

Supporting Information

Intermolecular Reductive Coupling of Esters with Benzophenones by Low-valent Titanium: Synthesis of Diarylmethyl ketones Revisited

Naoki Kise,* and Toshihiko Sakurai

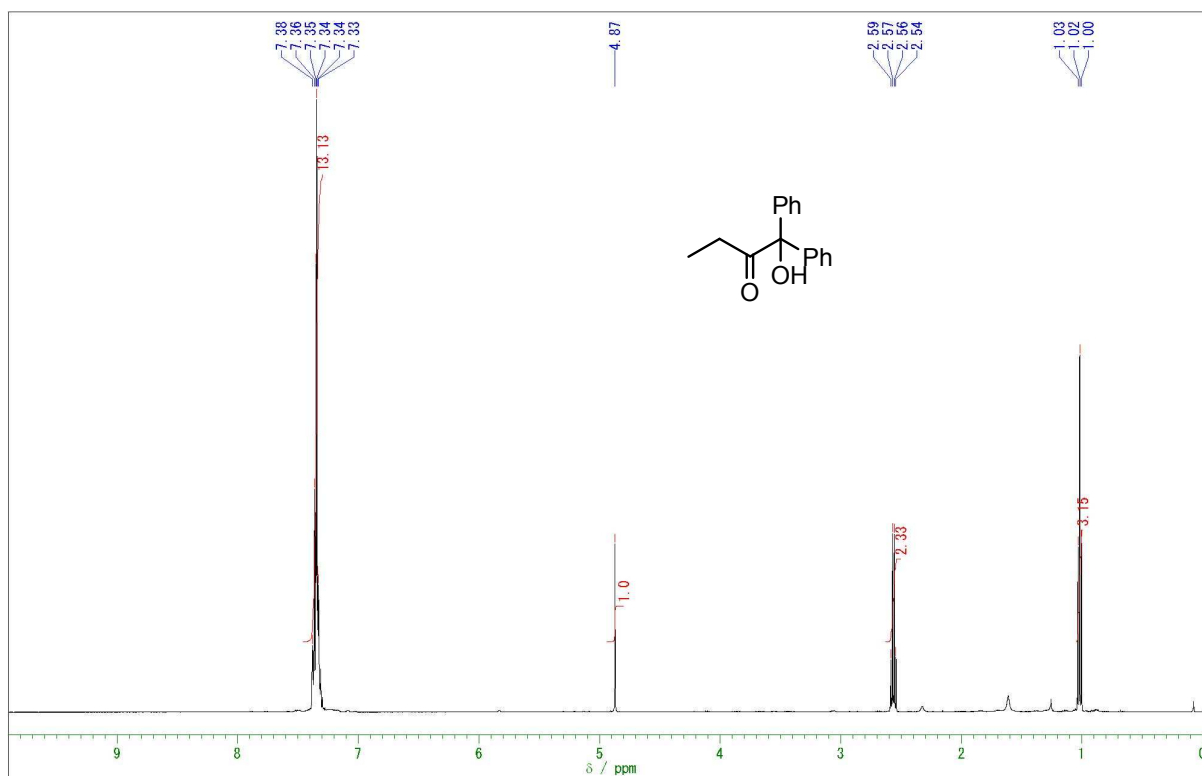
Department of Chemistry and Biotechnology, Graduate School of Engineering, Tottori University,
4-101, Koyama-cho Minami, Tottori 680-8552, Japan

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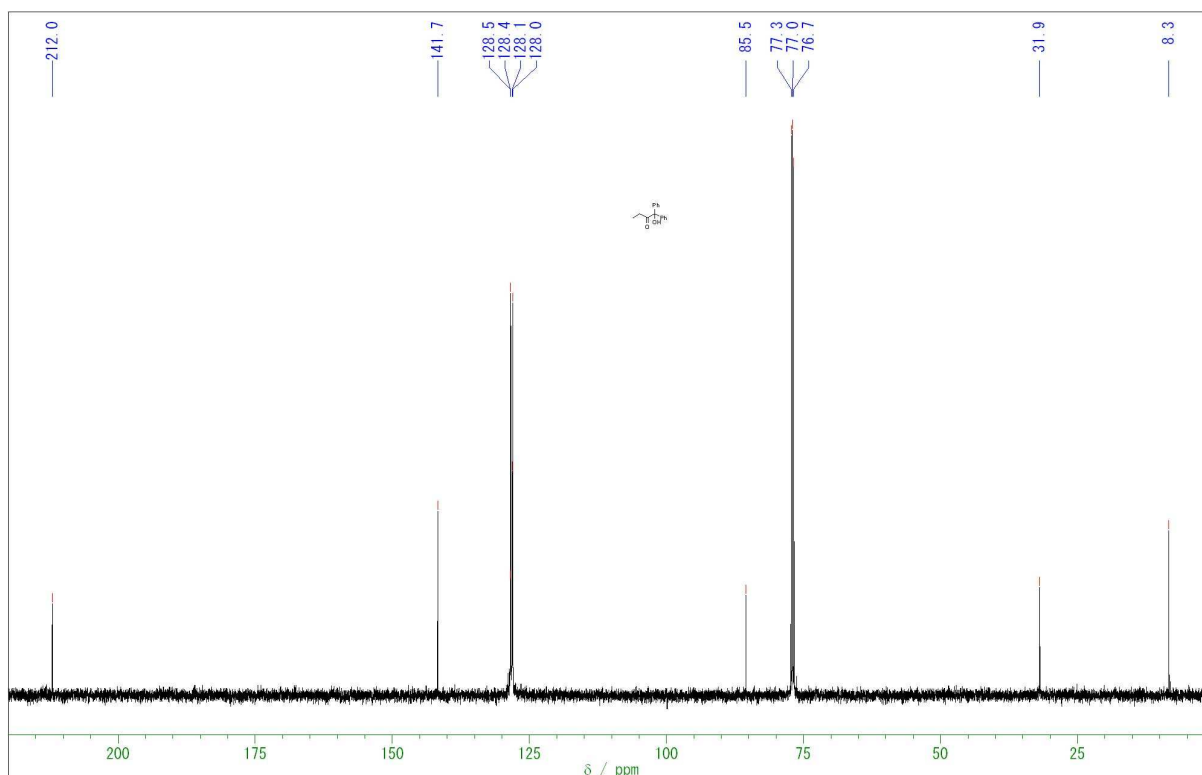
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¹H and ¹³C NMR Spectra of Products

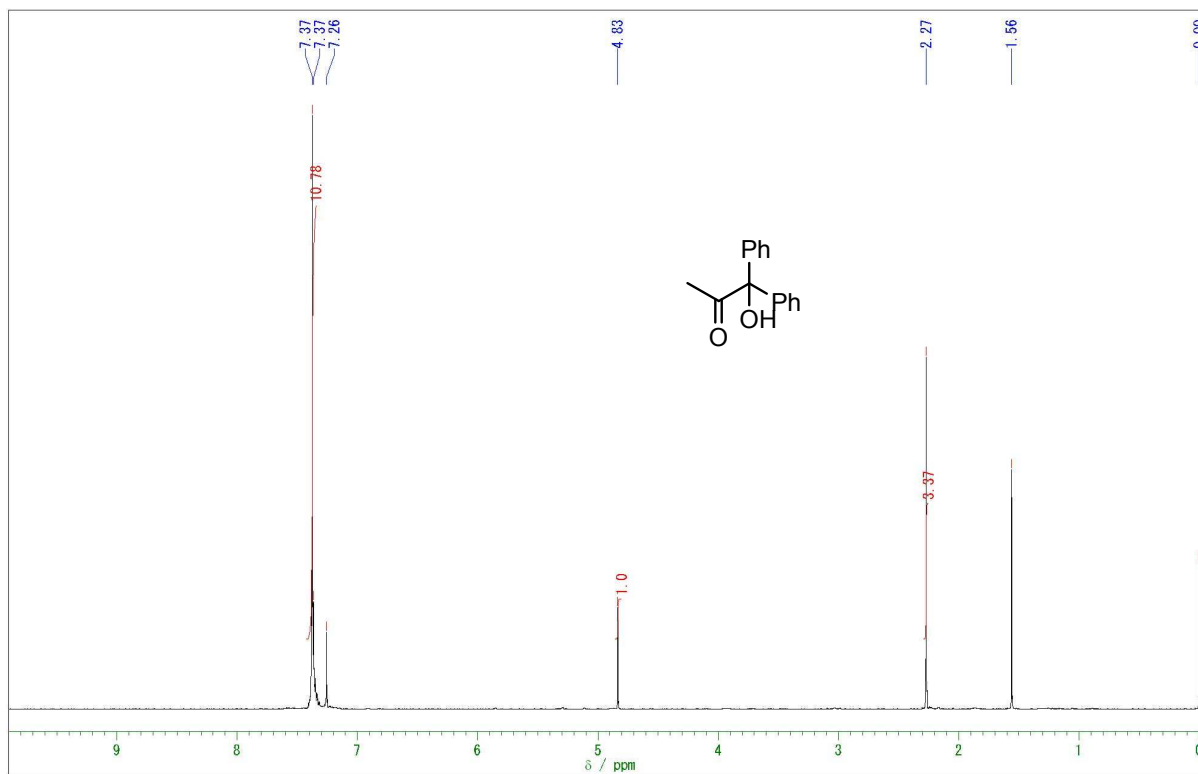
¹H NMR Spectrum of 3a (500 MHz, CDCl₃)



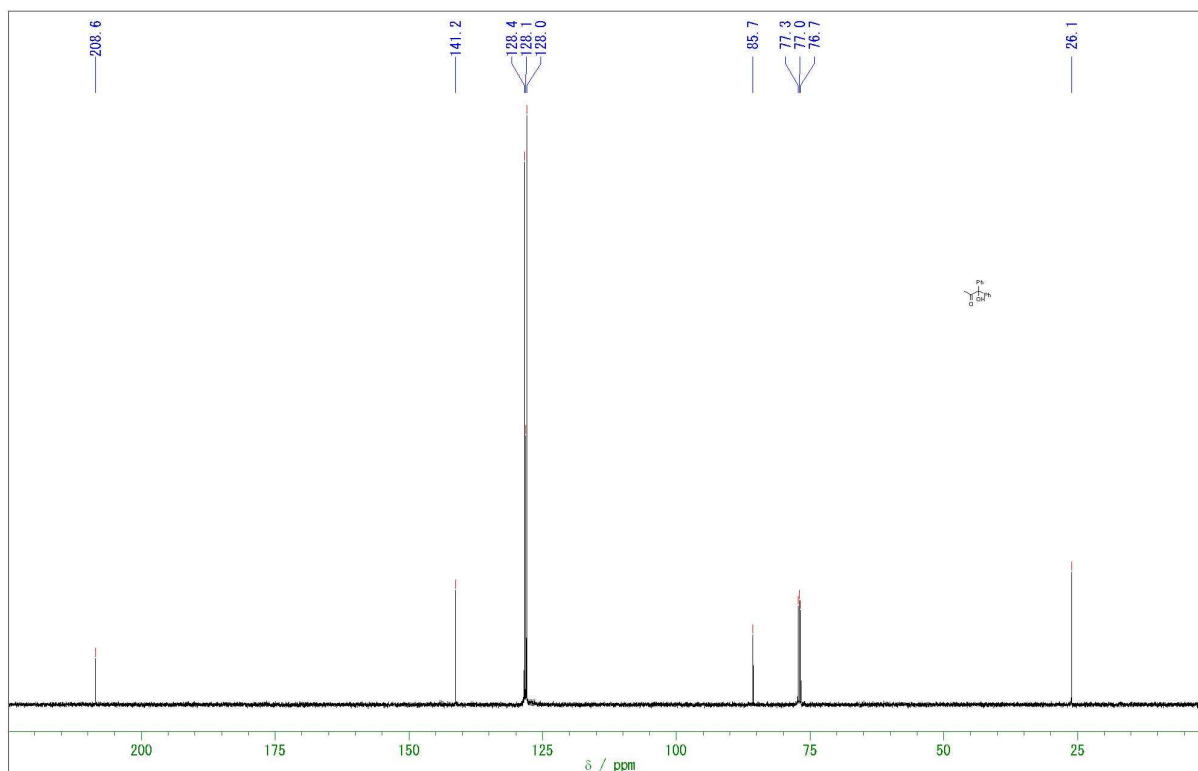
¹³C NMR Spectrum of 3a (125 MHz, CDCl₃)



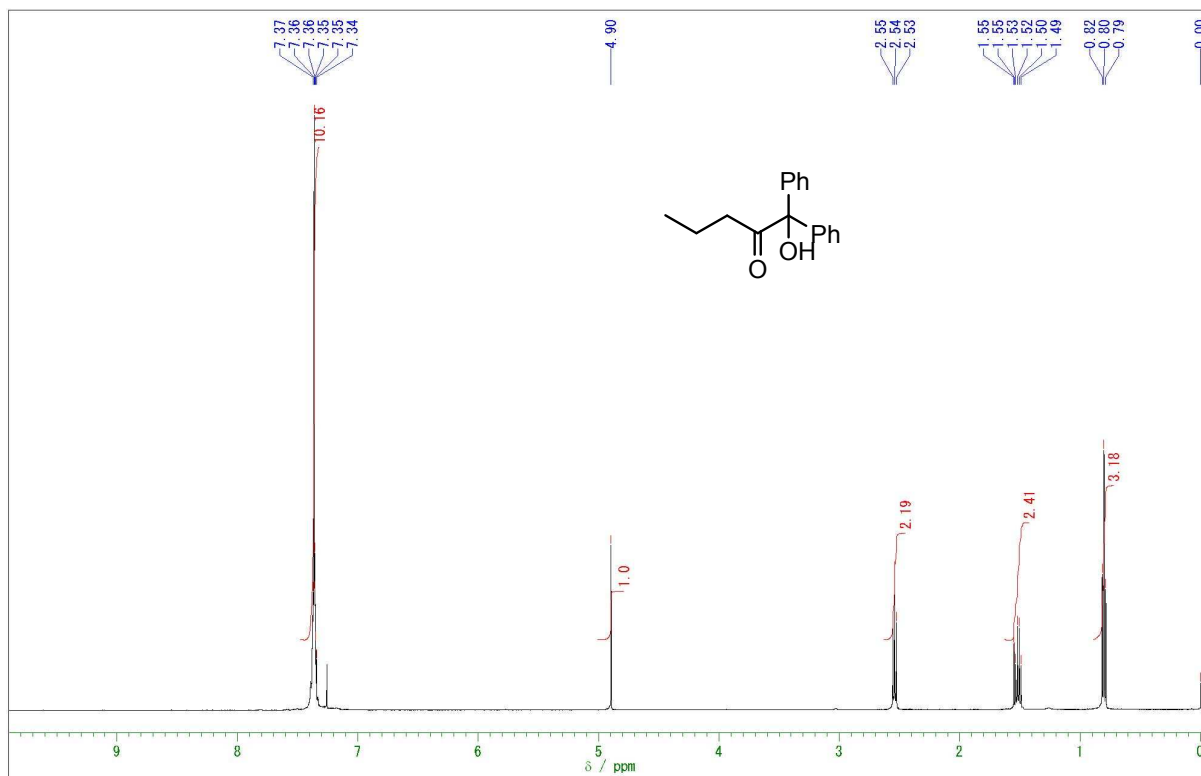
¹H NMR Spectrum of 3b (500 MHz, CDCl₃)



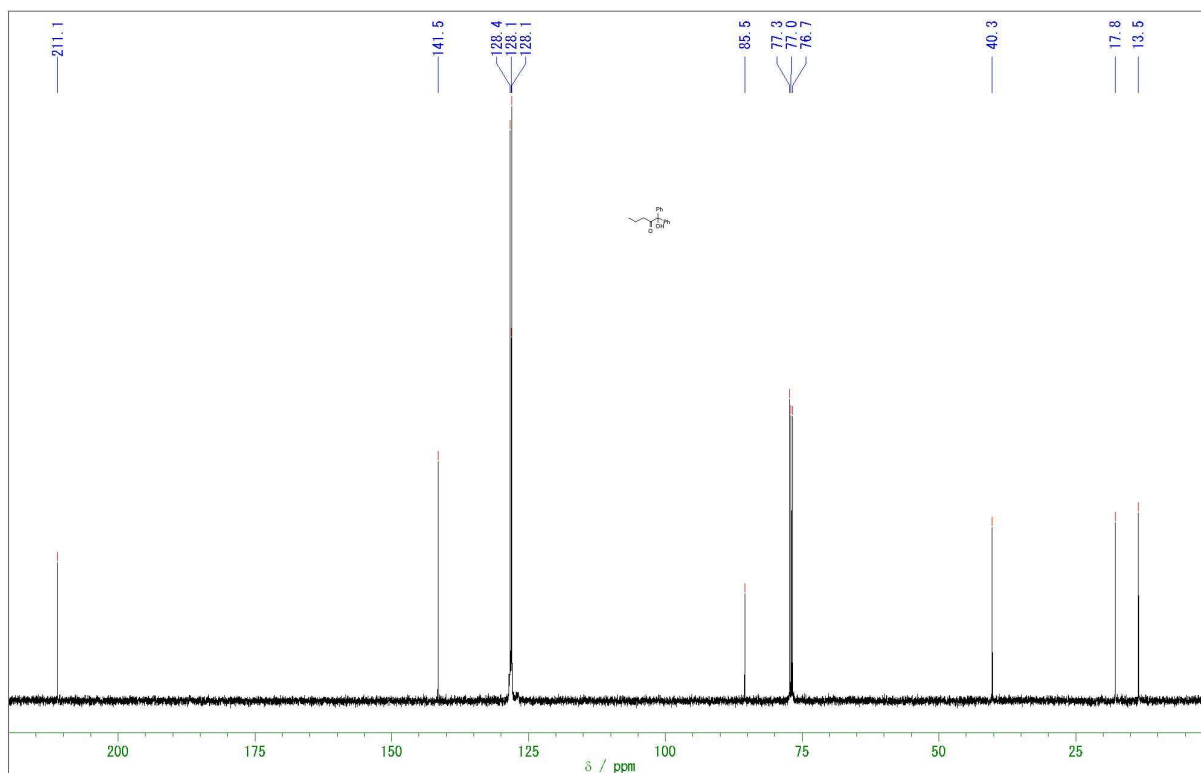
¹³C NMR Spectrum of 3b (125 MHz, CDCl₃)



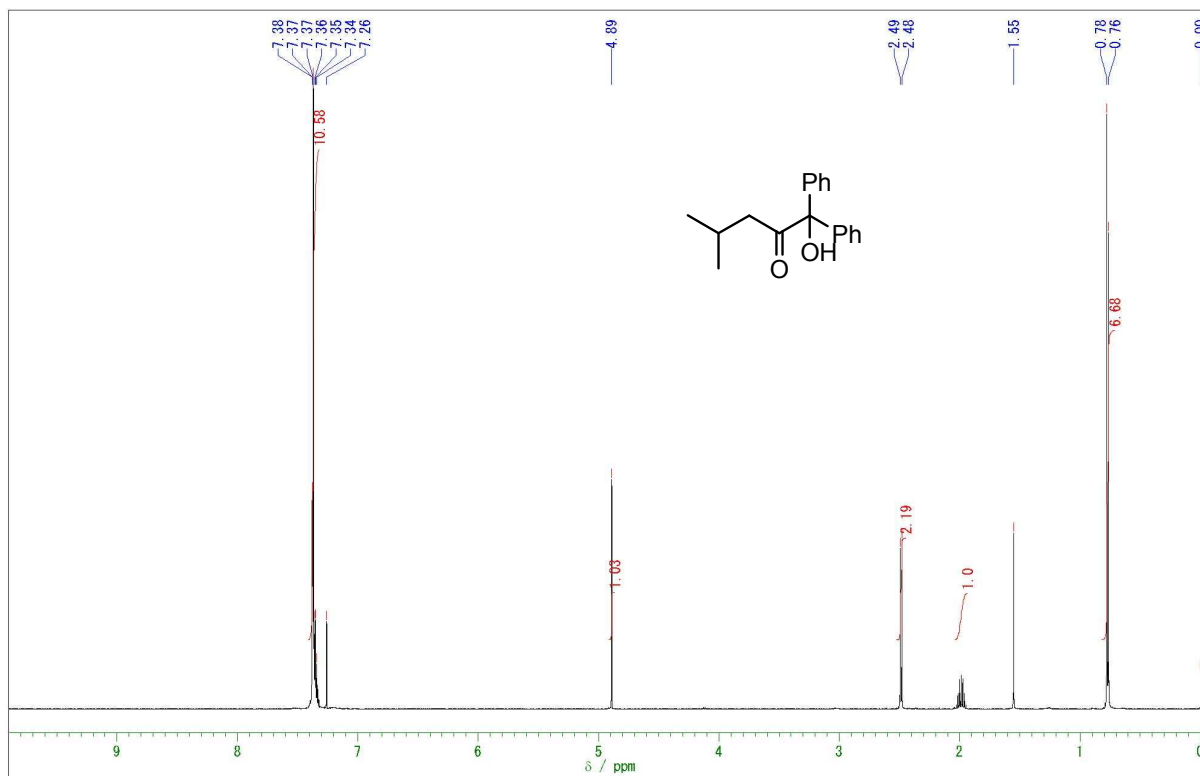
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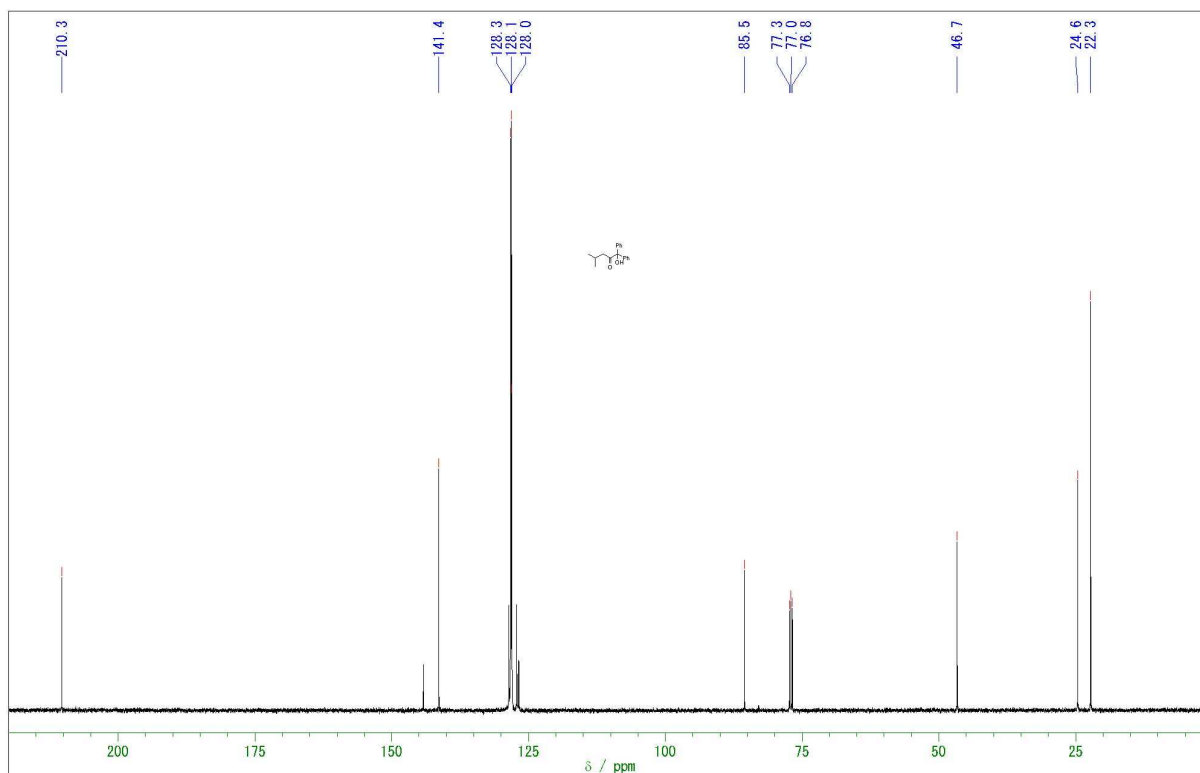
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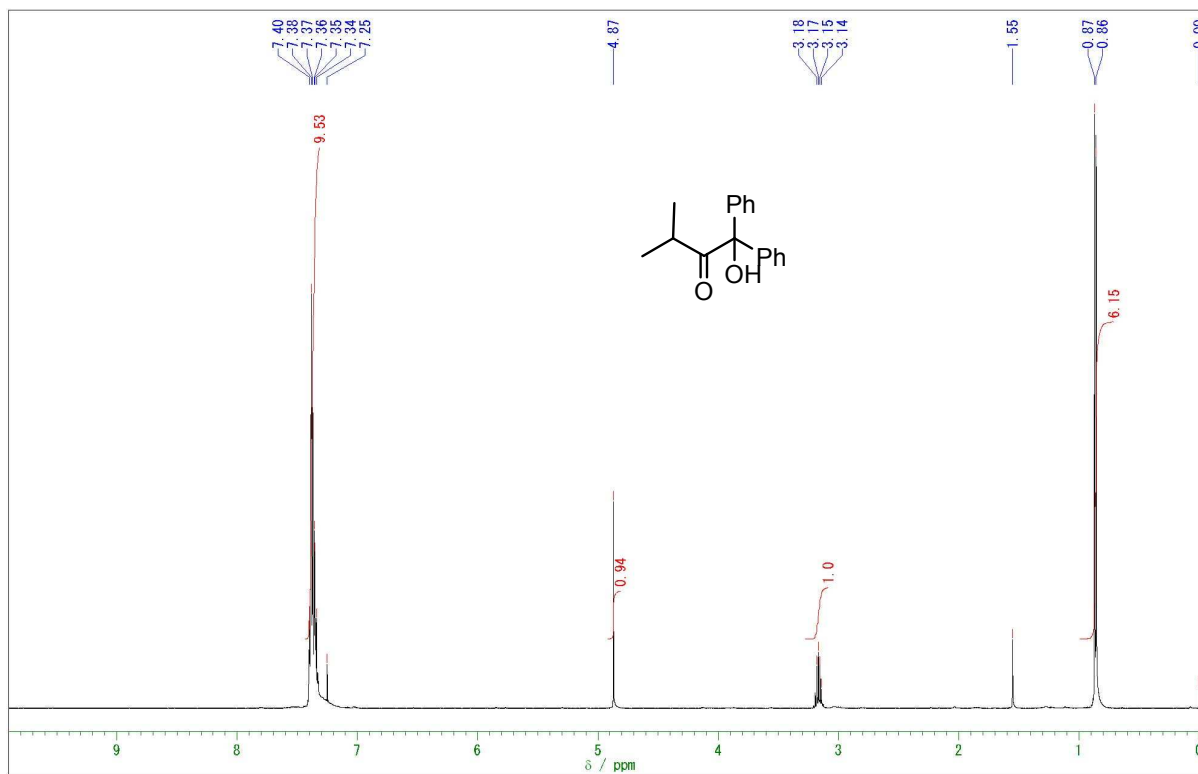
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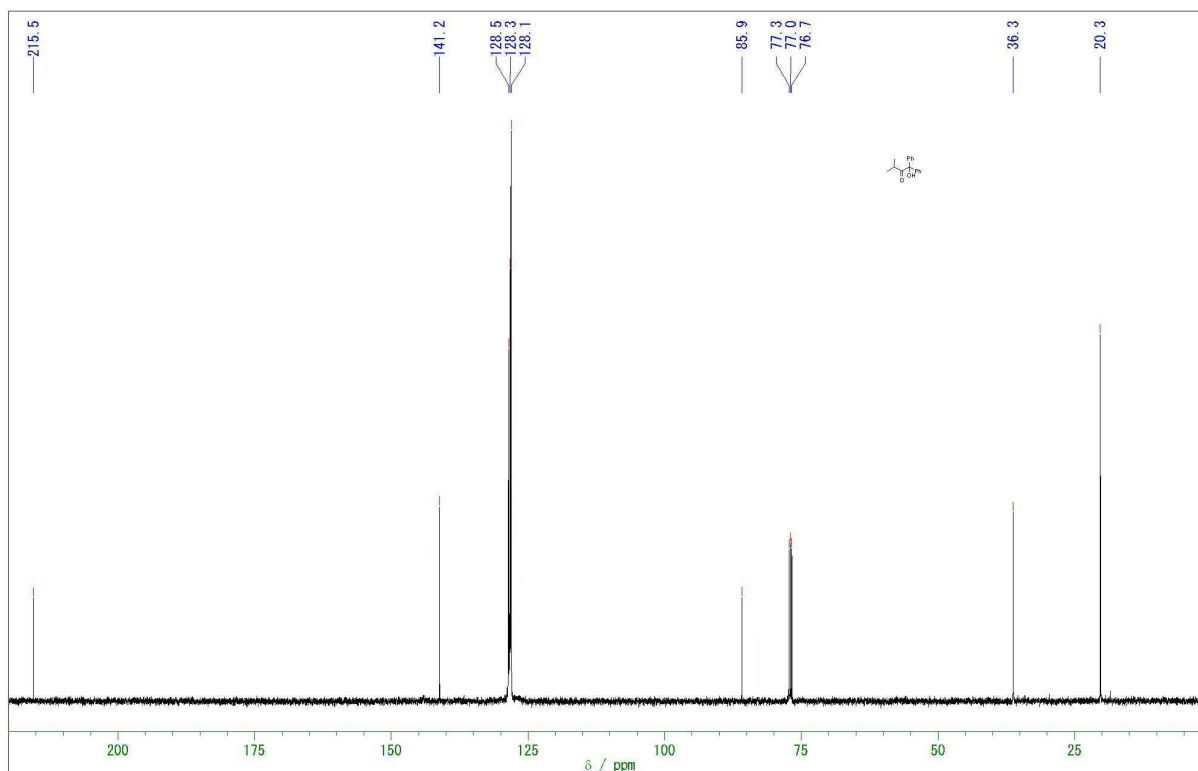
¹³C NMR Spectrum of 3d (125 MHz, CDCl₃)



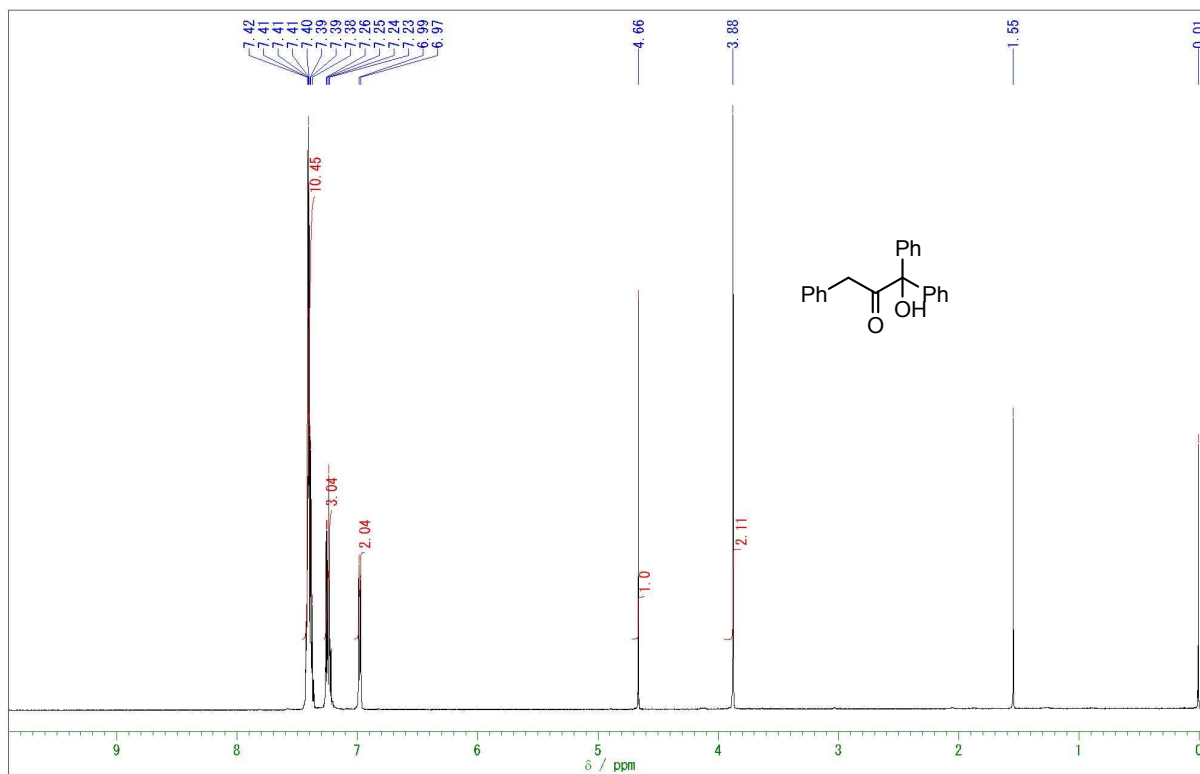
¹H NMR Spectrum of 3e (500 MHz, CDCl₃)



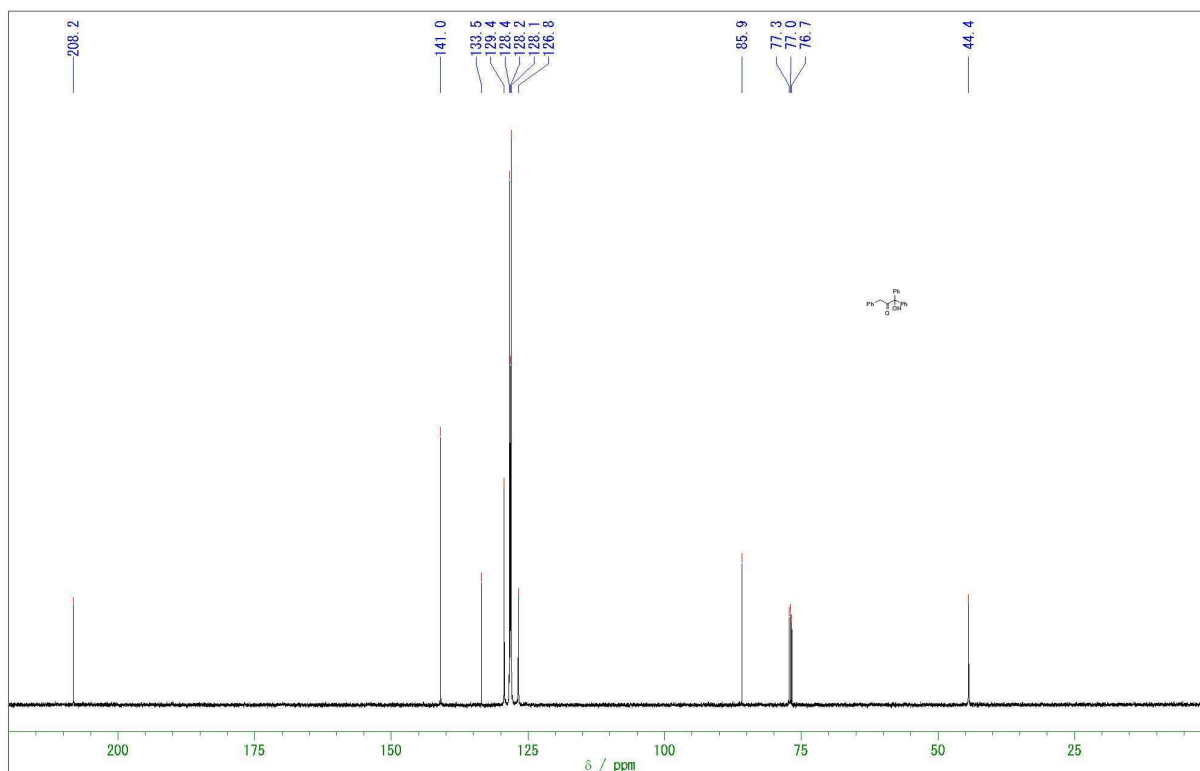
¹³C NMR Spectrum of 3e (125 MHz, CDCl₃)



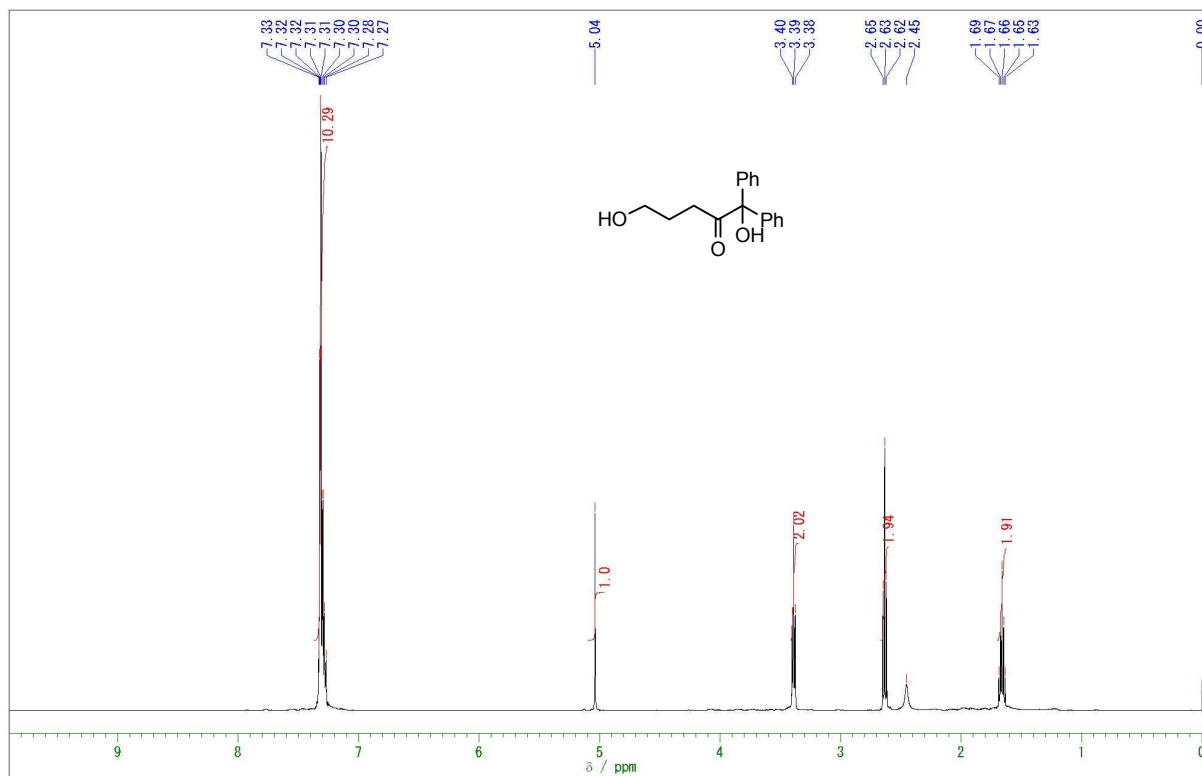
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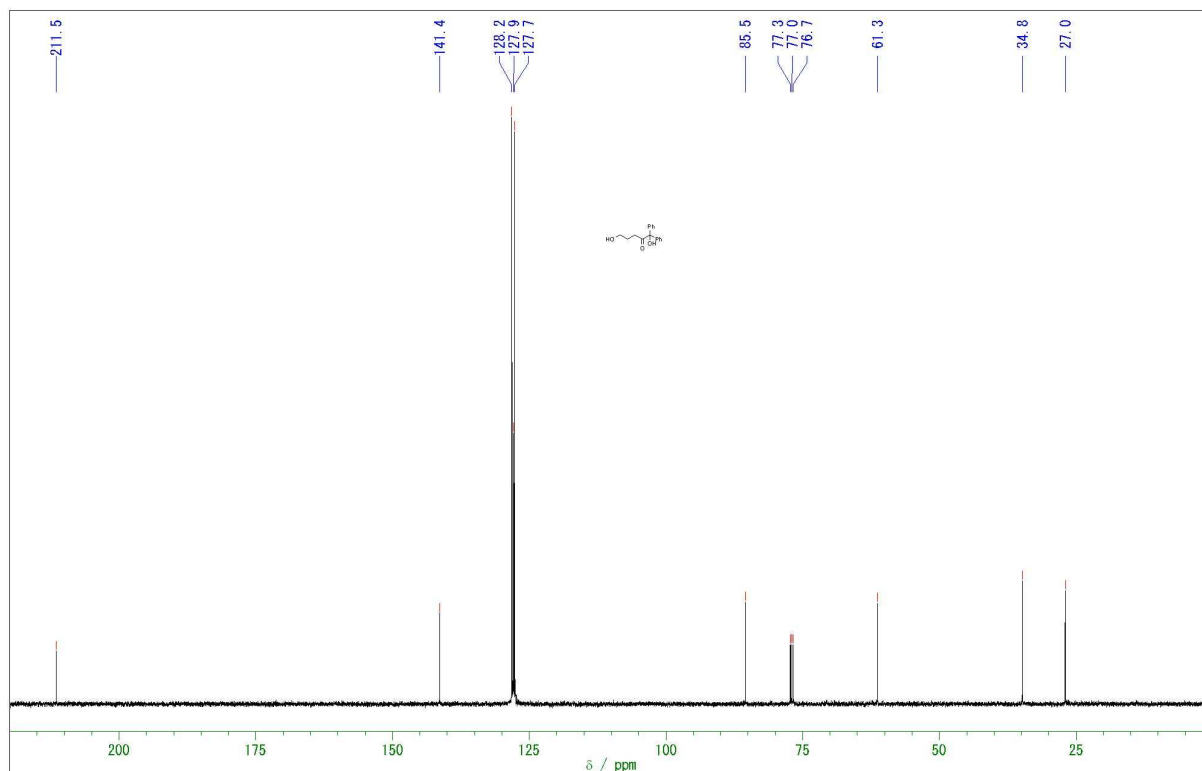
¹³C NMR Spectrum of 3f (125 MHz, CDCl₃)



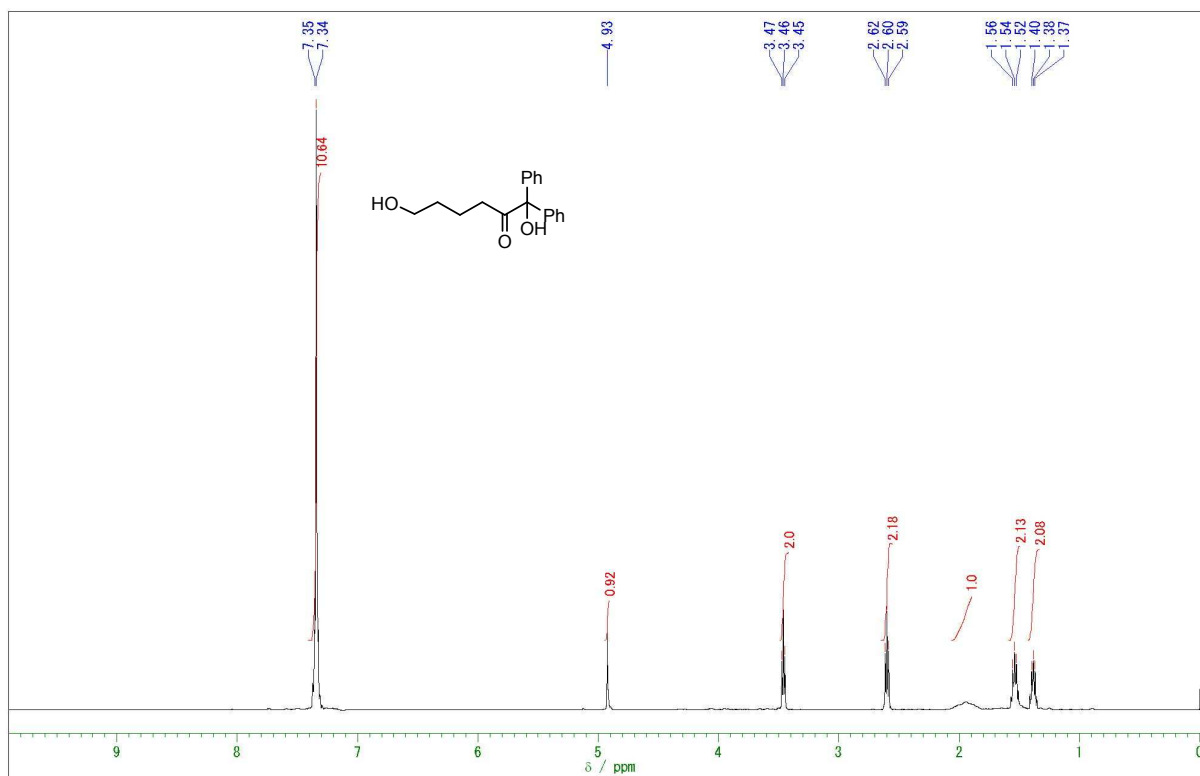
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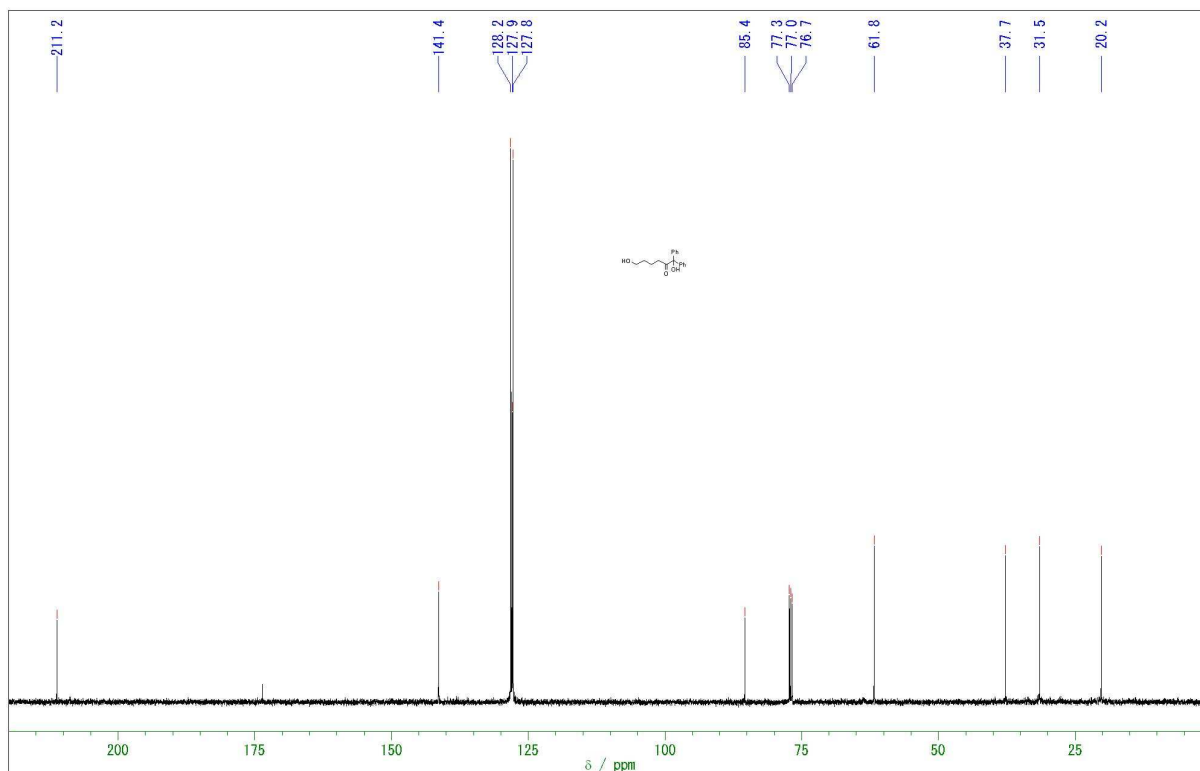
¹³C NMR Spectrum of 3g (125 MHz, CDCl₃)



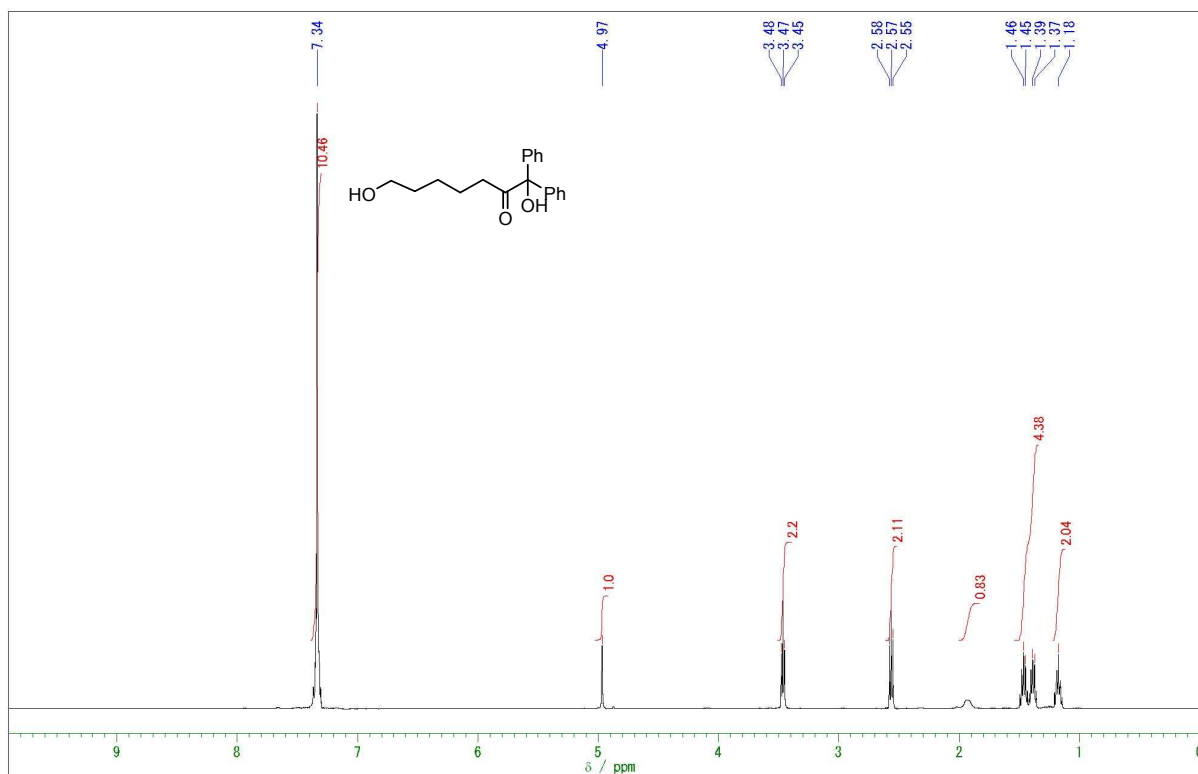
¹H NMR Spectrum of 3h (500 MHz, CDCl₃)



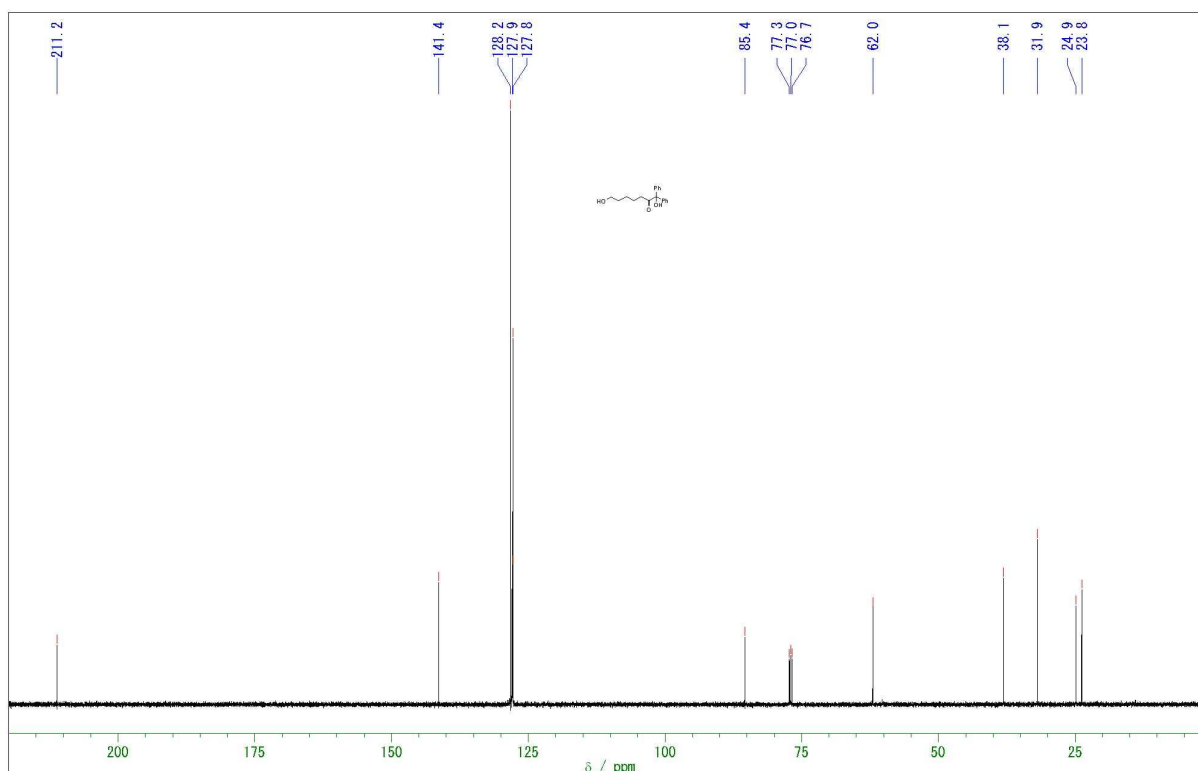
¹³C NMR Spectrum of 3h (125 MHz, CDCl₃)



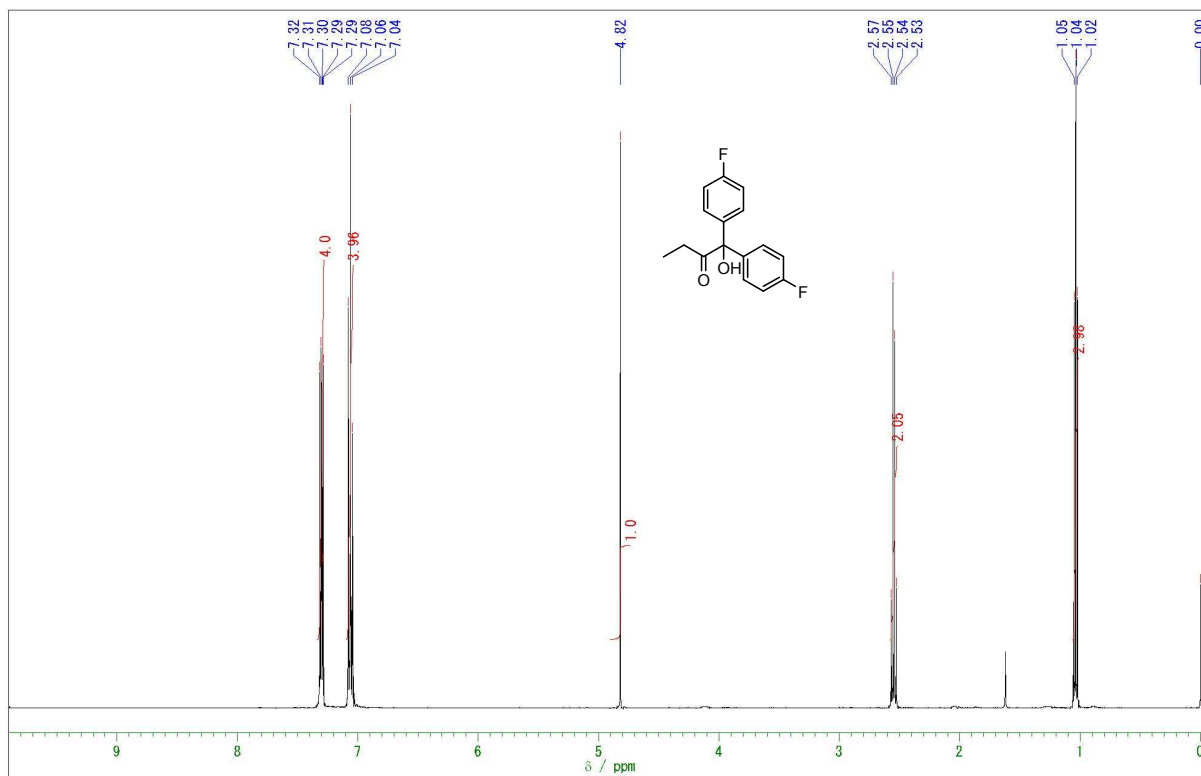
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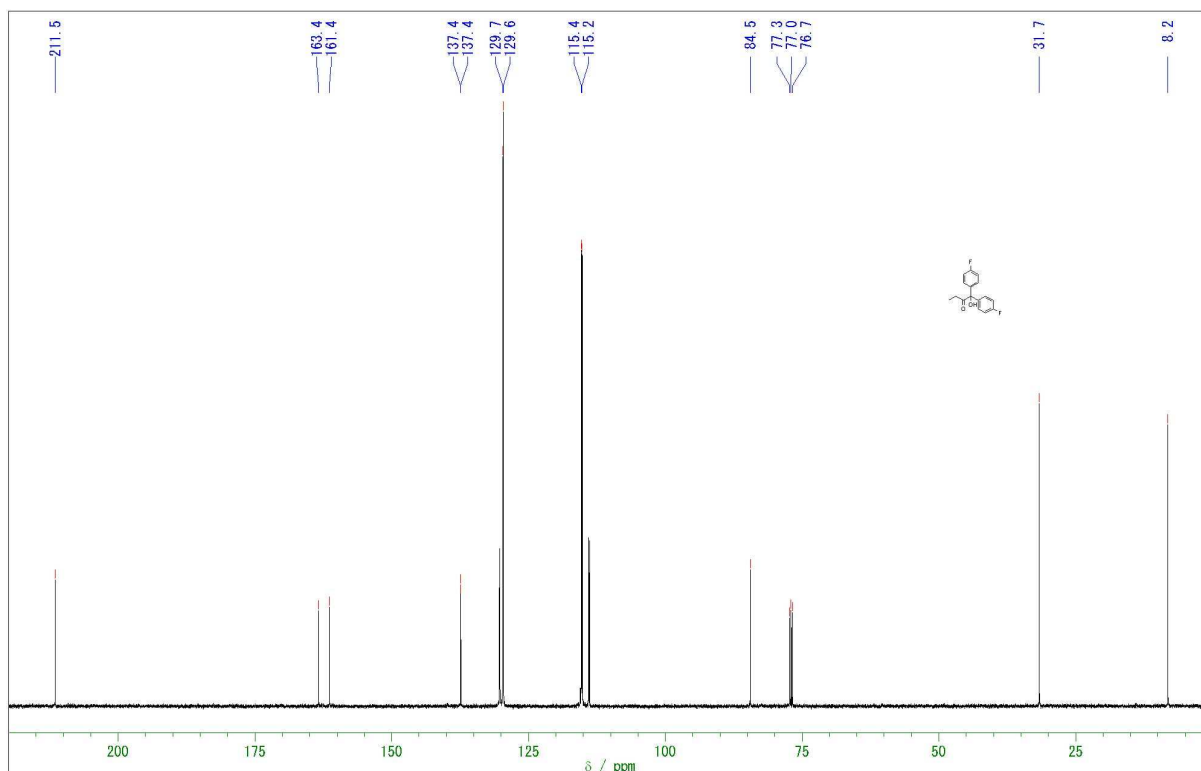
¹³C NMR Spectrum of 3i (125 MHz, CDCl₃)



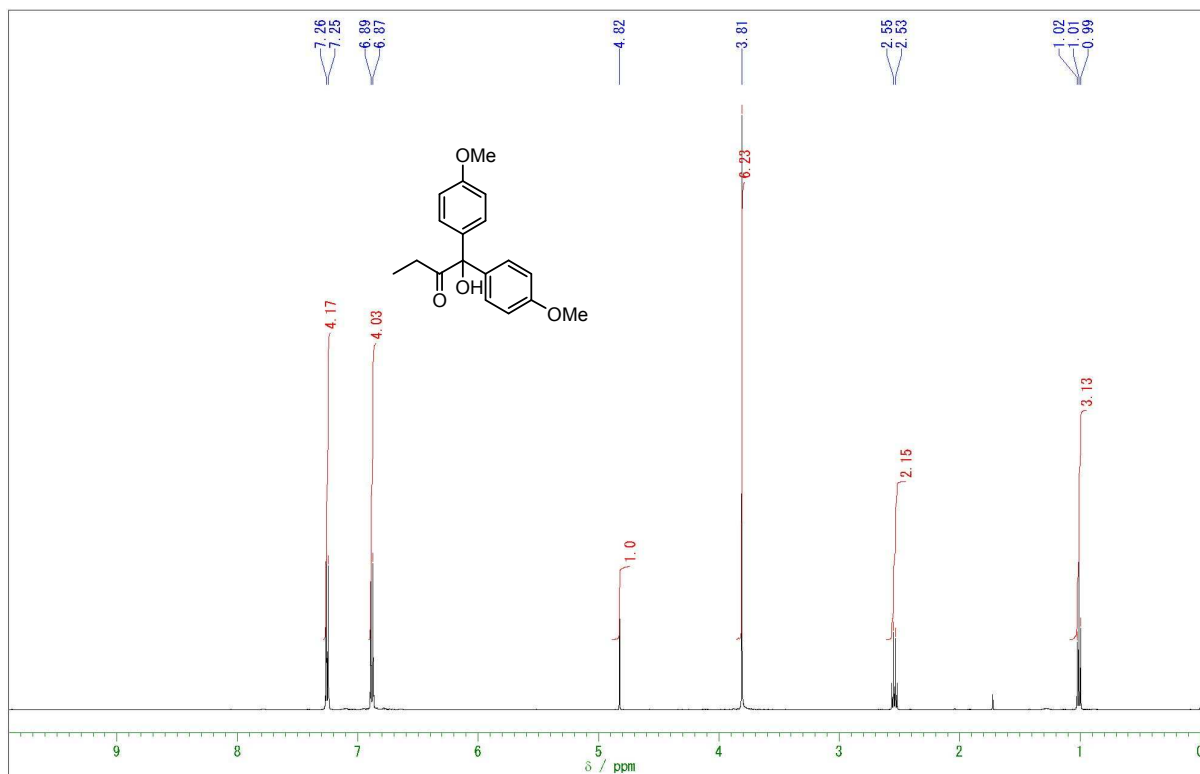
^1H NMR Spectrum of 3j (500 MHz, CDCl_3)



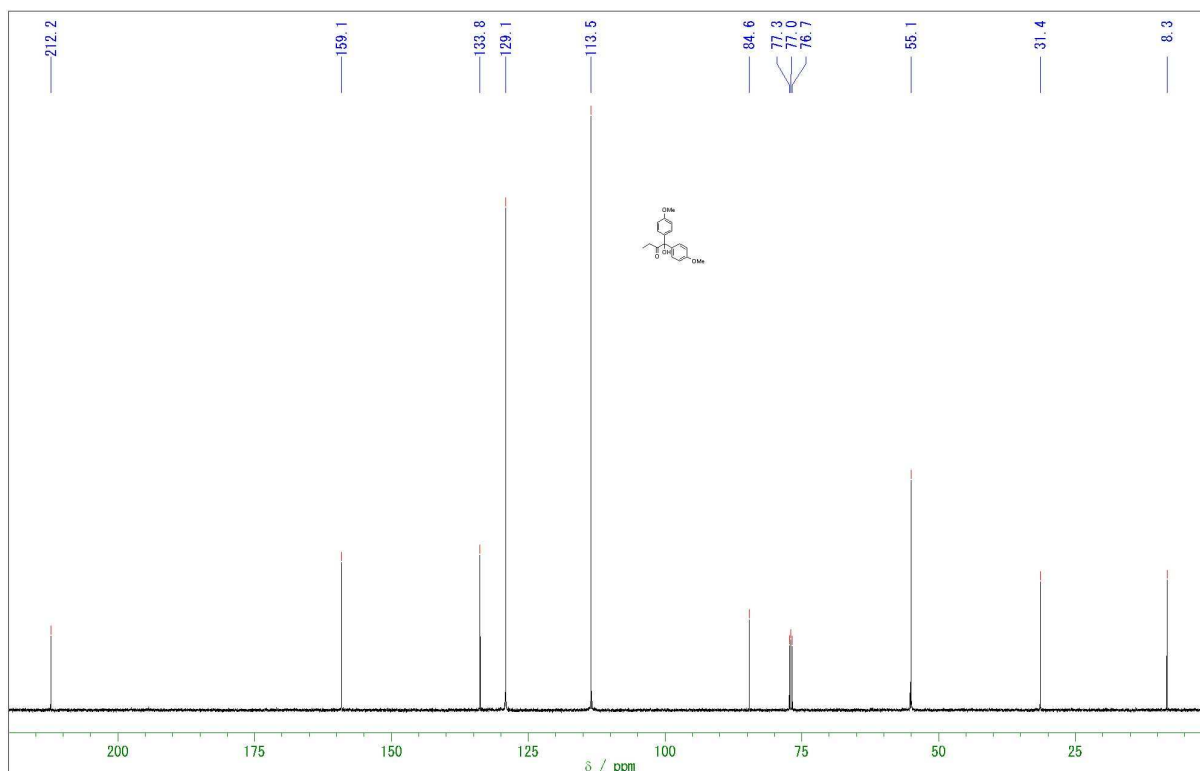
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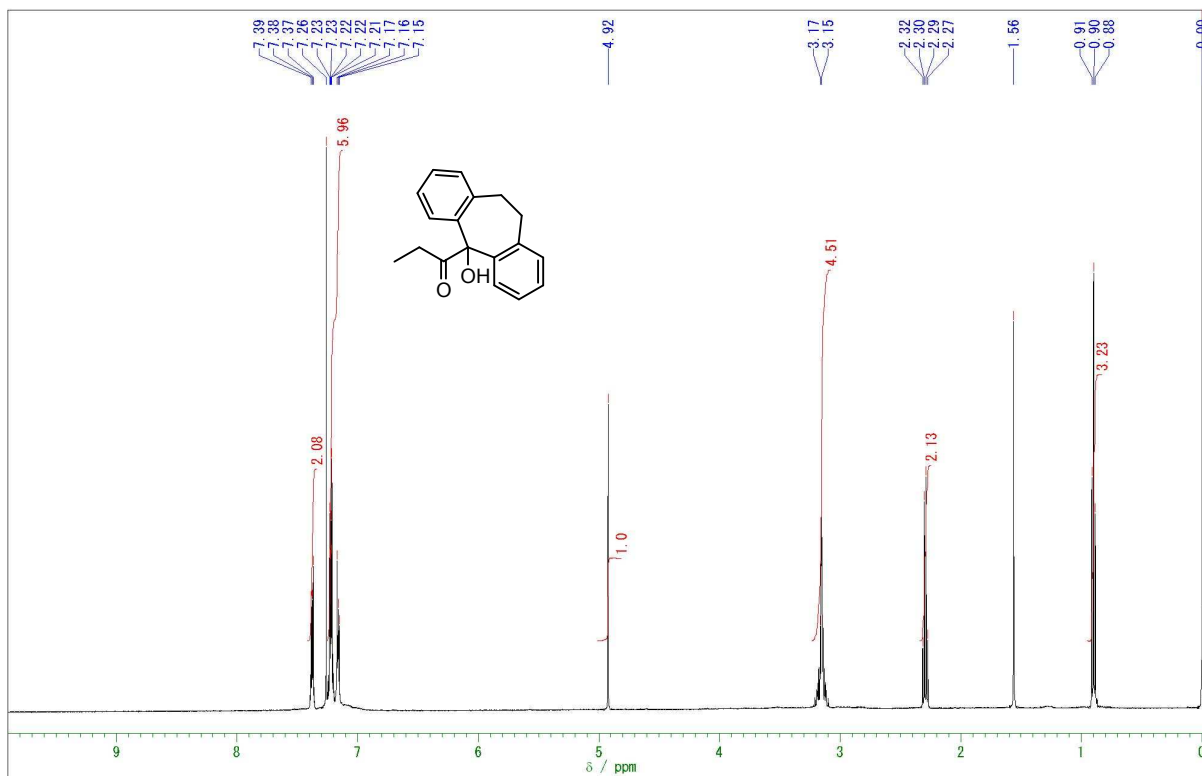
¹H NMR Spectrum of 3k (500 MHz, CDCl₃)



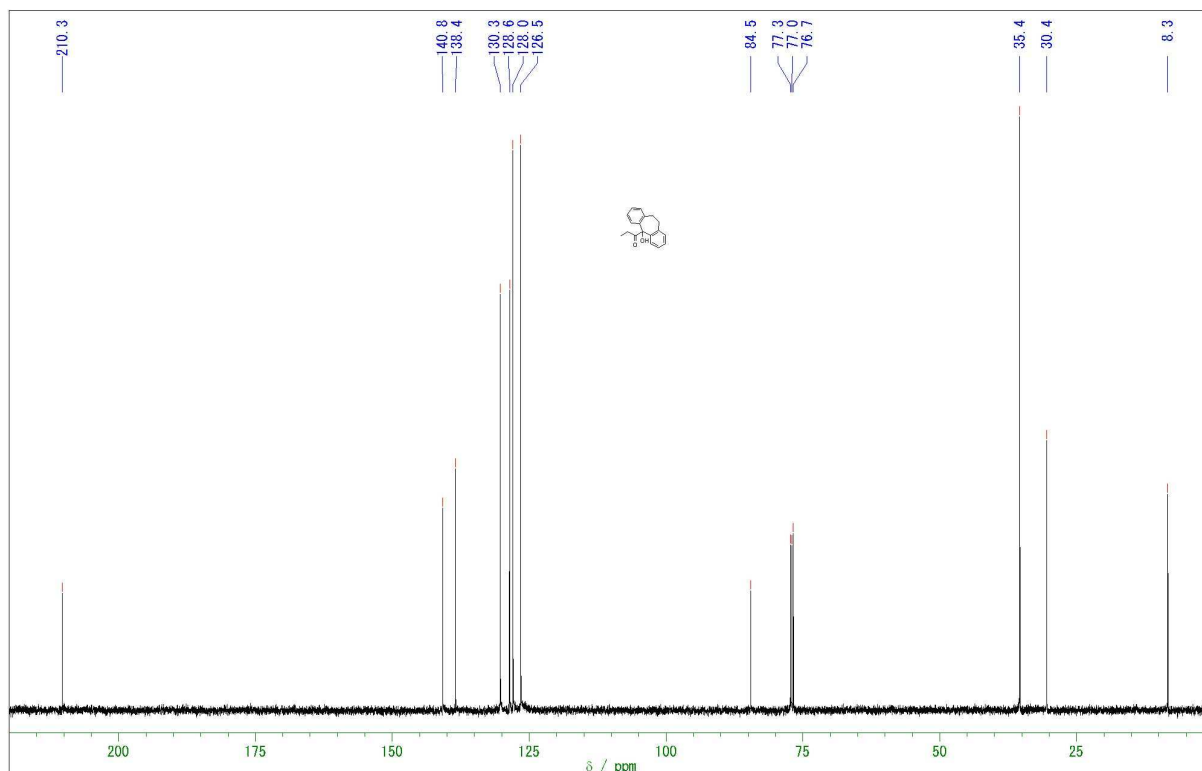
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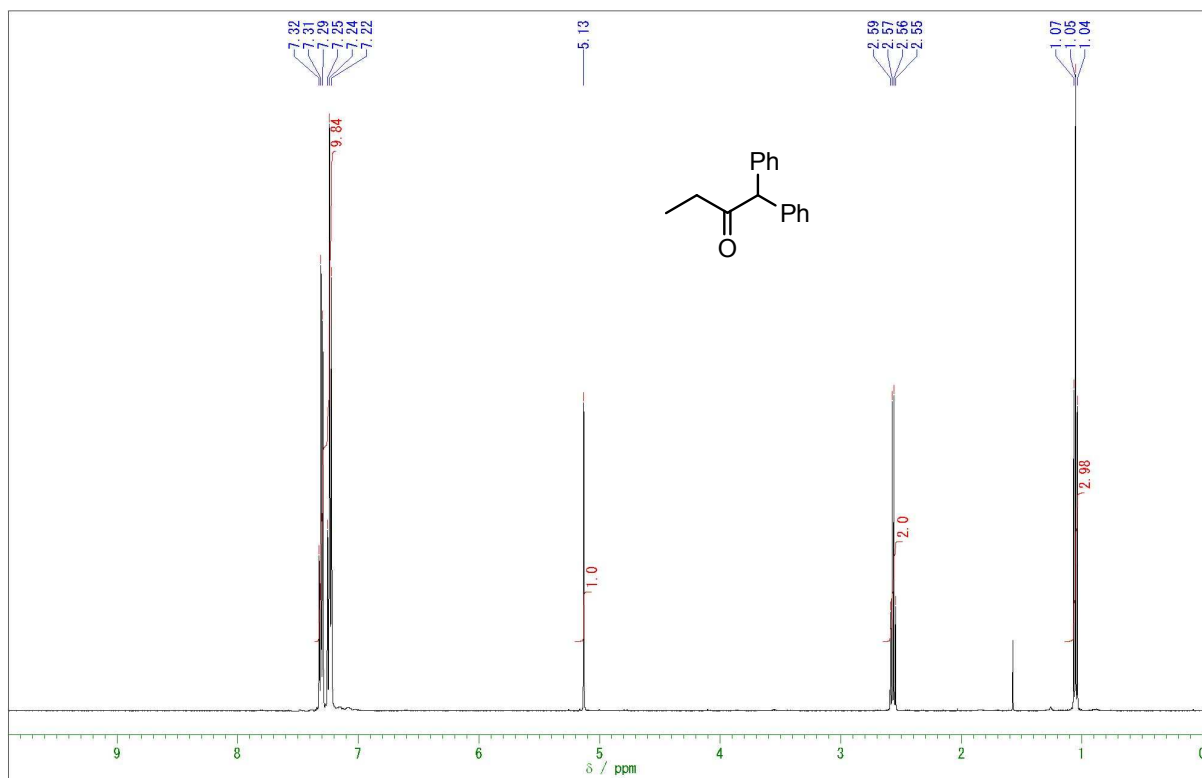
¹H NMR Spectrum of 3l (500 MHz, CDCl₃)



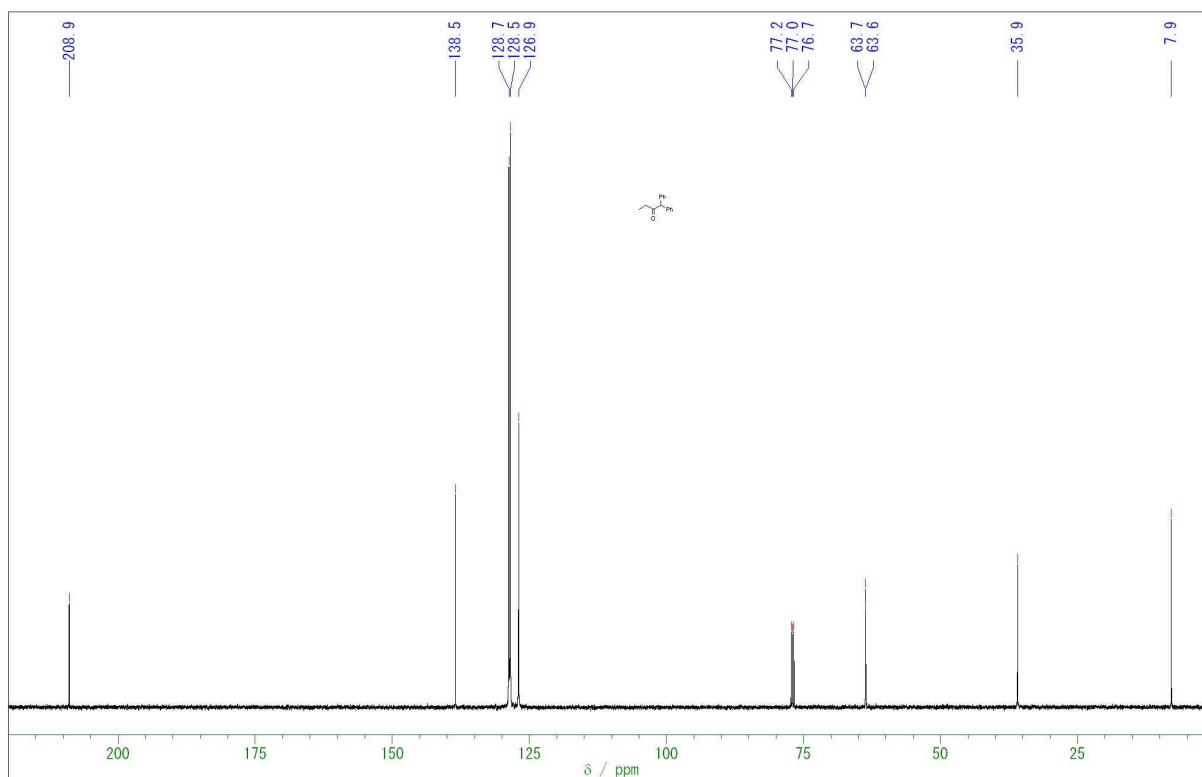
¹³C NMR Spectrum of 3l (125 MHz, CDCl₃)



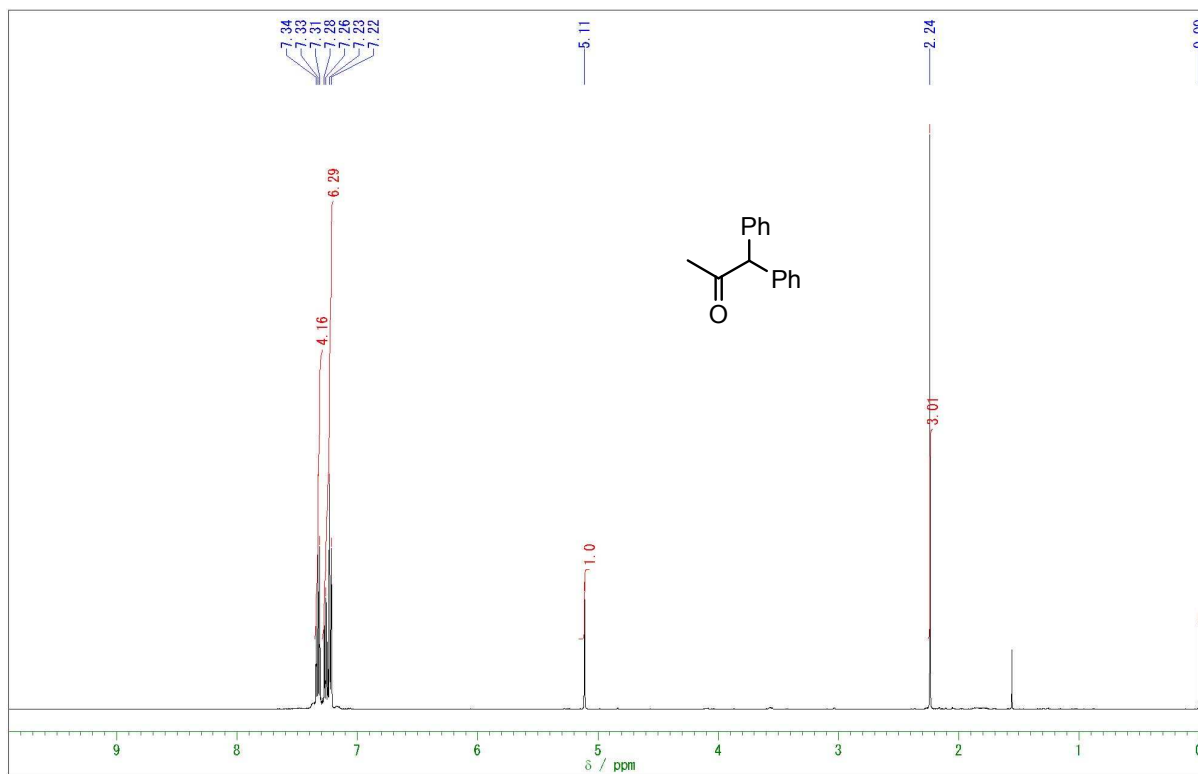
¹H NMR Spectrum of 4a (500 MHz, CDCl₃)



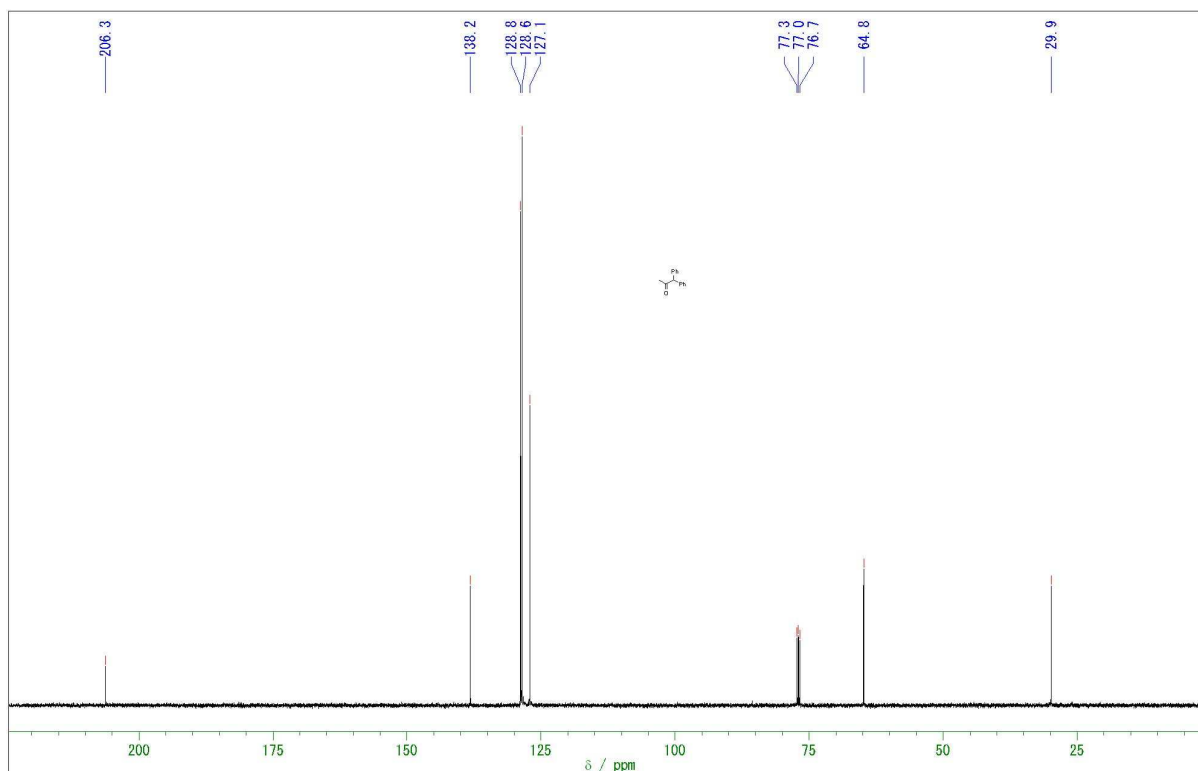
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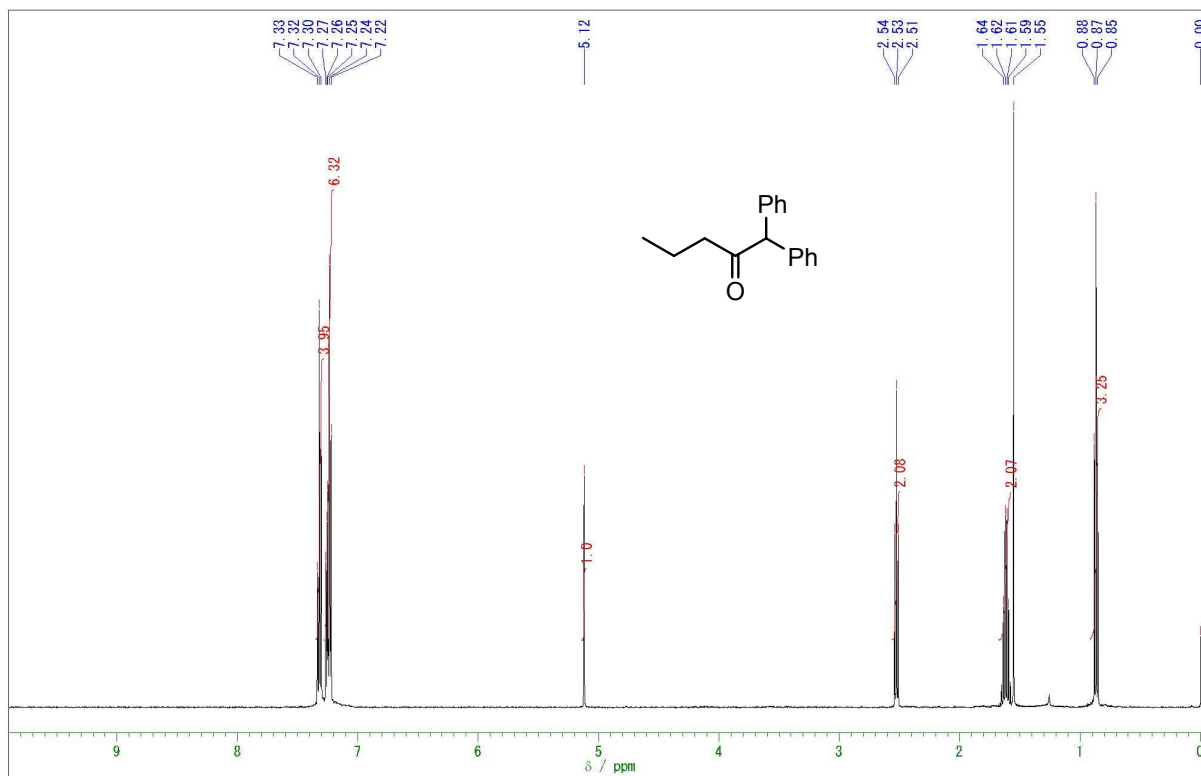
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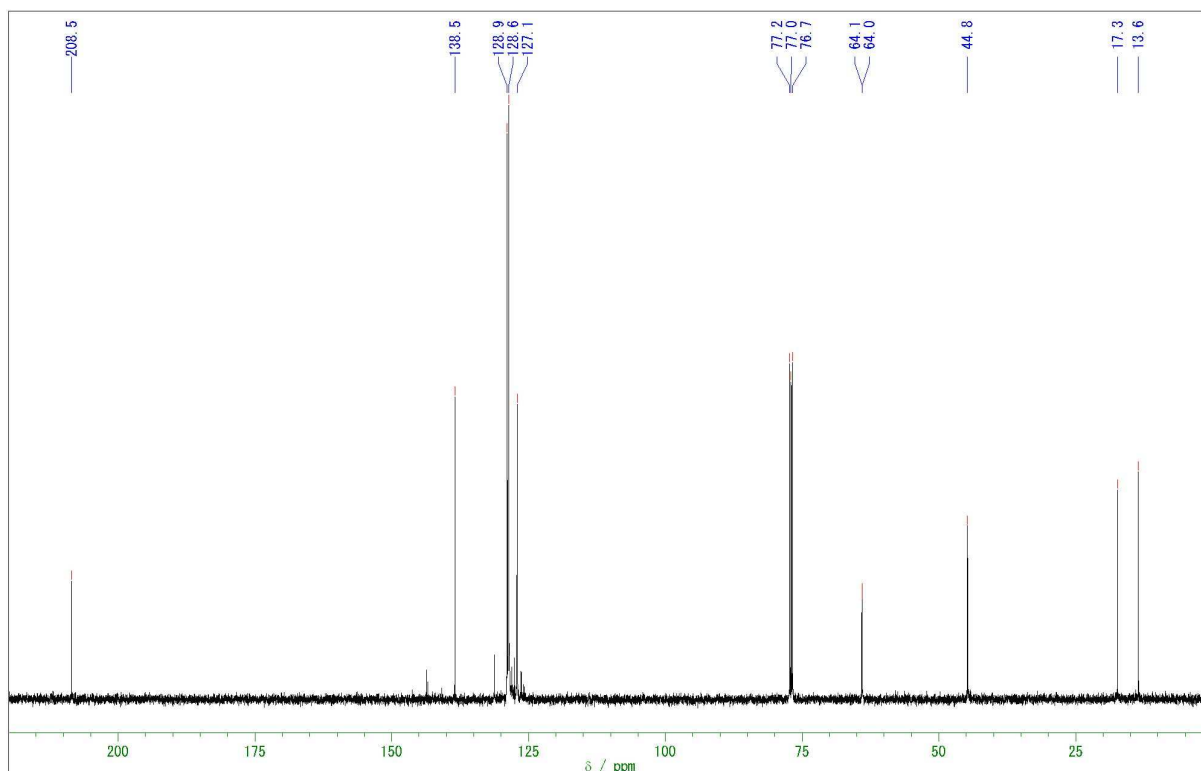
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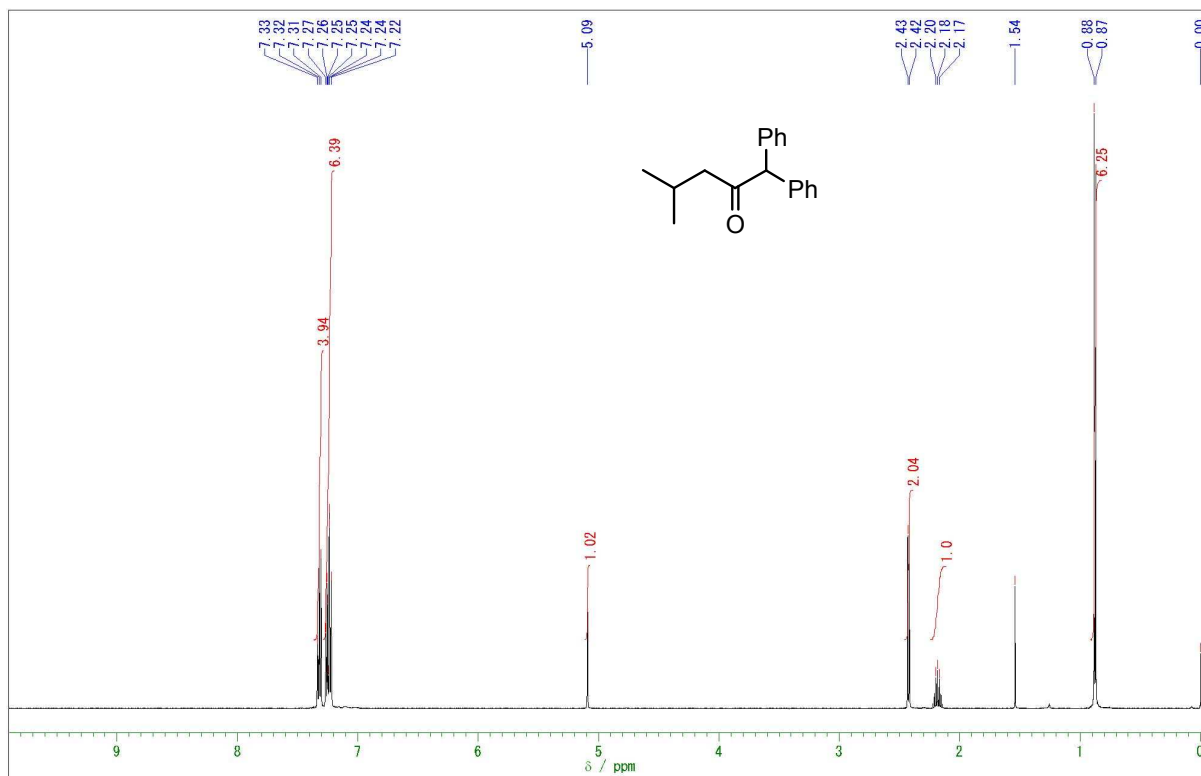
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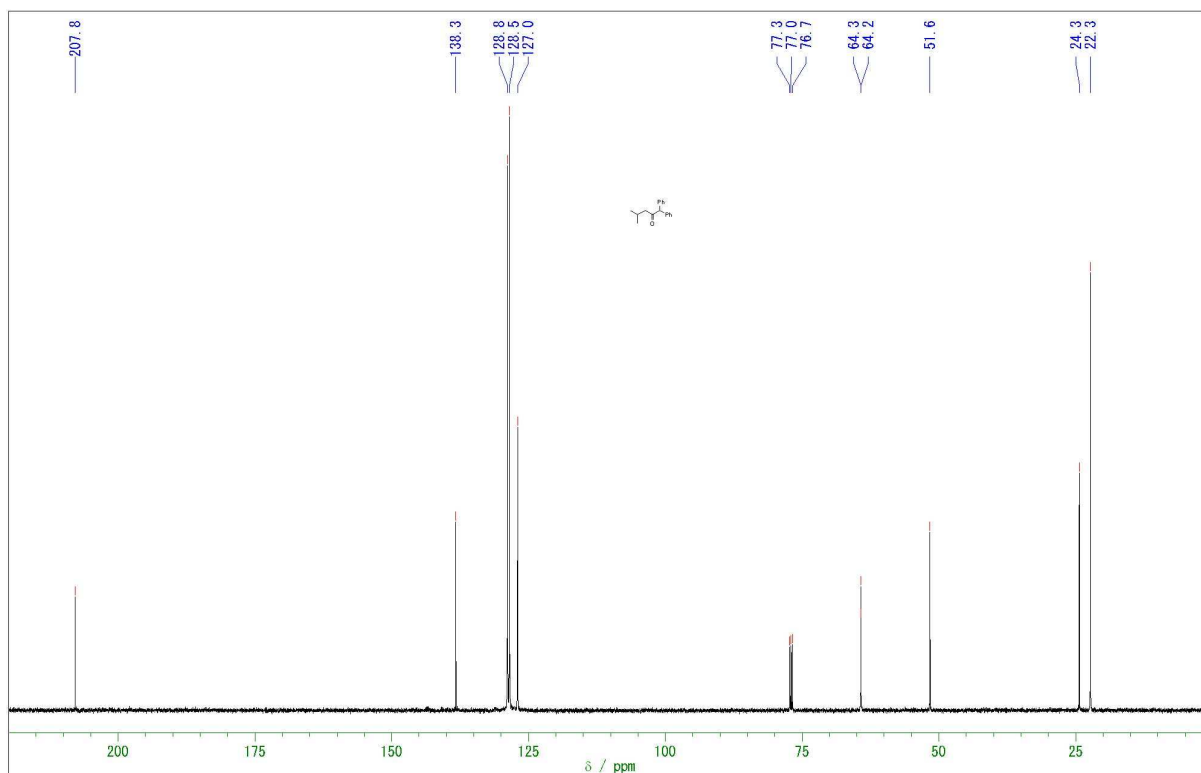
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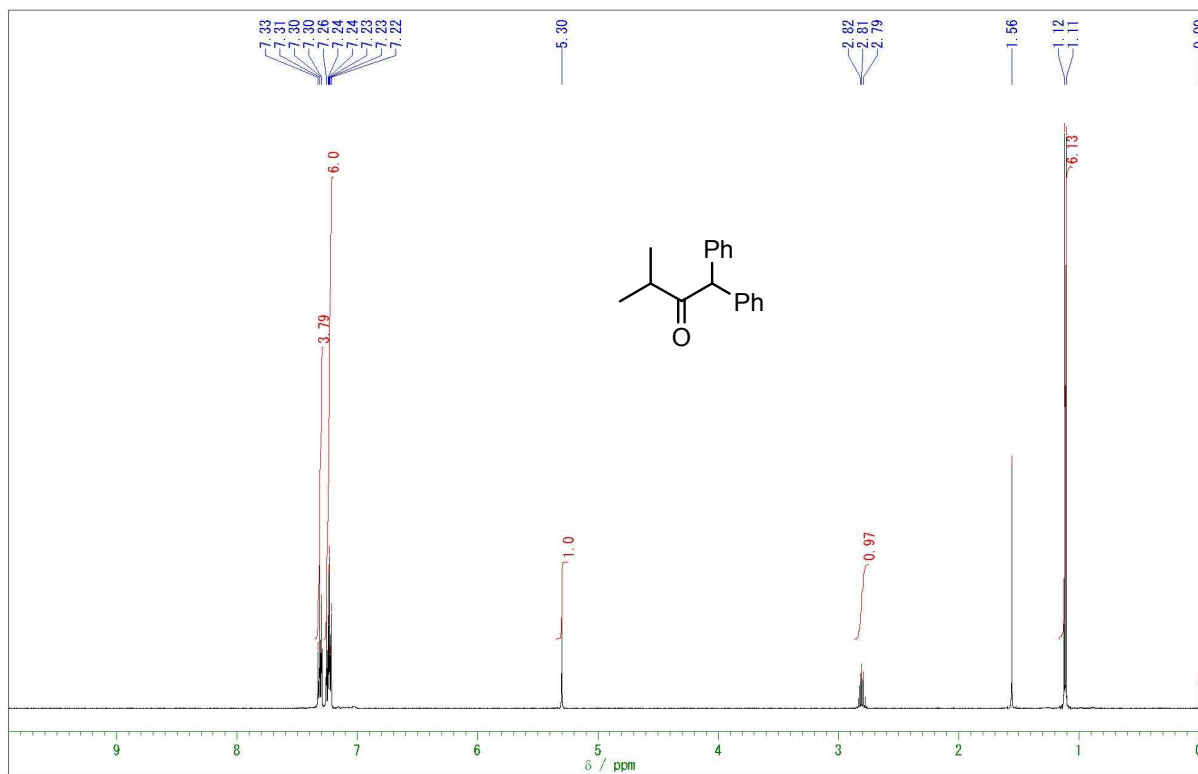
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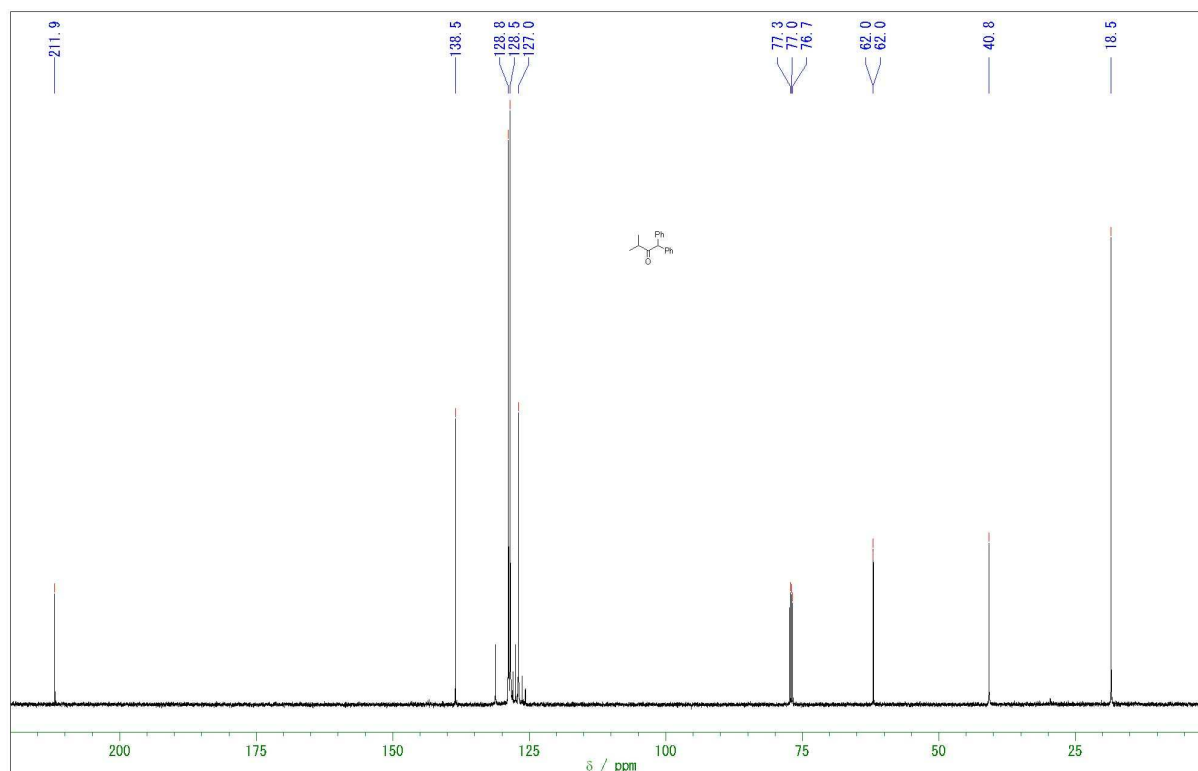
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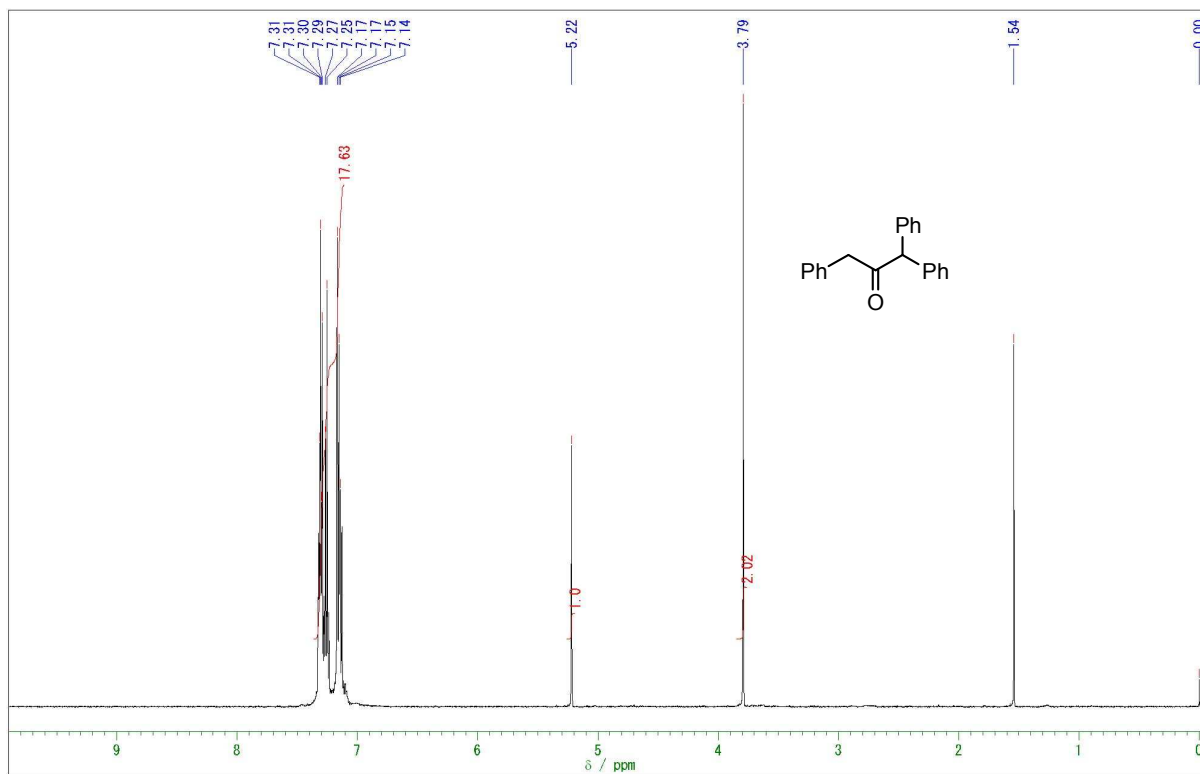
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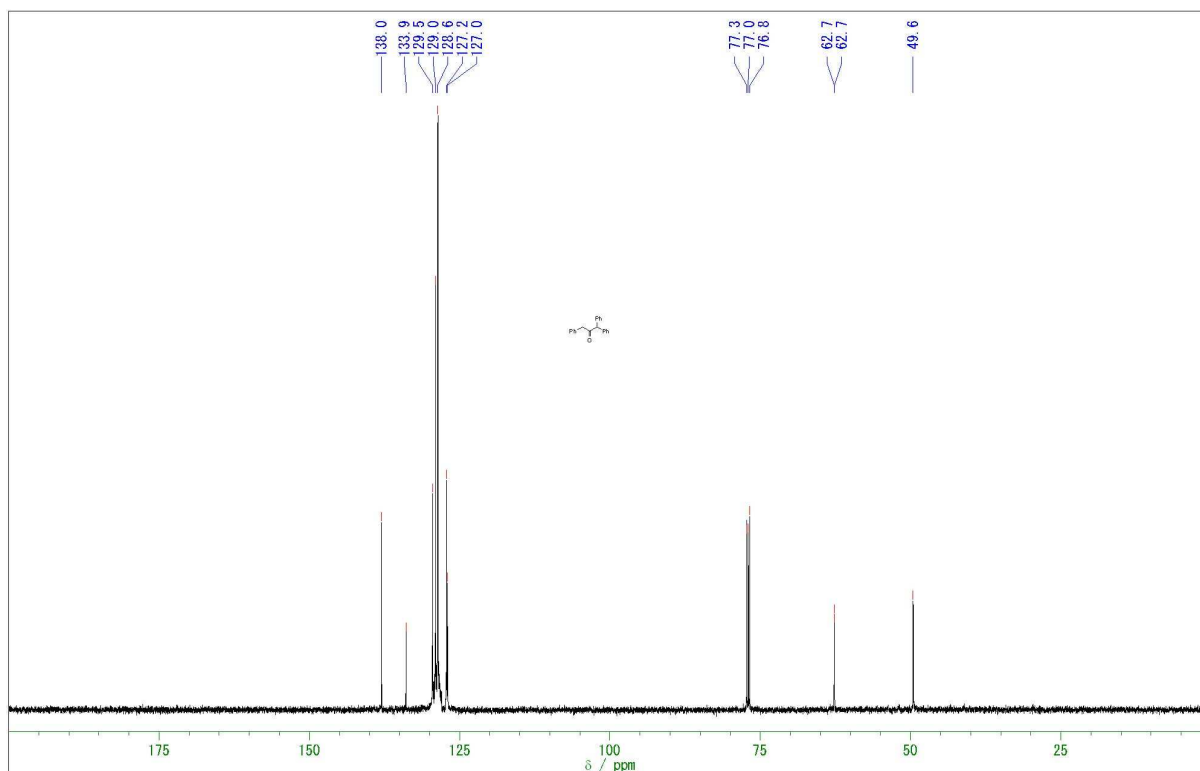
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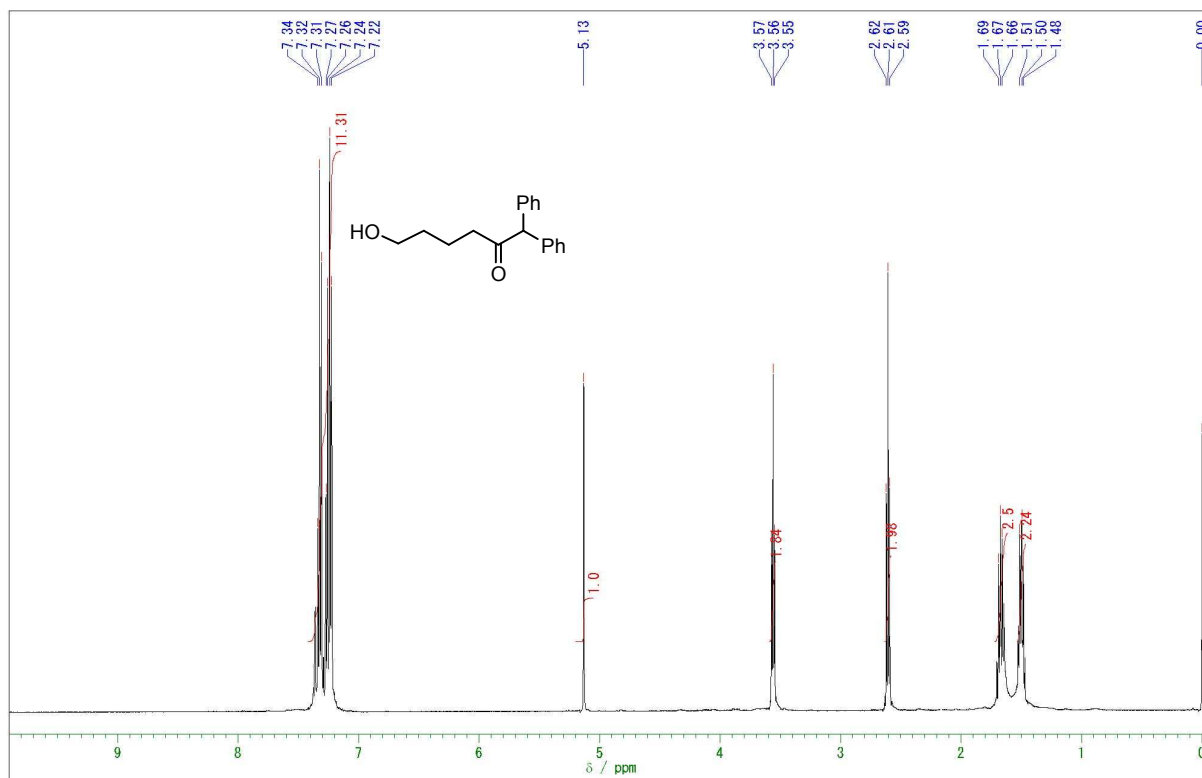
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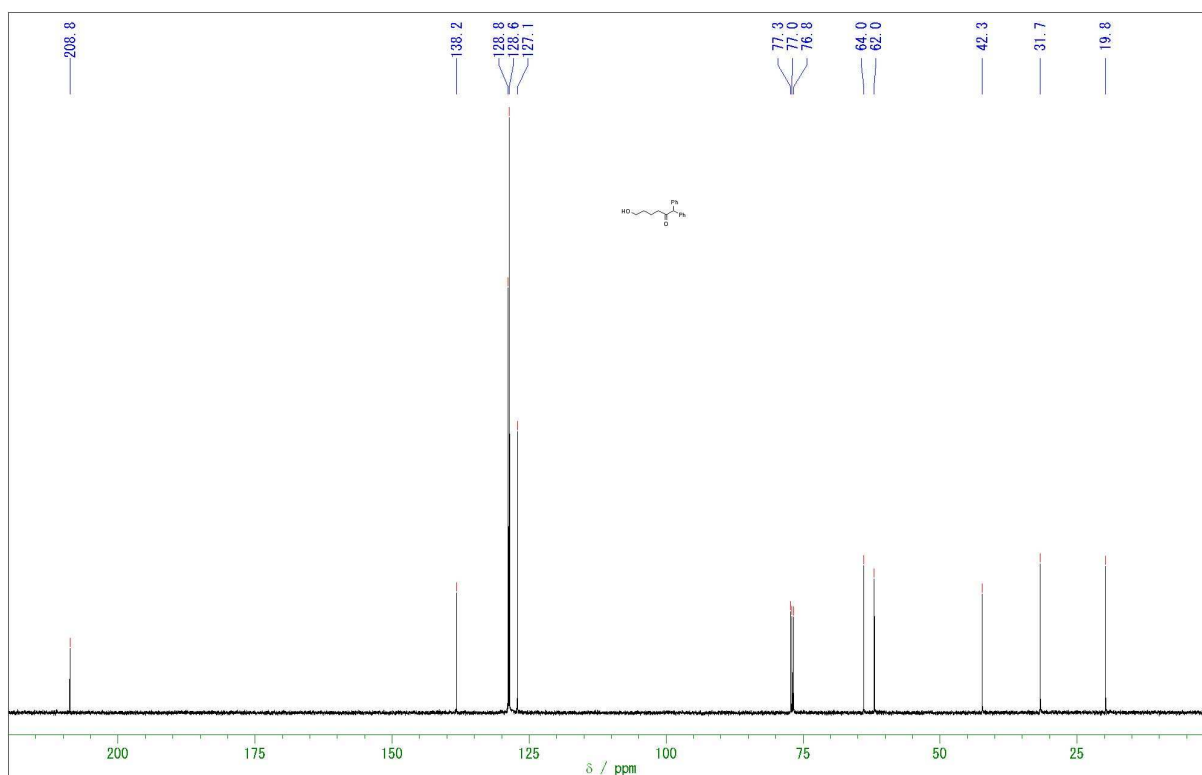
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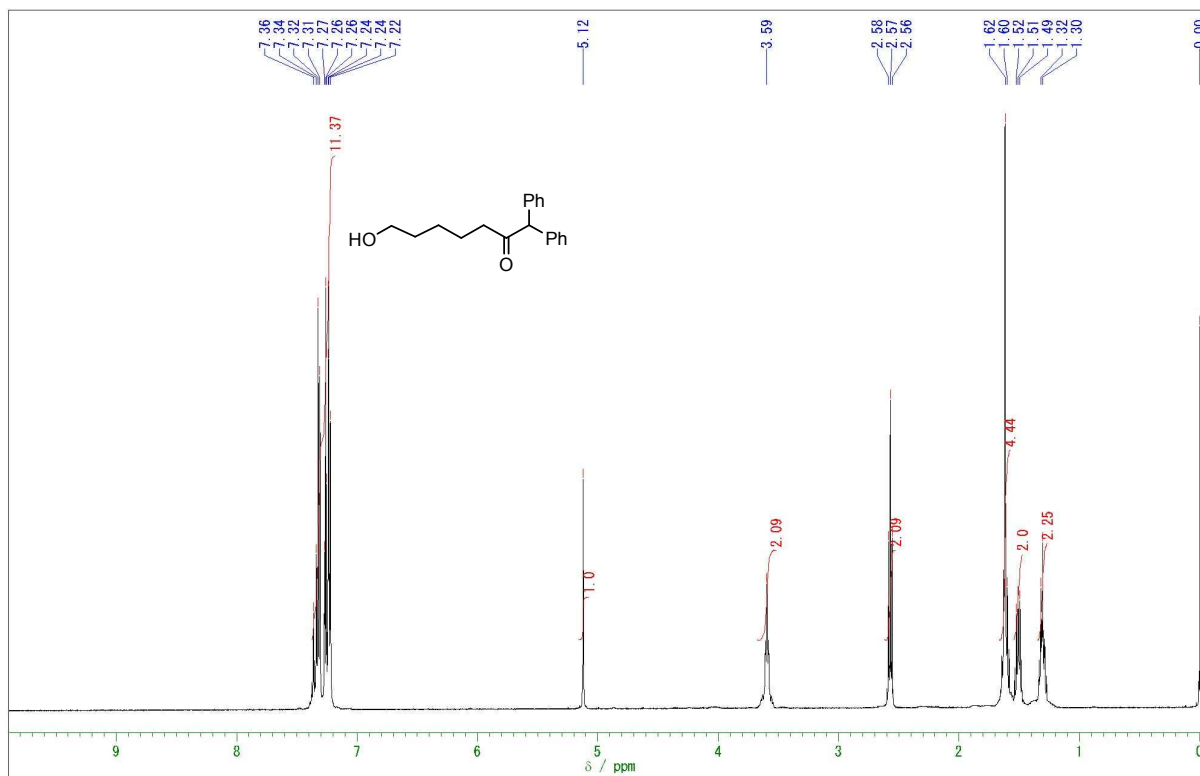
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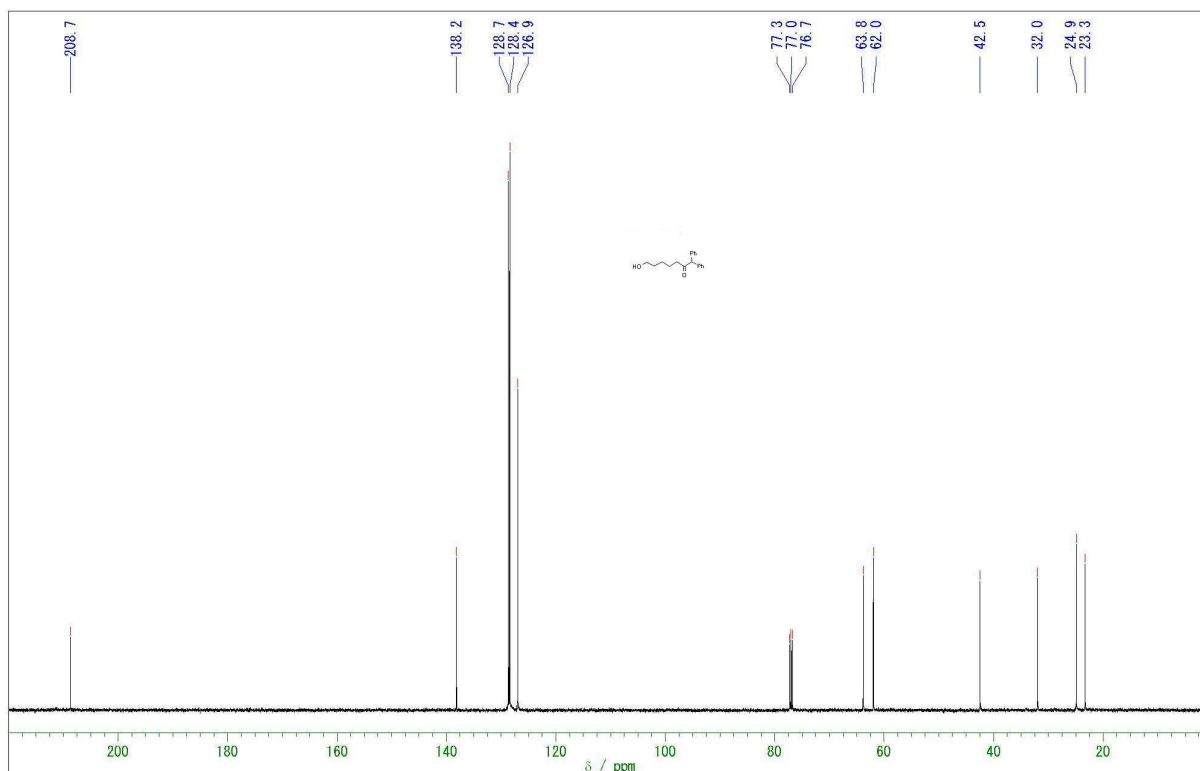
¹³C NMR Spectrum of 4h (125 MHz, CDCl₃)



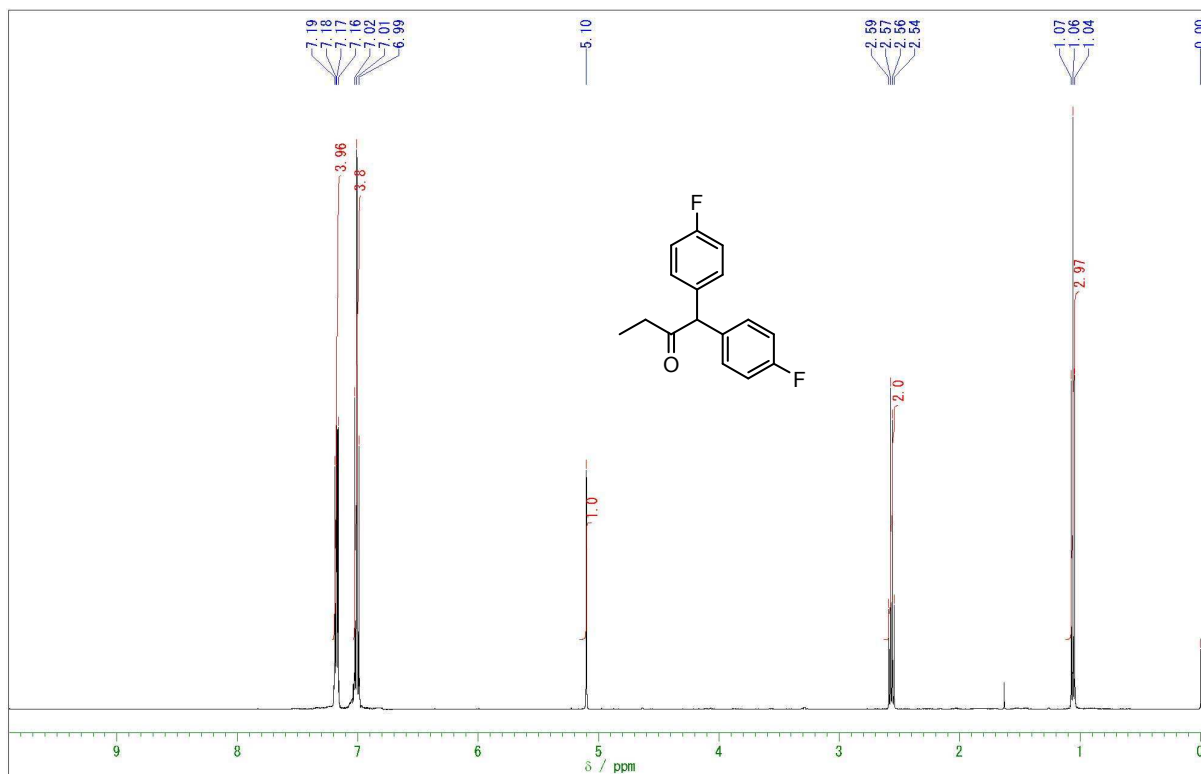
¹H NMR Spectrum of 4i (500 MHz, CDCl₃)



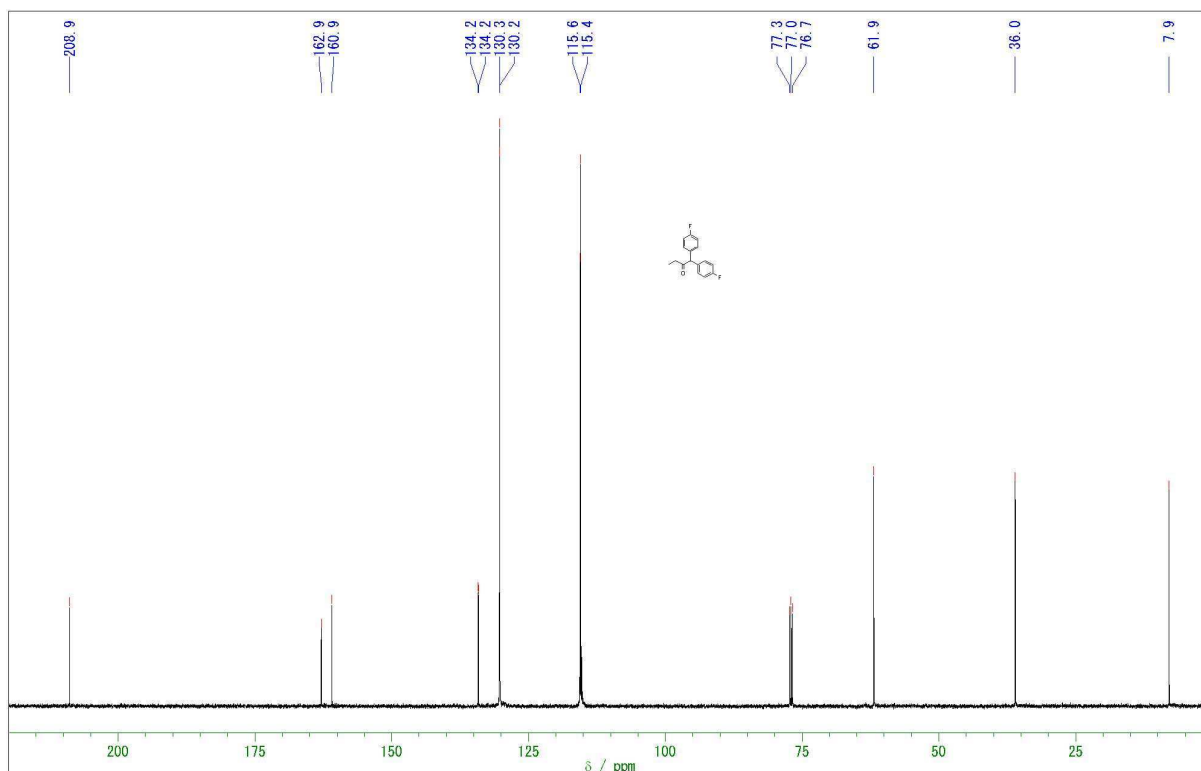
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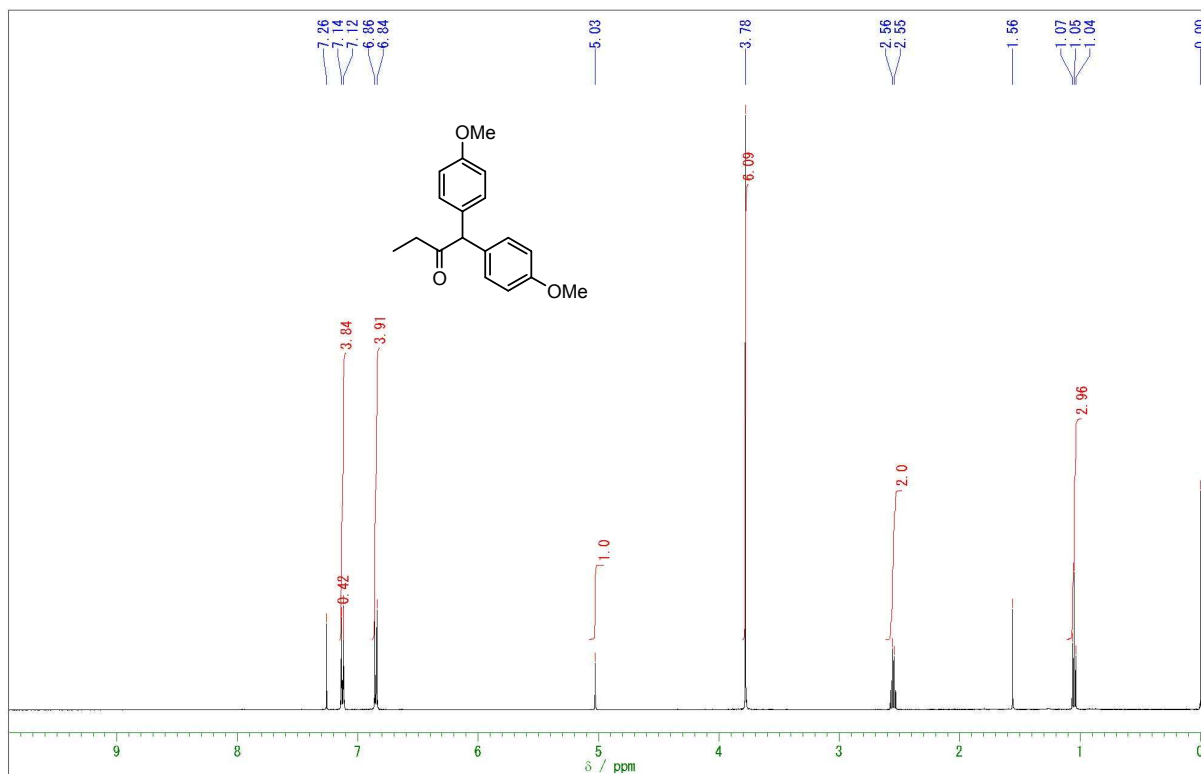
¹H NMR Spectrum of 4j (500 MHz, CDCl₃)



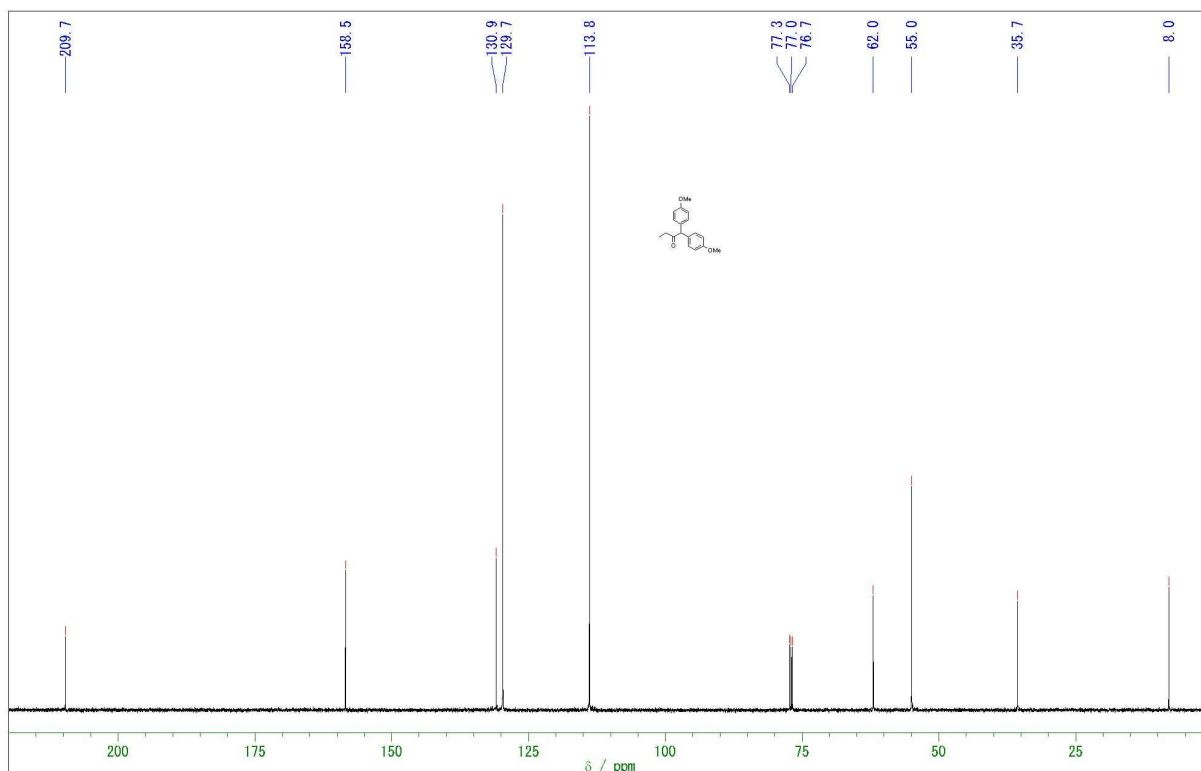
¹³C NMR Spectrum of 4j (125 MHz, CDCl₃)



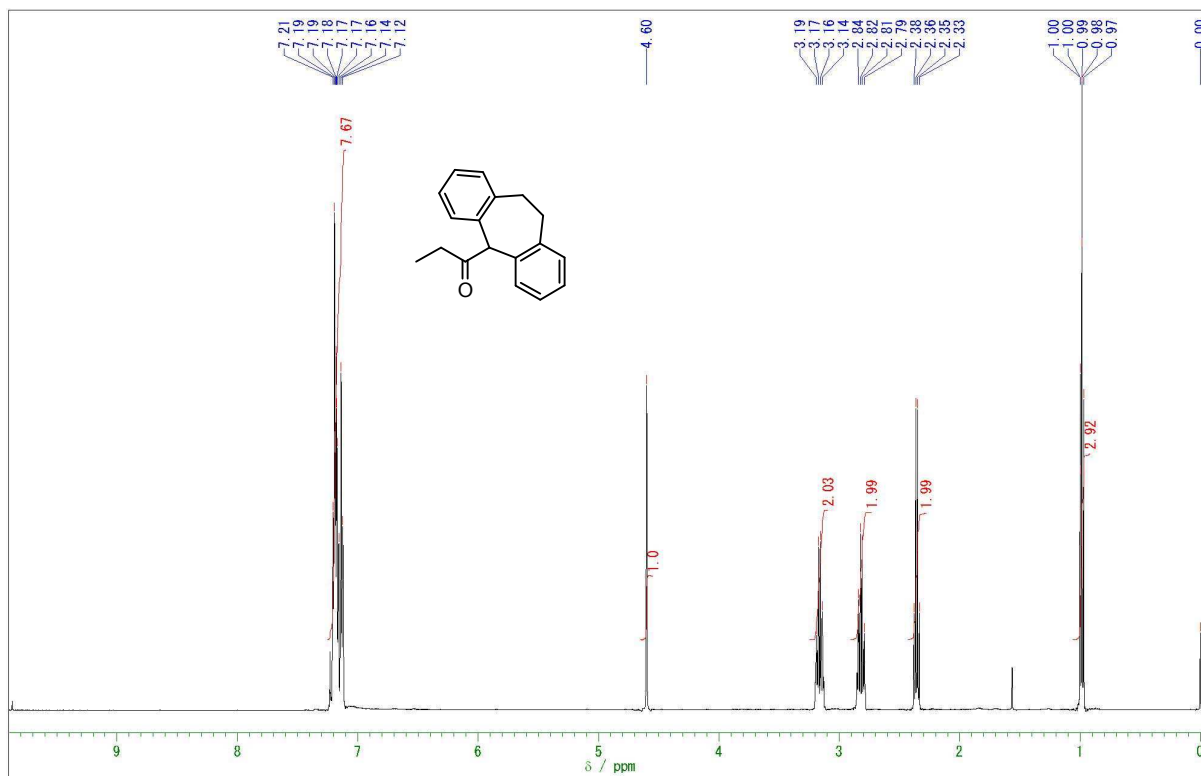
¹H NMR Spectrum of 4k (500 MHz, CDCl₃)



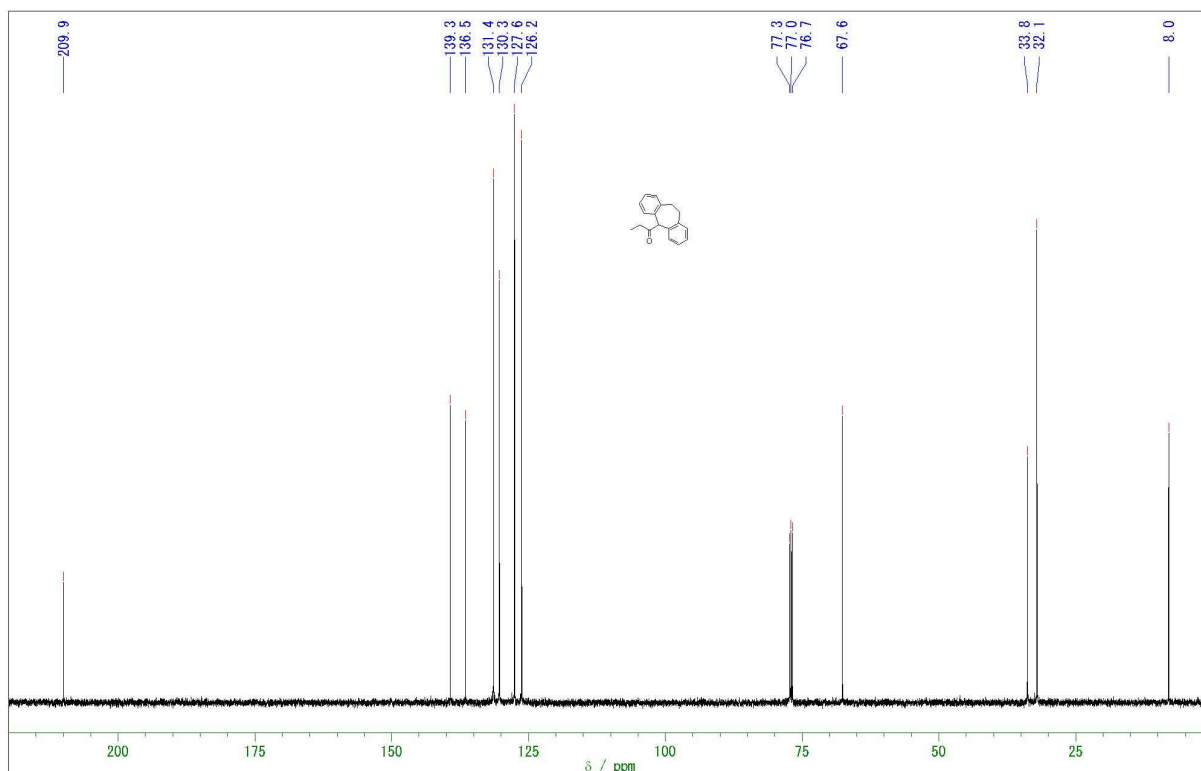
¹³C NMR Spectrum of 4k (125 MHz, CDCl₃)



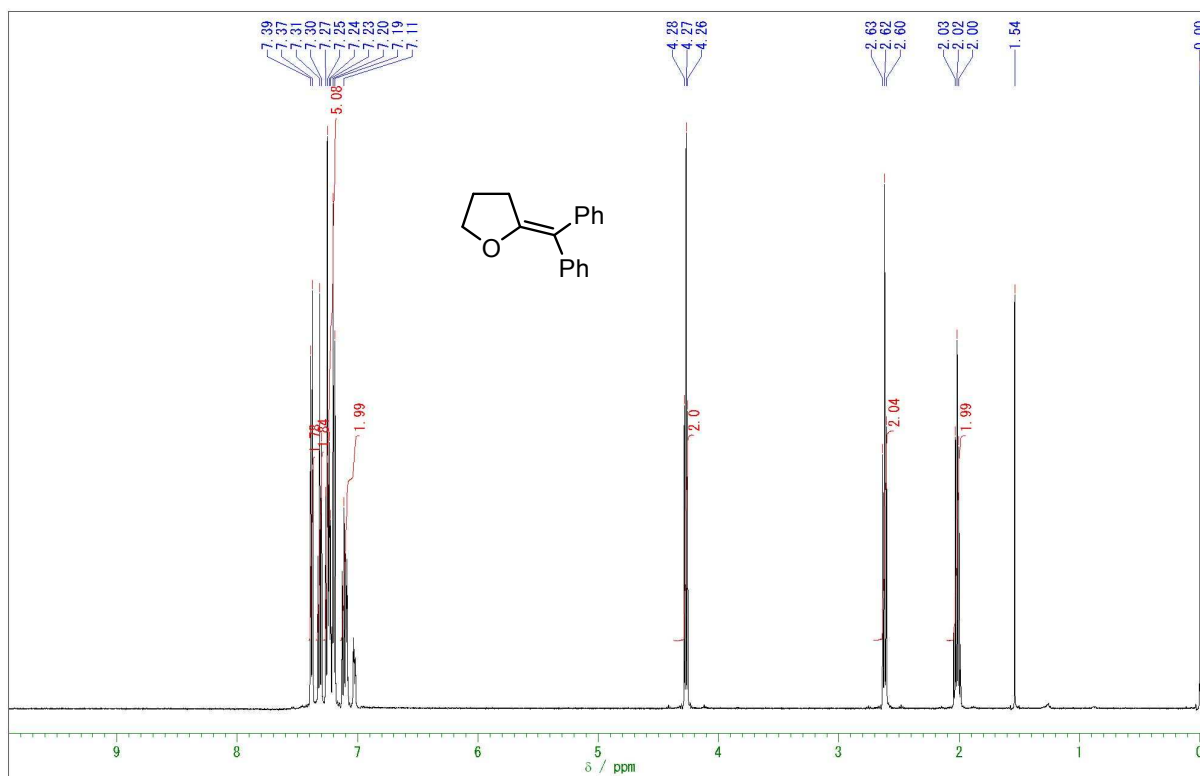
¹H NMR Spectrum of 4l (500 MHz, CDCl₃)



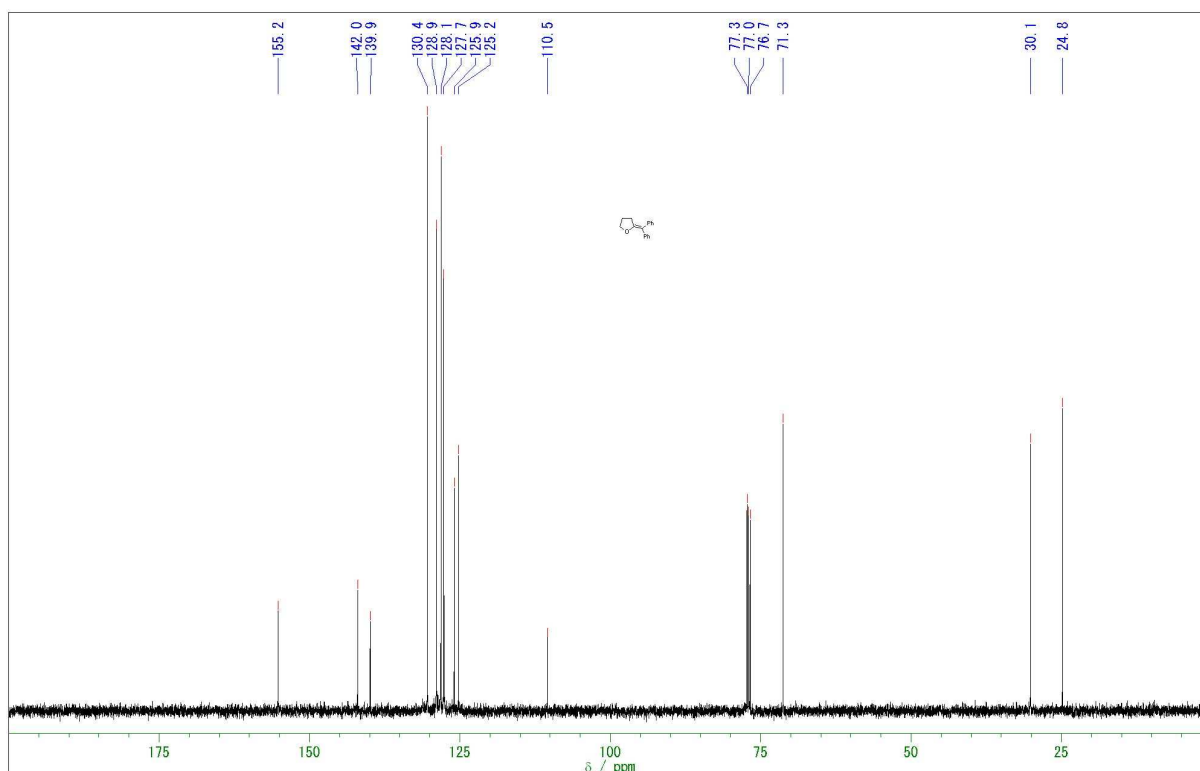
¹³C NMR Spectrum of 4l (125 MHz, CDCl₃)



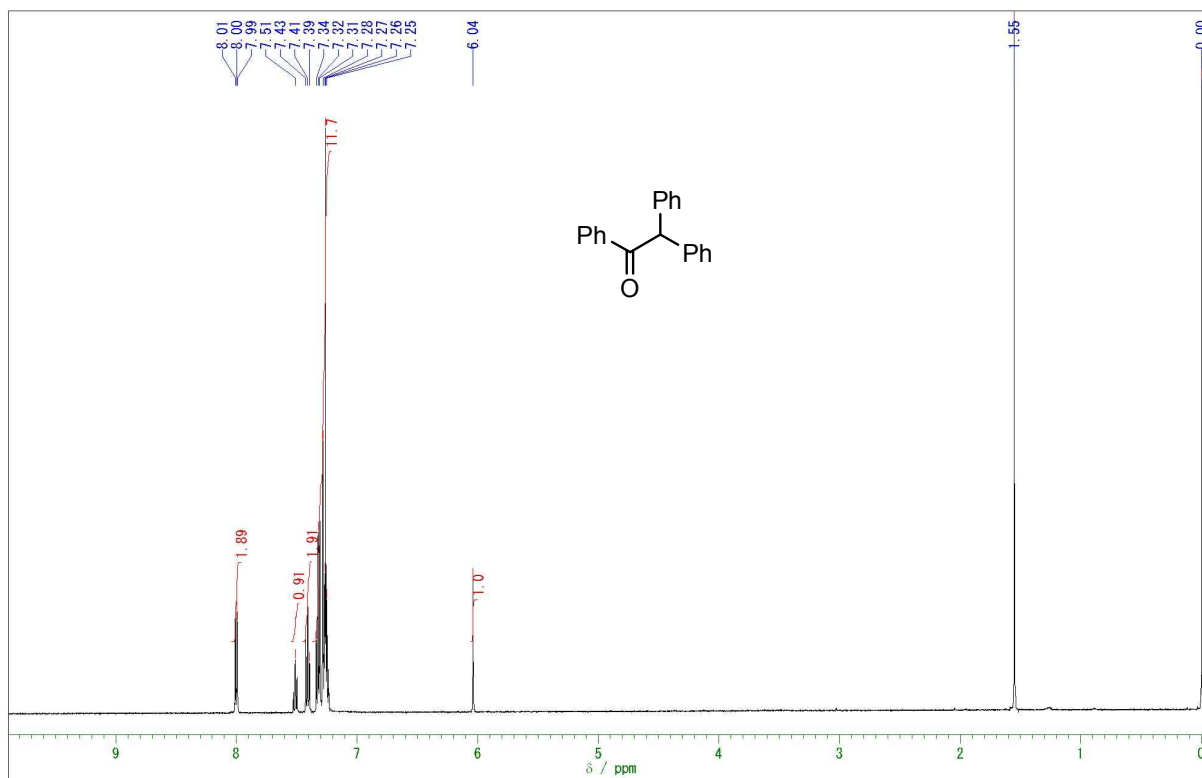
¹H NMR Spectrum of 5 (500 MHz, CDCl₃)



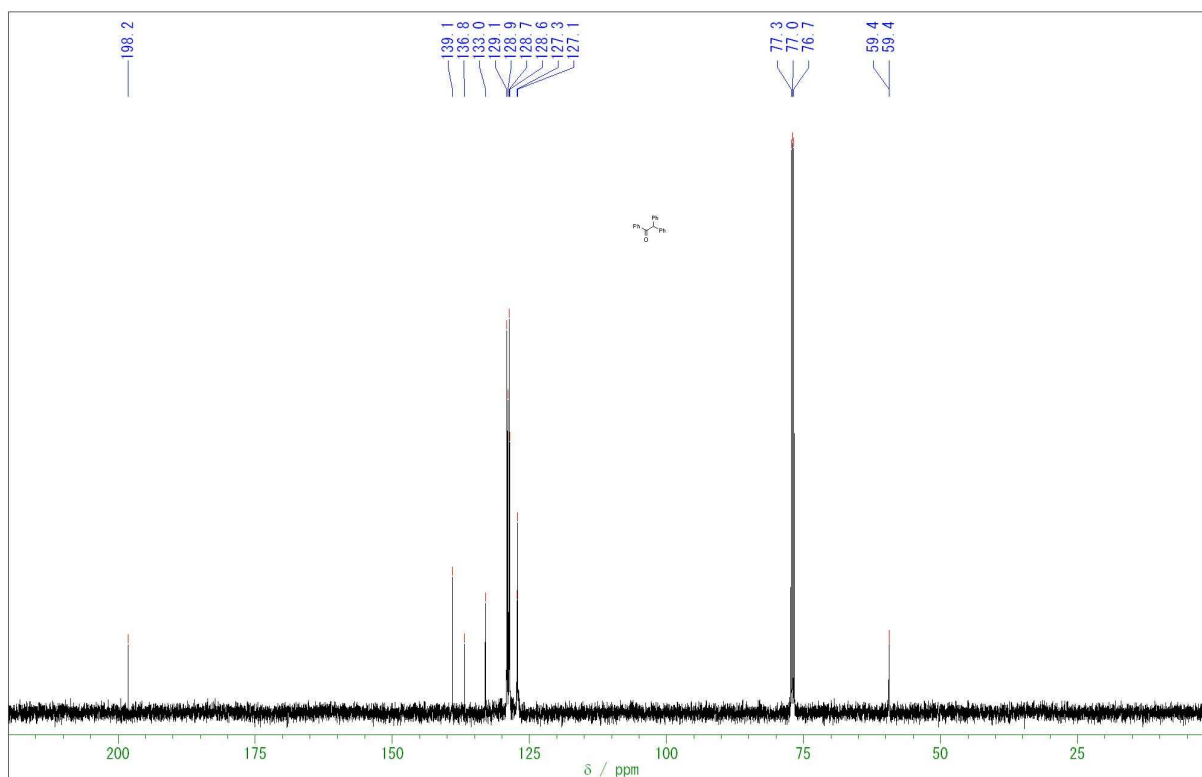
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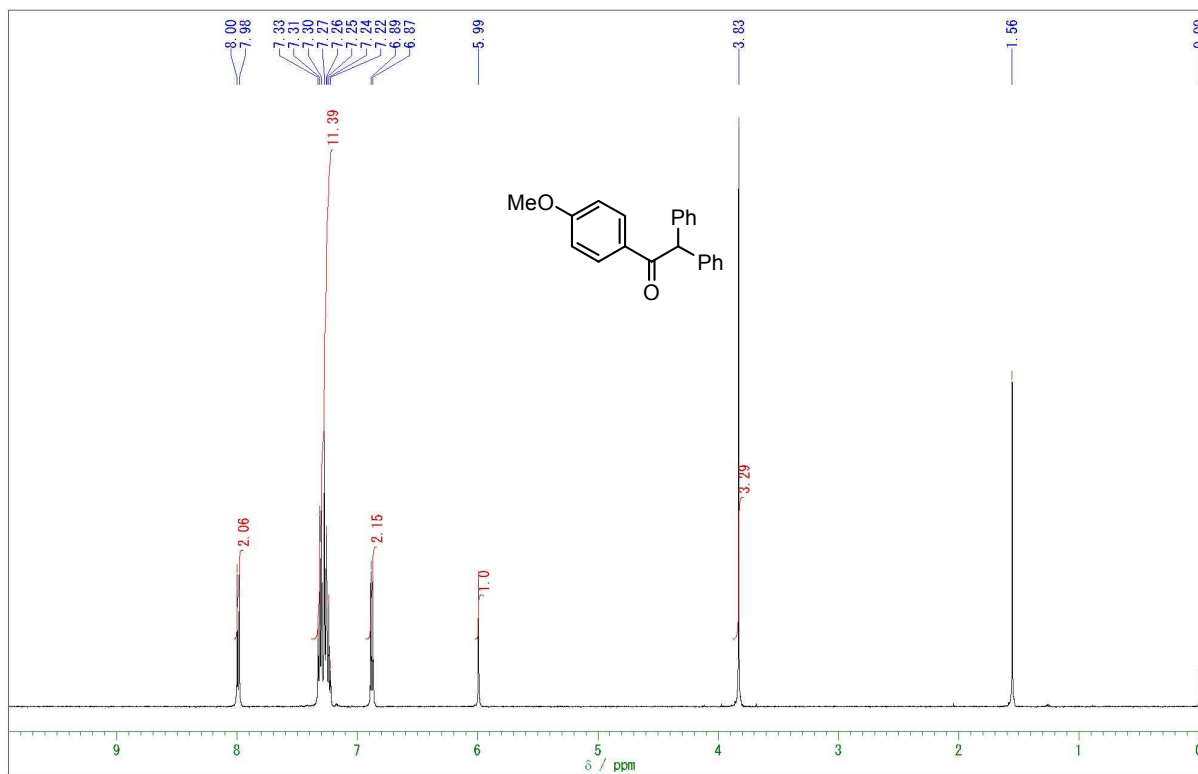
¹H NMR Spectrum of 7a (500 MHz, CDCl₃)



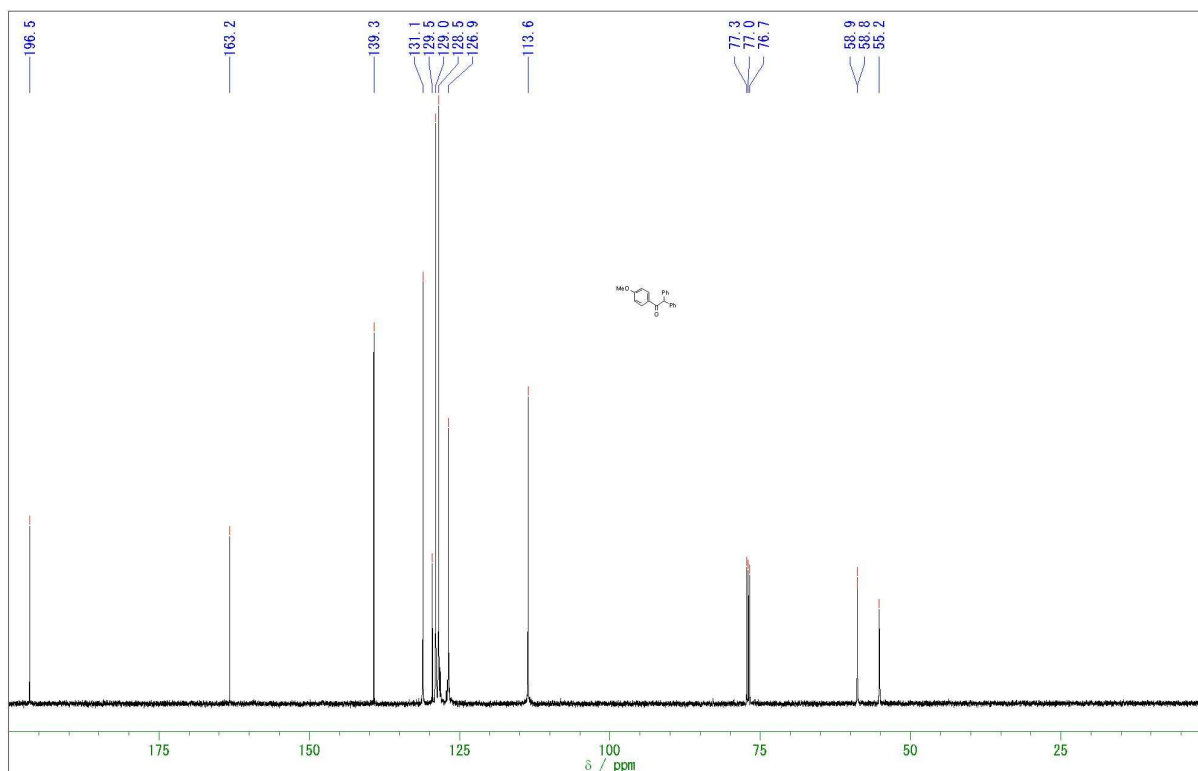
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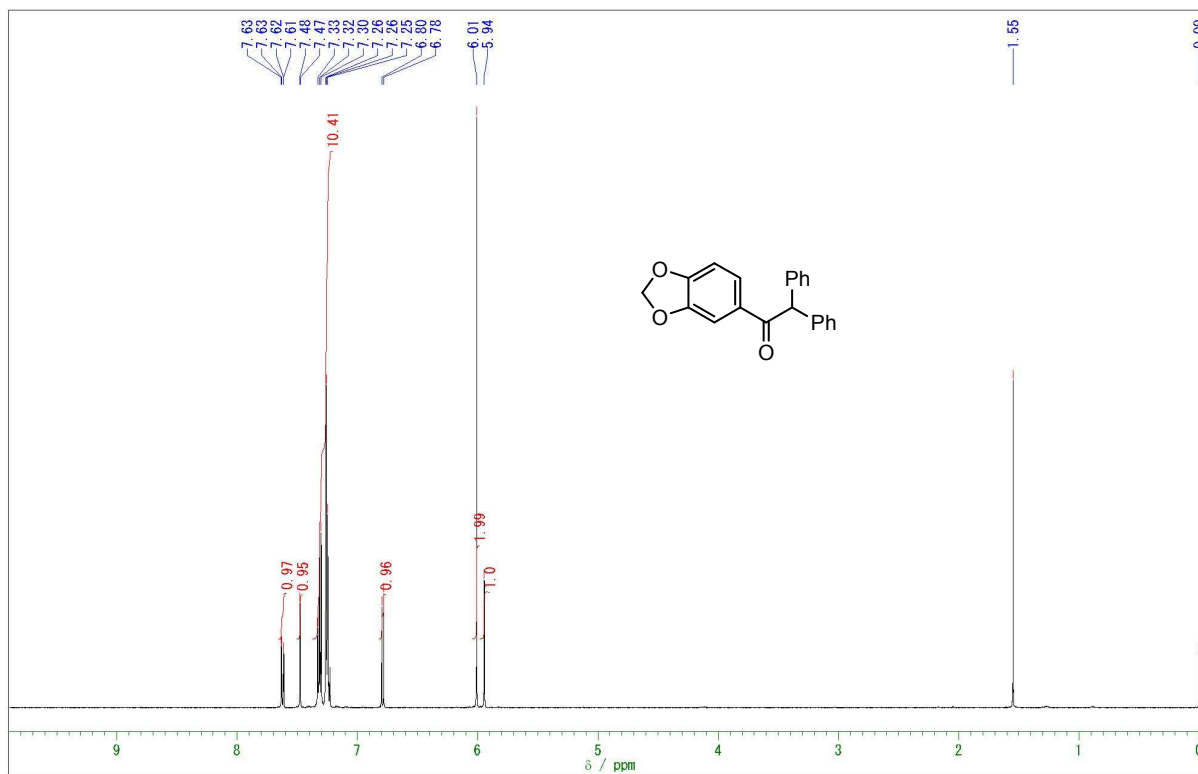
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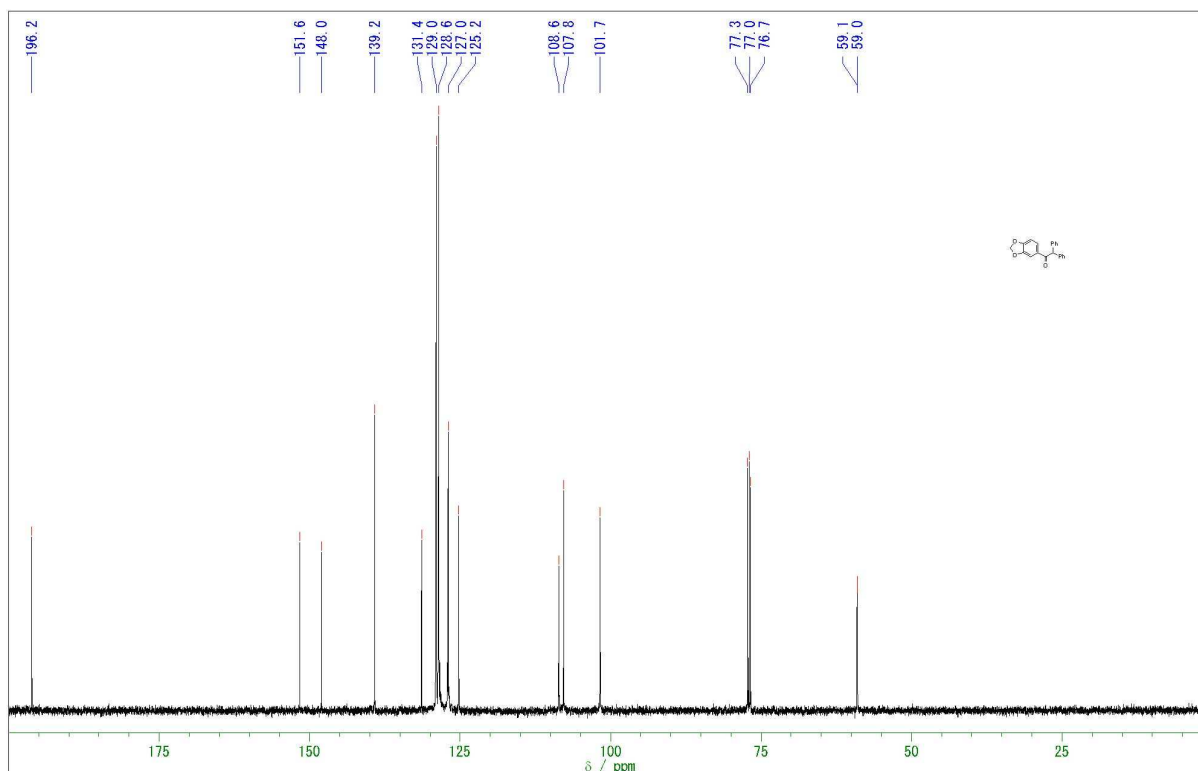
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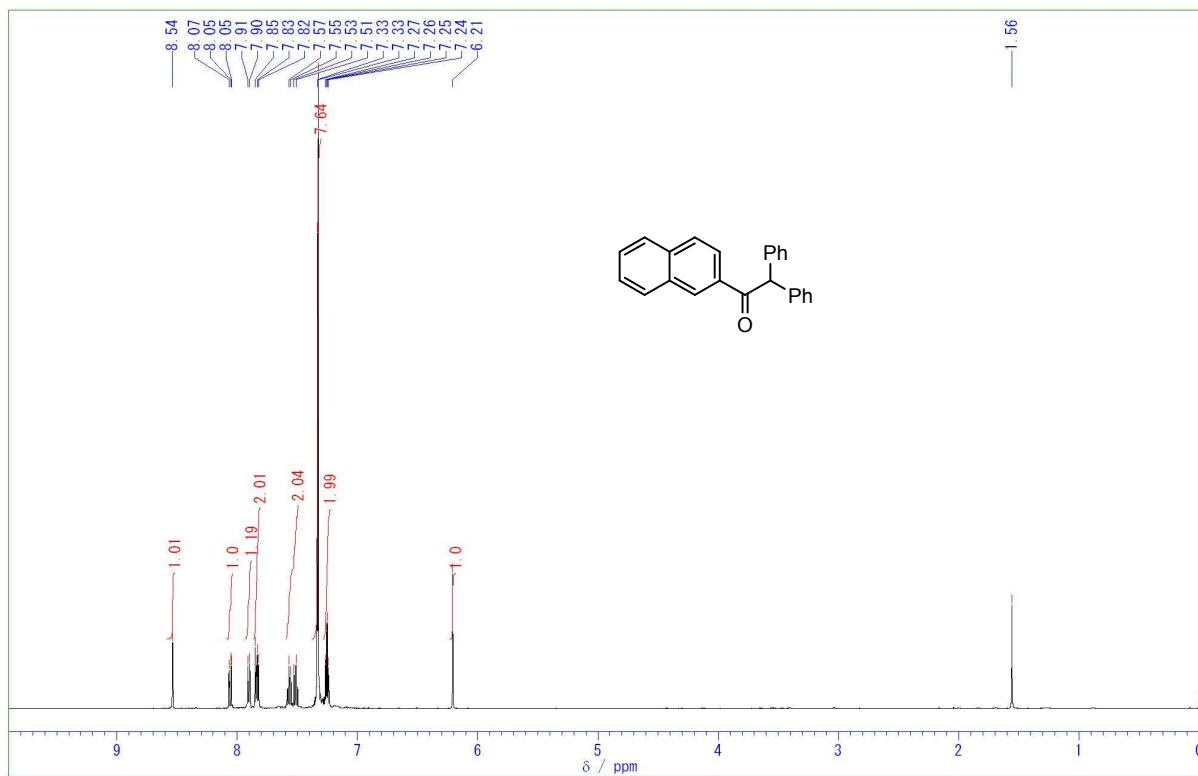
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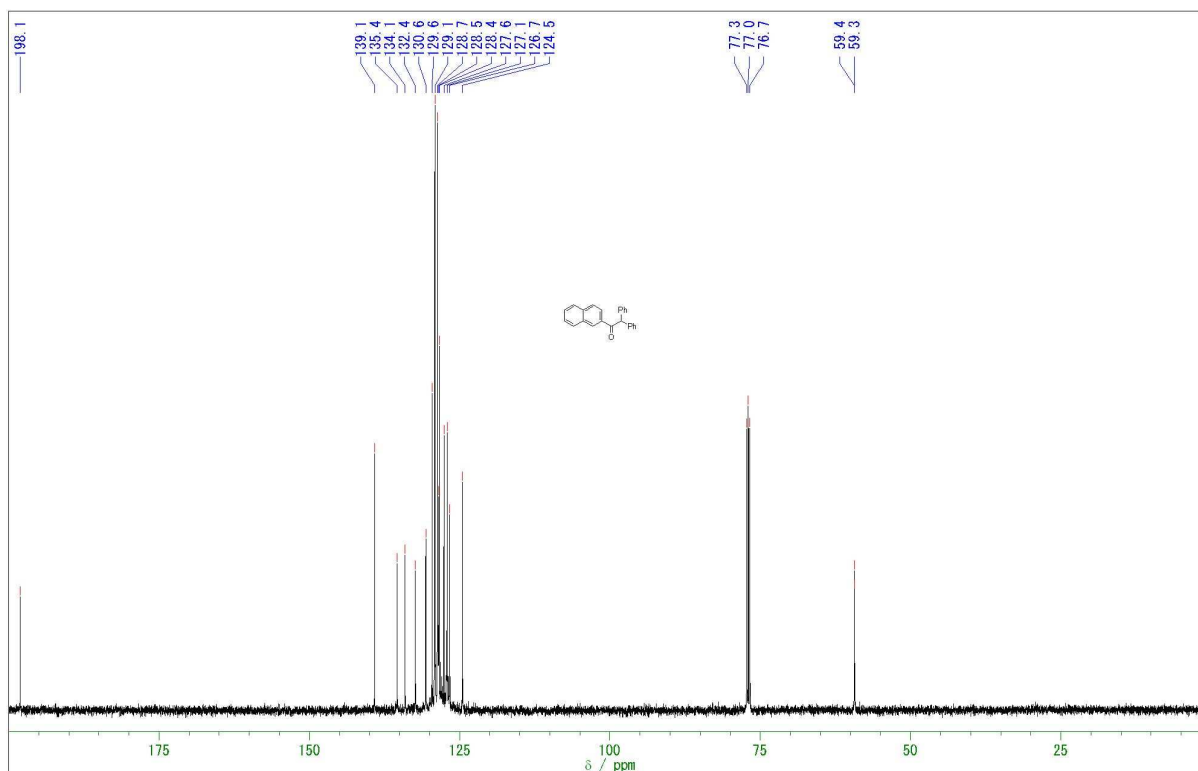
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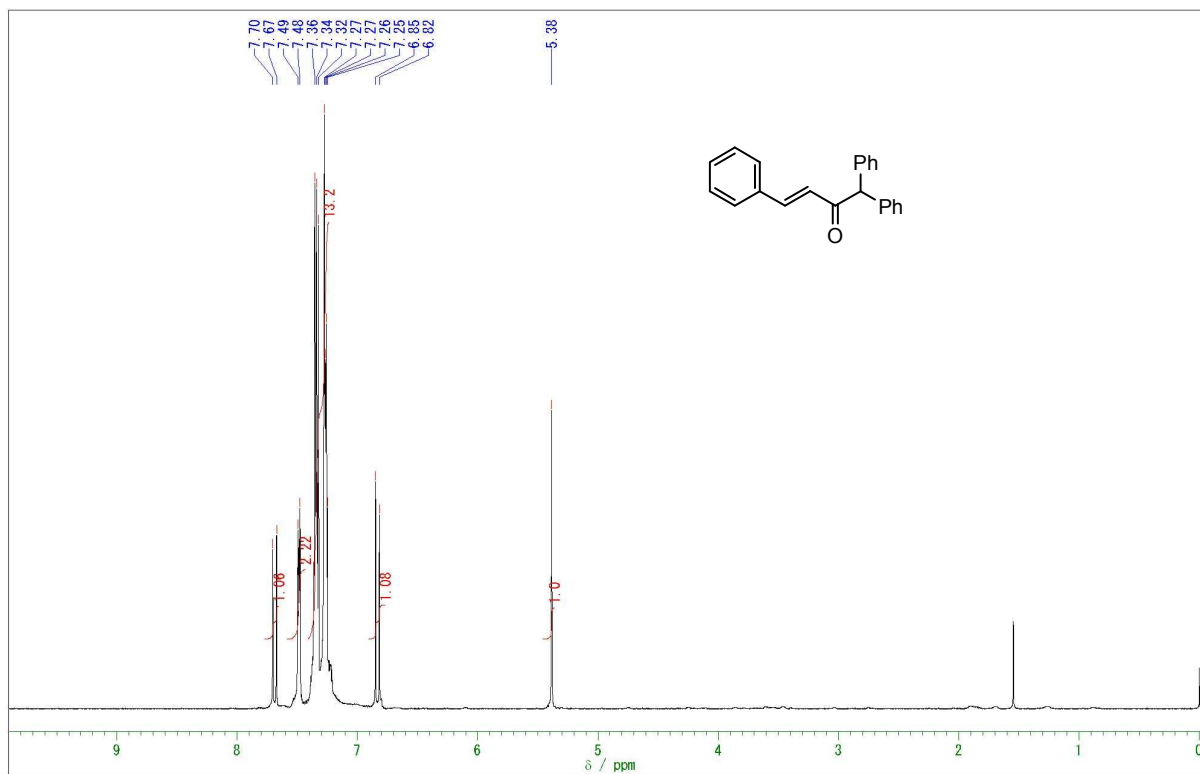
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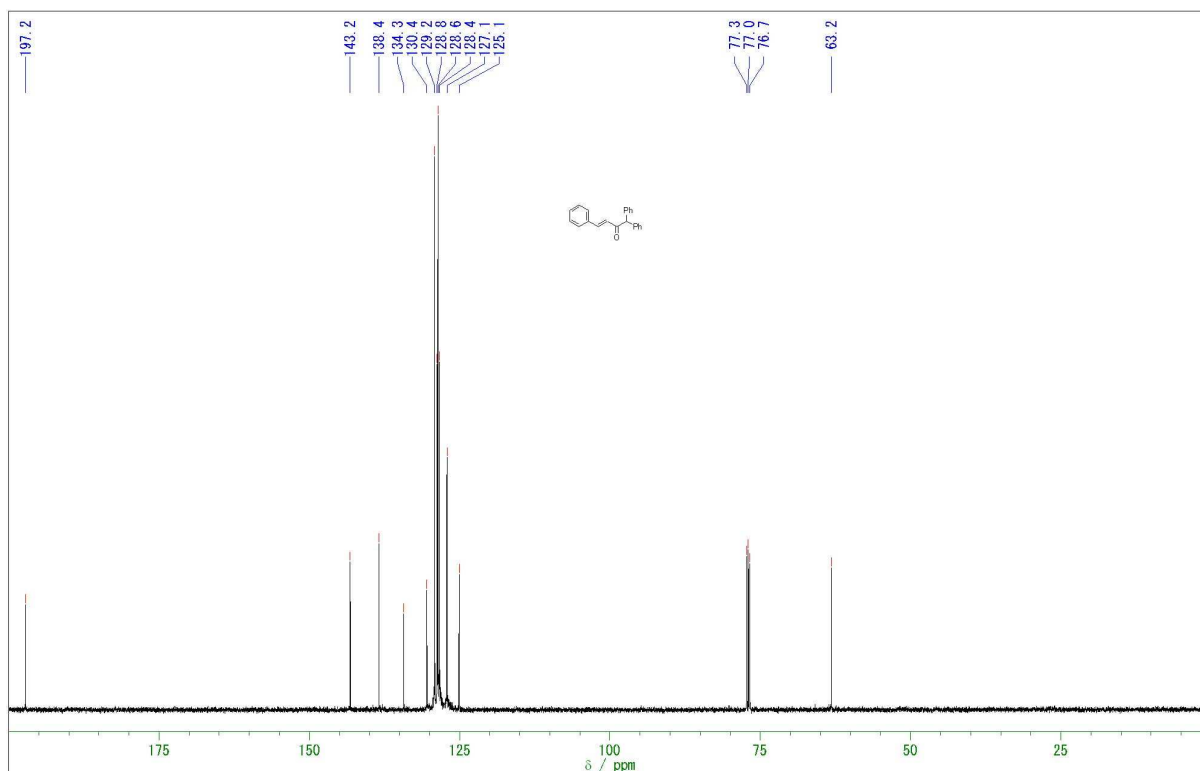
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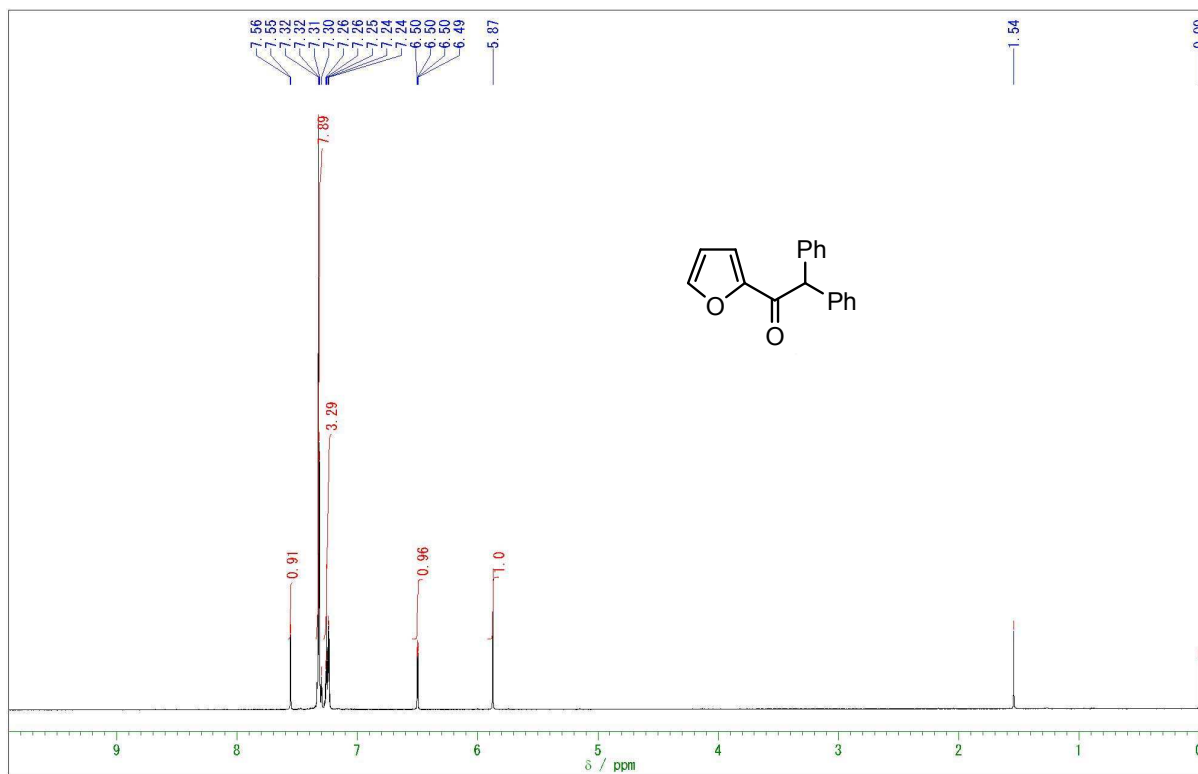
^1H NMR Spectrum of 7e (500 MHz, CDCl_3)



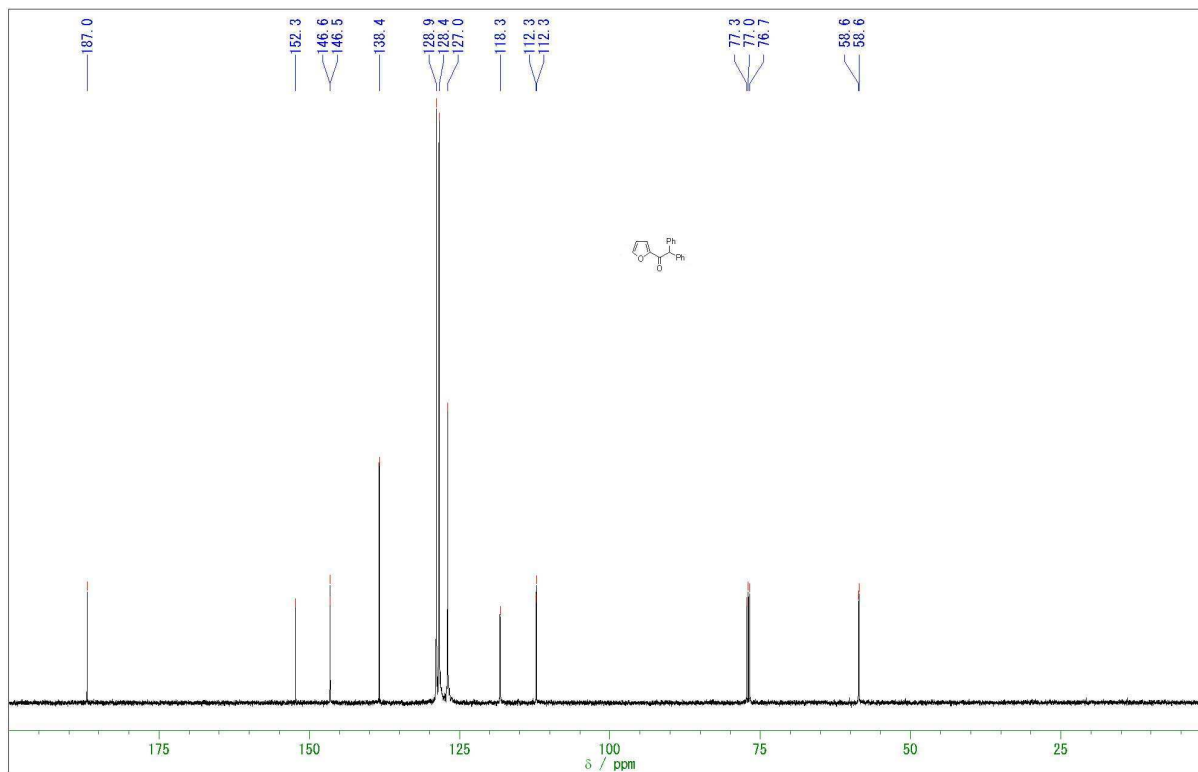
^{13}C NMR Spectrum of 7e (125 MHz, CDCl_3)



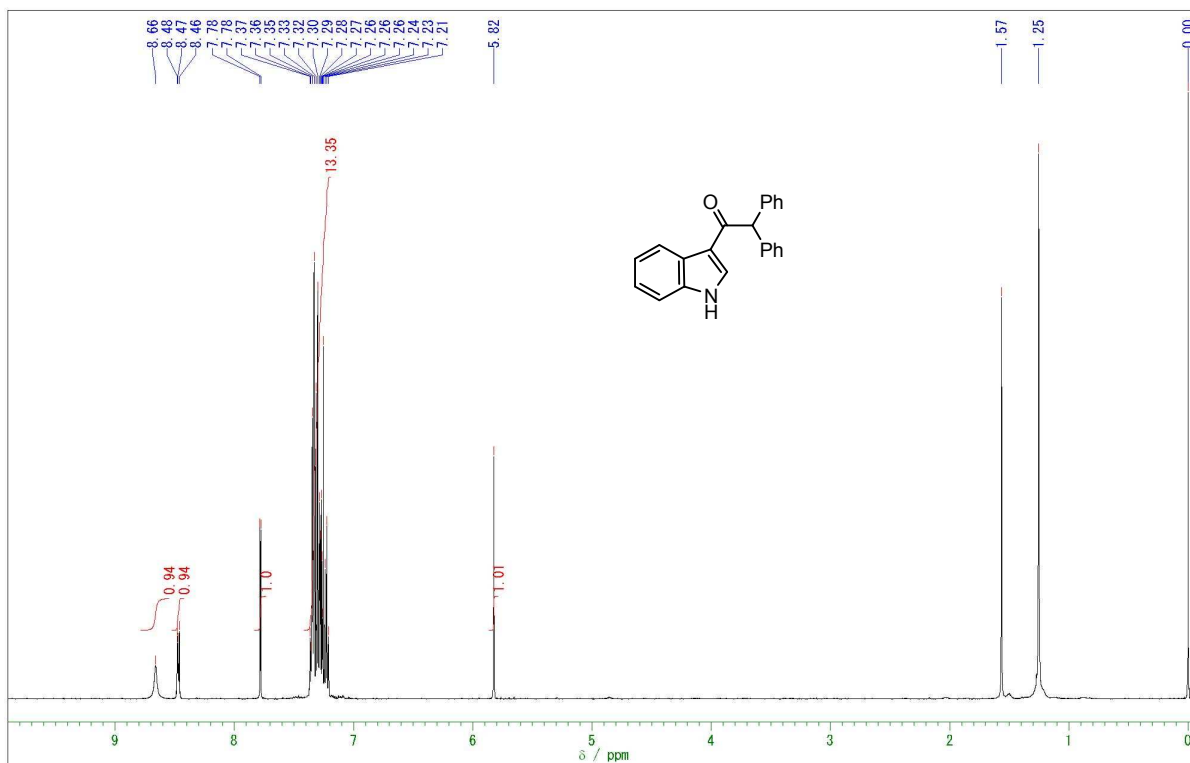
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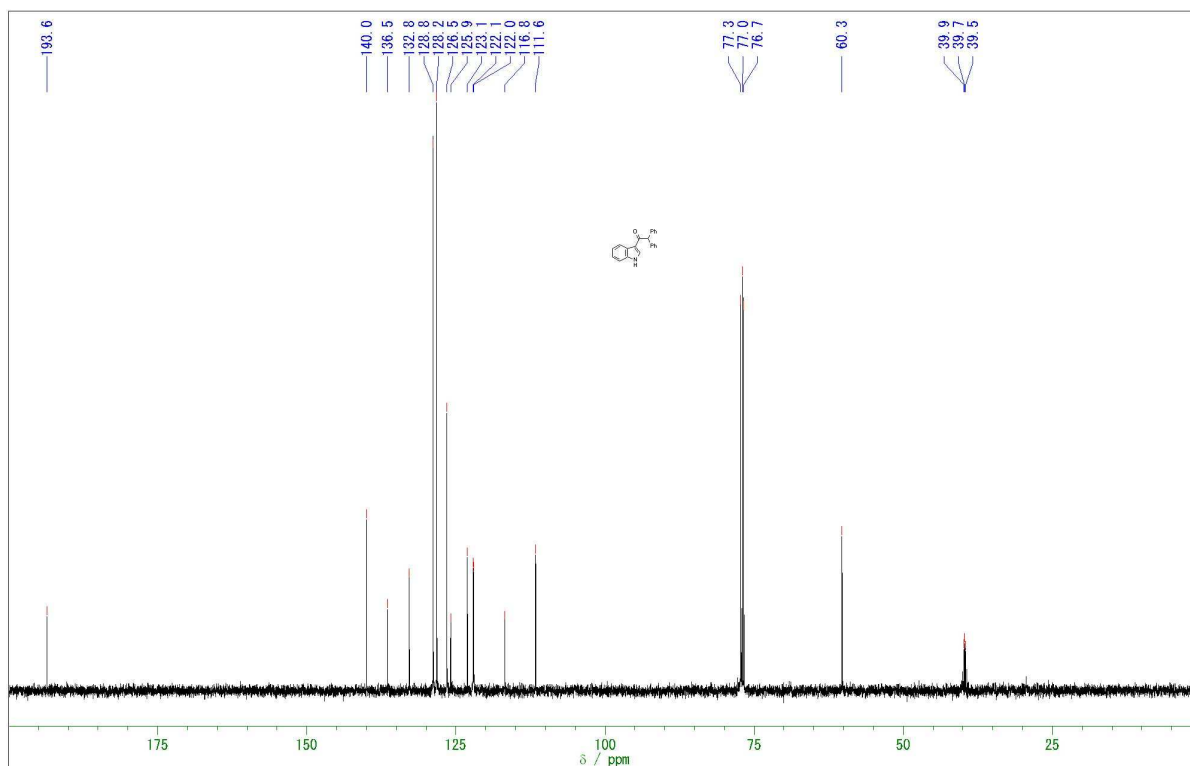
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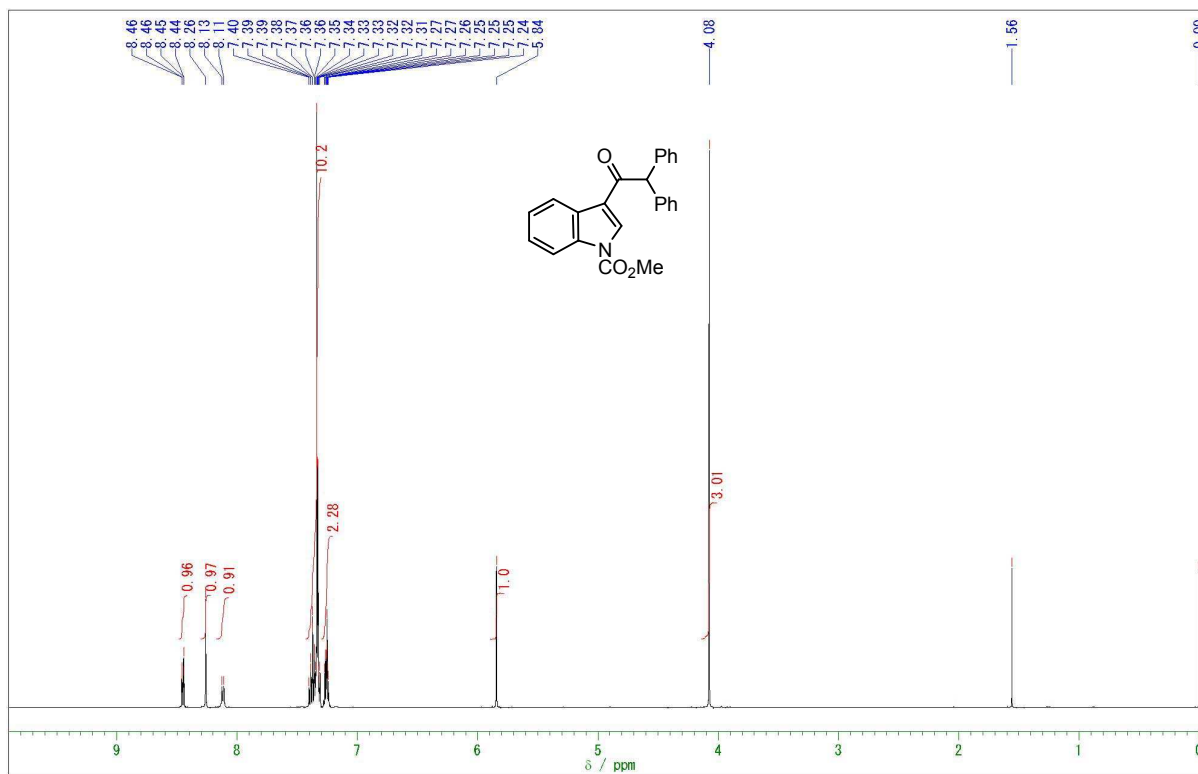
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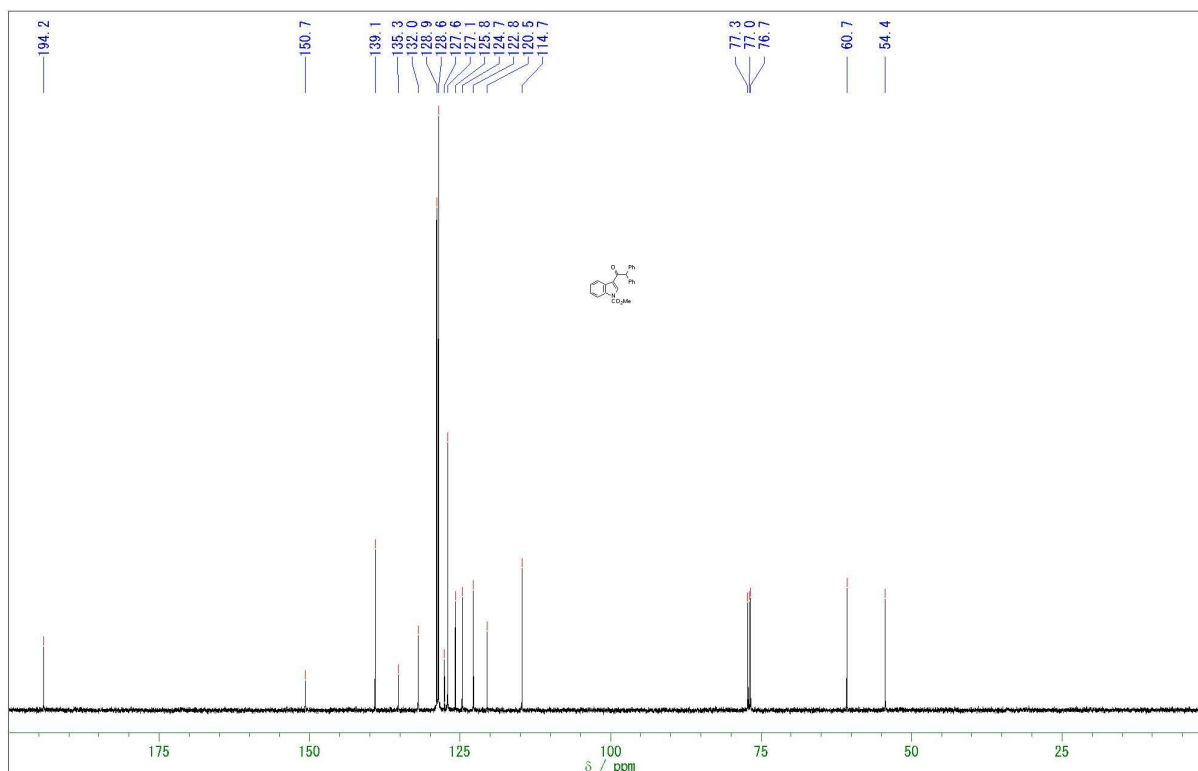
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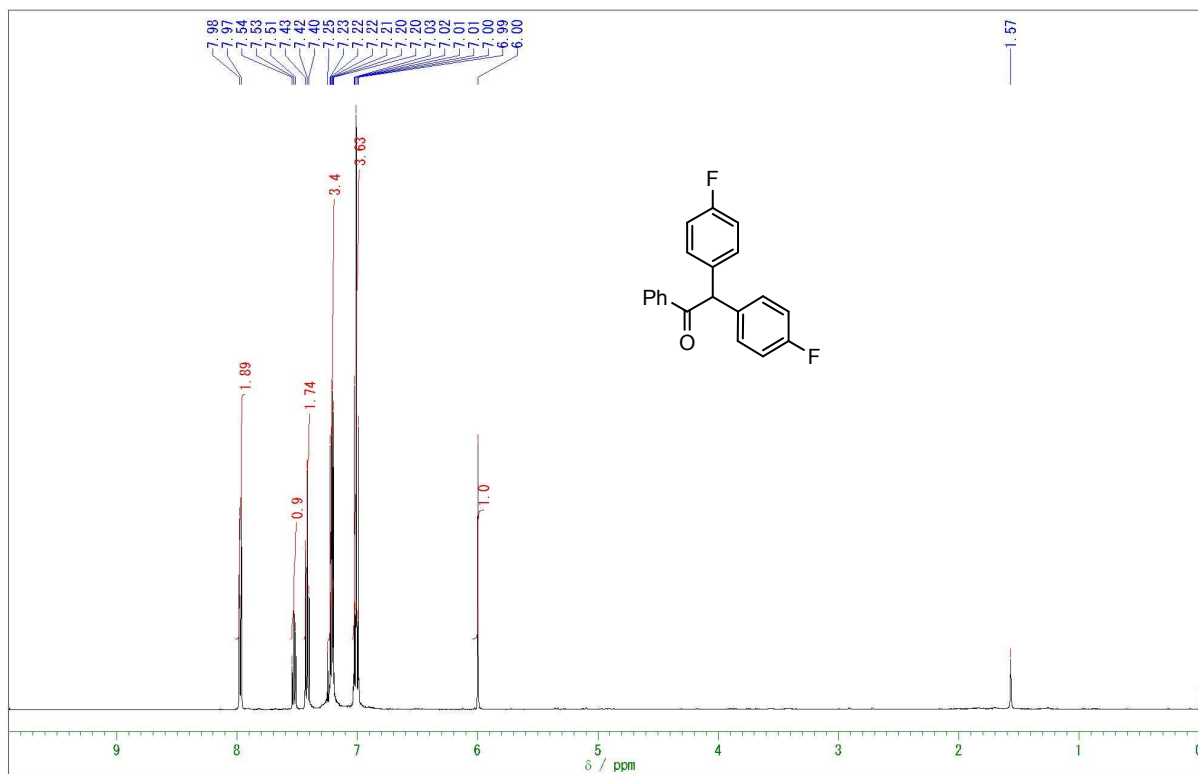
¹H NMR Spectrum of 7h (500 MHz, CDCl₃)



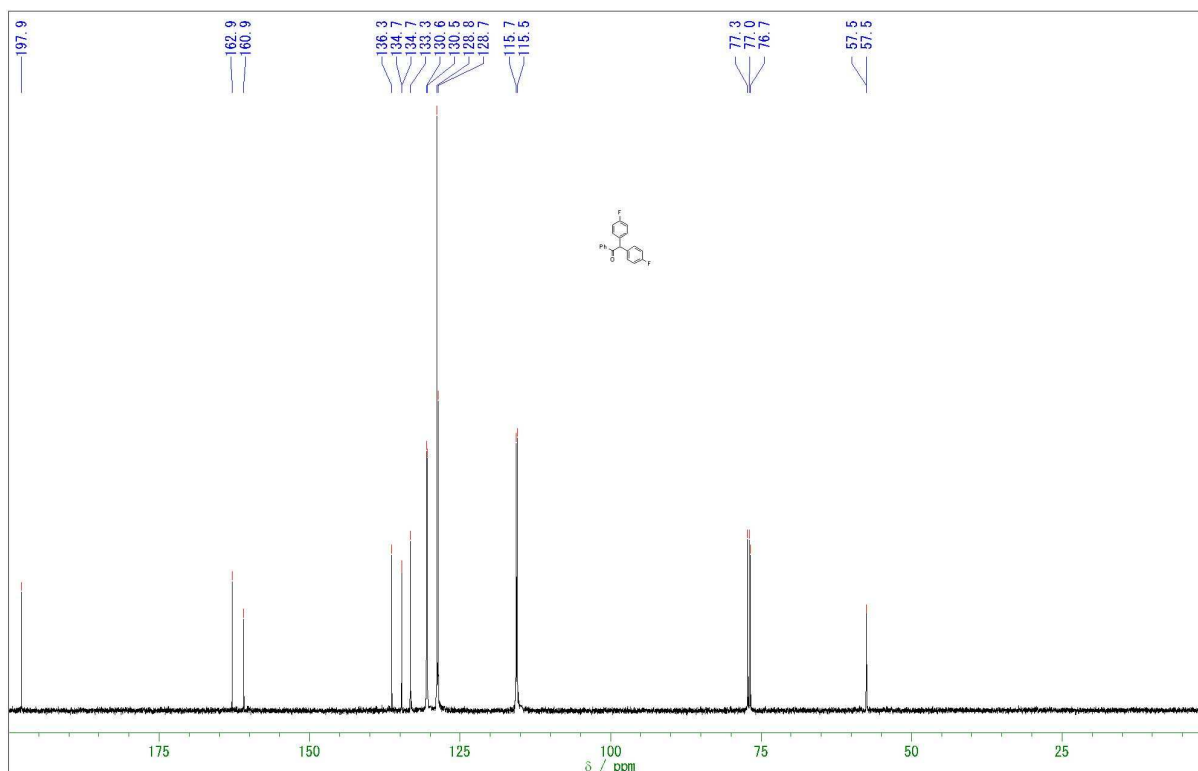
¹³C NMR Spectrum of 7h (125 MHz, CDCl₃)



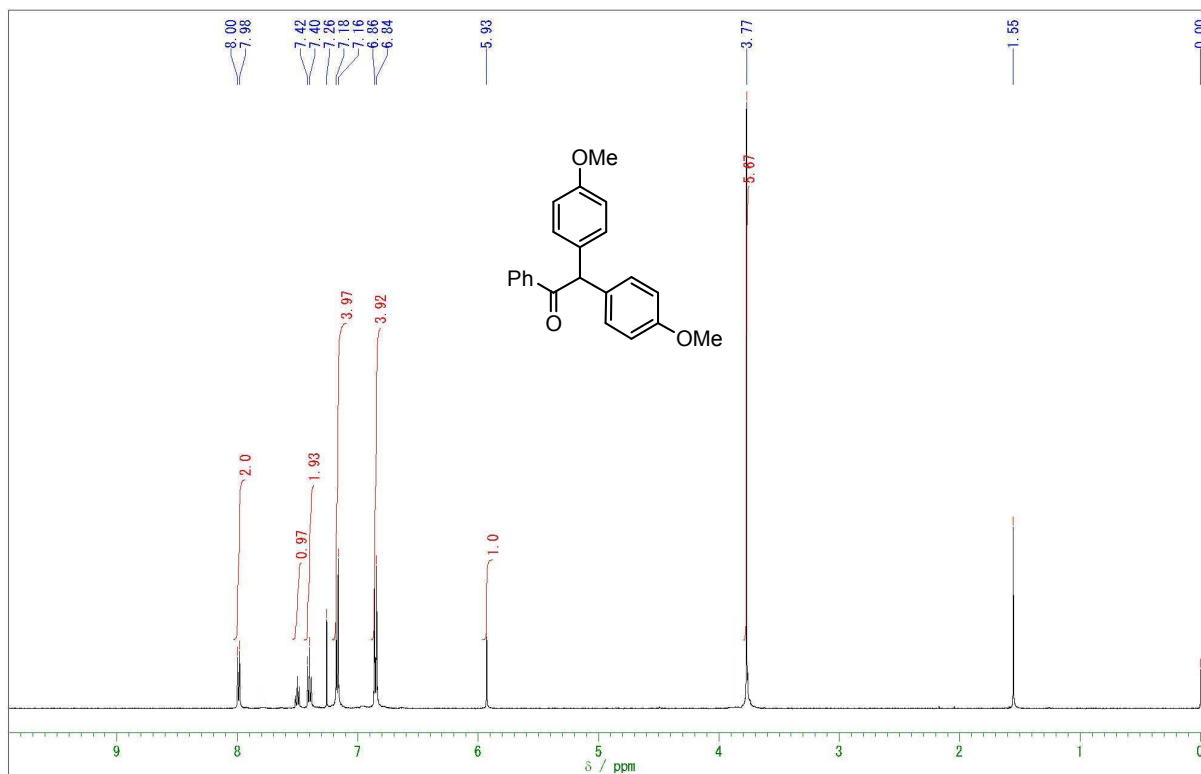
^1H NMR Spectrum of 7i (500 MHz, CDCl_3)



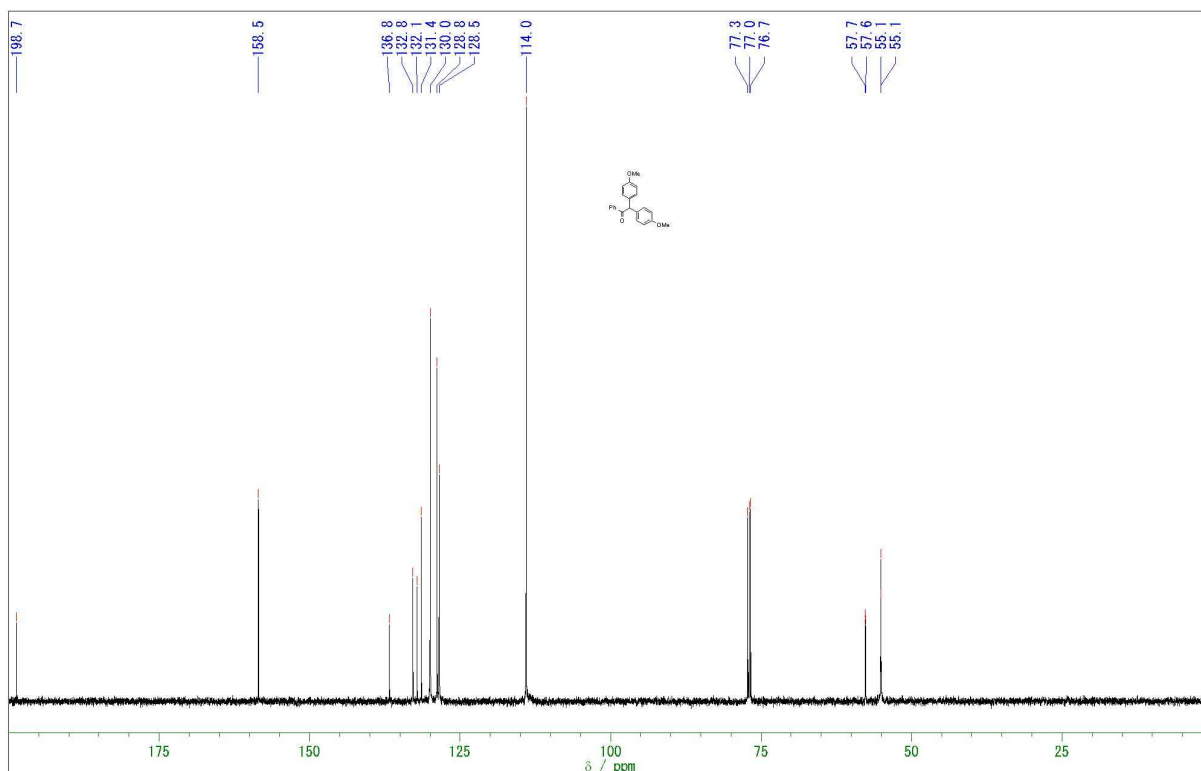
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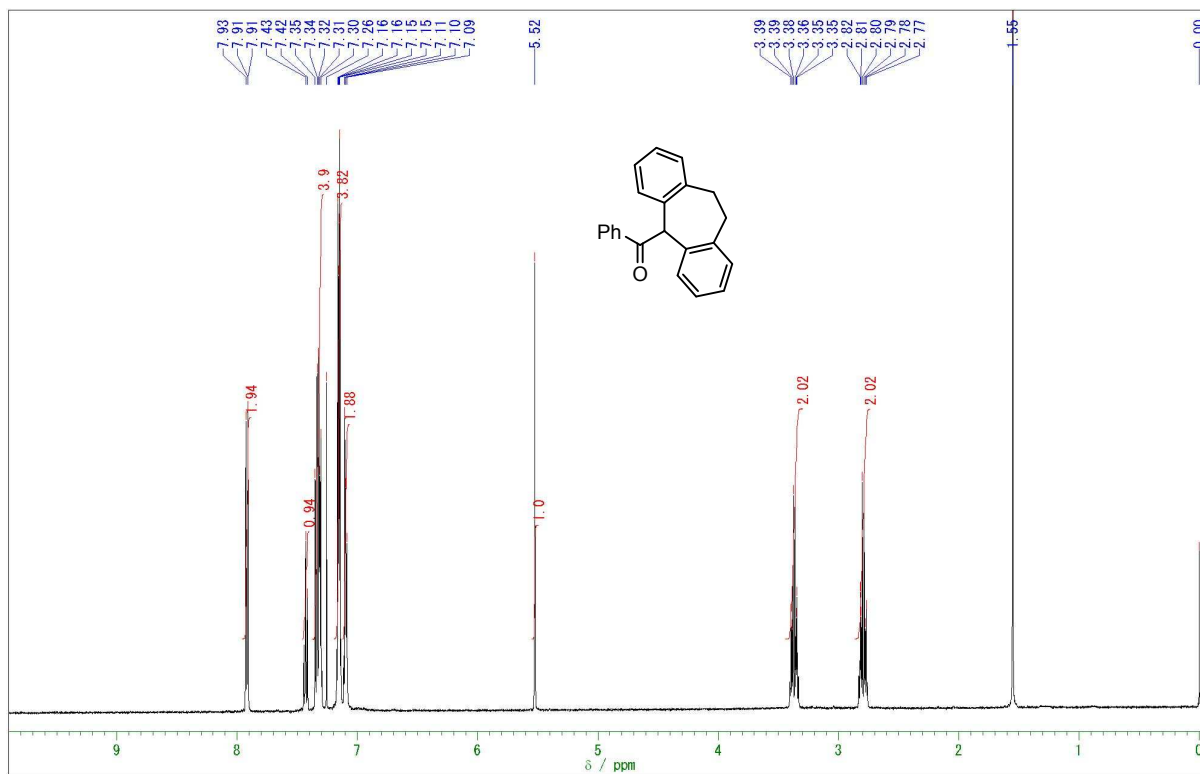
¹H NMR Spectrum of 7j (500 MHz, CDCl₃)



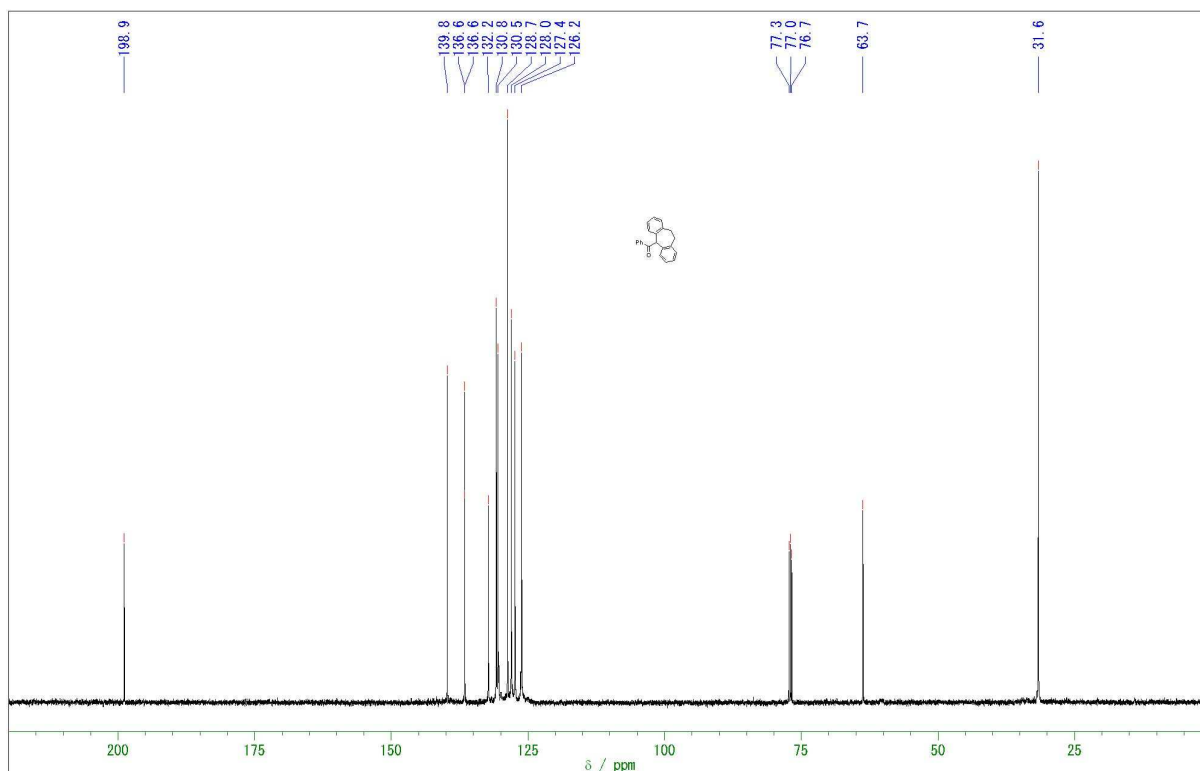
¹³C NMR Spectrum of 7j (125 MHz, CDCl₃)



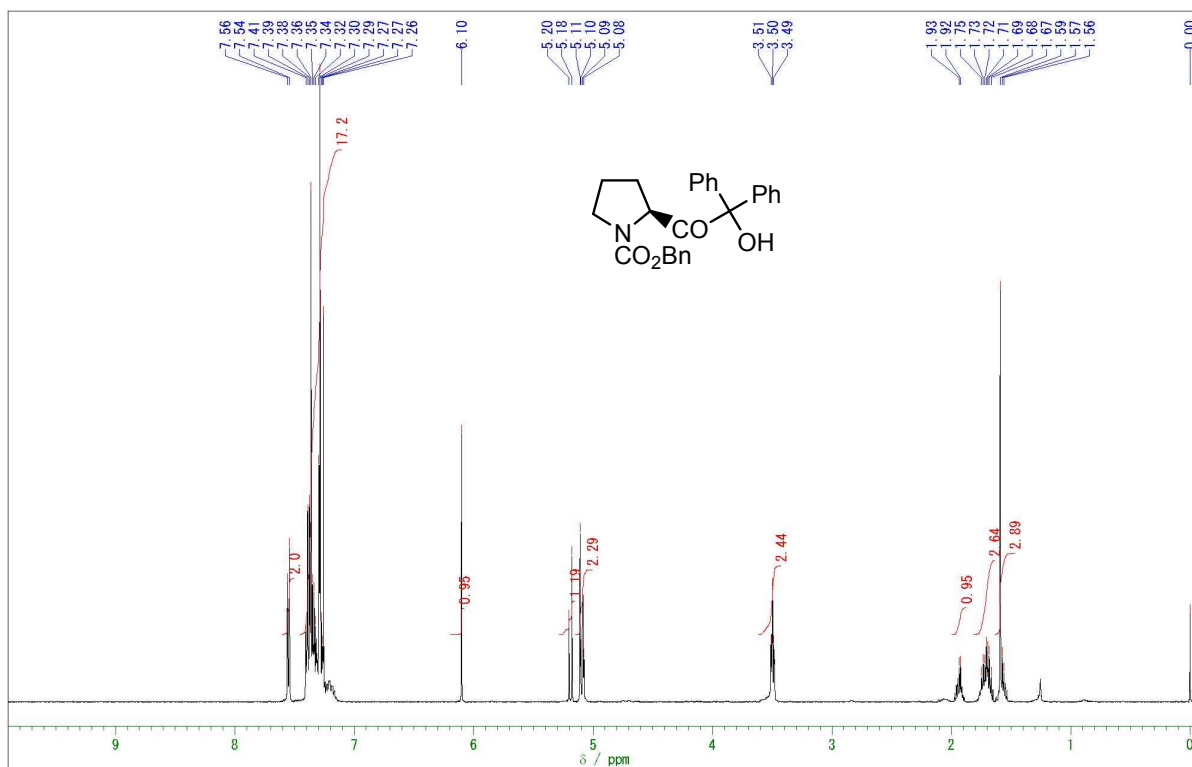
^1H NMR Spectrum of 7k (500 MHz, CDCl_3)



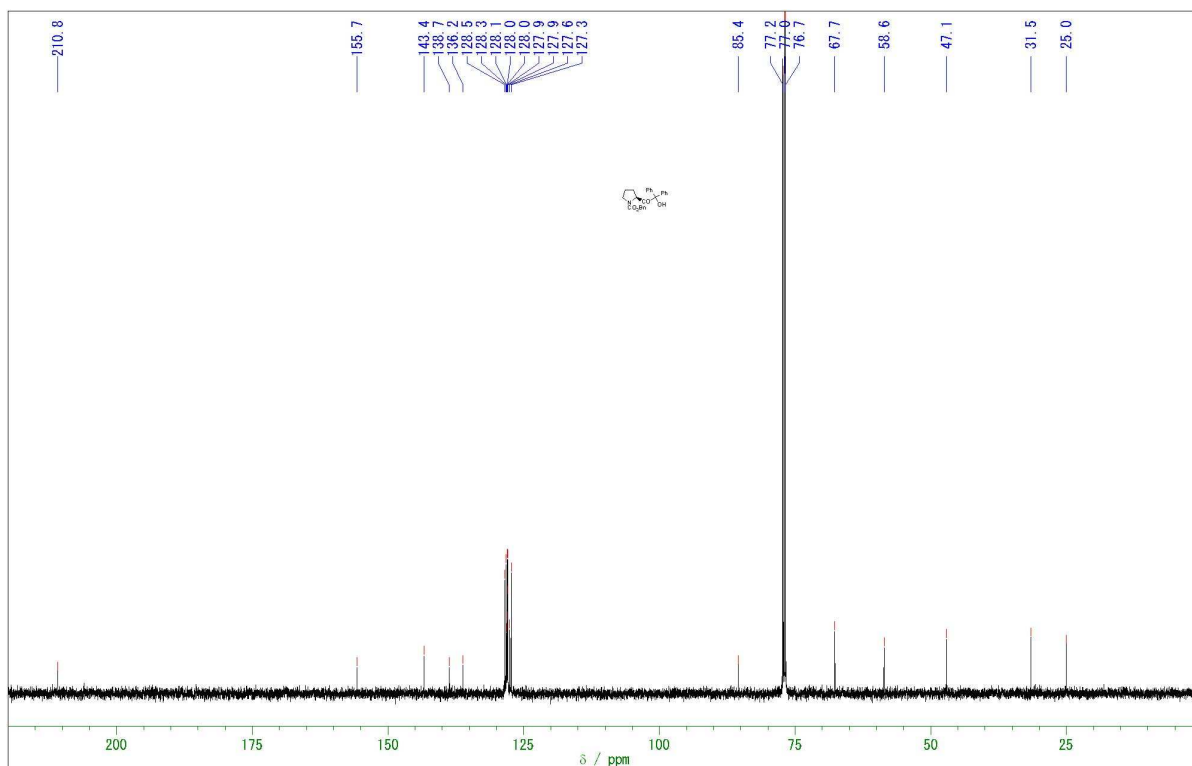
^{13}C NMR Spectrum of 7k (125 MHz, CDCl_3)



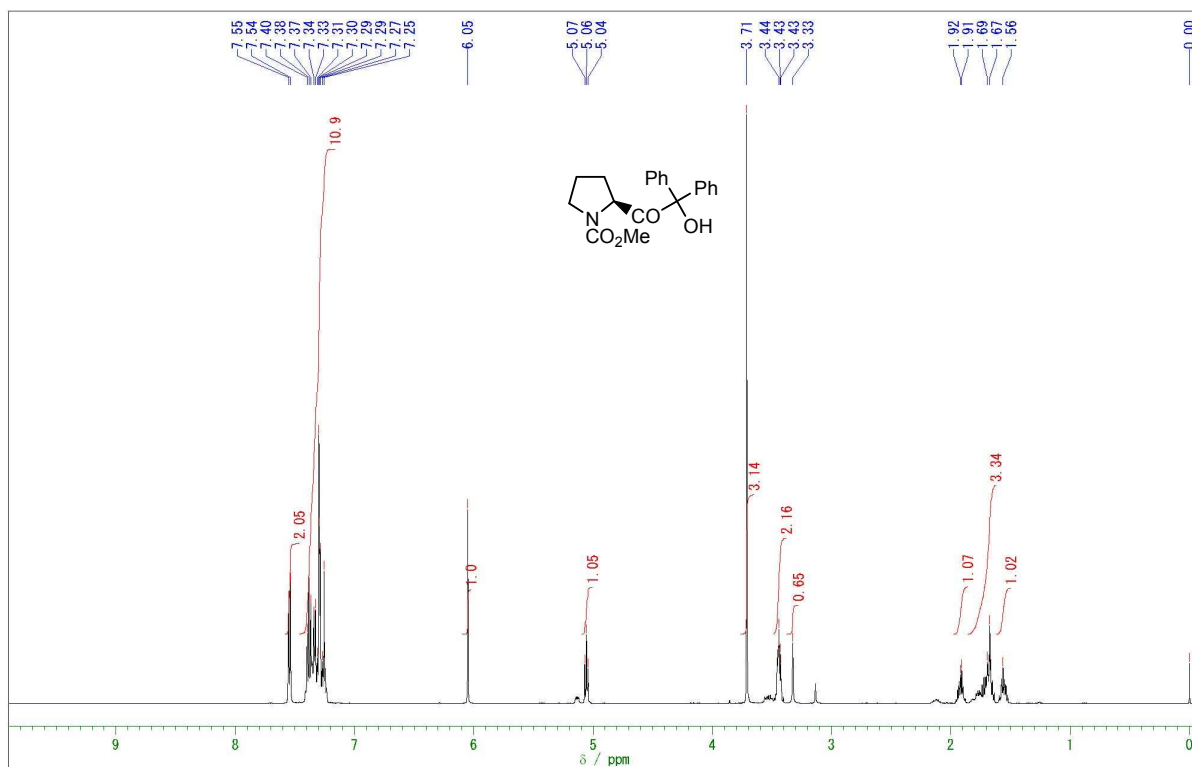
¹H NMR Spectrum of 9a (500 MHz, CDCl₃)



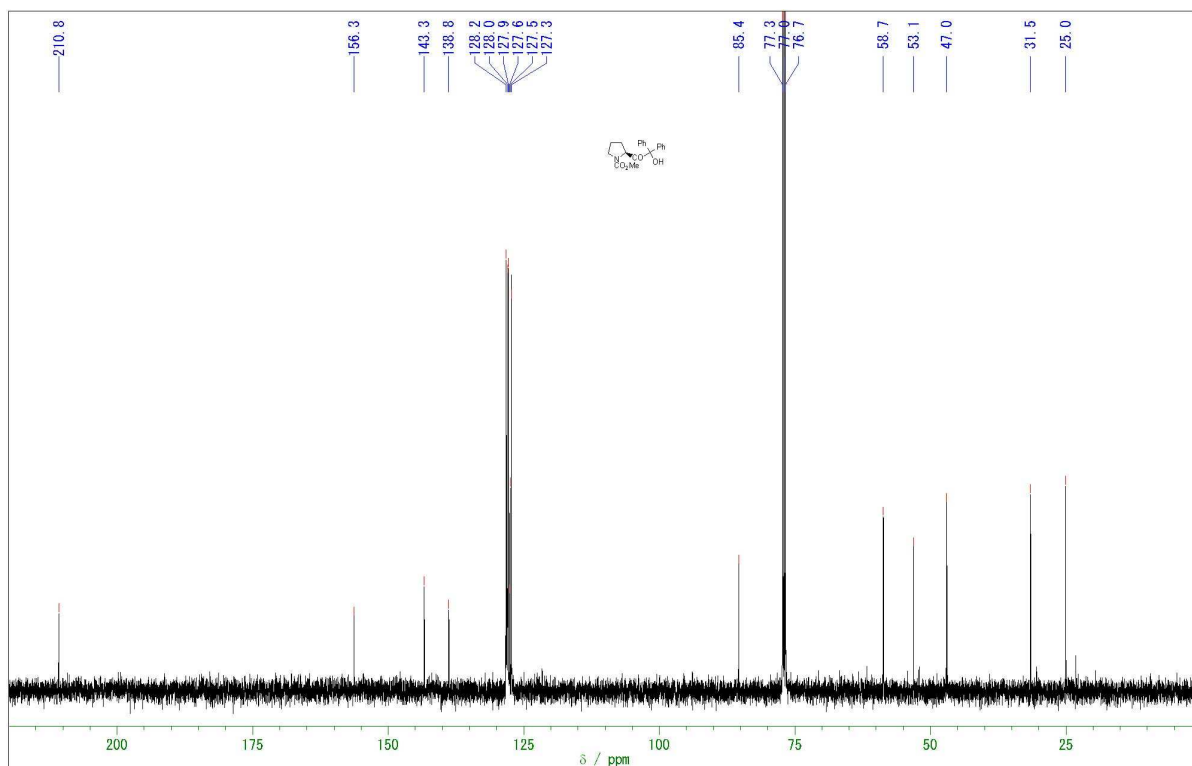
¹³C NMR Spectrum of 9a (125 MHz, CDCl₃)



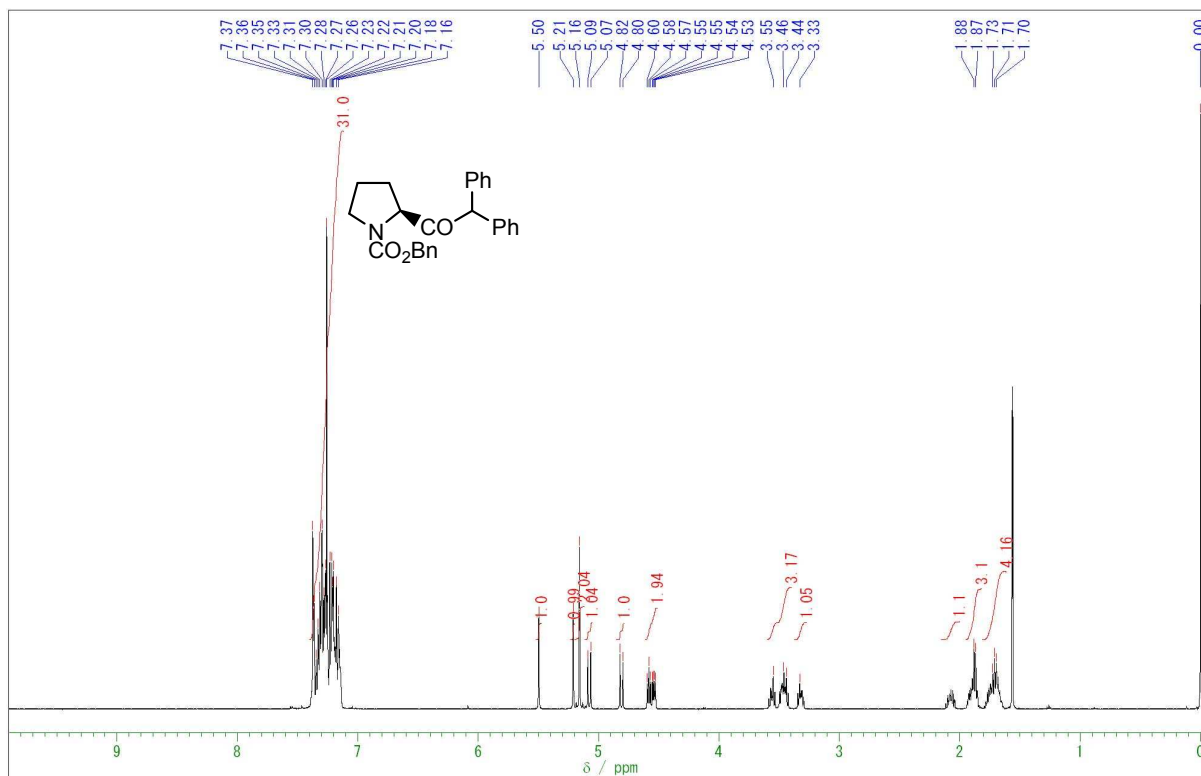
¹H NMR Spectrum of 9b (500 MHz, CDCl₃)



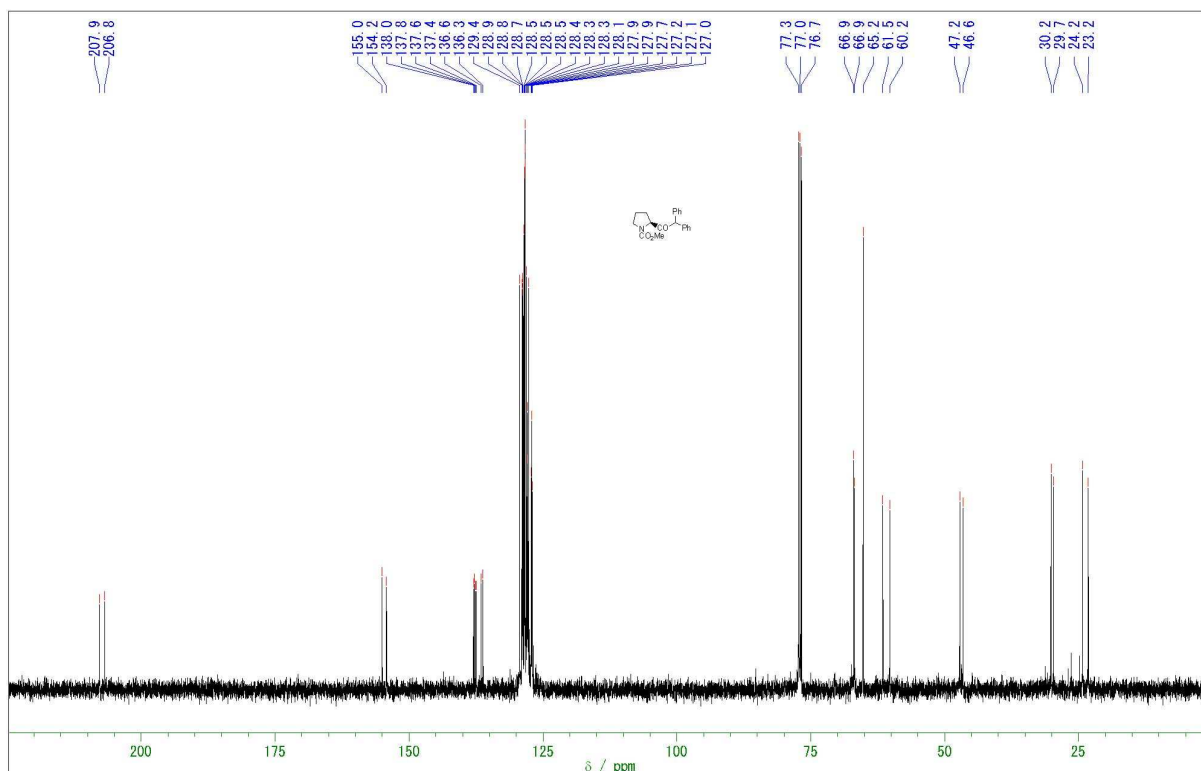
¹³C NMR Spectrum of 9b (125 MHz, CDCl₃)



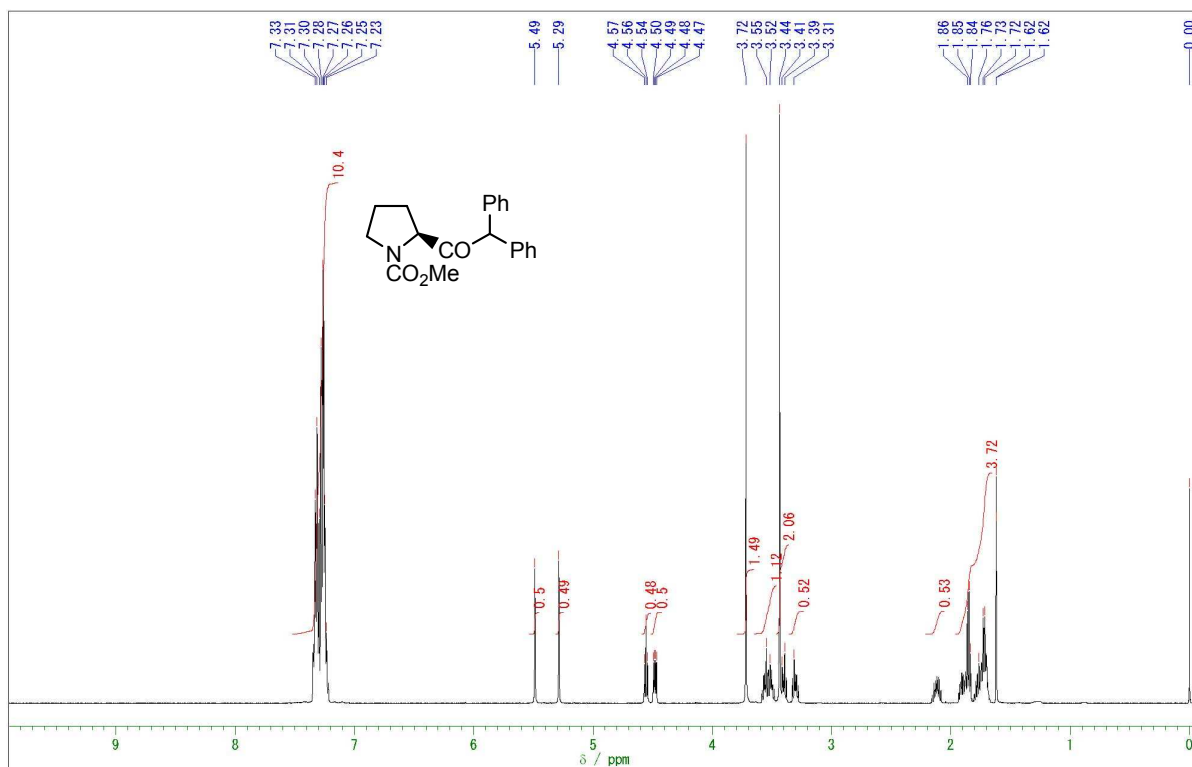
¹H NMR Spectrum of 10a (500 MHz, CDCl₃)



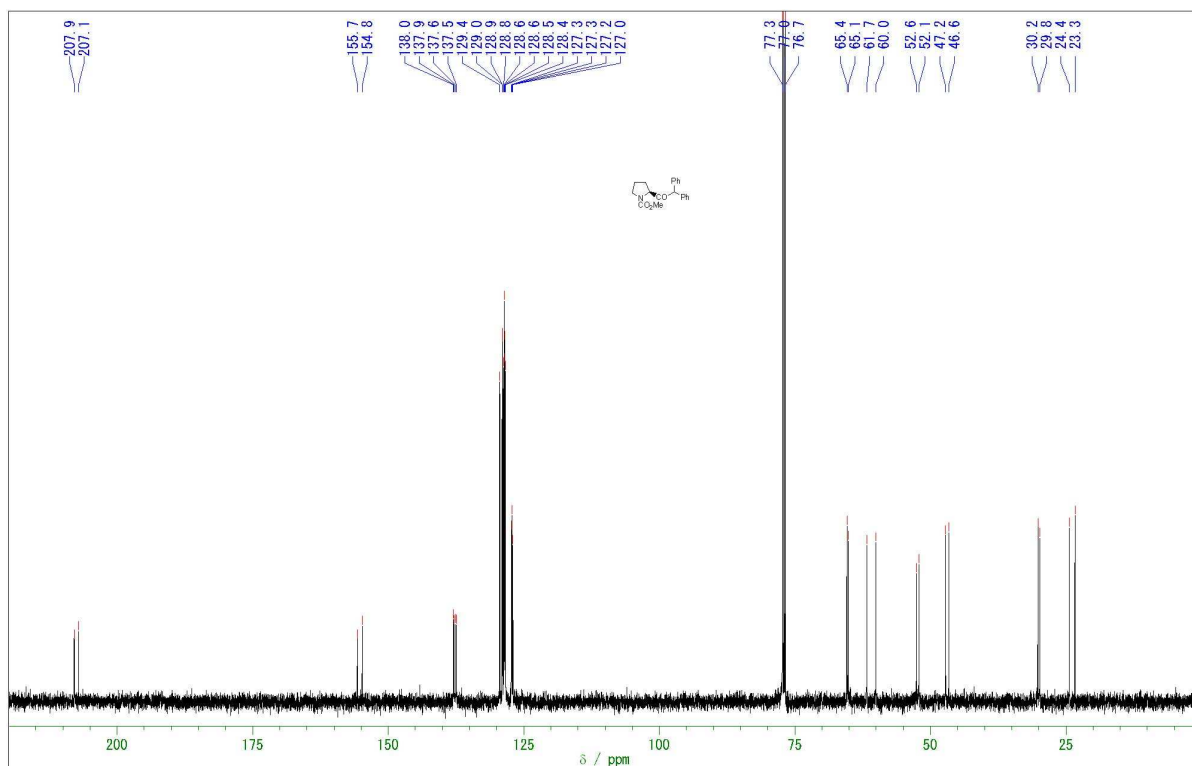
¹³C NMR Spectrum of 10a (125 MHz, CDCl₃)



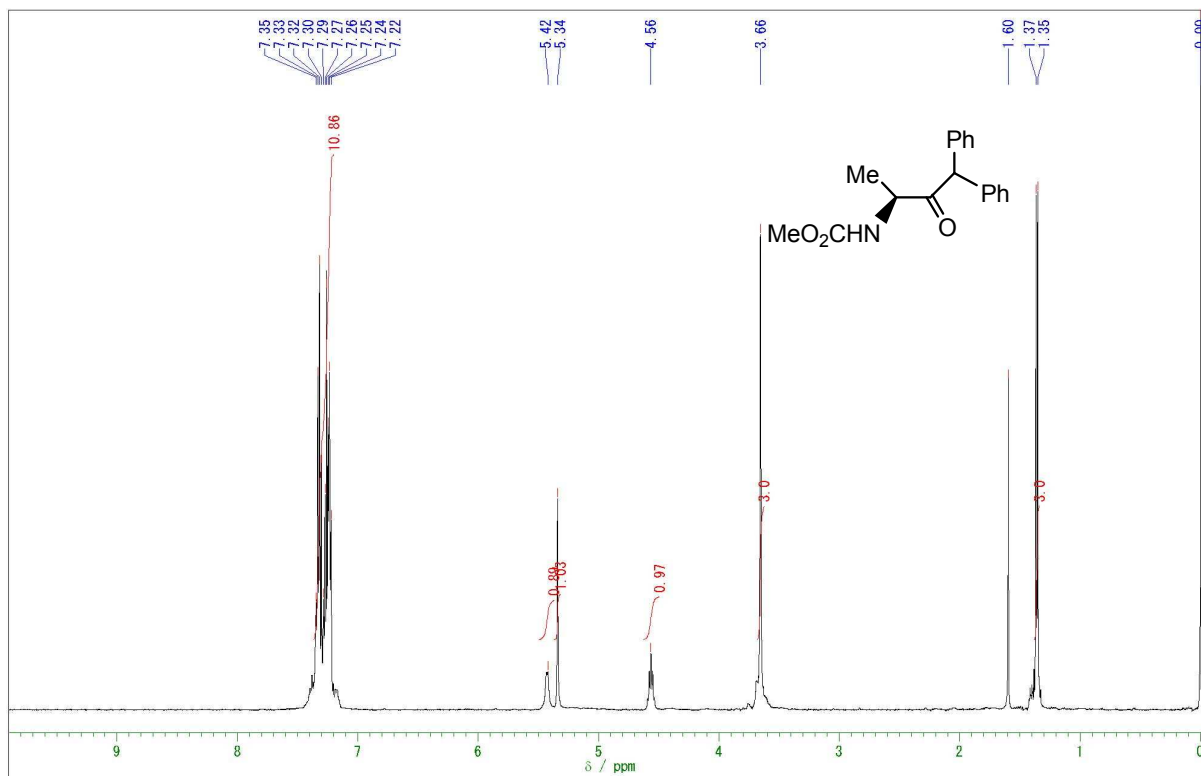
¹H NMR Spectrum of 10b (500 MHz, CDCl₃)



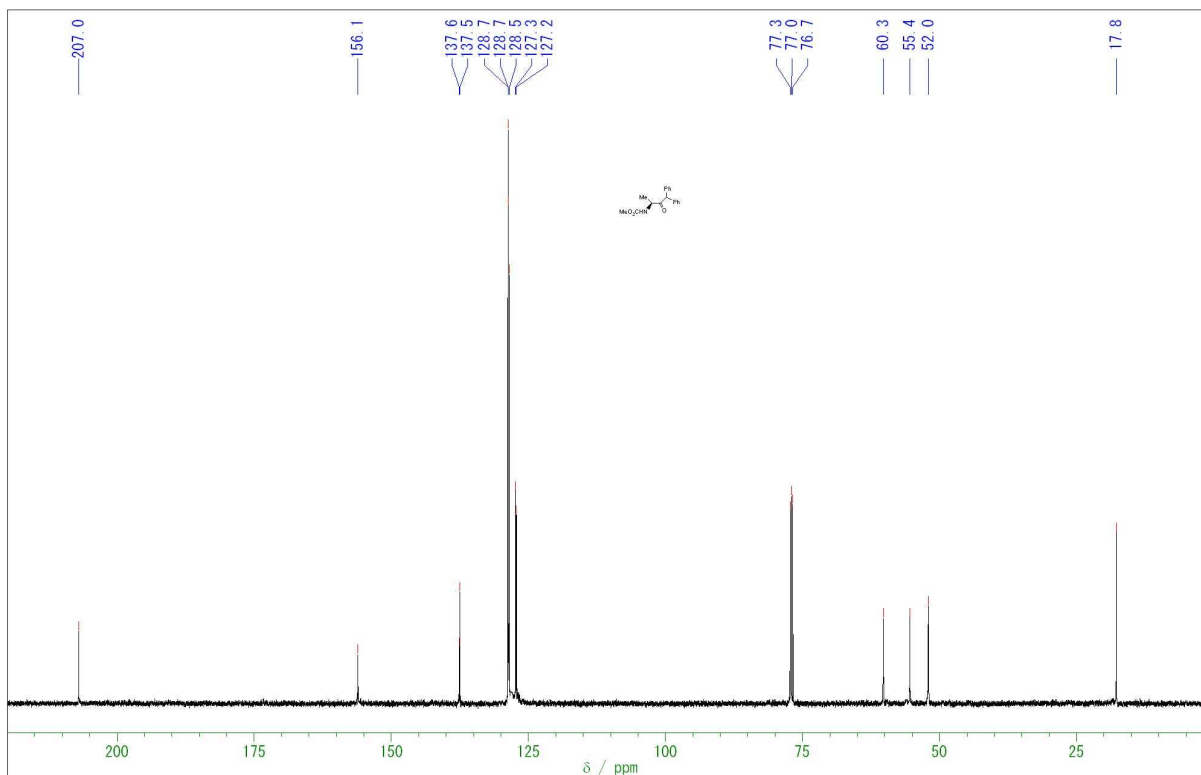
¹³C NMR Spectrum of 10b (125 MHz, CDCl₃)



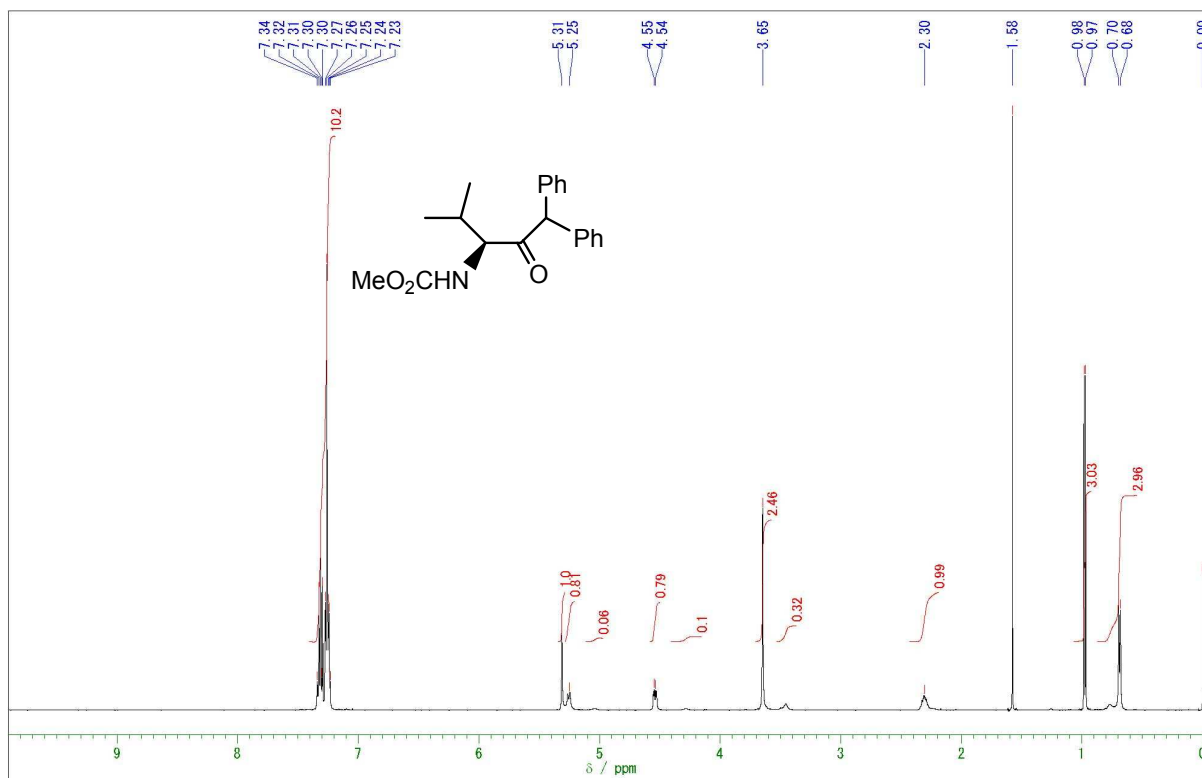
¹H NMR Spectrum of 10c (500 MHz, CDCl₃)



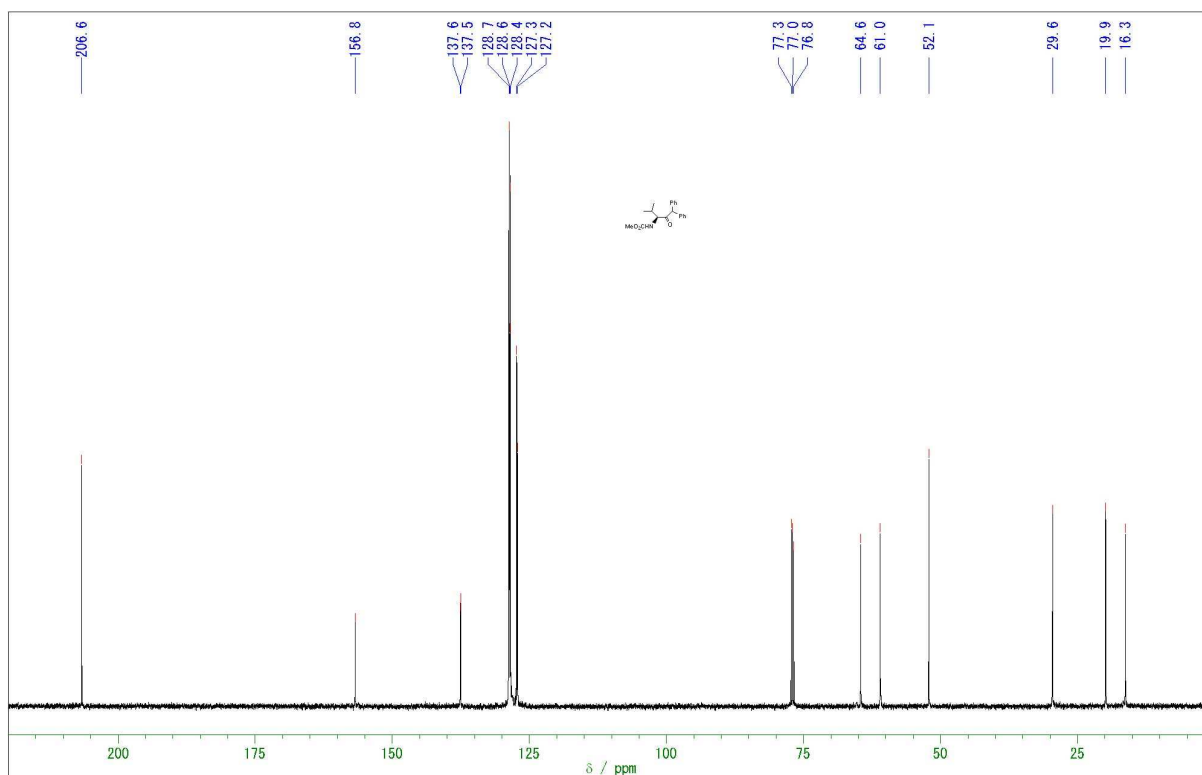
¹³C NMR Spectrum of 10c (125 MHz, CDCl₃)



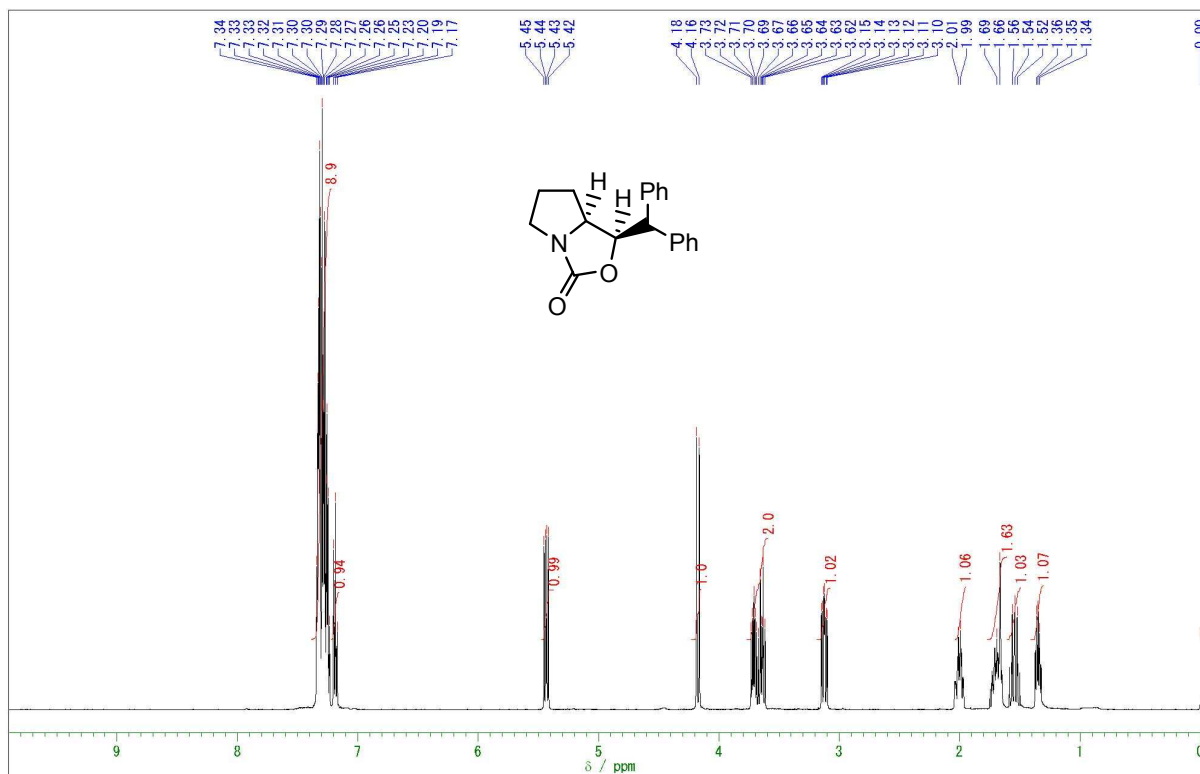
^1H NMR Spectrum of 10d (500 MHz, CDCl_3)



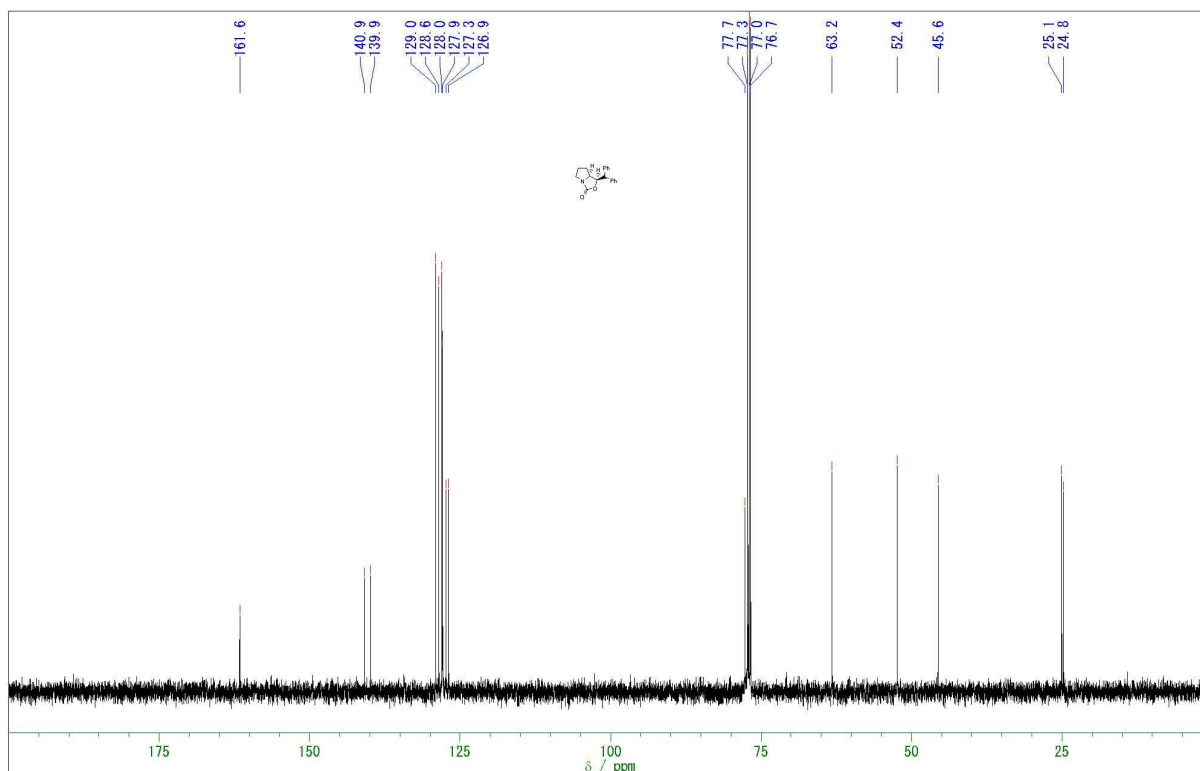
^{13}C NMR Spectrum of 10d (125 MHz, CDCl_3)



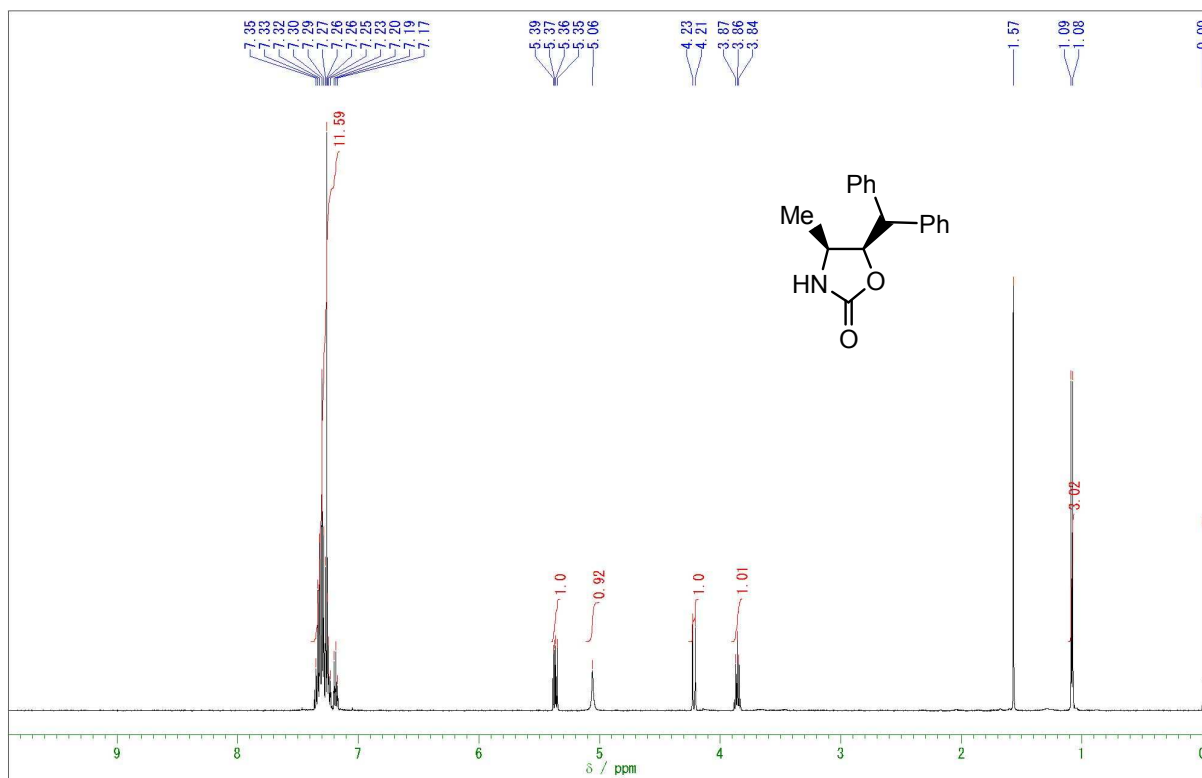
¹H NMR Spectrum of 11a (500 MHz, CDCl₃)



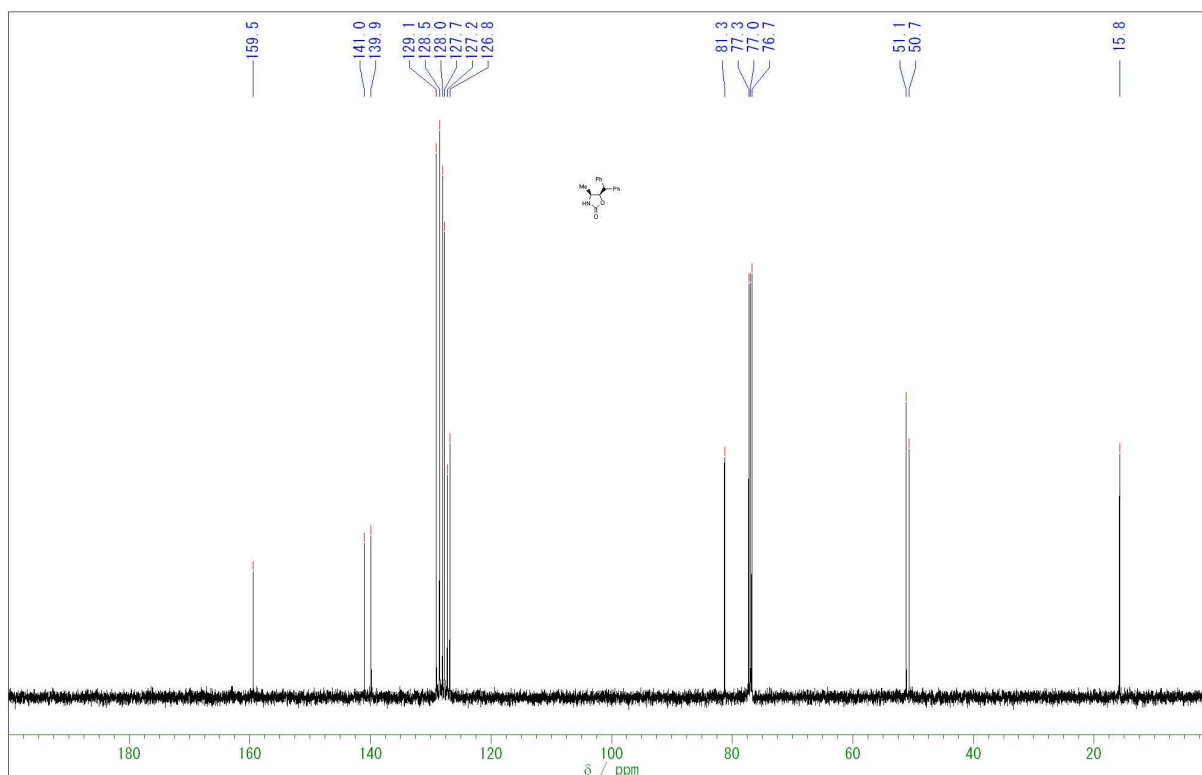
¹³C NMR Spectrum of 11a (125 MHz, CDCl₃)



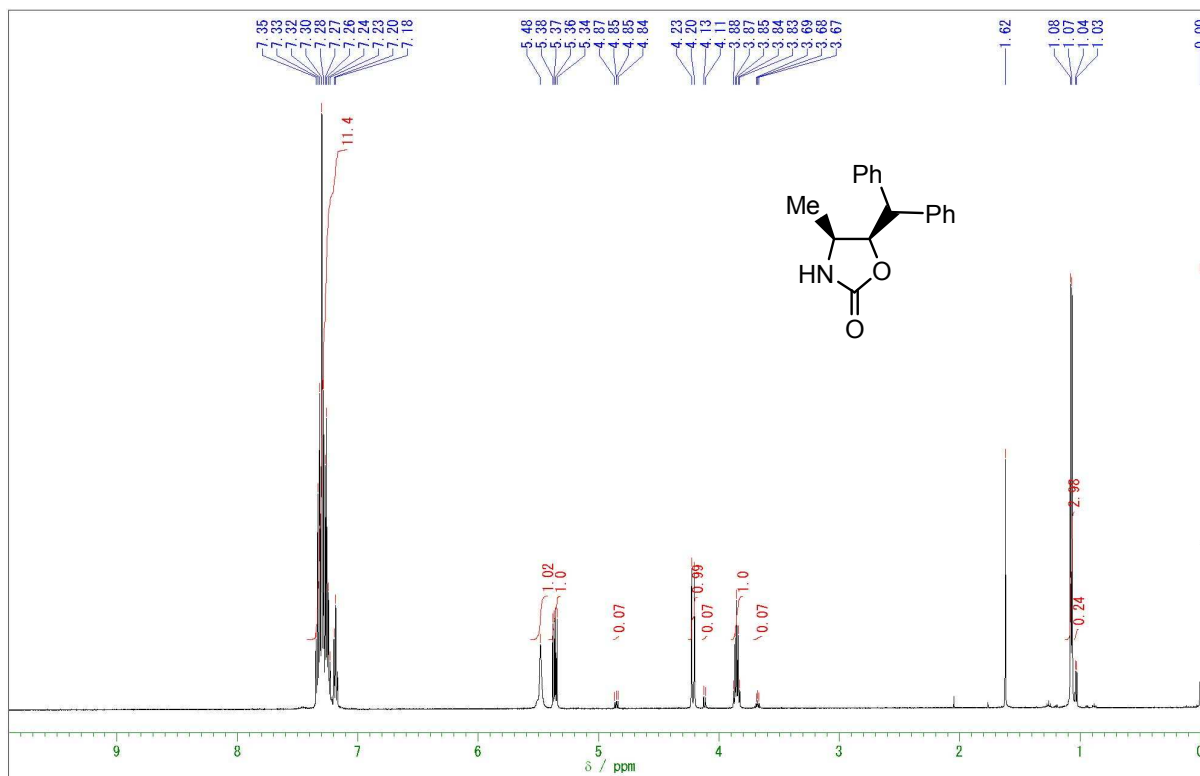
¹H NMR Spectrum of *cis*-11b (500 MHz, CDCl₃)



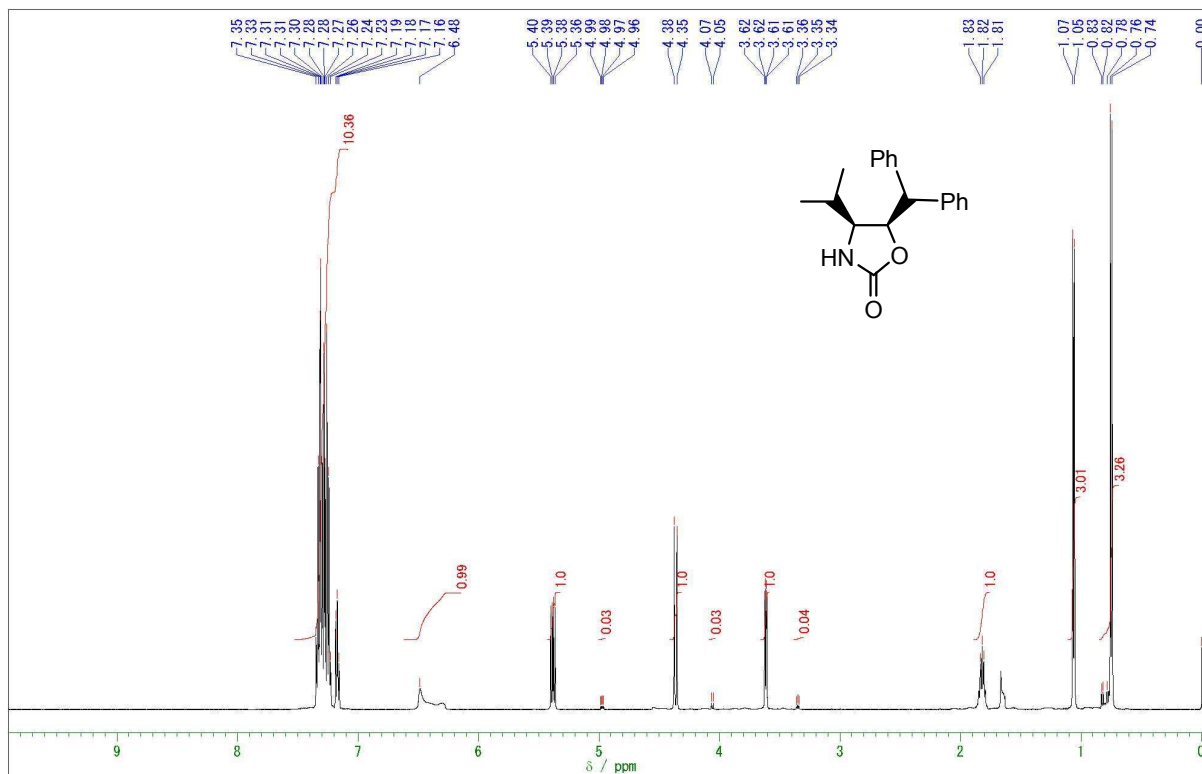
¹³C NMR Spectrum of *cis*-11b (125 MHz, CDCl₃)



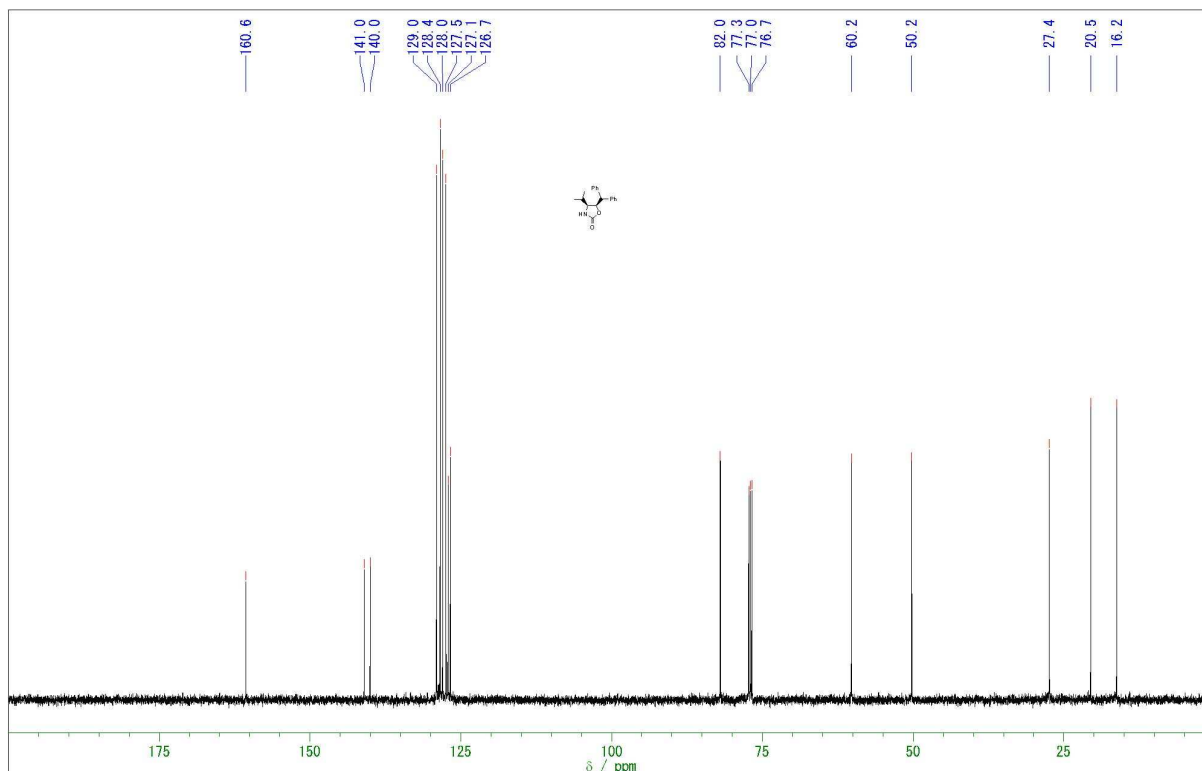
¹H NMR Spectrum of 11b (cis/trans = 94/6) (500 MHz, CDCl₃)



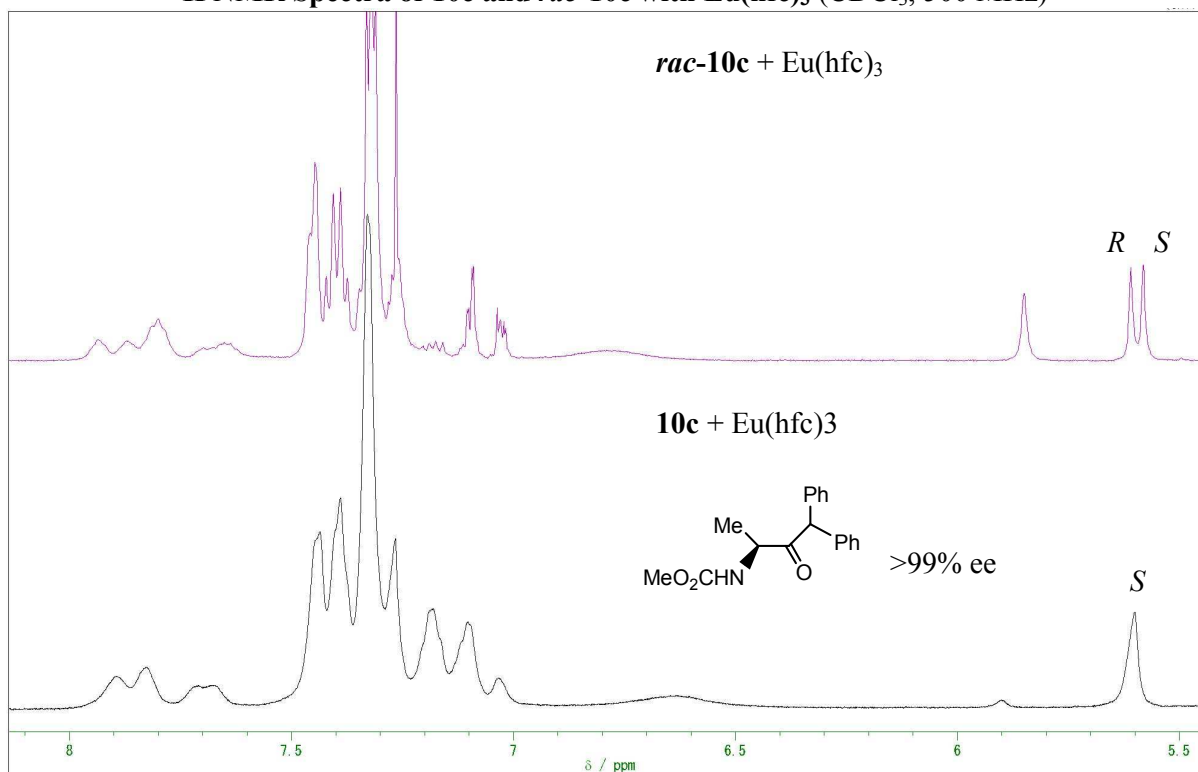
¹H NMR Spectrum of 11c (cis/trans = 97/3) (500 MHz, CDCl₃)



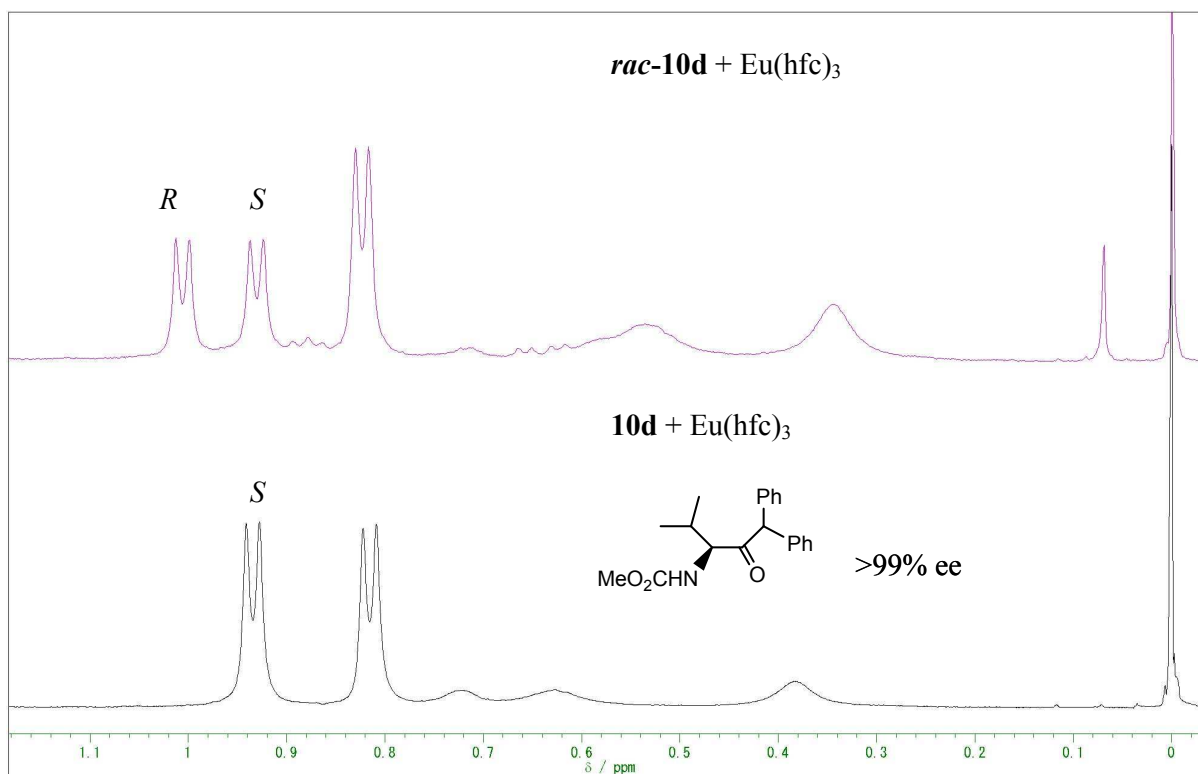
¹³C NMR Spectrum of 11c (125 MHz, CDCl₃)



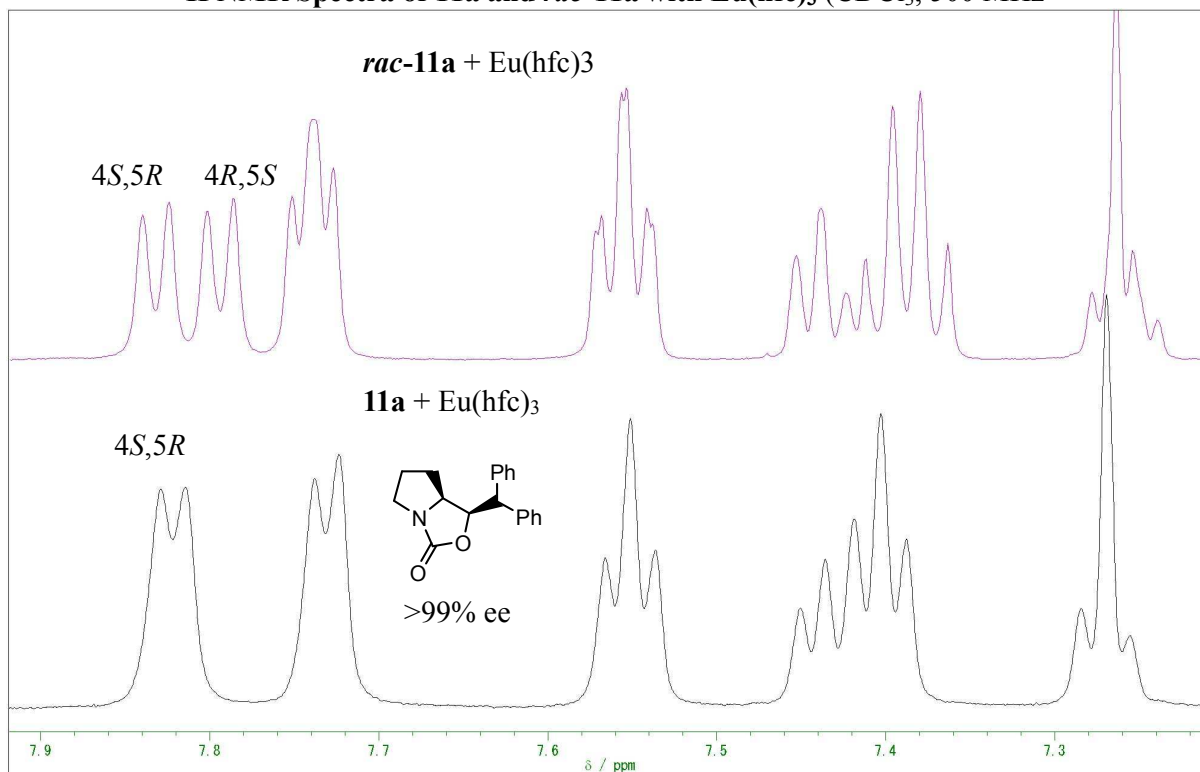
^1H NMR Spectra of 10c and *rac*-10c with $\text{Eu}(\text{hfc})_3$ (CDCl_3 , 500 MHz)



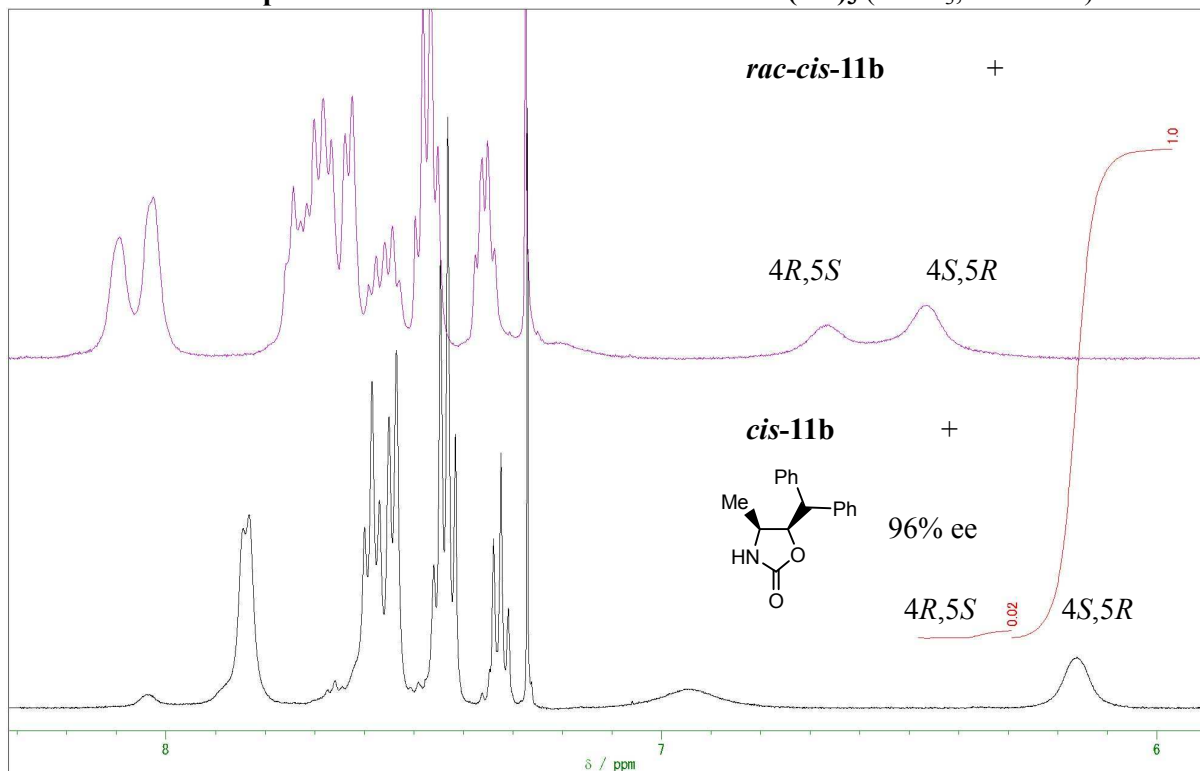
^1H NMR Spectra of 10c and *rac*-10d with $\text{Eu}(\text{hfc})_3$ (CDCl_3 , 500 MHz)



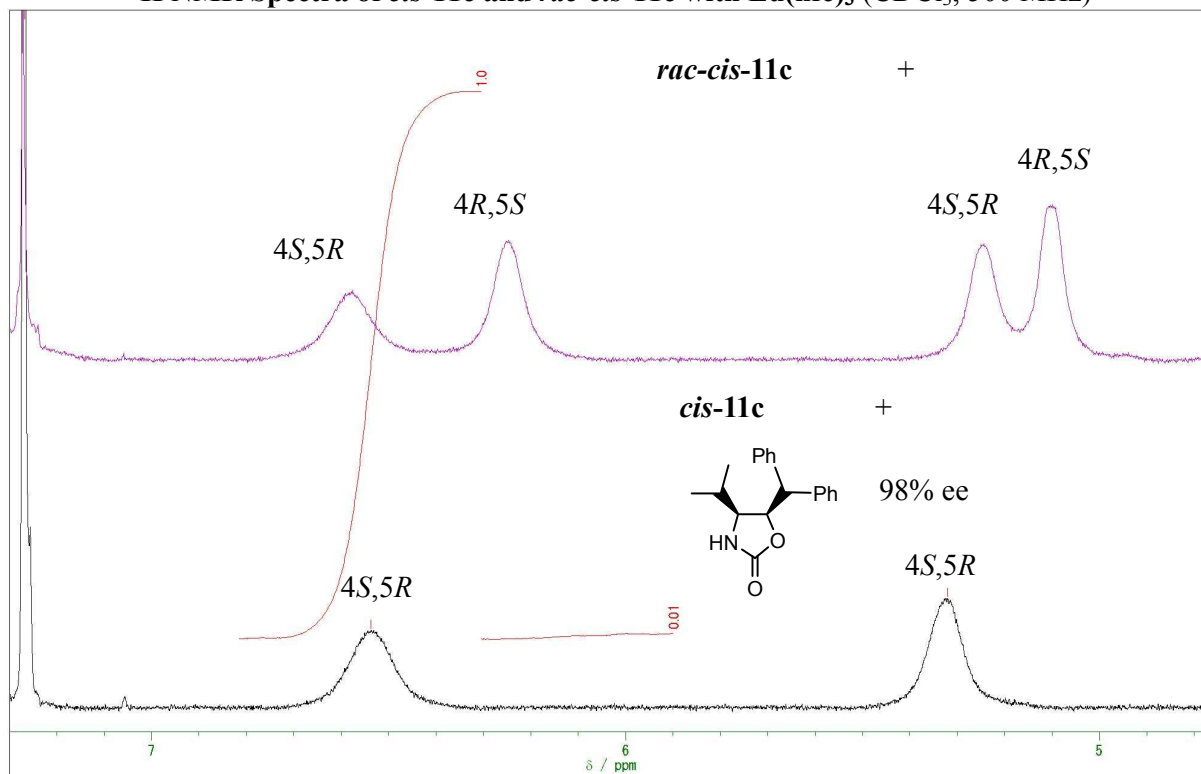
¹H NMR Spectra of 11a and *rac*-11a with Eu(hfc)₃ (CDCl₃, 500 MHz)



¹H NMR Spectra of *cis*-11b and *rac*-*cis*-11b with Eu(hfc)₃ (CDCl₃, 500 MHz)

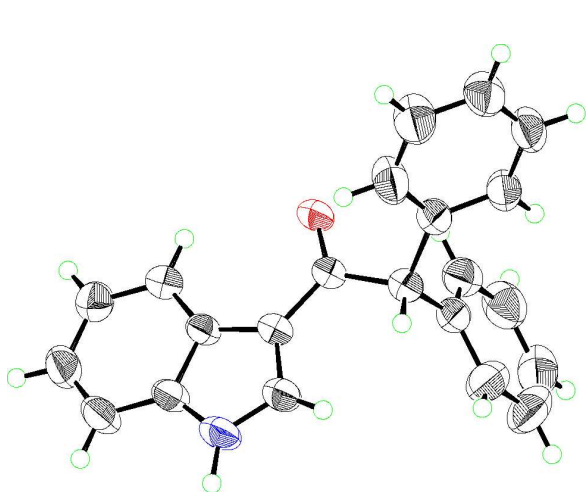


^1H NMR Spectra of *cis*-11c and *rac-cis*-11c with $\text{Eu}(\text{hfc})_3$ (CDCl_3 , 500 MHz)

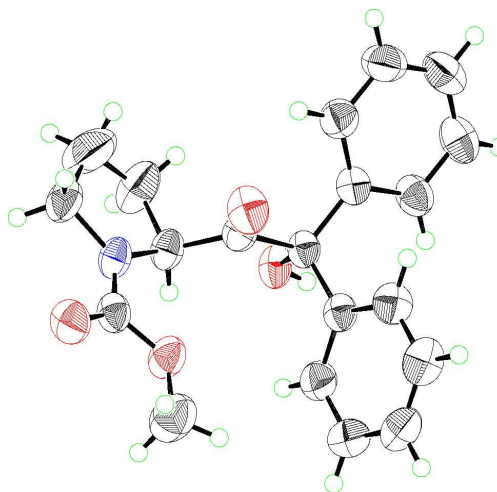


X-ray Crystallographic Structures of 7g, 9b, 10d, *rac*-11a, and *rac-cis*-11b

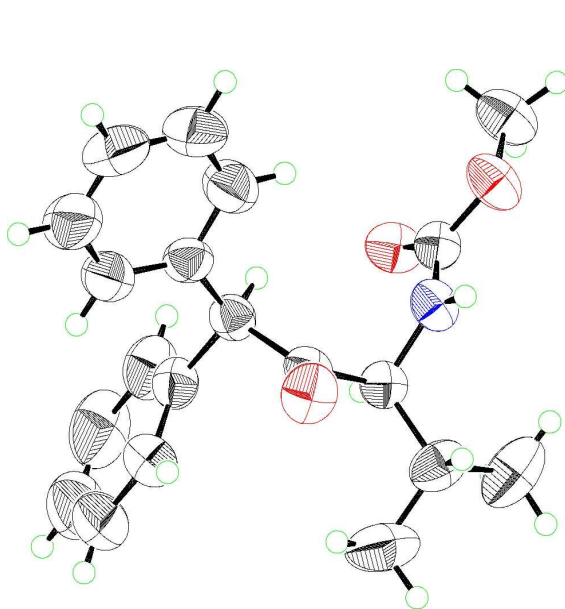
(ORTEP, 50% Probability)



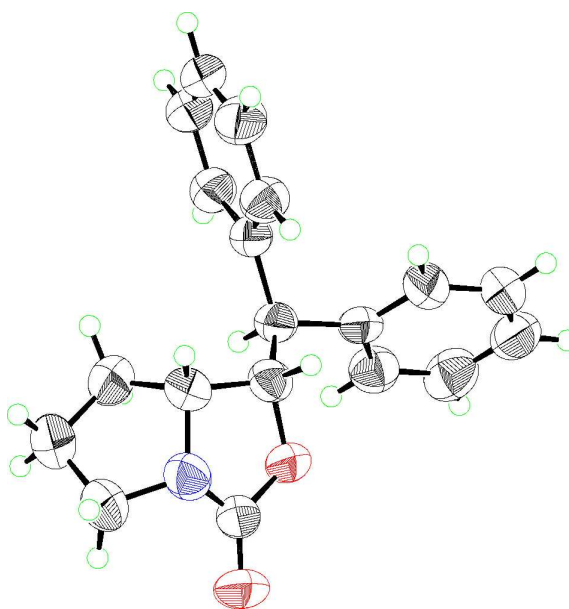
7g



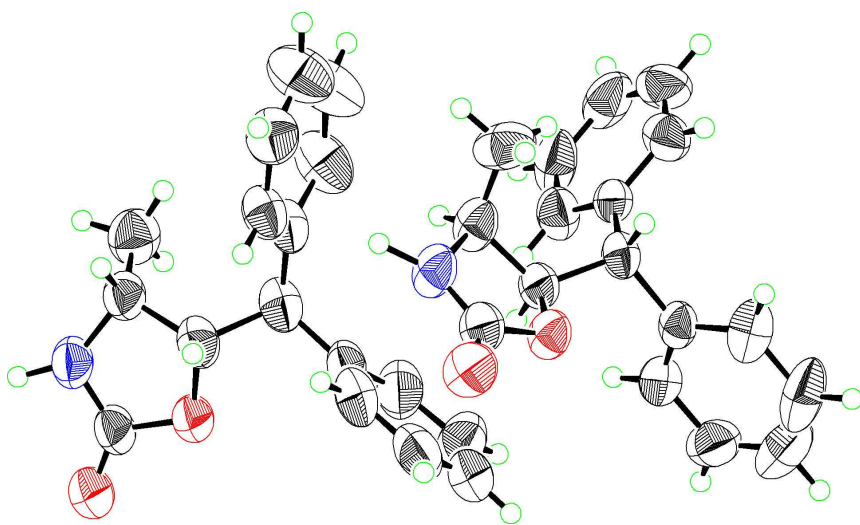
9b



10d



***rac*-11a**



rac-cis-11b