Electronic Supplementary Material (ESI) for Chemical Communications.

Electrochemical Oxidative C-C Bond Cleavage of Methylenecyclopropanes with Alcohols

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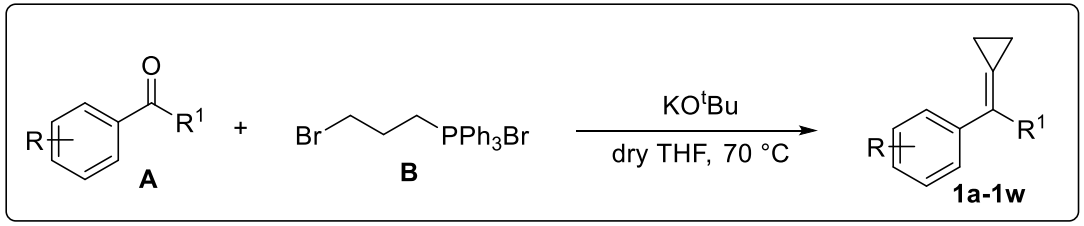
Contents

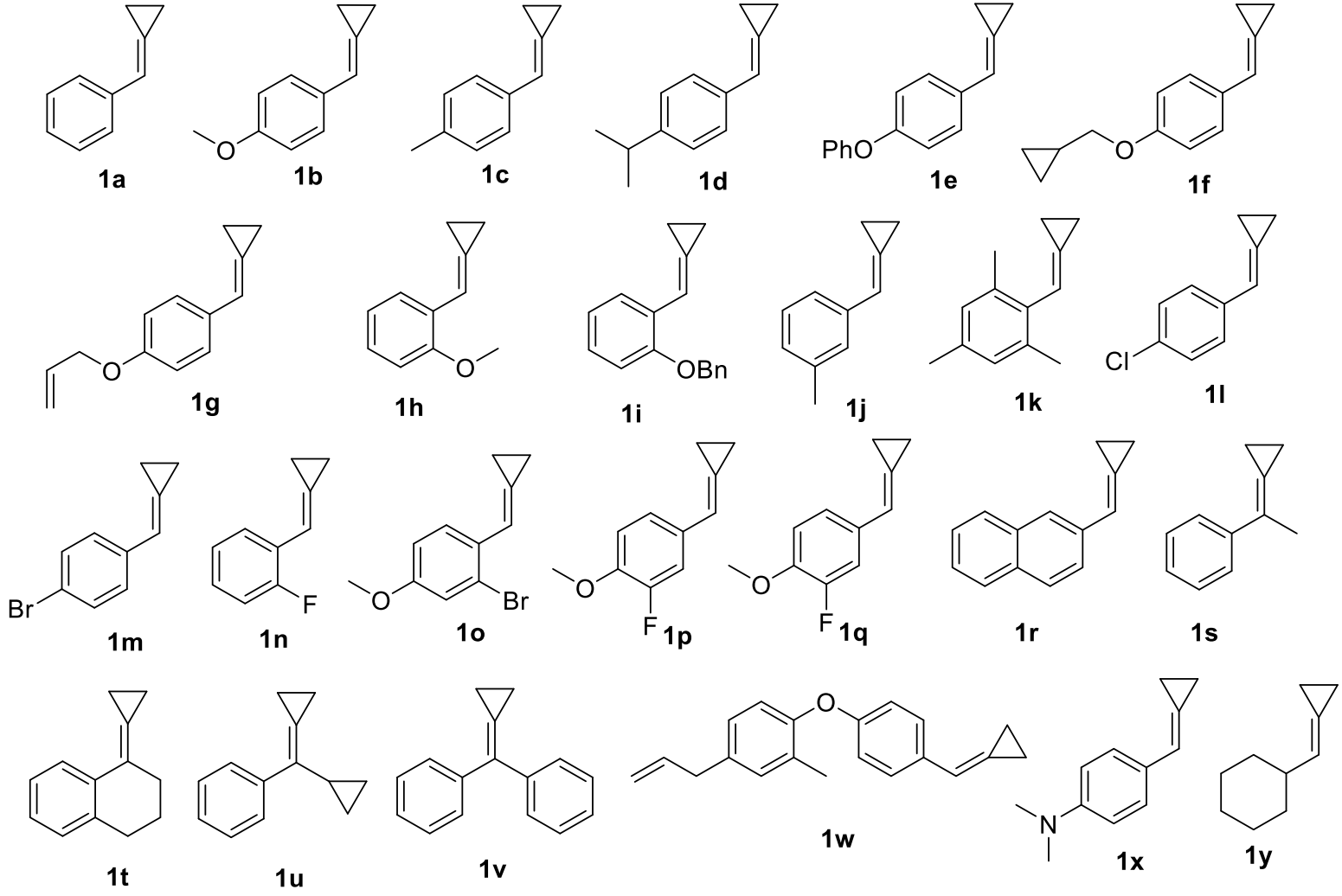
A. General Information

Unless noted otherwise, all reagents and solvents were purchased from commercial sources and used as received. All reactions were performed in oven dried round bottom flasks. Electrochemical reactions were performed at room temperature using DC power supply of Keysight technologies (25 V, 5A) and GW INSTEK GPP-4323 (32 V, 3 A). Electrodes were commercially available from IKA. Cyclic voltammetry analysis was carried out in CH instrument electrochemical analyzer (CHI1210C). The developed chromatogram was analyzed by UV lamp (254 nm) or p-anisaldehyde solution. Column chromatography was performed on silica gel mesh size 200-300. The proton (^{1}H) and carbon ^{13}C{^{1}H} and ^{19}F NMR spectra were recorded in 400 MHz JEOL JNM ECS400 spectrometer in the $CDCl_3$ solvent (unless otherwise mentioned) and are reported in δ units. Chemical shifts of NMR spectra are expressed in parts per million (ppm). Coupling constants (*J* Values) are reported in Hz. High-resolution mass spectra (HRMS) were obtained using the electron spray ionization (ESI) technique and TOF mass analyzer. Yields refer to isolated compounds, estimated to be less than 95% pure as determined by ^{1}HNMR. The description of the signals includes the following: s = singlet, d = doublet, dd = doublet of doublet, ddd = doublet of doublet of doublets, ddt = doublet of doublet of Triplets, dtd = doublet of triplet of doublets, tdd = triplet of doublet of doublets, t = triplet, dt = doublet of triplet, q = quartet, br = broad and m = multiplet.

B. General Procedure for synthesis of Alkylidene cyclopropane

Following a slightly modified a procedure[1] a solution of KO^{t}Bu (1.23 g, 3.00 equiv., 11.01 mmol) in THF (9 mL, 1.3 M) was gradually added to a solution of (3- bromopropyl)triphenylphosphonium bromide (2.56 g, 1.5 equiv., 5.50 mmol) in dry THF (11 mL, 0.5 M) and stirred at 70 °C for 30-60 minutes. Next, a solution of benzaldehyde (0.5g, 1.00 equiv., 3.67 mmol) in THF (1.83 mL, 2.0 M) was added dropwise and the mixture was refluxed or heated for 3-4 h and reaction completion was monitored by TLC. After cooling to the room temperature, the suspension was filtered, and the solvent was removed under vacuum to obtain the crude product. The crude product was purified by silica gel column chromatography 100 % hexane or 99:1 (hexane: ethyl acetate).




1a
1b
1c
1d
PhO
1e
O
1f
1g
1h
OBn
1i
1j
1k
Cl
1l
Br
1m
F
1n
1o
1p
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1s
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1v
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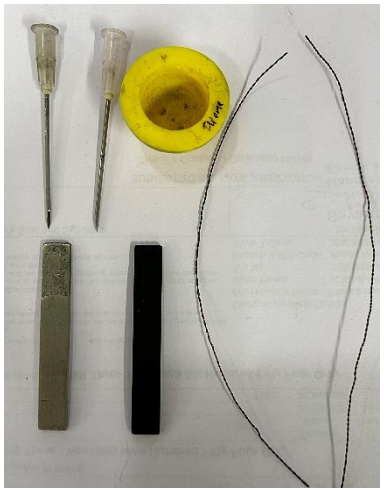
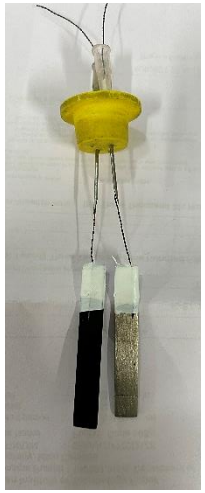
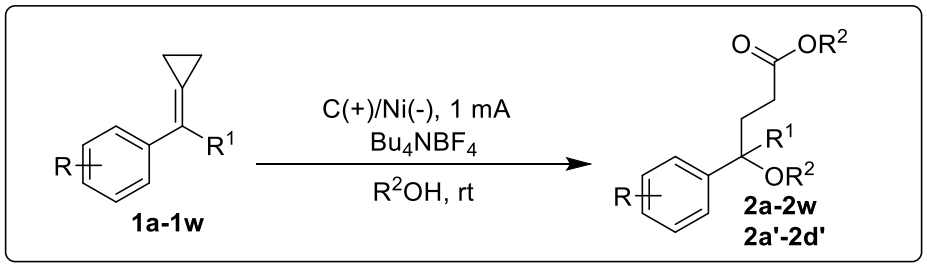
N
1x
1y

C. General set up and Procedure for Electrochemical reaction





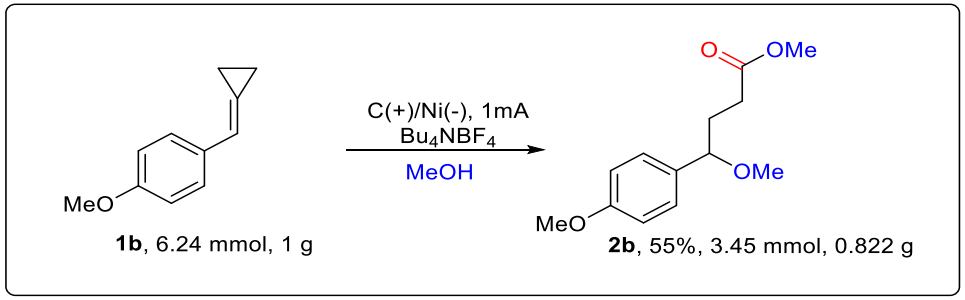


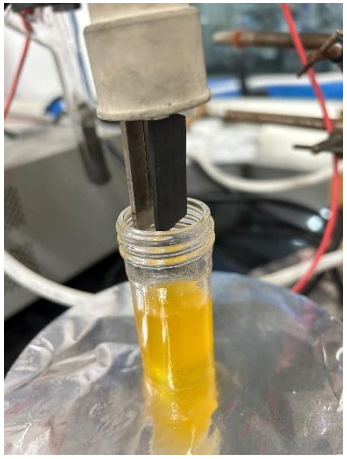
In a homemade undivided cell equipped with magnetic bar and graphite as anode and nickel as cathode having dimensions (W×H×D) 8×52.5×2 mm, mixture of **1a-1w** (1.0 equiv., 0.187 mmol), Bu_4NBF_4 (0.374 mmol, 2.0 equiv.) and methanol (4 ml) were added. The distance between the electrodes is 5 mm and dipped 20 mm in solution. The mixture was electrolyzed at a constant current of 1 mA at room temperature for 7-12 h in a DC power supply. Upon completion, the solvent was removed under reduced pressure and the crude was subjected to silica gel column chromatography (200-400 mesh) to afford the desired product.

D. General procedure for the electrochemical gram-scale synthesis

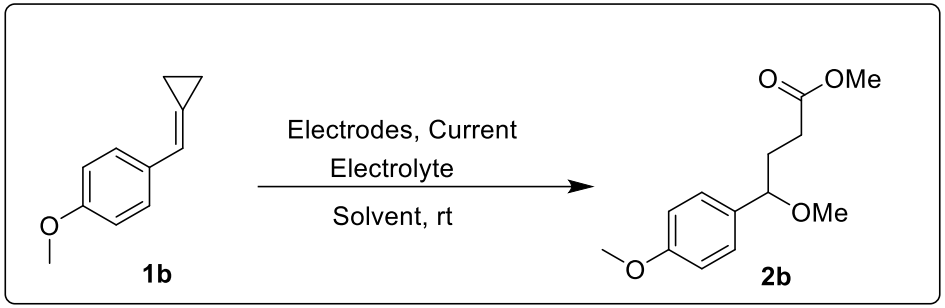
In an electrasyn 2.0 vial (20 ml) equipped with a magnetic bar and graphite as anode and nickel as cathode, **1b** (1 equiv., 6.24 mmol, 1.0 g), Bu_4NBF_4 (2 equiv., 12.48 mmol), and methanol (12 mL) were added. The mixture was electrolyzed at a constant current of 1 mA at room temperature for 40 h in a DC power supply. After 40 h, the solvent was removed under

reduced pressure, and the crude was purified by silica gel column chromatography using 4-5 % ethyl acetate in hexane to afford the desired product in 55% yield (0.822 g).





E. Optimization studies for the synthesis of methyl 4-methoxy-4-(4-methoxyphenyl)butanoate (2b)



1-(cyclopropylidenemethyl)-4-methoxybenzene (**1b**, 1 equiv., 0.187 mmol), electrolyte (2.0 equiv., 0.374 mmol) and solvent (4 ml) were taken in an undivided cell equipped with stir bar and graphite anode and nickel cathode. The mixture was electrolyzed at a constant current of 1 mA at room temperature for 7-12 h. After the completion of reaction, the mixture was evaporated in vacuo and the crude was purified by silica gel column chromatography using 3-7 % ethyl acetate in hexane to get the methyl 4-methoxy-4-(4-methoxyphenyl)butanoate **(2b)** in 50-80% isolated yield.

Table ES1: Optimization of reaction conditions

Entry	Solvent	Electrolyte	Electrode	Yield(%)[b]
1	MeOH	Bu_4NPF_6	C(+)/Ni(-)	55%
2[a]	**MeOH**	**Bu_4NBF_4**	**C(+)/Ni(-)**	**75%**
3	MeOH	Bu_4NOAc	C(+)/Ni(-)	50
4	MeOH	ET_4NOTf	C(+)/Ni(-)	48
5	MeOH	Et_4NBF_4	C(+)/Ni(-)	55
6	MeOH	$LiClO_4$	C(+)/Ni(-)	50
7	MeOH	Bu_4NBr	C(+)/Ni(-)	42
8	MeOH	Bu_4NI	C(+)/Ni(-)	45
9	MeOH	NH_4OAc	C(+)/Ni(-)	c. m.
10	MeOH	NaOAc	C(+)/Ni(-)	c. m.
11	MeOH	NaI	C(+)/Ni(-)	c. m.
12	ACN:MeOH (3.5:0.5) ml	Bu_4NBF_4	C(+)/Ni(-)	50
13	MeOH: H_2O (3.5:0.5) ml	Bu_4NBF_4	C(+)/Ni(-)	60

14	MeOH	Bu_4NBF_4	C(+)/C(-)	65
15	MeOH	Bu_4NBF_4	C(+)/Pt(-)	60
16	MeOH	Bu_4NBF_4	Pt(+)/Pt(-)	c. m.
17[c]	$MeNH_2$, $Et_3N{\cdot}3HF$ and 1*H*-Pyrazole (2 equiv.) instead of methanol	Bu_4NBF_4	C(+)/Ni(-)	n.r.
18	Dry methanol	Bu_4NBF_4	C(+)/Ni(-)	20%

[a]Reaction conditions: **1b** (0.187 mmol), Bu_4NBF_4 as the electrolyte (0.37 mmol), methanol as the solvent (4 mL), 1 mA constant current, graphite anode, nickel cathode, dimensions (W×H×D) 8×52.5×2 mm, distance between two electrodes is 5 mm and dipped 20 mm in solution, undivided cell, 25 °C. [b]Isolated yield, c.m. = complex mixture. n.r. = no reaction. [c]4 mL of ACN is used as solvent.

F. General Procedure for synthesis of 4-methoxy-4-(4-methoxyphenyl)butan-1-ol (3a)

To a stirred solution of LAH (1.5 equiv., 0.376 mmol) in diethyl ether was added dropwise a solution of methyl 4-methoxy-4-(4-methoxyphenyl)butanoate **2b** (1 equiv., 0.251 mmol) in of diethyl ether under a N_2 atmosphere. After addition was completed, the reaction mixture was stirred at room temperature for another 2-6 h. Upon completion (monitored by TLC), the excess LAH was destroyed by ice-cold water. H_2SO_4 (10%) and ether were added, and the aqueous layer was extracted

several times with diethyl ether. The combined organic layer was washed with water and 5% $NaHCO_3$, dried over $MgSO_4$, and concentrated in a rotary evaporator. The crude material was purified by silica gel chromatography 75:25 (Hexane: ethyl acetate) and desired product was obtained in 85% yield.

G. General Procedure for synthesis of Amide 3b and 3b'

An oven-dried round bottom flask equipped with a stir bar was charged with methyl 4-methoxy-4-(4-methoxyphenyl)butanoate **2b** (1.0 equiv., 0.167 mmol), aniline (1.2 equiv., 0.20 mmol), placed under a positive pressure of argon, and subjected to three evacuation/backfilling cycles. Toluene and LiHMDS (1.0 M in THF, 2.0 equiv.) were sequentially added with vigorous stirring at room temperature and the reaction mixture was stirred for 15 h at room temperature. On completion (monitored by TLC), the reaction mixture was quenched with NH_4Cl, extracted with EtOAc (3x) and the organic layers were combined, washed with HCl, water, brine and dried over Na_2SO_4 and concentrated. Purification by chromatography on silica gel (EtOAc/hexanes 30:70) afforded the title product.

H. General Procedure for synthesis of 4-methoxy-4-(4-methoxyphenyl)butanoic acid (3c)

methyl 4-methoxy-4-(4-methoxyphenyl)butanoate **2b** (1 equiv., 0.083 mmol) was dissolved in a THF/H_2O mixture (1:1, 2 mL) in a round bottom flask and NaOH (3 equiv., 0.249 mmol) was added and the slurry was stirred at room temperature for 18 hours. The mixture was quenched and acidified with 1 M HCl and the aqueous phase was extracted with EtOAc (3x).

The organic phase was washed with water (1x), brine (1x), dried over Na_2SO_4 and concentrated in vacuo. The crude was purified by silica gel chromatography 60:40 (Hexane: ethyl acetate).

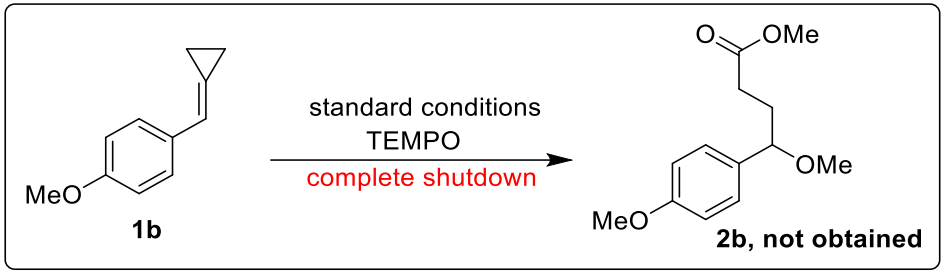
I. General Procedure for synthesis of (*1S,2S,5R*)-2-isopropyl-5-methylcyclohexyl 4-methoxy-4-(4-methoxyphenyl)butanoate (4c)

In a round bottom flask, (1R,2S,5R)-2-Isopropyl-5-methylcyclohexanol (1 equiv., 0.096 mmol) was dissolved in dry 1,4-dioxane. Acid **56** (2.5 equiv., 0.24 mmol) was gradually added to ensure complete solubility. The reaction mixture was stirred for 5 minutes after adding 4-dimethylaminopyridine (1 equiv., 0.096 mmol). It was followed by the addition of *N,N*-dicyclohexylcarbodiimide (2.5 equiv., 0.24 mmol), and the resultant mixture was stirred for 8–12 hours under a nitrogen atmosphere. The reaction progress was monitored using TLC. DCC was filtered off after the reaction was completed. The filtrate was mixed with DCM and subjected to an aqueous workup (3×). The organic layer was separated, passed through anhydrous Na_2SO_4, and concentrated. Further, the product was purified by silica gel chromatography.

J. Mechanistic studies

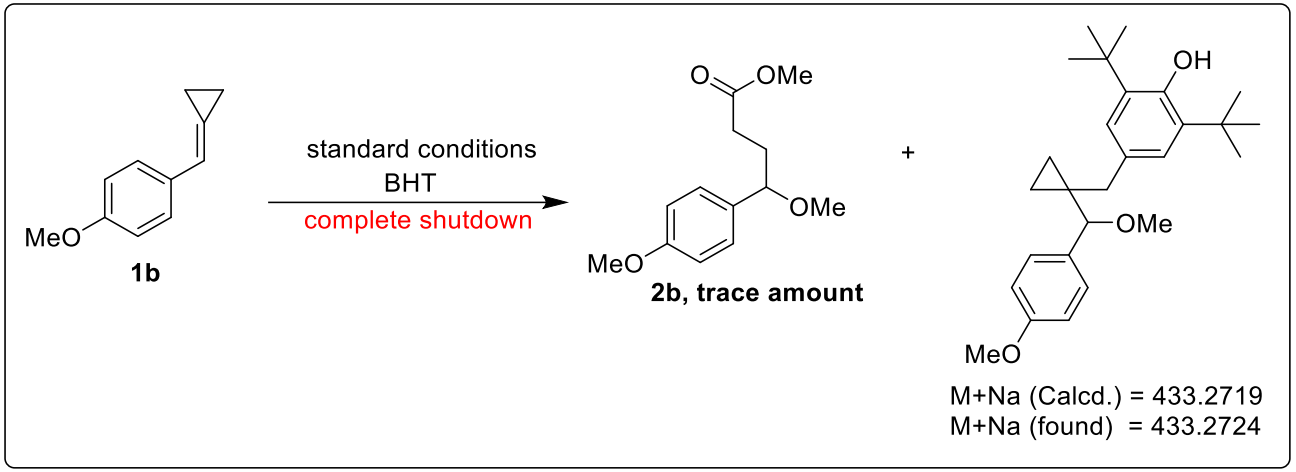
i) Radical scavenging experiment

(a) with 2,2,6,6-tetramethyl-1-piperidinyloxy radical (TEMPO)



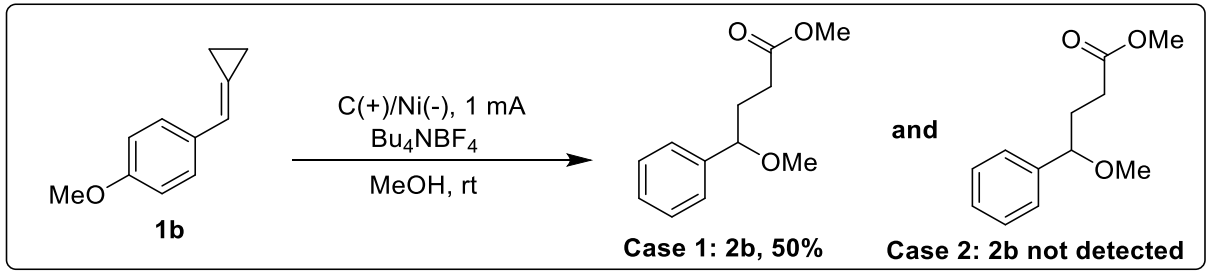
In an undivided cell equipped with magnetic bar and graphite as anode and nickel as cathode, **1b** (1.0 equiv., 0.187 mmol,), Bu_4NBF_4 (2.0 equiv., 0.344 mmol), TEMPO (2 equiv., 0.344 mmol) and methanol (4 ml) were added. The mixture was electrolyzed at a constant current of 1 mA at room temperature for 7-8 h in a DC power supply. The progress of the reaction was monitored by TLC, which shows that starting material remain unconsumed. This infers that employing TEMPO completely shut down the reaction indicating the possibility of a radical path for the reaction.

(b) Radical scavenging experiment with Butylated hydroxytoluene (BHT)



In an undivided cell equipped with magnetic bar and graphite as anode and nickel as cathode, **1b** (1.0 equiv., 0.187 mmol,), Bu_4NBF_4 (2.0 equiv., 0.344 mmol), BHT (2 equiv., 0.344 mmol) and methanol (4 ml) were added. The mixture was electrolyzed at a constant current of 1 mA at room temperature for 7-8 h in a DC power supply. The progress of the reaction was monitored by TLC, which shows that starting material consumed and complex reaction mixture was observed. The BHT adduct with the first methanol attack was found in HRMS which confirms that the reaction was initiated by oxidation of double to radical cation.

ii) Divided cell experiment

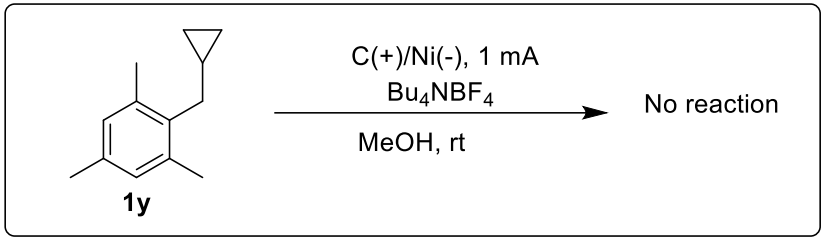


Case 1: In anodic chamber: A divided cell was equipped with two magnetic stir bars in anodic and cathodic chamber respectively. Further, the anodic chamber was filled with corresponding cyclopropane **1b** (1.0 equiv., 0.187 mmol), tetrabutylammonium hexafluorophosphate (Bu_4NBF_4) (3.0 equiv., 0.562 mmol), in methanol solvent. The cathodic chamber was filled only with supporting electrolyte solution and the solution was electrolyzed with carbon anode (in anodic chamber) and nickel cathode (in cathodic chamber) at a constant current of 1 mA for 10 h at room temperature (25-30 °C). However, there is a slight decrease in yield as the desired product was obtained in 50% yield.

Case 2: In cathodic chamber: A divided cell was equipped with two magnetic stir bars in anodic and cathodic chamber respectively. Further, the cathodic chamber was filled with corresponding cyclopropane **1b** (1.0 equiv., 0.187 mmol), tetrabutylammonium hexafluorophosphate (Bu_4NBF_4) (3.0 equiv., 0.562 mmol), in methanol solvent. The anodic chamber

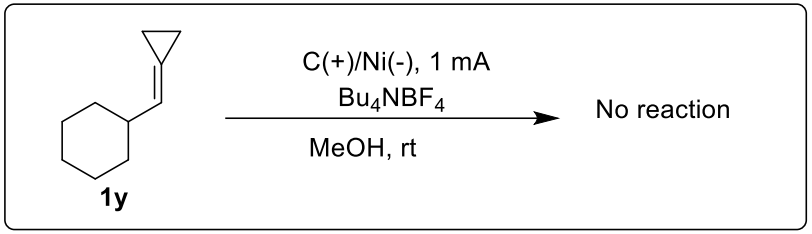
was filled with supporting electrolyte solution and the solution was electrolyzed with carbon anode (in anodic chamber) and nickel cathode (in cathodic chamber) at a constant current of 1 mA for 10 h at room temperature. The progress of the reaction was monitored by TLC, which shows that starting material remain unconsumed. This infers that the reaction takes place by the anodic oxidation.

iii) Electrochemical reaction of 2-(cyclopropylmethyl)-1,3,5-trimethylbenzene (1y)



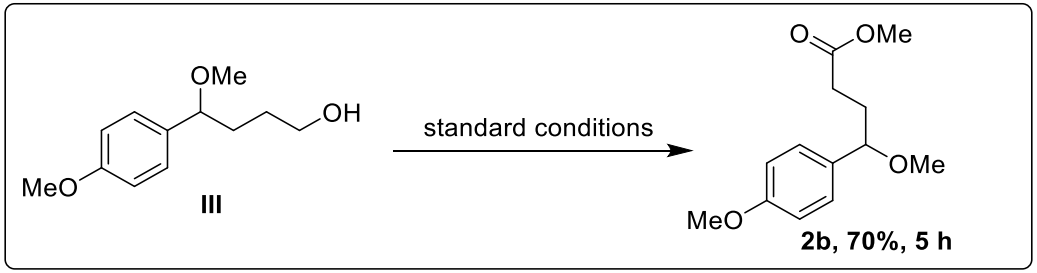
In an undivided cell equipped with magnetic bar and graphite as anode and nickel as cathode, **1y** (1.0 equiv., 0.172 mmol), Bu_4NBF_4 (2.0 equiv., 0.344 mmol) and methanol (4 ml) were added. The mixture was electrolyzed at a constant current of 1 mA at room temperature for 12 h in a DC power supply. After 12 hours, there was no formation of desired product, which confirms that double bond is necessary for the ring opening of the cyclopropane.

iv) Electrochemical reaction of (cyclopropylidenemethyl)cyclohexane (1w)



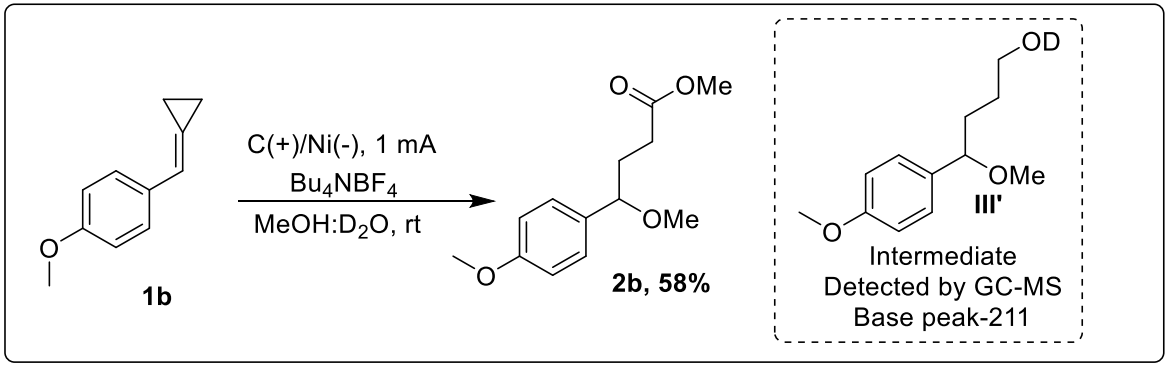
In an undivided cell equipped with magnetic bar and graphite as anode and nickel as cathode, **1y** (1.0 equiv., 0.220 mmol), Bu_4NBF_4 (2.0 equiv., 0.44 mmol) and methanol (4 ml) were added. The mixture was electrolyzed at a constant current of 1 mA at room temperature for 12 h in a DC power supply. After 12 hours, there was no formation of desired product, which confirms that aryl ring is also necessary for the ring opening of the cyclopropane

v) Reaction of Intermediate III under standard conditions



4-methoxy-4-(4-methoxyphenyl)butan-1-ol **III** (1.0 equiv., 0.142 mmol), electrolyte (2.0 equiv., 0.284 mmol) and solvent (4 ml) were taken in an undivided cell equipped with stir bar and graphite anode and nickel cathode. The mixture was electrolyzed at a constant current of 1 mA at room temperature for 5 h. After the completion of reaction, the mixture was evaporated in vacuo and the crude was purified by silica gel column chromatography using 4 % ethyl acetate in hexane to get the methyl 4-methoxy-4-(4-methoxyphenyl)butanoate **(2b)** in 70% isolated yield.

vi) D_2O Experiment



1-(cyclopropylidenemethyl)-4-methoxybenzene (**1b**, 1 equiv., 0.187 mmol), electrolyte (2.0 equiv., 0.374 mmol) and methanol: D_2O (3.5:0.5 ml) were taken in an undivided cell equipped with stir bar and graphite anode and nickel cathode. The mixture was electrolyzed at a constant current of 1 mA at room temperature for 7 h. After the completion of reaction, the mixture was evaporated in vacuo and the crude was purified by silica gel column chromatography using 3% ethyl acetate in hexane to get the methyl 4-methoxy-4-(4-methoxyphenyl)butanoate **(2b)** in 58% isolated yield. The intermediate **III'** was detected by GC-MS analysis which confirms that the ring opening of cyclopropane takes place by hydroxide ion (OD^-) from D_2O.

vii) Electricity on/off experiment

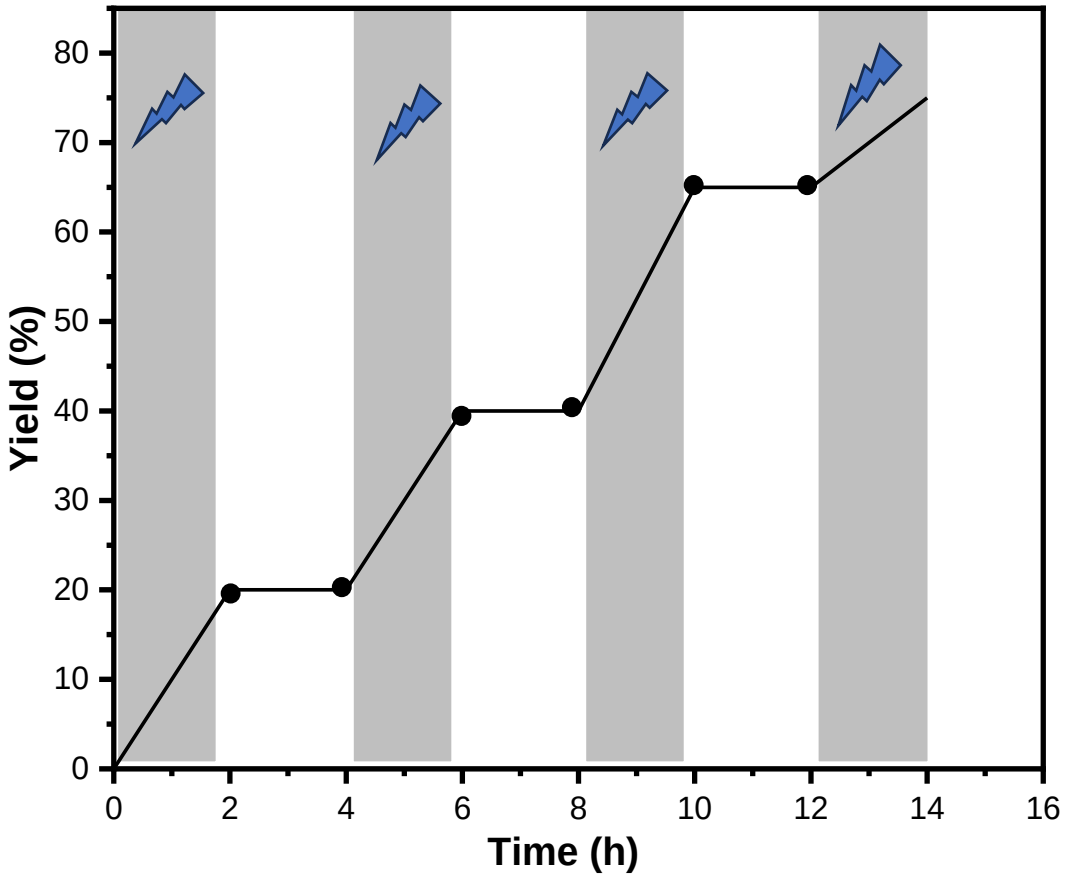


Figure 1. Electricity on/off experiment.

viii) Cyclic Voltammetry experiment

Cyclic voltammetry analysis was carried out in CH instrument electrochemical analyzer (CHI1210C). Samples were prepared in 5 ml vial with 0.01 M of substrate (**1b**), 0.01 M of (**1y**) and 0.1 M of Bu_4BF_4 in methanol (4ml). Measurements employed glassy carbon working electrode (Disk electrode), platinum wire counter electrode and a silver-silver chloride(non-aqueous) reference electrode. The sweep rate applied was 50 mV/s ranging from 0 to 3V. The oxidation potential of **1b** was observed to be 1.55 V (vs Ag/AgCl), and 2.2 V (vs Ag/AgCl) for **1y**. All the CV experiments were carried out in argon atmosphere in positive or oxidative direction and demonstrated as follow: (a) 0.1 M Bu_4NBF_4 (green) (b) 0.01 M **1b** (red) (d) 0.01 M **1v** (blue). Cyclic voltagrams are according to the IUPAC convention.

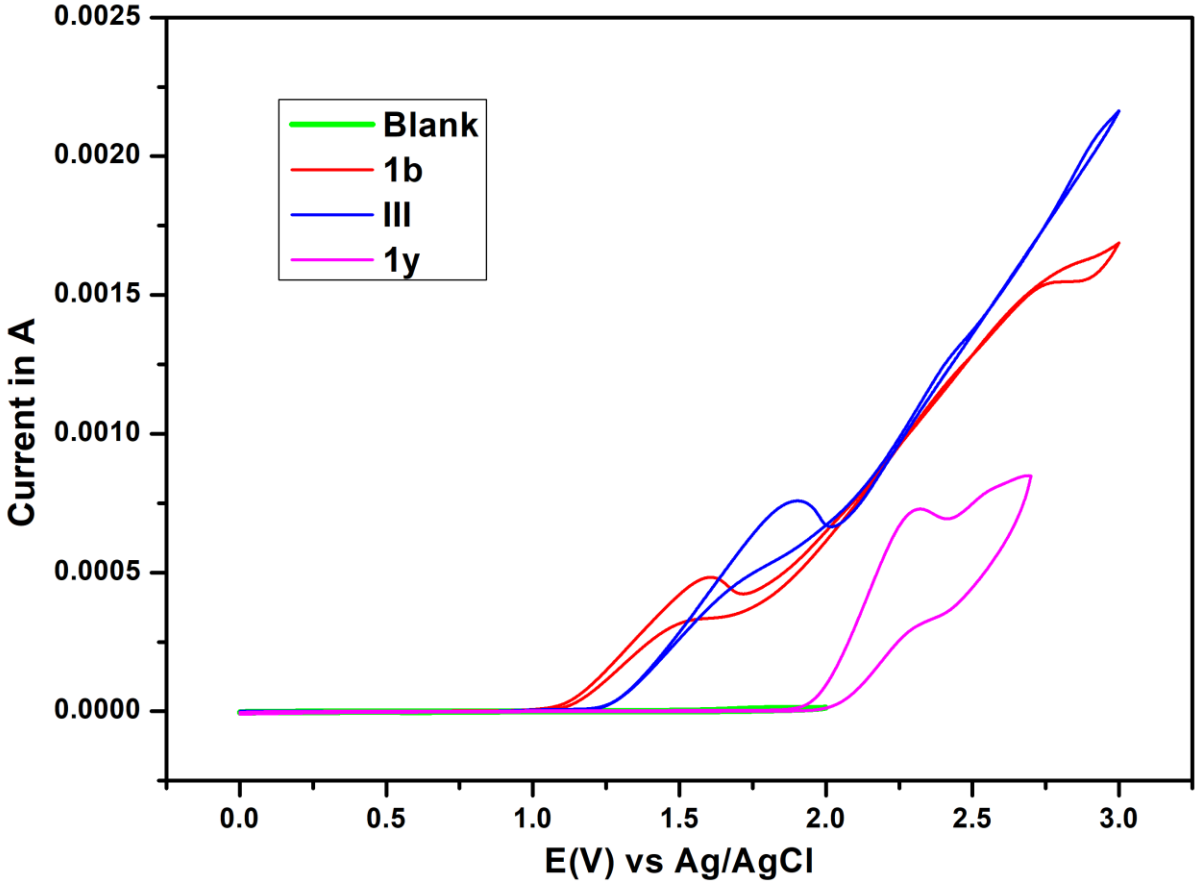


Figure 2. Cyclic Voltammetry experiment.

ix)Calculation of Faradaic efficiency

The faradaic efficiency of the reaction was calculated using the following formula:

$$n = \frac{Q_{theo}}{Q_{exp}} * 100\%$$

$$Q_{theo} = Zp \cdot Np \cdot F = Z \cdot N \cdot Y \cdot F$$

$$Q_{exp} = I \cdot t = Z \cdot N \cdot F \cdot equiv.$$

$$n = \frac{Z \cdot N \cdot Y \cdot F}{Z \cdot N \cdot F \cdot equiv.} = \frac{Y}{equiv.}$$

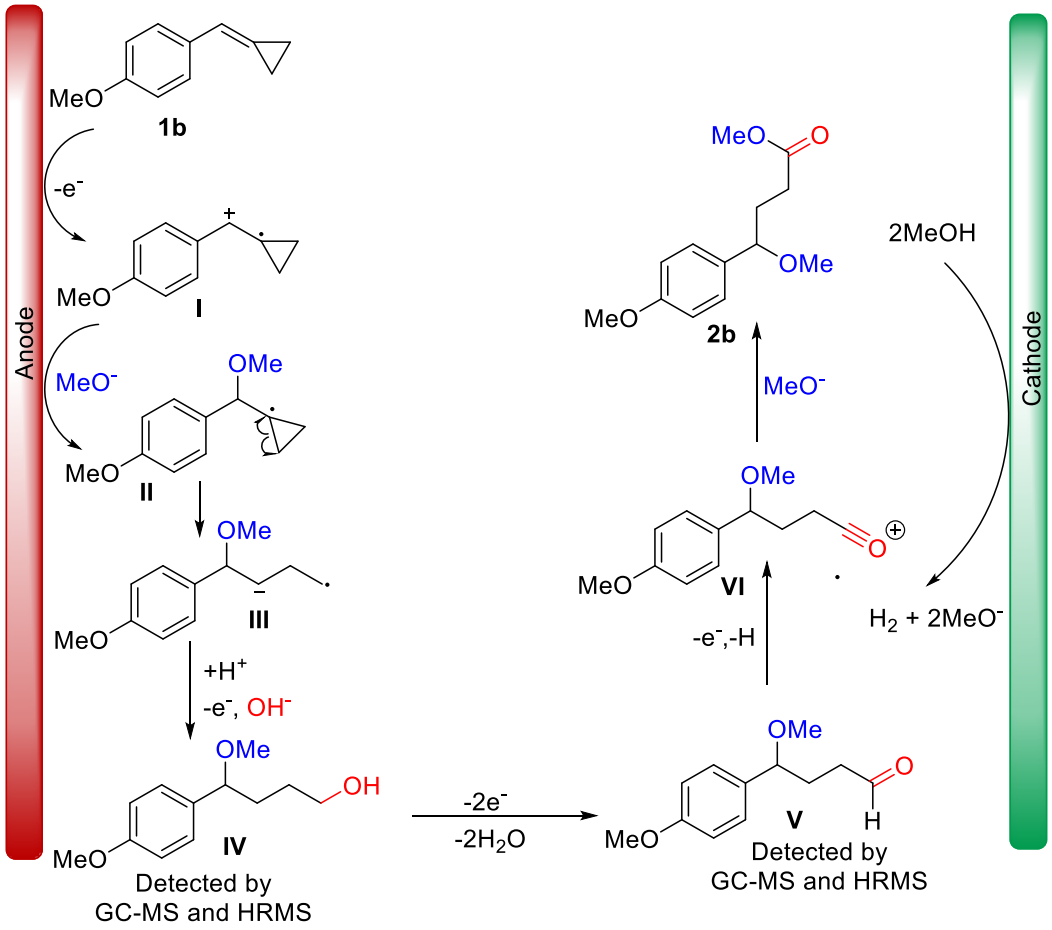
n: Faradaic efficiency in percent [%], Q_{theo}: theoretical charge in Coulomb [C], Q_{exp}: experimental charge in Coulomb [C], equiv.: electron equivalents (F mol^{-1} or equiv.), z_P: Number of electrons per product [−], N_P: Number of mols of the product [mol], Y: yield in percent [%].

Here, Y = 76 % yield, equiv.= 2.5 F mol^{-1}

$$n = \frac{76}{2.09} = 30.4\%$$

x) Plausible mechanism (Pathway 2)

Like path 1, the reaction gets initiated by single-electron oxidation of **1b** to generate radical cationic species **I**, which undergoes nucleophilic attack of methoxide generated at cathode leading to the radical species **II**. Radical species **II** release the strain of cyclopropyl ring via homolytic cleavage of C-C bond to afford radical anionic species **III**. The anion was stabilized by hydrogen atom and the radical further undergoes one electron oxidation followed by nucleophilic attack of hydroxide ion to generate intermediate **IV** (detected by GC-MS and HRMS). After that, like pathway-1, intermediate **IV** undergoes sequential two-electron oxidation and loss of two water molecules to afford aldehyde intermediate **V**. Single electron oxidation of aldehyde **V** followed by loss of hydrogen atom led to the formation of stable acylium cation **VI**, which on further nucleophilic addition of methoxide delivered the desired product **2b**.



Scheme 1. Plausible Mechanism (Pathway-2)

K. Single-crystal X-Ray data for compound 2v

Sample preparation:

Solvent used - LR grade ethanol and ethyl acetate (1:1).

Method used - Recrystallization from ethanol and ethyl acetate (1:1) by slow evaporation at room temperature.

For the determination of X-ray crystal structures of **2v** a single-crystal was selected and mounted with paratone oil on a glass fiber using gum. The data was collected at 298K on a CMOS based Bruker D8 Venture PHOTON 100 diffractometer equipped with a INCOATEC micro-focus source with graphite monochromatic Mo Kα radiation (λ = 0.71073 Å) operation at 50 kV and 30 mA. For the integration of diffraction profiles SAINT program[6] was used. Absorption correction was done applying SADABS HRMS of 4aSI-155 program.[7] The crystal structure was solved by SIR 92[8] and refined by full matrix least square method using SHELXL-97[9] WinGX system, Ver 1.70.01.[10] All the non-hydrogen atoms in the structure were located the Fourier map and refined anisotropically. The hydrogen atoms were fixed by HFIX in their ideal positions and refined using riding model with isotropic thermal parameters. The crystal structure (excluding structure factor) has been deposited to Cambridge Crystallographic Data Centre and allocated deposition number: **CCDC 2322098**.[11]

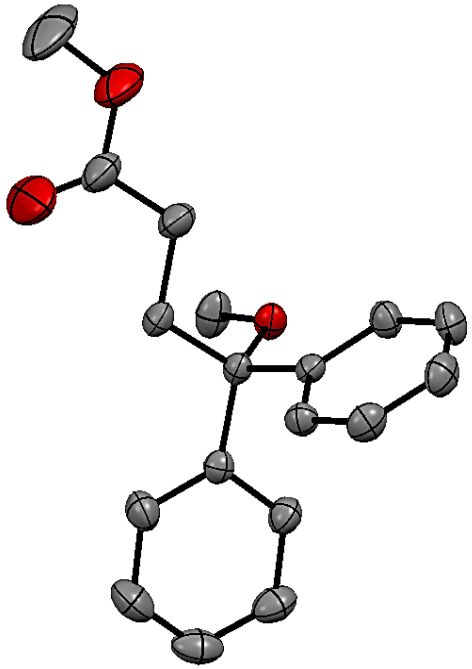


Figure 3. ORTEP for compound **2v** with 50% probability level.

Ccdc no.	2322098
Empirical formula	$C_{18}H_{20}O_3$
Formula weight	284.34
Temperature/K	298.00
Crystal system	monoclinic
Space group	C2/c
a/Å	33.380(12)
b/Å	5.972(3)
c/Å	18.656(7)
α/°	90
β/°	119.978(11)
γ/°	90
Volume/Å^3	3222(2)
Z	8
ρ_{calc}g/cm^3	1.173
μ/mm^{-1}	0.079
F(000)	1216.0
Crystal size/mm^3	0.215 × 0.123 × 0.045
Radiation	MoKα (λ = 0.71073)
2Θ range for data collection/°	6.898 to 52.862
Index ranges	$-41 \leq h \leq 41$, $-7 \leq k \leq 7$, $-23 \leq l \leq 22$
Reflections collected	17379
Independent reflections	3275 [R_{int} = 0.0606, R_{sigma} = 0.0412]
Data/restraints/parameters	3275/6/194
Goodness-of-fit on F^2	1.041
Final R indexes [I>=2σ (I)]	R_1 = 0.0790, wR_2 = 0.2235
Final R indexes [all data]	R_1 = 0.0978, wR_2 = 0.2399
Largest diff. peak/hole / e Å^{-3}	0.72/-0.44

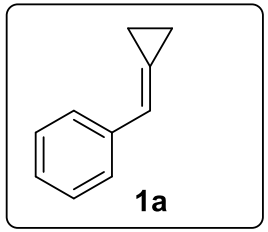
Table 1 Bond Lengths for 2t						
Atom	**Atom**	**Length/Å**		**Atom**	**Atom**	**Length/Å**
O3	C7	1.440(3)		C13	C7	1.543(3)
O3	C12	1.424(3)		C7	C6	1.528(3)
O1	C10	1.165(5)		C7	C8	1.540(3)
O2	C10	1.335(5)		C6	C5	1.388(3)
O2	C11	1.462(6)		C6	C1	1.391(3)
C18	C17	1.379(4)		C5	C4	1.386(4)
C18	C13	1.397(3)		C4	C3	1.378(4)
C17	C16	1.372(5)		C3	C2	1.375(4)
C16	C15	1.354(5)		C2	C1	1.380(4)
C15	C14	1.399(4)		C8	C9	1.522(4)
C14	C13	1.377(4)		C9	C10	1.481(4)

Table 2 Bond Angles for 2t.								
Atom	**Atom**	**Atom**	**Angle/°**		**Atom**	**Atom**	**Atom**	**Angle/°**
C12	O3	C7	115.90(19)		C8	C7	C13	113.44(19)
C10	O2	C11	115.0(4)		C5	C6	C7	122.6(2)
C17	C18	C13	121.4(3)		C5	C6	C1	118.1(2)
C16	C17	C18	119.9(3)		C1	C6	C7	119.3(2)
C15	C16	C17	119.8(3)		C4	C5	C6	120.3(2)
C16	C15	C14	121.0(3)		C3	C4	C5	121.1(3)
C13	C14	C15	120.3(3)		C2	C3	C4	118.9(2)
C18	C13	C7	117.9(2)		C3	C2	C1	120.6(3)
C14	C13	C18	117.6(2)		C2	C1	C6	121.1(2)
C14	C13	C7	124.5(2)		C9	C8	C7	112.5(2)
O3	C7	C13	109.25(17)		C10	C9	C8	113.2(3)
O3	C7	C6	106.04(17)		O1	C10	O2	121.6(3)
O3	C7	C8	110.24(18)		O1	C10	C9	126.7(3)
C6	C7	C13	107.83(17)		O2	C10	C9	110.7(3)
C6	C7	C8	109.75(18)					

L) Characterization data

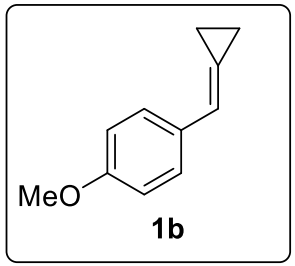
i) Characterization data of the starting materials

(cyclopropylidenemethyl)benzene (1a)



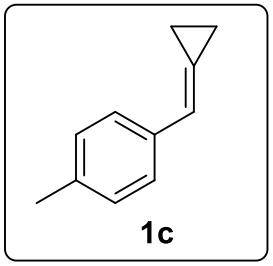
Overall yield: 55%, 0.337 g; **Nature**: oily liquid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.57 – 7.52 (m, 1H), 7.34 (dd, *J* = 10.4, 4.8 Hz, 2H), 7.22 (dd, *J* = 13.6, 6.2 Hz, 2H), 6.78 – 6.74 (m, 1H), 1.46 – 1.40 (m, 2H), 1.21 – 1.16 (m, 2H).

1-(cyclopropylidenemethyl)-4-methoxybenzene (1b)



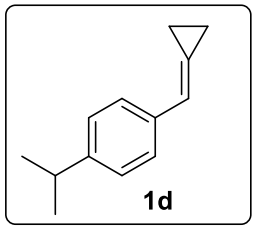
Overall yield: 60%, 0.352 g; **Nature:** yellow oil; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.46 (d, *J* = 8.7 Hz, 2H), 6.89 – 6.84 (m, 2H), 6.71 – 6.67 (m, 1H), 3.80 (s, 3H), 1.37 (ddd, *J* = 7.7, 6.2, 2.2 Hz, 2H), 1.17 – 1.12 (m, 2H).

1-(cyclopropylidenemethyl)-4-methylbenzene (1c)



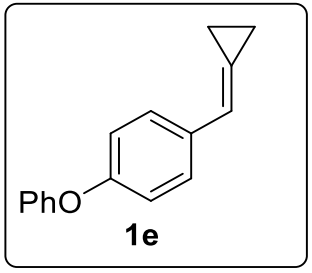
Overall yield: 40%, 0.239 g; **Nature:** yellow oil; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.44 (d, *J* = 8.0 Hz, 2H), 7.14 (d, *J* = 8.0 Hz, 2H), 6.74 – 6.71 (m, 1H), 2.35 (s, 3H), 1.43 – 1.38 (m, 2H), 1.19 – 1.14 (m, 2H).

1-(cyclopropylidenemethyl)-4-isopropylbenzene (1d)



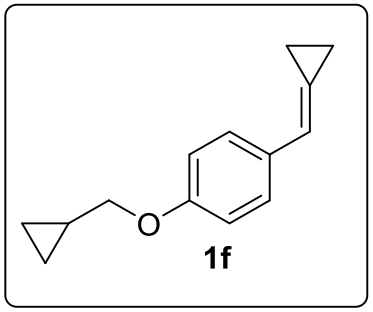
Overall yield: 45%, 0.260 g; **Nature:** yellow oil; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.52 (d, *J* = 7.2 Hz, 2H), 7.24 (t, *J* = 6.2 Hz, 2H), 6.78 (s, 1H), 2.95 (dt, *J* = 13.8, 6.9 Hz, 1H), 1.48 – 1.42 (m, 2H), 1.30 (dd, *J* = 6.9, 1.2 Hz, 6H), 1.24 – 1.18 (m, 2H).

1-(cyclopropylidenemethyl)-4-phenoxybenzene (1e)



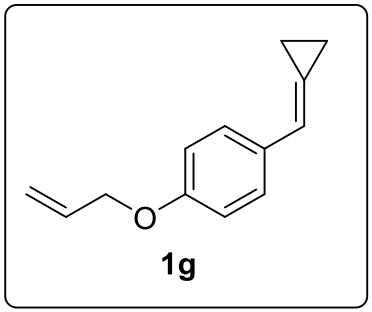
Overall yield: 60%, 0.335 g; **Nature:** yellow viscous liquid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.53 (d, *J* = 8.5 Hz, 2H), 7.35 (t, *J* = 7.9 Hz, 2H), 7.12 (dd, *J* = 11.5, 4.2 Hz, 1H), 7.06 – 6.99 (m, 4H), 6.75 (s, 1H), 1.44 – 1.39 (m, 2H), 1.22 – 1.17 (m, 2H).

1-(cyclopropylidenemethyl)-4-(cyclopropylmethoxy)benzene (1f)



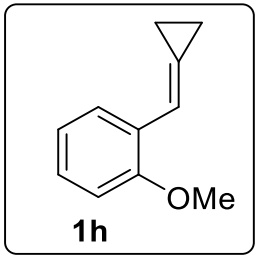
Overall yield: 50%, 0.282 g; **Nature:** white solid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.48 – 7.42 (m, 2H), 6.90 – 6.84 (m, 2H), 6.68 (t, *J* = 2.9 Hz, 1H), 3.80 (d, *J* = 6.9 Hz, 2H), 1.41 – 1.36 (m, 2H), 1.30 – 1.25 (m, 1H), 1.17 – 1.12 (m, 2H), 0.67 – 0.61 (m, 2H), 0.38 – 0.32 (m, 2H).

1-(allyloxy)-4-(cyclopropylidenemethyl)benzene (1g)



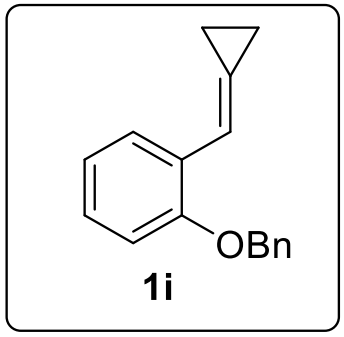
Overall yield: 55%, 0.314 g; **Nature:** white solid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.48 – 7.42 (m, 2H), 6.91 – 6.85 (m, 2H), 6.7-.6.67 (m, 1H), 6.06 (ddt, *J* = 17.2, 10.5, 5.3 Hz, 1H), 5.41 (dq, *J* = 17.4, 1.7 Hz, 1H), 5.29 (dt, *J* = 10.5, 1.4 Hz, 1H), 4.54 (dt, *J* = 5.2, 1.4 Hz, 2H), 1.40 – 1.35 (m, 2H), 1.17 – 1.12 (m, 2H).

1-(cyclopropylidenemethyl)-2-methoxybenzene (1h)



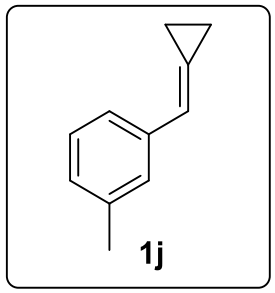
Overall yield: 60%, 0.352 g; **Nature:** yellow oil; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.76 (dd, *J* = 7.7, 1.7 Hz, 1H), 7.23 – 7.18 (m, 1H), 7.17 – 7.13 (m, 1H), 6.95 (t, *J* = 7.5 Hz, 1H), 6.89 (d, J = 8.4 Hz, 1H), 3.86 (s, 3H), 1.42 – 1.37 (m, 2H), 1.20 – 1.15 (m, 2H).

1-(benzyloxy)-2-(cyclopropylidenemethyl)benzene (1i)



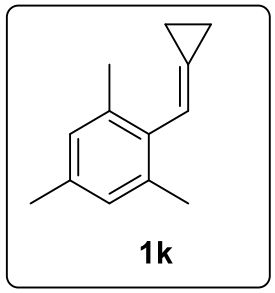
Overall yield: 70%, 0.387 g; **Nature:** white solid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.79 (dd, *J* = 7.6, 1.5 Hz, 1H), 7.46 (d, *J* = 7.1 Hz, 2H), 7.42 – 7.36 (m, 2H), 7.35 – 7.29 (m, 1H), 7.22 (dd, *J* = 4.0, 2.0 Hz, 1H), 7.16 (td, *J* = 7.8, 1.6 Hz, 1H), 6.95 (t, *J* = 8.4 Hz, 2H), 5.10 (s, 2H), 1.41 – 1.36 (m, 2H), 1.18 – 1.13 (m, 2H).

1-(cyclopropylidenemethyl)-3-methylbenzene (1j)



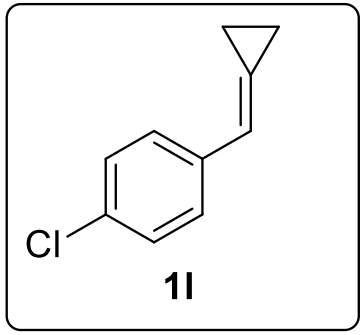
Overall yield: 40%, 0.239 g; **Nature:** colourless liquid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.38 (d, *J* = 8.1 Hz, 2H), 7.25 (t, *J* = 7.4 Hz, 1H), 7.06 (d, *J* = 7.4 Hz, 1H), 6.75 (s, 1H), 2.39 (s, 3H), 1.48 – 1.42 (m, 2H), 1.22 – 1.17 (m, 2H).

2-(cyclopropylidenemethyl)-1,3,5-trimethylbenzene (1k)



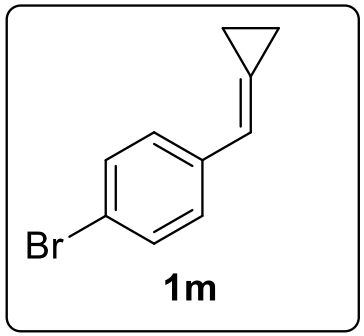
Overall yield: 45%, 0.260 g; **Nature:** colourless liquid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 6.98 (s, 2H), 6.89 (s, 1H), 2.39 (s, 3H), 2.35 (s, 6H), 1.38 – 1.33 (m, 2H), 1.20 (ddd, *J* = 6.9, 4.1, 2.2 Hz, 2H).

1-chloro-4-(cyclopropylidenemethyl)benzene (1l)



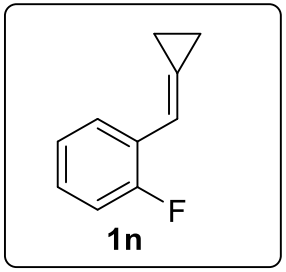
Overall yield: 50%, 0.293 g; **Nature:** white solid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.46 – 7.41 (m, 2H), 7.29 – 7.25 (m, 2H), 6.70 – 6.68 (m, 1H), 1.40 (ddd, *J* = 9.8, 5.8, 2.2 Hz, 2H), 1.20 – 1.15 (m, 2H).

1-bromo-4-(cyclopropylidenemethyl)benzene (1m)



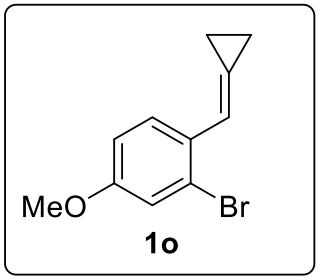
Overall yield: 55%, 0.309 g; **Nature:** yellow solid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.44 – 7.36 (m, 4H), 6.68 (dd, *J* = 3.9, 1.9 Hz, 1H), 1.42 – 1.36 (m, 2H), 1.19 – 1.14 (m, 2H).

1-(cyclopropylidene(phenyl)methyl)-2-fluorobenzene (1n)



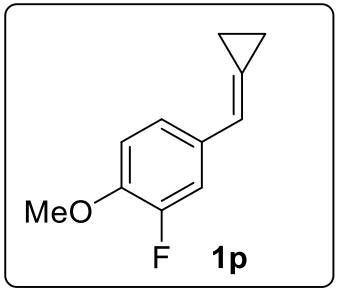
Overall yield: 45%, 0.266 g; **Nature:** yellow oil; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.75 (td, *J* = 7.7, 1.8 Hz, 1H), 7.29 – 7.22 (m, 1H), 7.13 – 7.06 (m, 2H), 7.00 – 6.96 (m, 1H), 1.44 – 1.38 (m, 2H), 1.22 – 1.16 (m, 2H).

2-bromo-1-(cyclopropylidenemethyl)-4-methoxybenzene (1o)



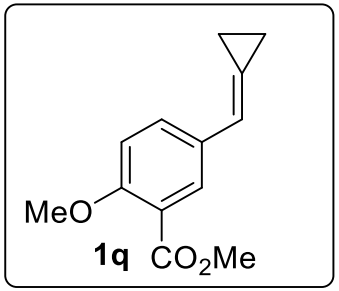
Overall yield: 65%, 0.358 g; **Nature:** white solid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.73 (d, *J* = 8.7 Hz, 1H), 7.09 (d, *J* = 2.7 Hz, 1H), 7.07 – 7.04 (m, 1H), 6.84 (dd, *J* = 8.7, 2.6 Hz, 1H), 3.78 (s, 3H), 1.40 – 1.35 (m, 2H), 1.21 – 1.16 (m, 2H).

4-(cyclopropylidenemethyl)-2-fluoro-1-methoxybenzene (1p)



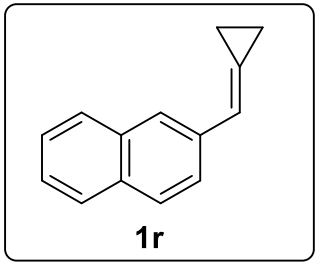
Overall yield: 60%, 0.345 g; **Nature:** yellow solid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.32 (dd, *J* = 12.8, 2.1 Hz, 1H), 7.15 (d, *J* = 8.4 Hz, 1H), 6.89 (t, *J* = 8.6 Hz, 1H), 6.64 (s, 1H), 3.87 (s, 3H), 1.40 – 1.35 (m, 2H), 1.18 – 1.13 (m, 2H).

methyl 5-(cyclopropylidenemethyl)-2-methoxybenzoate (1q)



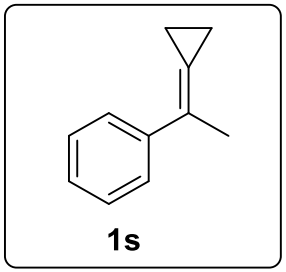
Overall yield: 60%, 0.250 g; **Nature:** yellow liquid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.91 (d, *J* = 2.3 Hz, 1H), 7.64 (dd, *J* = 8.6, 2.4 Hz, 1H), 6.93 (d, *J* = 8.7 Hz, 1H), 6.69 – 6.64 (m, 1H), 3.89 (s, 6H), 1.42 – 1.37 (m, 2H), 1.18 – 1.13 (m, 2H).

2-(cyclopropylidenemethyl)naphthalene (1r)



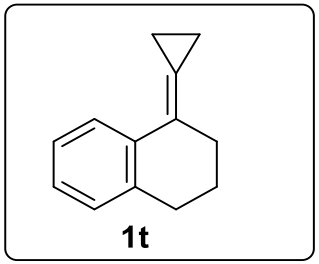
Overall yield: 30%, 0.173 g; **Nature:** Colourless liquid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.76 (m, 5H), 7.43 (m, 2H), 6.93 – 6.90 (m, 1H), 1.54 – 1.48 (m, 2H), 1.25 – 1.19 (m, 2H).

(1-cyclopropylideneethyl)benzene (1s)



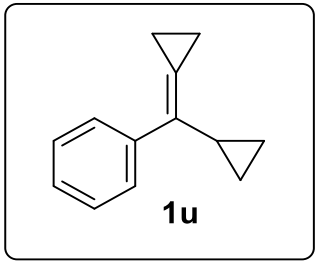
Overall yield: 50%, 0.299 g; **Nature:** white solid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.73 – 7.59 (m, 2H), 7.40 – 7.29 (m, 2H), 7.23 (ddd, *J* = 7.3, 6.3, 1.3 Hz, 1H), 2.26 – 2.23 (m, 3H), 1.46 (tdd, *J* = 7.1, 3.7, 1.9 Hz, 2H), 1.15 – 1.09 (m, 2H).

1-cyclopropylidene-1,2,3,4-tetrahydronaphthalene (1t)



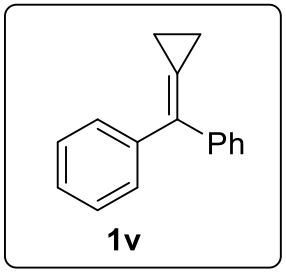
Overall yield: 50%, 0.291 g; **Nature:** colourless liquid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.93 (d, *J* = 7.4 Hz, 1H), 7.19 – 7.13 (m, 2H), 7.12 (dd, *J* = 5.1, 1.2 Hz, 2H), 2.85 (t, *J* = 6.2 Hz, 2H), 2.68 – 2.63 (m, 2H), 1.92 – 1.86 (m, 2H), 1.49 – 1.43 (m, 2H), 1.10 – 1.05 (m, 2H).

(cyclopropyl(cyclopropylidene)methyl)benzene(1u)



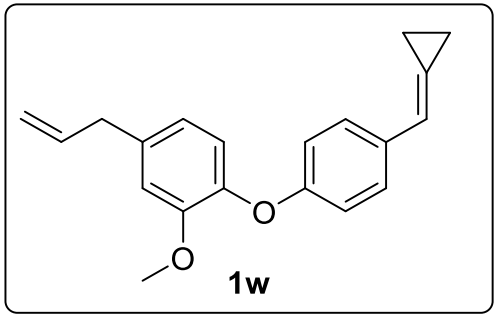
Overall yield: 60%, 0.340 g; **Nature:** colourless liquid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.82 (d, *J* = 7.5 Hz, 2H), 7.36 (t, *J* = 7.2 Hz, 2H), 7.25 (dd, *J* = 8.0, 6.7 Hz, 1H), 1.82 – 1.73 (m, 1H), 1.30 – 1.21 (m, 4H), 0.88 – 0.81 (m, 2H), 0.77 – 0.72 (m, 2H).

(cyclopropylidenemethylene)dibenzene (1v)



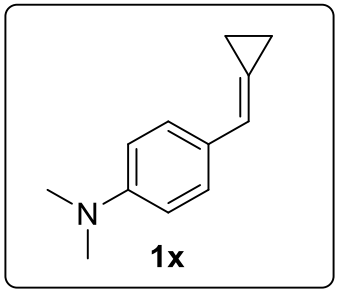
Overall yield: 65%, 0.367 g; **Nature:** white solid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.49 – 7.40 (m, 4H), 7.38 – 7.31 (m, 4H), 7.30 – 7.24 (m, 2H), 1.42 (s, 4H).

4-allyl-1-(4-(cyclopropylidenemethyl)phenoxy)-2-methoxybenzene (1w)



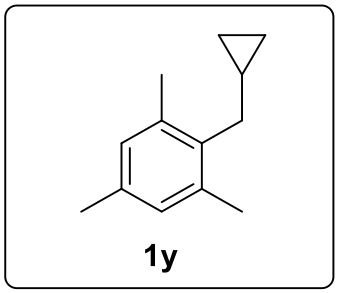
Overall yield: 40%, 0.217 g; **Nature:** colourless liquid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.44 (d, *J* = 8.7 Hz, 2H), 6.88 (ddd, *J* = 7.1, 5.1, 3.2 Hz, 3H), 6.81 (d, *J* = 1.9 Hz, 1H), 6.73 (dd, *J* = 8.2, 1.8 Hz, 1H), 6.69 (d, *J* = 1.8 Hz, 1H), 6.03 – 5.93 (m, 1H), 5.14 – 5.07 (m, 2H), 3.81 (s, 3H), 3.38 (d, *J* = 6.7 Hz, 2H), 1.39 – 1.34 (m, 2H), 1.17 – 1.12 (m, 2H).

4-(cyclopropylidenemethyl)-N,N-dimethylaniline (1x)



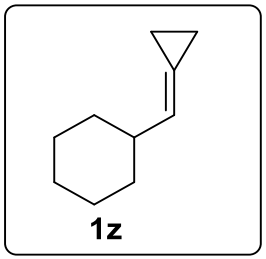
Overall yield: 60%, 0.289 g; **Nature:** white solid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.46 – 7.39 (m, 2H), 6.74 – 6.69 (m, 2H), 6.67 – 6.63 (m, 1H), 2.95 (s, 6H), 1.36 (ddd, *J* = 9.3, 5.3, 2.2 Hz, 2H), 1.15 – 1.10 (m, 2H).

2-(cyclopropylmethyl)-1,3,5-trimethylbenzene (1y)



Overall yield: 60%, 0.413 g; **Nature:** colourless liquid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 6.88 (s, 1H), 6.84 (s, 1H), 2.66 (d, *J* = 6.0 Hz, 2H), 2.35 (s, 36), 2.31 (s, 3H), 0.95 – 0.85 (m, 1H), 0.50 – 0.43 (m, 2H), 0.22 – 0.16 (m, 2H)

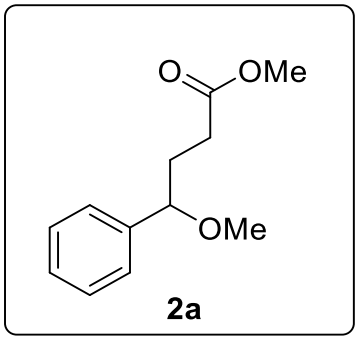
(cyclopropylidenemethyl)cyclohexane (1z)



Overall yield: 70%, 0.423g; **Nature:** colourless liquid; **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 5.70 – 5.65 (m, 1H), 2.18 – 2.10 (m, 1H), 1.80 – 1.60 (m, 6H), 1.26 (ddd, *J* = 9.2, 8.7, 2.7 Hz, 6H), 1.17 (dd, *J* = 17.6, 6.7 Hz, 2H), 1.08 – 1.02 (m, 2H), 0.97 – 0.92 (m, 2H).

Characterization data of final compounds

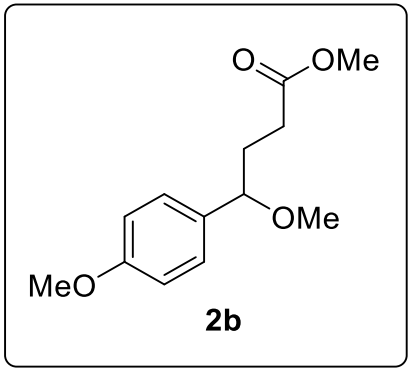
methyl 4-methoxy-4-phenylbutanoate (2a)[12, 13]



2a

Overall yield: 65%, 31 mg; **Nature:** yellow oil; R_f = 0.5 (Hexane/ethyl acetate = 95:5); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.36 – 7.31 (m, 2H), 7.29 – 7.24 (m, 3H), 4.14 (dd, *J* = 7.9, 5.3 Hz, 1H), 3.64 (s, 3H), 3.19 (s, 3H), 2.38 (t, *J* = 7.5 Hz, 2H), 2.11 – 1.91 (m, 2H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.0, 141.5, 128.5, 127.8, 126.6, 82.8, 56.8, 51.6, 33.1, 30.4; **HRMS** (ESI, Q-TOF) m/z $[M + H]^+$ Calcd for $C_{12}H_{16}NaO_3$ 231.0997, found $[M+Na]^+$ 231.0997.

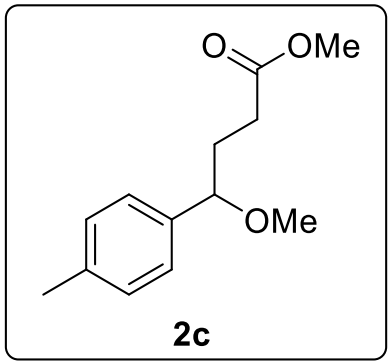
methyl 4-methoxy-4-(4-methoxyphenyl)butanoate (2b)



2b

Overall yield: 75%, 33 mg; **Nature:** yellow oil; R_f = 0.5 (Hexane/ethyl acetate = 95:5); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.18 (d, *J* = 8.6 Hz, 2H), 6.89 – 6.84 (m, 2H), 4.08 (dd, *J* = 7.8, 5.5 Hz, 1H), 3.79 (s, 3H), 3.63 (s, 3H), 3.16 (s, 3H), 2.35 (t, *J* = 7.4 Hz, 2H), 2.06 (dq, *J* = 14.9, 7.5 Hz, 2H), 1.97 – 1.88 (m, 1H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.0, 159.2, 133.5, 127.9, 113.8, 111.9, 82.3, 56.5, 55.3, 51.6, 33.1, 30.5; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{13}H_{18}NaO_4$ 261.1103, found $[M+Na]^+$ 261.1104

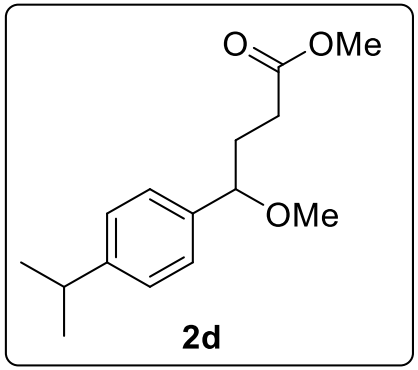
methyl 4-methoxy-4-(p-tolyl)butanoate (2c)



2c

Overall yield: 70%, 22 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 95:5); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.15 (s, 4H), 4.10 (dd, *J* = 7.9, 5.3 Hz, 1H), 3.64 (s, 3H), 3.18 (s, 3H), 2.36 (t, *J* = 7.5 Hz, 2H), 2.33 (s, 3H), 2.05 (td, *J* = 14.8, 7.4 Hz, 2H), 1.98 – 1.89 (m, 1H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.0, 138.4, 137.4, 129.2, 82.6, 56.7, 51.6, 33.1, 30.5, 21.2; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{13}H_{18}NaO_3$ 245.1154, found $[M+Na]^+$ 245.1144.

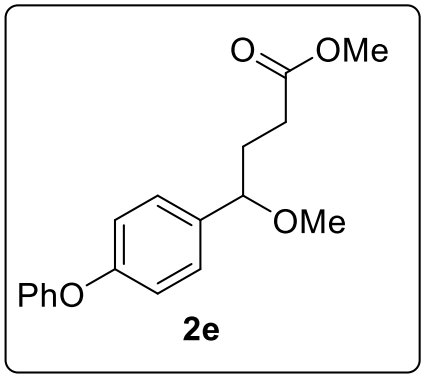
methyl 4-(4-isopropyl-2-methoxyphenyl)-4-methoxybutanoate (2d)



2d

Overall yield: 70%, 30 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 97:3); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.18 (s, 4H), 4.10 (dd, *J* = 7.9, 5.3 Hz, 1H), 3.63 (s, 3H), 3.19 (s, 3H), 2.88 (dt, *J* = 13.8, 6.9 Hz, 1H), 2.37 (t, *J* = 7.5 Hz, 2H), 2.11 – 1.90 (m, 2H), 1.23 (d, *J* = 7.0 Hz, 2H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.1, 148.3, 138.8, 126.6, 126.5, 82.6, 56.7, 51.6, 33.8, 33.1, 30.5, 24.0; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{15}H_{22}NaO_3$ 273.1467, found $[M+Na]^+$ 273.1477.

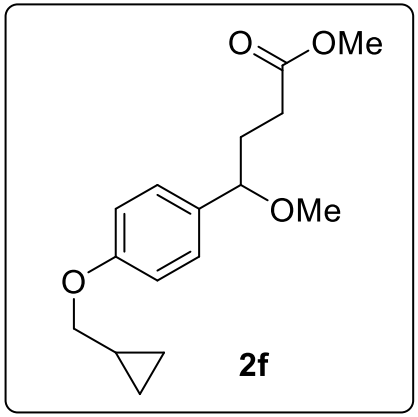
methyl 4-methoxy-4-(4-phenoxyphenyl)butanoate (2e)



2e

Overall yield: 72%, 28 mg; **Nature:** yellow oil; R_f = 0.5 (Hexane/ethyl acetate = 97:3); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.36 – 7.30 (m, 2H), 7.25 – 7.21 (m, 2H), 7.12 – 7.07 (m, 1H), 7.02 – 6.96 (m, 4H), 4.12 (dd, *J* = 7.9, 5.3 Hz, 1H), 3.65 (s, 3H), 3.20 (s, 3H), 2.38 (t, *J* = 7.5 Hz, 2H), 2.11 – 2.02 (m, 1H), 2.00 – 1.92 (m, 1H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.0, 156.9, 136.3, 129.8, 128.0, 123., 119.05, 118.7, 82.3, 56.7, 51.6, 33.1, 30.4; **HRMS** (ESI, Q-TOF) m/z [M + Na]$^+$ Calcd for $C_{18}H_{20}NaO_4$ 323.1259, found [M+Na]$^+$ 323.1259.

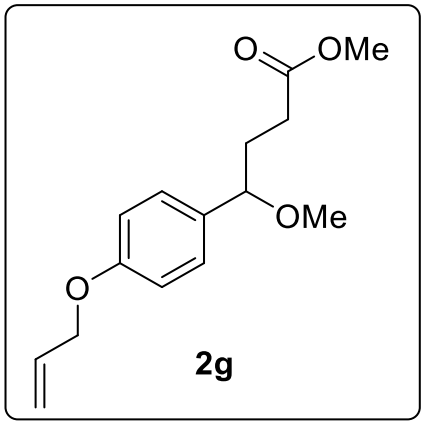
methyl 4-(4-(cyclopropylmethoxy)phenyl)-4-methoxybutanoate (2f)



2f

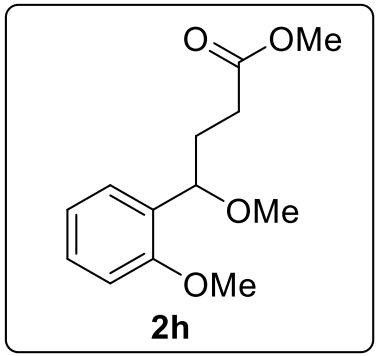
Overall yield: 80%, 33 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 93:7); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.19 – 7.15 (m, 2H), 6.88 – 6.84 (m, 2H), 4.07 (dd, *J* = 7.8, 5.5 Hz, 1H), 3.77 (d, *J* = 6.9 Hz, 2H), 3.63 (s, 3H), 3.15 (s, 3H), 2.34 (t, *J* = 7.5 Hz, 2H), 2.10 – 2.01 (m, 1H), 1.96 – 1.87 (m, 1H), 1.31 – 1.25 (m, 1H), 0.66 – 0.60 (m, 2H), 0.35 – 0.31 (m, 2H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.0, 158.6, 133.4, 127.8, 114.5, 82.4, 72.8, 56.5, 51.6, 33.1, 30.5, 10.3, 3.28; **HRMS** (ESI, Q-TOF) m/z [M + Na]$^+$ Calcd for $C_{16}H_{22}NaO_4$ 301.1416, found [M+Na]$^+$ 301.1417.

methyl 4-(4-(allyloxy)phenyl)-4-methoxybutanoate (2g)



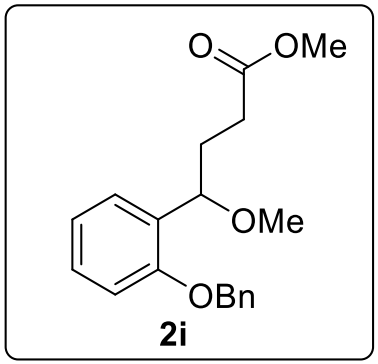
Overall yield: 78%, 33 mg; **Nature:** yellow oil; R_f = 0.5 (Hexane/ethyl acetate = 95:5); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.20 – 7.15 (m, 2H), 6.90 – 6.86 (m, 2H), 6.05 (ddt, *J* = 17.2, 10.5, 5.3 Hz, 1H), 5.40 (dq, *J* = 17.3, 1.7 Hz, 1H), 5.28 (dq, *J* = 10.5, 1.4 Hz, 1H), 4.52 (dt, *J* = 5.2, 1.4 Hz, 2H), 4.07 (dd, *J* = 7.8, 5.5 Hz, 1H), 3.63 (s, 3H), 3.16 (s, 3H), 2.35 (t, *J* = 7.5 Hz, 2H), 2.10 – 2.01 (m, 1H), 1.97 – 1.88 (m, 1H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.0, 158.2, 133.6, 133.3, 127.8, 117.8, 114.6, 82.3, 68.9, 56.6, 51.6, 33.1, 30.5; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{15}H_{20}NaO_4$ 287.1259, found $[M+Na]^+$ 287.1263.

methyl 4-methoxy-4-(2-methoxyphenyl)butanoate (2h)



Overall yield: 70%, 22 mg; **Nature:** yellow oil; R_f = 0.5 (Hexane/ethyl acetate = 93:7); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.32 (dd, *J* = 7.5, 1.7 Hz, 1H), 7.25 – 7.19 (m, 1H), 6.99 – 6.93 (m, 1H), 6.85 (d, *J* = 7.7 Hz, 1H), 4.62 (t, *J* = 6.2 Hz, 1H), 3.79 (s, 3H), 3.62 (s, 3H), 3.22 (s, 3H), 2.43 - 2.36 (m, 2H), 2.01 - 1.96 (m, 2H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.3, 157.0, 129.6, 128.3, 126.5, 120.7, 110.2, 76.37, 56.9, 55.3, 51.5, 31.7, 30.4; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{13}H_{18}NaO_4$ 261.1103, found $[M+Na]^+$ 261.1145.

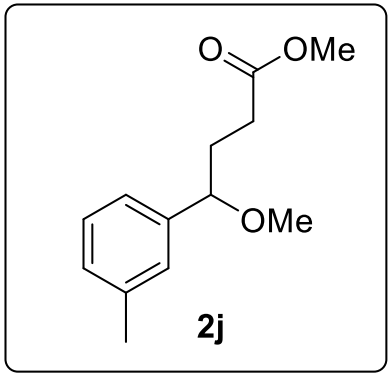
methyl 4-(2-(benzyloxy)phenyl)-4-methoxybutanoate (2i)



2i

Overall yield: 85%, 33 mg; **Nature:** yellow oil; R_f = 0.5 (Hexane/ethyl acetate = 93:7); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.43 – 7.36 (m, 5H), 7.35 – 7.30 (m, 1H), 7.22 (td, *J* = 8.2, 1.7 Hz, 1H), 6.99 (t, *J* = 7.4 Hz, 1H), 6.92 (d, *J* = 8.2 Hz, 1H), 5.08 (d, *J* = 3.5 Hz, 2H), 4.72 (t, *J* = 6.1 Hz, 1H), 3.57 (s, 3H), 3.23 (s, 3H), 2.42 – 2.36 (m, 2H), 2.07 – 2.01 (m, 2H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.1, 156.1, 137.2, 130.0, 128.6, 128.3, 127.9, 127.2, 126.6, 121.1, 111.8, 76.2, 70.0, 57.0, 51.5, 31.8, 30.4; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{19}H_{22}NaO_4$ 337.1416, found $[M+Na]^+$ 337.1417.

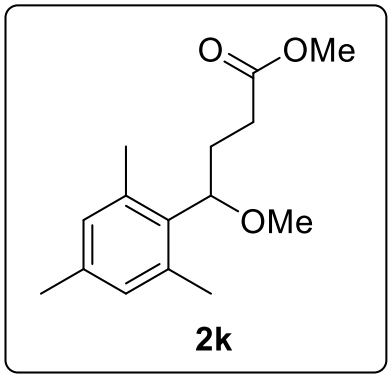
methyl 4-methoxy-4-(m-tolyl)butanoate (2j)



2j

Overall yield: 55%, 25 mg; **Nature:** yellow oil; R_f = 0.5 (Hexane/ethyl acetate = 97:3); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.24 – 7.20 (m, 1H), 7.10 – 7.04 (m, 3H), 4.09 (dd, *J* = 7.9, 5.3 Hz, 1H), 3.64 (s, 3H), 3.19 (s, 3H), 2.37 (t, *J* = 7.5 Hz, 2H), 2.34 (s, 3H), 2.10 – 2.00 (m, 1H), 1.99 – 1.91 (m, 1H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.0, 141.5, 138.1, 128.5, 128.4, 127.2, 123.7, 82.8, 56.8, 51.6, 33.1, 30.5, 21.5; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{13}H_{18}NaO_3$ 245.1154, found $[M+Na]^+$ 245.1156.

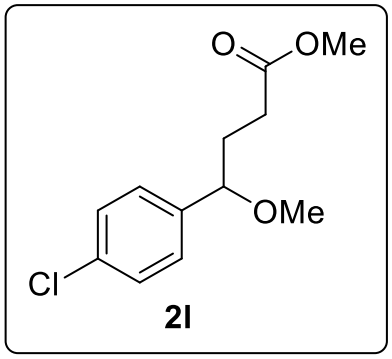
methyl 4-mesityl-4-methoxybutanoate (2k)



2k

Overall yield: 65%, 28 mg; **Nature:** yellow oil; R_f = 0.5 (Hexane/ethyl acetate = 95:5); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 6.81 (s, 2H), 4.62 (dd, *J* = 9.8, 4.6 Hz, 1H), 3.66 (s, 3H), 3.14 (s, 3H), 2.52 – 2.45 (m, 2H), 2.35 (s, 6H), 2.24 (s, 3H), 2.23 – 2.16 (m, 1H), 1.98 – 1.89 (m, 1H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.1, 136.7, 136.6, 133.5, 130.0, 79.5, 56.3, 51.6, 30.9, 29.9, 20.8, 20.4; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{15}H_{22}NaO_3$ 273.1467, found $[M+Na]^+$ 273.1476.

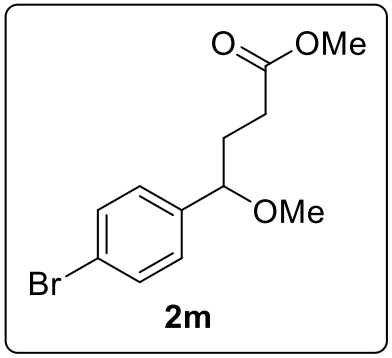
methyl 4-(4-chlorophenyl)-4-methoxybutanoate (2l)



2l

Overall yield: 75%, 33 mg; **Nature:** yellow oil; R_f = 0.5 (Hexane/ethyl acetate = 93:7); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.33 – 7.28 (m, 2H), 7.22 – 7.19 (m, 2H), 4.12 (dd, *J* = 8.0, 5.2 Hz, 1H), 3.64 (s, 3H), 3.18 (s, 3H), 2.39 – 2.33 (m, 2H), 2.05 – 1.88 (m, 2H).; **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 173.8, 140.2, 133.4, 128.7, 128.0, 82.1, 56.8, 51.6, 33.1, 30.2; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{12}H_{15}ClNaO_3$ 265.0607, found $[M+Na]^+$ 265.0605.

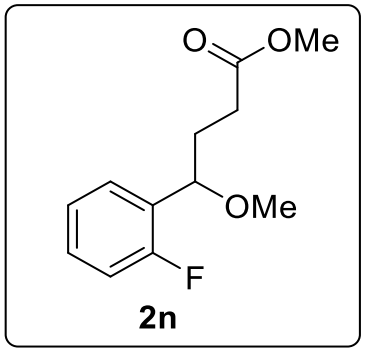
methyl 4-(4-bromophenyl)-4-methoxybutanoate (2m)



2m

Overall yield: 78%, 31 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 93:7); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.48 – 7.44 (m, 2H), 7.17 – 7.13 (m, 2H), 4.11 (dd, *J* = 8.0, 5.2 Hz, 1H), 3.64 (s, 3H), 3.18 (s, 3H), 2.38 – 2.34 (m, 2H), 2.05 – 1.98 (m, 1H), 1.96 – 1.87 (m, 1H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 173.8, 140.7, 131.7, 128.3, 121.5, 82.17, 56.9, 51.7, 33.0, 30.2; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{12}H_{15}BrNaO_3$ 309.0102, found $[M+Na]^+$ 309.0107.

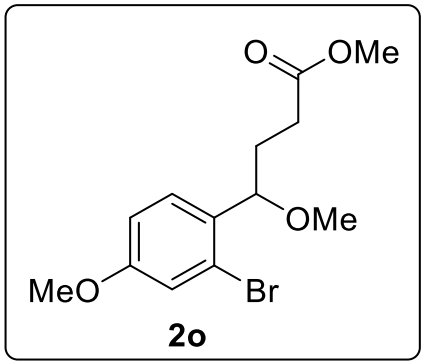
methyl 4-(2-fluorophenyl)-4-methoxybutanoate (2n)



2n

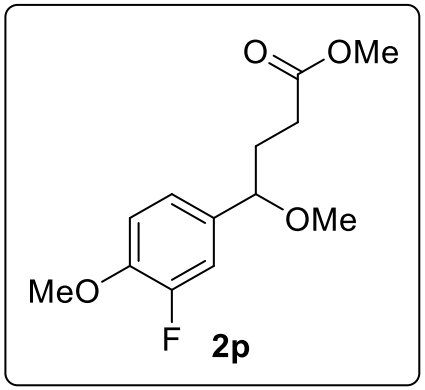
Overall yield: 58%, 26 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 95:5); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.37 (td, *J* = 7.5, 1.8 Hz, 1H), 7.24 (tdd, *J* = 7.2, 5.2, 1.9 Hz, 1H), 7.14 (td, *J* = 7.4, 1.0 Hz, 1H), 7.04 – 6.98 (m, 1H), 4.54 (dd, *J* = 7.7, 5.2 Hz, 1H), 3.63 (s, 3H), 3.22 (s, 3H), 2.43 – 2.37 (m, 2H), 2.10 – 1.98 (m, 2H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 173.8, 161.8, 159.4, 129.1, 129.0, 127.5, 124.4, 124.4, 115.5, 115.3, 75.8, 57.1, 51.6, 31.9, 30.3; **^{19}F NMR** (376 MHz, CHLOROFORM-D) δ -119.79; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{12}H_{15}FNaO_3$ 249.0903, found $[M+Na]^+$ 249.0903.

methyl 4-(2-bromo-4-methoxyphenyl)-4-methoxybutanoate (2o)



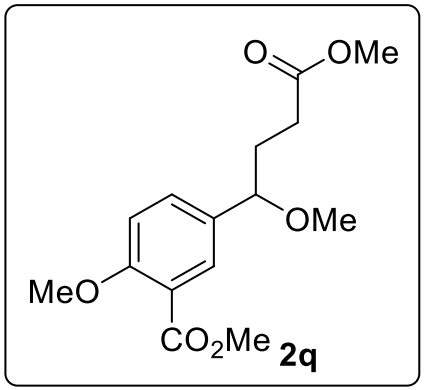
Overall yield: 80%, 31 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 93:7); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.30 (d, *J* = 8.7 Hz, 1H), 7.05 (d, *J* = 2.6 Hz, 1H), 6.88 (dd, *J* = 8.6, 2.6 Hz, 1H), 4.53 (dd, *J* = 7.8, 4.9 Hz, 1H), 3.78 (s, 3H), 3.64 (s, 3H), 3.18 (s, 3H), 2.48 – 2.34 (m, 2H), 2.02 – 1.89 (m, 2H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 173.9, 159.3, 132.5, 128.1, 123.4, 117.7, 114.2, 80.7, 56.9, 55.6, 51.6, 32.1, 30.4; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{13}H_{17}BrNaO_4$ 339.0208, found $[M+Na]^+$ 339.0206.

methyl 4-(3-fluoro-4-methoxyphenyl)-4-methoxybutanoate (2p)



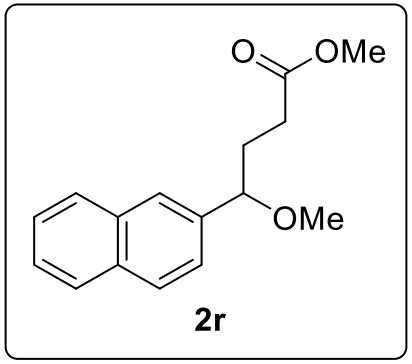
Overall yield: 76%, 32 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 97:3); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.01 (dd, *J* = 12.0, 2.0 Hz, 1H), 6.96 (dd, *J* = 8.5, 2.0 Hz, 1H), 6.91 (t, *J* = 8.2 Hz, 1H), 4.06 (dd, *J* = 7.9, 5.4 Hz, 1H), 3.86 (s, 3H), 3.63 (s, 3H), 3.16 (s, 3H), 2.34 (t, *J* = 7.4 Hz, 2H), 2.04 – 1.96 (m, 1H), 1.95 – 1.85 (m, 1H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 173.9, 153.7, 151.3, 147.1, 147.0, 134.6, 122.5, 114.2, 114.0, 113.2, 81.9, 56.7, 56.3, 51.6, 33.0, 30.3; **^{19}F NMR** (376 MHz, CHLOROFORM-D) δ -134.95; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{13}H_{17}BFNaO_4$ 279.1009, found $[M+Na]^+$ 279.1024.

methyl 5-(1,4-dimethoxy-4-oxobutyl)-2-methoxybenzoate (2q)



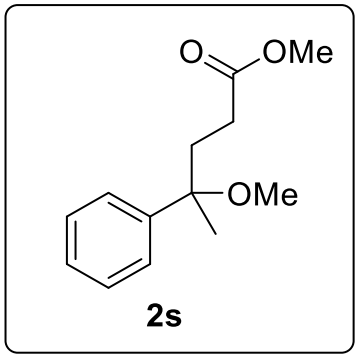
Overall yield: 75%, 30 mg; **Nature:** yellow oil; R_f = 0.5 (Hexane/ethyl acetate = 85:15); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.69 (d, *J* = 2.3 Hz, 1H), 7.39 (dd, *J* = 8.6, 2.3 Hz, 1H), 6.96 (d, *J* = 8.6 Hz, 1H), 4.11 (dd, *J* = 8.0, 5.2 Hz, 1H), 3.89 (s, 3H), 3.88 (s, 3H), 3.64 (s, 3H), 3.17 (s, 3H), 2.36 (t, *J* = 7.4 Hz, 2H), 2.05 (dt, *J* = 15.2, 7.3 Hz, 1H), 1.93 (ddd, *J* = 19.4, 10.7, 6.4 Hz, 1H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 173.9, 166.6, 158.8, 133.2, 131.7, 130.1, 119.9, 112.2, 81.9, 56.7, 56.2, 52.1, 51.6, 33.0, 30.4; **^{19}F NMR** (376 MHz, CHLOROFORM-D) δ -134.95; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{15}H_{20}NaO_6$ 319.1158, found $[M+Na]^+$ 319.1158.

methyl 4-methoxy-4-(naphthalen-2-yl)butanoate (2r)



Overall yield: 65%, 26 mg; **Nature:** yellow oil; R_f = 0.5 (Hexane/ethyl acetate = 95:5); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.83 (dd, *J* = 8.6, 5.7 Hz, 3H), 7.72 (s, 1H), 7.49 – 7.45 (m, 2H), 7.43 (dd, *J* = 8.5, 1.6 Hz, 1H), 4.32 (dd, *J* = 7.8, 5.4 Hz, 1H), 3.64 (s, 3H), 3.24 (s, 3H), 2.41 (t, *J* = 7.4 Hz, 2H), 2.21 – 2.12 (m, 1H), 2.09 – 2.01 (m, 1H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.0, 138.9, 133.2, 133.2, 128.5, 127.9, 127.8, 126.2, 125.9, 125.9, 124.3, 82.9, 56.9, 51.6, 33.0, 30.4; **HRMS** (ESI, Q-TOF) m/z $[M + H]^+$ Calcd for $C_{16}H_{19}O_3$ 259.1334, found $[M+H]^+$ 259.1256.

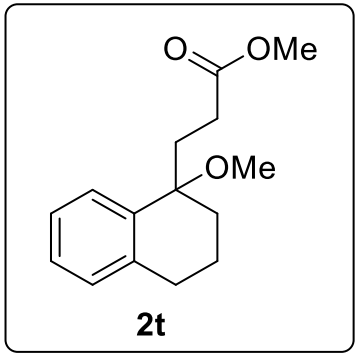
methyl 4-methoxy-4-phenylpentanoate (2s)



2s

Overall yield: 60%, 27 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 97:3); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.36 – 7.31 (m, 4H), 7.26 – 7.22 (m, 1H), 3.59 (s, 3H), 3.09 (s, 3H), 2.30 – 2.21 (m, 2H), 2.12 – 2.05 (m, 2H), 1.52 (s, 3H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.3, 144.4, 128.3, 127.0, 126.1, 78.2, 51.6, 50.4, 37.1, 29.0, 23.4; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{13}H_{18}NaO_3$ 245.1154, found $[M+Na]^+$ 245.1160.

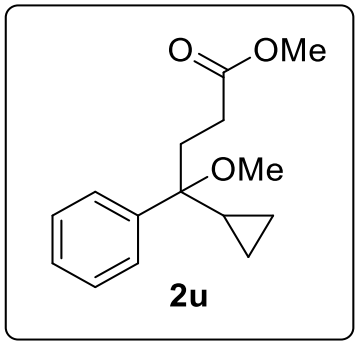
methyl 3-(1-methoxy-1,2,3,4-tetrahydronaphthalen-1-yl)propanoate (2t)



2t

Overall yield: 70%, 30 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 97:3); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.39 (dd, *J* = 7.5, 1.6 Hz, 1H), 7.17 (ddd, *J* = 13.4, 6.9, 1.6 Hz, 2H), 7.07 (dd, *J* = 6.7, 1.9 Hz, 1H), 3.62 (s, 3H), 3.02 (s, 3H), 2.82 – 2.68 (m, 2H), 2.48 – 2.34 (m, 2H), 2.13 – 2.02 (m, 4H), 1.91 – 1.81 (m, 2H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.5, 138.8, 138.4, 128., 127.14, 126.9, 125.9, 77.0, 51.6, 50.2, 37.2, 29.7, 29.6, 29.0, 20.5; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{15}H_{20}BrNaO_3$ 271.1310, found $[M+Na]^+$ 271.1316

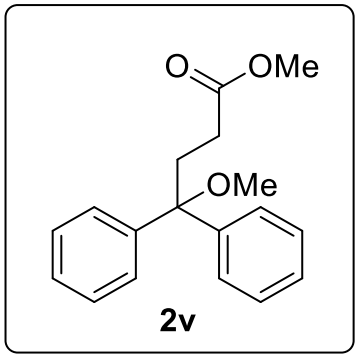
methyl 4-cyclopropyl-4-methoxy-4-phenylbutanoate (2u)



2u

Overall yield: 75%, 32 mg; **Nature:** colorless liquid; R_f = 0.5 (Hexane/ethyl acetate = 97:3); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.39 (dt, *J* = 3.1, 1.9 Hz, 2H), 7.34 – 7.30 (m, 2H), 7.25 – 7.21 (m, 1H), 3.62 (s, 3H), 3.19 (s, 3H), 2.53 – 2.44 (m, 1H), 2.24 – 2.15 (m, 2H), 2.03 – 1.96 (m, 1H), 1.09 (ddd, *J* = 11.7, 7.0, 4.2 Hz, 1H), 0.54 – 0.47 (m, 2H), 0.42 – 0.34 (m, 2H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.69, 143.28, 128.00, 126.96, 126.83, 79.28, 51.68, 50.20, 30.11, 28.41, 19.60, 2.69, 0.96. **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{15}H_{20}BrNaO_3$ 271.1310, found $[M+Na]^+$ 271.1311.

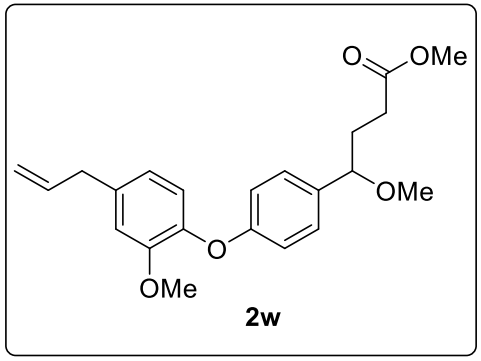
methyl 4-methoxy-4,4-diphenylbutanoate (2v)



2v

Overall yield: 65%, 26 mg; **Nature:** yellow oil; R_f = 0.5 (Hexane/ethyl acetate = 95:5); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.36 – 7.33 (m, 4H), 7.30 – 7.24 (m, 4H), 7.22 – 7.17 (m, 2H), 3.61 (s, 3H), 3.04 (s, 3H), 2.69 – 2.64 (m, 2H), 2.19 – 2.14 (m, 2H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.4, 144.7, 128.1, 126.9, 81.7, 51.6, 50.1, 30.0, 28.2; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{18}H_{20}BrNaO_3$ 307.1310, found $[M+Na]^+$ 307.1316.

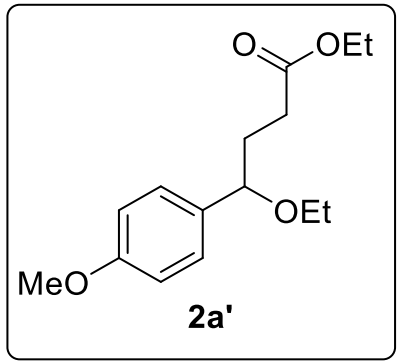
methyl 4-(4-(4-allyl-2-methoxyphenoxy)phenyl)-4-methoxybutanoate (2w)



2w

Overall yield: 60%, 22 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 93:7); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.19 – 7.14 (m, 2H), 6.92 – 6.87 (m, 3H), 6.81 (d, *J* = 1.9 Hz, 1H), 6.74 (dd, *J* = 8.0, 2.0 Hz, 1H), 5.98 (ddt, *J* = 16.9, 10.1, 6.8 Hz, 1H), 5.14 – 5.07 (m, 2H), 4.09 (dd, *J* = 7.8, 5.4 Hz, 1H), 3.81 (s, 3H), 3.64 (s, 3H), 3.38 (d, *J* = 6.8 Hz, 2H), 3.17 (s, 3H), 2.36 (d, *J* = 15.0 Hz, 2H), 2.10 – 2.00 (m, 1H), 1.98 – 1.89 (m, 1H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 174.0, 157.9, 151.4, 143.0, 137.3, 137.17, 135.2, 127.8, 121.3, 121.0, 116.9, 116.1, 113.0, 82.3, 56.6, 56.0, 51.65, 40.1, 33.1, 30.5; **HRMS** (ESI, Q-TOF) m/z [M + Na]$^+$ Calcd for $C_{22}H_{26}NaO_4$ 393.1678, found [M+Na]$^+$ 393.1679.

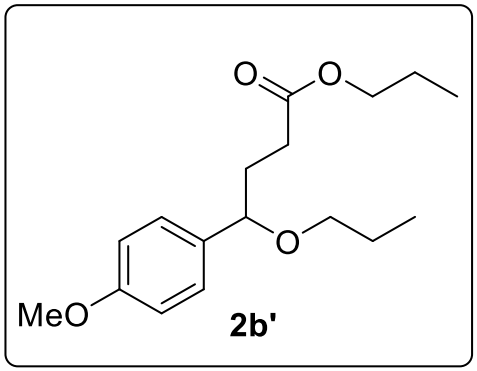
ethyl 4-ethoxy-4-(4-methoxyphenyl)butanoate (2a')



2a'

Overall yield: 58%, 28 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 95:5); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.19 (d, *J* = 8.2 Hz, 2H), 6.86 (d, *J* = 7.3 Hz, 2H), 4.21 – 4.16 (m, 1H), 4.12 – 4.05 (m, 2H), 3.78 (s, 3H), 3.38 – 3.30 (m, 2H), 3.37 – 3.22 (m, 2H), 2.35 (t, *J* = 7.4 Hz, 2H), 2.04 (td, *J* = 14.2, 6.9 Hz, 1H), 1.91 (td, *J* = 13.7, 6.9 Hz, 1H), 1.22 (td, *J* = 6.9, 1.2 Hz, 3H), 1.13 (td, *J* = 6.9, 1.3 Hz, 3H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 173.6, 159.0, 134.3, 127.7, 113.8, 80.4, 64.0, 60.3, 55.3, 33.3, 30.9, 15.3, 14.3; **HRMS** (ESI, Q-TOF) m/z [M + Na]$^+$ Calcd for $C_{15}H_{22}NaO_4$ 289.1416, found [M+Na]$^+$ 289.1456.

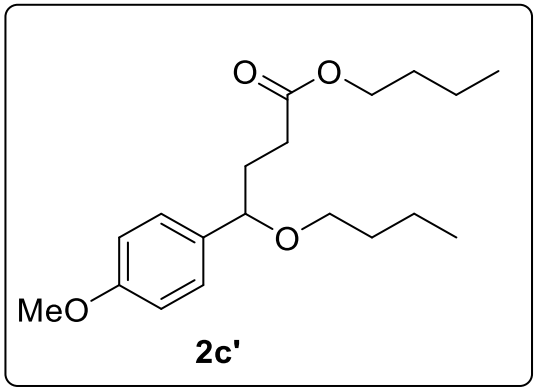
propyl 4-(4-methoxyphenyl)-4-propoxybutanoate (2b')



2b'

Overall yield: 55%, 30 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 97:3); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.21 – 7.17 (m, 2H), 6.88 – 6.84 (m, 2H), 4.17 (dd, *J* = 8.1, 5.2 Hz, 1H), 4.00 (t, *J* = 6.7 Hz, 2H), 3.79 (s, 3H), 3.24 (dt, *J* = 9.1, 6.7 Hz, 1H), 3.15 (dt, *J* = 9.1, 6.6 Hz, 1H), 2.38 (dd, *J* = 11.4, 4.0 Hz, 2H), 2.09 – 1.99 (m, 1H), 1.97 – 1.87 (m, 1H), 1.62 (dd, *J* = 14.4, 7.1 Hz, 2H), 1.52 (dt, *J* = 14.1, 7.1 Hz, 2H), 0.92 (t, *J* = 7.5 Hz, 3H), 0.87 (t, *J* = 7.4 Hz, 3H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 173.7, 159.1, 134.4, 127.7, 113.8, 80.6, 70.5, 66.0, 55.3, 33.4, 30.9, 23.1, 22.0, 10.7, 10.5; **HRMS** (ESI, Q-TOF) m/z [M + Na]$^+$ Calcd for $C_{17}H_{26}NaO_4$ 317.1729, found [M+Na]$^+$ 317.1730.

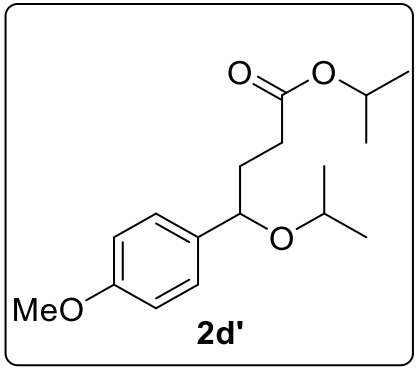
butyl 4-butoxy-4-(4-methoxyphenyl)butanoate (2c')



2c'

Overall yield: 70%, 41 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 97:3); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.21 – 7.17 (m, 2H), 6.88 – 6.83 (m, 2H), 4.16 (dd, *J* = 8.1, 5.2 Hz, 1H), 4.04 (t, *J* = 6.7 Hz, 2H), 3.79 (s, 3H), 3.27 (dt, *J* = 9.2, 6.6 Hz, 1H), 3.18 (dt, *J* = 9.2, 6.5 Hz, 1H), 2.36 (t, *J* = 7.8 Hz, 2H), 2.07 – 1.98 (m, 1H), 1.95 – 1.86 (m, 1H), 1.60 – 1.47 (m, 4H), 1.38 – 1.29 (m, 4H), 0.91 (t, *J* = 7.4 Hz, 3H), 0.86 (t, *J* = 7.3 Hz, 3H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 173.8, 159.0, 134.4, 127.7, 113.8, 80.6, 68.5, 64.2, 55.3, 33.4, 32.0, 30.9, 30.7, 19.4, 19.2, 14.0, 13.8; **HRMS** (ESI, Q-TOF) m/z [M + Na]$^+$ Calcd for $C_{19}H_{30}NaO_4$ 345.2042, found [M+Na]$^+$ 345.2047.

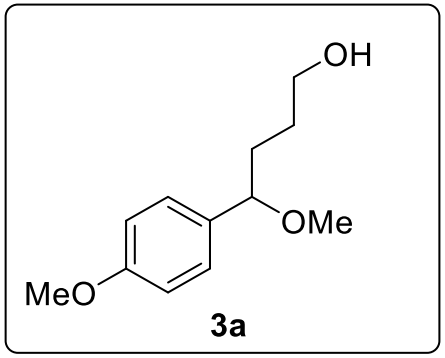
isopropyl 4-isopropoxy-4-(4-methoxyphenyl)butanoate (2d')



2d'

Overall yield: 60%, 32 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 97:3); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.23 – 7.19 (m, 2H), 6.87 – 6.83 (m, 2H), 4.98 (dt, *J* = 12.6, 6.2 Hz, 1H), 4.30 (dd, *J* = 8.4, 5.1 Hz, 1H), 3.79 (s, 3H), 3.43 (dt, *J* = 12.1, 6.1 Hz, 1H), 2.34 (td, *J* = 7.1, 1.5 Hz, 2H), 2.00 – 1.83 (m, 2H), 1.20 (d, *J* = 6.3 Hz, 6H), 1.10 (d, *J* = 6.0 Hz, 2H), 1.04 (d, *J* = 6.2 Hz, 2H); **^{13}C{^{1}H} NMR** (101 MHz, DMS-*d*^{6}); δ 172.6, 159.0, 135.4, 127.9, 114.2, 77.0, 68.3, 67.4, 55.5, 33.9, 31.0, 23.8, 22.1, 21.5; **HRMS** (ESI, Q-TOF) m/z [M + Na]$^+$ Calcd for $C_{17}H_{26}NaO_4$ 317.1729, found [M+Na]$^+$ 317.1736.

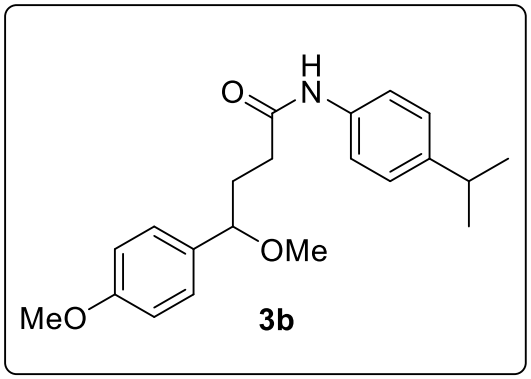
4-methoxy-4-(4-methoxyphenyl)butan-1-ol (3a)



3a

Overall yield: 85%, 44 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 70:30); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.21 – 7.16 (m, 2H), 6.89 – 6.85 (m, 2H), 4.07 (dd, *J* = 7.8, 5.0 Hz, 1H), 3.79 (s, 3H), 3.62 (t, *J* = 6.2 Hz, 2H), 3.17 (s, 3H), 1.87 – 1.79 (m, 1H), 1.77 – 1.69 (m, 1H), 1.66 – 1.57 (m, 2H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 13C NMR (101 MHz, CHLOROFORM-D) δ 159.1, 134.0, 127.7, 114.0, 83.6, 62.9, 56.4, 55.3, 35.1, 29.5; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{12}H_{18}NaO_3$ 233.1154, found $[M+H]^+$ 233.1164.

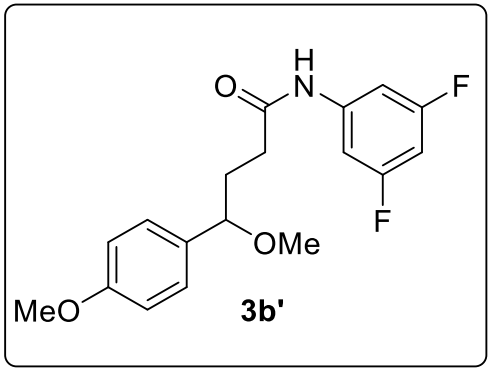
***N*-(4-isopropylphenyl)-4-methoxy-4-(4-methoxyphenyl)butanamide (3b)**



3b

Overall yield: 90%, 51 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 75:25); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.40 (d, *J* = 8.5 Hz, 2H), 7.18 (dd, *J* = 18.8, 8.5 Hz, 4H), 6.88 (d, *J* = 8.6 Hz, 2H), 4.17 (dd, *J* = 8.1, 5.2 Hz, 1H), 3.79 (s, 3H), 3.21 (s, 3H), 2.86 (dt, *J* = 13.8, 6.9 Hz, 1H), 2.47 – 2.37 (m, 2H), 2.14 – 2.04 (m, 2H), 1.21 (d, *J* = 6.9 Hz, 6H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 170.9, 159.3, 144.8, 135.7, 133.3, 127.8, 126.9, 119.9, 113.9, 82.7, 56.5, 55.3, 34.2, 33.6, 24.1; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{21}H_{27}NNaO_3$ 364.1889, found $[M+H]^+$ 364.1891.

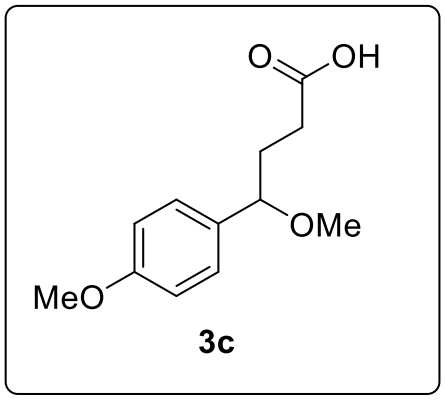
_N_-(3,5-difluorophenyl)-4-methoxy-4-(4-methoxyphenyl)butanamide (3b')



3b'

Overall yield: 80%, 33 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 75:25); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 8.31 (s, 1H), 7.21 – 7.16 (m, 2H), 7.11 (dd, *J* = 8.9, 2.0 Hz, 2H), 6.89 – 6.85 (m, 2H), 6.51 (tt, *J* = 8.8, 2.3 Hz, 1H), 4.17 (dd, *J* = 8.2, 4.9 Hz, 1H), 3.78 (s, 3H), 3.22 (s, 3H), 2.48 – 2.42 (m, 2H), 2.12 – 2.03 (m, 2H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 13C NMR (101 MHz, CHLOROFORM-D) δ 171.7, 164.5, 164.3, 162.0, 161.9, 159.4, 140.5, 140.4, 140.2, 132.9, 127.8, 114.0, 102.7, 102.4, 99.4, 99.2, 98.9, 82.9, 56.6, 55.3, 34.5, 33.4; **^{19}F NMR** (376 MHz, CHLOROFORM-D) δ -109.02; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{18}H_{19}F_2NNaO_3$ 358.1231, found $[M+H]^+$ 358.1230.

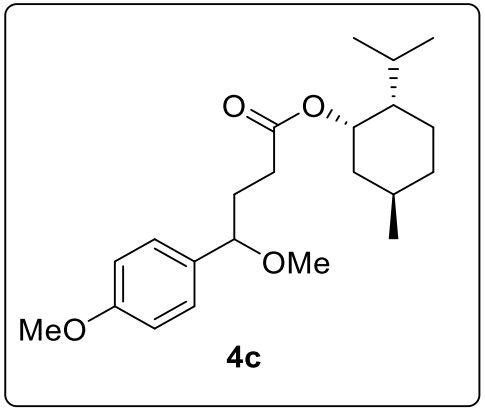
4-methoxy-4-(4-methoxyphenyl)butanoic acid (3c)



3c

Overall yield: 80%, 15 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 60:40); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.21 – 7.16 (m, 2H), 6.90 – 6.85 (m, 2H), 4.11 (dd, *J* = 8.0, 5.3 Hz, 1H), 3.79 (s, 3H), 3.18 (s, 3H), 2.41 (t, *J* = 7.3 Hz, 2H), 2.07 (dt, *J* = 15.0, 7.3 Hz, 1H), 1.98 – 1.88 (m, 1H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 179.2, 159.2, 133.2, 127.9, 113.9, 82.4, 56.5, 55.3, 32.8, 30.6; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{12}H_{17}O_4$ 225.1127, found $[M+H]^+$ 225.1137.

(*1S,2S,5R*)-2-isopropyl-5-methylcyclohexyl 4-methoxy-4-(4-methoxyphenyl)butanoate (4c)

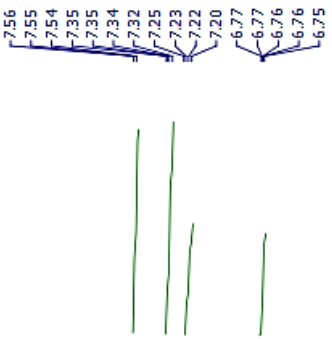


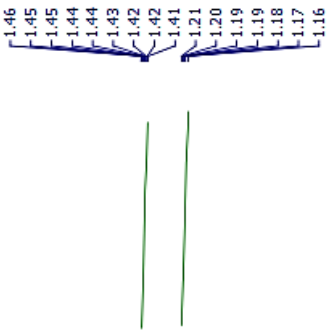
4c

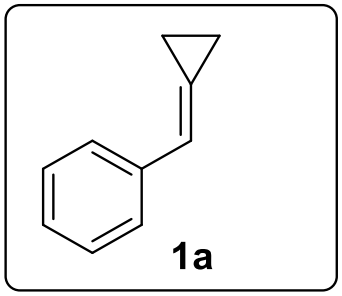
Overall yield: 60%, 38 mg; **Nature: yellow oil**; R_f = 0.5 (Hexane/ethyl acetate = 90:10); **^{1}H NMR** (400 MHz, CHLOROFORM-D); δ 7.18 (dd, *J* = 8.6, 0.9 Hz, 2H), 6.89 – 6.84 (m, 2H), 4.66 (td, *J* = 10.9, 4.4 Hz, 1H), 4.10 – 4.04 (m, 1H), 3.79 (s, 3H), 3.16 (s, 3H), 2.32 (ddd, *J* = 9.6, 5.8, 2.7 Hz, 2H), 2.06 (dt, *J* = 15.0, 7.4 Hz, 1H), 1.98 – 1.77 (m, 4H), 1.70 – 1.60 (m, 3H), 1.38 – 1.29 (m, 1H), 1.05 – 0.96 (m, 1H), 0.87 (dd, *J* = 6.7, 3.9 Hz, 6H), 0.73 (d, *J* = 7.0 Hz, 3H); **^{13}C{^{1}H} NMR** (101 MHz, CHLOROFORM-D); δ 173.0, 159.2, 133.6, 127.9, 113.8, 82.4, 74.0, 56.5, 55.3, 41.0, 34.3, 33.2, 31.4, 31.1, 26.2, 23.4, 22.1, 20.8, 16.3; **HRMS** (ESI, Q-TOF) m/z $[M + Na]^+$ Calcd for $C_{22}H_{23}NaO_4$ 385.2355, found $[M+H]^+$ 385.2353.

Spectra of compounds

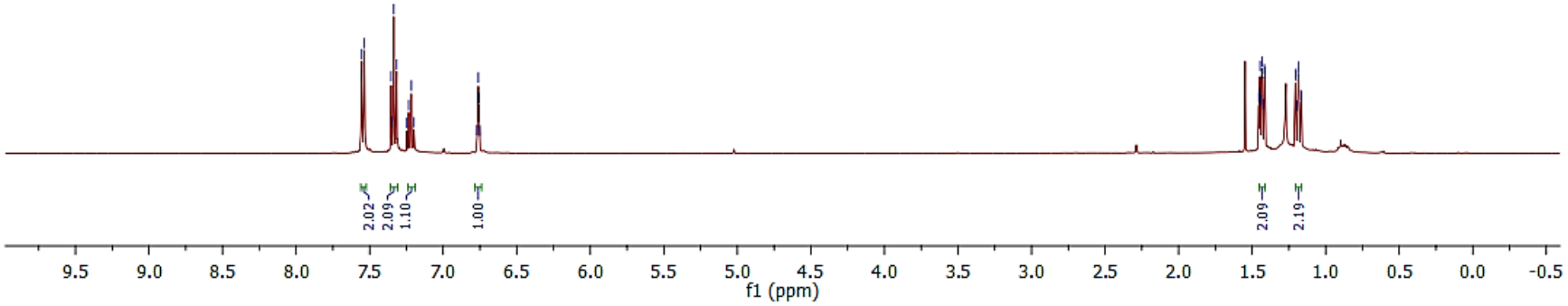
26-04-11

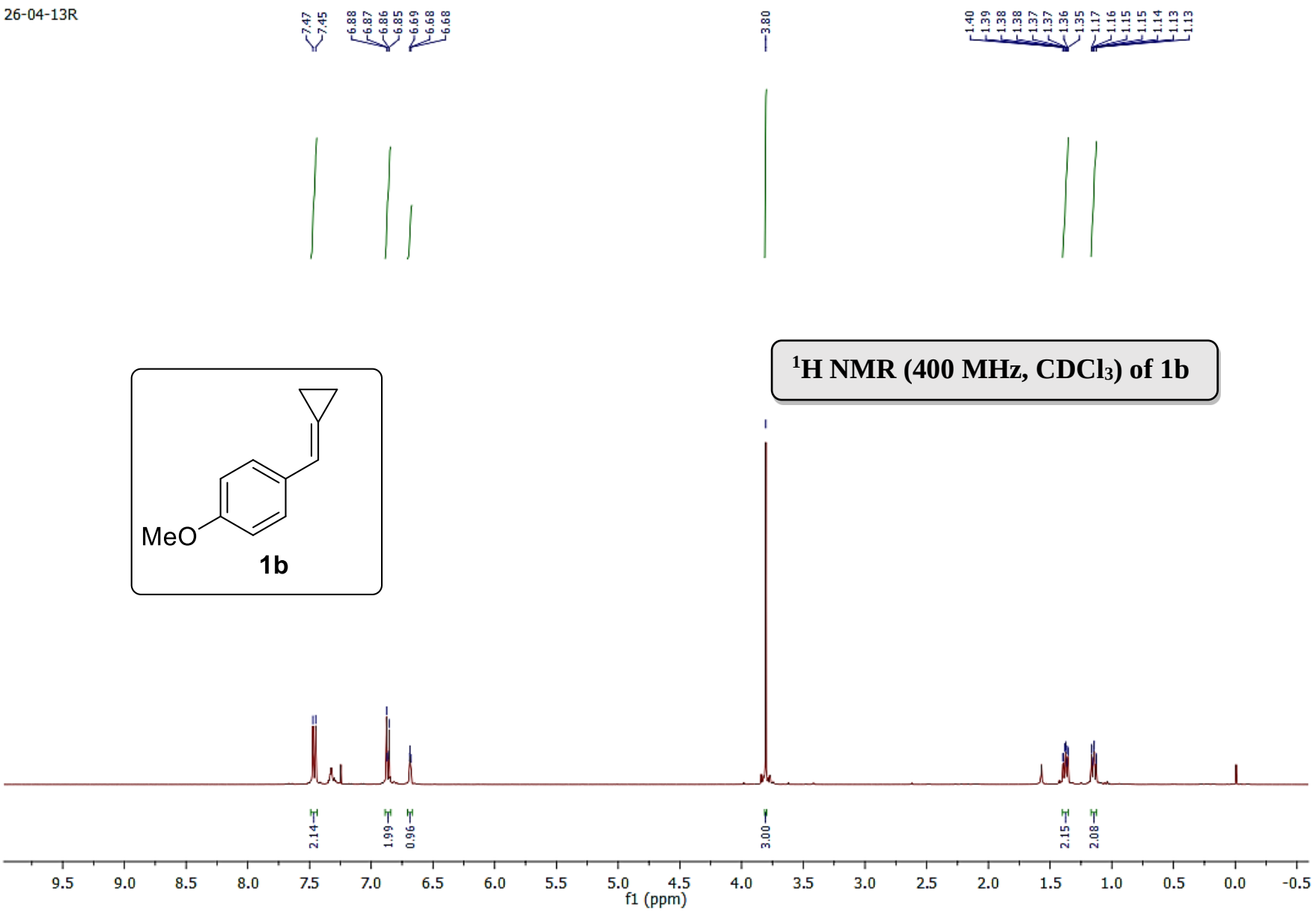




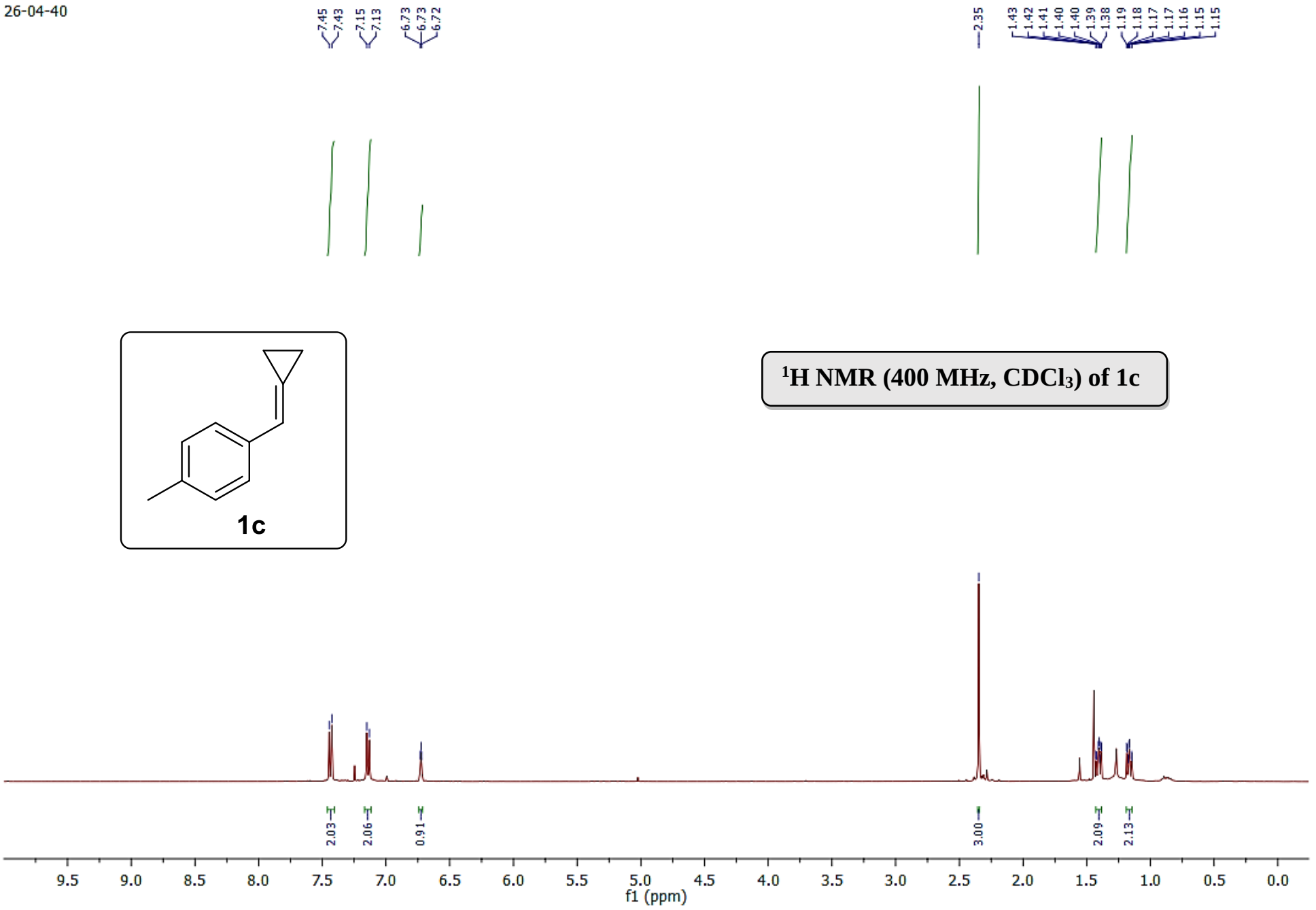


^{1}H NMR (400 MHz, $CDCl_3$) of 1a



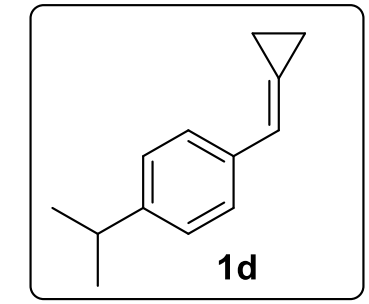


^{1}H NMR (400 MHz, $CDCl_3$) of 1b



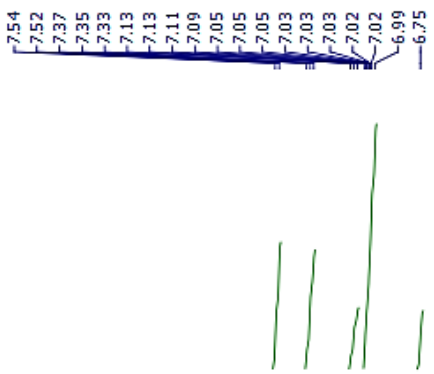
^{1}H NMR (400 MHz, $CDCl_3$) of 1c

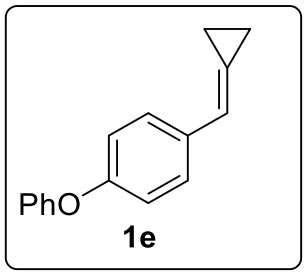
26-04-62R



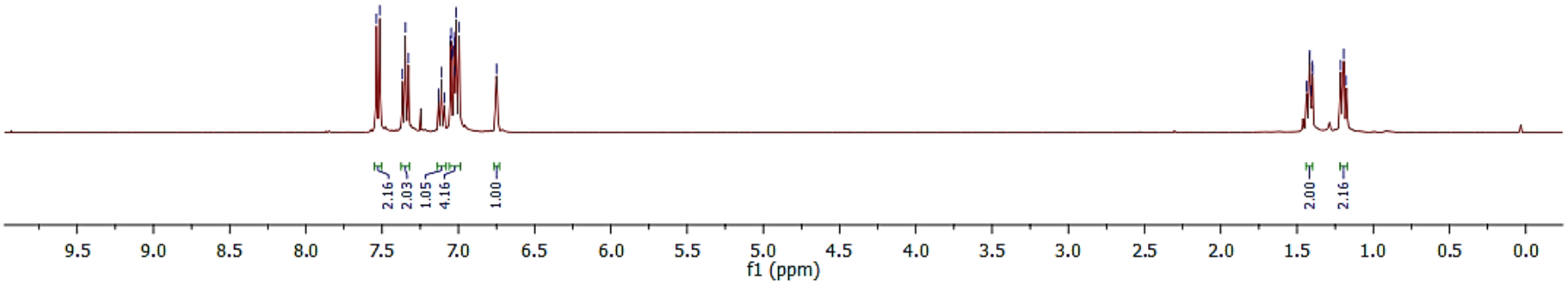
^{1}H NMR (400 MHz, $CDCl_3$) of 1d

26-04-110

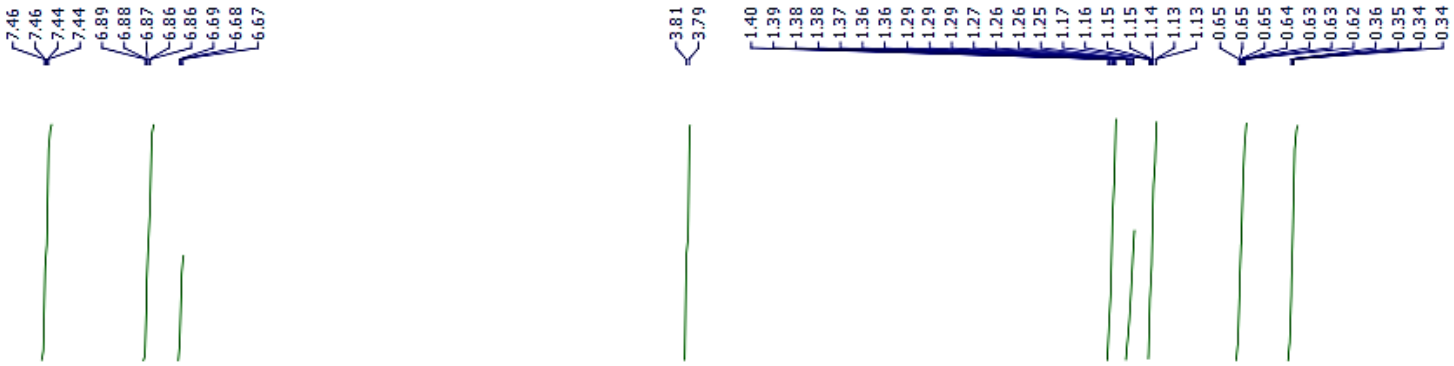


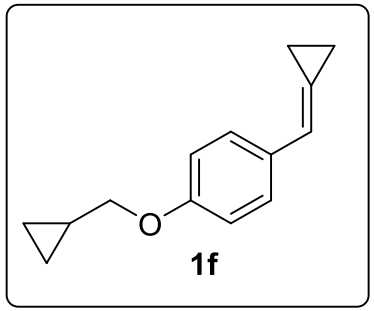


^{1}H NMR (400 MHz, $CDCl_3$) of 1e

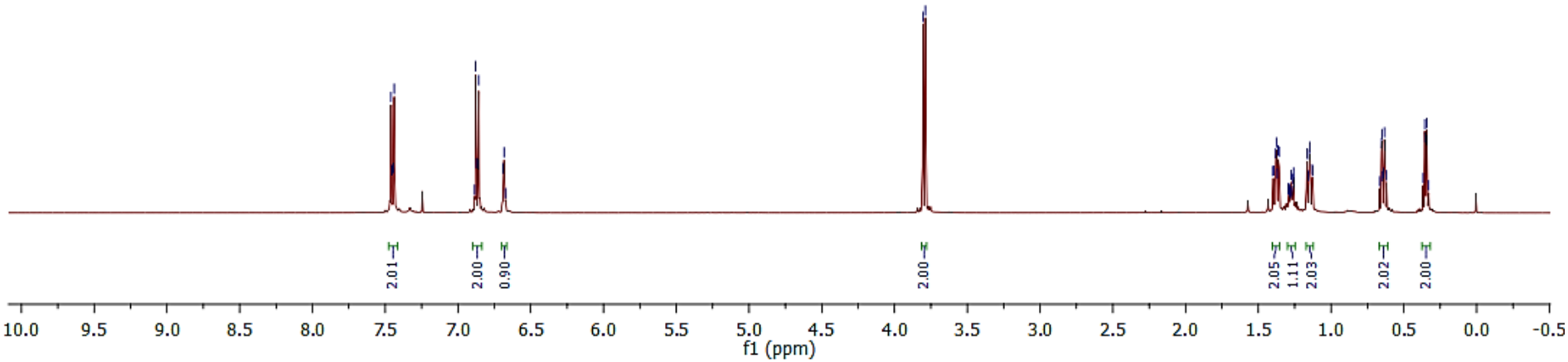


26-04-111

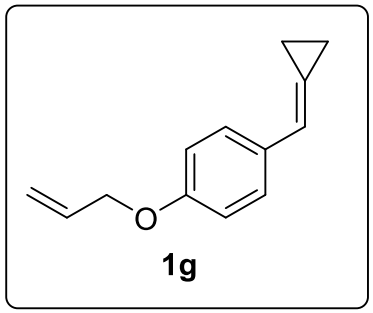




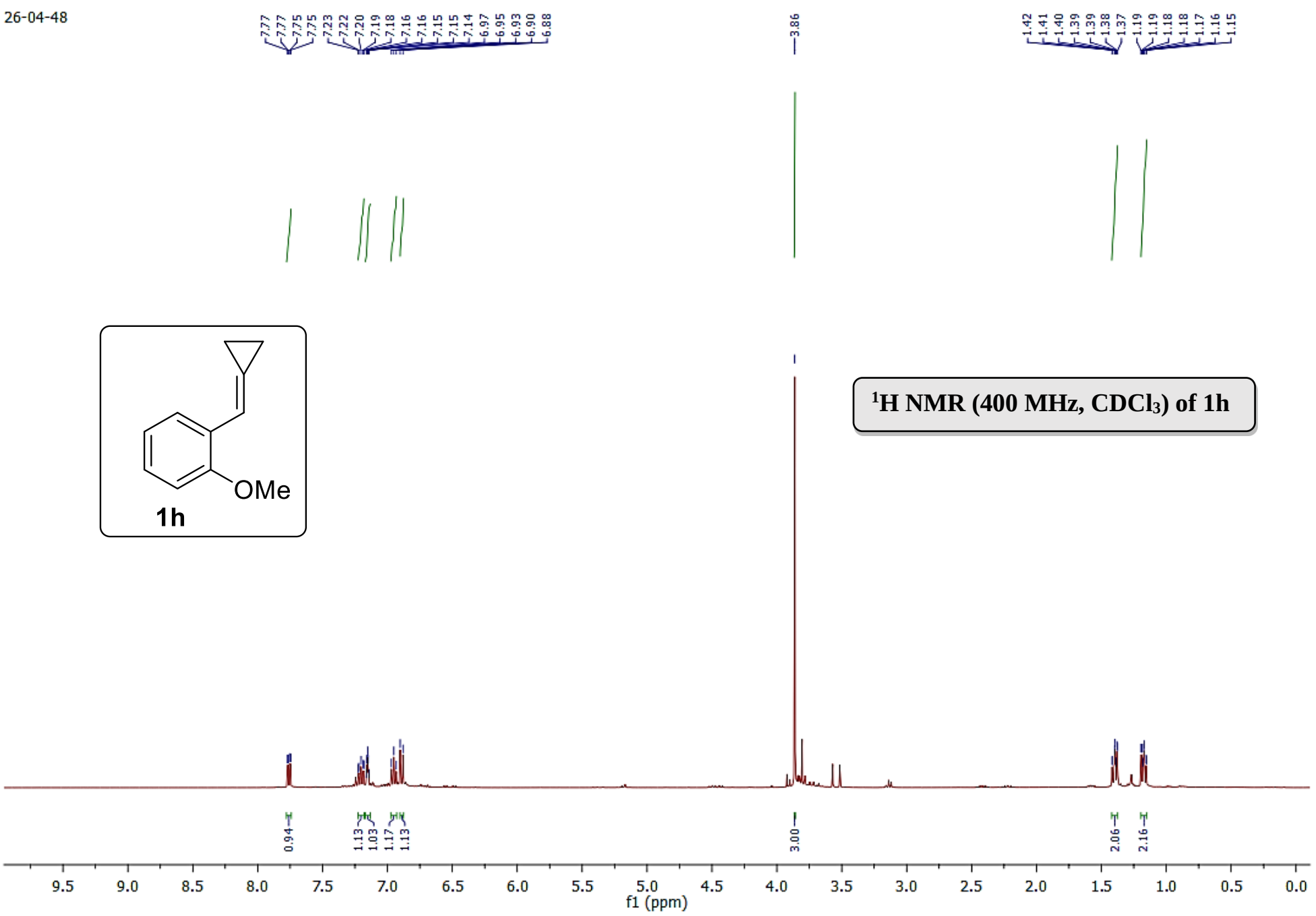
^{1}H NMR (400 MHz, $CDCl_3$) of 1f



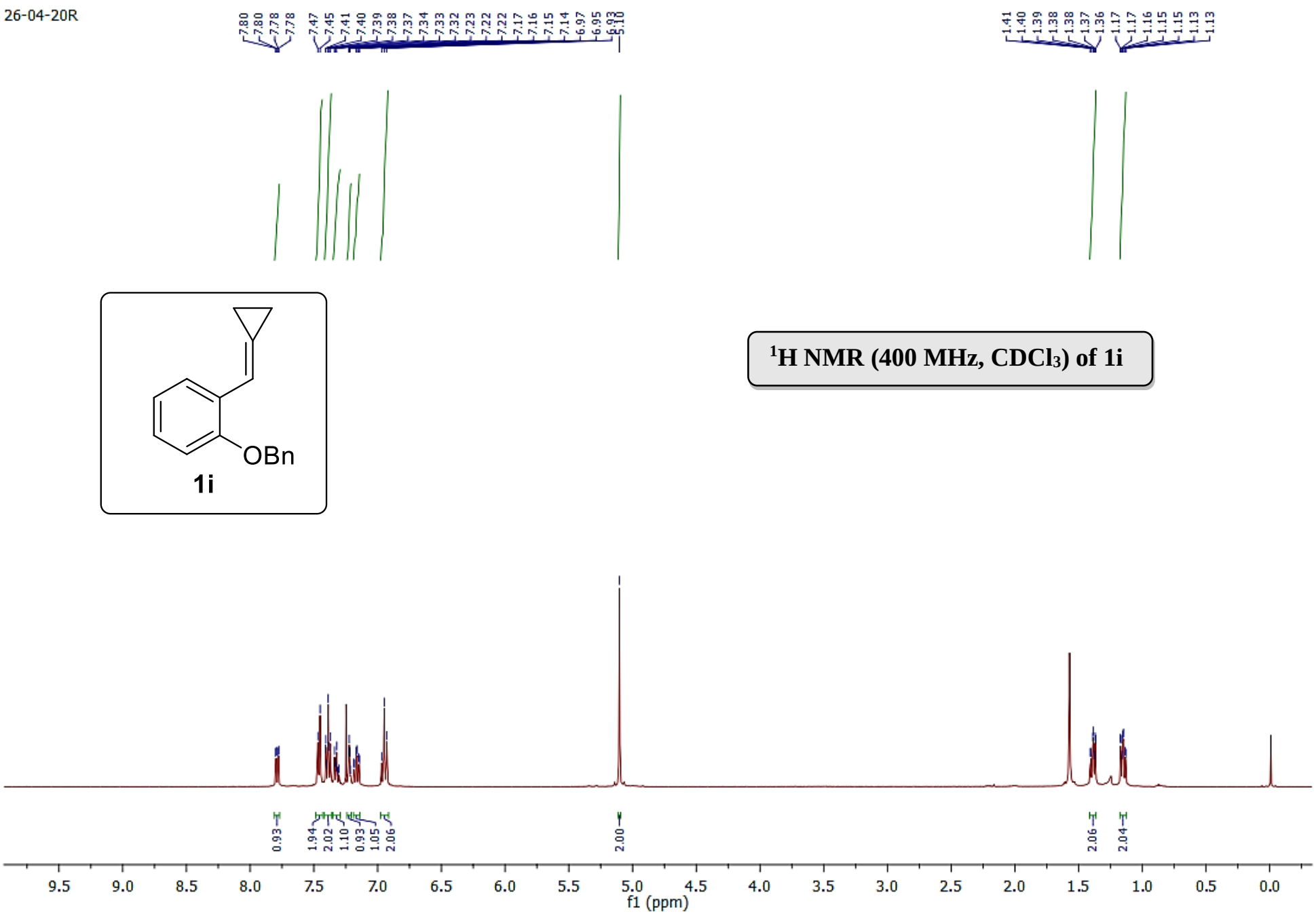
26-04-132



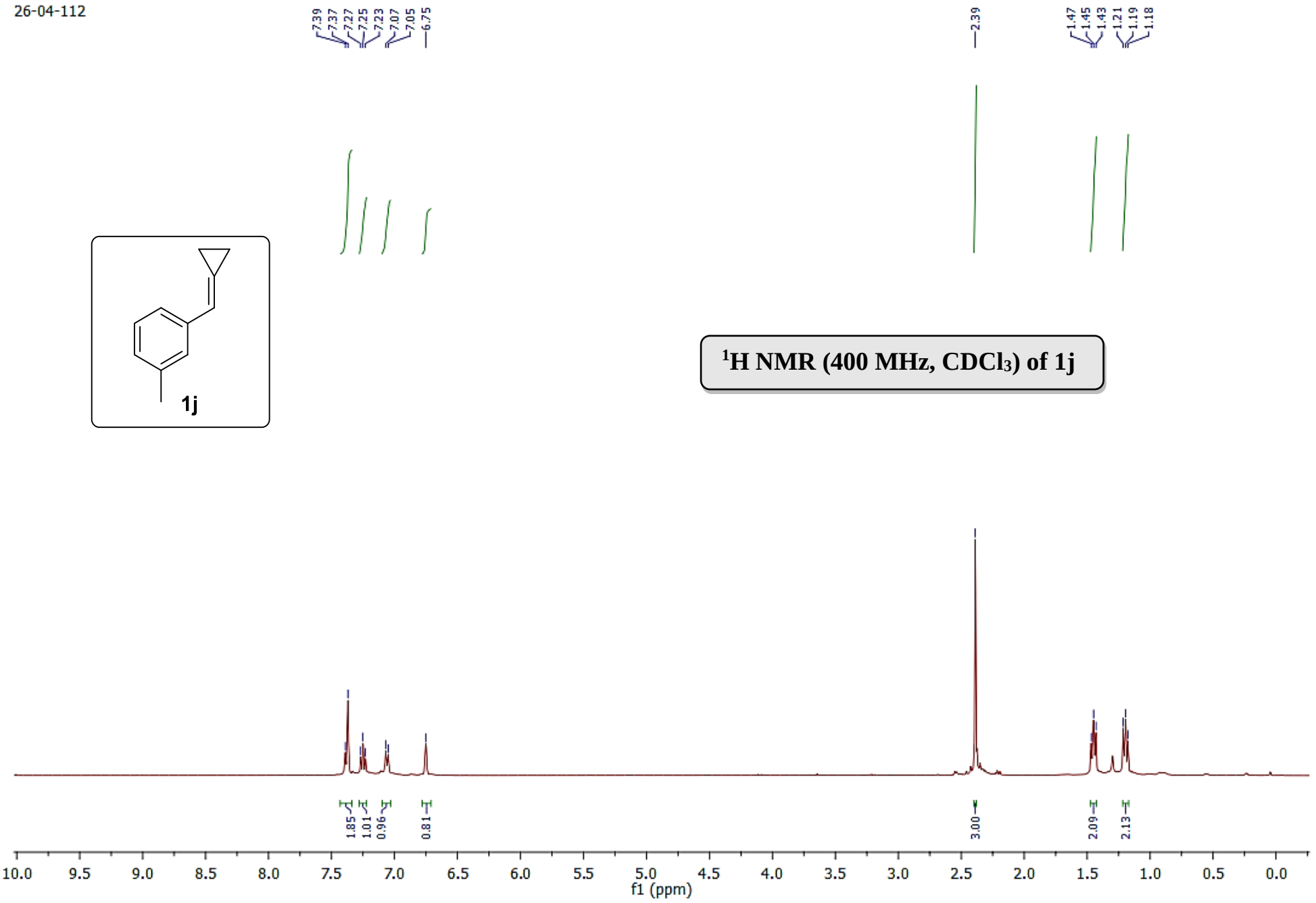
^{1}H NMR (400 MHz, $CDCl_3$) of 1g

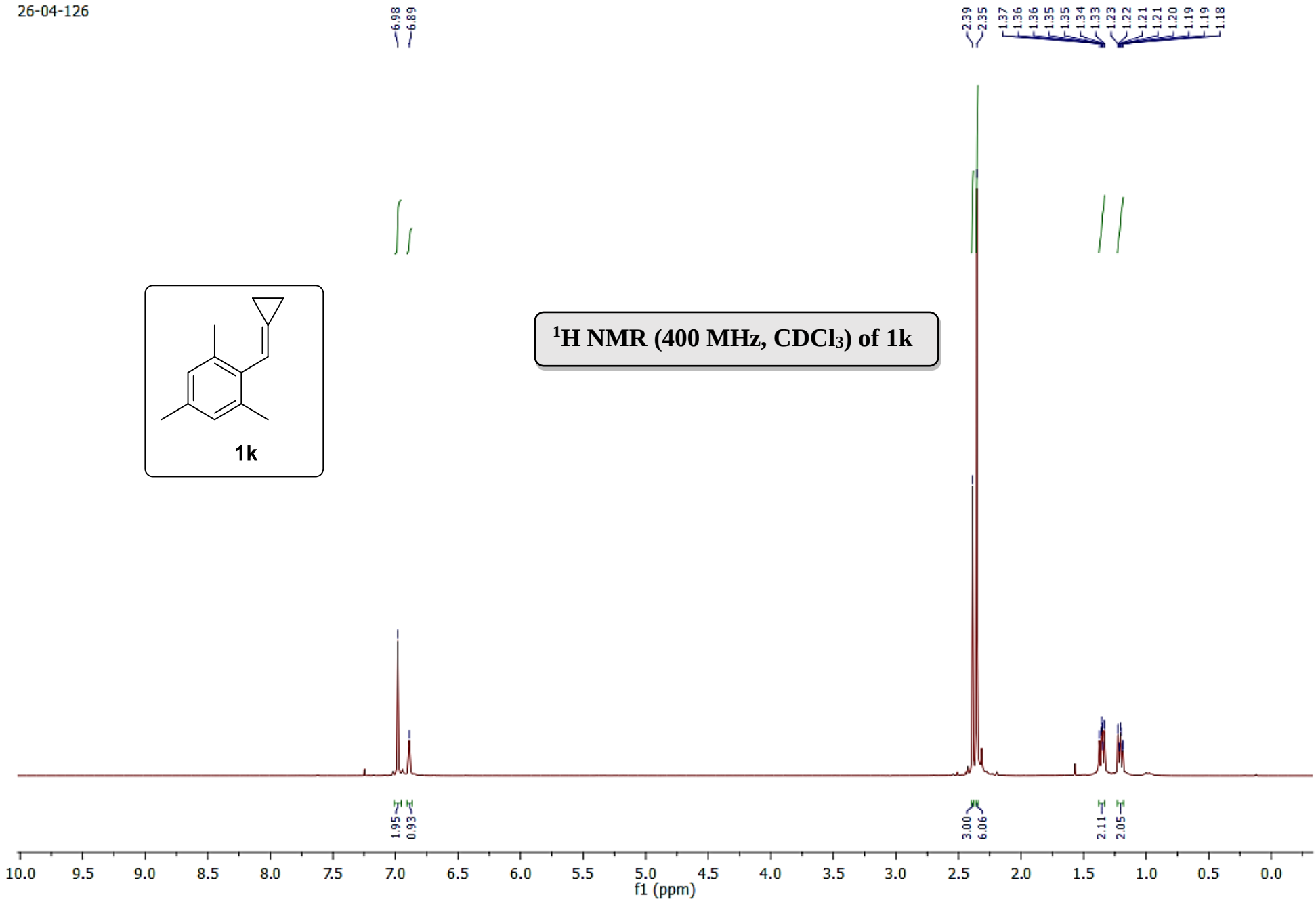


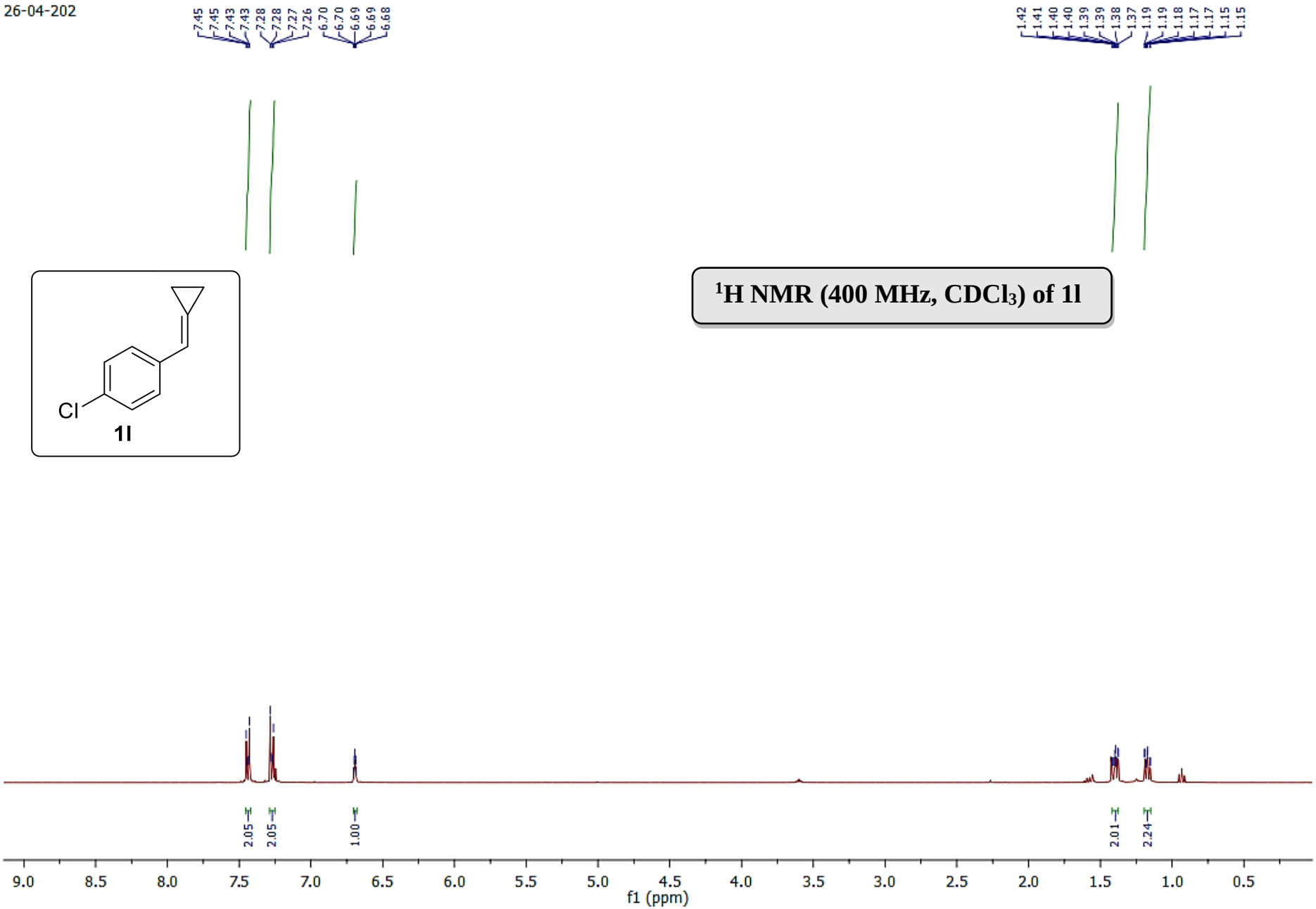
^{1}H NMR (400 MHz, $CDCl_3$) of 1h



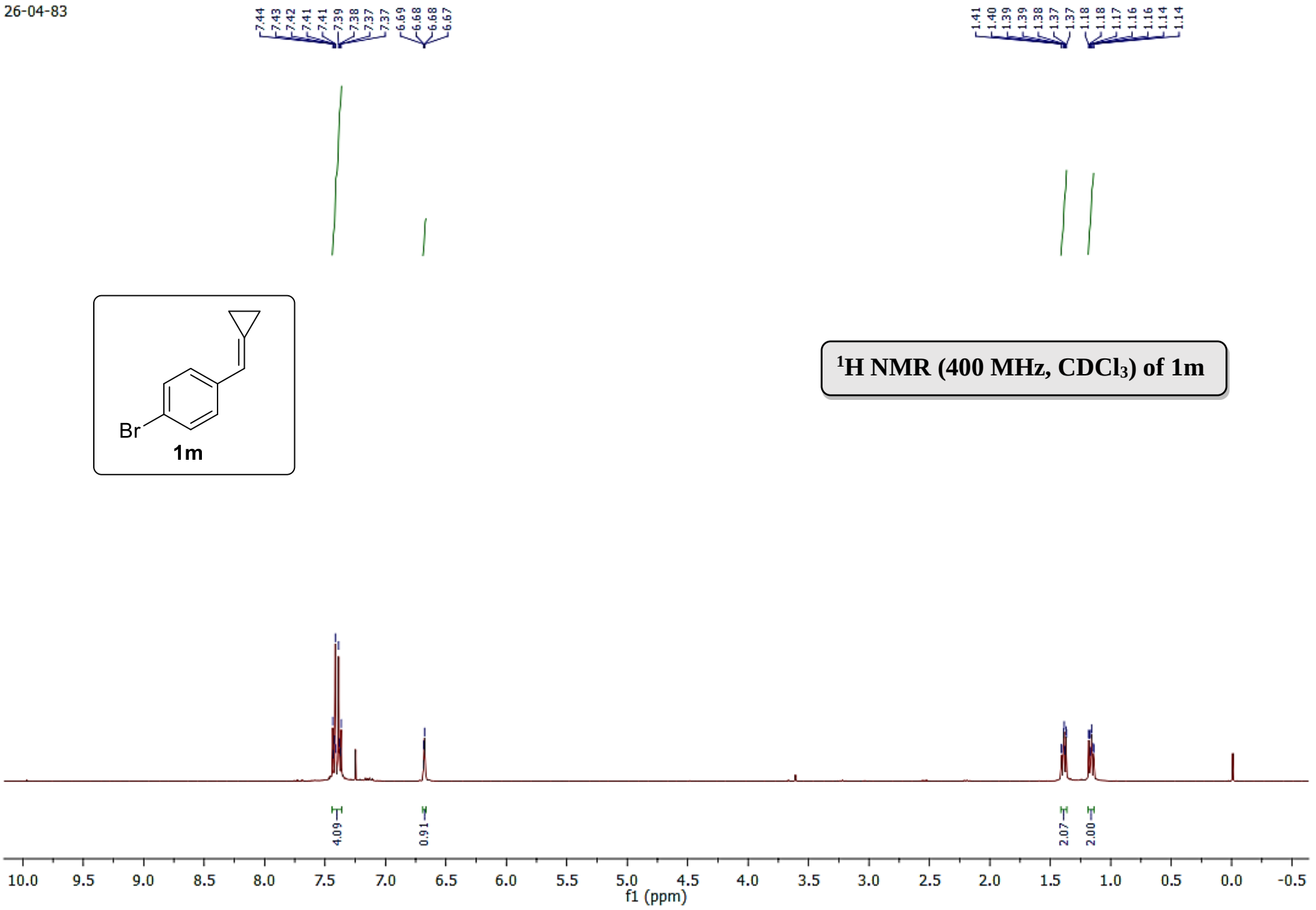
^{1}H NMR (400 MHz, $CDCl_3$) of 1i


26-04-112
7.39
7.37
7.27
7.25
7.23
7.07
7.05
6.75
2.39
1.47
1.45
1.43
1.21
1.19
1.18
1j
1H NMR (400 MHz, CDCl3) of 1j
1.85
1.01
0.96
0.81
3.00
2.09
2.13
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

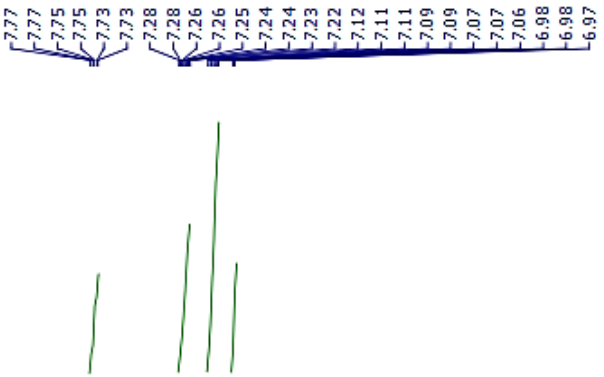

26-04-126
6.98
6.89
2.39
2.35
1.37
1.36
1.36
1.35
1.35
1.34
1.33
1.23
1.22
1.21
1.21
1.20
1.19
1.19
1.18
1k
1H NMR (400 MHz, CDCl3) of 1k
1.95
0.93
3.00
6.06
2.11
2.05
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

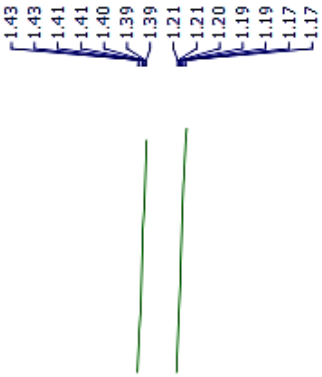


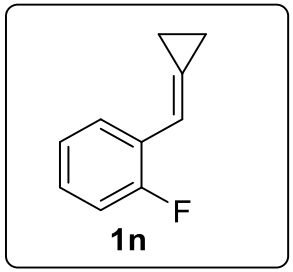
^{1}H NMR (400 MHz, $CDCl_3$) of 1l


26-04-83
7.44
7.43
7.42
7.41
7.41
7.39
7.38
7.37
7.37
6.69
6.68
6.68
6.67
1.41
1.40
1.39
1.39
1.38
1.37
1.37
1.18
1.18
1.17
1.16
1.16
1.14
1.14
Br
1m
^{1}H NMR (400 MHz, CDCl$_3$) of 1m
4.09
0.91
2.07
2.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

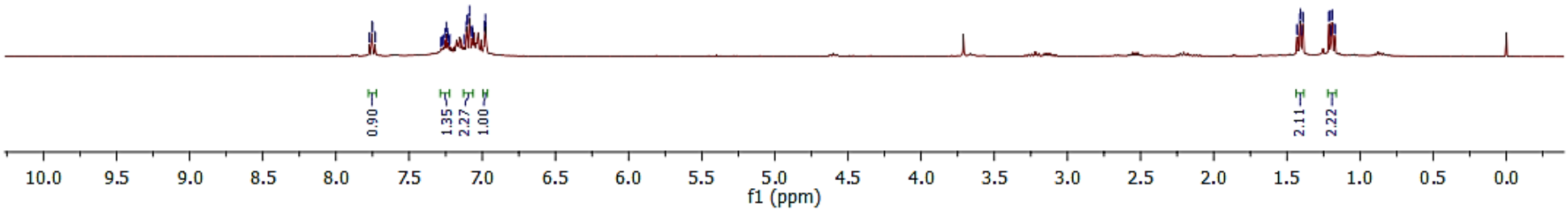
26-04-140

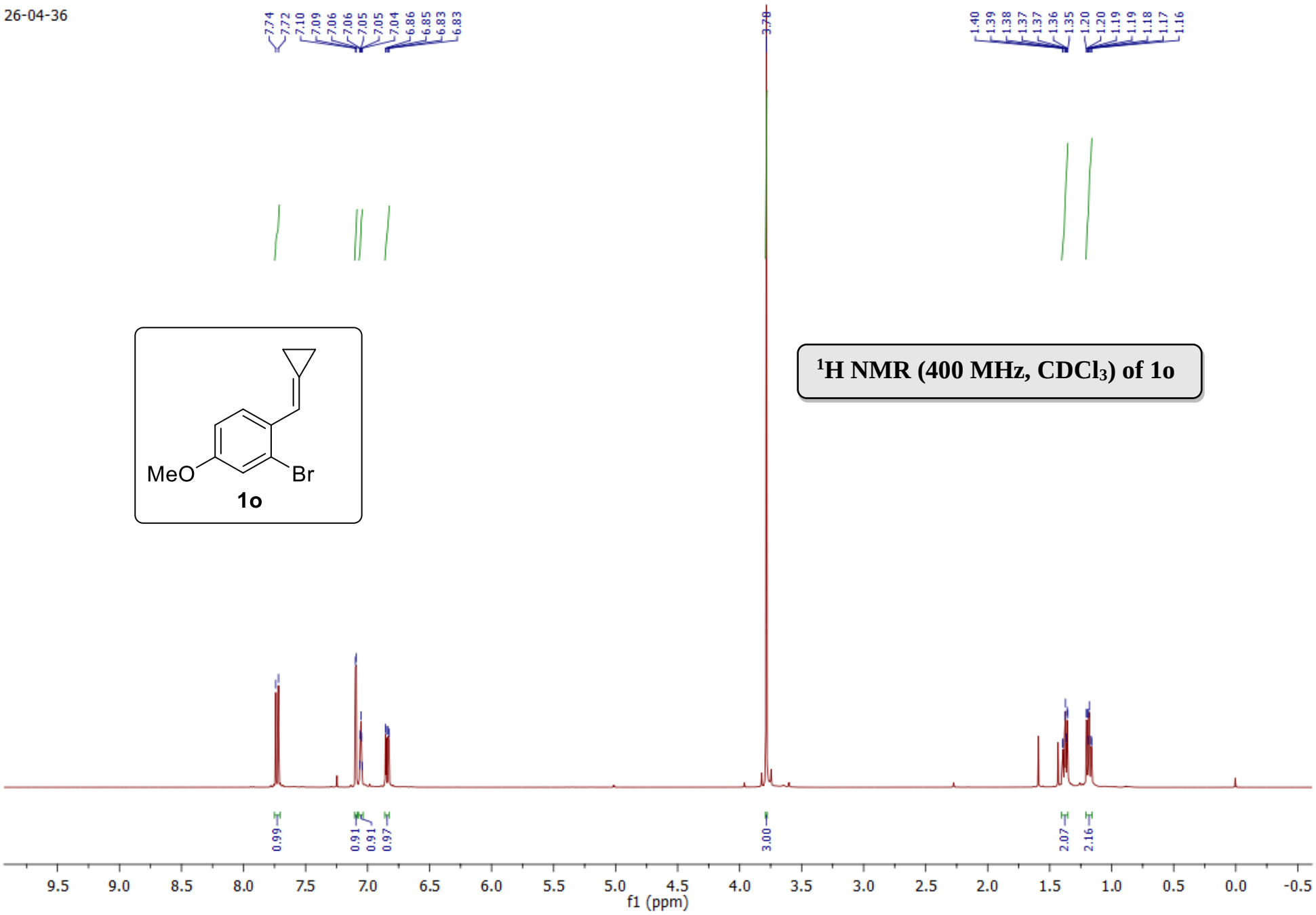




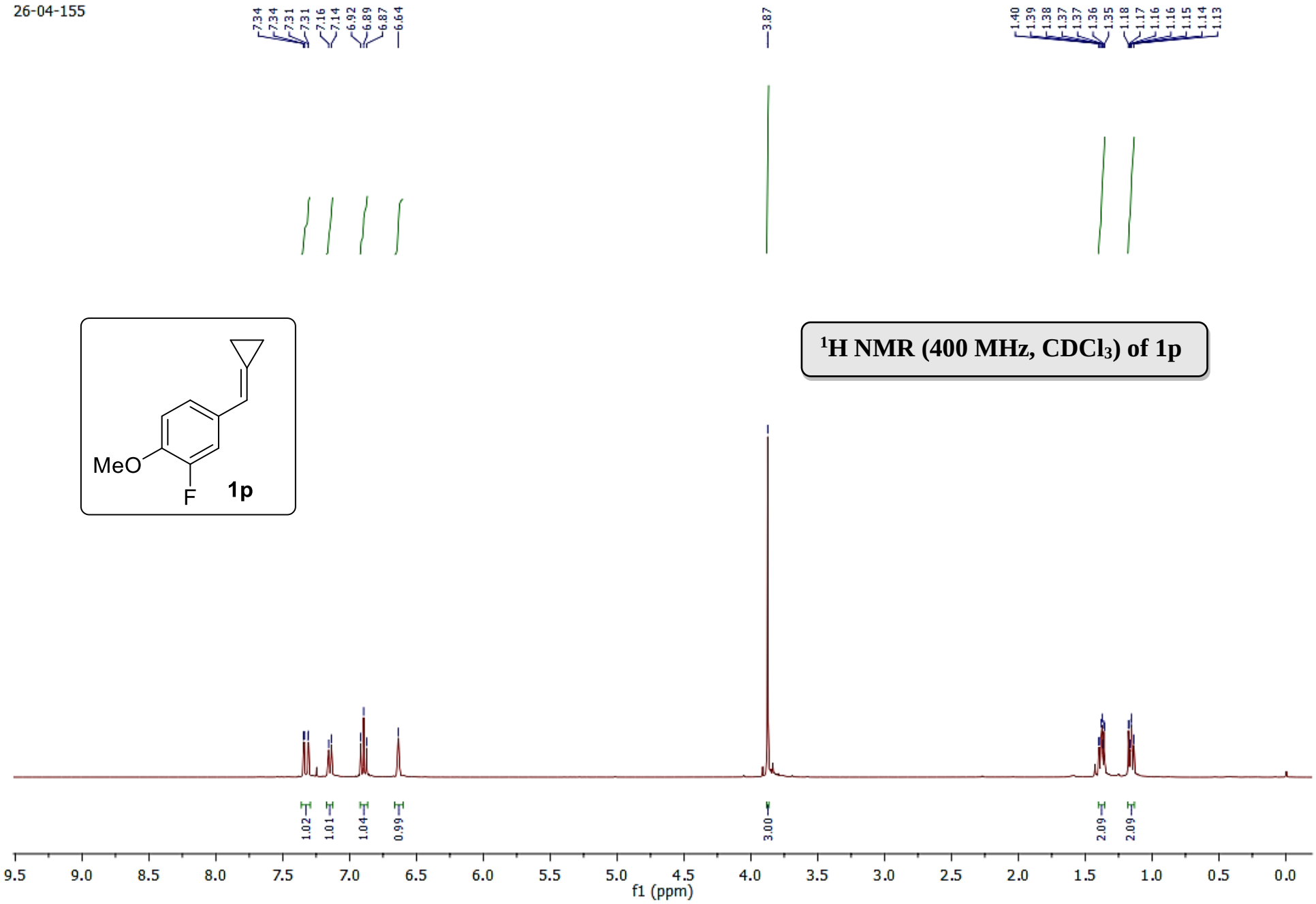


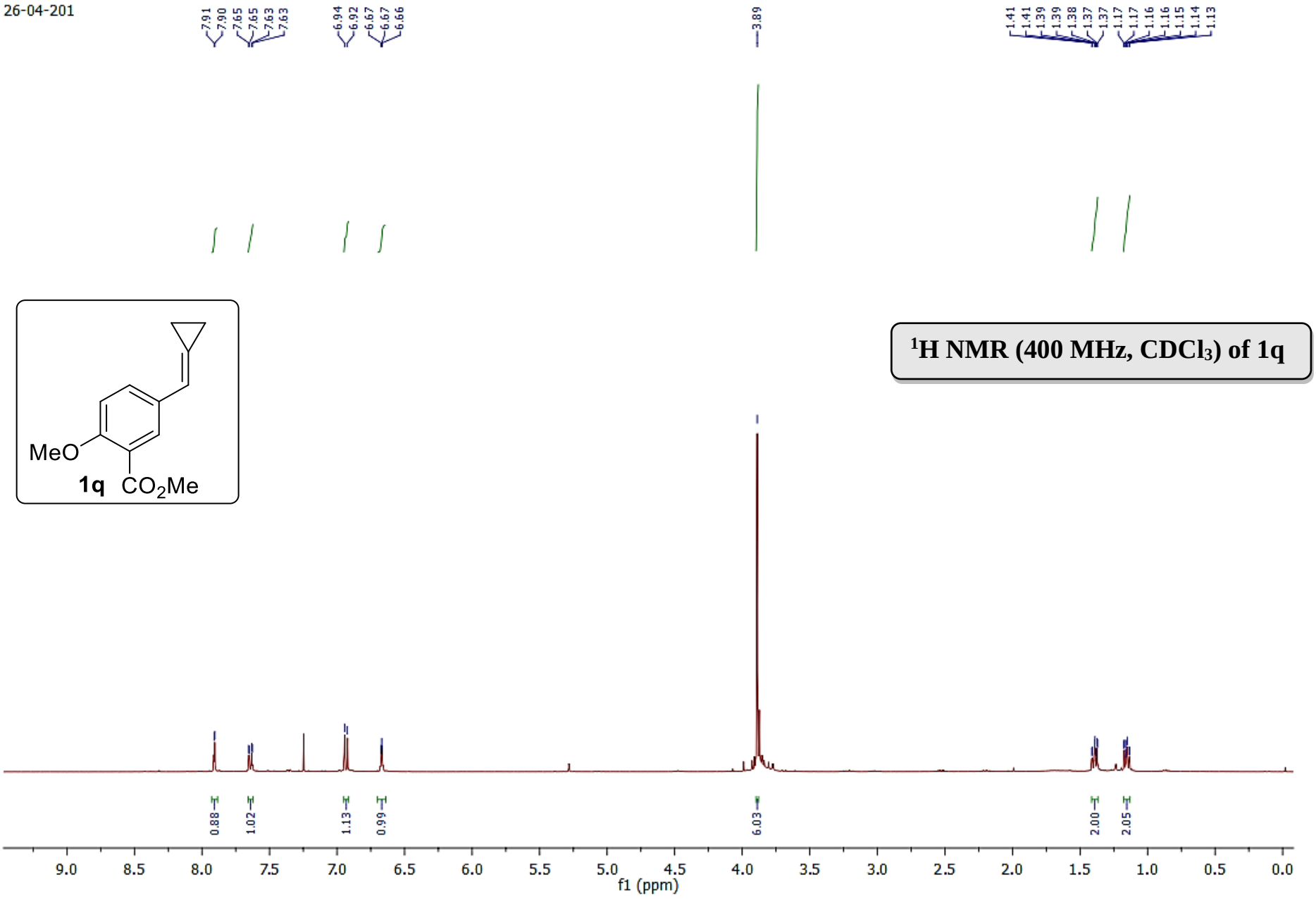
^{1}H NMR (400 MHz, $CDCl_3$) of 1n





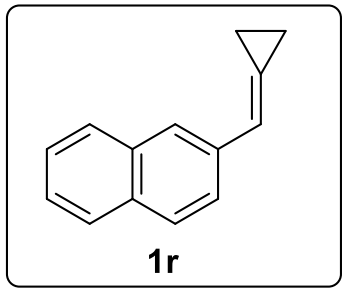
^{1}H NMR (400 MHz, $CDCl_3$) of 1o


26-04-155
7.34
7.34
7.31
7.31
7.16
7.14
6.92
6.89
6.87
6.64
3.87
1.40
1.39
1.38
1.37
1.37
1.36
1.35
1.18
1.17
1.16
1.16
1.15
1.14
1.13
MeO
F
1p
1H NMR (400 MHz, CDCl3) of 1p
1.02
1.01
1.04
0.99
3.00
2.09
2.09
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)



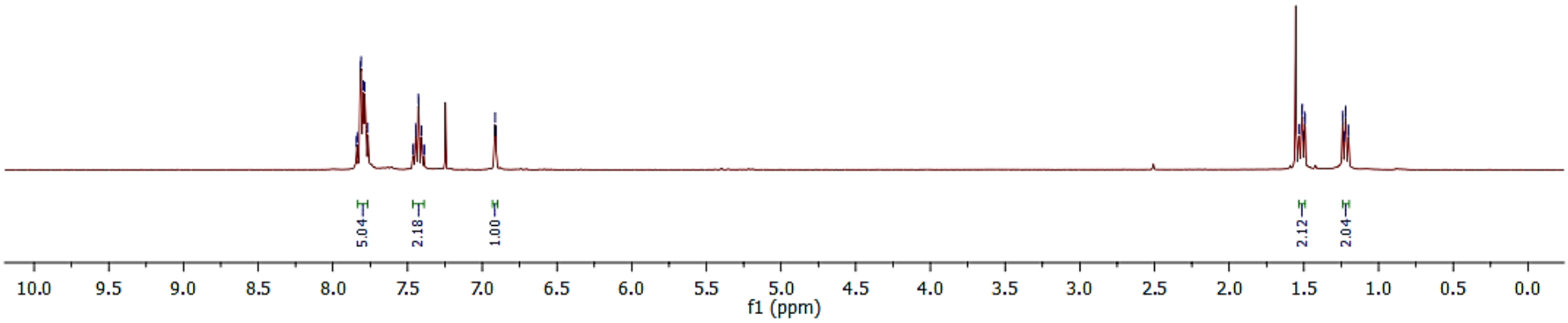
^{1}H NMR (400 MHz, $CDCl_3$) of 1q

26-04-52

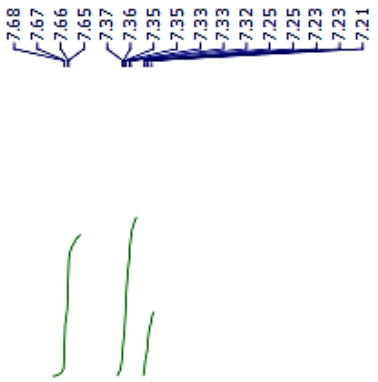


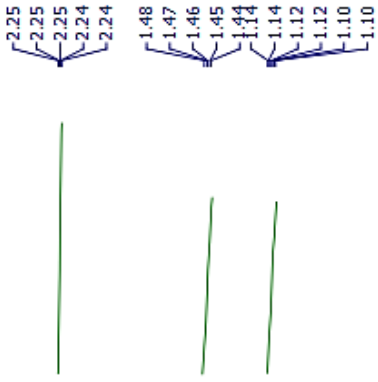
1r

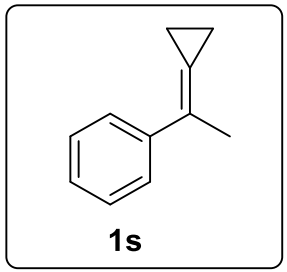
^{1}H NMR (400 MHz, $CDCl_3$) of 1r



26-04-135

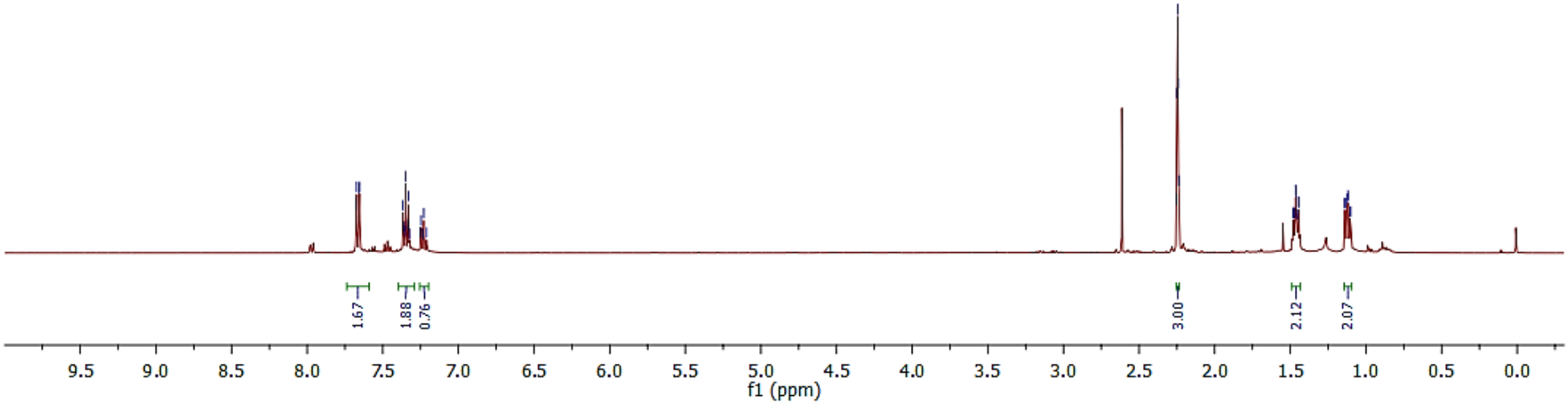




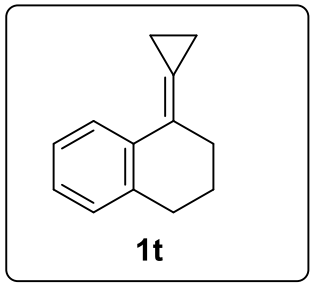


1s

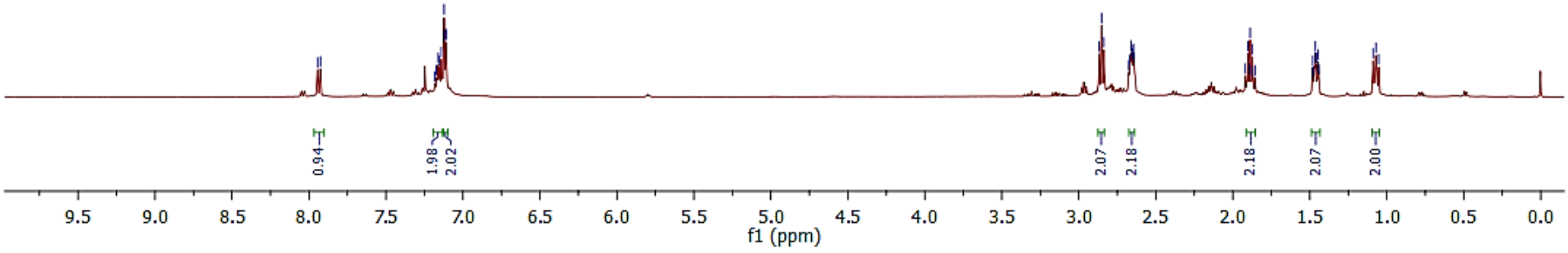
^{1}H NMR (400 MHz, $CDCl_3$) of 1s



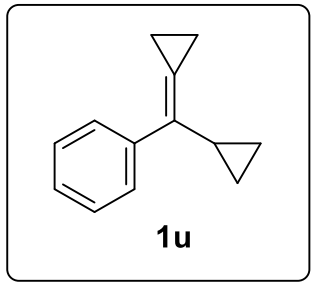
26-04-174



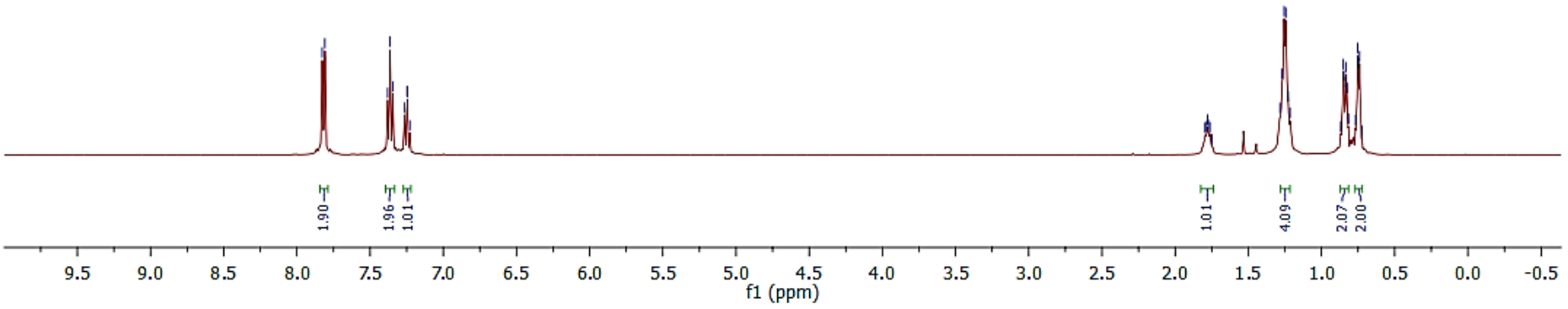
^{1}H NMR (400 MHz, $CDCl_3$) of 1t

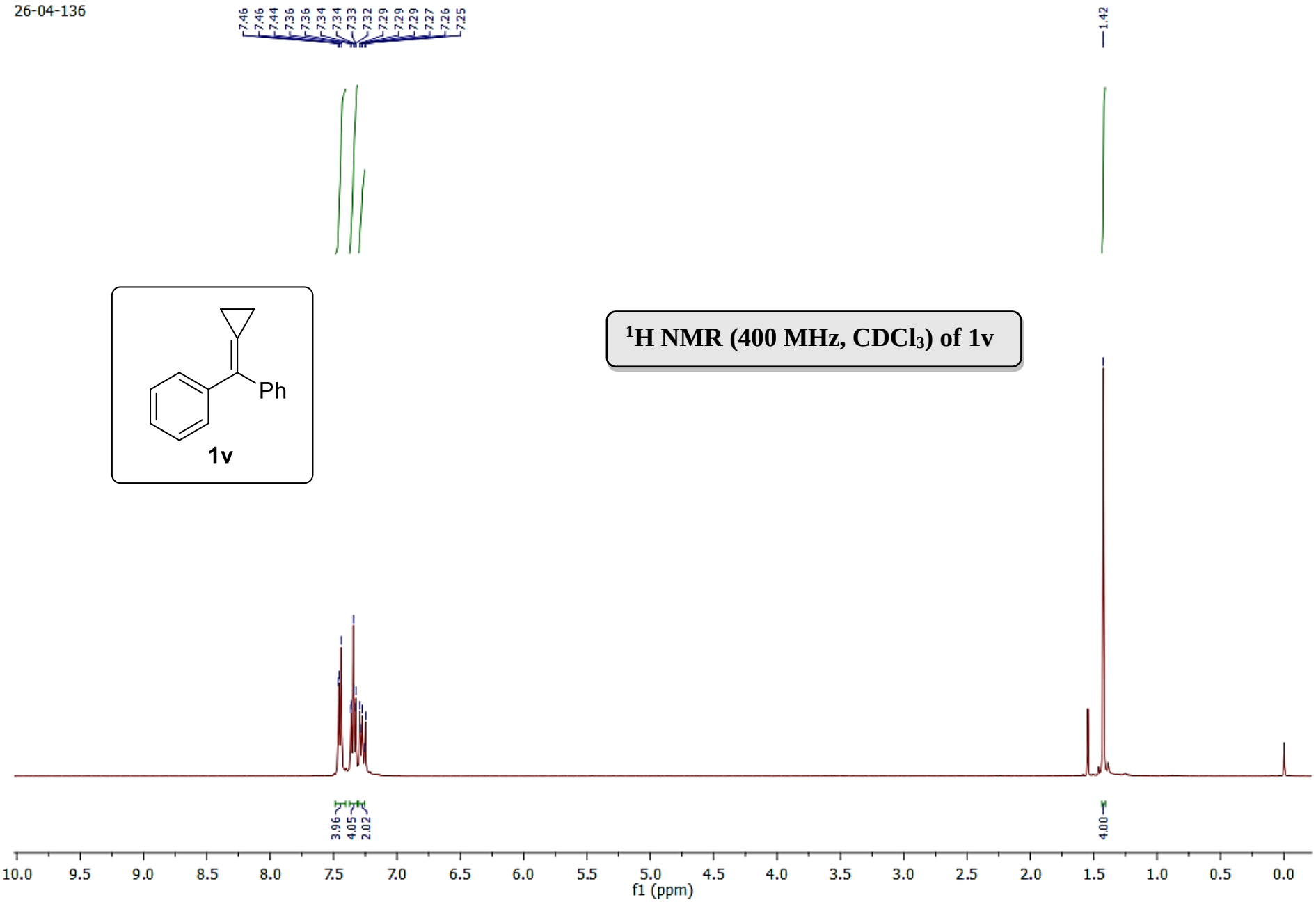


26-04-189



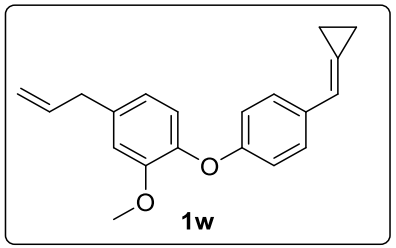
^{1}H NMR (400 MHz, $CDCl_3$) of 1u



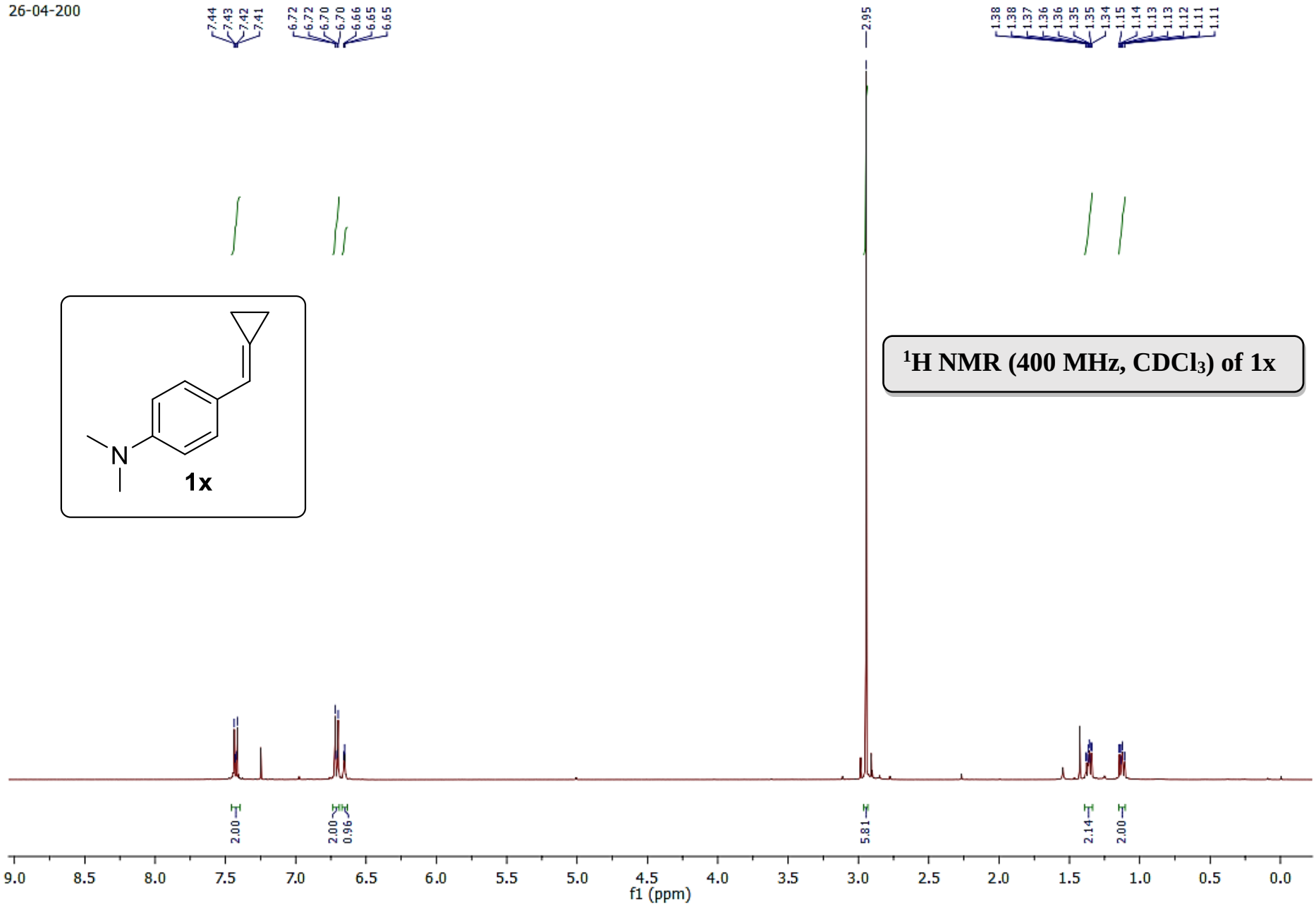


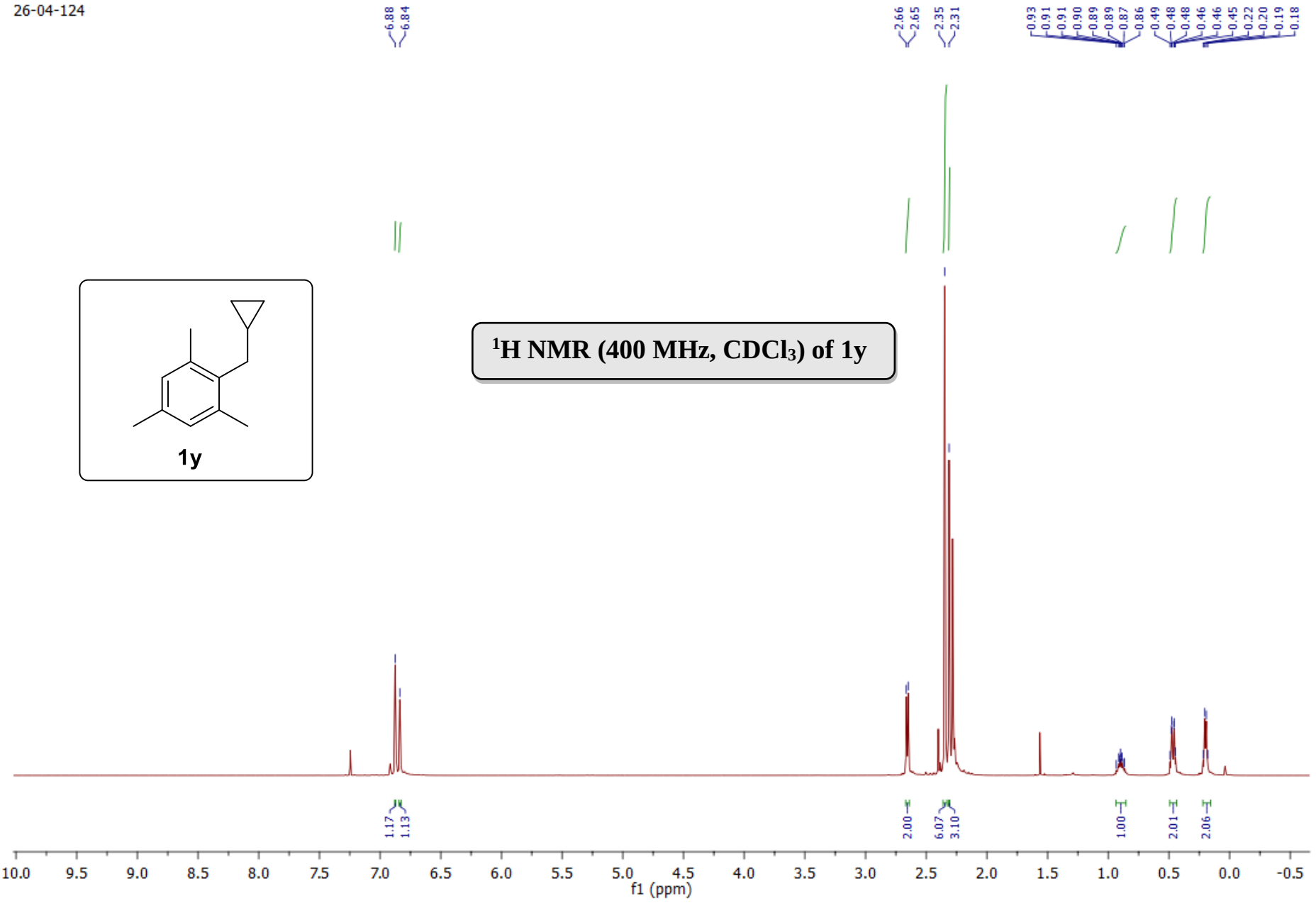
^{1}H NMR (400 MHz, $CDCl_3$) of 1v

26-04-127R

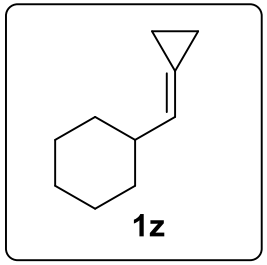


^{1}H NMR (400 MHz, $CDCl_3$) of 1w

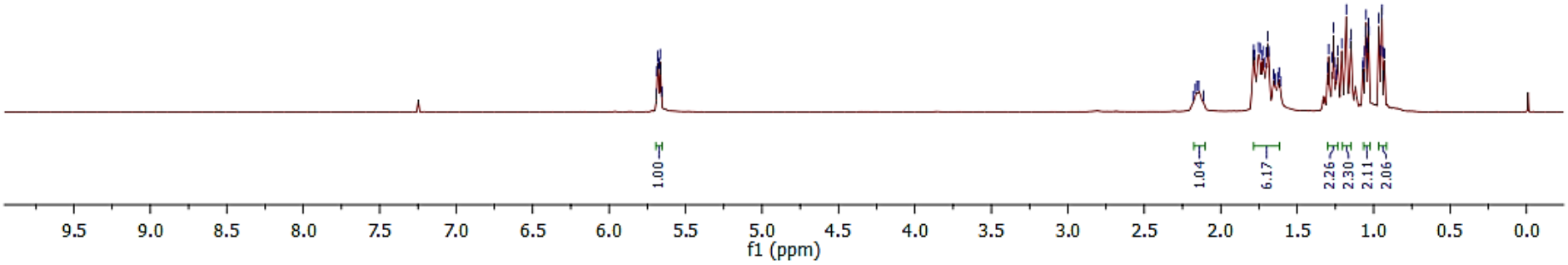

26-04-200
7.44
7.43
7.42
7.41
6.72
6.72
6.70
6.70
6.66
6.65
6.65
2.95
1.38
1.38
1.37
1.36
1.36
1.35
1.35
1.34
1.15
1.14
1.13
1.12
1.11
1.11
N
1x
[1]H NMR (400 MHz, CDCl3) of 1x
2.00
2.00
0.96
5.81
2.14
2.00
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


26-04-124
6.88
6.84
2.66
2.65
2.35
2.31
0.93
0.91
0.91
0.90
0.89
0.89
0.87
0.86
0.49
0.48
0.48
0.46
0.46
0.45
0.22
0.20
0.19
0.18
1y
^{1}H NMR (400 MHz, CDCl$_3$) of 1y
1.17
1.13
2.00
6.07
3.10
1.00
2.01
2.06
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

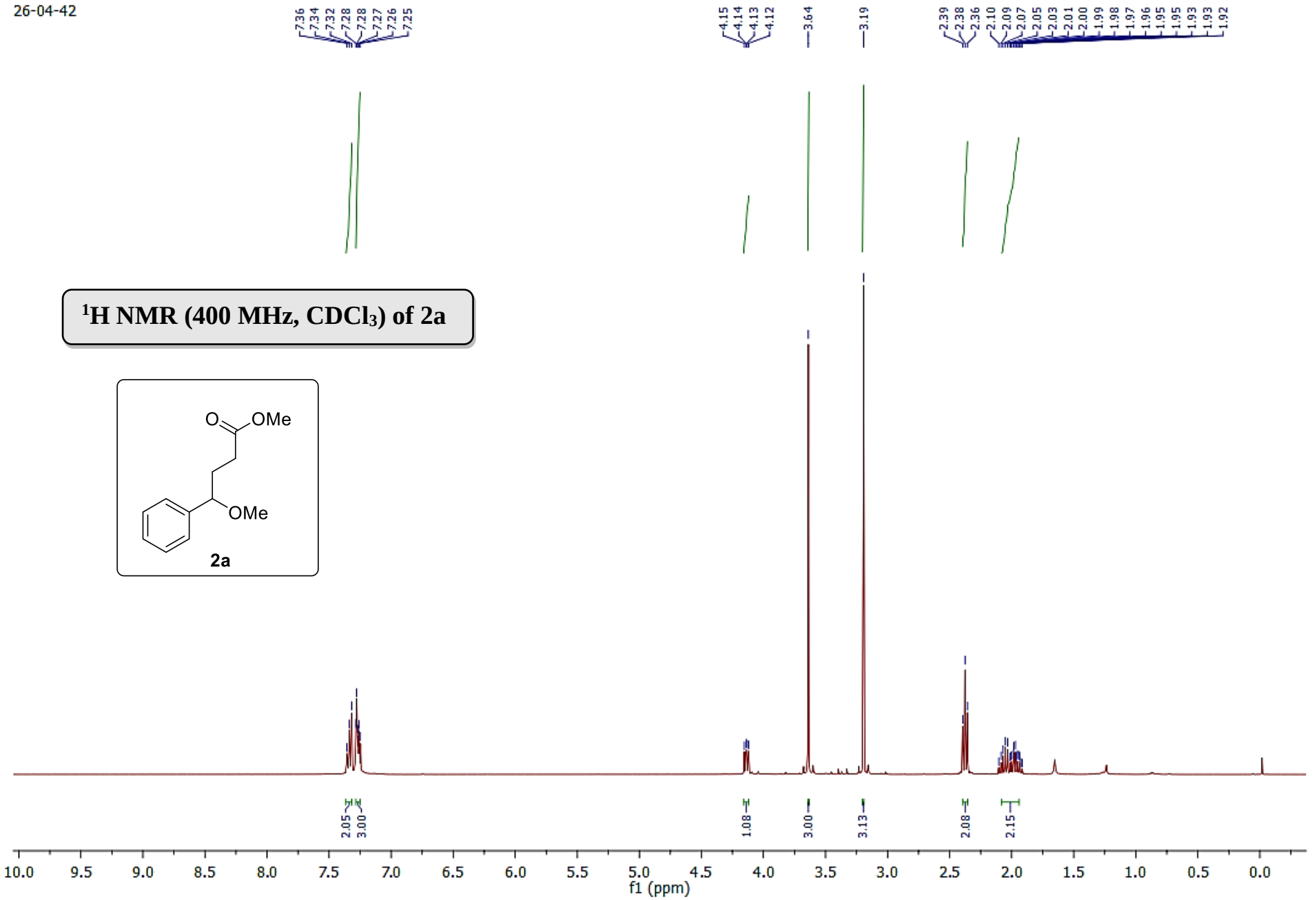
26-04-107

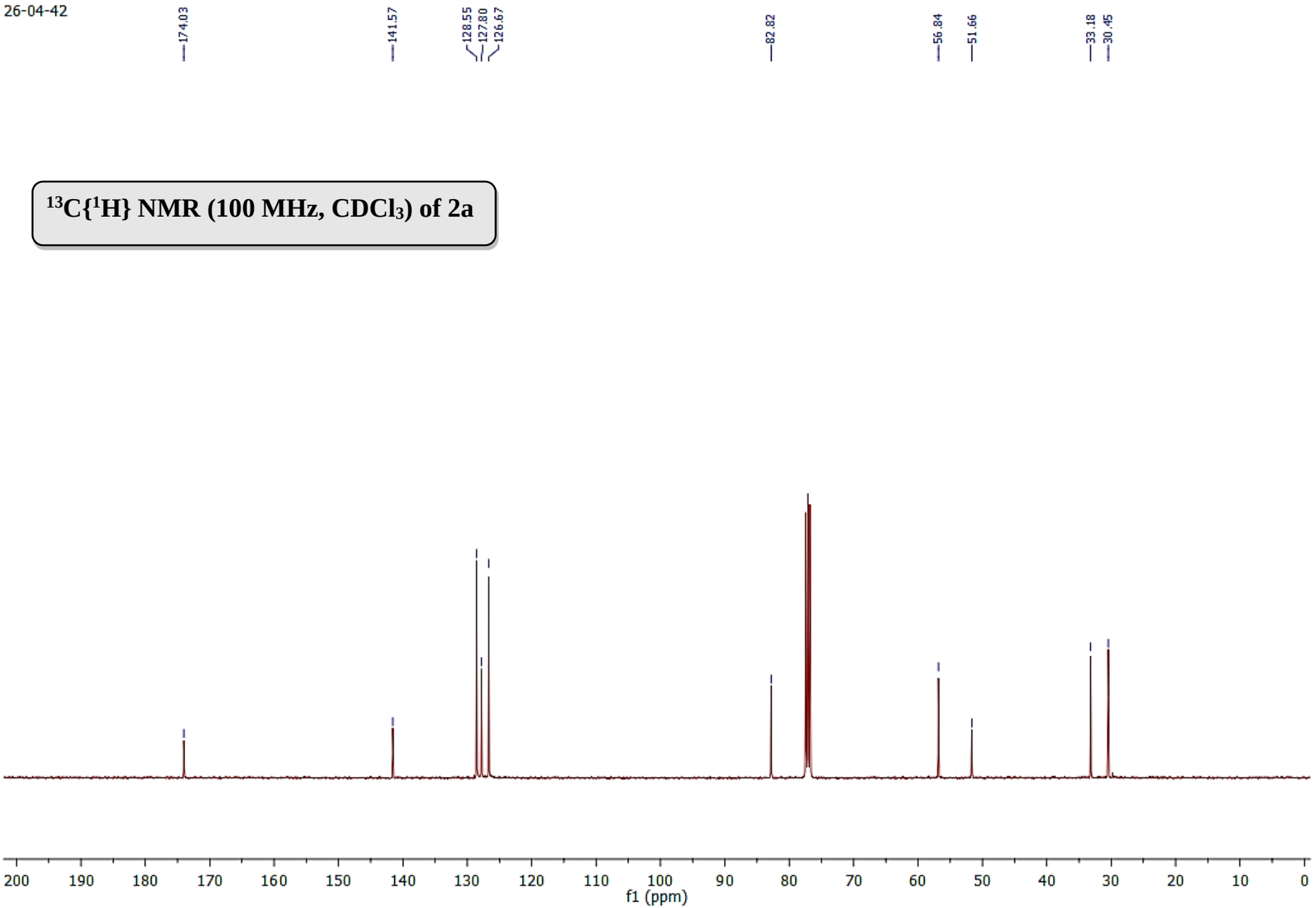


^{1}H NMR (400 MHz, $CDCl_3$) of 1z



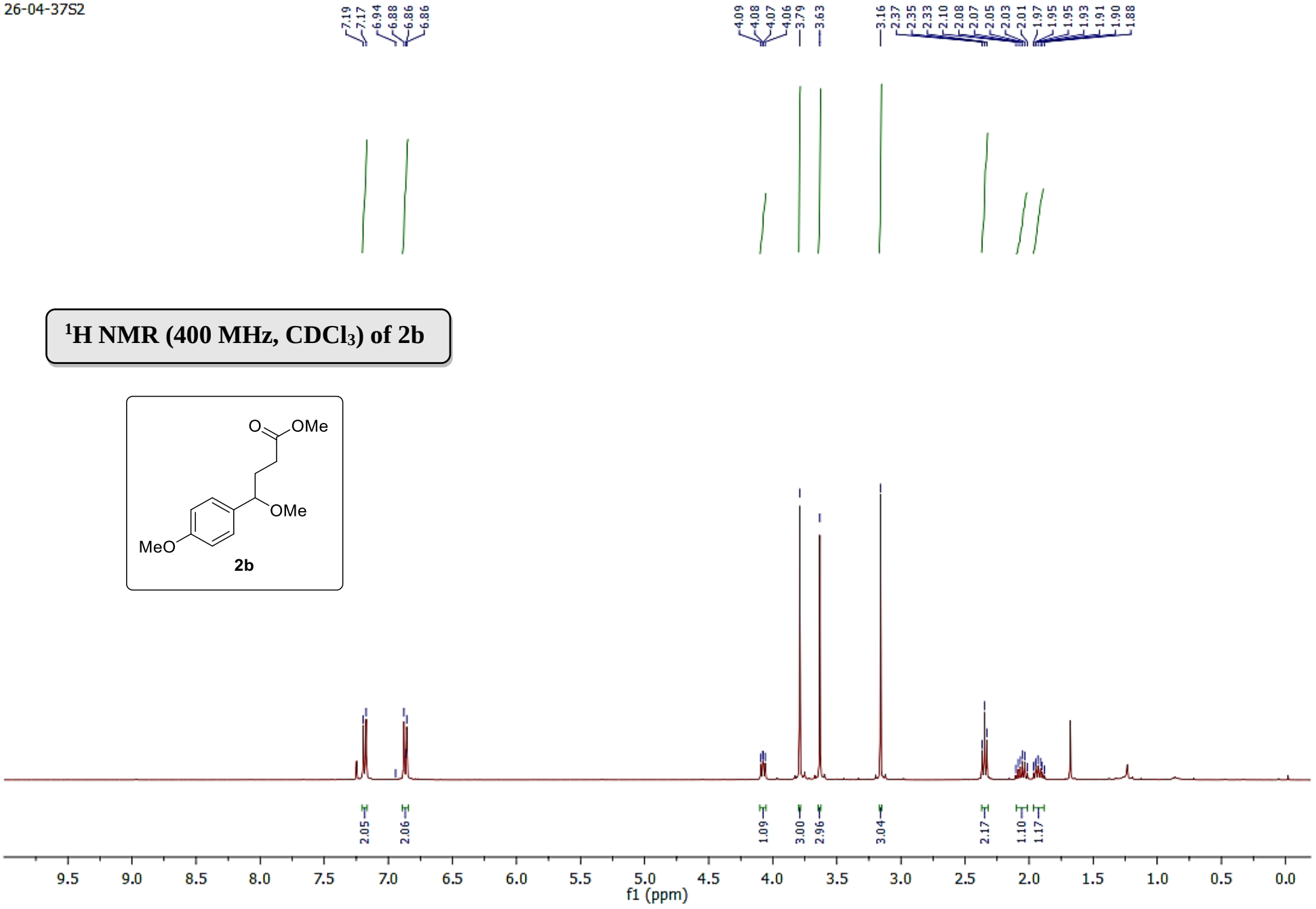
M.) Spectra of final compounds


26-04-42
7.36
7.34
7.32
7.28
7.28
7.27
7.26
7.25
4.15
4.14
4.13
4.12
3.64
3.19
2.39
2.38
2.36
2.10
2.09
2.07
2.05
2.03
2.01
2.00
1.99
1.98
1.97
1.96
1.95
1.95
1.93
1.93
1.92
^{1}H NMR (400 MHz, CDCl$_3$) of 2a
O
OMe
OMe
2a
2.05
3.00
1.08
3.00
3.13
2.08
2.15
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)



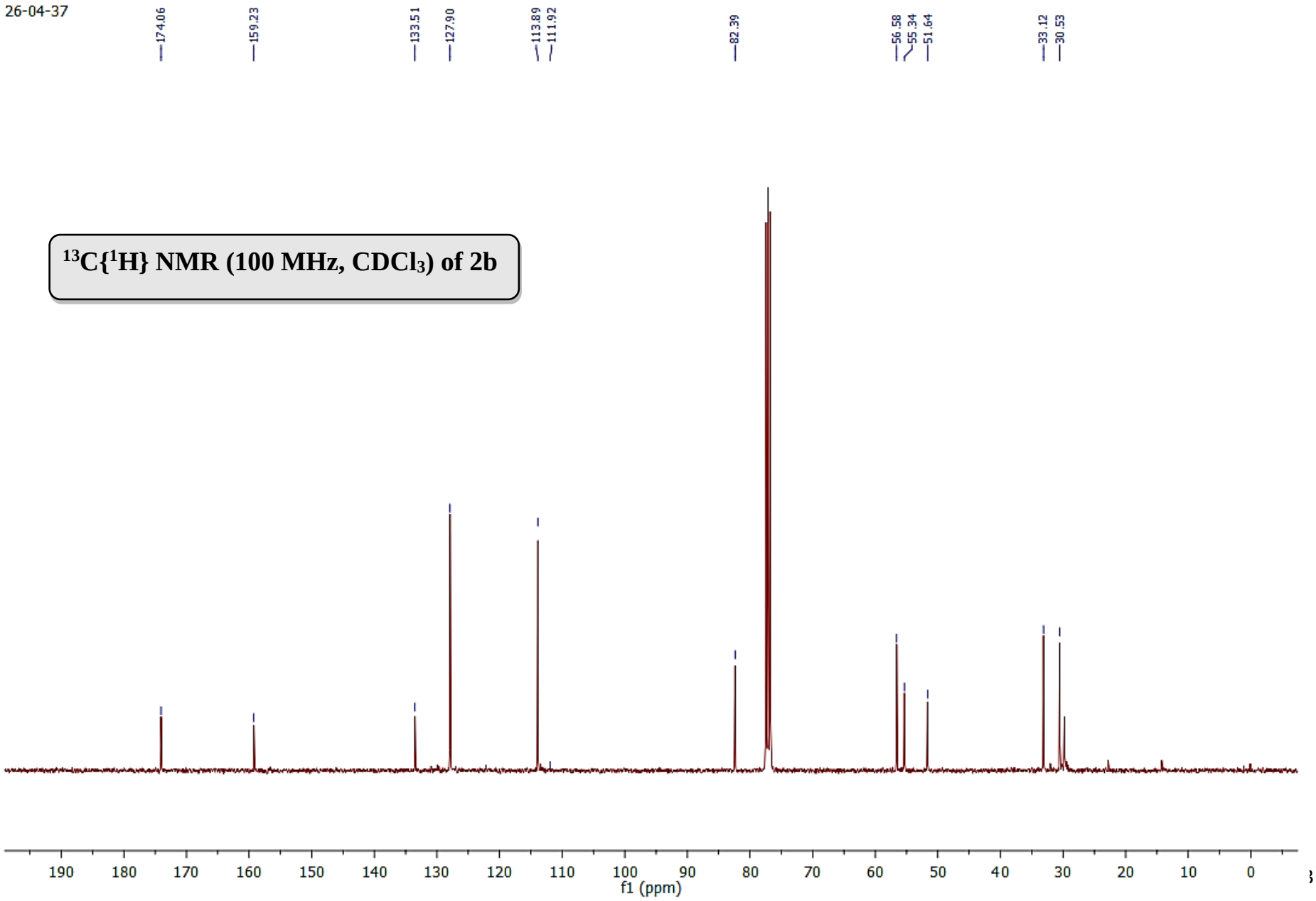
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2a

26-04-37S2



^{1}H NMR (400 MHz, $CDCl_3$) of 2b

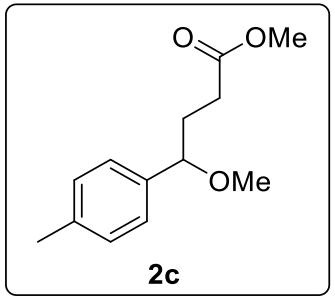
2b



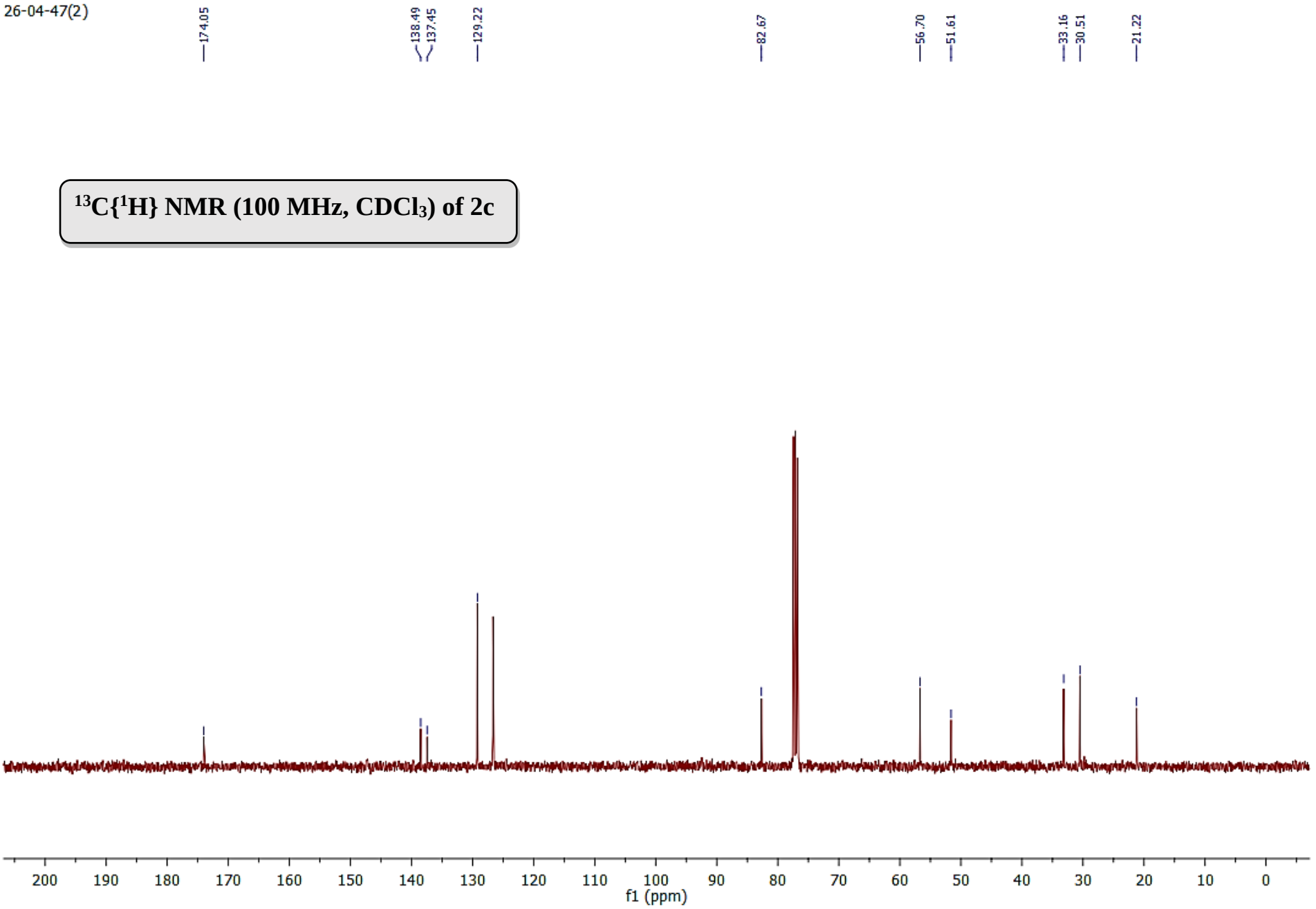
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2b

26-04-47(I)

^{1}H NMR (400 MHz, $CDCl_3$) of 2c

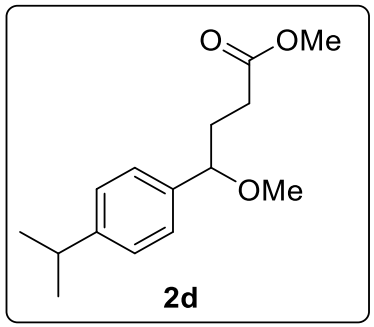


2c

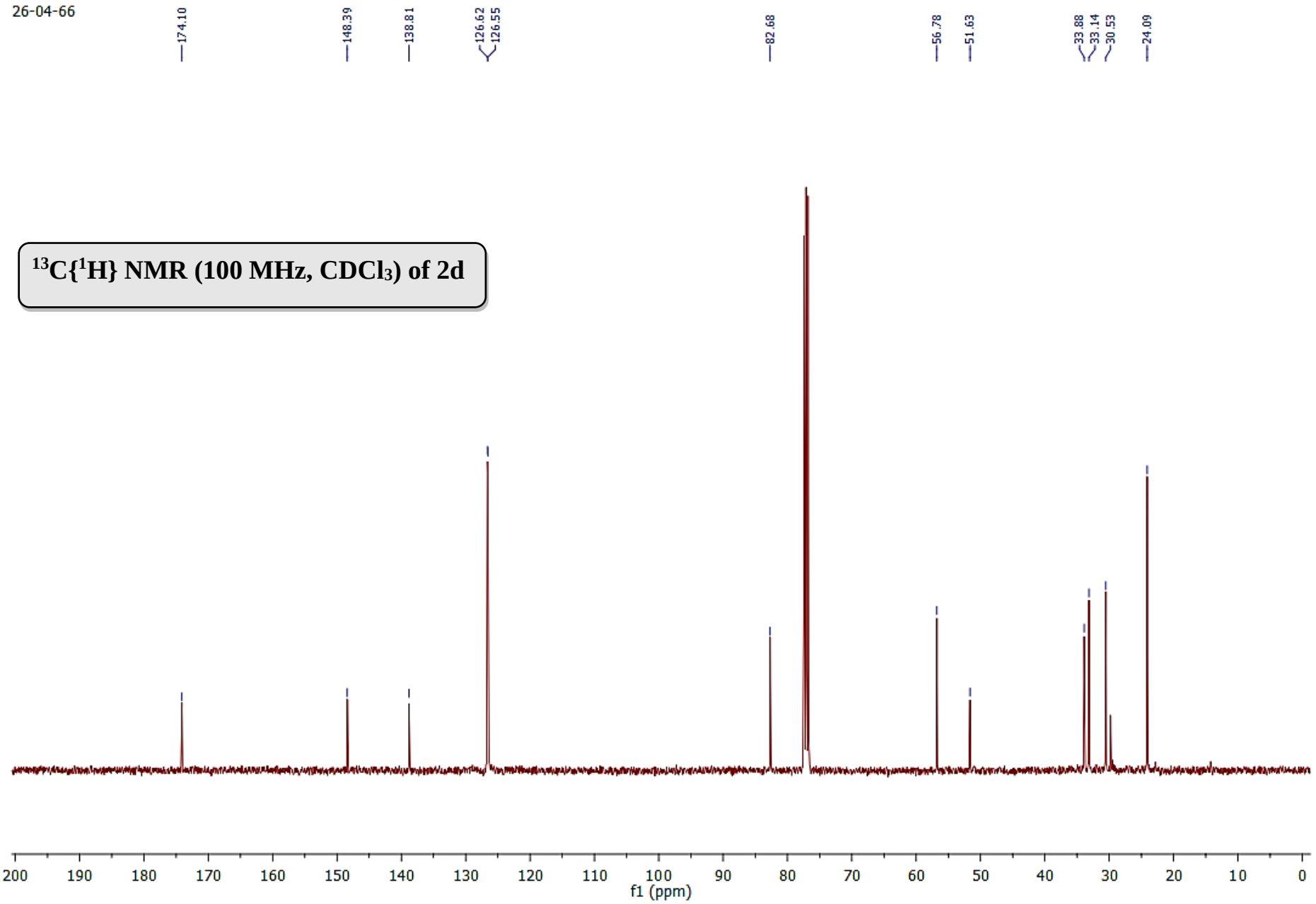


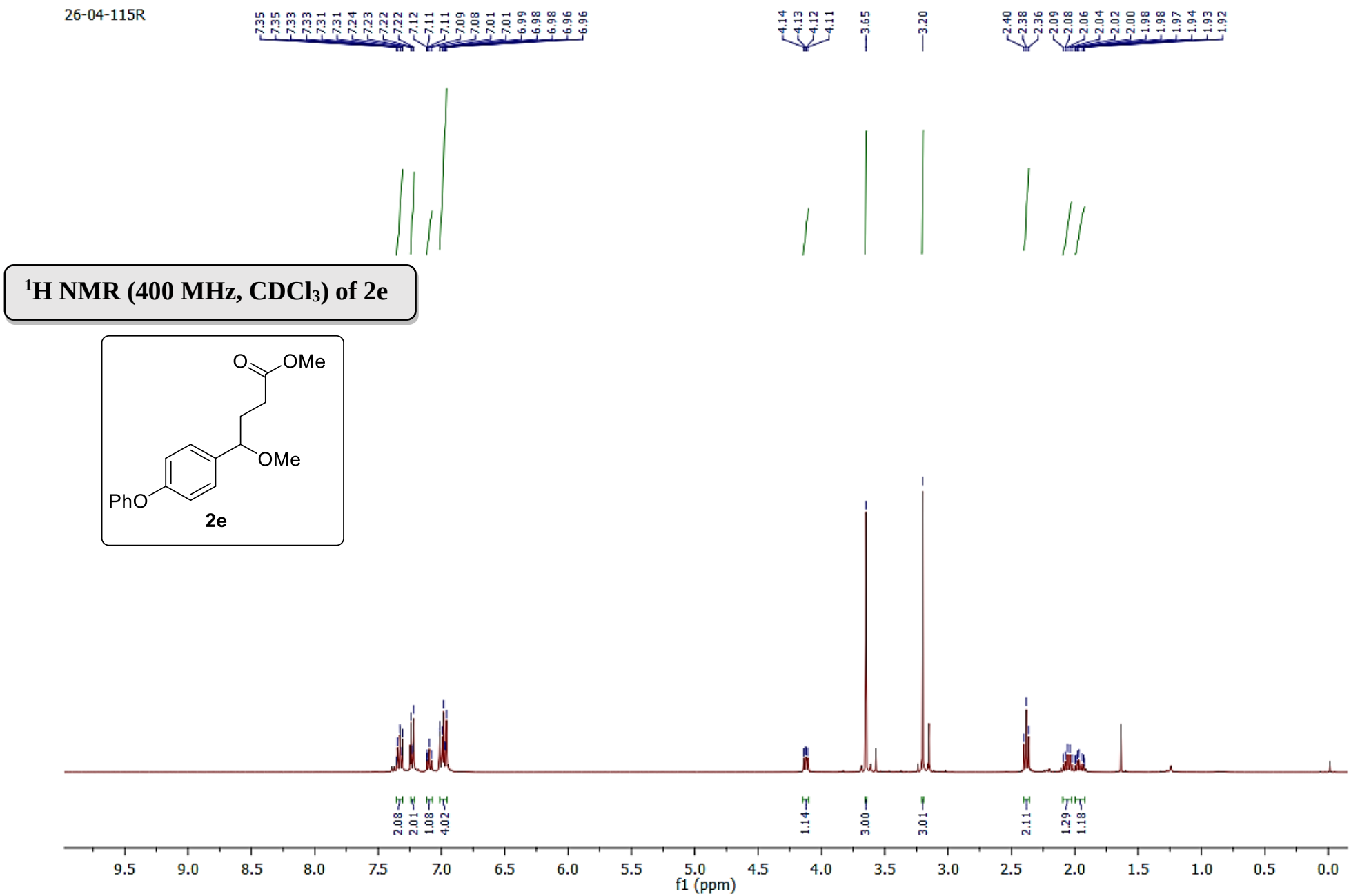
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2c

^{1}H NMR (400 MHz, $CDCl_3$) of 2d



2d

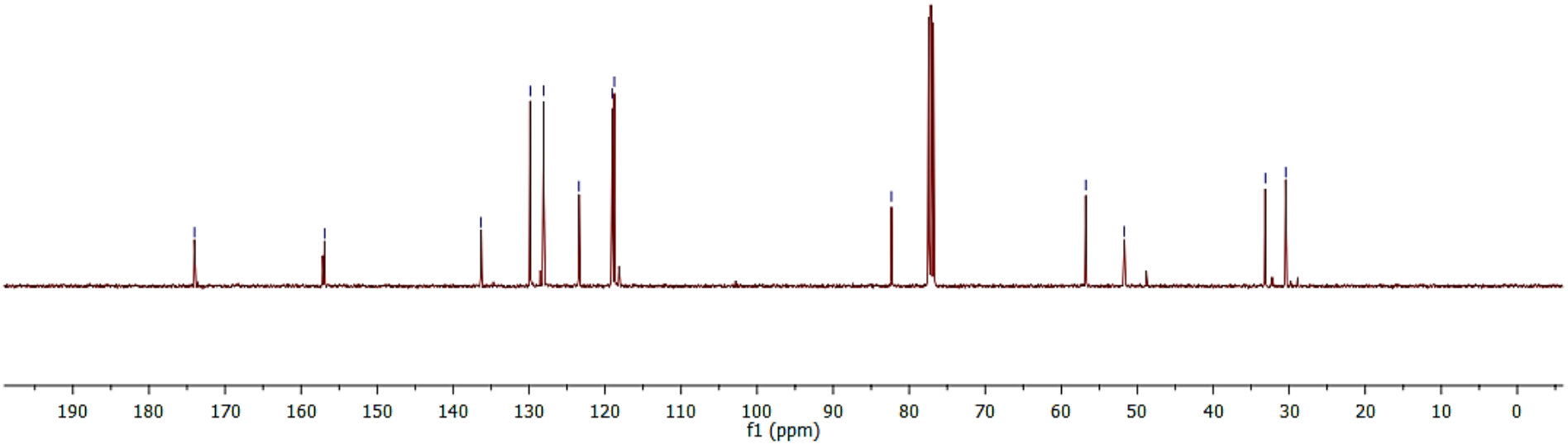

26-04-66
174.10
148.39
138.81
126.62
126.55
82.68
56.78
51.63
33.88
33.14
30.53
24.09
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2d
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

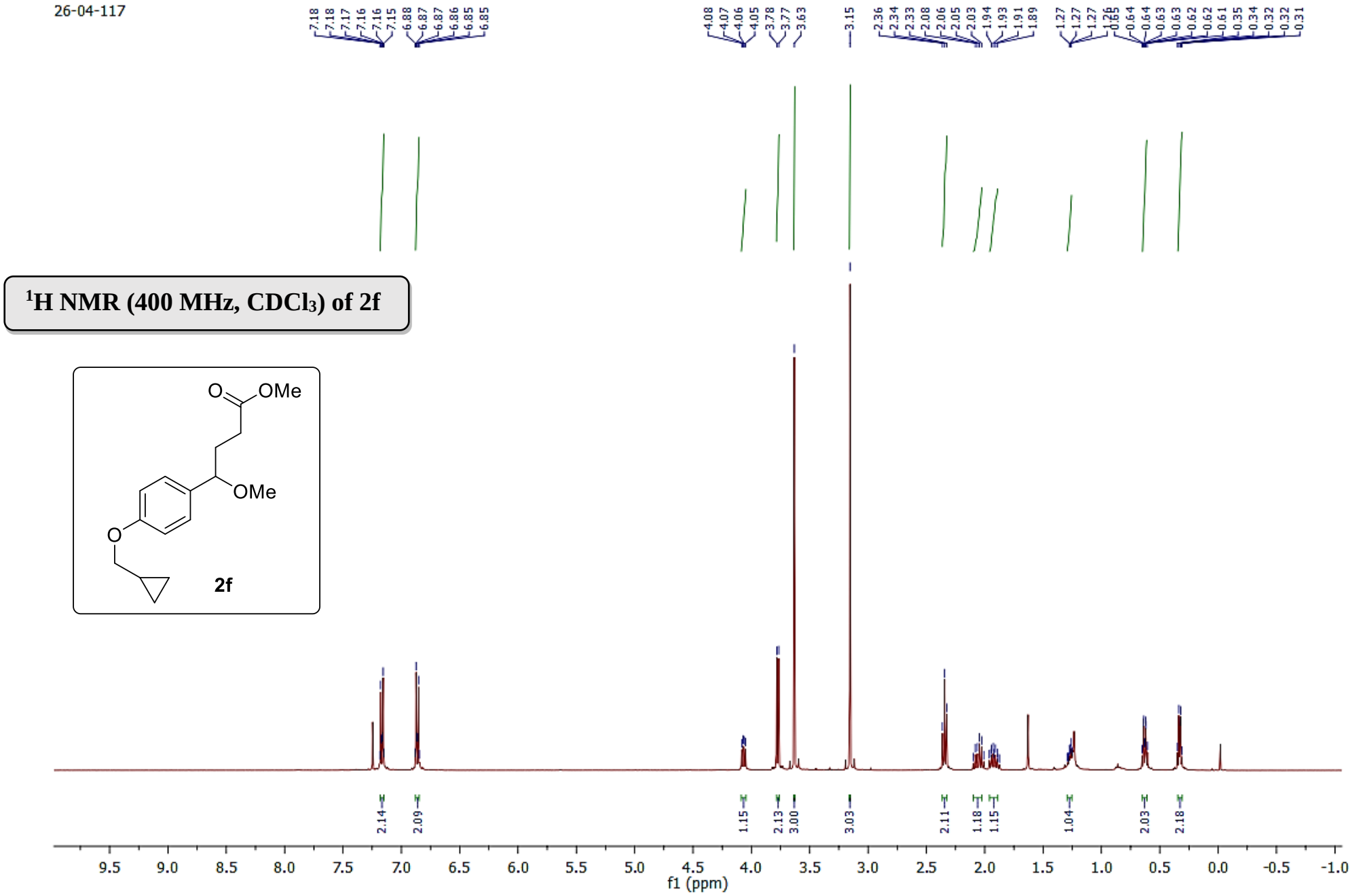

26-04-115R
7.35 7.35 7.33 7.33 7.31 7.31 7.24 7.23 7.22 7.22 7.12 7.11 7.11 7.09 7.08 7.01 7.01 6.99 6.98 6.98 6.96 6.96
4.14 4.13 4.12 4.11
3.65
3.20
2.40 2.38 2.36 2.09 2.08 2.06 2.04 2.02 2.00 1.98 1.98 1.97 1.94 1.93 1.92
^{1}H NMR (400 MHz, CDCl$_3$) of 2e
O
OMe
OMe
PhO
2e
2.08 2.01 1.08 4.02 1.14 3.00 3.01 2.11 1.29 1.18
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

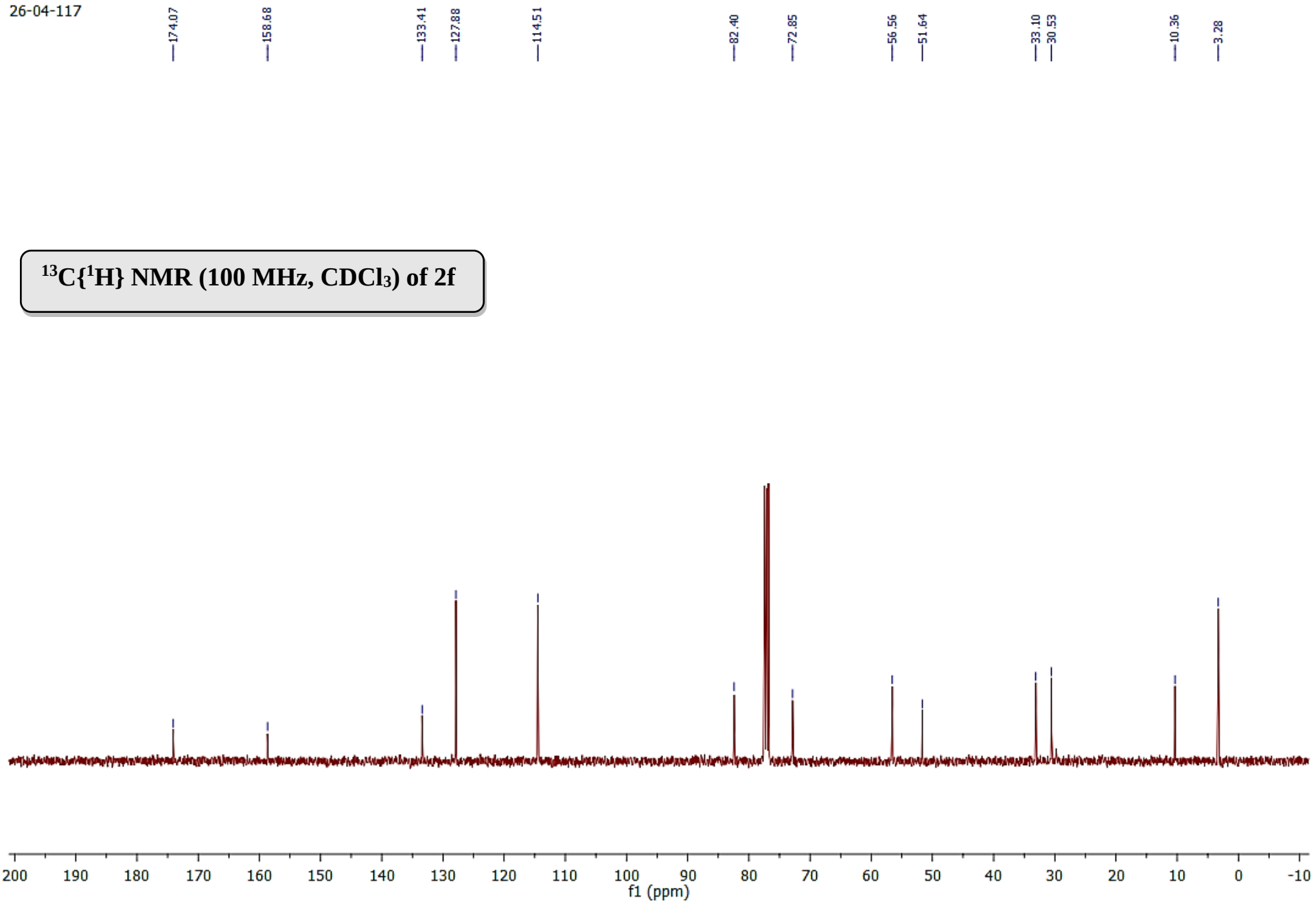
26-04-115R

174.02
156.91
136.30
129.86
128.07
123.42
119.05
118.78
82.33
56.77
51.69
33.15
30.47

$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2e



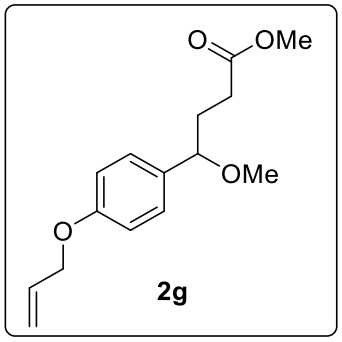

26-04-117
7.18
7.18
7.17
7.16
7.16
7.15
6.88
6.87
6.87
6.86
6.85
6.85
4.08
4.07
4.06
4.05
3.78
3.77
3.63
3.15
2.36
2.34
2.33
2.08
2.06
2.05
2.03
1.94
1.93
1.91
1.89
1.27
1.27
1.27
1.26
0.64
0.64
0.63
0.63
0.62
0.62
0.61
0.35
0.34
0.32
0.31
1H NMR (400 MHz, CDCl3) of 2f
O
OMe
OMe
O
2f
2.14
2.09
1.15
2.13
3.00
3.03
2.11
1.18
1.15
1.04
2.03
2.18
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
f1 (ppm)



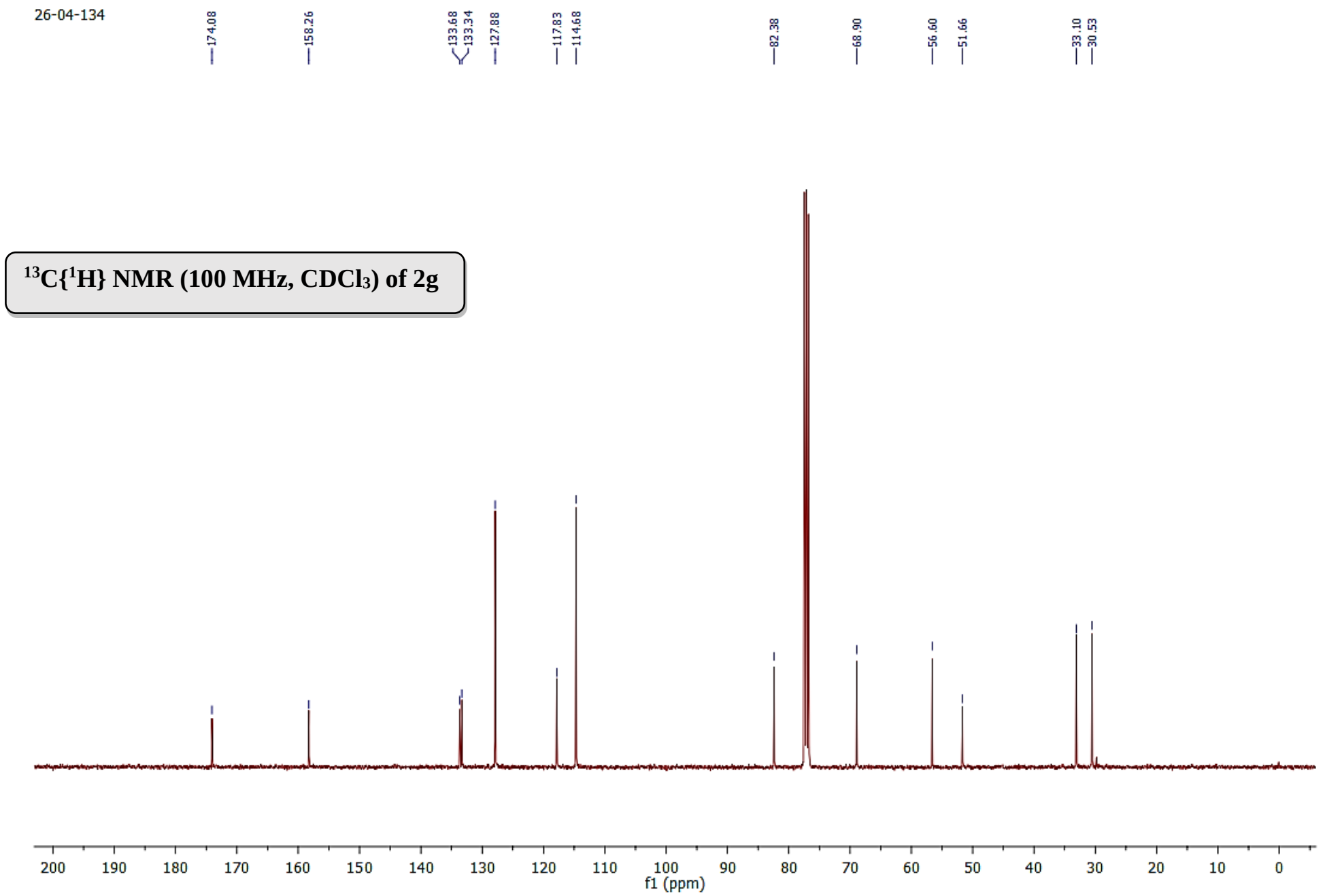
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2f

26-04-134

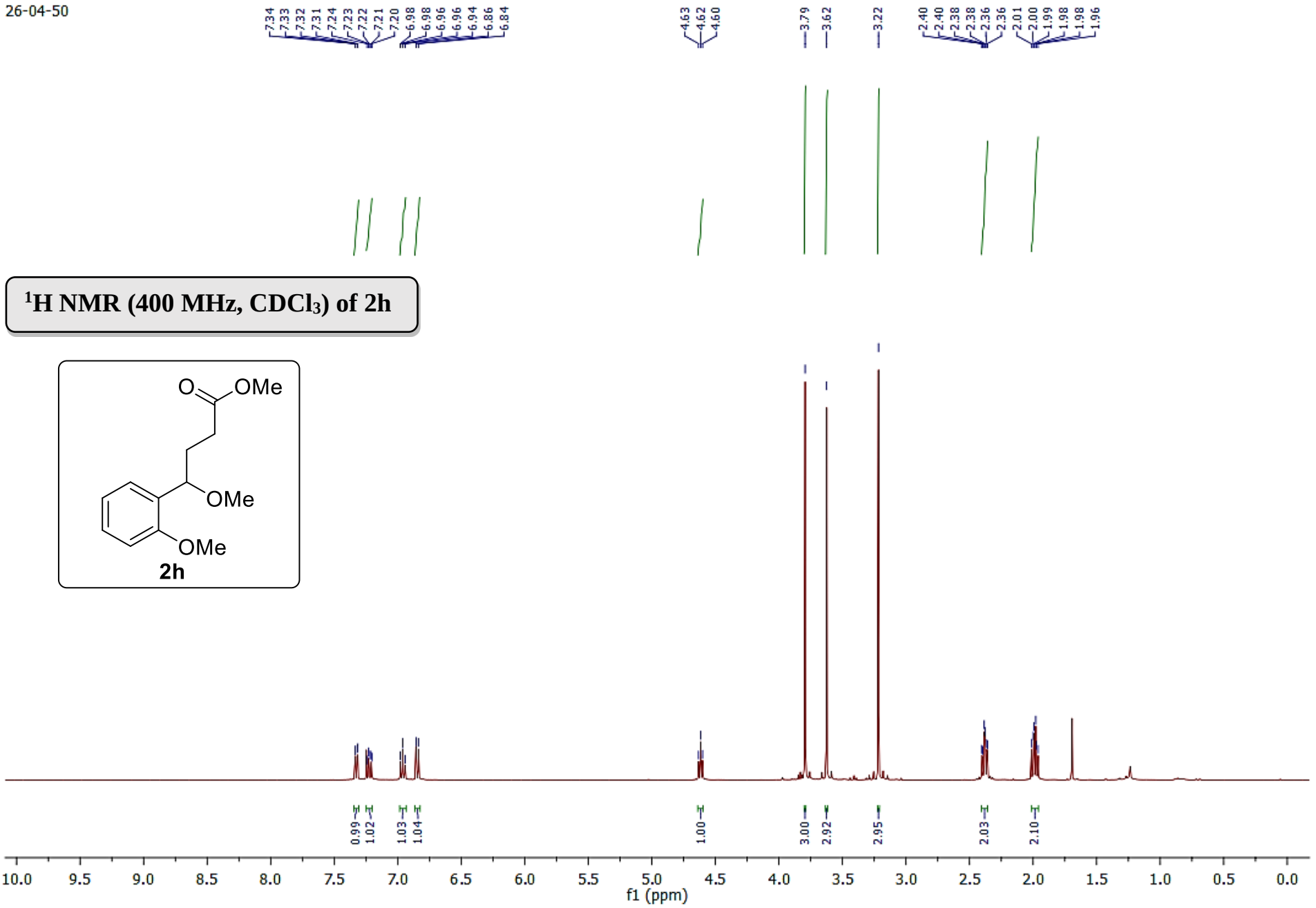
^{1}H NMR (400 MHz, $CDCl_3$) of 2g



2g

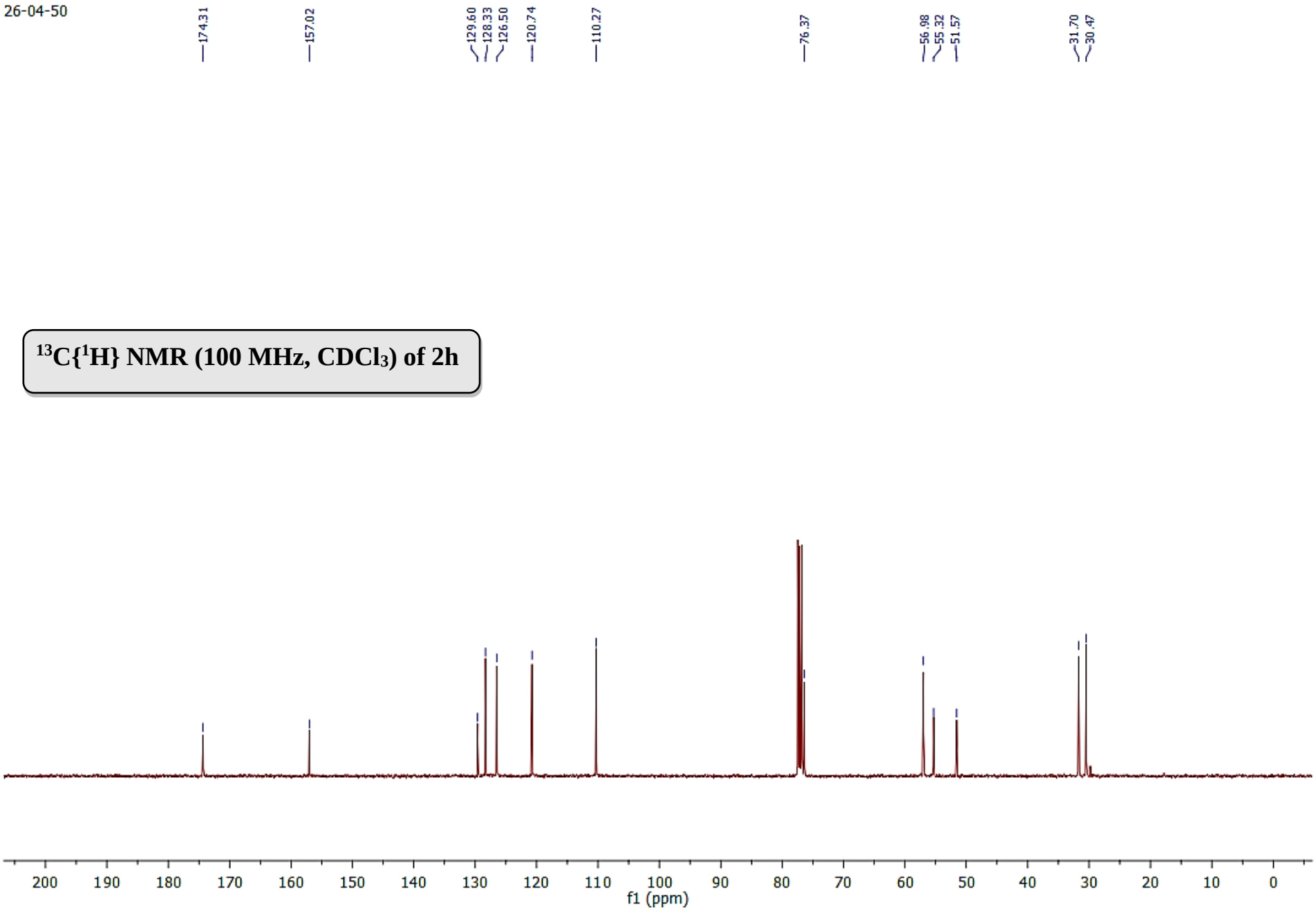


$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2g



^{1}H NMR (400 MHz, $CDCl_3$) of 2h

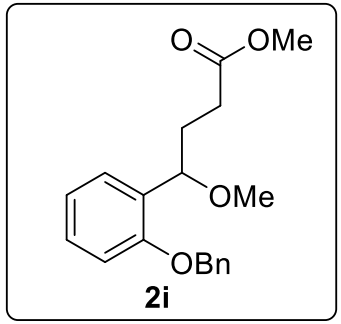
2h



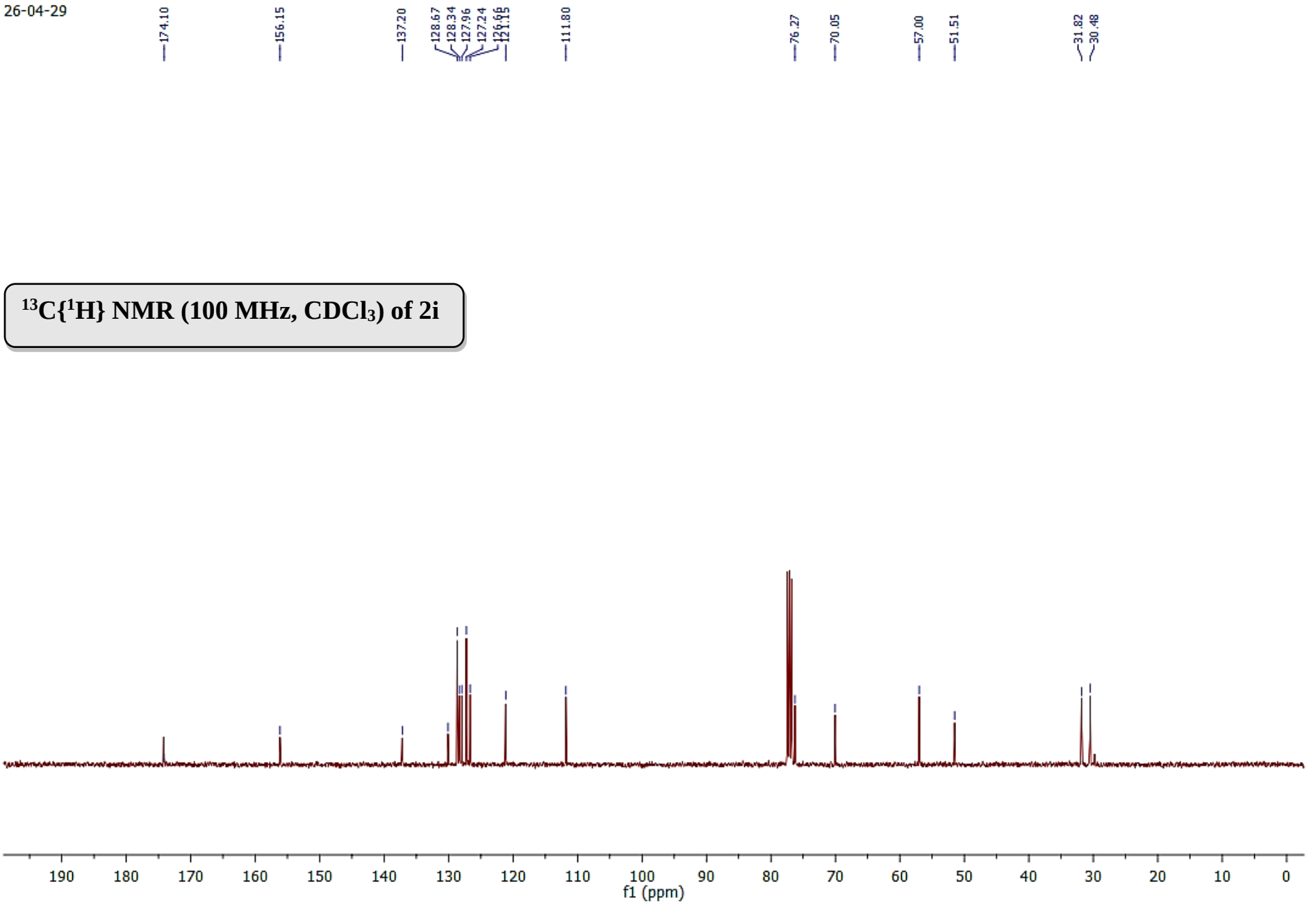
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2h

26-04-29

^{1}H NMR (400 MHz, $CDCl_3$) of 2i



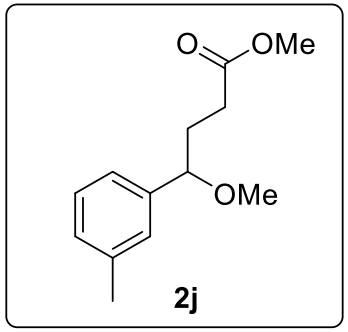
2i



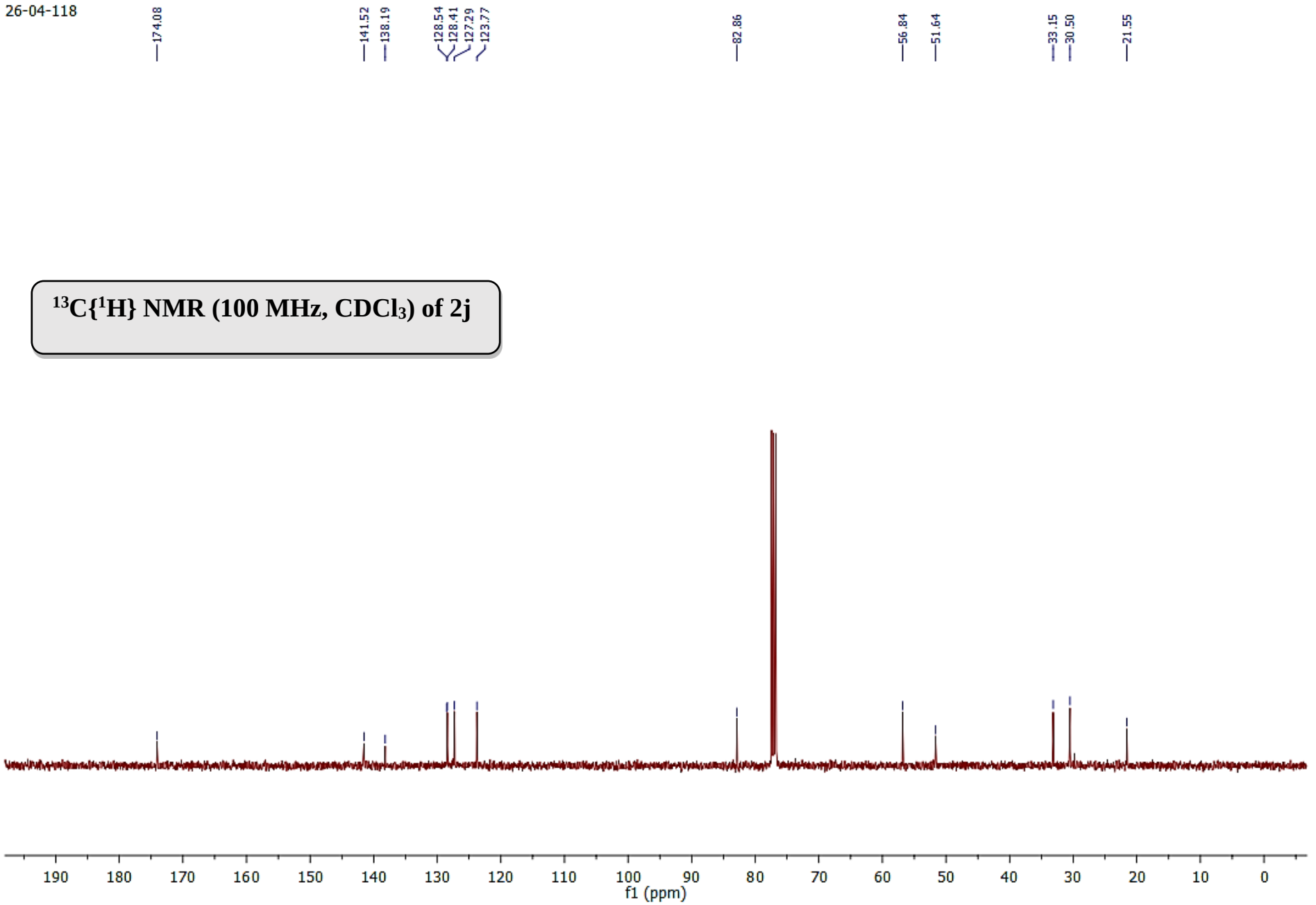
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2i

26-04-118

^{1}H NMR (400 MHz, $CDCl_3$) of 2j



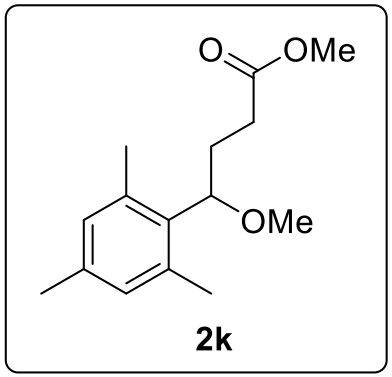
2j



$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2j

26-04-128

^{1}H NMR (400 MHz, $CDCl_3$) of 2k

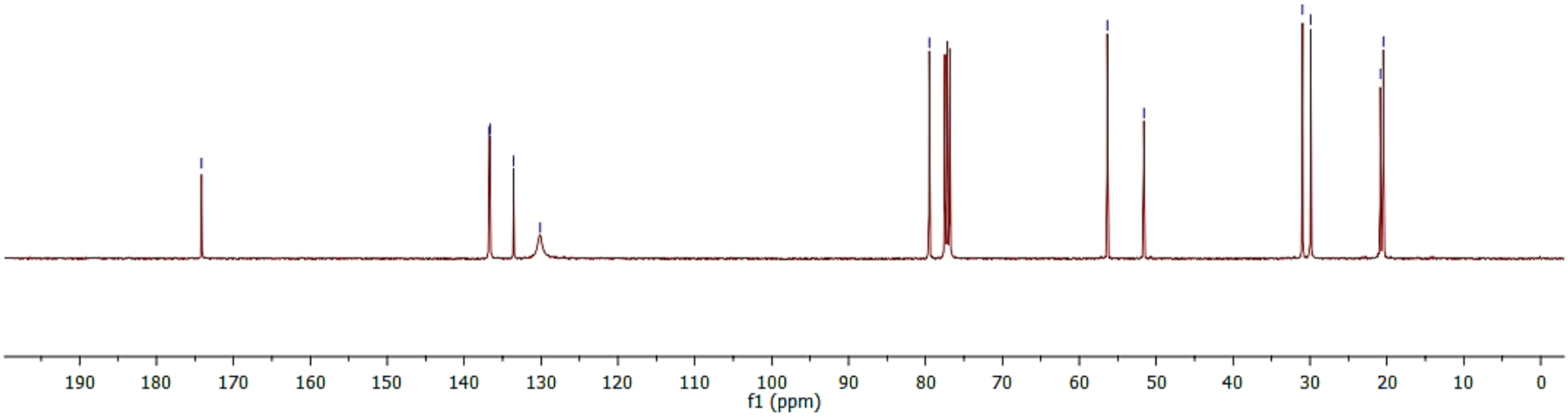


2k

26-04-128

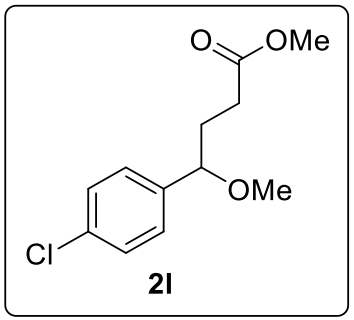
174.14
136.72
136.65
133.57
130.09
79.51
56.36
51.61
30.98
29.90
20.85
20.46

$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2k



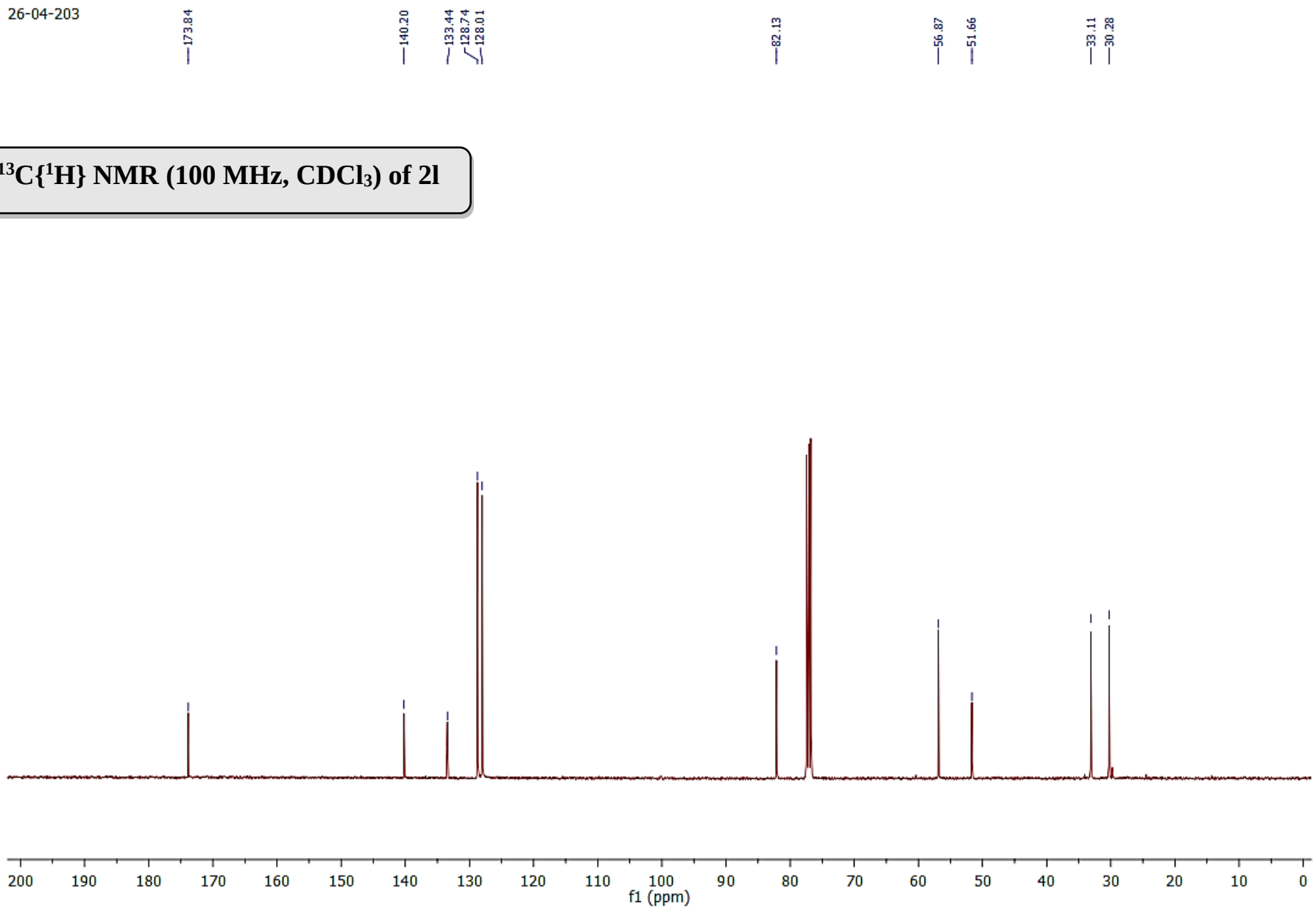
26-04-203

^{1}H NMR (400 MHz, $CDCl_3$) of 2l



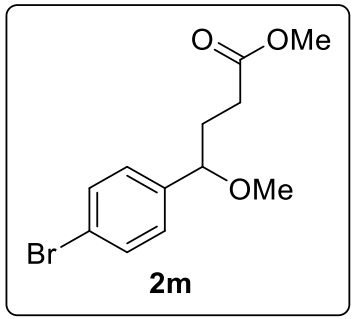
2l

$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2l

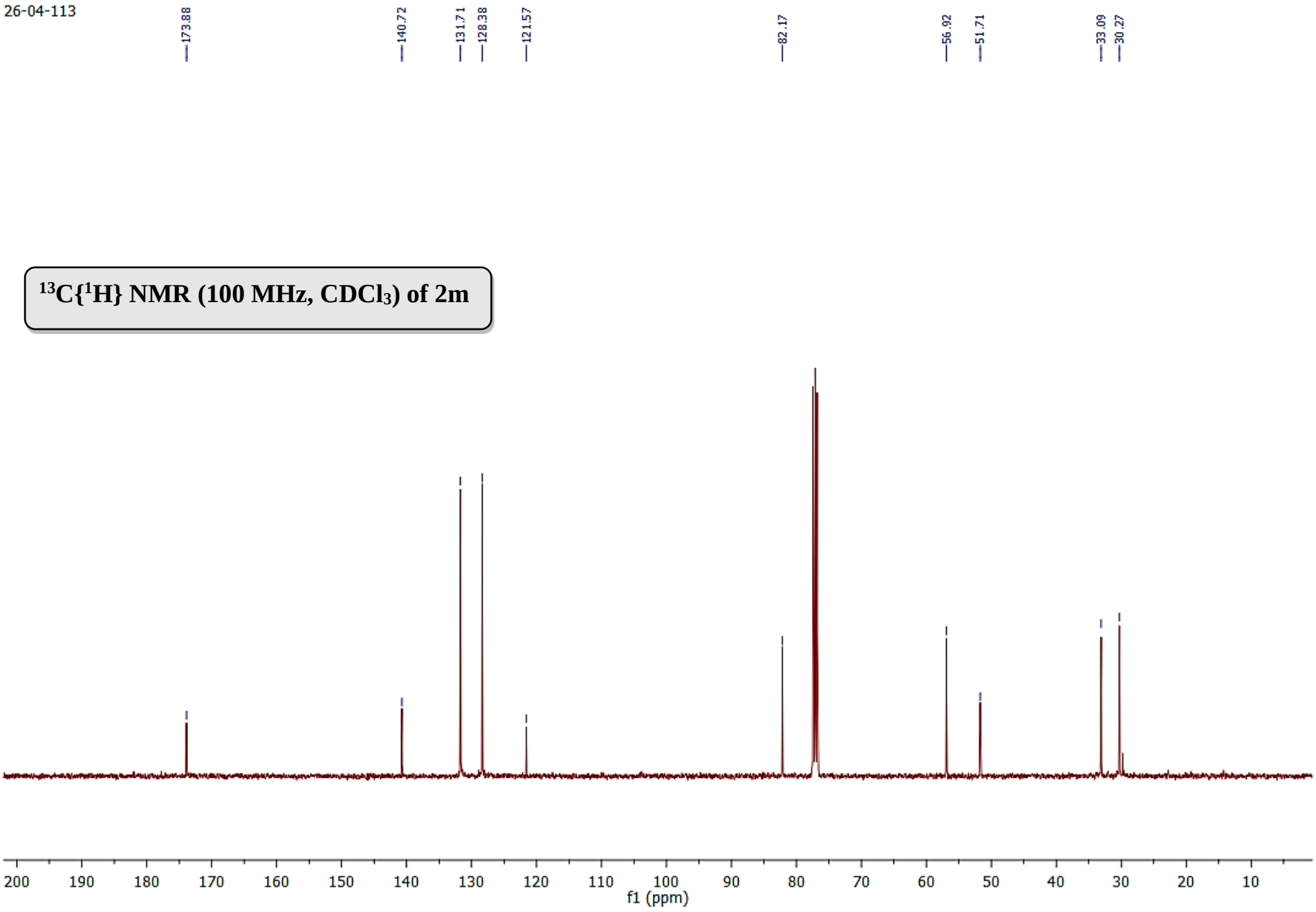


26-04-113

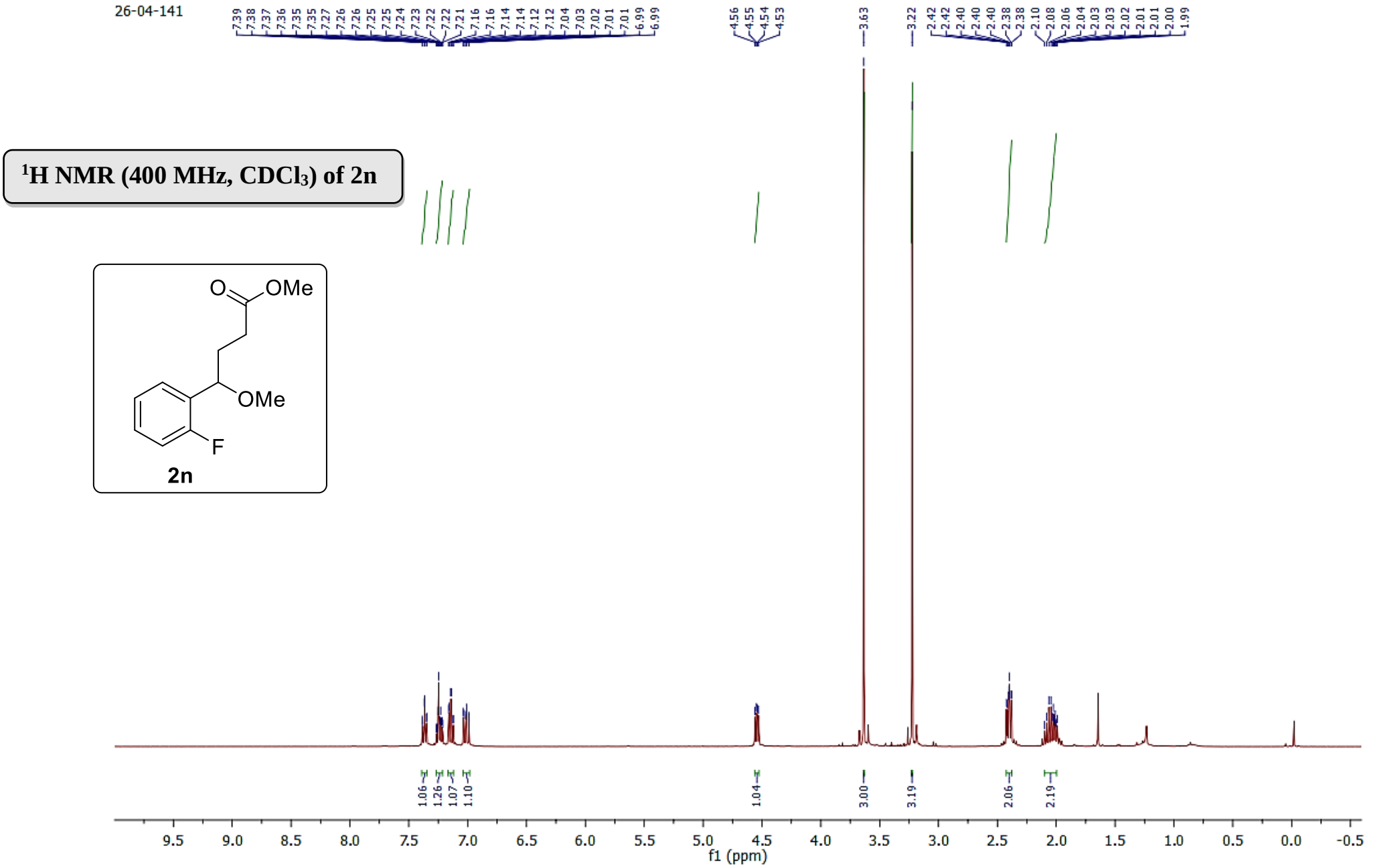
^{1}H NMR (400 MHz, $CDCl_3$) of 2m

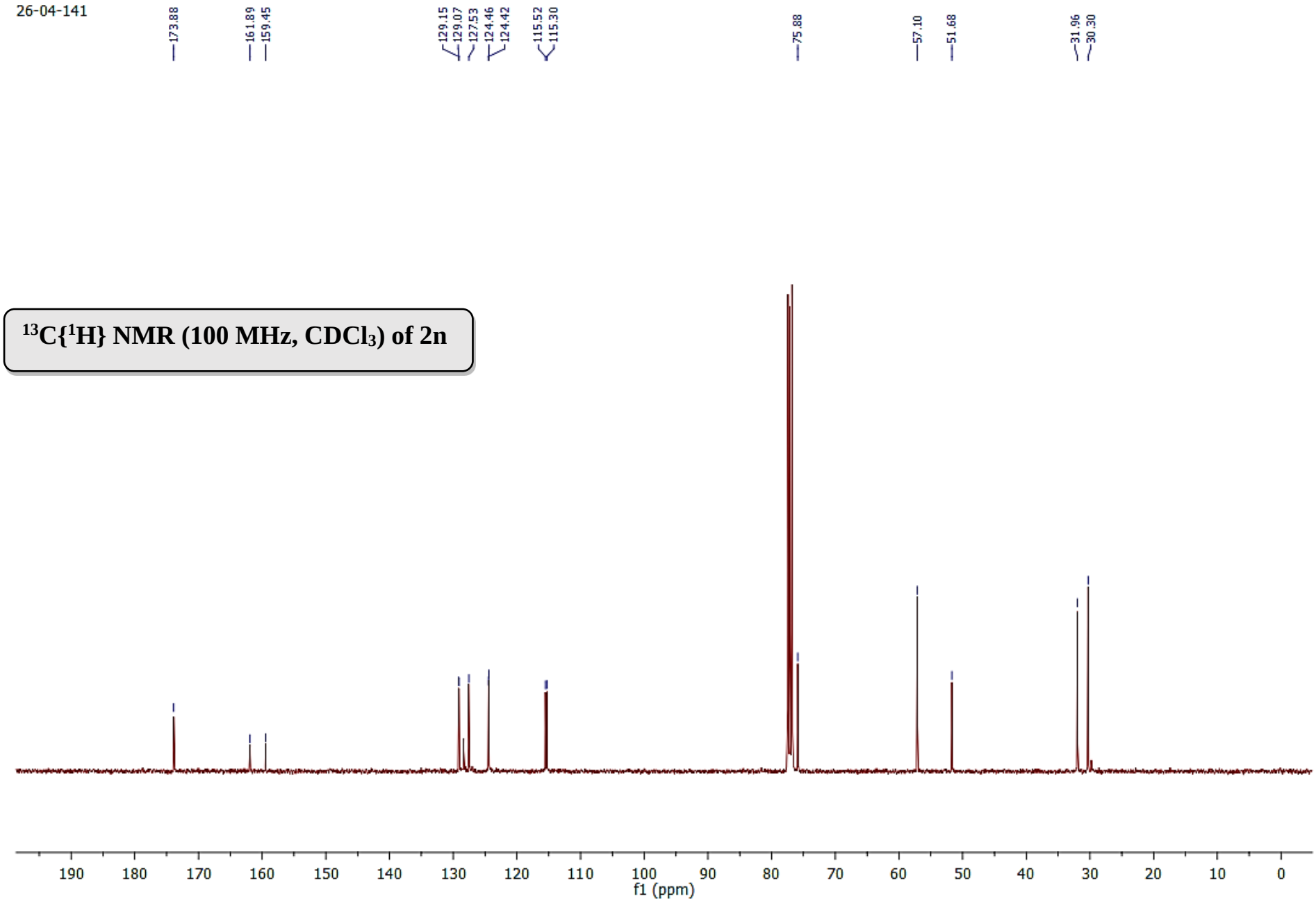


2m



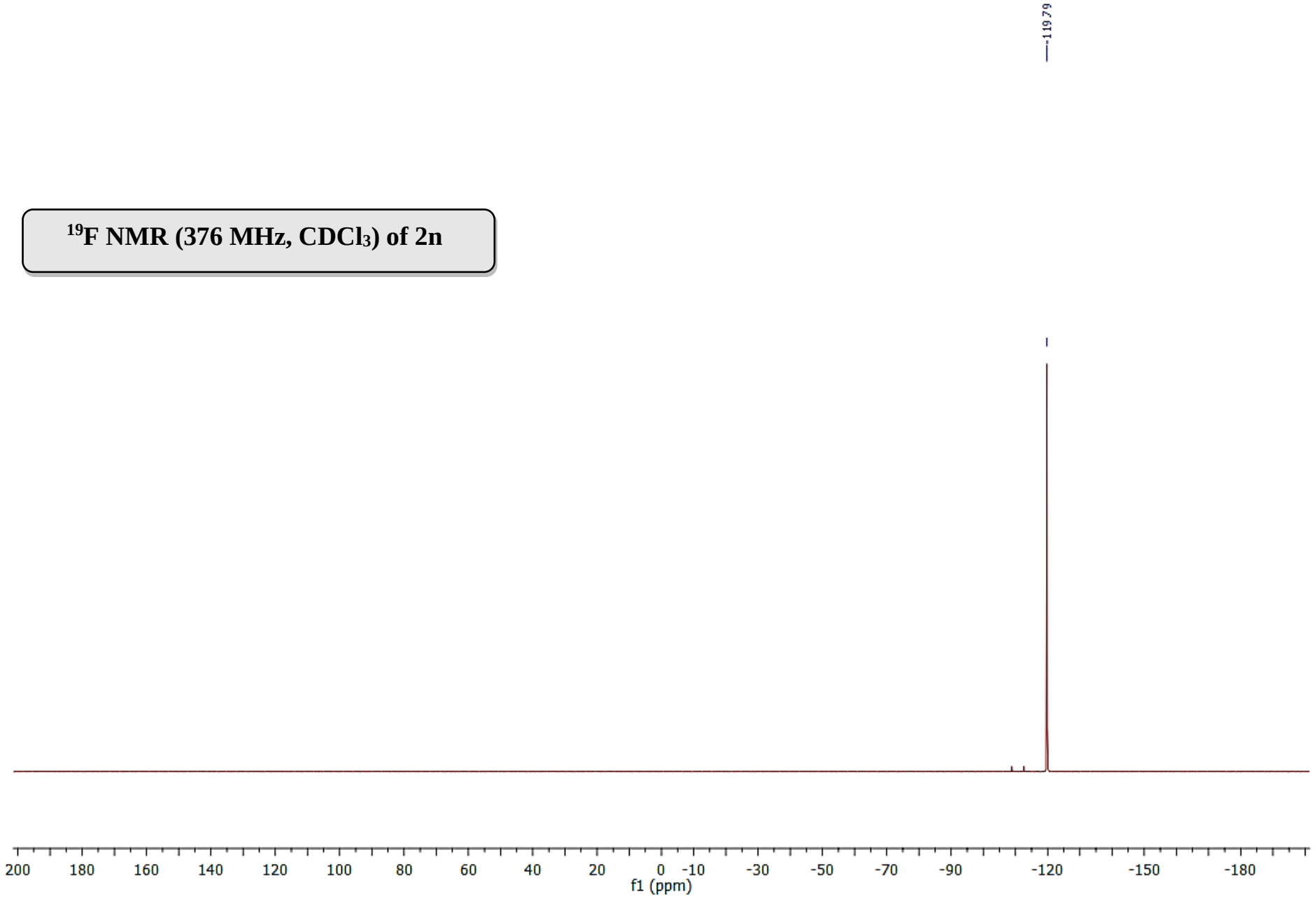
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2m


26-04-141
7.39 7.38 7.37 7.36 7.35 7.35 7.27 7.26 7.26 7.25 7.25 7.24 7.23 7.22 7.22 7.21 7.16 7.16 7.14 7.14 7.12 7.12 7.04 7.03 7.02 7.01 7.01 6.99 6.99
4.56 4.55 4.54 4.53
3.63
3.22
2.42 2.42 2.40 2.40 2.40 2.38 2.38 2.10 2.08 2.06 2.04 2.03 2.03 2.02 2.01 2.01 2.00 1.99
1H NMR (400 MHz, CDCl3) of 2n
O
OMe
OMe
F
2n
1.06 1.26 1.07 1.10 1.04 3.00 3.19 2.06 2.19
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)



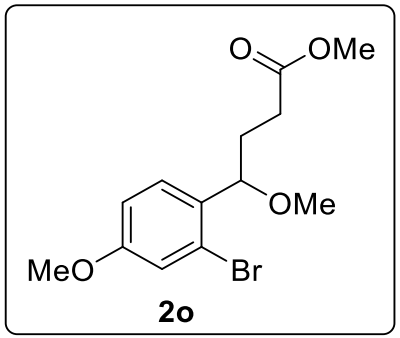
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2n

^{19}F NMR (376 MHz, $CDCl_3$) of 2n

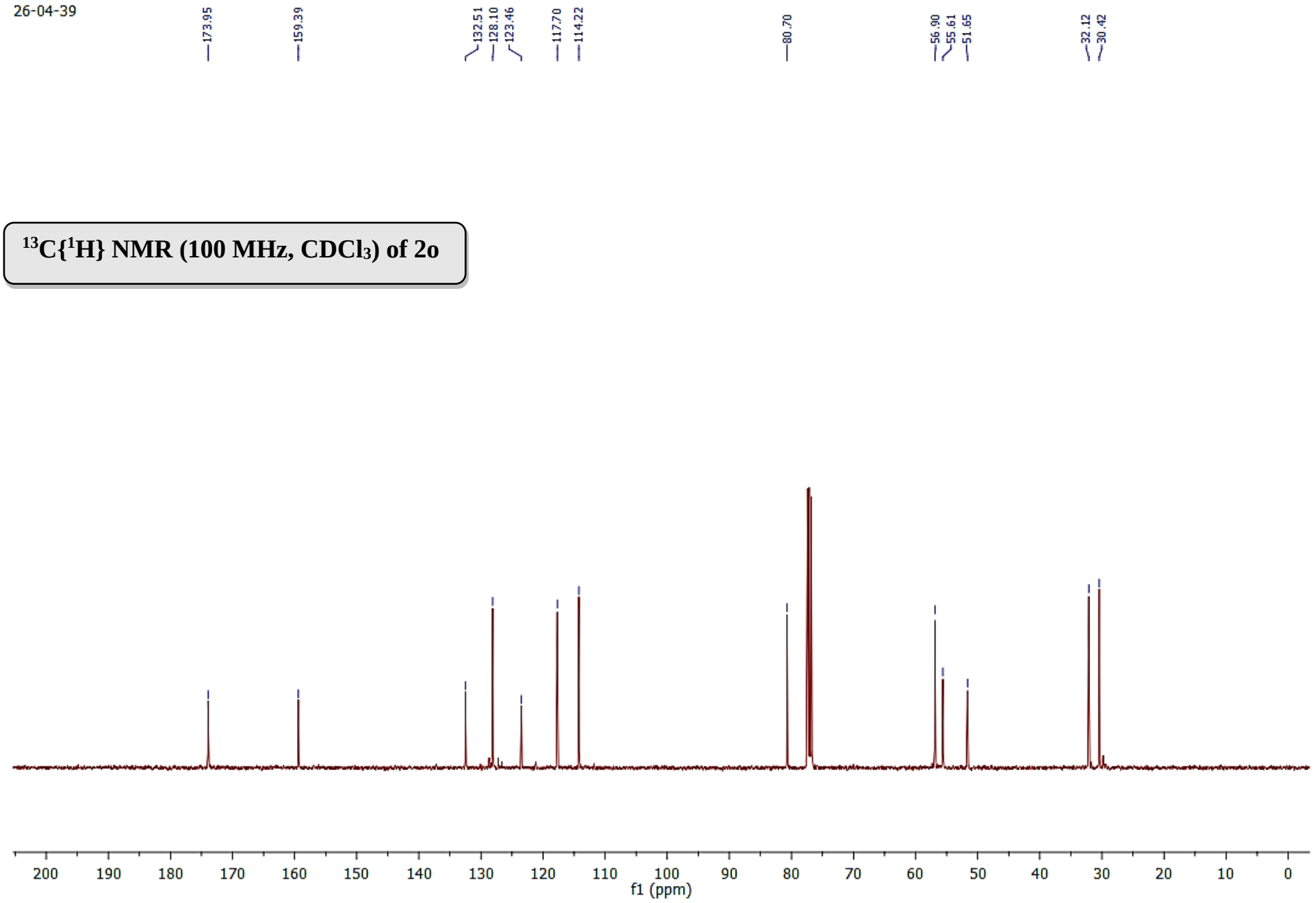


26-04-39

^{1}H NMR (400 MHz, $CDCl_3$) of 2o



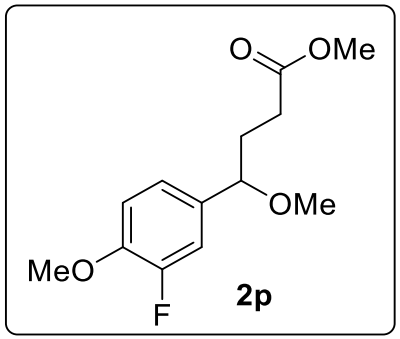
2o

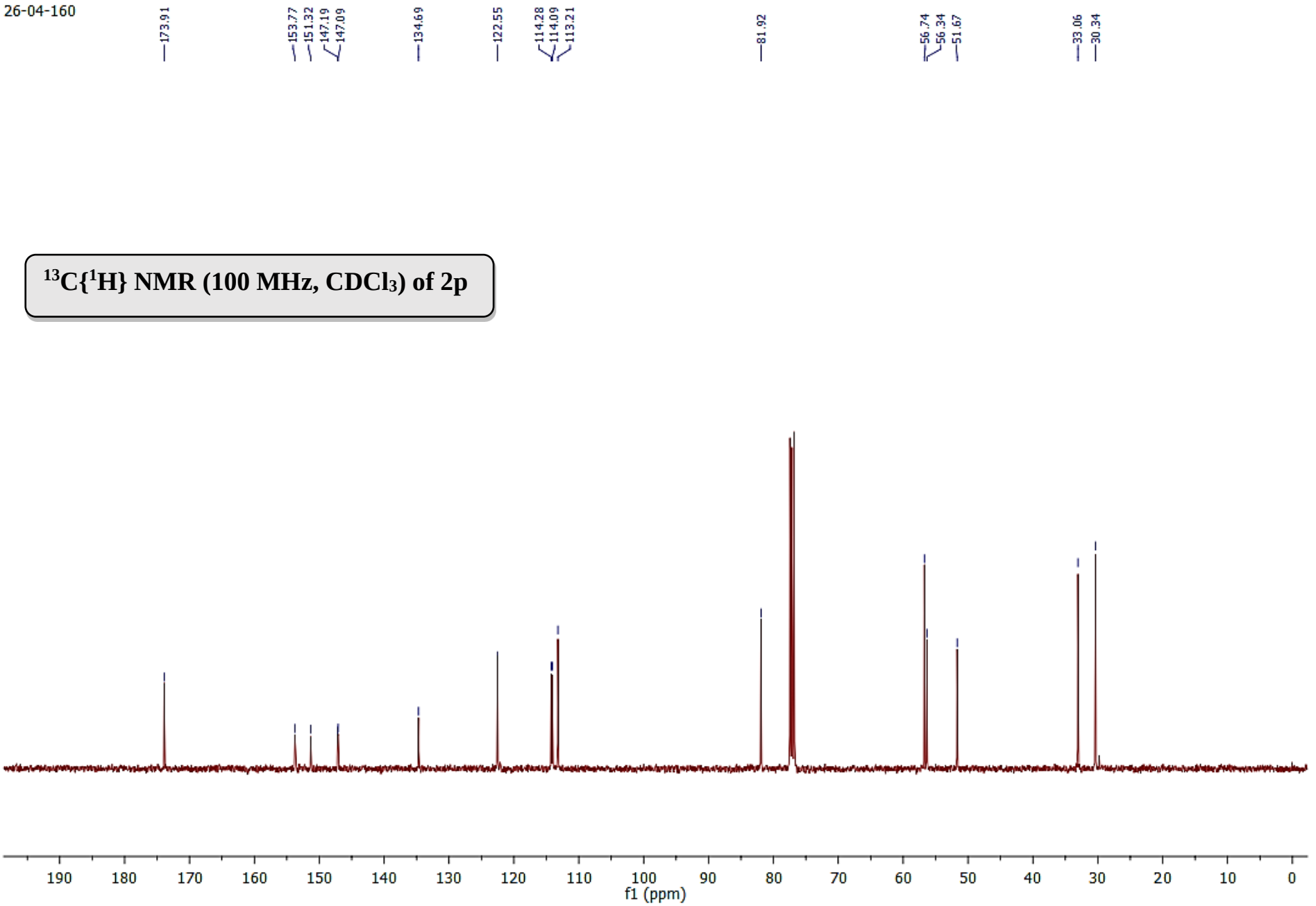


$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2o

26-04-160

^{1}H NMR (400 MHz, $CDCl_3$) of 2p



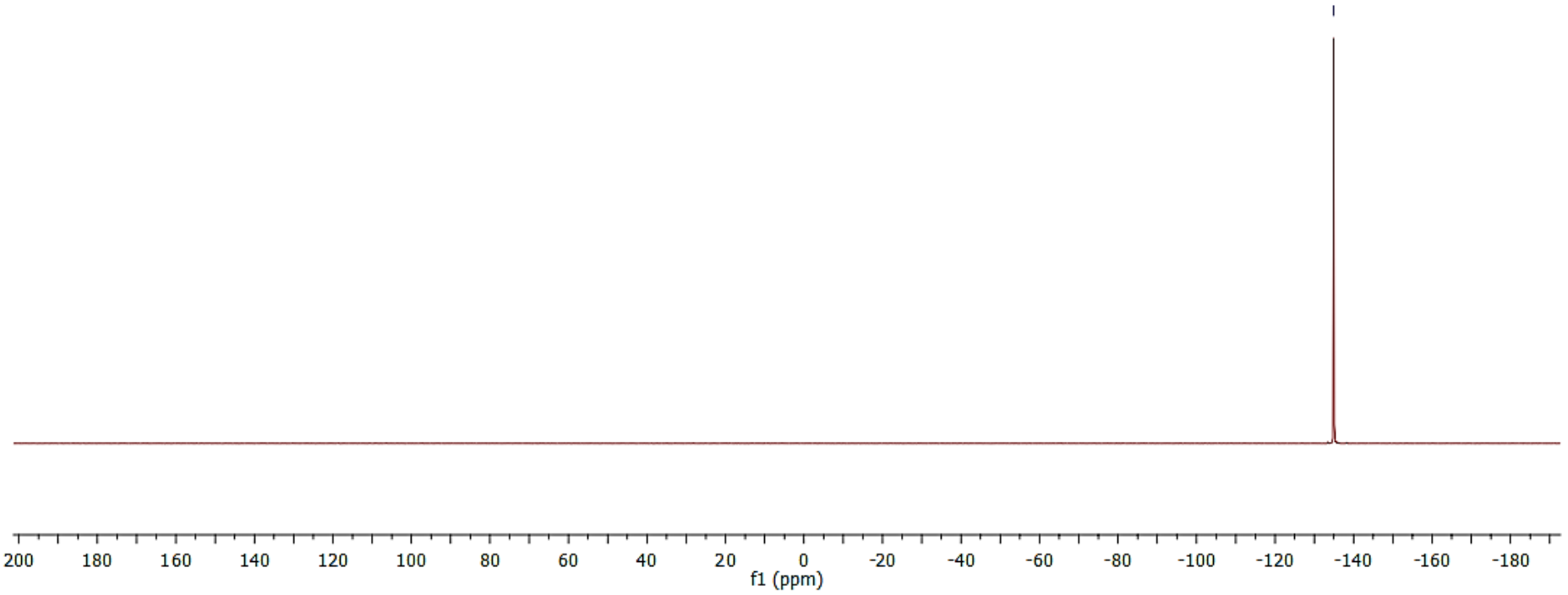


$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2p

single_pulse

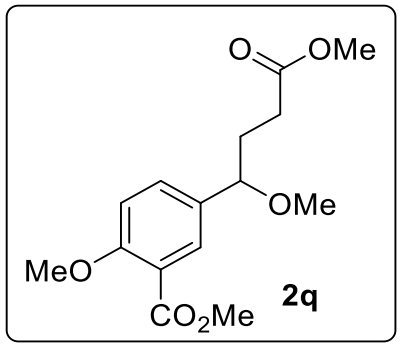
-134.95

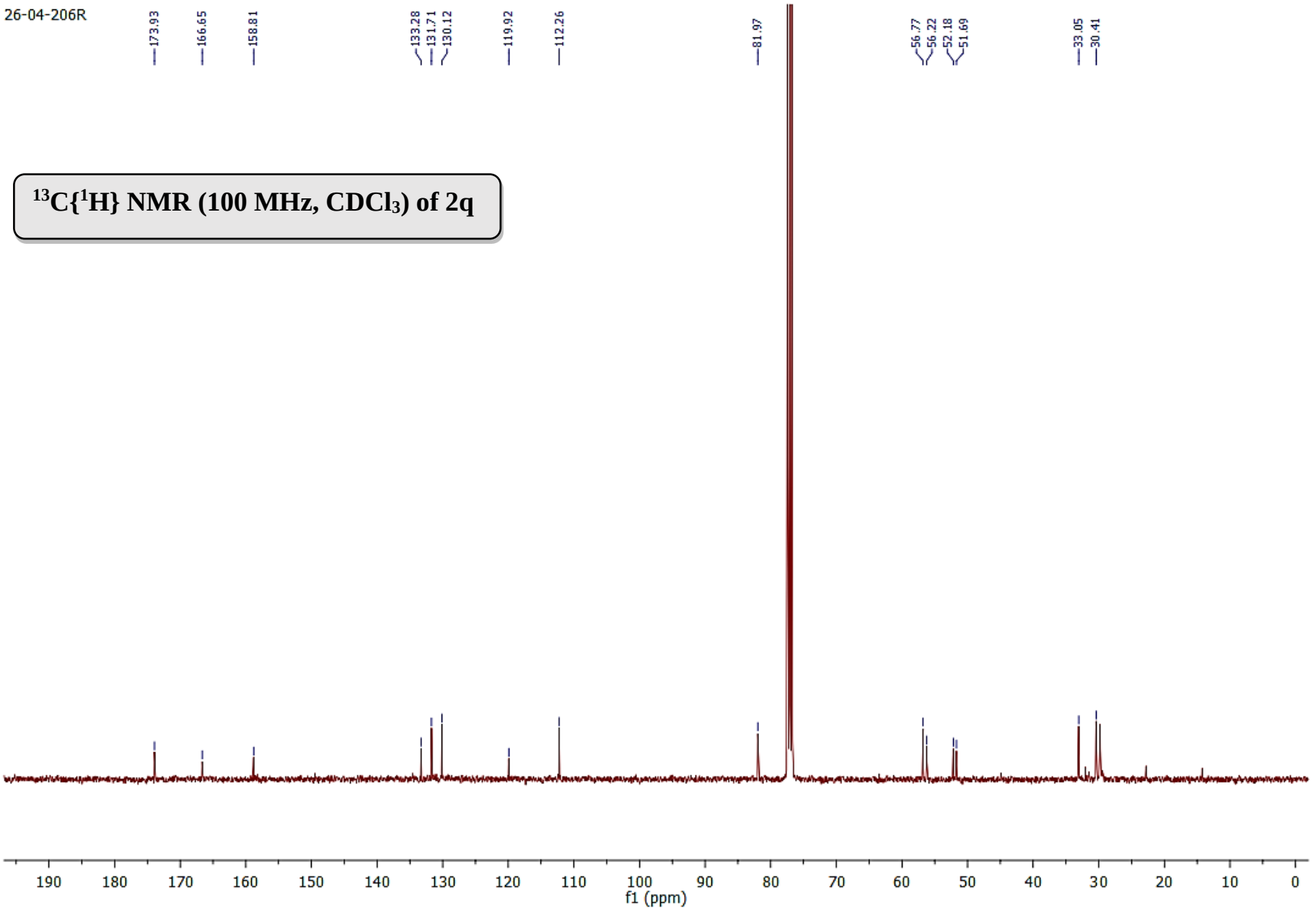
^{19}F NMR (376 MHz, $CDCl_3$) of 2p



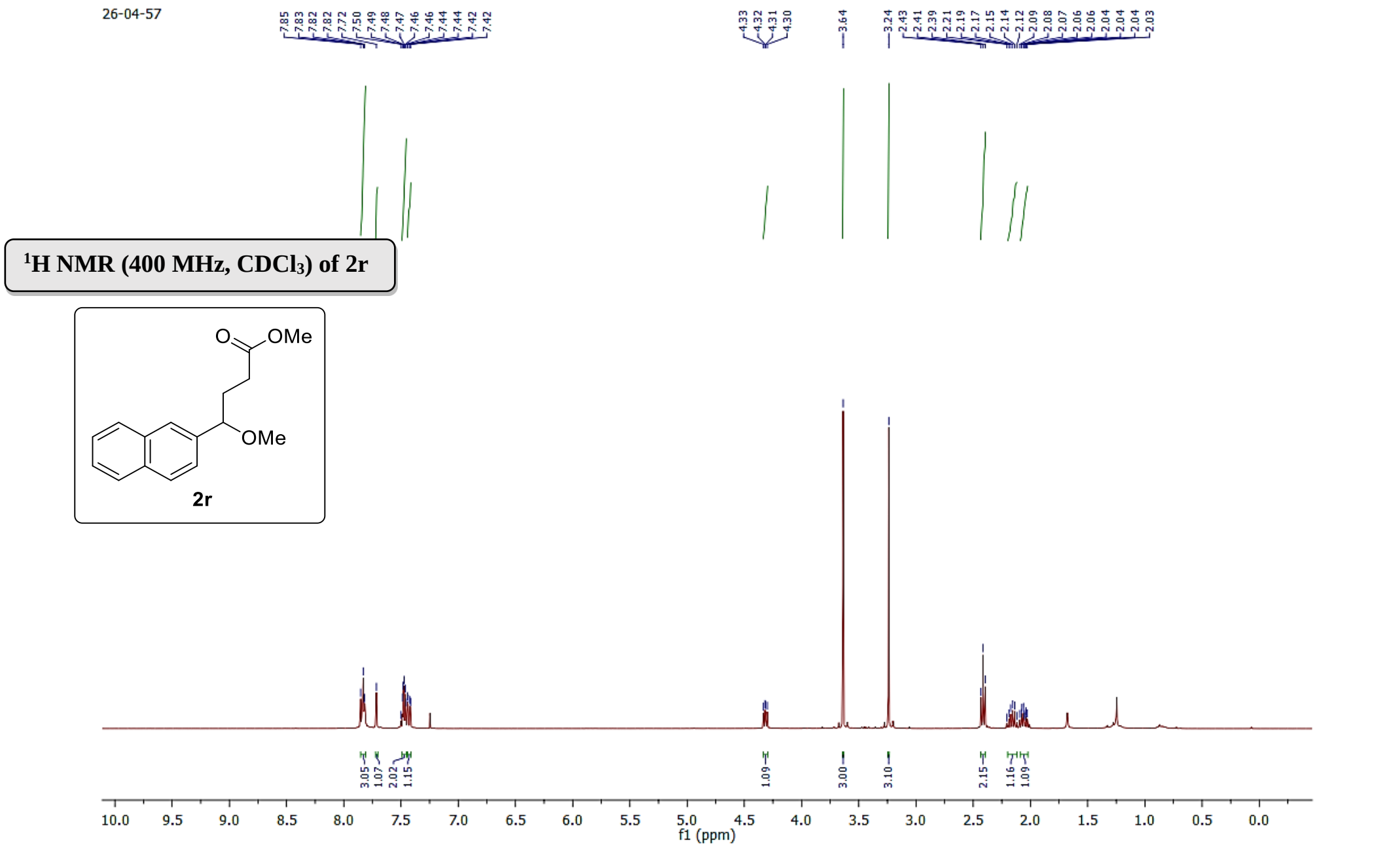
26-04-206R

^{1}H NMR (400 MHz, $CDCl_3$) of 2q





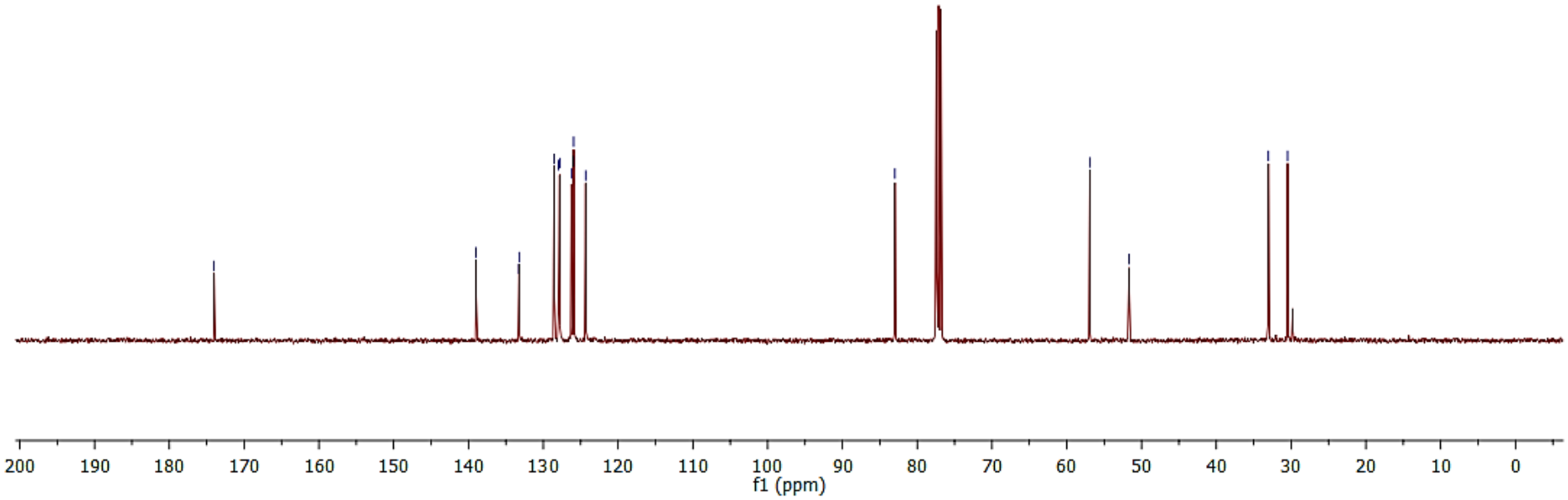
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2q


26-04-57
7.85
7.83
7.82
7.82
7.72
7.50
7.49
7.48
7.47
7.46
7.46
7.44
7.44
7.42
7.42
4.33
4.32
4.31
4.30
3.64
3.24
2.43
2.41
2.39
2.21
2.19
2.17
2.15
2.14
2.12
2.09
2.08
2.07
2.06
2.06
2.04
2.04
2.04
2.03
^{1}H NMR (400 MHz, CDCl$_3$) of 2r
O
OMe
OMe
2r
3.05
1.07
2.02
1.15
1.09
3.00
3.10
2.15
1.16
1.09
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

26-04-57

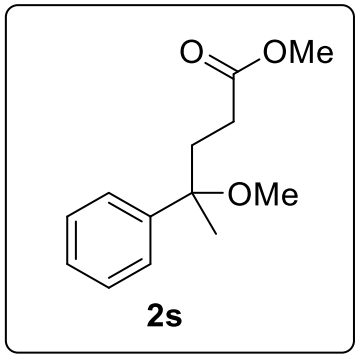
174.02
138.99
133.27
133.23
128.55
127.93
127.81
126.26
125.98
125.94
124.34
82.98
56.93
51.67
33.03
30.47

$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2r

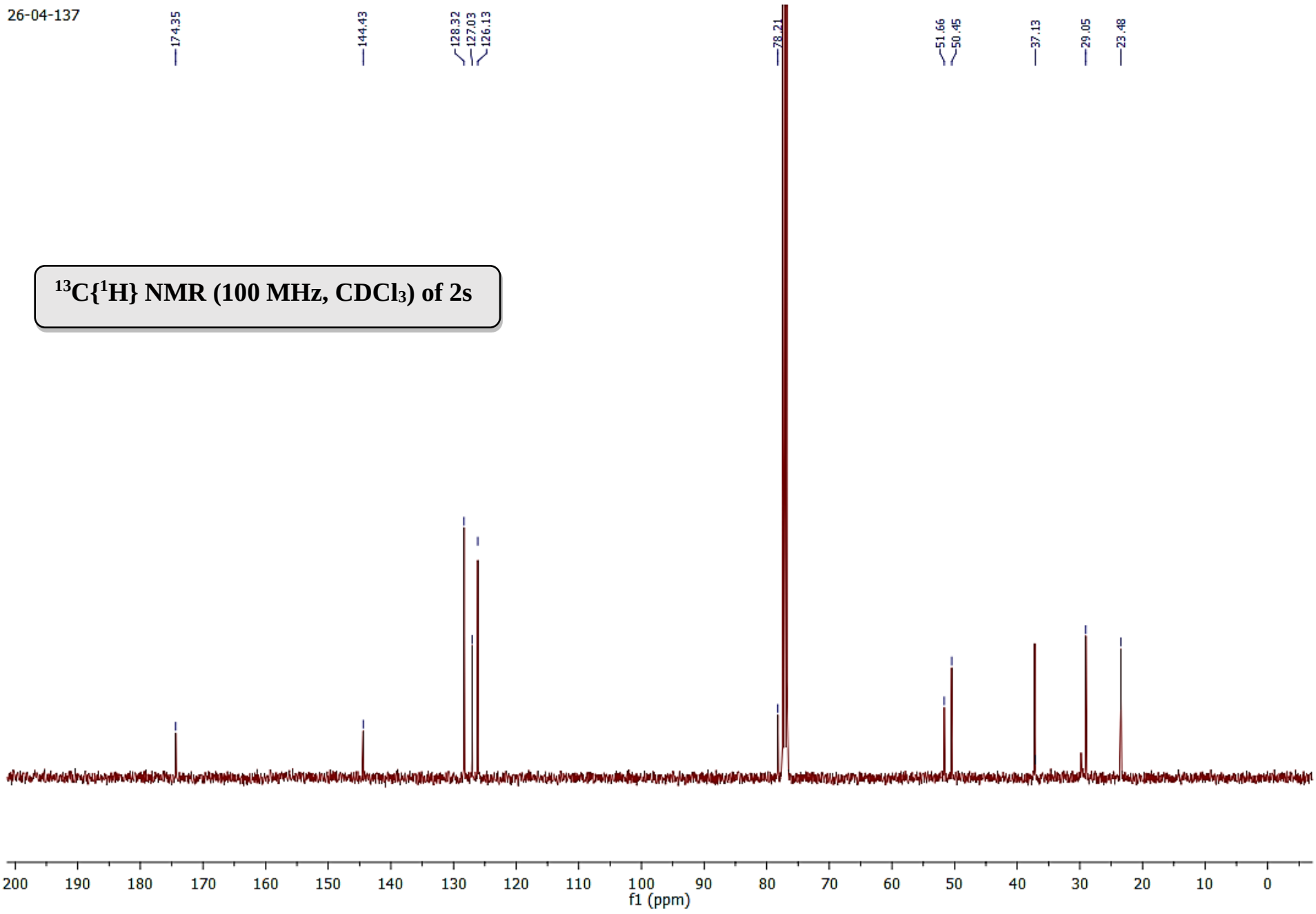


26-04-137

^{1}H NMR (400 MHz, $CDCl_3$) of 2s



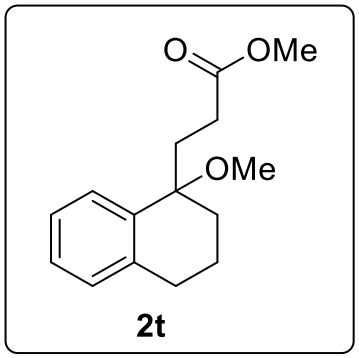
2s



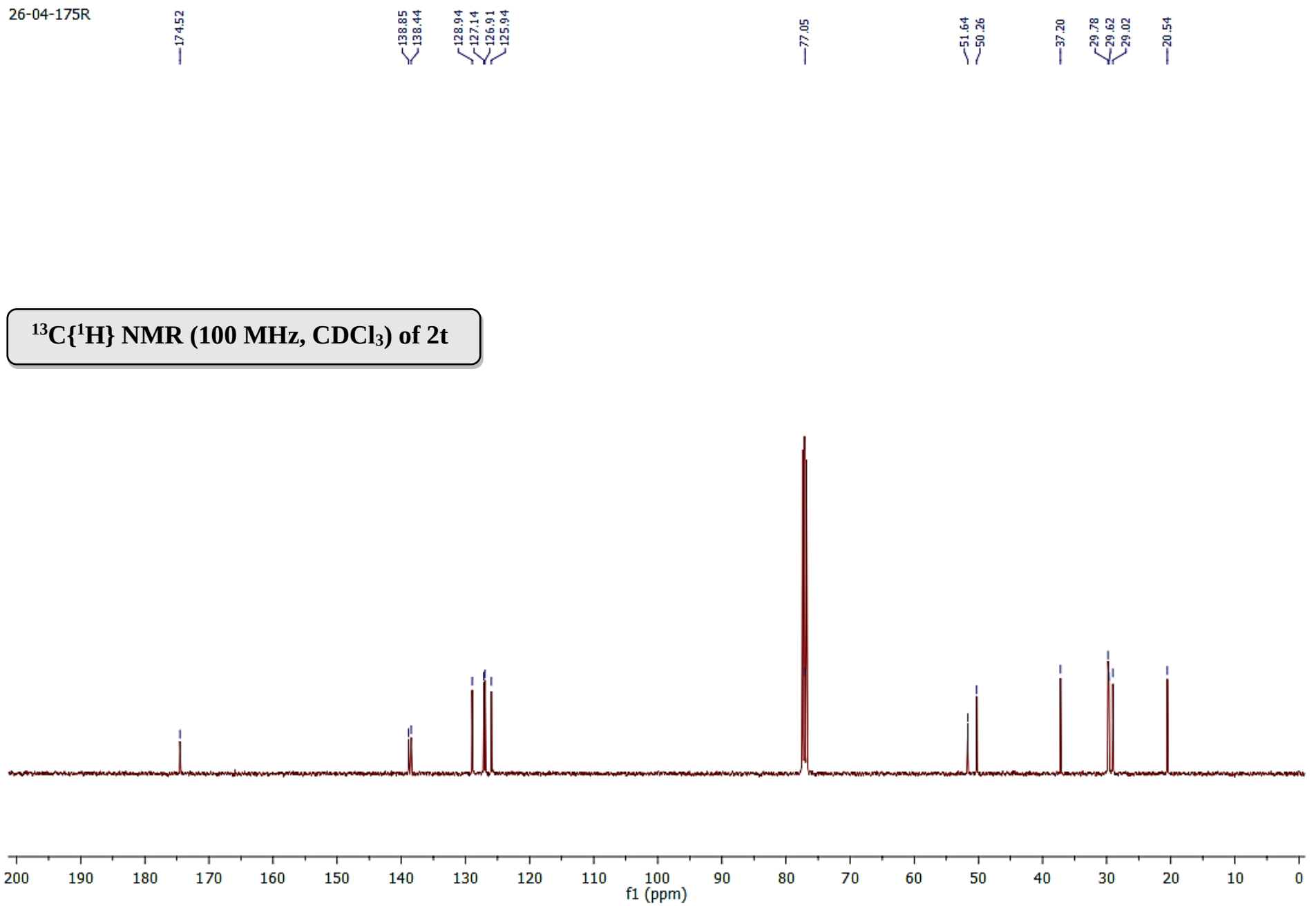
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2s

26-04-175R

^{1}H NMR (400 MHz, $CDCl_3$) of 2t



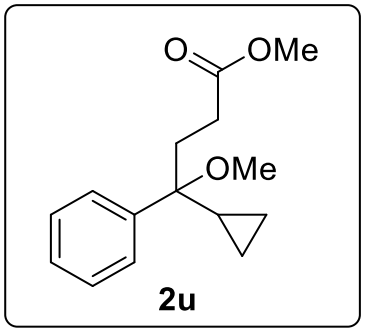
2t



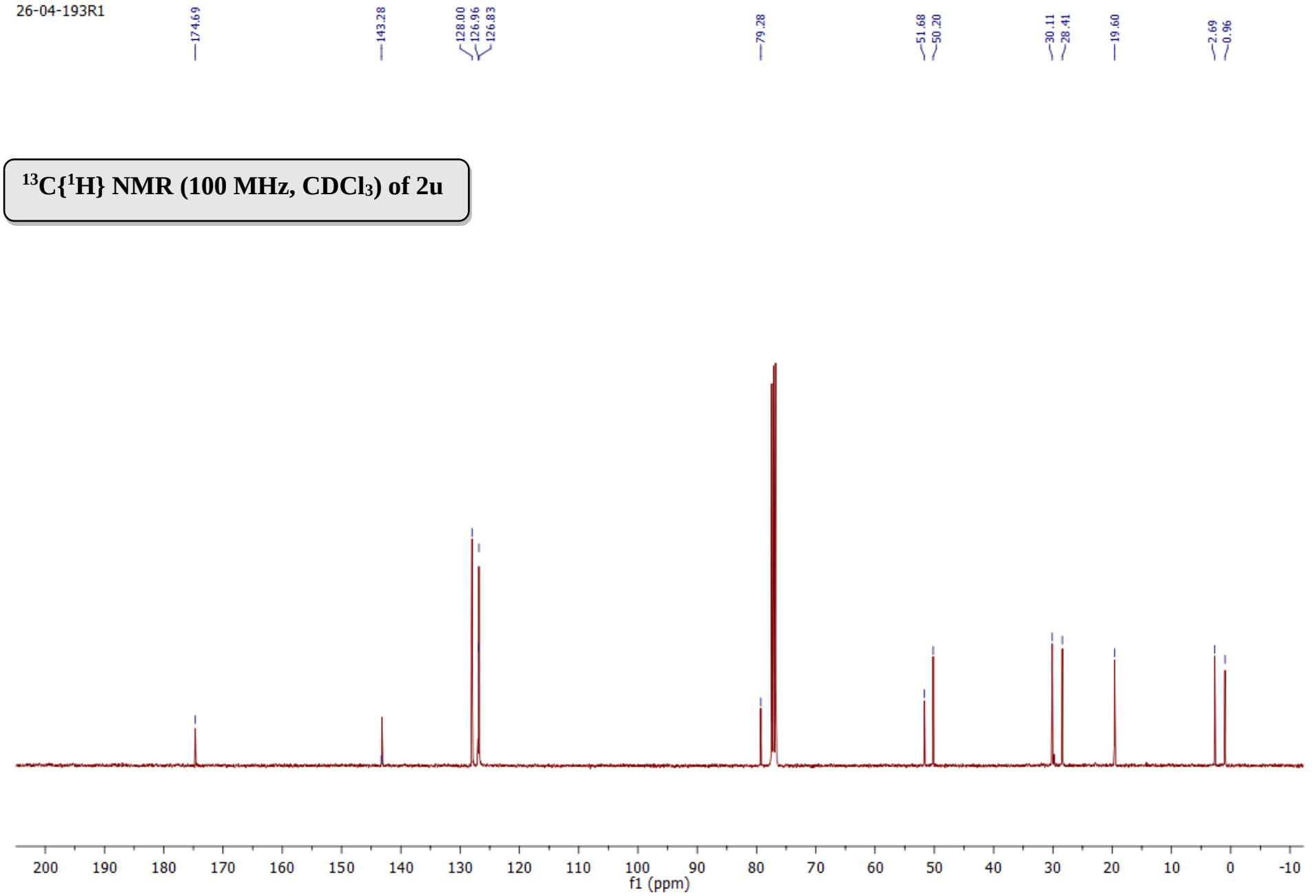
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2t

26-04-193R1

^{1}H NMR (400 MHz, $CDCl_3$) of 2u



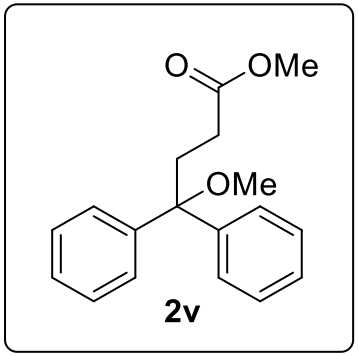
2u



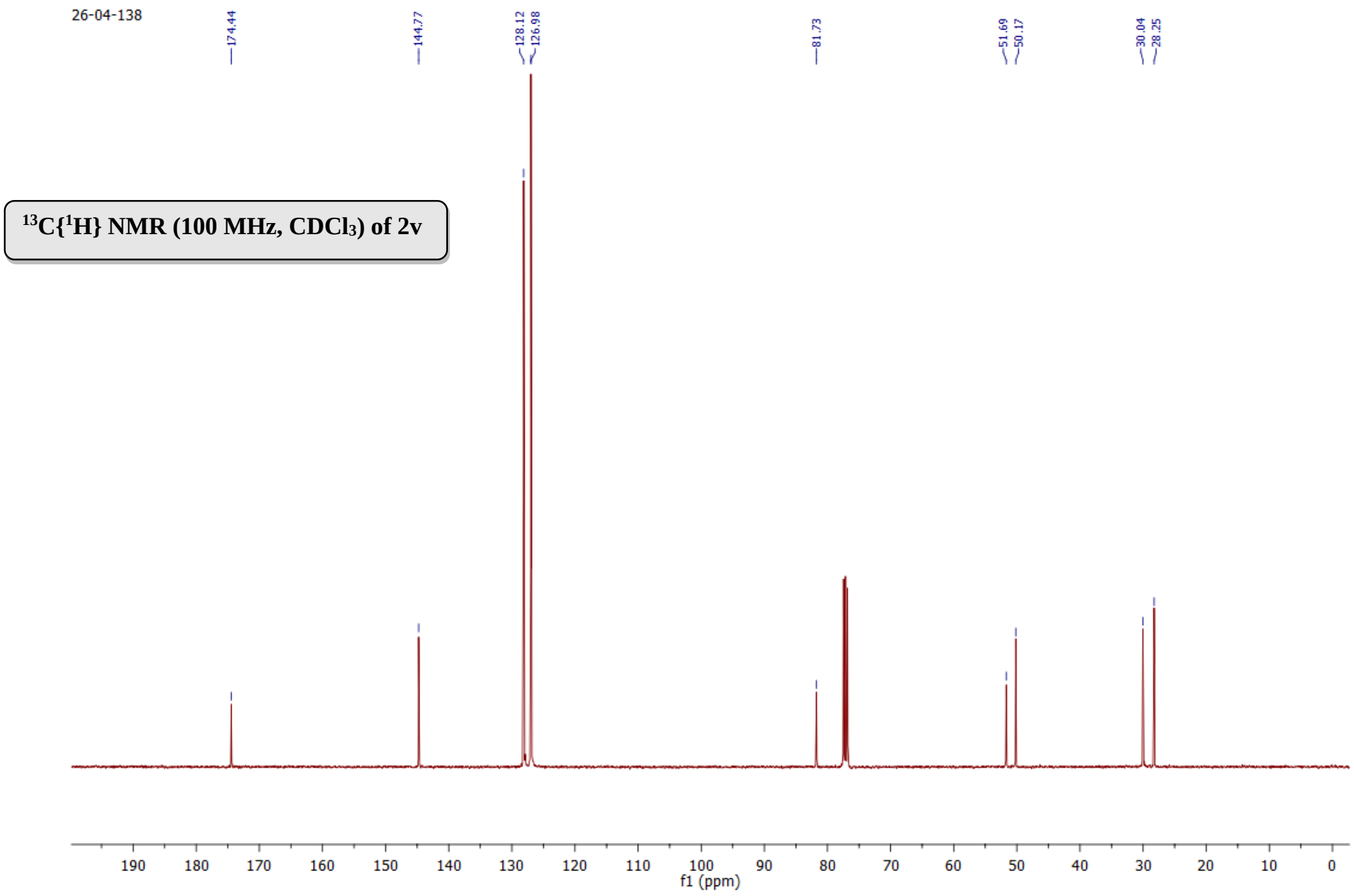
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2u

26-04-138

^{1}H NMR (400 MHz, $CDCl_3$) of 2v

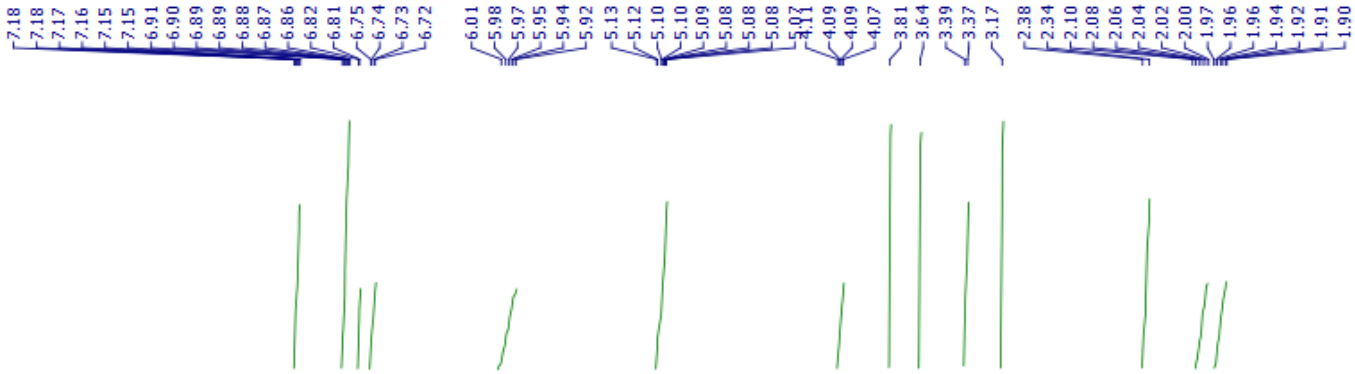


2v

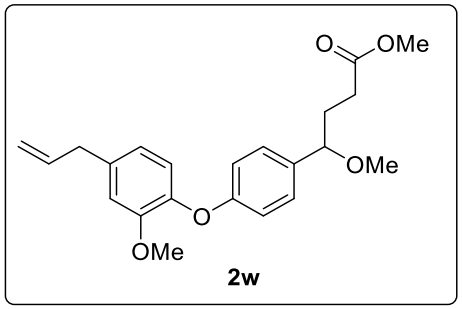


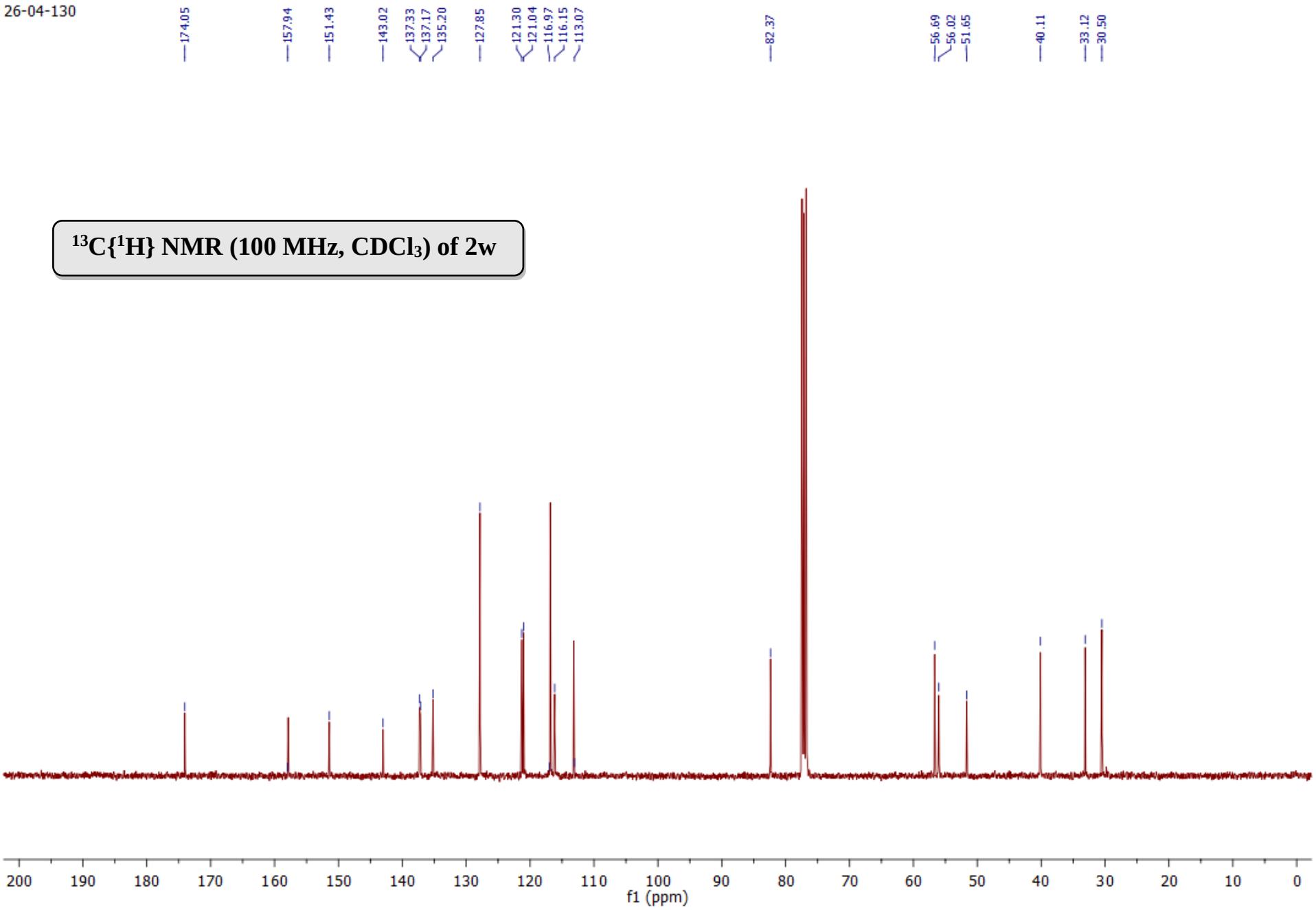
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2v

26-04-130

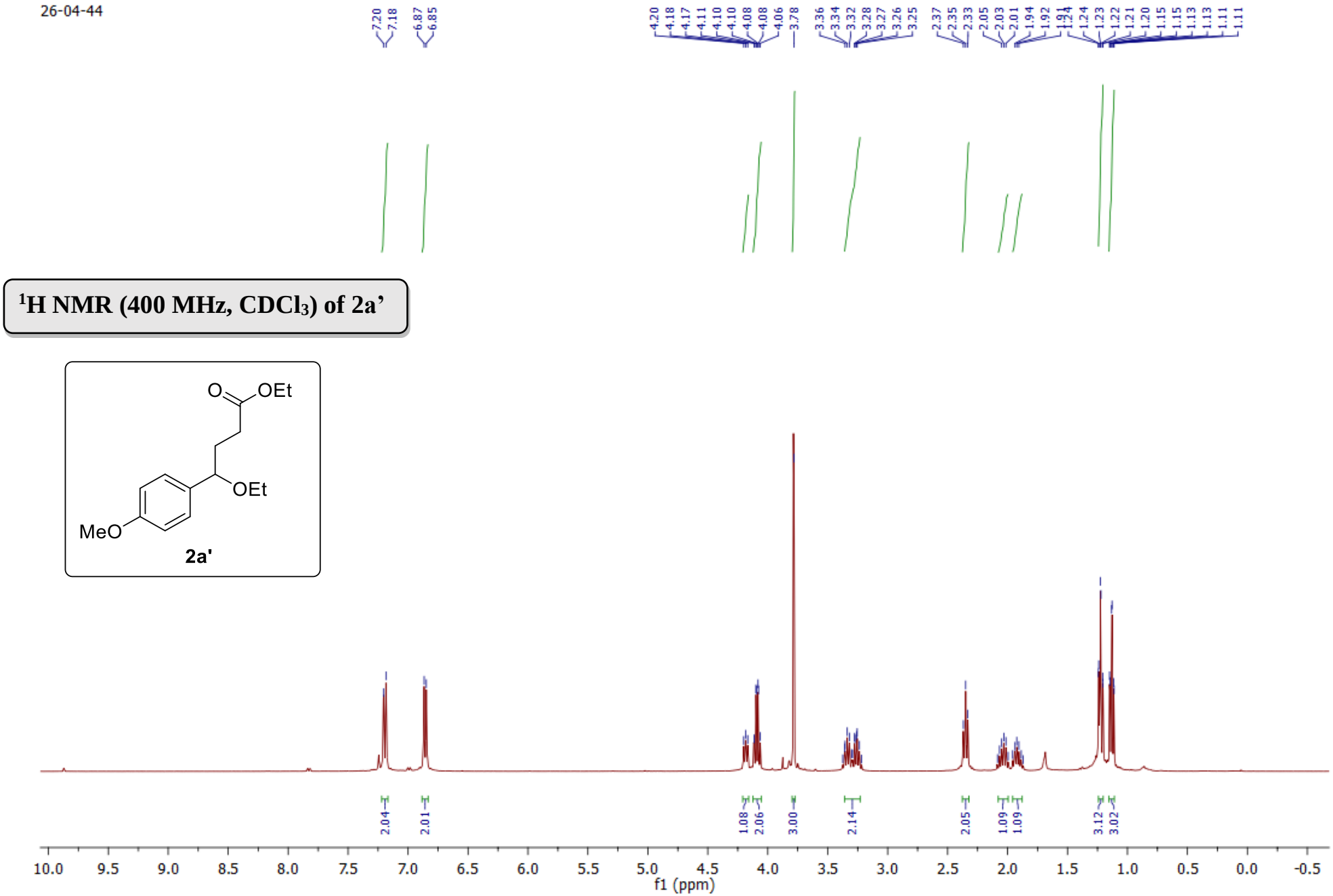


^{1}H NMR (400 MHz, $CDCl_3$) of 2w





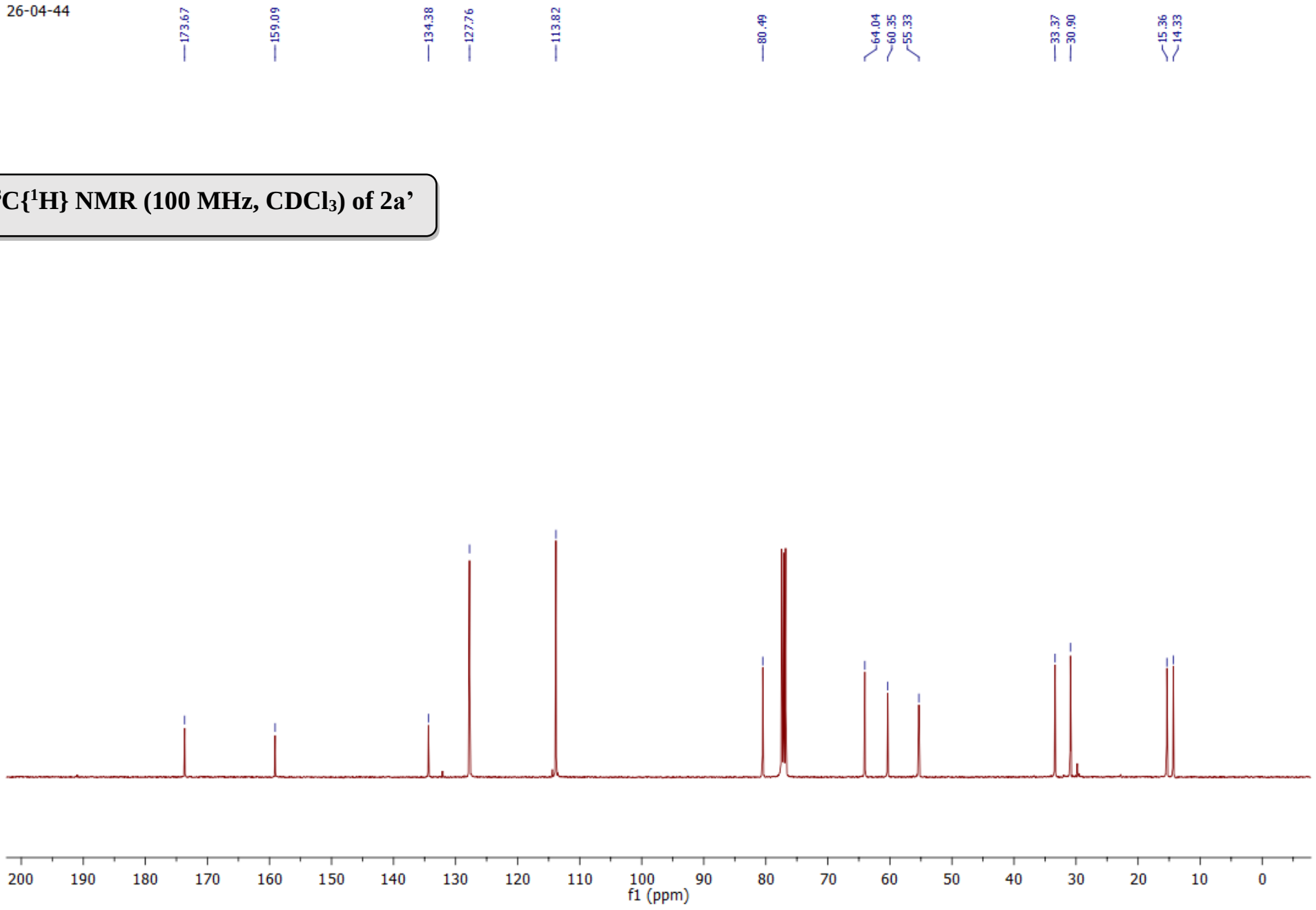
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2w



^{1}H NMR (400 MHz, $CDCl_3$) of 2a'

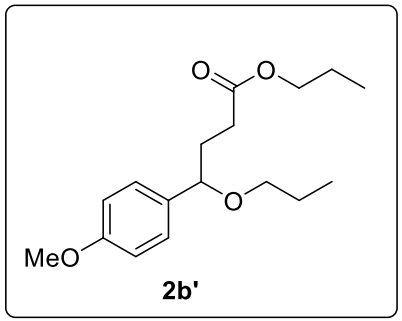
2a'

$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2a'

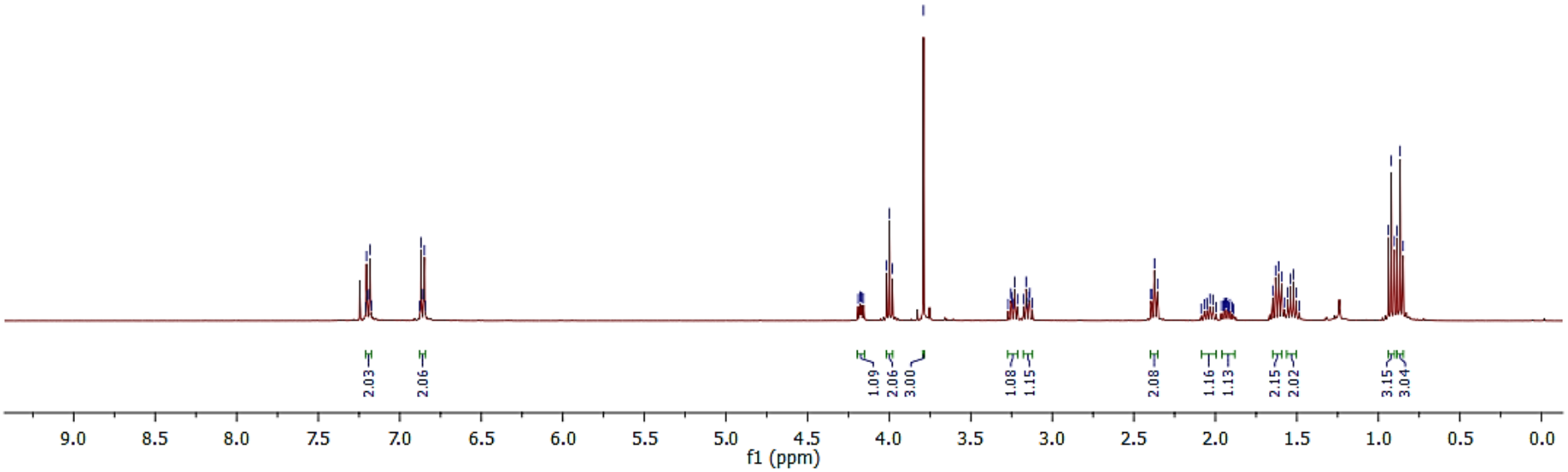


26-04-71R

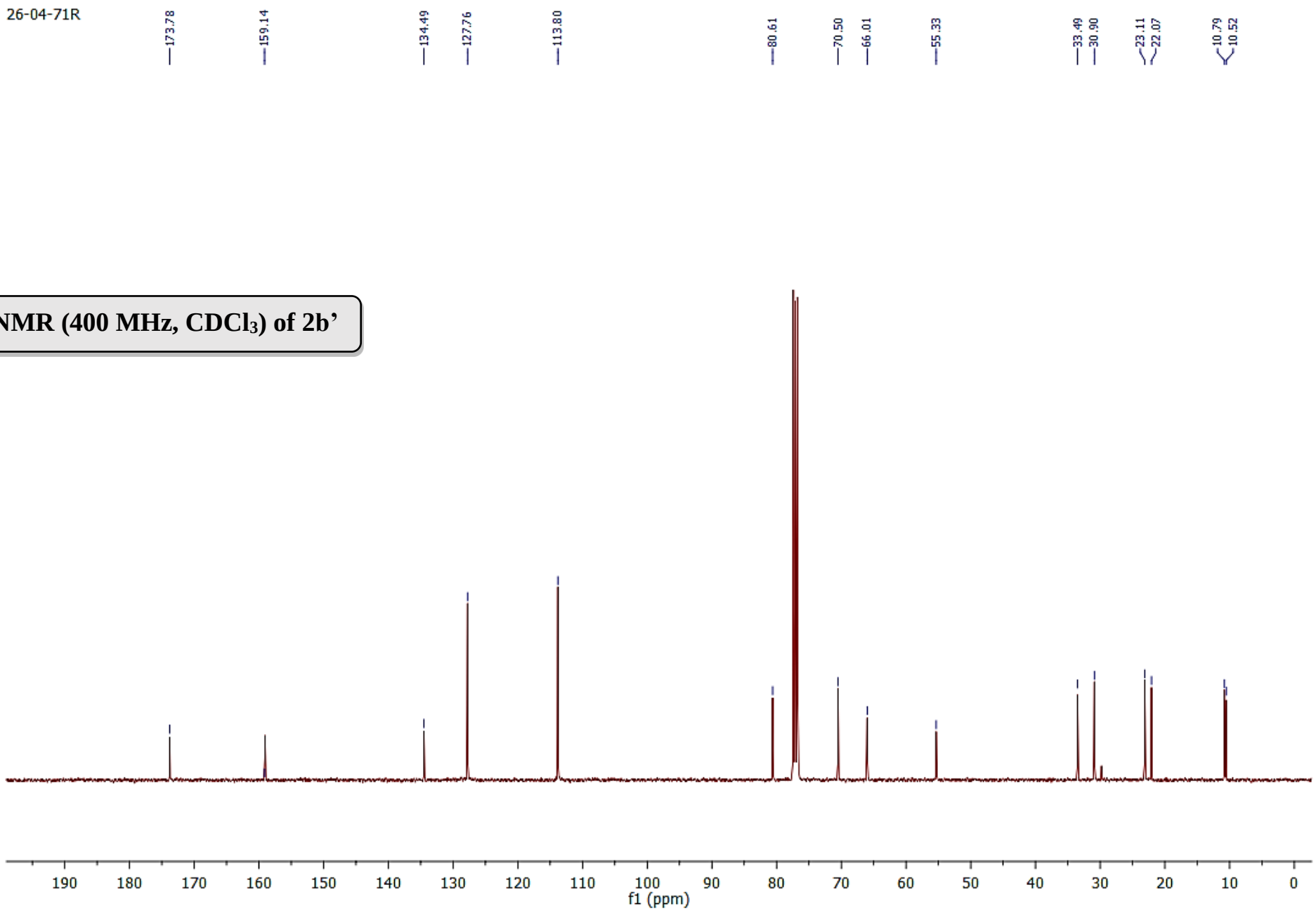
^{1}H NMR (400 MHz, $CDCl_3$) of 2b'



2b'

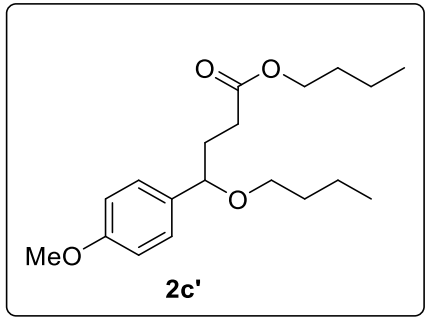


^{1}H NMR (400 MHz, $CDCl_3$) of 2b'

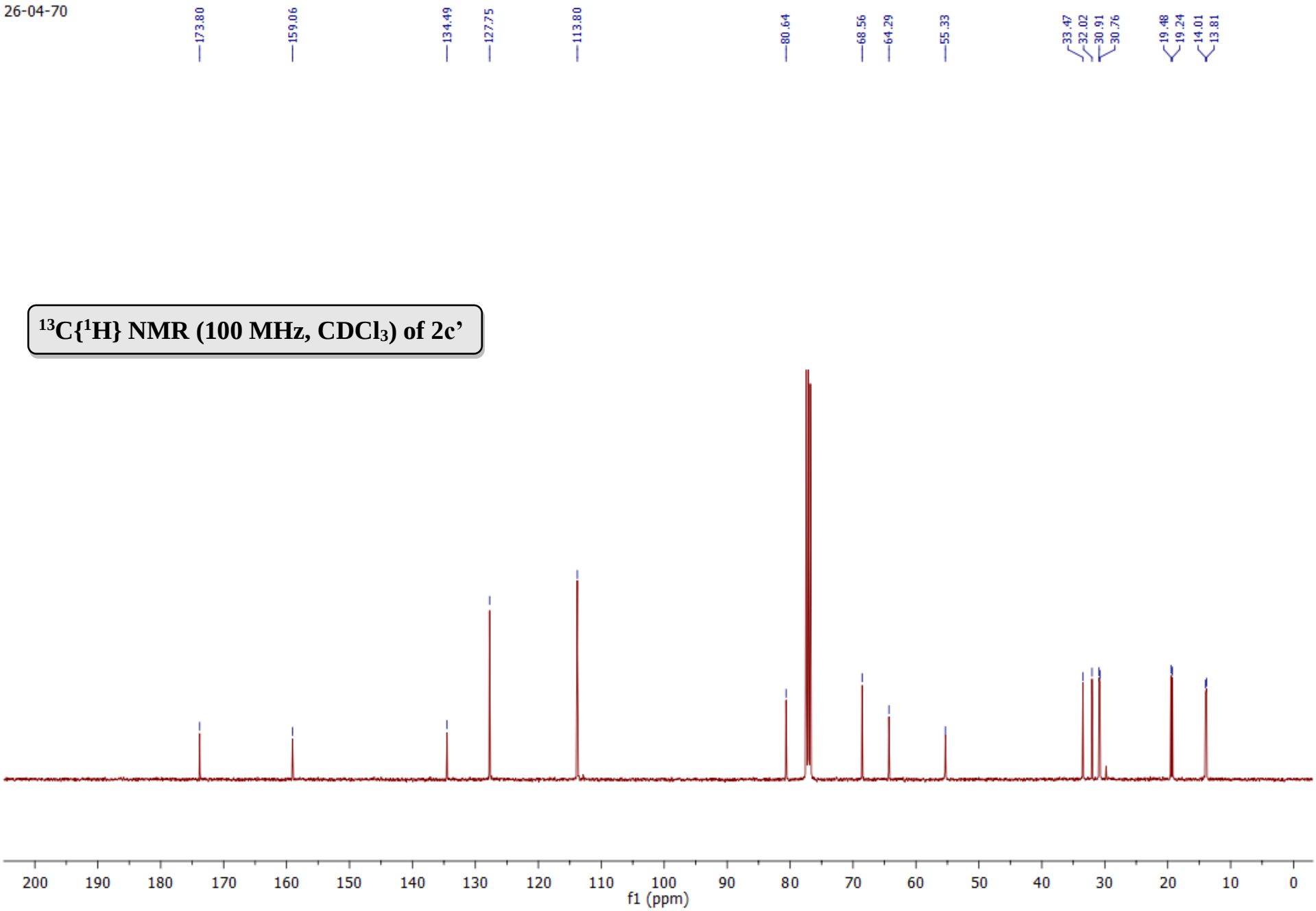


26-04-70

^{1}H NMR (400 MHz, $CDCl_3$) of 2c'



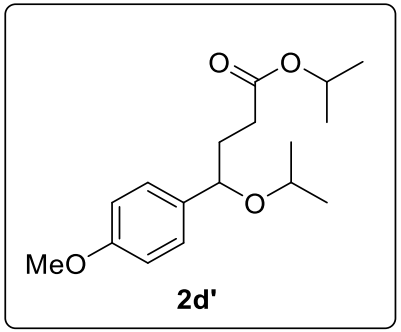
2c'



$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 2c'

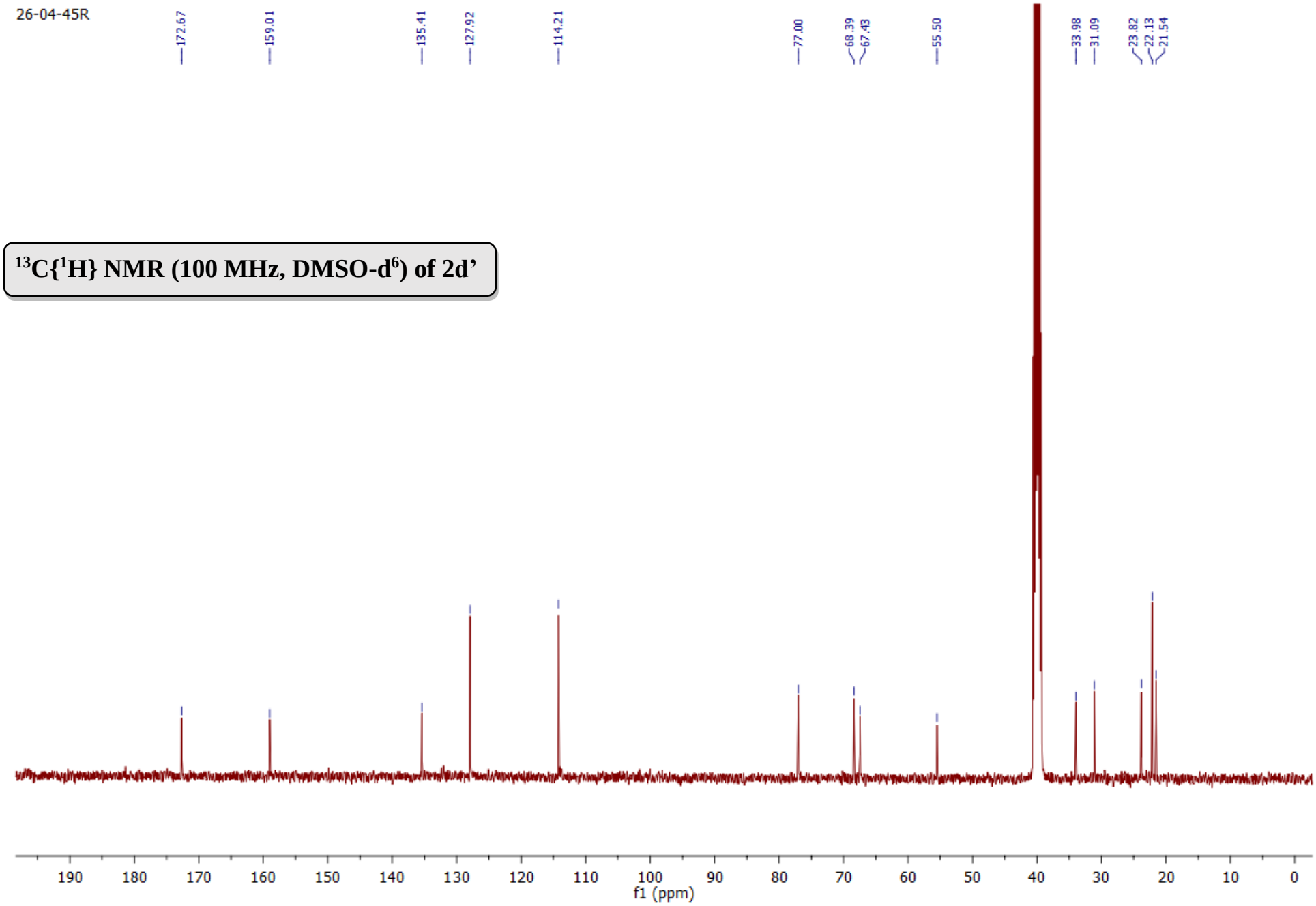
26-04-45

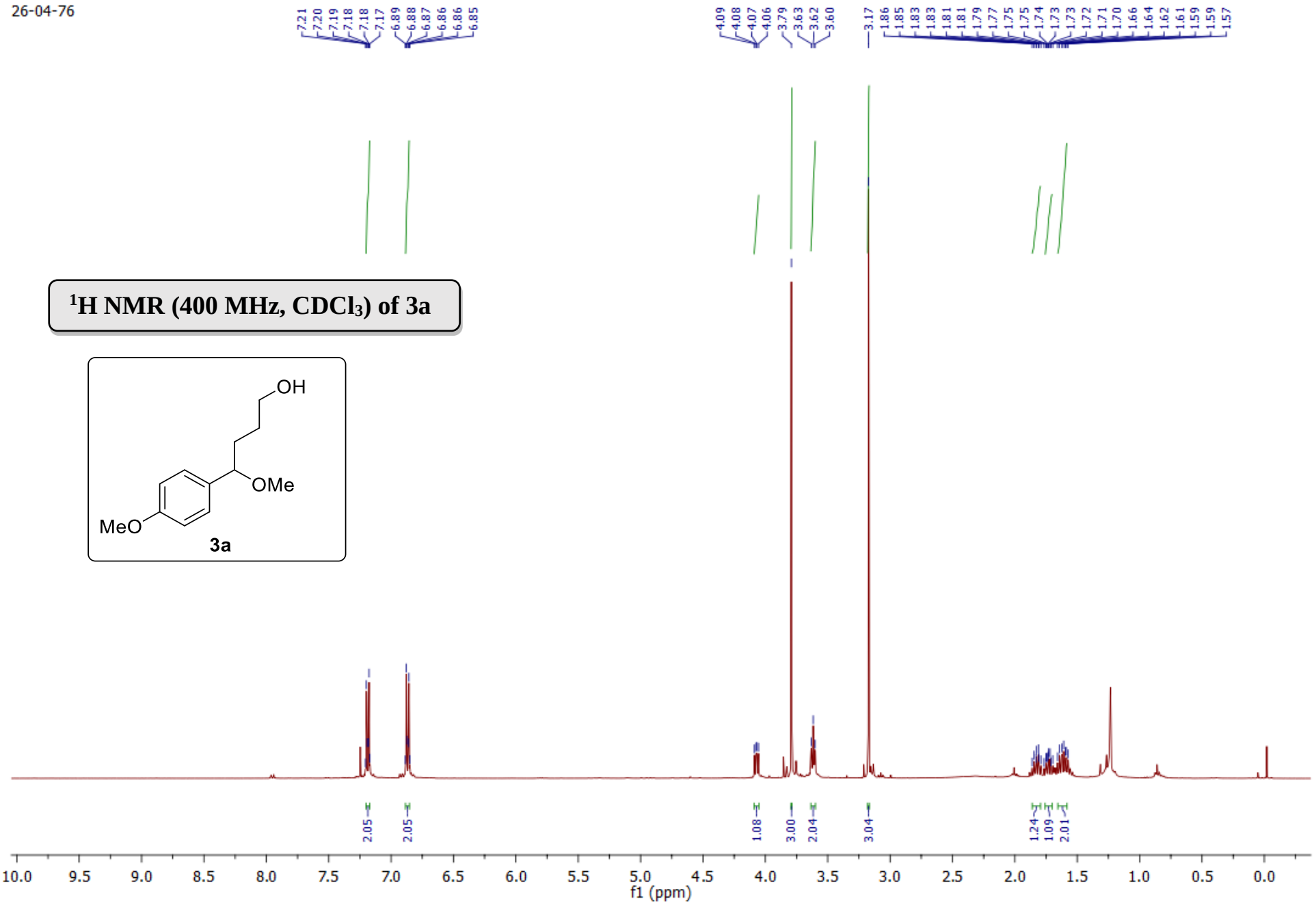
^{1}H NMR (400 MHz, $CDCl_3$) of 2d'

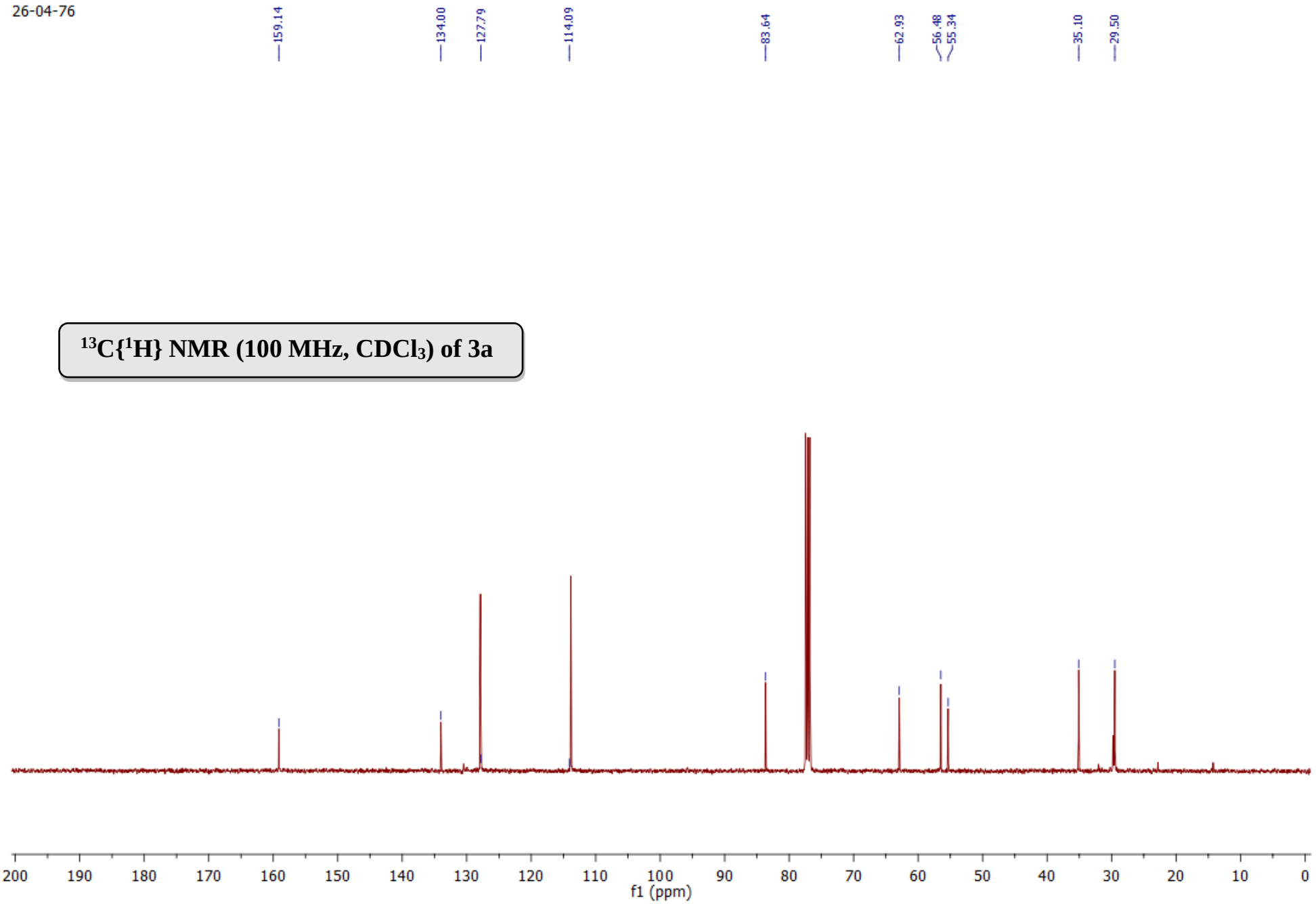


2d'

$^{13}C\{^{1}H\}$ NMR (100 MHz, DMSO-d^{6}) of 2d'

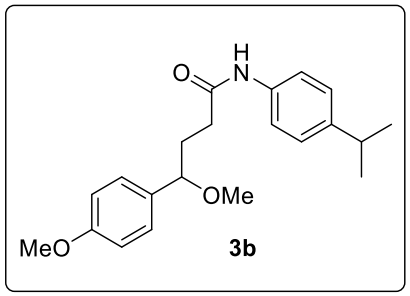


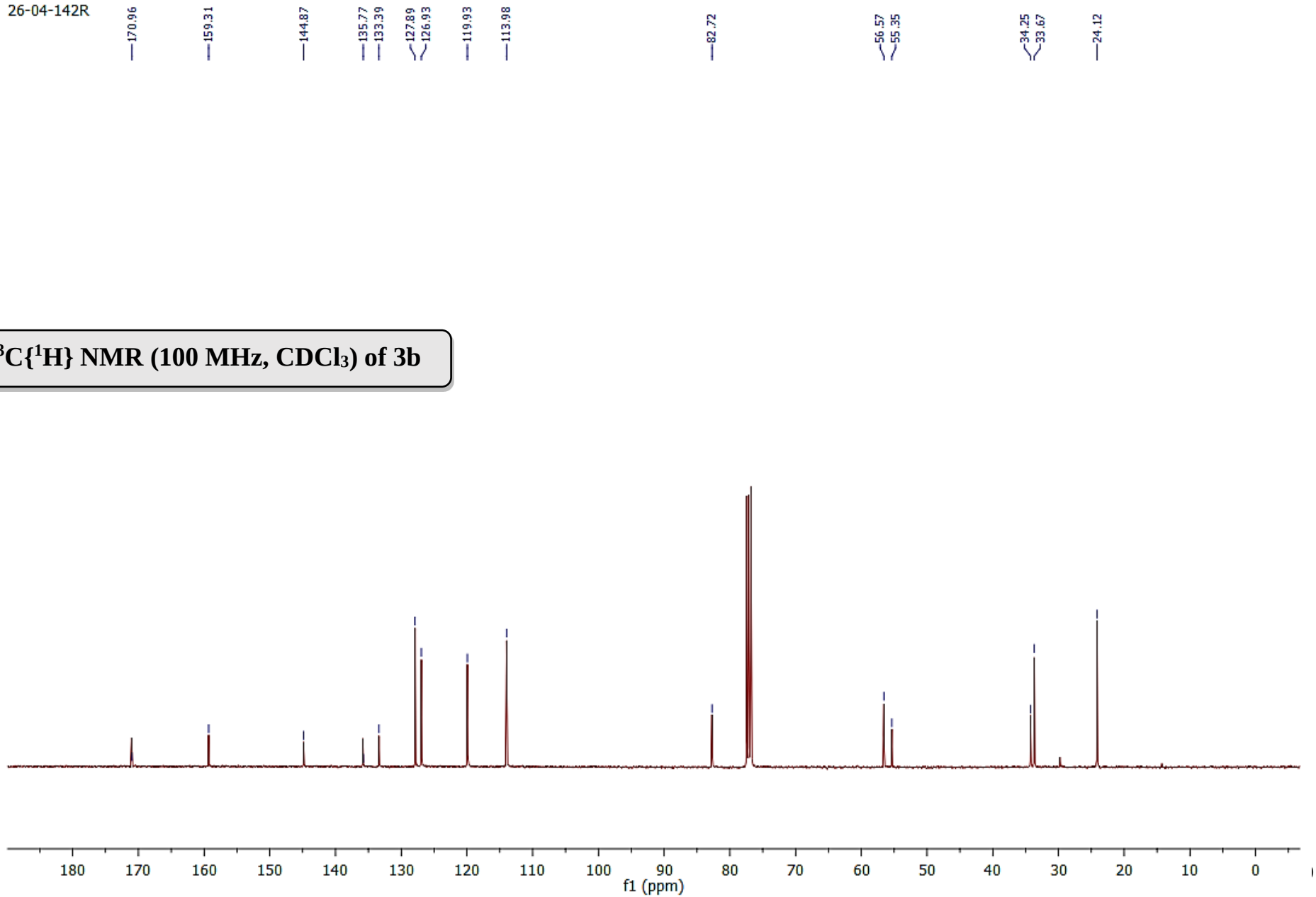

26-04-76
7.21
7.20
7.19
7.18
7.18
7.17
6.89
6.88
6.87
6.86
6.86
6.85
4.09
4.08
4.07
4.06
3.79
3.63
3.62
3.60
3.17
1.86
1.85
1.83
1.83
1.81
1.81
1.79
1.77
1.75
1.75
1.74
1.73
1.73
1.72
1.71
1.70
1.66
1.64
1.62
1.61
1.59
1.59
1.57
^{1}H NMR (400 MHz, CDCl$_3$) of 3a
OH
OMe
MeO
3a
2.05
2.05
1.08
3.00
2.04
3.04
1.24
1.09
2.01
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)



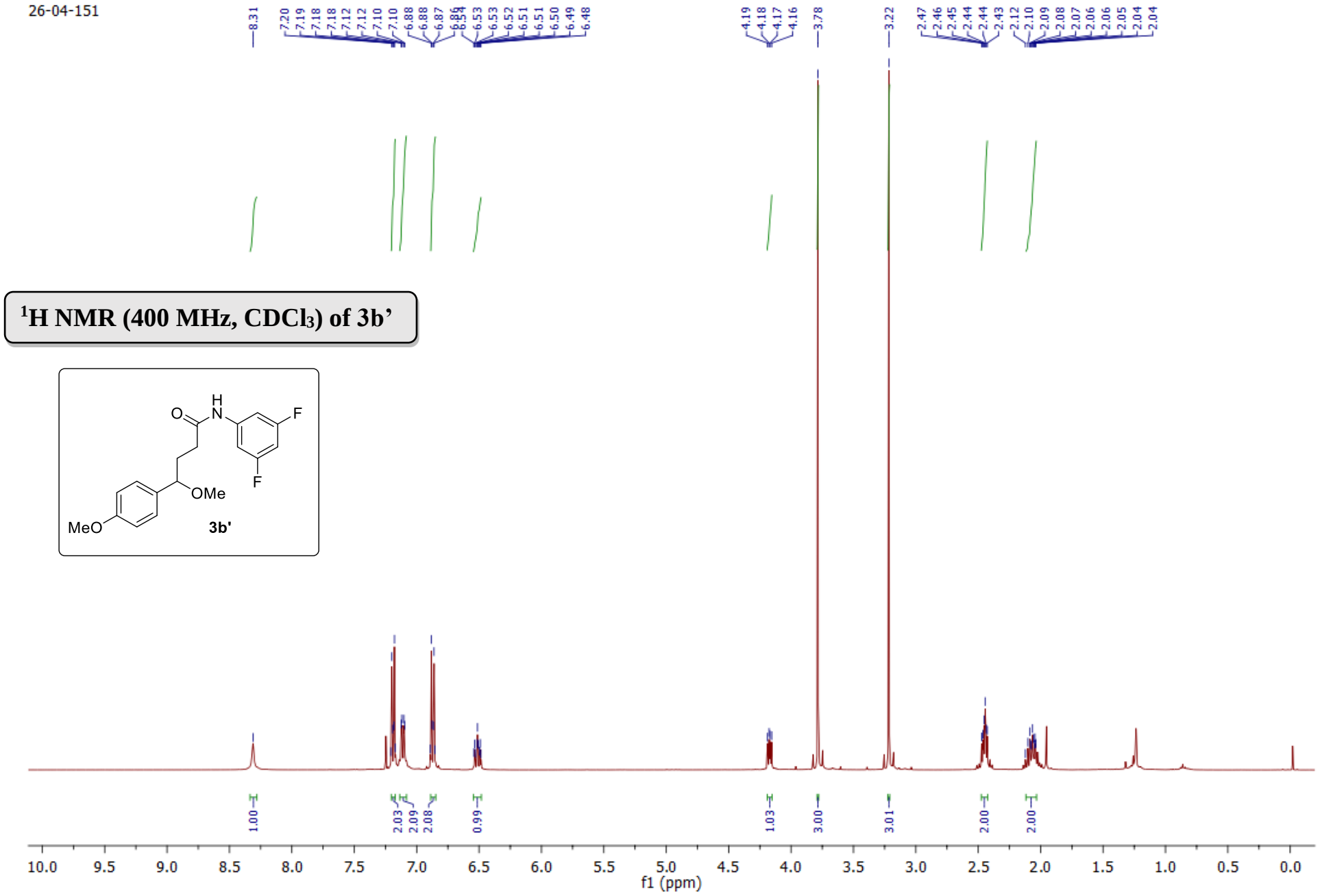
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 3a

^{1}H NMR (400 MHz, $CDCl_3$) of 3b





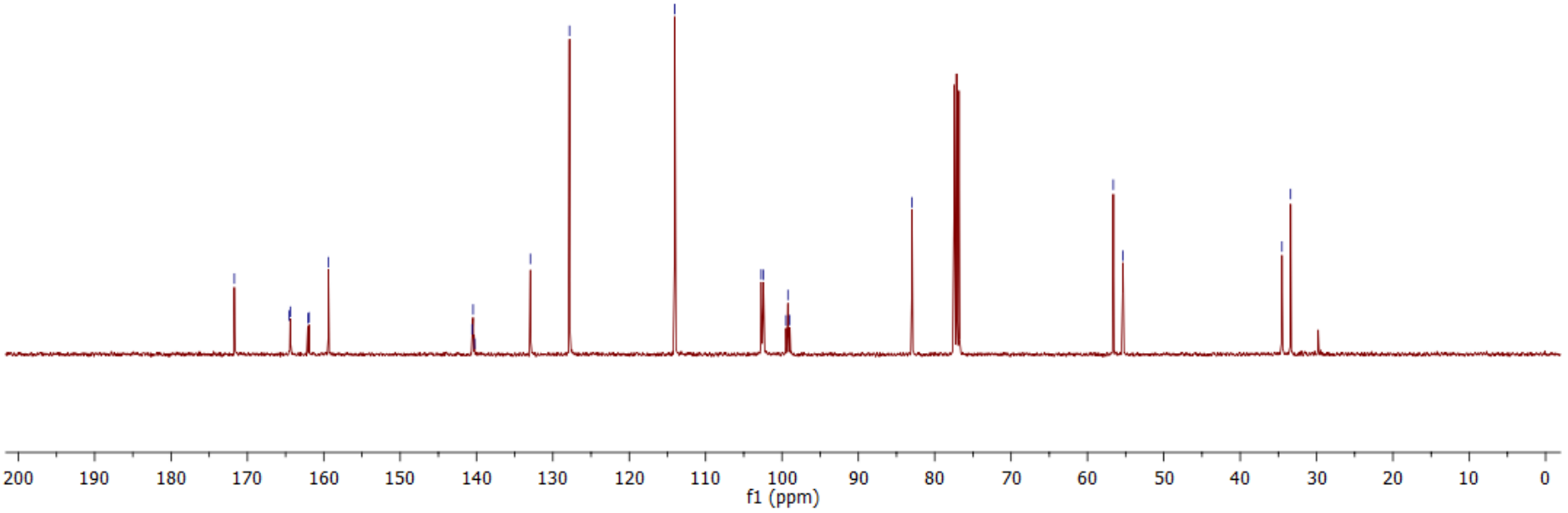
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 3b


26-04-151
8.31
7.20
7.19
7.18
7.18
7.12
7.12
7.10
7.10
6.88
6.88
6.87
6.86
6.54
6.53
6.53
6.52
6.51
6.51
6.50
6.49
6.48
4.19
4.18
4.17
4.16
3.78
3.22
2.47
2.46
2.45
2.44
2.44
2.43
2.12
2.10
2.09
2.08
2.07
2.06
2.06
2.05
2.04
2.04
1H NMR (400 MHz, CDCl3) of 3b'
O
H
N
F
F
OMe
MeO
3b'
1.00
2.03
2.09
2.08
0.99
1.03
3.00
3.01
2.00
2.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

26-04-151

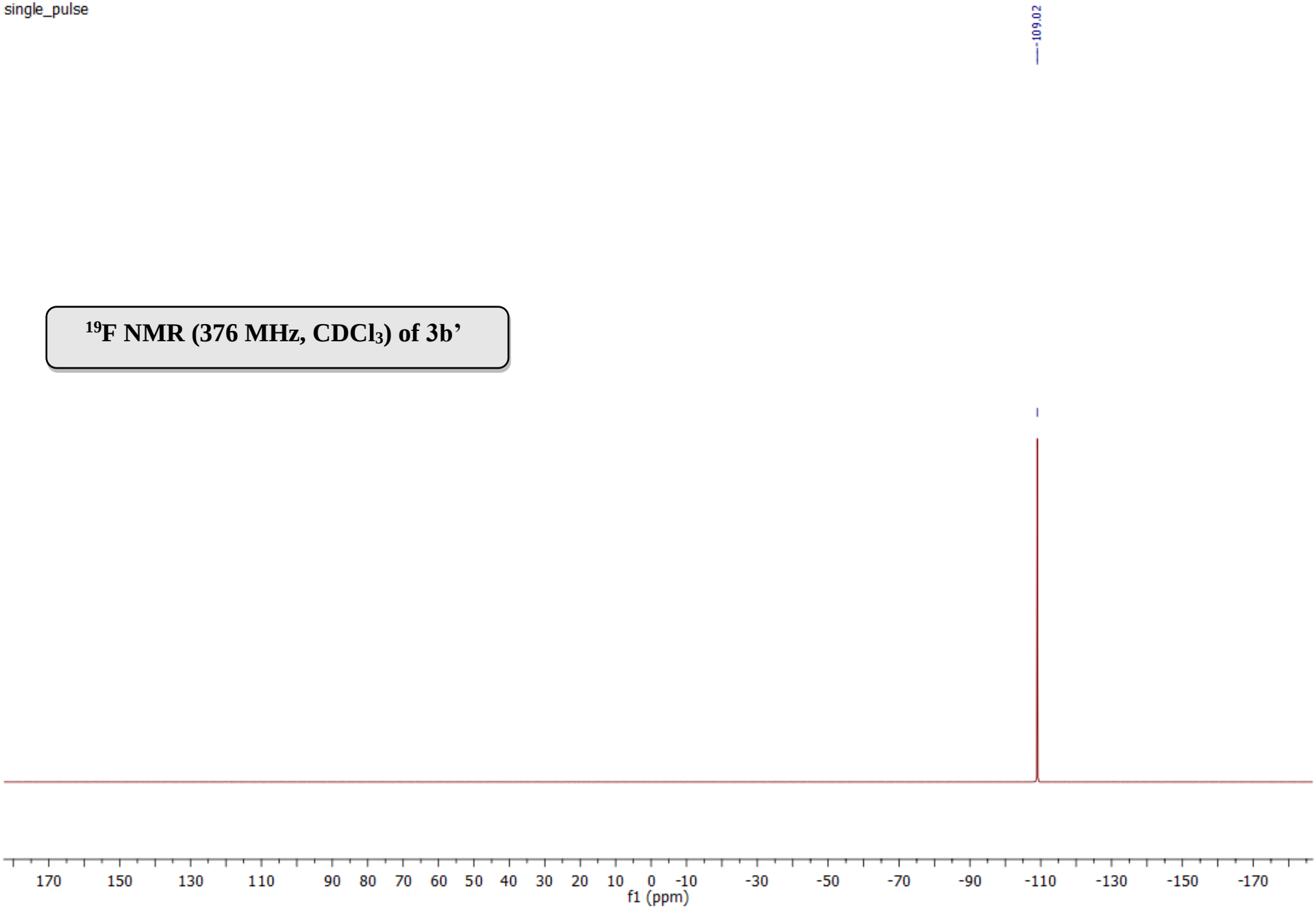
171.71
164.53
164.38
162.08
161.93
159.40
140.58
140.45
140.24
132.95
127.83
114.05
102.72
102.43
99.47
99.22
98.96
82.99
56.61
55.36
34.53
33.40

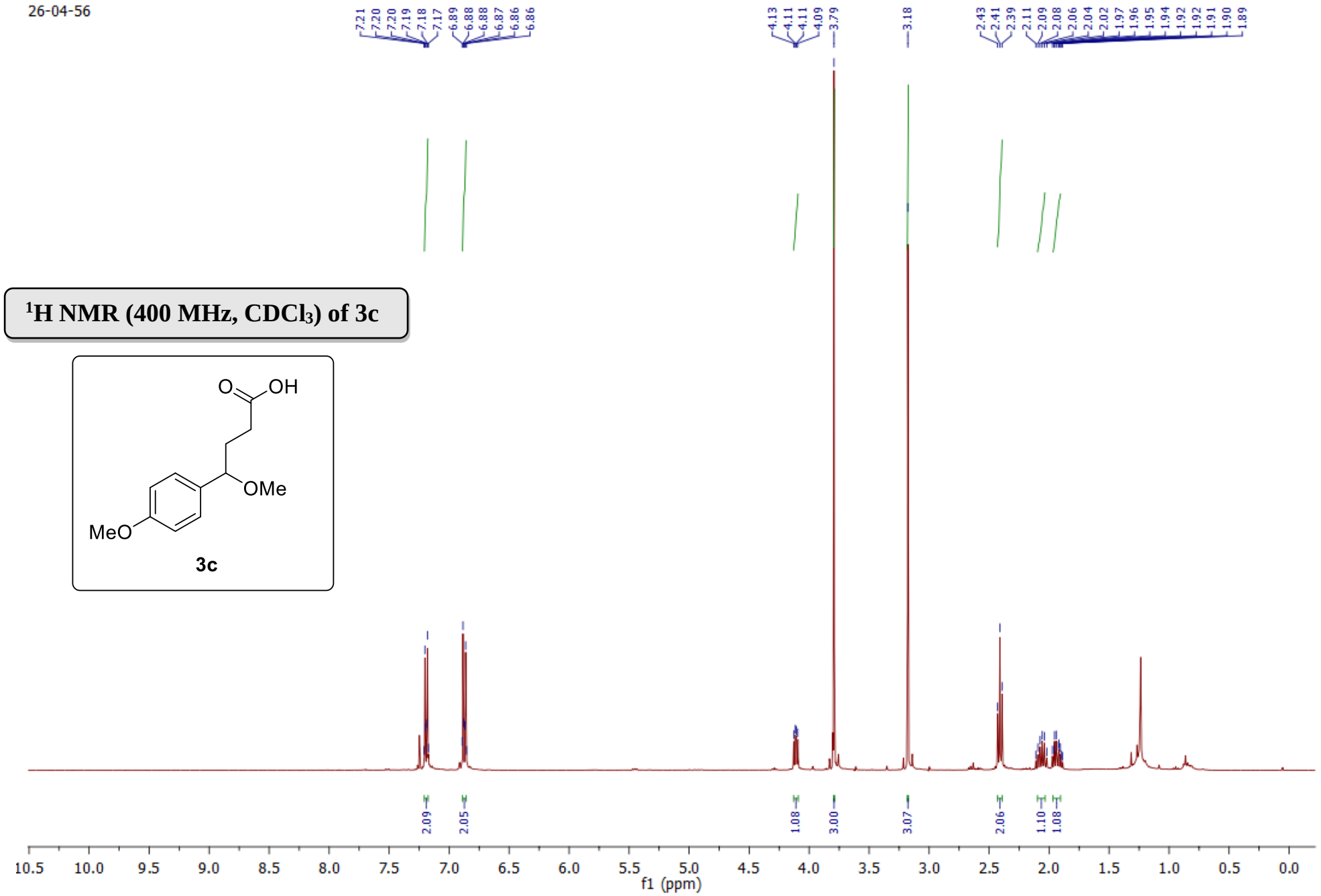
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 3b'



single_pulse

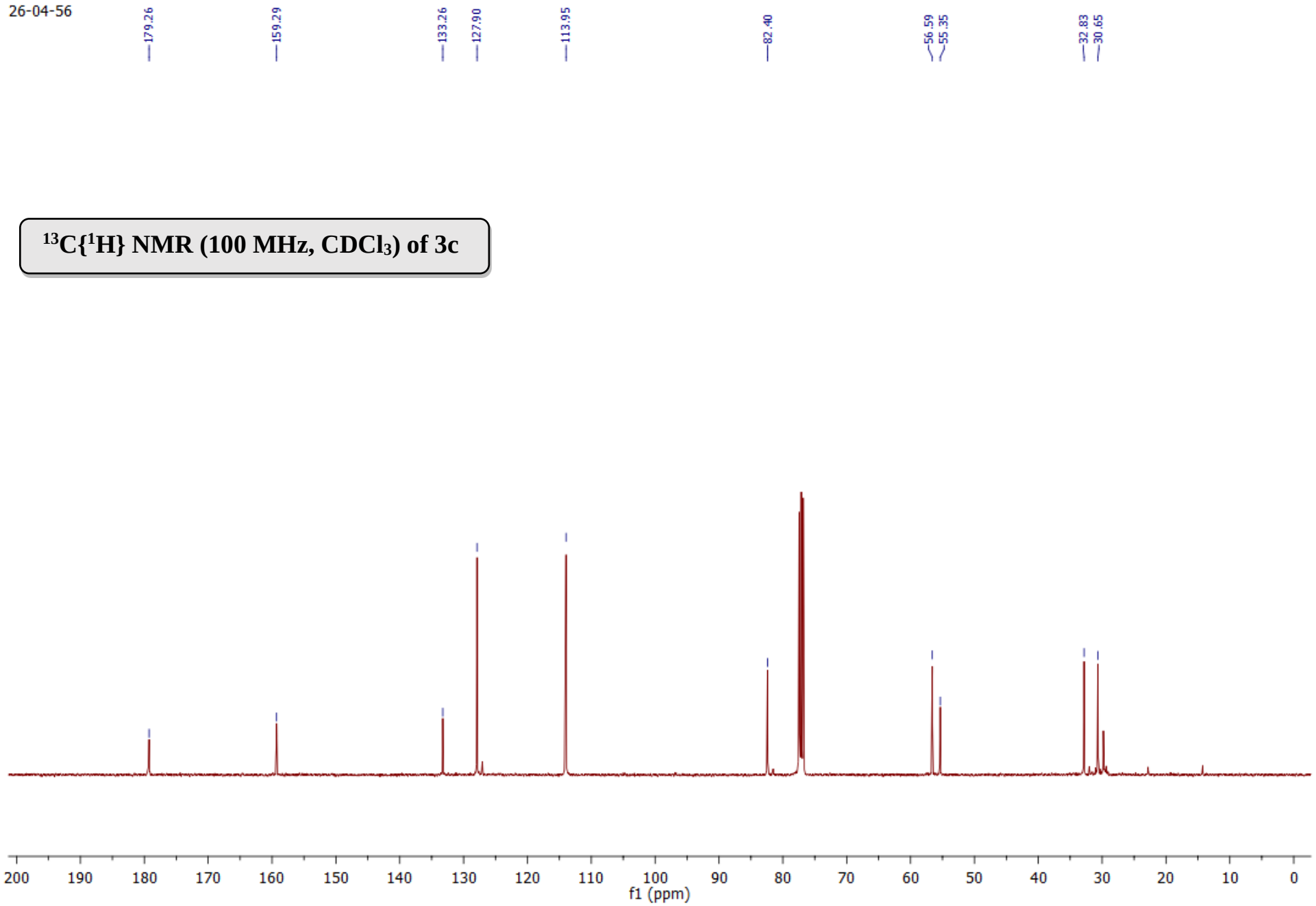
^{19}F NMR (376 MHz, $CDCl_3$) of 3b'





^{1}H NMR (400 MHz, $CDCl_3$) of 3c

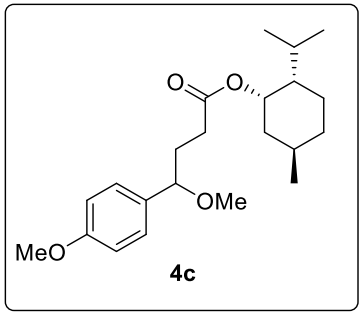
3c



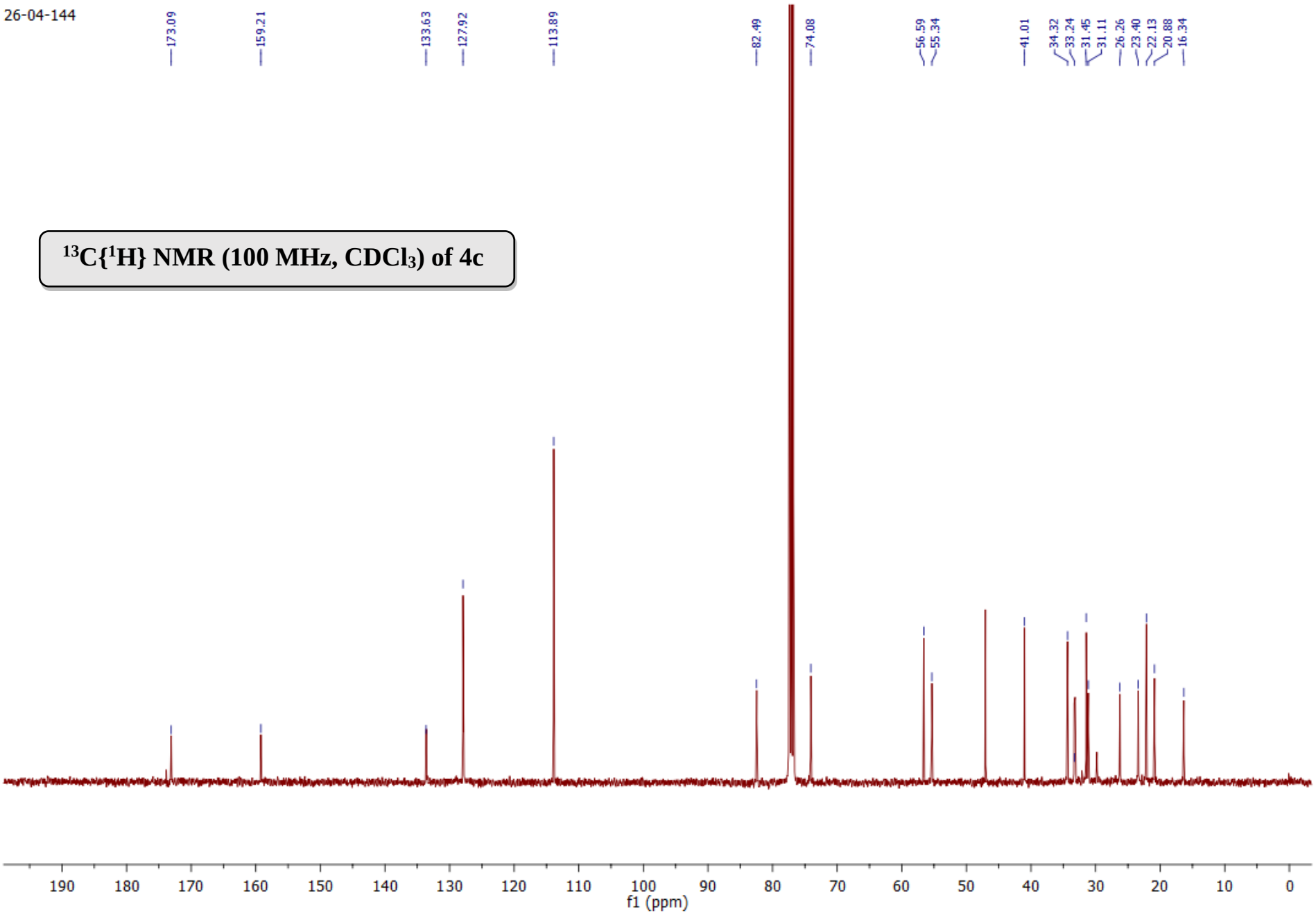
$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 3c

26-04-144

^{1}H NMR (400 MHz, $CDCl_3$) of 4c

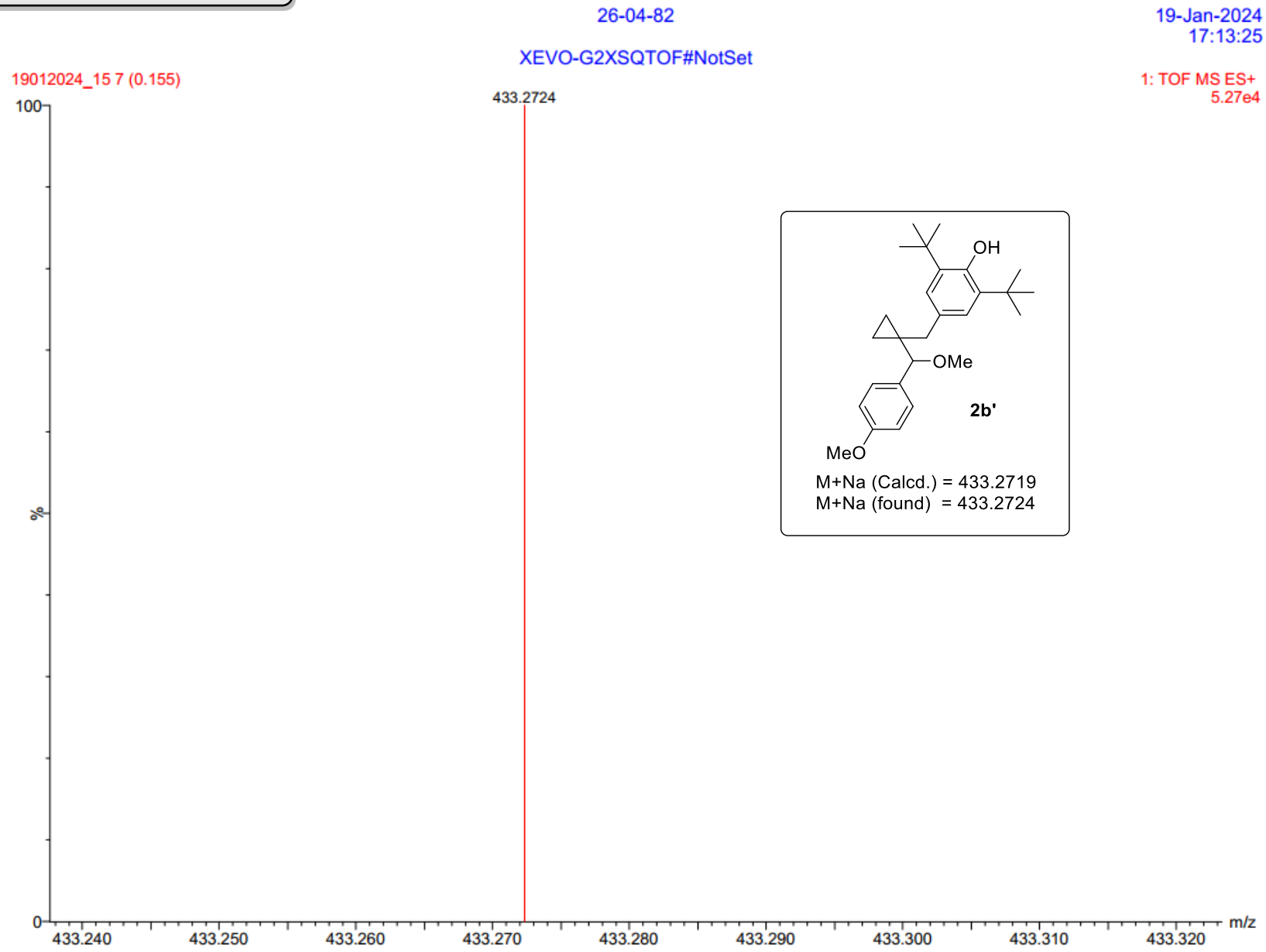


4c

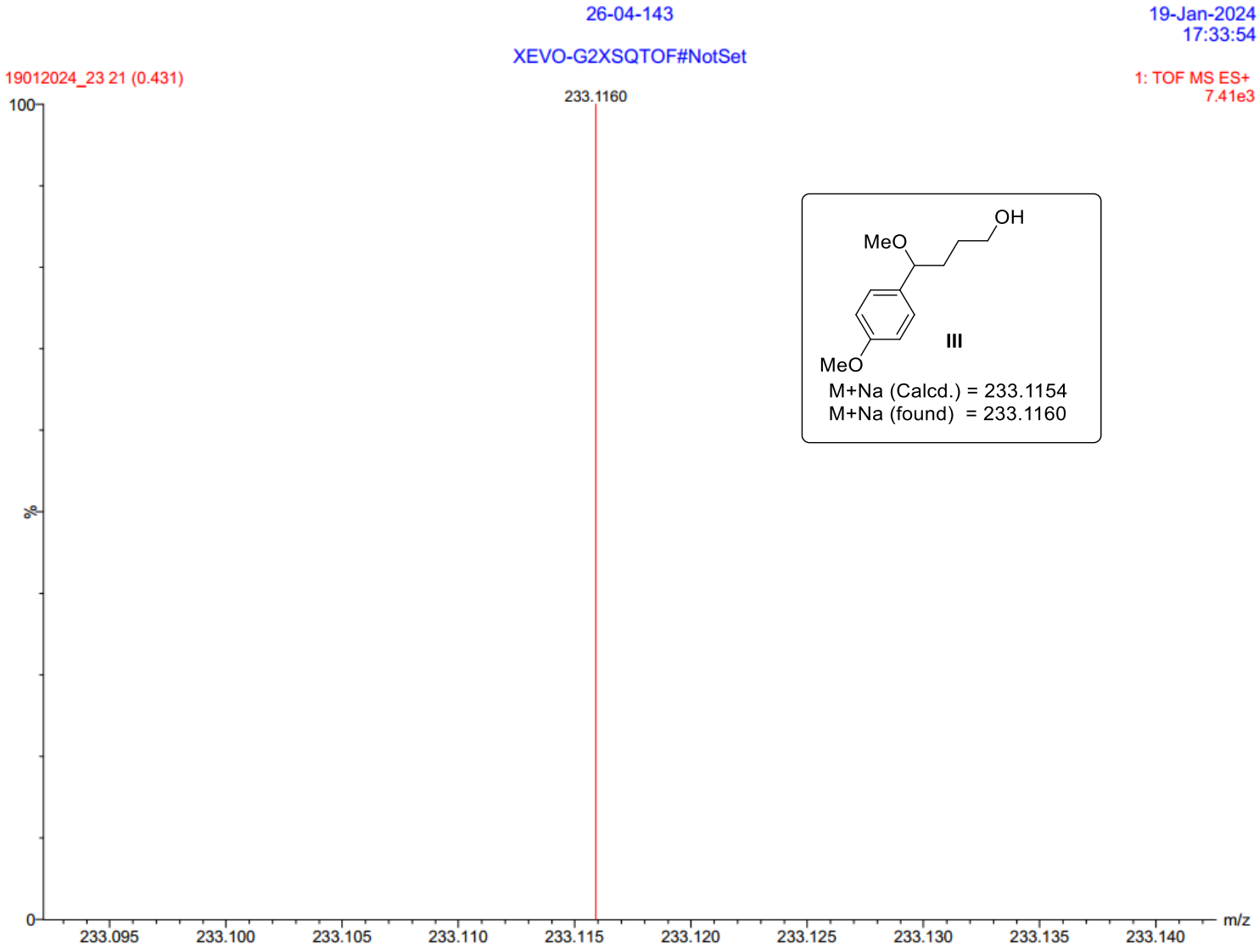


$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) of 4c

HRMS of 2b’


26-04-82
XEVO-G2XSQTOF#NotSet
19-Jan-2024
17:13:25
19012024_15 7 (0.155)
1: TOF MS ES+
5.27e4
433.2724
100
%
0
433.240
433.250
433.260
433.270
433.280
433.290
433.300
433.310
433.320
m/z
OH
OMe
MeO
2b'
M+Na (Calcd.) = 433.2719
M+Na (found) = 433.2724

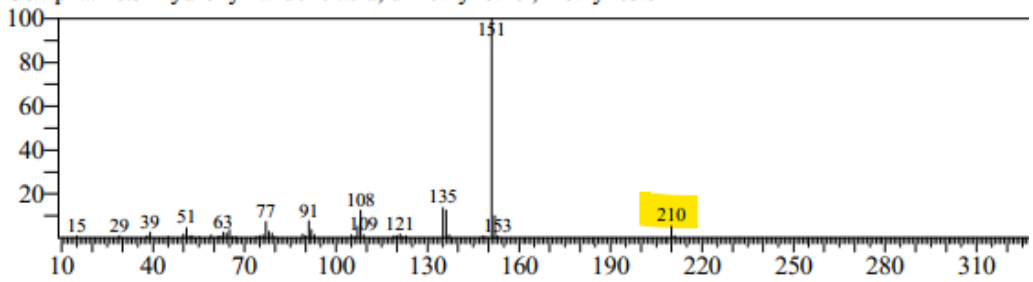
HRMS of intermediate III



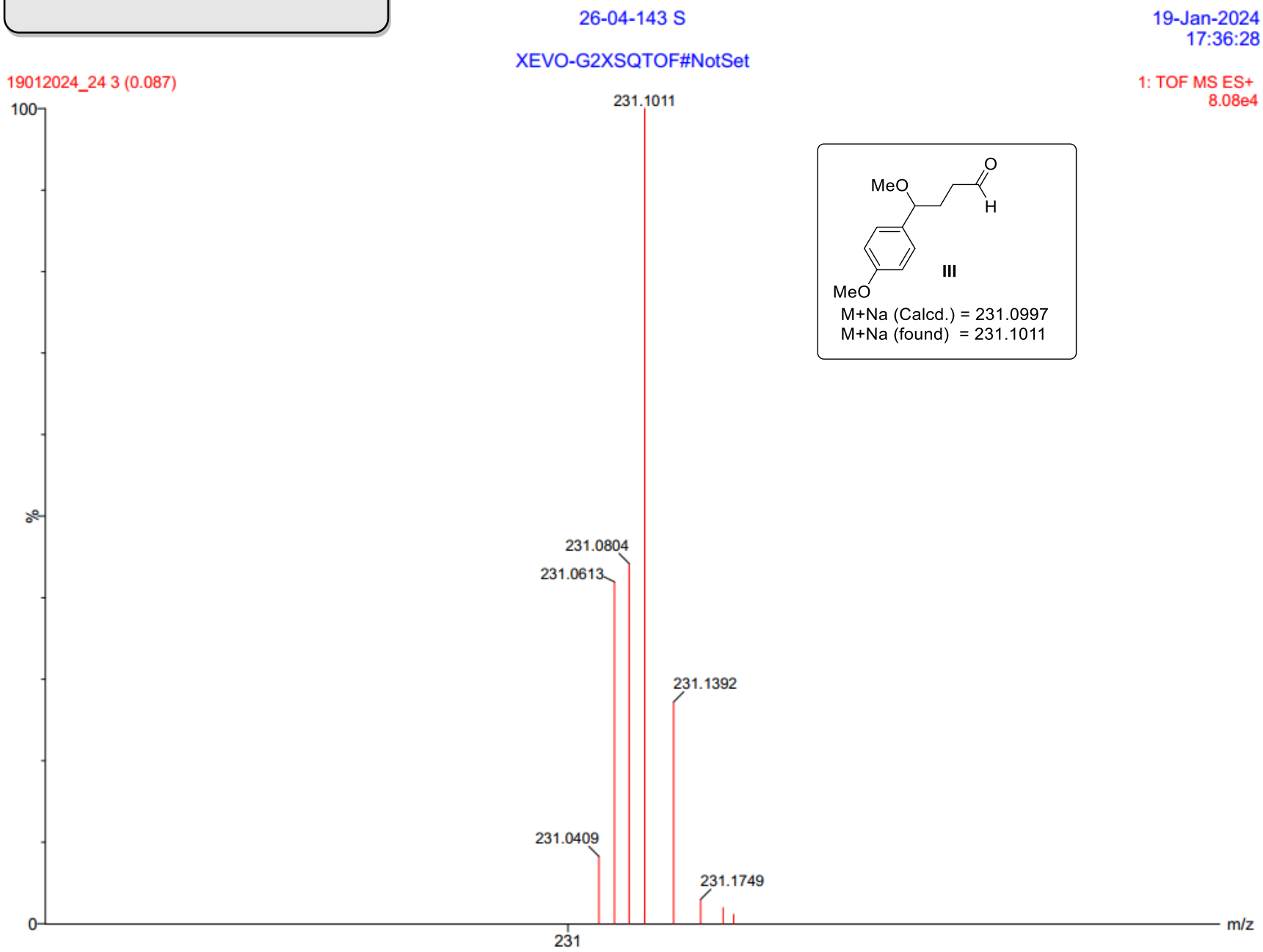
GC-MS of Reaction mixture

Base peak of III-210

Hit#:1 Entry:80999 Library:NIST17.lib
SI:79 Formula:C11H14O4 CAS:0-00-0 MolWeight:210 RetIndex:1460
CompName:3-Hydroxymandelic acid, dimethyl ether, methyl ester

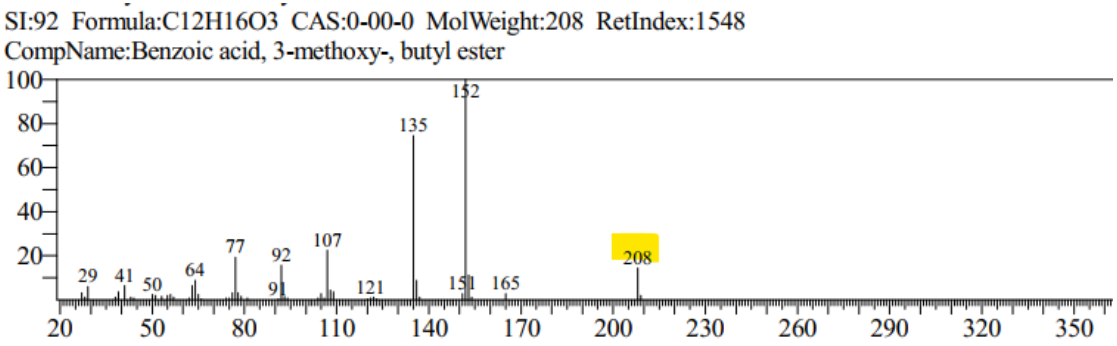


HRMS of intermediate IV



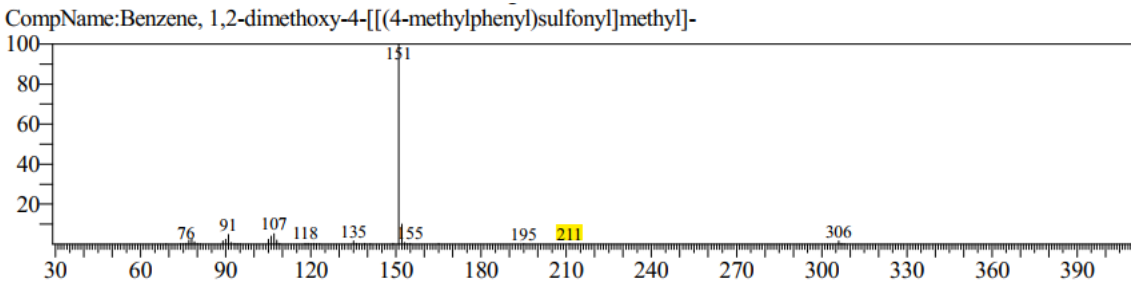
GC-MS of Reaction mixture

Base peak of IV-208



GC-MS of Reaction mixture

Base peak of III'-211



N) References

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