

Supplementary Material

Synthesis of multi-substituted allenes from organoalane reagents and propargyl
esters by nickel-catalyzed

Xuebei Shao, Zhen Zhang, Qinghan Li *, Zhigang Zhao

College of Chemistry and Environmental Protection Engineering, Southwest University for
Nationalities, Chengdu, 610041, China

* Corresponding author. Tel.: +86-28-8592-8015; fax: +86-28-8552-4382; e-mail: lqhchem@163.com, lqhchem@swun.cn

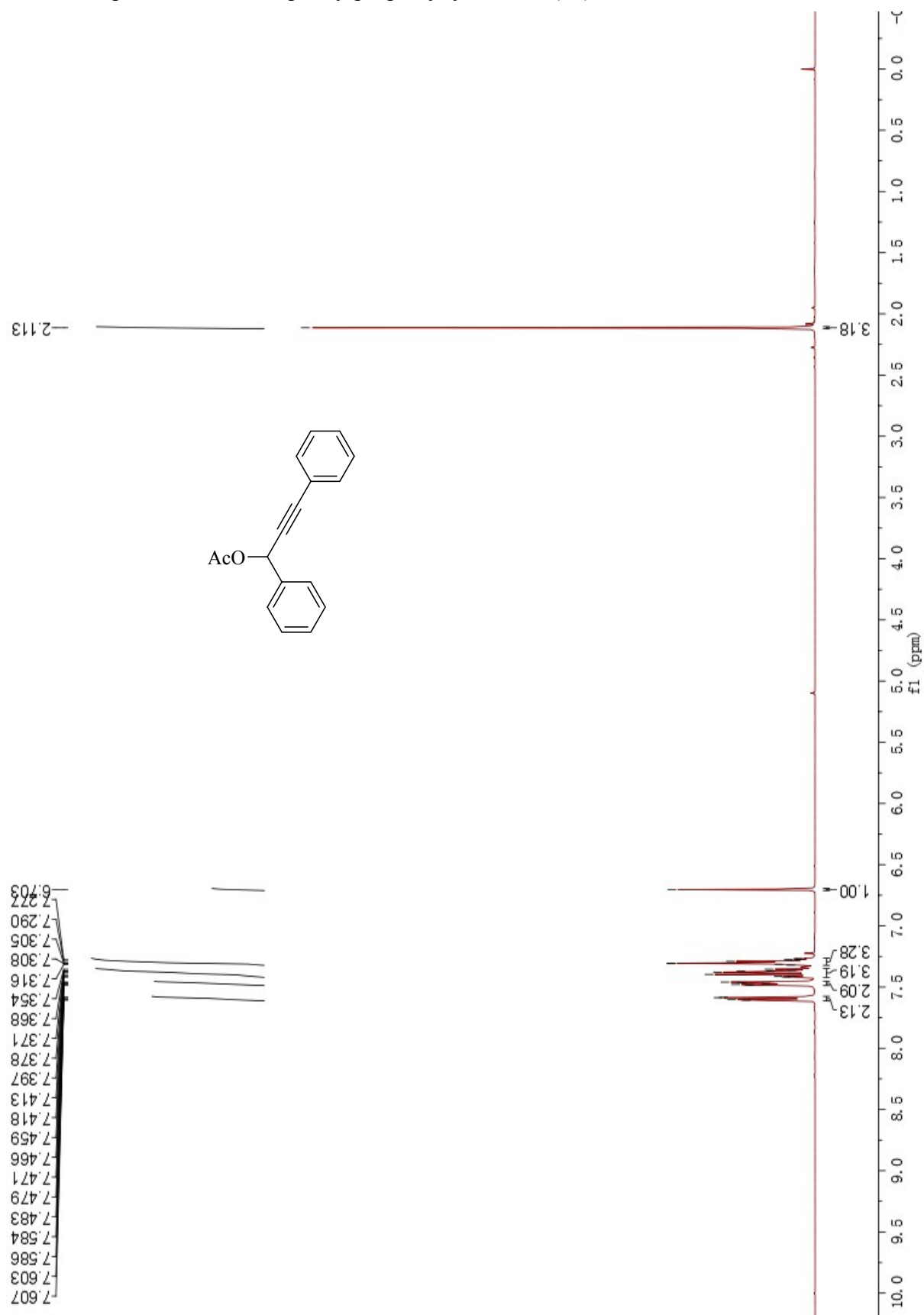
Table of Contents

I.	¹H and ¹³C NMR Spectra of new Propargyl acetates 1(a-q) and 4(a-r)	S4
1.	1,3-Diphenylprop-2-ynyl acetate (1a)	S4
2.	3-Phenyl-1- <i>o</i> -tolylprop-2-ynyl acetate (1b)	S6
3.	3-Phenyl-1- <i>m</i> -tolylprop-2-ynyl acetate (1c)	S8
4.	3-Phenyl-1- <i>p</i> -tolylprop-2-ynyl acetate (1d)	S10
5.	1-(2-Methoxyphenyl)-3-phenylprop-2-ynyl acetate (1e)	S12
6.	1-(2-Chlorophenyl)-3-phenylprop-2-ynyl acetate (1f)	S14
7.	1-(4-Chlorophenyl)-3-phenylprop-2-ynyl acetate (1g)	S16
8.	1-(4-bromophenyl)-3-phenylprop-2-ynyl acetate (1h)	S18
9.	3-Phenyl-1-(4-(trifluoromethyl)phenyl)prop-2-ynyl acetate (1i)	S20
10.	1-(Naphthalen-1-yl)-3-phenylprop-2-ynyl acetate (1j)	S22
11.	1-Phenyl-1-yn-3-yl acetate (1k)	S24
12.	1,4-diphenylbut-3-yn-2-yl acetate (1l)	S26
13.	3-Phenyl-1-(pyridin-3-yl)prop-2-ynyl acetate (1m)	S28
14.	1-Phenyl-3-(trimethylsilyl)prop-2-ynyl acetate (1n)	S30
15.	1- <i>p</i> -Tolyl-3-(trimethylsilyl)prop-2-ynyl acetate (1o)	S32
16.	1-(4-Chlorophenyl)-3-(trimethylsilyl)prop-2-ynyl acetate (1p)	S34
17.	1-(Naphthalen-2-yl)-3-(trimethylsilyl)prop-2-ynyl acetate (1q)	S36
18.	1-(trimethylsilyl)oct-1-yn-3-yl acetate (1r):	S38
19.	2-methyl-4-phenylbut-3-yn-2-yl acetate (4a)	S40
20.	2-Methyl-4-(4-methylphenyl)but-3-yn-2-yl acetate (4b)	S42
21.	2-Methyl-4-(3-chlorophenyl)but-3-yn-2-yl acetate (4c)	S44
22.	2-Methyl-4-(2-fluorophenyl)but-3-yn-2-yl acetate (4d)	S46
23.	2-Methyl-4-(3-fluorophenyl)but-3-yn-2-yl acetate (4e)	S48
24.	2-Methyl-4-(4-fluorophenyl)but-3-yn-2-yl acetate (4f)	S50
25.	2-Methyl-4-(3-bromophenyl)but-3-yn-2-yl acetate (4g)	S52
26.	2-Methyl-4-(4-bromophenyl)but-3-yn-2-yl acetate (4h)	S54
27.	2-Methyl-4-thienylbut-3-yn-2-yl acetate(4i)	S56
28.	3-methyl-1-phenylpent-1-yn-3-yl acetate (4j)	S58
29.	3-methyl-1-(2-fluorophenyl)pent-1-yn-3-yl acetate (4k)	S60
30.	3-methyl-1-(3-fluorophenyl)pent-1-yn-3-yl acetate(4l)	S62
31.	3-methyl-1-(4-fluorophenyl)pent-1-yn-3-yl acetate (4m)	S64
32.	3-methyl-1-(3-chlorophenyl)pent-1-yn-3-yl acetate (4n)	S66
33.	3-methyl-1-(3-bromophenyl)pent-1-yn-3-yl acetate (4o)	S68
34.	3-methyl-1-(4-methylphenyl)pent-1-yn-3-yl acetate(4p)	S70
35.	4-(4-fluorophenyl)-2-phenylbut-3-yn-2-yl acetate (4q)	S72
36.	4-(4-chlorophenyl)-2-phenylbut-3-yn-2-yl acetate (4r)	S74
II.	¹H and ¹³C NMR Spectra of Propargyl carbonate 7(a,b).	S74
1.	1,3-Diphenylprop-2-ynyl methyl carbonate (7a)	S76
2.	2-methyl-4-phenylbut-3-yn-2-yl carbonate (7b)	S78
III.	¹H and ¹³C NMR Spectra of Coupling Products 2(a-q) and 5(a-r)	
1.	1,3-Diphenylbuta-1,2-diene (2a)	S78

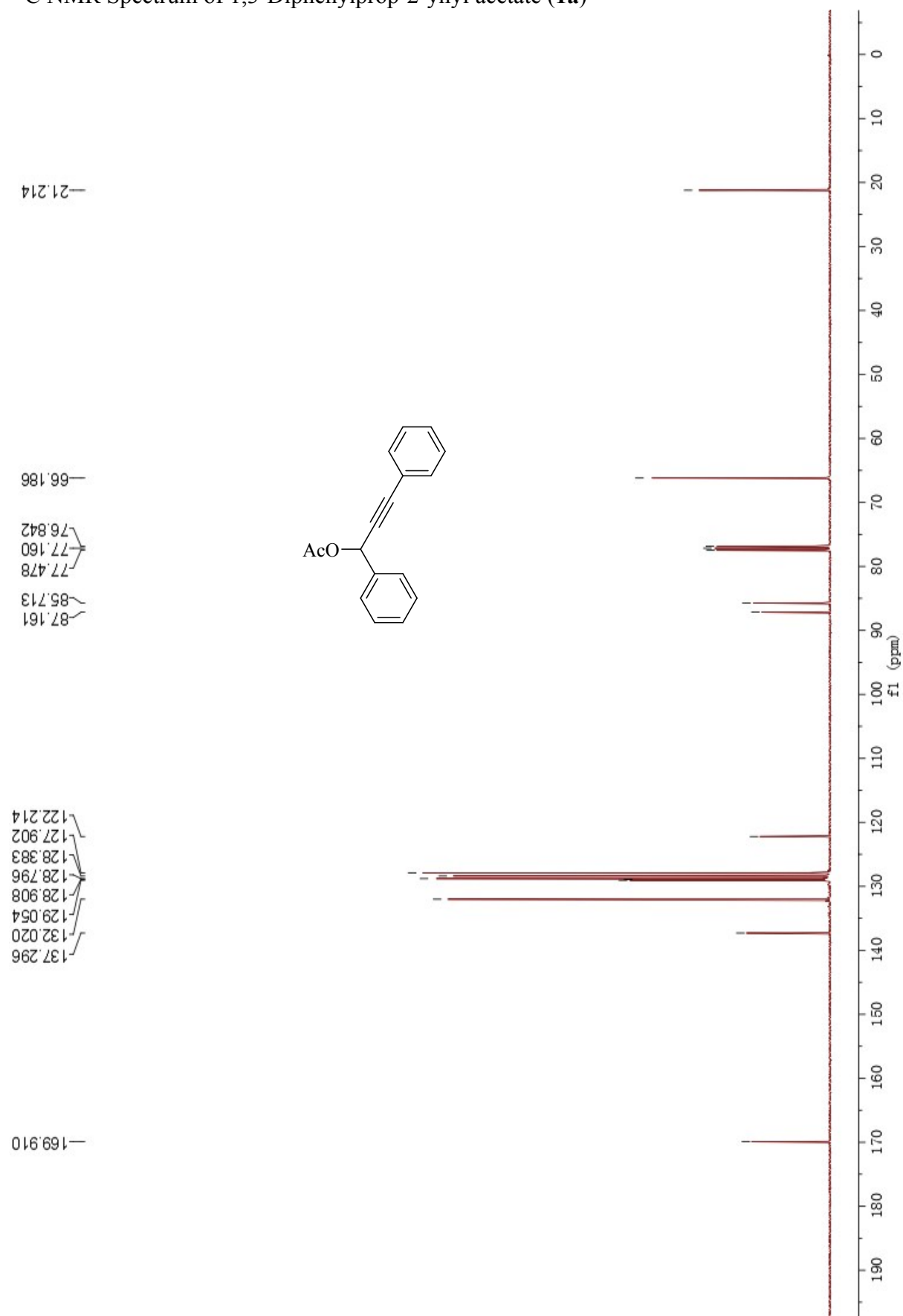
2. 1-(2-Methylphenyl)-3-phenylbuta-1,2-diene (2b)	S80
3. 1-(3-Methylphenyl)-3-phenylbuta-1,2-diene (2c)	S82
4. 1-(4-Methylphenyl)-3-phenylbuta-1,2-diene (2d)	S84
5. 1-(2-Methoxyphenyl)-3-phenylbuta-1,2-diene (2e)	S86
6. 1-(2-Chlorophenyl)-3-phenylbuta-1,2-diene (2f)	S88
7. 1-(4-Chlorophenyl)-3-phenylbuta-1,2-diene (2g)	S90
8. 1-(4-Bromophenyl)-3-phenylbuta-1,2-diene (2h)	S92
9. 1-(4-Trifluoromethylphenyl)-3-phenylbuta-1,2-diene (2i)	S94
10. 1-(Naphthyl-1-yl)-3-phenylbuta-1,2-diene (2j)	S96
11. 2-Phenyl-nona-2,3-diene (2k)	S98
12. 1,4-diphenylpenta-2,3-diene (2l)	S100
13. 3-(3-phenylbuta-1,2-dienyl)pyridine (2m)	S102
14. Phenyl-3-trimethylsilylbuta-1,2-diene (2n)	S104
15. 1-(4-Methylphenyl)-3-trimethylsilylbuta-1,2-diene (2o)	S106
16. 1-(4-Chlorophenyl)-3-trimethylsilylbuta-1,2-diene (2p)	S108
17. 3-(Naphthalen-2-yl)-3-trimethylsilylbuta-1,2-diene (2q)	S110
18. 1-(4-methylpenta-2,3-dien-2-yl)benzene (5a)	S112
19. 1-methyl-4-(4-methylpenta-2,3-dien-2-yl)benzene (5b)	S114
20. 1-chloro-3-(4-methylpenta-2,3-dien-2-yl)benzene (5c)	S116
21. 1-fluoro-2-(4-methylpenta-2,3-dien-2-yl)benzene (5d)	S118
22. 1-fluoro-3-(4-methylpenta-2,3-dien-2-yl)benzene (5e)	S120
23. 1-fluoro-4-(4-methylpenta-2,3-dien-2-yl)benzene (5f)	S122
24. 1-bromo-3-(4-methylpenta-2,3-dien-2-yl)benzene (5g)	S124
25. 1-bromo-4-(4-methylpenta-2,3-dien-2-yl)benzene (5h)	S126
25. 2-(4-methylpenta-2,3-dien-2-yl)thiophene (5i)	S128
26. 1-(4-methylhexa-2,3-dien-2-yl)benzene (5j)	S130
27. 1-fluoro-2-(4-methylhexa-2,3-dien-2-yl)benzene (5k)	S132
28. 1-fluoro-3-(3-methylhexa-2,3-dien-2-yl)benzene (5l)	S134
29. 1-fluoro-4-(4-methylhexa-2,3-dien-2-yl)benzene (5m)	S136
30. 1-chloro-3-(4-methylhexa-2,3-dien-2-yl)benzene (5n)	S138
31. 1-bromo-3-(4-methylhexa-2,3-dien-2-yl)benzene (5o)	S140
32. 1-methyl-4-(4-methylpenta-2,3-dien-2-yl)benzene (5p)	S142
33. 1-fluoro-4-(3-phenylbuta-1,2-dienyl)benzene (5q)	S144
34. 1-chloro-4-(3-phenylbuta-1,2-dienyl)benzene (5r)	S146
IV. Control experiments	S148

¹H and ¹³C NMR Spectra of new Propargyl acetates

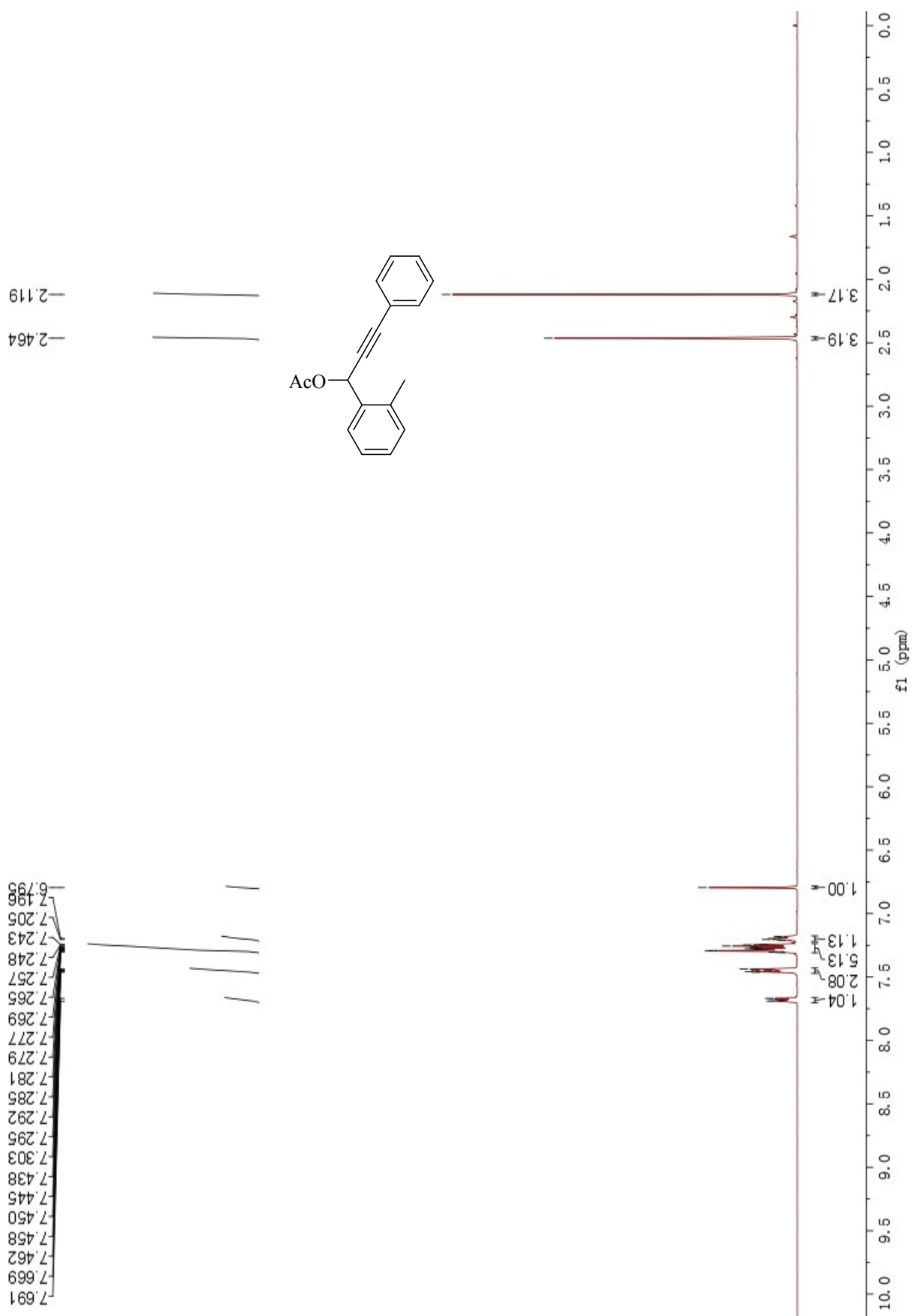
¹H NMR Spectrum of 1,3-Diphenylprop-2-ynyl acetate (**1a**)



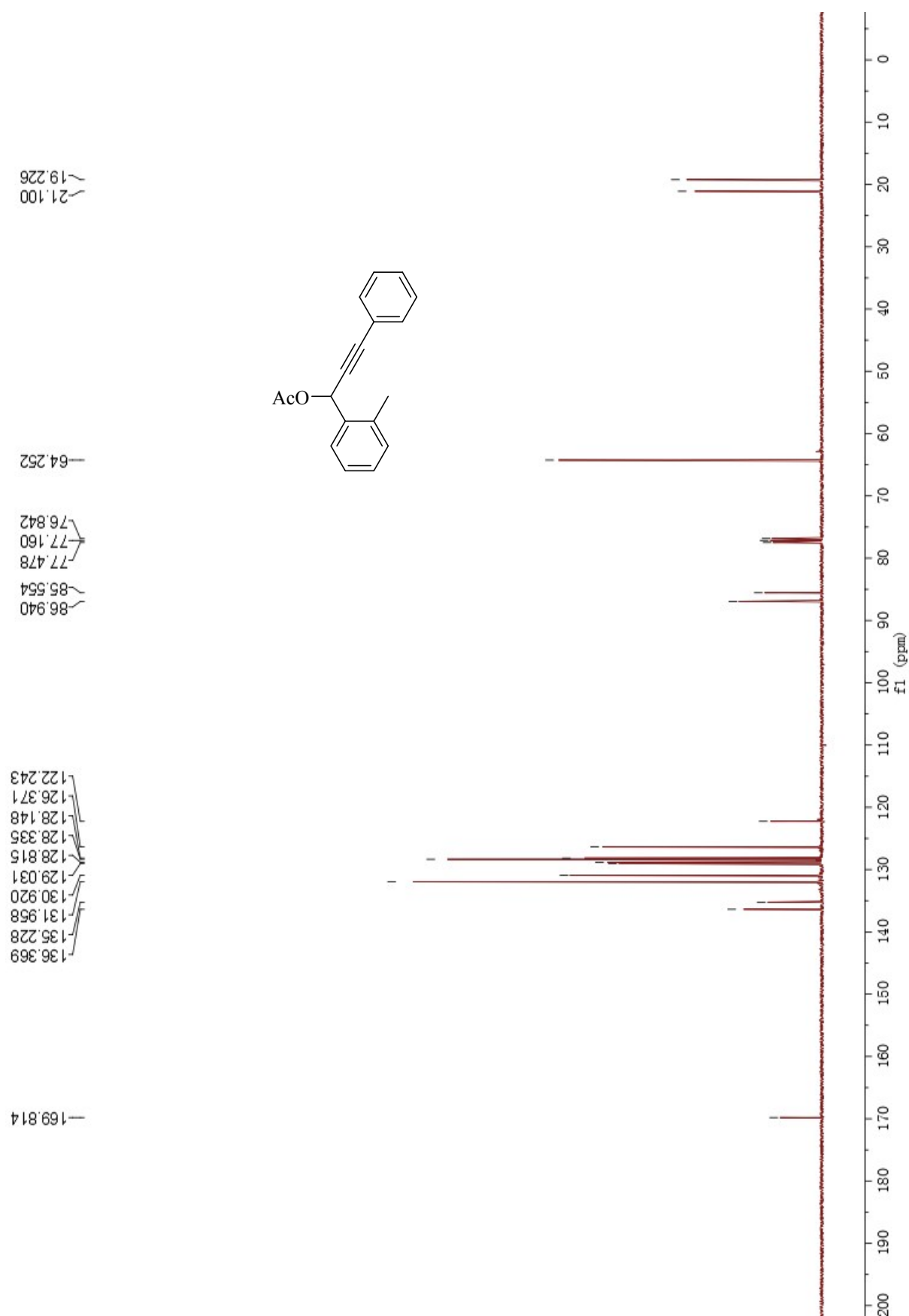
^{13}C NMR Spectrum of 1,3-Diphenylprop-2-ynyl acetate (**1a**)



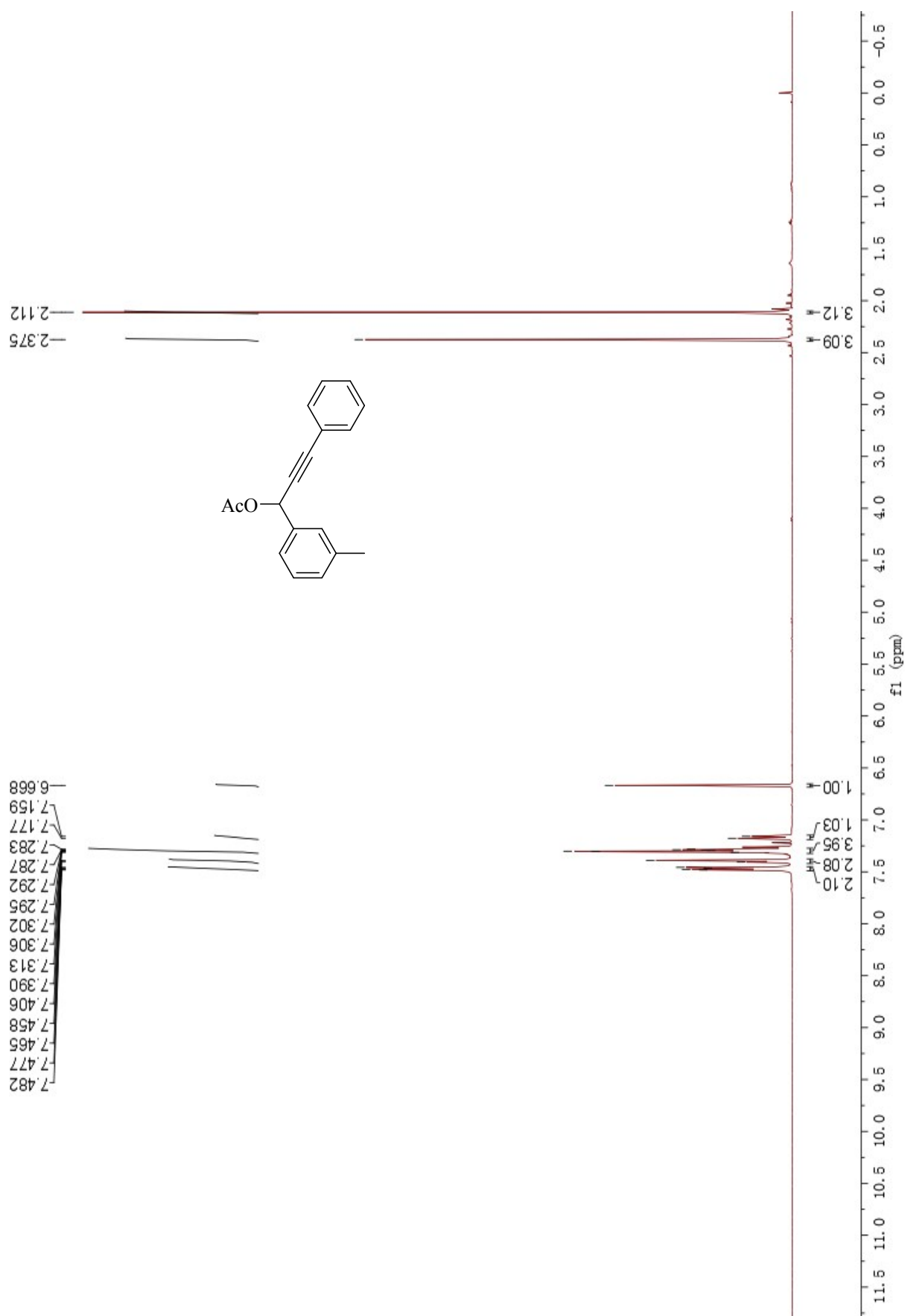
¹H NMR Spectrum of 3-Phenyl-1-*o*-tolylprop-2-ynyl acetate (**1b**)



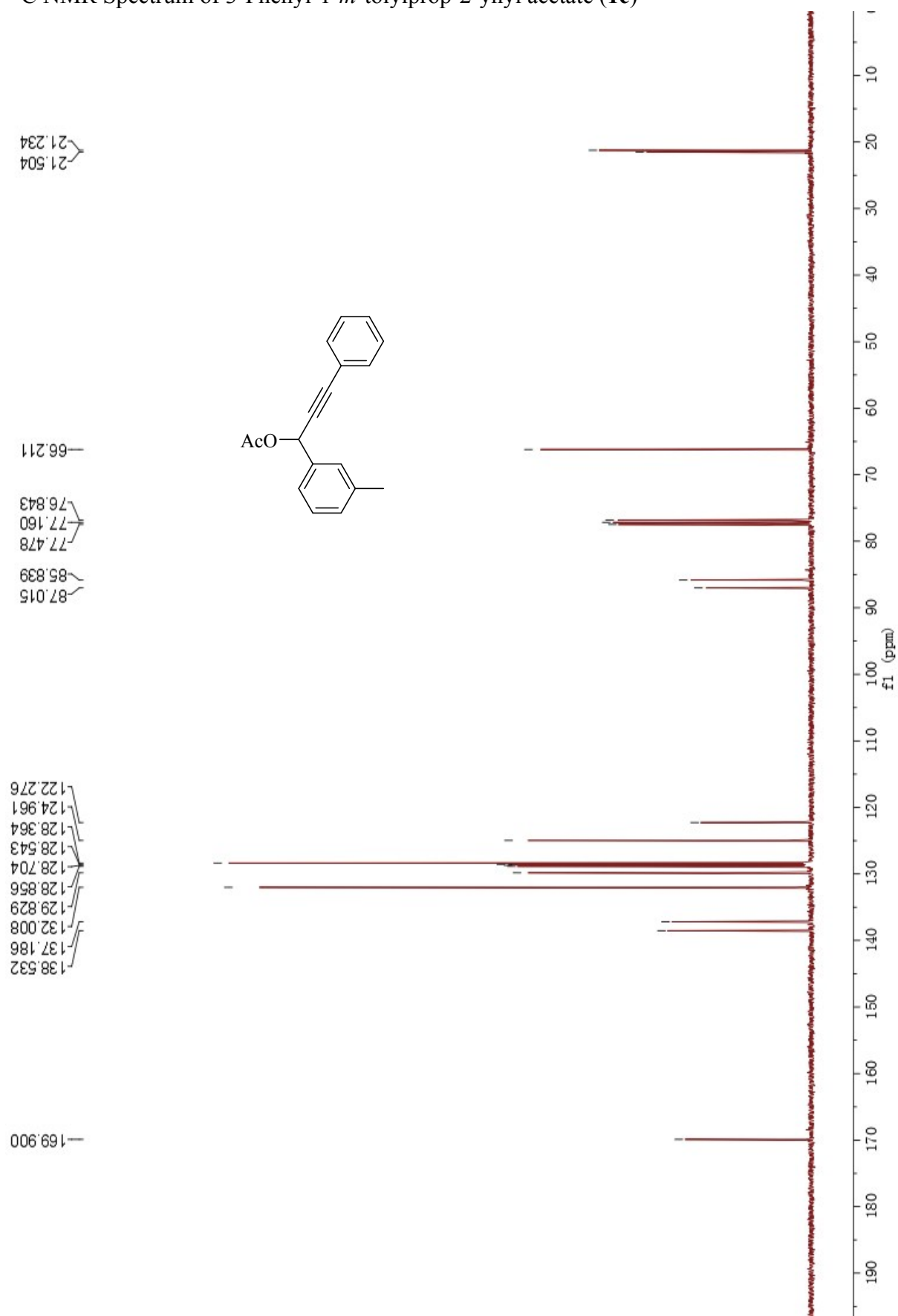
^{13}C NMR Spectrum of 3-Phenyl-1-*o*-tolylprop-2-ynyl acetate (**1b**)



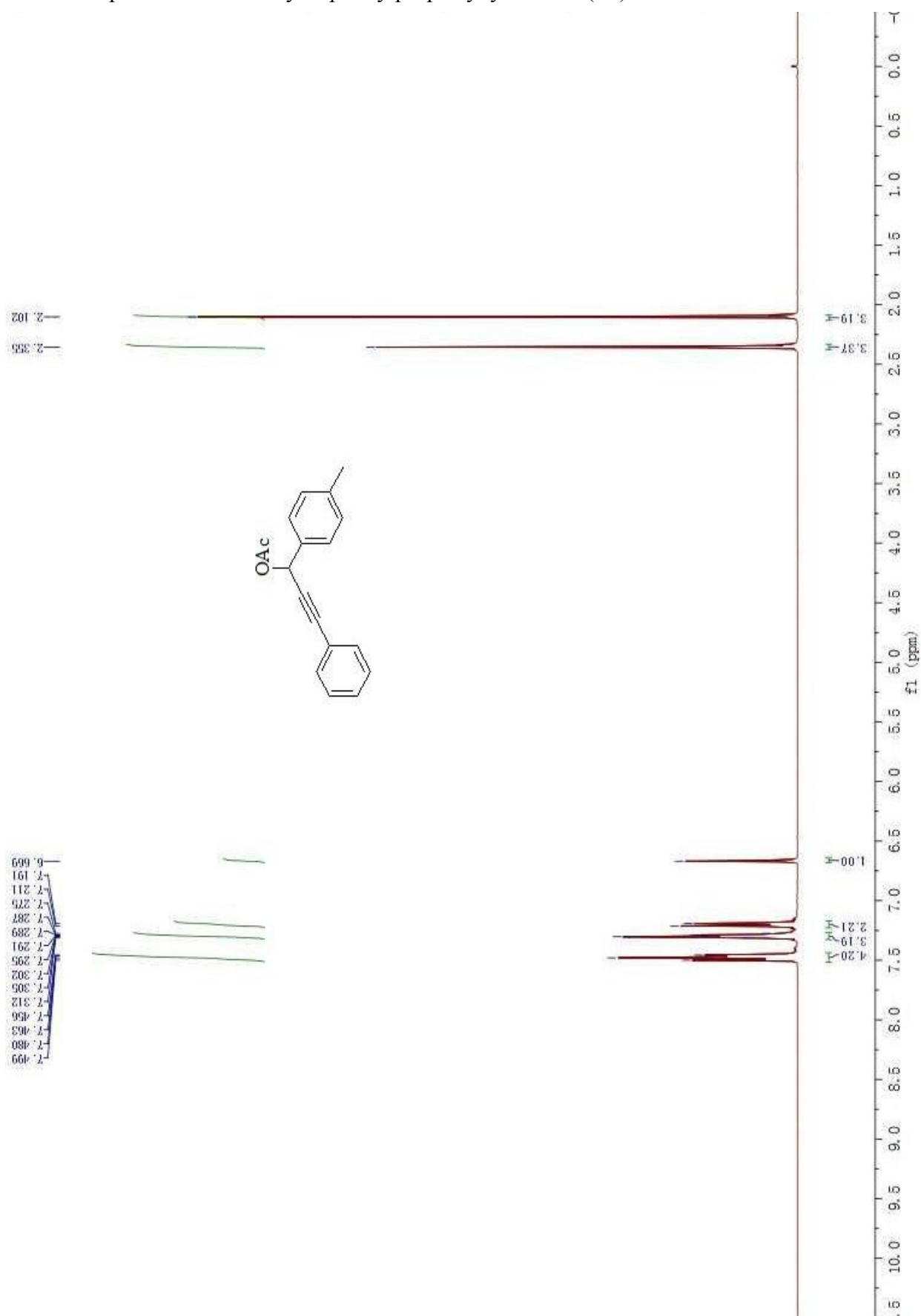
^1H NMR Spectrum of 3-Phenyl-1-*m*-tolylprop-2-ynyl acetate (**1c**)



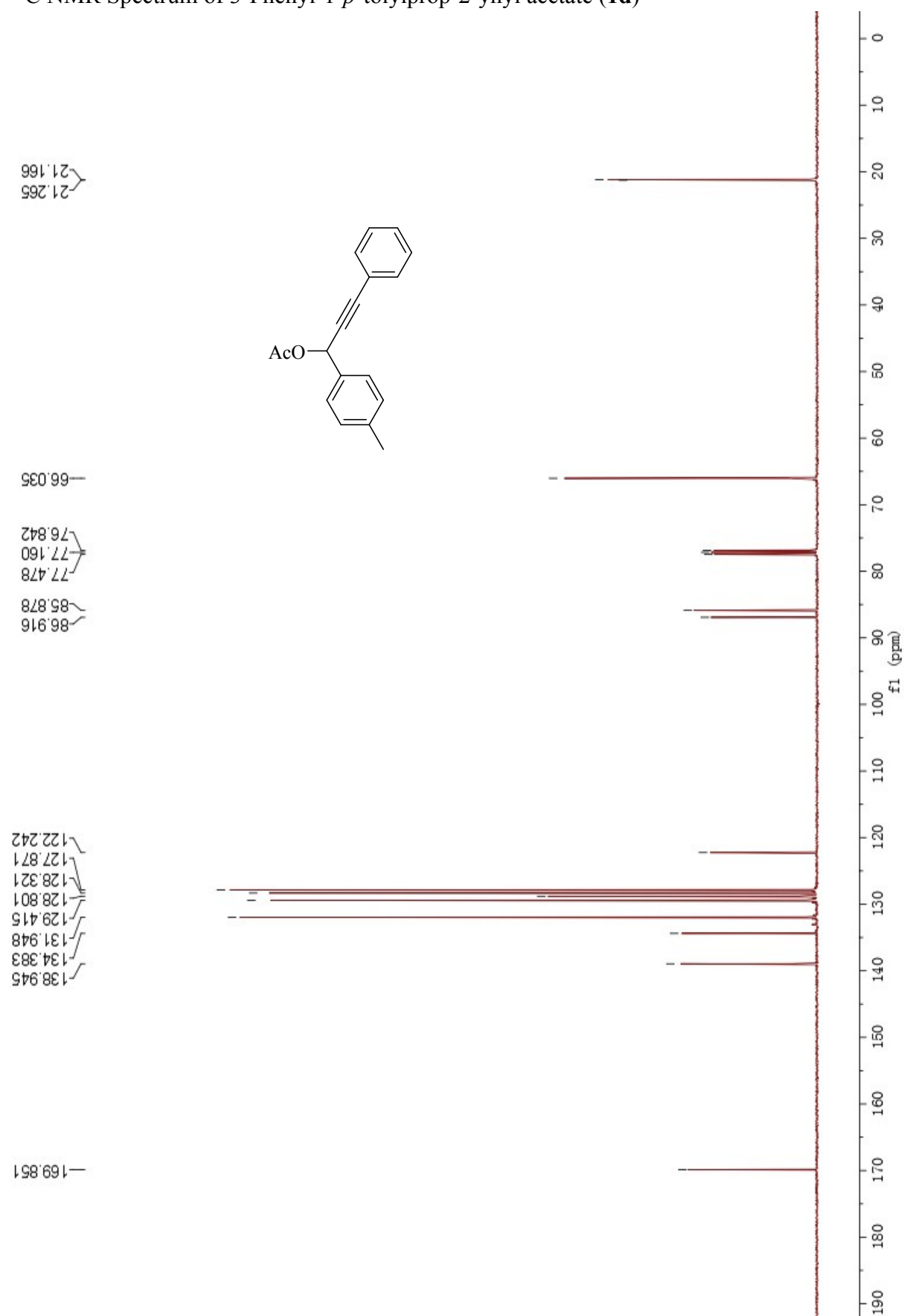
^{13}C NMR Spectrum of 3-Phenyl-1-*m*-tolylprop-2-ynyl acetate (**1c**)



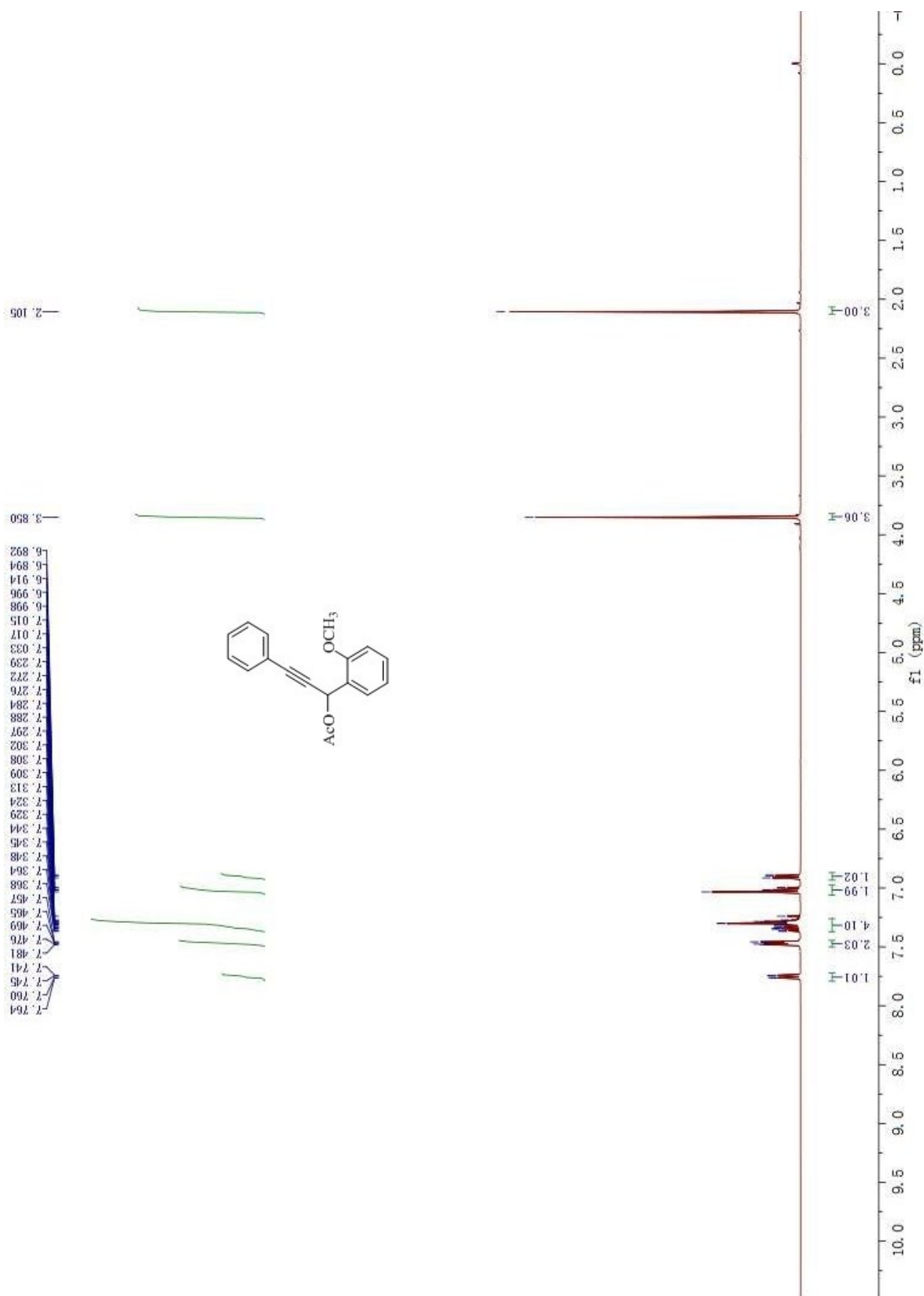
^1H NMR Spectrum of 3-Phenyl-1-*p*-tolylprop-2-ynyl acetate (**1d**)



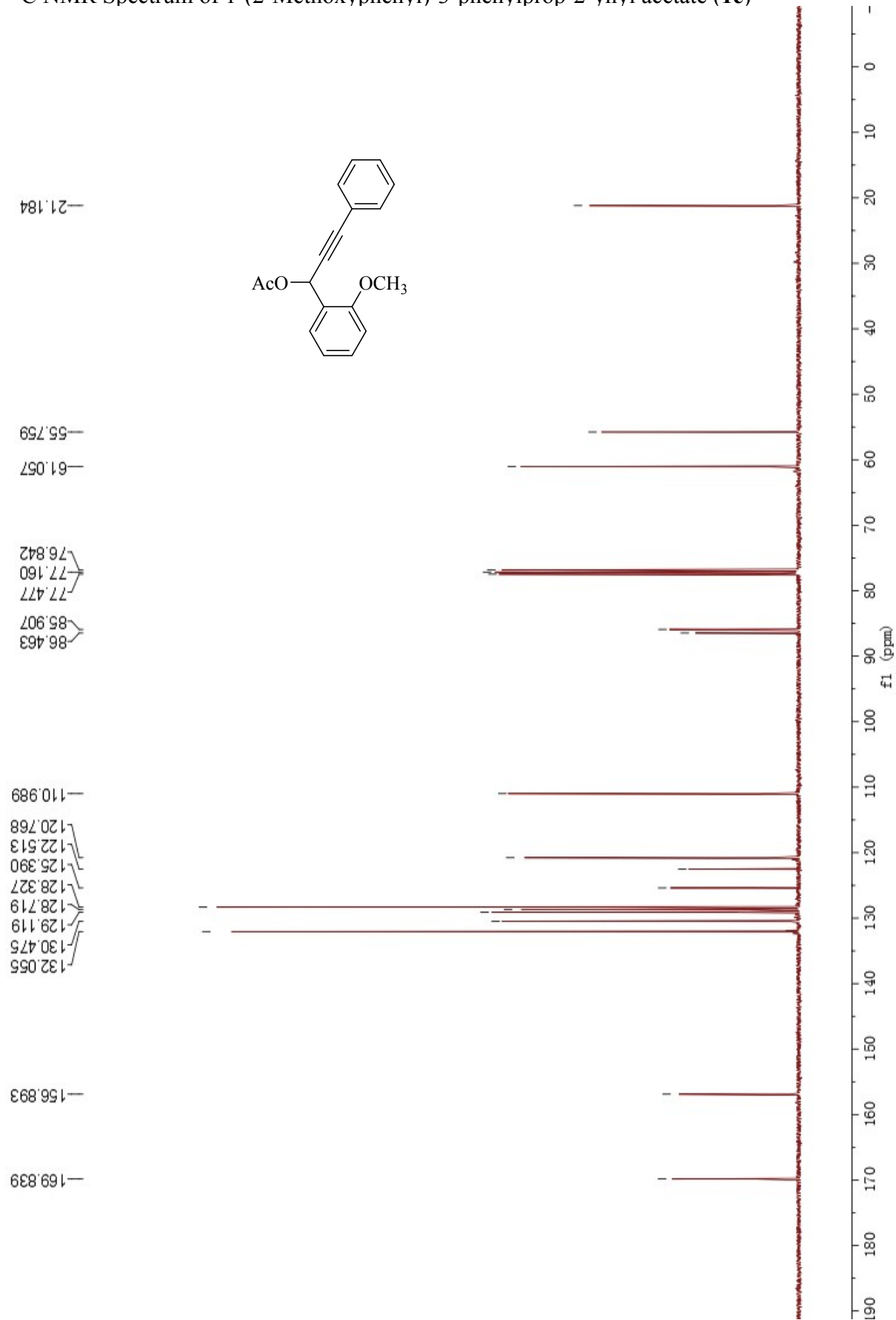
^{13}C NMR Spectrum of 3-Phenyl-1-*p*-tolylprop-2-ynyl acetate (**1d**)



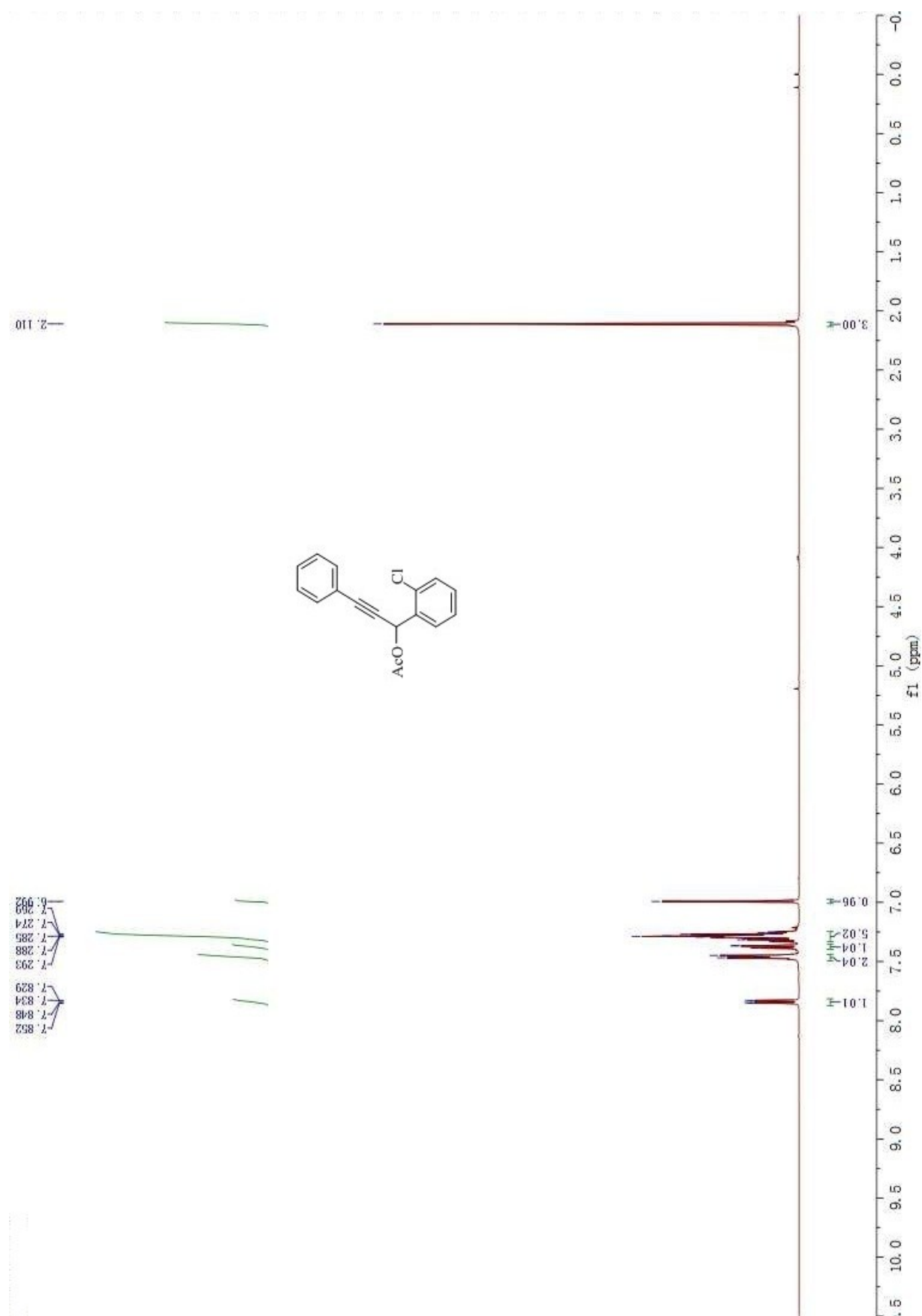
¹H NMR Spectrum of 1-(2-Methoxyphenyl)-3-phenylprop-2-ynyl acetate (**1e**)



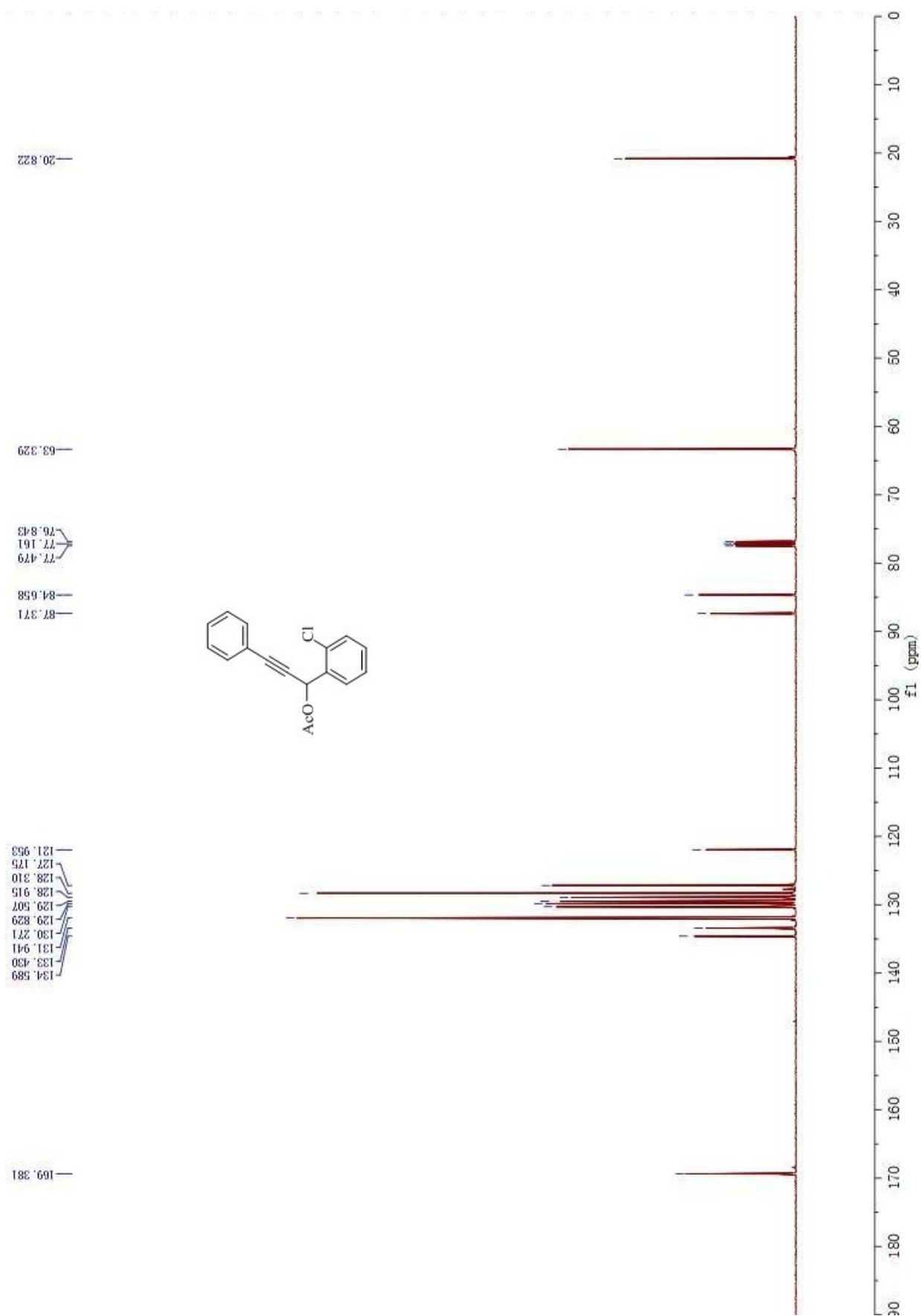
¹³C NMR Spectrum of 1-(2-Methoxyphenyl)-3-phenylprop-2-ynyl acetate (**1e**)



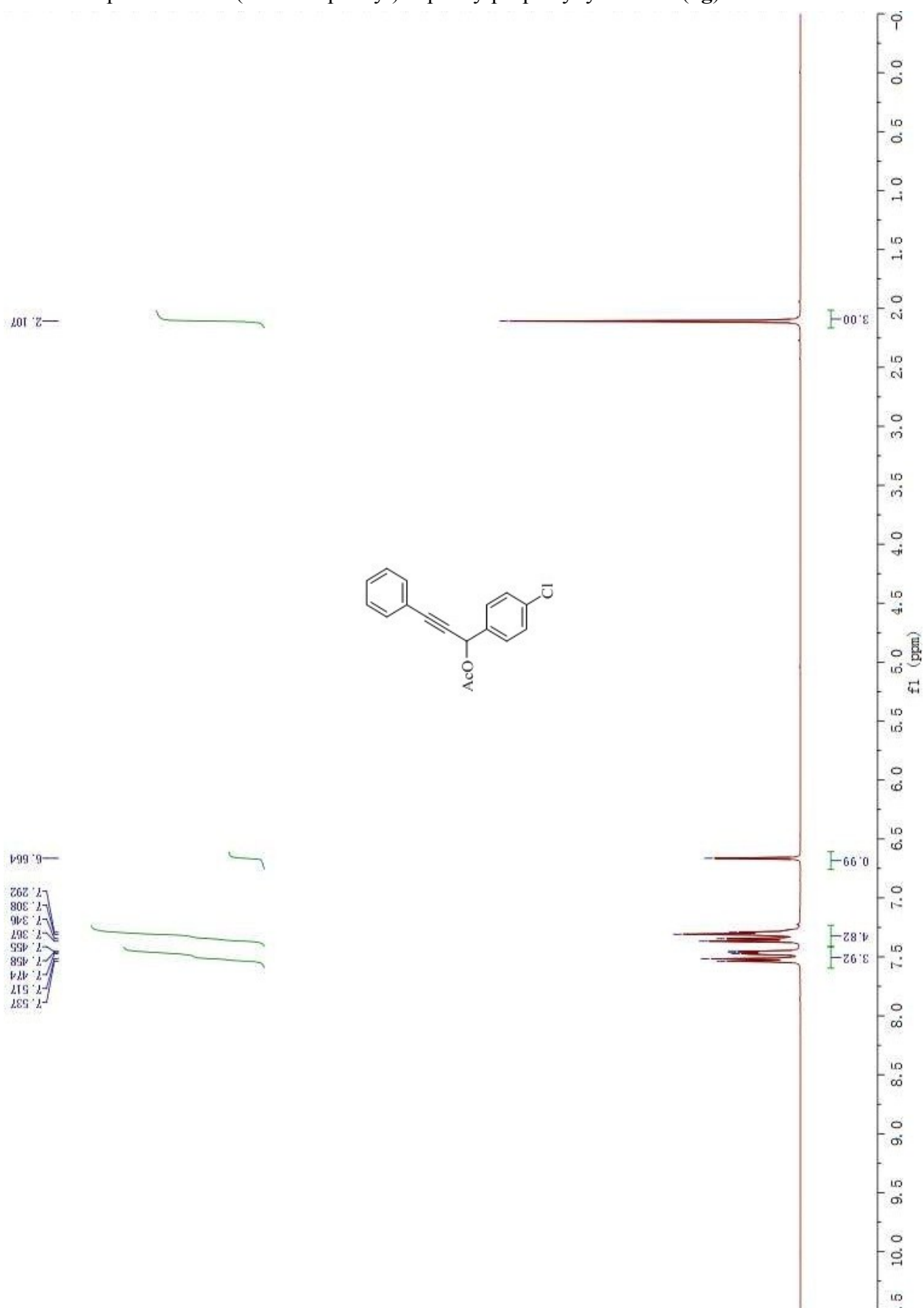
¹H NMR Spectrum of 1-(2-Chlorophenyl)-3-phenylprop-2-ynyl acetate (**1f**)



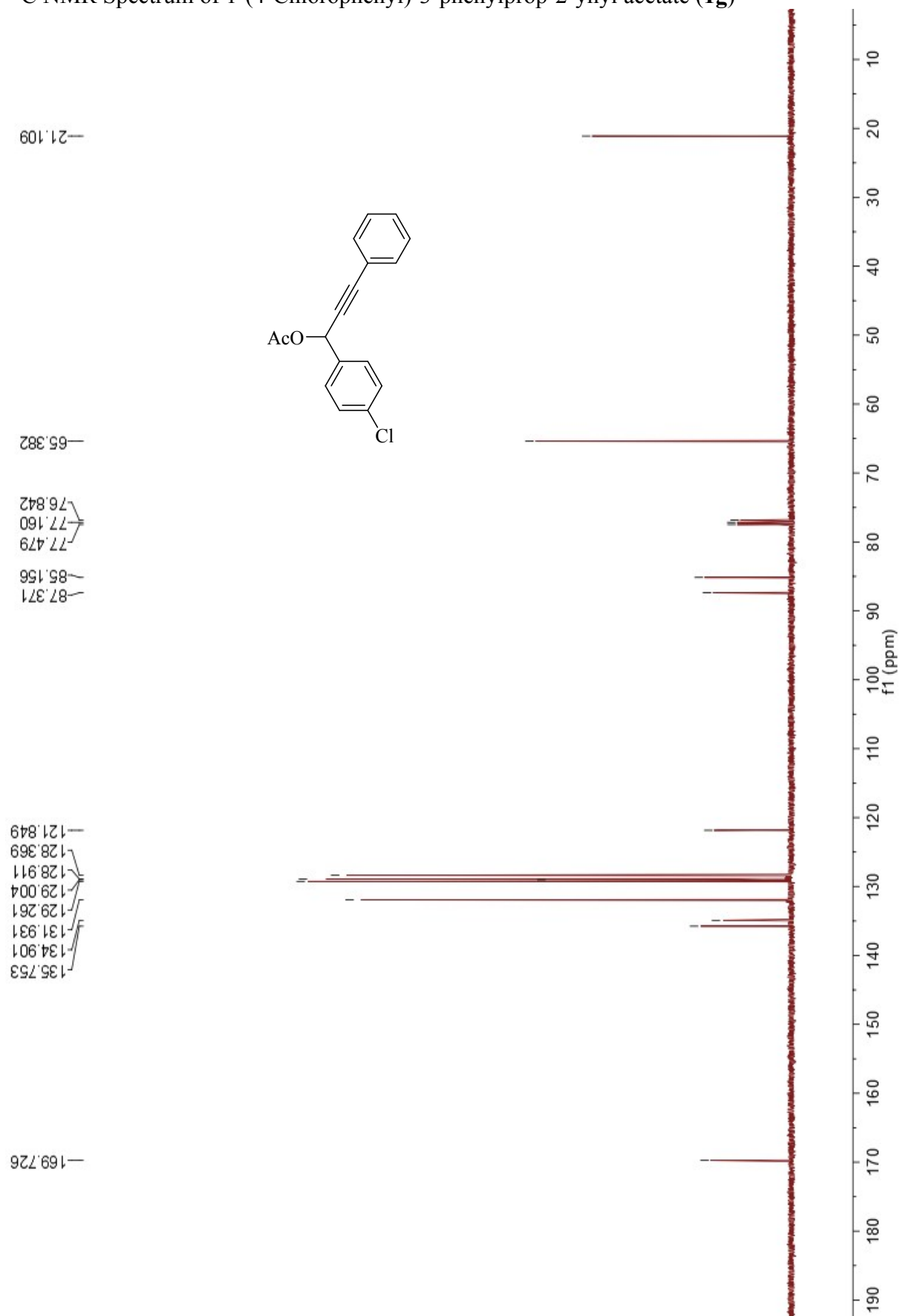
¹³C NMR Spectrum of 1-(2-Chlorophenyl)-3-phenylprop-2-ynyl acetate (**1f**)



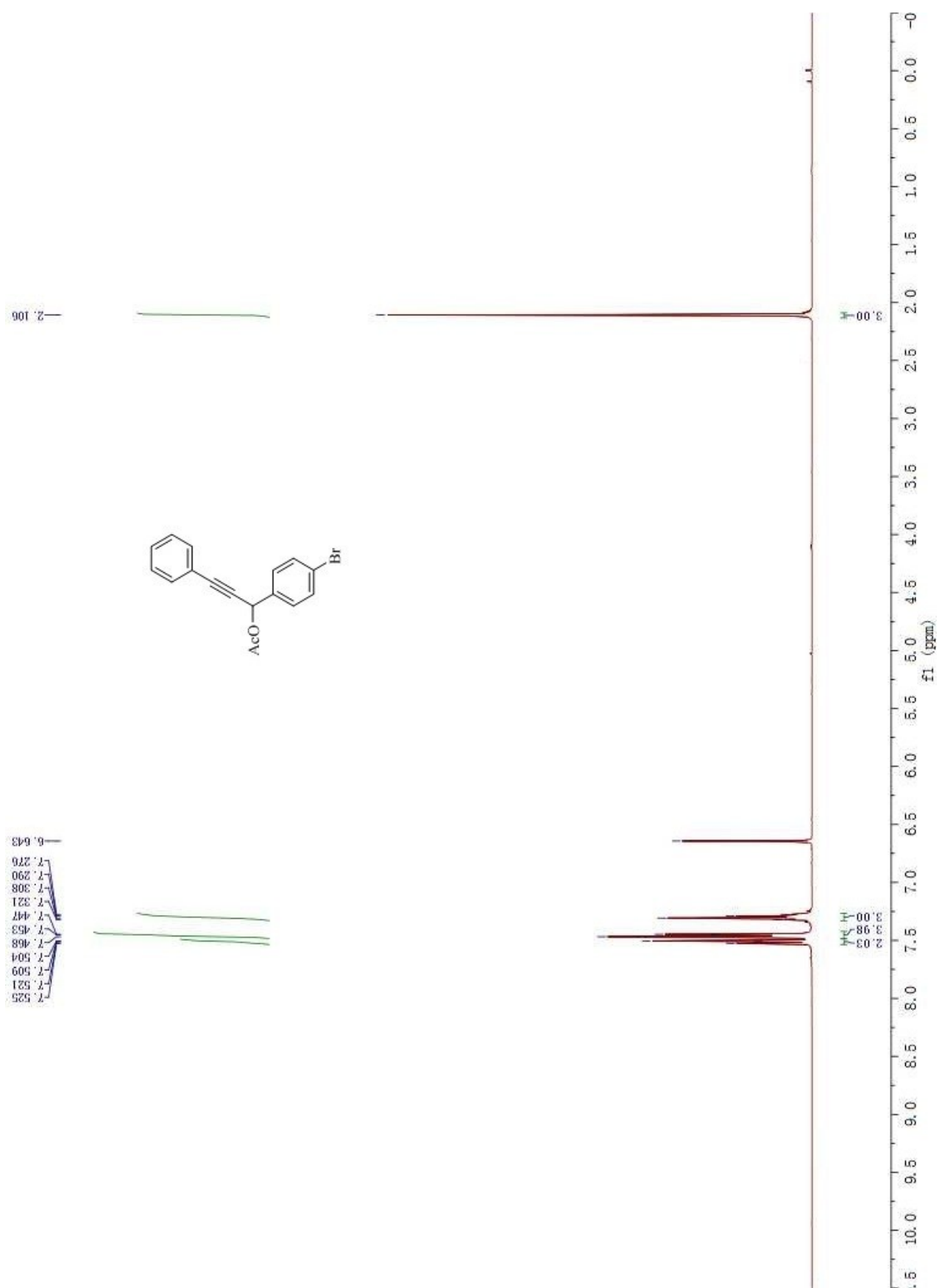
¹H NMR Spectrum of 1-(4-Chlorophenyl)-3-phenylprop-2-ynyl acetate (**1g**)



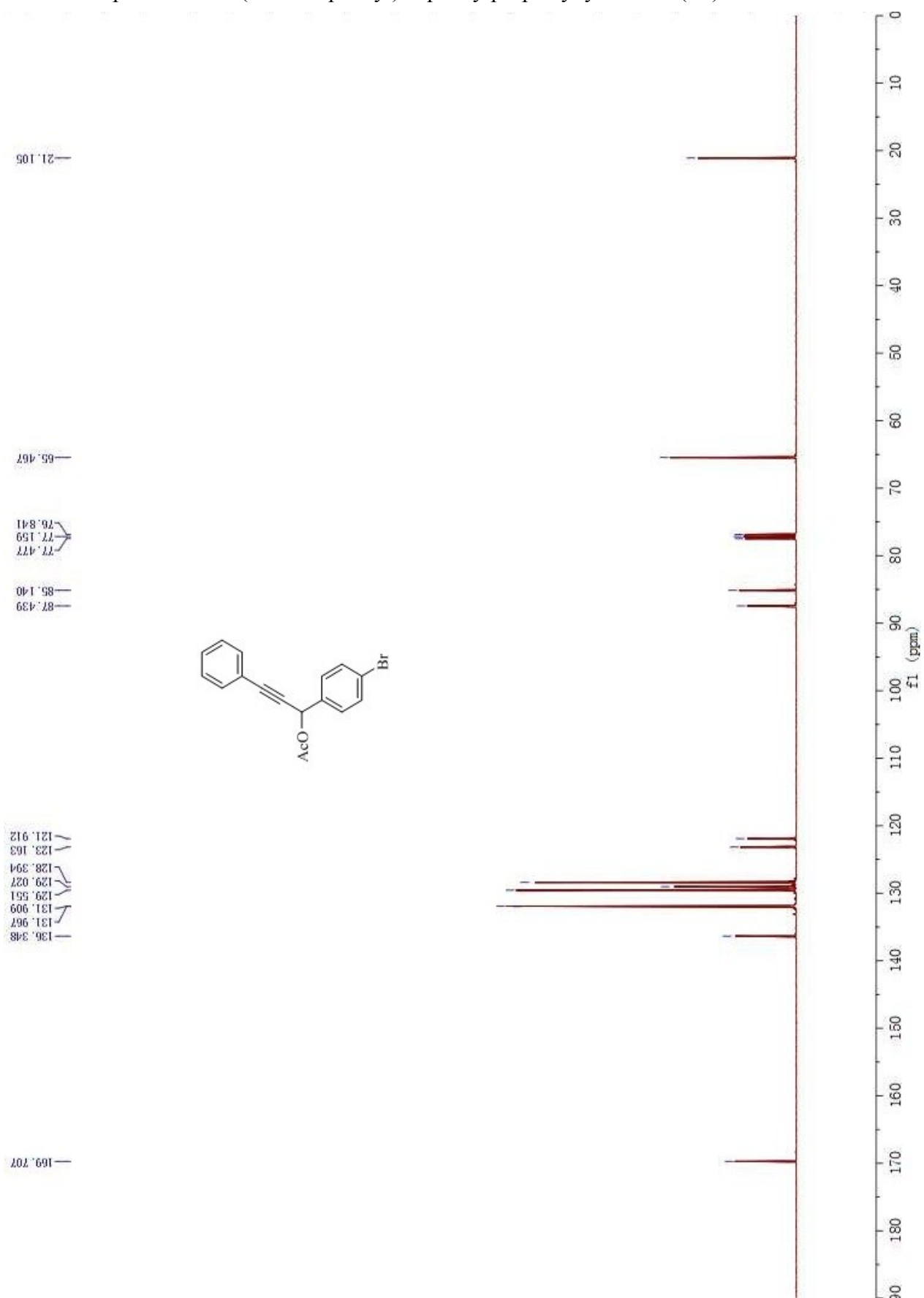
^{13}C NMR Spectrum of 1-(4-Chlorophenyl)-3-phenylprop-2-ynyl acetate (**1g**)



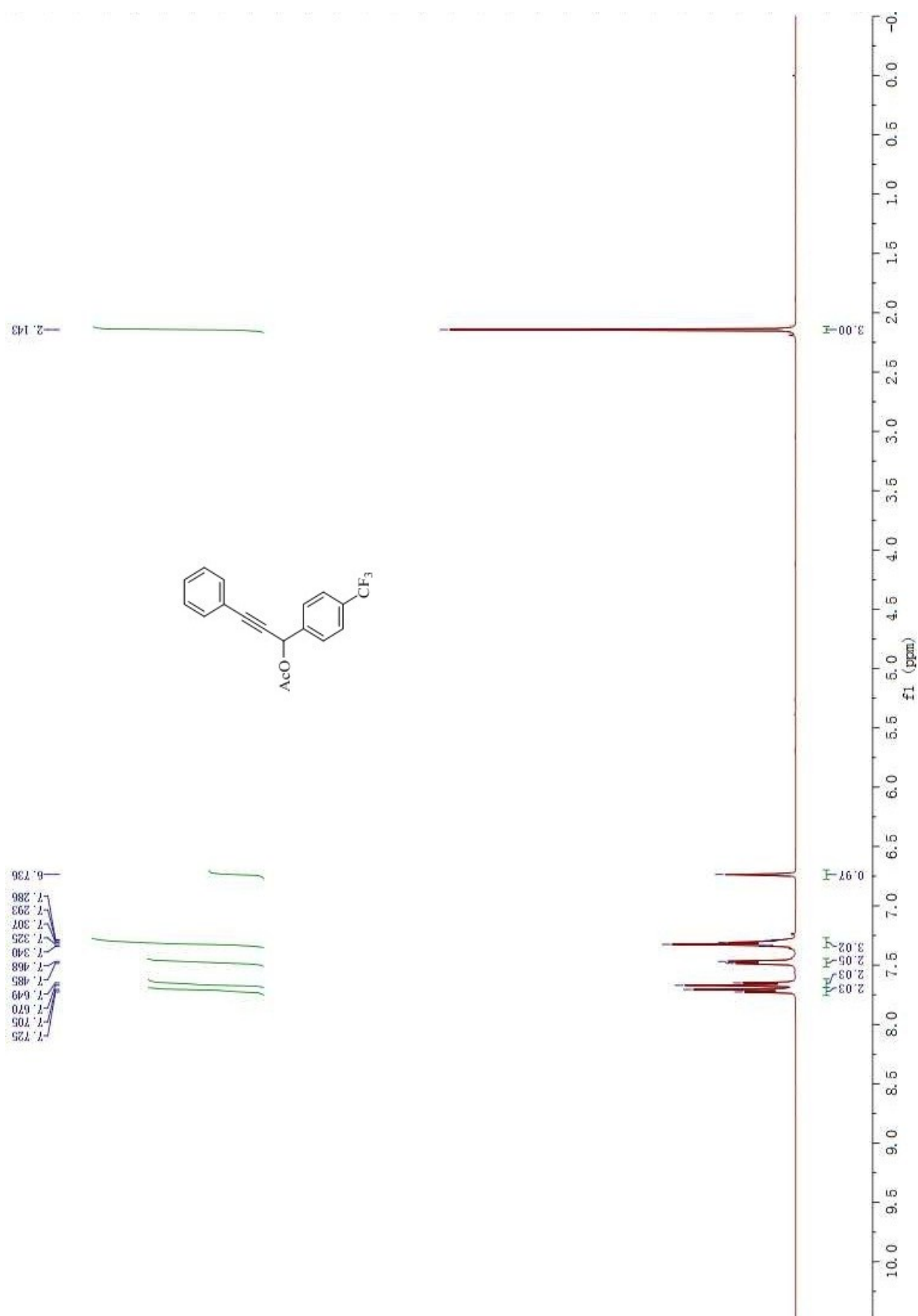
^1H NMR Spectrum of 1-(4-bromophenyl)-3-phenylprop-2-ynyl acetate (**1h**)



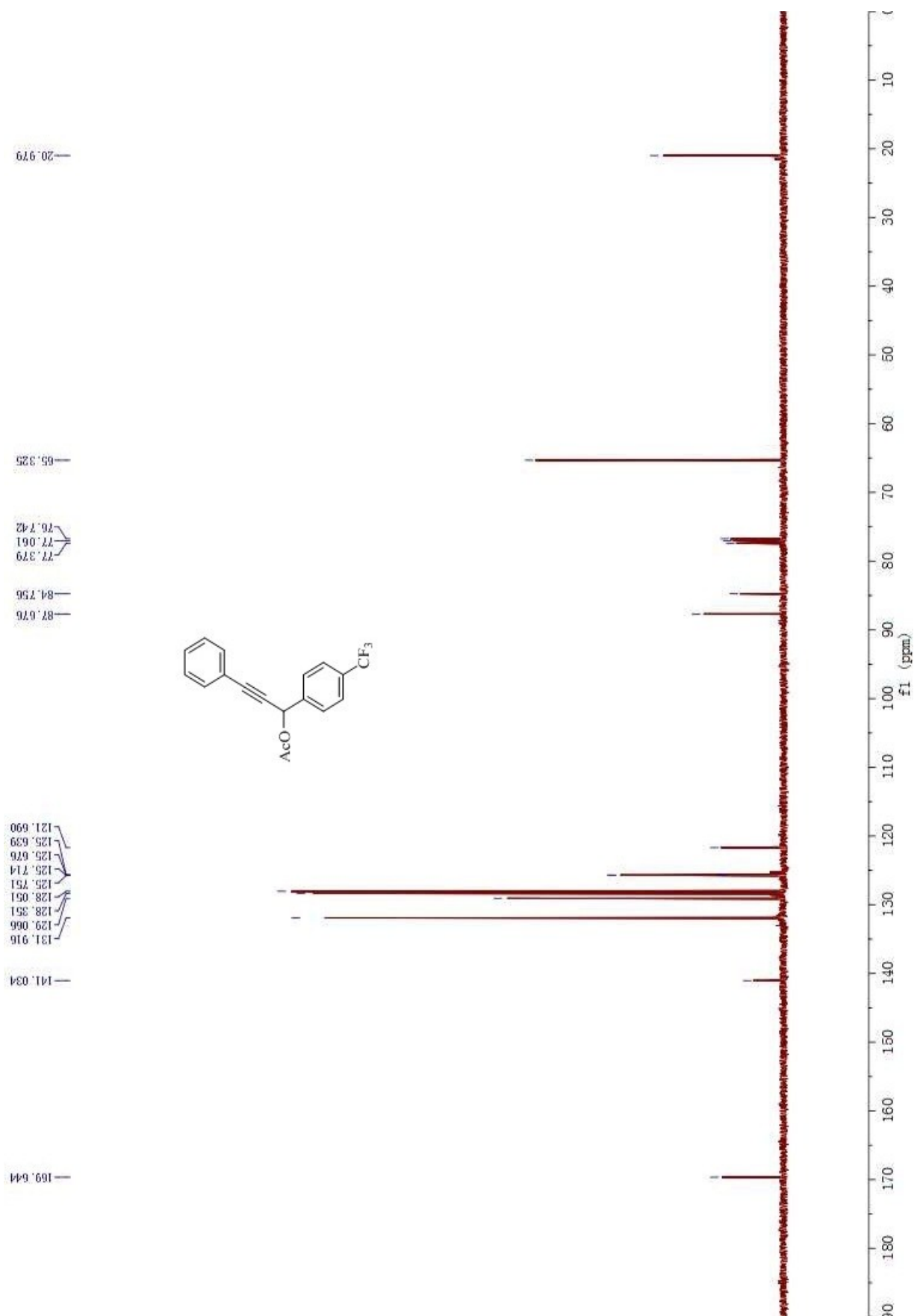
¹³C NMR Spectrum of 1-(4-bromophenyl)-3-phenylprop-2-ynyl acetate (**1h**)



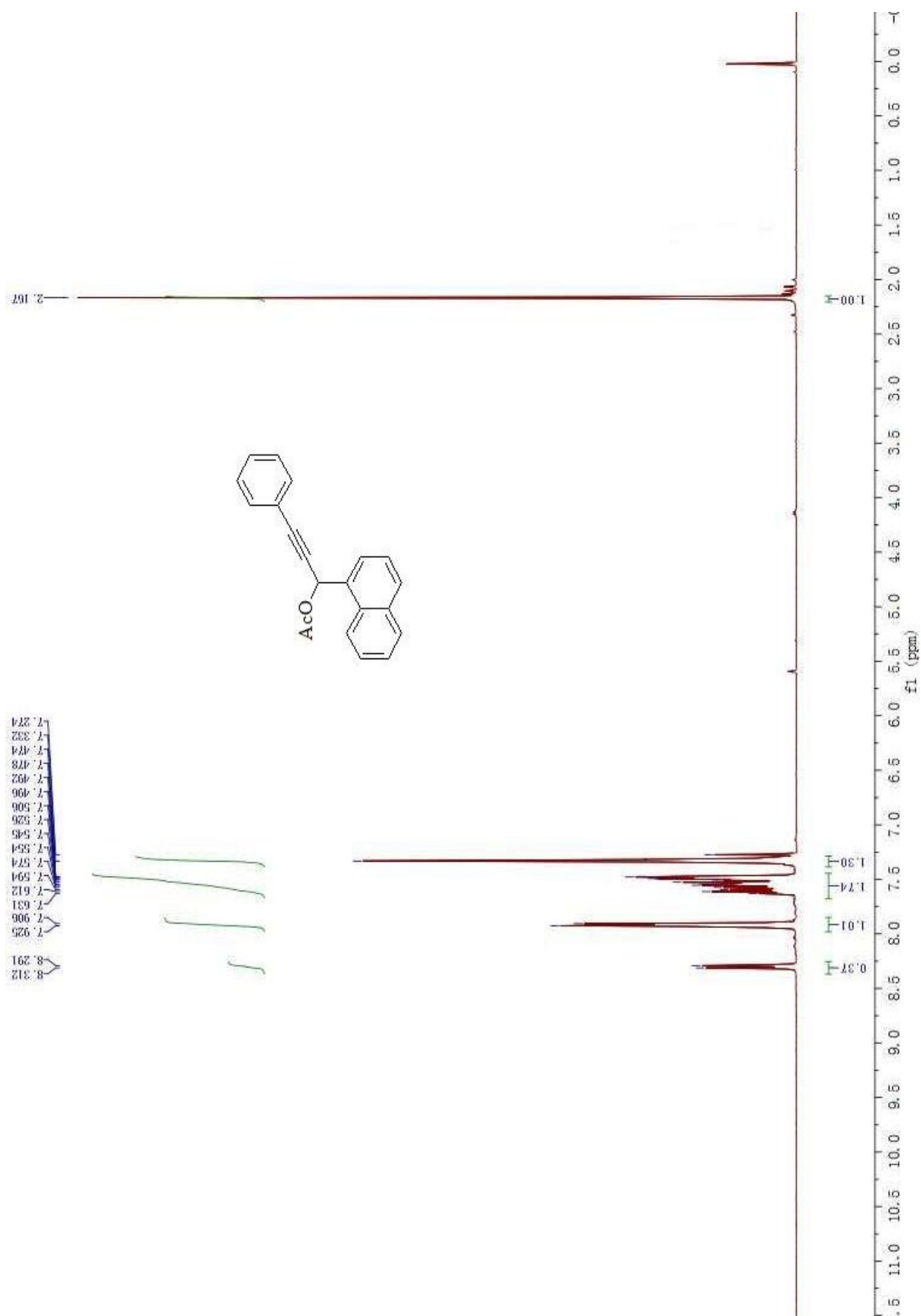
¹H NMR Spectrum of 3-Phenyl-1-(4-(trifluoromethyl)phenyl)prop-2-ynyl acetate (**1i**)



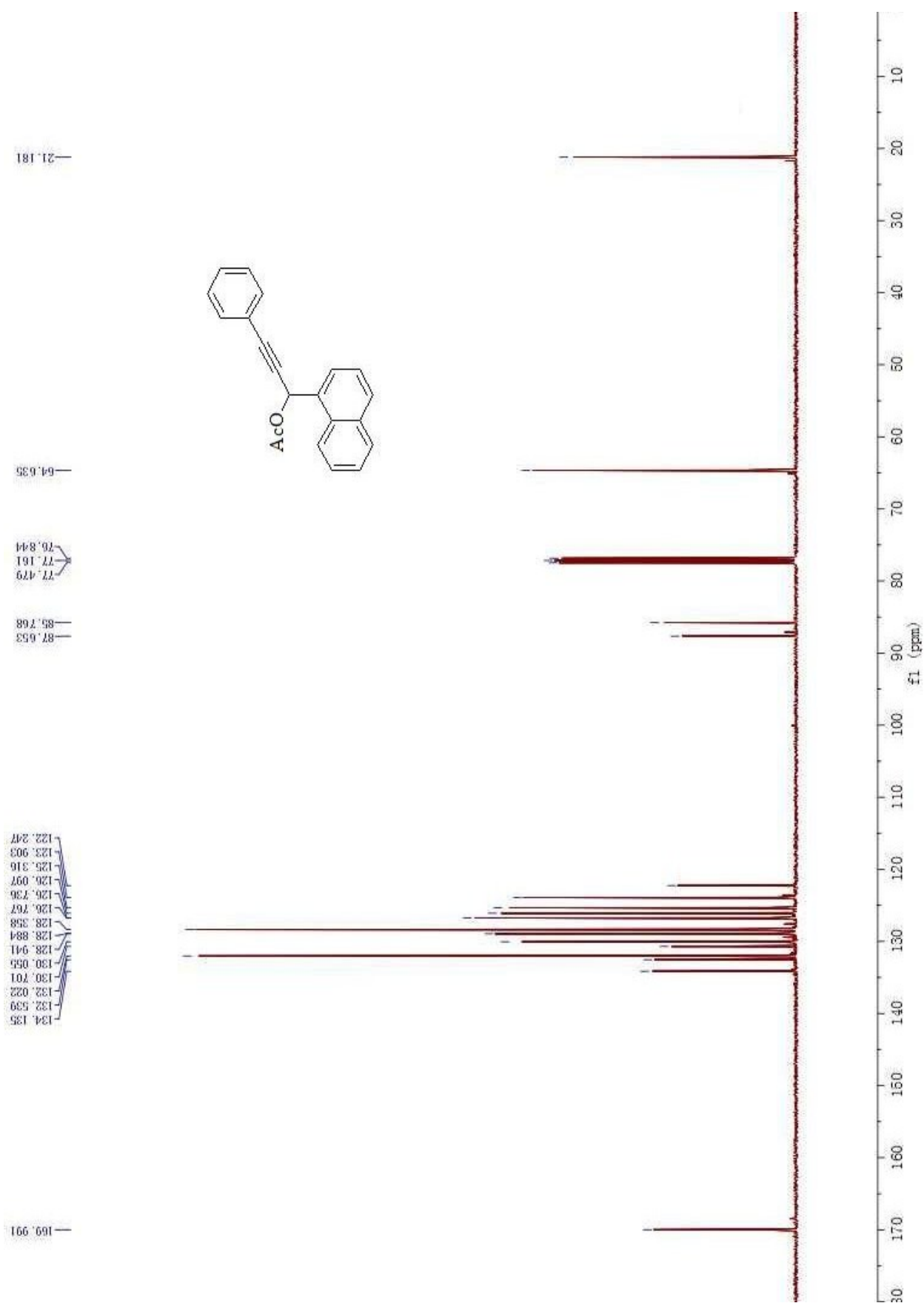
¹³C NMR Spectrum of 3-Phenyl-1-(4-(trifluoromethyl)phenyl)prop-2-ynyl acetate (**1i**)



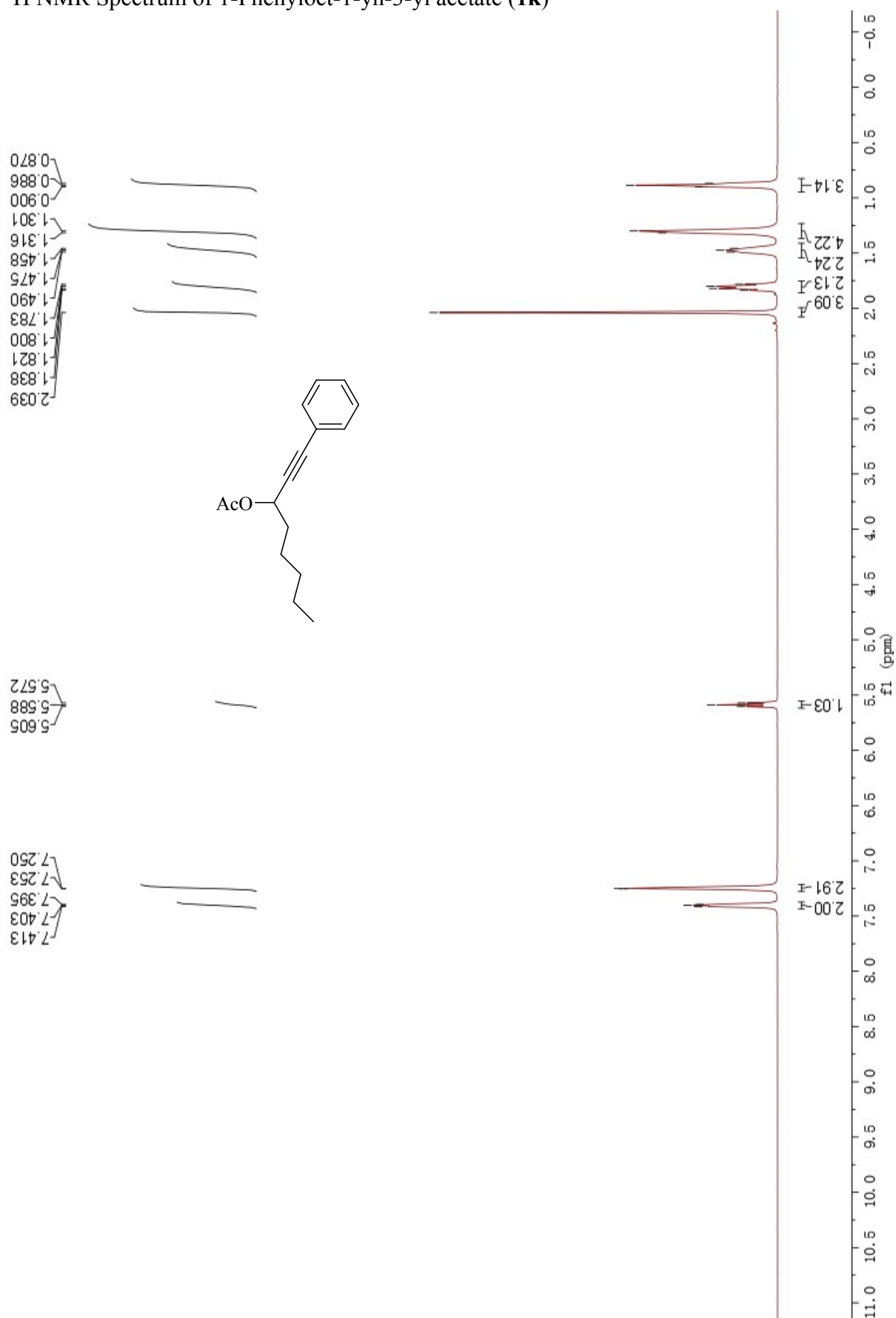
¹H NMR Spectrum of 1-(Naphthalen-1-yl)-3-phenylprop-2-ynyl acetate (**1j**)



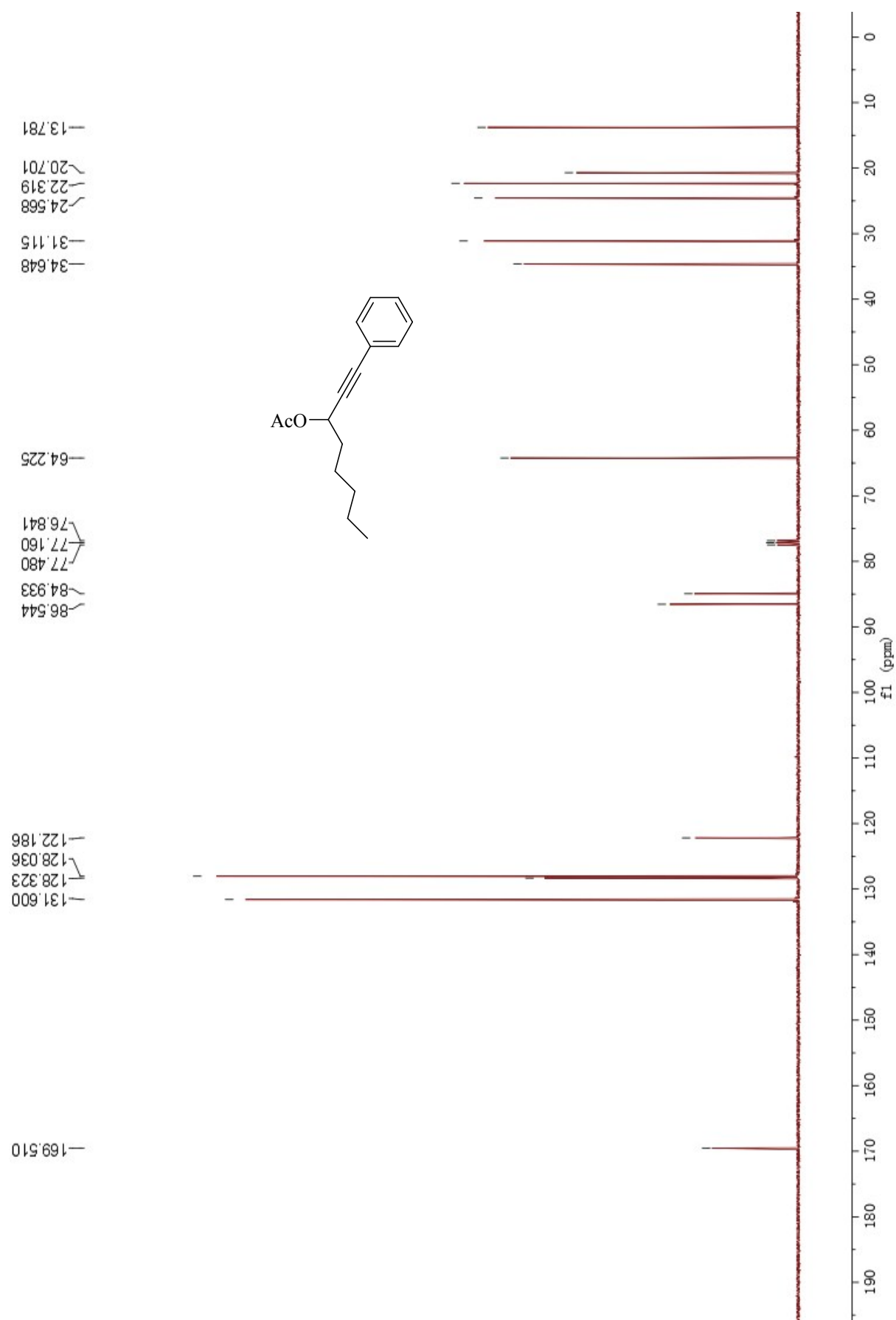
^{13}C NMR Spectrum of 1-(Naphthalen-1-yl)-3-phenylprop-2-ynyl acetate (**1j**)



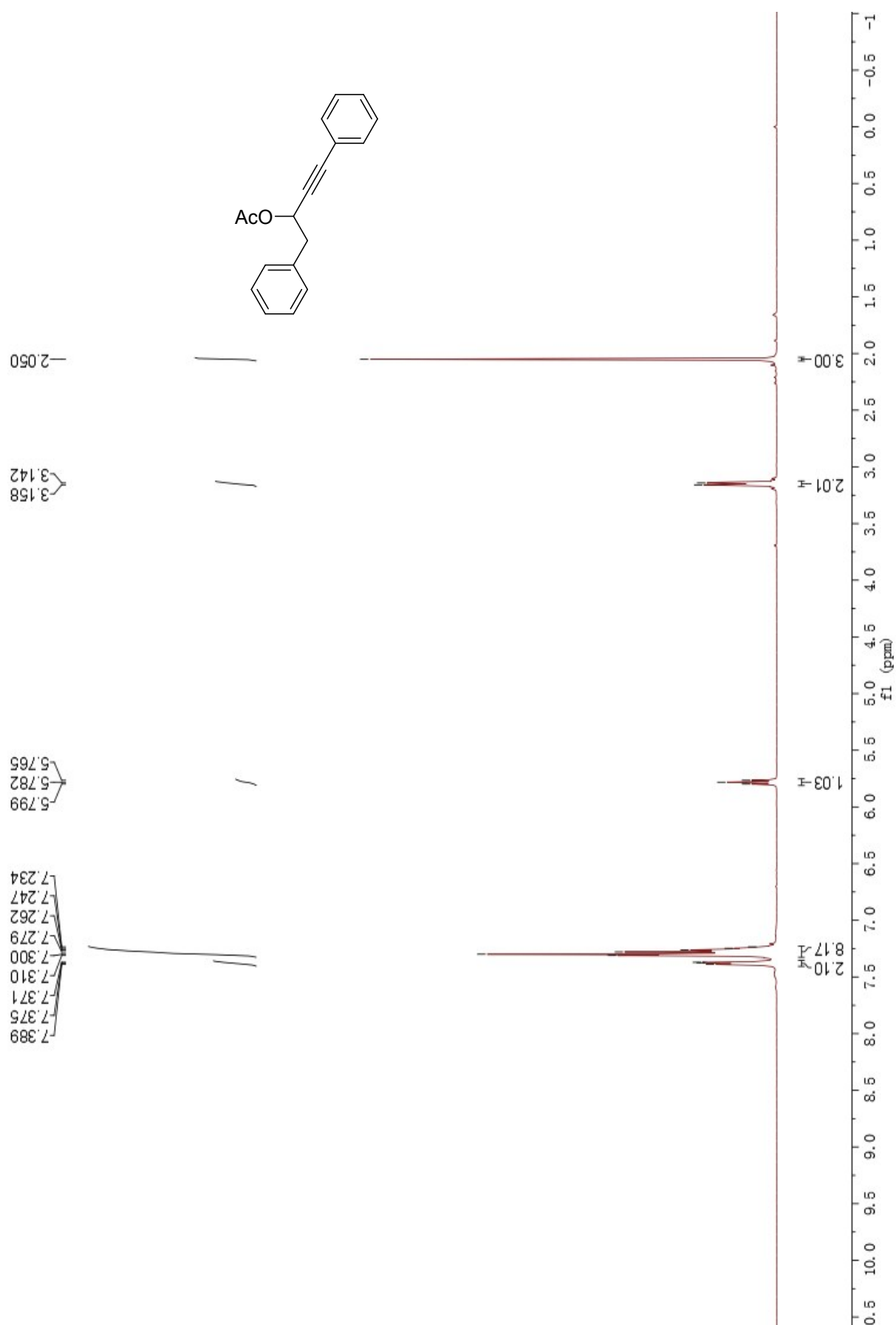
^1H NMR Spectrum of 1-Phenyloct-1-yn-3-yl acetate (**1k**)



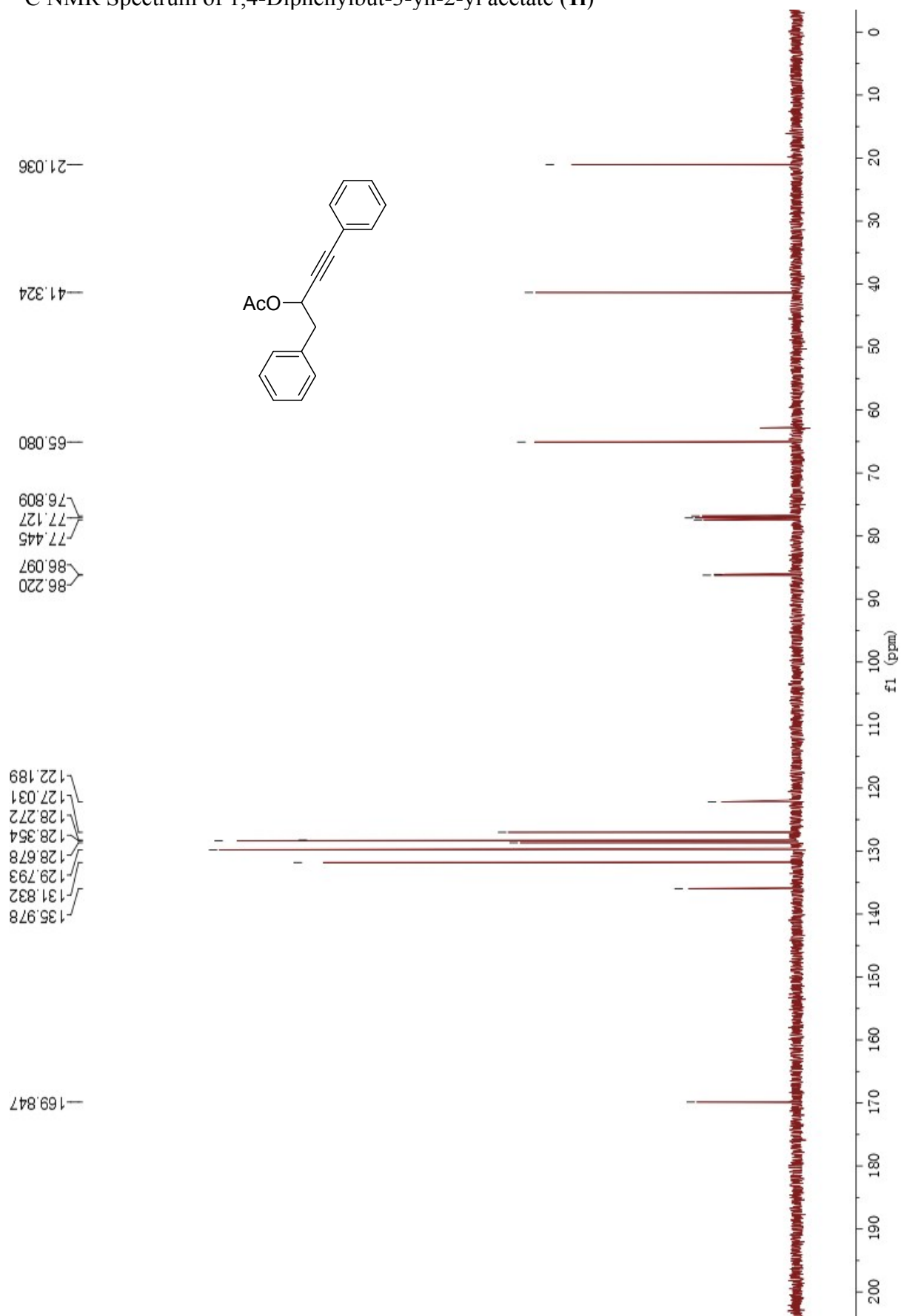
^{13}C NMR Spectrum of 1-Phenyloct-1-yn-3-yl acetate (**1k**)



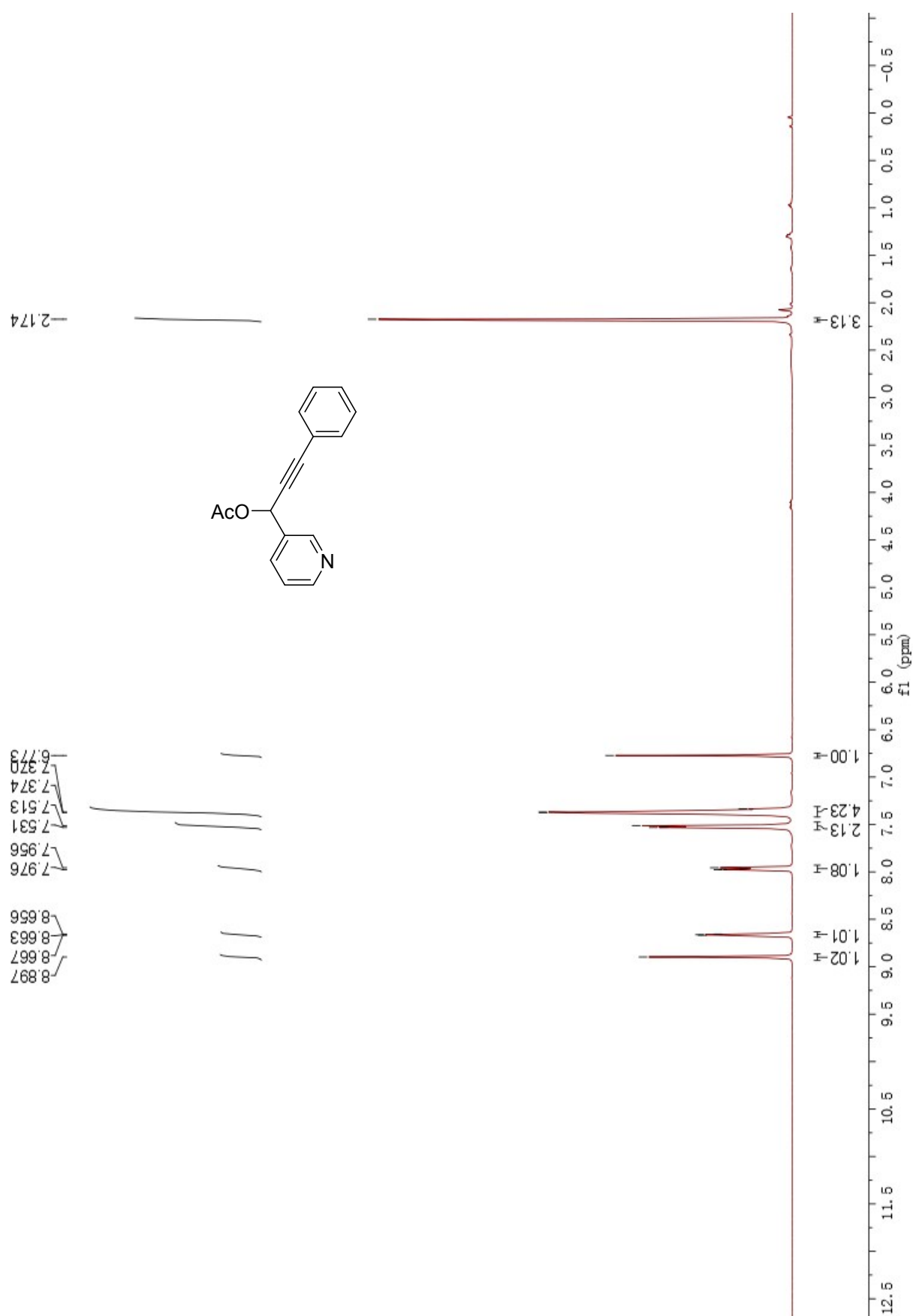
¹H NMR Spectrum of 1,4-Diphenylbut-3-yn-2-yl acetate (**11**)



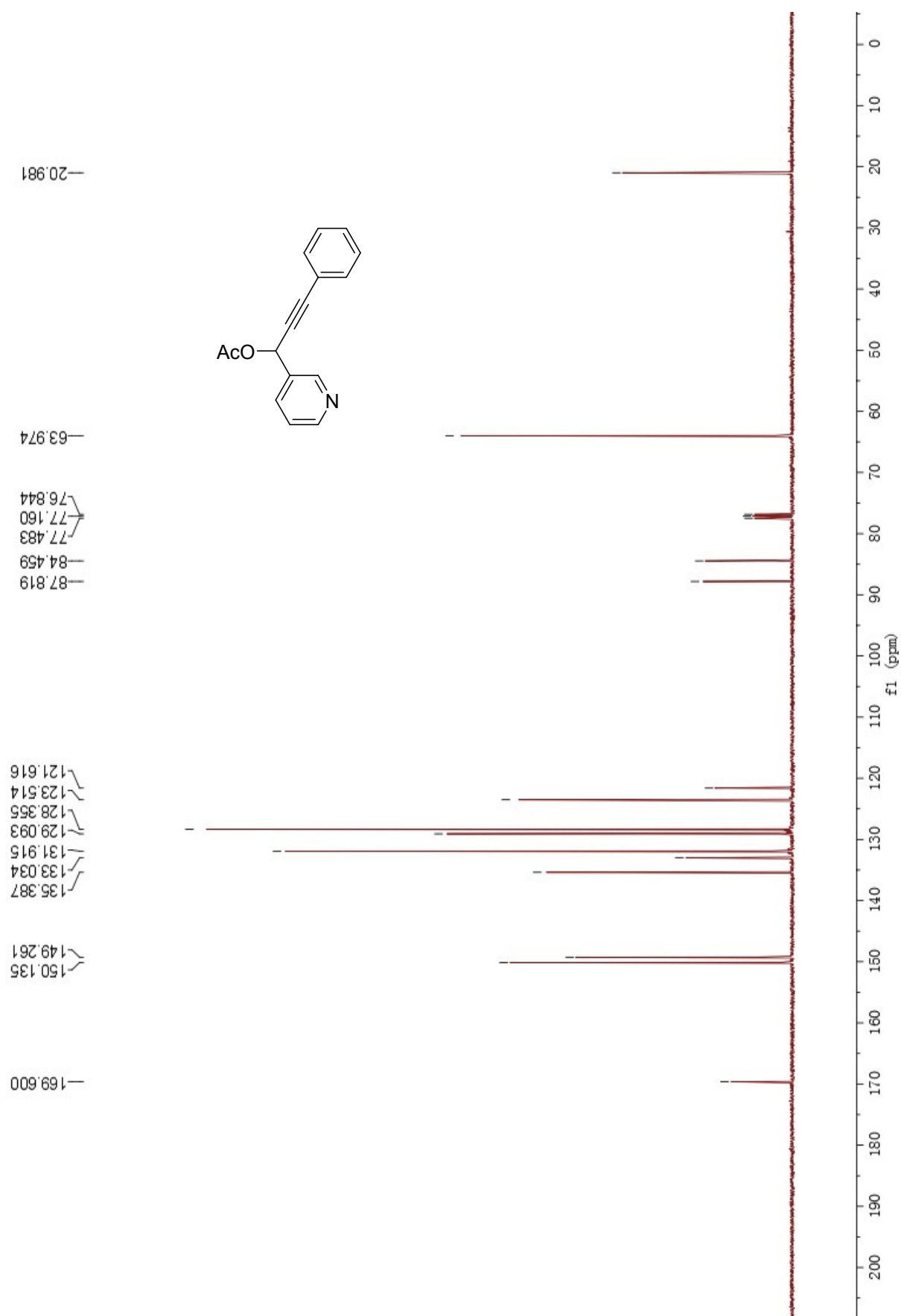
^{13}C NMR Spectrum of 1,4-Diphenylbut-3-yn-2-yl acetate (**11**)



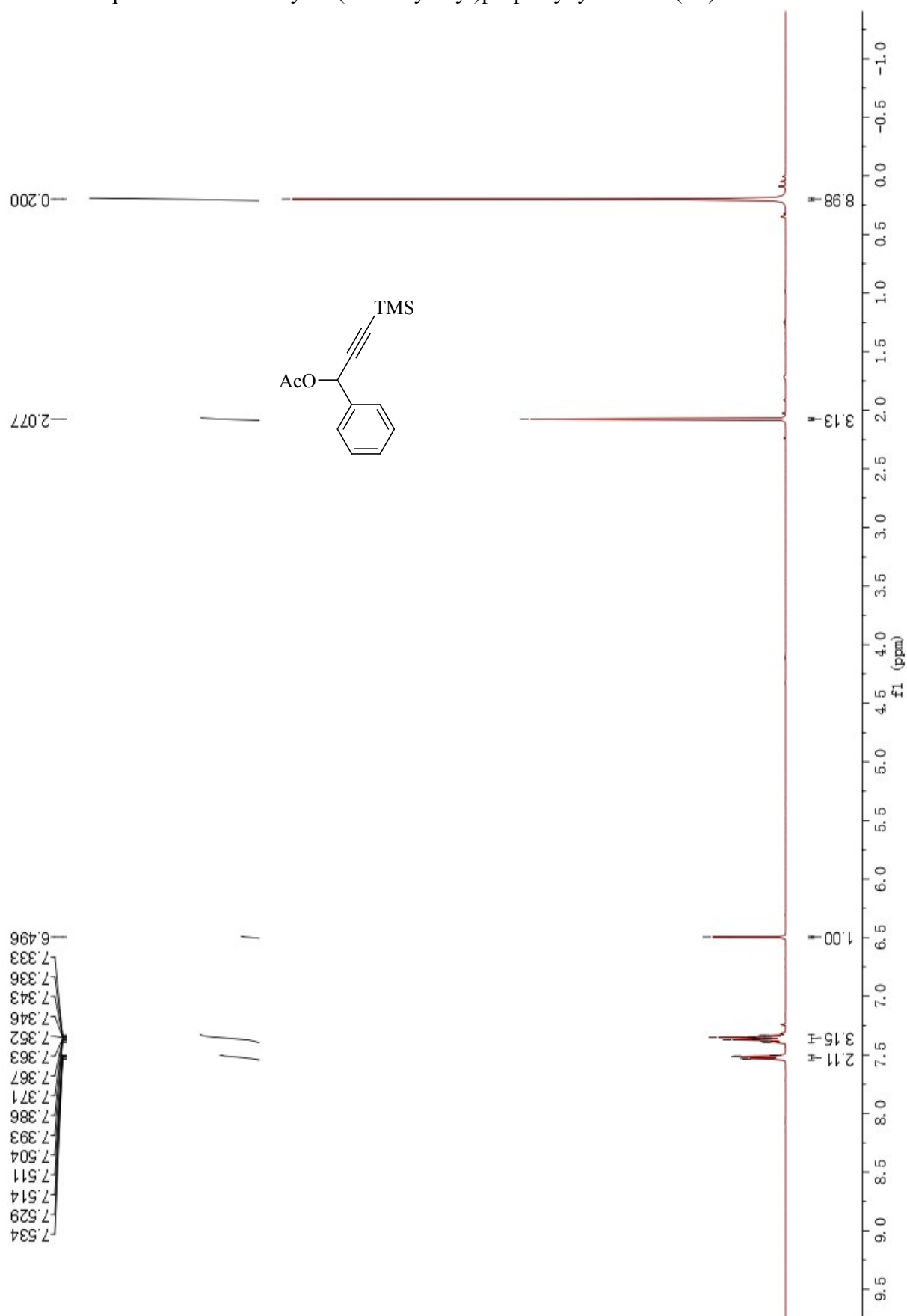
¹H NMR Spectrum of 3-Phenyl-1-(pyridin-3-yl)prop-2-ynyl acetate (**1m**)



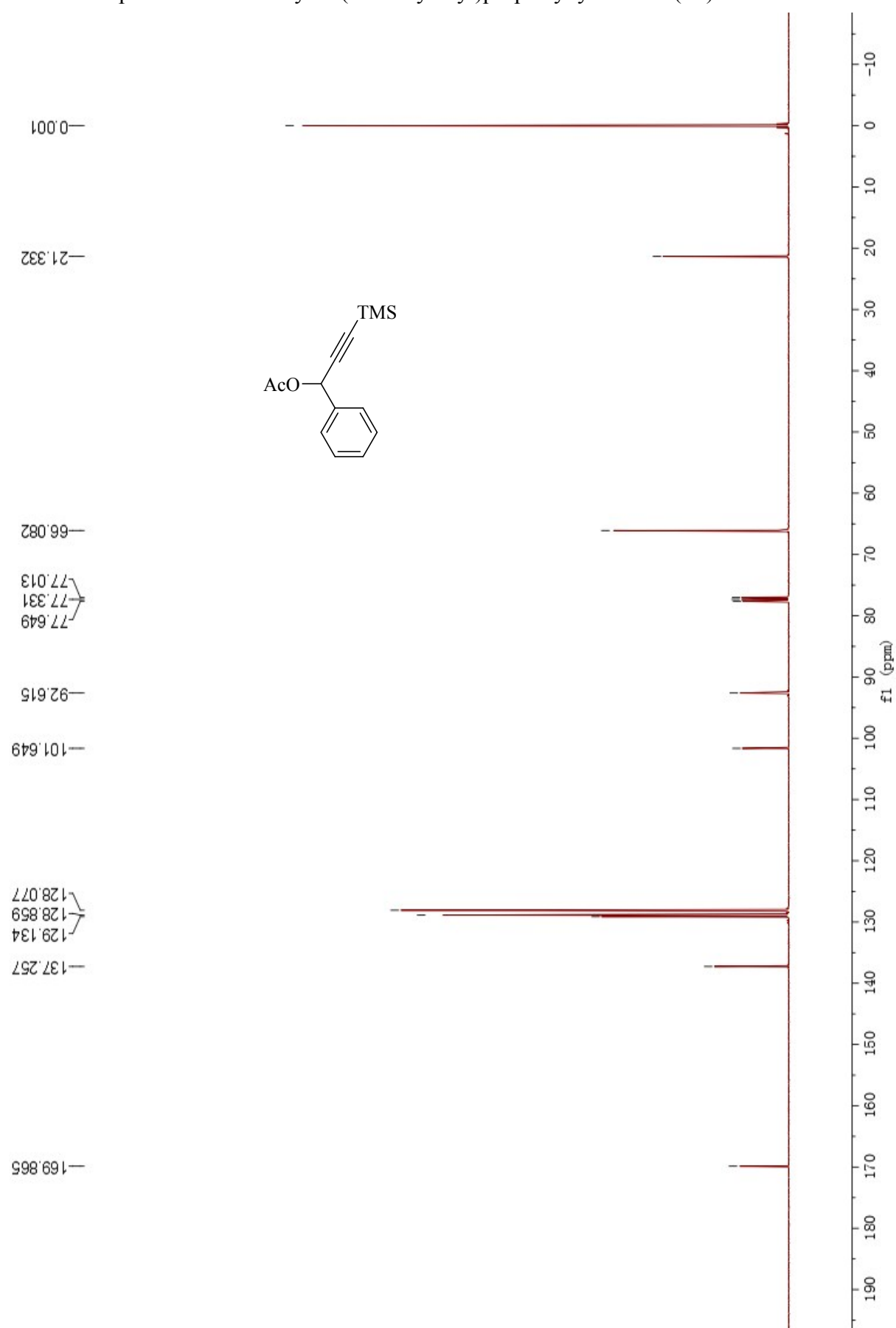
^{13}C NMR Spectrum of 3-Phenyl-1-(pyridin-3-yl)prop-2-ynyl acetate (**1m**)



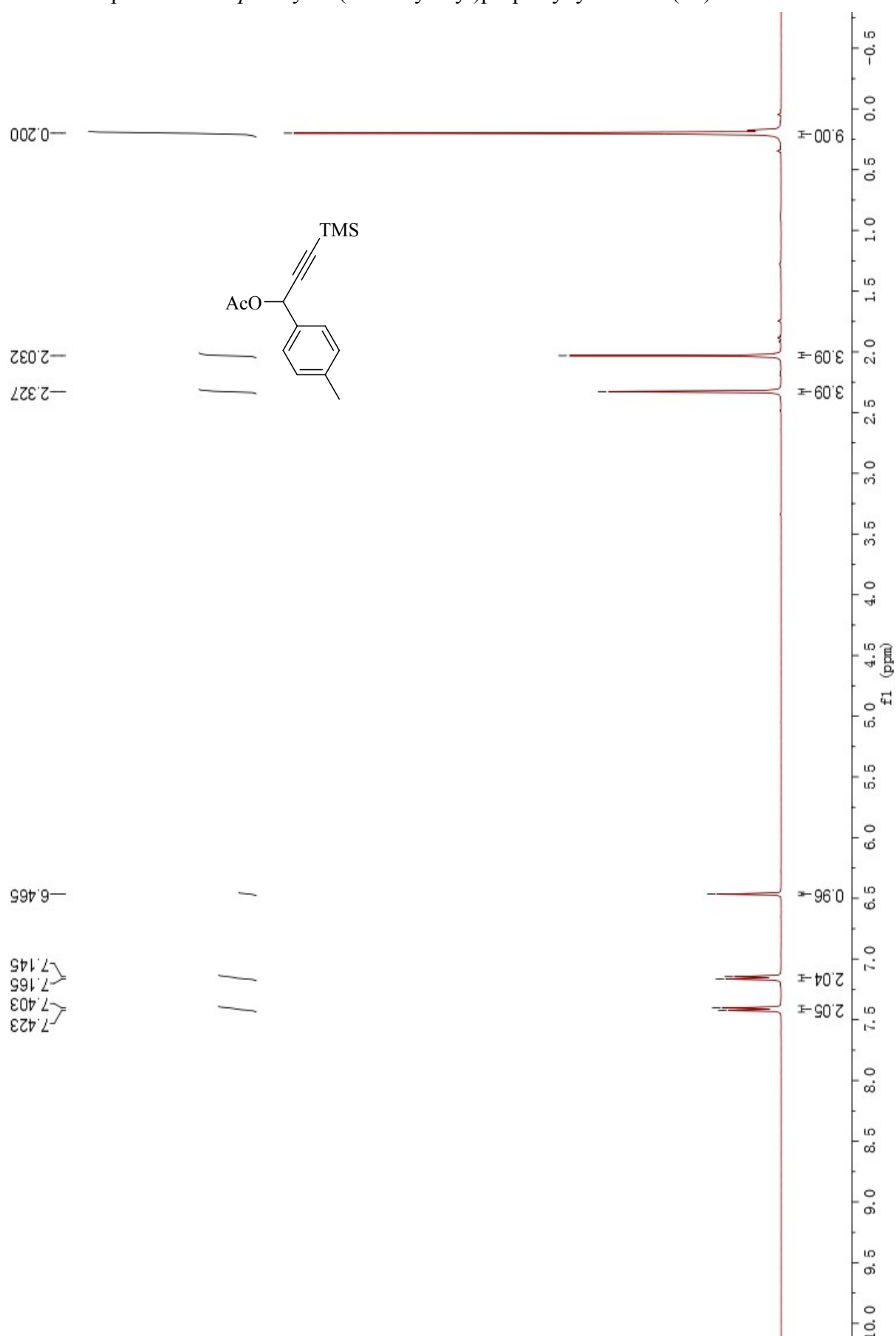
^1H NMR Spectrum of 1-Phenyl-3-(trimethylsilyl)prop-2-ynyl acetate (**1n**)



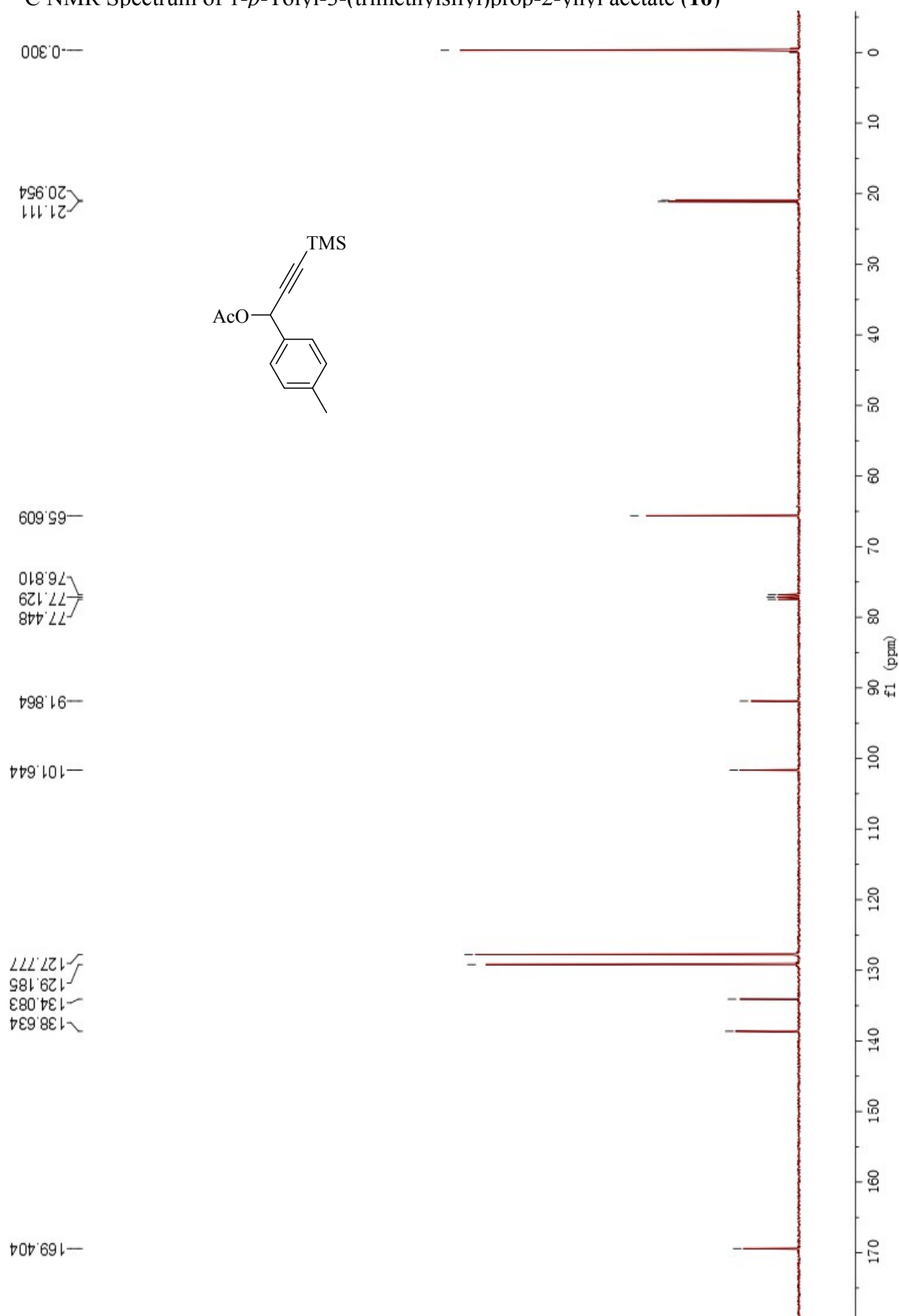
^{13}C NMR Spectrum of 1-Phenyl-3-(trimethylsilyl)prop-2-ynyl acetate (**1n**)



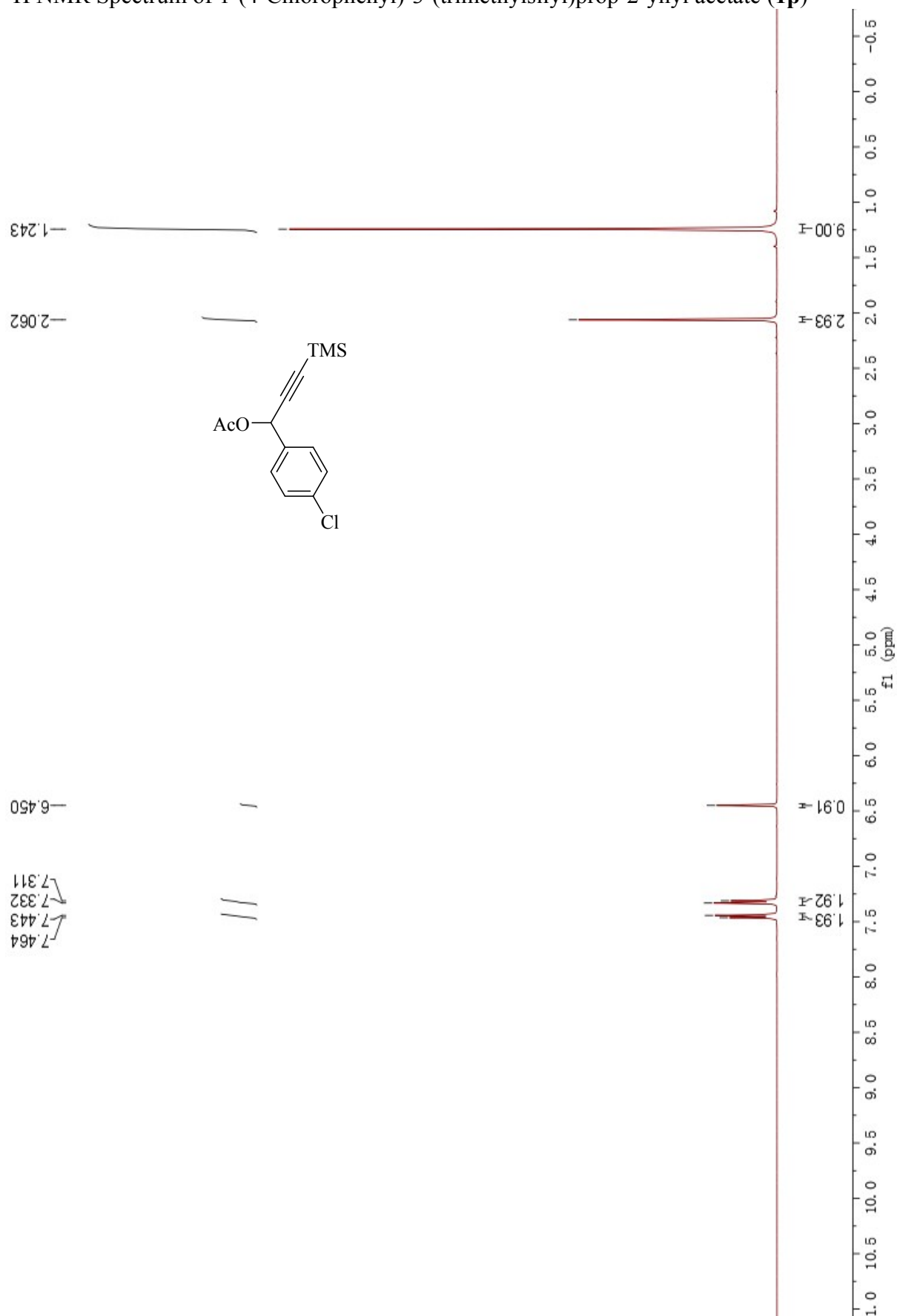
^1H NMR Spectrum of 1-*p*-Tolyl-3-(trimethylsilyl)prop-2-ynyl acetate (**10**)



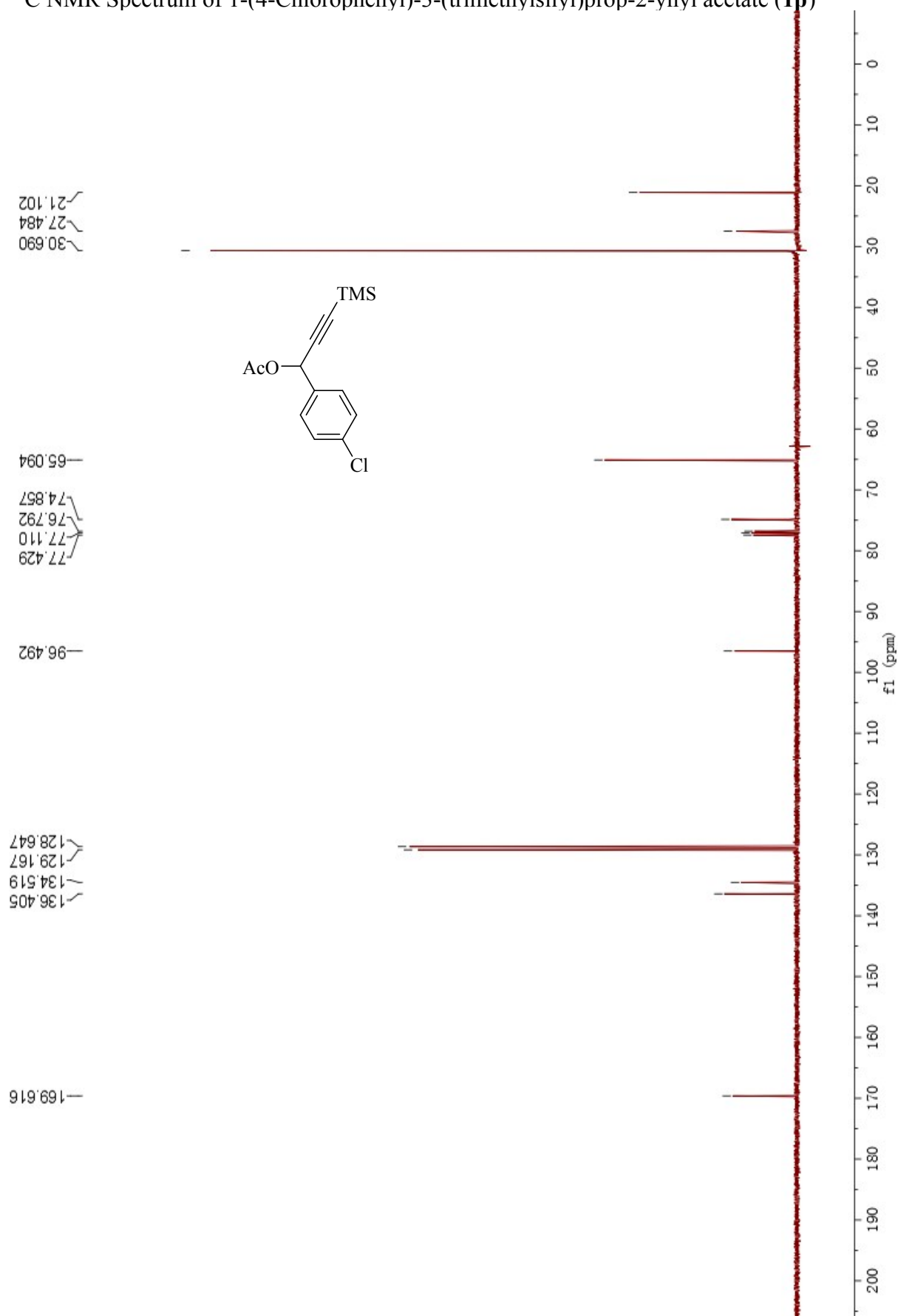
^{13}C NMR Spectrum of 1-*p*-Tolyl-3-(trimethylsilyl)prop-2-ynyl acetate (**1o**)



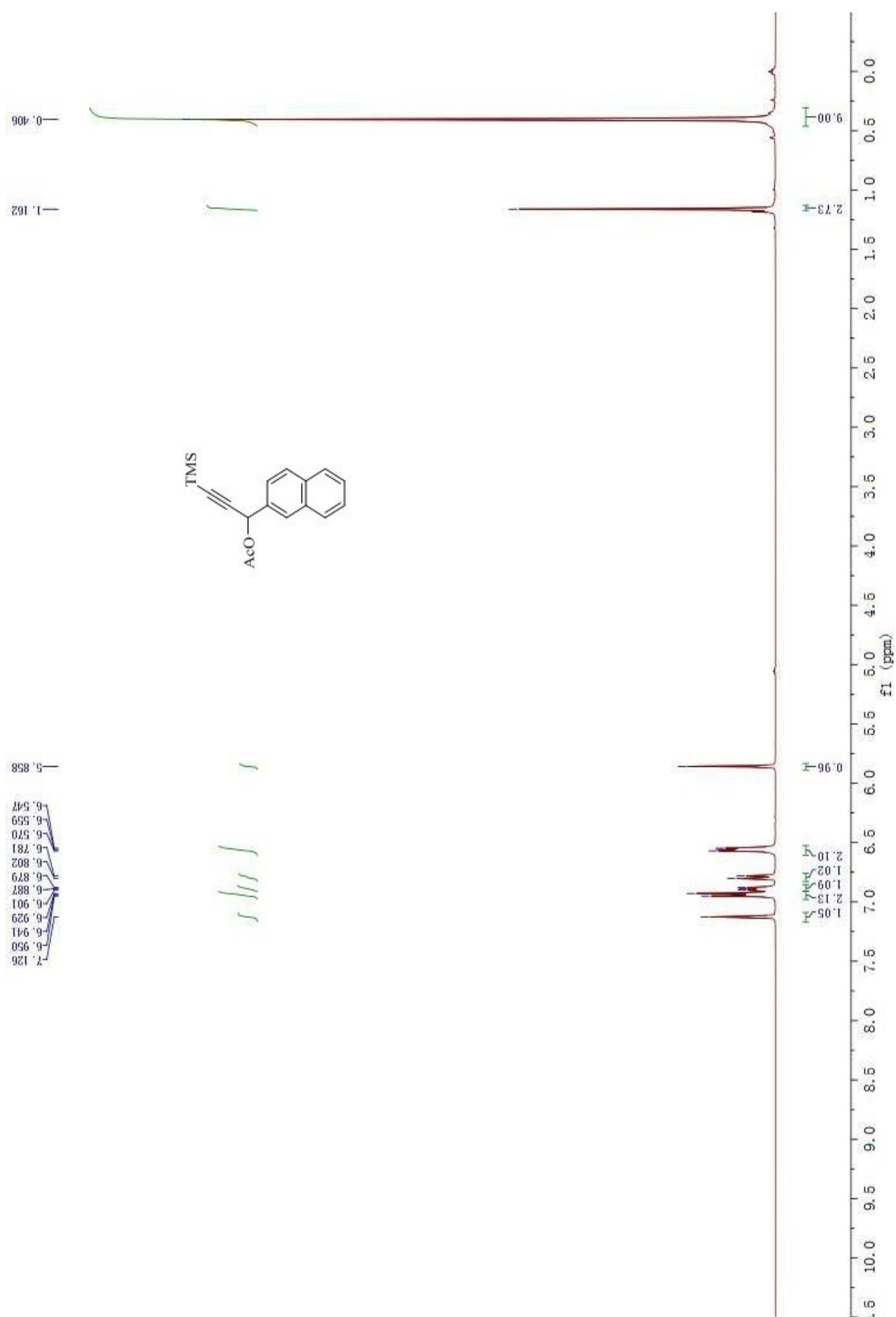
^1H NMR Spectrum of 1-(4-Chlorophenyl)-3-(trimethylsilyl)prop-2-ynyl acetate (**1p**)



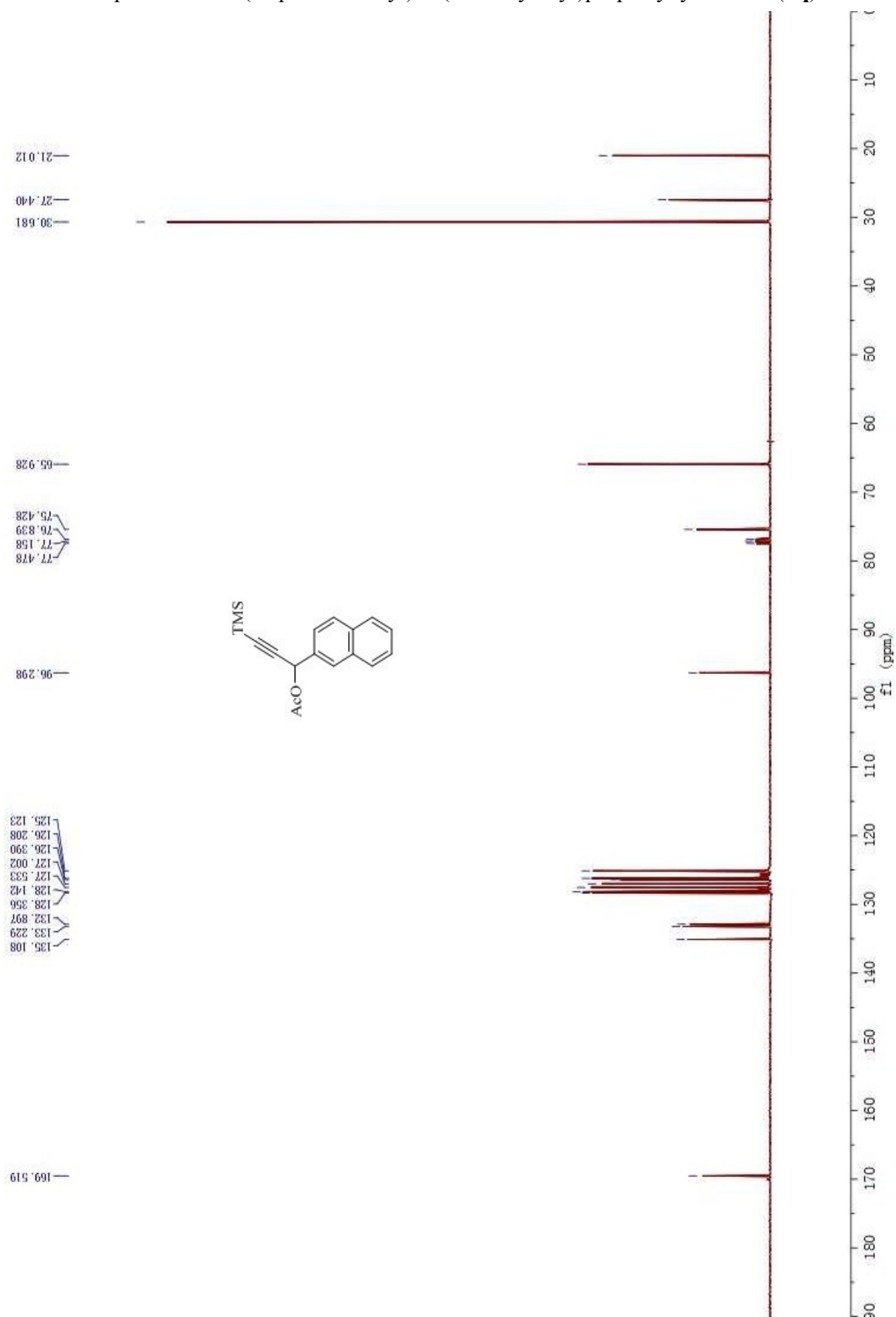
^{13}C NMR Spectrum of 1-(4-Chlorophenyl)-3-(trimethylsilyl)prop-2-ynyl acetate (**1p**)



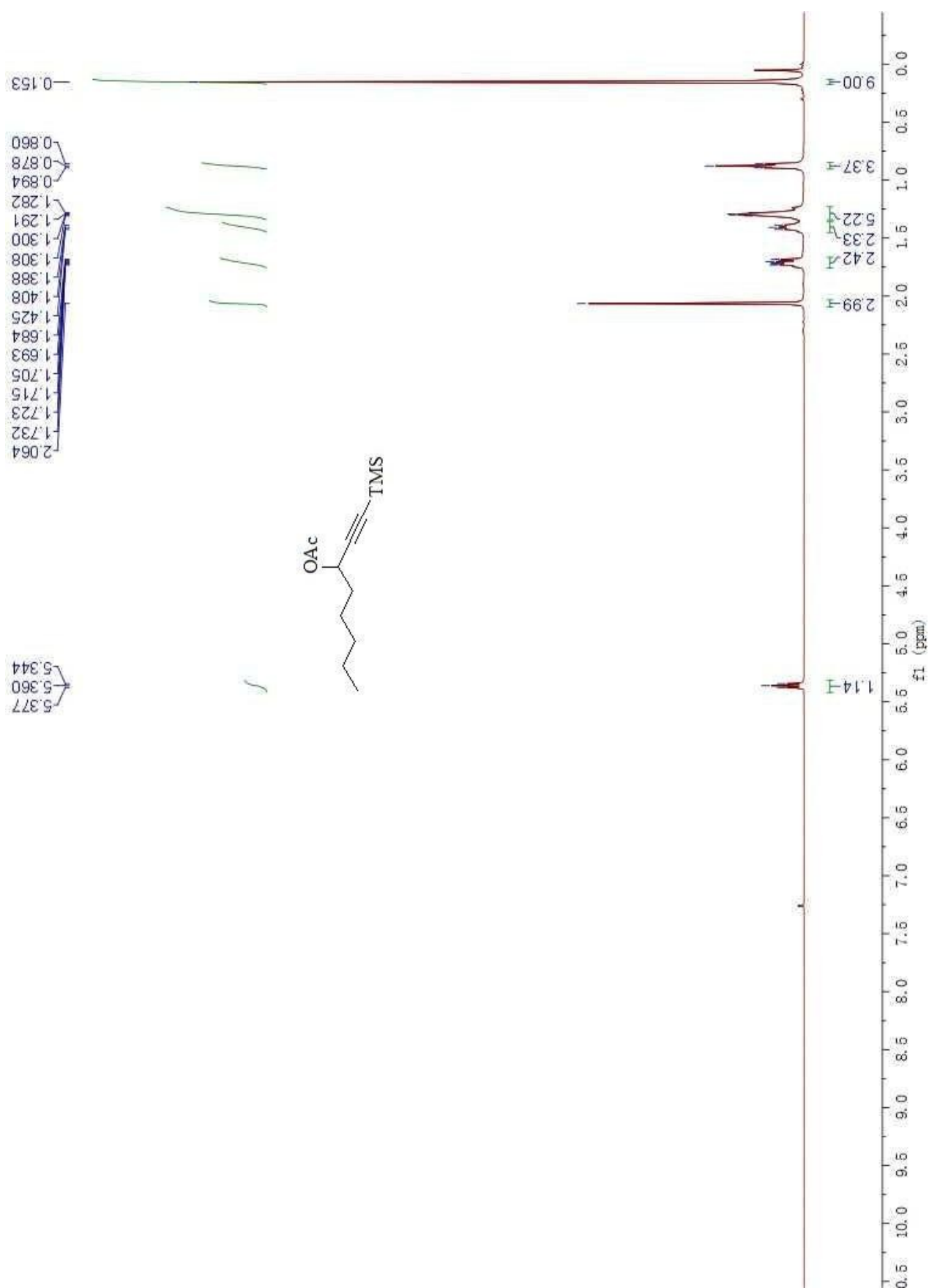
^1H NMR Spectrum of 1-(Naphthalen-2-yl)-3-(trimethylsilyl)prop-2-ynyl acetate (**1q**)



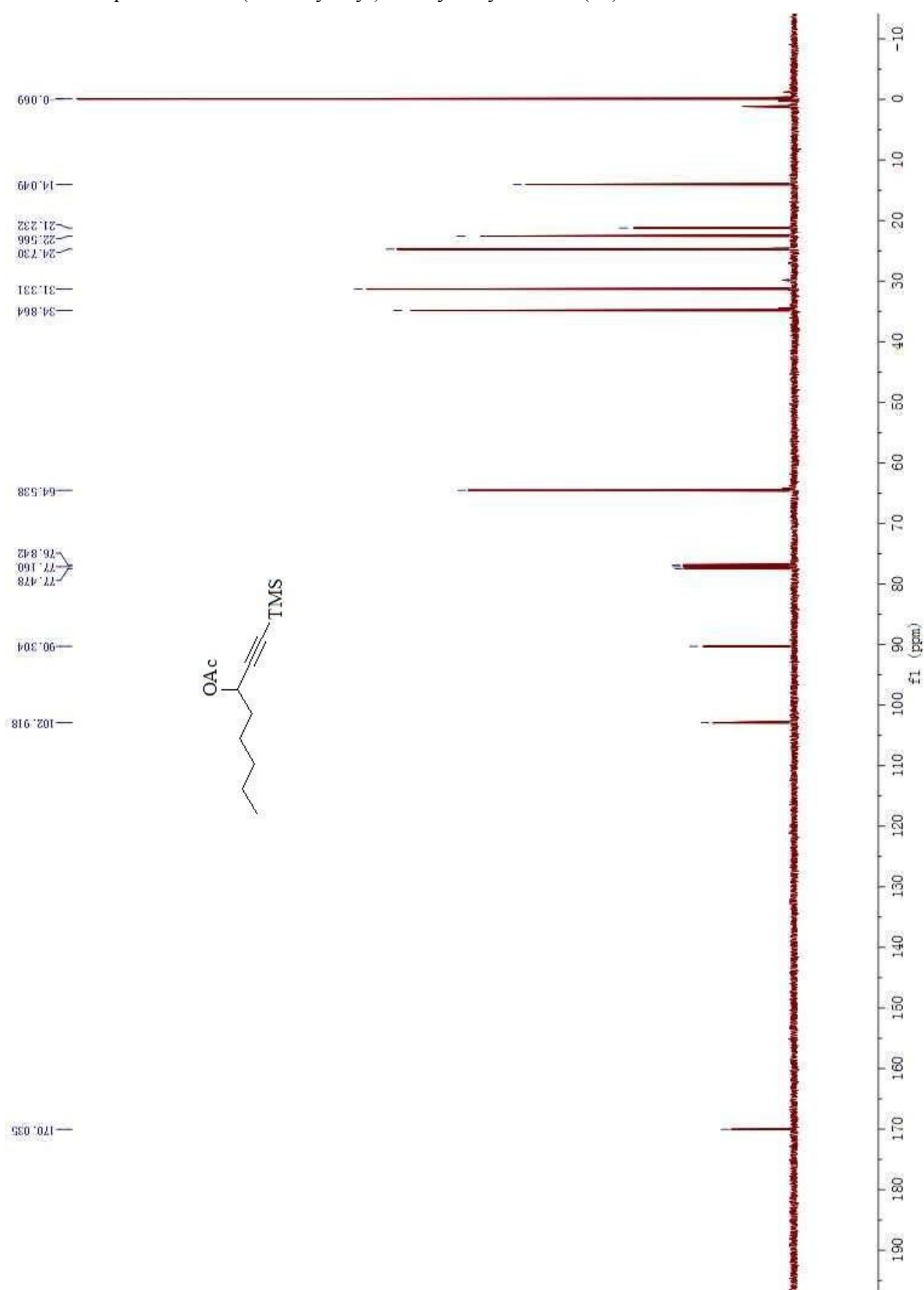
^{13}C NMR Spectrum of 1-(Naphthalen-2-yl)-3-(trimethylsilyl)prop-2-ynyl acetate (**1q**)



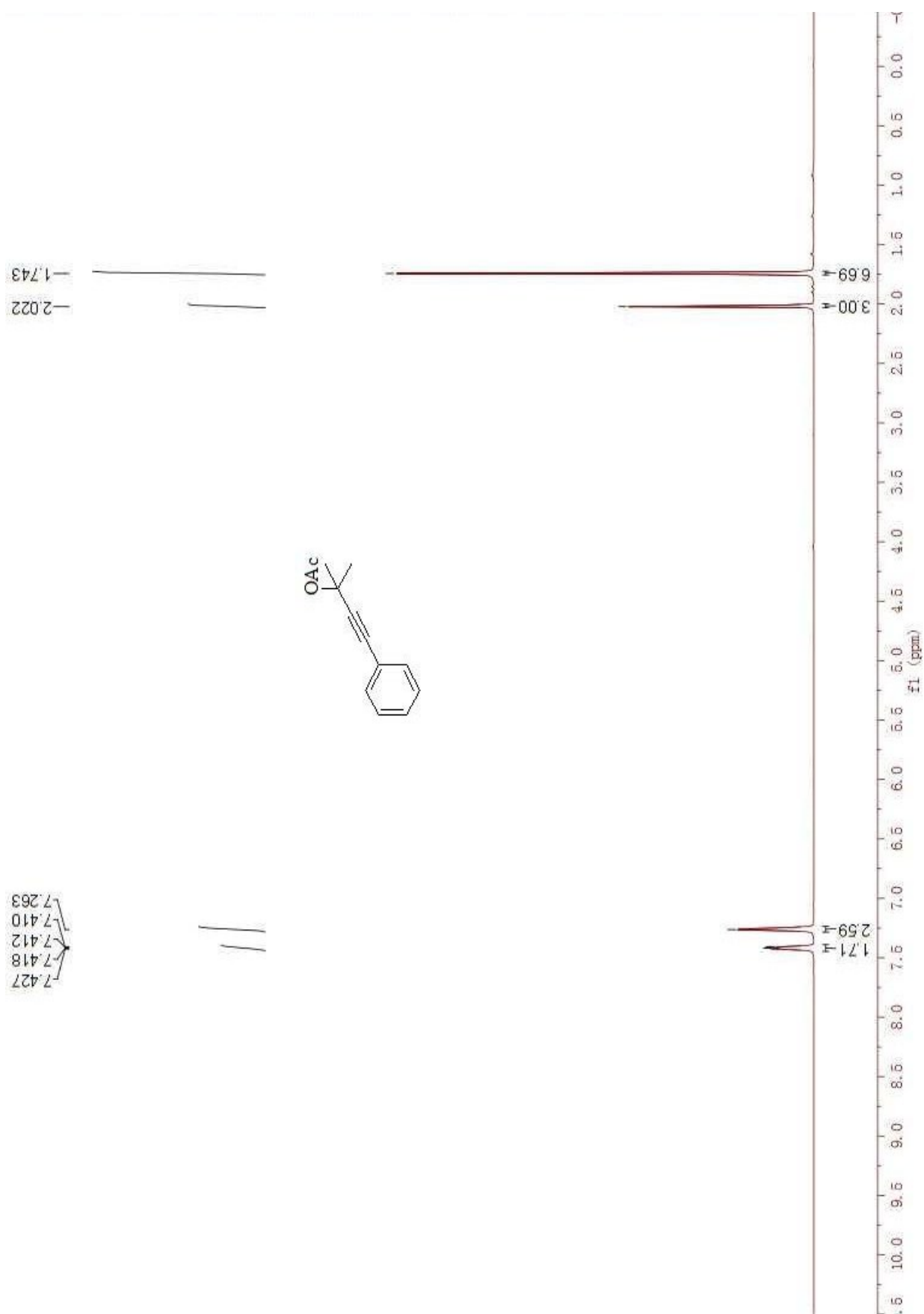
^1H NMR Spectrum of 1-(trimethylsilyl)oct-1-yn-3-yl acetate (**1r**)



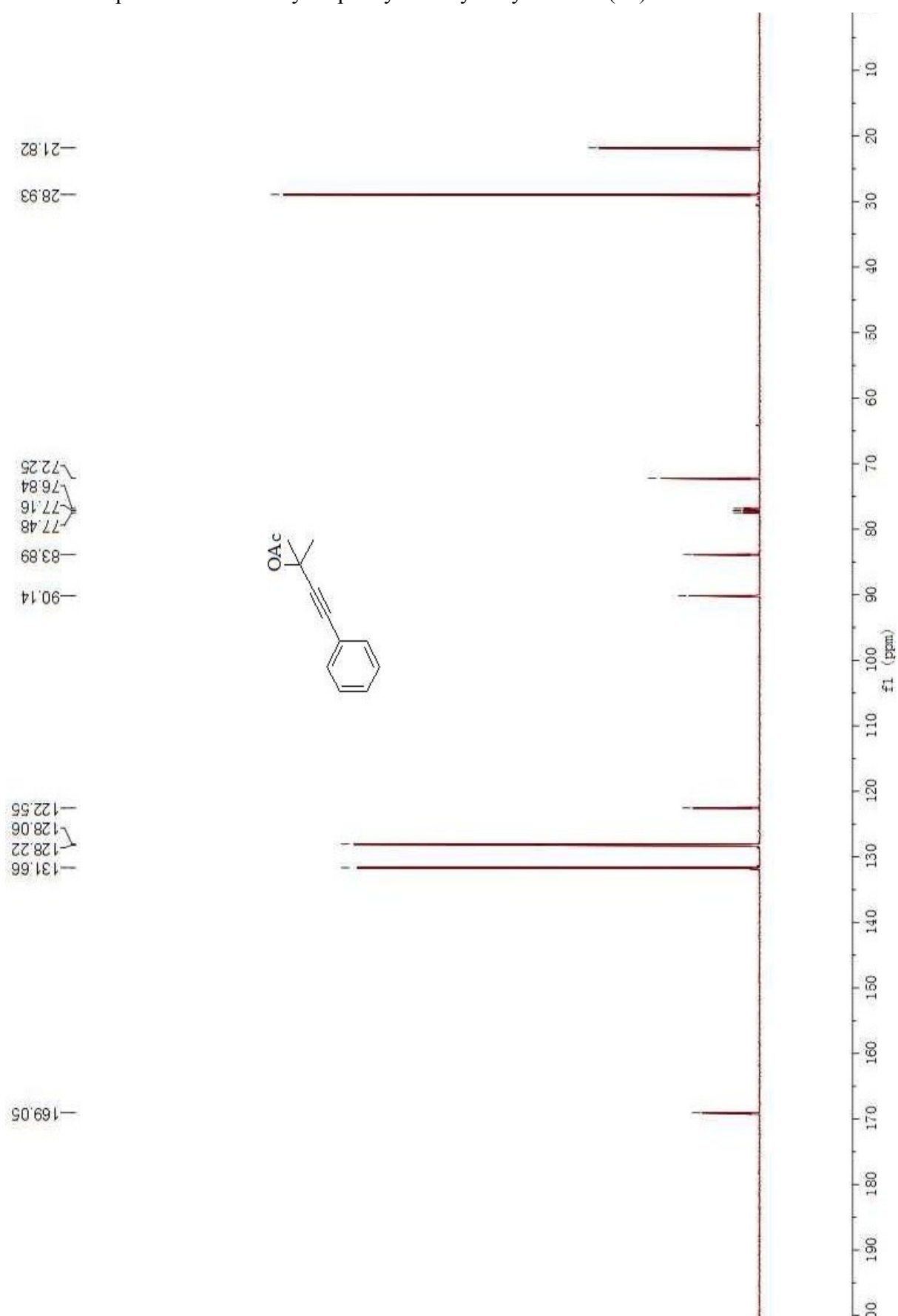
^{13}C NMR Spectrum of 1-(trimethylsilyl)oct-1-yn-3-yl acetate (**1r**)



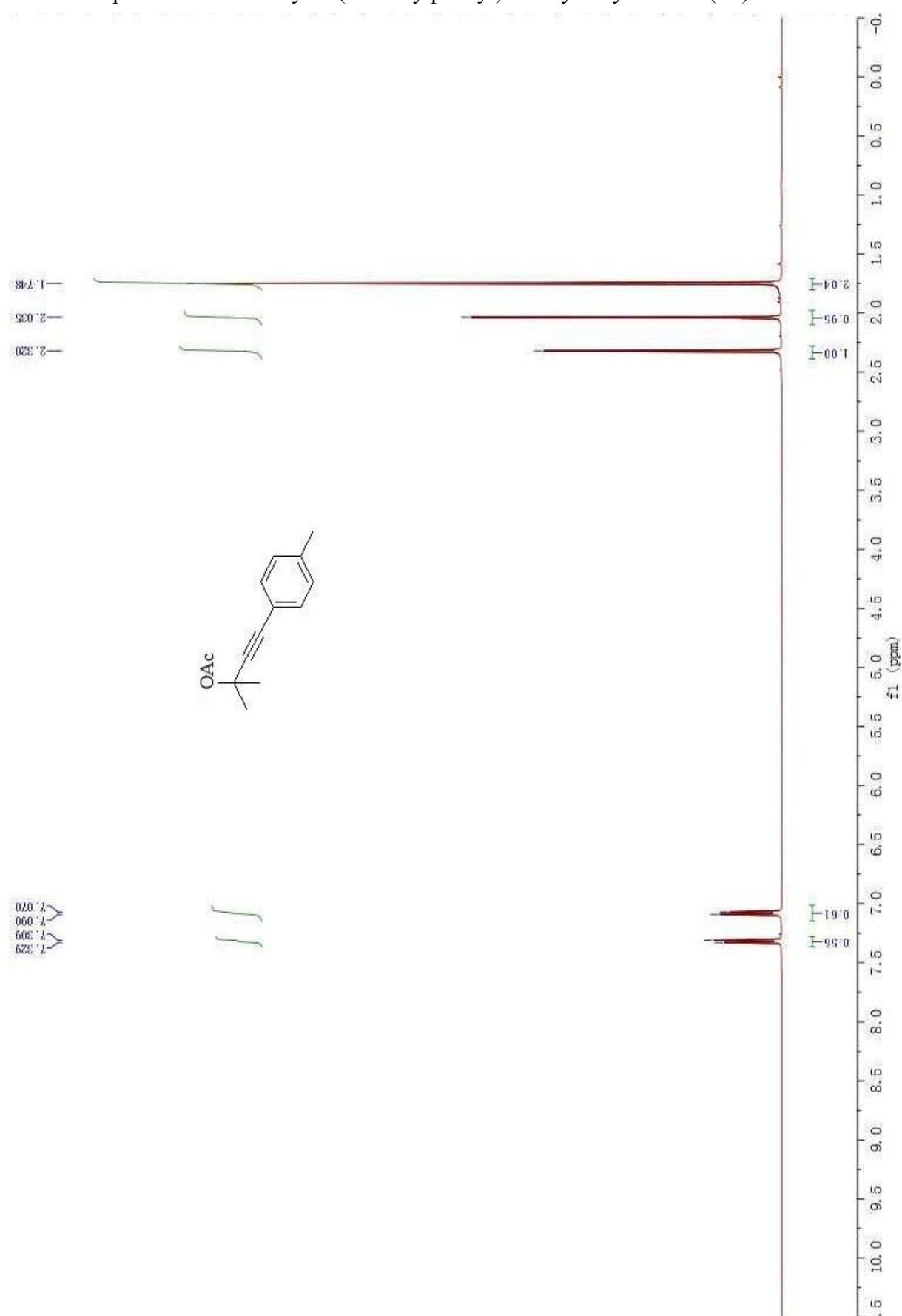
^1H NMR Spectrum of 2-methyl-4-phenylbut-3-yn-2-yl acetate (**4a**)



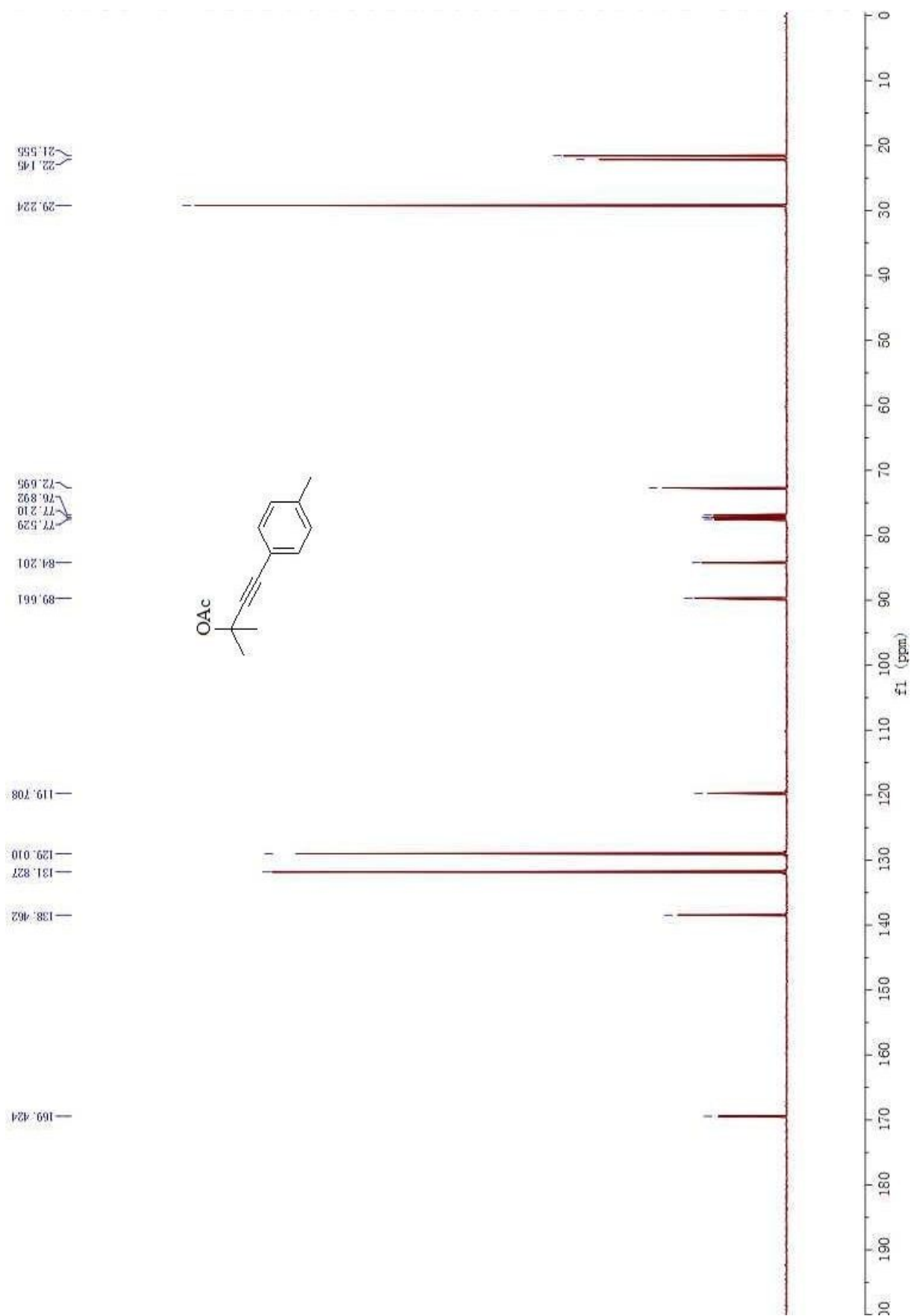
^{13}C NMR Spectrum of 2-methyl-4-phenylbut-3-yn-2-yl acetate (**4a**)



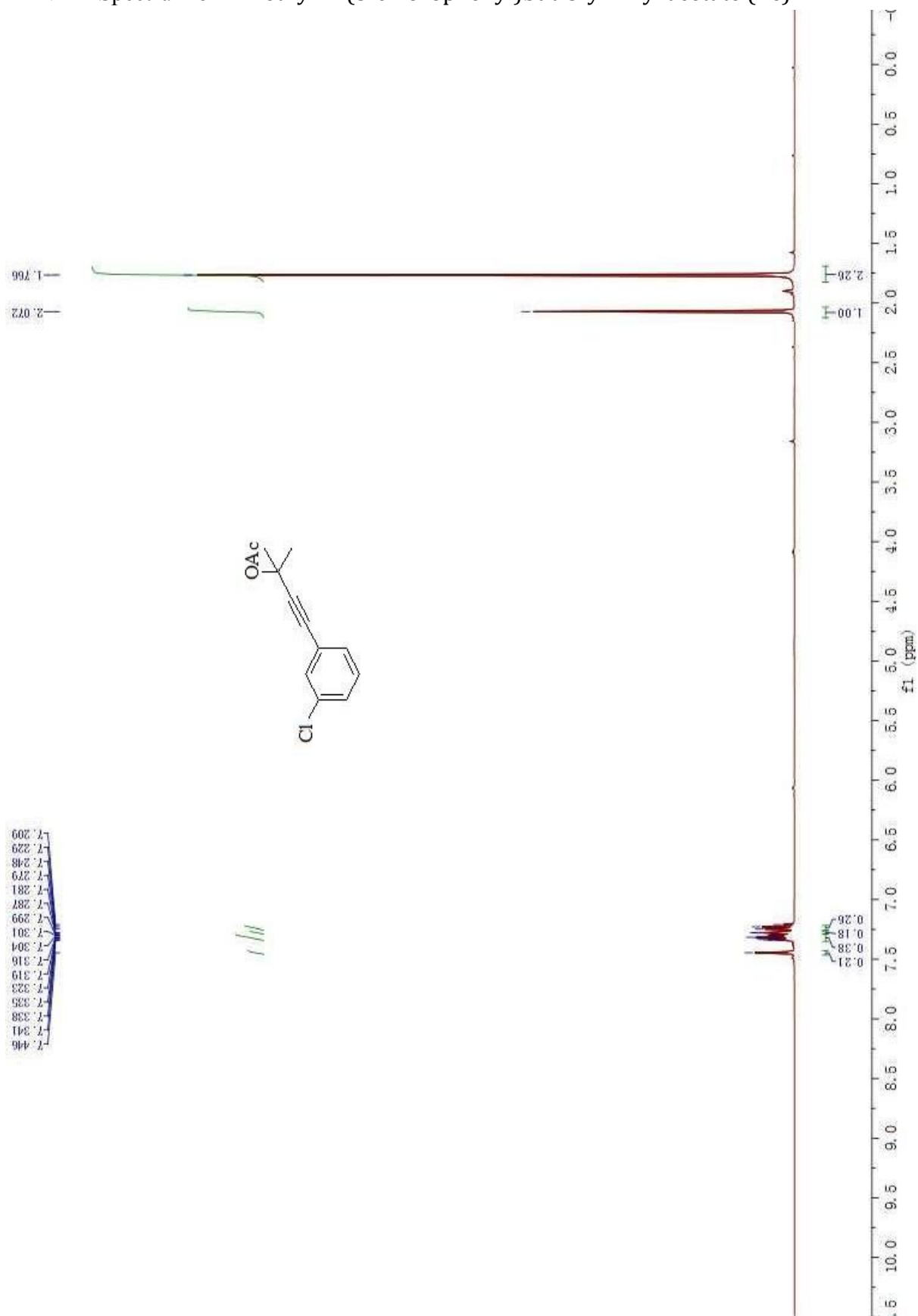
¹H NMR Spectrum of 2-Methyl-4-(4-methylphenyl)but-3-yn-2-yl acetate (**4b**)



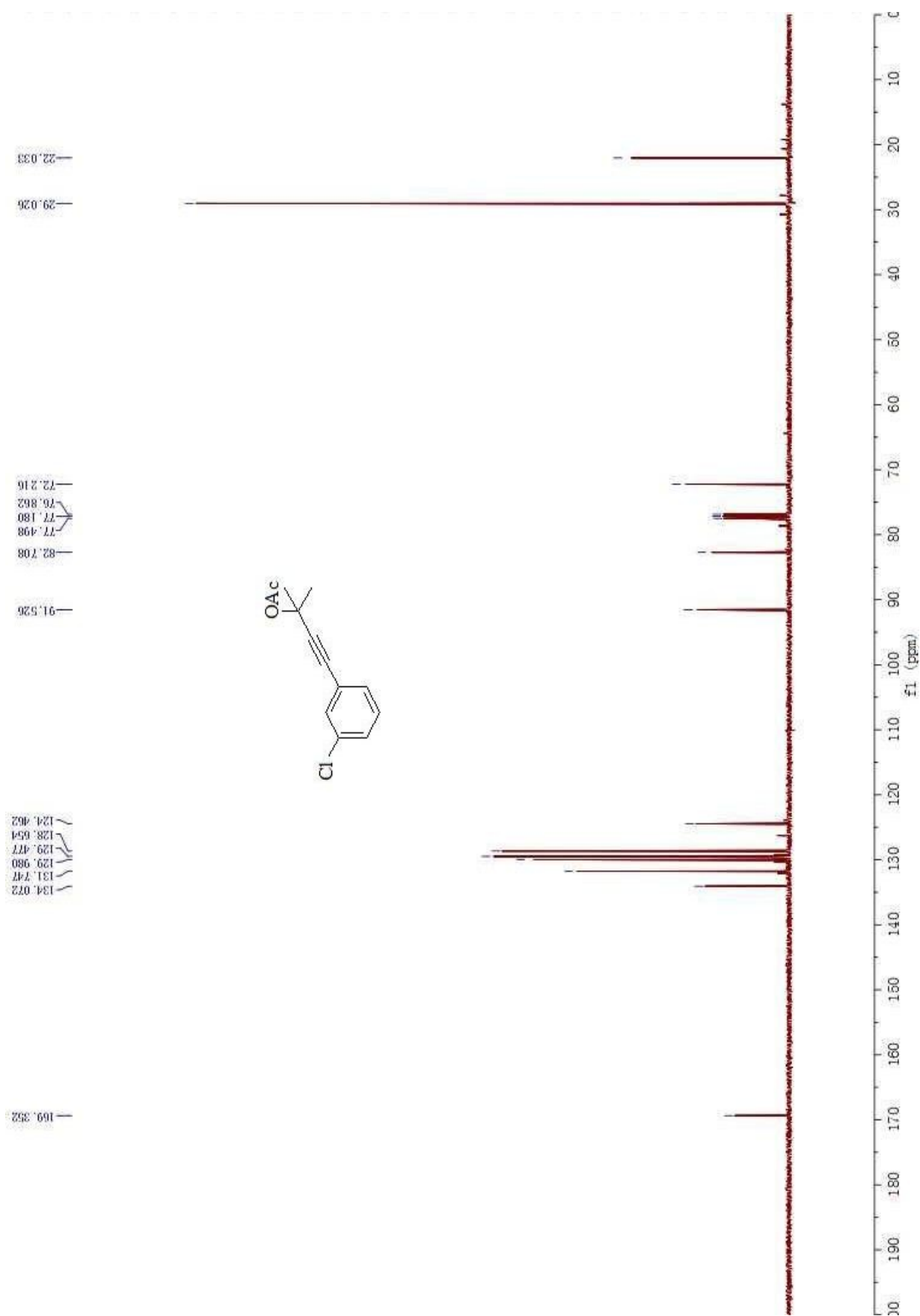
¹³C NMR Spectrum of 2-Methyl-4-(4-methylphenyl)but-3-yn-2-yl acetate (**4b**)



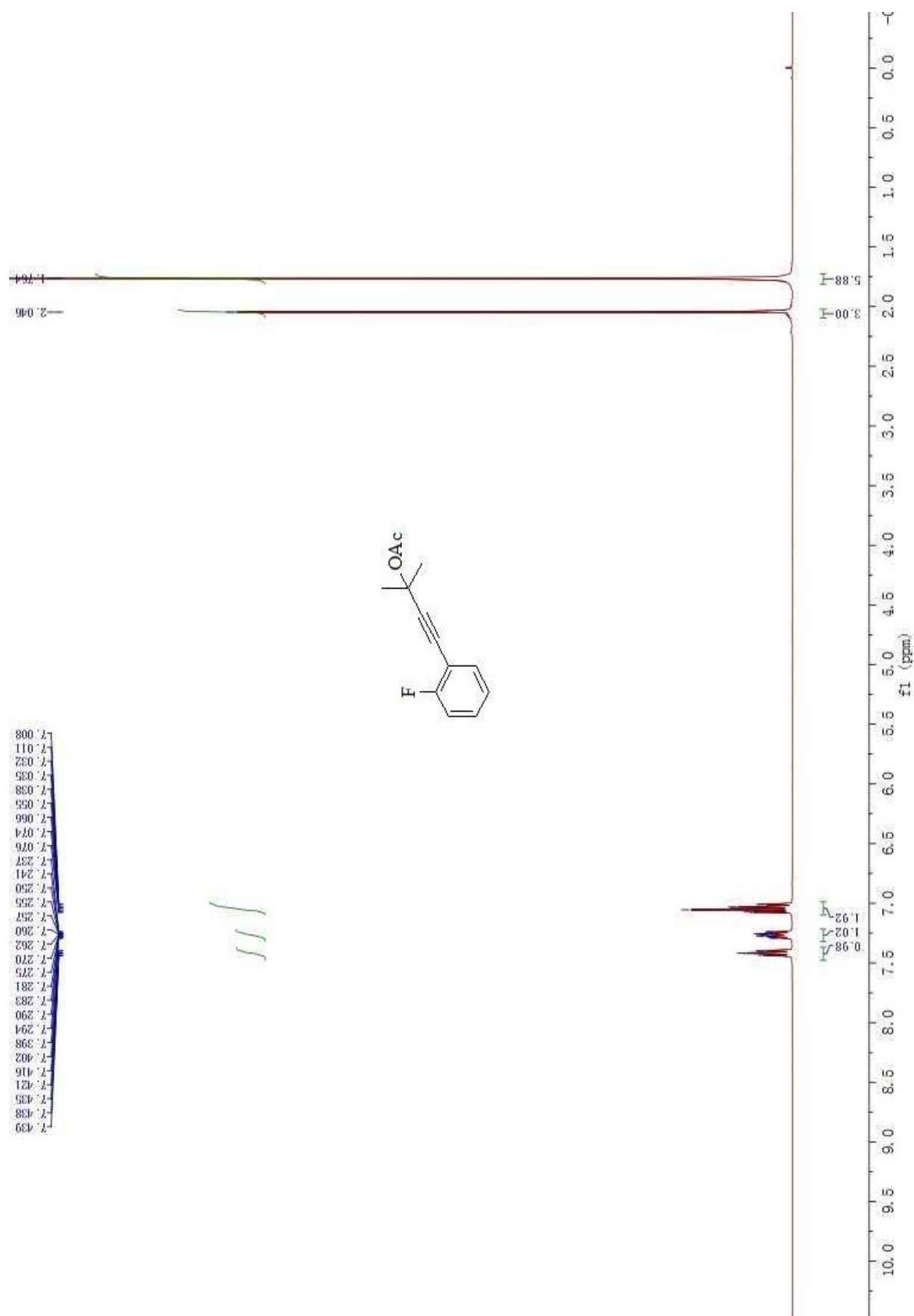
¹H NMR Spectrum of 2-Methyl-4-(3-chlorophenyl)but-3-yn-2-yl acetate (**4c**)



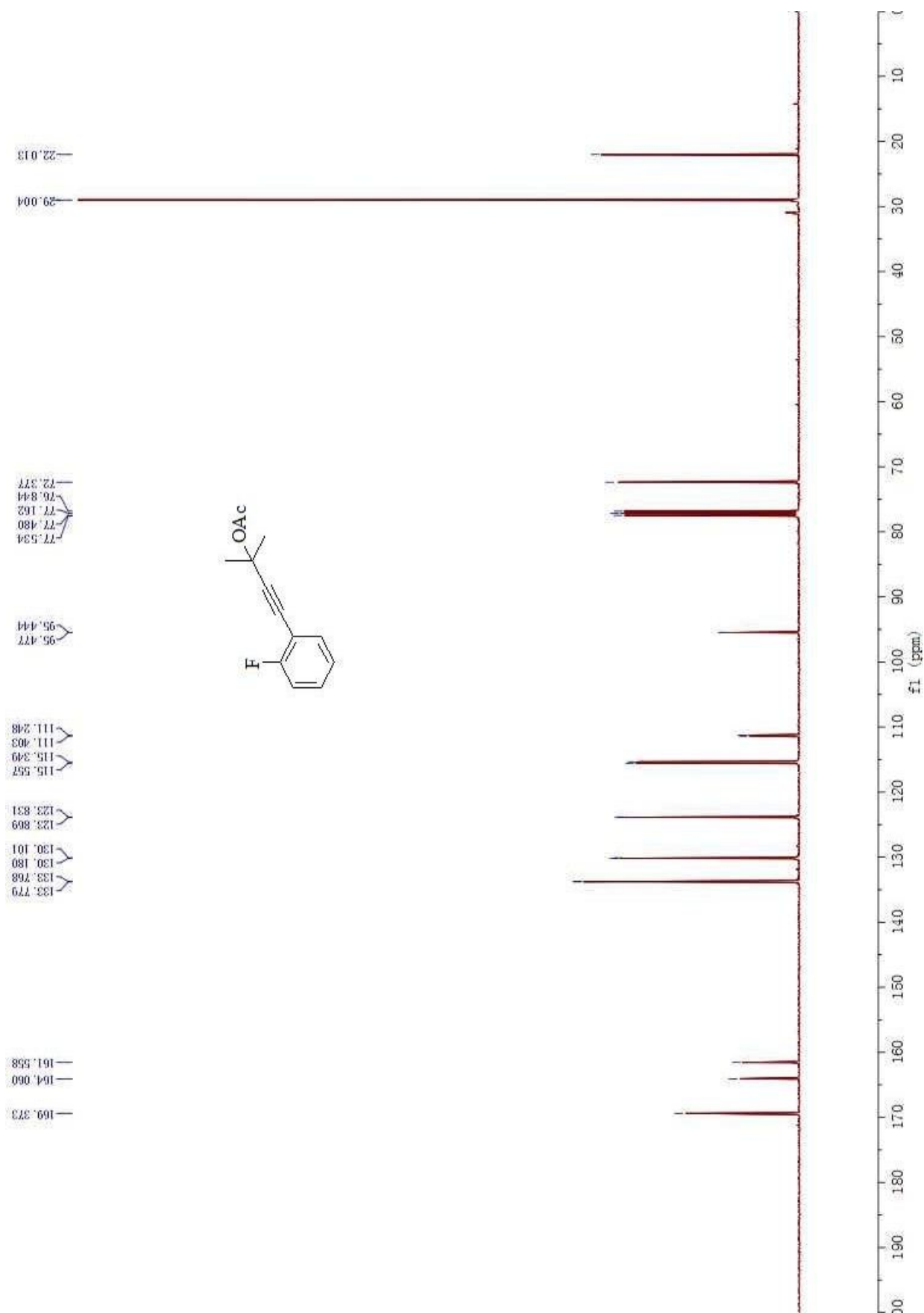
¹³C NMR Spectrum of 2-Methyl-4-(3-chlorophenyl)but-3-yn-2-yl acetate (**4c**)



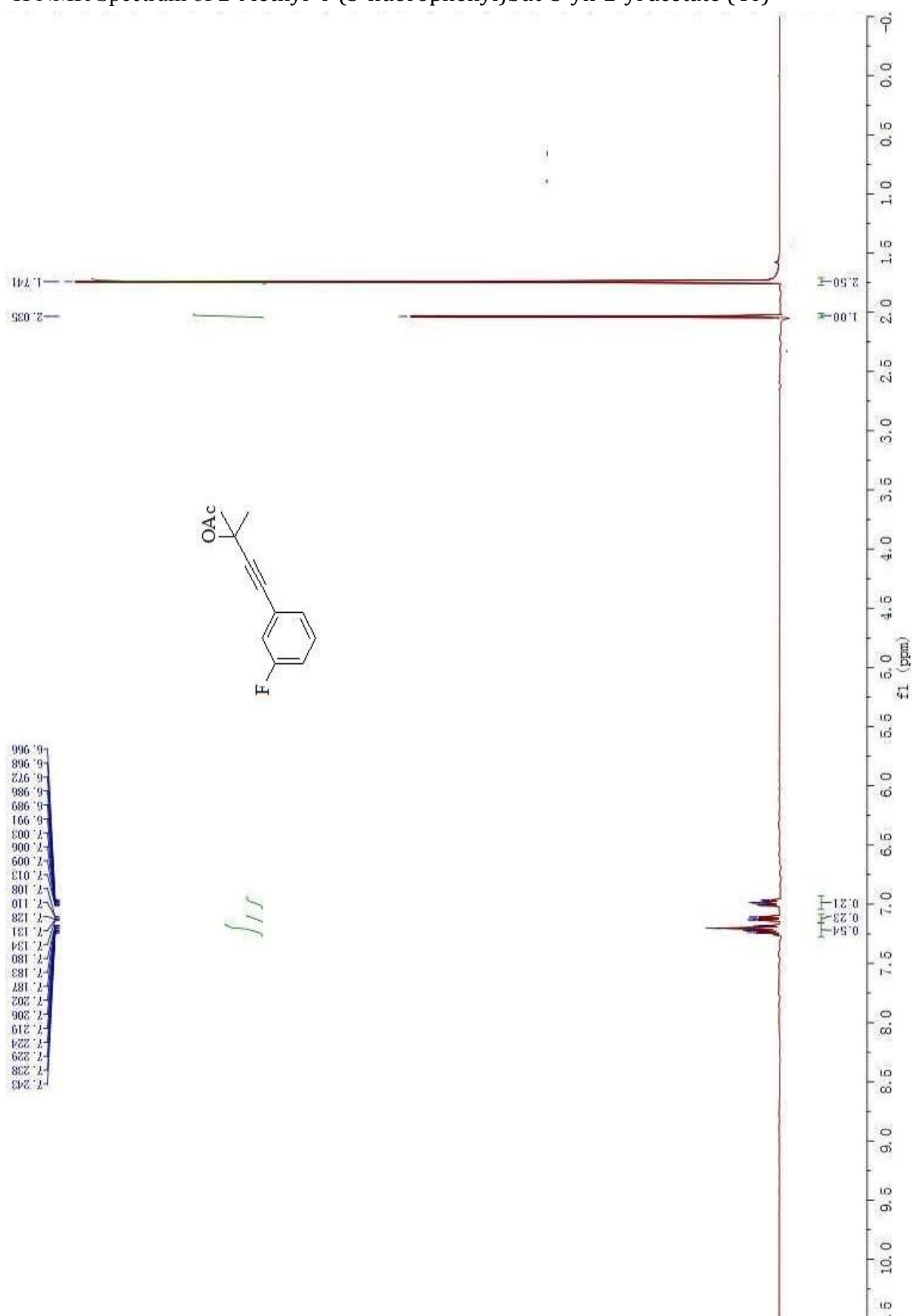
^1H NMR Spectrum of 2-Methyl-4-(2-fluorophenyl)but-3-yn-2-yl acetate (**4d**):



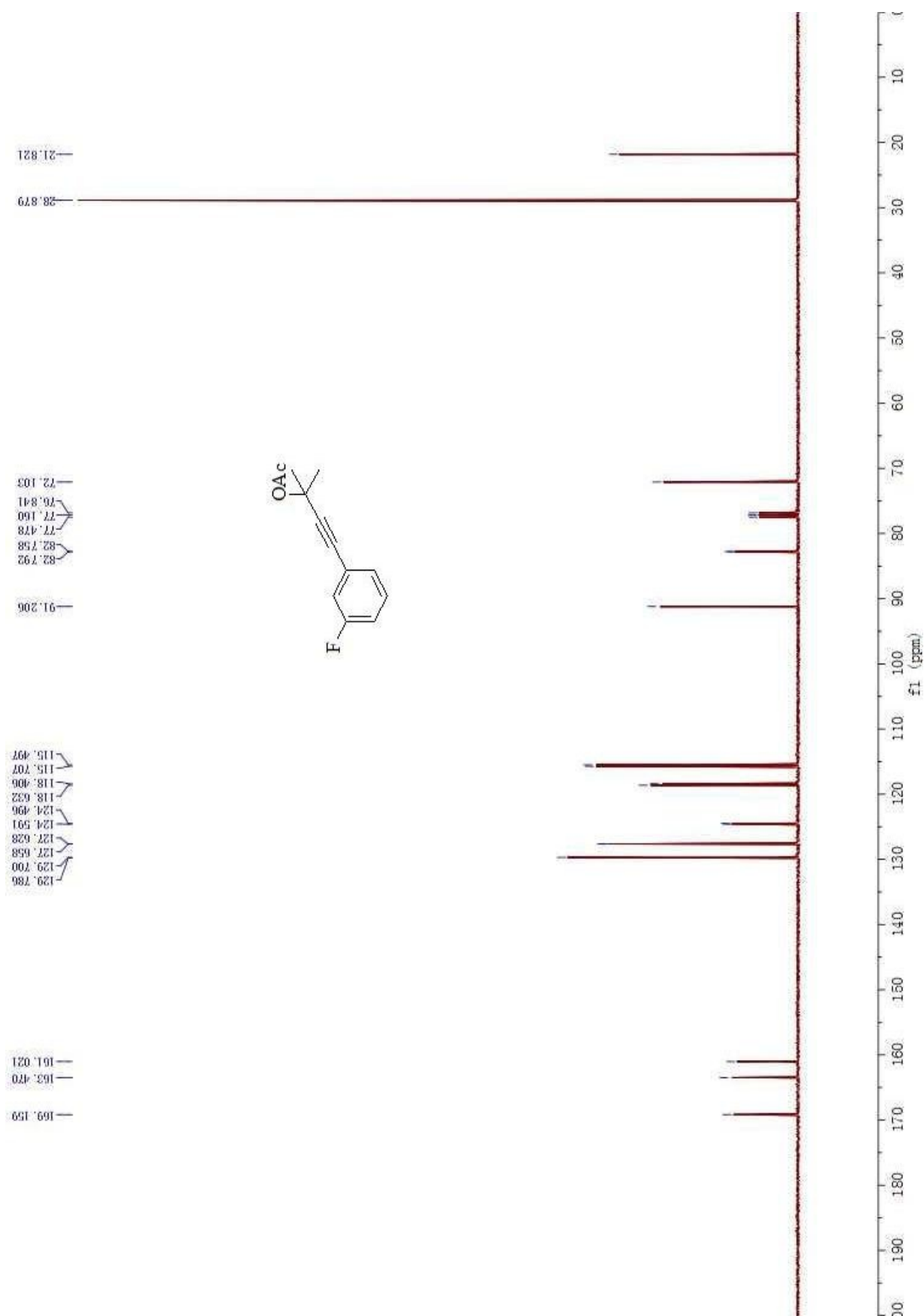
^{13}C NMR Spectrum of 2-Methyl-4-(2-fluorophenyl)but-3-yn-2-yl acetate (**4d**):



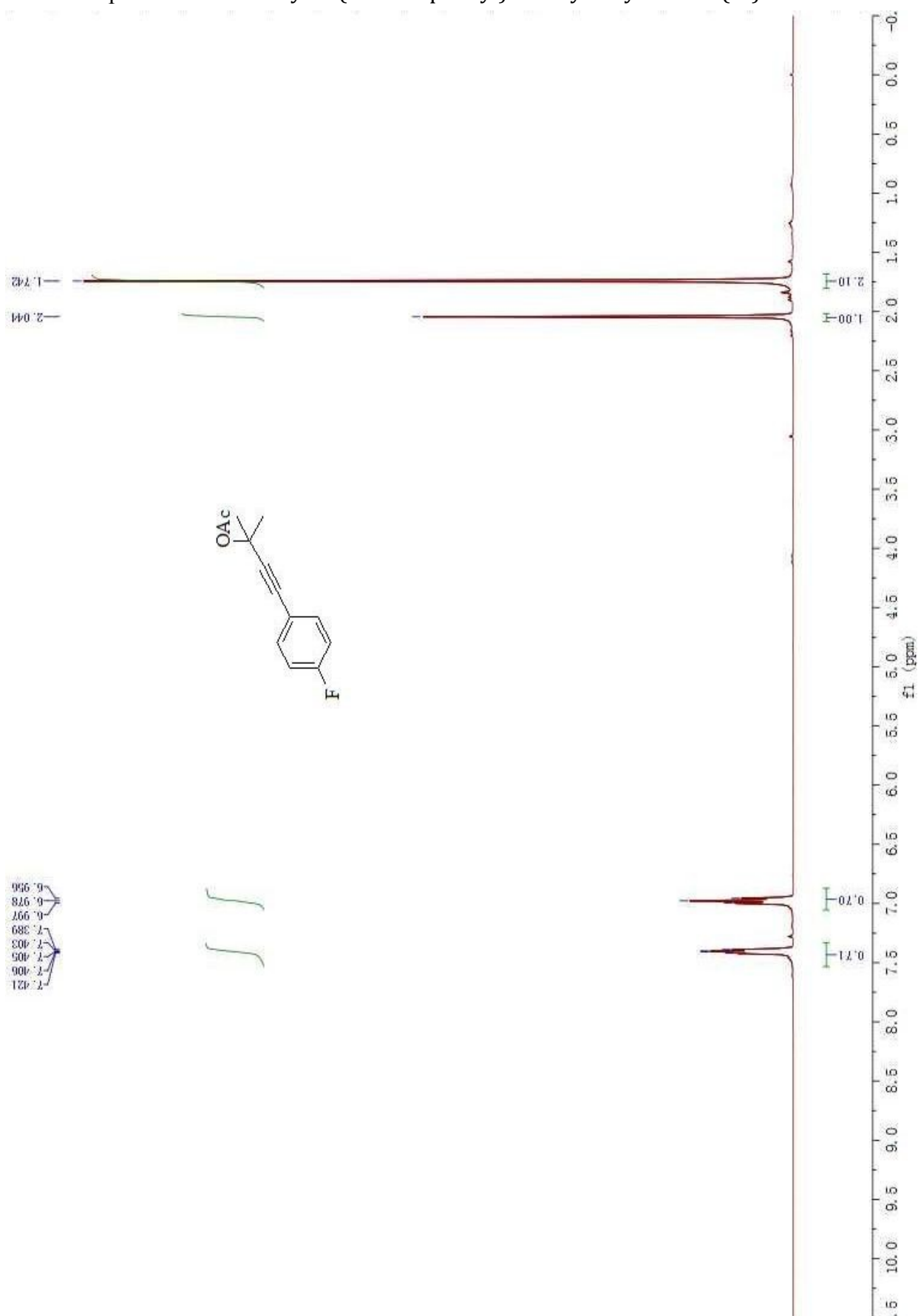
¹H NMR Spectrum of 2-Methyl-4-(3-fluorophenyl)but-3-yn-2-yl acetate (**4e**)



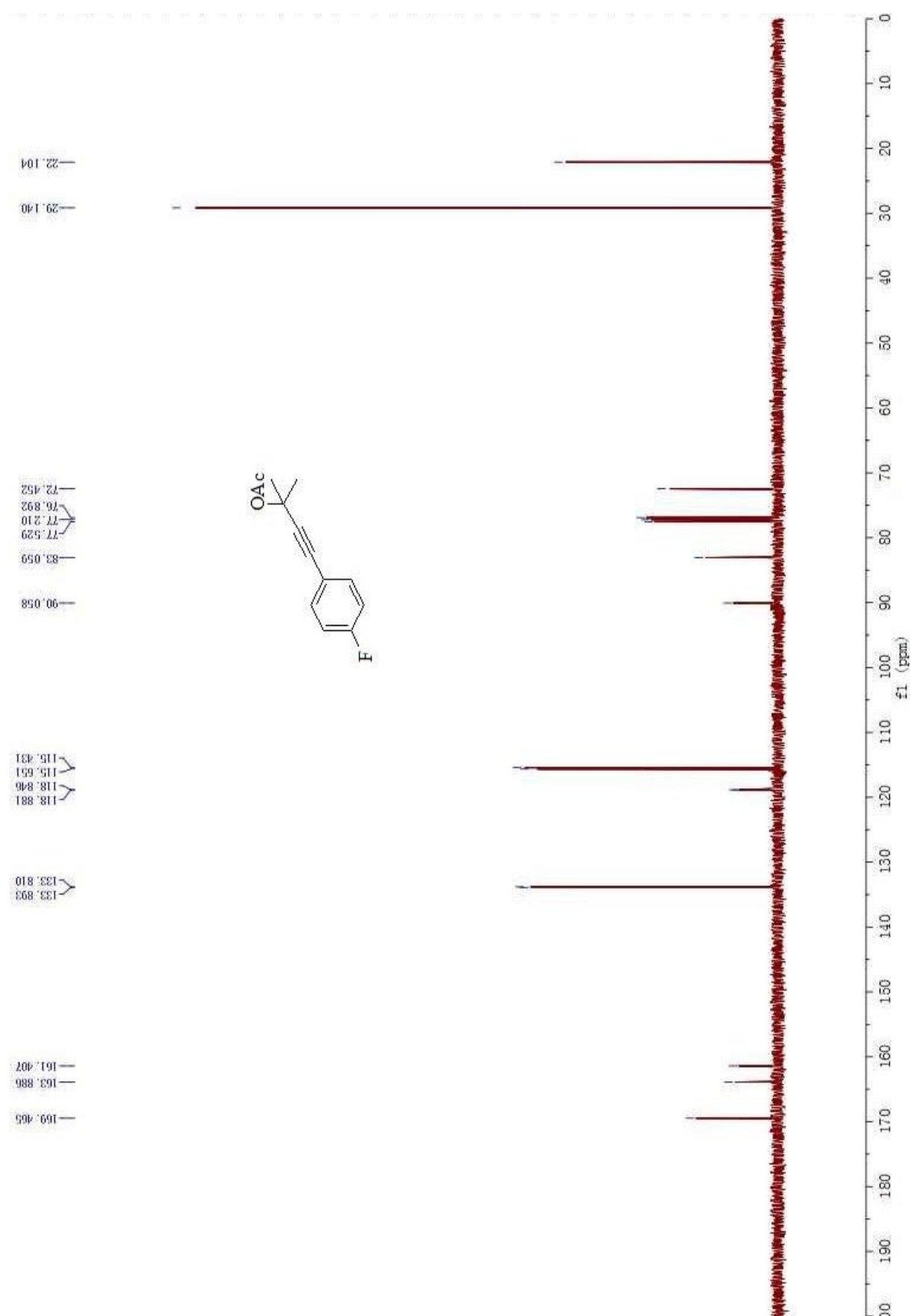
¹³C NMR Spectrum of 2-Methyl-4-(3-fluorophenyl)but-3-yn-2-yl acetate (**4e**)



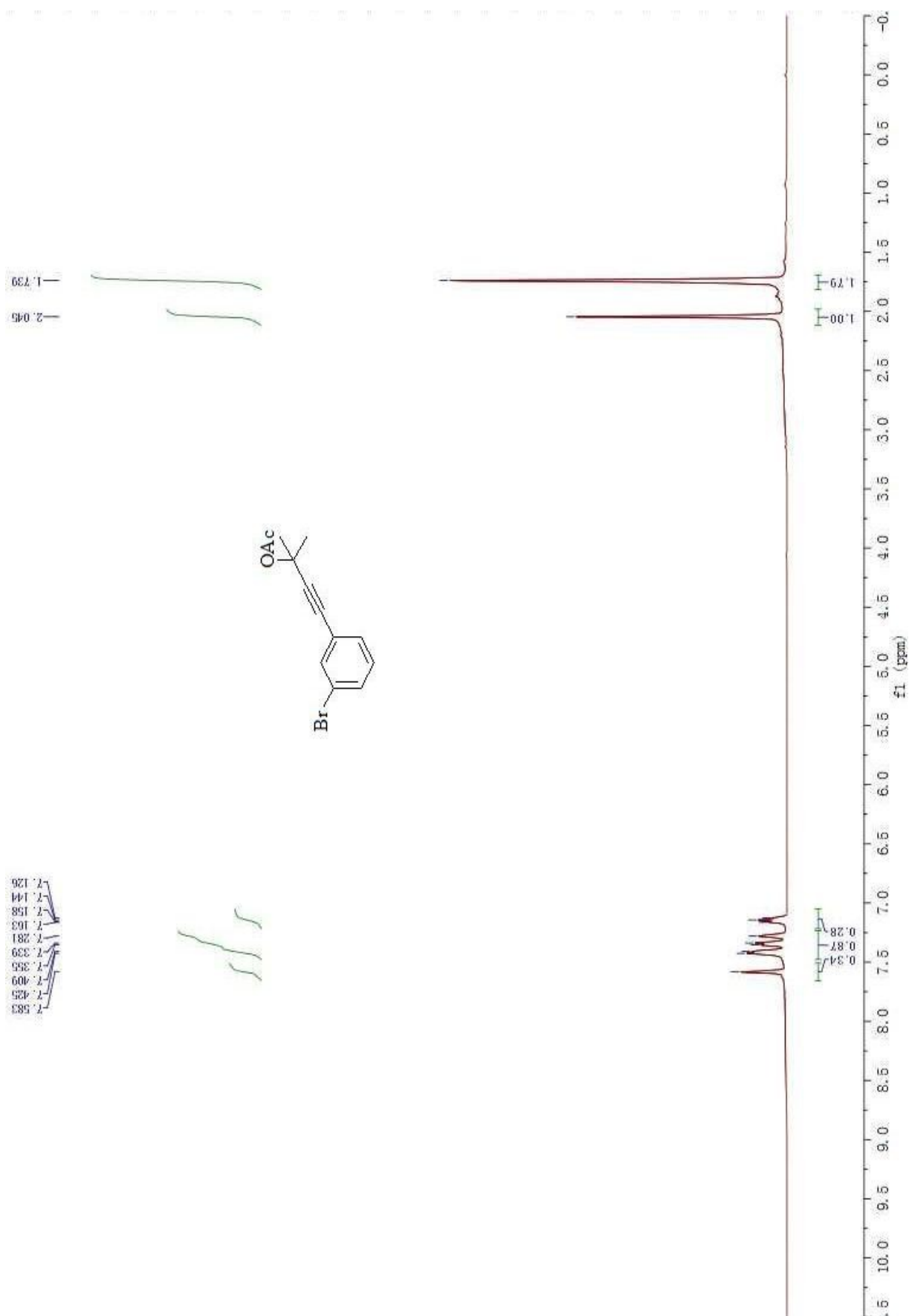
^1H NMR Spectrum of 2-Methyl-4-(4-fluorophenyl)but-3-yn-2-yl acetate(**4f**)



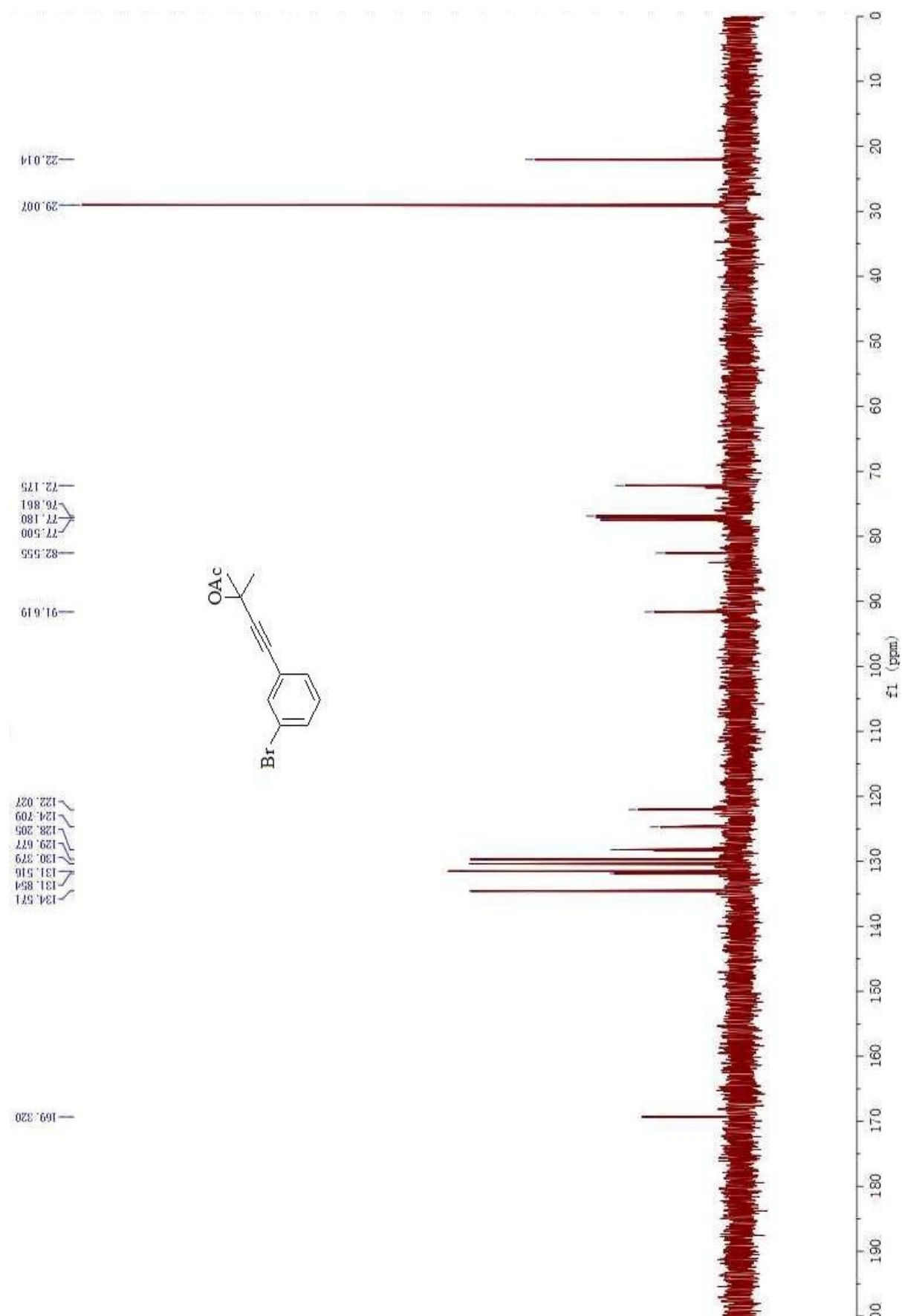
¹³C NMR Spectrum of 2-Methyl-4-(4-fluorophenyl)but-3-yn-2-yl acetate(**4f**)



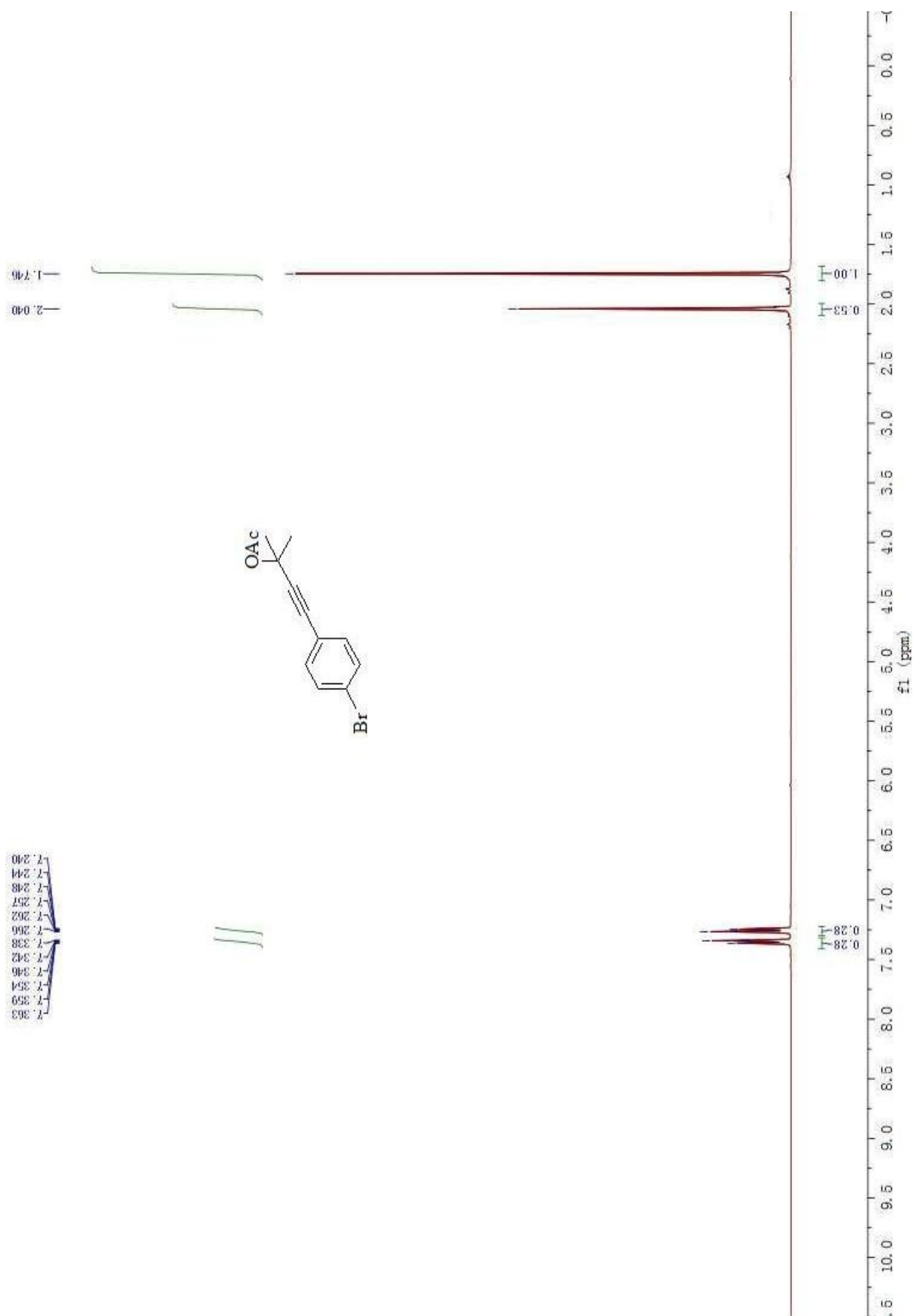
¹H NMR Spectrum of 2-Methyl-4-(3-bromophenyl)but-3-yn-2-yl acetate (**4g**)



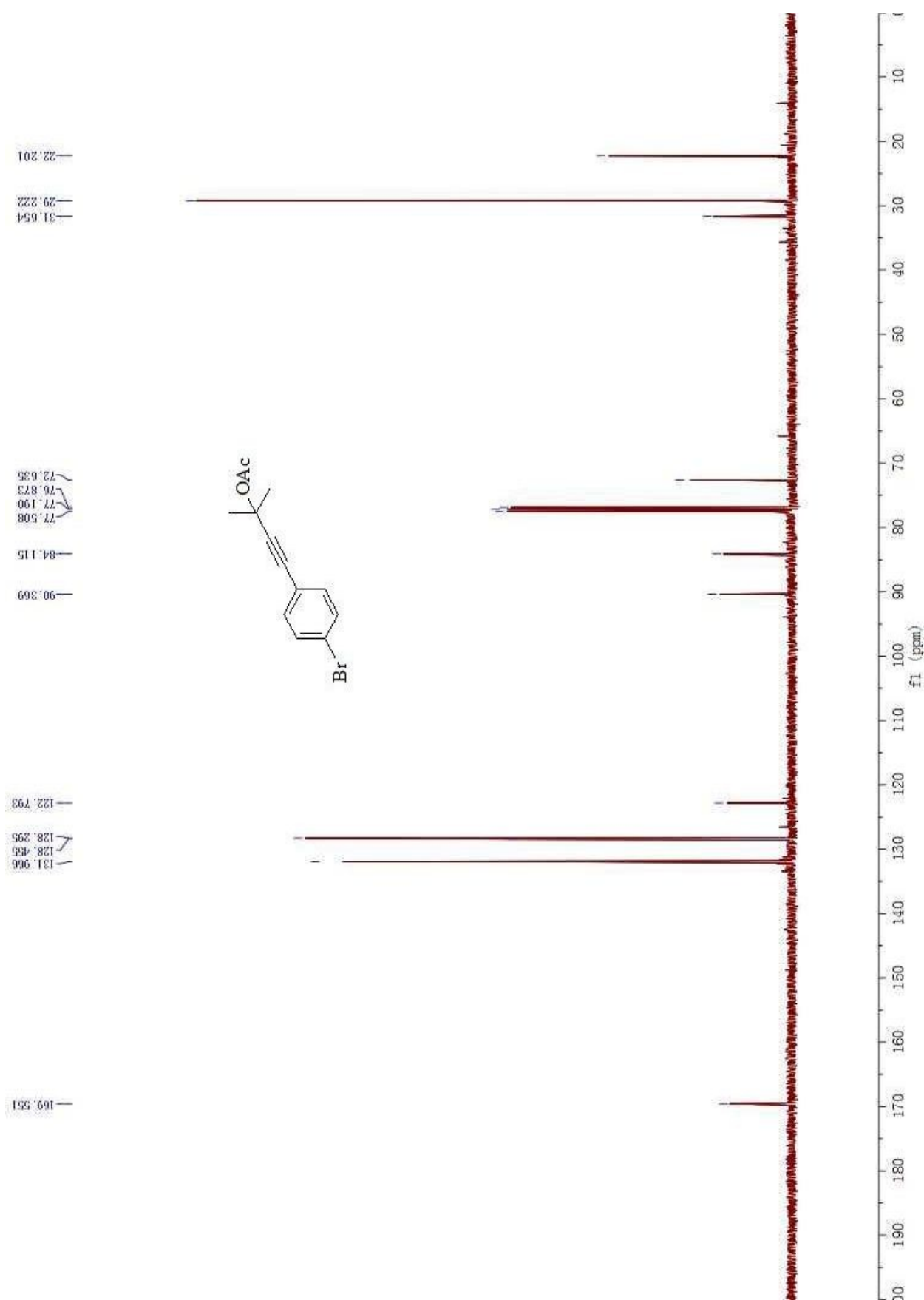
¹³C NMR Spectrum of 2-Methyl-4-(3-bromophenyl)but-3-yn-2-yl acetate (**4g**)



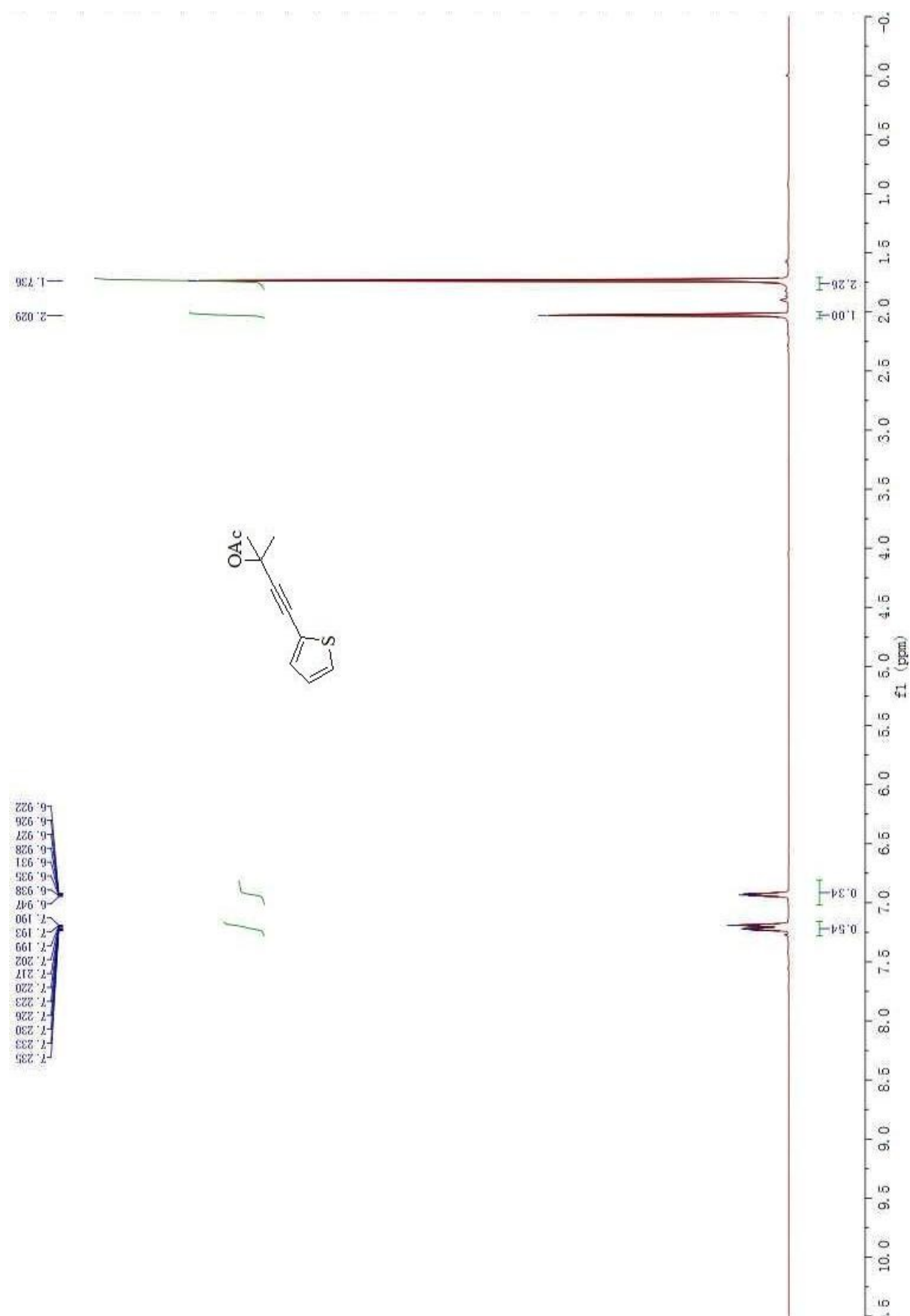
¹H NMR Spectrum of 2-Methyl-4-(4-bromophenyl)but-3-yn-2-yl acetate (**4h**)



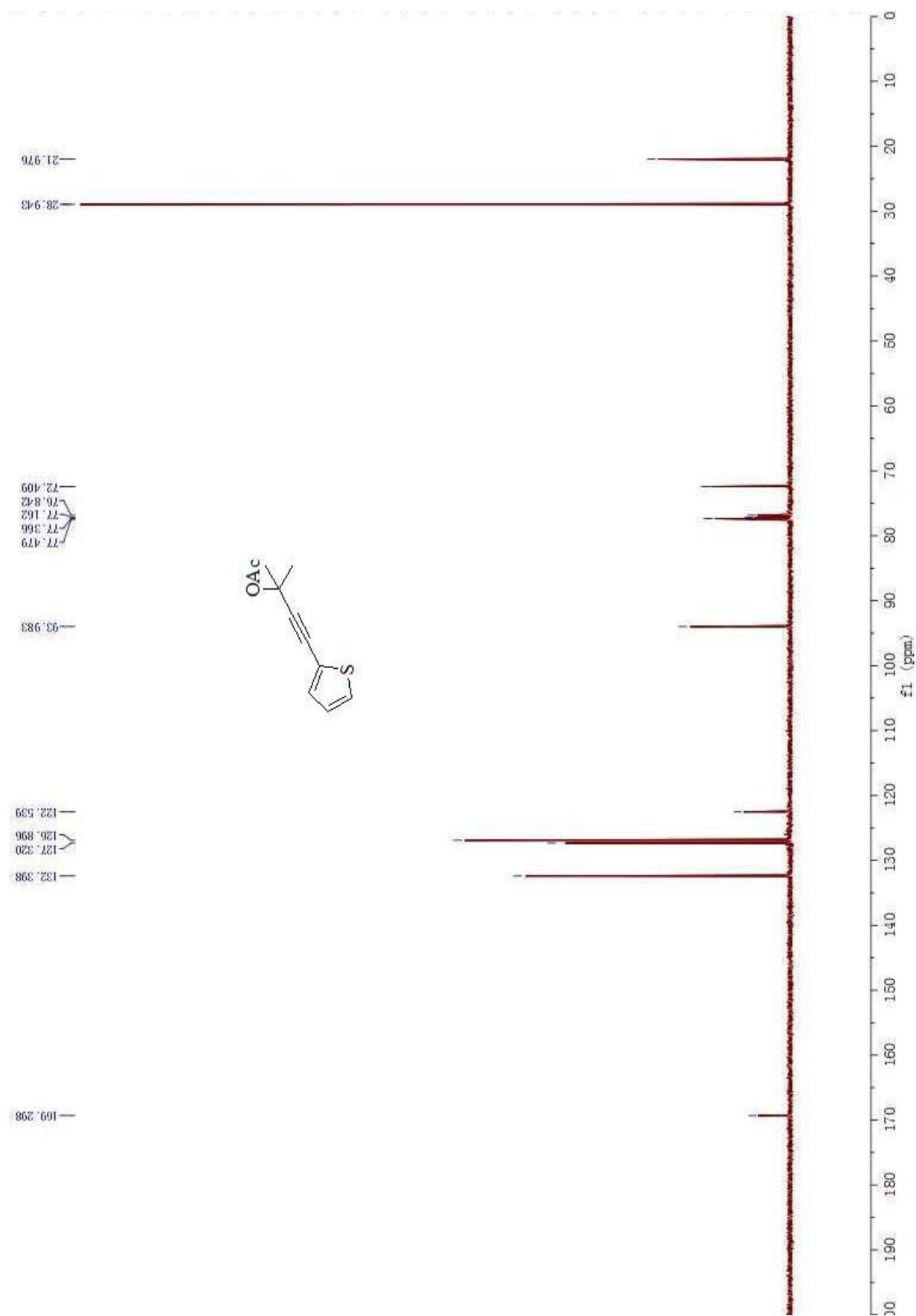
¹³C NMR Spectrum of 2-Methyl-4-(4-bromophenyl)but-3-yn-2-yl acetate (**4h**)



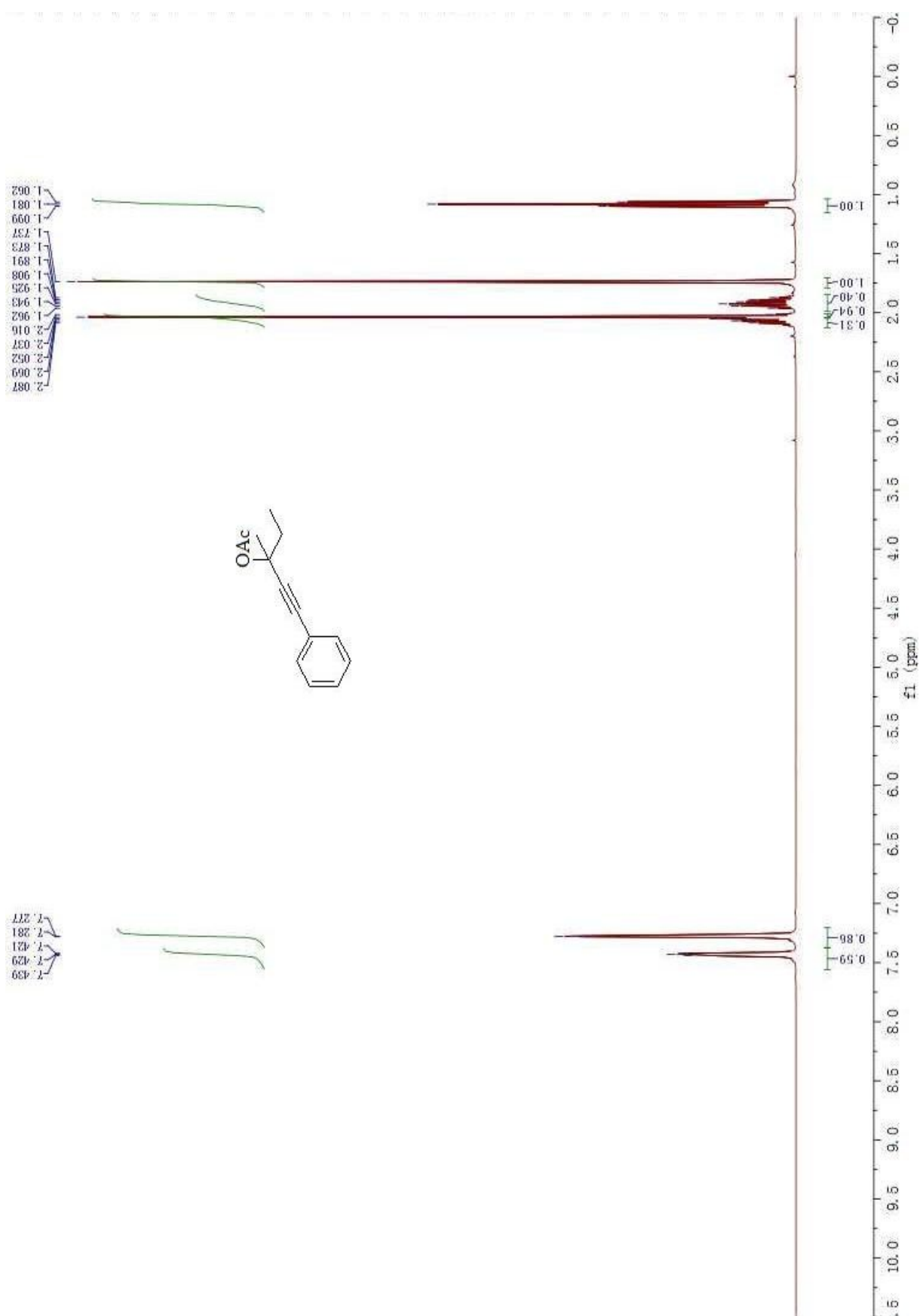
¹H NMR Spectrum of 2-Methyl-4-thienylbut-3-yn-2-yl acetate (**4i**)



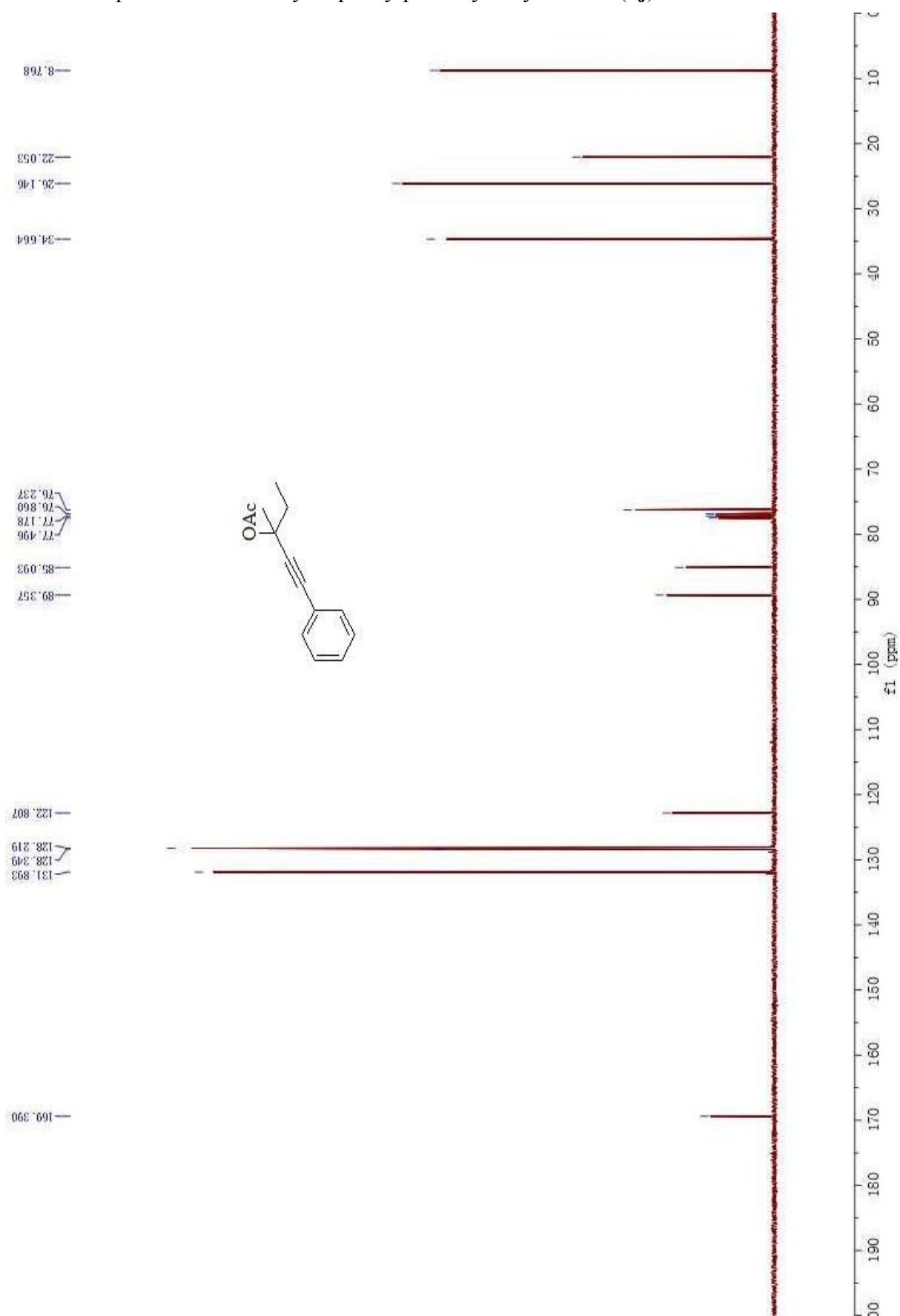
¹³C NMR Spectrum of 2-Methyl-4-thienylbut-3-yn-2-yl acetate (**4i**)



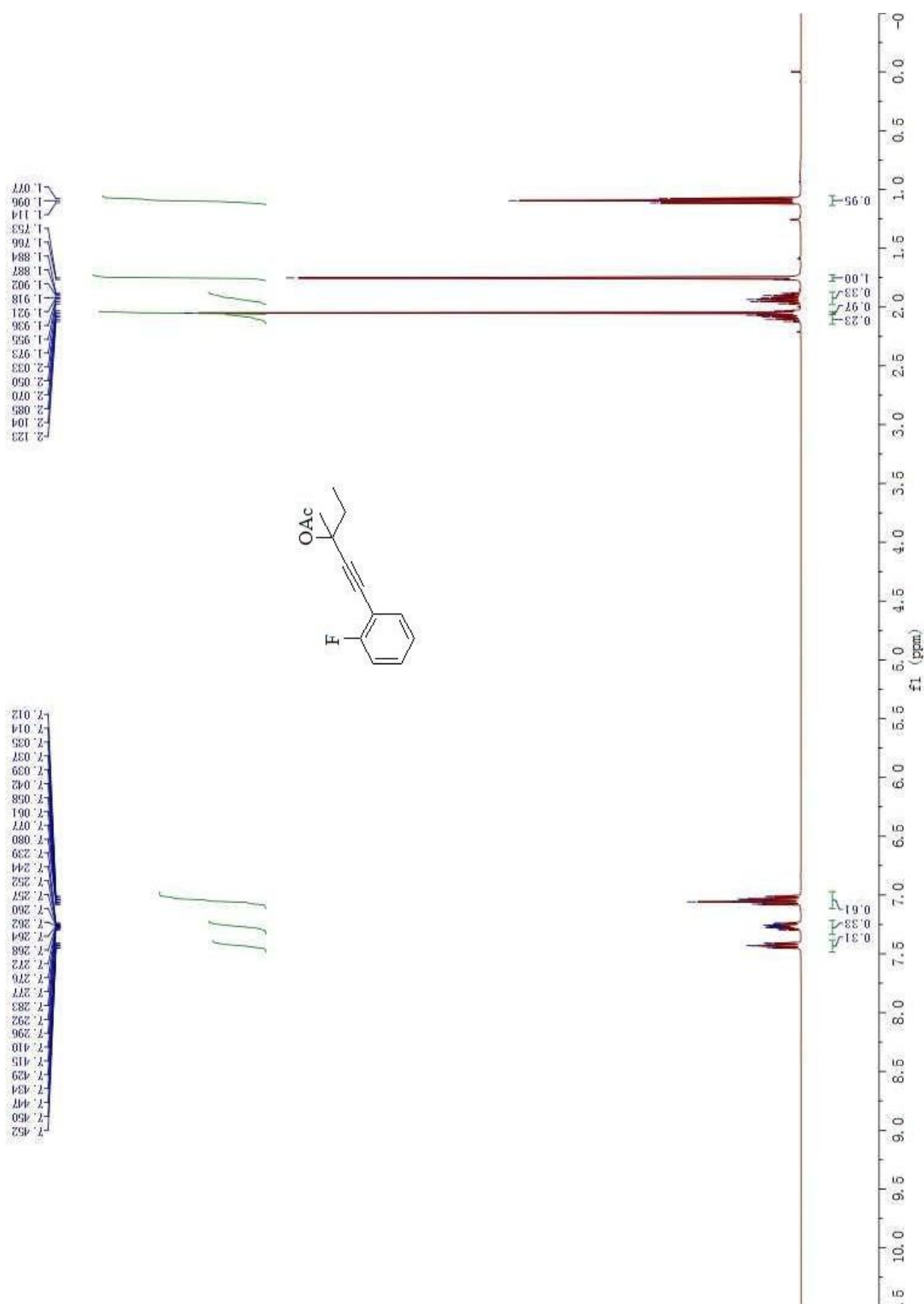
¹H NMR Spectrum of 3-methyl-1-phenylpent-1-yn-3-yl acetate (**4j**)



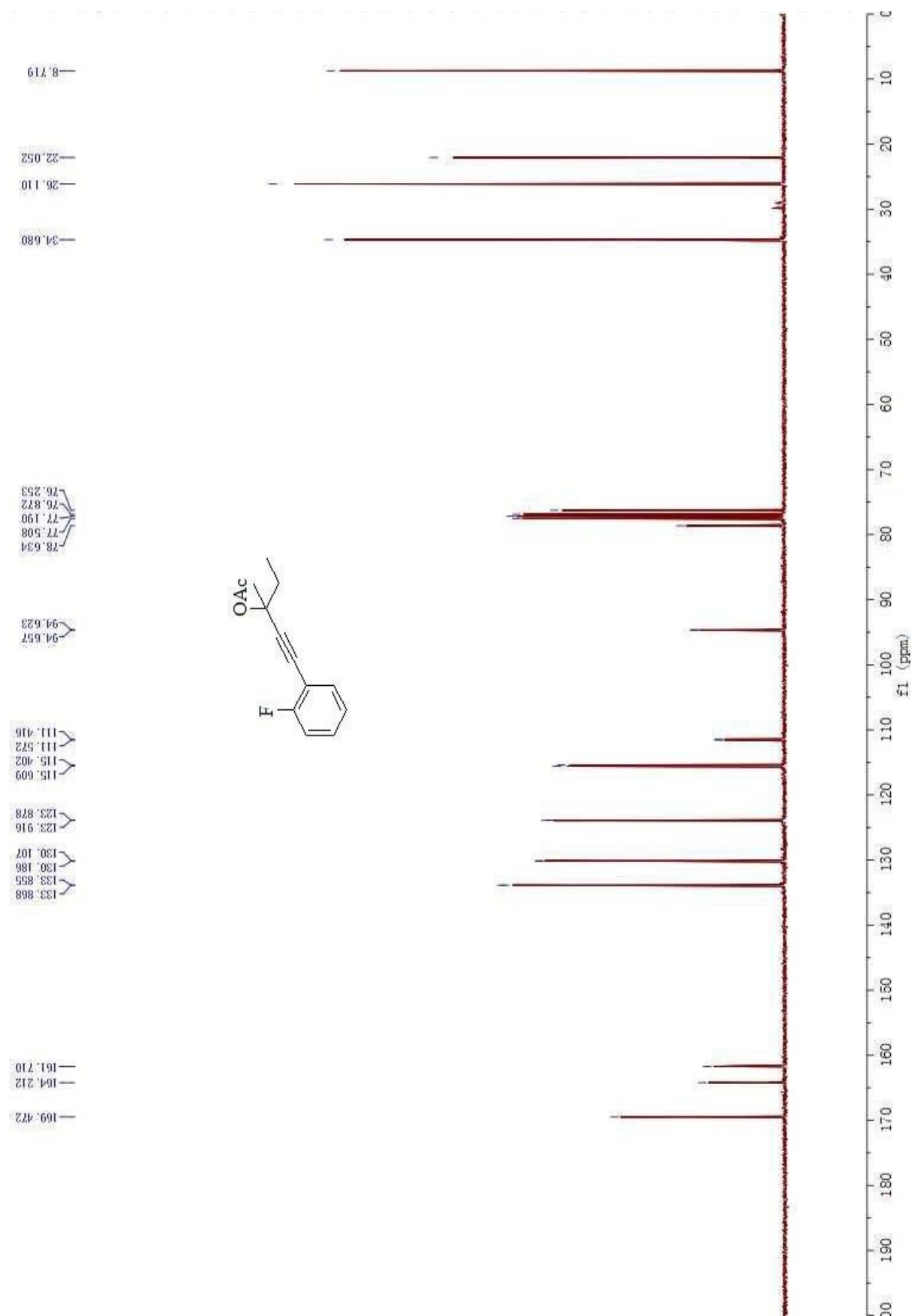
¹³C NMR Spectrum of 3-methyl-1-phenylpent-1-yn-3-yl acetate (**4j**)



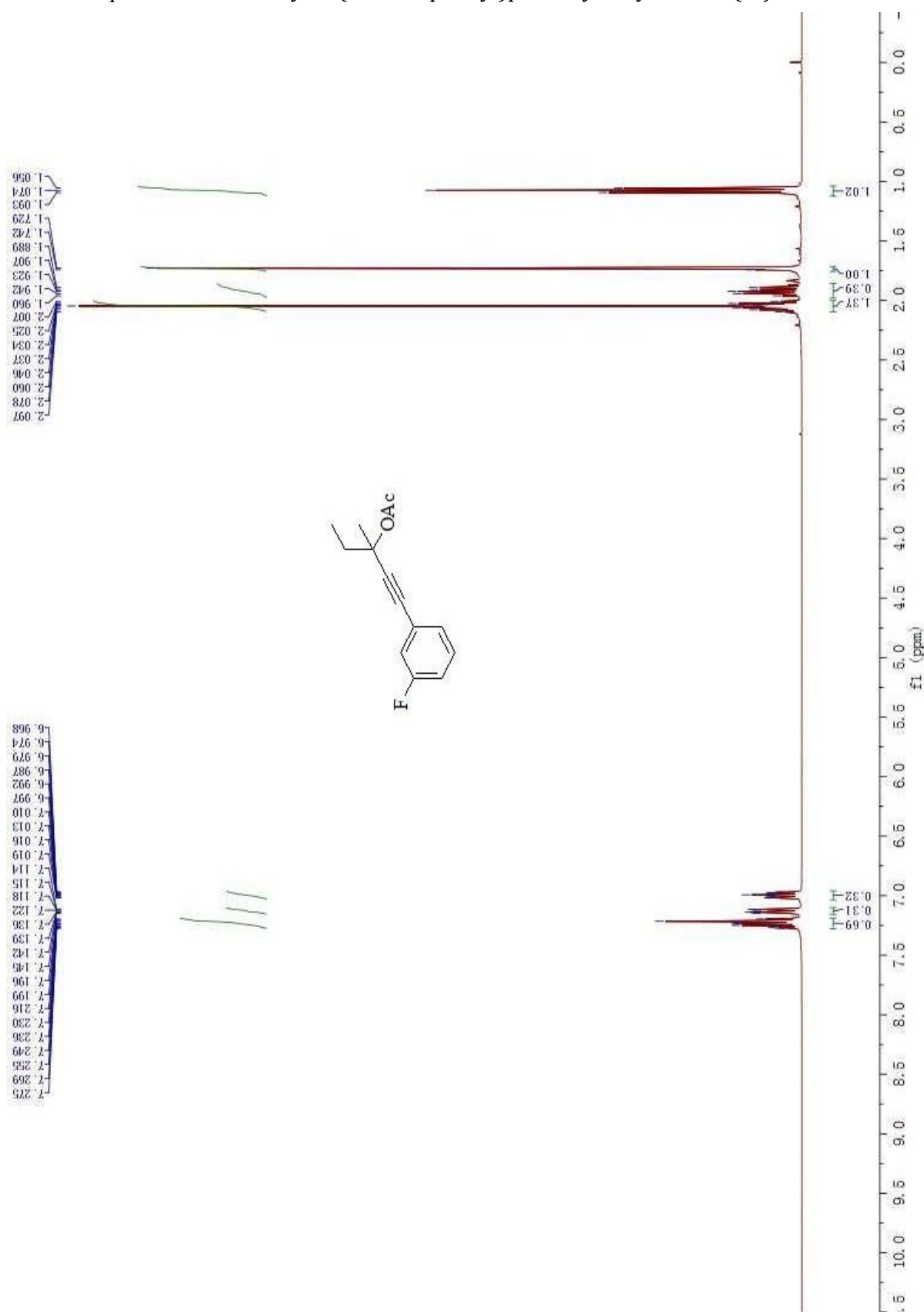
^1H NMR Spectrum of 3-methyl-1-(2-fluorophenyl)pent-1-yn-3-yl acetate (**4k**):



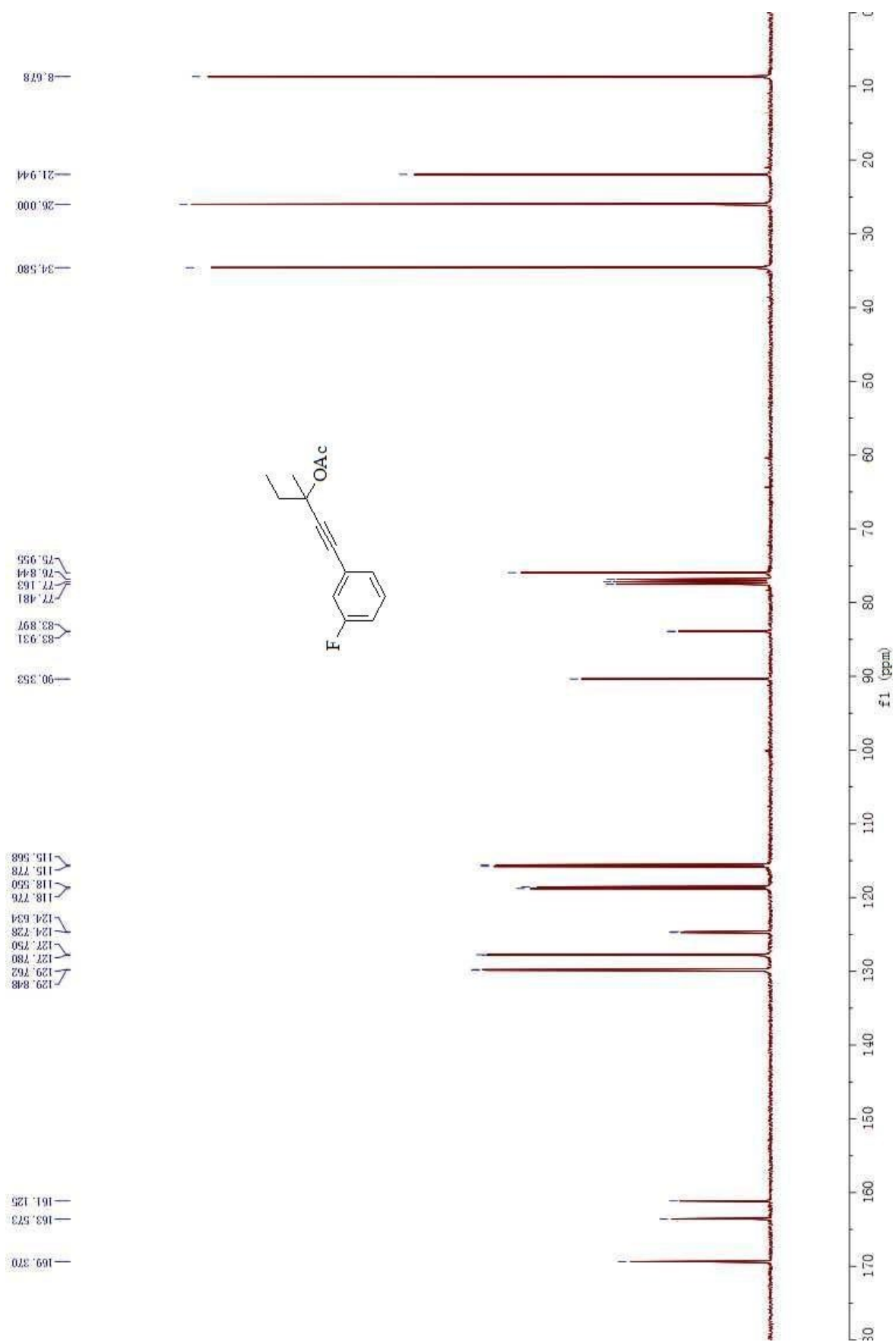
^{13}C NMR Spectrum of 3-methyl-1-(2-fluorophenyl)pent-1-yn-3-yl acetate (**4k**)



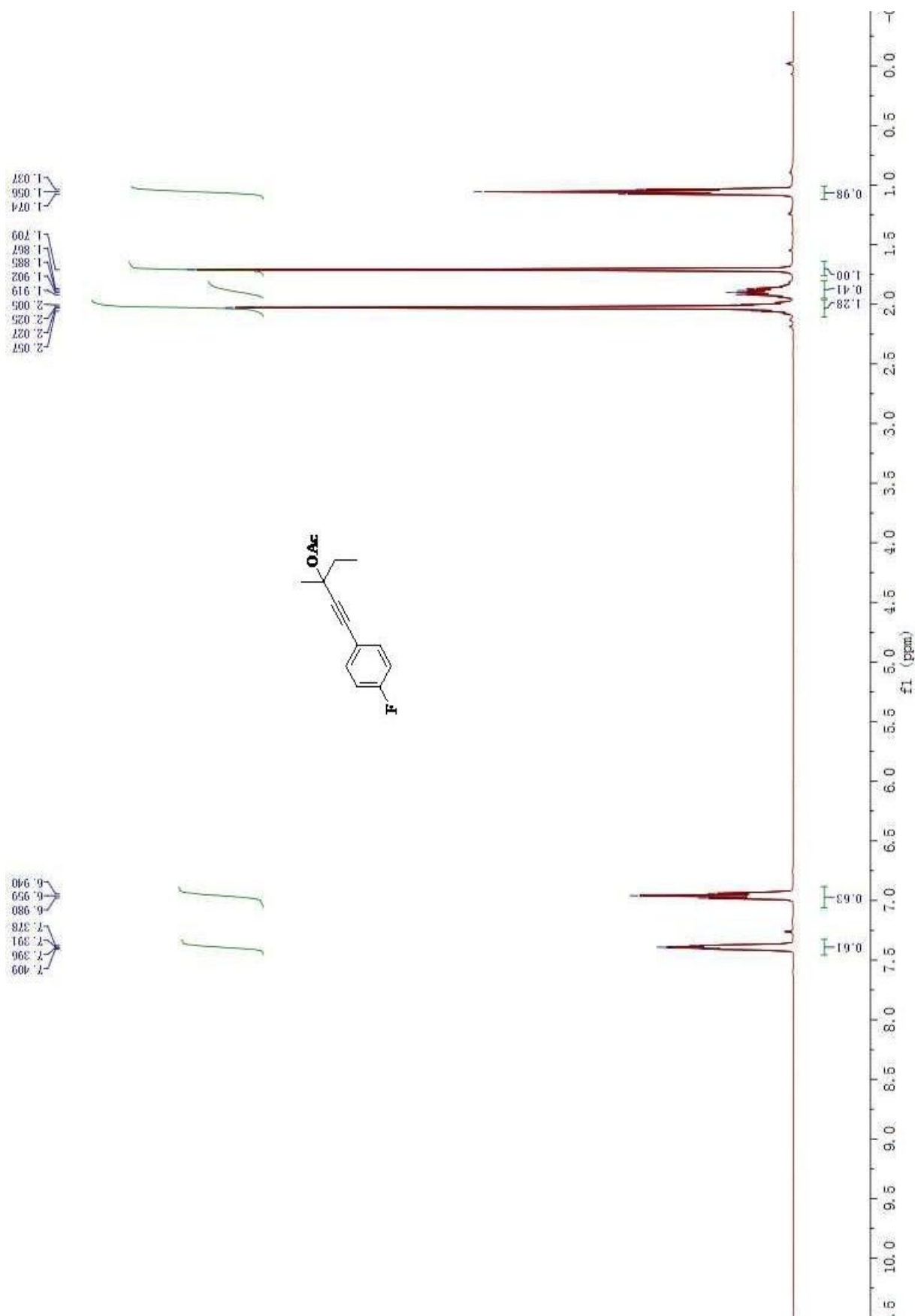
¹H NMR Spectrum of 3-methyl-1-(3-fluorophenyl)pent-1-yn-3-yl acetate(**4l**)



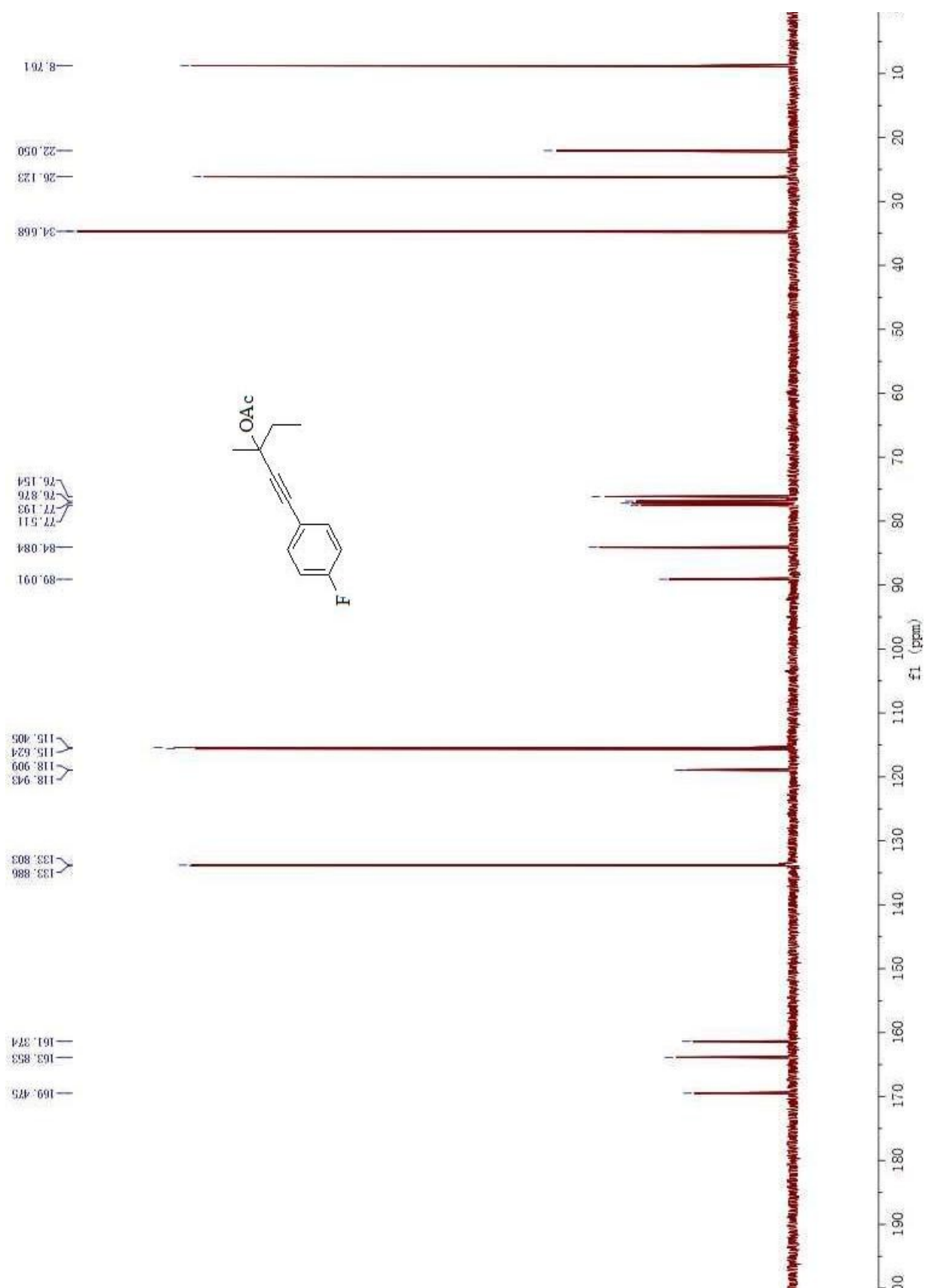
¹³C NMR Spectrum of 3-methyl-1-(3-fluorophenyl)pent-1-yn-3-yl acetate(**4l**)



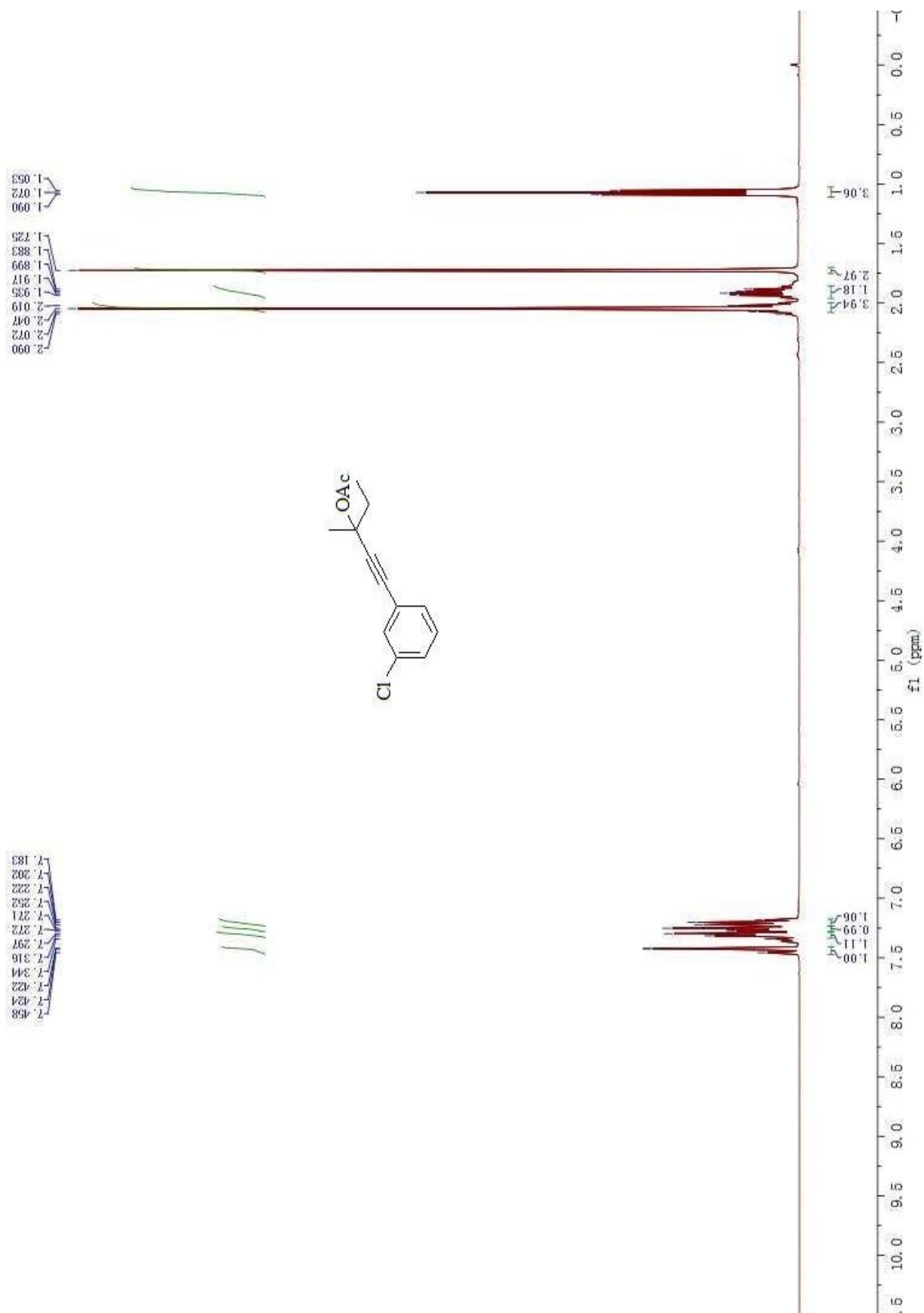
^1H NMR Spectrum of 3-methyl-1-(4-fluorophenyl)pent-1-yn-3-yl acetate (**4m**):



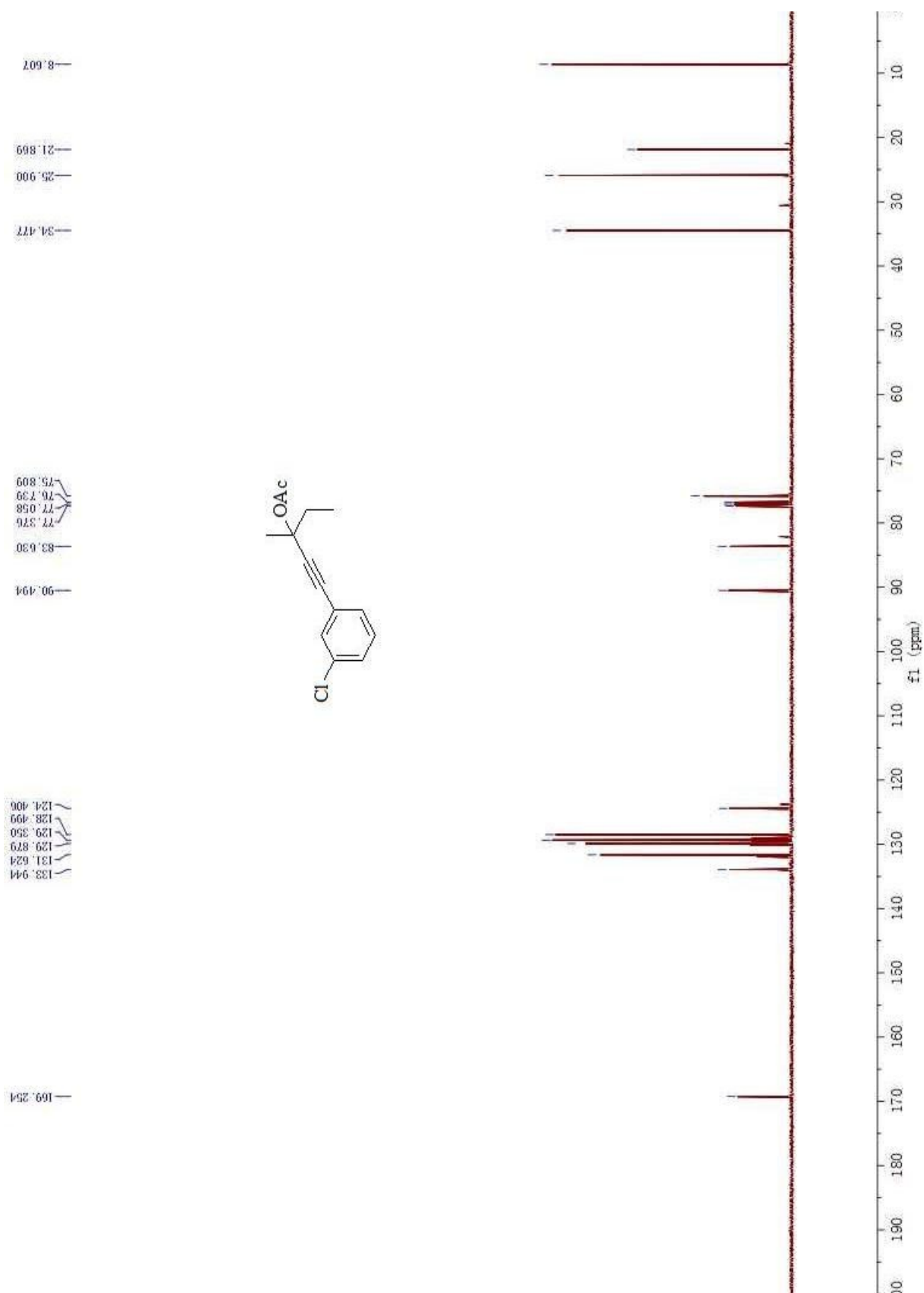
^{13}C NMR Spectrum of 3-methyl-1-(4-fluorophenyl)pent-1-yn-3-yl acetate (**4m**):



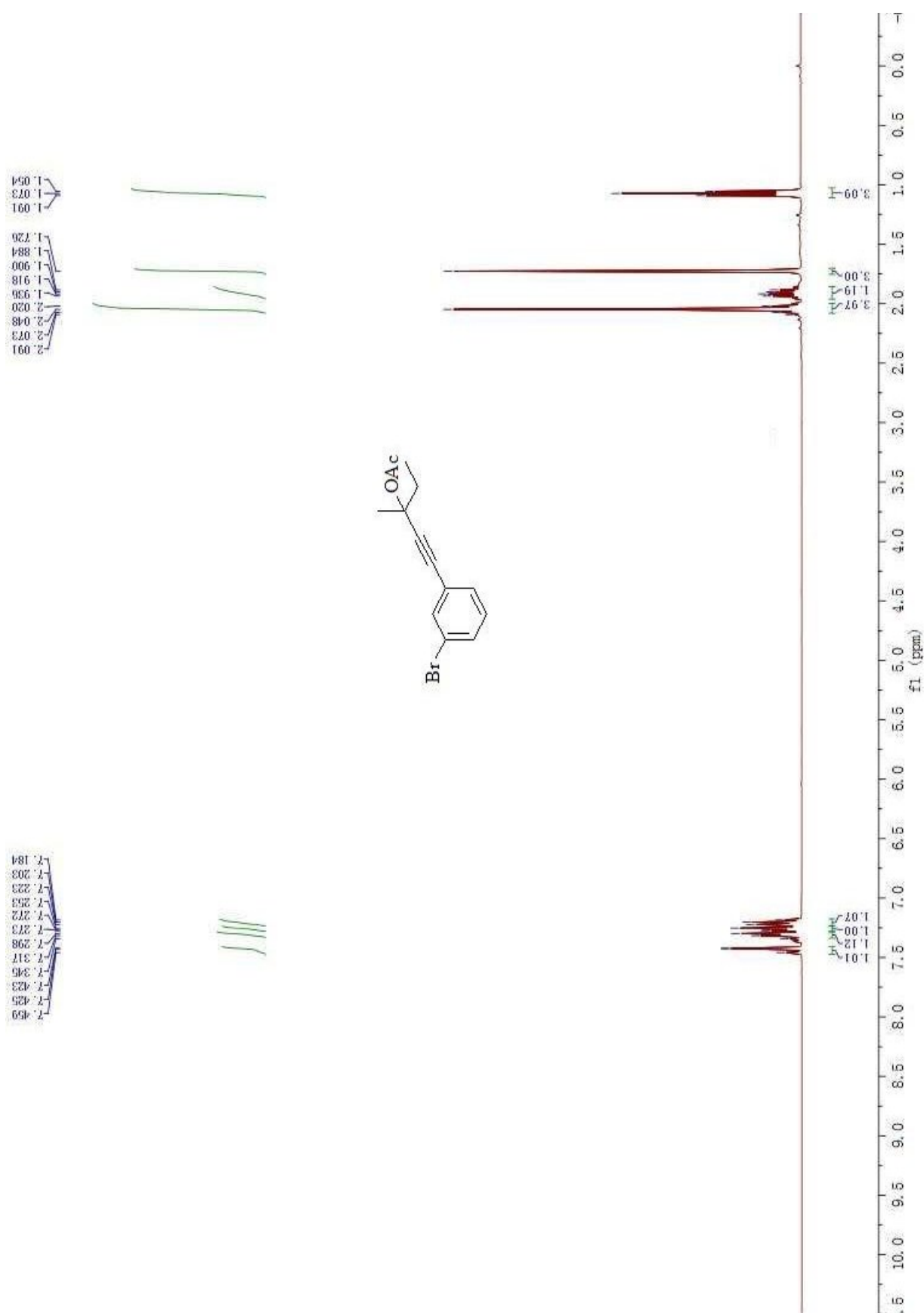
^1H NMR Spectrum of 3-methyl-1-(3-chlorophenyl)pent-1-yn-3-yl acetate (**4n**):



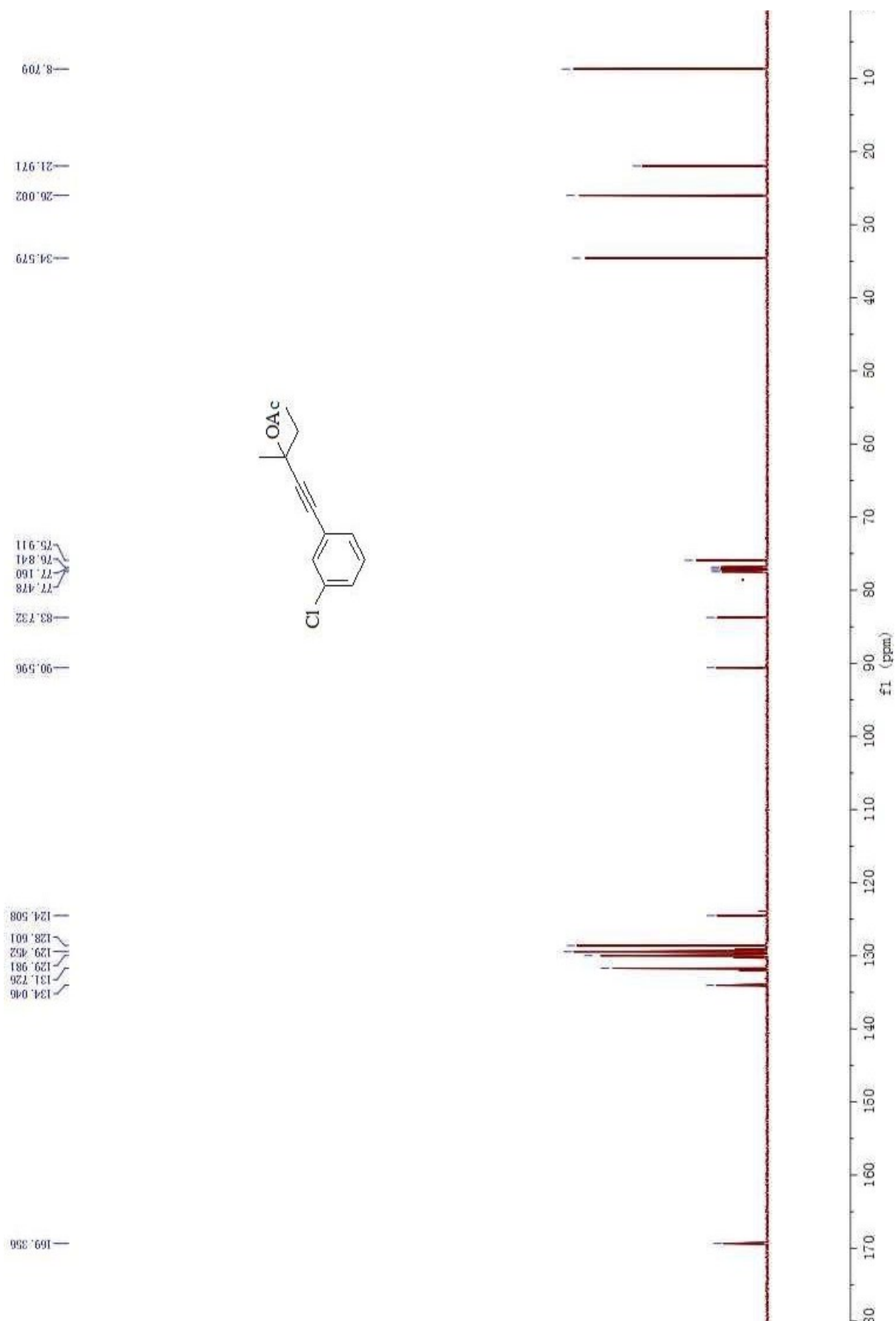
^{13}C NMR Spectrum of 3-methyl-1-(3-chlorophenyl)pent-1-yn-3-yl acetate (**4n**):



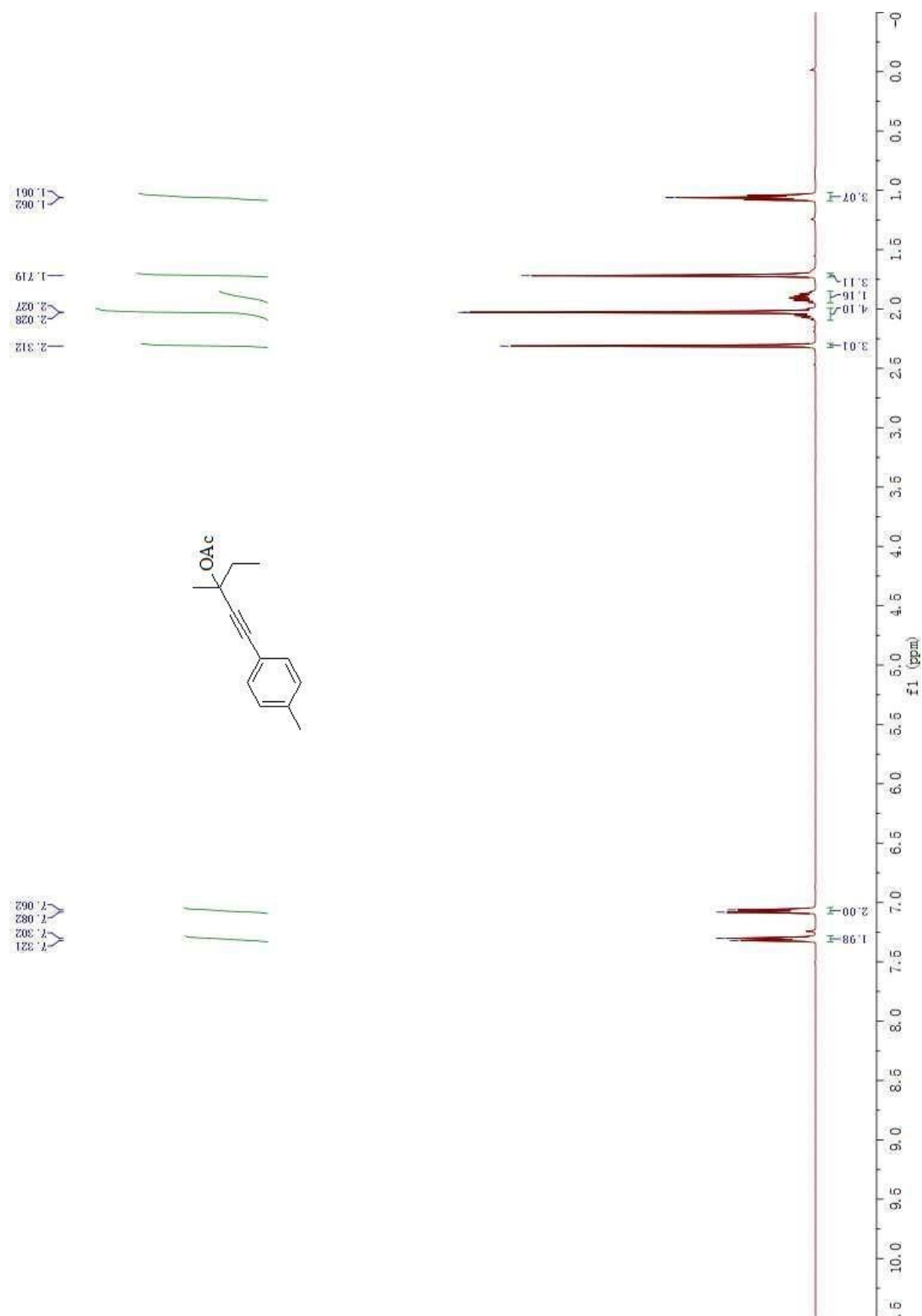
^1H NMR Spectrum of 3-methyl-1-(3-bromophenyl)pent-1-yn-3-yl acetate (**4o**):



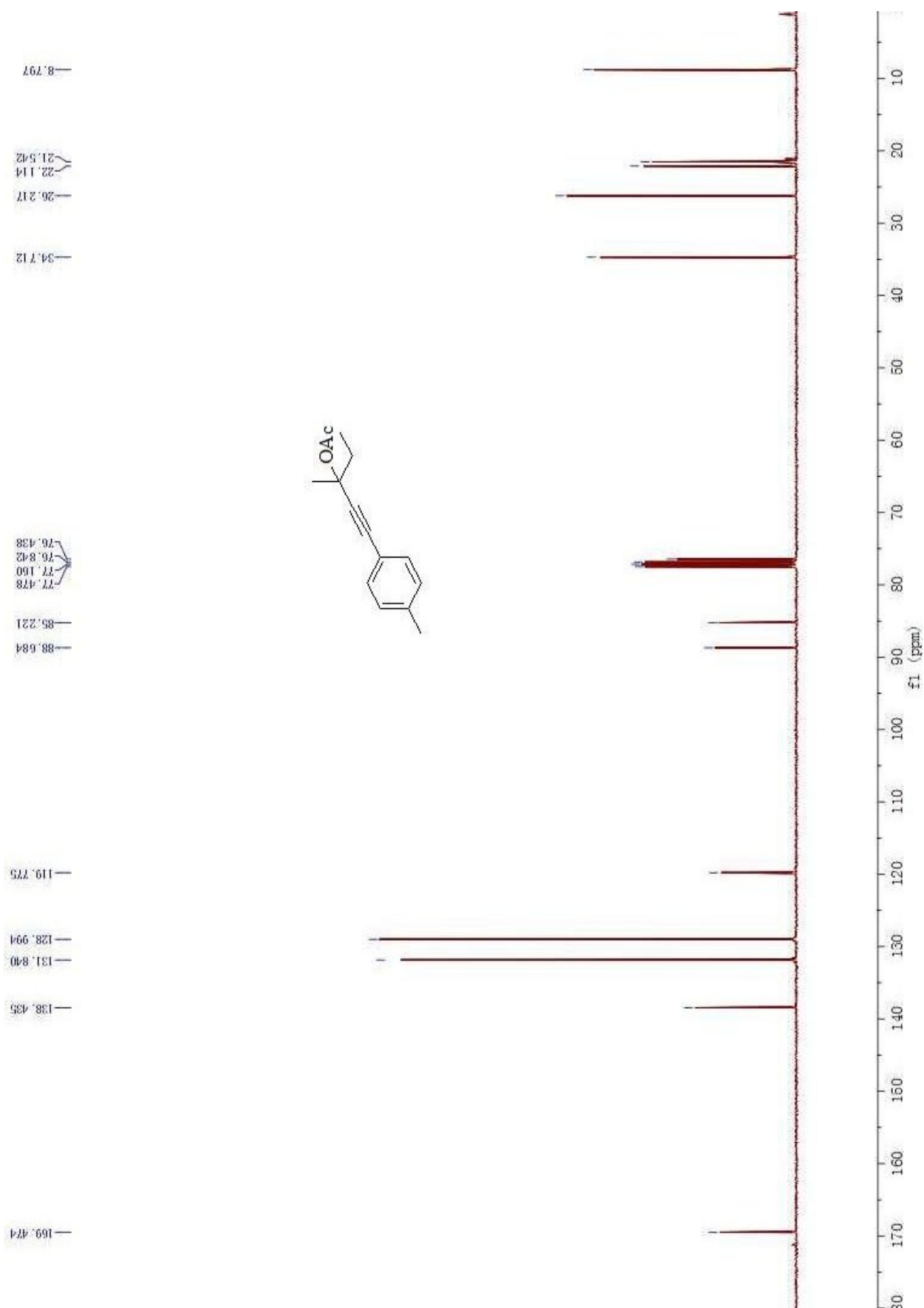
^{13}C NMR Spectrum of 3-methyl-1-(3-bromophenyl)pent-1-yn-3-yl acetate (**4o**):



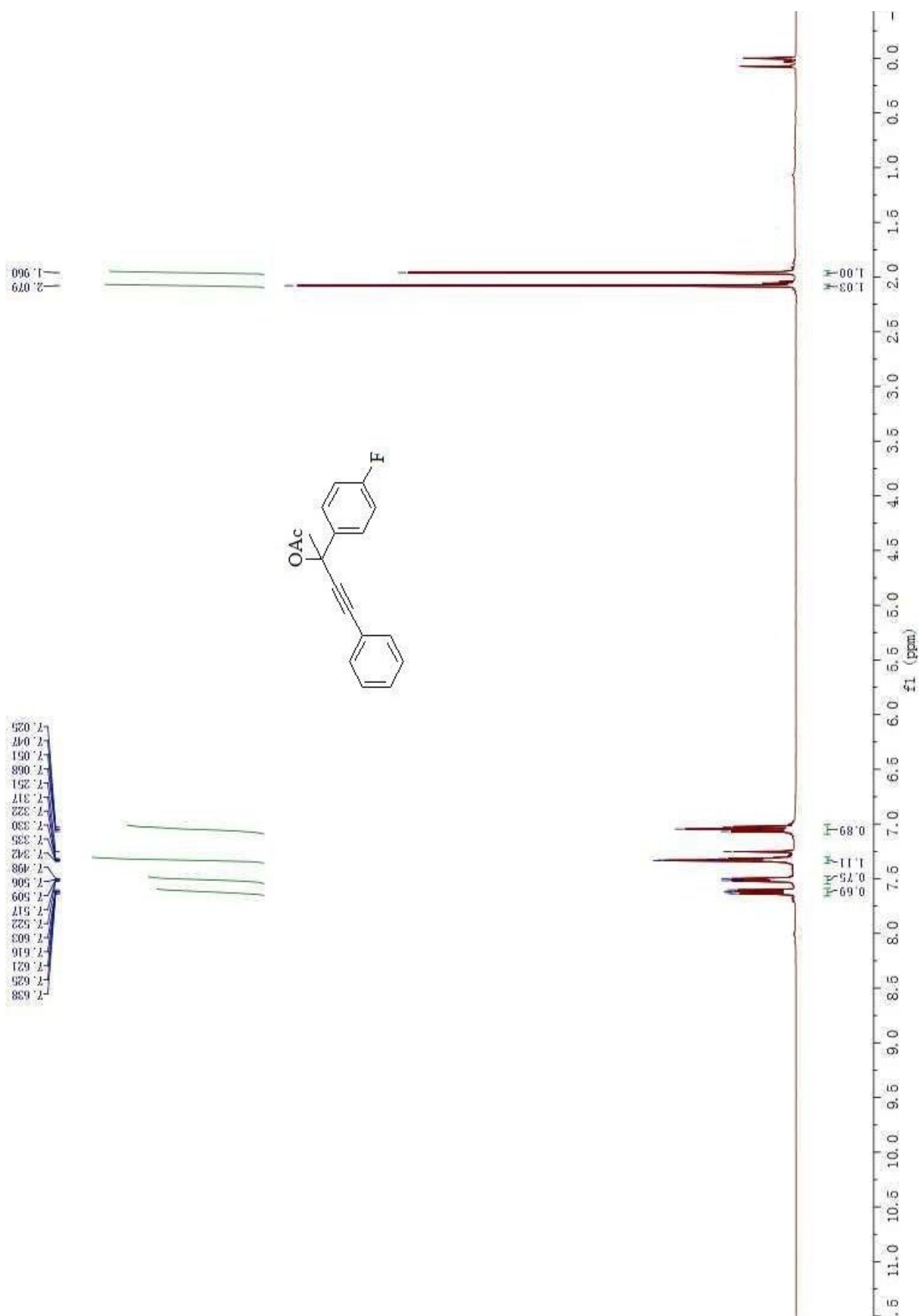
^1H NMR Spectrum of 3-methyl-1-(4-methylphenyl)pent-1-yn-3-yl acetate (**4p**):



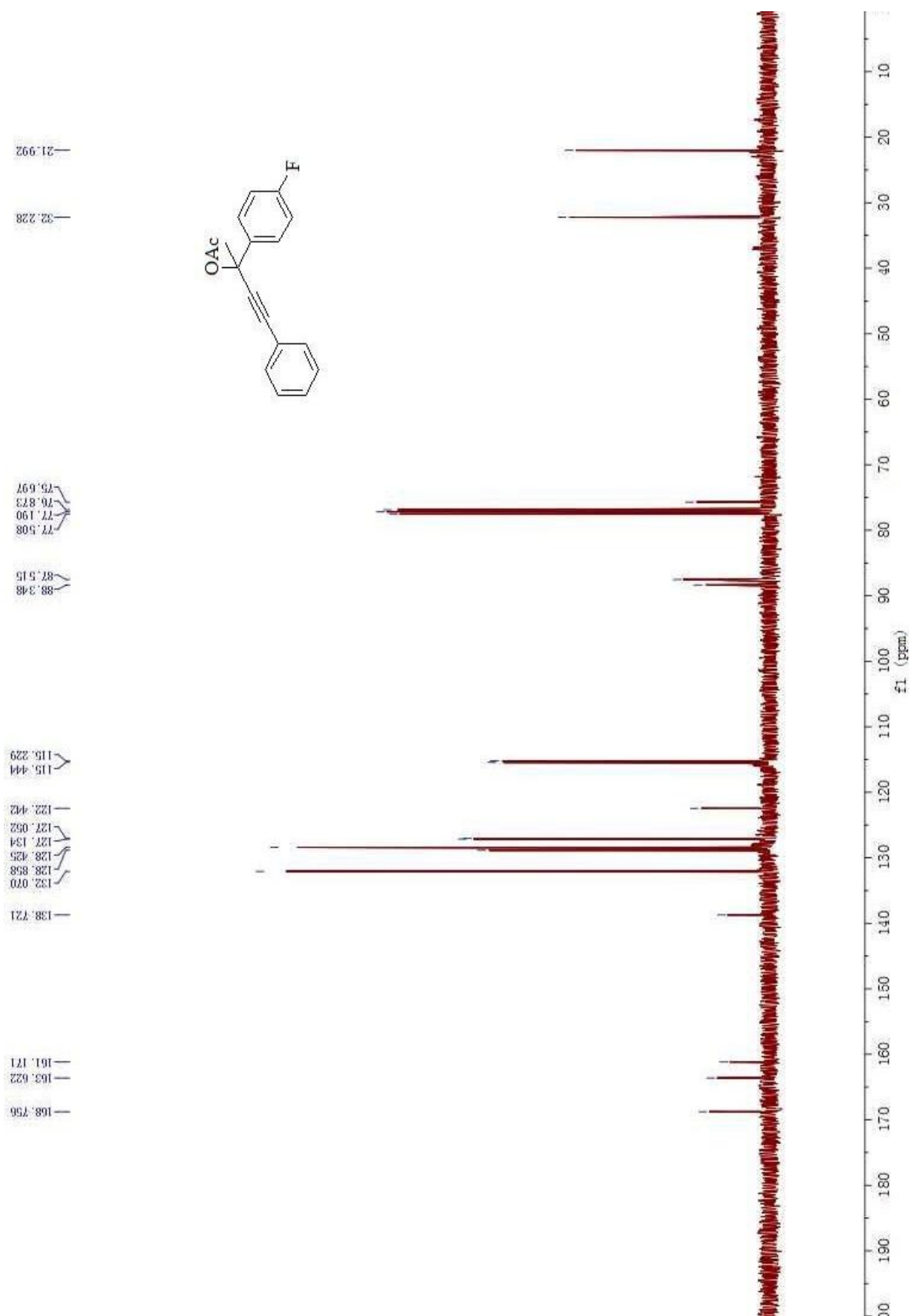
^{13}C NMR Spectrum of 3-methyl-1-(4-methylphenyl)pent-1-yn-3-yl acetate (**4p**):



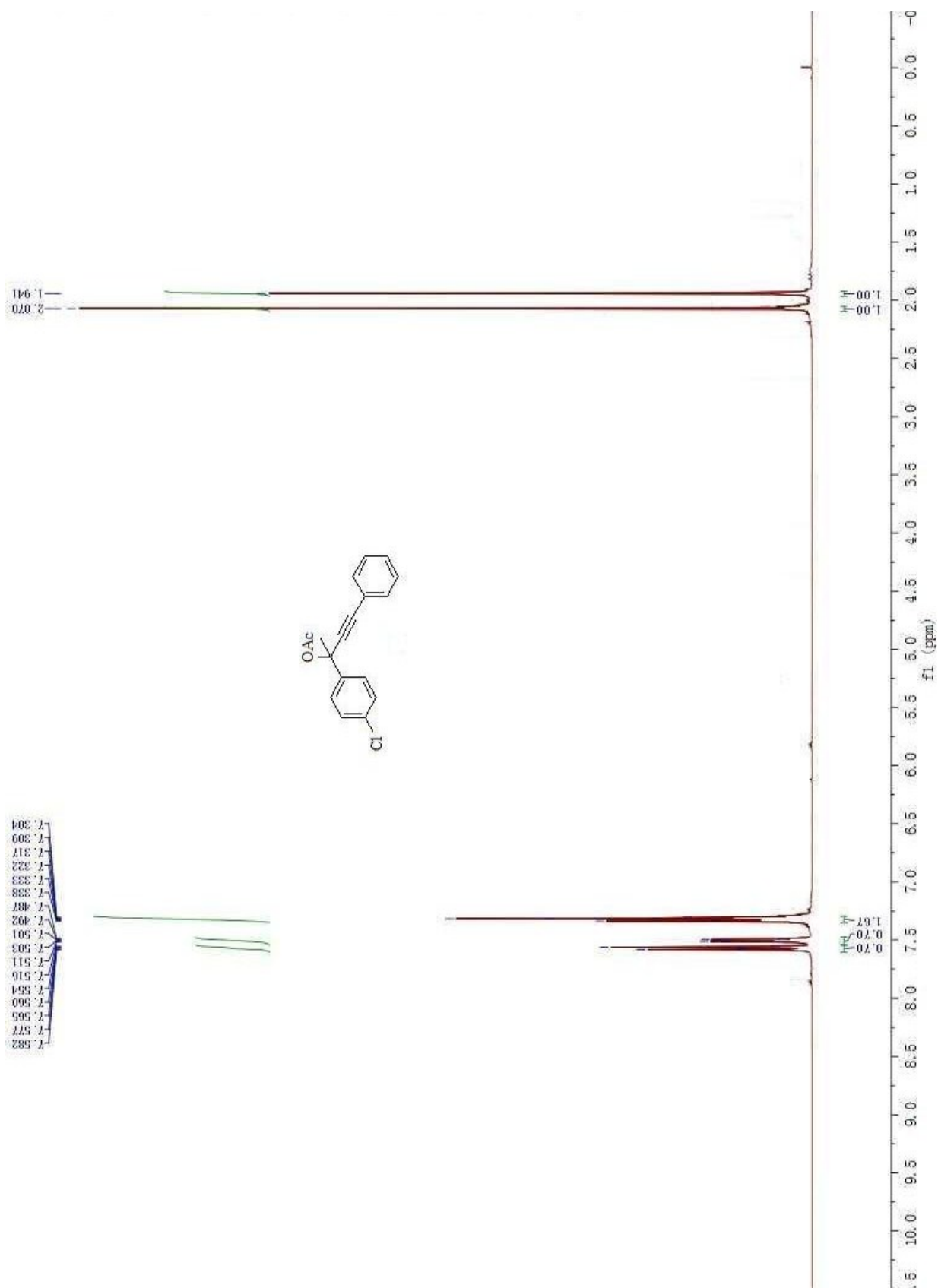
^1H NMR Spectrum of 4-(4-fluorophenyl)-2-phenylbut-3-yn-2-yl acetate(**4q**):



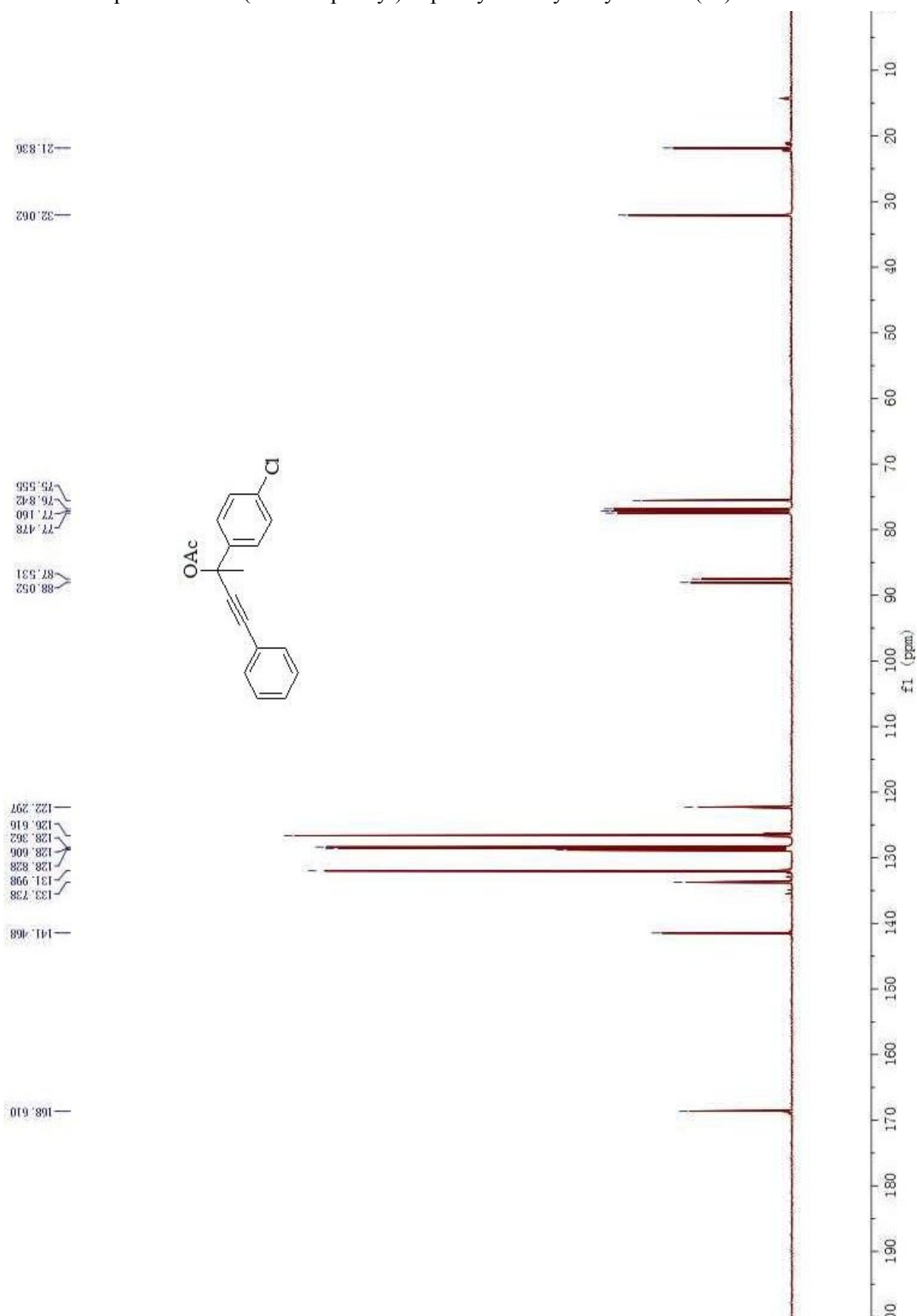
^{13}C NMR Spectrum of 4-(4-fluorophenyl)-2-phenylbut-3-yn-2-yl acetate(**4q**):



^1H NMR Spectrum of 4-(4-chlorophenyl)-2-phenylbut-3-yn-2-yl acetate(**4r**):

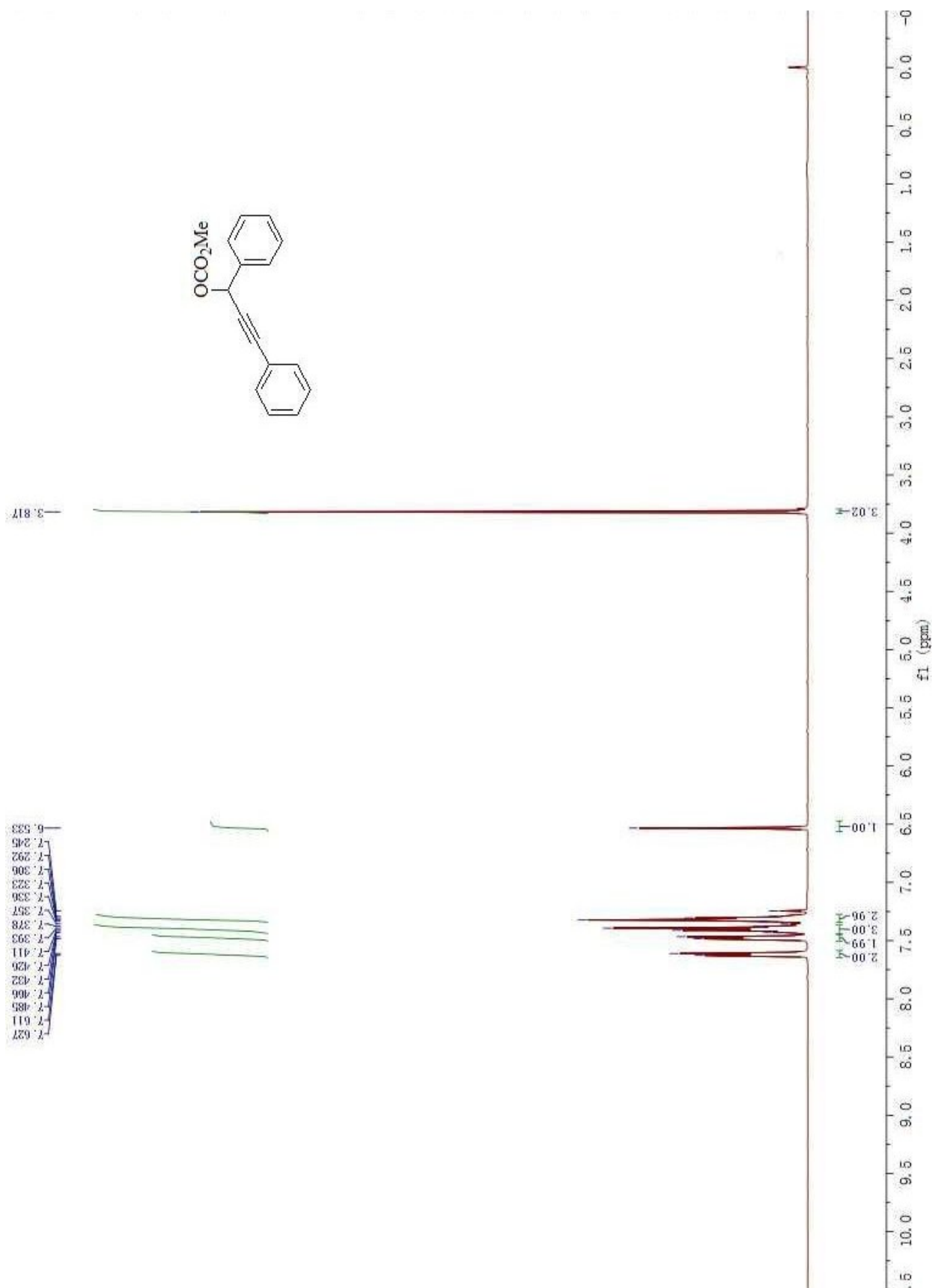


^{13}C NMR Spectrum of 4-(4-chlorophenyl)-2-phenylbut-3-yn-2-yl acetate(**4r**):

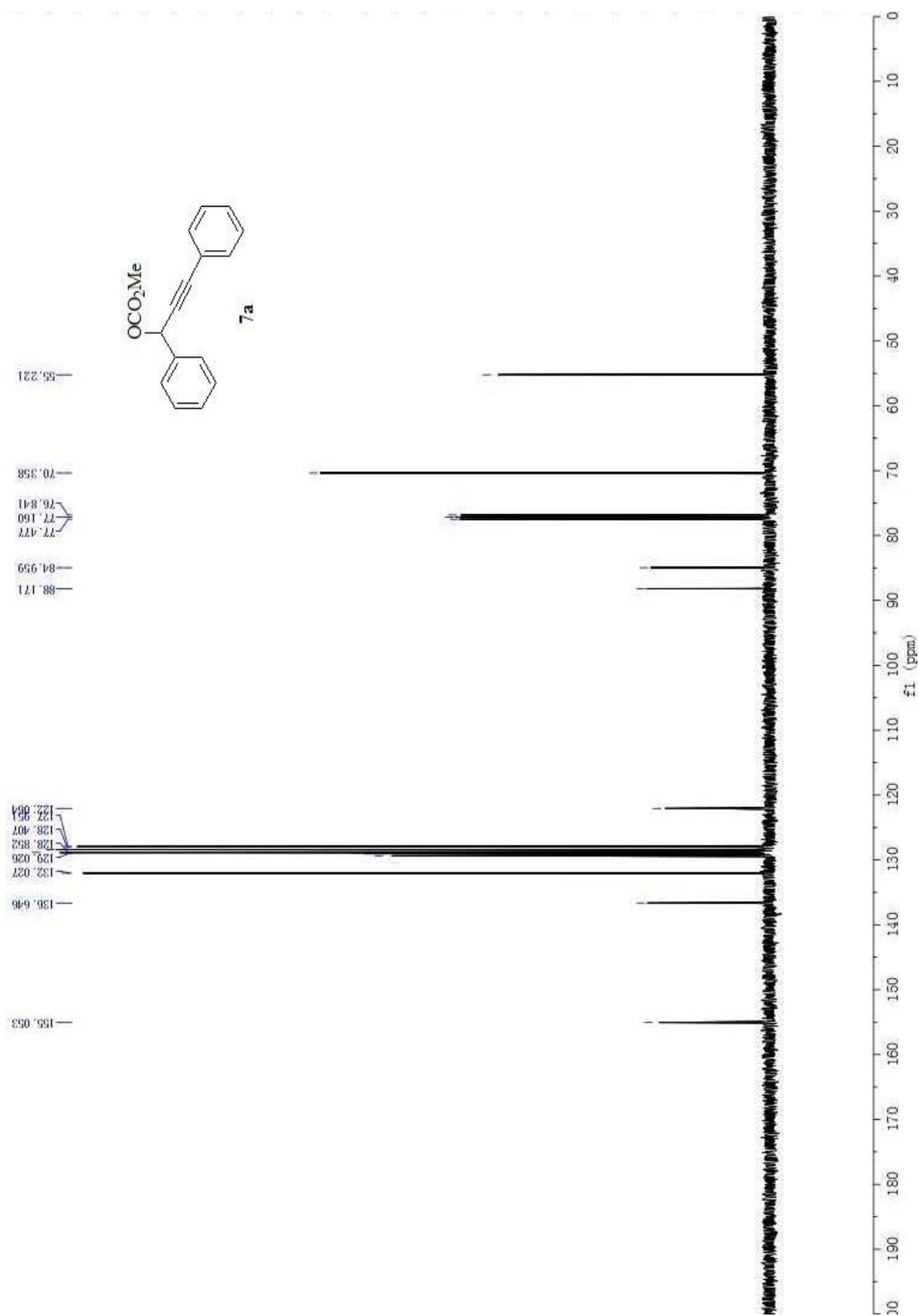


II. ^1H and ^{13}C NMR Spectra of Propargyl carbonate 7(a,b).

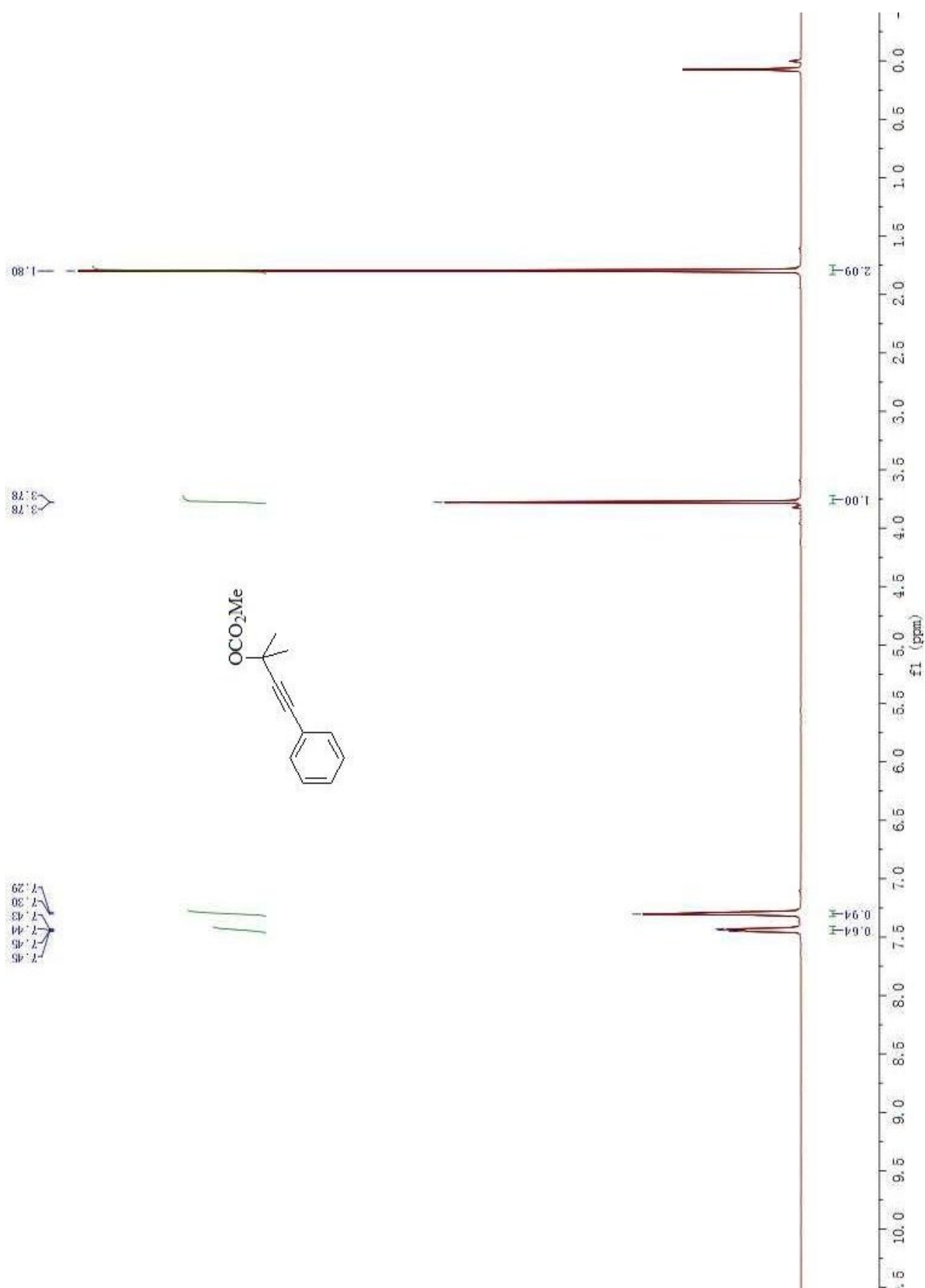
^1H NMR Spectrum of 1,3-Diphenylprop-2-ynyl methyl carbonate (**7a**)



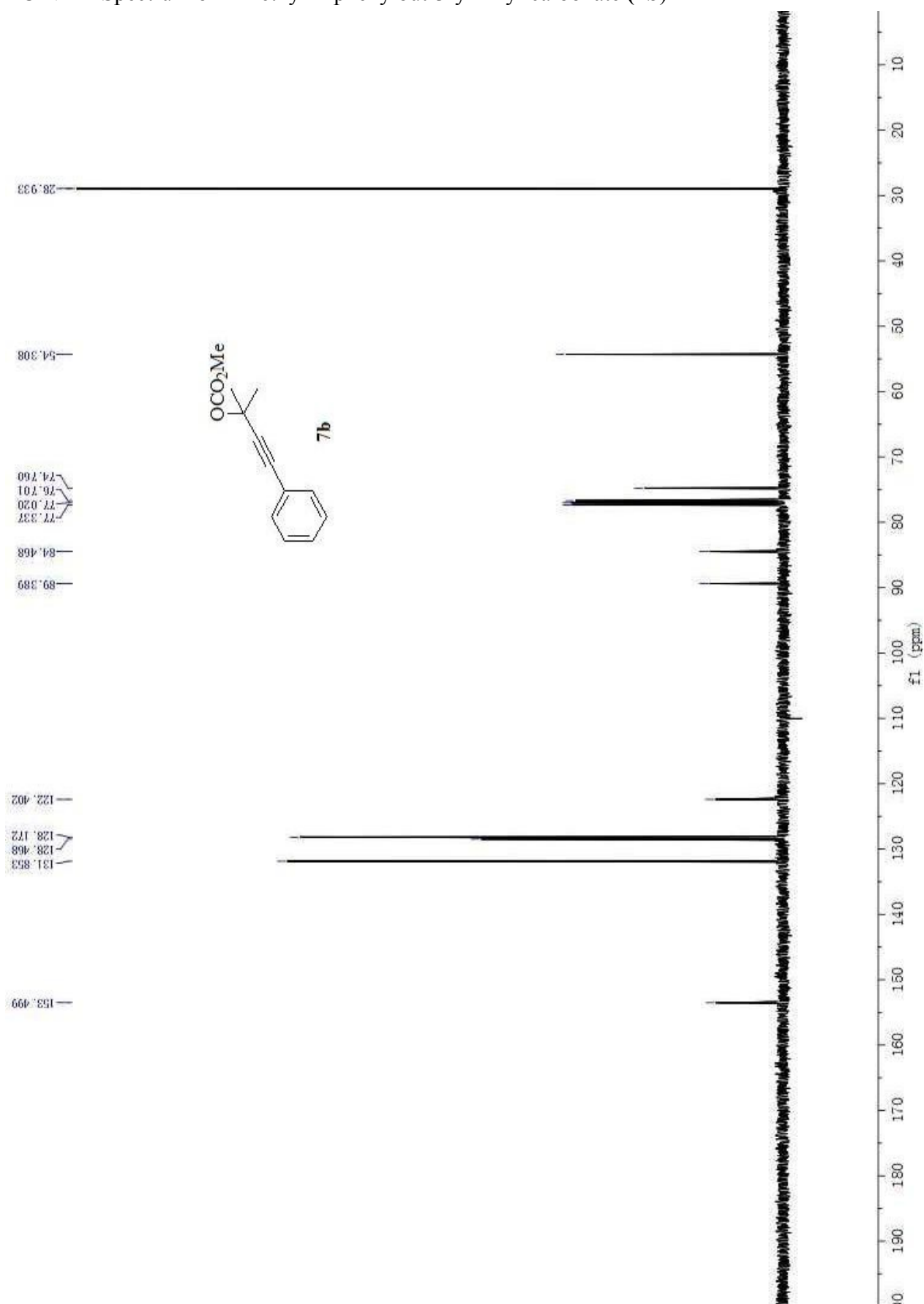
¹³C NMR Spectrum of 1,3-Diphenylprop-2-ynyl methyl carbonate (**7a**)



^1H NMR Spectrum of 2-methyl-4-phenylbut-3-yn-2-yl carbonate (**7b**)

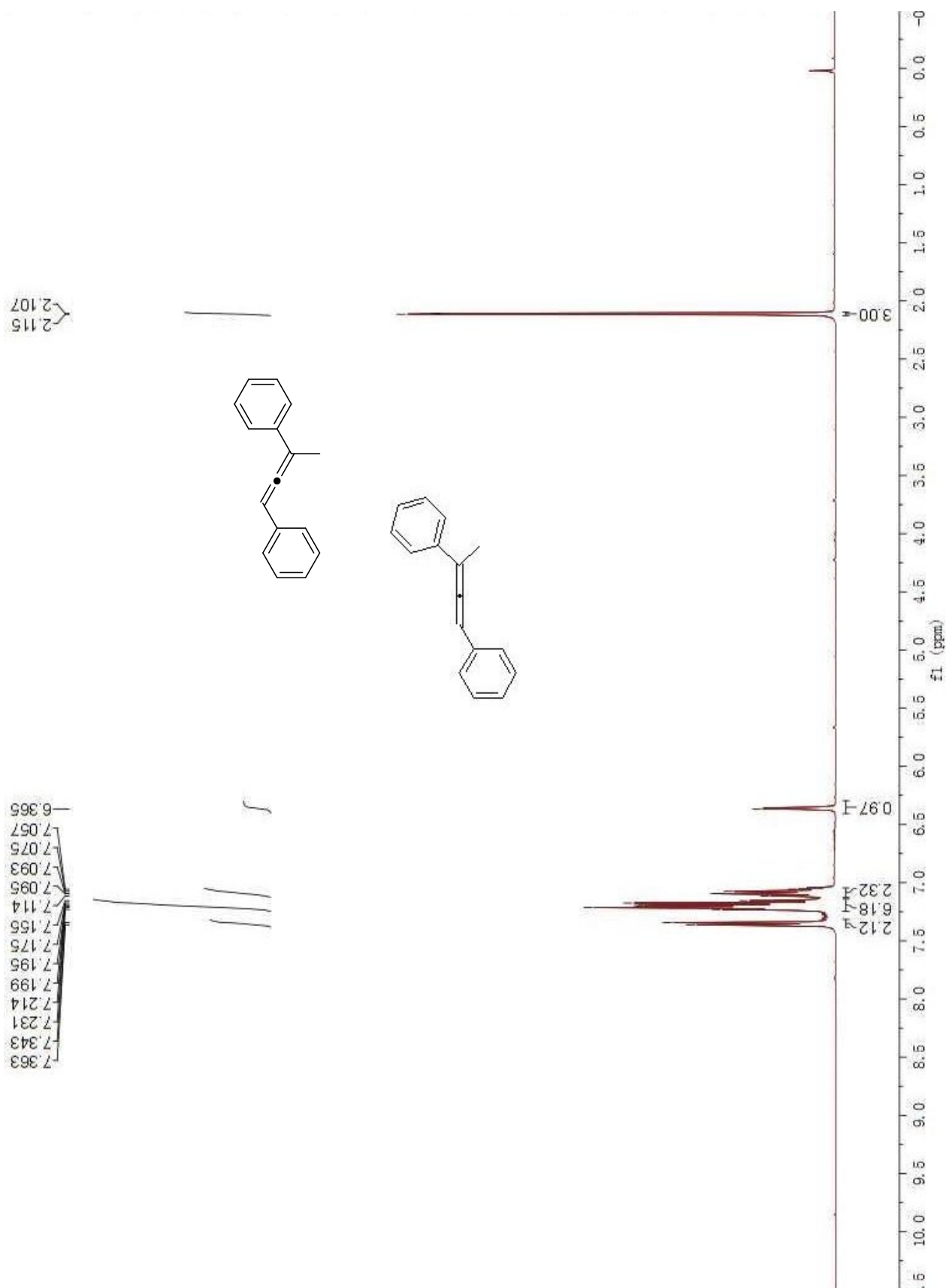


^{13}C NMR Spectrum of 2-methyl-4-phenylbut-3-yn-2-yl carbonate (**7b**)

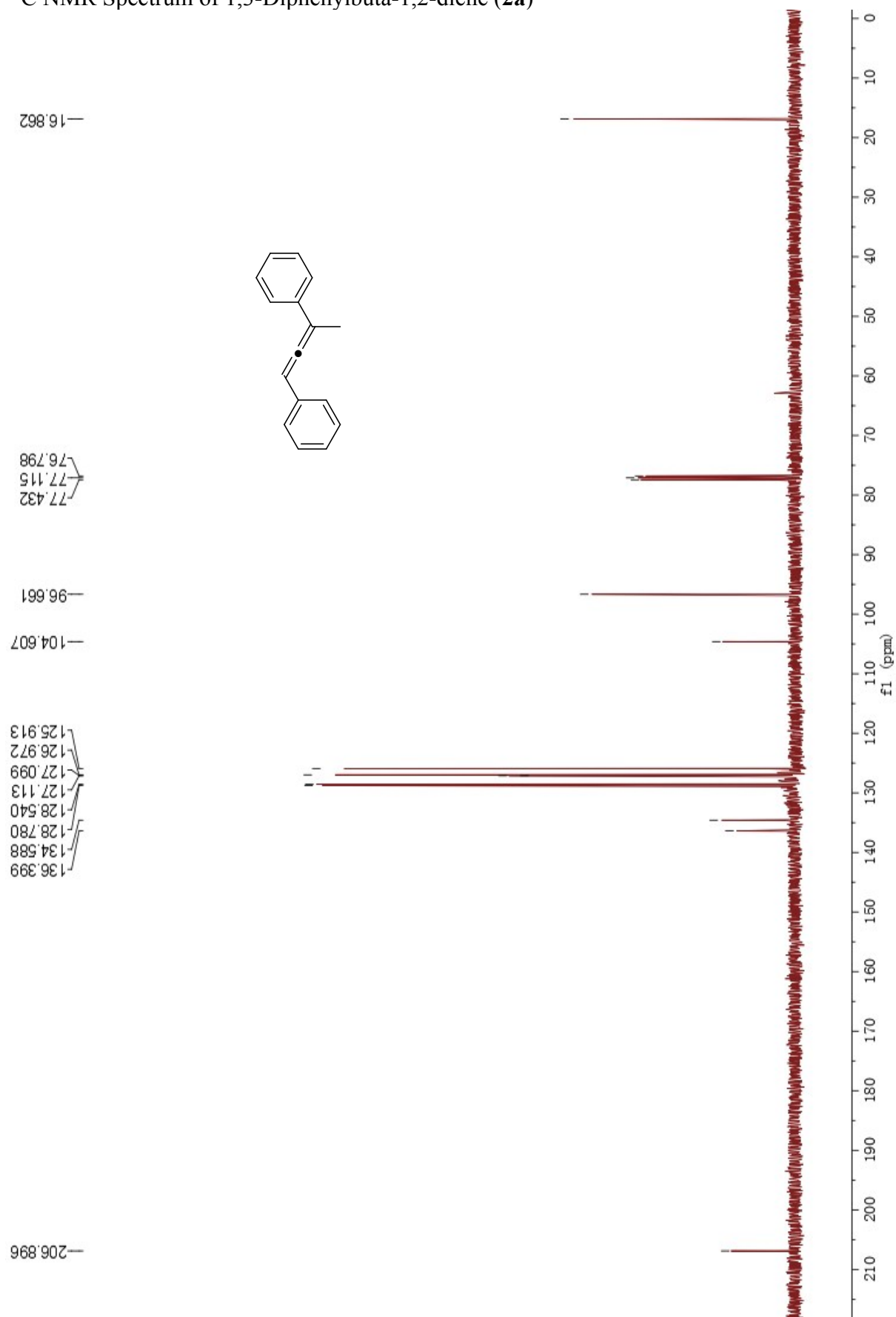


III. ^1H and ^{13}C NMR Spectra of Coupling Products

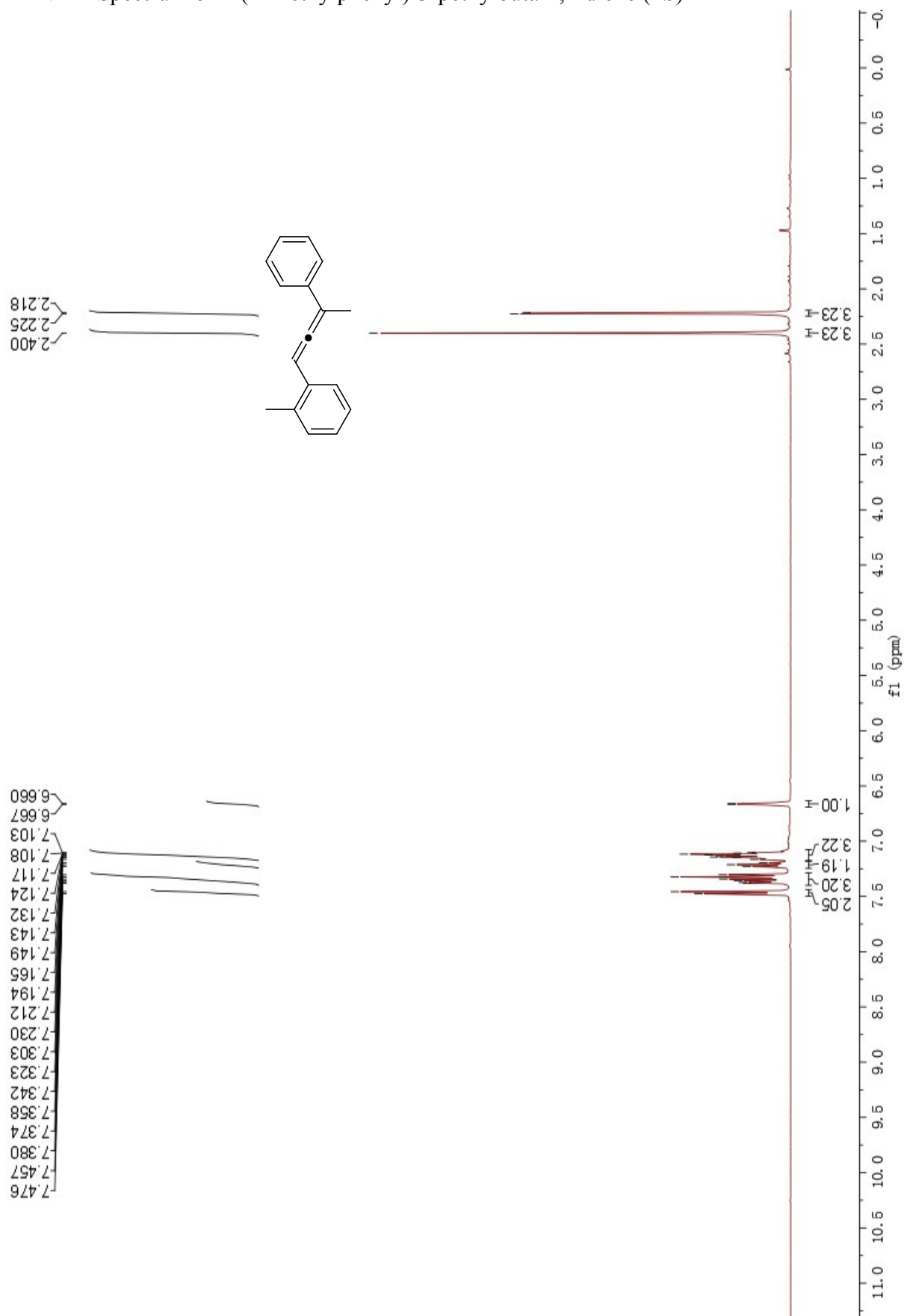
^1H NMR Spectrum of 1,3-Diphenylbuta-1,2-diene (**2a**)



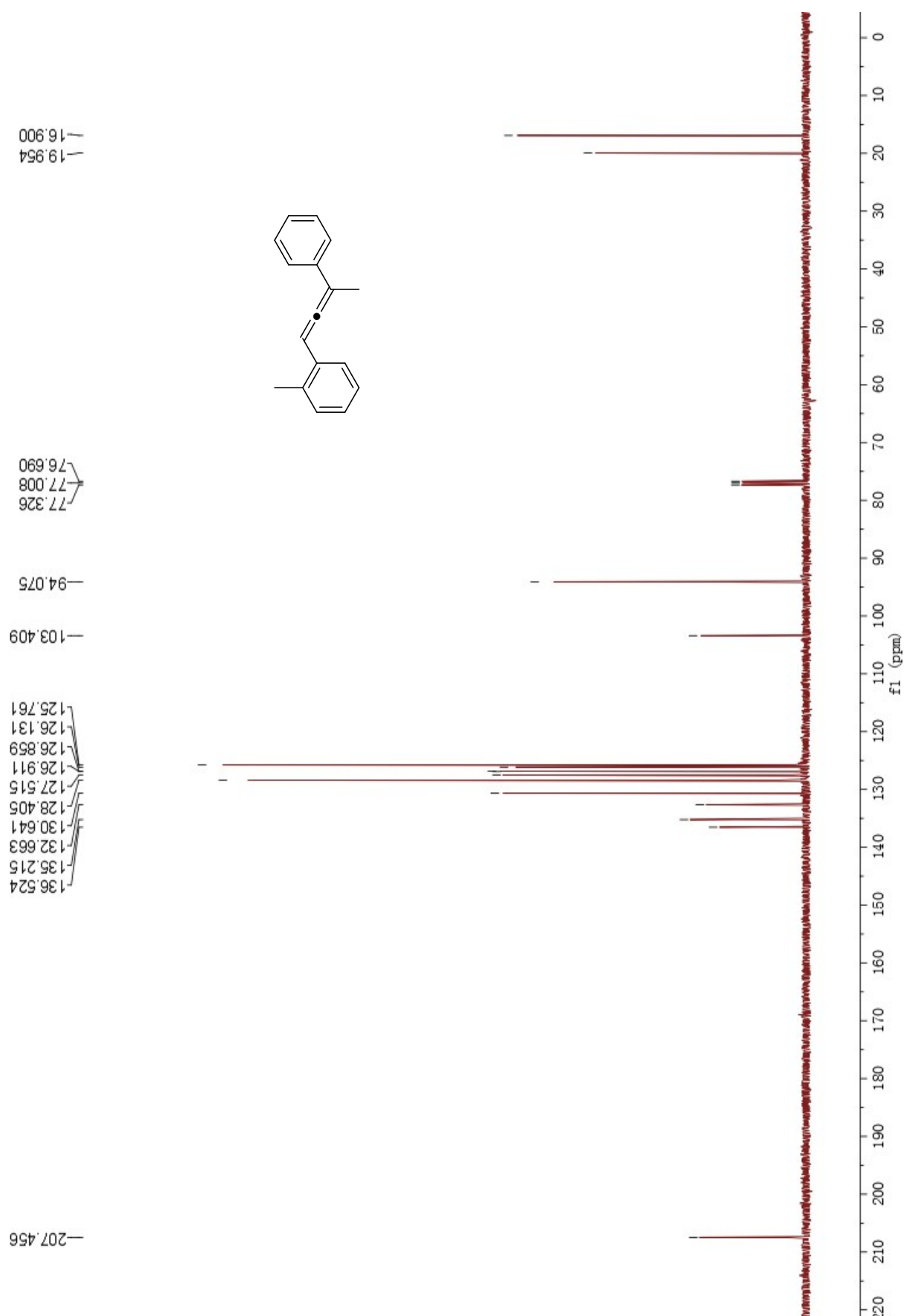
^{13}C NMR Spectrum of 1,3-Diphenylbuta-1,2-diene (**2a**)



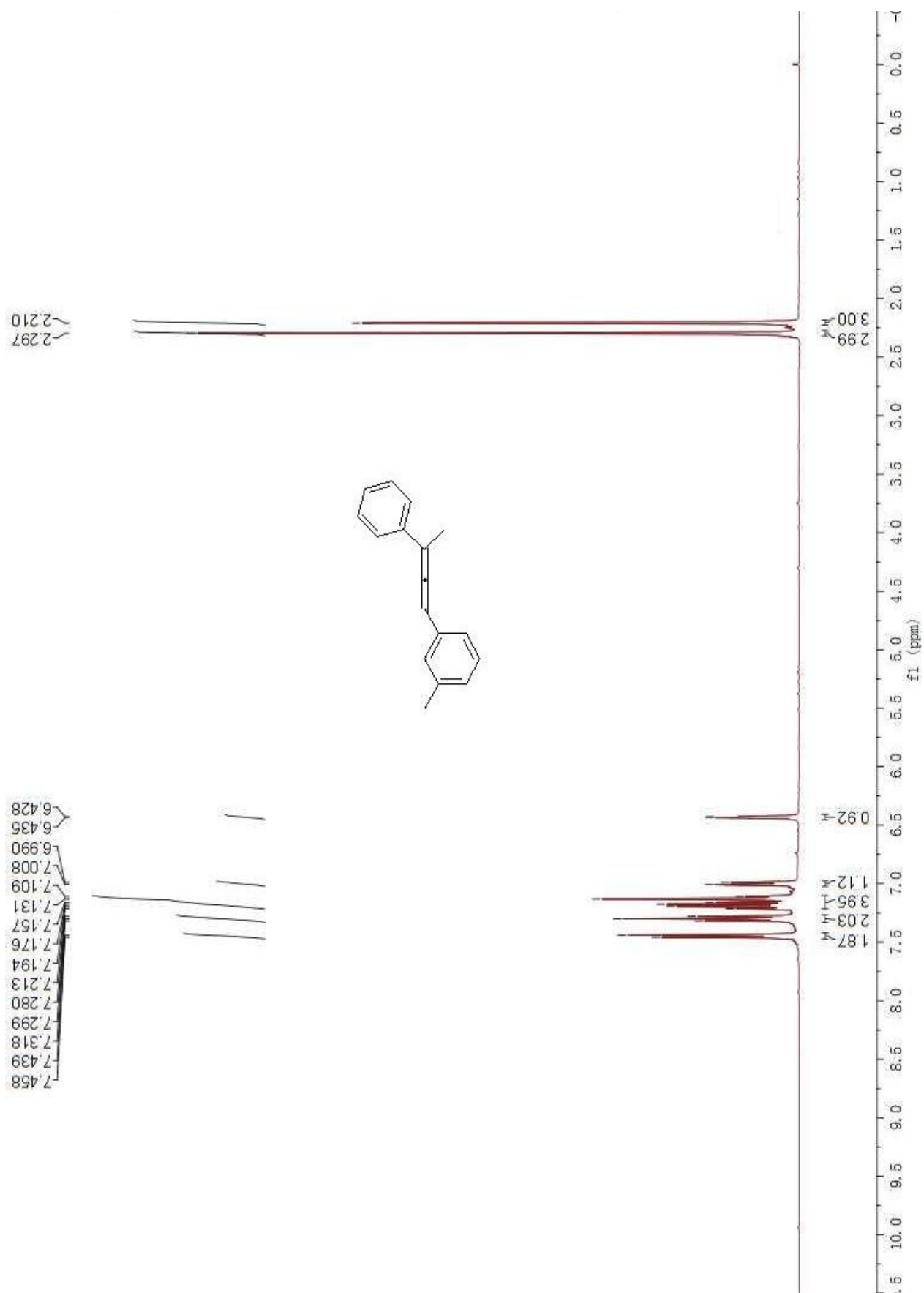
^1H NMR Spectrum of 1-(2-Methylphenyl)-3-pethylbuta-1,2-diene (**2b**)



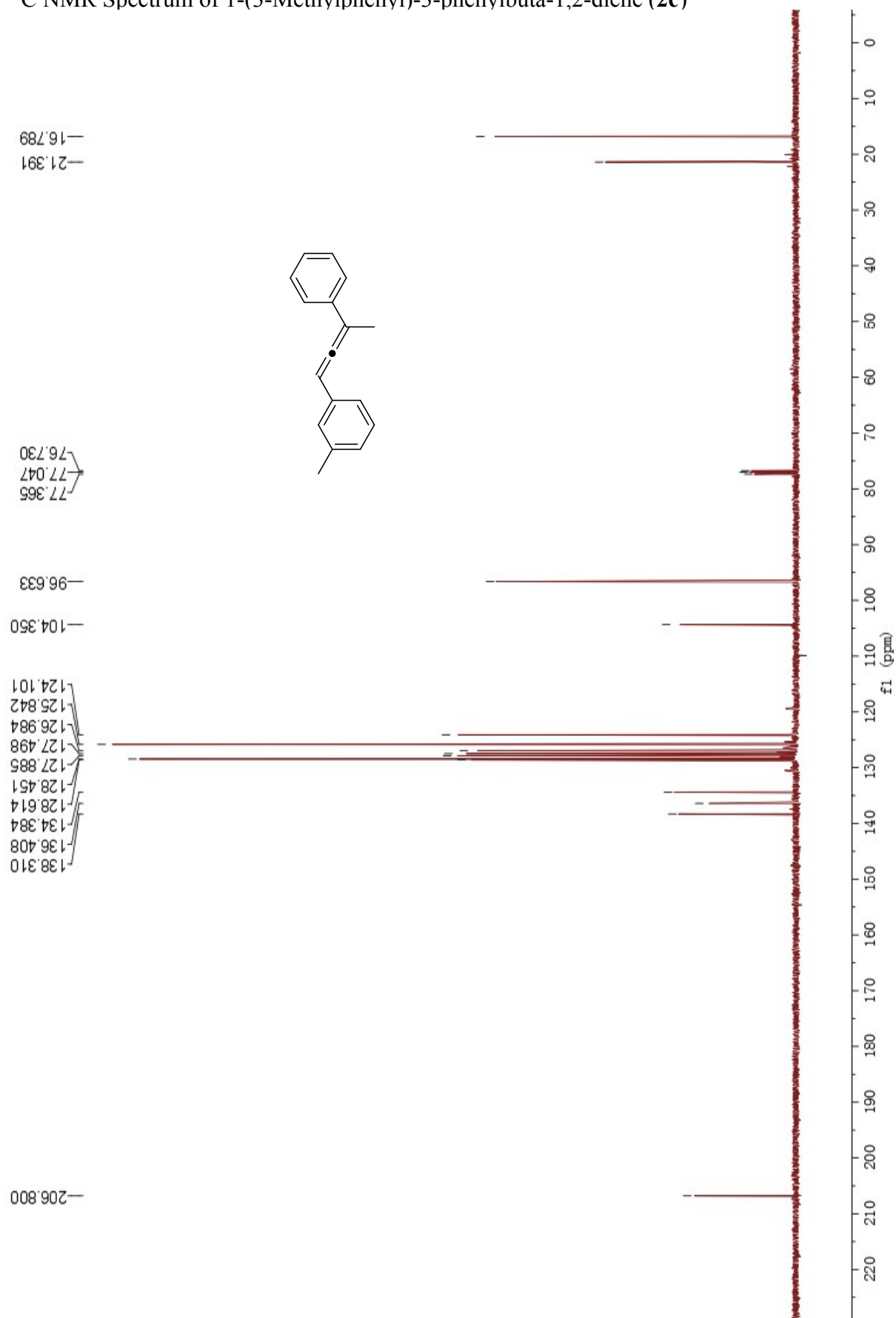
^{13}C NMR Spectrum of 1-(2-Methylphenyl)-3-phenylbuta-1,2-diene (**2b**)



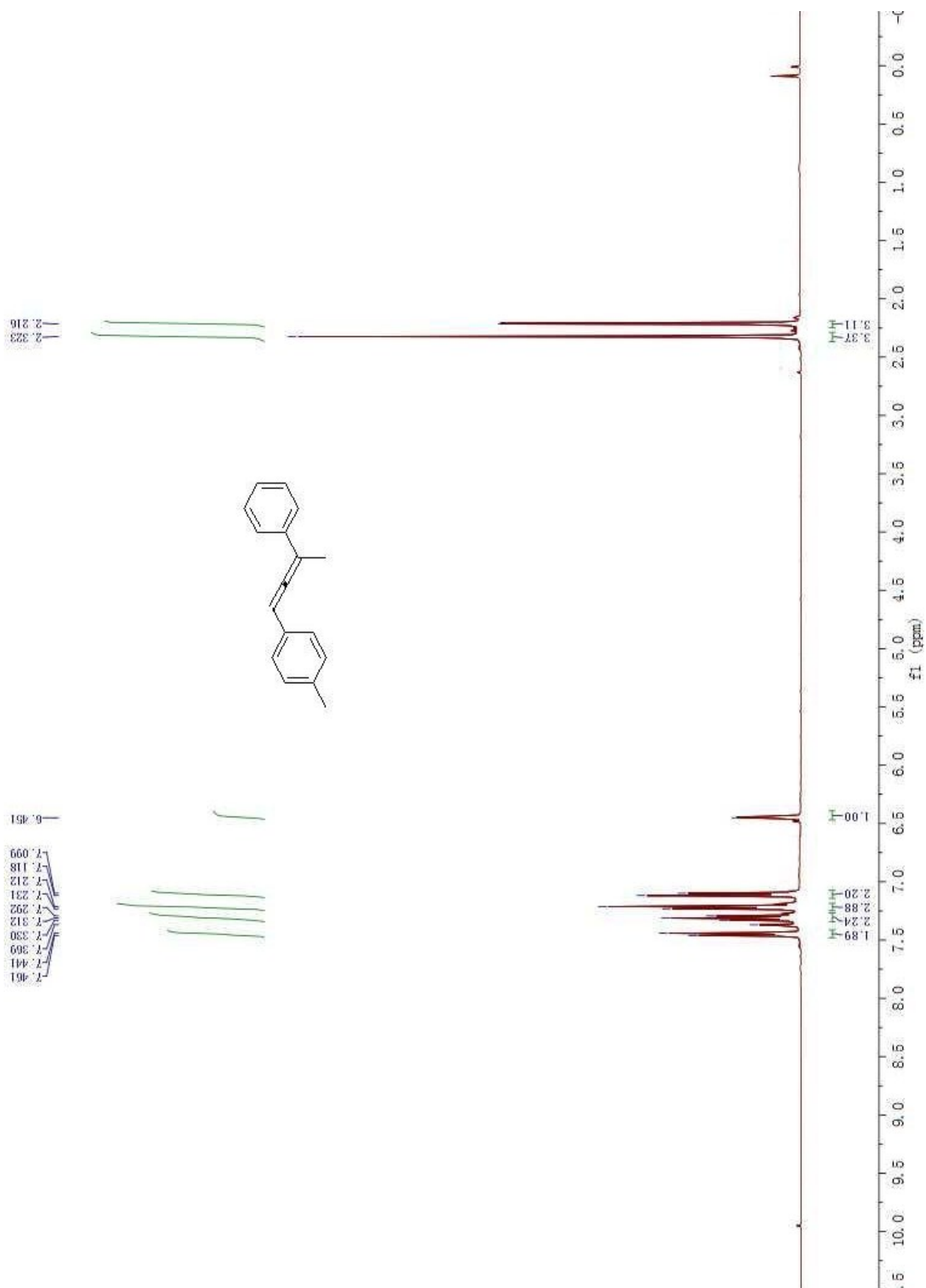
^1H NMR Spectrum of 1-(3-Methylphenyl)-3-phenylbuta-1,2-diene (**2c**)



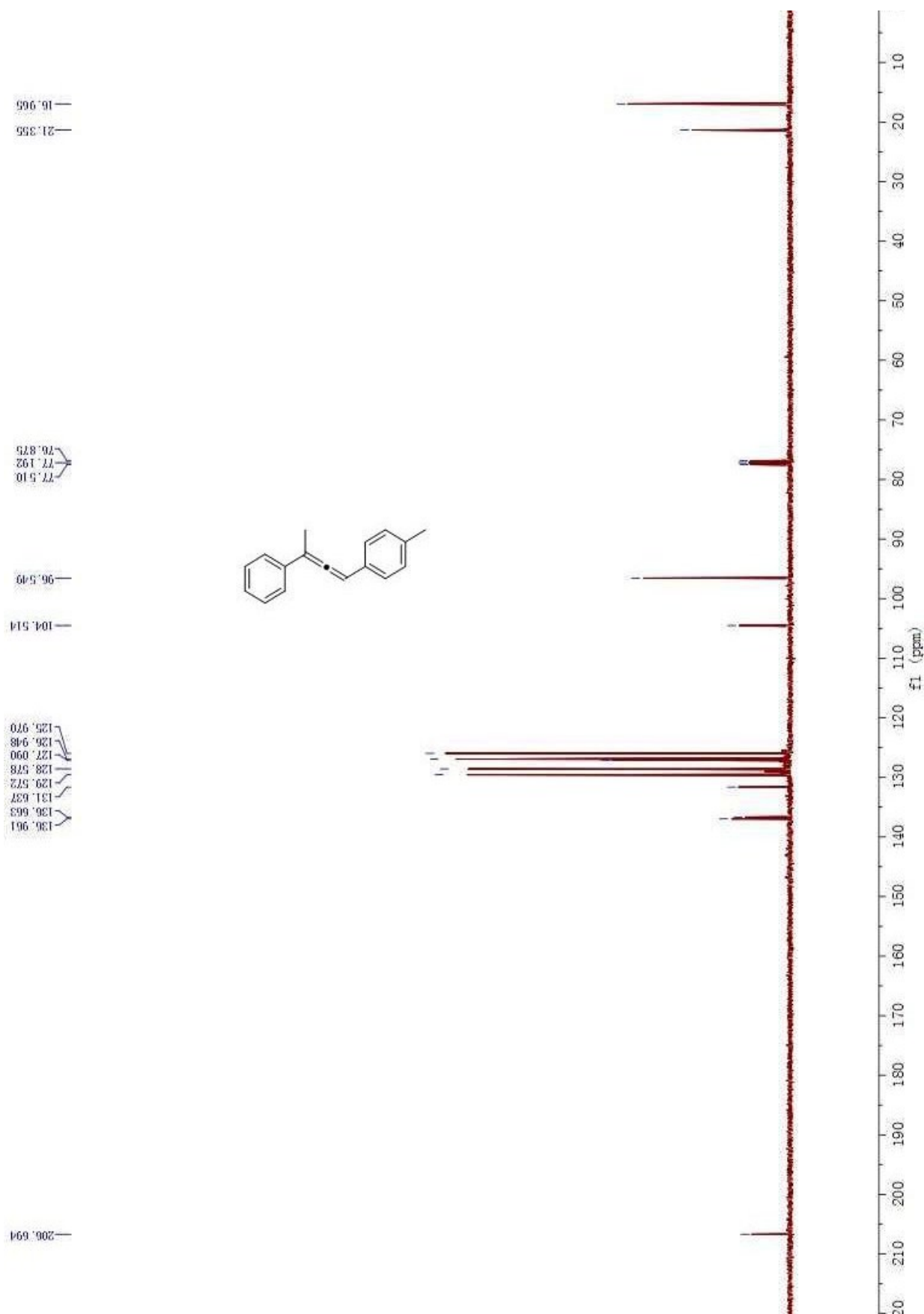
^{13}C NMR Spectrum of 1-(3-Methylphenyl)-3-phenylbuta-1,2-diene (**2c**)



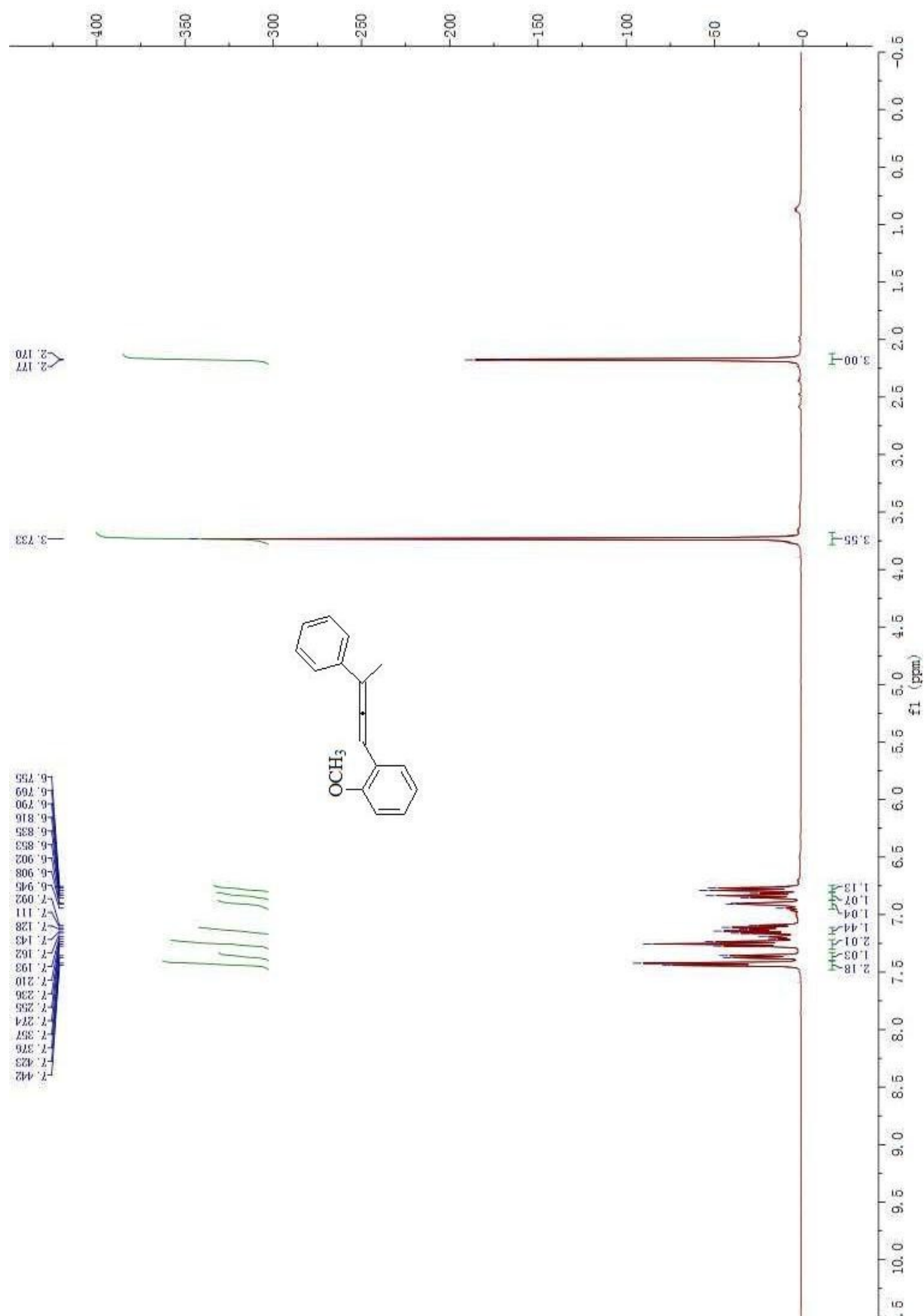
¹H NMR Spectrum of 1-(4-Methylphenyl)-3-phenylbuta-1,2-diene (**2d**)



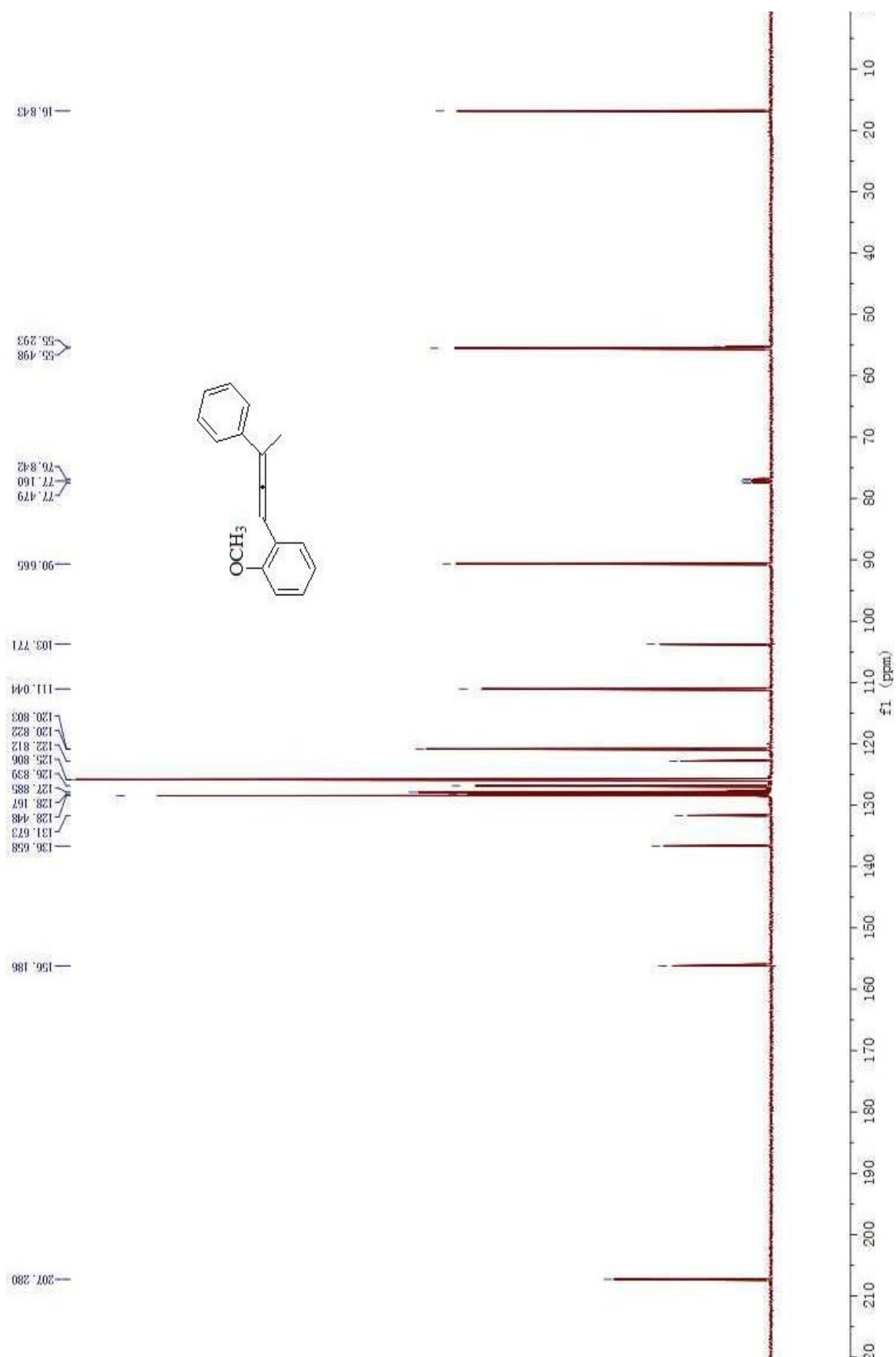
¹³C NMR Spectrum of 1-(4-Methylphenyl)-3-phenylbuta-1,2-diene (**2d**)



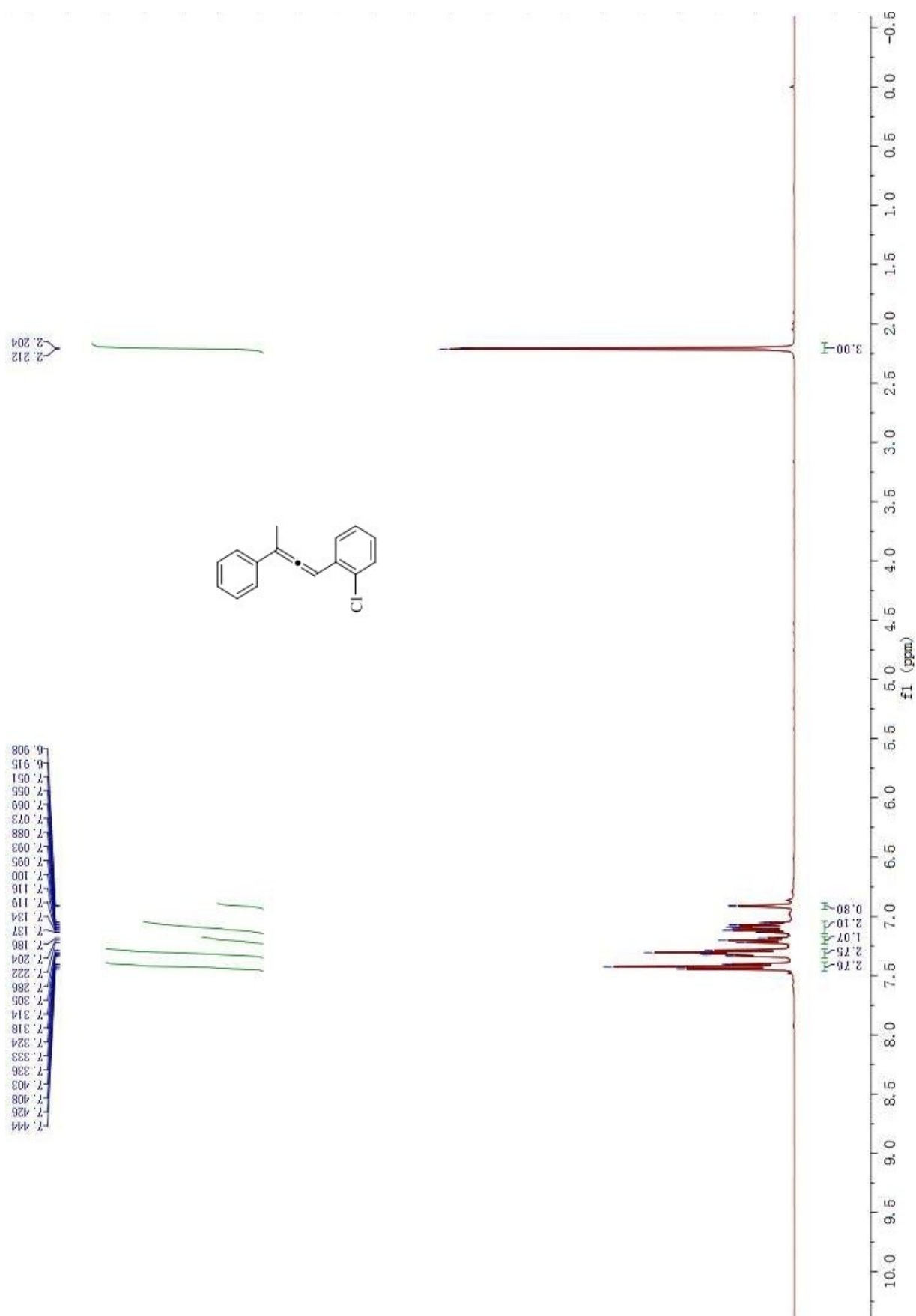
¹H NMR Spectrum of 1-(2-Methoxyphenyl)-3-phenylbuta-1,2-diene (**2e**)



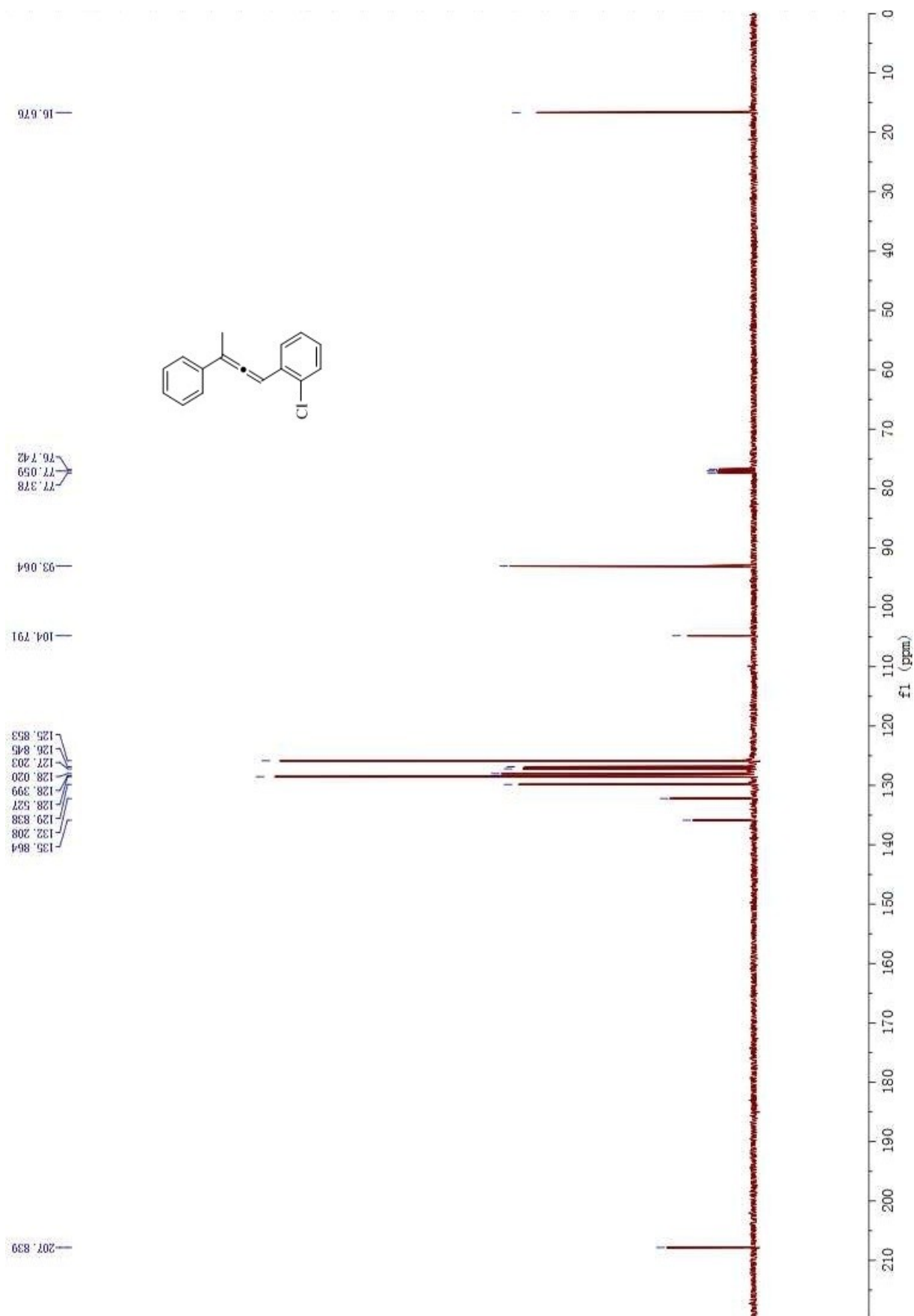
^{13}C NMR Spectrum of 1-(2-Methoxyphenyl)-3-phenylbuta-1,2-diene (**2e**)



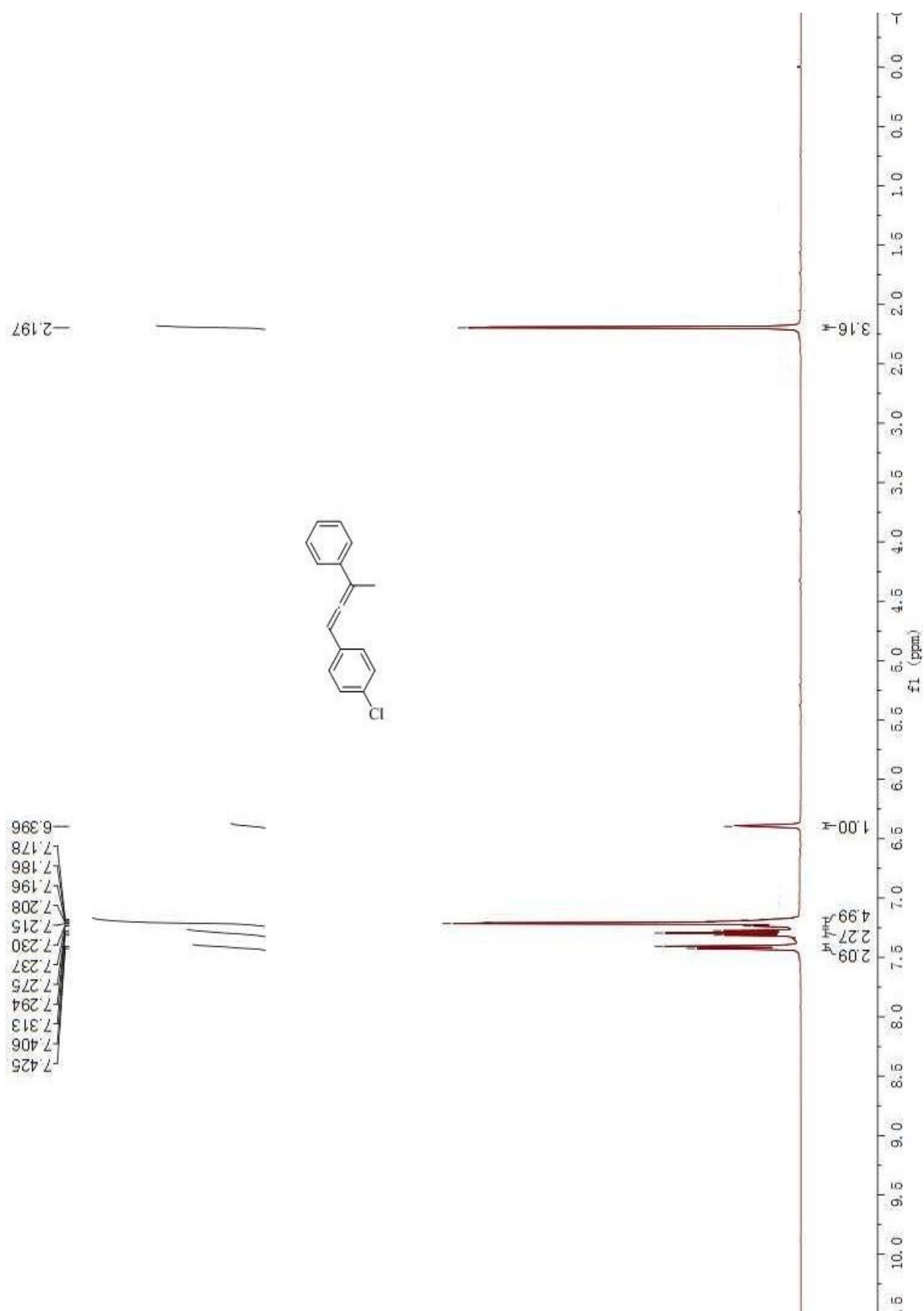
¹H NMR Spectrum of 1-(2-Chlorophenyl)-3-phenylbuta-1,2-diene (**2f**)



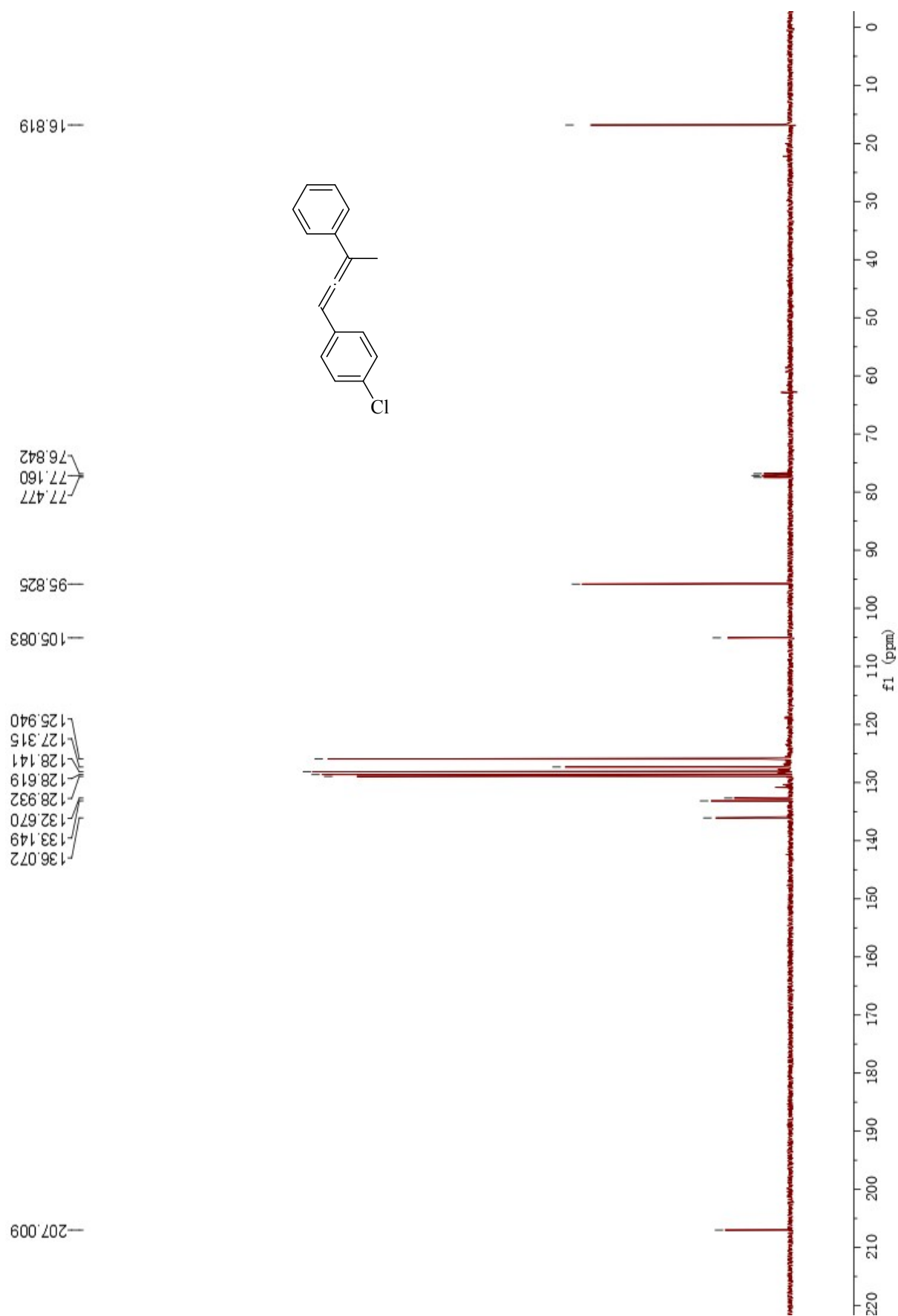
¹³C NMR Spectrum of 1-(2-Chlorophenyl)-3-phenylbuta-1,2-diene (**2f**)



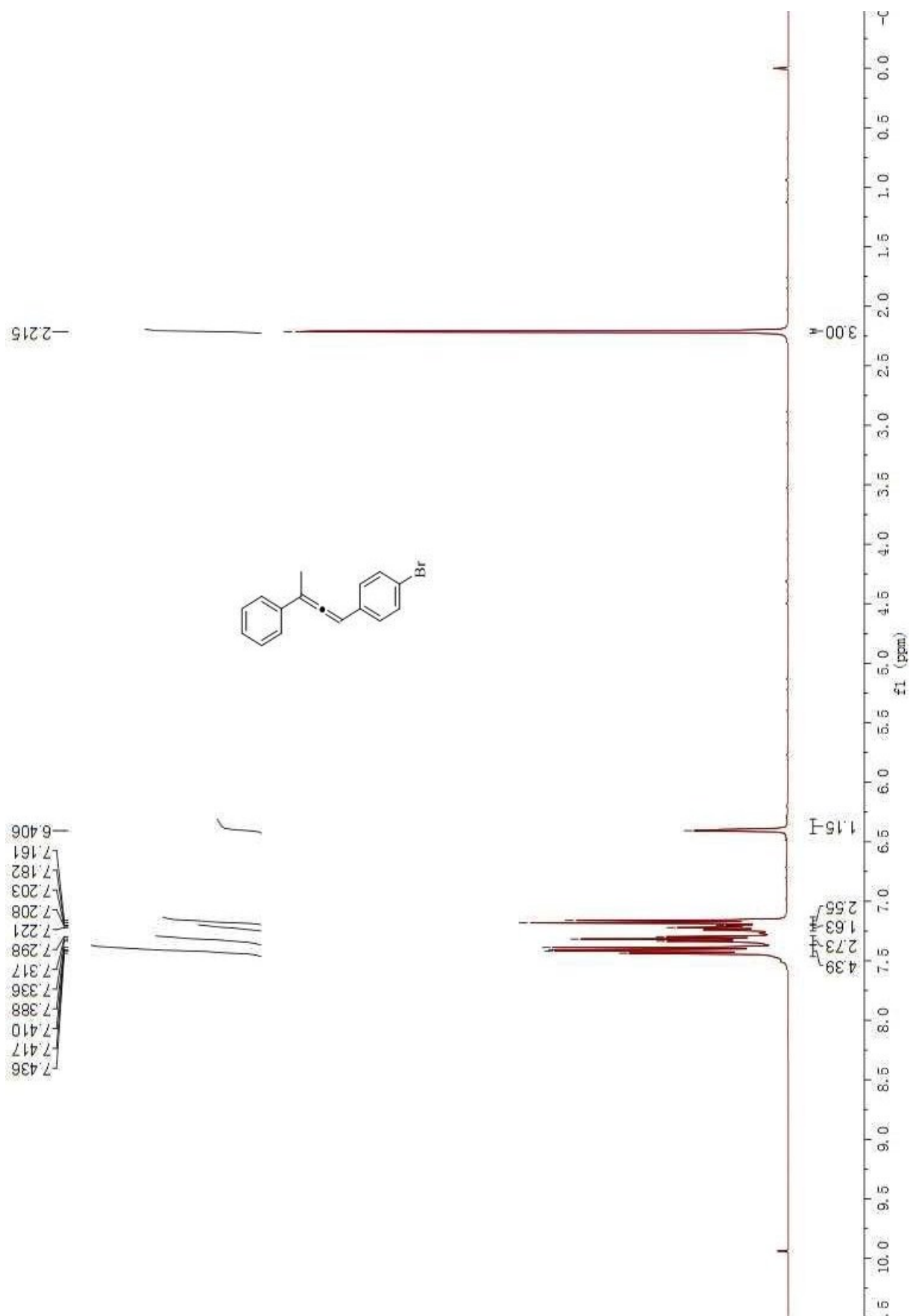
¹H NMR Spectrum of 1-(4-Chlorophenyl)-3-phenylbuta-1,2-diene (**2g**)



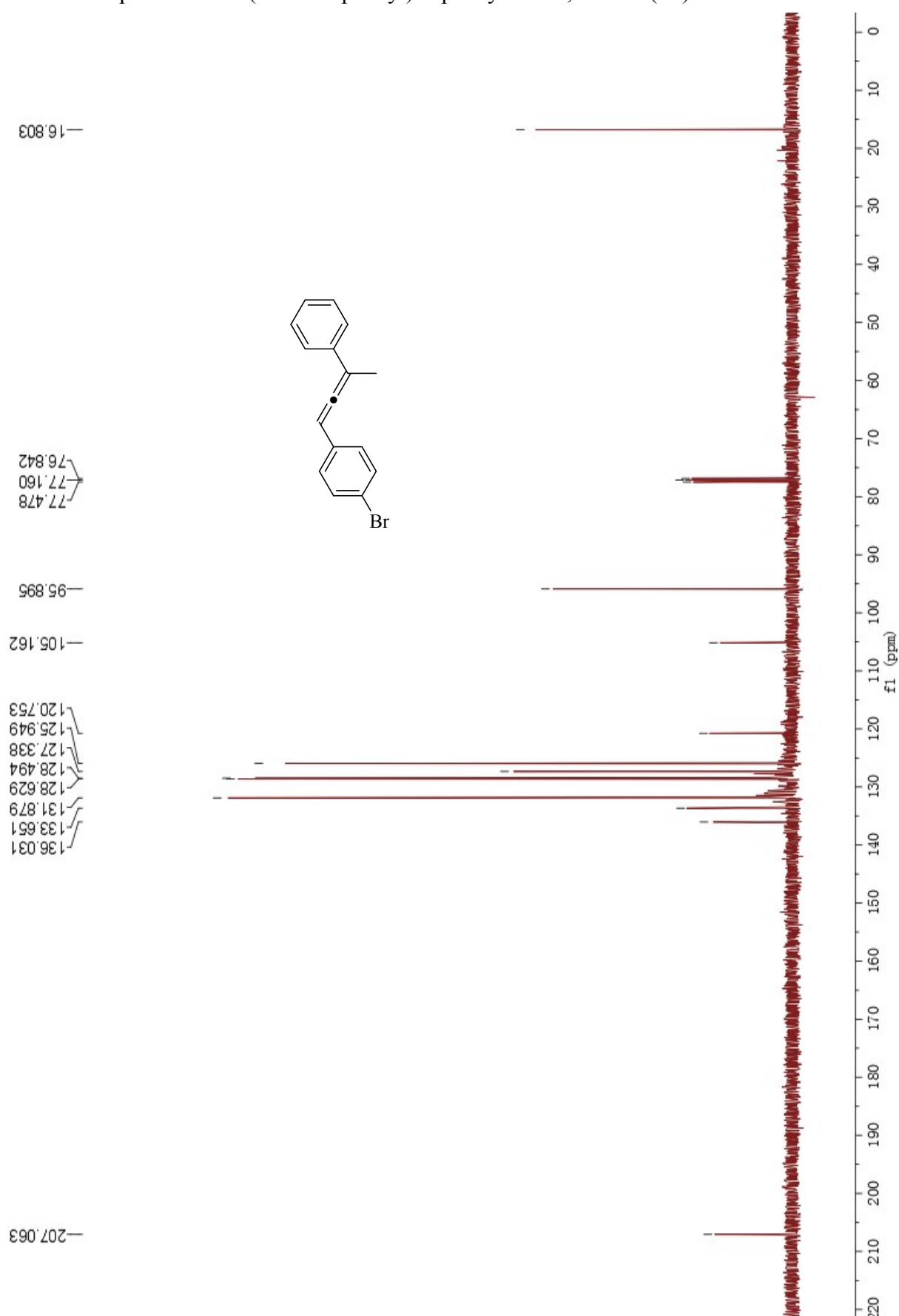
^{13}C NMR Spectrum of 1-(4-Chlorophenyl)-3-phenylbuta-1,2-diene (**2g**)



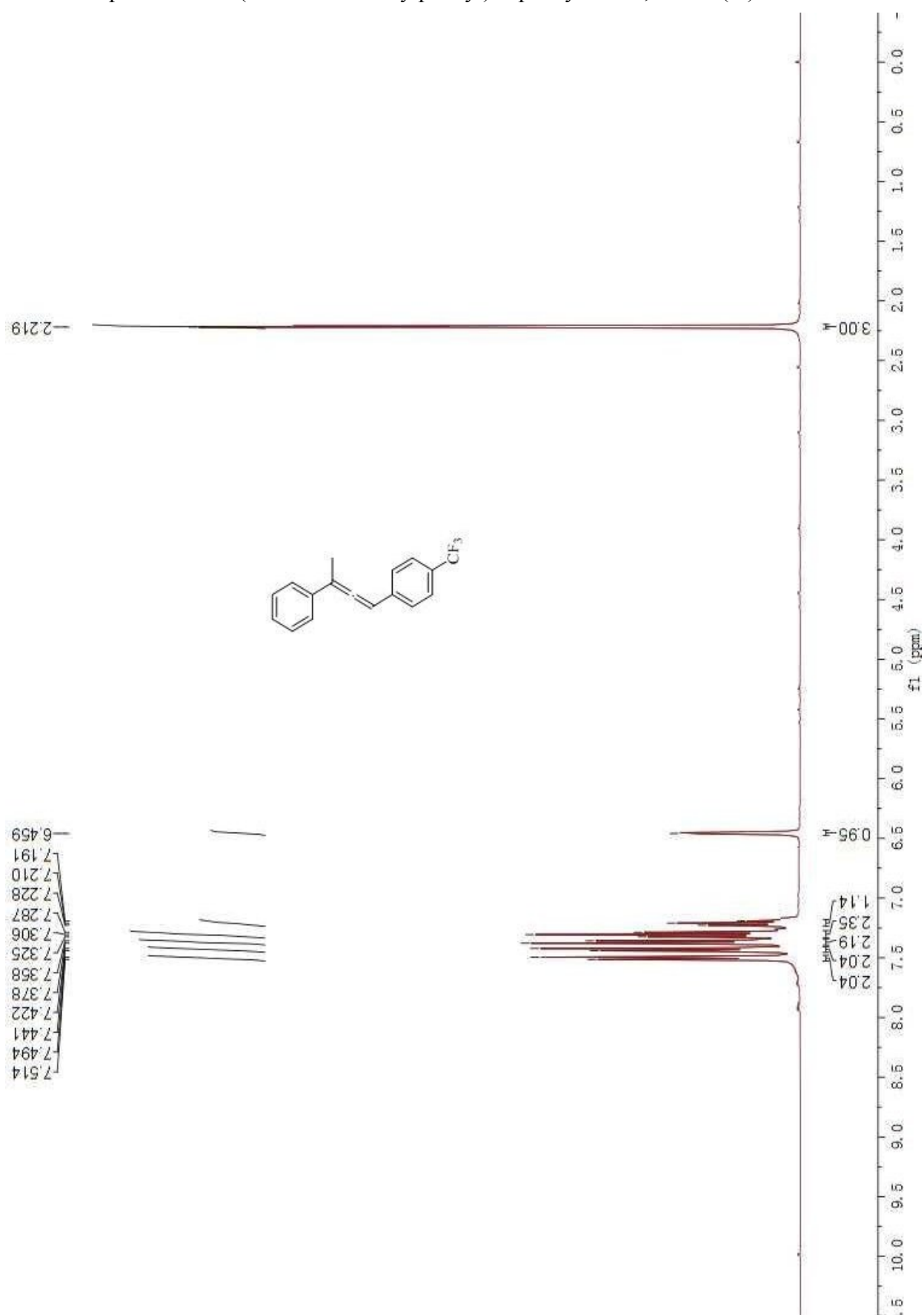
^1H NMR Spectrum of 1-(4-Bromophenyl)-3-phenylbuta-1,2-diene (**2h**)



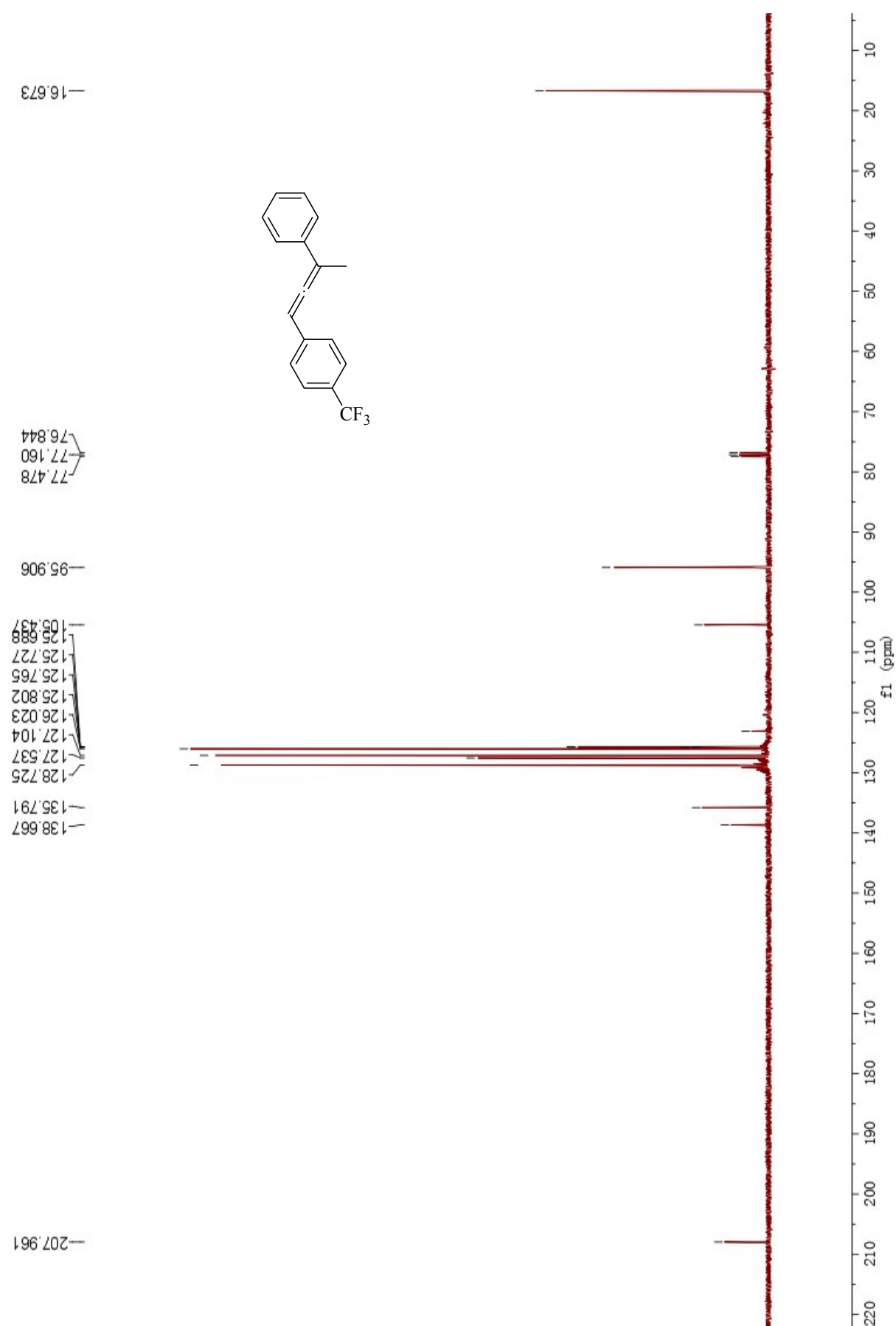
^{13}C NMR Spectrum of 1-(4-Bromophenyl)-3-phenylbuta-1,2-diene (**2h**)



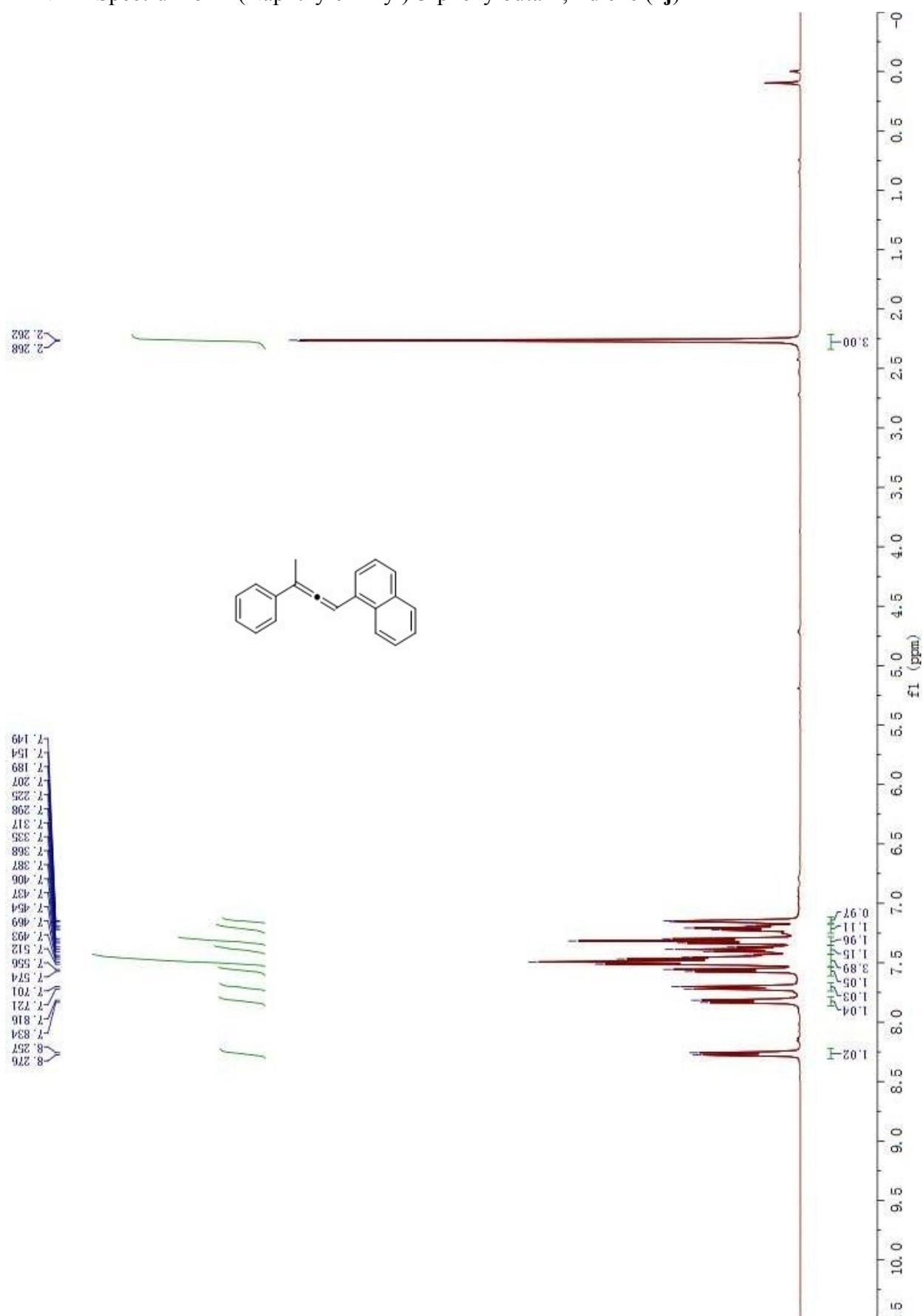
^1H NMR Spectrum of 1-(4-Trifluoromethylphenyl)-3-phenylbuta-1,2-diene(**2i**)



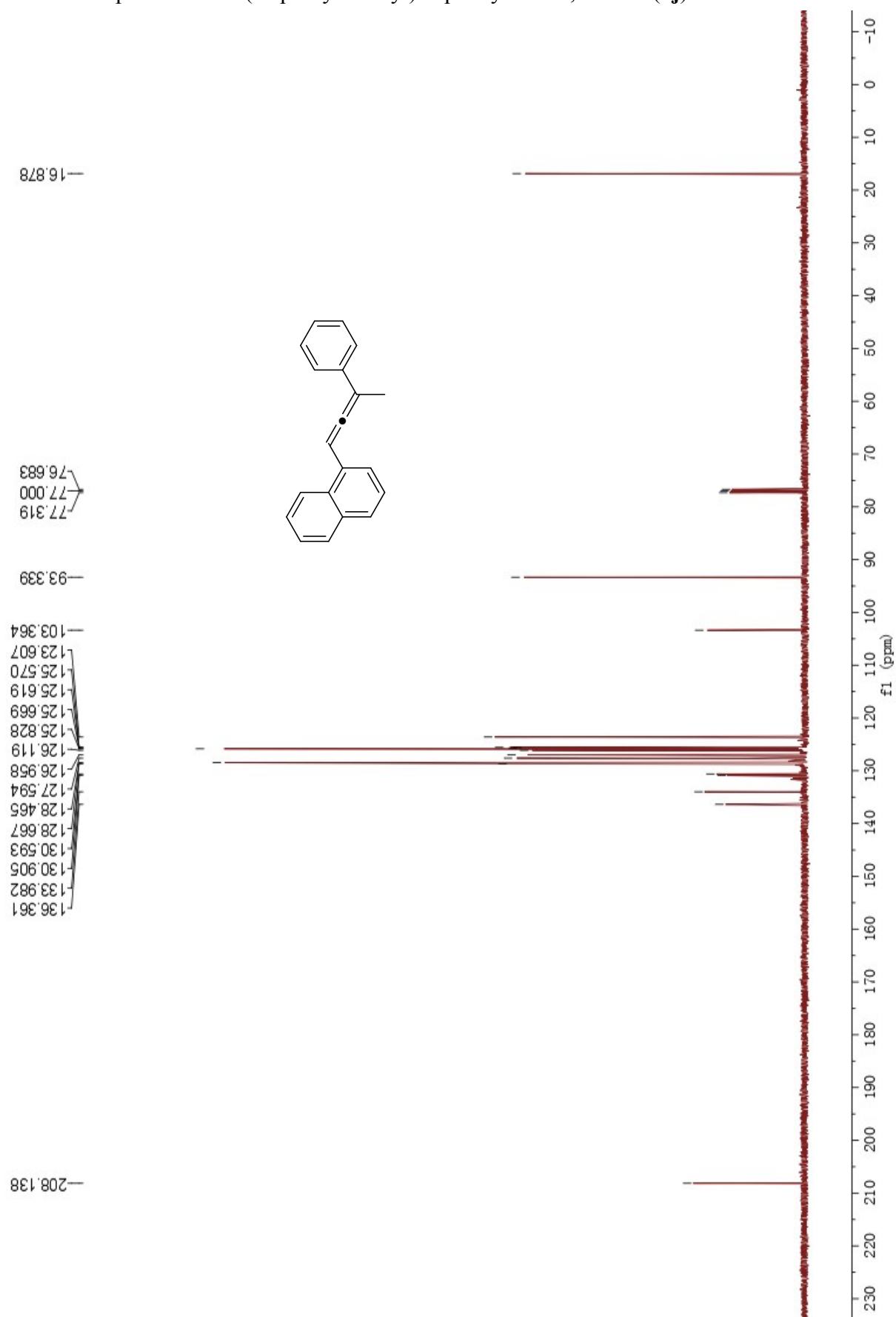
¹³C NMR Spectrum of 1-(4-Trifluoromethylphenyl)-3-phenylbuta-1,2-diene(**2i**)



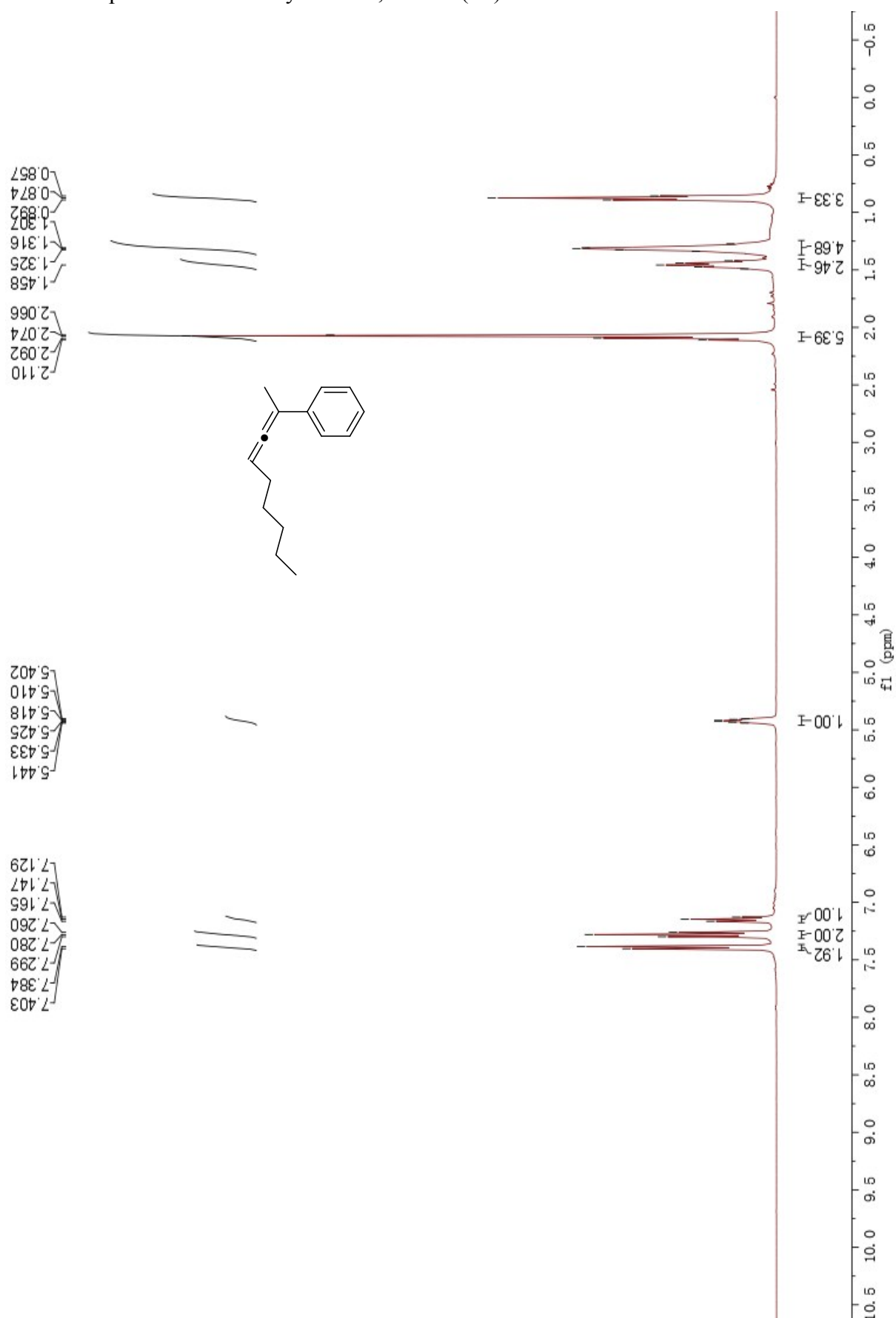
¹H NMR Spectrum of 1-(Naphthyl-1-yl)-3-phenylbuta-1,2-diene (**2j**)



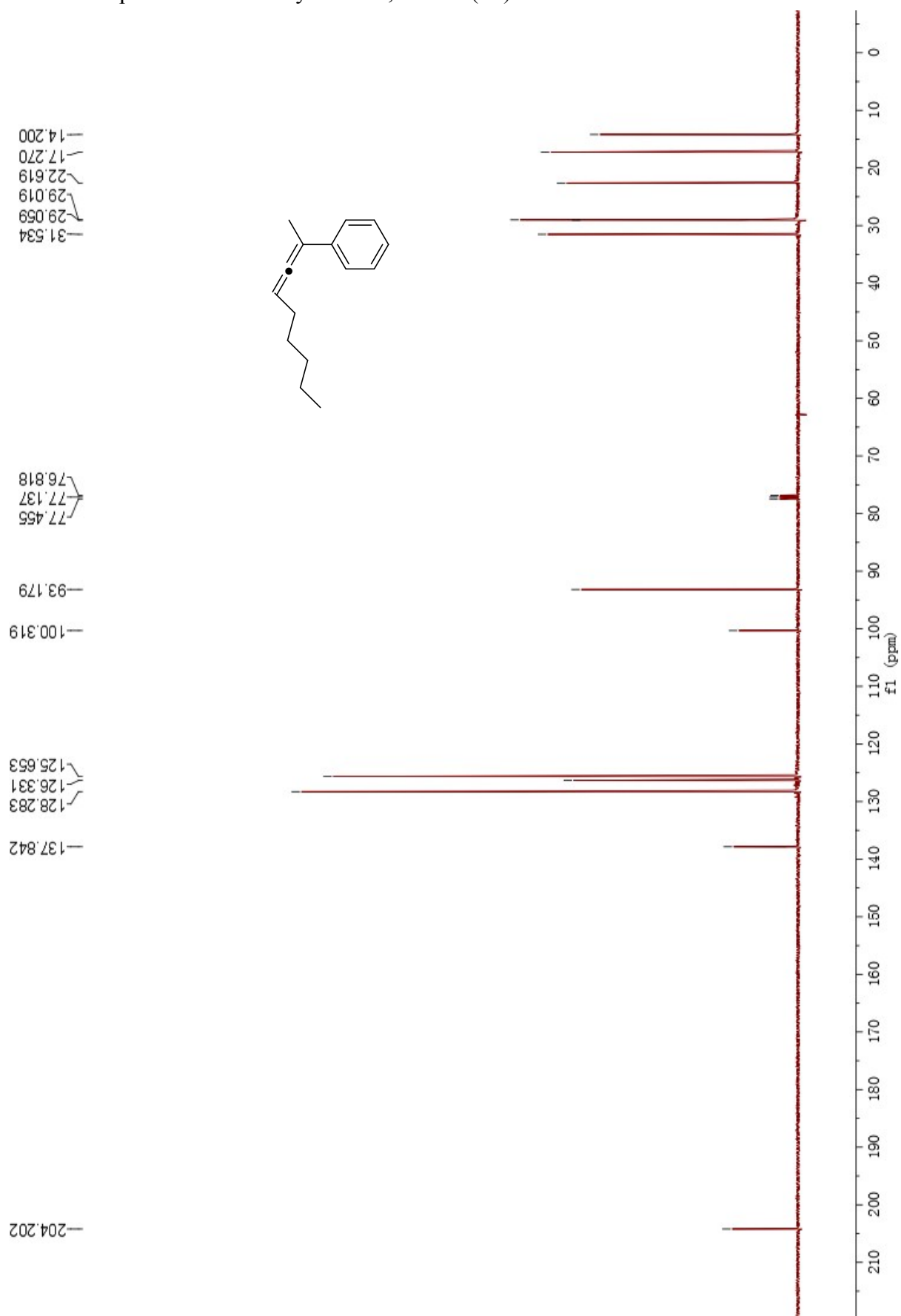
^{13}C NMR Spectrum of 1-(Naphthyl-1-yl)-3-phenylbuta-1,2-diene (**2j**)



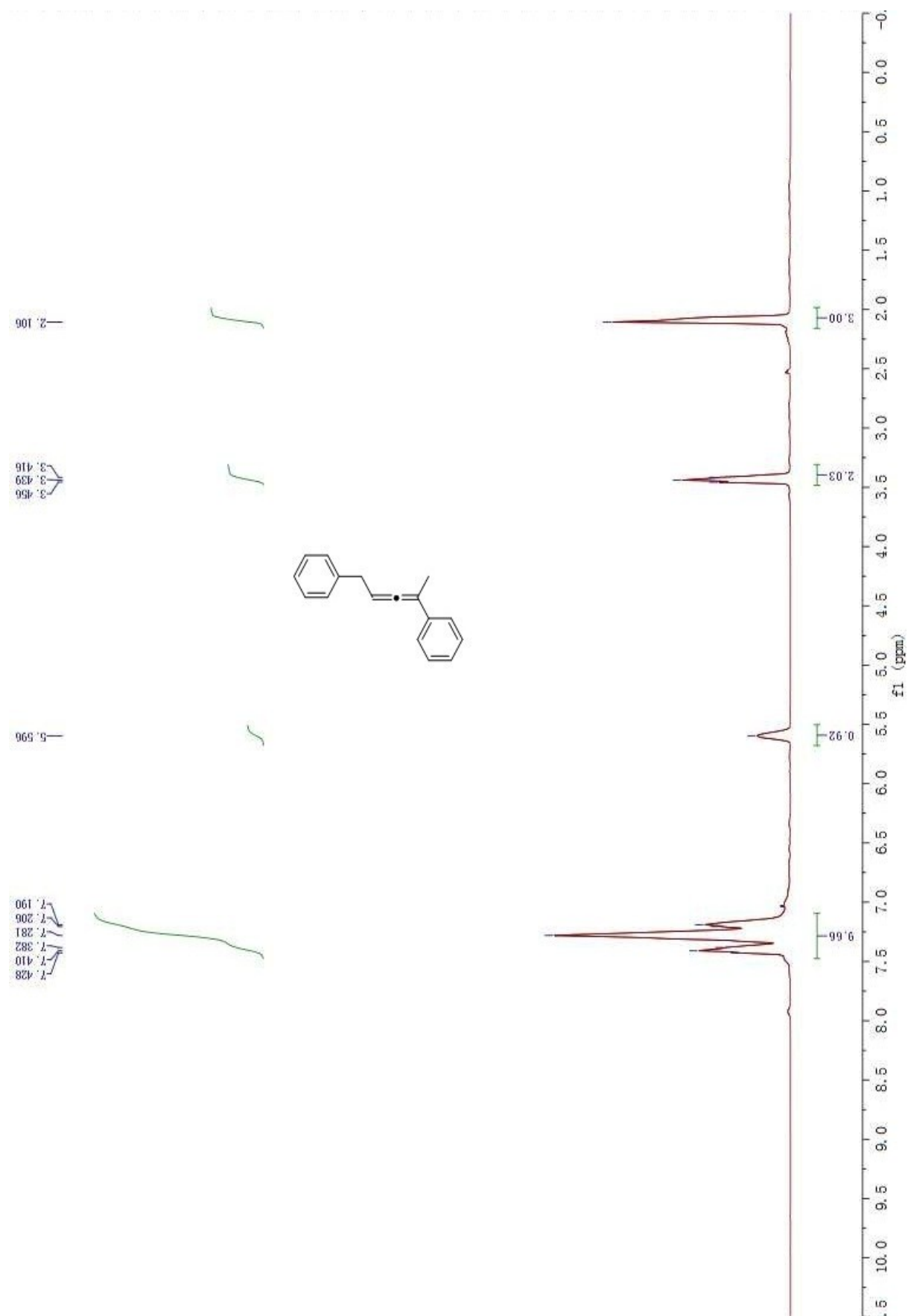
^1H NMR Spectrum of 2-Phenyl-nona-2,3-diene (**2k**)



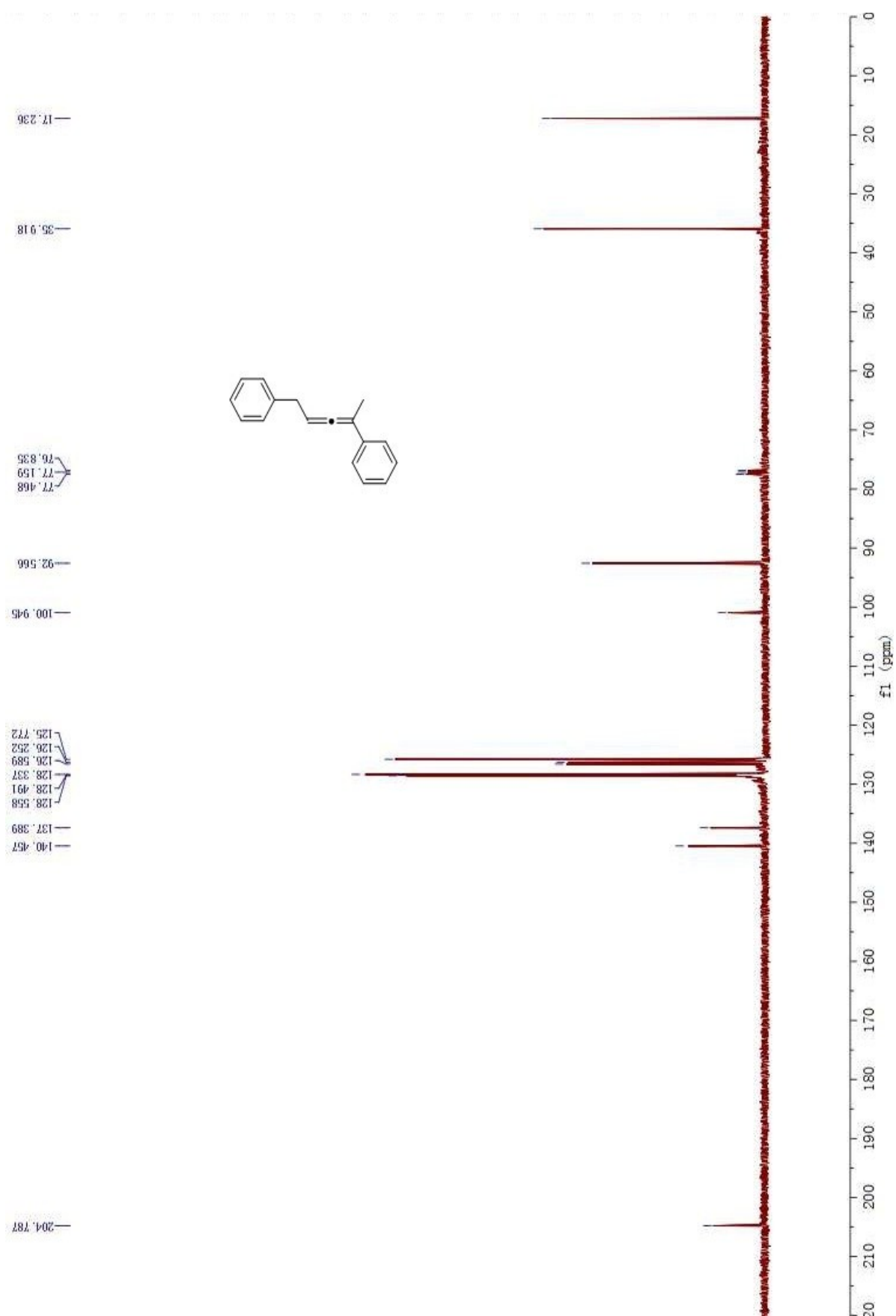
¹³C NMR Spectrum of 2-Phenyl-nona-2,3-diene (**2k**)



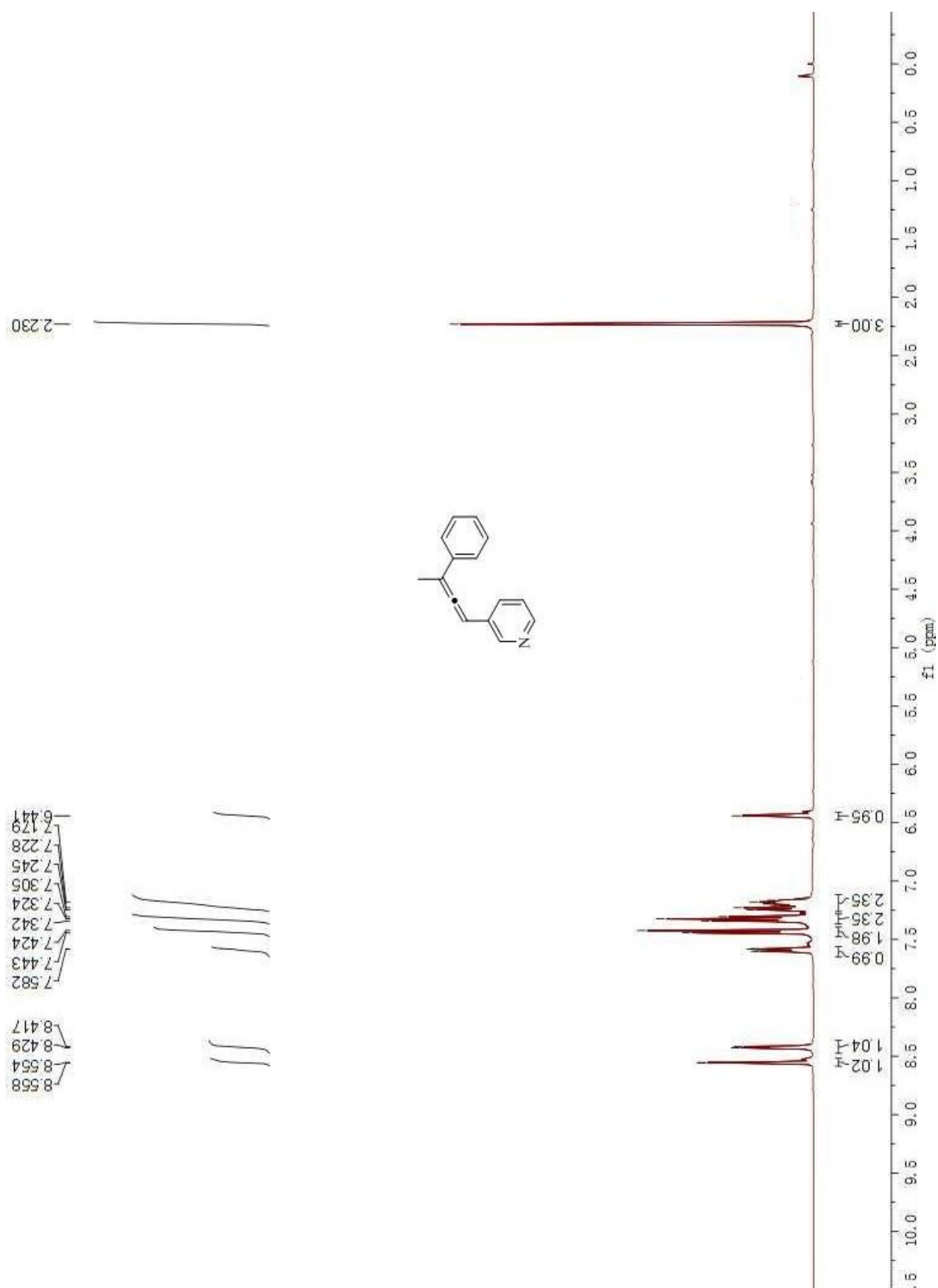
¹H NMR Spectrum of 1,4-diphenylpenta-2,3-diene (**2I**)



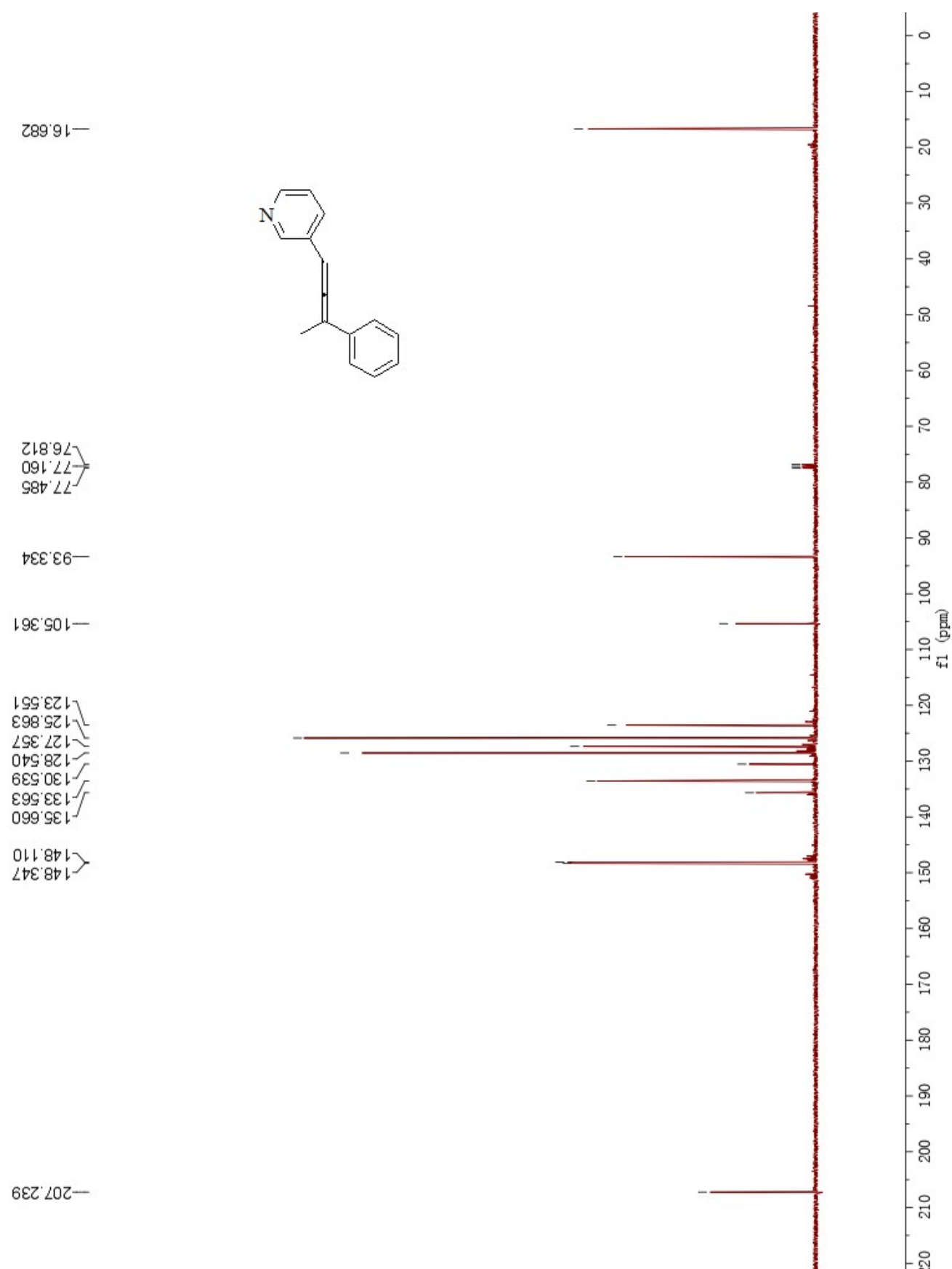
¹³C NMR Spectrum of 1,4-diphenylpenta-2,3-diene (**21**)



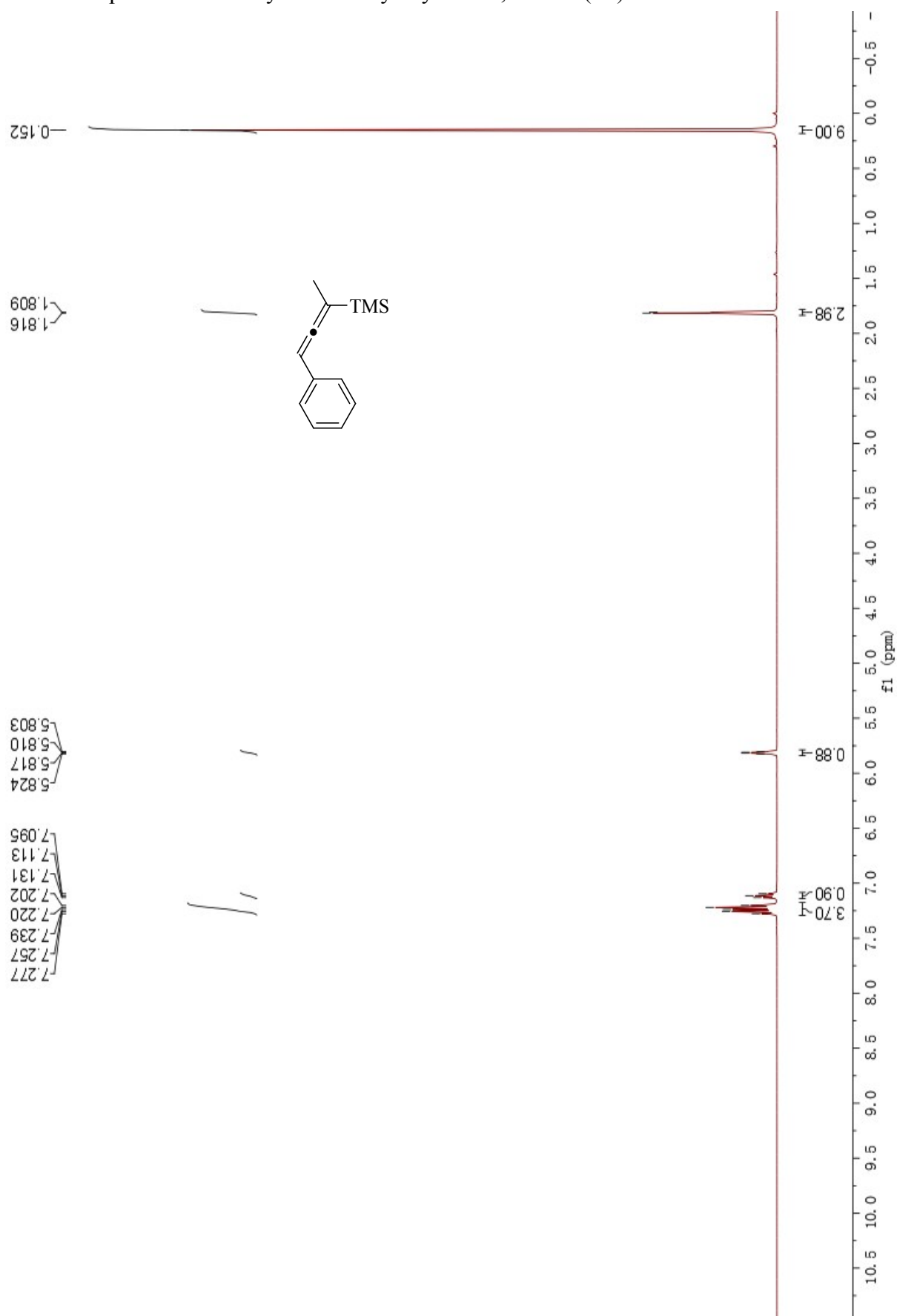
^1H NMR Spectrum of 3-(3-phenylbuta-1,2-dienyl)pyridine(**2m**)



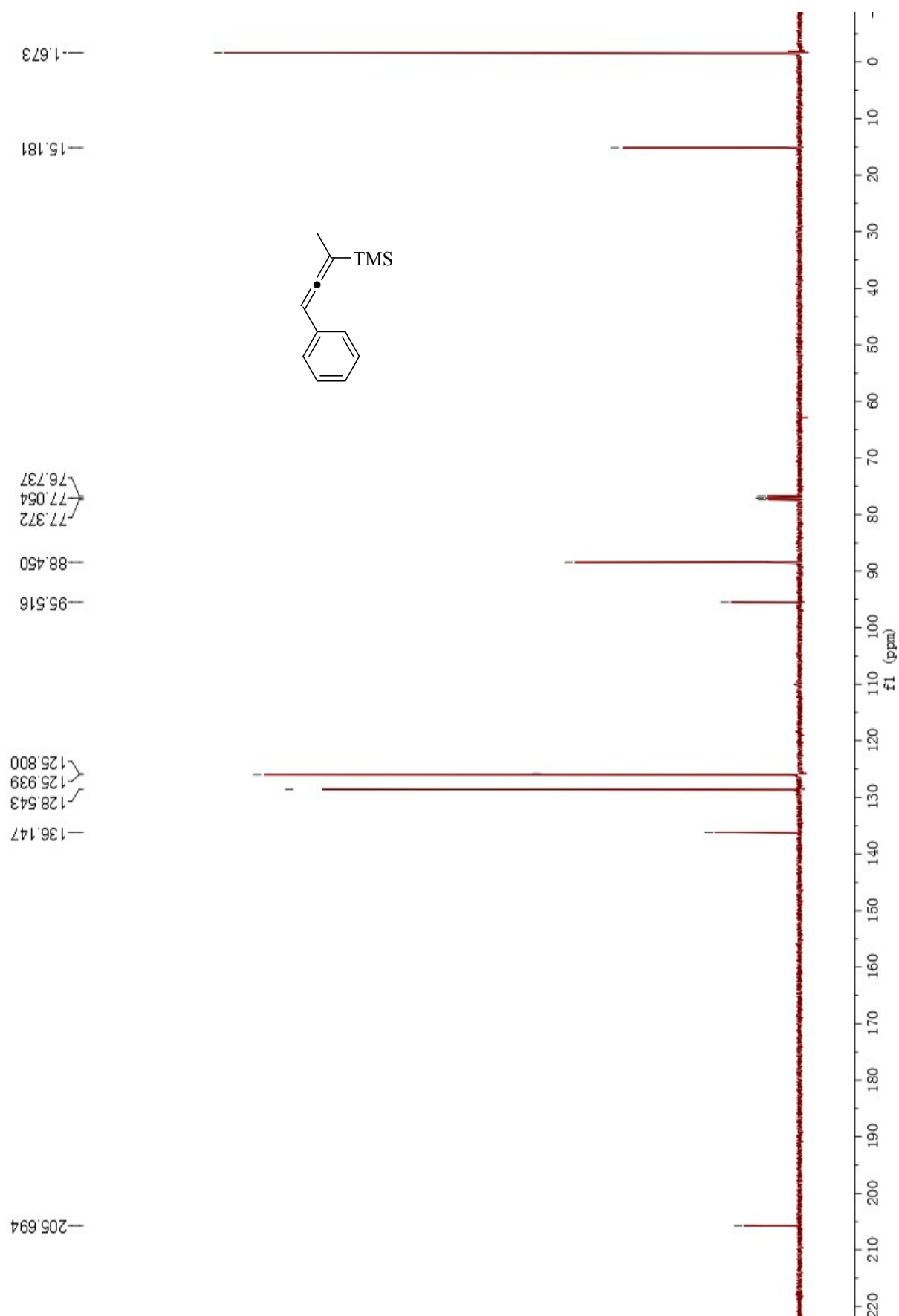
^{13}C NMR Spectrum of 3-(3-phenylbuta-1,2-dienyl)pyridine(**2m**)



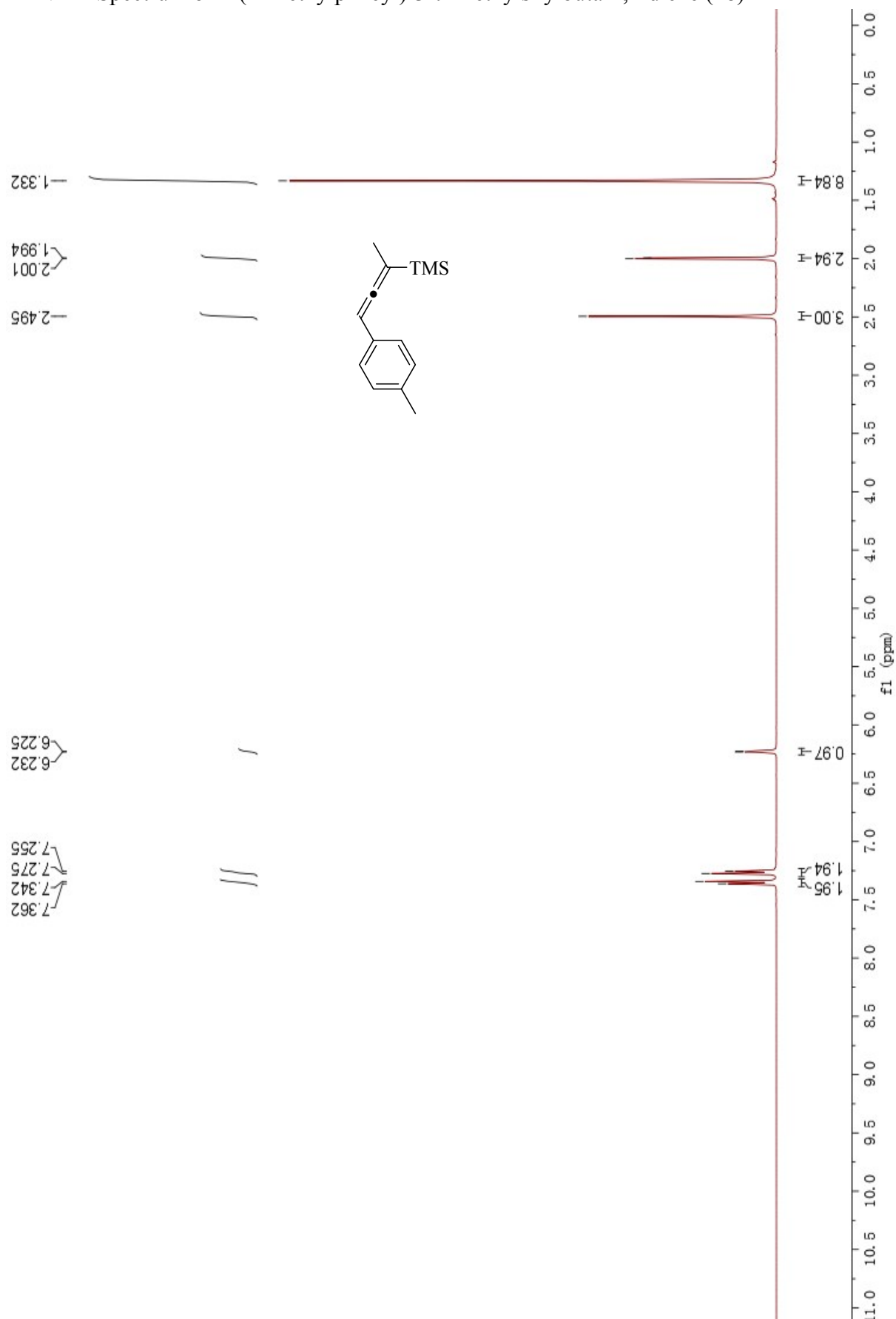
^1H NMR Spectrum of Phenyl-3-trimethylsilylbuta-1,2-diene (**2n**)



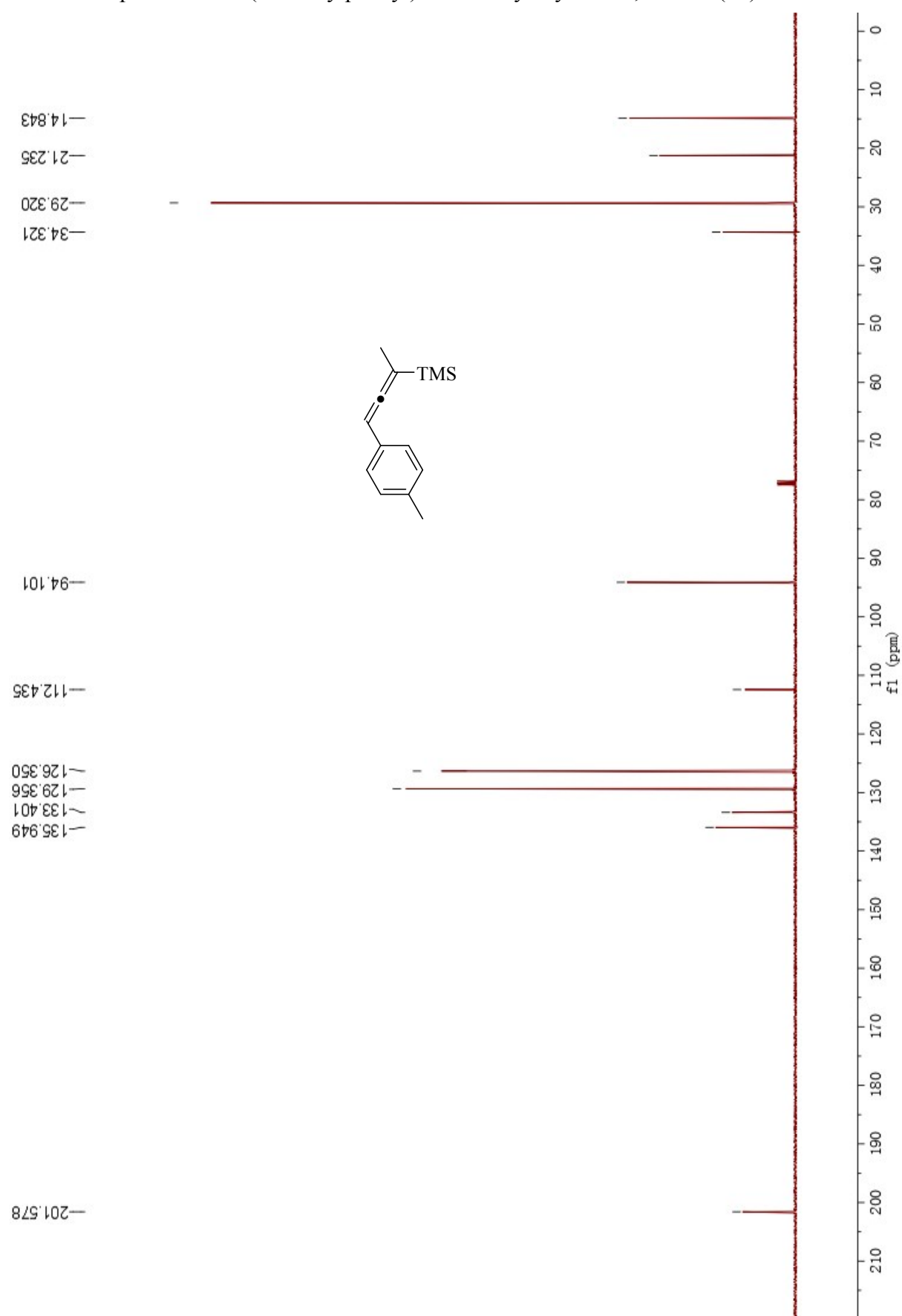
^{13}C NMR Spectrum of Phenyl-3-trimethylsilylbuta-1,2-diene (**2n**)



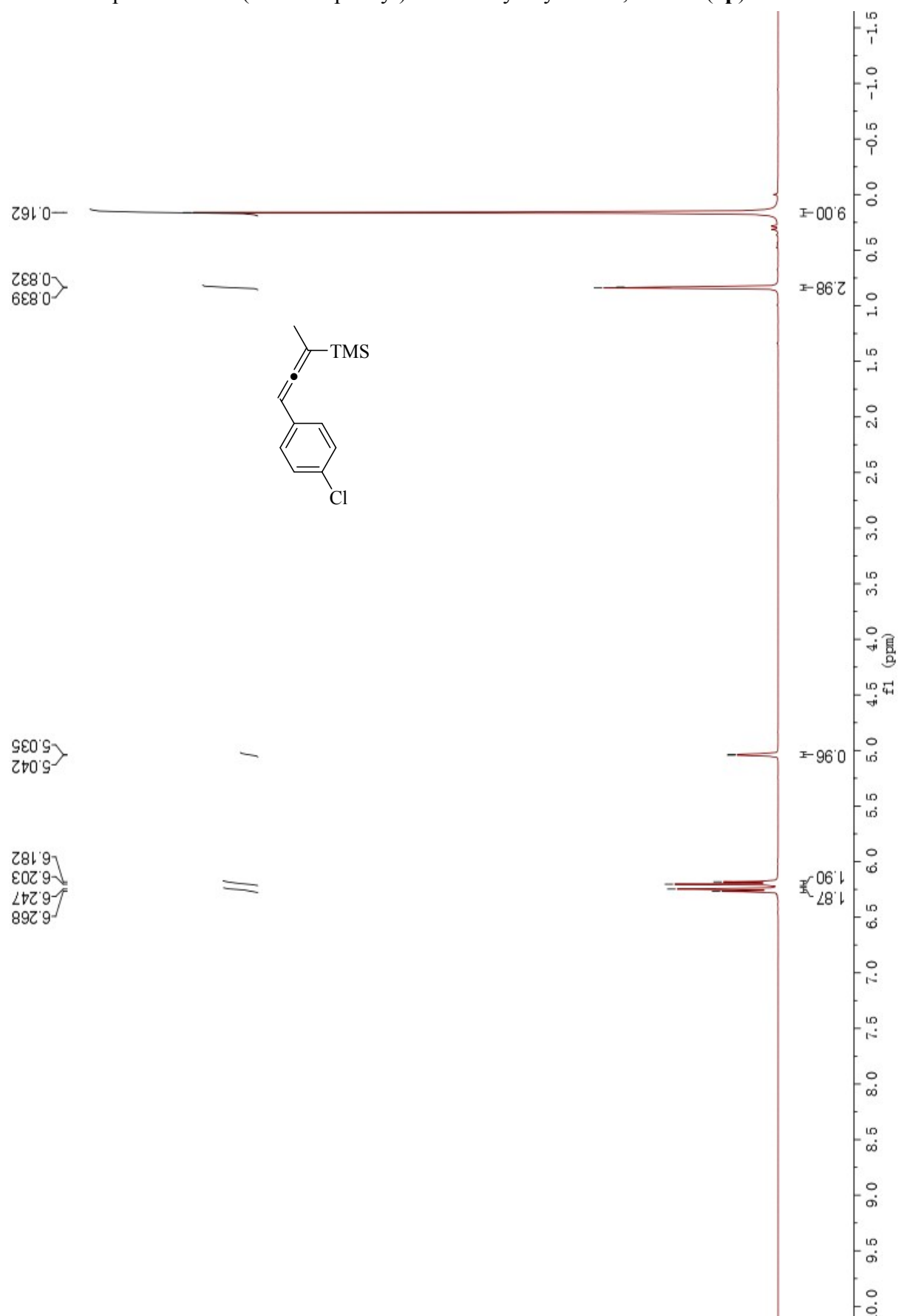
^1H NMR Spectrum of 1-(4-Methylphenyl)-3-trimethylsilylbuta-1,2-diene (**2o**)



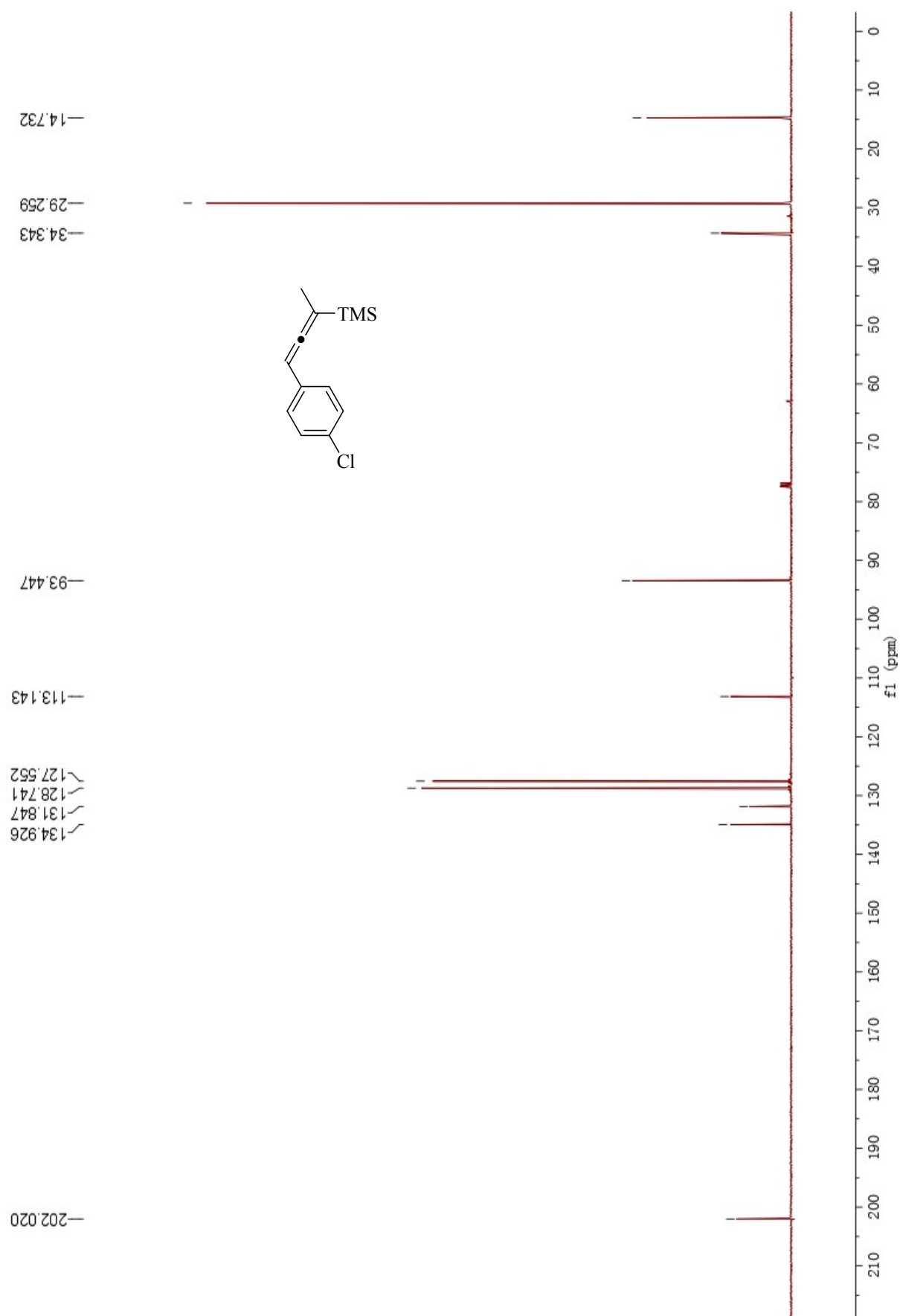
^{13}C NMR Spectrum of 1-(4-Methylphenyl)-3-trimethylsilylbuta-1,2-diene (**2o**)



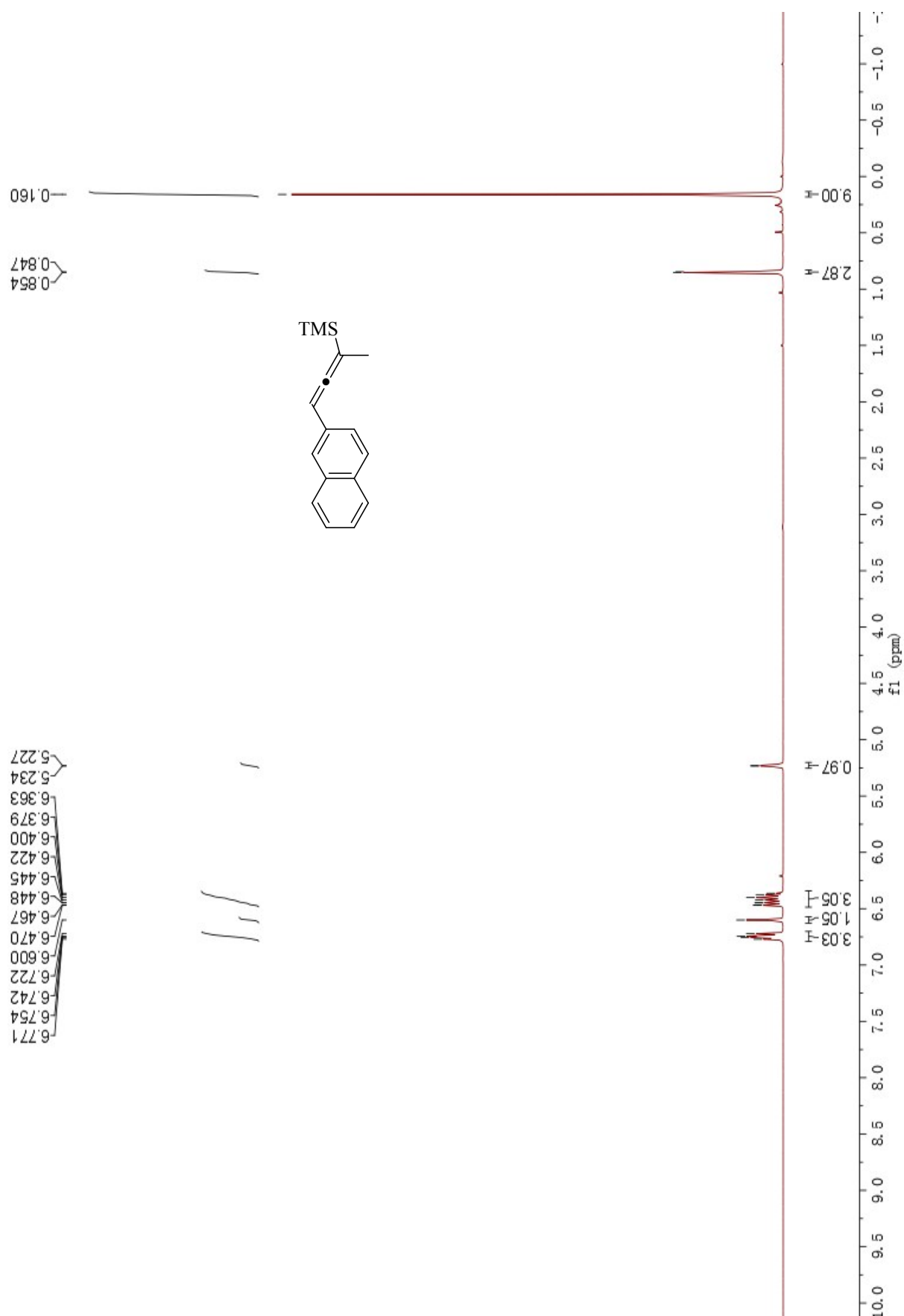
^1H NMR Spectrum of 1-(4-Chlorophenyl)-3-trimethylsilylbuta-1,2-diene (**2p**)



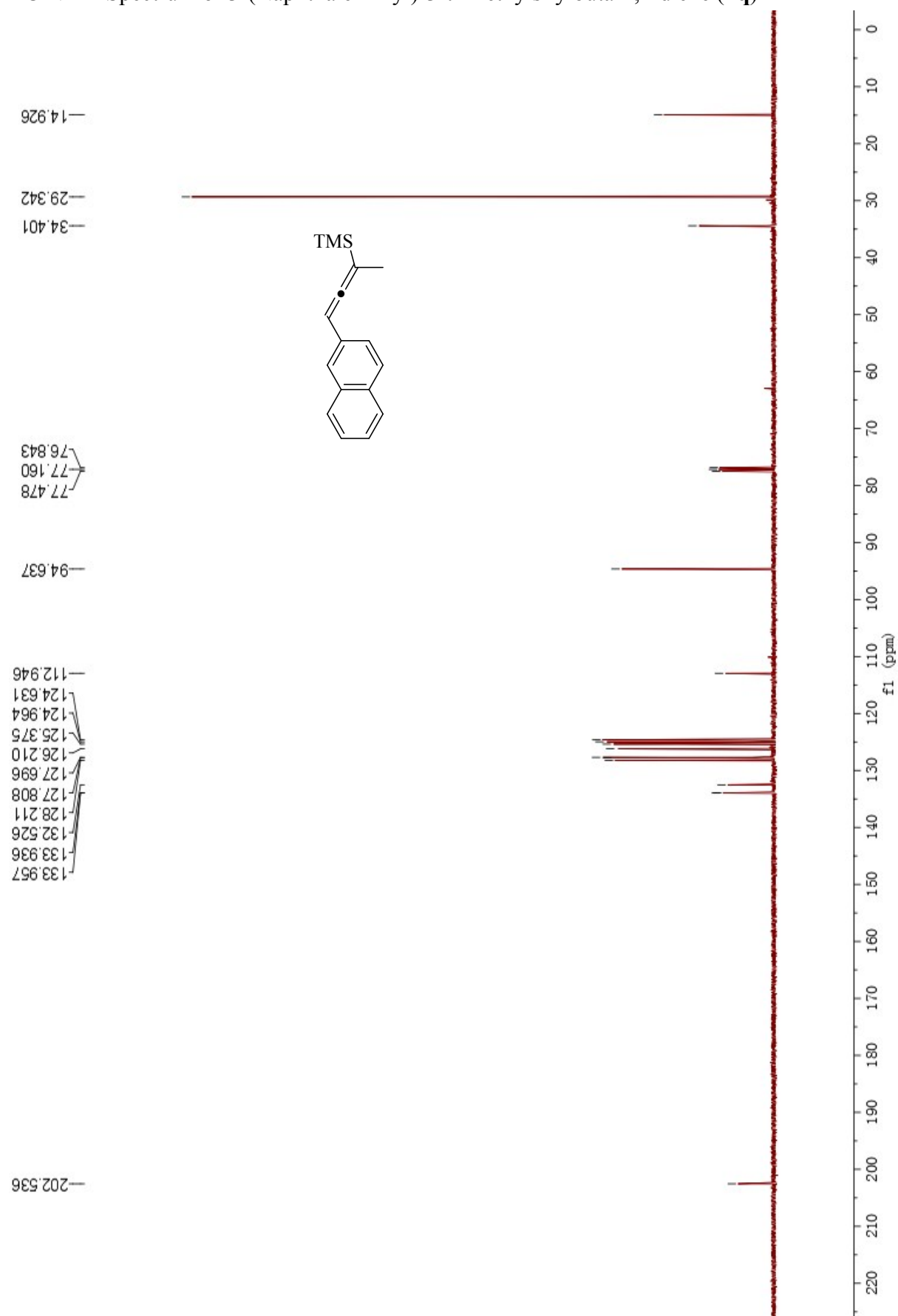
^{13}C NMR Spectrum of 1-(4-Chlorophenyl)-3-trimethylsilylbuta-1,2-diene (**2p**)



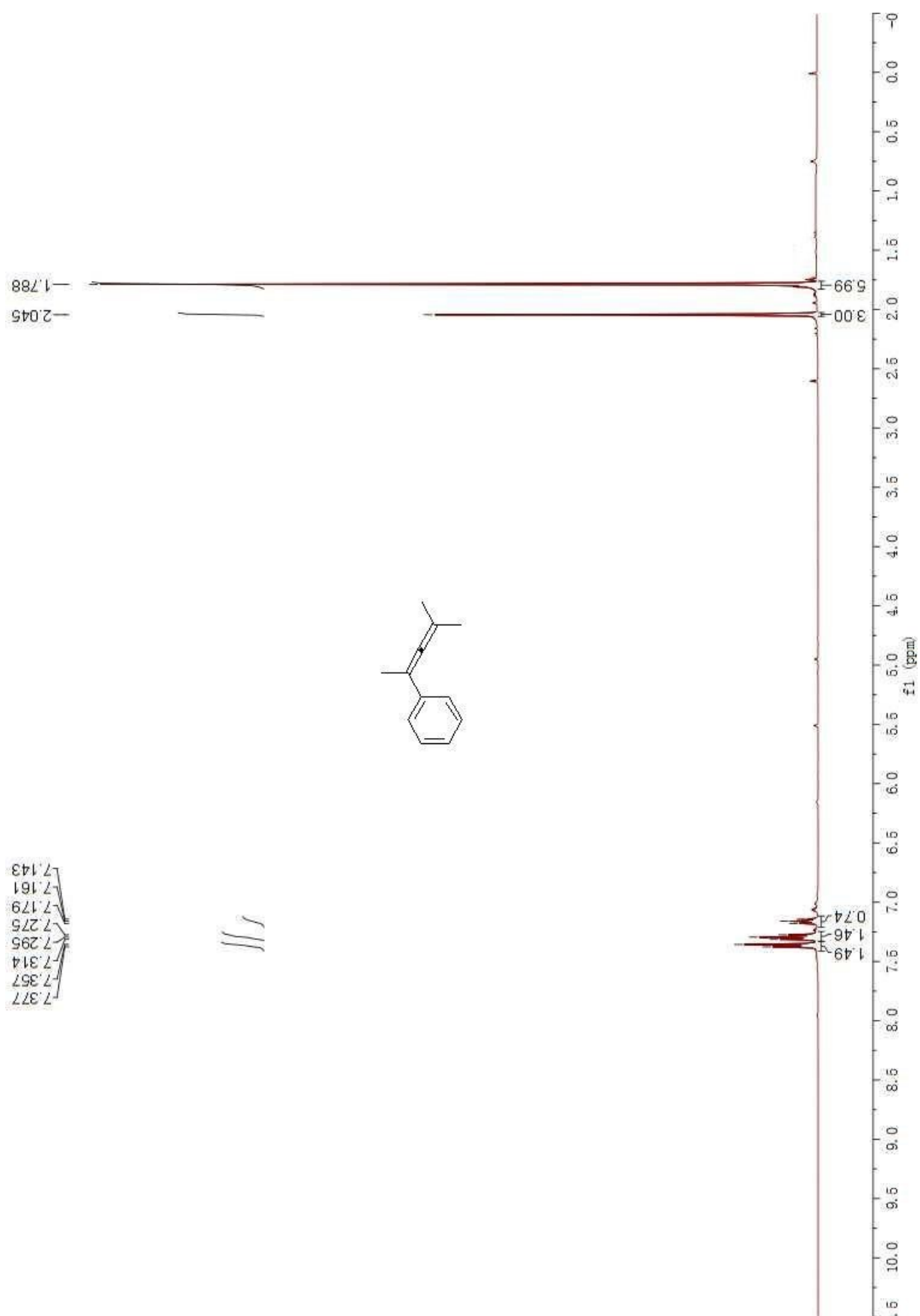
^1H NMR Spectrum of 3-(Naphthalen-2-yl)-3-trimethylsilylbuta-1,2-diene (**2q**)



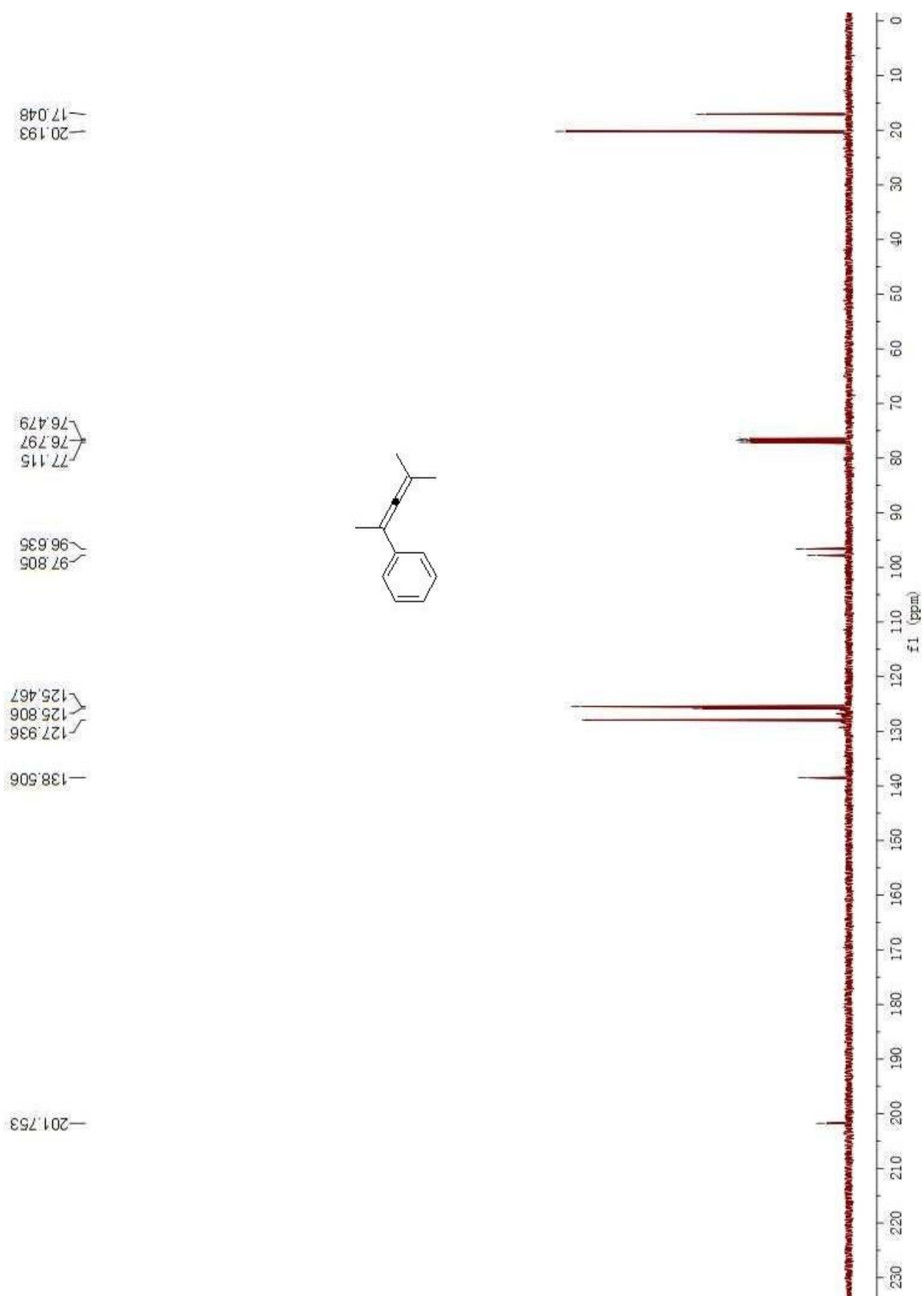
^{13}C NMR Spectrum of 3-(Naphthalen-2-yl)-3-trimethylsilylbuta-1,2-diene (**2q**)



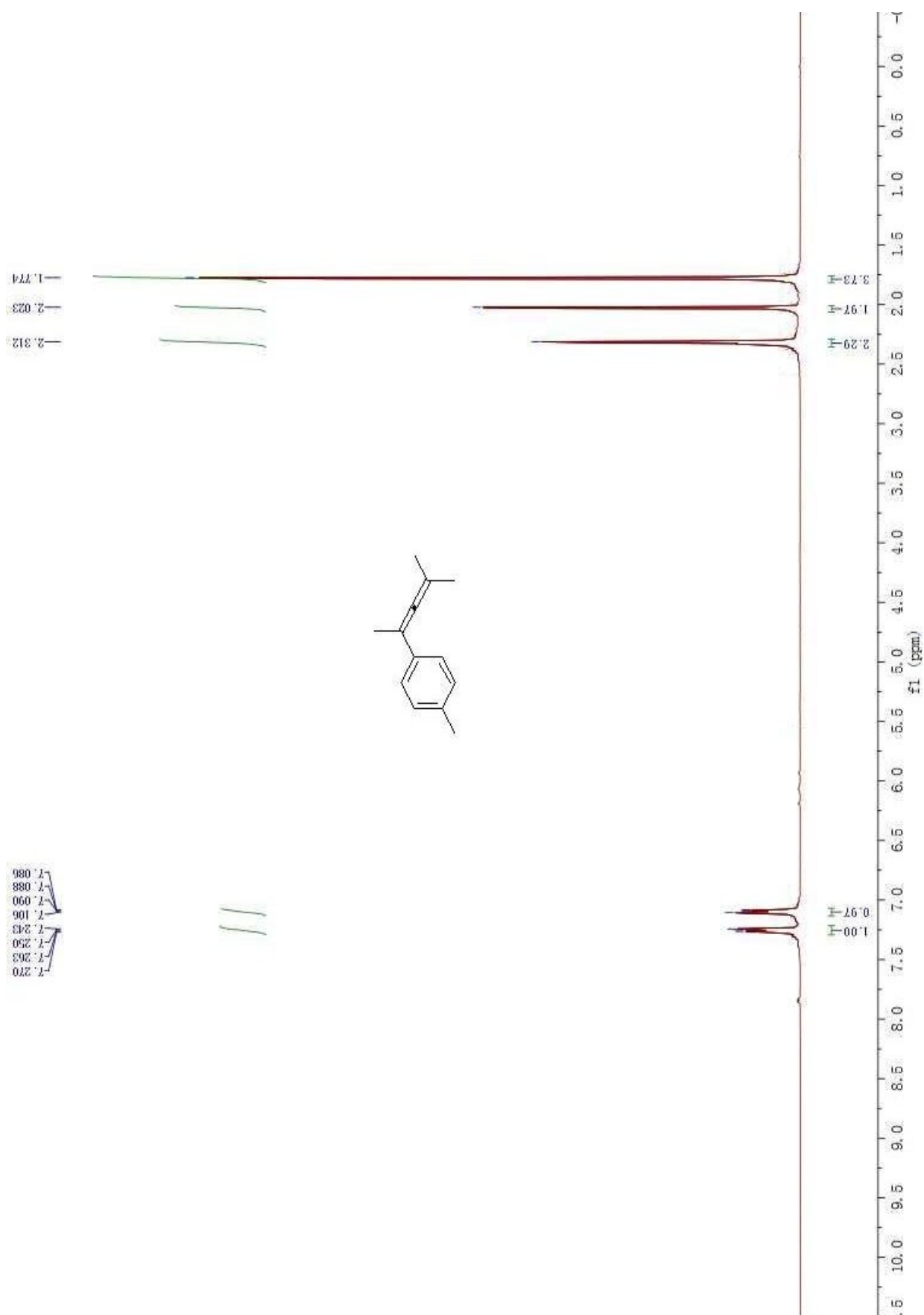
^1H NMR Spectrum of 1-(4-methylpenta-2,3-dien-2-yl)benzene (**5a**)



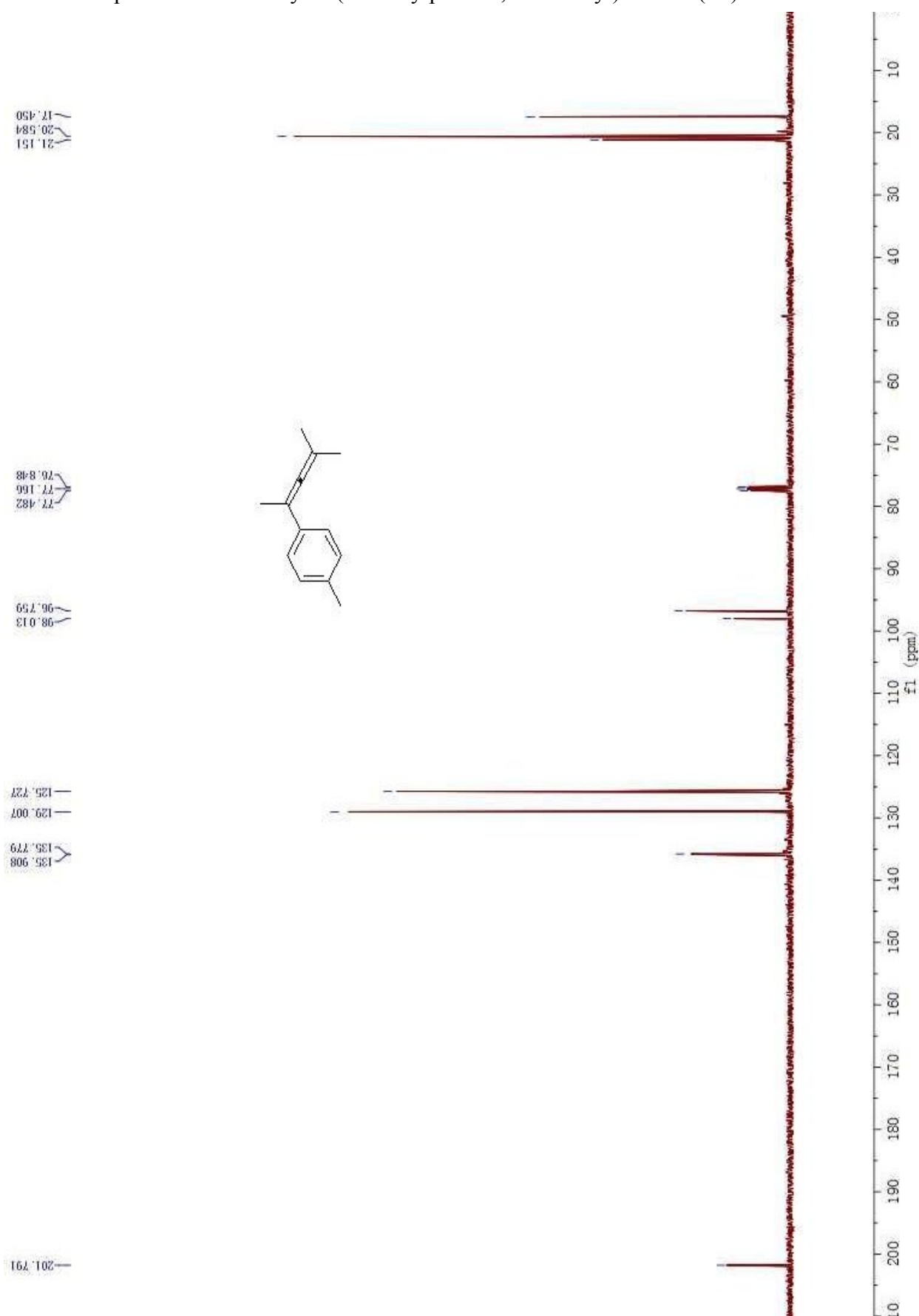
^{13}C NMR Spectrum of 1-(4-methylpenta-2,3-dien-2-yl)benzene (**5a**)



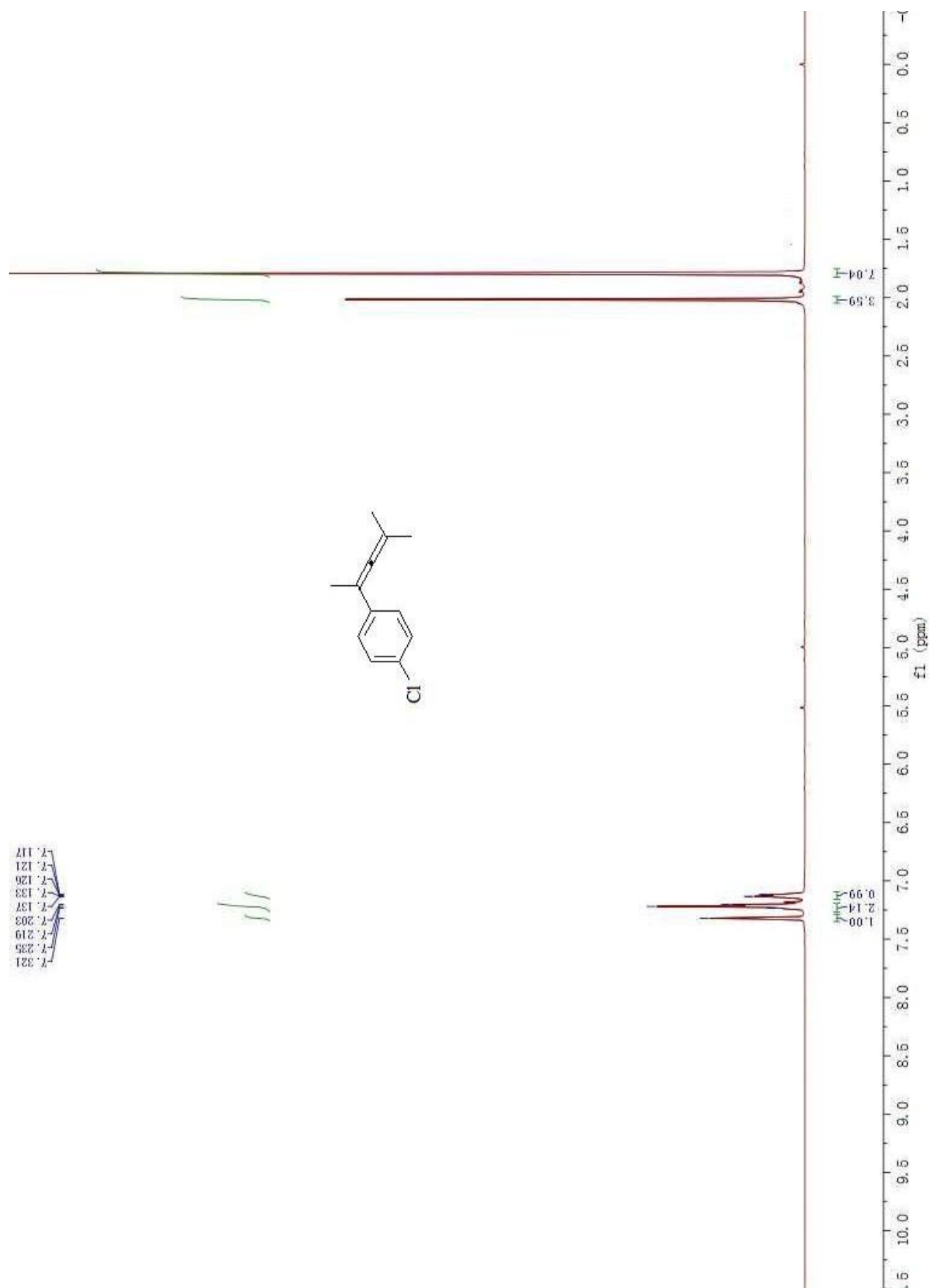
^1H NMR Spectrum of 1-methyl-4-(4-methylpenta-2,3-dien-2-yl)benzene(**5b**)



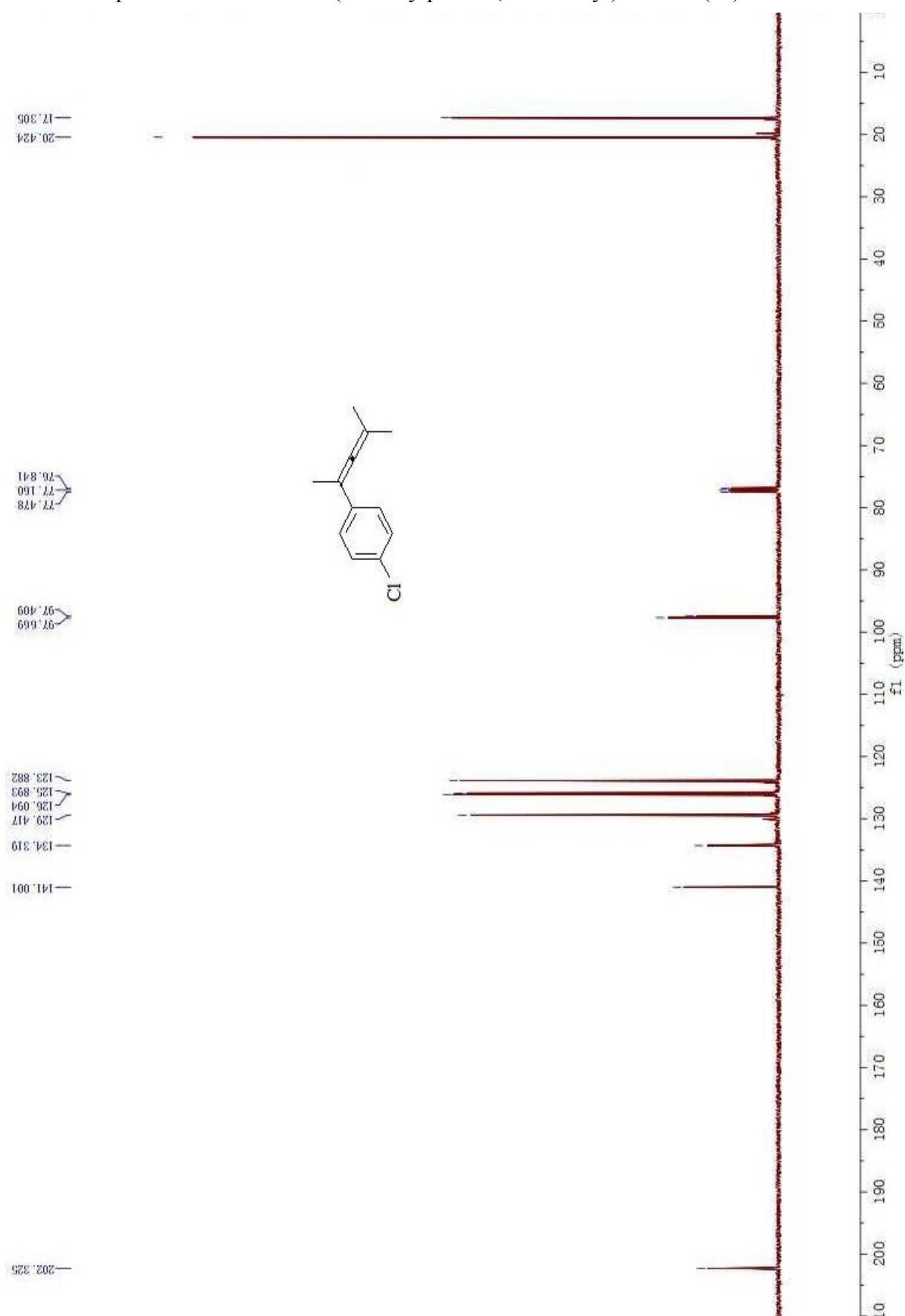
^{13}C NMR Spectrum of 1-methyl-4-(4-methylpenta-2,3-dien-2-yl)benzene(**5b**)



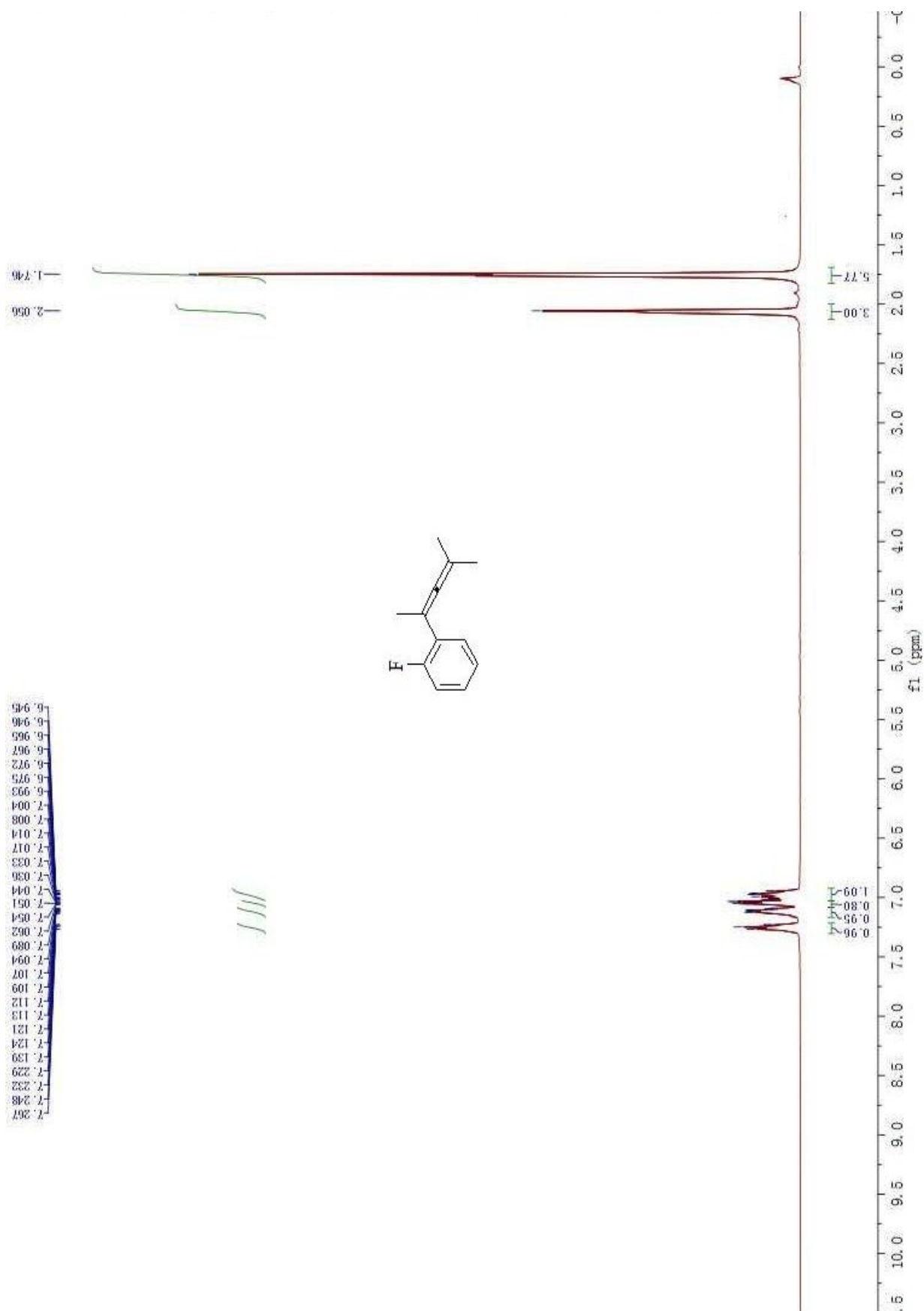
^1H NMR Spectrum of 1-chloro-3-(4-methylpenta-2,3-dien-2-yl)benzene (**5c**)



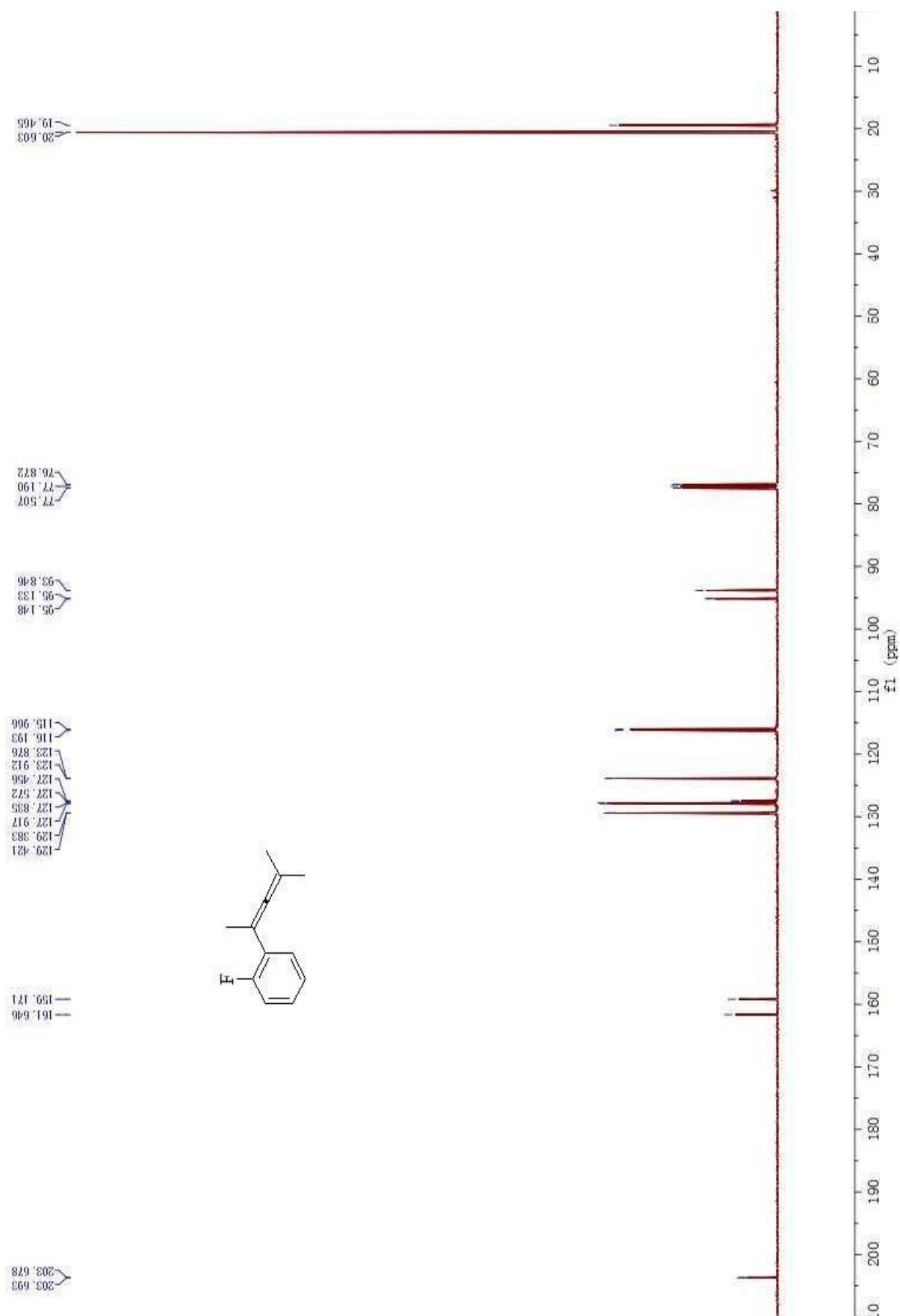
^{13}C NMR Spectrum of 1-chloro-3-(4-methylpenta-2,3-dien-2-yl)benzene (**5c**)



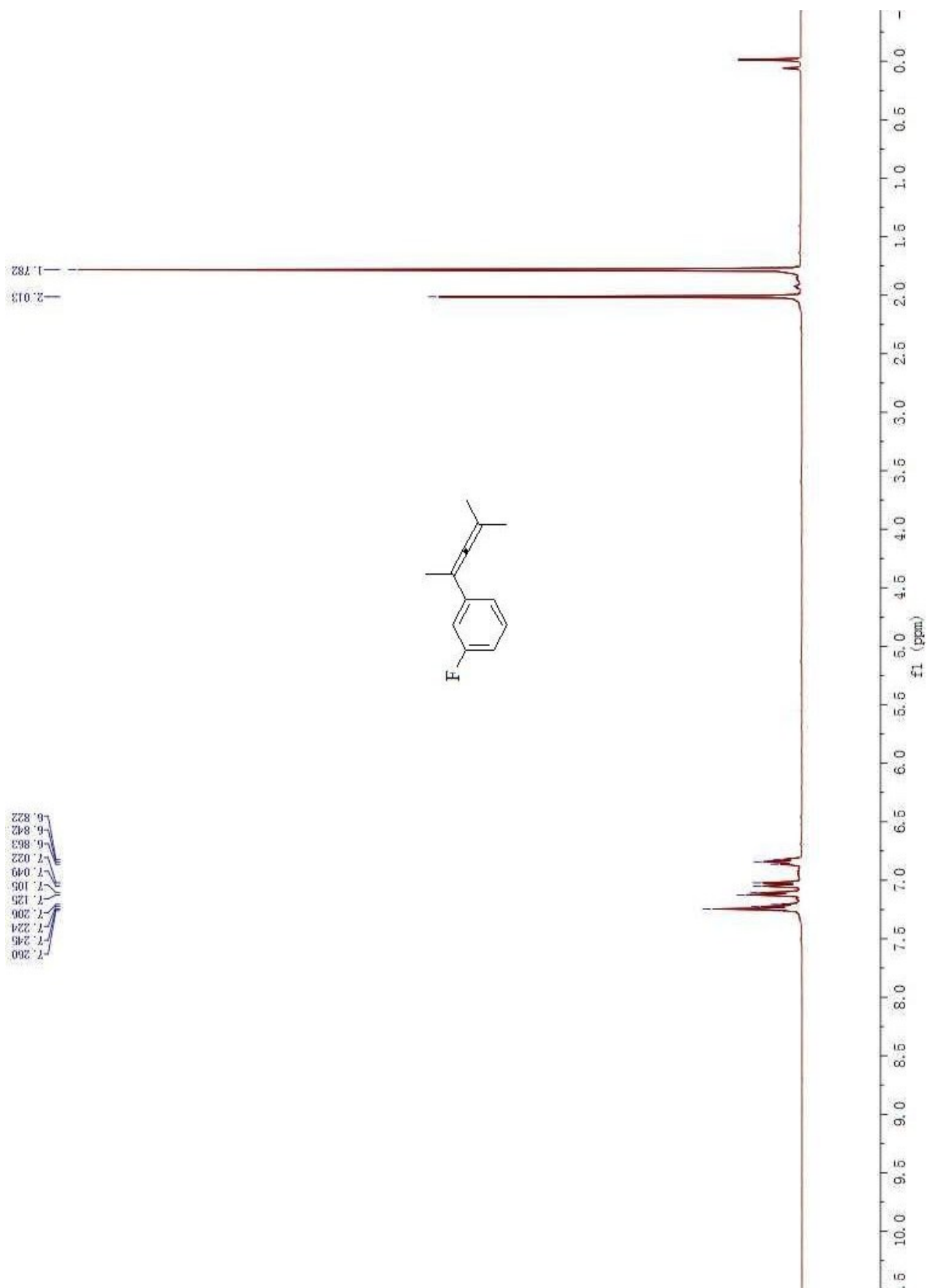
¹H NMR Spectrum of 1-flouro-2-(4-methylpenta-2,3-dien-2-yl)benzene (**5d**)



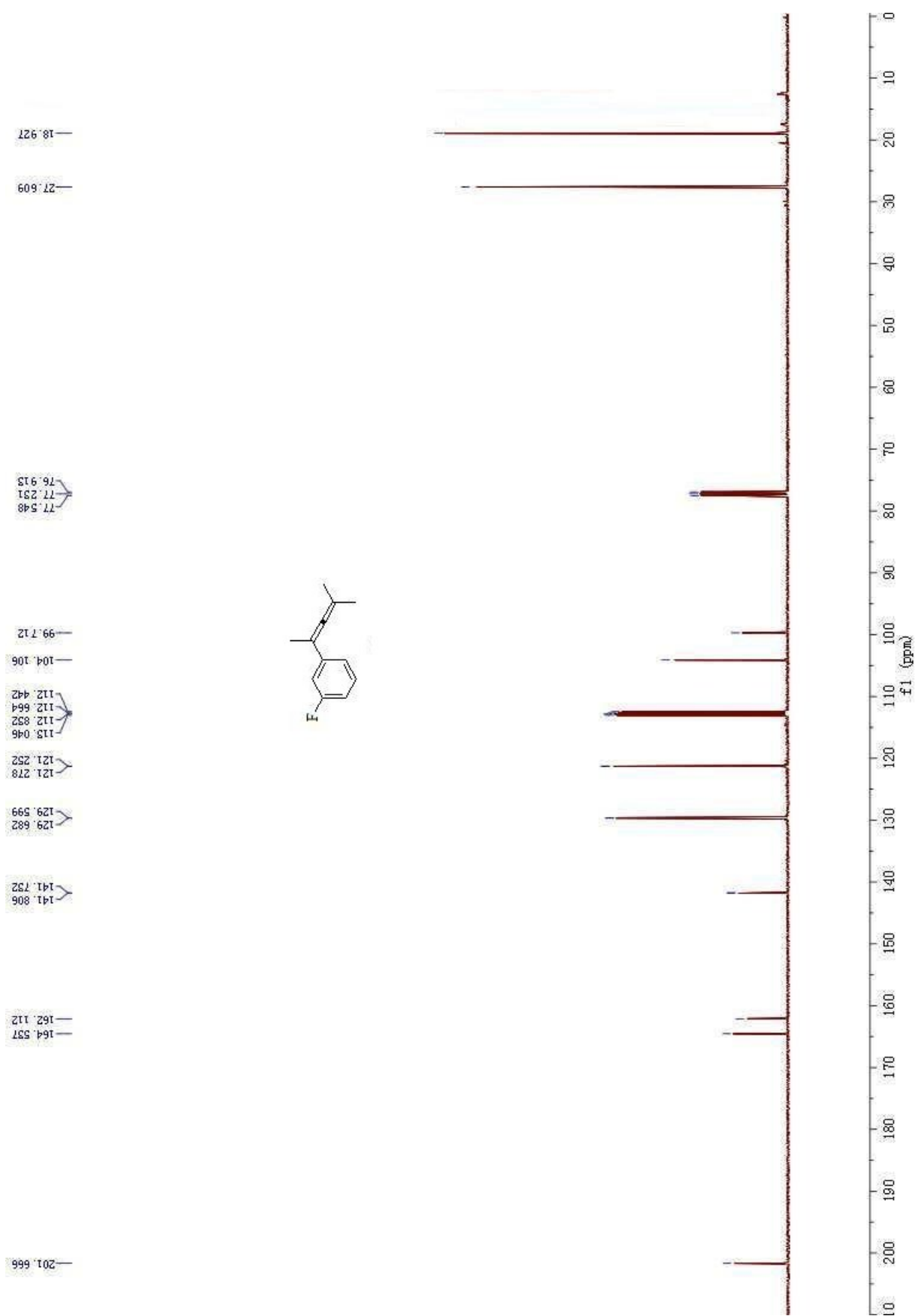
^{13}C NMR Spectrum of 1-flouro-2-(4-methylpenta-2,3-dien-2-yl)benzene (**5d**)



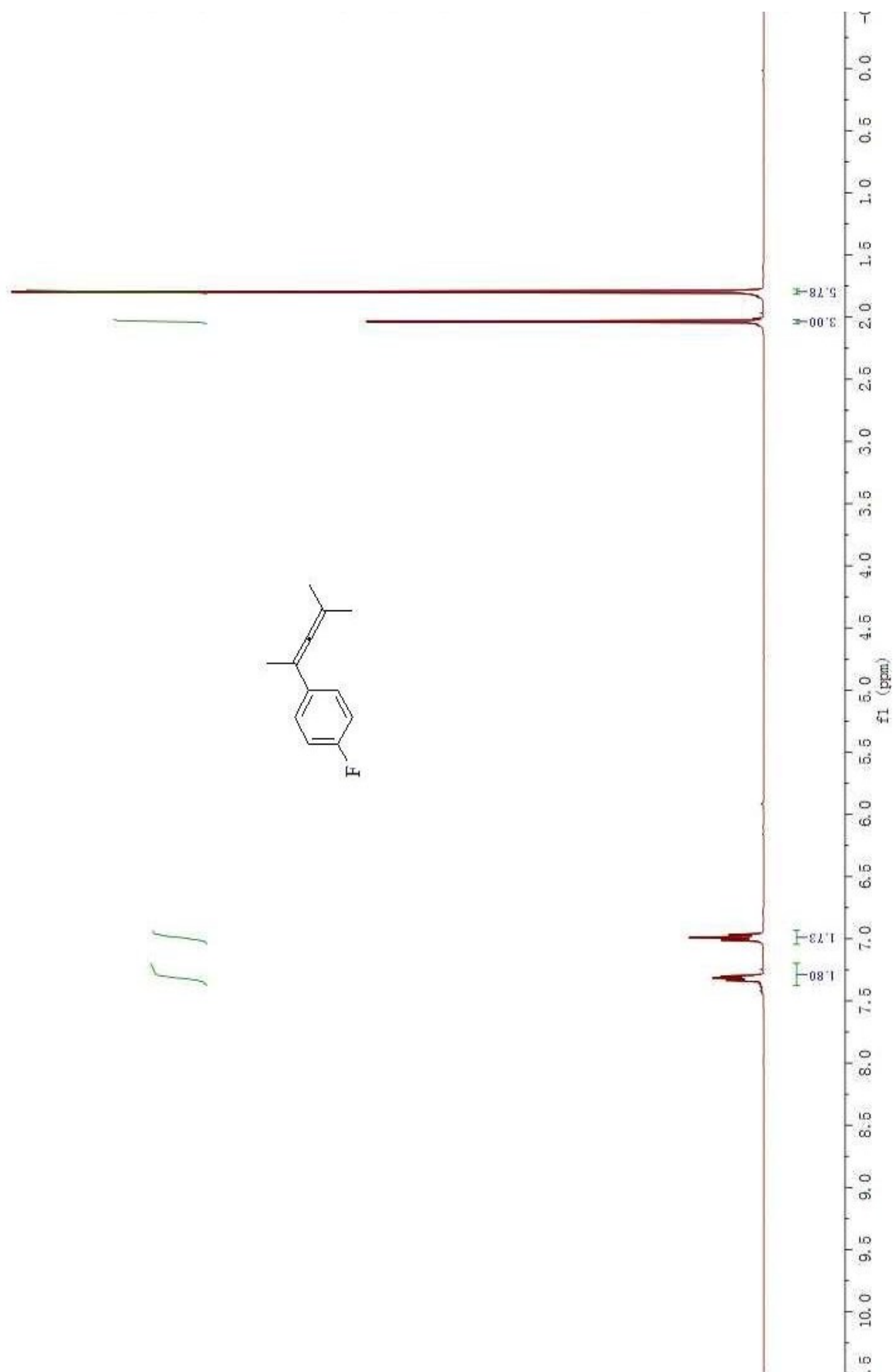
^1H NMR Spectrum of 1-flouro-3-(4-methylpenta-2,3-dien-2-yl)benzene (**5e**)



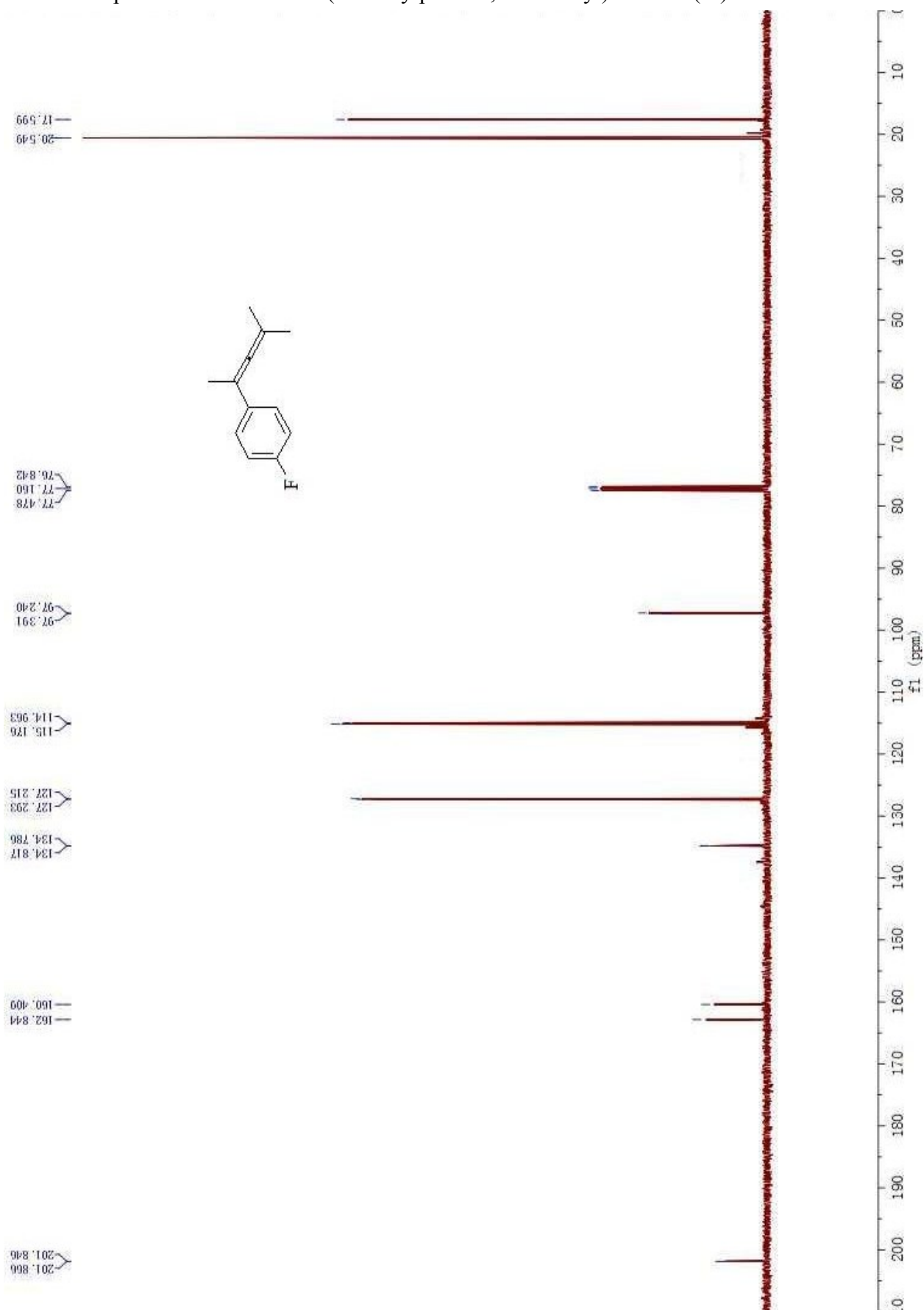
^{13}C NMR Spectrum of 1-fluoro-3-(4-methylpenta-2,3-dien-2-yl)benzene (**5e**):



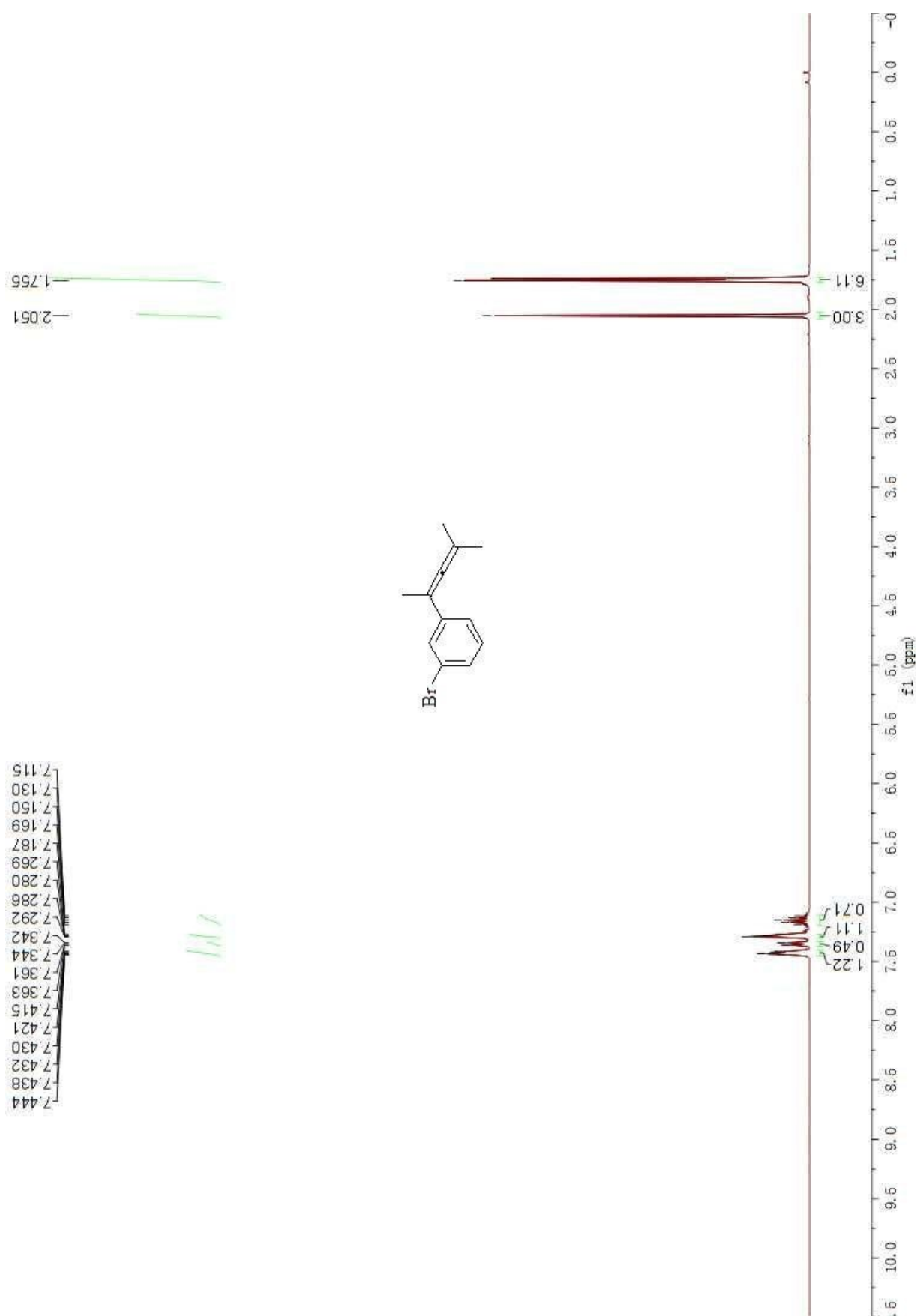
^1H NMR Spectrum of 1-fluoro-4-(4-methylpenta-2,3-dien-2-yl)benzene (**5f**)



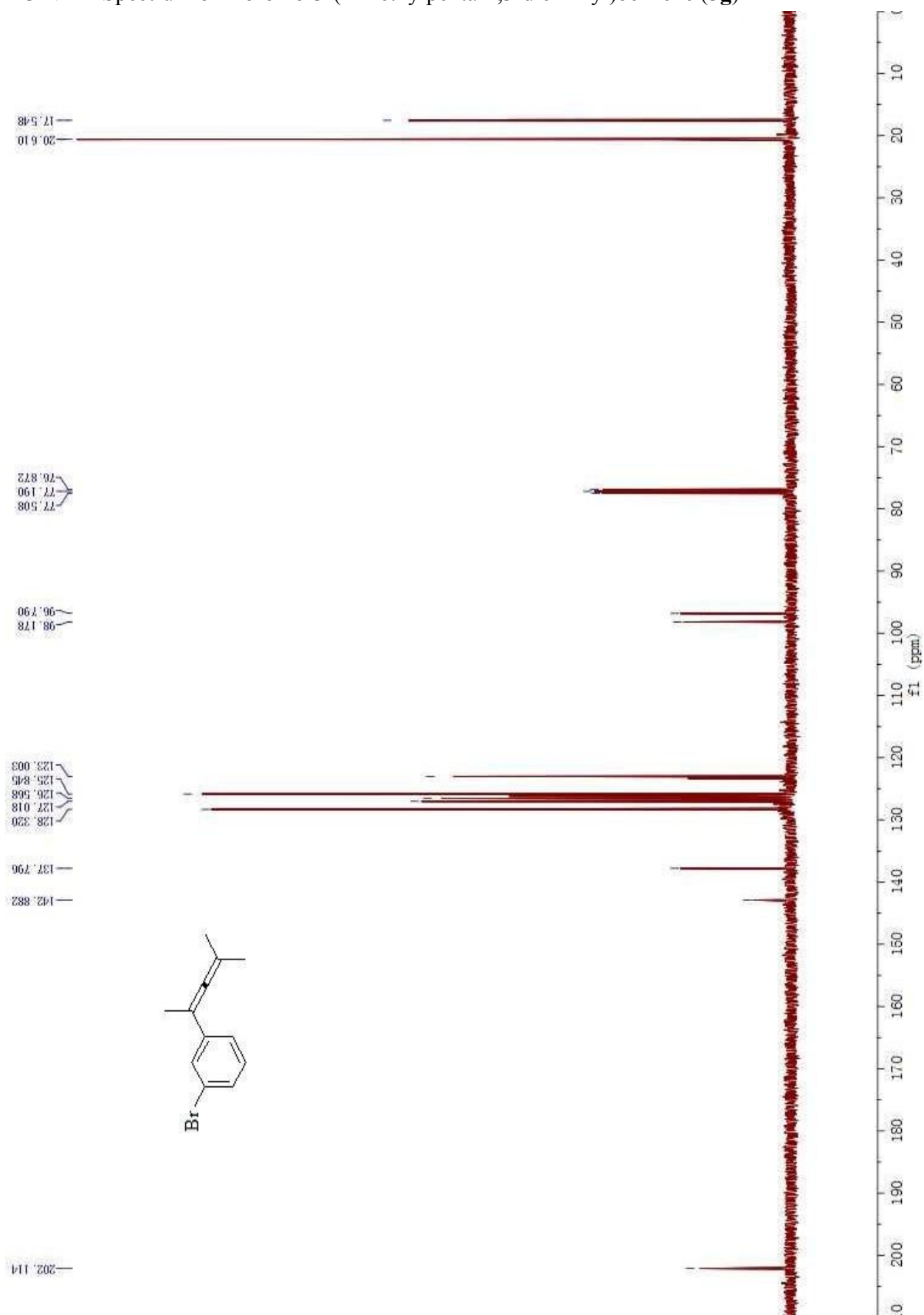
¹³C NMR Spectrum of 1-fluoro-4-(4-methylpenta-2,3-dien-2-yl)benzene (**5f**)



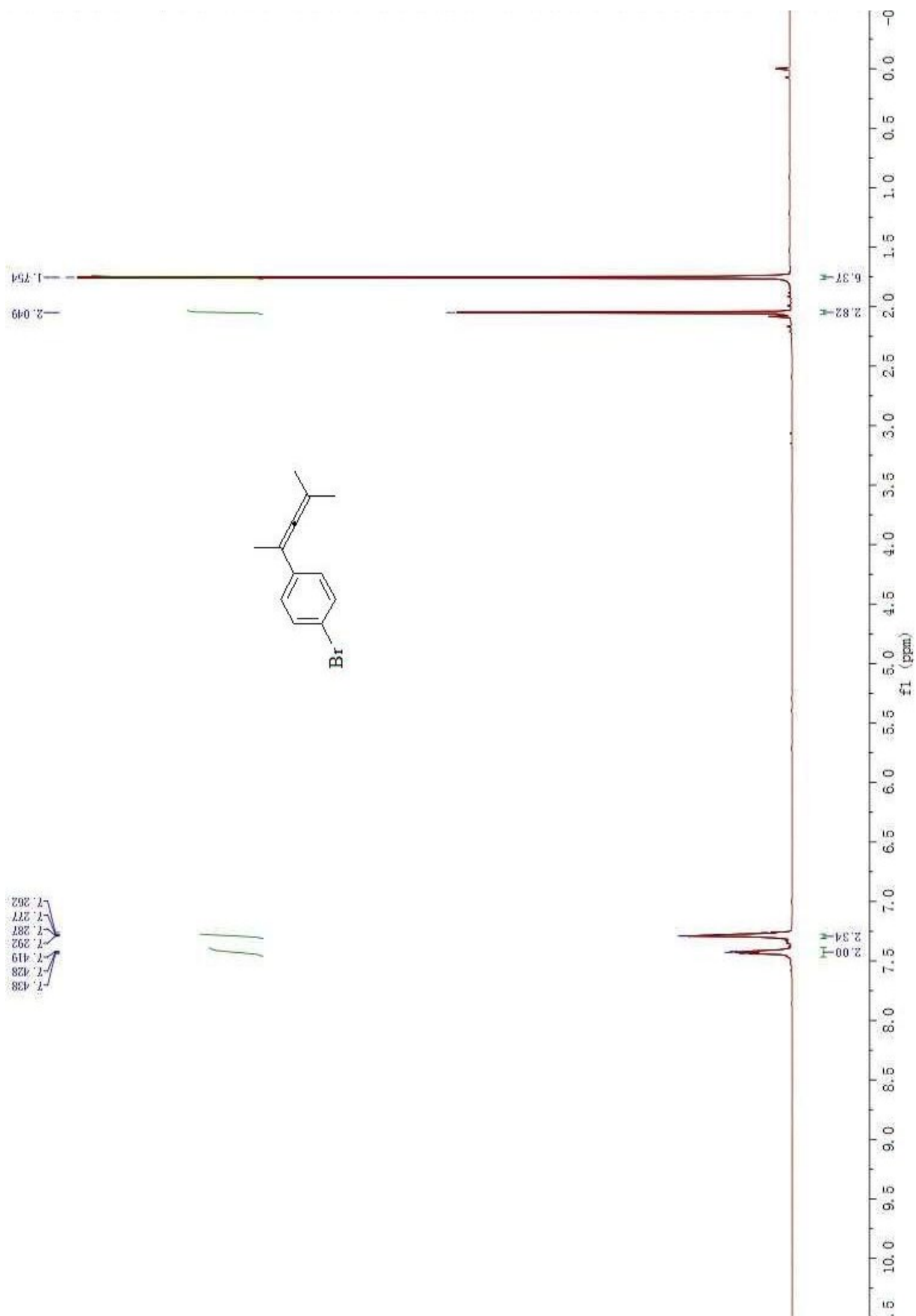
^1H NMR Spectrum of 1-bromo-3-(4-methylpenta-2,3-dien-2-yl)benzene (**5g**)



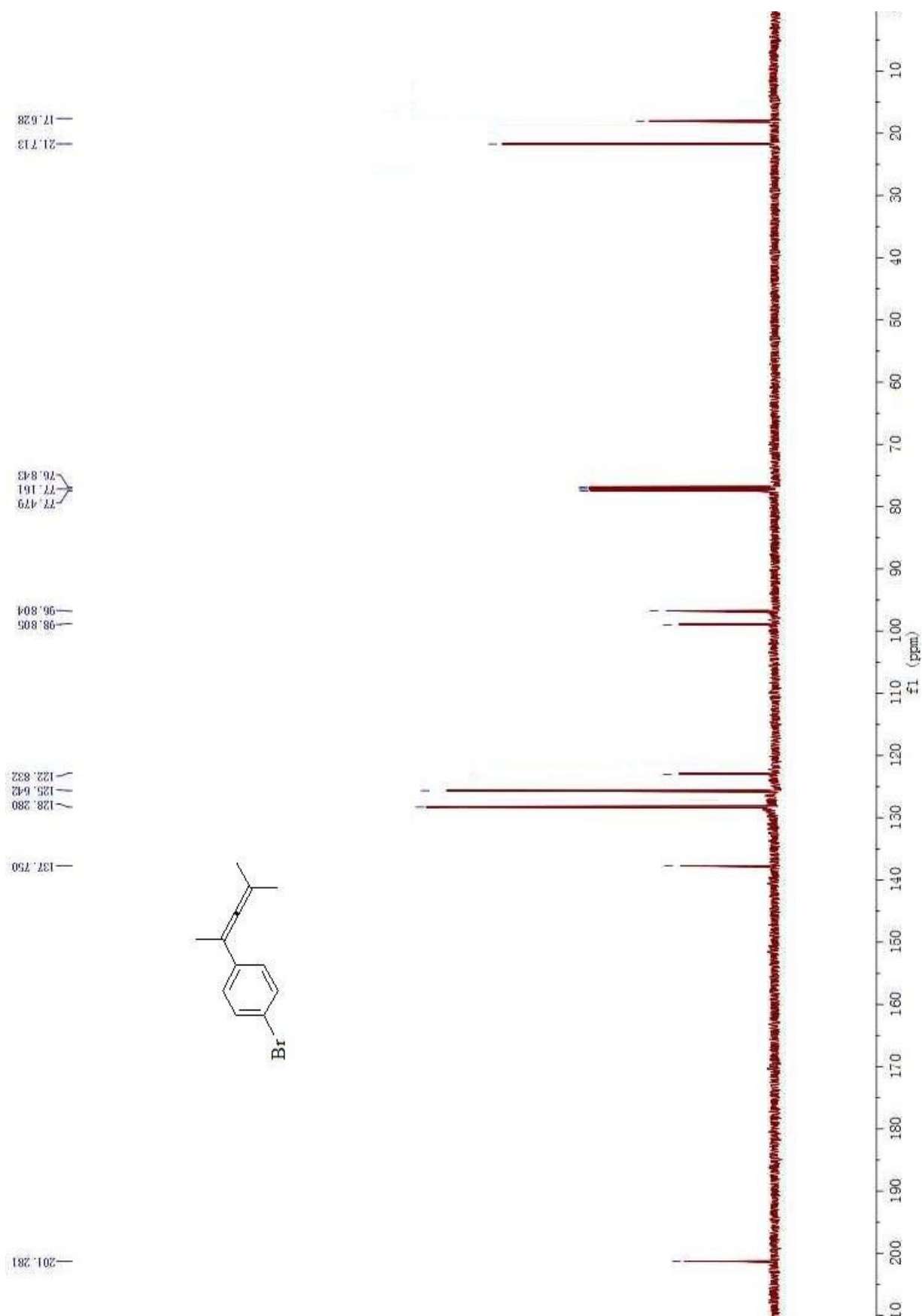
^{13}C NMR Spectrum of 1-bromo-3-(4-methylpenta-2,3-dien-2-yl)benzene (**5g**)



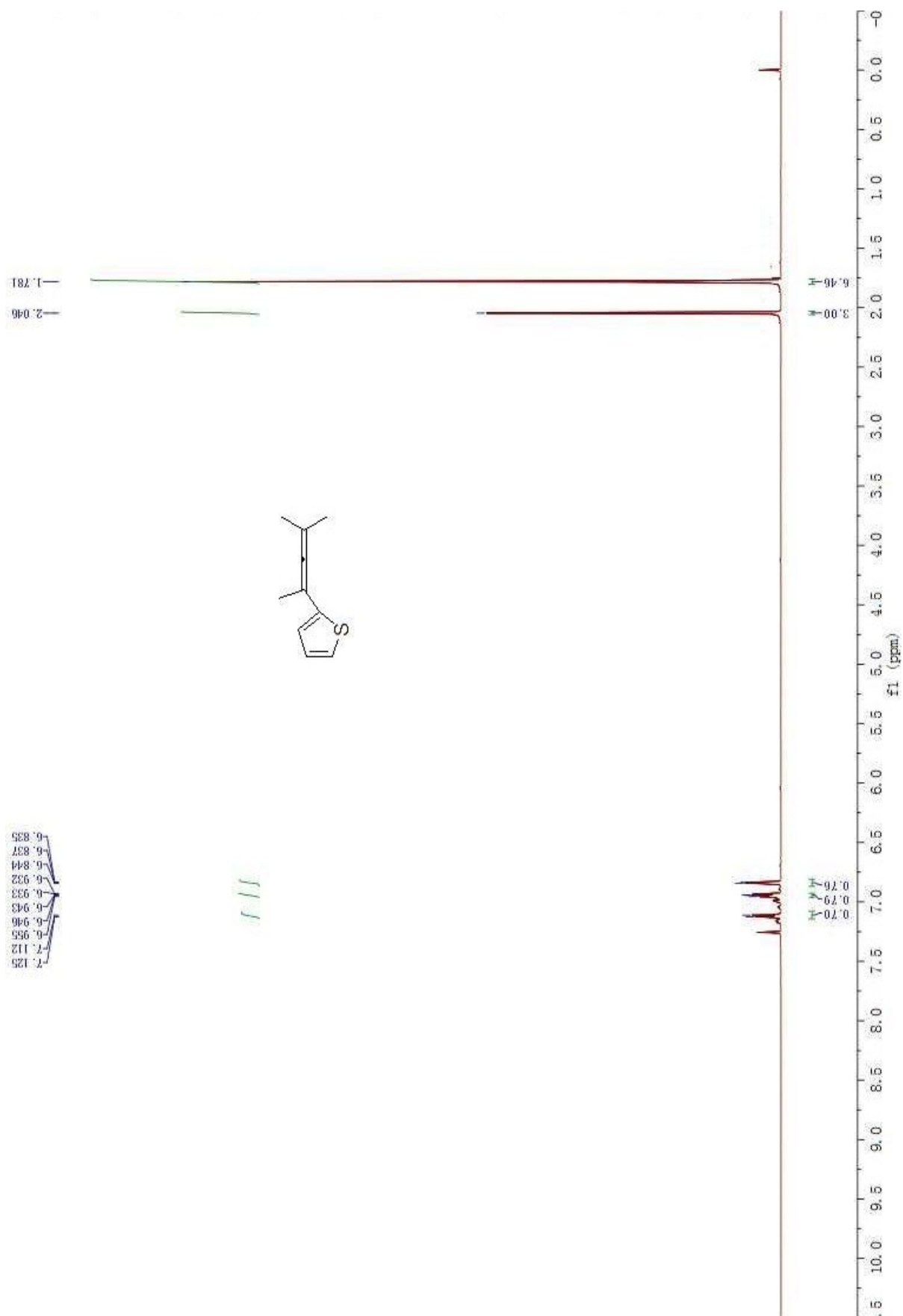
^1H NMR Spectrum of 1-bromo-4-(4-methylpenta-2,3-dien-2-yl)benzene (**5h**)



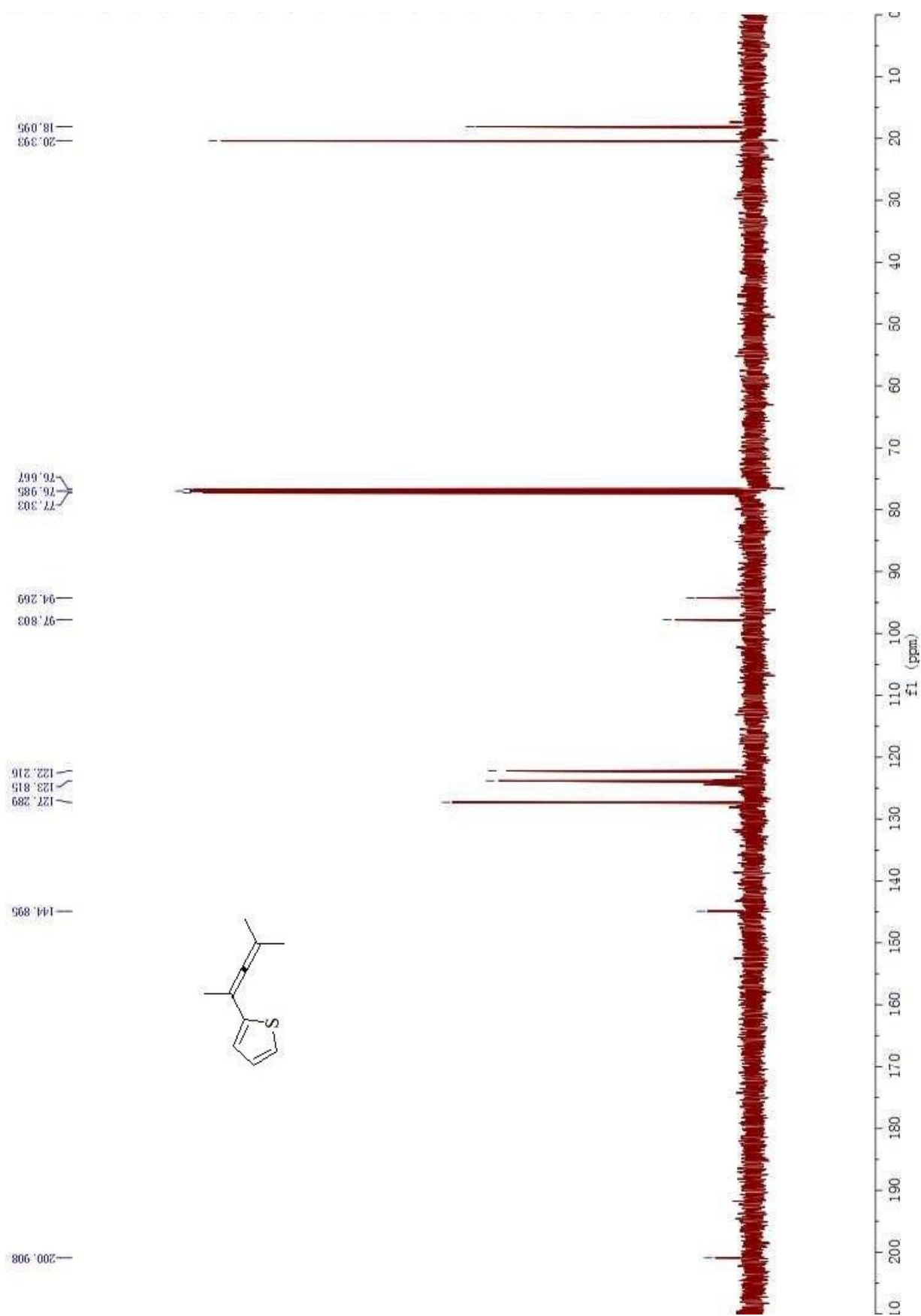
^{13}C NMR Spectrum of 1-bromo-4-(4-methylpenta-2,3-dien-2-yl)benzene (**5h**)



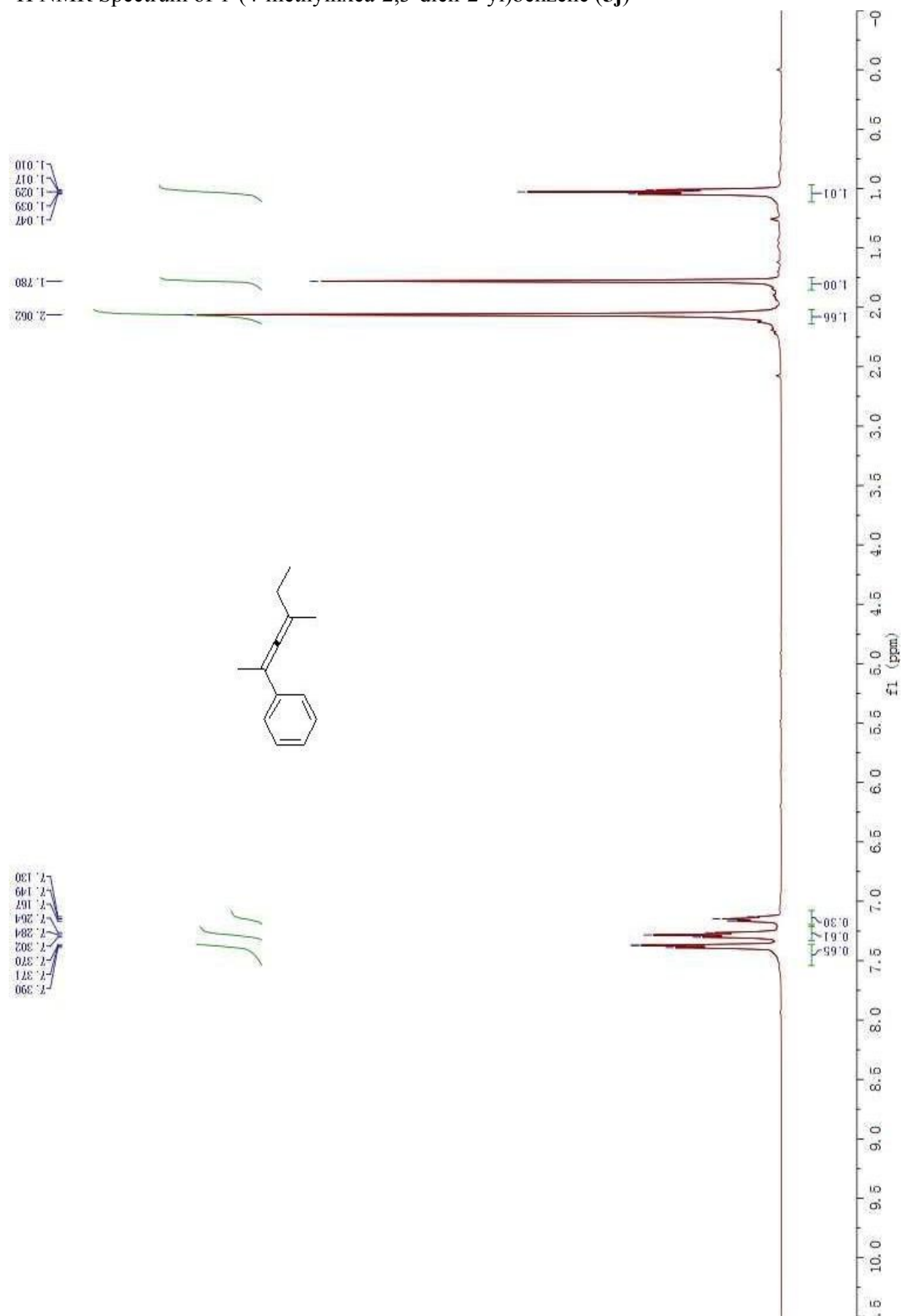
¹H NMR Spectrum of 2-(4-methylpenta-2,3-dien-2-yl)thiophene (**5i**)



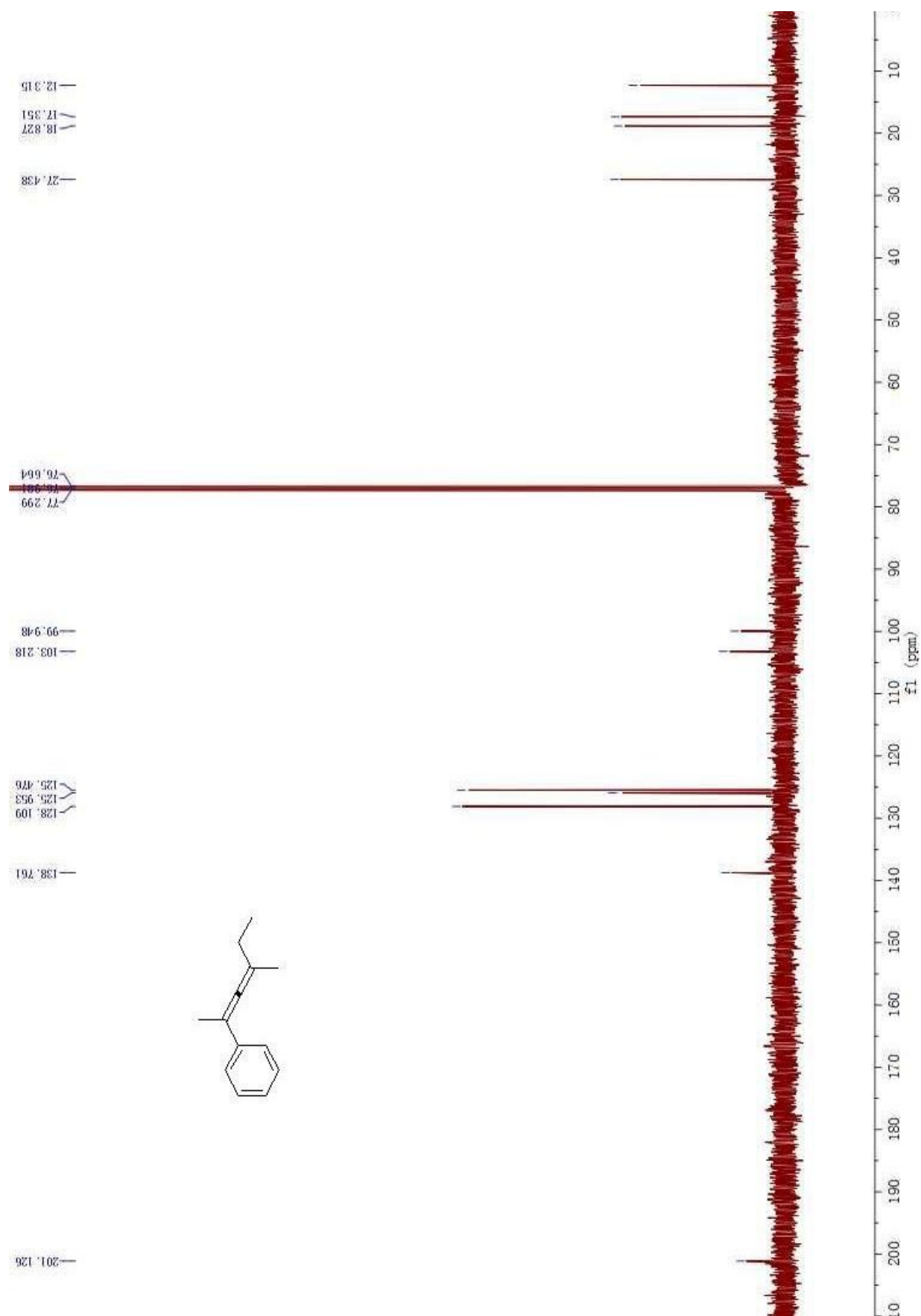
^{13}C NMR Spectrum of 2-(4-methylpenta-2,3-dien-2-yl)thiophene (**5i**)



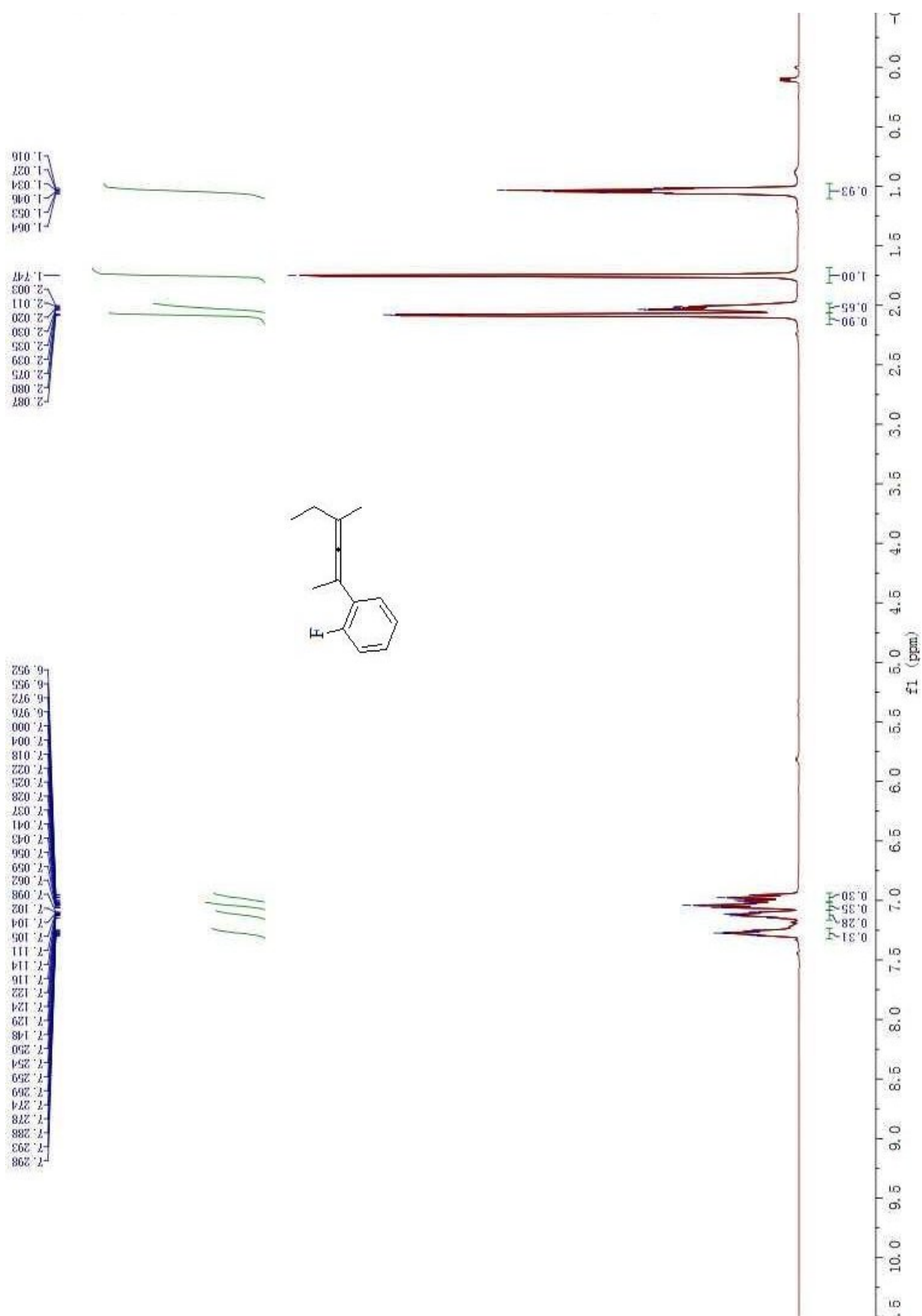
^1H NMR Spectrum of 1-(4-methylhexa-2,3-dien-2-yl)benzene (**5j**)



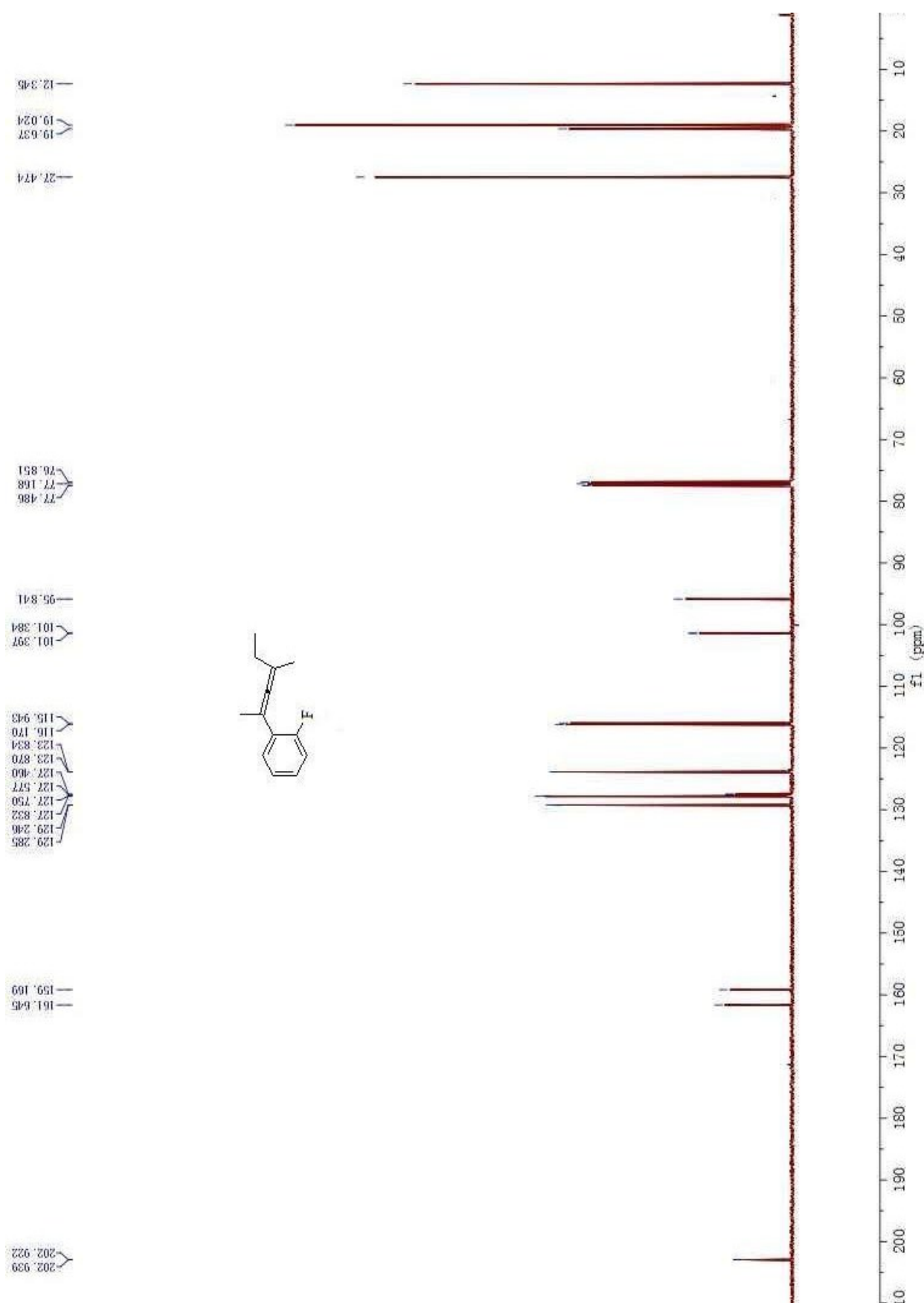
^{13}C NMR Spectrum of 1-(4-methylhexa-2,3-dien-2-yl)benzene (**5j**)



¹H NMR Spectrum of 1-fluoro-2-(4-methylhexa-2,3-dien-2-yl)benzene (**5k**)

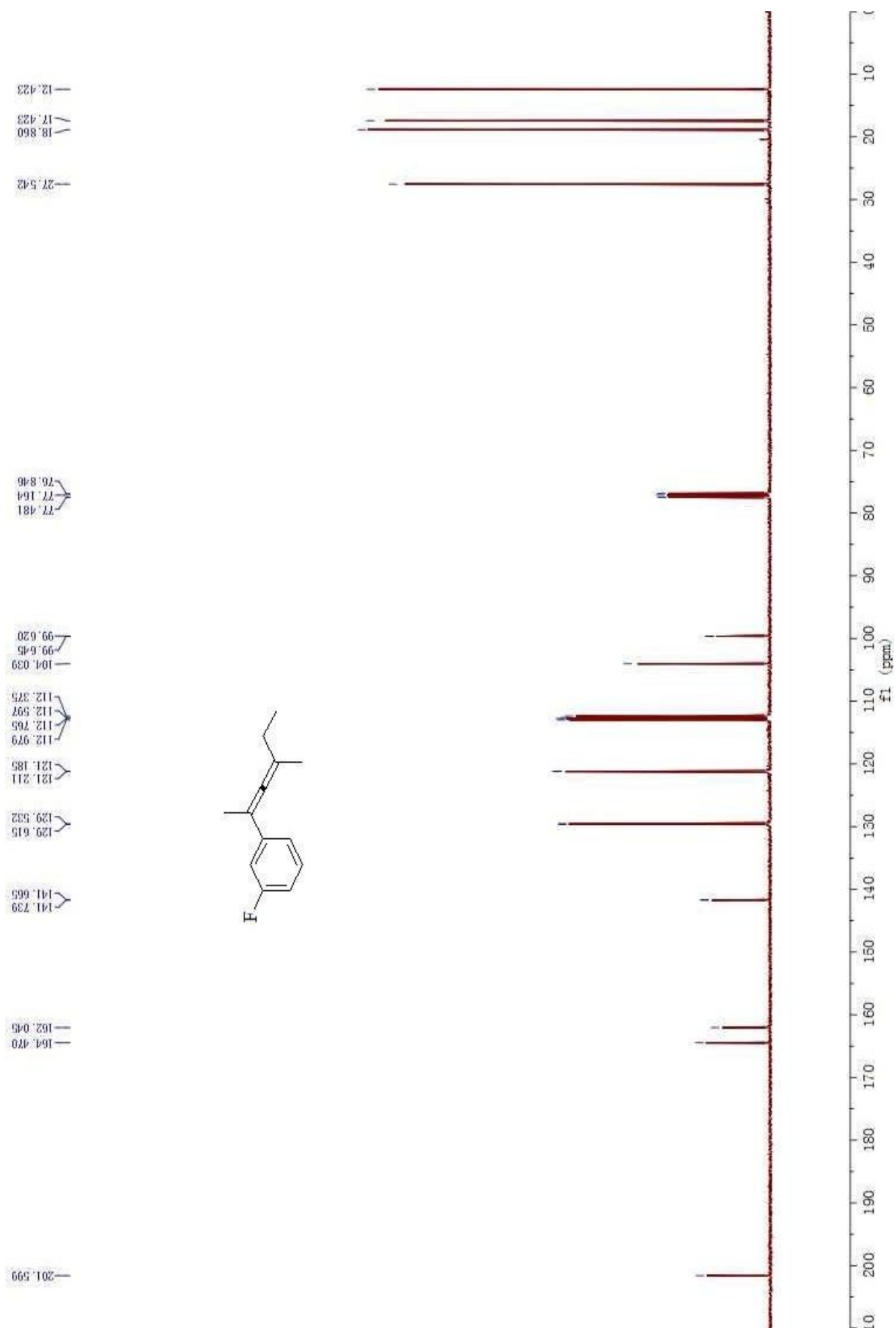


^{13}C NMR Spectrum of 1-fluoro-2-(4-methylhexa-2,3-dien-2-yl)benzene (**5k**)

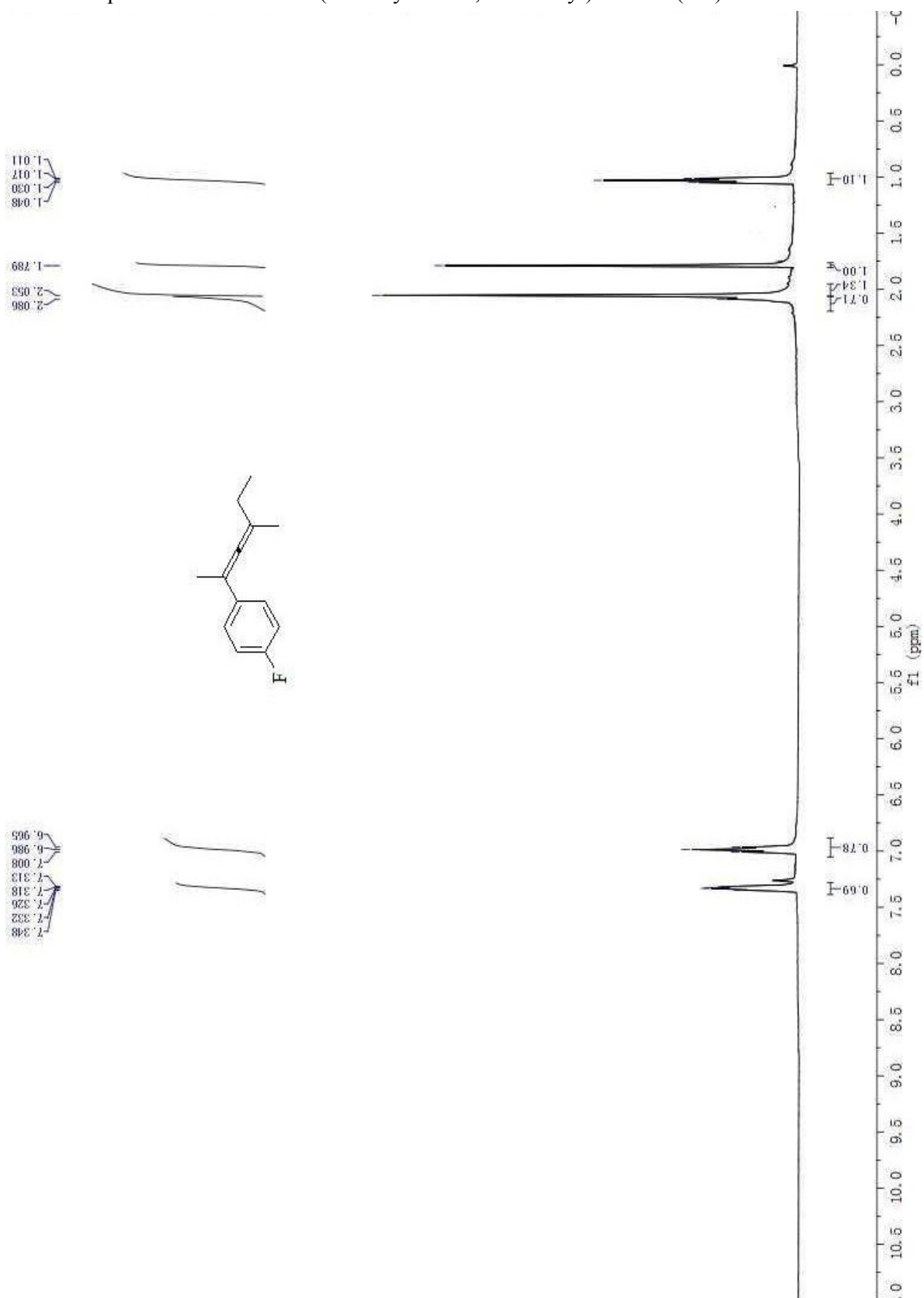


[illegible]

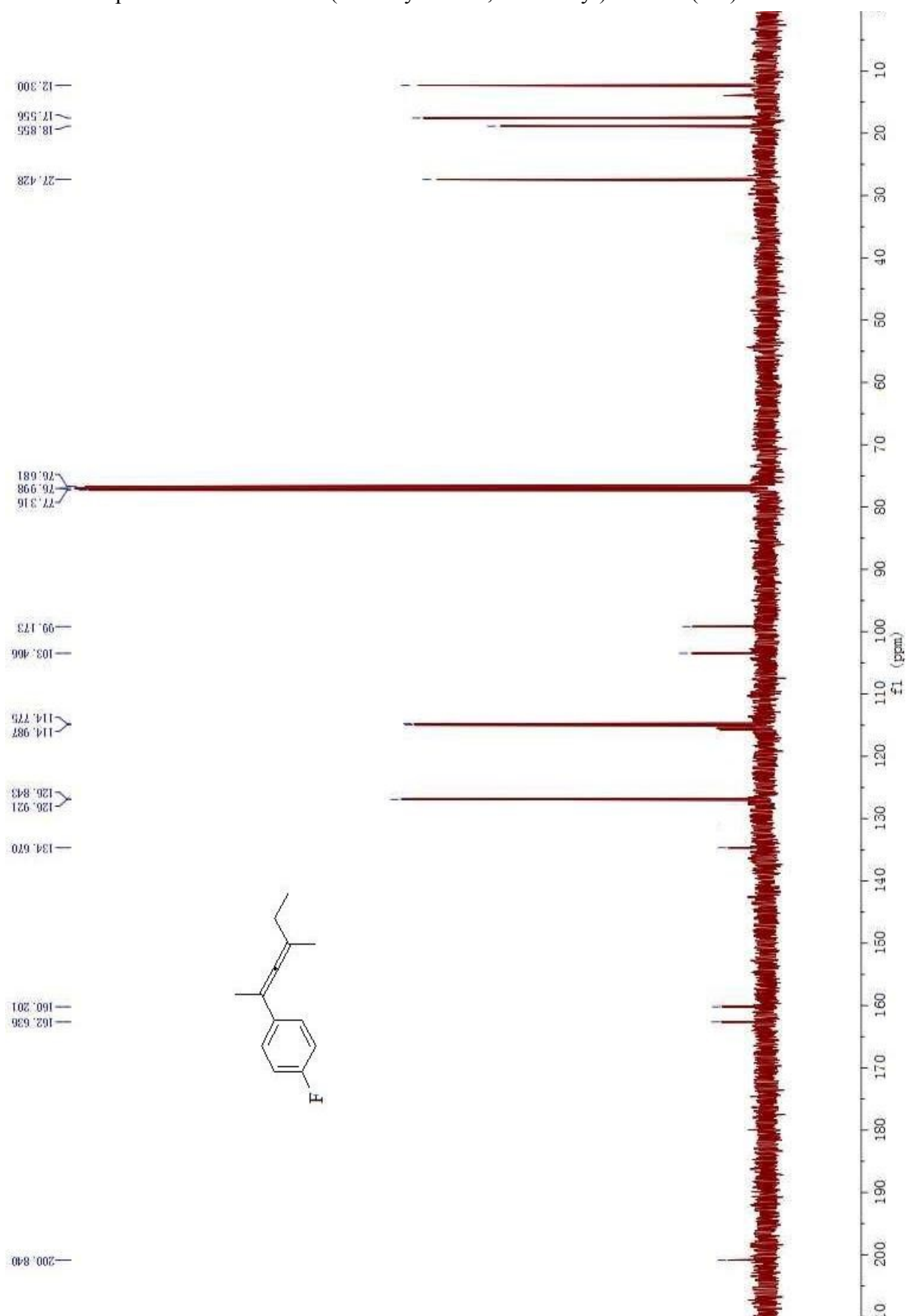
^{13}C NMR Spectrum of 1-fluoro-3-(3-methylhexa-2,3-dien-2-yl)benzene (**5l**)



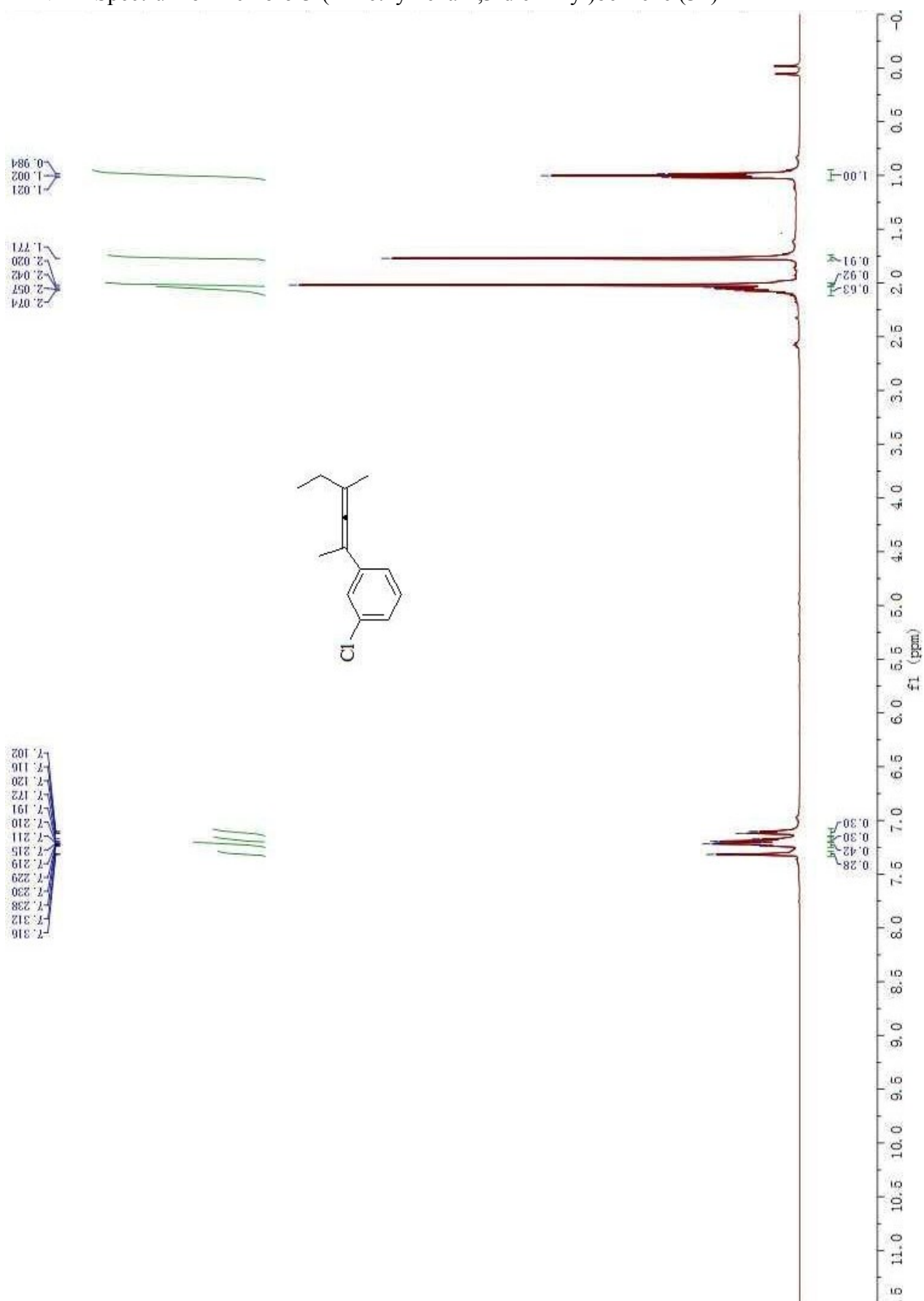
¹H NMR Spectrum of 1-fluoro-4-(4-methylhexa-2,3-dien-2-yl)benzene (**5m**)



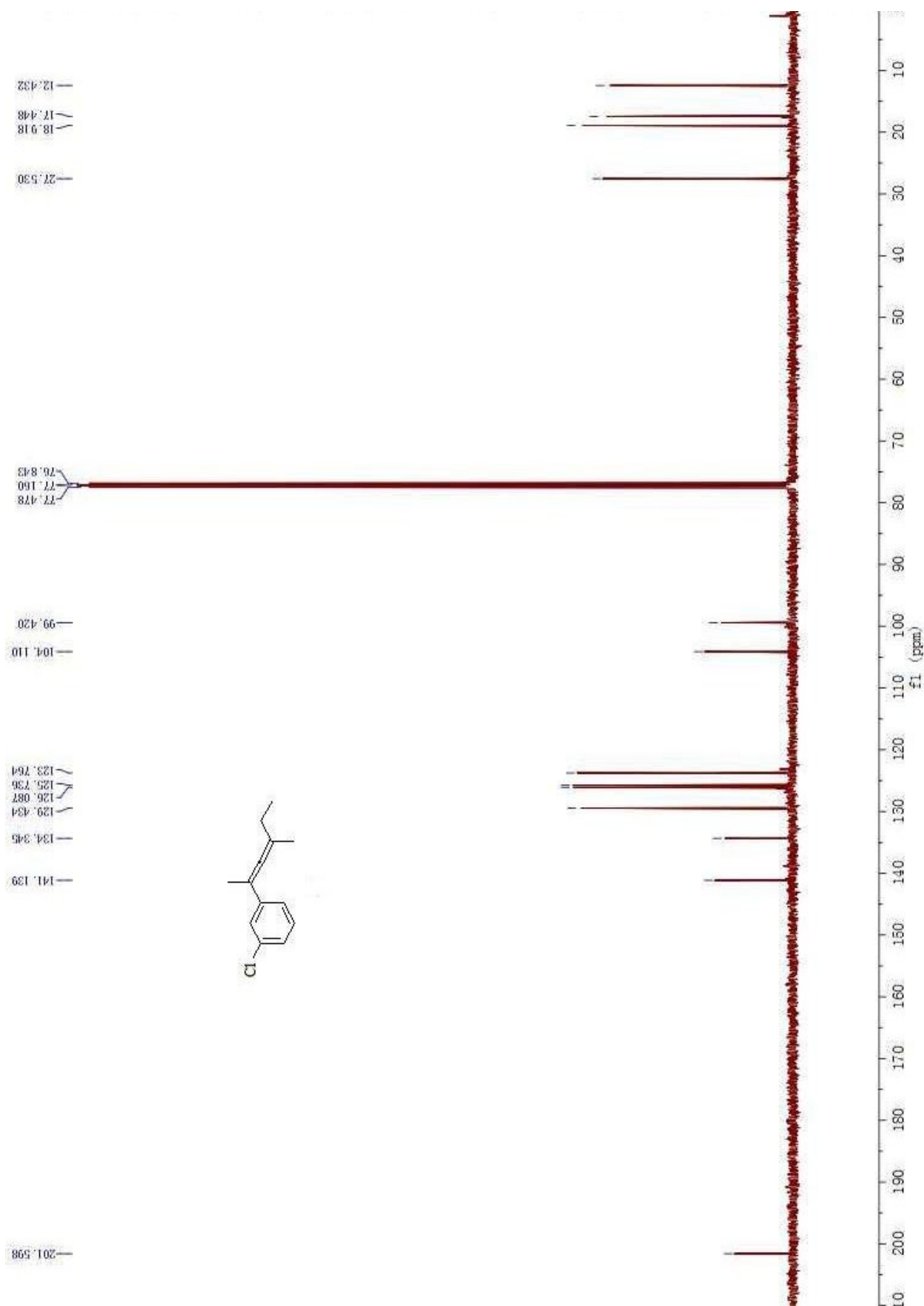
^{13}C NMR Spectrum of 1-fluoro-4-(4-methylhexa-2,3-dien-2-yl)benzene (**5m**)



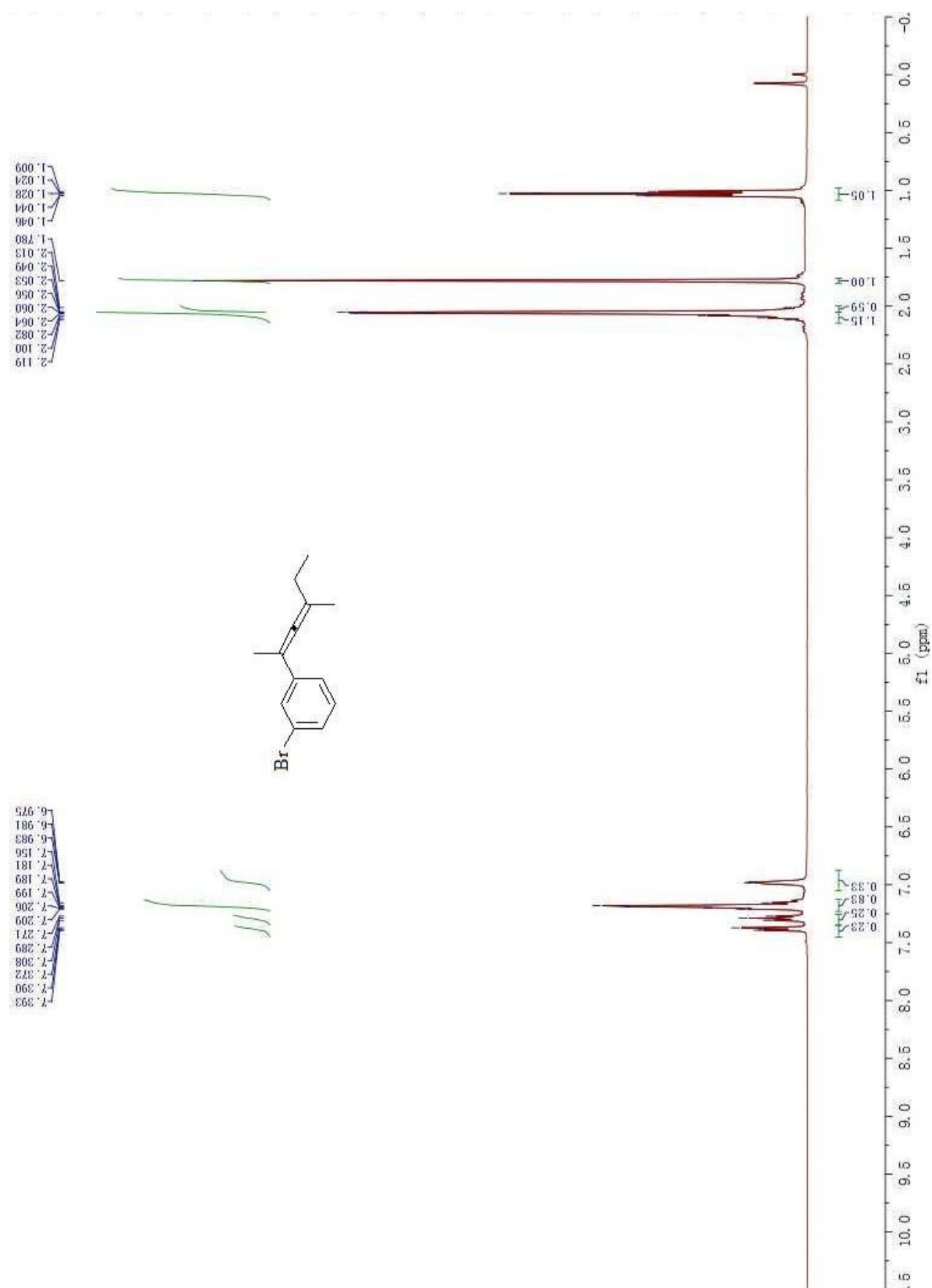
^1H NMR Spectrum of 1-chloro-3-(4-methylhexa-2,3-dien-2-yl)benzene (**5n**)



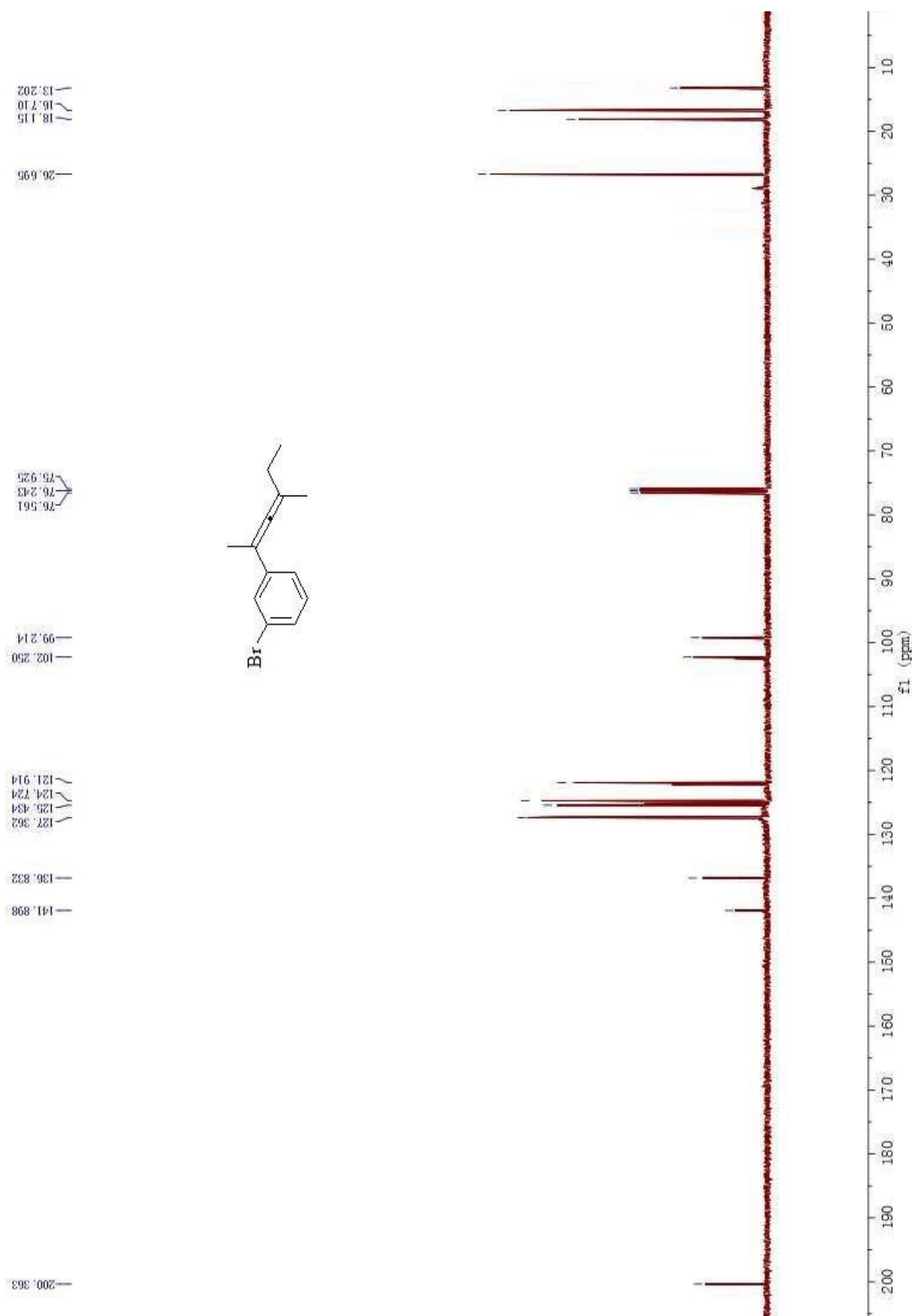
^{13}C NMR Spectrum of 1-chloro-3-(4-methylhexa-2,3-dien-2-yl)benzene (**5n**)



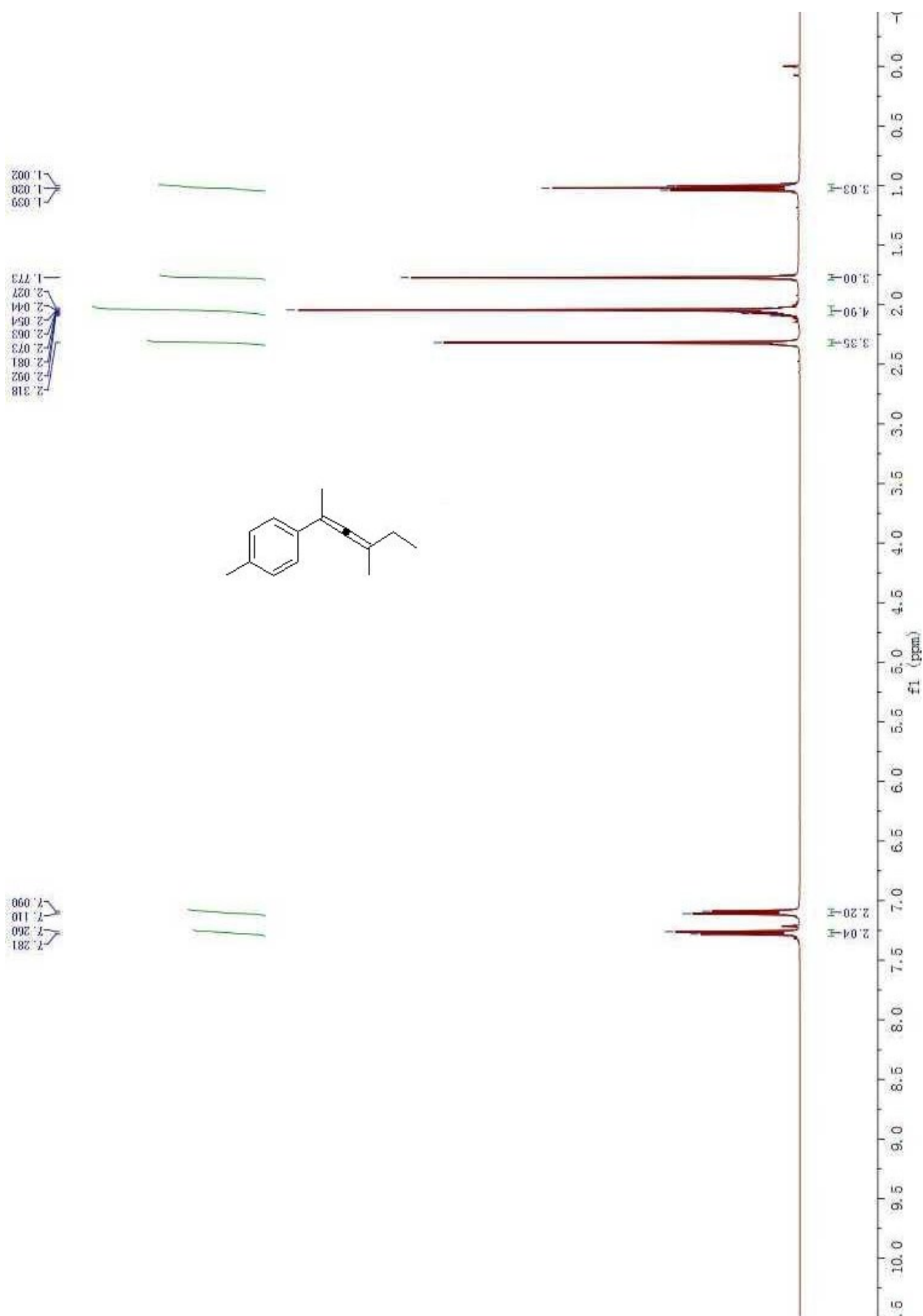
¹H NMR Spectrum of 1-bromo-3-(4-methylhexa-2,3-dien-2-yl)benzene (**5o**)



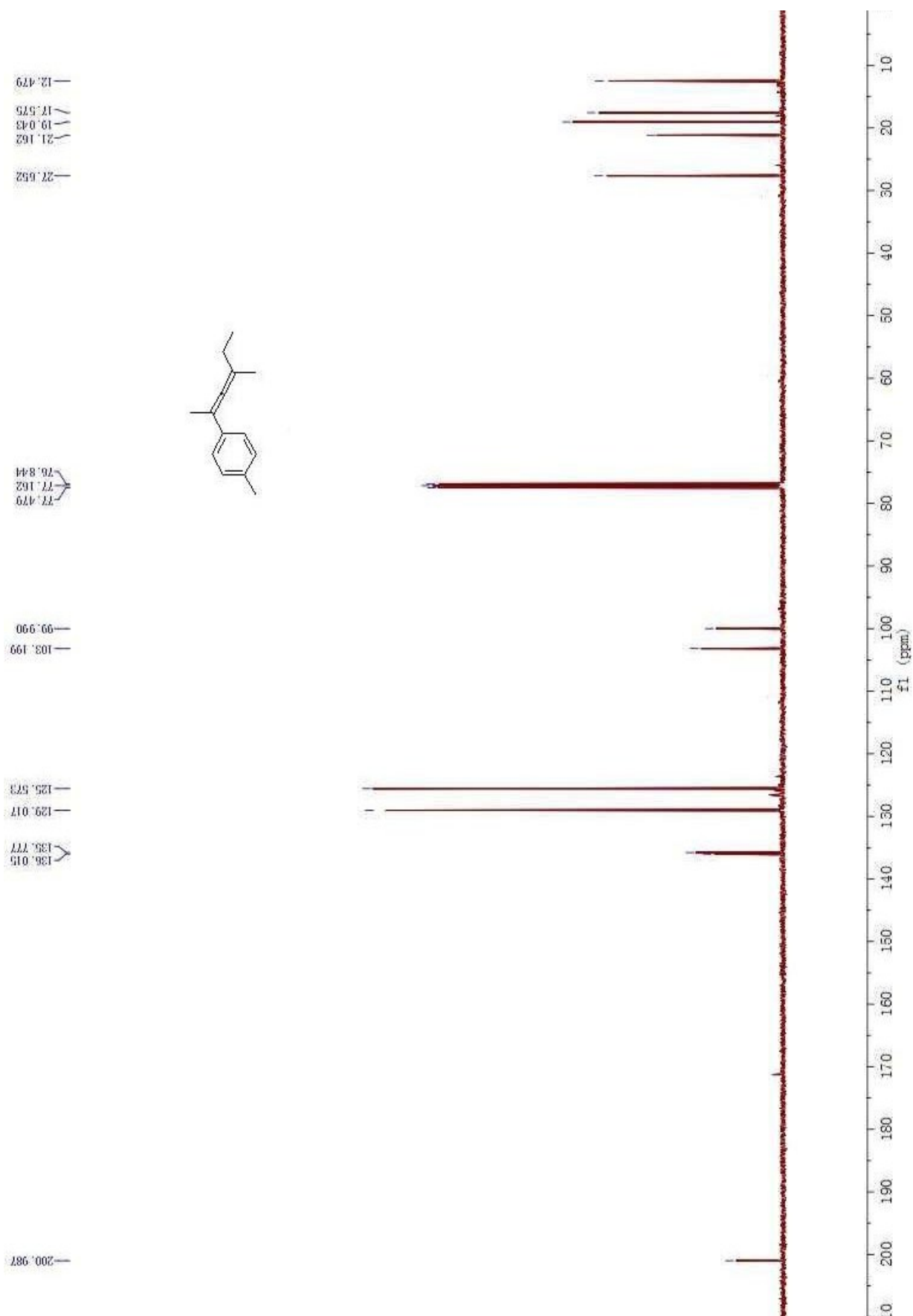
^{13}C NMR Spectrum of 1-bromo-3-(4-methylhexa-2,3-dien-2-yl)benzene (**5o**)



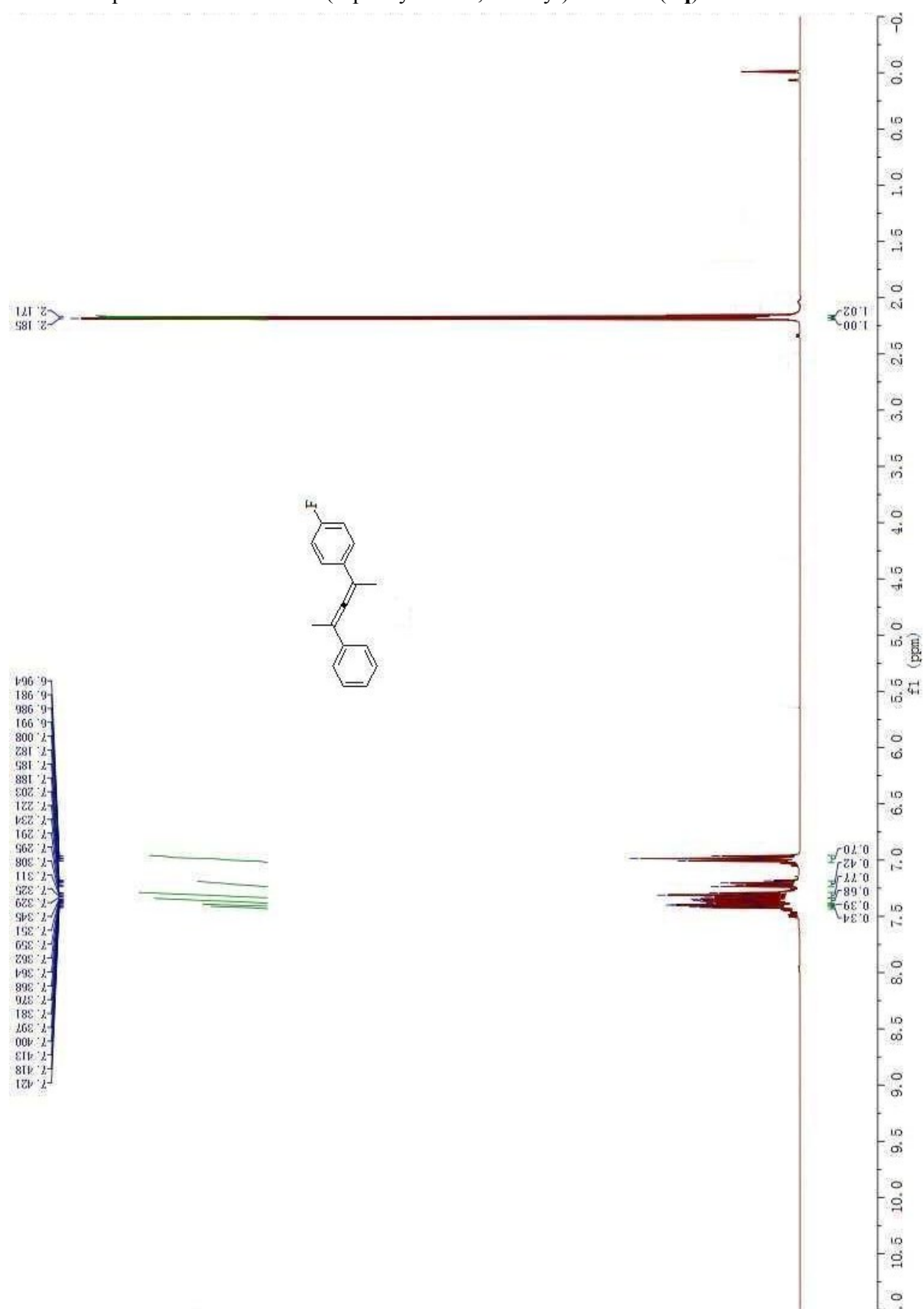
¹H NMR Spectrum of 1-methyl-4-(4-methylpenta-2,3-dien-2-yl)benzene(**5p**)



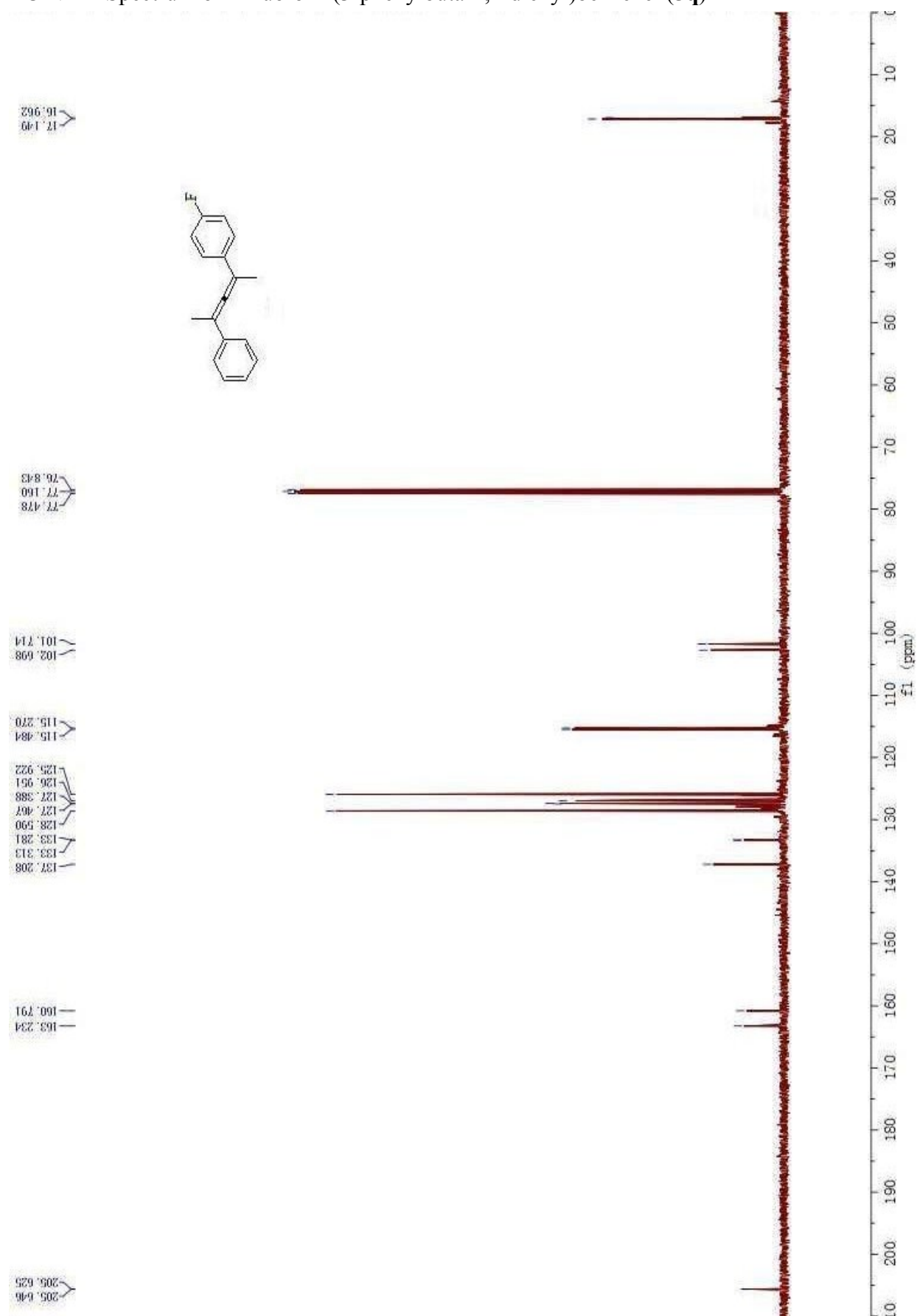
^{13}C NMR Spectrum of 1-methyl-4-(4-methylpenta-2,3-dien-2-yl)benzene(**5p**)



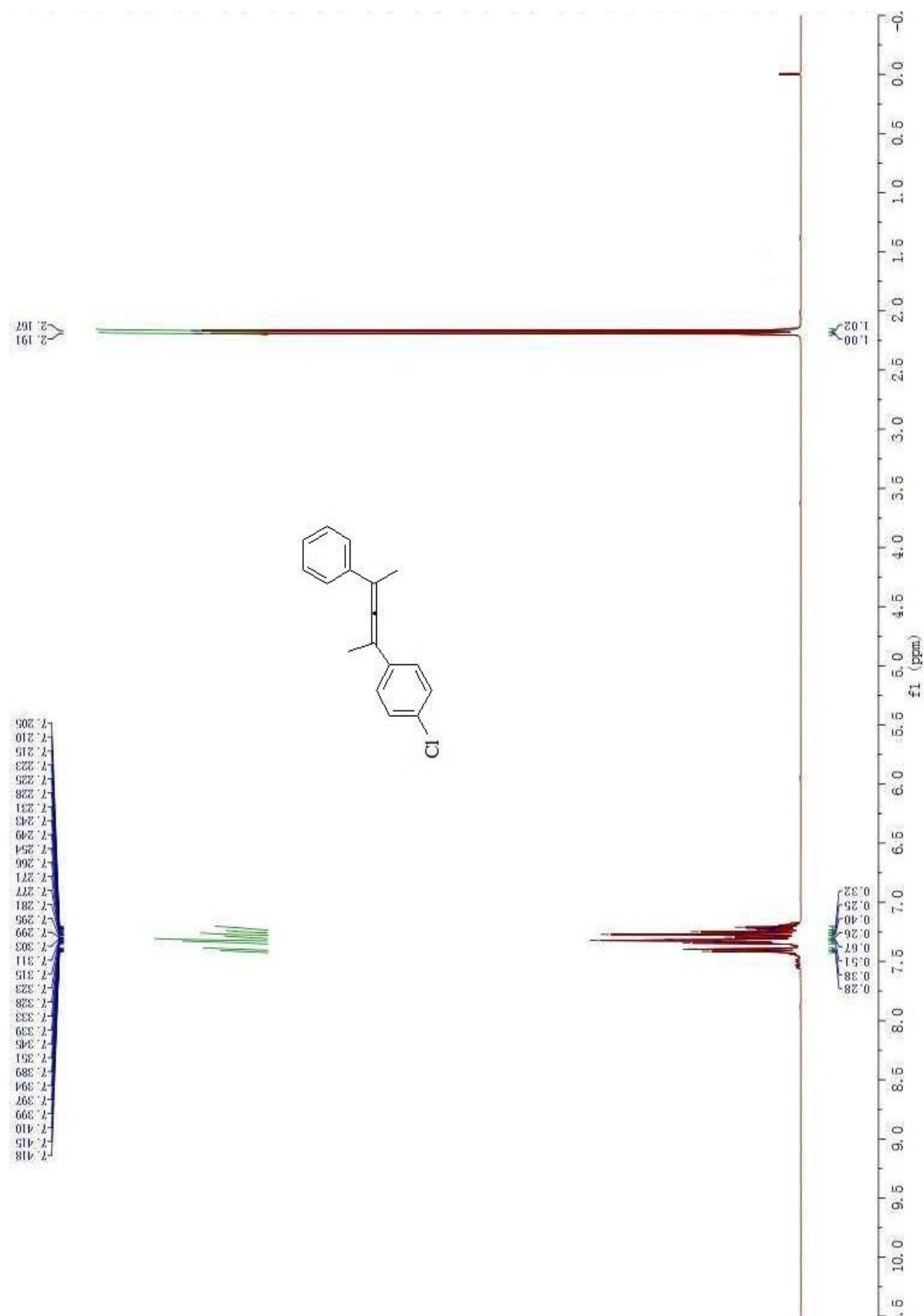
¹H NMR Spectrum of 1-fluoro-4-(3-phenylbuta-1,2-dienyl)benzene (**5q**)



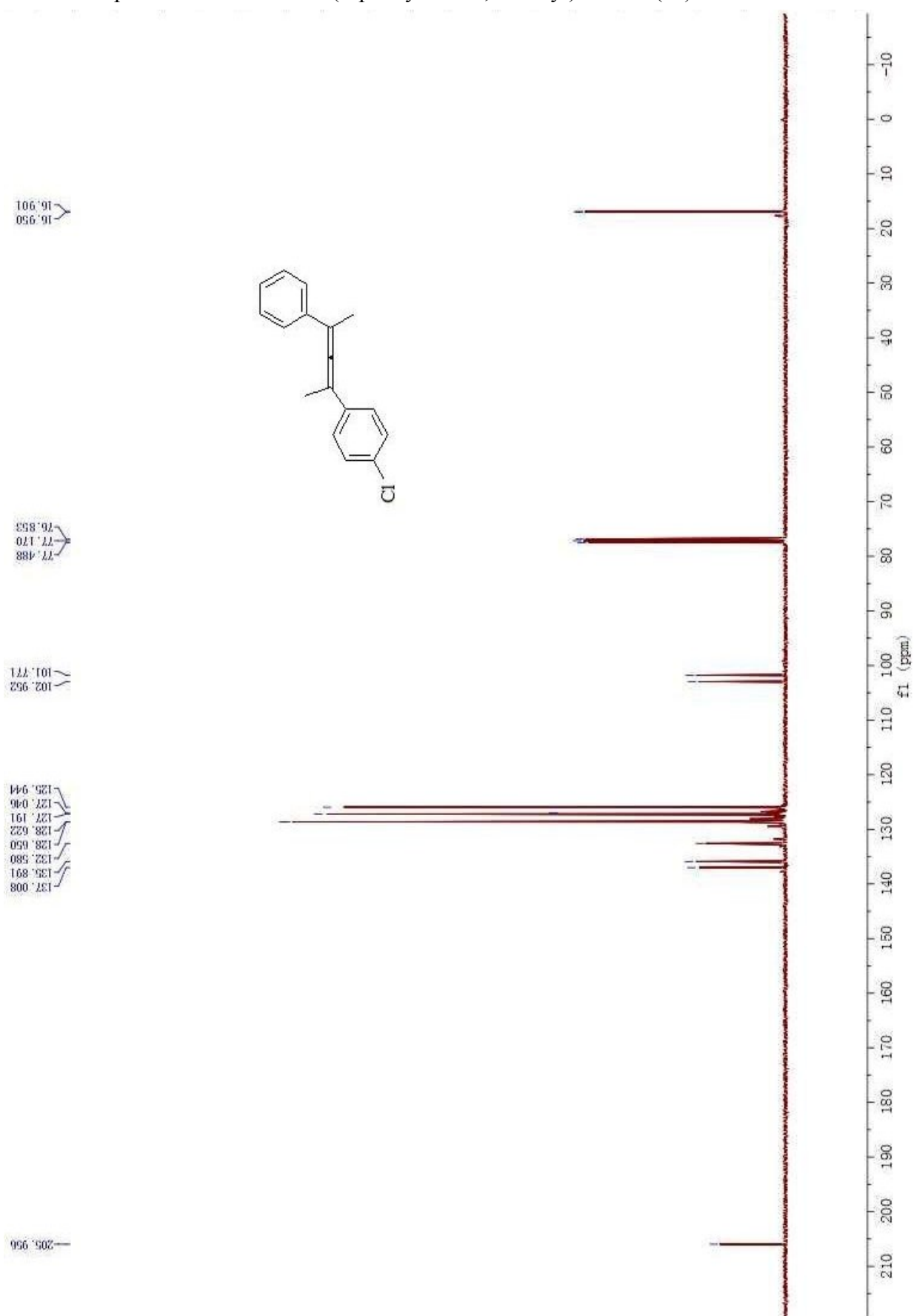
¹³C NMR Spectrum of 1-fluoro-4-(3-phenylbuta-1,2-dienyl)benzene (**5q**)



¹H NMR Spectrum of 1-chloro-4-(3-phenylbuta-1,2-dienyl)benzene(**5r**)



^{13}C NMR Spectrum of 1-chloro-4-(3-phenylbuta-1,2-dienyl)benzene(**5r**)



IV. Control experiments

Under a dry nitrogen atmosphere, a mixture of $\text{Ni}(\text{PPh}_3)_2\text{Cl}_2$ (0.0131 g, 0.02 mmol), PPh_3 (0.0104 g, 0.04 mmol) in a reaction vessel was added an organoaluminum (0.02 mmol) in 1 mL THF followed by an addition of propargyl ester (0.50 mmol). The resulted solution was stirred at 60°C for 2 h. Then the mixture was evaporated *in vacuum*. The residue was analyzed by infrared spectroscopy and ^1H NMR.

