

**Phosphine-catalyzed [4+2] annulation of  $\gamma$ -benzyl allenoates: facile  
synthesis of benzothieno[3,2-*b*]pyran derivatives**

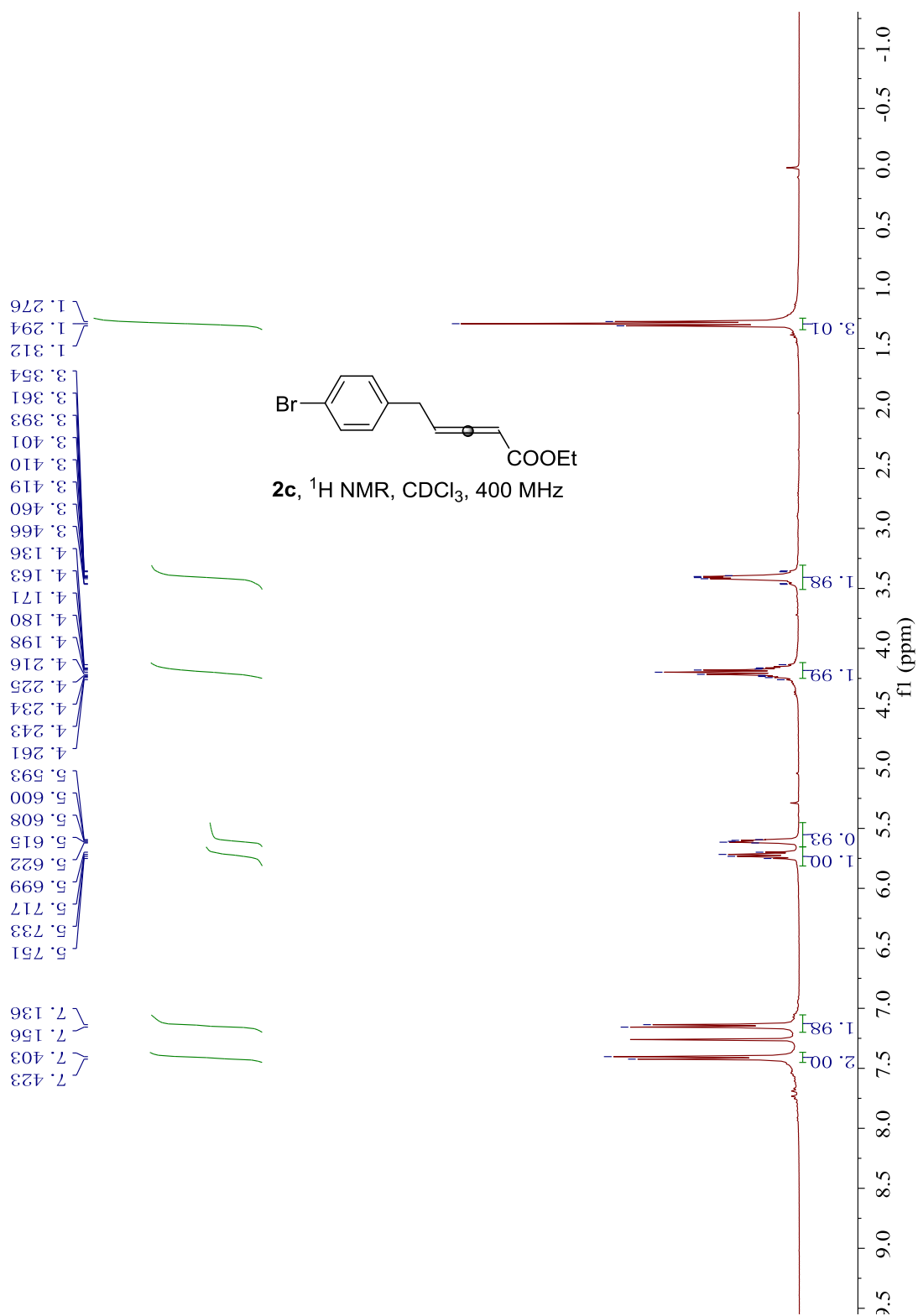
Shanshan Ma, Aimin Yu\* and Xiangtai Meng\*

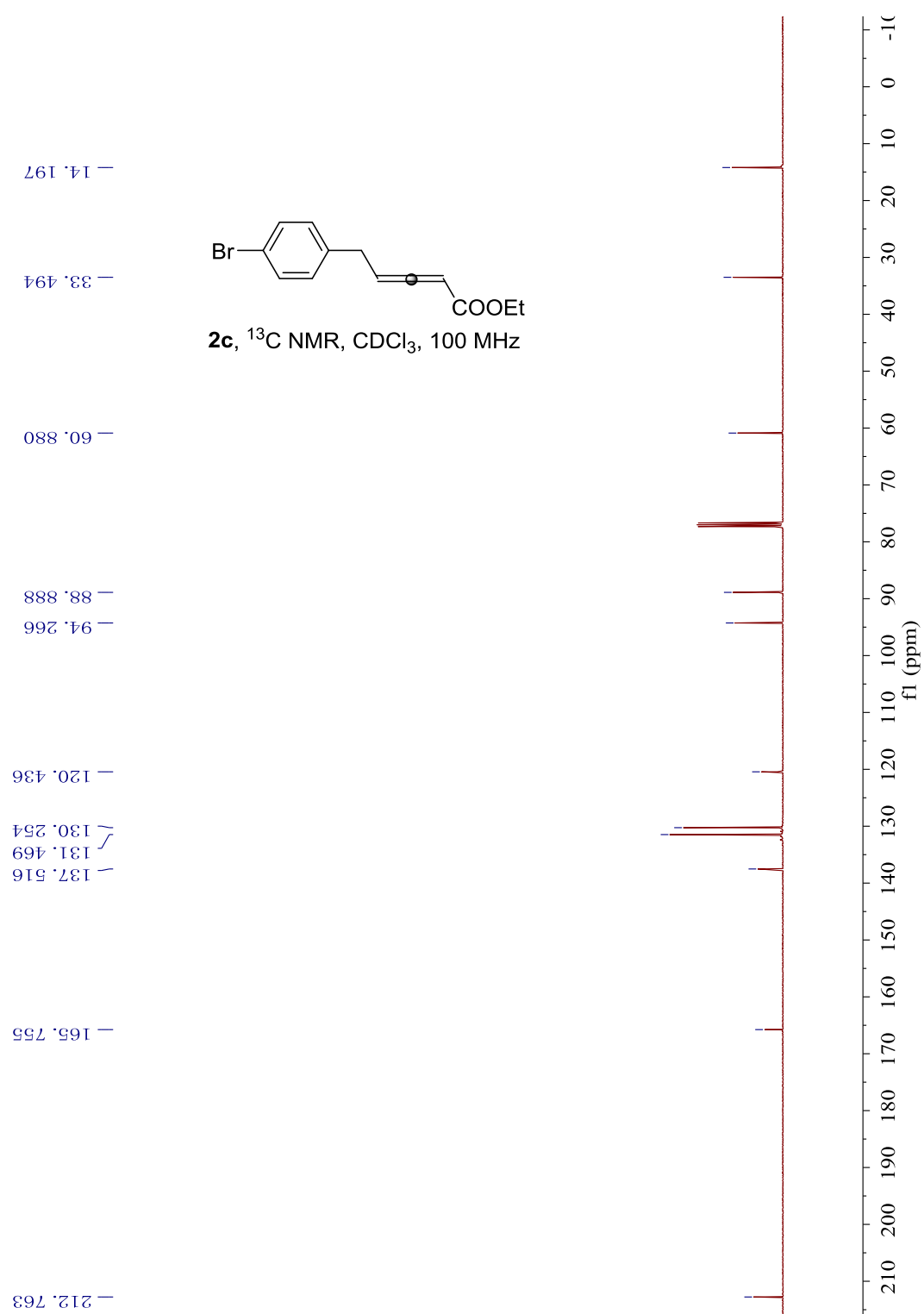
Tianjin Key Laboratory of Organic Solar Cells and Photochemical Conversion, School of Chemistry & Chemical Engineering, Tianjin University of Technology, Tianjin 300384, P. R. China. E-mail: aiminyu@tjut.edu.cn; mengxiangtai23@mail.nankai.edu.cn

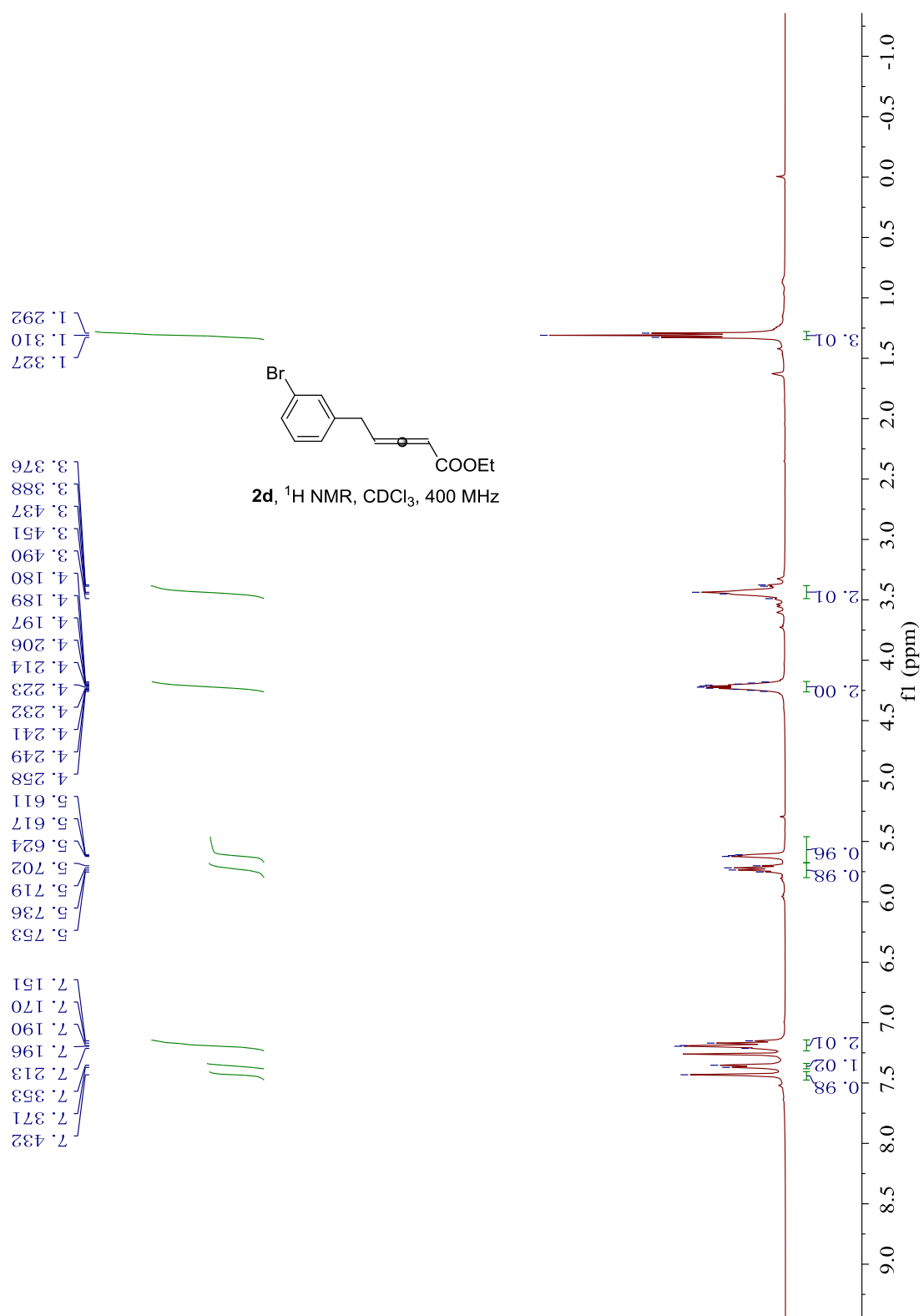
Contents

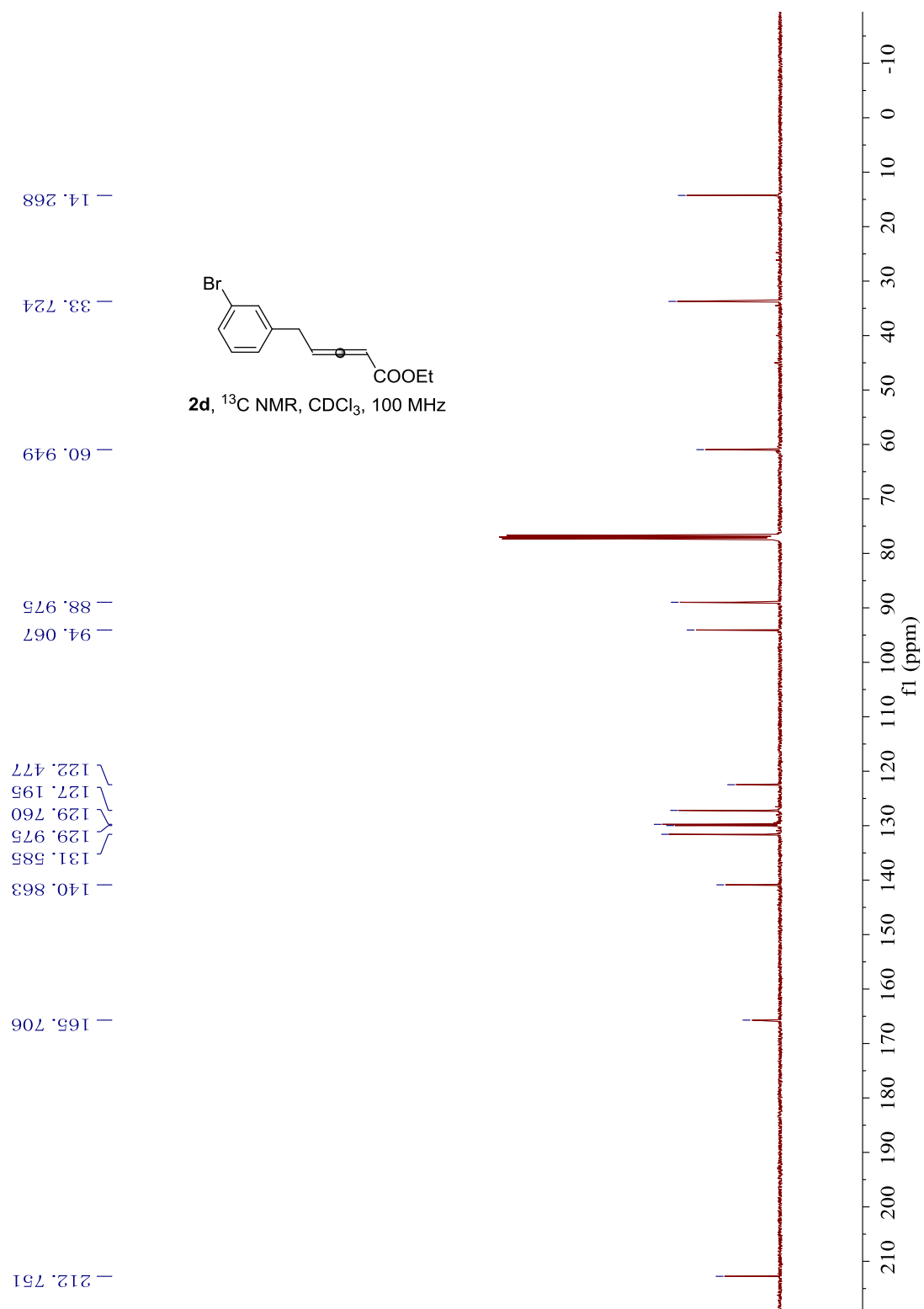
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| 1. Copies of $^1\text{H}$ NMR and $^{13}\text{C}$ NMR spectra of all new compounds..... | S2 |
|-----------------------------------------------------------------------------------------|----|

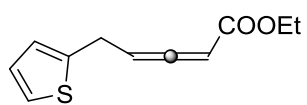
### 1. Copies of <sup>1</sup>H NMR and <sup>13</sup>C NMR spectra of all new compounds



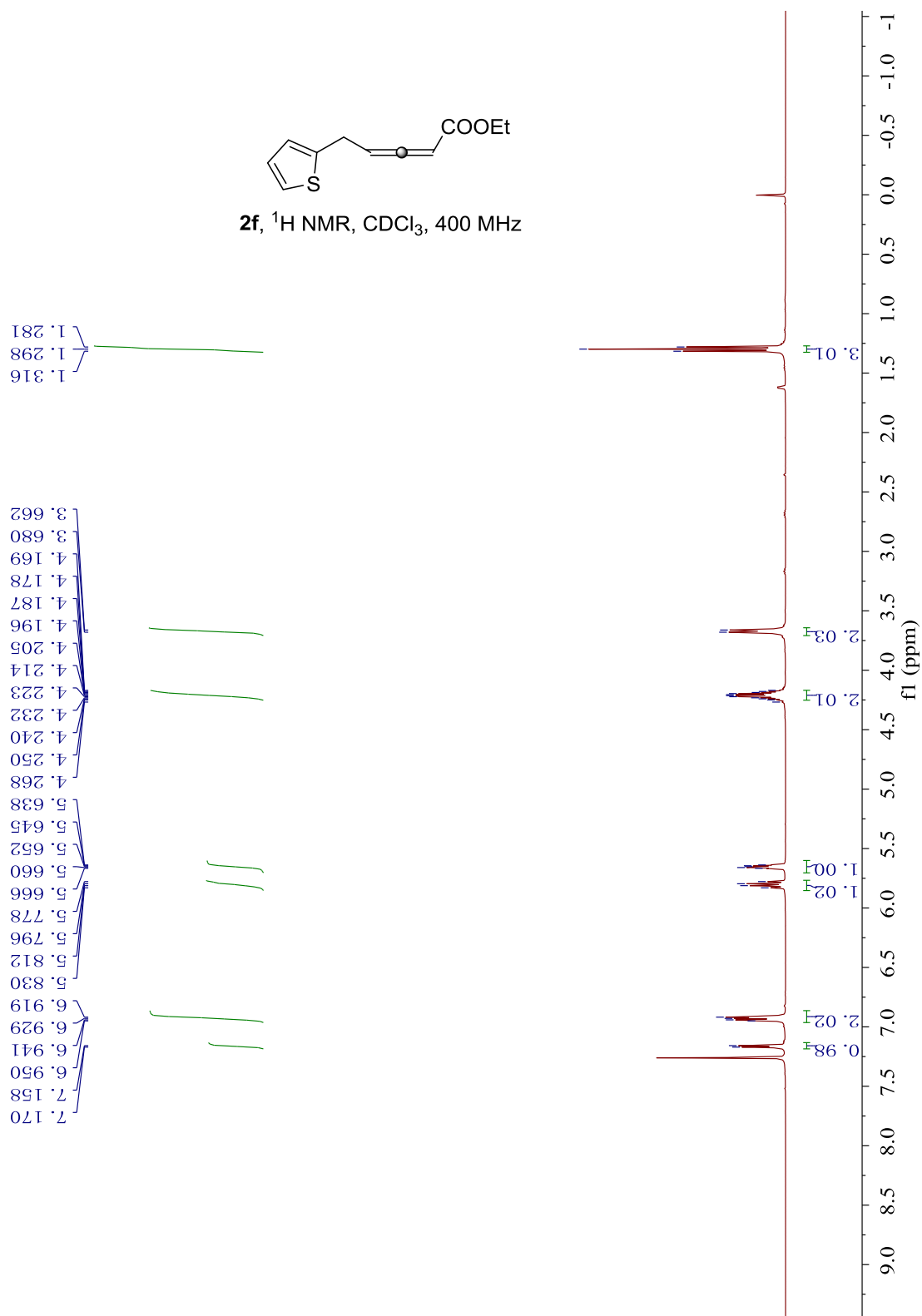


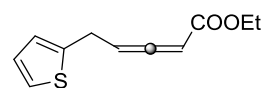




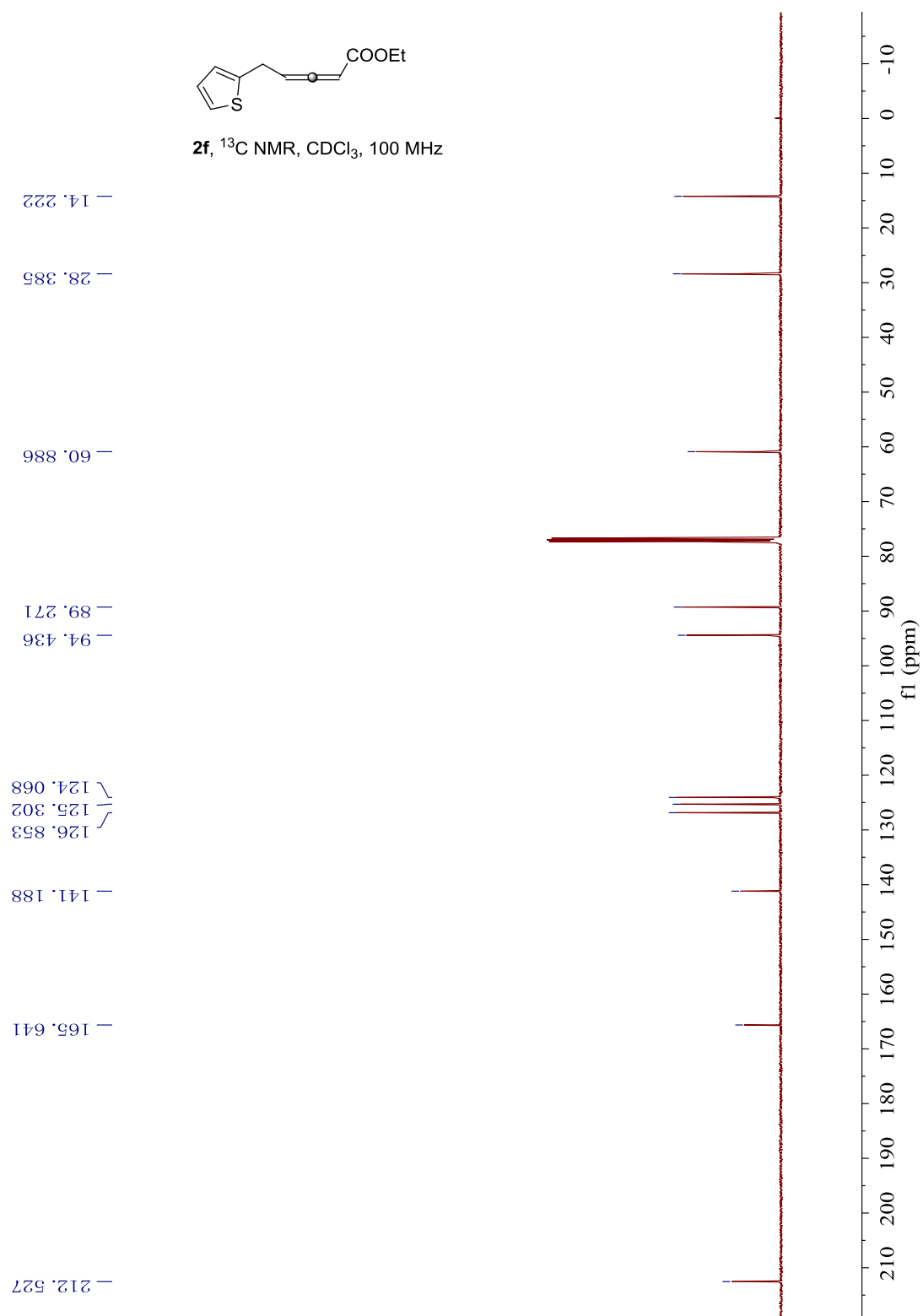


**2f**,  $^1\text{H}$  NMR,  $\text{CDCl}_3$ , 400 MHz

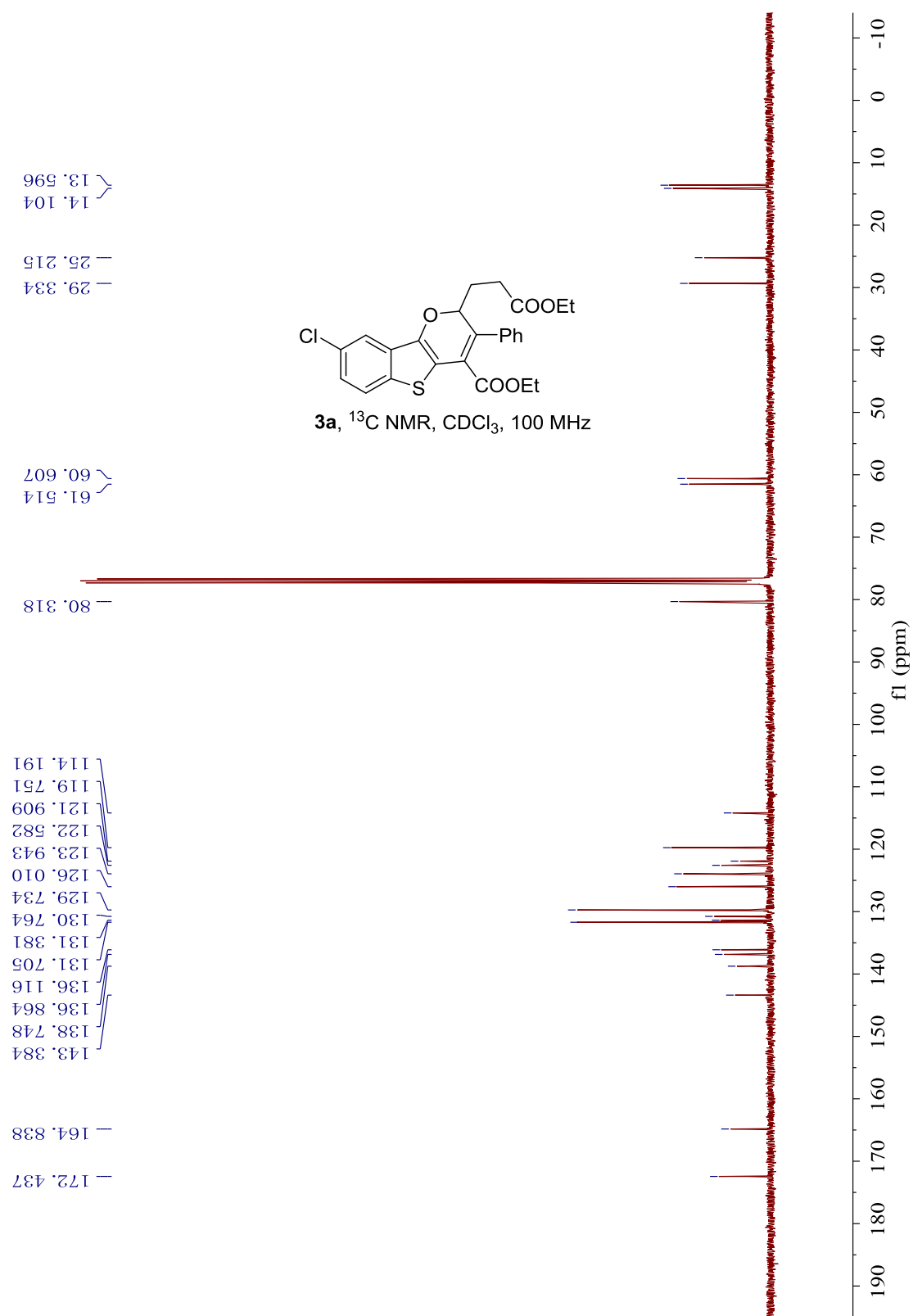


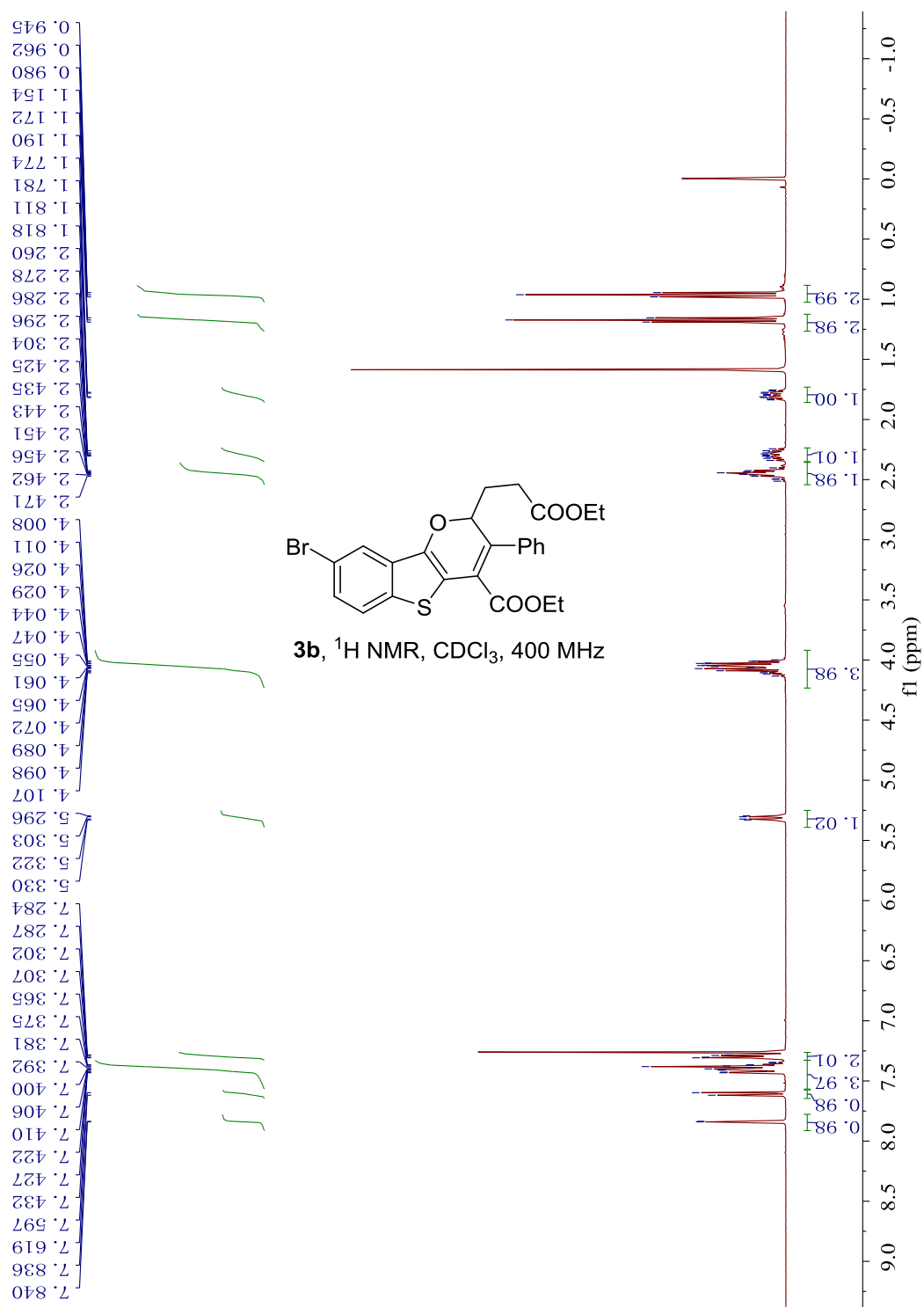


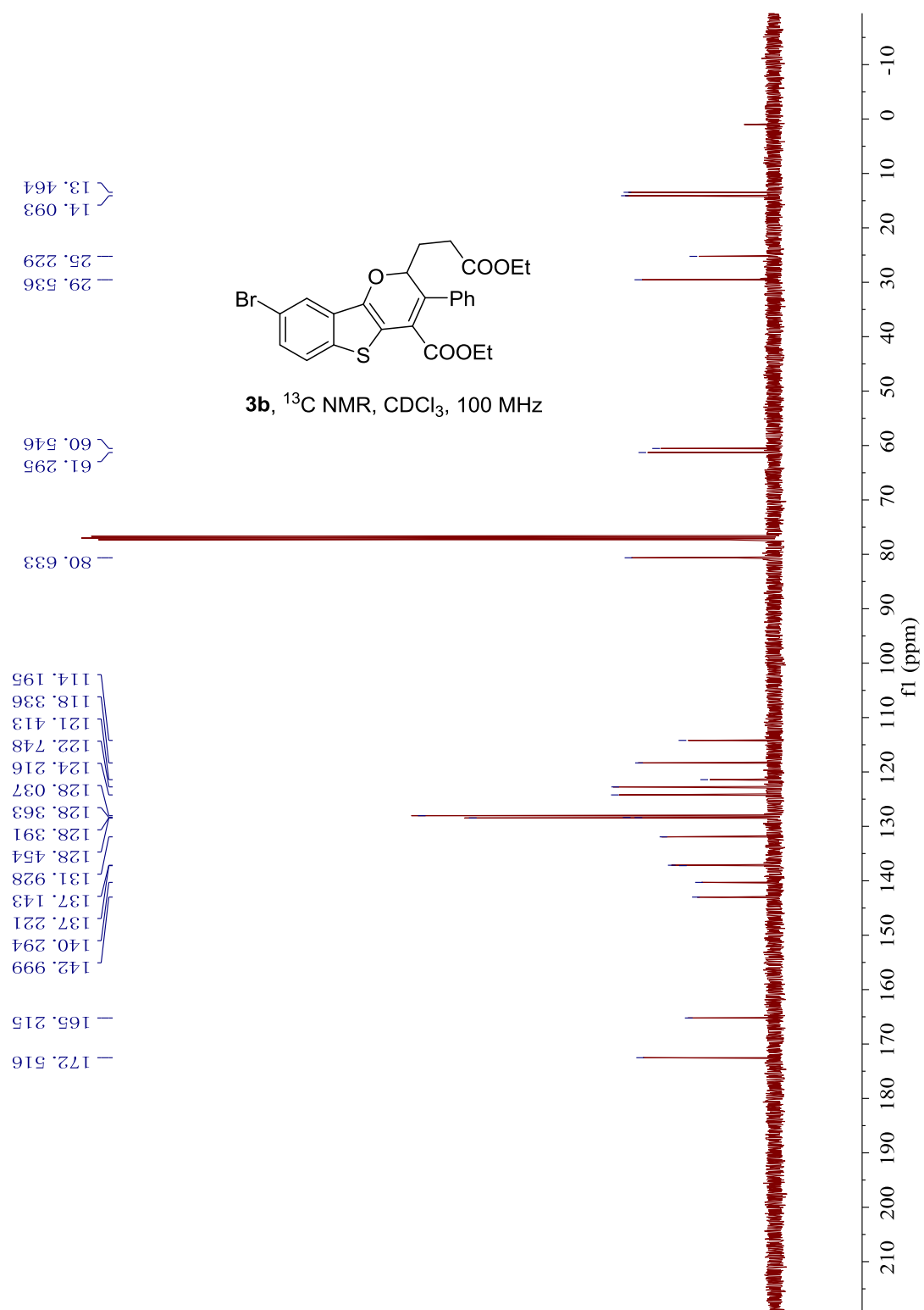
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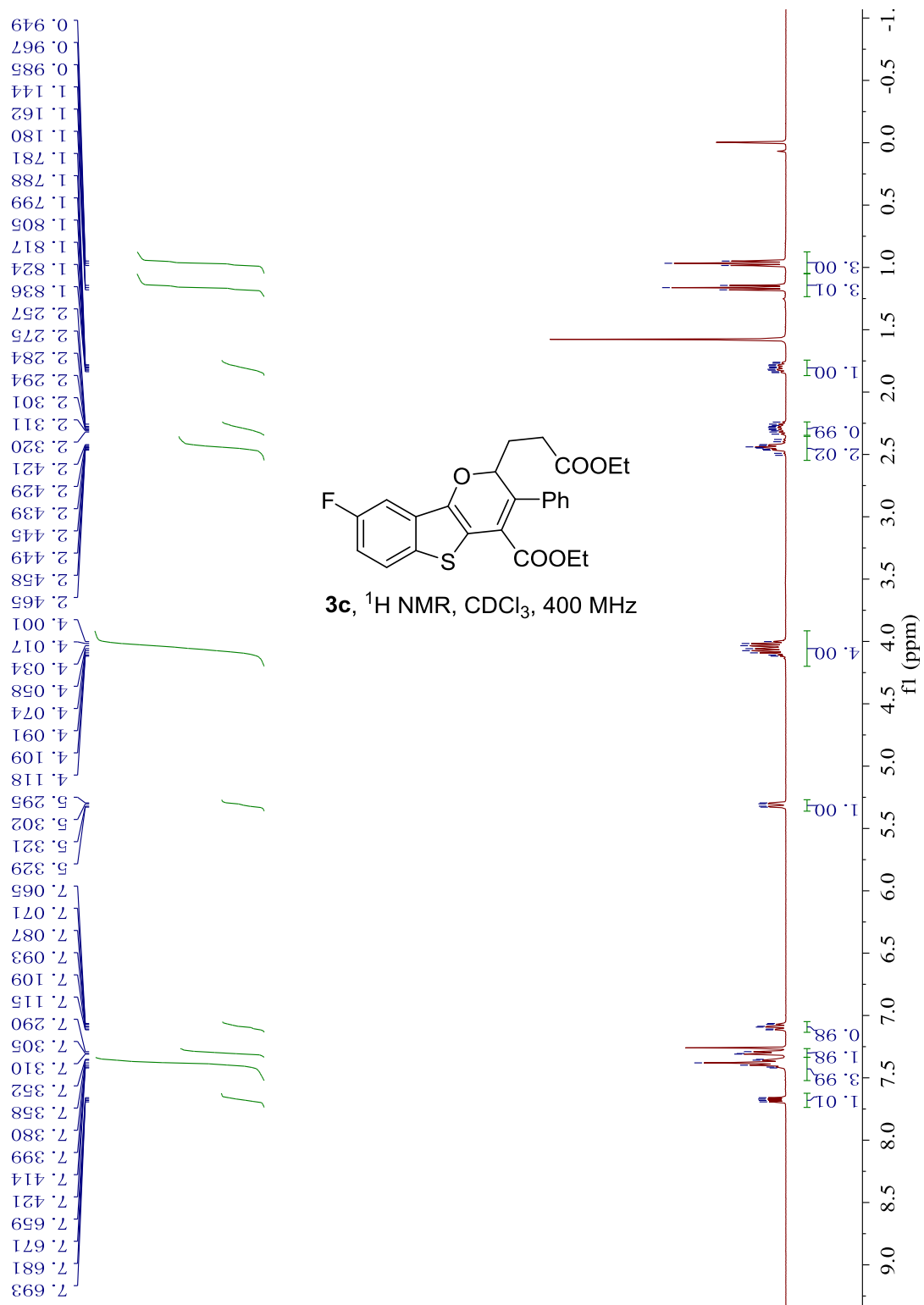


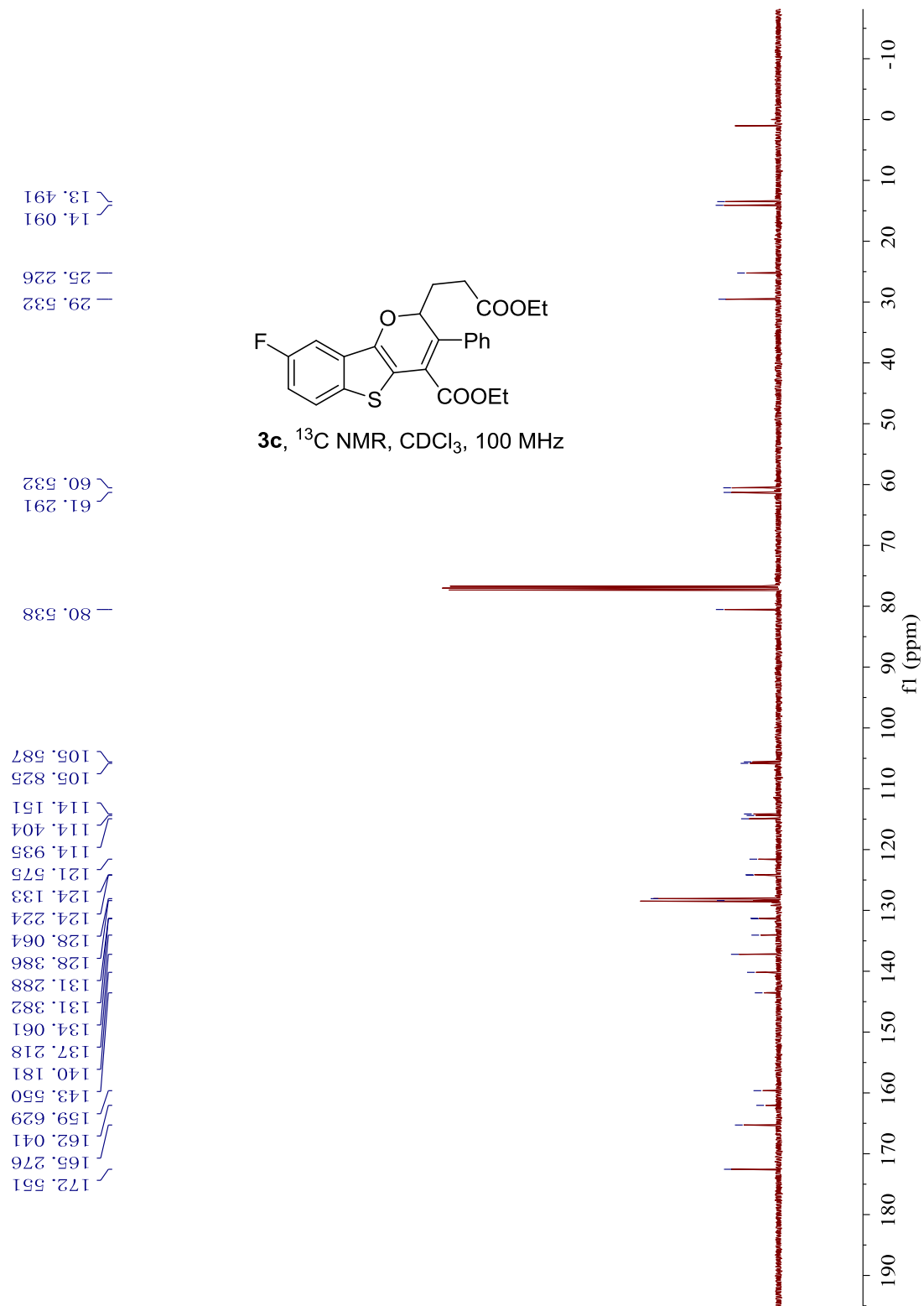


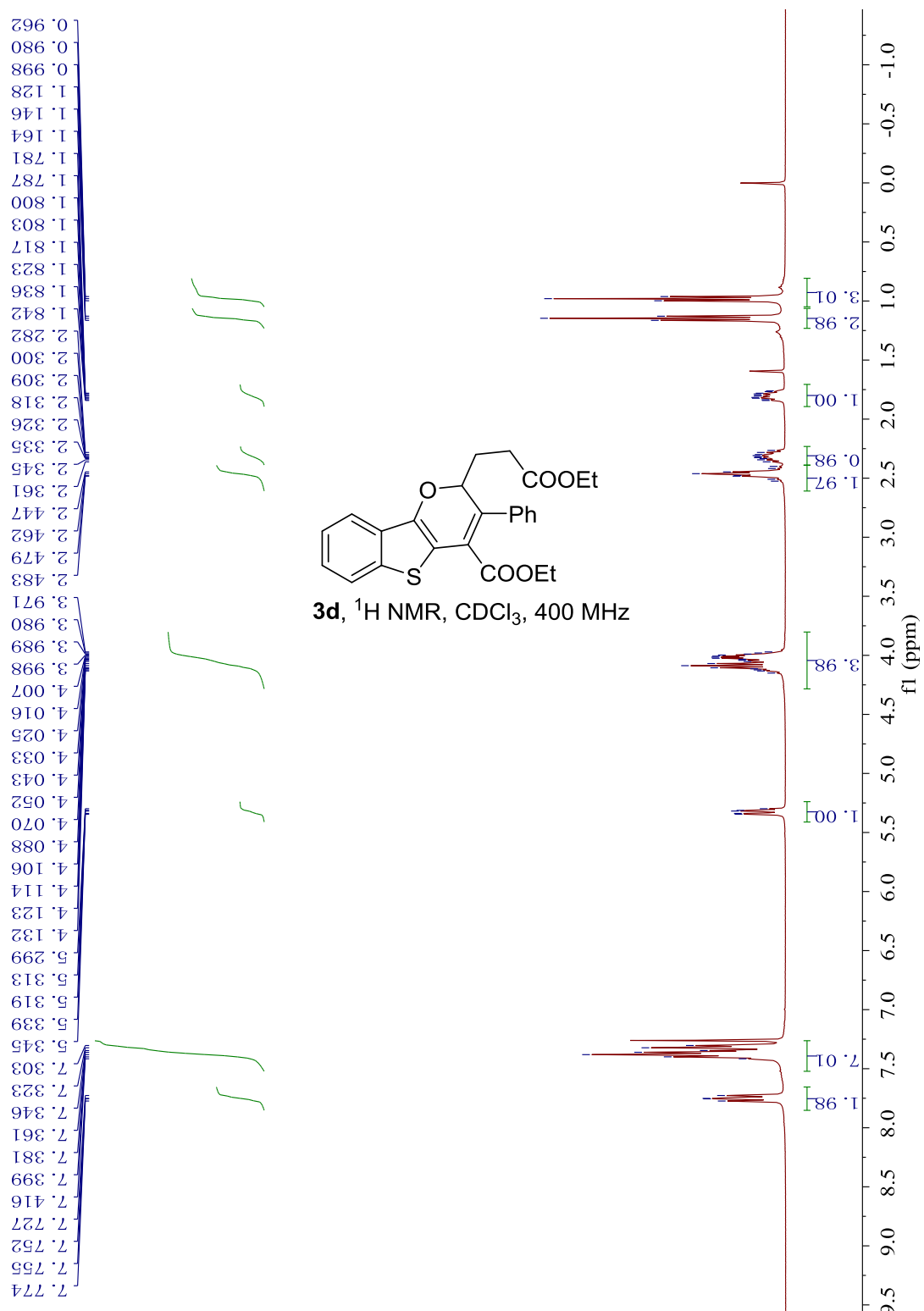


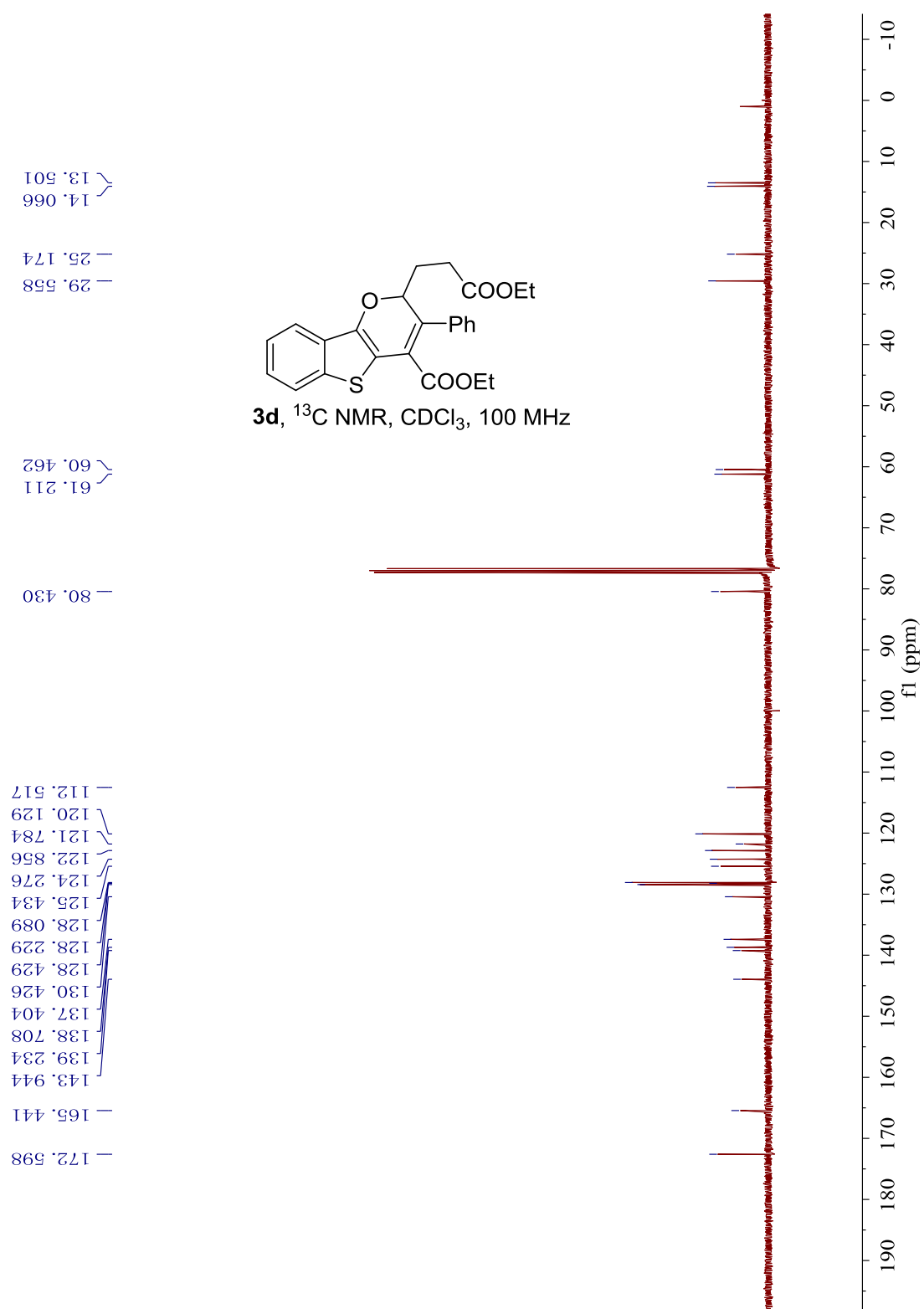




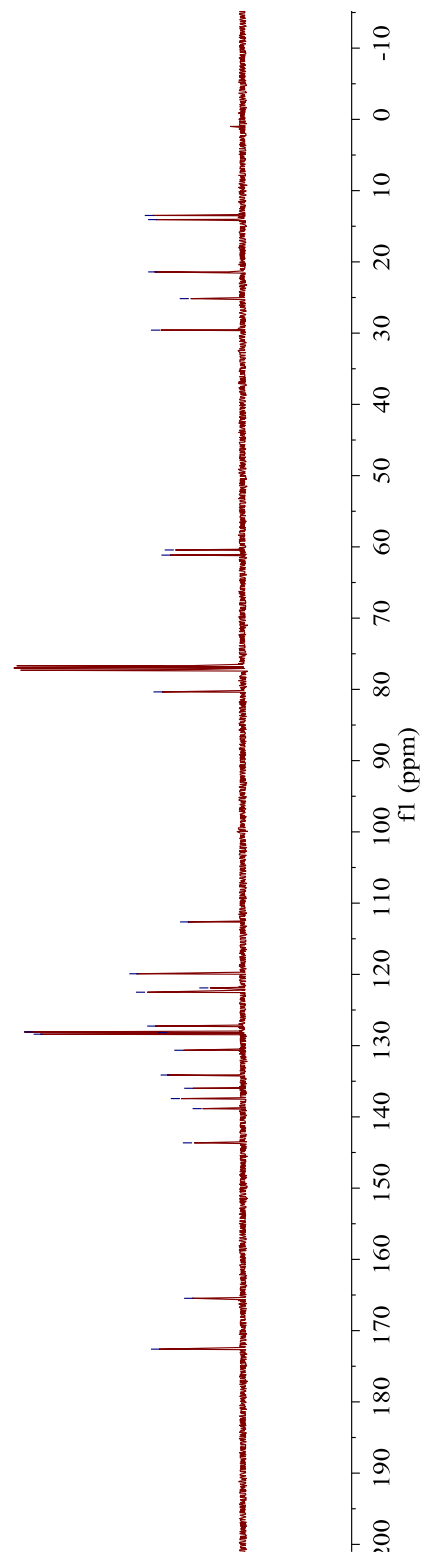
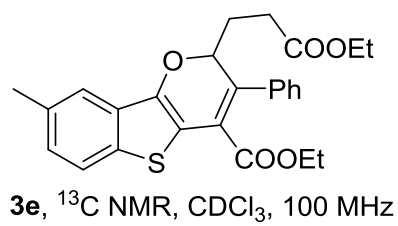












29.577  
25.157  
21.407  
14.064  
13.484

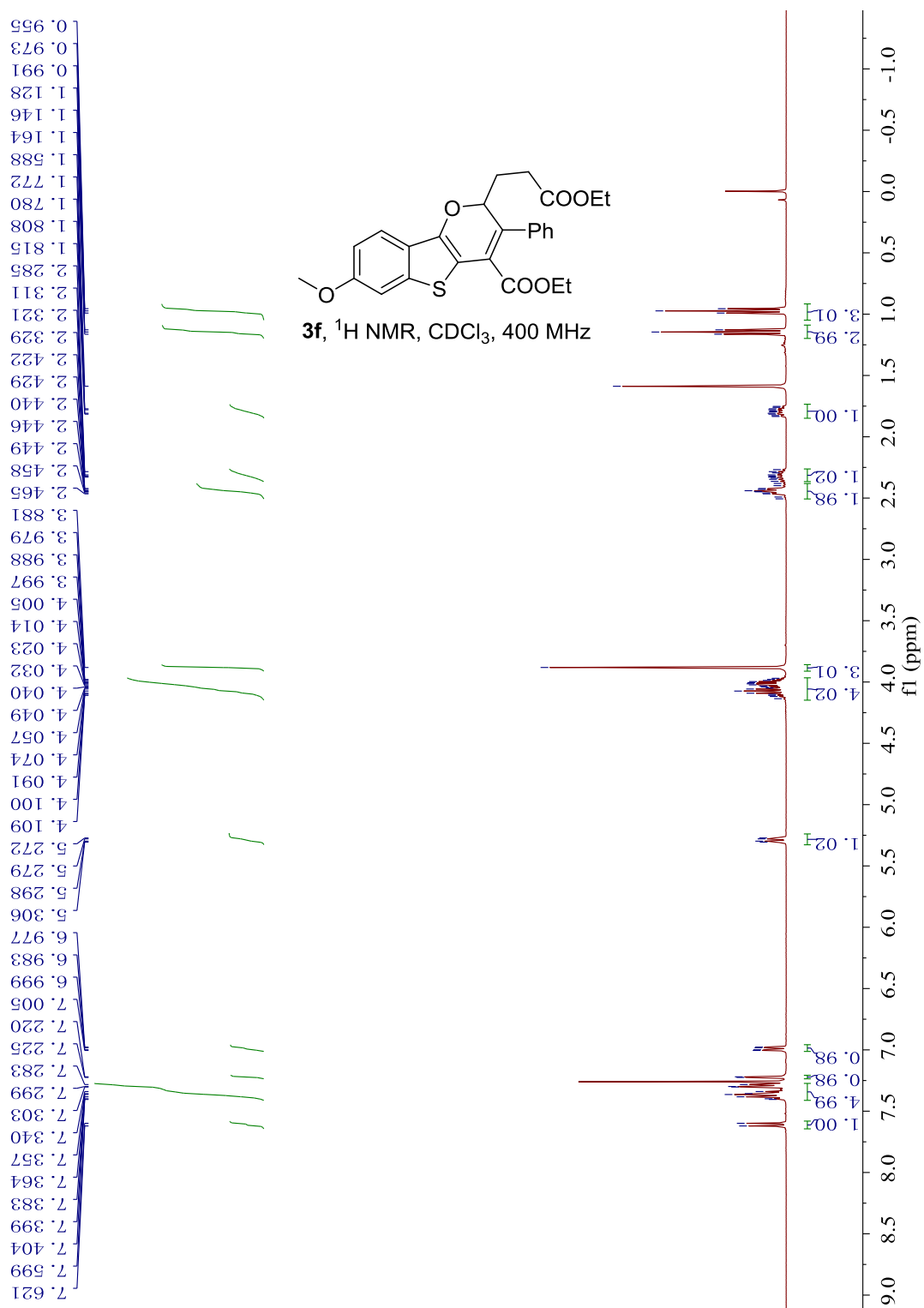
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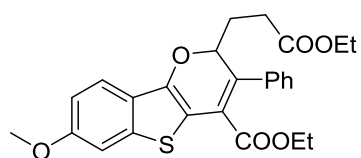
80.353

143.643  
138.841  
137.432  
135.983  
134.123  
130.650  
128.395  
128.164  
128.078  
127.257  
122.501  
121.897  
119.912  
112.636

165.463

172.598





**3f**,  $^{13}\text{C}$  NMR,  $\text{CDCl}_3$ , 100 MHz

13.484  
14.064  
21.407  
25.157  
29.577

60.431  
61.155

80.353

112.636  
119.912  
121.897  
122.501  
127.257  
128.078  
128.164  
128.395  
130.650  
134.123  
135.983  
137.432  
138.841  
143.643

165.463  
172.598

