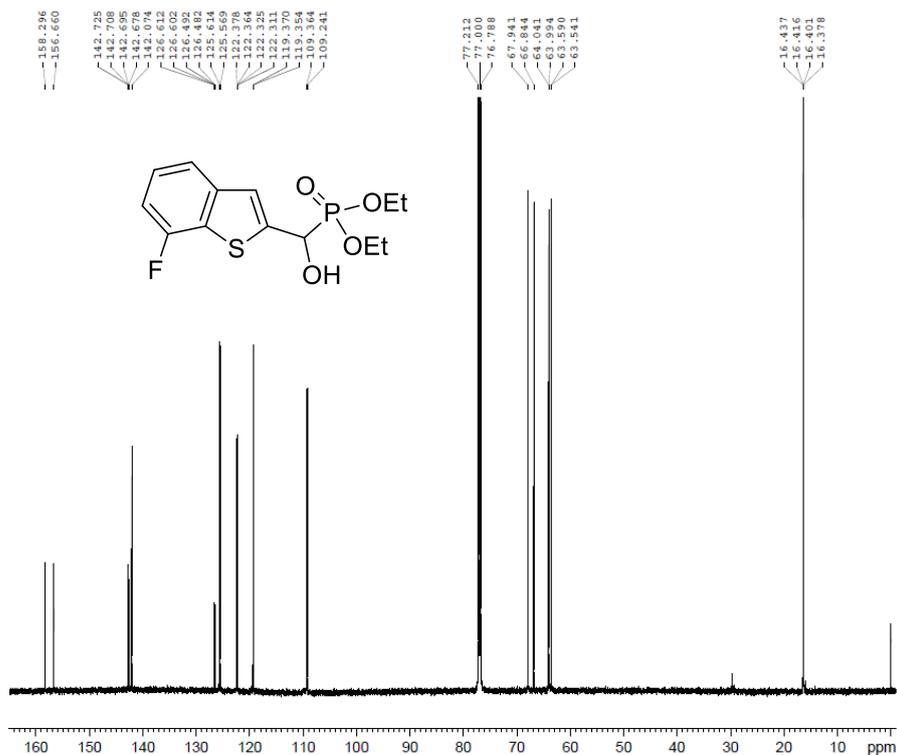
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FIDRES 2.934382 Hz  
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RG 196.07  
DW 5.200 usec  
DE 18.00 usec  
TE 295.0 K  
D1 2.00000000 sec  
D11 0.03000000 sec  
TD0 1  
SFO1 242.8723078 MHz  
NUC1 31P  
P1 12.00 usec  
PLW1 66.12100220 W  
SFO2 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
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WDW no  
SSB 0  
LB 0 Hz  
GB 0  
PC 1.40



# <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2c

2c



Standard 13C  
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MIM0609\_1  
Milen Matyas  
2024.07.22. (KP)

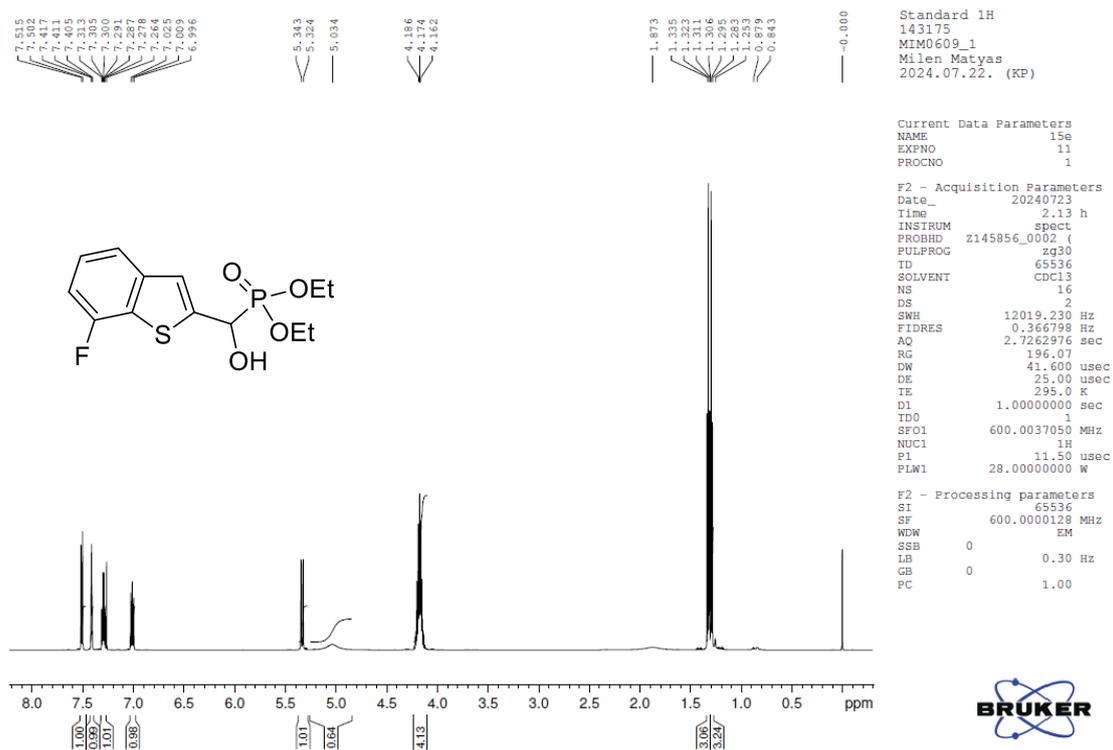
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SWH 36231.883 Hz  
FIDRES 1.105709 Hz  
AQ 0.9043968 sec  
RG 196.07  
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D11 0.03000000 sec  
TD0 1  
SFO1 150.8852070 MHz  
NUC1 13C  
P1 9.90 usec  
PLW1 71.00000000 W  
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NUC2 1H  
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PLW13 0.35339001 W

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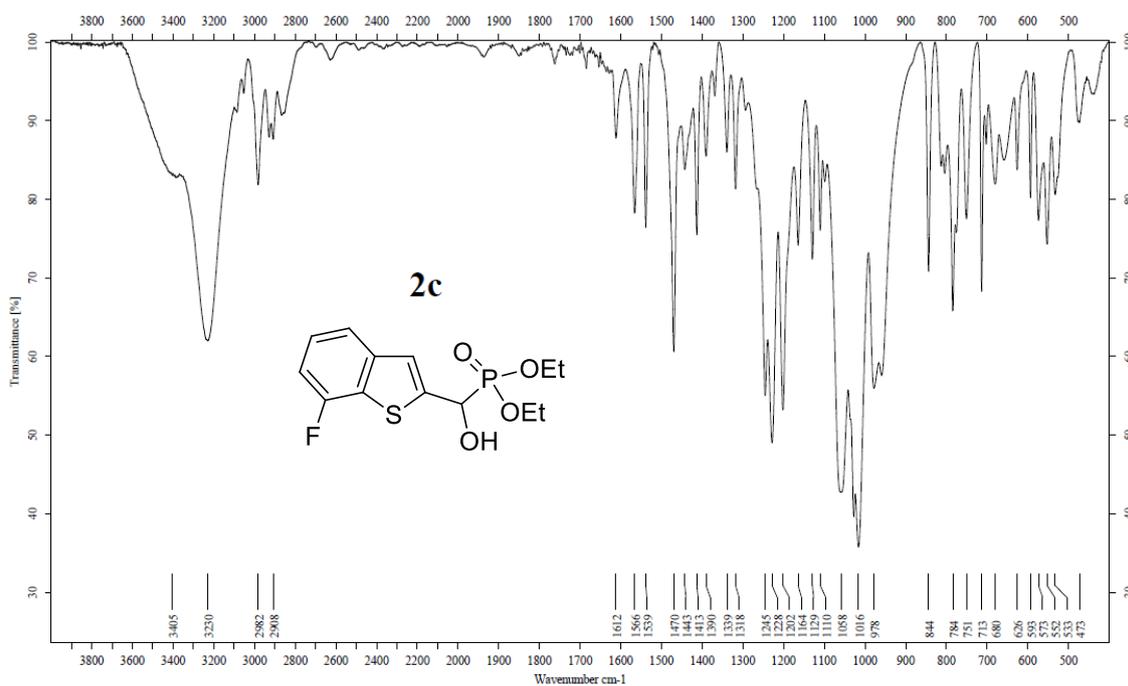


**<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2c**



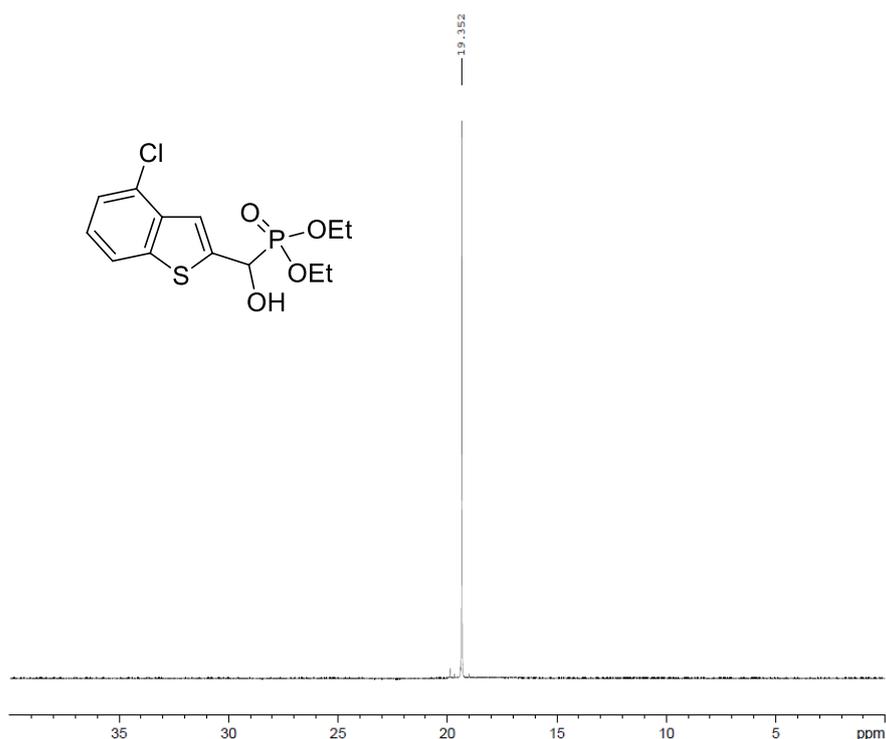
**IR (KBr) spectra for compound 2c**

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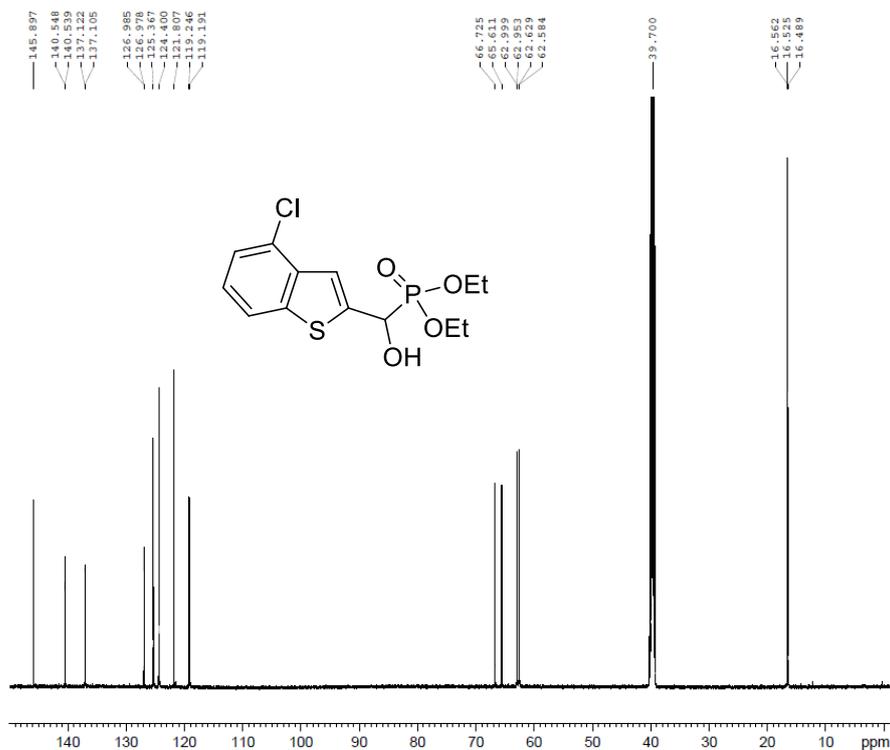
# <sup>31</sup>P NMR (242 MHz, DMSO-*d*<sub>6</sub>) spectra for compound 2d

2d



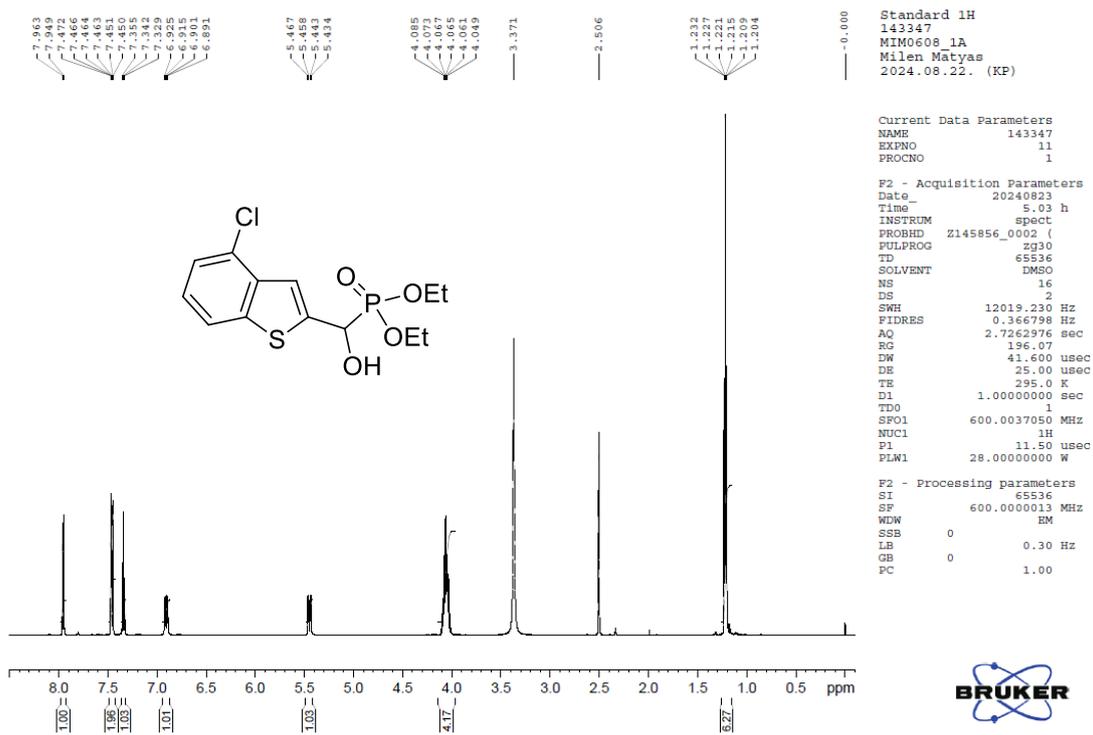
# <sup>13</sup>C NMR (150 MHz, DMSO-*d*<sub>6</sub>) spectra for compound 2d

2d



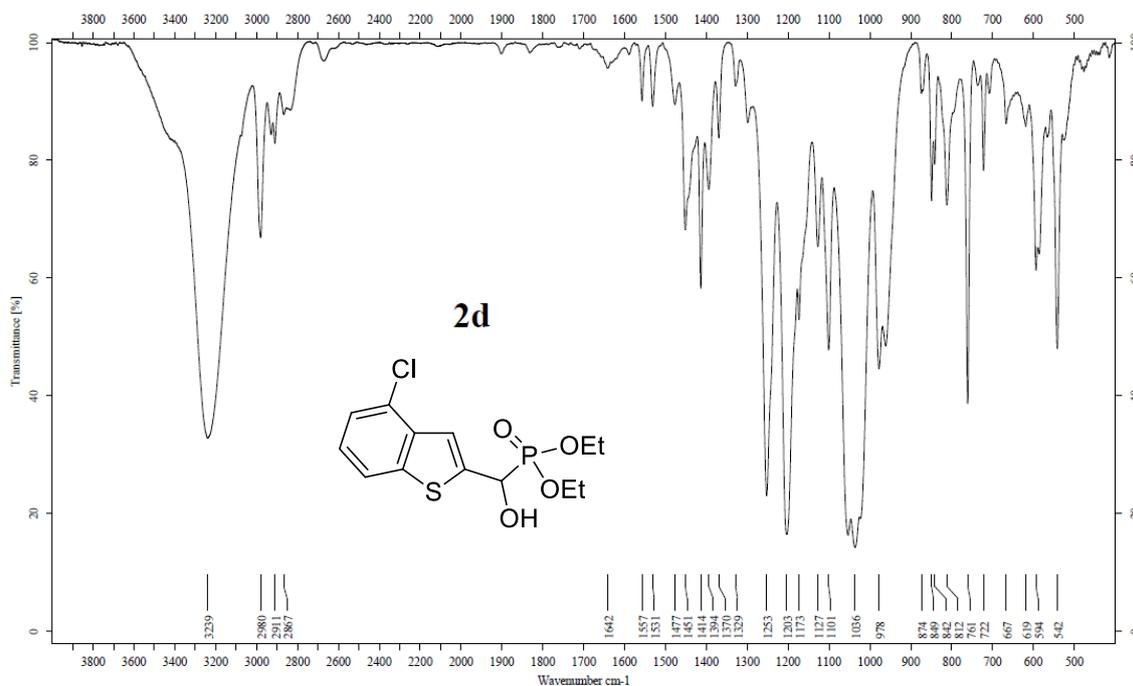
# <sup>1</sup>H NMR (600 MHz, DMSO-d<sub>6</sub>) spectra for compound 2d

2d

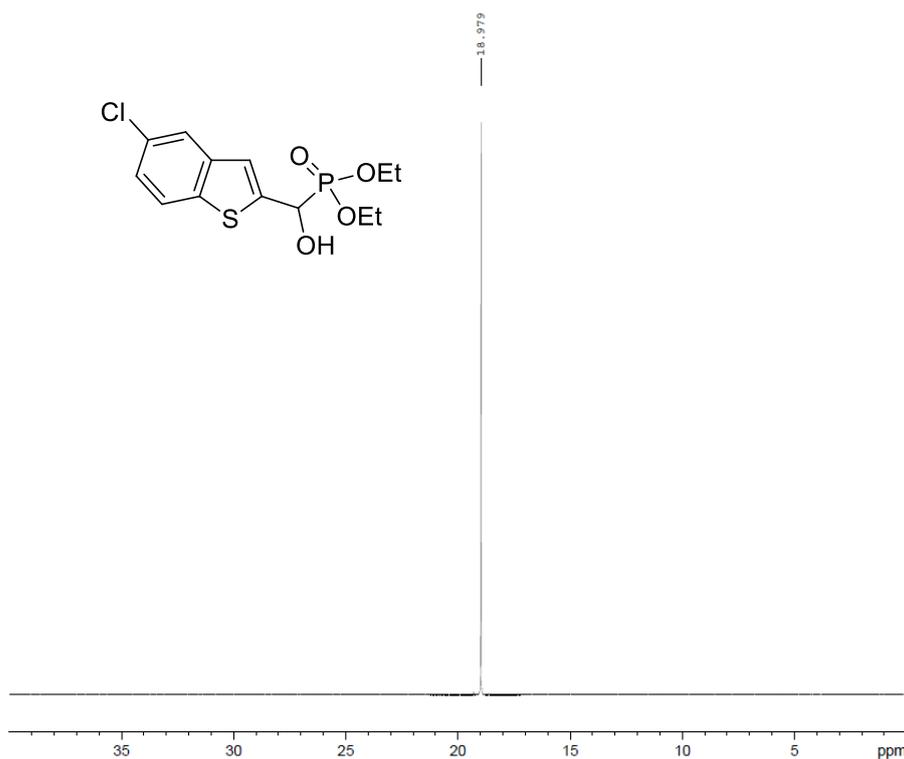


# IR (KBr) spectra for compound 2d

143347	Milen Mátyás	HZs	BRUKER Alpha
MIM0608_1A	KBr	8/16/2024	Resolution: 2 cm-1
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**<sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2e**



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MIM0605 1  
Milen Matyas  
2024.07.12. (DA)

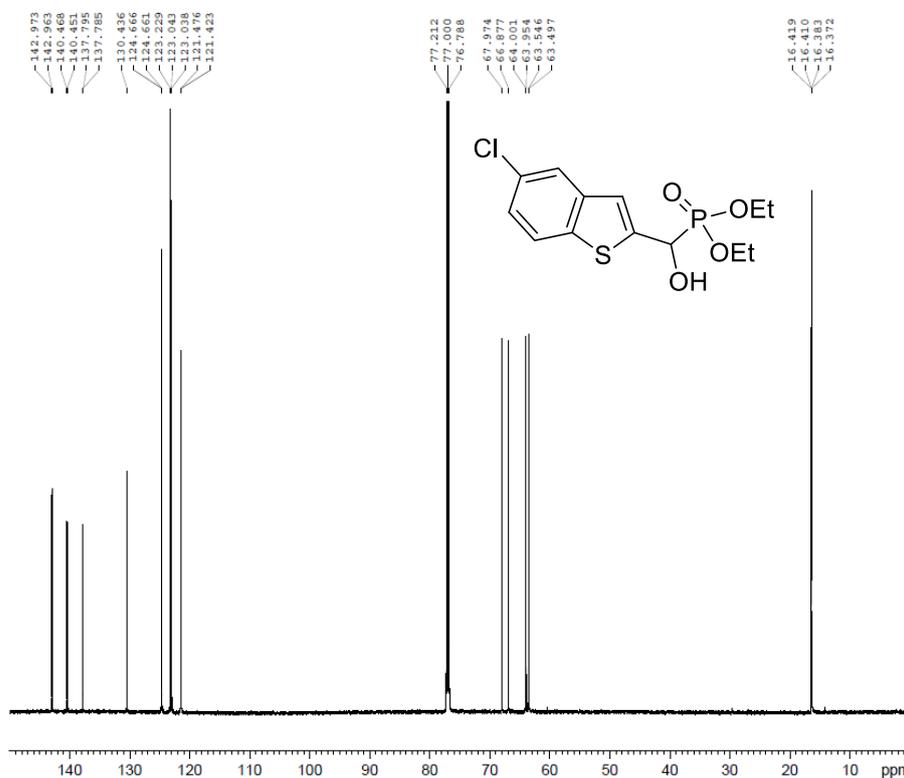
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PC 1.40



**<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2e**



Standard 13C  
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MIM0605 1A  
Milen Matyas  
2024.08.06. (KP)

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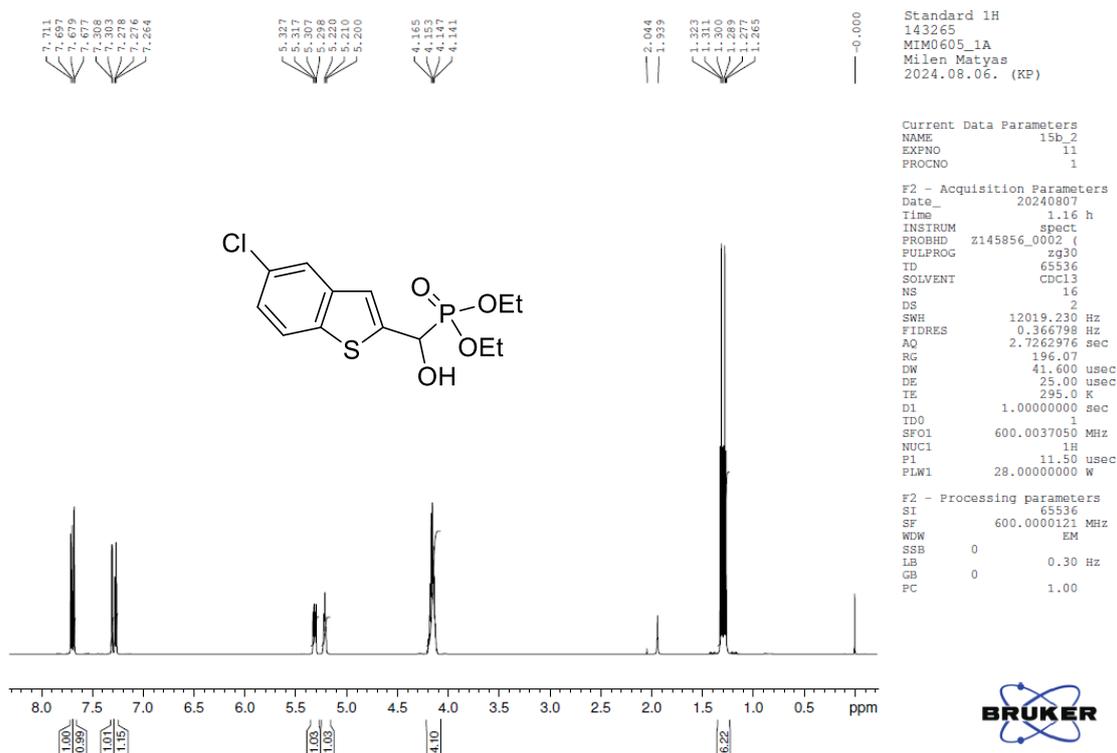
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P1 9.90 usec  
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SFO2 600.0024000 MHz  
NUC2 1H  
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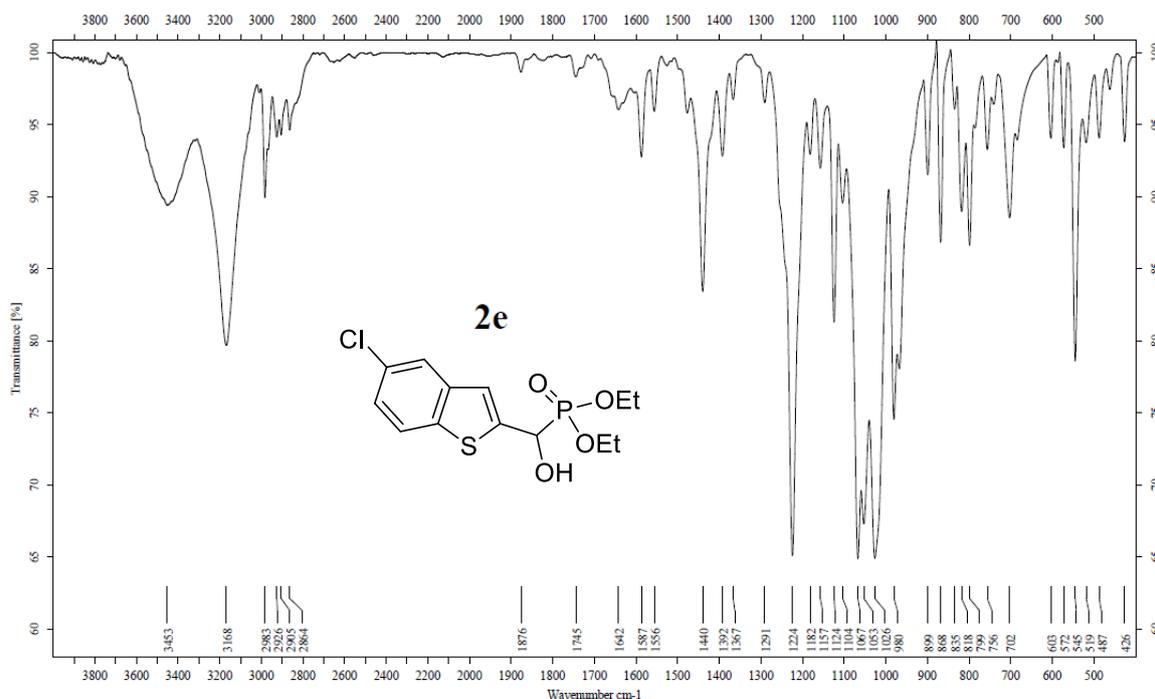
# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2e

2e

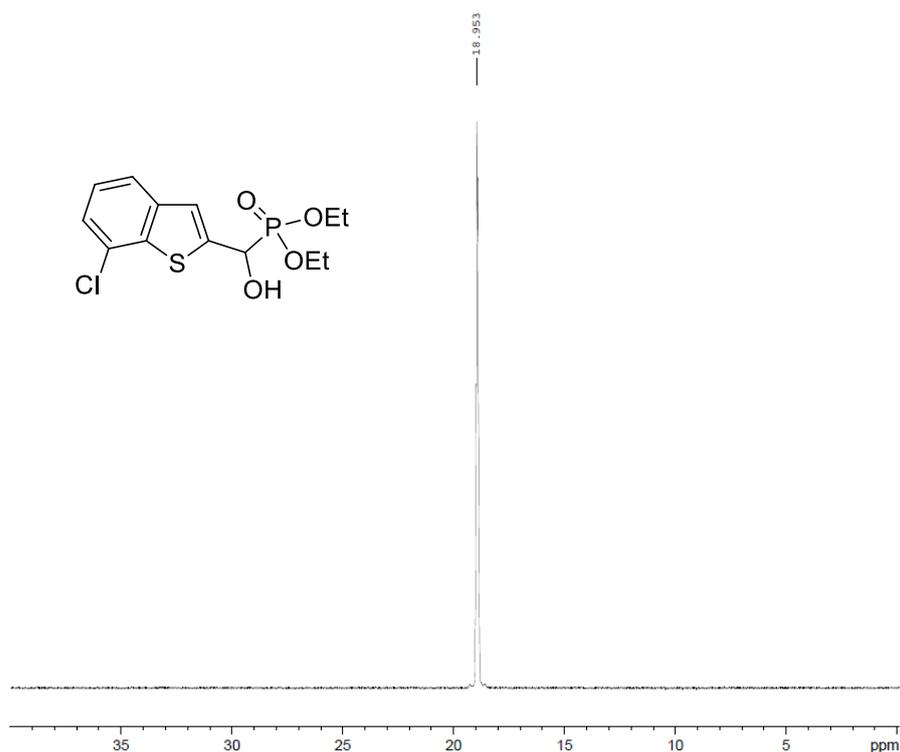


# IR (KBr) spectra for compound 2e

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			Number of Scans: 16



**<sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2f**  
**2f**



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 Milen Matyas  
 2024.08.13. (KP)

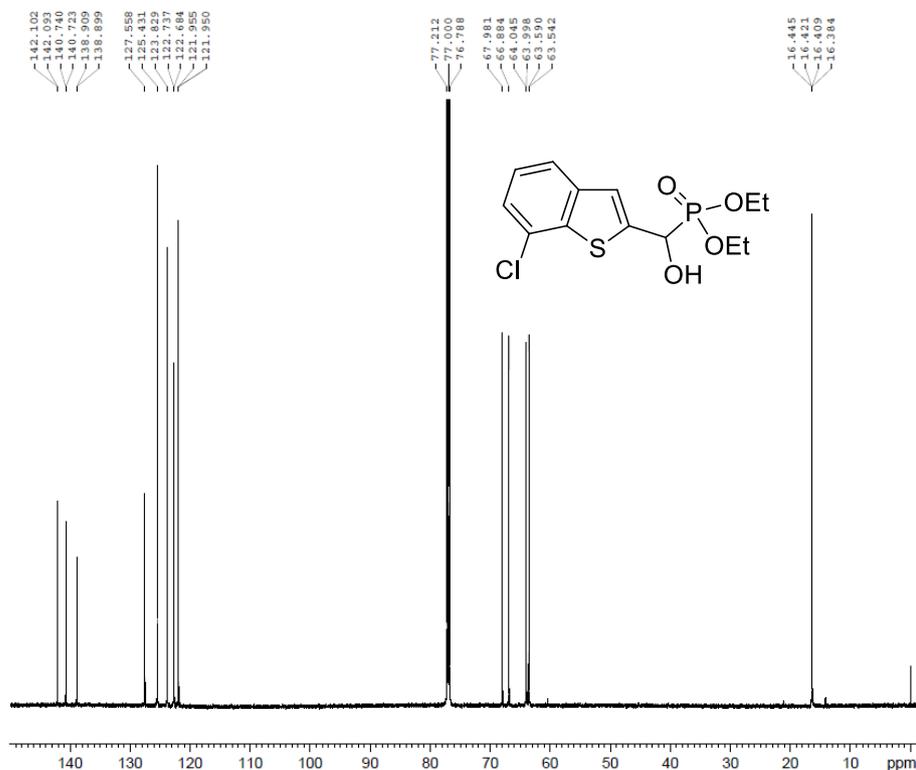
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 TE 295.0 K  
 D1 2.00000000 sec  
 TDO 1  
 SFO1 242.8723078 MHz  
 NUC1 31P  
 P1 12.00 usec  
 PLW1 66.12100220 W

F2 - Processing parameters  
 SI 32768  
 SF 242.8844520 MHz  
 WDW EM  
 SSB 0  
 LB 1.00 Hz  
 GB 0  
 PC 1.40



**<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2f**  
**2f**



Standard 13C  
 143294  
 MIM0617\_1  
 Milen Matyas  
 2024.08.13. (KP)

Current Data Parameters  
 NAME 143294  
 EXPNO 12  
 PROCNO 1

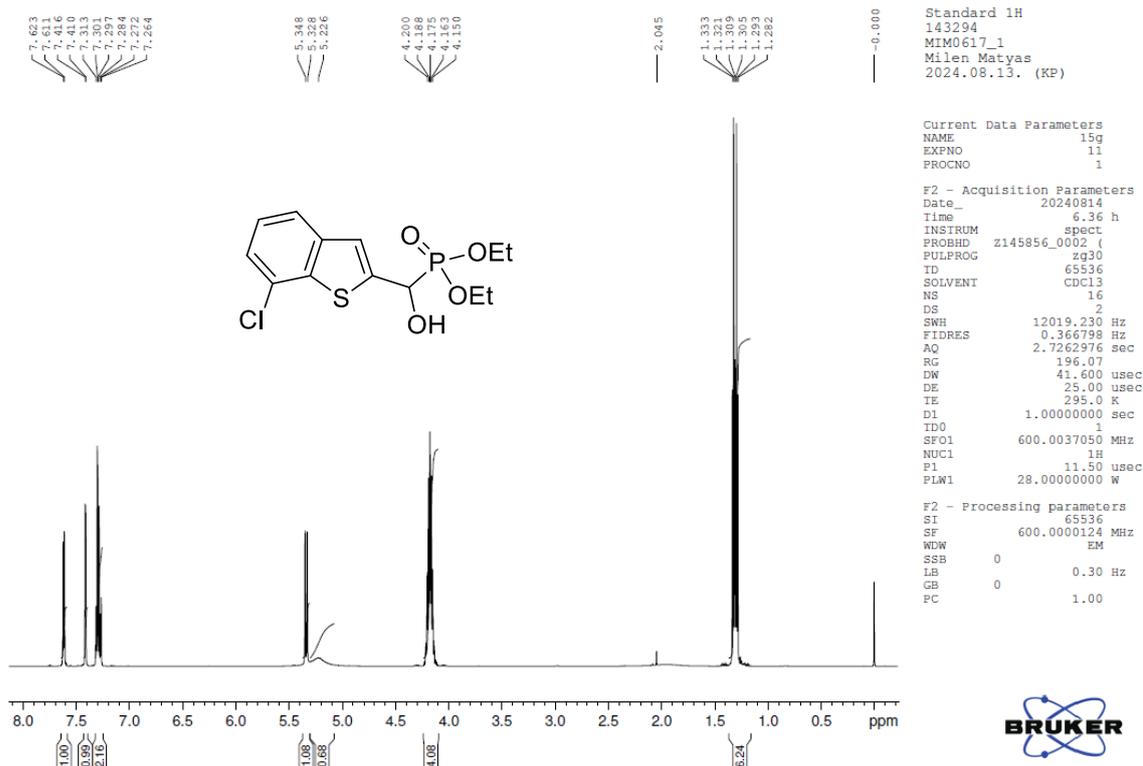
F2 - Acquisition Parameters  
 Date\_ 20240814  
 Time 7.44 h  
 INSTRUM spect  
 PROBHD Z145856\_0002 ( )  
 PULPROG zgpg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 2048  
 DS 4  
 SWH 36231.893 Hz  
 FIDRES 1.105709 Hz  
 AQ 0.9043968 sec  
 RG 196.07  
 DW 13.800 usec  
 DE 18.00 usec  
 TE 295.0 K  
 D1 1.00000000 sec  
 D11 0.03000000 sec  
 TDO 1  
 SFO1 150.8852070 MHz  
 NUC1 13C  
 P1 9.90 usec  
 PLW1 71.00000000 W  
 SFO2 600.0024000 MHz  
 NUC2 1H  
 CPDPRG2 waltz16  
 PCPD2 80.00 usec  
 PLW2 32.90000153 W  
 PLW12 0.70370001 W  
 PLW13 0.35339001 W

F2 - Processing parameters  
 SI 131072  
 SF 150.8701286 MHz  
 WDW EM  
 SSB 0  
 LB 1.00 Hz  
 GB 0  
 PC 1.40

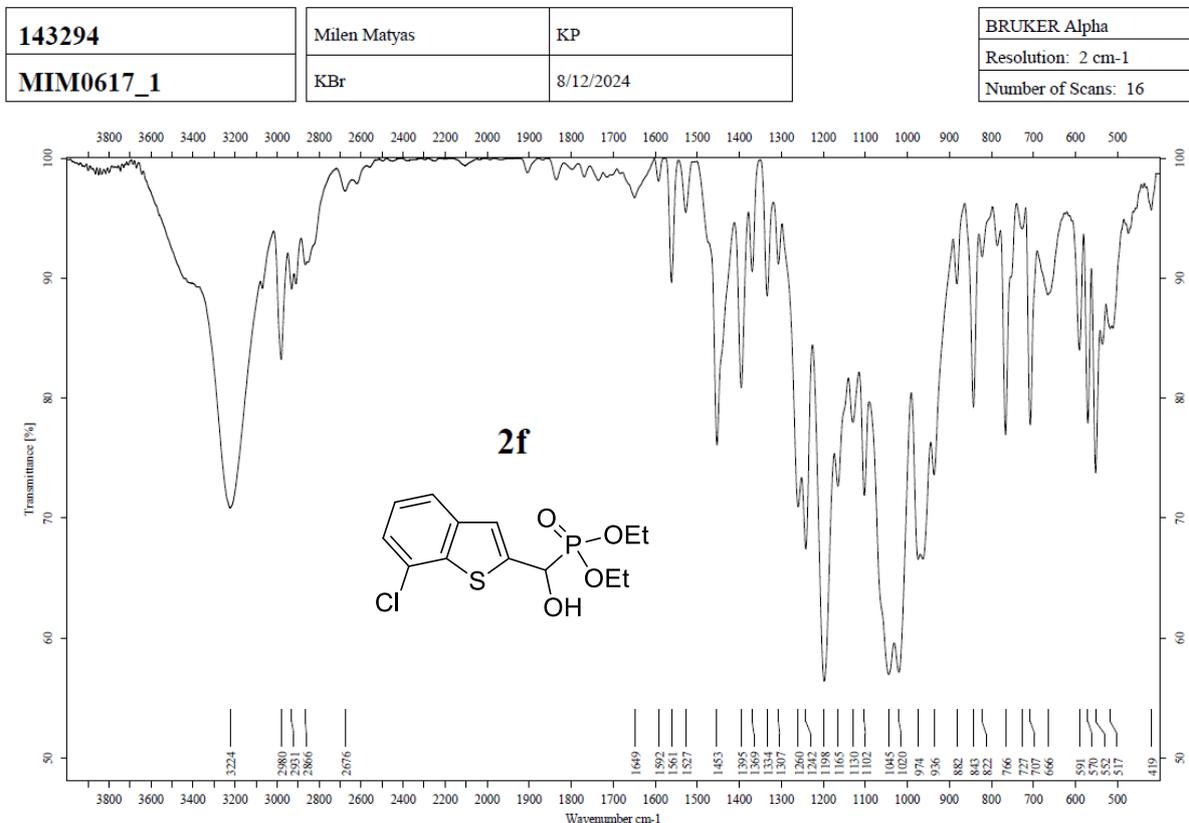


# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2f

## 2f

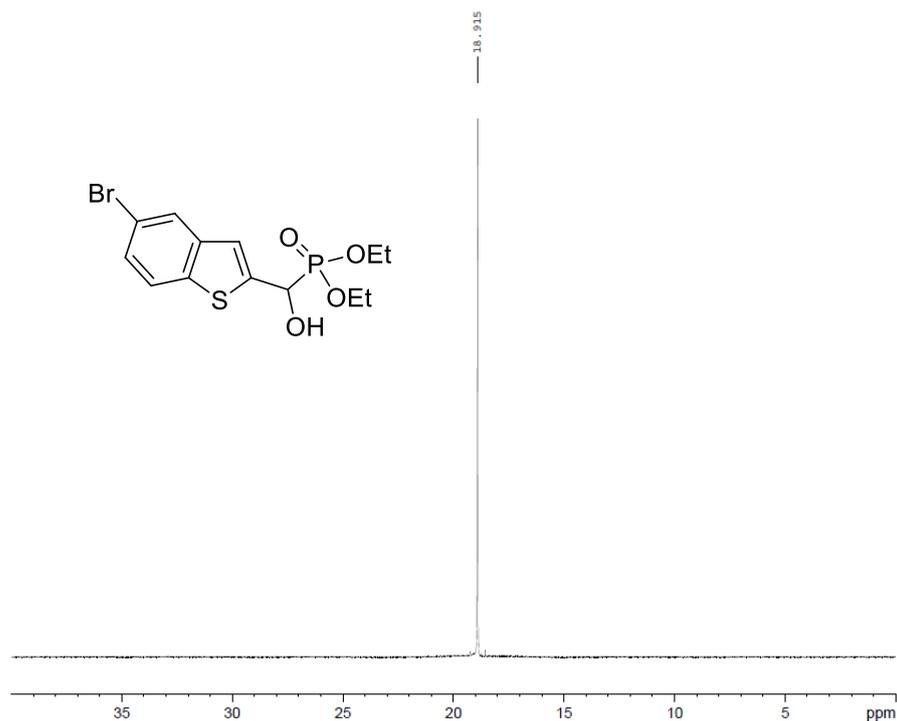


# IR (KBr) spectra for compound 2f



### <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2g

2g



31P CPD  
143485  
MIM0632\_1  
Milen Matyas  
2024.09.11. (KP)

Current Data Parameters  
NAME 143485  
EXPNO 15  
PROCNO 1

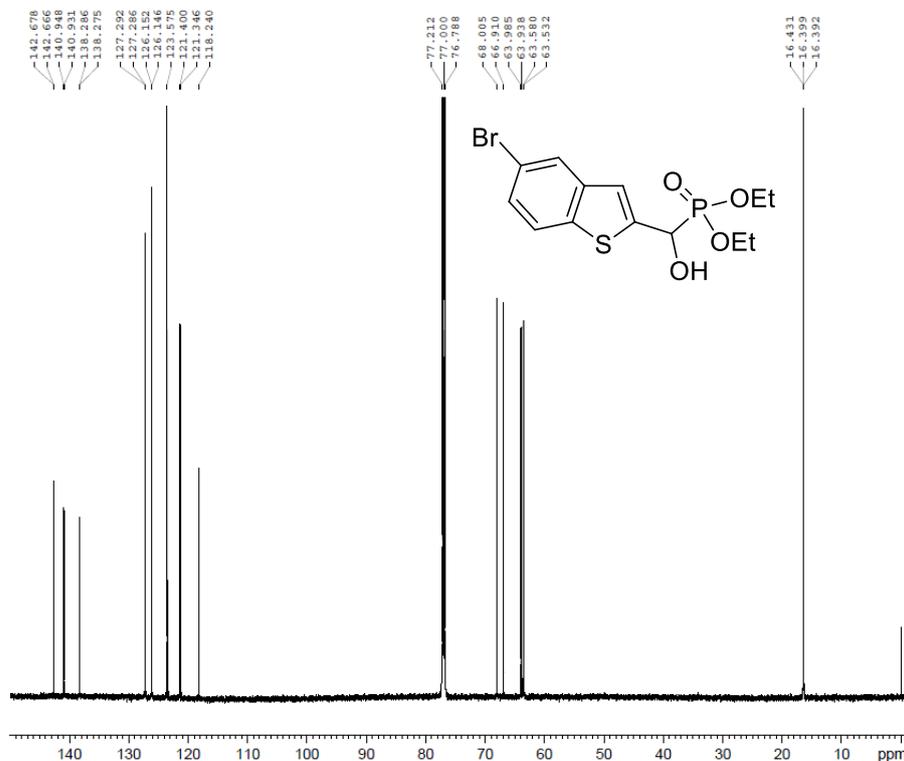
F2 - Acquisition Parameters  
Date\_ 20240911  
Time 21.57 h  
INSTRUM spect  
PROBHD Z145856\_0002 (  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 16  
DS 4  
SWH 96153.844 Hz  
FIDRES 2.934382 Hz  
AQ 0.3407872 sec  
RG 196.07  
DW 5.200 usec  
DE 18.00 usec  
TE 295.0 K  
D1 2.00000000 sec  
D11 0.03000000 sec  
TDO 1  
SFO1 242.8723078 MHz  
NUC1 31P  
P1 12.00 usec  
PLW1 66.12100220 W  
SFO2 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 32768  
SF 242.8844520 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC



### <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2g

2g



Standard 13C  
143485  
MIM0632\_1  
Milen Matyas  
2024.09.11. (KP)

Current Data Parameters  
NAME 143485  
EXPNO 12  
PROCNO 1

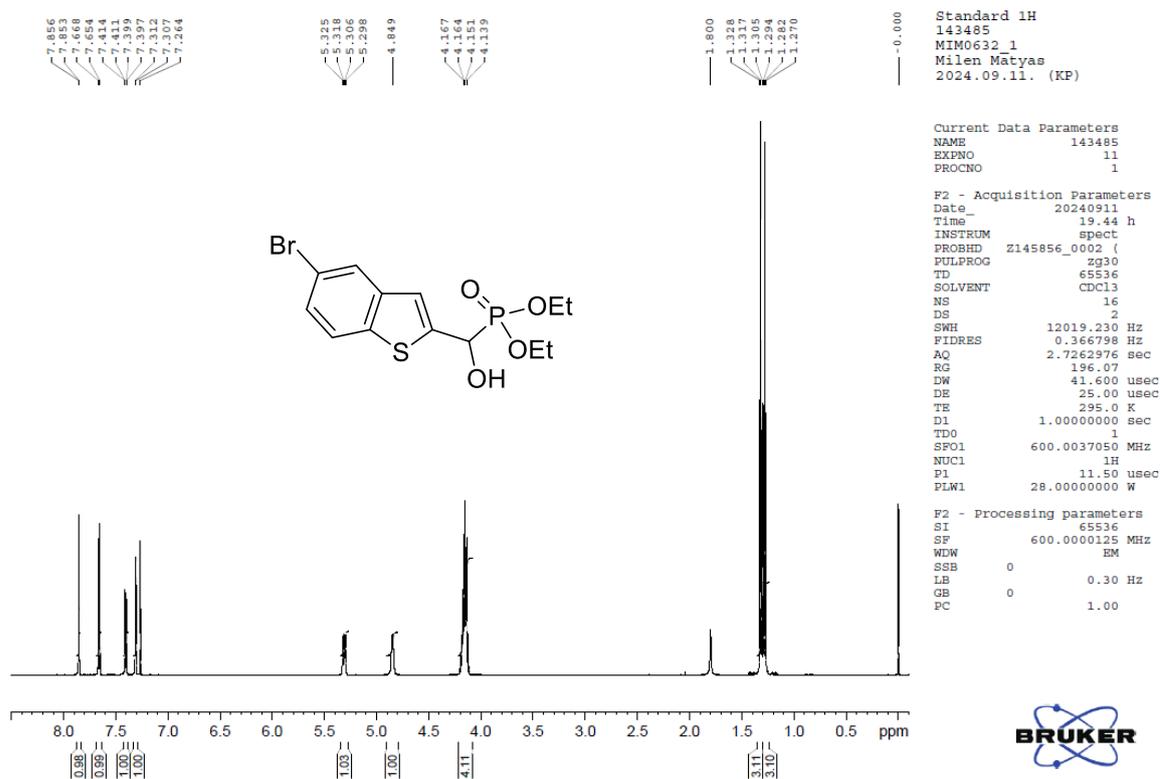
F2 - Acquisition Parameters  
Date\_ 20240911  
Time 20.53 h  
INSTRUM spect  
PROBHD Z145856\_0002 (  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 2048  
DS 4  
SWH 36231.883 Hz  
FIDRES 1.105709 Hz  
AQ 0.9043968 sec  
RG 196.07  
DW 13.800 usec  
DE 18.00 usec  
TE 295.0 K  
D1 1.00000000 sec  
D11 0.03000000 sec  
TDO 1  
SFO1 150.8852070 MHz  
NUC1 13C  
P1 9.90 usec  
PLW1 71.00000000 W  
SFO2 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 131072  
SF 150.8701277 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40

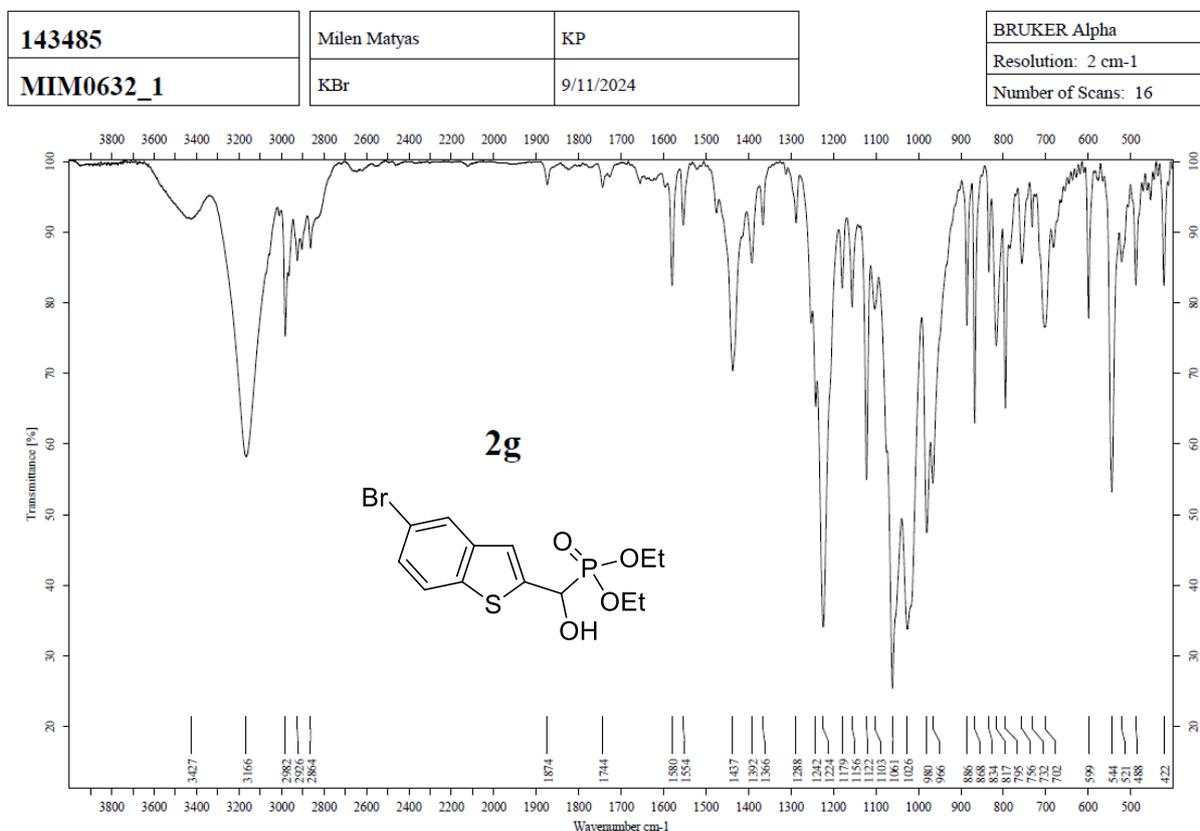


# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2g

2g

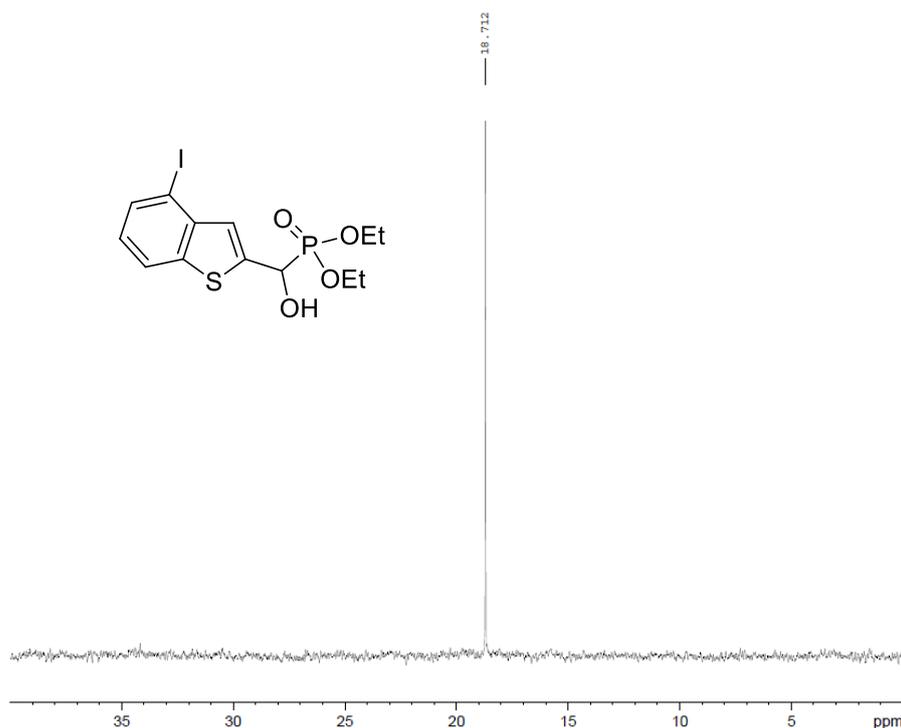


# IR (KBr) spectra for compound 2g



# <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2h

2h



31P CPD  
143462  
MIM0629\_1  
Milen Matyas  
2024.09.06. (KP)

Current Data Parameters  
NAME 143462  
EXPNO 16  
PROCNO 1

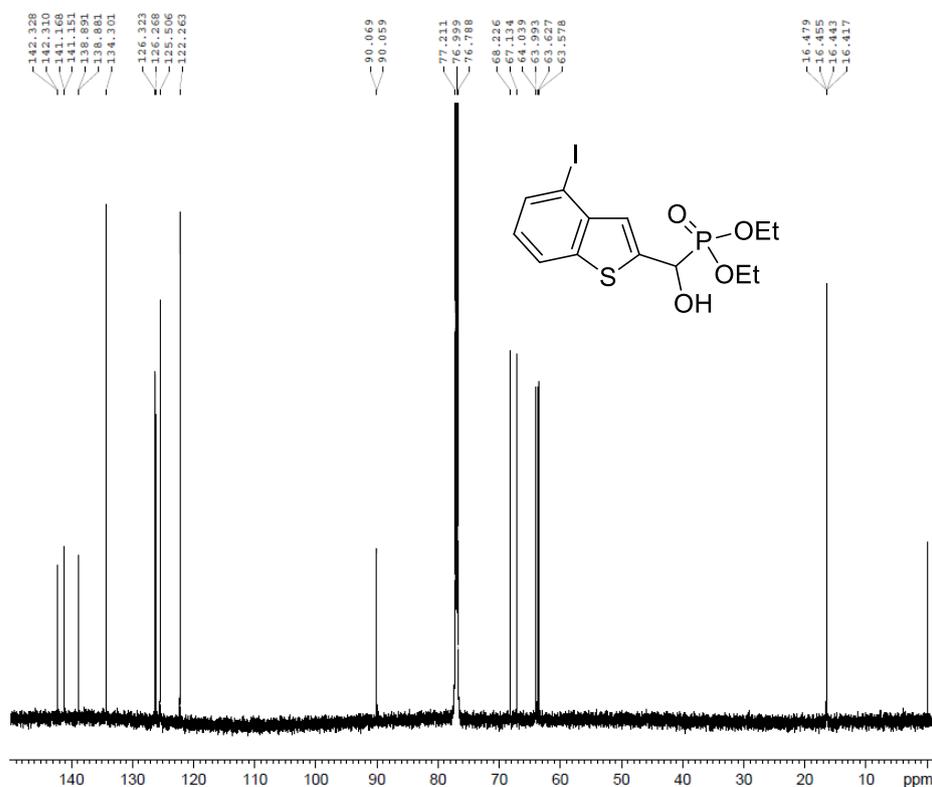
F2 - Acquisition Parameters  
Date\_ 20240906  
Time\_ 23.23 h  
INSTRUM spect  
PROBHD Z145856\_0002 (  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 16  
DS 4  
SWH 96153.844 Hz  
FIDRES 2.934382 Hz  
AQ 0.3407872 sec  
RG 196.07  
DW 5.200 usec  
DE 18.00 usec  
TE 295.0 K  
D1 2.00000000 sec  
D11 0.03000000 sec  
TDO 1  
SFO1 242.8723078 MHz  
NUC1 31P  
PI 12.00 usec  
PLW1 66.12100220 W  
SFO2 600.0024000 MHz  
NUC2 1H  
CPDPRG[2] waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 32768  
SF 242.8844520 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC



# <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2h

2h



Standard 13C  
143462  
MIM0629\_1  
Milen Matyas  
2024.09.06. (KP)

Current Data Parameters  
NAME 143462  
EXPNO 12  
PROCNO 1

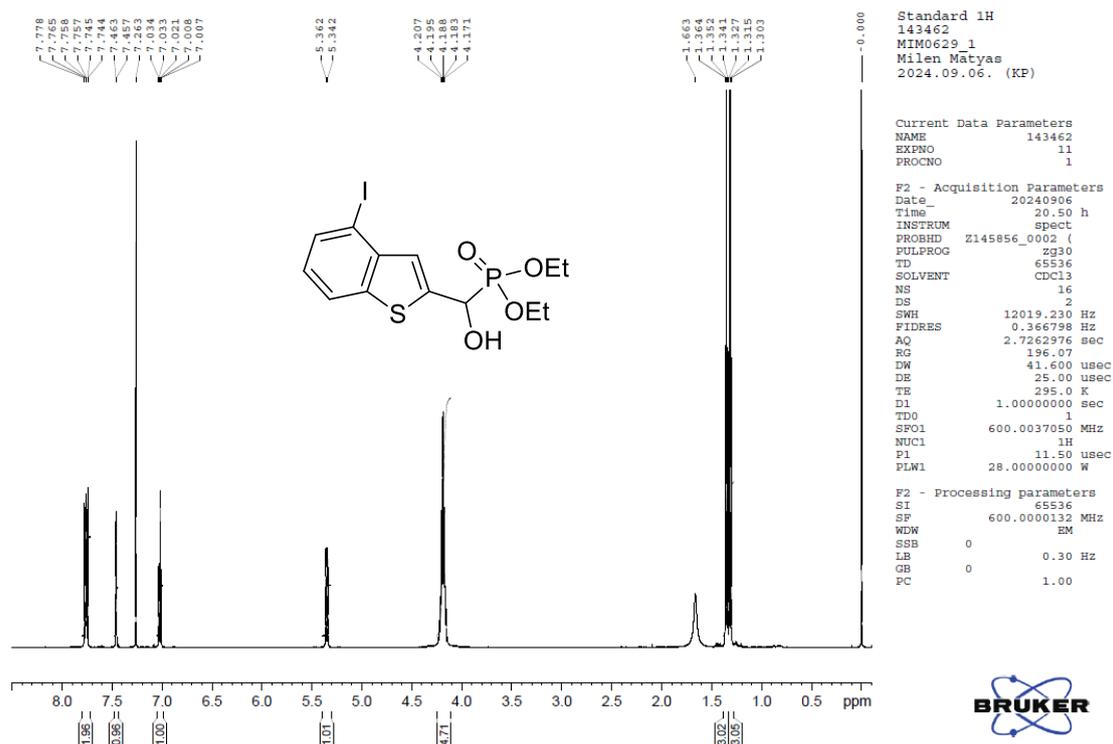
F2 - Acquisition Parameters  
Date\_ 20240906  
Time\_ 21.59 h  
INSTRUM spect  
PROBHD Z145856\_0002 (  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 2048  
DS 4  
SWH 36231.883 Hz  
FIDRES 1.105709 Hz  
AQ 0.9043968 sec  
RG 196.07  
DW 13.800 usec  
DE 18.00 usec  
TE 295.0 K  
D1 1.00000000 sec  
D11 0.03000000 sec  
TDO 1  
SFO1 150.8852070 MHz  
NUC1 13C  
PI 9.90 usec  
PLW1 71.00000000 W  
SFO2 600.0024000 MHz  
NUC2 1H  
CPDPRG[2] waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 131072  
SF 150.8701263 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40



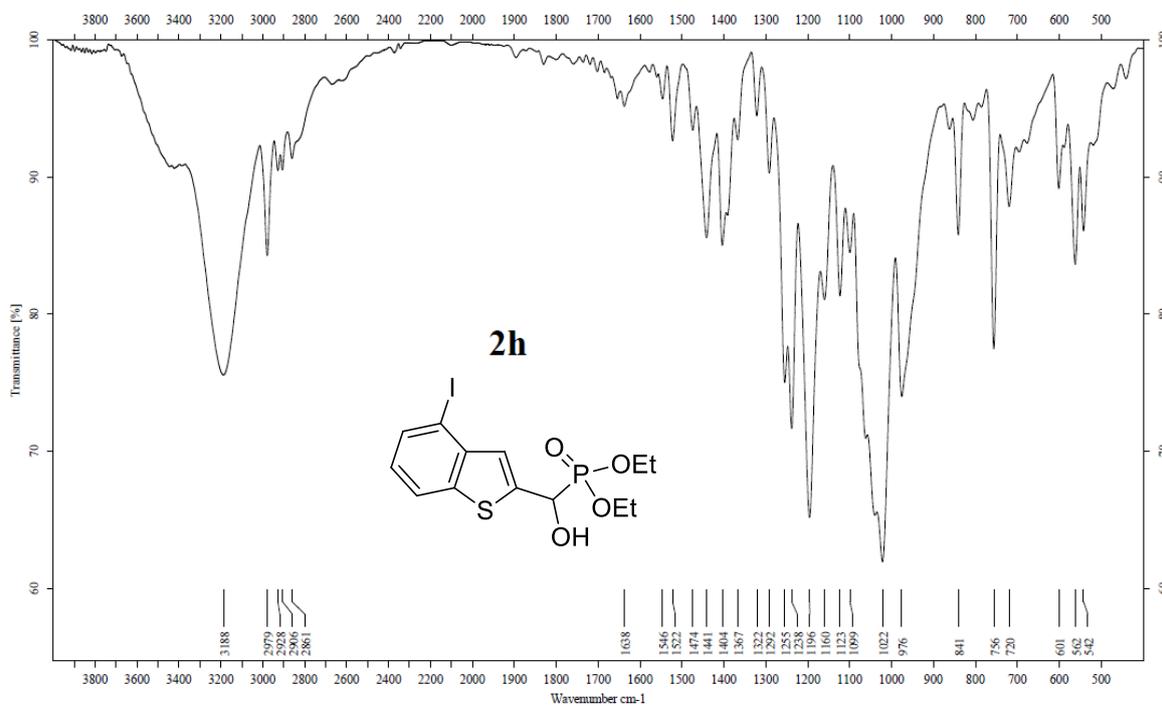
# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2h

2h



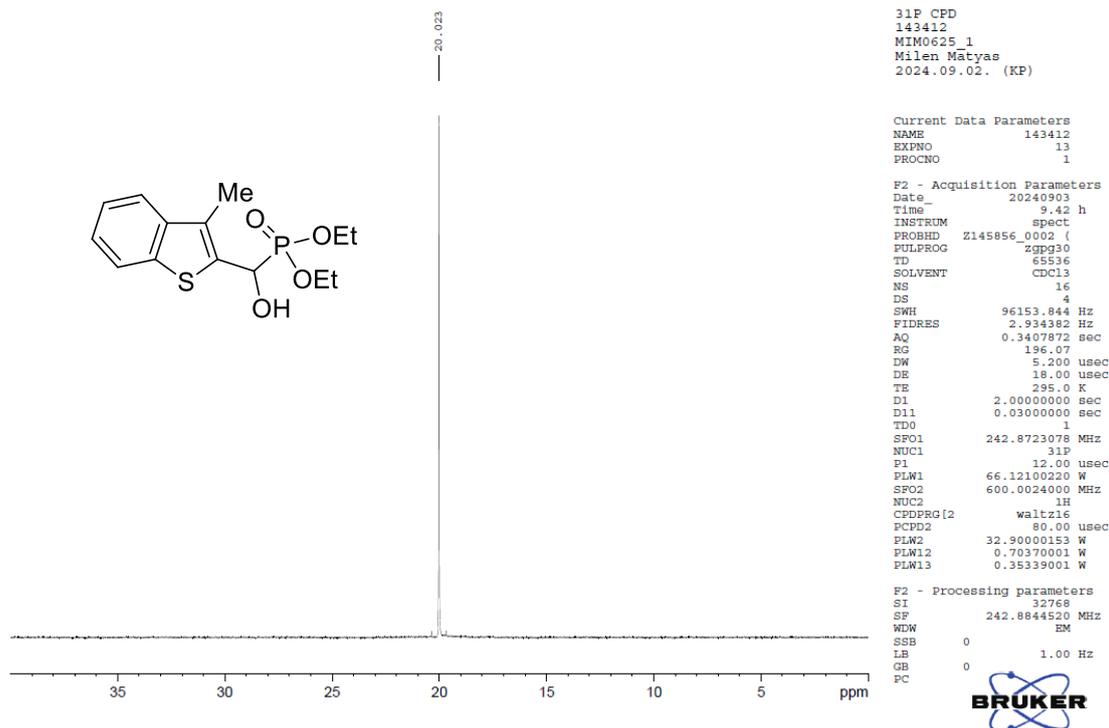
# IR (KBr) spectra for compound 2h

143462	Milen Matyas	KP	BRUKER Alpha
MIM0629_1	KBr	9/9/2024	Resolution: 2 cm-1
			Number of Scans: 16



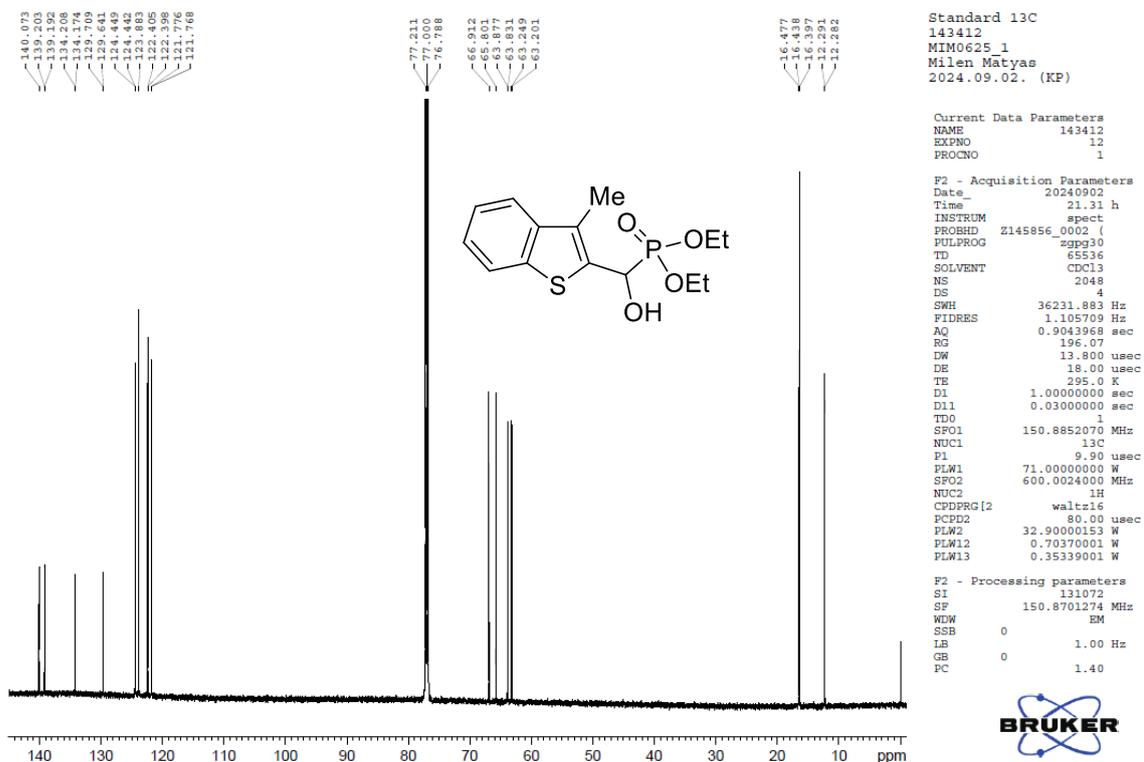
### <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2i

2i



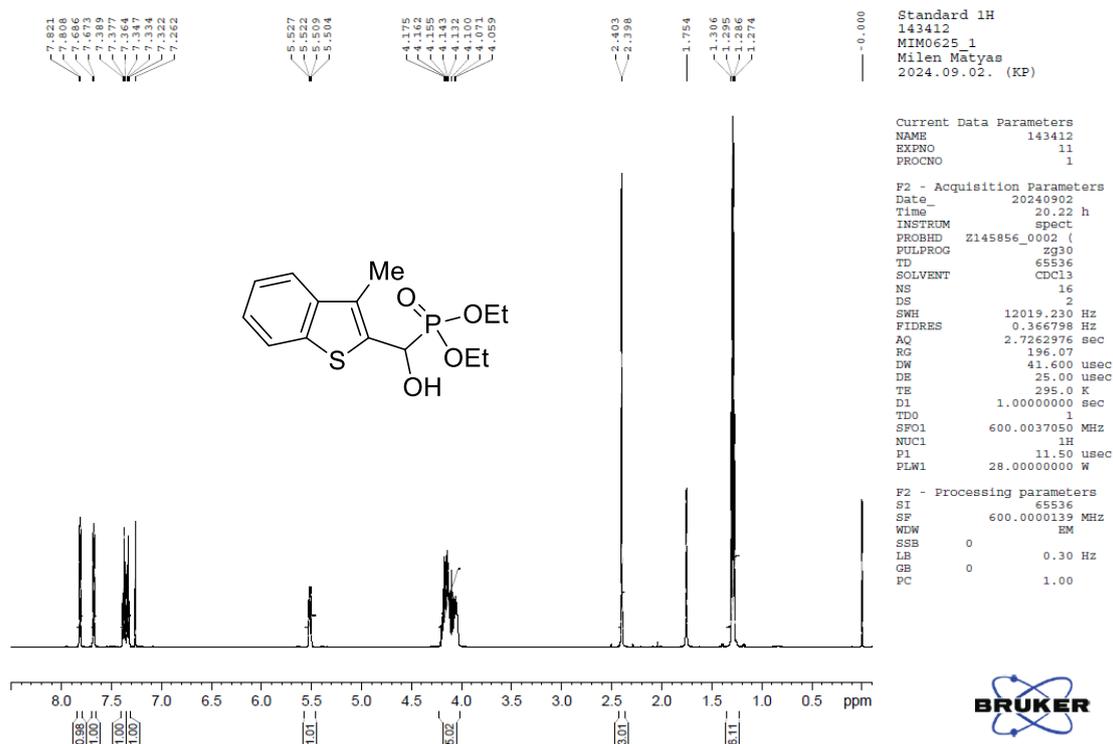
### <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2i

2i



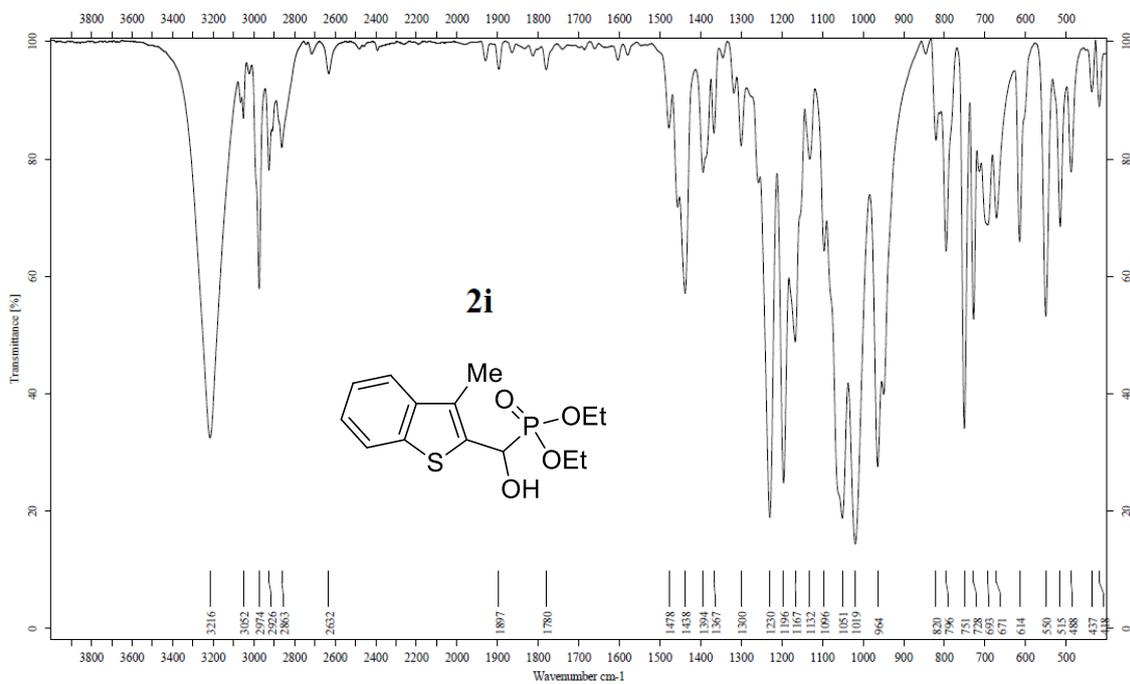
# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2i

2i



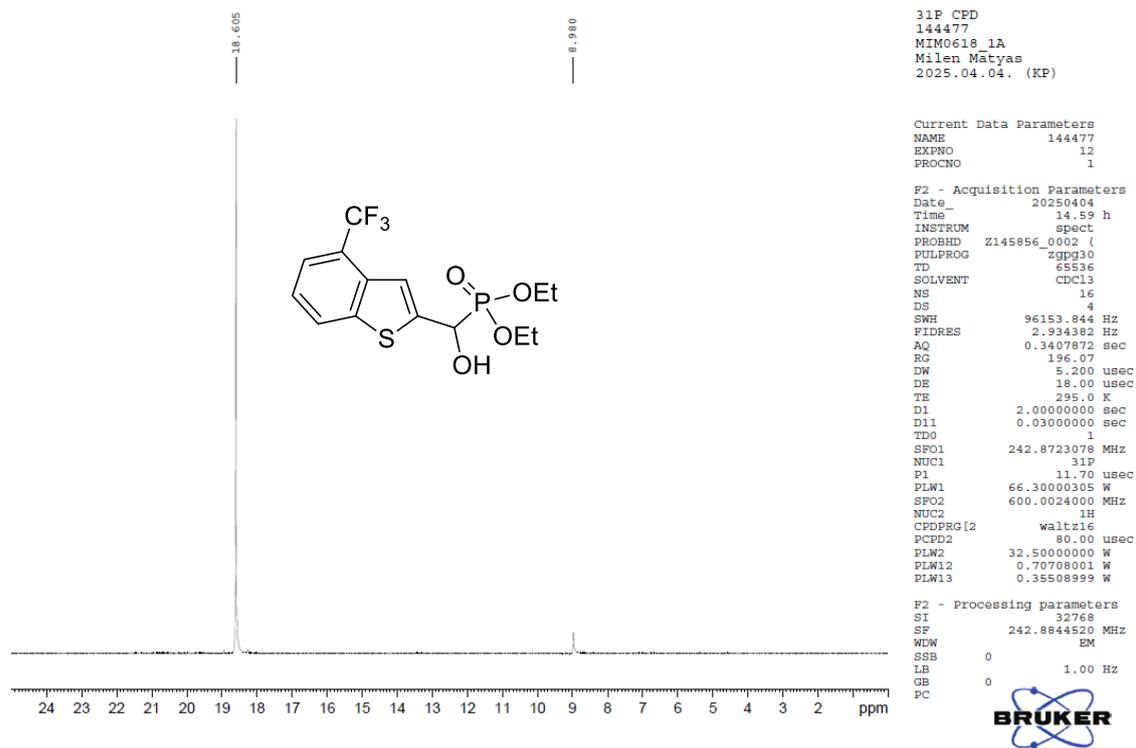
# IR (KBr) spectra for compound 2i

143412	Milen Matyas	KP	BRUKER Alpha
MIM0625_1	KBr	9/2/2024	Resolution: 2 cm-1
			Number of Scans: 16



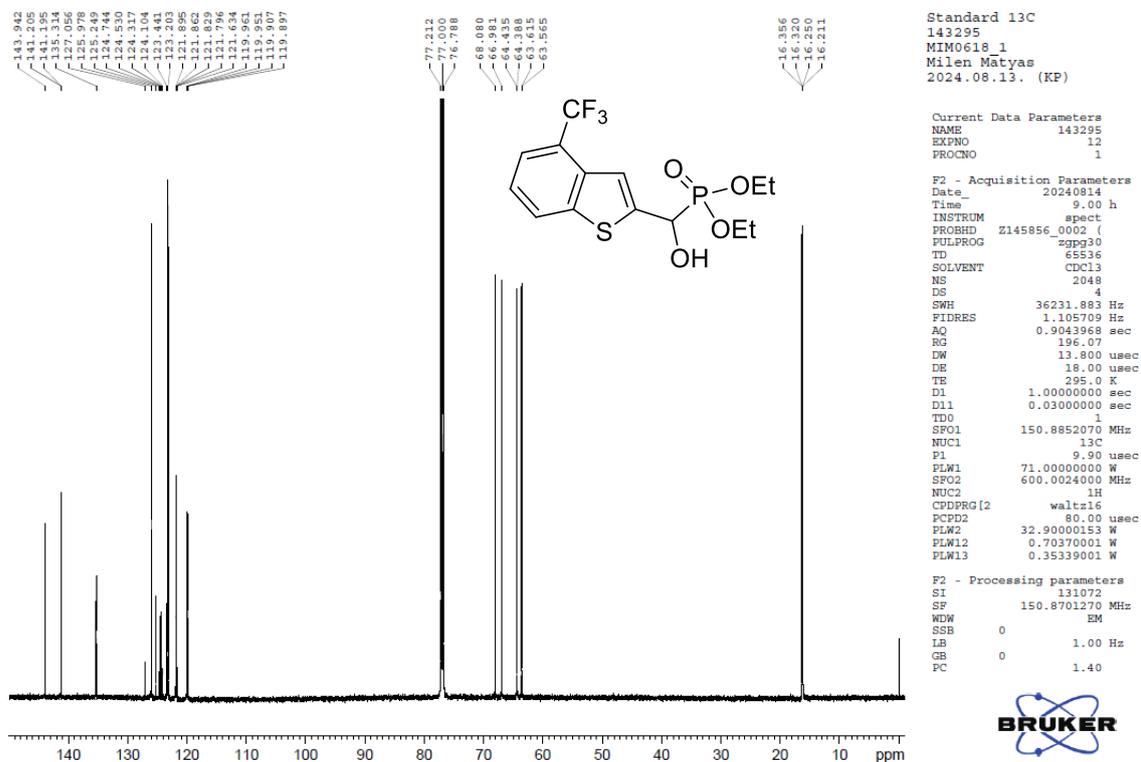
# <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2j

## 2j



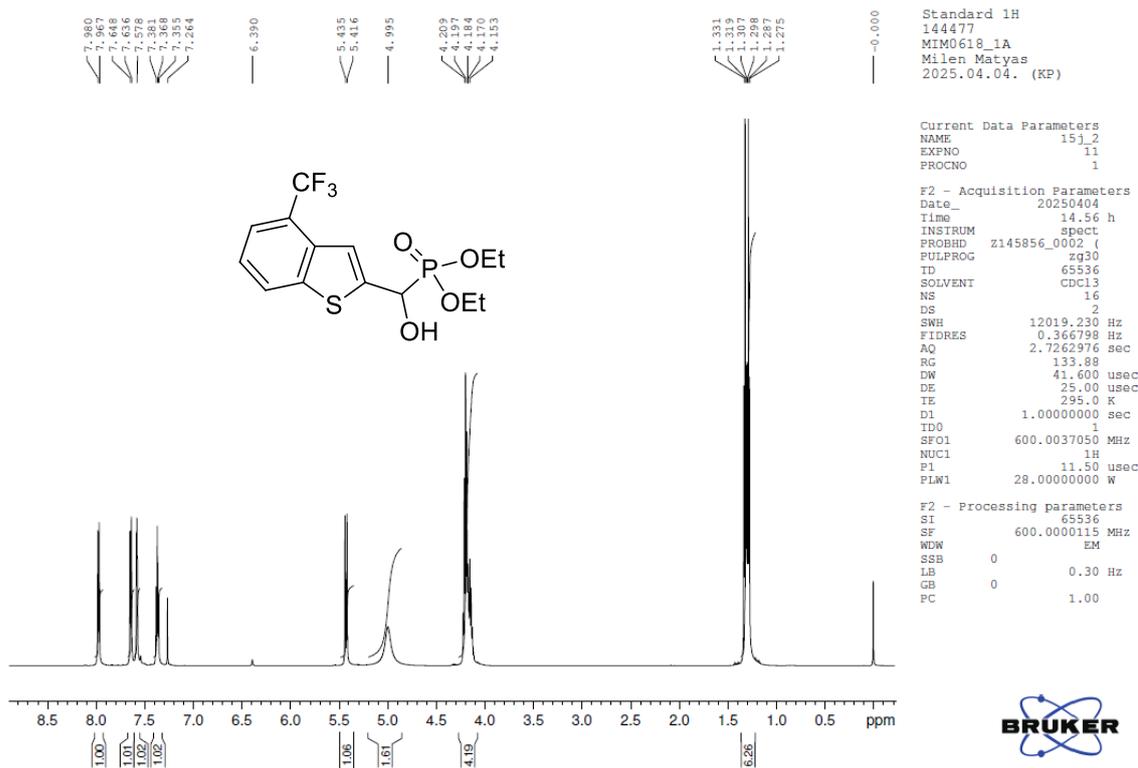
# <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2j

## 2j



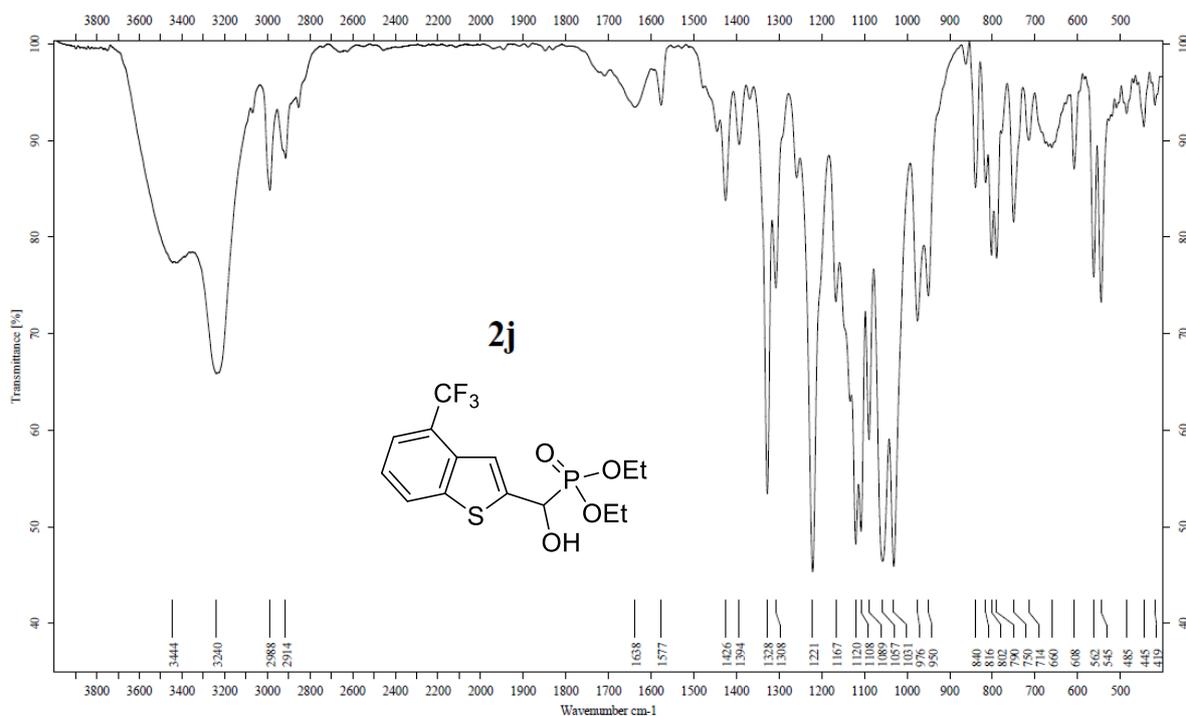
# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2j

2j



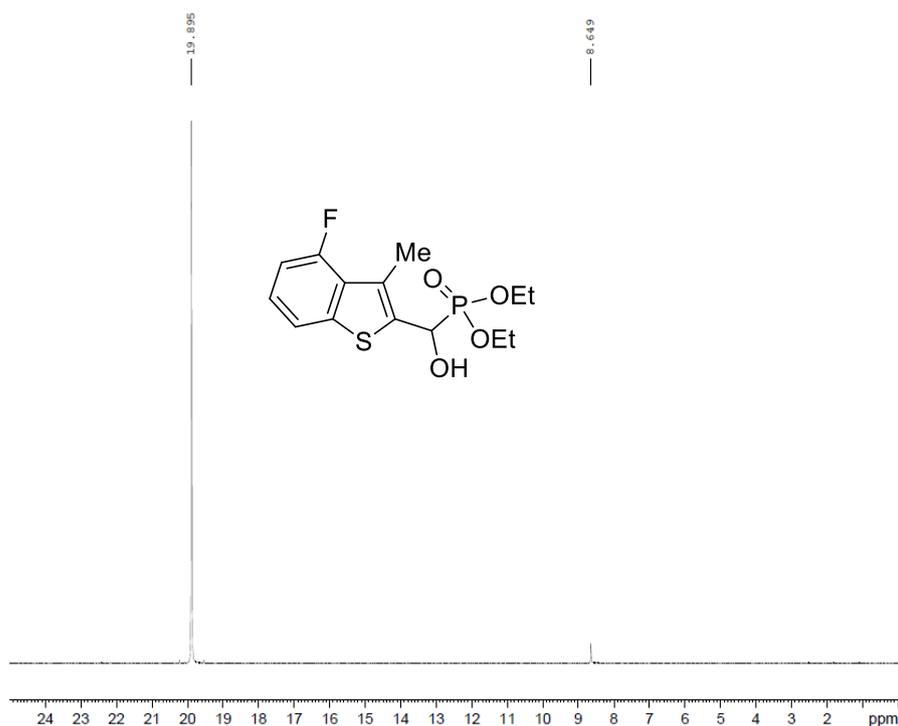
# IR (IR) spectra for compound 2j

143295	Milen Matyas	KP	BRUKER Alpha
MIM0618_1	KBr	8/12/2024	Resolution: 2 cm-1
			Number of Scans: 16



# <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2k

## 2k



31P CPD  
143461  
MIM0628\_1  
Milen Matyas  
2024.09.06. (KP)

Current Data Parameters  
NAME 143461  
EXPNO 24  
PROCNO 1

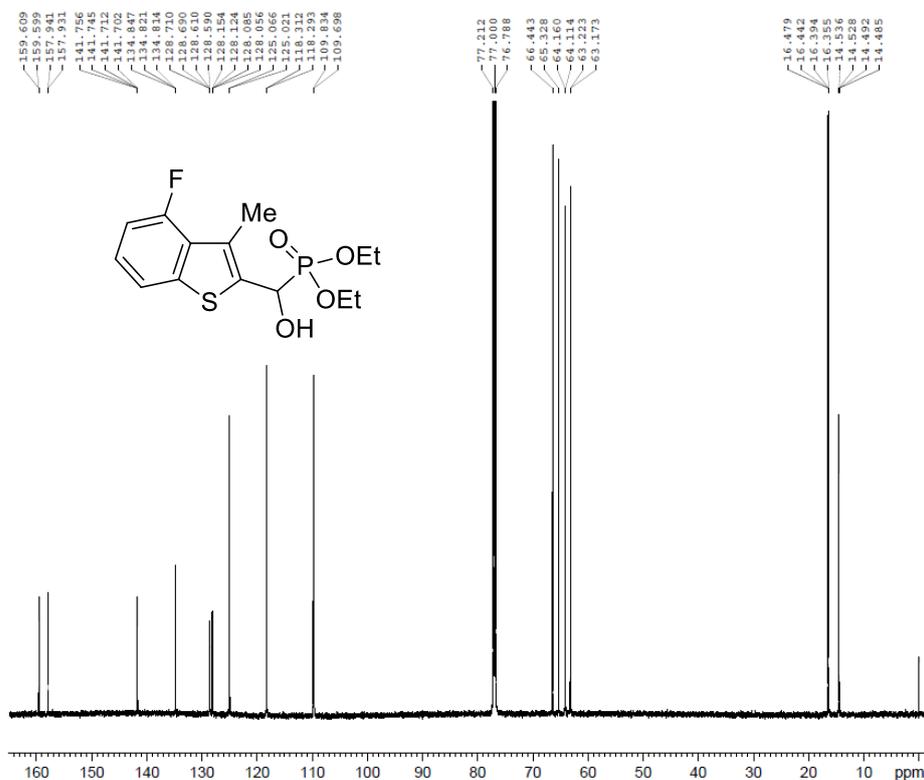
F2 - Acquisition Parameters  
Date\_ 20240906  
Time\_ 20.46 h  
INSTRUM spect  
PROBHD Z145856\_0002 ( zpgp30  
PULPROG 2pgp30  
TD 65536  
SOLVENT CDCl3  
NS 16  
DS 4  
SWH 96153.844 Hz  
FIDRES 2.934382 Hz  
AQ 0.3407872 sec  
RG 196.07  
DW 5.200 usec  
DE 18.00 usec  
TE 295.0 K  
D1 2.00000000 sec  
D11 0.03000000 sec  
TD0 1  
SFO1 242.8723078 MHz  
NUC1 31P  
P1 12.00 usec  
PLW1 66.12100220 W  
SFO2 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 242.8844520 MHz  
SF EM  
WDW 0  
SSB 1.00 Hz  
LB 0  
GB 0  
PC



# <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2k

## 2k



Standard 13C  
143461  
MIM0628\_1  
Milen Matyas  
2024.09.06. (KP)

Current Data Parameters  
NAME 143461  
EXPNO 26  
PROCNO 1

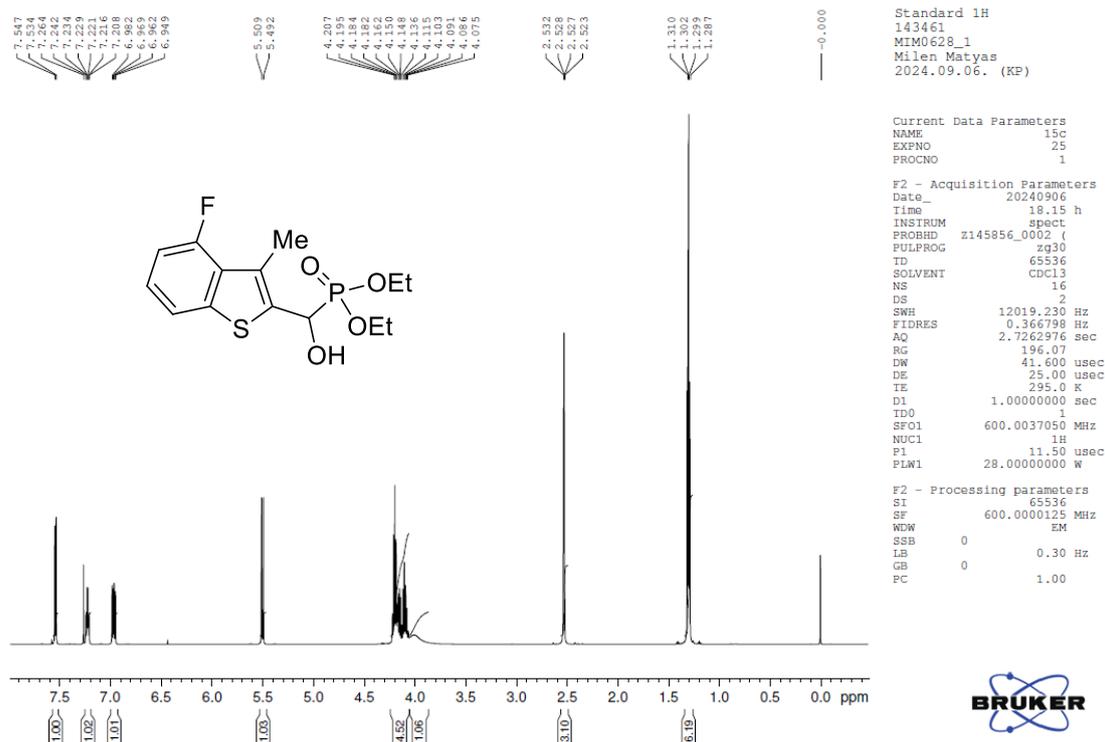
F2 - Acquisition Parameters  
Date\_ 20240906  
Time\_ 19.23 h  
INSTRUM spect  
PROBHD Z145856\_0002 ( zpgp30  
PULPROG 2pgp30  
TD 65536  
SOLVENT CDCl3  
NS 2048  
DS 4  
SWH 36231.883 Hz  
FIDRES 1.105709 Hz  
AQ 0.9043968 sec  
RG 196.07  
DW 13.800 usec  
DE 18.00 usec  
TE 295.0 K  
D1 1.00000000 sec  
D11 0.03000000 sec  
TD0 1  
SFO1 150.8852070 MHz  
NUC1 13C  
P1 9.90 usec  
PLW1 71.00000000 W  
SFO2 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 131072  
SF 150.8701284 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40



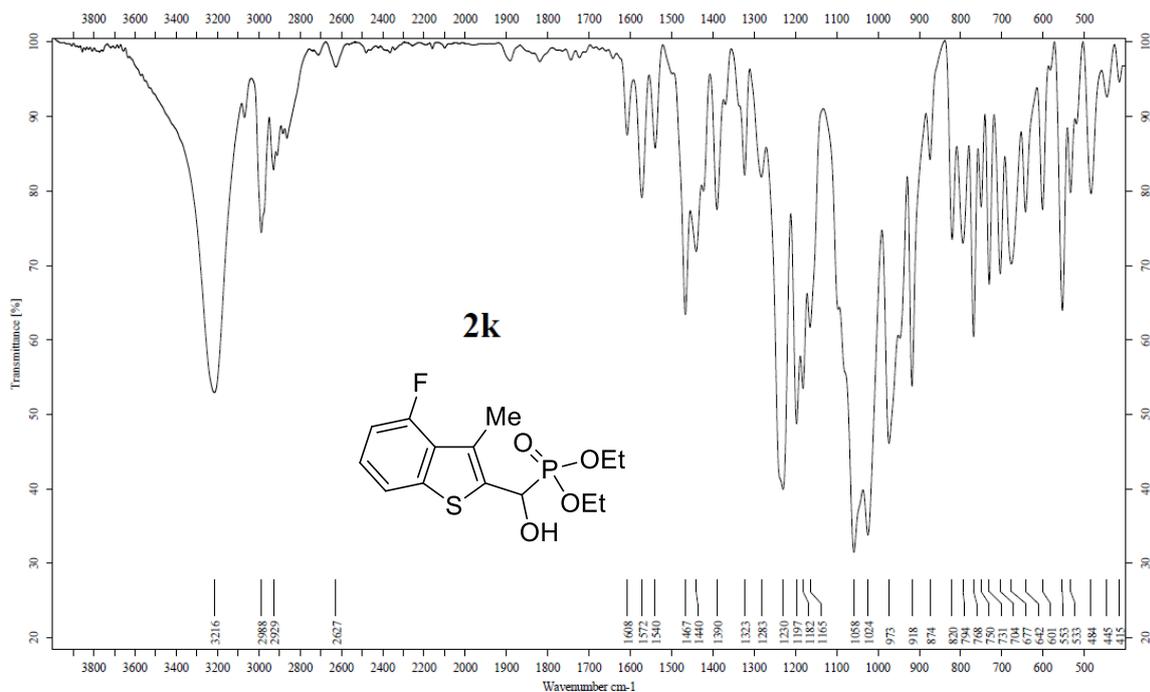
# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2k

2k



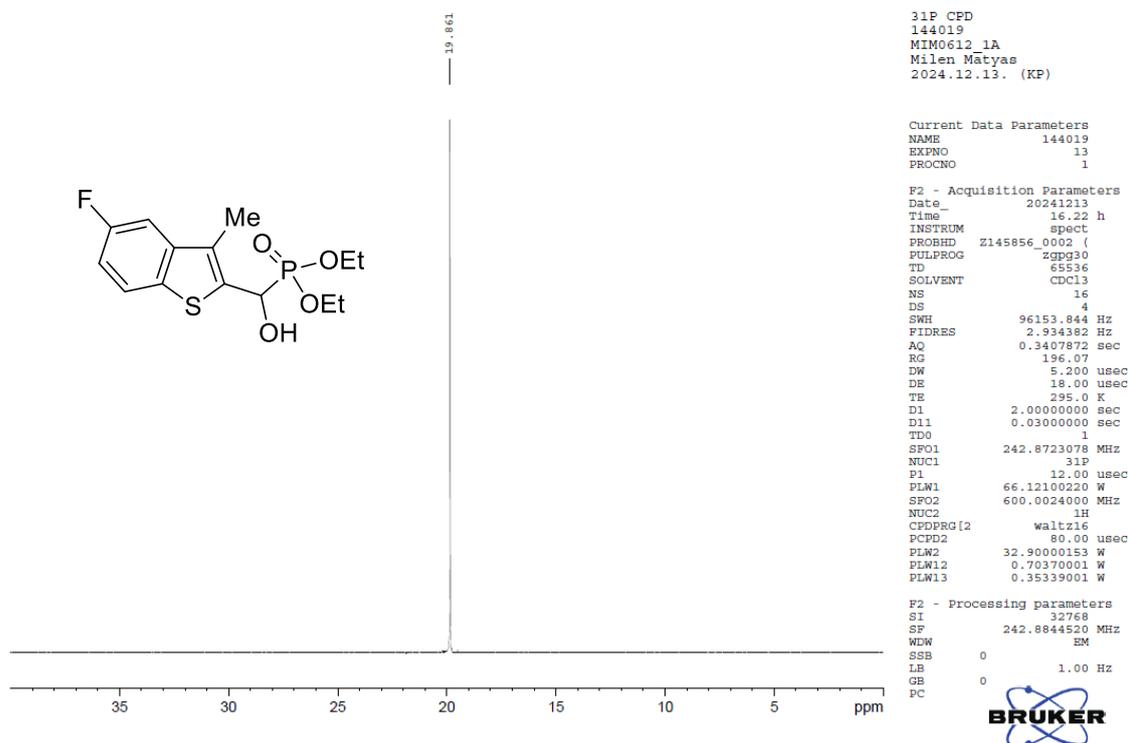
# IR (KBr) spectra for compound 2k

143461	Milen Matyas	KP	BRUKER Alpha
MIM0628_1	KBr	9/9/2024	Resolution: 2 cm-1
			Number of Scans: 16



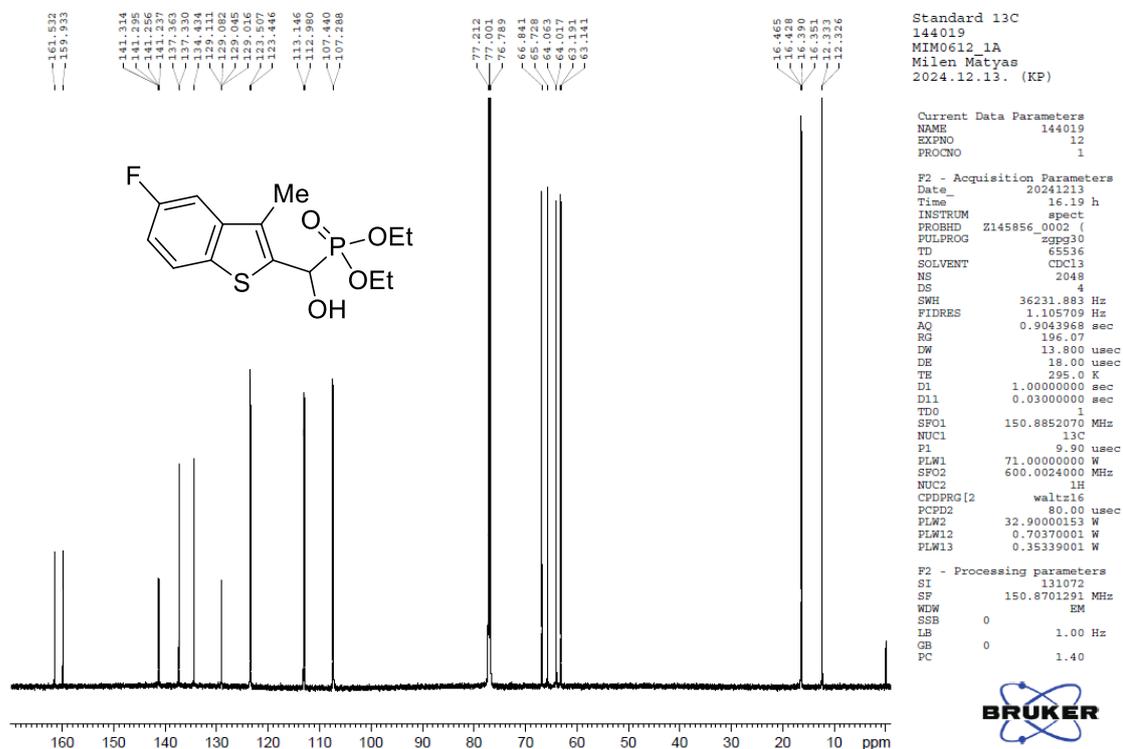
### <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2l

2l



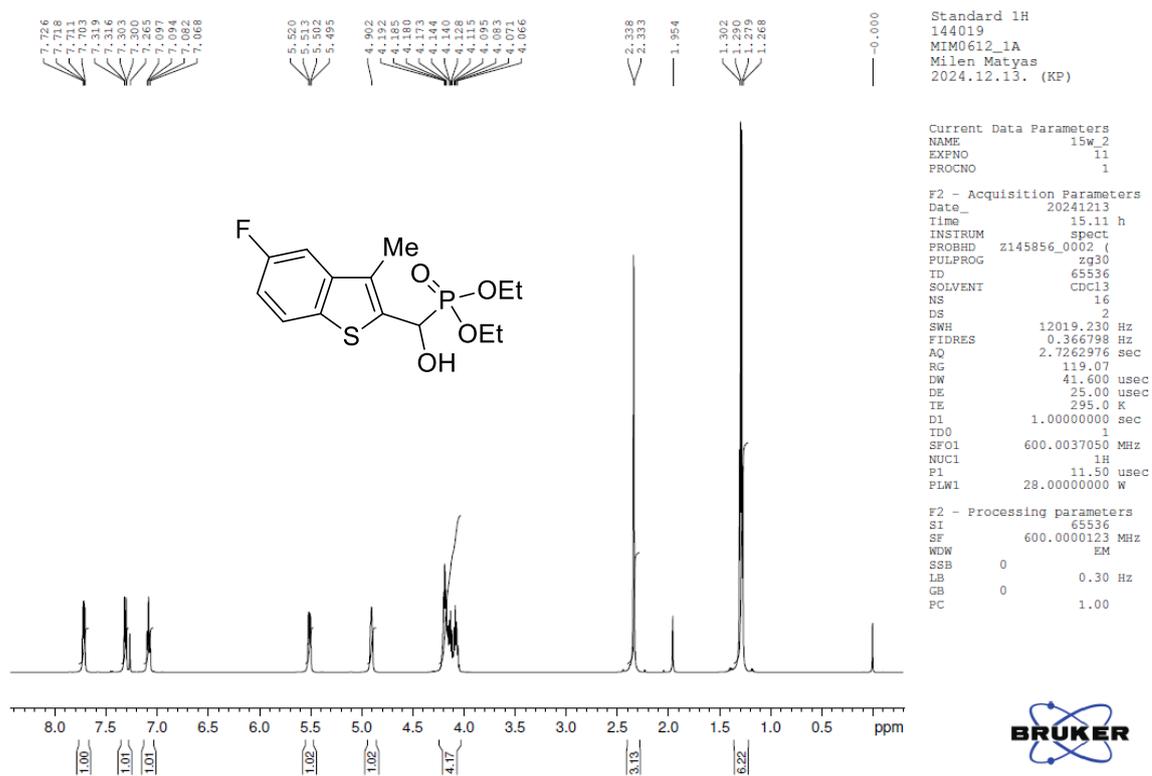
### <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2l

2l



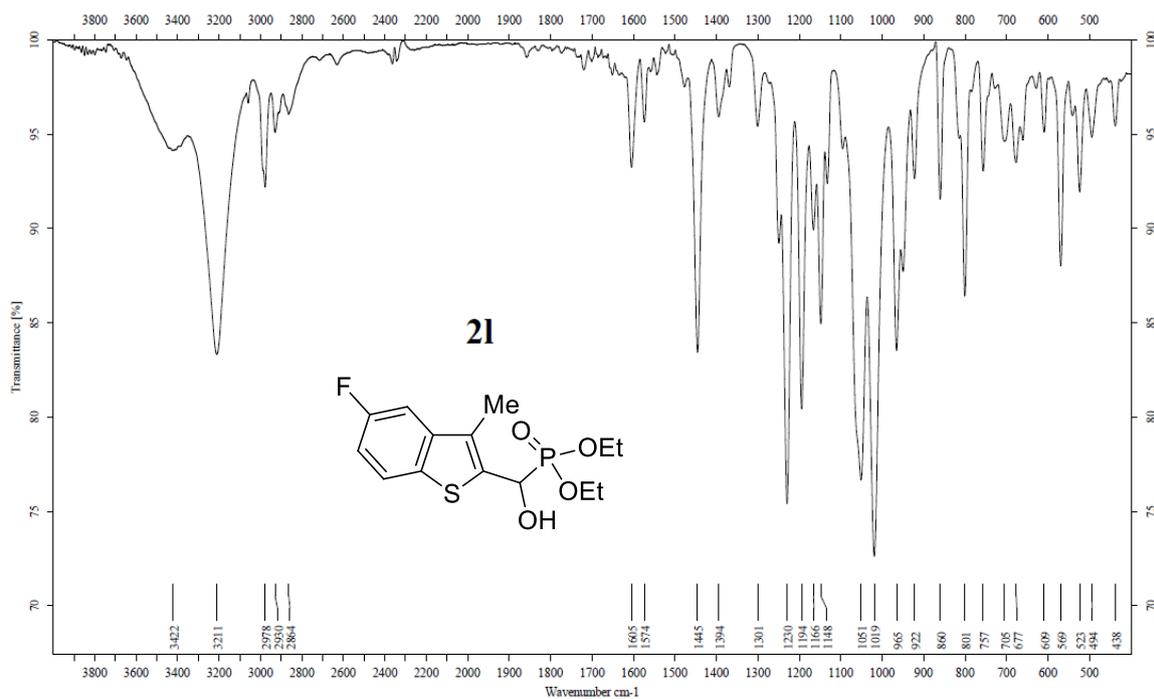
# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2l

2l



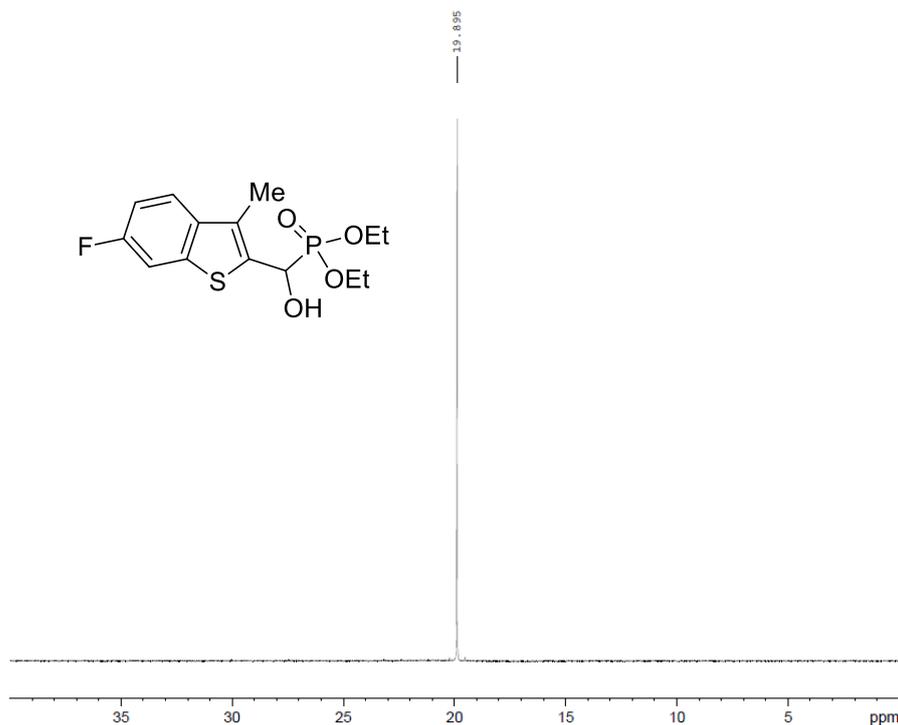
# IR (KBr) spectra for compound 2l

144019	Milen Matyas	KP	BRUKER Alpha
MIM0612_1A	KBr	12/13/2024	Resolution: 2 cm-1
			Number of Scans: 16



# <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2m

## 2m



31P CPD  
143413  
MIM0626\_1  
Milen Matyas  
2024.09.02. (KP)

Current Data Parameters  
NAME 143413  
EXPNO 16  
PROCNO 1

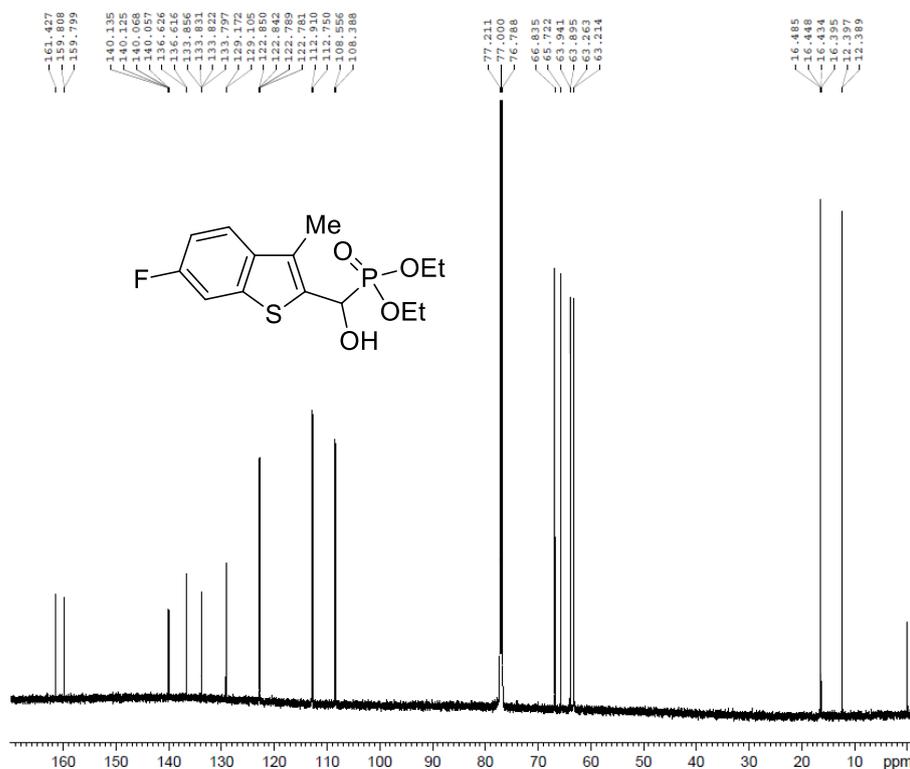
F2 - Acquisition Parameters  
Date\_ 20240903  
Time 1.19 h  
INSTRUM spect  
PROBHD Z145856\_0002 (  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 16  
DS 4  
SWH 96153.844 Hz  
FIDRES 2.934382 Hz  
AQ 0.3407872 sec  
RG 196.07  
DW 5.200 usec  
DE 18.00 usec  
TE 295.0 K  
D1 2.00000000 sec  
D11 0.03000000 sec  
TDO 1  
SF01 242.8723078 MHz  
NUC1 31P  
P1 12.00 usec  
PLW1 66.12100220 W  
SF02 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 32768  
SF 242.8844520 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC



# <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2m

## 2m



Standard 13C  
143413  
MIM0626\_1  
Milen Matyas  
2024.09.02. (KP)

Current Data Parameters  
NAME 143413  
EXPNO 12  
PROCNO 1

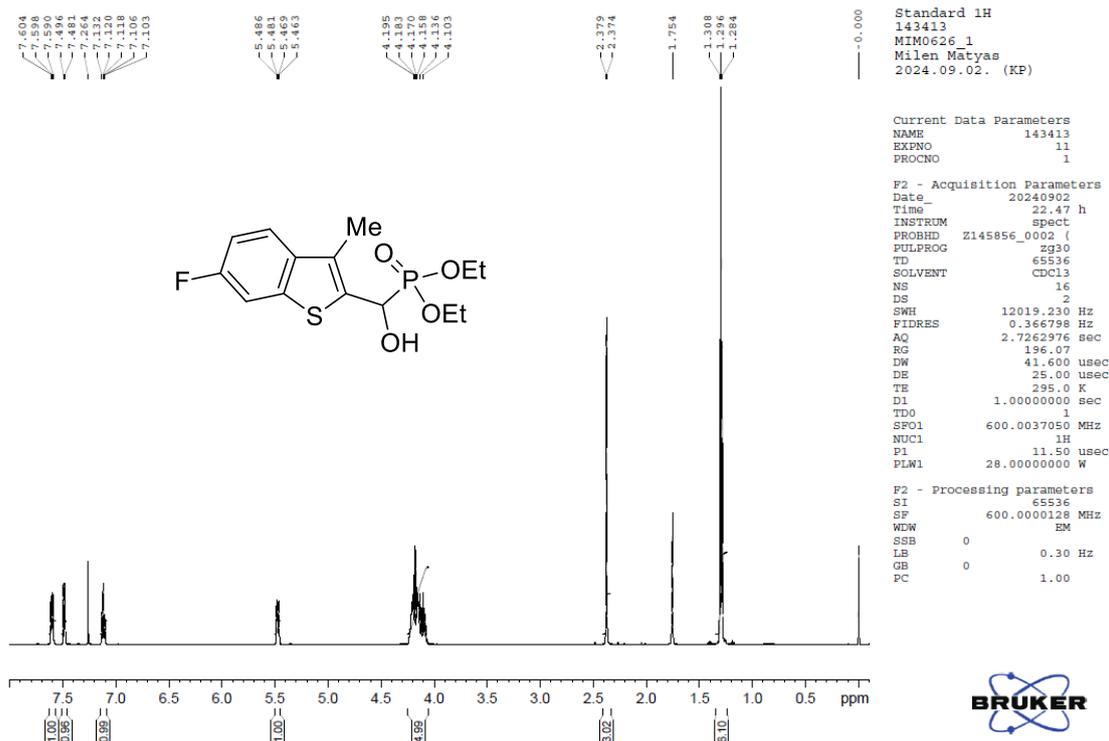
F2 - Acquisition Parameters  
Date\_ 20240902  
Time 23.56 h  
INSTRUM spect  
PROBHD Z145856\_0002 (  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 2048  
DS 4  
SWH 36231.883 Hz  
FIDRES 1.105709 Hz  
AQ 0.9043968 sec  
RG 196.07  
DW 13.800 usec  
DE 18.00 usec  
TE 295.0 K  
D1 1.00000000 sec  
D11 0.03000000 sec  
TDO 1  
SF01 150.8852070 MHz  
NUC1 13C  
P1 9.90 usec  
PLW1 71.00000000 W  
SF02 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 131072  
SF 150.8701270 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40



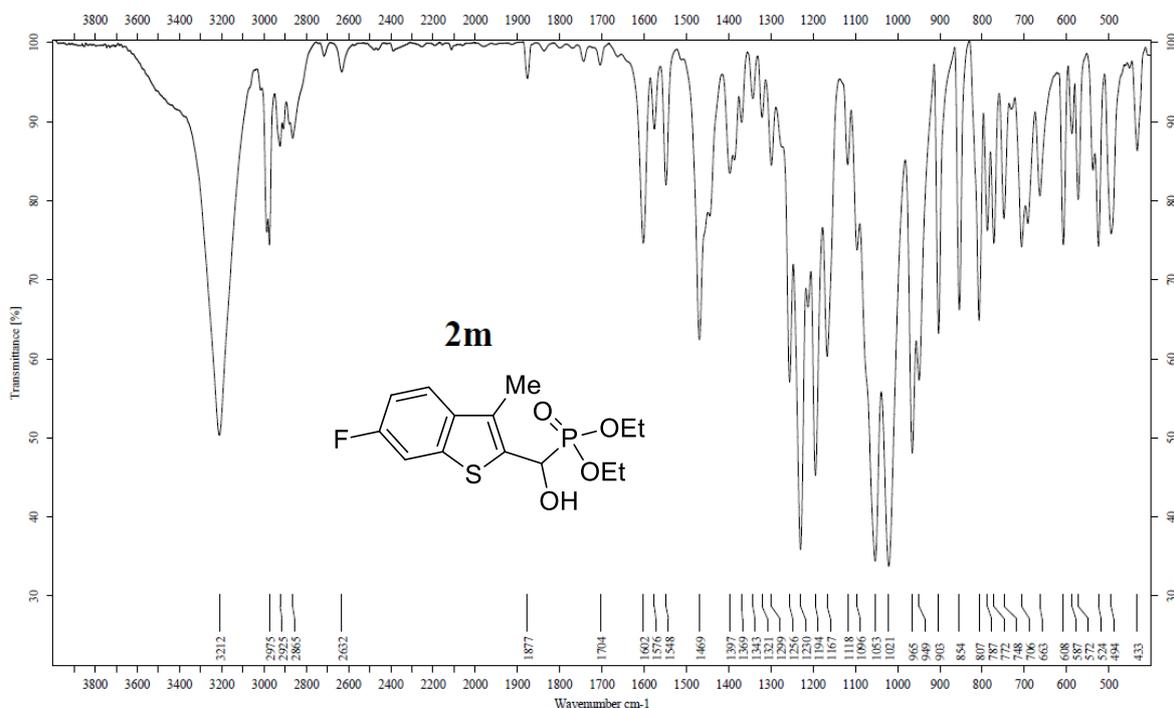
# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2m

2m



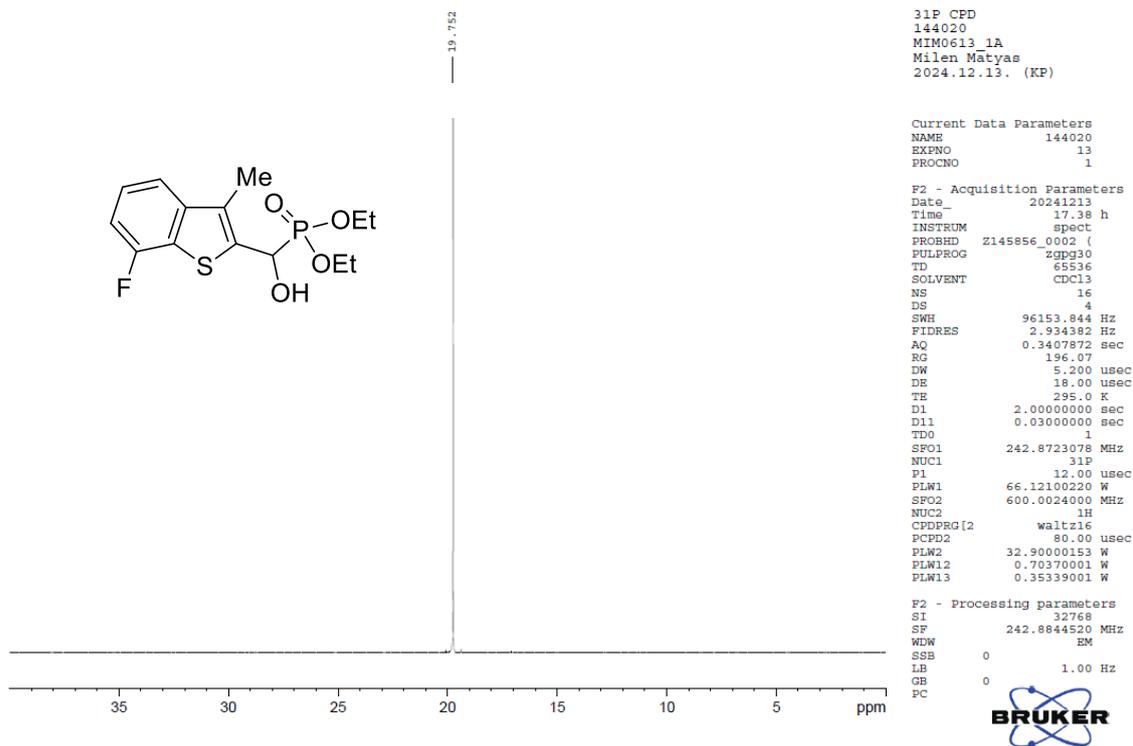
# IR (KBr) spectra for compound 2m

143413	Milen Matyas	KP	BRUKER Alpha
MIM0626_1	KBr	9/2/2024	Resolution: 2 cm-1
			Number of Scans: 16



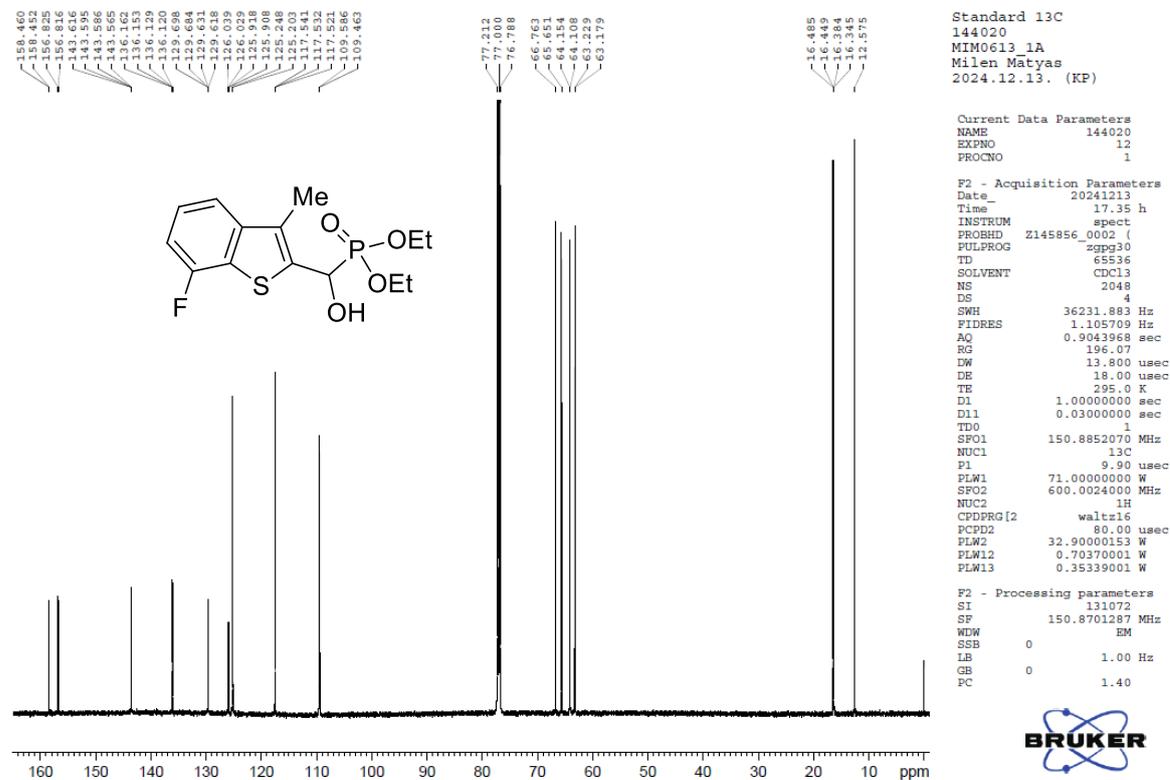
### <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2n

2n

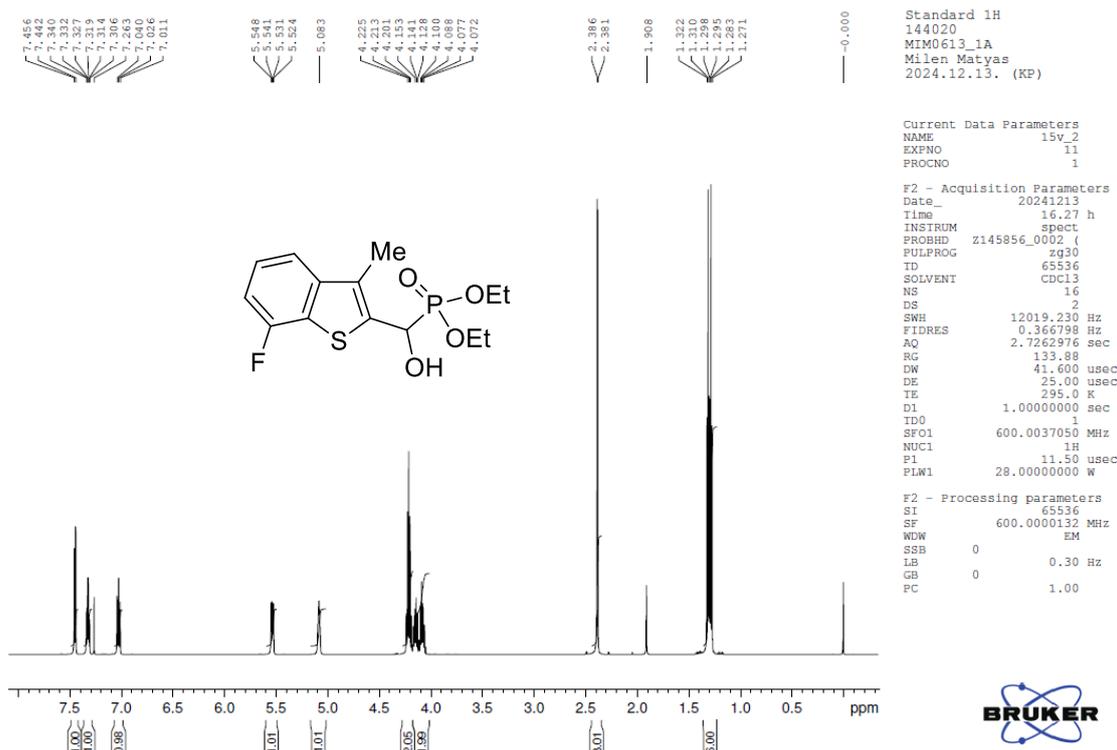


### <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2n

2n

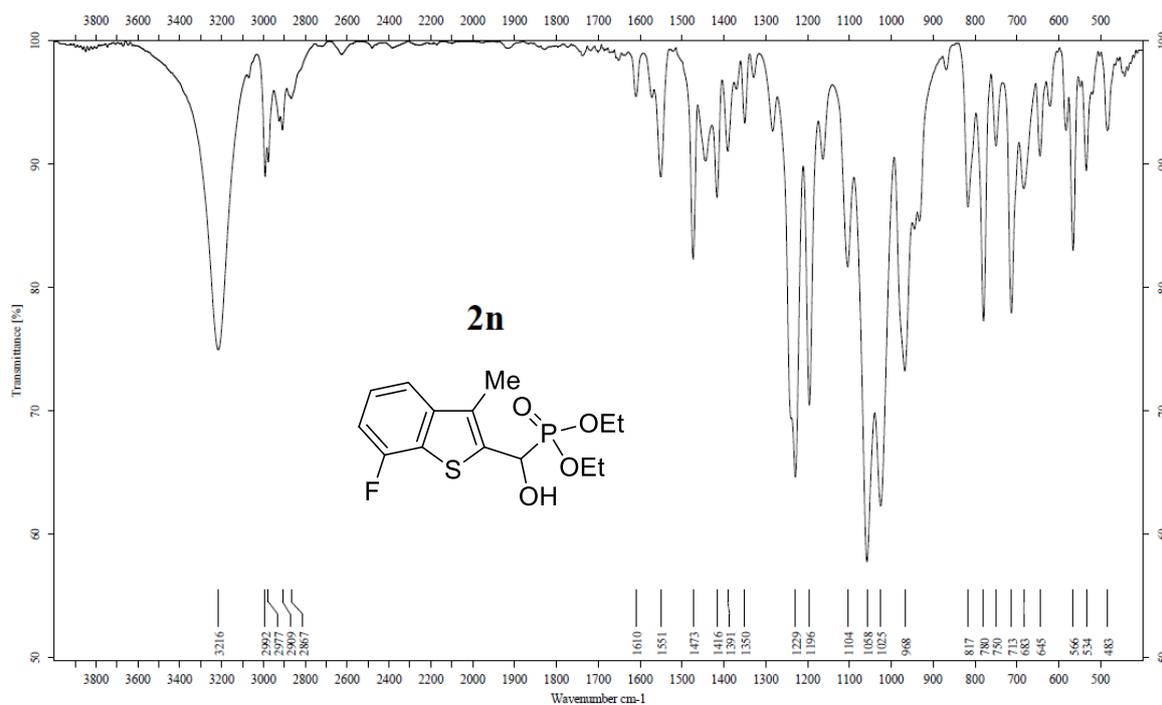


# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2n



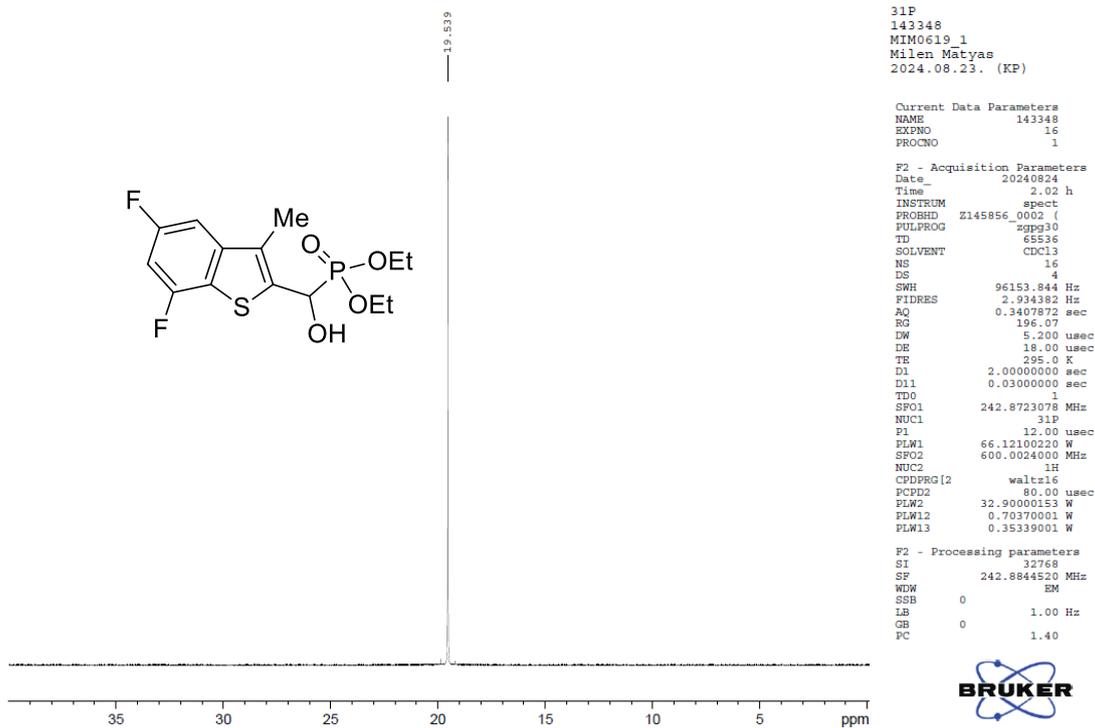
# IR (KBr) spectra for compound 2n

144020	Milen Matyas	KP	BRUKER Alpha
MIM0613_1A	KBr	12/13/2024	Resolution: 2 cm-1
			Number of Scans: 16



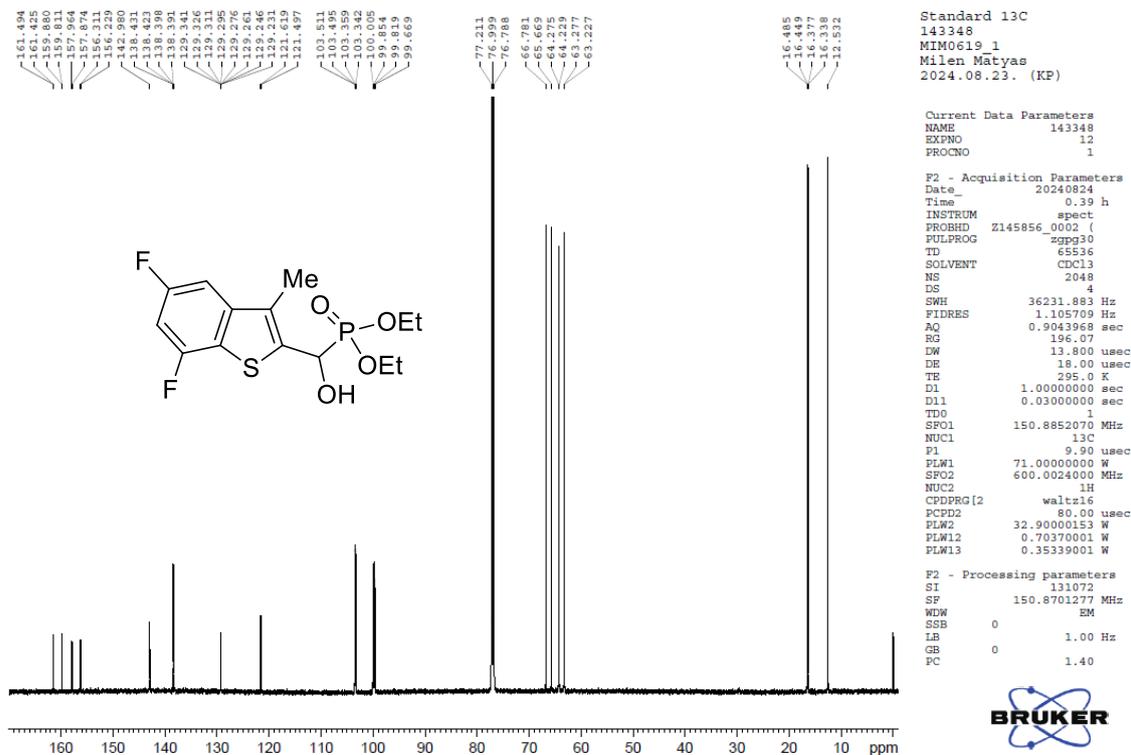
# <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2o

2o

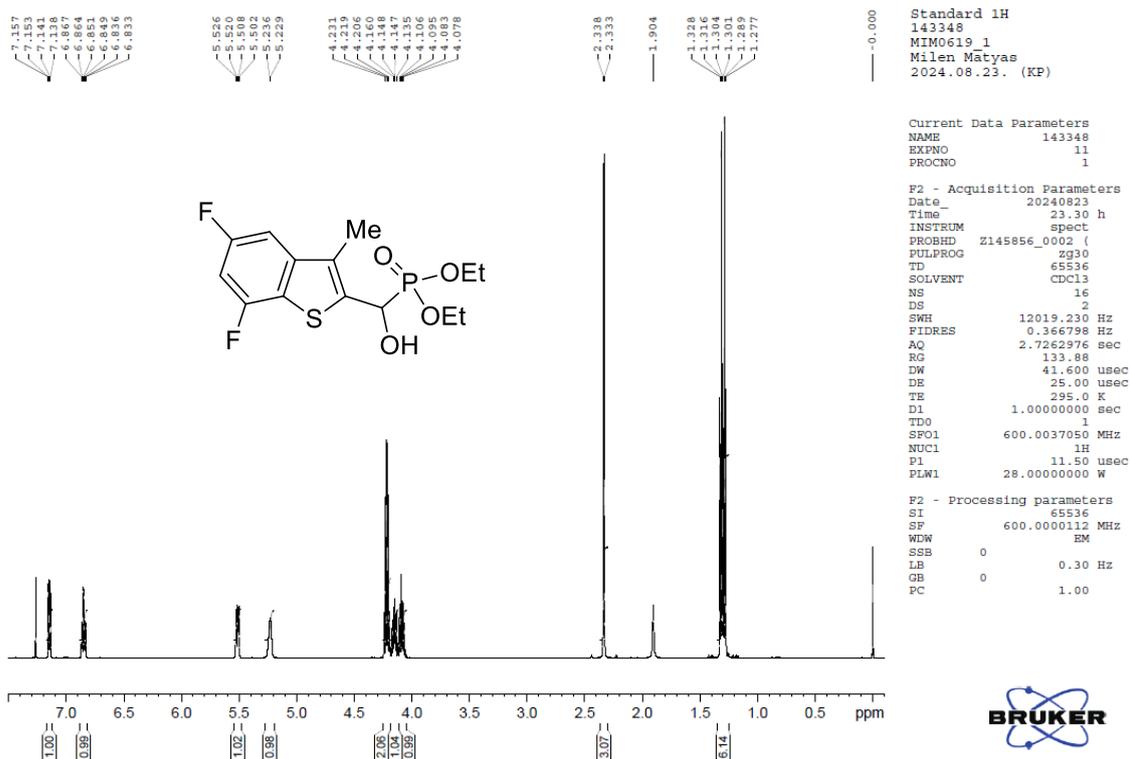


# <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2o

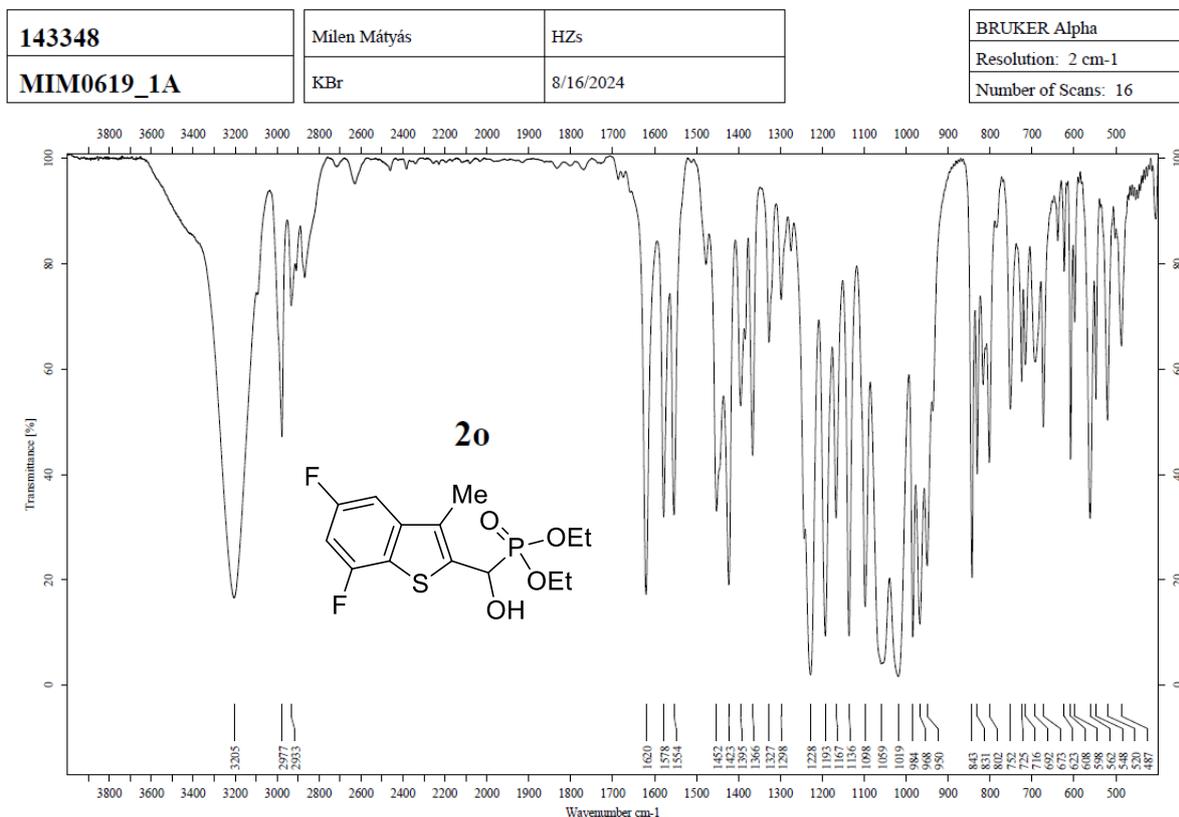
2o



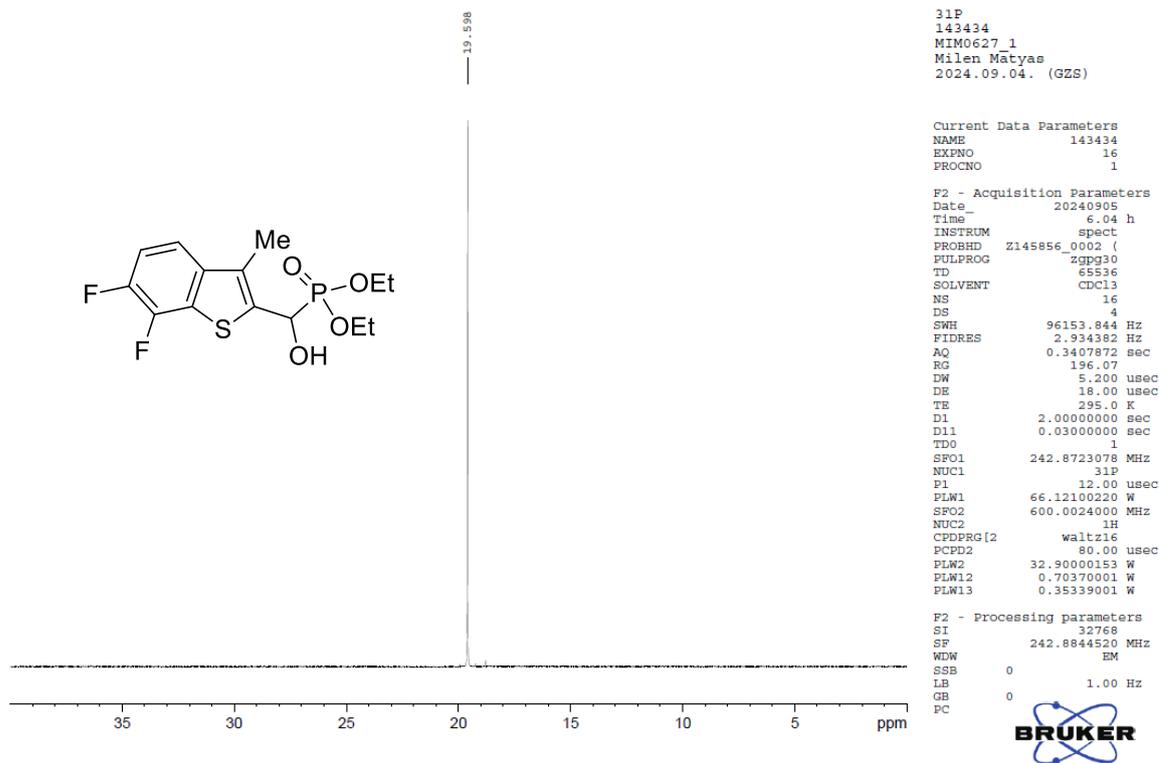
# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2o



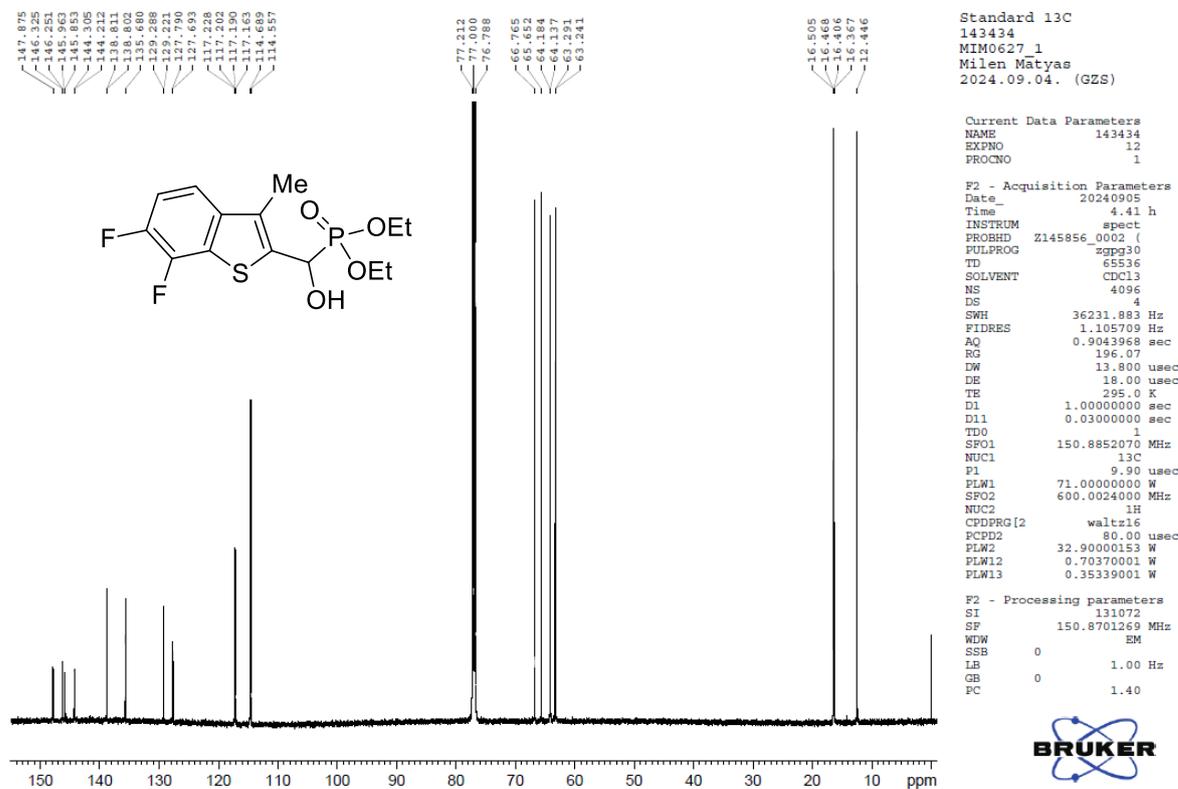
## IR (KBr) spectra for compound 2o



<sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2p

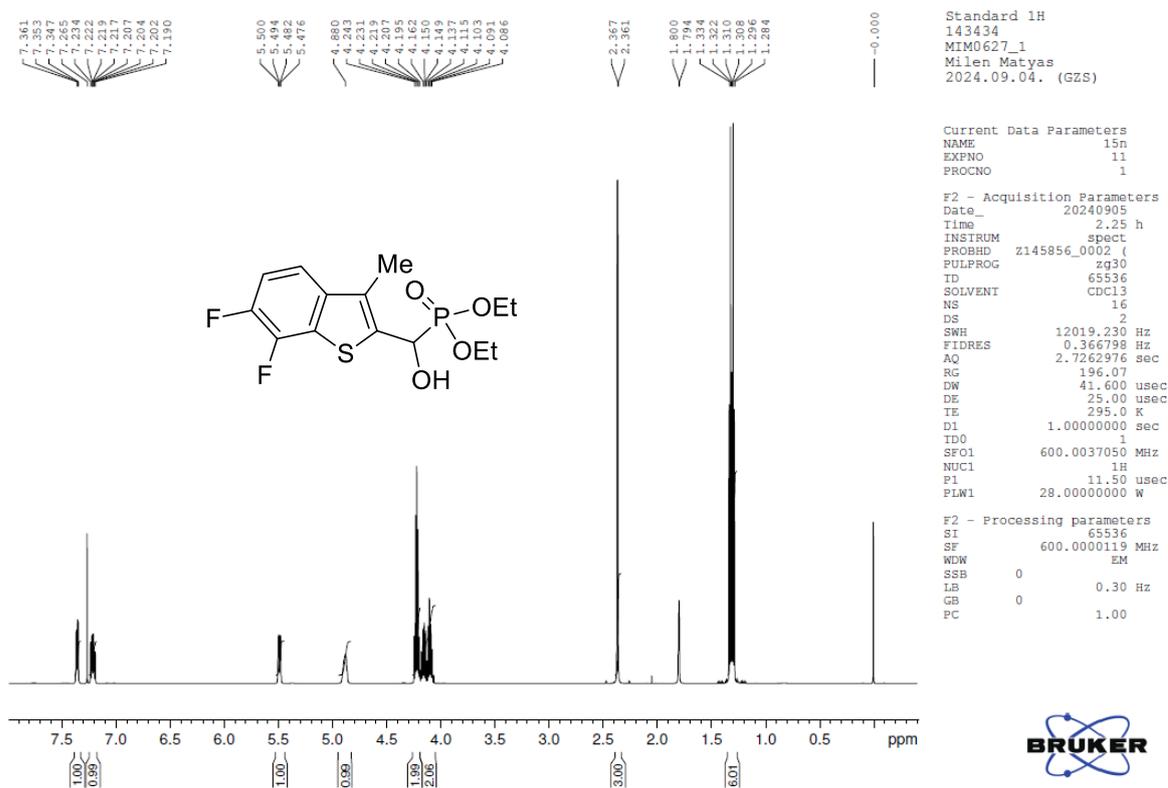


<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2p



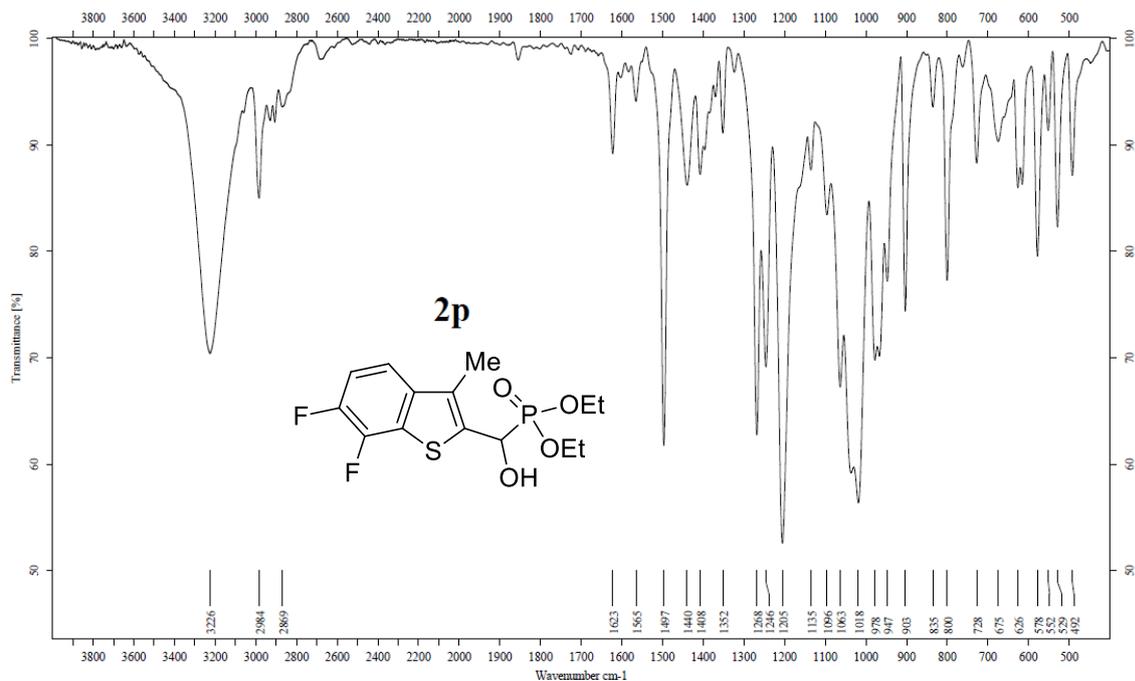
# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2p

## 2p



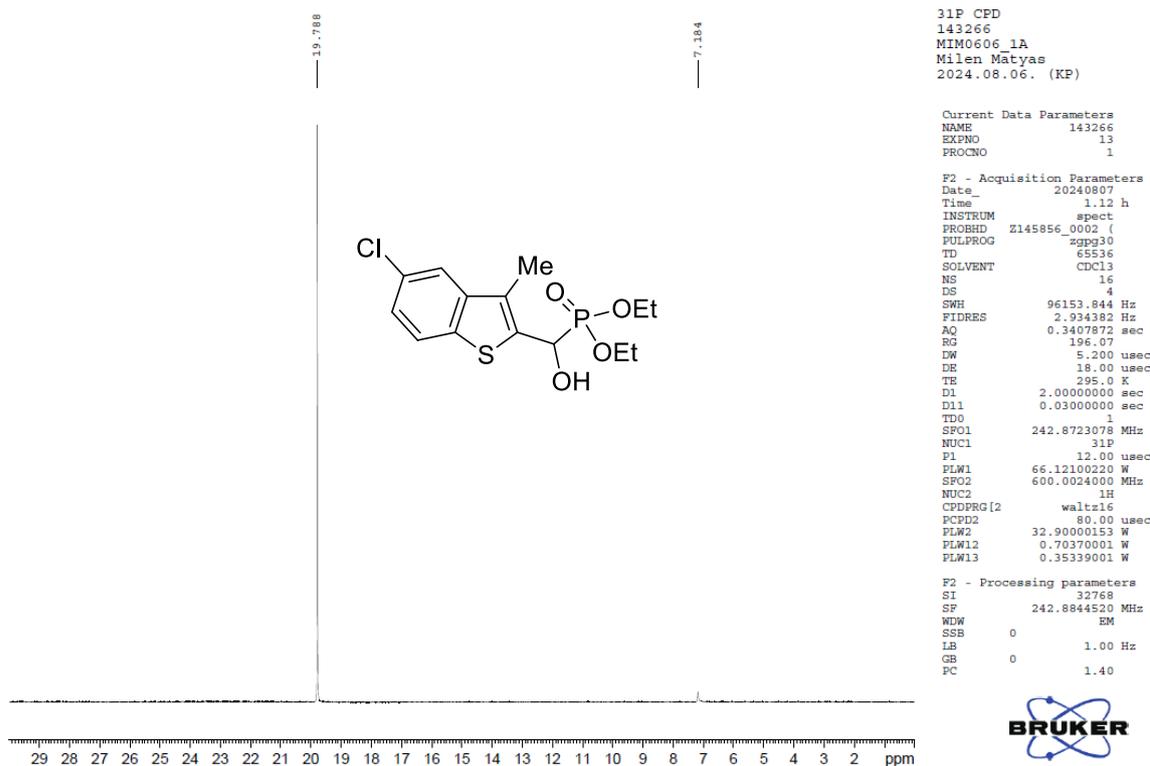
# IR (KBr) spectra for compound 2p

143434	Milen Matyas	KP	BRUKER Alpha
MIM0627_1	KBr	9/5/2024	Resolution: 2 cm-1
			Number of Scans: 16



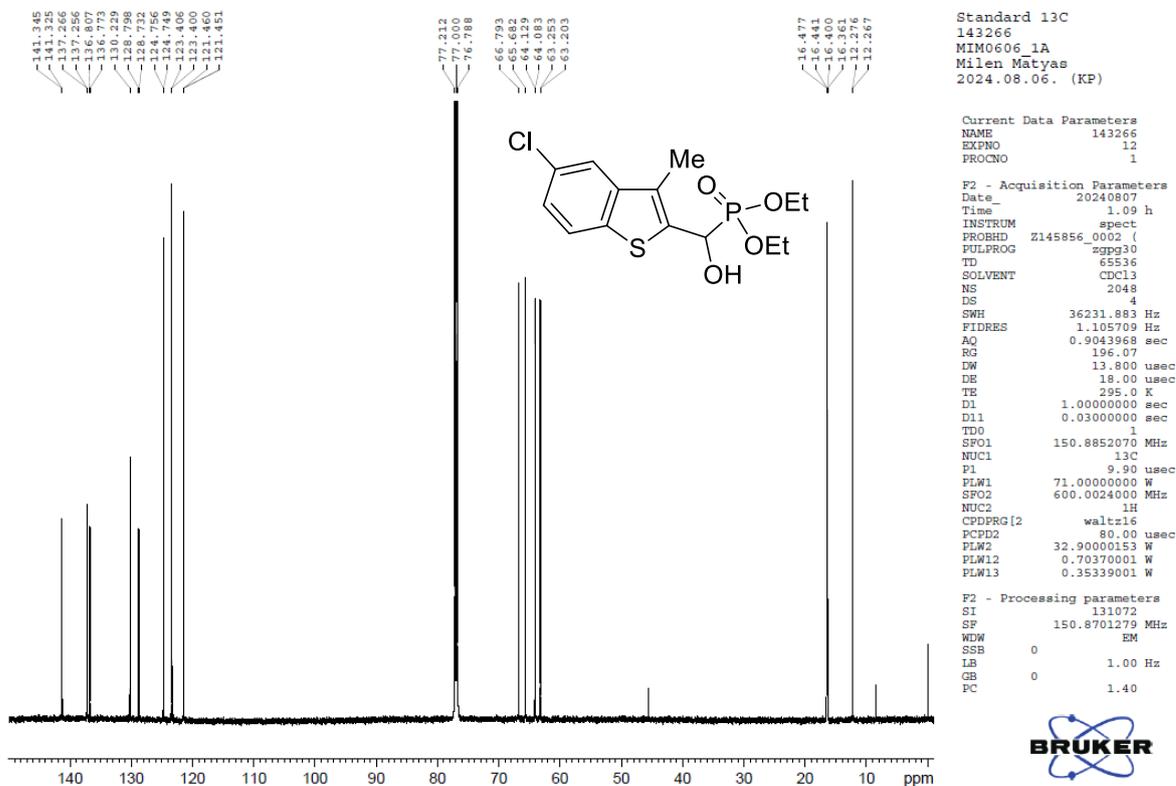
# <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2q

## 2q



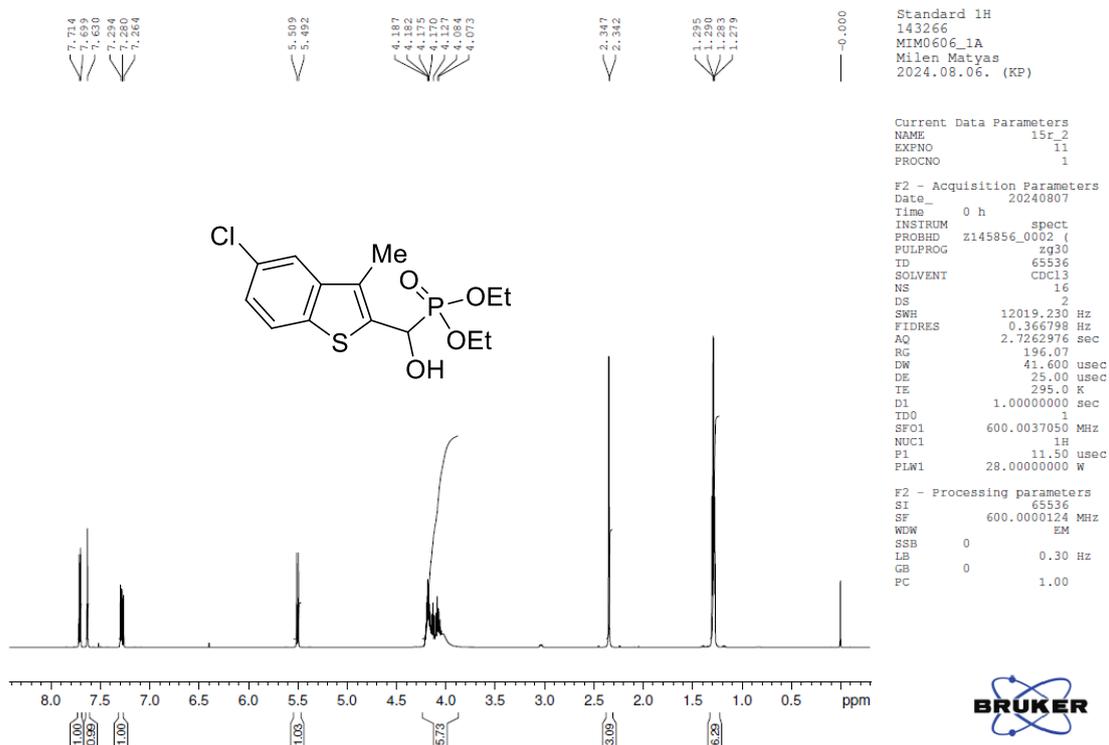
# <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2q

## 2q

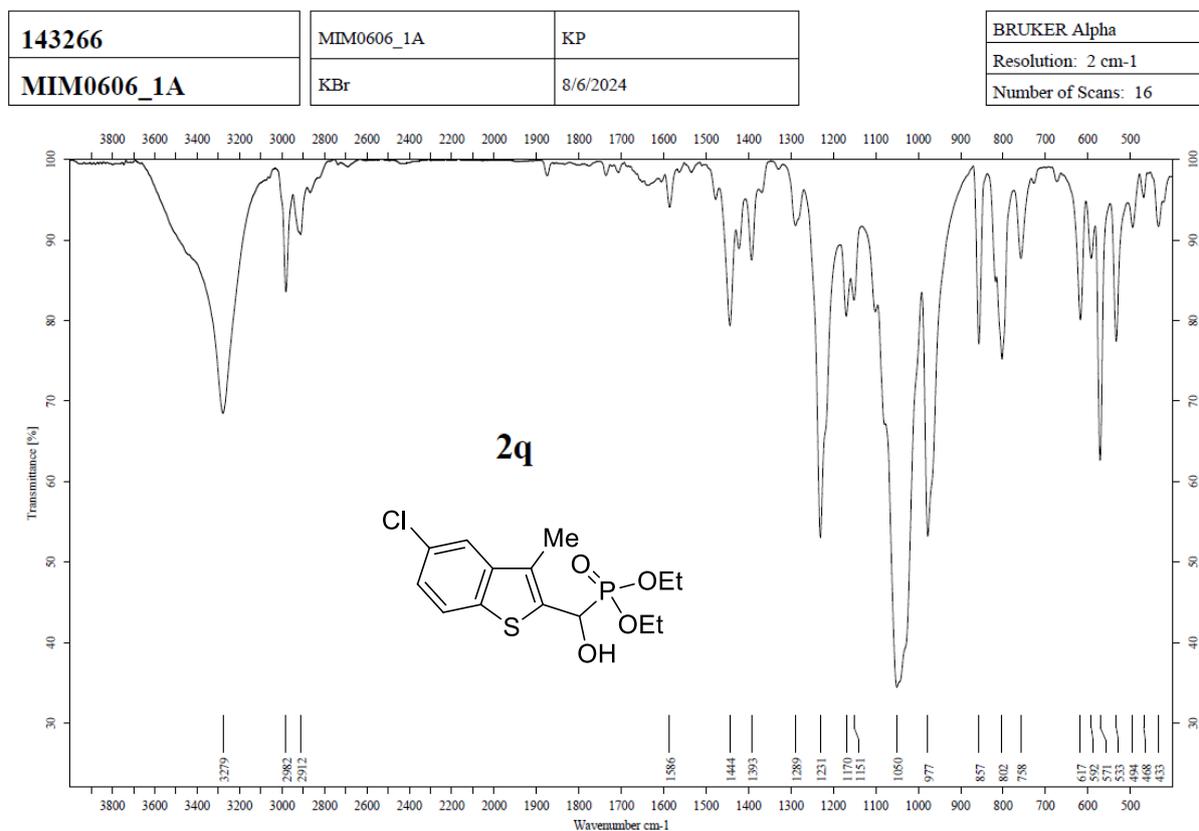


# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2q

2q

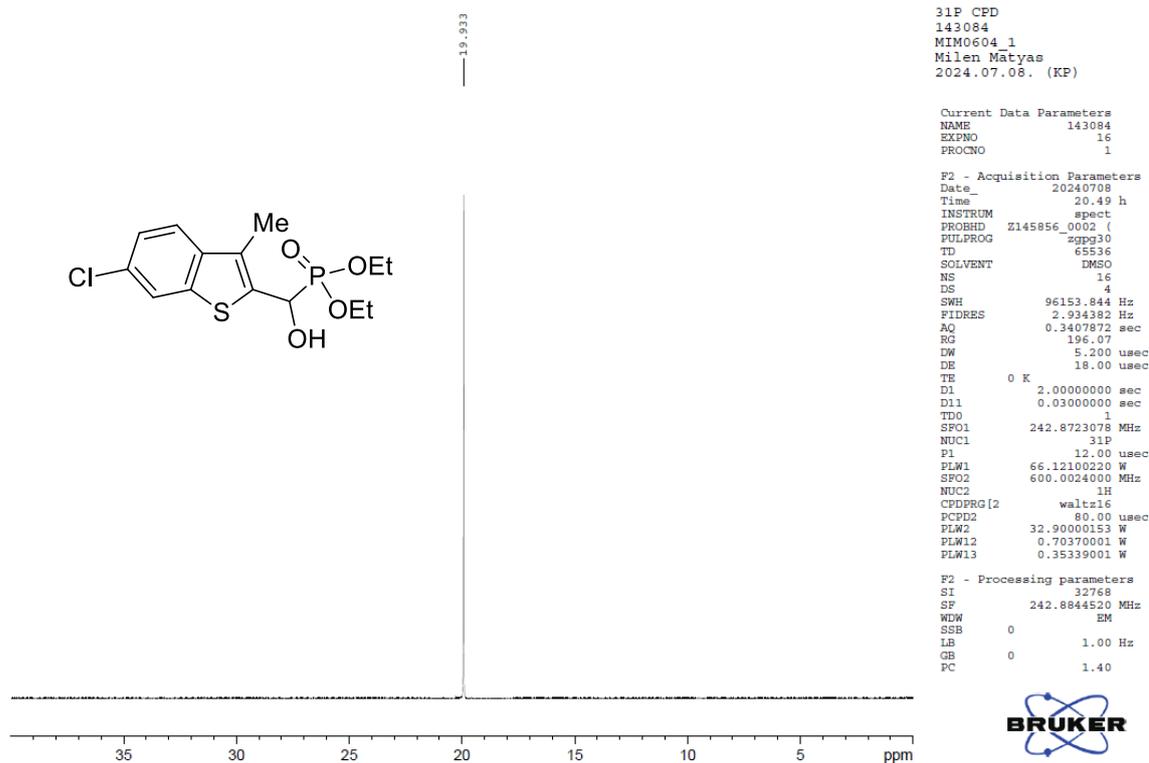


# IR (KBr) spectra for compound 2q



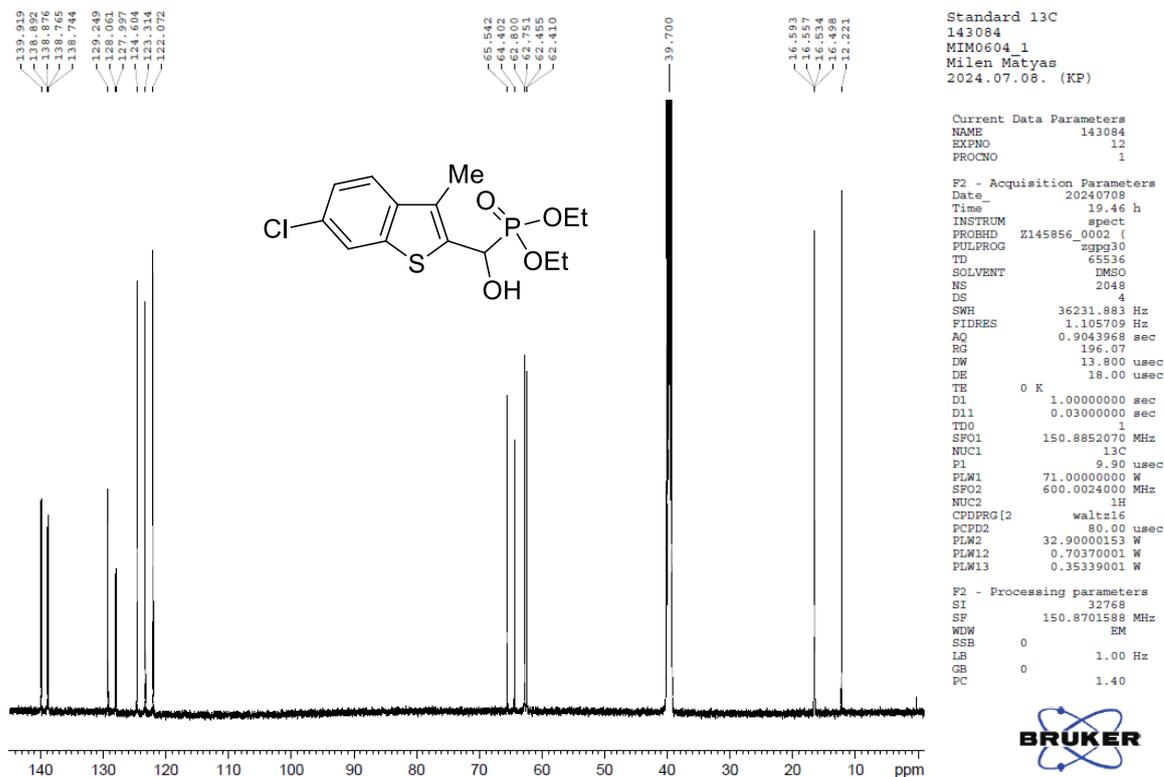
### <sup>31</sup>P NMR (242 MHz, DMSO-*d*<sub>6</sub>) spectra for compound 2r

2r



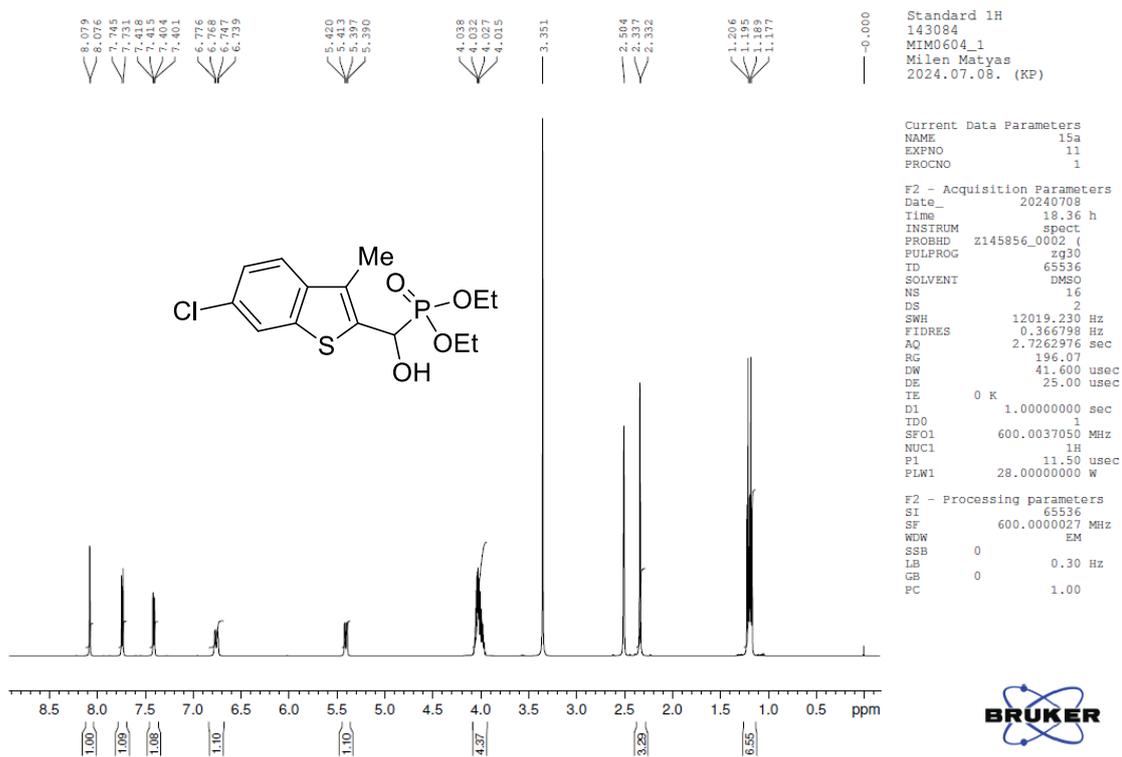
### <sup>13</sup>C NMR (150 MHz, DMSO-*d*<sub>6</sub>) spectra for compound 2r

2r



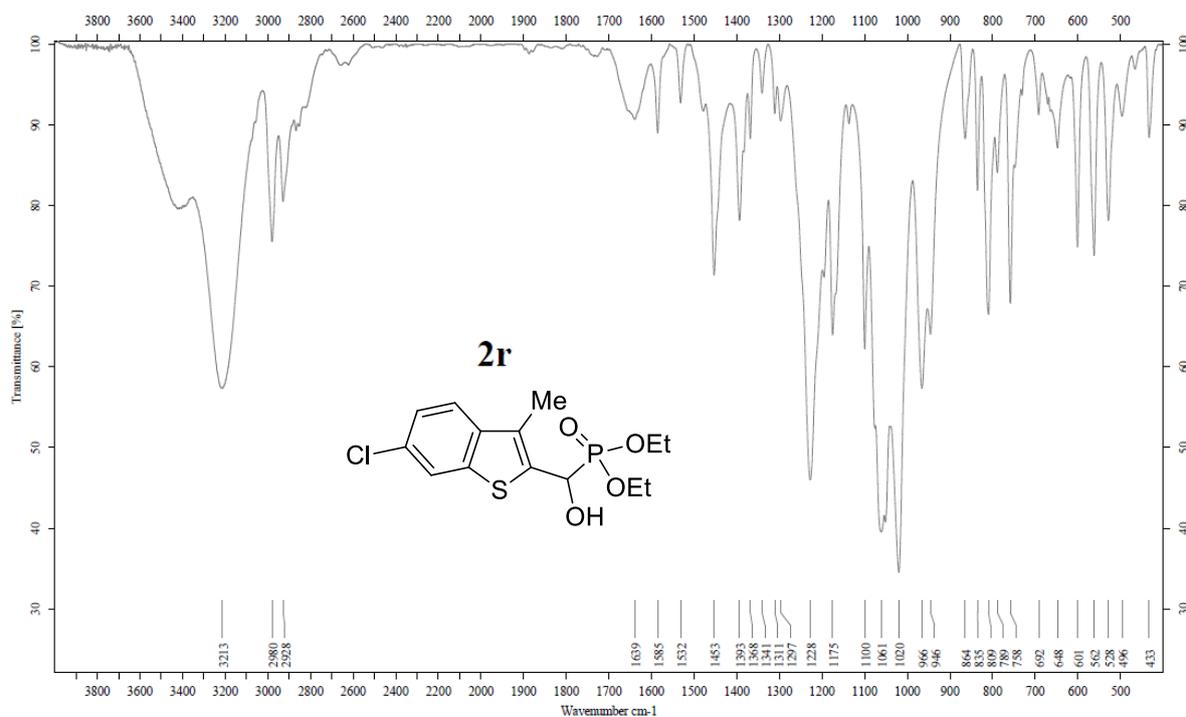
# <sup>1</sup>H NMR (600 MHz, DMSO-d<sub>6</sub>) spectra for compound 2r

2r



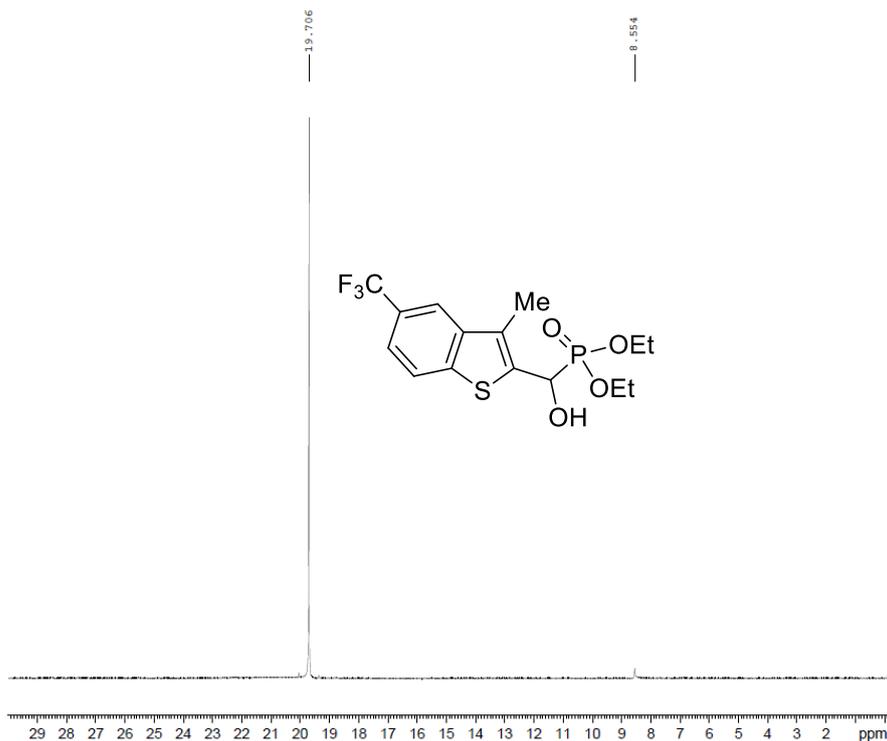
# IR (KBr) spectra for compound 2r

143084	Milen Matyas	PZ	BRUKER Alpha
MIM0604_1	KBr	7/8/2024	
			Number of Scans: 16



# <sup>31</sup>P NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2s

2s



31P CPD  
143274  
MIM0615\_1  
Milen Matyas  
2024.08.07. (KP)

Current Data Parameters  
NAME 143274  
EXPNO 13  
PROCNO 1

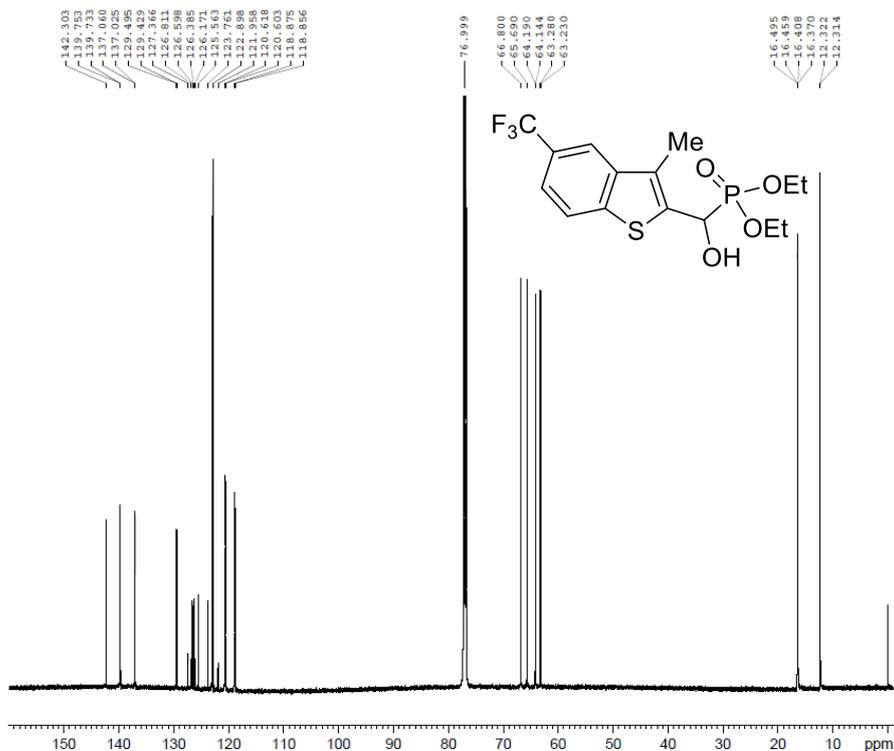
F2 - Acquisition Parameters  
Date\_ 20240807  
Time 22.22 h  
INSTRUM spect  
PROBHD Z145856\_0002 ( )  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 16  
DS 4  
SWH 96153.844 Hz  
FIDRES 2.934382 Hz  
AQ 0.3407872 sec  
RG 196.07  
DW 5.200 usec  
DE 18.00 usec  
TE 295.0 K  
D1 2.0000000 sec  
D11 0.0300000 sec  
TD0 1  
SFO1 242.8723078 MHz  
NUC1 31P  
P1 12.00 usec  
PLW1 66.12100220 W  
SFO2 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 32768  
SF 242.8844520 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40



# <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2s

2s



Standard 13C  
143274  
MIM0615\_1  
Milen Matyas  
2024.10.18. (KP)

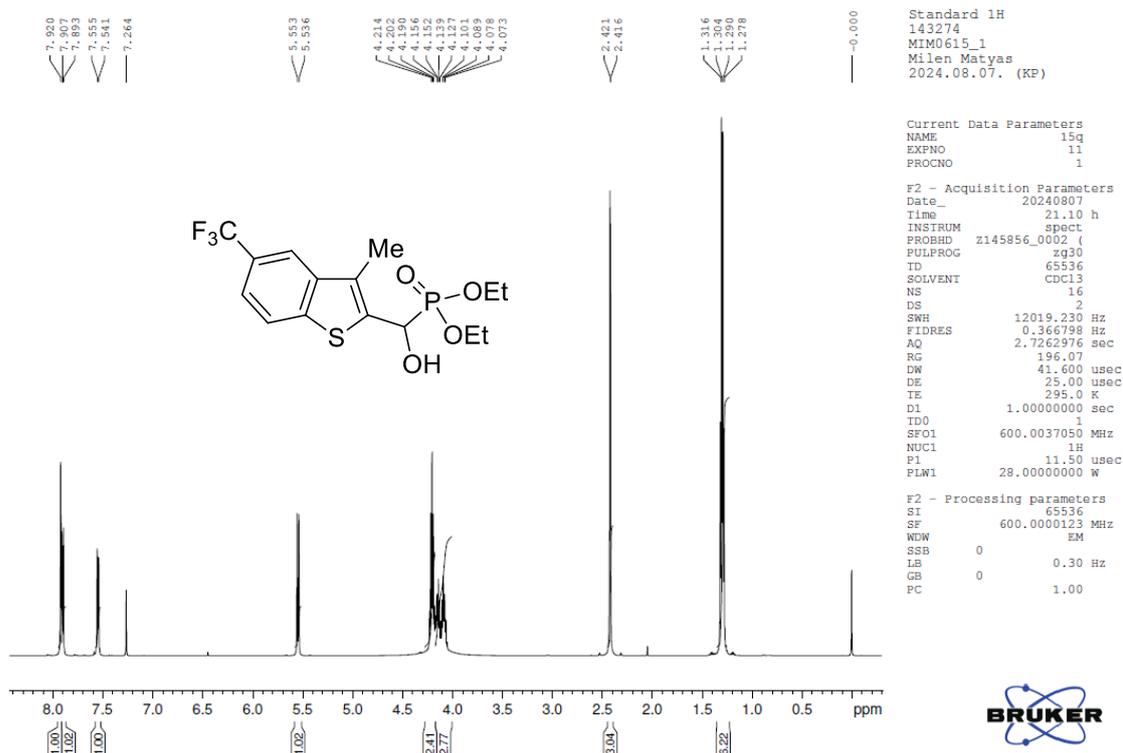
Current Data Parameters  
NAME 143274  
EXPNO 22  
PROCNO 1

F2 - Acquisition Parameters  
Date\_ 20241018  
Time 21.05 h  
INSTRUM spect  
PROBHD Z145856\_0002 ( )  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 8192  
DS 4  
SWH 36231.883 Hz  
FIDRES 1.105709 Hz  
AQ 0.9043968 sec  
RG 196.07  
DW 13.800 usec  
DE 18.00 usec  
TE 295.0 K  
D1 1.0000000 sec  
D11 0.0300000 sec  
TD0 1  
SFO1 150.8852070 MHz  
NUC1 13C  
P1 9.90 usec  
PLW1 71.00000000 W  
SFO2 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 524288  
SF 150.8701269 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40

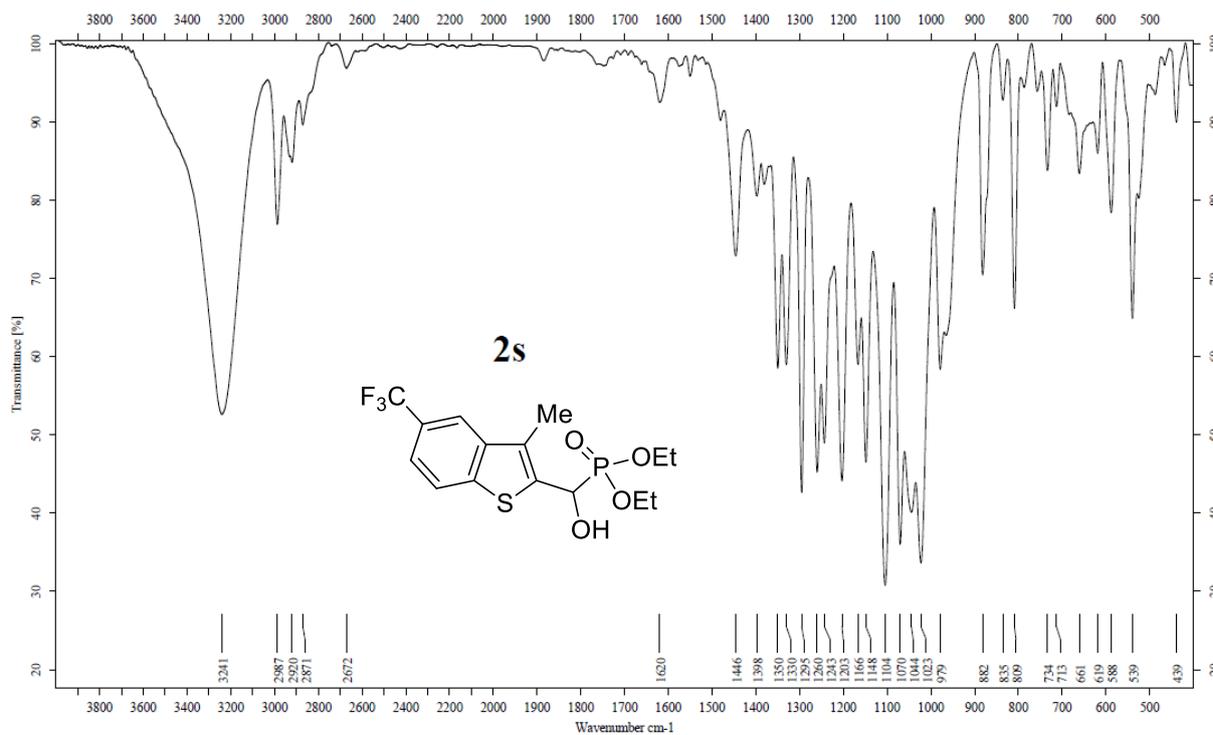


# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2s



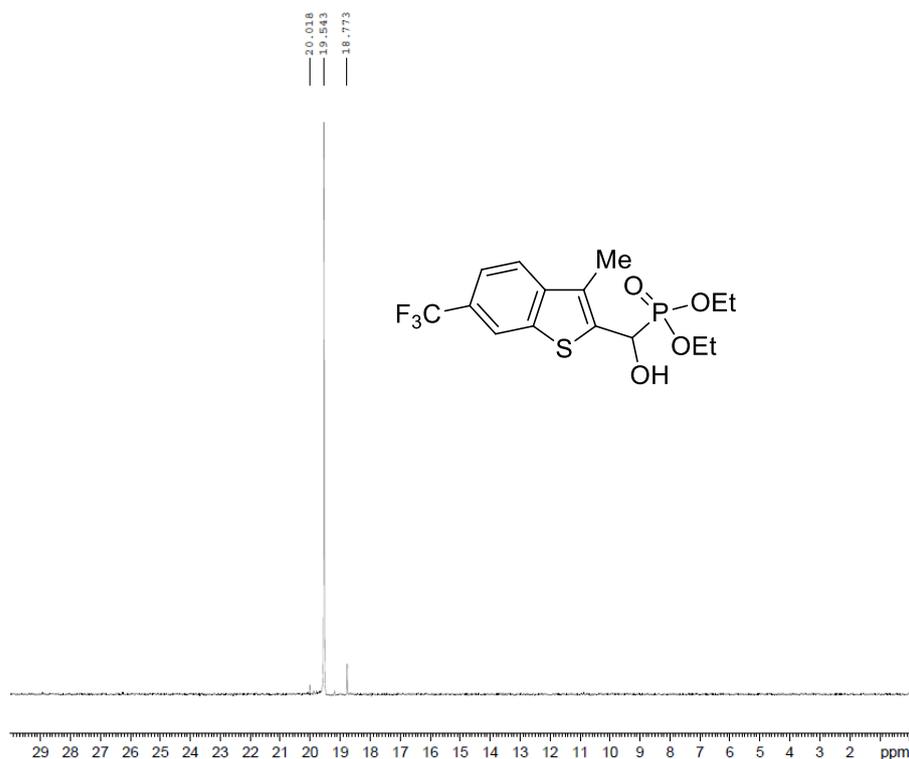
## IR (KBr) spectra for compound 2s

143274	Milen Matyas	KP	<b>BRUKER Alpha</b> Resolution: 2 cm-1 Number of Scans: 16
MIM0615_1	KBr	8/7/2024	



# <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2t

## 2t



31P CPD  
143382  
MIM0620\_1  
Milen Matyas  
2024.08.27. (KP)

Current Data Parameters  
NAME 143382  
EXPNO 13  
PROCNO 1

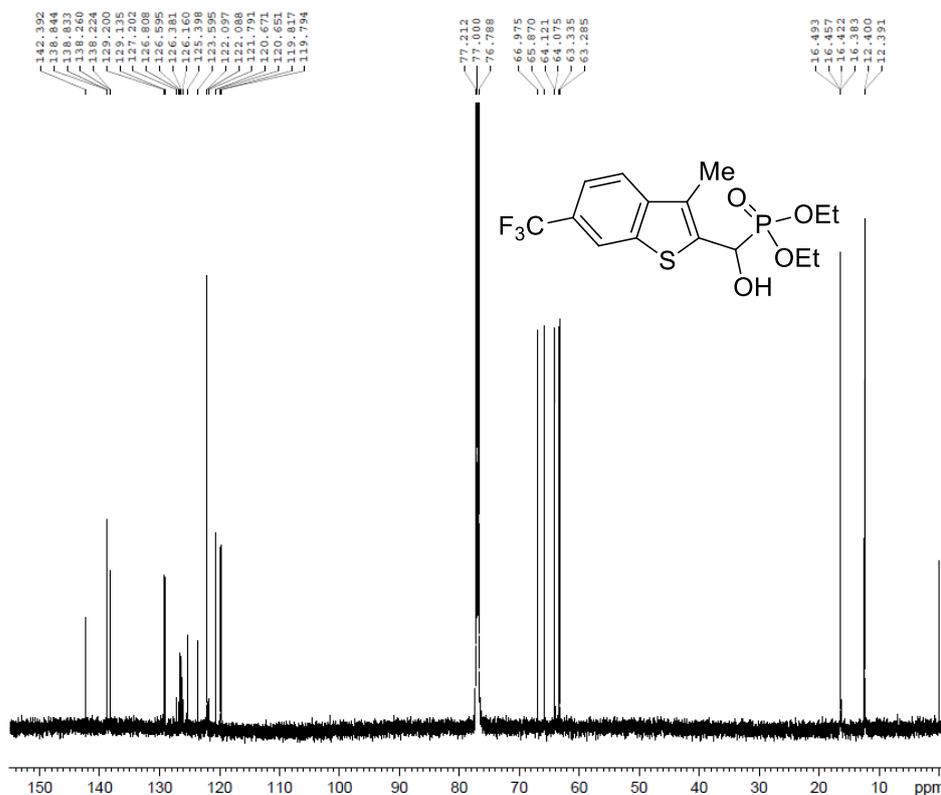
F2 - Acquisition Parameters  
Date\_ 20240827  
Time 17.45 h  
INSTRUM spect  
PROBHD Z145856\_0002 (  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 16  
DS 4  
SWH 96153.844 Hz  
FIDRES 2.934382 Hz  
AQ 0.3407872 sec  
RG 196.07  
DW 5.200 usec  
DE 18.00 usec  
TE 295.0 K  
D1 2.00000000 sec  
D11 0.03000000 sec  
TDO 1  
SFO1 242.8723079 MHz  
NUC1 31P  
P1 12.00 usec  
PLW1 66.12100220 W  
SFO2 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 32768  
SF 242.8844520 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40



# <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2t

## 2t



Standard 13C  
143382  
MIM0620\_1  
Milen Matyas  
2024.08.27. (KP)

Current Data Parameters  
NAME 143382  
EXPNO 12  
PROCNO 1

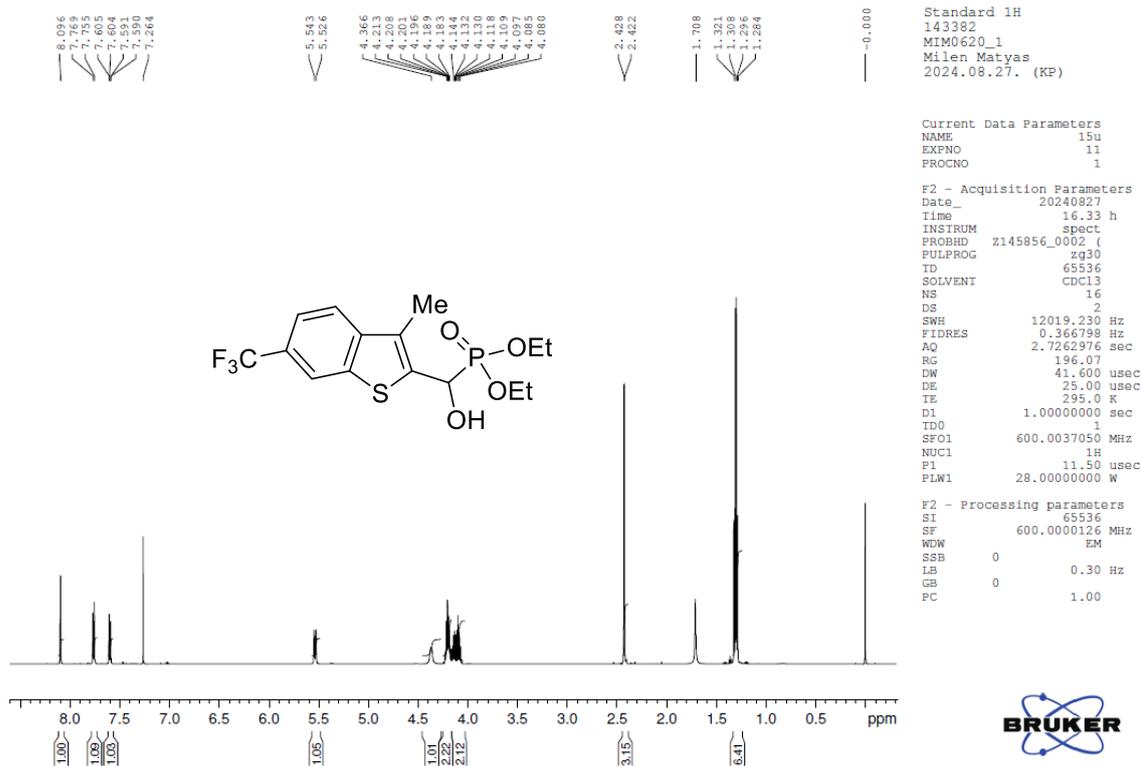
F2 - Acquisition Parameters  
Date\_ 20240827  
Time 17.42 h  
INSTRUM spect  
PROBHD Z145856\_0002 (  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 2048  
DS 4  
SWH 36231.883 Hz  
FIDRES 1.105709 Hz  
AQ 0.9043968 sec  
RG 196.07  
DW 13.800 usec  
DE 18.00 usec  
TE 295.0 K  
D1 1.00000000 sec  
D11 0.03000000 sec  
TDO 1  
SFO1 150.8852070 MHz  
NUC1 13C  
P1 9.90 usec  
PLW1 71.00000000 W  
SFO2 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 131072  
SF 150.8701261 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40



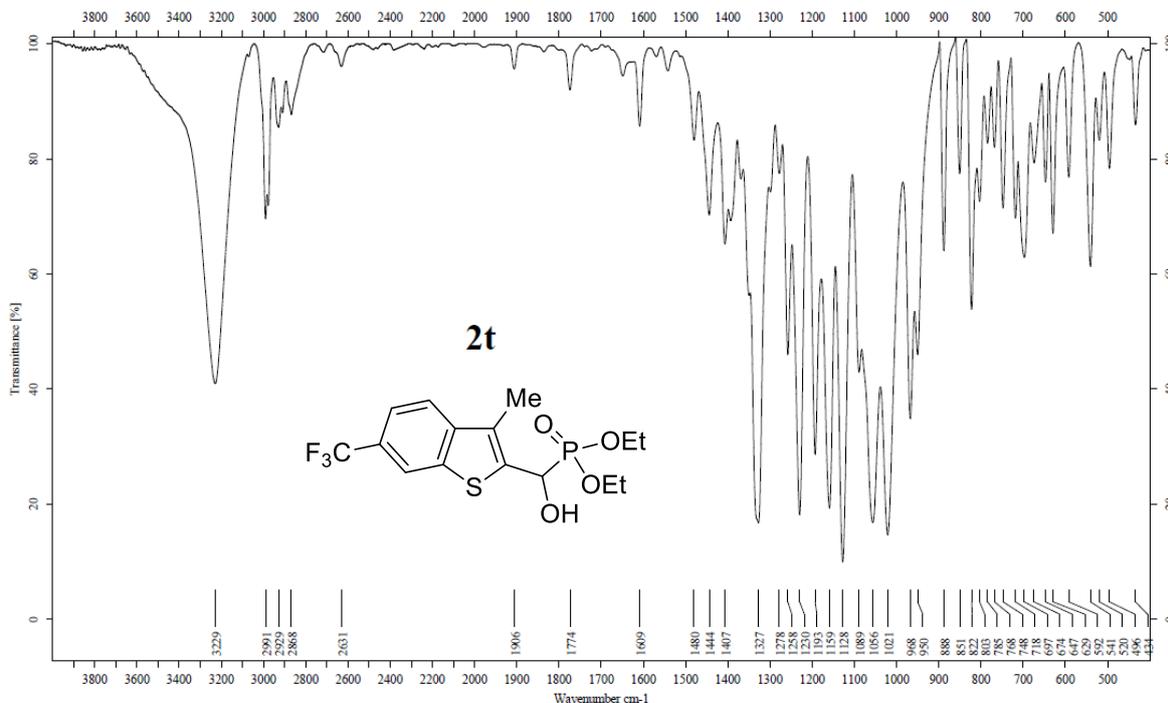
# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2t

2t

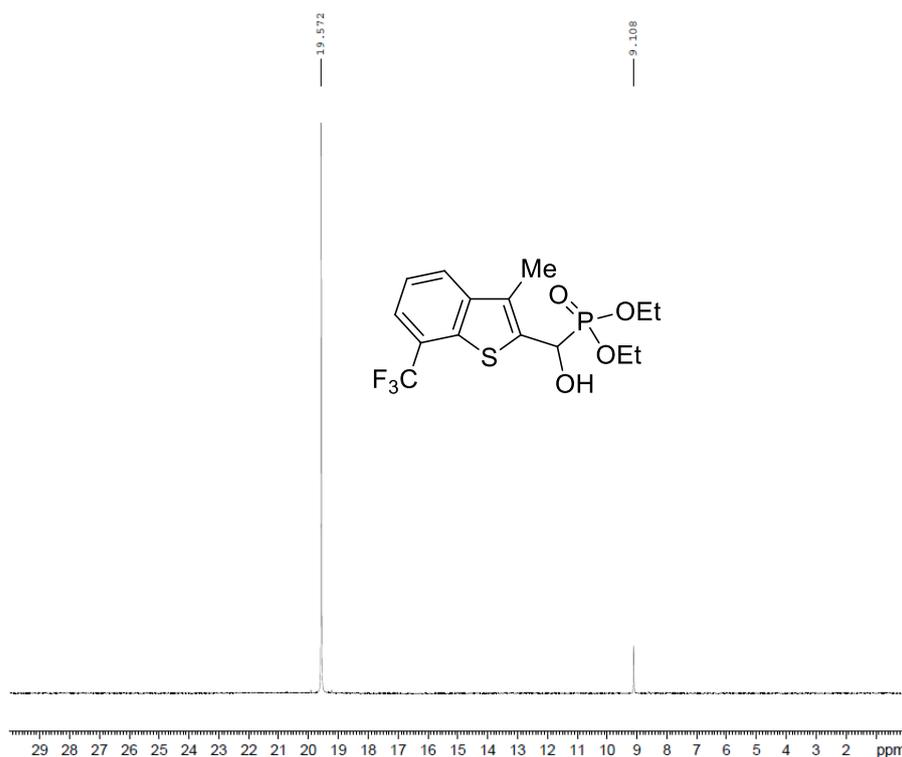


# IR (KBr) spectra for compound 2t

143382	Milen Matyas	KP	BRUKER Alpha
MIM0620_1	KBr	9/3/2024	Resolution: 2 cm-1
			Number of Scans: 16



**<sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2u**



31P CPD  
143273  
MIM0614\_1  
Milen Matyas  
2024.08.07. (KP)

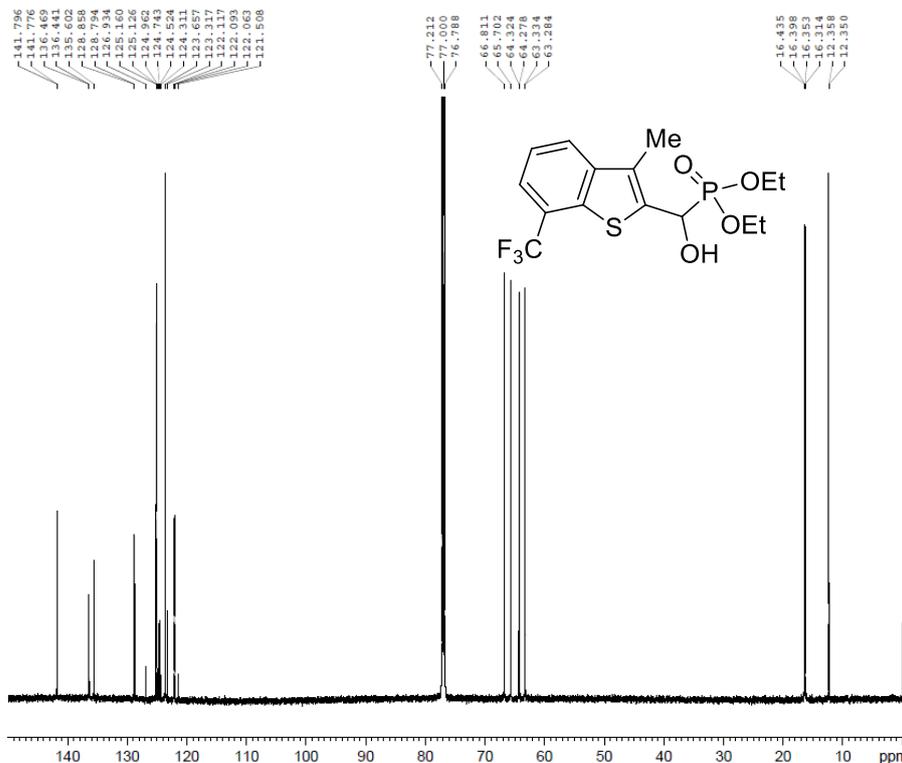
Current Data Parameters  
NAME 143273  
EXPNO 13  
PROCNO 1

F2 - Acquisition Parameters  
Date\_ 20240807  
Time 23.38 h  
INSTRUM spect  
PROBHD Z145856\_0002 (Z145856\_0002)  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 16  
DS 4  
SWH 96153.844 Hz  
FIDRES 2.934382 Hz  
AQ 0.3407872 sec  
RG 196.07  
DW 5.200 usec  
DE 18.00 usec  
TE 295.0 K  
D1 2.0000000 sec  
D11 0.0300000 sec  
TD0 1  
SFO1 242.8723078 MHz  
NUC1 31P  
P1 12.00 usec  
PLW1 66.12100220 W  
SFO2 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 32768  
SF 242.8844520 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40



**<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2u**



Standard 13C  
143273  
MIM0614\_1  
Milen Matyas  
2024.08.07. (KP)

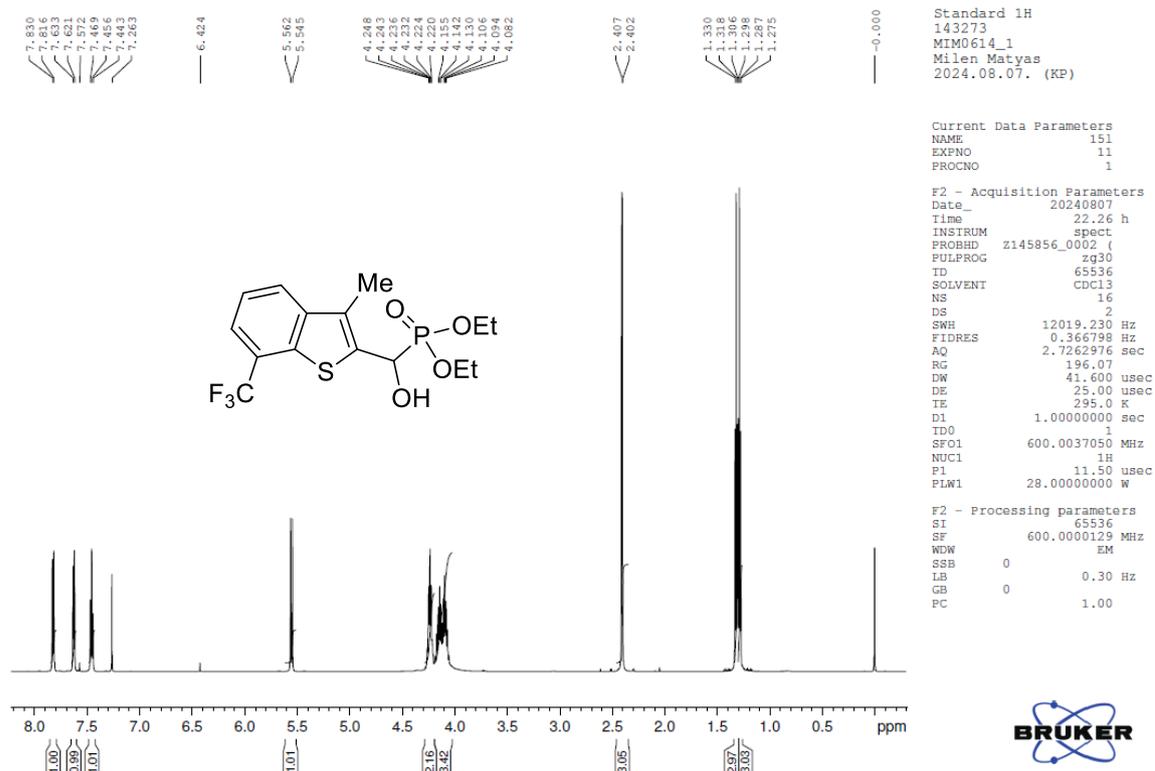
Current Data Parameters  
NAME 143273  
EXPNO 12  
PROCNO 1

F2 - Acquisition Parameters  
Date\_ 20240807  
Time 23.35 h  
INSTRUM spect  
PROBHD Z145856\_0002 (Z145856\_0002)  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 2048  
DS 4  
SWH 36231.883 Hz  
FIDRES 1.105709 Hz  
AQ 0.9043968 sec  
RG 196.07  
DW 13.800 usec  
DE 18.00 usec  
TE 295.0 K  
D1 1.0000000 sec  
D11 0.0300000 sec  
TD0 1  
SFO1 150.8852070 MHz  
NUC1 13C  
P1 9.90 usec  
PLW1 71.0000000 W  
SFO2 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

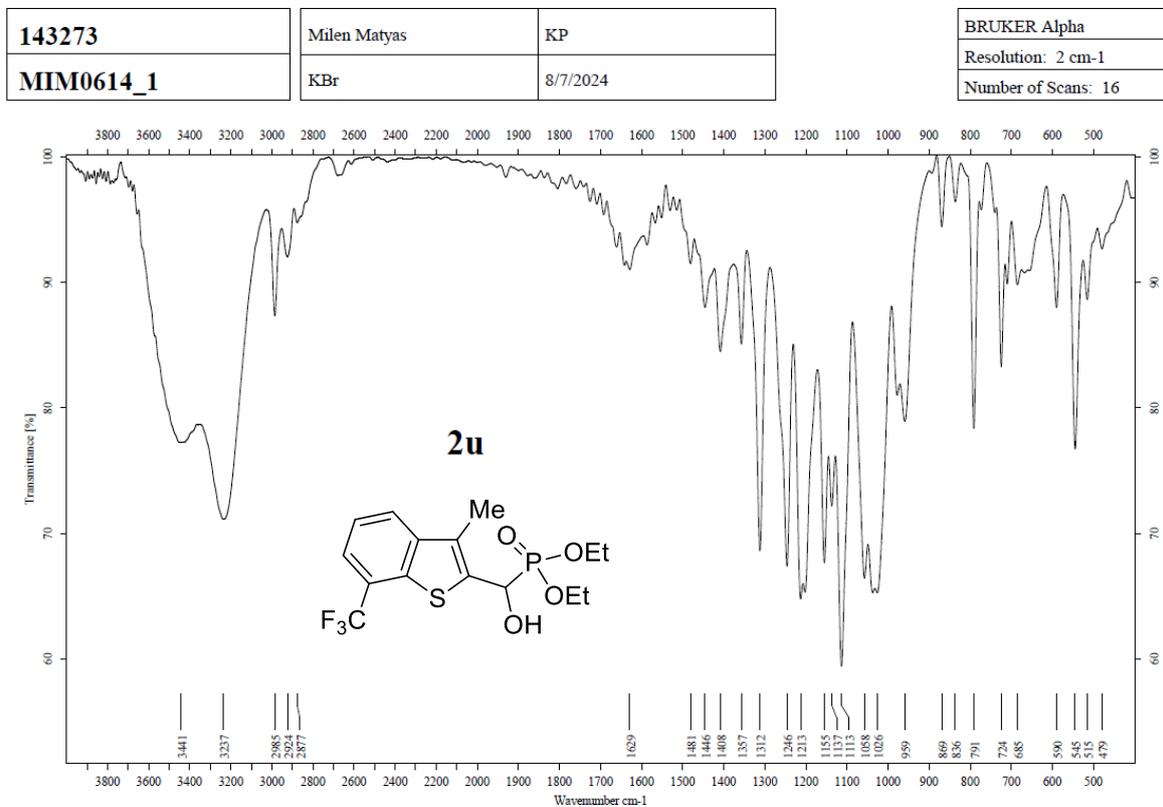
F2 - Processing parameters  
SI 131072  
SF 150.8701268 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40



# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2u

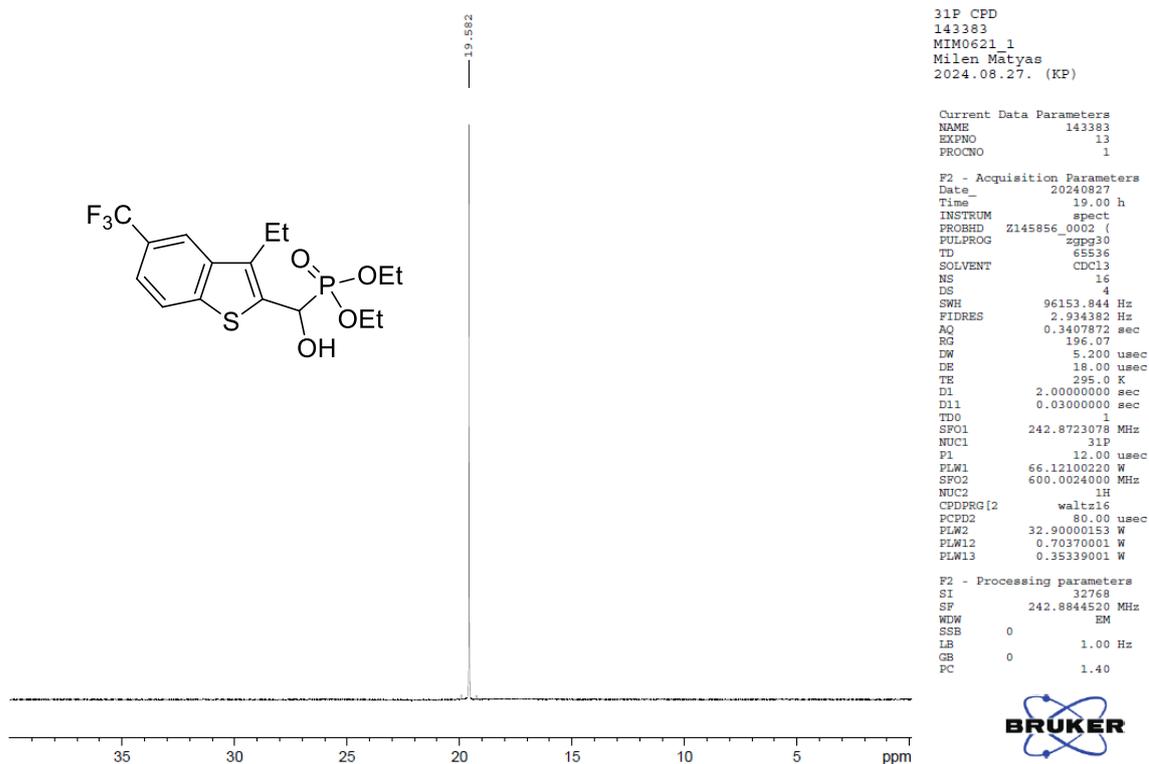


# IR (KBr) spectra for compound 2u



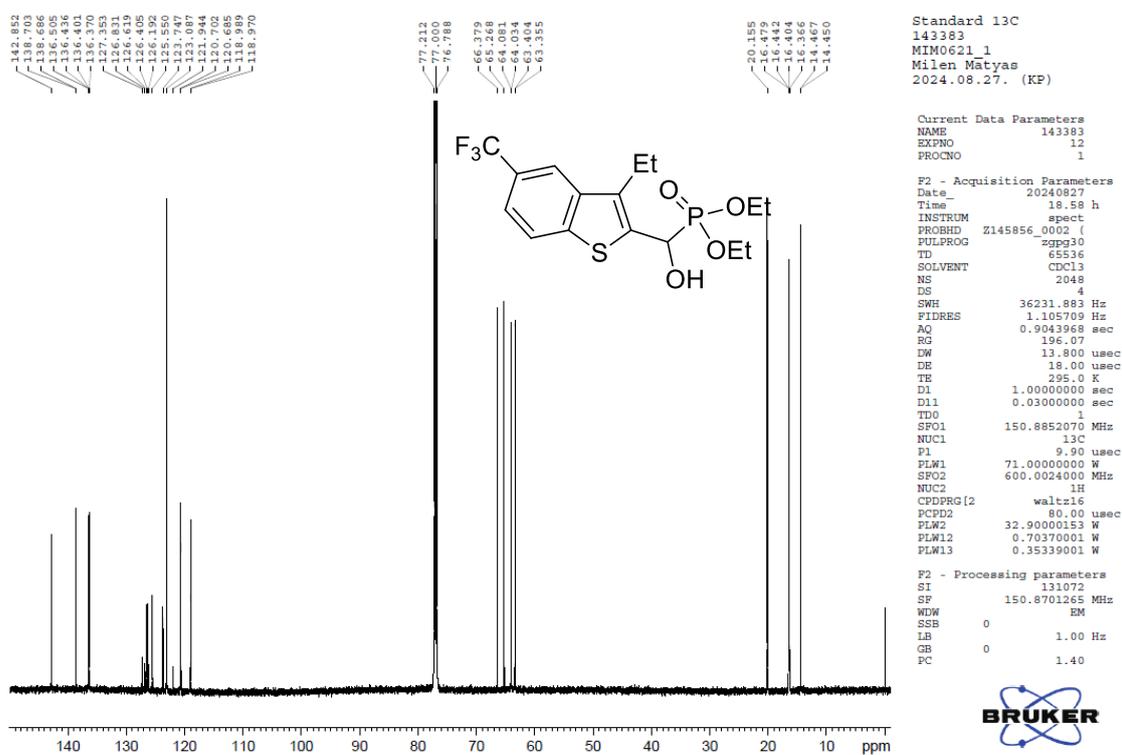
# <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2v

## 2v



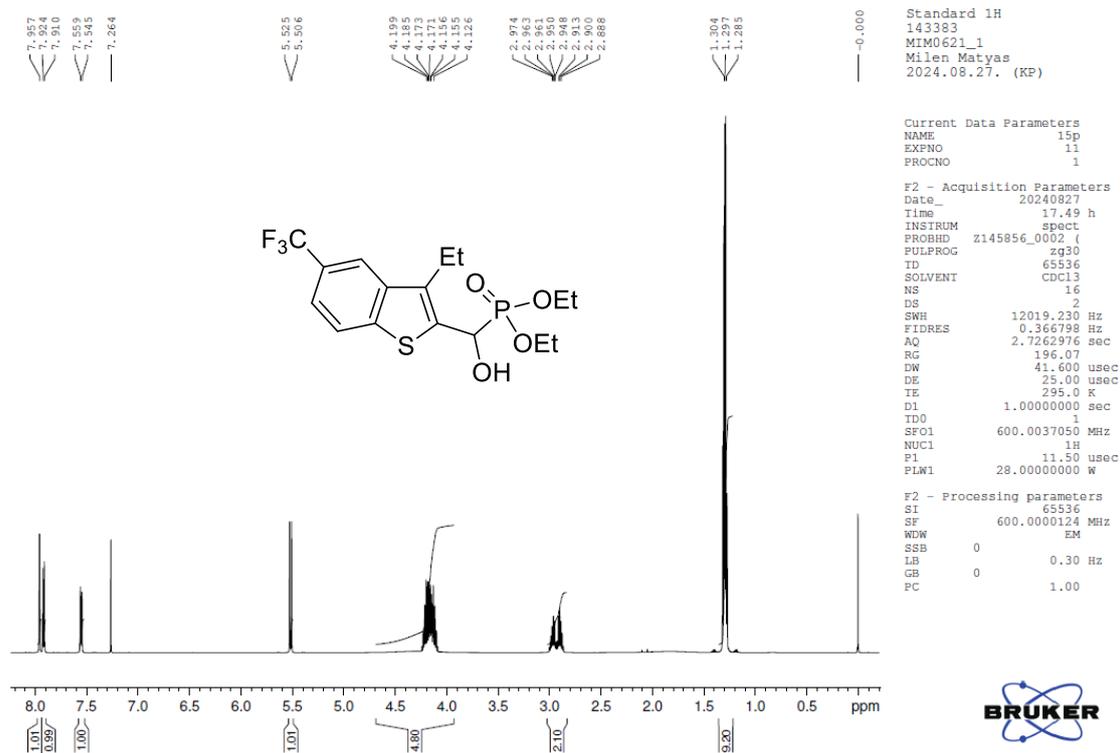
# <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2v

## 2v

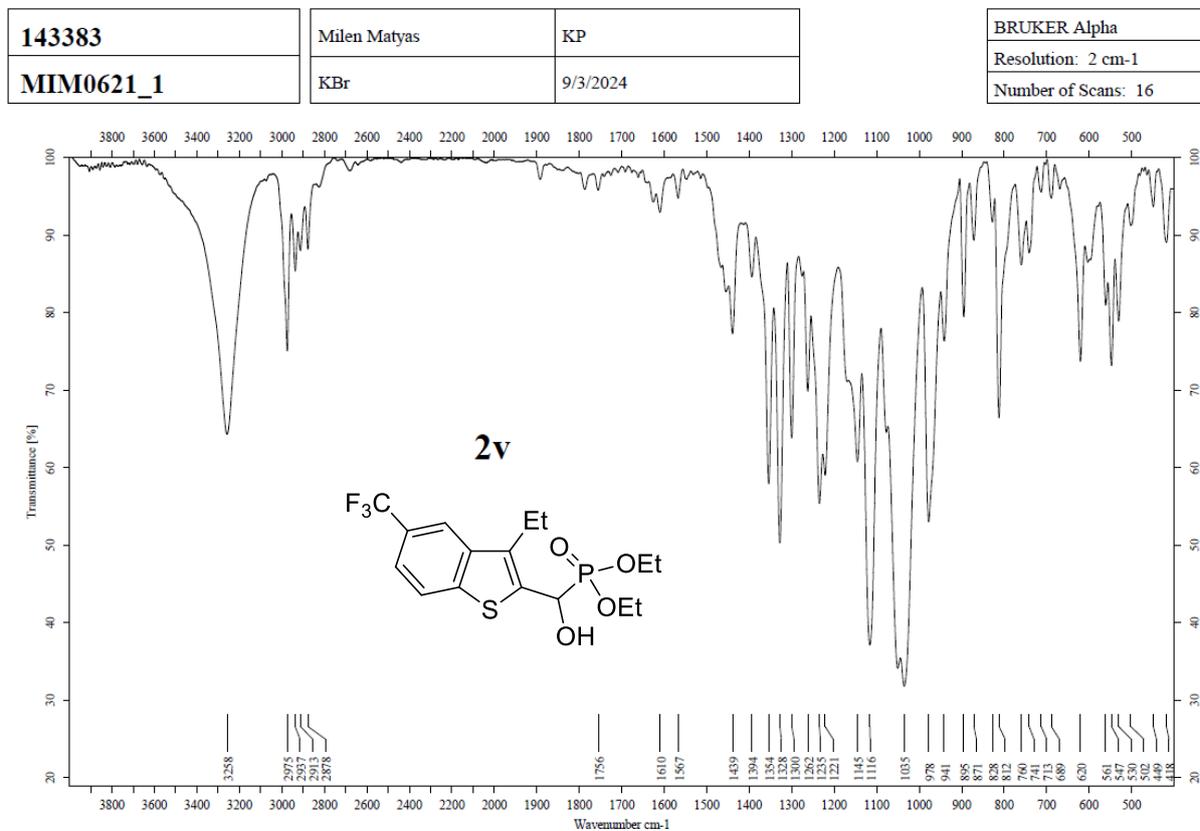


# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2v

2v

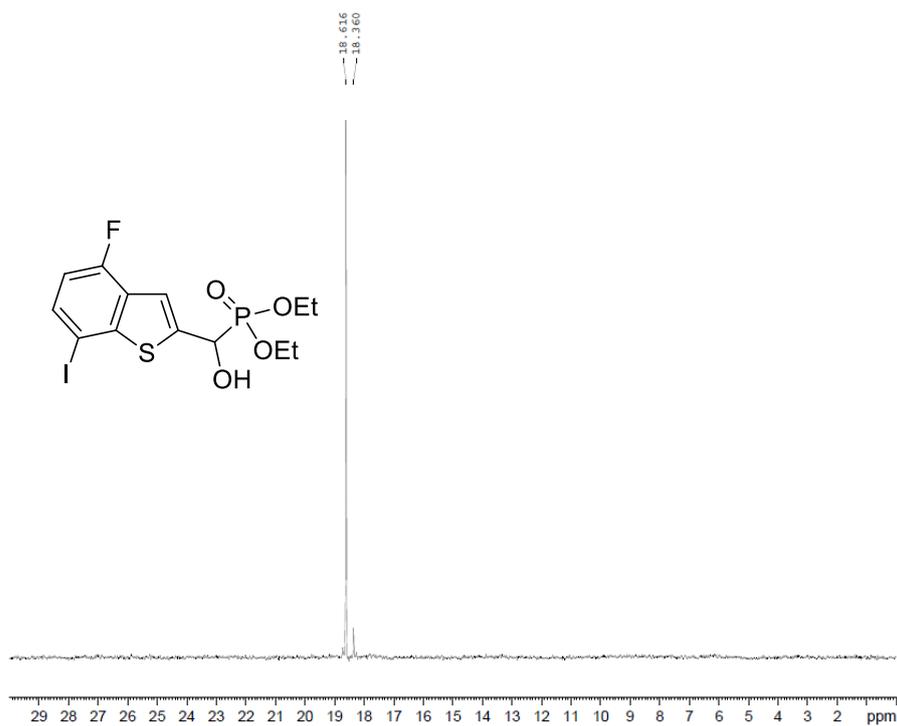


# IR (KBr) spectra for compound 2v



# <sup>31</sup>P NMR (242 MHz, CDCl<sub>3</sub>) spectra for compound 2w

2w



31P CPD  
143468  
MIM0630\_1  
Milen Matyas  
2024.09.09. (KP)

Current Data Parameters  
NAME 143468  
EXPNO 16  
PROCNO 1

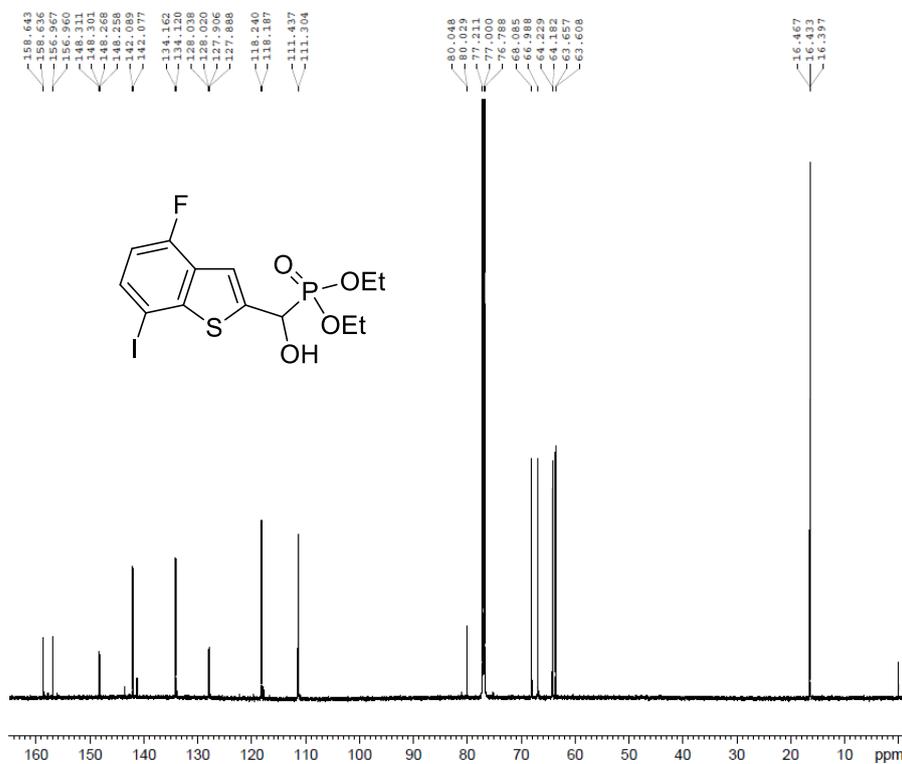
F2 - Acquisition Parameters  
Date\_ 20240909  
Time 18.35 h  
INSTRUM spect  
PROBHD Z145856\_0002 ( )  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 16  
DS 4  
SWH 96153.844 Hz  
FIDRES 2.934382 Hz  
AQ 0.3407872 sec  
RG 196.07  
DW 5.200 usec  
DE 18.00 usec  
TE 295.0 K  
D1 2.00000000 sec  
D11 0.03000000 sec  
TDO 1  
SF01 242.8723078 MHz  
NUC1 31P  
P1 12.00 usec  
PLW1 66.12100220 W  
SF02 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 32768  
SF 242.8844520 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC



# <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) spectra for compound 2w

2w



Standard 13C  
143468  
MIM0630\_1  
Milen Matyas  
2024.09.09. (KP)

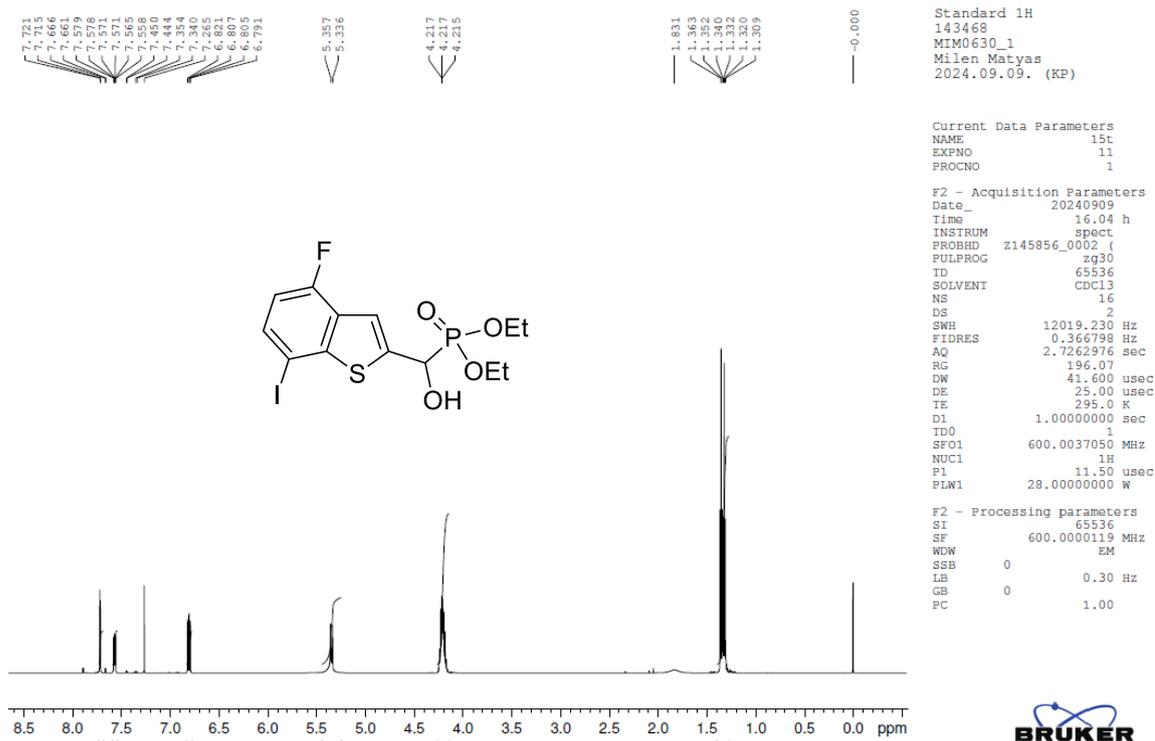
Current Data Parameters  
NAME 143468  
EXPNO 12  
PROCNO 1

F2 - Acquisition Parameters  
Date\_ 20240909  
Time 17.12 h  
INSTRUM spect  
PROBHD Z145856\_0002 ( )  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 2048  
DS 4  
SWH 36231.883 Hz  
FIDRES 1.105709 Hz  
AQ 0.9043968 sec  
RG 196.07  
DW 13.800 usec  
DE 18.00 usec  
TE 295.0 K  
D1 1.00000000 sec  
D11 0.03000000 sec  
TDO 1  
SF01 150.8852070 MHz  
NUC1 13C  
P1 9.90 usec  
PLW1 71.00000000 W  
SF02 600.0024000 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 80.00 usec  
PLW2 32.90000153 W  
PLW12 0.70370001 W  
PLW13 0.35339001 W

F2 - Processing parameters  
SI 131072  
SF 150.8701277 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40

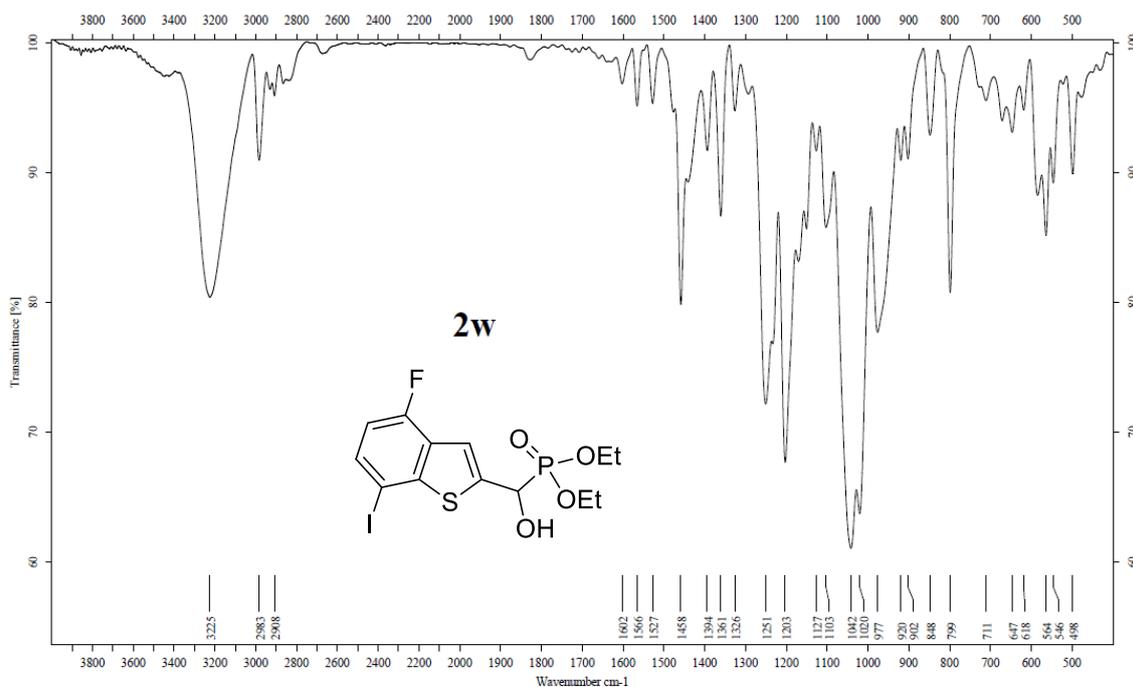


# <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) spectra for compound 2w



# IR (KBr) spectra for compound 2w

143468	Milen Matyas	KP	BRUKER Alpha
MIM0630_1	KBr	9/9/2024	Resolution: 2 cm-1
			Number of Scans: 16

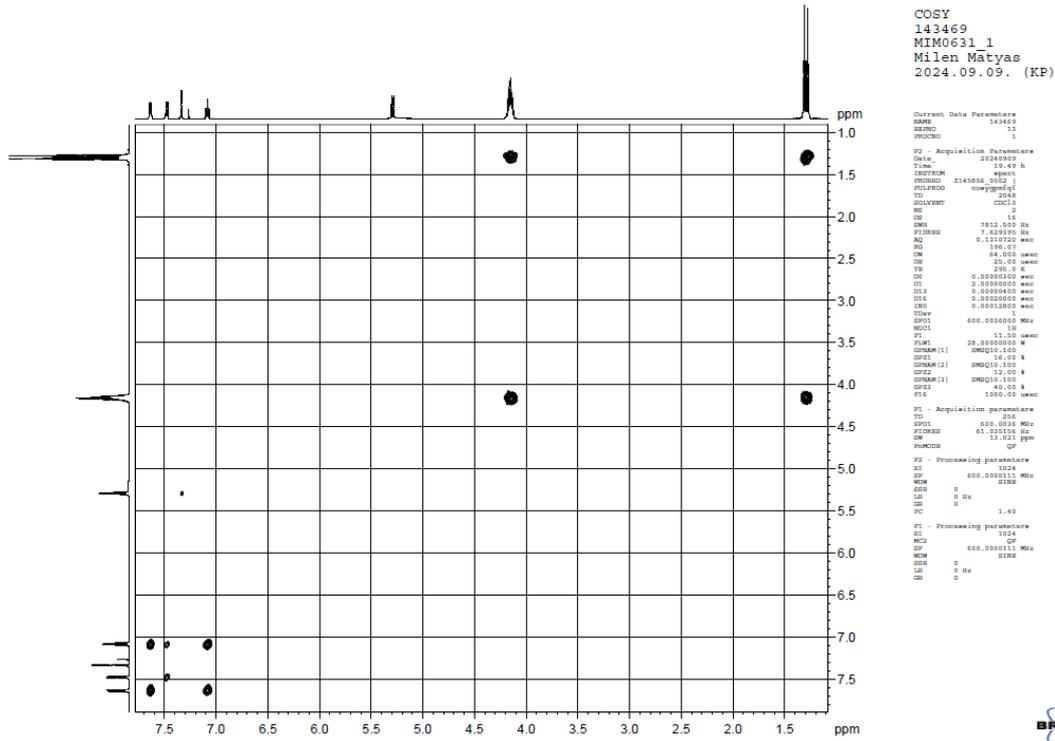






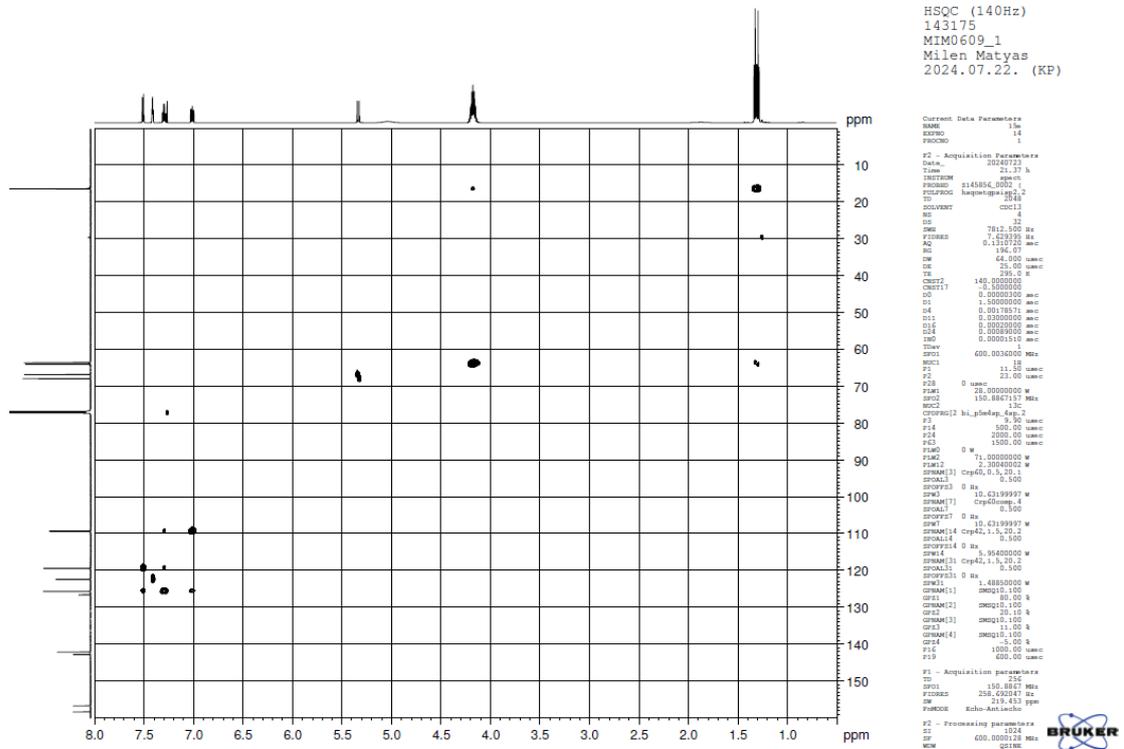
# COSY NMR spectra for compound 2b

2b



# HSQC NMR (140 Hz) spectra for compound 2c

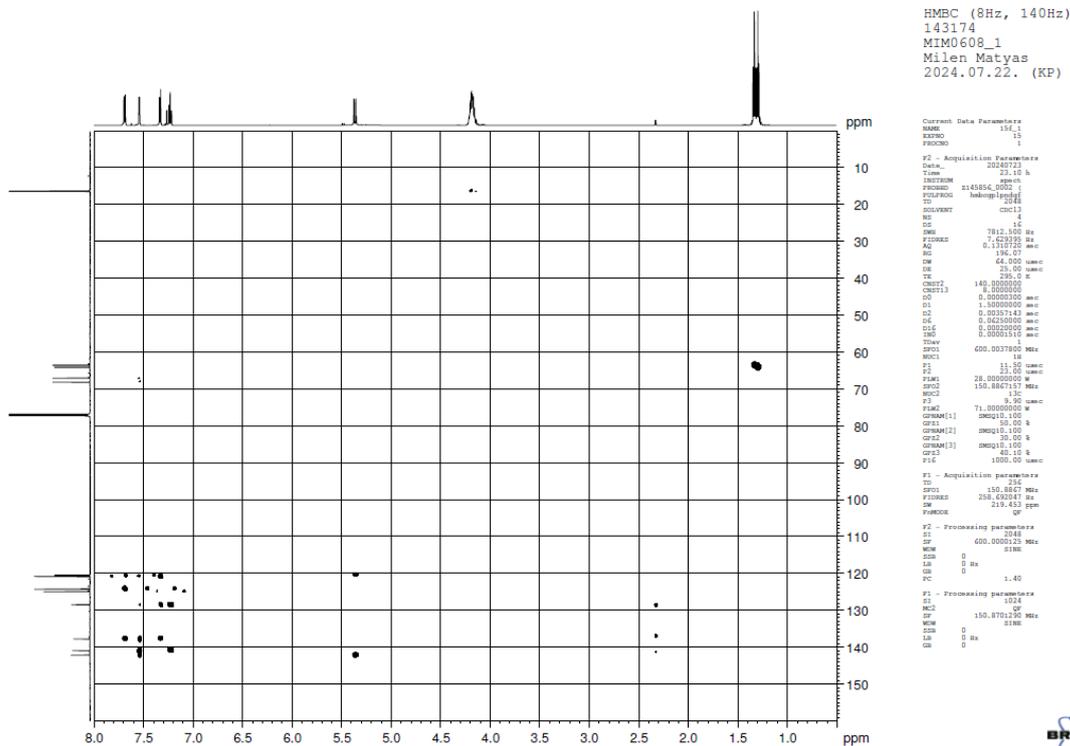
2c





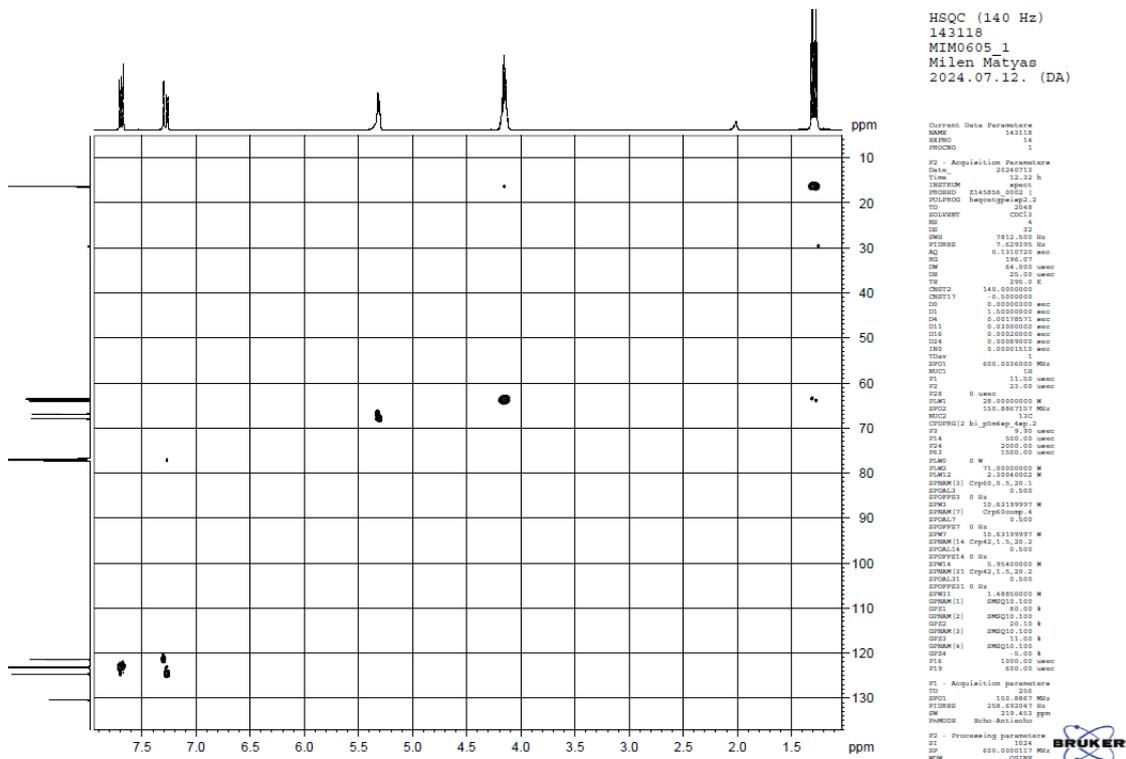
# HMBC NMR (8Hz, 140 Hz) spectra for compound 2d

2d



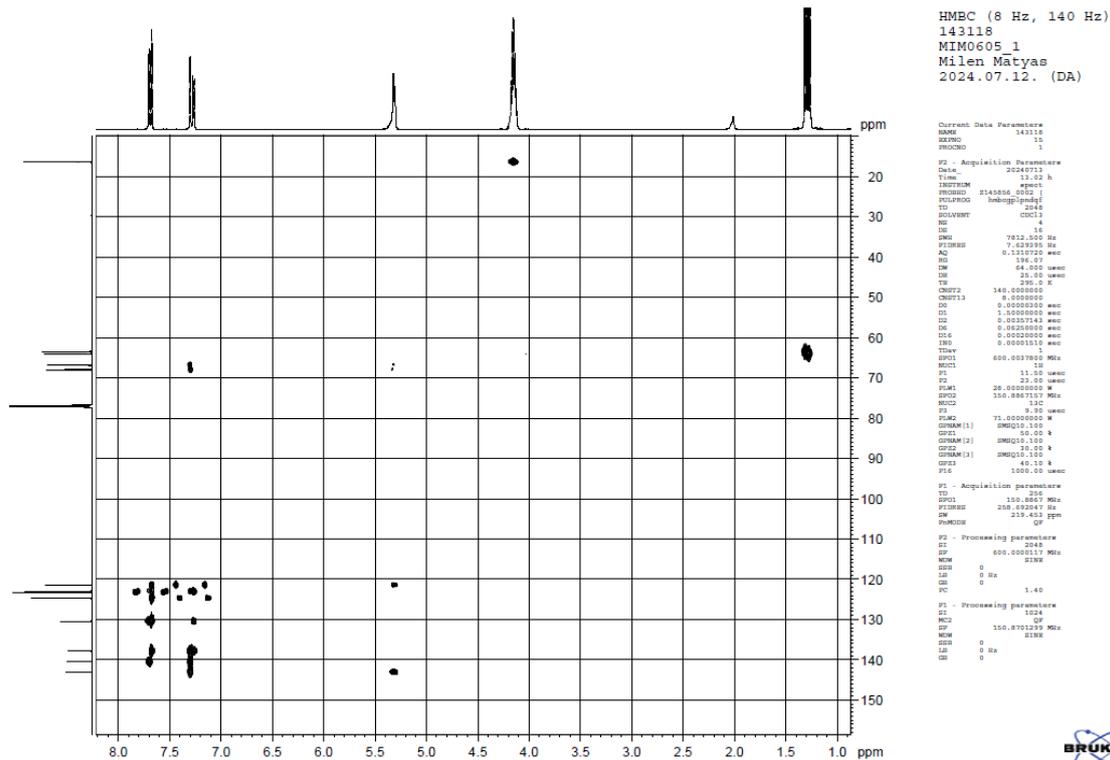
# HSQC NMR (140 Hz) spectra for compound 2e

2e



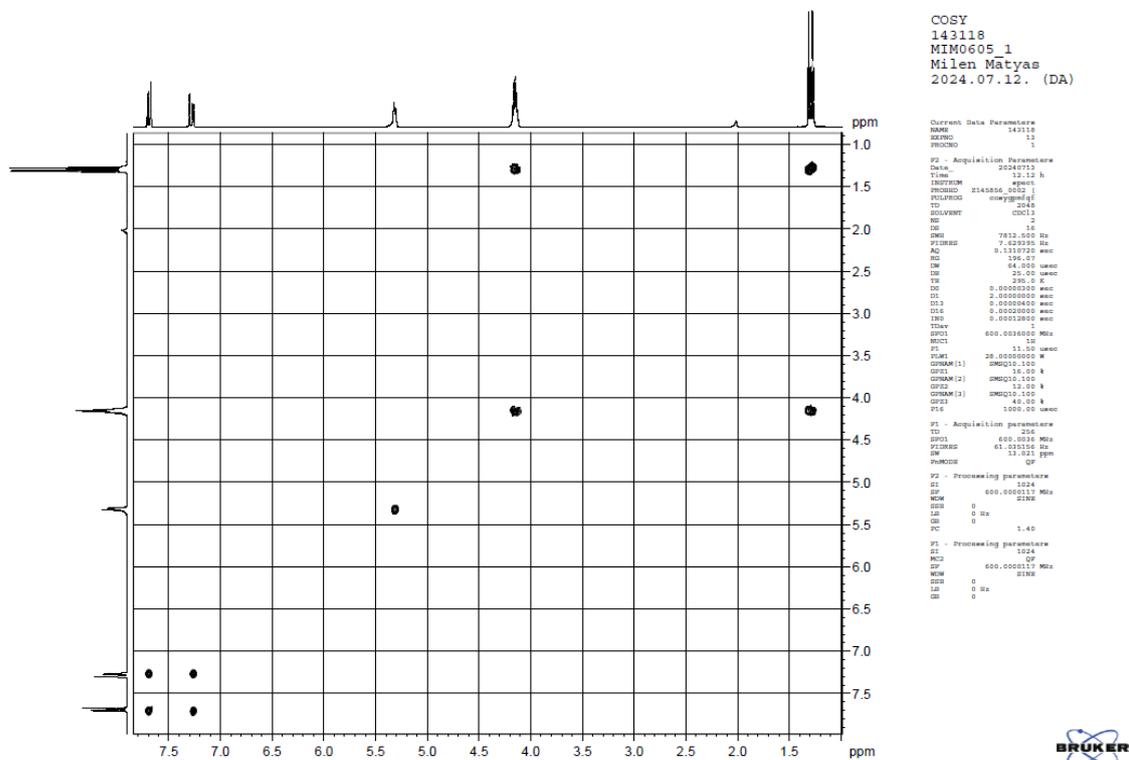
# HMBC NMR (8 Hz, 140 Hz) spectra for compound 2e

2e



# COSY NMR spectra for compound 2e

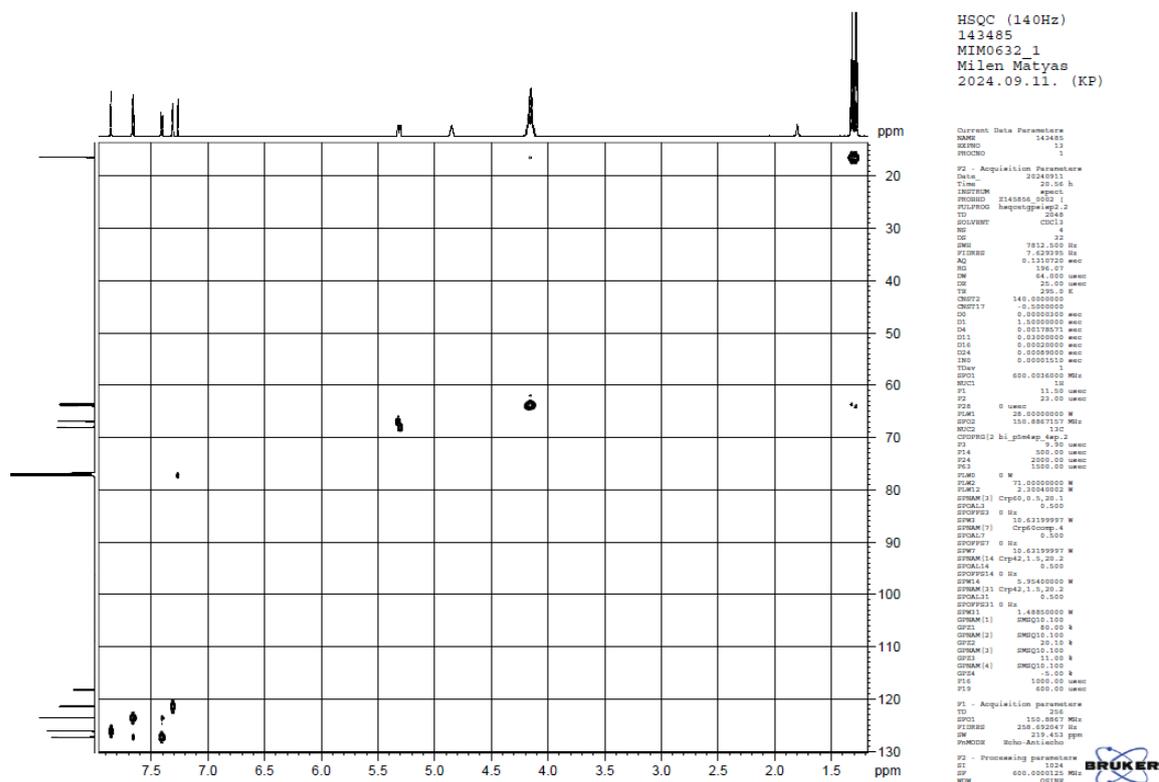
2e





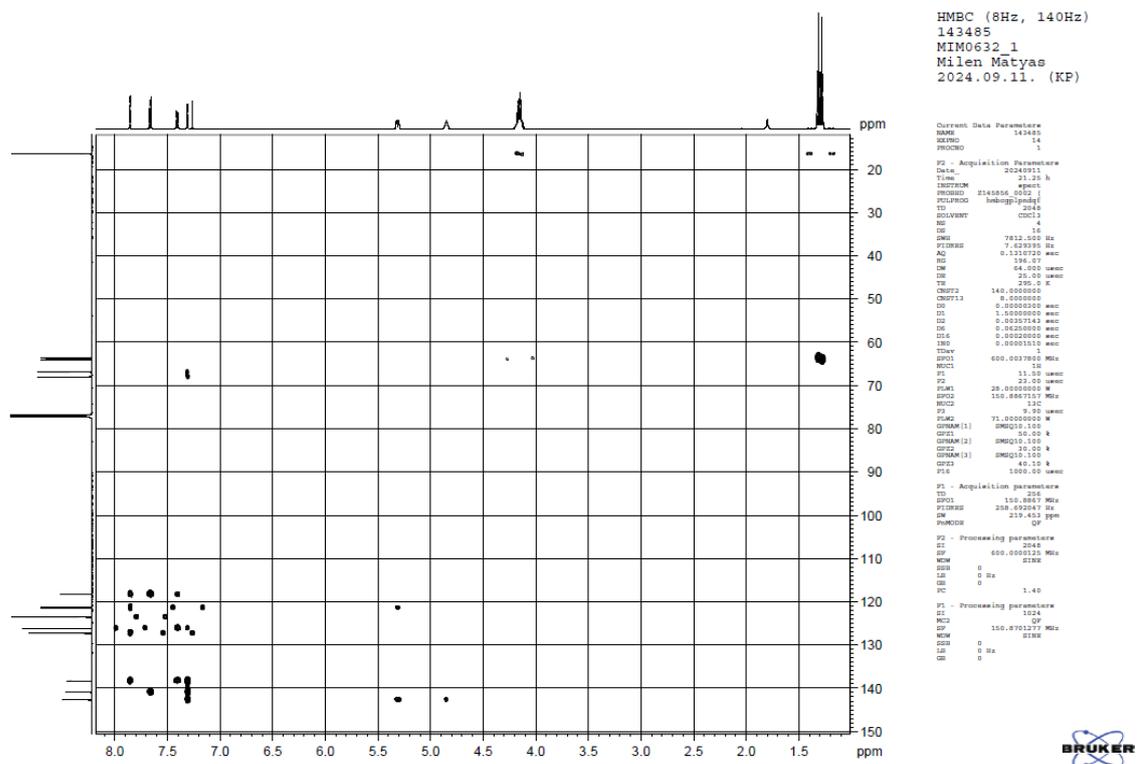
# HSQC NMR (140 Hz) spectra for compound 2g

2g



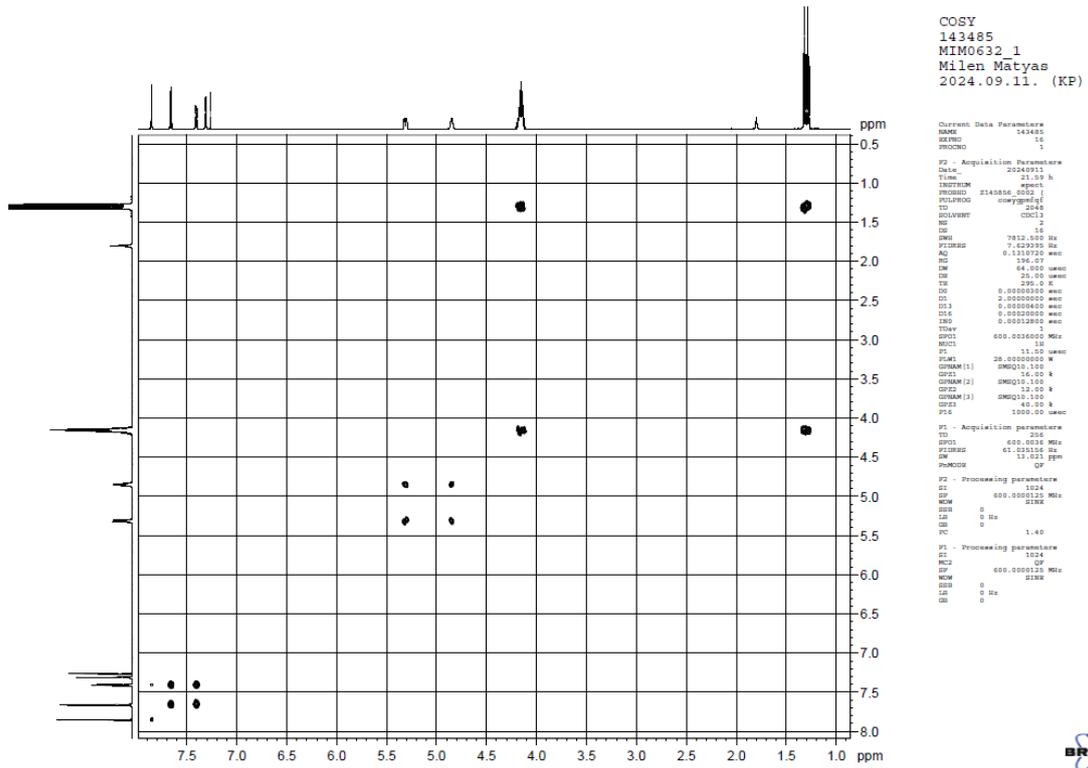
# HMBC NMR (8 Hz, 140 Hz) spectra for compound 2g

2g



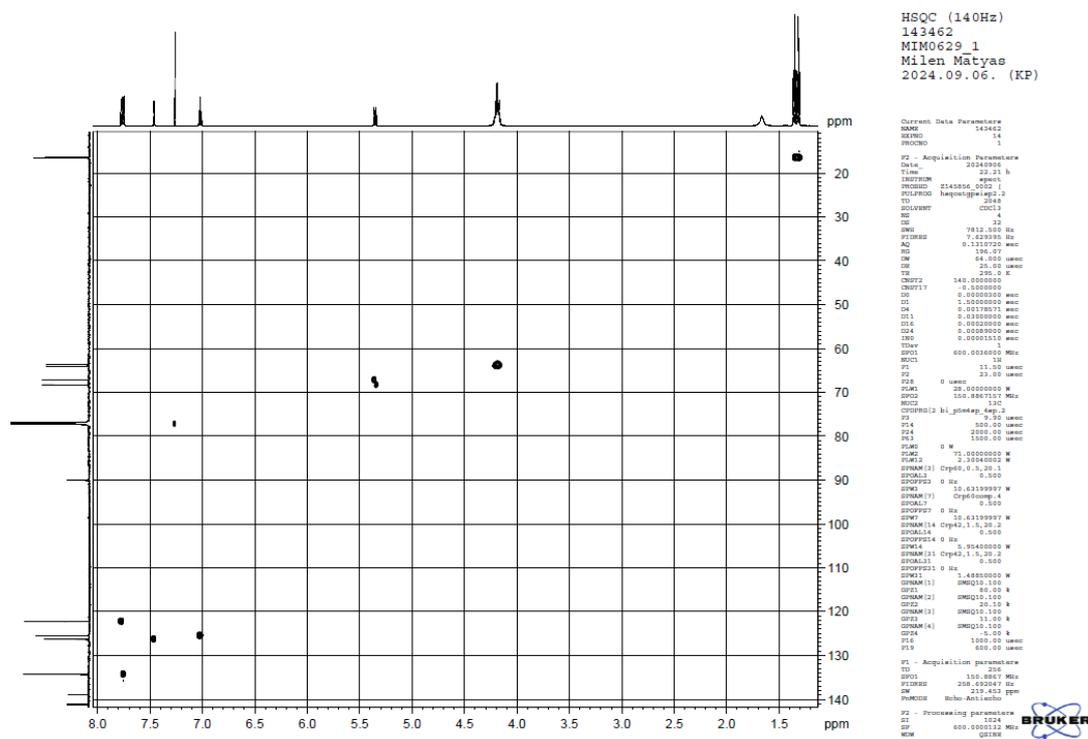
# COSY spectra for compound 2g

2g



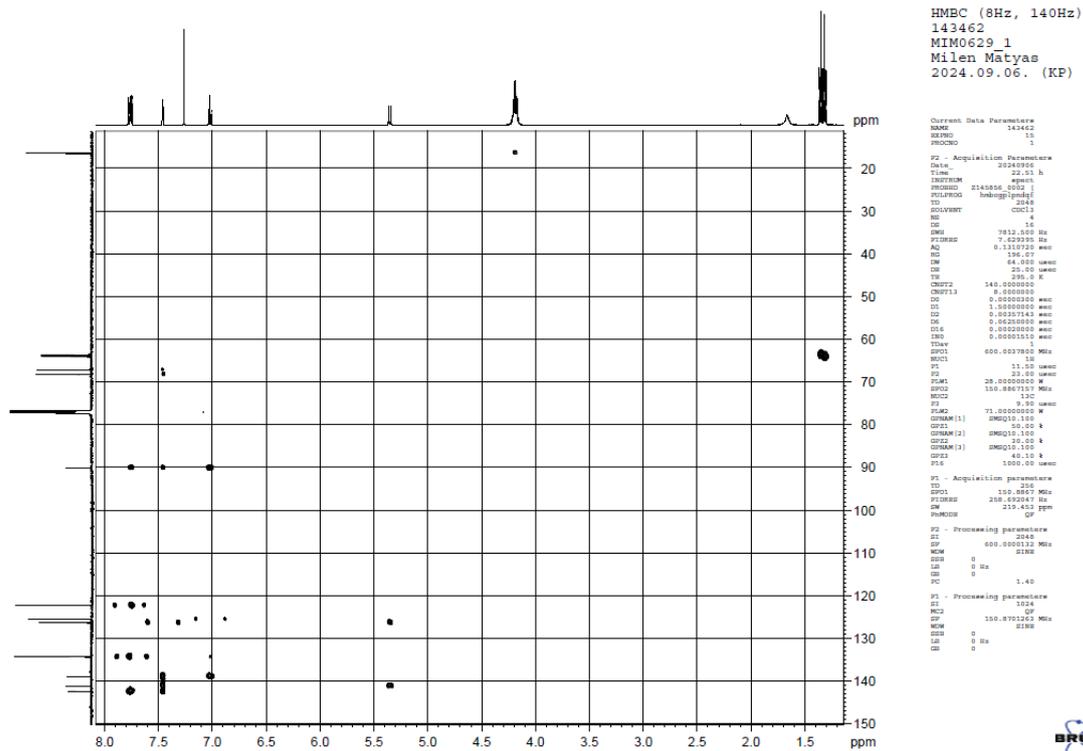
# HSQC NMR (140 Hz) spectra for compound 2h

2h



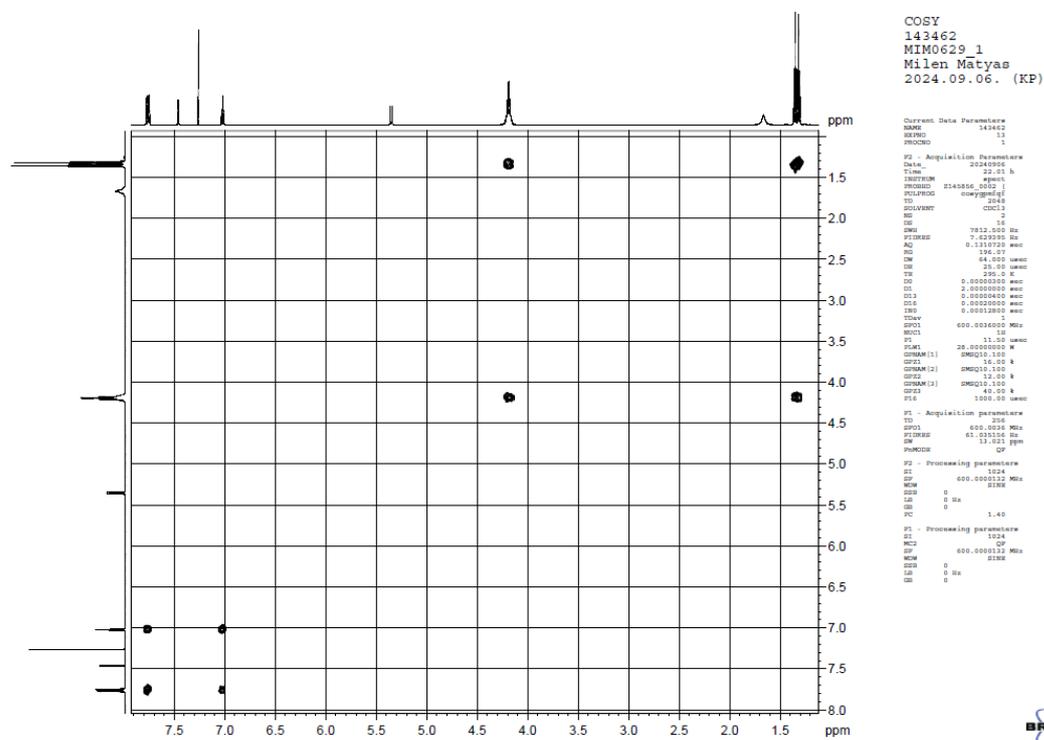
# HMBC NMR (8 Hz, 140 Hz) spectra for compound 2h

## 2h



# COSY NMR spectra for compound 2h

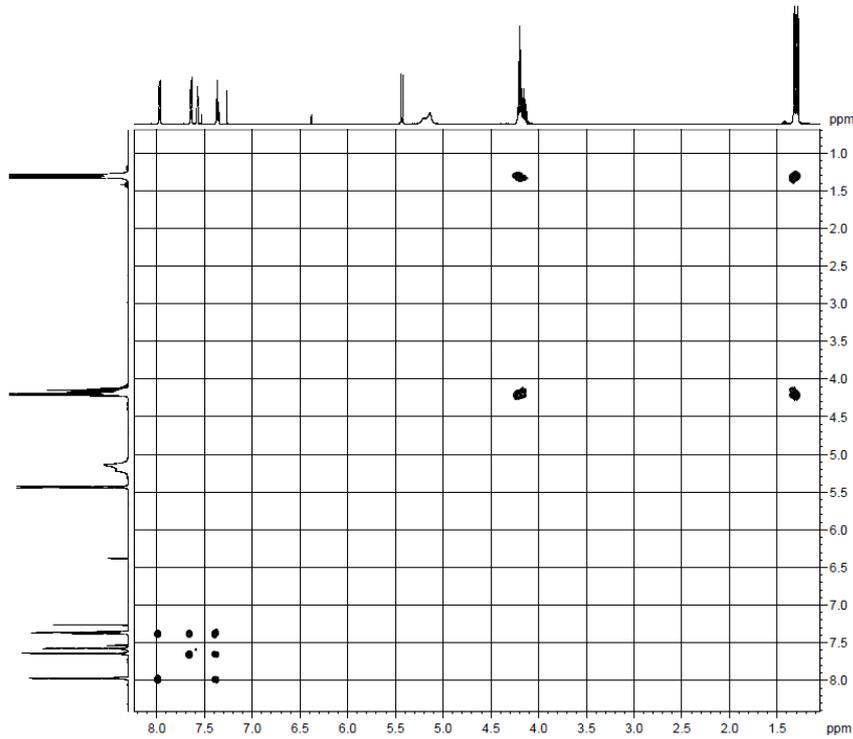
## 2h





# COSY NMR spectra for compound 2j

2j



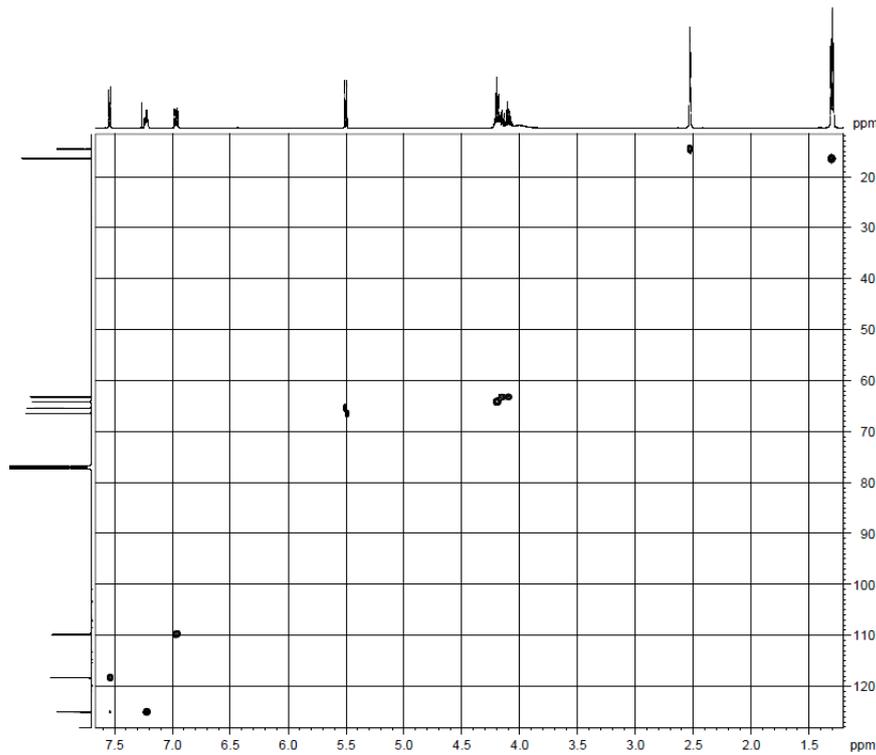
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143295  
MIM0618\_1  
Milen Matyas  
2024.09.27. (GZS)

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PROCNO 1  
F2 - Acquisition Parameters  
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Time 22:21.9  
INSTRUM spect  
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PULPROG cosygmgf2  
TD 2618  
SOLVENT CDCl3  
NS 2  
DS 2  
SWH 7812.500 Hz  
FIDRES 7.62939 Hz  
AQ 0.1210720 sec  
RG 196.07  
DM 64.000 usec  
DE 20.00 usec  
TE 295.0 K  
DQ 0.0000000 sec  
DD 2.0000000 sec  
DI1 0.0000000 sec  
DI2 0.0000000 sec  
DI3 0.0000000 sec  
DI4 0.0000000 sec  
DI5 0.0000000 sec  
TDEL 0.00012800 sec  
TDAY 1  
SFO1 600.0016000 MHz  
SFO2 150.0000000 MHz  
P1 28.00000000 W  
PC 11.00 usec  
SFO1(1) SMO10.100  
SFO2(1) SMO10.100  
SFO1(2) SMO10.100  
SFO2(2) SMO10.100  
SFO1(3) SMO10.100  
SFO2(3) SMO10.100  
SFO1(4) SMO10.100  
SFO2(4) SMO10.100  
P1 256  
SFO1 600.001600 MHz  
SFO2 150.000000 MHz  
FIDRES 61.03156 Hz  
DM 15.001 ppm  
PNUC12 C  
PNUC13 C  
P1 - Processing parameters  
SI 1024  
SF 600.000000 MHz  
WDW 0  
SSB 0  
LB 0 Hz  
GB 0  
PC 1.40  
P1 - Processing parameters  
SI 1024  
SF 600.000000 MHz  
WDW 0  
SSB 0  
LB 0 Hz  
GB 0
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# HSQC NMR (140 Hz) spectra for compound 2k

2k



HSQC (140Hz)  
143461  
MIM0628\_1  
Milen Matyas  
2024.09.06. (KP)

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PROCNO 1  
F2 - Acquisition Parameters  
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PULPROG hsqcgm24p2_3  
TD 2618  
SOLVENT CDCl3  
NS 2  
DS 2  
SWH 7812.500 Hz  
FIDRES 7.62939 Hz  
AQ 0.1210720 sec  
RG 196.07  
DM 64.000 usec  
DE 20.00 usec  
TE 295.0 K  
DQ 0.0000000 sec  
DD 2.0000000 sec  
DI1 0.0000000 sec  
DI2 0.0000000 sec  
DI3 0.0000000 sec  
DI4 0.0000000 sec  
DI5 0.0000000 sec  
TDEL 0.00012800 sec  
TDAY 1  
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SFO2 150.0000000 MHz  
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PC 11.00 usec  
SFO1(1) SMO10.100  
SFO2(1) SMO10.100  
SFO1(2) SMO10.100  
SFO2(2) SMO10.100  
SFO1(3) SMO10.100  
SFO2(3) SMO10.100  
SFO1(4) SMO10.100  
SFO2(4) SMO10.100  
P1 256  
SFO1 600.001600 MHz  
SFO2 150.000000 MHz  
FIDRES 61.03156 Hz  
DM 15.001 ppm  
PNUC12 C  
PNUC13 C  
P1 - Processing parameters  
SI 1024  
SF 600.000000 MHz  
WDW 0  
SSB 0  
LB 0 Hz  
GB 0  
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SF 600.000000 MHz  
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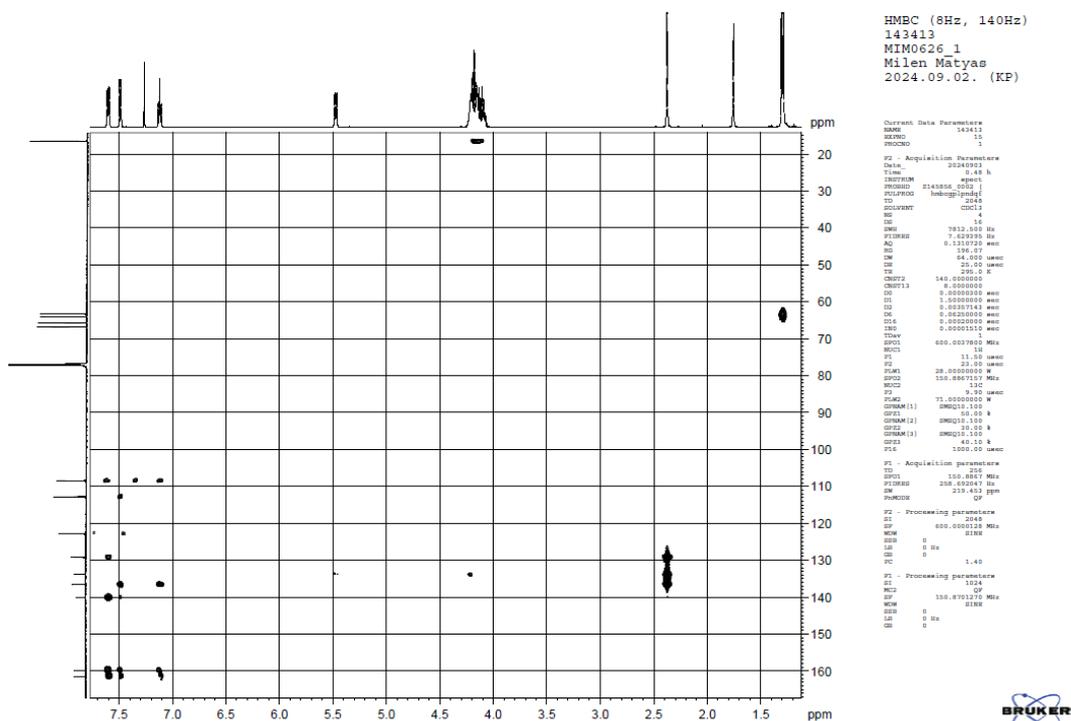






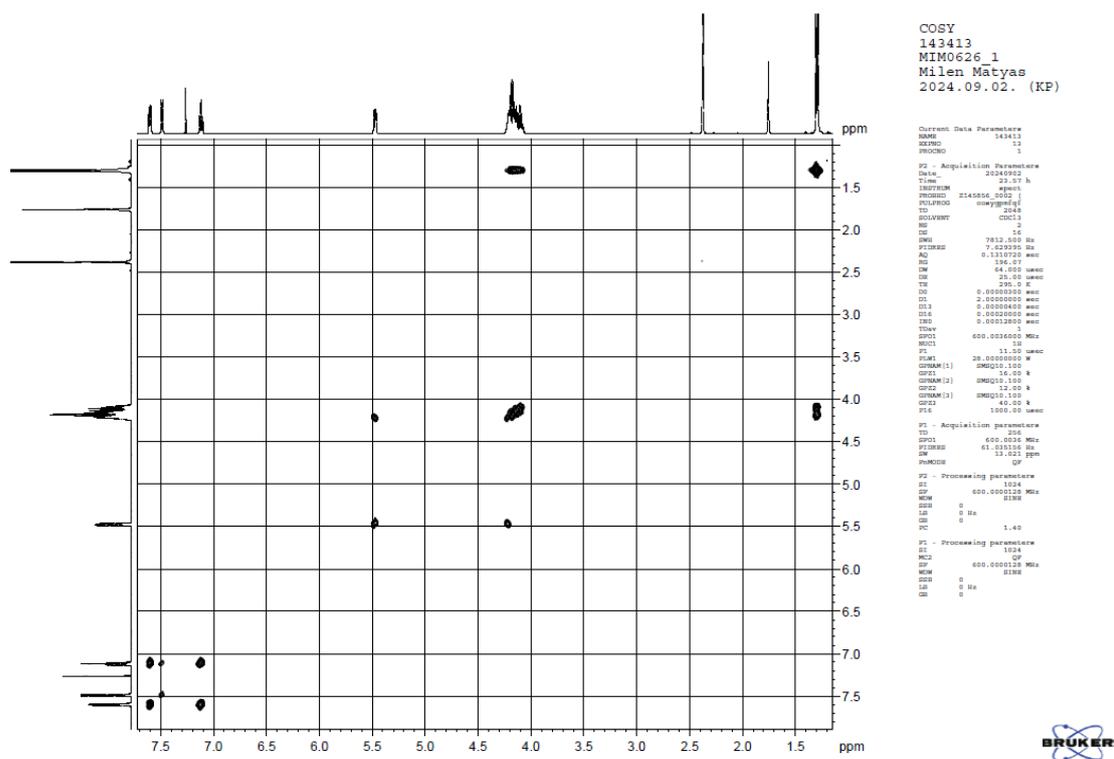
# HMBC NMR (8Hz, 140 Hz) spectra for compound 2m

## 2m



# COSY NMR spectra for compound 2m

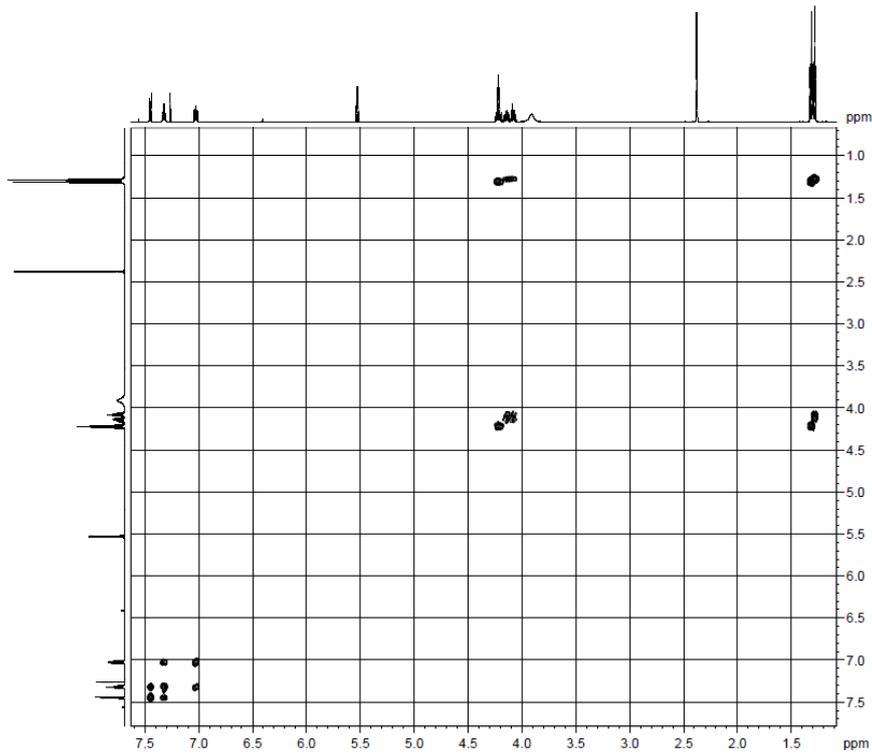
## 2m





# COSY NMR spectra for compound 2n

2n



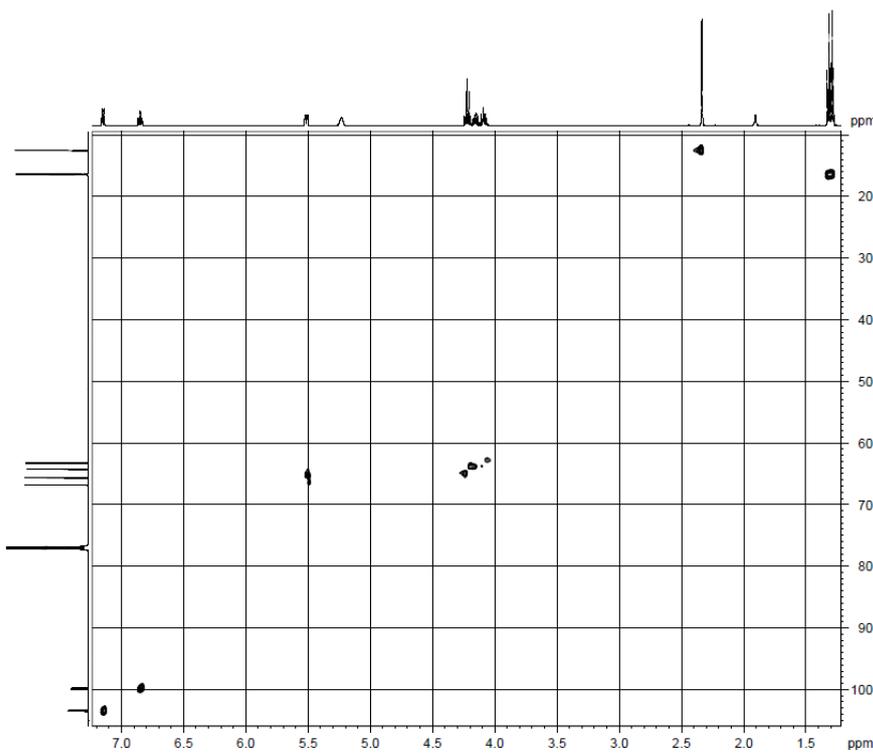
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143156  
MIM0613\_1  
Milen Matyas  
2024.07.18. (KP)

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PROCNO 1  
  
F2 - Acquisition Parameters  
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Time 20:36 &  
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PULPROG zgpg30  
TD 262  
SOLVENT CDCl3  
NS 2  
DS 16  
SWH 7812.500 Hz  
FIDRES 7.429995 Hz  
AQ 0.1310720 sec  
RG 196.07  
DM 64.000 usec  
DE 25.00 usec  
TE 296.0 K  
DD 0.0000000 sec  
D1 2.0000000 sec  
D15 0.0000400 sec  
D16 0.0000000 sec  
D18 0.0001200 sec  
TD0 1  
SFO1 600.000000 MHz  
NUC1 13C  
P1 10  
PL1 28.0000000  
SFO2 101.250000 MHz  
SFO3 15.00 &  
SFO4 13.00 &  
SFO5 40.00 &  
SFO6 100.00 usec  
F1 - Acquisition parameters  
TD 256  
SFO1 600.0000 MHz  
FIDRES 41.000000 Hz  
AQ 11.021 ppm  
PULPROG zgpg30  
PC 1  
  
F2 - Processing parameters  
SI 3274  
SF 600.000130 MHz  
WDW 0  
SSB 0 Hz  
GB 0  
PC 1.40  
  
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SF 600.000130 MHz  
WDW 0  
SSB 0 Hz  
GB 0
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# HSQC NMR (140 Hz) spectra for compound 2o

2o



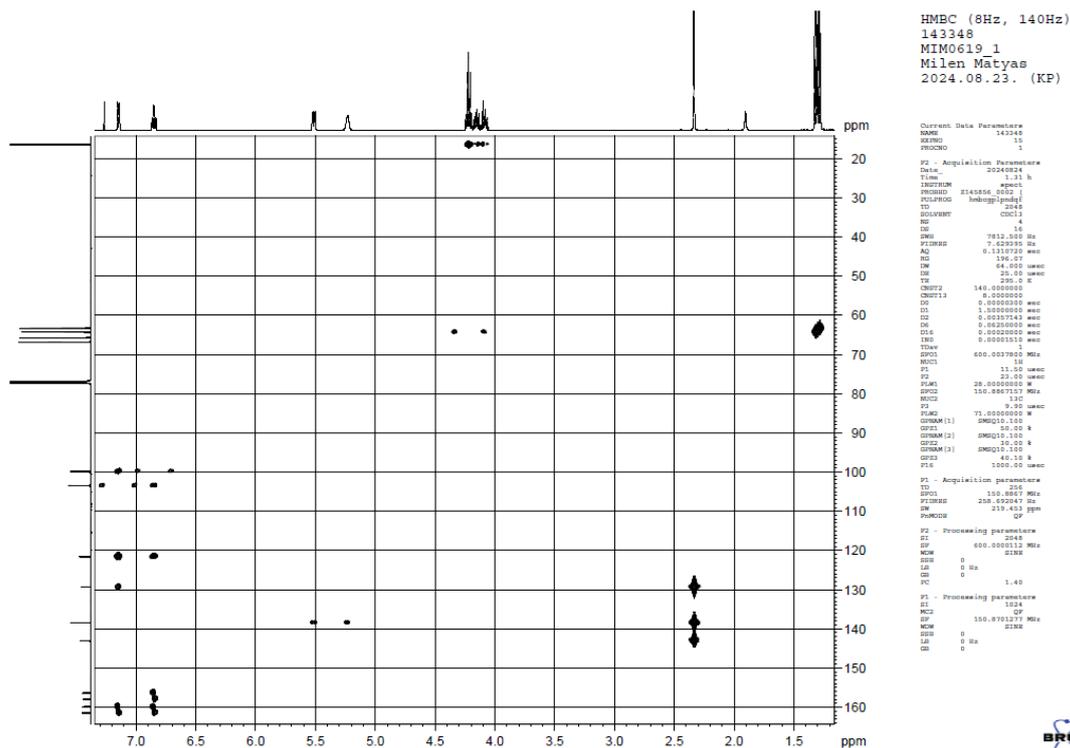
HSQC (140Hz)  
143348  
MIM0619\_1  
Milen Matyas  
2024.08.23. (KP)

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PROCNO 1  
  
F2 - Acquisition Parameters  
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TD 4  
SOLVENT CDCl3  
NS 4  
DS 32  
SWH 7812.500 Hz  
FIDRES 7.429995 Hz  
AQ 0.1310720 sec  
RG 196.07  
DM 64.000 usec  
DE 25.00 usec  
TE 296.0 K  
DD 0.0000000 sec  
D1 2.0000000 sec  
D15 0.0000000 sec  
D16 0.0000000 sec  
D18 0.0000000 sec  
D19 0.0000000 sec  
D20 0.0001510 sec  
TD0 1  
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NUC1 13C  
P1 11.00 usec  
PL1 23.00 usec  
F2 0 usec  
PL2 28.0000000 W  
SFO2 150.8867197 MHz  
NUC2 13C  
CPROG2 b1_gmzgpg_4pg_2  
F3 0.00 usec  
PL3 2000.00 usec  
PL4 1000.00 usec  
PL5 0 W  
PL6 71.0000000 W  
PL7 2.30040000 W  
SFO3 101.250000 MHz  
SFO4 15.00 &  
SFO5 13.00 &  
SFO6 40.00 &  
SFO7 100.00 usec  
F1 - Acquisition parameters  
TD 256  
SFO1 600.0000 MHz  
FIDRES 41.000000 Hz  
AQ 11.021 ppm  
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PC 1  
  
F2 - Processing parameters  
SI 3274  
SF 600.000132 MHz  
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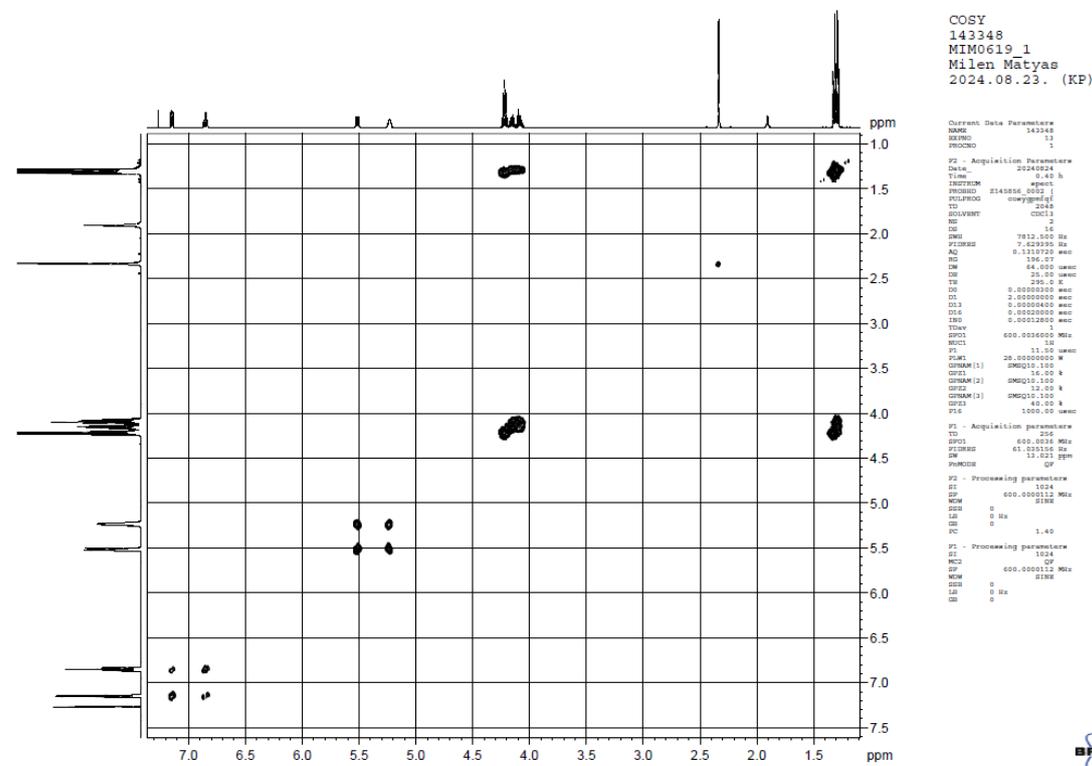
# HMBC NMR (8 Hz, 140 Hz) spectra for compound 2o

2o



# COSY NMR spectra for compound 2o

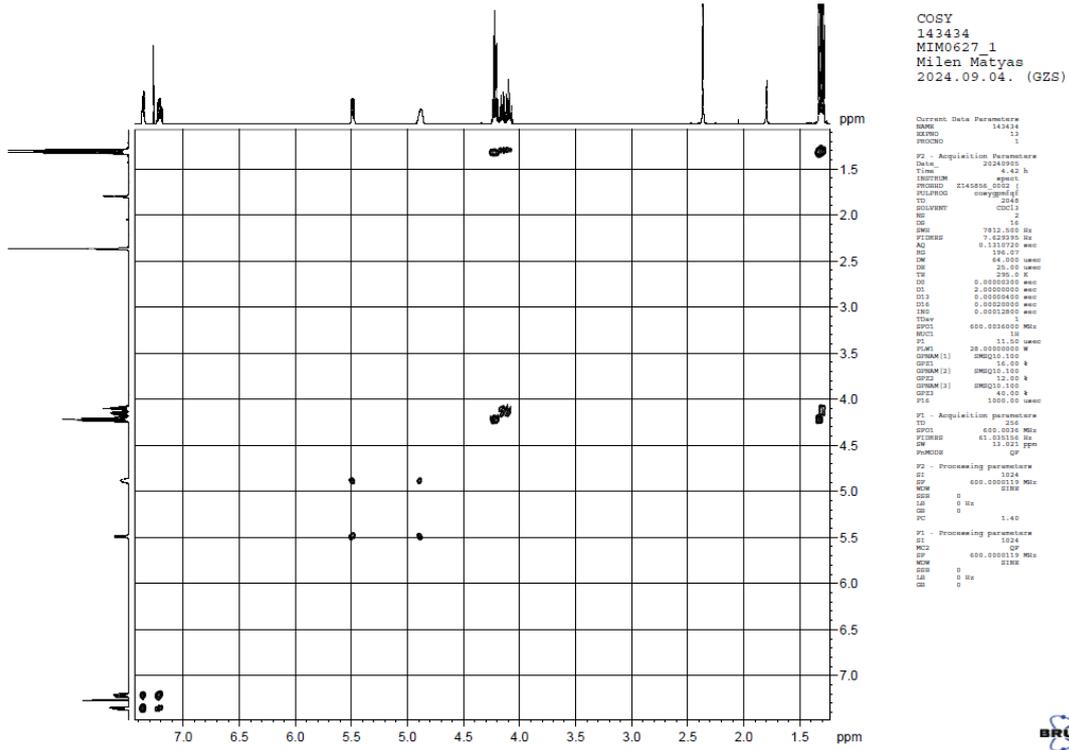
2o





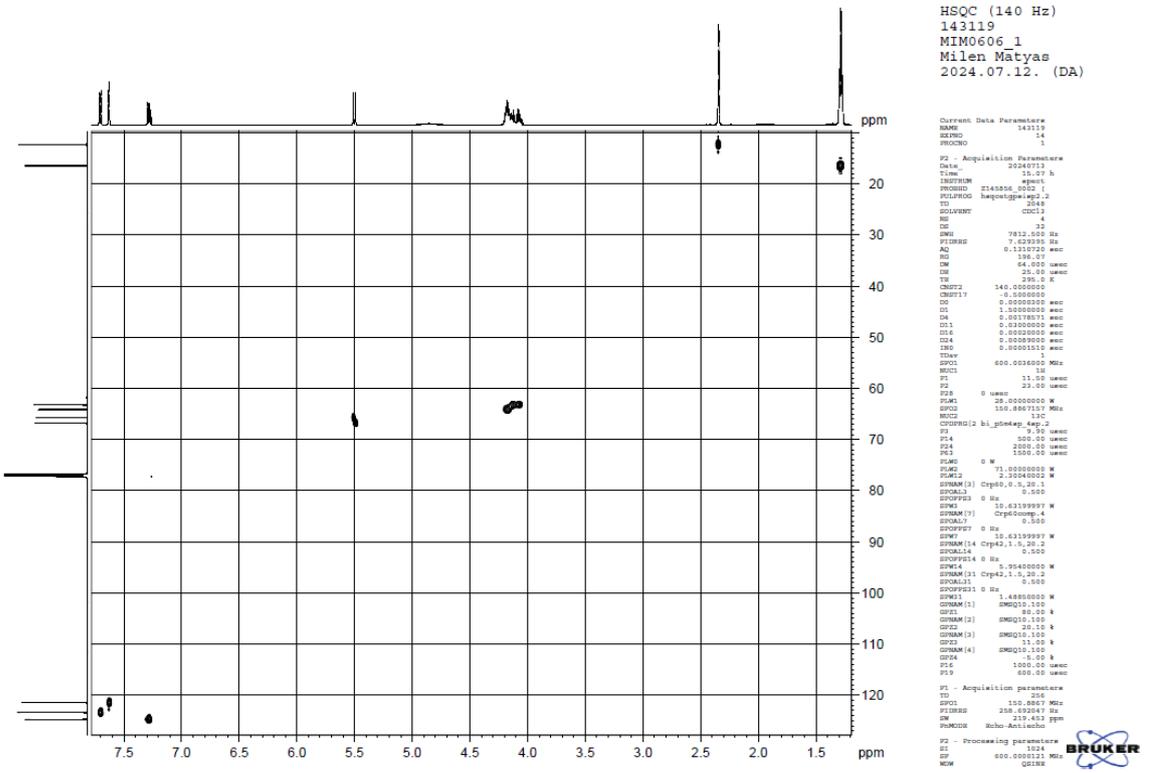
# COSY NMR spectra for compound 2p

## 2p



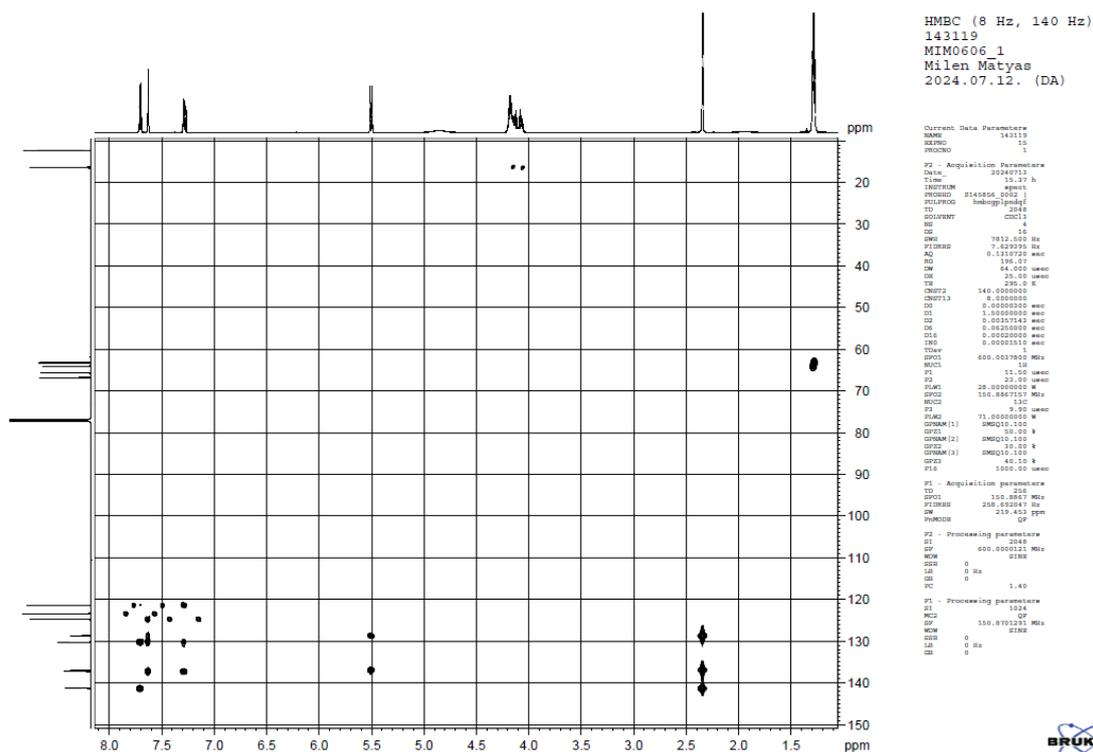
# HSQC NMR (140 Hz) spectra for compound 2q

## 2q



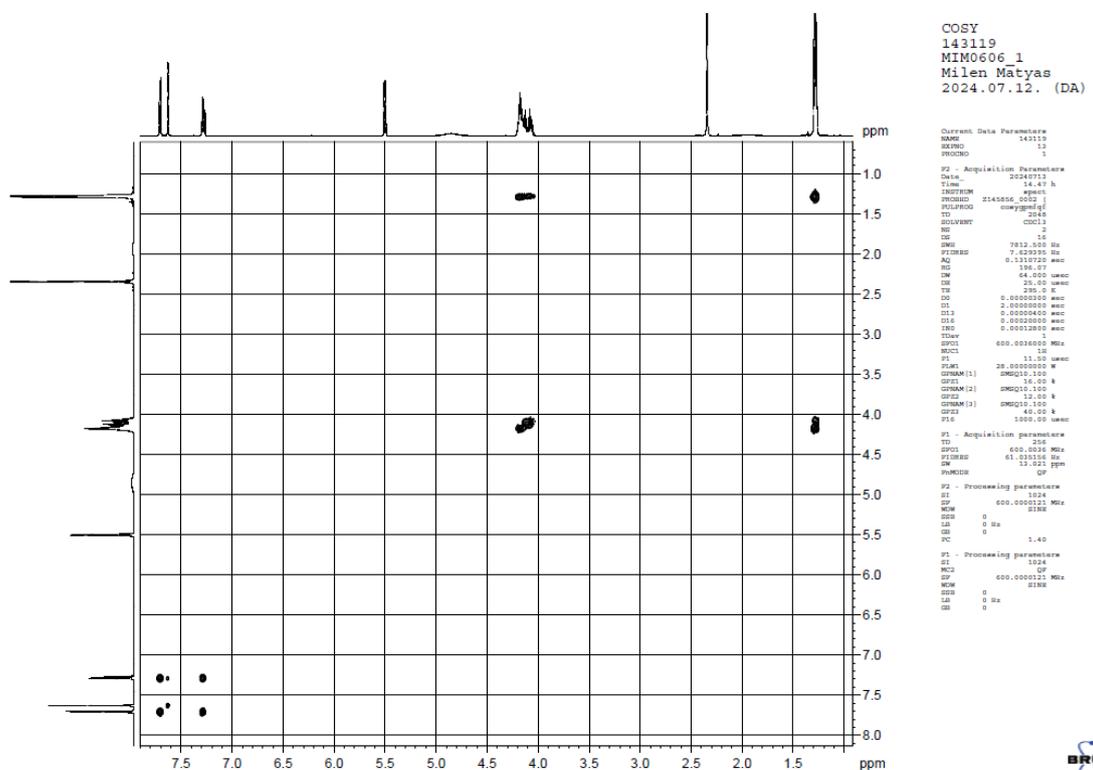
# HMBC NMR (8 Hz, 140 Hz) spectra for compound 2q

2q



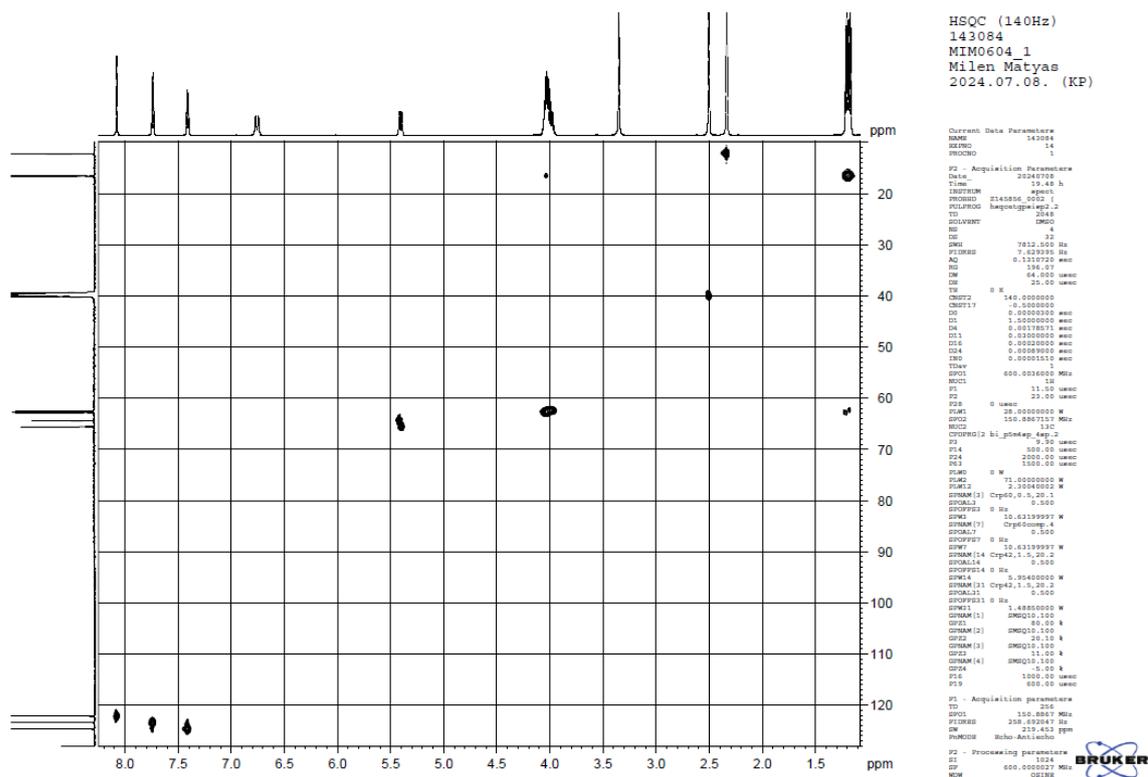
# COSY NMR spectra for compound 2q

2q



# HSQC NMR (140 Hz) spectra for compound 2r

2r



# HMBC NMR (8 Hz, 140 Hz) spectra for compound 2r

2r

