# Supporting information

## Cation Delocalization and Photo-isomerization Enhance the Uncaging Quantum Yield of a Photocleavable Protecting Group

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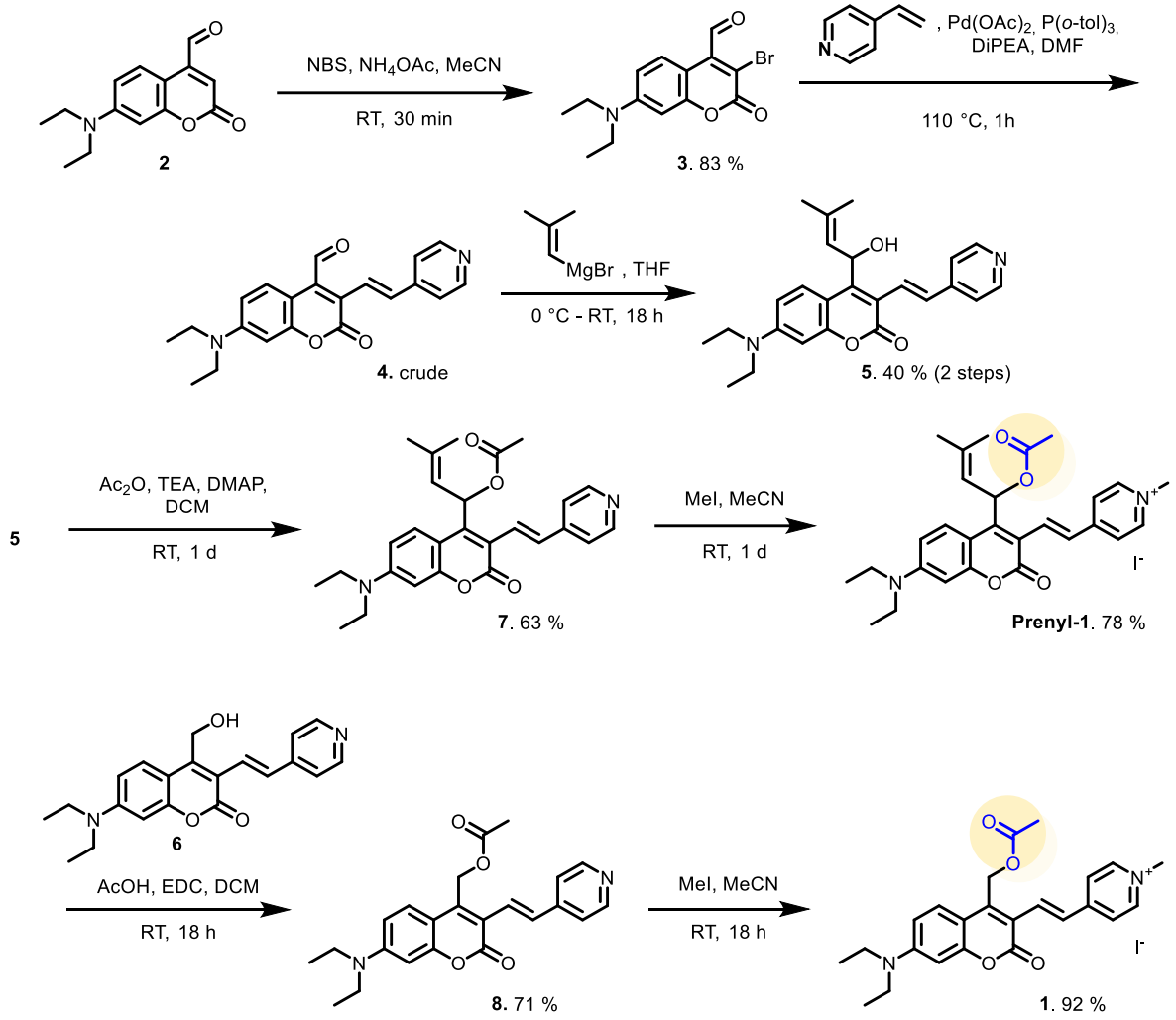
# 1. Synthetic methods

## 1.1 Synthetic scheme




## 1.2 Experimental procedures

Compound **2** (7-(diethylamino)-2-oxo-2H-chromene-4-carbaldehyde)

Prepared using a published procedure.[1] **$^{1}$H NMR** (400 MHz, $CDCl_3$) δ 10.03 (s, 1H), 8.30 (d, J = 9.2 Hz, 1H), 6.63 (dd, J = 9.2, 2.4 Hz, 1H), 6.52 (d, J = 2.2 Hz, 1H), 6.45 (s, 1H), 3.42 (q, J = 7.1 Hz, 4H), 1.22 (t, J = 7.1 Hz, 6H). **$^{13}$C NMR** (101 MHz, CDCl3) δ 192.6, 161.8, 157.4, 151.0, 143.9, 127.0, 117.2, 109.5, 103.7, 97.6, 44.8, 12.5. Spectra matching with literature.

Compound **3** (3-bromo-7-(diethylamino)-2-oxo-2H-chromene-4-carbaldehyde)

In a flame dried round-bottom flask, compound **2** (621 mg, 2.53 mmol, 1.00 equiv.) was dissolved in dry acetonitrile (14 mL). Under a nitrogen atmosphere, NBS (547 mg, 3.07 mmol, 1.22 equiv.) and ammonium acetate (24 mg, 0.31 mmol, 0.12 equiv.) were added. Immediately after addition, the dark red solution turned darker red and complete conversion was confirmed by TLC. The mixture was poured into water and the water layer was extracted with EtOAc (3 x). The combined organic layers were washed with brine, dried over $MgSO_4$, filtered and concentrated under reduced pressure. The crude product was purified by dry column vacuum chromatography (eluent: DCM/pentane = 6:4) to

afford the product (724 mg, 2.23 mmol, 88 %) as a dark-red solid. Rf = 0.3 (DCM/pentane = 6:4). **$^{1}$H-NMR** (400 MHz, $CDCl_3$) δ 10.39 (s, 1H), 7.97 (d, J = 9.2 Hz, 1H), 6.62 (dd, J = 9.3, 2.7 Hz, 1H), 6.51 (d, J = 2.6 Hz, 1H), 3.42 (q, J = 7.1 Hz, 4H), 1.22 (t, J = 7.1 Hz, 6H). **$^{13}$C-NMR** (101 MHz, $CDCl_3$) δ 193.0, 158.4, 155.9, 151.2, 142.1, 126.8, 110.1, 109.9, 104.8, 97.6, 45.0, 12.6. **HRMS** (ESI) calc. for $C_{14}H_{15}BrNO_3^+$ ($M+H^+$): 324.0230; found: 324.0237.

Compound **4** ((E)-7-(diethylamino)-2-oxo-3-(2-(pyridin-4-yl)vinyl)-2H-chromene-4-carbaldehyde)

A flask was charged with compound **3** (1.58 g, 4.52 mmol, 1.00 equiv.), P(*o*-tol)$_3$ (288 mg, 0.95 mmol, 0.21 equiv.), $Pd(OAc)_2$ (108 mg, 0.48 mmol, 0.11 equiv.), DIPEA (1.6 mL, 9.19 mmol, 2.08 equiv.) and 4-vinylpyridine (1.5 mL, 13.91 mmol, 3.14 equiv.) in DMF (30 mL). The mixture was then purged with $N_2$ for 15 min, subsequently heated to 110 °C and stirred for 1 h at this temperature. Upon completion of the reaction, the mixture was cooled to RT, diluted with water and extracted with DCM (3 x). The combined organic layers were washed with brine (3 x) to remove DMF, dried over $MgSO_4$, filtered and concentrated under reduced pressure to give 1.95 g of a crude material. $^{1}$H-NMR analysis revealed sufficient purity of the material for the subsequent reaction. **$^{1}$H-NMR** (400 MHz, $CDCl_3$) δ 10.32 (s, 1H), 8.68 – 8.57 (m, 2H), 7.89 (d, J = 9.2 Hz, 1H), 7.52 (d, J = 16.0 Hz, 1H), 7.41 – 7.33 (m, 2H), 7.00 (d, J = 16.0 Hz, 1H), 6.64 (dd, J = 9.3, 2.6 Hz, 1H), 6.54 (d, J = 2.6 Hz, 1H), 3.45 (q, J = 7.1 Hz, 4H), 1.24 (t, J = 7.1 Hz, 6H). **HRMS** (ESI) calc. for $C_{21}H_{21}N_2O_3^+$ ($M+H^+$): 349.1547; found: 349.1551.

Compound **5** ((E)-7-(diethylamino)-4-(1-hydroxy-3-methylbut-2-en-1-yl)-3-(2-(pyridin-4-yl)vinyl)-2H-chromen-2-one)

**Step 1: preparation of the Grignard reagent**
A three-necked flask containing Mg turnings (680 mg, 28.00 mmol, 16.27 equiv.) was flame dried. Then, a crystal of iodine was added and the flask was heated with a flame until a purple vapor was observed and was filling the flask completely. Subsequently, dry THF (22 mL) and 1-bromo-2-methylpropene (2.3 mL, 22.45 mmol, 13.05 equiv.) were added and the mixture was heated to 65 °C and stirred for 6 h under nitrogen to produce a 1 M mixture of the Grignard reagent.

**Step 2**
A three-necked flask was flame dried and crude compound **4** (600 mg, 1.72 mmol, 1.00 equiv.) and dry THF (17 mL) were added. The mixture was cooled to 0 °C using an ice bath and the previously prepared Grignard reagent (1.90 mL, 1.90 mmol, 1.10 equiv.) was added carefully. After addition, the ice bath was removed and the mixture was stirred at RT for 18 h. The mixture was diluted with ethyl acetate, washed with saturated aqueous $NH_4Cl$, brine, dried over $MgSO_4$, and concentrated under reduced pressure. The crude material was purified by silica gel chromatography (9:1 to 7:3 DCM/acetone), to obtain **5** as a brown oil (222 mg, 0.55 mmol, corrected yield 40 %). **$^{1}$H-NMR** (400 MHz, $CDCl_3$) δ 8.50 – 8.42 (m, 2H), 8.07 (d, J = 9.3 Hz, 1H), 7.45 (d, J = 16.1 Hz, 1H), 7.31 (d, J = 16.2 Hz, 1H), 7.24 – 7.17 (m, 2H), 6.58 (dd, J = 9.3, 2.7 Hz, 1H), 6.42 (d, J = 2.6 Hz, 1H), 6.09 (d, J = 8.6 Hz, 1H), 5.74 (dp, J = 8.5, 1.4 Hz, 1H), 3.39 (q, J = 7.1 Hz, 4H), 1.83 (d, J = 1.4 Hz, 3H), 1.78 (d, J = 1.4 Hz, 3H), 1.20 (t, J = 7.1 Hz, 6H). **$^{13}$C-NMR** (101 MHz, $CDCl_3$) δ 161.5, 155.7, 153.2, 150.4, 149.9, 145.7, 139.5, 131.4, 128.8, 125.8, 124.6, 121.0, 114.0, 108.9, 107.2, 97.4, 67.2, 44.9, 26.2, 18.7, 12.7. **HRMS** (ESI) calc. for $C_{25}H_{29}N_2O_3^+$ ($M+H^+$): 405.2173; found: 405.2176.

Compound **6** ((E)-7-(diethylamino)-4-(hydroxymethyl)-3-(2-(pyridin-4-yl)vinyl)-2H-chromen-2-one)

Compound **6** was prepared following a literature procedure[2]

**$^1$H-NMR** (400 MHz, $CD_3OD/CDCl_3$ 1:1) δ 8.42 (d, *J* = 5.3 Hz, 2H), 7.70 (d, *J* = 9.2 Hz, 1H), 7.60 (q, *J* = 16.1 Hz, 2H), 7.49 (d, *J* = 5.5 Hz, 2H), 6.66 (dd, *J* = 9.2, 2.6 Hz, 1H), 6.46 (d, *J* = 2.6 Hz, 1H), 4.21 (s, 2H), 3.42 (q, *J* = 7.0 Hz, 4H), 1.20 (t, *J* = 7.1 Hz, 6H). **$^{13}$C-NMR** (101 MHz, $CD_3OD/CDCl_3$ 1:1) δ 162.2, 155.8, 151.3, 150.5, 148.9, 147.4, 130.5, 127.4, 126.7, 121.8, 115.1, 110.0, 108.7, 97.4, 56.6, 45.1, 12.6. Spectra matching with literature.

Compound **7** ((E)-1-(7-(diethylamino)-2-oxo-3-(2-(pyridin-4-yl)vinyl)-2H-chromen-4-yl)-3-methylbut-2-en-1-yl acetate)

To a solution of compound **5** (123 mg, 0.30 mmol, 1.00 equiv.) in DCM (3 mL) was added $Ac_2O$ (42 µL, 0.45 mmol, 1.46 equiv.), $Et_3N$ (49 µL, 0.35 mmol, 1.16 equiv.) and DMAP (2 mg, 0.02 mmol, 0.06 equiv.). The mixture was stirred for 2 h in the dark at room temperature, diluted with DCM, washed with sat. aq. $NaHCO_3$, brine, dried over $MgSO_4$ and concentrated under reduced pressure. The crude material was purified by silica gel chromatography (12:1 to 4:1 DCM/acetone). Compound **7** was obtained as an orange solid (89 mg, 0.20 mmol, 65 %). **$^1$H-NMR** (400 MHz, $CDCl_3$) δ 8.57 (d, 2H), 7.86 (d, J = 9.3 Hz, 1H), 7.63 (d, J = 16.1 Hz, 1H), 7.55 (d, J = 16.1 Hz, 1H), 7.38 (d, 2H), 7.06 (d, J = 8.9 Hz, 1H), 6.63 (dd, J = 9.3, 2.7 Hz, 1H), 6.51 (d, J = 2.7 Hz, 1H), 5.65 (dp, J = 9.0, 1.4 Hz, 1H), 3.43 (q, J = 7.1 Hz, 4H), 2.07 (s, 3H), 1.82 (d, J = 1.4 Hz, 3H), 1.79 (d, J = 1.4 Hz, 3H), 1.23 (t, J = 7.1 Hz, 6H). **$^{13}$C-NMR** (101 MHz, $CDCl_3$) δ 170.1, 161.0, 155.7, 150.5, 150.3, 149.0, 145.6, 142.4, 132.1, 127.8, 125.6, 121.1, 120.5, 114.8, 109.1, 106.8, 97.6, 68.8, 44.9, 26.2, 21.2, 19.0, 12.5. **HRMS** (ESI) calc. for $C_{27}H_{31}N_2O_4^+$ ($M+H^+$): 447.2278; found: 447.2271.

**Prenyl-1** ((E)-4-(2-(4-(1-acetoxy-3-methylbut-2-en-1-yl)-7-(diethylamino)-2-oxo-2H-chromen-3-yl)vinyl)-1-methylpyridin-1-ium) iodide

In a round bottom flask, compound **7** (43 mg, 0.10 mmol, 1.00 equiv.) was dissolved in MeCN (1 mL). Methyl iodide (28 µL, 0.45 mmol, 4.67 equiv.) was added, and the mixture was stirred at RT for 24 h in the dark. Then, the mixture was concentrated under reduced pressure and an oil was obtained. Diethyl ether was added, and the resulting precipitate was filtered off. To recover more material, the filtrate was concentrated under reduced pressure once again, diethyl ether was added and the precipitate was filtered off. The combined residues were washed with diethyl ether and dried under vacuum to yield **Prenyl-1** as a dark red product (54 mg, 0.09 mmol, 95 %). **$^1$H-NMR** (400 MHz, $CD_3OD/CDCl_3$ 3:1) δ 8.66 (d, *J* = 6.3 Hz, 2H), 8.13 (d, *J* = 15.7 Hz, 1H), 8.05 – 7.84 (m, 4H), 7.07 (d, *J* = 8.6 Hz, 1H), 6.75 (dd, *J* = 9.4, 2.6 Hz, 1H), 6.50 (d, *J* = 2.6 Hz, 1H), 5.63 (d, *J* = 8.6 Hz, 1H), 4.31 (s, 3H), 3.49 (q, *J* = 6.8 Hz, 4H), 2.08 (s, 3H), 1.81 (s, 3H), 1.79 (s, 3H), 1.24 (t, *J* = 7.0 Hz, 6H).**$^{13}$C-NMR** (101MHz, $CD_3OD$) δ 171.8, 162.0, 157.6, 155.7, 154.7, 153.2, 146.2, 143.9, 135.1, 129.7, 127.9, 124.7, 121.3, 112.8, 111.2, 107.6, 97.9, 70.00, 47.9, 45.8, 26.1, 20.8, 19.0, 12.8. **HRMS** (ESI) calc. for $C_{28}H_{33}N_2O_4^+$ ($M+H^+$): 461.2435; found: 461.2422. Procedure adapted from Bojtár *et al*.[2]

Compound **8**

(E)-(7-(diethylamino)-2-oxo-3-(2-(pyridin-4-yl)vinyl)-2H-chromen-4-yl)methyl acetate

Compound **6** (65 mg, 0.19 mmol, 1.00 eq., prepared using published procedures)[2] and EDC (178 mg, 0.93 mmol, 5.00 equiv.) were dissolved in dry DCM (2.3 mL) under nitrogen atmosphere. AcOH (53 µL, 0.93 mmol, 5.00 equiv.) was added and the mixture was stirred at room temperature in the dark for 18 h. The mixture was diluted with DCM and washed with saturated aqueous $NaHCO_3$ and water. After both washing steps, the aqueous layer was back extracted with DCM, and the combined organic layers were taken to the next step. The combined organic layers were washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. Silica gel chromatography (DCM/MeOH 98:2 to 97:3) yielded the pure product as a red powder (52 mg, 71 %). **$^1$H-NMR** (400 MHz, $CDCl_3$) δ 8.57 (d, *J* = 5.0 Hz, 2H), 7.73 (d, *J* = 16.0 Hz, 1H), 7.59 – 7.49 (m, 2H), 7.45 (d, *J* = 5.5 Hz, 2H), 6.65 (dd, *J* = 9.2, 2.6 Hz, 1H), 6.52 (d, *J* = 2.6 Hz, 1H), 5.44 (s, 2H), 3.44 (q, *J* = 7.1 Hz, 4H), 2.13 (s, 3H), 1.23 (t, *J* = 7.1 Hz, 6H). **$^{13}$C-NMR** (101 MHz, $CDCl_3$) δ 170.6, 160.7, 155.5, 151.0, 149.5, 146.2, 144.3, 131.8, 126.6, 125.5, 121.3, 116.7, 109.6, 108.3, 97.5, 58.0, 45.0, 21.0, 12.7. **HRMS** (ESI): calc. for $C_{23}H_{25}N_2O_4^+$ ($M+H^+$): 383.1809; found: 393.1810.

Compound **I**

(E)-4-(2-(4-(acetoxymethyl)-7-(diethylamino)-2-oxo-2H-chromen-3-yl)vinyl)-1-methylpyridin-1-ium

To a solution of compound **8** (35 mg, 0.09 mmol, 1.00 equiv.) in MeCN (1 mL) was added MeI (28 µL, 0.45 mmol, 5.00 equiv.). The solution was stirred at room temperature in the dark for 18 h, diluted with $Et_2O$ (10 mL) and filtered. The residue that remained in the flask was dissolved in a minimal amount of DCM, diluted with $Et_2O$ (5 mL) and filtered. The residue on the filter was washed with $Et_2O$ (2 x) and dried under vacuum to yield compound **1** as a dark red solid (44 mg, 92 %). **$^1$H-NMR** (400 MHz, $CDCl_3$) δ 8.48 (d, J = 4.1 Hz, 2H), 8.07 (d, J = 9.3 Hz, 1H), 7.46 (d, J = 16.1 Hz, 1H), 7.32 (d, J = 16.2 Hz, 1H), 7.25 (d, J = 6.0 Hz, 2H), 6.59 (dd, J = 9.3, 2.7 Hz, 1H), 6.44 (d, J = 2.6 Hz, 1H), 6.10 (d, J = 8.6 Hz, 1H), 5.75 (d, J = 8.5 Hz, 1H), 3.40 (q, J = 7.1 Hz, 4H), 1.84 (s, 3H), 1.79 (s, 3H), 1.21 (t, J = 7.1 Hz, 6H).

**$^{13}$C-NMR** (101 MHz, $CDCl_3$) δ 170.6, 160.1, 156.3, 154.8, 152.2, 148.7, 144.8, 134.2, 127.8, 126.2, 124.1, 114.0, 110.3, 108.5, 97.3, 57.5, 48.5, 45.2, 21.2, 12.7. **HRMS** (ESI): calc. for $C_{24}H_{27}N_2O_4^+$ ($M^+$): 407.1965; found: 407.1966. Procedure adapted from Bojtár *et al*.[2]

## 1.3 Heck reaction screening

Table S1. The different conditions that were screened for the Heck reaction.

| Reaction | Compound 3 | Catalyst | Ligand | Base | Solvent | Conditions |
|---|---|---|---|---|---|---|
| **A** | 50 mg | 0.1 eq. $Pd(dppf)Cl_2$ | - | 3 eq. DiPEA | DMF | 110°C, 18h |
| **B** | 50 mg | 0.1 eq. $Pd(OAc)_2$ | 0.2 eq. P(*o*-tol)$_3$ | 3 eq. DiPEA | Toluene | 110°C, 18h |
| **C** | 50 mg | 0.1 eq. $Pd(OAc)_2$ | 0.2 eq. P(*o*-tol)$_3$ | 3 eq. DiPEA | DMF | 110°C, 18h |
| **D** | 50 mg | 0.1 eq. $Pd(OAc)_2$ | - | 1.4 eq. $K_3PO_4$ | DMF | 110°C, 18h |

The employed reaction conditions (Table S1) were based on different literature procedures of Heck coupling reactions on substrates showing structural similarities to compound **4**.[2–4] Reaction A was based on the original procedure using Q-Phos, but instead of Q-Phos, the structurally similar ligand $Pd(dppf)Cl_2$ was used. For reactions A – C, DiPEA was used as the base as a substitute for $Cy_2NMe$, which was not present in the laboratory stock. All reaction mixtures contained compound **3** as the limiting reagent and contained three equivalents of the coupling reagent 4-vinylpyridine. After addition of all reagents, all mixtures were purged with $N_2$ for 10 min and heated to 110 °C. After stirring at 110 °C for 18 h, the mixtures were cooled and a sample was taken for HPLC-MS analysis. The desired mass was observed for conditions A and C, however, the HPLC-MS trace for C was cleaner. Therefore, these conditions were applied at large scale.

## 1.4 NMR-spectra

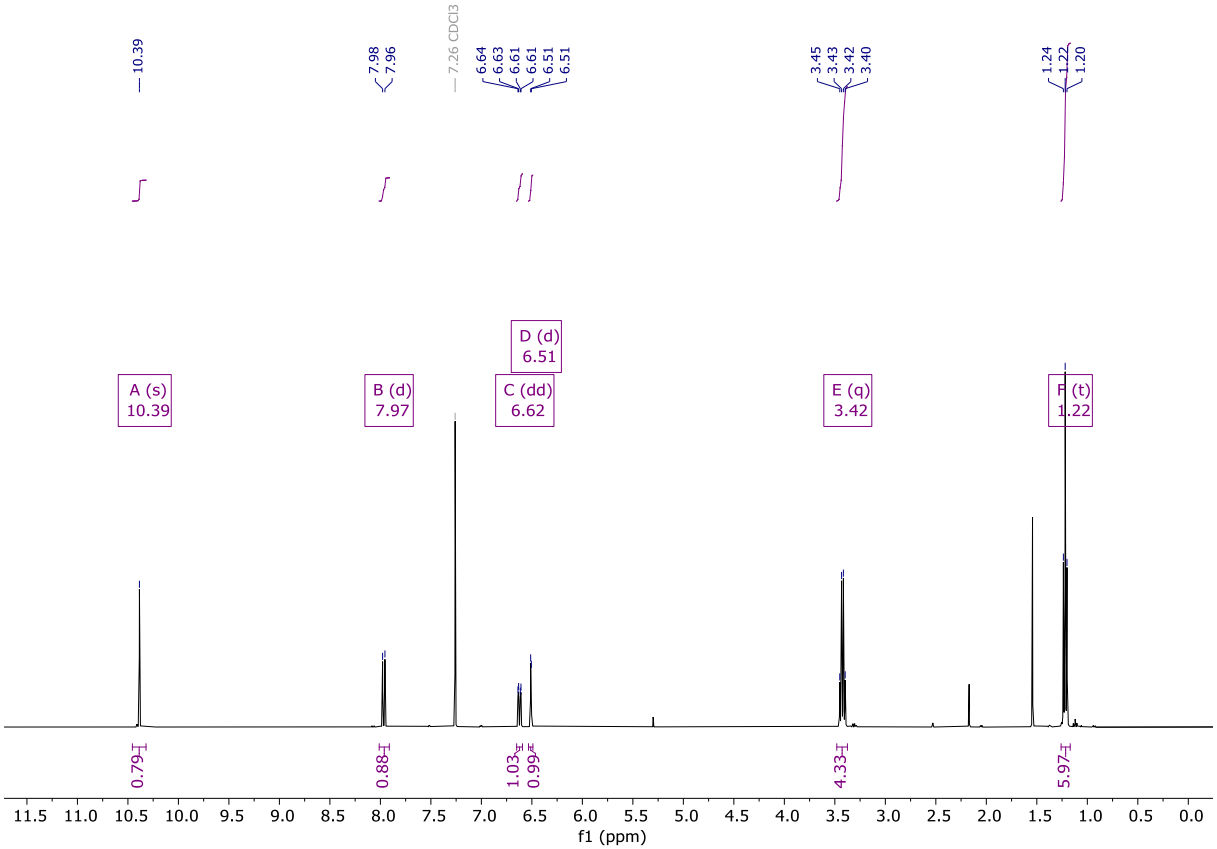



Figure S1. $^{1}$H-NMR spectrum of compound **3** in $CDCl_3$

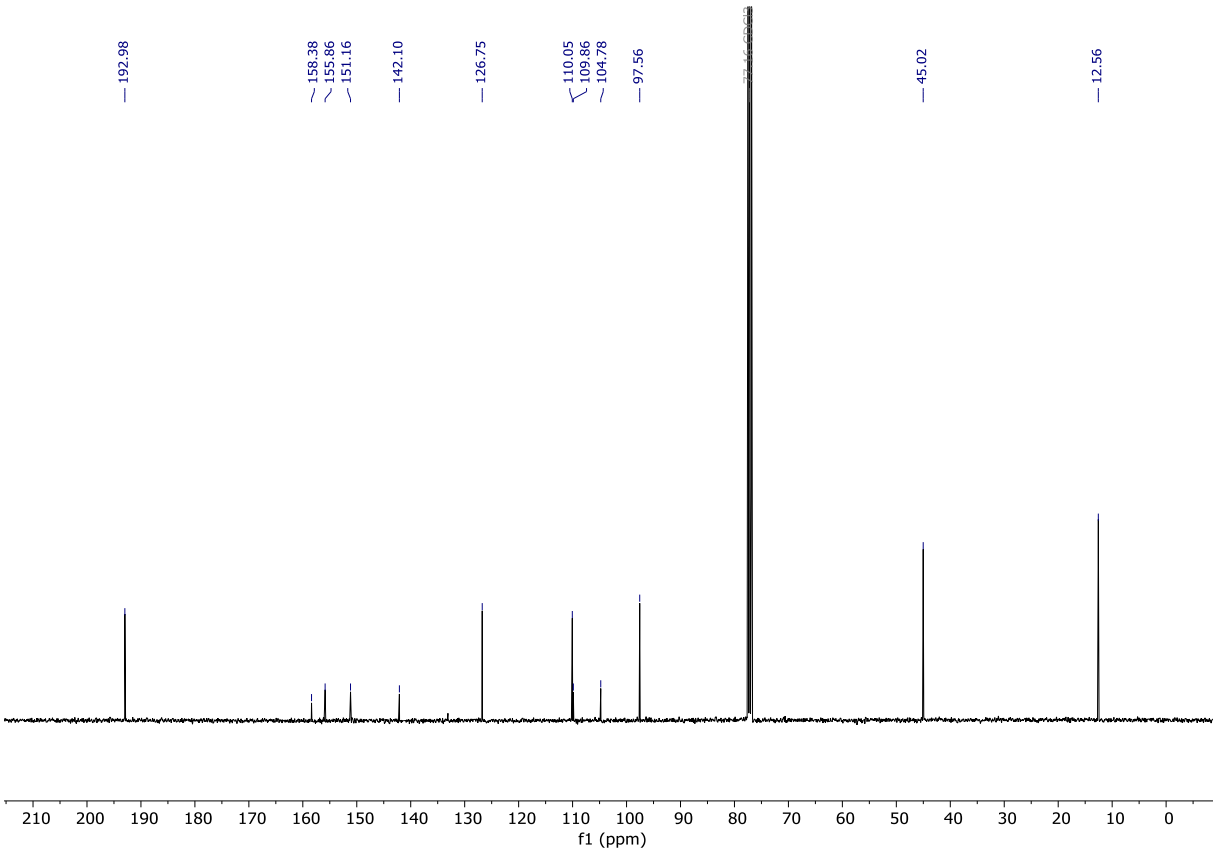



Figure S2. $^{13}$C-NMR spectrum of compound **3** in $CDCl_3$

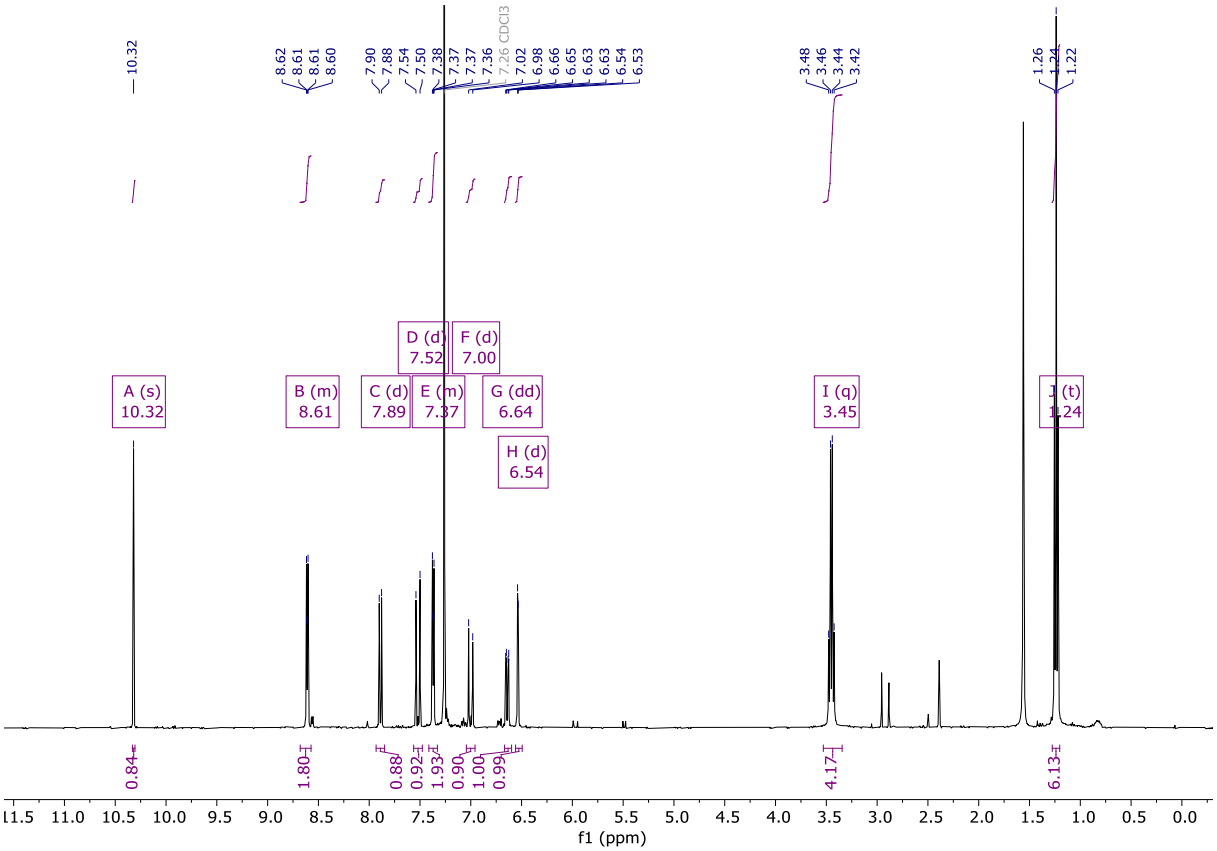



Figure S3. $^{1}$H-NMR spectrum of compound **4** (crude) in $CDCl_3$

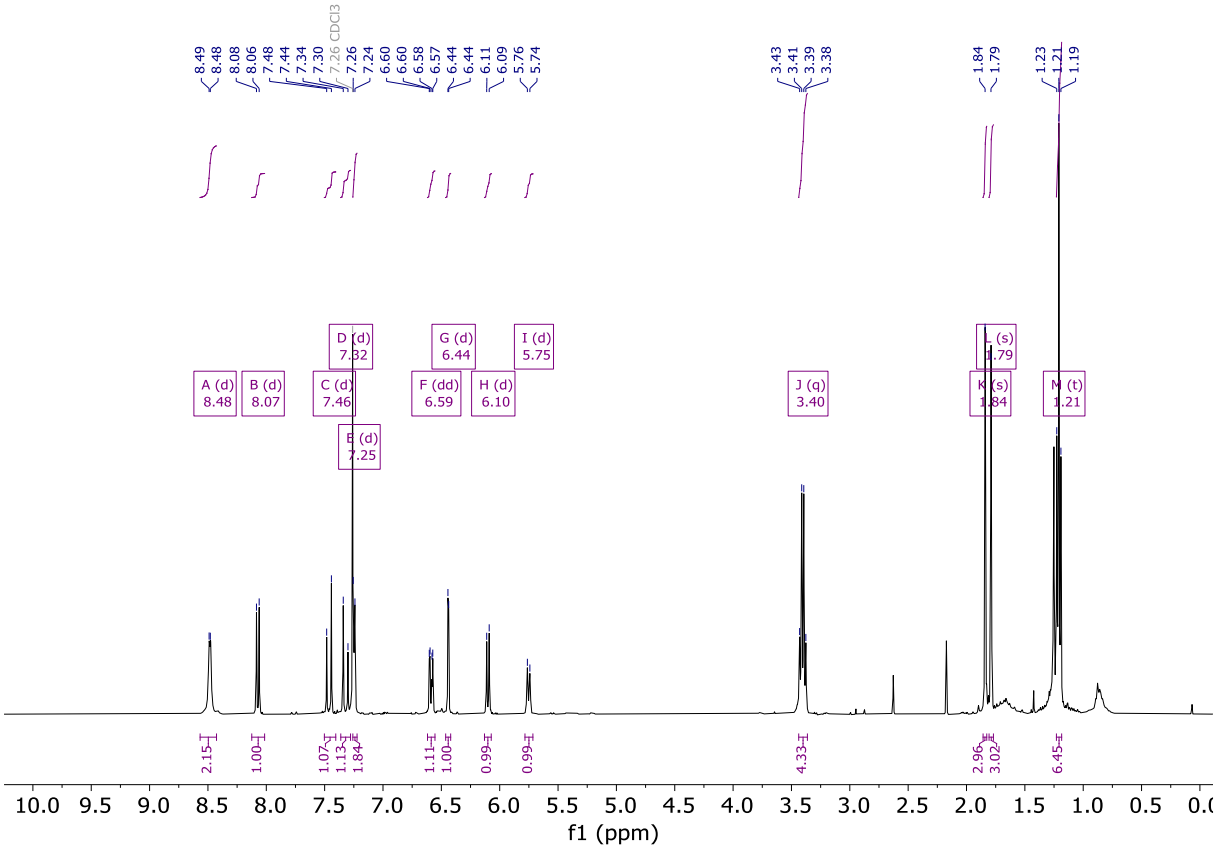



Figure S4. $^{1}$H-NMR spectrum of compound **5** in $CDCl_3$

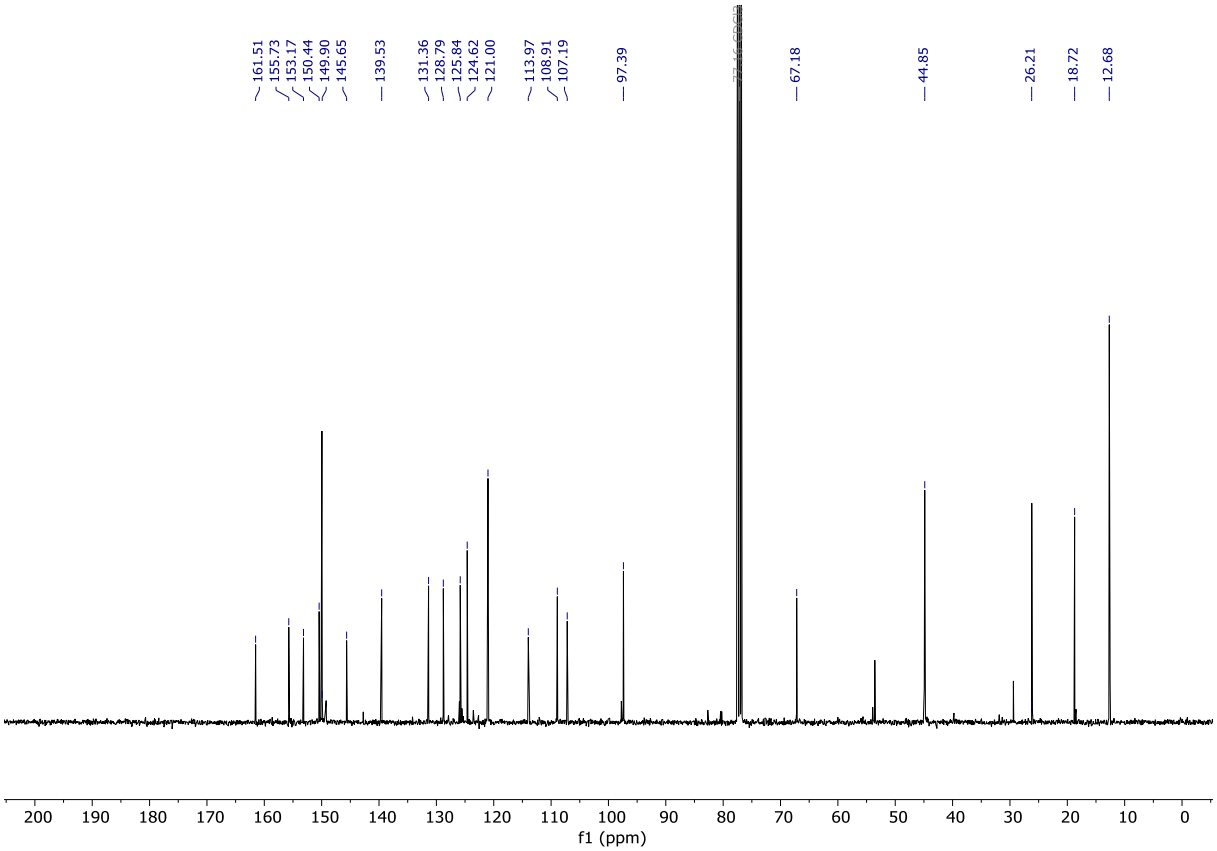



Figure S5. $^{13}$C-NMR spectrum of compound **5** in $CDCl_3$

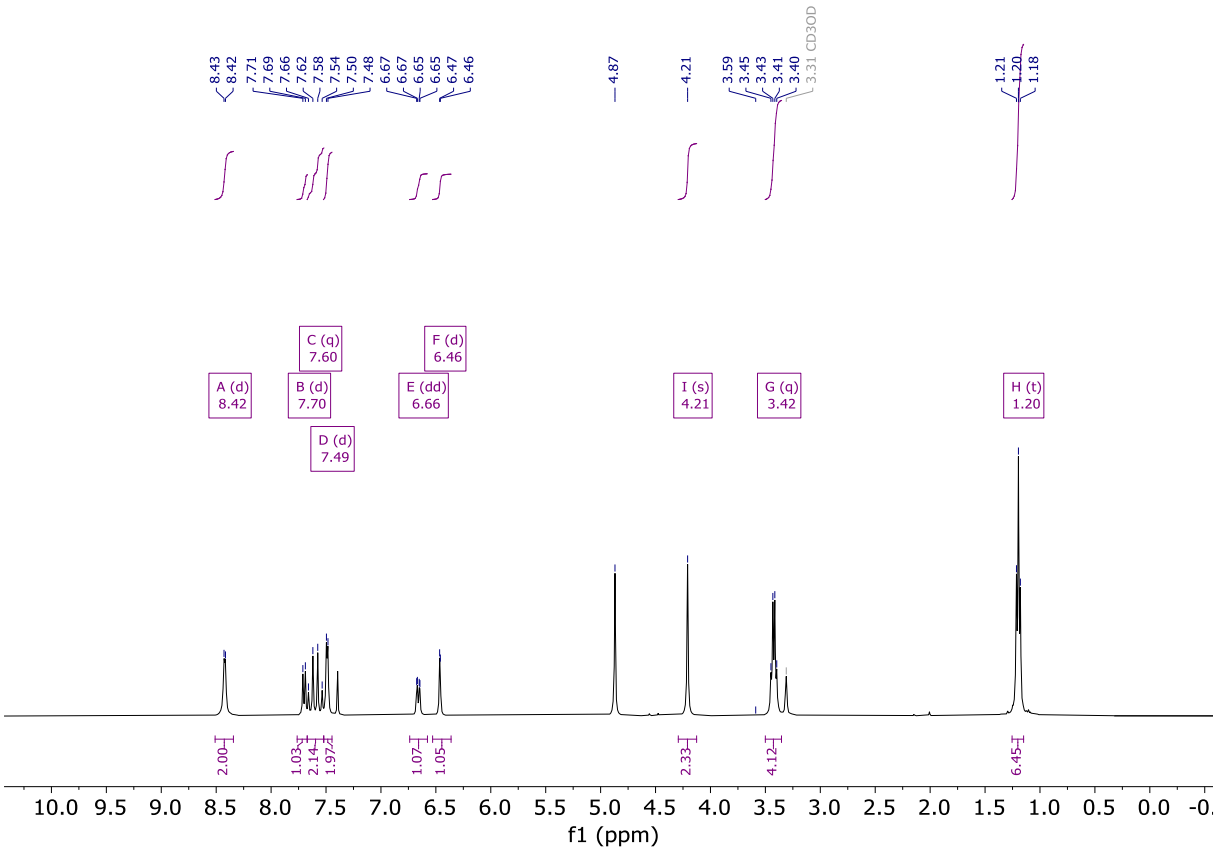



Figure S6. $^{1}$H-NMR spectrum of compound **6** in $CDCl_3/CD_3OD$ 1:1

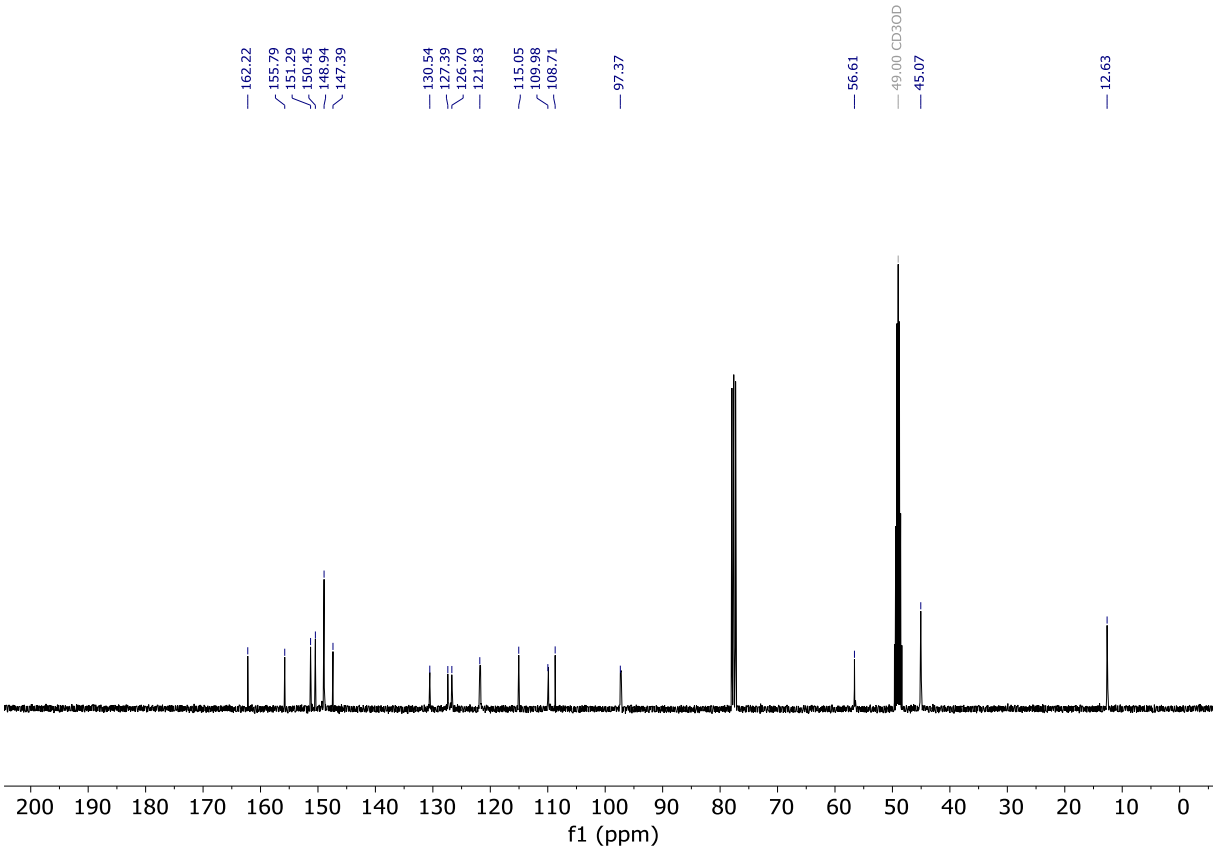



Figure S7. $^{13}$C-NMR spectrum of compound **6** in in $CDCl_3/CD_3OD$ 1:1

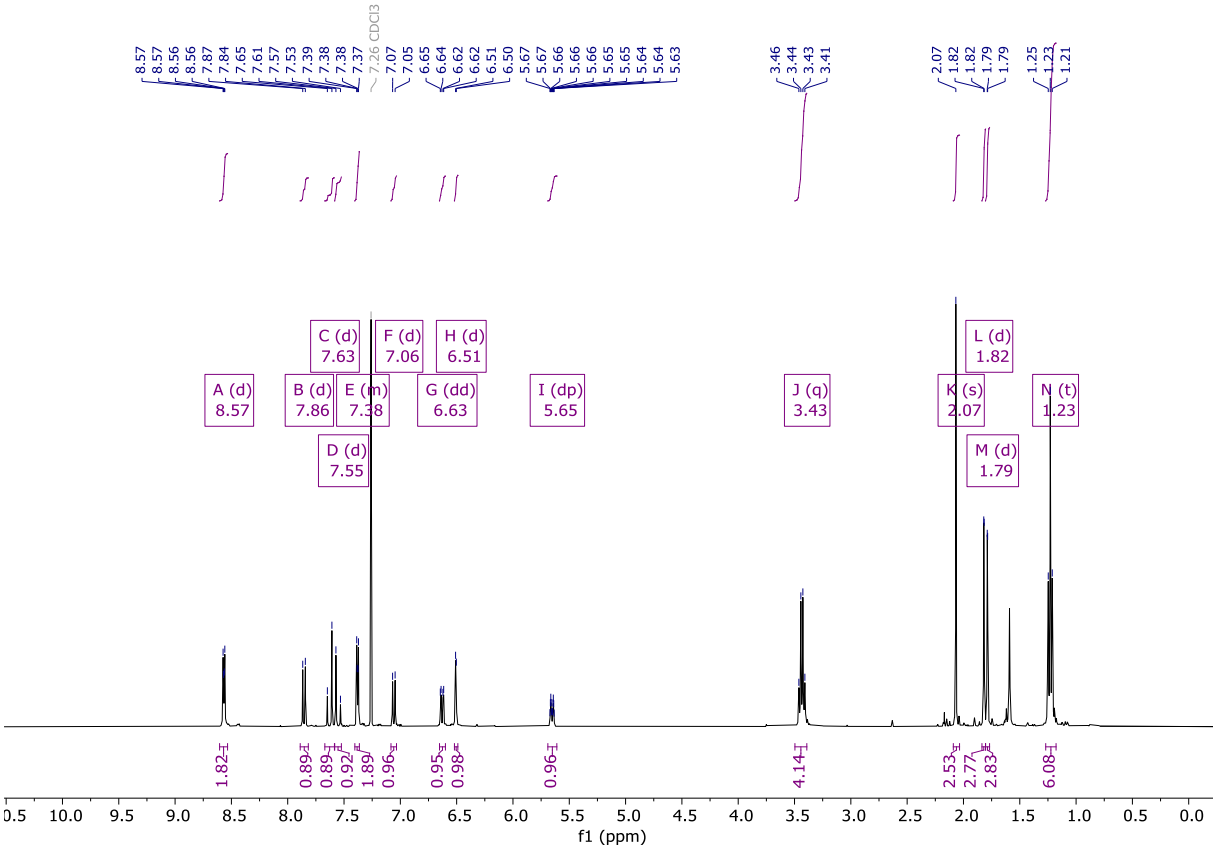



Figure S8. $^{1}$H-NMR spectrum of compound **7** in $CDCl_3$

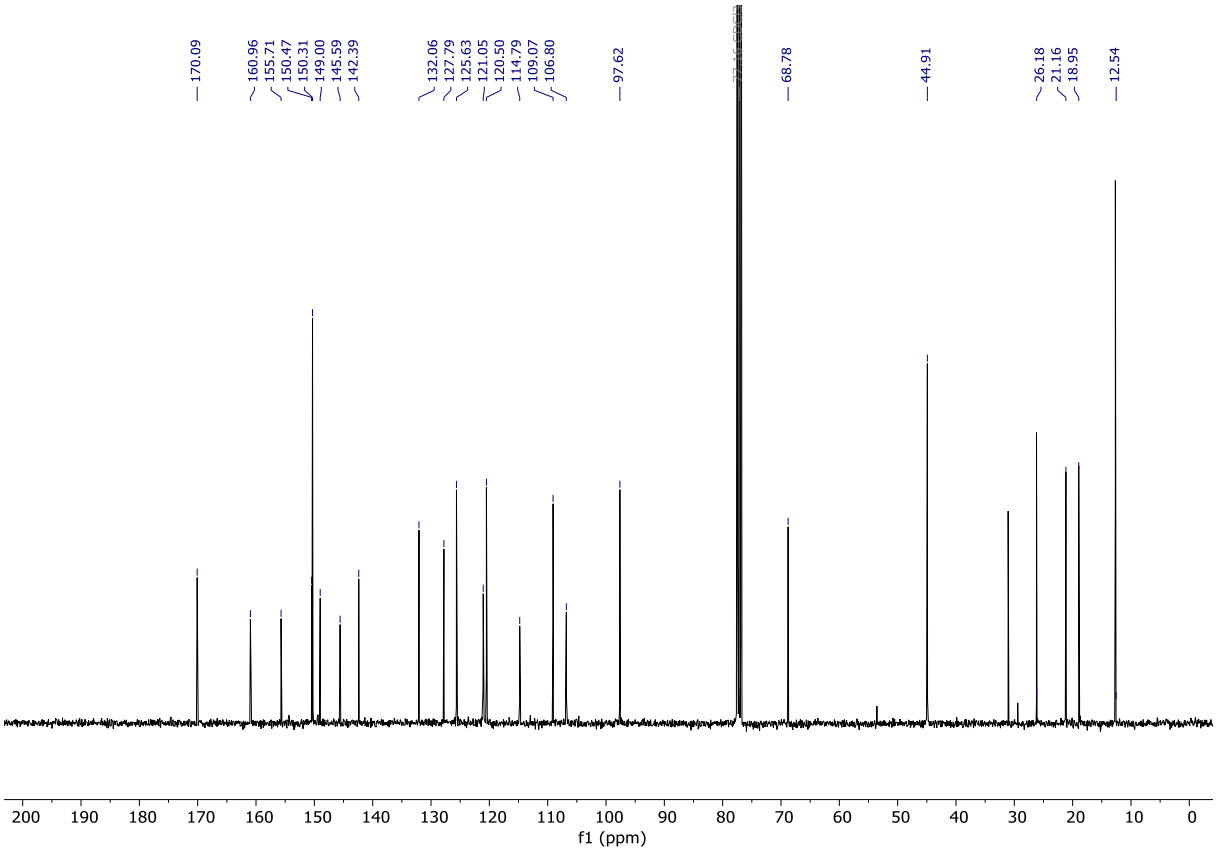



Figure S9. $^{13}$C-NMR spectrum of compound **7** in $CDCl_3$

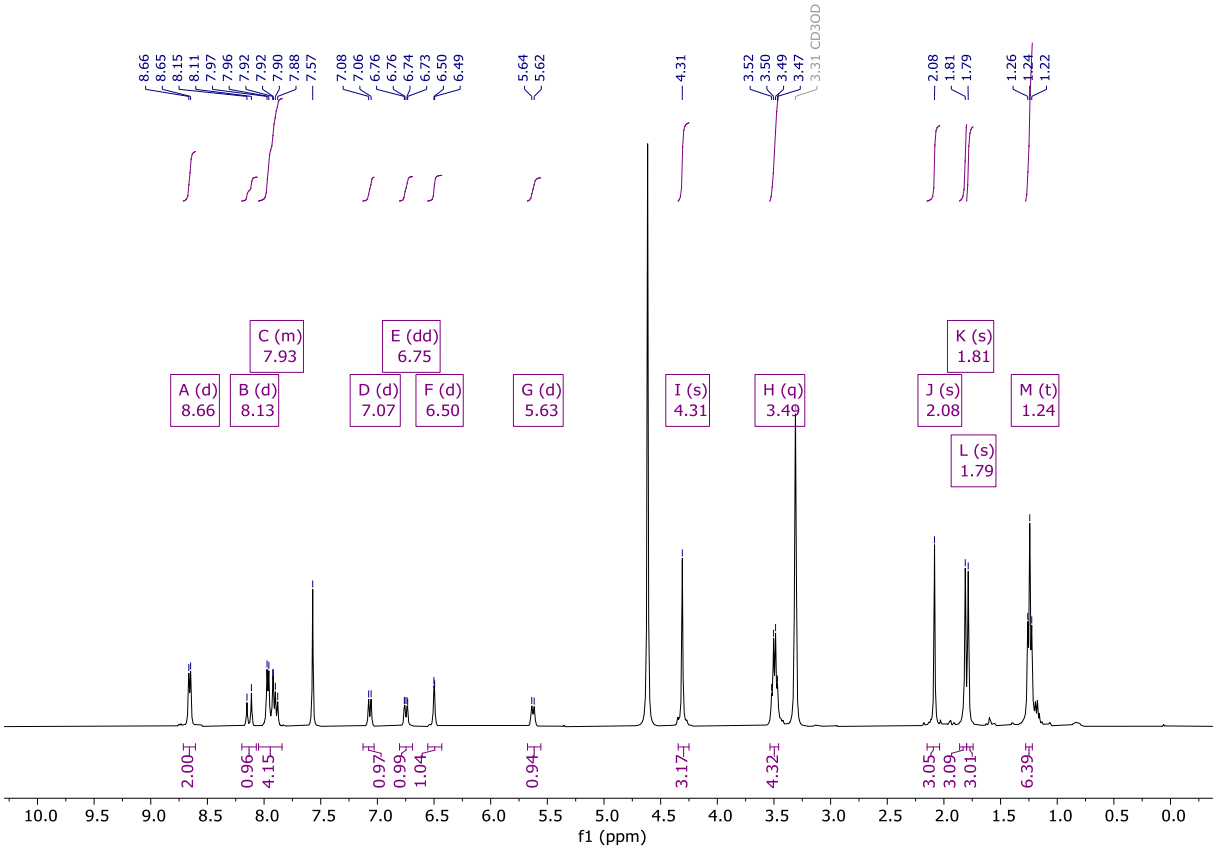



Figure S10. $^{1}$H-NMR spectrum of compound **Prenyl-I** in 3:1 MeOD/$CDCl_3$

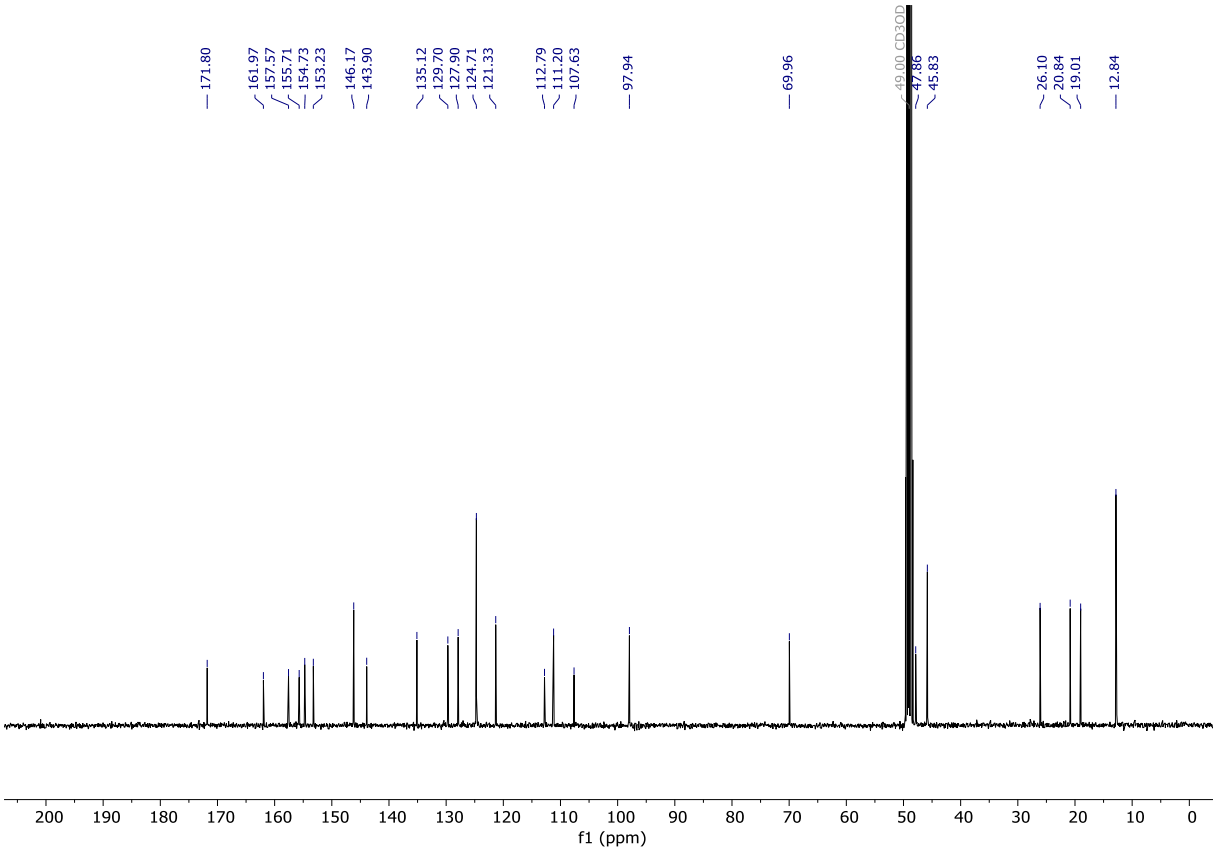



Figure S11. $^{13}$C-NMR spectrum of compound **Prenyl-I** in $CD_3OD$

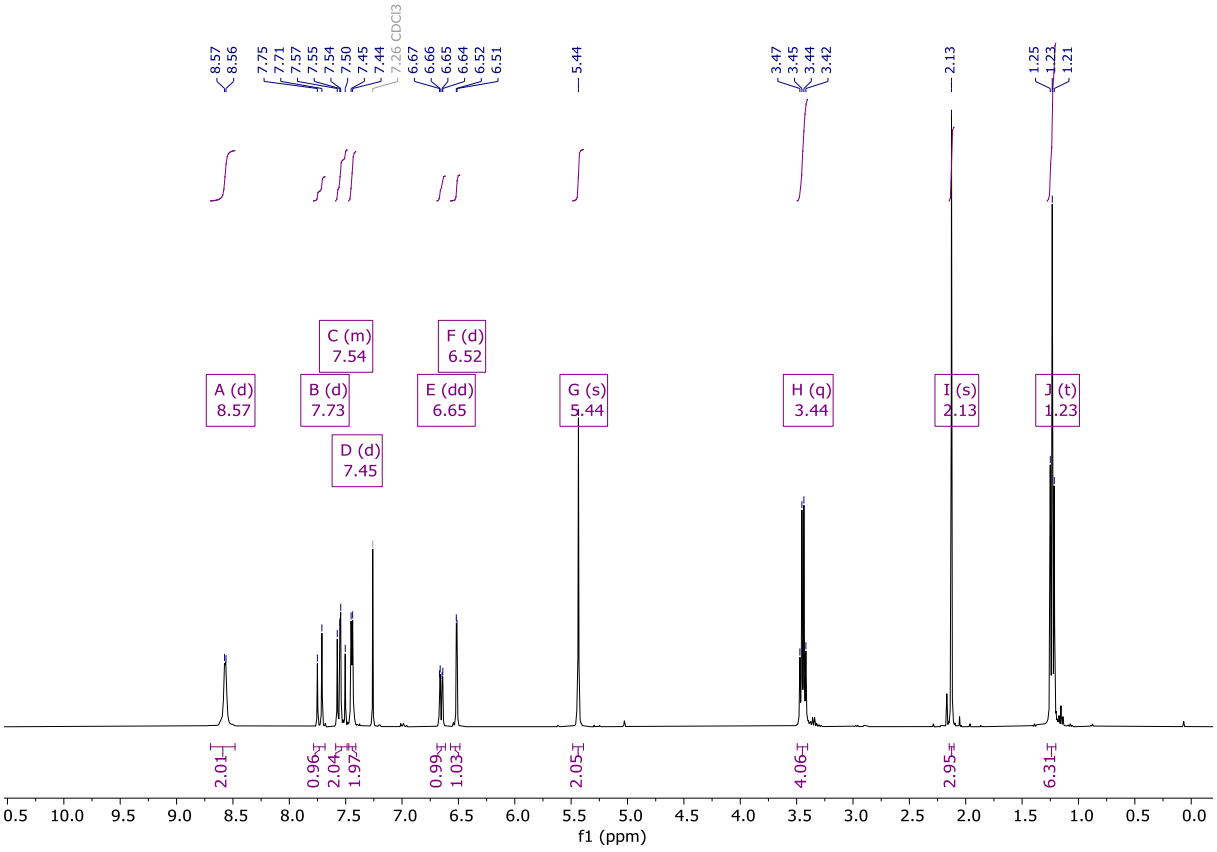



Figure S12. $^{1}$H-NMR spectrum of compound **8** in $CDCl_3$

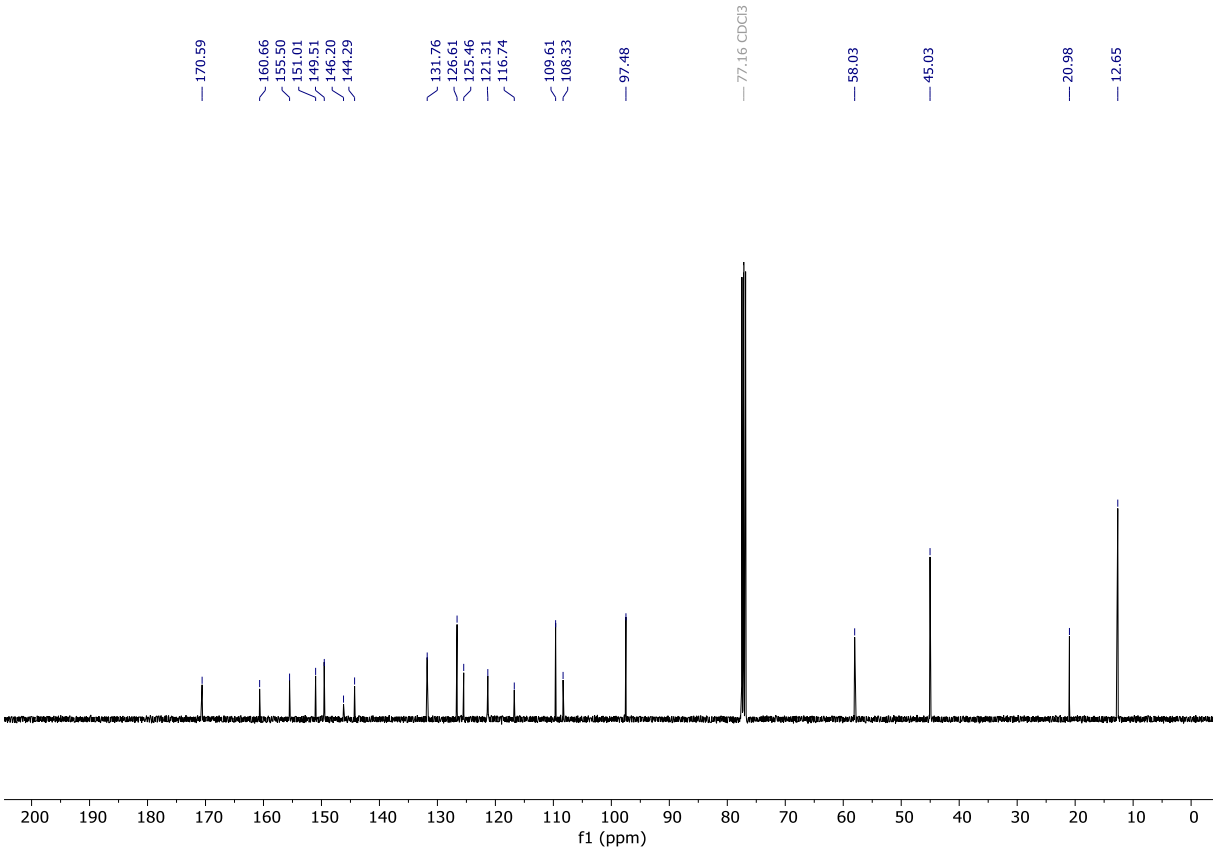



Figure S13. $^{13}$C-NMR spectrum of compound **8** in $CDCl_3$

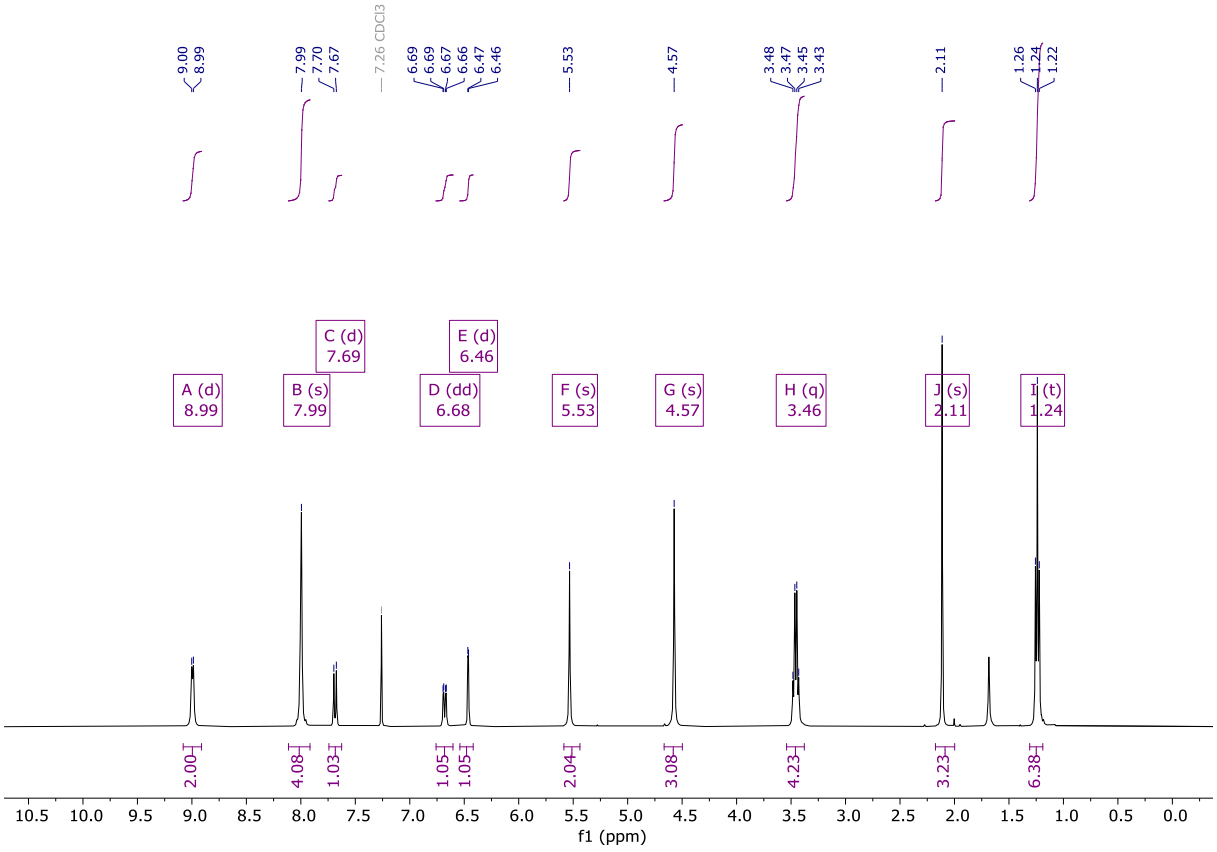



Figure S14. $^{1}$H-NMR spectrum of compound **I** in $CDCl_3$

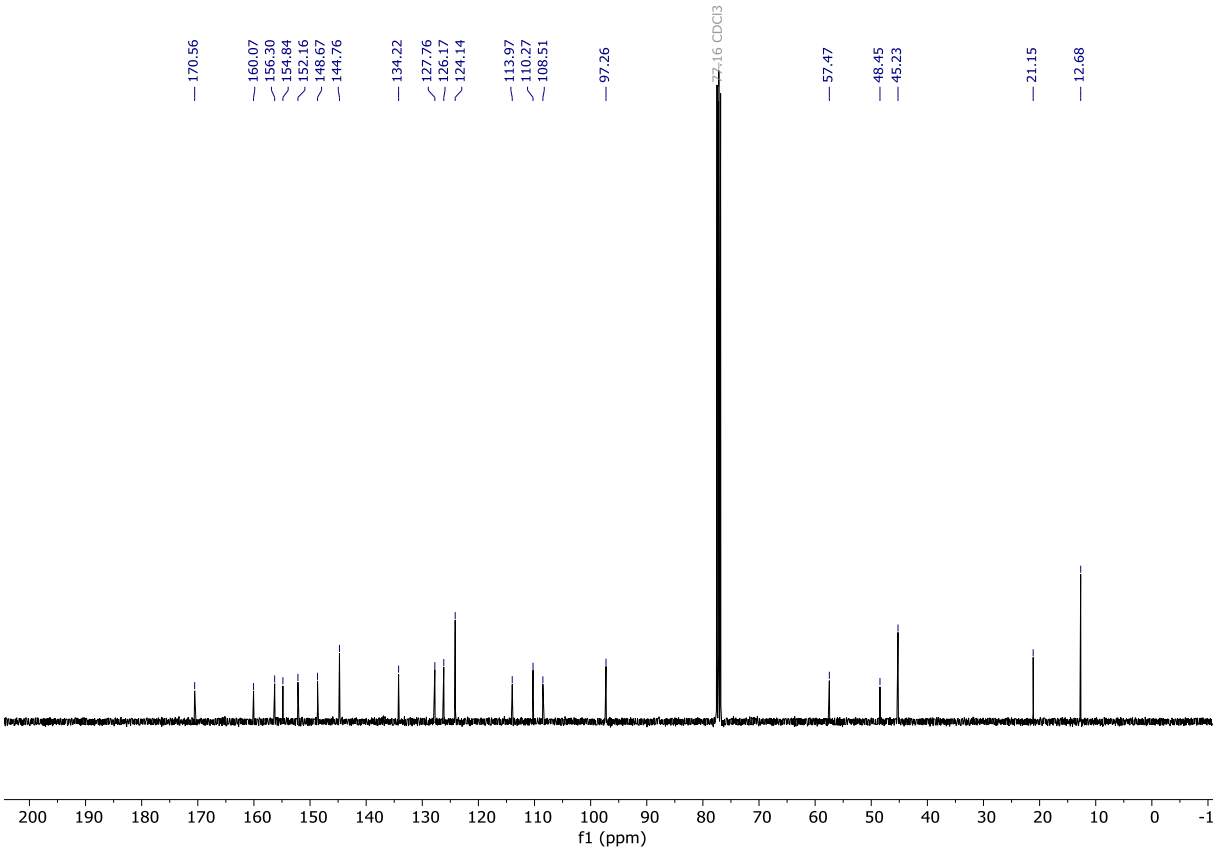



Figure S15. $^{13}$C-NMR spectrum of compound **I** in $CDCl_3$

# 2. Photochemistry

## 2.1 Quantum Yield Determination by $^1$H-NMR

The QYs of payload release for **I** and **Prenyl-I** were determined by conducting a photoheterolysis NMR experiment in parallel with a suitable actinometer, **BODIPY**. This PPG with a known QY (0.14% in MeOD)[5] uncages a PL identical to compounds **I** and **Prenyl-I** (AcOH). The release of the AcOH from separate 0.5 ml 1.0 mM solutions of the respective compound (in 1:1 DMSO-$d_6$/$D_2O$, non-degassed) and the actinometer (in $CD_3OD$) was monitored by $^1$H-NMR. All samples contained 1.0 mM of $DMSO_2$ (dimethyl sulfone) to serve as the internal standard for the AcOH release quantification and 1.0 mM of AcOH at the start, to simplify identification of the signal corresponding to the released payload. At a 1.0 mM concentration, both **I**, **Prenyl-I** and **BODIPY** exhibit optical absorbances of > 3 at 530 nm, meaning that > 99.9 % of photons of this wavelength to be passed through the samples would be absorbed. The samples of **I**, **Prenyl-I** and **BODIPY** were then irradiated side-by-side with a Sahlmann Photochemical Solutions 530 nm LED system (3 x 270 mW, peak wavelength = 526 nm, FWHM 35.1 nm). At different time intervals (Δt**Prenyl-I** = 2 min, Δt**I** = 20 min and Δt**BODIPY** = 10 min) an $^1$H-NMR spectrum was recorded on an Agilent Technologies 400-MR (400/54 Premium Shielded) spectrometer (400 MHz for $^1$H nucleus) to quantify the AcOH released. The irradiation measurements for **I** and **Prenyl-I** were conducted in triplicate and the measurements for **BODIPY** in quadruplicate. The generated amount of AcOH was averaged and plotted versus time for all compounds.

The slopes of the generation of AcOH from the irradiation of **I** and **Prenyl-I** were divided by the slope of the generation of AcOH from the irradiation of actinometer **BODIPY**, and finally multiplied by the QY of **BODIPY** (section 2.4, Table S5) according to this equation:

$$QY = \frac{slope\ \boldsymbol{I}\ or\ \boldsymbol{Prenyl\_I}}{slope\ \boldsymbol{BODIPY}} \times\ QY\ \boldsymbol{BODIPY}$$

The amount of *cis*-isomer produced was quantified in a similar fashion, through integration of the acetate $CH_3$ signal of the *cis*-isomer (section 2.4 Table S6, Table S7)

## 2.2 $^{1}$H-NMR spectra identifying the *cis*-isomers of **I** and **Prenyl-I**

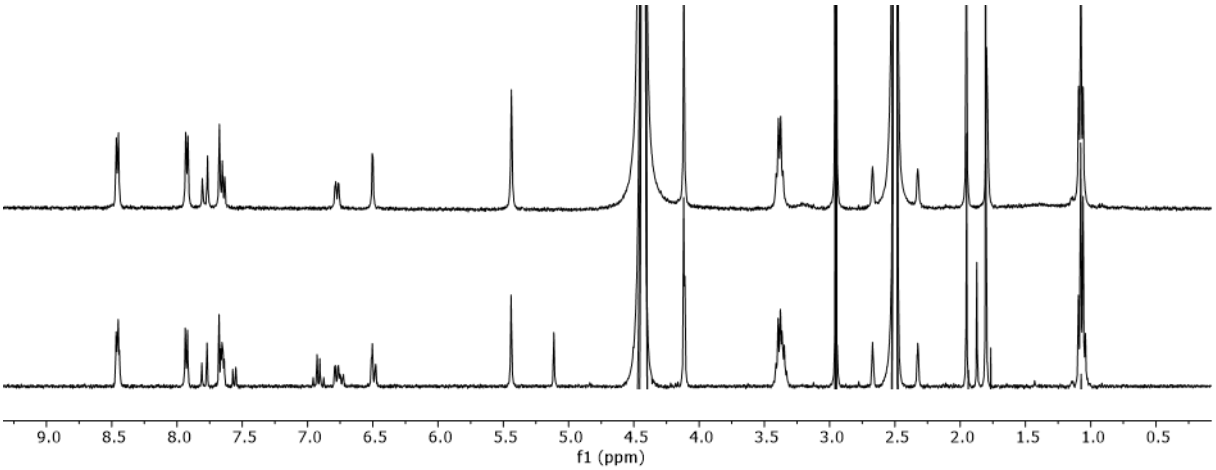



Figure S16. $^{1}$H-NMR spectra of PPG **I** (1 mM, 1:1 $D_2O$/DMSO-$d_6$) in the dark (top) and after 40 minutes of irradiation (λ = 530 nm, bottom).

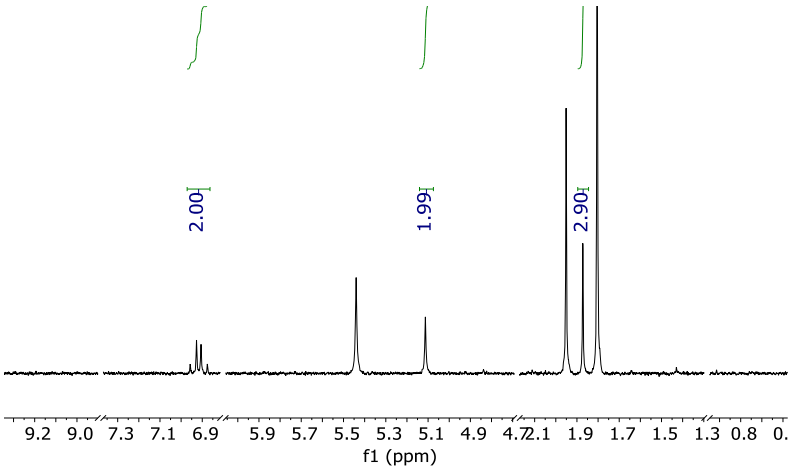



Figure S17. Partial $^{1}$H-NMR spectra of PPG **I** (1 mM, 1:1 $D_2O$/DMSO-$d_6$) after 40 minutes of irradiation (λ = 530 nm). Shown are the three signals belonging to the *cis*-isomer as discussed in this manuscript, with relative integrals 2:2:3.

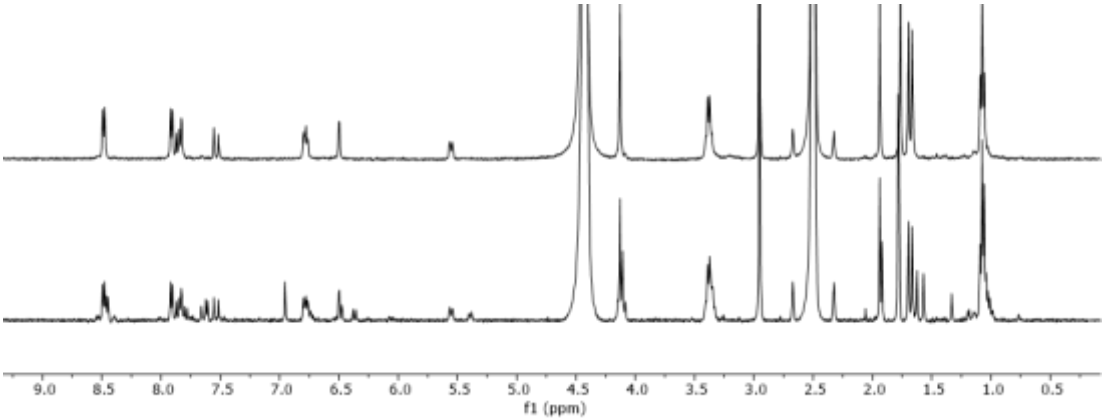



Figure S18. $^{1}$H-NMR spectra of **Prenyl-I** (1 mM, 1:1 $D_2O$/DMSO-$d_6$) in the dark (top) and after 6 minutes of irradiation (λ = 530 nm, bottom).

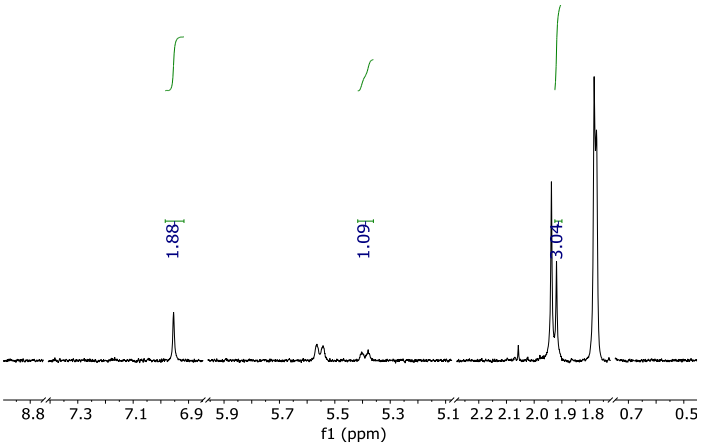



Figure S19. Partial $^{1}$H-NMR spectra of **Prenyl-I** (1 mM, 1:1 $D_2O$/DMSO-$d_6$) after 6 minutes of irradiation (λ = 530 nm). Shown are the three signals belonging to the *cis*-isomer as discussed in this manuscript, with relative integrals 2:1:3.

## 2.3 $^{1}$H-NMR spectra upon irradiation

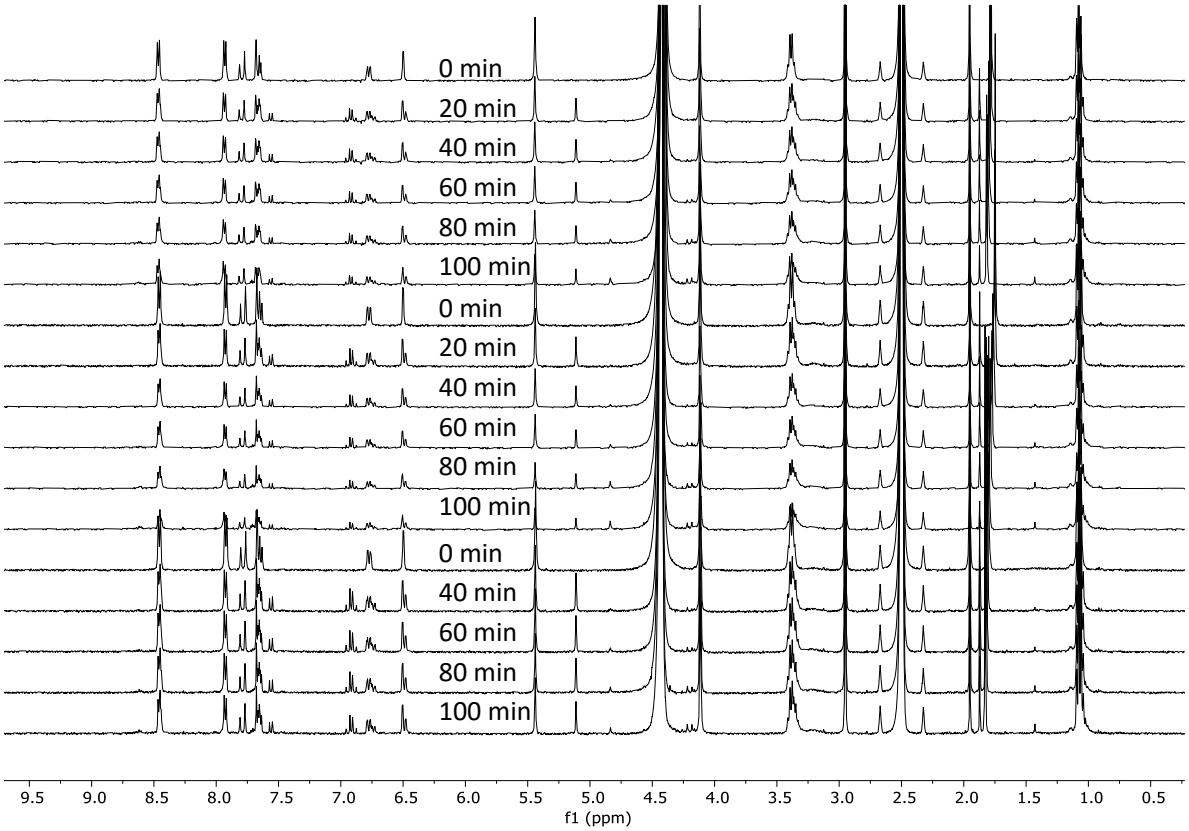



Figure S20. $^{1}$H-NMR spectra of PPG **I** (1 mM, 1:1 DMSO-$d_6$/$D_2O$) in the dark and after irradiation (λ = 530 nm) for the times indicated.

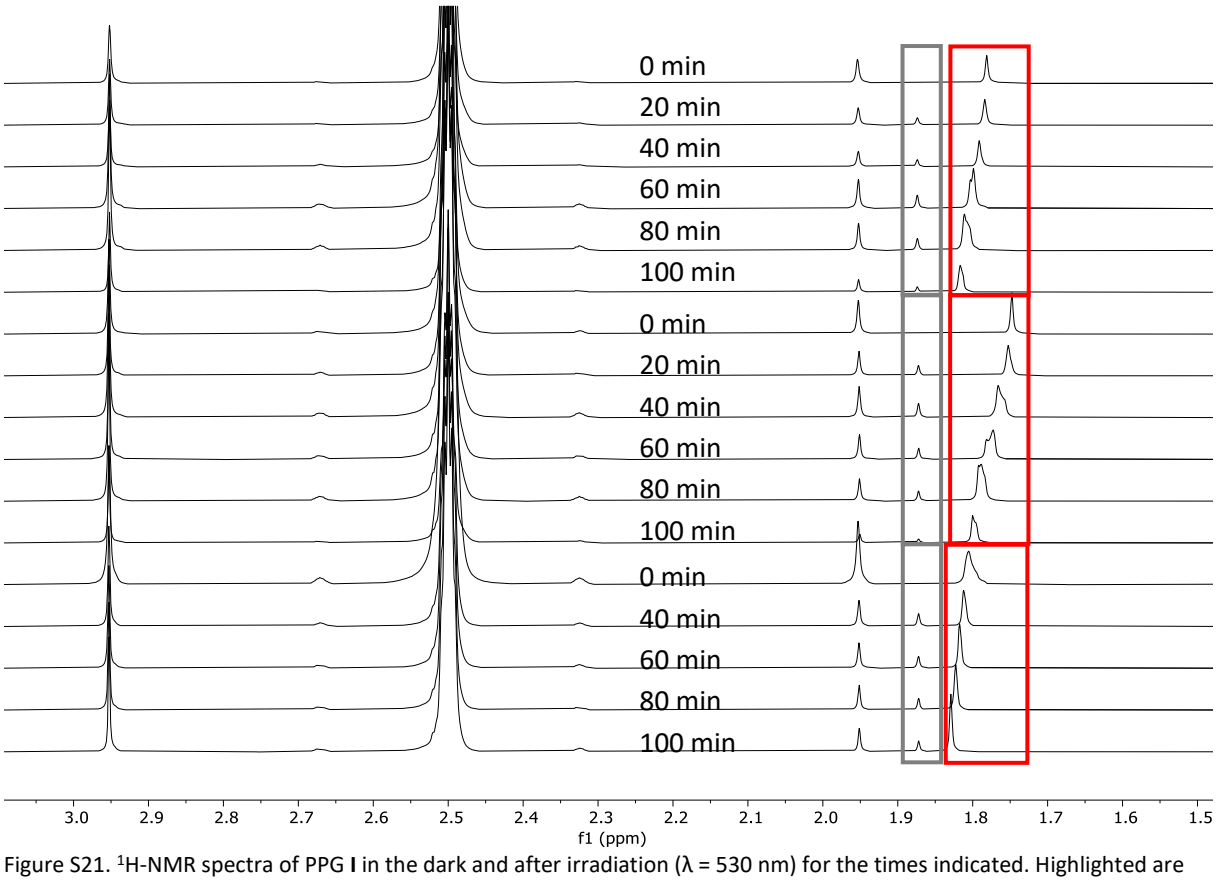



Figure S21. $^{1}$H-NMR spectra of PPG **I** in the dark and after irradiation (λ = 530 nm) for the times indicated. Highlighted are the AcOH signals (red boxes) and *cis*-isomer acetate signals (grey box) that were integrated.

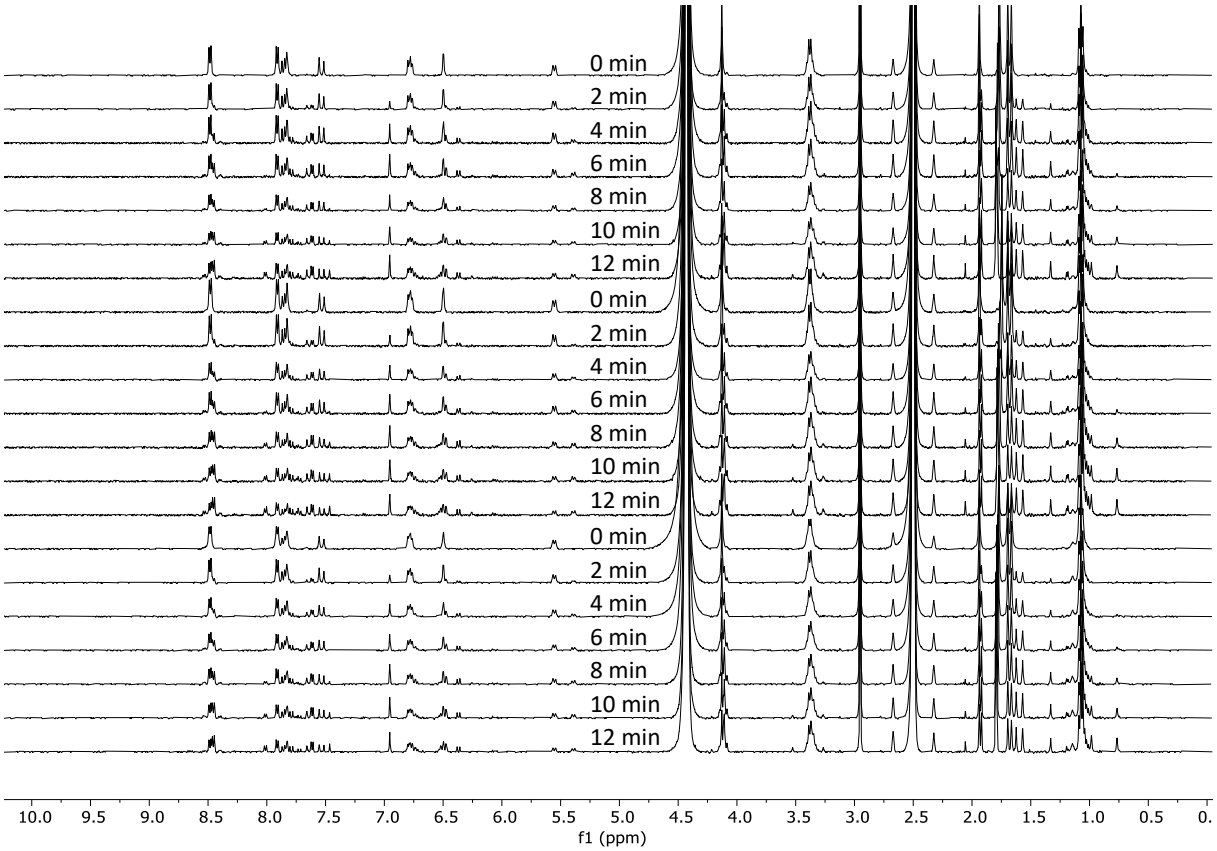



Figure S22. $^1$H-NMR spectra of **Prenyl-I** (1 mM, 1:1 DMSO-$d_6$/$D_2O$) in the dark and after irradiation (λ = 530 nm) for the times indicated.

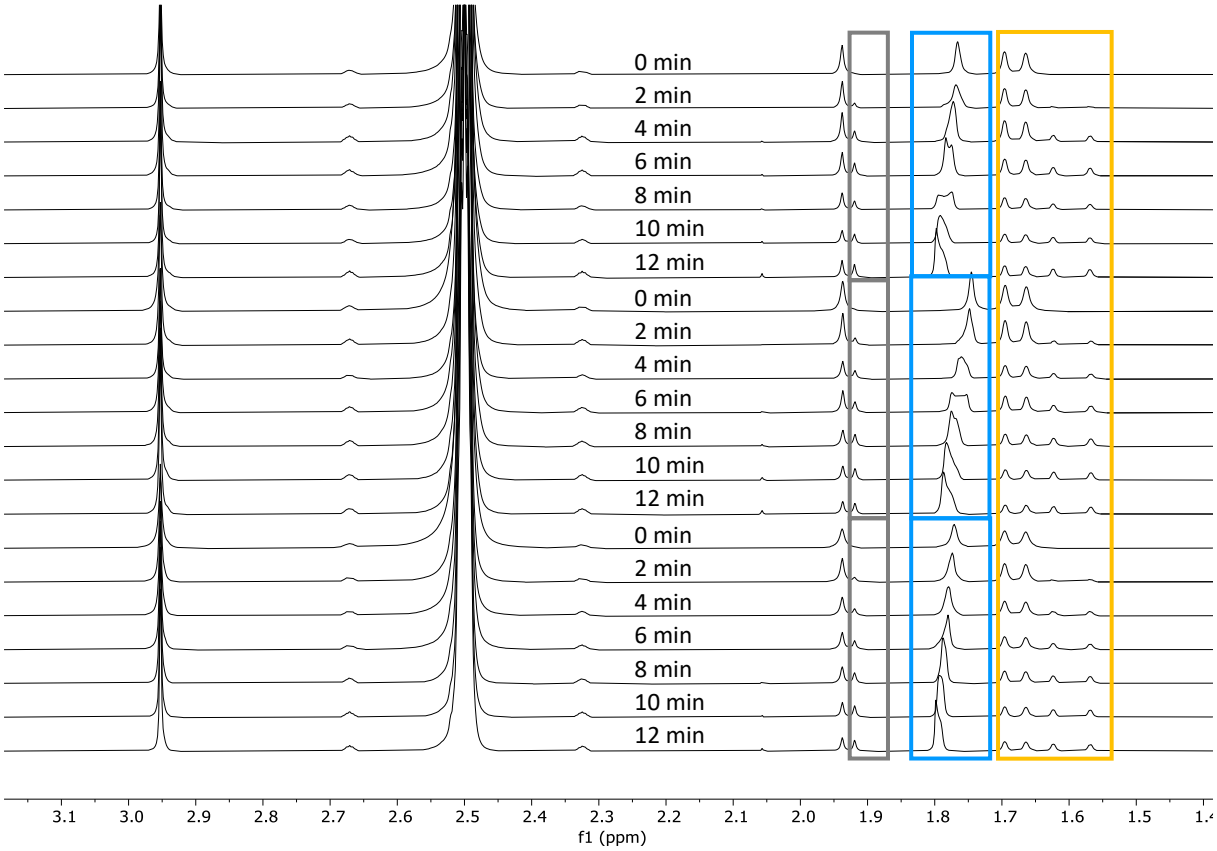



Figure S23. $^1$H-NMR spectra of **Prenyl-I** (1 mM, 1:1 DMSO-$d_6$/$D_2O$) in the dark and after irradiation (λ = 530 nm) for the times indicated. Highlighted are the AcOH signals (blue boxes) and *cis*-isomer acetate signals (grey boxes) that were integrated. Also highlighted are the prenyl C$H_3$ signals from both isomers (yellow box).

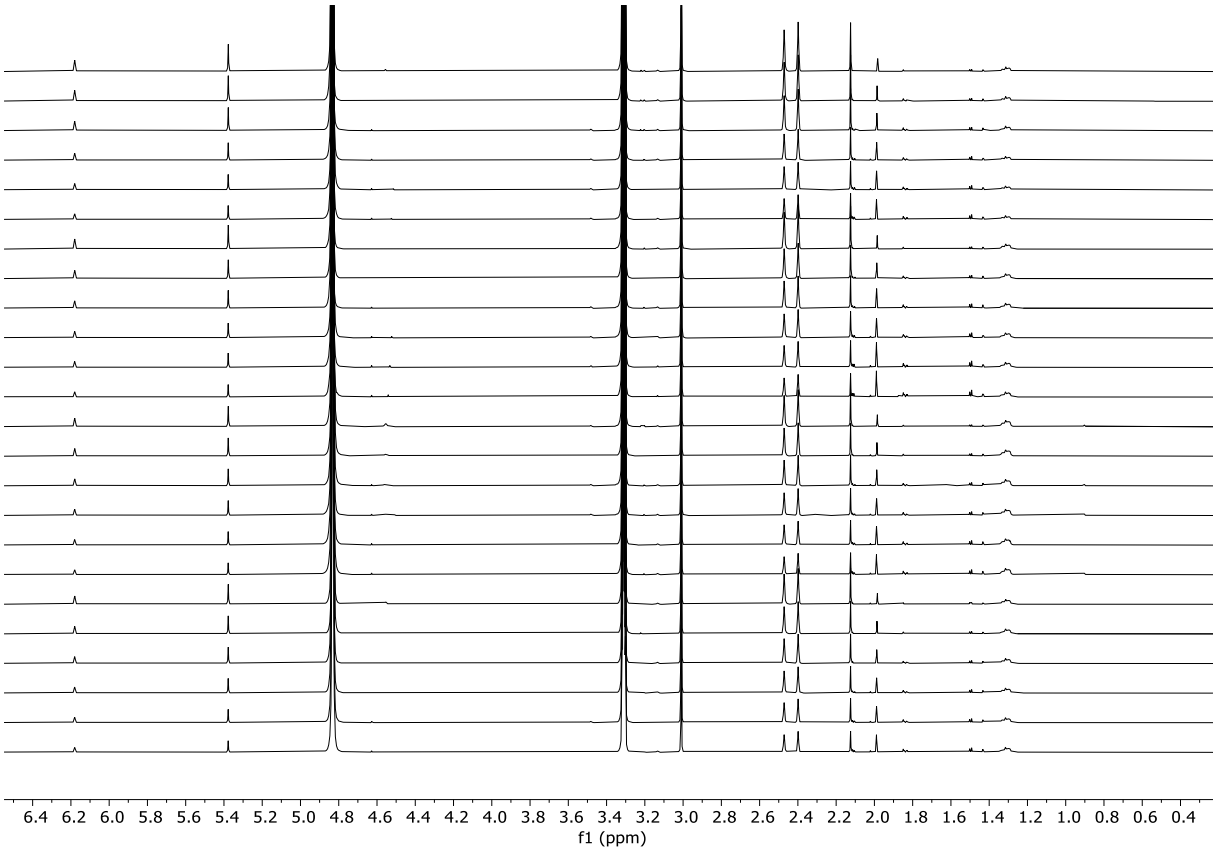



Figure S24. $^{1}$H-NMR spectra of **BODIPY** (1 mM, $CD_3OD$) in the dark and after irradiation (λ = 530 nm) for the times indicated.

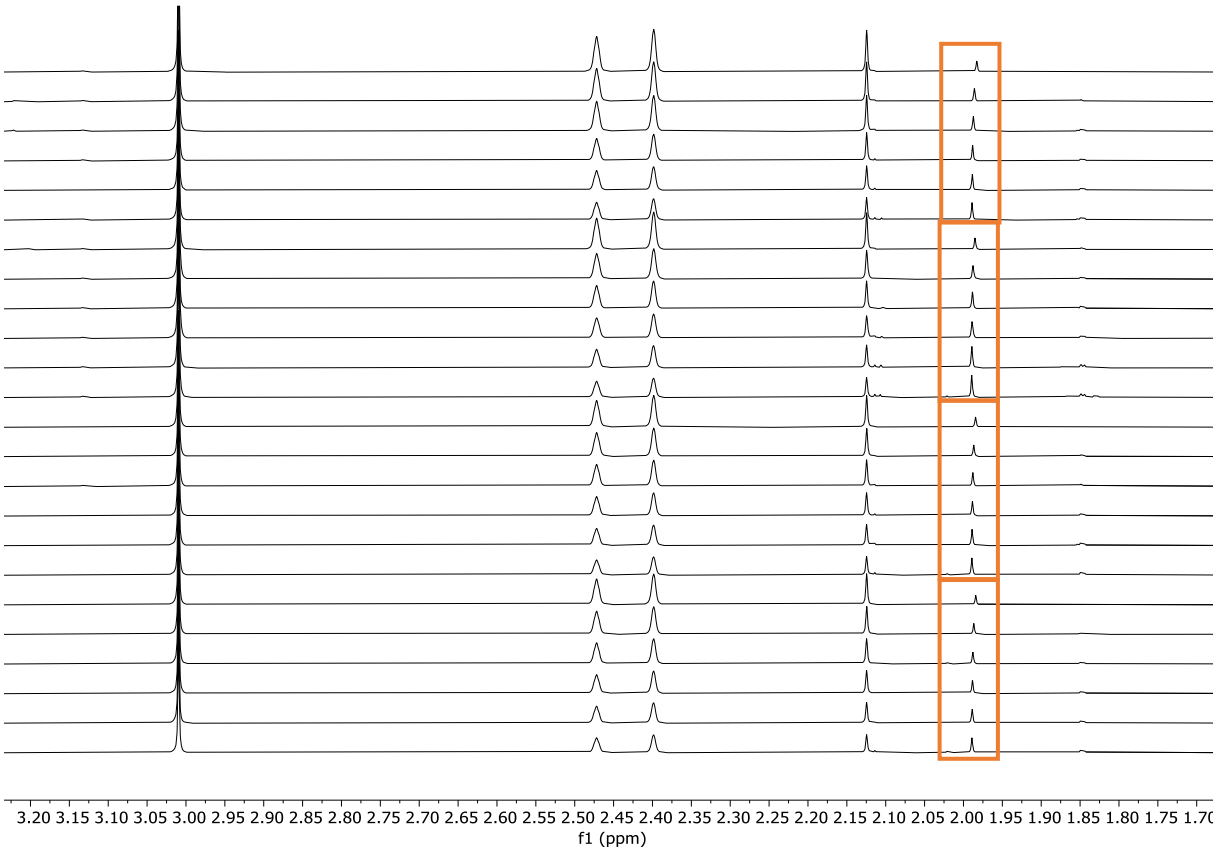



Figure S25. $^{1}$H-NMR spectra of **BODIPY** (1 mM, $CD_3OD$) in the dark and after irradiation (λ = 530 nm) for the times indicated. Highlighted are the AcOH signals (orange boxes) that were integrated.

## 2.4 Integrals of the AcOH and *cis*-isomer signals

The difference in integral of the AcOH signals between the measurement at a given irradiation time point and the measurement at $t_0$ are shown below (Table S2, Table S3, Table S4). These integrals were determined relative to the $DMSO_2$ signal, that was integrated to 6. The amount of AcOH formed was then calculated by dividing the integral by 3 (expected integral at 1 mM concentration), and multiplying by the volume in µL (500) to reach a value in nmol.

| **BODIPY** – AcOH integrals | | | | |
|---|---|---|---|---|
| **Time (min)** | **Average Δ AcOH integral** | **SD** | **AcOH formed (nmol)** | **SD** |
| **0** | 0 | 0 | 0 | 0 |
| **10** | 0.105 | 0.030 | 17.5 | 4.9 |
| **20** | 0.173 | 0.028 | 28.8 | 4.6 |
| **30** | 0.240 | 0.021 | 40.0 | 3.5 |
| **40** | 0.310 | 0.030 | 51.7 | 5.1 |
| **50** | 0.368 | 0.029 | 61.3 | 4.8 |

Table S2. Integrals of the AcOH signals for the $^1$H-NMR irradiation experiment of **BODIPY**.

| Compound **I** – AcOH integrals | | | | |
|---|---|---|---|---|
| **Time (min)** | **Average Δ AcOH integral** | **SD** | **AcOH formed (nmol)** | **SD** |
| **0** | 0 | 0 | 0 | 0 |
| **20** | 0.090 | 0.130 | 15.0 | 21.7 |
| **40** | 0.177 | 0.133 | 29.4 | 22.1 |
| **60** | 0.397 | 0.165 | 66.1 | 27.5 |
| **80** | 0.587 | 0.268 | 97.8 | 44.7 |
| **100** | 0.807 | 0.274 | 134.4 | 45.7 |

Table S3. Integrals of the AcOH signals for the $^1$H-NMR irradiation experiment of PPG **I**.

| **Prenyl-I** – AcOH integrals | | | | |
|---|---|---|---|---|
| **Time (min)** | **Average Δ AcOH integral** | **SD** | **AcOH formed (nmol)** | **SD** |
| **0** | 0 | 0 | 0 | 0 |
| **2** | 0.053 | 0.019 | 8.9 | 3.1 |
| **4** | 0.173 | 0.026 | 28.9 | 4.4 |
| **6** | 0.370 | 0.051 | 61.7 | 8.5 |
| **8** | 0.510 | 0.041 | 85.0 | 6.8 |
| **10** | 0.680 | 0.054 | 113.3 | 8.9 |
| **12** | 0.790 | 0.057 | 131.7 | 9.5 |

Table S4. Integrals of the AcOH signals for the $^1$H-NMR irradiation experiment of **Prenyl-I**.

| | **Rate** | **Rate SD** | **QY** | **SD** |
|---|---|---|---|---|
| **BODIPY** | 1.20 | 0.08 | 0.0014[5] | 0.0001 |
| **I*** | 1.73 | 0.51 | 0.0020 | 0.0006 |
| **Prenyl-I**** | 12.86 | 0.79 | 0.0150 | 0.0009 |

Table S5. Quantum Yields of payload release of **I** and **Prenyl-I**. *Rate determined from the linear area of the graph, through a linear fit from t = 40 min to t = 100 min. ** Rate determined from the linear area of the graph, through a linear fit from t = 4 min to t = 12 min.

Similarly the acetate C$H_3$ signal of the *cis*-isomer of **I** and **Prenyl-I** was integrated relative to the $DMSO_2$ signal. The amount of *cis*-isomer formed was then calculated by dividing the integral by 3 (expected integral at 1 mM concentration), and multiplying by the volume in µL (500) to reach a value in nmol (Table S6, Table S7).

| Compound **I** – *cis* isomer C$H_3$ integrals | | | | |
|---|---|---|---|---|
| **Time (min)** | **Average integral** | **SD** | ***cis*-isomer formed (nmol)** | **SD** |
| **0** | 0 | 0 | 0 | 0 |
| **20** | 0.835 | 0.030 | 139.2 | 5.0 |
| **40** | 0.900 | 0.104 | 150.0 | 17.4 |
| **60** | 0.817 | 0.128 | 136.1 | 21.3 |
| **80** | 0.723 | 0.123 | 120.6 | 20.5 |
| **100** | 0.620 | 0.147 | 103.3 | 24.5 |

Table S6. Integrals of the *cis*-isomer acetate C$H_3$ signal at 1.87 ppm for the $^1$H-NMR irradiation experiment of compound **I**.

| **Prenyl-I** – *cis* isomer C$H_3$ integrals | | | | |
|---|---|---|---|---|
| **Time (min)** | **Average integral** | **SD** | ***cis*-isomer formed (nmol)** | **SD** |
| **0** | 0.000 | 0.000 | 0.0 | 0.0 |
| **2** | 0.460 | 0.045 | 76.7 | 7.6 |
| **4** | 0.643 | 0.078 | 107.2 | 12.9 |
| **6** | 0.703 | 0.039 | 117.2 | 6.4 |
| **8** | 0.710 | 0.029 | 118.3 | 4.9 |
| **10** | 0.703 | 0.009 | 117.2 | 1.6 |
| **12** | 0.640 | 0.016 | 106.7 | 2.7 |

Table S7. Integrals of the *cis*-isomer acetate C$H_3$ signal at 1.92 ppm for the $^1$H-NMR irradiation experiment of **Prenyl-I**.

## 2.5 Absorption spectra of I and Prenyl-I upon irradiation

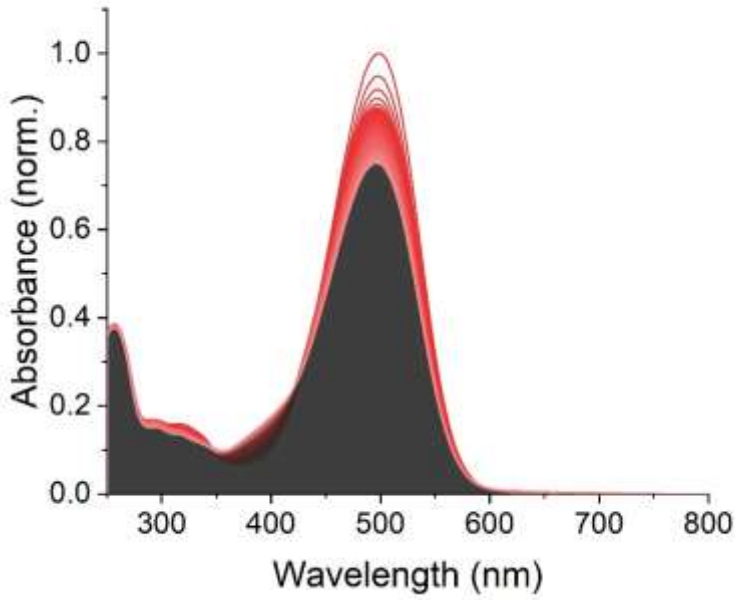



Figure S 26. Normalized UV-Vis absorption spectra of compound I (20 µM, water/MeCN 9:1, v/v) collected under irradiation with green light (λmax = 530 nm) over a 1 hour period.

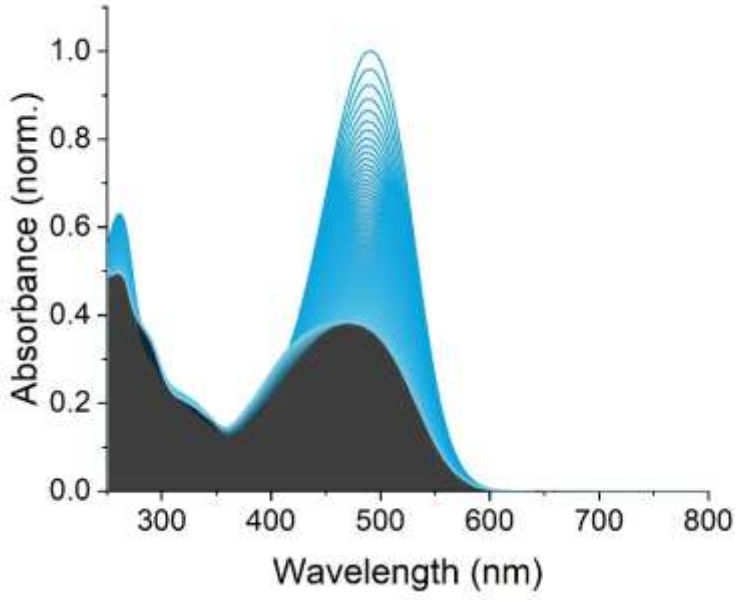
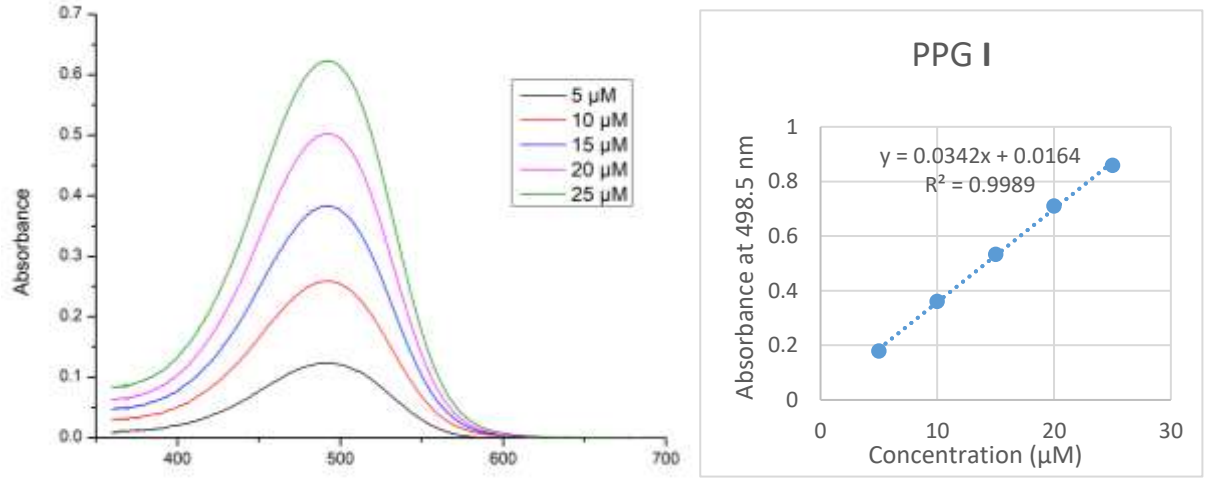


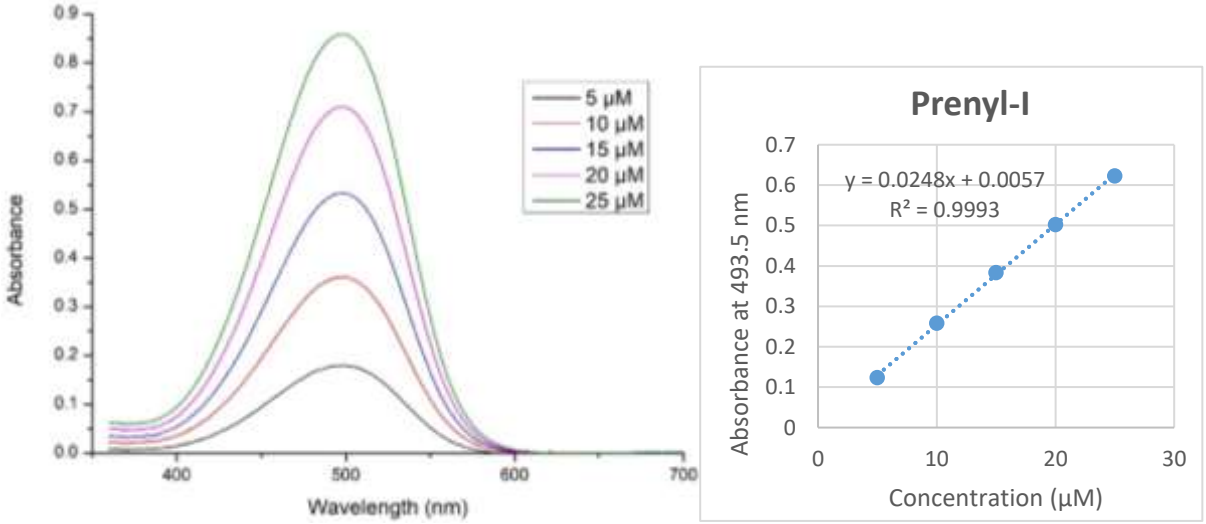

Figure S 27. Normalized UV-Vis absorption spectra of compound Prenyl-I (20 µM, water/MeCN 9:1, v/v) collected under irradiation with green light (λ = 530 nm) over a 1 hour period.

## 2.6 Molar absorption coefficient




ε at $\lambda_{max}$ (498.5 nm) = 3.42 * $10^4$ $M^{-1}$ $cm^{-1}$

Figure S 28. Determination of the molar absorption coefficient of PPG **I** 25 °C)




ε at $\lambda_{max}$ (493.5 nm) = 2.48 * $10^4$ $M^{-1}$ $cm^{-1}$

Figure S 29. Determination of the molar absorption coefficient of PPG **Prenyl-I** in water/MeCN 9:1 (25 °C)

# 3. DFT calculations

## 3.1 Methods

All computational input files were prepared in GaussView 6.0 on a local Windows 10 terminal. Input files were then transferred to the Rijksuniversiteit Groningen Peregrine HPC cluster where DFT or TDDFT calculations were carried out using the Gaussian 16 (g16) suite of programs.

The DFT thermochemistry of heterolysis for coumarin PPGs **I** and **Prenyl-I** was examined. Geometry optimization of their structures to $S_0$, $S_1$ or $T_1$ minima or heterolysis transition states was carried out using the g16 opt command at the MN15 functional and Def2SVP basis set level of theory with implicit solvation using the Solvation Model based on Density (SMD = water).[6–8] Transition state geometry inputs were the result of rational guess based on bond-breaking atomic distances, or were the result of potential energy surface relaxed coordinate scans using the g16 scan command at the MN15/Def2SVP/SMD=water level. Intrinsic mp. coordinate (IRC)iv calculations were carried out on the transition state structures to verify that they connected to the associated reactant and product minima structures.

After optimization, frequency DFT calculations of all obtained optimized structures were carried out using the g16 freq command at the MN15/Def2SVP/SMD=water level, to confirm that minima structures had zero imaginary frequencies and that transition states had a single imaginary frequency. All shown free energies (Figure S30) are ZPE and thermally corrected and were obtained from the frequency calculations. All shown free energies are reported in parentheses in kcal/mol, at 298.15 K and 1 atm.

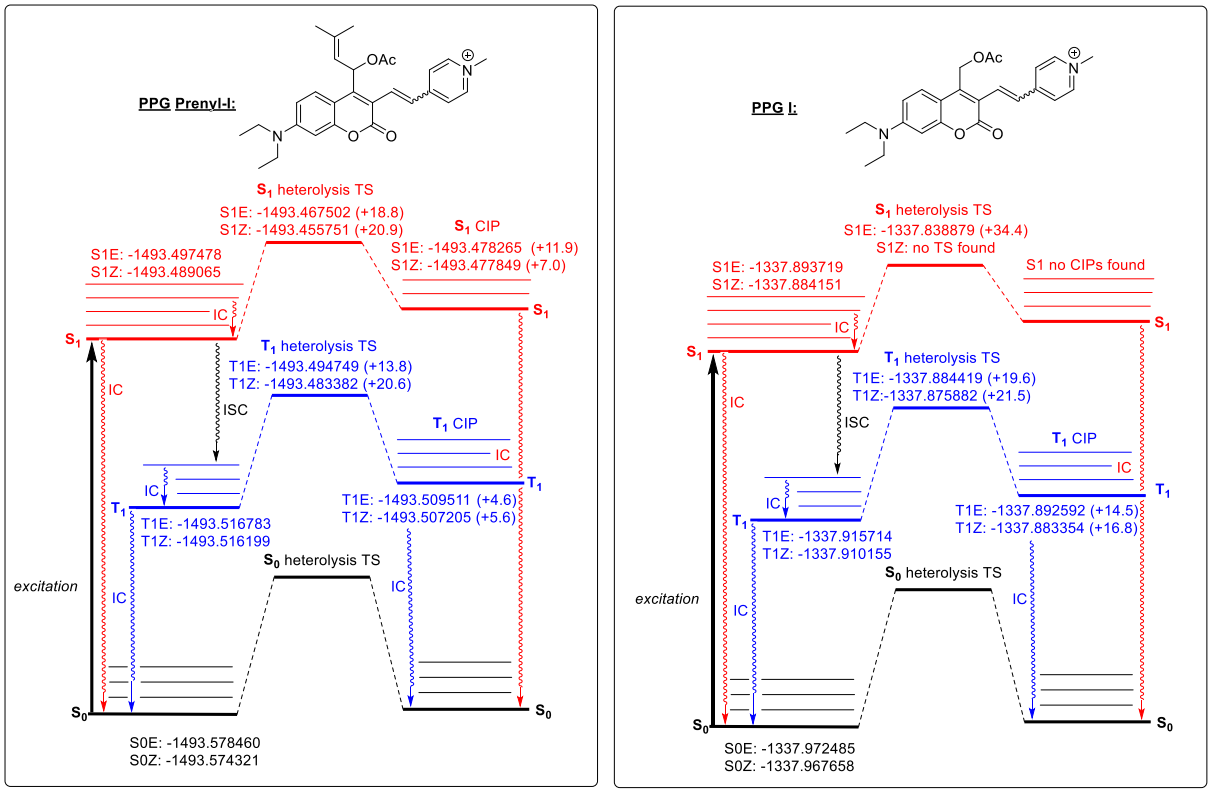



Figure S30. An overview of the calculated ZPE-corrected free energies of structures optimized at the MN15/Def2SVP/SMD=$H_2O$ level. S0 ground state and S1 or T1 excited states energies for the photoheterolysis of PPGs **Prenyl-I** and **I** are given in Hartrees and energy differences are shown in kcal/mol between brackets.

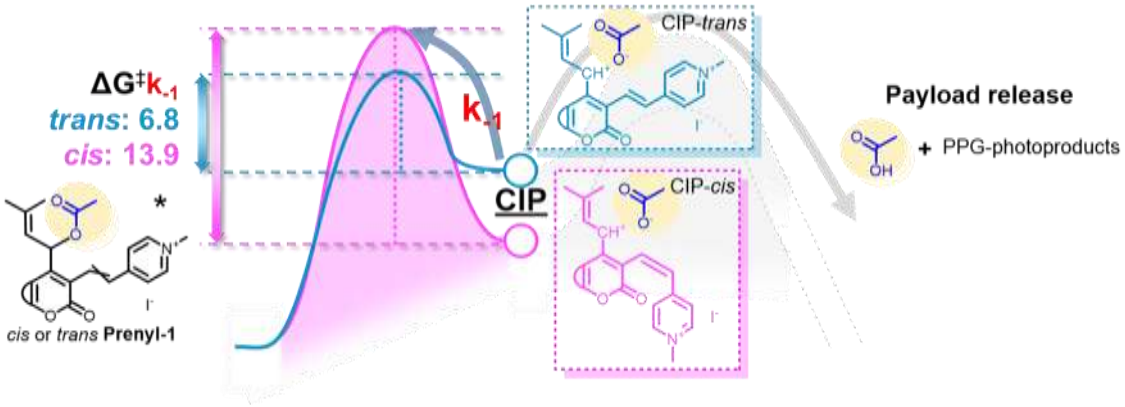



Figure S31. Schematic representation of the $\mathbf{k_{-1}}$ energy barriers of the *cis*- and *trans*-isomer of **Prenyl-I** computed by DFT. Values are reported in kcal·mol$^{-1}$, obtained at the MN15/Def2SVP/SMD=$H_2O$ level of theory.[6–8]

## 3.2 $S_1$ Excited State Geometries of *E*-Prenyl-I and *Z*-Prenyl-I

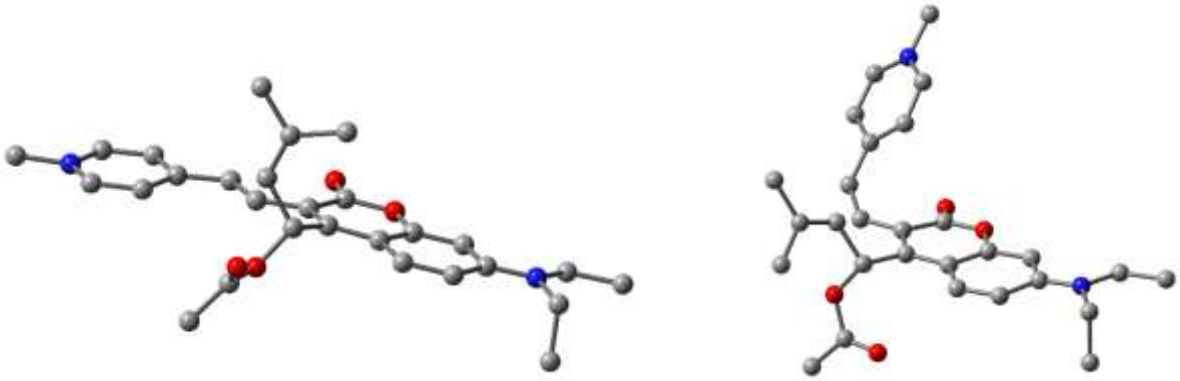


Figure S32. A comparison of the $S_1$ excited state geometries optimized at the MN15/Def2SVP/SMD=H2O level of PPG ***E*-Prenyl-I** (left) and PPG ***Z*-Prenyl-I** (right). The geometries show the double bond of ***E*-Prenyl-I** in plane with the coumarin chromophore, versus the double bond of ***Z*-Prenyl-I** out of plane, destabilizing the ***Z*-configuration** in the $S_1$ excited state.

## 3.3 DFT Optimized Geometries XYZ-coordinates

### ***E*-Prenyl-I $S_0$ optimized geometry [# opt=calcfc freq scrf=(smd,solvent=water) def2svp mn15]

EE + Thermal Free Energy Correction: -1493.578460 Ha

1 1

| | | | |
|---|---|---|---|
| C | -0.32998800 | 0.27226300 | -0.00398100 |
| C | 0.48329400 | -0.85672400 | -0.04687700 |
| C | -0.12763100 | -2.18463600 | -0.01536900 |
| O | -1.48854300 | -2.24492100 | 0.02076700 |
| C | -2.30747600 | -1.16021400 | 0.02546300 |
| C | -1.75607400 | 0.13922300 | 0.01050100 |
| C | -2.70611400 | 1.19676200 | -0.00043600 |
| C | -4.06177900 | 0.96966500 | 0.01016300 |
| C | -4.60025700 | -0.35704200 | 0.04971700 |
| N | -5.94364800 | -0.59072600 | 0.09543000 |
| C | -6.88420300 | 0.49699600 | -0.16148200 |
| C | -6.40146700 | -1.97661600 | -0.05745200 |
| C | -3.66787300 | -1.42104000 | 0.03798600 |
| H | -2.37044200 | 2.23372400 | -0.03211000 |
| H | -4.72526400 | 1.83219500 | -0.01555900 |
| H | -7.85625000 | 0.21511100 | 0.26014400 |
| H | -6.57308900 | 1.38248800 | 0.40853900 |
| H | -6.03891100 | -2.37720100 | -1.02232500 |
| H | -5.91865800 | -2.58281200 | 0.72449600 |
| H | -3.96955400 | -2.46622500 | 0.04114900 |
| C | 0.28043600 | 1.66960000 | 0.04114000 |
| O | 0.93536000 | 1.87966900 | -1.21692700 |
| C | 1.21907100 | 3.15400400 | -1.54270100 |
| O | 0.89754300 | 4.08589100 | -0.83516100 |
| C | 1.96728100 | 3.24583200 | -2.83109000 |
| H | 2.04980000 | 4.29269300 | -3.14065400 |
| H | 2.97162500 | 2.82097500 | -2.68523100 |
| H | 1.46256100 | 2.64912600 | -3.60222400 |
| C | 1.24809700 | 1.89706400 | 1.18417100 |
| C | -7.02314100 | 0.82332100 | -1.64047700 |
| H | -7.74840900 | 1.63580000 | -1.79238700 |
| H | -6.05874300 | 1.14017300 | -2.06728200 |
| H | -7.37136800 | -0.05771400 | -2.20200800 |
| C | -7.90054100 | -2.17615800 | 0.04407000 |
| H | -8.29640400 | -1.82184900 | 1.00710000 |
| H | -8.44934100 | -1.67620500 | -0.76706400 |
| H | -8.11014400 | -3.25250100 | -0.02815300 |
| O | 0.45669900 | -3.25256700 | -0.01817600 |

| | | | |
|---|---|---|---|
| H | -0.52448100 | 2.41129300 | 0.12007900 |
| C | 0.92399800 | 1.93218200 | 2.48621900 |
| C | -0.47416800 | 1.73547600 | 2.99932900 |
| H | -0.59671700 | 0.71247100 | 3.39434600 |
| H | -0.67427100 | 2.42198800 | 3.83646100 |
| C | 1.97293000 | 2.14414900 | 3.53868000 |
| H | 1.75293500 | 3.05083200 | 4.12571000 |
| H | 1.97486400 | 1.30461100 | 4.25329600 |
| H | 2.97883700 | 2.23852500 | 3.10658800 |
| H | 2.29351000 | 2.04212100 | 0.88470700 |
| H | -1.24599200 | 1.89303600 | 2.23337500 |
| C | 1.92957500 | -0.74196200 | -0.13443500 |
| C | 2.87707600 | -1.70838800 | -0.03590500 |
| H | 2.60471600 | -2.74759100 | 0.14159700 |
| H | 2.28141100 | 0.26927700 | -0.33348000 |
| C | 4.30419600 | -1.44307400 | -0.15191600 |
| C | 5.20189200 | -2.52961000 | -0.06561800 |
| C | 4.87256800 | -0.16444400 | -0.34158600 |
| C | 6.55943700 | -2.32810600 | -0.17018600 |
| H | 4.82635400 | -3.54266500 | 0.08365100 |
| C | 6.23969900 | -0.02065600 | -0.43707300 |
| H | 4.26116400 | 0.73599700 | -0.41211200 |
| H | 7.28331900 | -3.14214900 | -0.11138400 |
| H | 6.71608400 | 0.94937100 | -0.58220000 |
| N | 7.06738000 | -1.08783800 | -0.35419400 |
| C | 8.52099500 | -0.92501600 | -0.47510600 |
| H | 8.75787400 | 0.14153900 | -0.53284700 |
| H | 9.00944500 | -1.36611200 | 0.40151300 |
| H | 8.86993500 | -1.43205500 | -1.38291400 |

***E*-Prenyl-I $S_1$** optimized geometry [# opt=calcfc freq td=(root=1) scrf=(smd,solvent=water) def2svp mn15]

EE + Thermal Free Energy Correction: -1493.497478 Ha

1 1

| | | | |
|---|---|---|---|
| C | 0.33763400 | 0.30623800 | -0.04083100 |
| C | -0.50121000 | -0.85979800 | -0.05647800 |
| C | 0.13101800 | -2.18533400 | -0.20986400 |
| O | 1.48931200 | -2.24271600 | -0.21411500 |
| C | 2.30426600 | -1.15684800 | -0.07696500 |
| C | 1.73881000 | 0.15194200 | 0.01623600 |
| C | 2.69642400 | 1.21165200 | 0.15646500 |
| C | 4.04654800 | 0.98793700 | 0.18676000 |
| C | 4.58972300 | -0.33958600 | 0.07005700 |
| N | 5.92120900 | -0.57393300 | 0.07718800 |
| C | 6.86936700 | 0.50891100 | 0.33248000 |
| C | 6.39491400 | -1.96654500 | 0.08044600 |
| C | 3.65357500 | -1.41000700 | -0.04965000 |
| H | 2.34729000 | 2.23898200 | 0.26263900 |
| H | 4.70718600 | 1.84404600 | 0.31184300 |
| H | 7.83118300 | 0.22852600 | -0.11103700 |
| H | 6.54288200 | 1.40411700 | -0.21218300 |
| H | 5.98000700 | -2.47081400 | 0.97059000 |
| H | 5.95653800 | -2.47416200 | -0.79274500 |
| H | 3.96526800 | -2.44950800 | -0.12975100 |
| C | 7.03300100 | 0.80258500 | 1.81688200 |
| H | 7.76265600 | 1.61185100 | 1.96196400 |
| H | 6.07656700 | 1.11374600 | 2.26414700 |
| H | 7.39185600 | -0.08787900 | 2.35463700 |
| C | 7.89817900 | -2.14693600 | 0.04733500 |
| H | 8.34651900 | -1.72332800 | -0.86252000 |
| H | 8.39471900 | -1.71059000 | 0.92565200 |
| H | 8.10629500 | -3.22581300 | 0.04952500 |
| O | -0.45074600 | -3.24207600 | -0.33491500 |
| C | -1.90010500 | -0.76199300 | 0.07828000 |
| C | -2.88831300 | -1.75136600 | 0.00425500 |
| H | -2.61590900 | -2.78500300 | -0.20601800 |
| H | -2.25805600 | 0.24425600 | 0.28958700 |
| C | -4.27102300 | -1.48809100 | 0.18230600 |
| C | -5.21425200 | -2.56031000 | 0.09903500 |
| C | -4.82882500 | -0.19485600 | 0.45034600 |
| C | -6.55391600 | -2.34061700 | 0.27143400 |
| H | -4.86627800 | -3.57526700 | -0.10084900 |
| C | -6.17965200 | -0.03803100 | 0.61164900 |

| | | | |
|---|---|---|---|
| H | -4.20127300 | 0.69392000 | 0.53495700 |
| H | -7.29384800 | -3.14028900 | 0.21441400 |
| H | -6.63269500 | 0.93318000 | 0.81552500 |
| N | -7.04219100 | -1.09110700 | 0.53005700 |
| C | -8.48245500 | -0.88344100 | 0.64808400 |
| H | -8.67079400 | 0.03419100 | 1.21655000 |
| H | -8.94002900 | -0.79239700 | -0.34737900 |
| H | -8.93256700 | -1.73461200 | 1.17257600 |
| C | -0.28200800 | 1.68439800 | -0.09830400 |
| C | -1.21626300 | 1.88173600 | -1.27518300 |
| H | 0.51347000 | 2.43950700 | -0.16067300 |
| C | -0.83204800 | 1.90286100 | -2.56158900 |
| H | -2.27637300 | 2.00967600 | -1.02487000 |
| C | 0.59451800 | 1.72798300 | -3.00112900 |
| C | -1.83110900 | 2.07738900 | -3.66785900 |
| H | 0.75831800 | 0.70202100 | -3.37318500 |
| H | 0.82261300 | 2.40627400 | -3.83799000 |
| H | 1.32401800 | 1.91244000 | -2.20003700 |
| H | -1.60086300 | 2.97964200 | -4.25792000 |
| H | -1.78168800 | 1.22769800 | -4.36875200 |
| H | -2.85879800 | 2.15743200 | -3.28714200 |
| O | -0.98725600 | 1.90888900 | 1.13724000 |
| C | -1.34264200 | 3.17417900 | 1.41123500 |
| O | -1.03344500 | 4.10262600 | 0.69202500 |
| C | -2.15088200 | 3.26714200 | 2.66365200 |
| H | -2.31458700 | 4.31718100 | 2.92677400 |
| H | -3.11767300 | 2.76900300 | 2.49563700 |
| H | -1.64166300 | 2.73630700 | 3.47892000 |

***E*-Prenyl-I $S_1$ TS** optimized geometry [# opt=(calcfc,ts,noeigentest) freq=noraman td=(root=1) scrf=(smd,solvent=water) def2svp mn15]

EE + Thermal Free Energy Correction: -1493.467502 Ha

1 1

| | | | |
|---|---|---|---|
| C | -0.35834400 | 0.18361200 | 0.55565600 |
| C | 0.44116300 | -0.86136600 | -0.02791300 |
| C | -0.15735900 | -2.17512700 | -0.25486500 |
| O | -1.52238500 | -2.25129500 | -0.20347100 |
| C | -2.32538000 | -1.16169200 | -0.01991700 |
| C | -1.77187700 | 0.09074400 | 0.37057700 |
| C | -2.69498200 | 1.16272200 | 0.55672200 |
| C | -4.04260000 | 0.99484000 | 0.39275700 |
| C | -4.59419000 | -0.28866300 | 0.03612600 |
| N | -5.91983100 | -0.47682300 | -0.10476300 |
| C | -6.85572600 | 0.64123400 | 0.02426400 |
| C | -6.40986900 | -1.77564000 | -0.59978500 |
| C | -3.67495700 | -1.36215800 | -0.17774200 |
| H | -2.30488000 | 2.15698700 | 0.77966900 |
| H | -4.69346500 | 1.85789000 | 0.51887200 |
| H | -7.83041800 | 0.23098800 | 0.30920400 |
| H | -6.54171800 | 1.27205200 | 0.86530900 |
| H | -5.95217300 | -1.95694100 | -1.58673900 |
| H | -6.02269100 | -2.55852700 | 0.07017700 |
| H | -4.00368600 | -2.36157300 | -0.45469000 |
| C | -6.97286900 | 1.45112500 | -1.25857200 |
| H | -7.69481000 | 2.26790700 | -1.11863100 |
| H | -6.00276500 | 1.88913500 | -1.53833400 |
| H | -7.32028000 | 0.82051500 | -2.09046900 |
| C | -7.91426000 | -1.91395800 | -0.69929200 |
| H | -8.40521700 | -1.82394900 | 0.27981600 |
| H | -8.36030100 | -1.18538600 | -1.39091600 |
| H | -8.13067500 | -2.91828800 | -1.08870100 |
| O | 0.43809500 | -3.20735800 | -0.49080100 |
| C | 1.79747200 | -0.60319400 | -0.33053100 |
| C | 2.82298700 | -1.48746300 | -0.59497100 |
| H | 2.63623400 | -2.56104000 | -0.64073300 |
| H | 2.03859800 | 0.46039300 | -0.31477200 |
| C | 4.18868900 | -1.06345300 | -0.74864100 |
| C | 5.18422000 | -2.02650700 | -1.04926200 |
| C | 4.63264300 | 0.27570100 | -0.58023800 |
| C | 6.50197400 | -1.65594000 | -1.18164900 |
| H | 4.91205600 | -3.07481500 | -1.17889500 |
| C | 5.96428900 | 0.58451400 | -0.72336900 |

| | | | |
|---|---|---|---|
| H | 3.94745900 | 1.08483700 | -0.32298800 |
| H | 7.29229900 | -2.36964900 | -1.41660600 |
| H | 6.34451300 | 1.59950000 | -0.60109400 |
| N | 6.88597800 | -0.36624800 | -1.02159100 |
| C | 8.28779400 | 0.01534700 | -1.21750200 |
| H | 8.53907400 | 0.83070900 | -0.53043600 |
| H | 8.92768700 | -0.84979400 | -1.01426100 |
| H | 8.43934600 | 0.34927800 | -2.25241200 |
| C | 0.23971200 | 1.27516200 | 1.25162400 |
| C | 1.49803000 | 1.20041000 | 1.98690700 |
| H | -0.41462100 | 2.11060300 | 1.50570100 |
| C | 2.02747400 | 0.14858600 | 2.66075900 |
| H | 2.04633400 | 2.14804600 | 2.02628100 |
| C | 1.36663700 | -1.18253700 | 2.86450800 |
| C | 3.39221000 | 0.27429500 | 3.26916100 |
| H | 1.81554600 | -1.94526200 | 2.20364300 |
| H | 1.53889700 | -1.52222000 | 3.89784500 |
| H | 0.28464800 | -1.16286700 | 2.68113200 |
| H | 3.37002000 | 0.06422100 | 4.35082900 |
| H | 4.06136600 | -0.48167000 | 2.82107200 |
| H | 3.83048800 | 1.26807700 | 3.10340200 |
| O | 0.99079200 | 2.45070700 | -0.32123600 |
| C | 0.30009500 | 3.50297800 | -0.56802700 |
| O | -0.77023800 | 3.80765700 | -0.01400000 |
| C | 0.89707200 | 4.41688100 | -1.62201800 |
| H | 0.22746100 | 5.26014000 | -1.83009800 |
| H | 1.86726600 | 4.79380200 | -1.26679000 |
| H | 1.08498200 | 3.84799300 | -2.54344000 |

***E*-Prenyl-I $S_1$ CIP** optimized geometry [# opt=calcfc freq=noraman td=(root=1) scrf=(smd,solvent=water) def2svp mn15]

EE + Thermal Free Energy Correction: -1493.478265 Ha

1 1

| | | | |
|---|---|---|---|
| C | -0.47299000 | 0.19442600 | -0.76468200 |
| C | 0.35738400 | 0.70918800 | 0.26277500 |
| C | -0.23682000 | 1.47124500 | 1.36598900 |
| O | -1.59864700 | 1.43177900 | 1.48641700 |
| C | -2.41285800 | 0.77181800 | 0.62234000 |
| C | -1.87190500 | 0.16268300 | -0.55014000 |
| C | -2.80260300 | -0.44108300 | -1.45246400 |
| C | -4.13886200 | -0.47610700 | -1.18892200 |
| C | -4.67286700 | 0.12707600 | 0.01365000 |
| N | -5.98208800 | 0.09873700 | 0.28782700 |
| C | -6.92128700 | -0.62082400 | -0.57849900 |
| C | -6.46098800 | 0.63860400 | 1.57716700 |
| C | -3.75163200 | 0.76229700 | 0.90874000 |
| H | -2.42620300 | -0.89496700 | -2.37018300 |
| H | -4.80010300 | -0.97085700 | -1.89701900 |
| H | -7.91014600 | -0.17196600 | -0.44153700 |
| H | -6.65167800 | -0.43636300 | -1.62479500 |
| H | -5.94819200 | 0.08559300 | 2.38005400 |
| H | -6.12108900 | 1.68237800 | 1.64589600 |
| H | -4.07674400 | 1.25660600 | 1.82145900 |
| C | -6.95913500 | -2.10929600 | -0.26949500 |
| H | -7.68951700 | -2.60395400 | -0.92461200 |
| H | -5.97394300 | -2.57102200 | -0.43482000 |
| H | -7.25395000 | -2.28634800 | 0.77538000 |
| C | -7.95803000 | 0.58935100 | 1.79369200 |
| H | -8.50586600 | 1.20086000 | 1.06334500 |
| H | -8.35353900 | -0.43578000 | 1.77280400 |
| H | -8.15984600 | 1.00353700 | 2.79106100 |
| O | 0.36653800 | 2.11526800 | 2.19613700 |
| C | 1.75671400 | 0.41696800 | 0.25075000 |
| C | 2.76267500 | 0.97611500 | 0.99015900 |
| H | 2.57742000 | 1.83760100 | 1.63246600 |
| H | 2.02613400 | -0.39007800 | -0.43706000 |
| C | 4.12911200 | 0.48381400 | 0.94521600 |
| C | 5.14333000 | 1.21642400 | 1.59392000 |
| C | 4.50956500 | -0.70989300 | 0.28688900 |
| C | 6.45218900 | 0.77972300 | 1.55638100 |
| H | 4.90582000 | 2.13819000 | 2.12651100 |
| C | 5.83109300 | -1.09517400 | 0.28723900 |

| | | | |
|---|---|---|---|
| H | 3.78333600 | -1.35671600 | -0.21484900 |
| H | 7.26528500 | 1.32085000 | 2.04063000 |
| H | 6.17560800 | -2.00528800 | -0.20593600 |
| N | 6.78365200 | -0.35701900 | 0.90761200 |
| C | 8.17676400 | -0.81879500 | 0.86240600 |
| H | 8.24403100 | -1.80986300 | 1.32673100 |
| H | 8.50133500 | -0.88172200 | -0.18318700 |
| H | 8.80895900 | -0.11013300 | 1.40586000 |
| C | 0.09114300 | -0.30767900 | -2.00324900 |
| C | 1.11274700 | 0.29088900 | -2.75246200 |
| H | -0.26909100 | -1.28441900 | -2.33356800 |
| C | 1.55372100 | 1.61035700 | -2.73269800 |
| H | 1.60194500 | -0.36710400 | -3.47852300 |
| C | 0.86202100 | 2.72108800 | -2.01408700 |
| C | 2.75831400 | 1.99148300 | -3.52594600 |
| H | 1.31074700 | 2.89235800 | -1.01812500 |
| H | 0.98463000 | 3.65957000 | -2.57530500 |
| H | -0.20970400 | 2.53243000 | -1.86812900 |
| H | 2.49747600 | 2.74407100 | -4.28887600 |
| H | 3.50162300 | 2.47334200 | -2.86802300 |
| H | 3.22660800 | 1.12814100 | -4.01612400 |
| O | 2.10790100 | -2.65818000 | -1.11110400 |
| C | 1.28896000 | -2.90122100 | -0.17616200 |
| O | 0.04806600 | -3.04254200 | -0.32159100 |
| C | 1.85905000 | -2.99326400 | 1.23573400 |
| H | 2.82649300 | -3.51543900 | 1.23117700 |
| H | 2.04087700 | -1.97360700 | 1.61572100 |
| H | 1.16064600 | -3.49380000 | 1.91918100 |

***E*-Prenyl-I $T_1$** optimized geometry [# opt=calcfc freq scrf=(smd,solvent=water) def2svp mn15]

EE + Thermal Free Energy Correction: -1493.516783 Ha

1 3

| | | | |
|---|---|---|---|
| C | -0.33583000 | 0.33639400 | 0.09339100 |
| C | 0.52013700 | -0.83069800 | 0.11465800 |
| C | -0.10882700 | -2.15618400 | 0.34876600 |
| O | -1.45885900 | -2.22528500 | 0.31997100 |
| C | -2.28704400 | -1.14620000 | 0.14120600 |
| C | -1.73361100 | 0.16310200 | 0.03583600 |
| C | -2.70662800 | 1.20385600 | -0.11869300 |
| C | -4.05623500 | 0.95877700 | -0.16225400 |
| C | -4.58184200 | -0.36916000 | -0.04701800 |
| N | -5.91744400 | -0.62664800 | -0.07335400 |
| C | -6.86956900 | 0.43778900 | -0.38124000 |
| C | -6.36297900 | -2.02717500 | -0.10467700 |
| C | -3.63198600 | -1.42063700 | 0.09726900 |
| H | -2.37285600 | 2.23607100 | -0.22786900 |
| H | -4.72637800 | 1.80592200 | -0.29916400 |
| H | -7.84327900 | 0.15381800 | 0.03361300 |
| H | -6.57424400 | 1.34594900 | 0.15997300 |
| H | -5.92670700 | -2.51394700 | -0.99430700 |
| H | -5.93213700 | -2.53936200 | 0.76908800 |
| H | -3.92801700 | -2.46385300 | 0.18968700 |
| C | -6.98463500 | 0.70583900 | -1.87445600 |
| H | -7.71858200 | 1.50246400 | -2.06197200 |
| H | -6.01686800 | 1.02180800 | -2.29333100 |
| H | -7.31178500 | -0.19852200 | -2.40975400 |
| C | -7.86374800 | -2.23287100 | -0.09608000 |
| H | -8.33265600 | -1.81622300 | 0.80680200 |
| H | -8.35366500 | -1.80224700 | -0.98103900 |
| H | -8.05676500 | -3.31455500 | -0.10282800 |
| O | 0.48335200 | -3.19227200 | 0.56321400 |
| C | 1.89792000 | -0.73336500 | -0.06870800 |
| C | 2.88332800 | -1.74415500 | -0.02418300 |
| H | 2.59665000 | -2.77655100 | 0.16802000 |
| H | 2.25655200 | 0.26850600 | -0.30154700 |
| C | 4.27037900 | -1.50291000 | -0.21411700 |
| C | 5.18005200 | -2.59957300 | -0.18028800 |
| C | 4.84543100 | -0.21663900 | -0.43947200 |
| C | 6.52417900 | -2.40430200 | -0.36364700 |
| H | 4.80873700 | -3.61133700 | -0.01129700 |
| C | 6.20001600 | -0.08411800 | -0.61419900 |
| H | 4.23564500 | 0.68672000 | -0.47520400 |

| | | | |
|---|---|---|---|
| H | 7.24712000 | -3.22075900 | -0.34639000 |
| H | 6.67494400 | 0.88217300 | -0.78728000 |
| N | 7.03162400 | -1.15947200 | -0.58172500 |
| C | 8.47771100 | -0.98435700 | -0.72359800 |
| H | 8.67739100 | -0.03972800 | -1.24058600 |
| H | 8.95141600 | -0.96704400 | 0.26707200 |
| H | 8.88748600 | -1.81669600 | -1.30685300 |
| C | 0.27058500 | 1.71597300 | 0.11798400 |
| C | 1.24605400 | 1.95200000 | 1.25344300 |
| H | -0.53357300 | 2.46004200 | 0.20182400 |
| C | 0.90777500 | 1.99743600 | 2.55196600 |
| H | 2.29428400 | 2.09391100 | 0.96311000 |
| C | -0.50012600 | 1.81241800 | 3.04524600 |
| C | 1.94092400 | 2.21541400 | 3.61897400 |
| H | -0.63068800 | 0.80006700 | 3.46441700 |
| H | -0.71473600 | 2.52008500 | 3.86136400 |
| H | -1.25842600 | 1.94848000 | 2.26112400 |
| H | 1.71526600 | 3.12718900 | 4.19616600 |
| H | 1.93196100 | 1.38176400 | 4.34058200 |
| H | 2.95337100 | 2.30471400 | 3.20102700 |
| O | 0.92947900 | 1.94852200 | -1.14734000 |
| C | 1.21560300 | 3.22070100 | -1.45877100 |
| O | 0.89896300 | 4.15102700 | -0.74390500 |
| C | 1.96175600 | 3.32760100 | -2.74887900 |
| H | 2.05128500 | 4.37832800 | -3.04340500 |
| H | 2.96339600 | 2.89294100 | -2.61372500 |
| H | 1.45038800 | 2.74703700 | -3.52803100 |

***E*-Prenyl-I $T_1$ TS** optimized geometry [# opt=(calcfc,ts,noeigentest) freq=noraman scrf=(smd,solvent=water) scf=qc

def2svp mn15]

EE + Thermal Free Energy Correction: -1493.494749 Ha

1 3

| | | | |
|---|---|---|---|
| C | -0.34855200 | 0.25741100 | 0.68960400 |
| C | 0.49035100 | -0.84149200 | 0.23678900 |
| C | -0.10037800 | -2.18364500 | 0.16387600 |
| O | -1.45997100 | -2.25436900 | 0.12939600 |
| C | -2.27298400 | -1.14891100 | 0.11636200 |
| C | -1.74476200 | 0.13843100 | 0.40933000 |
| C | -2.67811200 | 1.21419500 | 0.41552100 |
| C | -4.01252600 | 1.02044300 | 0.16974900 |
| C | -4.53527600 | -0.29144100 | -0.09609400 |
| N | -5.85164000 | -0.50308300 | -0.31634100 |
| C | -6.79258100 | 0.61726200 | -0.36668700 |
| C | -6.30277900 | -1.84960000 | -0.71074000 |
| C | -3.60510800 | -1.37459800 | -0.12655000 |
| H | -2.30549500 | 2.22804100 | 0.57305200 |
| H | -4.66985700 | 1.88785000 | 0.16265800 |
| H | -7.78643800 | 0.23287200 | -0.11371700 |
| H | -6.53698000 | 1.32811100 | 0.42890500 |
| H | -5.76550700 | -2.12923100 | -1.63175200 |
| H | -5.97466000 | -2.55372100 | 0.06869300 |
| H | -3.91286600 | -2.40060300 | -0.31814400 |
| C | -6.81358200 | 1.29725100 | -1.72736300 |
| H | -7.54181800 | 2.12029600 | -1.72071200 |
| H | -5.82491500 | 1.71075800 | -1.97747700 |
| H | -7.10076900 | 0.58710700 | -2.51698900 |
| C | -7.79395100 | -2.00616100 | -0.92036500 |
| H | -8.36489700 | -1.81961400 | -0.00003500 |
| H | -8.17847200 | -1.35507200 | -1.71807700 |
| H | -7.97984500 | -3.04632500 | -1.22140000 |
| O | 0.50765500 | -3.23341800 | 0.13287800 |
| C | 1.83188200 | -0.60192300 | -0.11008700 |
| C | 2.83092600 | -1.51586800 | -0.39966100 |
| H | 2.63238100 | -2.58636100 | -0.34976000 |
| H | 2.08205800 | 0.46023300 | -0.15416000 |
| C | 4.17423000 | -1.12851400 | -0.75307400 |
| C | 5.13568300 | -2.13313300 | -1.01029000 |
| C | 4.61115200 | 0.21543200 | -0.86196100 |
| C | 6.42690300 | -1.79657800 | -1.35107200 |
| H | 4.86170700 | -3.18666300 | -0.94309200 |

| | | | |
|---|---|---|---|
| C | 5.91285400 | 0.49083400 | -1.20834700 |
| H | 3.94112900 | 1.05635800 | -0.68129200 |
| H | 7.19439100 | -2.54349700 | -1.55630500 |
| H | 6.28889800 | 1.50991100 | -1.30659700 |
| N | 6.80582000 | -0.50117200 | -1.44951200 |
| C | 8.19535600 | -0.15566300 | -1.77109400 |
| H | 8.73880900 | 0.07767200 | -0.84651500 |
| H | 8.67042800 | -1.00395700 | -2.27402900 |
| H | 8.20399300 | 0.71858100 | -2.43127600 |
| C | 0.20348300 | 1.39933500 | 1.31983200 |
| C | 1.39993000 | 1.37161700 | 2.17656200 |
| H | -0.49813100 | 2.20869600 | 1.53687200 |
| C | 1.81936200 | 0.38543200 | 3.00146400 |
| H | 1.95955700 | 2.31262600 | 2.19192000 |
| C | 1.14847800 | -0.94284700 | 3.20633100 |
| C | 3.06629200 | 0.58031500 | 3.81525000 |
| H | 1.66096800 | -1.72884100 | 2.62294400 |
| H | 1.22276400 | -1.23709700 | 4.26470000 |
| H | 0.08919400 | -0.94464900 | 2.91699100 |
| H | 2.84433800 | 0.51028900 | 4.89279300 |
| H | 3.78781100 | -0.22492500 | 3.59619100 |
| H | 3.54779300 | 1.54697900 | 3.61332000 |
| O | 1.02963800 | 2.48243400 | -0.14831600 |
| C | 0.36072500 | 3.51189400 | -0.53419600 |
| O | -0.72176400 | 3.88363200 | -0.05470400 |
| C | 1.00434400 | 4.28429500 | -1.66810000 |
| H | 0.41078800 | 5.17151200 | -1.91910300 |
| H | 2.02320500 | 4.58176800 | -1.38240100 |
| H | 1.08855400 | 3.63178400 | -2.54920000 |

***E*-Prenyl-I $T_1$ CIP** optimized geometry [# opt=calcfc freq=noraman scrf=(smd,solvent=water) def2svp mn15]

EE + Thermal Free Energy Correction: -1493.509511 Ha

1 3

| | | | |
|---|---|---|---|
| C | -0.44832400 | -1.03280800 | 0.59928000 |
| C | 0.38433900 | -0.85215800 | -0.56771700 |
| C | -0.21799400 | -1.03697200 | -1.89375800 |
| O | -1.57354100 | -0.92577800 | -1.96993400 |
| C | -2.35811800 | -0.61250400 | -0.89475300 |
| C | -1.83539400 | -0.68261300 | 0.42558100 |
| C | -2.73227500 | -0.37891600 | 1.48688500 |
| C | -4.03739300 | -0.04018300 | 1.25443300 |
| C | -4.56124800 | 0.00372200 | -0.08648100 |
| N | -5.84410300 | 0.32726300 | -0.33056600 |
| C | -6.74378800 | 0.71917000 | 0.75922200 |
| C | -6.29940400 | 0.47543000 | -1.72839700 |
| C | -3.66567200 | -0.29409000 | -1.16028200 |
| H | -2.36619000 | -0.38005000 | 2.51340500 |
| H | -4.66937000 | 0.21135100 | 2.10316700 |
| H | -7.76787600 | 0.50239900 | 0.43921200 |
| H | -6.55327500 | 0.07362900 | 1.62441100 |
| H | -5.68176000 | 1.26059900 | -2.19297000 |
| H | -6.06399400 | -0.46318300 | -2.25093700 |
| H | -3.98118800 | -0.28611300 | -2.20133000 |
| C | -6.59172200 | 2.18966400 | 1.11836300 |
| H | -7.29473400 | 2.44428100 | 1.92329500 |
| H | -5.57028700 | 2.40638100 | 1.46514900 |
| H | -6.80812300 | 2.83126000 | 0.25167200 |
| C | -7.76725000 | 0.79319100 | -1.91285800 |
| H | -8.41721100 | -0.00724000 | -1.53271000 |
| H | -8.05578100 | 1.74461300 | -1.44469700 |
| H | -7.94950100 | 0.88475400 | -2.99233900 |
| O | 0.38260000 | -1.28219300 | -2.91660100 |
| C | 1.72332100 | -0.40840100 | -0.42081800 |
| C | 2.68117400 | -0.23705900 | -1.39066400 |
| H | 2.50598300 | -0.56174500 | -2.41668800 |
| H | 1.97575000 | -0.11303600 | 0.60175900 |
| C | 3.96901900 | 0.37279500 | -1.11559100 |
| C | 4.94300100 | 0.40743400 | -2.13581500 |
| C | 4.31081600 | 0.95596300 | 0.12665500 |
| C | 6.17444400 | 0.98234700 | -1.90476200 |
| H | 4.73302900 | -0.02565100 | -3.11455100 |
| C | 5.55646400 | 1.51945100 | 0.29580900 |

| | | | |
|---|---|---|---|
| H | 3.61004600 | 0.99416700 | 0.96556100 |
| H | 6.95755100 | 1.02474400 | -2.66298500 |
| H | 5.86538500 | 1.98529400 | 1.23211500 |
| N | 6.46977500 | 1.52836300 | -0.70376800 |
| C | 7.76598700 | 2.18672700 | -0.49800500 |
| H | 7.68905500 | 3.24214100 | -0.78873200 |
| H | 8.03857300 | 2.11485700 | 0.55977000 |
| H | 8.52312900 | 1.68929900 | -1.11299600 |
| C | 0.05937300 | -1.43476200 | 1.84098700 |
| C | 1.29257500 | -2.11004400 | 2.11441500 |
| H | -0.54528300 | -1.20074400 | 2.72130800 |
| C | 1.94005700 | -3.05355400 | 1.35999400 |
| H | 1.71619700 | -1.90284500 | 3.10385800 |
| C | 1.42428200 | -3.63134700 | 0.07957400 |
| C | 3.24162100 | -3.61547800 | 1.83550700 |
| H | 1.93374900 | -3.17519500 | -0.78806600 |
| H | 1.64745000 | -4.70872700 | 0.04422900 |
| H | 0.34314500 | -3.48763200 | -0.05191200 |
| H | 3.16294800 | -4.70513200 | 1.98464200 |
| H | 4.01355200 | -3.46851500 | 1.06087200 |
| H | 3.58255800 | -3.14753400 | 2.76847600 |
| O | 1.86111300 | 1.17297500 | 2.56028400 |
| C | 0.95333700 | 1.88215300 | 2.03365100 |
| O | -0.27397300 | 1.79399700 | 2.28932700 |
| C | 1.39487100 | 2.89468700 | 0.98168700 |
| H | 2.33731700 | 3.37833500 | 1.27588500 |
| H | 1.58357300 | 2.36191600 | 0.03403300 |
| H | 0.61966700 | 3.65084400 | 0.80099000 |

***Z*-Prenyl-I $S_1$** optimized geometry [# opt=calcfc freq td=(root=1) scrf=(smd,solvent=water) def2svp mn15]

EE + Thermal Free Energy Correction: -1493.489065 Ha

1 1

| | | | |
|---|---|---|---|
| C | -0.03856500 | 0.99857700 | -0.18844600 |
| C | 1.05021300 | 0.25671400 | -0.74463100 |
| C | 0.78933100 | -1.10280700 | -1.26370300 |
| O | -0.42430700 | -1.65561500 | -1.00117700 |
| C | -1.46081900 | -0.98287800 | -0.42471200 |
| C | -1.30163200 | 0.38606500 | -0.04649300 |
| C | -2.47855600 | 1.00445800 | 0.49278100 |
| C | -3.65187000 | 0.32413200 | 0.66934500 |
| C | -3.77094500 | -1.06919800 | 0.32432300 |
| N | -4.91036700 | -1.76353000 | 0.53059900 |
| C | -6.11518000 | -1.09637700 | 1.02245500 |
| C | -4.99492800 | -3.14880800 | 0.04136100 |
| C | -2.62568200 | -1.69025600 | -0.25696500 |
| H | -2.45411700 | 2.06011700 | 0.75880800 |
| H | -4.50556600 | 0.86633600 | 1.07206800 |
| H | -6.74186300 | -1.84882500 | 1.51351700 |
| H | -5.83033400 | -0.38877400 | 1.81148400 |
| H | -4.82051800 | -3.14116200 | -1.04835100 |
| H | -4.15933400 | -3.71387600 | 0.48297700 |
| H | -2.62846300 | -2.72904400 | -0.58064900 |
| C | -6.89177400 | -0.39874700 | -0.08483000 |
| H | -7.79001000 | 0.07946800 | 0.33084500 |
| H | -6.27844000 | 0.37674700 | -0.56847700 |
| H | -7.20785800 | -1.11842100 | -0.85484600 |
| C | -6.29046400 | -3.87189700 | 0.34444600 |
| H | -6.46605500 | -3.97334300 | 1.42480100 |
| H | -7.16254400 | -3.38427900 | -0.11388300 |
| H | -6.21560000 | -4.88395100 | -0.07674000 |
| O | 1.55651800 | -1.76350200 | -1.92905700 |
| C | 2.33451800 | 0.81711500 | -0.94195600 |
| C | 3.59795800 | 0.21033600 | -1.03496900 |
| H | 4.37945700 | 0.82041000 | -1.50148600 |
| H | 2.35244500 | 1.90847000 | -1.02264400 |
| C | 4.05140000 | -1.01880300 | -0.49214000 |
| C | 5.35466400 | -1.50697500 | -0.82515200 |
| C | 3.31875900 | -1.81568300 | 0.44565900 |
| C | 5.82083200 | -2.68761900 | -0.31358800 |
| H | 5.98911100 | -0.94133200 | -1.50991000 |
| C | 3.84241000 | -2.98153500 | 0.93456100 |

| | | | |
|---|---|---|---|
| H | 2.34867600 | -1.49048700 | 0.82458600 |
| H | 6.80342000 | -3.09066200 | -0.56362000 |
| H | 3.31118600 | -3.60123200 | 1.65811800 |
| N | 5.07241300 | -3.43305500 | 0.55338200 |
| C | 5.57910800 | -4.71490800 | 1.03337300 |
| H | 5.00962100 | -5.01701600 | 1.91934100 |
| H | 5.47371700 | -5.48495500 | 0.25601800 |
| H | 6.63910100 | -4.61720700 | 1.29832700 |
| C | 0.20972800 | 2.40151100 | 0.31006600 |
| C | 1.27877500 | 2.46590700 | 1.37041400 |
| H | -0.72118100 | 2.81495300 | 0.71824500 |
| C | 1.57100000 | 3.58877400 | 2.05224100 |
| H | 1.82374200 | 1.54334600 | 1.59555500 |
| C | 0.88691100 | 4.90380300 | 1.80977600 |
| C | 2.64881100 | 3.60571300 | 3.09537000 |
| H | 0.69012300 | 5.41198400 | 2.76649200 |
| H | 1.54417200 | 5.57221500 | 1.22864500 |
| H | -0.06156700 | 4.80935600 | 1.26241400 |
| H | 3.41407700 | 4.35891800 | 2.84571000 |
| H | 2.23316100 | 3.89930900 | 4.07326200 |
| H | 3.13911600 | 2.62788700 | 3.19860100 |
| O | 0.58830600 | 3.27291400 | -0.78635400 |
| C | -0.39442400 | 3.74176800 | -1.56745900 |
| O | -1.55942200 | 3.43802700 | -1.40283500 |
| C | 0.12502800 | 4.65965300 | -2.62585000 |
| H | -0.70369200 | 5.03193000 | -3.23676200 |
| H | 0.65757500 | 5.49663600 | -2.15288400 |
| H | 0.84773400 | 4.11978800 | -3.25372400 |

***Z*-Prenyl-I $S_1$ TS** optimized geometry [# opt=(calcfc,ts,noeigentest) freq td=(root=1) scrf=(smd,solvent=water) def2svp mn15]

EE + Thermal Free Energy Correction: -1493.455751 Ha

1 1

| | | | |
|---|---|---|---|
| C | -0.20370000 | 0.96419000 | 0.13846900 |
| C | 0.87129700 | 0.22617500 | -0.46683200 |
| C | 0.64542300 | -1.13655700 | -0.95370200 |
| O | -0.58986100 | -1.68611800 | -0.75715000 |
| C | -1.64755700 | -0.99637800 | -0.24636100 |
| C | -1.49499300 | 0.34703500 | 0.19696200 |
| C | -2.67630700 | 0.96181500 | 0.71500100 |
| C | -3.87978000 | 0.31456400 | 0.77133300 |
| C | -4.01215500 | -1.04760100 | 0.32109500 |
| N | -5.18584000 | -1.70559700 | 0.37747100 |
| C | -6.41007300 | -1.02165500 | 0.79550000 |
| C | -5.27461100 | -3.05643600 | -0.20392200 |
| C | -2.84046700 | -1.67759500 | -0.19565600 |
| H | -2.63126400 | 1.98713500 | 1.08079600 |
| H | -4.74065300 | 0.85193800 | 1.16438800 |
| H | -7.10491900 | -1.77753400 | 1.17644800 |
| H | -6.18014400 | -0.37098900 | 1.64813000 |
| H | -5.00364800 | -2.98526900 | -1.27074400 |
| H | -4.50065300 | -3.67739700 | 0.27214500 |
| H | -2.84477900 | -2.70118200 | -0.56379000 |
| C | -7.04710700 | -0.23472600 | -0.34070200 |
| H | -7.96730300 | 0.25121500 | 0.01274400 |
| H | -6.36274100 | 0.54346300 | -0.71136000 |
| H | -7.30497500 | -0.89752400 | -1.18016200 |
| C | -6.61505900 | -3.74500900 | -0.06012600 |
| H | -6.88842400 | -3.90484100 | 0.99245800 |
| H | -7.42619700 | -3.19842000 | -0.56148800 |
| H | -6.53469300 | -4.73172300 | -0.53660500 |
| O | 1.44446800 | -1.81990600 | -1.56251800 |
| C | 2.08123200 | 0.88962100 | -0.81683300 |
| C | 3.36892400 | 0.44753800 | -1.04582300 |
| H | 4.03058000 | 1.17421500 | -1.52809900 |
| H | 1.94208000 | 1.96731300 | -0.95762300 |
| C | 4.03512500 | -0.77159800 | -0.65981800 |
| C | 5.31532100 | -1.04218400 | -1.19895400 |
| C | 3.54152800 | -1.70020000 | 0.29176500 |
| C | 6.00555800 | -2.17819800 | -0.83982200 |
| H | 5.76546200 | -0.35498200 | -1.91679400 |
| C | 4.28388000 | -2.80722800 | 0.62817100 |

| | | | |
|---|---|---|---|
| H | 2.59145400 | -1.54246000 | 0.80120900 |
| H | 6.98460100 | -2.42670000 | -1.25107400 |
| H | 3.94416000 | -3.53840200 | 1.36263700 |
| N | 5.49158300 | -3.04961900 | 0.06028000 |
| C | 6.21637500 | -4.27725900 | 0.40187100 |
| H | 6.07136100 | -4.49605300 | 1.46564300 |
| H | 5.83295600 | -5.11230600 | -0.19889400 |
| H | 7.28219800 | -4.13525500 | 0.19489700 |
| C | -0.03658200 | 2.30854600 | 0.60378100 |
| C | 1.09697900 | 2.90544500 | 1.29401700 |
| H | -0.95678200 | 2.87284500 | 0.75721400 |
| C | 2.01966800 | 2.34153600 | 2.11294200 |
| H | 1.10285000 | 3.99887500 | 1.21759000 |
| C | 2.10148400 | 0.89319300 | 2.48262700 |
| C | 3.05704600 | 3.20765900 | 2.76360600 |
| H | 3.00177700 | 0.44166600 | 2.03259500 |
| H | 2.22284400 | 0.80090900 | 3.57381600 |
| H | 1.22442100 | 0.30771600 | 2.17952800 |
| H | 2.97703100 | 3.15105700 | 3.86170900 |
| H | 4.06625500 | 2.84236100 | 2.50953600 |
| H | 2.97438200 | 4.25821100 | 2.45396500 |
| O | 0.14808100 | 3.28948200 | -1.21695900 |
| C | -0.34531300 | 4.47436400 | -1.18176000 |
| O | -0.89811600 | 4.98899300 | -0.19499900 |
| C | -0.18418100 | 5.26678300 | -2.46479700 |
| H | -0.44472700 | 4.64649100 | -3.33289600 |
| H | -0.80337100 | 6.17184600 | -2.44080200 |
| H | 0.87235200 | 5.55564700 | -2.57054700 |

***Z*-Prenyl-I $S_1$ CIP** optimized geometry [# opt=calcfc freq td=(root=1) scrf=(smd,solvent=water) def2svp mn15]

EE + Thermal Free Energy Correction: -1493.477849 Ha

1 1

| | | | |
|---|---|---|---|
| C | 0.10612000 | 0.87670900 | 0.34069200 |
| C | 1.14546600 | 0.16771500 | -0.30130800 |
| C | 0.95439100 | -1.23050200 | -0.70996700 |
| O | -0.27854500 | -1.78090500 | -0.51606100 |
| C | -1.32589600 | -1.10782300 | 0.02711100 |
| C | -1.15893200 | 0.21767200 | 0.51199400 |
| C | -2.29797400 | 0.81676500 | 1.12713200 |
| C | -3.50804100 | 0.18607000 | 1.18188400 |
| C | -3.67729200 | -1.13758400 | 0.63185900 |
| N | -4.86592900 | -1.76012800 | 0.64635200 |
| C | -6.06807000 | -1.07617200 | 1.12942700 |
| C | -5.00186500 | -3.06822500 | -0.02450700 |
| C | -2.52643600 | -1.77158300 | 0.06722300 |
| H | -2.20761900 | 1.81112300 | 1.56330500 |
| H | -4.34528900 | 0.70158500 | 1.64722100 |
| H | -6.78047700 | -1.84144300 | 1.45372400 |
| H | -5.81336900 | -0.50199600 | 2.02805100 |
| H | -4.71349300 | -2.93171800 | -1.07923800 |
| H | -4.25909200 | -3.74769000 | 0.41904300 |
| H | -2.55946700 | -2.77803500 | -0.34362200 |
| C | -6.68370800 | -0.18490800 | 0.06045700 |
| H | -7.58819000 | 0.29620500 | 0.45747600 |
| H | -5.97759200 | 0.60061400 | -0.24912500 |
| H | -6.96261100 | -0.77083500 | -0.82772000 |
| C | -6.37071600 | -3.70869000 | 0.05578600 |
| H | -6.66192200 | -3.94091800 | 1.08960700 |
| H | -7.15331000 | -3.09220700 | -0.40809300 |
| H | -6.32304800 | -4.65692300 | -0.49692600 |
| O | 1.78267600 | -1.92814600 | -1.25615600 |
| C | 2.29606100 | 0.87035100 | -0.82370300 |
| C | 3.59148400 | 0.49199500 | -1.00705500 |
| H | 4.21227200 | 1.16734700 | -1.60326200 |
| H | 2.04226200 | 1.87790500 | -1.17780500 |
| C | 4.31111900 | -0.64551000 | -0.45413300 |
| C | 5.55258900 | -0.99991600 | -1.01767200 |
| C | 3.87793700 | -1.38583500 | 0.66609100 |
| C | 6.27002800 | -2.06364600 | -0.51086800 |
| H | 5.95361300 | -0.44501700 | -1.86675000 |
| C | 4.64064900 | -2.43063300 | 1.13858200 |

| | | | |
|---|---|---|---|
| H | 2.95794300 | -1.13430300 | 1.19488300 |
| H | 7.22585300 | -2.38320000 | -0.92706300 |
| H | 4.34722600 | -3.02784700 | 2.00276100 |
| N | 5.81104000 | -2.76787100 | 0.54662500 |
| C | 6.56640600 | -3.92887100 | 1.03391800 |
| H | 6.40751800 | -4.03339600 | 2.11225300 |
| H | 6.21543100 | -4.83315400 | 0.52061900 |
| H | 7.63058200 | -3.77681800 | 0.82637700 |
| C | 0.23672900 | 2.24575300 | 0.73543400 |
| C | 1.41509500 | 2.92752500 | 1.07807100 |
| H | -0.69103000 | 2.81992300 | 0.74015400 |
| C | 1.46051900 | 4.30493100 | 1.20253800 |
| H | 2.33340300 | 2.36282300 | 1.26440600 |
| C | 0.27871800 | 5.16131500 | 0.87217600 |
| C | 2.70138800 | 4.99105500 | 1.65187600 |
| H | -0.47248600 | 5.10607300 | 1.67919400 |
| H | 0.57081300 | 6.21404200 | 0.76308300 |
| H | -0.21738200 | 4.82408100 | -0.05093200 |
| H | 3.06055700 | 5.67636800 | 0.86529500 |
| H | 2.48300900 | 5.62879000 | 2.52537800 |
| H | 3.50286300 | 4.28669900 | 1.90925000 |
| O | -0.23336800 | 2.78570800 | -2.20655300 |
| C | -1.41337300 | 2.43662400 | -1.92915600 |
| O | -2.21594800 | 3.09558000 | -1.21429800 |
| C | -1.90579400 | 1.11977700 | -2.52619100 |
| H | -2.78838700 | 0.73904100 | -1.99125900 |
| H | -2.18159600 | 1.28675500 | -3.57972300 |
| H | -1.10090800 | 0.36805700 | -2.51301100 |

***Z*-Prenyl-I $T_1$** optimized geometry [# opt=calcfc freq scrf=(smd,solvent=water) def2svp mn15]

EE + Thermal Free Energy Correction: -1493.516199 Ha

1 3

| | | | |
|---|---|---|---|
| C | -0.19226900 | 0.81425900 | -0.12197900 |
| C | 0.73108500 | 0.00455500 | -0.85044000 |
| C | 0.32322100 | -1.36086300 | -1.25050000 |
| O | -0.95629700 | -1.72436800 | -1.03595500 |
| C | -1.88778700 | -0.92771500 | -0.41554300 |
| C | -1.52642900 | 0.35358500 | 0.06076200 |
| C | -2.58052800 | 1.06467700 | 0.70121000 |
| C | -3.84968900 | 0.54789400 | 0.83712900 |
| C | -4.18717900 | -0.75333900 | 0.35292500 |
| N | -5.44007700 | -1.28922100 | 0.50671100 |
| C | -6.55158400 | -0.42445300 | 0.89170700 |
| C | -5.73681700 | -2.53411700 | -0.20913100 |
| C | -3.15381900 | -1.47104400 | -0.29615800 |
| H | -2.39626000 | 2.06986900 | 1.08116800 |
| H | -4.60205100 | 1.16596000 | 1.32453500 |
| H | -7.35946400 | -1.05714800 | 1.27862100 |
| H | -6.24524600 | 0.19657200 | 1.74398300 |
| H | -5.57809200 | -2.38435200 | -1.29392900 |
| H | -5.00118300 | -3.29090700 | 0.10373500 |
| H | -3.30401300 | -2.46509200 | -0.71257400 |
| C | -7.05833400 | 0.43828500 | -0.25410600 |
| H | -7.90012200 | 1.06564300 | 0.07326700 |
| H | -6.26328800 | 1.10079700 | -0.63052800 |
| H | -7.40344200 | -0.18922600 | -1.09093600 |
| C | -7.12421400 | -3.09697500 | 0.02818400 |
| H | -7.31241900 | -3.28061000 | 1.09629900 |
| H | -7.91825400 | -2.44310400 | -0.36053400 |
| H | -7.20175600 | -4.05962400 | -0.49623700 |
| O | 1.06188500 | -2.17773300 | -1.76463300 |
| C | 2.01946600 | 0.38749800 | -1.17664800 |
| C | 3.04991400 | -0.45184300 | -1.78449200 |
| H | 2.98128000 | -0.74414800 | -2.83641700 |
| H | 2.33177700 | 1.40582800 | -0.92653500 |
| C | 4.20232200 | -0.83314100 | -1.06570600 |
| C | 5.25006300 | -1.57369500 | -1.67998200 |
| C | 4.37553100 | -0.49091200 | 0.30858000 |
| C | 6.36478700 | -1.92213900 | -0.95647500 |
| H | 5.17843700 | -1.86961300 | -2.72721500 |
| C | 5.51199000 | -0.86996600 | 0.97546900 |
| H | 3.60719200 | 0.07293600 | 0.84082500 |

| | | | |
|---|---|---|---|
| H | 7.19061500 | -2.48760100 | -1.38846300 |
| H | 5.68543900 | -0.63044700 | 2.02603700 |
| N | 6.49425300 | -1.57371800 | 0.34994900 |
| C | 7.70001400 | -1.92979100 | 1.10358100 |
| H | 8.24710900 | -1.01708500 | 1.37143700 |
| H | 7.41331900 | -2.46296300 | 2.01798900 |
| H | 8.33463900 | -2.57180900 | 0.48491800 |
| C | 0.28855100 | 2.12082300 | 0.48116000 |
| C | 1.48629000 | 1.95840700 | 1.39104200 |
| H | -0.53976800 | 2.58432700 | 1.03581200 |
| C | 1.50973800 | 1.24504500 | 2.52855400 |
| H | 2.39654800 | 2.46766100 | 1.05492600 |
| C | 0.31265100 | 0.51023500 | 3.06377500 |
| C | 2.77623700 | 1.09882500 | 3.32276800 |
| H | 0.33466600 | -0.54728300 | 2.74802400 |
| H | 0.31844800 | 0.51458900 | 4.16440800 |
| H | -0.64035100 | 0.93843900 | 2.72101000 |
| H | 2.64013000 | 1.47120800 | 4.35119100 |
| H | 3.04914700 | 0.03307100 | 3.41172100 |
| H | 3.61724800 | 1.63557600 | 2.86015300 |
| O | 0.69616900 | 3.04331400 | -0.54771500 |
| C | -0.25901500 | 3.62184200 | -1.28912700 |
| O | -1.44153700 | 3.42163900 | -1.09964700 |
| C | 0.31677400 | 4.50481400 | -2.34784400 |
| H | -0.48403900 | 5.06228300 | -2.84436300 |
| H | 1.05169900 | 5.19051300 | -1.90574400 |
| H | 0.84523400 | 3.87898800 | -3.08190500 |

***Z*-Prenyl-I $T_1$ TS** optimized geometry [# opt=(calcfc,ts,noeigentest) freq scrf=(smd,solvent=water) def2svp mn15]

EE + Thermal Free Energy Correction: -1493.483382 Ha

1 3

| | | | |
|---|---|---|---|
| C | -0.14732100 | 1.11364100 | 0.23006400 |
| C | 0.93582600 | 0.42164200 | -0.43301000 |
| C | 0.72579100 | -0.90852300 | -1.00267700 |
| O | -0.48985100 | -1.49632200 | -0.81550000 |
| C | -1.55512700 | -0.85994700 | -0.24405700 |
| C | -1.43129400 | 0.46187600 | 0.26134200 |
| C | -2.61907900 | 1.01372700 | 0.82413600 |
| C | -3.80143100 | 0.32298900 | 0.88253600 |
| C | -3.89821800 | -1.01831400 | 0.38067300 |
| N | -5.04884600 | -1.72479600 | 0.44418400 |
| C | -6.27926500 | -1.10940300 | 0.94504600 |
| C | -5.11090900 | -3.05373200 | -0.19141100 |
| C | -2.72373200 | -1.58224300 | -0.19747700 |
| H | -2.60162500 | 2.02819100 | 1.21912200 |
| H | -4.66875800 | 0.81619700 | 1.31690200 |
| H | -6.92561300 | -1.90971900 | 1.32027600 |
| H | -6.03406400 | -0.48739300 | 1.81420700 |
| H | -4.88062800 | -2.92296600 | -1.26133600 |
| H | -4.29765800 | -3.66138500 | 0.23211100 |
| H | -2.70374700 | -2.58749200 | -0.61304700 |
| C | -6.99272800 | -0.30210900 | -0.12911400 |
| H | -7.91737500 | 0.12511600 | 0.28307000 |
| H | -6.35789400 | 0.52175800 | -0.48836300 |
| H | -7.25640900 | -0.93709700 | -0.98787200 |
| C | -6.41981500 | -3.79675900 | -0.03187800 |
| H | -6.64677300 | -4.01713600 | 1.02061600 |
| H | -7.26812100 | -3.25828800 | -0.47712400 |
| H | -6.32156300 | -4.75600600 | -0.55834800 |
| O | 1.52910500 | -1.53372900 | -1.66826700 |
| C | 2.14471000 | 1.11742100 | -0.75072100 |
| C | 3.43623300 | 0.69760200 | -0.96065800 |
| H | 4.11270400 | 1.45196000 | -1.37340000 |
| H | 1.99070900 | 2.19557300 | -0.86619300 |
| C | 4.09585300 | -0.55416800 | -0.64220200 |
| C | 5.37399700 | -0.79684900 | -1.18809900 |
| C | 3.58746000 | -1.53591800 | 0.24161700 |
| C | 6.05599000 | -1.95981500 | -0.89700100 |
| H | 5.83400100 | -0.06961800 | -1.85844800 |
| C | 4.31773200 | -2.66981800 | 0.50952800 |

| | | | |
|---|---|---|---|
| H | 2.63248400 | -1.40571200 | 0.74932500 |
| H | 7.03655100 | -2.18631900 | -1.31651600 |
| H | 3.96573400 | -3.44740500 | 1.18858600 |
| N | 5.52785600 | -2.88237900 | -0.06343200 |
| C | 6.25401600 | -4.11776600 | 0.25247900 |
| H | 6.47615600 | -4.14511300 | 1.32614100 |
| H | 5.63399800 | -4.98165800 | -0.01480400 |
| H | 7.18648100 | -4.14076300 | -0.31940800 |
| C | 0.01819700 | 2.41878200 | 0.77153200 |
| C | 1.20792100 | 2.95792300 | 1.45091900 |
| H | -0.90631300 | 2.90482500 | 1.09040900 |
| C | 2.08174000 | 2.33425000 | 2.26943800 |
| H | 1.31537000 | 4.04174200 | 1.33545400 |
| C | 2.06995200 | 0.87964400 | 2.63014900 |
| C | 3.19277400 | 3.11773900 | 2.90746200 |
| H | 2.96361300 | 0.38675000 | 2.21141900 |
| H | 2.14244400 | 0.76932000 | 3.72429000 |
| H | 1.17710900 | 0.34429300 | 2.28347600 |
| H | 3.13743200 | 3.05030000 | 4.00641100 |
| H | 4.16898300 | 2.69146600 | 2.62060900 |
| H | 3.17380000 | 4.17670800 | 2.61556200 |
| O | 0.16564200 | 3.63073700 | -0.80041600 |
| C | -0.91921900 | 3.80097400 | -1.47268900 |
| O | -2.04027200 | 3.39854900 | -1.13069600 |
| C | -0.73372900 | 4.53482300 | -2.78561800 |
| H | -1.69771200 | 4.89572300 | -3.16462800 |
| H | -0.02931700 | 5.36885300 | -2.66854500 |
| H | -0.30201600 | 3.83563400 | -3.51803900 |

***Z*-Prenyl-I $T_1$ CIP** optimized geometry [# opt=calcfc freq scrf=(smd,solvent=water) def2svp mn15

EE + Thermal Free Energy Correction: -1493.507205 Ha

1 3

| | | | |
|---|---|---|---|
| C | -0.22361500 | 0.74879700 | 0.47529400 |
| C | 0.59565400 | -0.41993300 | 0.57303500 |
| C | 0.00968900 | -1.69929100 | 0.99267000 |
| O | -1.34877200 | -1.78307300 | 1.02298000 |
| C | -2.17556500 | -0.74396200 | 0.72495500 |
| C | -1.65045400 | 0.55292600 | 0.47801400 |
| C | -2.60253500 | 1.58569900 | 0.23841300 |
| C | -3.94599900 | 1.33779500 | 0.18754500 |
| C | -4.45980300 | 0.00986400 | 0.40887700 |
| N | -5.77655700 | -0.25603400 | 0.35047500 |
| C | -6.73969600 | 0.77787900 | -0.04126200 |
| C | -6.24024300 | -1.65184800 | 0.49121500 |
| C | -3.51846100 | -1.02595400 | 0.69387300 |
| H | -2.25696500 | 2.60644900 | 0.08004800 |
| H | -4.62000800 | 2.16492200 | -0.02416100 |
| H | -7.70959900 | 0.50751400 | 0.38790100 |
| H | -6.45257400 | 1.72597800 | 0.42769500 |
| H | -5.75985500 | -2.23828900 | -0.30786800 |
| H | -5.84582600 | -2.03284700 | 1.44415100 |
| H | -3.82078000 | -2.05248700 | 0.88828100 |
| C | -6.83624800 | 0.91164700 | -1.55368400 |
| H | -7.58407800 | 1.67579000 | -1.80614900 |
| H | -5.86926200 | 1.21319200 | -1.98376400 |
| H | -7.14118500 | -0.03950000 | -2.01423800 |
| C | -7.73920800 | -1.85379200 | 0.45442300 |
| H | -8.24784100 | -1.34592600 | 1.28552100 |
| H | -8.18657500 | -1.52821100 | -0.49500200 |
| H | -7.92678600 | -2.93123100 | 0.55844600 |
| O | 0.62729800 | -2.69638200 | 1.29838600 |
| C | 1.96971500 | -0.37007200 | 0.16696500 |
| C | 2.97841000 | -1.24926500 | 0.43048500 |
| H | 2.80270300 | -2.15043100 | 1.01749900 |
| H | 2.20638000 | 0.50657900 | -0.43834200 |
| C | 4.34910000 | -1.02309600 | -0.00531500 |
| C | 5.30552100 | -2.03908000 | 0.18393400 |
| C | 4.79705600 | 0.18436400 | -0.58737000 |
| C | 6.61473100 | -1.84806600 | -0.21022100 |
| H | 5.02193200 | -2.98860600 | 0.63921200 |
| C | 6.11577400 | 0.32059200 | -0.95643400 |
| H | 4.12944100 | 1.03349000 | -0.74001600 |

| | | | |
|---|---|---|---|
| H | 7.38386900 | -2.61131400 | -0.08808700 |
| H | 6.50846900 | 1.23292900 | -1.40697800 |
| N | 7.00543000 | -0.68453400 | -0.77205500 |
| C | 8.40045900 | -0.47979400 | -1.18312600 |
| H | 8.43269100 | -0.26319200 | -2.25738300 |
| H | 8.82153900 | 0.36517700 | -0.62545100 |
| H | 8.97132200 | -1.38823700 | -0.96895300 |
| C | 0.31156300 | 2.05105800 | 0.26360600 |
| C | 1.55831800 | 2.58906900 | 0.67741400 |
| H | -0.30182500 | 2.71643600 | -0.34941800 |
| C | 2.32482500 | 2.26999100 | 1.77923300 |
| H | 1.91859700 | 3.42936300 | 0.07224400 |
| C | 1.89840100 | 1.34435800 | 2.87178000 |
| C | 3.66818700 | 2.89988800 | 1.95449600 |
| H | 2.43985000 | 0.38461000 | 2.80532200 |
| H | 2.16545700 | 1.78329500 | 3.84611400 |
| H | 0.82144400 | 1.13186000 | 2.86062600 |
| H | 3.72579400 | 3.44786400 | 2.90972500 |
| H | 4.43879700 | 2.11033000 | 2.00955900 |
| H | 3.92131800 | 3.57994700 | 1.13000600 |
| O | 0.59208600 | 0.40755000 | -2.68557200 |
| C | -0.65609100 | 0.58196700 | -2.63387300 |
| O | -1.23812400 | 1.69857700 | -2.64965300 |
| C | -1.52212700 | -0.67470000 | -2.56207400 |
| H | -2.56113100 | -0.43753800 | -2.29017000 |
| H | -1.51687500 | -1.17329600 | -3.54444900 |
| H | -1.09460300 | -1.38627500 | -1.83720700 |

# 4. Water solubility of **Prenyl-I**

Solubility test in PBS-buffer, pH 7.3, 25 °C

| **µM** | **50** | **100** | **200** | **400** |
|---|---|---|---|---|
| DMSO % | 1 | 2 | 4 | 8 |

Figure S33. Solubility test of **Prenyl-I**, showing no precipitation in PBS-buffer at concentrations up to 400 µM.

# 5. References


(1) Weinrich, T.; Gränz, M.; Grünewald, C.; Prisner, T. F.; Göbel, M. W. Synthesis of a Cytidine Phosphoramidite with Protected Nitroxide Spin Label for EPR Experiments with RNA. *European J Org Chem* **2017**, *2017* (3), 491–496. https://doi.org/10.1002/ejoc.201601174.

(2) Bojtár, M.; Kormos, A.; Kis-Petik, K.; Kellermayer, M.; Kele, P. Green-Light Activatable, Water-Soluble Red-Shifted Coumarin Photocages. *Org Lett* **2019**, *21* (23), 9410–9414. https://doi.org/10.1021/acs.orglett.9b03624.

(3) Yao, Q.; Kinney, E. P.; Yang, Z. Ligand-Free Heck Reaction: Pd(OAc)2 as an Active Catalyst Revisited. *Journal of Organic Chemistry* **2003**, *68* (19), 7528–7531. https://doi.org/10.1021/jo034646w.

(4) Bryan, C. S.; Lautens, M. A Tandem Catalytic Approach to Methyleneindenes: Mechanistic Insights into Gem -Dibromoolefin Reactivity. *Org Lett* **2010**, *12* (12), 2754–2757. https://doi.org/10.1021/ol100844v.

(5) Slanina, T.; Shrestha, P.; Palao, E.; Kand, D.; Peterson, J. A.; Dutton, A. S.; Rubinstein, N.; Weinstain, R.; Winter, A. H.; Klán, P. In Search of the Perfect Photocage: Structure–Reactivity Relationships in Meso -Methyl BODIPY Photoremovable Protecting Groups. *J Am Chem Soc* **2017**, *139* (42), 15168–15175. https://doi.org/10.1021/jacs.7b08532.

(6) Zheng, J.; Xu, X.; Truhlar, D. G. Minimally Augmented Karlsruhe Basis Sets. *Theor Chem Acc* **2011**, *128* (3), 295–305. https://doi.org/10.1007/S00214-010-0846-Z/TABLES/10.

(7) Yu, H. S.; He, X.; Li, S. L.; Truhlar, D. G. MN15: A Kohn–Sham Global-Hybrid Exchange–Correlation Density Functional with Broad Accuracy for Multi-Reference and Single-Reference Systems and Noncovalent Interactions. *Chem Sci* **2016**, *7* (8), 5032–5051. https://doi.org/10.1039/C6SC00705H.

(8) Marenich, A. V.; Cramer, C. J.; Truhlar, D. G. Universal Solvation Model Based on Solute Electron Density and on a Continuum Model of the Solvent Defined by the Bulk Dielectric Constant and Atomic Surface Tensions. *Journal of Physical Chemistry B* **2009**, *113* (18), 6378–6396. https://doi.org/10.1021/JP810292N/SUPPL_FILE/JP810292N_SI_003.PDF.