

## Supplementary Information

# Synthesis and antiproliferative activity of phosphorus substituted 4-cyanooxazolines, 2-aminocyanooxazolines, 2-iminocyanooxazolidines, and 2-aminocyanothiazolines by rearrangement of cyanoaziridines

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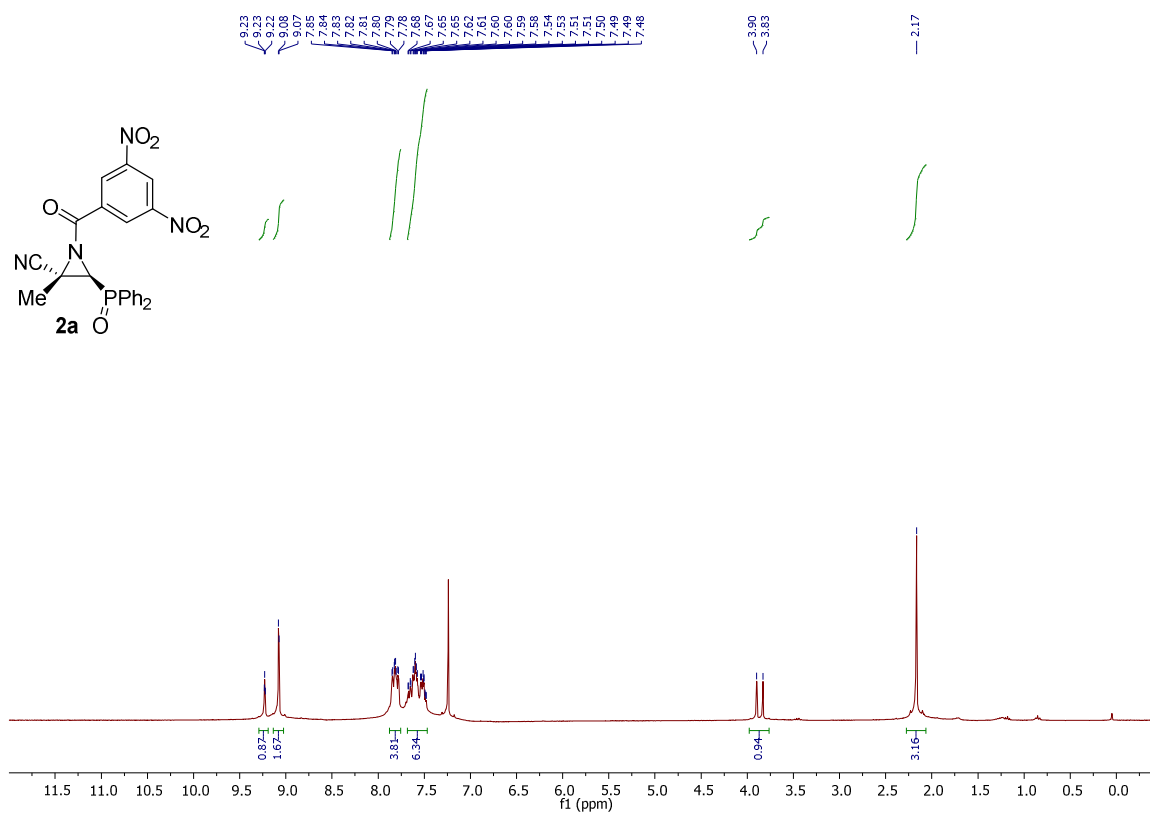
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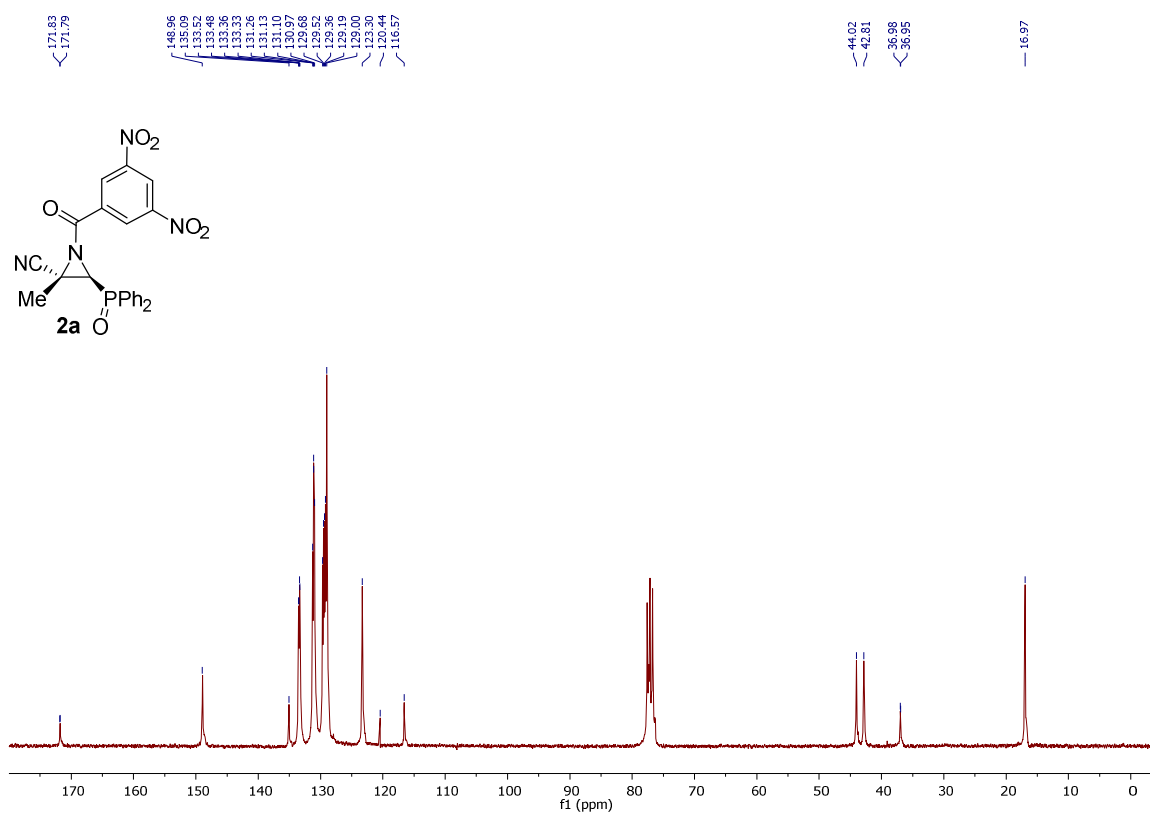
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$^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ) of compound **2a**.



$^{13}\text{C}$  [ $^1\text{H}$ ] NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **2a**.

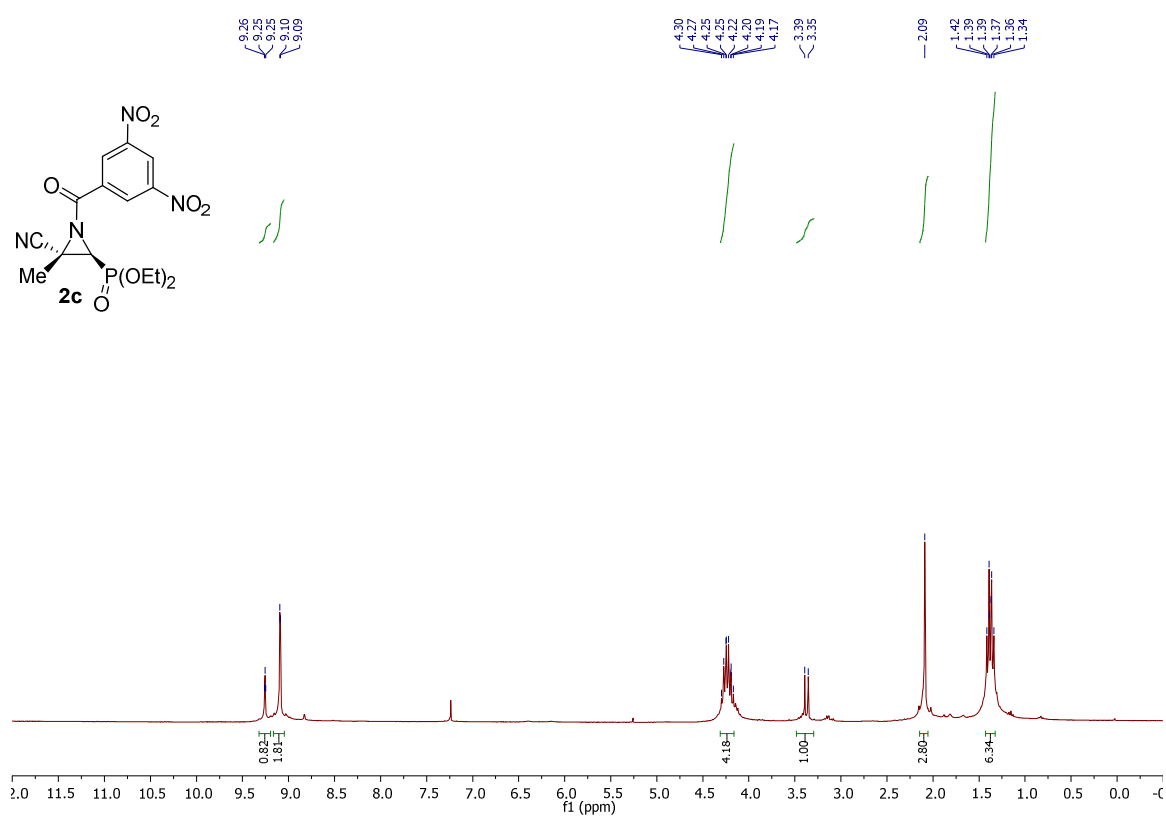


CC[C@H]1N(C(=O)c2ccc([N+](=O)[O-])cc2)C(=O)P(=O)(c3ccccc3)c3ccccc31  
**2b**

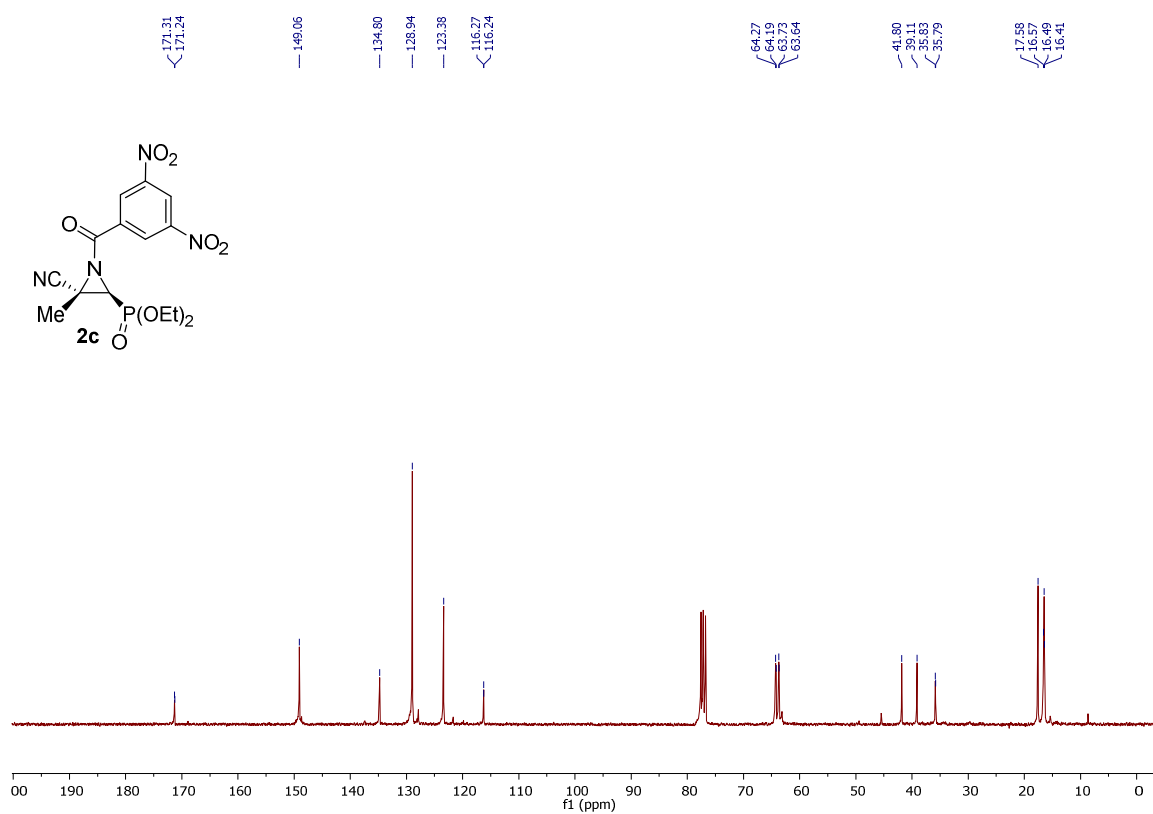
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 135.08  
 133.46  
 133.43  
 133.27  
 133.23  
 131.18  
 131.16  
 131.08  
 131.05  
 129.64  
 129.47  
 129.31  
 129.20  
 128.44  
 123.36  
 115.60  
 44.25  
 43.19  
 43.16  
 43.03  
 24.16  
 10.50

f1 (ppm)

$^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ) of compound **2c**.



$^{13}\text{C}$   $\{^1\text{H}\}$  NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **2c**.



**Chemical structure of 3a:** CN1C(=O)C(c2cc([N+](=O)[O-])cc([N+](=O)[O-])c2)OC1P(=O)(c3ccccc3)c4ccccc4

**<sup>1</sup>H NMR spectrum (CDCl<sub>3</sub>):**

- Chemical shifts (ppm):** 9.20, 9.19, 9.18, 9.17, 9.16, 9.15, 9.14, 9.13, 9.12, 9.11, 9.10, 9.09, 9.08, 9.07, 9.06, 9.05, 9.04, 9.03, 9.02, 9.01, 9.00, 8.99, 8.98, 8.97, 8.96, 8.95, 8.94, 8.93, 8.92, 8.91, 8.90, 8.89, 8.88, 8.87, 8.86, 8.85, 8.84, 8.83, 8.82, 8.81, 8.80, 8.79, 8.78, 8.77, 8.76, 8.75, 8.74, 8.73, 8.72, 8.71, 8.70, 8.69, 8.68, 8.67, 8.66, 8.65, 8.64, 8.63, 8.62, 8.61, 8.60, 8.59, 8.58, 8.57, 8.56, 8.55, 8.54, 8.53, 8.52, 8.51, 8.50, 8.49, 8.48, 8.47, 8.46, 8.45, 8.44, 8.43, 8.42, 8.41, 8.40, 8.39, 8.38, 8.37, 8.36, 8.35, 8.34, 8.33, 8.32, 8.31, 8.30, 8.29, 8.28, 8.27, 8.26, 8.25, 8.24, 8.23, 8.22, 8.21, 8.20, 8.19, 8.18, 8.17, 8.16, 8.15, 8.14, 8.13, 8.12, 8.11, 8.10, 8.09, 8.08, 8.07, 8.06, 8.05, 8.04, 8.03, 8.02, 8.01, 8.00, 7.99, 7.98, 7.97, 7.96, 7.95, 7.94, 7.93, 7.92, 7.91, 7.90, 7.89, 7.88, 7.87, 7.86, 7.85, 7.84, 7.83, 7.82, 7.81, 7.80, 7.79, 7.78, 7.77, 7.76, 7.75, 7.74, 7.73, 7.72, 7.71, 7.70, 7.69, 7.68, 7.67, 7.66, 7.65, 7.64, 7.63, 7.62, 7.61, 7.60, 7.59, 7.58, 7.57, 7.56, 7.55, 7.54, 7.53, 7.52, 7.51, 7.50, 7.49, 7.48, 7.47, 7.46, 7.45, 7.44, 7.43, 7.42, 7.41, 7.40, 7.39, 7.38, 7.37, 7.36, 7.35, 7.34, 7.33, 7.32, 7.31, 7.30, 7.29, 7.28, 7.27, 7.26, 7.25, 7.24, 7.23, 7.22, 7.21, 7.20, 7.19, 7.18, 7.17, 7.16, 7.15, 7.14, 7.13, 7.12, 7.11, 7.10, 7.09, 7.08, 7.07, 7.06, 7.05, 7.04, 7.03, 7.02, 7.01, 7.00, 6.99, 6.98, 6.97, 6.96, 6.95, 6.94, 6.93, 6.92, 6.91, 6.90, 6.89, 6.88, 6.87, 6.86, 6.85, 6.84, 6.83, 6.82, 6.81, 6.80, 6.79, 6.78, 6.77, 6.76, 6.75, 6.74, 6.73, 6.72, 6.71, 6.70, 6.69, 6.68, 6.67, 6.66, 6.65, 6.64, 6.63, 6.62, 6.61, 6.60, 6.59, 6.58, 6.57, 6.56, 6.55, 6.54, 6.53, 6.52, 6.51, 6.50, 6.49, 6.48, 6.47, 6.46, 6.45, 6.44, 6.43, 6.42, 6.41, 6.40, 6.39, 6.38, 6.37, 6.36, 6.35, 6.34, 6.33, 6.32, 6.31, 6.30, 6.29, 6.28, 6.27, 6.26, 6.25, 6.24, 6.23, 6.22, 6.21, 6.20, 6.19, 6.18, 6.17, 6.16, 6.15, 6.14, 6.13, 6.12, 6.11, 6.10, 6.09, 6.08, 6.07, 6.06, 6.05, 6.04, 6.03, 6.02, 6.01, 6.00, 5.99, 5.98, 5.97, 5.96, 5.95, 5.94, 5.93, 5.92, 5.91, 5.90, 5.89, 5.88, 5.87, 5.86, 5.85, 5.84, 5.83, 5.82, 5.81, 5.80, 5.79, 5.78, 5.77, 5.76, 5.75, 5.74, 5.73, 5.72, 5.71, 5.70, 5.69, 5.68, 5.67, 5.66, 5.65, 5.64, 5.63, 5.62, 5.61, 5.60, 5.59, 5.58, 5.57, 5.56, 5.55, 5.54, 5.53, 5.52, 5.51, 5.50, 5.49, 5.48, 5.47, 5.46, 5.45, 5.44, 5.43, 5.42, 5.41, 5.40, 5.39, 5.38, 5.37, 5.36, 5.35, 5.34, 5.33, 5.32, 5.31, 5.30, 5.29, 5.28, 5.27, 5.26, 5.25, 5.24, 5.23, 5.22, 5.21, 5.20, 5.19, 5.18, 5.17, 5.16, 5.15, 5.14, 5.13, 5.12, 5.11, 5.10, 5.09, 5.08, 5.07, 5.06, 5.05, 5.04, 5.03, 5.02, 5.01, 5.00, 4.99, 4.98, 4.97, 4.96, 4.95, 4.94, 4.93, 4.92, 4.91, 4.90, 4.89, 4.88, 4.87, 4.86, 4.85, 4.84, 4.83, 4.82, 4.81, 4.80, 4.79, 4.78, 4.77, 4.76, 4.75, 4.74, 4.73, 4.72, 4.71, 4.70, 4.69, 4.68, 4.67, 4.66, 4.65, 4.64, 4.63, 4.62, 4.61, 4.60, 4.59, 4.58, 4.57, 4.56, 4.55, 4.54, 4.53, 4.52, 4.51, 4.50, 4.49, 4.48, 4.47, 4.46, 4.45, 4.44, 4.43, 4.42, 4.41, 4.40, 4.39, 4.38, 4.37, 4.36, 4.35, 4.34, 4.33, 4.32, 4.31, 4.30, 4.29, 4.28, 4.27, 4.26, 4.25, 4.24, 4.23, 4.22, 4.21, 4.20, 4.19, 4.18, 4.17, 4.16, 4.15, 4.14, 4.13, 4.12, 4.11, 4.10, 4.09, 4.08, 4.07, 4.06, 4.05, 4.04, 4.03, 4.02, 4.01, 4.00, 3.99, 3.98, 3.97, 3.96, 3.95, 3.94, 3.93, 3.92, 3.91, 3.90, 3.89, 3.88, 3.87, 3.86, 3.85, 3.84, 3.83, 3.82, 3.81, 3.80, 3.79, 3.78, 3.77, 3.76, 3.75, 3.74, 3.73, 3.72, 3.71, 3.70, 3.69, 3.68, 3.67, 3.66, 3.65, 3.64, 3.63, 3.62, 3.61, 3.60, 3.59, 3.58, 3.57, 3.56, 3.55, 3.54, 3.53, 3.52, 3.51, 3.50, 3.49, 3.48, 3.47, 3.46, 3.45, 3.44, 3.43, 3.42, 3.41, 3.40, 3.39, 3.38, 3.37, 3.36, 3.35, 3.34, 3.33, 3.32, 3.31, 3.30, 3.29, 3.28, 3.27, 3.26, 3.25, 3.24, 3.23, 3.22, 3.21, 3.20, 3.19, 3.18, 3.17, 3.16, 3.15, 3.14, 3.13, 3.12, 3.11, 3.10, 3.09, 3.08, 3.07, 3.06, 3.05, 3.04, 3.03, 3.02, 3.01, 3.00, 2.99, 2.98, 2.97, 2.96,

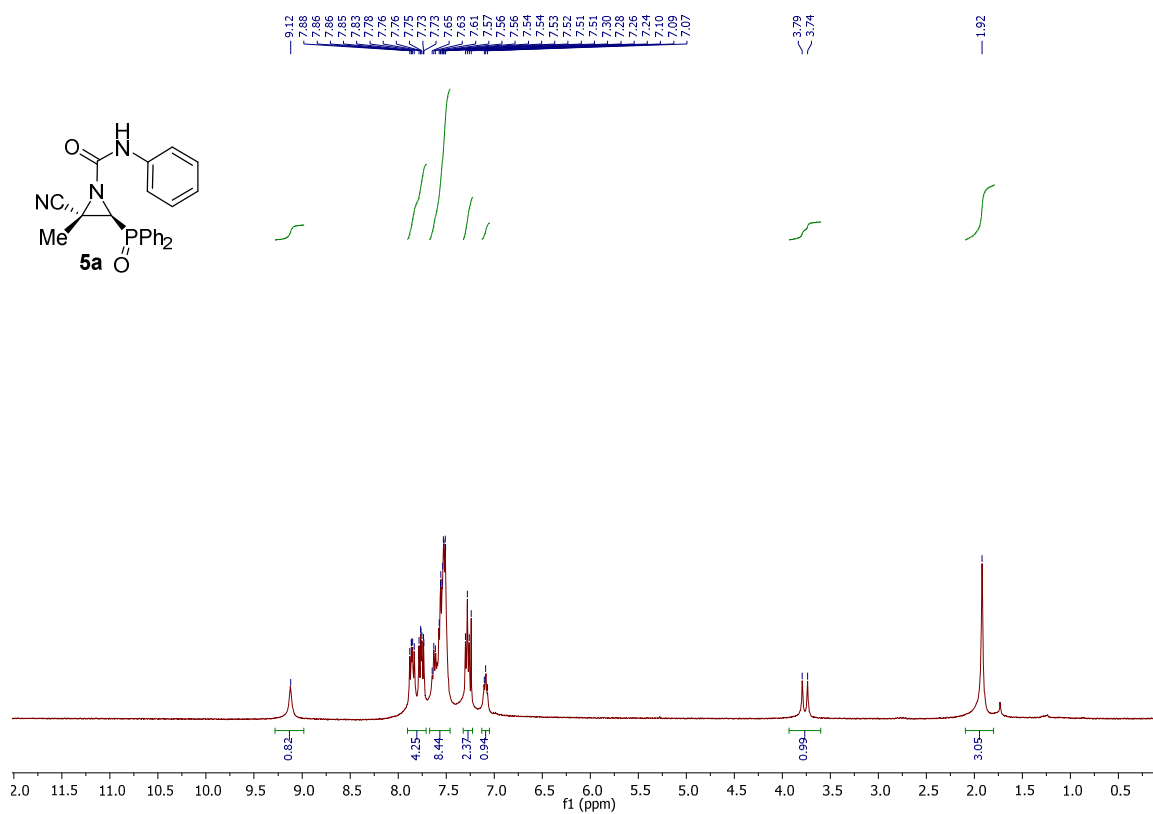
**3a**

C[C@H]1[C@@H](COP(=O)([O-])c2ccccc2)O[C@H](C(=O)c3cc([N+](=O)[O-])ccc3[N+](=O)[O-])N1C#N

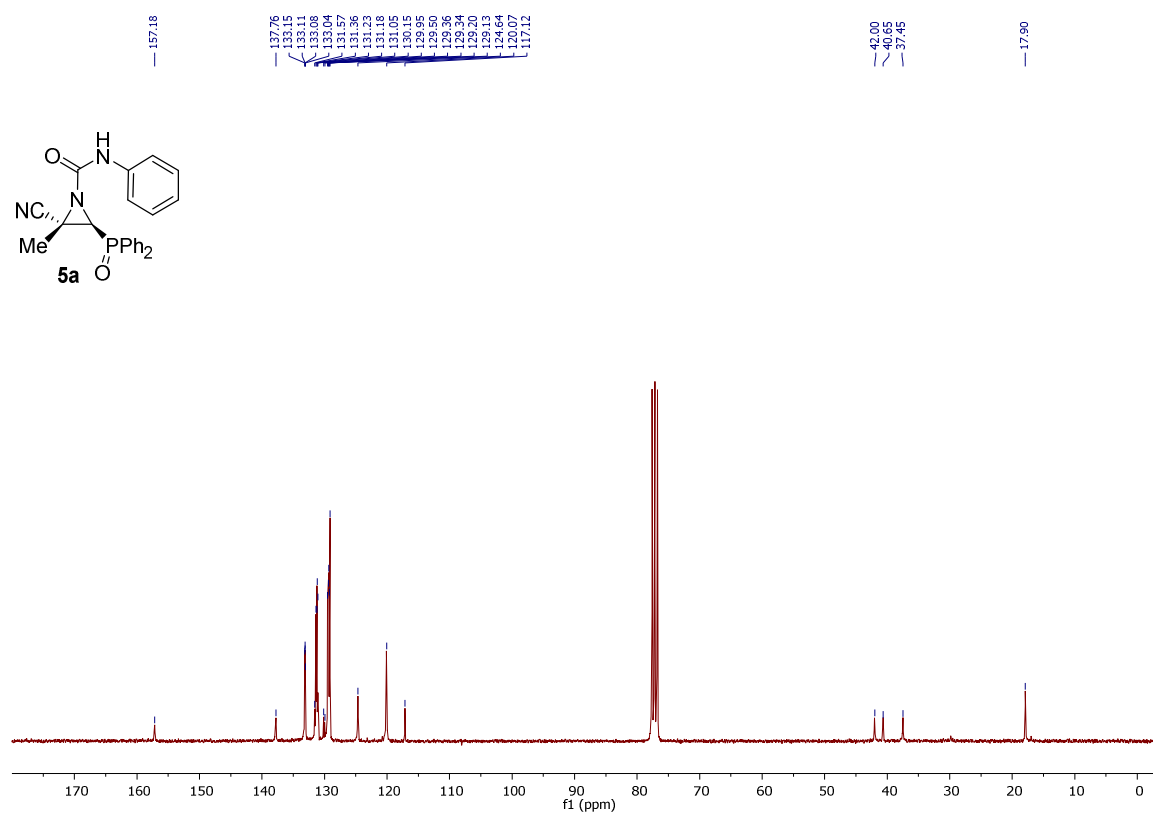
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128.3970  
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119.8691  
119.7501  
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23.0549  
22.9856

f1 (ppm)

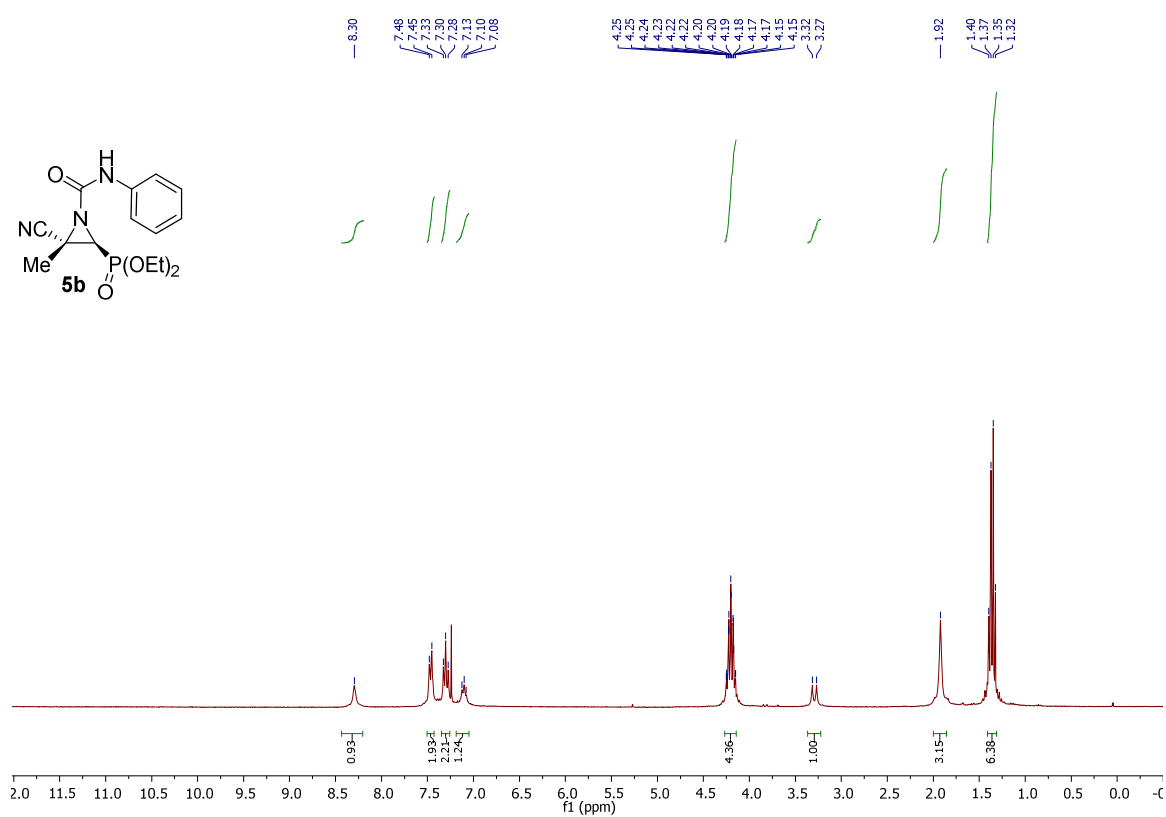
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ) of compound **5a**.



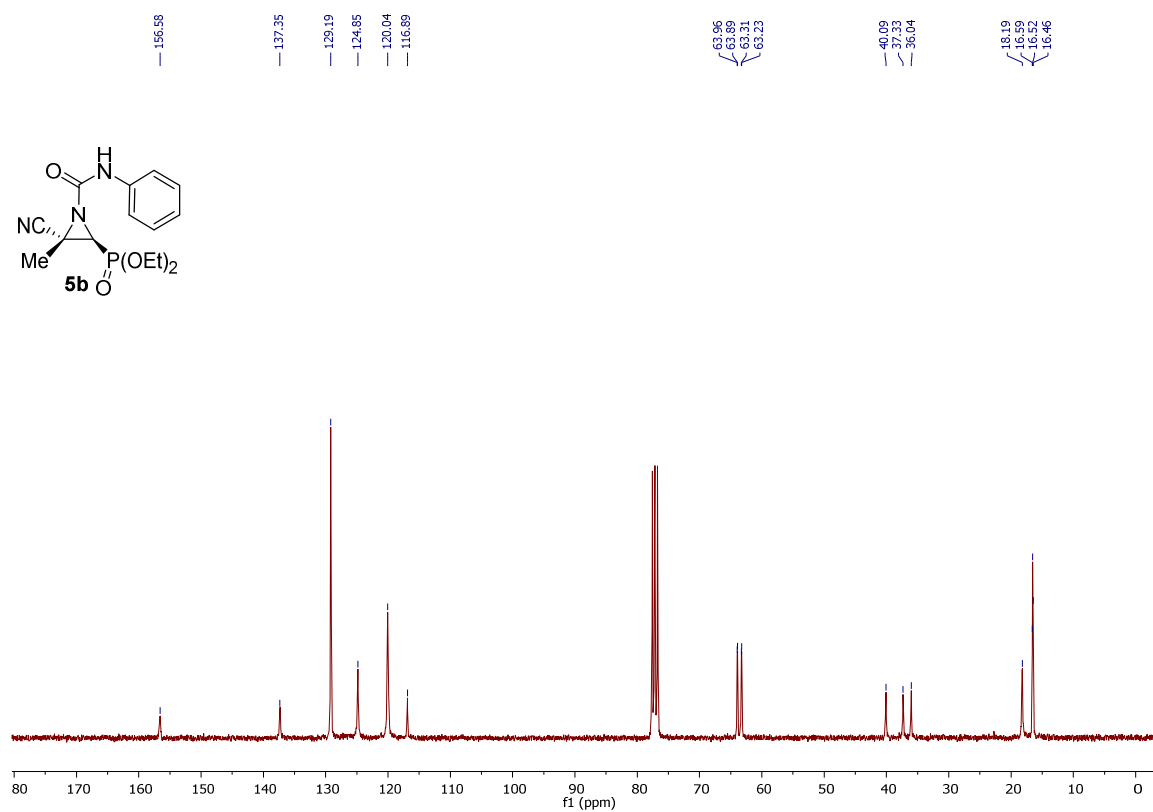
$^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **5a**.



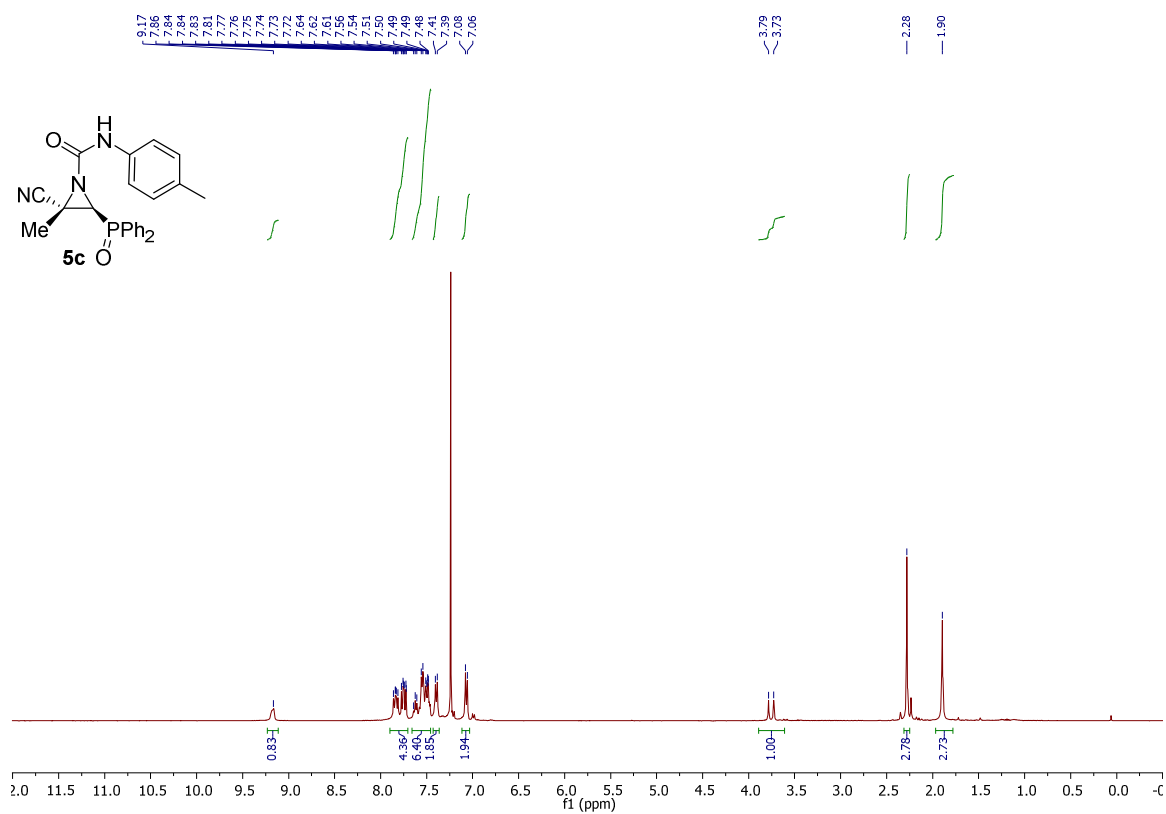
$^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ) of compound **5b**.



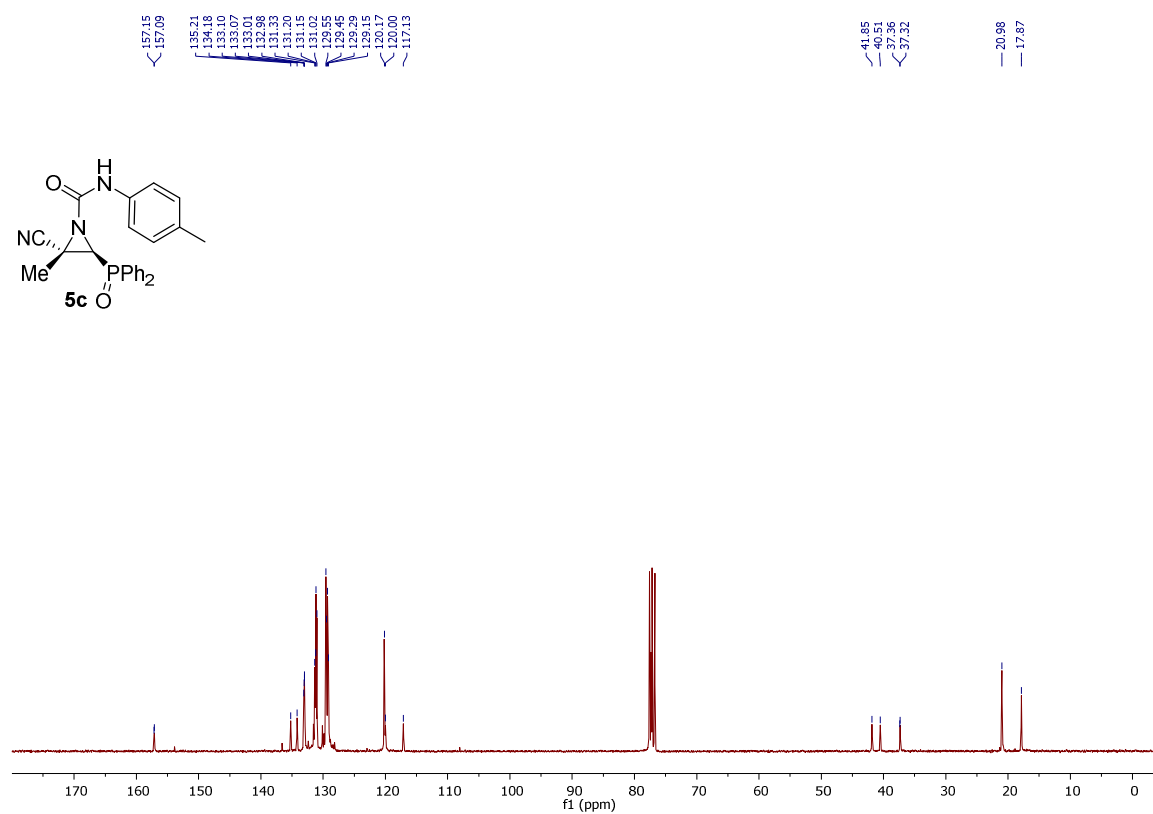
$^{13}\text{C}$   $\{^1\text{H}\}$  NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **5b**.



$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ) of compound **5c**.

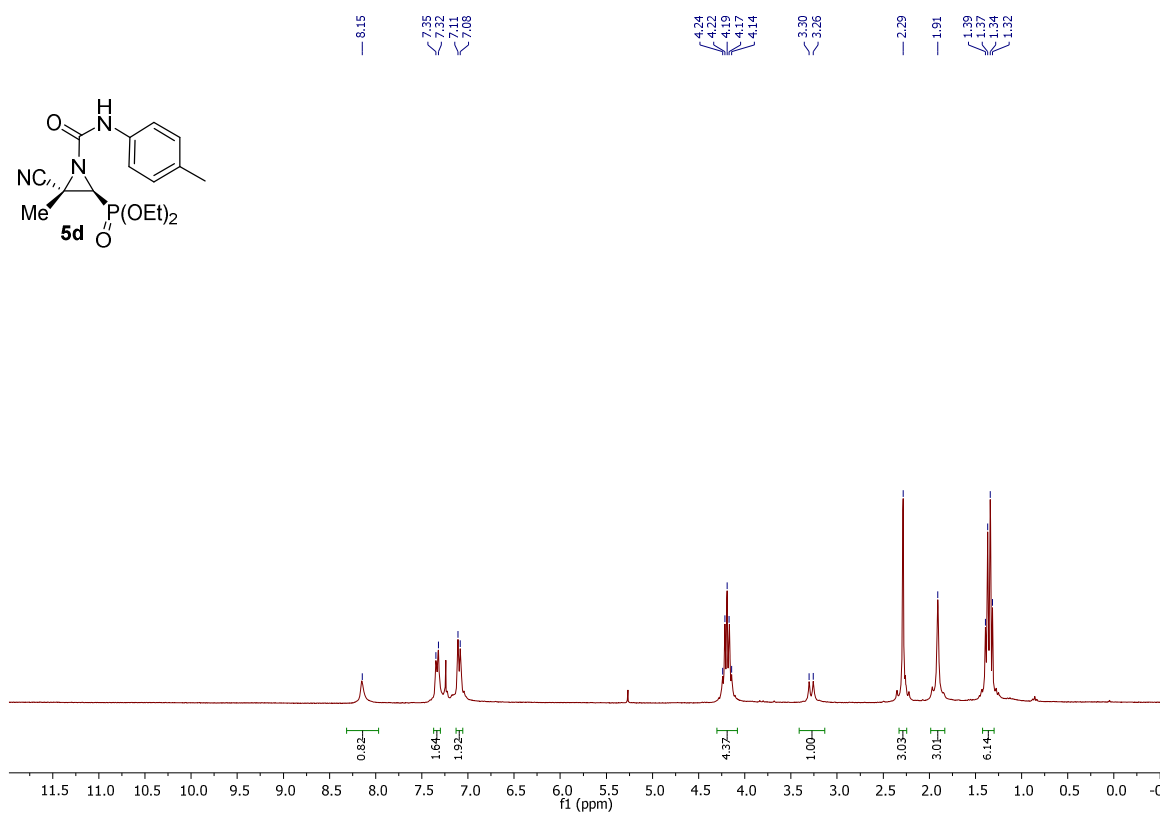


$^{13}\text{C}$  [ $^1\text{H}$ ] NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **5c**.

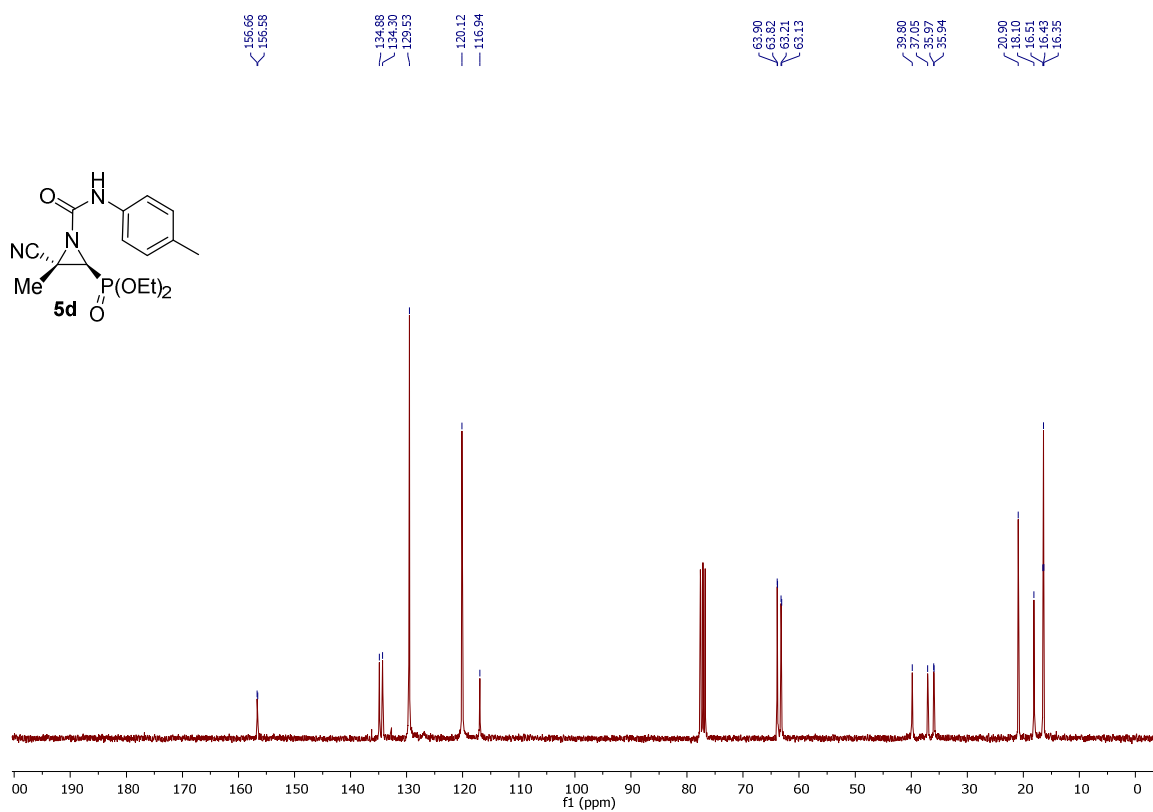




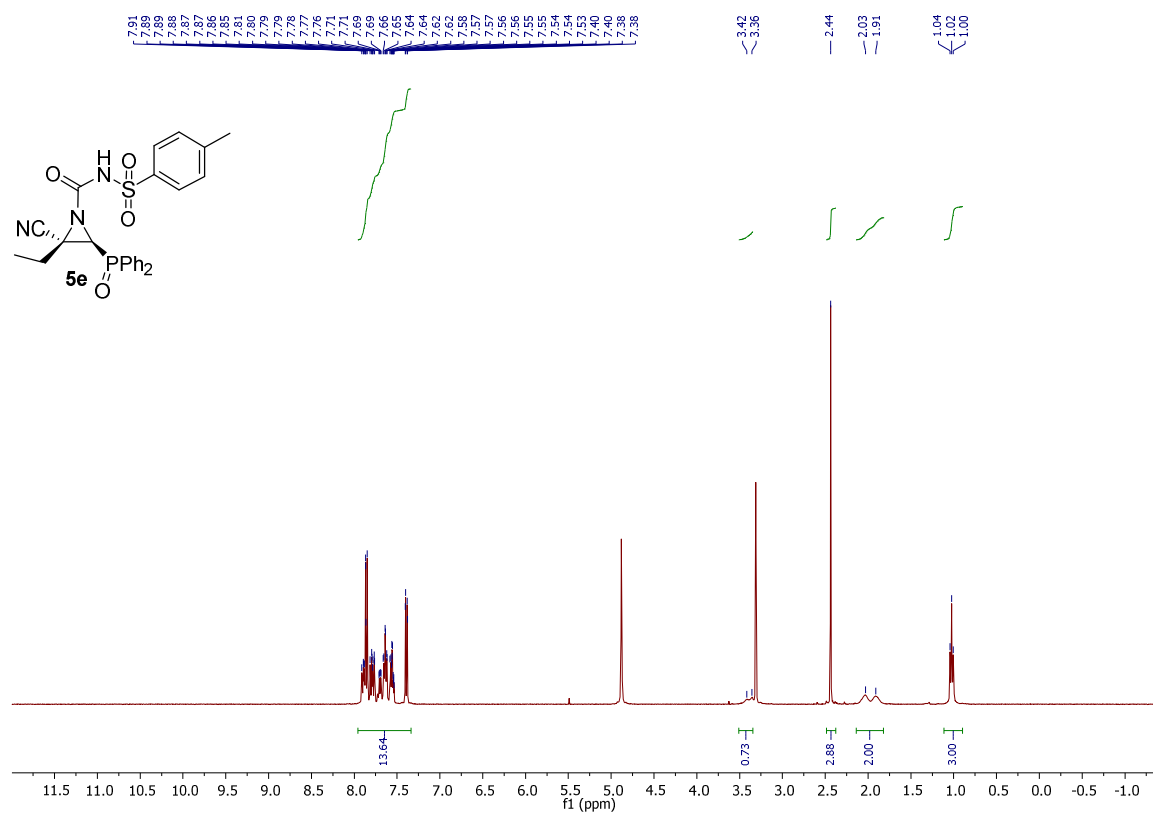
$^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ) of compound **5d**.



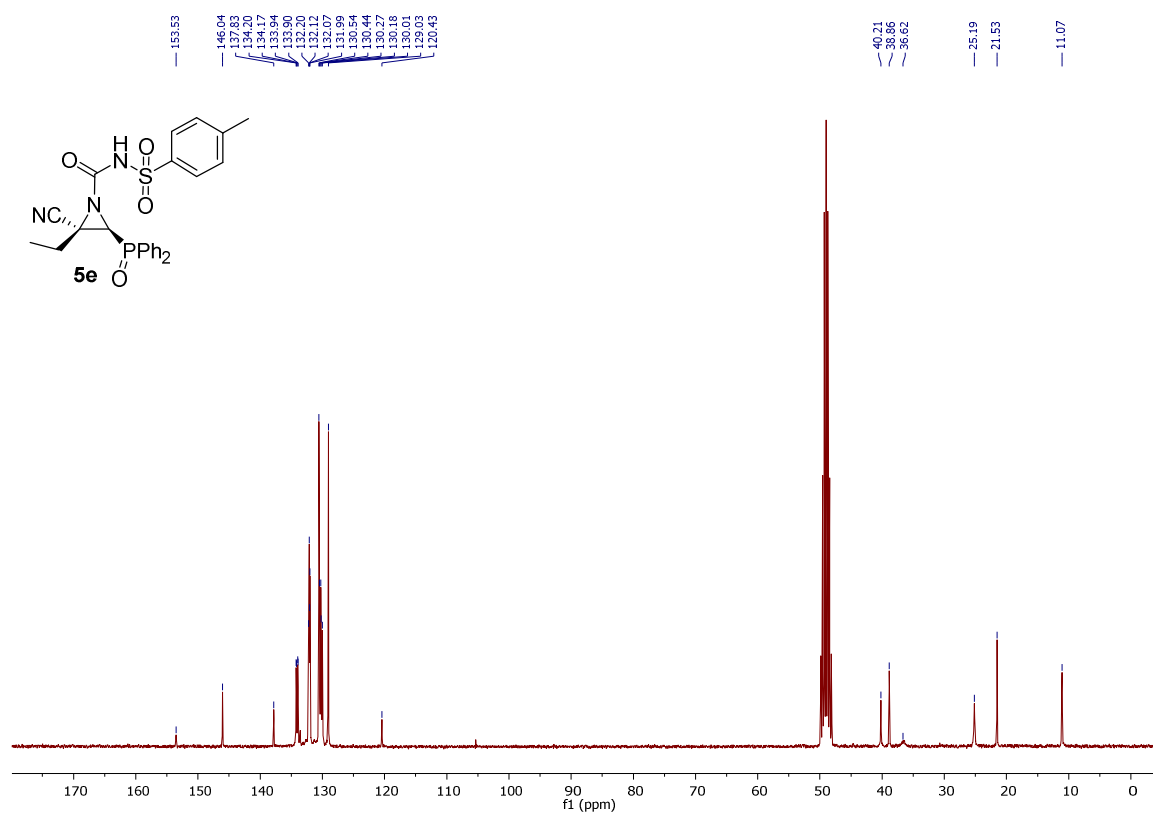
$^{13}\text{C}$  [ $^1\text{H}$ ] NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **5d**.



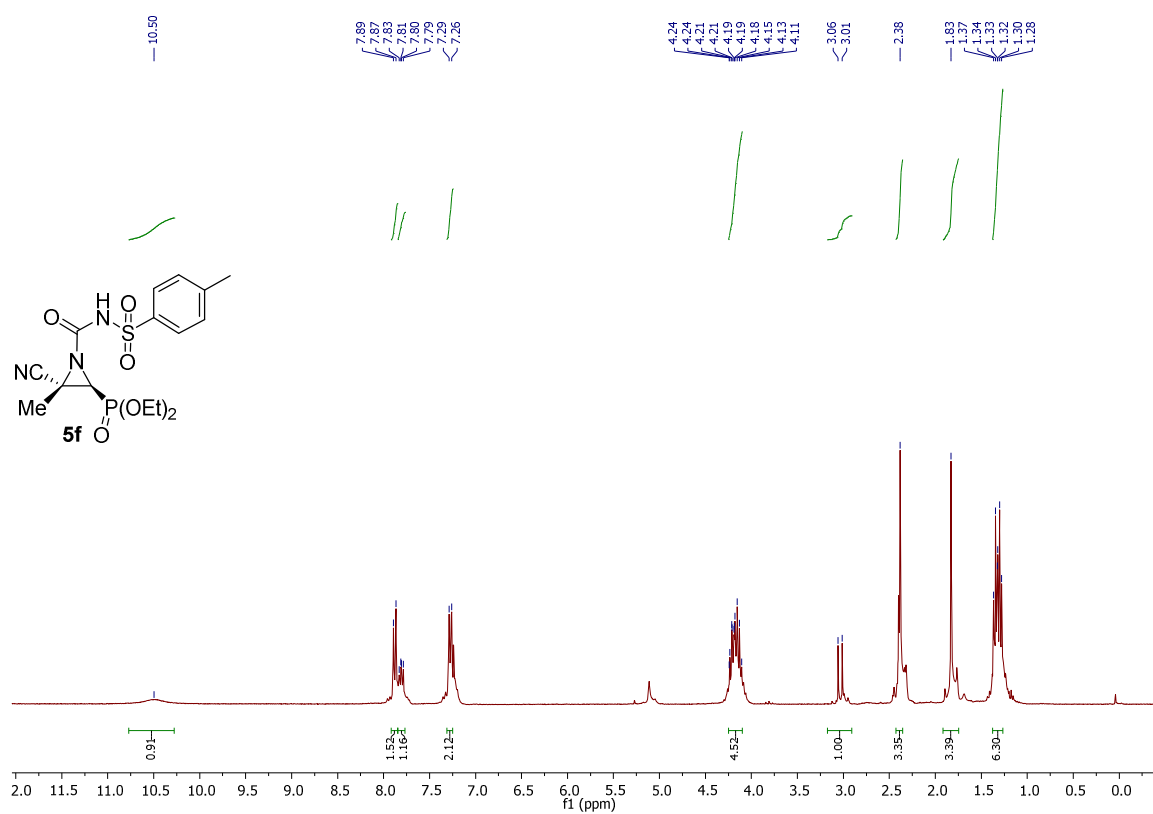
$^1\text{H}$  NMR (400 MHz, MeOD) of compound **5e**.



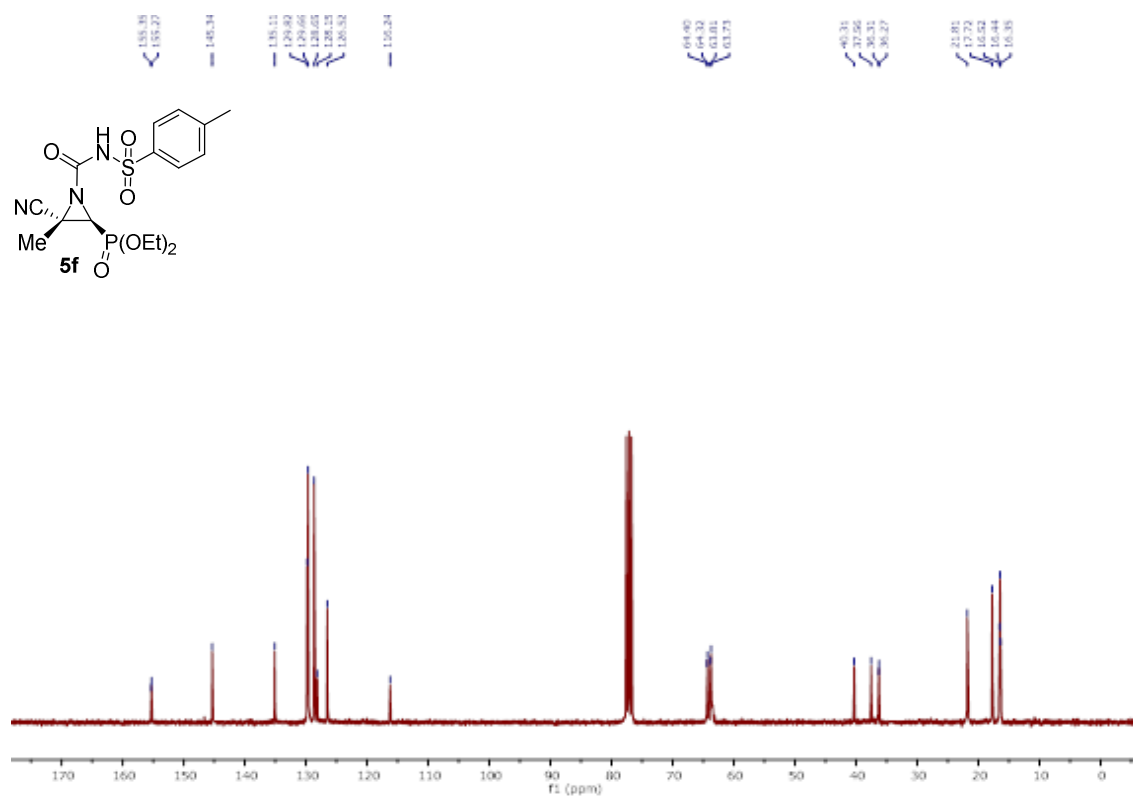
$^{13}\text{C}$   $\{^1\text{H}\}$  NMR (75 MHz, MeOD) of compound **5e**.



$^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ) of compound **5f**.



$^{13}\text{C}$  [ $^1\text{H}$ ] NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **5f**.



CCNC(=O)N1C(C#N)C1(C)P(=O)(O)P(c1ccccc1)c2ccccc2

**5g**

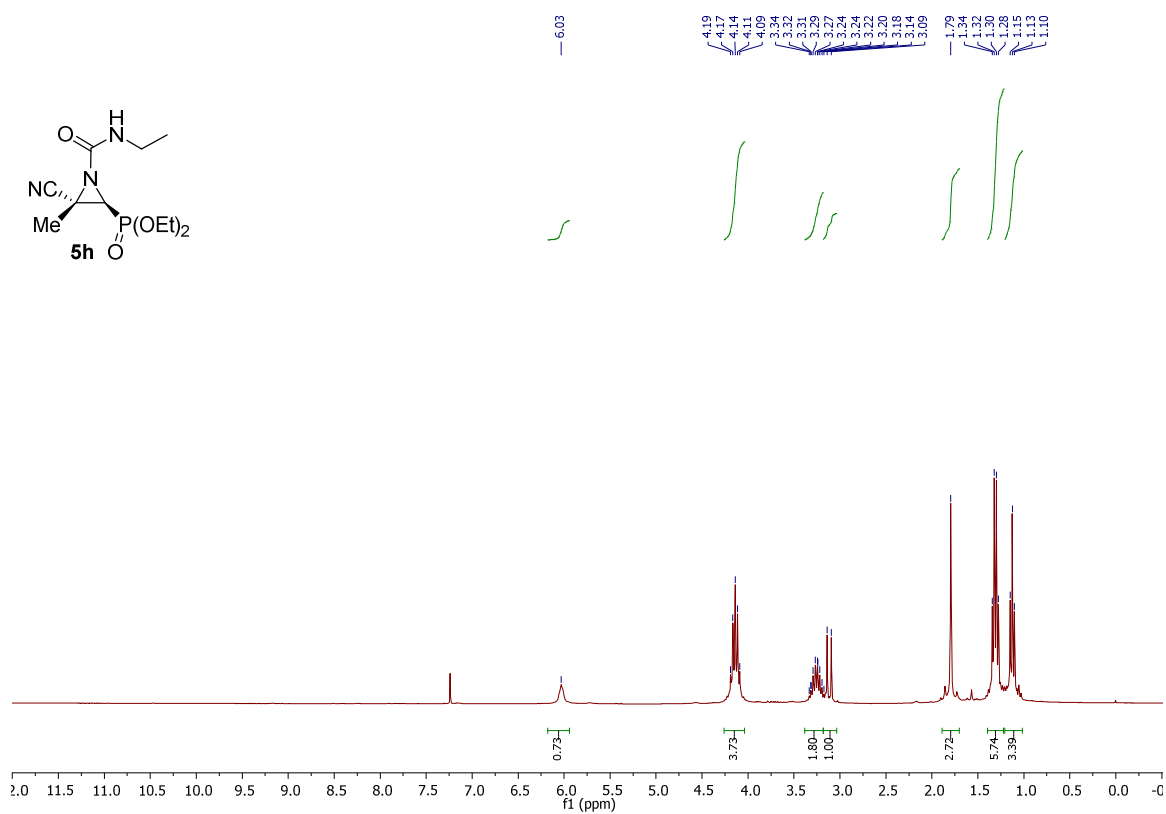
<sup>1</sup>H NMR spectrum (CDCl<sub>3</sub>) of compound **5g**. The spectrum shows peaks at 1.13 ppm (triplet, 3H, integration 3.00), 1.15 ppm (triplet, 3H, integration 3.00), 2.00 ppm (singlet, 1H, integration 0.95), 3.37 ppm (doublet, 2H, integration 2.11), 3.57 ppm (doublet, 2H, integration 1.00), 7.46 ppm (triplet, 3H, integration 6.00), 7.53 ppm (triplet, 3H, integration 6.00), and 7.58 ppm (triplet, 3H, integration 4.00).

CCNC(=O)N1[C@H](C)C(=O)P1(c2ccccc2)c3ccccc3

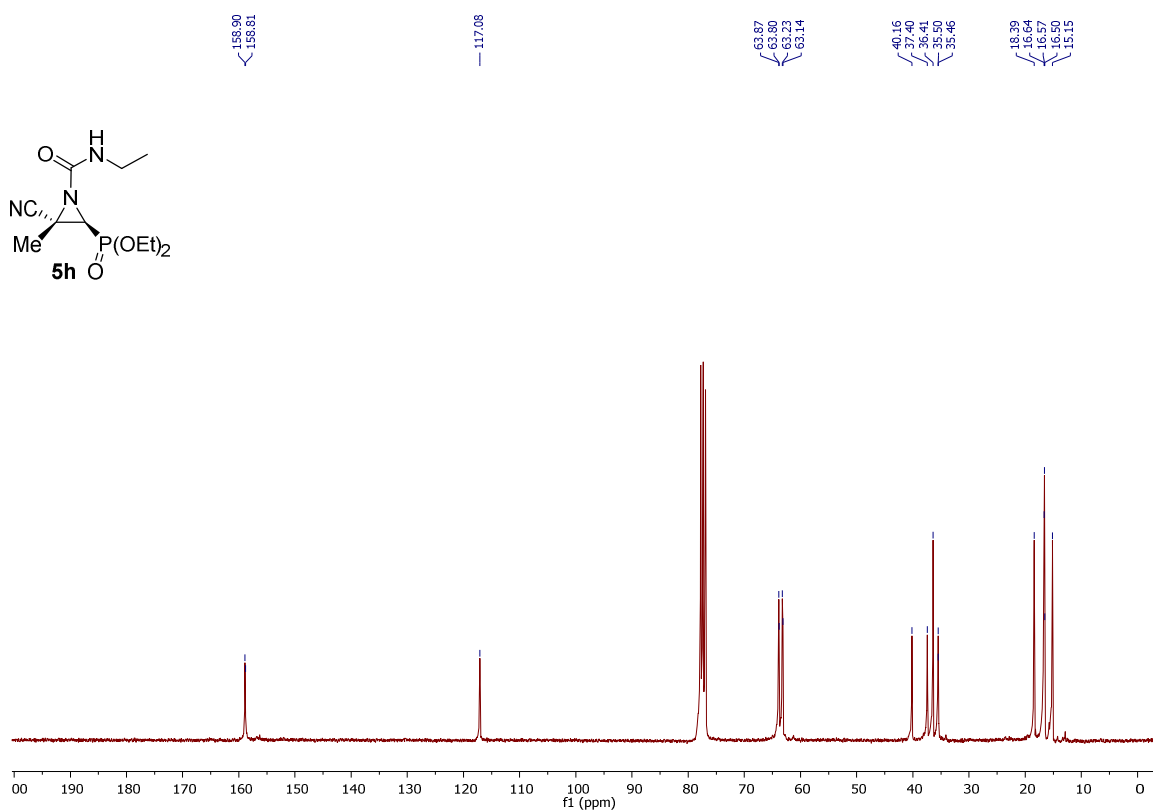
Chemical structure of **5g** (N-ethyl-1-methyl-2-oxo-2-phenylphosphorinane-1-carboxamide) is shown. The structure features a five-membered ring containing a phosphorus atom double-bonded to an oxygen atom and single-bonded to a methyl group, a carbonyl group, and a nitrogen atom substituted with an ethyl group. A phenyl group is attached to the phosphorus atom.

The <sup>13</sup>C NMR spectrum (CDCl<sub>3</sub>) shows the following chemical shifts (ppm): 159.11, 158.14, 132.97, 132.96, 132.95, 132.94, 132.93, 132.92, 132.91, 132.90, 132.89, 132.88, 132.87, 132.86, 132.85, 132.84, 132.83, 132.82, 132.81, 132.80, 132.79, 132.78, 132.77, 132.76, 132.75, 132.74, 132.73, 132.72, 132.71, 132.70, 132.69, 132.68, 132.67, 132.66, 132.65, 132.64, 132.63, 132.62, 132.61, 132.60, 132.59, 132.58, 132.57, 132.56, 132.55, 132.54, 132.53, 132.52, 132.51, 132.50, 132.49, 132.48, 132.47, 132.46, 132.45, 132.44, 132.43, 132.42, 132.41, 132.40, 132.39, 132.38, 132.37, 132.36, 132.35, 132.34, 132.33, 132.32, 132.31, 132.30, 132.29, 132.28, 132.27, 132.26, 132.25, 132.24, 132.23, 132.22, 132.21, 132.20, 132.19, 132.18, 132.17, 132.16, 132.15, 132.14, 132.13, 132.12, 132.11, 132.10, 132.09, 132.08, 132.07, 132.06, 132.05, 132.04, 132.03, 132.02, 132.01, 132.00, 131.99, 131.98, 131.97, 131.96, 131.95, 131.94, 131.93, 131.92, 131.91, 131.90, 131.89, 131.88, 131.87, 131.86, 131.85, 131.84, 131.83, 131.82, 131.81, 131.80, 131.79, 131.78, 131.77, 131.76, 131.75, 131.74, 131.73, 131.72, 131.71, 131.70, 131.69, 131.68, 131.67, 131.66, 131.65, 131.64, 131.63, 131.62, 131.61, 131.60, 131.59, 131.58, 131.57, 131.56, 131.55, 131.54, 131.53, 131.52, 131.51, 131.50, 131.49, 131.48, 131.47, 131.46, 131.45, 131.44, 131.43, 131.42, 131.41, 131.40, 131.39, 131.38, 131.37, 131.36, 131.35, 131.34, 131.33, 131.32, 131.31, 131.30, 131.29, 131.28, 131.27, 131.26, 131.25, 131.24, 131.23, 131.22, 131.21, 131.20, 131.19, 131.18, 131.17, 131.16, 131.15, 131.14, 131.13, 131.12, 131.11, 131.10, 131.09, 131.08, 131.07, 131.06, 131.05, 131.04, 131.03, 131.02, 131.01, 131.00, 130.99, 130.98, 130.97, 130.96, 130.95, 130.94, 130.93, 130.92, 130.91, 130.90, 130.89, 130.88, 130.87, 130.86, 130.85, 130.84, 130.83, 130.82, 130.81, 130.80, 130.79, 130.78, 130.77, 130.76, 130.75, 130.74, 130.73, 130.72, 130.71, 130.70, 130.69, 130.68, 130.67, 130.66, 130.65, 130.64, 130.63, 130.62, 130.61, 130.60, 130.59, 130.58, 130.57, 130.56, 130.55, 130.54, 130.53, 130.52, 130.51, 130.50, 130.49, 130.48, 130.47, 130.46, 130.45, 130.44, 130.43, 130.42, 130.41, 130.40, 130.39, 130.38, 130.37, 130.36, 130.35, 130.34, 130.33, 130.32, 130.31, 130.30, 130.29, 130.28, 130.27, 130.26, 130.25, 130.24, 130.23, 130.22, 130.21, 130.20, 130.19, 130.18, 130.17, 130.16, 130.15, 130.14, 130.13, 130.12, 130.11, 130.10, 130.09, 130.08, 130.07, 130.06, 130.05, 130.04, 130.03, 130.02, 130.01, 130.00, 129.99, 129.98, 129.97, 129.96, 129.95, 129.94, 129.93, 129.92, 129.91, 129.90, 129.89, 129.88, 129.87, 129.86, 129.85, 129.84, 129.83, 129.82, 129.81, 129.80, 129.79, 129.78, 129.77, 129.76, 129.75, 129.74, 129.73, 129.72, 129.71, 129.70, 129.69, 129.68, 129.67, 129.66, 129.65, 129.64, 129.63, 129.62, 129.61, 129.60, 129.59, 129.58, 129.57, 129.56, 129.55, 129.54, 129.53, 129.52, 129.51, 129.50, 129.49, 129.48, 129.47, 129.46, 129.45, 129.44, 129.43, 129.42, 129.41, 129.40, 129.39, 129.38, 129.37, 129.36, 129.35, 129.34, 129.33, 129.32, 129.31, 129.30, 129.29, 129.28, 129.27, 129.26, 129.25, 129.24, 129.23, 129.22, 129.21, 129.20, 129.19, 129.18, 129.17, 129.16, 129.15, 129.14, 129.13, 129.12, 129.11, 129.10, 129.09, 129.08, 129.07, 129.06, 129.05, 129.04, 129.03, 129.02, 129.01, 129.00, 128.99, 128.98, 128.97, 128.96, 128.95, 128.94, 128.93, 128.92, 128.91, 128.90, 128.89, 128.88, 128.87, 128.86, 128.85, 128.84, 128.83, 128.82, 128.81, 128.80, 128.79, 128.78, 128.77, 128.76, 128.75, 128.74, 128.73, 128.72, 128.71, 128.70, 128.69, 128.68, 128.67, 128.66, 128.65, 128.64, 128.63, 128.62, 128.61, 128.60, 128.59, 128.58, 128.57, 128.56, 128.55, 128.54, 128.53, 128.52, 128.51, 128.50, 128.49, 128.48, 128.47, 128.46, 128.45, 128.44, 128.43, 128.42, 128.41, 128.40, 128.39, 128.38, 128.37, 128.36, 128.35, 128.34, 128.33, 128.32, 128.31, 128.30, 128.29, 128.28, 128.27, 128.26, 128.25, 128.24, 128.23, 128.22, 128.21, 128.20, 128.19, 128.18, 128.17, 128.16, 128.15, 128.14, 128.13, 128.12, 128.11, 128.

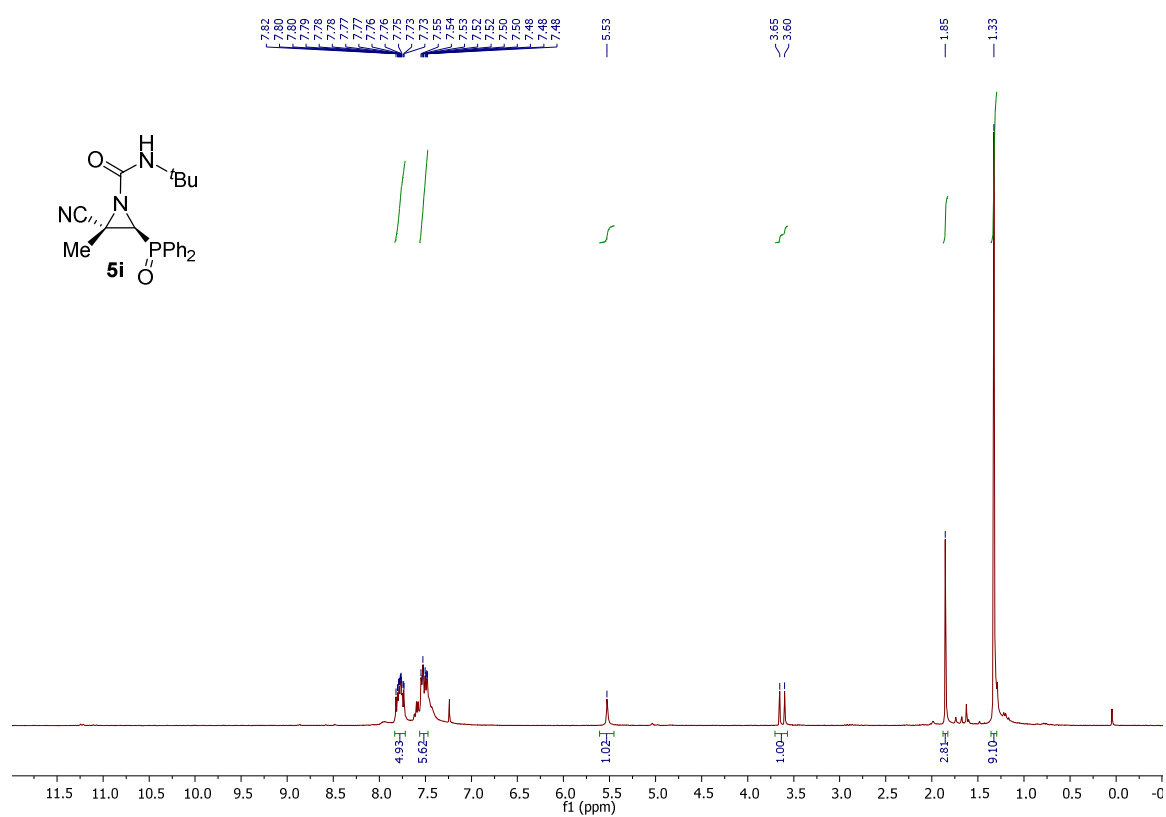
$^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ) of compound **5h**.



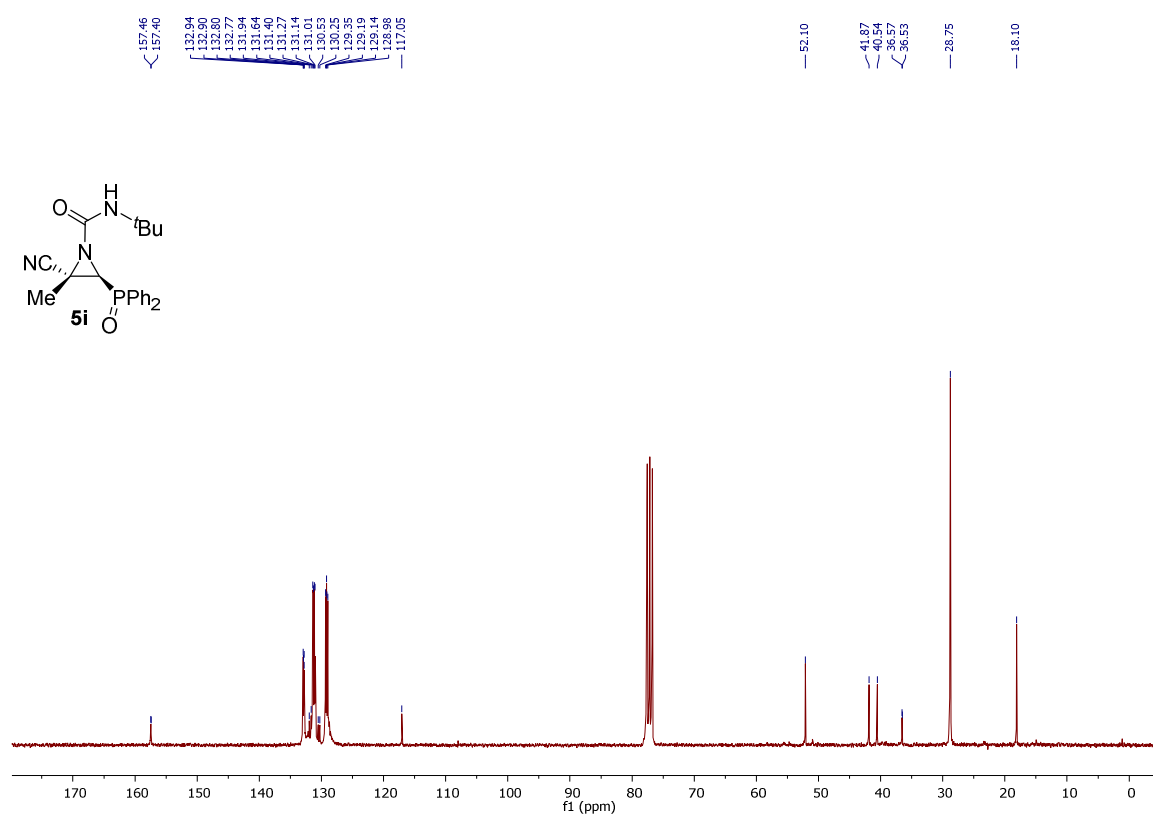
$^{13}\text{C}$  [ $^1\text{H}$ ] NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **5h**.



$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ) of compound **5i**.



$^{13}\text{C}$   $\{^1\text{H}\}$  NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **5i**.



**Figure S10.** <sup>1</sup>H NMR spectrum of compound **5j** in CDCl<sub>3</sub>. The chemical structure of **5j** is shown in the inset. The spectrum displays peaks corresponding to the structure, with integration values and chemical shifts (ppm) indicated above the peaks.


**Chemical structure of 5j:** CC1(C)N(C(=O)N(C)C)C(=O)P1(=O)OCC

**Peak Data:**

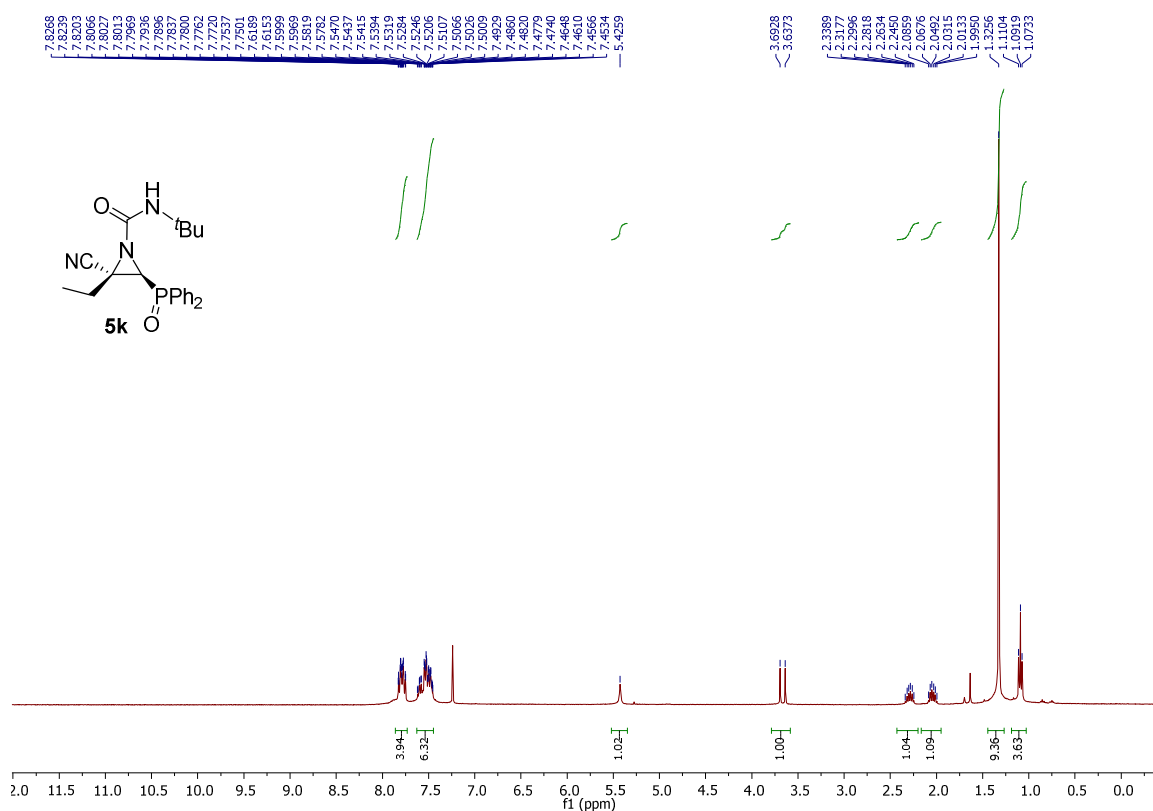
Chemical Shift (ppm)	Integration
7.25	1.04
5.45	1.04
4.21, 4.18, 4.13, 4.11	4.26
3.16, 3.11	1.00
1.81	3.35
1.36, 1.33, 1.32, 1.30	14.98

Chemical structure of **5j** is shown above the spectrum. The spectrum displays peaks corresponding to the structure, with chemical shifts (ppm) labeled above the peaks:

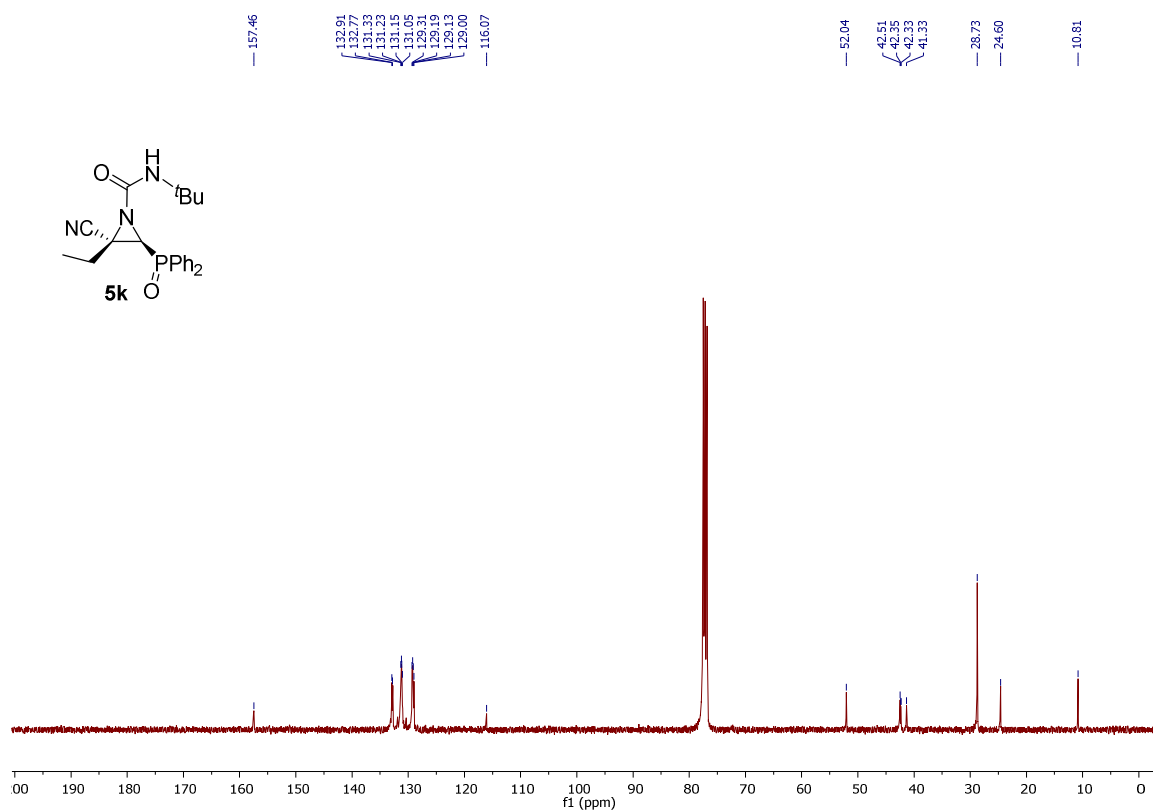
- 157.13, 157.04 (Carbonyl carbons)
- 116.90, 116.87 (N-alkene carbons)
- 63.71, 63.63, 63.04, 62.95 (Methoxy carbons)
- 52.07 (Methoxy carbon)
- 39.66, 36.90, 35.37, 35.32 (Methyl carbons)
- 28.75 (Methyl carbon)
- 18.40, 16.56, 16.48, 16.41 (Methyl carbons)

CC(C)(C)NC(=O)N1[C@H](C#N)[C@@H](C)P1(=O)OCC

$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ) of compound **5k**.

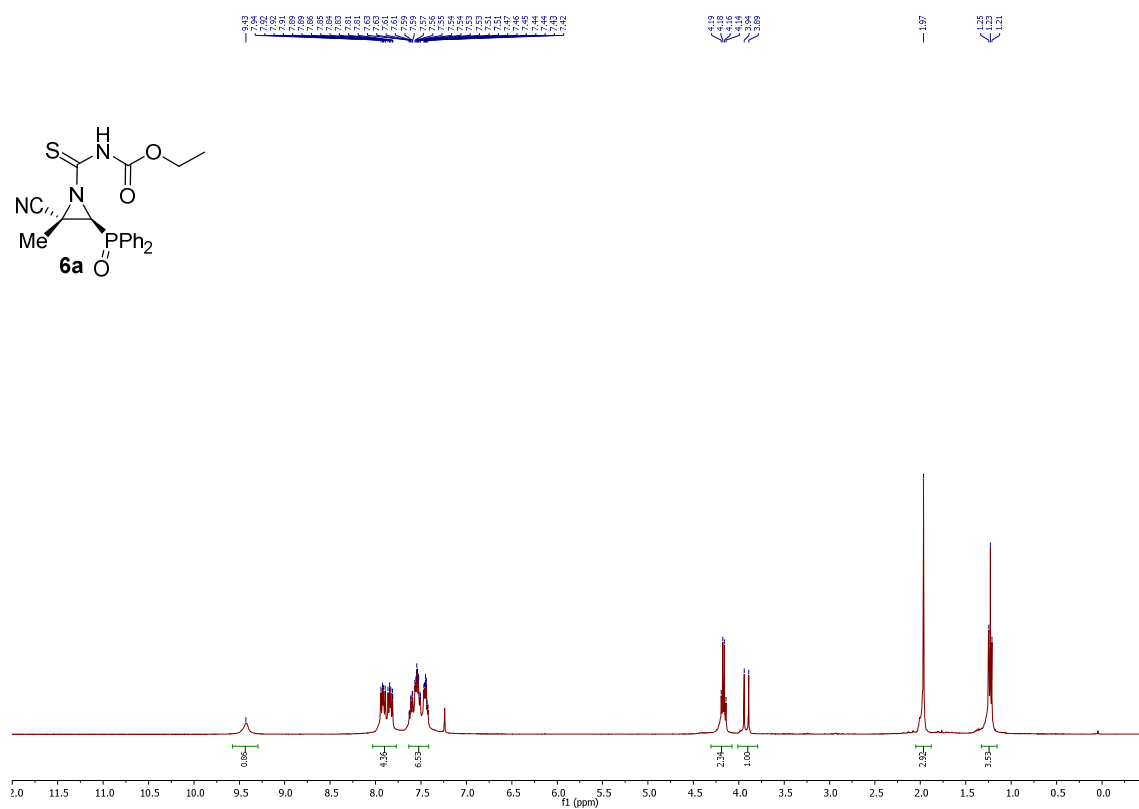


$^{13}\text{C}$  [ $^1\text{H}$ ] NMR (100 MHz,  $\text{CDCl}_3$ ) of compound **5k**.

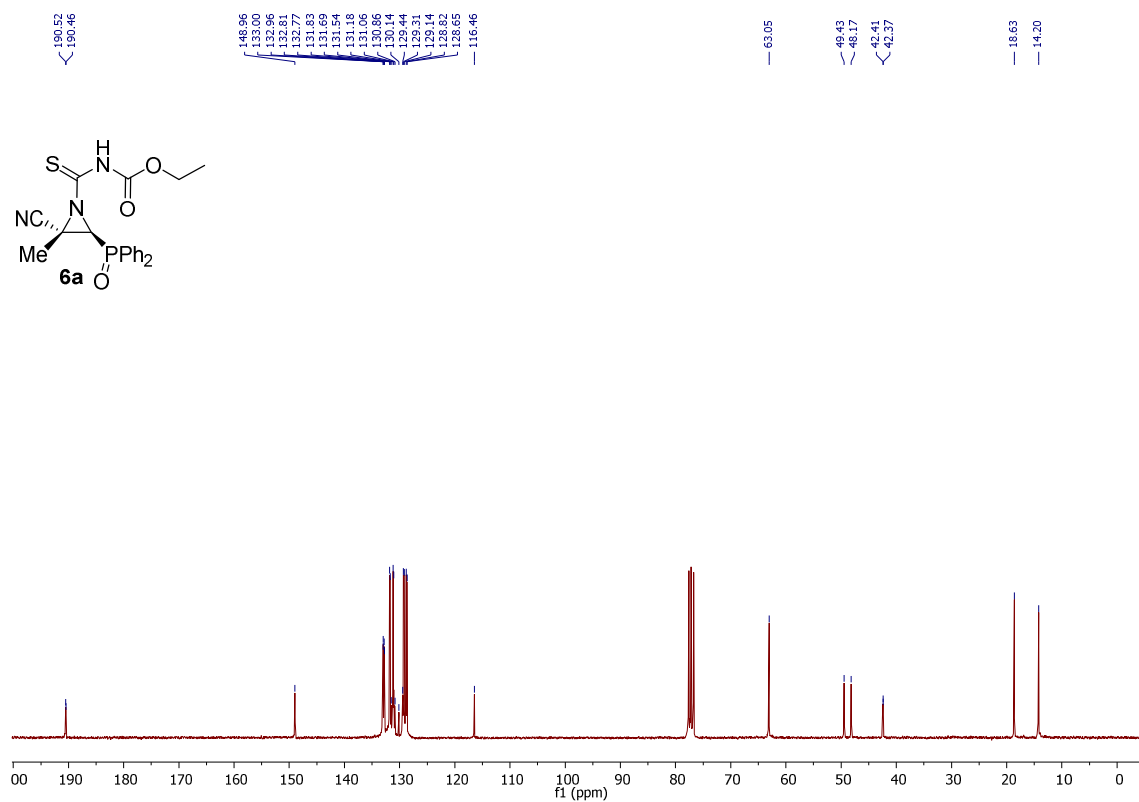




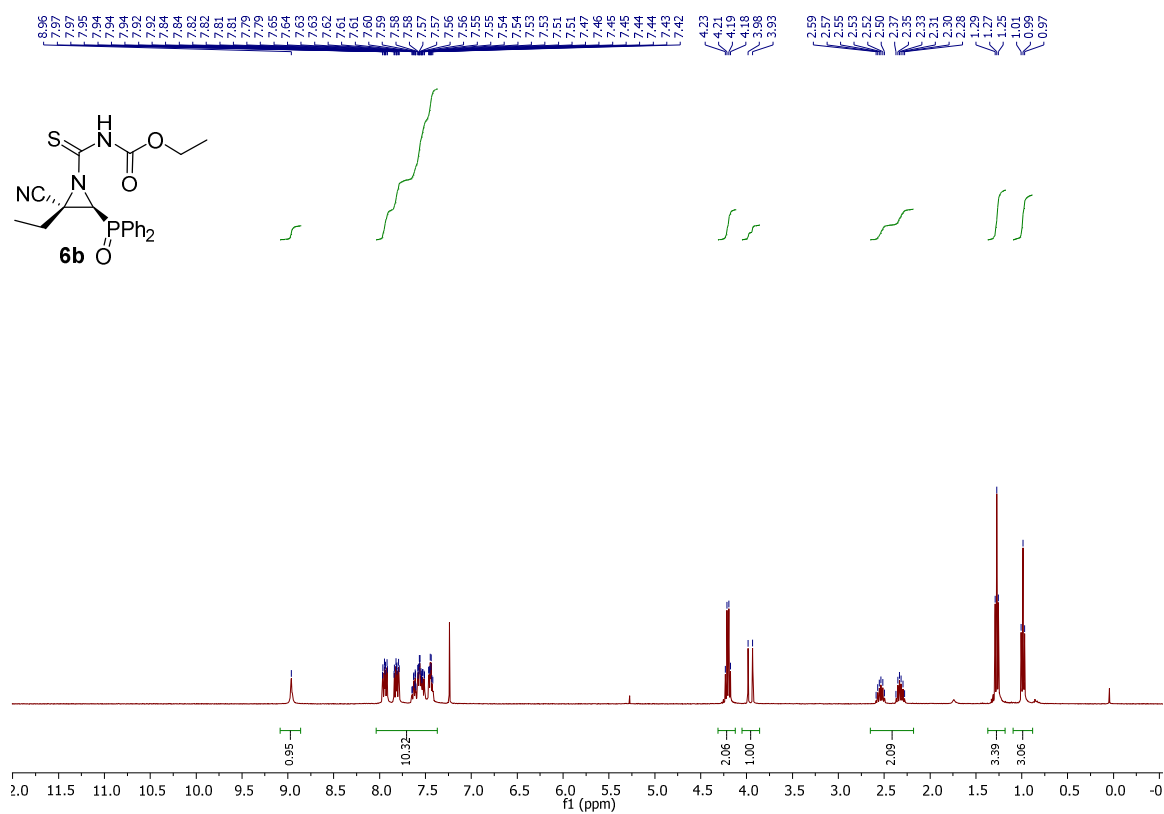
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ) of compound **6a**.



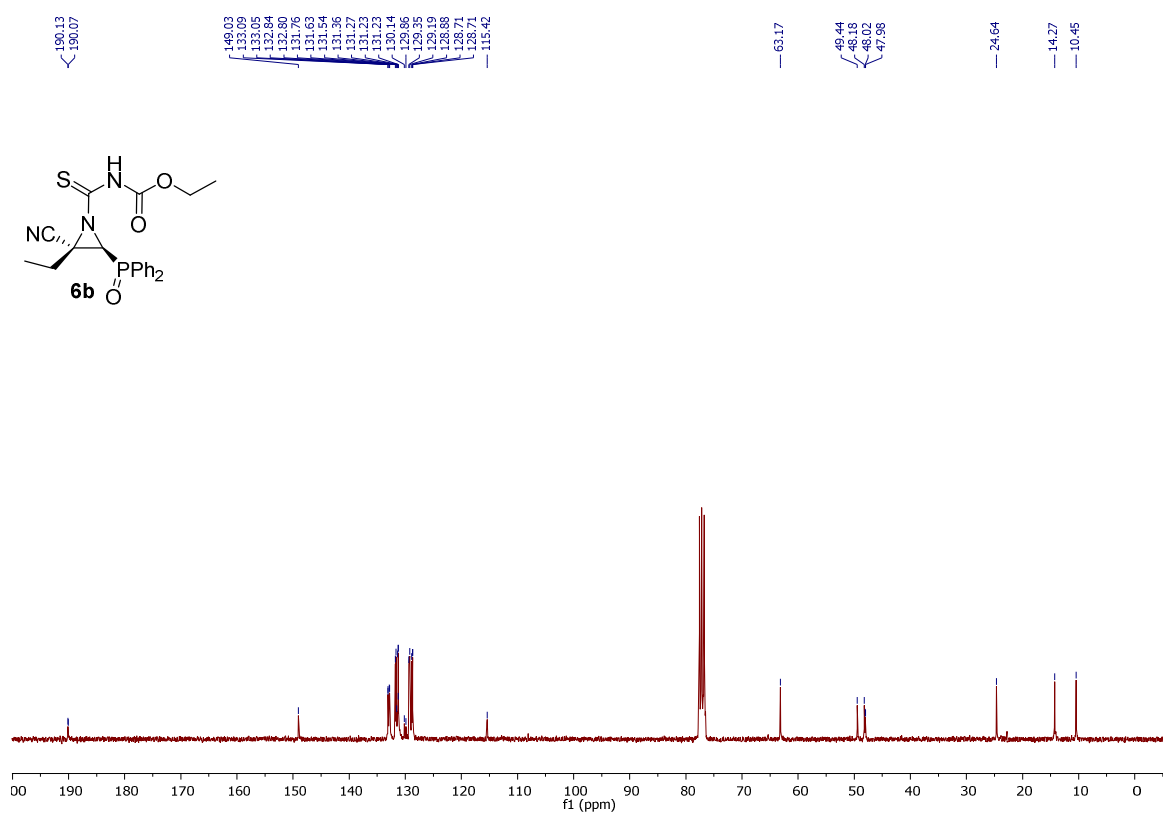
$^{13}\text{C}$   $\{^1\text{H}\}$  NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **6a**.



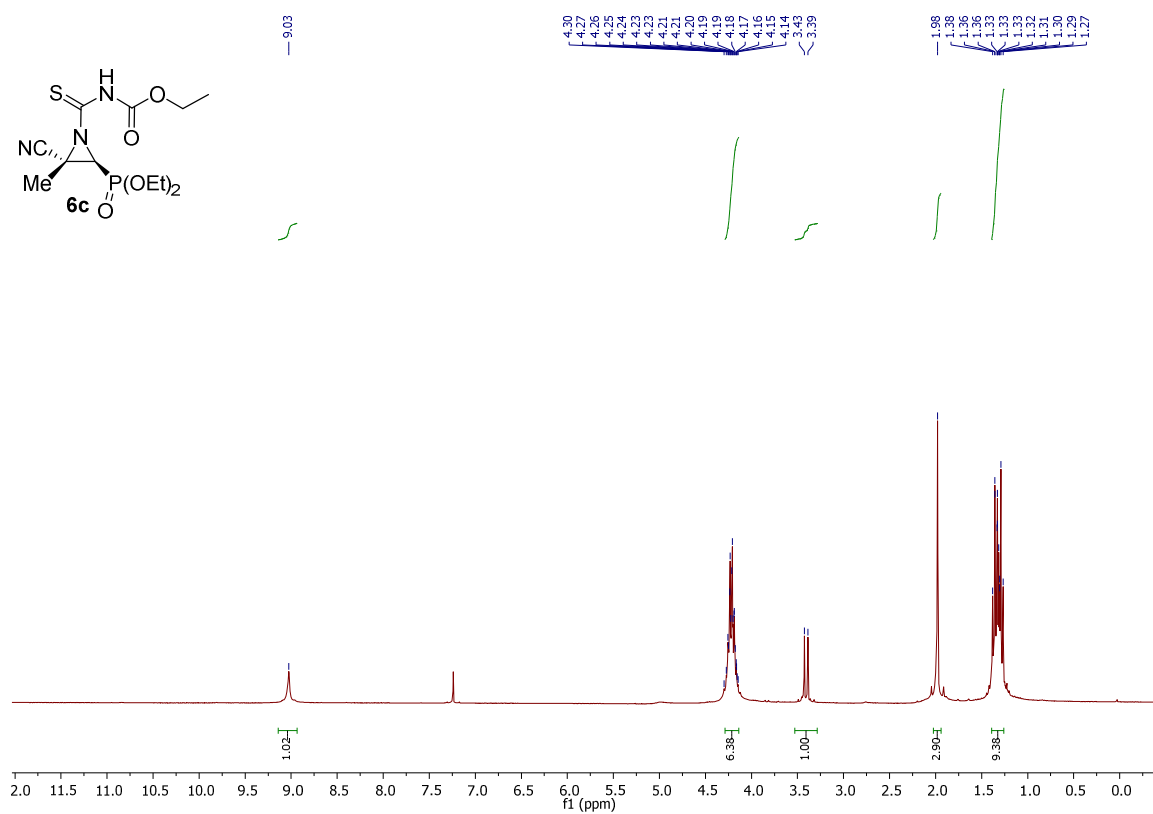
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ) of compound **6b**.



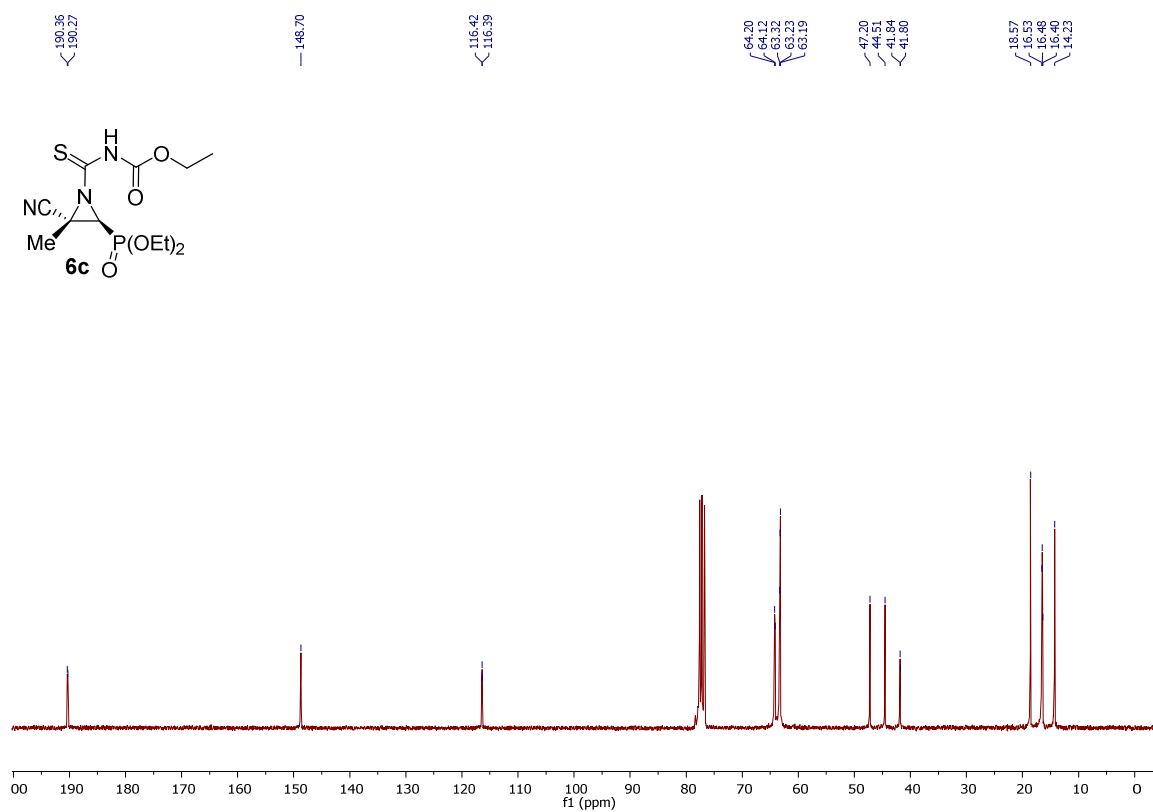
$^{13}\text{C}$  [ $^1\text{H}$ ] NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **6b**.



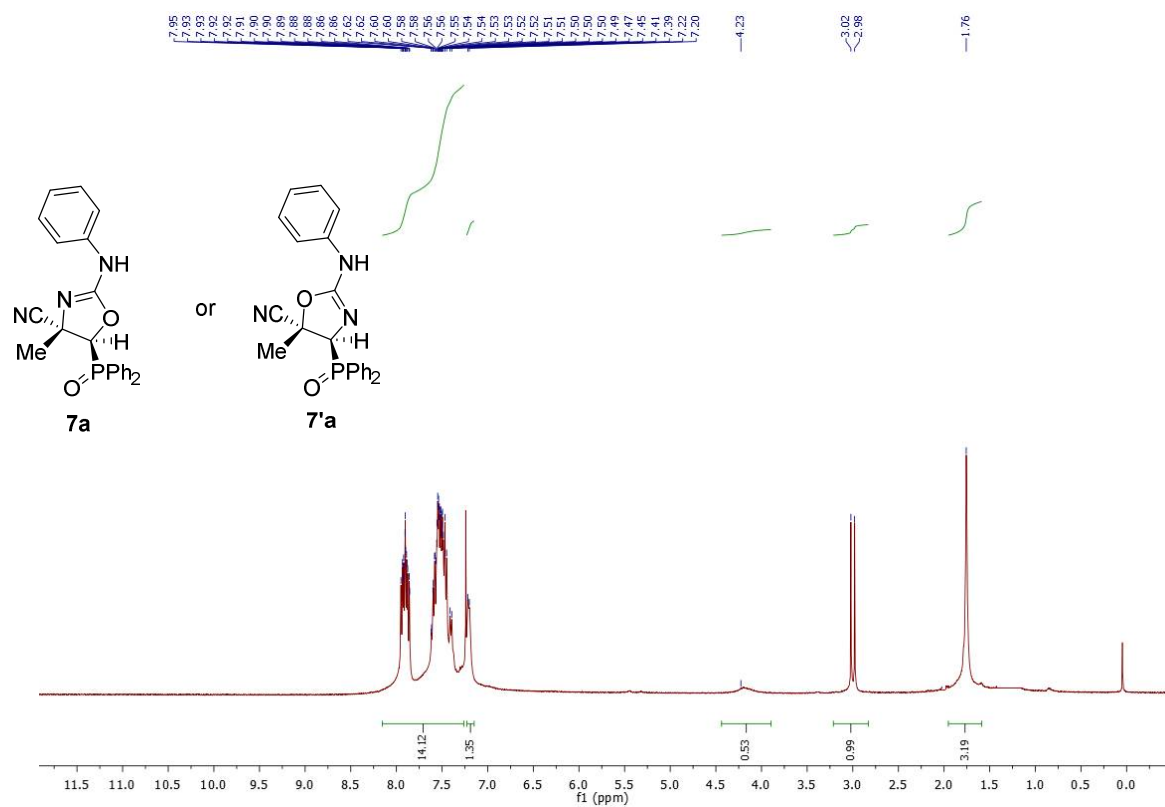
$^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ) of compound **6c**.



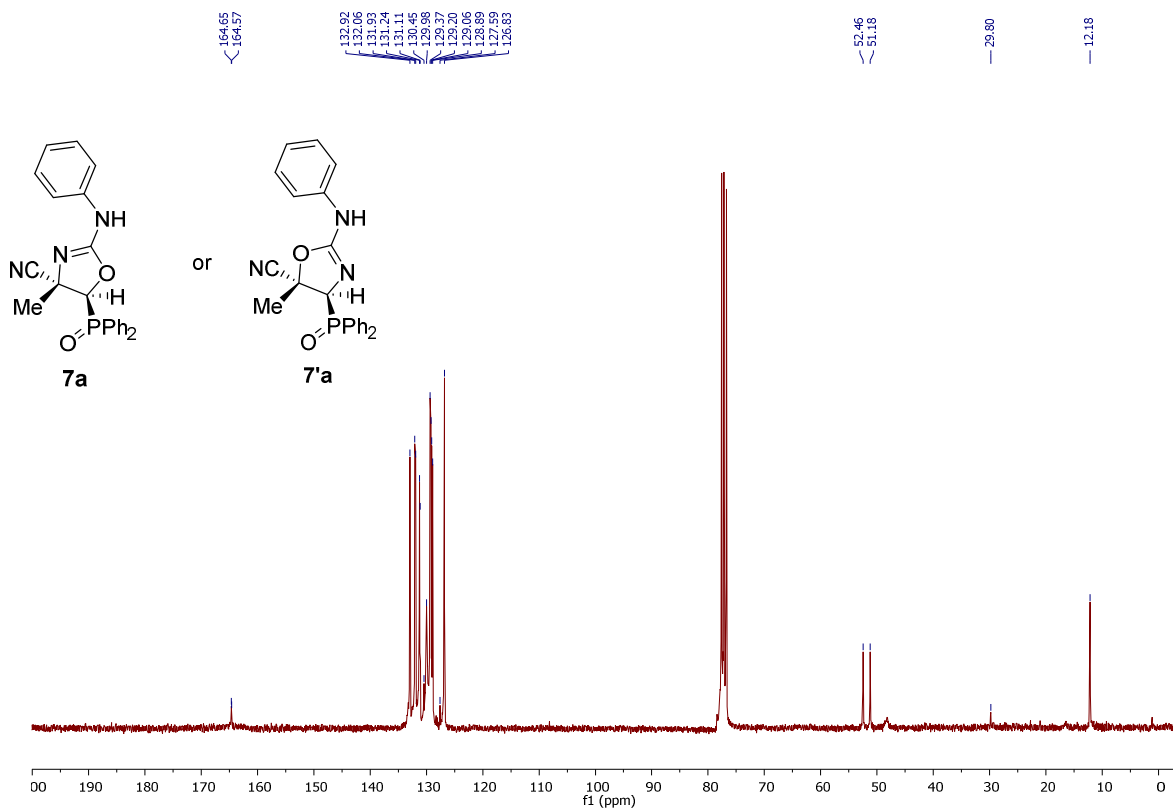
$^{13}\text{C}$  [ $^1\text{H}$ ] NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **6c**.



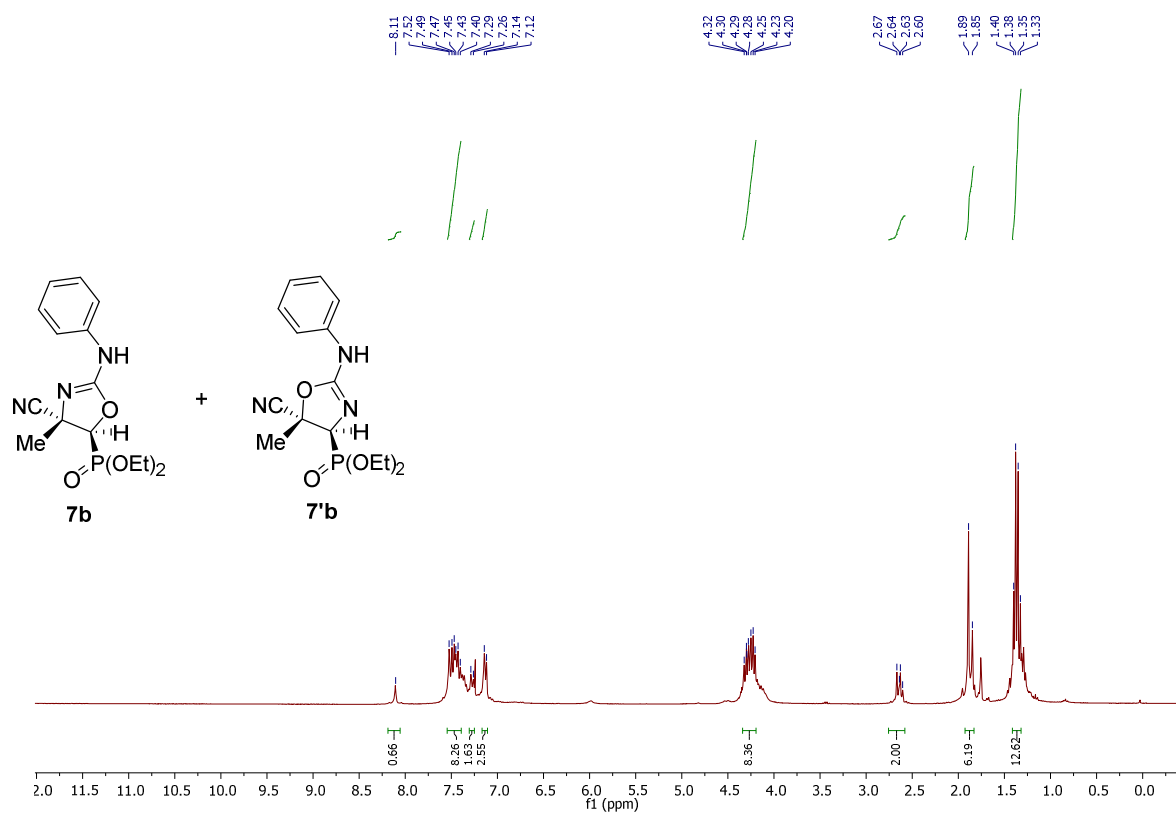
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ) of compound **7a** or **7'a**.



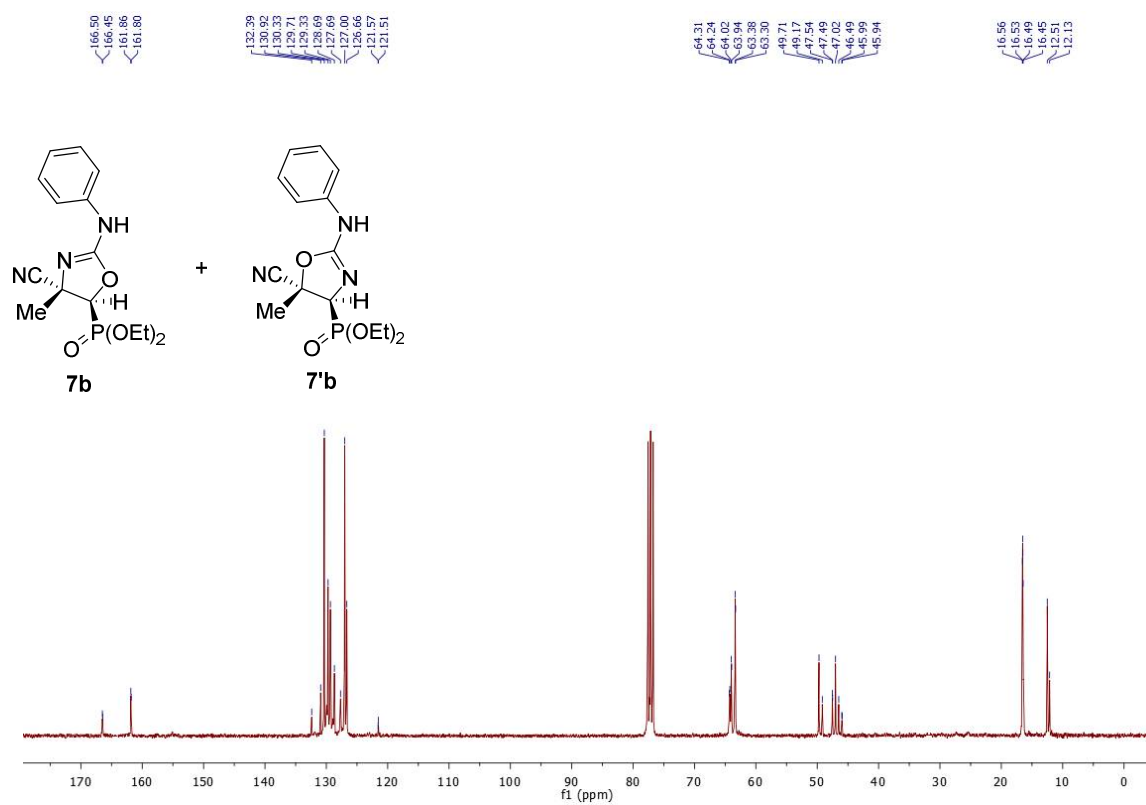
$^{13}\text{C}$   $\{^1\text{H}\}$  NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **7a** or **7'a**.



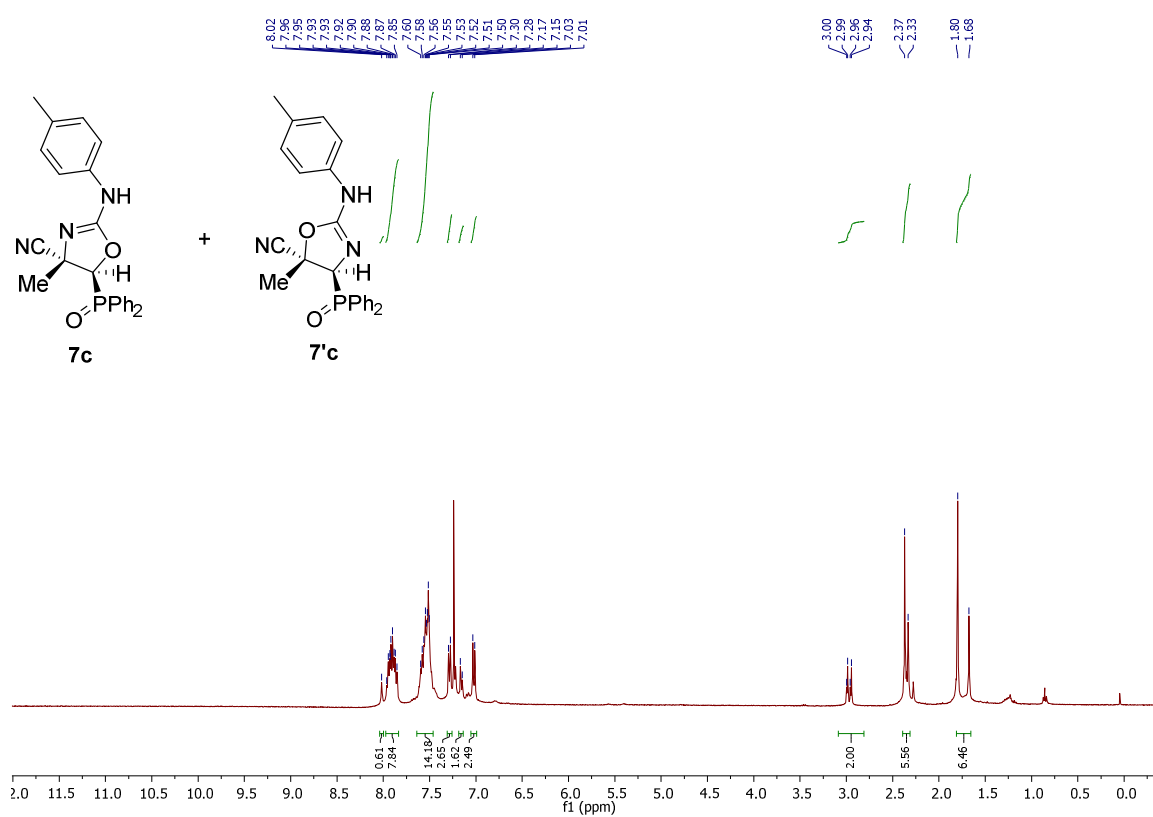
$^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ) of compound **7b** + **7'b**.



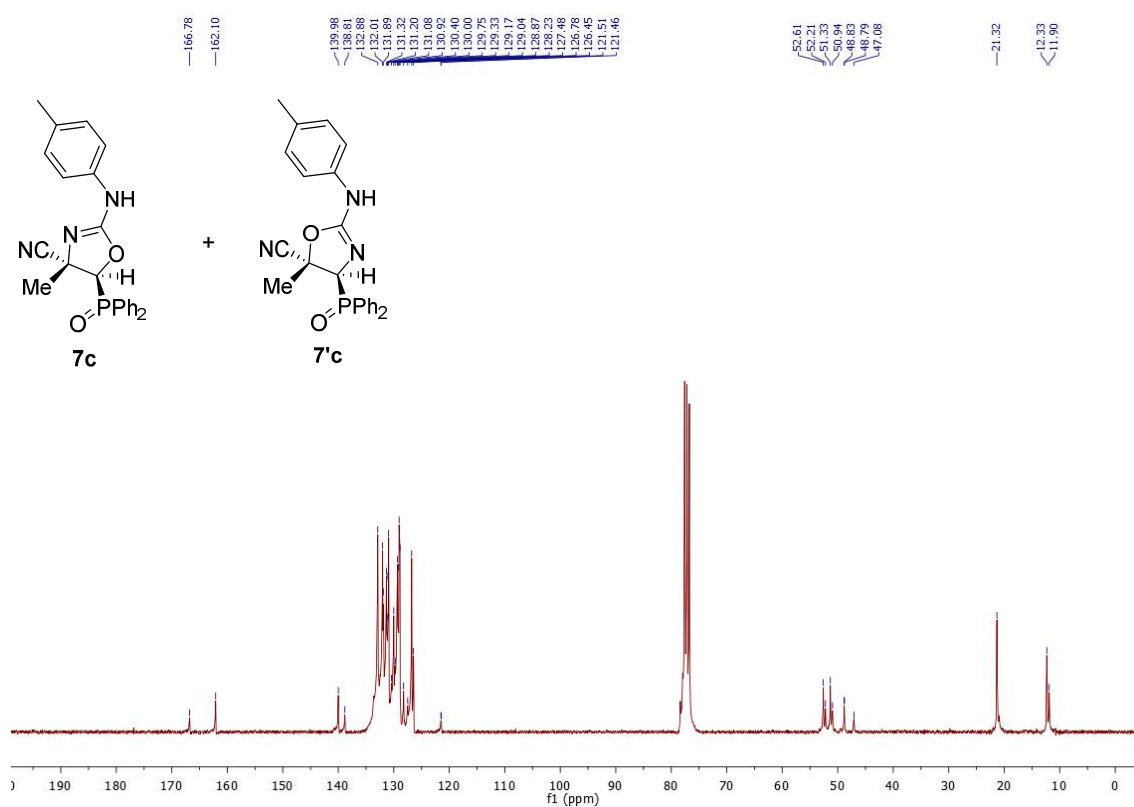
$^{13}\text{C}$  [ $^1\text{H}$ ] NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **7b** + **7'b**.



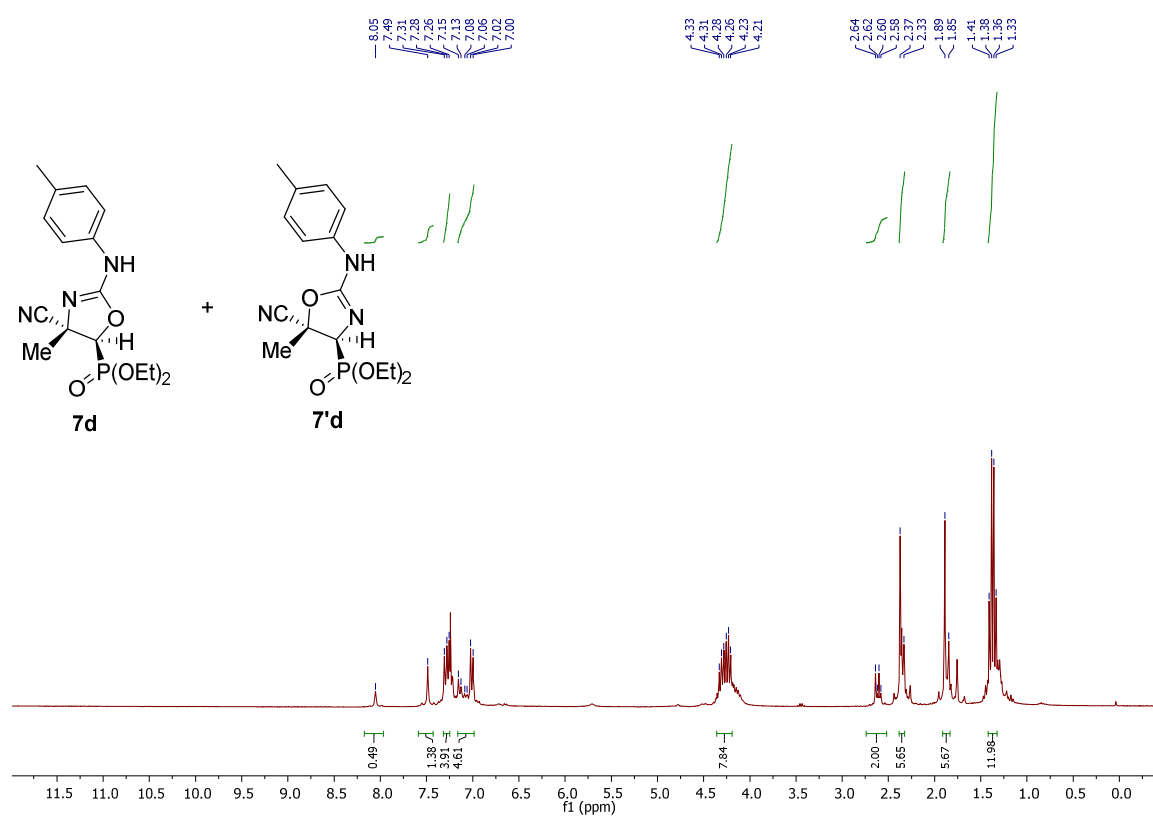
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ) of compound **7c** + **7'c**.



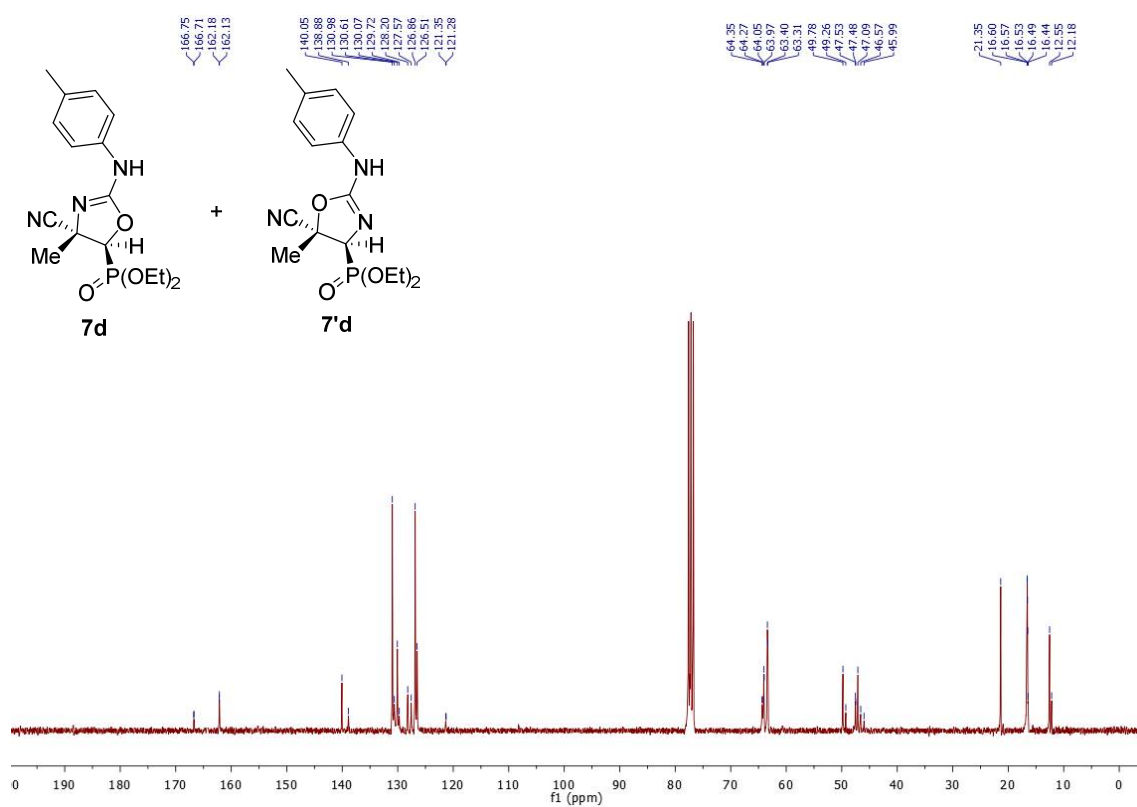
$^{13}\text{C}$  [ $^1\text{H}$ ] NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **7c** + **7'c**.



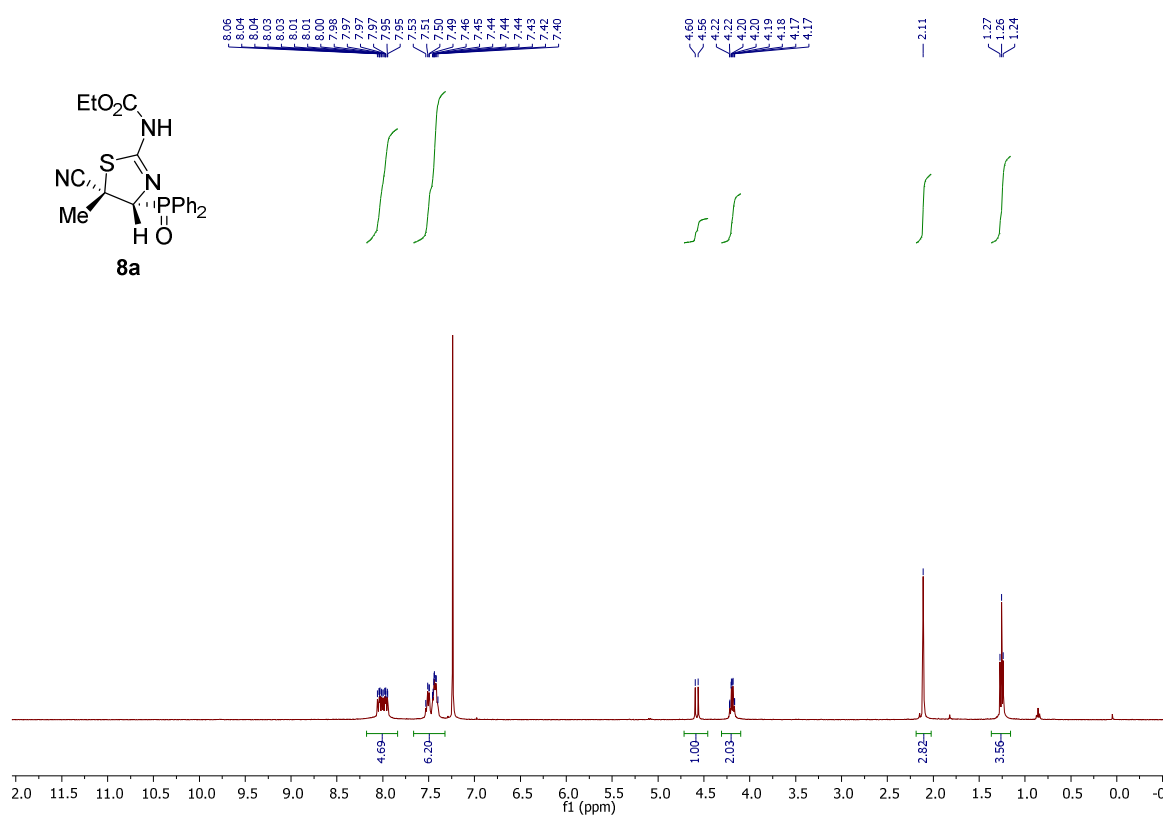
$^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ) of compound **7d** + **7'd**.



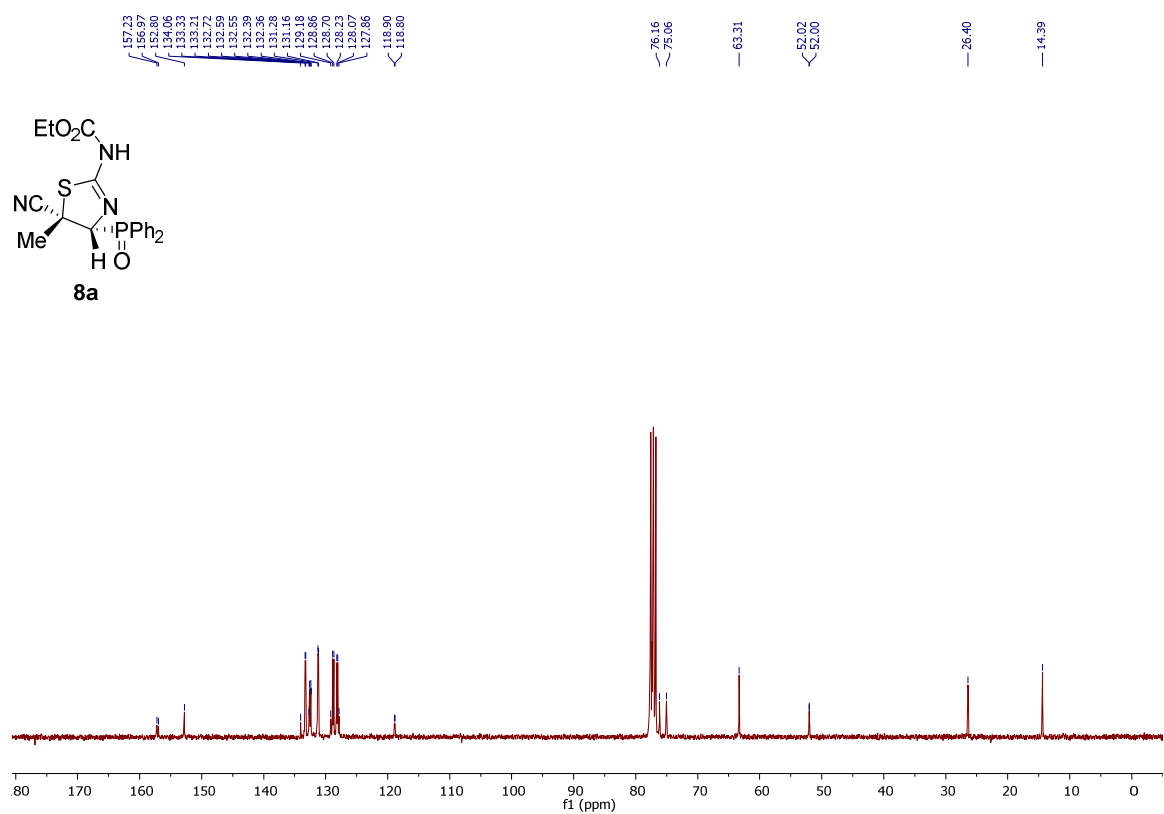
$^{13}\text{C}$  [ $^1\text{H}$ ] NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **7d** + **7'd**.



$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ) of compound **8a**.

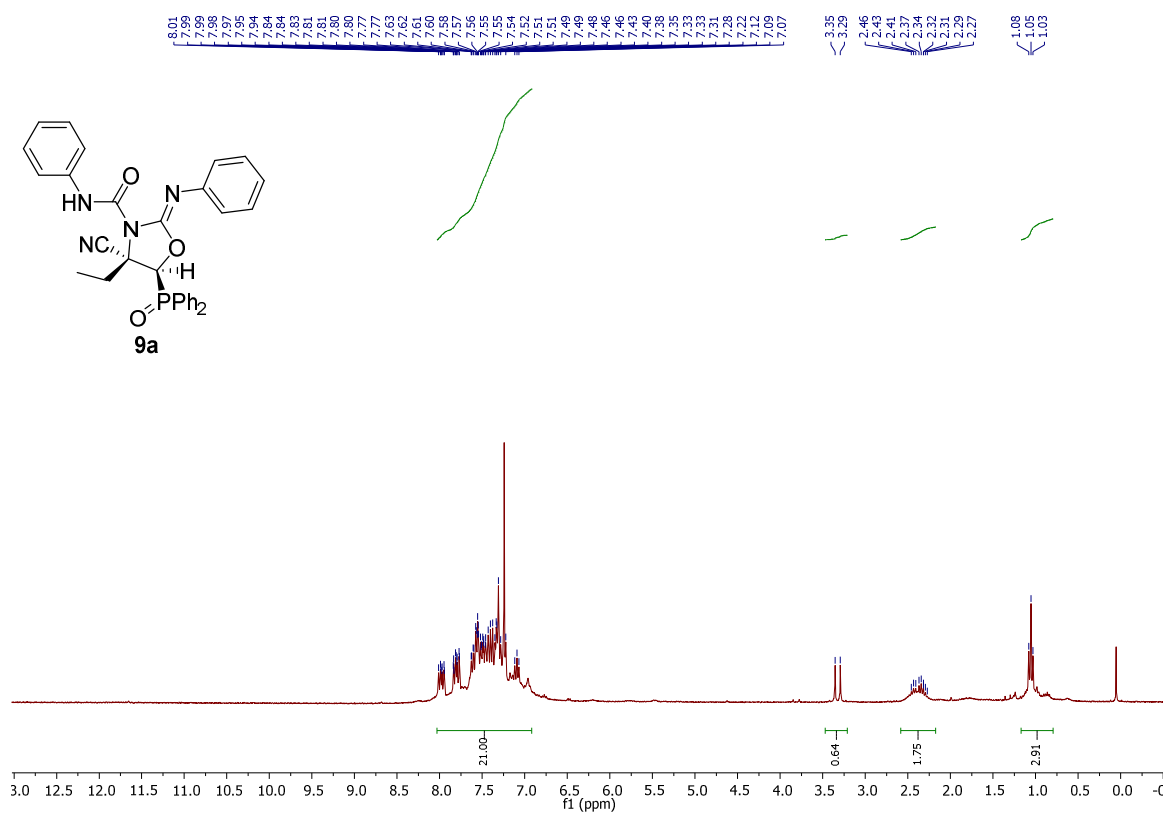


$^{13}\text{C}$  { $^1\text{H}$ } NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **8a**.

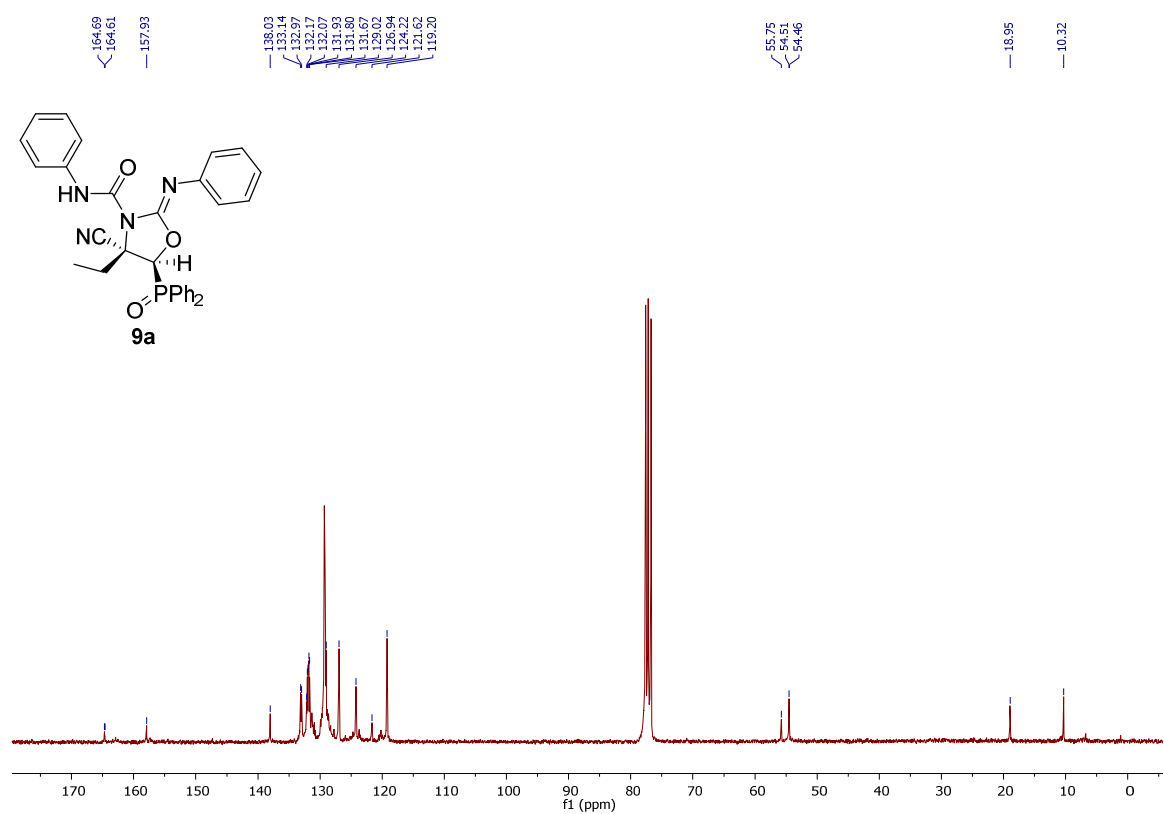




$^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ) of compound **9a**.



$^{13}\text{C}$  [ $^1\text{H}$ ] NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **9a**.



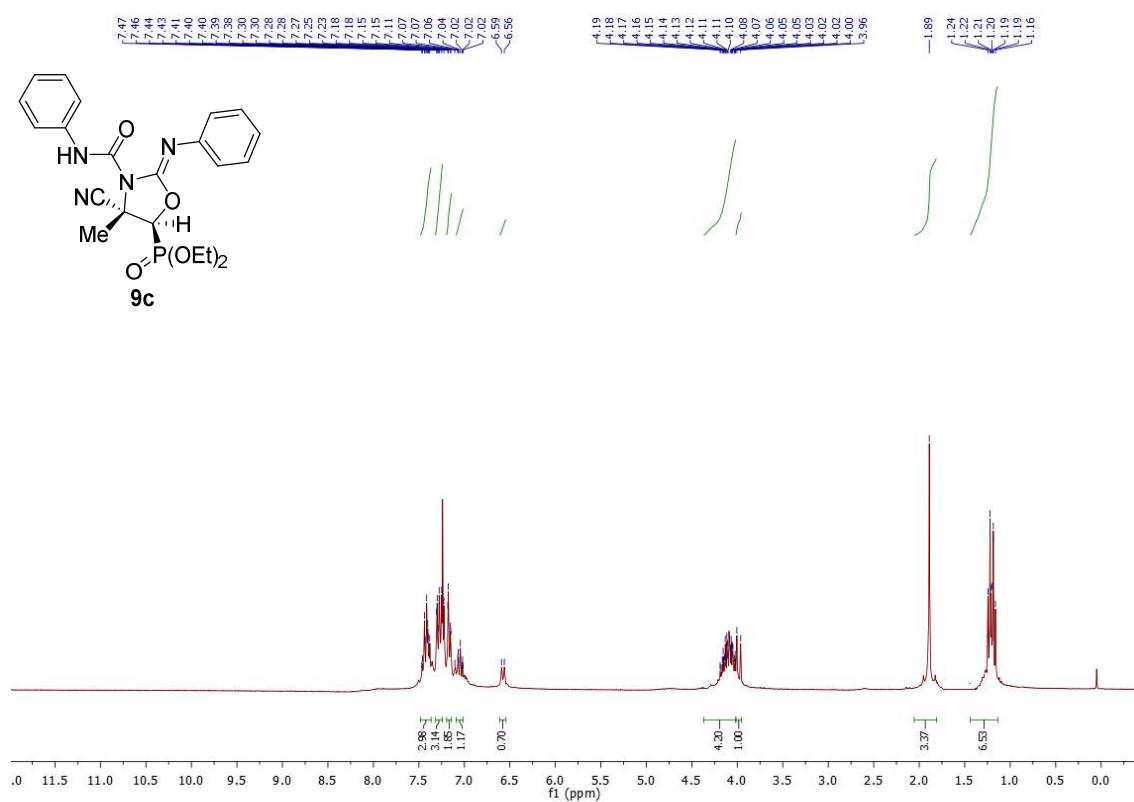
Chemical structure of **9b** is shown on the left. The <sup>1</sup>H NMR spectrum (CDCl<sub>3</sub>) is displayed on the right, with the following chemical shifts (δ) listed at the top: 8.03, 8.01, 8.00, 7.99, 7.98, 7.97, 7.96, 7.87, 7.84, 7.83, 7.82, 7.80, 7.80, 7.64, 7.63, 7.61, 7.60, 7.59, 7.58, 7.57, 7.56, 7.55, 7.55, 7.53, 7.51, 7.51, 7.31, 7.28, 7.22, 7.19, 7.14, 7.11, 7.08, 3.24, 3.18, 2.33, 2.29, and 1.91.

The spectrum shows a complex multiplet in the aromatic region (7.0–7.8 ppm) with an integration of 19.00. A doublet at 3.24 and 3.18 ppm has an integration of 0.66. A doublet at 2.33 and 2.29 ppm has an integration of 5.71. A doublet at 1.91 ppm has an integration of 2.79.

Chemical structure of **9b** is shown in the top left corner. The <sup>13</sup>C NMR spectrum (CDCl<sub>3</sub>) is displayed below the structure, with the x-axis labeled 'f1 (ppm)' ranging from 0 to 200. The spectrum shows several peaks, with the following chemical shifts (ppm) labeled above the corresponding peaks:

- 164.62
- 164.54
- 158.07
- 139.37
- 135.42
- 133.76
- 132.09
- 128.55
- 132.82
- 132.05
- 131.89
- 131.76
- 129.98
- 129.69
- 129.58
- 129.33
- 129.17
- 129.00
- 126.66
- 120.88
- 120.31
- 119.18
- 54.52
- 53.29
- 49.11
- 49.06
- 21.35
- 20.97
- 12.58

$^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ) of compound **9c**.



$^{13}\text{C}$  { $^1\text{H}$ } NMR (75 MHz,  $\text{CDCl}_3$ ) of compound **9c**.

