Supporting Information

Recyclable iodine-catalyzed oxidative C-H chalcogenation of 1,1-diarylethenes in water: Green synthesis of trisubstituted vinyl sulfides and selenides

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1. General reagent information

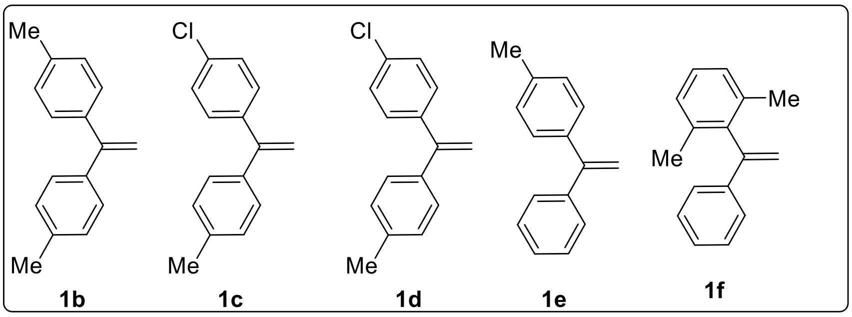
Starting materials such as ethene-1,1-diyldibenzene, α-methylstyrene, and all commercially available diorganyl disulphides, and solvents were purchased from Sigma-Aldrich, TCI, and other local chemical companies and used as such. Flash column chromatography was performed using silica gel (100-200 mesh). The de are commercially available.

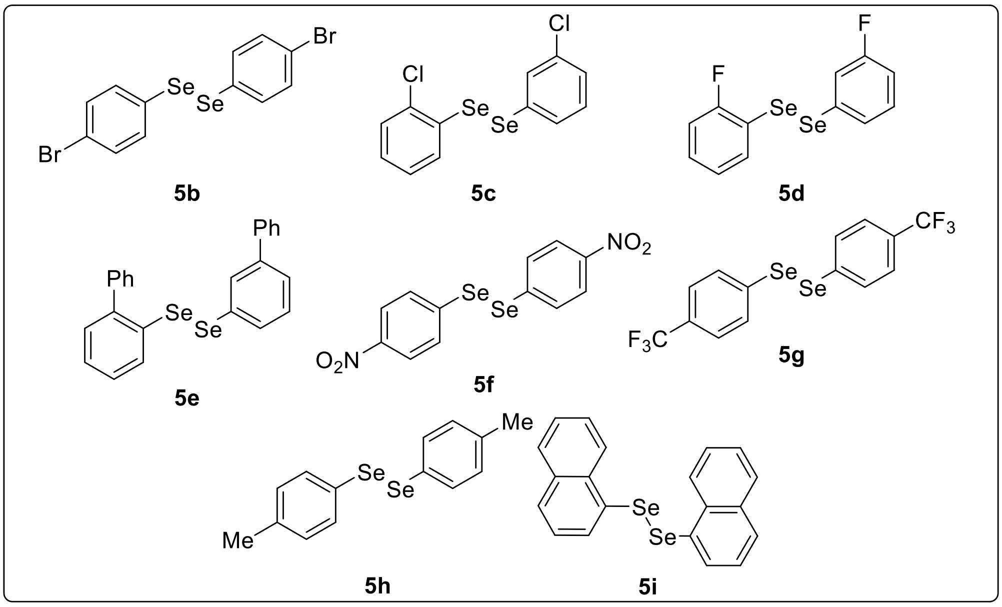
1.1. General analytical information

^{1}H, ^{13}C, ^{77}Se and ^{19}F NMR spectra were recorded on a Bruker 400 MHz instrument (400 MHz for ^{1}H NMR, 100 MHz for ^{13}C NMR, 76 MHz for ^{77}Se NMR and 376 MHz for ^{19}F NMR). Copies of ^{1}H, ^{13}C, ^{77}Se and ^{19}F NMR spectra can be found at the end of the Supporting Information. ^{1}H NMR data are reported in units, parts per million (ppm), and were measured relative to residual chloroform (7.26 ppm) in the deuterated solvent. ^{13}C{1H} NMR spectra are reported in ppm relative to deuterochloroform (77.00 ppm) and all were obtained with ^{1}H decoupling. Coupling constants were reported in Hz. Reactions were monitored by thin layer chromatography (TLC) and ^{1}H NMR of the crude reaction mixture using 1,3,5-trimethoxybenzene as the internal standard. Mass spectral data of unknown compounds were obtained on a high-resolution mass spectrometer, HRMS (6546 Q-TOF LC/MS, Agilent). Melting points of unknown compounds were recorded on a KRUSS Optronic M3000 apparatus. Single Crystal X-ray data were recorded on Rigaku Oxford Diffraction (XtalLab).

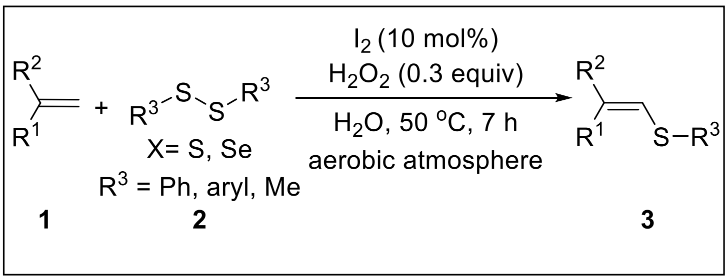
2. Synthesis of 1,1-diarylethenes (1b-1f) and diaryl diselenides (5b-5i).

All starting materials (1b,[3] 1c,[3] 1d,[3] 1e,[3] 5b,[1] 5c,[1] 5d,[1] 5e,[2] 5f,[1] 5g,[1] 5h,[1] 5i[2]) which are shown below were synthesized by following a literature protocol and characterized by ^{1}H and ^{13}C NMR.[1,2,3,5]





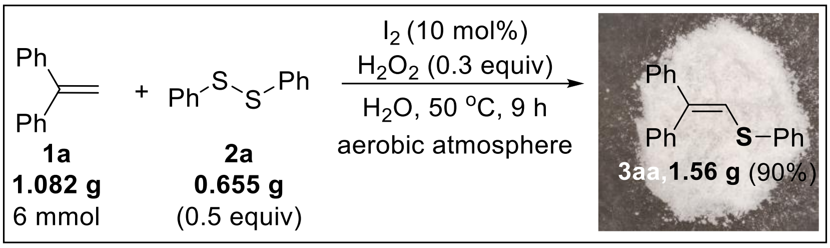
3. General experimental procedure for the synthesis of vinyl sulfanes (3aa-3an, 3bi, 3ci and 3ba−3fa) and vinyl selanes (6aa-6aj and 6ba−6ia).



Representative experimental procedure for the synthesis of (2,2-diphenylvinyl)(phenyl)sulfane (3aa):

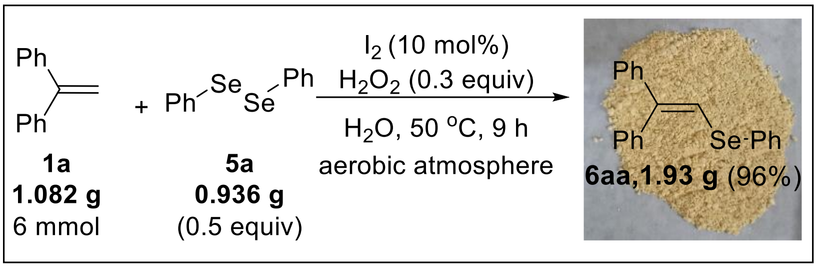
Ethene-1,1-diyldibenzene **1a** (0.088 mL, 0.5 mmol, 1 equiv), I_2 (0.013 g, 0.05 mmol) and 1,2-diphenyldisulfane **2a** (0.055 g, 0.25 mmol, 0.5 equiv) in a round-bottom flask (RBF) and H_2O (0.3 mL). was added to it. Then 30% aqueous H_2O_2 (v/v) (0.015 mL, 0.15 mmol, 0.3 equiv) was added and the reaction mixture was stirred at 50 °C under aerobic atmosphere. The progress of the reaction was monitored by TLC and after 7 h both the starting materials were found to be fully converted to product. To avoid the huge-solvent-consuming column chromatographic technique, we first quenched the iodine by $Na_2S_2O_3$ solution and then the product was separated from the reaction mixture through simple extraction using EtOAc (3 x 10 mL). The solvent was evaporated to dryness which furnished the pure product, (2,2-diphenylvinyl)(phenyl)sulfane **3aa** (0.135 g, 0.47 mmol) in 94% yield. The reactions where staring materials were not fully consumed, column chromatographic purification were conducted to obtain the pure product.

4.1. Gram-scale synthesis of (2,2-diphenylvinyl)(phenyl)sulfane (3aa):



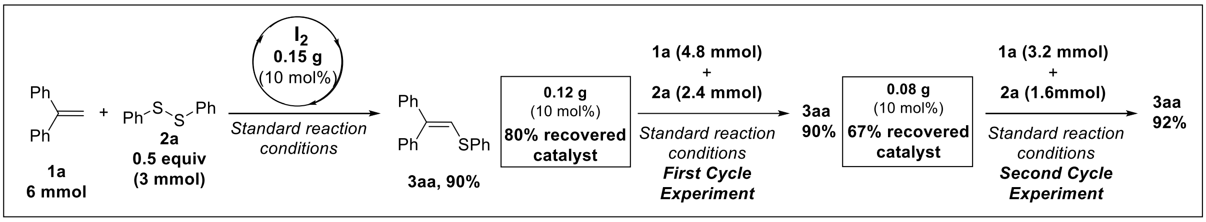
Ethene-1,1-diyldibenzene **1a** (1.06 mL, 6 mmol, 1 equiv), I_2 (0.152 g, 0.6 mmol) and 1,2-diphenyldisulfane **2a** (0.654 g, 3 mmol, 0.5 equiv) were taken in an RBF and H_2O (3.7 mL) was added to it. Then 30% aqueous H_2O_2 (v/v) (0.18 mL, 1.8 mmol, 0.3 equiv) was added and the reaction mixture was stirred at 50 °C under an aerobic atmosphere. The progress of the reaction was monitored by TLC and after 9 h both the starting materials were found to be fully converted to product. To avoid the huge-solvent-consuming column chromatographic technique, we first quenched the iodine by $Na_2S_2O_3$ solution and then the product was separated from the reaction mixture through simple extraction using EtOAc (3 x 25 mL). The solvent was evaporated to dryness which furnished the pure product, (2,2-diphenylvinyl)(phenyl)sulfane **3aa** (1.56 g, 5.4 mmol) in yield 90% and around 72 mL EtOAc was recovered.

4.2. Gram-scale synthesis of (2,2-diphenylvinyl)(phenyl)selane (6aa):



Ethene-1,1-diyldibenzene **1a** (1.06 mL, 6 mmol, 1 equiv), I_2 (0.152 g, 0.6 mmol) and 1,2-diphenyldiselane **2a** (0.94 g, 0.3 mmol, 0.5 equiv) were taken in a RBF and in H_2O (3.7 mL) was added to it. Then 30% aqueous H_2O_2 (v/v) (0.18 mL, 1.8 mmol, 0.3 equiv) was added and the reaction mixture was stirred at 50 °C under aerobic atmosphere. The progress of the reaction was monitored by TLC and after 9 h both the starting materials were found to be fully converted to product. To avoid the huge-solvent-consuming column chromatographic technique, we first quenched the iodine by $Na_2S_2O_3$ solution and then the product was separated from the reaction mixture through simple extraction using EtOAc (3 x 25 mL). The solvent was evaporated to dryness which furnished the pure product, (2,2-diphenylvinyl)(phenyl)selane **6aa** (1.93 g, 5.8 mmol) in 96% yield and around 72 mL EtOAc was recovered.

5. Recovery and recyclability of iodine:[4]

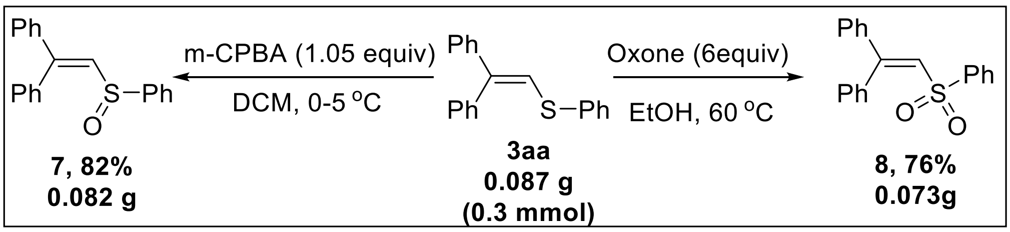


Step-1: Ethene-1,1-diyldibenzene **1a** (1.1 mL, 6 mmol, 1 equiv), I_2 (0.15 g, 0.6 mmol), 1,2-diphenyldisulfane **2a** (0.654 g, 3 mmol, 0.5 equiv) were taken in a RBF and H_2O (3.7 mL) was added to it. Then 30% aqueous H_2O_2 (v/v) (0.18 mL, 1.8 mmol, 0.3 equiv) was added and the reaction mixture was stirred at 50 °C under aerobic atmosphere for 9 h. The solution was then transferred to a separating funnel for extraction. The reaction mixture was extracted with ethyl acetate twice (2 X 20 mL) and the combined organic layer was washed with water (3 X 10 mL). The solvent was evaporated under reduced pressure and iodine (0.12 g, 80%) was recovered first from the crude reaction mixture by column chromatography using pentane as eluent. The column chromatography process was further continued to obtain the pure product, (2,2-diphenylvinyl)(phenyl)sulfane **3aa** (1.56 g, 5.4 mmol) in 90% yield.

Step-2: Recovered I_2 (0.12 g, 0.48 mmol), ethene-1,1-diyldibenzene **1a** (0.85 mL, 4.8 mmol, 1 equiv), and 1,2-diphenyldisulfane **2a** (0.523 g, 2.4 mmol, 0.5 equiv) were taken in a RBF and H_2O (2.93 mL) was added to it. Then 30% aqueous H_2O_2 (v/v) (0.14 mL, 1.44 mmol, 0.3 equiv) was added and the reaction mixture was stirred at 50 °C under an aerobic atmosphere for 9 h. The solution was then transferred to a separating funnel for extraction. The reaction mixture was extracted with ethyl acetate twice (2 X 20 mL) and the combined organic layer was washed with water (3 X 10 mL). The solvent was evaporated under reduced pressure and iodine (0.08 g, 67%) was recovered from the crude reaction mixture first by column chromatography using pentane as eluent. The column chromatography process was further continued to afford the pure product, (2,2-diphenylvinyl)(phenyl)sulfane **3aa** (1.24g, 4.3 mmol) in 90% yield.

Step-3: To a solution of ethene-1,1-diyldibenzene **1a** (0.564 mL, 3.2 mmol, 1 equiv), I_2 (0.08 g, 0.32 mmol) and 1,2-diphenyldisulfane **2a** (0.35 g, 1.6 mmol, 0.5 equiv) in H_2O (1.95 mL) was added in a flame-dried RBF. Then 30% aqueous H_2O_2 (v/v) (0.096 mL, 0.96 mmol, 0.3 equiv) was added and the reaction mixture was stirred at 50 °C under an aerobic atmosphere for 9 h. The solution was then transferred to a separating funnel for extraction. The reaction mixture was extracted with ethyl acetate twice (2 X 20 mL) and the combined organic layer was washed with water (3 X 10 mL). The crude reaction mixture was purified by column chromatography to afford pure (2,2-diphenylvinyl)(phenyl)sulfane **3aa** (0.85 g, 2.95 mmol) in 92% yield.

6. Experimental procedure for the synthesis of 2-(phenylsulfinyl)ethene-1,1-diyl)dibenzene 7 and (2-(phenylsulfonyl)ethene-1,1-diyl)dibenzene 8.[6]



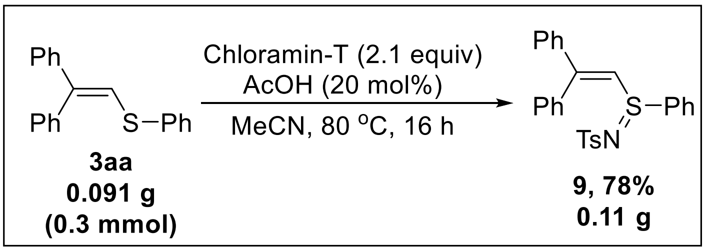
6.1. Experimental procedure for the synthesis of 2-(phenylsulfinyl)ethene-1,1-diyl)dibenzene 7:

3-Chloroperoxybenzoic acid, *m*-CPBA (purity: 65-70%) (0.140 g, 0.32 mmol) was added to the solution of (2,2-diphenylvinyl)(phenyl)sulfane **3aa** (0.087 g, 0.3 mmol, 1 equiv) dissolved in dichloromethane, DCM (2.5 mL) at 0 °C. Then, the reaction mixture was stirred vigorously for 2 h at room temperature. The progress of the reaction was monitored by TLC and after the completion of the reaction the solvent was evaporated under reduced pressure. The crude reaction mixture was extracted with DCM thrice (3 x 10 mL). The combined organic layer was washed with water (3 x 10 mL) and evaporated under reduced pressure. The crude product was purified by flash column chromatography through silica gel to afford the (2-(phenylsulfinyl)ethene-1,1-diyl)dibenzene **7** in (0.082 g, 0.25 mmol) in 82% yield.

6.2. Experimental procedure for the synthesis of (2-(phenylsulfonyl)ethene-1,1-diyl)dibenzene 8:

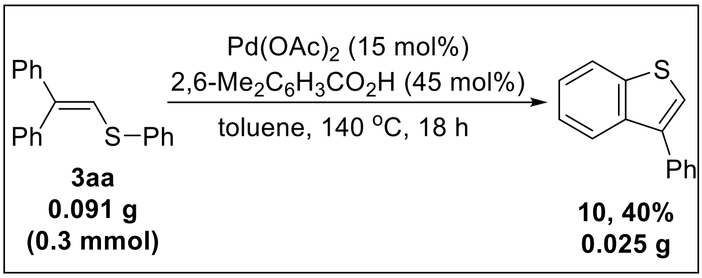
Oxone (1.11 g, 1.8 mmol) was added to the solution of (2,2-diphenylvinyl)(phenyl)sulfane **3aa** (0.091 g, 0.3 mmol, 1 equiv) in ethanol (1.5 mL). The reaction mixture was stirred at 60 °C. The progress of the reaction was monitored by TLC until completion. After the completion of the reaction, the solvent was evaporated under reduced pressure. The crude reaction mixture was extracted with ethyl acetate thrice (3 x 10 mL). The combined organic layer was washed with water (3 x 10 mL) and evaporated under reduced pressure. The crude product was purified by flash column chromatography through silica gel to afford (2-(phenylsulfonyl)ethene-1,1-diyl)dibenzene **8** in (0.073 g, 0.23 mmol) 76% yield.

7. Experimental procedure for the synthesis of *N*-((2,2-diphenylvinyl)(phenyl)-λ_4-sulfanylidene)-4-methylbenzenesulfonamide (9):



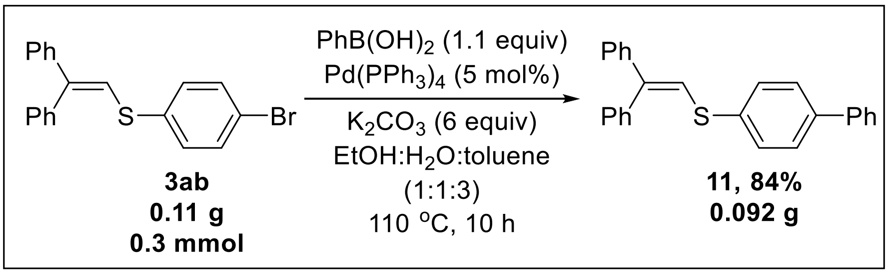
To a solution of (2,2-Diphenylvinyl)(phenyl)sulfane **3aa** (0.091 g, 0.3 mmol) in MeCN (0.1 M) was added Chloramin-T trihydrate (0.18 g , 0.63 mmol) and glacial acetic acid (3 µL, 0.06 mmol). The reaction mixture was then refluxed at 80 °C for 16 h. The mixture was allowed to cool to room temperature. The solvent was removed under reduced pressure. The crude reaction mixture was extracted with ethyl acetate thrice (3 x 30 mL). The combined organic layer was washed with brine solution (30 mL) and concentrated under reduced pressure. The crude product was purified by flash column chromatography through silica gel to afford *N*-((2,2-diphenylvinyl)(phenyl)-*λ₄*-sulfanylidene)-4-methylbenzenesulfonamide **9** (0.11 g, 0.24 mmol) in 78% yield**.**

Experimental procedure for the synthesis of 3-phenylbenzo[*b*]thiophene [7]



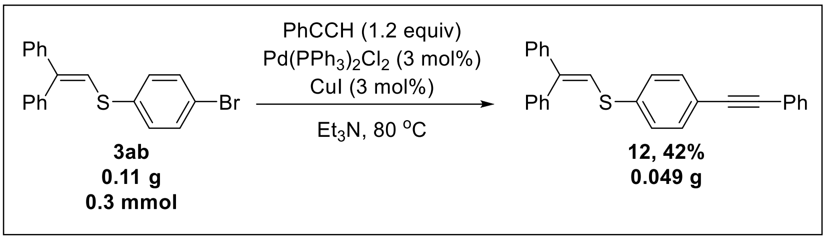
(2,2-diphenylvinyl)(phenyl)sulfane **3aa** (0.091 g, 0.3 mmol), diacetoxypalladium (0.010 g, 0.045 mmol, 1 equiv) , 2,6-dimethylbenzoic acid (0.021 g, 0.135 mmol) in toluene (1.5 M) were taken in a 10 mL RBF. The reaction mixture was refluxed at 140 °C for 16 h. The mixture was cooled to room temperature and extracted with ethyl acetate (30x3 mL) three times. The combined organic layer was further washed with brine (30 mL) and subsequently dried over anhydrous Na_2SO_4. Finally, the solvent was evaporated under reduced pressure to get the crude product which was purified by flash column chromatography on silica gel to afford 3-phenylbenzo[*b*]thiophene **10** (0.025 g, 0.12 mmol) in 40% yield.

Experimental procedure for the synthesis of [1,1'-biphenyl]-4-yl(2,2-diphenylvinyl)sulfane (11):



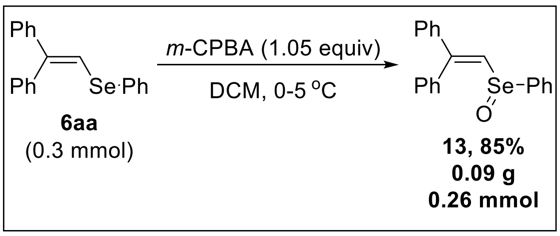
4(4-Bromophenyl)(2,2-diphenylvinyl)sulfane **3ab** (0.11 g, 0.3 mmol, 1 equiv), phenyl boronic acid (0.040 g, 0.33 mmol), $Pd(PPh_3)_4$ (0.017 g, 0.015 mmol), K_2CO_3 (0.124 g, 0.9 mmol) and solvent (1 mL, EtOH : H_2O : PhMe = 1:1:3) were taken in a 25 mL RBF. The reaction mixture was refluxed at 110 °C and the progress of the reaction was monitored by thin layer chromatography. The mixture was cooled to room temperature and extracted with ethyl acetate (30x3 mL) three times. The combined organic layer was further washed with brine (30 mL) and subsequently dried over anhydrous Na_2SO_4. Finally the solvent was evaporated under reduced pressure to get the crude product which was purified by flash column chromatography on silica gel to afford [1,1'-biphenyl]-4-yl(2,2-diphenylvinyl)sulfane **11** (0.092 g, 0.25 mmol) in 84% yield**.**

Experimental Procedure for The Synthesis of (2,2-diphenylvinyl)(4-(phenylethynyl)phenyl)sulfane (12):



To a solution of 4(4-Bromophenyl)(2,2-diphenylvinyl)sulfane **3ab** (0.11 g, 0.3 mmol, 1 equiv) in Et_3N (3 mL) were added $PdCl_2(PPh_3)_2$ (0.006 g , 0.009 mmol) and CuI (0.0017 g, 0.009 mmol) under nitrogen atmosphere in a standard Schlenk-line process. The reaction mixture was stirred for 5 min under an inert atmosphere. Then, 2-phenyl acetylene (40 µL, 0.36 mmol, 1.2 equiv) was added to the reaction mixture. The resulting mixture was then heated under an inert atmosphere at 80 °C for 18 h. The mixture was allowed to cool to room temperature. The solvent was evaporated under reduced pressure. The crude reaction mixture was extracted with ethyl acetate thrice (3 x 30 mL). The combined organic layer was washed with brine solution (30 mL) and concentrated under reduced pressure. The crude product was purified by flash column chromatography through silica gel to afford the product (2,2-diphenylvinyl)(4-(phenylethynyl)phenyl)sulfane **12** (0.049 g, 0.13 mmol) in 42% yield**.**

Experimental procedure for the synthesis of (2-(phenylseleninyl)ethene-1,1-diyl)dibenzene (13)



3-Chloroperoxybenzoic acid, *m*-CPBA (purity: 65-70%) (0.140 g, 0.32 mmol) was added to a solution of (2,2-diphenylvinyl)(phenyl)selane **6aa** (0.168 g, 0.3 mmol) dissolved in dichloromethane (2.5 mL) at 0 ºC. The reaction mixture was cooled at 0 ºC. Then, the reaction mixture was stirred vigorously for 2 h. After the completion of the reaction the solvent was evaporated under reduced pressure. The crude reaction mixture was extracted with dichloromethane thrice (3 x 10 mL). The combined organic layer was washed with water (3 x 10 mL) and evaporated under reduced pressure. The crude product was purified by flash column chromatography through silica gel to afford the (2-(phenylseleninyl)ethene-1,1-diyl)dibenzene **13** in (0.09 g, 0.26 mmol) in 85% yield.

8. X-ray crystal structure of 3bi.

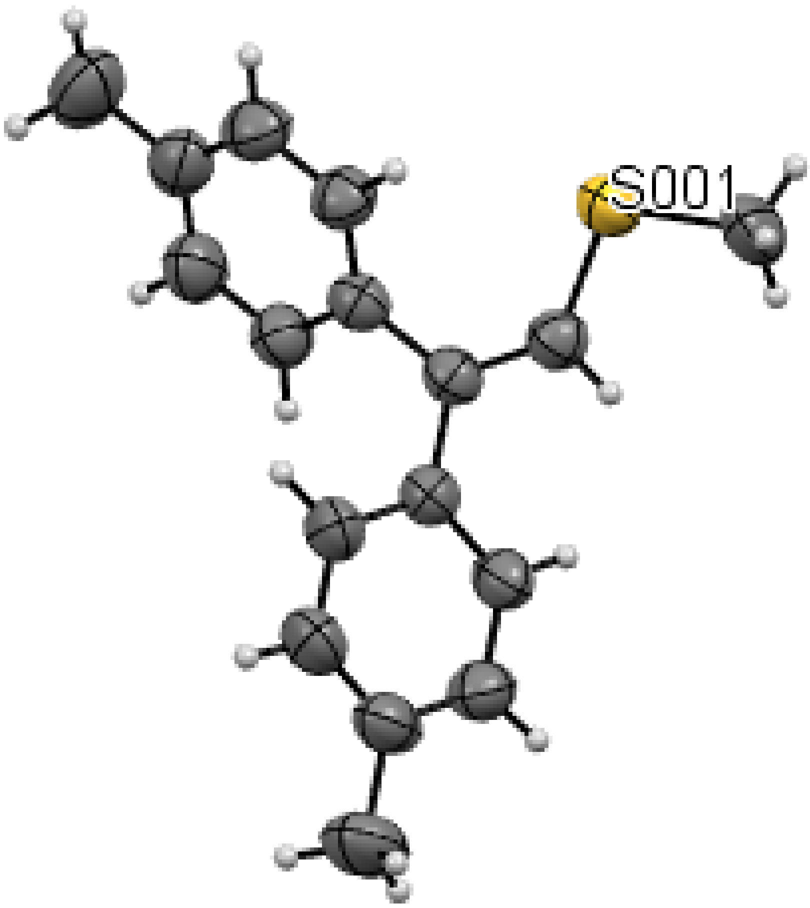


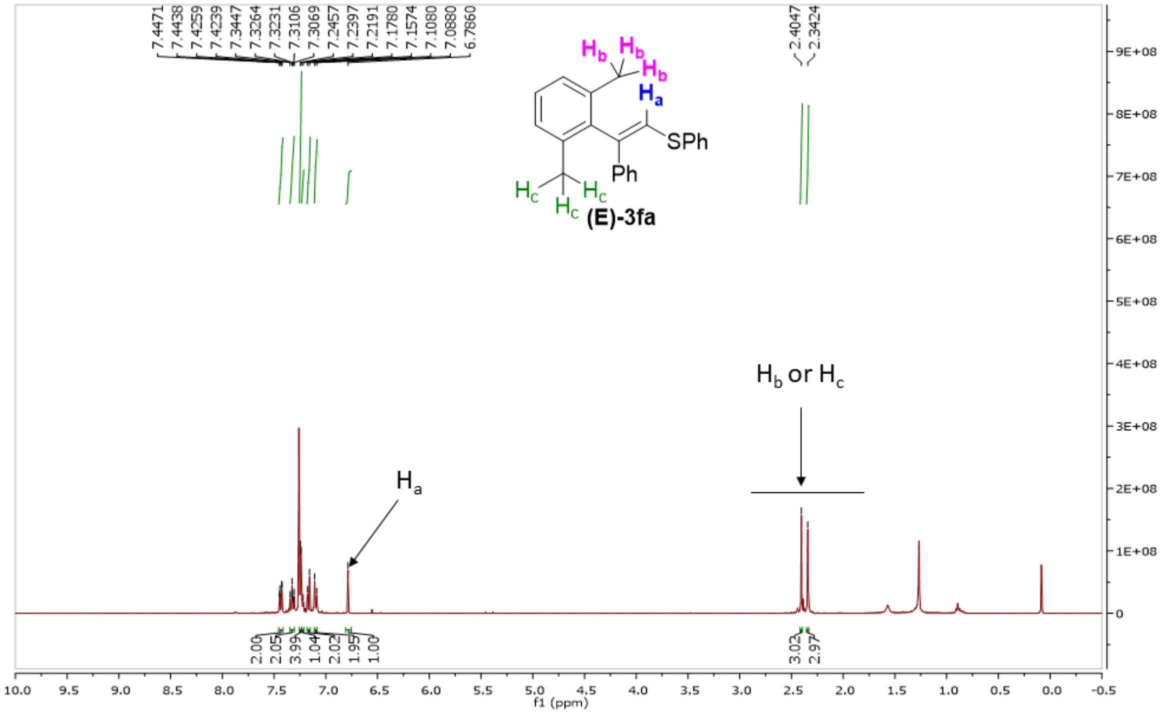
Figure S1. X-ray crystal structure of **3bi** (thermal ellipsoids shown at 50% probability) including hetero-atom numbering.

8.1. Table-*S1*. Selected crystal data of 3bi

Parameters	***3bi***
Empirical formula	$C_{17}H_{18}S$
Formula weight	*254.37*
Temperature/K	*295*
Crystal system	*orthorhombic*
Space group	*P 21 21 21*
a/Å	*9.4617(5)*
b/Å	*11.8672(7)*
c/Å	*13.2190(8)*
α (°)	*90*
β (°)	*90*
γ(°)	*90*
Volume/Å³	*1484.28(15)*
Z	*4*
μ/mm^{-1}	*1.754*
D_x [g cm^{-3}]	*1.138*
F(000)	*544*
2Θ range for data collection (°)	*5.008-79.763*
Index ranges	$-11 \leq h \leq 12$, - $-10 \leq k \leq 14$, - $-16 \leq l \leq 15$
Reflections measured	*2648*
Unique reflections	*5041*
Parameters /restraints	*209/0*
Goodness-of-fit on F2	*1.084*
R_1 [$I \geq 2\sigma(I)$]	*0.0419*
wR_2 (all data)	*0.1226*
Largest diff. peak/hole/e Å⁻³	*0.204/-0.264*
CCDC	***2261525***

9. Determination of stereochemistry of (2,2-diphenylvinyl)(phenyl)sulfane, 3fa.

(A)



(B)

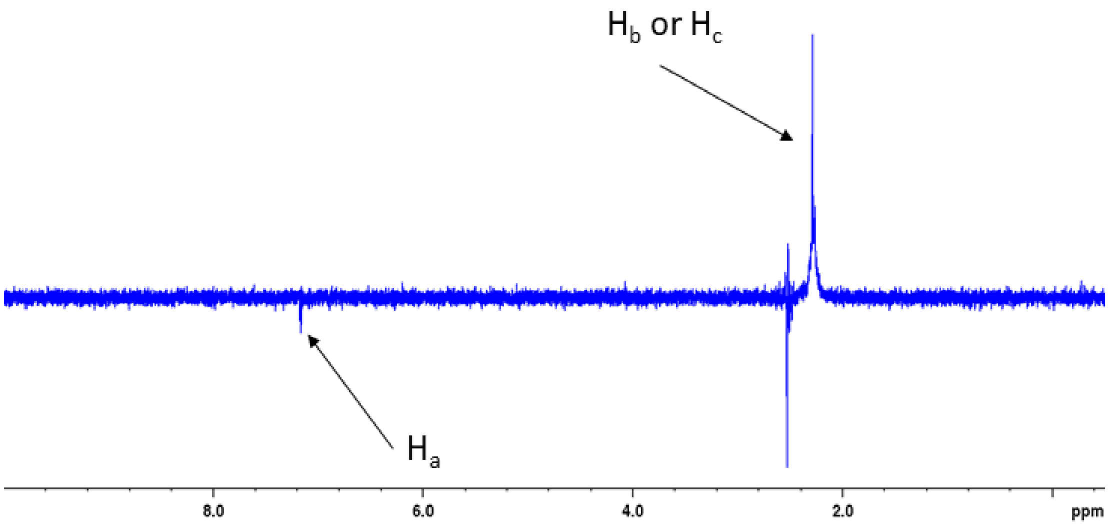


Figure S2: (A) ^{1}H-NMR spectrum of **3fa**, (B) NOE difference spectrum, with irradiation at 6.79 ppm.

10.1. *In situ* detection of *tert*-butyl(2,2-diphenylvinyl)sulfane (3ao) by LC-MS

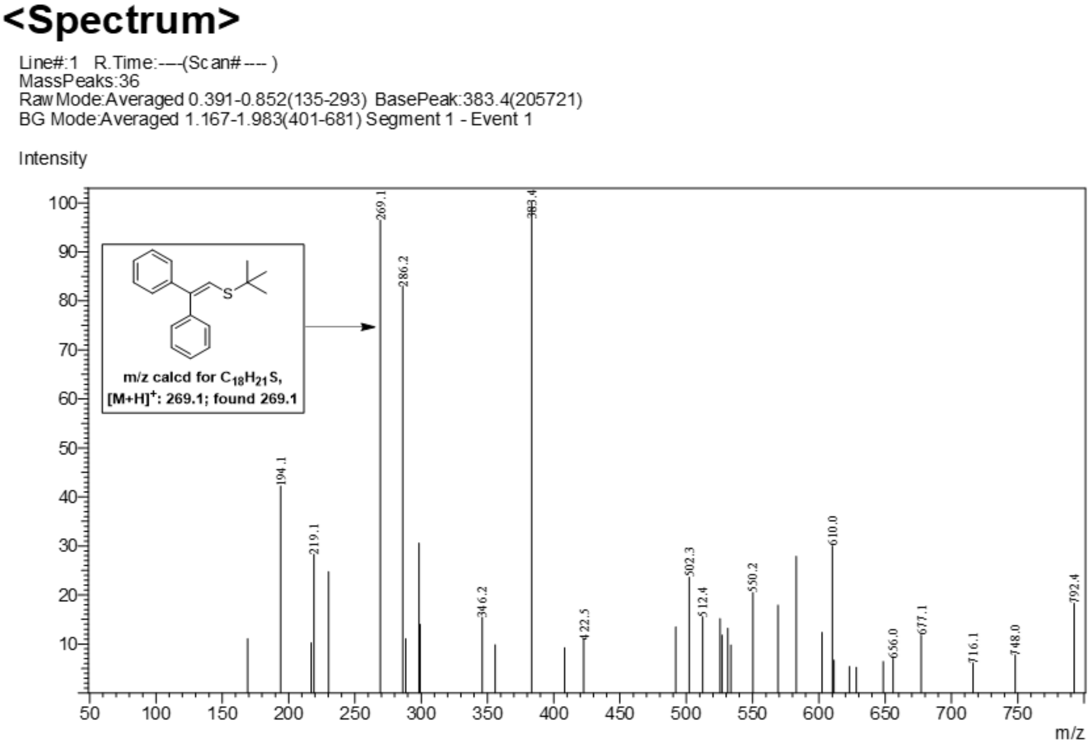


Figure S3. Mass spectrum of the reaction mixture of ethene-1,1-diyldibenzene, I_2 and 1,2-di-tert-butyldisulfane

10.2. *In situ* detection of 2,2-diphenylethene-1-thiol (C) by LC-MS

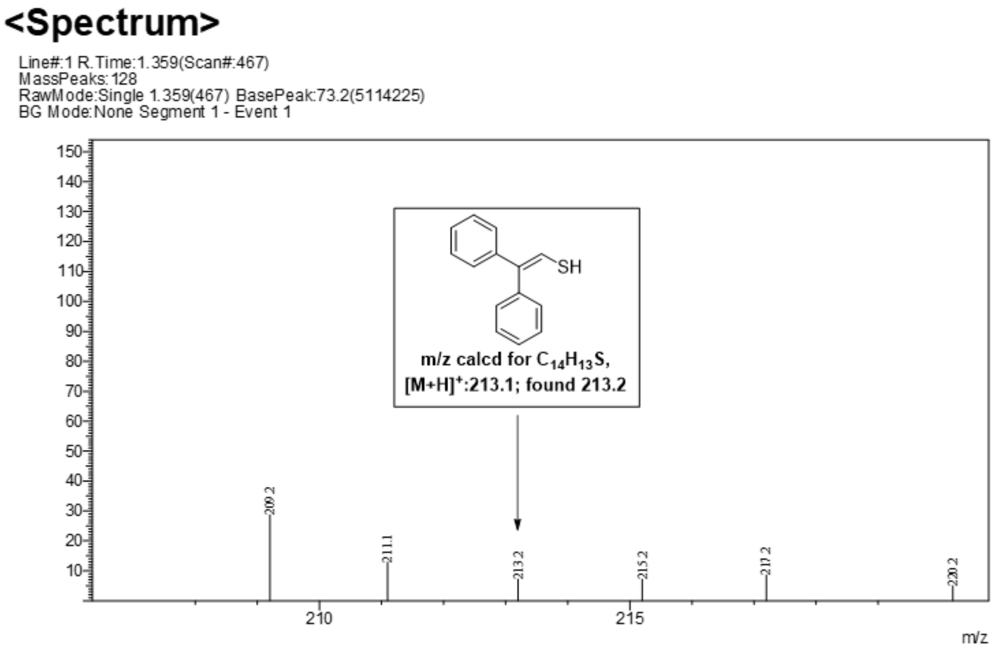
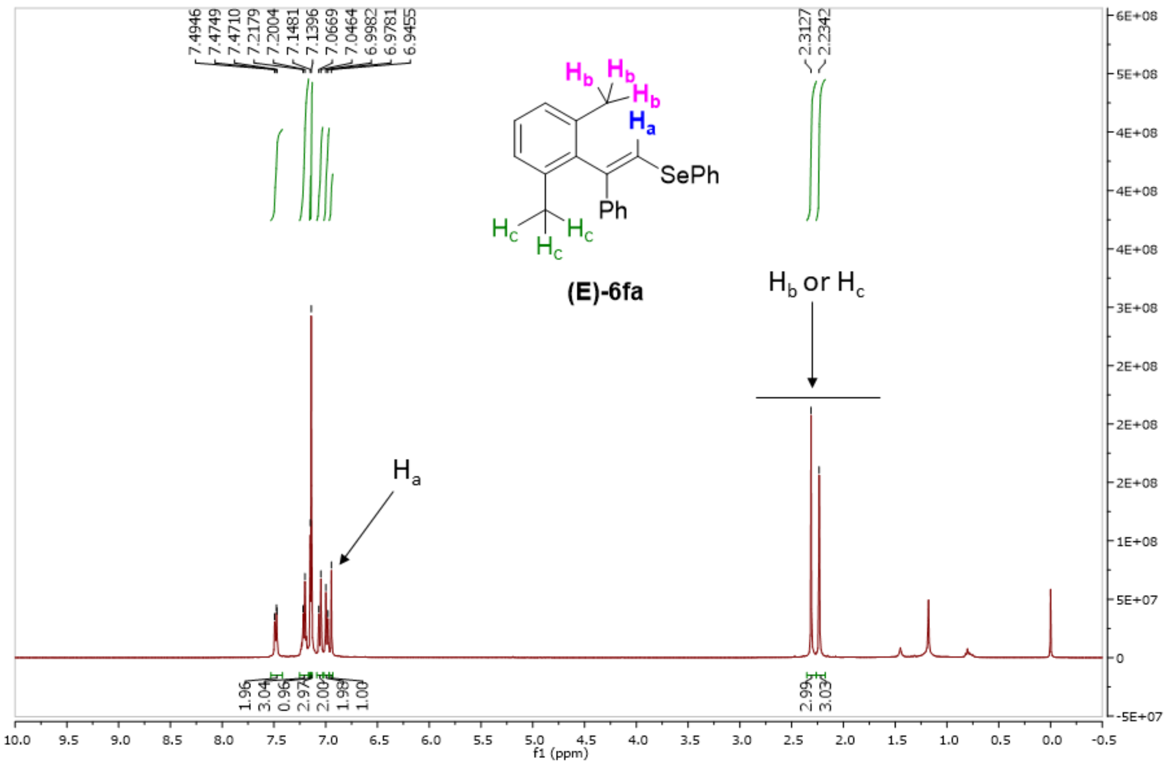


Figure S4. Mass spectrum of the reaction mixture of ethene-1,1-diyldibenzene, I_2 and 1,2-di-tert-butyldisulfane

11. Determination of stereochemistry of (2,2-diphenylvinyl)(phenyl)selane, 6fa.

(A)



(B)

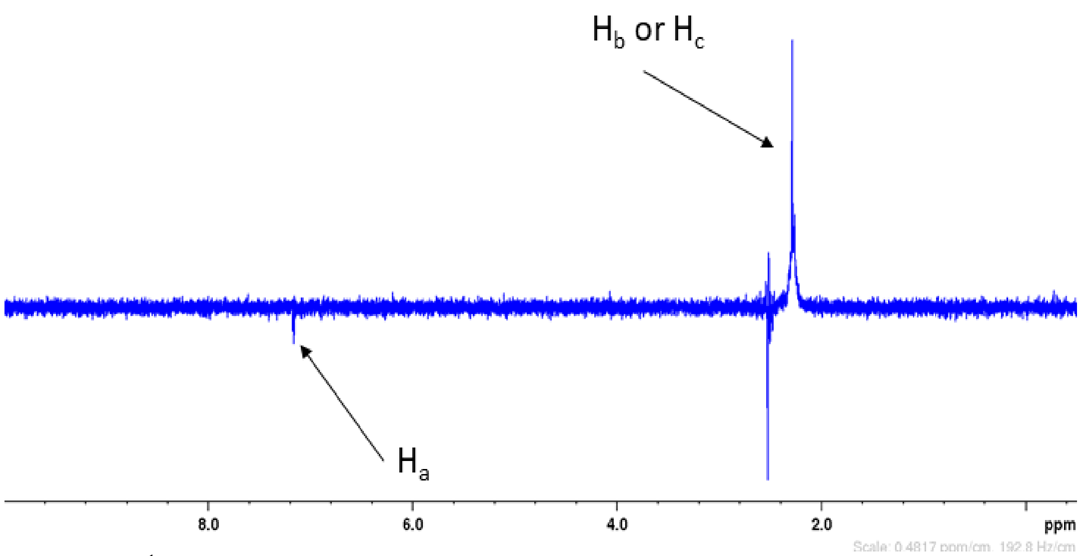
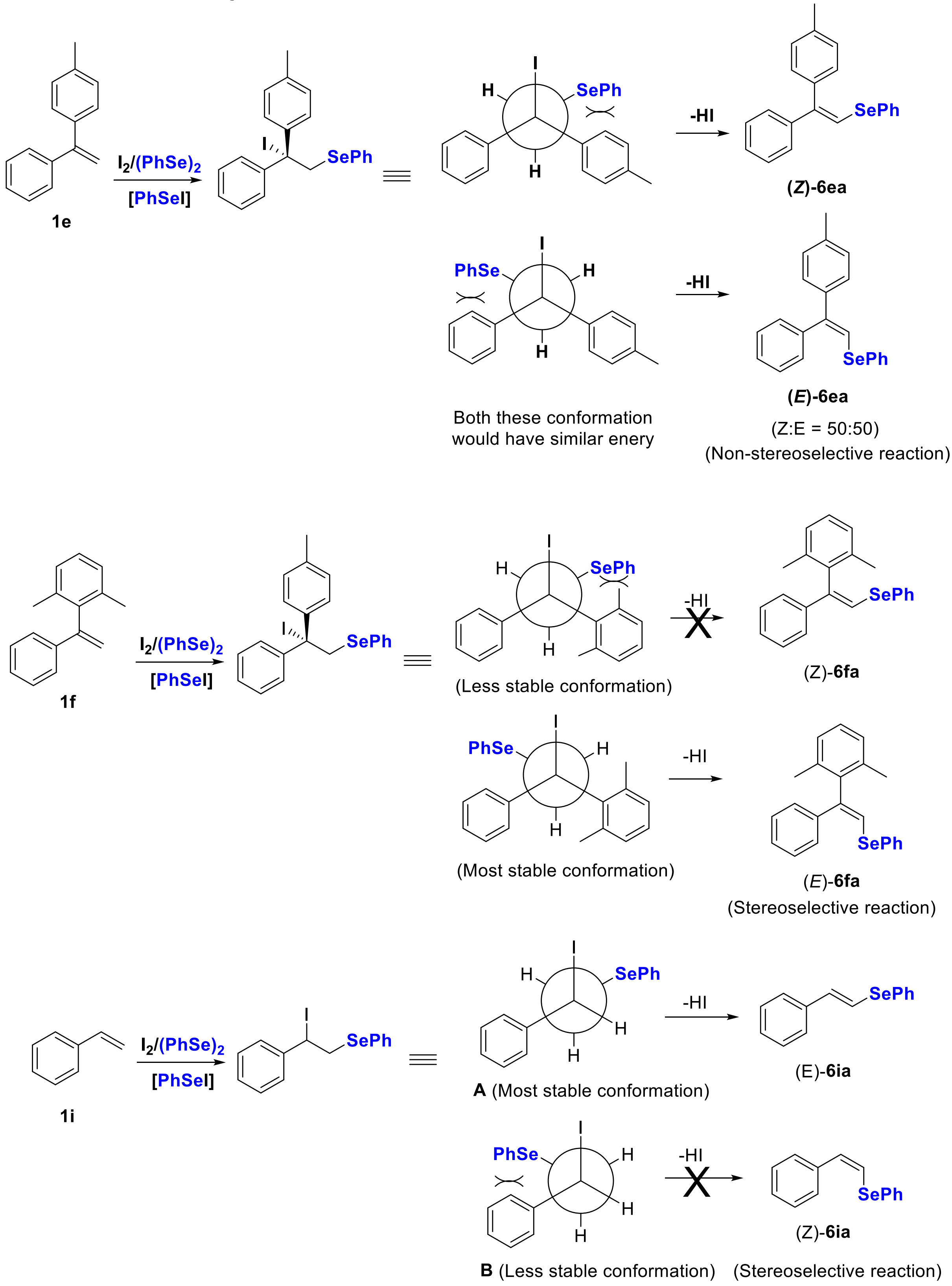


Figure S5: (A) ^{1}H-NMR spectrum of **6fa**, (B) NOE difference spectrum, with irradiation at 6.95 ppm.

12. Scheme S1. Explanation of stereoselectivity of C-H chalcogenation reactions with unsymmetrical alkenes



13. *Table S2.* Calculation of EcoScale score of the developed protocol for the synthesis of (2,2-diphenylvinyl)(phenyl)sulfane (3aa) [8]

Eco Scale Calculation:

Eco Scale = 100 - Sum of individual penalties
Score on Eco Scale: > 75, Excellent; >50, acceptable; <50, Inadequate

Parameters	Penalty Points
1. Yield: (100 - % of yield)/2 = (100 - 90)/2 = 5	5
2. Price of reaction components (To obtain 10 mmol of end product, **3aa**)	
A. Calculation of Penalty Points :	
a.ethene-1,1-diyldibenzene = 11.37 mmol = 2.05 g = USD 7.08	
b. 1,2-diphenyldisulfane = 5.69 mmol = 1.24 g = USD 0.64	
c. Iodine (As catalyst) = 1.14 mmol = 0.289 g = USD 0.099	
d. Hydrogen Peroxide (30% of aqueous solution) = 0.33 mL = USD 0.087	
Total cost of synthesis of **3aa** = (6.49 + 0.64 + 0.099 + 0.087) = USD 7.32 Thus inexpensive, since <$10(total cost of synthesis of 10 mmol of **3aa**) :	0
3. Safety	
ethene-1,1-diyldibenzene	0
1,2-diphenyldisulfane (T)	**5**
Iodine (T)	**5**
4. Technical Setup	
Common Setup	**0**
5. Temperature/ Time	
50 °C, 7 h (Heating, > 1h)	**3**
6. Work up and purification :	
a. Adding solvent	**0**
b. No classical chromatography	0
Total penalty points:	**18**

B. Ecoscale calculation:

EcoScale score: (100 - 18) = 82 (>75; it is an excellent synthesis)

14. *Table S3.* Calculation of EcoScale score of the developed protocol for the synthesis of (2,2-diphenylvinyl)(phenyl)selane (6aa) [8]

Eco Scale Calculation:

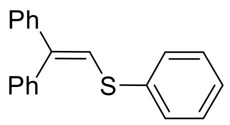
Eco Scale = 100 - Sum of individual penalties
Score on Eco Scale: > 75, Excellent; >50, acceptable; <50, Inadequate

Parameters	Penalty Points
1. Yield: (100 - % of yield)/2 = (100 - 96)/2 = 2	2
2. Price of reaction components (To obtain 10 mmol of end product, **6aa**)	
A. Calculation of Penalty Points :	
a.ethene-1,1-diyldibenzene = 10.42 mmol = 1.88 g = USD 6.49	
b. 1,2-diphenyldiselane = 5.21 mmol = 1.63 g = USD 2.45	
c. Iodine (As catalyst) = 1.04 mmol = 0.264 g = USD 0.091	
d. Hydrogen Peroxide (30% of aqueous solution) = 0.31 mL = USD 0.082	
Total cost of synthesis of **6aa** = (6.49 + 2.45 + 0.091 + 0.082) = USD 9.113 Thus expensive, since < $10 (total cost of synthesis of 10 mmol of **6aa**):	0
3. Safety	
ethene-1,1-diyldibenzene	0
1,2-diphenyldiselane (T)	**5**
Iodine (T)	**5**
4. Technical Setup	
Common Setup	**0**
5. Temperature/ Time	
50 ^{o}C, 7 h (Heating, > 1h)	**3**
6. Work up and purification :	
a. Adding solvent	**0**
b. No classical chromatography	0
Total penalty points:	**15**

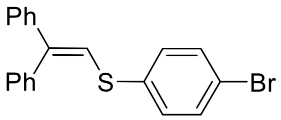
B. Ecoscale calculation:

EcoScale score: (100 - 15) = 85 (>75; it is an excellent synthesis)

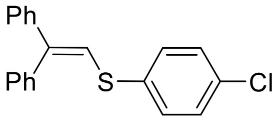
15. Analytical data of all synthesized products (3aa - 3an, 3ba – 3fa, 3bi, 3ci and 4, 6aa - 6aj, 6ba – 6ia, 7 - 14)



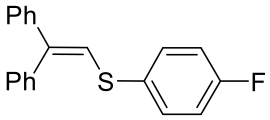
(2,2-Diphenylvinyl)(phenyl)sulfane (3aa):[9] White solid (0.135 g, 94%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.54 – 7.48 (m, 4H), 7.45 (m, 3H), 7.42 – 7.36 (m, 3H), 7.35 (d, *J* = 2.9 Hz, 3H), 7.32 (m, 2H), 6.95 (s, 1H). **^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 141.4, 141.0, 139.1, 136.5, 129.7, 129.5, 129.1, 128.3, 128.3, 127.7, 127.3, 127.2, 126.7, 124.1.



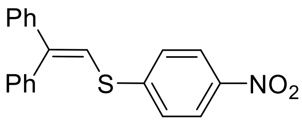
(4-Bromophenyl)(2,2-diphenylvinyl)sulfane (3ab):[9] White solid (0.138 g, 75%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$** δ 7.39 – 7.07 (m, 14H), 6.68 (s, 1H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 142.1, 141.2, 138.9, 135.7, 132.1, 130.8, 129.7, 128.4, 128.3, 127.9, 127.5, 127.2, 122.9, 120.6.



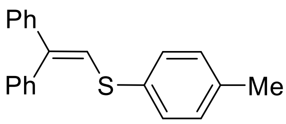
(4-Chlorophenyl)(2,2-diphenylvinyl)sulfane (3ac):[9] White solid (0.15 g, 94%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.49 – 7.44 (m, 2H), 7.43 – 7.37 (m, 5H), 7.36 – 7.29 (m, 7H), 6.83 (s, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 141.9, 141.2, 138.9, 135.0, 132.7, 130.6, 129.7, 129.2, 128.4, 128.3, 127.9, 127.5, 127.2, 123.2.



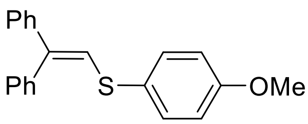
2,2-Diphenylvinyl)(4-fluorophenyl)sulfane (3ad):[9] White solid (0.14 g, 92%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.30 (m, 4H), 7.23 (m, 3H), 7.17 – 7.10 (m, 5H), 6.94 – 6.85 (m, 2H), 6.65 (s, 1H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 162.1 (d, $^{1}J_{C\text{-}F}$ = 246 Hz), 141.3, 140.8, 139.0, 132.0 (d, $^{3}J_{C\text{-}F}$ = 8 Hz), 131.5 (d, $^{4}J_{C\text{-}F}$ = 4 Hz), 129.7, 128.4, 128.2, 127.8, 127.3, 127.1, 124.6, 116.2(d, $^{2}J_{C\text{-}F}$ = 22 Hz) (Overlapping peaks present). **^{19}F NMR (376 MHz, $CDCl_3$)** δ -114.45 (s).



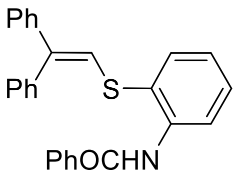
(2,2-Diphenylvinyl)(4-nitrophenyl)sulfane (3ae):[9] Yellow solid (0.13 g, 79%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 8.17 (d, *J* = 9.0 Hz, 2H), 7.48 (d, *J* = 9.0 Hz, 2H), 7.45 – 7.42 (m, 2H), 7.36 – 7.30 (m, 8H), 6.87 (s, 1H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 146.61, 146.33, 145.70, 140.77, 138.56, 129.57, 128.47, 128.32, 128.19, 128.12, 127.42, 127.21, 124.13, 118.51.



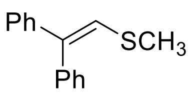
(2,2-Diphenylvinyl)(p-tolyl)sulfane (3af):[9] White solid (0.103 g, 68%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.27 (s, 1H), 7.27 – 7.18 (m, 6H), 7.13 – 7.06 (m, 5H), 6.99-6.97 (m, 2H), 6.70 (s, 1H), 2.18 (s, 3H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 141.5, 140.1, 139.2, 136.9, 132.8, 130.0, 129.8, 129.7, 128.3, 128.2, 127., 127.1, 125.2, 21.0 (overlapping peaks are present).



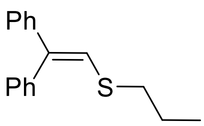
(2,2-Diphenylvinyl)(4-methoxyphenyl)sulfane (3ag):[9] Colourless liquid (0.13 g, 82%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.29-7.24 (m, 6H), 7.22 (s, 1H), 7.11-7.10 (m, 5H), 6.76-6.73 (m, 2H), 6.65 (s, 1H), 3.64 (s, 3H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 159.2, 141.4, 139.1, 132.5, 129.7, 128.3, 128.2, 127.6, 127.03, 126.99, 126.7, 126.5, 114.7, 55.3 (overlapping peaks are present).



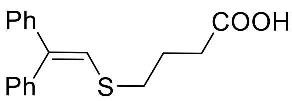
***N*-(2-((2,2-diphenylvinyl)thio)phenyl)benzamide (3ah):** Yellow liquid (0.11 g, 52%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 8.92 (brS, 1H), 8.62 (dd, *J* = 8.3, 1.1 Hz, 1H), 7.90 – 7.78 (m, 2H), 7.67 (dd, *J* = 7.7, 1.4 Hz, 1H), 7.57 – 7.52 (m, 1H), 7.49 – 7.41 (m, 6H), 7.32 (dd, *J* = 8.0, 1.5 Hz, 2H), 7.23 (dd, *J* = 5.1, 1.8 Hz, 3H), 7.18 – 7.10 (m, 3H), 6.49 (s, 1H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 165.2, 142.4, 140.7, 139.3, 138.6, 134.8, 134.6, 132.0, 130.5, 129.6, 128.8, 128.5, 128.3, 128.2, 127.6, 127.2, 127.1, 124.4, 124.0, 123.2, 120.8. **HRMS (ESI)**, m/z calcd for $C_{27}H_{22}NOS$ $[M + H]^+$: 408.1417; found: 408.1390.



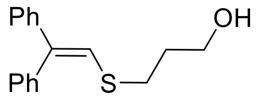
(2,2-diphenylvinyl)(methyl)sulfane (3ai):[8] Yellow oil (0.109 g, 96%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$** δ 7.31 – 7.27 (m, 2H), 7.24 – 7.20 (m, 3H), 7.15 (s, 1H), 7.12 (m, 4H), 6.45 (s, 1H), 2.25 (s, 3H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 141.7, 139.4, 138.3, 129.63 128.3, 128.2, 127.6, 127.5, 126.9, 126.8, 17.9.



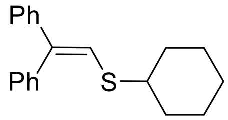
(2,2-Diphenylvinyl)(propyl)sulfane (3aj): Yellow liquid (0.12 g, 92%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.51-7.48 (m, 1H), 7.47 (d, *J* = 2.0 Hz, 1H), 7.45 (d, *J* = 1.7 Hz, 1H), 7.43 (m, 1H), 7.40 (m, 1H), 7.37-7.35 (m, 2H), 7.34 – 7.30 (m, 3H), 6.70 (s, 1H), 2.86 – 2.81 (m, 2H), 1.81 (d, *J* = 7.3 Hz, 2H), 1.11 (t, *J* = 7.3 Hz, 3H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 141.9, 139.5, 138.2, 129.62 128.2, 128.1, 127.3, 126.9, 126.7, 126.3, 36.8, 23.6, 13.2. **HRMS (ESI)**, m/z calcd for $C_{18}H_{19}S$ $[M + H]^+$: 255.1202; found: 255.1169.



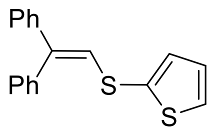
4-((2,2-Diphenylvinyl)thio)butanoic acid (3ak): Yellow viscous liquid (0.11 g, 76%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.31-7.29 (m, 3H), 7.25 – 7.20 (m, 3H), 7.14 – 7.12 (m, 4H), 6.47 (s, 1H), 2.73 (t, *J* = 7.1 Hz, 2H), 2.42 (t, *J* = 7.2 Hz, 2H), 1.97 – 1.89 (m, 2H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 179.0, 141.7, 139.4, 139.3, 129.6, 128.3, 128.2, 127.5, 126.95, 126.9, 125.2, 33.8, 32.3, 25.1. **HRMS (ESI)**, m/z calcd for $C_{18}H_{18}O_2S$ [M]: 298.1028; found: 298.1053.



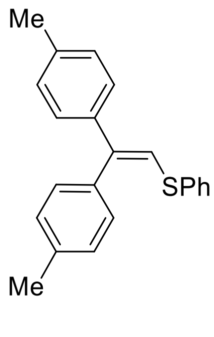
3-((2,2-Diphenylvinyl)thio)propan-1-ol (3al): Viscous liquid (0.084 g, 62%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.30 – 7.28 (m, 2H), 7.24 – 7.22 (m, 3H), 7.19 – 7.17 (m, 2H), 7.16 – 7.11 (m, 3H), 6.59 (s, 1H), 2.88 – 2.80 (m, 1H), 1.96 (d, *J* = 2.9 Hz, 1H), 1.74 – 1.68 (m, 2H), 1.35-1.25 (m, 2H).**^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 178.6, 141.7, 139.5, 139.4, 129.7, 128.3, 128.2, 127.5, 127.0, 126.9, 125.2, 33.8, 32.2, 25.1. **Anal** calcd for $C_{17}H_{18}OS$: C, 75.52; H, 6.71; S, 11.86; found C, 75.40; H, 6.82; S, 11.79.



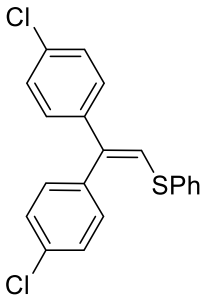
Cyclohexyl(2,2-diphenylvinyl)sulfane (3am): Colourless oil (0.097 g, 69%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.30 – 7.28 (m, 3H), 7.23 (d, *J* = 7.4 Hz, 2H), 7.119 – 7.17 (m, 2H), 7.16 – 7.11 (m, 3H), 6.59 (s, 1H), 2.88 – 2.80 (m, 1H), 2.02 – 1.94 (m, 2H), 1.74 – 1.68 (m, 2H), 1.58 – 1.53 (m, 1H), 1.40 – 1.16 (m, 5H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 142.2, 139.7, 138.2, 129.7, 128.2, 128.2, 127.3, 127.0, 126.7, 124.7, 46.8, 33.8, 26.1, 25.6. **HRMS (ESI)**, m/z calcd for $C_{20}H_{22}S$ [M]: 294.1442; found: 294.1437.



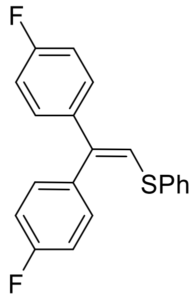
2-((2,2-Diphenylvinyl)thio)thiophene (3an):[9] White solid (0.109 g, 74%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.37 – 7.32 (m, 2H), 7.31 – 7.25 (m, 4H), 7.20 – 7.14 (m, 3H), 7.13 – 6.91 (m, 4H), 6.63 (s, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 141.0, 139.2, 138.8, 133.9, 132.7, 129.7, 129.3, 128.5, 128.3, 127.9, 127.6, 127.3, 127.1.



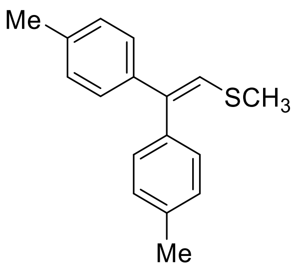
(2,2-Di-p-tolylvinyl)(phenyl)sulfane (3ba):[9] Colourless liquid (0.124 g, 78%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.35 – 7.31 (m, 2H), 7.22 (t, *J* = 7.6 Hz, 2H), 7.15 – 7.14 (m, 5H), 7.07 (d, *J* = 8.2 Hz, 2H), 7.00 (d, *J* = 7.9 Hz, 2H), 6.68 (s, 1H), 2.30 (s, 3H), 2.24 (s, 3H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)**, δ 141.4, 138.9, 137.5, 137.1, 136.8, 136.4, 129.6, 129.3, 129.03, 128.96, 128.2, 127.2, 126.6, 122.4, 21.3, 21.1.



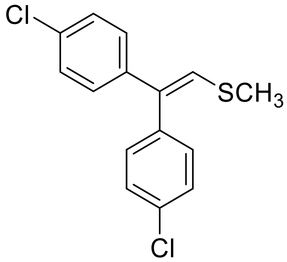
(2,2-Bis(4-chlorophenyl)vinyl)(phenyl)sulfane (3ca): White solid (0.16 g, 91%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.38 – 7.33 (m, 3H), 7.31 – 7.26 (m, 3H), 7.22 – 7.16 (m, 5H), 7.08 – 7.06 (m, 2H), 6.76 (s, 1H). **^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 139.6, 138.2, 137.1, 135.7, 133.8, 133.3, 131.1, 129.8, 129.2, 128.8, 128.6, 128.34, 127.2, 125.7.**HRMS (ESI)**, m/z calcd for $C_{20}H_{15}Cl_2S$ $[M + H]^+$: 356.0193; found: 356.0160.



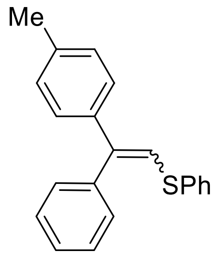
((2,2-Bis(4-fluorophenyl)vinyl)(phenyl)sulfane (3da): Yellow oil (0.126 g, 78%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.31 (d, J = 7.4 Hz, 2H), 7.23 – 7.18 (m, 4H), 7.13 (d, J = 7.2 Hz, 1H), 7.09 – 7.05 (m, 2H), 6.99 (t, J = 8.7 Hz, 2H), 6.85 (t, J = 8.6 Hz, 2H), 6.66 (s, 1H). **^{13}C NMR (100 MHz, CDCl$_3$** δ 162.20 (d, $^1J_{C\text{-}F}$ = 246 Hz), 162.21 (d, $^1J_{C\text{-}F}$ = 246 Hz), 138.9, 137.5, 136.0, 134.9, 131.45 (d, $^3J_{C\text{-}F}$ = 8 Hz), 129.6, 129.2, 128.7 (d, $^3J_{C\text{-}F}$ = 8 Hz), 127.0, 124.3, 115.2 (d, $^2J_{C\text{-}F}$ = 21 Hz), 115.4 (d, $^2J_{C\text{-}F}$ = 21 Hz). **^{19}F NMR (376 MHz, CDCl$_3$)** δ -113.28 (s), -114.51 (s). **HRMS (ESI)**, m/z calcd for $C_{20}H_{15}F_2S$ $[M + H]^+$: 325.0857; found: 325.0811.



(2,2-Di-p-tolylvinyl)(methyl)sulfane (3bi): Yellow solid (0.12 g, 92%); eluent hexane; mp = 65 - 67 ^{o}C; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.21 (s, 4H), 7.12 – 7.10 (m, 2H), 6.48 (s, 1H), 2.39 (s, 3H), 2.37 (s, 3H), 2.34 (s, 3H). **^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 139.1, 138.4, 137.1, 136.6, 136.5, 129.5, 128.9, 128.9, 126.9, 126.1, 21.3, 21.0, 18.0. **HRMS (ESI)**, m/z calcd for $C_{17}H_{18}S$ [M]: 254.1129; found: 254.1199. The assignment is also supported by an X-ray crystallographic structure determination (**CCDC 2261525**).

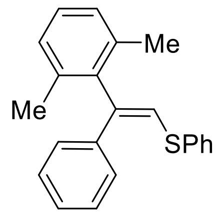


(2,2-Bis(4-chlorophenyl)vinyl)(methyl)sulfane (3ci):[9] Orange solid (011 g, 72%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.27 (d, J = 8.6 Hz, 2H), 7.16 – 7.12 (m, 4H), 7.01 (d, J = 8.7 Hz, 2H), 6.46 (s, 1H), 2.29 (s, 3H). **^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 139.8, 137.4, 135.8, 133.4, 132.8, 131.0, 128.9, 128.7, 128.4, 128.1, 17.9.

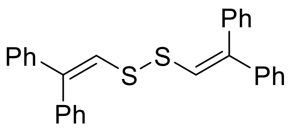


(Phenyl(2-phenyl-2-(p-tolyl)vinyl)sulfane (3ea): Colourless oil (0.114 g, 75%, Z:E = 55:45); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.39 – 7.35 (m, 5H), 7.33 – 7.25 (m, 9H), 7.22 – 7.19 (m, 10H), 7.07 (dd, J = 21.0, 5.0 Hz, 4H), 6.78 (s, 1H), 6.77 (s, 1H), 2.35 (s, 3H), 2.29 (s, 3H). **$^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$** δ 141.7, 141.4, 141.18, 139.3\3, 138.7, 137.6, 137.2, 136.7, 136.6, 136.2, 129.7, 129.6, 129.5, 129.4, 129.1, 129.0, 128.3, 128.3, 127.7, 127.3, 127.1, 126.7, 126.6, 123.6, 122.9 **Anal** calcd for $C_{21}H_{18}S$: C, 83.40; H, 6.00; S, 10.60; found C, 83.23; H, 5.82; S, 10.56.

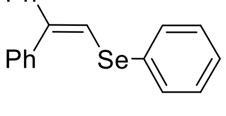
.



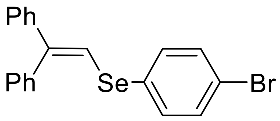
(E)-(2-(2,6-dimethylphenyl)-2-phenylvinyl)(phenyl)sulfane (3fa): Colourless liquid (0.068 g, 43%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.44 – 7.42 (m, 2H), 7.35 – 7.31 (m, 2H), 7.24 – 7.22 (m, 4H), 7.22 (s, 1H), 7.17 (d, *J* = 8.2 Hz, 2H), 7.10 (d, J = 8.0 Hz, 2H), 6.79 (s, 1H), 2.40 (s, 3H), 2.34 (s, 3H).**$^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$)** δ 141.4, 138.9, 137.5, 137.1, 136.8, 136.4, 129.6, 129.4, 129.04, 128.96, 128.2, 127.2, 126.6, 122.4, 21.3, 21.1. **Anal** calcd for $C_{22}H_{20}S$: C, 83.50; H, 6.37; S, 10.13; found C, 83.64; H, 6.31; S, 10.05.



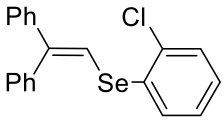
1,2-Bis(2,2-diphenylvinyl)disulfane (4): Yellow solid (0.13 g, 60%); eluent hexane; mp = 96 - 98 °C; **^{1}H NMR (400 MHz, $CDCl_3$** δ 7.49 – 7.45 (m, 8H), 7.42 – 7.40 (m, 5H), 7.37 (t, *J* = 4.3 Hz, 4H), 7.31 (d, *J* = 1.4 Hz, 3H), 6.91 (s, 2H). **^{13}C NMR (100 MHz, $CDCl_3$**) δ 141.7, 139.9, 139.0, 129.7, 128.4, 128.3, 127.7, 127.2, 124.5 (Overlapping peaks are present). **Anal** calcd for $C_{28}H_{22}S_2$: C, 79.58; H, 5.25; S, 15.17; found C, 79.40; H, 5.43; S, 15.33.



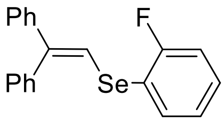
(2,2-Diphenylvinyl)(phenyl)selane (6aa):[10] Yellow solid (0.16 g, 96%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.44 (dd, *J* = 7.5, 1.9 Hz, 2H), 7.32 – 7.19 (m, 5H), 7.19 – 7.02 (m, 8H), 7.00 (s, 1H). **$^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$)** δ 143.0, 141.5, 140.3, 132.4, 131.2, 129.2, 129.2, 128.4, 128.2, 127.8, 127.3, 127.2, 127.1, 122.5.



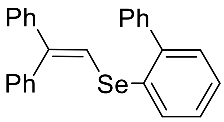
(4-Bromophenyl)(2,2-diphenylvinyl)selane (6ab):[10] White solid (0.16 g, 77%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.32-7.31 (m, 5H), 7.30 – 7.26 (m, 2H), 7.22 – 7.19 (m, 2H), 7.16 – 7.13 (m, 5H), 6.93 (s, 1H). **^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 143.8, 141.3, 140.1, 134.0, 132.4, 130.5, 129.3, 128.5, 128.3, 128.1, 127.4, 127.2, 121.7, 121.5.



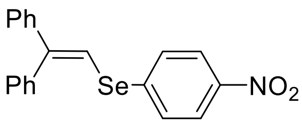
(2-Chlorophenyl)(2,2-diphenylvinyl)selane (6ac):[10] White solid (0.174 g, 94%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.54 (dd, *J* = 7.7, 1.7 Hz, 2H), 7.40 – 7.37 (m, 4H), 7.34 – 7.30 (m, 6H), 7.19 – 7.16 (m, 1H), 7.15 – 7.13 (m, 1H), 7.10 (s, 1H).**^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 155.2, 141.5, 139.1, 135.4, 132.8, 130.3, 129.7, 128.9, 128.7, 128.7, 128.6, 128.3, 128.2, 128.0, 127.8, 127.6.



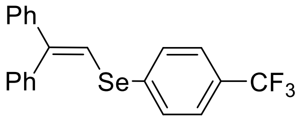
(2,2-Diphenylvinyl)(2-fluorophenyl)selane (6ad): Yellow solid (0.164 g, 93%); eluent hexane; mp = 58 - 60 ºC; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.65 – 7.60 (m, 1H), 7.51 – 7.46 (m, 2H), 7.42 (m, 3H), 7.34 – 7.28 (m, 6H), 7.18 – 7.10 (m, 3H). **^{13}C NMR (100 MHz, CDCl$_3$)** δ 161.3 (d, $^1J_{C\text{-}F}$ = 242Hz), 144.0, 141.4, 140.0, 133.9, 129.4, 129.3, 128.5, 128.3, 128.0, 127.4, 127.2, 124.9, 120.1, 118.2 (d, $^2J_{C\text{-}F}$ = 23 Hz), 115.7 (d, $^2J_{C\text{-}F}$ = 23 Hz). **^{77}Se NMR (76 MHz, CDCl$_3$)** δ 302.08 (s). **^{19}F NMR (376 MHz, CDCl$_3$)** δ -103.64 (s). **Anal** calcd for $C_{20}H_{15}FSe$ C, 67.99; H, 4.28 found C, 68.14; H, 4.16.



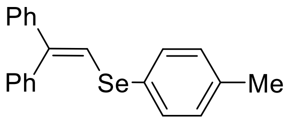
[1,1'-Biphenyl]-2-yl(2,2-diphenylvinyl)selane (6ae): Yellow solid (0.15 g, 75%); eluent hexane; mp = 87 - 89 ºC; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.74 – 7.71 (m, 1H), 7.39 – 7.33 (m, 11H), 7.28 (s, 3H), 7.24 – 7.22 (m, 2H), 7.21 – 7.19 (m, 2H), 7.06 (s, 1H). **^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 144.1, 143.9, 141.8, 141.6, 140.2, 134.2, 132.1, 132.0, 130.2, 129.4, 129.1, 128.3, 128.2, 128.1, 127.8, 127.5, 127.2, 127.0, 122.2 (Overlapping peaks are present). **^{77}Se NMR (76 MHz, CDCl$_3$)** δ 350.06 (s). **Anal** calcd for $C_{26}H_{20}Se$: C, 75.91; H, 4.90; found C, 75.80; H, 5.02.



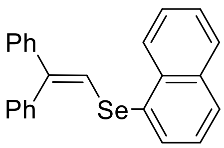
(2,2-Diphenylvinyl)(4-nitrophenyl)selane (6af): Yellow solid (0.071 g, 37%); eluent hexane; mp = 55 - 57 ºC; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.34 – 7.28 (m, 4H), 7.27 – 7.21 (m, 3H), 7.20 – 7.13 (m, 7H), 6.66 (s, 1H). **^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 142.1, 141.2, 138.9, 135.7, 132.1, 130.8, 129.7, 128.4, 128.3, 127.9, 127.5, 127.2, 122.9, 120.6.. **Anal** calcd for $C_{20}H_{15}NO_2Se$: C, 63.17; H, 3.98; N, 3.68; found C, 63.47; H, 3.56; N, 3.82.



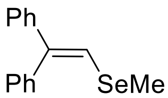
(2,2-Diphenylvinyl)(4-(trifluoromethyl)phenyl)selane (6ag):[10] White solid (0.13 g, 62%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$** δ 7.52 (d, *J* = 8.0 Hz, 2H), 7.42 (d, *J* = 8.1 Hz, 2H), 7.35 – 7.27 (m, 3H), 7.21 – 7.12 (m, 7H), 6.97 (s, 1H).**^{13}C NMR (100 MHz, CDCl$_3$)** δ 145.1, 141.2, 140.06, 137.0, 131.7, 129.2, 128.6, 128.4, 128.2, 127.6, 127.2, 126.0, 125.4, 124.0 (d, $^1J_{C\text{-}F}$ = 270 Hz), 120.0.



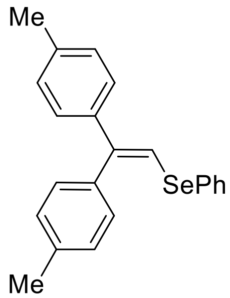
(2,2-Diphenylvinyl)(p-tolyl)selane (6ah):[10] Yellow solid (0.13 g, 73%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$**) δ 7.36 – 7.33 (m, 1H), 7.32 – 7.29 (m, 2H), 7.24 – 7.23 (m, 3H), 7.22 (s, 1H), 7.21 – 7.11 (m, 7H), 6.47 (s, 1H), 2.28 (s, 3H). **^{13}C NMR (100 MHz, CDCl$_3$** δ 141.7, 139.5, 138.4, 133.4, 132.9, 129.7, 128.6, 128.3, 128.2, 127.6, 127.5, 127.0, 126.8, 18.0.



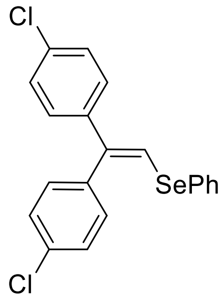
(2,2-Diphenylvinyl)(naphthalen-1-yl)selane (6ai):[10] Yellow solid (0.16 g, 84%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$**) δ 8.47 (d, *J* = 8.2 Hz, 1H), 8.03 (d, *J* = 7.1 Hz, 1H), 7.95 (t, *J* = 7.3 Hz, 2H), 7.69 – 7.60 (m, 3H), 7.59–7.57 (m, 3H), 7.55 – 7.49 (m, 2H), 7.33 (s, 5H), 7.21 (s, 1H). **^{13}C NMR (100 MHz, CDCl$_3$)** δ 142.9, 141.4, 140.3, 134.1, 134.0, 132.8, 130.4, 129.4, 128.9, 128.6, 128.5, 128.2, 127.9, 127.6, 127.1, 127.1, 126.8, 126.3, 125.8, 122.9.



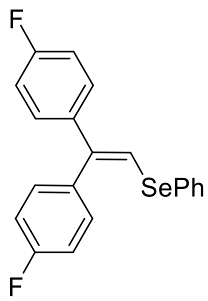
(2,2-Diphenylvinyl)(methyl)selane (6aj): White solid (0.126 g, 92%); eluent hexane; mp = 55 - 57 °C; **^{1}H NMR (400 MHz, CDCl$_3$**) δ 7.28 – 7.26 (m, 2H), 7.23 – 7.22 (m, 1H), 7.20 (d, *J* = 1.6 Hz, 1H), 7.18 (d, *J* = 1.4 Hz, 1H), 7.17 – 7.15 (m, 1H), 7.12 – 7.10 (m, 4H), 6.78 (s, 1H), 2.09 (s, 3H). **^{13}C NMR (100 MHz, CDCl$_3$)** δ 141.9, 141.8, 140.5, 129.2, 128.4, 128.2, 127.6, 126.9, 126.9, 123.0, 7.6. **Anal** calcd for $C_{15}H_{14}Se$: C, 65.94; H, 5.16 found C, 65.82; H, 5.32.



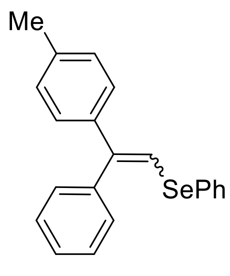
(2,2-Di-p-tolylvinyl)(phenyl)selane (6ba): Yellow solid (0.14 g, 78%); eluent hexane; mp = 85 - 87 °C; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.49 – 7.46 (m, 2H), 7.23 – 7.17 (m, 3H), 7.13 (s, 4H), 7.05 (d, *J* = 8.2 Hz, 2H), 6.98 (d, *J* = 8.1 Hz, 2H), 6.94 (s, 1H), 2.30 (s, 3H), 2.23 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 143.2, 139.0, 137.6, 137.5, 137.0, 132.3, 131.8, 129.2, 129.2, 129.1, 128.9, 127.2, 127.1, 120.8, 21.3, 21.1. **^{77}Se NMR (76 MHz, $CDCl_3$)** δ 371.81 (s). **Anal** calcd for $C_{22}H_{20}Se$ C, 72.72; H, 5.55 found C, 72.96 ; H, 5.38.



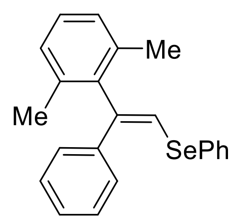
(2,2-Bis(4-chlorophenyl)vinyl)(phenyl)selane (6ca):[10] Yellow oil (0.15 g, 74%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.50 – 7.47 (m, 2H), 7.33 – 7.30 (m, 2H), 7.25 – 7.22 (m, 3H), 7.18 (s, 1H), 7.17 – 7.15 (m, 2H), 7.14 (s, 1H), 7.05 (d, *J* = 2.1 Hz, 1H), 7.03 (d, J = 2.2 Hz, 2H).**^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$)** δ 140.4, 139.7, 138.2, 133.9, 133.3, 132.7, 131.0, 130.7, 129.4, 128.9, 128.5, 128.3, 127.7, 124.2.



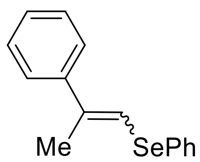
(2,2-Bis(4-fluorophenyl)vinyl)(phenyl)selane (6da): Yellow oil (0.169 g, 91%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.65 – 7.56 (m, 2H), 7.36 – 7.32 (m, 5H), 7.25 – 7.18 (m, 2H), 7.15 (t, *J* = 8.7 Hz, 2H), 7.08 (s, 1H), 6.99 (t, *J* = 8.7 Hz, 2H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 162.3 (d, $^{1}J_{C-F}$ = 246 Hz), 162.2 (d, $^{1}J_{C-F}$ = 240 Hz), 140.9, 137.7, 136.0, 132.6, 131.2, 131.0 (d, $^{3}J_{C-F}$ = 8 Hz), 129.4, 128.5 (d, $^{3}J_{C-F}$ = 8 Hz), 127.6, 122.7, 115.5 (d, $^{2}J_{C-F}$ = 39 Hz), 115.3 (d, $^{2}J_{C-F}$ = 39 Hz),. **^{77}SeNMR (76 MHz, $CDCl_3$)** δ 378.00 (s). **^{19}F NMR (376 MHz, $CDCl_3$)** δ -113.14 (s), -114.63 (s). **HRMS (ESI)**, m/z calcd for $C_{20}H_{14}F_2Se$ [M]: 372.0229; found: 372.0237.



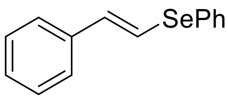
Phenyl(2-phenyl-2-(p-tolyl)vinyl)selane (6ea): Colourless oil (0.11 g, 65%, Z:E = 50:50); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.51-7.46 (m, 4H), 7.38 – 7.23 (m, 6H), 7.22 – 7.17 (m, 5H), 7.16 (dd, *J* = 5.9, 2.1 Hz, 4H), 7.15 (d, *J* = 4.3 Hz, 4H), 7.11 (d, *J* = 3.8 Hz, 2H), 7.06 – 6.99 (m, 3H), 6.98 (s, 1H), 6.97 (s, 1H), 2.31 (s, 3H), 2.22 (s, 3H).**^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 143.2, 143.1, 141.7, 140.5, 138.8, 137.7, 137.4, 137.1, 132.4, 132.4, 131.7, 129.3, 129.2, 129.2, 129.0, 128.7, 128.4, 128.2, 127.8, 127.3, 127.3, 127.2, 127.1, 127.0, 122.0, 121.3, 21.3, 21.1.



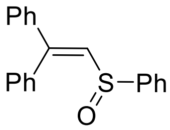
(*E*)-(2-(2,6-dimethylphenyl)-2-phenylvinyl)(phenyl)selane (6fa): Pale yellow oil (0.1 g, 55%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.53 – 7.42 (m, 2H), 7.21 (d, *J* = 7.0 Hz, 3H), 7.15 (s, 1H), 7.14 (s, 3H), 7.06 (d, *J* = 8.2 Hz, 2H), 6.99 (d, *J* = 8.1 Hz, 2H), 6.95 (s, 1H), 2.31 (s, 3H), 2.23 (s, 3H). **^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 143.2, 139.0, 137.6, 137.5, 137.0, 132.3, 131.8, 129.2, 129.2, 129.1, 128.9, 127.2, 127.1, 120.8, 21.3, 21.1. **Anal** calcd for $C_{22}H_{20}Se$: C, 72.72; H, 5.55; found C, 72.86; H, 5.38.



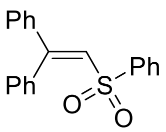
Phenyl(2-phenylprop-1-en-1-yl)selane (6ga): Yellow oil (0.042 g, 31%, Z:E = 50:50); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.62 – 7.57 (m, 4H), 7.44 (dd, J = 8.0, 6.6 Hz, 3H), 7.40 – 7.37 (m, 2H), 7.35 – 7.31 (m, 5H), 7.28 – 7.25 (m, 6H), 7.15 (s, 1H), 7.10 (s, 1H), 2.43 (s, 3H), 2.35 (s, 3H). **^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 143.1, 141.7, 140.5, 138.8, 137.7, 137.4, 137.1, 132.4, 132.4, 131.7, 129.2, 129.2, 129.0, 128.7, 128.4, 128.2, 127.8, 127.3, 127.3, 127.19, 127.2, 127.0, 21.3, 21.1. **Anal** calcd for $C_{15}H_{14}Se$: C, 65.94; H, 5.16; found C, 65.99; H, 5.04.



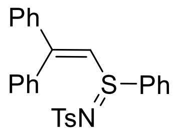
(*E*)-phenyl(styryl)selane (6ia):[10] Yellow solid (0.032 g, 25%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.67 – 7.49 (m, 2H), 7.43 (dd, *J* = 9.3, 5.6 Hz, 2H), 7.40 – 7.32 (m, 3H), 7.29 - 7.25 (m, 3H), 7.24 (d, *J* = 7.6 Hz, 1H), 7.16 (d, *J* = 7.8 Hz, 1H). **^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 143.1, 133.5, 132.3, 129.3, 129.0, 128.5, 128.2, 128.0, 127.7, 127.2.



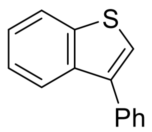
(2-(Phenylsulfinyl)ethene-1,1-diyl)dibenzene (7):[12] White solid (0.075 g, 82%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.64 – 7.57 (m, 2H), 7.46 – 7.38 (m, 6H), 7.32 – 7.25 (m, 3H), 7.21 (dt, *J* = 10.8, 7.7 Hz, 4H), 6.75 (s, 1H). **^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 152.8, 144.8, 138.9, 136.9, 133.3, 130.8, 130.1, 129.8, 129.4, 129.2, 128.5, 128.4, 128.4, 124.6.



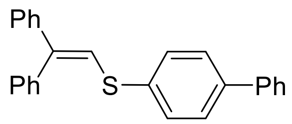
(2-(Phenylsulfinyl)ethene-1,1-diyl)dibenzene (8):[13] White solid (0.073 g, 76%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.59 – 7.57 (m, 2H), 7.48 (t, *J* = 4.0 Hz, 1H), 7.40 – 7.34 (m, 4H), 7.33 – 7.29 (m, 4H), 7.23 – 7.20 (m, 2H), 7.10 – 7.06 (m, 2H), 7.03 (s, 1H). **^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 155.2, 141.4, 139.0, 135.4, 132.8, 130.3, 129.7, 128.9, 128.7, 128.6, 128.6, 128.2, 127.8, 127.6.



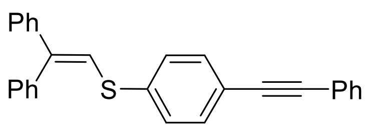
***N*-((2,2-diphenylvinyl)(phenyl)-λ_4-sulfanylidene)-4-methylbenzenesulfonamide (9):** White solid (0.11 g, 78%); eluent 20% ethyl acetate : hexane; mp = 96 - 98 ºC; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.71 – 7.65 (m, 4H), 7.51 – 7.46 (m, 4H), 7.40 – 7.36 (m, 3H), 7.31 (t, *J* = 7.5 Hz, 2H), 7.19 – 7.13 (m, 4H), 7.08 – 7.06 (m, 2H), 6.67 (s, 1H), 2.35 (s, 3H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 155.5, 141.6, 141.4, 137.9, 136.9, 136.1, 131.8, 130.6, 129.8, 129.7, 129.7, 129.1, 128.7, 128.6, 128.5, 126.43, 126.4, 123.0, 21.4. **Anal** calcd for $C_{27}H_{23}NO_2S_2$: C, 70.87; H, 5.07; N, 3.06; S, 14.01; found C,70.99; H, 5.03; N, 3.02; S, 14.04.



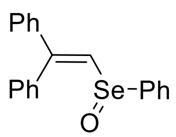
3-Phenylbenzo[b]thiophene (10):[14] White solid (0.018 g, 40%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.78 (m, 2H), 7.45 (dd, *J* = 8.2, 1.3 Hz, 2H), 7.35 (dd, *J* = 8.1, 6.8 Hz, 2H), 7.25 – 7.18 (m, 2H), 7.16 – 7.08 (m, 2H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 140.7, 138.1, 137.9, 136.0, 131.0, 129.2, 128.7, 127.5, 124.4, 124.3, 123.4, 122.9.



[1,1'-Biphenyl]-4-yl(2,2-diphenylvinyl)sulfane (11):[9] White solid (0.092 g, 84%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.60 – 7.56 (m, 4H), 7.53 – 7.50 (m, 2H), 7.47 – 7.42 (m, 4H), 7.40 – 7.36 (m, 4H), 7.32 – 7.27 (m, 5H), 6.91 (s, 1H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 141.4, 141.3, 140.3, 139.8, 139.2, 135.5, 129.8, 129.8, 128.9, 128.4, 128.3, 127.8, 127.8, 127.5, 127.3, 127.2, 126.9, 123.9.

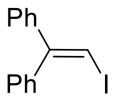


(2,2-Diphenylvinyl)(4-(phenylethynyl)phenyl)sulfane (12): Yellow viscous liquid (0.049 g, 42%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.70 (m, 1H), 7.40 – 7.29 (m, 12H), 7.25 (d, *J* = 2.2 Hz, 1H), 7.24 (d, *J* = 2.2 Hz, 2H), 7.22 – 7.21 (m, 1H), 7.20 – 7.17 (m, 2H), 7.04 (s, 1H). **^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$)** δ 143.4, 136.3, 132.3, 131.4, 131.2, 131.1, 131.0, 129.0, 128.1, 127.9, 127.8, 127.5, 127.24 125.9, 125.7, 125.4, 124.9, 124.2, 123.9, 122.9, 92.9, 89.1. **Anal** calcd for $C_{28}H_{20}S$: C, 86.56; H, 5.19; S, 8.25; found C, 86.65; H, 5.14; S, 8.21.



(2-(Phenylseleninyl)ethene-1,1-diyl)dibenzene (13): Colourless oil (0.081 g, 77%); eluent hexane; **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.66 (dd, *J* = 7.7, 1.8 Hz, 2H), 7.47 – 7.38 (m, 6H), 7.25-7.23 (m, 4H), 7.22 – 7.18 (m, 3H), 6.88 (s, 1H).

^{13}C NMR (100 MHz, CDCl$_3$) δ 153.9, 142.0, 138.3, 137.7, 133.6, 131.1, 129.8, 129.7, 129.5, 128.7, 128.7, 128.5, 128.2, 126.4. **^{77}SeNMR (76 MHz, CDCl$_3$)** δ 848.85 (s). **Anal** calcd for $C_{20}H_{16}OSe$: C, 68.38; H, 4.59; found C, 68.49; H, 4.41.



(2-Iodoethene-1,1-diyl)dibenzene (14):[15] Pale yellow oil (0.138 g, 90%); eluent hexane; **^{1}H NMR (400 MHz, CDCl$_3$)** δ 7.31 (d, J = 7.2 Hz, 3H), 7.20 – 7.14 (m, 5H), 7.12 (dd, J = 3.7, 1.6 Hz, 2H), 6.84 (s, 1H).**^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$)** δ 152.7, 141.8, 141.1, 129.4, 128.3, 128.3, 128.1, 128.0, 127.5, 79.0.

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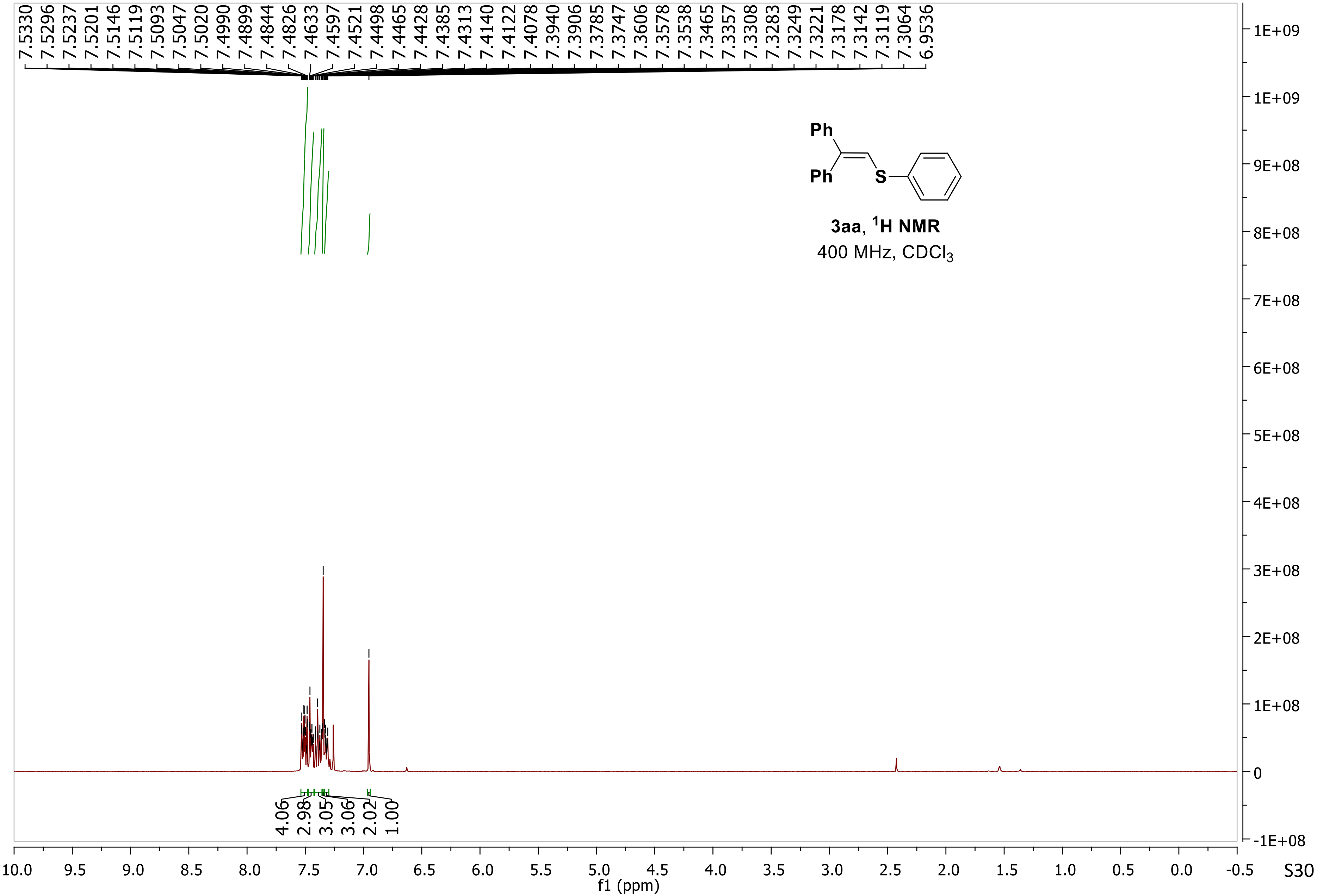
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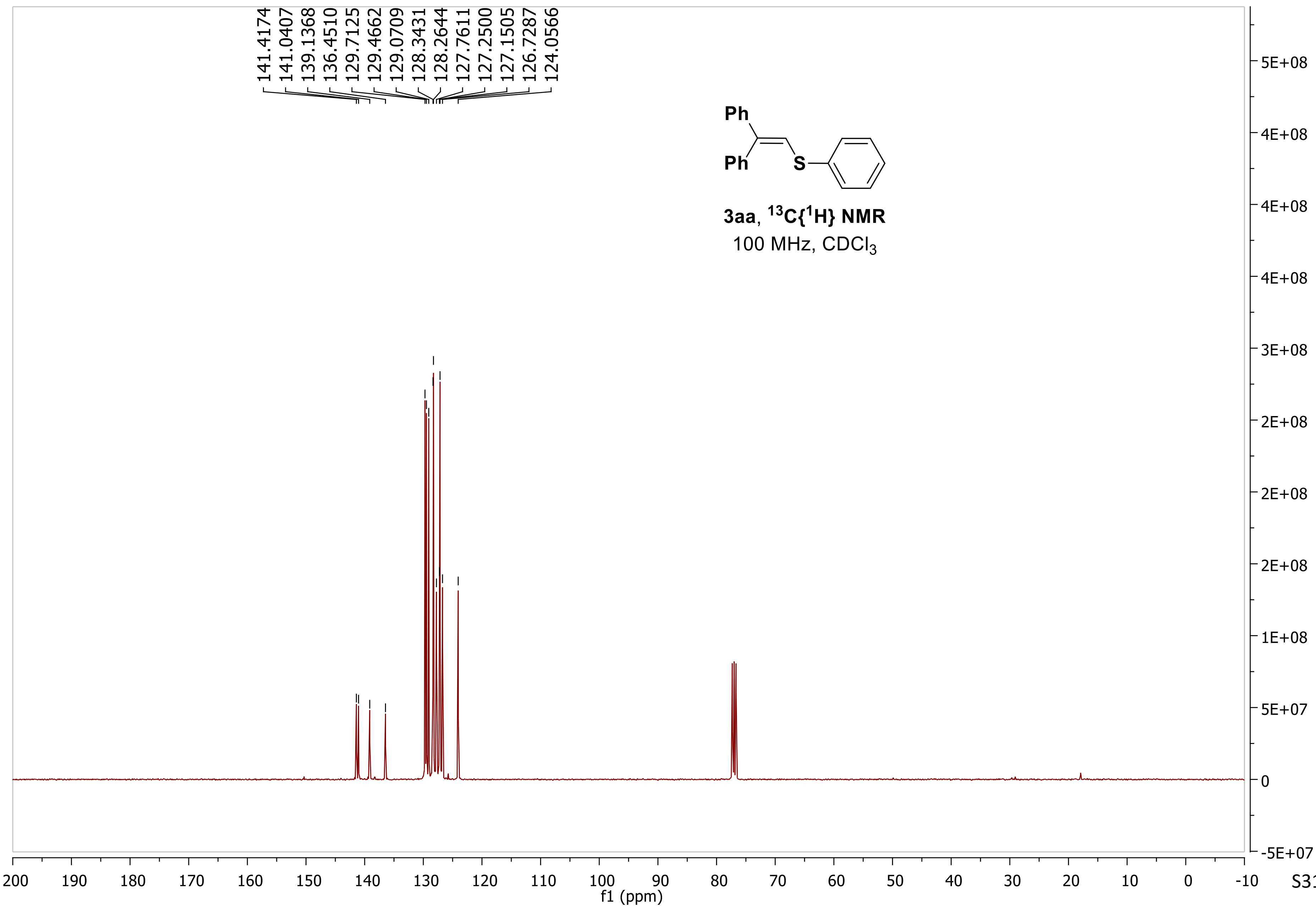
1.00
f1 (ppm)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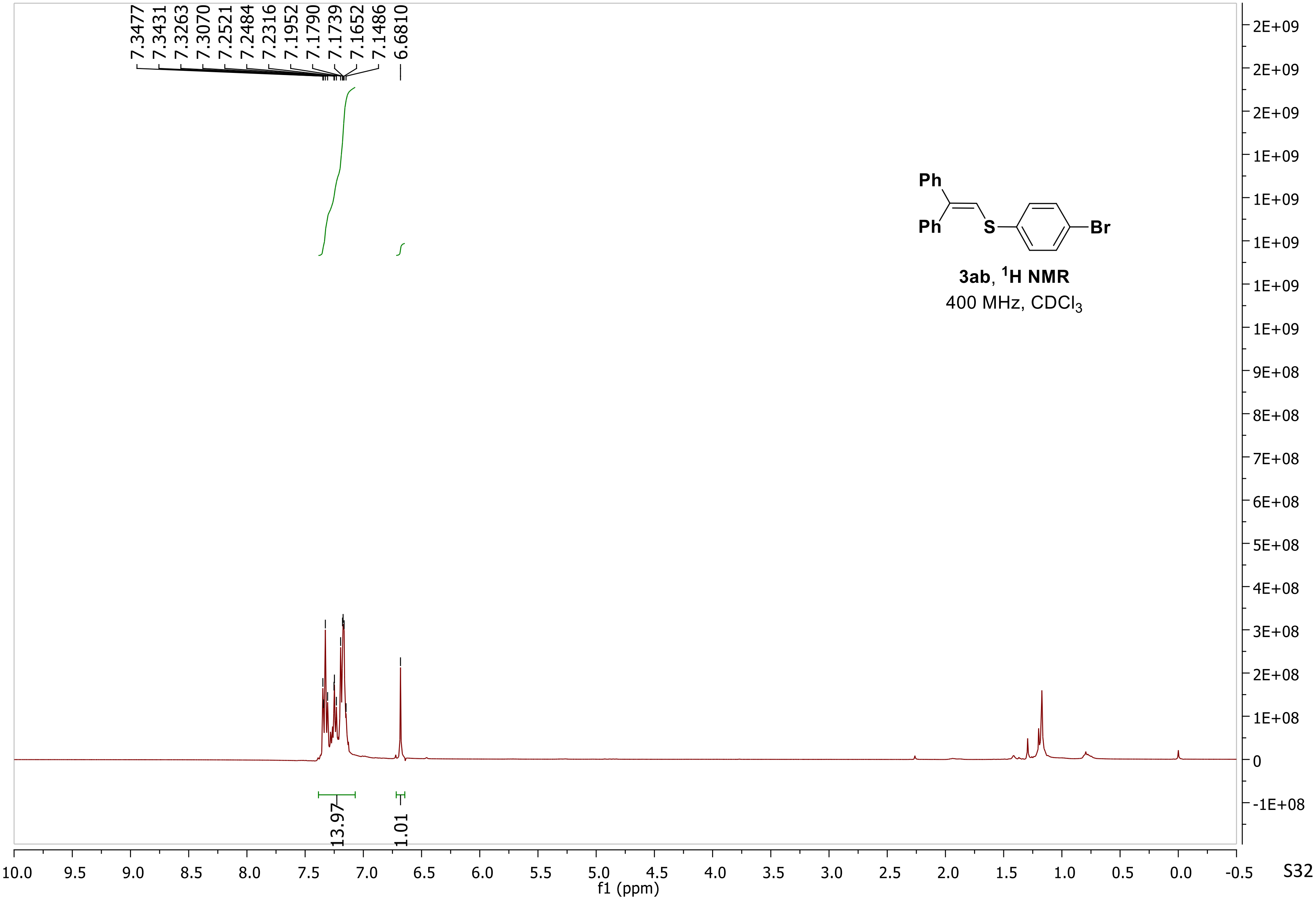
100 MHz, $CDCl_3$
f1 (ppm)



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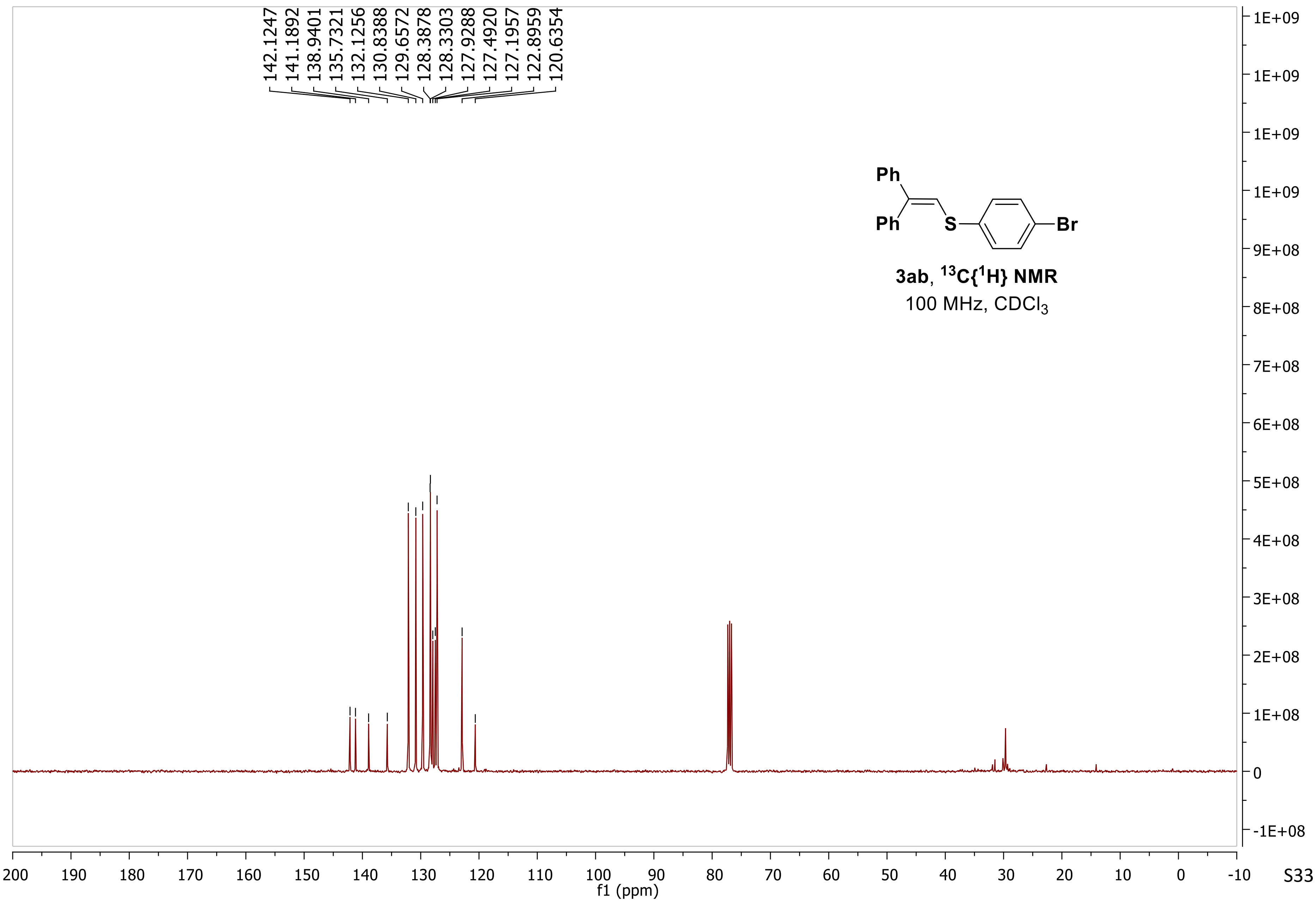
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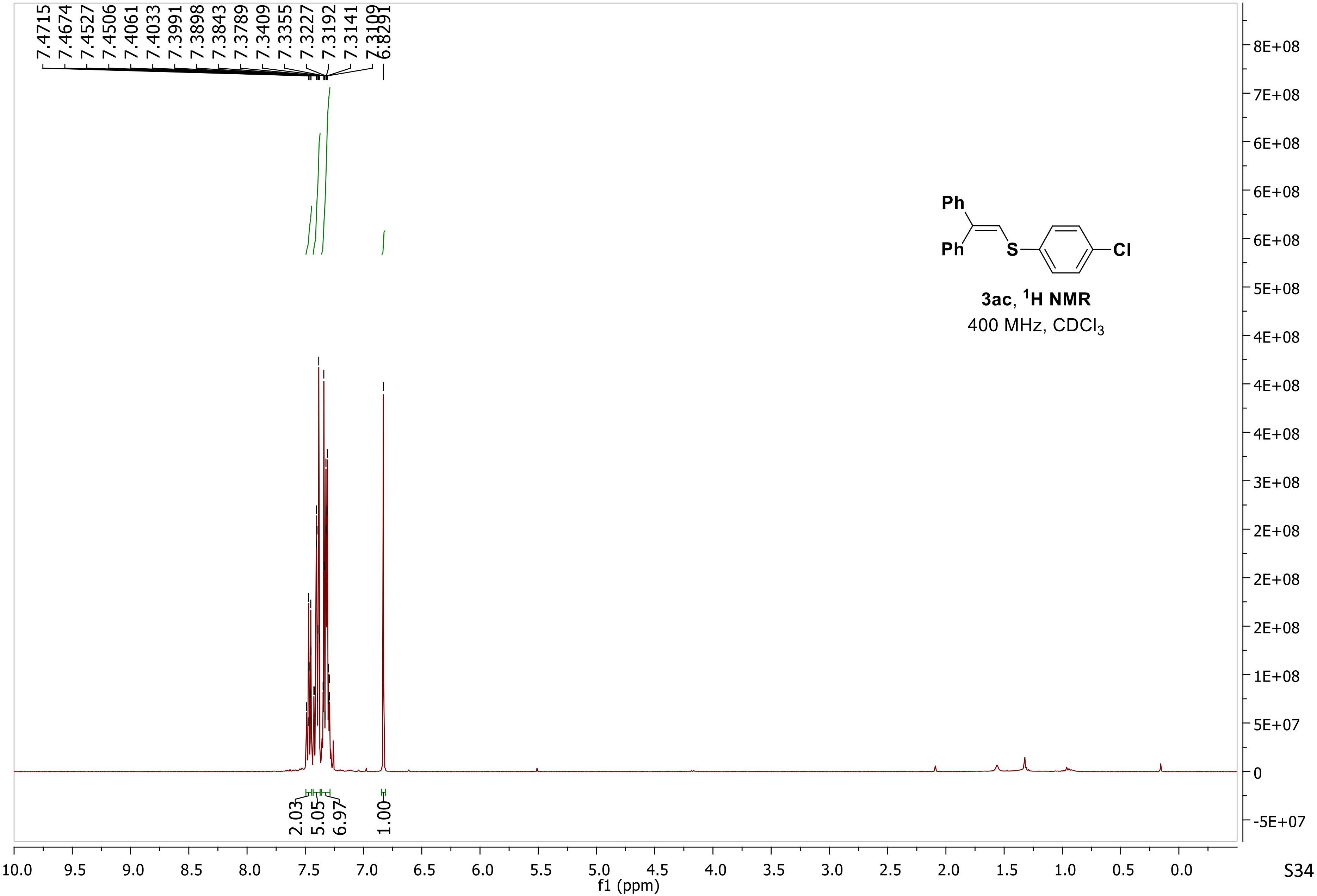
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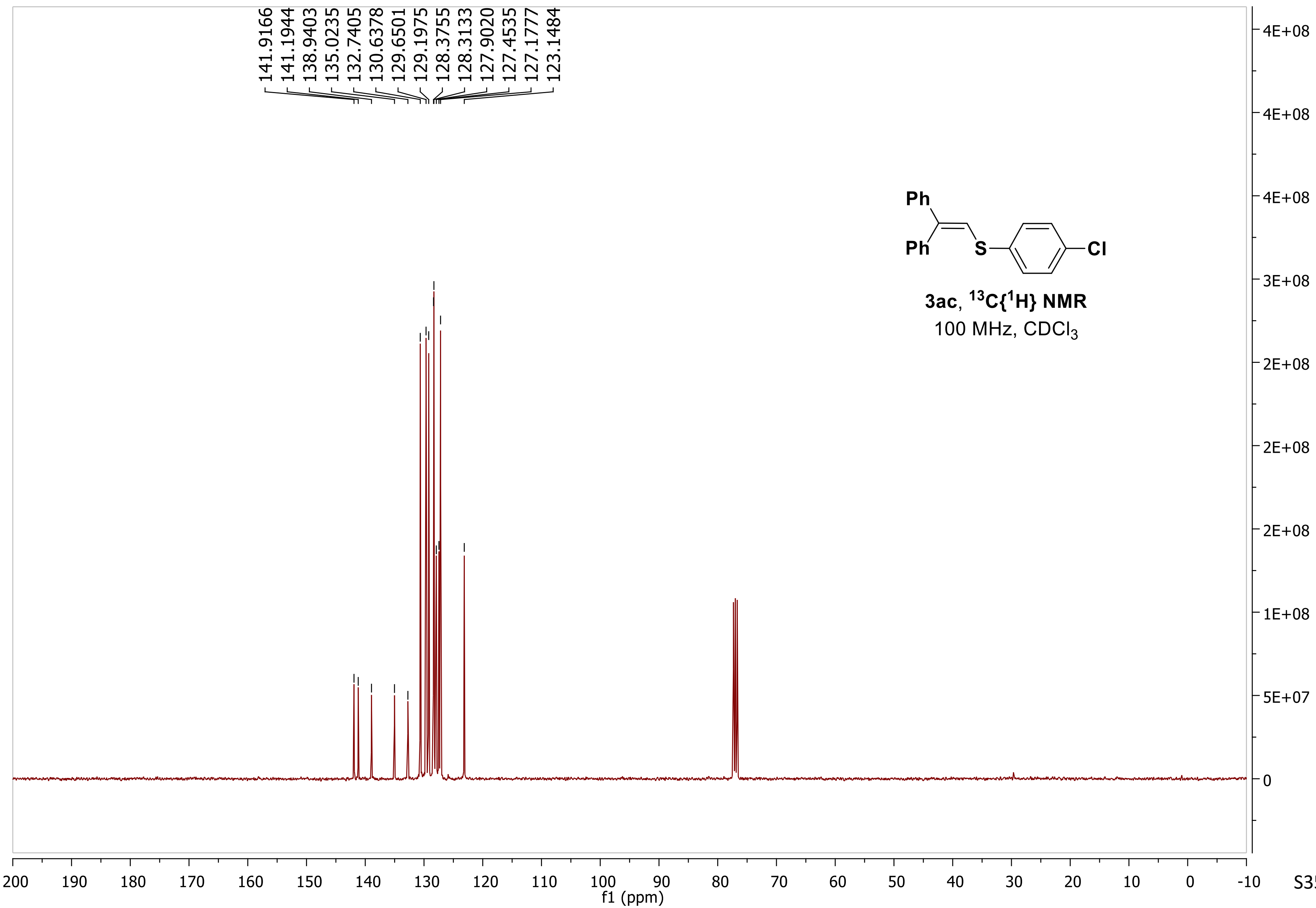
f1 (ppm)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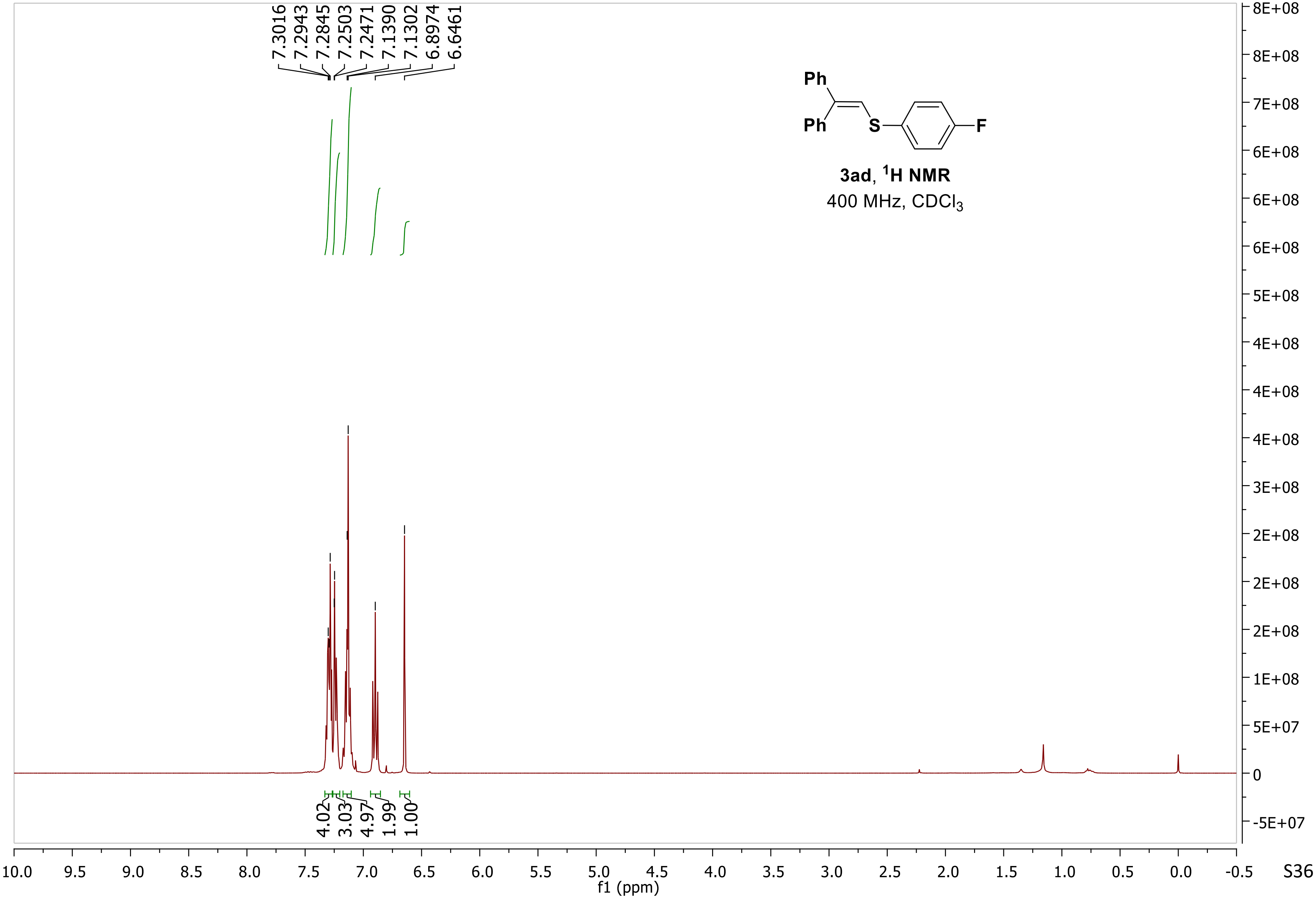
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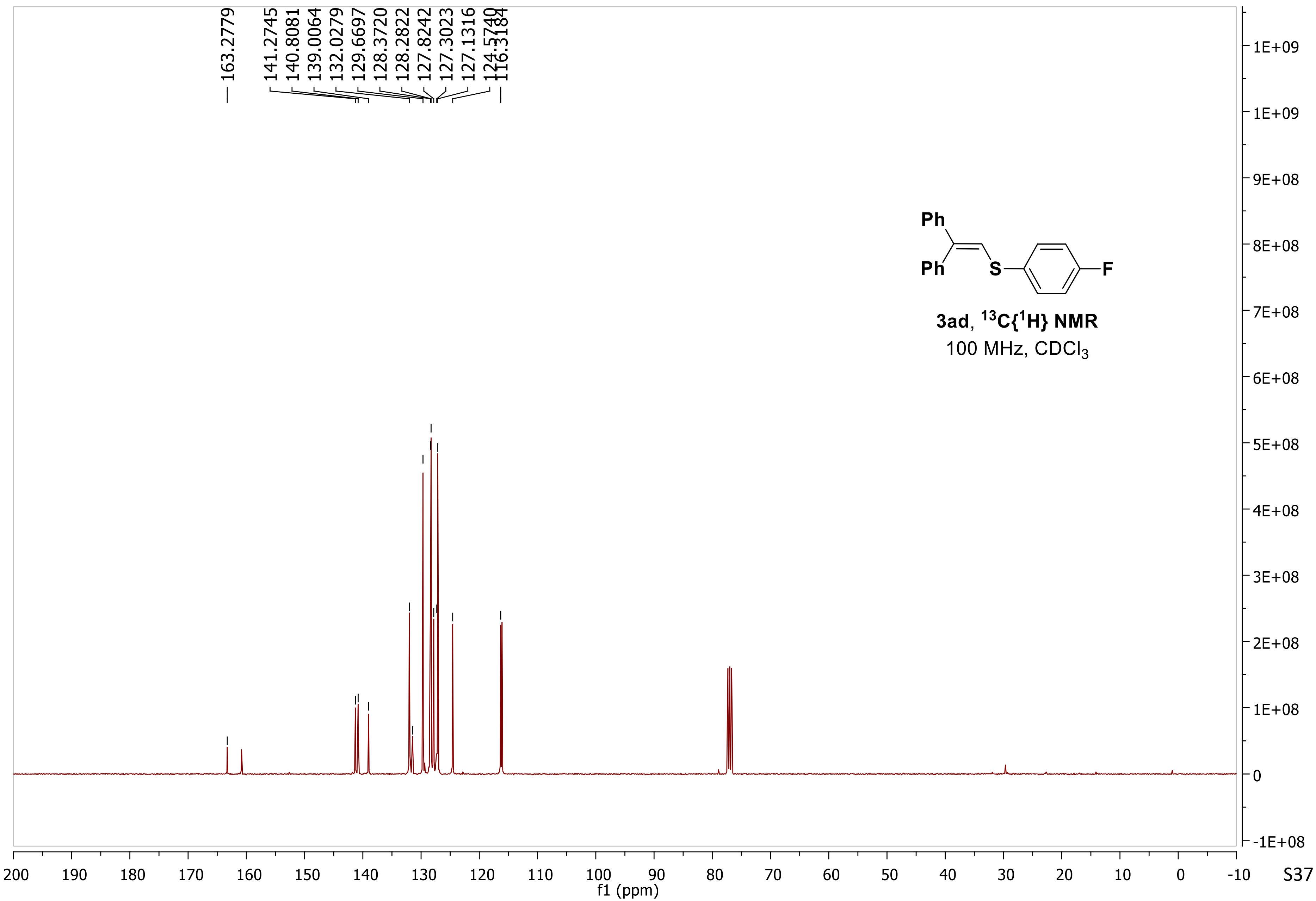
f1 (ppm)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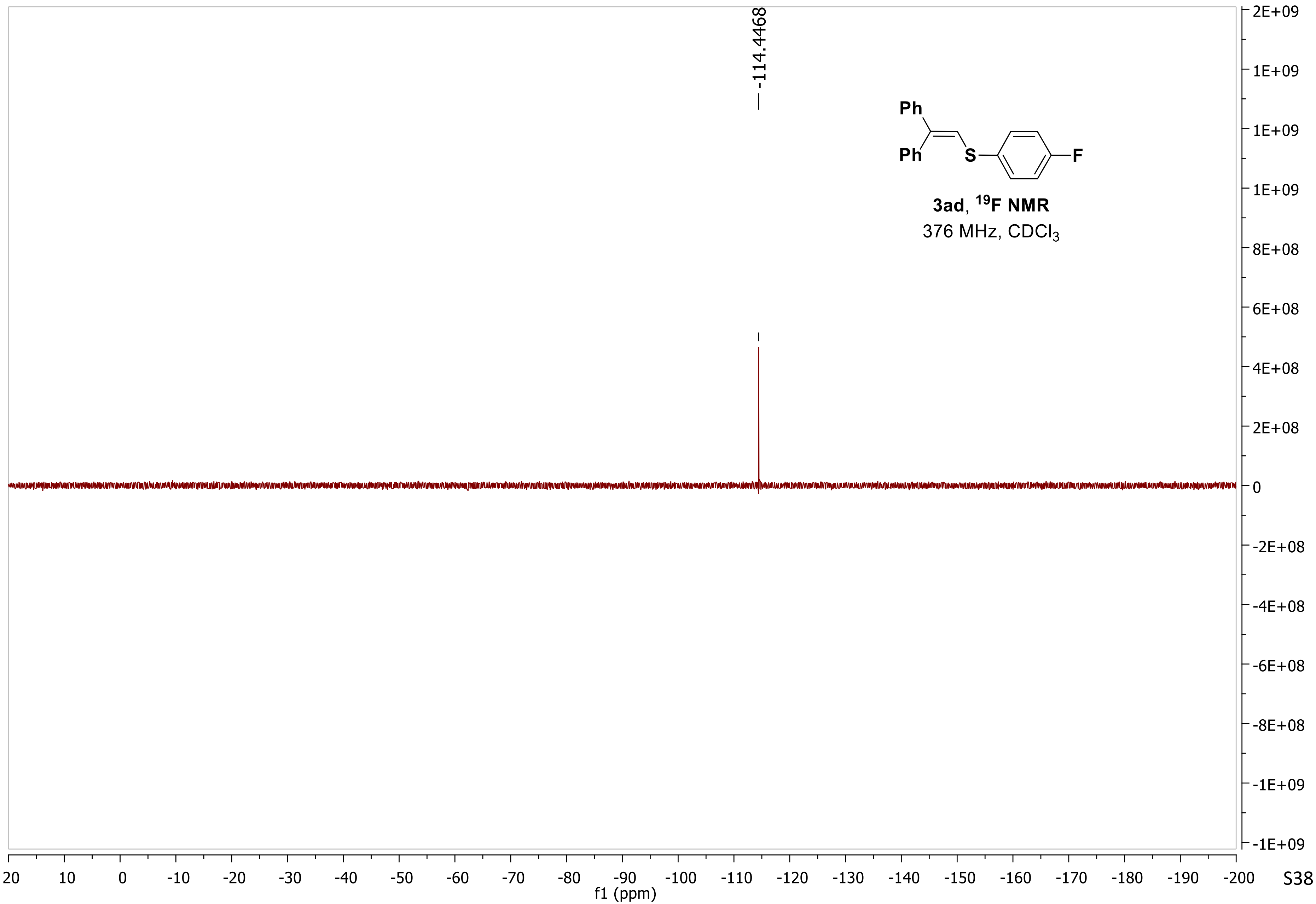
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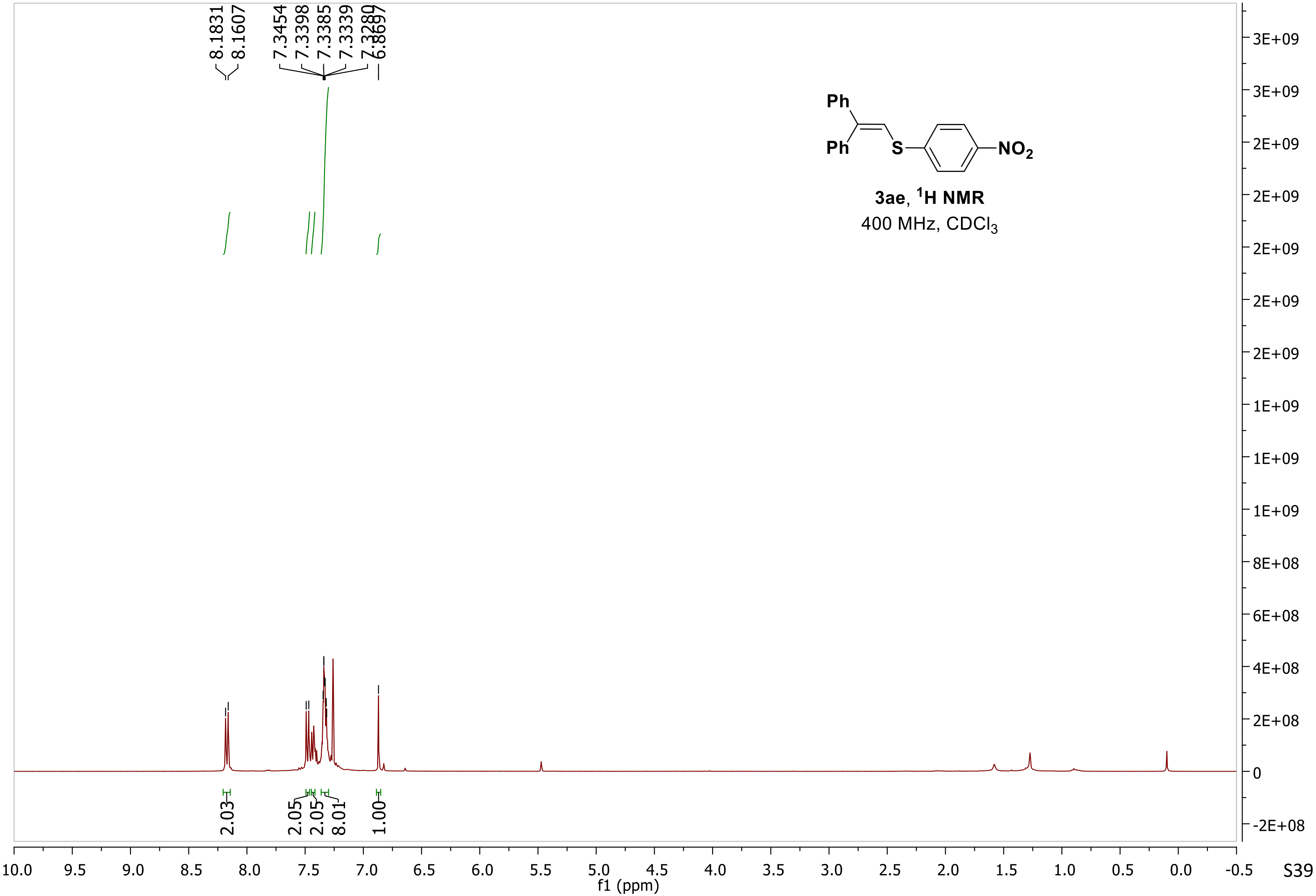
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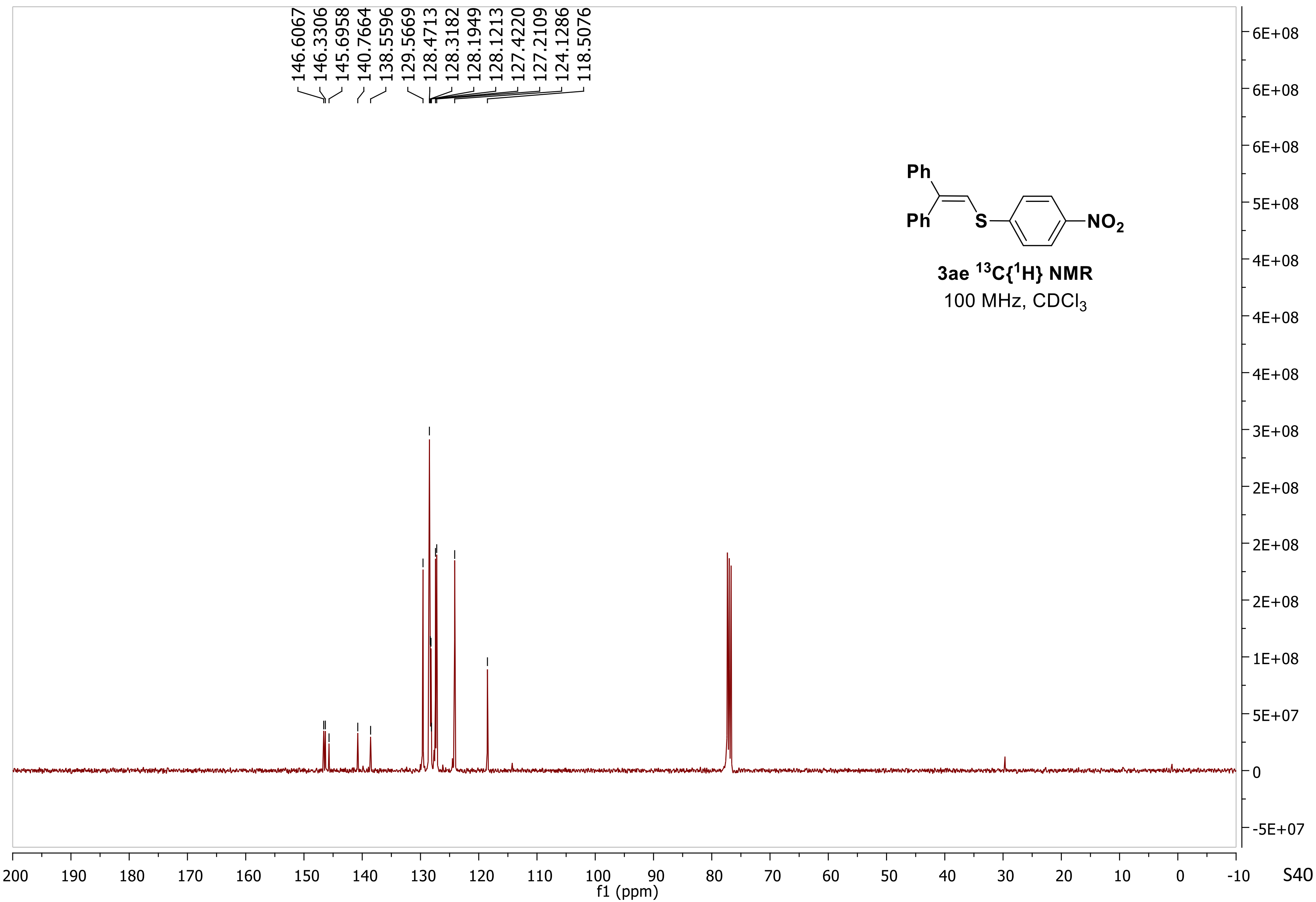
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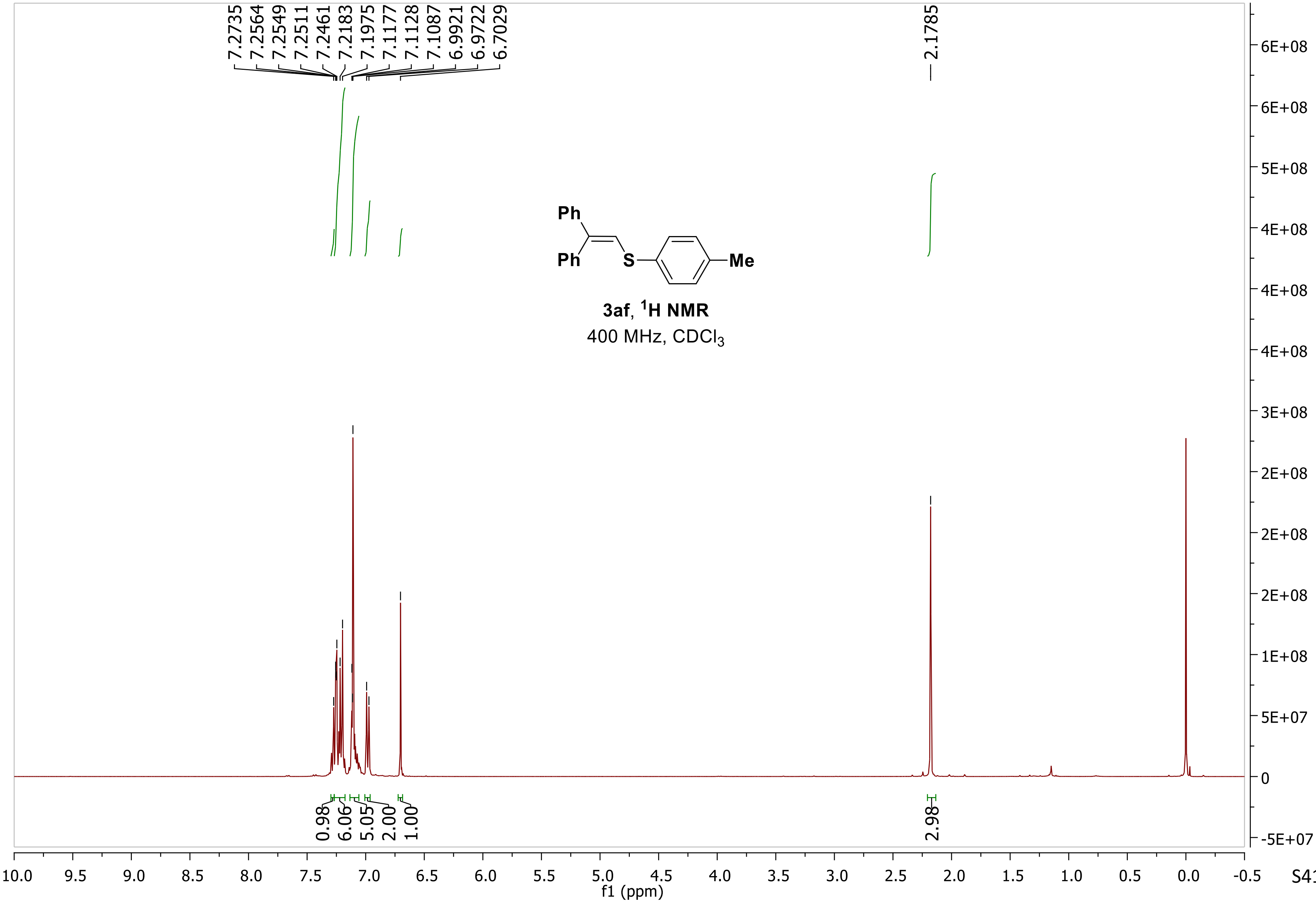

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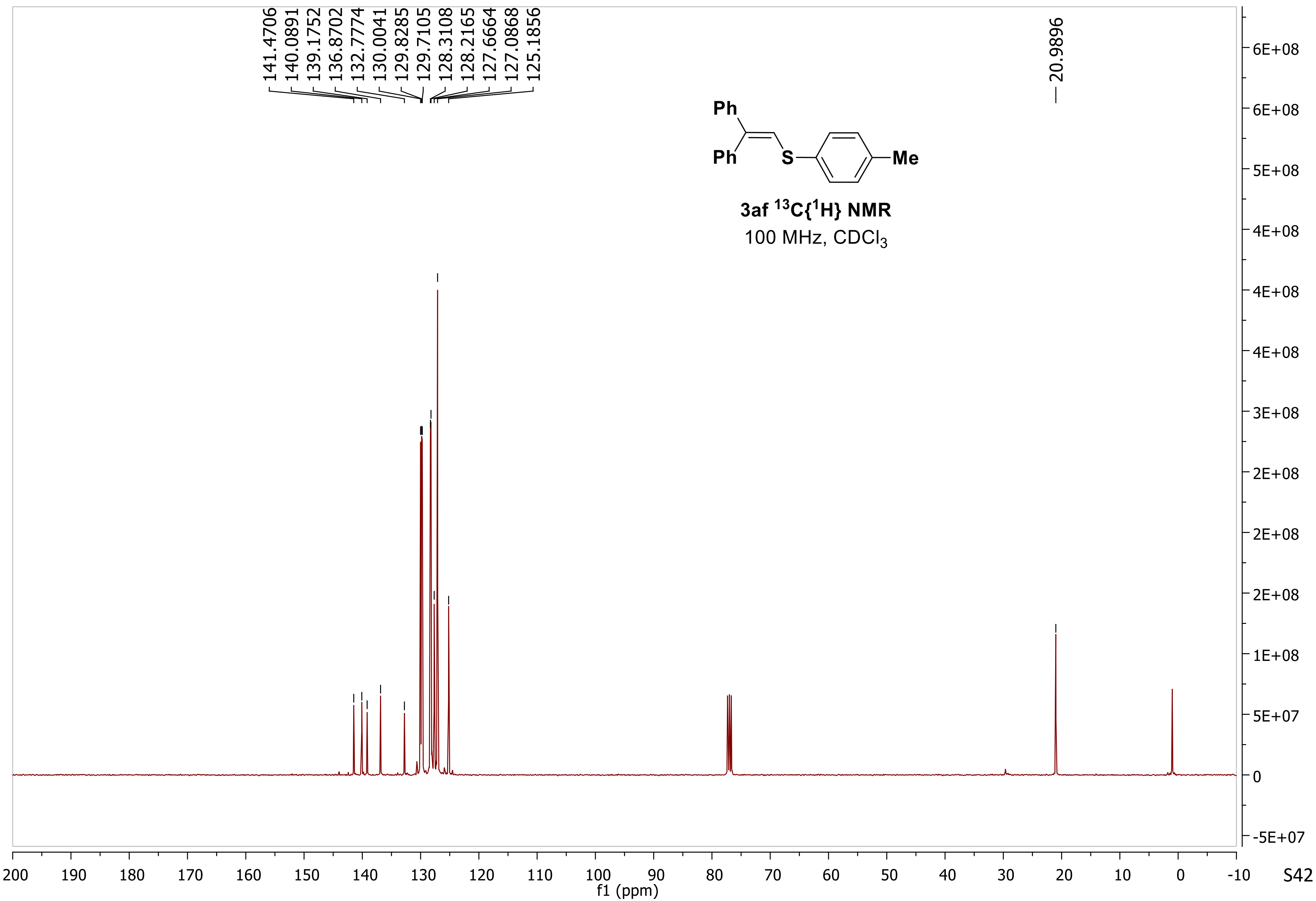
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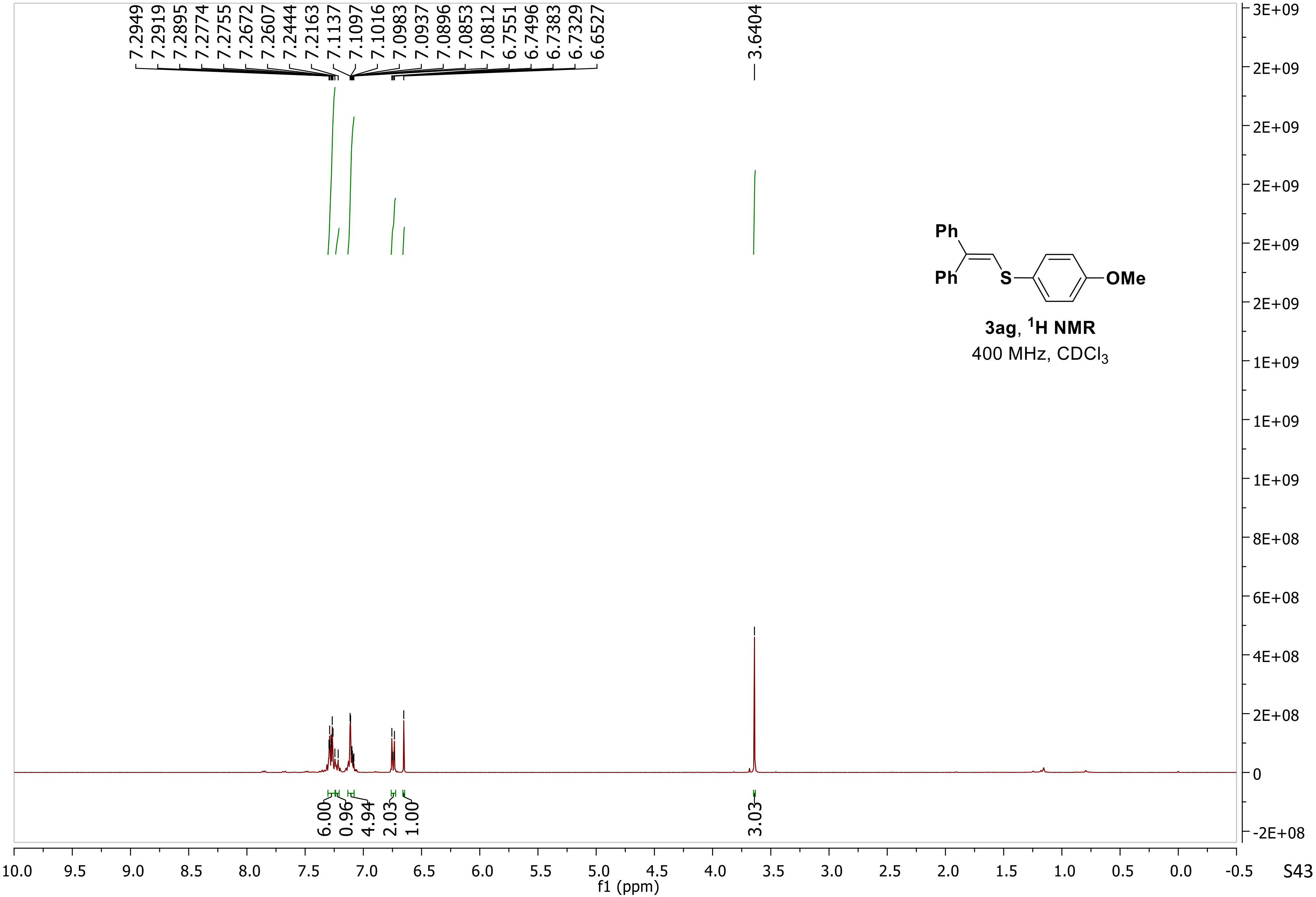
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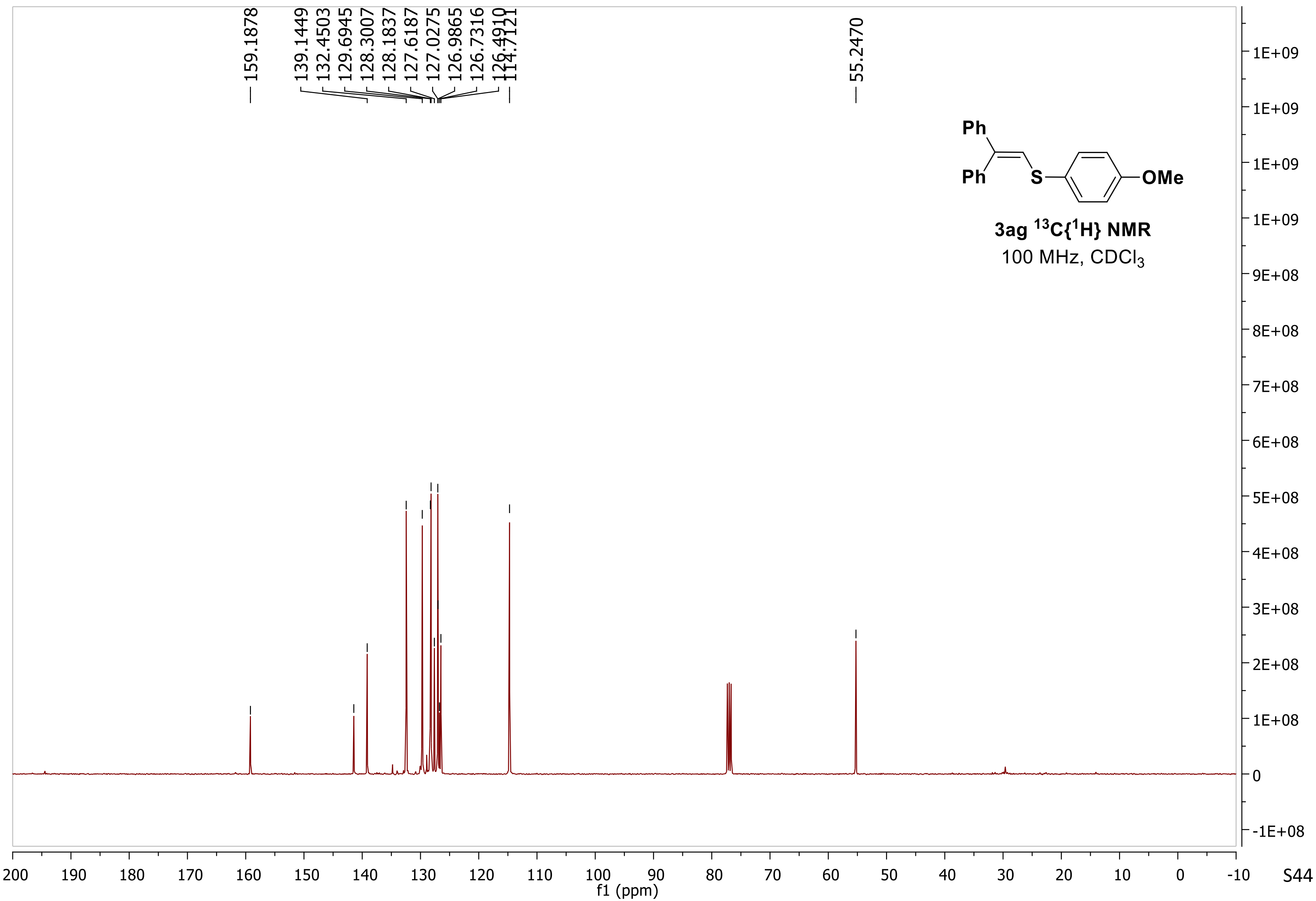
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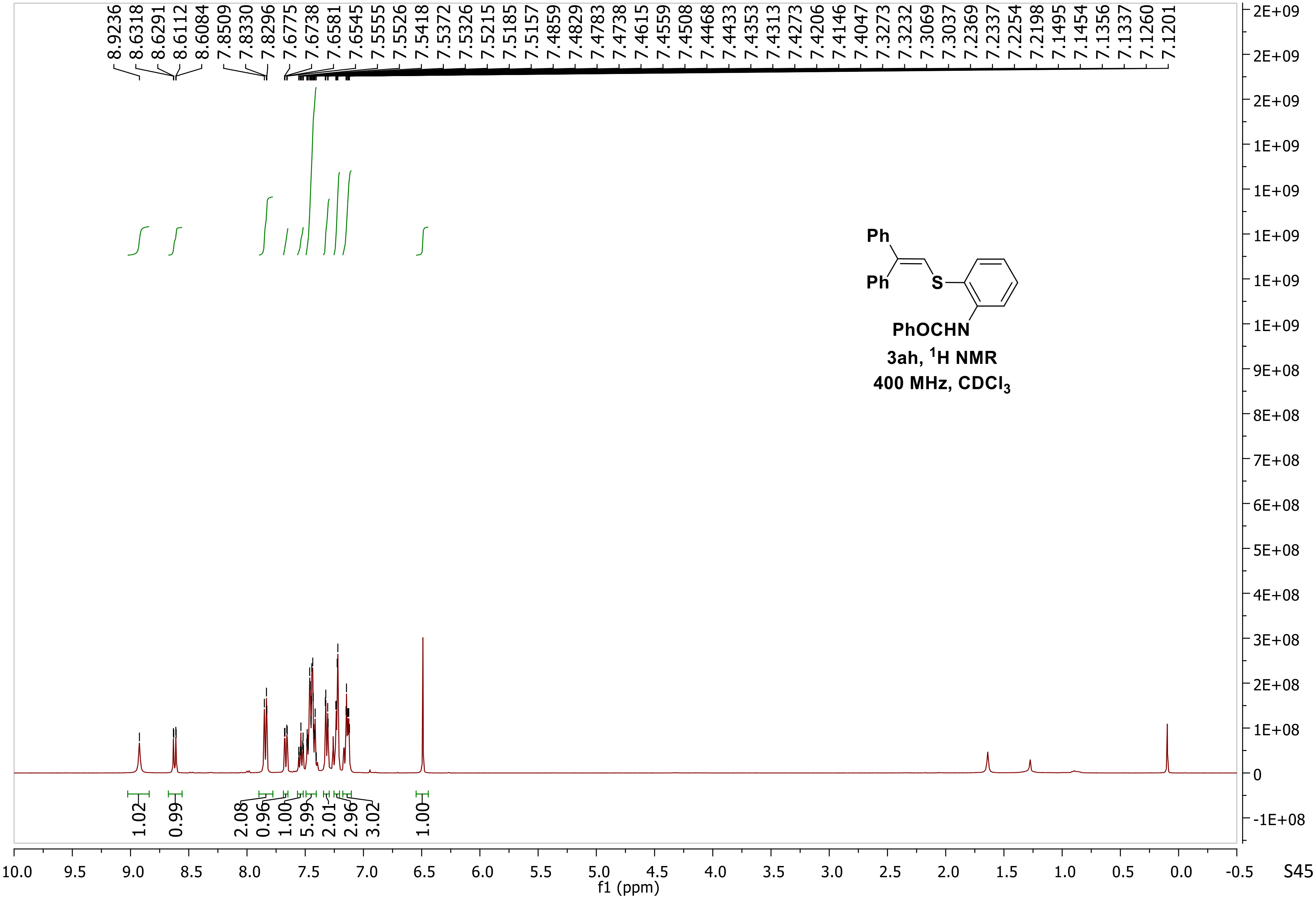

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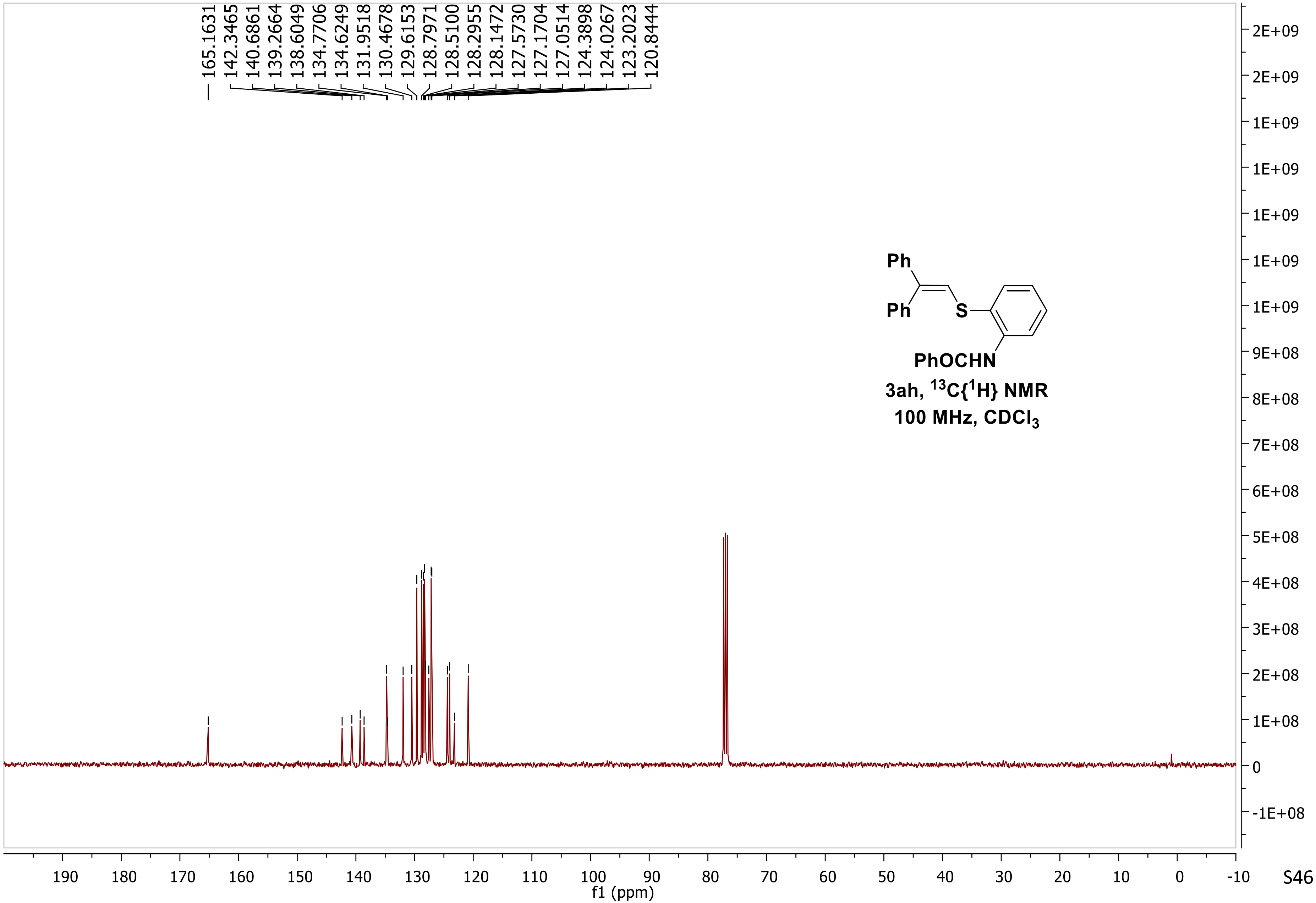
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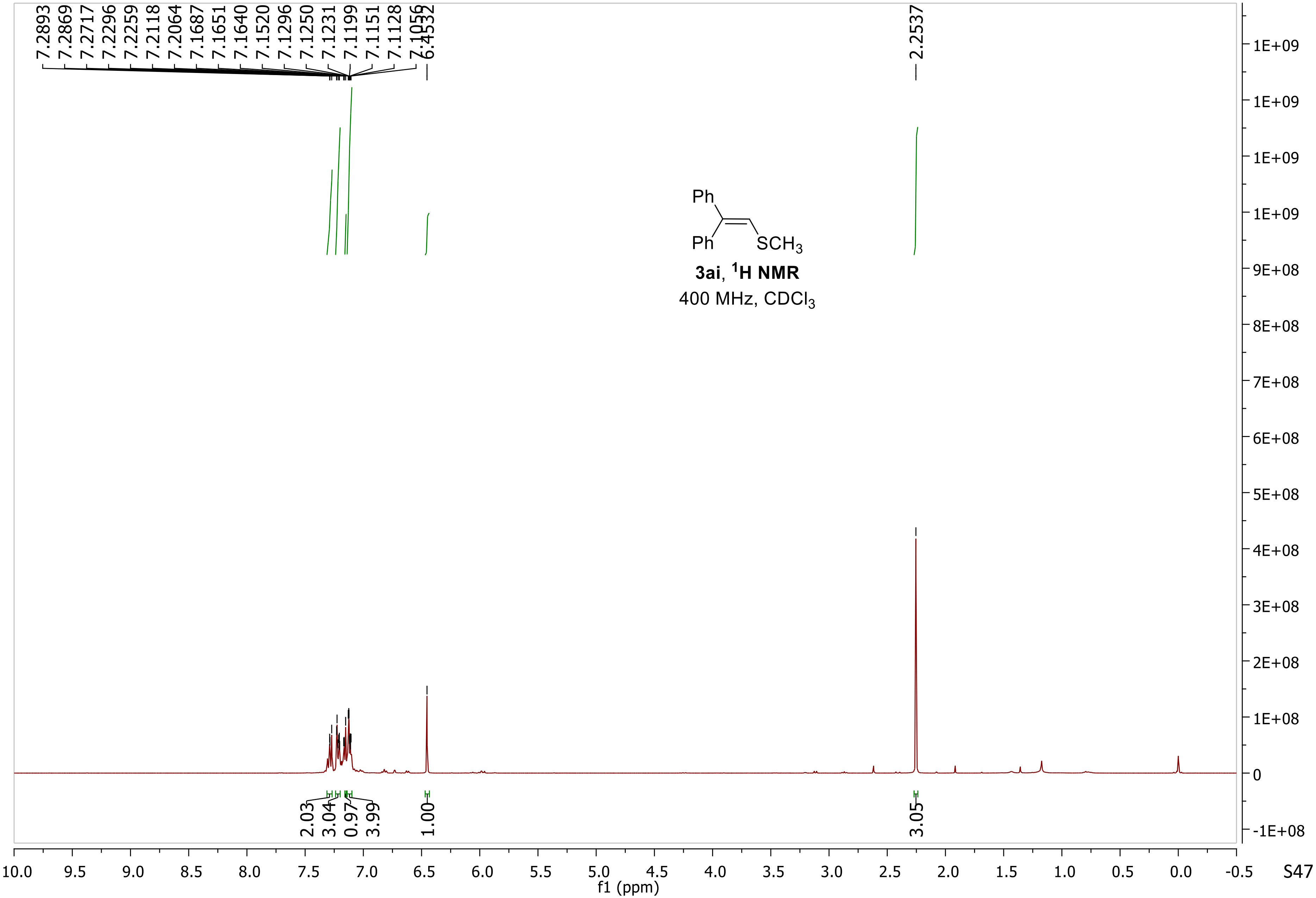
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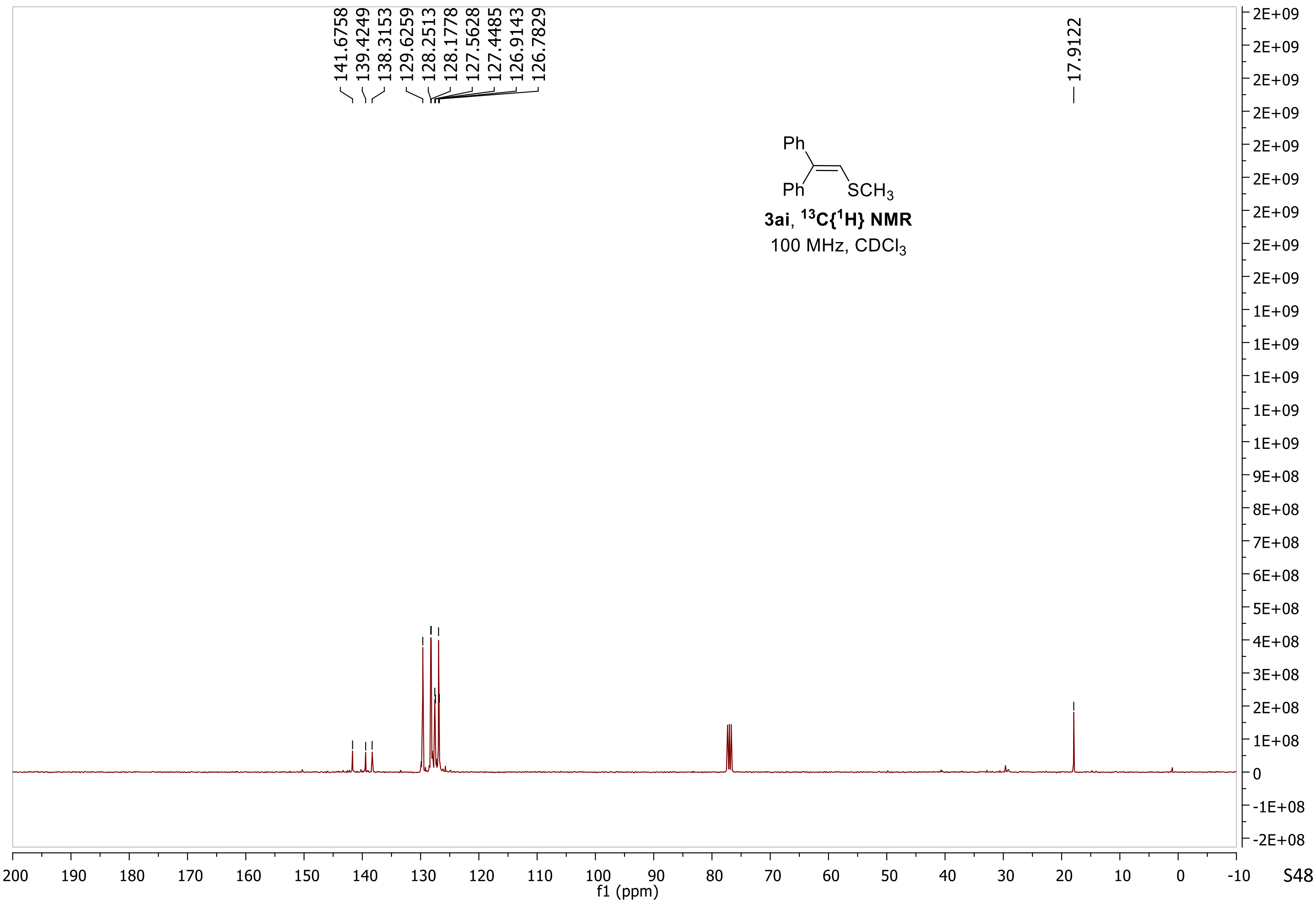
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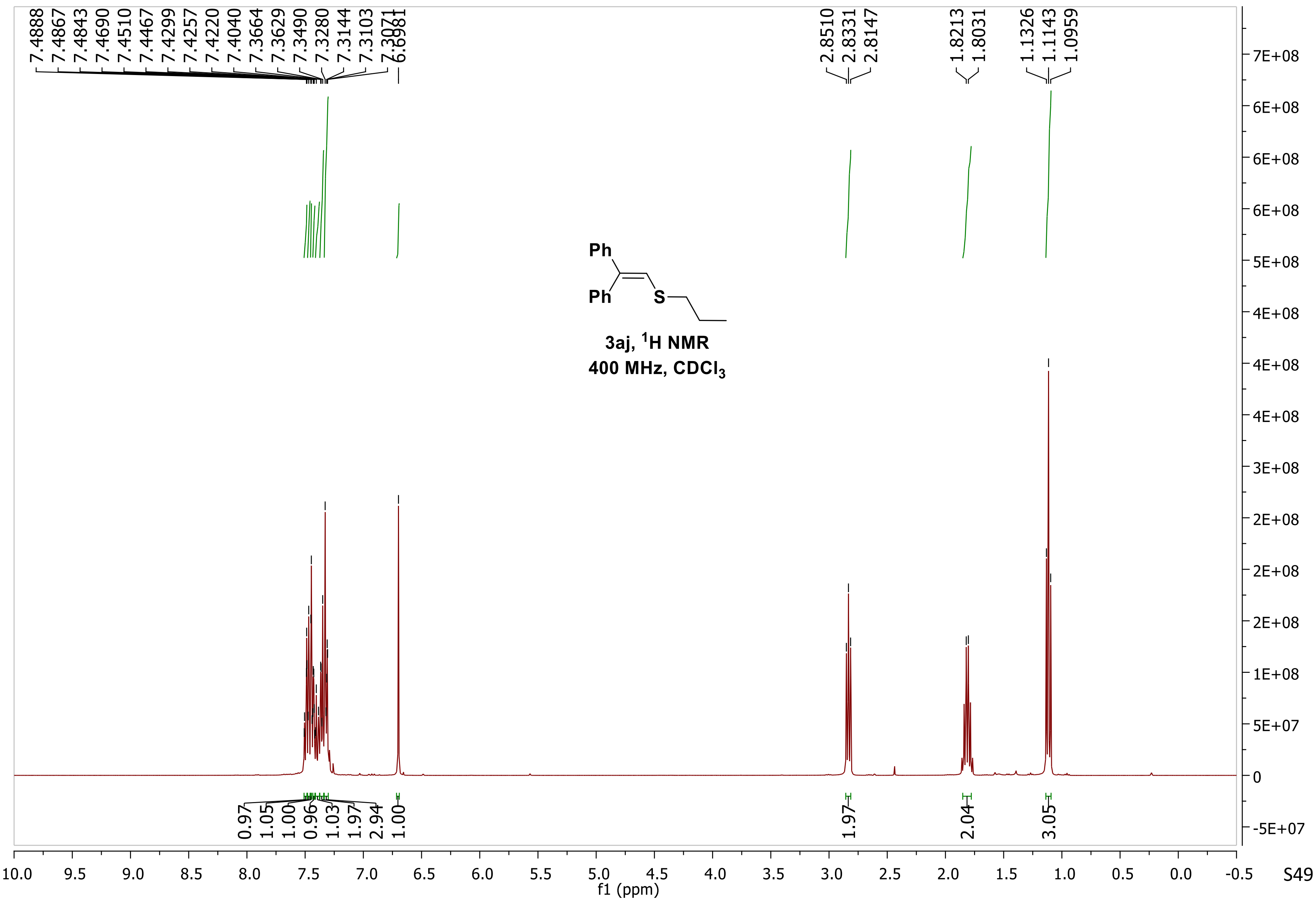
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7.4843
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7.4510
7.4467
7.4299
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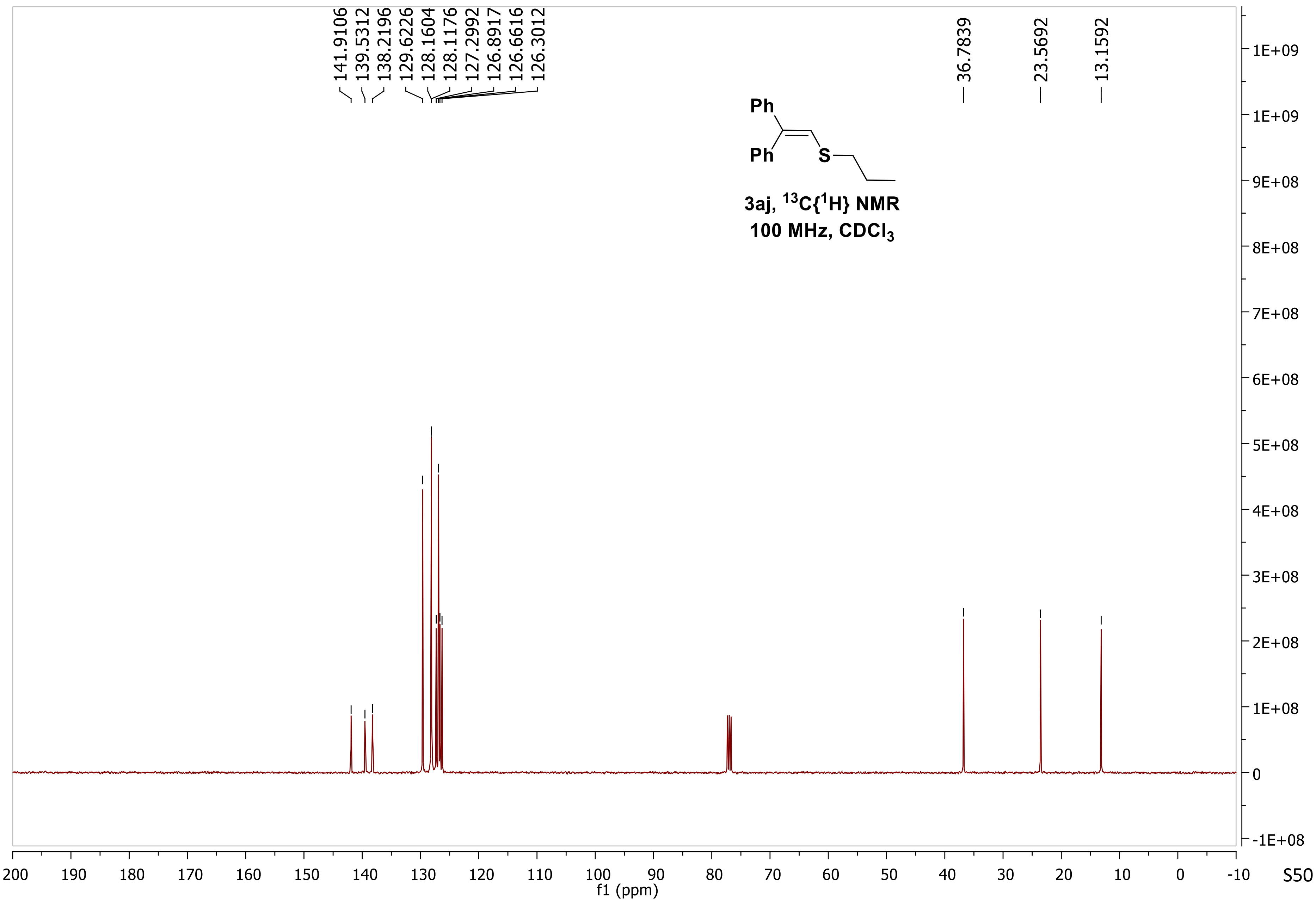
7.4220
7.4040
7.3664
7.3629
7.3490
7.3280
7.3144
7.3103
7.3071
6.6981
2.8510
2.8331
2.8147
1.8213
1.8031
1.1326
1.1143
1.0959
Ph
Ph
S
3aj, ¹H NMR
400 MHz, CDCl3
0.97
1.05
1.00
0.96
1.03
1.97
2.94
1.00
1.97
2.04
3.05
f1 (ppm)



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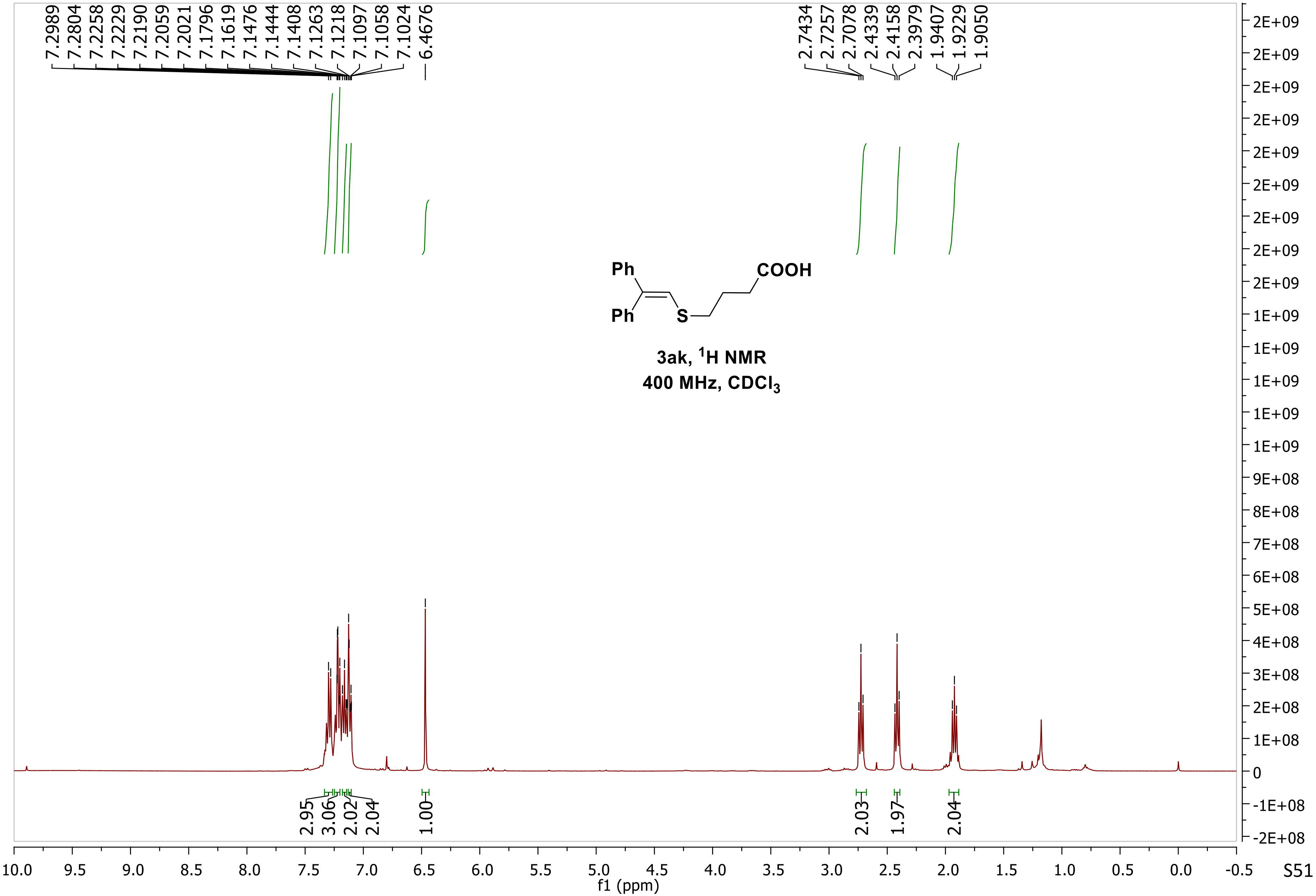
138.2196
129.6226
128.1604
128.1176
127.2992
126.8917
126.6616
126.3012
36.7839
23.5692
13.1592
Ph
Ph
S
3aj, $^{13}C\{^{1}H\}$ NMR
100 MHz, $CDCl_3$
f1 (ppm)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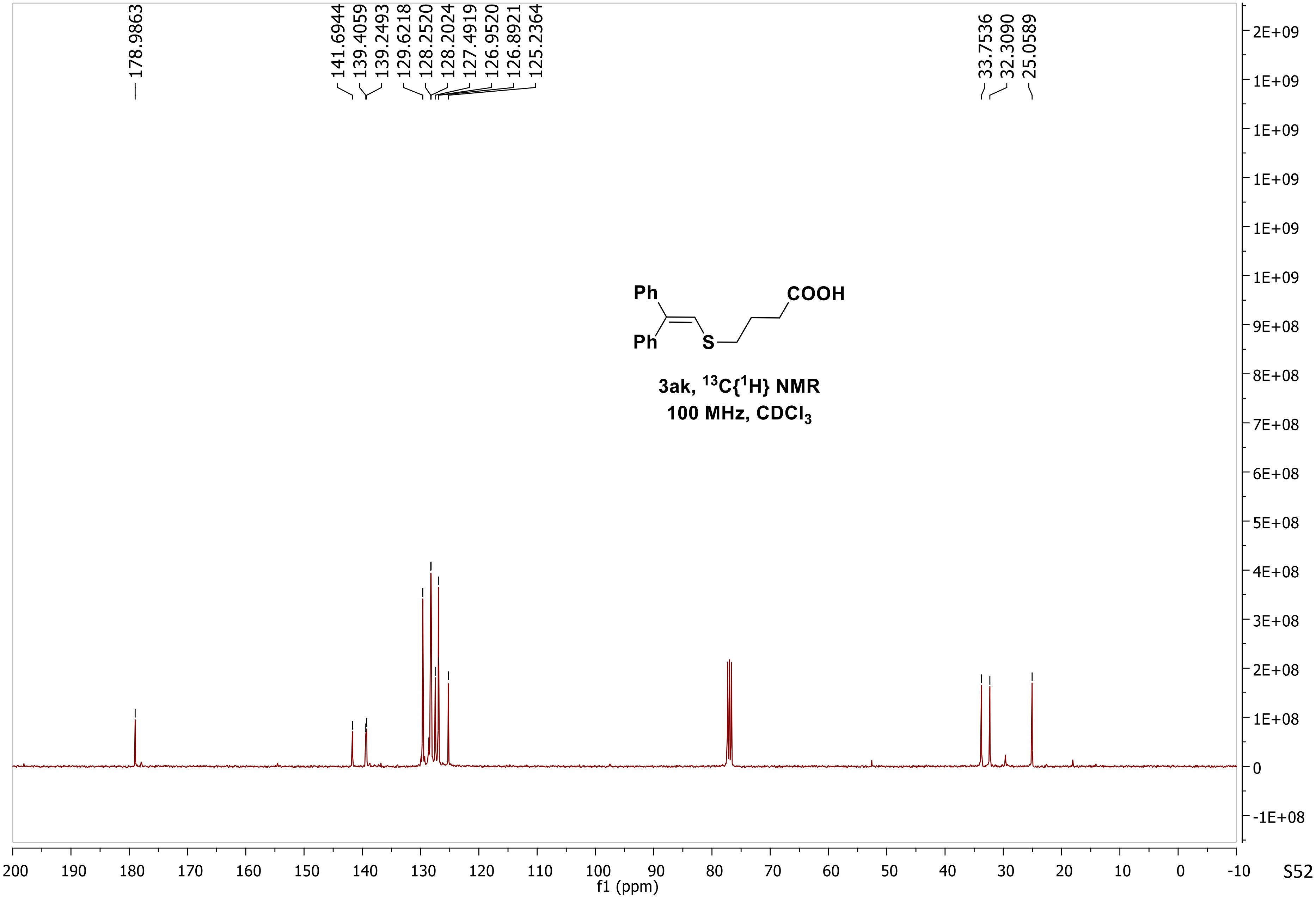
400 MHz, CDCl3
f1 (ppm)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125.2364
33.7536
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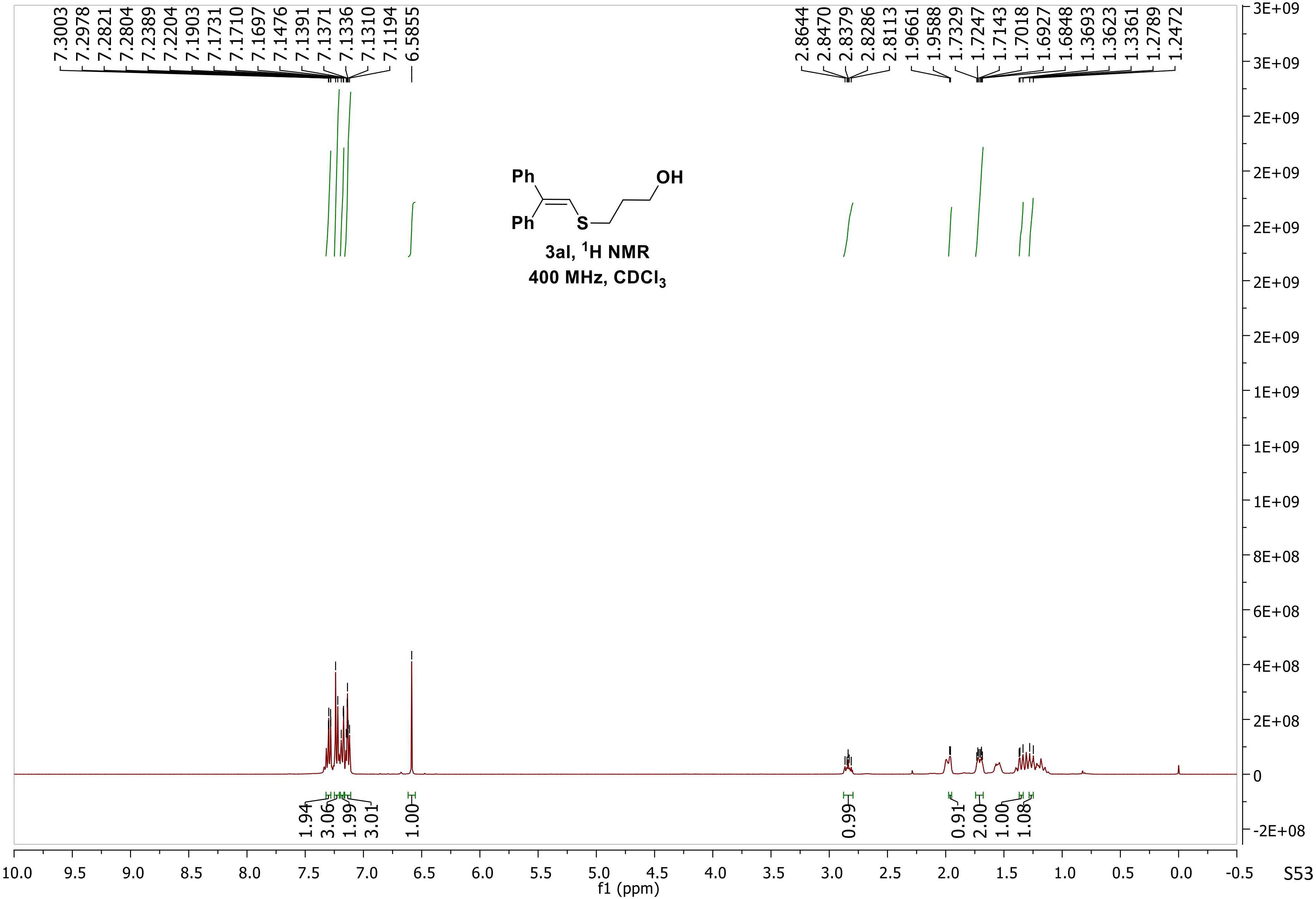
Ph
Ph
S
COOH
3ak, $^{13}C\{^1H\}$ NMR
100 MHz, $CDCl_3$
f1 (ppm)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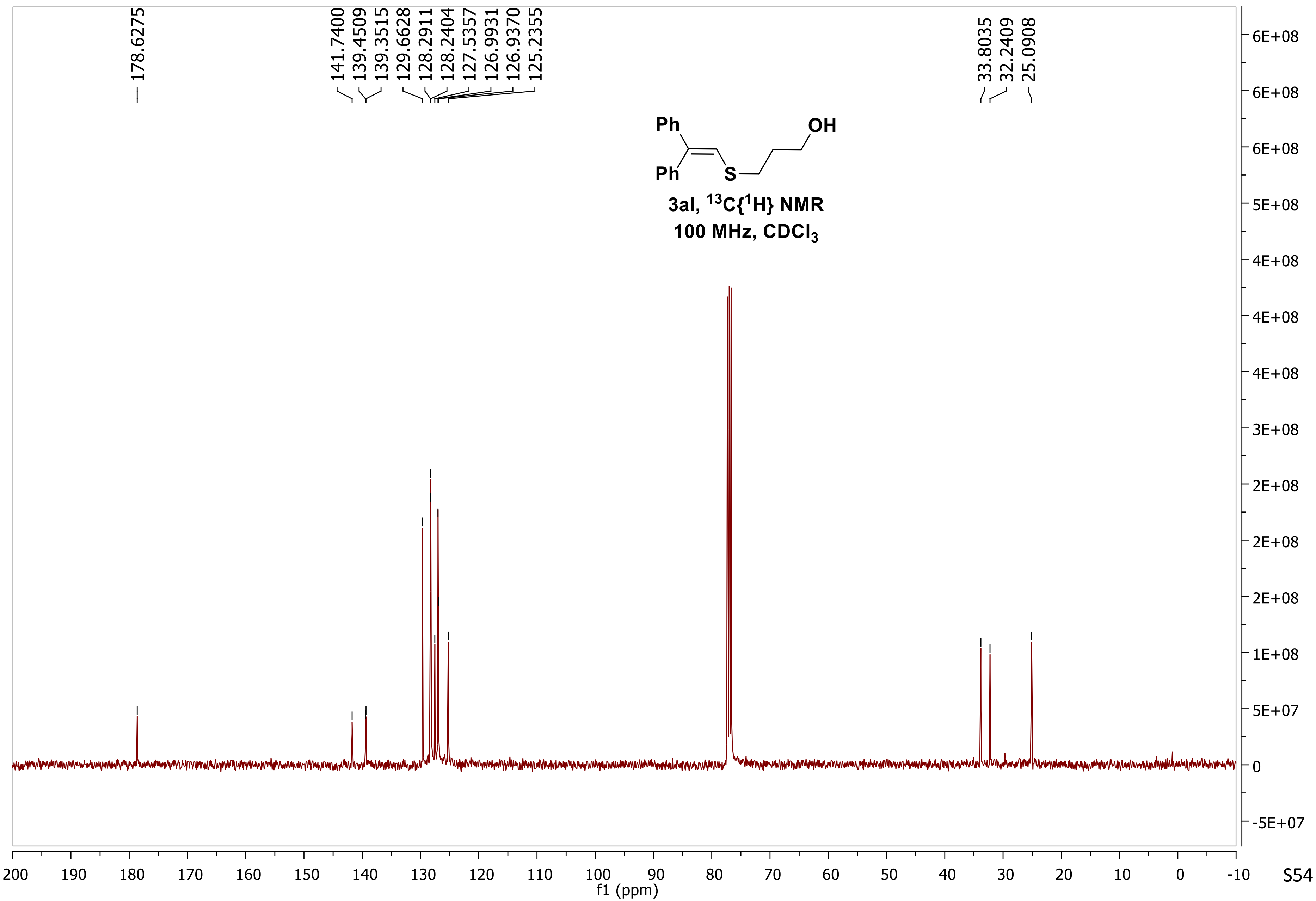
7.2978
7.2821
7.2804
7.2389
7.2204
7.1903
7.1731
7.1710
7.1697
7.1476
7.1391
7.1371
7.1336
7.1310
7.1194
6.5855
2.8644
2.8470
2.8379
2.8286
2.8113
1.9661
1.9588
1.7329
1.7247
1.7143
1.7018
1.6927
1.6848
1.3693
1.3623
1.3361
1.2789
1.2472
Ph
Ph
S
OH
3al, 1H NMR
400 MHz, CDCl3
1.94
3.06
1.99
3.01
1.00
0.99
0.91
2.00
1.00
1.08
f1 (ppm)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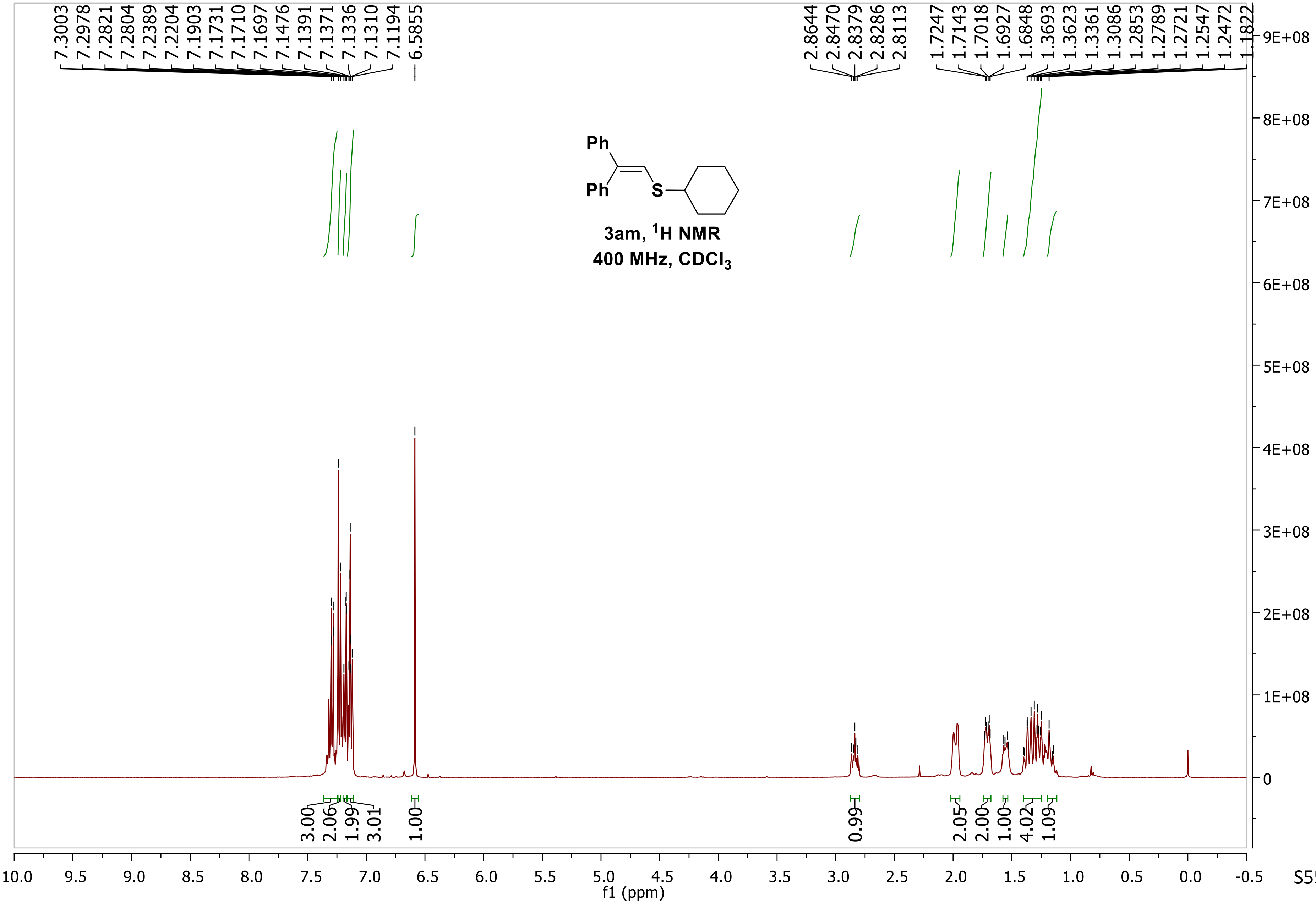
33.8035
32.2409
25.0908
Ph
Ph
S
OH
3al, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)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7.2821
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7.1903
7.1731
7.1710
7.1697
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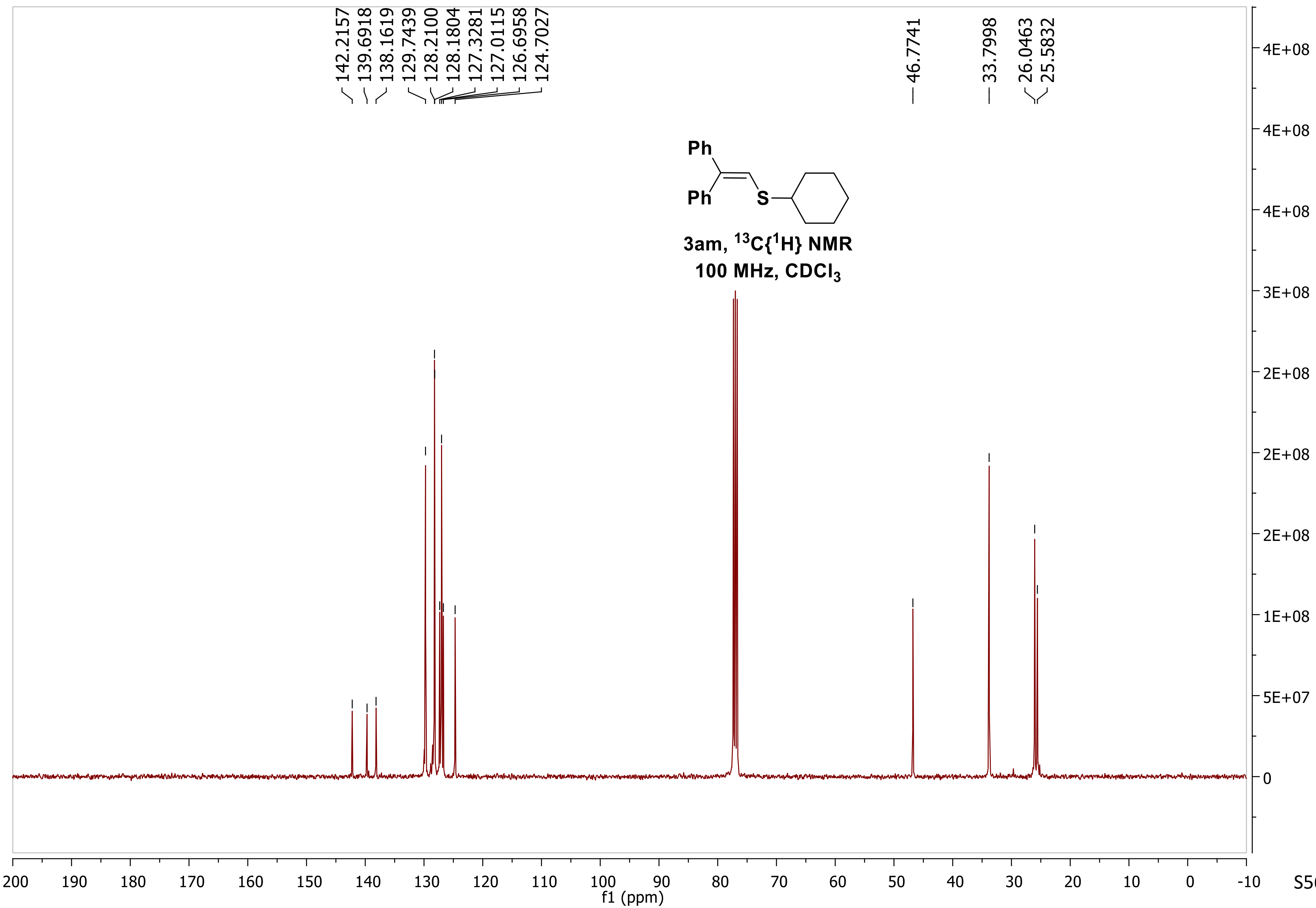
7.1391
7.1371
7.1336
7.1310
7.1194
6.5855
2.8644
2.8470
2.8379
2.8286
2.8113
1.7247
1.7143
1.7018
1.6927
1.6848
1.3693
1.3623
1.3361
1.3086
1.2853
1.2789
1.2721
1.2547
1.2472
1.1822
Ph
Ph
S
3am, 1H NMR
400 MHz, CDCl3
3.00
2.06
1.99
3.01
1.00
0.99
2.05
2.00
1.00
4.02
1.09
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)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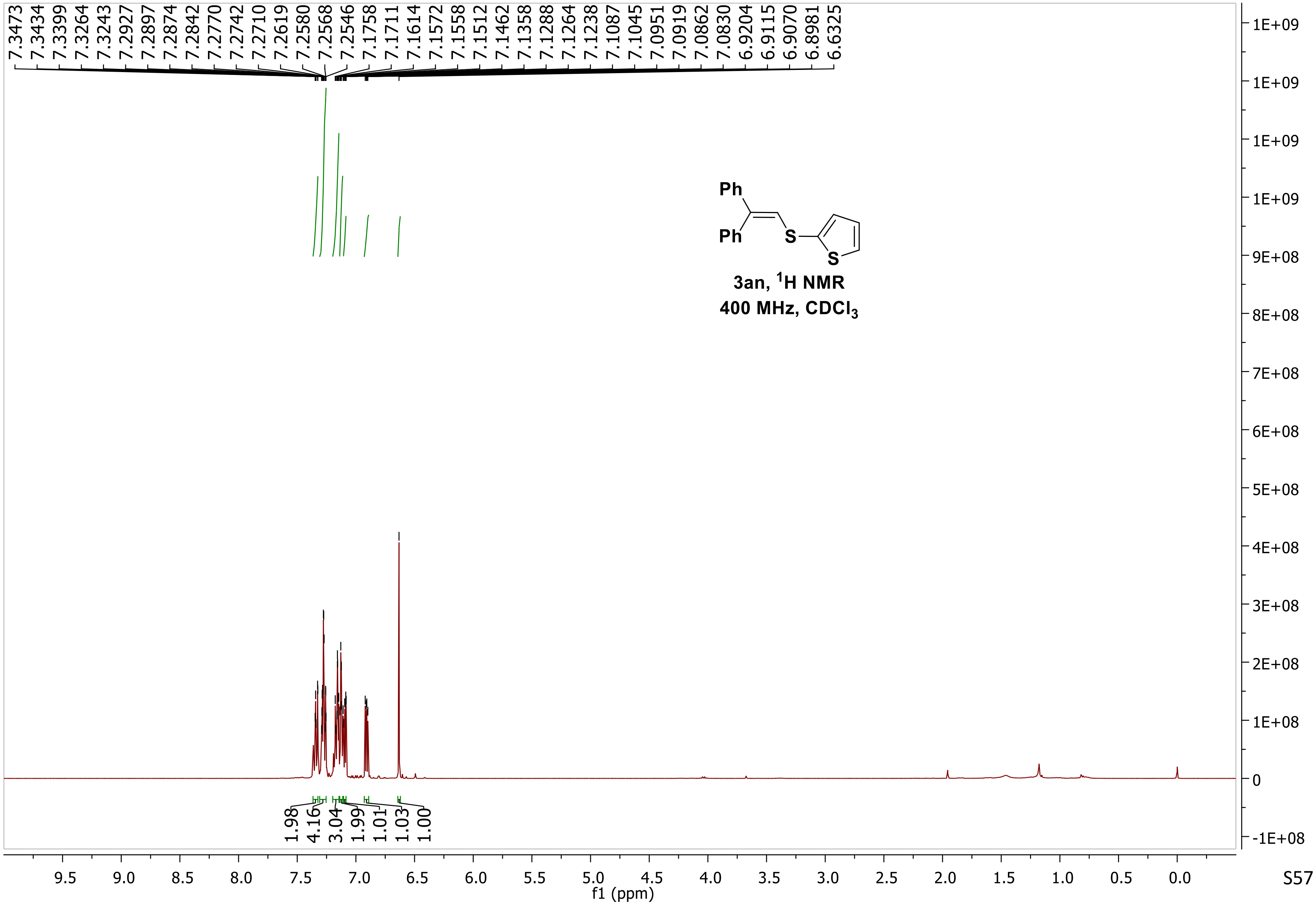
138.1619
129.7439
128.2100
128.1804
127.3281
127.0115
126.6958
124.7027
46.7741
33.7998
26.0463
25.5832
Ph
Ph
S
3am, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)



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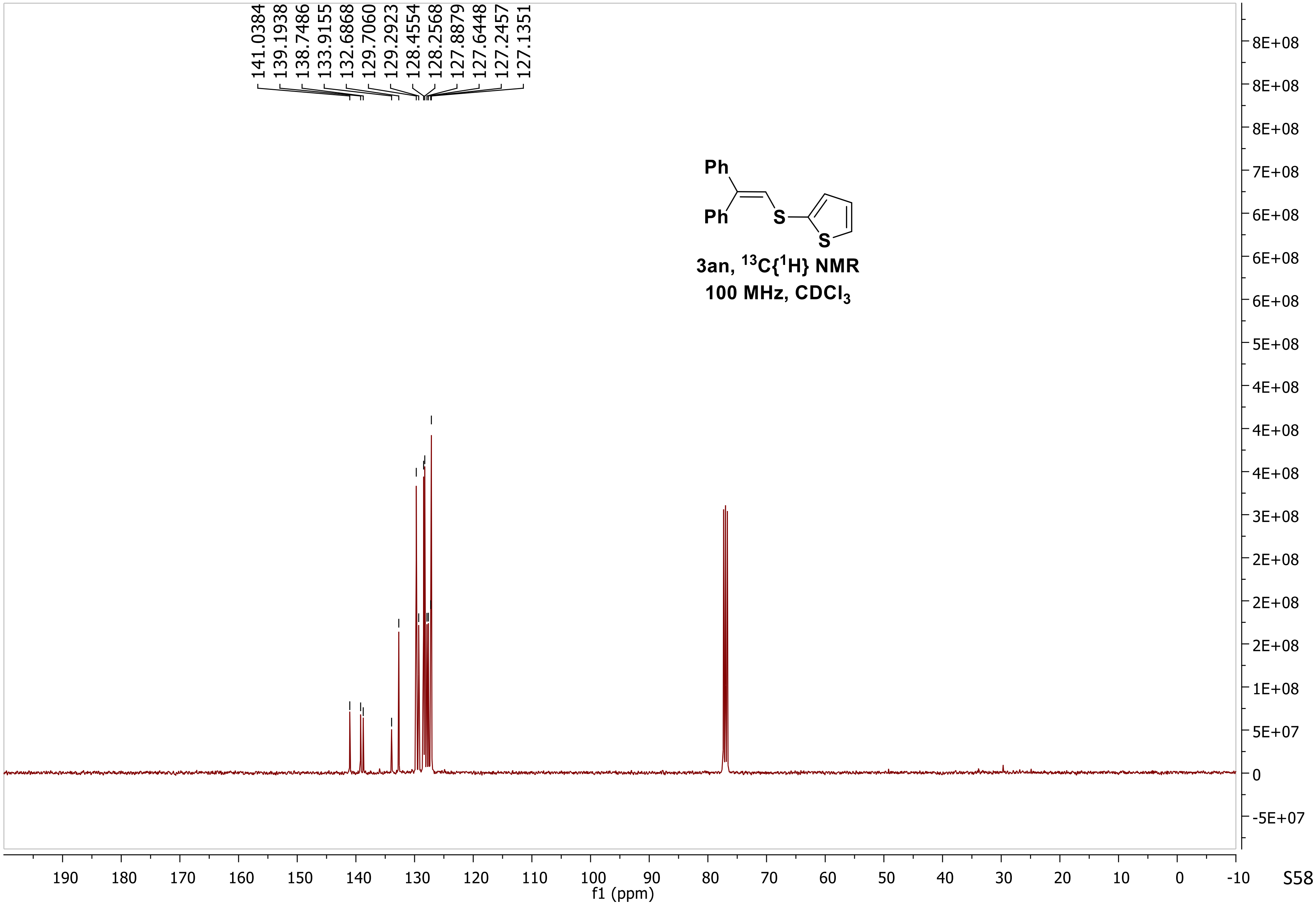
7.3434
7.3399
7.3264
7.3243
7.2927
7.2897
7.2874
7.2842
7.2770
7.2742
7.2710
7.2619
7.2580
7.2568
7.2546
7.1758
7.1711
7.1614
7.1572
7.1558
7.1512
7.1462
7.1358
7.1288
7.1264
7.1238
7.1087
7.1045
7.0951
7.0919
7.0862
7.0830
6.9204
6.9115
6.9070
6.8981
6.6325
Ph
Ph
S
S
3an, ¹H NMR
400 MHz, CDCl₃
1.98
4.16
3.04
1.99
1.01
1.03
1.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
1E+09
1E+09
1E+09
1E+09
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
-1E+08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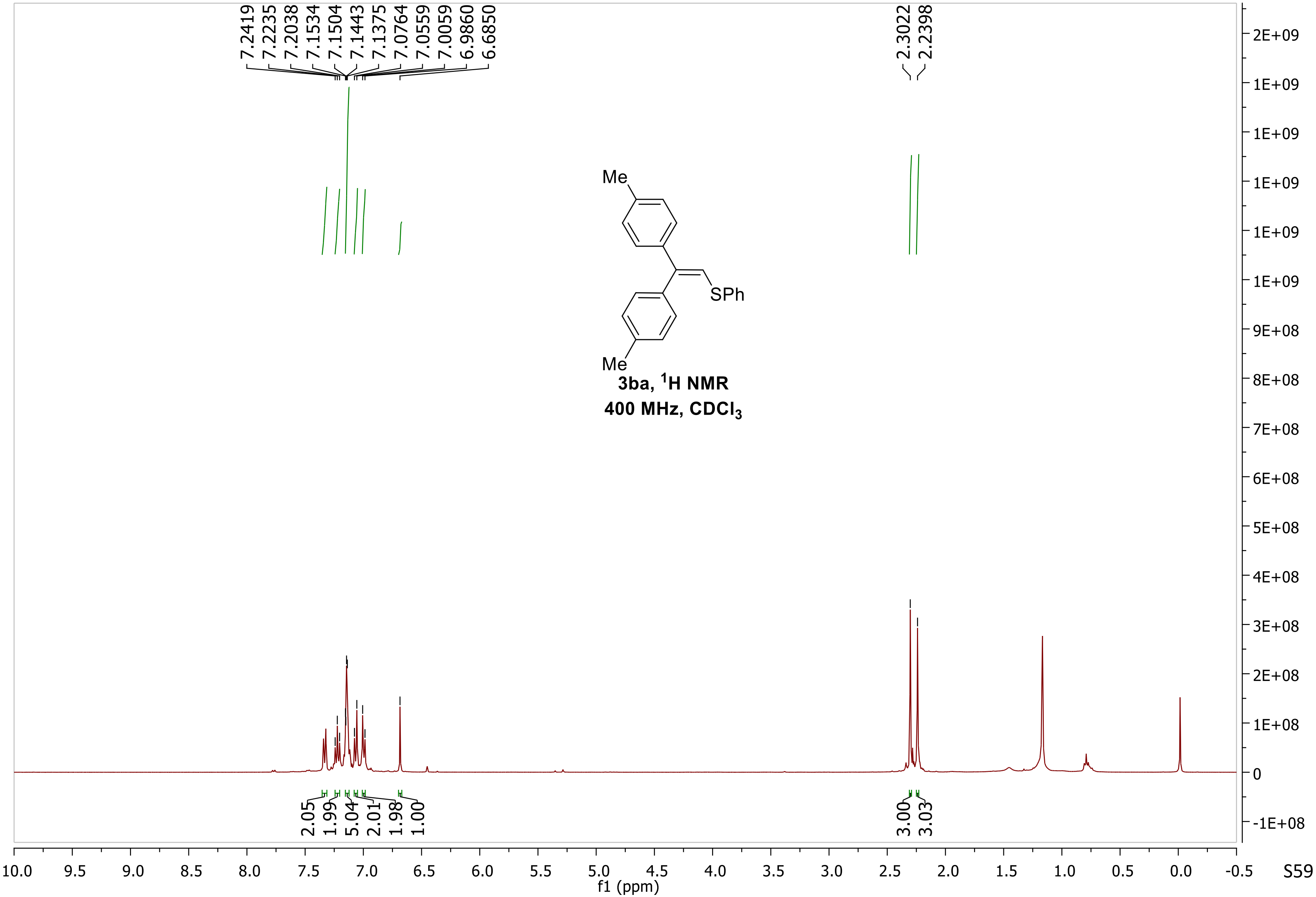
138.7486
133.9155
132.6868
129.7060
129.2923
128.4554
128.2568
127.8879
127.6448
127.2457
127.1351
Ph
Ph
S
S
3an, $^{13}C\{^1H\}$ NMR
100 MHz, $CDCl_3$
f1 (ppm)



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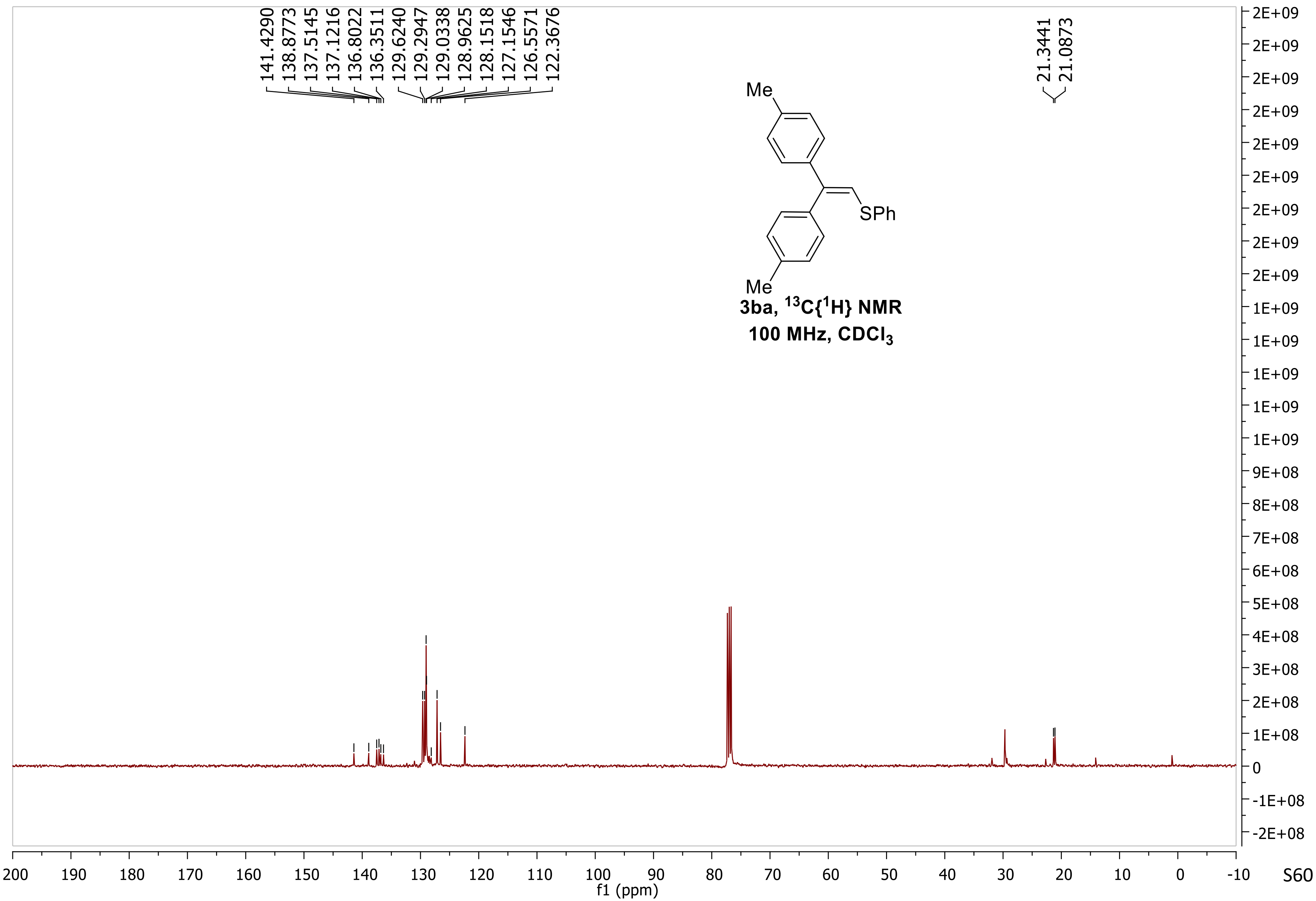
7.2235
7.2038
7.1534
7.1504
7.1443
7.1375
7.0764
7.0559
7.0059
6.9860
6.6850
2.3022
2.2398
Me
SPh
Me
3ba, 1H NMR
400 MHz, CDCl3
2.05
1.99
5.04
2.01
1.98
1.00
3.00
3.03
f1 (ppm)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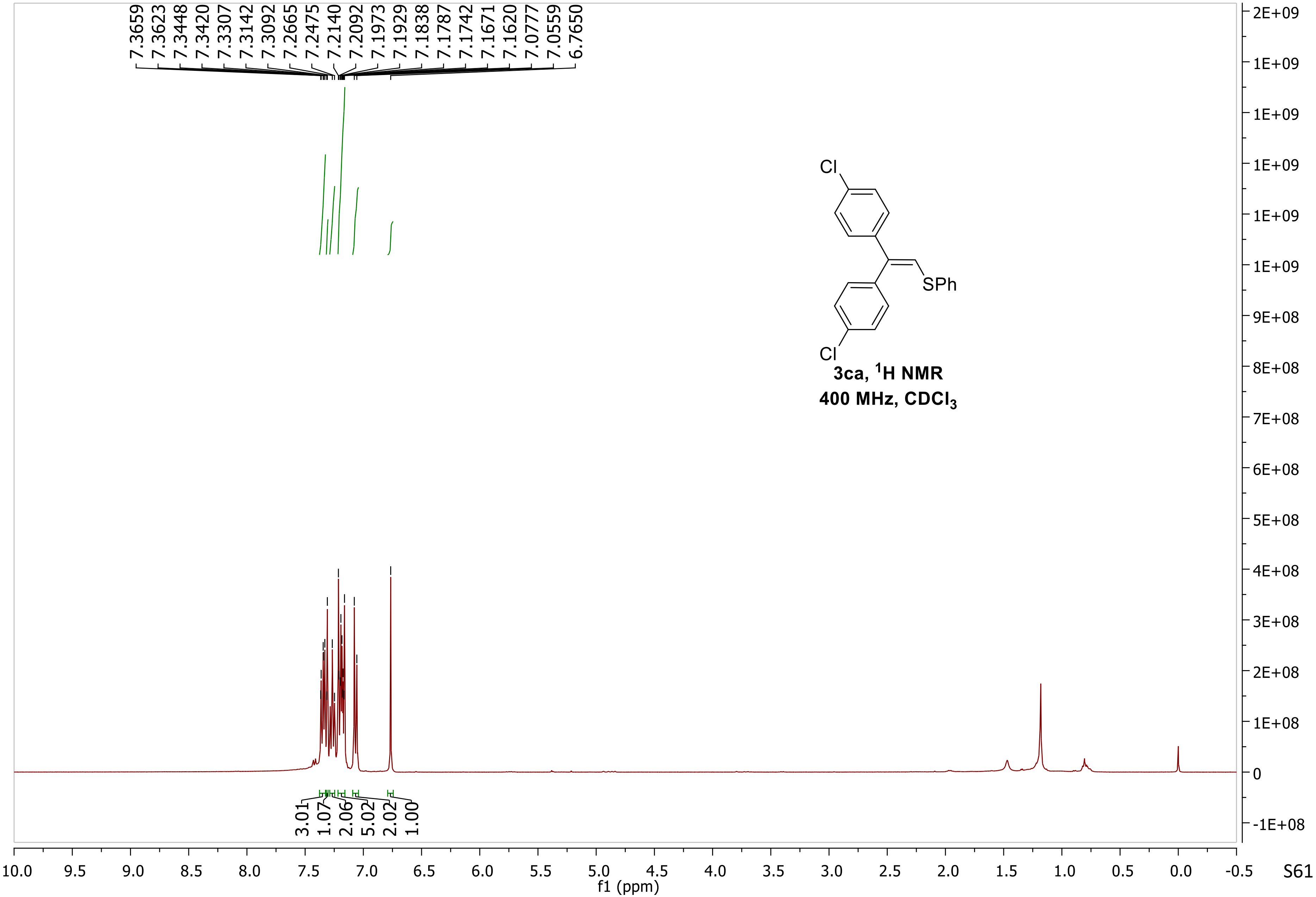
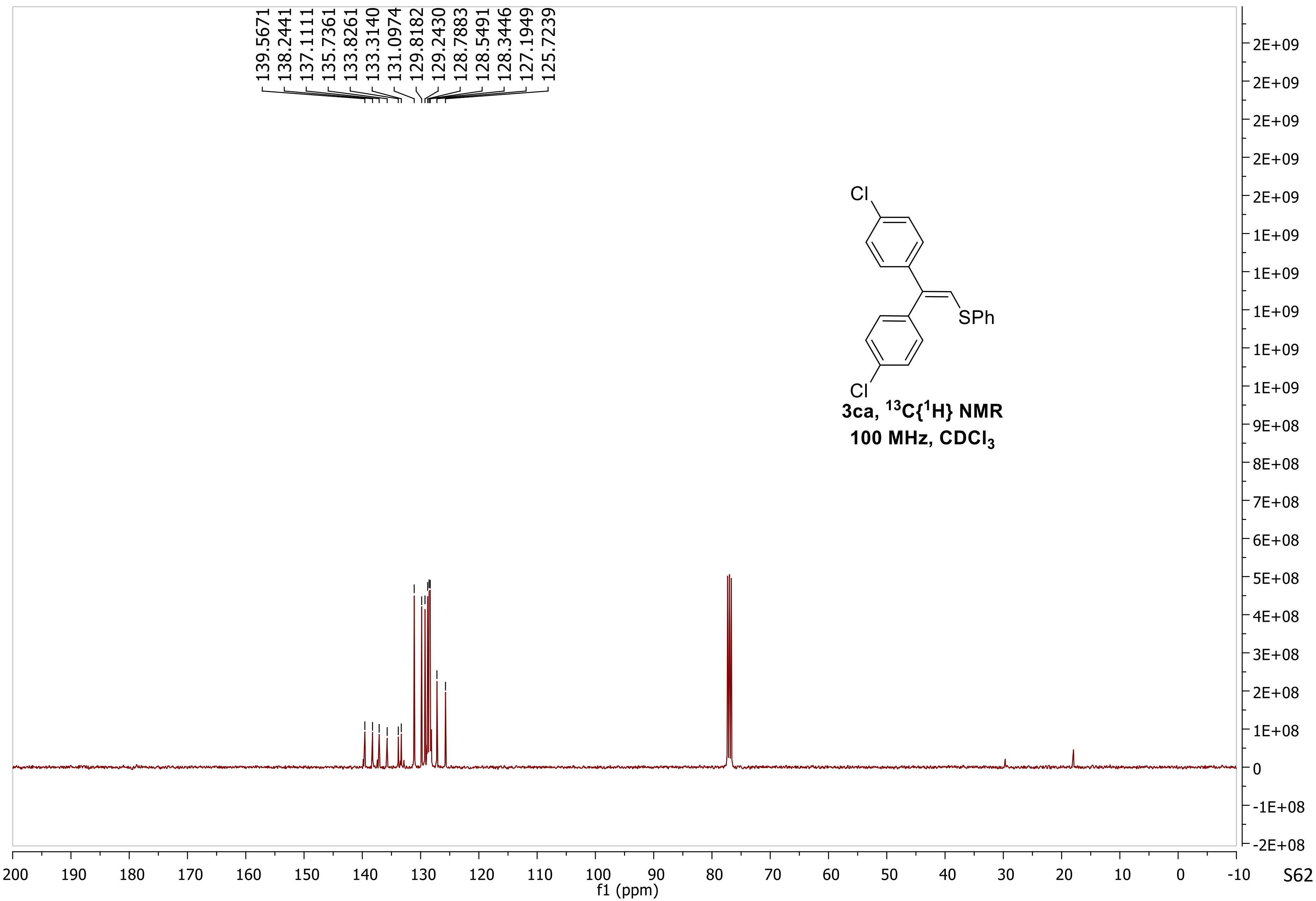
137.1216
136.8022
136.3511
129.6240
129.2947
129.0338
128.9625
128.1518
127.1546
126.5571
122.3676
21.3441
21.0873
Me
SPh
Me
3ba, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)


7.3659
7.3623
7.3448
7.3420
7.3307
7.3142
7.3092
7.2665
7.2475
7.2140
7.2092
7.1973
7.1929
7.1838
7.1787
7.1742
7.1671
7.1620
7.0777
7.0559
6.7650
Cl
SPh
Cl
3ca, ^{1}H NMR
400 MHz, $CDCl_3$
3.01
1.07
2.06
5.02
2.02
1.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)
2E+09
1E+09
1E+09
1E+09
1E+09
1E+09
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
-1E+08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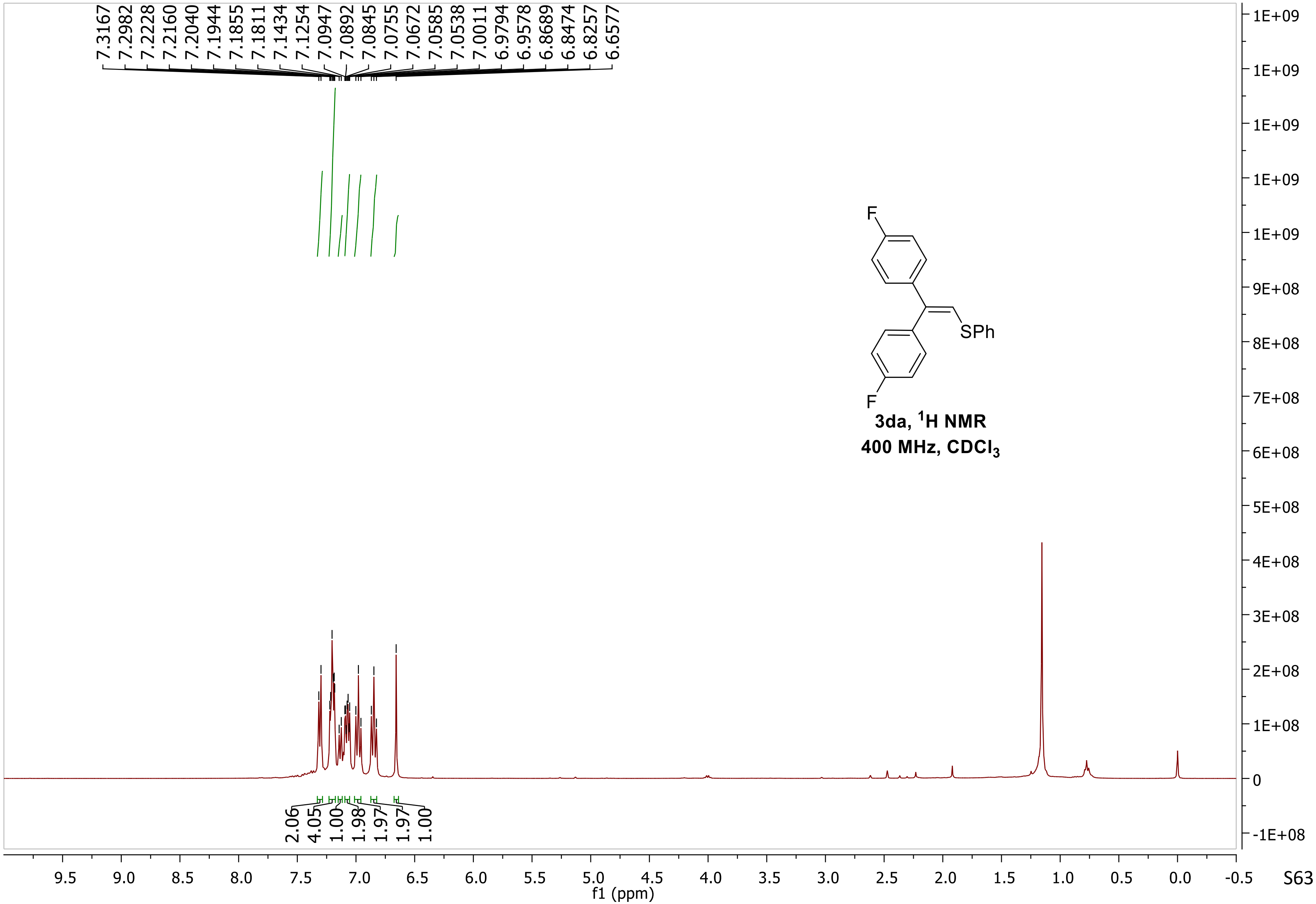
129.2430
128.7883
128.5491
128.3446
127.1949
125.7239
Cl
SPh
Cl
3ca, 13C{1H} NMR
100 MHz, CDCl3
2E+09
2E+09
2E+09
2E+09
2E+09
1E+09
1E+09
1E+09
1E+09
1E+09
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
-1E+08
-2E+08
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)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7.2228
7.2160
7.2040
7.1944
7.1855
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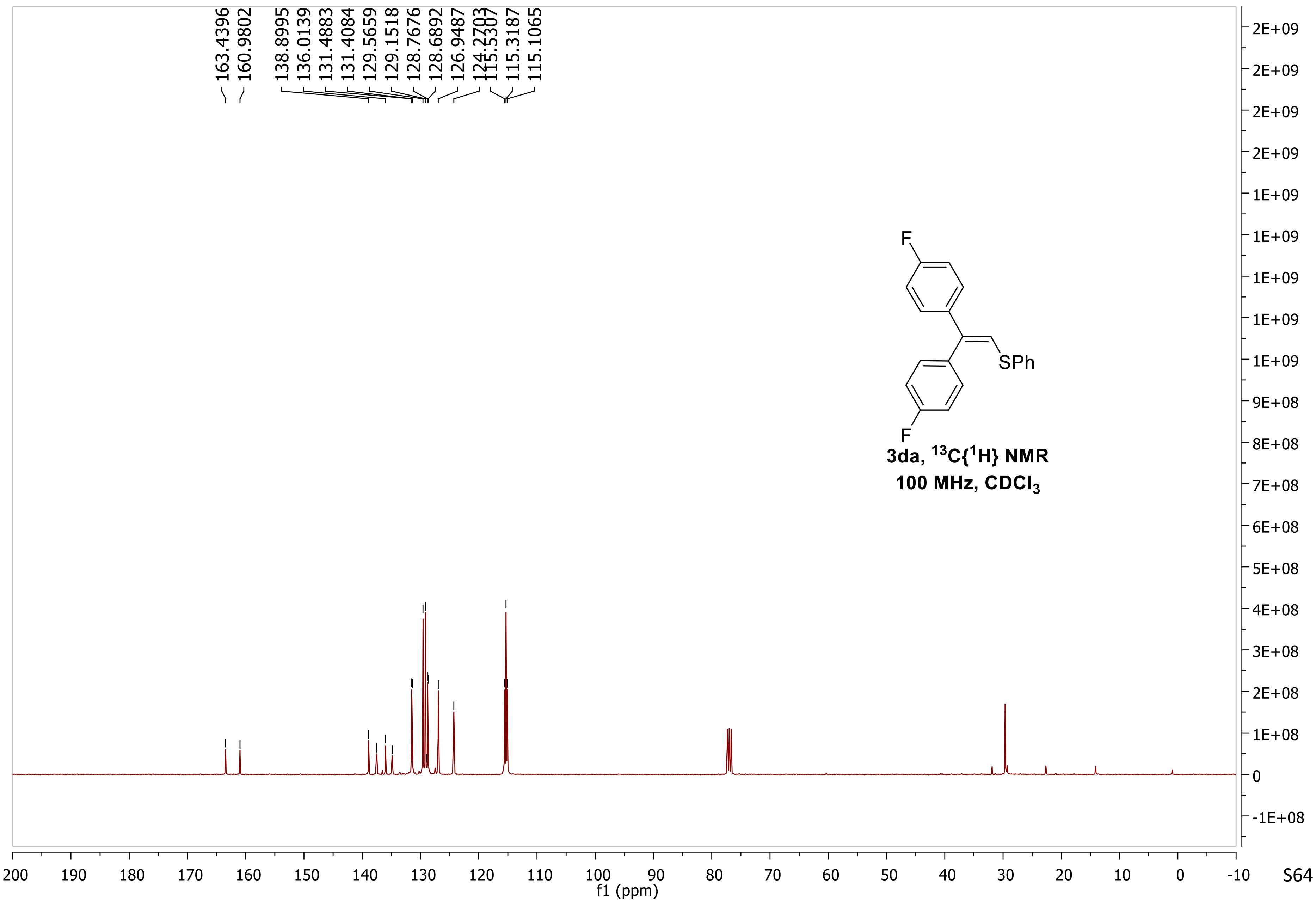
7.1254
7.0947
7.0892
7.0845
7.0755
7.0672
7.0585
7.0538
7.0011
6.9794
6.9578
6.8689
6.8474
6.8257
6.6577
F
SPh
F
3da, 1H NMR
400 MHz, CDCl3
2.06
4.05
1.00
1.98
1.97
1.97
1.00
f1 (ppm)



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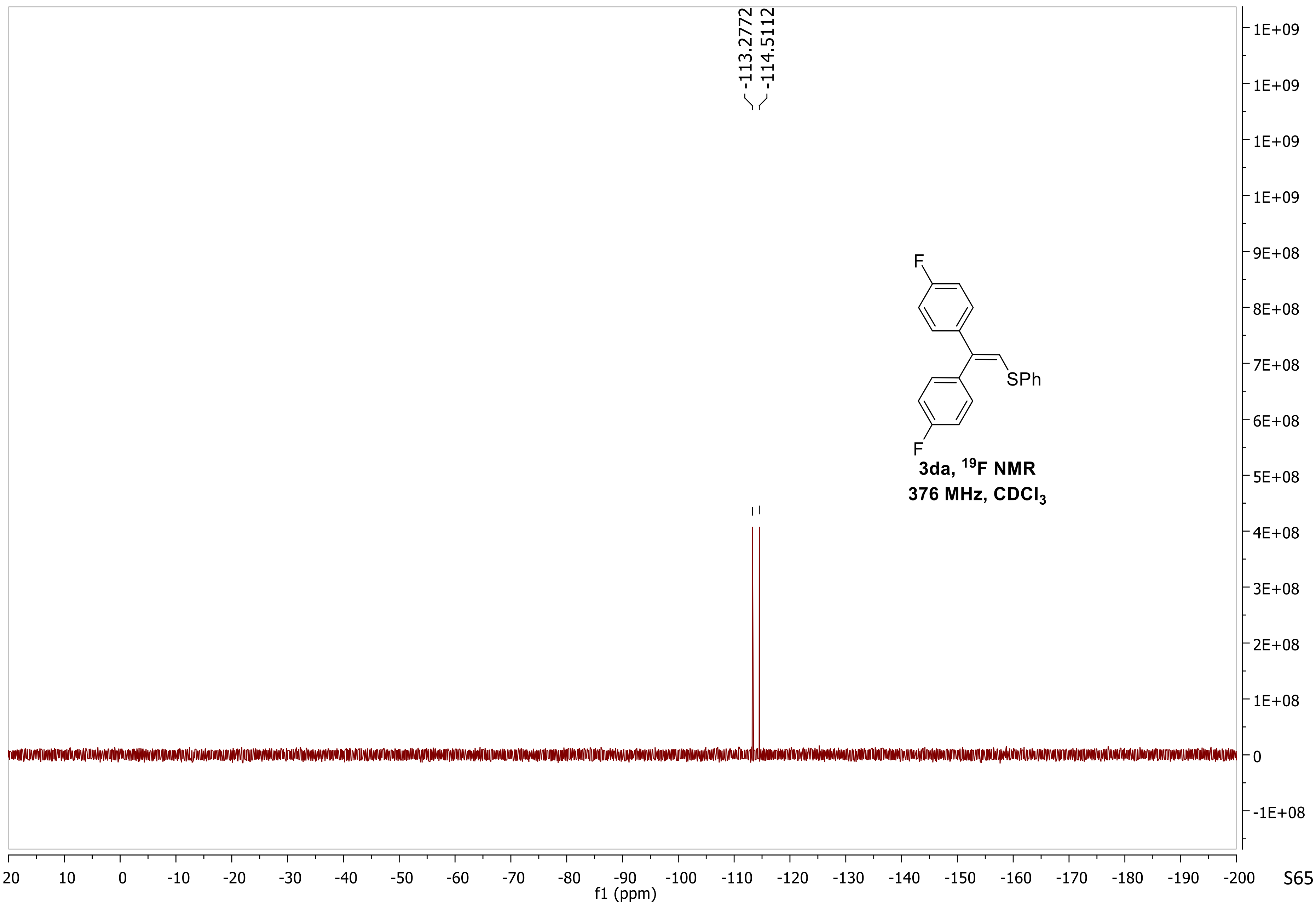
160.9802
138.8995
136.0139
131.4883
131.4084
129.5659
129.1518
128.7676
128.6892
126.9487
124.2703
115.5307
115.3187
115.1065
F
SPh
F
3da, $^{13}C\{^{1}H\}$ NMR
100 MHz, $CDCl_3$
f1 (ppm)



-113.2772
-114.5112
F
F
SPh
3da, 19F NMR
376 MHz, CDCl3
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1E+09
1E+09
1E+09
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
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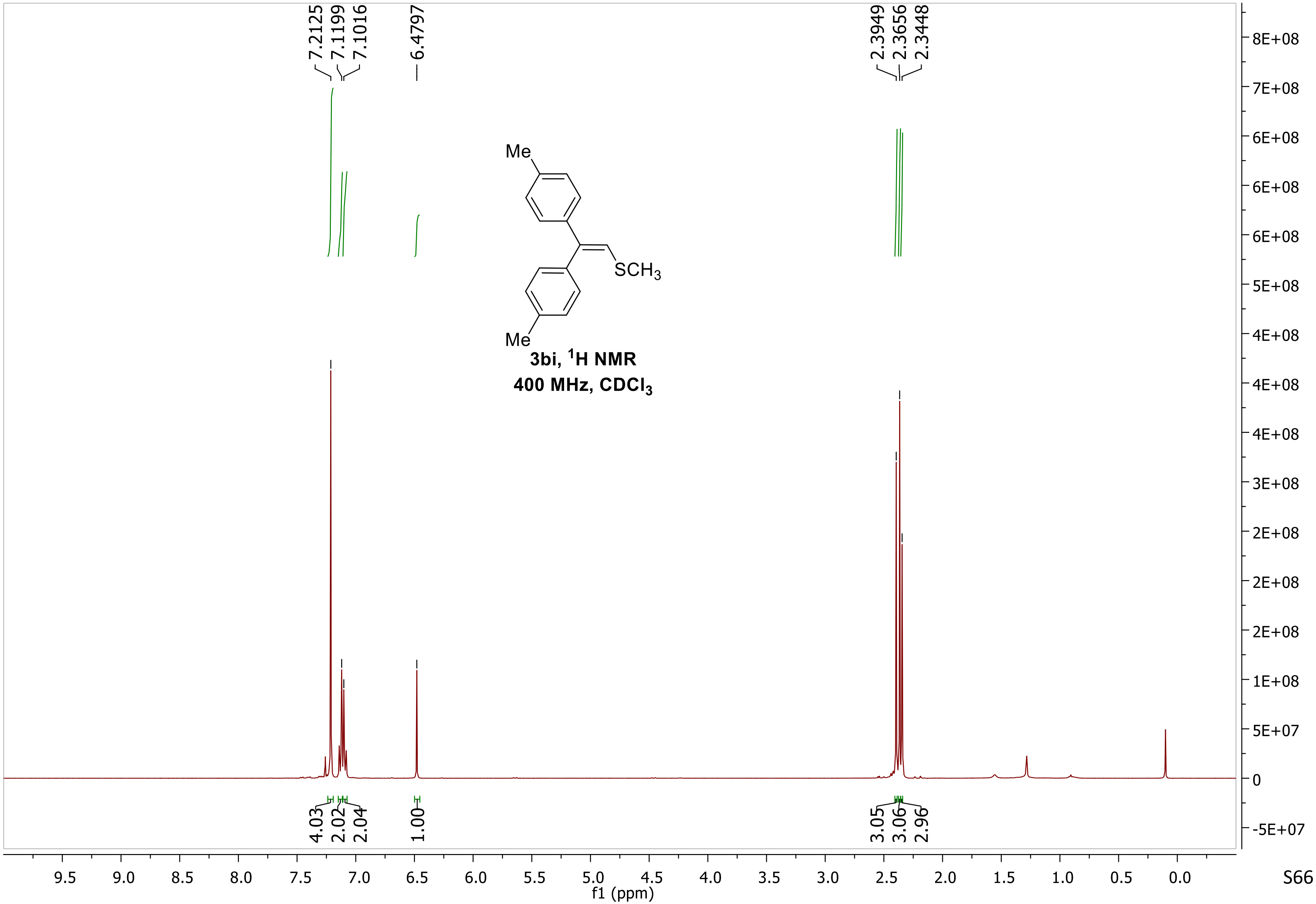
f1 (ppm)



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7.1199
7.1016
6.4797
2.3949
2.3656
2.3448
Me
SCH3
Me
3bi, 1H NMR
400 MHz, CDCl3
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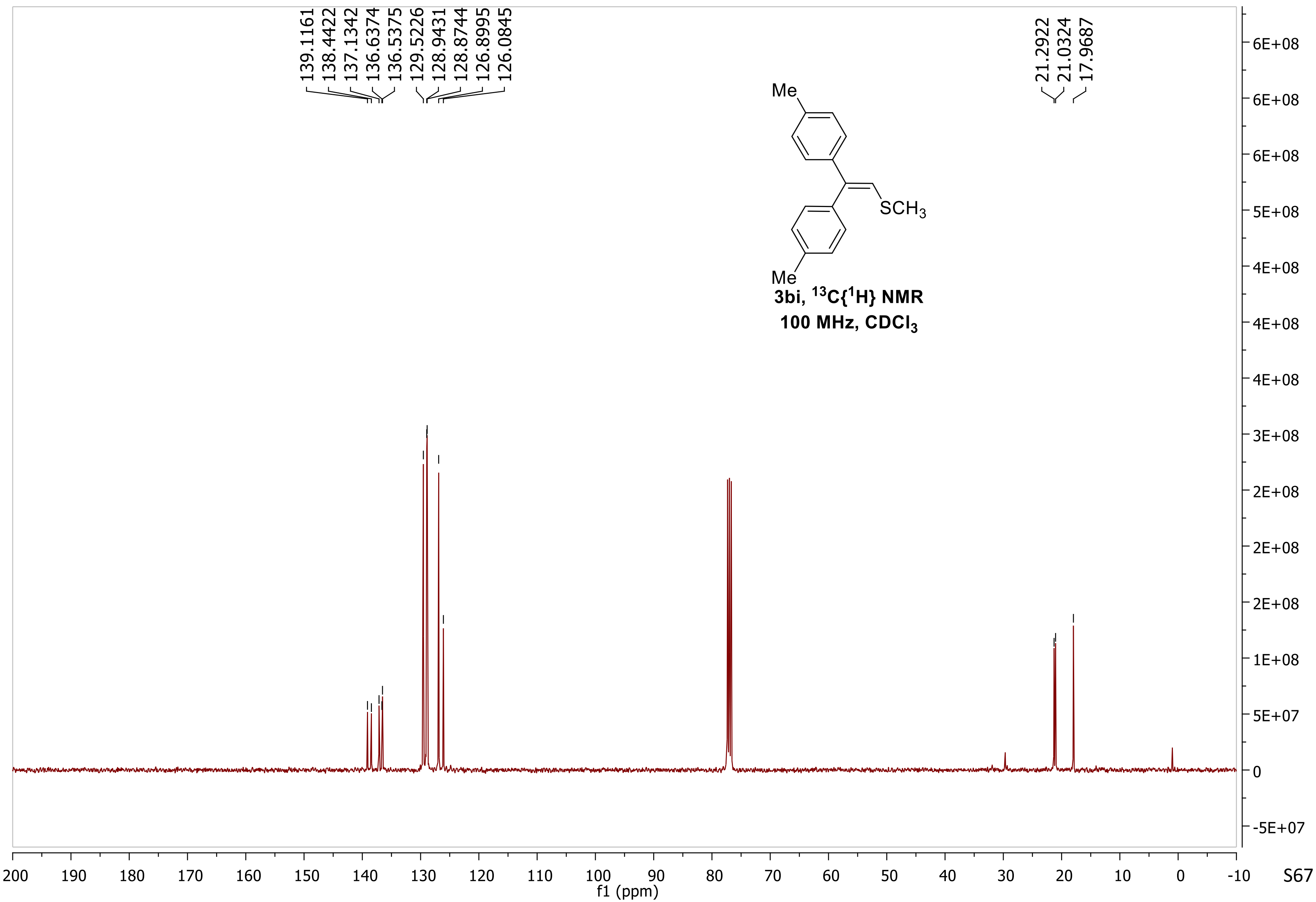
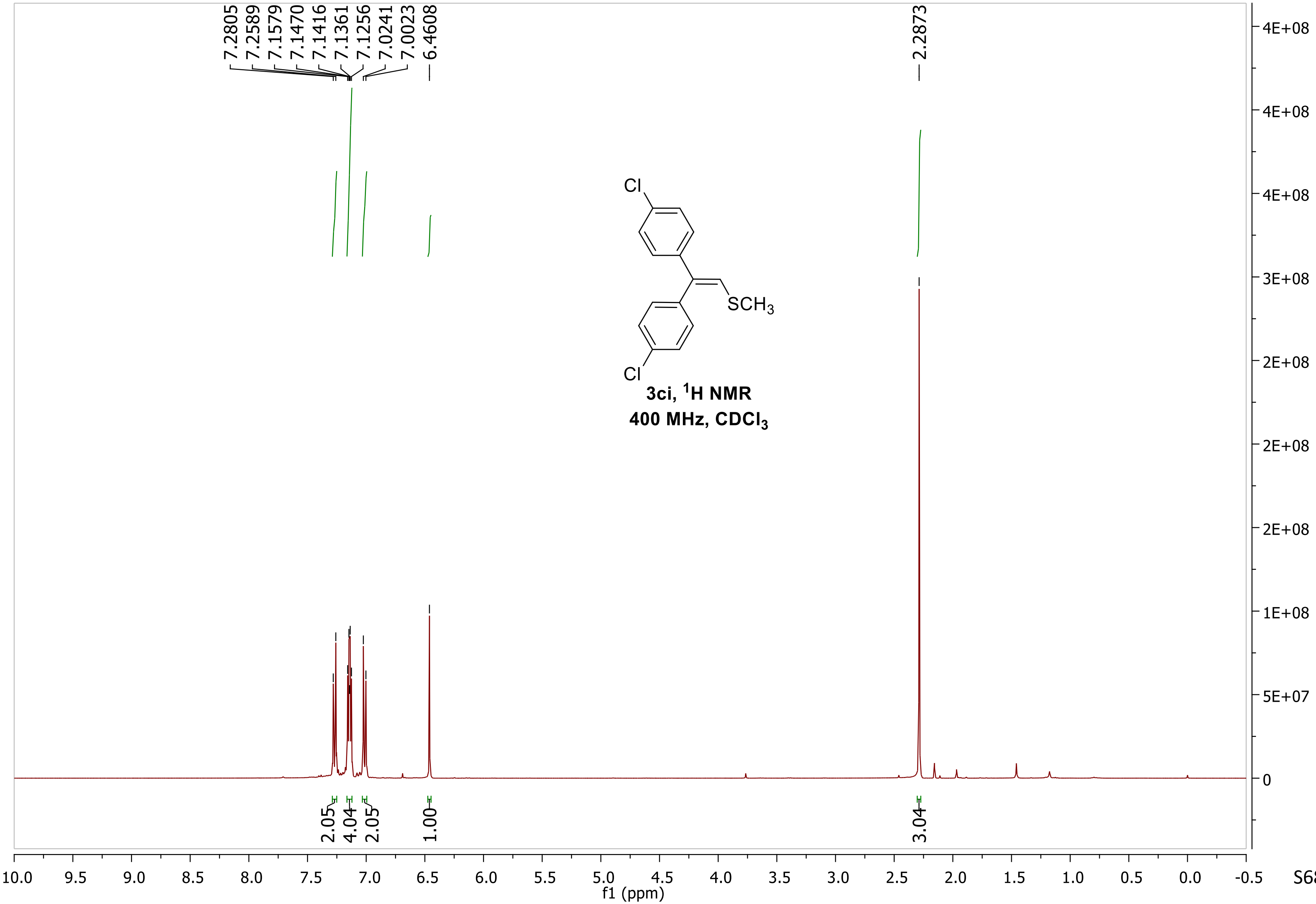
3.06
2.96
f1 (ppm)



139.1161
138.4422
137.1342
136.6374
136.5375
129.5226
128.9431
128.8744
126.8995
126.0845
21.2922
21.0324
17.9687
Me
SCH3
Me
3bi, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)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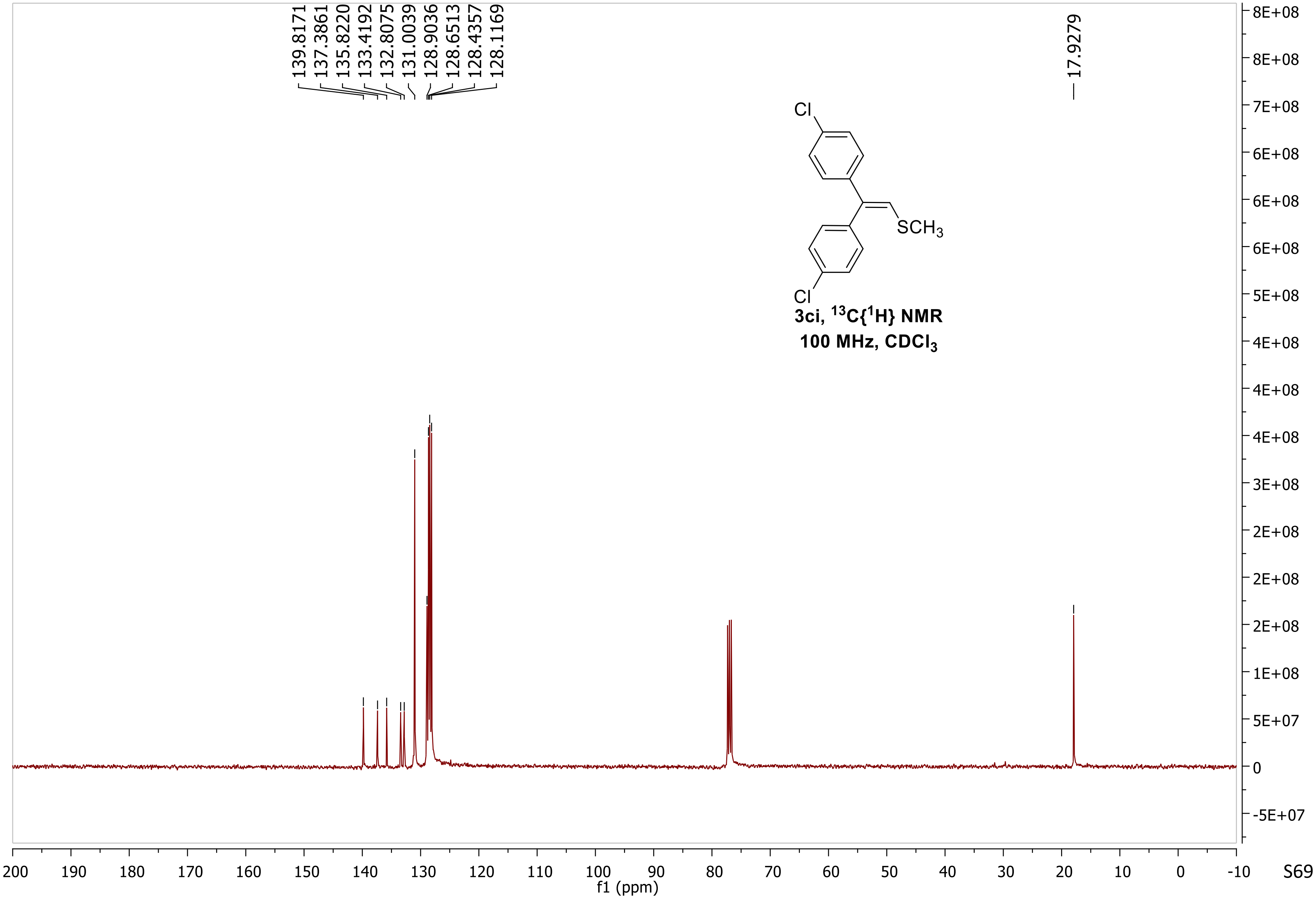
7.1579
7.1470
7.1416
7.1361
7.1256
7.0241
7.0023
6.4608
2.2873
Cl
SCH3
Cl
3ci, 1H NMR
400 MHz, CDCl3
2.05
4.04
2.05
1.00
3.04
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)
4E+08
4E+08
4E+08
3E+08
2E+08
2E+08
2E+08
1E+08
5E+07
0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132.8075
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128.9036
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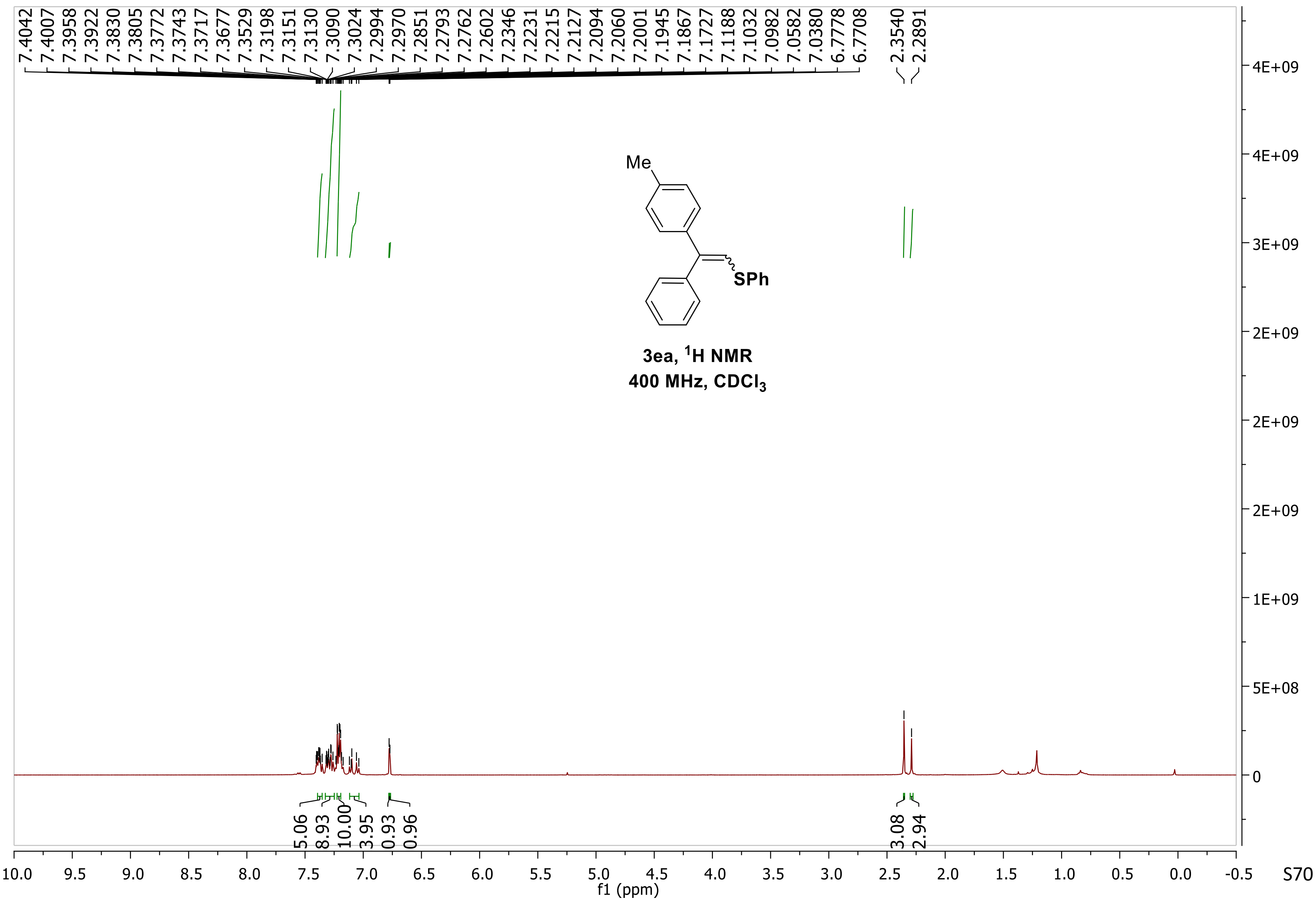
17.9279
Cl
SCH3
Cl
3ci, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)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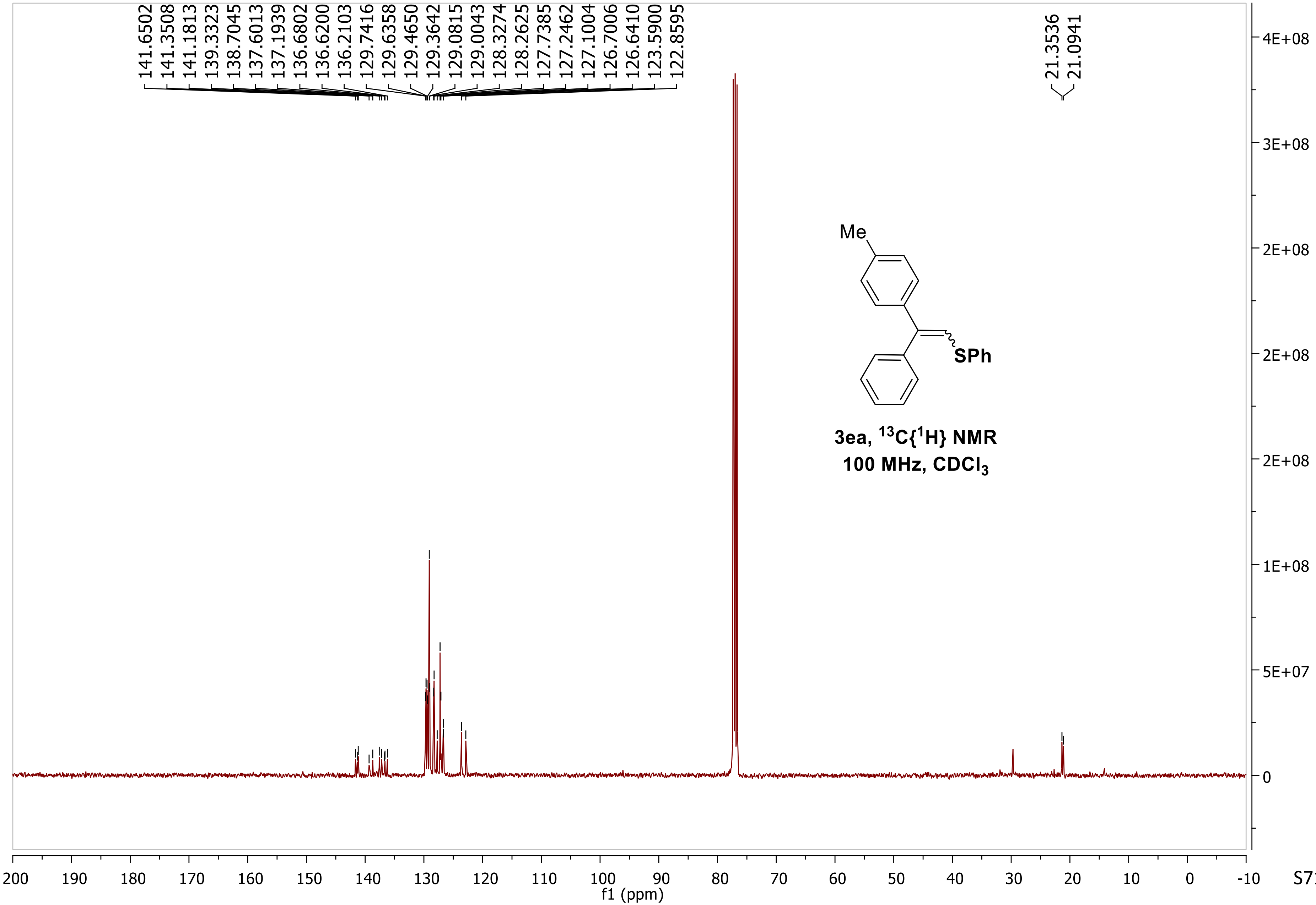
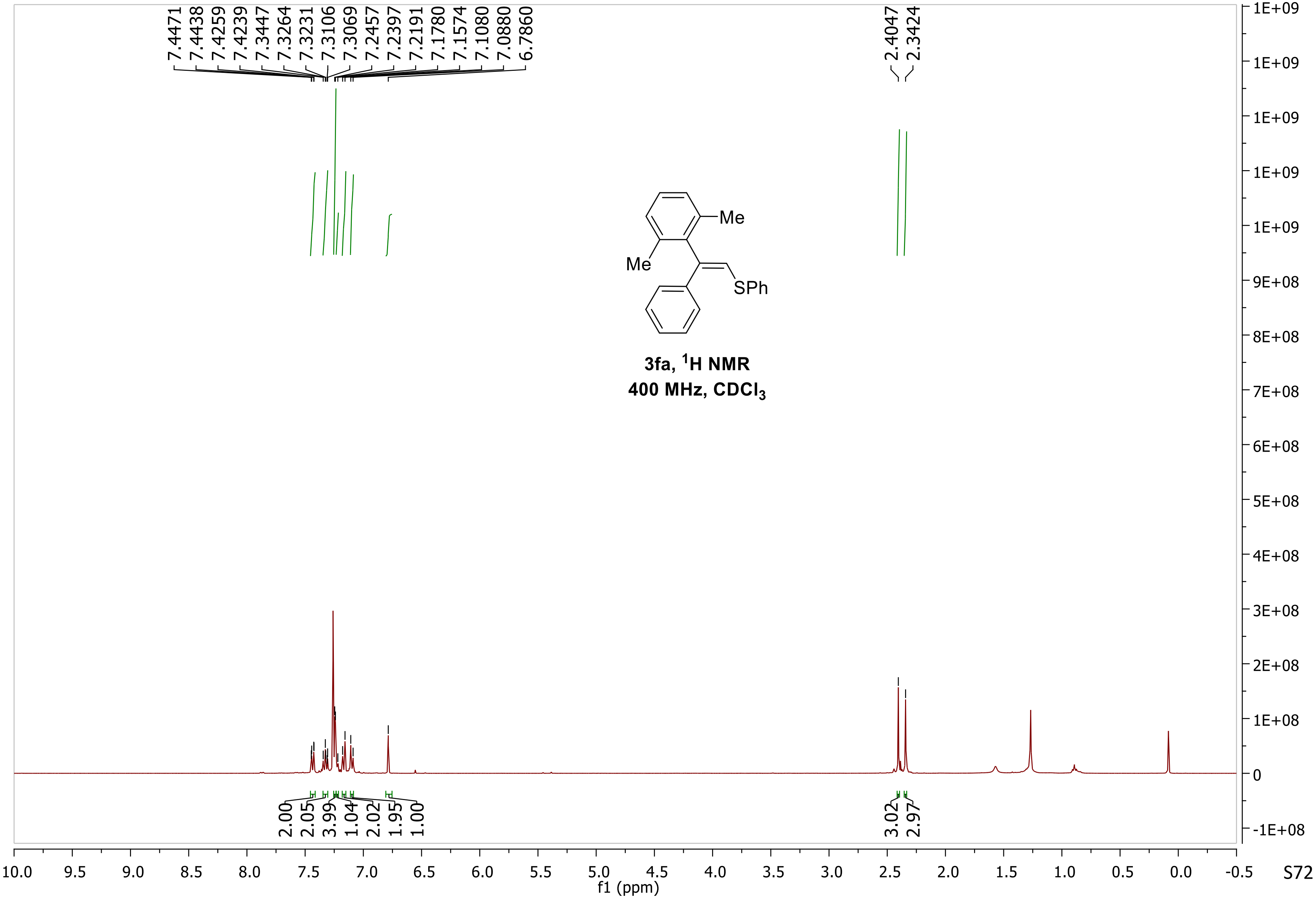
2.3540 2.2891
Me
SPh
3ea, ¹H NMR
400 MHz, CDCl3
5.06 8.93 10.00 3.95 0.93 0.96
3.08 2.94
f1 (ppm)



3ea, $^{13}C\{^{1}H\}$ NMR
100 MHz, $CDCl_3$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7.4239
7.3447
7.3264
7.3231
7.3106
7.3069
7.2457
7.2397
7.2191
7.1780
7.1574
7.1080
7.0880
6.7860
2.4047
2.3424
Me
Me
SPh
3fa, 1H NMR
400 MHz, CDCl3
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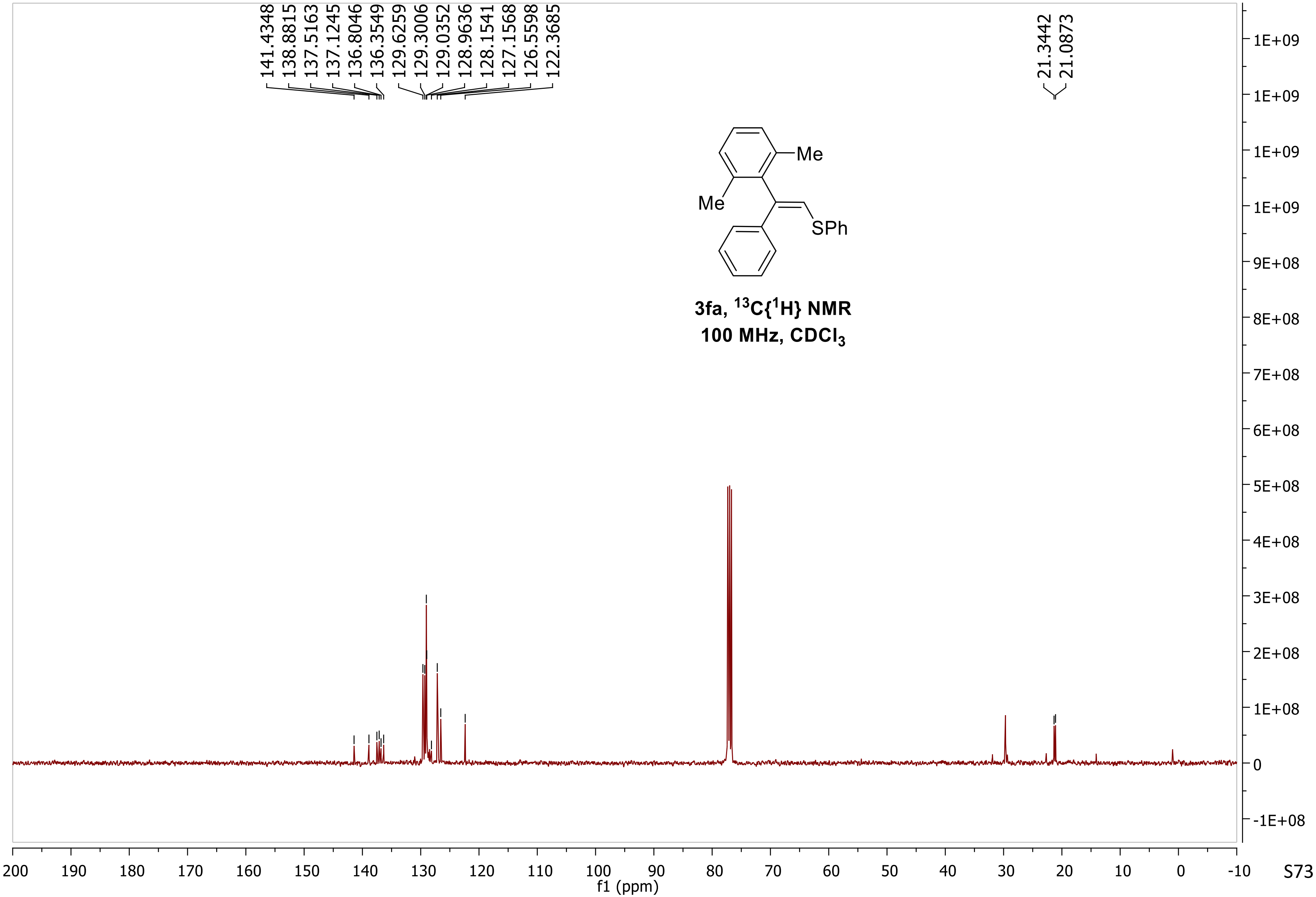
2.05
3.99
1.04
2.02
1.95
1.00
3.02
2.97
f1 (ppm)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136.8046
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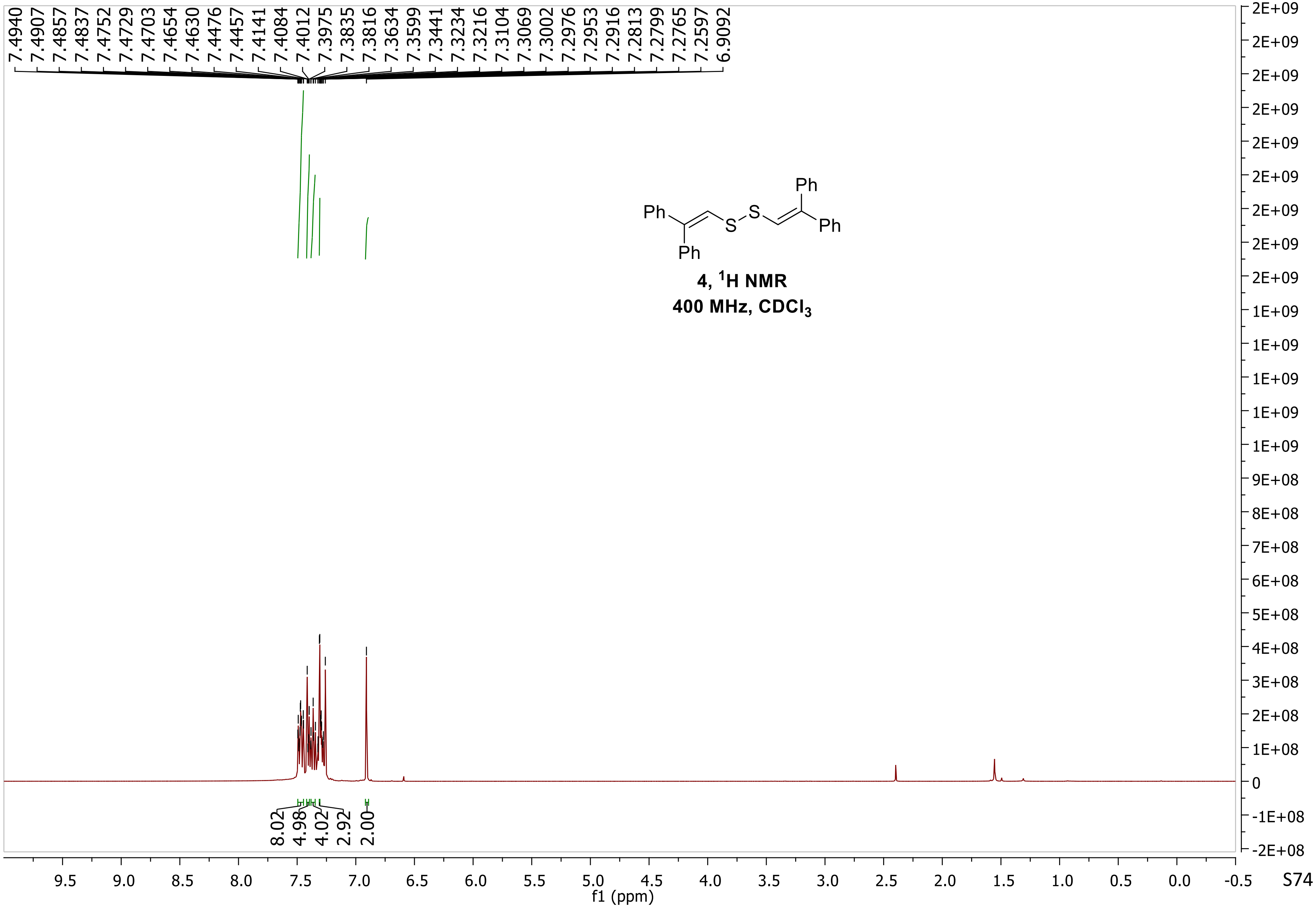
129.6259
129.3006
129.0352
128.9636
128.1541
127.1568
126.5598
122.3685
21.3442
21.0873
Me
Me
SPh
3fa, 13C{1H} NMR
100 MHz, CDCl3
1E+09
1E+09
1E+09
1E+09
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
-1E+08
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)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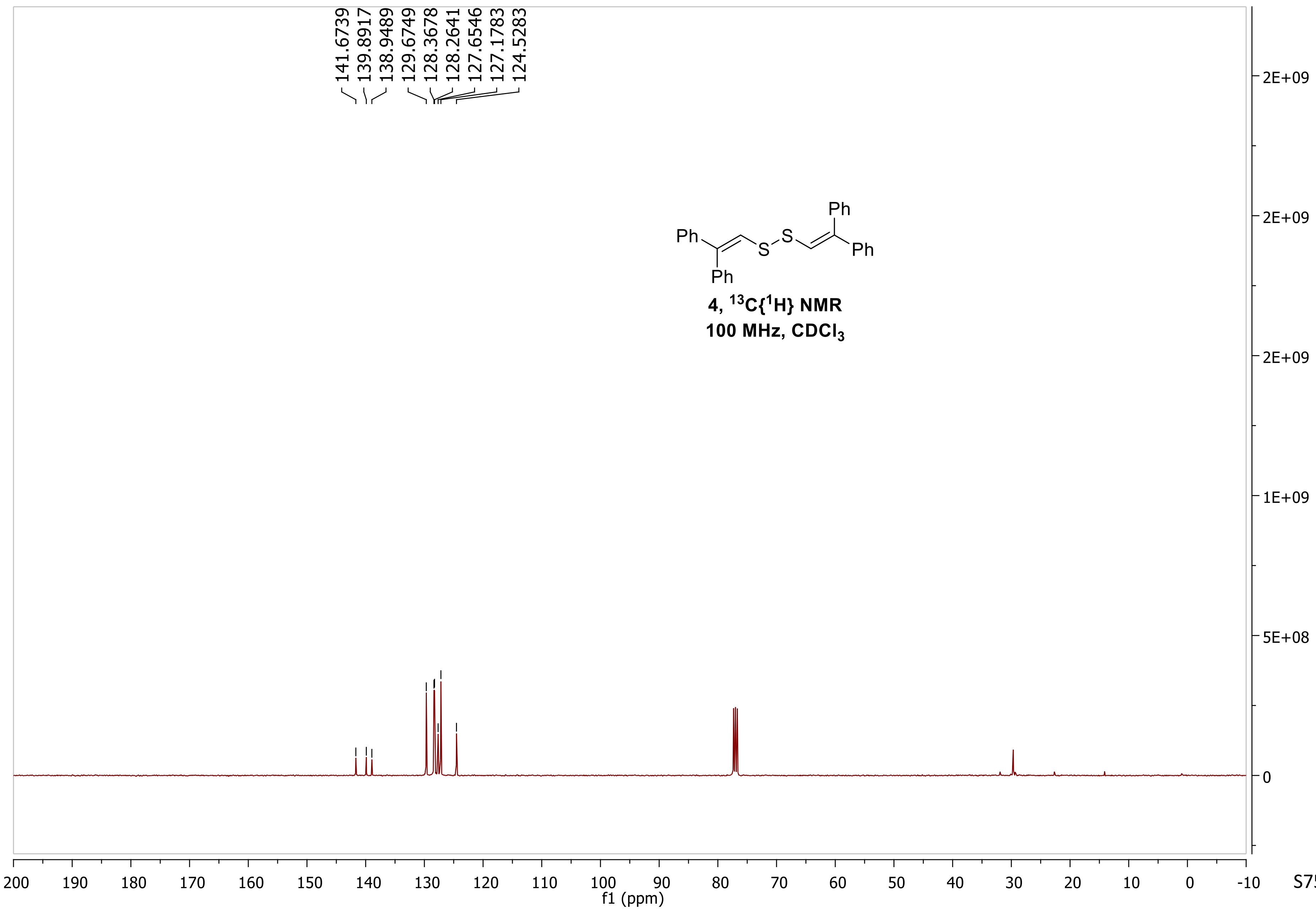
7.4141
7.4084
7.4012
7.3975
7.3835
7.3816
7.3634
7.3599
7.3441
7.3234
7.3216
7.3104
7.3069
7.3002
7.2976
7.2953
7.2916
7.2813
7.2799
7.2765
7.2597
6.9092
Ph
S
S
Ph
Ph
Ph
4, 1H NMR
400 MHz, CDCl3
8.02
4.98
4.02
2.92
2.00
f1 (ppm)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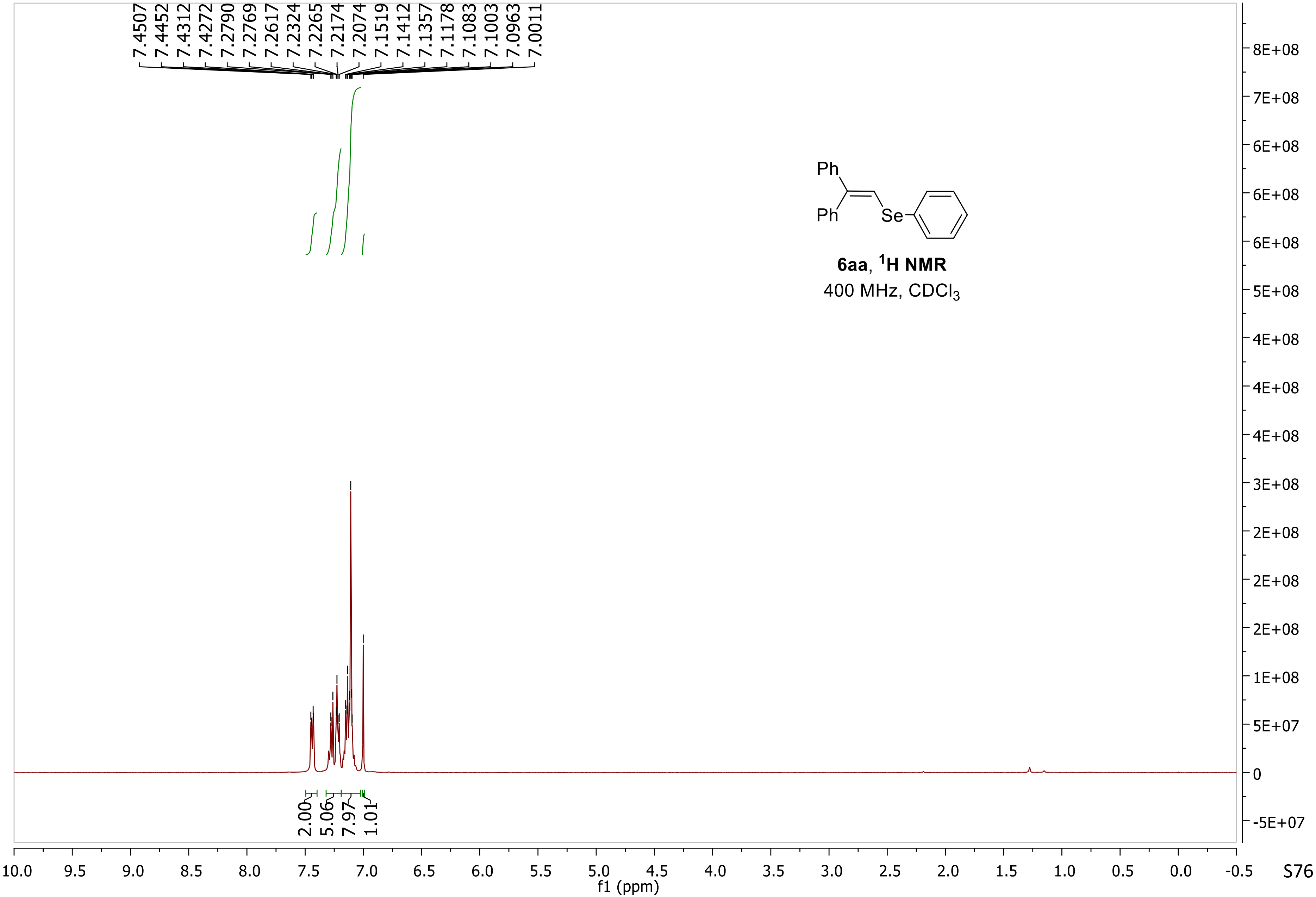
129.6749
128.3678
128.2641
127.6546
127.1783
124.5283
Ph
S
S
Ph
Ph
Ph
4, 13C{1H} NMR
100 MHz, CDCl3
2E+09
2E+09
2E+09
1E+09
5E+08
0
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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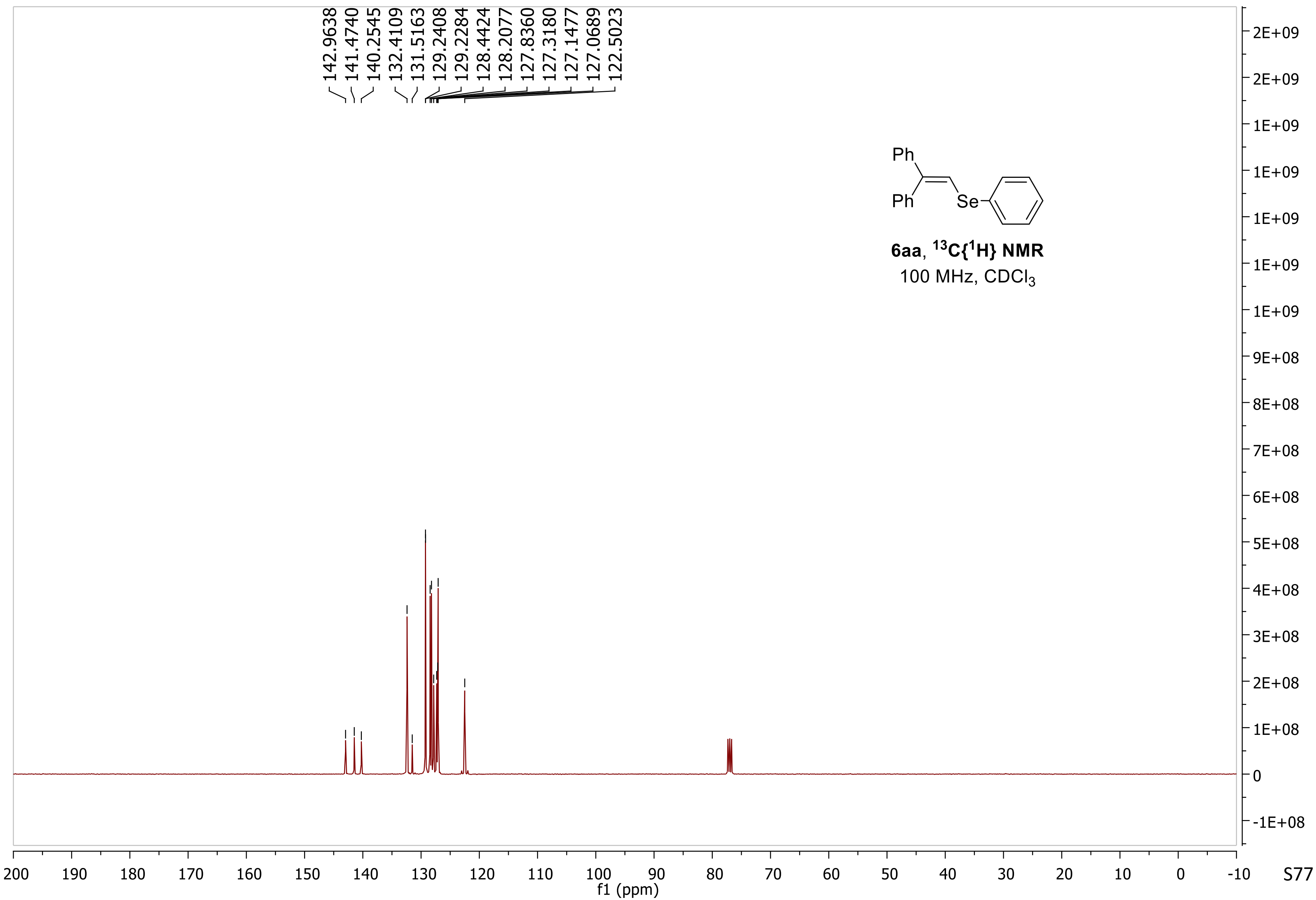
7.4312
7.4272
7.2790
7.2769
7.2617
7.2324
7.2265
7.2174
7.2074
7.1519
7.1412
7.1357
7.1178
7.1083
7.1003
7.0963
7.0011
Ph
Ph
Se
6aa, 1H NMR
400 MHz, CDCl3
2.00
5.06
7.97
1.01
f1 (ppm)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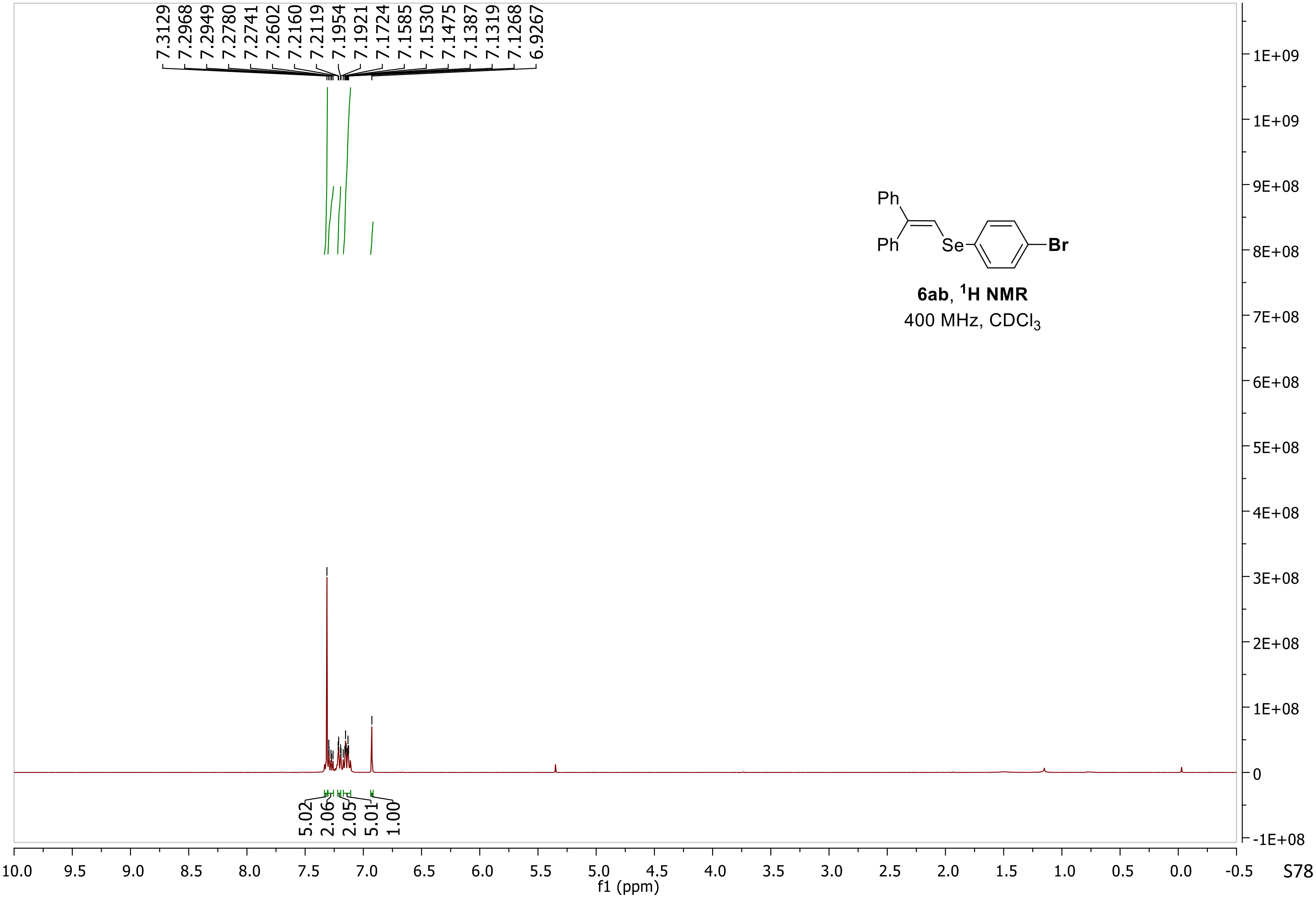
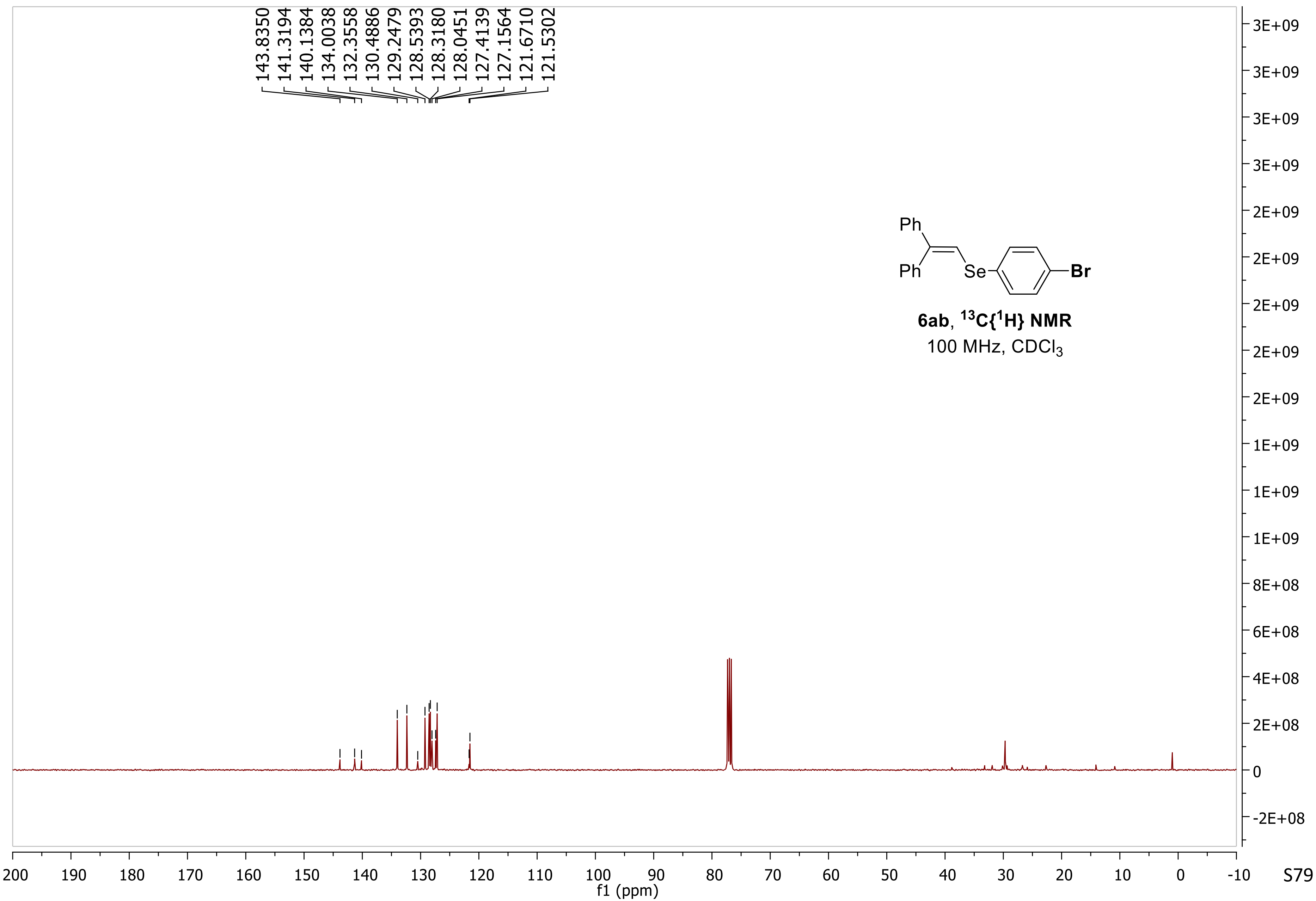
141.4740
140.2545
132.4109
131.5163
129.2408
129.2284
128.4424
128.2077
127.8360
127.3180
127.1477
127.0689
122.5023
Ph
Ph
Se
6aa, 13C{1H} NMR
100 MHz, CDCl3
2E+09
2E+09
1E+09
1E+09
1E+09
1E+09
1E+09
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
-1E+08
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.3129
7.2968
7.2949
7.2780
7.2741
7.2602
7.2160
7.2119
7.1954
7.1921
7.1724
7.1585
7.1530
7.1475
7.1387
7.1319
7.1268
6.9267
Ph
Ph
Se
Br
6ab, ¹H NMR
400 MHz, CDCl3
5.02
2.06
2.05
5.01
1.00
f1 (ppm)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141.3194
140.1384
134.0038
132.3558
130.4886
129.2479
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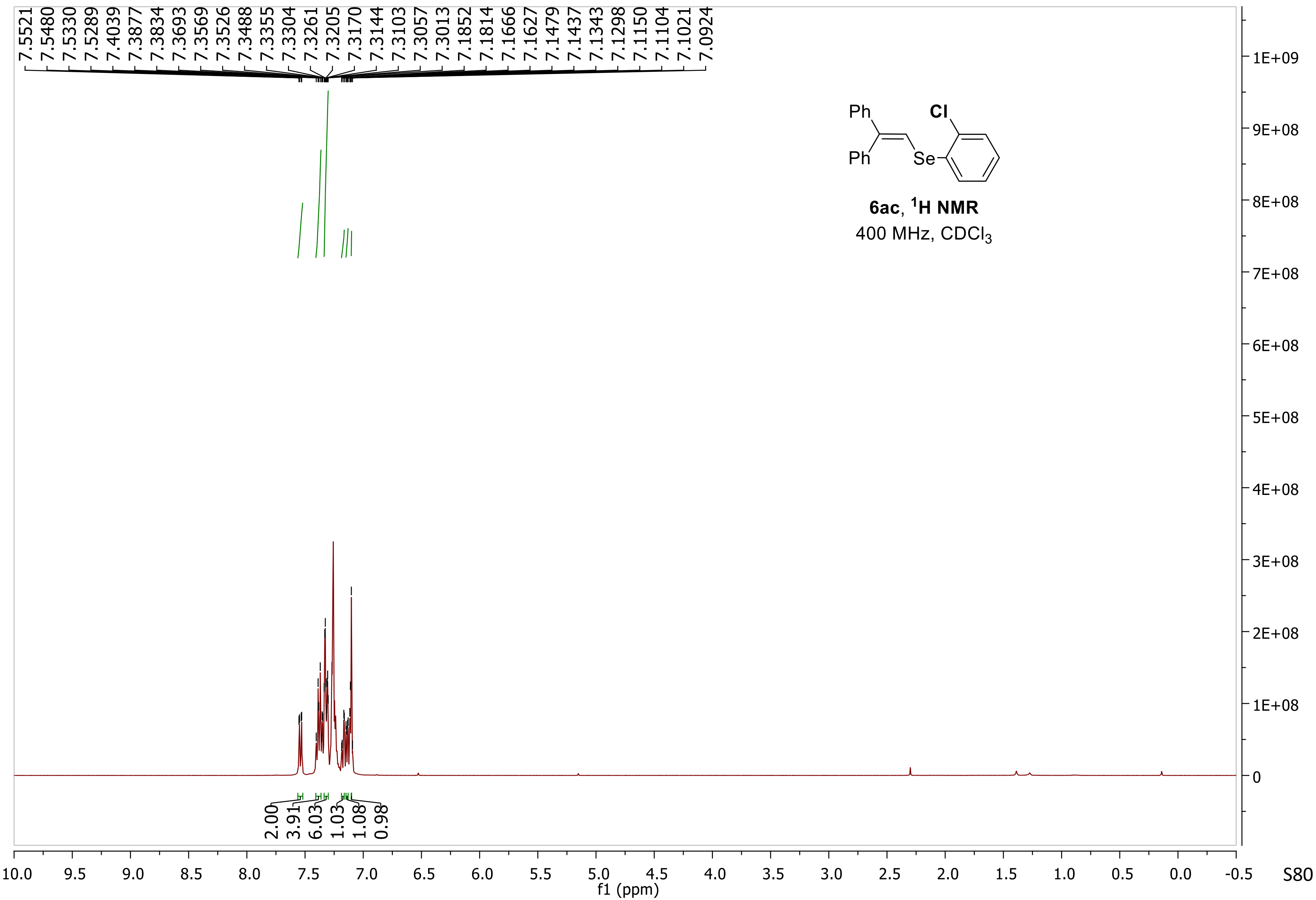
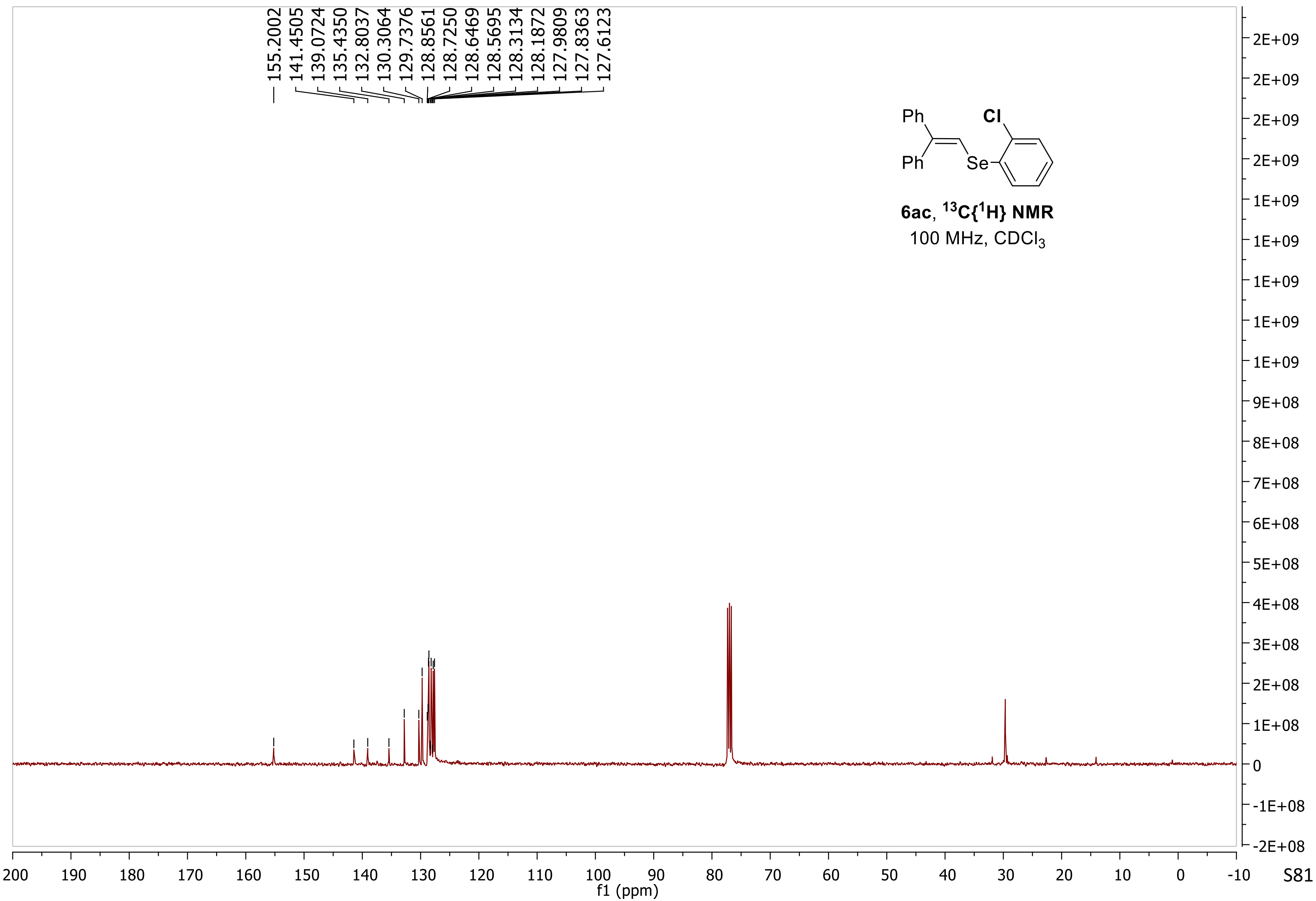
128.3180
128.0451
127.4139
127.1564
121.6710
121.5302
Ph
Ph
Se
Br
6ab, $^{13}C\{^{1}H\}$ NMR
100 MHz, $CDCl_3$
f1 (ppm)


7.5521
7.5480
7.5330
7.5289
7.4039
7.3877
7.3834
7.3693
7.3569
7.3526
7.3488
7.3355
7.3304
7.3261
7.3205
7.3170
7.3144
7.3103
7.3057
7.3013
7.1852
7.1814
7.1666
7.1627
7.1479
7.1437
7.1343
7.1298
7.1150
7.1104
7.1021
7.0924
Ph
Ph
Cl
Se
6ac, 1H NMR
400 MHz, CDCl3
2.00
3.91
6.03
1.03
1.08
0.98
f1 (ppm)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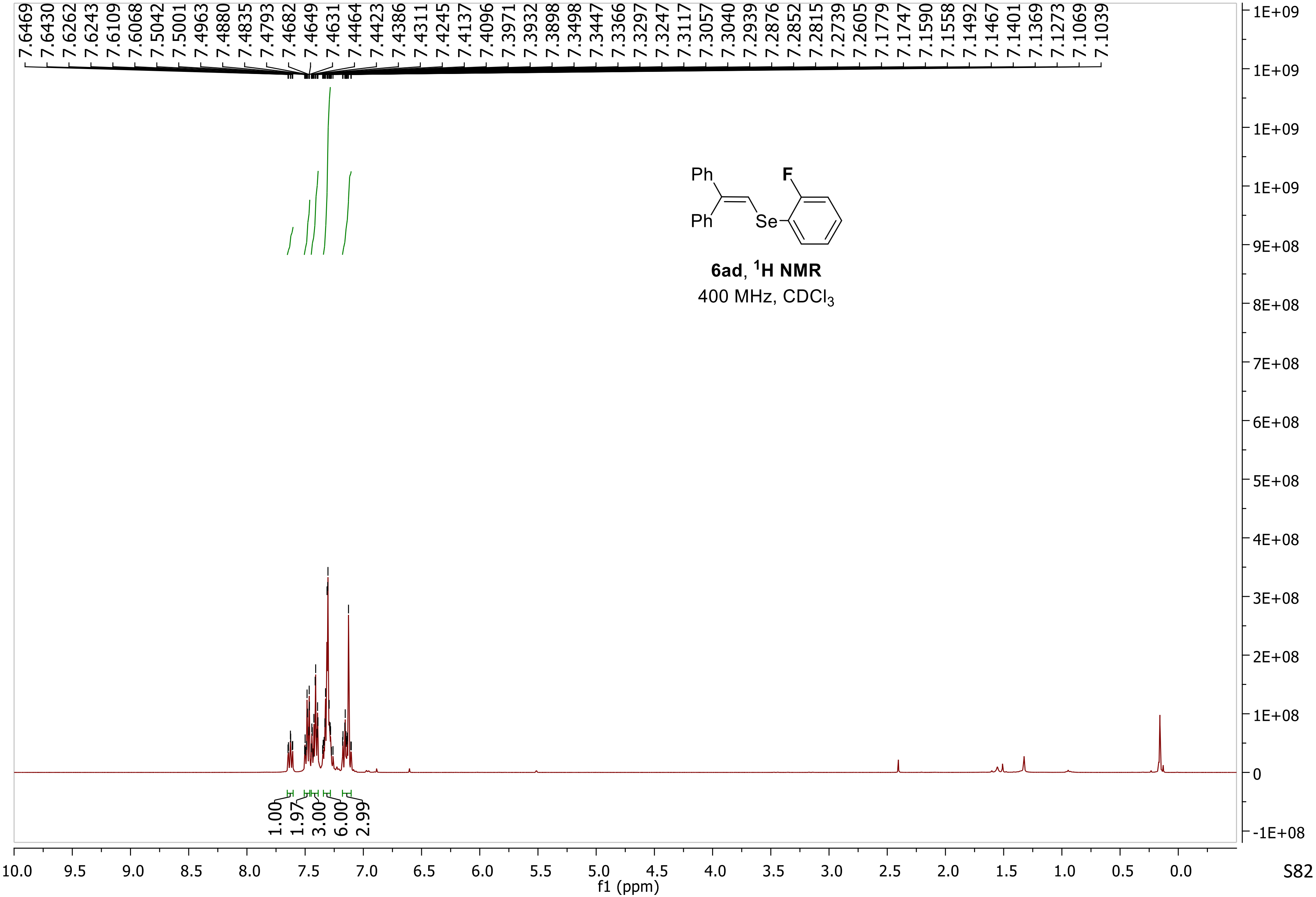
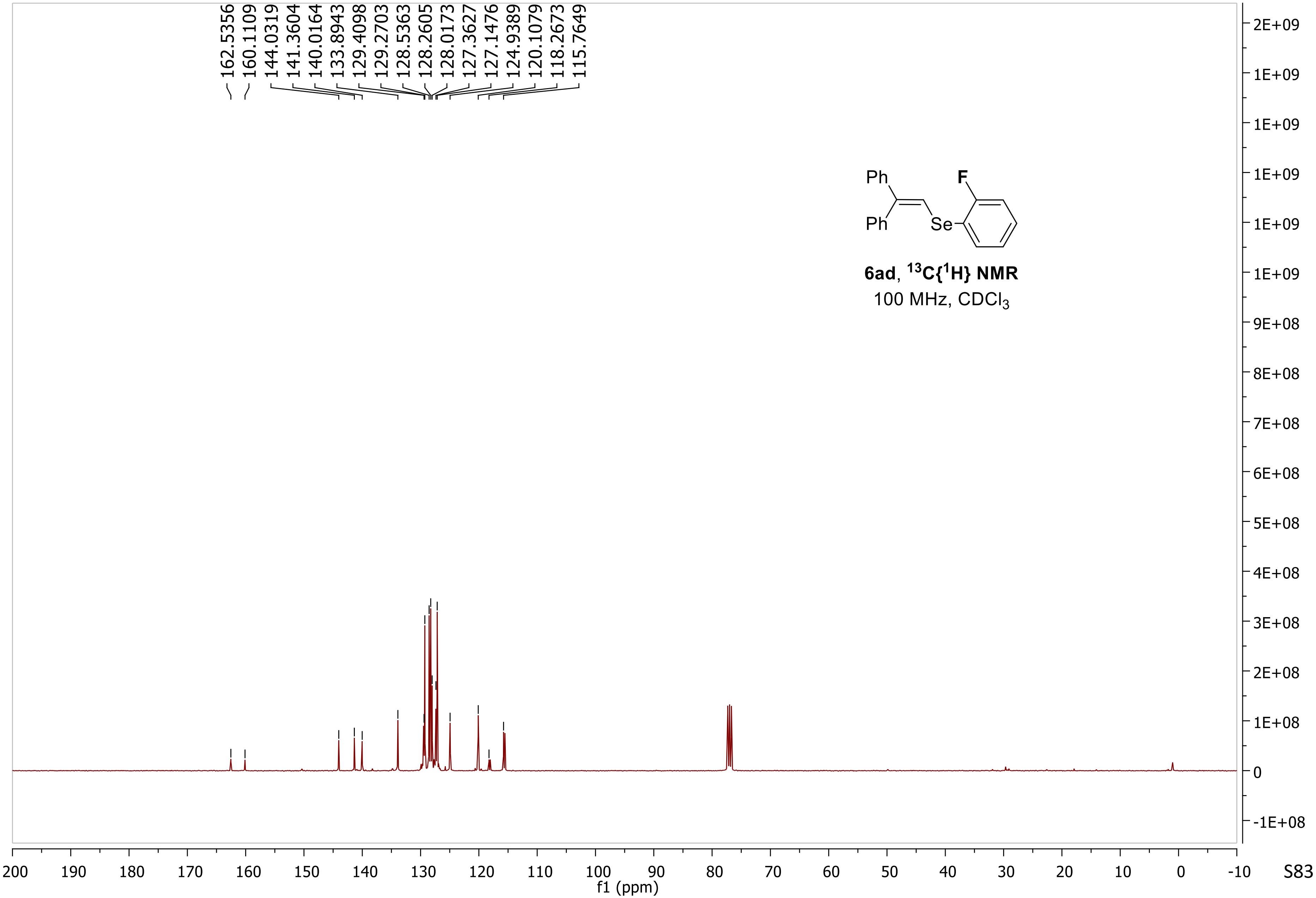
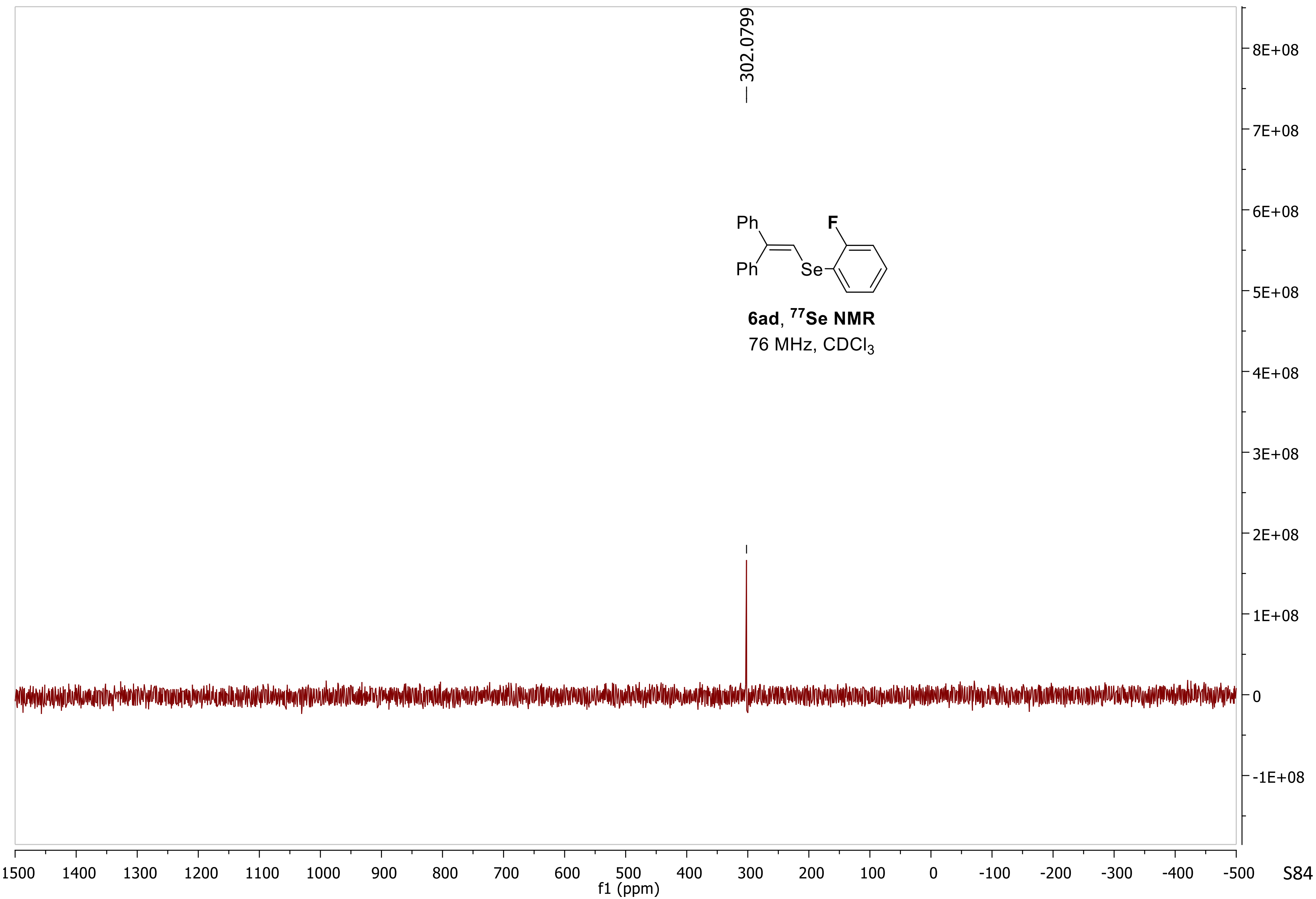
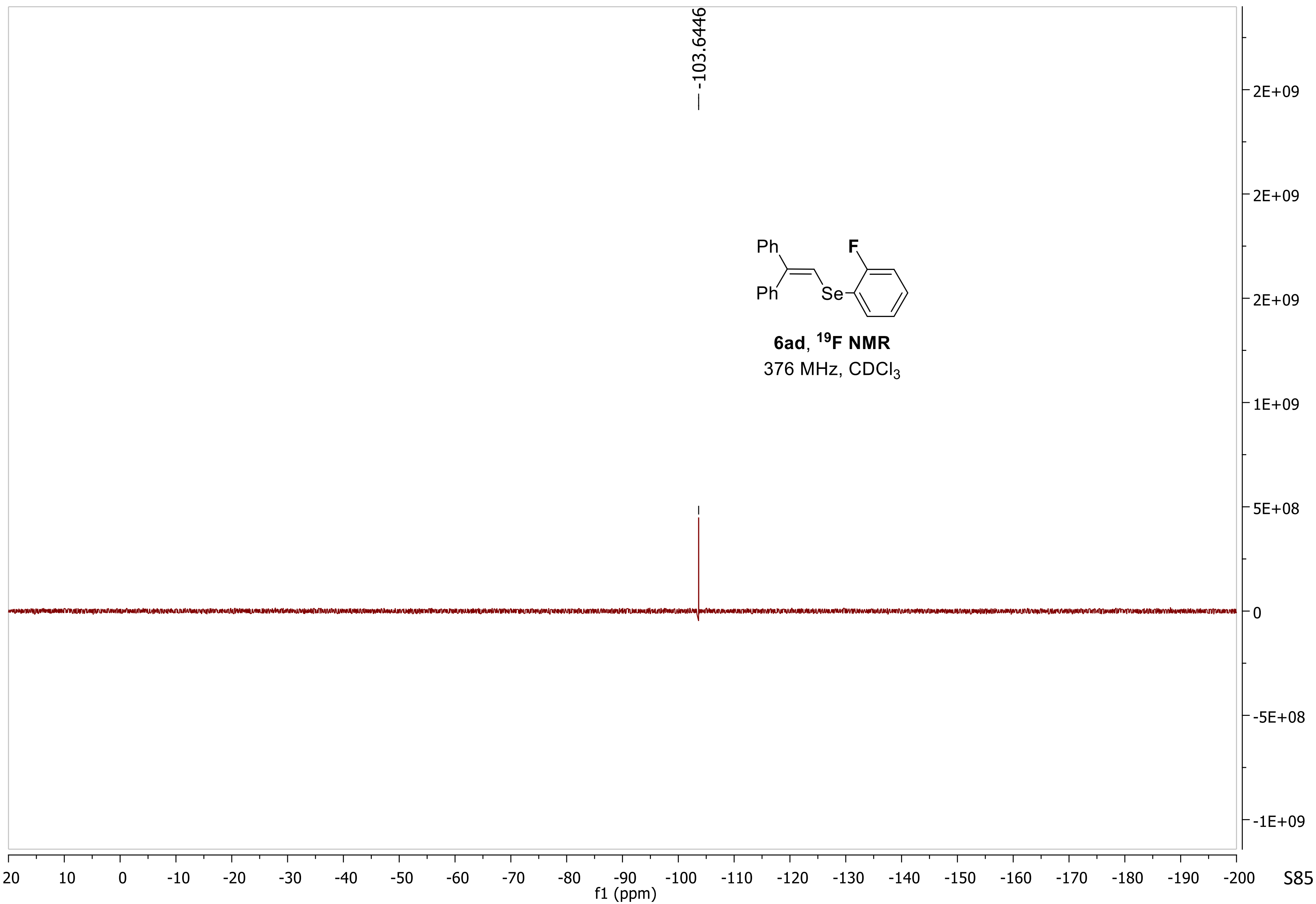
141.4505
139.0724
135.4350
132.8037
130.3064
129.7376
128.8561
128.7250
128.6469
128.5695
128.3134
128.1872
127.9809
127.8363
127.6123
Ph
Ph
Cl
Se
6ac, ¹³C{¹H} NMR
100 MHz, CDCl₃
f1 (ppm)

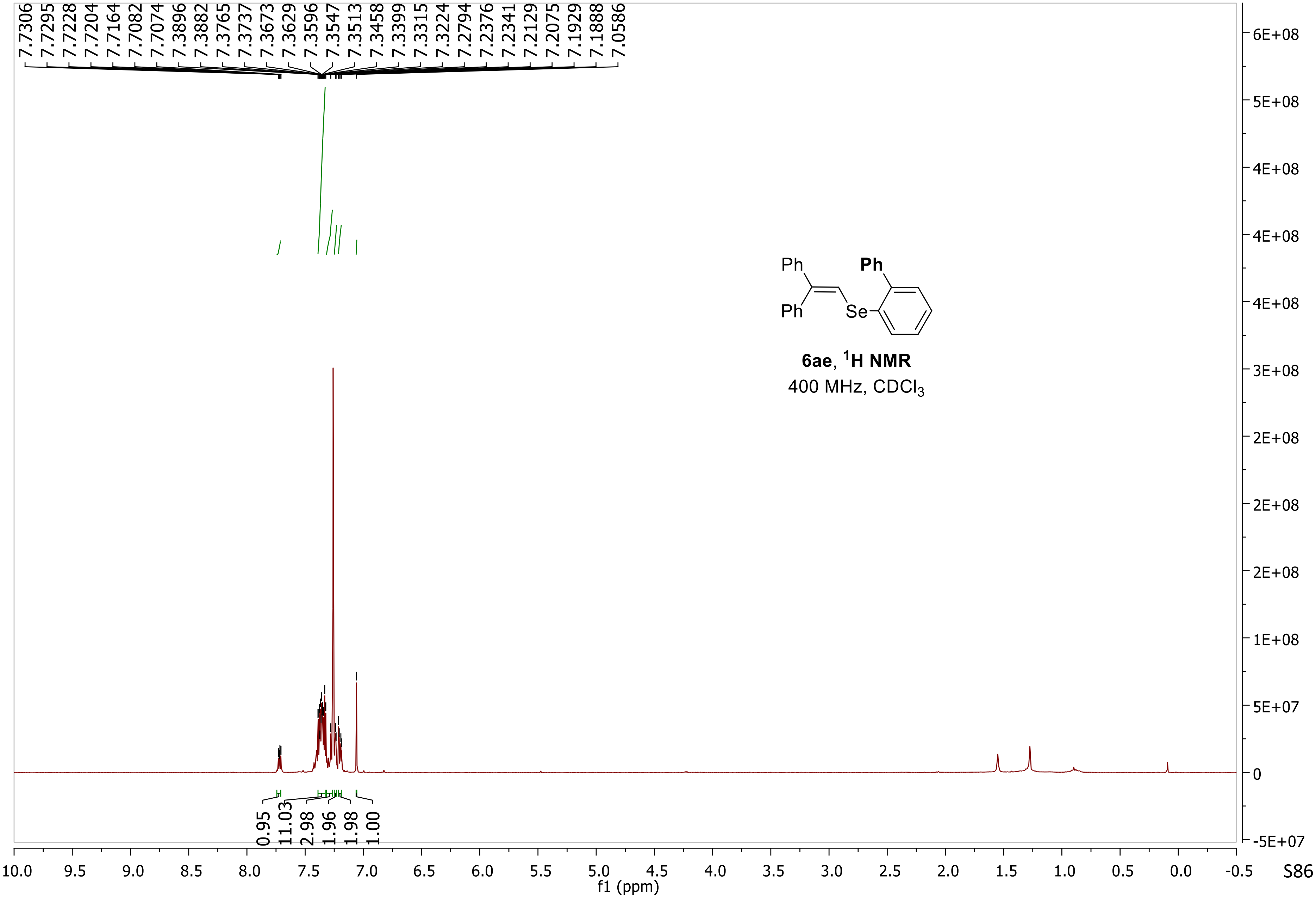

7.6469
7.6430
7.6262
7.6243
7.6109
7.6068
7.5042
7.5001
7.4963
7.4880
7.4835
7.4793
7.4682
7.4649
7.4631
7.4464
7.4423
7.4386
7.4311
7.4245
7.4137
7.4096
7.3971
7.3932
7.3898
7.3498
7.3447
7.3366
7.3297
7.3247
7.3117
7.3057
7.3040
7.2939
7.2876
7.2852
7.2815
7.2739
7.2605
7.1779
7.1747
7.1590
7.1558
7.1492
7.1467
7.1401
7.1369
7.1273
7.1069
7.1039
Ph
Ph
F
Se
6ad, 1H NMR
400 MHz, CDCl3
1.00
1.97
3.00
6.00
2.99
f1 (ppm)

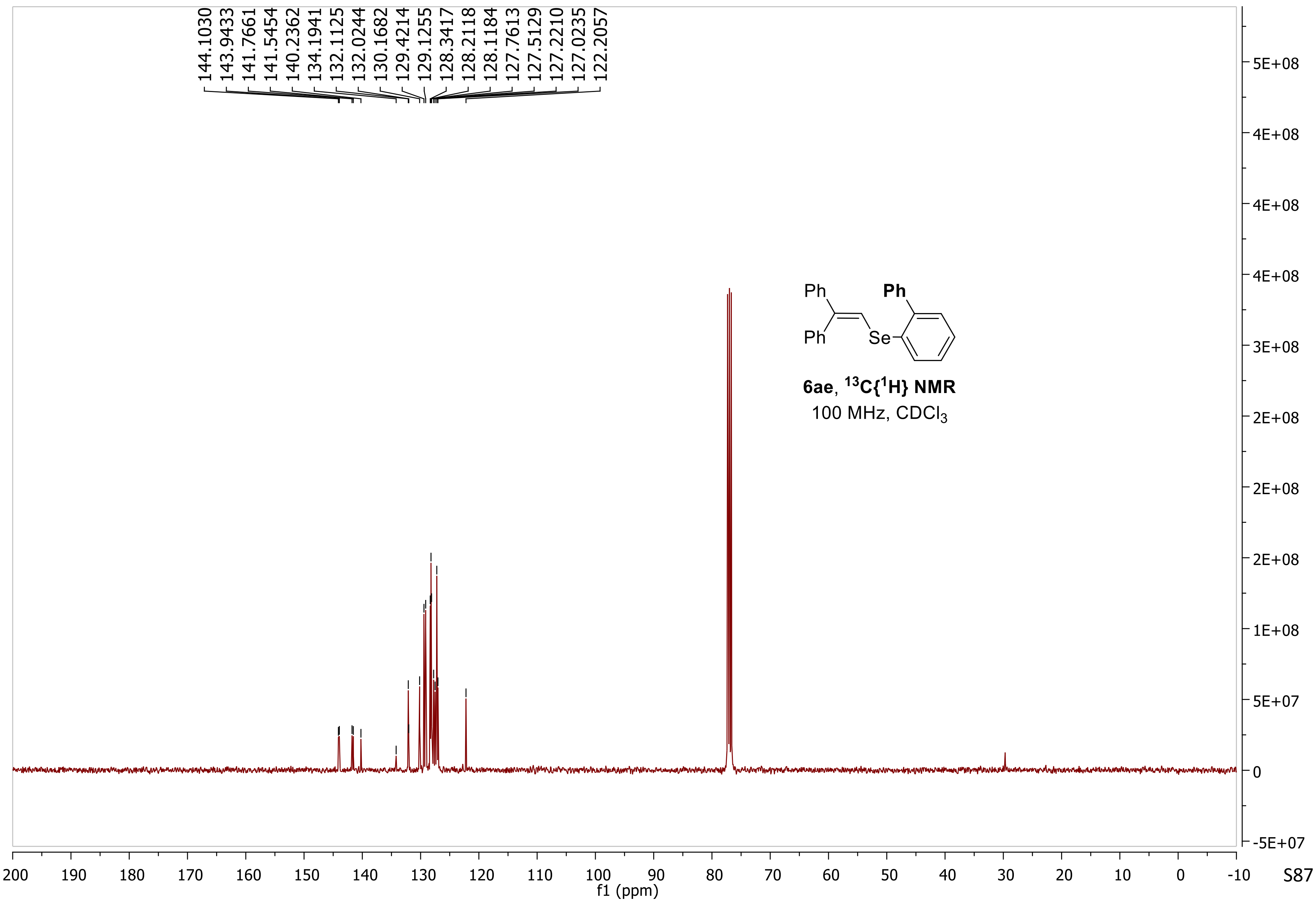


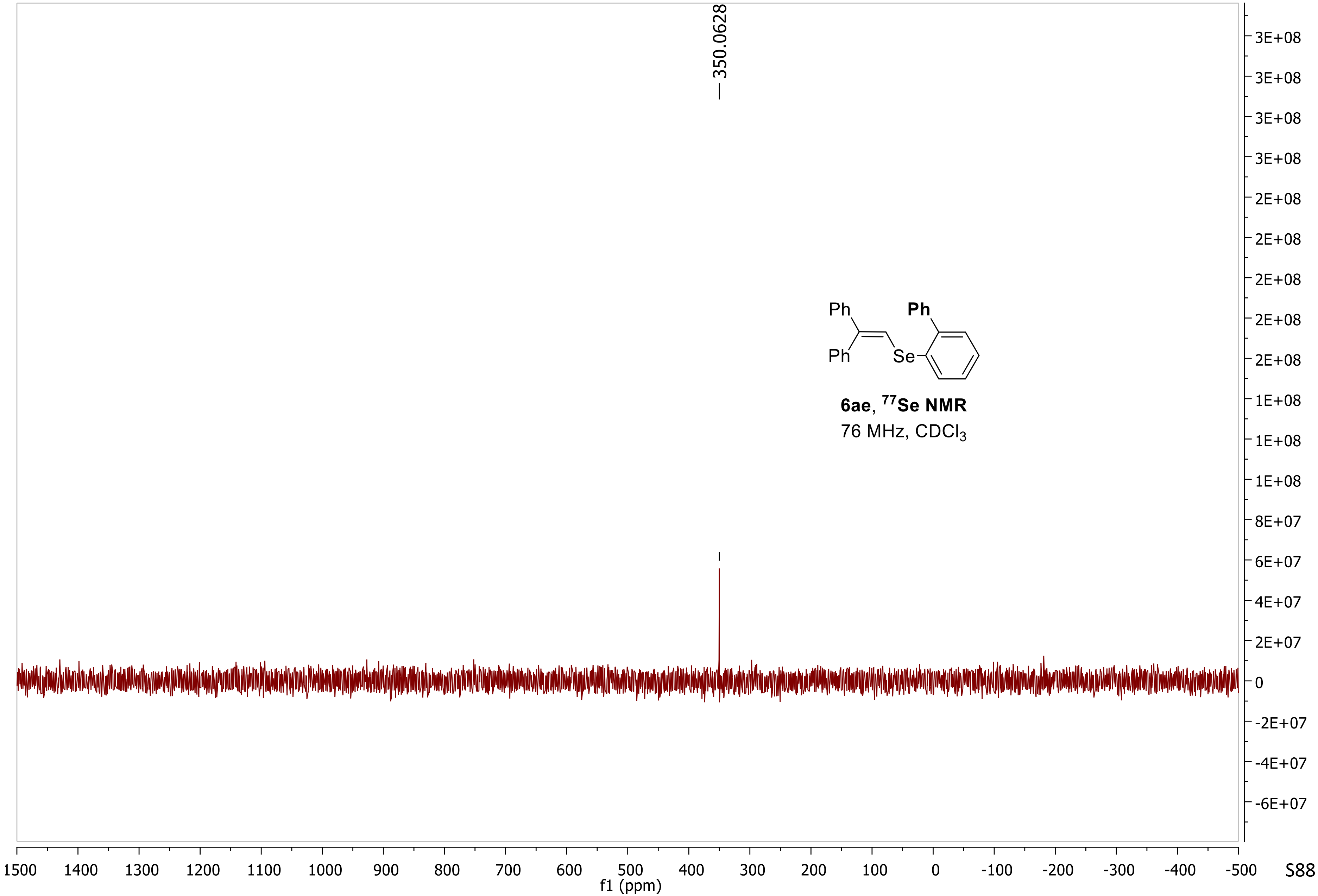
6ad, **^{13}C{^{1}H} NMR**
100 MHz, $CDCl_3$


302.0799
Ph
Ph
Se
F
6ad, 77Se NMR
76 MHz, CDCl3
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
-1E+08
1500 1400 1300 1200 1100 1000 900 800 700 600 500 400 300 200 100 0 -100 -200 -300 -400 -500
f1 (ppm)

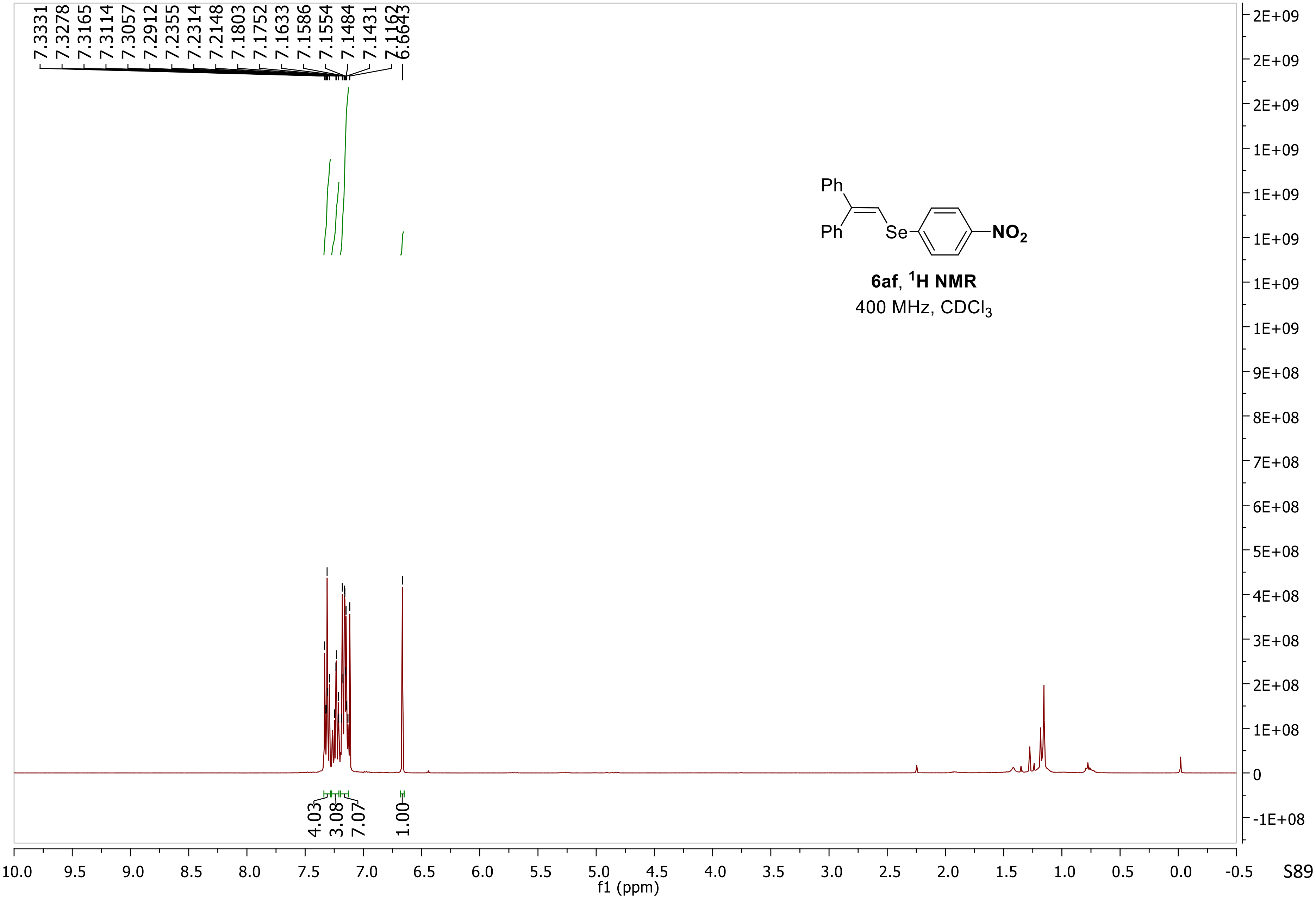

-103.6446
Ph
Ph
Se
F
6ad, ¹⁹F NMR
376 MHz, CDCl3
2E+09
2E+09
2E+09
1E+09
5E+08
0
-5E+08
-1E+09
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)

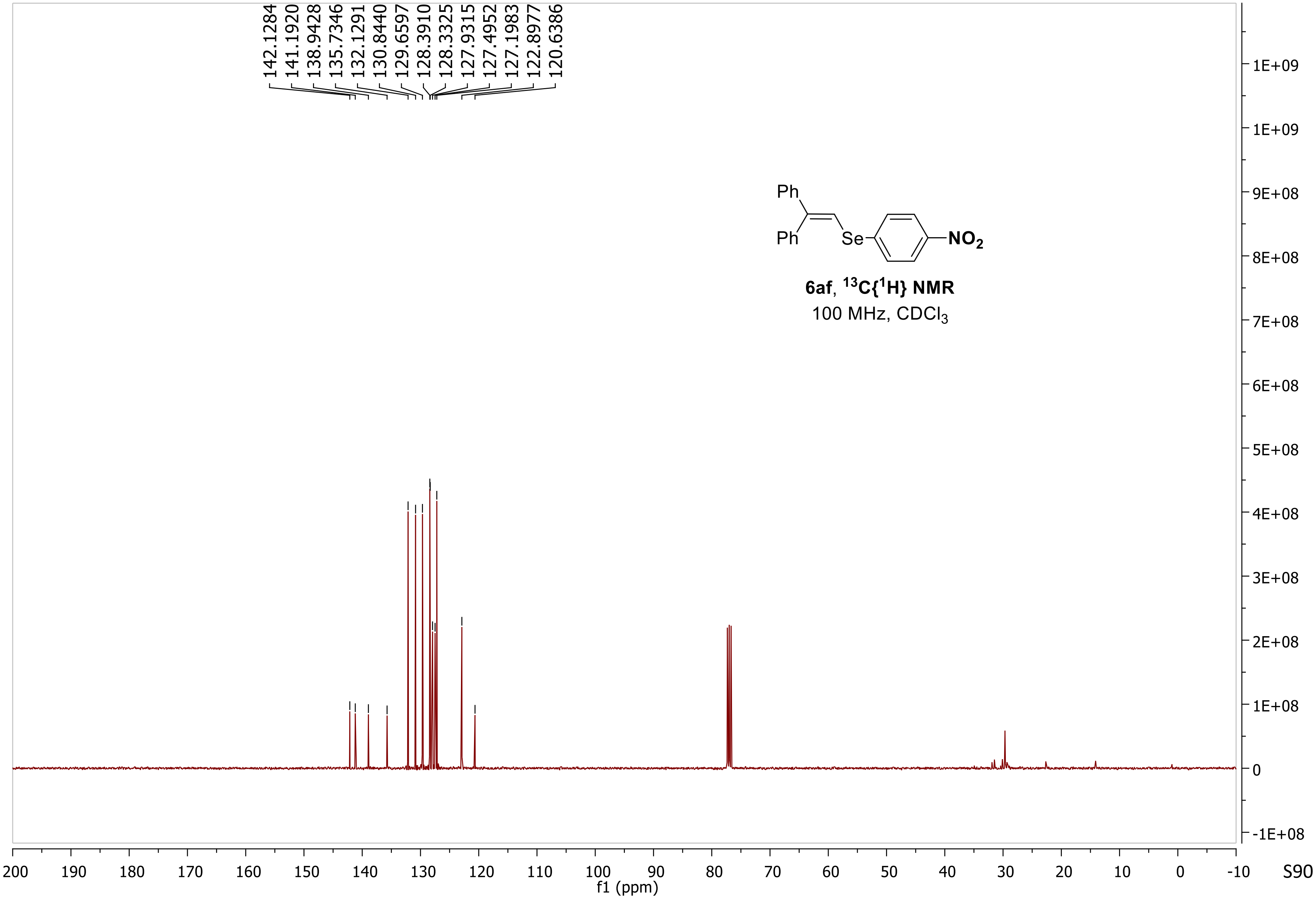

7.7306
7.7295
7.7228
7.7204
7.7164
7.7082
7.7074
7.3896
7.3882
7.3765
7.3737
7.3673
7.3629
7.3596
7.3547
7.3513
7.3458
7.3399
7.3315
7.3224
7.2794
7.2376
7.2341
7.2129
7.2075
7.1929
7.1888
7.0586
Ph
Ph
Ph
Se
6ae, 1H NMR
400 MHz, CDCl3
0.95
11.03
2.98
1.96
1.98
1.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)
6E+08
5E+08
4E+08
4E+08
3E+08
2E+08
2E+08
1E+08
5E+07
0
-5E+07

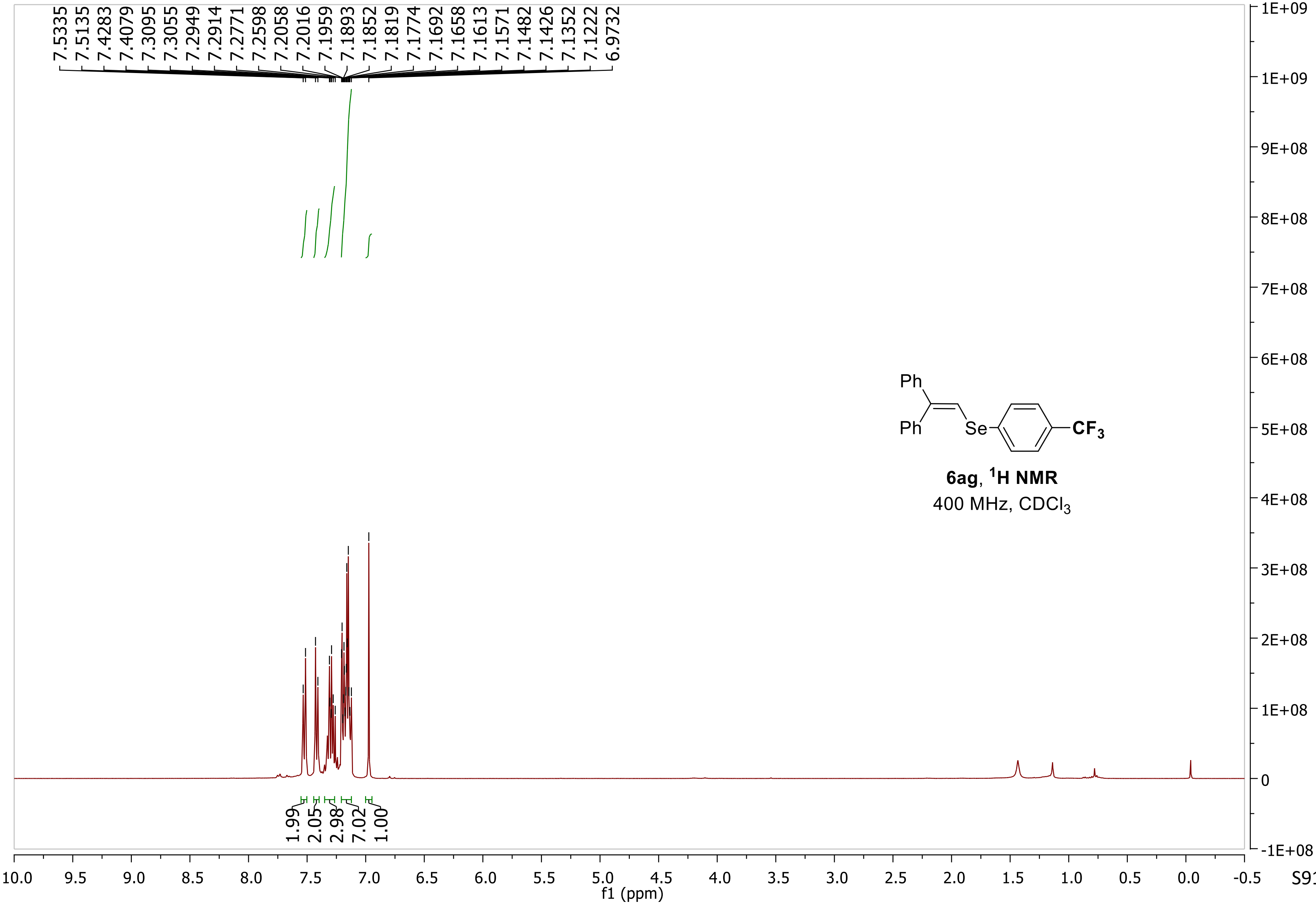

144.1030
143.9433
141.7661
141.5454
140.2362
134.1941
132.1125
132.0244
130.1682
129.4214
129.1255
128.3417
128.2118
128.1184
127.7613
127.5129
127.2210
127.0235
122.2057
Ph
Ph
Ph
Se
6ae, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)

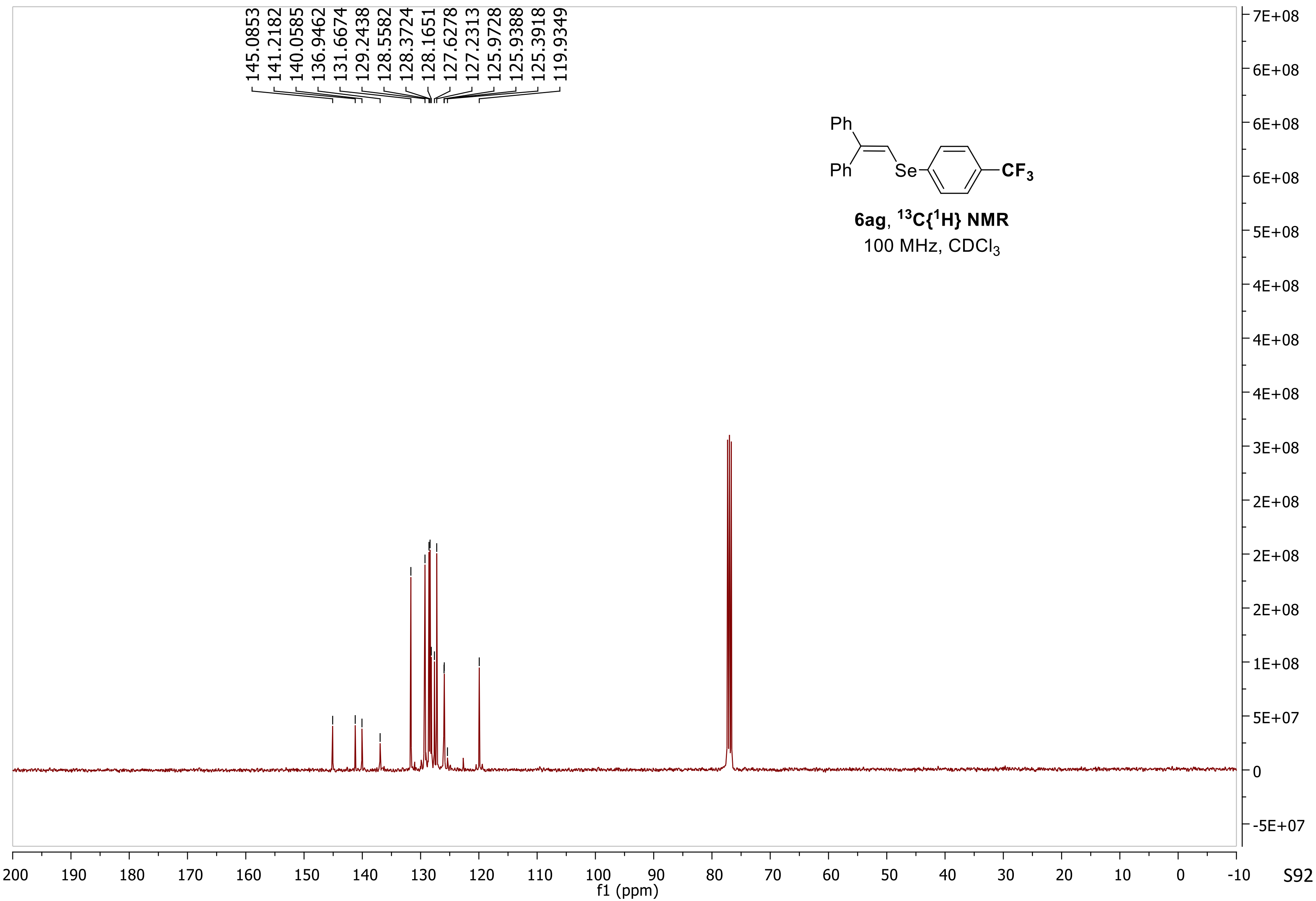


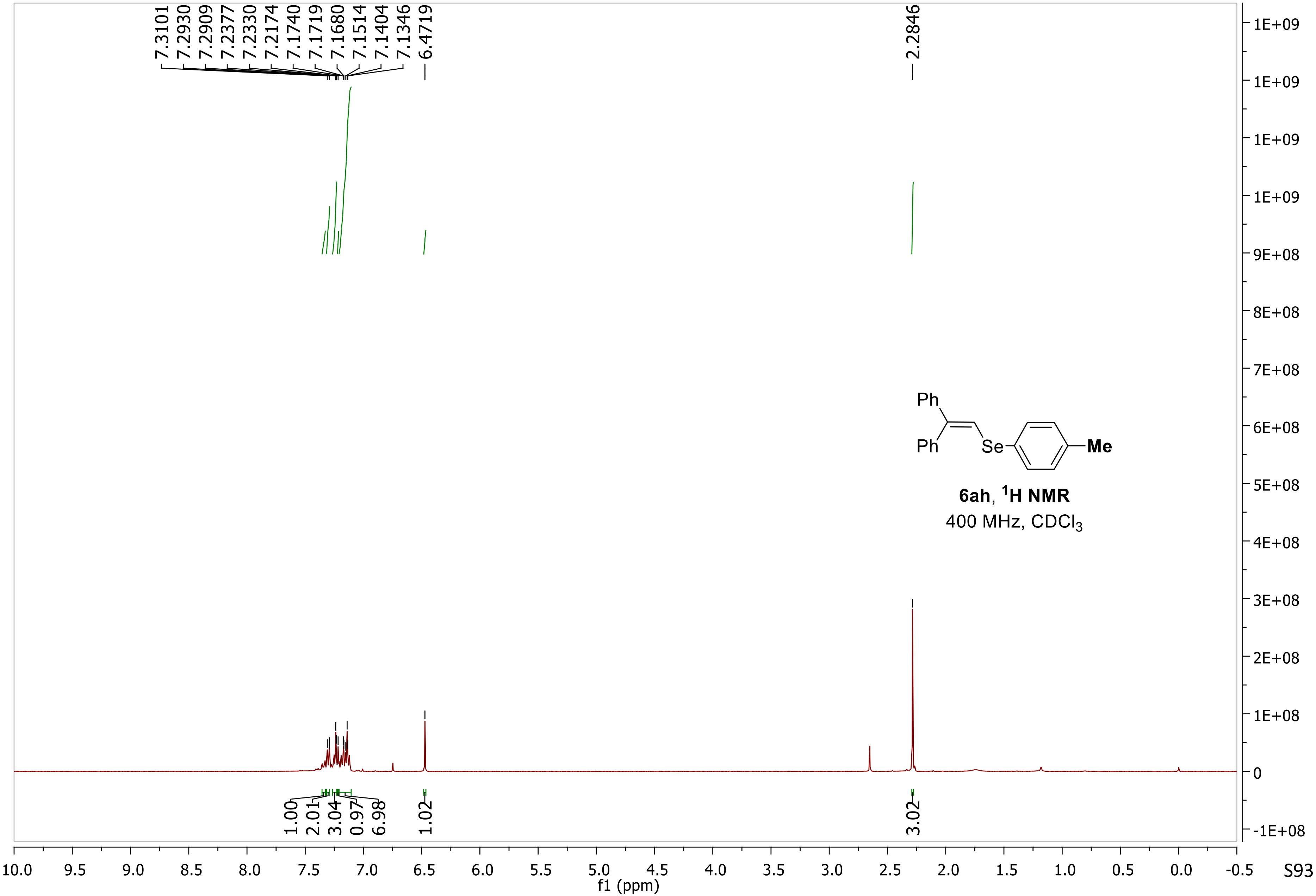
6ae, ^{77}**Se NMR**
76 MHz, $CDCl_3$


7.3331
7.3278
7.3165
7.3114
7.3057
7.2912
7.2355
7.2314
7.2148
7.1803
7.1752
7.1633
7.1586
7.1554
7.1484
7.1431
7.1162
6.6643
Ph
Ph
Se
NO2
6af, 1H NMR
400 MHz, CDCl3
4.03
3.08
7.07
1.00
f1 (ppm)


142.1284
141.1920
138.9428
135.7346
132.1291
130.8440
129.6597
128.3910
128.3325
127.9315
127.4952
127.1983
122.8977
120.6386
Ph
Ph
Se
NO2
6af, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)


7.5335
7.5135
7.4283
7.4079
7.3095
7.3055
7.2949
7.2914
7.2771
7.2598
7.2058
7.2016
7.1959
7.1893
7.1852
7.1819
7.1774
7.1692
7.1658
7.1613
7.1571
7.1482
7.1426
7.1352
7.1222
6.9732
1.99
2.05
2.98
7.02
1.00
Ph
Ph
Se
CF3
6ag, 1H NMR
400 MHz, CDCl3
f1 (ppm)
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
1E+09
1E+09
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
-1E+08


145.0853
141.2182
140.0585
136.9462
131.6674
129.2438
128.5582
128.3724
128.1651
127.6278
127.2313
125.9728
125.9388
125.3918
119.9349
Ph
Ph
Se
CF3
6ag, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)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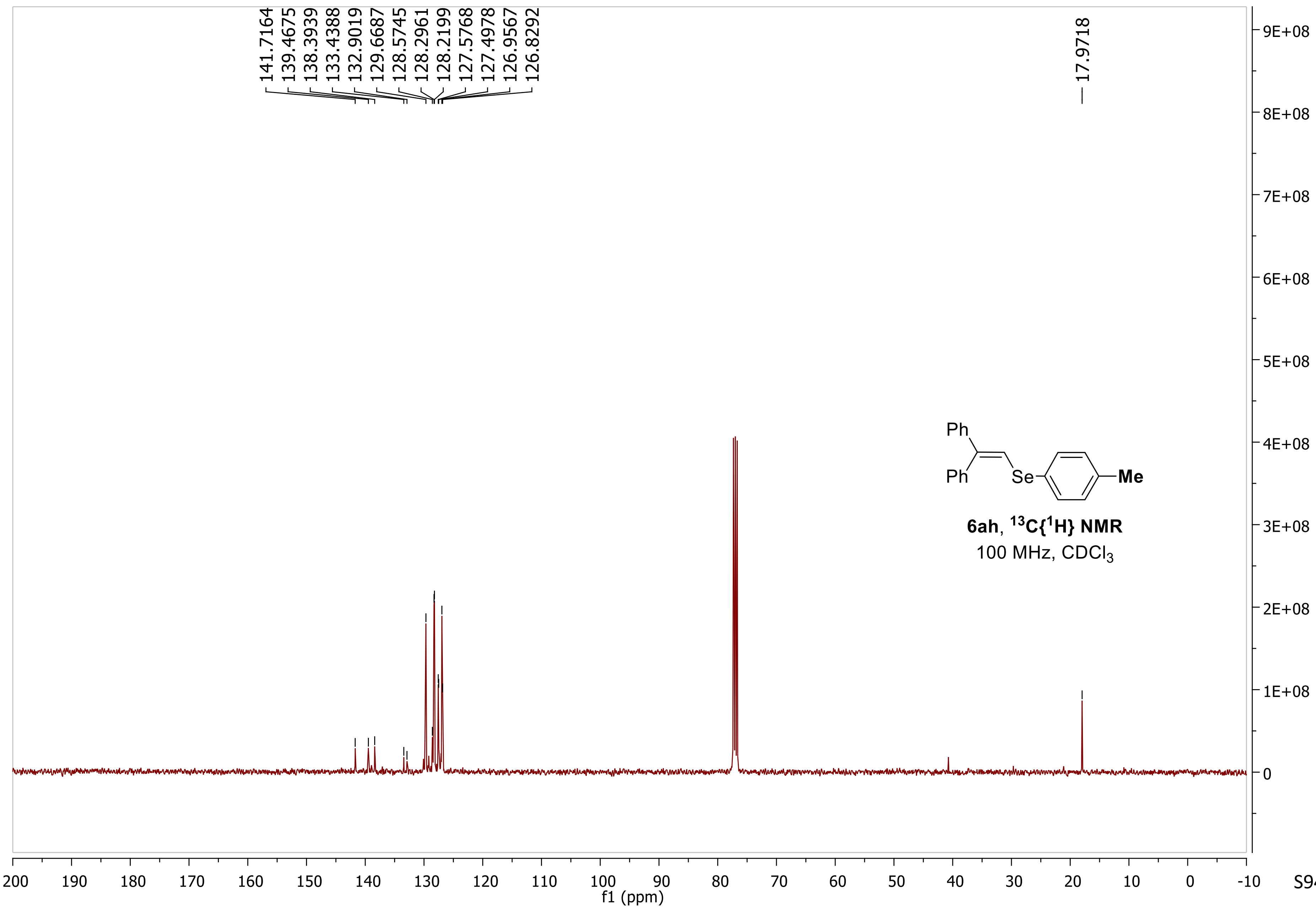
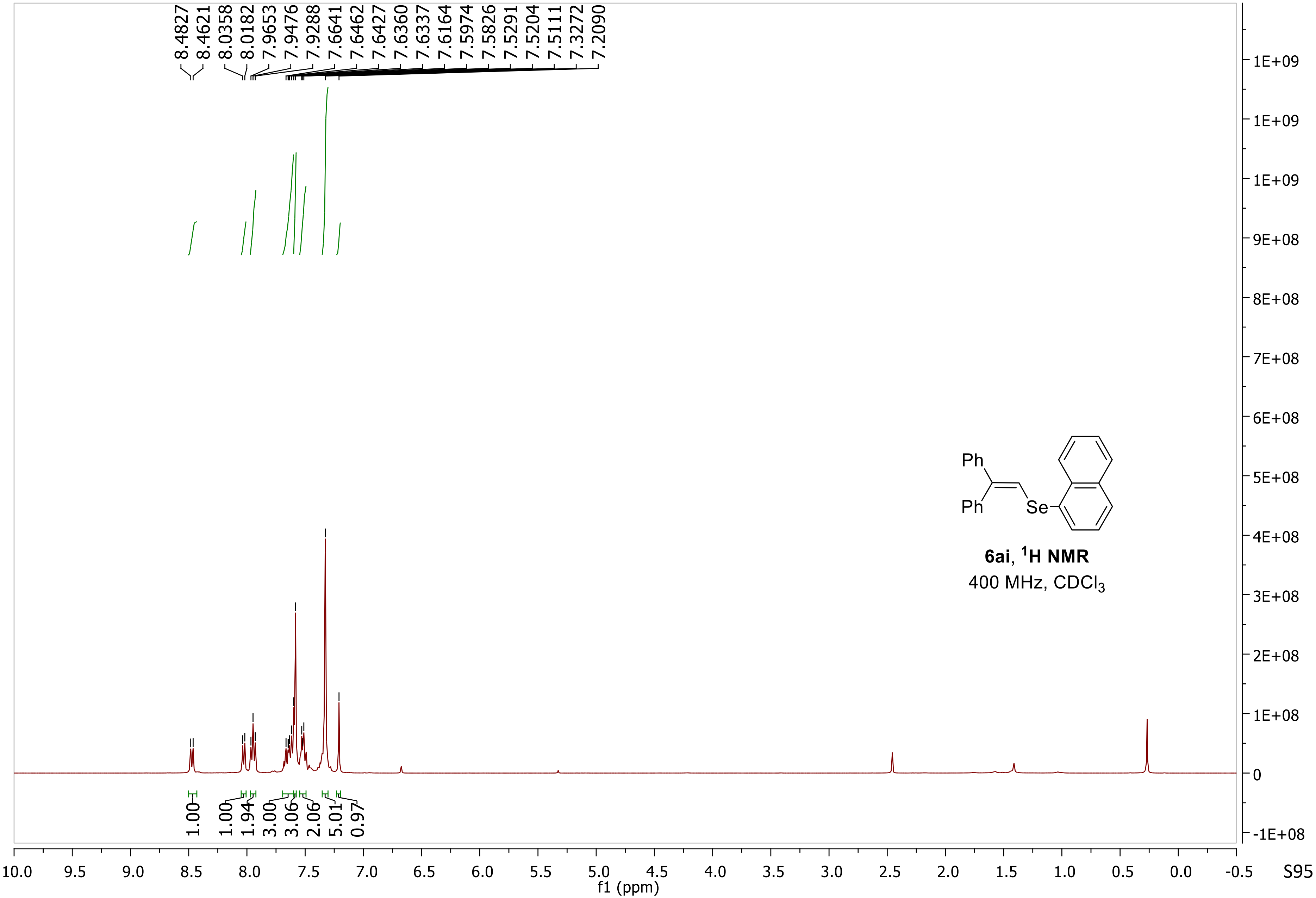
7.2930
7.2909
7.2377
7.2330
7.2174
7.1740
7.1719
7.1680
7.1514
7.1404
7.1346
6.4719
2.2846
Ph
Ph
Se
Me
6ah, ¹H NMR
400 MHz, CDCl3
1.00
2.01
3.04
0.97
6.98
1.02
3.02
f1 (ppm)

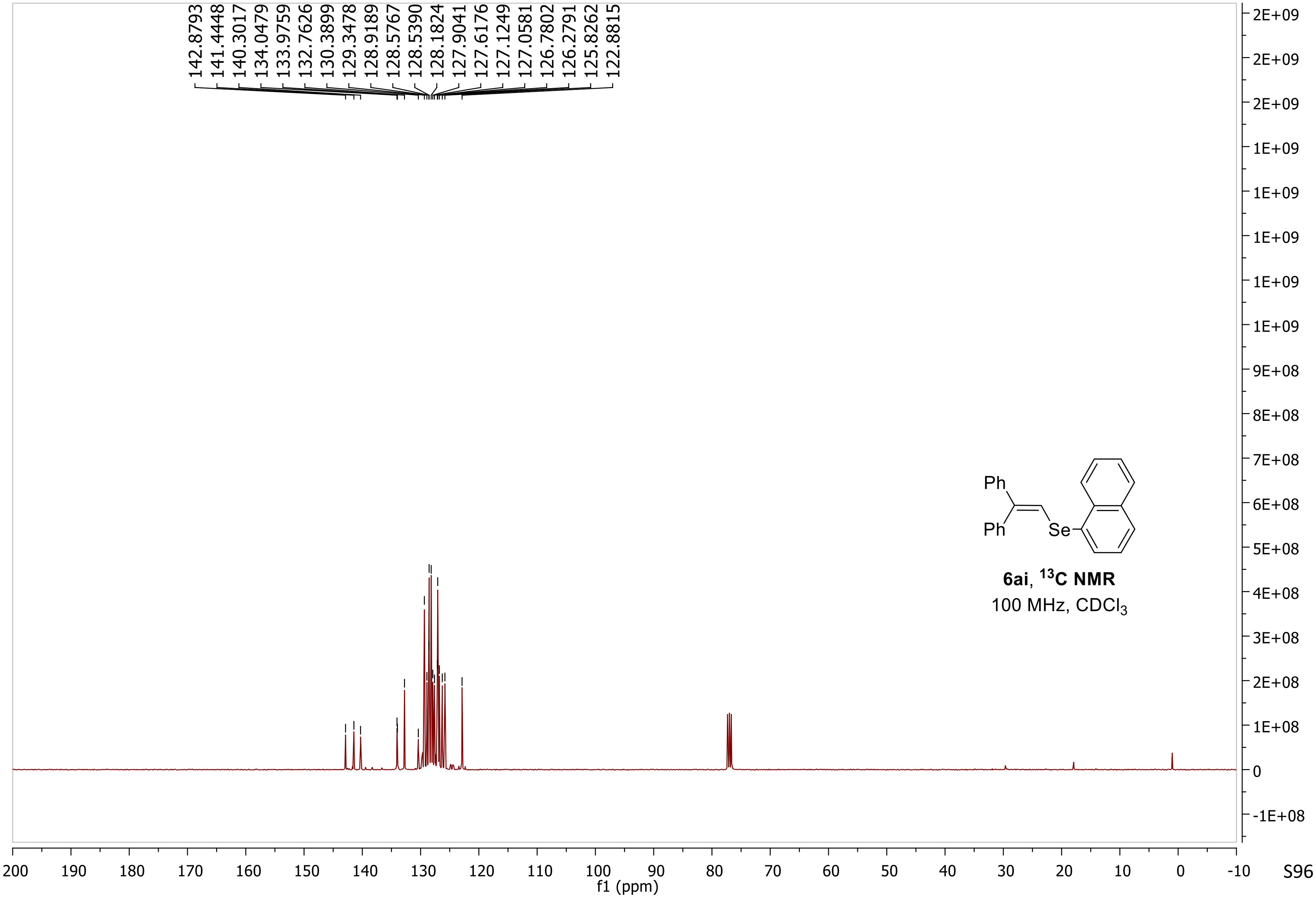


6ah, $^{13}C\{^1H\}$ **NMR**
100 MHz, $CDCl_3$

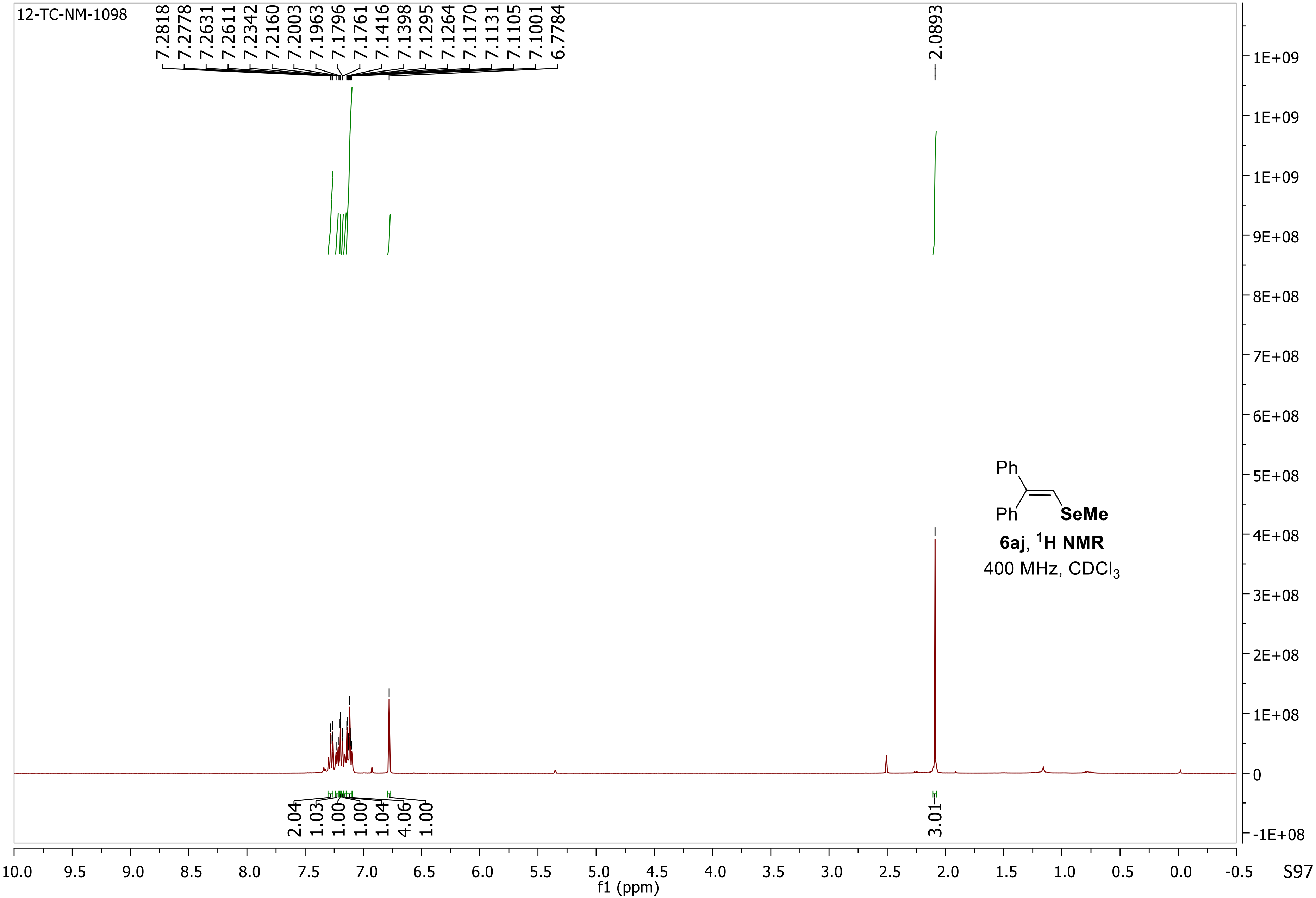


6ai, **^{1}H NMR**

400 MHz, $CDCl_3$



6ai, **^{13}C NMR**
100 MHz, $CDCl_3$


12-TC-NM-1098
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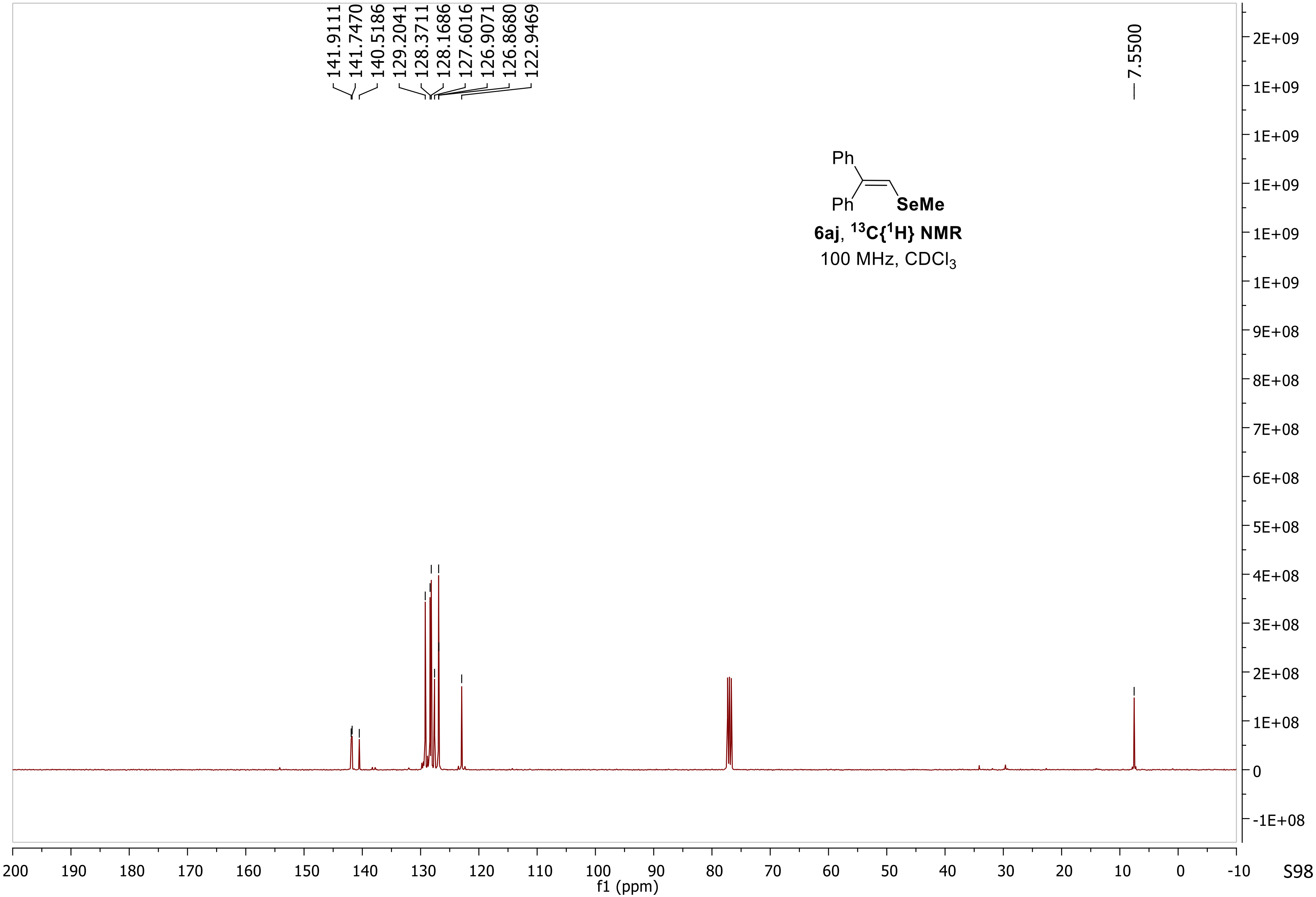
7.2778
7.2631
7.2611
7.2342
7.2160
7.2003
7.1963
7.1796
7.1761
7.1416
7.1398
7.1295
7.1264
7.1170
7.1131
7.1105
7.1001
6.7784
2.0893
Ph
Ph
SeMe
6aj, ¹H NMR
400 MHz, CDCl3
2.04
1.03
1.00
1.00
1.04
4.06
1.00
3.01
f1 (ppm)


141.9111
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129.2041
128.3711
128.1686
127.6016
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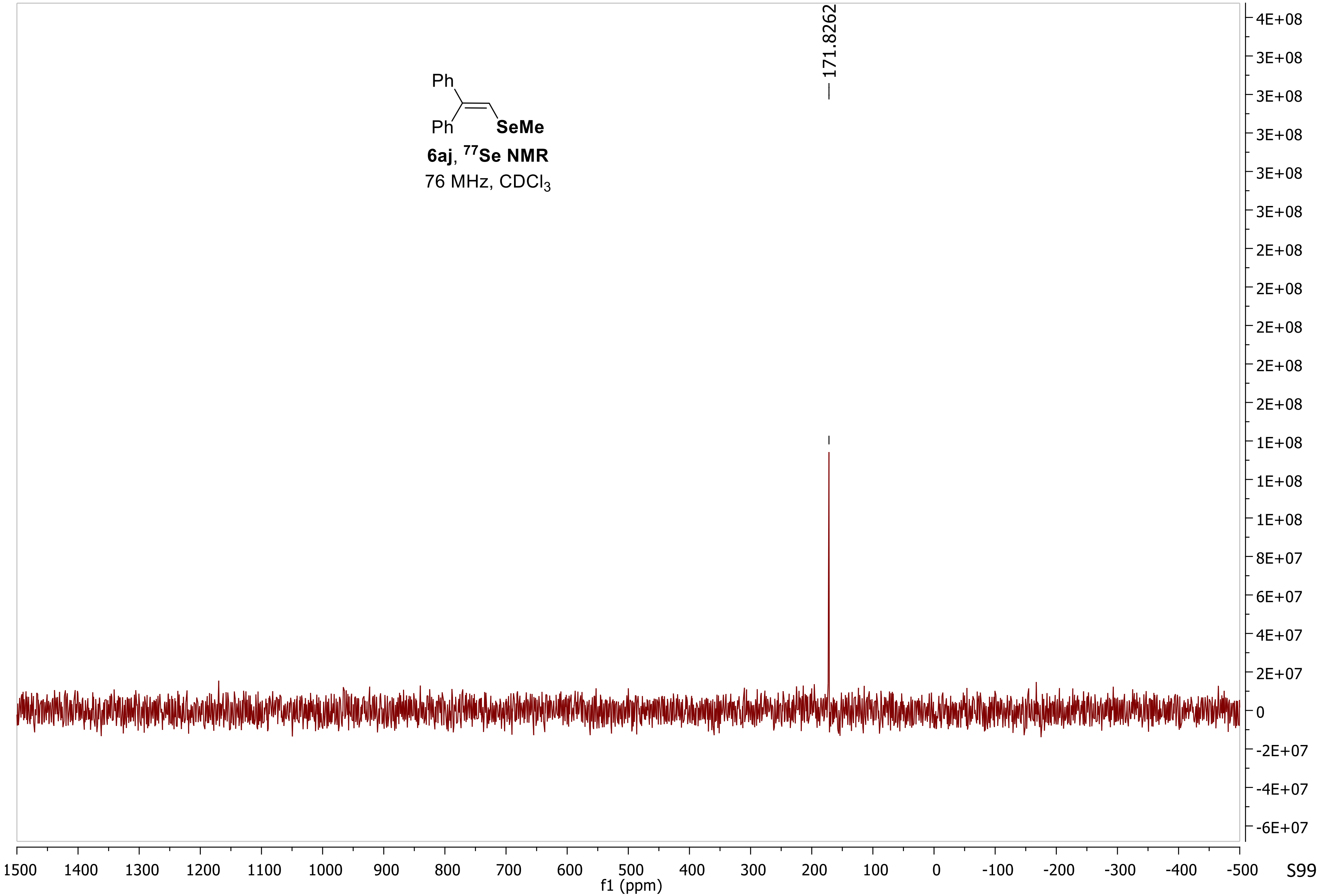
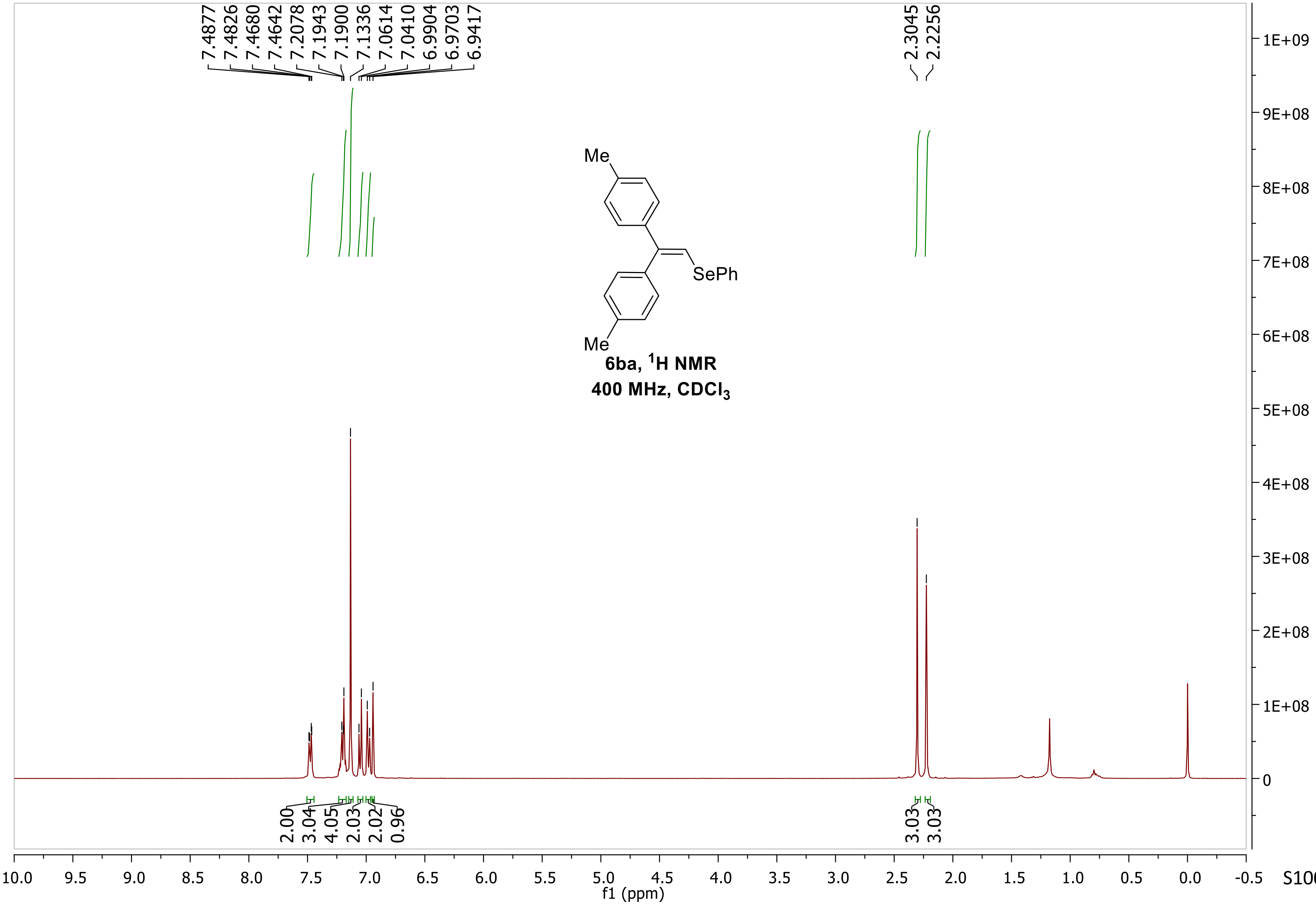
122.9469
7.5500
Ph
Ph
SeMe
6aj, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)



Ph
Ph
SeMe
6aj, 77Se NMR
76 MHz, CDCl3
171.8262
f1 (ppm)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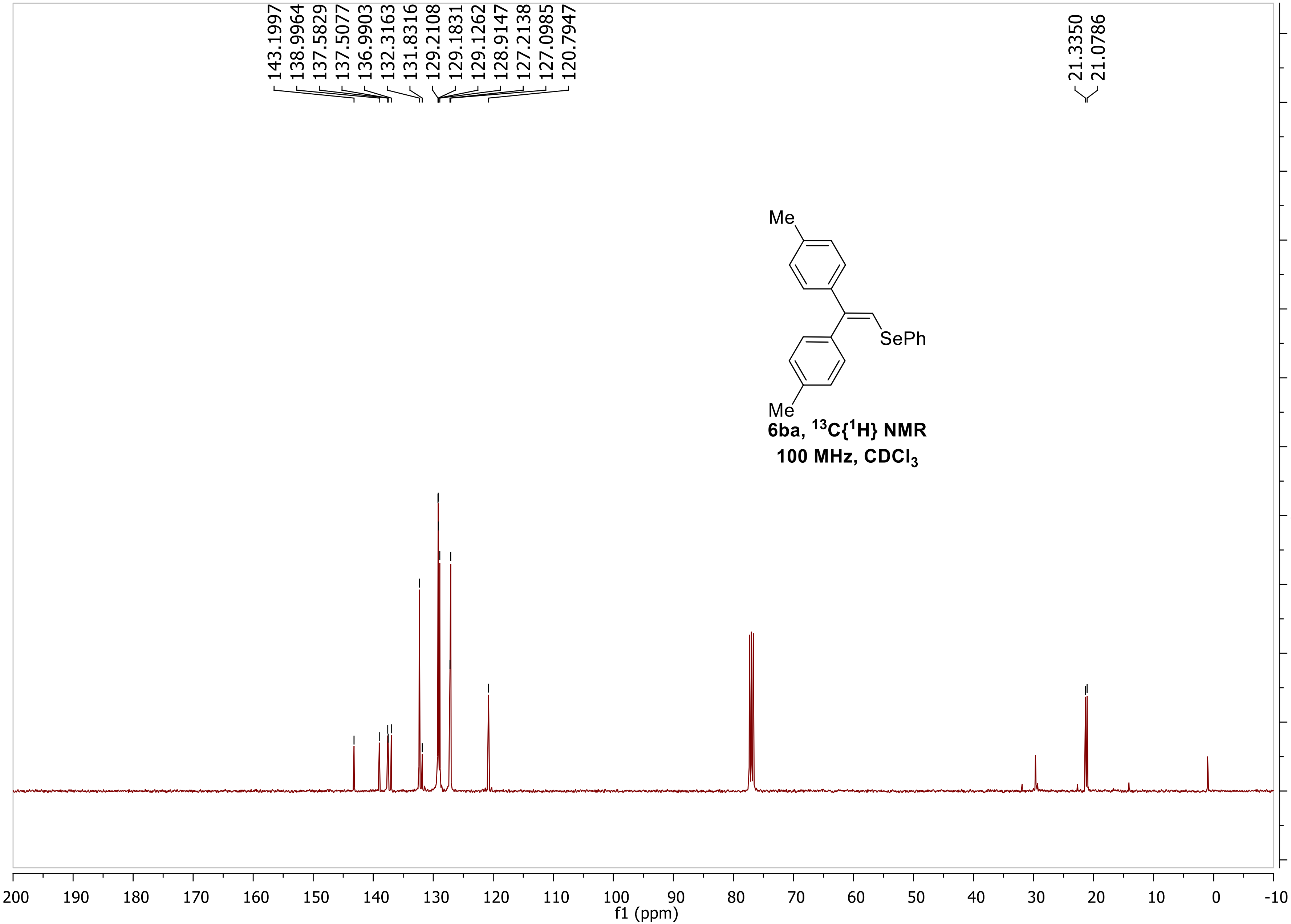
7.4826
7.4680
7.4642
7.2078
7.1943
7.1900
7.1336
7.0614
7.0410
6.9904
6.9703
6.9417
2.3045
2.2256
Me
SePh
Me
6ba, ¹H NMR
400 MHz, CDCl₃
1E+09
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
2.00
3.04
4.05
2.03
2.02
0.96
3.03
3.03
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


143.1997
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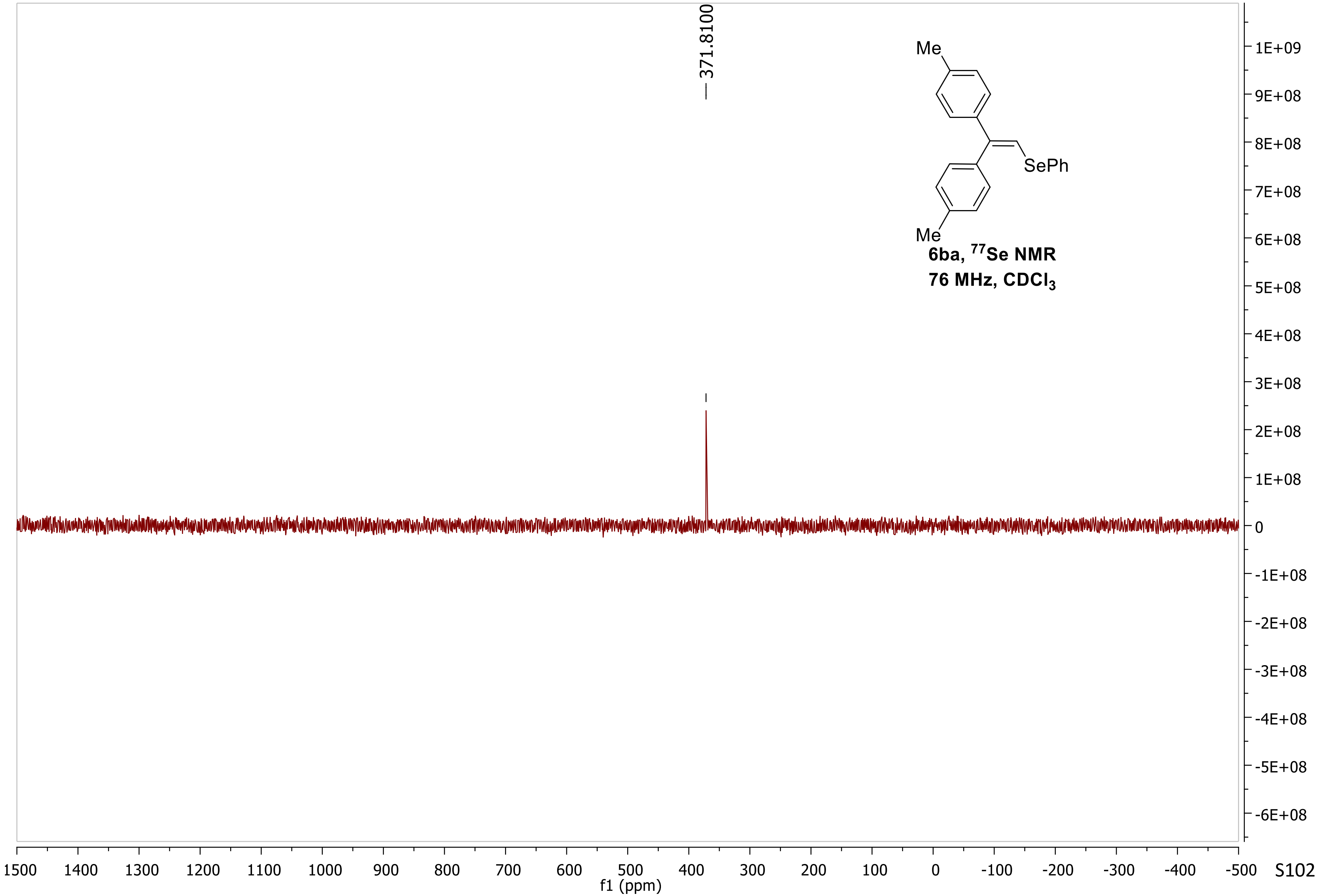
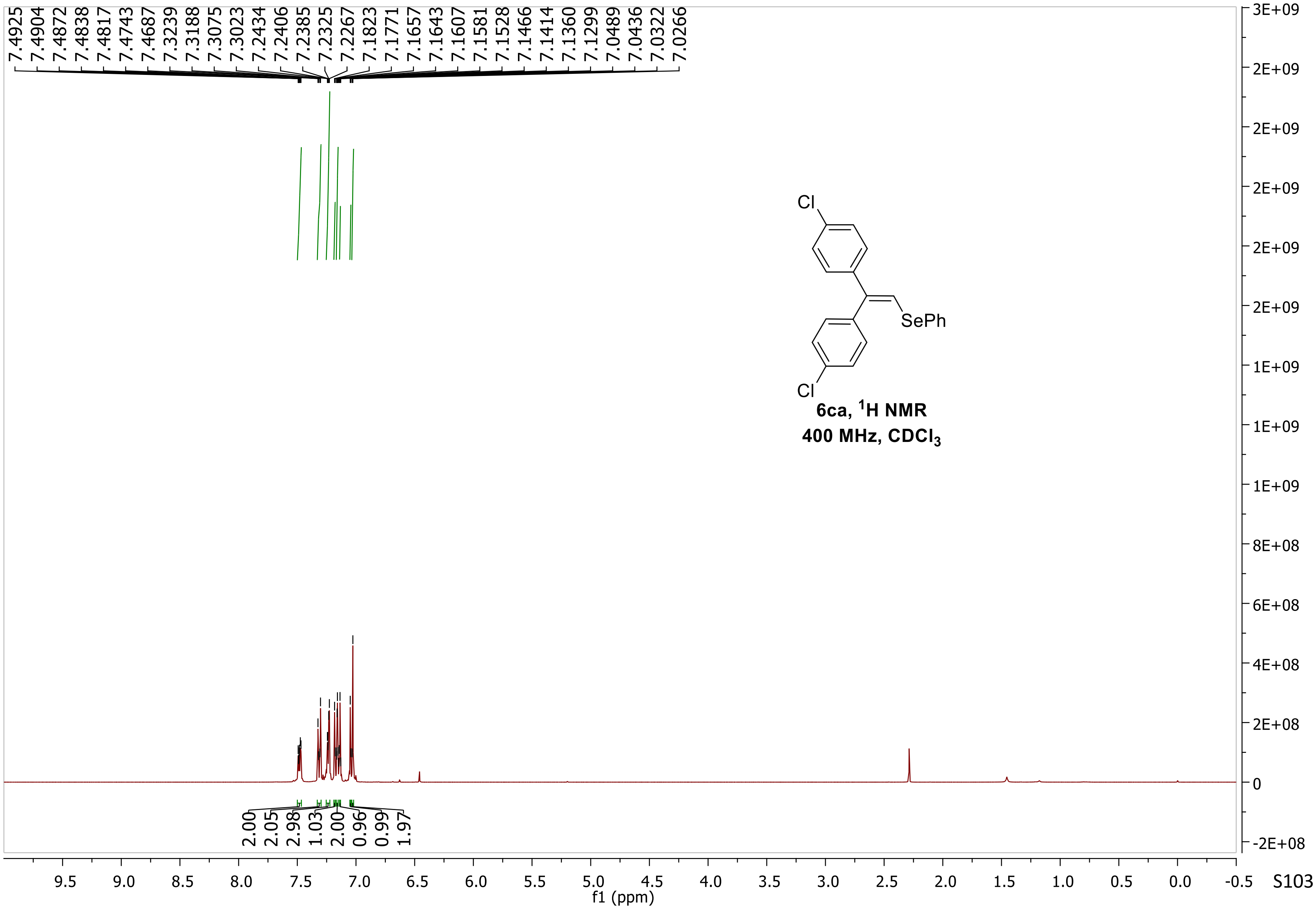
137.5829
137.5077
136.9903
132.3163
131.8316
129.2108
129.1831
129.1262
128.9147
127.2138
127.0985
120.7947
21.3350
21.0786
Me
SePh
Me
6ba, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)



371.8100
Me
SePh
Me
6ba, 77Se NMR
76 MHz, CDCl3
1E+09
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
-1E+08
-2E+08
-3E+08
-4E+08
-5E+08
-6E+08
1500 1400 1300 1200 1100 1000 900 800 700 600 500 400 300 200 100 0 -100 -200 -300 -400 -500
f1 (ppm)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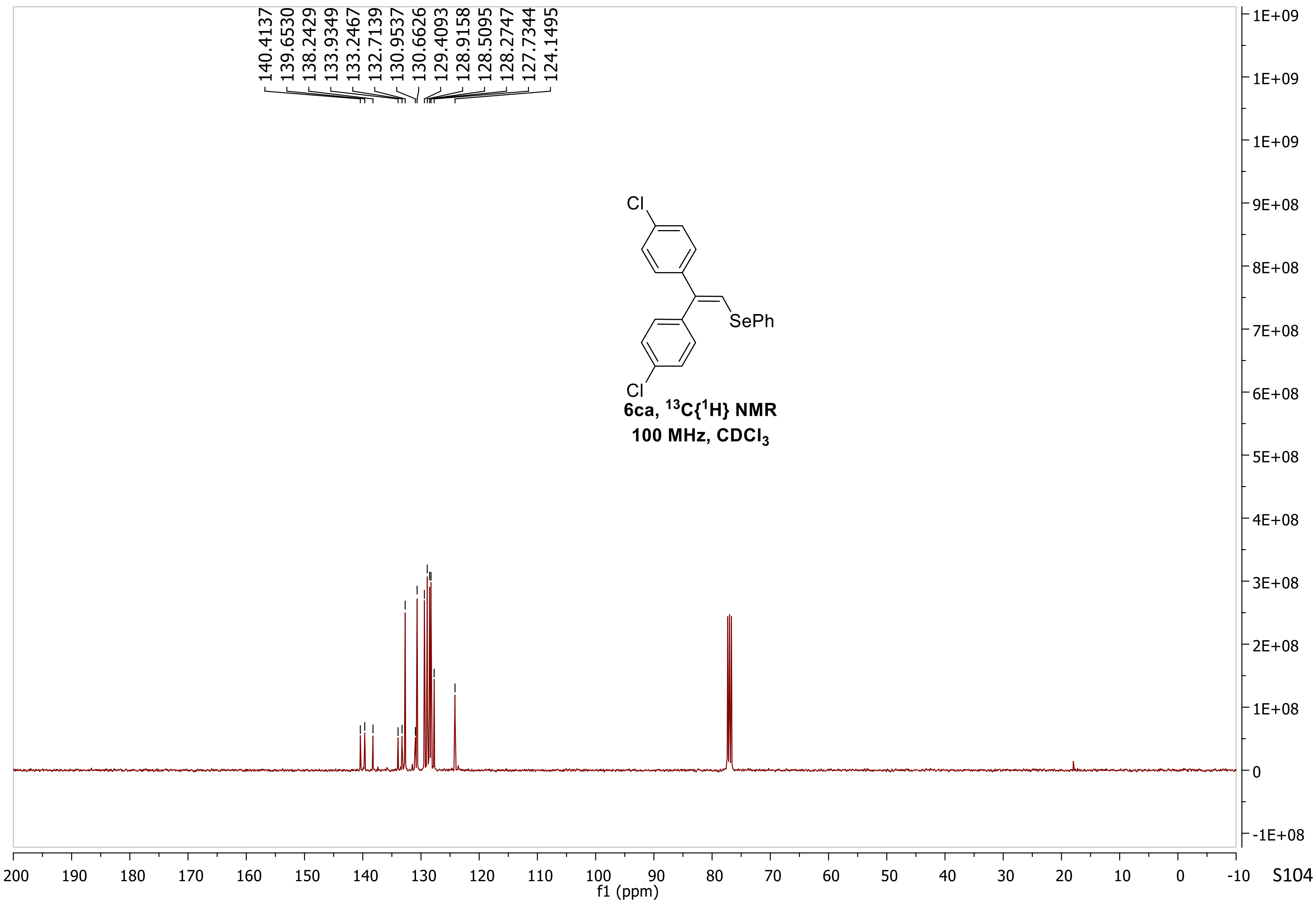
Cl
SePh
Cl
6ca, 1H NMR
400 MHz, CDCl3
2.00 2.05 2.98 1.03 2.00 0.96 0.99 1.97
f1 (ppm)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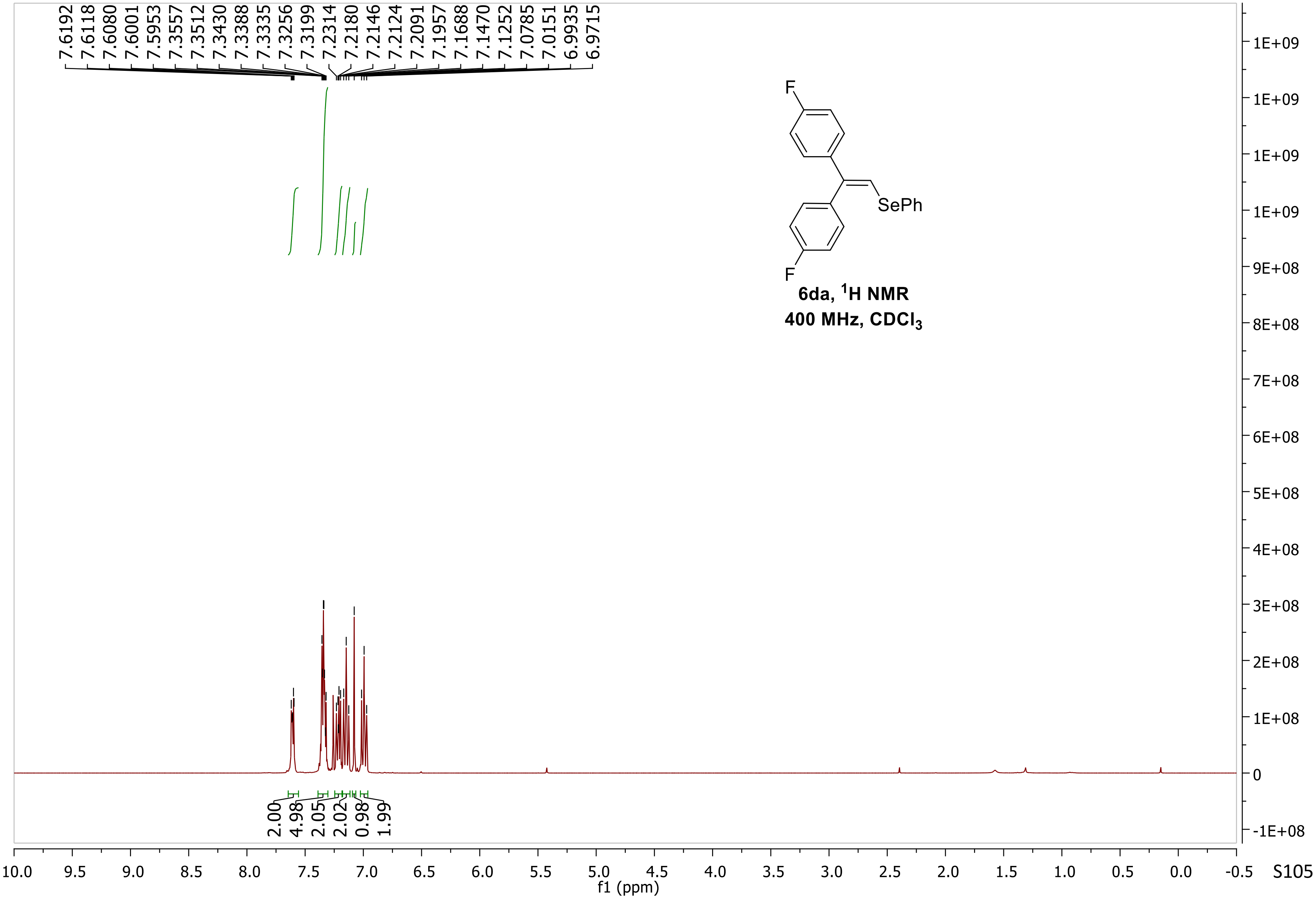
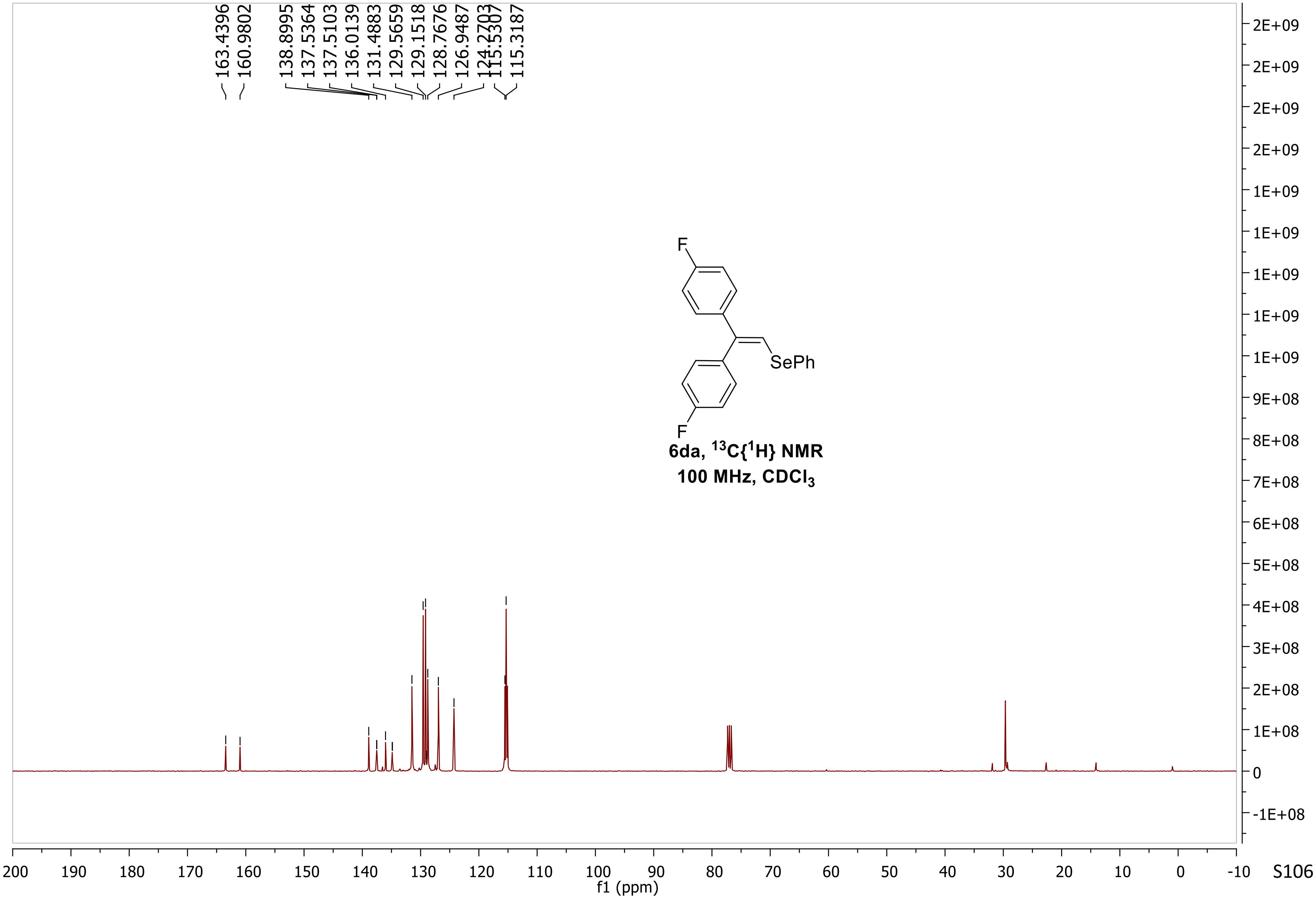
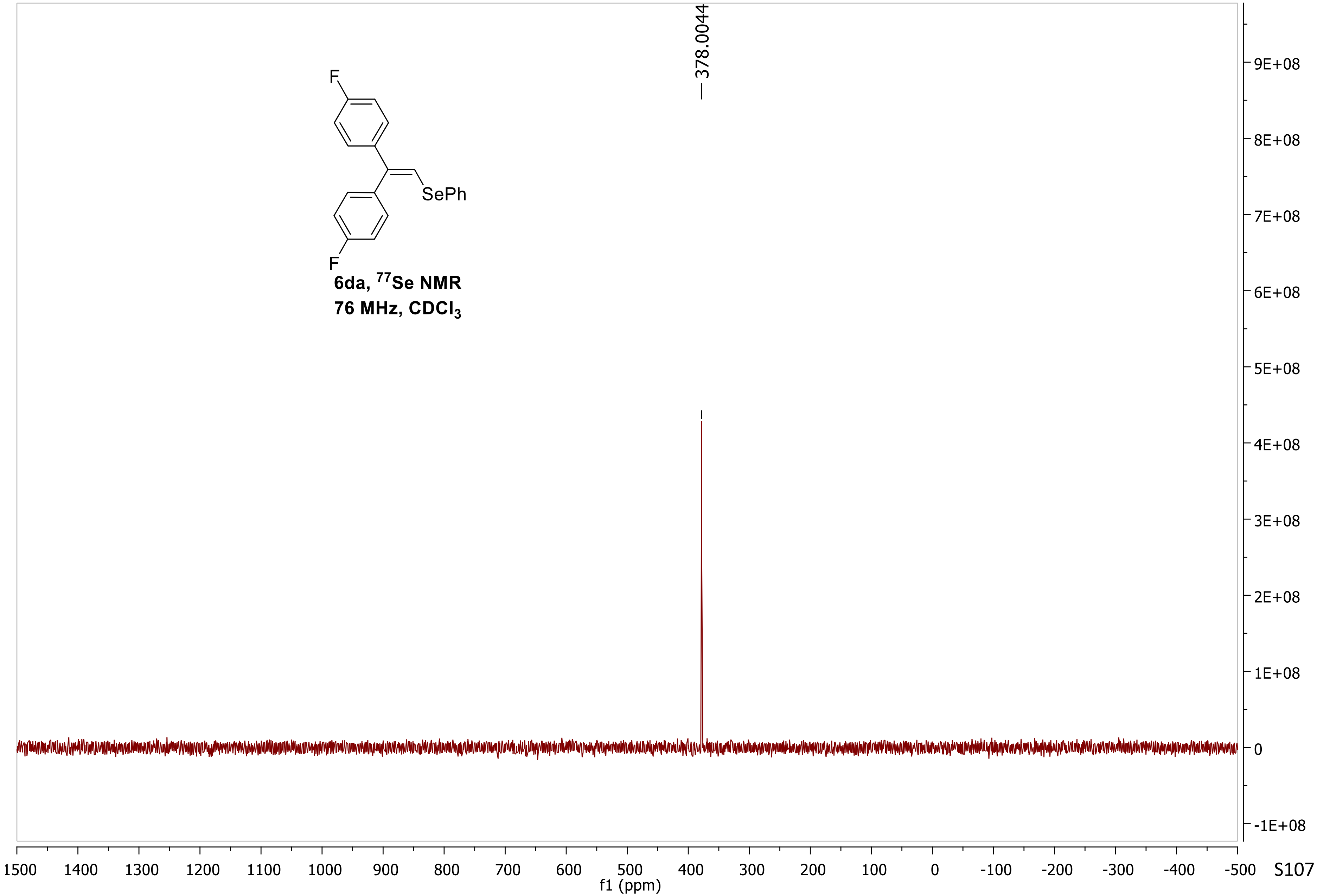
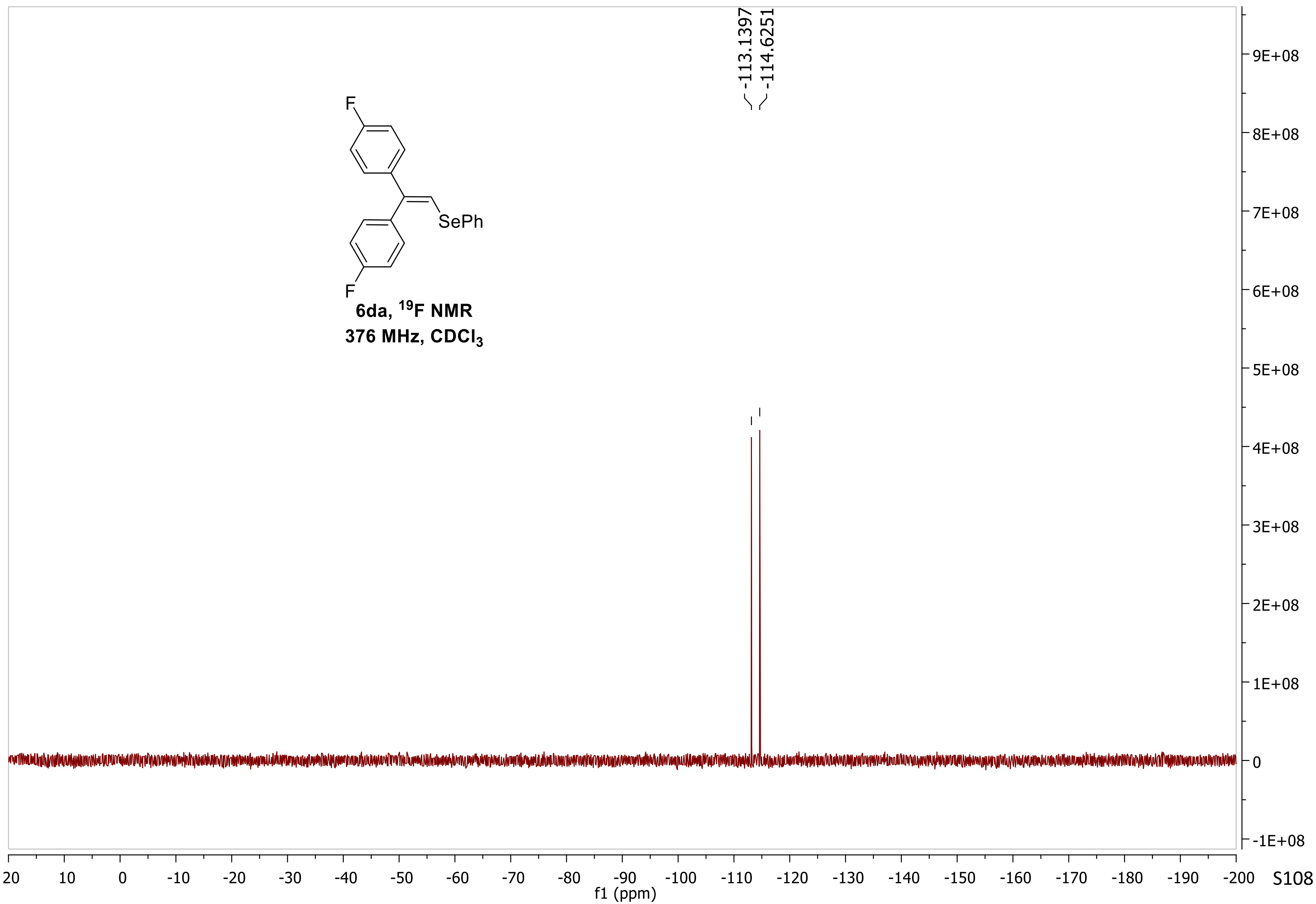
139.6530
138.2429
133.9349
133.2467
132.7139
130.9537
130.6626
129.4093
128.9158
128.5095
128.2747
127.7344
124.1495
Cl
SePh
Cl
6ca, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)



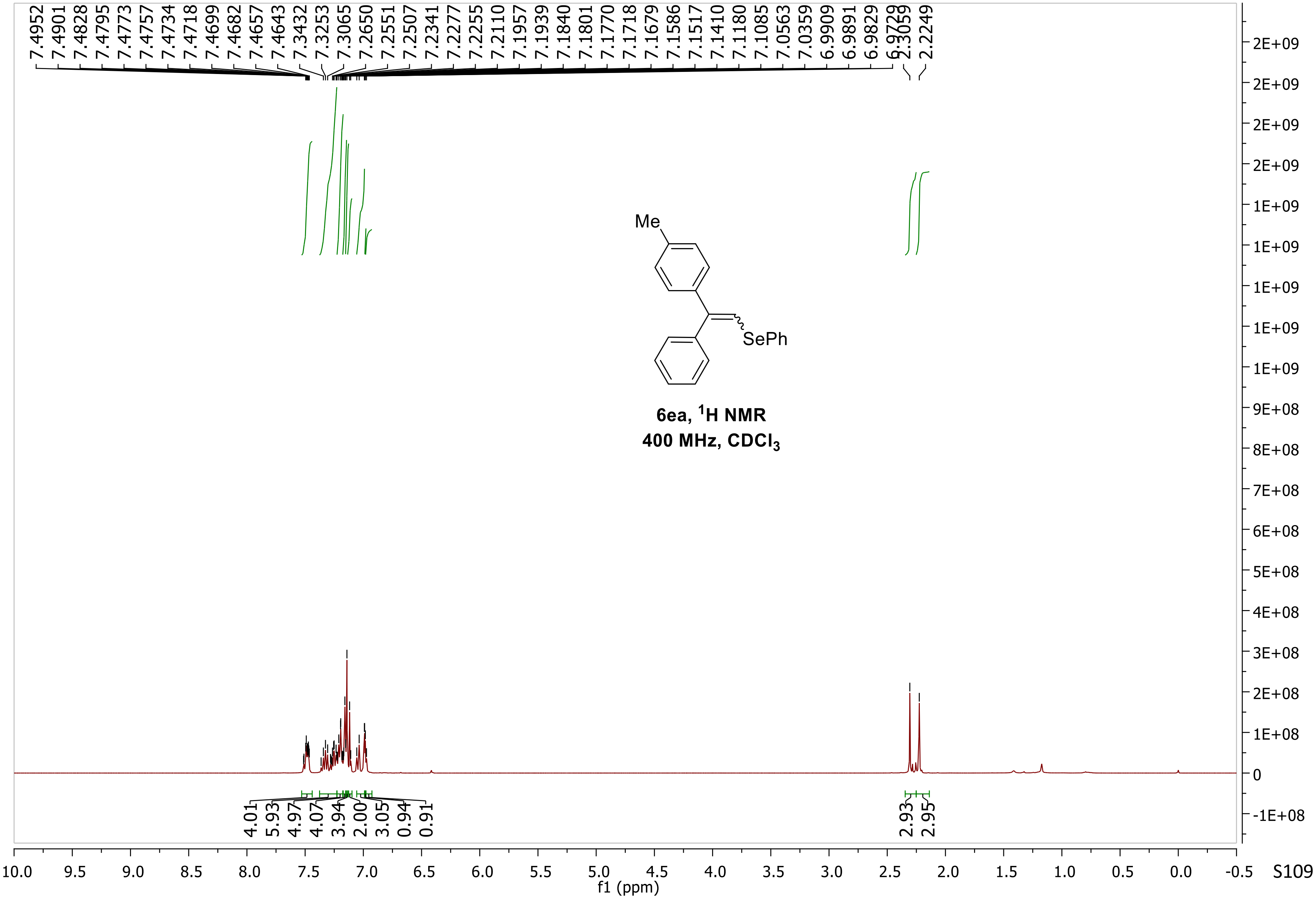
6da, 1H NMR
400 MHz, $CDCl_3$

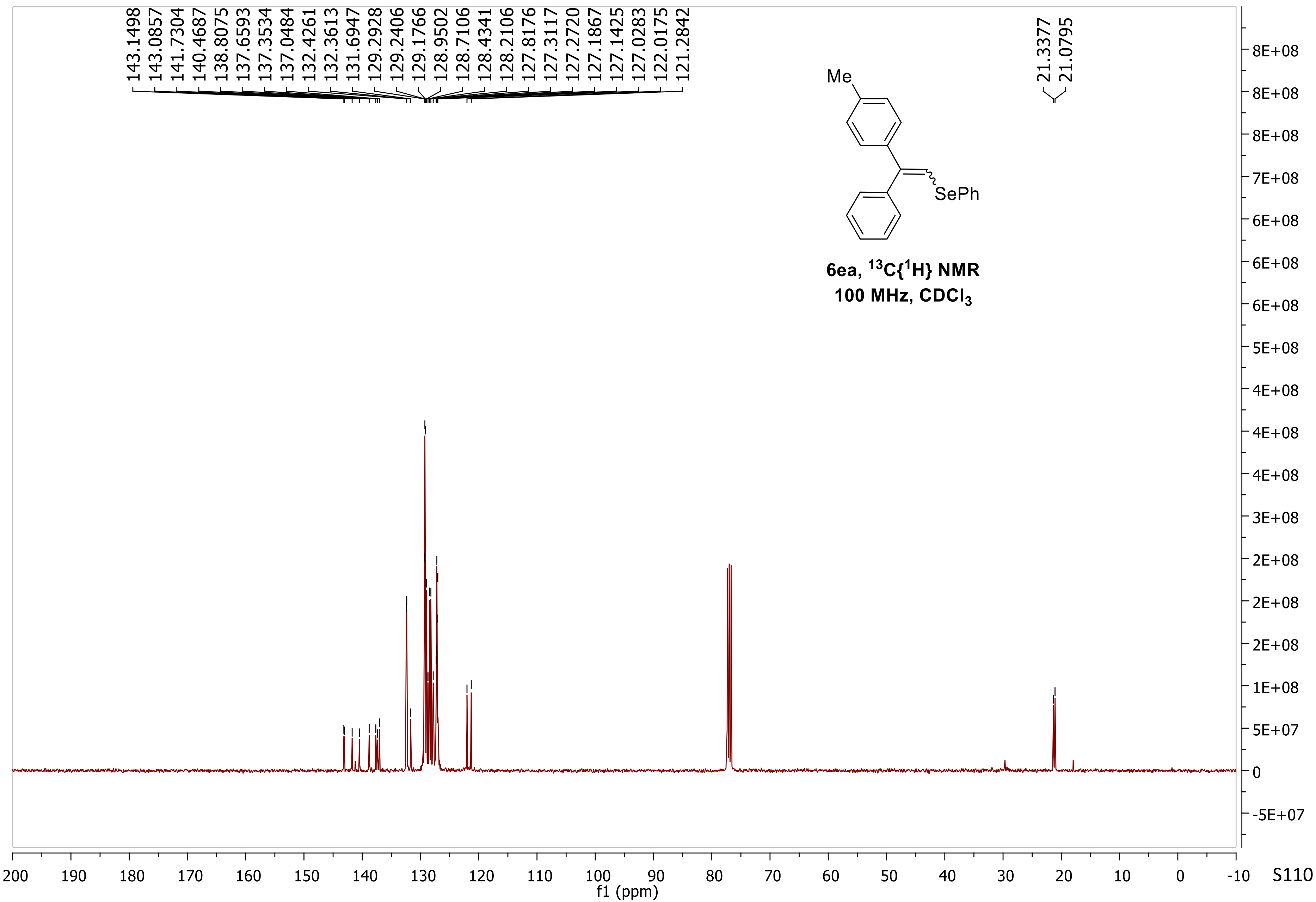

163.4396
160.9802
138.8995
137.5364
137.5103
136.0139
131.4883
129.5659
129.1518
128.7676
126.9487
124.2703
115.5307
115.3187
F
SePh
F
6da, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)


378.0044
F
SePh
F
6da, 77Se NMR
76 MHz, CDCl3
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
-1E+08
1500 1400 1300 1200 1100 1000 900 800 700 600 500 400 300 200 100 0 -100 -200 -300 -400 -500
f1 (ppm)



-113.1397
-114.6251
SePh
F
F
6da, 19F NMR
376 MHz, CDCl3
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
-1E+08
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)


Me
SePh
6ea, 1H NMR
400 MHz, CDCl3
f1 (ppm)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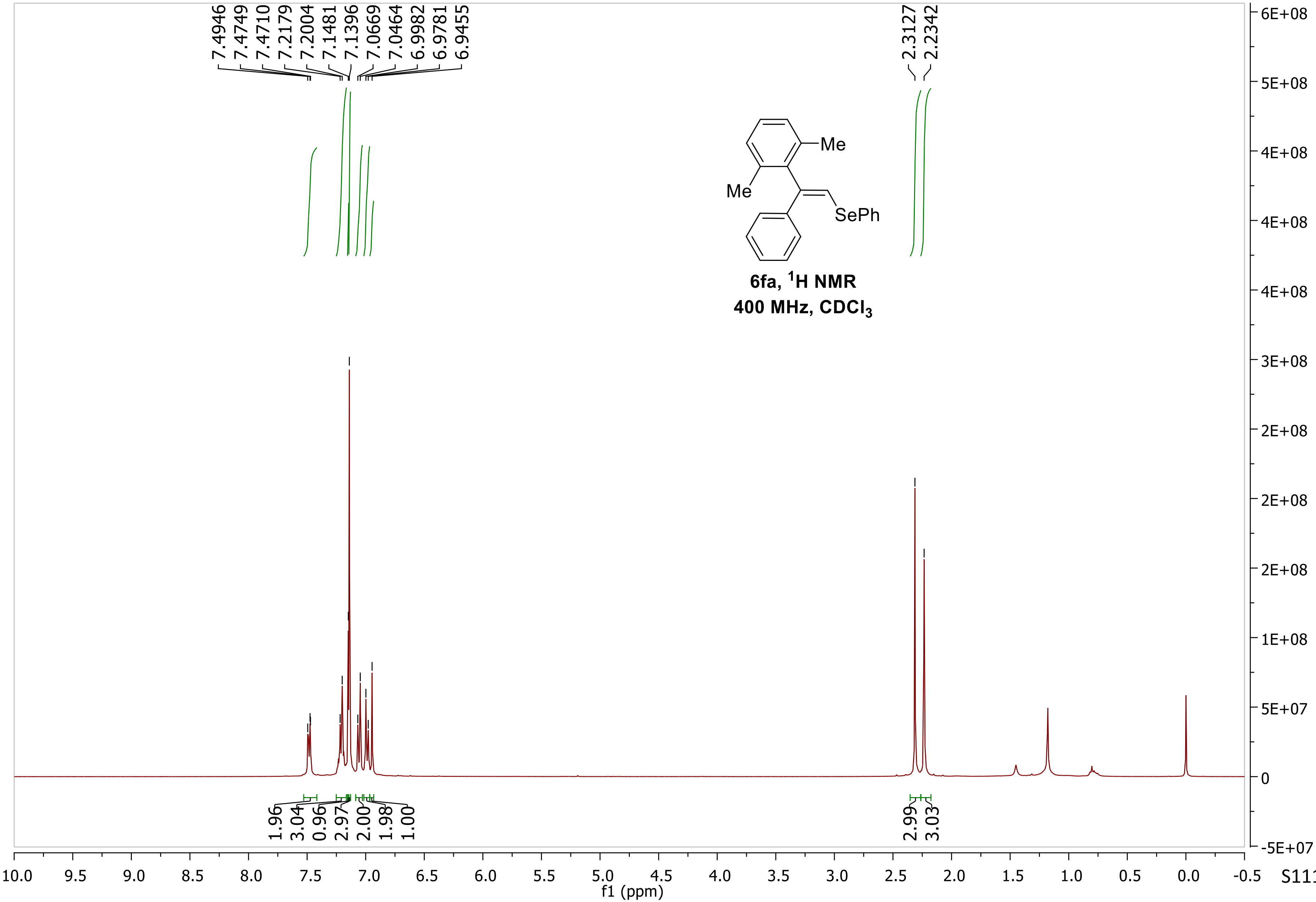
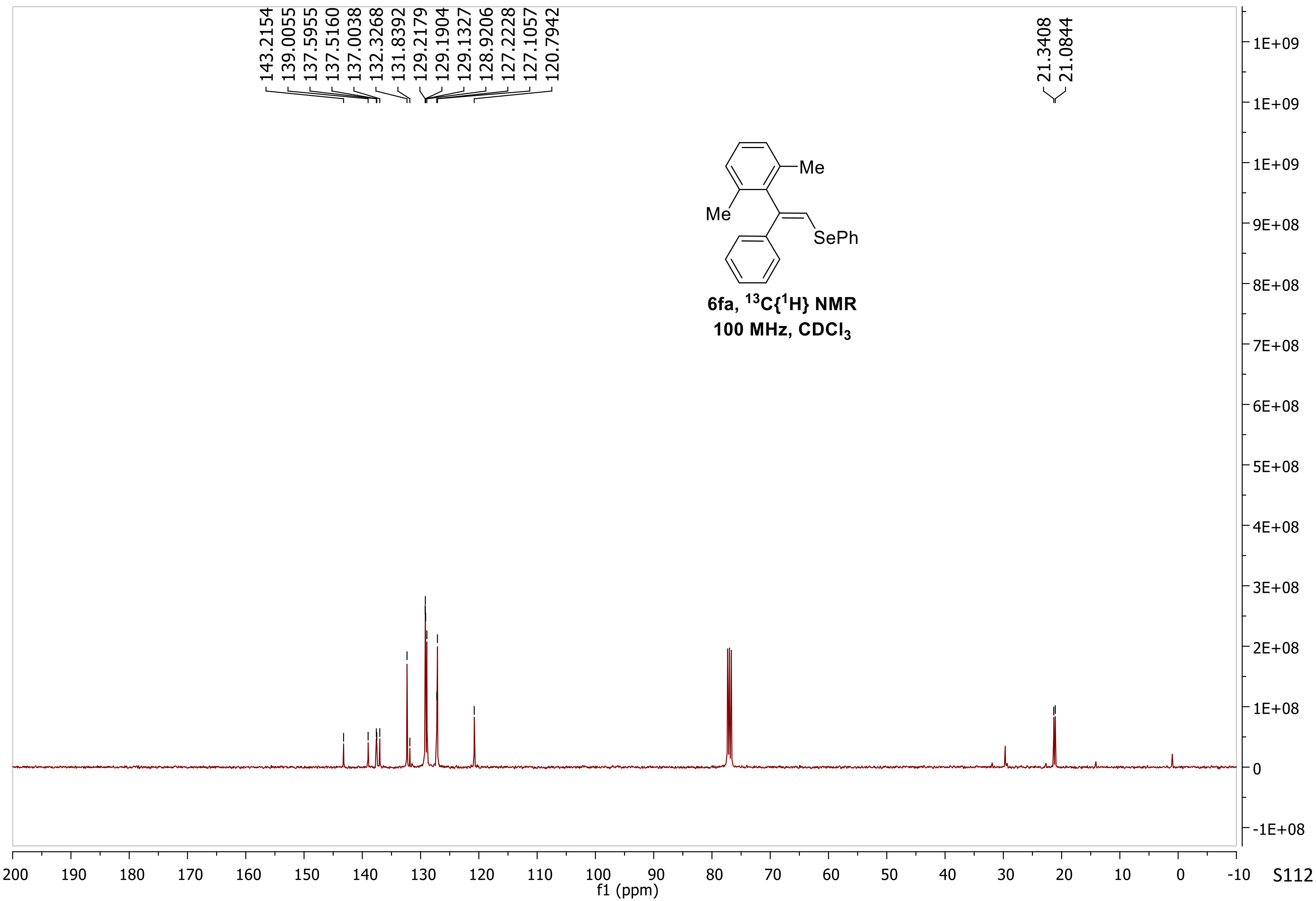
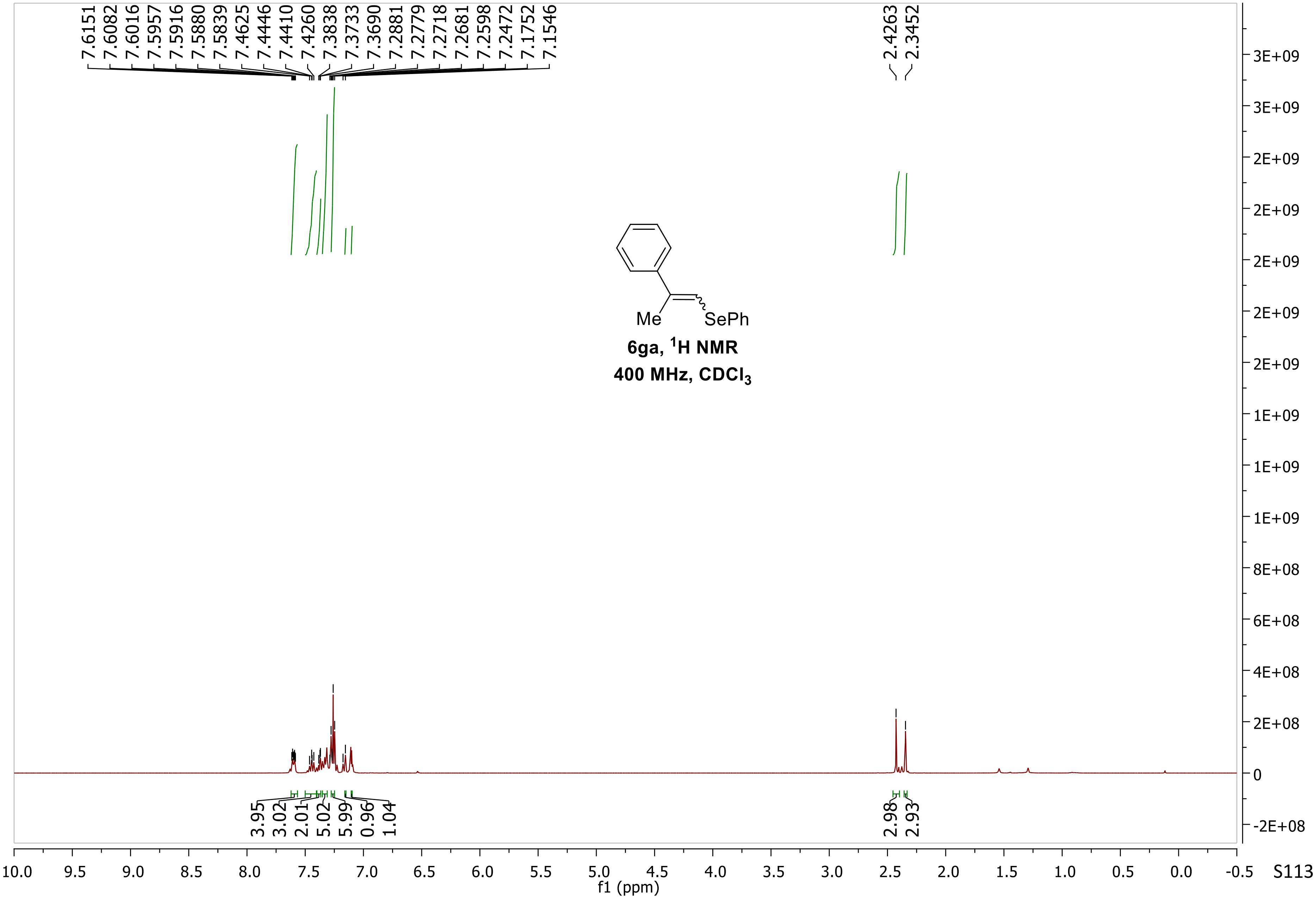
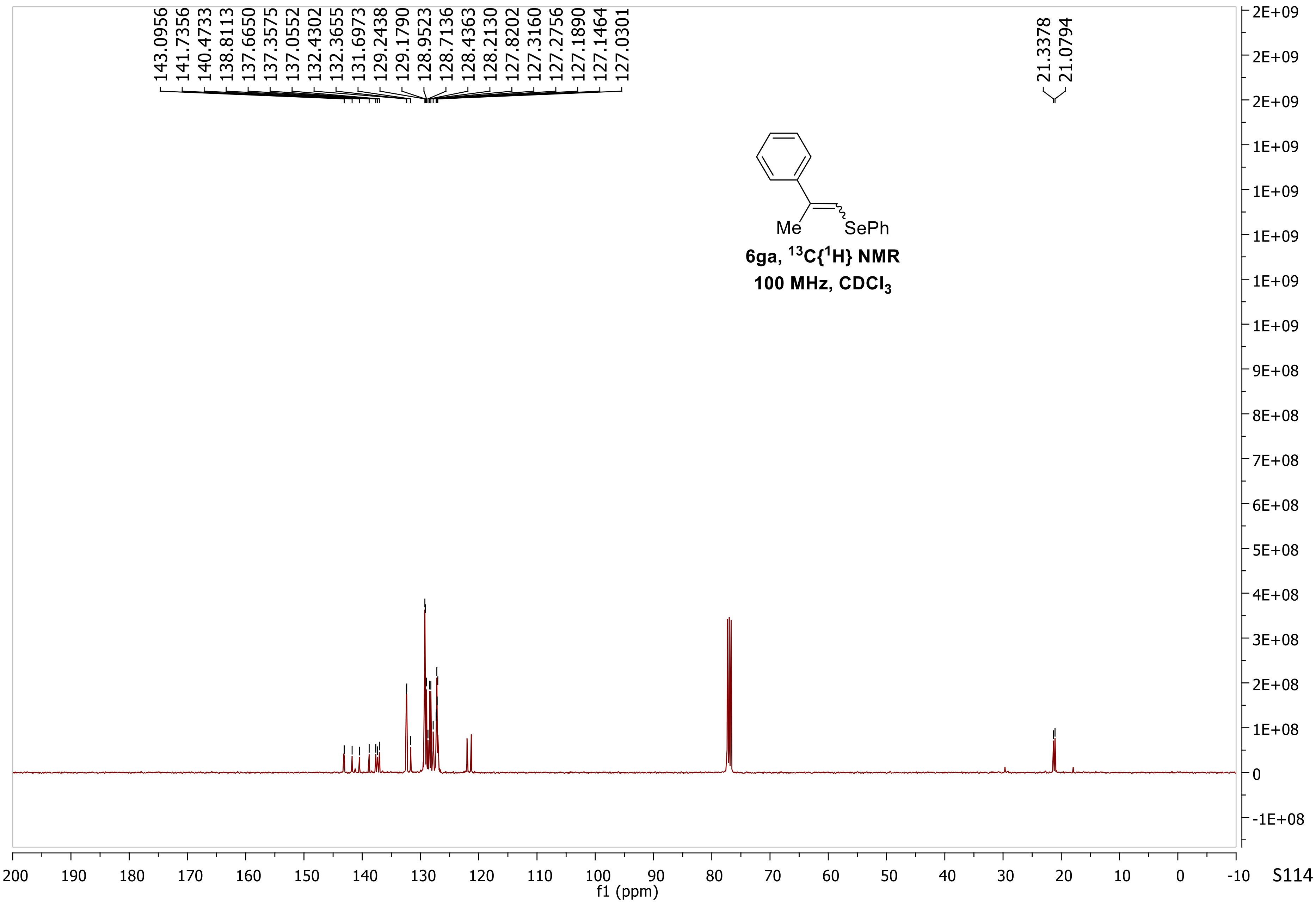
143.0857
141.7304
140.4687
138.8075
137.6593
137.3534
137.0484
132.4261
132.3613
131.6947
129.2928
129.2406
129.1766
128.9502
128.7106
128.4341
128.2106
127.8176
127.3117
127.2720
127.1867
127.1425
127.0283
122.0175
121.2842
21.3377
21.0795
Me
SePh
6ea, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)

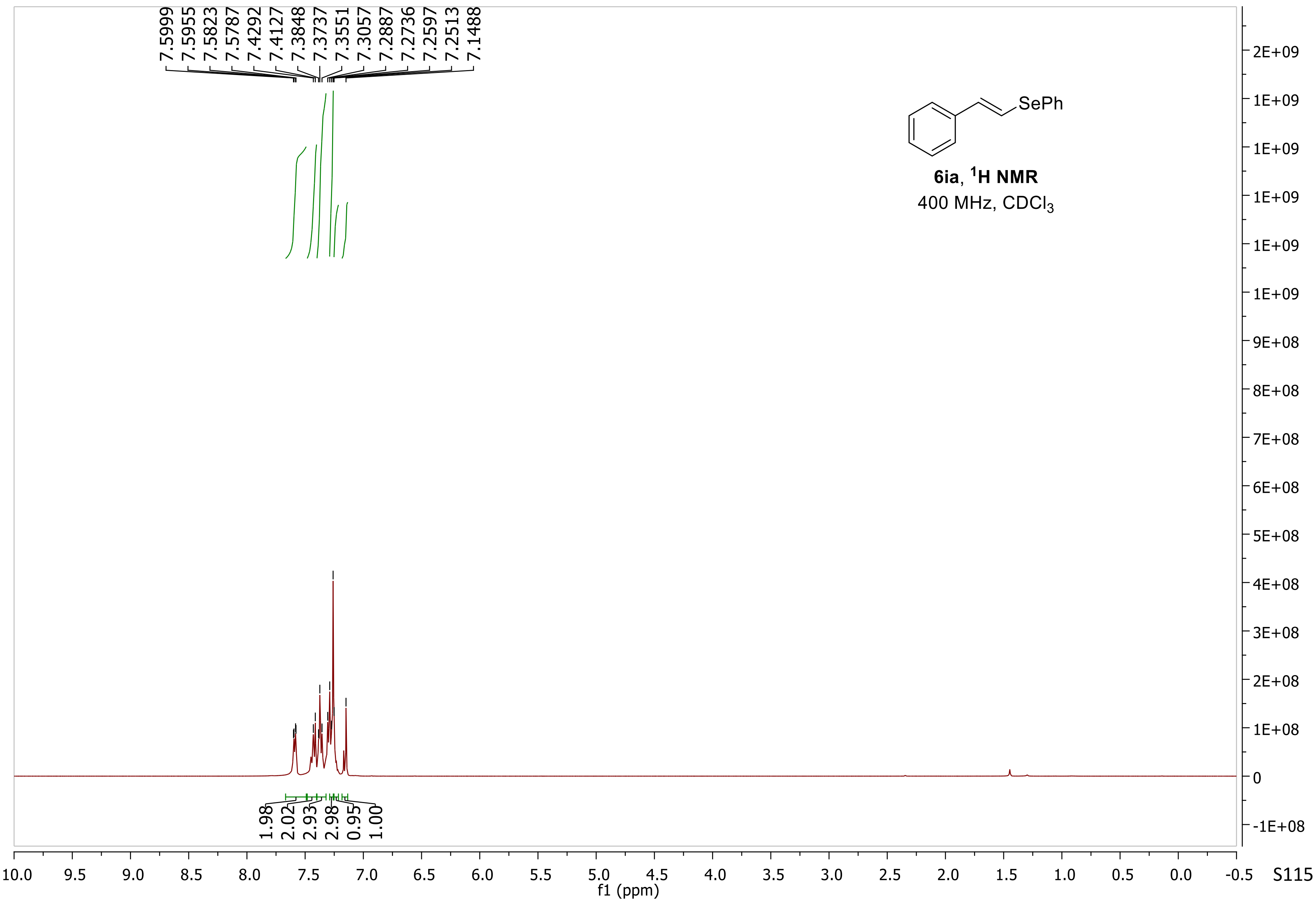


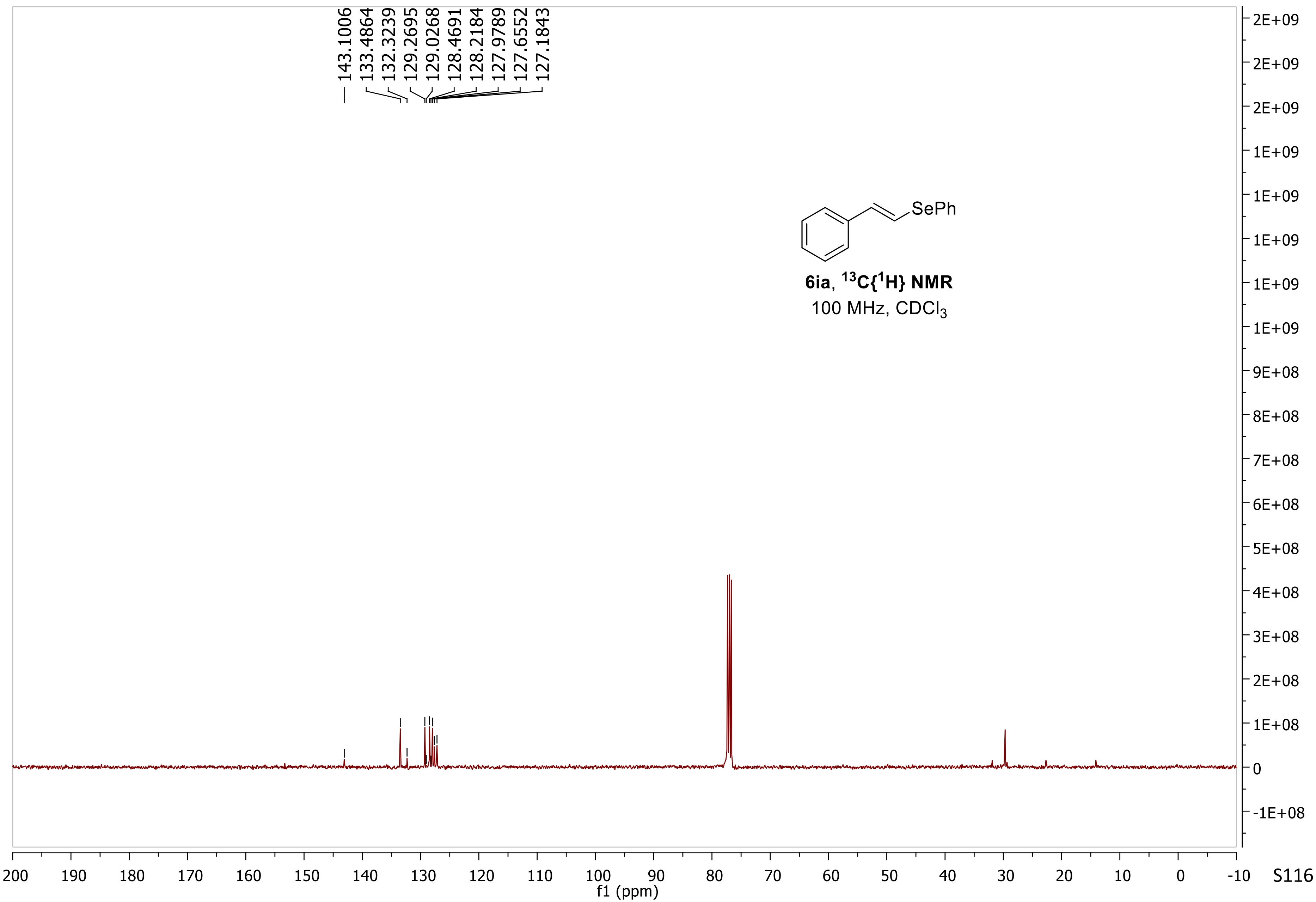
7.4946
7.4749
7.4710
7.2179
7.2004
7.1481
7.1396
7.0669
7.0464
6.9982
6.9781
6.9455
2.3127
2.2342
Me
Me
SePh
6fa, ¹H NMR
400 MHz, CDCl3
1.96
3.04
0.96
2.97
2.00
1.98
1.00
2.99
3.03
6E+08
5E+08
4E+08
4E+08
4E+08
3E+08
2E+08
2E+08
2E+08
1E+08
5E+07
0
-5E+07
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


143.2154
139.0055
137.5955
137.5160
137.0038
132.3268
131.8392
129.2179
129.1904
129.1327
128.9206
127.2228
127.1057
120.7942
21.3408
21.0844
Me
Me
SePh
6fa, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)

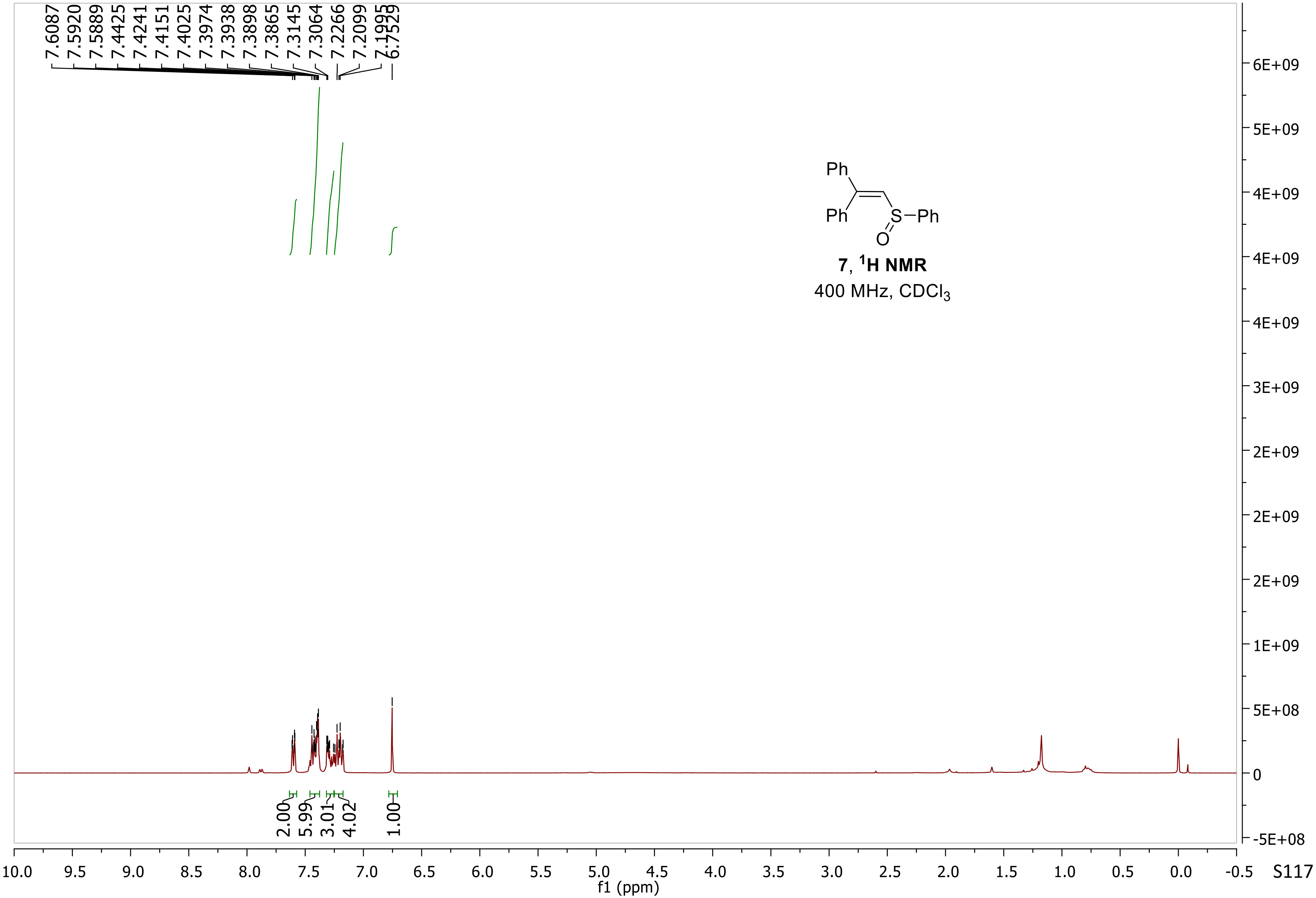

7.6151
7.6082
7.6016
7.5957
7.5916
7.5880
7.5839
7.4625
7.4446
7.4410
7.4260
7.3838
7.3733
7.3690
7.2881
7.2779
7.2718
7.2681
7.2598
7.2472
7.1752
7.1546
2.4263
2.3452
Me
SePh
6ga, 1H NMR
400 MHz, CDCl3
3.95
3.02
2.01
5.02
5.99
0.96
1.04
2.98
2.93
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)
3E+09
3E+09
2E+09
2E+09
2E+09
2E+09
2E+09
1E+09
1E+09
1E+09
8E+08
6E+08
4E+08
2E+08
0
-2E+08


143.0956
141.7356
140.4733
138.8113
137.6650
137.3575
137.0552
132.4302
132.3655
131.6973
129.2438
129.1790
128.9523
128.7136
128.4363
128.2130
127.8202
127.3160
127.2756
127.1890
127.1464
127.0301
21.3378
21.0794
Me
SePh
6ga, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)

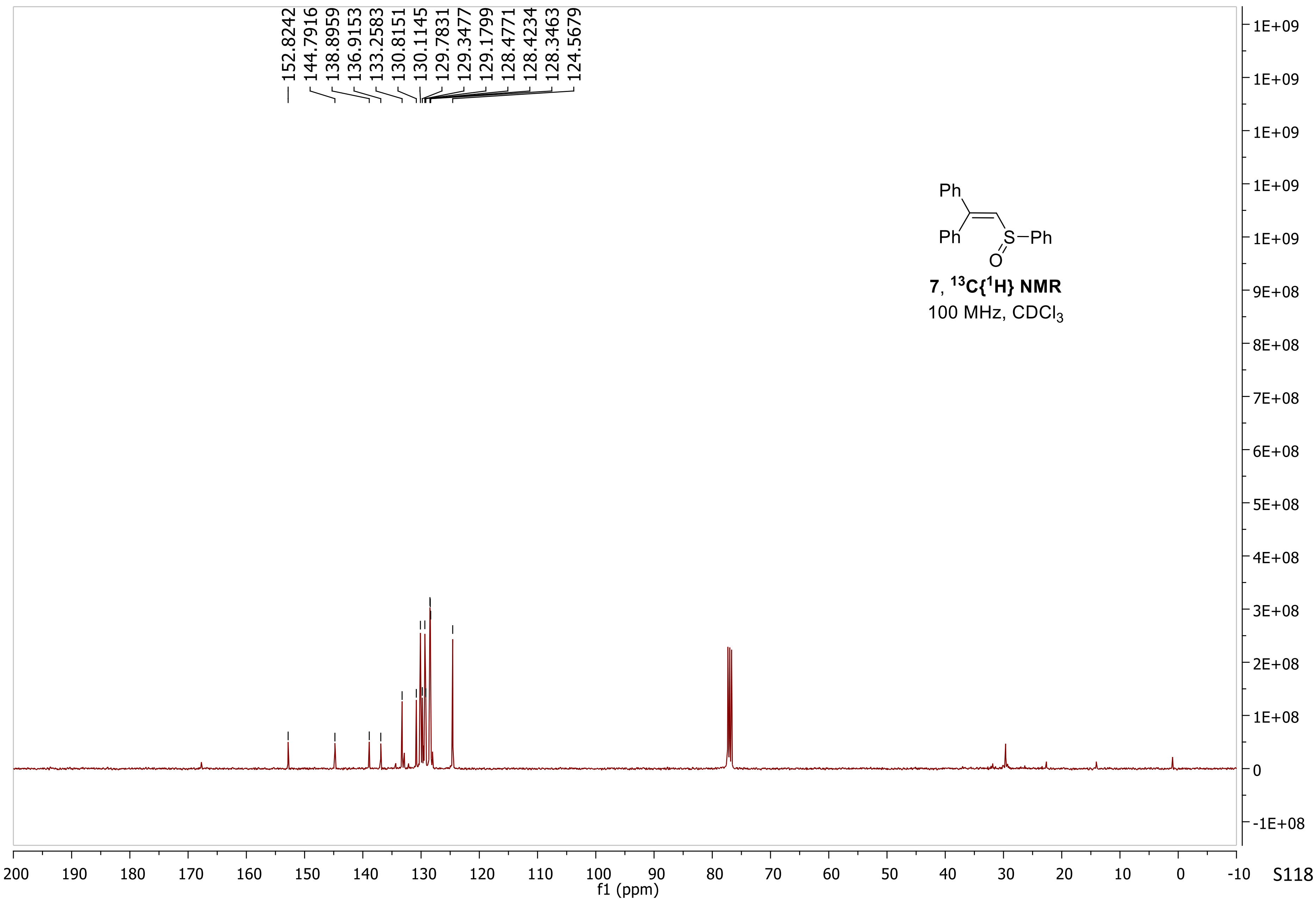

7.5999
7.5955
7.5823
7.5787
7.4292
7.4127
7.3848
7.3737
7.3551
7.3057
7.2887
7.2736
7.2597
7.2513
7.1488
SePh
6ia, 1H NMR
400 MHz, CDCl3
1.98
2.02
2.93
2.98
0.95
1.00
f1 (ppm)

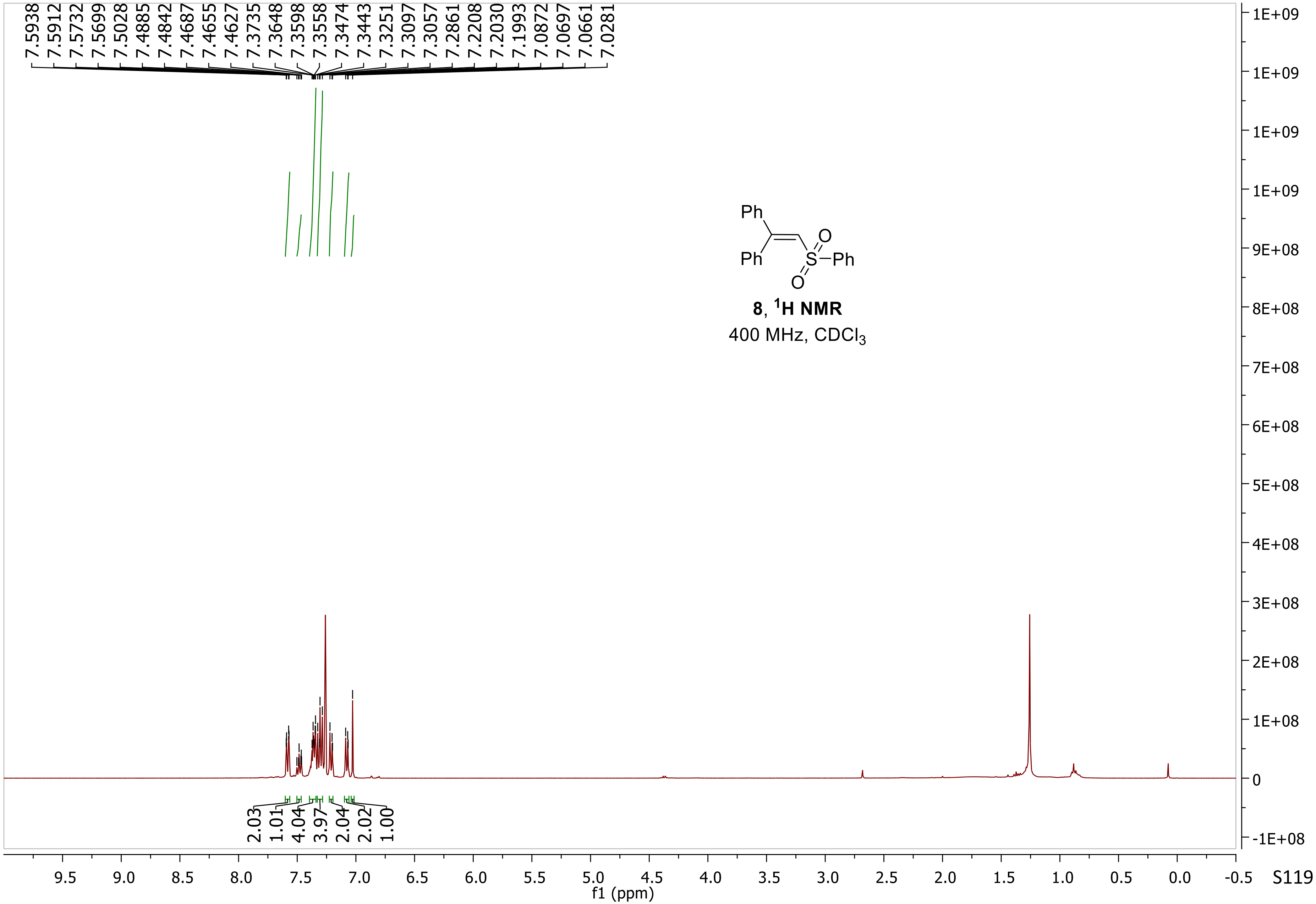


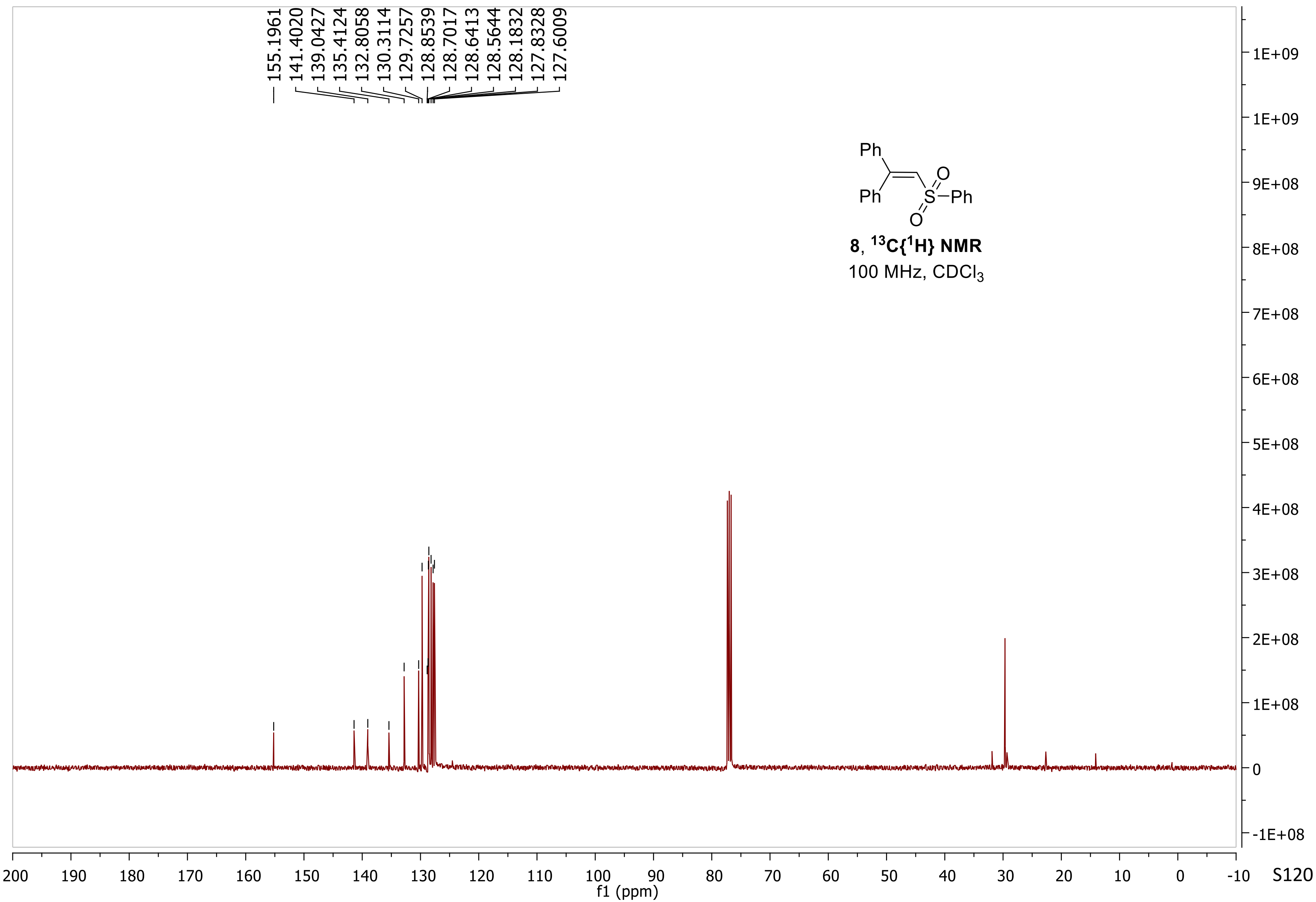
143.1006
133.4864
132.3239
129.2695
129.0268
128.4691
128.2184
127.9789
127.6552
127.1843
SePh
6ia, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)

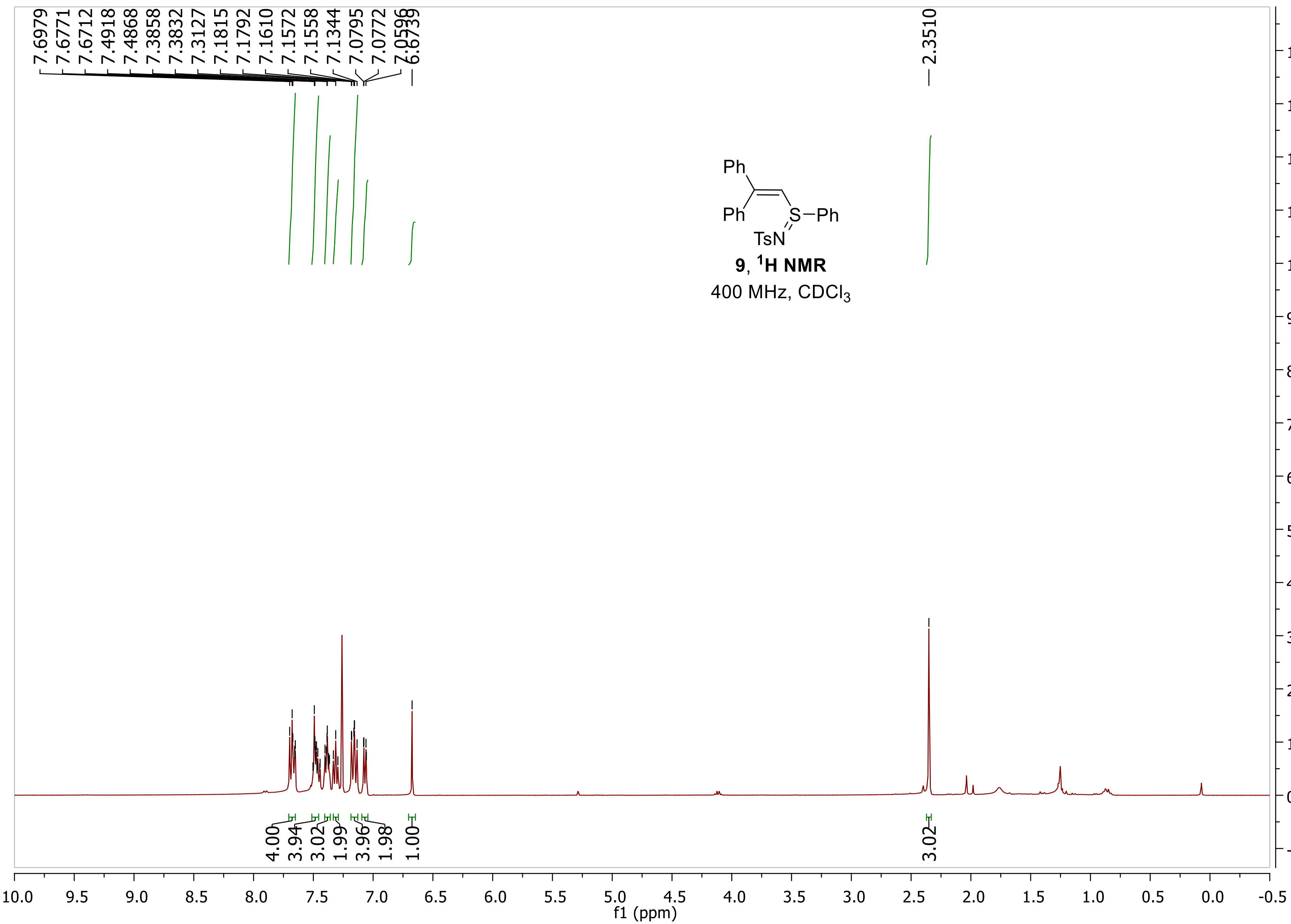


7.6087
7.5920
7.5889
7.4425
7.4241
7.4151
7.4025
7.3974
7.3938
7.3898
7.3865
7.3145
7.3064
7.2266
7.2099
7.1995
6.7529
Ph
Ph
S
Ph
O
7, 1H NMR
400 MHz, CDCl3
2.00
5.99
3.01
4.02
1.00
f1 (ppm)

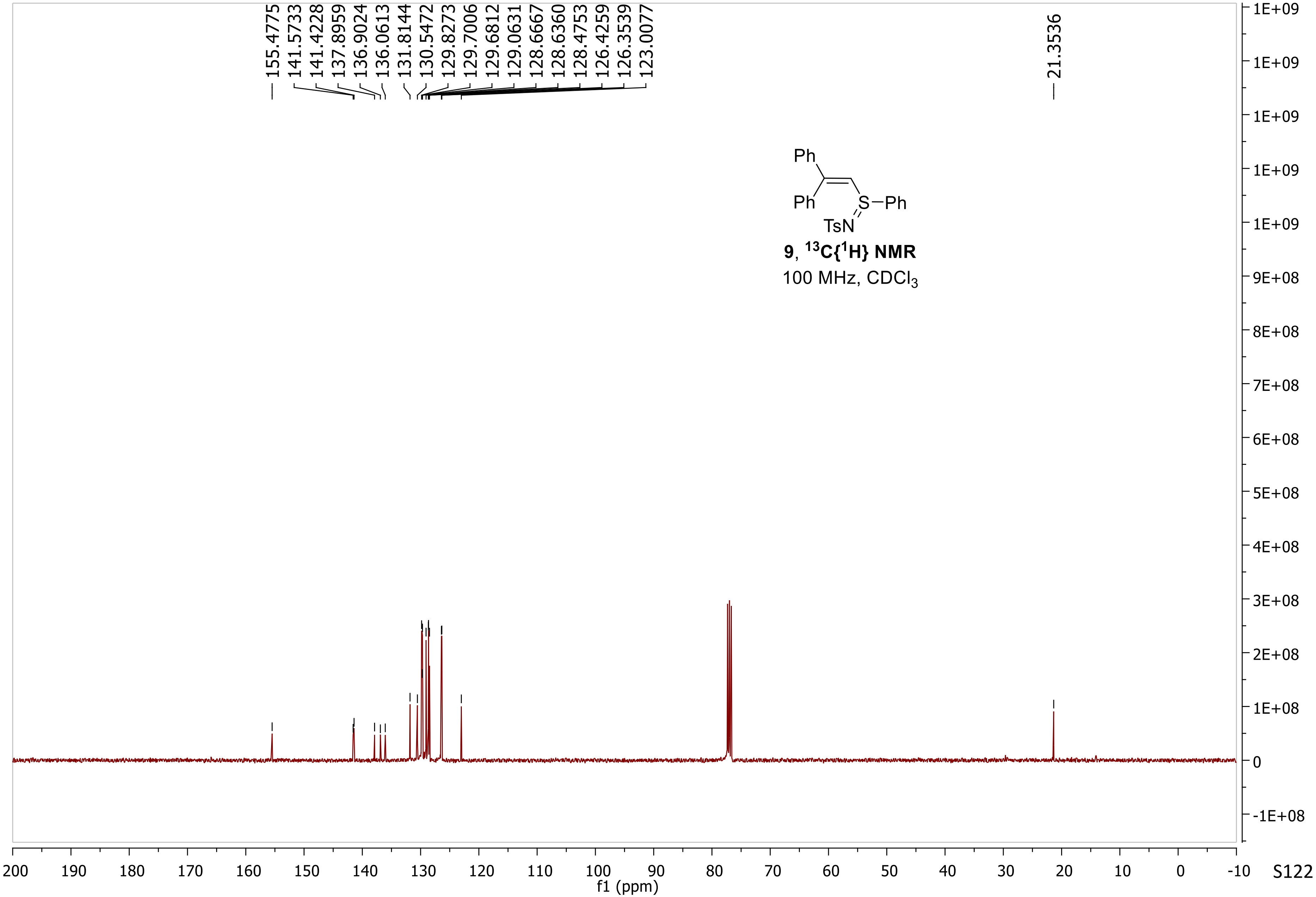

152.8242
144.7916
138.8959
136.9153
133.2583
130.8151
130.1145
129.7831
129.3477
129.1799
128.4771
128.4234
128.3463
124.5679
Ph
Ph
S
Ph
O
7, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)


7.5938
7.5912
7.5732
7.5699
7.5028
7.4885
7.4842
7.4687
7.4655
7.4627
7.3735
7.3648
7.3598
7.3558
7.3474
7.3443
7.3251
7.3097
7.3057
7.2861
7.2208
7.2030
7.1993
7.0872
7.0697
7.0661
7.0281
Ph
Ph
O
S
Ph
O
8, ^{1}H NMR
400 MHz, $CDCl_3$
2.03
1.01
4.04
3.97
2.04
2.02
1.00
f1 (ppm)


155.1961
141.4020
139.0427
135.4124
132.8058
130.3114
129.7257
128.8539
128.7017
128.6413
128.5644
128.1832
127.8328
127.6009
Ph
Ph
O
S
Ph
O
8, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)

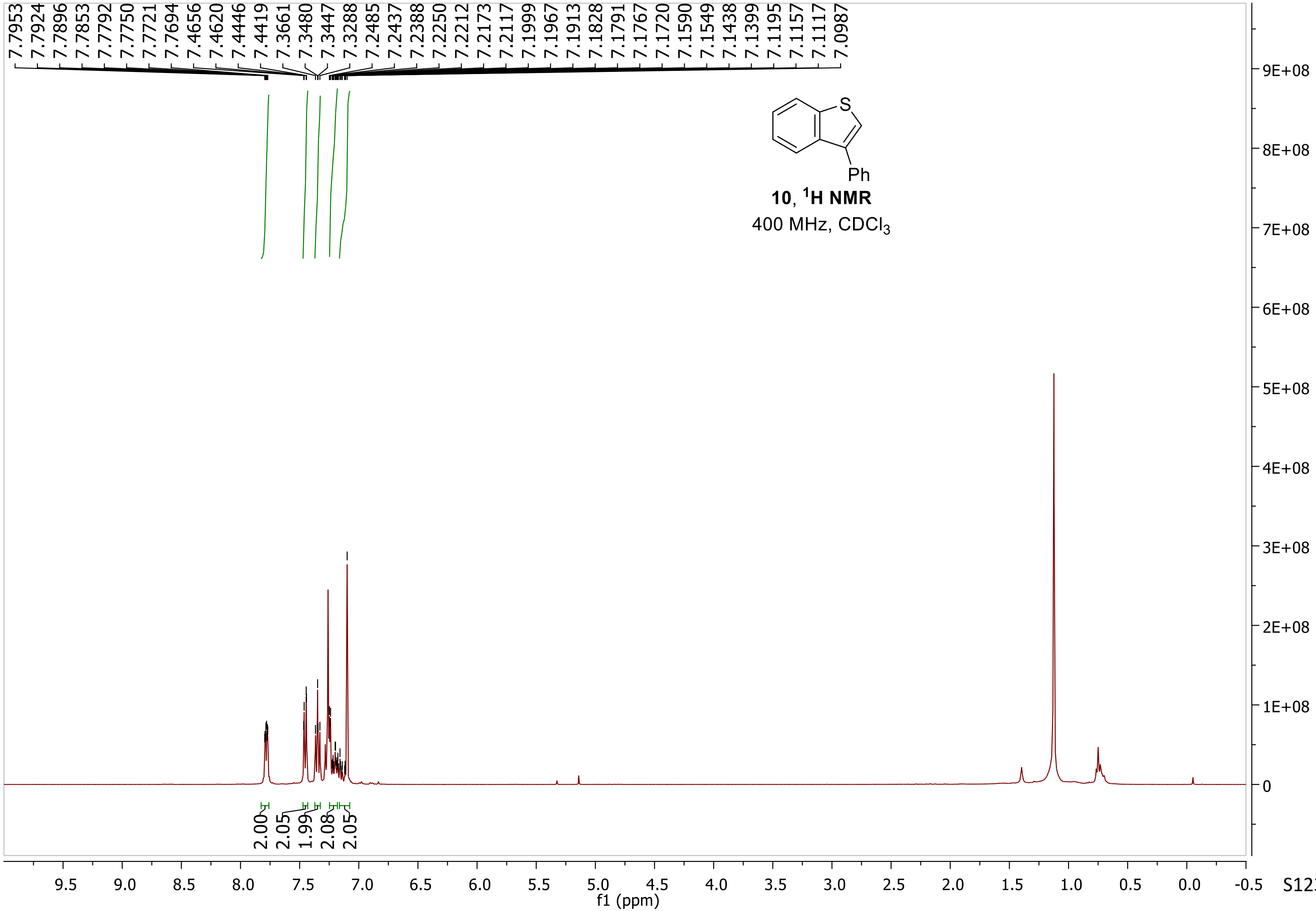


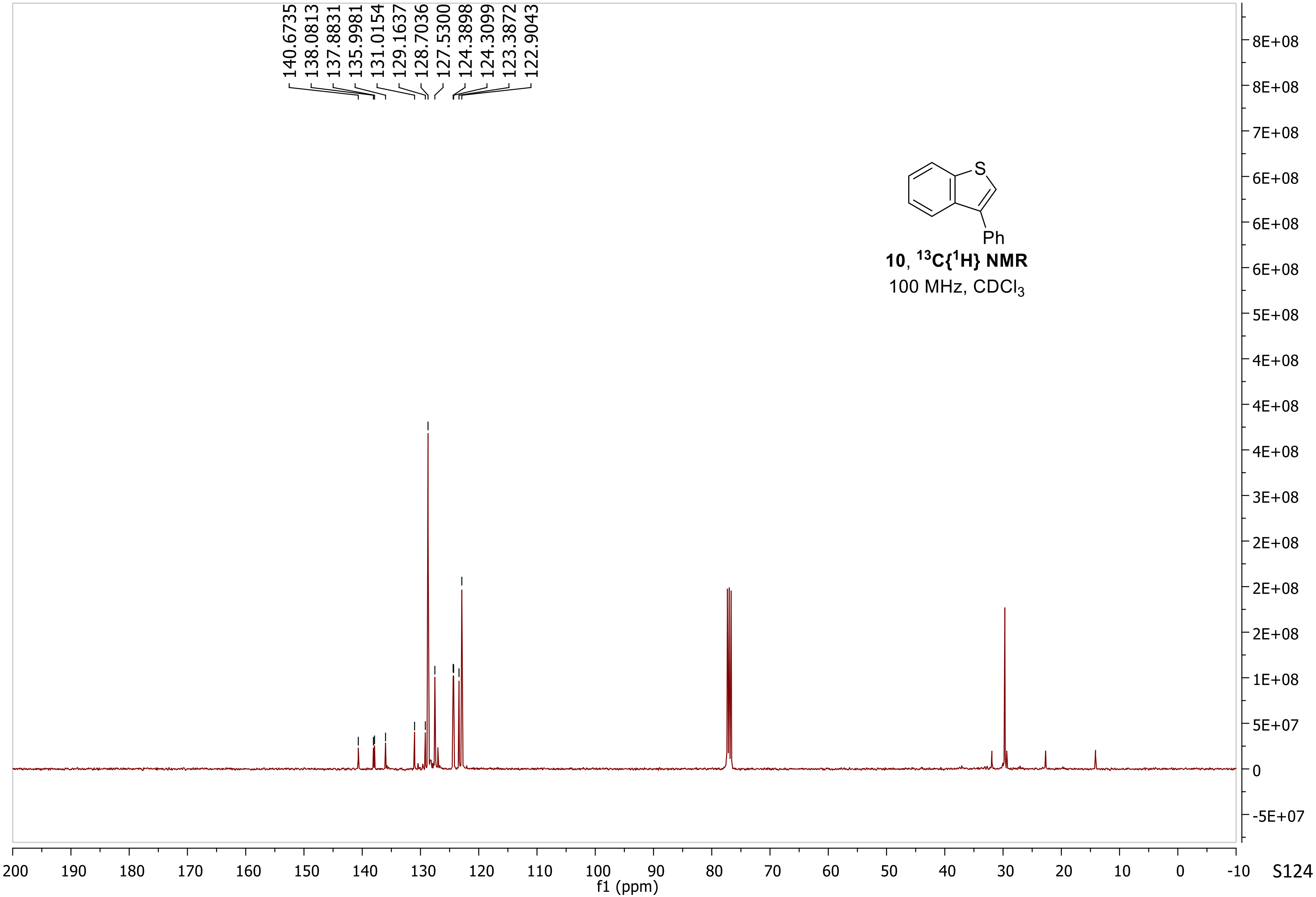
7.6979
7.6771
7.6712
7.4918
7.4868
7.3858
7.3832
7.3127
7.1815
7.1792
7.1610
7.1572
7.1558
7.1344
7.0795
7.0772
7.0596
6.6739
2.3510
Ph
Ph
S
Ph
TsN
9, 1H NMR
400 MHz, CDCl3
4.00
3.94
3.02
1.99
3.96
1.98
1.00
3.02
f1 (ppm)

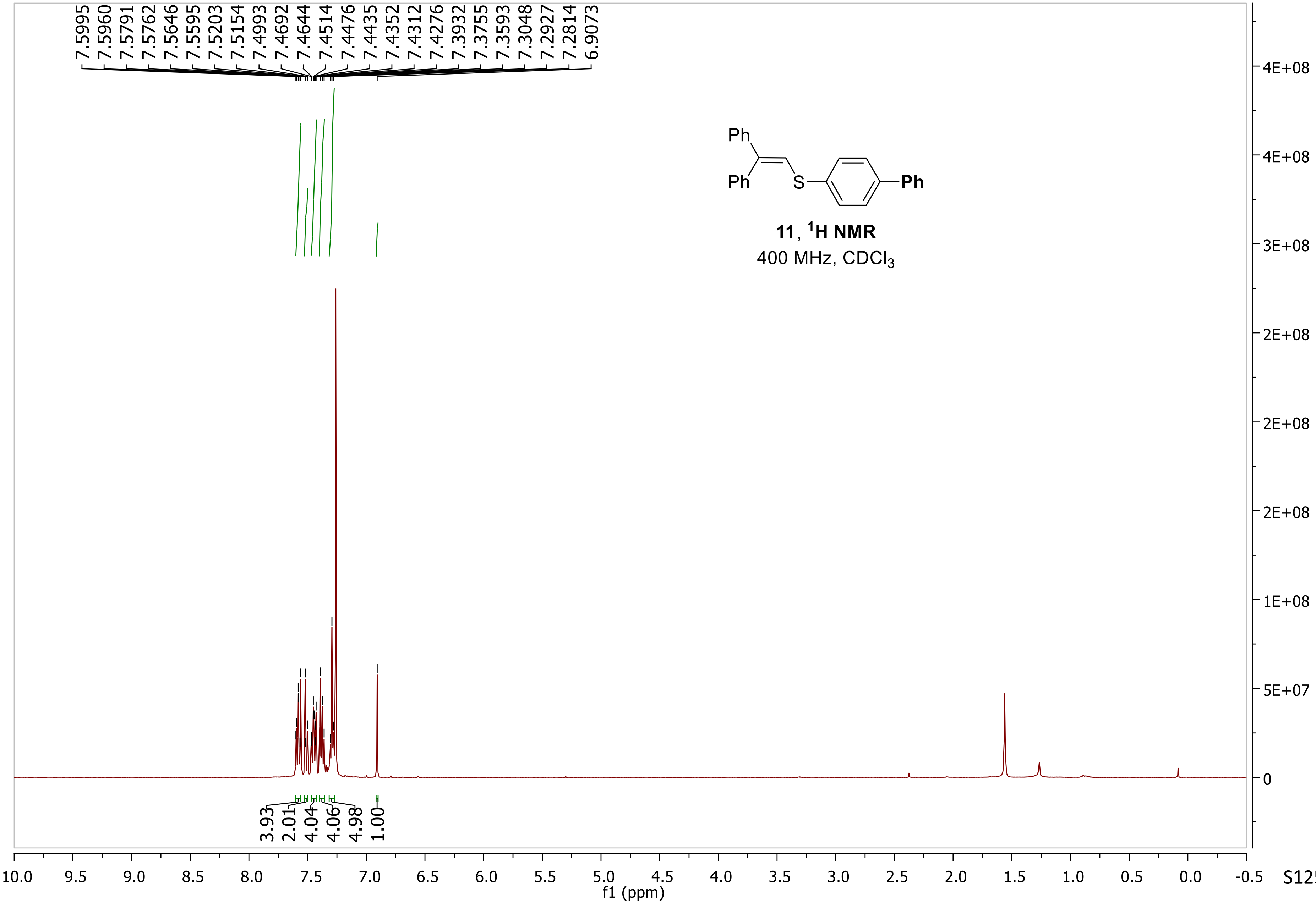


9, **^{13}C{^{1}H} NMR**

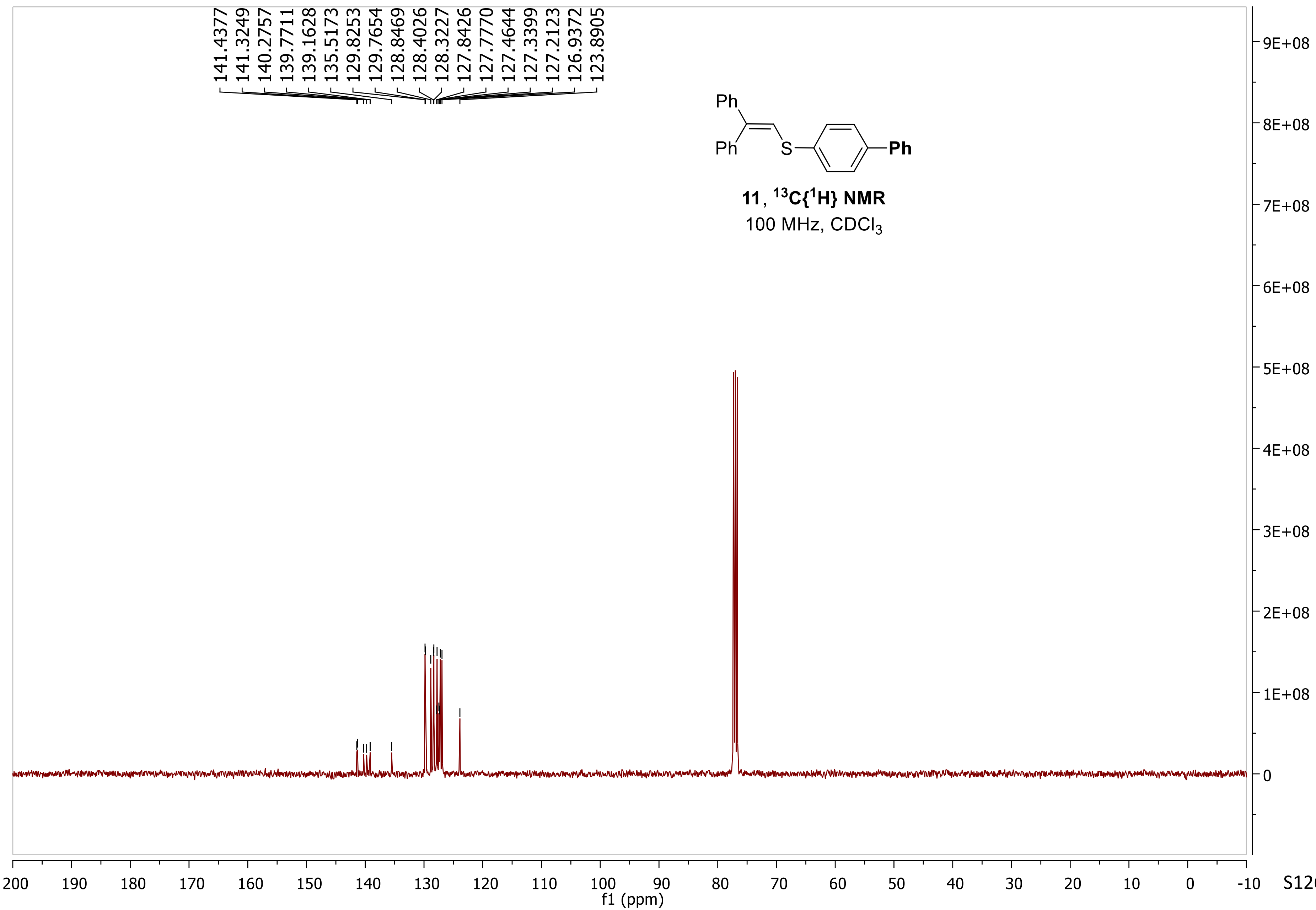
100 MHz, $CDCl_3$


7.7953
7.7924
7.7896
7.7853
7.7792
7.7750
7.7721
7.7694
7.4656
7.4620
7.4446
7.4419
7.3661
7.3480
7.3447
7.3288
7.2485
7.2437
7.2388
7.2250
7.2212
7.2173
7.2117
7.1999
7.1967
7.1913
7.1828
7.1791
7.1767
7.1720
7.1590
7.1549
7.1438
7.1399
7.1195
7.1157
7.1117
7.0987
S
Ph
10, ^{1}H NMR
400 MHz, $CDCl_3$
2.00
2.05
1.99
2.08
2.05
f1 (ppm)


140.6735
138.0813
137.8831
135.9981
131.0154
129.1637
128.7036
127.5300
124.3898
124.3099
123.3872
122.9043
S
Ph
10, 13C{1H} NMR
100 MHz, CDCl3
f1 (ppm)



7.5995
7.5960
7.5791
7.5762
7.5646
7.5595
7.5203
7.5154
7.4993
7.4692
7.4644
7.4514
7.4476
7.4435
7.4352
7.4312
7.4276
7.3932
7.3755
7.3593
7.3048
7.2927
7.2814
6.9073
Ph
Ph
S
Ph
11, 1H NMR
400 MHz, CDCl3
3.93
2.01
4.04
4.06
4.98
1.00
f1 (ppm)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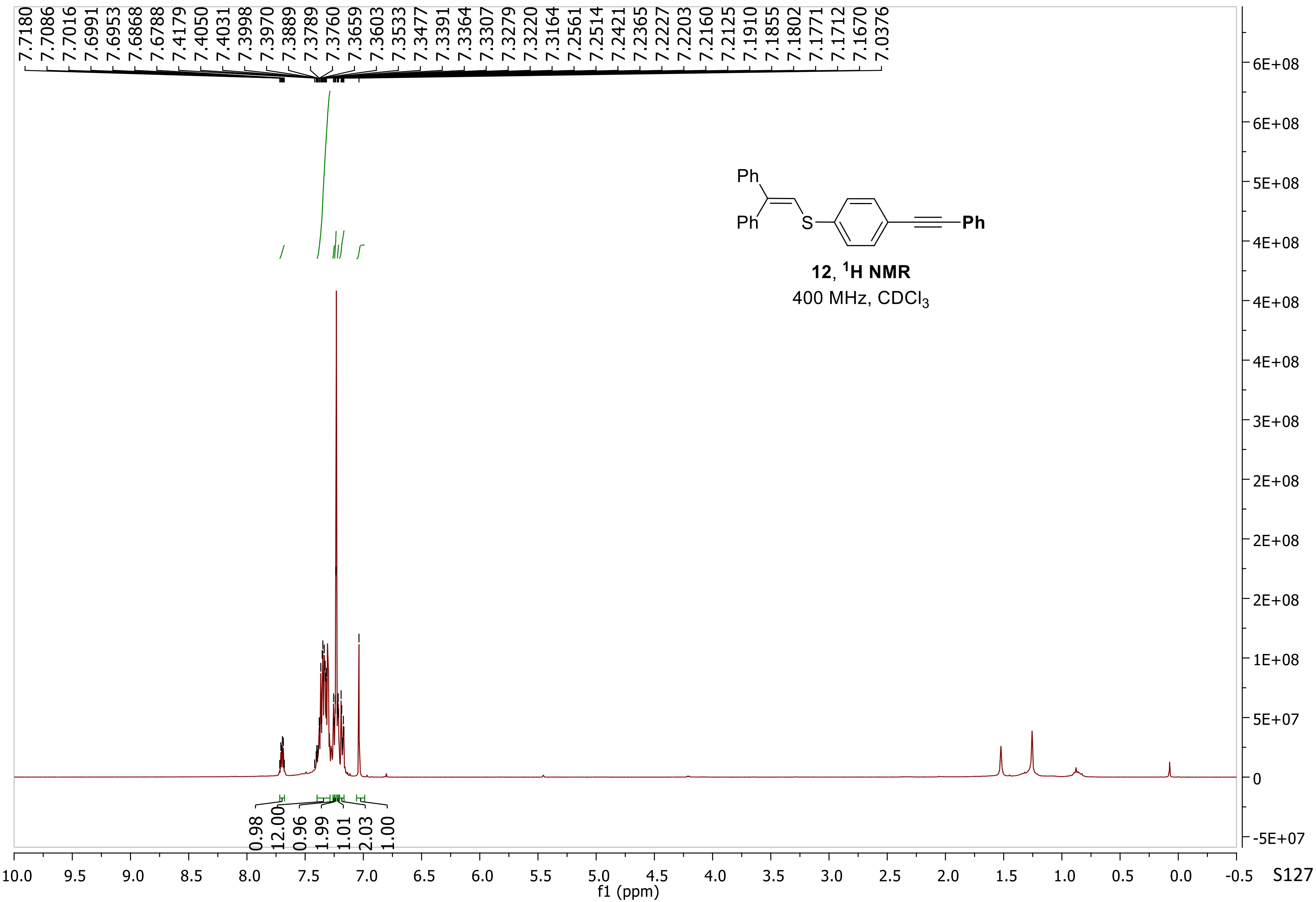
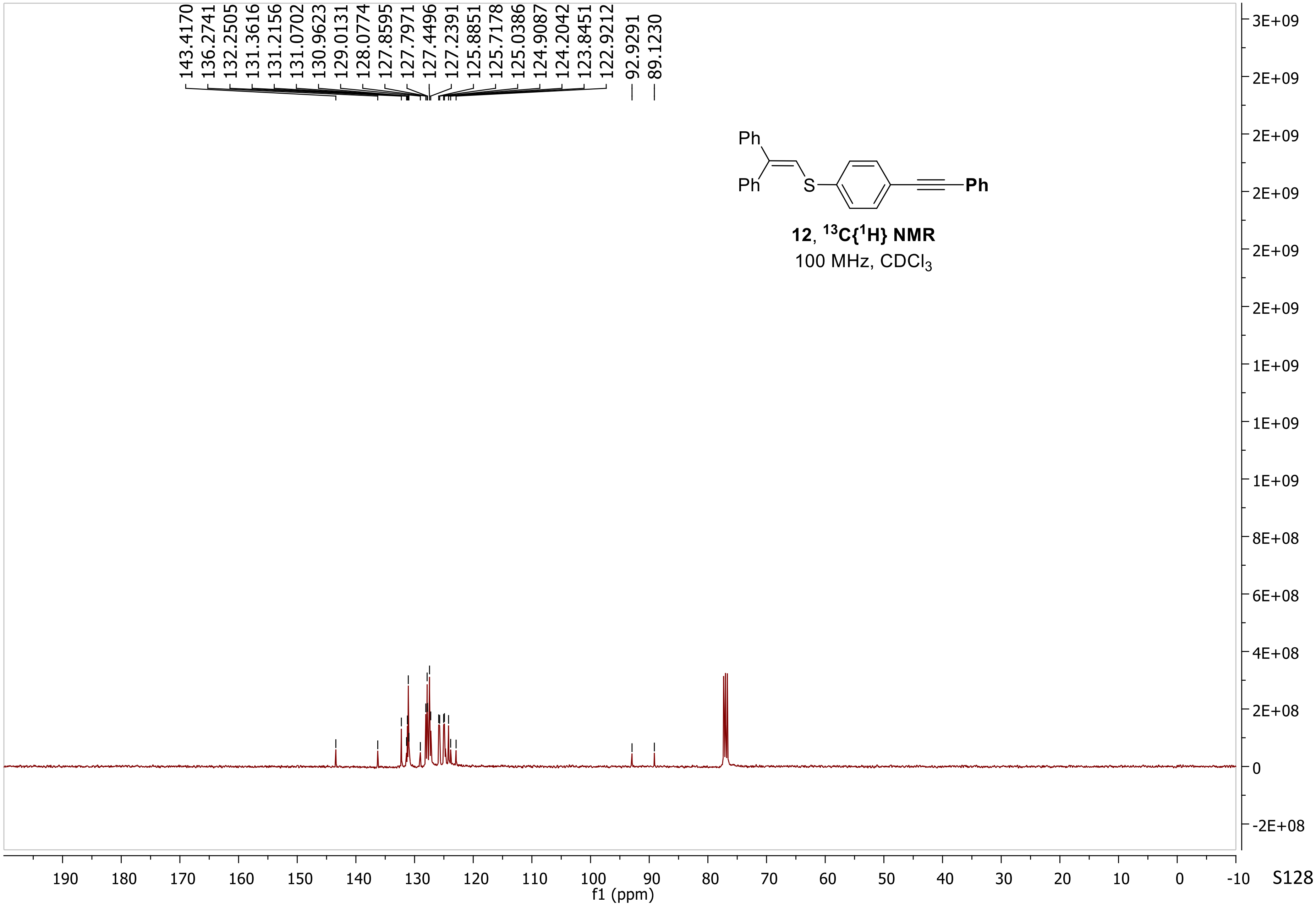
141.3249
140.2757
139.7711
139.1628
135.5173
129.8253
129.7654
128.8469
128.4026
128.3227
127.8426
127.7770
127.4644
127.3399
127.2123
126.9372
123.8905
Ph
Ph
S
Ph
11, $^{13}C\{^{1}H\}$ NMR
100 MHz, $CDCl_3$
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)



12, ^{1}H NMR
400 MHz, $CDCl_3$
f1 (ppm)


143.4170
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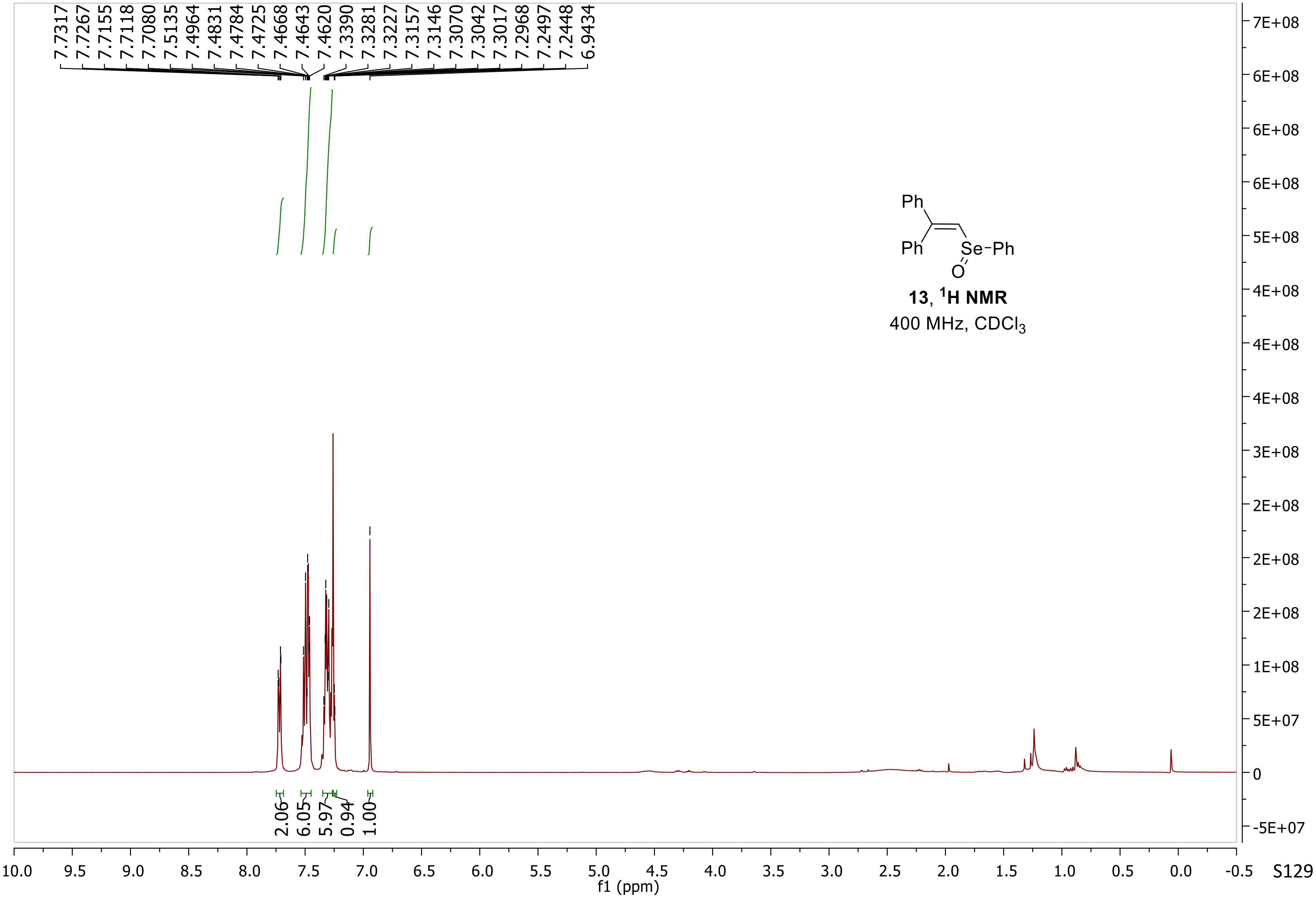
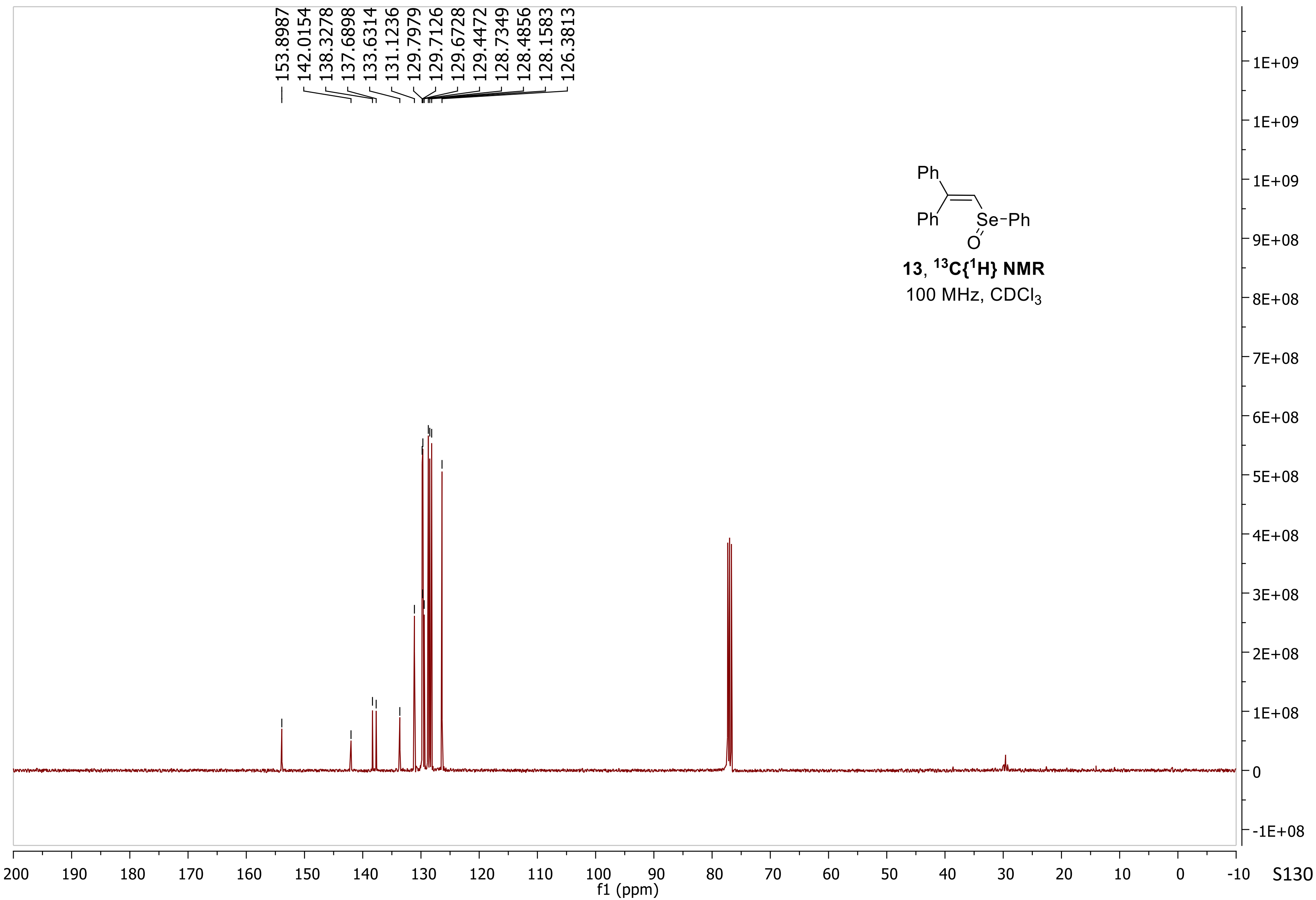
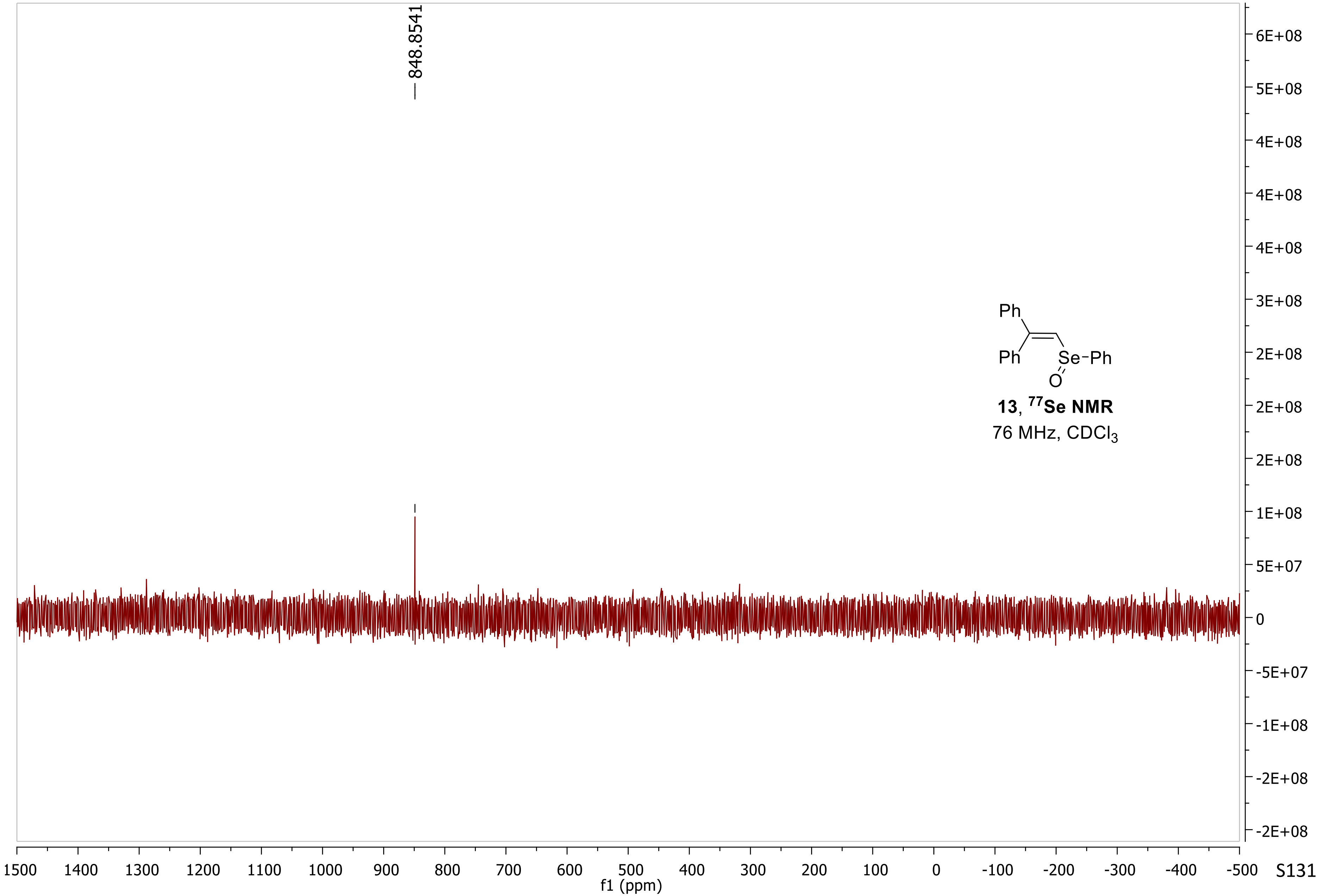
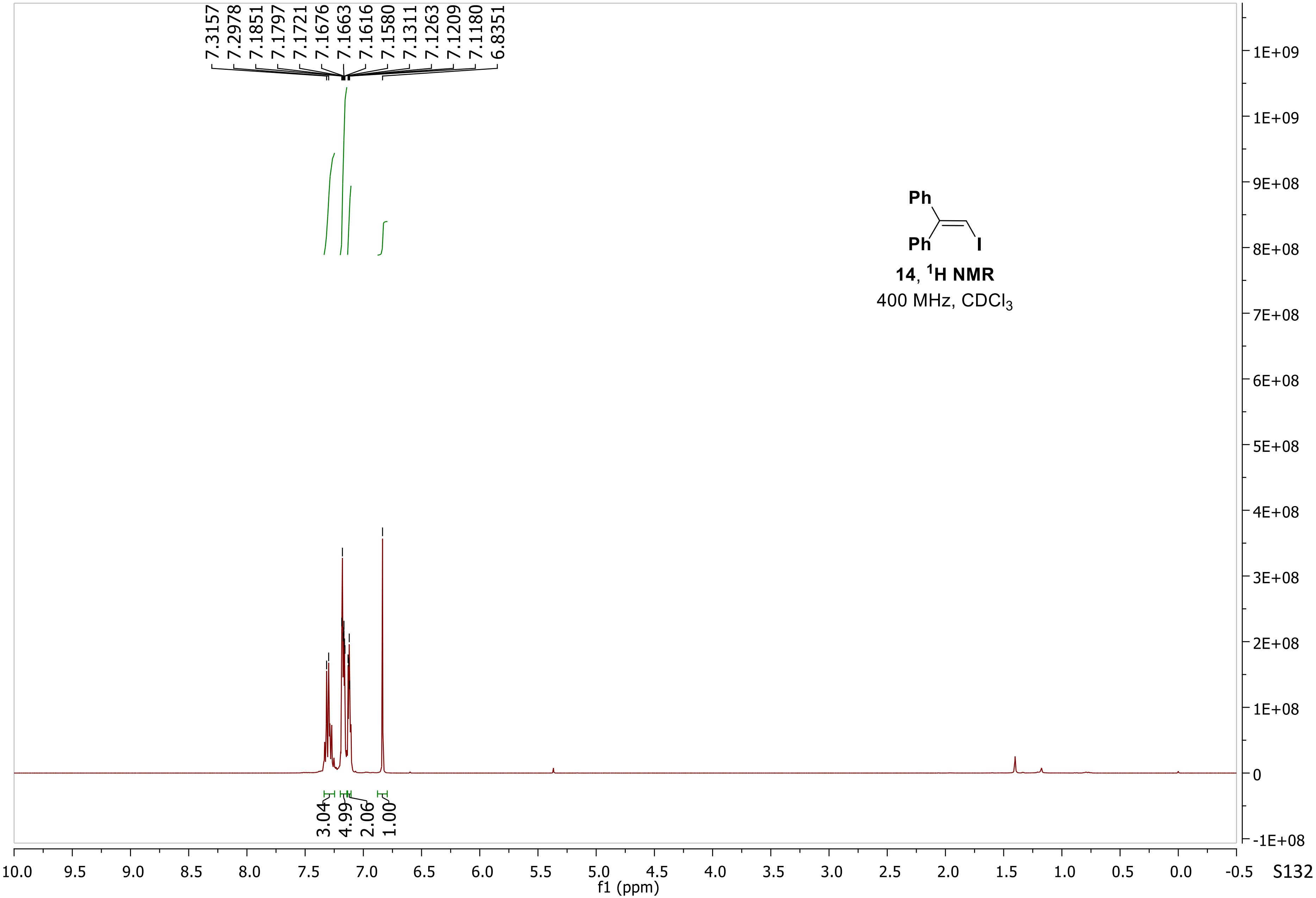
132.2505
131.3616
131.2156
131.0702
130.9623
129.0131
128.0774
127.8595
127.7971
127.4496
127.2391
125.8851
125.7178
125.0386
124.9087
124.2042
123.8451
122.9212
92.9291
89.1230
Ph
Ph
S
Ph
12, $^{13}C\{^{1}H\}$ NMR
100 MHz, $CDCl_3$
f1 (ppm)

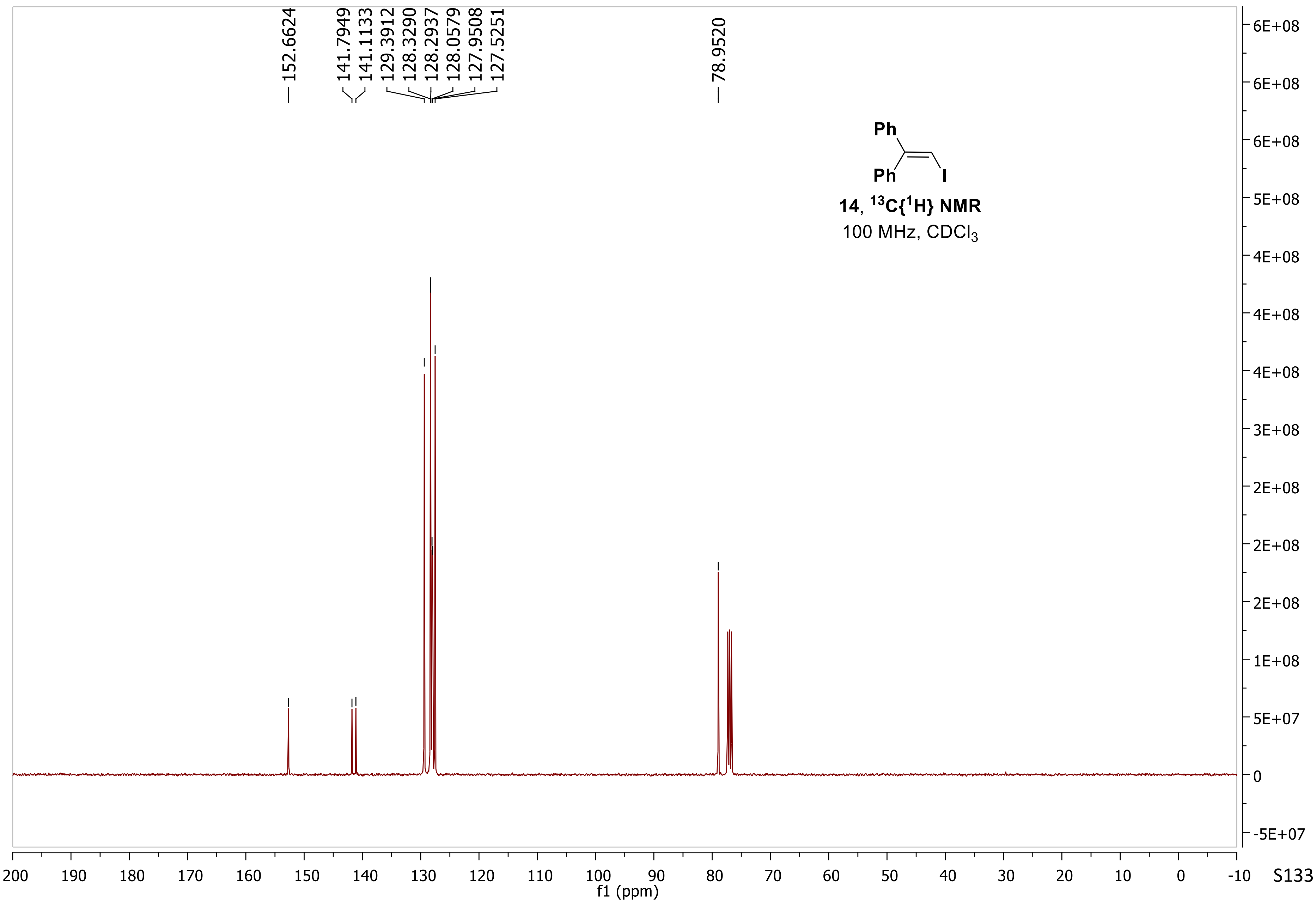

7.7317
7.7267
7.7155
7.7118
7.7080
7.5135
7.4964
7.4831
7.4784
7.4725
7.4668
7.4643
7.4620
7.3390
7.3281
7.3227
7.3157
7.3146
7.3070
7.3042
7.3017
7.2968
7.2497
7.2448
6.9434
Ph
Ph
Se–Ph
O
13, ¹H NMR
400 MHz, CDCl3
2.06
6.05
5.97
0.94
1.00
f1 (ppm)



153.8987
142.0154
138.3278
137.6898
133.6314
131.1236
129.7979
129.7126
129.6728
129.4472
128.7349
128.4856
128.1583
126.3813
Ph
Ph
Se
Ph
O
13, $^{13}C\{^{1}H\}$ NMR
100 MHz, $CDCl_3$
f1 (ppm)


848.8541
Ph
Ph
Se–Ph
O
13, 77Se NMR
76 MHz, CDCl3
f1 (ppm)


7.3157
7.2978
7.1851
7.1797
7.1721
7.1676
7.1663
7.1616
7.1580
7.1311
7.1263
7.1209
7.1180
6.8351
Ph
Ph
I
14, ¹H NMR
400 MHz, CDCl₃
3.04
4.99
2.06
1.00
f1 (ppm)


152.6624
141.7949
141.1133
129.3912
128.3290
128.2937
128.0579
127.9508
127.5251
78.9520
Ph
Ph
I
14, 13C{1H} NMR
100 MHz, CDCl3
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
5E+07
0
-5E+07
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)