

Supporting Information

**Mn(III)-Catalyzed Synthesis of Selenophosphates and
Tellurophosphates**

Jialu Wang, Jun Liu, Yuhui Xie, Changjiang Wu, Xinyu Wang and Gong-Qing Liu *

*Organoselenium Synthesis and Function Laboratory, School of Pharmacy, Nantong University,
Nantong 226019, People's Republic of China.*

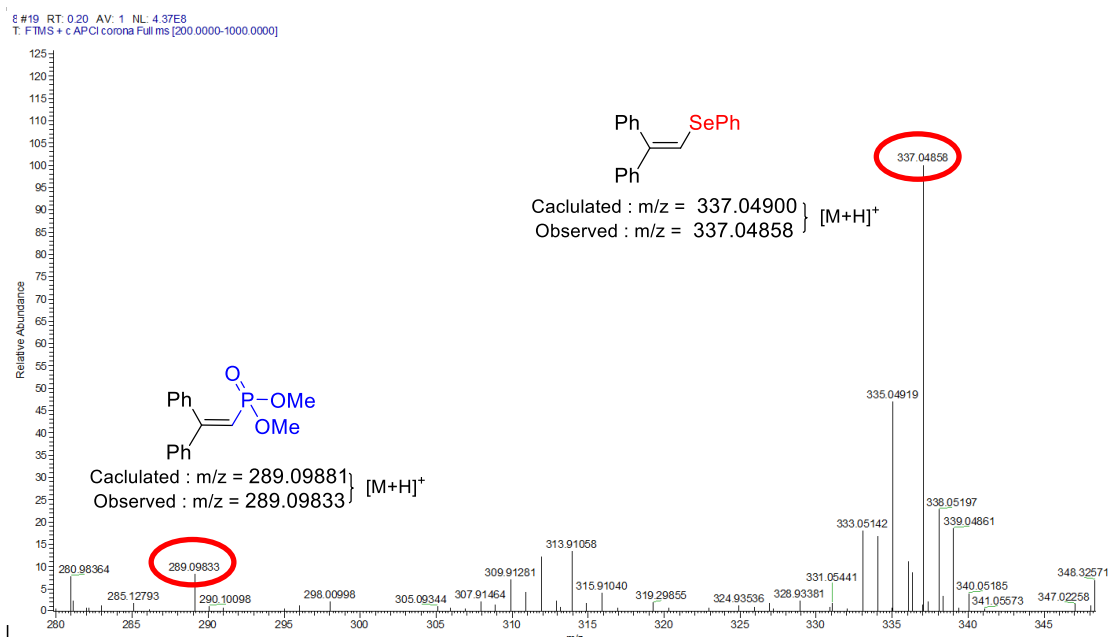
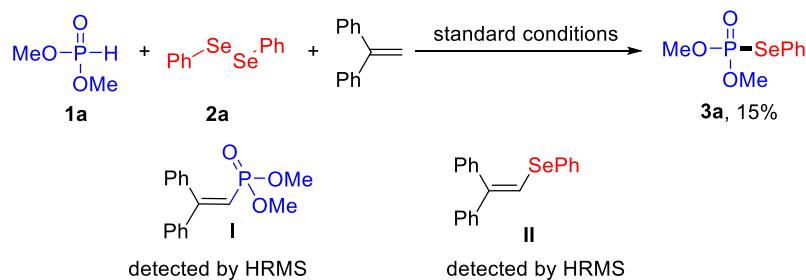
E-mail: gqliu@ntu.edu.cn

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1. HRMS experiments

A solution of dimethyl phosphonate **1a** (0.20 mmol), Ph₂Se₂ **2a** (0.12 mmol), 1,1-diphenylethylene (0.60 mmol), Mn(OAc)₃ (0.010 mmol) and THF (2 mL) was placed in 20-mL test tube. The resulting mixture was stirred at room temperature under air for 12 h. a 15% yield of **3a** was detected, and two adducts were identified by HRMS analysis.



2. Copies of NMR spectra

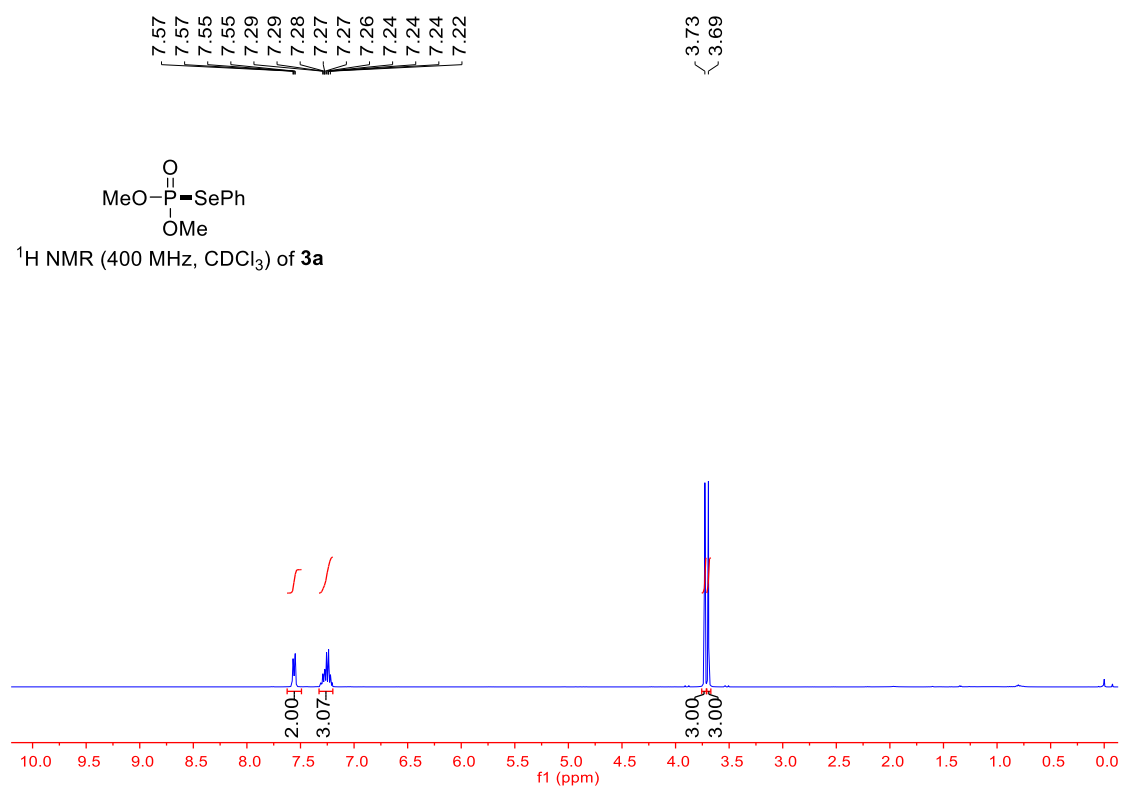


Figure S1: ^1H NMR spectrum for compound **3a**

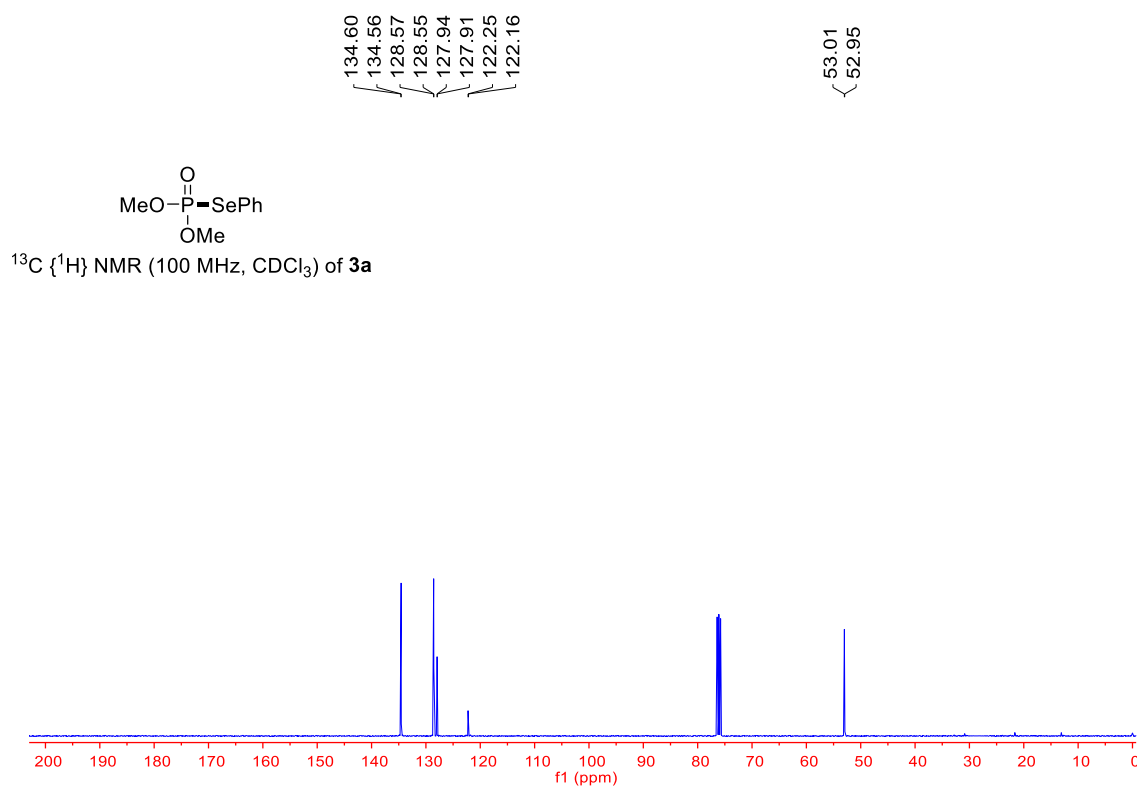


Figure S2: ^{13}C NMR spectrum for compound **3a**

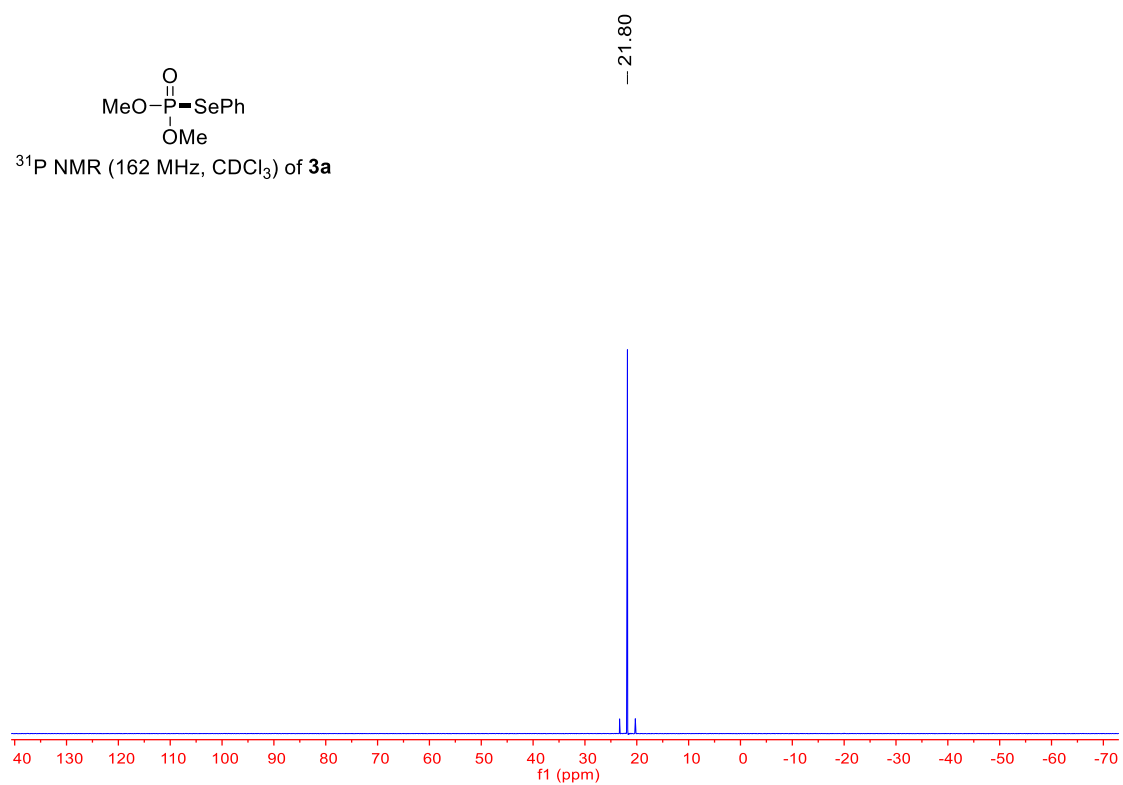


Figure S3: ³¹P NMR spectrum for compound **3a**

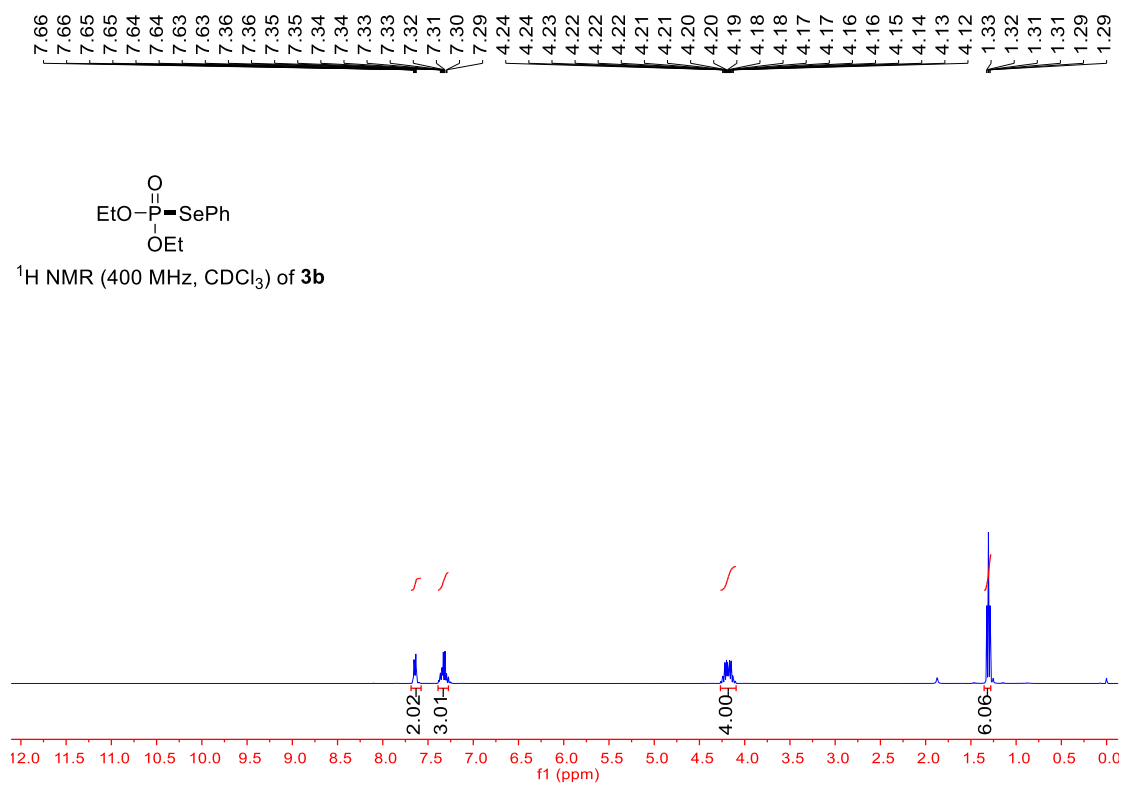


Figure S4: ¹H NMR spectrum for compound **3b**

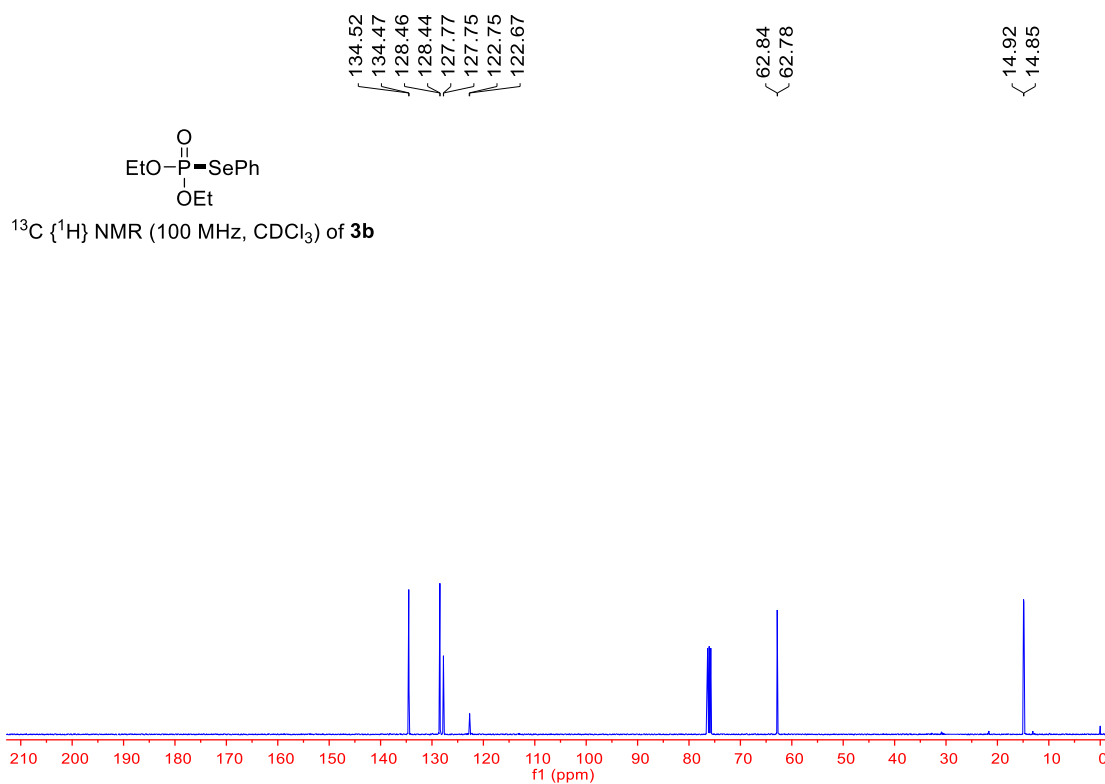


Figure S5: ^{13}C NMR spectrum for compound **3b**

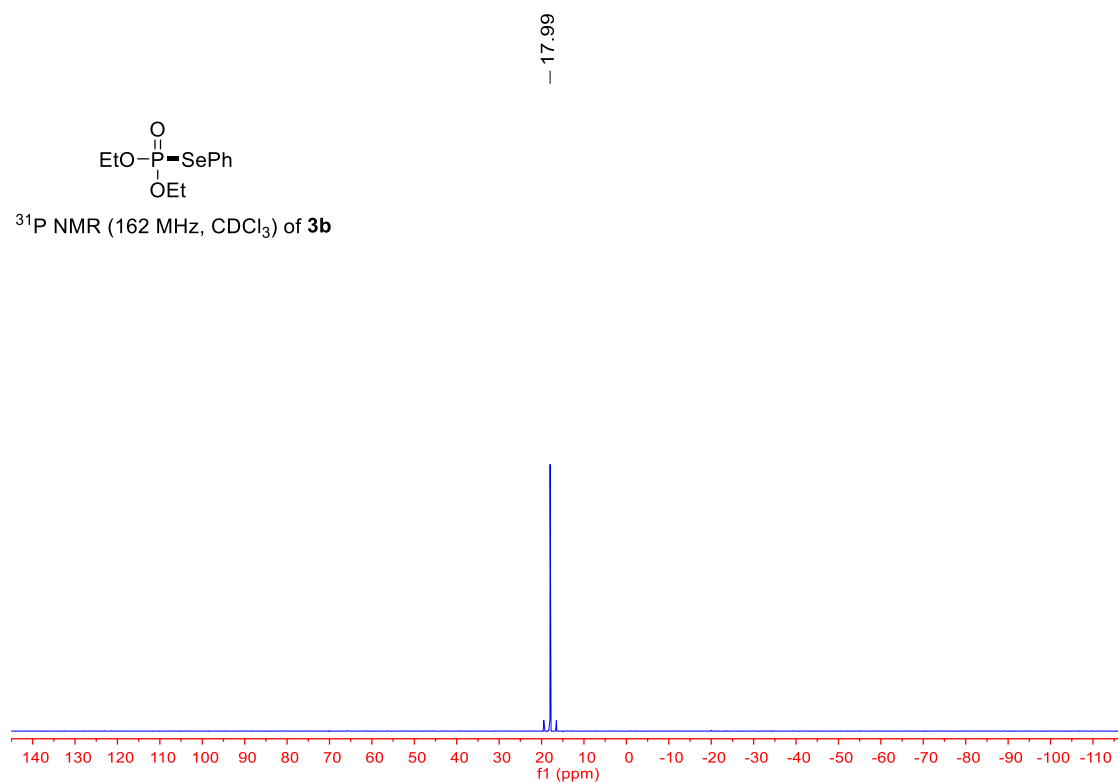


Figure S6: ^{31}P NMR spectrum for compound **3b**

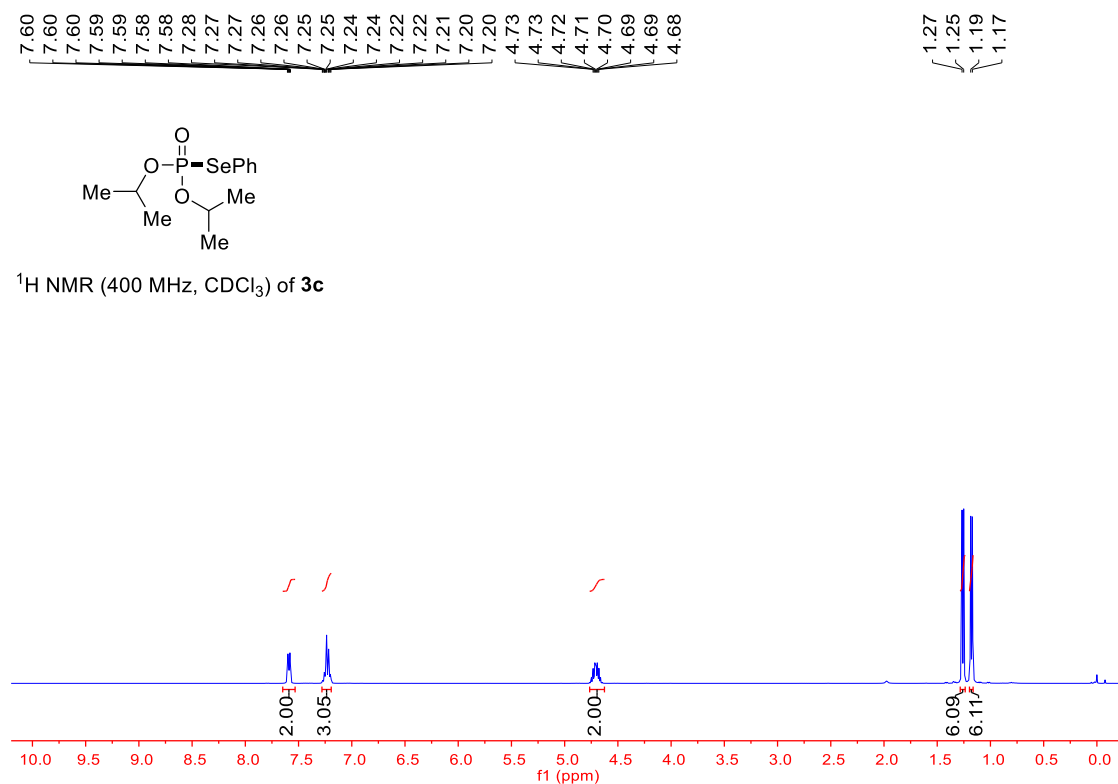


Figure S7: ^1H NMR spectrum for compound **3c**

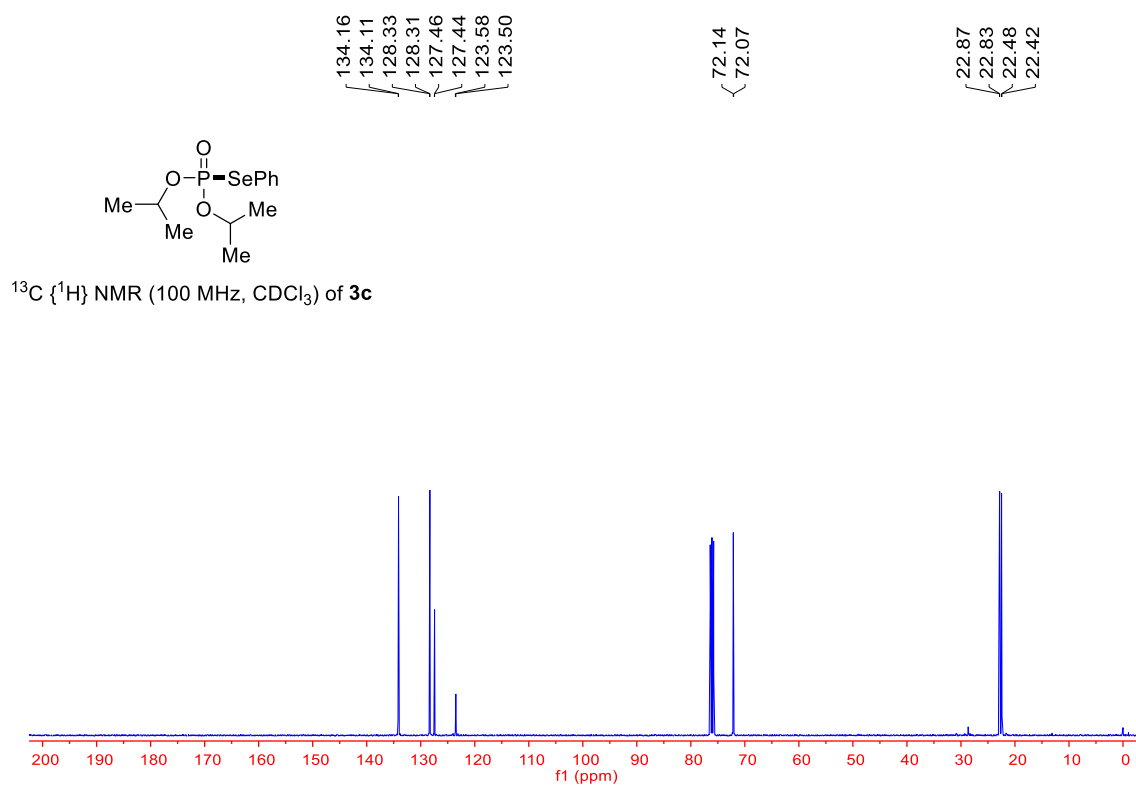


Figure S8: ^{13}C NMR spectrum for compound **3c**

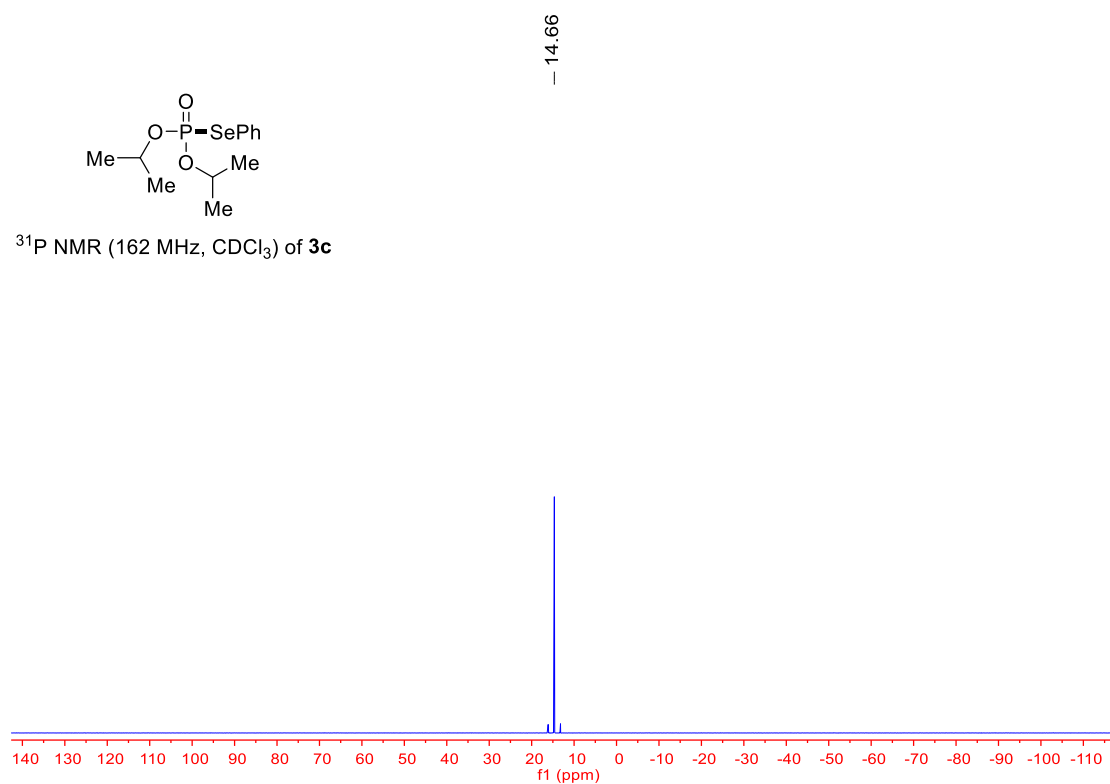


Figure S9: ^{31}P NMR spectrum for compound **3c**

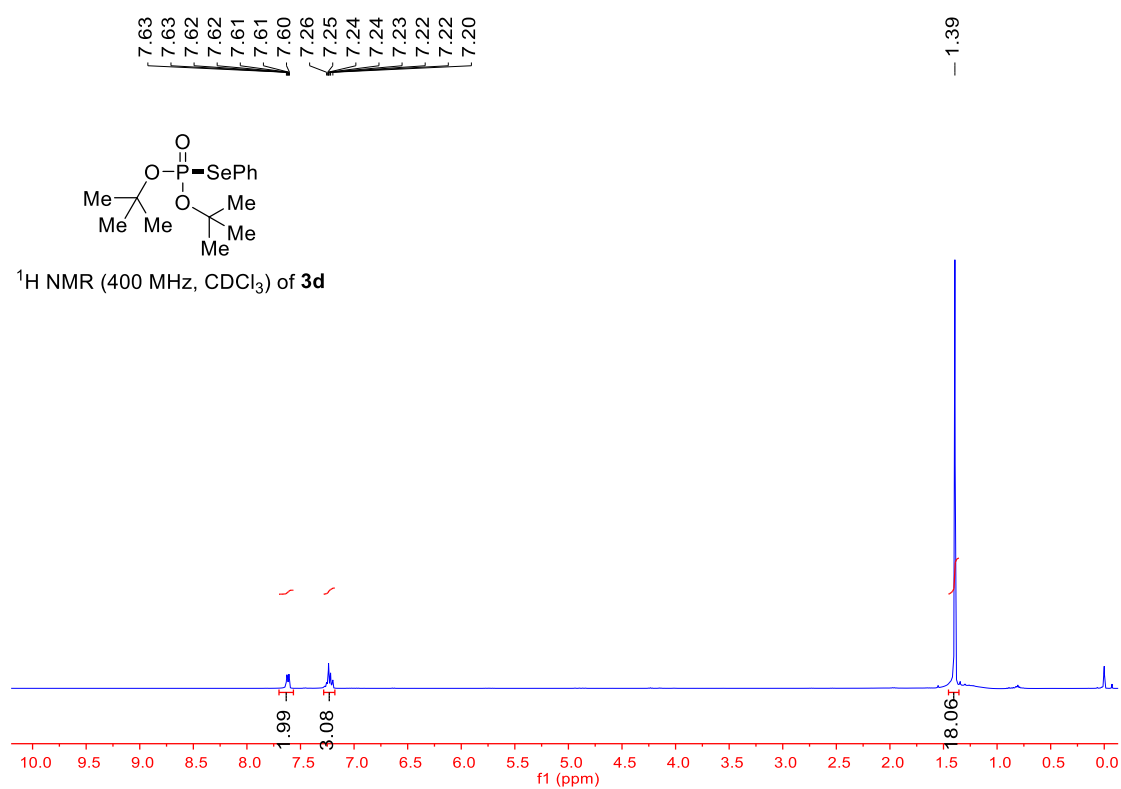


Figure S10: ^1H NMR spectrum for compound **3d**

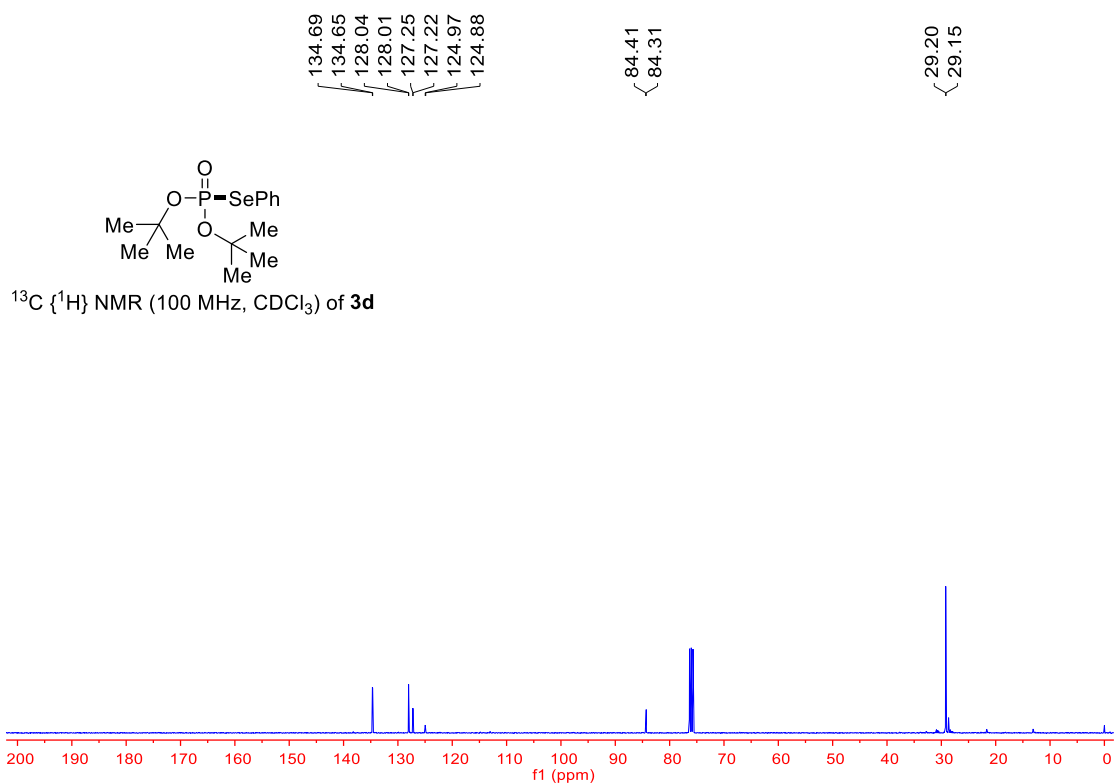


Figure S11: ^{13}C NMR spectrum for compound **3d**

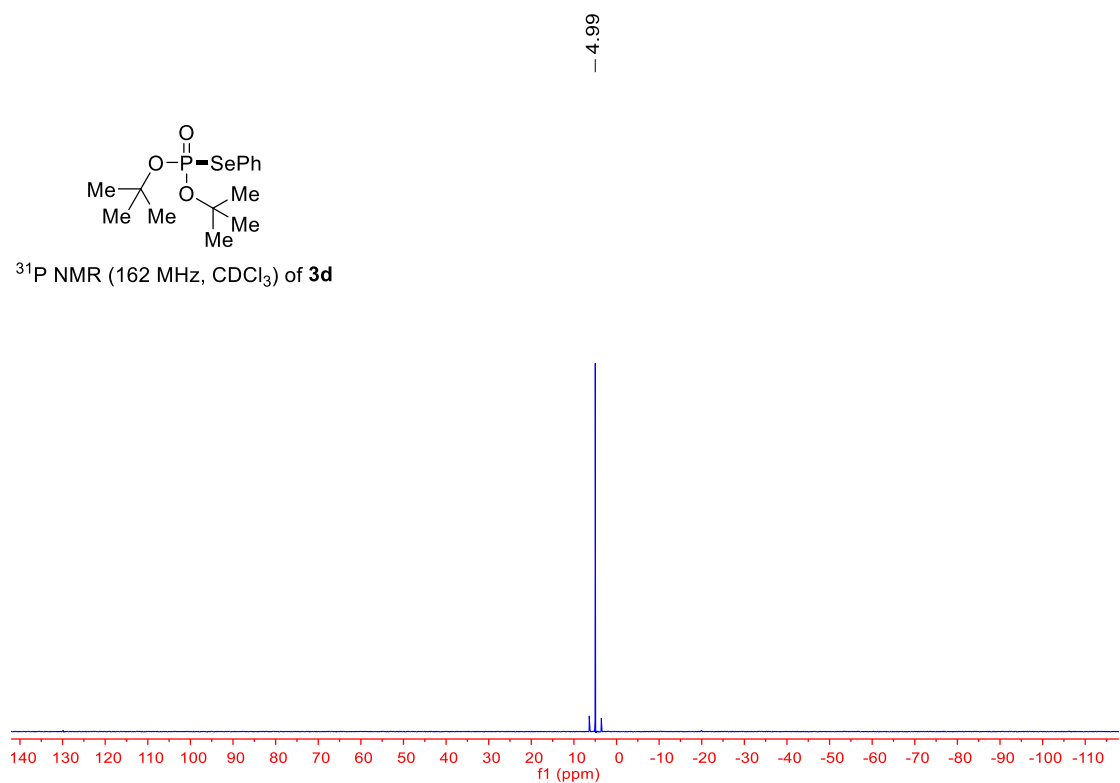


Figure S12: ^{31}P NMR spectrum for compound **3d**

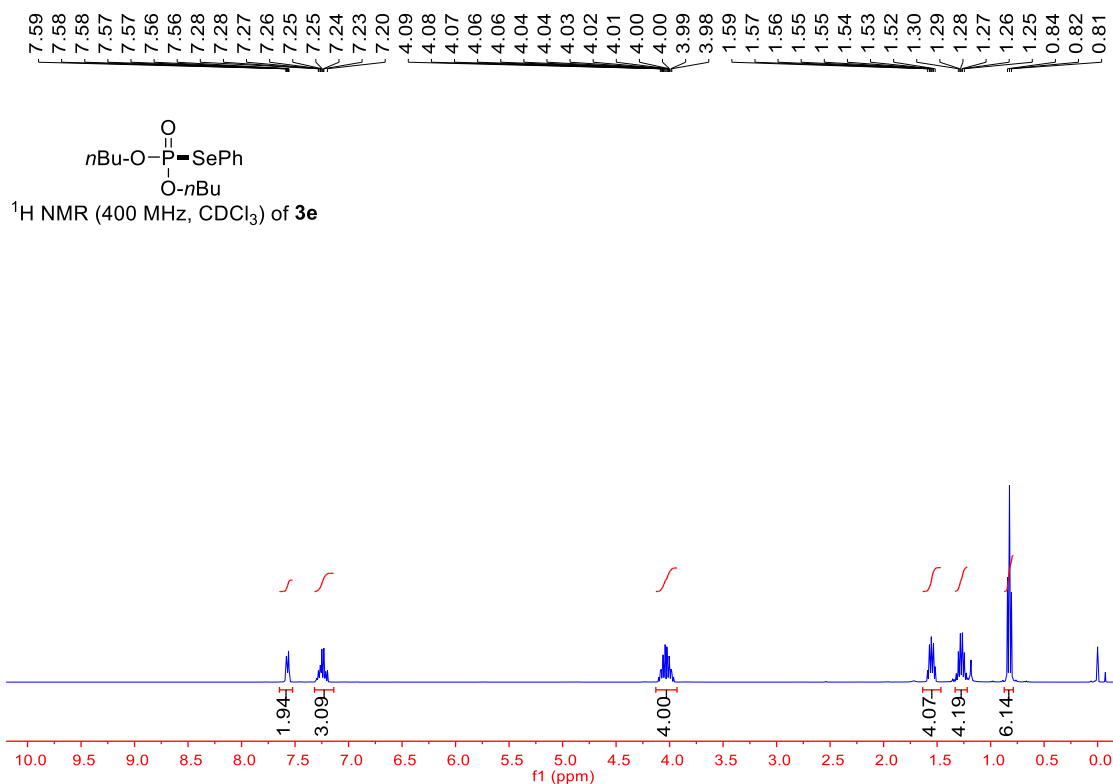


Figure S13: ^1H NMR spectrum for compound **3e**

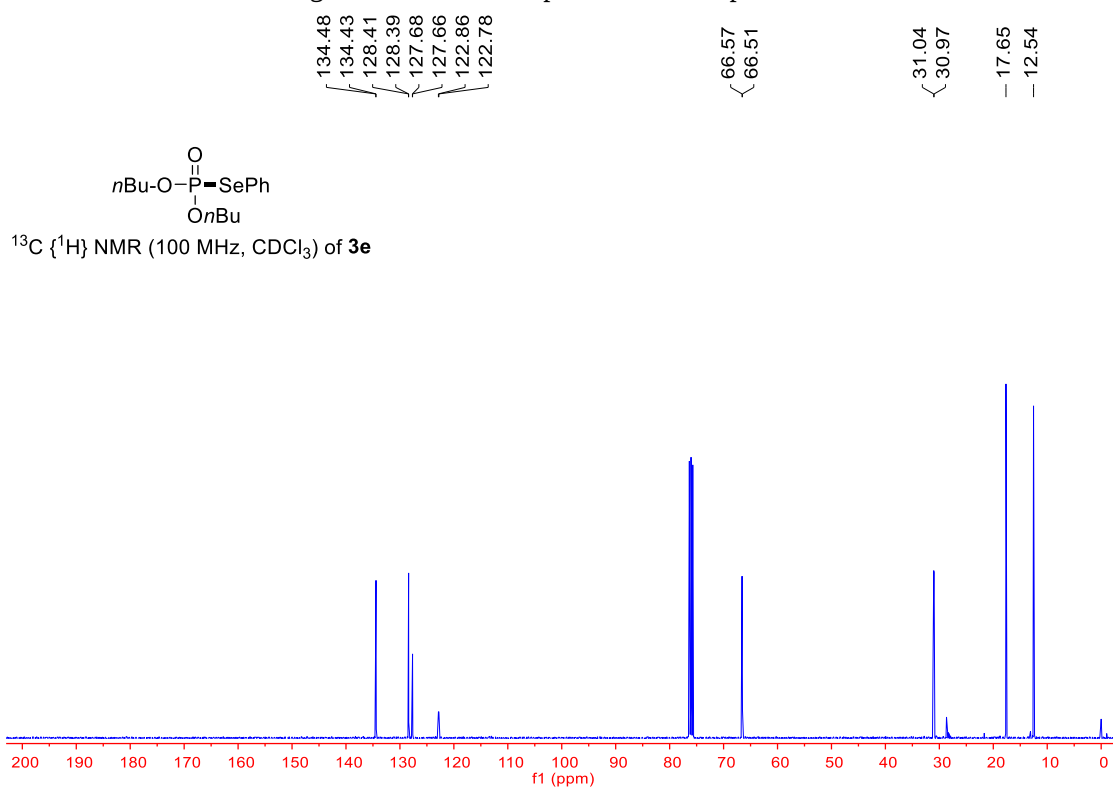


Figure S14: ^{13}C NMR spectrum for compound **3e**

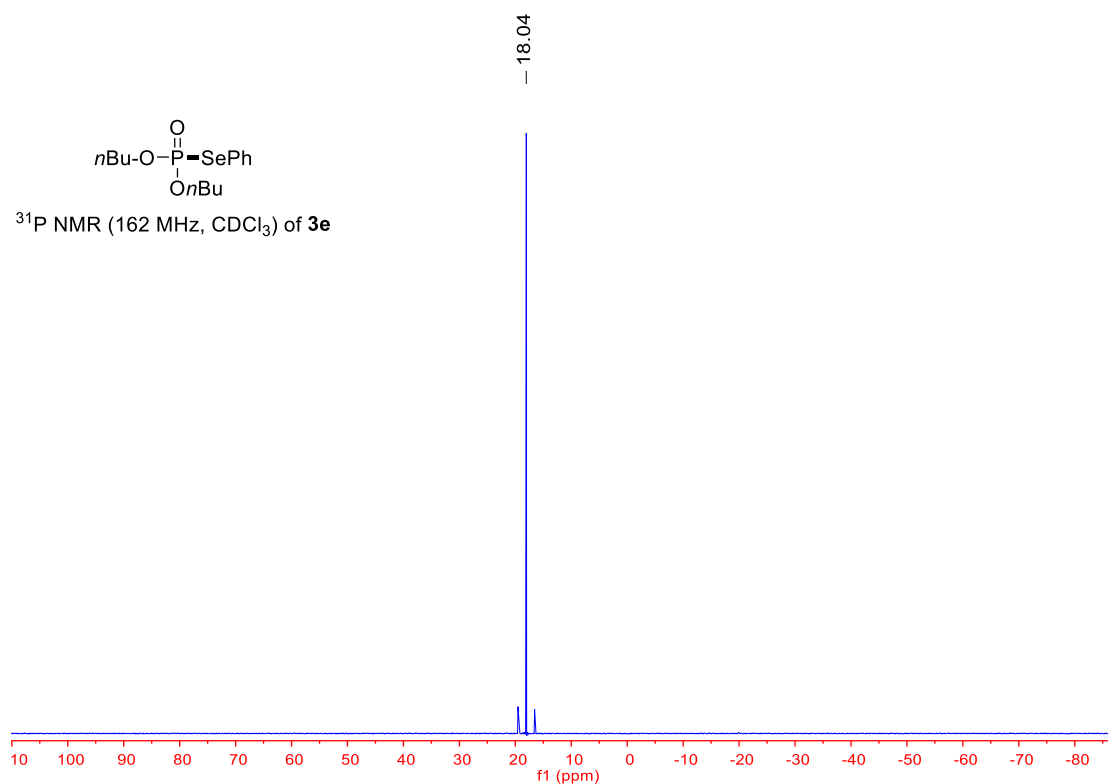


Figure S15: ^{31}P NMR spectrum for compound **3e**

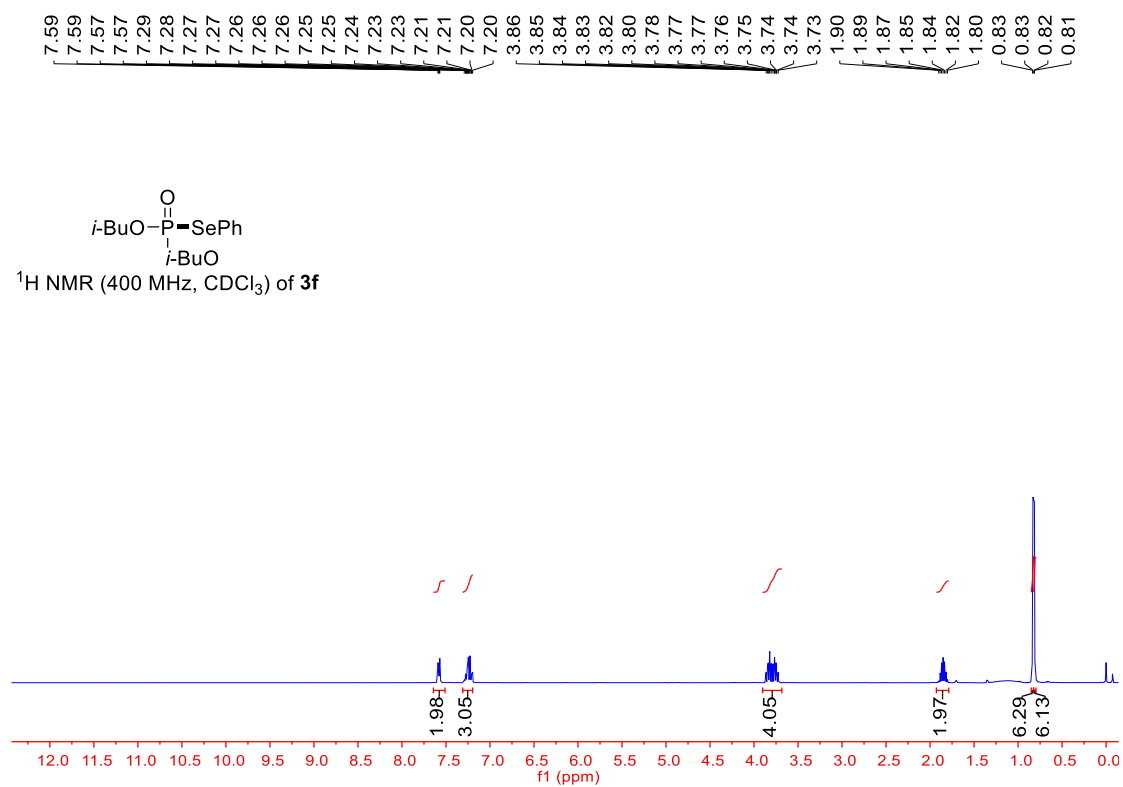


Figure S16: ^1H NMR spectrum for compound **3f**

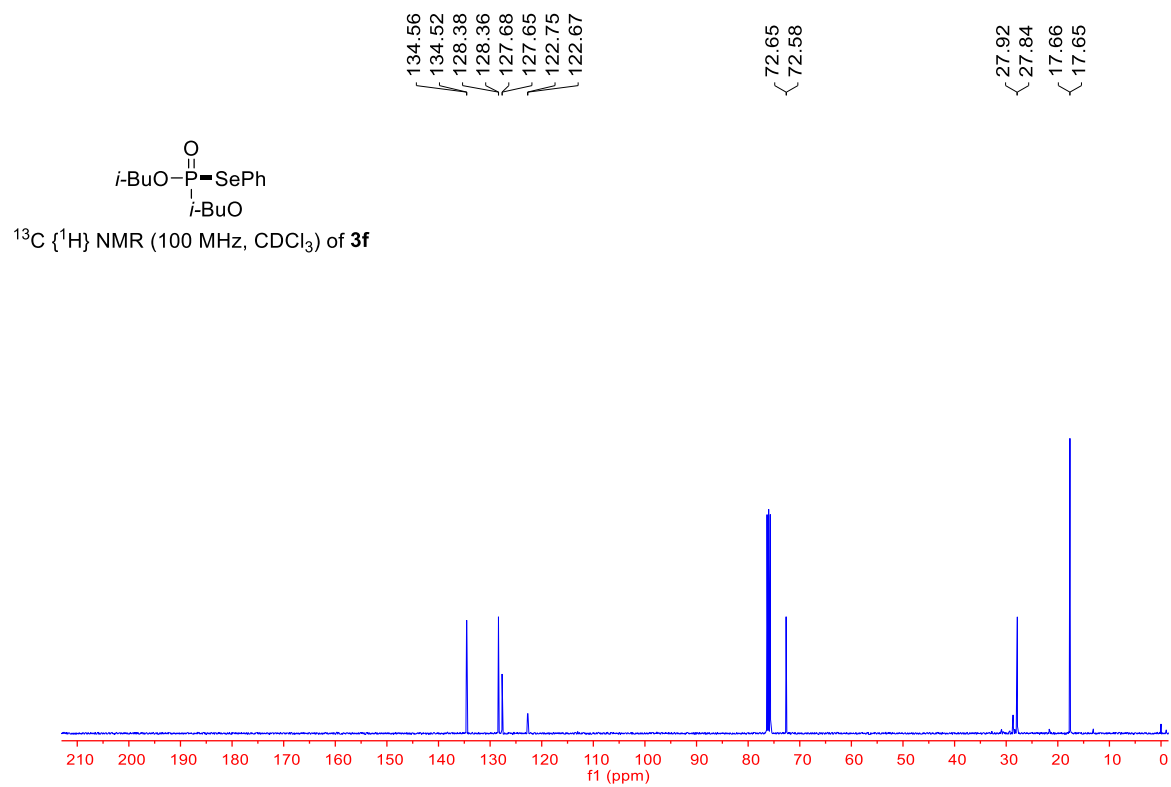


Figure S17: ^{13}C NMR spectrum for compound **3f**

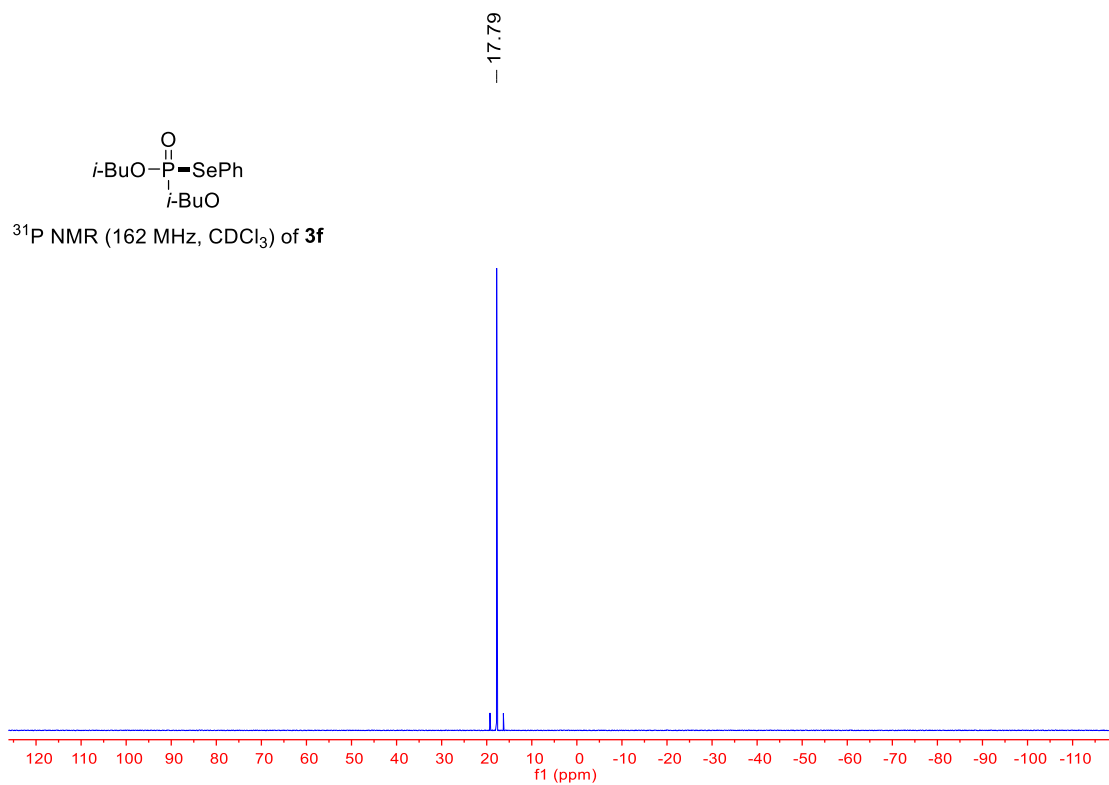


Figure S18: ^{31}P NMR spectrum for compound **3f**

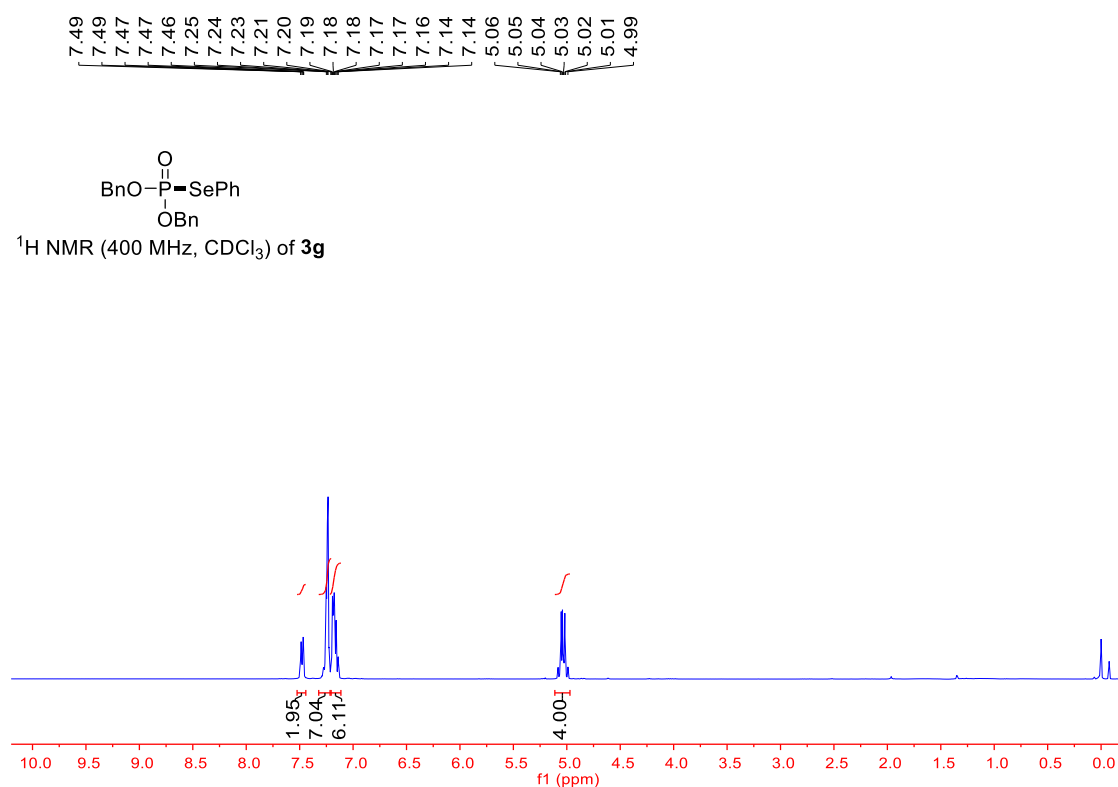


Figure S19: ¹H NMR spectrum for compound **3g**

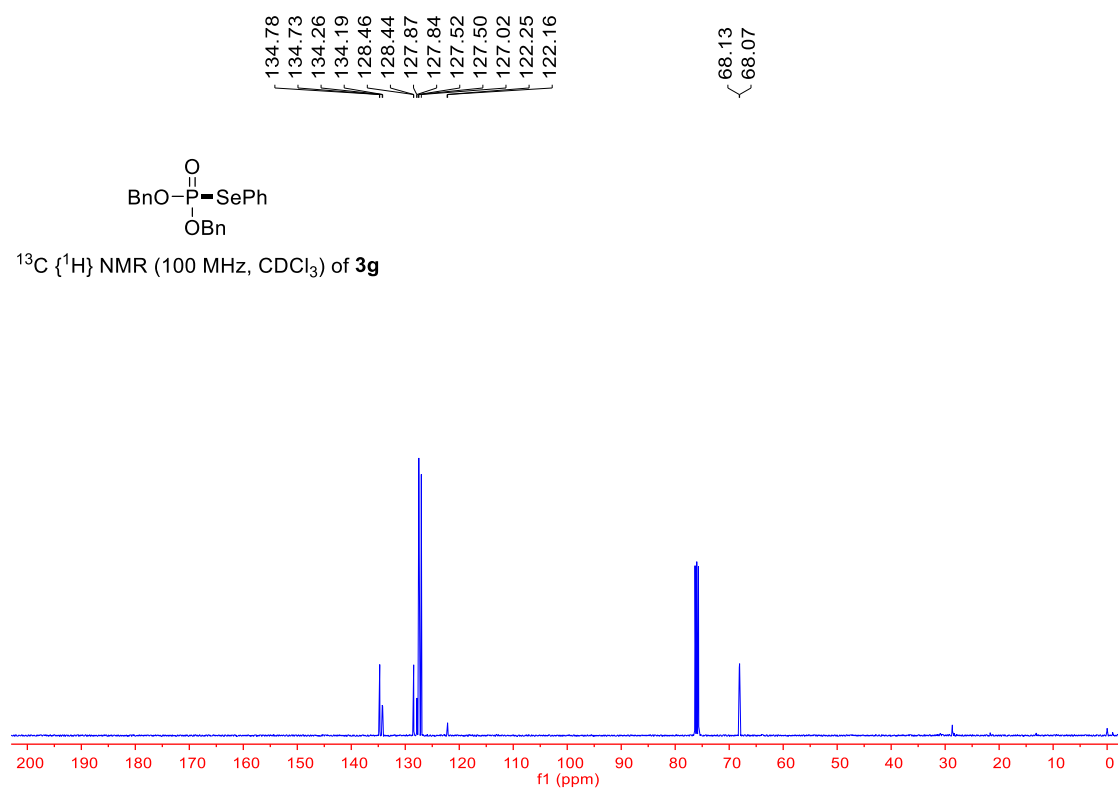


Figure S20: ¹³C NMR spectrum for compound **3g**

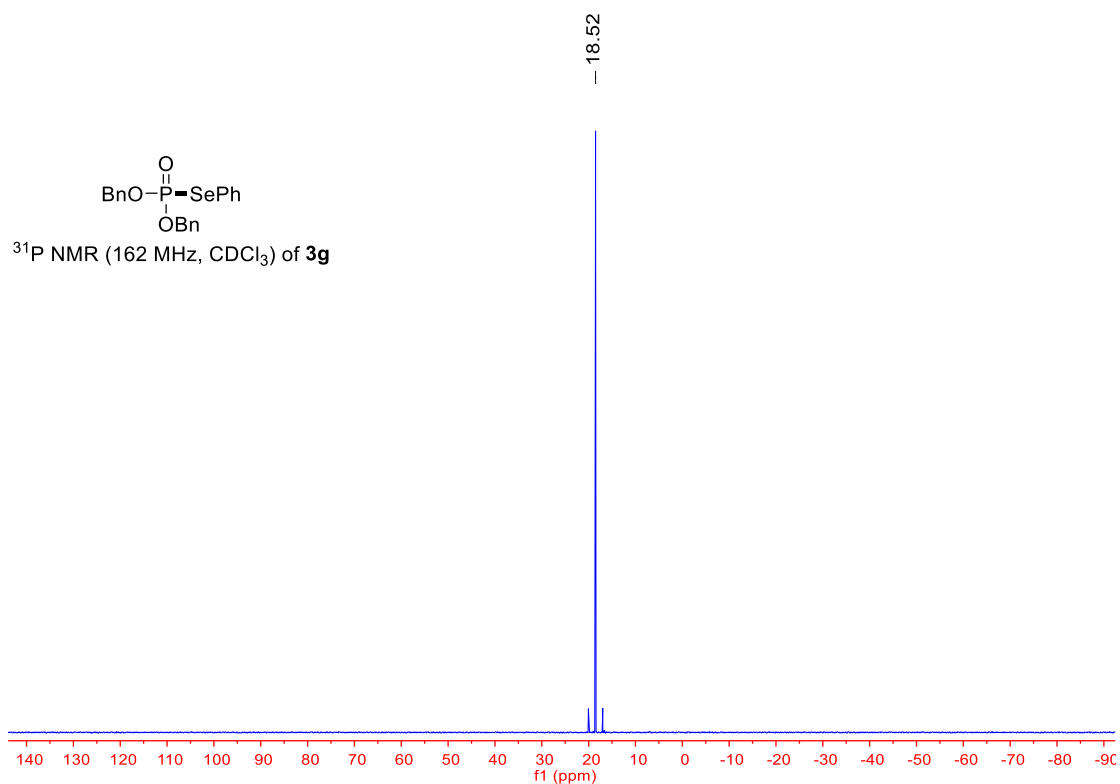


Figure S21: ³¹P NMR spectrum for compound **3g**

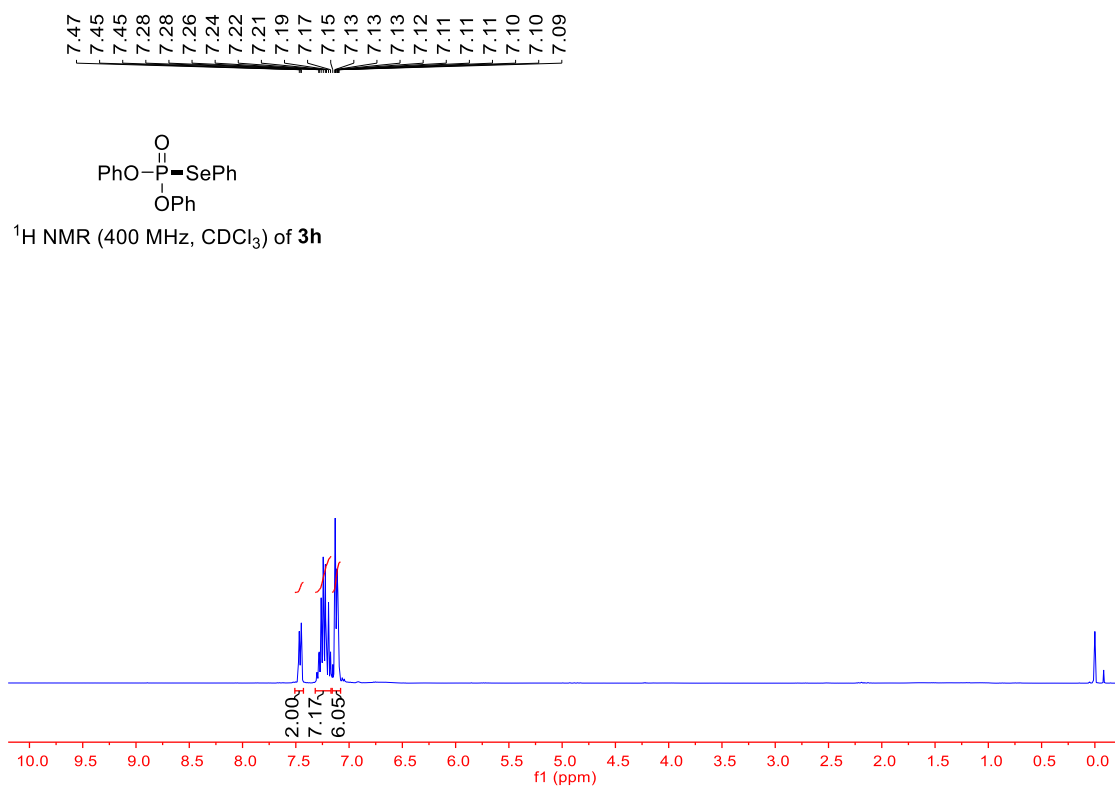


Figure S22: ¹H NMR spectrum for compound **3h**

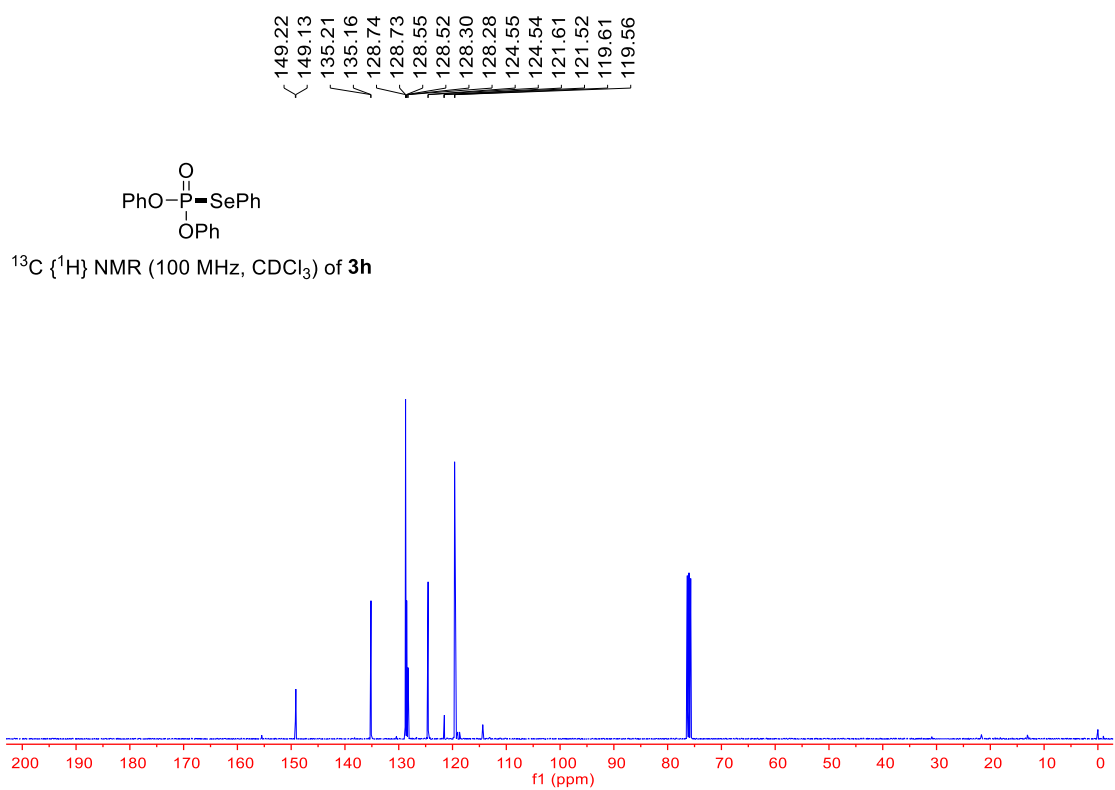


Figure S23: ^{13}C NMR spectrum for compound **3h**

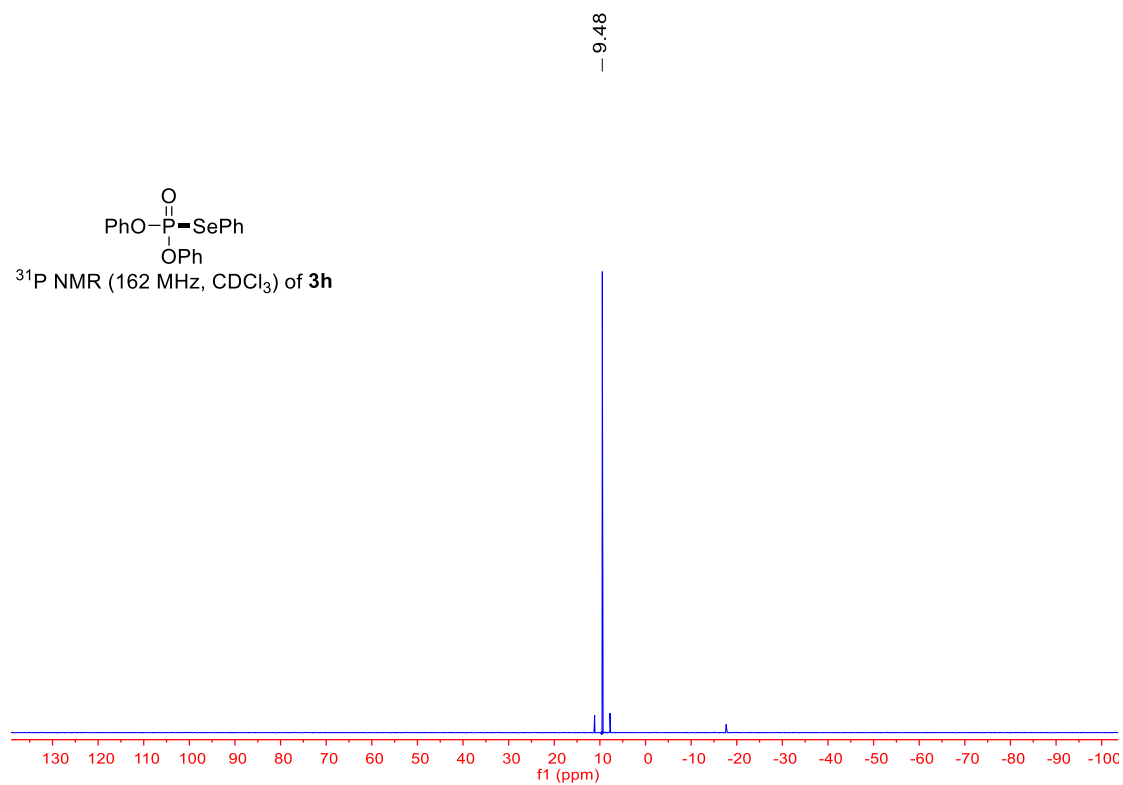


Figure S24: ^{31}P NMR spectrum for compound **3h**

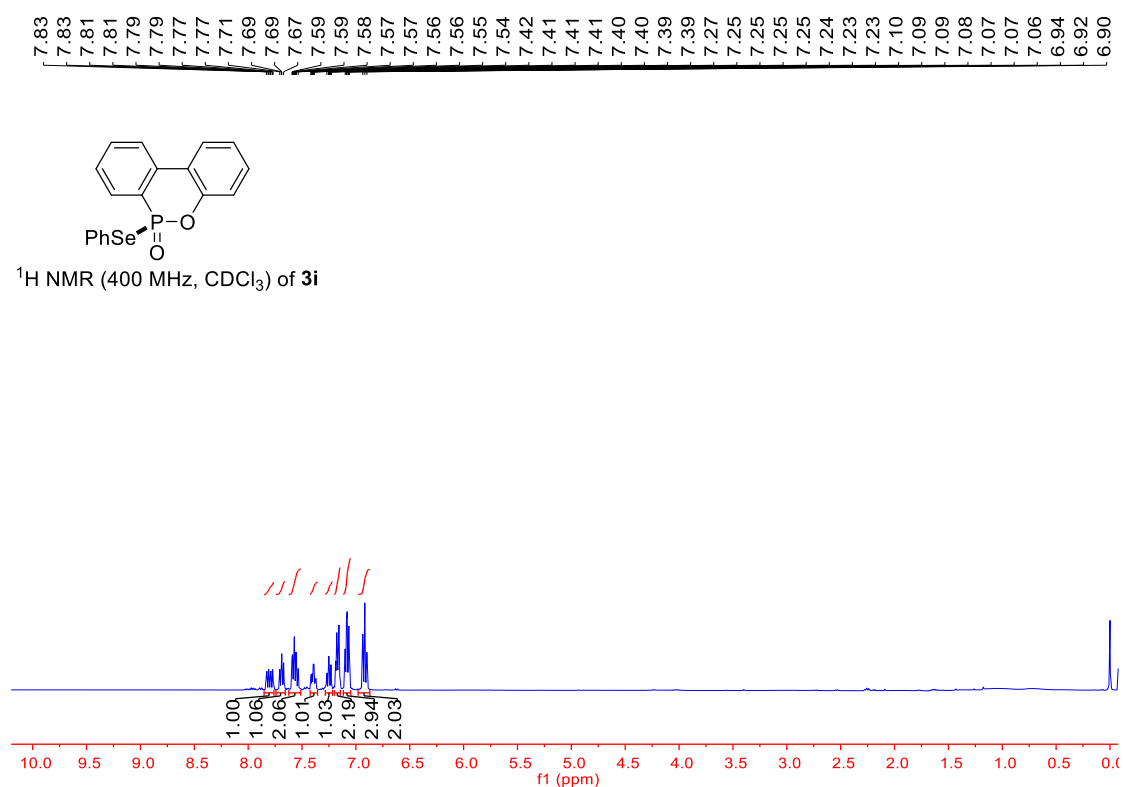


Figure S25: ^1H NMR spectrum for compound **3i**

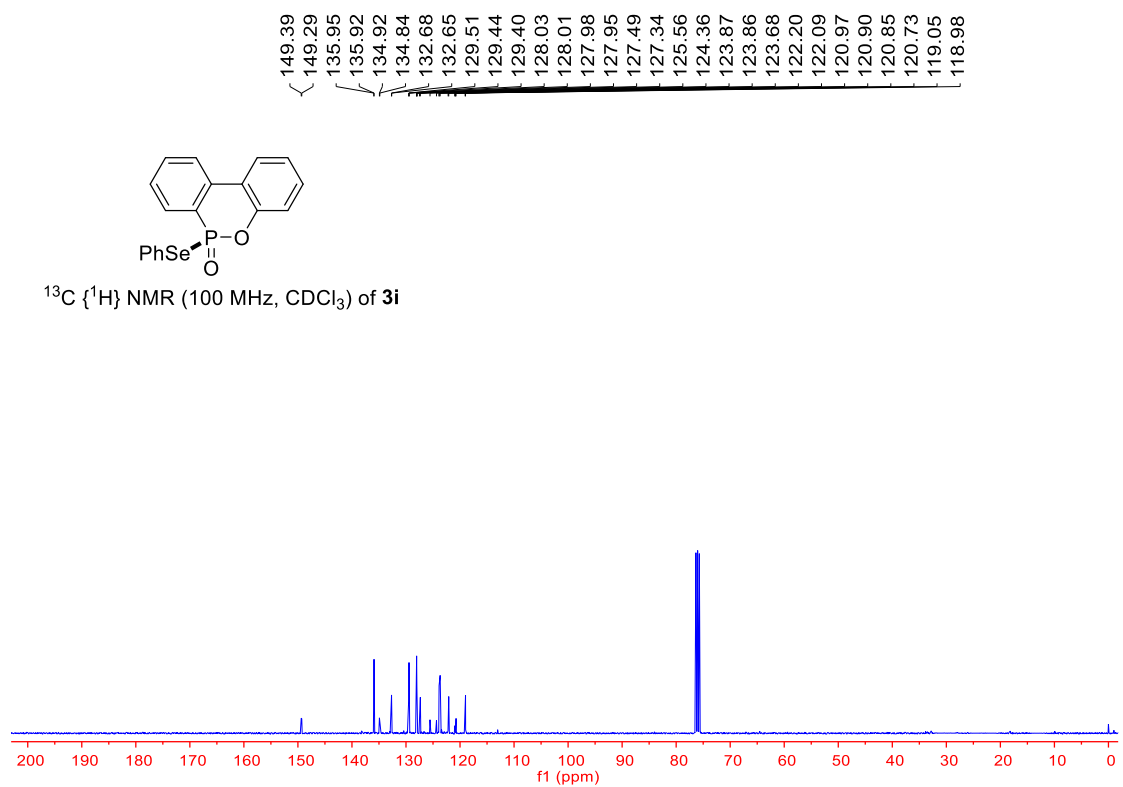


Figure S26: ^{13}C NMR spectrum for compound **3i**

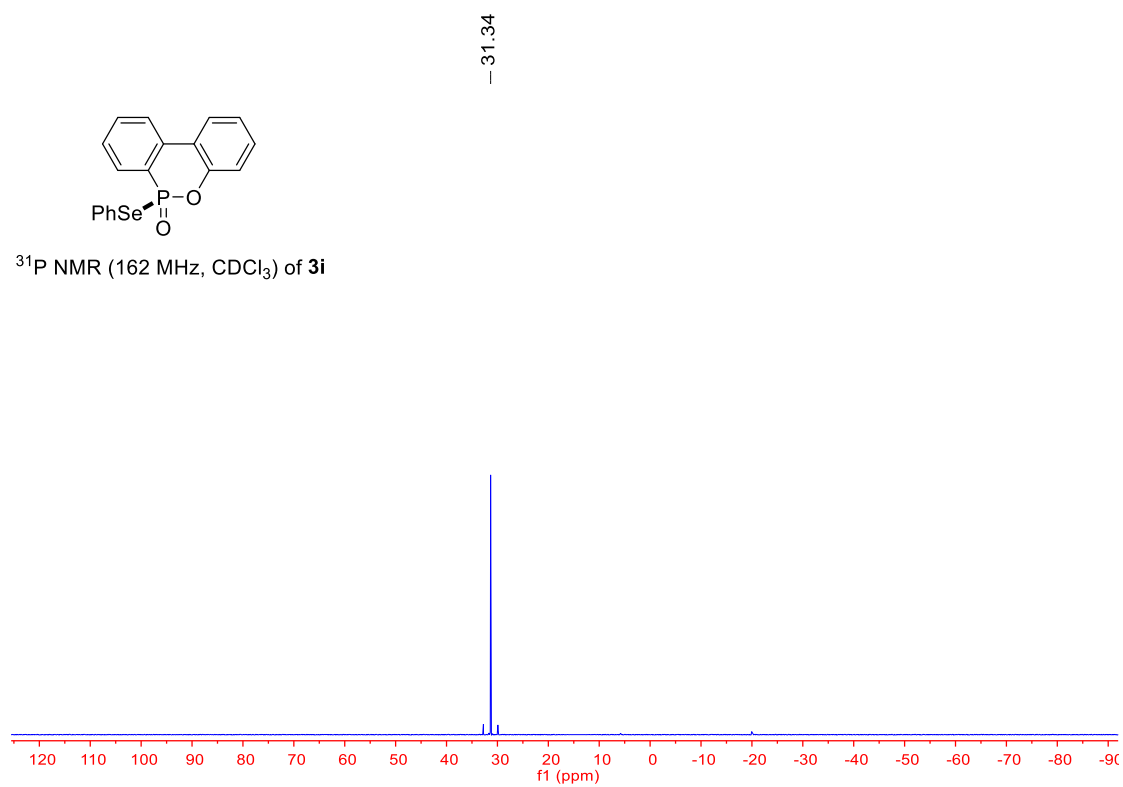


Figure S27: ³¹P NMR spectrum for compound **3i**

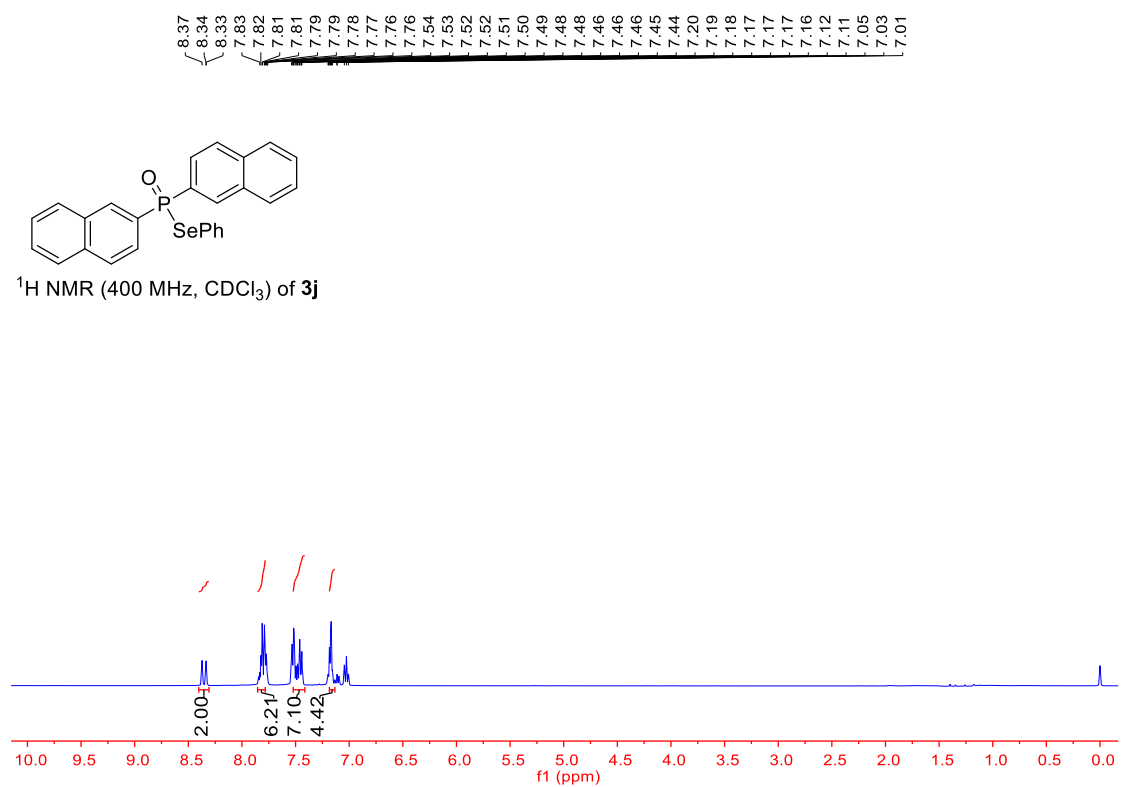


Figure S28: ¹H NMR spectrum for compound **3j**

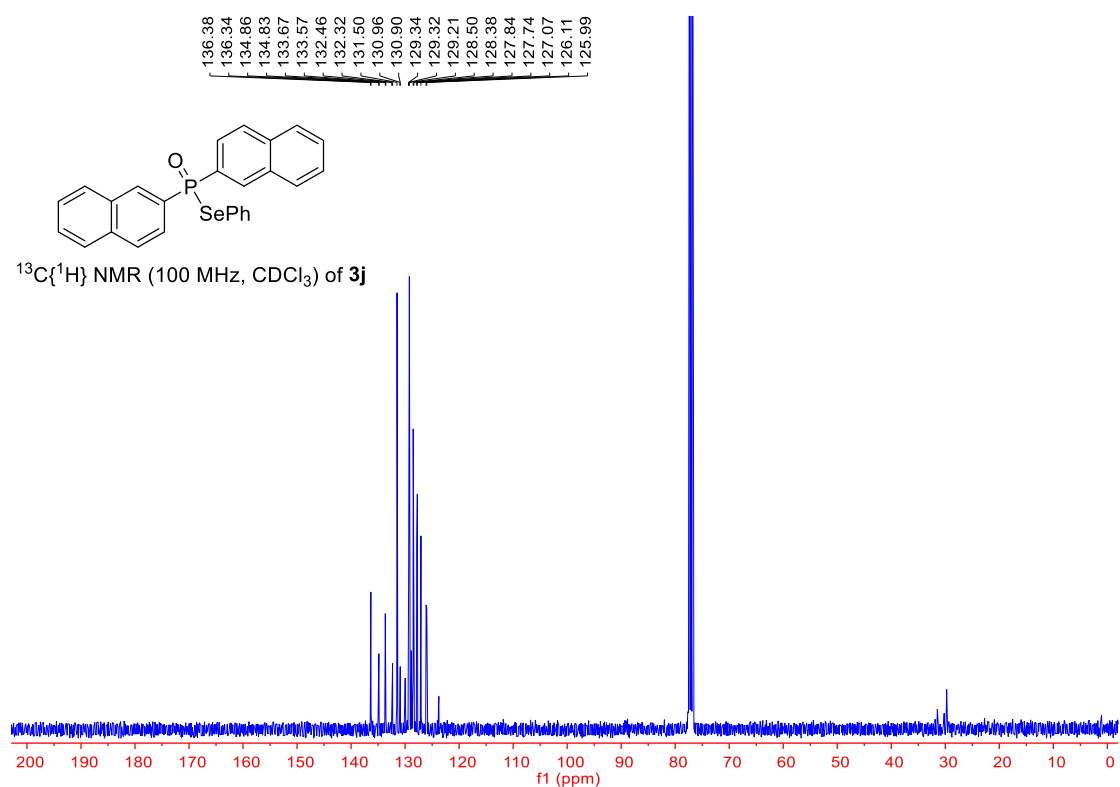


Figure S29: ^{13}C NMR spectrum for compound **3j**

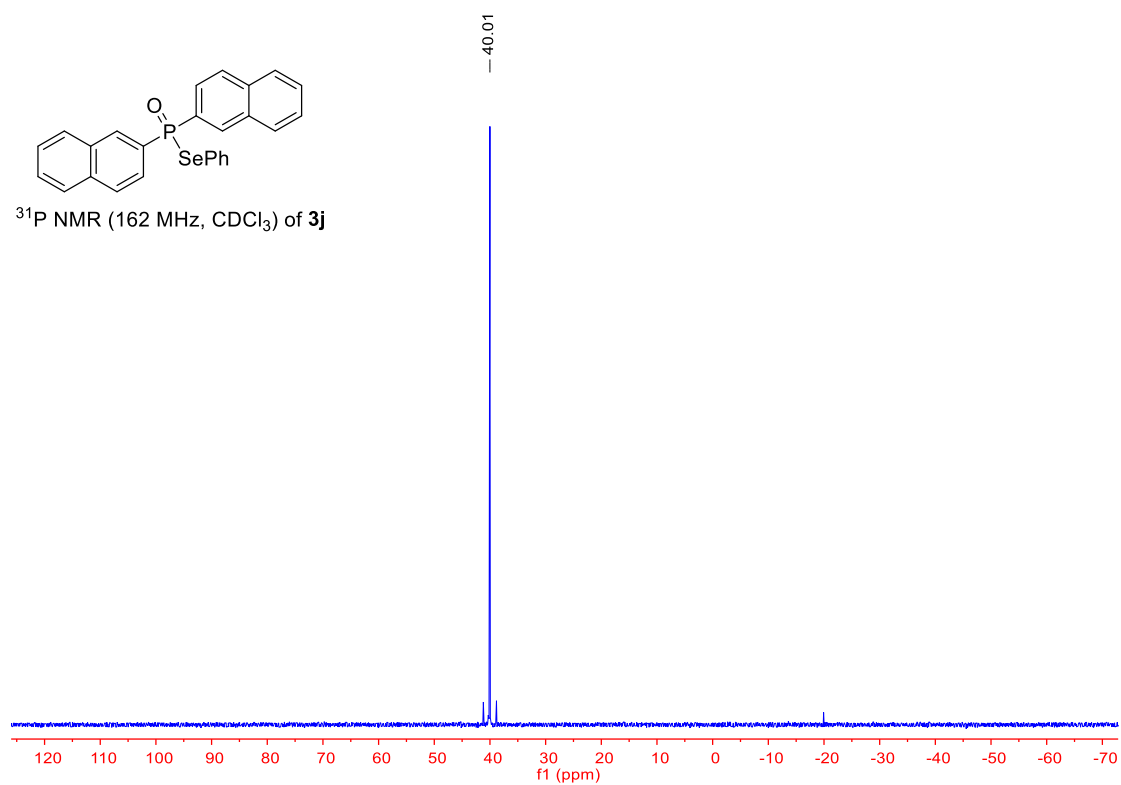


Figure S30: ^{31}P NMR spectrum for compound **3j**

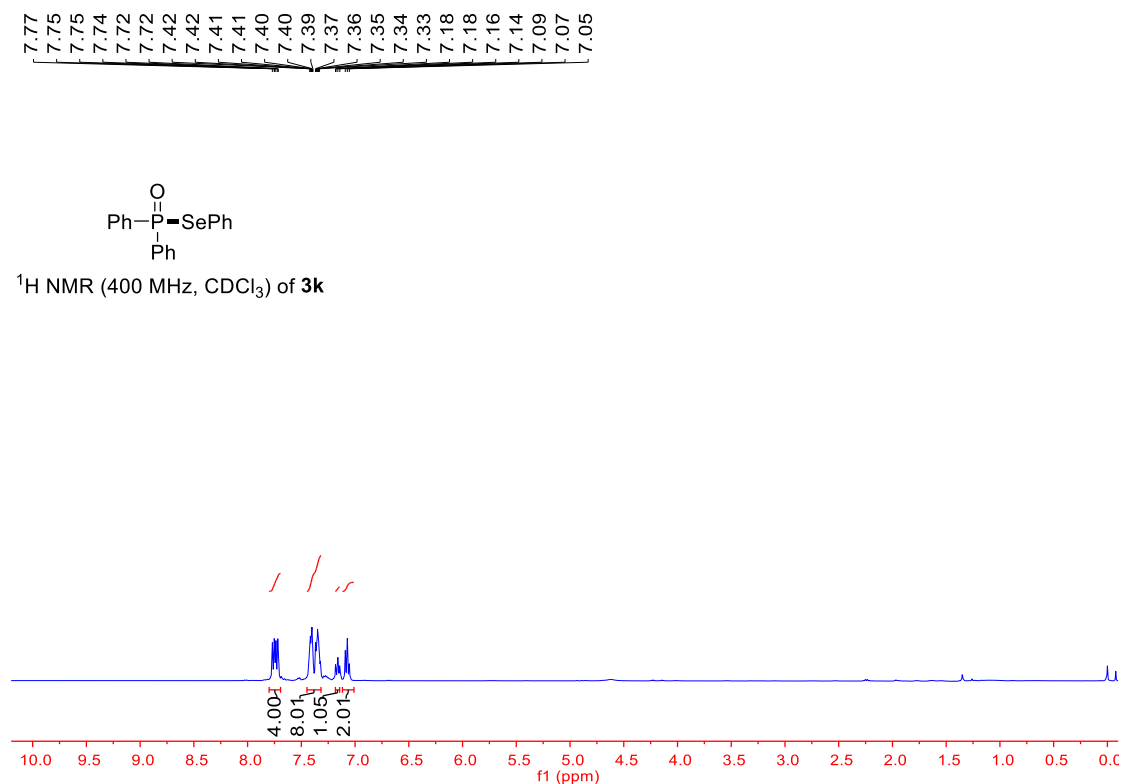


Figure S31: ^1H NMR spectrum for compound **3k**

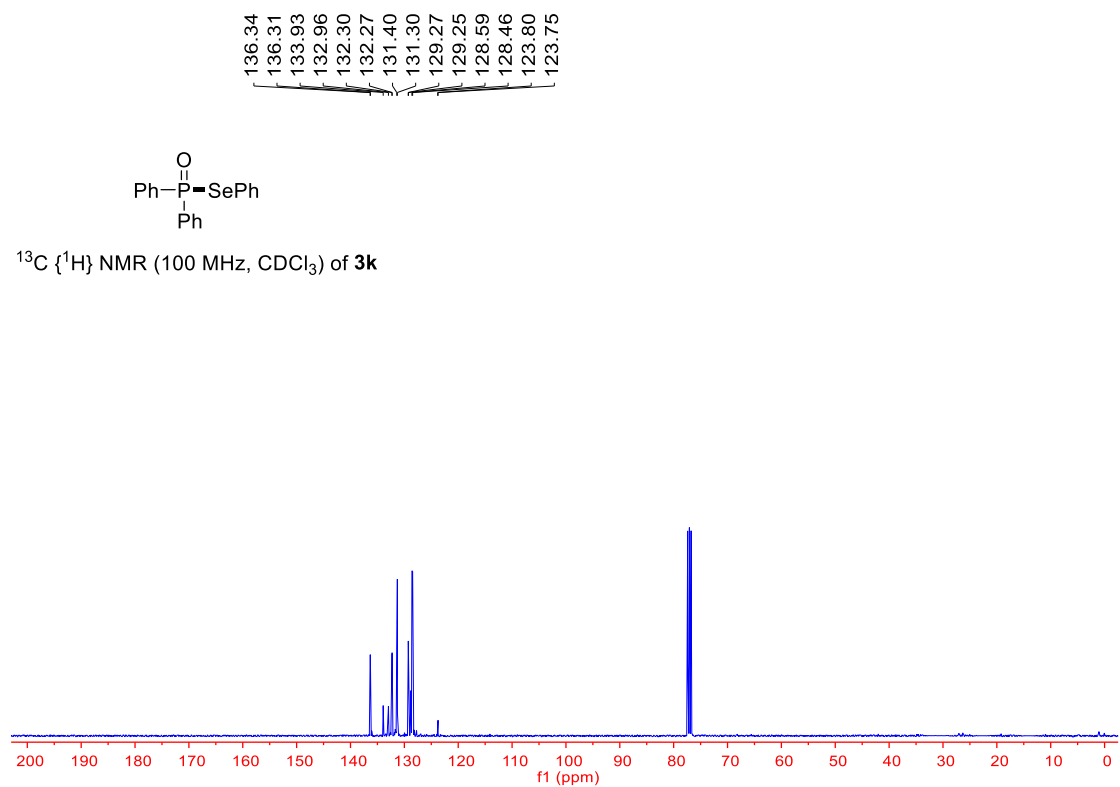


Figure S32: ^{13}C NMR spectrum for compound **3k**

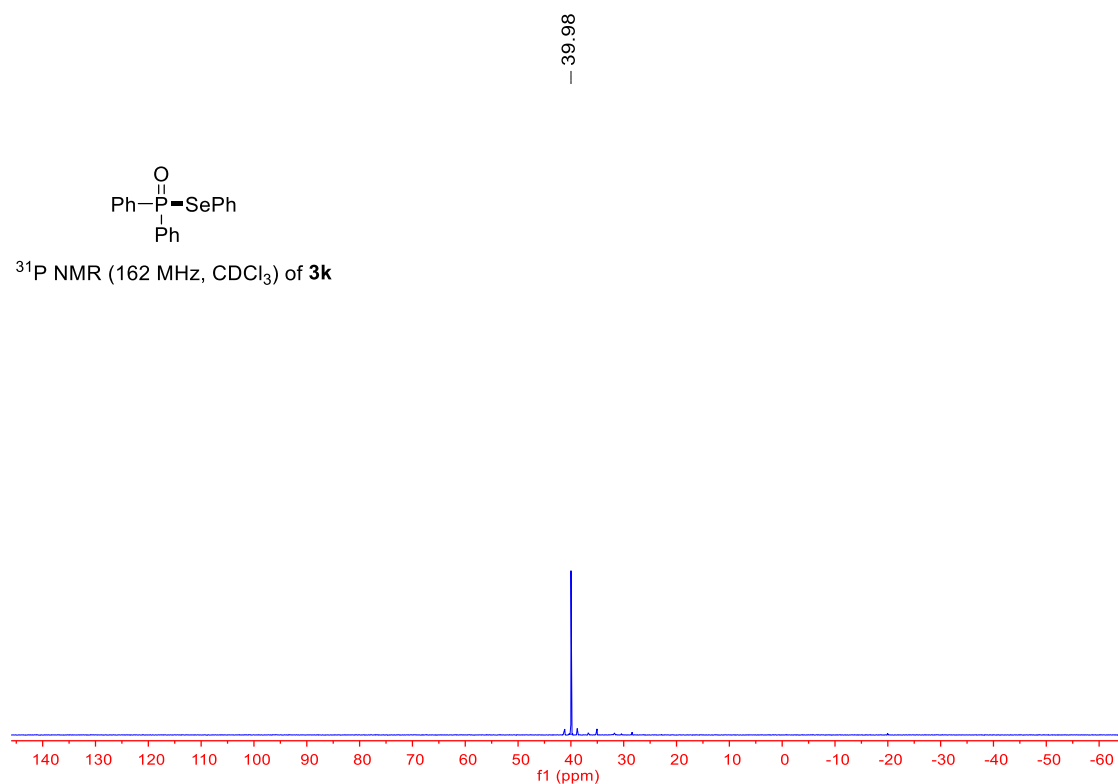


Figure S33: ³¹P NMR spectrum for compound **3k**

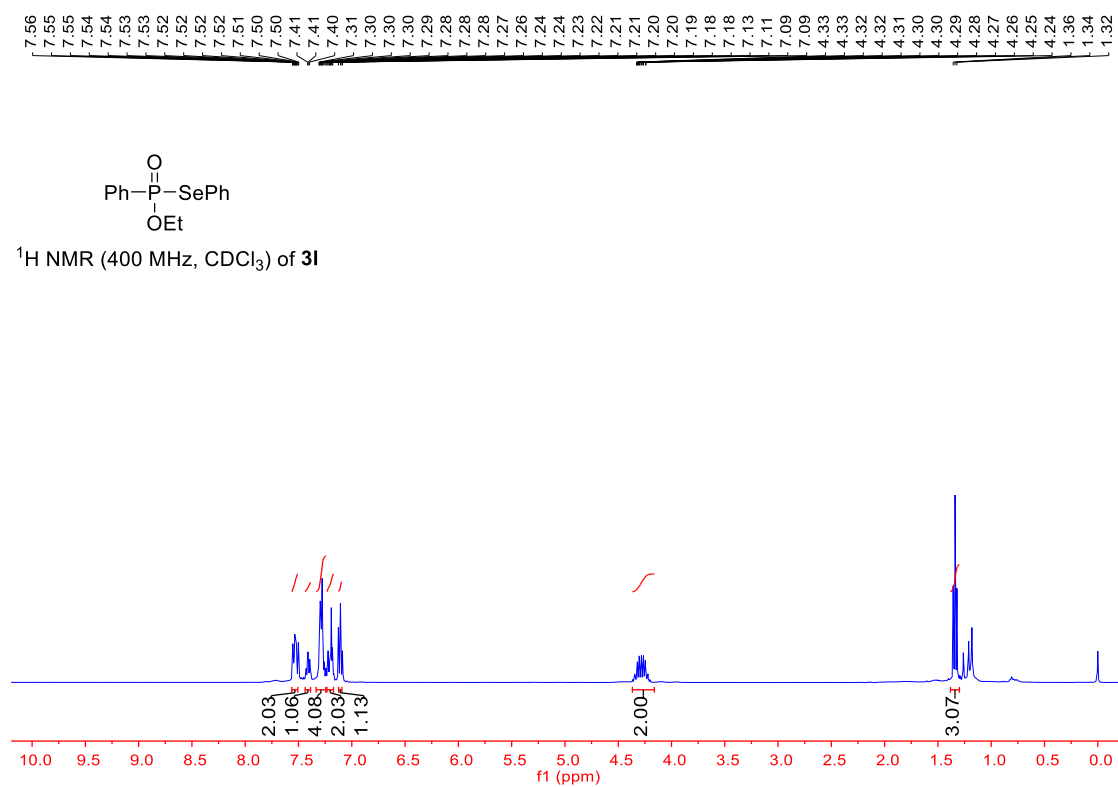


Figure S34: ¹H NMR spectrum for compound **3l**

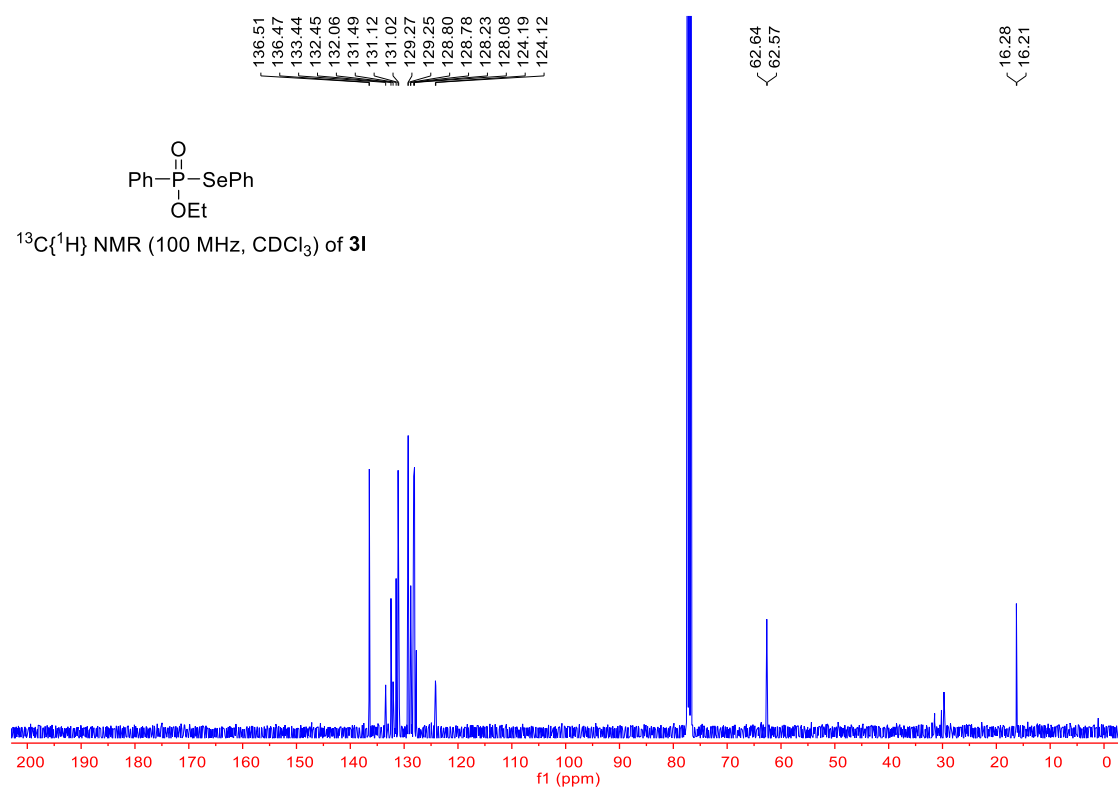


Figure S35: ^{13}C NMR spectrum for compound **3I**

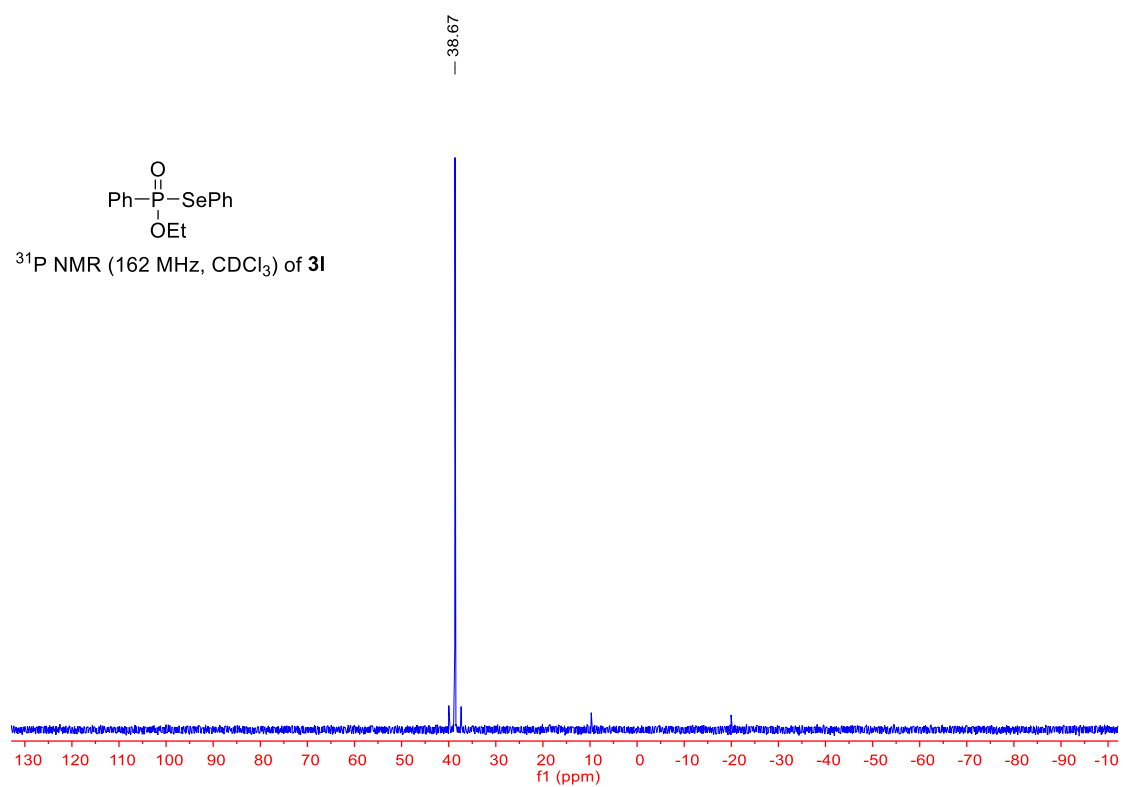


Figure S36: ^{31}P NMR spectrum for compound **3I**

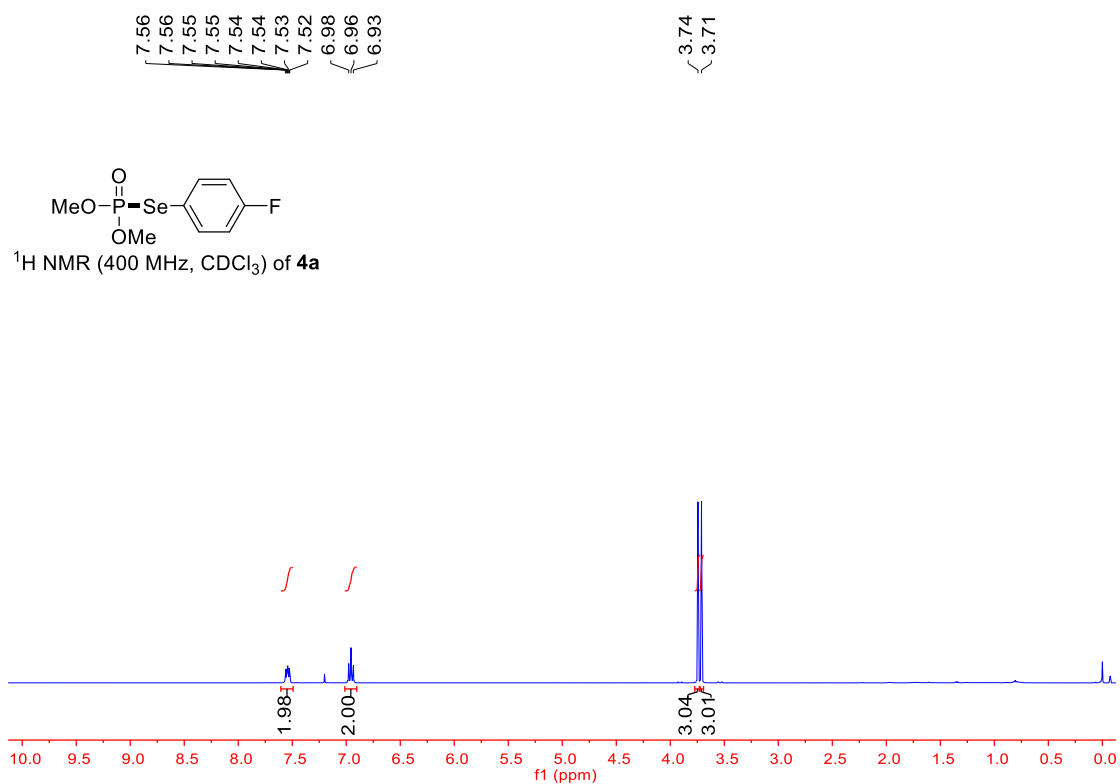


Figure S37: ^1H NMR spectrum for compound **4a**

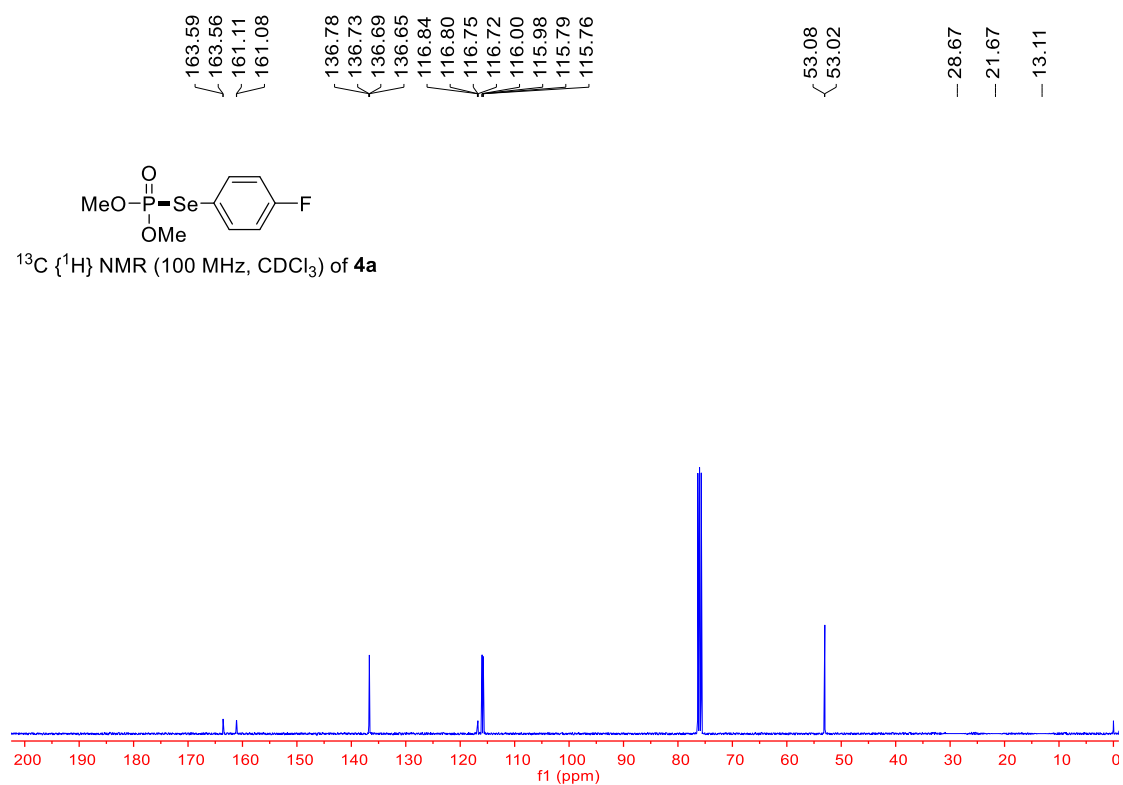


Figure S38: ^{13}C NMR spectrum for compound **4a**

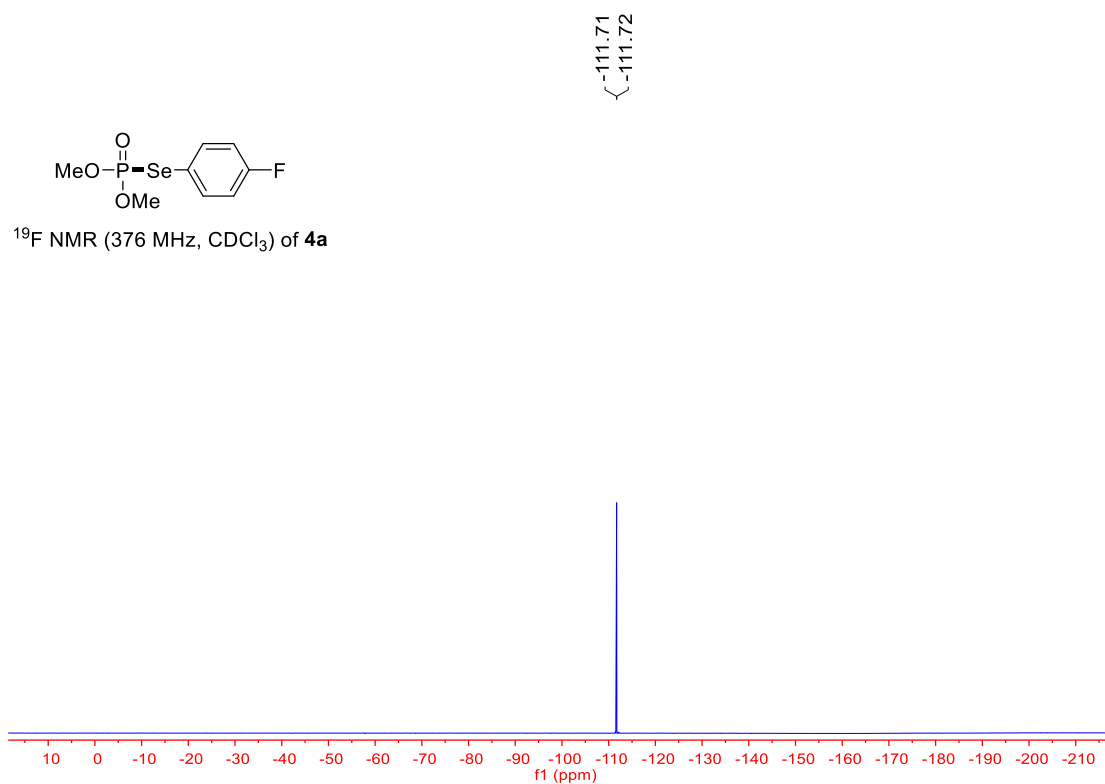


Figure S39: ^{19}F NMR spectrum for compound **4a**

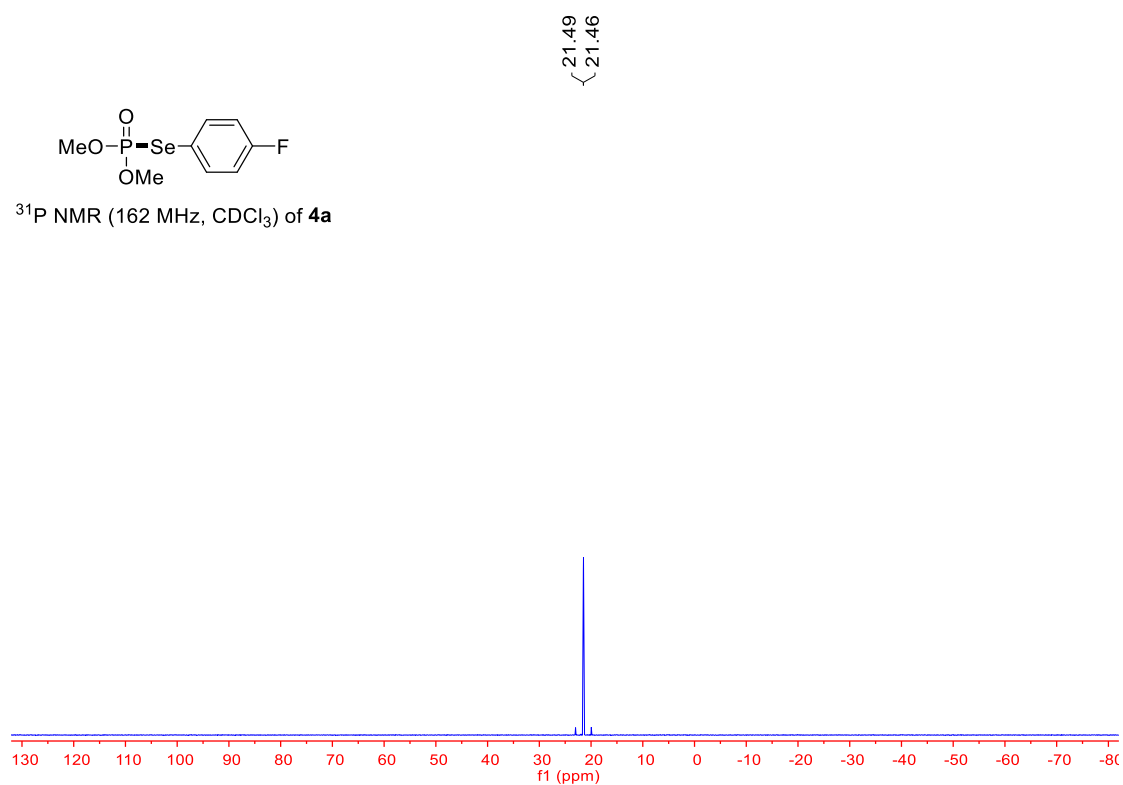


Figure S40: ^{31}P NMR spectrum for compound **4a**

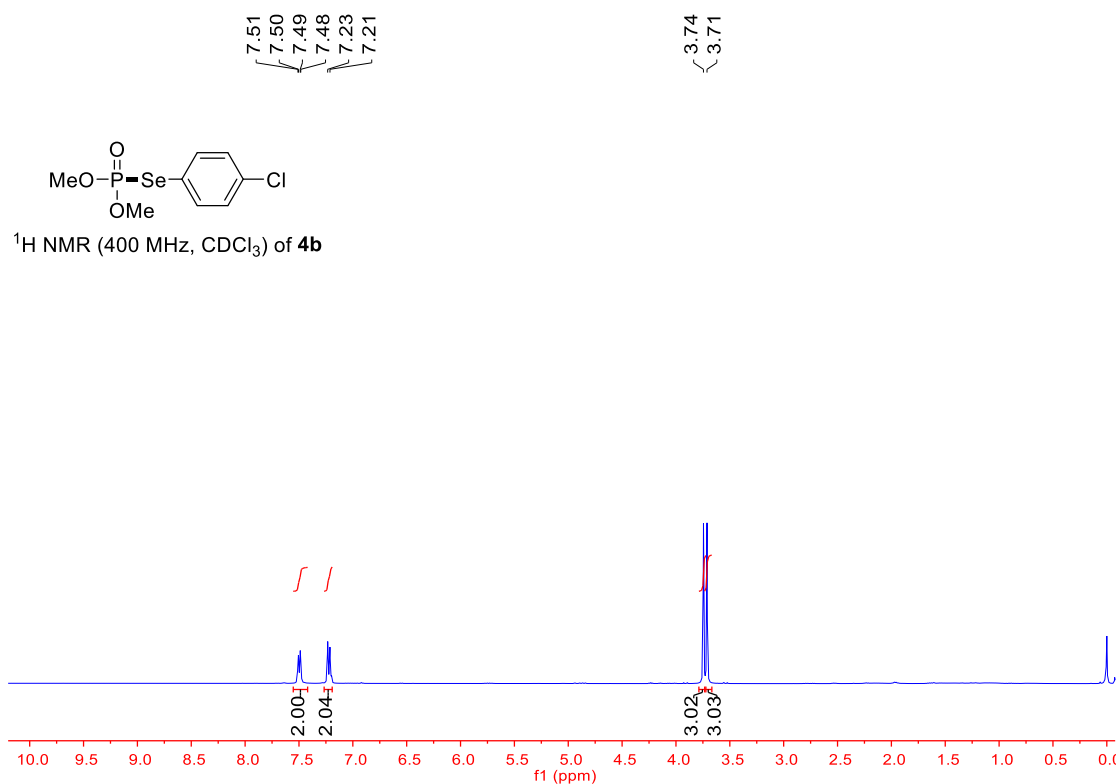


Figure S41: ¹H NMR spectrum for compound **4b**

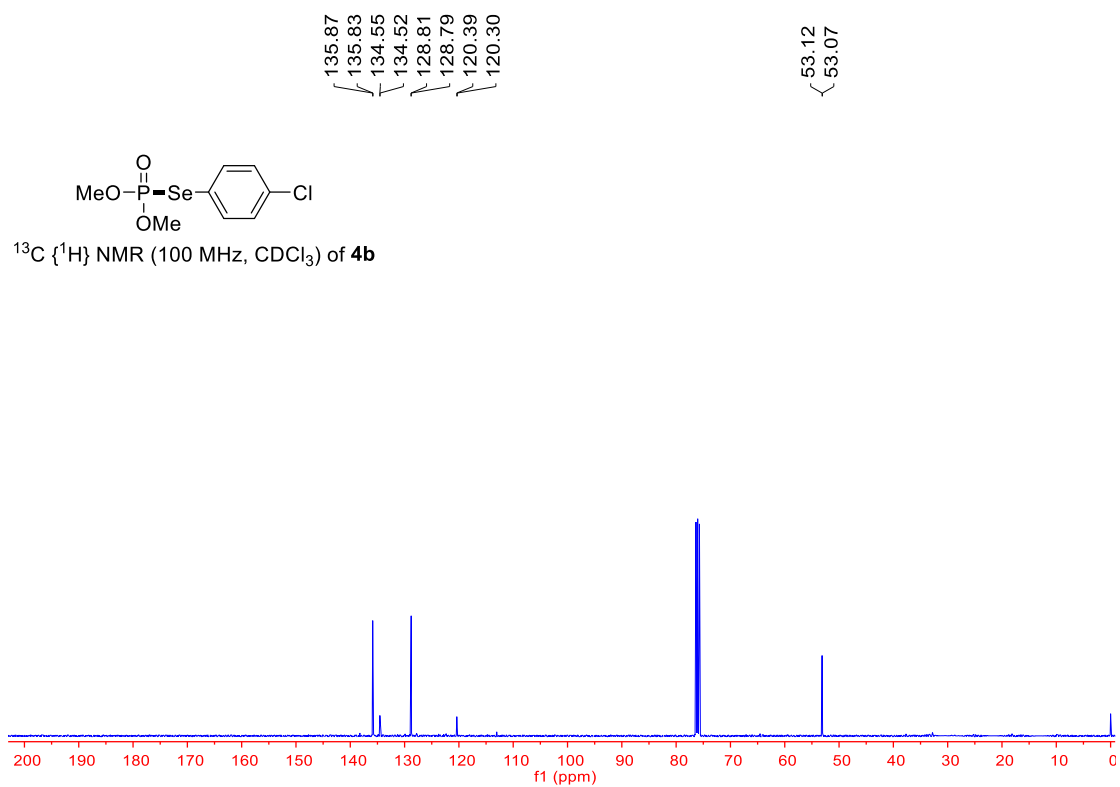


Figure S42: ¹³C NMR spectrum for compound **4b**

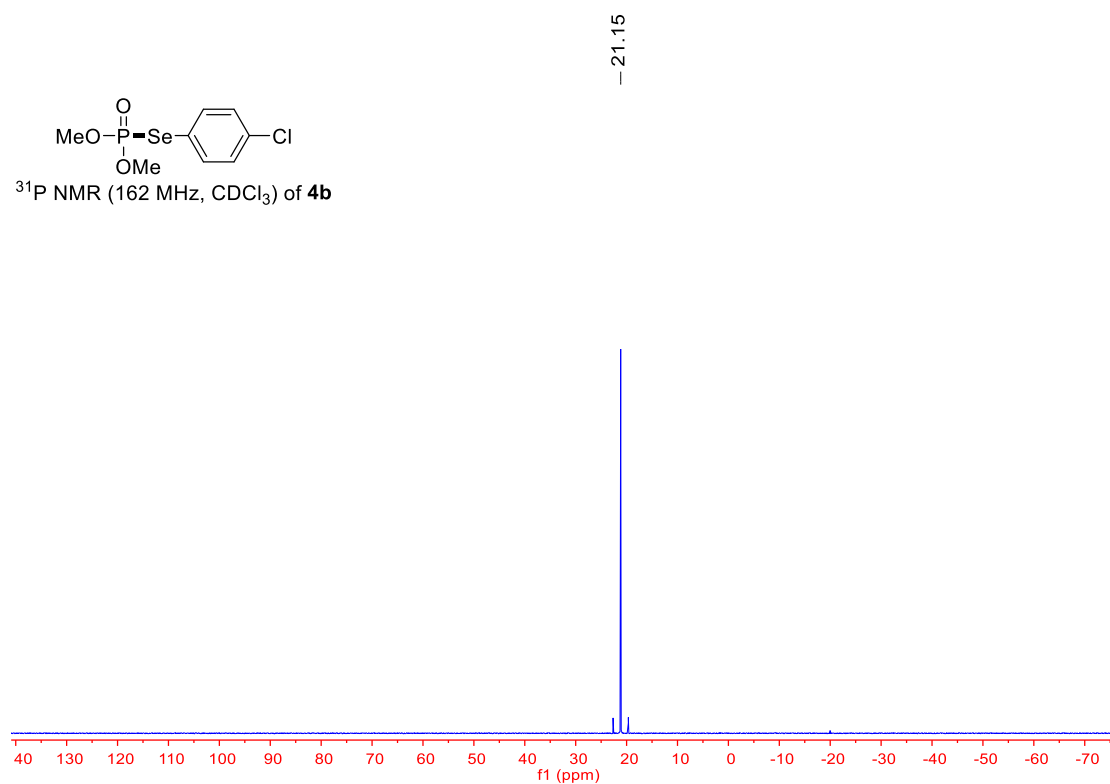


Figure S43: ^{31}P NMR spectrum for compound **4b**

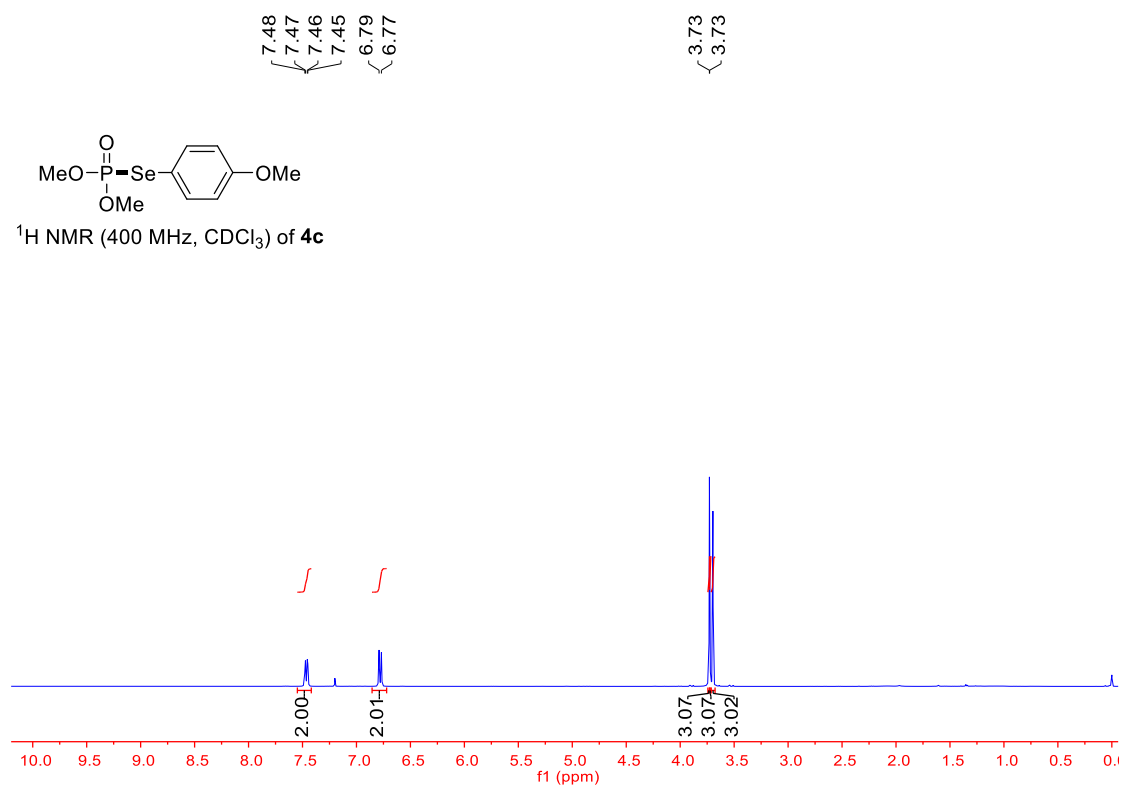


Figure S44: ^1H NMR spectrum for compound **4c**

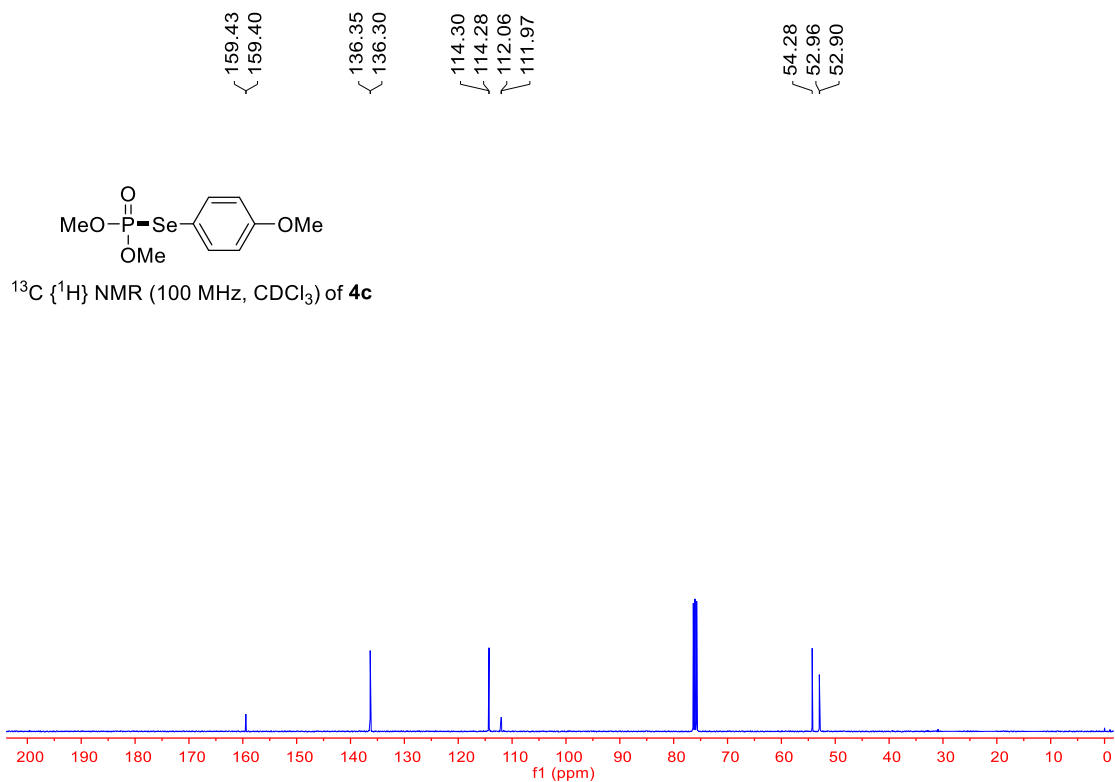


Figure S45: ^{13}C NMR spectrum for compound **4c**

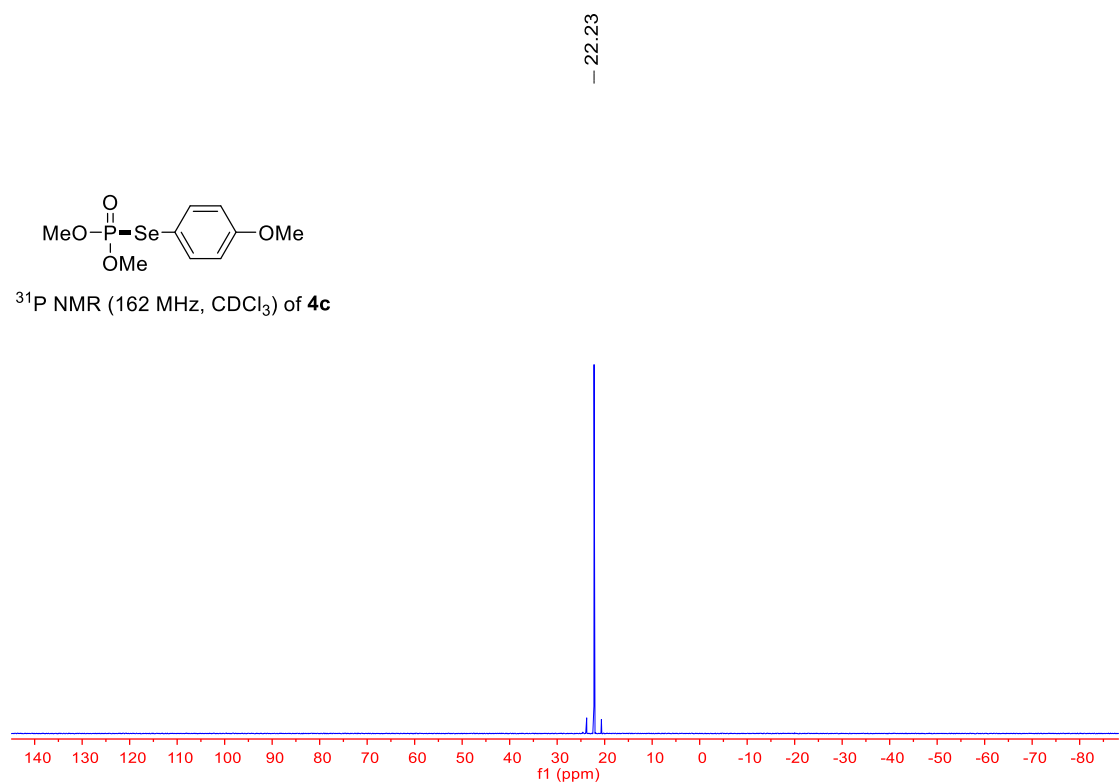


Figure S46: ^{31}P NMR spectrum for compound **4c**

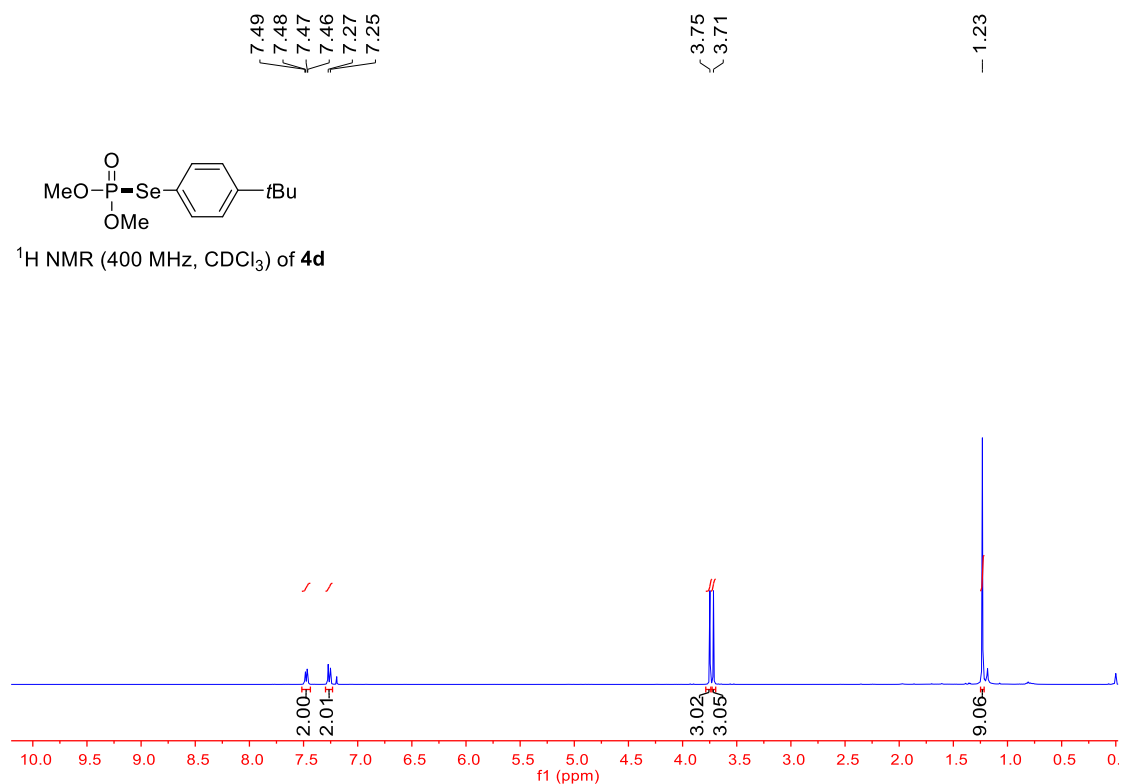


Figure S47: ^1H NMR spectrum for compound **4d**

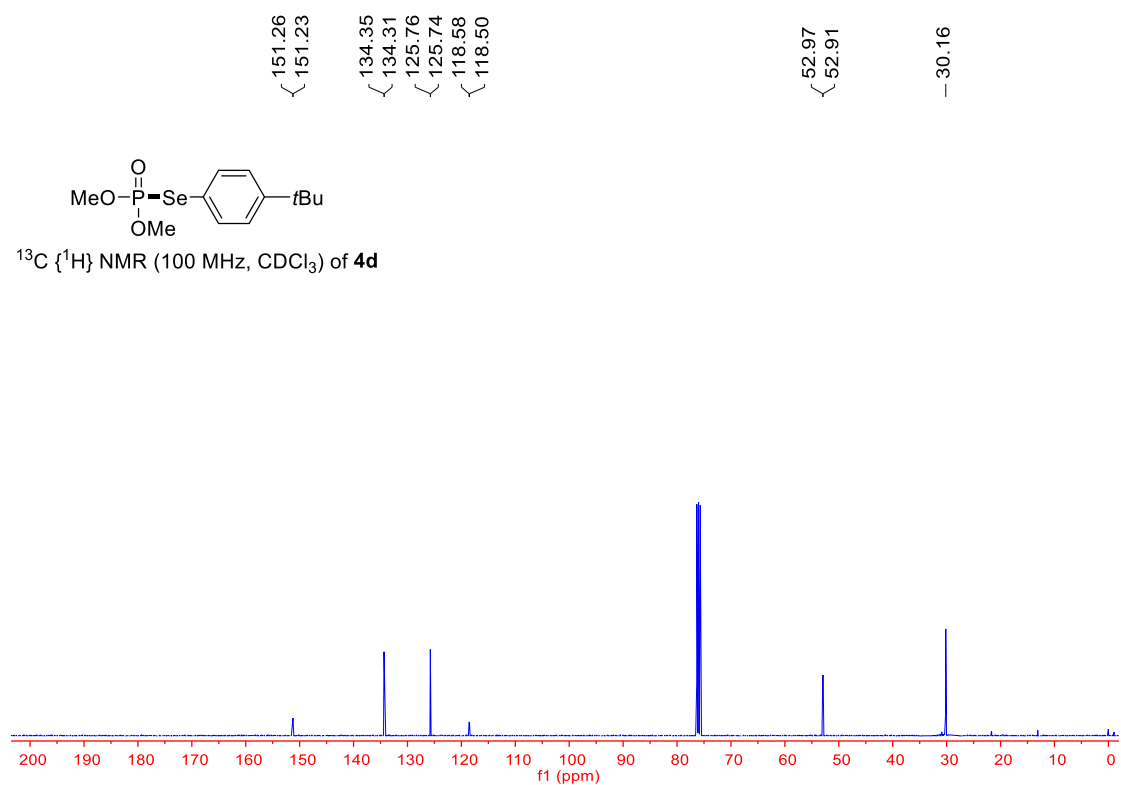


Figure S48: ^{13}C NMR spectrum for compound **4d**

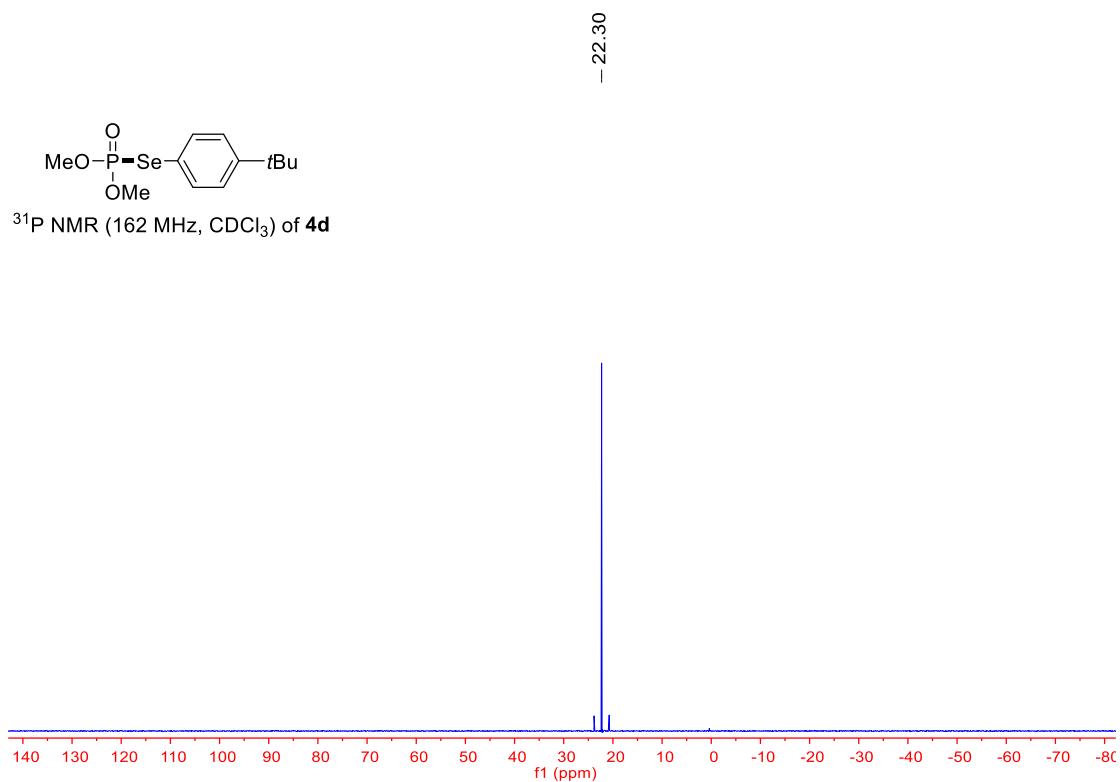
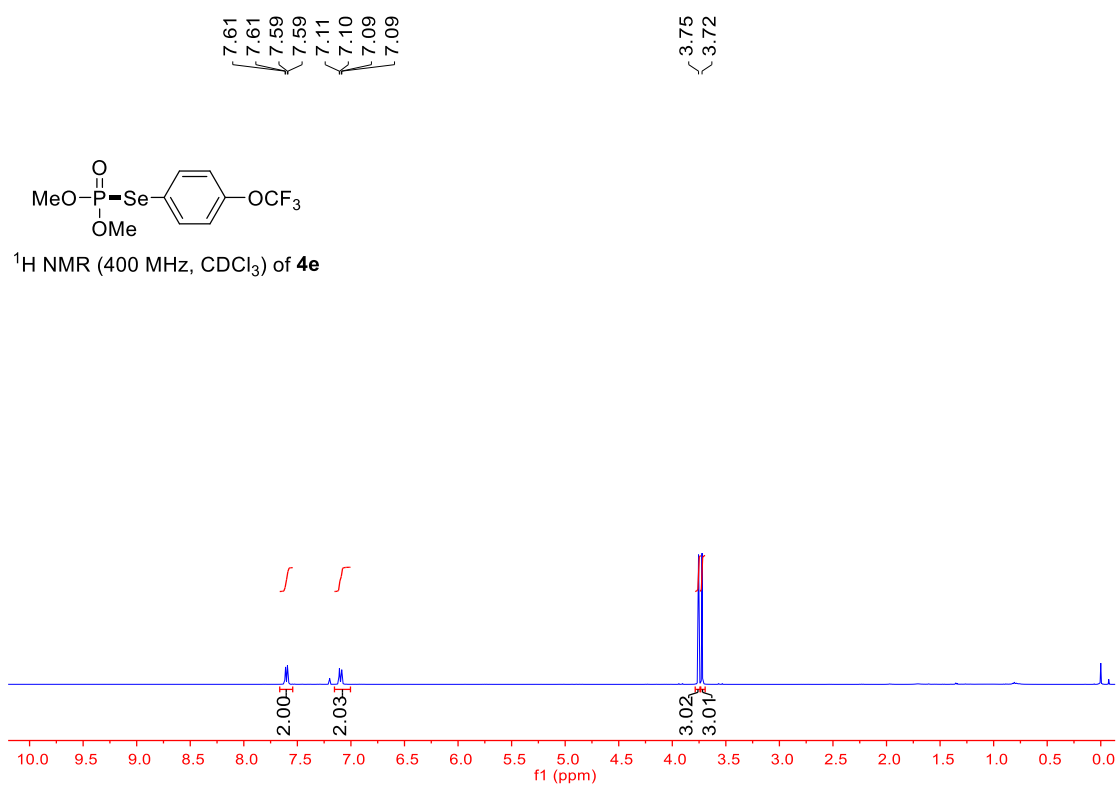


Figure S49: ³¹P NMR spectrum for compound **4d**



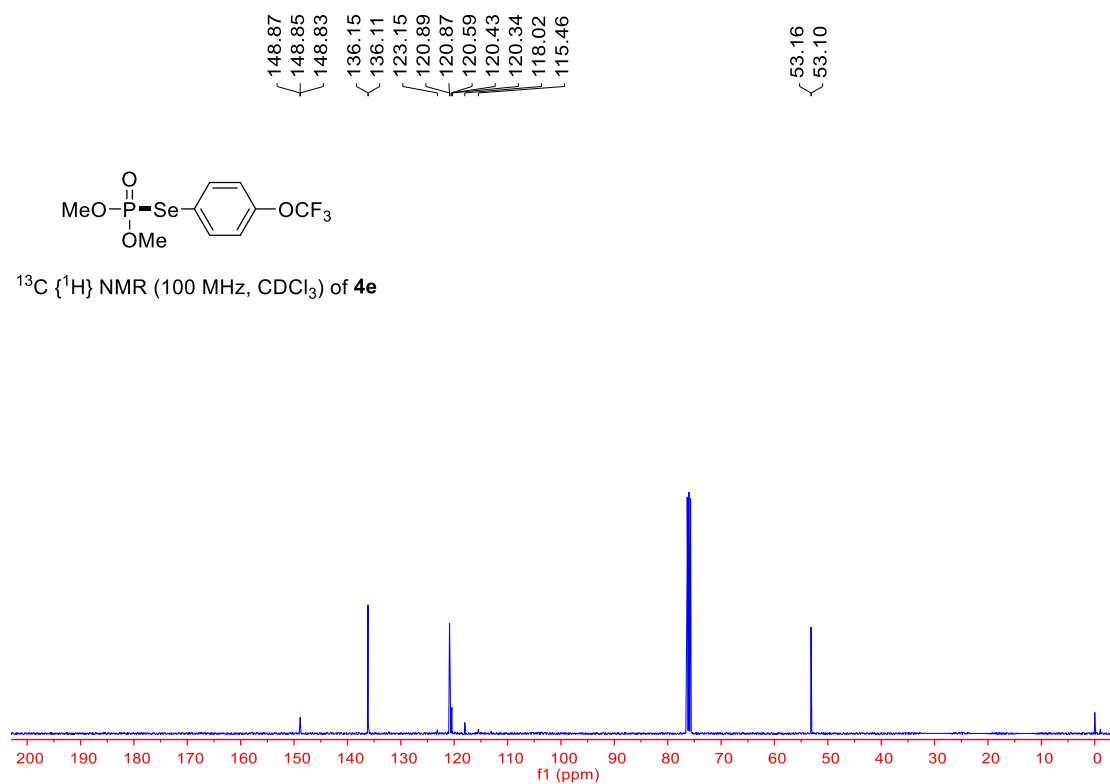


Figure S51: ^{13}C NMR spectrum for compound **4e**

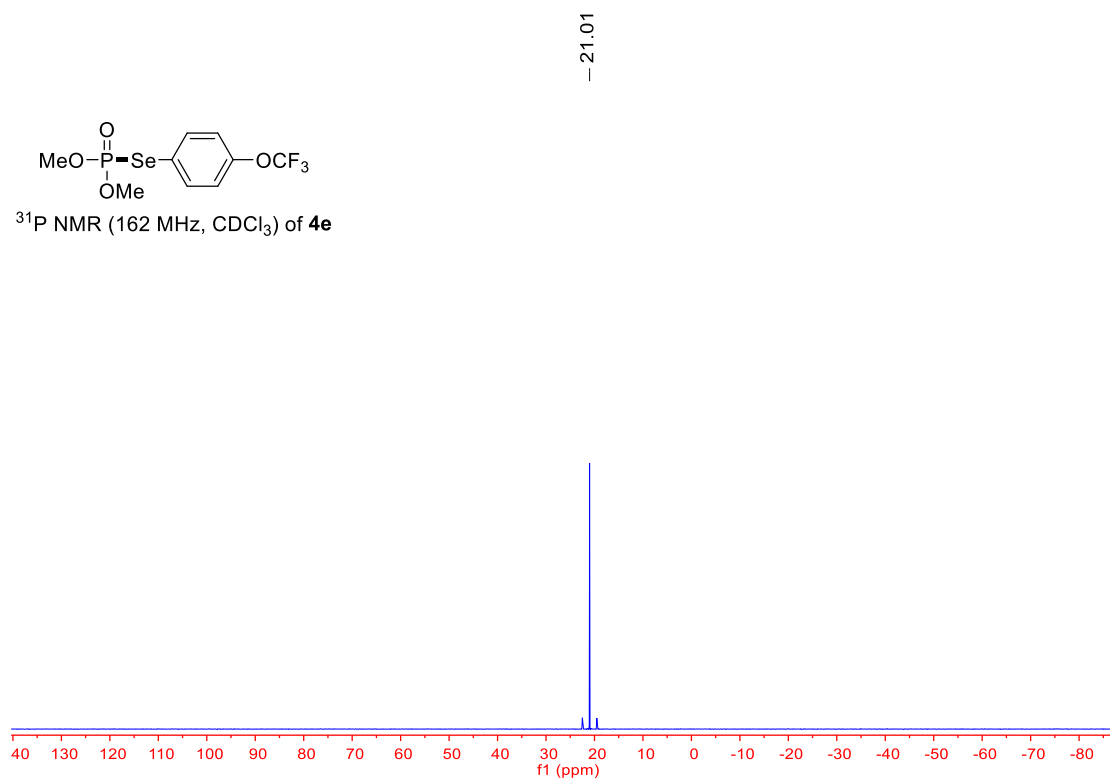


Figure S52: ^{31}P NMR spectrum for compound **4e**

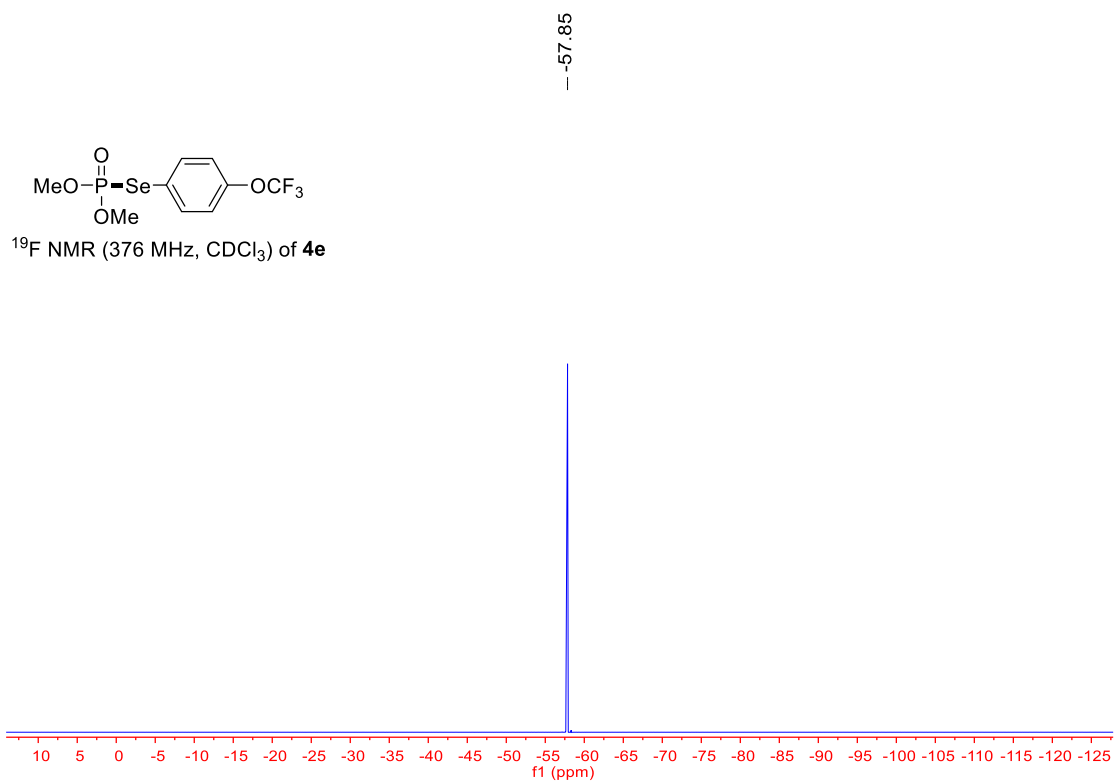


Figure S53: ¹⁹F NMR spectrum for compound **4e**

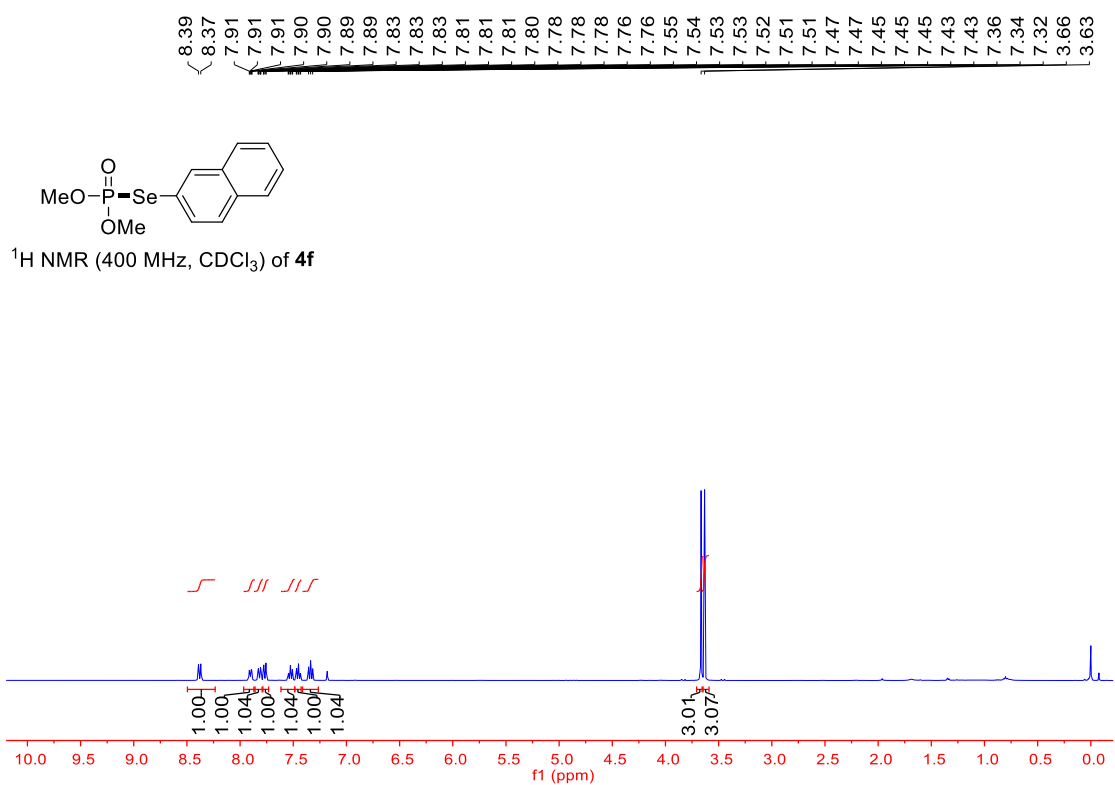


Figure S54: ¹H NMR spectrum for compound **4f**

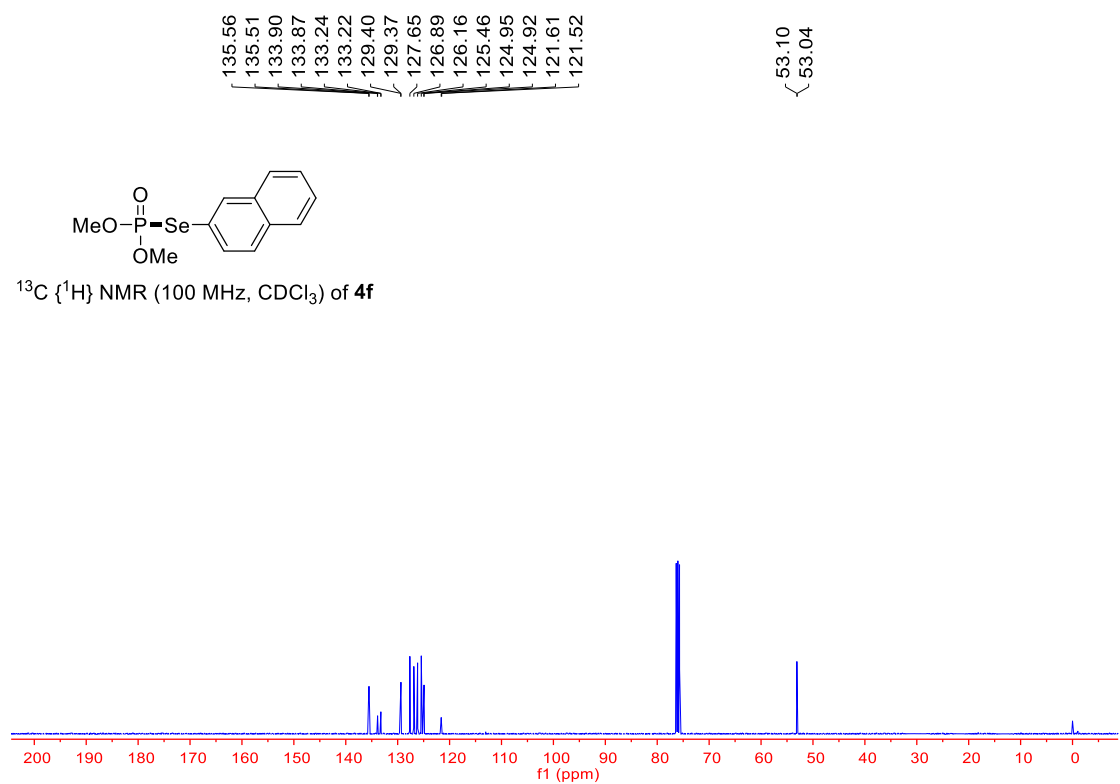


Figure S55: ^{13}C NMR spectrum for compound **4f**

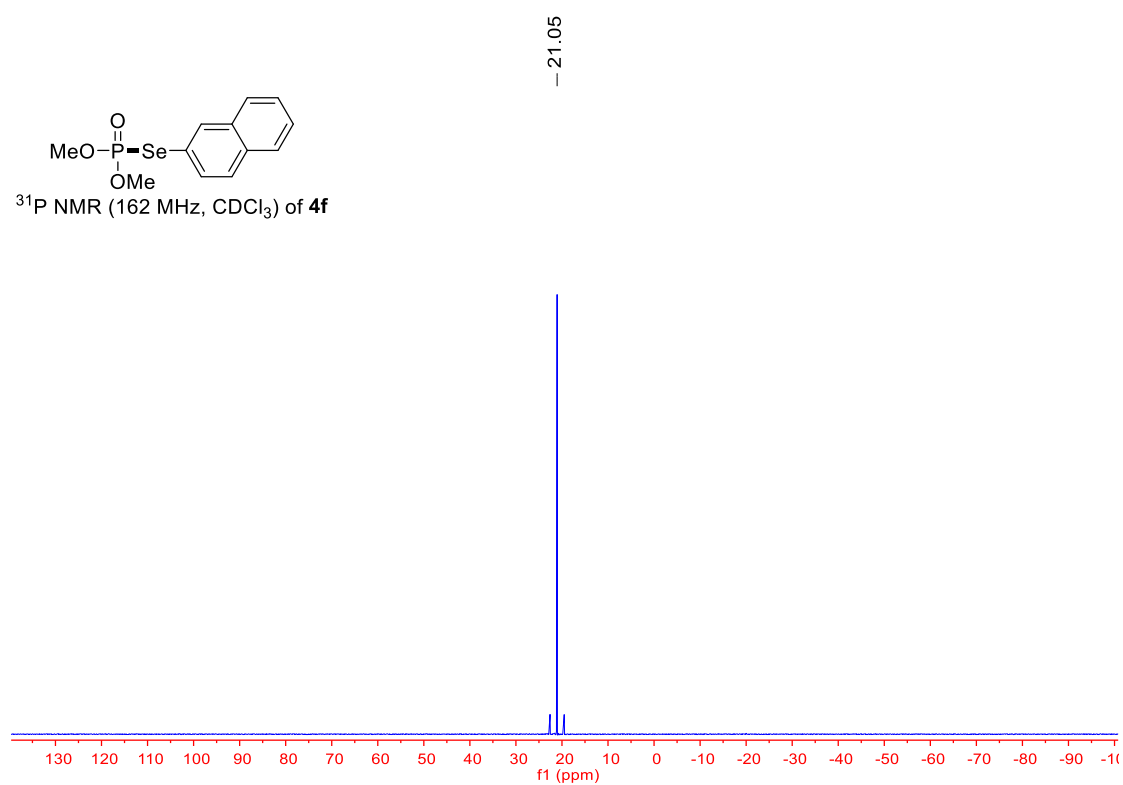


Figure S56: ^{31}P NMR spectrum for compound **4f**

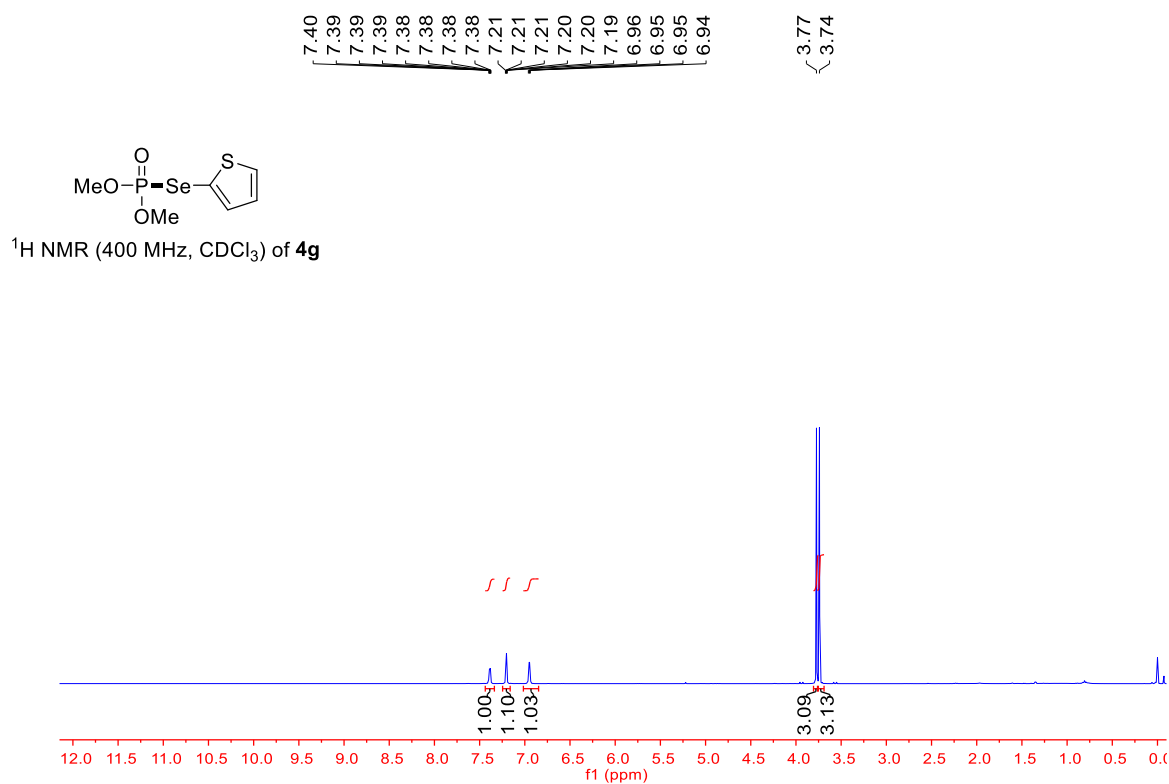


Figure S57: ¹H NMR spectrum for compound **4g**

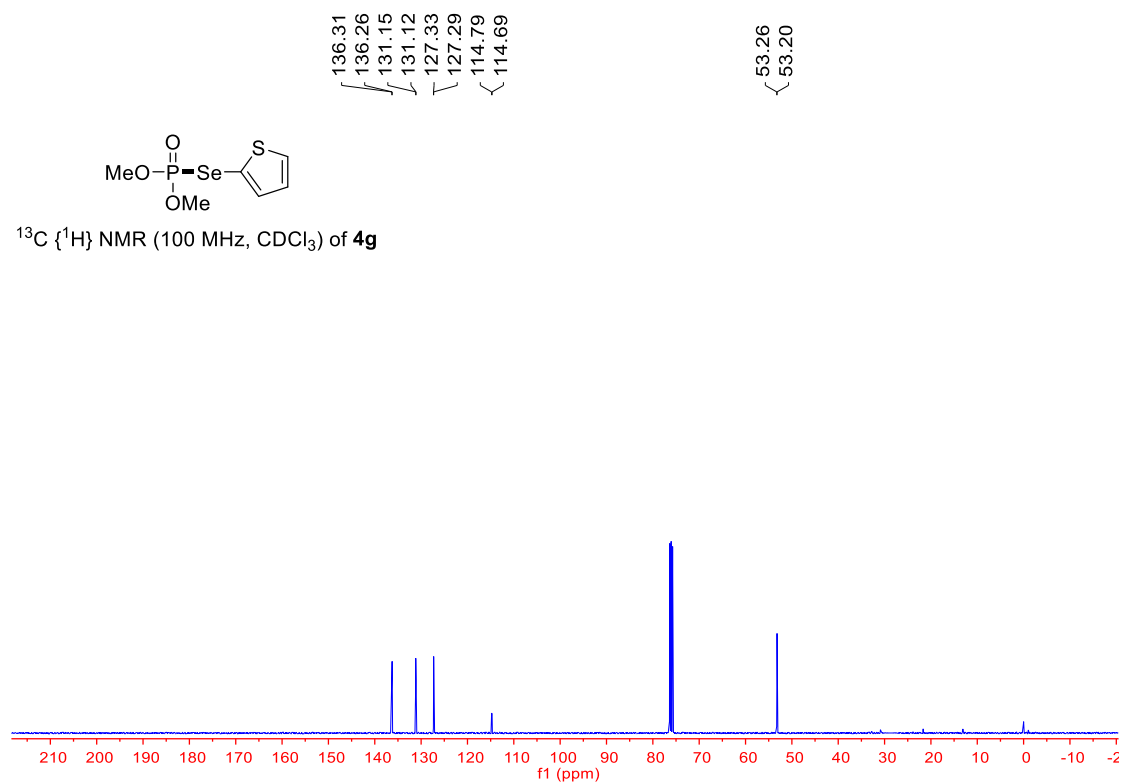


Figure S58: ¹³C NMR spectrum for compound **4g**

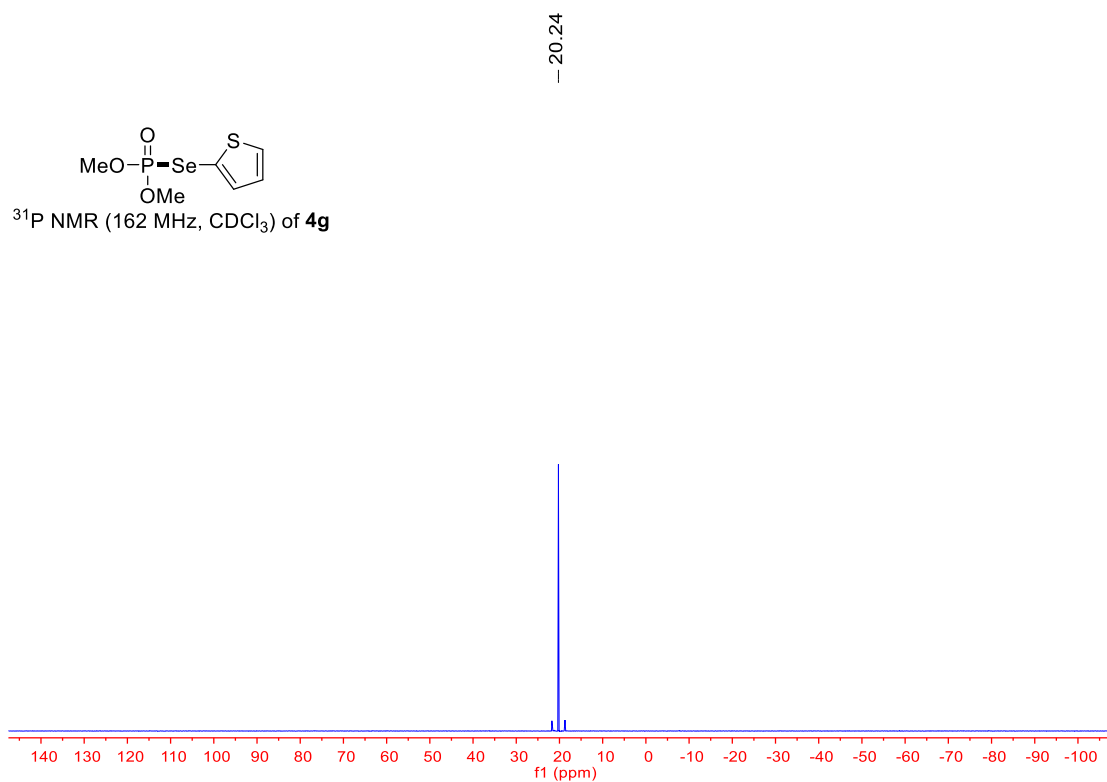


Figure S59: ³¹P NMR spectrum for compound **4g**

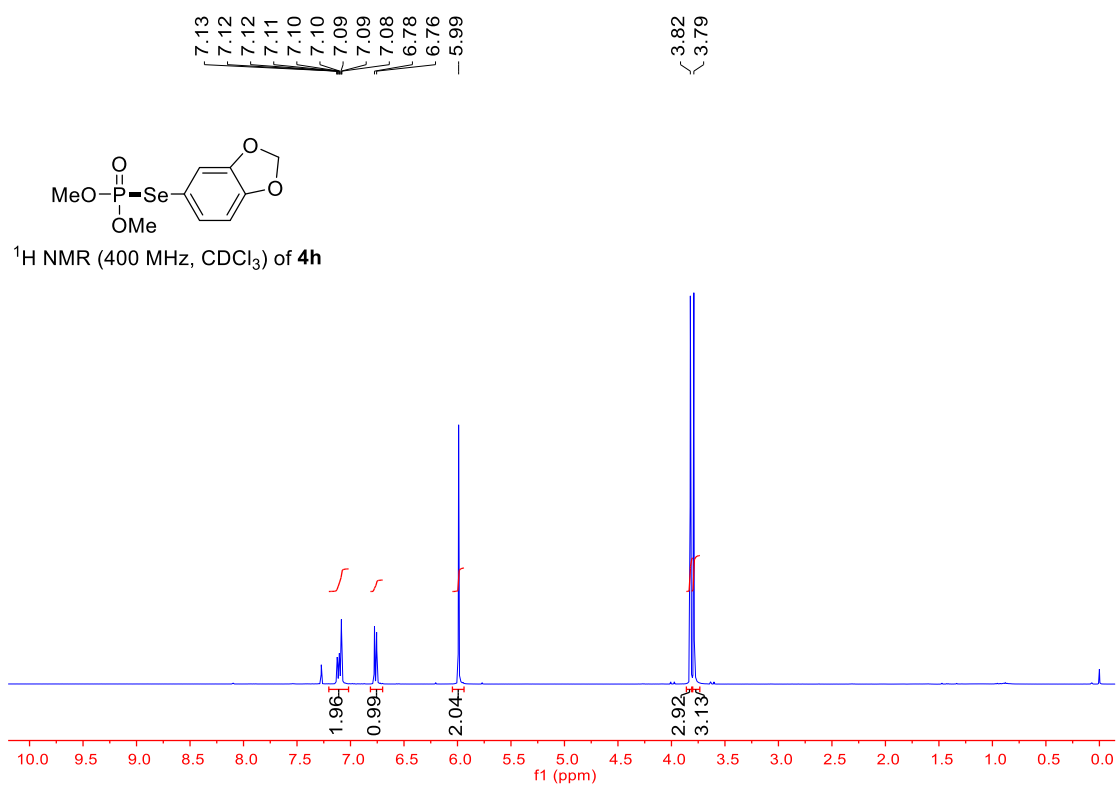


Figure S60: ¹H NMR spectrum for compound **4h**

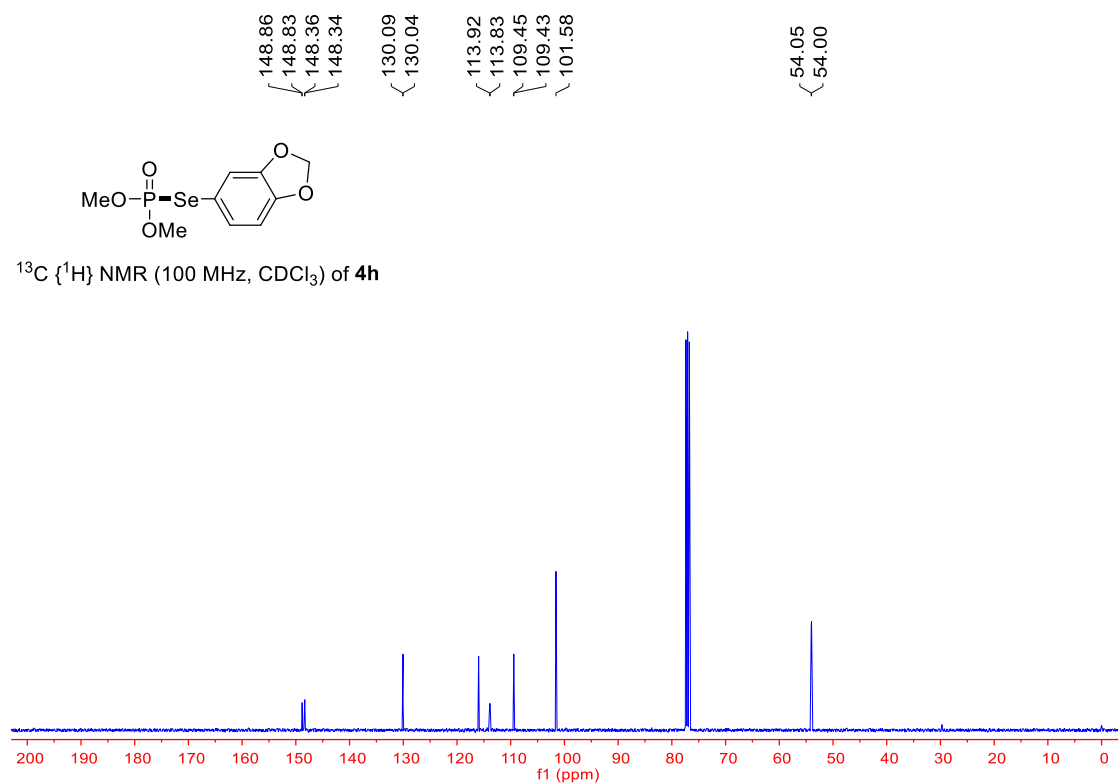


Figure S61: ^{13}C NMR spectrum for compound **4h**

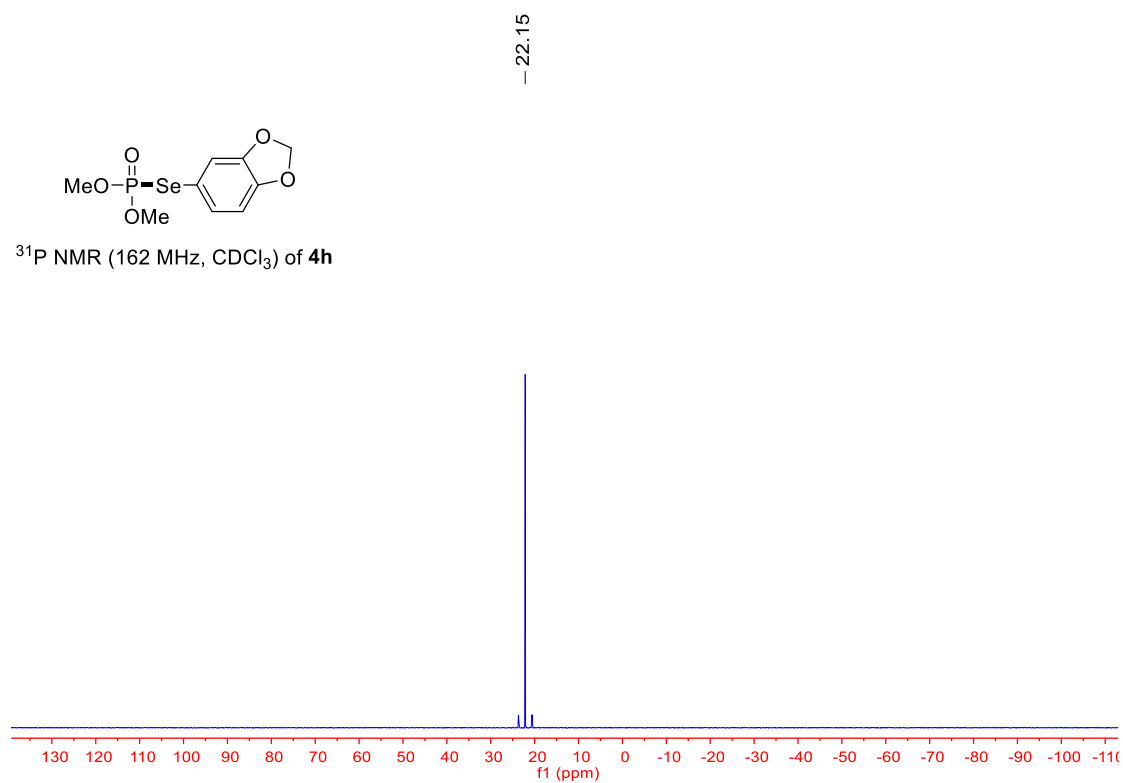


Figure S62: ^{31}P NMR spectrum for compound **4h**

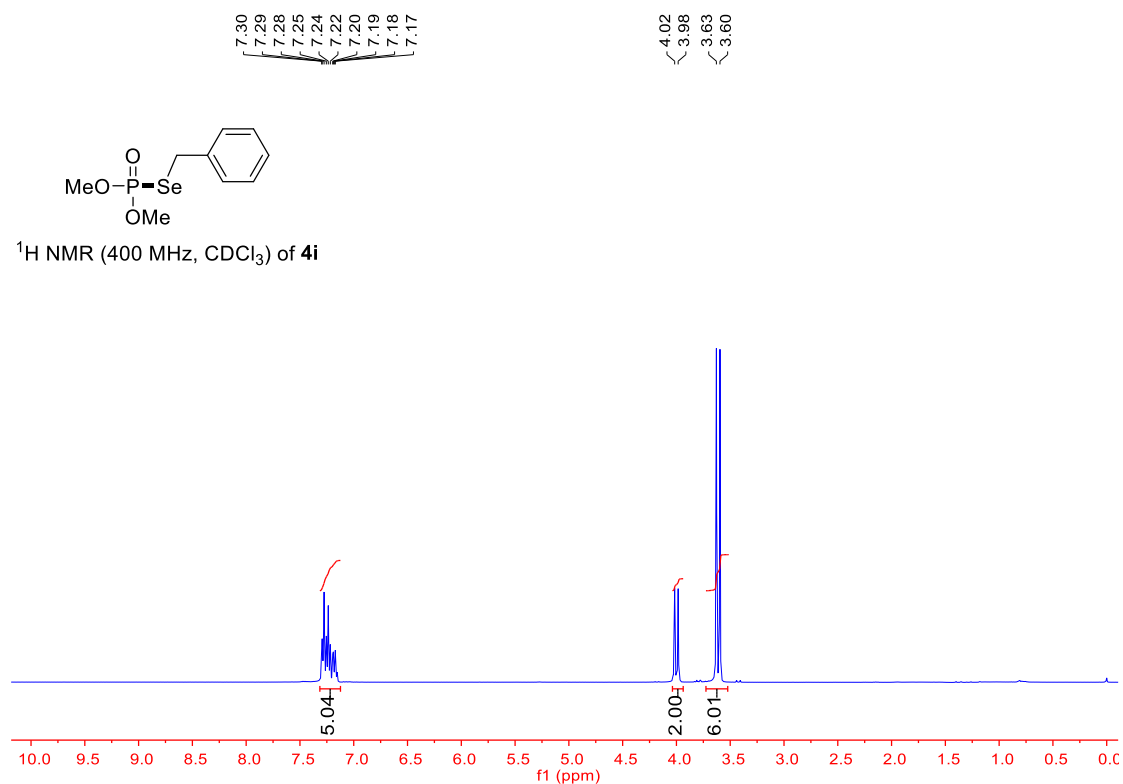


Figure S63: ¹H NMR spectrum for compound **4i**

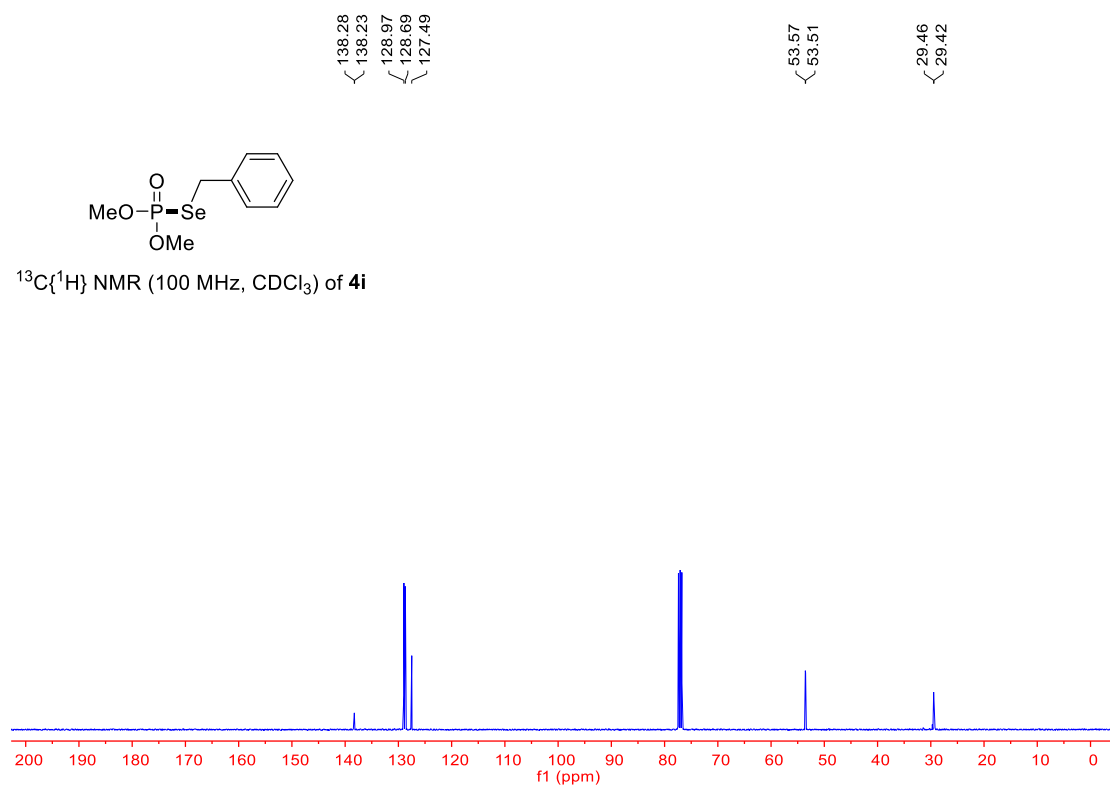


Figure S64: ¹³C NMR spectrum for compound **4i**

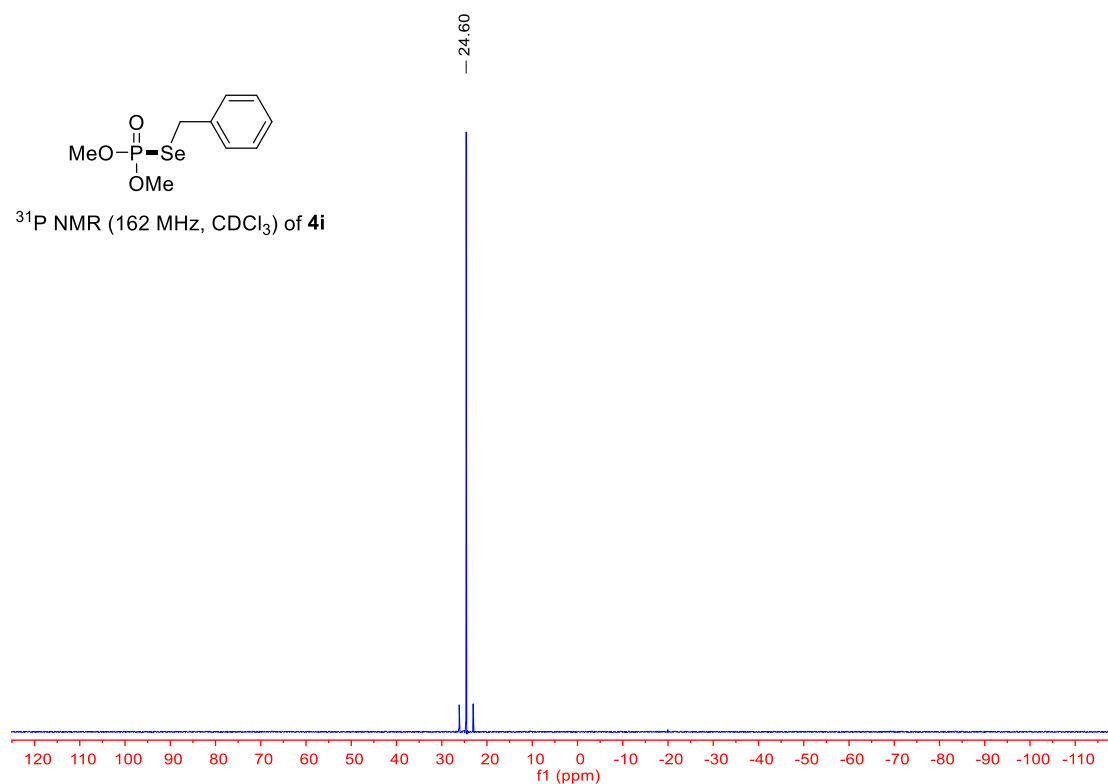


Figure S65: ³¹P NMR spectrum for compound **4i**

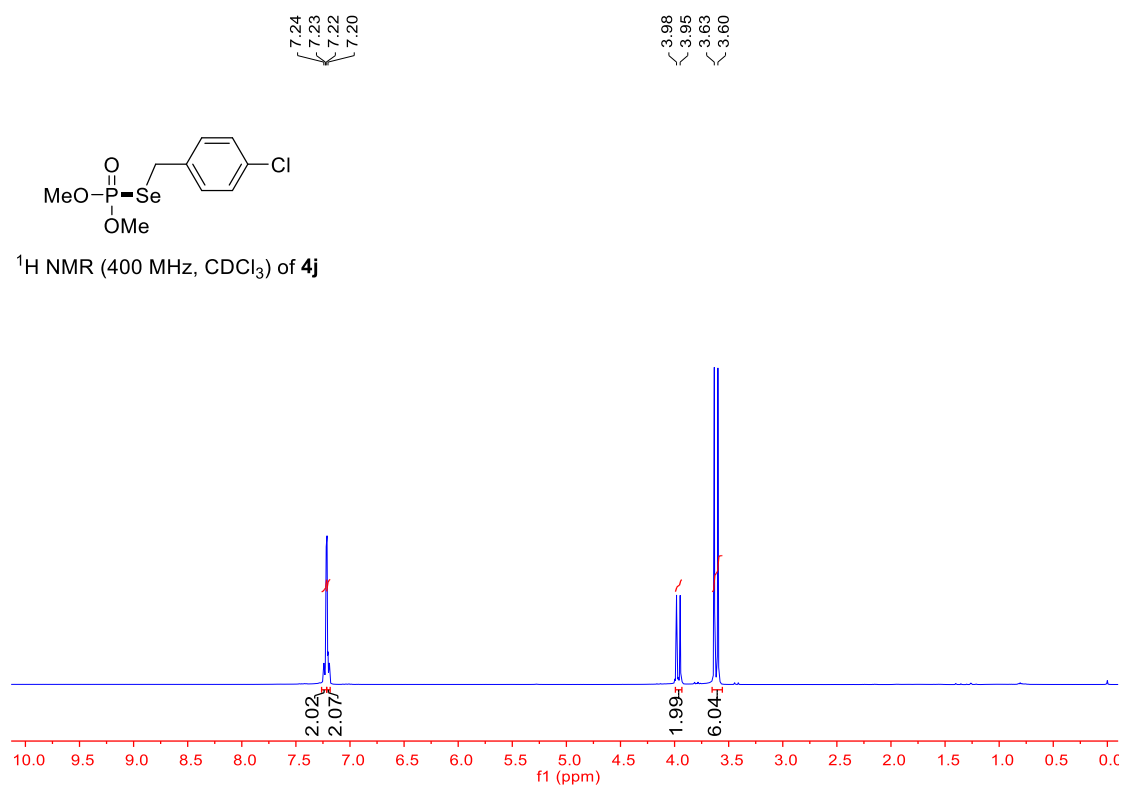


Figure S66: ¹H NMR spectrum for compound **4j**

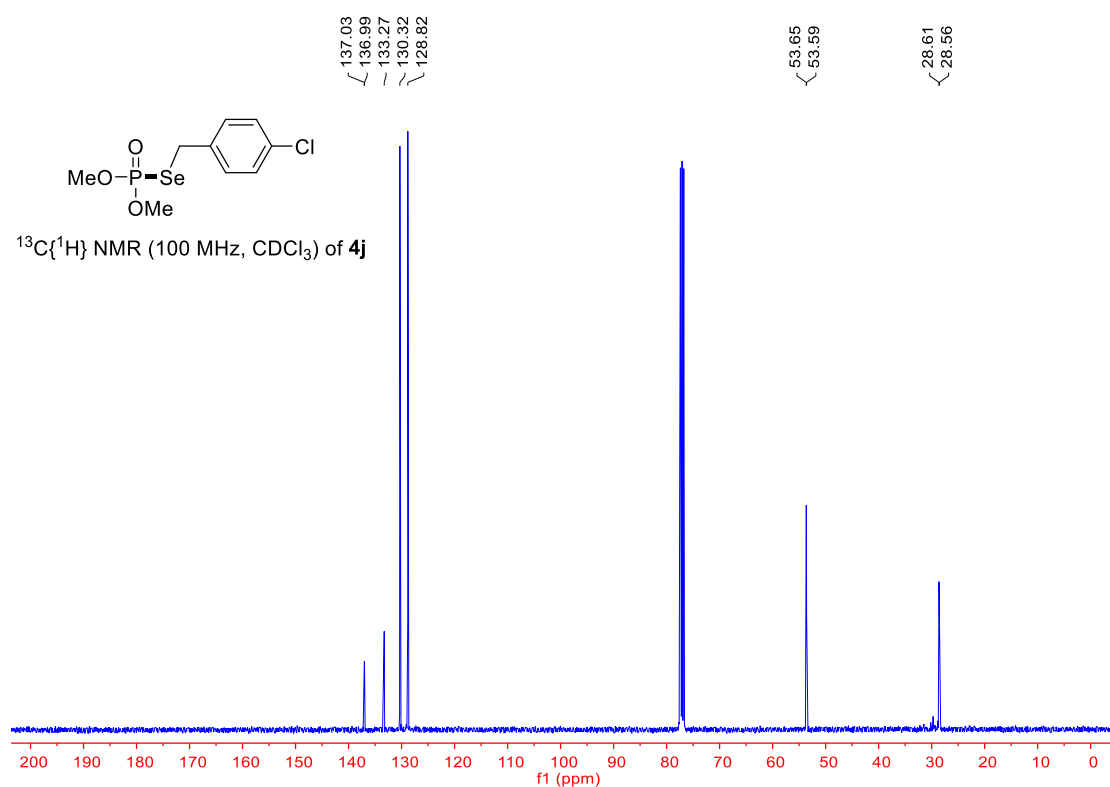


Figure S67: ^{13}C NMR spectrum for compound **4j**

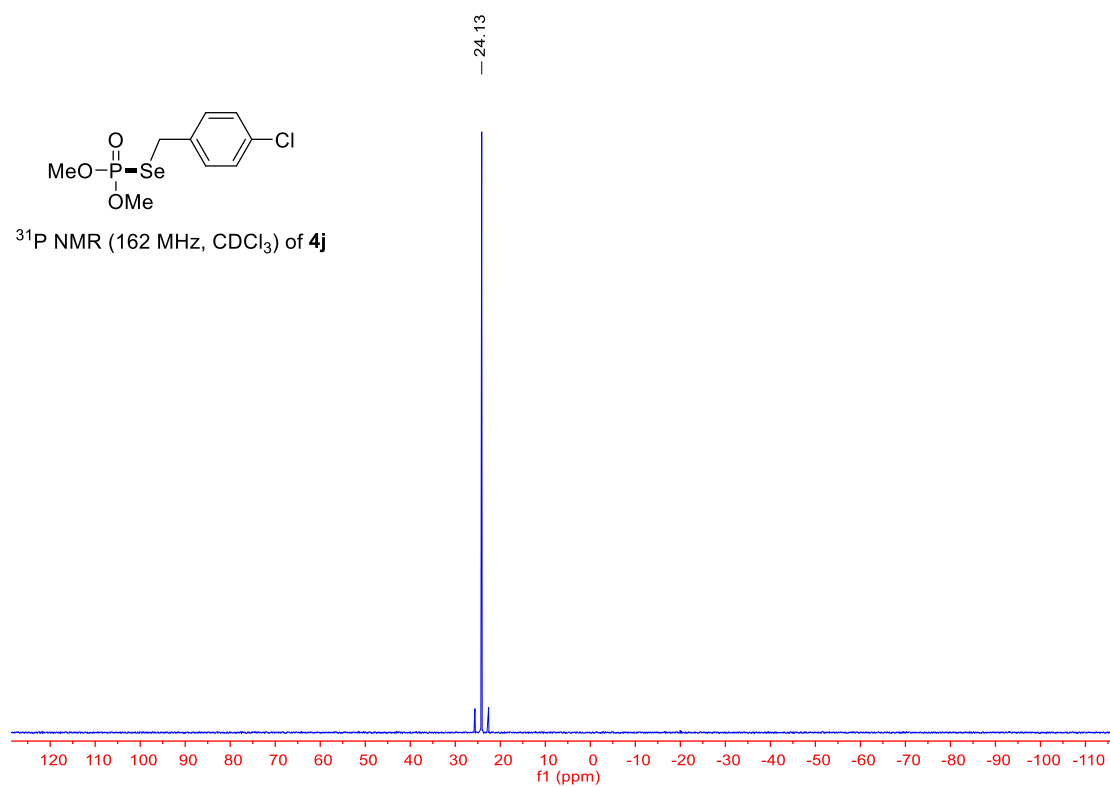


Figure S68: ^{31}P NMR spectrum for compound **4j**

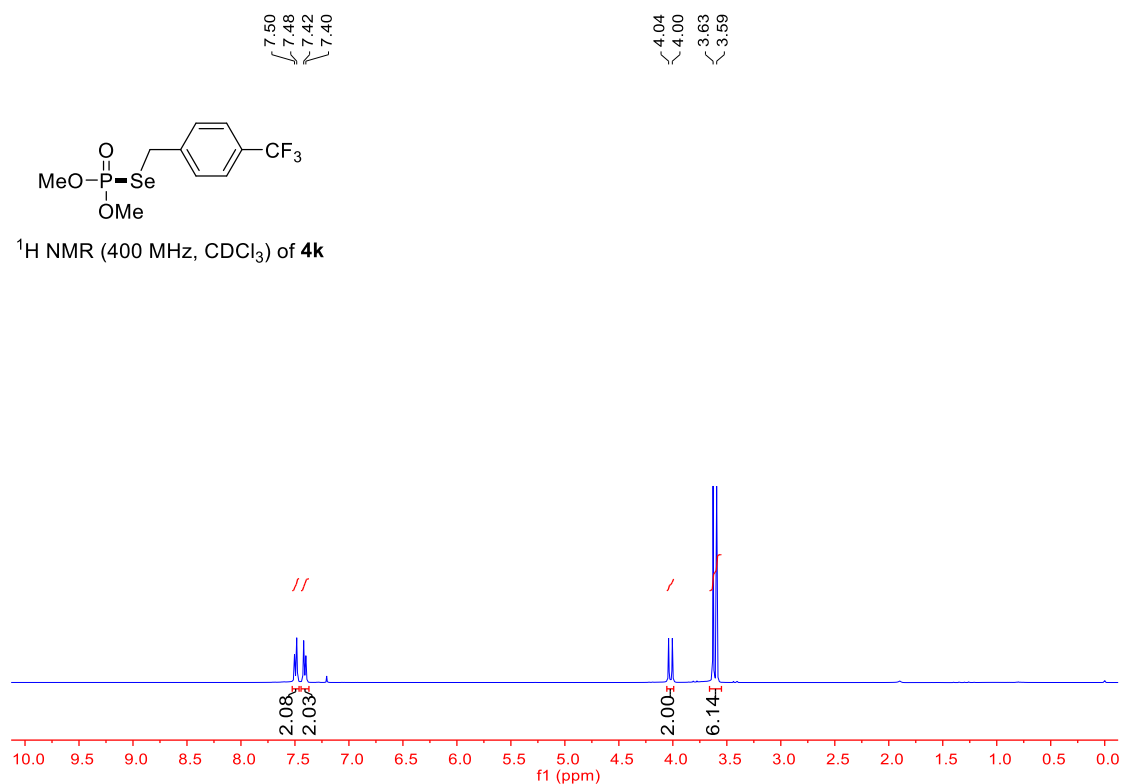


Figure S69: ^1H NMR spectrum for compound **4k**

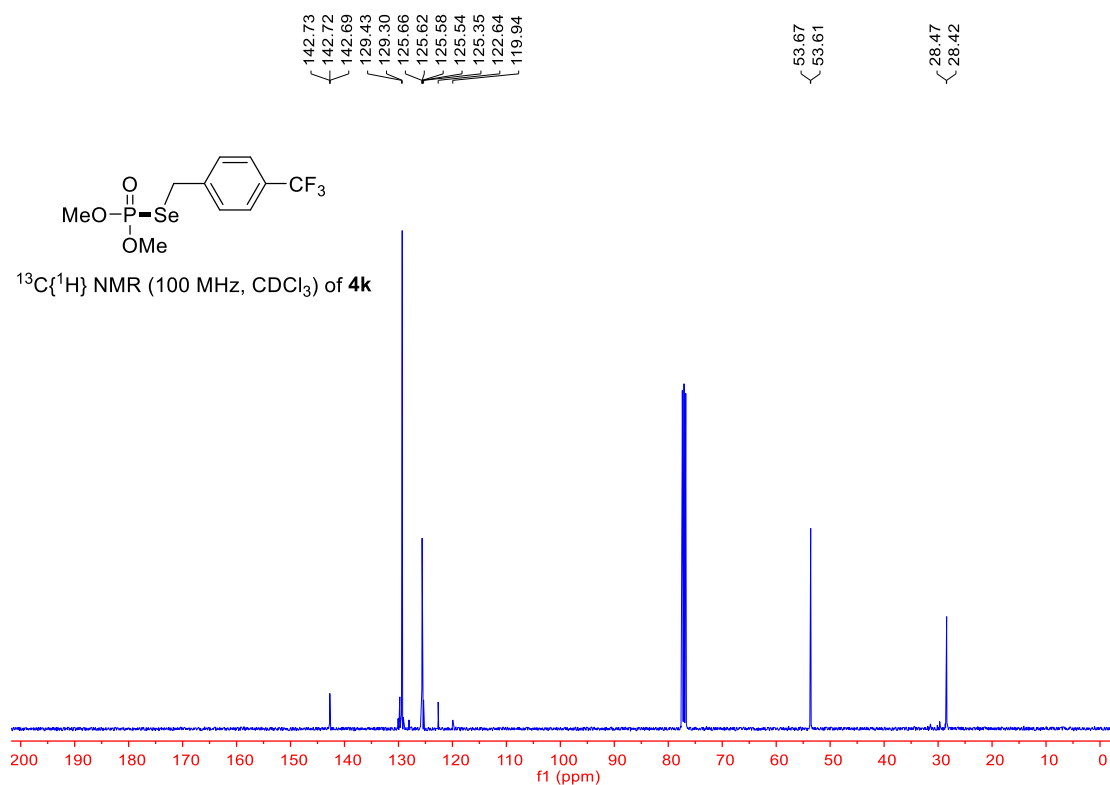


Figure S70: ^{13}C NMR spectrum for compound **4k**

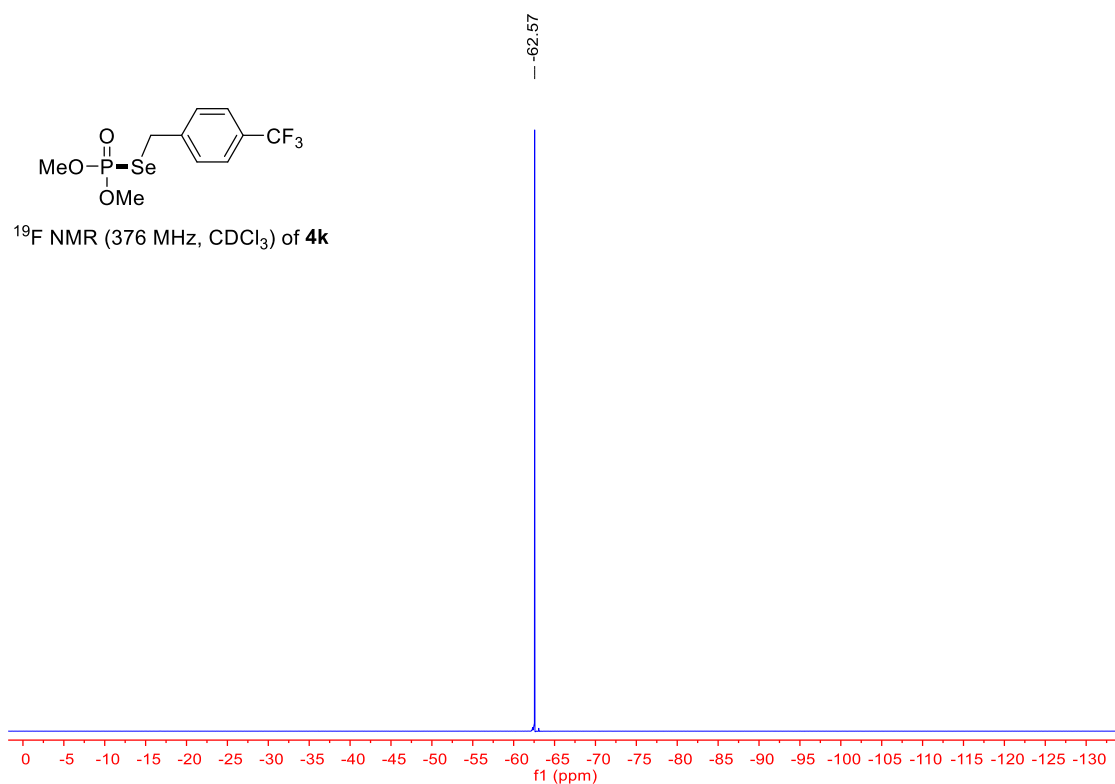


Figure S71: ^{19}F NMR spectrum for compound **4k**

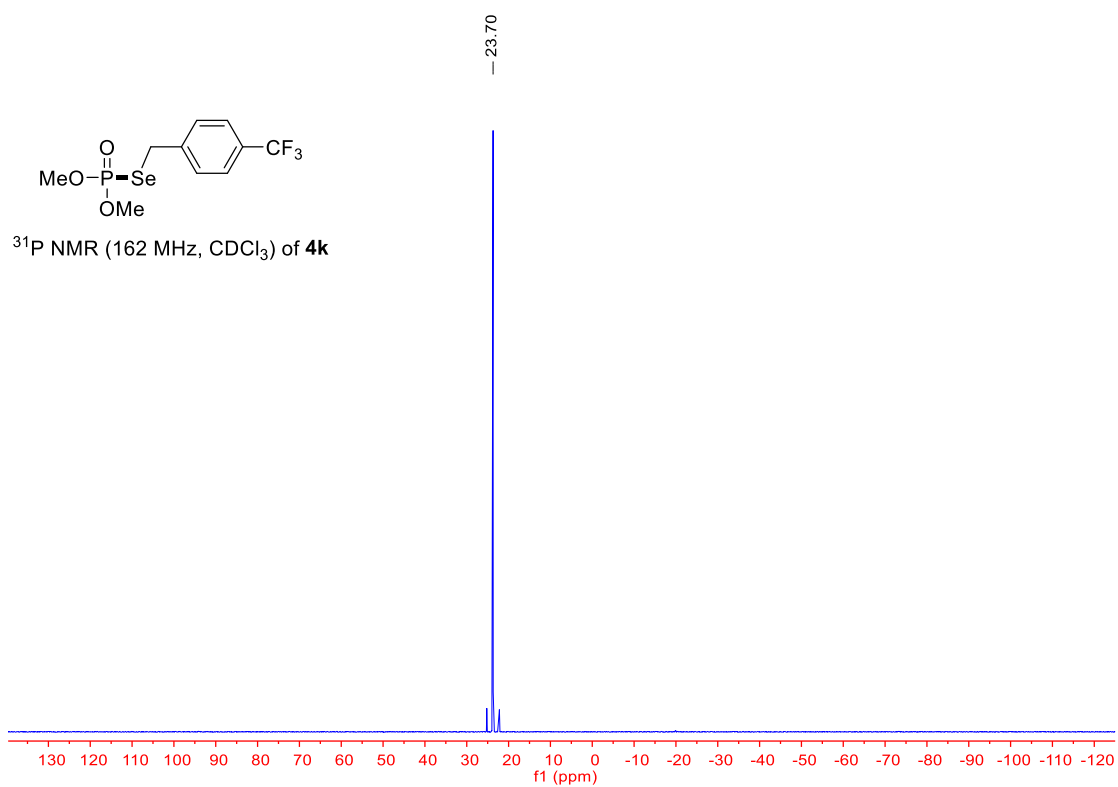


Figure S72: ^{31}P NMR spectrum for compound **4k**

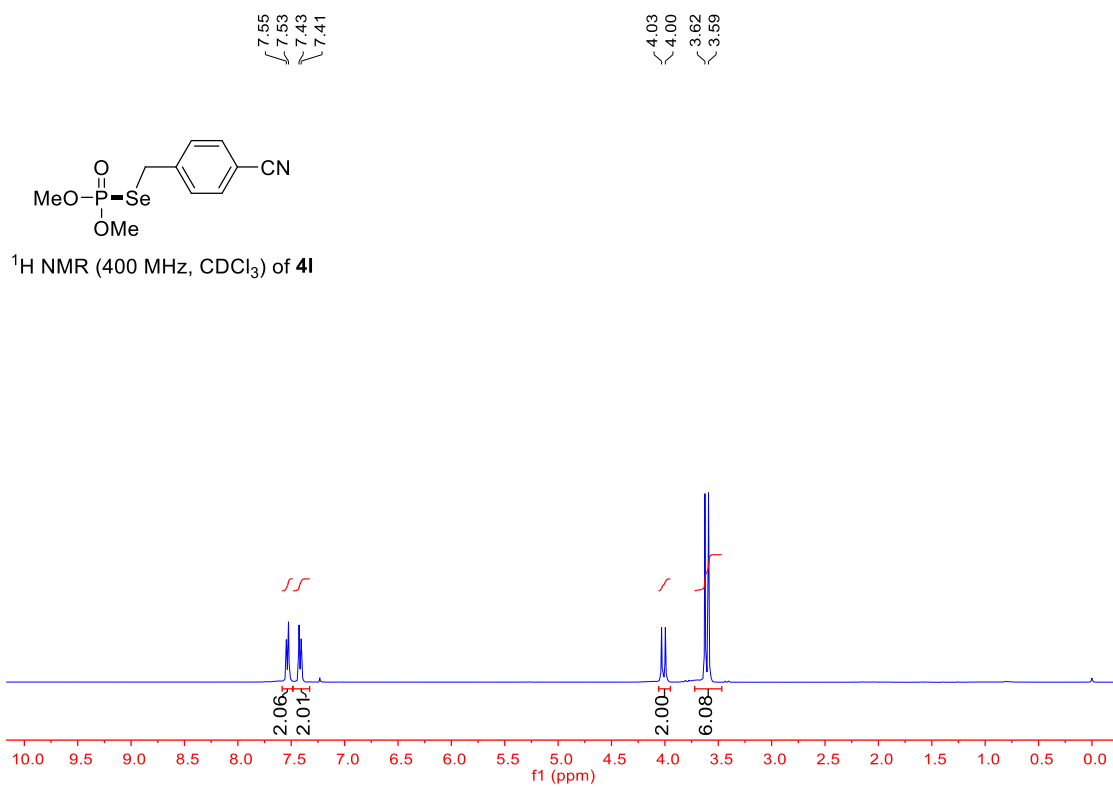


Figure S73: ¹H NMR spectrum for compound **4I**

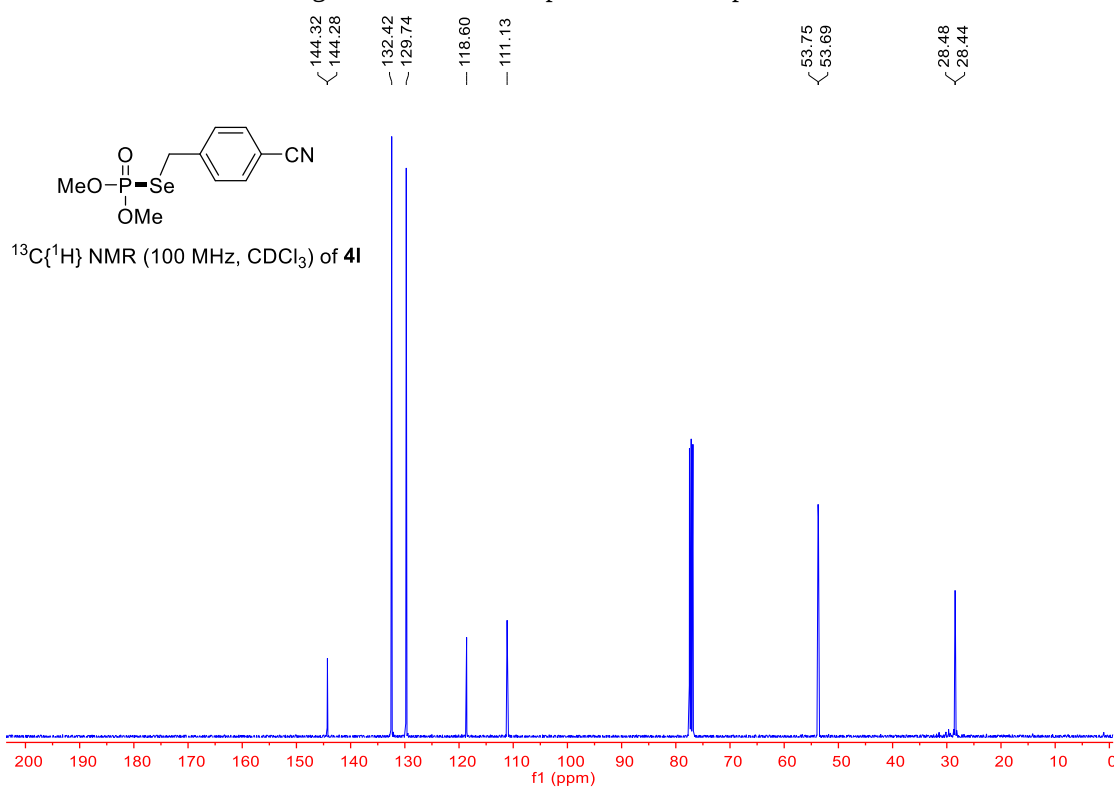


Figure S74: ¹³C NMR spectrum for compound **4I**

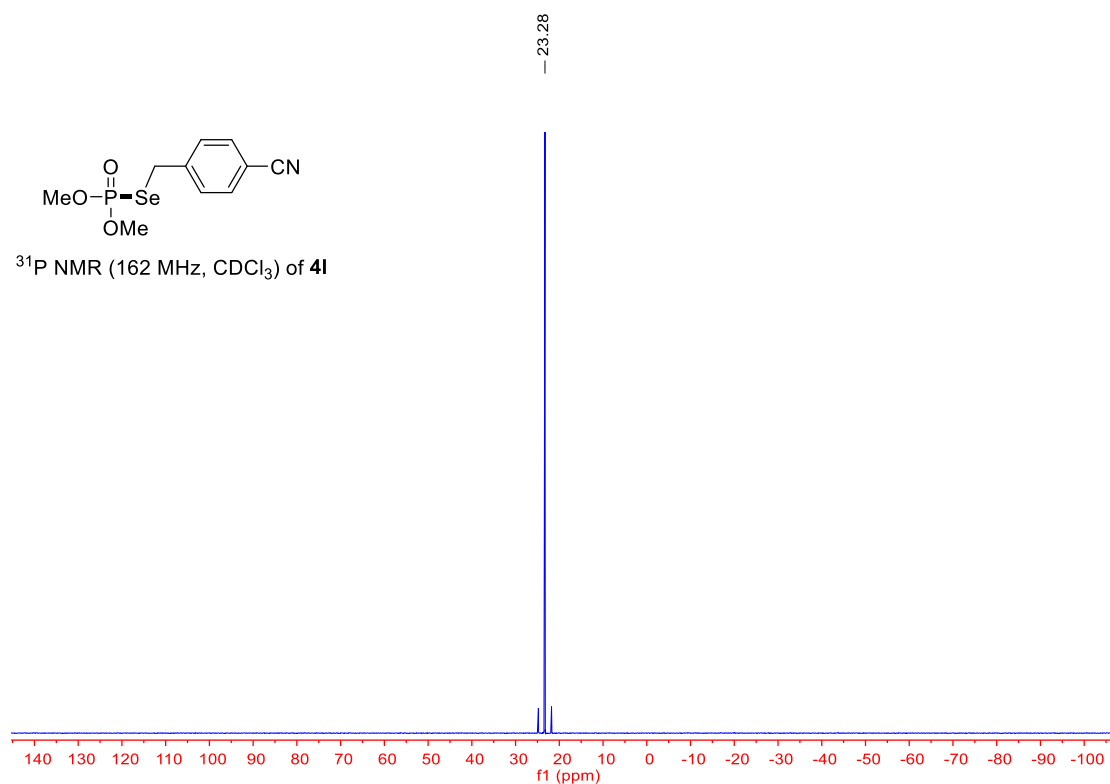


Figure S75: ^{31}P NMR spectrum for compound **4l**

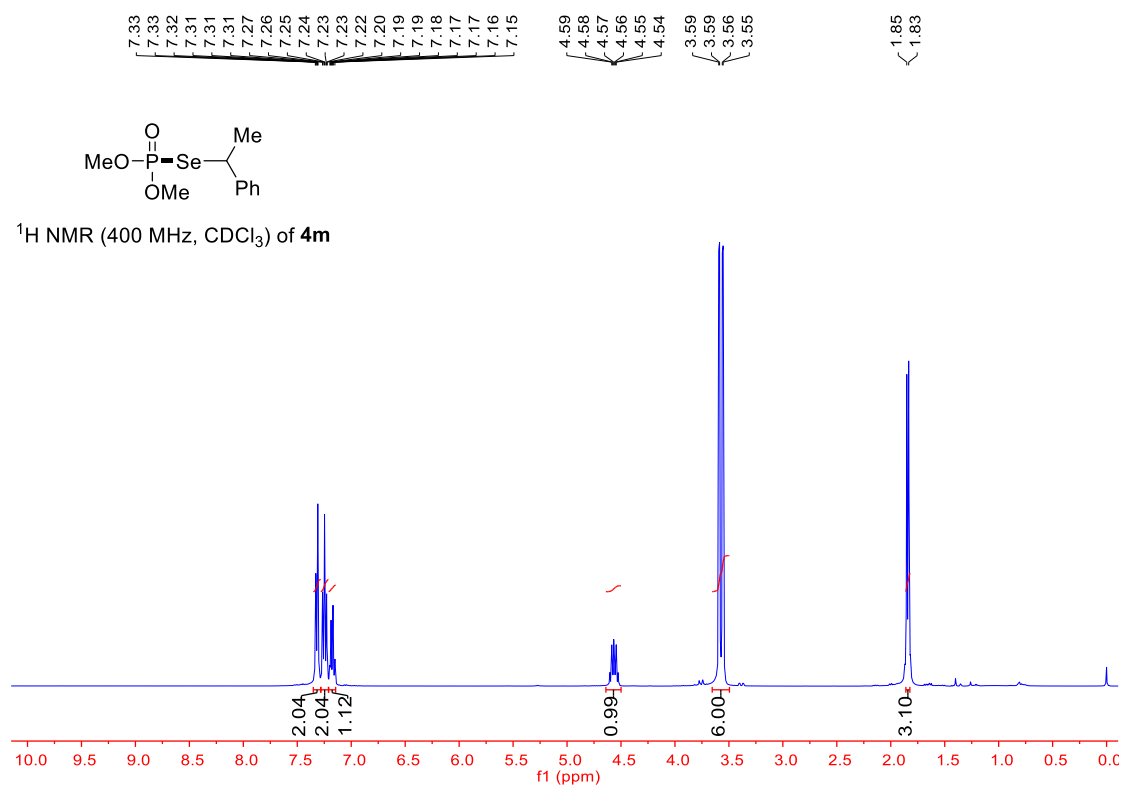


Figure S76: ^1H NMR spectrum for compound **4m**

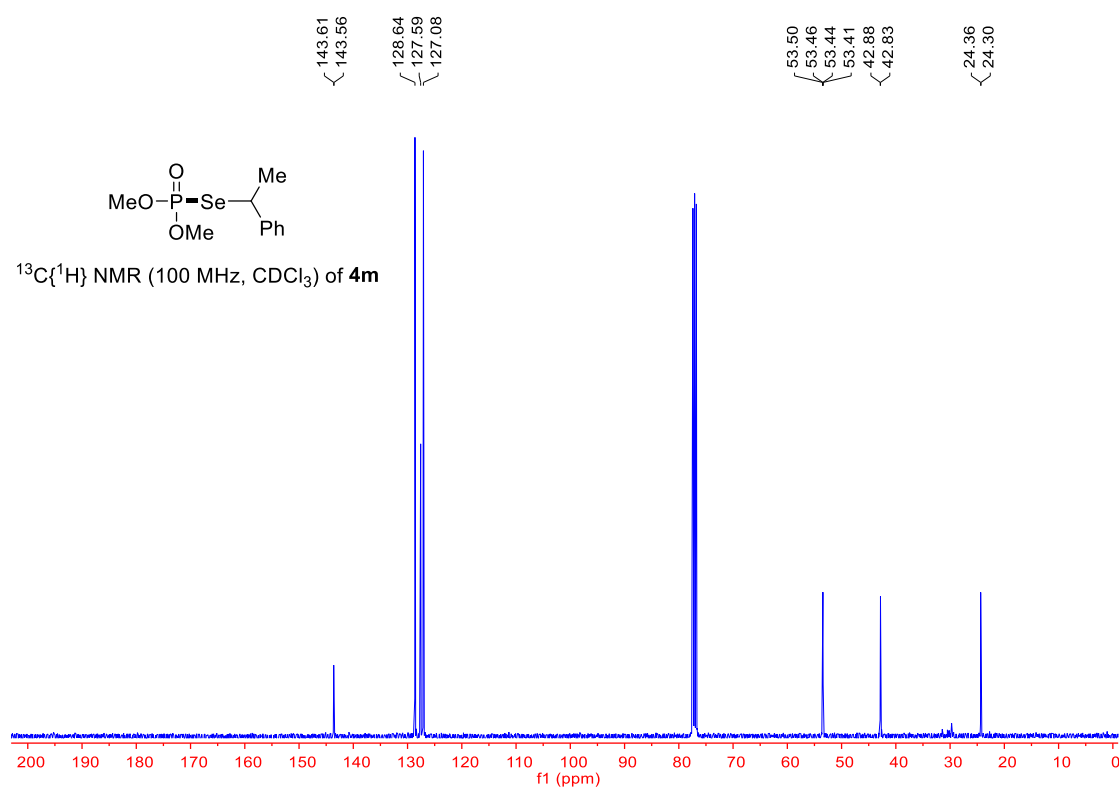


Figure S77: ^{13}C NMR spectrum for compound **4m**

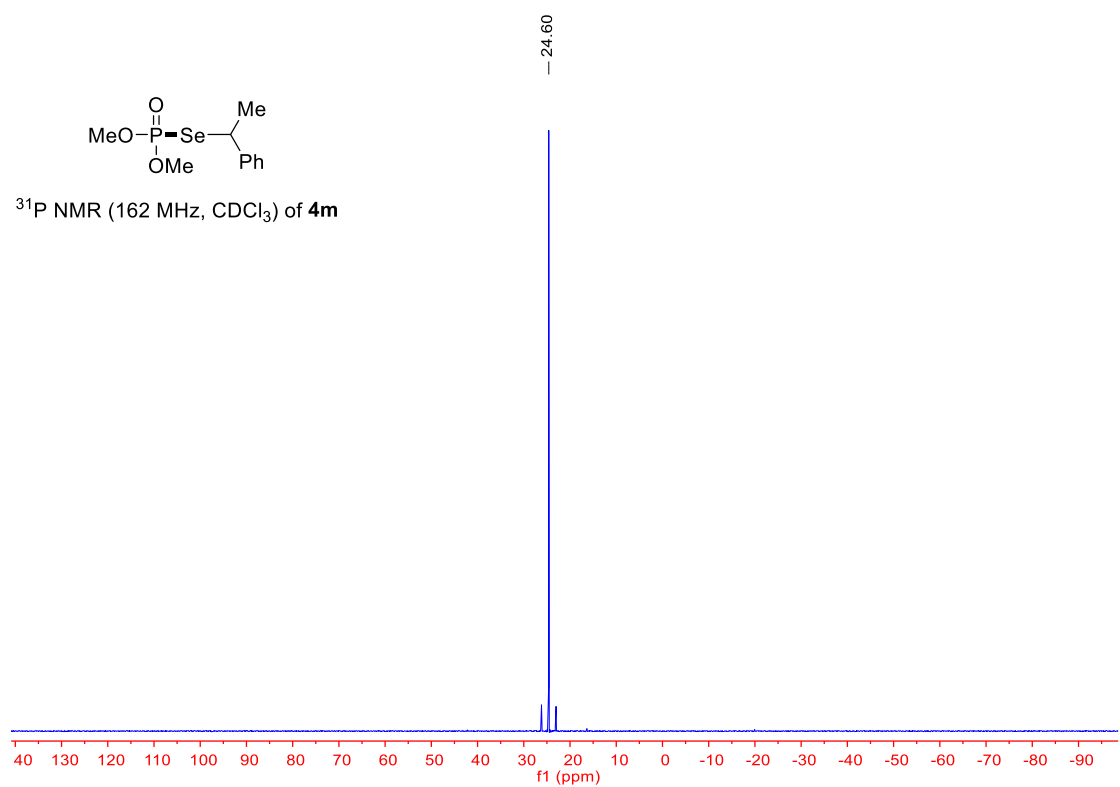


Figure S78: ^{31}P NMR spectrum for compound **4m**

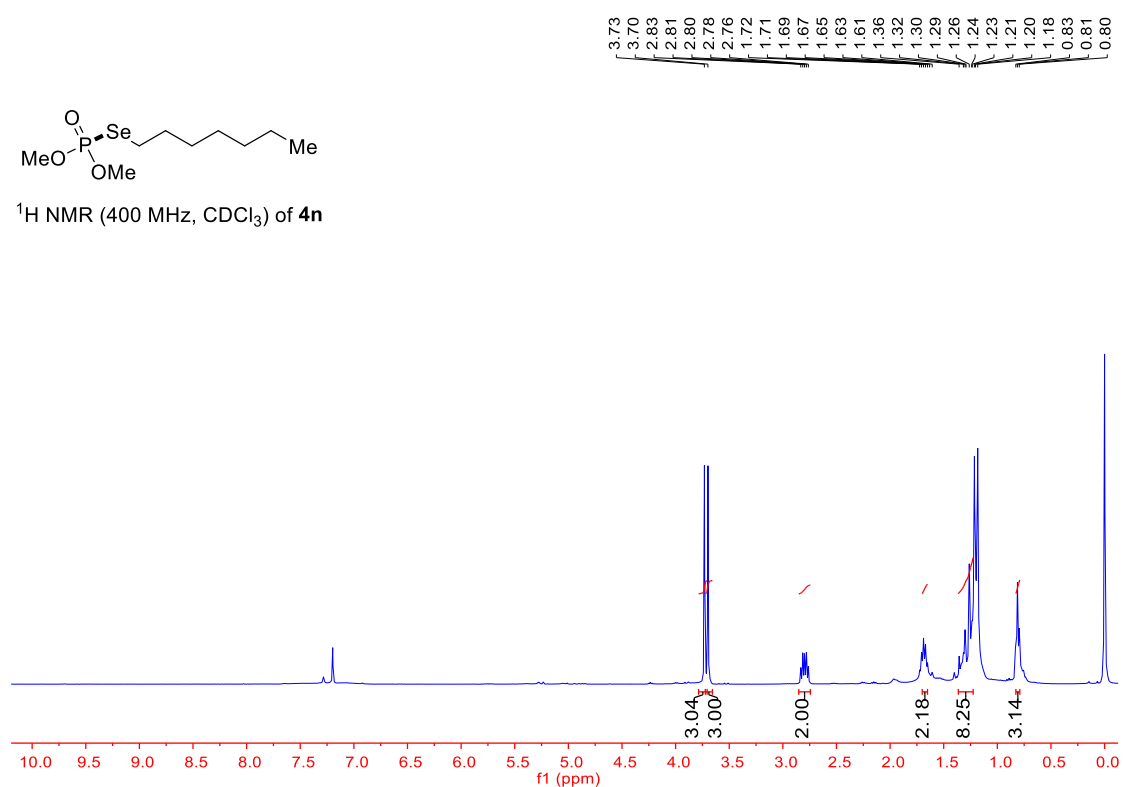


Figure S79: ^1H NMR spectrum for compound **4n**

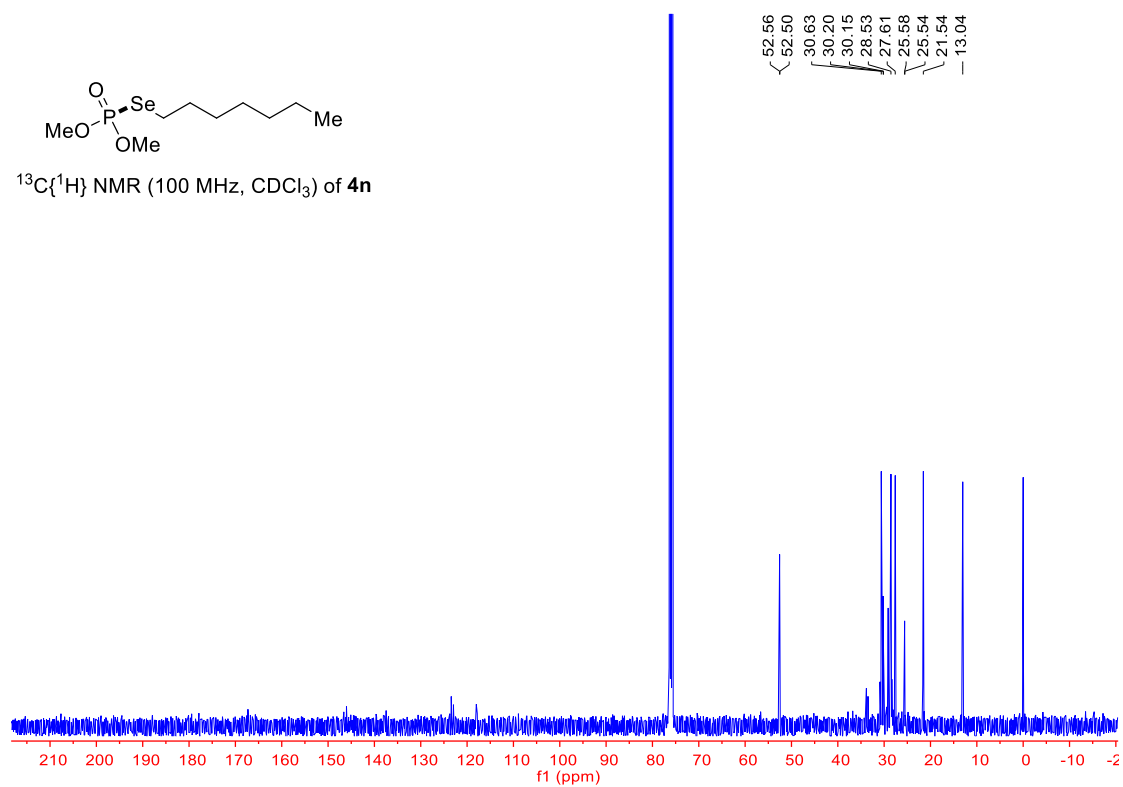


Figure S80: ^{13}C NMR spectrum for compound **4n**

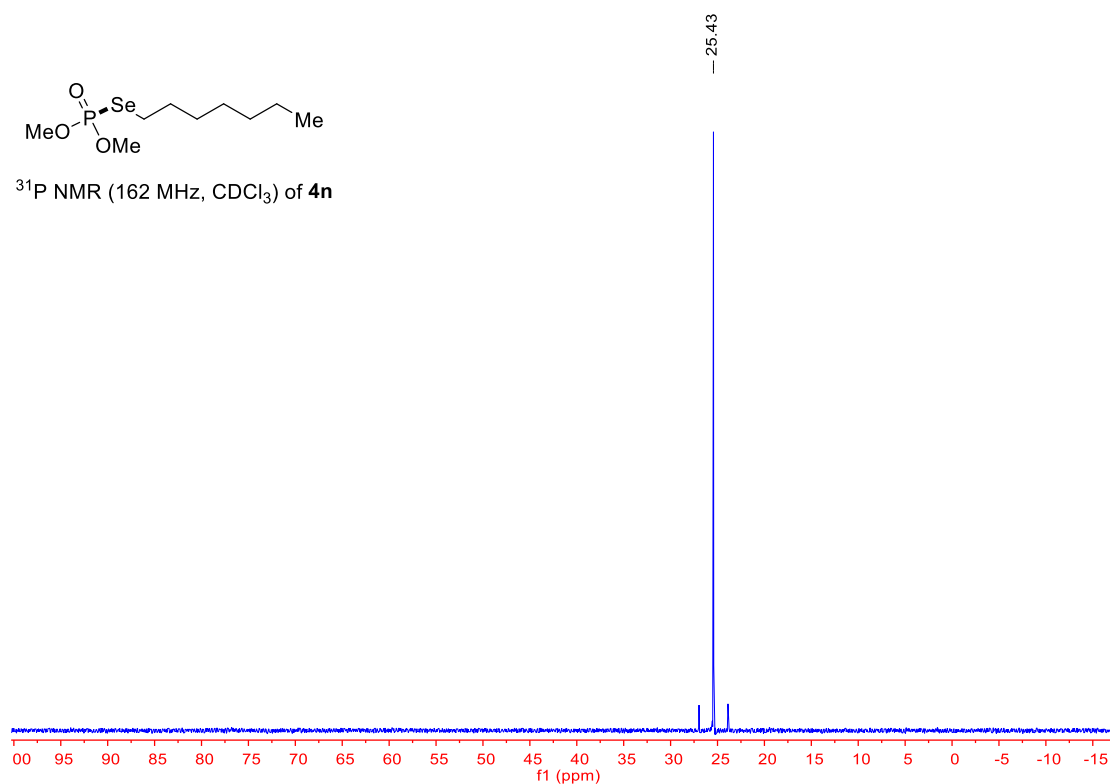


Figure S81: ³¹P NMR spectrum for compound **4n**

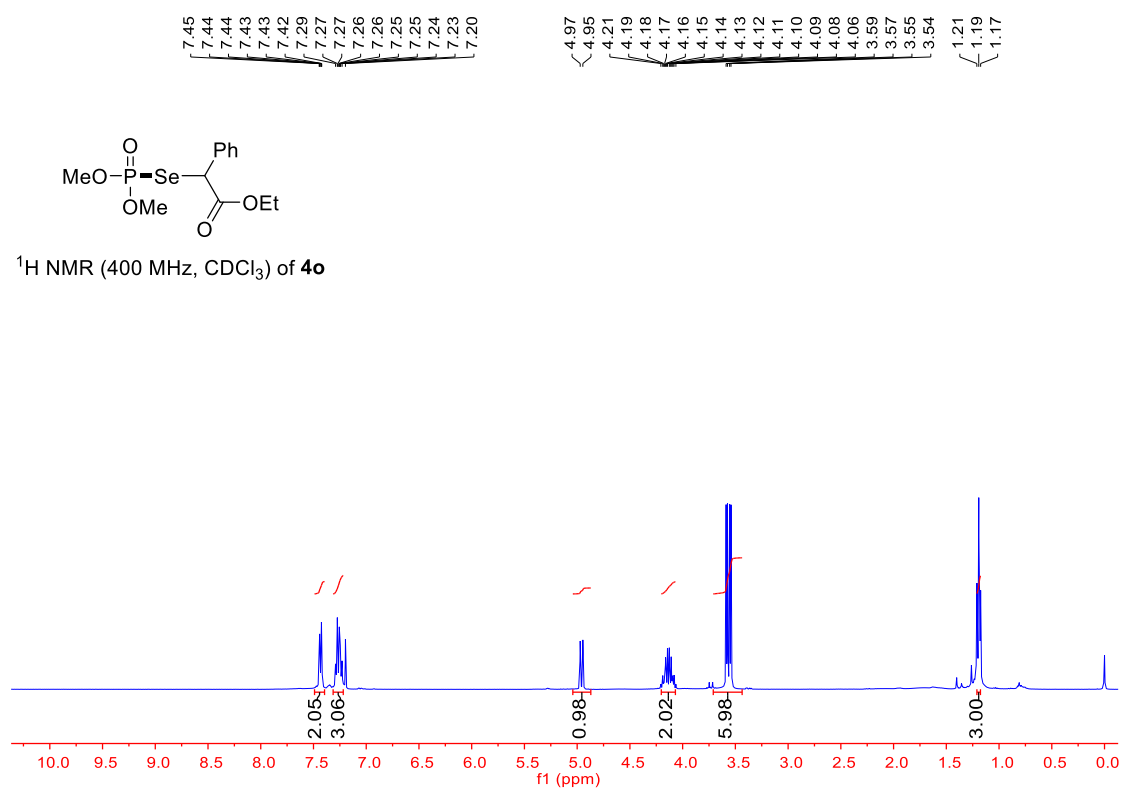


Figure S82: ¹H NMR spectrum for compound **4o**

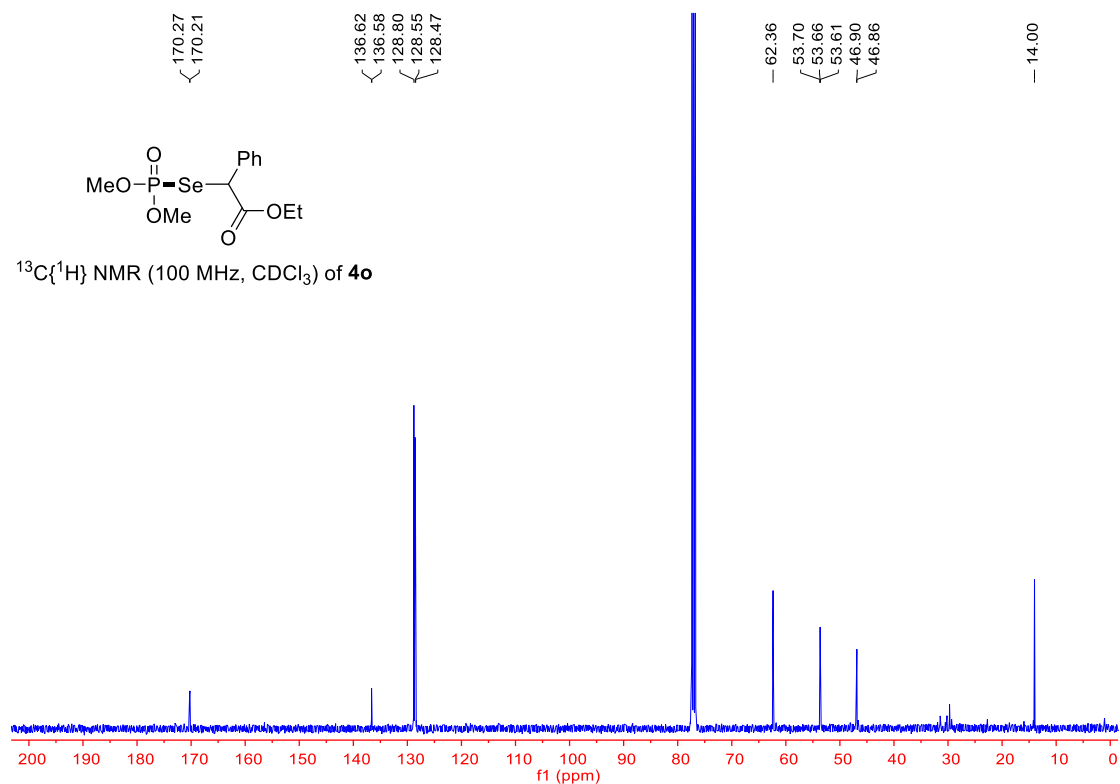


Figure S83: ^{13}C NMR spectrum for compound **4o**

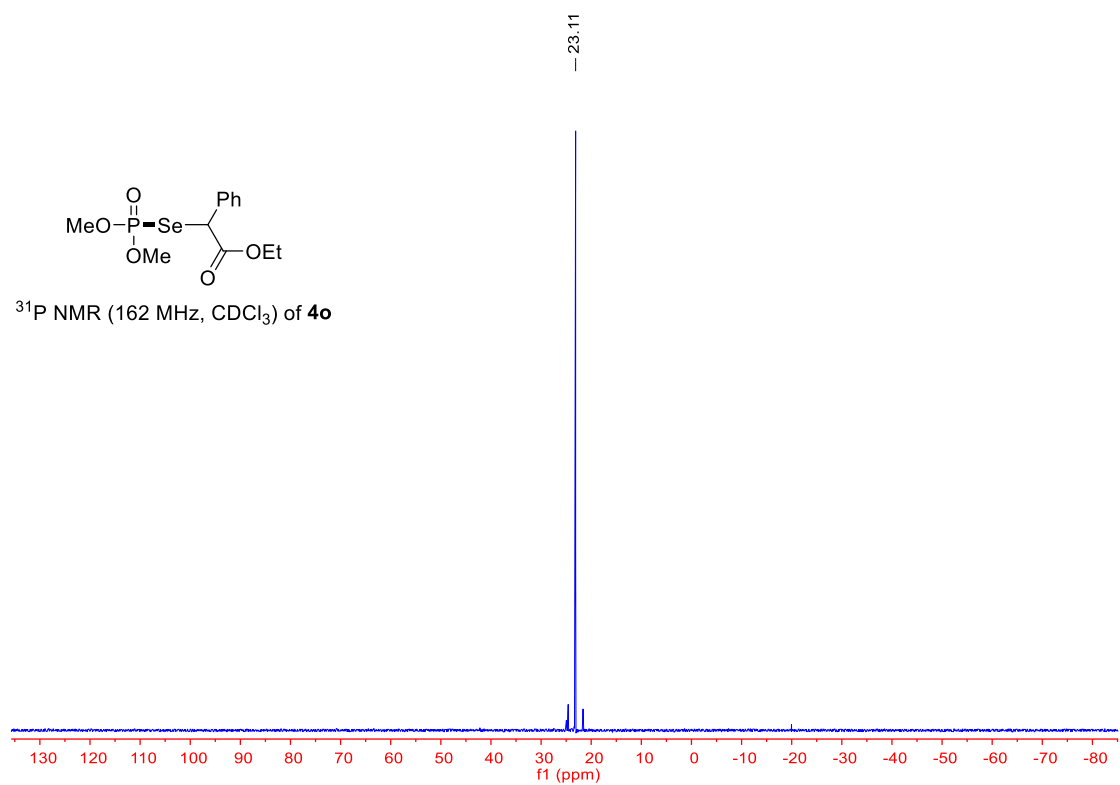


Figure S84: ^{31}P NMR spectrum for compound **4o**

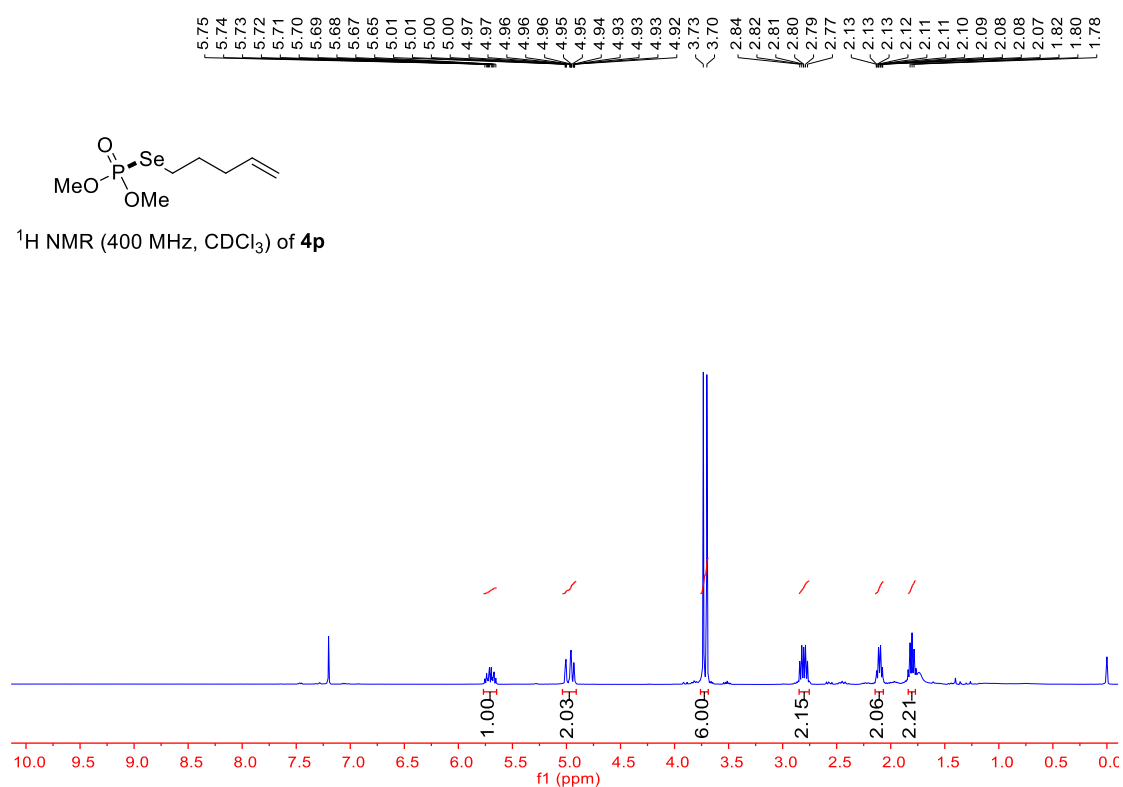


Figure S85: ¹H NMR spectrum for compound **4p**

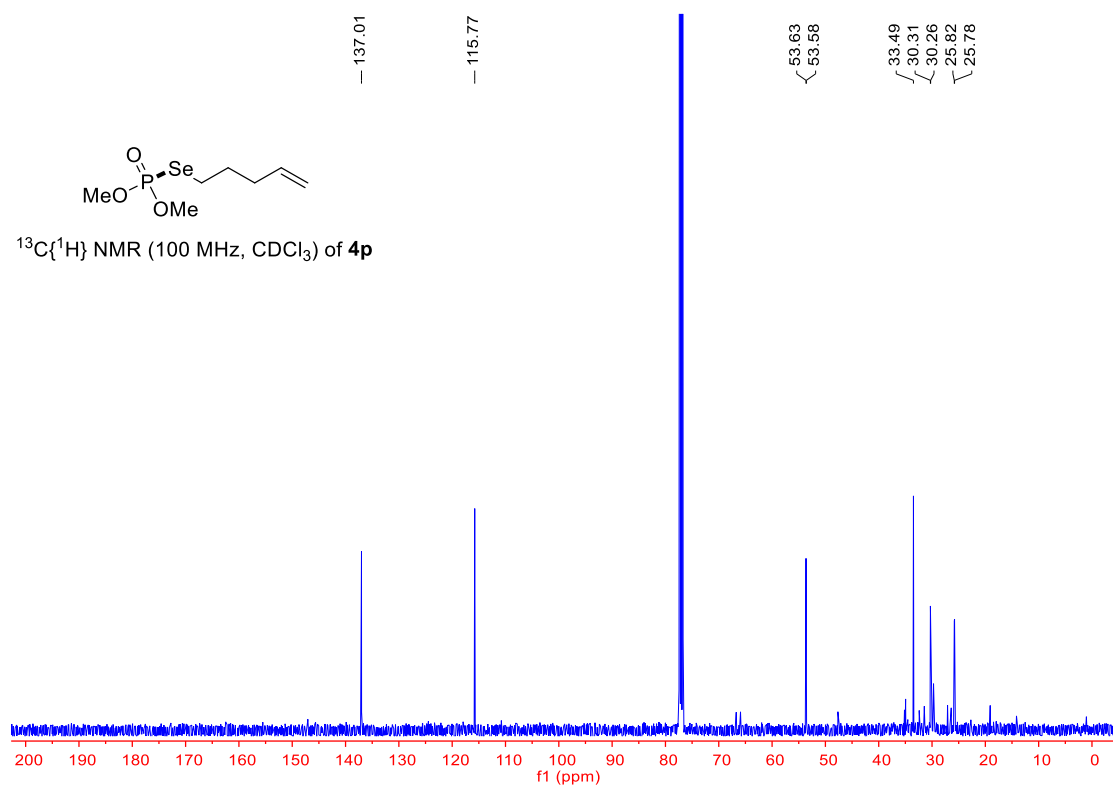


Figure S86: ¹³C NMR spectrum for compound **4p**

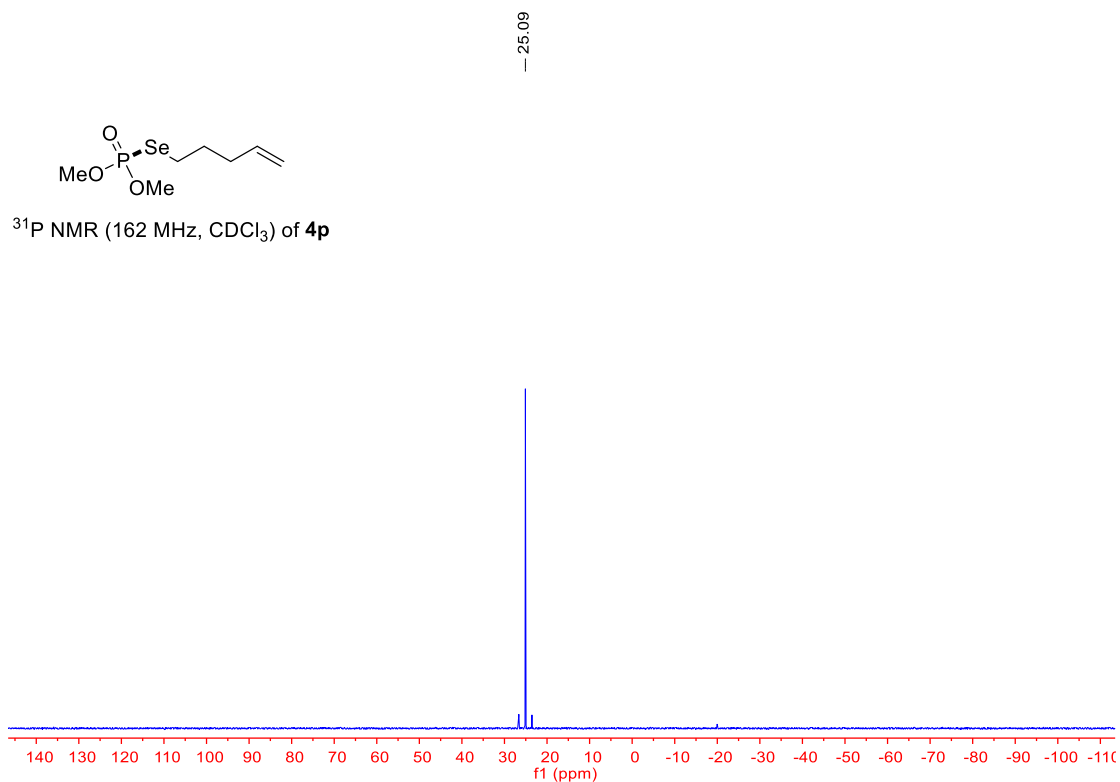


Figure S87: ³¹P NMR spectrum for compound **4p**

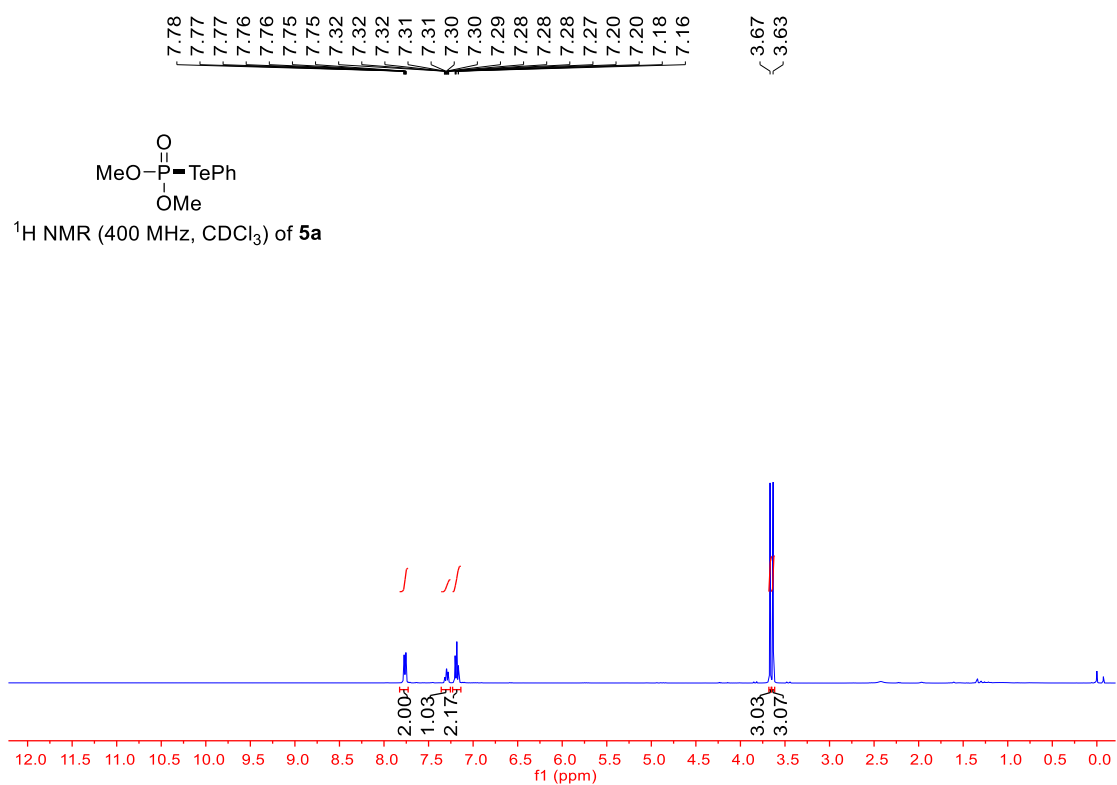


Figure S88: ¹H NMR spectrum for compound **5a**

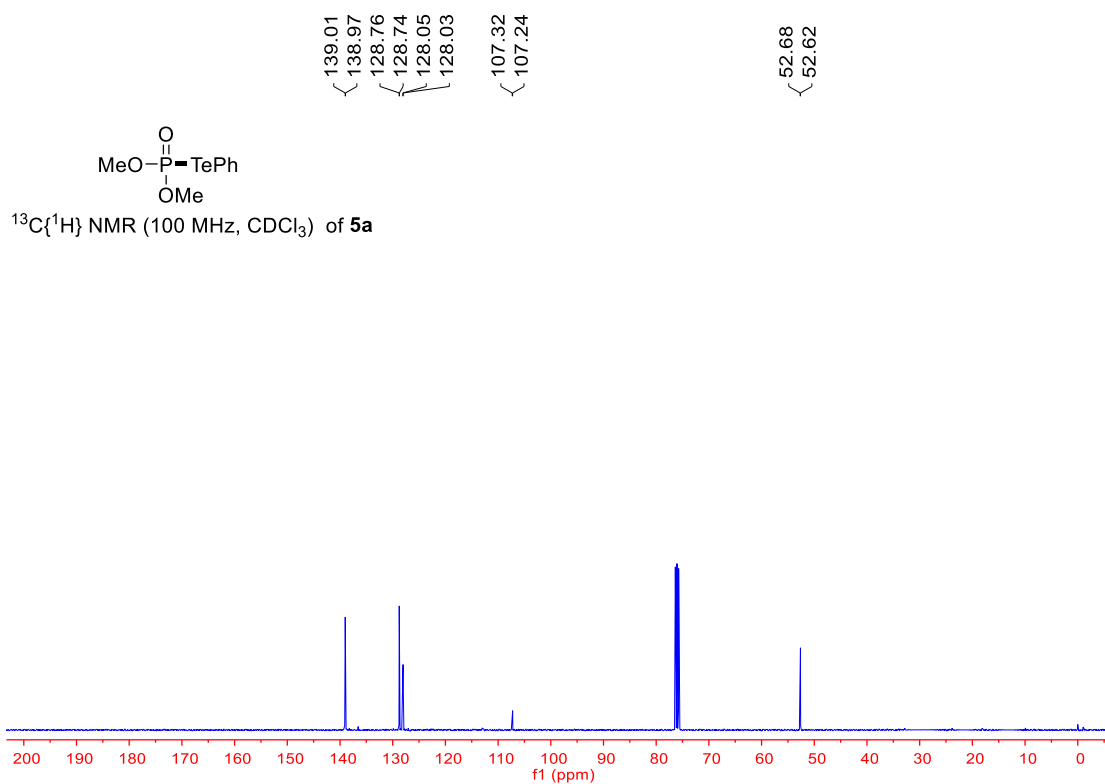


Figure S89: ^{13}C NMR spectrum for compound **5a**

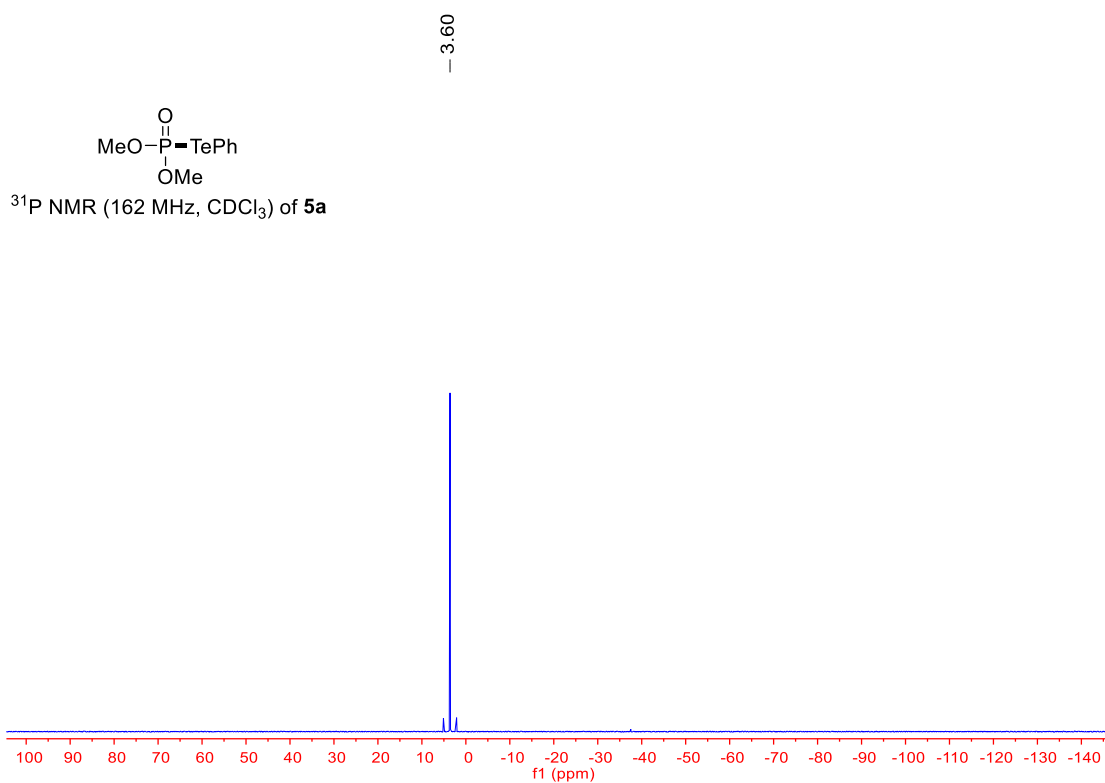


Figure S90: ^{31}P NMR spectrum for compound **5a**

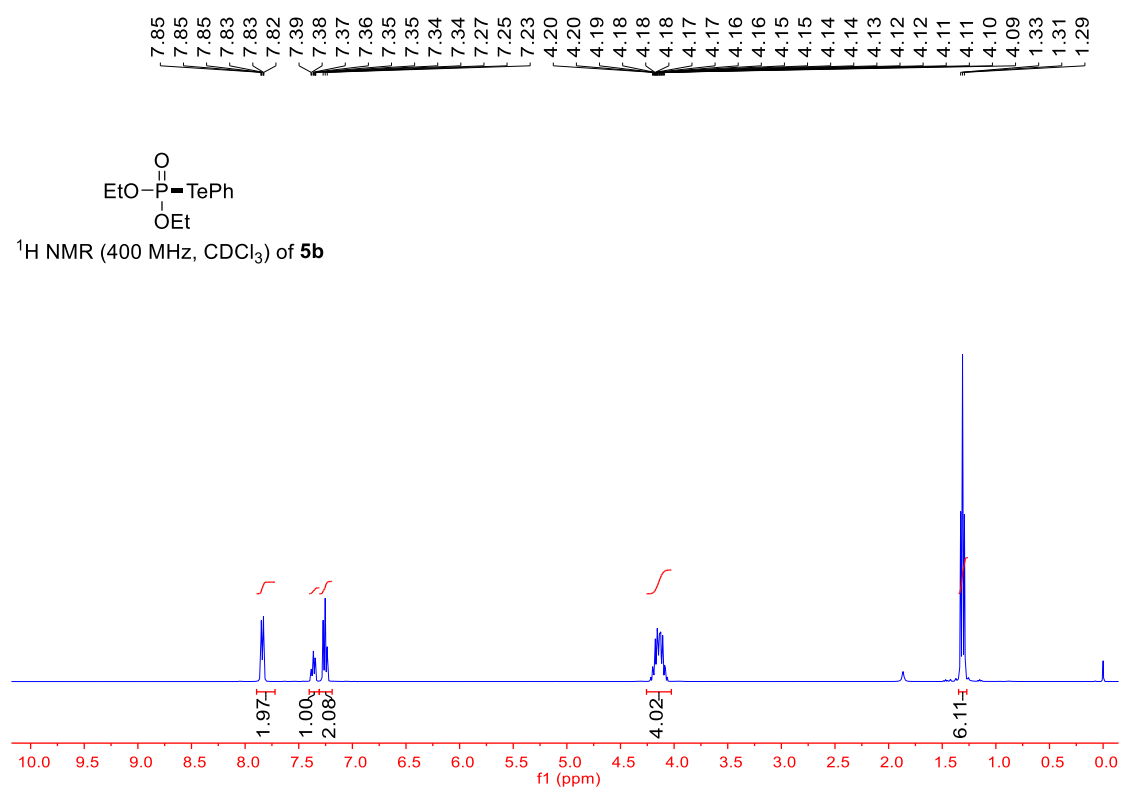


Figure S91: ¹H NMR spectrum for compound **5b**

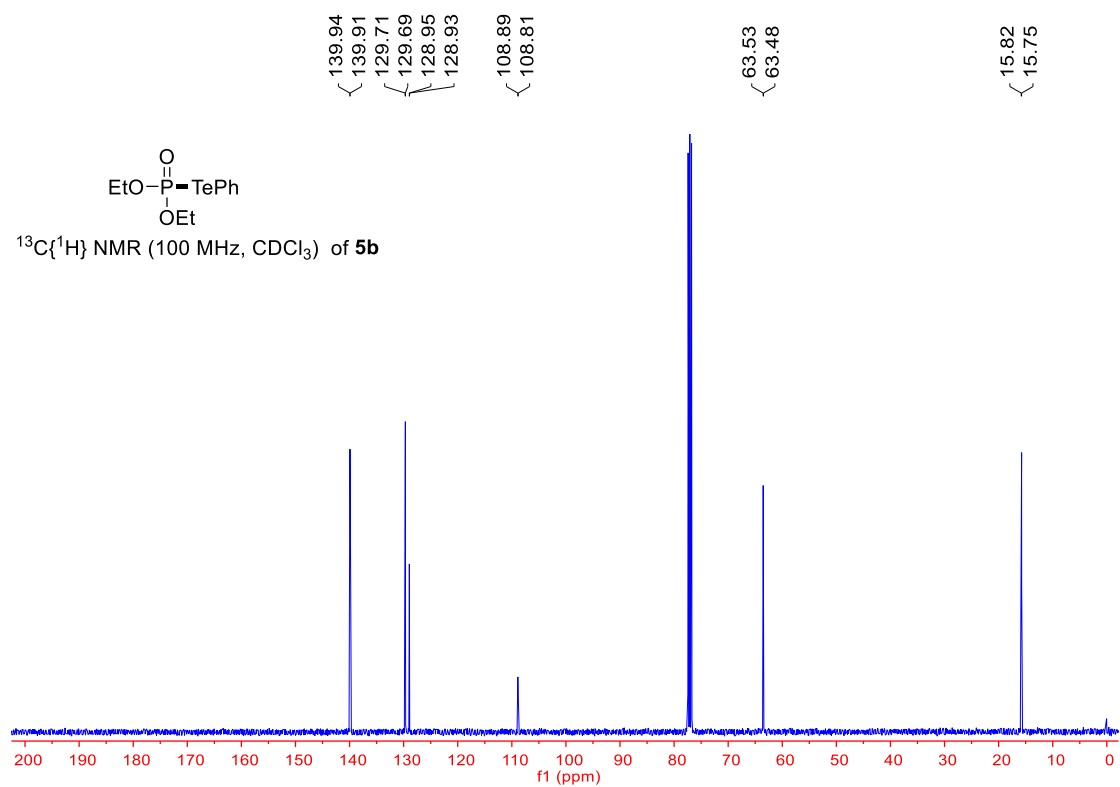


Figure S92: ¹³C NMR spectrum for compound **5b**

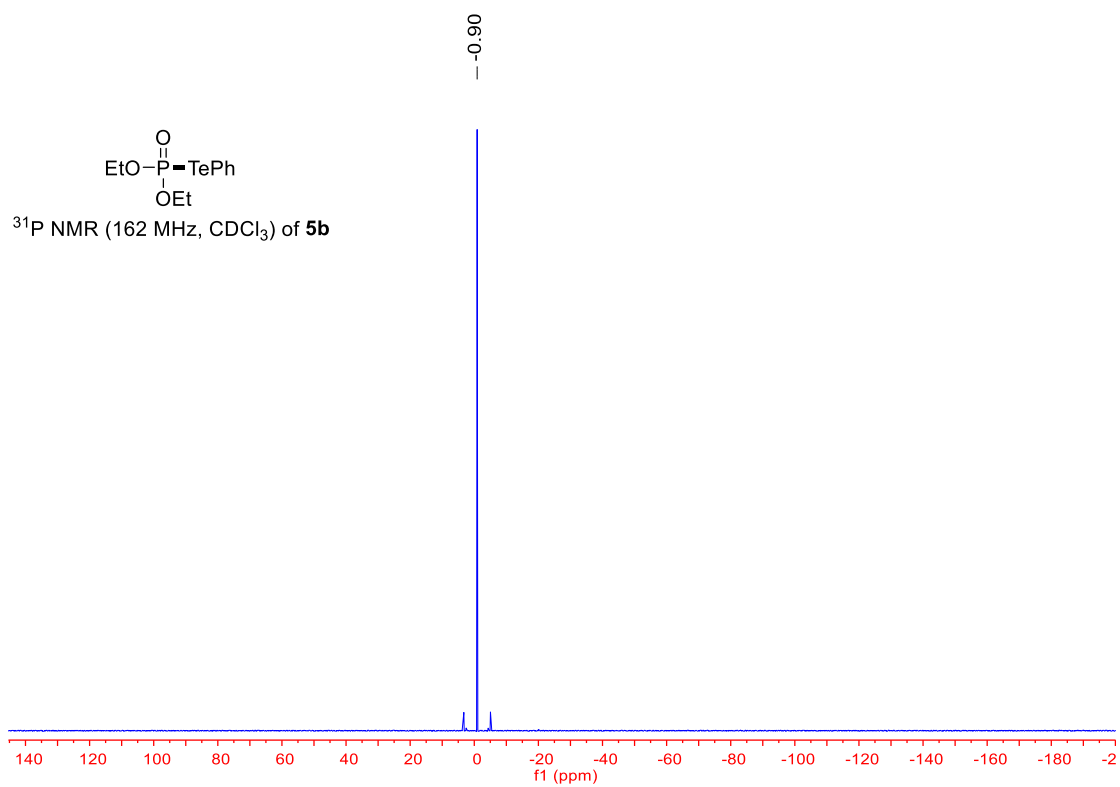


Figure S93: ³¹P NMR spectrum for compound **5b**

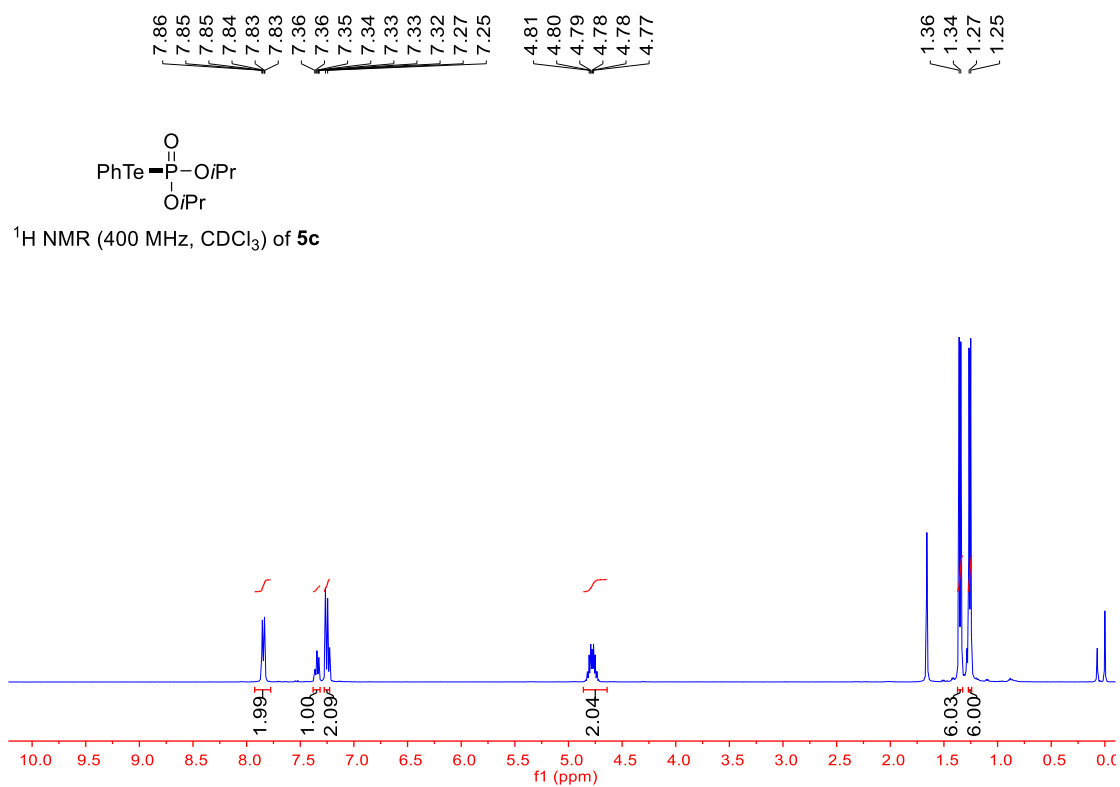


Figure S94: ¹H NMR spectrum for compound **5c**

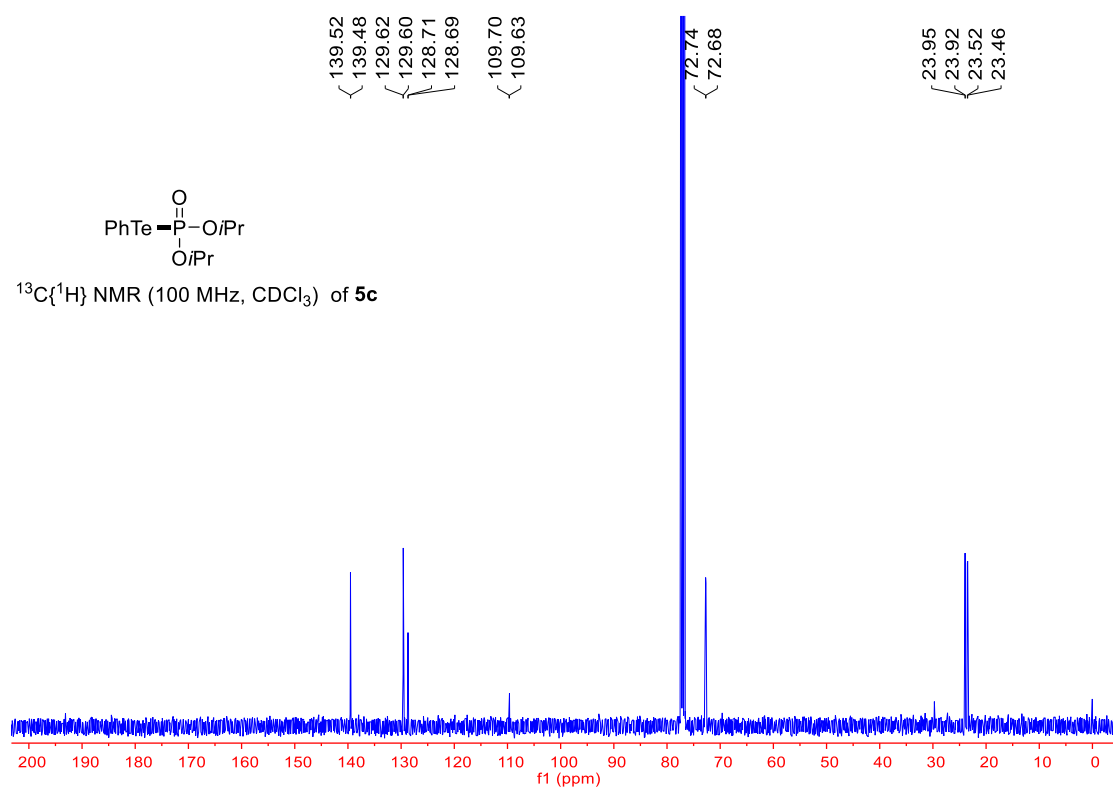


Figure S95: ¹³C NMR spectrum for compound **5c**

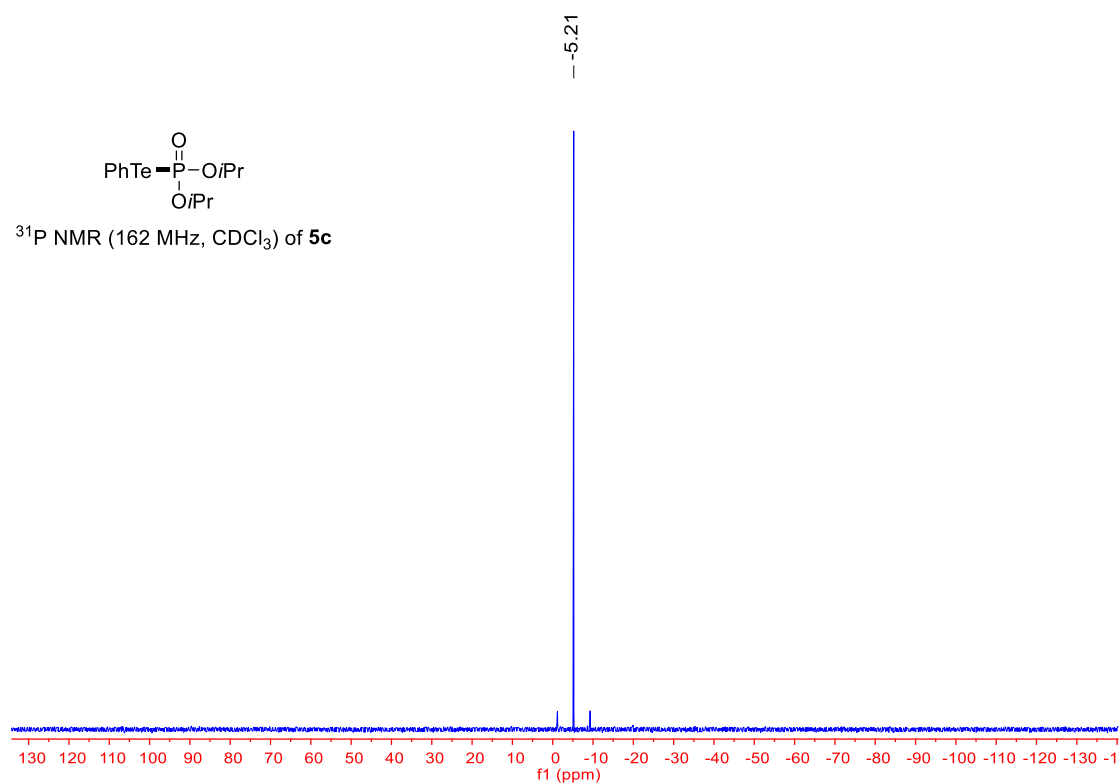


Figure S96: ³¹P NMR spectrum for compound **5c**

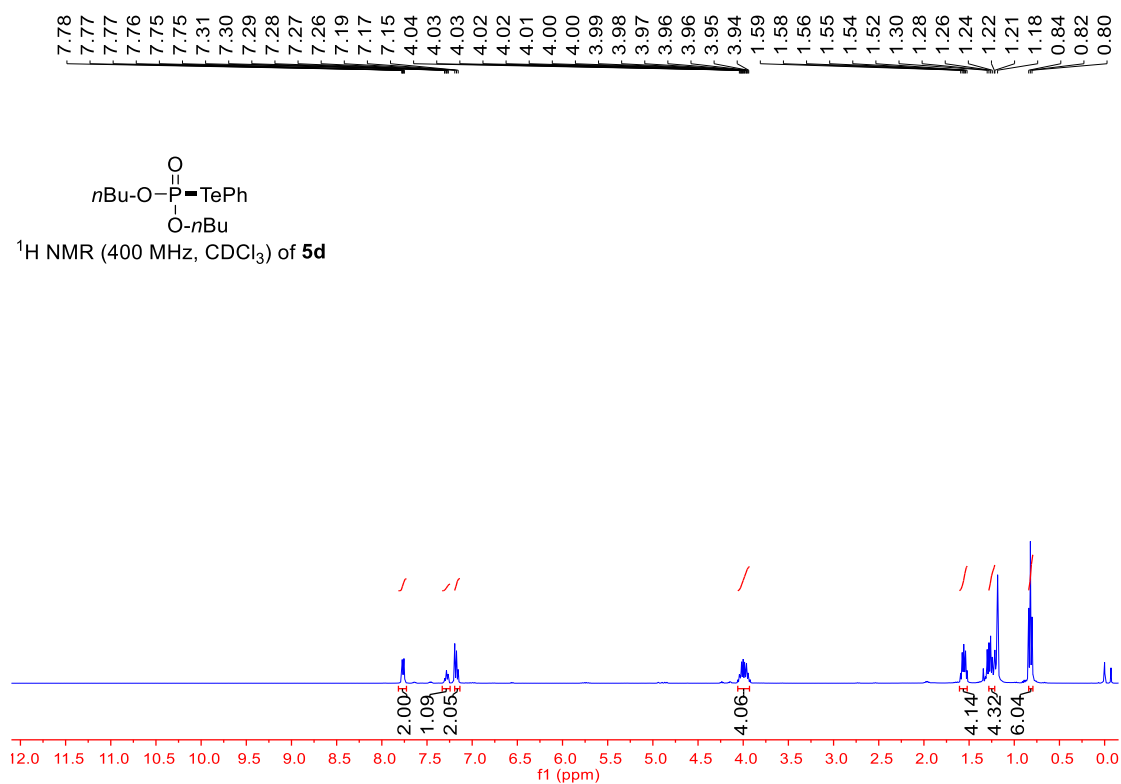


Figure S97: ¹H NMR spectrum for compound **5d**

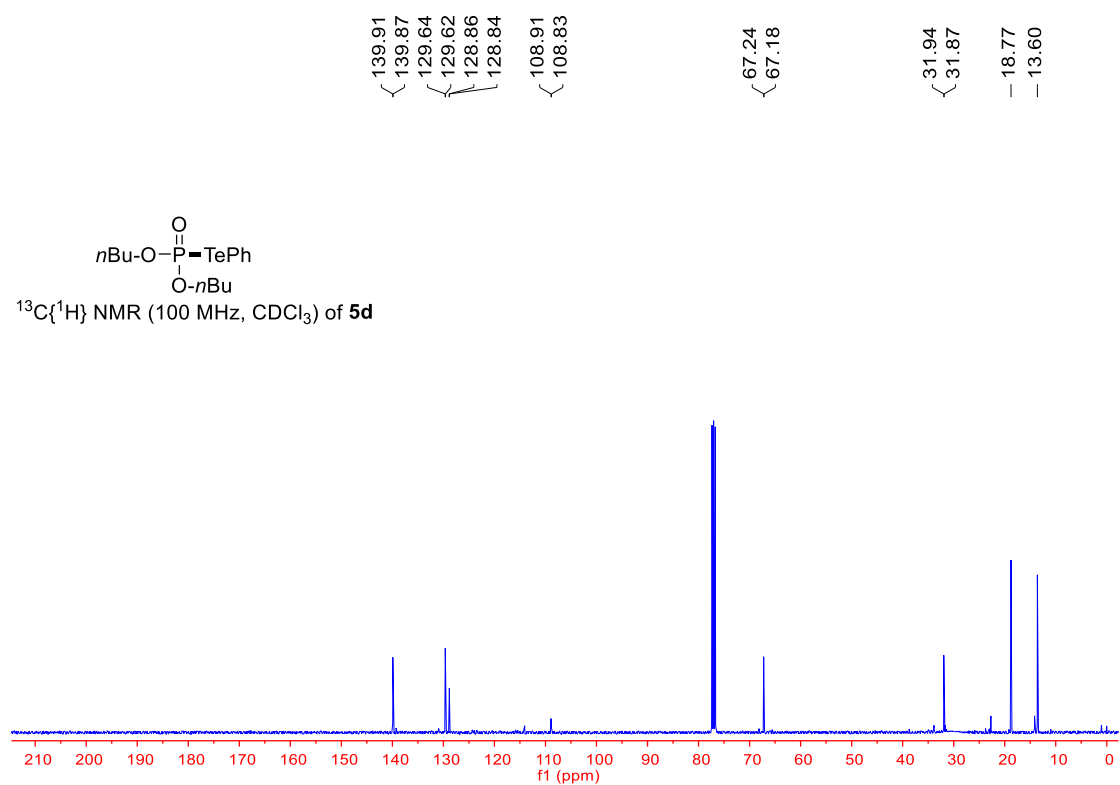


Figure S98: ¹³C NMR spectrum for compound **5d**

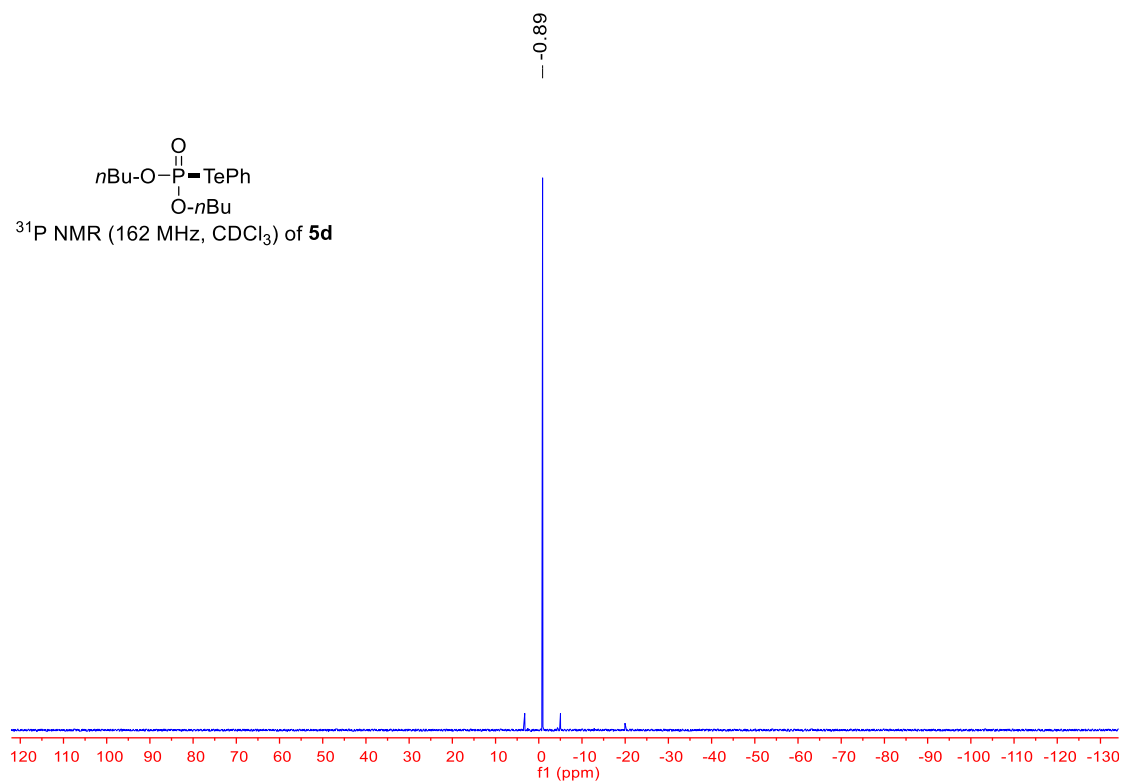


Figure S99: ³¹P NMR spectrum for compound **5d**

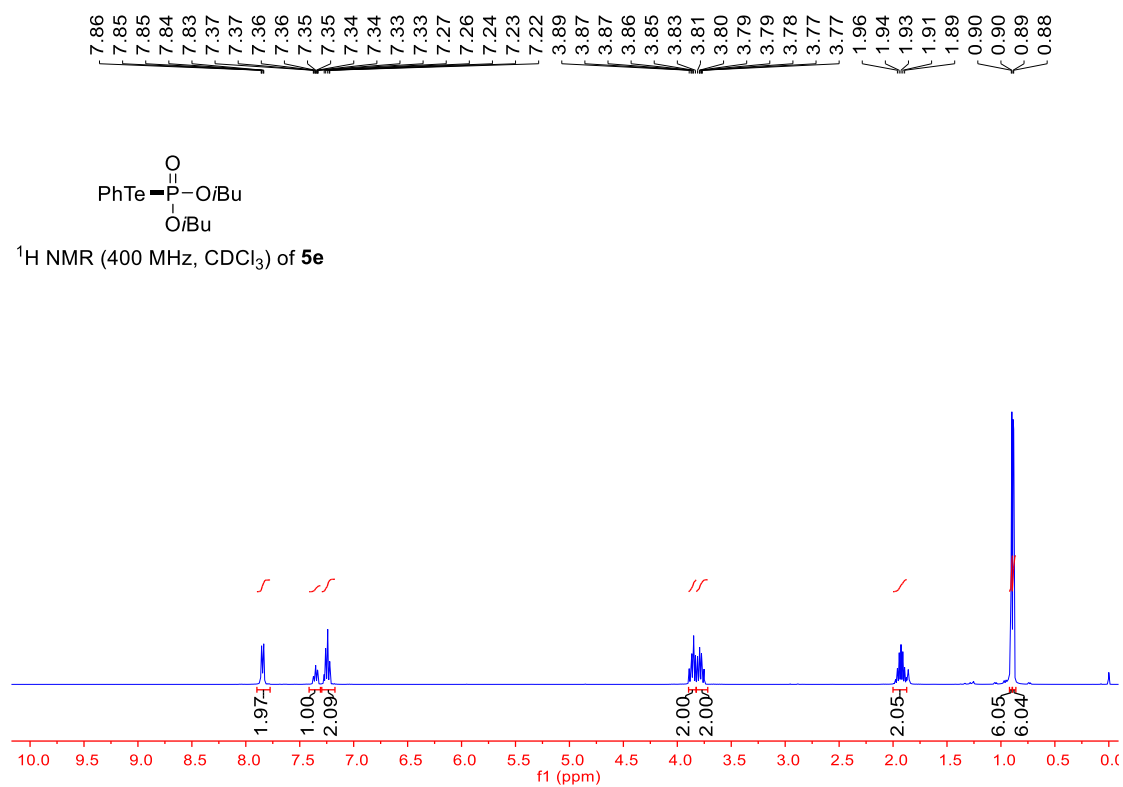


Figure S100: ¹H NMR spectrum for compound **5e**

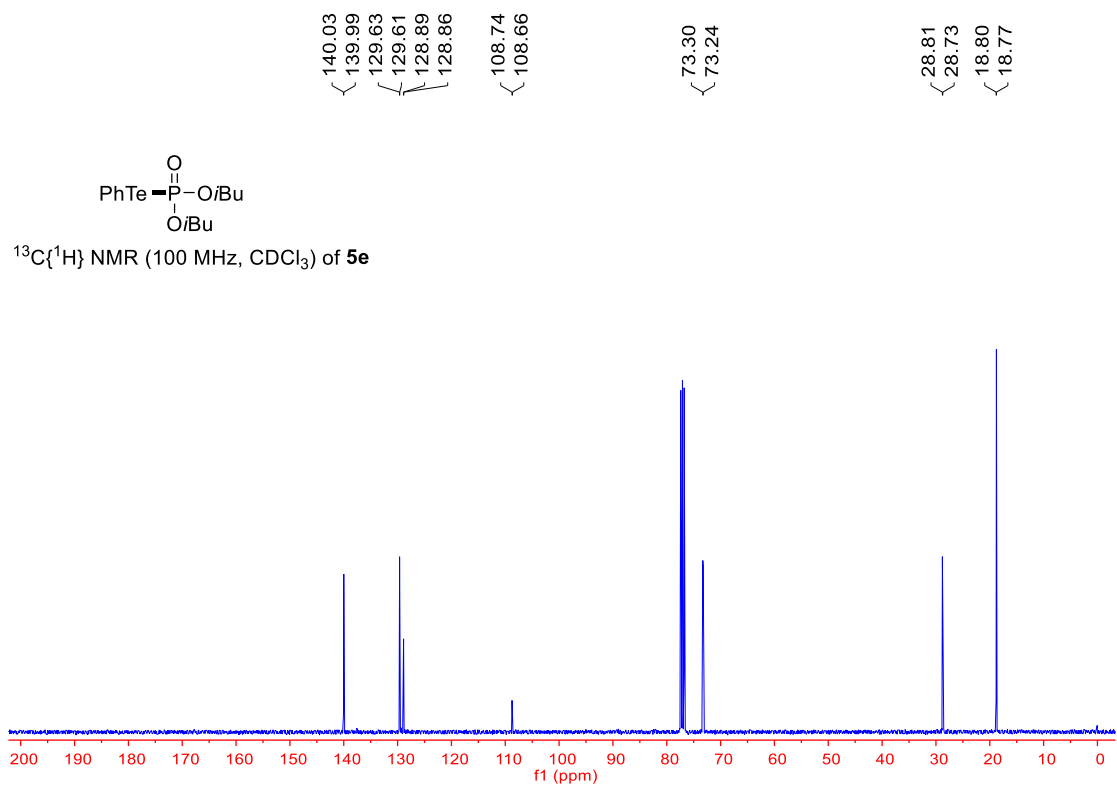


Figure S101: ^{13}C NMR spectrum for compound **5e**

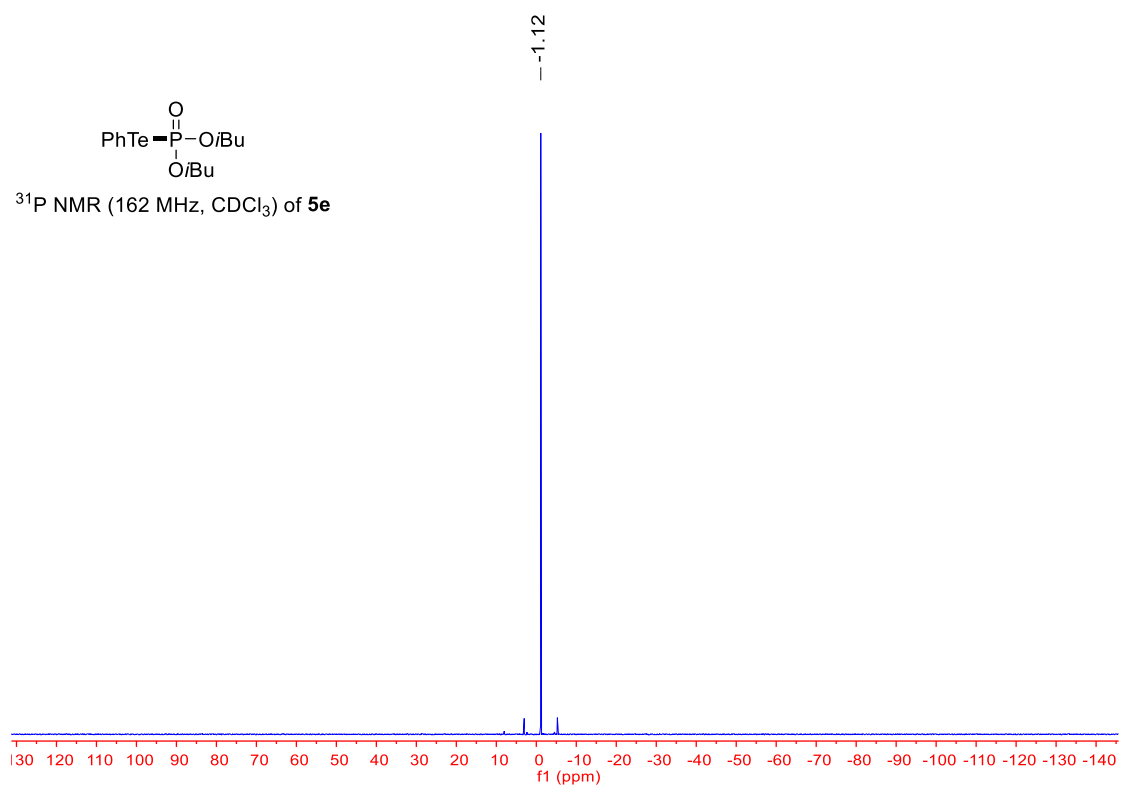


Figure S102: ^{31}P NMR spectrum for compound **5e**

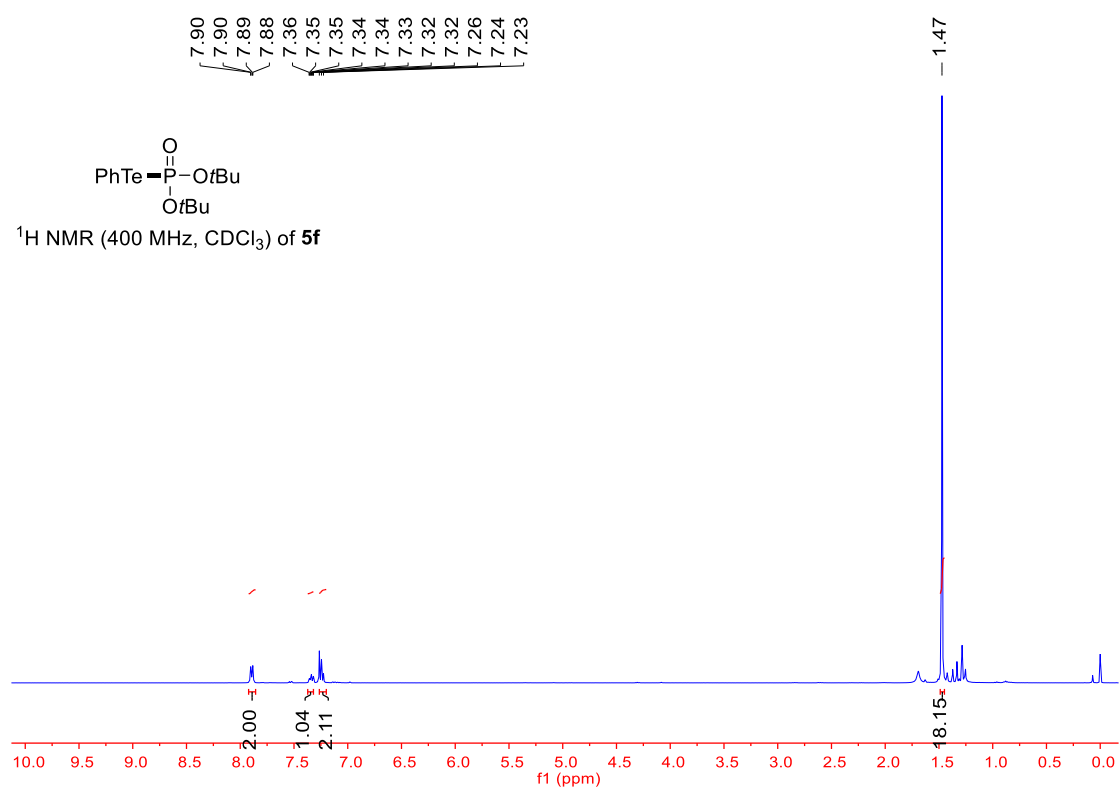


Figure S103: ^1H NMR spectrum for compound **5f**

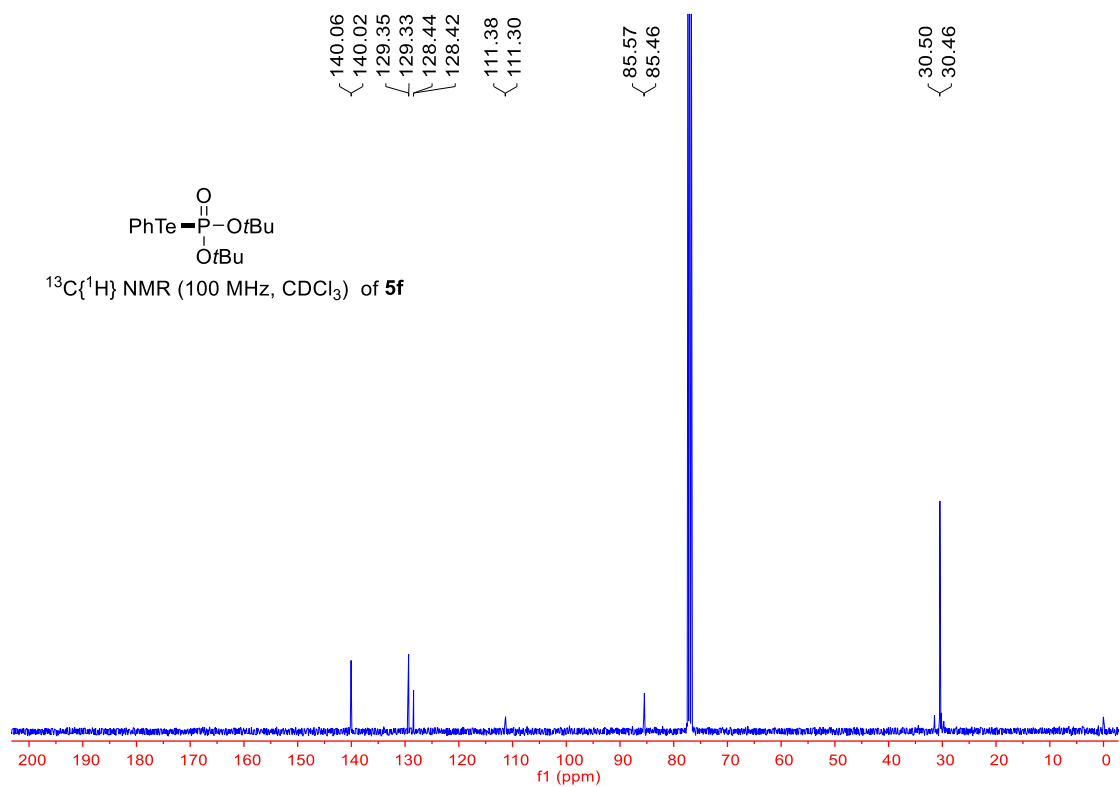


Figure S104: ^{13}C NMR spectrum for compound **5f**

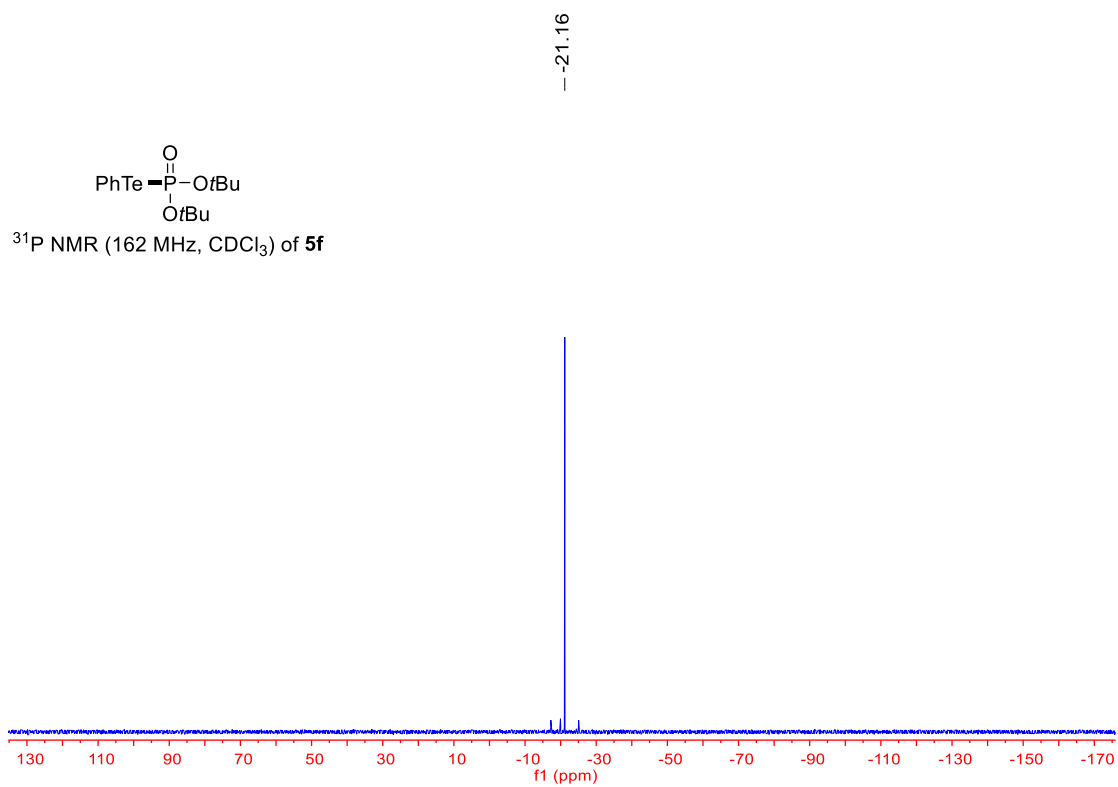


Figure S105: ³¹P NMR spectrum for compound **5f**

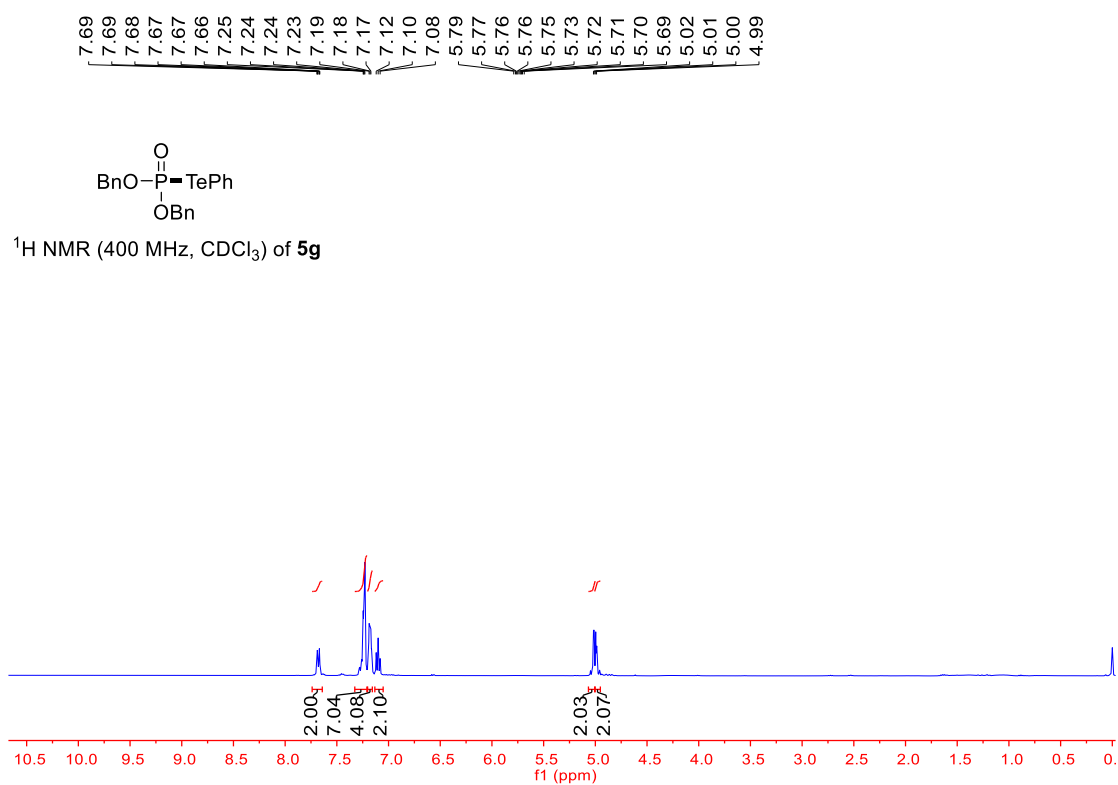


Figure S106: ¹H NMR spectrum for compound **5g**

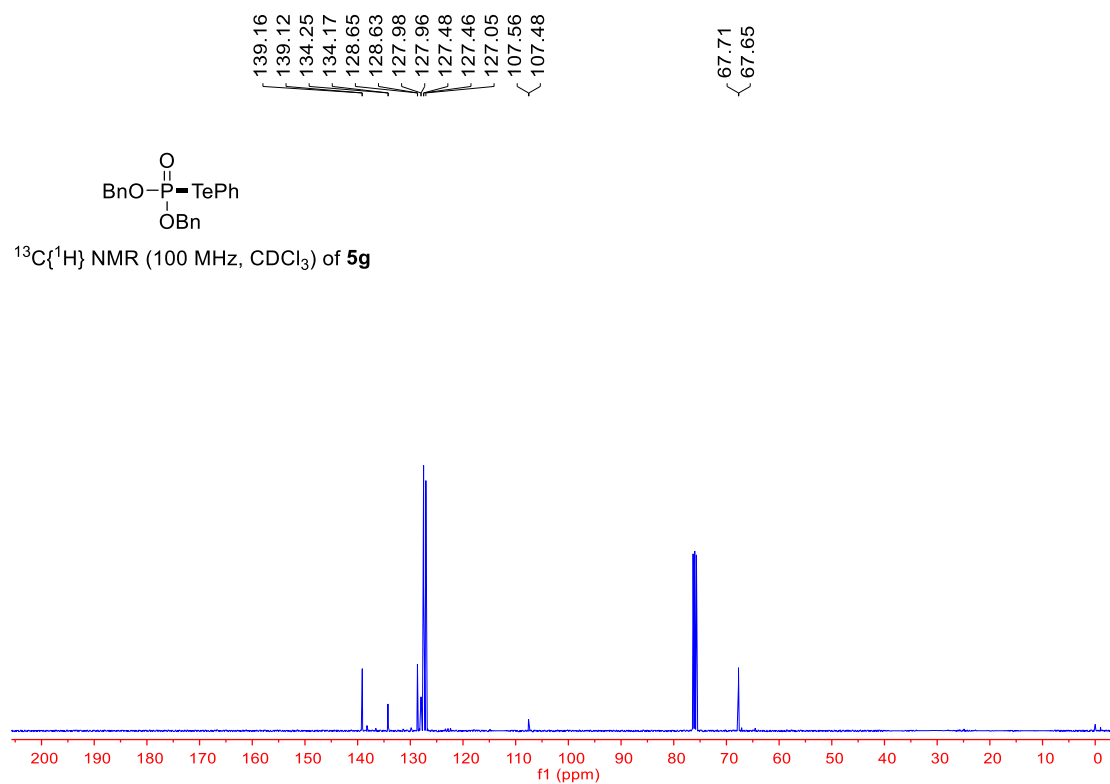


Figure S107: ^{13}C NMR spectrum for compound **5g**

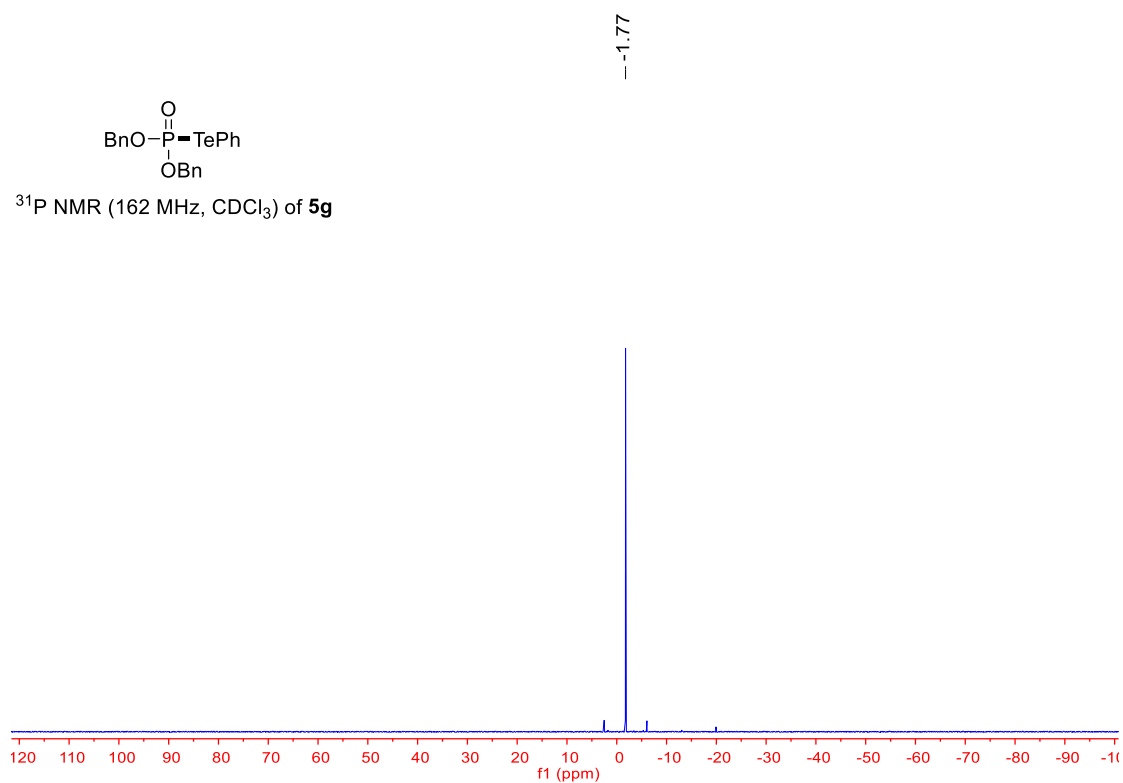
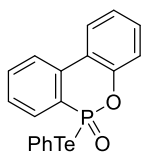


Figure S108: ^{31}P NMR spectrum for compound **5g**



^1H NMR (400 MHz, CDCl_3) of **5h**

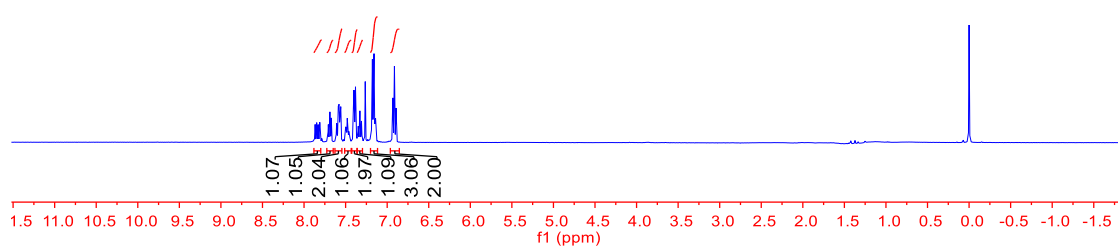
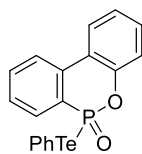


Figure S109: ^1H NMR spectrum for compound **5h**

150.03
149.93
141.29
141.26
135.33
135.25
133.58
133.56
130.51
130.07
129.96
129.22
129.20
128.87
128.84
128.50
128.36
124.99
124.85
123.16
123.05
122.26
122.14
120.33
120.27
108.36



$^{13}\text{C}\{^1\text{H}\}$ NMR (100 MHz, CDCl_3) of **5h**

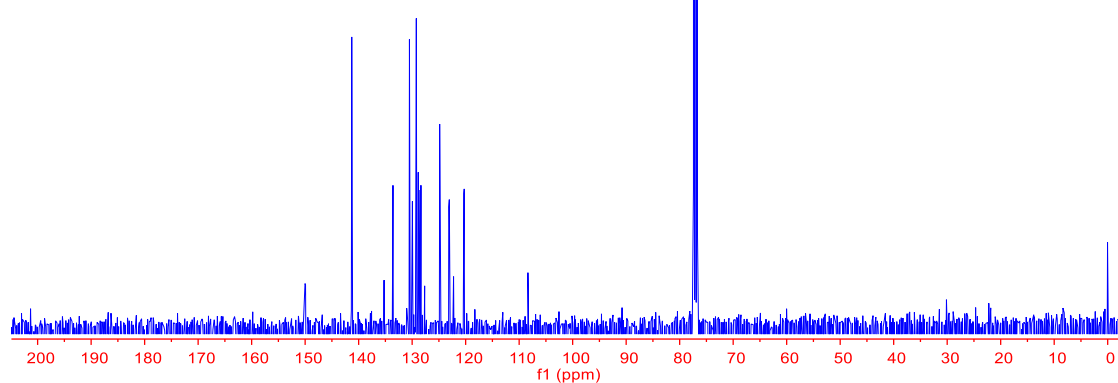


Figure S110: ^{13}C NMR spectrum for compound **5h**

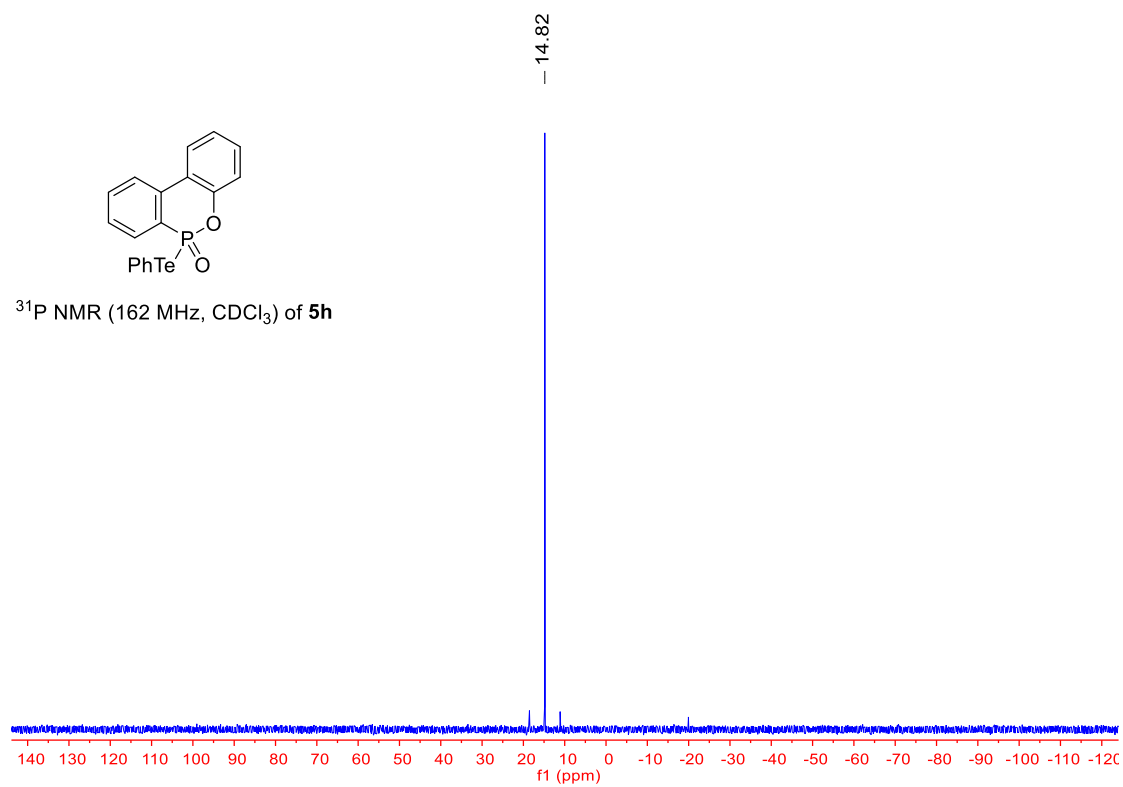


Figure S111: ^{31}P NMR spectrum for compound **5h**