Supporting Information

for

(*Z*)-Selective Transfer Semihydrogenation of Alkynes Catalyzed by *in situ* Generated Oxidizable Copper Nanoparticles

Rafał Kusy* and Karol Grela*

Institute of Organic Chemistry, Polish Academy of Sciences, Kasprzaka 44/52, 01-224 Warsaw, Poland

E-mail: prof.grela@gmail.com, raphal.qs@gmail.com

CONTENTS

1. General information

All chemicals were purchased from Alfa Aesar, Acros Organics, TCI, Fluorochem, Sigma Aldrich, or Strem and used without further purification.

Unless stated otherwise, all reactions were carried out under an argon atmosphere. In case of water-sensitive reactions, the glassware was dried in an oven prior to use. THF and DME were dried with sodium/potassium and distilled under an argon atmosphere. MeOH was dried by the addition of magnesium and sodium and distilled over produced methanolates. EtOH was dried using molecular sieves. Et_3N, MeCN, *i*PrOH were dried with CaH_2 and distilled under argon atmosphere. All chemicals were purchased from Aldrich, Fluorochem or TCI and used without further purification. Merck silica gel (60, 230-400 mesh) was used for column chromatography.

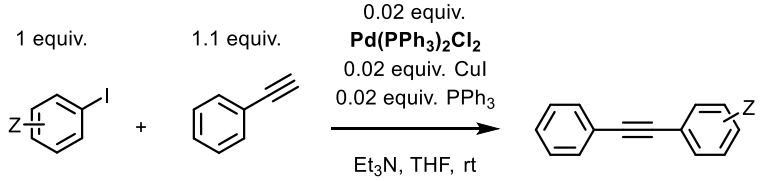
The screening reactions were performed using the Radleys Carousel reactor. GC analyses were performed employing PerkinElmer Clarus 680 chromatograph. Conversions and diastereomeric ratios were determined using GC chromatograms analysis. Durene was used as an internal standard.

^1H NMR, ^2H NMR, ^{13}C NMR, and ^{19}F NMR spectra were recorded on Agilent Mercury 400 MHz, Varian 500 MHz, or Varian 600 MHz spectrometer at room temperature. Chemical shifts (δ) were expressed in parts per million (ppm) and referenced to residual $CDCl_3$ signals. In the ^1H NMR spectra of substrates and products containing aromatic rings, the highest coupling constants were provided and multiplicity was described as a doublet of multiplets (dm) or triplet of multiplets (tm), to be consistent with the cited literature. EI and ESI mass spectra were obtained on AutoSpec Premier spectrometer. IR spectra were recorded on JASCO FT/IR-6200 spectrometer.

2. Procedures

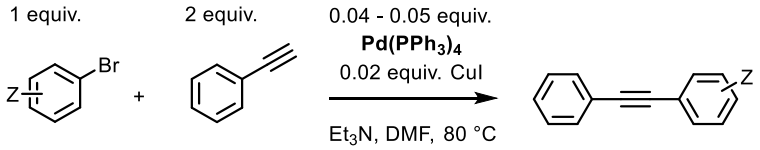
2.1. Substrates synthesis

2.1.1. General procedure of aryl-aryl alkynes synthesis from aryl iodides



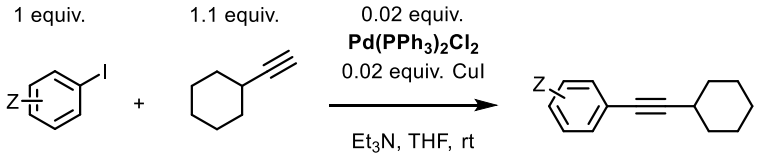
An oven-dried Schlenk flask was charged with CuI (0.5 mmol, 0.02 equiv.), PPh_3 (0.5 mmol, 0.02 equiv.), $Pd(PPh3)_2Cl_2$ (0.5 mmol, 0.02 equiv.) and solid aryl iodide (25 mmol, 1 equiv.). The vessel was evacuated and backfilled with argon three times. Subsequently, dry THF (50 ml), phenylacetylene (27.5 mmol, 1.1 equiv.), and dry Et_3N (50 ml) were added and the mixture was stirred. After completion of the reaction, which was indicated by TLC, the mixture was quenched with water and the aqueous phase was extracted three times with AcOEt (3×50 ml). The combined extracts were dried over $MgSO_4$ and the solvents were evaporated under reduced pressure. The product was purified by column chromatography. Further recrystallization or vacuum distillation was used if needed.

2.1.2. General procedure of aryl-aryl alkynes synthesis from aryl bromides



An oven-dried Schlenk flask was charged with CuI (0.5 mmol, 0.02 equiv.), $Pd(PPh3)_4$ (1.25 mmol, 0.05 equiv.) and solid aryl bromide (25 mmol, 1 equiv.). The vessel was evacuated and backfilled with argon three times. Subsequently, dry DMF (60 ml), phenylacetylene (50 mmol, 2 equiv.), and dry Et_3N (10 ml) were added and the mixture was stirred at 80 °C. After completion of the reaction, which was indicated by GC or TLC, the mixture was quenched with water and the aqueous phase was extracted three times with AcOEt (3×50 ml). The combined extracts were dried over $MgSO_4$ and the solvents were evaporated under reduced pressure. The product was purified by column chromatography. Further recrystallization or vacuum distillation was used if needed.

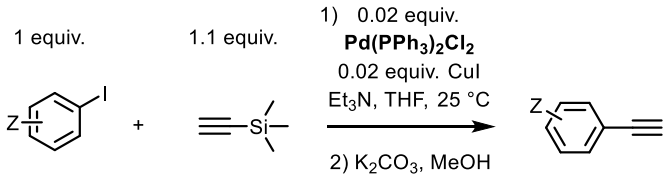
2.1.3. General procedure of aryl-alkyl alkynes synthesis from aryl iodides



An oven-dried Schlenk flask was charged with CuI (0.5 mmol, 0.02 equiv.), PPh_3 (0.5 mmol, 0.02 equiv.), $Pd(PPh3)_2Cl_2$ (0.5 mmol, 0.02 equiv.) and solid aryl iodide (25 mmol, 1 equiv.). The vessel was evacuated and backfilled with argon three times. Subsequently, dry THF (50 ml), ethynylcyclohexane (27.5 mmol, 1.1 equiv.), and dry Et_3N (50 ml) were added and the mixture was stirred. After completion of the reaction, which was indicated by GC,

the mixture was quenched with water and the aqueous phase was extracted three times with AcOEt (3×50 ml). The combined extracts were dried over $MgSO_4$ and the solvents were evaporated under reduced pressure. The product was purified by column chromatography. Further vacuum distillation was used.

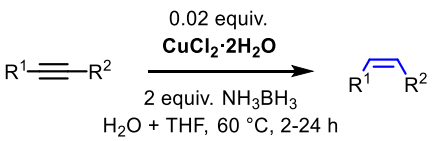
2.1.4. General procedure of terminal alkynes synthesis from aryl iodides



An oven-dried Schlenk flask was charged with CuI (0.5 mmol, 0.02 equiv.), PPh_3 (0.5 mmol, 0.02 equiv.), $Pd(PPh3)_2Cl_2$ (0.5 mmol, 0.02 equiv.) and solid aryl iodide (25 mmol, 1 equiv.). The vessel was evacuated and backfilled with argon three times. Subsequently, dry THF (50 ml), trimethylsilylacetylene (27.5 mmol, 1.1 equiv.) and dry Et_3N (50 ml) were added and the mixture was stirred. After completion of the reaction, which was indicated by TLC, the mixture was quenched with water and the aqueous phase was extracted three times with AcOEt (3×50 ml). The combined extracts were dried over $MgSO_4$ and the solvents were evaporated under reduced pressure. The product was purified by column chromatography followed by vacuum distillation. Subsequently, K_2CO_3 and methanol was added to the flask and the mixture was stirred. After completion of the reaction, which was indicated by TLC, methanol was evaporated and water with Et_2O were added. The aqueous phase was extracted three times with Et_2O. The combined extracts were dried over $MgSO_4$ and the solvents were evaporated under reduced pressure to obtain a pure product.

2.2. SEMIHYDROGENATION

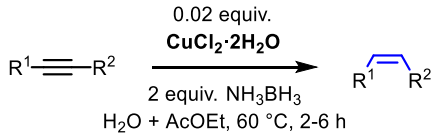
2.2.1. General procedure of alkyne semihydrogenation in THF–H_2O



A vial was charged with alkyne (0.5 mmol, 1 equiv.), THF (0.5 ml) and **$CuCl_2·2H_2O$** (0.01 mmol, 0.02 equiv.). Subsequently, ammonia-borane (1 mmol, 2 equiv.), THF (1.5 ml) and water (2 ml) were added to the solution. The mixture was stirred at 60 °C for 2-24 h. After completion of the reaction, which was indicated by GC or TLC, the mixture was quenched

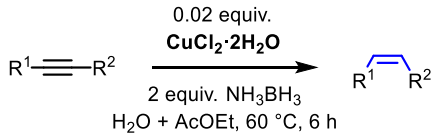
with water and the aqueous phase was extracted with DCM (3×15 ml). The combined extracts were dried over Na_2SO_4 and the solvents were evaporated under reduced pressure to obtain a pure product.

2.2.2. General procedure of alkyne semihydrogenation in AcOEt–H_2O



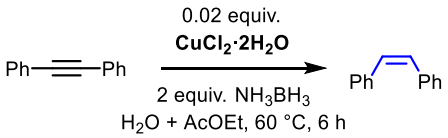
A vial was charged with alkyne (0.5 mmol, 1 equiv.), AcOEt (0.5 ml) and **$CuCl_2·2H_2O$** (0.01 mmol, 0.02 equiv.). Subsequently, ammonia-borane (1 mmol, 2 equiv.), AcOEt (1.5 ml) and water (2 ml) were added to the solution. The mixture was stirred at 60 °C for 2-24 h. After completion of the reaction, which was indicated by GC or TLC, the mixture was quenched with water and aqueous phase was with DCM (3×15 ml). The combined extracts were dried over Na_2SO_4 and the solvents were evaporated under reduced pressure to obtain pure product.

2.2.3. General procedure of alkyne semihydrogenation in MeOH



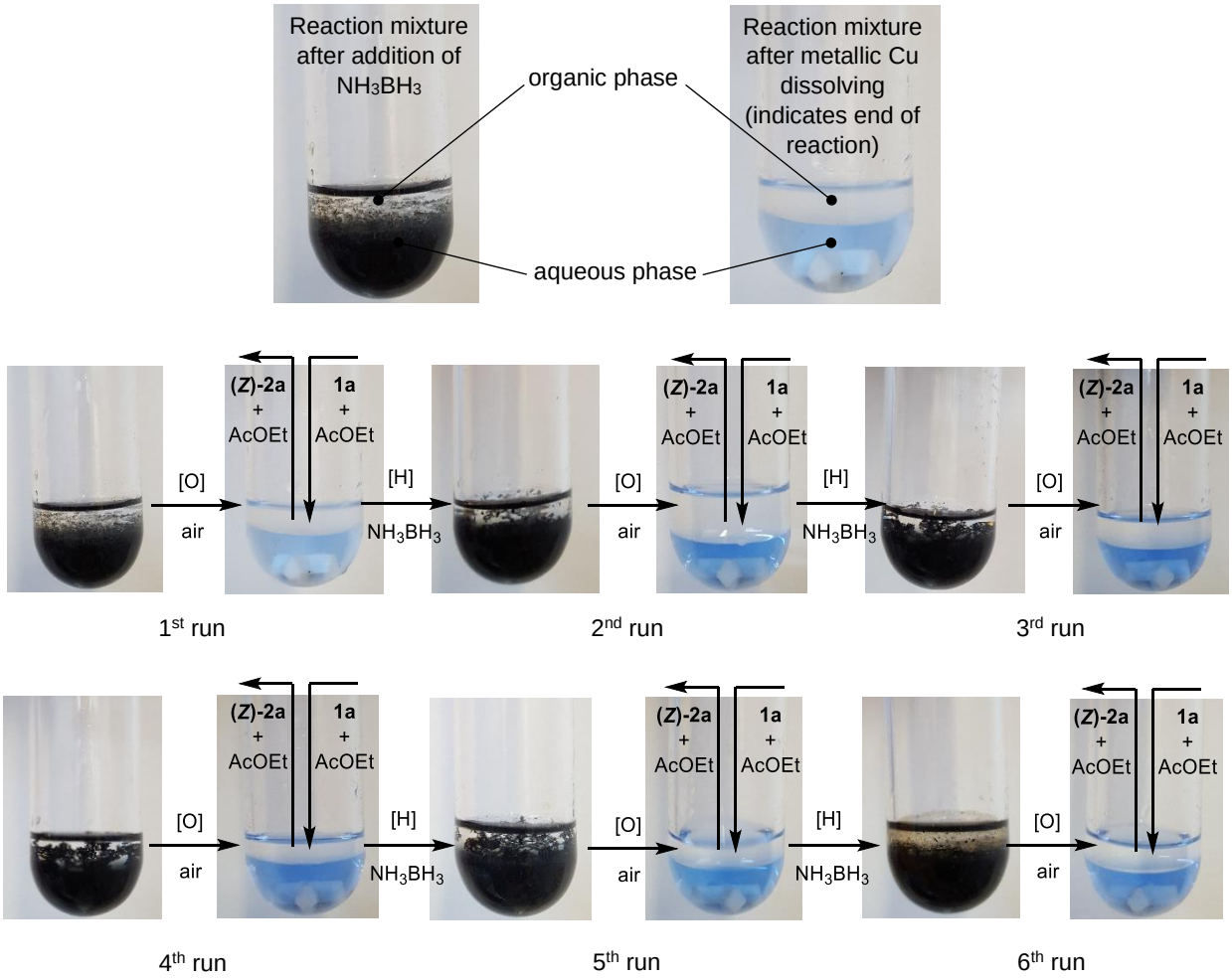
A vial was charged with alkyne (0.5 mmol, 1 equiv.), dry MeOH (0.5 ml), and **$CuCl_2·2H_2O$** (0.01 mmol, 0.02 equiv.). Subsequently, ammonia-borane (1 mmol, 2 equiv.) and dry MeOH (1.5 ml) were added to the solution. The mixture was stirred at 60 °C for 2-24 h. After completion of the reaction, which was indicated by GC or TLC, the mixture was quenched with water and the aqueous phase was extracted with DCM (3×15 ml). The combined extracts were dried over Na_2SO_4 and the solvents were evaporated under reduced pressure to obtain a pure product.

2.2.4. Recyclability test

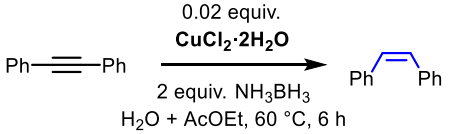


A vial was charged with diphenylacetylene (0.5 mmol, 1 equiv.), AcOEt (0.5 ml) and **$CuCl_2·2H_2O$** (0.01 mmol, 0.02 equiv.). Subsequently, ammonia-borane (1 mmol, 2 equiv.),

AcOEt (1.5 ml) and water (2 ml) were added to the solution. The mixture was stirred at 60 °C for 6 h and analyzed by GC. Once the black suspension turned into a blue solution, the organic phase was removed and the aqueous one was washed several times with AcOEt. An addition of diphenylacetylene (0.5 mmol, 1 equiv.), AcOEt (0.5 ml), ammonia-borane (1 mmol, 2 equiv.) and AcOEt (1.5 ml) allowed to carry out semihydrogenation of another portion of the substrate using the same catalyst.

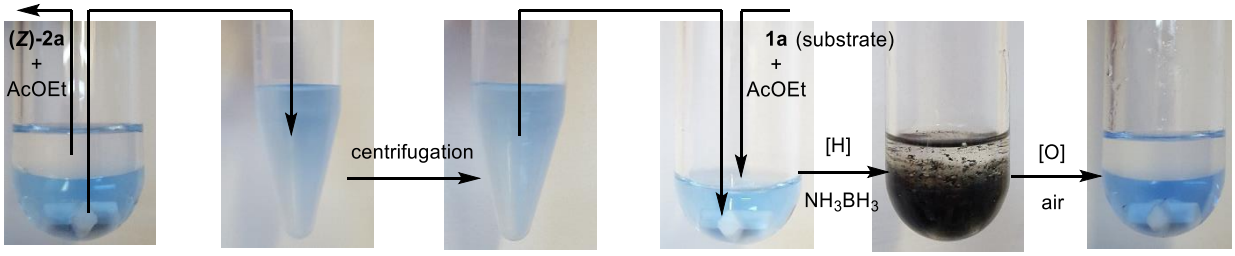


2.2.5. Recyclability test after centrifugation of an aqueous phase



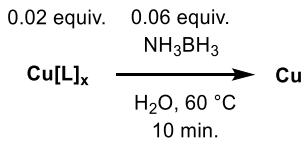
A vial was charged with diphenylacetylene (0.5 mmol, 1 equiv.), AcOEt (0.5 ml), and **$CuCl_2 \cdot 2H_2O$** (0.01 mmol, 0.02 equiv.). Subsequently, ammonia-borane (1 mmol, 2 equiv.),

AcOEt (1.5 ml) and water (2 ml) were added to the solution. The mixture was stirred at 60 °C for 6 h and analysed by GC. Once the black suspension turned into a blue solution, the organic phase was removed and the aqueous one was washed several times with AcOEt, transferred into an Eppendorf tube, and centrifuged for 20 min (11000 rpm). No precipitate was observed. The aqueous phase was decanted into an empty reaction vessel and followed by the addition of diphenylacetylene (0.5 mmol, 1 equiv.), AcOEt (0.5 ml), ammonia-borane (1 mmol, 2 equiv.) and AcOEt (1.5 ml) to carry out semihydrogenation of another portion of the substrate using the same catalyst.

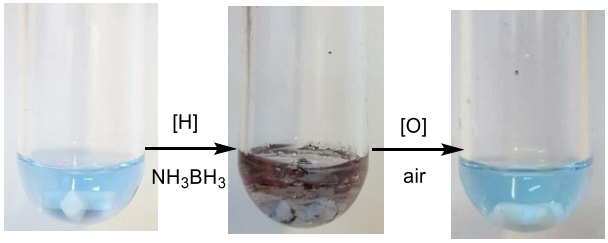


After 1st run | Homogeneous solution (no precipitate) | 2nd run

2.2.6. Reduction of the copper complex

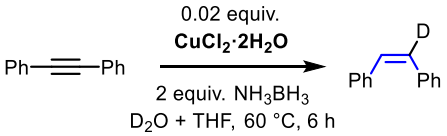


To the aqueous phase containing blue copper complex **$Cu[L]_x$** (0.01 mmol, 0.02 equiv.), obtained after semihydrogenatinon of diphenylactylene and placed in an open reaction tube, ammonia-borane (0.03 mmol, 0.06 equiv.) was added. The mixture was stirred at 60 °C for 10 min until the discoloration of the solution along with metallic copper production. The precipitate dissolving was observed when stirring was prolonged.



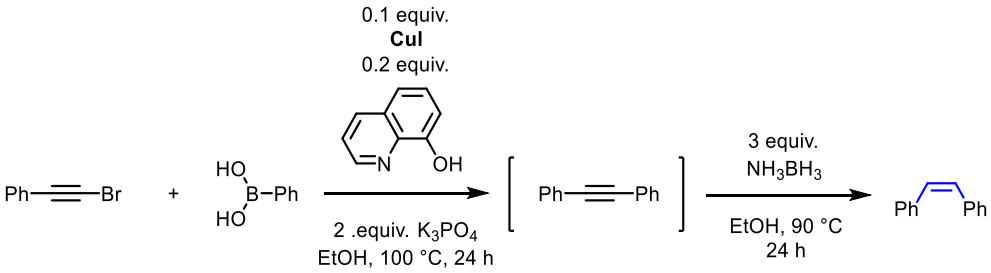
After 1st run | 2nd run

2.2.7. Isotope labeling



An oven-dried and argon-filled vial was charged with alkyne (0.5 mmol, 1 equiv.), THF (0.5 ml), and **$CuCl_2 \cdot 2H_2O$** (0.01 mmol, 0.02 equiv.). Subsequently, ammonia-borane (1 mmol, 2 equiv.), THF (1.5 ml) and D_2O (2 ml) were added to the solution. The mixture was stirred at 60 °C for 2-24 h. After completion of the reaction, which was indicated by GC or TLC, the mixture was quenched with water and the aqueous phase was extracted with DCM (3×15 ml). The combined extracts were dried over Na_2SO_4 and the solvents were evaporated under reduced pressure to obtain a pure product.

2.2.8. Tandem Suzuki coupling-semihydrogenation



An oven-dried and argon-filled ampula was charged with and **CuI** (0.1 mmol, 0.1 equiv.), 8-hydroxyquinoline (0.2 mmol, 0.2 equiv.), phenylboronic acid (1 mmol, 1 equiv.), and anhydrous K_3PO_4 (2 mmol, 2 equiv.). The vessel was evacuated and backfilled with argon three times. Subsequently, 1-bromo-2-phenylacetylene (1 mmol, 1 equiv.), and dry EtOH (3 ml) were added to the solution. The mixture was stirred at 100 °C for 24 h. After completion of the reaction, the vessel was cooled down to rt and ammonia-borane (3 mmol, 3 equiv.) was added followed by dry EtOH (2 ml). The mixture was stirred at 90 °C for 24 h and quenched with water and the aqueous phase was extracted three times with DCM (3×15 ml). The combined extracts were dried over Na_2SO_4 and the solvents were evaporated under reduced pressure. The product was purified by column chromatography.

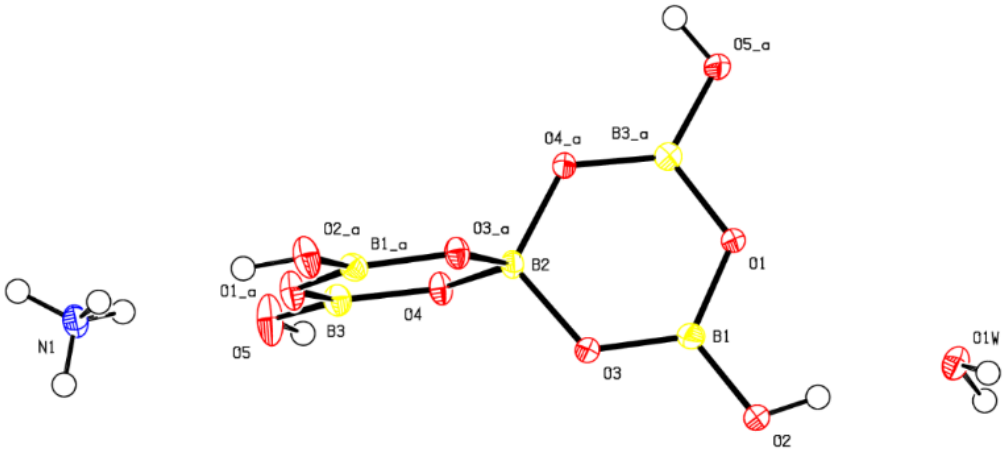
2.2.6. Transformation of borate to boric acid

To an aqueous phase containing spent ammonia-borane (0.01 mmol, 0.02 equiv.), obtained after semihydrogenatinon of diphenylactylene, concentrated HCl was added until

the mixture became acidic. The crude was dissolved in DMSO-d_6 and analysed using ^{11}B NMR (page S124).

An obtained solid ammonium pentaborate was dissolved in water and concentrated HCl was added until the mixture became acidic. The crude was dissolved in DMSO-d_6 and analysed using ^{11}B NMR (page S125).

3. Crystallographic data and measurement details



Ortep drawing of **$(NH_4)B_5O_6(OH)_4{\cdot}2H_2O$**

```
Bond precision:  O- B = 0.0030 A          Wavelength=0.71073

Cell:            a=11.3246(3)      b=11.0147(3)      c=9.1513(3)
                 alpha=90          beta=90           gamma=90
Temperature:     100 K

                 Calculated                Reported
Volume           1141.51(6)                1141.51(6)
Space group      A b a 2                   A b a 2
Hall group       A 2 -2ac                  A 2 -2ac
Moiety formula   B5 H4 O10, 2(H2 O), H4 N  N H4 [B5 O10 H4], 2(H2 O)
Sum formula      B5 H12 N O12              H12 B5 N O12
Mr               272.16                    272.16
Dx,g cm-3        1.584                     1.584
Z                4                         4
Mu (mm-1)        0.158                     0.158
F000             560.0                     560.0
F000'            560.48
h,k,lmax         15,15,12                  15,14,12
Nref             1669[ 884]                1271
Tmin,Tmax        0.968,0.981               0.872,1.000
Tmin'            0.961

Correction method= # Reported T Limits: Tmin=0.872 Tmax=1.000
AbsCorr = MULTI-SCAN

Data completeness= 1.44/0.76      Theta(max)= 30.096

R(reflections)= 0.0297( 1217)     wR2(reflections)= 0.0764( 1271)

S = 1.092                 Npar= 97
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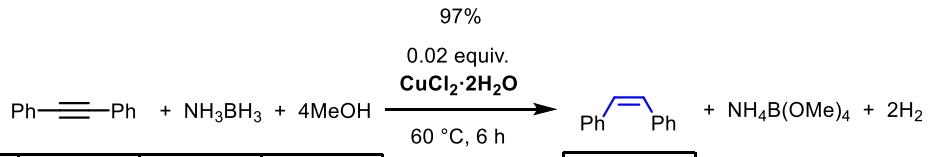
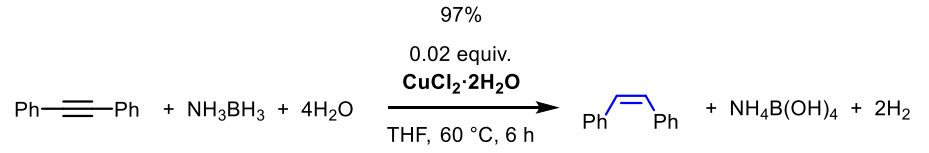
The crystal was obtained from the aqueous phase after model semihydrogenation in AcOEt–H_2O.

4. GREEN CHEMISTRY METRICS CALCULATIONS

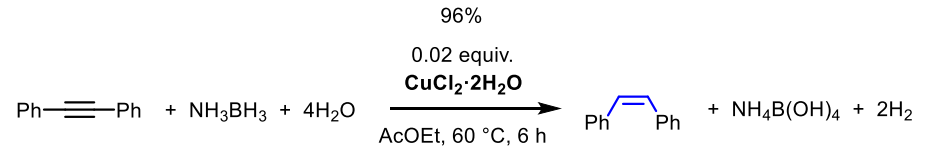
For semihydrogenation of diphenylacetylene carried out in three solvents systems green metrics were provided:



MW [g·mol^{-1}]	178	31	32	180
Amount [mmol]	0.5	1	2	0.5
Mass [mg]	89	31	64	90



MW [g·mol^{-1}]	178	31	18	180
Amount [mmol]	0.5	1	2	0.5
Mass [mg]	89	31	36	90



MW [g·mol^{-1}]	178	31	18	180
Amount [mmol]	0.5	1	2	0.5
Mass [mg]	89	31	36	90

3.1. ATOM ECONOMY

Atom Economy (AE) is the percentage of the theoretical mass of the desired product to the theoretical mass of all reactants used.

$$AE = \frac{theoretical\ mass\ of\ desired\ product}{thoretical\ mass\ of\ reactants} \cdot 100\%$$

For reaction carried out in MeOH: 180/(178+31+4×32)×100% = 53%

For reaction carried out in THF–H_2O: 180/(178+31+4×18)×100% = 64%

For reaction carried out in AcOEt–H_2O: 180/(178+31+4×18)×100% = 64%

3.2. Reaction mass efficiency

Reaction Mass Efficiency (RME) is the percentage of the actual mass of the desired product to the actual mass of all reactants used.

$$RME = \frac{theoretical\ mass\ of\ desired\ product}{actual\ mass\ reactants} \cdot yield$$

For reaction carried out in MeOH: 90/(89+31+64)×97% = 47%

For reaction carried out in THF–H_2O: 90/(89+31+36)×97% = 56%

For reaction carried out in AcOEt–H_2O: 90/(89+31+36)×96% = 55%

3.3. Effective mass efficiency

Effective Mass Efficiency (EME) is the percentage of the actual mass of the desired product to the mass of all non-benign reactants used.

$$EME = \frac{theoretical\ mass\ of\ desired\ product}{mass\ of\ non\ benign\ reactants} \cdot yield$$

For reaction carried out in MeOH: 90/(89+31)×97%=72%

For reaction carried out in THF–H_2O: 90/(89+31)×97%=72%

For reaction carried out in AcOEt–H_2O: 90/(89+31)×96%=72%

3.4. Environmental factor

Environmental Factor[1] (E) is ratio of total waste to the actual mass of the products:

$$E = \frac{actual\ mass\ of\ total\ waste}{actual\ mass\ of\ product}$$

$$E = \frac{\sum(mass\ of\ reactants) + \sum(mass\ of\ solvents) - \sum(products)}{\sum(mass\ of\ product)}$$

For reaction carried out in MeOH: (89+31+3168-90*0.97)/(90*0.97) = 37

For reaction carried out in THF–H_2O: (89+31+2000+1767-90*0.97)/(90*0.97) = 44

For reaction carried out in AcOEt–H_2O: (89+31+2000+1800-90*0.96)/(90*0.96) = 44

3.5. EcoScale score

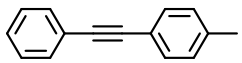
The EcoScale[2] is used for the evaluation of the effectiveness of chemical synthesis. It ranges from 100-0 points based on parameters referring to price, safety, technical setup, temperature, and workup:

$$EcoScale = 100 - penalty\ points$$

Parameter	MeOH	THF–H_2O	AcOEt–H_2O	Lindlar[3] Method
1. Yield	1.5 (97%)	1.5 (97%)	2 (96%)	1.5 (97%)
2. Price of reaction components:				
• Dipehnylacetylene (<10$)	0	0	0	0
• $CuCl_2{\cdot}2H_2O$ (<10$)	0	0	0	-
• Lindlar Catalyst (<10$)	-	-	-	0
• Ammonia-borane (>10$ <50$)	3	3	3	-
• Hydrogen (<10$)	-	-	-	0
• Solvent (<10$)	0	0	0	0
3. Safety:				
• Dipehnylacetylene	0	0	0	0
• $CuCl_2{\cdot}2H_2O$ (N)	5	5	5	-
• Lindlar Catalyst (F, N)	-	-	-	10
• Ammonia-borane (F)	5	5	5	-
• Hydrogen (F+)	-	-	-	10
• Quinoline (T, N)	-	-	-	10
• Solvent	10 (T, F)	5 (F)	5 (F)	5 (F)
4. Technical setup:				
• Common setup	0	0	0	0
• Inert gas	1	0	0	0
5. Temperature and time:				
• Heating, >1h	3	3	3	-
6. Work-up:				
• Liquid-liquid extraction	3	3	3	3
• Removal of solvent of low bp	0	0	0	0
Sum of Penalty Points:	**31.5**	**25.5**	**26**	**39.5**
EcoScale score:	**68.5**	**74.5**	**74.0**	**60.5**

EcoScale score of the described methodology was compared with Lindlar method[3] which was rated as a less eco-friendly approach. In the case of systems based on water, the result is almost excellent (74.5 points). Prices of the components were calculated for the 10 mmol reaction scale.

5. Analytical and spectral data

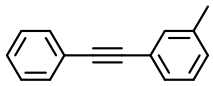


1b

1-methyl-4-(2-phenylethynyl)benzene[4]

White solid. Yield 99%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.57 – 7.49 (m, 2H), 7.43 (dm, *J* = 8.2 Hz, 2H), 7.38 – 7.29 (m, 3H), 7.16 (dm, *J* = 7.8 Hz, 2H), 2.37 (s, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 138.4, 131.5, 131.5, 129.1, 128.3, 128.1, 123.5, 120.2, 89.5, 88.7, 21.5.

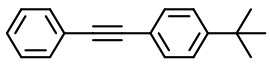


1c

1-methyl-3-(2-phenylethynyl)benzene[4]

Coluorless oil, Yield 86%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.59 – 7.52 (m, 2H), 7.42 – 7.33 (m, 5H), 7.27 (tm, *J* = 7.5 Hz, 1H), 7.20 – 7.16 (dm, *J* = 7.8 Hz, 1H), 2.39 (s, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 138.2, 132.3, 131.7, 129.3, 128.8, 128.5, 128.4, 128.3, 123.5, 123.2, 89.7, 89.2, 21.4.

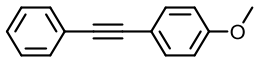


1d

1-*tert*-butyl-4-(2-phenylethynyl)benzene[5]

White solid. Yield 81%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.58 – 7.54 (m, 2H), 7.52 – 7.48 (m, 2H), 7.43 – 7.33 (m, 5H), 1.36 (s, 9H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 151.7, 131.7, 131.5, 128.4, 128.2, 125.5, 123.7, 120.4, 89.7, 88.9, 34.9, 31.3.

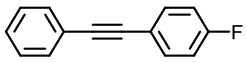


1e

1-methoxy-4-(2-phenylethynyl)benzene[6]

White solid. Yield 88%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.55 – 7.50 (m, 2H), 7.48 (dm, *J* = 8.9 Hz, 2H), 7.38 – 7.28 (m, 3H), 6.88 (dm, *J* = 8.8 Hz, 2H), 3.83 (s, 3H) **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 159.8, 133.2, 131.6, 128.5, 128.1, 123.8, 115.5, 114.1, 89.5, 88.2, 77.4, 77.2, 76.9, 55.5.

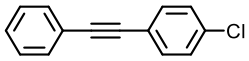


1f

1-fluoro-4-(2-phenylethynyl)benzene[4]

White solid. Yield 78%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.57 – 7.47 (m, 4H), 7.40 – 7.30 (m, 3H), 7.05 (tm, *J* = 8.7 Hz, 2H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 162.65 (d, J_{CF} = 249.4 Hz), 133.63 (d, J_{CF} = 8.5 Hz), 131.71, 128.52, 128.48, 123.24, 119.53 (d, J_{CF} = 3.5 Hz), 115.79 (d, J_{CF} = 22.1 Hz), 89.18, 88.43. **^{19}F NMR** (470 MHz $CDCl_3$) δ (ppm) -111.03 (tt, *J* = 8.7, 5.4 Hz).

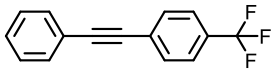


1g

1-chloro-4-(2-phenylethynyl)benzene[4]

White solid. Yield 99%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) 7.56 – 7.49 (m, 2H), 7.49 – 7.43 (m, 2H), 7.39 – 7.30 (m, 5H)**^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 134.4, 133.0, 131.7, 128.8, 128.6, 128.5, 123.1, 121.9, 90.5, 88.4.

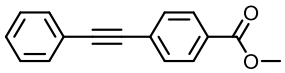


1h

1-trifluoromethyl-4-(2-phenylethynyl)benzene[4]

White solid. Yield 98%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.66 – 7.58 (m, 4H), 7.58 – 7.51 (m, 2H), 7.41 – 7.33 (m, 3H).**^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 132.0, 131.9, 130.1 (q, J_{CF} = 32.8 Hz), 129.0, 128.6, 127.3, 125.4 (q, J_{CF} = 3.7 Hz), 124.10 (q, J_{CF} = 272.0 Hz) 122.7, 91.9, 88.1. **^{19}F NMR** (470 MHz $CDCl_3$) δ (ppm) -62.81 (s).

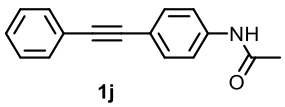


1i

Methyl 4-(2-phenylethynyl)benzoate[7]

Creamy solid. Yield 64%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 8.02 (dm, *J* = 8.7 Hz, 2H), 7.59 (dm, *J* = 8.7 Hz, 2H), 7.57 – 7.52 (m, 2H), 7.40 – 7.34 (m, 3H), 3.93 (s, 3H).**^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 166.7, 131.9, 131.7, 129.7, 129.6, 128.9, 128.6, 128.2, 122.9, 92.5, 88.8, 52.4.

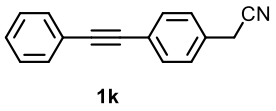


1j

***N*-(4-(2-phenylethynyl)phenyl)acetamide**[6]

Creamy solid. Yield 99%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.56 – 7.46 (m, 6H), 7.37 – 7.30 (m, 3H), 7.20 (s, 1H), 2.20 (s, 3H).**^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 168.3, 138.1, 138.0, 132.6, 131.7, 128.5, 128.3, 123.5, 119.5, 119.1, 89.2, 89.2, 24.9.

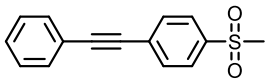


1k

2-(4-(2-phenylethynyl)phenyl)acetonitrile[6]

White solid. Yield 88%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.59 – 7.52 (m, 4H), 7.41 – 7.31 (m, 5H), 3.79 (s, 2H).**^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 132.4, 131.8, 130.0, 128.7, 128.5, 128.1, 123.5, 123.1, 117.6, 90.4, 88.6, 23.7.

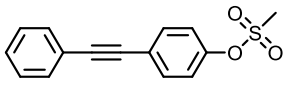


1l

1-(methylsulfonyl)-4-(2-phenylethynyl)benzene[8]

Tan solid. Yield 40%. Prepared using procedure 2.1.2.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.93 (dm, *J* = 8.5 Hz, 2H), 7.70 (dm, *J* = 8.5 Hz, 2H), 7.59 – 7.52 (m, 2H), 7.39 (dd, J = 5.1, 1.9 Hz, 3H), 3.07 (s, 3H).**^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 139.7, 132.4, 132.0, 129.4, 129.3, 128.7, 127.6, 122.4, 93.6, 87.7, 44.6.

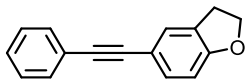


1m

4-(2-phenylethynyl)phenyl methanesulfonate

White solid. Yield 70%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.58 (d, J = 8.8 Hz, 2H), 7.56 – 7.51 (m, 2H), 7.39 – 7.34 (m, 3H), 7.28 (d, J = 8.7 Hz, 2H), 3.16 (s, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 148.9, 133.4, 131.8, 128.8, 128.6, 123.0, 122.9, 122.3, 90.7, 88.0, 37.7. **HRMS (EI)** *m/z* Calcd. for $C_{15}H_{12}O_3S$: 272.0507, Found: 272.0508 **MS (EI)** *m/z* 272.0 (M^+), 193.0 (100%), 165.0, 139.0, 115.0, 81.2, 69.2 **EA** Calcd. for $C_{15}H_{12}O_3S$: C: 66.16, H: 4.44, S: 11.77 Found: C: 65.93, H: 4.46, S: 11.53 **IR** (KBr) cm^{-1} : 3087, 3036, 3016, 2938, 2220, 1914, 1499, 1366, 1171, 1148, 972, 888, 781, 524 **M.p.** = 151 °C

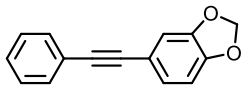


1n

5-(2-phenylethynyl)-2,3-dihyrobenzofuran

White solid. Yield 80%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.54 – 7.47 (m, 2H), 7.40 – 7.27 (m, 5H), 6.76 (d, *J* = 8.3 Hz, 1H), 4.60 (t, *J* = 8.7 Hz, 2H), 3.22 (t, *J* = 8.7 Hz, 2H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 160.5, 132.3, 131.6, 128.4, 128.4, 128.0, 127.5, 123.9, 115.2, 109.6, 90.0, 87.6, 71.7, 29.6. **HRMS (EI)** *m*/*z* Calcd. for $C_{16}H_{12}O$: 220.0892, Found: 220.0888 **MS (EI)** *m*/*z* 219.9 (M^+, 100%), 222.1, 190.9, 164.9, 138.9, 110.0, 82.6, 63.2 **EA** Calcd. for $C_{16}H_{12}O$: C: 87.25, H: 5.49 Found: C: 88.78, H: 5.53 **IR** (KBr) cm^{-1} : 3046, 2963, 2893, 2849, 2201, 1953, 1877, 1747, 1592, 1495, 1326, 990, 819, 753, 689, 522, 502, 473

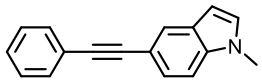


1o

5-(2-phenylethynyl)-benzo[1,3]dioxole[9]

White solid. Yield 100%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.54 – 7.48 (m, 2H), 7.37 – 7.29 (m, 3H), 7.07 (dd, *J* = 8.0, 1.6 Hz, 1H), 6.98 (d, *J* = 1.6 Hz, 1H), 6.79 (d, *J* = 8.0 Hz, 1H), 5.99 (s, 2H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 148.1, 147.6, 131.6, 128.5, 128.2, 126.4, 123.5, 116.7, 111.7, 108.6, 101.5, 89.4, 87.9.

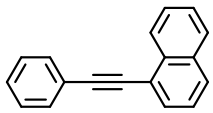


1p

1-methyl-5-(2-phenylethynyl)-1*H*-indole[10]

Brown solid. Yield 74%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.85 (dd, J = 1.6, 0.7 Hz, 1H), 7.59 – 7.53 (m, 2H), 7.41 (dd, J = 8.5, 1.5 Hz, 1H), 7.38 – 7.27 (m, 4H), 7.08 (d, J = 3.1 Hz, 1H), 6.49 (dd, J = 3.1, 0.9 Hz, 1H), 3.80 (s, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 136.4, 131.4, 129.8, 128.3, 128.3, 127.6, 125.2, 124.8, 124.0, 113.8, 109.3, 101.3, 91.2, 87.0, 32.9.



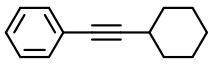
1q

1-(2-phenylethynyl)naphthalene[5]

Pale yellow solid. Yield 88%. Prepared using procedure 2.1.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 8.47 (ddd, *J* = 8.4, 2.3, 1.2 Hz, 1H), 7.88 (d, *J* = 8.1 Hz, 1H), 7.86 (d, *J* = 8.2 Hz, 1H), 7.79 (dt, *J* = 7.1, 1.4 Hz, 1H), 7.67 (dq, *J* = 8.1, 1.4 Hz, 2H), 7.62 (ddt, *J* =

8.2, 6.8, 1.3 Hz, 1H), 7.55 (ddd, *J* = 8.0, 6.8, 1.2 Hz, 1H), 7.48 (dd, *J* = 8.2, 7.2 Hz, 1H), 7.45 – 7.34 (m, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 133.4, 133.4, 131.8, 130.5, 128.9, 128.6, 128.5, 128.5, 126.9, 126.6, 126.4, 125.4, 123.6, 121.1, 94.5, 87.7.



1r

1-(2-cyklohexylethynyl)benzene[11]

Coluorless oil. Yield 85%. Prepared using procedure 2.1.3.

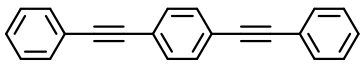
^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.43 – 7.36 (m, 2H), 7.30 – 7.22 (m, 3H), 2.59 (tt, *J* = 9.0, 3.8 Hz, 1H), 1.94 – 1.84 (m, 2H), 1.82 – 1.71 (m, 2H), 1.60 – 1.48 (m, 3H), 1.42 – 1.28 (m, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 131.7, 128.3, 127.5, 124.3, 94.6, 80.7, 32.9, 29.8, 26.1, 25.1.

1w

4-*tert*-butylphenylacetylene[12]

Pale-yellow oil. Yield 81%. Prepared using procedure 2.1.4.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.44 (dm, *J* = 8.5 Hz, 2H), 7.35 (dm, *J* = 8.5 Hz, 2H), 3.03 (s, 1H), 1.32 (s, 9H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 152.2, 132.0, 125.5, 119.2, 84.0, 76.6, 34.9, 31.3.

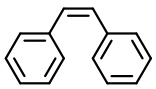


1z

1, 4-bis(2-phenylethynyl)benzene[13]

White solid.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.58 – 7.50 (m, 8H), 7.40 – 7.33 (m, 6H) **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 131.8, 131.7, 128.6, 128.5, 123.3, 123.2, 91.4, 89.3.

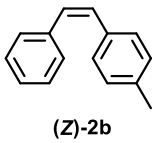


(*Z*)-2a

(*Z*)-stilbene[14]

Colourless oil. Yield 96%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.31 – 7.18 (m, 10H), 6.63 (s, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 137.4, 130.4, 129.0, 129.0, 128.3, 127.2.

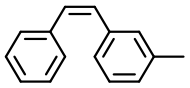


(*Z*)-2b

(*Z*)-4-methylstilbene[14]

Colourless oil. Yield 95%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.33 – 7.19 (m, 5H), 7.19 – 7.15 (m, 2H), 7.08 – 7.02 (m, 2H), 6.58 (AB, *J* = 12.7 Hz, 2H), 2.34 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 137.6, 137.0, 134.4, 130.3, 129.7, 129.0, 129.0, 128.9, 128.3, 127.1, 21.4.

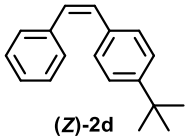


(*Z*)-2c

(*Z*)-3-methylstilbene[14]

Colourless oil. Yield 90%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.31 – 7.20 (m, 5H), 7.16 – 7.01 (m, 4H), 6.59 (AB, *J* = 12.6 Hz, 2H), 2.29 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 137.9, 137.5, 137.3, 130.5, 130.2, 129.7, 129.0, 128.3, 128.2, 128.0, 127.2, 126.0, 21.5.

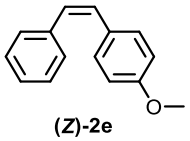


(*Z*)-2d

(*Z*)-4-*tert*-butylstilbene[14]

Colourless oil. Yield 92%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.34 – 7.20 (m, 9H), 6.59 (AB, *J* = 12.7 Hz, 2H), 1.33 (s, 9H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 150.3, 137.7, 134.3, 130.2, 129.7, 129.0, 128.7, 128.4, 127.1, 125.2, 34.7, 31.4.

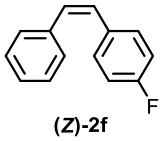


(*Z*)-2e

(*Z*)-4-methoxystilbene[14]

Colourless oil. Yield 95%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.31 – 7.17 (m, 7H), 6.80 – 6.75 (m, 2H), 6.54 (AB, *J* = 12.3, 2H), 3.80 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 158.8, 137.7, 130.3, 129.9, 129.8, 128.9, 128.9, 128.4, 127.0, 113.7, 55.3.

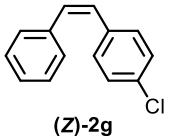


(*Z*)-2f

(*Z*)-4-fluorostilbene[14]

Colourless oil. Yield 92%. Prepared using procedure 2.2.2.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.29 – 7.19 (m, 7H), 6.96 – 6.89 (m, 2H), 6.62 (A, d, J = 12.2 Hz, 1H), 6.56 (B, d, J = 12.2 Hz, 1H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 162.0 (d, J_{CF} = 246.8 Hz), 137.2, 133.3 (d, J_{CF} = 3.5 Hz), 130.7 (d, J_{CF} = 7.7 Hz), 130.4 (d, J_{CF} = 1.5 Hz), 129.2, 129.0, 128.4, 127.3, 115.3 (d, J_{CF} = 21.4 Hz). **^{19}F NMR** (376 MHz $CDCl_3$) δ (ppm) -114.66 – -114.78 (m).

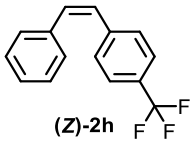


(*Z*)-2g

(*Z*)-4-chlorostilbene[14]

Colourless oil. Yield 95%. Prepared using procedure 2.2.2.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.28 – 7.15 (m, 9H), 6.63 (A, d, J = 12.2 Hz, 1H), 6.53 (B, d, J = 12.3 Hz, 1H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 137.0, 135.8, 132.9, 131.1, 130.4, 129.1, 128.9, 128.5, 128.5, 127.5.

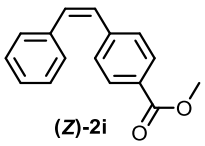


(*Z*)-2h

(*Z*)-4-trifluoromethylstilbene[14]

Colourless oil. Yield 92%. Prepared using procedure 2.2.2.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.49 (dm, J = 7.8 Hz, 2H), 7.36 (dm, J = 7.9 Hz, 2H), 7.31 – 7.20 (m, 5H), 6.75 (A, d, J = 12.2 Hz, 1H), 6.62 (B, d, J = 12.3 Hz, 1H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 141.0 (q, J_{CF} = 1.3 Hz), 136.7, 132.5, 129.3, 129.2 (q, J_{CF} = 32.7 Hz), 129.0, 128.9, 128.6, 127.1, 125.29 (q, J_{CF} = 3.8 Hz), 122.96(q, J_{CF} = 271.7.8 Hz). **^{19}F NMR** (376 MHz $CDCl_3$) δ (ppm) -62.55. (s).

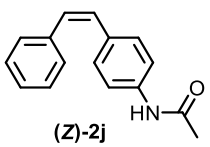


(*Z*)-2i

(*Z*)-4-methoxycarbonylstilbene[14]

Colourless oil. Yield 92%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) (dm, J = 8.2 Hz, 2H), 7.30 (dm, J = 8.1 Hz, 2H), 7.25 – 7.19 (m, 5H), 6.71 (A, d, J = 12.3 Hz, 1H), 6.61 (B, d, J = 12.2 Hz, 1H), 3.90 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 167.1, 142.2, 136.8, 132.4, 129.7, 129.4, 129.0, 128.7, 128.5, 127.7, 52.2.

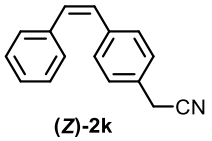


(*Z*)-2j

(*Z*)-4-acetamidestilbene[15]

Creamy solid. Yield 96%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.31 – 7.24 (m, 2H), 7.20 (s, 2H), 7.18 – 7.07 (m, 7H), 6.47 (AB, *J* = 12.2 Hz, 2H), 2.08 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 168.4, 137.4, 136.9, 133.3, 130.0, 129.7, 129.7, 128.9, 128.4, 127.2, 119.5, 24.8.

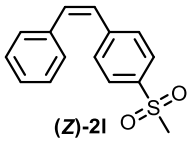


(*Z*)-2k

(*Z*)-2-(4-styrylphenyl)acetonitrile

Yellowish oil. Yield 99%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.77 – 7.71 (m, 2H), 7.41 – 7.35 (m, 2H), 7.26 – 7.14 (m, 5H), 6.75 (A, d, *J* = 12.2 Hz, 1H), 6.56 (B, d, *J* = 12.3 Hz, 1H), 3.01 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 143.2, 138.7, 136.3, 133.6, 129.8, 128.9, 128.7, 128.3, 128.0, 127.4, 44.6. **HRMS (EI)** *m*/*z* Calcd. for $C_{16}H_{13}N$: 219.1048, Found: 219.1054 **MS (EI)** *m*/*z* 219.1 (M^+), 191.1, 179.1, 152.1, 89.3, 71.5, 57.5, 43.6 **EA** Calcd. for $C_{16}H_{13}N$: C: 87.64, H: 5.98, N: 6.39 Found: C: 87.40, H: 6.15, N: 6.19 **IR** (in CH_2Cl_2) cm^{-1} : 3665, 3530, 3079, 3053, 3021, 2925, 2251, 1599, 1510, 1492, 1448, 1416, 1183, 1115, 1073, 1021, 924, 819, 775, 899, 512, 464

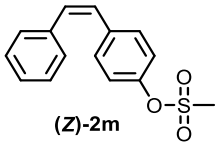


(*Z*)-2l

(*Z*)-4-methylsufonylstilbene

Creamy wax. Yield 94%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) δ 7.77 – 7.71 (m, 2H), 7.41 – 7.35 (m, 2H), 7.26 – 7.14 (m, 5H), 6.75 (d, J = 12.2 Hz, 1H), 6.56 (d, J = 12.3 Hz, 1H), 3.01 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 143.2, 138.7, 136.3, 133.6, 129.8, 128.9, 128.7, 128.3, 128.0, 127.4, 44.6.

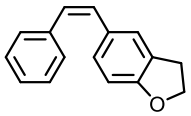


(*Z*)-2m

(*Z*)-4-styrylphenyl methanesulfonate

Creamy wax. Yield 93%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) δ 7.32 – 7.20 (m, 7H), 7.16 – 7.10 (m, 2H), 6.66 (A, d, *J* = 12.2 Hz, 1H), 6.55 (B, d, *J* = 12.2 Hz, 1H), 3.13 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 148.1, 136.8, 136.7, 131.5, 130.6, 128.9, 128.7, 128.5, 127.6, 121.9, 37.5. **HRMS (EI)** *m*/*z* Calcd. for $C_{15}H_{14}O_3SNa$: 297.0561, Found: 297.0553 **MS (ESI)** *m*/*z* 297.9 ($[M+Na]^+$ 100%) **EA** Calcd. for $C_{15}H_{14}O_3S$: C: 65.67, H: 5.14, S: 11.69 Found: C: 56.57, H: 5.19, S: 11.74 **IR** (in CH_2Cl_2) cm^{-1} : 3901, 3852, 3054, 3023, 2936, 2543, 1598, 1500, 1389, 1200, 1175, 1149, 970, 869, 795, 696, 573, 502

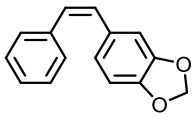


(*Z*)-2n

(*Z*)-2,3-dihydro-5-styrylbenzofuran

Colorless oil. Yield 97%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.32 – 7.17 (m, 5H), 7.13 – 7.08 (m, 1H), 7.08 – 7.00 (m, 1H), 6.66 (dm, *J* = 8.2 Hz, 1H), 6.54 (A, d, J = 12.2 Hz, 1H), 6.49 (B, d, J = 12.2 Hz, 1H), 4.56 (t, *J* = 8.7 Hz, 2H), 3.12 (t, *J* = 8.8 Hz, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 159.4, 137.8, 130.3, 129.7, 129.2, 129.0, 128.5, 128.3, 127.0, 127.0, 125.6, 109.1, 71.5, 29.7. **HRMS (EI)** *m*/*z* Calcd. for $C_{16}H_{14}O$: 222.1045, Found: 222.1046 **MS (EI)** *m*/*z* 222.1 (M^+, 100%), 178.1, 165.1, 133.2, 115.3, 89.3 **EA** Calcd. for $C_{16}H_{14}O$: C: 86.45, H: 6.35 Found: C: 86.15, H: 6.32 **IR** (film) cm^{-1} : 3077, 3054, 3008, 2964, 2894, 2855, 1953, 1884, 1609, 1492, 1445, 1236, 1094, 983, 943, 818, 773, 742, 699, 497, 472

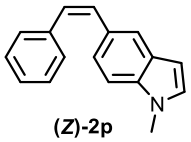


(*Z*)-2o

(*Z*)-1-(3,4-methylenedioxyphenyl)-2-phenylethene

Colorless oil. Yield 97%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.31 – 7.17 (m, 5H), 6.78 – 6.68 (m, 3H), 6.53 A, (d, *J* = 12.2 Hz, 1H), 6.49 (B, d, *J* = 12.1 Hz, 1H), 5.93 (s, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 147.5, 146.8, 137.4, 131.3, 129.9, 129.4, 128.9, 128.4, 127.2, 123.1, 109.0, 108.3, 101.0.

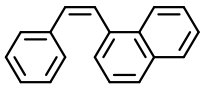


(*Z*)-2p

(*Z*)-1-methyl-5-styryl-1*H*-indole

Tan oil. Yield 90%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.55 (q, *J* = 1.1 Hz, 1H), 7.33 – 7.28 (m, 2H), 7.25 – 7.12 (m, 5H), 7.01 (d, *J* = 3.1 Hz, 1H), 6.74 (A, dd, *J* = 12.1, 0.8 Hz, 1H), 6.53 (B, d, *J* = 12.2 Hz, 1H), 6.40 (d, *J* = 3.1 Hz, 1H), 3.76 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 138.1, 136.1, 131.6, 129.2, 129.1, 128.6, 128.5, 128.2, 128.1, 126.8, 123.1, 121.6, 109.0, 101.4, 33.0. **HRMS (EI)** *m*/*z* Calcd. for $C_{17}H_{15}N$: 233.1204, Found: 233.1207 **MS (EI)** *m*/*z* 232.9 (M^+, 100%), 231.9, 216.9, 189.0, 165.0, 144.1, 108.7, 97.3, 85.4, 71.4, 57.5, 43.6 **EA** Calcd. for $C_{17}H_{15}N$: C: 87.52, H: 6.48, N: 6.00 Found: C: 87.32, H: 6.32, N: 5.86 **IR** (in CH_2Cl_2) cm^{-1} : 3099, 3053, 3011, 2925, 1950, 1615, 1511, 1490, 1466, 1335, 1245, 1078, 890, 803, 726, 697, 427

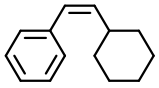


(*Z*)-2q

(*Z*)-1-strylnaphthalene

Colorless oil. Yield 97%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.12 – 8.06 (m, 1H), 7.91 – 7.85 (m, 1H), 7.78 (ddd, J = 7.2, 2.6, 1.1 Hz, 1H), 7.54 – 7.46 (m, 2H), 7.38 – 7.32 (m, 2H), 7.09 (s, 5H), 7.06 (A, dd, *J* = 12.1, 0.7 Hz, 1H), 6.84 (B, d, *J* = 12.2 Hz, 1H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 136.9, 135.4, 133.8, 132.2, 131.7, 129.2, 128.6, 128.6, 128.2, 127.7, 127.2, 126.6, 126.2, 126.1, 125.8, 125.1.

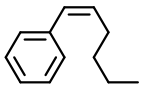


(*Z*)-2r

(*Z*)-1-(2-cyclohexyl-1-ethenyl)benzene[16]

Colorless oil. Yield 93%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.42 – 7.14 (m, 5H), 6.32 (d, *J* = 11.7 Hz, 1H), 5.50 (dd, *J* = 11.7, 10.1 Hz, 1H), 2.59 (ddt, *J* = 14.6, 7.7, 3.9 Hz, 1H), 1.83 – 1.61 (m, 5H), 1.36 – 1.11 (m, 5H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 139.2, 138.1, 128.7, 128.3, 126.9, 126.5, 37.0, 33.4, 26.2, 25.8.



(*Z*)-2s

(*Z*)-1-phenylhex-1-ene[17]

Colourless oil. Yield 95%. Prepared using procedure 2.2.1.

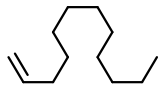
^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.37 – 7.27 (m, 4H), 7.25 – 7.19 (m, 1H), 6.41 (dt, *J* = 11.6, 1.9 Hz, 1H), 5.68 (dt, *J* = 11.7, 7.3 Hz, 1H), 2.34 (qd, *J* = 7.3, 1.9 Hz, 2H), 1.49 – 1.30 (m, 4H), 0.91 (t, *J* = 7.2 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 138.0, 133.4, 128.9, 128.8, 128.2, 126.5, 32.3, 28.5, 22.6, 14.1.

(*Z*)-2t

(*Z*)-dodec-6-ene[14]

Colourless oil. Yield 96%. Prepared using procedure 2.2.3.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 5.43 – 5.29 (m, 2H), 2.06 – 1.91 (m, 4H), 1.38 – 1.22 (m, 12H), 0.89 (t, *J* = 6.8 Hz, 6H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 130.1, 31.7, 29.6, 27.3, 22.7, 14.2.

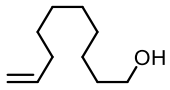


(*Z*)-2u

Dodec-1-ene[17]

Colourless oil. Yield 84%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 5.82 (ddt, *J* = 16.9, 10.2, 6.7 Hz, 1H), 4.99 (dq, *J* = 17.1, 1.7 Hz, 1H), 4.93 (ddt, J = 10.2, 2.3, 1.2 Hz, 1H), 2.09 – 2.00 (m, 2H), 1.41 – 1.19 (m, 16H), 0.88 (t, *J* = 7.2, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 139.4, 114.2, 34.0, 32.1, 29.8, 29.7, 29.5, 29.3, 29.1, 22.8, 14.3.

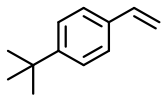


(*Z*)-2v

Dec-9-en-1-ol[18]

Colourless oil. Yield 87%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 5.81 (ddt, *J* = 16.9, 10.2, 6.7 Hz, 1H), 4.99 (ddt, *J* = 17.1, 2.2, 1.6 Hz, 1H), 4.93 (ddt, *J* = 10.2, 2.3, 1.2 Hz, 1H), 3.64 (t, *J* = 6.6 Hz, 2H), 2.08 – 1.99 (m, 2H), 1.64 – 1.48 (m, 3H), 1.44 – 1.20 (m, 10H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 139.3, 114.3, 63.2, 33.9, 32.9, 29.6, 29.5, 29.2, 29.0, 25.9.

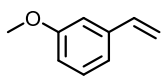


(*Z*)-2w

4-*tert*-butylstyrene[19]

Yellowish oil. Yield 91%. Prepared using procedure 2.2.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.36 (s, 4H), 6.71 (dd, J = 17.6, 10.9 Hz, 1H), 5.71 (dd, J = 17.6, 1.0 Hz, 1H), 5.20 (dd, J = 10.9, 1.0 Hz, 1H), 1.33 (s, 9H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 151.0, 136.7, 135.0, 126.1, 125.6, 113.1, 34.7, 31.4.

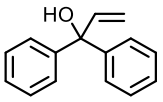


(*Z*)-2x

3-methoxystyrene[18]

Yellowish oil. Yield 86%. Prepared using procedure 2.2.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.28 – 7.23 (m, 1H), 7.06 – 6.93 (m, 2H), 6.85 – 6.80 (m, 1H), 6.70 (dd, *J* = 17.6, 10.9 Hz, 1H), 5.75 (dd, *J* = 17.5, 0.9 Hz, 1H), 5.26 (dd, *J* = 10.9, 0.9 Hz, 1H), 3.83 (s, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 160.0, 139.2, 136.9, 129.6, 119.1, 114.3, 113.6, 111.7, 55.4.

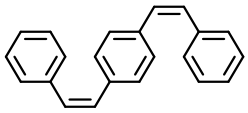


(*Z*)-2y

1,1-diphenylprop-2-en-1-ol[20]

Colourless oil. Yield 89%. Prepared using procedure 2.2.1.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.43 – 7.37 (m, 4H), 7.37 – 7.31 (m, 4H), 7.31 – 7.25 (m, 2H), 6.57 – 6.48 (m, 1H), 5.35 (dd, J = 6.6, 1.2 Hz, 1H), 5.32 (s, 1H), 2.30 (s, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ (ppm) 145.9, 143.7, 128.3, 127.4, 127.0, 114.2, 79.5.

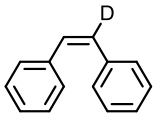


(*Z,Z*)-2z

(*Z, Z*)-1,4-distyrylbenzene[21]

Colourless oil. Yield 89%. Prepared using procedure 2.2.1.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.29 – 7.18 (m, 10H), 7.12 (s, 4H), 6.59 (d, *J* = 12.3 Hz, 2H), 6.54 (d, *J* = 12.2 Hz, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ (ppm) 137.4, 136.2, 130.4, 130.1, 129.0, 128.9, 128.3, 127.3.



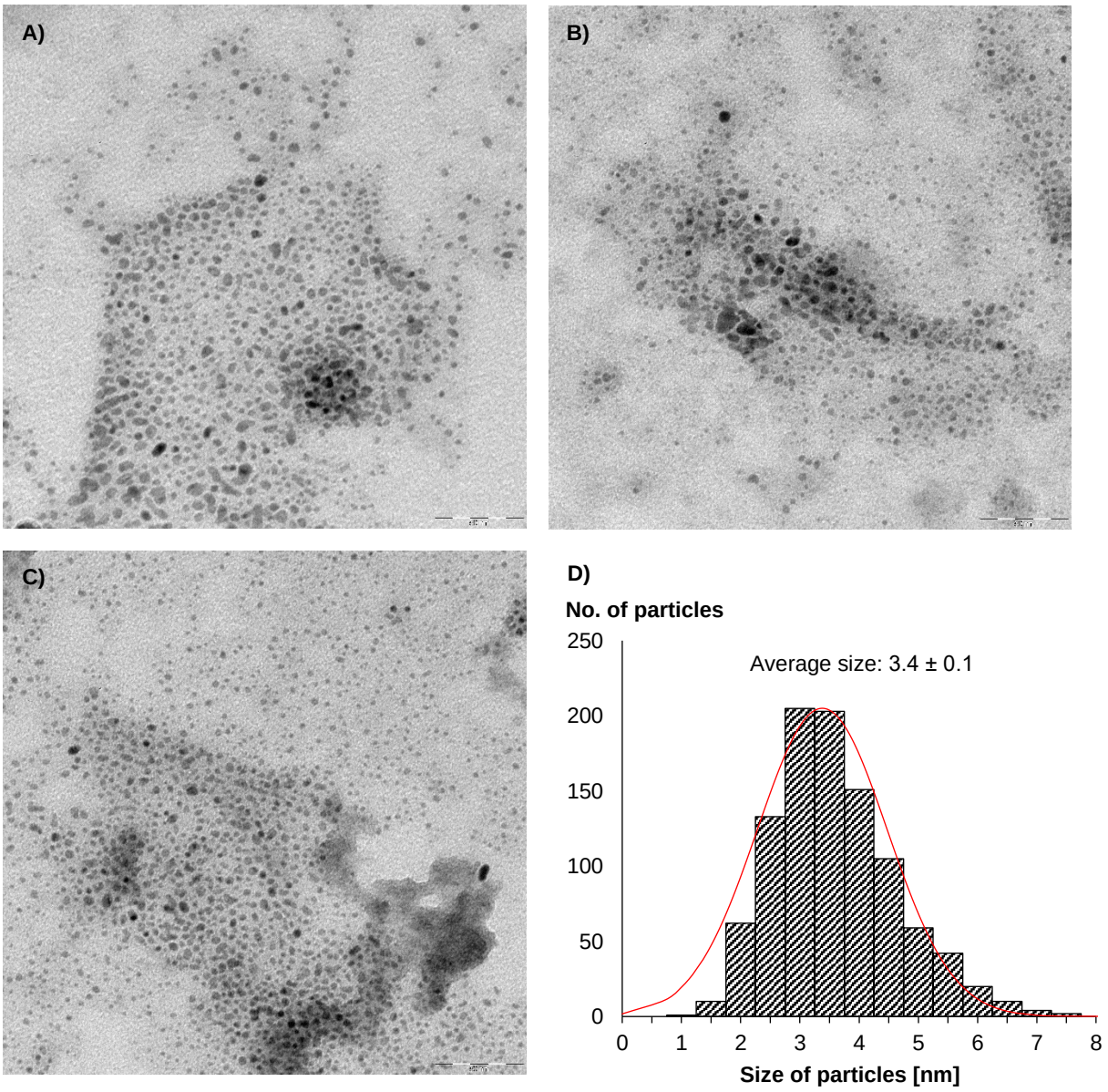
d_1-(*Z*)-2a

(*Z*)-1-deutero-1,2-diphenylethene[21]

Colourless oil. Yield 95%. Incorporation of D: 81%. Prepared using procedure 2.2.5.

^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.35 – 7.18 (m, 10H), 6.64 (s, 1H). **^{2}H NMR** (92 MHz, $CDCl_3$) δ (ppm) 6.65 (s, 1D). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 137.4, 137.3, 130.4, 130.3, 129.0, 128.3, 127.2, 127.2. **HRMS (EI)** *m/z* Calcd. for $C_{14}H_{11}D$: 181.1002, Found: 181.0998 **MS (EI)** *m/z* 181.1 (M^+), 180.1 (100%), 179.0, 166.1, 165.1, 152.1, 89.3, 77.4, 51.5

6. NANOPARTICLES CHARACTERIZATION



A-C) TEM images of CuNPs D) Histogram of particle size distribution

7. REFERENCES

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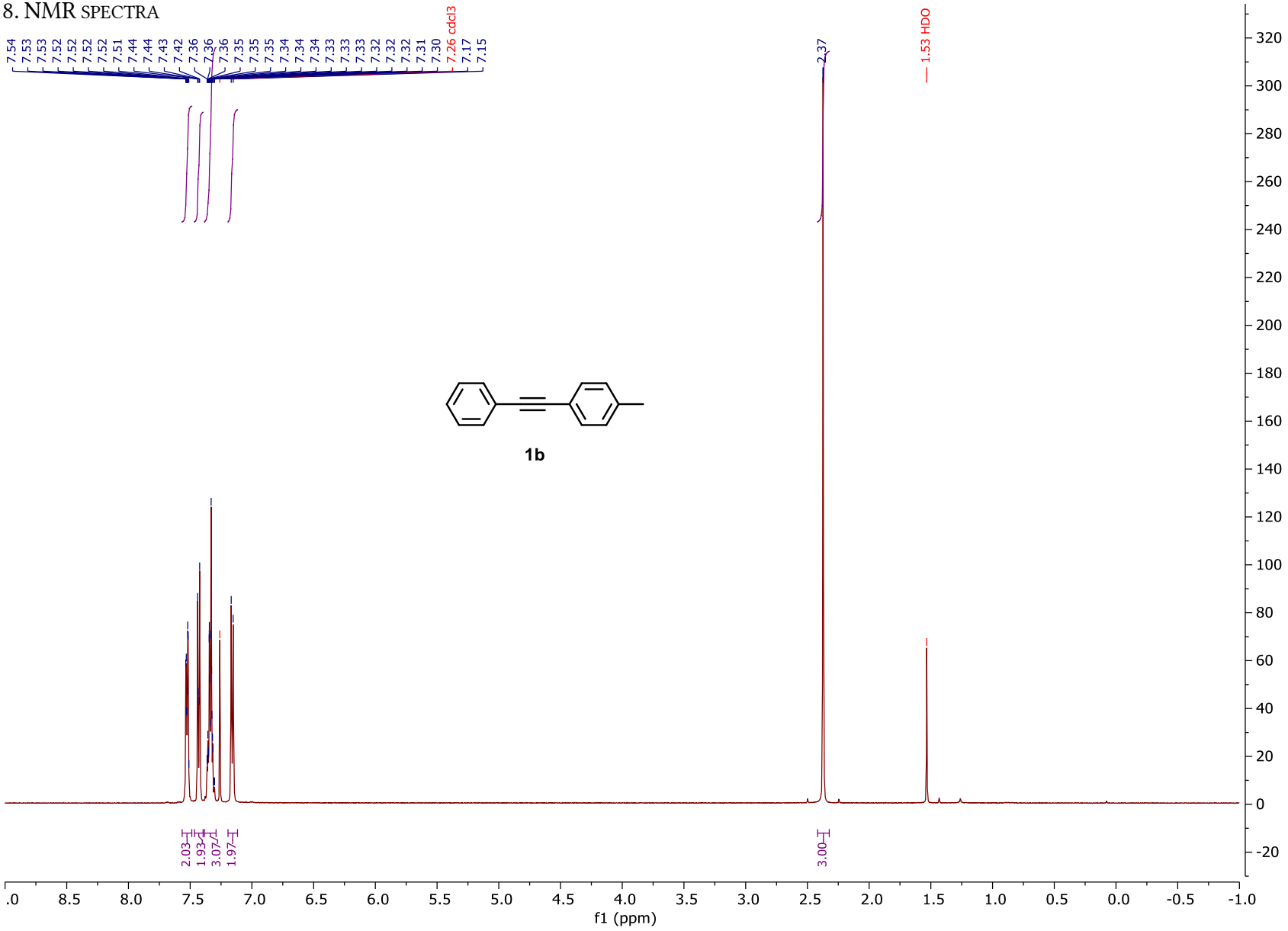
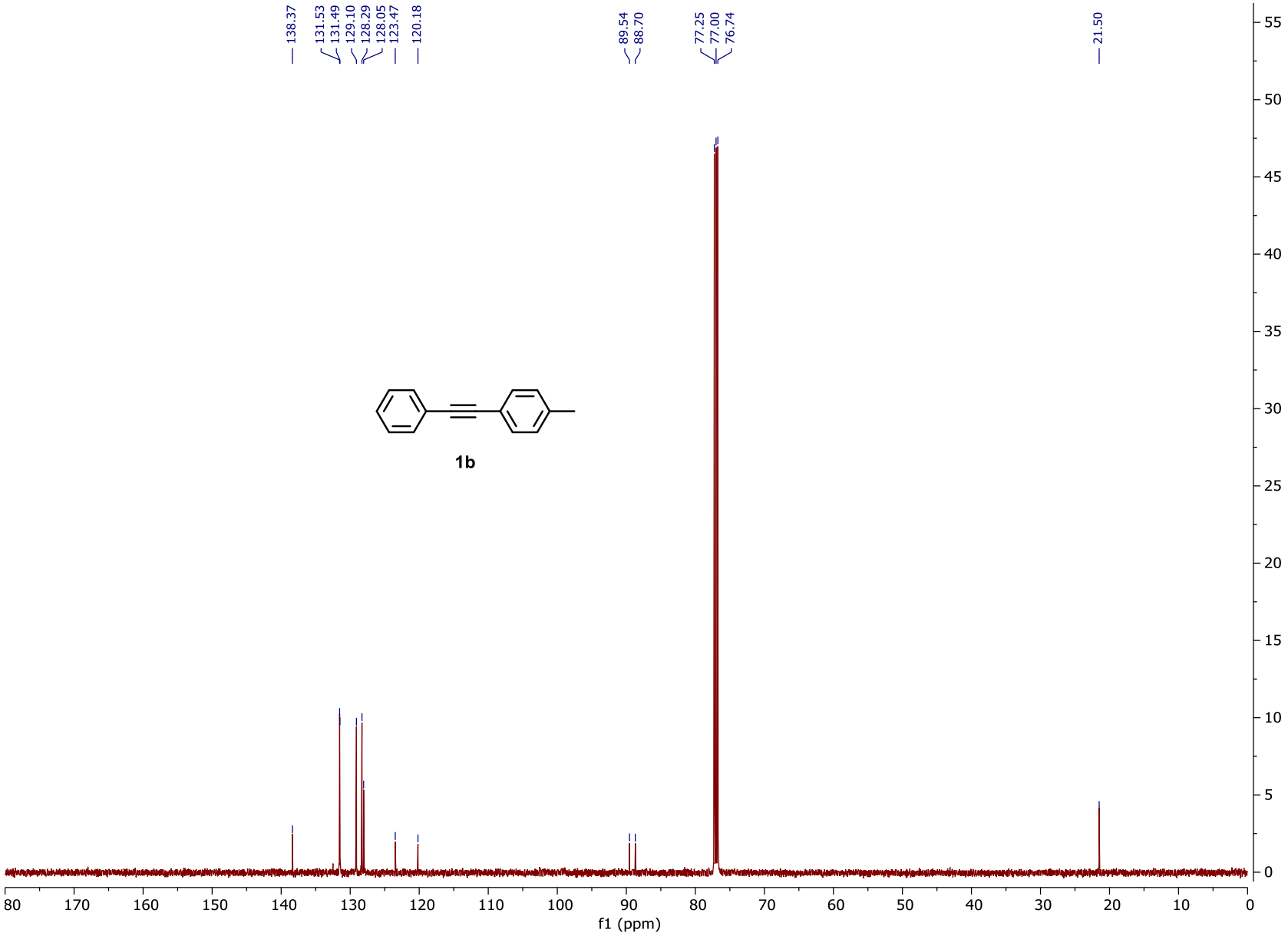
8. NMR SPECTRA

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120.18
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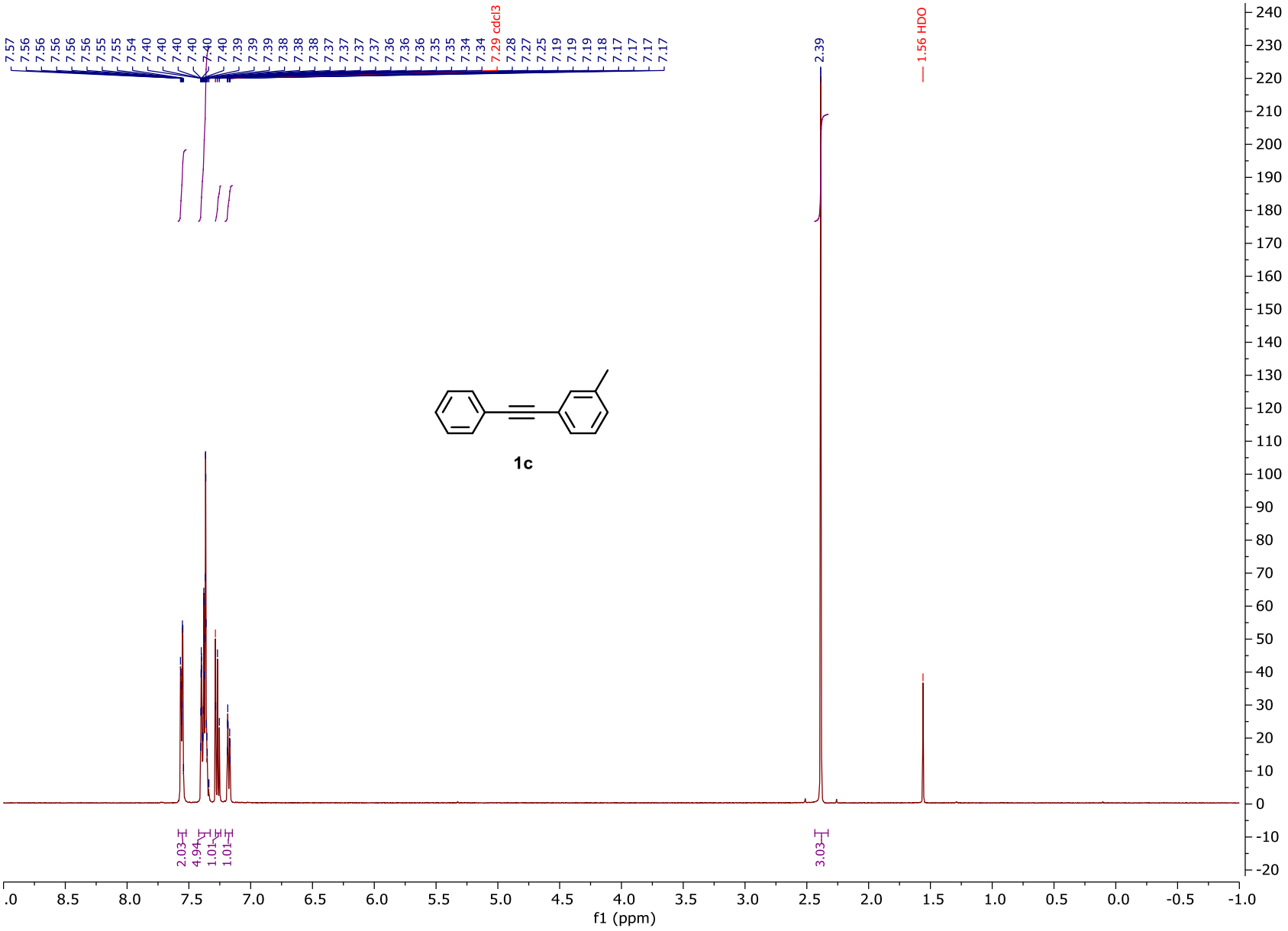
88.70
77.25
77.00
76.74
21.50
1b
f1 (ppm)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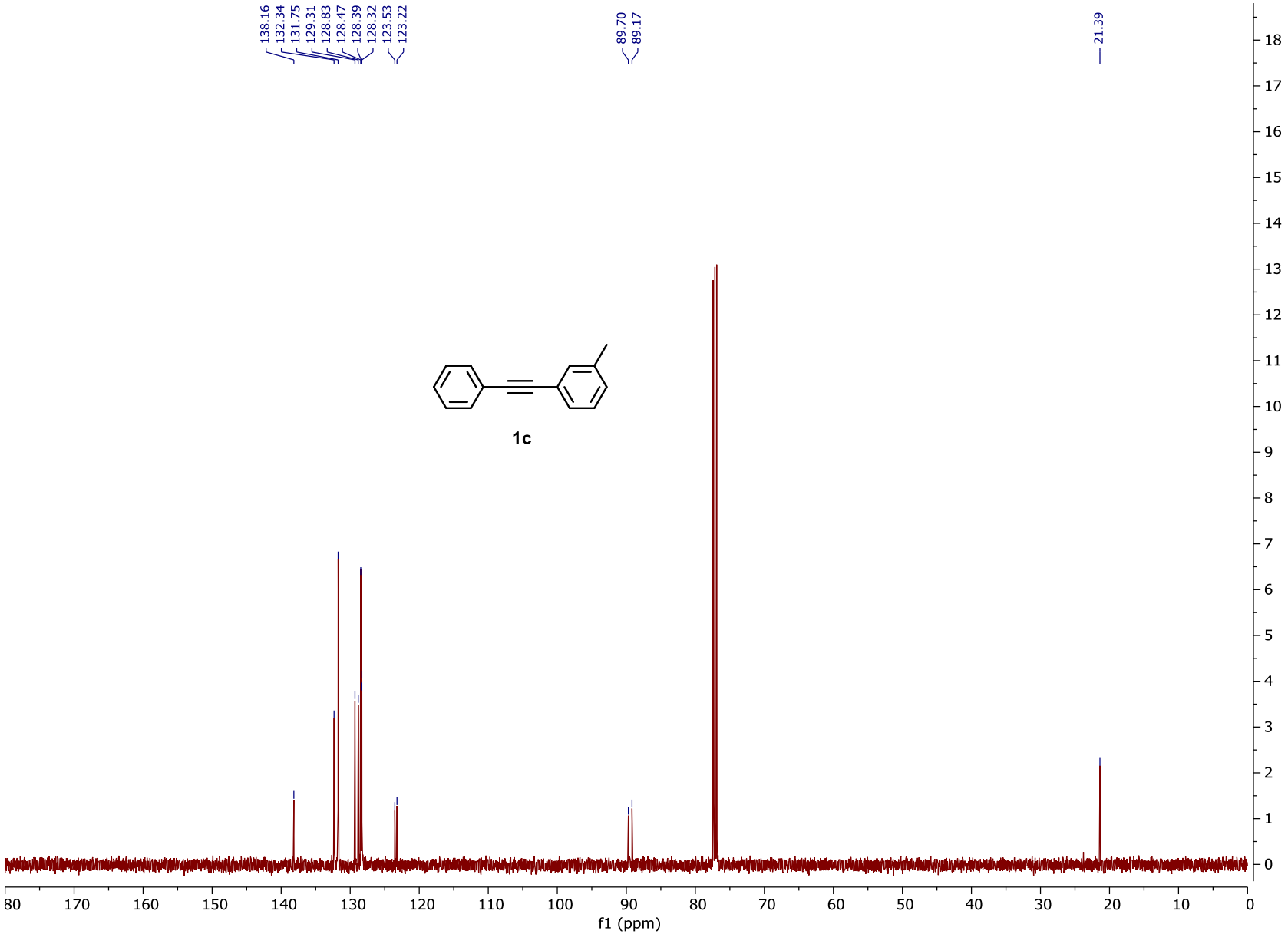
2.39
1.56 HDO
1c
2.03
4.94
1.01
1.01
3.03
f1 (ppm)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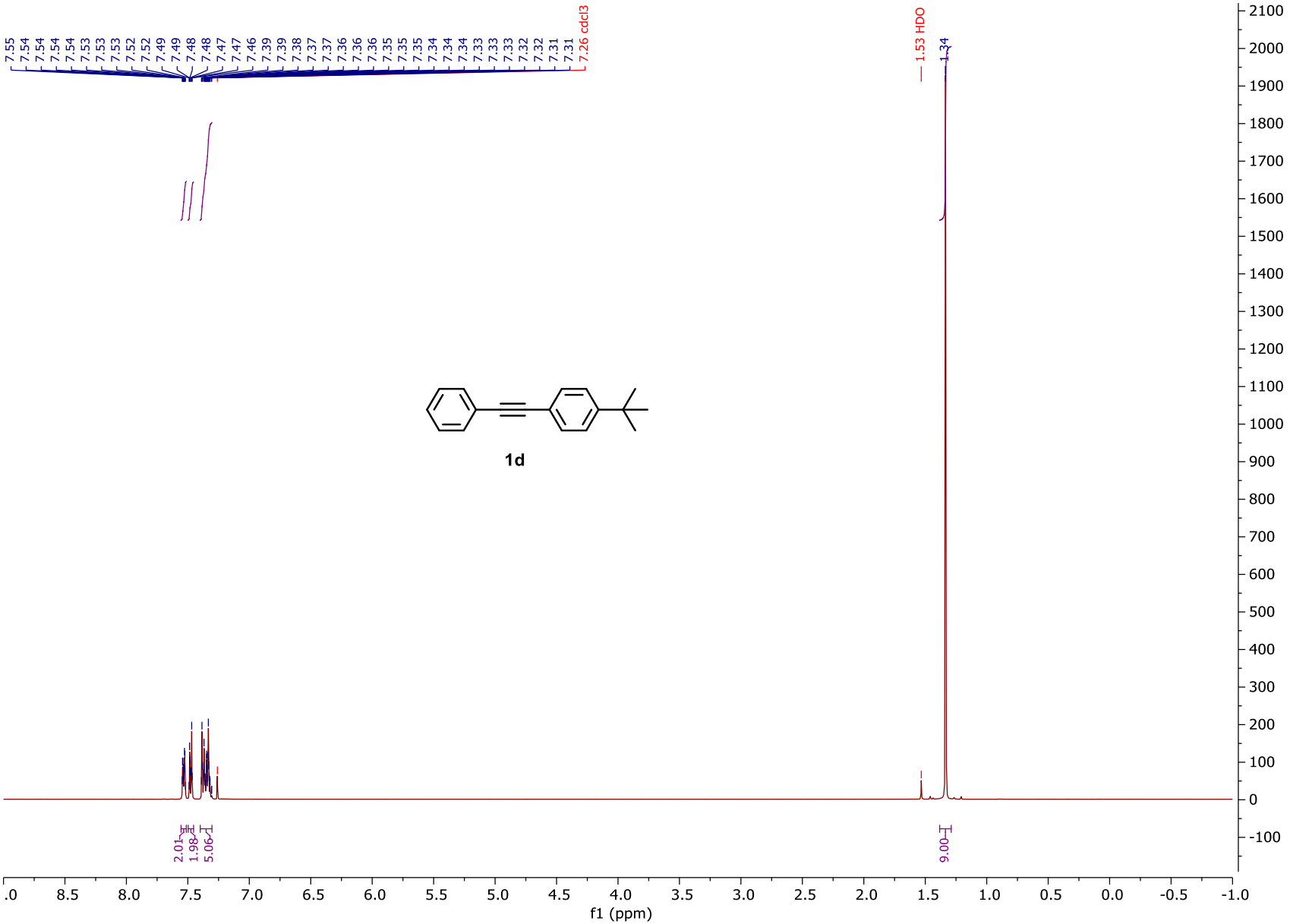
1c
f1 (ppm)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7.33
7.33
7.32
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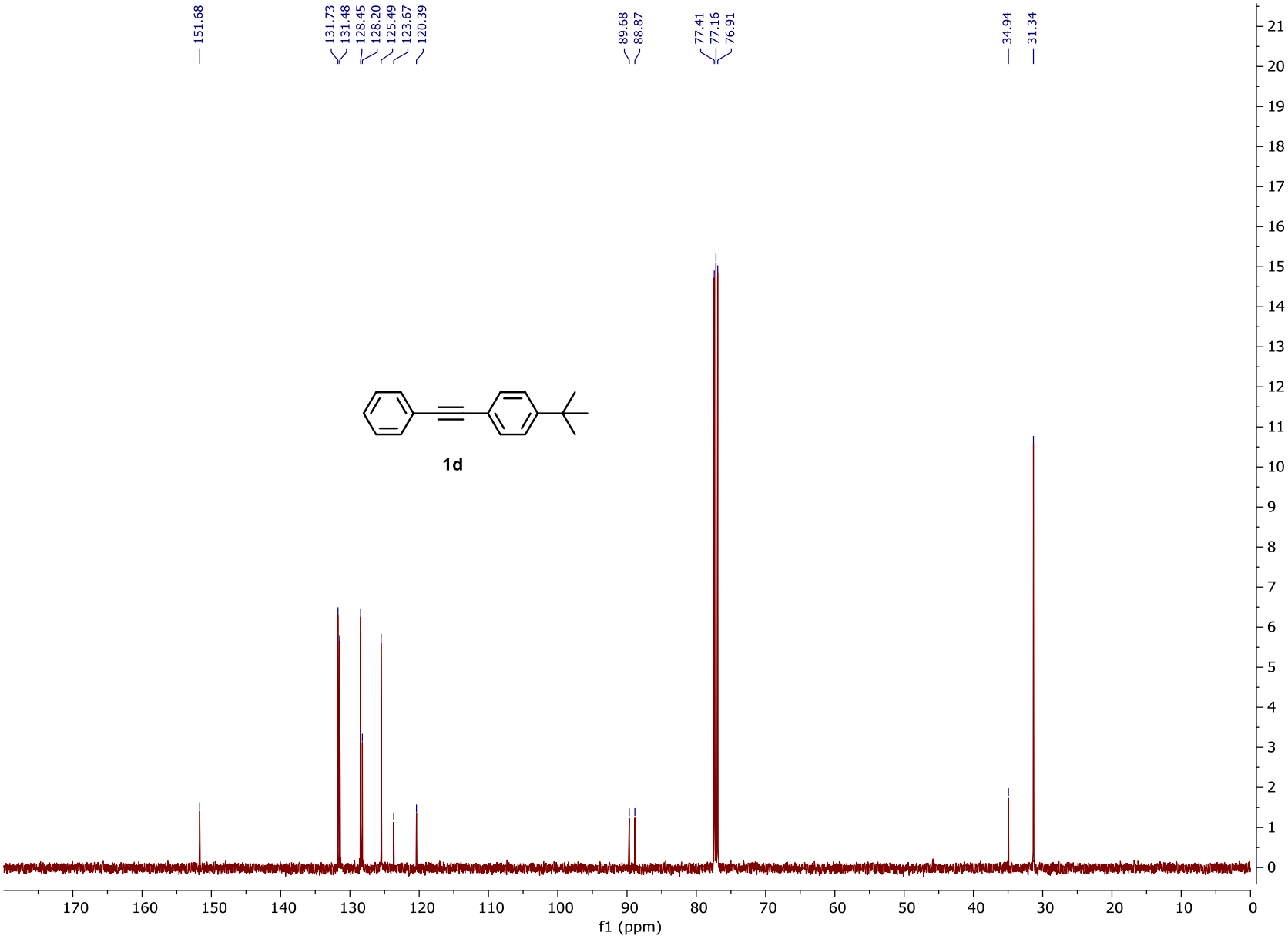
f1 (ppm)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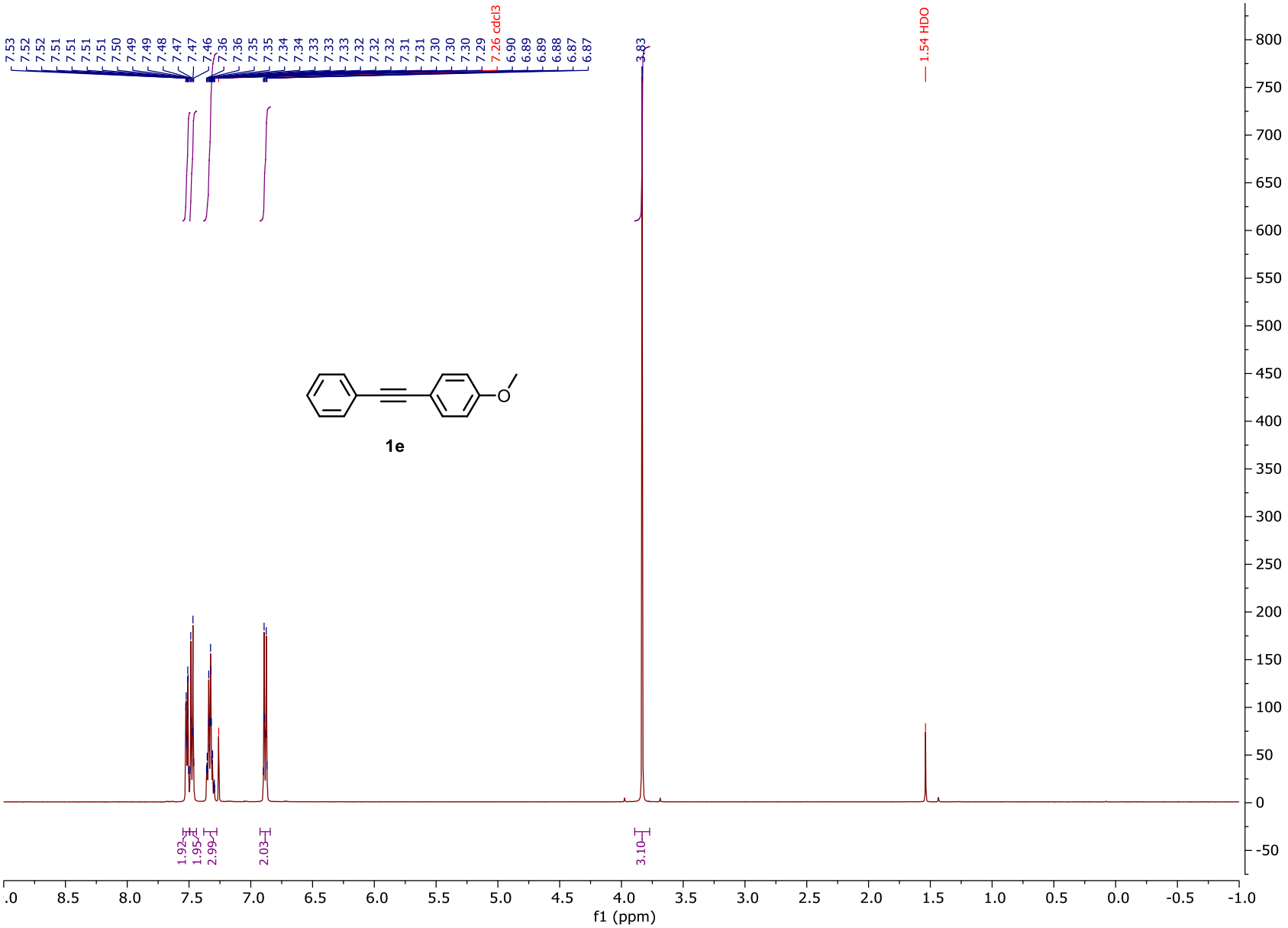
31.34
1d
f1 (ppm)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7.30
7.29
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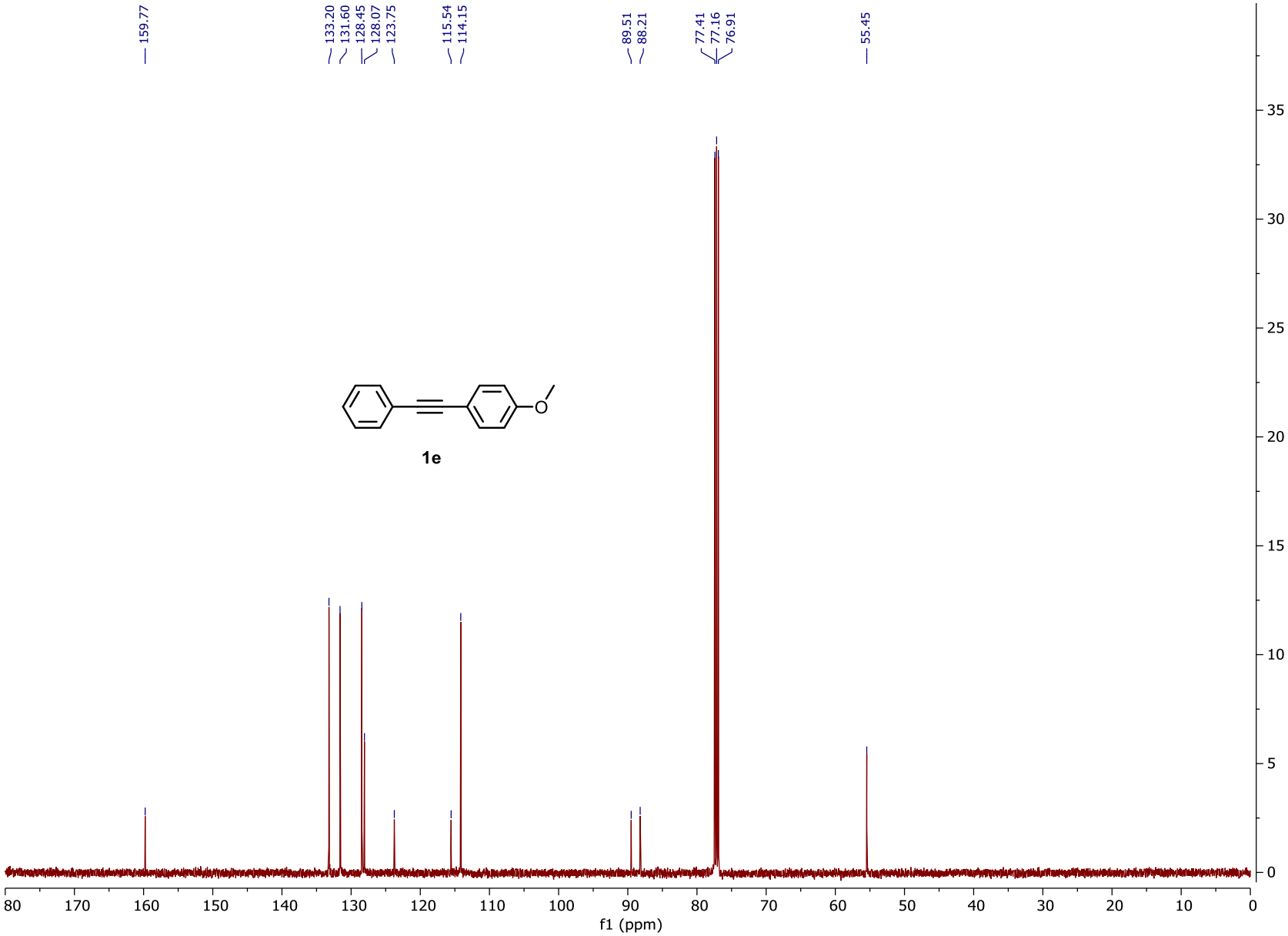
3.10
f1 (ppm)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76.91
55.45
O
1e
35
30
25
20
15
10
5
0
80
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50
40
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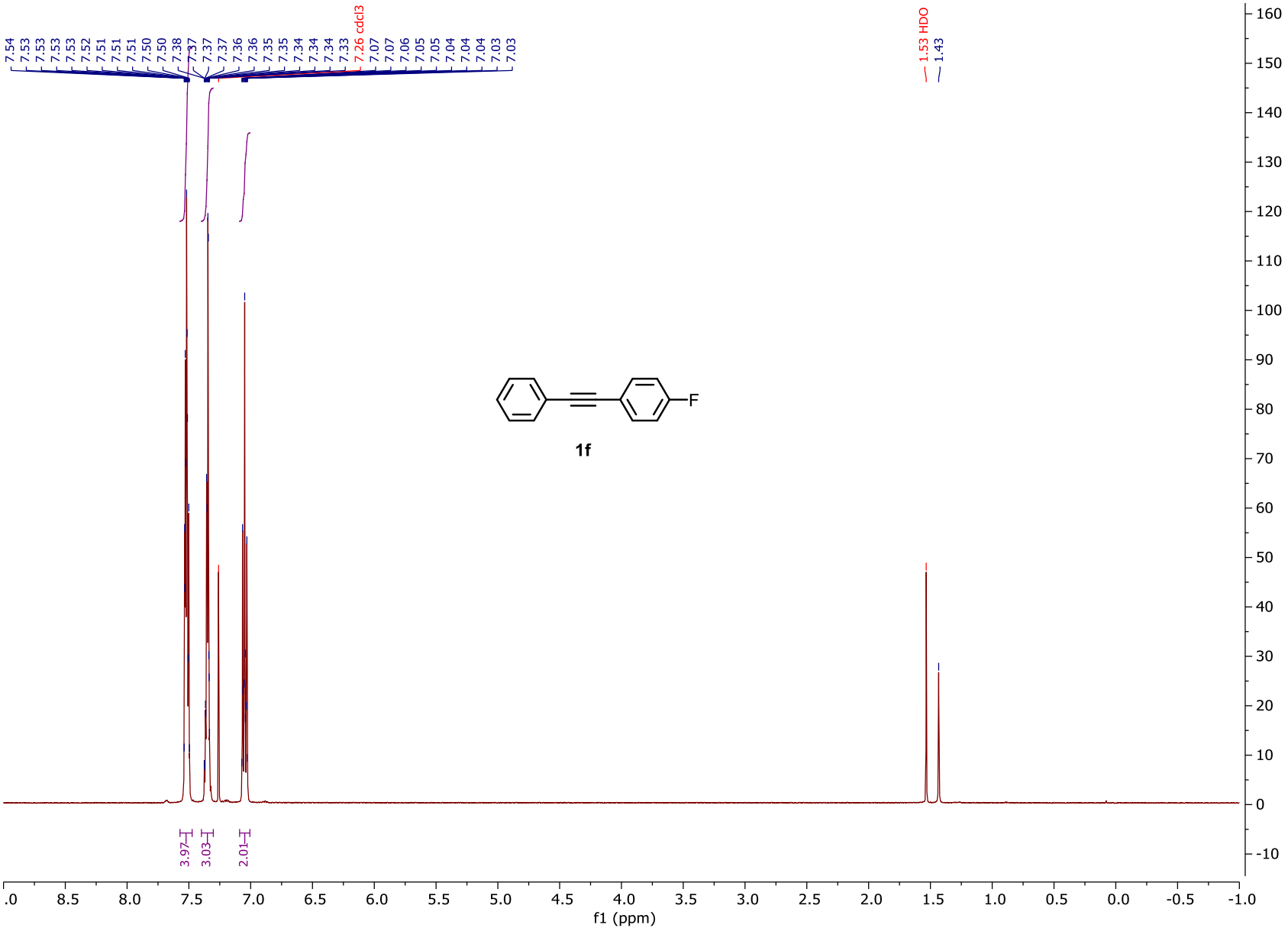
10
0
f1 (ppm)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7.07
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7.05
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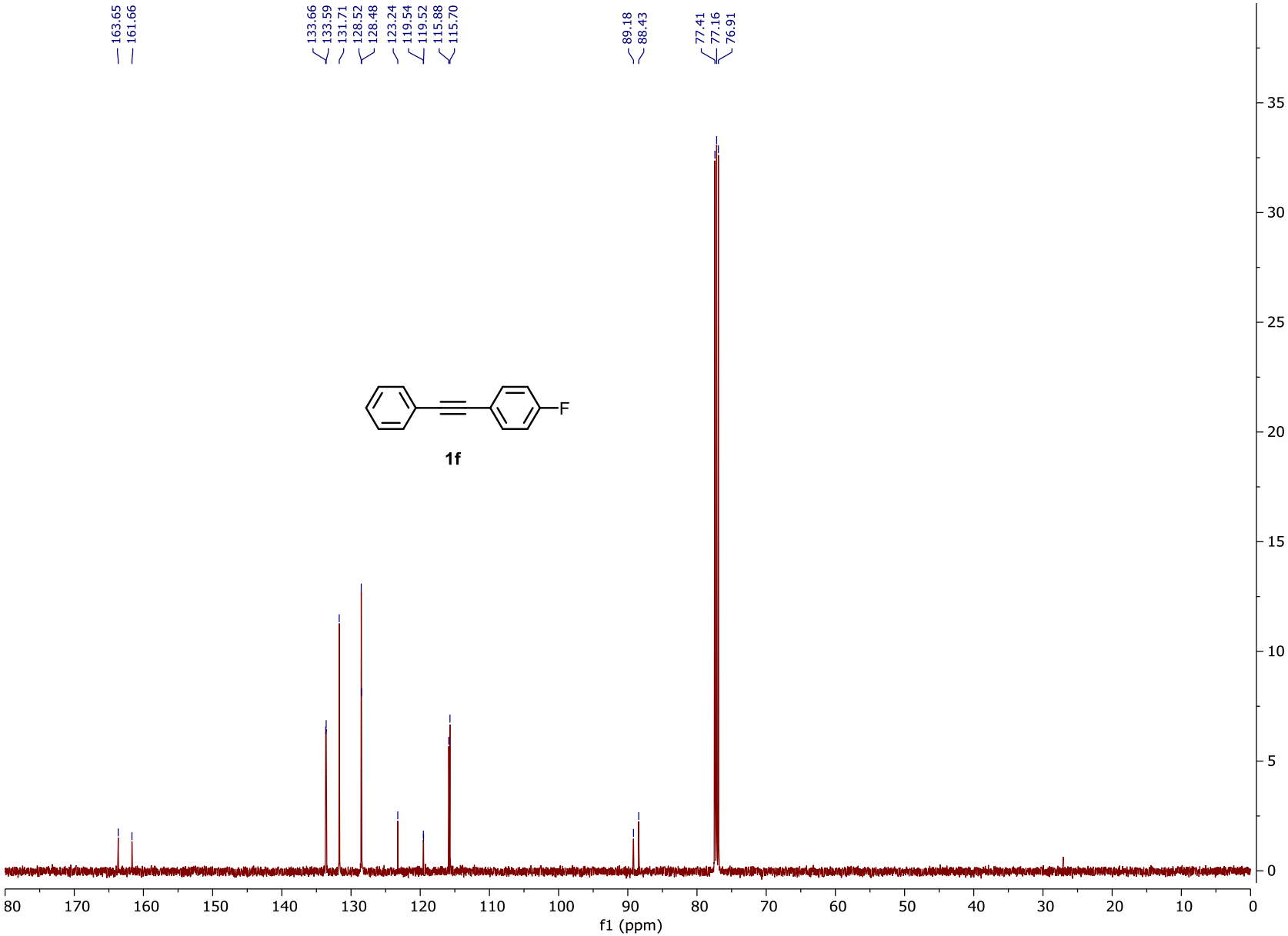
2.01
f1 (ppm)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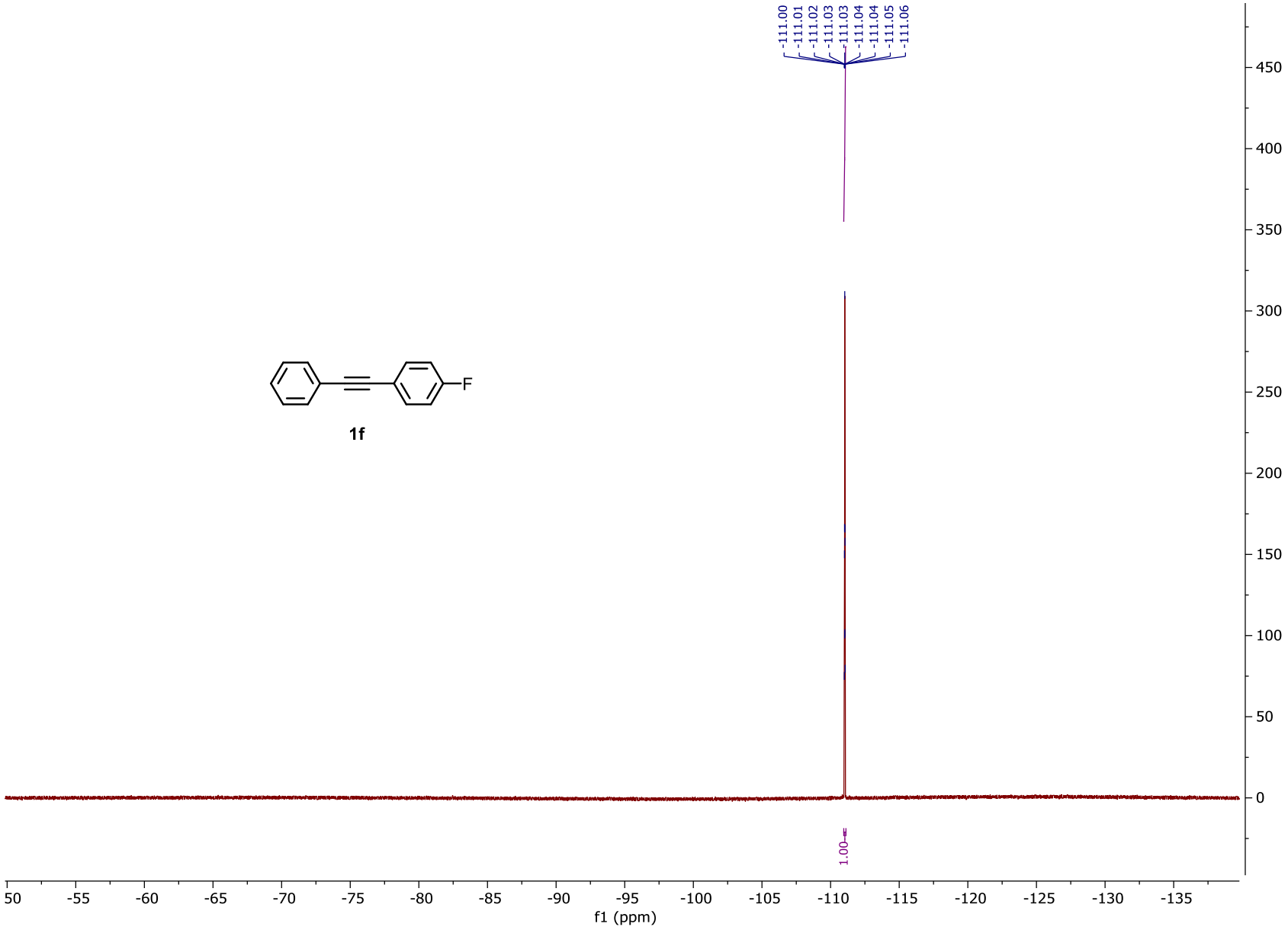
1f
f1 (ppm)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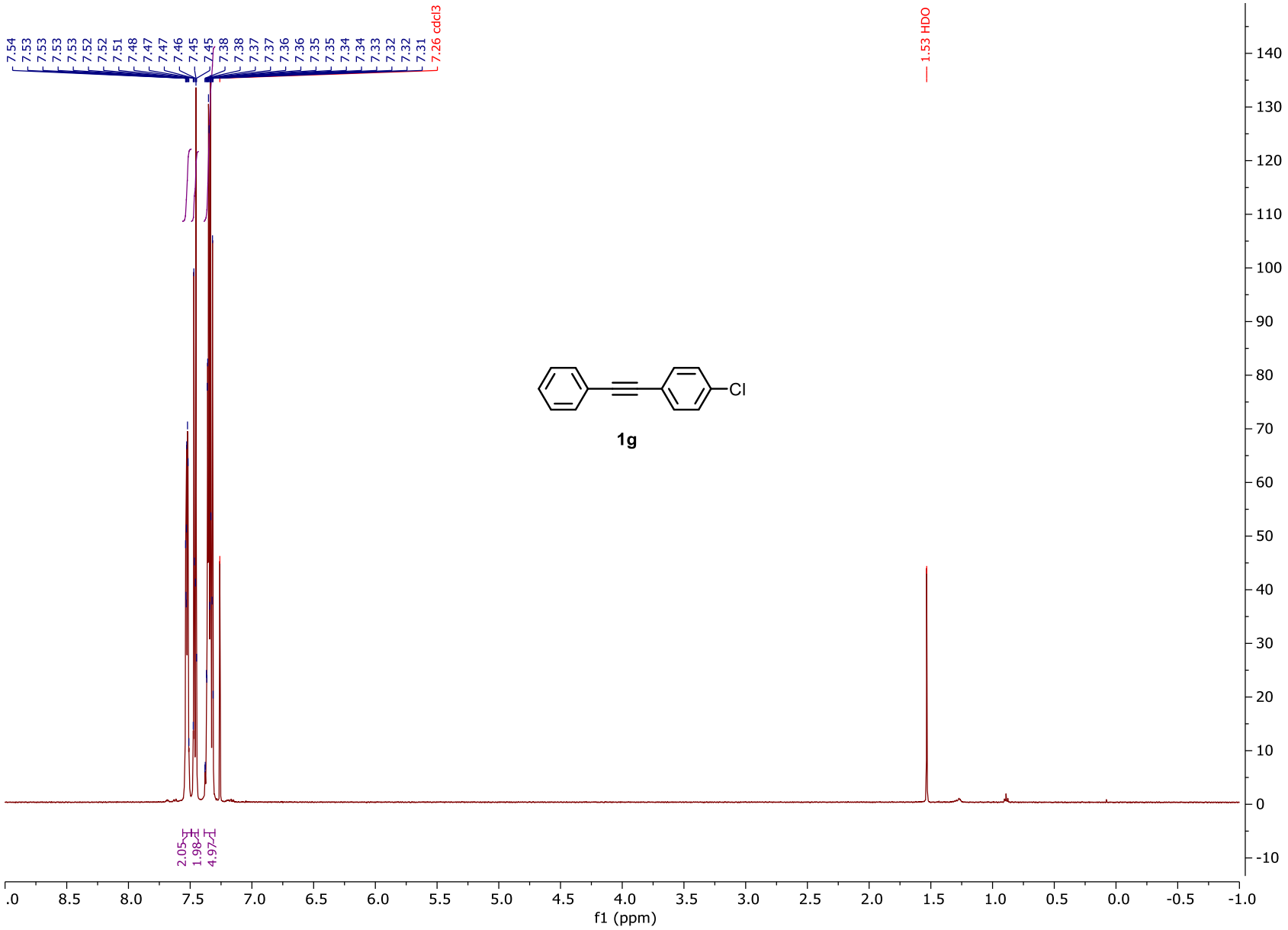
1.00
f1 (ppm)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7.37
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7.36
7.35
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7.33
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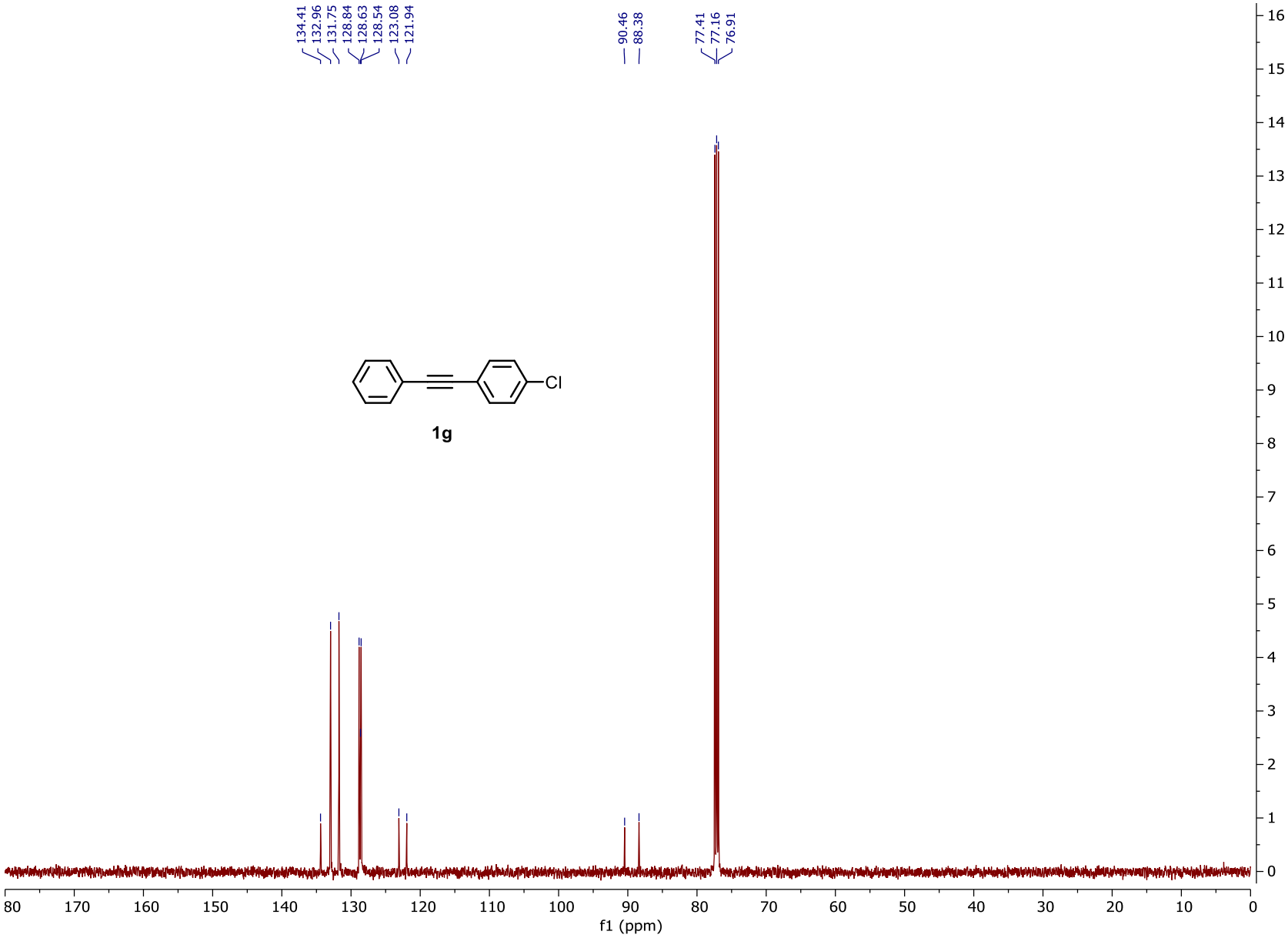
f1 (ppm)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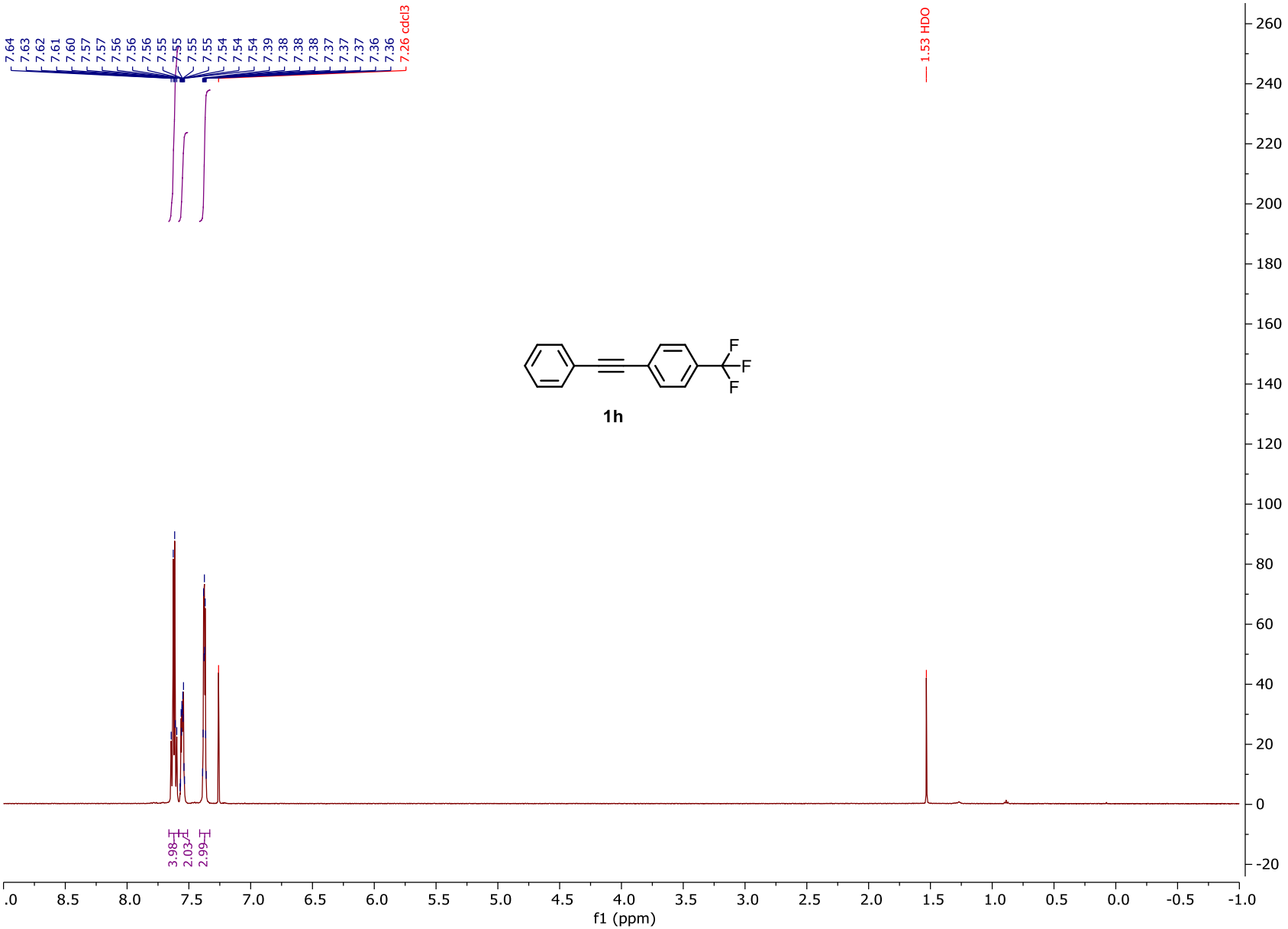
1g
f1 (ppm)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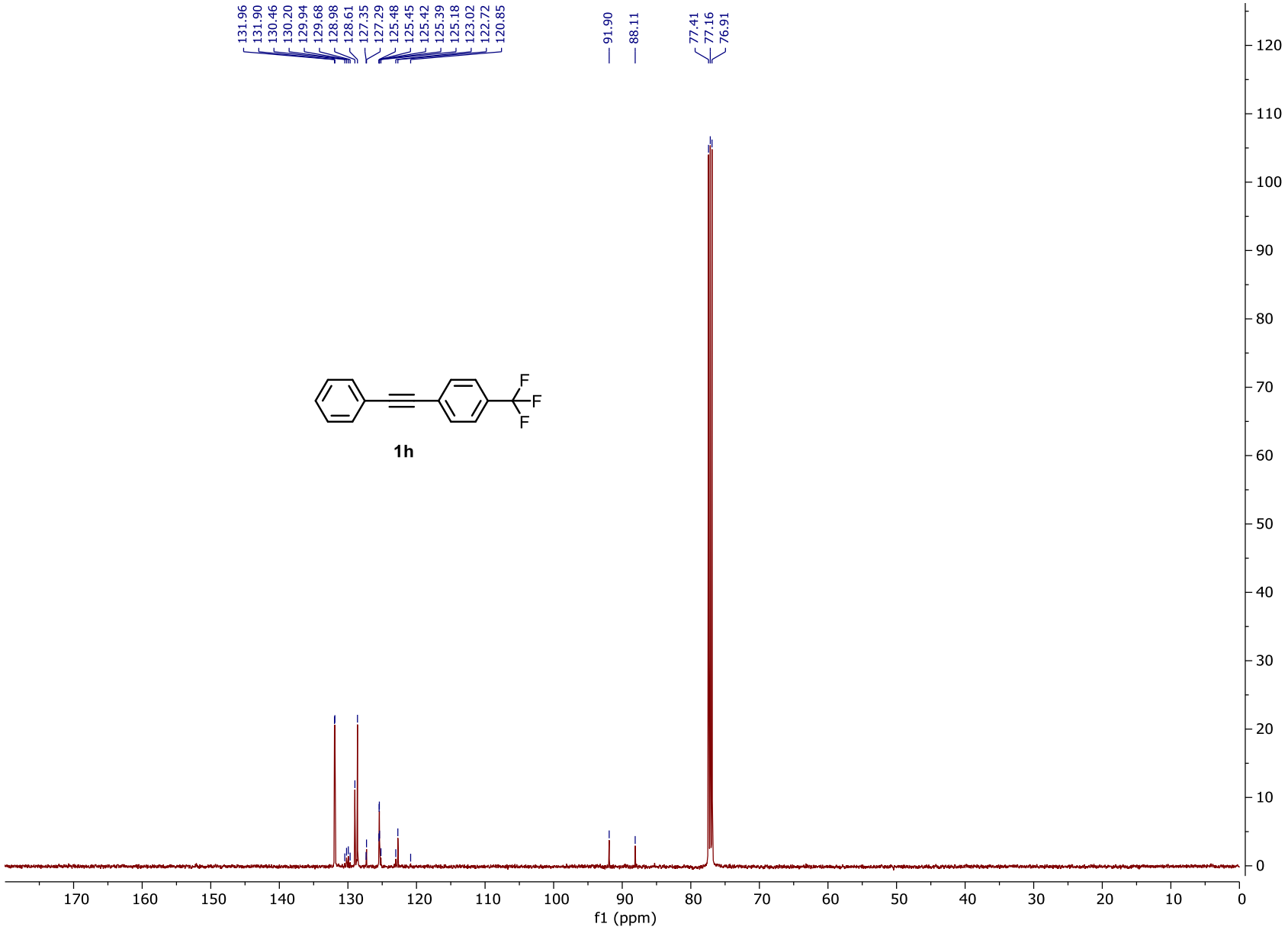
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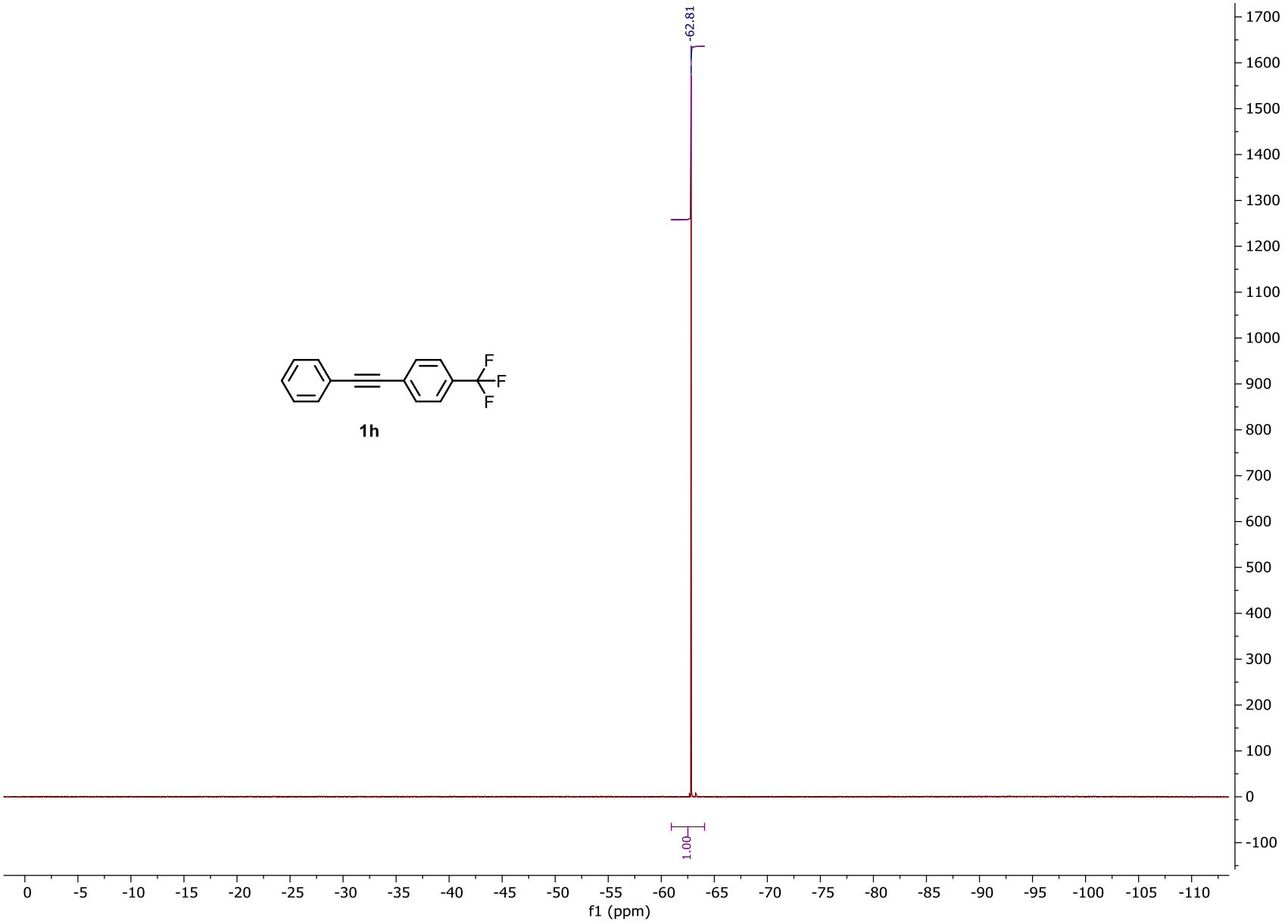
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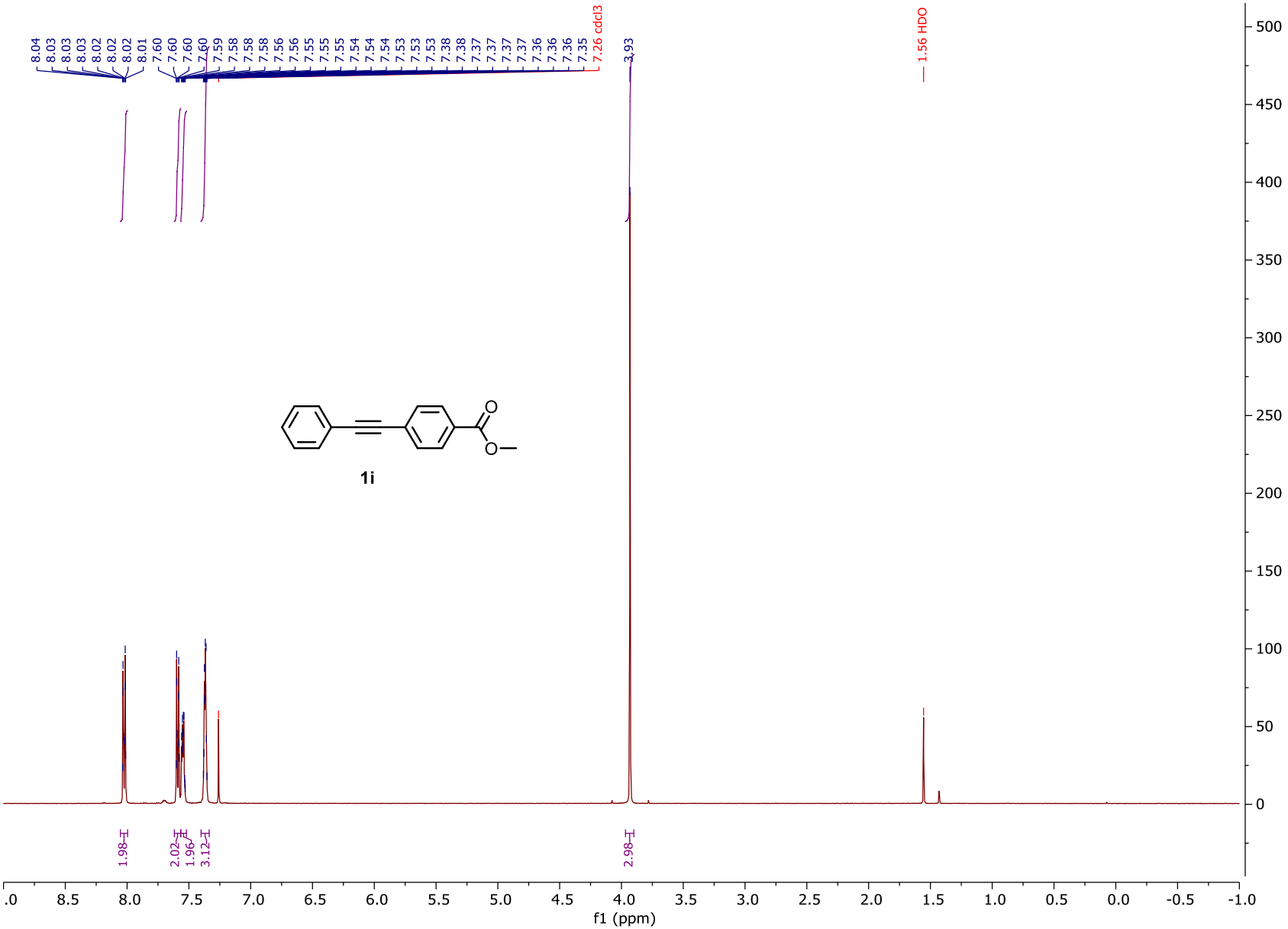
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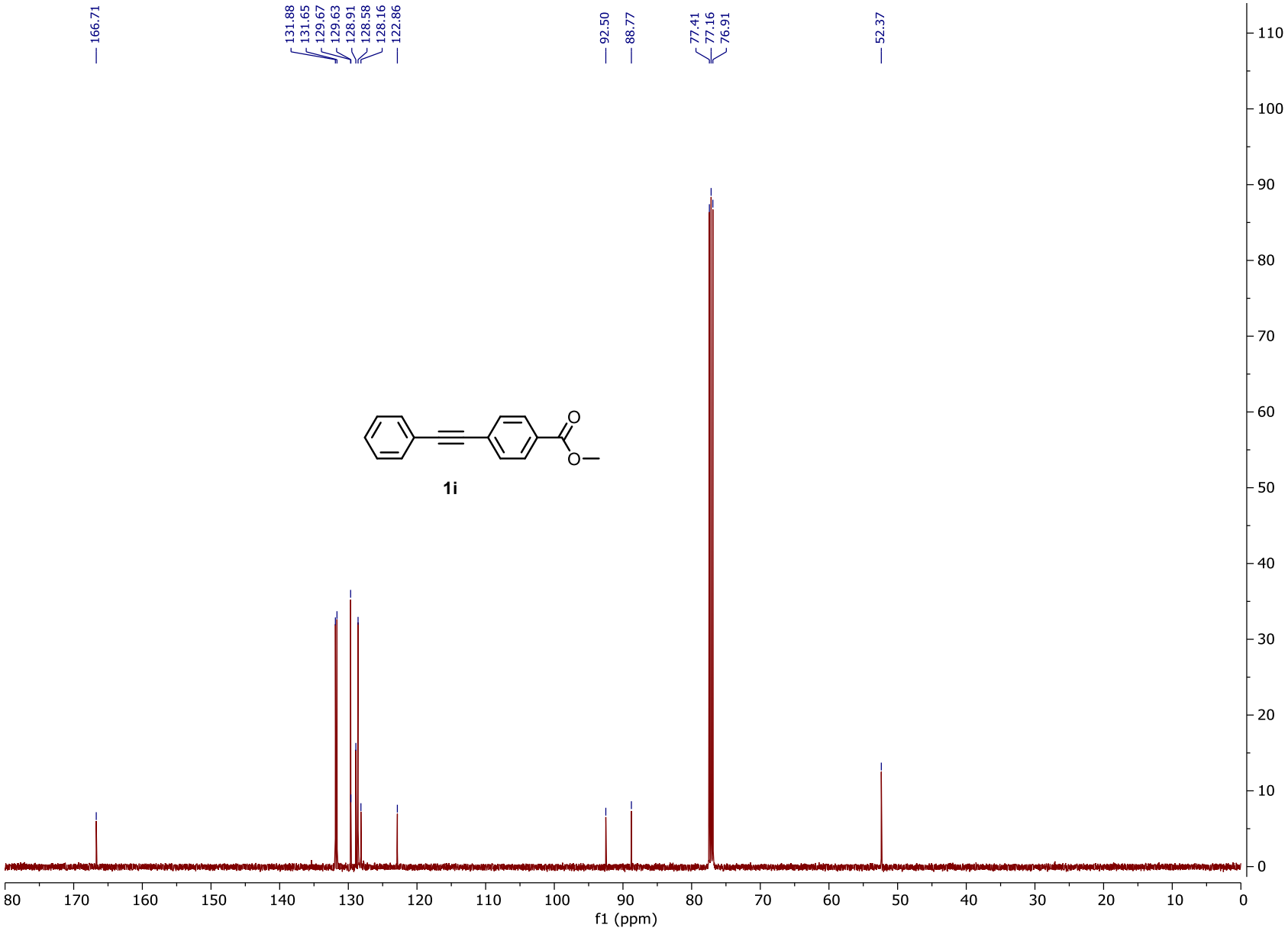
f1 (ppm)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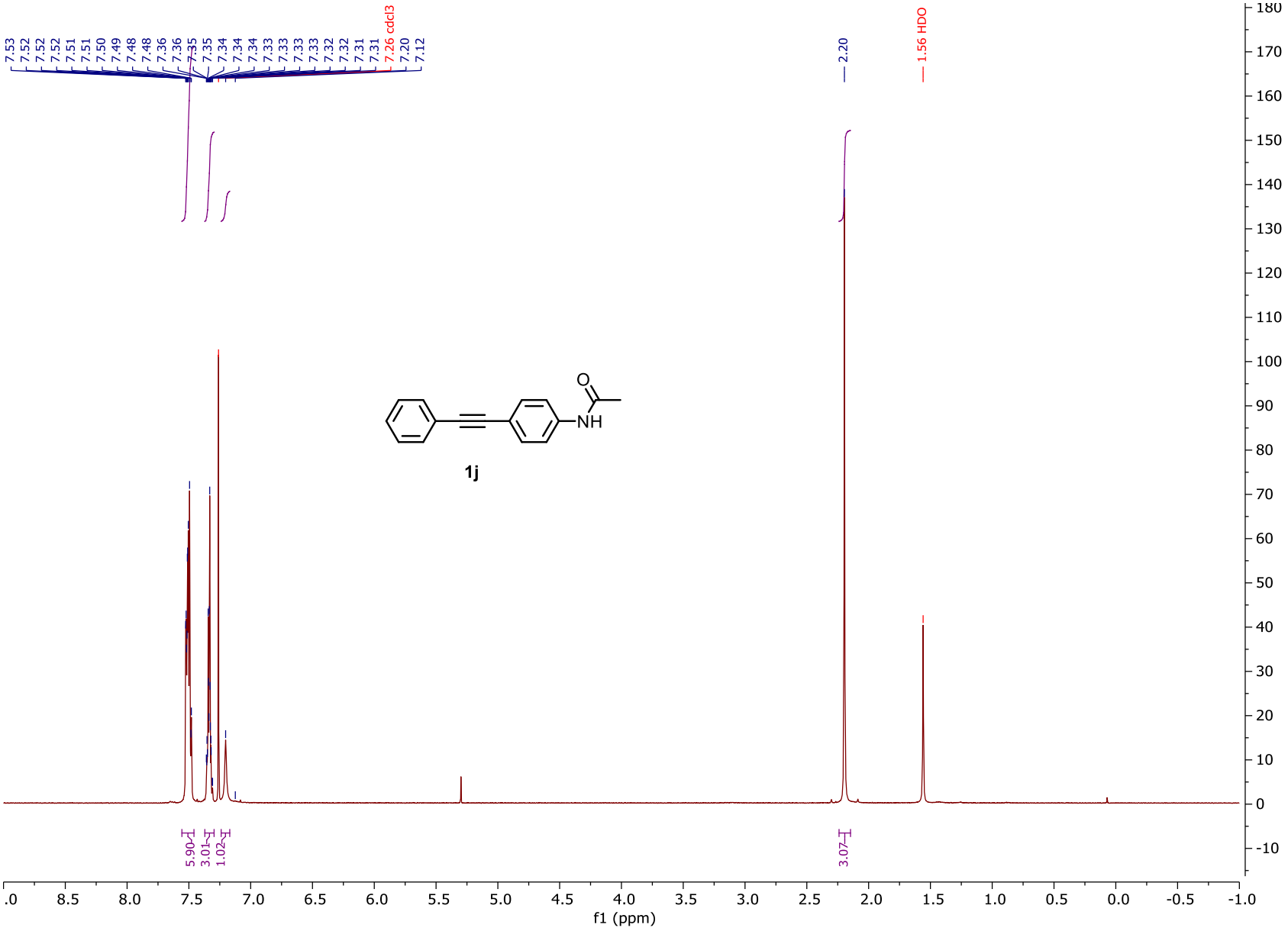
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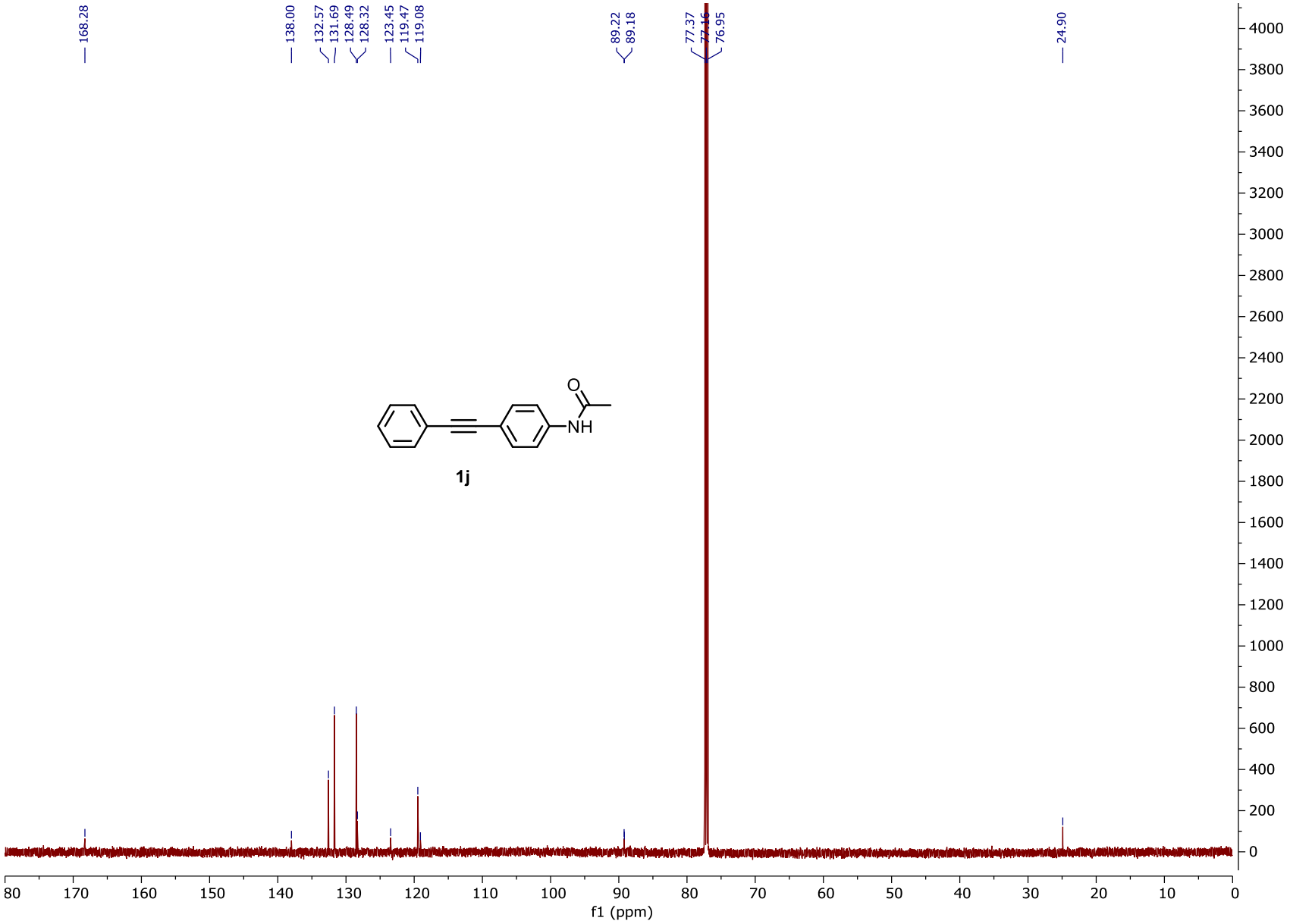
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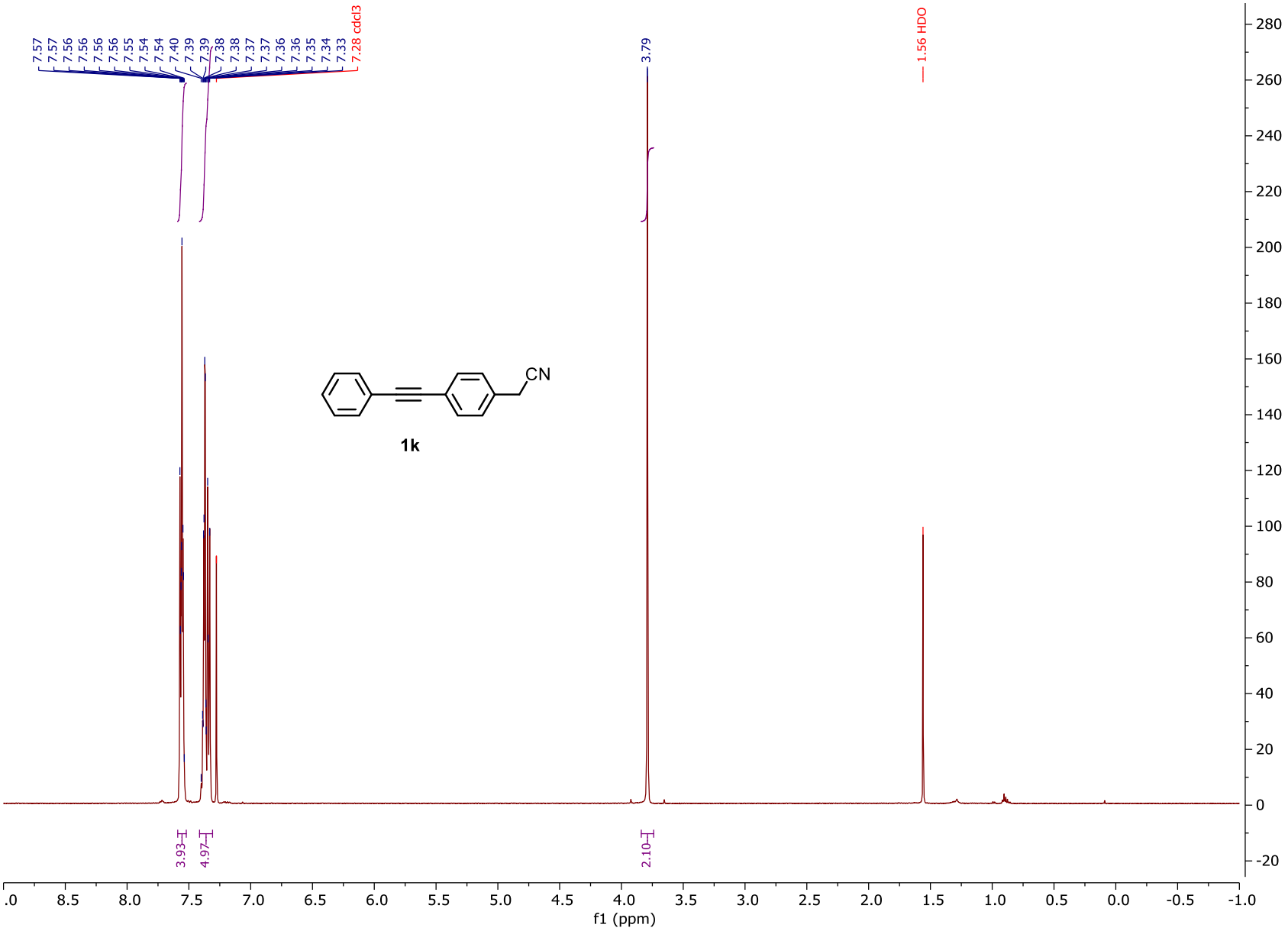
O
NH
1j
f1 (ppm)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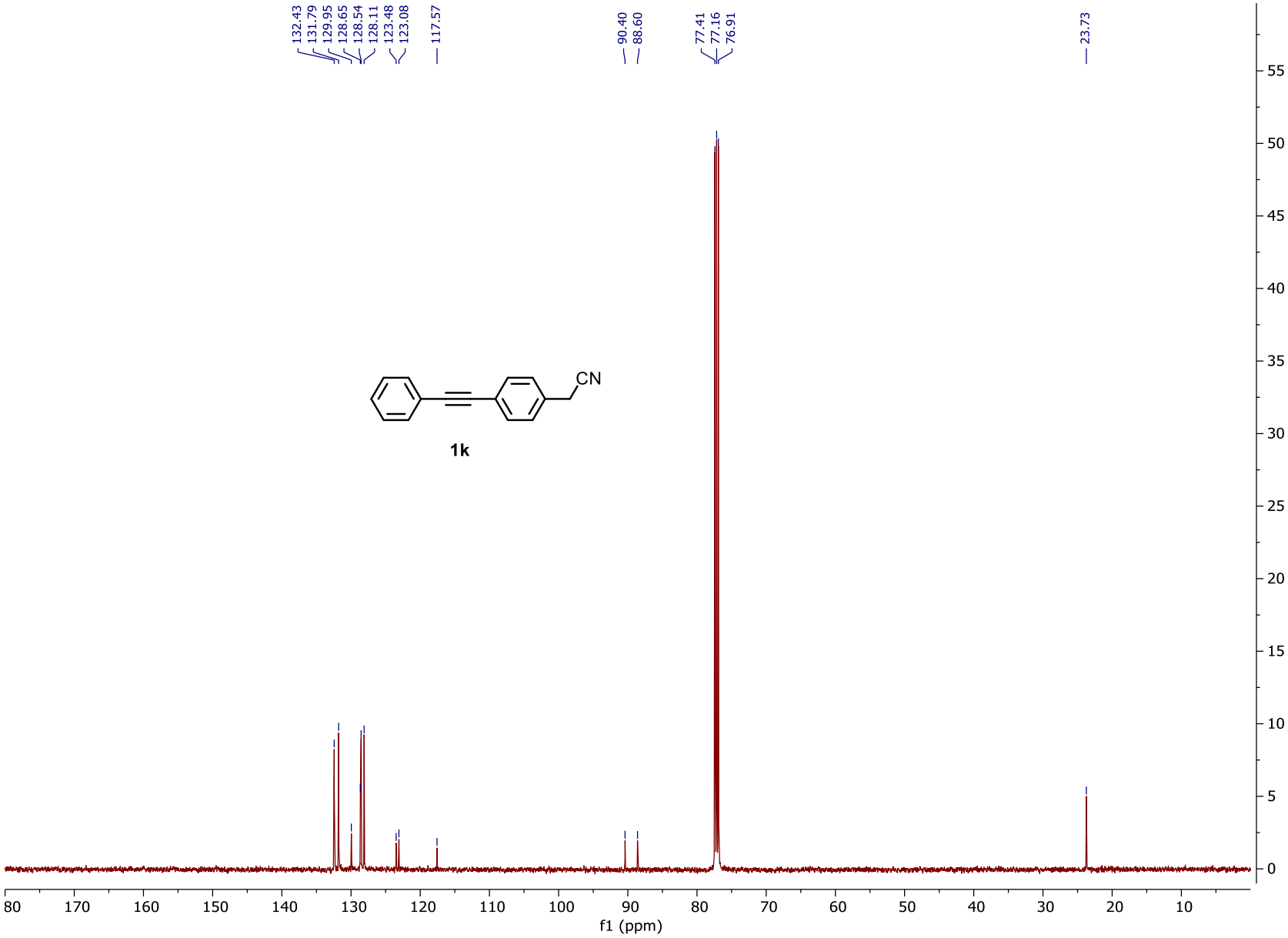
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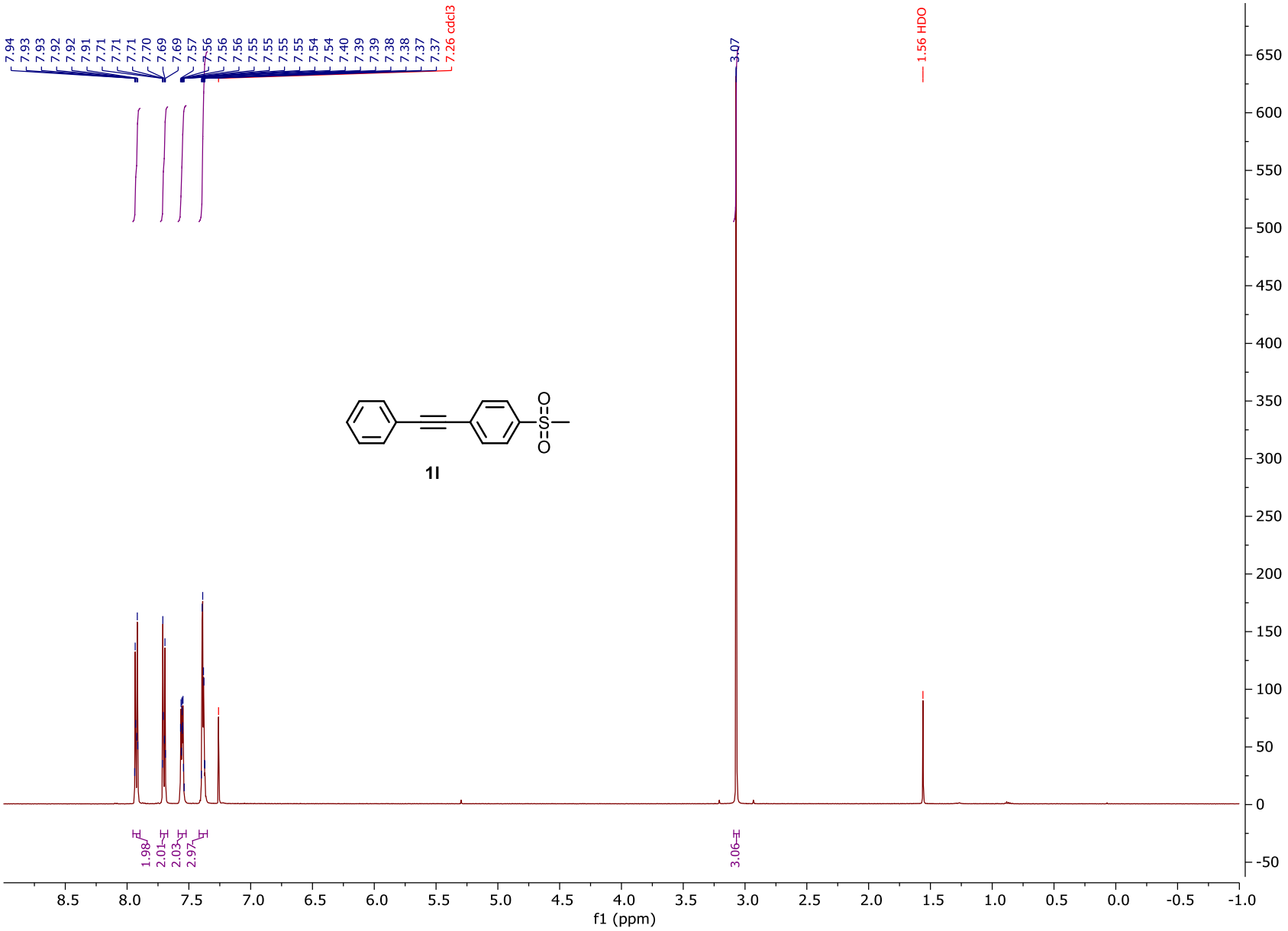
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7.71
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7.69
7.57
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7.55
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7.55
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7.38
7.38
7.37
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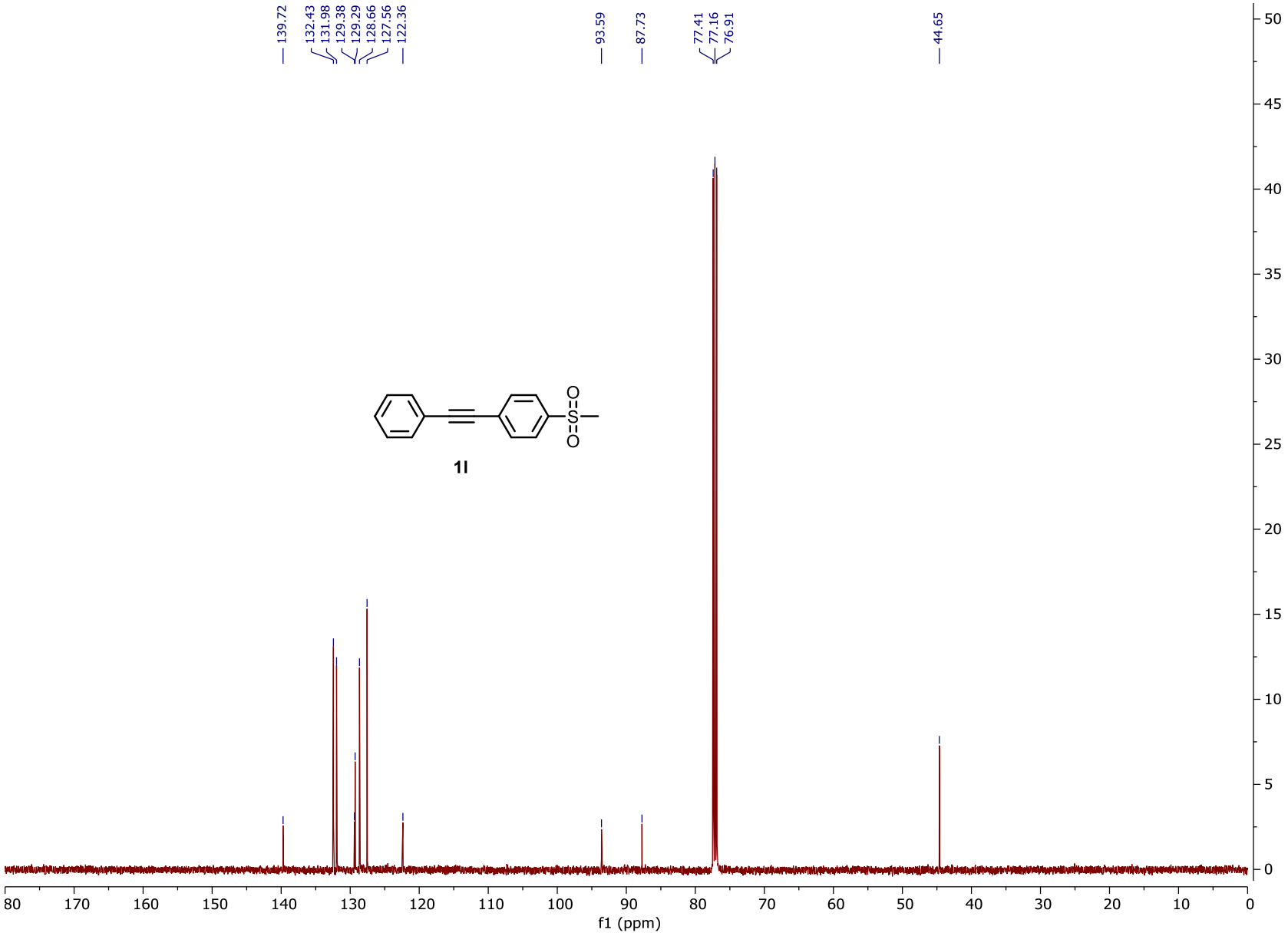
2.01
2.03
2.97
3.06
1l
f1 (ppm)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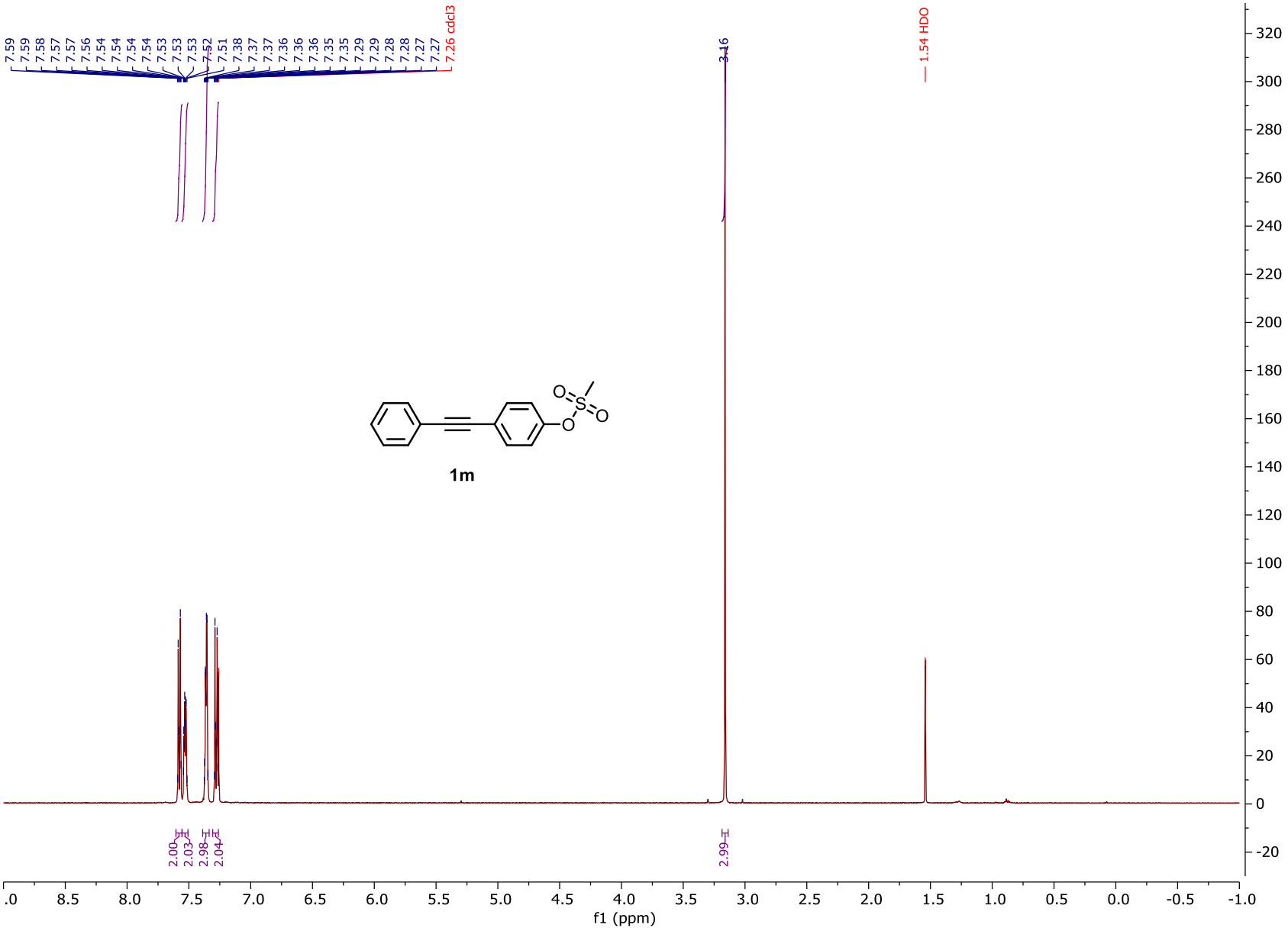
77.16
76.91
44.65
1l
f1 (ppm)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7.27
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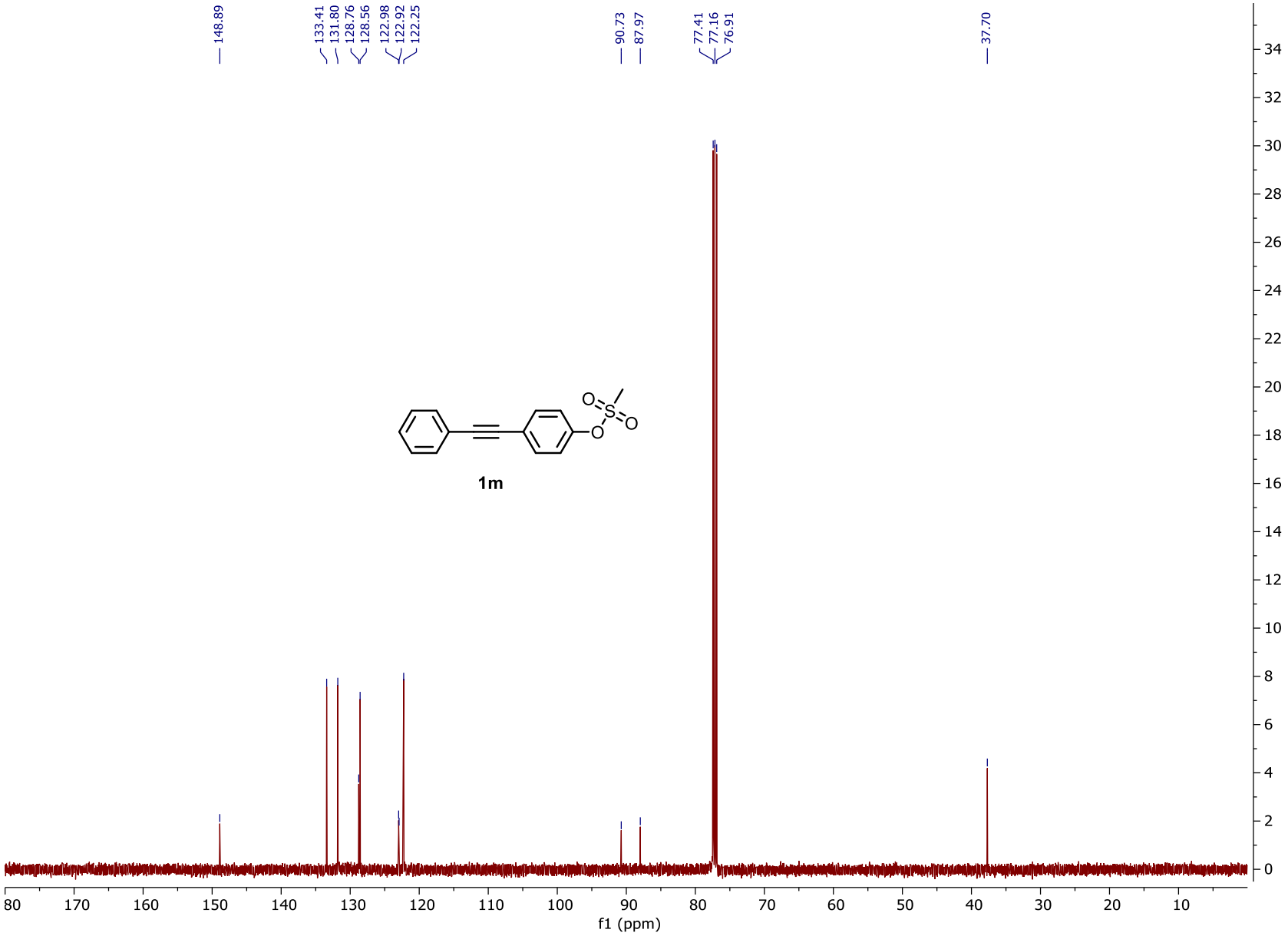
2.03
2.98
2.04
2.99
f1 (ppm)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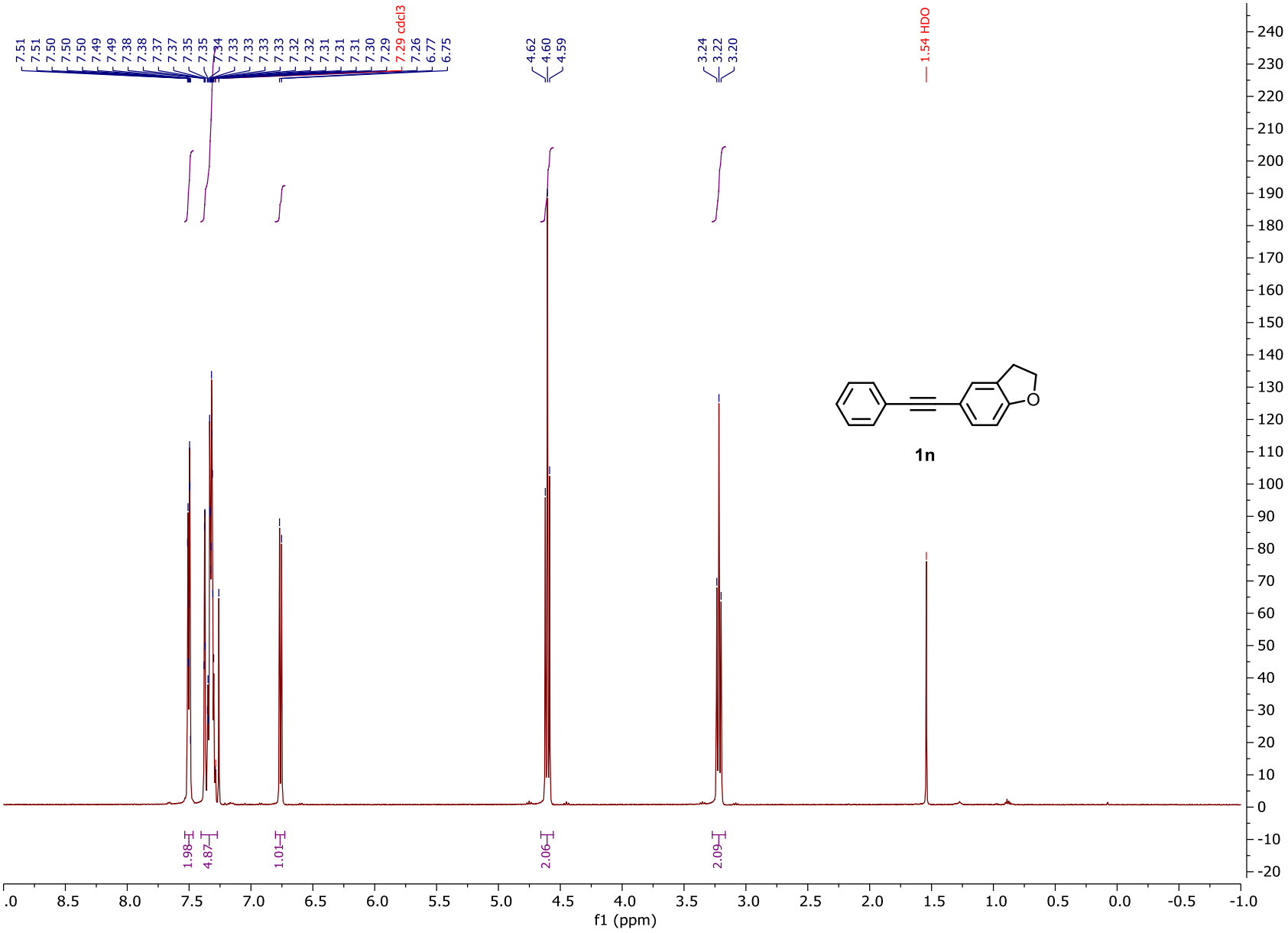
77.16
76.91
37.70
1m
f1 (ppm)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7.32
7.32
7.31
7.31
7.31
7.30
7.29
7.29 cdcl3
7.26
6.77
6.75
4.62
4.60
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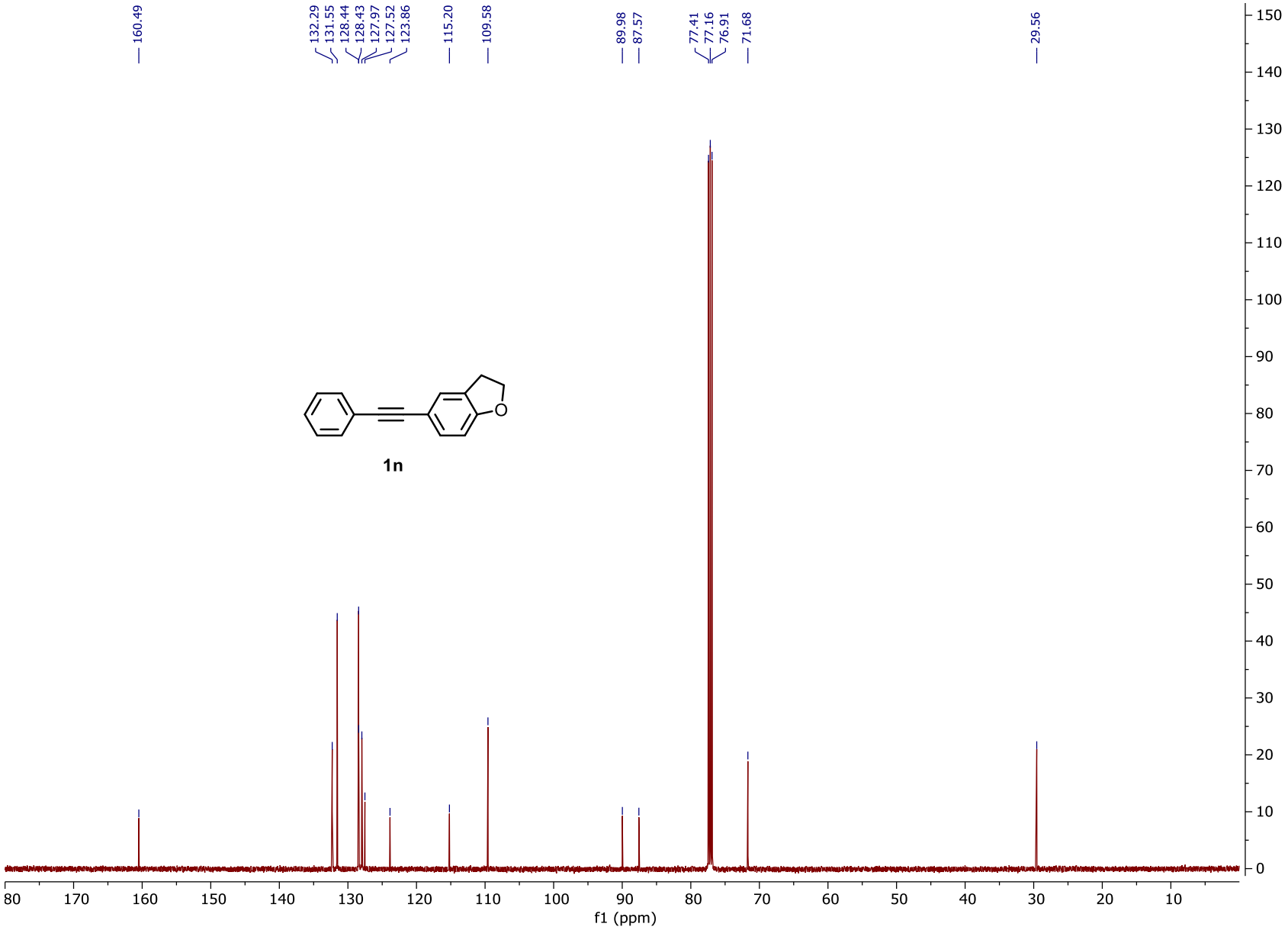
4.87
1.01
2.06
2.09
f1 (ppm)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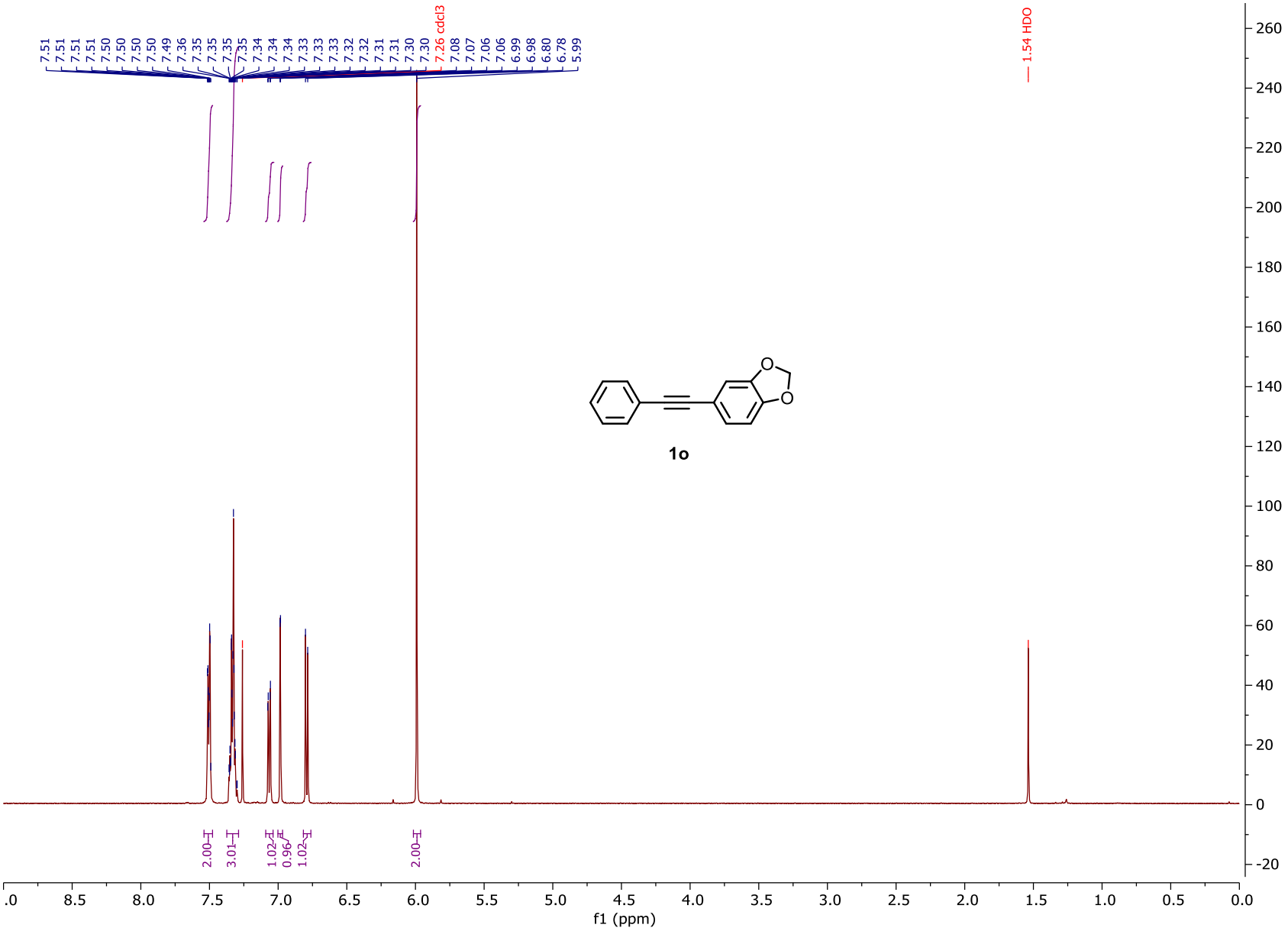
77.16
76.91
71.68
29.56
1n
f1 (ppm)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7.08
7.07
7.06
7.06
6.99
6.98
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2.00
3.01
1.02
0.96
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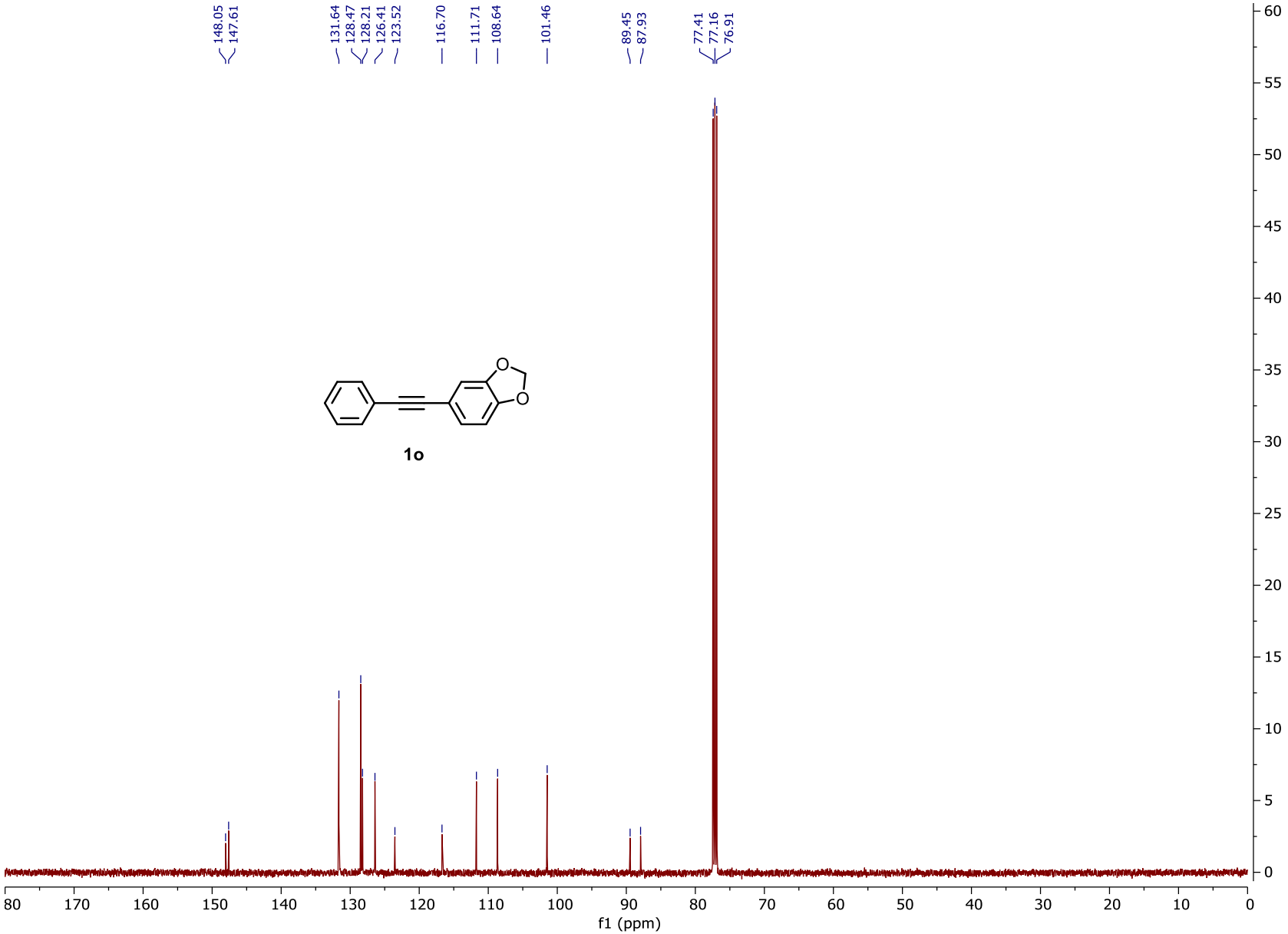
2.00
f1 (ppm)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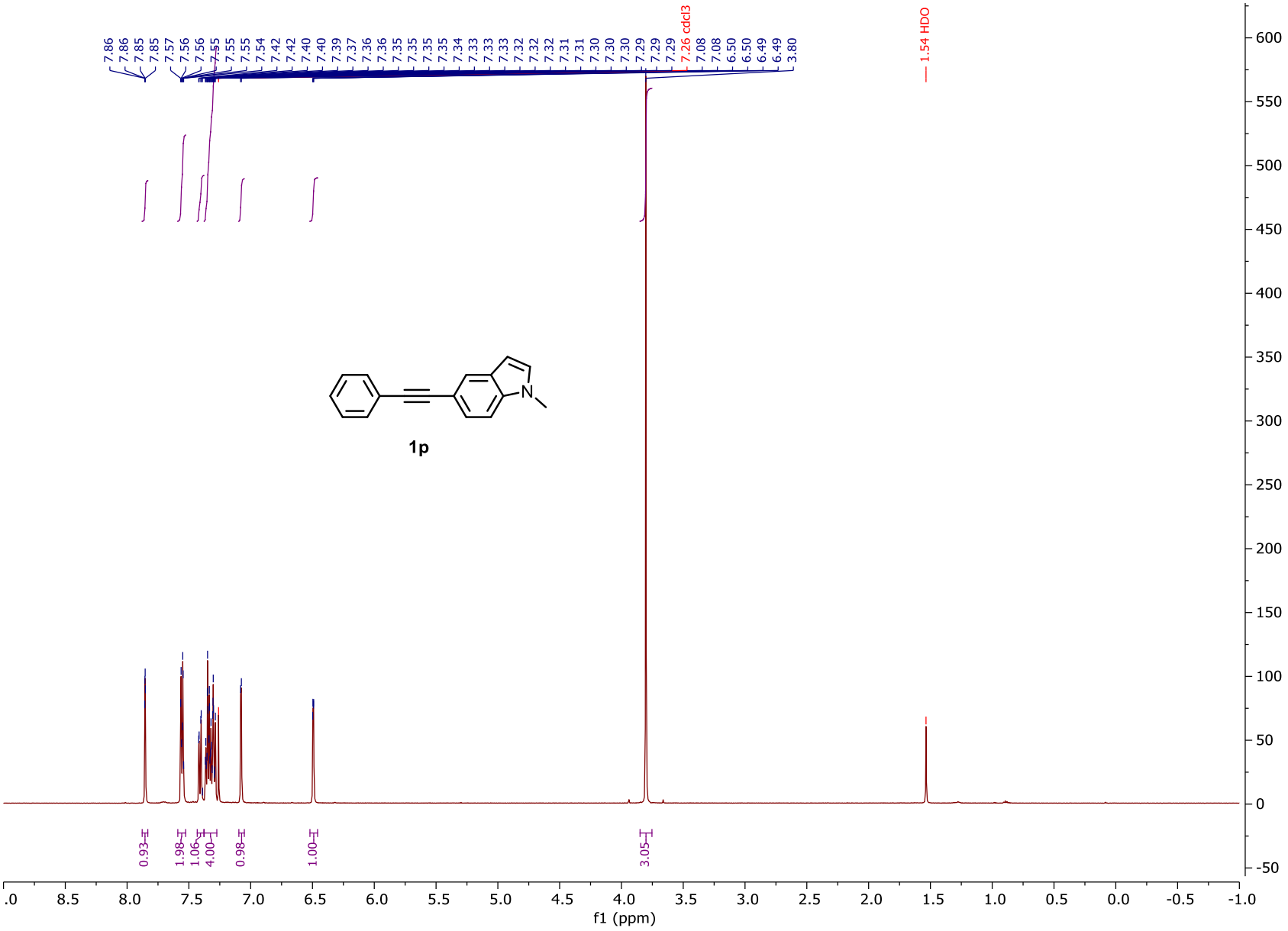
77.41
77.16
76.91
1o
f1 (ppm)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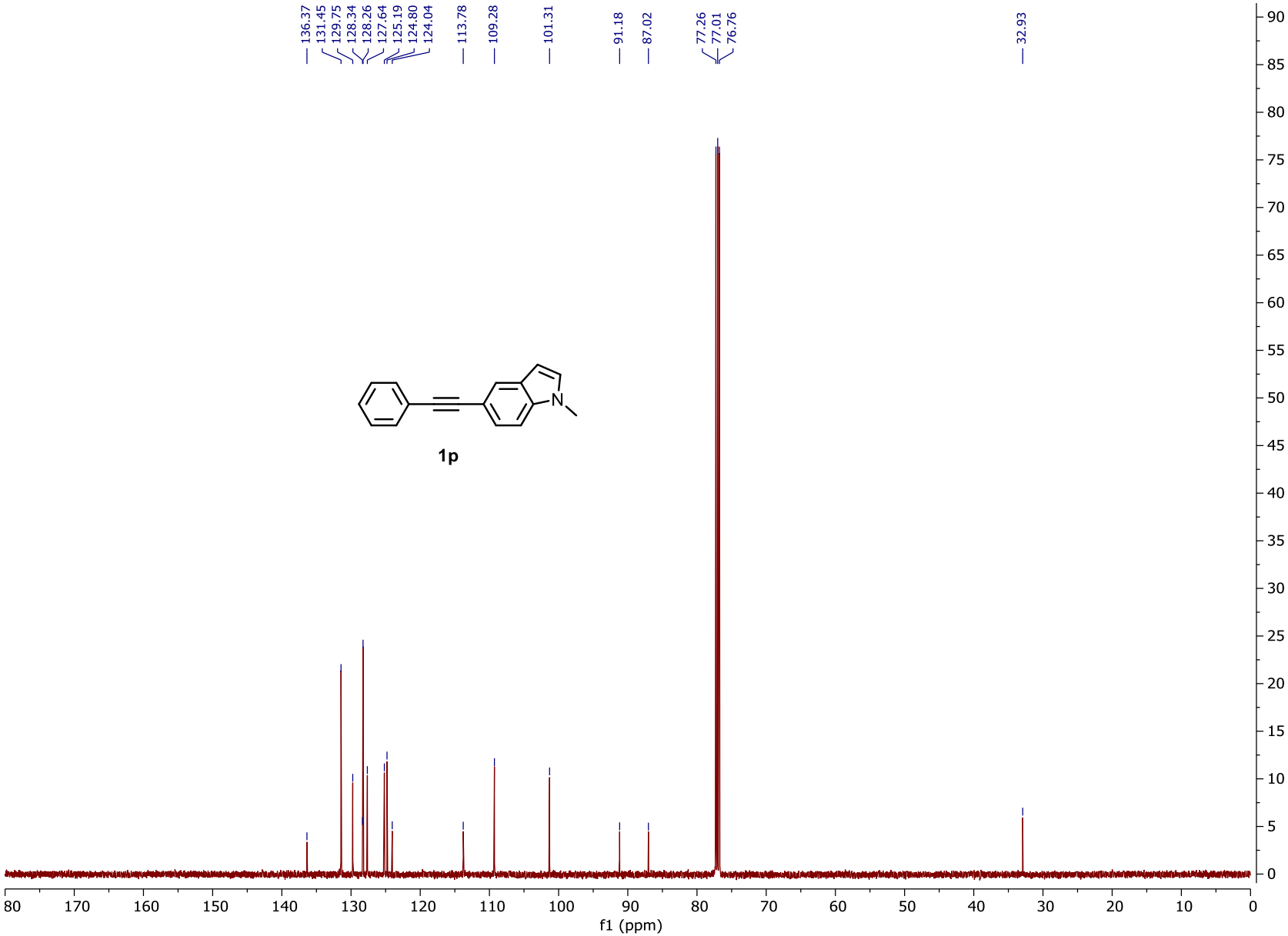
1.54 HDO
1p
0.93 1.98 1.06 4.00 0.98 1.00 3.05
f1 (ppm)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124.04
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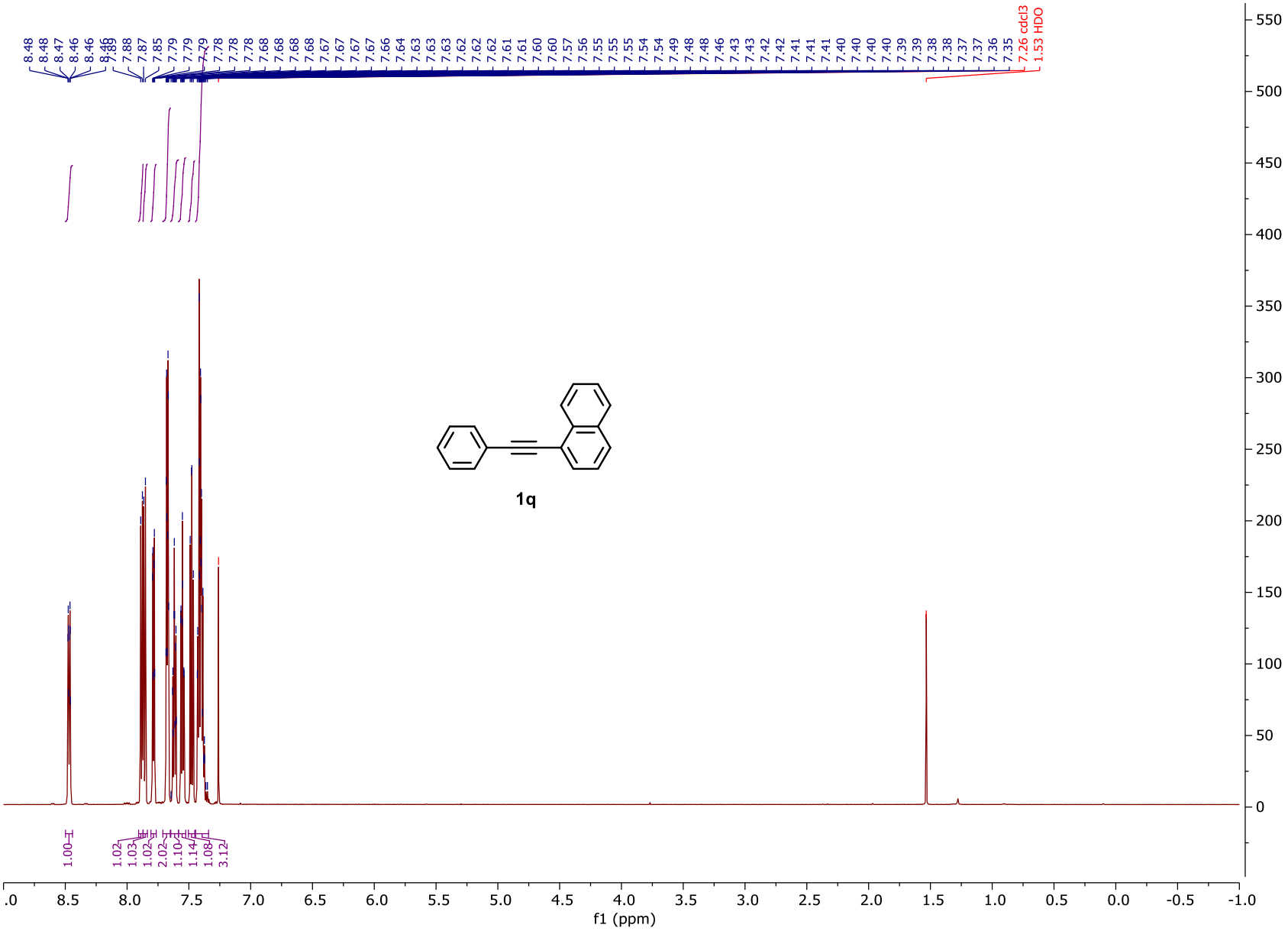
77.26
77.01
76.76
32.93
N
1p
f1 (ppm)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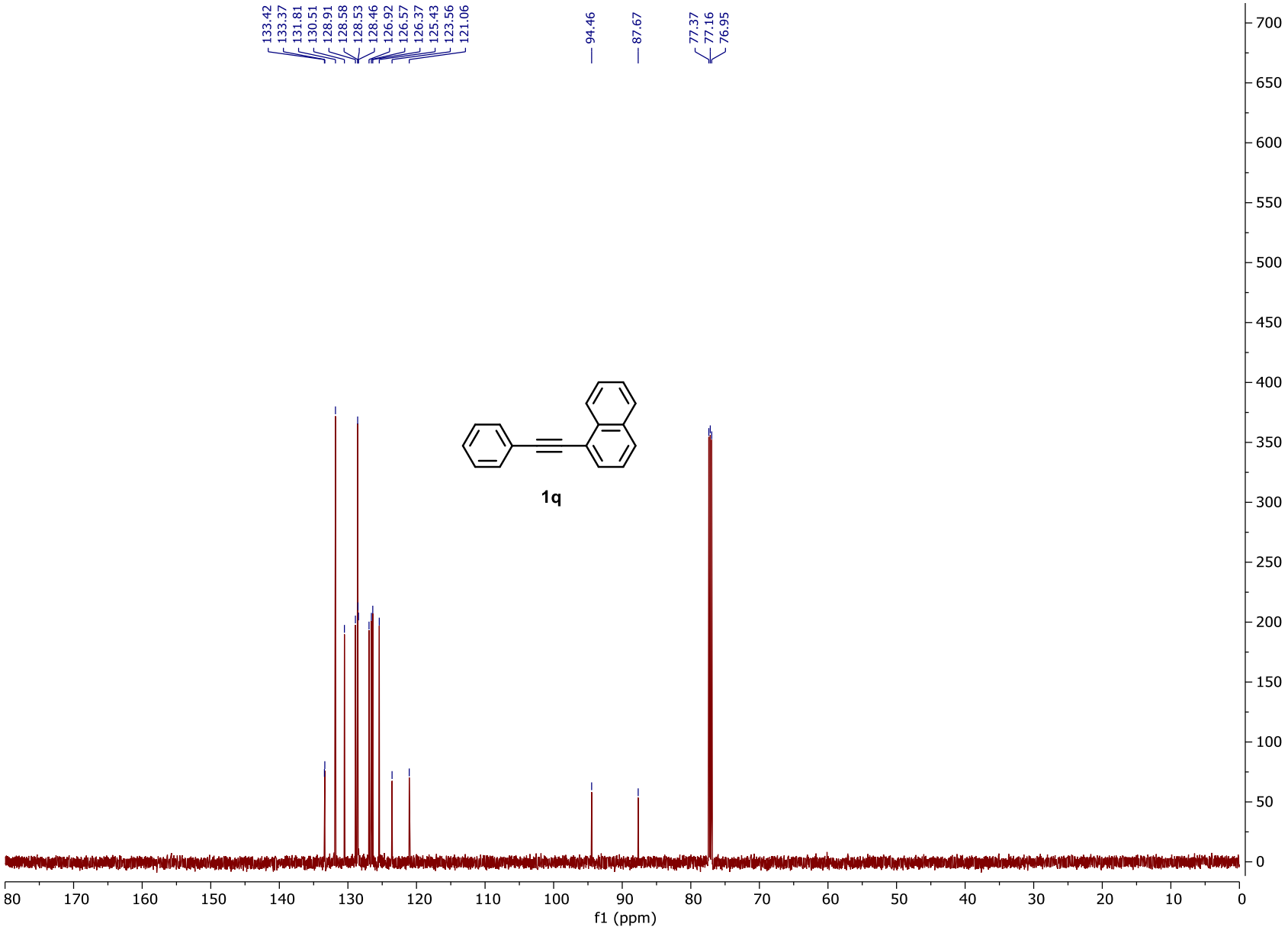
1q
1.00 1.02 1.03 1.02 2.02 1.10 1.14 1.08 3.12
f1 (ppm)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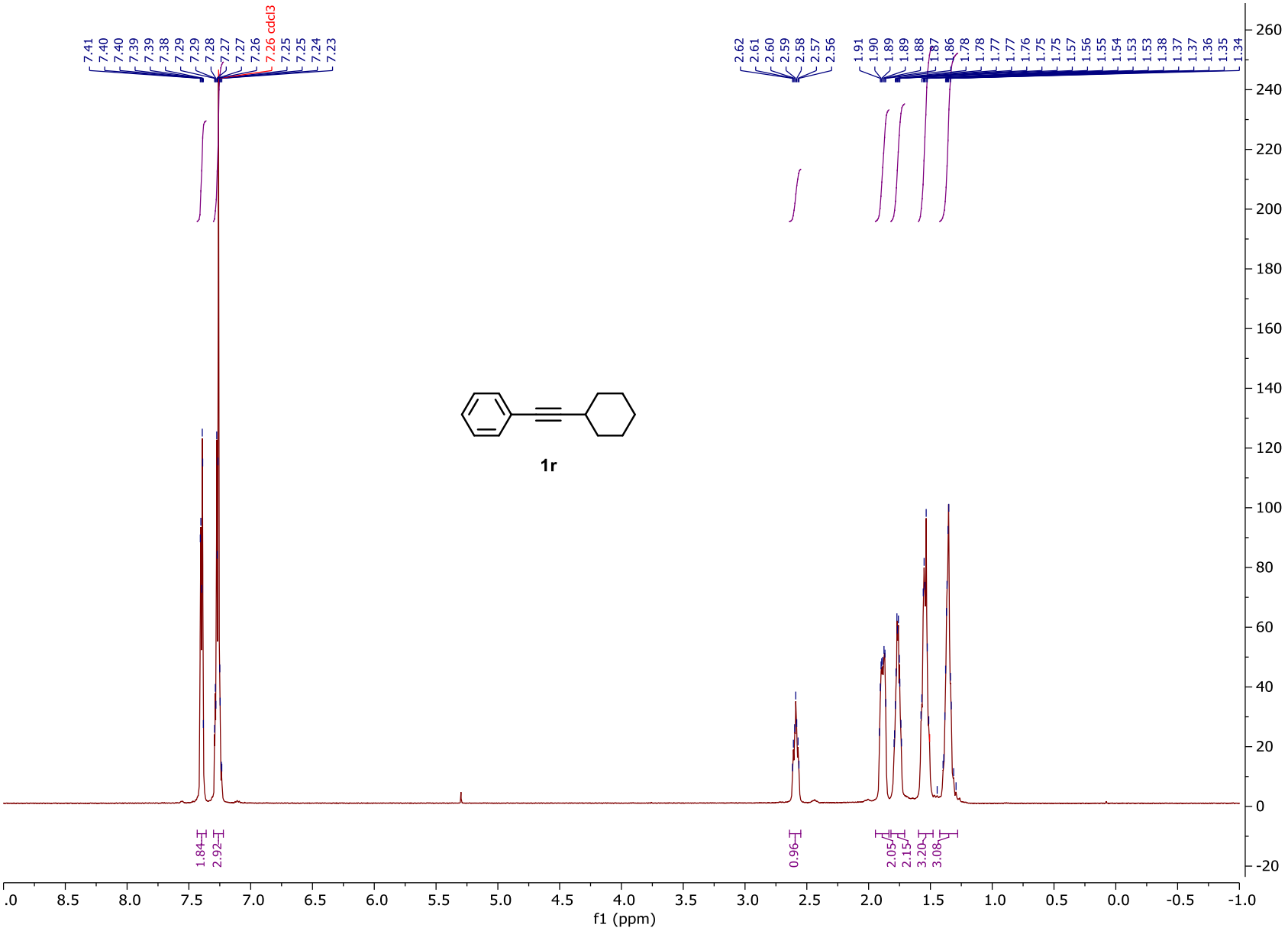
77.37
77.16
76.95
1q
f1 (ppm)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1.54
1.53
1.53
1.38
1.37
1.37
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1.35
1.34
1r
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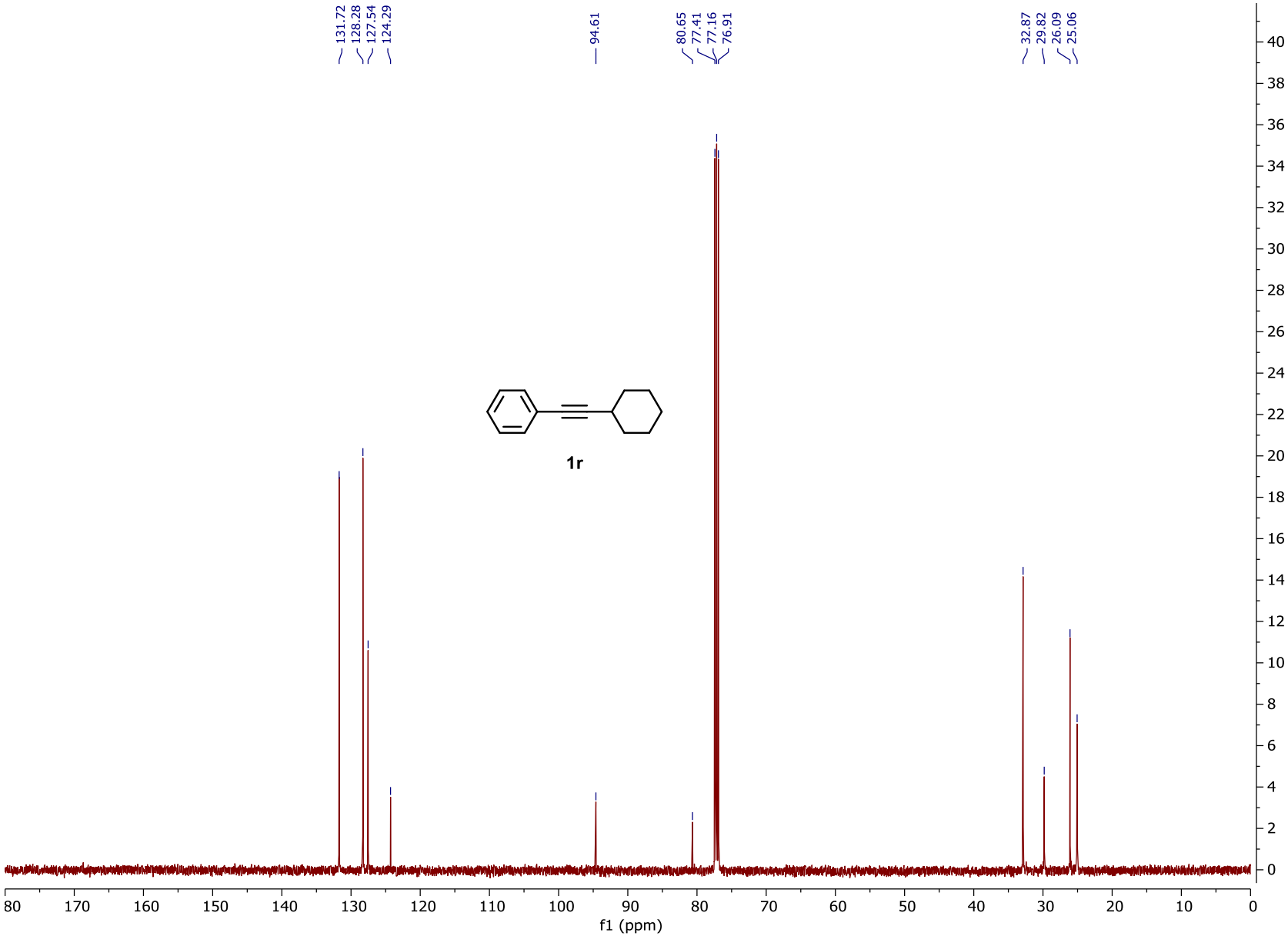
2.92
0.96
2.05
2.15
3.20
3.08
f1 (ppm)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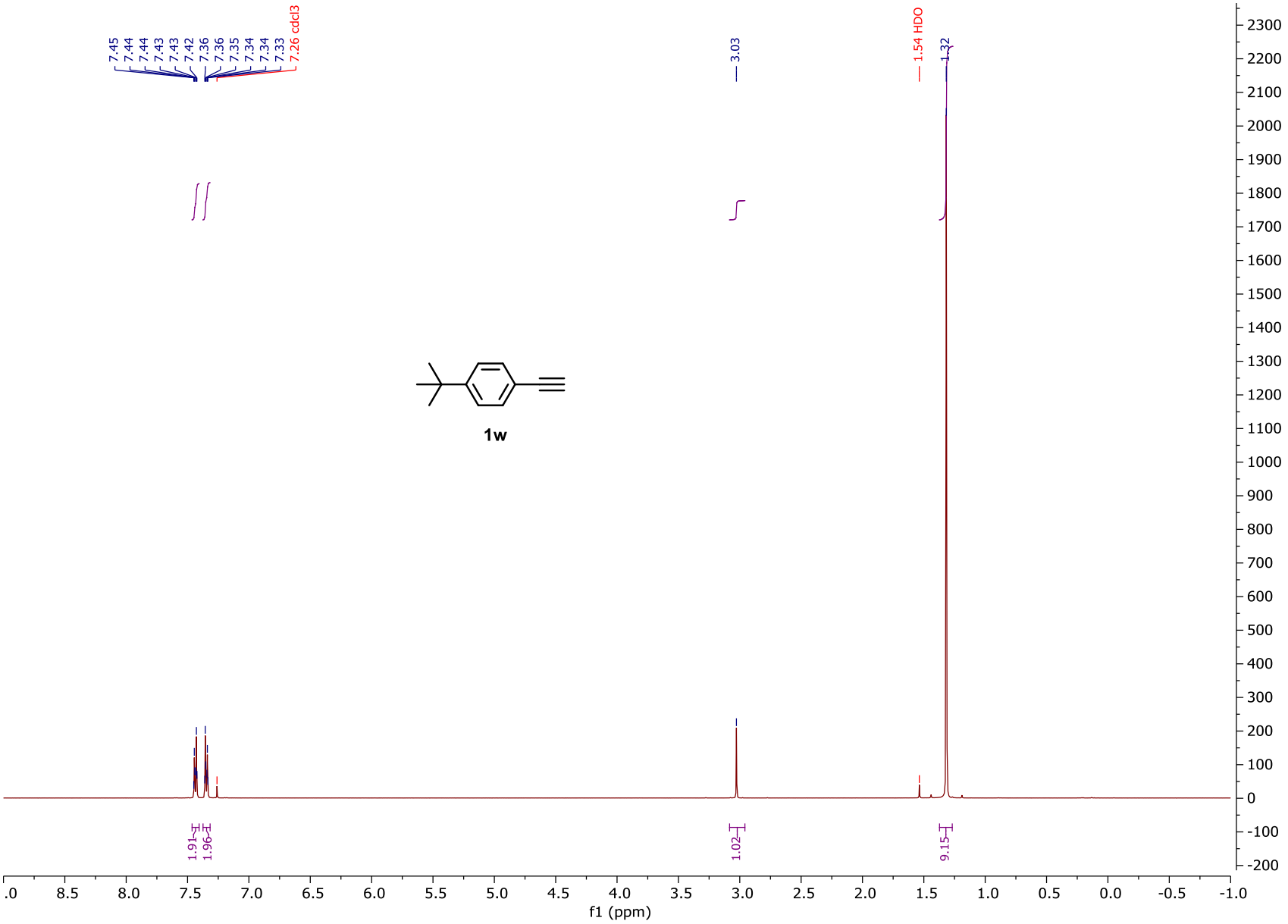
128.28
127.54
124.29
94.61
80.65
77.41
77.16
76.91
32.87
29.82
26.09
25.06
1r
f1 (ppm)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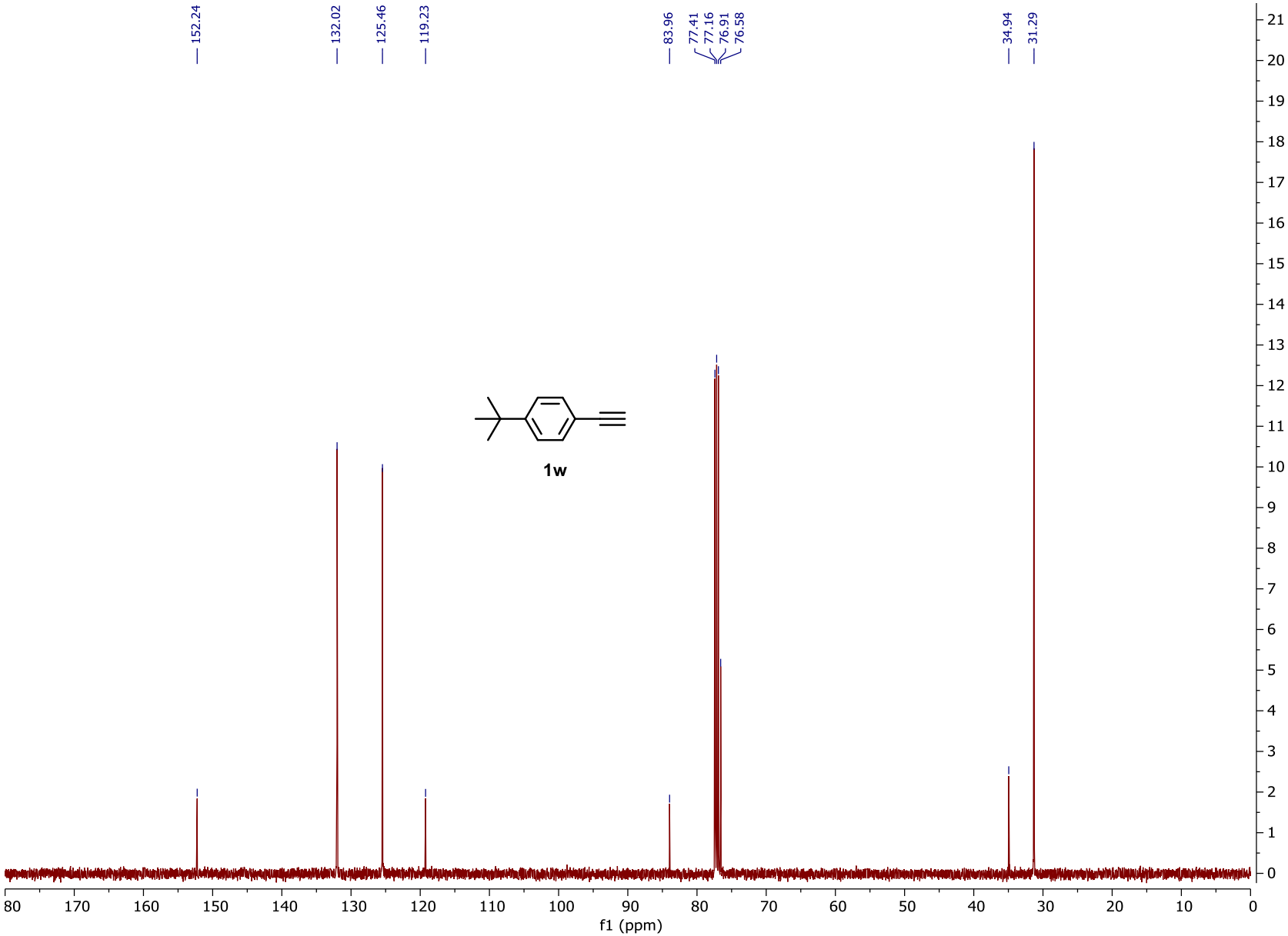
7.44
7.43
7.43
7.42
7.36
7.36
7.35
7.34
7.34
7.33
7.26 cdcl3
3.03
1.54 HDO
1.32
1w
1.91
1.96
1.02
9.15
f1 (ppm)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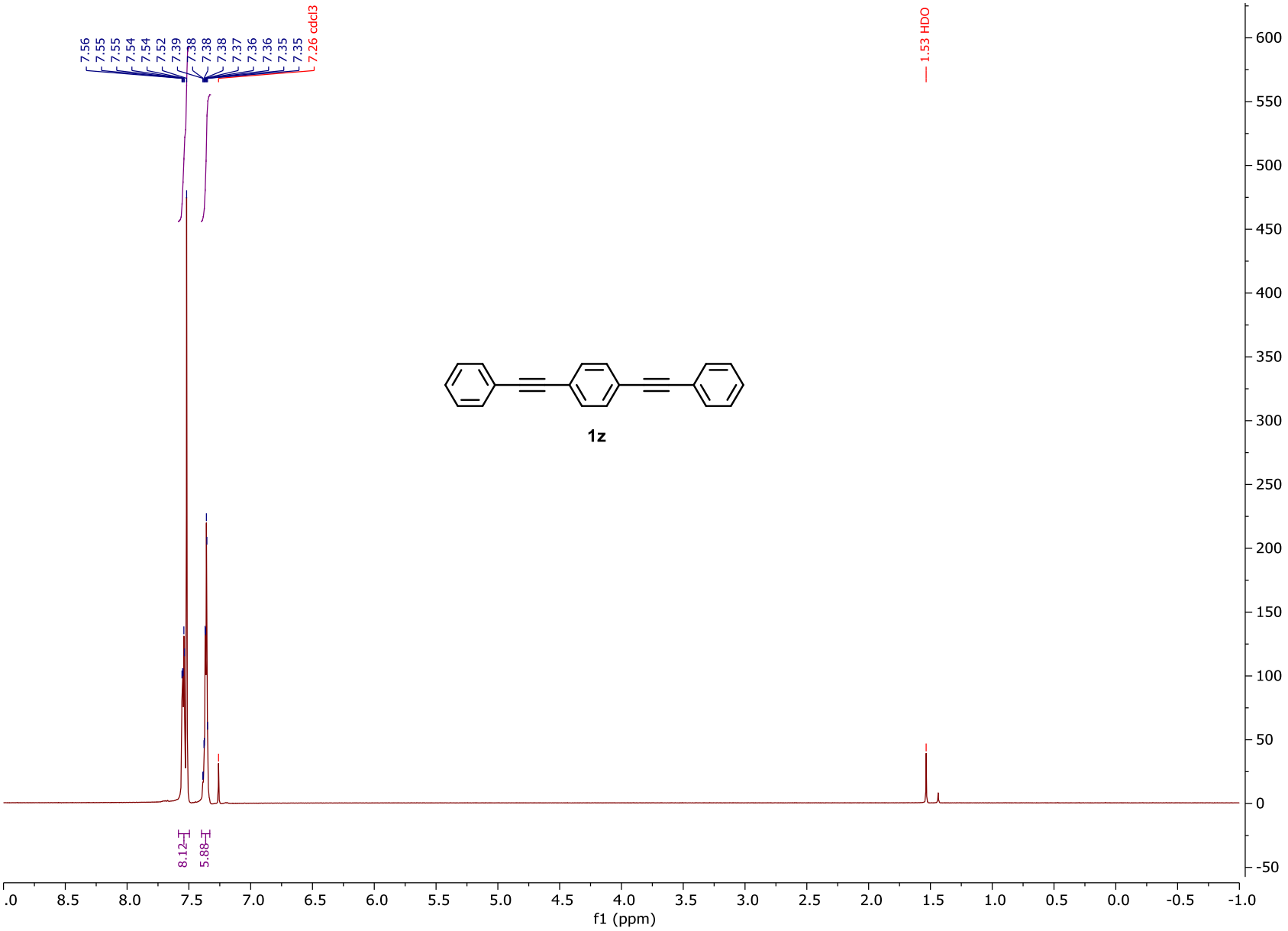
77.16
76.91
76.58
34.94
31.29
1w
f1 (ppm)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7.38
7.38
7.38
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7.36
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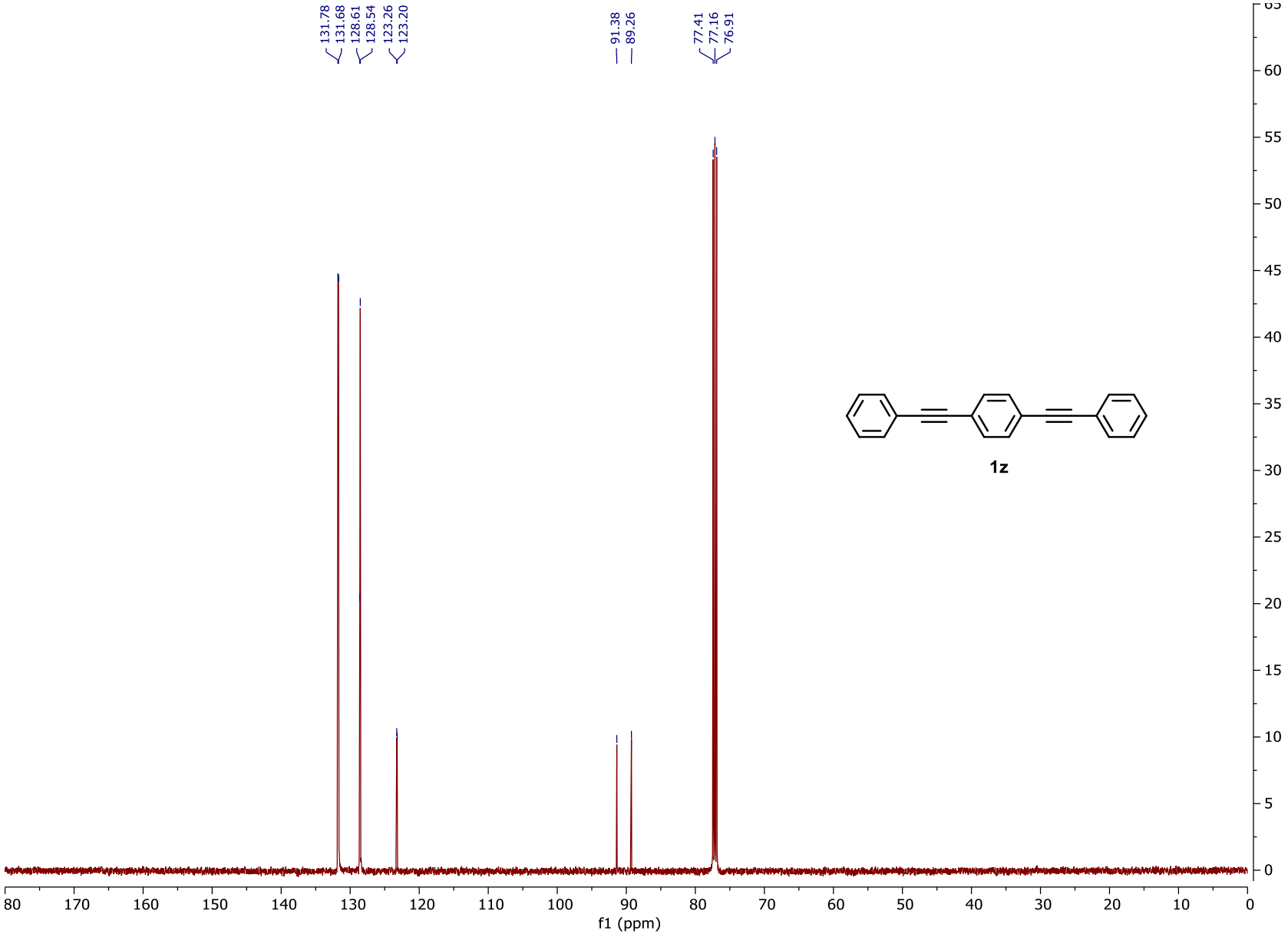
7.35
7.35
7.26 cdcl3
1.53 HDO
8.12
5.88
f1 (ppm)

1z


131.78
131.68
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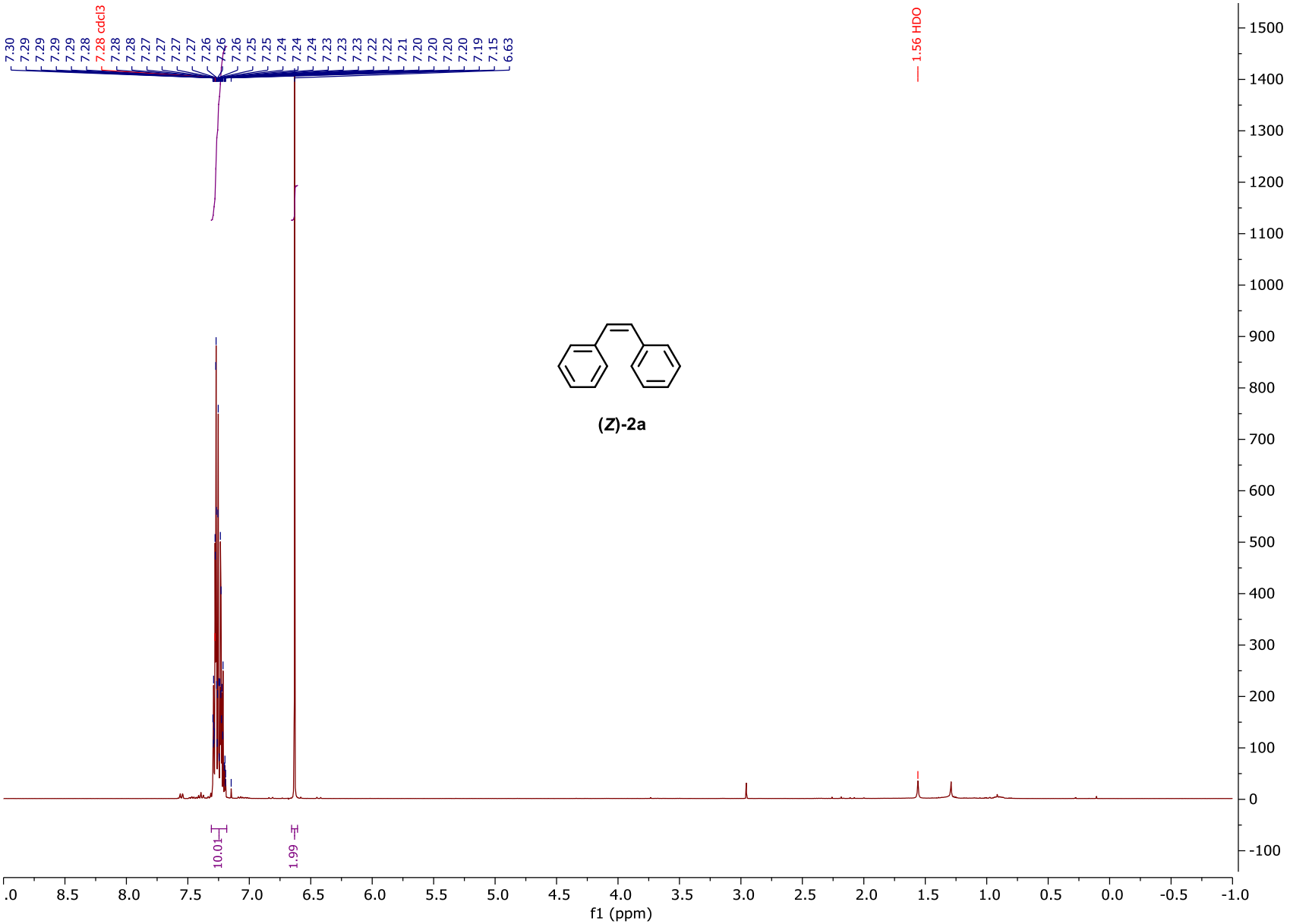
128.54
123.26
123.20
91.38
89.26
77.41
77.16
76.91
1z
f1 (ppm)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7.28 cdcl3
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7.26
7.26
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7.25
7.24
7.24
7.24
7.23
7.23
7.23
7.22
7.22
7.21
7.20
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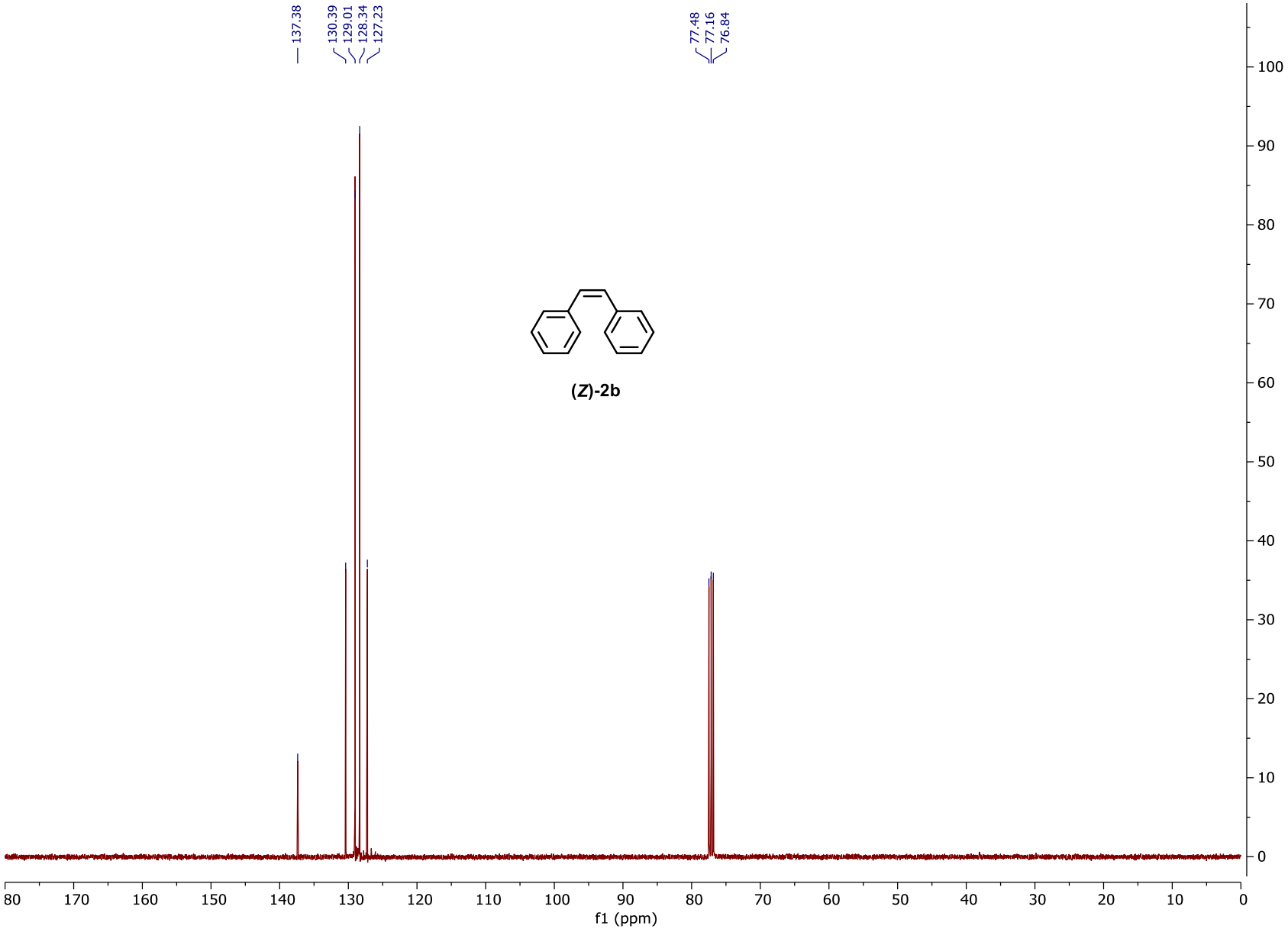
7.19
7.15
6.63
1.56 HDO
(Z)-2a
10.01
1.99
f1 (ppm)


137.38
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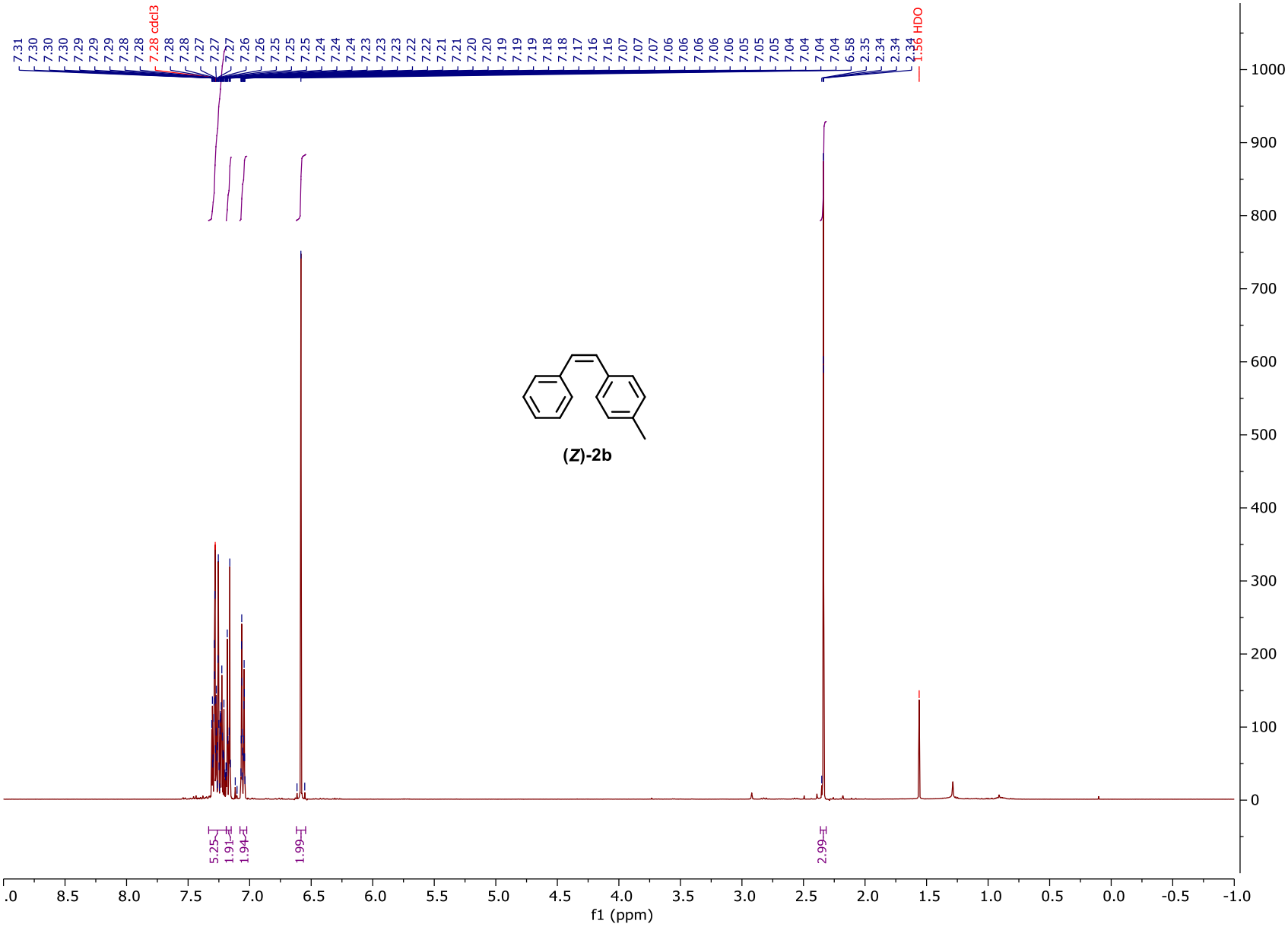
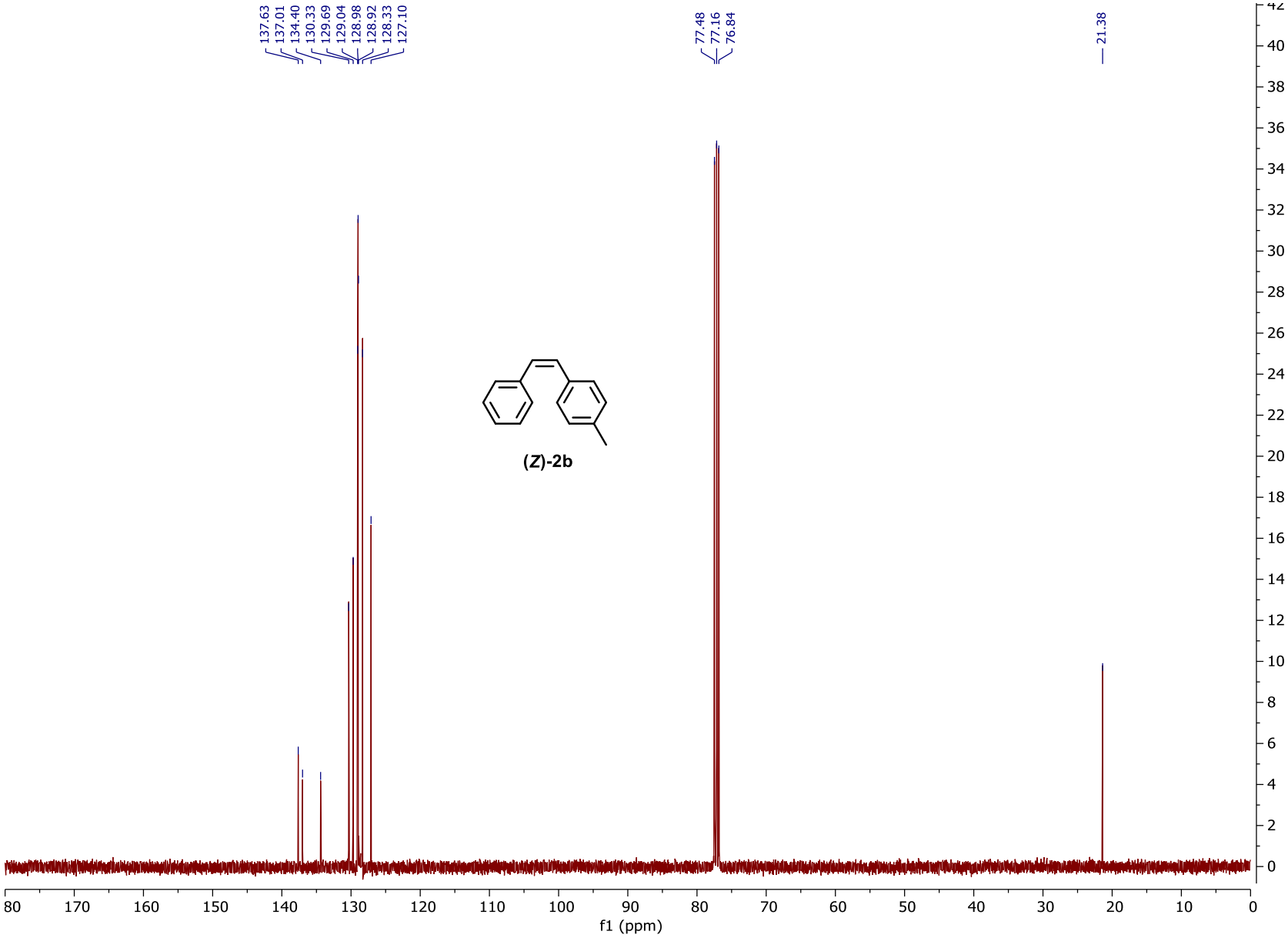
77.16
76.84
(Z)-2b
f1 (ppm)


7.31 7.30 7.30 7.29 7.29 7.29 7.28 7.28 7.28 cdcl3 7.28 7.28 7.27 7.27 7.27 7.26 7.26 7.25 7.25 7.25 7.24 7.24 7.24 7.23 7.23 7.23 7.22 7.22 7.21 7.21 7.20 7.20 7.19 7.19 7.19 7.18 7.18 7.17 7.16 7.16 7.07 7.07 7.07 7.06 7.06 7.06 7.06 7.06 7.05 7.05 7.05 7.04 7.04 7.04 7.04 6.58 2.35 2.34 2.34 2.34 1.56 HDO
(Z)-2b
5.25 1.91 1.94 1.99 2.99
1000 900 800 700 600 500 400 300 200 100 0
.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)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134.40
130.33
129.69
129.04
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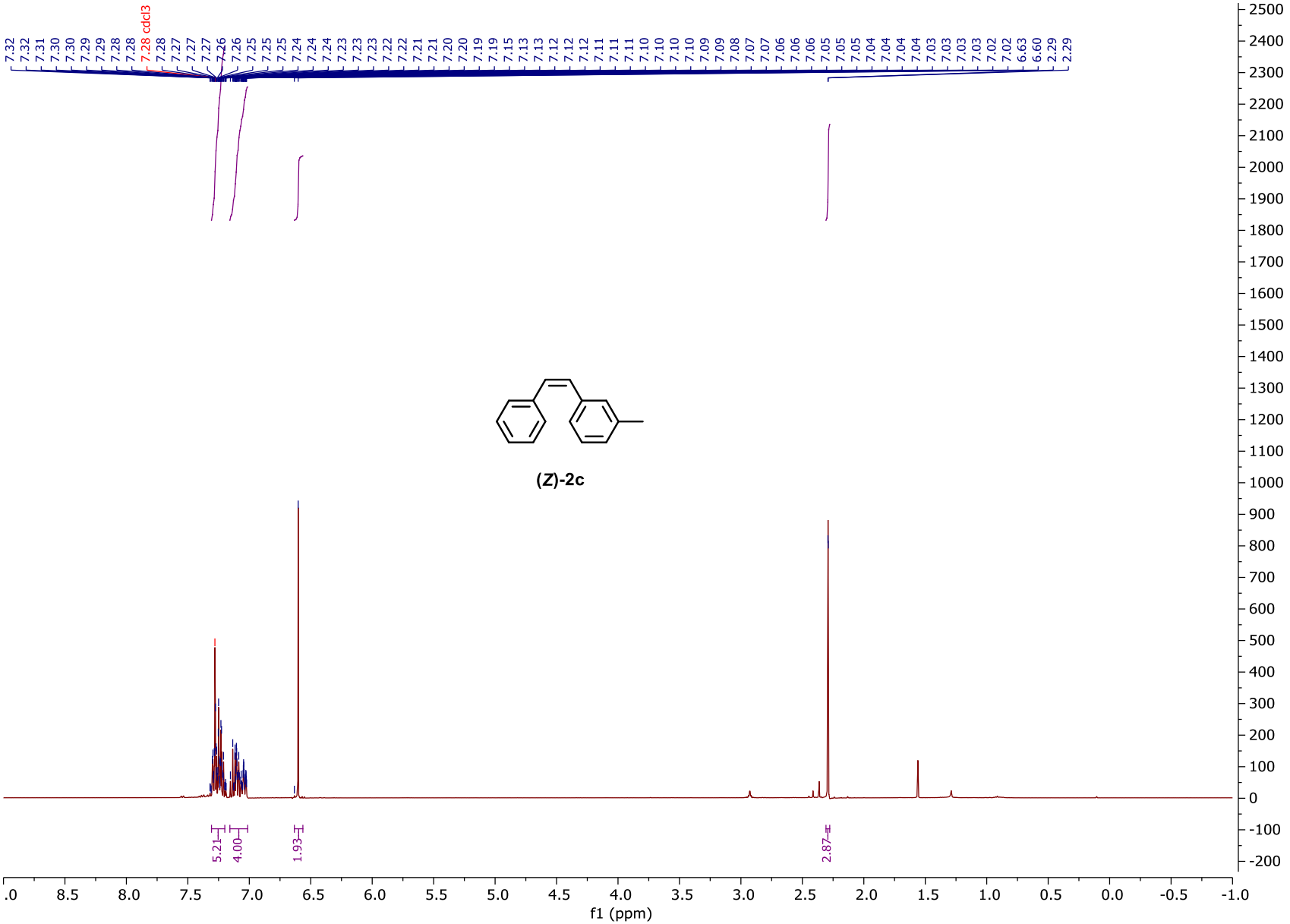
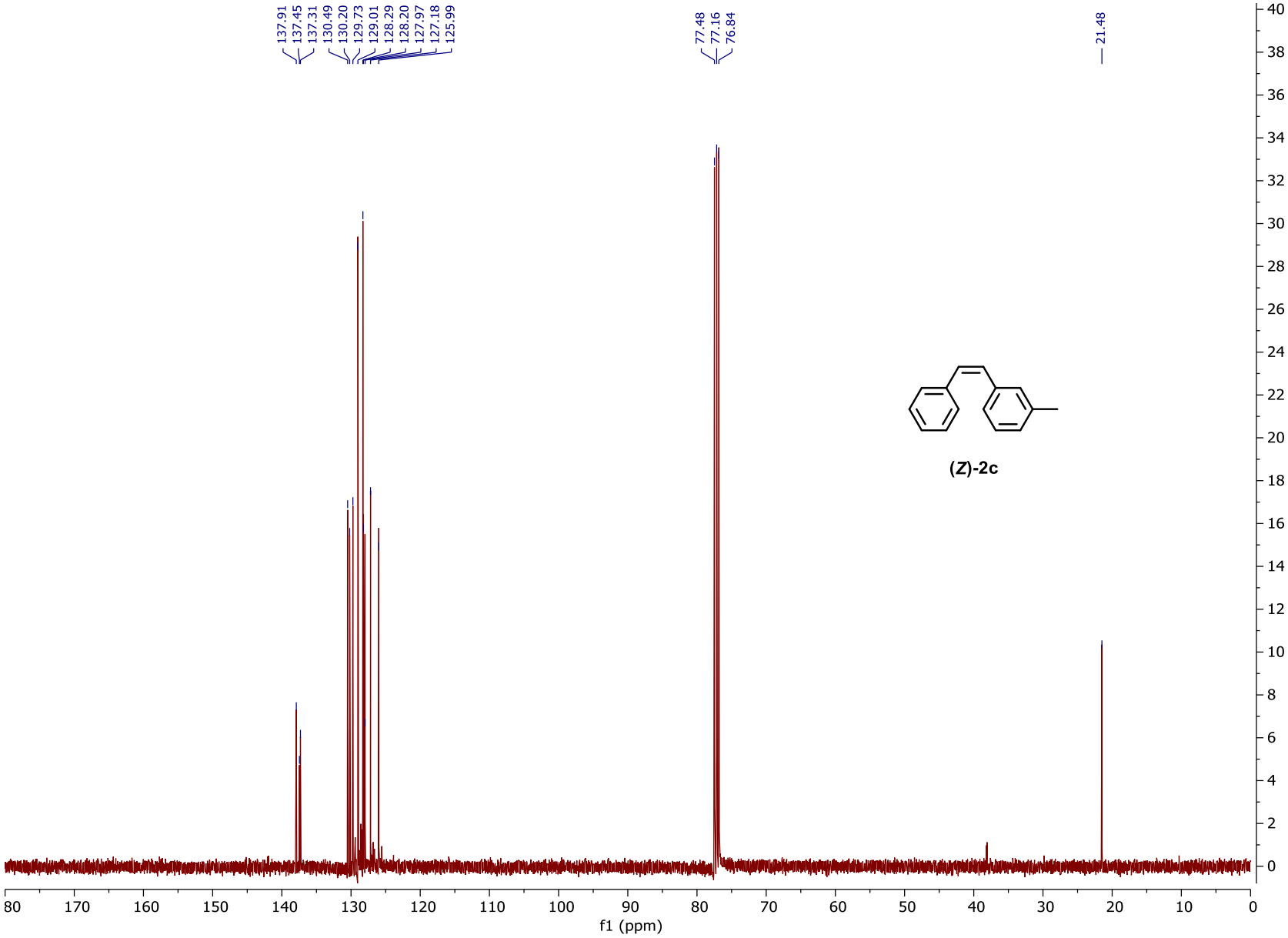
128.92
128.33
127.10
77.48
77.16
76.84
21.38
(Z)-2b
f1 (ppm)


7.32 7.32 7.31 7.30 7.30 7.29 7.29 7.28 7.28 7.28 cdcl3 7.28 7.27 7.27 7.27 7.26 7.26 7.25 7.25 7.25 7.24 7.24 7.24 7.23 7.23 7.23 7.22 7.22 7.21 7.21 7.20 7.20 7.19 7.19 7.15 7.13 7.13 7.12 7.12 7.12 7.11 7.11 7.11 7.10 7.10 7.10 7.10 7.09 7.09 7.08 7.07 7.07 7.06 7.06 7.06 7.06 7.05 7.05 7.05 7.04 7.04 7.04 7.04 7.03 7.03 7.03 7.03 7.02 7.02 6.63 6.60 2.29 2.29
(Z)-2c
5.21
4.00
1.93
2.87
f1 (ppm)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130.20
129.73
129.01
128.29
128.20
127.97
127.18
125.99
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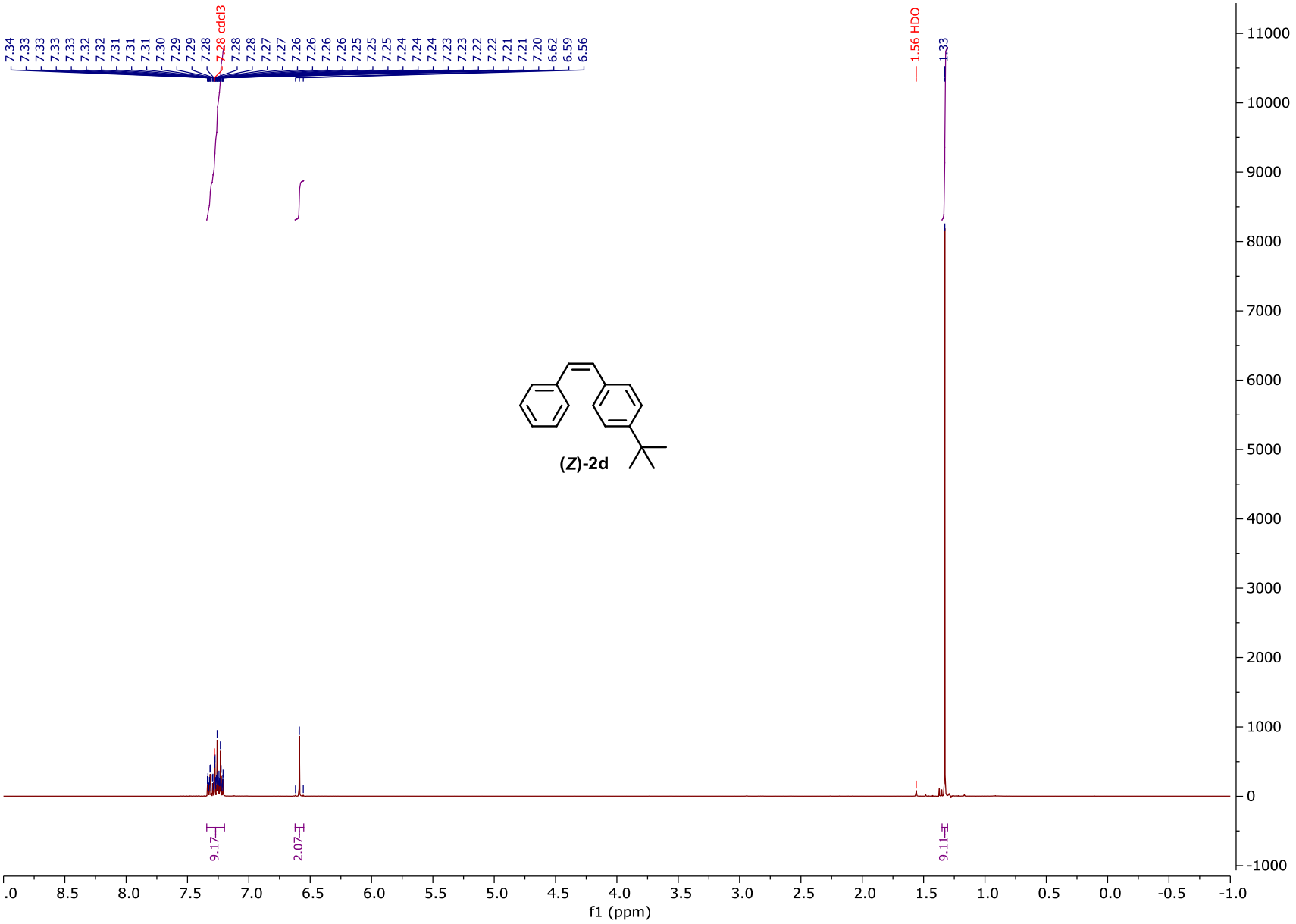
77.16
76.84
21.48
(Z)-2c
f1 (ppm)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7.28
7.28 cdcl3
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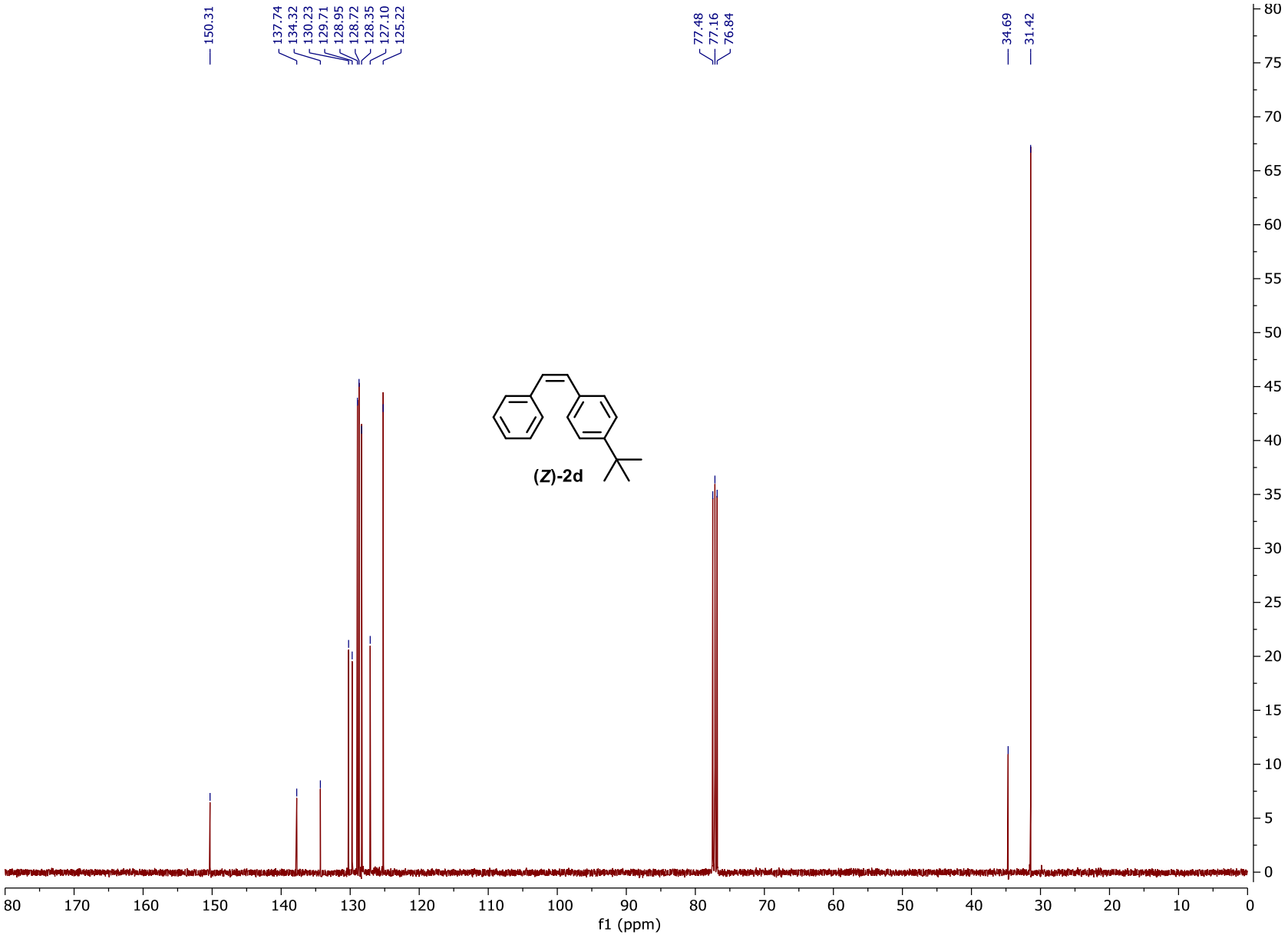
7.24
7.24
7.23
7.23
7.22
7.22
7.21
7.21
7.20
6.62
6.59
6.56
1.56 HDO
1.33
(Z)-2d
9.17
2.07
9.11
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
f1 (ppm)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128.72
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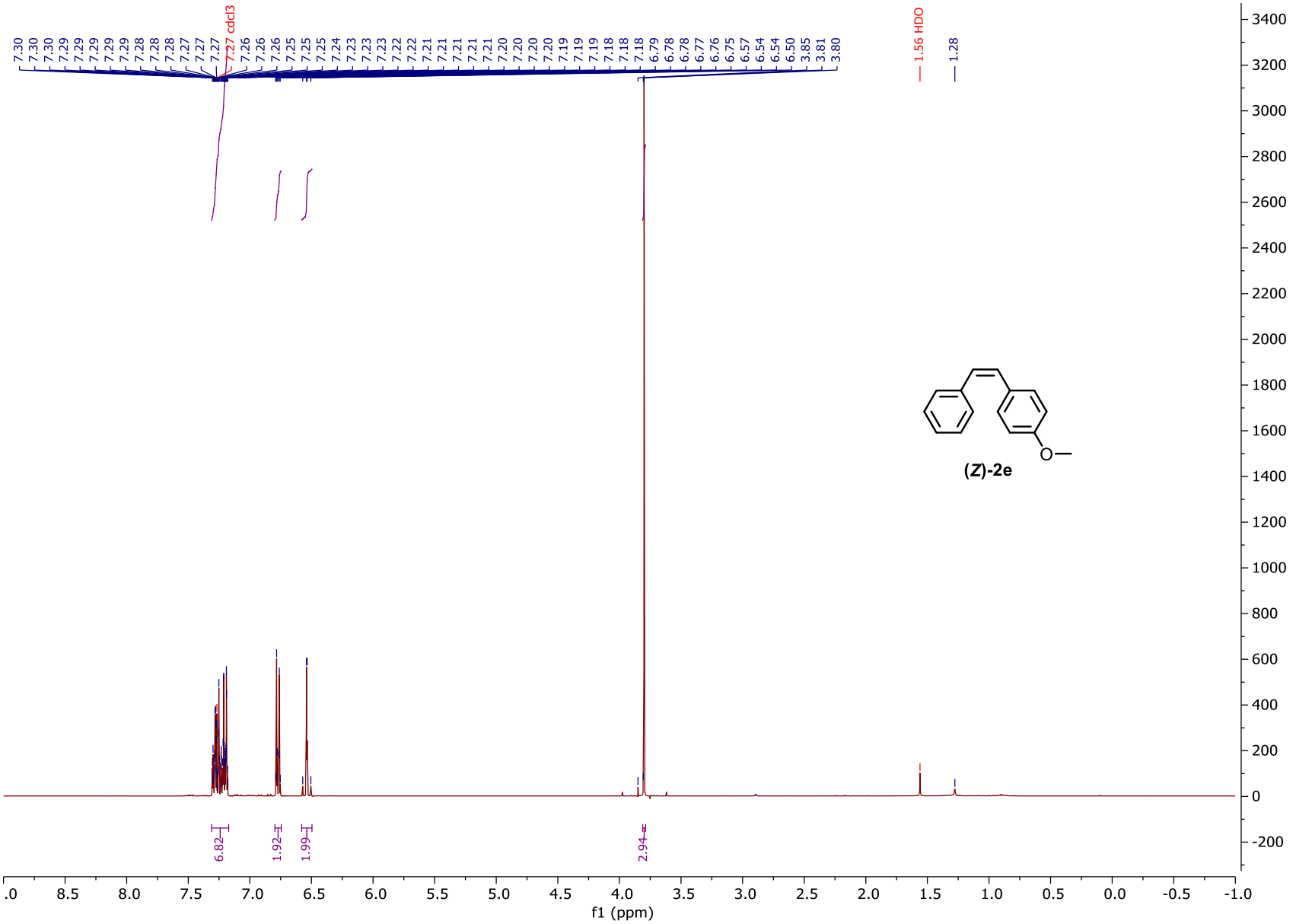
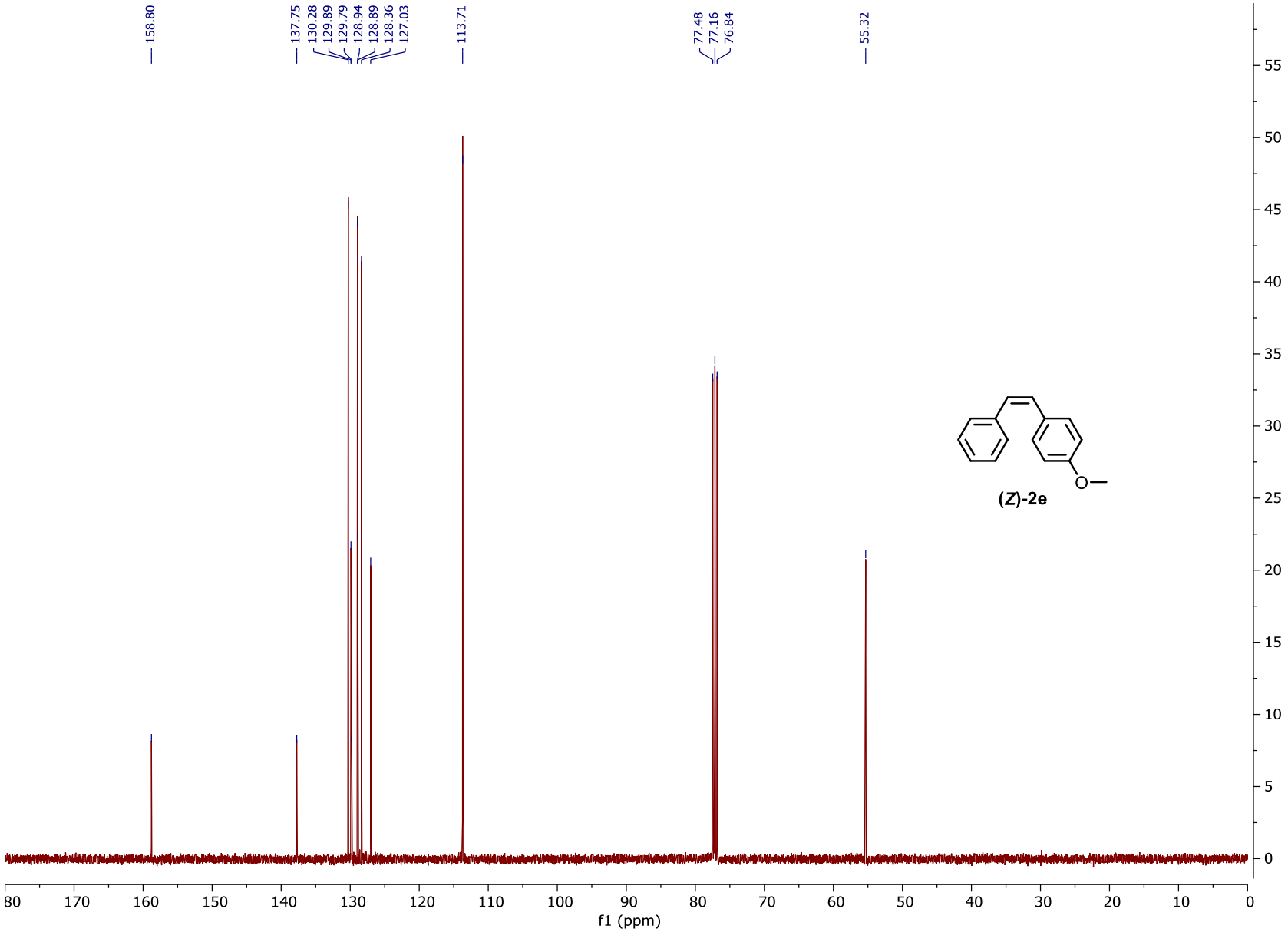
127.10
125.22
77.48
77.16
76.84
34.69
31.42
(Z)-2d
f1 (ppm)


7.30 7.30 7.30 7.29 7.29 7.29 7.29 7.29 7.28 7.28 7.28 7.27 7.27 7.27 7.27 cdcl3 7.26 7.26 7.26 7.25 7.25 7.25 7.24 7.23 7.23 7.23 7.22 7.22 7.21 7.21 7.21 7.21 7.21 7.20 7.20 7.20 7.20 7.19 7.19 7.19 7.18 7.18 7.18 6.79 6.78 6.78 6.77 6.76 6.75 6.57 6.54 6.54 6.50 3.85 3.81 3.80
1.56 HDO
1.28
(Z)-2e
6.82
1.92
1.99
2.94
f1 (ppm)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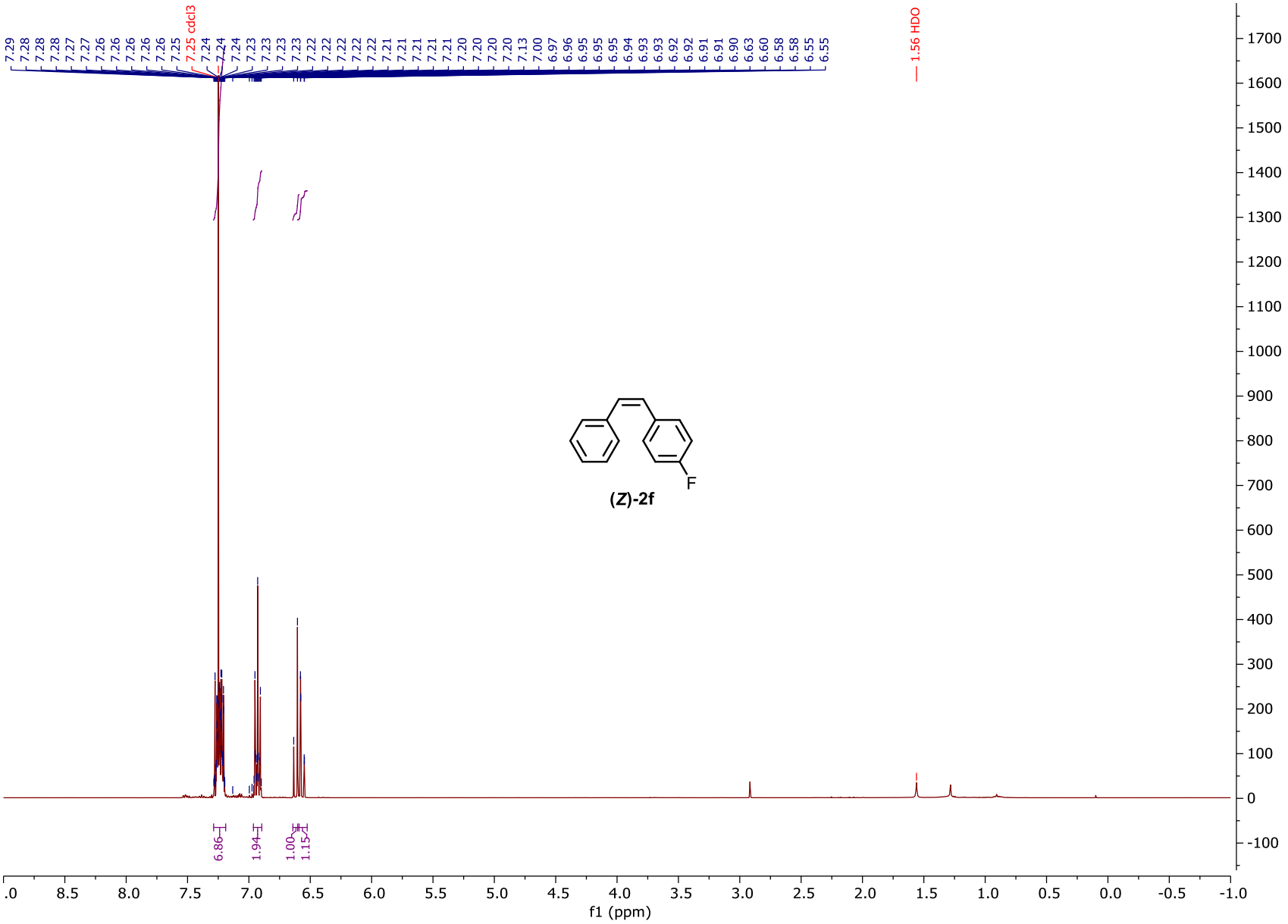
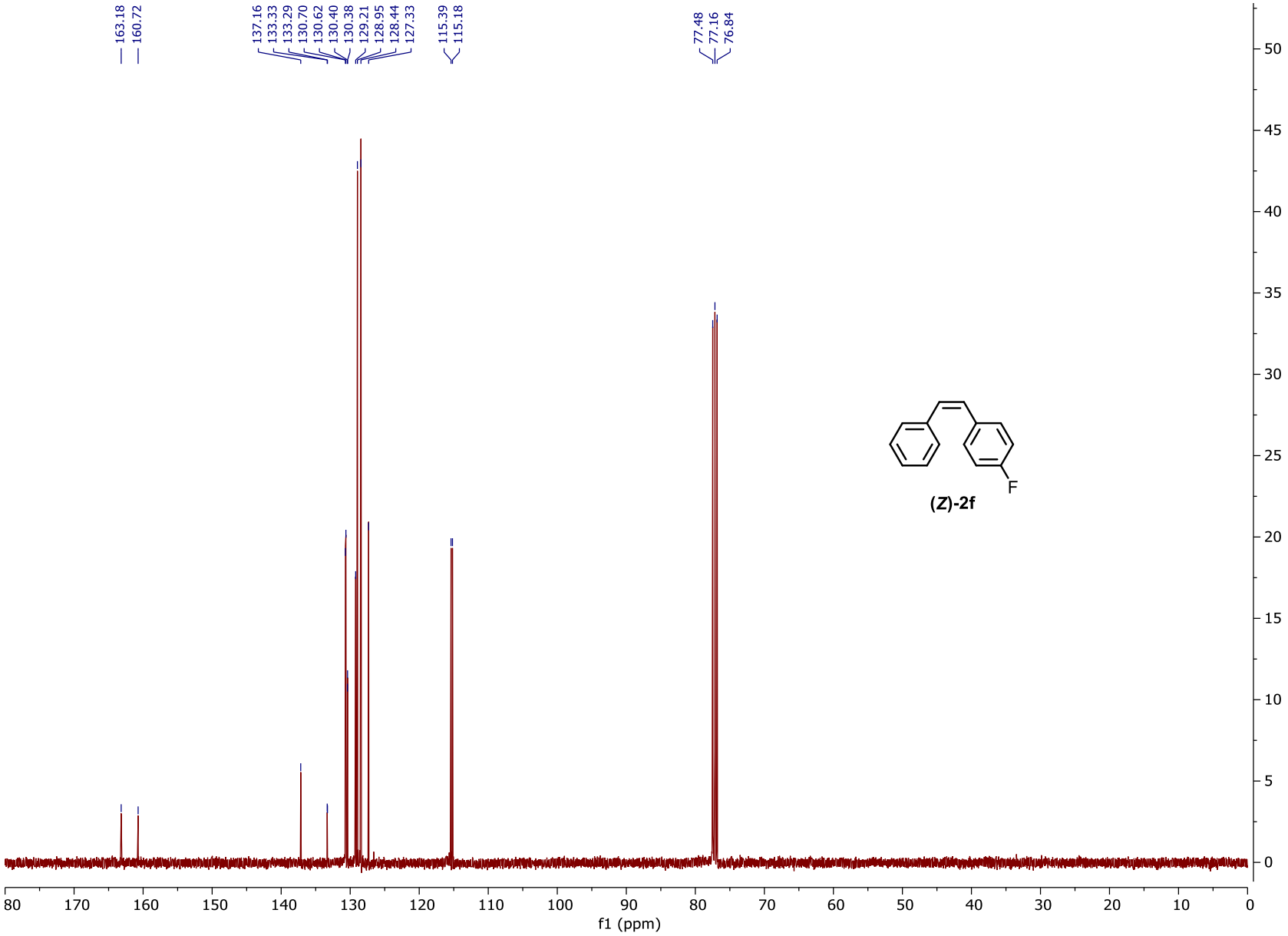
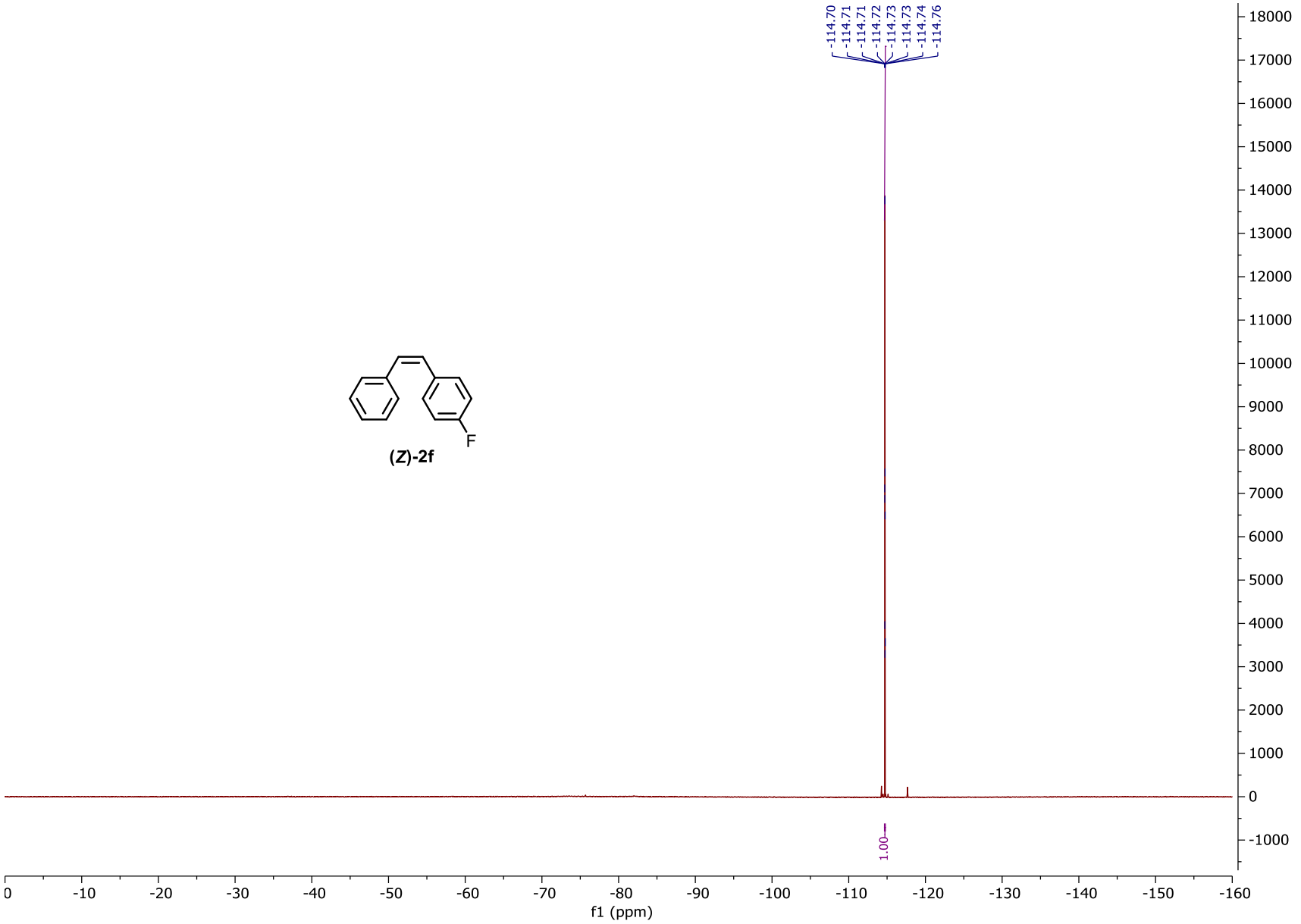
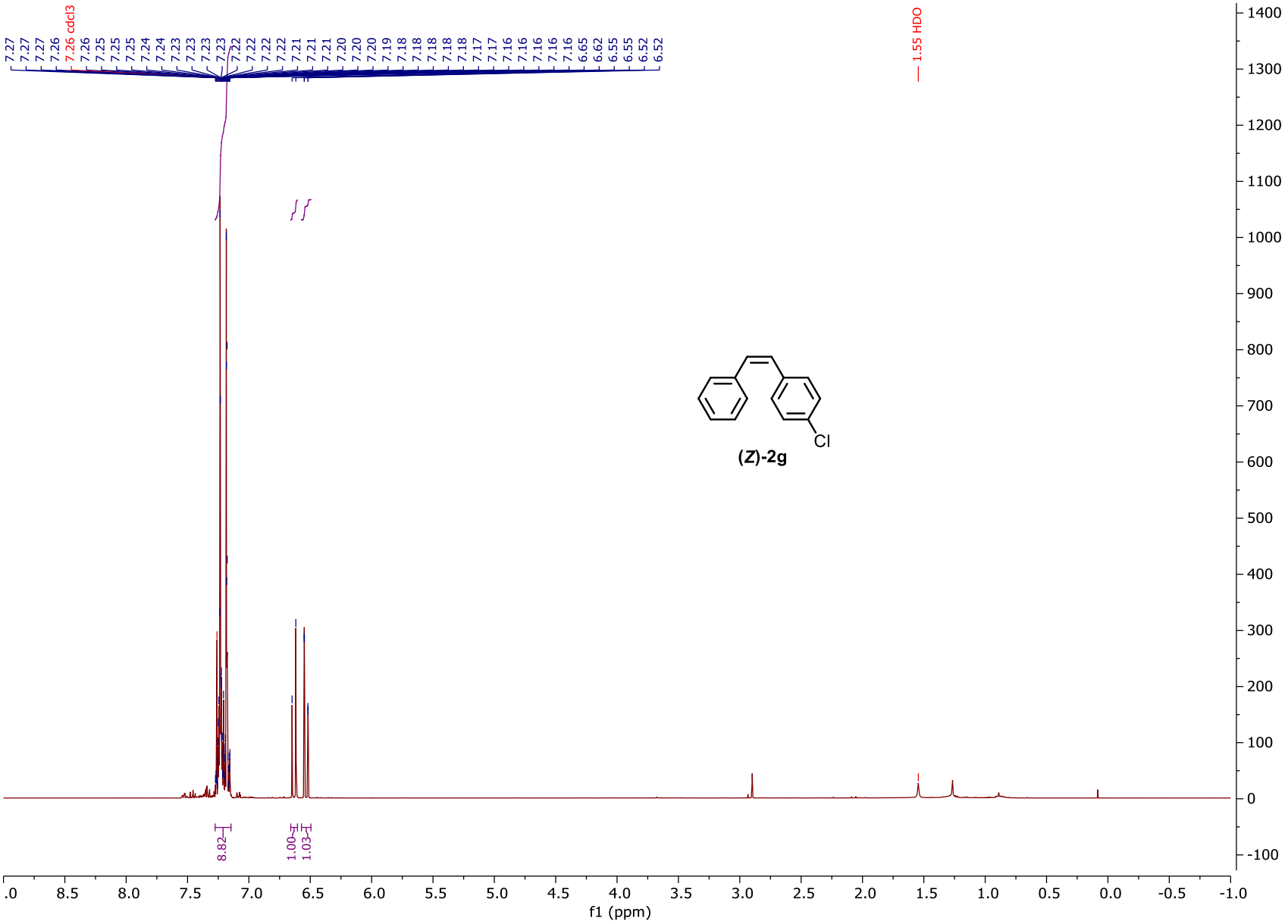
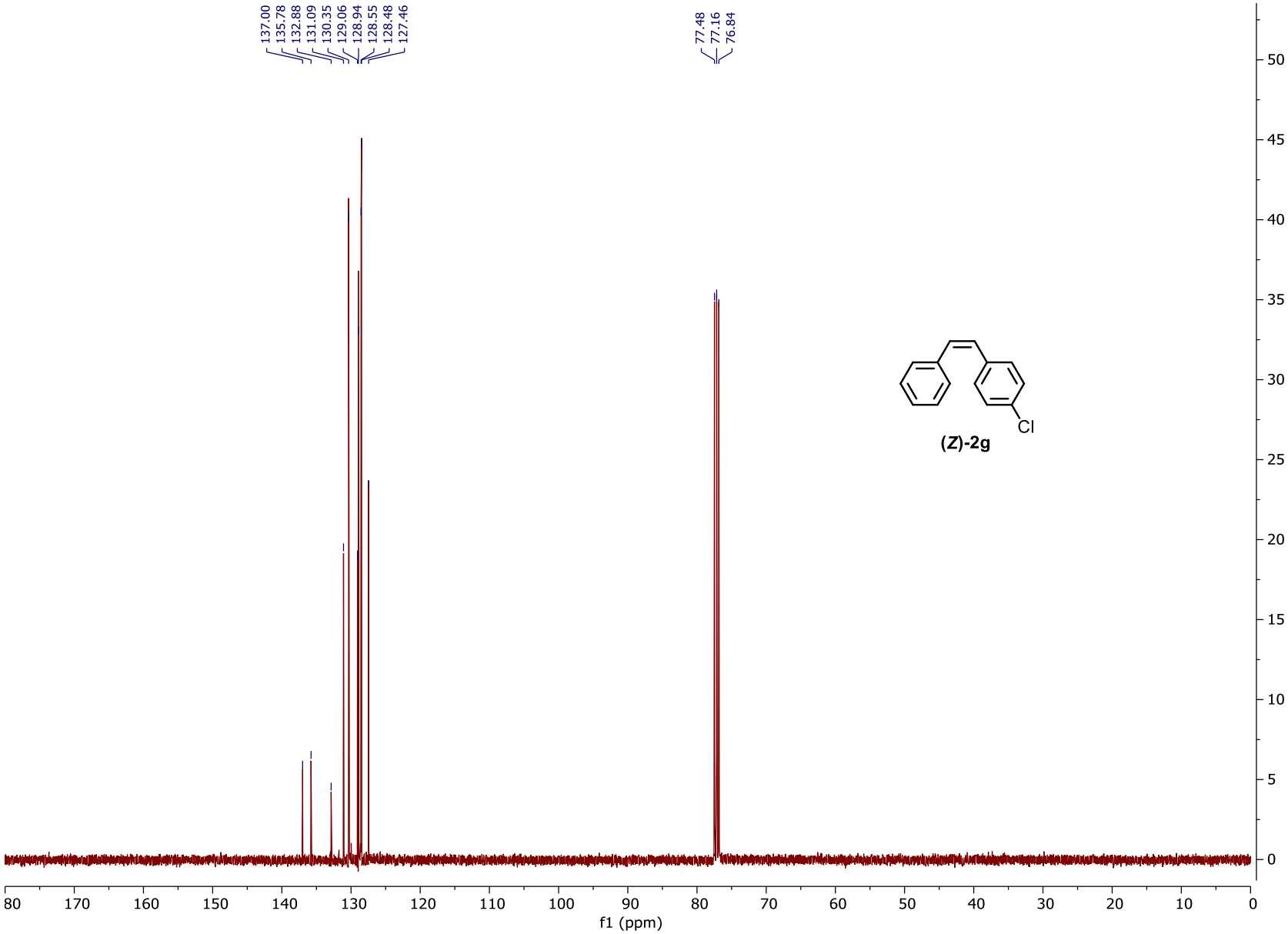
128.36
127.03
113.71
77.48
77.16
76.84
55.32
(Z)-2e
f1 (ppm)

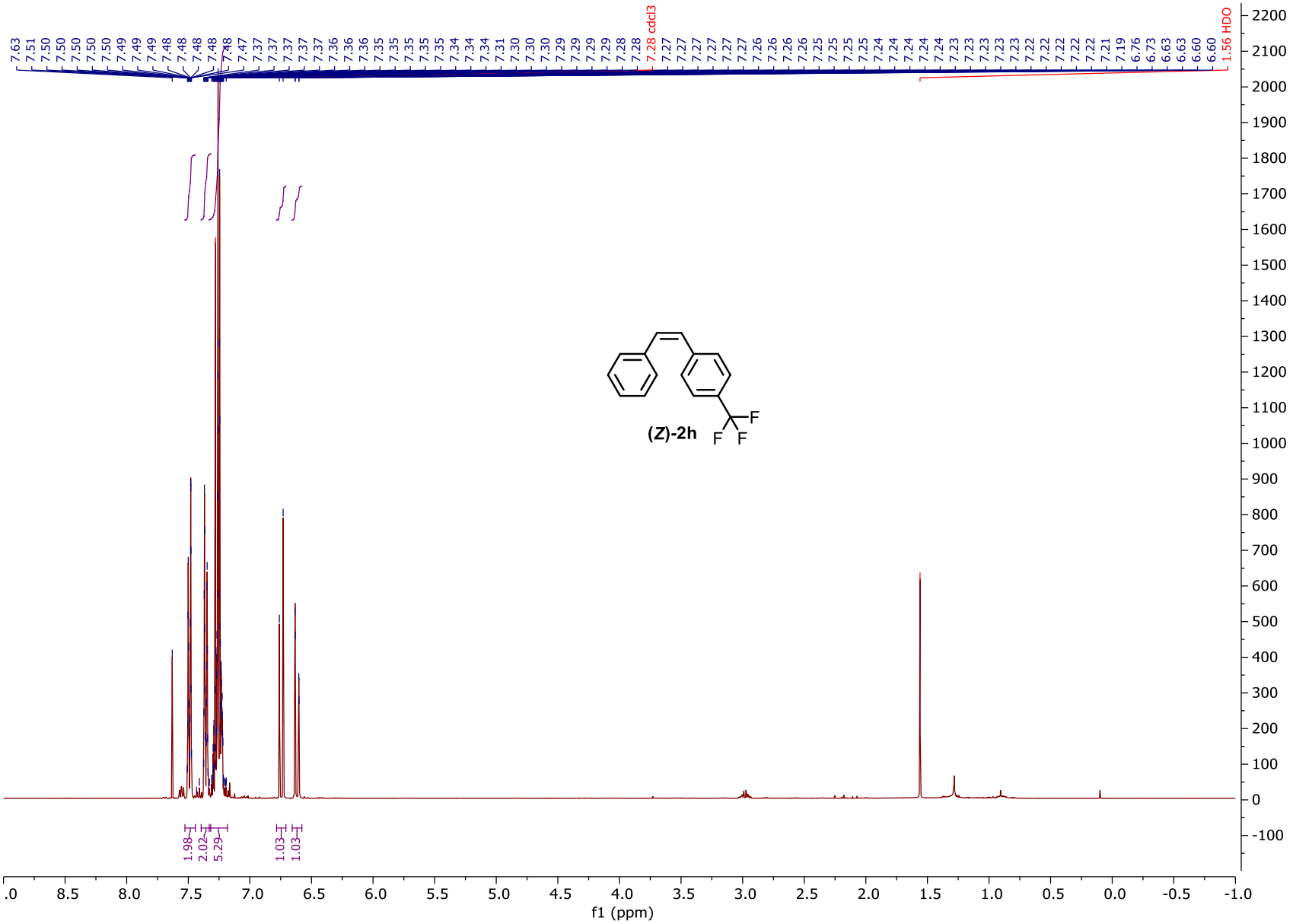

7.29 7.28 7.28 7.28 7.27 7.27 7.26 7.26 7.26 7.26 7.26 7.25 7.25 cdcl3 7.24 7.24 7.24 7.23 7.23 7.23 7.23 7.22 7.22 7.22 7.22 7.22 7.21 7.21 7.21 7.21 7.21 7.20 7.20 7.20 7.20 7.13 7.00 6.97 6.96 6.95 6.95 6.95 6.94 6.93 6.93 6.92 6.92 6.91 6.91 6.90 6.63 6.60 6.58 6.58 6.55 6.55
1.56 HDO
F
(Z)-2f
6.86
1.94
1.00
1.15
f1 (ppm)

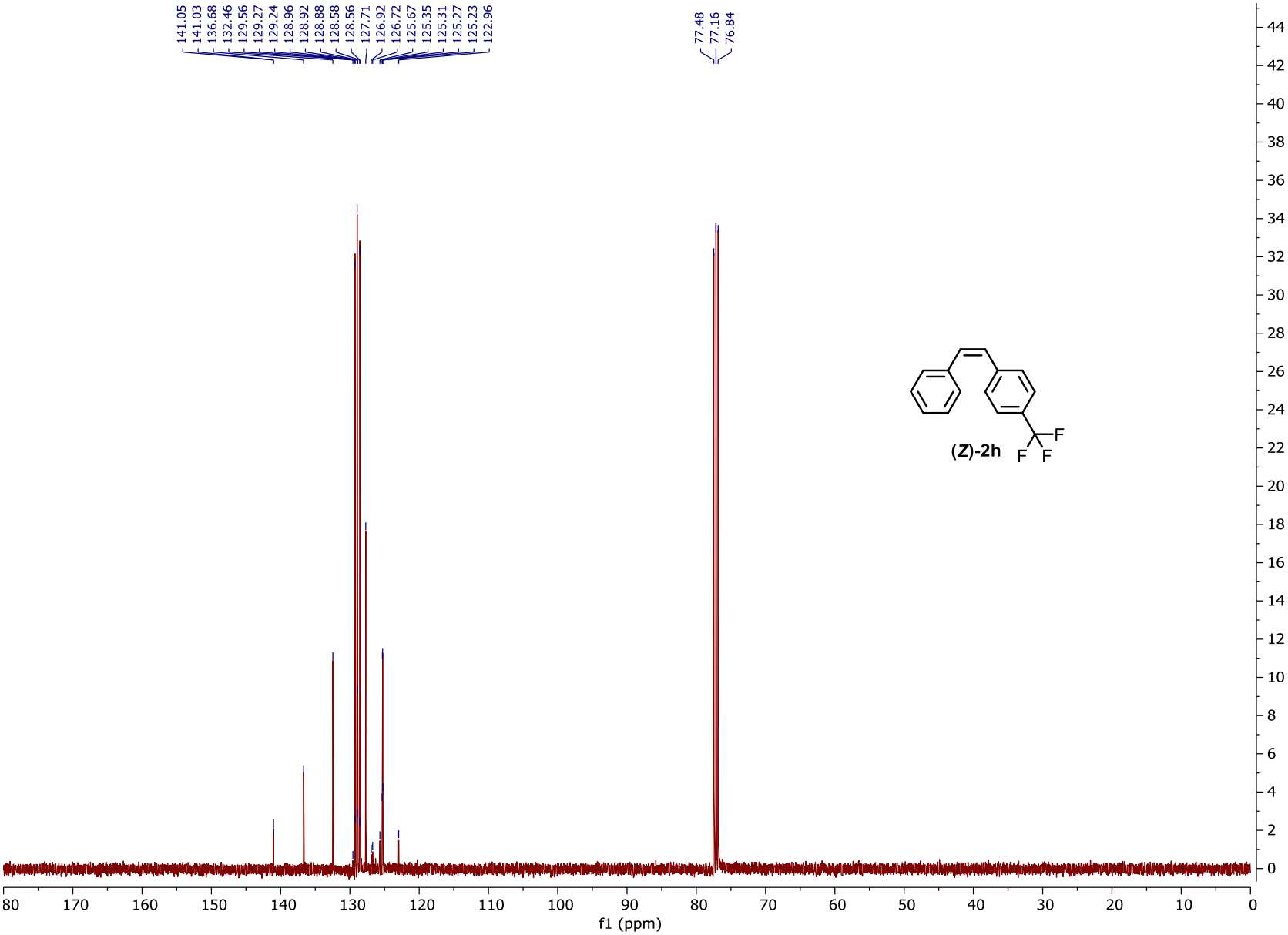

163.18
160.72
137.16
133.33
133.29
130.70
130.62
130.40
130.38
129.21
128.95
128.44
127.33
115.39
115.18
77.48
77.16
76.84
F
(Z)-2f
f1 (ppm)

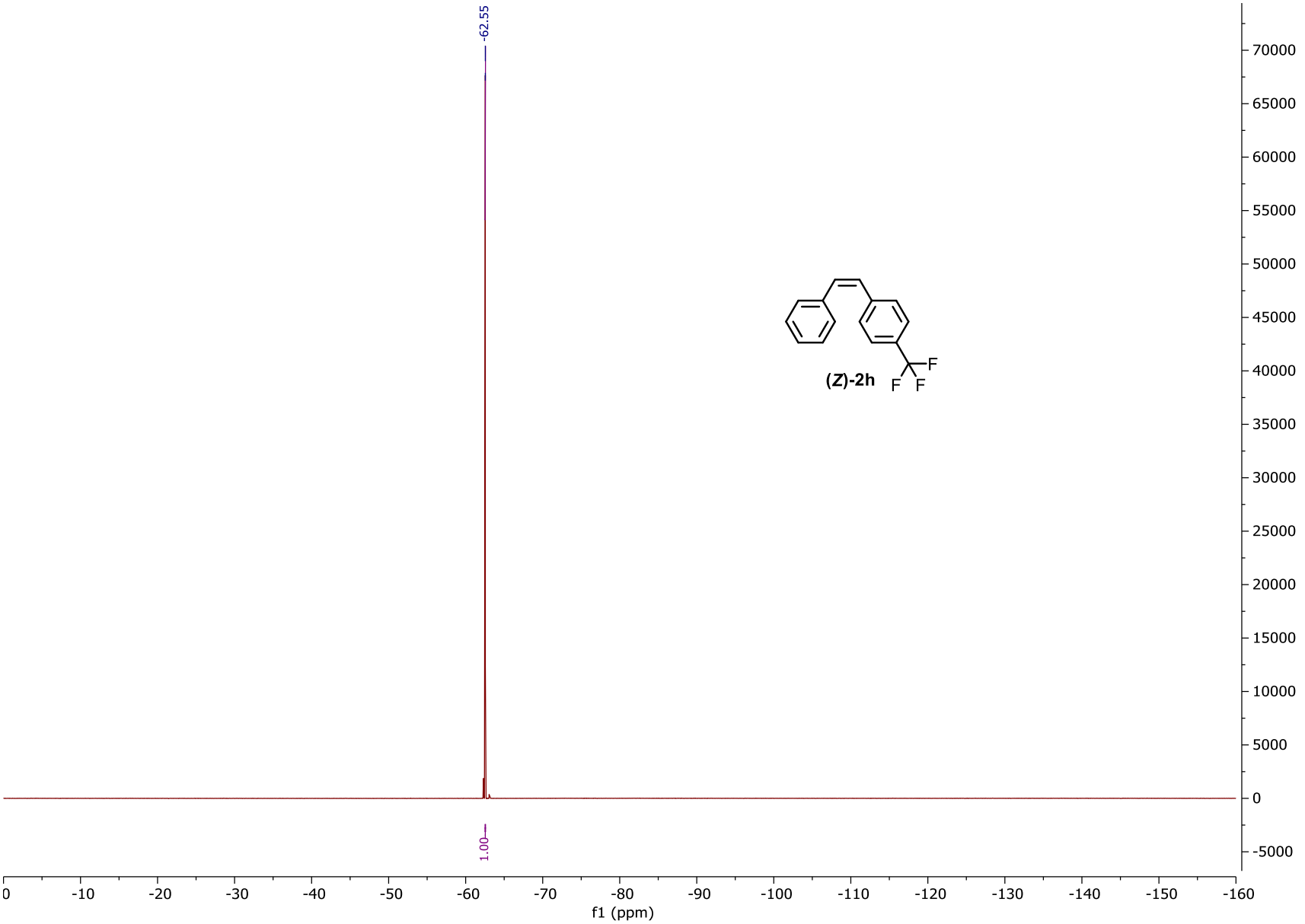

-114.70
-114.71
-114.71
-114.72
-114.73
-114.73
-114.74
-114.76
F
(Z)-2f
1.00
f1 (ppm)

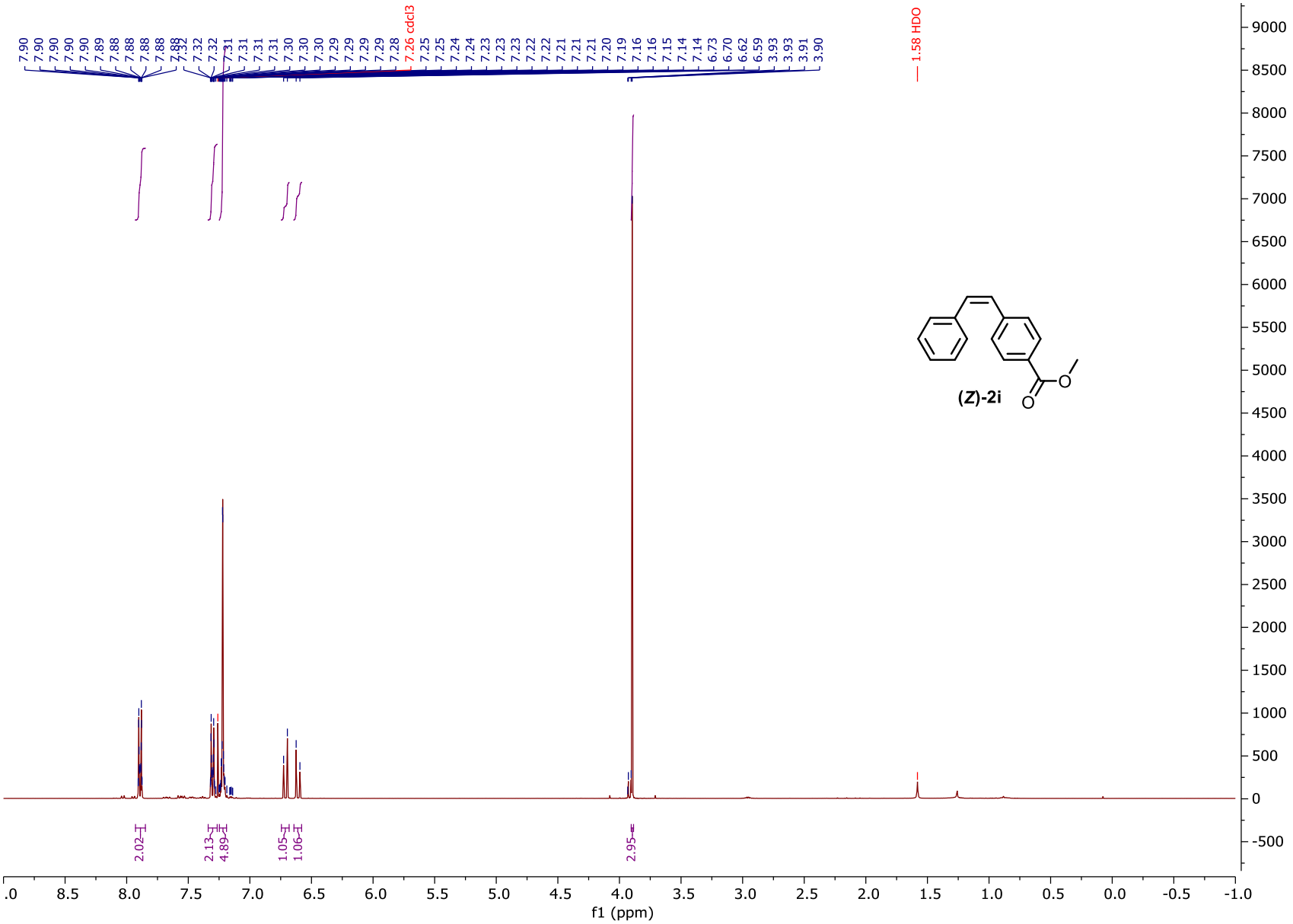

7.27
7.27
7.27
7.26
7.26 cdcl3
7.25
7.25
7.25
7.24
7.24
7.23
7.23
7.23
7.23
7.22
7.22
7.22
7.22
7.21
7.21
7.21
7.20
7.20
7.20
7.19
7.18
7.18
7.18
7.18
7.17
7.17
7.16
7.16
7.16
7.16
6.65
6.62
6.55
6.55
6.52
6.52
1.55 HDO
Cl
(Z)-2g
8.82
1.00
1.03
f1 (ppm)

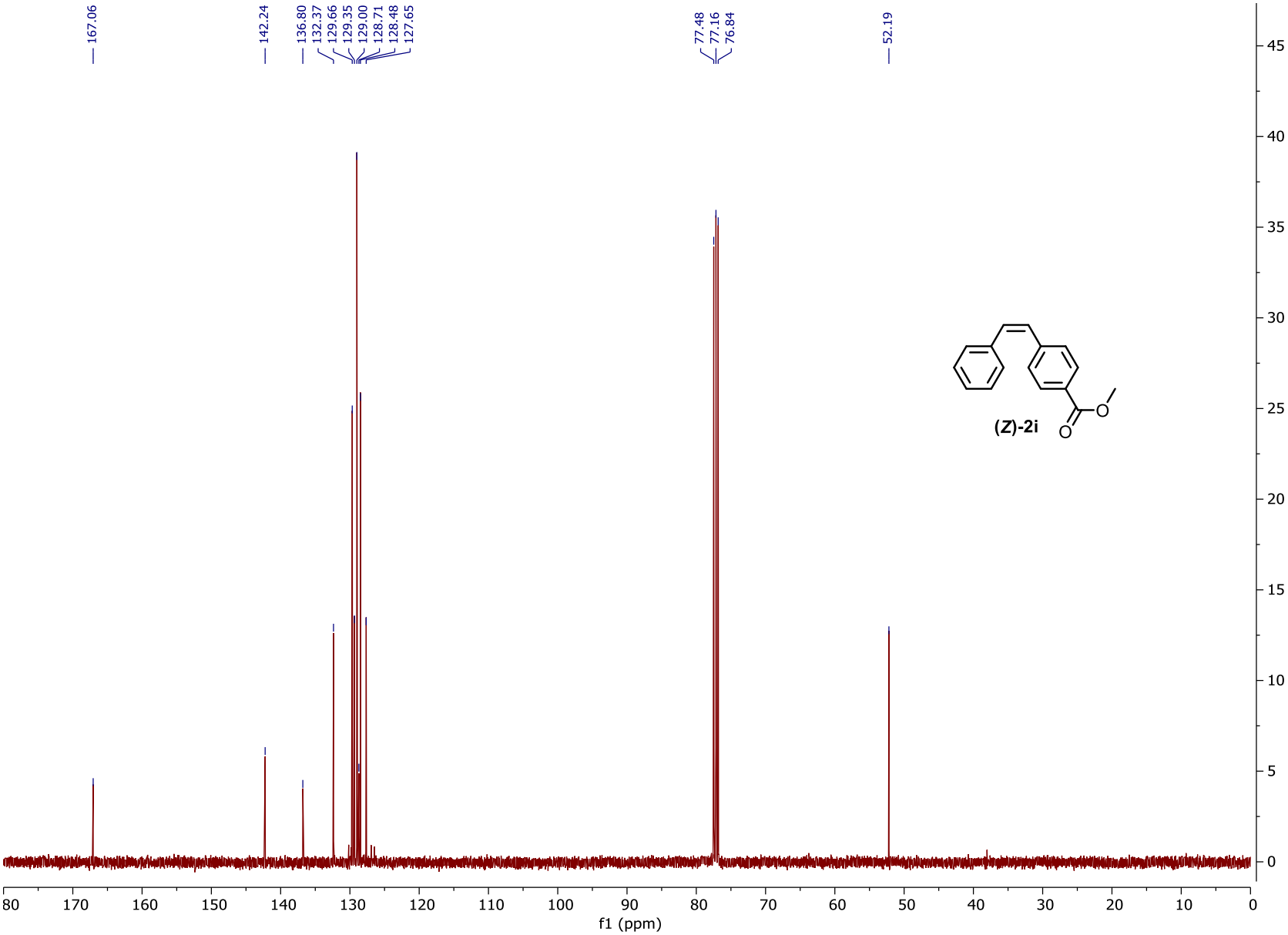

137.00
135.78
132.88
131.09
130.35
129.06
128.94
128.55
128.48
127.46
77.48
77.16
76.84
Cl
(Z)-2g
f1 (ppm)

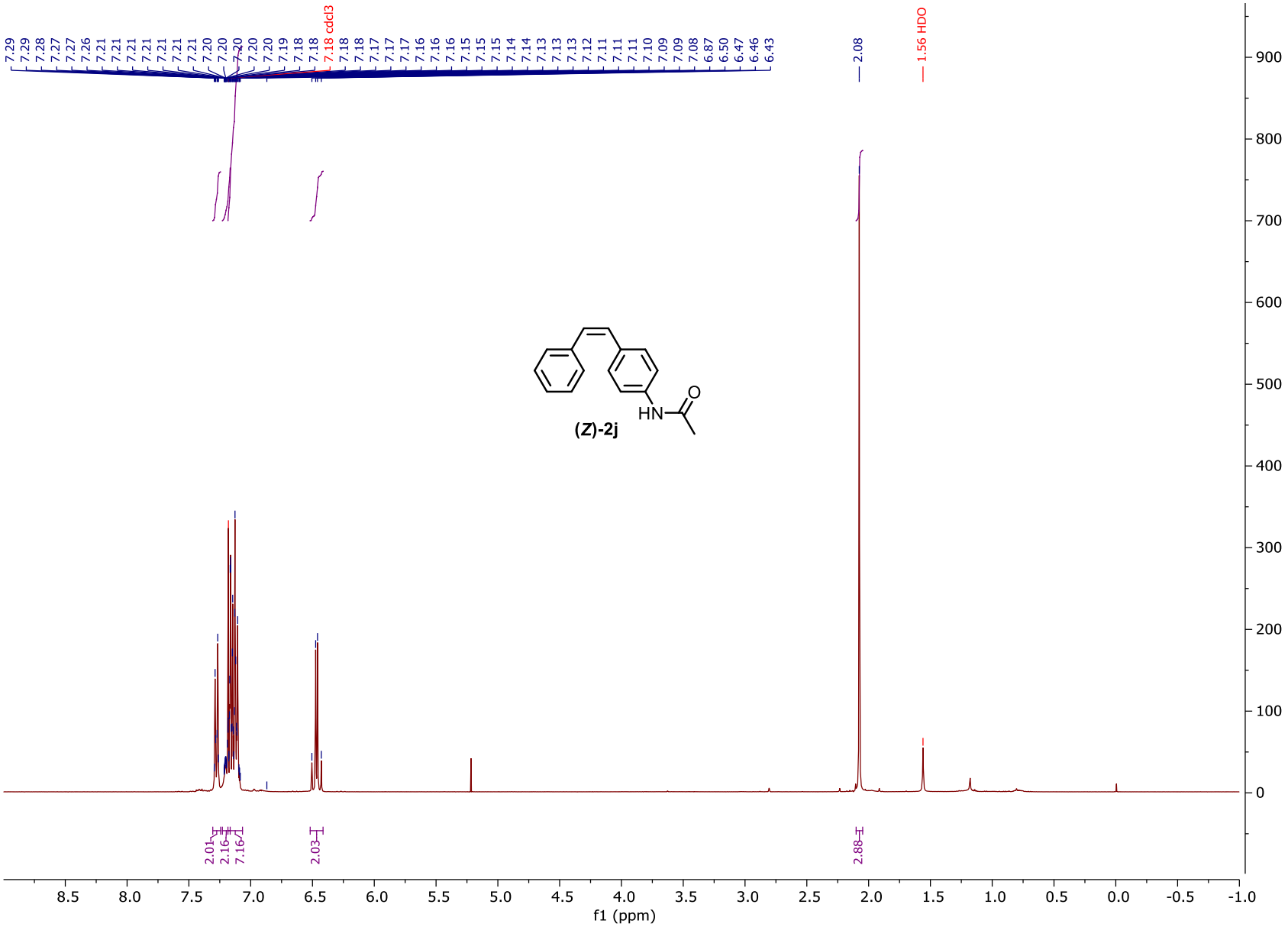

7.28 cdcl3
1.56 HDO
(Z)-2h
F
F
F
1.98
2.02
5.29
1.03
1.03
f1 (ppm)

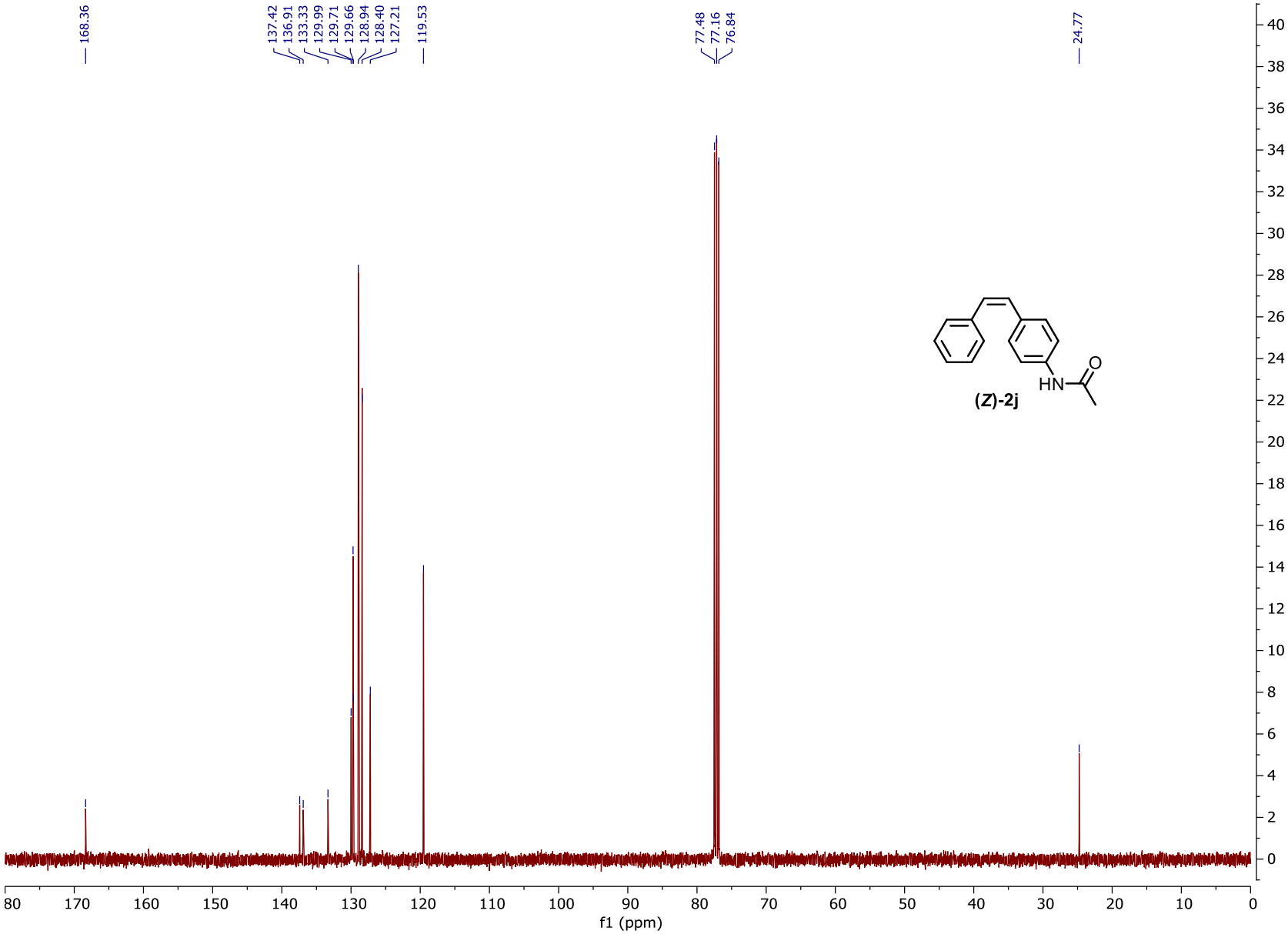

141.05
141.03
136.68
132.46
129.56
129.27
129.24
128.96
128.92
128.88
128.58
128.56
127.71
126.92
126.72
125.67
125.35
125.31
125.27
125.23
122.96
77.48
77.16
76.84
(Z)-2h
F
F
F
f1 (ppm)

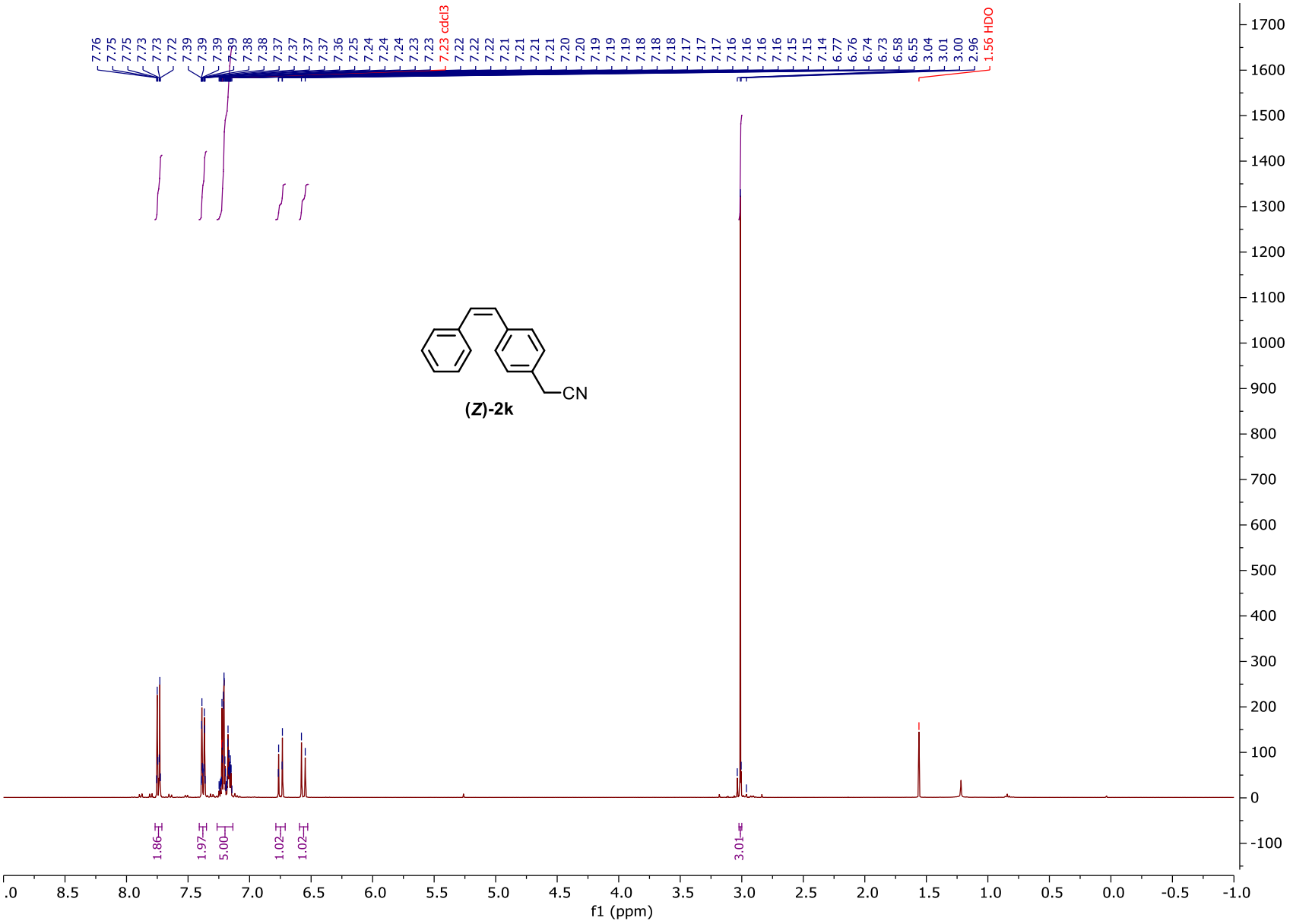

-62.55
1.00
(Z)-2h
F
F
F
70000
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
f1 (ppm)

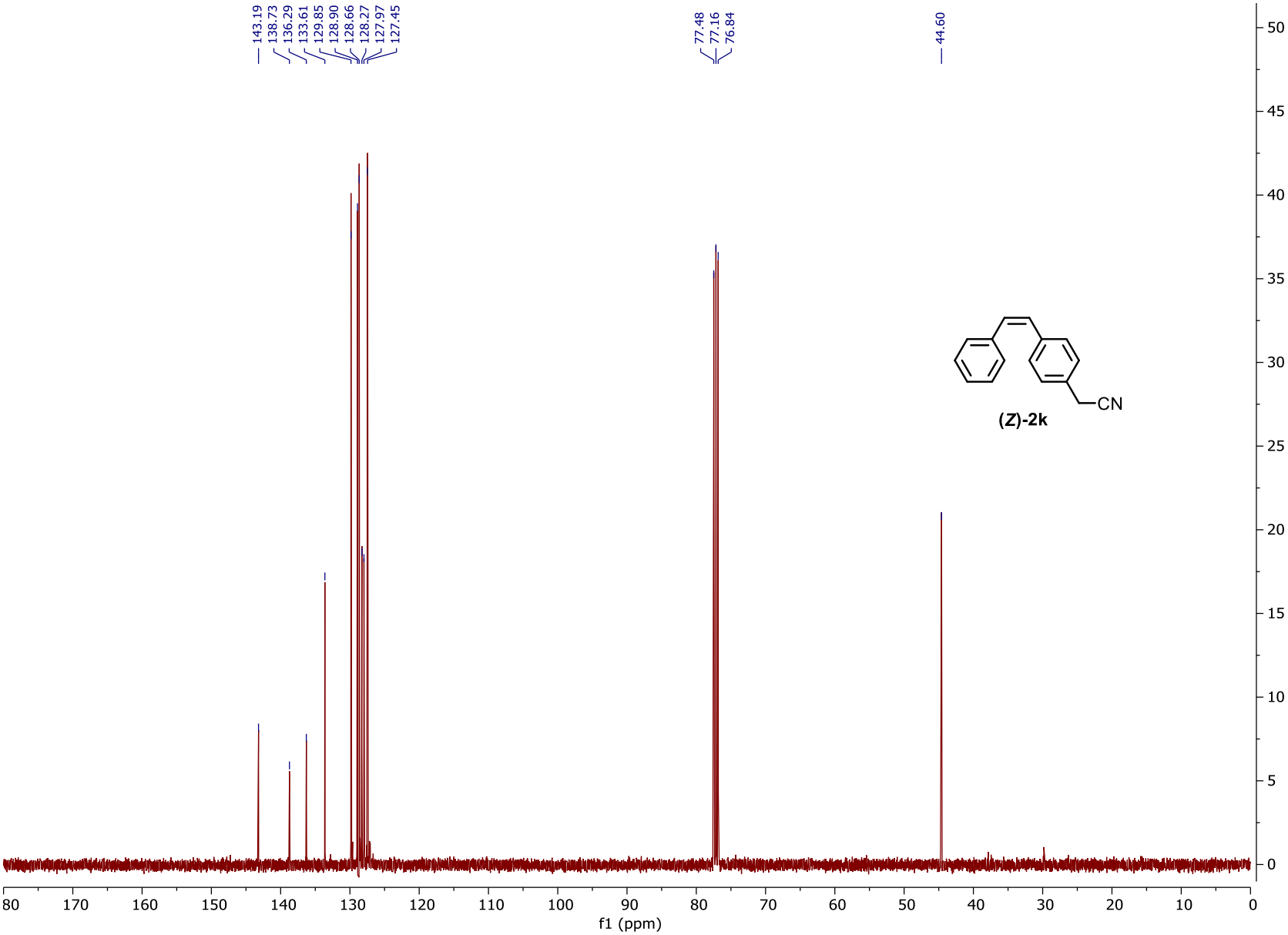

7.90 7.90 7.90 7.90 7.90 7.89 7.88 7.88 7.88 7.88 7.32 7.32 7.31 7.31 7.31 7.31 7.30 7.30 7.30 7.29 7.29 7.29 7.29 7.28 7.26 cdcl3 7.25 7.25 7.24 7.24 7.23 7.23 7.23 7.22 7.22 7.21 7.21 7.21 7.20 7.19 7.16 7.16 7.15 7.14 7.14 6.73 6.70 6.62 6.59 3.93 3.93 3.91 3.90
1.58 HDO
(Z)-2i
2.02
2.13
4.89
1.05
1.06
2.95
f1 (ppm)

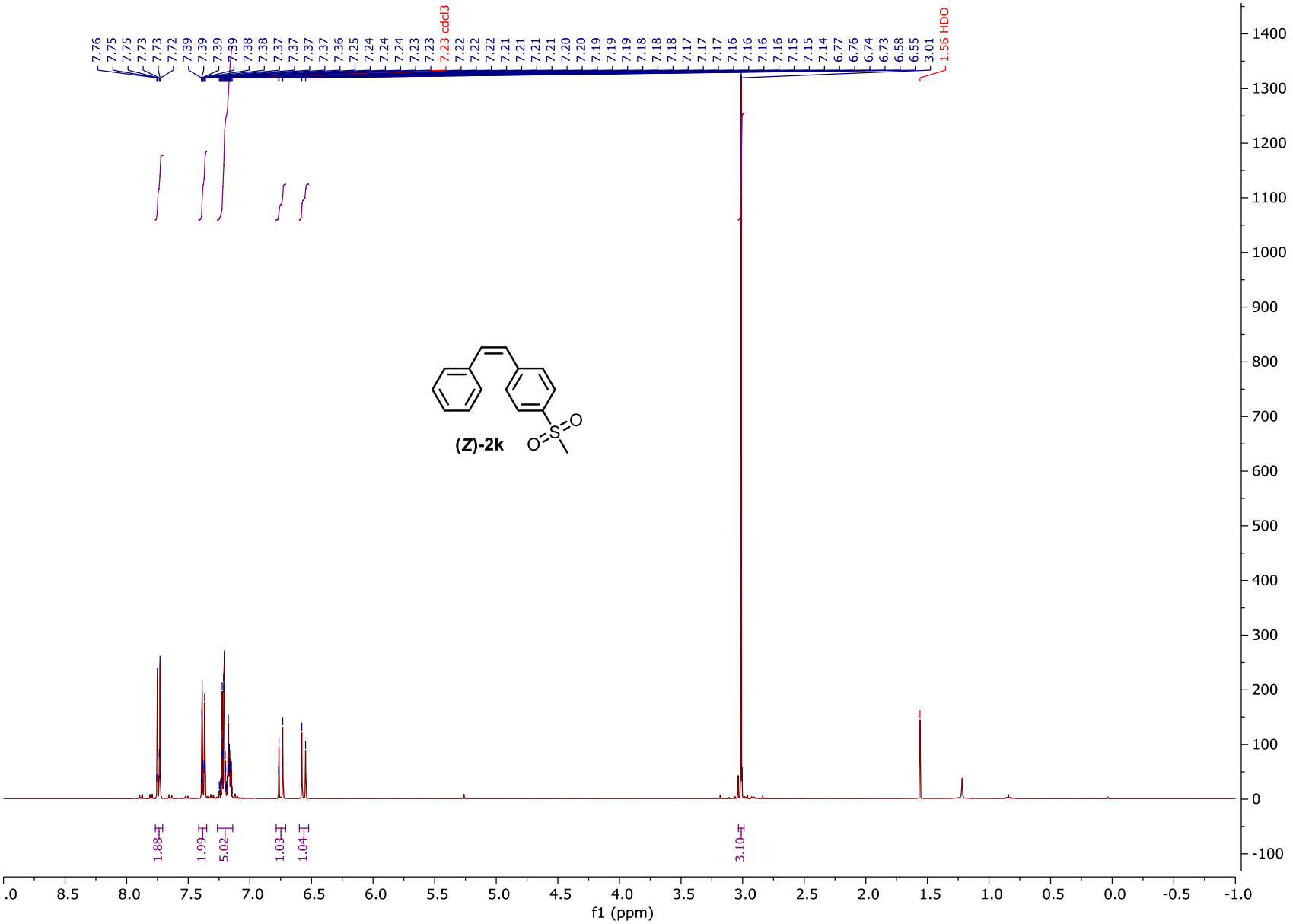

167.06
142.24
136.80
132.37
129.66
129.35
129.00
128.71
128.48
127.65
77.48
77.16
76.84
52.19
(Z)-2i
f1 (ppm)

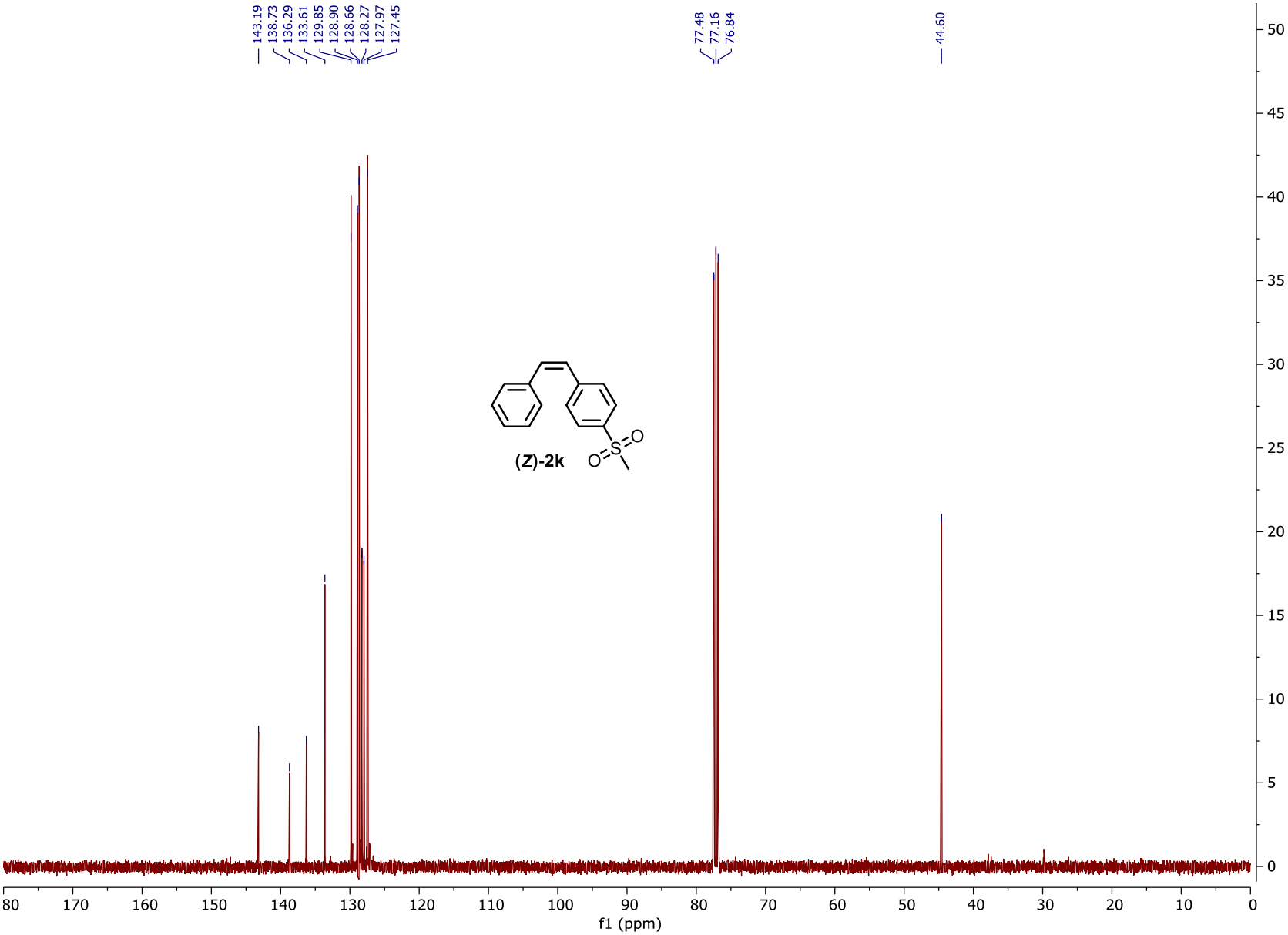

7.29 7.29 7.28 7.27 7.27 7.26 7.21 7.21 7.21 7.21 7.21 7.21 7.20 7.20 7.20 7.20 7.20 7.19 7.18 7.18 7.18 cdcl3 7.18 7.18 7.17 7.17 7.17 7.16 7.16 7.16 7.15 7.15 7.15 7.14 7.14 7.13 7.13 7.13 7.12 7.11 7.11 7.11 7.10 7.09 7.09 7.08 6.87 6.50 6.47 6.46 6.43
2.08
1.56 HDO
(Z)-2j
HN
O
2.01
2.16
7.16
2.03
2.88
f1 (ppm)

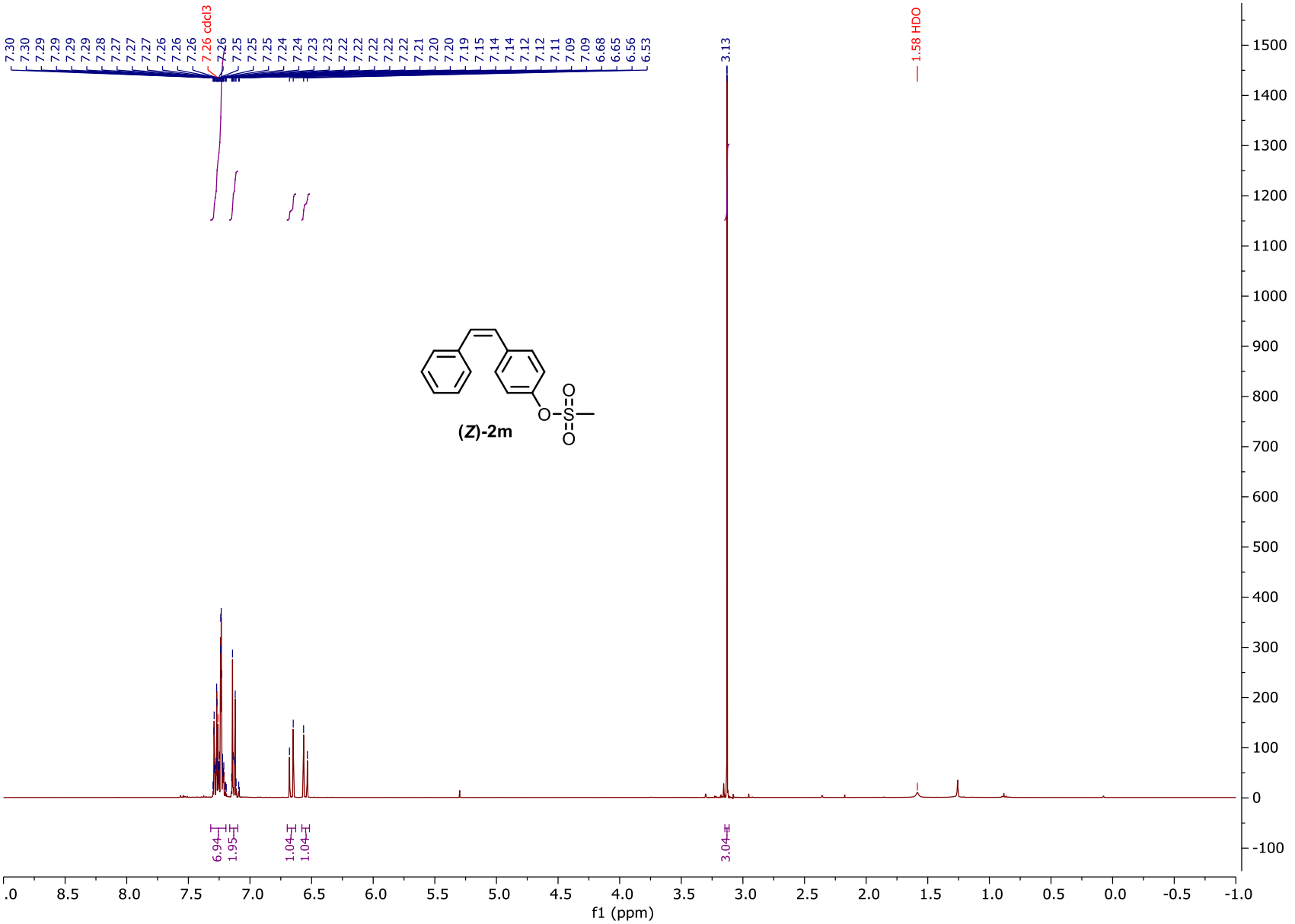

168.36
137.42
136.91
133.33
129.99
129.71
129.66
128.94
128.40
127.21
119.53
77.48
77.16
76.84
24.77
HN
O
(Z)-2j
f1 (ppm)

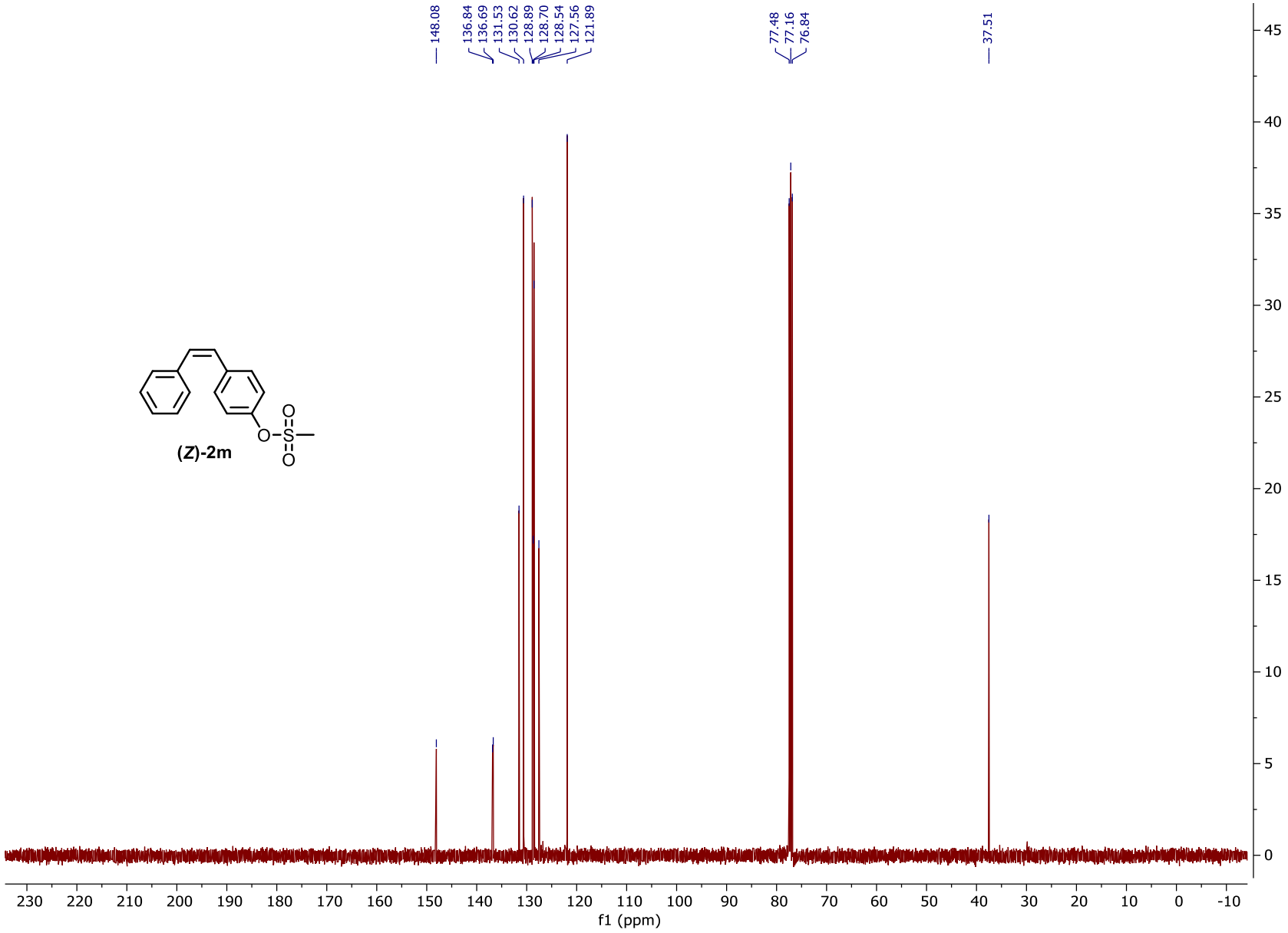

7.76 7.75 7.75 7.73 7.73 7.72 7.39 7.39 7.39 7.39 7.38 7.38 7.37 7.37 7.37 7.36 7.25 7.24 7.24 7.24 7.23 7.23 cdcl3 7.22 7.22 7.22 7.21 7.21 7.21 7.21 7.20 7.20 7.19 7.19 7.19 7.18 7.18 7.18 7.17 7.17 7.17 7.16 7.16 7.16 7.16 7.15 7.15 7.14 6.77 6.76 6.74 6.73 6.58 6.55 3.04 3.01 3.00 2.96 1.56 HDO
CN
(Z)-2k
1.86 1.97 5.00 1.02 1.02 3.01
f1 (ppm)

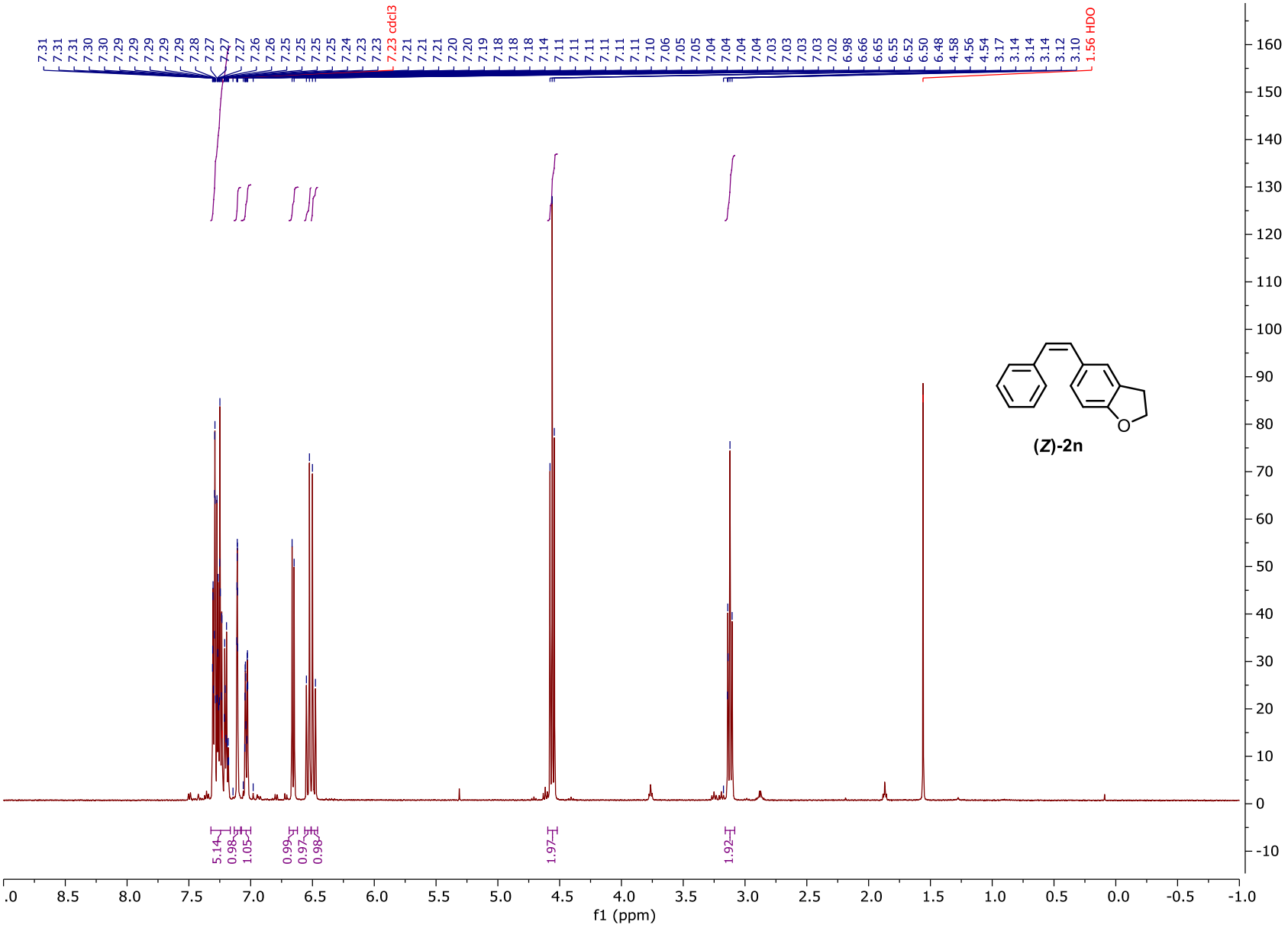

143.19
138.73
136.29
133.61
129.85
128.90
128.66
128.27
127.97
127.45
77.48
77.16
76.84
44.60
CN
(Z)-2k
f1 (ppm)

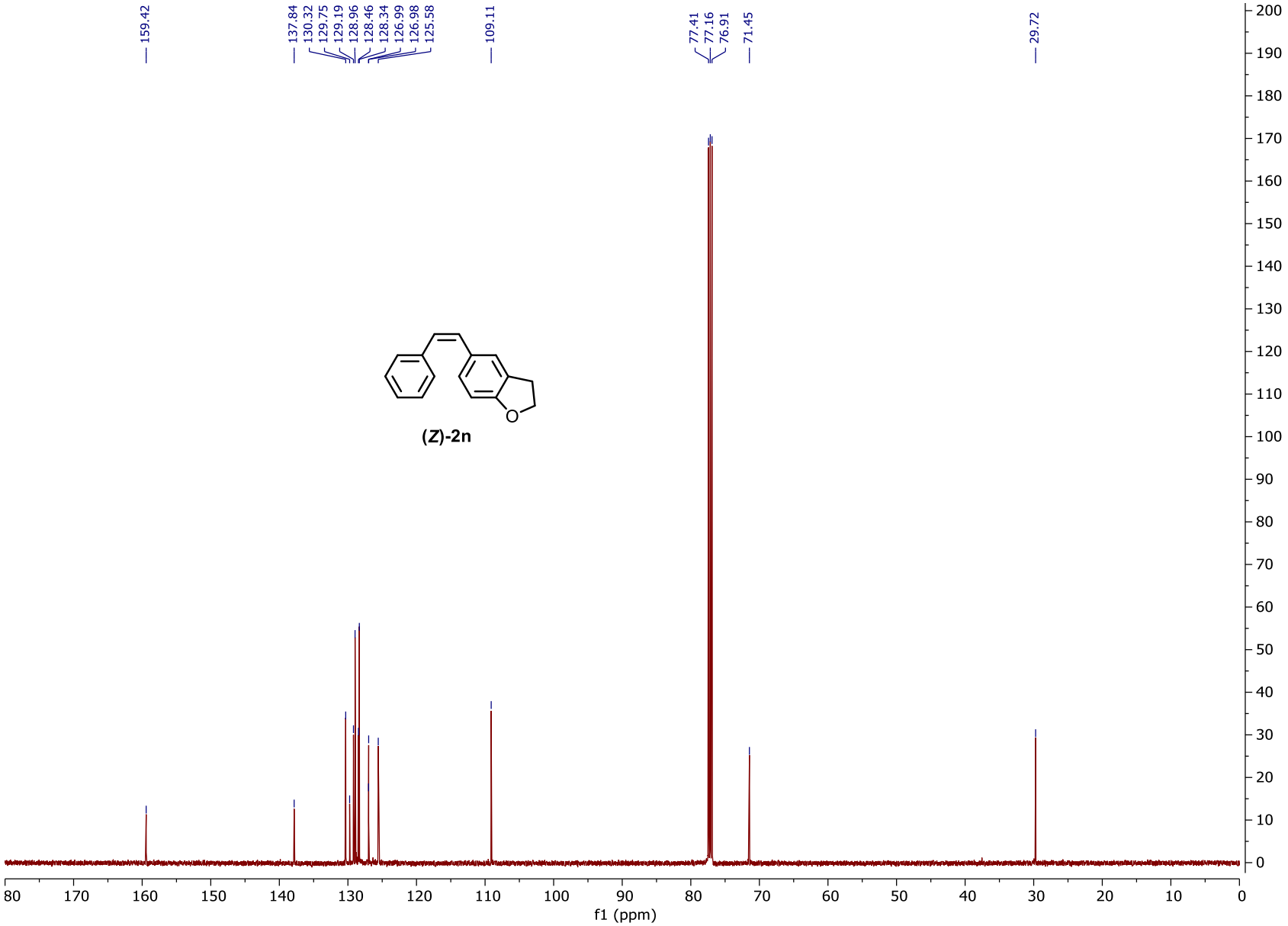

7.76 7.75 7.75 7.73 7.73 7.72 7.39 7.39 7.39 7.39 7.38 7.38 7.37 7.37 7.37 7.36 7.25 7.24 7.24 7.24 7.23 7.23 cdcl3 7.22 7.22 7.22 7.21 7.21 7.21 7.21 7.20 7.20 7.19 7.19 7.19 7.18 7.18 7.18 7.17 7.17 7.17 7.16 7.16 7.16 7.16 7.15 7.15 7.14 6.77 6.76 6.74 6.73 6.58 6.55 3.01 1.56 HDO
(Z)-2k
1.88 1.99 5.02 1.03 1.04 3.10
f1 (ppm)


143.19
138.73
136.29
133.61
129.85
128.90
128.66
128.27
127.97
127.45
77.48
77.16
76.84
44.60
(Z)-2k
f1 (ppm)


7.30 7.30 7.29 7.29 7.29 7.29 7.28 7.27 7.27 7.27 7.26 7.26 7.26 7.26 7.26 cdcl3 7.25 7.25 7.25 7.24 7.24 7.23 7.23 7.22 7.22 7.22 7.22 7.22 7.21 7.20 7.20 7.19 7.15 7.14 7.14 7.12 7.12 7.11 7.09 7.09 6.68 6.65 6.56 6.53
3.13
1.58 HDO
(Z)-2m
6.94
1.95
1.04
1.04
3.04
f1 (ppm)


148.08
136.84
136.69
131.53
130.62
128.89
128.70
128.54
127.56
121.89
77.48
77.16
76.84
37.51
(Z)-2m
f1 (ppm)


7.31 7.31 7.31 7.30 7.30 7.29 7.29 7.29 7.29 7.29 7.28 7.27 7.27 7.27 7.26 7.26 7.25 7.25 7.25 7.25 7.24 7.23 7.23 7.23 cdcl3 7.21 7.21 7.21 7.20 7.20 7.19 7.18 7.18 7.18 7.14 7.11 7.11 7.11 7.11 7.11 7.10 7.06 7.05 7.05 7.04 7.04 7.04 7.04 7.03 7.03 7.03 7.03 7.02 6.98 6.66 6.65 6.55 6.52 6.50 6.48 4.58 4.56 4.54 3.17 3.14 3.14 3.14 3.12 3.10 1.56 HDO
(Z)-2n
5.14 0.98 1.05 0.99 0.97 0.98 1.97 1.92
f1 (ppm)


159.42
137.84
130.32
129.75
129.19
128.96
128.46
128.34
126.99
126.98
125.58
109.11
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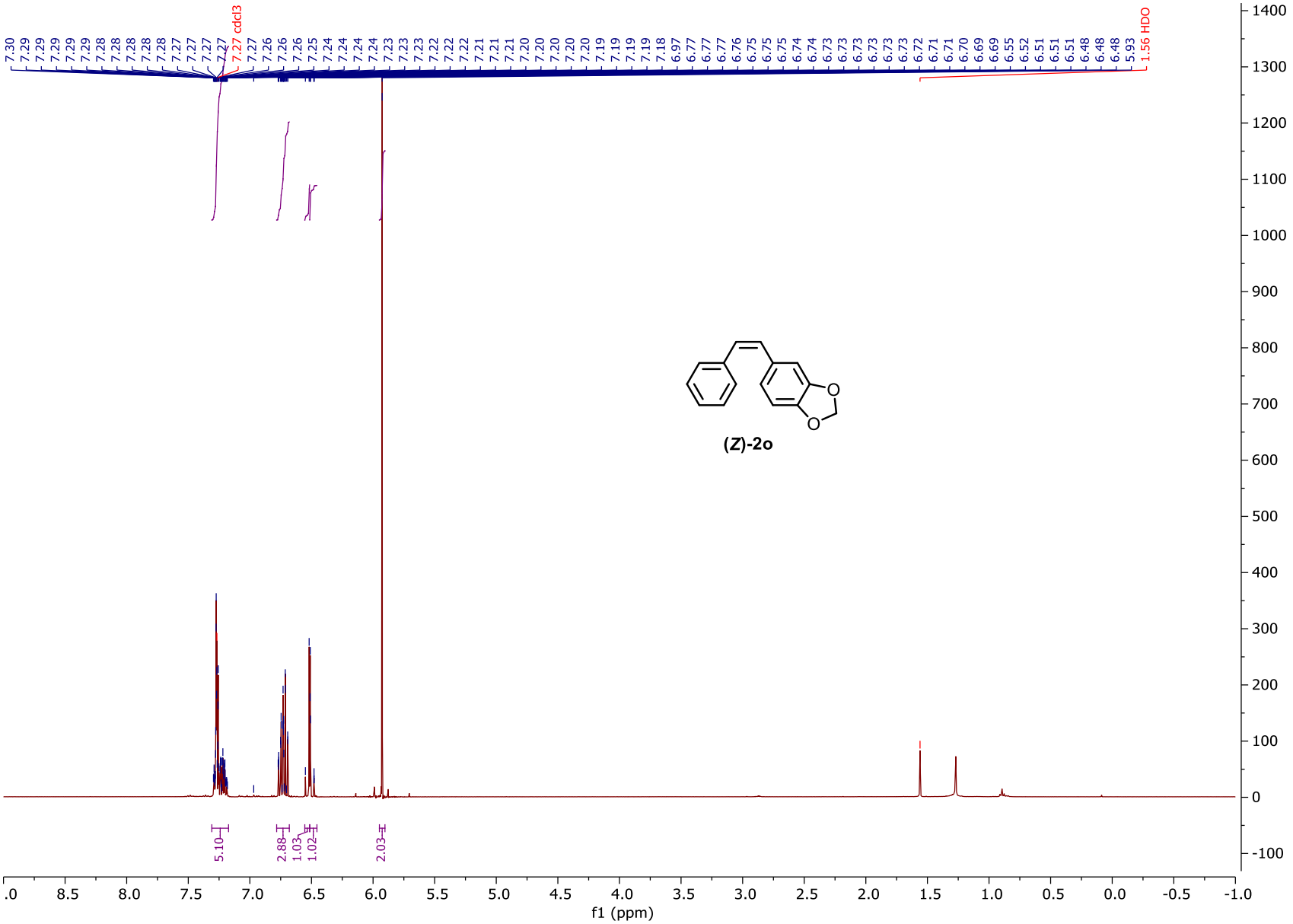
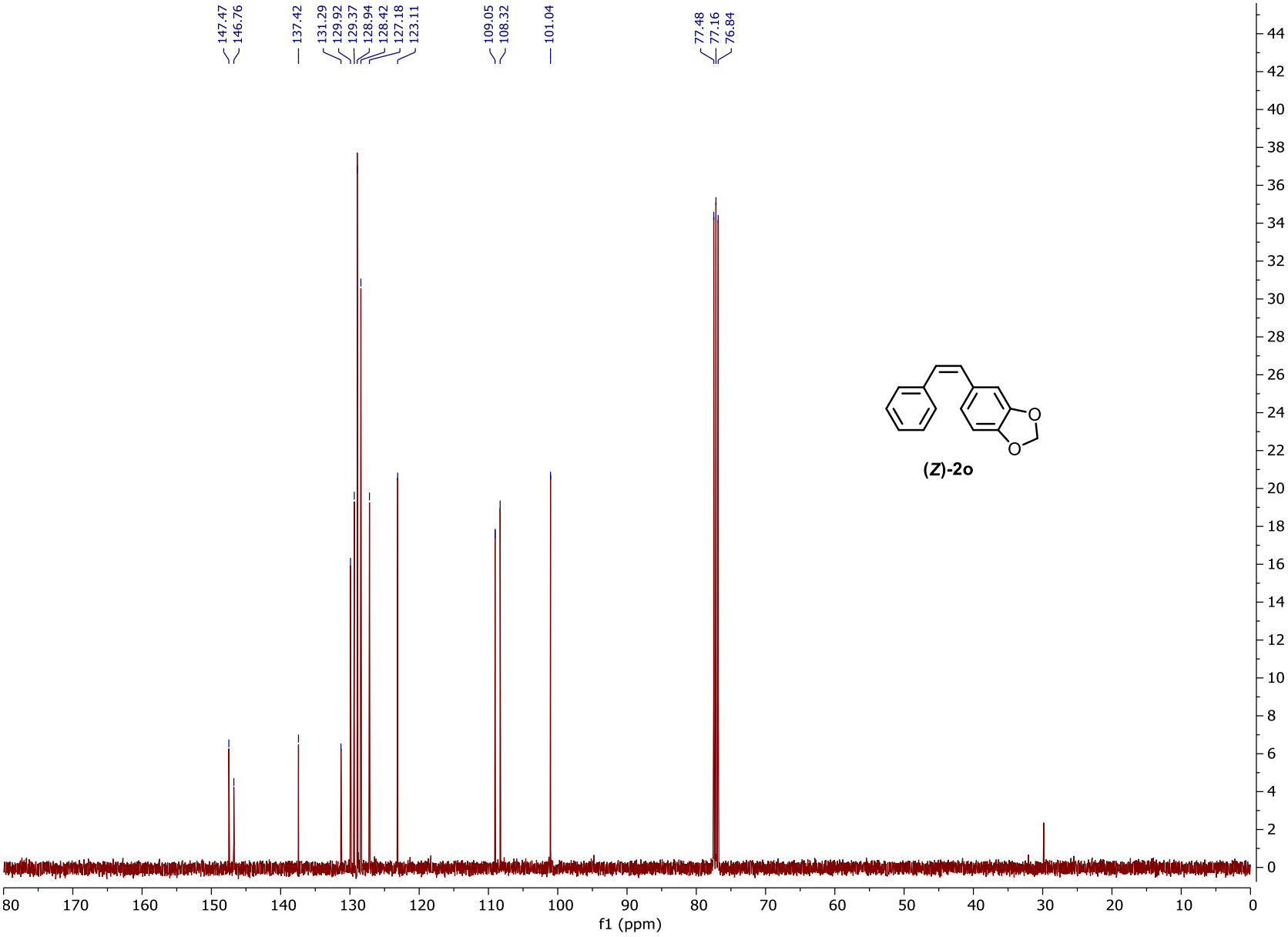
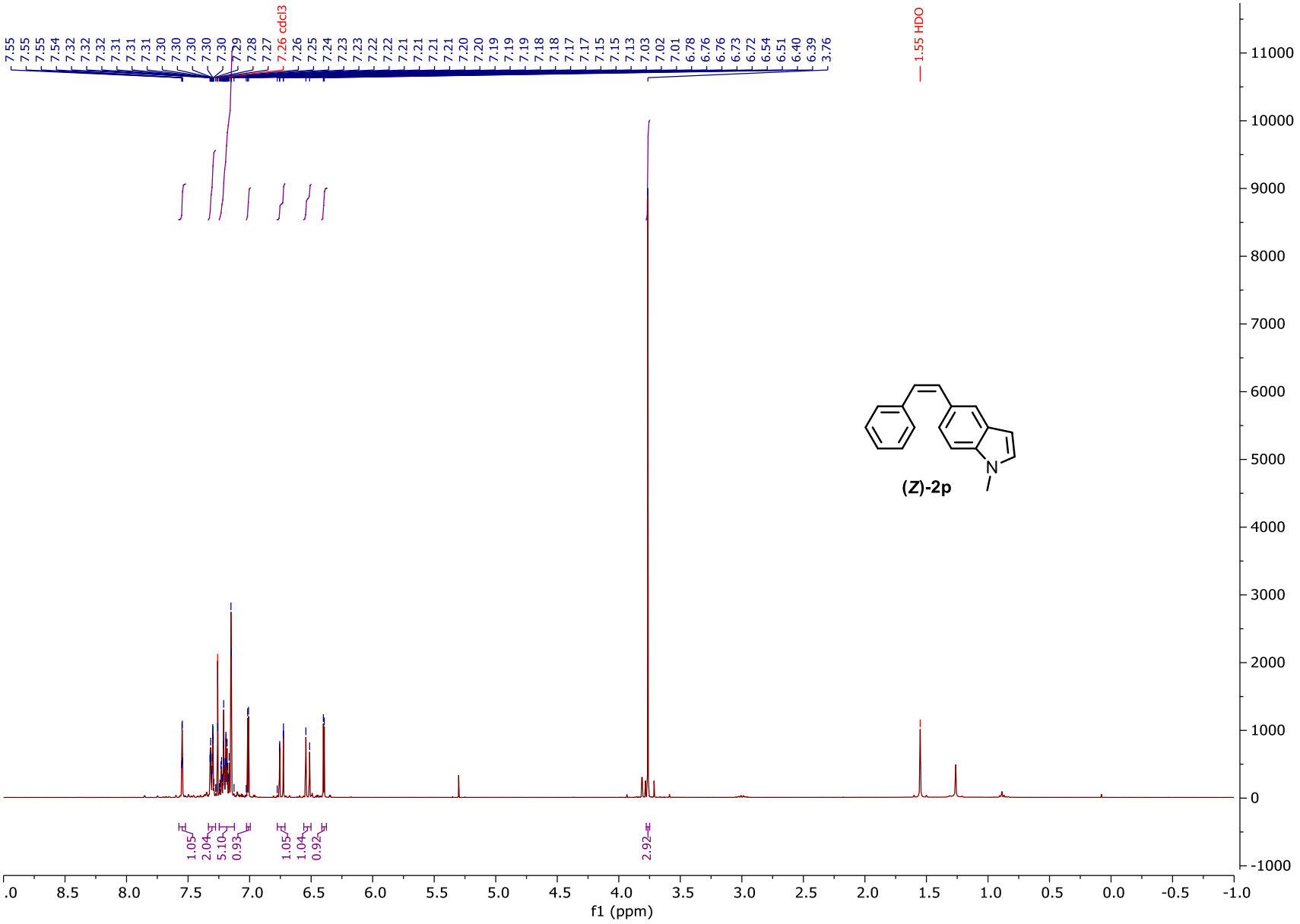
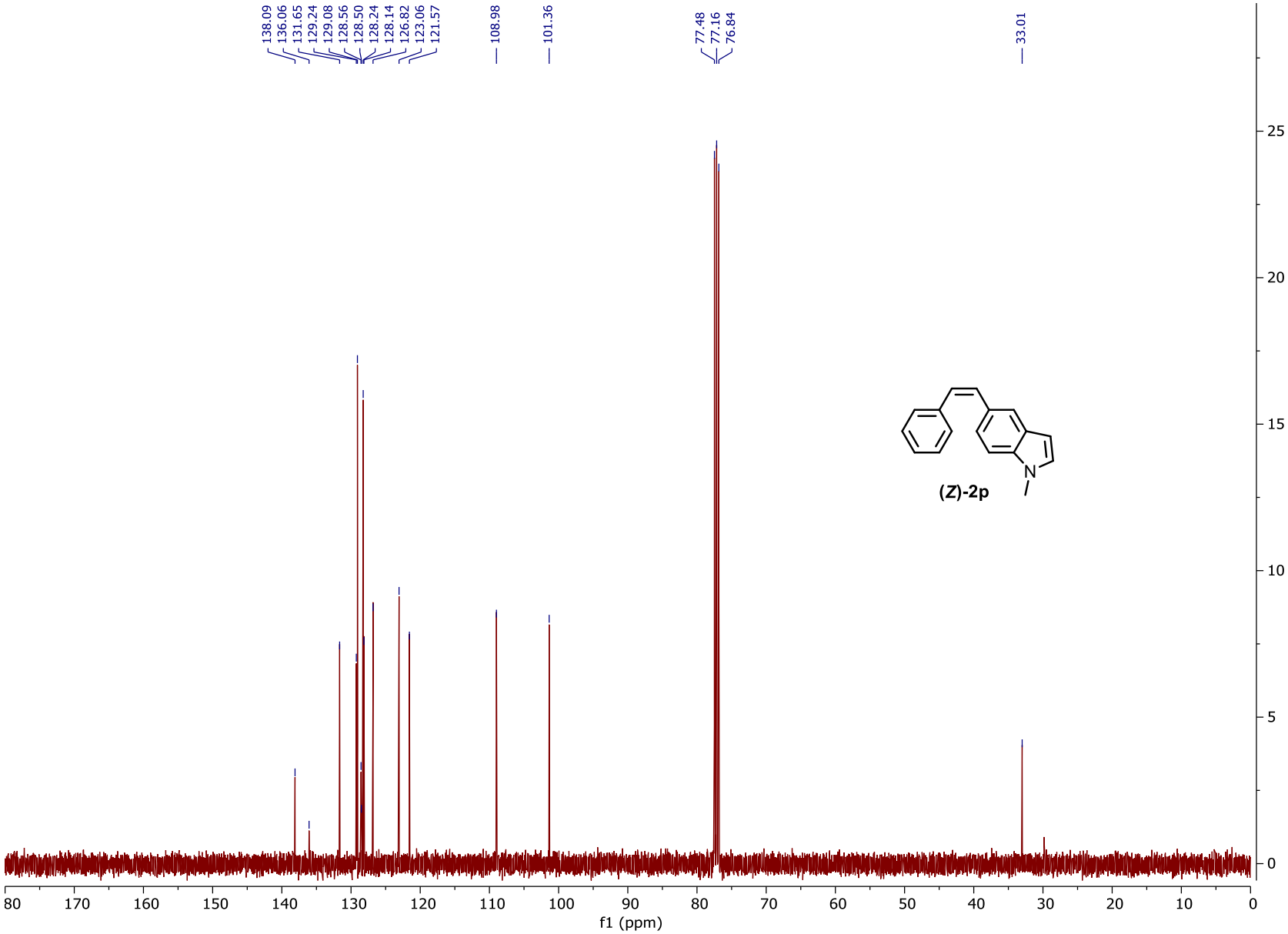
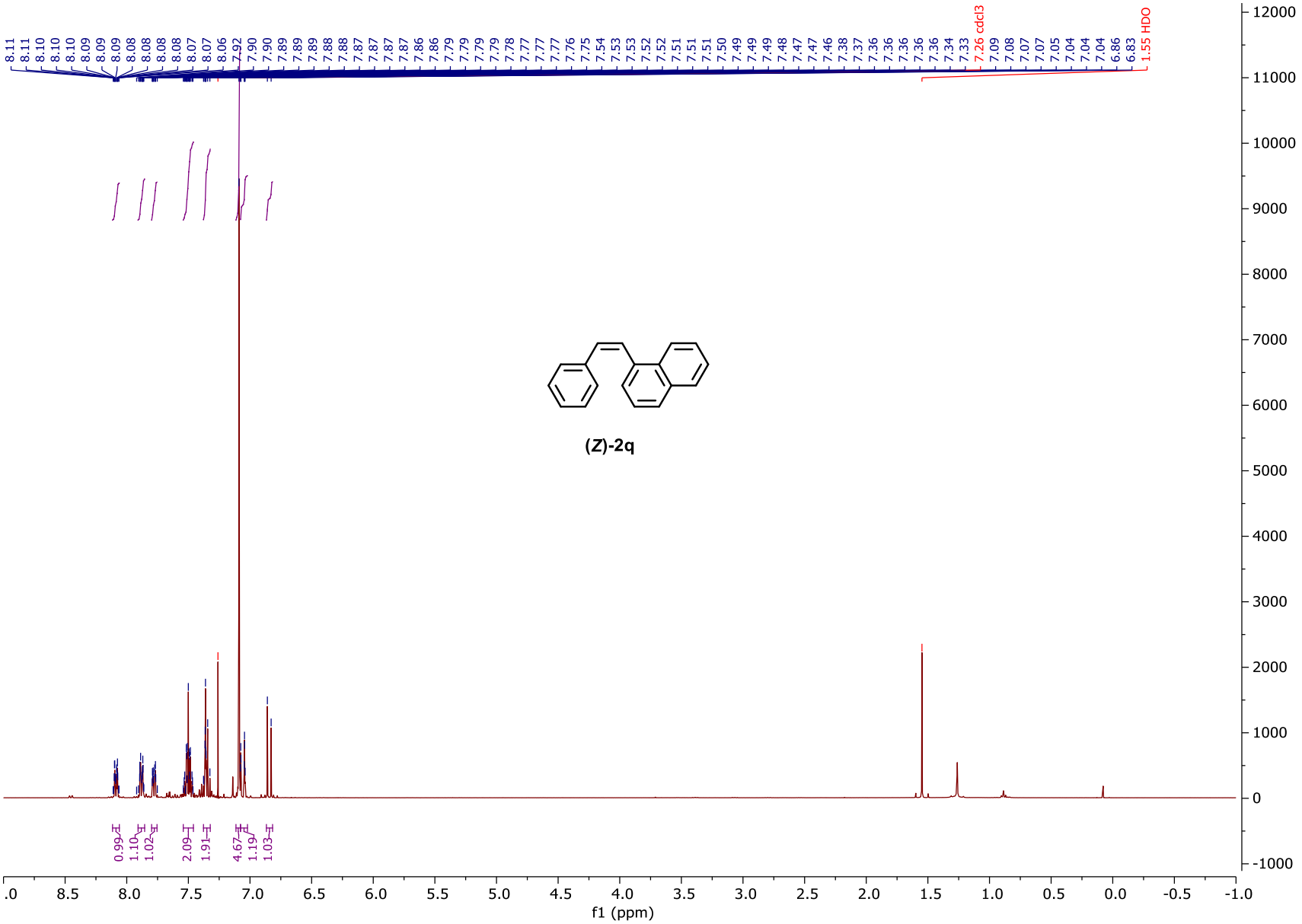
77.16
76.91
71.45
29.72
(Z)-2n
f1 (ppm)

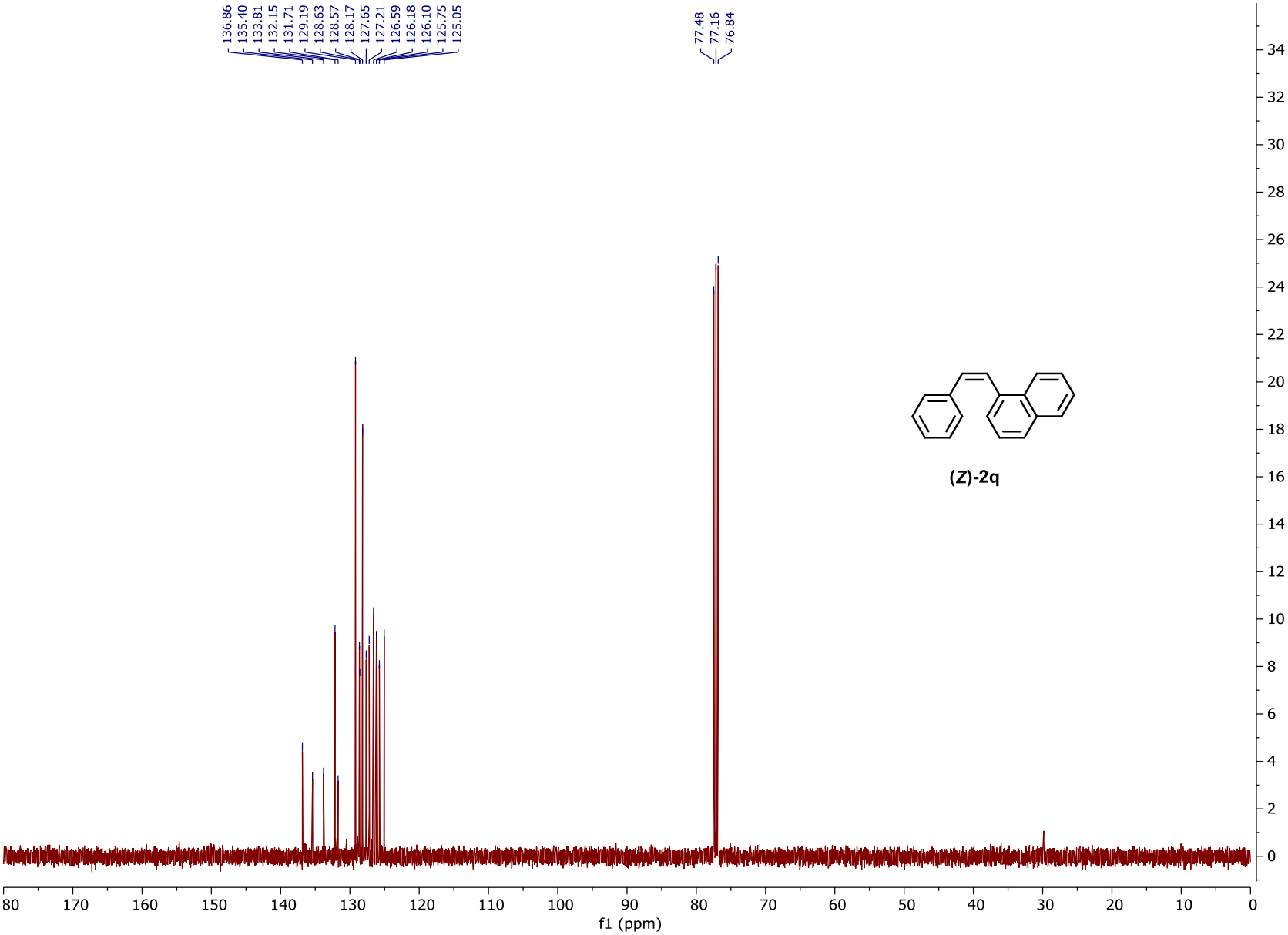

7.27 cdcl3
1.56 HDO
(Z)-2o
5.10
2.88
1.03
1.02
2.03
f1 (ppm)


147.47
146.76
137.42
131.29
129.92
129.37
128.94
128.42
127.18
123.11
109.05
108.32
101.04
77.48
77.16
76.84
(Z)-2o
f1 (ppm)


7.55 7.55 7.55 7.54 7.32 7.32 7.32 7.31 7.31 7.31 7.30 7.30 7.30 7.30 7.29 7.28 7.27 7.26 cdcl3 7.26 7.25 7.24 7.23 7.23 7.22 7.22 7.21 7.21 7.21 7.21 7.20 7.20 7.19 7.19 7.19 7.18 7.18 7.17 7.17 7.15 7.15 7.13 7.03 7.02 7.01 6.78 6.76 6.76 6.73 6.72 6.54 6.51 6.40 6.39 3.76
1.55 HDO
(Z)-2p
1.05 2.04 5.10 0.93 1.05 1.04 0.92 2.92
f1 (ppm)


138.09
136.06
131.65
129.24
129.08
128.56
128.50
128.24
128.14
126.82
123.06
121.57
108.98
101.36
77.48
77.16
76.84
33.01
N
(Z)-2p
f1 (ppm)


(Z)-2q
f1 (ppm)


136.86
135.40
133.81
132.15
131.71
129.19
128.63
128.57
128.17
127.65
127.21
126.59
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126.10
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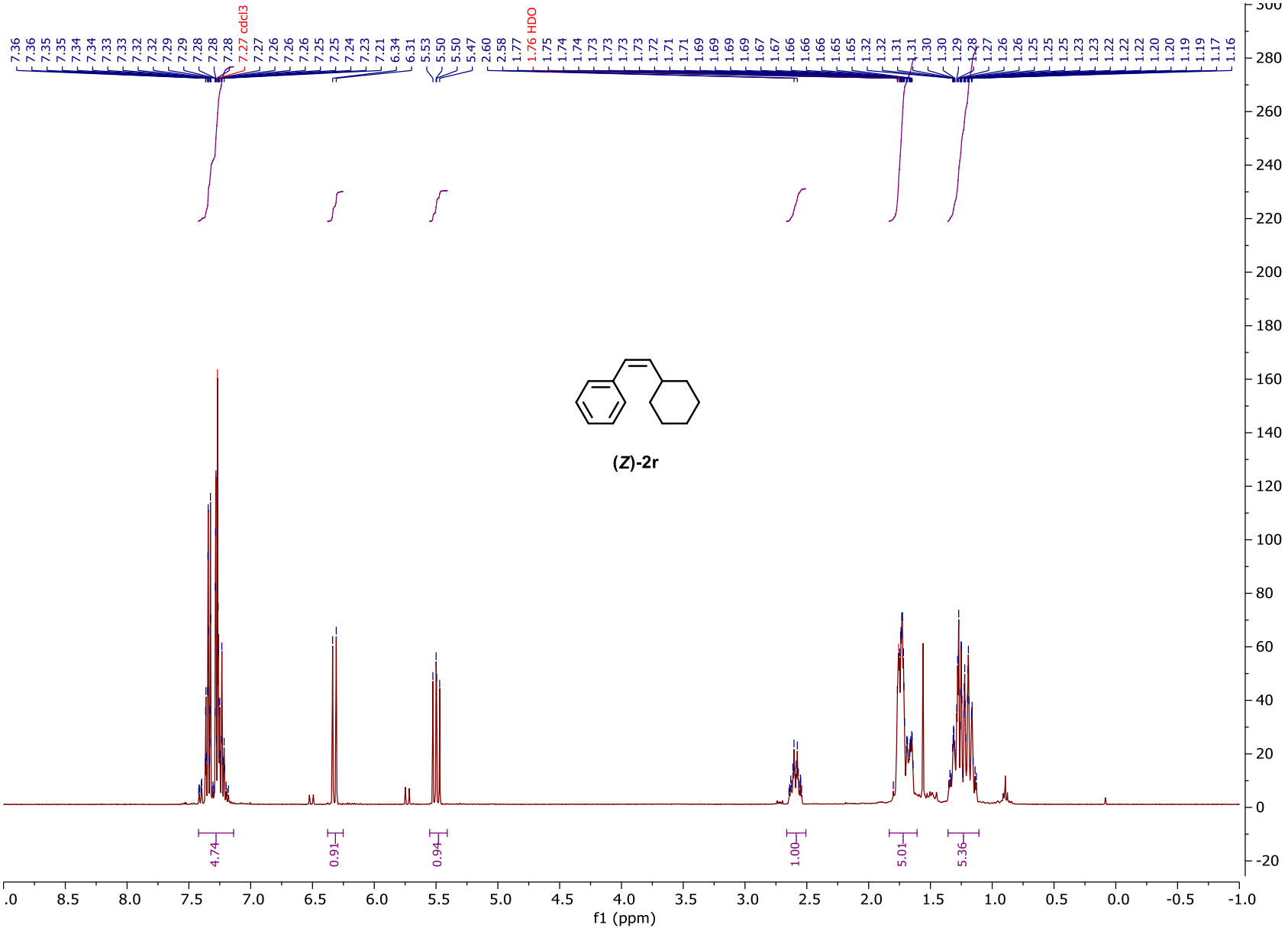
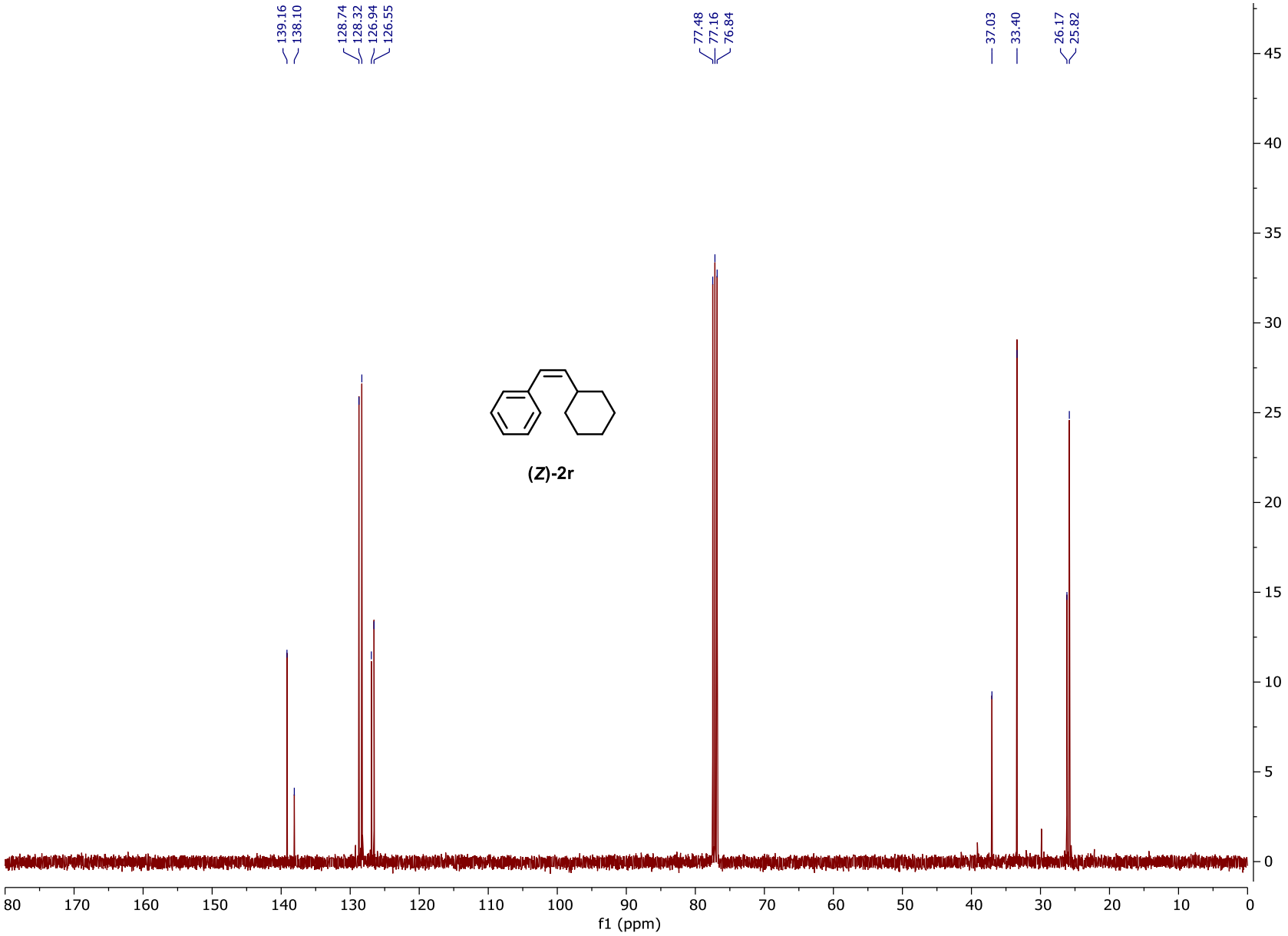
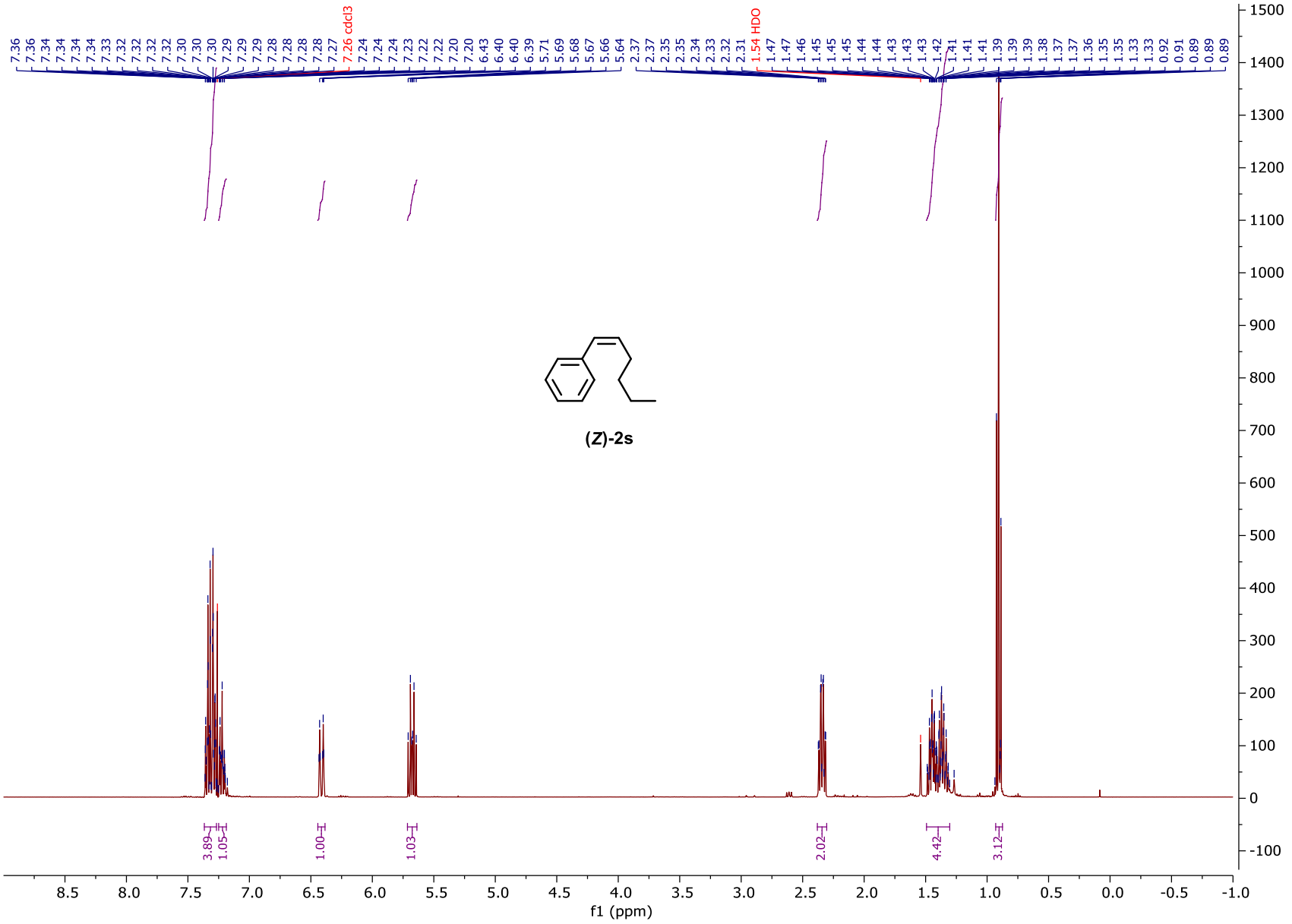
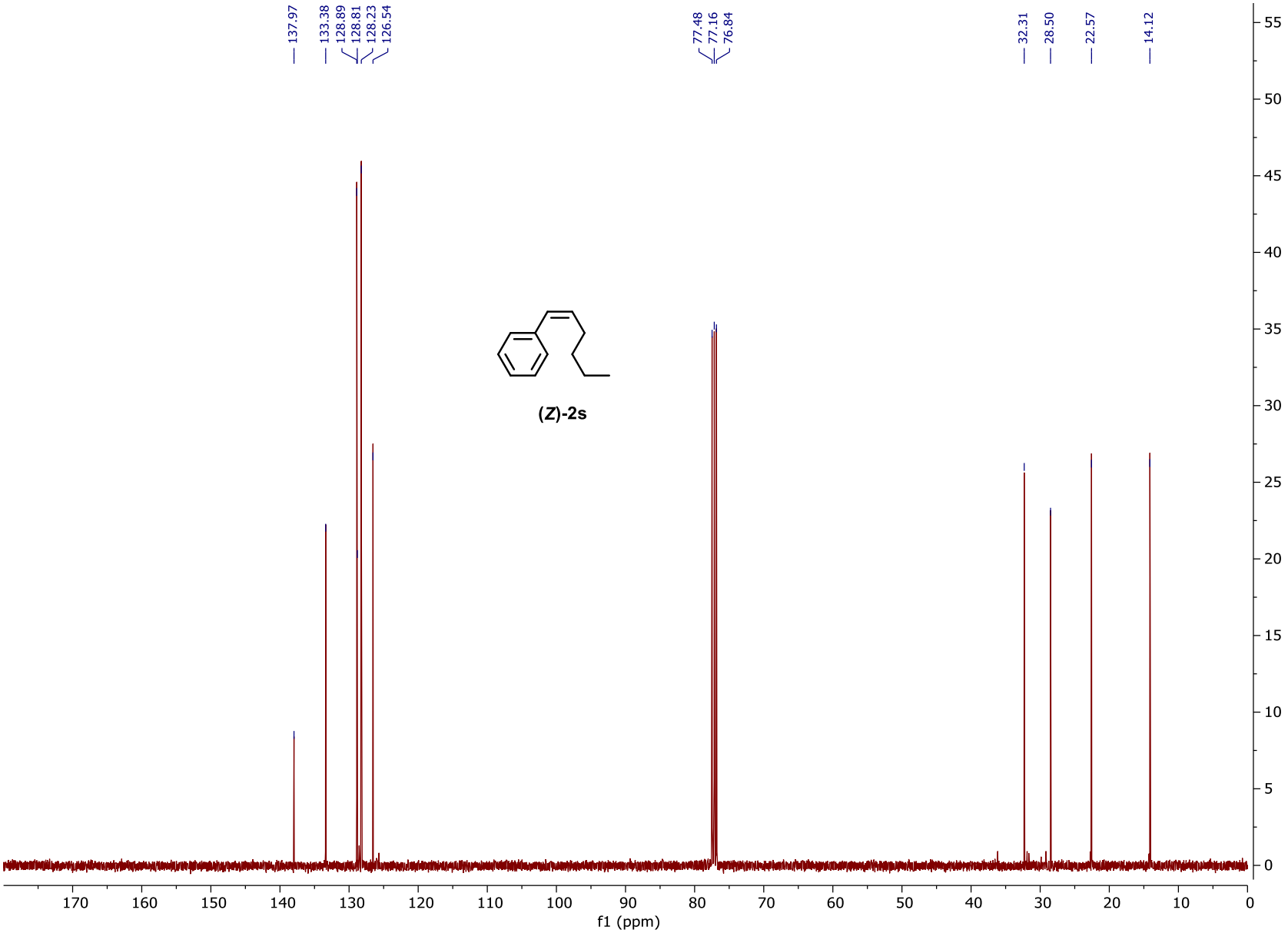
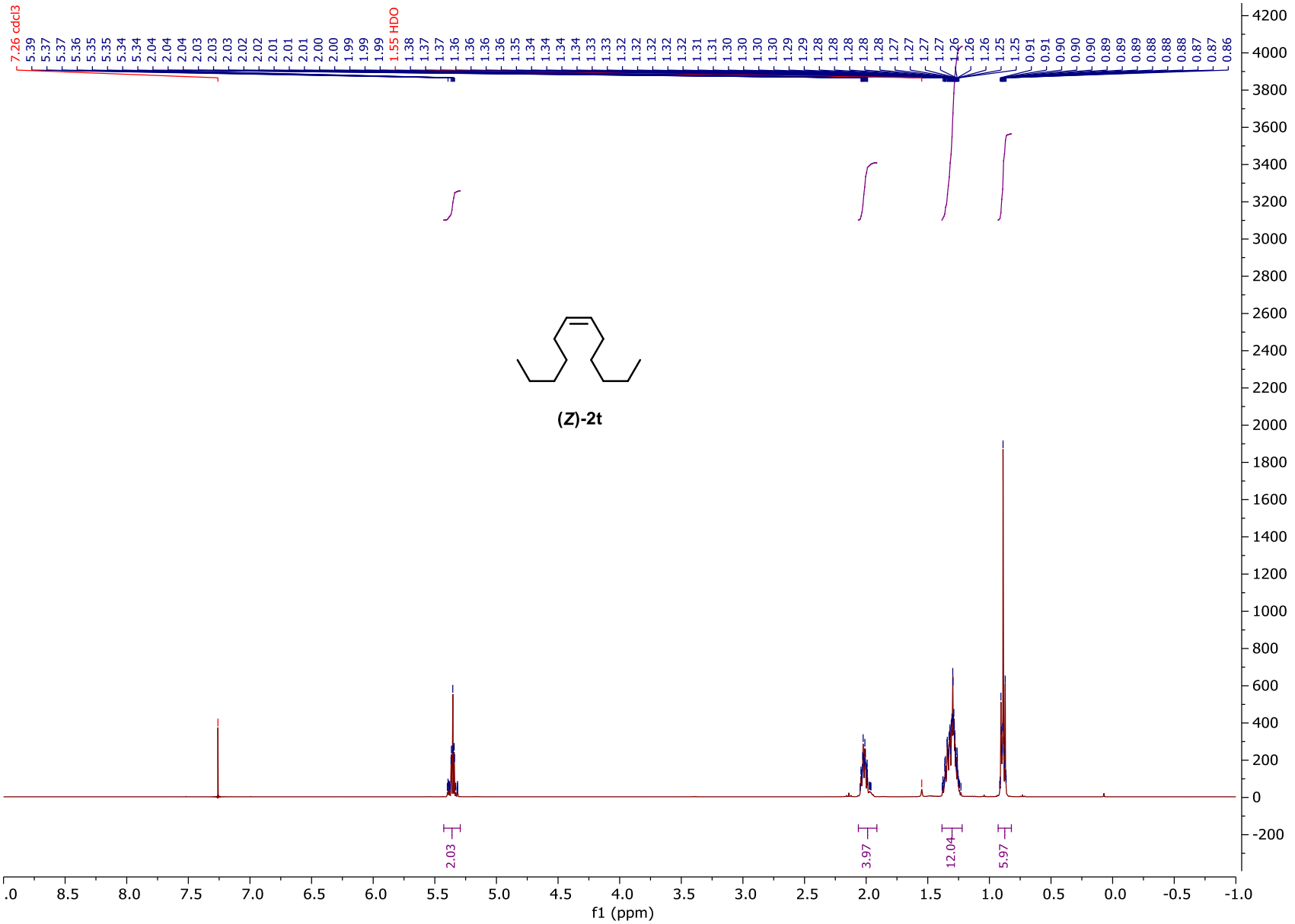
77.48
77.16
76.84
(Z)-2q
f1 (ppm)

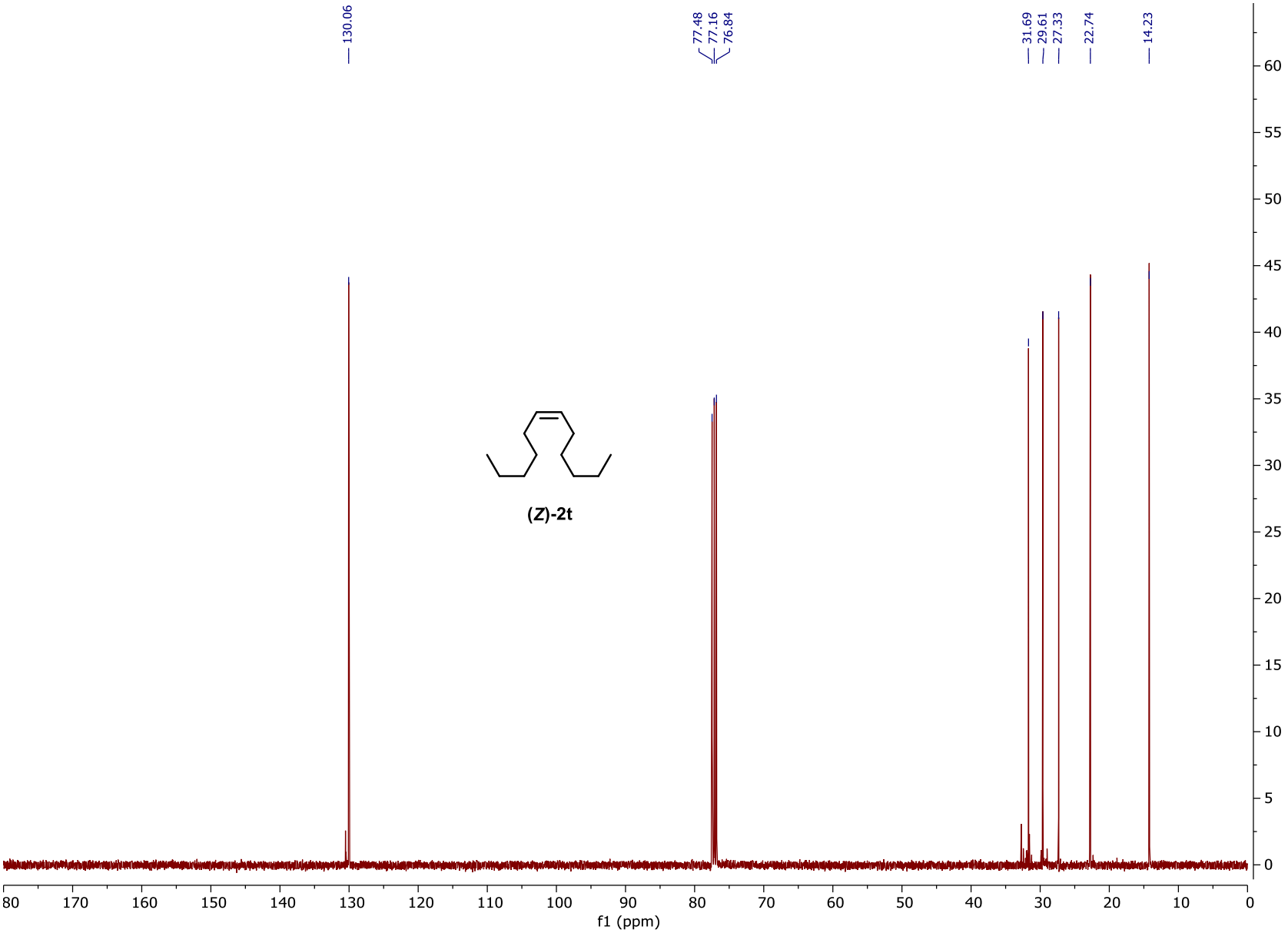

7.27 cdcl3
1.76 HDO
(Z)-2r
4.74
0.91
0.94
1.00
5.01
5.36
f1 (ppm)

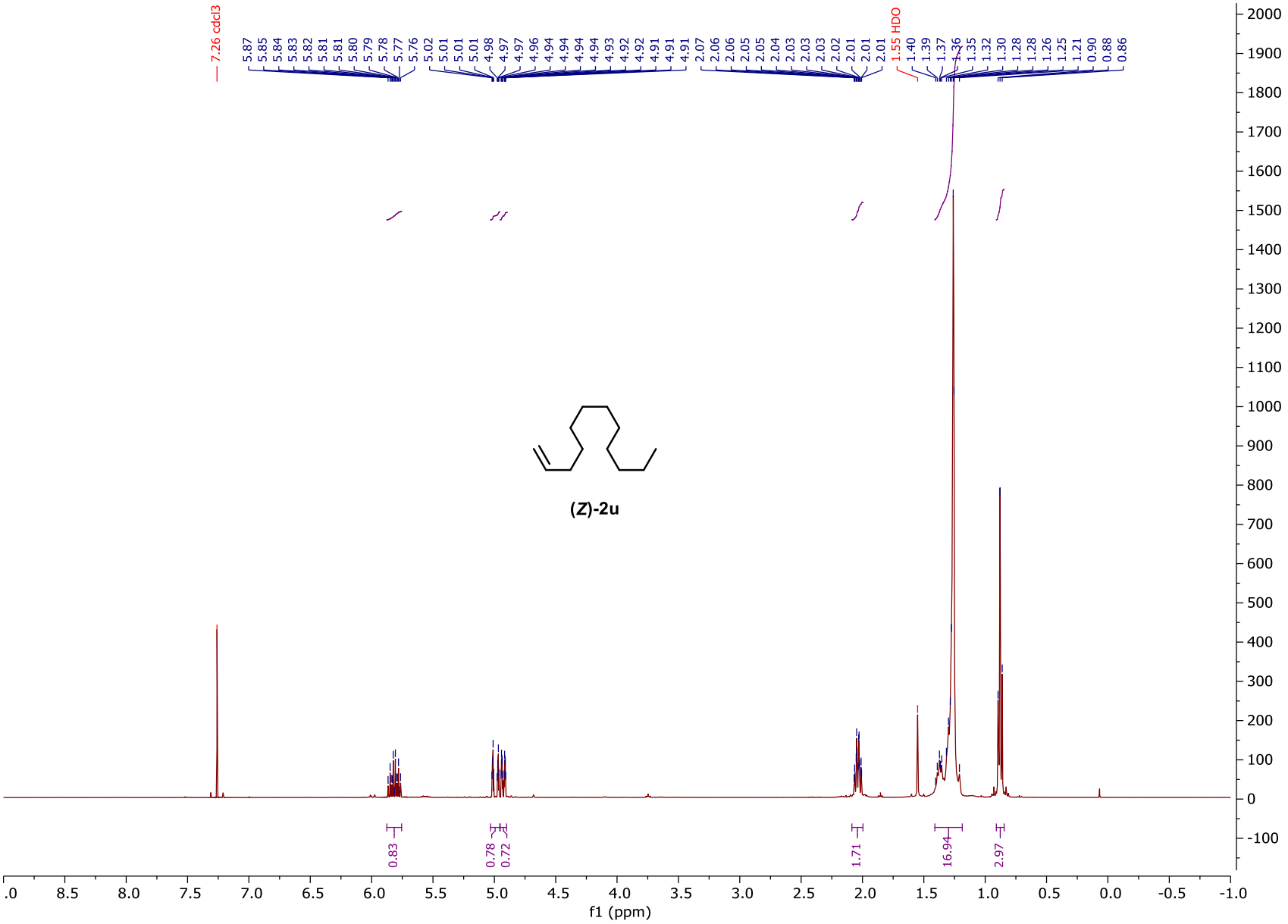

139.16
138.10
128.74
128.32
126.94
126.55
77.48
77.16
76.84
37.03
33.40
26.17
25.82
(Z)-2r
f1 (ppm)


7.26 cdcl3
1.54 HDO
(Z)-2s
3.89
1.05
1.00
1.03
2.02
4.42
3.12
f1 (ppm)


137.97
133.38
128.89
128.81
128.23
126.54
77.48
77.16
76.84
32.31
28.50
22.57
14.12
(Z)-2s
f1 (ppm)


7.26 cdcl3
1.55 HDO
(Z)-2t
2.03
3.97
12.04
5.97
f1 (ppm)


130.06
77.48
77.16
76.84
31.69
29.61
27.33
22.74
14.23
(Z)-2t
f1 (ppm)


7.26 cdcl3
5.87
5.85
5.84
5.83
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5.81
5.81
5.80
5.79
5.78
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5.76
5.02
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5.01
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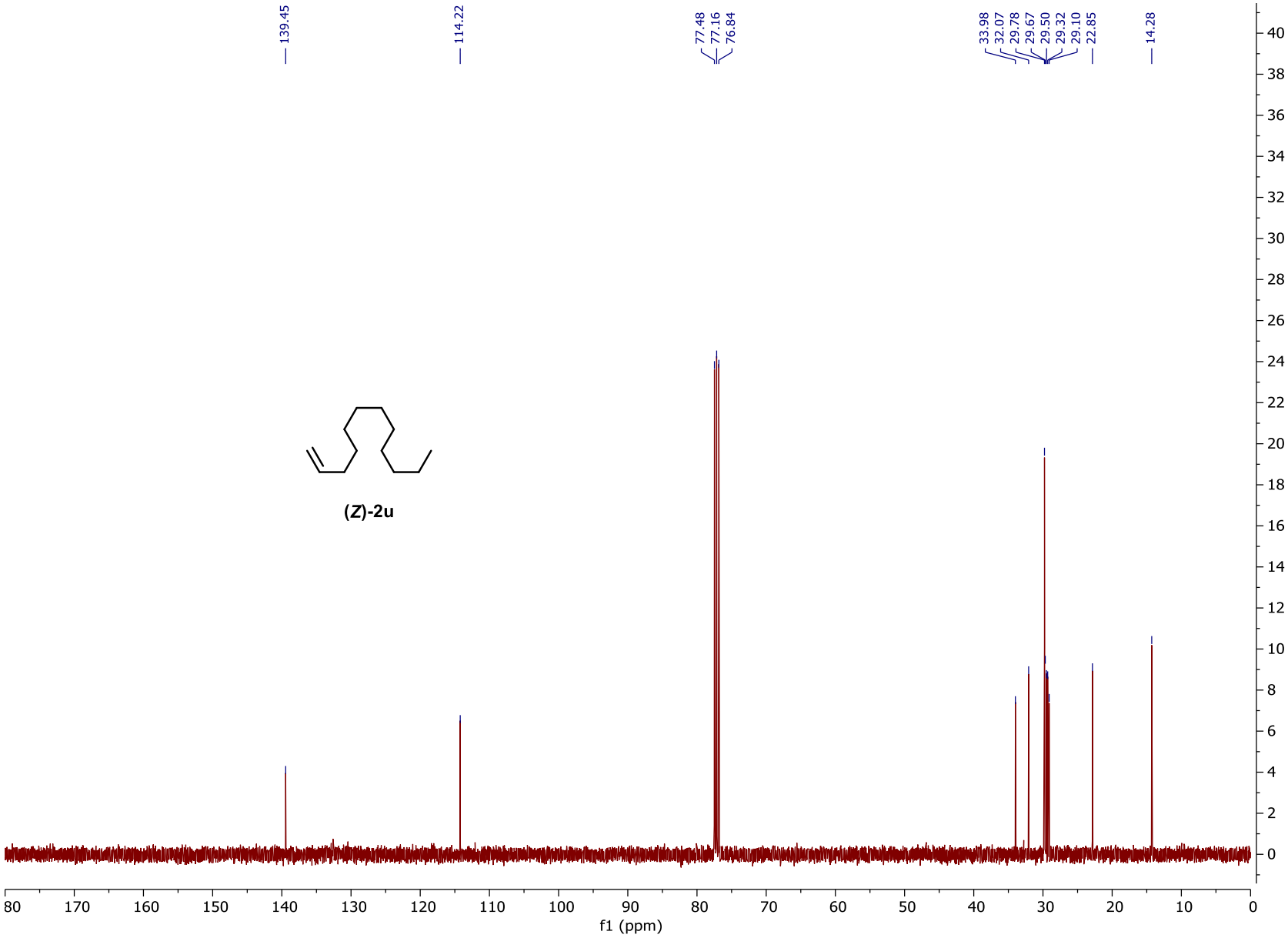
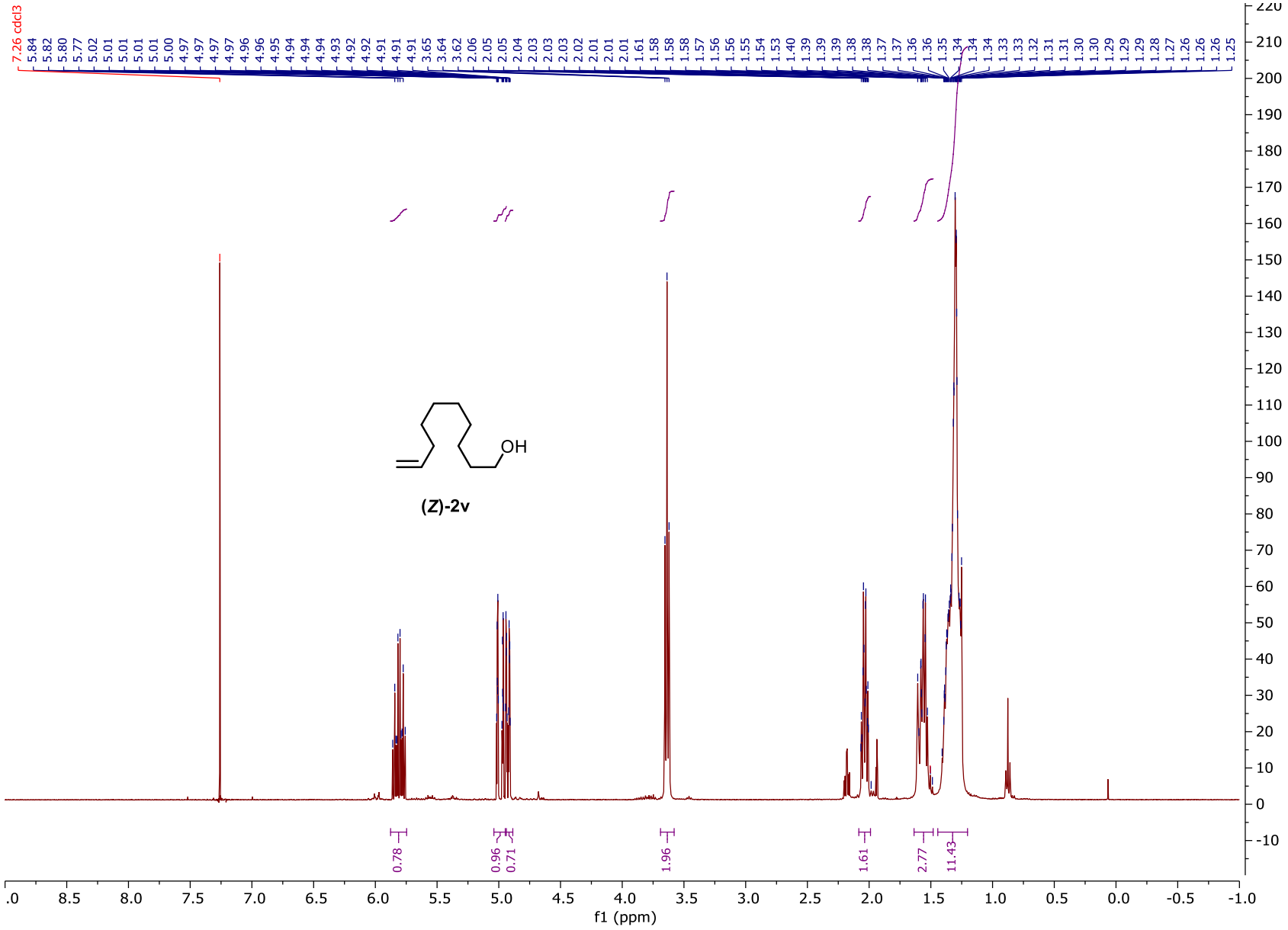
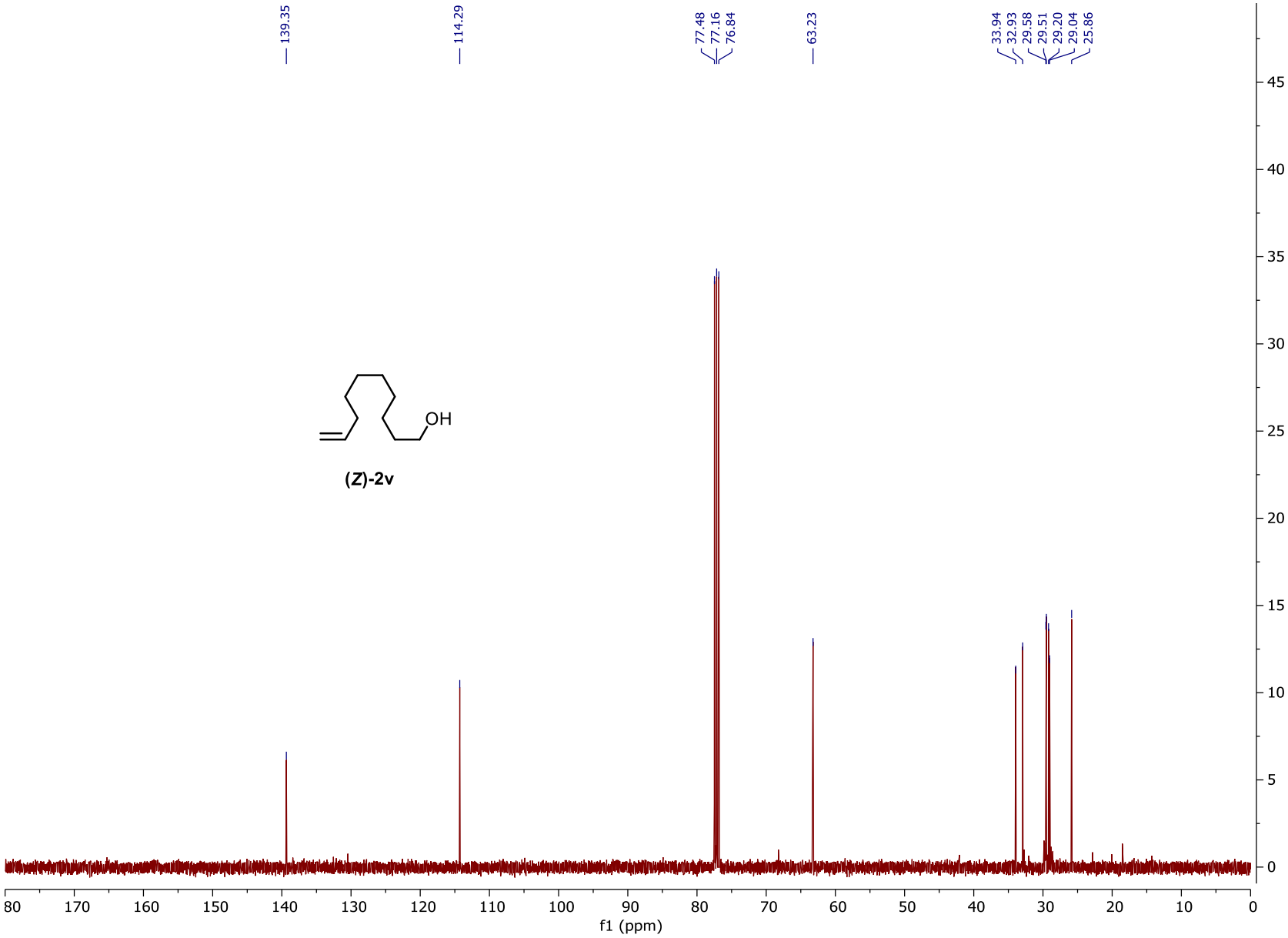
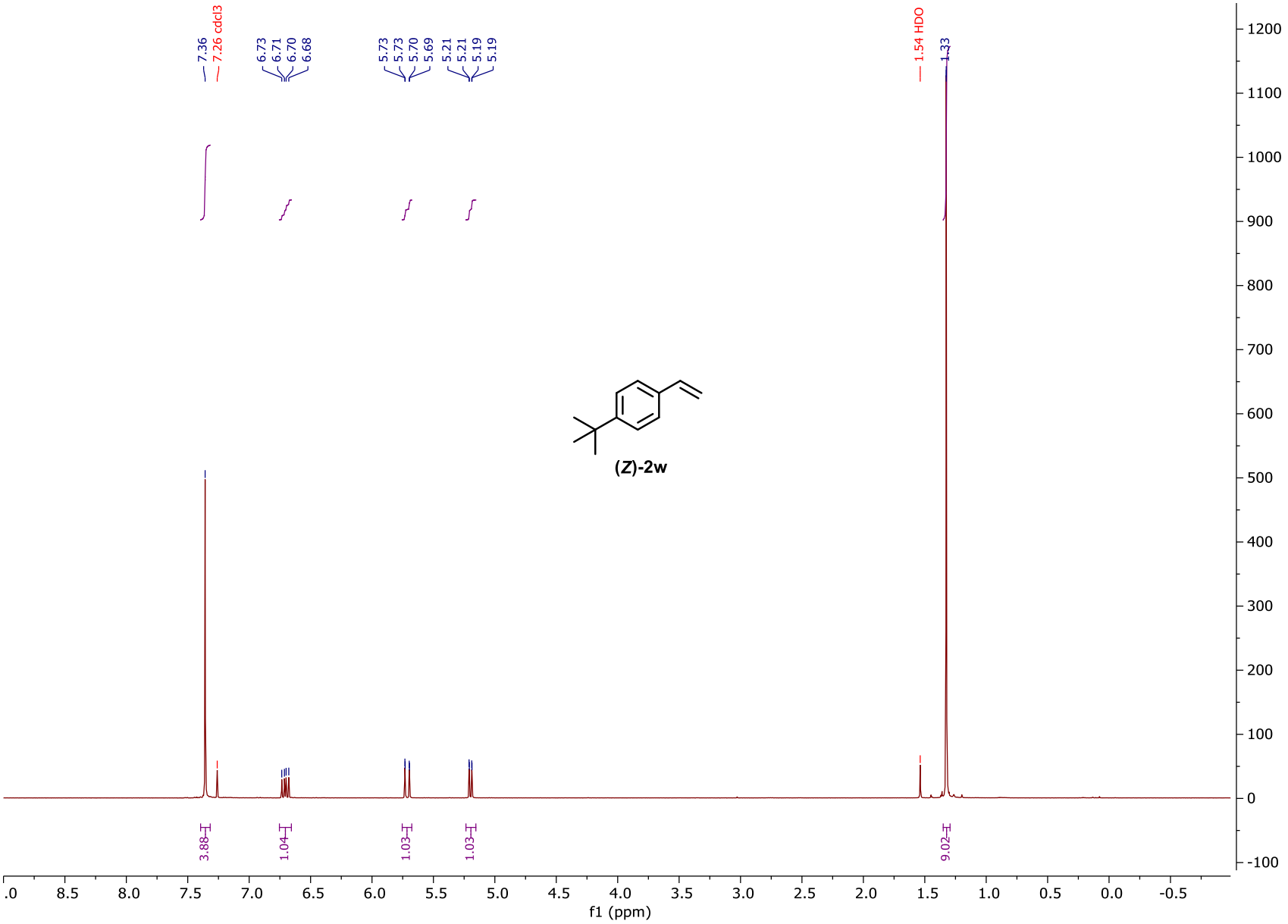
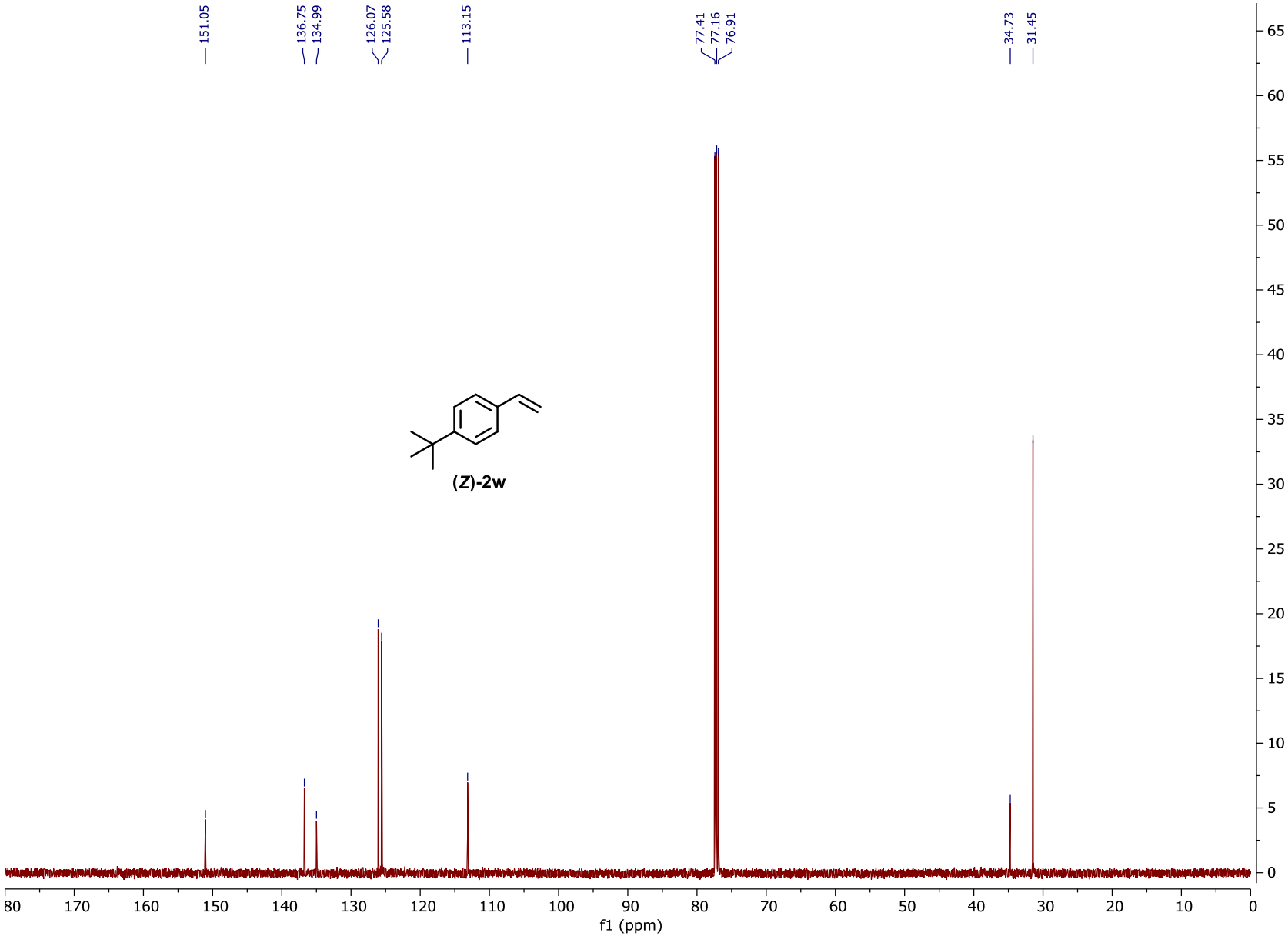
2.04
2.03
2.03
2.03
2.02
2.01
2.01
2.01
1.55 HDO
1.40
1.39
1.37
1.36
1.35
1.32
1.30
1.28
1.28
1.26
1.25
1.21
0.90
0.88
0.86
(Z)-2u
0.83
0.78
0.72
1.71
16.94
2.97
f1 (ppm)

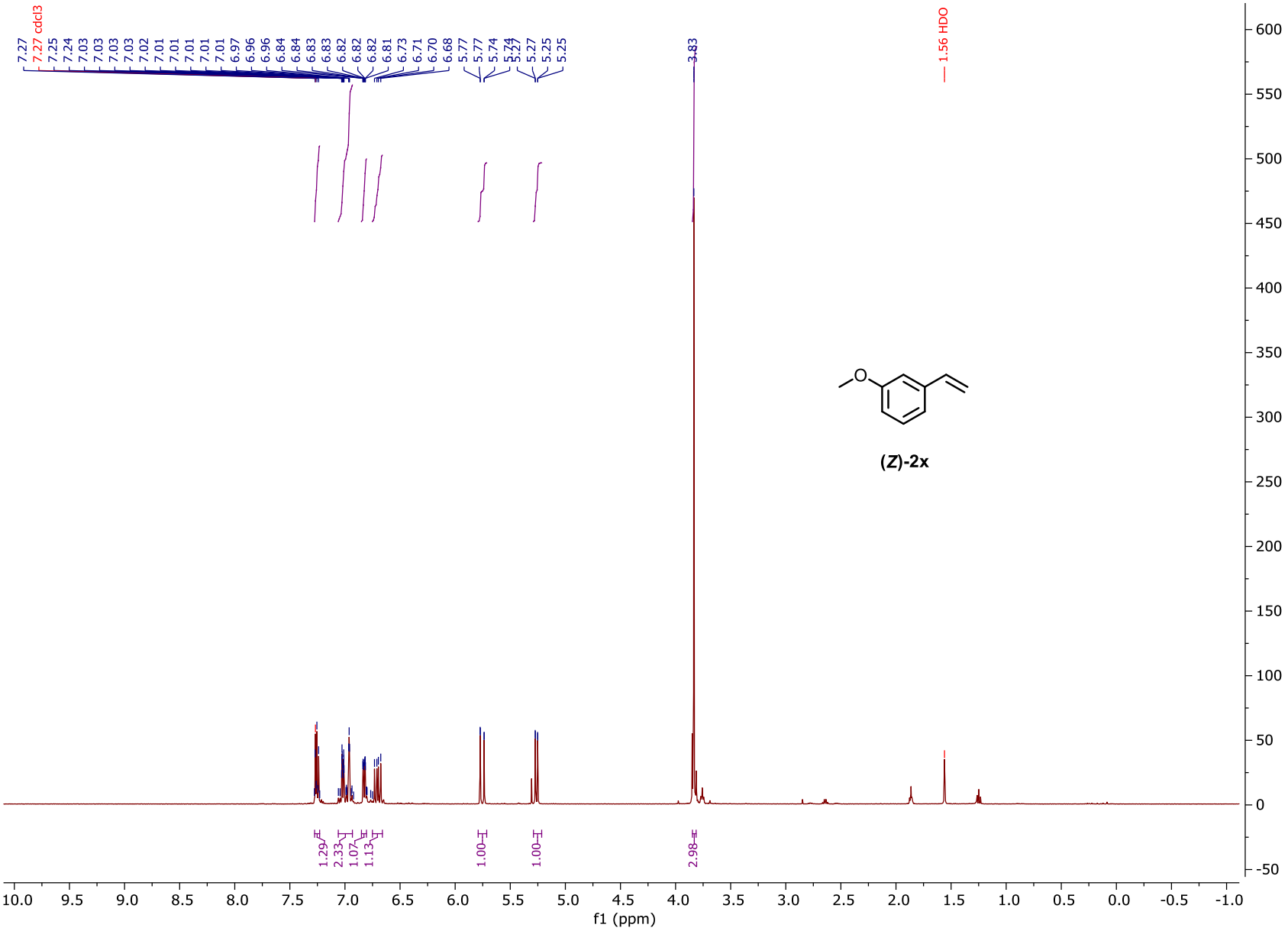

139.45
114.22
77.48
77.16
76.84
33.98
32.07
29.78
29.67
29.50
29.32
29.10
22.85
14.28
(Z)-2u
f1 (ppm)


OH
(Z)-2v
f1 (ppm)

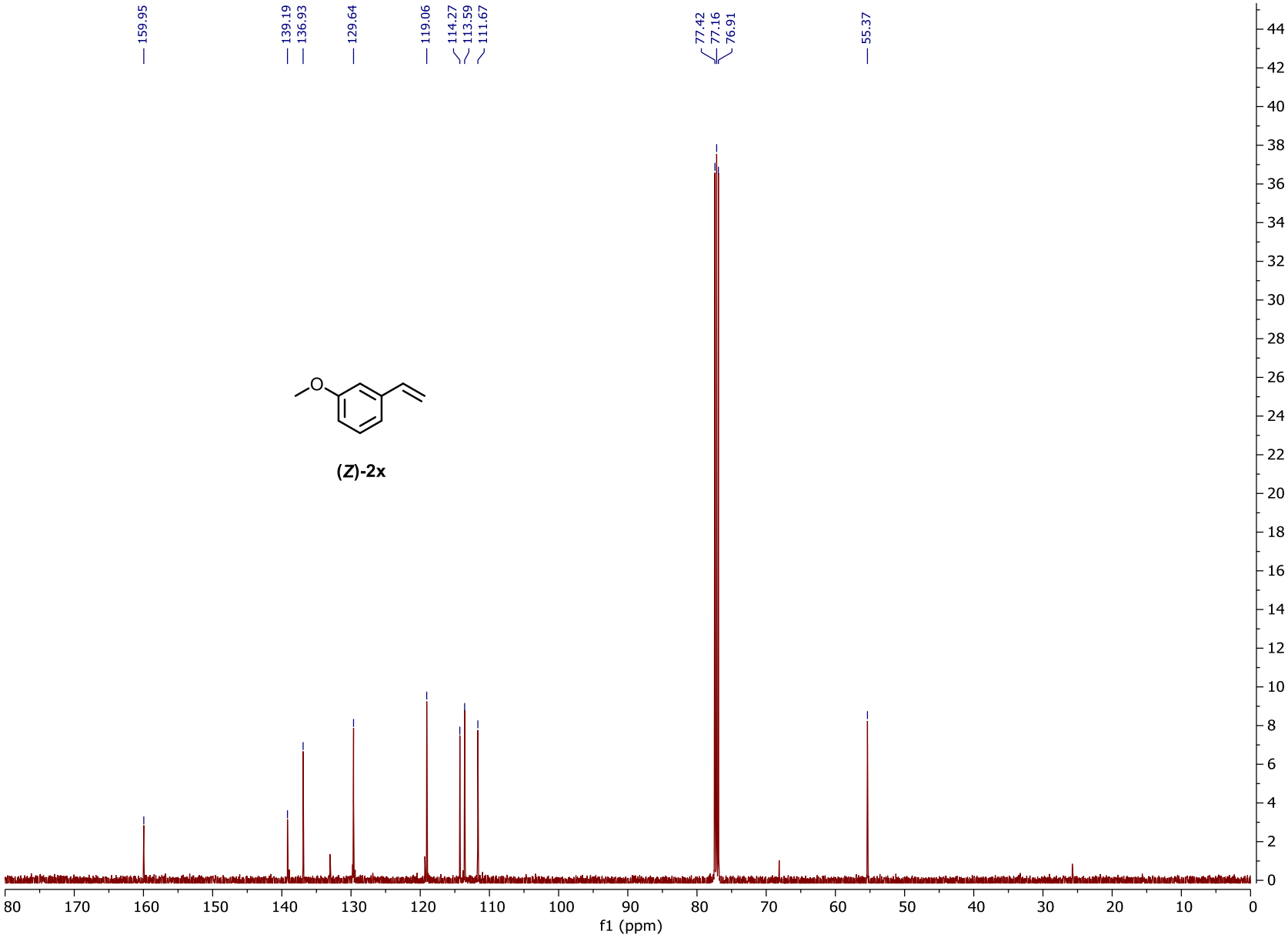

139.35
114.29
77.48
77.16
76.84
63.23
33.94
32.93
29.58
29.51
29.20
29.04
25.86
OH
(Z)-2v
f1 (ppm)

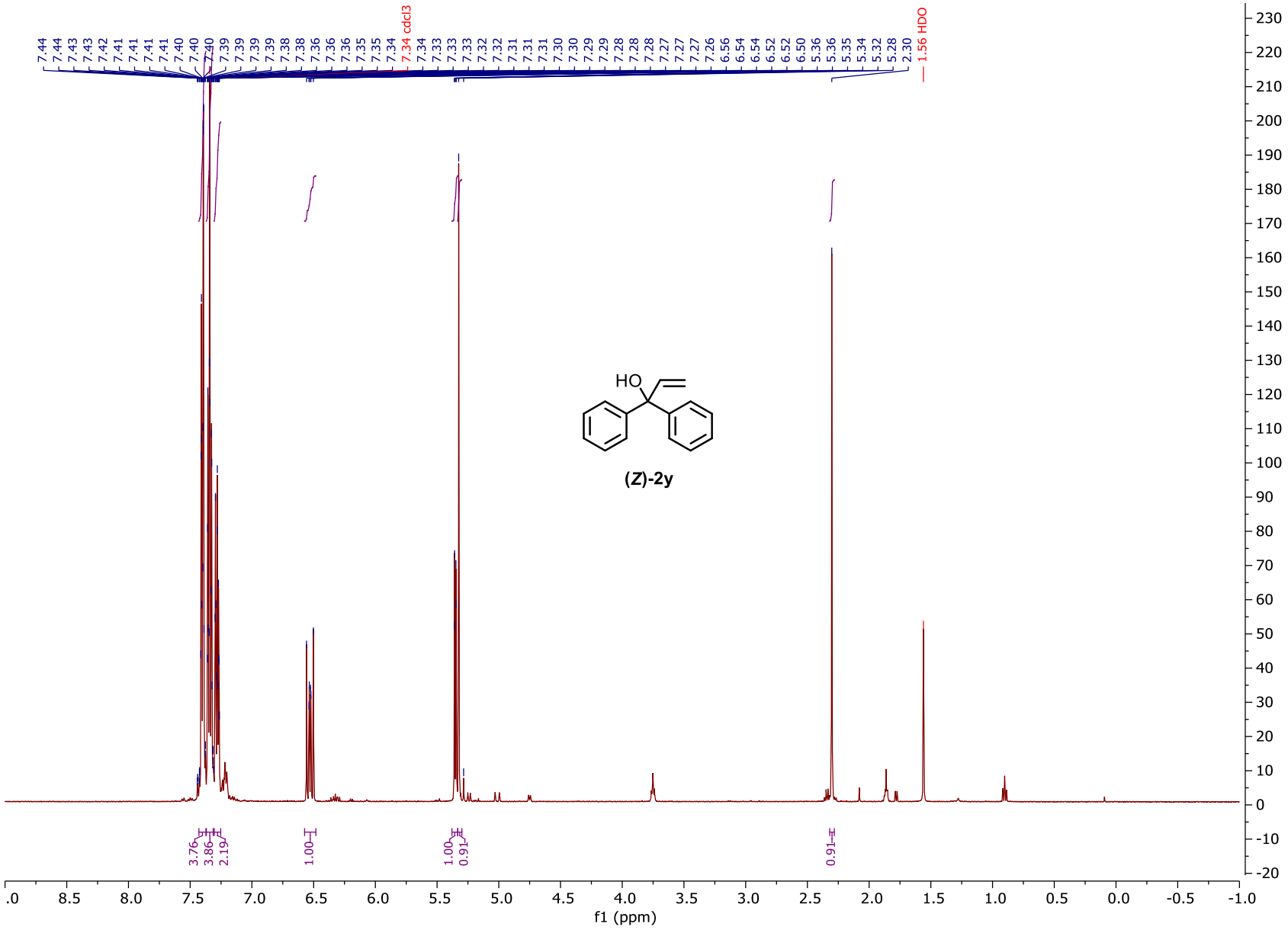

7.36
7.26 cdcl3
6.73
6.71
6.70
6.68
5.73
5.73
5.70
5.69
5.21
5.21
5.19
5.19
1.54 HDO
1.33
(Z)-2w
3.88
1.04
1.03
1.03
9.02
f1 (ppm)

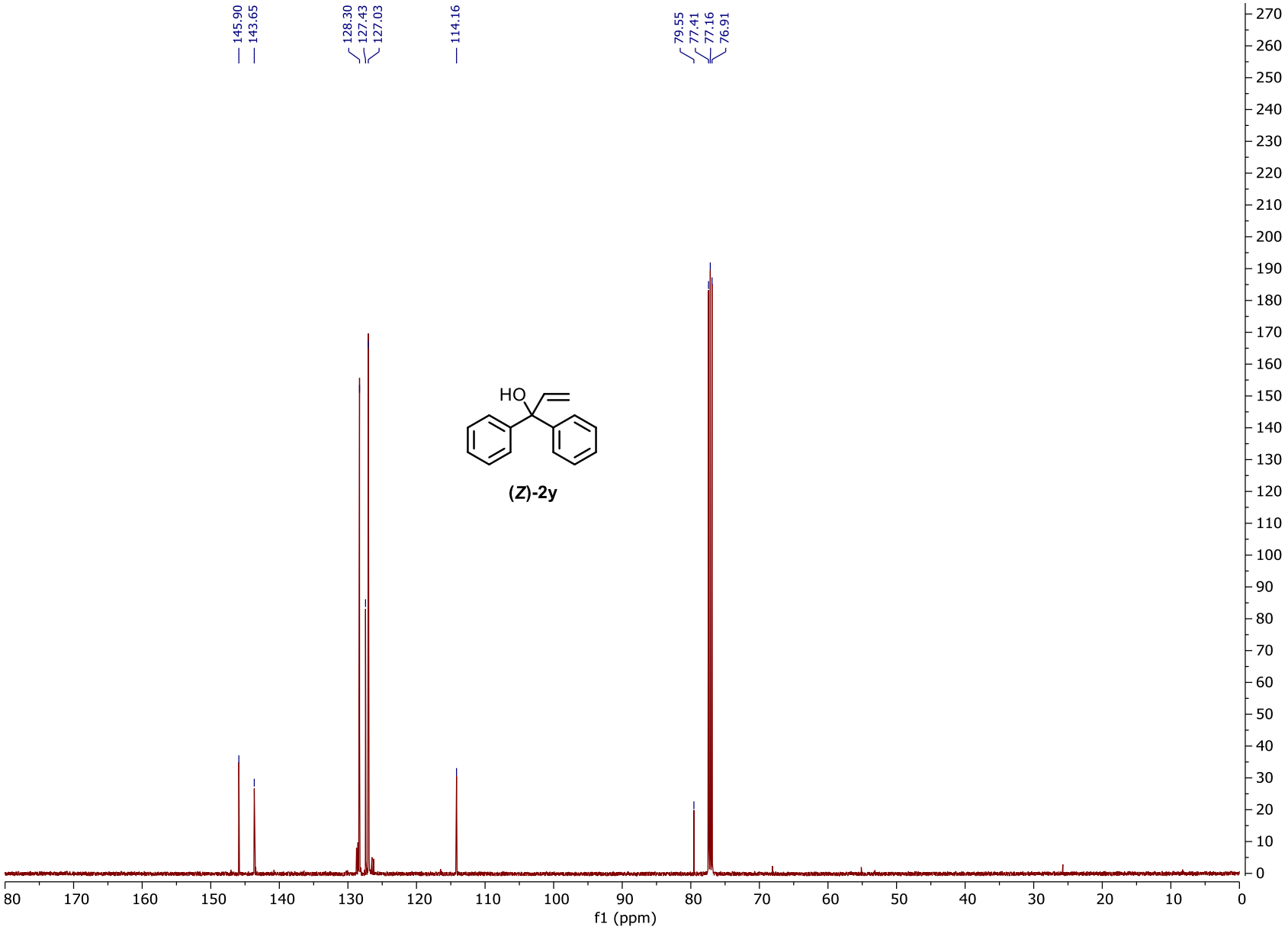

151.05
136.75
134.99
126.07
125.58
113.15
77.41
77.16
76.91
34.73
31.45
(Z)-2w
f1 (ppm)

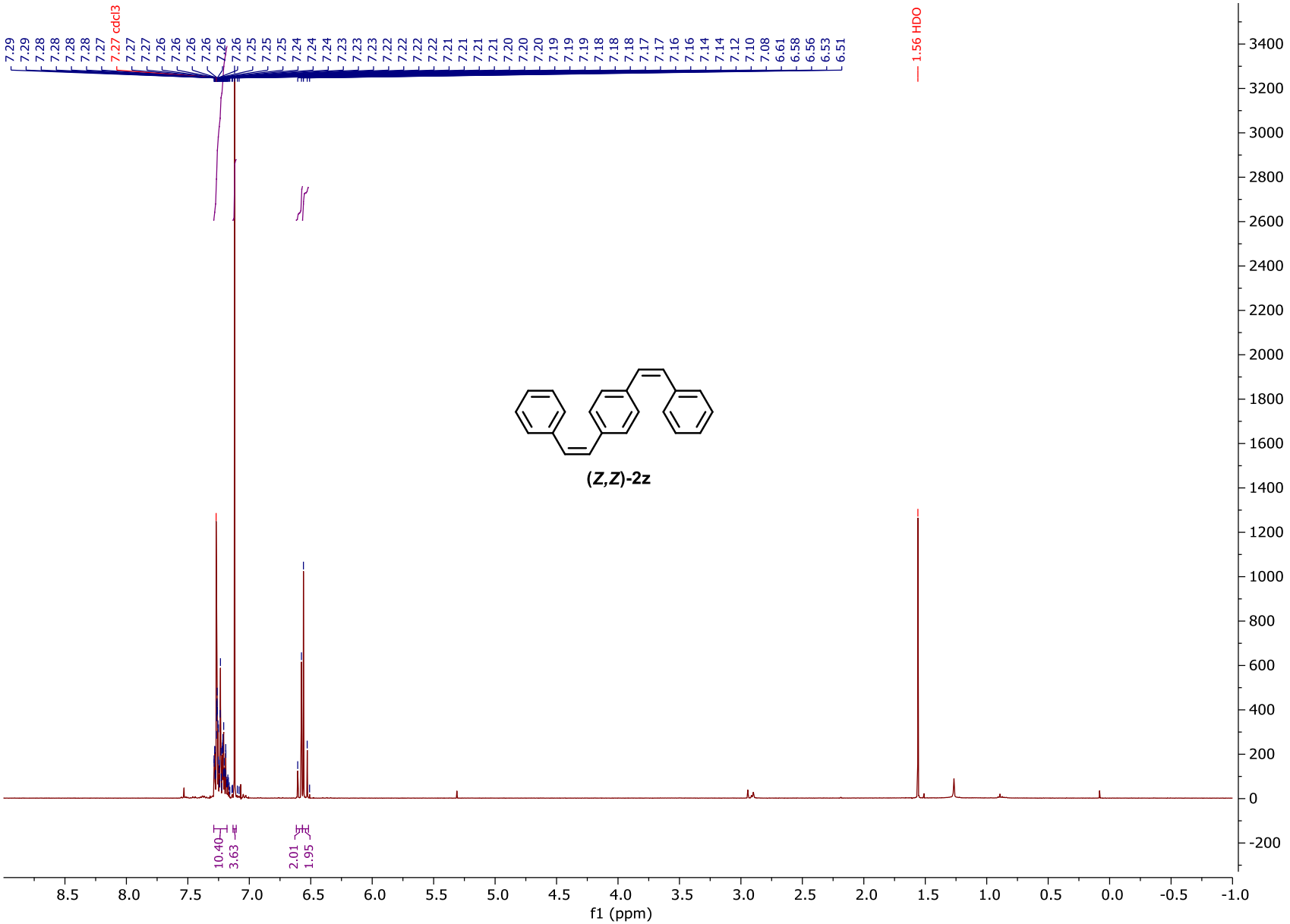

7.27
7.27 cdcl3
7.25
7.24
7.03
7.03
7.03
7.03
7.02
7.01
7.01
7.01
7.01
7.01
6.97
6.96
6.96
6.84
6.84
6.83
6.83
6.82
6.82
6.82
6.81
6.73
6.71
6.70
6.68
5.77
5.77
5.74
5.74
5.27
5.25
5.25
3.83
1.56 HDO
1.29
2.33
1.07
1.13
1.00
1.00
2.98
f1 (ppm)

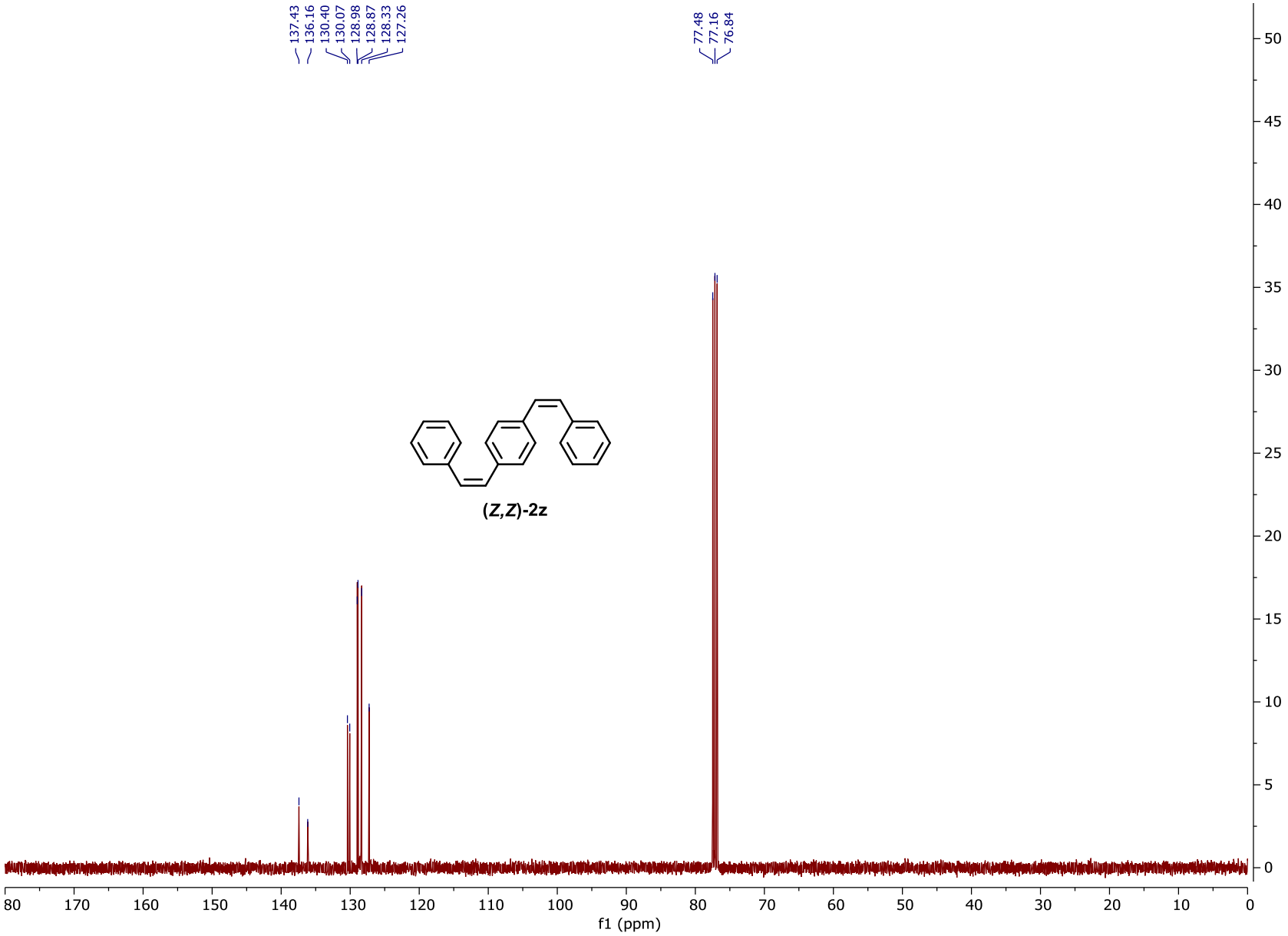
(*Z*)-2x

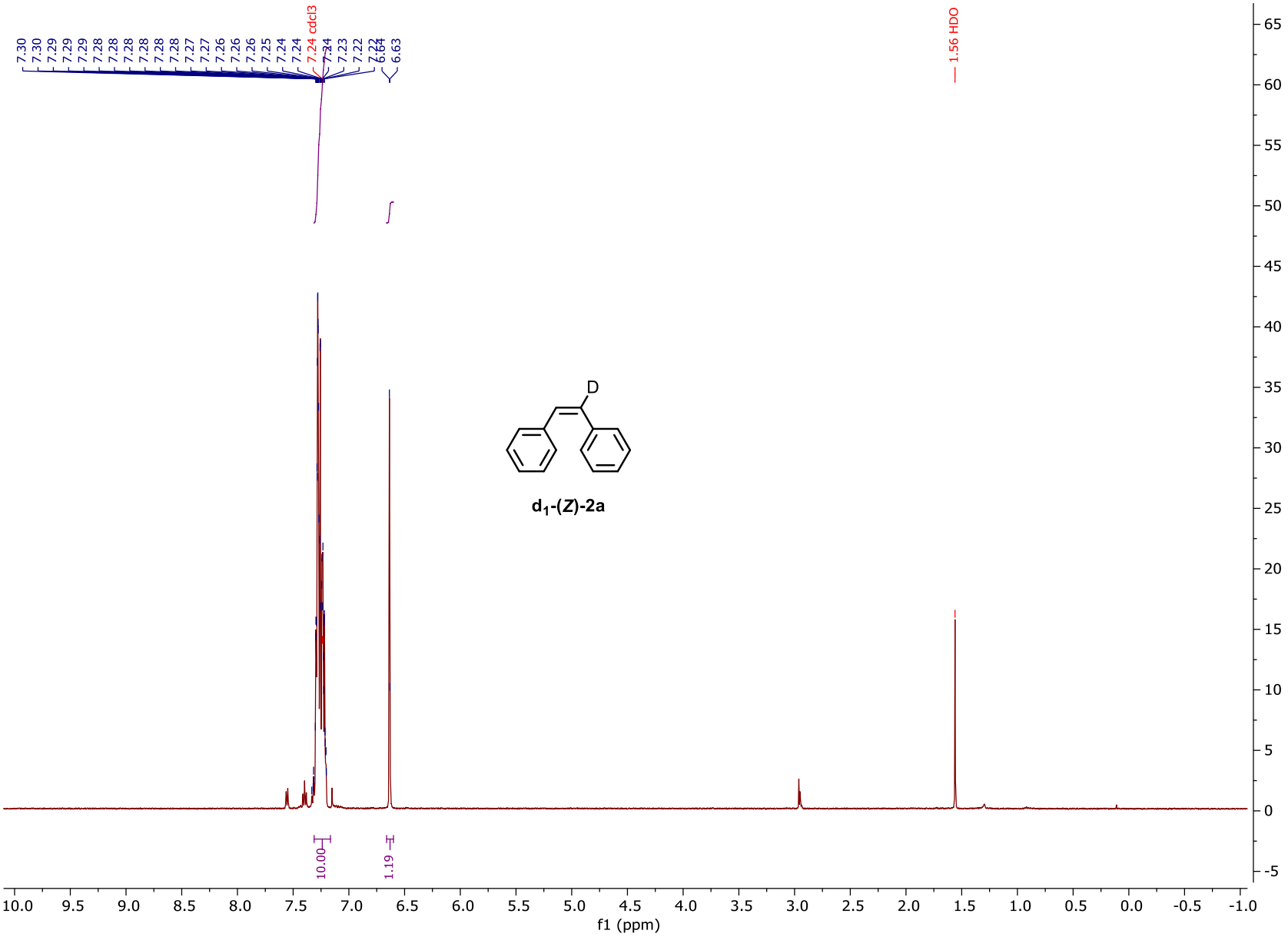

159.95
139.19
136.93
129.64
119.06
114.27
113.59
111.67
77.42
77.16
76.91
55.37
(Z)-2x
f1 (ppm)

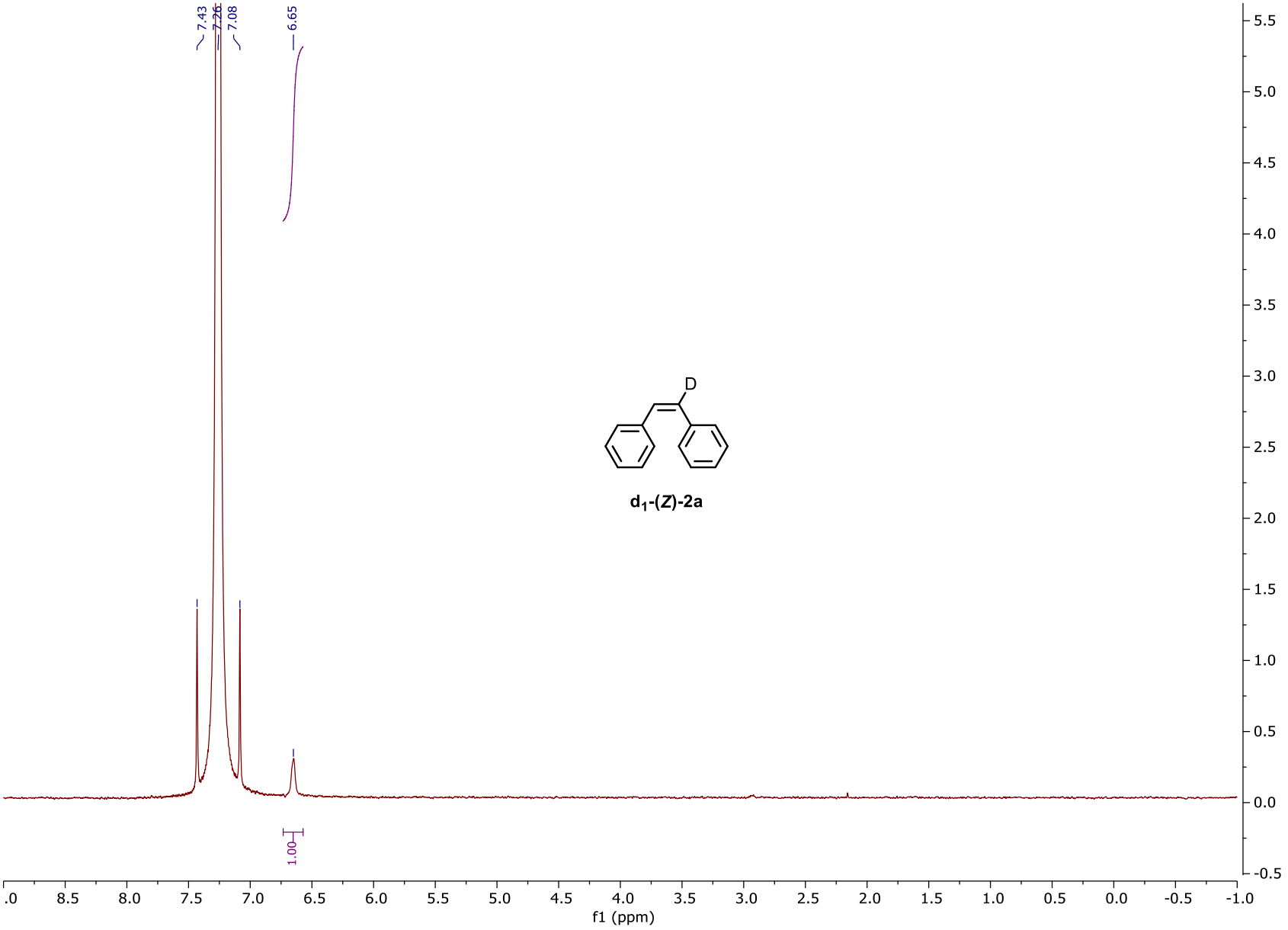

7.34 cdcl3
1.56 HDO
HO
(Z)-2y
3.76
3.86
2.19
1.00
1.00
0.91
0.91
f1 (ppm)

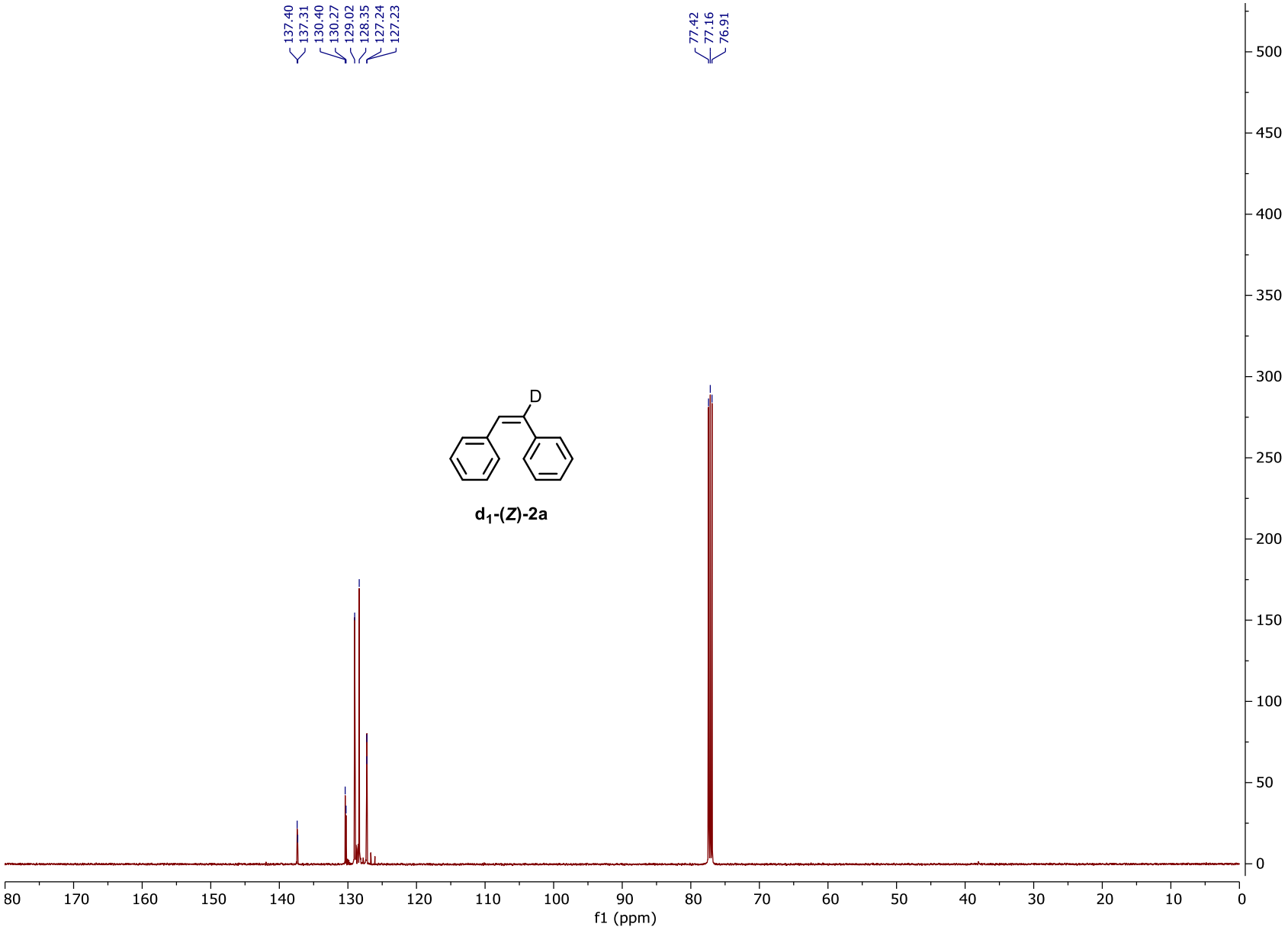

145.90
143.65
128.30
127.43
127.03
114.16
79.55
77.41
77.16
76.91
HO
(Z)-2y
f1 (ppm)

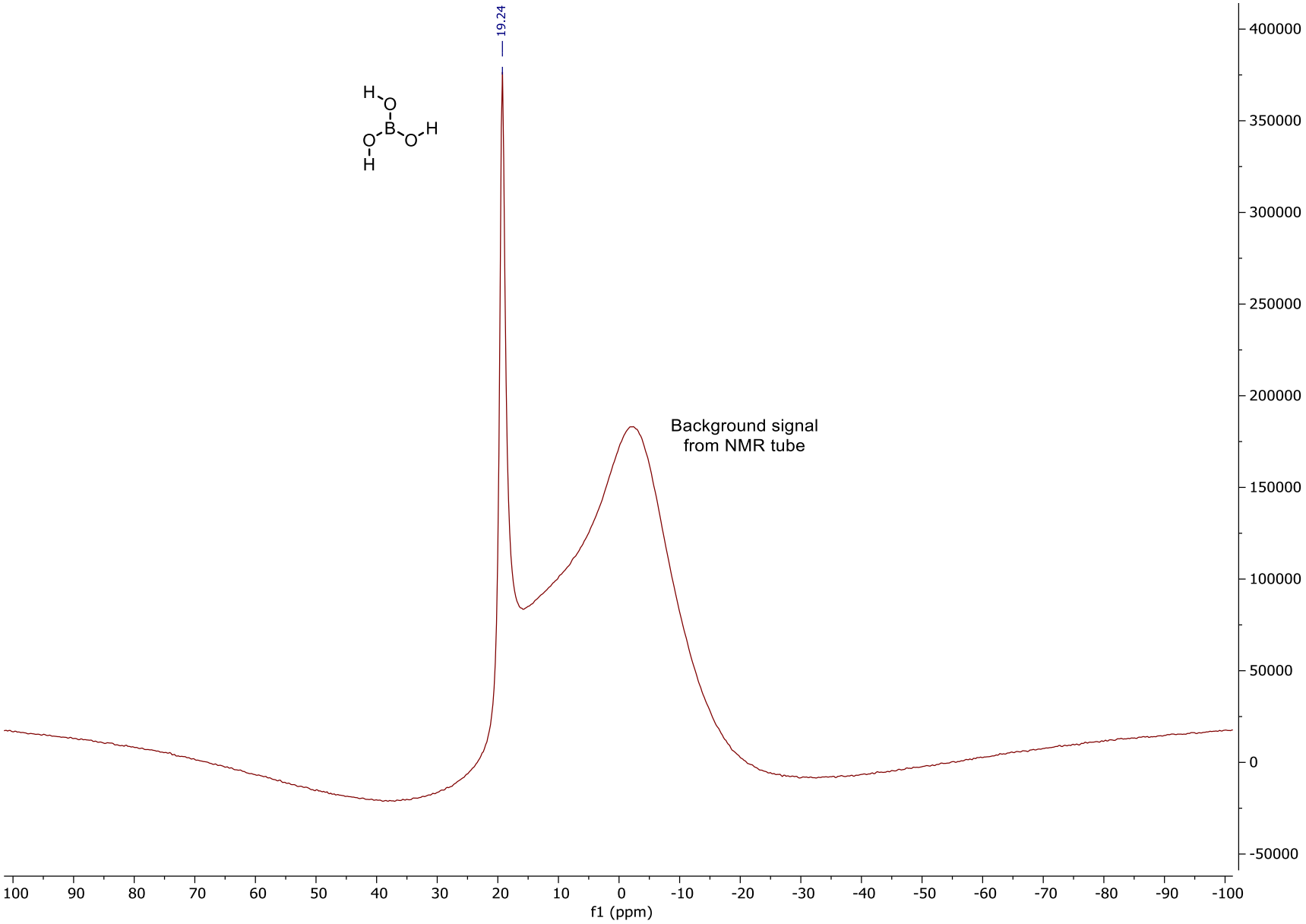

7.29 7.29 7.28 7.28 7.28 7.28 7.27 7.27 cdcl3 7.27 7.26 7.26 7.26 7.26 7.26 7.25 7.25 7.25 7.24 7.24 7.24 7.23 7.23 7.23 7.22 7.22 7.22 7.21 7.21 7.21 7.21 7.20 7.20 7.20 7.19 7.19 7.19 7.18 7.18 7.18 7.17 7.17 7.16 7.16 7.14 7.14 7.12 7.10 7.08 6.61 6.58 6.56 6.53 6.51
1.56 HDO
(Z,Z)-2z
10.40
3.63
2.01
1.95
f1 (ppm)

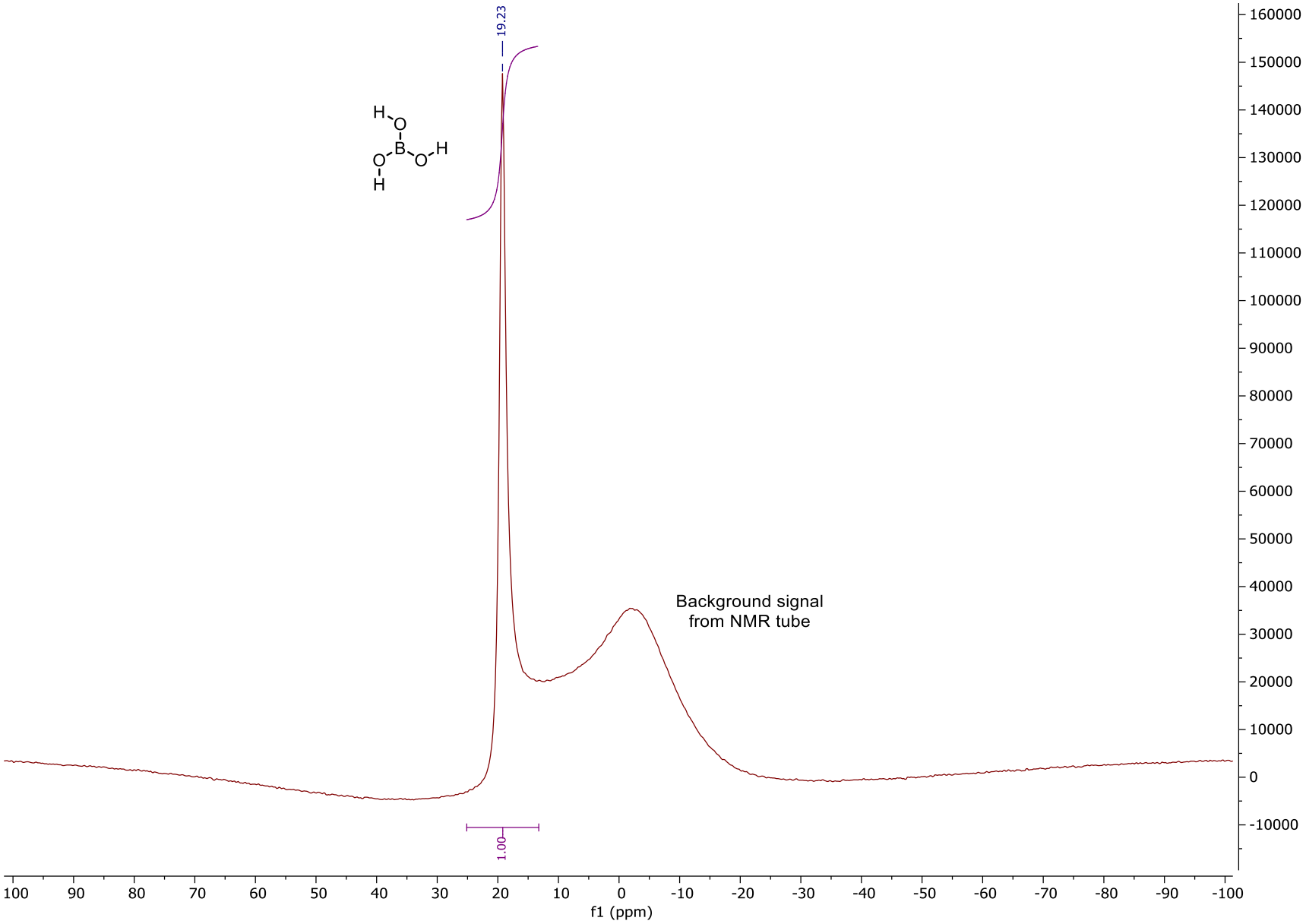

137.43
136.16
130.40
130.07
128.98
128.87
128.33
127.26
77.48
77.16
76.84
(Z,Z)-2z
f1 (ppm)


7.30
7.30
7.29
7.29
7.29
7.28
7.28
7.28
7.28
7.28
7.28
7.27
7.27
7.26
7.26
7.26
7.25
7.24
7.24
7.24 cdcl3
7.24
7.23
7.22
7.22
6.64
6.63
1.56 HDO
D
d1-(Z)-2a
10.00
1.19
f1 (ppm)


7.43
7.26
7.08
6.65
D
d1-(Z)-2a
1.00
f1 (ppm)


137.40
137.31
130.40
130.27
129.02
128.35
127.24
127.23
77.42
77.16
76.91
D
d1-(Z)-2a
f1 (ppm)


19.24
Background signal
from NMR tube
400000
350000
300000
250000
200000
150000
100000
50000
0
-50000
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
f1 (ppm)


19.23
Background signal
from NMR tube
1.00
f1 (ppm)