Electronic Supplementary Information

for

Reactive cyclic intermediates in the ProTide prodrugs activation: Trapping the elusive pentavalent phosphorane

Eliška Procházková,[a] Rafael Navrátil,[b] Zlatko Janeba,[a] Jana Roithová,[b,c,*] and Ondřej Baszczyňski[a,*]

[a] *Institute of Organic Chemistry and Biochemistry, Czech Academy of Sciences, Flemingovo nám. 2, 166 10, Prague 6, Czech Republic.*

** Corresponding author: baszczynski@uochb.cas.cz*

[b] *Department of Organic Chemistry, Faculty of Science, Charles University, Hlavova 2030/8, 128 43, Prague 2, Czech Republic.*

[c] *Institute for Molecules and Materials, Radboud University Nijmegen, Heyendaalseweg 135, 6525 Nijmegen, The Netherlands.*

** Corresponding author: jana.roithova@ru.nl*

Table of Contents

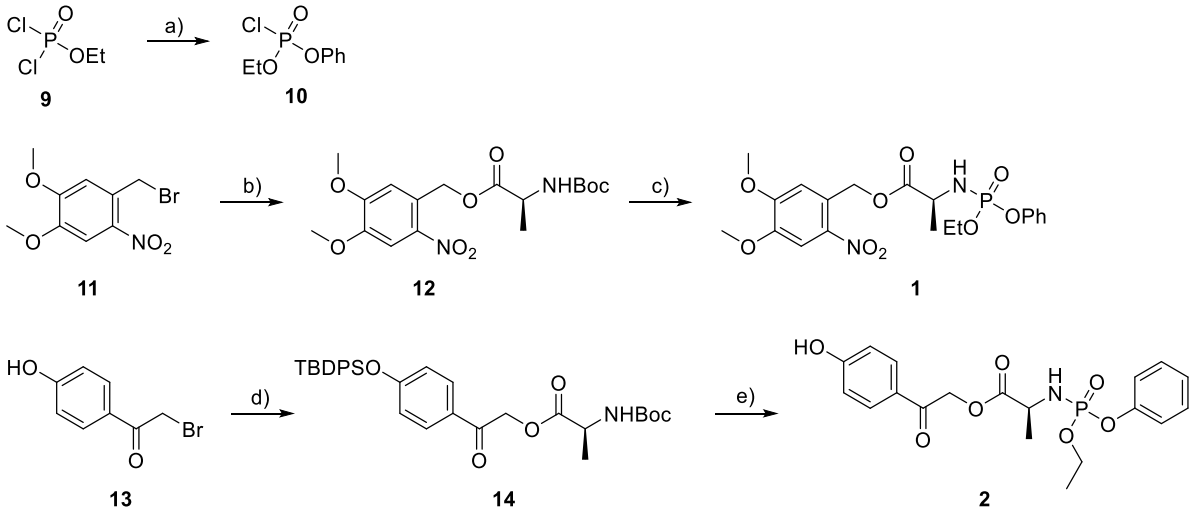
1. Experimental section

Chemicals were purchased from Sigma–Aldrich (Prague, Czech Republic). 1-(bromomethyl)-4,5-dimethoxy-2-nitrobenzene and 2-bromo-1-(4-hydroxyphenyl)ethan-1-one were purchased from Fluorochem Ltd. (United Kingdom). Dry solvents were purchased from Acros Organics (Czech Republic).

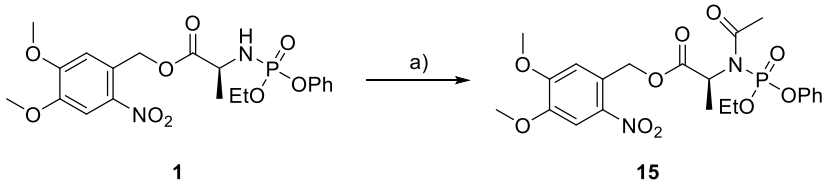
Unless otherwise stated, solvents were evaporated at 40 °C/2 kPa, and compounds were dried on Hi-vac pump at 2 kPa. Thin layer chromatography (TLC) was performed on TLC aluminium sheets (silica gel 60 F_{254}; Merck), and chromatographic systems are described in the text. Column chromatography was performed on CombiFlash® (Teledyne Isco) chromatography system using silica gel 230–400 mesh, 60 Å (Merck) or reversed-phase C-18 RediSep Rf Gold® pre-packed columns.

UPLC–MS spectra were measured on Waters UPLC H-Class Core System equipped with Acquity UPLC column (BEH C18 1.7µm, 2.1x100 mm), Waters Acquity PDA detector and Mass spectrometer Waters SQD2. HRMS data were taken with a LTQ Orbitrap XL spectrometer.

1.1. Synthesis

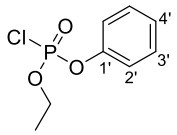


Scheme 1. Synthesis of compound **1** and **2.** Reaction conditions: a) ethyl dichlorophosphate, phenol, DCM, Et_3N, –78 °C to 25 °C, 16 h; b) Boc-Ala-OH, Cs_2CO_3, DMF, 0 °C to 25 °C, 18 h; c) 1. TFA, DCM, 0 °C to 25 °C, 2 h; 2. DCM, Et_3N, ethyl phenyl chlorophosphate **10**, –78 °C to 25 °C, 16 h; d) 1. Boc-Ala-OH, Ag_2CO_3, DMF, 25 °C, 16 h; 2. *tert*-butyl diphenylsilyl chloride, pyridine, DMAP, 0 °C to 25 °C, 16 h; e) 1. TFA, DCM, 0 °C to 25 °C, 2 h; 2. DCM, Et_3N, ethyl phenyl chlorophosphate **10**, –78 °C to 25 °C, 16 h; 3. THF, TBAF.$3H_2O$, CH_3COOH, 0 °C to 25 °C, 2 h.



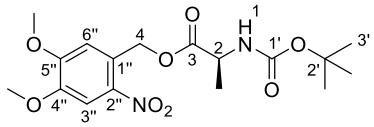
Scheme 2. Synthesis of compound **15**. Reaction conditions: a) NaH, acetylchloride, THF, 0–25 °C.

Phosphorylation agent - Ethyl phenyl phosphorochloridate **10**



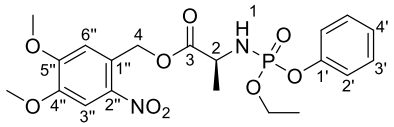
Phenol (94 µL, 0.95 mmol, 0.95 eq.) and triethylamine (138 µL, 0.95 mmol, 0.95 eq.) were dissolved in dichloromethane (3 mL). The solution was cooled down to –78 °C and ethyl phosphorodichloridate **9** (119 µL, 1 mmol, 1 eq.) was added dropwise. The mixture was stirred at –78 °C for 15 minutes and then it was allowed to warm up to 25 °C and stirred for 2 hours. Crude reaction mixture was stored under argon, and it was directly used as a phosphorylation reagent for the next reaction steps (phosphorylation of protected amino acids). UPLC/MS (ESI^+) RT = 4.25 min, $[M+H]^+$ 221.09; for EtOP(O)(OPh)OH, RT = 2.80 min, $[M+H]^+$ 202.70.

4,5-Dimethoxy-2-nitrobenzyl (*tert*-butoxycarbonyl)-L-alaninate **12**



Boc-Ala-OH (189 mg, 1 mmol, 1 eq.) was dissolved in DMF (4 mL), caesium carbonate (195 mg, 0.6 mmol, 0.6 eq.) was added and the suspension was stirred at 25 °C for 15 minutes. The suspension was cooled down to 0 °C and 1-(bromomethyl)-4,5-dimethoxy-2-nitrobenzene **11** (290 mg, 1.05 mmol, 1.05 eq.) was added in one portion. Then the mixture was stirred at 25 °C for 16 hours. Product was purified by Flash silica gel chromatography using gradient cyclohexane/ethylacetate (0–40%) to give title compound as a white amorphous solid (340 mg, 84%). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.71 (s, 1H, 3'), 7.42 (d, J_{NH-2} = 7.2, NH), 7.20 (s, 1H, 6'), 5.45 and 5.41 (2 x d, J_{gem} = 16.9, J_{gem} = 16.9, 5), 4.13 (m, 1H, 2), 3.94 (s, 3H, 5'-*O*-CH_3), 3.87 (s, 3H, 4'-*O*-CH_3), 1.36 (s, 9H, *O*-C(**CH_3**)$_3$), 1.28 (d, 3H, J_{CH3-2} = 7.3, 2-CH_3). ^{13}C NMR (100 MHz, DMSO-d_6) δ 173.07 (3), 155.55 (1), 153.53 (5'), 148.08 (4'), 139.59 (2'), 126.65 (1'), 111.03 (6'), 108.42 (3'), 78.45 (*O*-**C**$(CH_3)_3$), 63.14 (5), 56.49 and 56.44 (4', 5'-OCH_3), 49.33 (2), 28.32 (*O*-C(**CH_3**)$_3$), 16.92 (2-CH_3). HRMS (ES^+) calcd for $C_{17}H_{24}O_8N_2Na$ 407.1425, found $[M+H]^+$ 407.1425. UPLC/MS (ESI^+) RT = 4.96 min, $[M+H]^+$ 385.39; $[\alpha]^{20}_D$ = +21.7 (c = 0.314 g/100ml, $CHCl_3$).

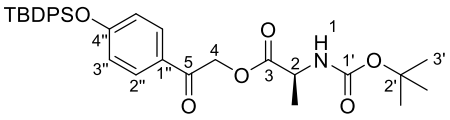
4,5-Dimethoxy-2-nitrobenzyl (ethoxy(phenoxy)phosphoryl)-L-alaninate **1**



Compound **12** (320 mg, 0.83 mmol, 0.83 eq.) was dissolved in dichloromethane (3 mL) and cooled to 0 °C. Trifluoroacetic acid (3 mL) was added dropwise and the mixture was stirred at 0 °C for 30 minutes. The reaction was allowed to warm up to 25 °C and stirred for additional 2 hours. Solvent was evaporated and crude residue was co-evaporated with dichloromethane (3x), toluene (1x) and dried on Hi-vac pump (0.1 mBar) for 2 hours. Dry residue was dissolved in dichloromethane (3 mL) and triethylamine (280 µL, 2 mmol, 2 eq.) was added. Solution was cooled down to –78 °C and ethyl phenyl phosphorochloridate **10** (1 mmol, 1 eq.) was added dropwise. Reaction mixture was stirred at –78 °C for 30 minutes, and then it was allowed to warm up to 25 °C and stirred for 16 hours. Crude reaction mixture was purified by reverse phase (C-18) Flash chromatography using gradient water/methanol (0–100%) which afforded the title compound as a white amorphous solid (160 mg, 41%). ^{1}H NMR (500 MHz, DMSO-d_6, 2 diastereoisomers) δ 7.71 and 7.70 (s, 3''), 7.35–7.30 (m, 3'), 7.21 and 7.20 (s , 6''), 7.18–7.11 (m, 3H, 2', 4'), 6.06 and 6.01 (dd, J_{NH-P} = 13.1, J_{NH-2} = 10.1, 1), 5.45–5.36 (m, 2H, 4), 4.07–3.92 (m, 3H, O**CH_2**CH_3,

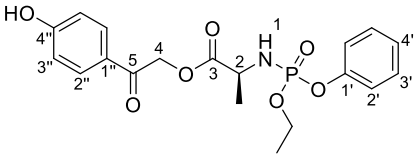
2), 3.89 and 3.88 and 3.87 and 3.87 (s, 2x 3H, 4''-O**CH₃**, 5''-O**CH₃**), 1.29 and 1.26 (d, 3H, $J_{CH3\text{-}2}$ = 7.1, 2-CH_3), 1.21 and 1.18 (t, 3H, $J_{CH3\text{-}CH2}$ = 7.1 , OCH_2**CH₃**). ^{13}C NMR (126 MHz, DMSO-d_6) δ 173.12 and 172.97 (2x d, $J_{3\text{-}P}$ = 4.3, $J_{3\text{-}P}$ = 4.3, 3), 153.48 (5''), 151.0 and 150.96 (2x d, $J_{1'\text{-}P}$ = 6.8, $J_{1'\text{-}P}$ = 6.4, 1'), 148.14 and 148.13 (4''), 139.71 (1'' or 2''), 129.73 (3'), 126.33 (2'' or 1''), 124.61 and 124.57 (4'), 120.36 and 120.28 (2x d, $J_{2'\text{-}P}$ = 4.6, $J_{2'\text{-}P}$ = 4.5, 2'), 111.32 (6''), 108.38 (3''), 63.22 (4), 62.48 and 62.42 (2x d, $J_{CH2\text{-}P}$ = 5.5, $J_{CH2\text{-}P}$ = 5.4, O**CH₂**CH_3), 56.50 and 56.30 (4''-OCH_3, 5''-OCH_3), 50.20-50.03 (2), 19.77–19.71 (2x d, $J_{CH3\text{-}P}$ = 5.4, $J_{CH3\text{-}P}$ = 5.4, 2-CH_3), 16.12 and 16.07 (2x d, $J_{CH3\text{-}P}$ = 6.4, $J_{CH3\text{-}P}$ = 6.4, OCH_2**CH₃**). ^{31}P NMR (202 MHz, DMSO-d_6) δ 3.44 and 3.27 ppm. HRMS (ES^-) calcd for $C_{20}H_{24}O_9N_2P$ 468.1225, found $[M\text{-}H]^-$ 467.1221. UPLC/MS (ESI^+) RT = 4.59 min, $[M+H]^+$ 469.37.

2-(4-((*tert*-Butyldiphenylsilyl)oxy)phenyl)-2-oxoethyl (*tert*-butoxycarbonyl)-L-alaninate **14**



Boc-Ala-OH (1.9 g, 10 mmol, 1 eq.) was dissolved in DMF (30 mL), silver carbonate (1380 mg, 5 mmol, 0.5 eq.) was added and the suspension was stirred at 25 °C for 15 minutes. The suspension was cooled down to 0 °C and 2-bromo-1-(4-hydroxyphenyl)ethan-1-one **13** (2150 mg, 10 mmol, 10 eq.) was added in one portion. Then the mixture was stirred at 25 °C for 16 hours. The solvent was evaporated and the crude compound (UPCL/MS (ESI^+) RT = 4.00 min, $[M+H]^+$ 324.34) was dissolved in pyridine (15 mL) cooled to 0 °C and *tert*-butyl diphenylsilylchloride (2.34 mL, 8.97 mL) was added dropwise followed by DMAP (2 mg). The mixture was stirred at 25 °C for 16 hours. Solvent was evaporated and crude product was purified by Flash chromatography using gradient cyclohexane/ethylacetate (0–40%) to give the title compound as a white solid (2.793 g, 50%). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.80 (m, 2H, 2'), 7.68 (m, 4H, 3''), 7.53–7.43 (m, 6H, 2'', 4''), 7.33 (d, 1H, $J_{NH\text{-}2}$ = 7.5, NH), 6.84 (m, 2H, 3'), 5.45 (d, J_{gem} = 16.8, 4a), 5.29 (d, J_{gem} = 16.8, 4b), 4.13 (m, 2H), 1.37 (s, 9H, O-C(**CH₃**)₃), 1.33 (d, 3H, $J_{CH3\text{-}2}$ = 7.3, 2-CH_3), 1.05 (s, 9H, Si-C(**CH₃**)₃). ^{13}C NMR (100 MHz, DMSO-d_6) δ 191.04 (5), 172.95 (3), 167.7 (1), 159.93 (4'), 135.13 (3''), 131.48 (1''), 130.66 (4''), 130.26 (2'), 128.40 (2''), 127.65 (1'), 119.75 (3'), 78.32 (O-**C**$(CH_3)_3$), 66.41 (4), 49.01 (2), 28.35 (O-C(**CH₃**)₃), 26.33 (Si-C(**CH₃**)₃), 19.10 (Si-**C**$(CH_3)_3$), 17.20 (2-CH_3). HRMS (ES^+) calcd for $C_{32}H_{39}O_6NNaSi$ 584.3439, found $[M+Na]^+$ 584.2434. UPLC/MS (ESI^+) RT = 5.95 min, $[M+H]^+$ 562.48. $[\alpha]^{20}_D$ = –19.7 (c = 0.502 g/100ml, $CHCl_3$).

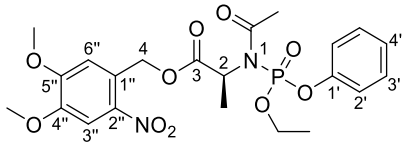
2-(4-Hydroxyphenyl)-2-oxoethyl (ethoxy(phenoxy)phosphoryl)-L-alaninate **2**



Compound **14** (561 mg, 1 mmol, 1 eq.) was dissolved in dichloromethane (3 mL) and cooled to 0 °C. Trifluoroacetic acid (3 mL) was added dropwise and the mixture was stirred at 0 °C for 30 minutes. The reaction was allowed to warm up to 25 °C and stirred for additional 2 hours. Solvent was evaporated and crude residue was co-evaporated with dichloromethane (3x), toluene (1x) and dried on Hi-vac pump (0.1 mBar) for 2 hours. Dry residue was dissolved in dichloromethane (3 mL) and triethylamine (280 µL, 2 mmol, 4 eq.) was added. Solution was cooled down to –78 °C and ethyl phenyl phosphorochloridate **10** (1 mmol, 1 eq.) was added dropwise. Reaction mixture was stirred at –78 °C for 30 minutes, and then it was allowed to warm up to 25 °C and stirred for 16 hours. Crude reaction mixture was purified by Flash chromatography using gradient cyclohexane/ethylacetate (0–40%) to

give *O*-TBDMS protected title compound (UPLC/MS (ESI$^+$) RT = 5.89, $[M+H]^+$ 646.25), which was directly dissolved in a mixture consisting of: TBAF.$3H_2O$ (0.56 g, 1.6 mmol) and acetic acid (93 µL, 1.62 mmol) in THF (8 mL) at 0 °C. Then the mixture was allowed to warm up to 25 °C and stirred for additional 3 hours. Crude product was purified by reverse phase (C-18) Flash chromatography using gradient water/methanol (0–100%) which afforded the title compound as a white amorphous solid (45 mg, 10%). ^{1}H NMR (500 MHz, DMSO-d_6, 2 diastereoisomers) δ 10.6 bs (OH), 7.85–7.81 (m, 2H, 2''), 7.39–7.34 (m, 2H, 3'), 7.23–7.15 (m, 3H, 2', 4'), 6.88-6.84 (m, 2H, 3''), 6.00 and 5.94 (2 x dd, $J_{1\text{-}CH3}$ = 13.3, $J_{1\text{-}2}$ = 10.1, 1), 5.45–5.44 (2 x dd, J_{gem} = 16.6, 4a), 5.35–5.33 (2 x d, J_{gem} = 16.6, 4b), 4.11–3.91 (m, 3H, O**CH$_2$**CH$_3$, 2), 1.34–1.32 (2 x dd, $J_{CH3\text{-}2}$ = 7.1, $J_{CH3\text{-}P}$ = 0.8, 2-CH$_3$), 1.28–1.25 (2 x td, $J_{CH3\text{-}CH2}$ = 7.1, $J_{CH3\text{-}P}$ =0.8, OCH$_2$**CH$_3$**). ^{13}C NMR (126 MHz, DMSO-d_6) δ 190.47 and 190.45 (5), 173.22 and 173.09 (2 x d, $J_{3\text{-}P}$ = 4.9, $J_{3\text{-}P}$ = 4.7, 3), 163.12 (4''), 151.06 and 150.99 (2 x d, $J_{1'\text{-}P}$ = 6.6, $J_{1'\text{-}P}$ = 6.6, 1'), 130.54 (2''), 129.77 and 129.73 (3'), 125.38 (1''), 124.60 and 124.55 (4'), 120.50 and 120.33 (2 x d, $J_{2'\text{-}P}$ = 5.2, $J_{2'\text{-}P}$ = 5.2, 2'), 115.68 (3''), 66.44 (4), 62.42 and 62.36 (2 x d, $J_{CH2\text{-}P}$ = 5.2, $J_{CH2\text{-}P}$ = 5.2, O**CH$_2$**CH$_3$), 49.98 and 49.80 (2), 20.14 and 20.11 (2 x d, $J_{CH3\text{-}P}$ = 6.5, $J_{CH3\text{-}P}$ = 6.5, 2-CH$_3$), 16.16 and 16.09 (2 x d, $J_{CH3\text{-}P}$ = 5.9, OCH$_2$**CH$_3$**). ^{31}P NMR (202 MHz, DMSO-d_6) δ 3.72 and 3.17. HRMS (ES$^+$) calcd for $C_{19}H_{22}O_7NNaP$ 430.1026, found $[M+Na]^+$ 430.1023. UPLC/MS (ESI$^+$) RT = 3.98 and 3.99 min, $[M+H]^+$ 408.28.

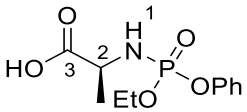
4,5-dimethoxy-2-nitrobenzyl *N*-acetyl-*N*-(ethoxy(phenoxy)phosphoryl)-L-alaninate **1-Ac**



Compound **1** (112 mg, 0.23 mmol) was dissolved in THF (3 mL) and the solution was cooled down to 0 °C and sodium hydride (29 mg, 0.72 mmol) was added. The mixture was stirred at 0 °C for 15 minutes and acetyl chloride (86 µL, 1.2 mmol) was added dropwise. The mixture was allowed to warm up to 25 °C and stirred for 3 hours. Then the reaction was cooled down to 0 °C, and quenched by slow addition of saturated aqueous $NaHCO_3$ (5 mL). The reaction mixture was partitioned between ethylacetate and water. Organic phase was dried by $MgSO_4$ and evaporated in *vacuo*. Crude product was purified by silica gel Flash chromatography using gradient cyclohexane/ethylacetate (0–80%) followed by reverse phase Flash chromatography using gradient water/acetonitrile (5–95%) to give the title compound (14 mg, 12%) as a colourless viscous oil. ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.69 and 7.68 (2 x s, 3''), 7.43–7.33 and 7.27–7.19 (2 x m, 2H and 3H, 2', 3', 4'), 7.13 and 7.08 (2 x s, 6''), 5.46 and 5.45 (2 x d, 1H, J_{gem} = 14.5, 4a), 5.31 and 5.29 (2 x d, J_{gem} = 14.5, 4b), 4.95–4.79 (m, 2), 4.28–4.18 (m, 2H, O**CH$_2$**CH$_3$), 3.89 and 3.88 and 3.87 and 3.86 (4 x s, 4 x 3H, 4''-OCH$_3$, 5''-OCH$_3$, both diastereoisomers), 2.39 and 2.38 (2 x s, 2 x 3H, N-CO-CH$_3$), 1.39 and 1.28 (2 x d, 2 x 3H, $J_{CH3\text{-}2}$ = 6.9, $J_{CH3\text{-}2}$ = 6.8, 2-CH$_3$), 1.25 and 1.25 (2 x q, $J_{CH3\text{-}CH2}$ = 7.0, $J_{CH3\text{-}CH2}$ = 7.0). ^{13}C NMR (100 MHz, DMSO-d_6) δ 171.48 and 171.40 (1-CO), 170.17 (3), 153.42 and 153.37 (5''), 149.78 and 149.58 (2 x d, $J_{1'\text{-}P}$ = 7.4, $J_{1'\text{-}P}$ = 6.6, 1'), 148.09 and 148.01 (4''), 139.70 and 139.56 (1'' or 2''), 130.26 and 130.13 (3'), 126.52 and 126.33 (2'' or 1''), 126.01 and 125.82 (4'), 120.43 and 120.34 (2 x d, $J_{2'\text{-}P}$ = 4.9, $J_{2'\text{-}P}$ = 4.7, 2'), 111.30 and 110.93 (6''), 108.33 and 108.31 (3''), 64.90-65.02 (m, **CH$_2$**CH$_3$), 63.54–63.43 (4), 56.41 and 56.49 (5''-O-CH$_3$ or 4''-O-CH$_3$), 56.29 and 56.28 (4''-O-CH$_3$ or 5''-O-CH$_3$), 54.42–54.07 (2 x d, $J_{2\text{-}P}$ = 3.9, $J_{2\text{-}P}$ = 3.9, 2), 24.50–24.43 (N-CO-**CH$_3$**), 15.91–15.48 (2-CH$_3$), 15.88–15.81 (2 x d, $J_{CH3\text{-}P}$ = 3.7, $J_{CH3\text{-}P}$ = 3.7, CH$_2$**CH$_3$**). HRMS (ES$^+$) calcd for $C_{22}H_{27}O_{10}N_2NaP$ 533.1296, found $[M+Na]^+$ 533.1293. UPLC/MS (ESI$^+$) RT = 4.78 min, $[M+H]^+$ 511.35.

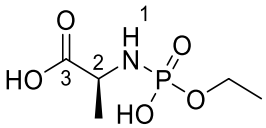
Characterization and preparation of intermediate I[1], monoamidate product 3 and sideproduct 5:

Intermediate **I[1]**: (ethoxy(phenoxy)phosphoryl)-L-alanine



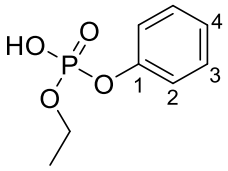
^{13}C NMR (125.7 MHz, D_2O/DMSO-d_6, ¼, v/v, 24 mM, 2 diastereoisomers) δ 175.99 and 175.90 (2 x d, $J_{3\text{-}P}$ = 4.6, $J_{3\text{-}P}$ = 4.6, 3), 151.50 and 151.44 (2 x d, $J_{1'\text{-}P}$ = 6.4, $J_{1'\text{-}P}$ = 6.4, 1'), 130.74 and 130.70 (3'), 125.78 and 125.74 (4'), 121.21 and 121.04 (2 x d, $J_{2'\text{-}P}$ = 4.5, $J_{2'\text{-}P}$ = 4.5, 2'), 63.73 and 63.67 (2 x d, $J_{CH2\text{-}P}$ = 5.5, $J_{CH2\text{-}P}$ = 5.5, **CH_2**CH_3), 20.79–20.60 (m, 2-CH_3), 16.81 and 16.75 (2 x d, CH_2**CH_3**). ^{31}P NMR (202 MHz, DMSO-d_6) δ 3.93 and 3.43 ppm. HRMS (ES^-) calcd for $C_{11}H_{15}O_5NP$ 272.0693, found $[M\text{-}H]^-$ 272.0689.

Monoamidate product **3**: (ethoxy(hydroxy)phosphoryl)-L-alanine



After 10 min *ex situ* irradiation, (pH = 7.4). ^{1}H NMR (500 MHz, Tris/ DMSO-d_6, 1/4, v/v) δ 3.5 (m, 2), 3.5 (m, 2H, O**CH_2**CH_3), 1.17 (d, 3H, $J_{CH3\text{-}2}$ = 7.0, 2-**CH_3**), 1.10 (t, 3H, $J_{CH3\text{-}CH2}$ = 7.1, OCH_2**CH_3**). ^{13}C NMR (125.7 MHz, DMSO-*d*6) δ 177.79 (3), 60.12 (O**CH_2**CH_3), 50.83 (2), 20.19 (d, $J_{CH3\text{-}P}$ = 7.3, 2-CH_3), 17.16 (d, $J_{CH3\text{-}P}$ = 7.3, OCH_2**CH_3**). ^{13}C NMR (125.7 MHz, D_2O/DMSO-d_6, ¼, v/v, 24mM) δ 177.47 (3), 60.99 (d, $J_{CH2\text{-}P}$ = 5.1, **CH_2**CH_3), 50.64 (d, $J_{2\text{-}P}$ = 4.1, 2), 20.33 (d, $J_{CH3\text{-}P}$ = 7.0, 2-CH_3), 16.24 (CH_2**CH_3**). ^{31}P NMR (202 MHz, DMSO-d_6) δ 6.52 ppm. HRMS (ES^-) calcd for $C_5H_{11}NO_5P$ 196.0380, found $[M\text{-}H]^-$ 196.0379.

Side product **5**: ethyl phenyl hydrogen phosphate



Phenol (94 µL, 0.95 mmol, 0.95 eq.) and triethylamine (138 µL, 0.95 mmol, 0.95 eq.) were dissolved in dichloromethane (3 mL). The solution was cooled down to –78 °C and ethyl phosphorodichloridate **9** (119 µL, 1 mmol, 1 eq.) was added dropwise. The mixture was stirred at –78 °C for 15 minutes and then it was allowed to warm up to 25 °C and stirred for 16 hours. Crude reaction mixture was directly applied on column and purified by reverse phase chromatography using gradient water/acetonitrile (0–100%) to give a colourless viscous liquid, which was re-purified on HPLC using Phenomenex Gemini column (10 µm, C18, 110A, 250 x 21.2 mm) with gradient water/acetonitrile (95/5 to 5/95) to obtain the title compound (30 mg, 15%). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.34 (m, 2H, 3), 7.17 (m, 2H, 2), 7.12 (m, 4), 3.99 (dq, 2H, $J_{CH2\text{-}P}$ = 8.0, $J_{CH2\text{-}CH3}$ = 7.1, *O*-**CH_2**CH_3), 1.19 (dt, 3H, $J_{CH3\text{-}CH2}$ = 7.1, $J_{CH3\text{-}P}$ = 0.9, *O*-CH_2**CH_3**). ^{13}C NMR (100 MHz, DMSO-d_6) δ 151.79 (d, $J_{1\text{-}P}$ = 6.6, 1), 129.71 (3), 124.09 (4), 120.17 (d, $J_{2\text{-}P}$ = 4.8, 2), 62.61 (d, $J_{CH2\text{-}P}$ = 5.9, *O*-**CH_2**CH_3), 16.26 (d, $J_{CH3\text{-}P}$ = 7.0, *O*-CH_2**CH_3**). ^{31}P NMR (202 MHz, DMSO-d_6) δ -6.65. HRMS (ES^+) calcd for $C_8H_{10}O_4P$ 201.0322, found $[M+H]^-$ 201.0322. UPLC/MS (ESI^+) for EtOP(O)(OPh)OH, RT = 2.80 min, $[M+H]^+$ 202.70.

1.2. Instrumental methods

NMR spectroscopy

NMR spectra recorded in order to characterize studied compounds were recorded on a Bruker Avance III spectrometer with a broad-band PRODIGY cryo-probe probe with ATM module (5 mm CPBBO BB-^{1}H/^{19}F/D Z-GRD) operating at 400 MHz for ^{1}H and 100 MHz for ^{13}C. For NMR signal assignment, standard Bruker pulse sequences for 1D (^{1}H, ^{13}C-APT, ^{31}P) as well as 2D NMR experiments (COSY, ROESY, HSQC, HMBC) at corrected temperature 25 °C were employed. All NMR data were processed and interpreted using Topspin 3.5. As a reference, solvent signals were used: DMSO-d_6: 2.50 (^{1}H) and 39.7 (^{13}C) ppm and H_3PO_4 for ^{31}P as 0 ppm.
For irradiation experiments, we used Bruker Avance III spectrometer with a broad-band cryo probe with ATM module (5 mm CPBBO BB-^{1}H/^{19}F/^{15}N/D Z-GRD) operating at 500 MHz for ^{1}H, 125.7 MHz for ^{13}C and 202 MHz for ^{31}P experiments.As a source of irradiation, we used a light emitting diode (LED) at 365 nm (9.8 mW) from Thorlabs, Germany. The light was guided into the spectrometer directly into the NMR tube *via* a multimode silica optical fiber with 1 mm diameter, 0.39 NA, high amount of OH from Thorlabs, Germany. Irradiation of the sample was applied with a roughly cut and glazed end of the fiber centred in the central axis of the NMR tube. For *ex situ* irradiation, we used a commercial UV lamp (LED at 365 nm, 1W).

Mass spectrometry / Ion spectroscopy

The mass spectra (Figures S10 and S12) very acquired using a commercial TSQ 7000 (Finnigan) mass spectrometer. Standard electrospray (ESI) and atmospheric pressure ionization (APCI) were used. Exact ionization conditions are giver in each figure caption.

We used the ISORI instrument to acquire infrared photodissociation spectra of studied ions. For more details about the instrument and the technique, please refer to ref. 1–4 in this Supporting Information. Briefly, the mass-selected ions (*m/z* 314 in case of $\mathbf{I^{P}}$**-Ac** and *m/z* 178 in case of $\mathbf{I^{2}}$) were guided into the ion trap of the ISORI instrument and cooled by a helium/deuterium (9:1) buffer gas to 20 K (the temperature of the trap was kept at 20 K). Under these conditions, vibrationally relaxed ions formed weakly-bound complexes with deuterium molecules. Subsequently, the deuterium complexes were irradiated by a tunable infrared laser and upon resonant absorption, the deuterium complexes dissociated. Recording the dissociation yield ($1 - N_i / N_{i0}$) while scanning the laser frequency provided infrared photodissociation spectra. All presented spectra were recorded by monitoring the dissociation of complexes bearing single deuterium tagging molecule. Each presented spectrum represents an averaged spectrum, typically composed out of 5 or more scans.

2. Results

2.1. NMR spectroscopy

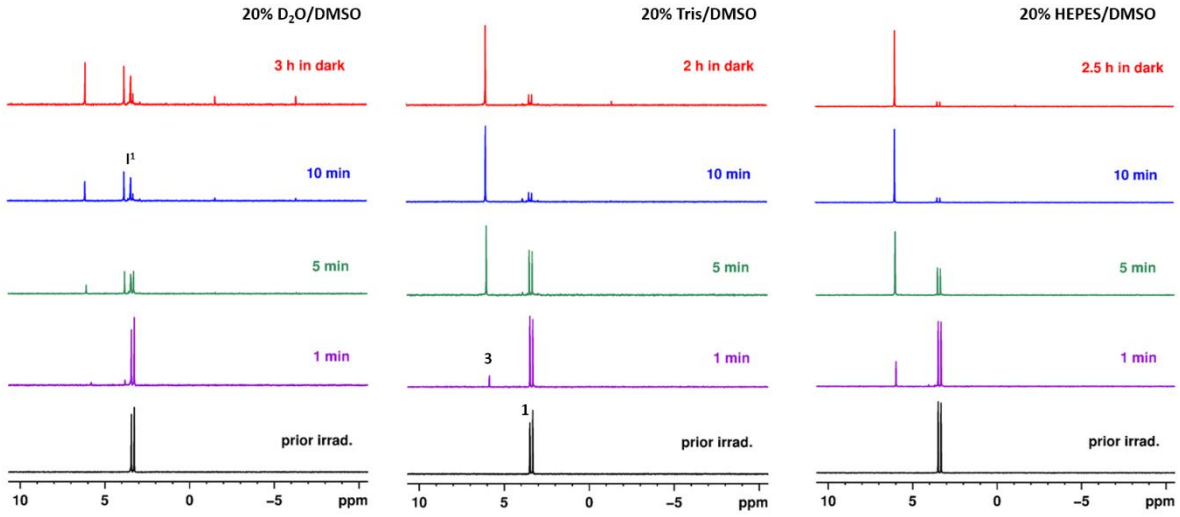


Figure S1. Activation pathway of compound **1** monitored by ^{31}P NMR spectroscopy (8 mM, 1 min., 5 min. (1+4) and 10 min. (1+4+5) *ex situ* irradiation) in three different solvent mixtures: 20% (v/v) D_2O/DMSO-d_6, 20% (v/v) Tris/DMSO-d_6 and 20% (v/v) HEPES/DMSO-d_6.

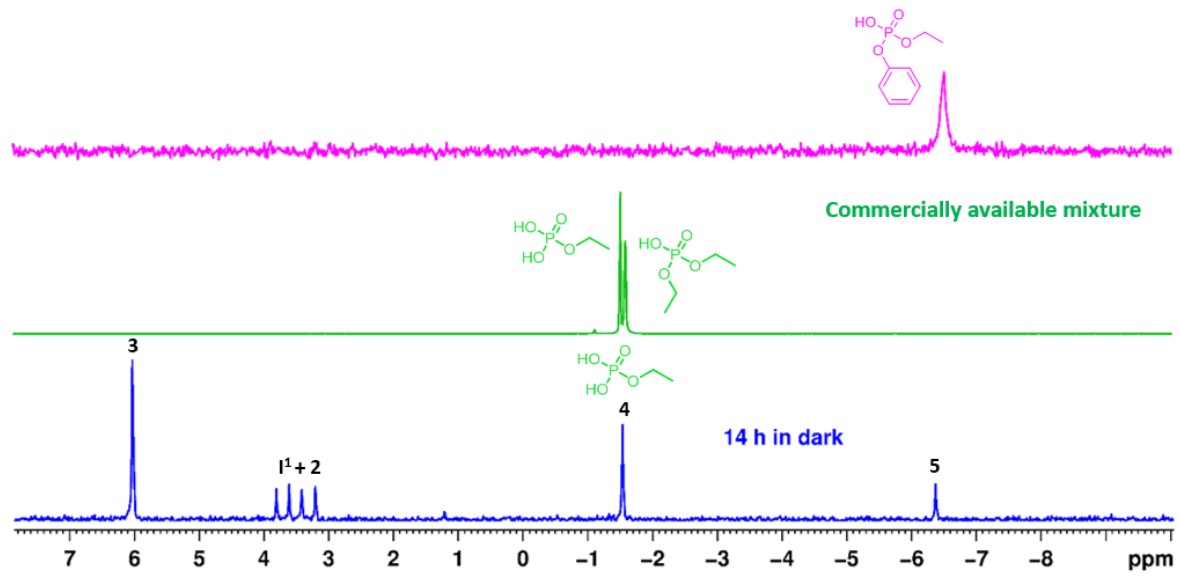


Figure S2. Activation of ProTide analogue **2** (24 mM in 20% (v/v) D_2O/DMSO-d_6) monitored by ^{31}P NMR spectroscopy. To identify the side products with phosphorus chemical shift ca. –1.5 and –6.5 ppm, we used a commercially available standard measured in 20% (v/v) D_2O/DMSO-d_6 to provide a clear evidence of presence of ethyl phosphate **4** and we prepared phenyl phosphate derivative **5**.

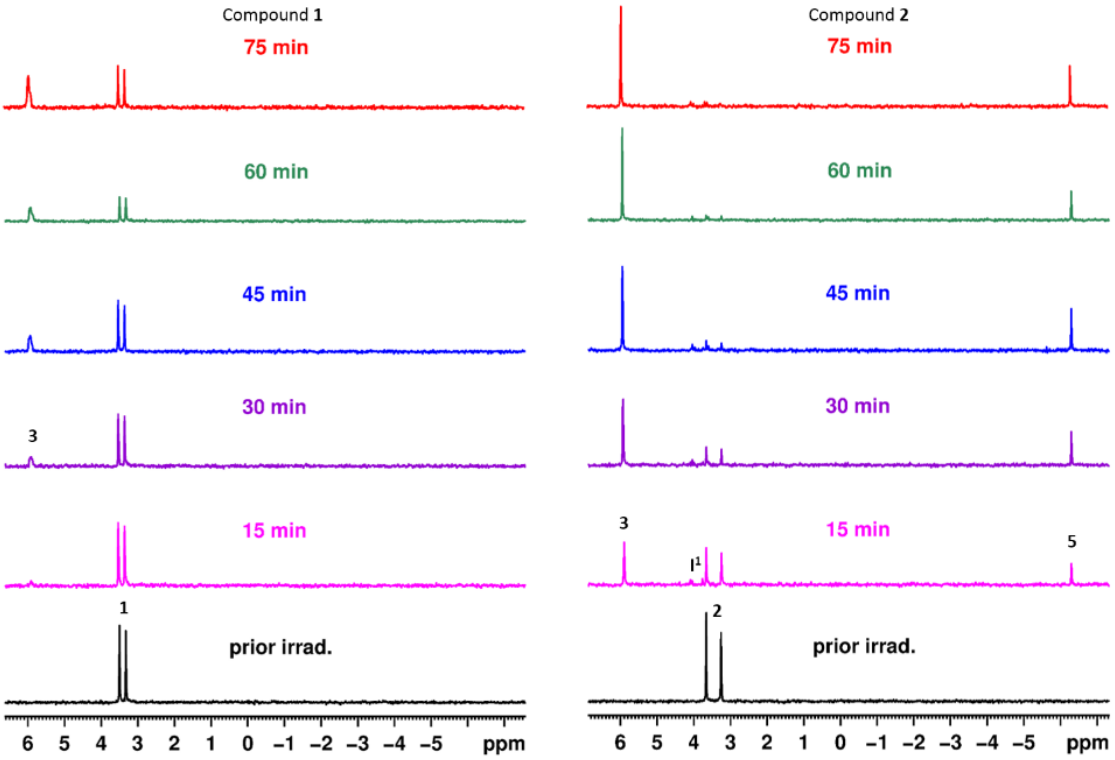


Figure S3. Activation of compounds **1** (left) and **2** (right) showing different rates of photoactivation in 20% (v/v) Tris/DMSO-d_6 monitored by ^{31}P NMR with *in situ* irradiation.

In situ structure determination of the intermediate **I^1**

For this determination, we selected 20% (v/v) D_2O/DMSO-d_6 solvent mixture, which stabilized the intermediate **I^1** significantly as shown in Figure S1. With respect to the fact that this structure determination is based on ^{13}C measurements and natural abundance of ^{13}C is quite low (ca. 1%), we needed to prepare a sample with higher concentration (24 mM) to record ^{13}C spectra in reasonable time. However, at this high concentration, we could not use our device for *in situ* irradiation to cleave the photoremovable group effectively. Therefore, we employed *ex situ* irradiation approach, and we irradiated the sample with 365 nm light for 30 minutes outside of the NMR spectrometer. We monitored the reaction rate and the composition of the reaction mixture by ^{31}P NMR spectroscopy. As shown in Figure S4, after 30 minutes of irradiation outside of the NMR spectrometer, the intermediate **I^1** was obtained as a major component in reaction mixture. After 14 hours, most of the intermediate **I^1** converted into the monoamidate product **3**, which became the major component.

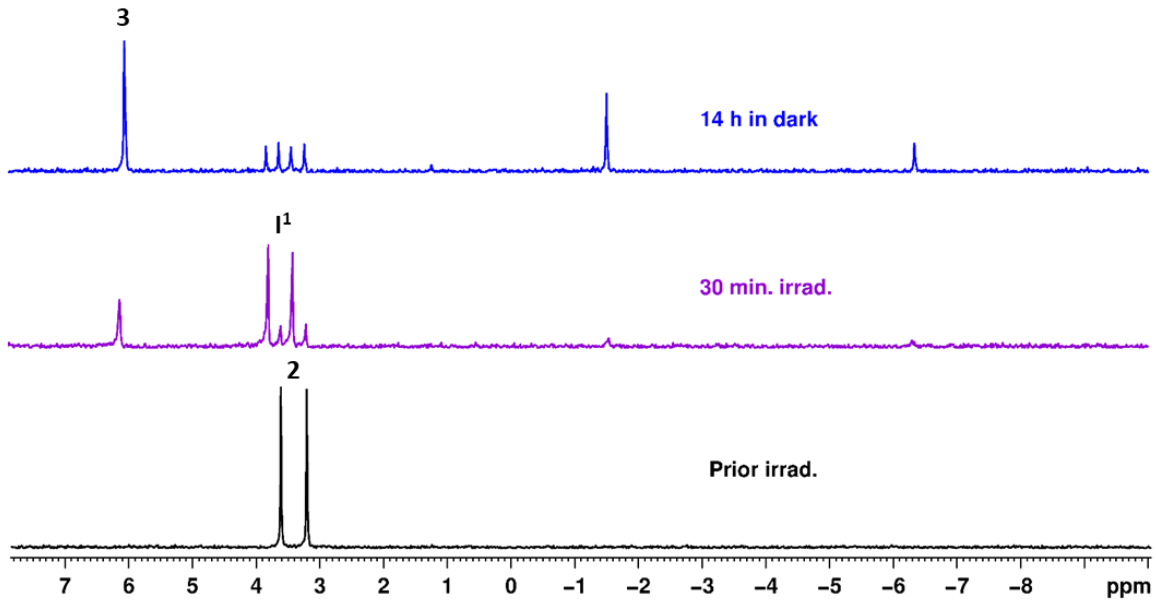


Figure S4. Activation of ProTide analogue **2** (24 mM in 20% (v/v) D_2O/DMSO-d_6) monitored by ^{31}P NMR spectroscopy. Immediately after the irradiation, the intermediate **I**^{1} is a predominant component. After several hours in dark, **I**^{1} is converted into the final product **3**.

The structure of the intermediate **I**^{1} was determined by comparison of ^{13}C-APT NMR spectra recorded immediately after the irradiation and after several hours, when the final product **3** was formed (Figure S5). We measured APT (attached proton test) spectra, because they helped us to distinguish between the signal of quaternary and CH_2 carbons (signals "up") and signal of CH/CH_3 groups (signals "down"). In Figure S5, ^{13}C-APT spectra are divided into four parts going from aromatic region (spectrum on top) to aliphatic region (bottom spectrum) for clarity. The red spectrum in Figure S5 was recorded immediately after the irradiation, when the major component was the intermediate **I**^{1}. The signals corresponding to the intermediate **I**^{2} disappear after several hours when **I**^{1} is transformed into the final product **3**. Therefore, we recorded the second ^{13}C-APT spectrum after several hour (black), and we could identify signals corresponding to the intermediate (the red one, which disappeared from the black spectrum).

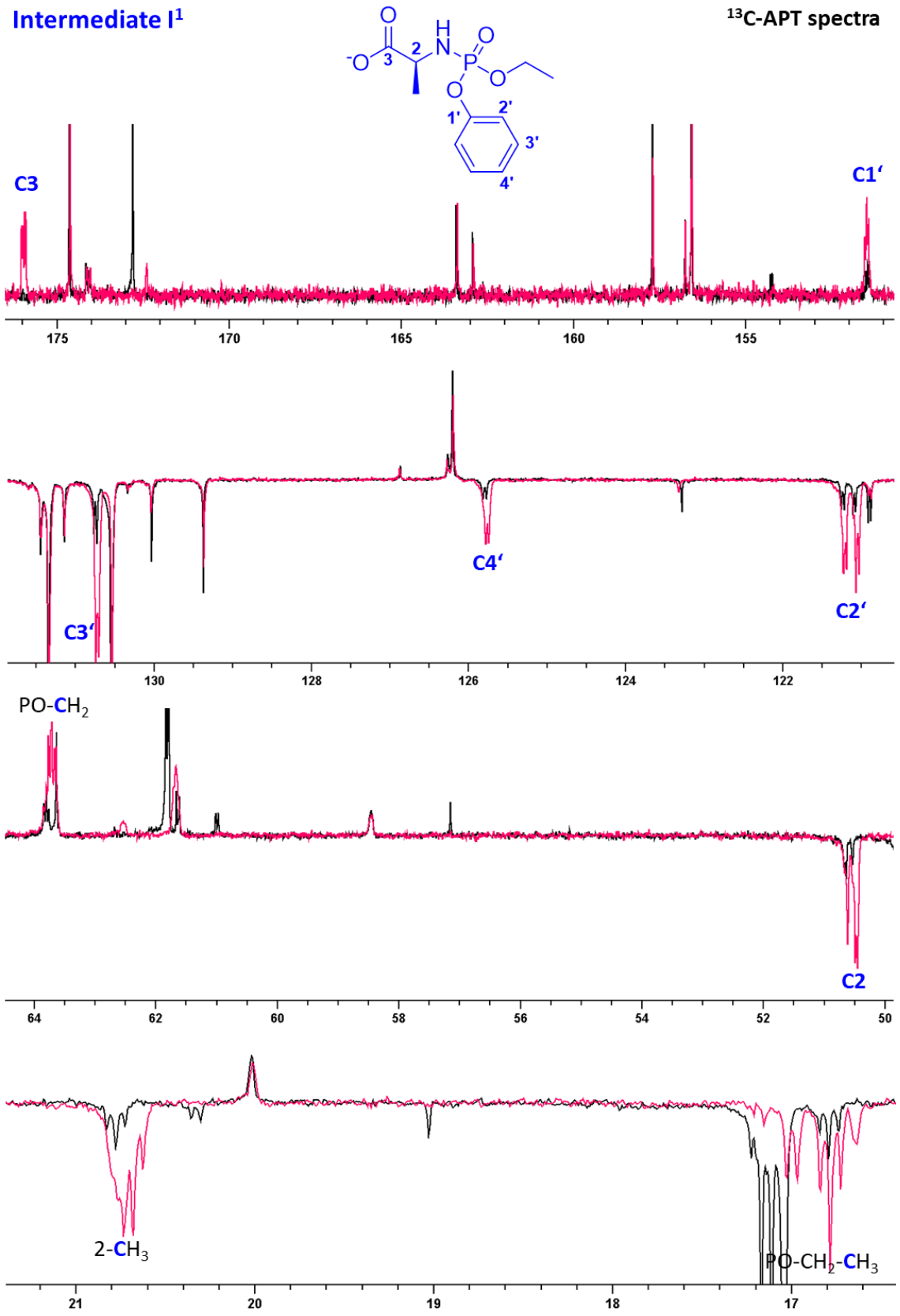


Figure S5. *S*tructure determination of intermediate **I**[1] by comparison of ^{13}C-APT spectra of compound **2** in 20% (v/v) D_2O/DMSO-d_6 (24 mM) after 30 min*utes* of *ex situ* irradiation (red) when the concentration of intermediate **I**[1] was the highest, and after several hours when the intermediate **I**[1] was quantitatively converted into the final product **3** (black).

In situ structure determination of the monoamidate product **3**

The highest concentration of the final product **3** was detected in 20% (v/v) Tris/DMSO-d_6 mixture, where the intermediate **I**[1] is quickly converted into the final product (Figure S6). As a starting compound, the ProTide analogue **1** was used, because no side products with phosphorus signal around –6 ppm were detected (see compounds comparison in Figure S2). To record the ^{13}C NMR spectra, the sample with higher concentration (8 mM) was prepared, and therefore, *ex situ* irradiation was used.

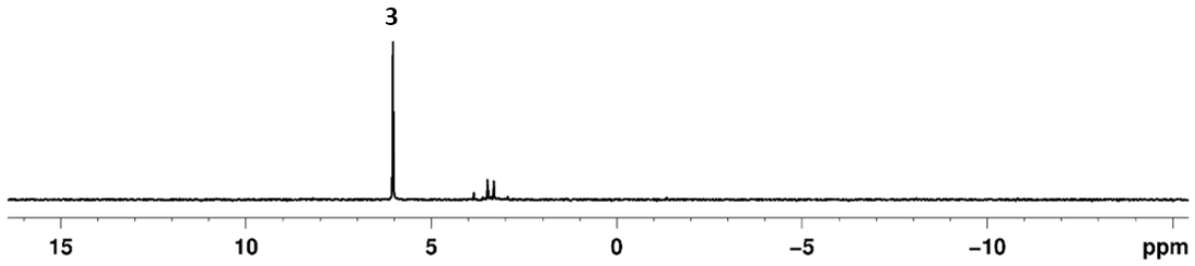


Figure S6. ^{31}P NMR spectrum of ProTide analogue **1** in 20% (v/v) Tris/DMSO-d_6 (8 mM) after 10 minutes *ex situ* irradiation.

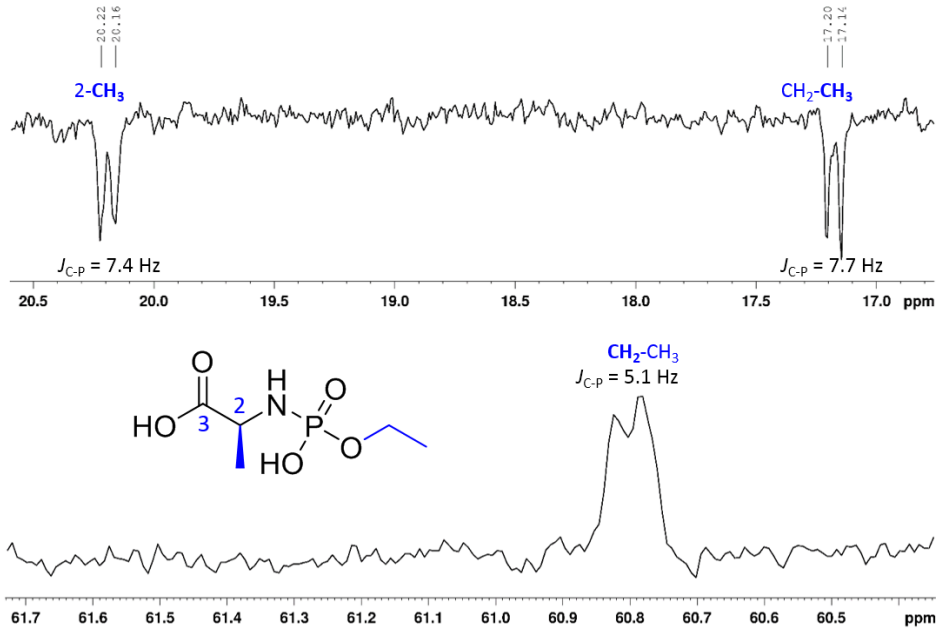


Figure S7. ^{13}C APT NMR spectra of the final product **3**, where the signal splitting caused by C-P spin-spin interaction ($J_{C\text{-}P}$) is observed. This is a clear evidence that ethyl as well as amino acid moieties are connected to the phosphorus atom.

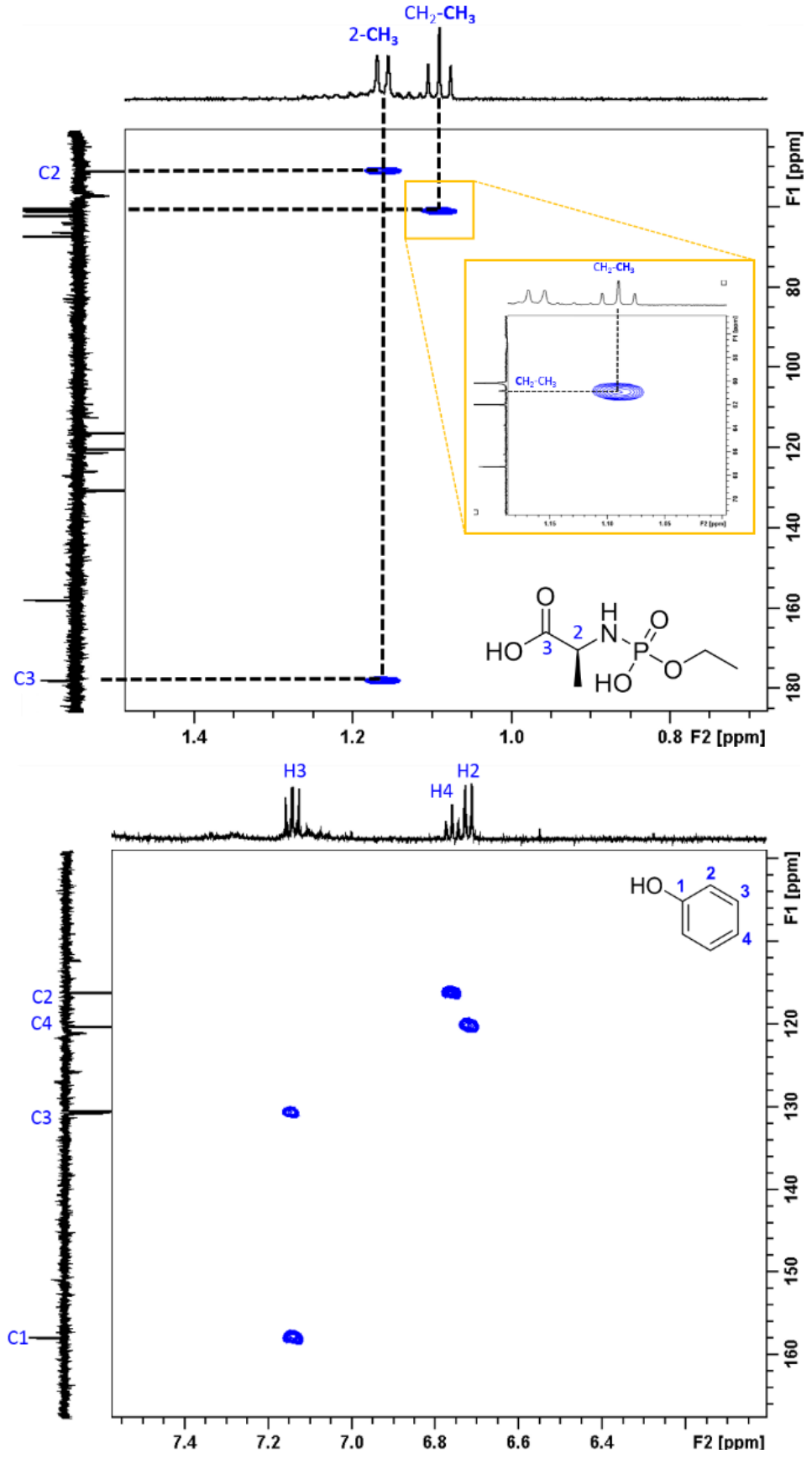


Figure S8. *In situ* structure determination of the final product **3**. Part of the H,C-HMBC spectrum, which confirms the structure of the final product (top) and released phenol (bottom).

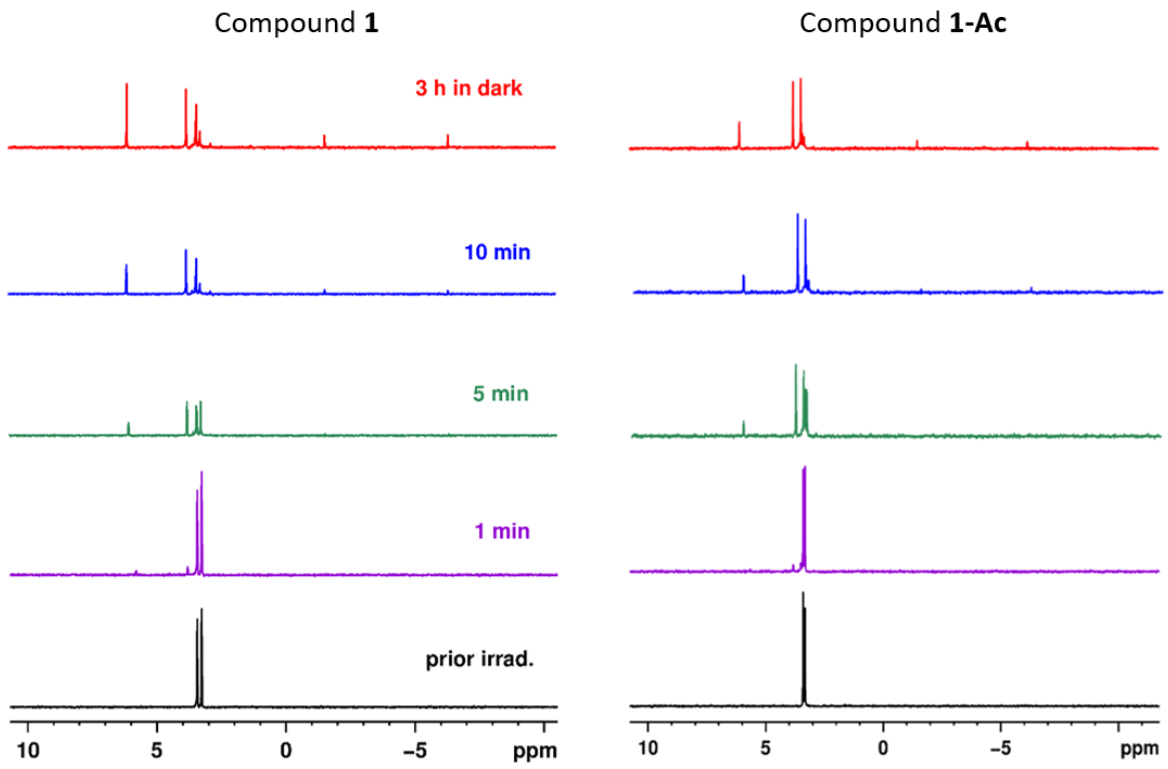


Figure S9. Comparison of the activation pathway of compound **1** (left) and **1-Ac** (right) monitored by ^{31}P NMR spectroscopy (8 mM, 1 min., 5 min. (1+4) and 10 min. (1+4+5) *ex situ* irradiation) in 20% (v/v) D_2O/DMSO-d_6. Both spectra show that **1-Ac** undergoes the same activation pathway as **1**.

2.2. Mass spectrometry

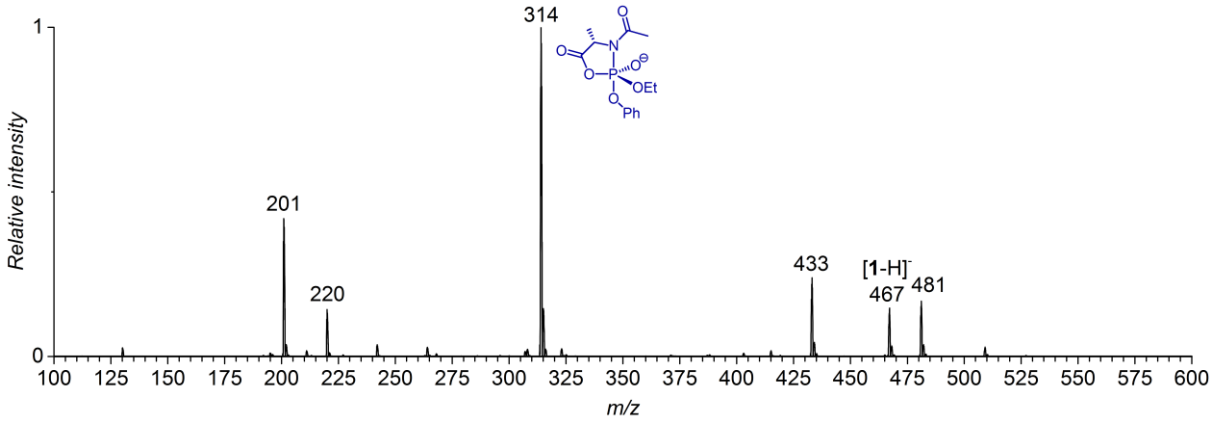


Figure S10. Negative-mode atmospheric pressure ionization (APCI) mass spectrum of the methanolic solution of pure **1-Ac** (0.8 mM; HPLC grade methanol was used), which was irradiated with 365 nm light for 10 minutes at room temperature before APCI. APCI conditions: 10 μA discharge current, 1.75 kV voltage, 400 °C vaporizer temperature, 230 °C capillary temperature, N_2 sheath gas 90 psi, 2 ml/hour flowrate. The signal of the anion with *m*/*z* 314 was optimized to get the highest intensity, which was required for IRPD experiments. We note that no signal with *m*/*z* 314 is present without the sample irradiation. The spectrum also contains the signal of deprotonatated **1**, which is present in the sample as impurity.

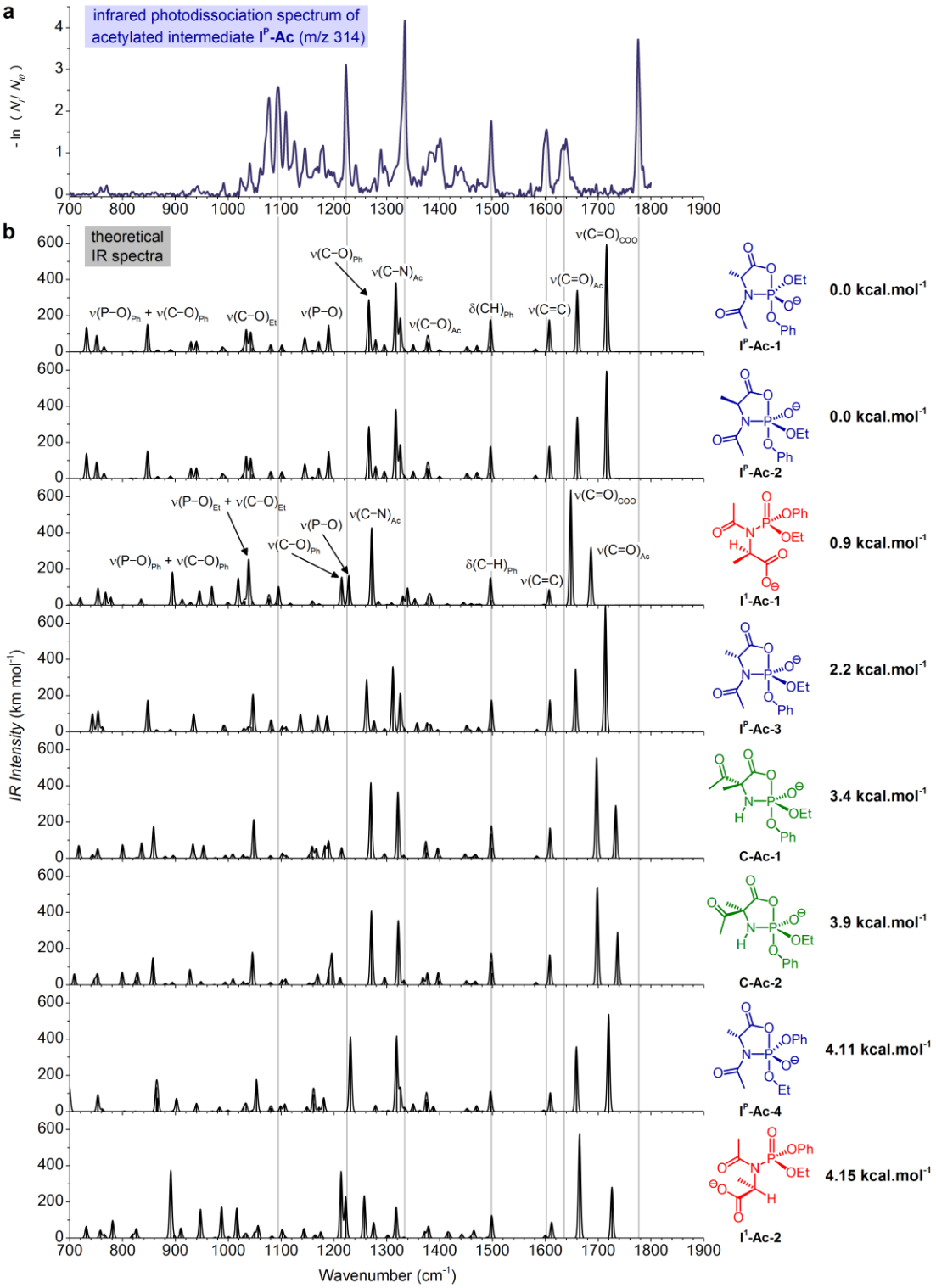


Figure S11. (a) Infrared photodissociation spectrum of a singly charged anion with *m*/*z* 314 corresponding to the *N*-acetylated intermediate **I^{P}-Ac** measured using the D_2 tagging technique at 20 K. The methanolic solution of **1-Ac** was irradiated by 365 nm light for 10 minutes before the transfer to the gas phase using APCI source (please refer to Figure S10 for exact ionization conditions). (b) Theoretical infrared spectra of isomeric anions with a *m*/*z* 314 calculated at the B3LYP-D3/6-311*G++ level (frequencies were scaled by 0.985) broadened with Gaussians (FWHM 5 cm^{-1}). The relative energies include zero-point energy correction. Isomers are ordered according to their relative energetic stability and distinguished by the following colour code: blue – **I^{P}-Ac** intermediates; red – **I^{1}-Ac** intermediates; green – other, *C*- and *P*-acetylated structures, which we also considered but which would

have to result from *N*-acetyl group rearrangement during the transfer of ions to the gas phase (this is very unlikely). The XYZ coordinates of all structures, which are given below, follow the same atom numbering.

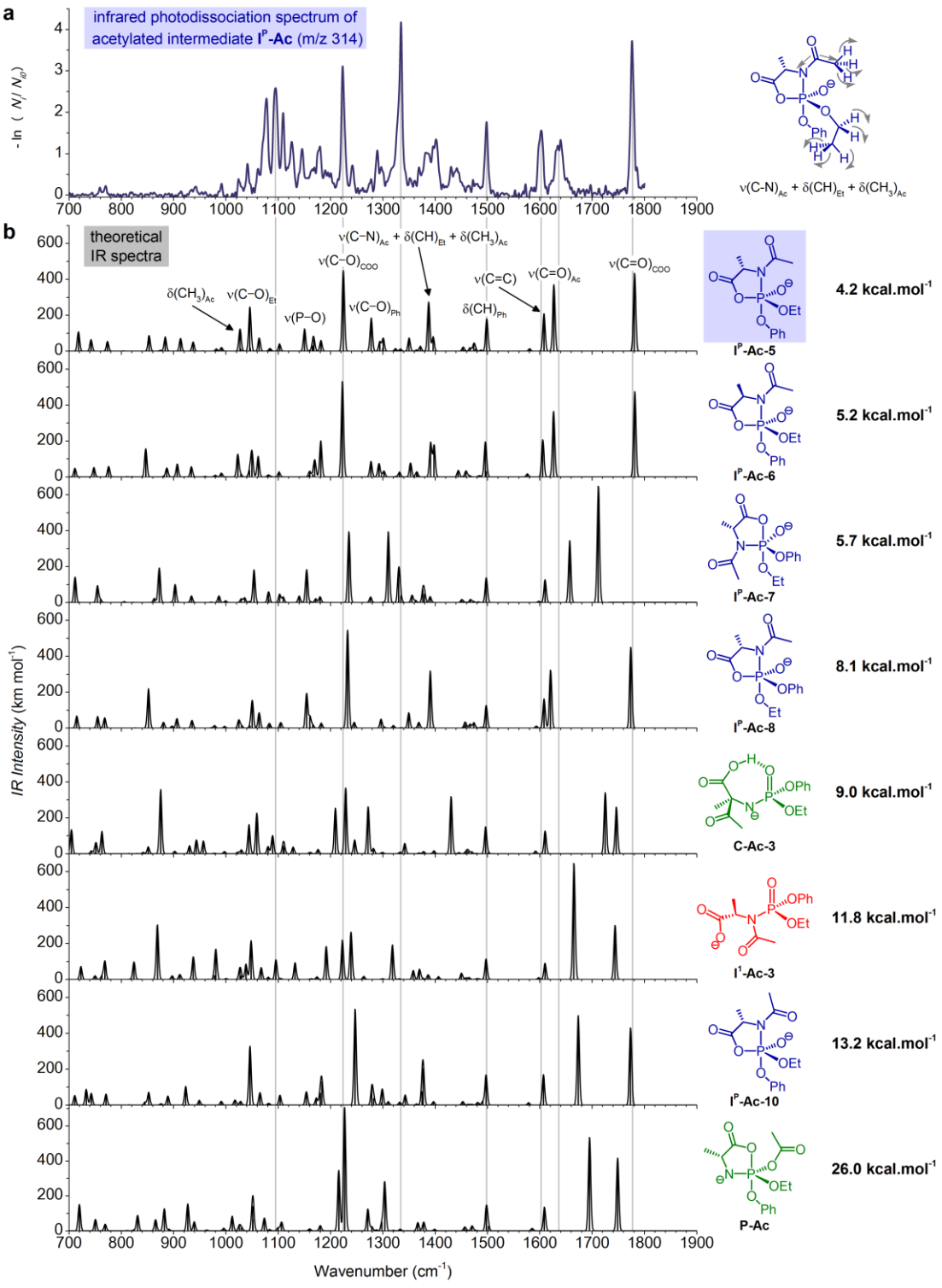


Figure S11 (continued). The structure of **I^P-Ac** intermediate assigned to the experimental spectrum is highlighted with a blue box. We also included the visualization of a motion resulting from the coupling between the ν(C–N) vibration of the *N*-acetyl group and deformation vibrations of neighbouring methyl and ethyl groups. This coupling most likely red-shifts the ν(C–N) frequency by approximately 50 cm^{-1}, compared with the experimental value.

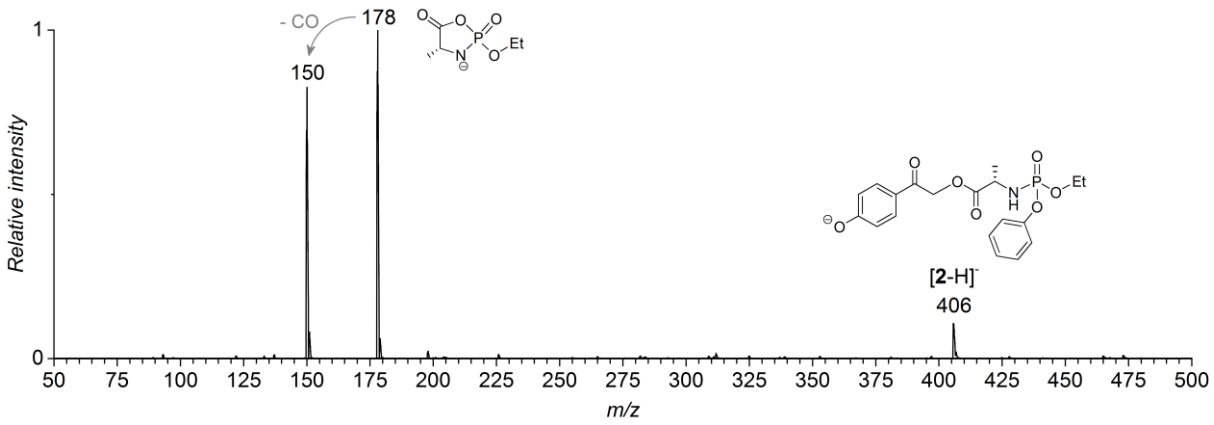


Figure S12. Negative-mode electrospray ionization (ESI) mass spectrum of the methanolic solution of **2** (1 mM). ESI conditions: 6 kV voltage, 300 °C capillary temperature, N_2 sheath gas 30 psi, –12 V capillary voltage, –130 V tube lens voltage, 0.15 ml/hour flowrate. The signal of the studied $\mathbf{I^2}$ anion with mass of 178 was optimized to the highest intensity, which we achieved by hardening the ionization conditions (controlled by the tube lens voltage). The ion with *m/z* 150 results from a further fragmentation (loss of 28 mass units, most likely CO from $\mathbf{I^2}$).

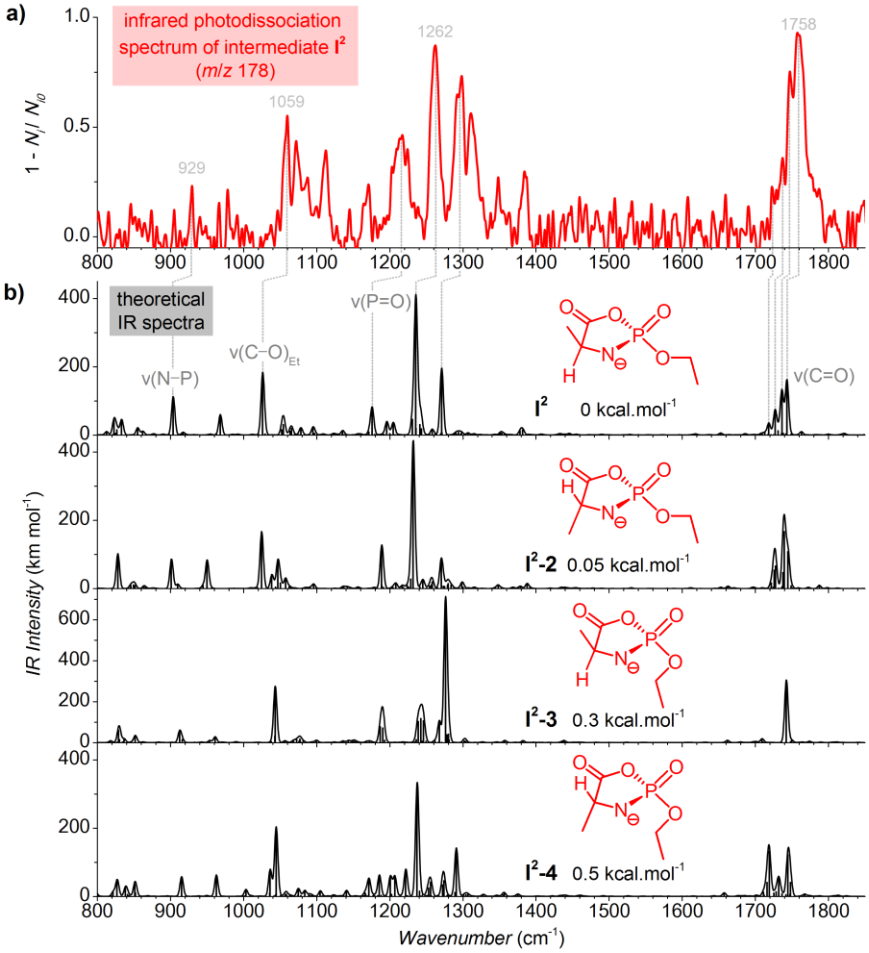


Figure S13. (a) Infrared photodissociation (IRPD) spectrum of a singly charged anion with *m/z* 178 corresponding to the deprotonated cyclic intermediate $\mathbf{I^2}$ measured using the D_2 tagging technique at 20 K. The ions were generated by dissociation of the parent [**2**-H] anion (*m/z* 406) during the transfer to the gas phase. (b) Theoretical anharmonic infrared spectra of isomeric anions with *m/z* 178 calculated at B3LYP-D3/6-311*G++ level. We would like to note, that geometry optimization of an acyclic isomer always converged to one of the cyclic isomers.

2.3. NMR and HR-MS spectra of the studied compounds

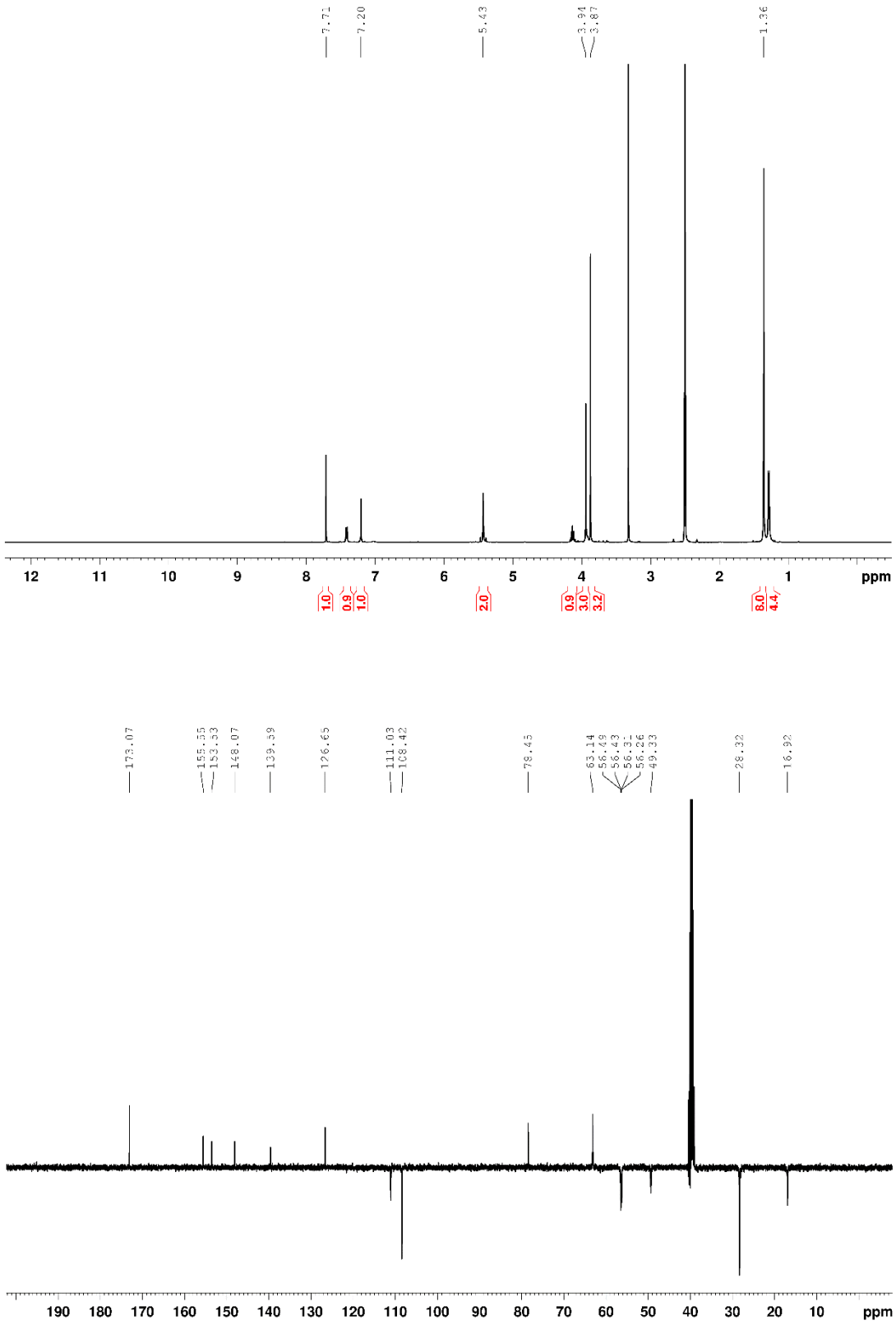


Figure S14: ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **12** measured in DMSO-d_6 at room temperature.

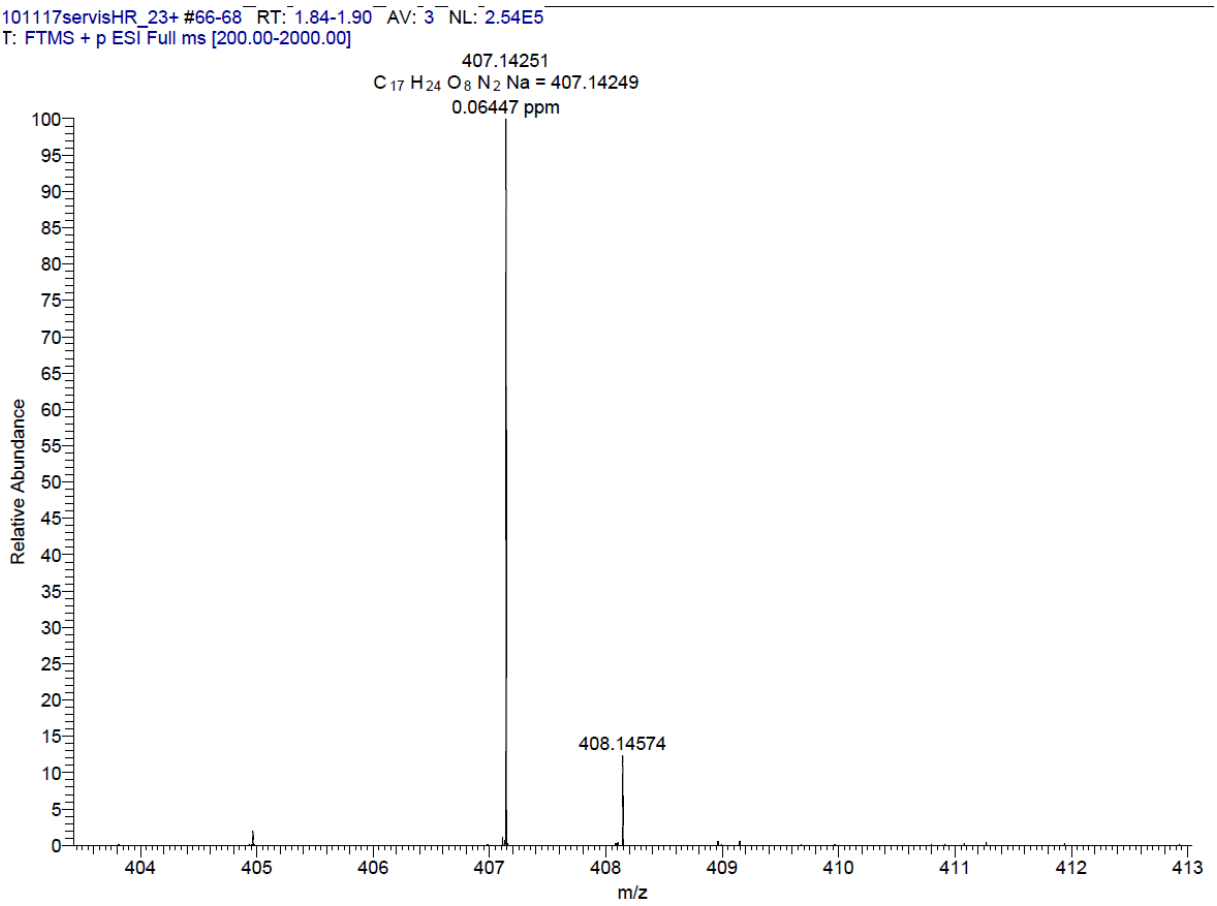


Figure S15: High-resolution mass spectra (HRMS) of compound **12**.

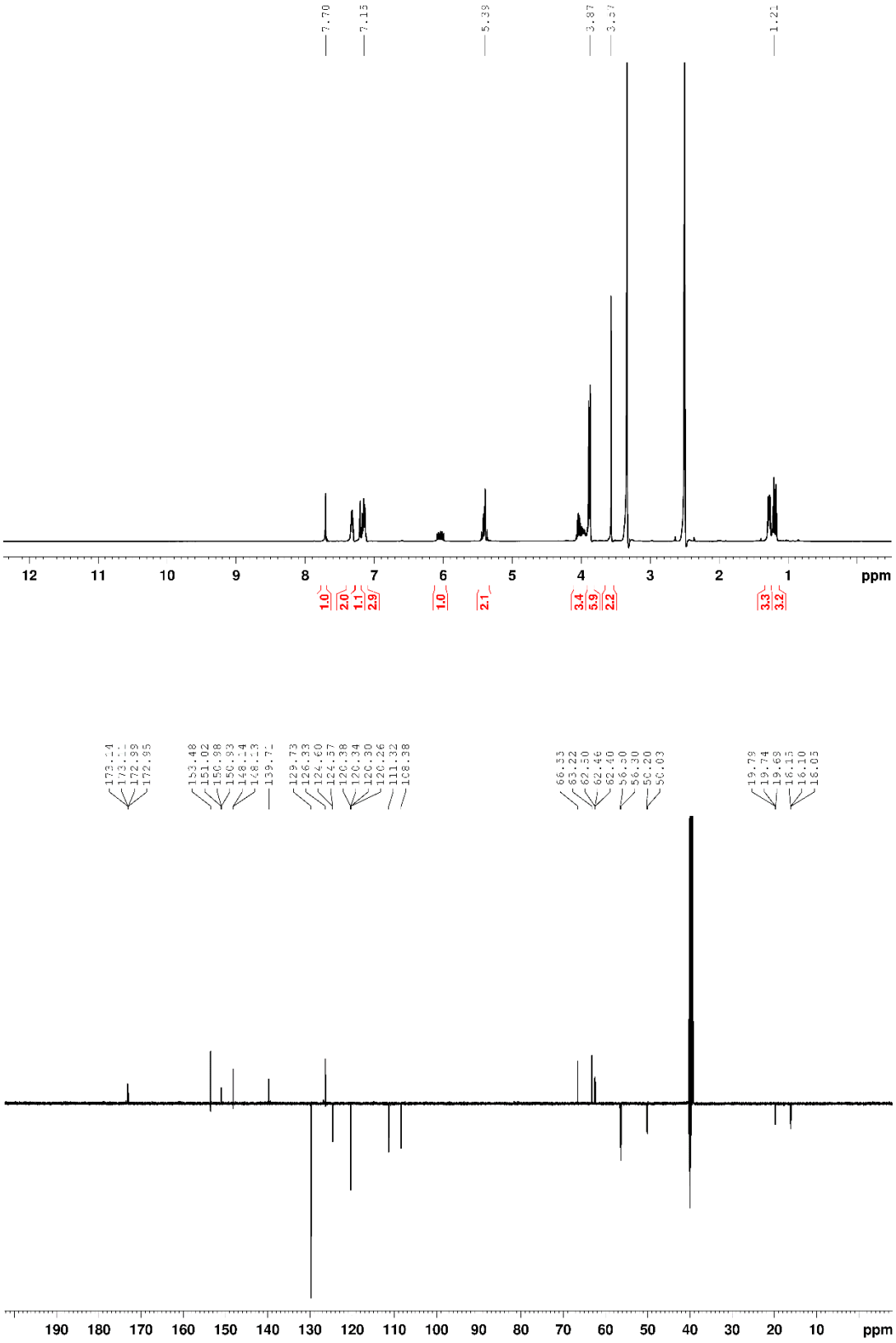


Figure S16: ^{1}H (top) and ^{13} C (bottom) NMR spectra of compound **1** measured in DMSO-d_6 at room temperature.

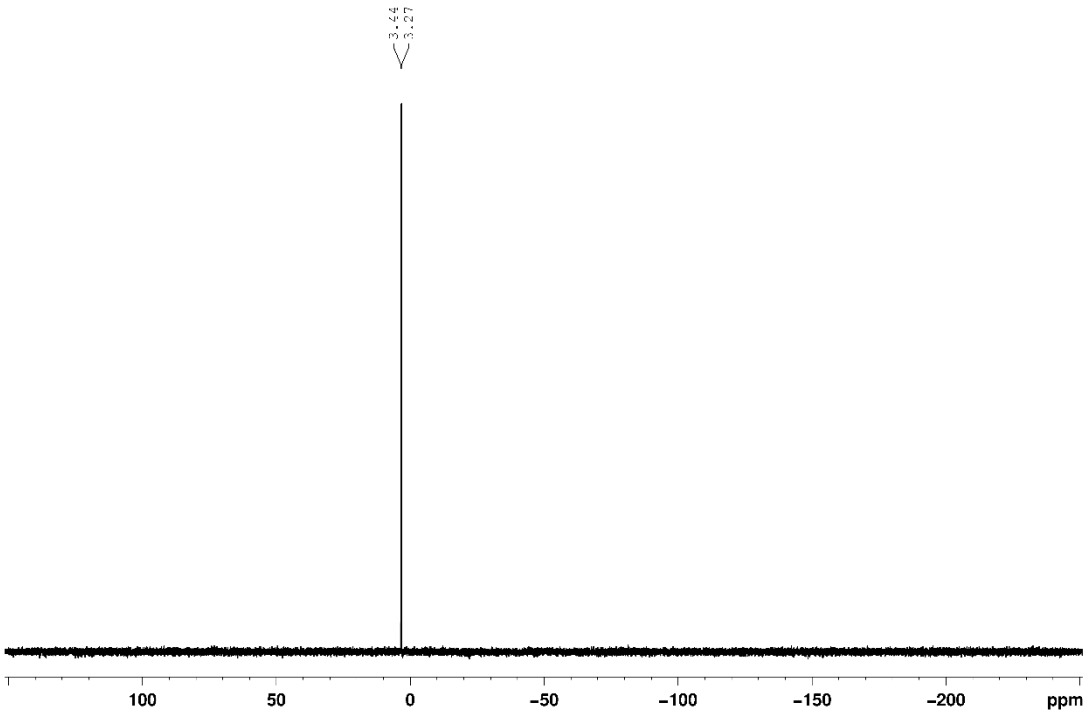


Figure S17: ^{31}P NMR spectrum of compound **1** measured in 20% D_2O/DMSO-d_6 at room temperature.

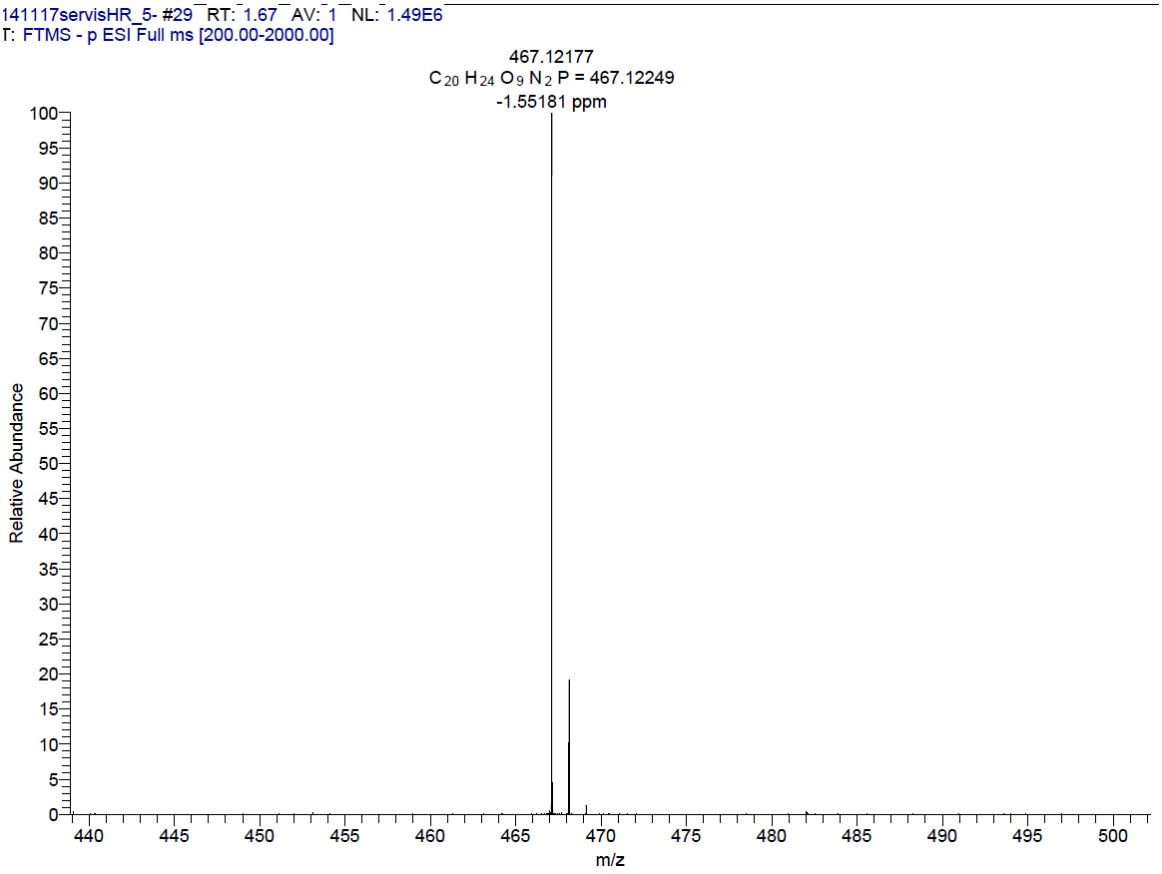


Figure S18: High-resolution mass spectra (HRMS) of compound **1**.

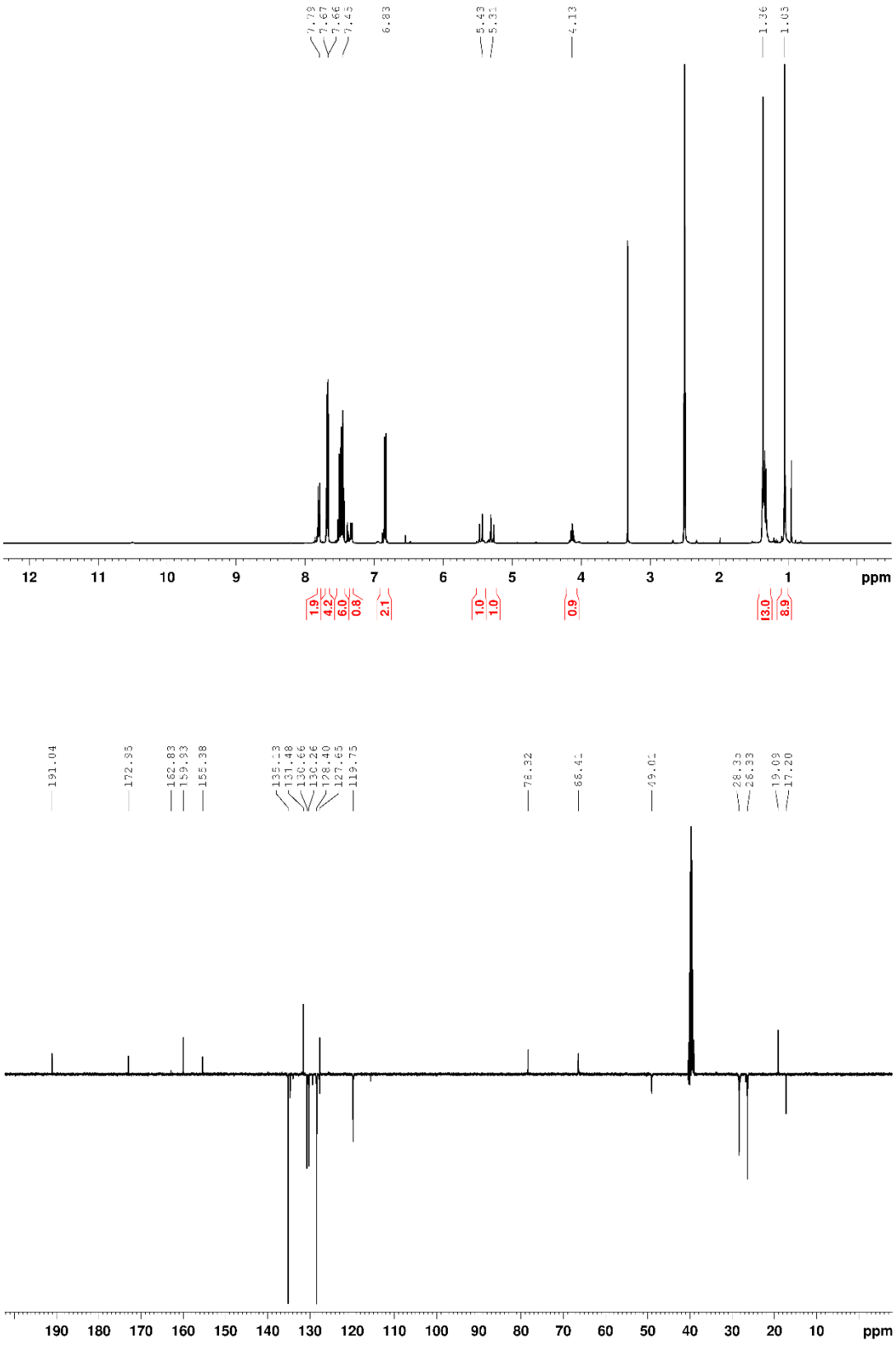


Figure S19: ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **14** measured in DMSO-d_6 at room temperature.

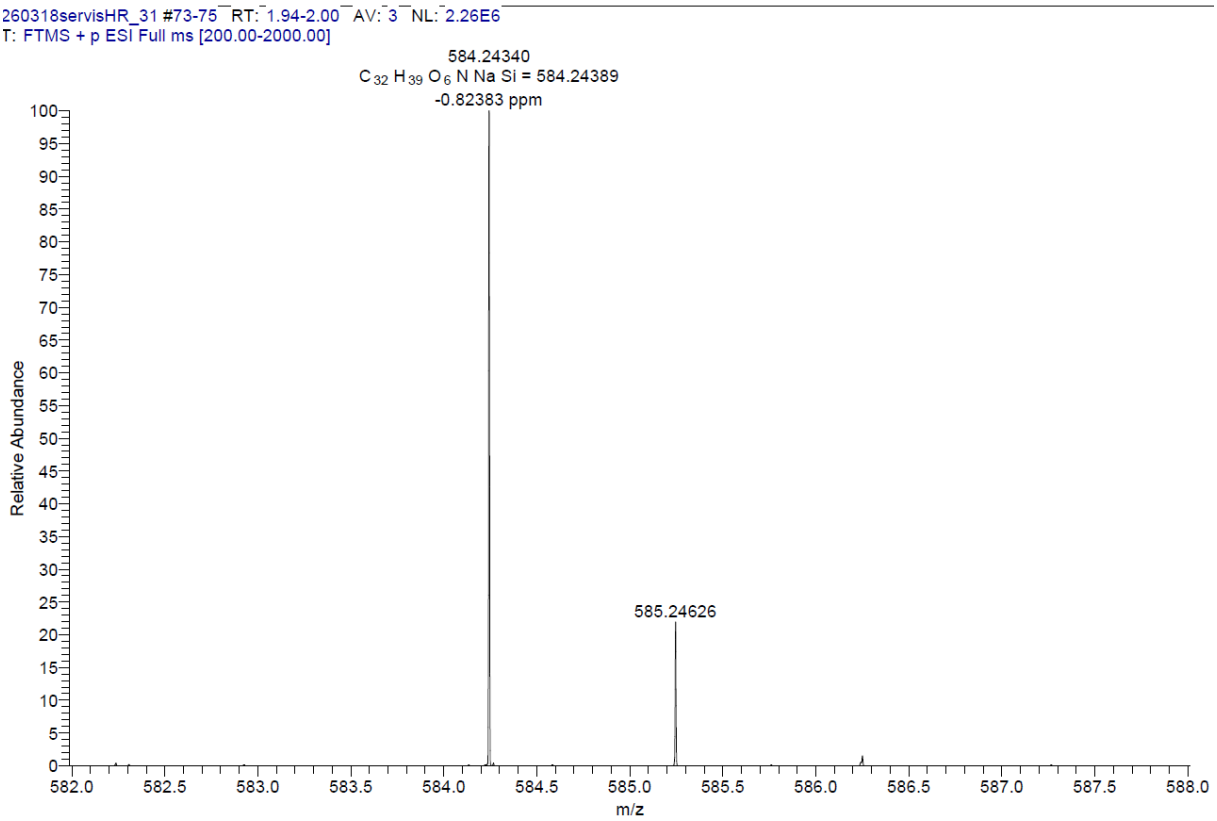


Figure S20: High-resolution mass spectra (HRMS) of compound **14**.

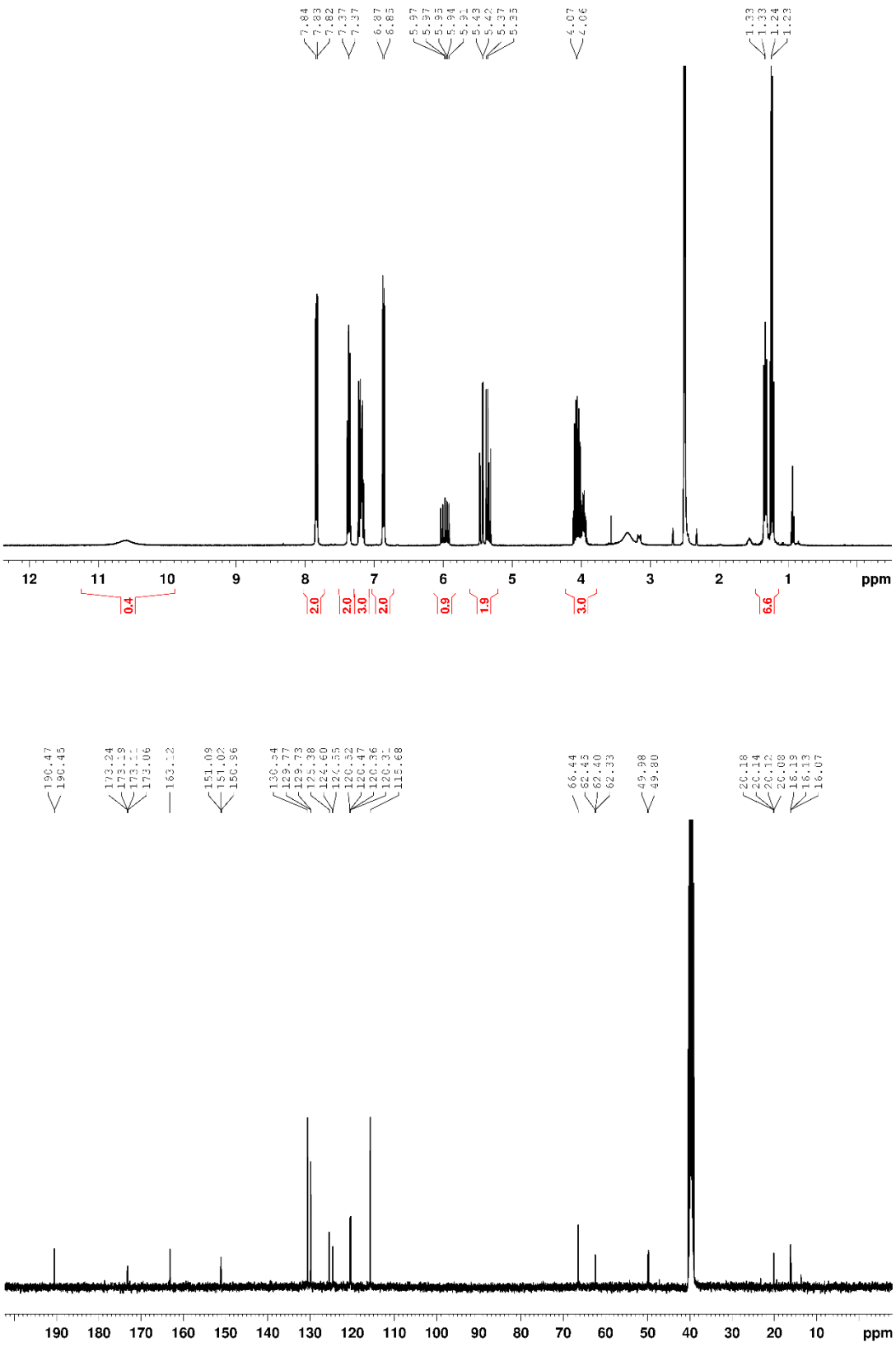


Figure S21: [1]H (top) and [13] C (bottom) NMR spectra of compound **2** measured in DMSO-d_6 at room temperature.

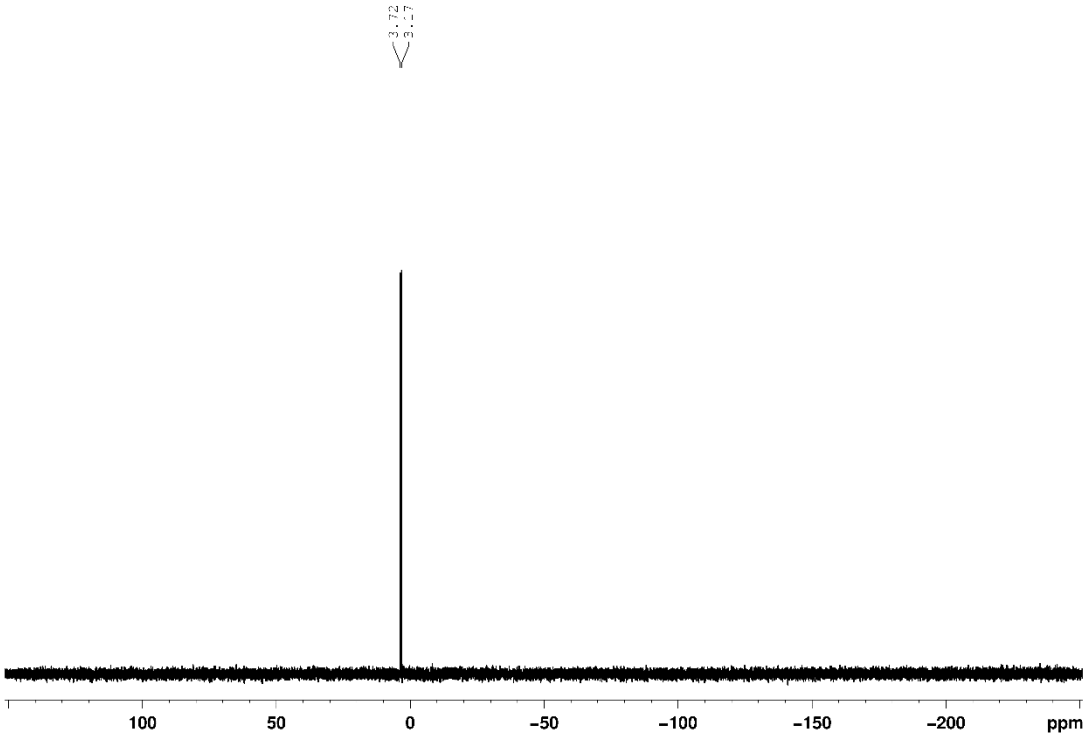


Figure S22: ^{31}P NMR spectrum of compound **2** measured in DMSO-d_6 at room temperature.

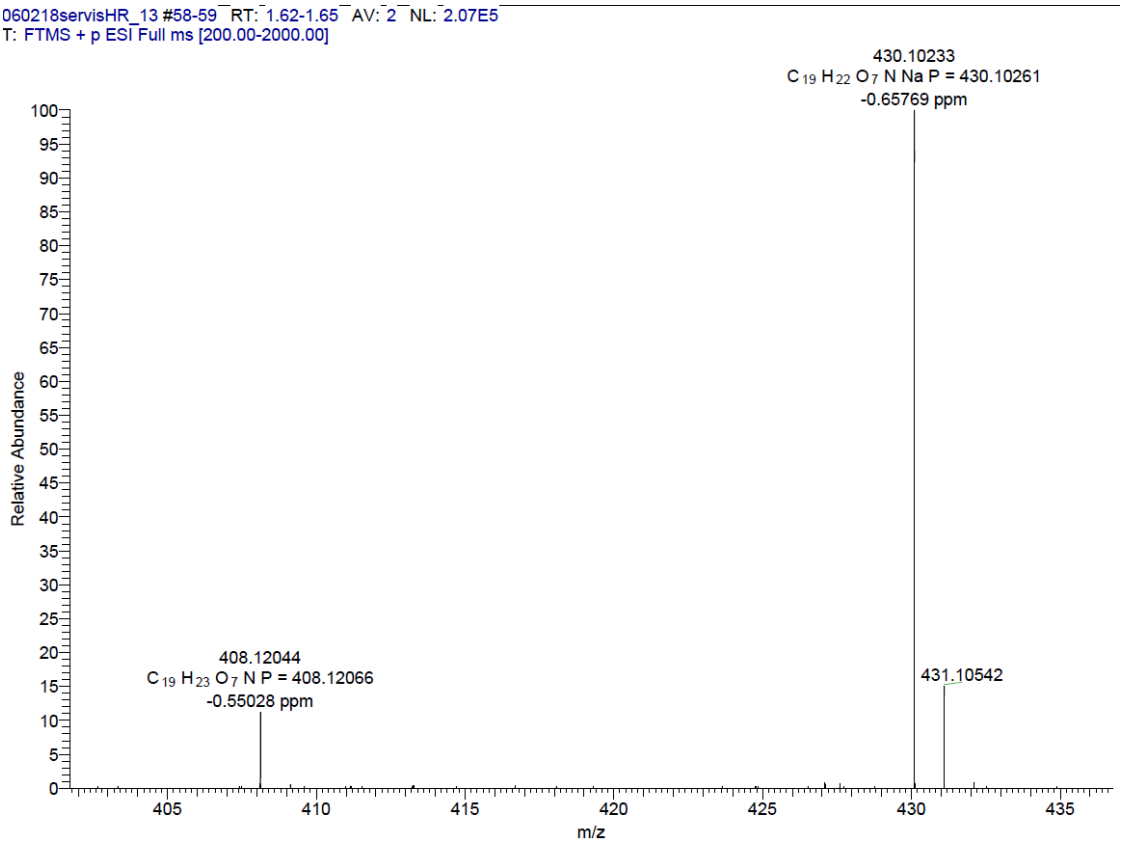


Figure S23: High-resolution mass spectra (HRMS) of compound **2**.

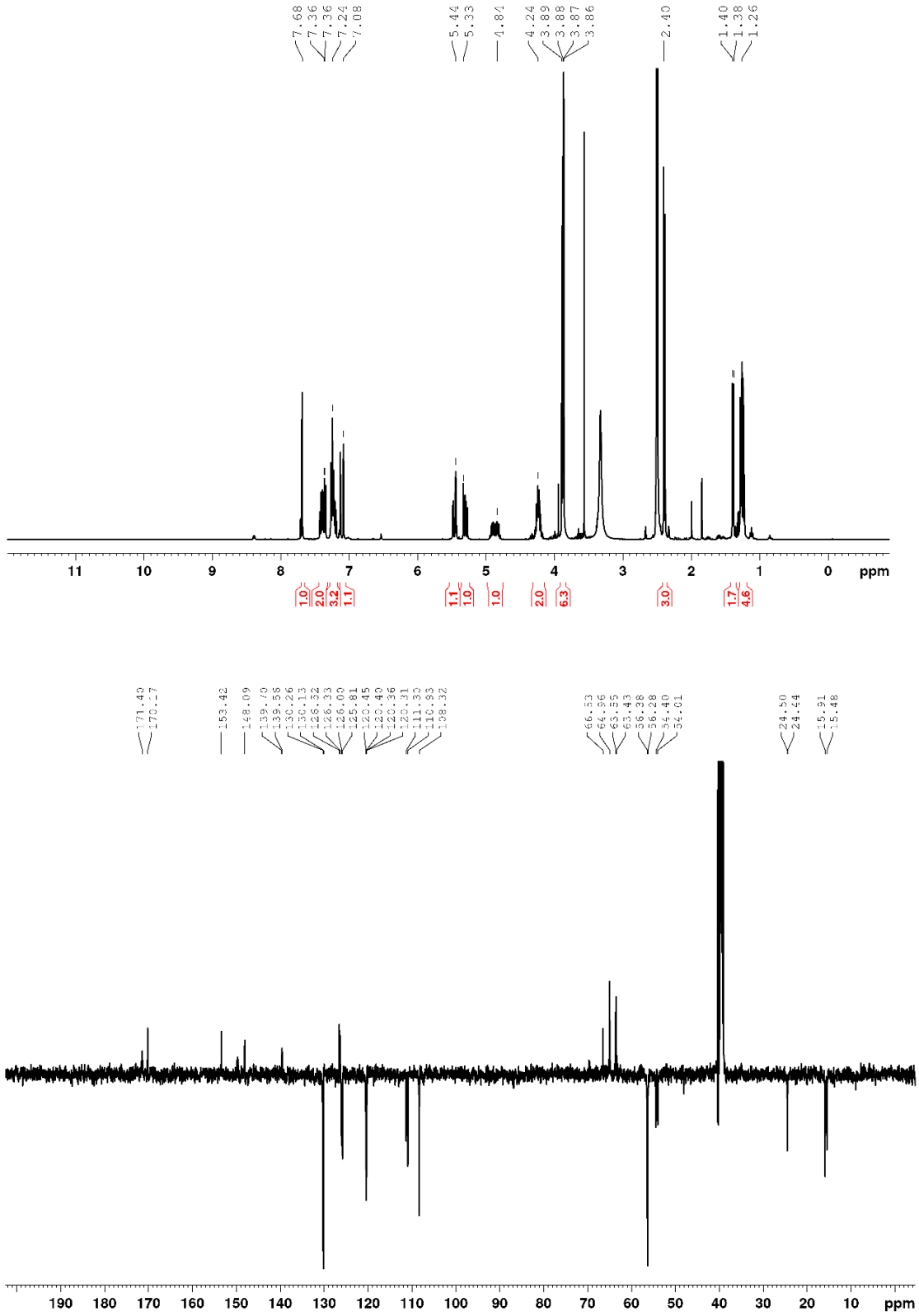


Figure S24: ^{1}H (top) and ^{13} C (bottom) NMR spectra of compound **1-Ac** measured in DMSO-d_6 at room temperature.

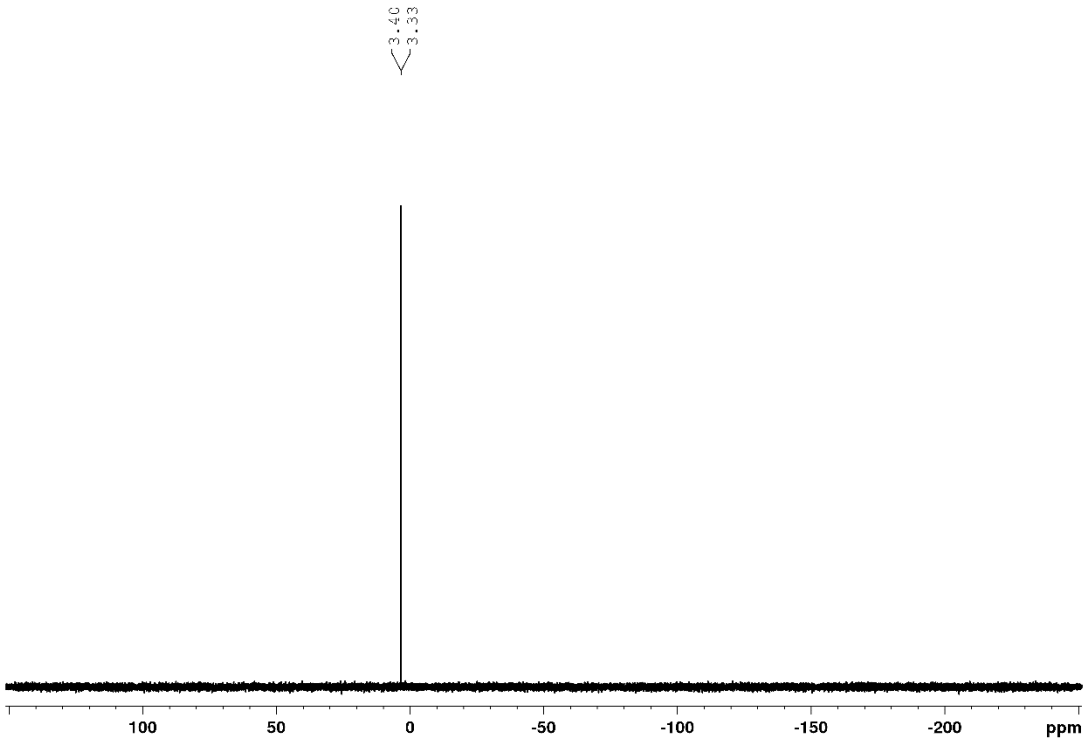


Figure S25: ^{31}P NMR spectrum of compound **1-Ac** measured in 20% D_2O/DMSO-d_6 at room temperature.

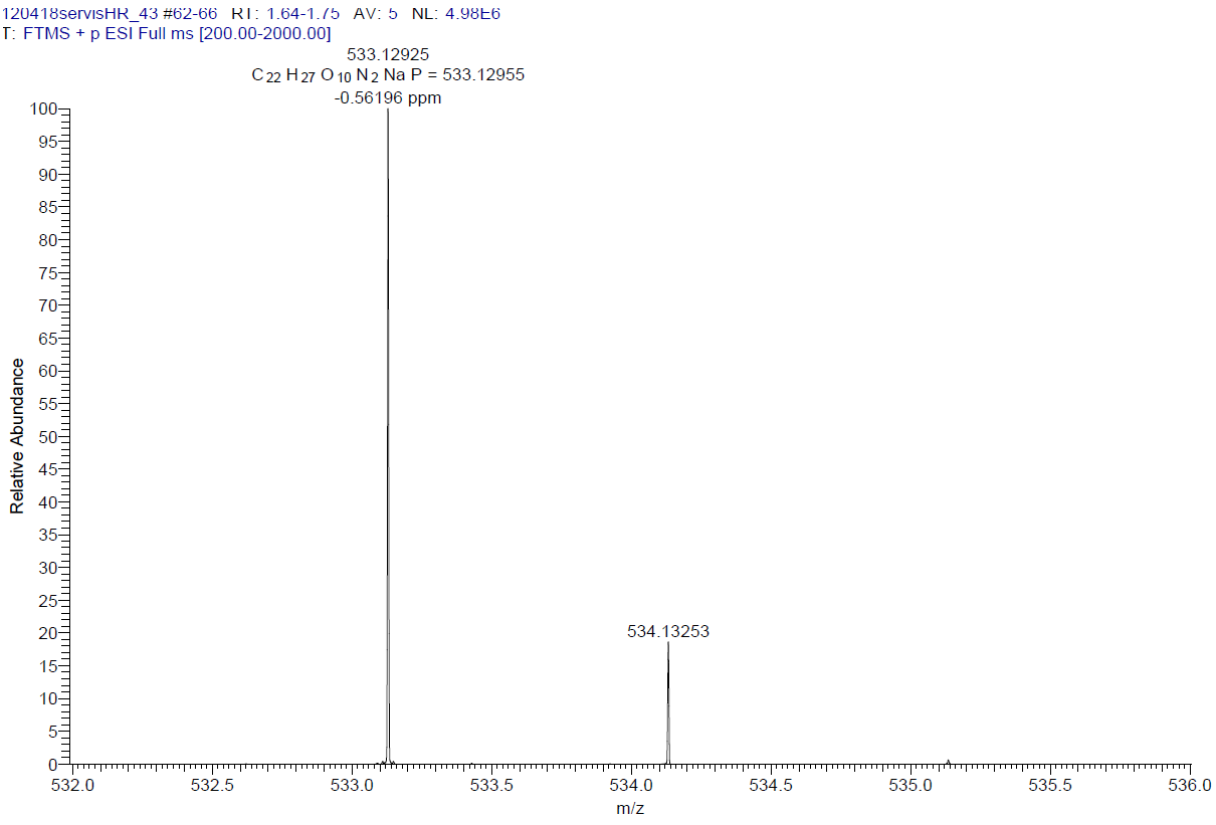


Figure S26: High-resolution mass spectra (HRMS) of compound **1-Ac**.

2.4. DFT calculations

Calculations of theoretical infrared spectra were carried out using density functional theory (DFT) with the B3LYP method, 6-311+G** basis set and Grimme's D3 dispersion correction as implemented in Gaussian G09 package. Calculations of the Hessian matrix were performed for all optimized structures at the same level of theory in order to ensure that structures correspond to energy minima and to obtain thereoretical infrared spectra. The theoretical infrared frequencies were scaled by 0.985. The anharmonic infrared spectrum was calculated as implemented in Gaussian G09 program by using the keyword *Freq=Anharmonic*. No frequency scaling factor was used in this case. The XYZ coordinates of all structures can be found at the end of Supporting Information.

2.5. XYZ coordinates of optimized structures

The format of individual records is following:

number_of_atoms

NAME charge multiplicity (1 = singlet) electronic_energy(Hartree) zero_point_energy(Hartree) number_of_imaginary_frequencies method / basis set

atom1 x y z

...

38

I^1-Ac-1 -1 1 -1353.6106205 0.2943441 0 RB3LYP-D3/6-311+G**

P 0.1534586809 -0.233977599 -0.2440571006

O -0.214667909 -1.4758800356 0.6644969906

O 0.5649680456 -0.9858464191 -1.6351688078

O 1.242124581 0.6202576645 0.2843398938

N -1.310232492 0.6183691538 -0.4757475347

C -2.6247592912 0.0206967564 -0.0442023327

H -3.3652779361 0.6378658603 -0.5525907585

C -2.8149159689 0.1814003073 1.4623772111

H -2.0692164747 -0.3937875915 2.0140684362

H -3.7989339988 -0.199517976 1.7370613348

H -2.739036957 1.2365880373 1.7429804193

C -2.8823005228 -1.4251355319 -0.5967870734

O -2.4623429699 -1.6375093496 -1.7632934455

O -3.5041109051 -2.1942865953 0.1605009838

C -1.3500474032 1.9646178739 -0.8690113707

O -2.4013294584 2.5867407872 -0.866140989

H 0.5788962946 2.8205930326 -0.449586392

H 0.4930863396 2.0824202214 -2.038109567

H -0.3696641988 3.6116201347 -1.7455880396

C -0.073848864 2.6592938059 -1.3077823541

C -0.3822235012 -2.8735618645 0.2581229761

H -1.1947553651 -3.2385015224 0.8836874954

H -0.7190243368 -2.9008749551 -0.7764299754

C 0.9209983454 -3.6176898532 0.4709193359

H 1.2535772011 -3.5391058409 1.5094048627

H 1.7031591758 -3.217390232 -0.178834158

H 0.7784733029 -4.676156115 0.2288963808

C 0.626969414 -0.3748790452 -2.8781331045

C 1.8635536253 0.0634302187 -3.346150973

C -0.5343057958 -0.2471817796 -3.6357641771

C 1.9386311324 0.6556082124 -4.6062097374

C -0.4409874289 0.3528339344 -4.8905462078

C 0.786434516 0.8058194679 -5.378994574

H 2.7354021072 -0.0496676747 -2.7134884646

H -1.462235643 -0.6184477195 -3.2045320446

H 2.8955652798 1.0060225021 -4.9784638056

H -1.3382061775 0.4675713712 -5.4894688555

H 0.8452334347 1.273482788 -6.3562040868

38

I^1-Ac-2 -1 1 -1353.6048414 0.2937704 0 RB3LYP-D3/6-311+G**

P 0.1635413509 0.3689403122 -0.8190450479

O 0.8233928197 -0.857615524 0.0436111816

O 0.2899802268 0.2148948318 -2.2887165757
O 0.9882706669 1.5867718483 -0.1840534905
C 0.6768385737 2.9640079775 -0.5729922903
H 1.227172744 3.1731346501 -1.4953941636
H -0.401631471 3.0518025029 -0.7226473251
C 1.0975613031 3.8588466068 0.5718970358
H 0.4813019655 3.6460580554 1.4466524401
H 2.1542711086 3.7153950263 0.815835668
H 0.9370421274 4.9047266829 0.2930633673
N -1.3780962795 0.3961904442 -0.1757444723
C -1.4594262207 0.641106499 1.3070644056
C -2.0479083502 2.0767051485 1.6269907681
O -2.2942158459 2.2503538695 2.8364980552
O -2.1063823052 2.8797350176 0.6676184708
C -2.0946627067 -0.5196356878 2.069716893
H -2.0344510131 -0.2897566914 3.134267361
H -3.1413538485 -0.64199662 1.7990809271
H -1.556103514 -1.4514338131 1.8648990859
H -0.4230459215 0.7158906048 1.6406397623
C 2.1746300764 -1.1364320204 0.090011895
C 2.7089532381 -1.4456248763 1.3390268261
C 2.9704643882 -1.1646986269 -1.0559429381
C 4.0544061546 -1.7889563338 1.4435893782
C 4.3172921414 -1.5022115504 -0.9349069791
C 4.8654379377 -1.8170811257 0.3085486086
H 2.060300131 -1.4064416893 2.2054391022
H 2.5292270513 -0.9186949448 -2.0136197673
H 4.4701544668 -2.0280748617 2.416503831
H 4.9398892395 -1.5210940712 -1.8231001527
H 5.9139894256 -2.0803428691 0.3927261844
C -2.5880784789 0.4195714091 -0.9026241997
O -3.647426928 0.2920194268 -0.3260890825
H -3.5797127116 0.6590029896 -2.7440167856
H -2.0292791798 1.5420485694 -2.6593234916
H -2.0118624438 -0.1927302797 -2.9058374121
C -2.5456966486 0.615087796 -2.4052616613

38

I^{1}-Ac-3 -1 1 -1353.5918118 0.2928533 0 RB3LYP-D3/6-311+G**
P 0.1965977543 0.5597872049 0.2487625912
O -0.671040052 -0.7896126957 -0.143733401
O 0.1711737433 0.8427292531 1.7047833898
O -0.5283389869 1.7009380101 -0.6517484709
C -1.573337477 2.5336668498 -0.1015204965
H -2.5203066557 1.9861514955 -0.1498065561
H -1.3479641555 2.742087567 0.9475016258
C -1.6283816947 3.8040505625 -0.9277107717
H -0.6757156372 4.3353267974 -0.8726341748
H -1.8333916046 3.5725350933 -1.9756724337
H -2.4206875976 4.4600592078 -0.5536301861
N 1.6569595433 0.354575819 -0.4683204186
C 2.8016249929 -0.1139604933 0.3900906049
C 3.4012300311 -1.459726287 -0.18695469
O 4.3716088835 -1.8837110308 0.4715006804
O 2.8217893803 -1.9420619694 -1.186166163
C 3.8415550787 0.9790179178 0.6294381795
H 4.6245914487 0.5632319181 1.2653281224
H 4.2830436313 1.3017111865 -0.3130485527
H 3.3874416496 1.8430870494 1.1264905193
H 2.3590048906 -0.3788245293 1.3520335053
C -2.0245833088 -0.892388256 0.0942430245
C -2.8434017688 -1.2115450184 -0.9886035524
C -2.5646872452 -0.72147632 1.3707780159
C -4.2153688644 -1.3542701999 -0.7950025709
C -3.9399091315 -0.861117992 1.5490012759
C -4.7704926429 -1.1759021102 0.4728822375
H -2.386489467 -1.3430047179 -1.96164745
H -1.9036018623 -0.4706917787 2.1904011675
H -4.8512091919 -1.6043212415 -1.6375825829
H -4.3623051305 -0.7272525541 2.5392258314
H -5.8390280496 -1.2857380473 0.6214344234
C 1.8915693429 0.4029048945 -1.8860770294
O 2.9061686228 0.9008386501 -2.3131536051
H 1.1460245797 -0.0509808717 -3.8161634741
H 0.7383087474 -1.2364955088 -2.5364523482
H -0.1405907935 0.309997307 -2.6339478749
C 0.8241076968 -0.177630562 -2.7833709915

38

I^{P}-Ac-1 -1 1 -1353.6121224 0.2944375 0 RB3LYP-D3/6-311+G**
P -0.5528074708 0.4062048235 -0.3334887343
O -0.2916405279 0.2623068333 -1.9501881332
O 0.0137943594 1.5411769449 0.4533357414
O 0.6739602818 -0.8490531498 -0.1200527362
C 1.9710254805 -0.7390565174 -0.4632251266
C 2.6693103267 -1.9429593246 -0.6582761441
C 2.6622260814 0.4753529499 -0.6179558059
C 4.0162606119 -1.9366611736 -1.0047901685
C 4.0092618546 0.4657873148 -0.9739479268
C 4.7000986617 -0.7304367988 -1.1712711352
H 2.1222490875 -2.8713700296 -0.5401095144
H 2.1362277435 1.4021989187 -0.4361317521

H 4.5332401638 -2.8800215538 -1.1530918979
H 4.5272578854 1.4131511548 -1.0908131657
H 5.7492447993 -0.7238489442 -1.4467824533
N -1.6963838665 -0.7550293844 0.3054310139
C -2.9754889558 -0.8168703987 -0.413149932
H -3.7607255214 -1.0353107824 0.3113617236
C -2.9914770862 -1.88176661 -1.514394032
H -2.1808366928 -1.7041461919 -2.2254689587
H -3.9460589641 -1.8439869304 -2.0443708385
H -2.8624756675 -2.8694592635 -1.0674523247
C -3.2132895127 0.590326103 -0.9640711491
O -2.1735735862 1.3548503974 -0.8090634898
O -4.2726780723 0.9107612126 -1.4810471735
C -1.5625583067 -1.520993068 1.4490114257
O -2.4078862803 -2.3645346327 1.7345128889
H 0.4135097114 -1.9423267387 2.1474687975
H -0.015136499 -0.2409161302 2.3176896078
H -0.7567024802 -1.4688063998 3.3974233835
C -0.4008529986 -1.2573668238 2.3878166092
C -0.46256965 1.3694859216 -2.8579359343
H -1.4794687922 1.352575438 -3.2575723212
H -0.3321102074 2.3120285113 -2.3212935897
C 0.5804467654 1.2018113185 -3.9493542984
H 0.4404631643 0.250935247 -4.4704133064
H 1.5840620006 1.207965861 -3.5173967327
H 0.4988720973 2.0150810422 -4.6783089161

38

I^{P}-Ac-2 -1 1 -1353.6121219 0.2944389 0 RB3LYP-D3/6-311+G**
P -0.4743067194 0.1905482297 -0.78061426
O 0.0095840221 0.5693709437 -2.1409483765
O -0.0651060449 1.0598833132 0.55346714
O 0.7372204059 -0.9899522523 -0.2657138054
C -0.1618794701 2.4979110628 0.593896575
H -0.0889708586 2.902809622 -0.4180973221
H -1.1378877551 2.7811012437 0.9955500152
C 0.9778074148 2.985820212 1.4715408994
H 0.8941939091 2.5653370464 2.4772517654
H 1.9376753739 2.6749990288 1.0521124213
H 0.9561828215 4.0782186593 1.5465486664
C 2.0595481147 -0.758673629 -0.1658530728
C 2.7825798211 -1.622953943 0.6739886783
C 2.7524181071 0.2579841194 -0.846203879
C 4.1557469141 -1.4737178857 0.8368516087
C 4.1266695271 0.4005108384 -0.6661715957
C 4.8424028801 -0.45593058 0.1713334401
H 2.2344092156 -2.3992135906 1.1956425908
H 2.2046386272 0.9031922402 -1.5188052769
H 4.6917852315 -2.1522344375 1.4937161882
H 4.6456560521 1.1923136591 -1.1983141729
H 5.9124830192 -0.3349478933 0.3015188832
N -1.6626308343 -1.0580350314 -0.4750234503
C -2.8701662535 -0.599211895 0.2231454454
H -3.7167015235 -1.1775155937 -0.1485756063
C -3.0671756531 0.8583971917 -0.1973504799
O -2.0516690812 1.3112577438 -0.8706569088
O -4.0771816316 1.4824564589 0.0900656567
C -1.6285715974 -2.3711174379 -0.9076744132
O -2.4903327142 -3.167327289 -0.5457137111
H -0.1769010251 -1.9776846495 -2.4969150312
H 0.2787142185 -3.2319985828 -1.3450861143
H -1.0043234364 -3.5707442838 -2.5262167054
C -0.5594853367 -2.8005367091 -1.8941046484
C -2.7774204782 -0.7569424305 1.7441841959
H -3.6797986454 -0.3523556662 2.2084597621
H -2.682423723 -1.8151859769 1.9952593054
H -1.9064950629 -0.2203210975 2.1286807235

38

I^{P}-Ac-3 -1 1 -1353.6087264 0.2945221 0 RB3LYP-D3/6-311+G**
P 0.6723723476 -0.0121447492 0.2375587346
O 0.5867816203 0.1488548414 1.7209834335
O -0.0598929549 1.0212429816 -0.7930737802
O -0.59424463 -1.1736084104 -0.0662165089
C 0.0592608509 2.4541442575 -0.6957745211
H 0.2413967889 2.7374488203 0.3432814716
H 0.9209347375 2.7774303356 -1.2833383874
C -1.2432141854 3.0380447963 -1.214588106
H -1.4120793841 2.7396642001 -2.252902117
H -2.0847467079 2.6798559759 -0.6168059609
H -1.2112346861 4.1316738946 -1.1670280922
C -1.909183019 -0.9379504807 0.1345354787
C -2.8141181361 -1.7012473495 -0.6194457947
C -2.4148375766 -0.0089685879 1.0600166425
C -4.1870029225 -1.5336122166 -0.4653385019
C -3.7910370655 0.1528873173 1.1988510505
C -4.6899635299 -0.600042208 0.441784272
H -2.4180480012 -2.421620686 -1.3245699189
H -1.7202103693 0.5514955337 1.6703231085
H -4.8670548717 -2.1343283933 -1.0616805981
H -4.1641884072 0.8748494925 1.9190271918
H -5.7597920665 -0.4658537661 0.5599562906

N 1.8050227093 -1.1324318769 -0.4797381141
C 3.157212262 -0.9770619152 0.0951202706
H 3.8717011058 -1.3070003724 -0.657870442
C 3.3659407302 -1.7803379482 1.3809331898
H 2.6322192297 -1.4877826085 2.1346523113
H 4.3699761559 -1.5871905419 1.7664172288
H 3.2604920302 -2.8470628744 1.1690535641
C 3.3531087522 0.5326524547 0.298571152
O 2.2486169264 1.1905365699 0.1359718373
O 4.4515626679 1.0024989431 0.5573386342
C 1.6781916707 -1.9557837503 -1.5852260692
O 2.5641337431 -2.7557503252 -1.8716089553
H -0.2647989502 -2.5730132343 -2.2258500207
H 0.0000699214 -0.8463697741 -2.4668623051
H 0.8334323897 -2.0429633093 -3.511119762
C 0.4764682242 -1.8234684361 -2.5034414068

38

I^{P}-Ac-4 -1 1 -1353.6052383 0.2940948 0 RB3LYP-D3/6-311+G**
P -0.2711052722 -0.3959960362 -0.4581357912
O -0.1702437089 -1.2239305999 -1.9345985631
O 0.7643971484 0.6304294004 -0.1208709404
O 0.3019659025 -1.8063454542 0.2916851088
N -1.7801338561 -0.6357036226 0.4104068821
C -3.0029503672 -0.4088374591 -0.3680483373
H -3.7593350217 0.0098734488 0.2963943097
C -3.5466122924 -1.6881313673 -1.0126872548
H -2.7849617232 -2.1452640931 -1.6492998882
H -4.4206516719 -1.4467651231 -1.6220794486
H -3.8298036933 -2.3976777617 -0.2328189228
C -2.6406750621 0.650802841 -1.4081994551
O -1.3595346233 0.8582837614 -1.4596798816
O -3.4919972288 1.2104128301 -2.0809403586
C -1.9238073057 -0.9417414066 1.7510090575
O -3.0290271179 -1.2086382608 2.2151529358
H -0.269893929 -1.8502022306 2.7564177489
H 0.0501248468 -0.1759774913 2.3025630099
H -1.0841199753 -0.5436970318 3.6452320544
C -0.7165503965 -0.8589257353 2.6671274486
C 1.664242563 -2.1765943899 0.1255138037
H 2.2252158557 -1.3716135303 -0.3595881707
H 2.093716432 -2.3064091976 1.1286120093
C 1.766293195 -3.4730693674 -0.6699128805
H 1.3456508743 -3.328724088 -1.6666680895
H 1.2054755282 -4.2696705313 -0.17236142
H 2.8119727821 -3.7888529823 -0.7642317849
C 0.0425446919 -0.6752350618 -3.1723756065
C 0.8821226638 0.4226901837 -3.3811626581
C -0.5515993677 -1.3222242578 -4.2562400066
C 1.1171059108 0.860901732 -4.6803958033
C -0.3033497845 -0.876829203 -5.5528298508
C 0.5331988263 0.2165297463 -5.7734812783
H 1.3045732426 0.9288874161 -2.5223804876
H -1.2064293605 -2.163317319 -4.0620654306
H 1.7585337992 1.7217724676 -4.8393491296
H -0.7737110594 -1.3816163968 -6.3905333343
H 0.7202263566 0.5692423209 -6.7820324937

38

I^{P}-Ac-5 -1 1 -1353.6052379 0.2942118 0 RB3LYP-D3/6-311+G**
P 0.3921556014 0.3607535634 -0.3978814266
O 0.0259934158 1.7212998426 0.1162846111
O 0.7920658929 0.0651744978 -1.9634346592
O -1.2653463042 -0.2173737233 -0.8044368869
C -2.3489036543 -0.224214261 -0.0157401684
C -3.493815287 -0.8591681354 -0.5340897551
C -2.42642505 0.3501989561 1.2658119013
C -4.6719399201 -0.9245769929 0.2012878384
C -3.6120019917 0.2724899731 1.9923780441
C -4.744093995 -0.3601526627 1.4764995138
H -3.4260924533 -1.3004347016 -1.522351711
H -1.5666533898 0.8681690859 1.6645242616
H -5.5381362545 -1.4239977071 -0.2230625429
H -3.6492553947 0.7207855837 2.9808993229
H -5.6606042459 -0.4128689917 2.0543246407
N 2.2242831548 0.4052661752 -0.0496702798
C 2.6722179675 -0.4994472355 0.9927272351
H 3.5283187481 -1.0903604602 0.6517572906
C 1.5119373038 -1.435121405 1.2392345834
O 0.3908608525 -1.0440972118 0.6088927799
O 1.5416125702 -2.4158229966 1.9407700574
C 3.1599151102 1.2107198822 -0.6189789949
O 4.3596281892 1.1309187694 -0.3227553267
H 1.7423691384 2.6764277189 -1.3658603055
H 3.4728451932 2.9980258616 -1.7167474725
H 2.5828297197 1.7459288002 -2.6134946789
C 2.6992954583 2.2334086658 -1.642940386
C -0.0753276939 0.2306146789 -3.0972319538
H -0.9292700521 0.8583415455 -2.8404510963
H 0.5326344963 0.7575285459 -3.8418687481
C -0.5253326432 -1.1209483194 -3.6268805382
H -1.1160929462 -1.6309770615 -2.865905713

H 0.3412639978 -1.7394433317 -3.8767529061
H -1.1336705214 -0.9923483336 -4.5293172485
C 3.0475501971 0.2091365386 2.3082768333
H 2.2080956353 0.8147431114 2.6595255108
H 3.2994057438 -0.5316843271 3.0709400508
H 3.9043020139 0.8573880267 2.1276078714

38
I^{P}-Ac-6 -1 1 -1353.6037473 0.2942512 0 RB3LYP-D3/6-311+G**
P -1.4801515953 0.4345286966 2.5615112442
O -1.0363542501 1.8277324993 2.2443788022
O -2.7586820716 0.067670627 3.5472596781
O -0.3246980614 0.1026965161 3.9232000879
C 0.3535120227 0.93784987 4.7189974894
C 1.3672585003 0.3523005104 5.504807816
C 0.1001982397 2.3144059908 4.8778648005
C 2.0894191608 1.1060750946 6.4224066672
C 0.8350312726 3.0563124443 5.8009945965
C 1.830365638 2.469590263 6.5829456879
H 1.5606204821 -0.7055581532 5.3681914436
H -0.6433143964 2.7840155618 4.2510379833
H 2.8629173857 0.6257476472 7.0146128278
H 0.6248026536 4.1170578078 5.9039491371
H 2.3947372327 3.0603725965 7.2965084197
N -2.6725115276 0.1991630882 1.1537138096
C -2.6268050984 -1.12201357 0.555630671
H -2.6404286866 -1.049022356 -0.5351071365
C -3.7705153055 -2.0475663631 1.0118029397
H -3.7836377511 -2.1114040524 2.1022737547
H -3.63742734 -3.0472439446 0.5907677178
H -4.7159217685 -1.6278873424 0.6677926582
C -1.2935479538 -1.6943962327 0.9781723076
O -0.7085034328 -0.9757281708 1.9542387854
O -0.7895424291 -2.6980506041 0.5384452943
C -3.6306172829 1.0528992354 0.7025220259
O -4.3765837445 0.7523604581 -0.2394284736
H -2.8696512896 2.9855587403 1.2717672558
H -4.6392109185 2.9010525549 0.9603898135
H -3.9215740329 2.2568695539 2.4685268281
C -3.7772302559 2.3946765325 1.394326508
C -2.7750433013 -0.0185448564 4.9817457215
H -2.107536577 0.7176877766 5.4321987356
H -3.8013409099 0.2507655679 5.2520255602
C -2.4481662906 -1.4248928302 5.4594798786
H -1.4286650714 -1.6846709836 5.1743076214
H -3.137945913 -2.1468836775 5.0130541352
H -2.5400868628 -1.4841271438 6.5495732766

38
I^{P}-Ac-7 -1 1 -1353.6029198 0.2943094 0 RB3LYP-D3/6-311+G**
P -0.0994961493 0.0318074751 -0.9109619727
O 0.324923429 -1.3657556021 -0.5739330254
O 0.3505707419 0.7235925887 -2.3701103281
O 1.0427366813 0.9758857571 -0.1134705185
N -1.3742152757 0.8765959989 -0.0611273495
C -2.58618483 0.0501538005 0.0969380654
H -3.4398103605 0.7240722006 0.1619645249
C -2.5494643934 -0.8451718245 1.3380050095
H -1.6800377914 -1.5054699935 1.303649704
H -3.4562776044 -1.4538151338 1.3696024161
H -2.4979842642 -0.226140983 2.2367719702
C -2.7174247179 -0.7517649688 -1.2047867729
O -1.6597391739 -0.6523099704 -1.9416592989
O -3.7375436339 -1.3748205898 -1.4639996185
C -1.4436559638 2.1882352029 0.3794379339
O -2.3538179751 2.545658893 1.1216917701
H 0.3907345654 3.2804494824 0.5661513068
H -0.050054749 2.9839181758 -1.1104162649
H -0.9753972639 4.1756849768 -0.1364865862
C -0.4497253208 3.2193901391 -0.1258950976
C 2.4249175951 0.7084750474 -0.3236573134
H 2.5850806186 0.2422009815 -1.3020258049
H 2.9324559247 1.6813842234 -0.3392768827
C 2.9856066192 -0.1760537515 0.784181068
H 2.4612821608 -1.1326613716 0.7781483965
H 2.8395864801 0.2988730422 1.7588246042
H 4.0587418939 -0.3450695456 0.6349076467
C 0.2950725725 0.1528148838 -3.6157702125
C 0.5385433487 -1.2052358924 -3.836877159
C 0.0678523227 1.0127590015 -4.6897781091
C 0.5519677313 -1.6880953991 -5.1414111118
C 0.0894280682 0.5167832315 -5.9917581484
C 0.3323652668 -0.836054664 -6.2261788821
H 0.6746525253 -1.8587199988 -2.9846238333
H -0.1284595603 2.058376589 -4.4844793939
H 0.7268442818 -2.7456006549 -5.3106114804
H -0.0926708027 1.1902969831 -6.8231474787
H 0.3410044308 -1.2241415987 -7.2390187706

38
I^{P}-Ac-8 -1 1 -1353.599026 0.2942734 0 RB3LYP-D3/6-311+G**
P -0.6100237694 0.5276830934 -0.2459507254

O -0.5683763952 0.7810815965 -1.7214456611
O -1.4197136377 1.592628782 0.8246481768
O 0.8970569289 1.2304911945 0.1281924404
N -2.2366145134 -0.4374909973 -0.2055723837
C -2.1251714436 -1.8265242081 0.1964134025
H -2.8735201323 -2.0739454412 0.9558455886
C -0.7544467878 -1.9569816998 0.8110216378
O 0.0107655054 -0.8793566468 0.5831530062
O -0.3400691191 -2.9175638337 1.4150364622
C -3.4734041151 -0.0034349972 -0.5676462922
O -4.4700209483 -0.7369876624 -0.4927185909
H -2.7843662601 1.707337849 -1.7104771374
H -4.5603828414 1.475961505 -1.6264611685
H -3.6638009138 2.1090144688 -0.229457994
C -3.6216026046 1.4193595842 -1.0752040268
C -2.2568013924 -2.8192503462 -0.9756801298
H -1.5251360491 -2.5782877491 -1.7512465309
H -2.0867287139 -3.8398458195 -0.623727842
H -3.259618661 -2.7362208292 -1.3932522368
C 1.445302877 1.2776557665 1.4399811728
H 1.6560319125 2.3312214214 1.6669807629
H 0.7255556017 0.9250995367 2.1873530885
C 2.719863827 0.4464174448 1.5109494768
H 3.4367961599 0.7945163019 0.7618106371
H 2.4882883723 -0.6011308133 1.3125051553
H 3.1819622824 0.5297006572 2.5020338622
C -1.1563554328 2.9247700877 0.9559902987
C -1.4880941365 3.5106082584 2.1809443952
C -0.6445230685 3.7143506367 -0.0806437155
C -1.3114225457 4.8790190915 2.3718131078
C -0.4671560038 5.0794989568 0.1262248734
C -0.7967431133 5.6729011731 1.3466910458
H -1.8821761031 2.8750893546 2.9652811412
H -0.3785702562 3.2429318179 -1.0177837156
H -1.572937093 5.3233506841 3.32690119
H -0.0646640387 5.686051976 -0.6787508298
H -0.6535677322 6.7376812694 1.4958305343

38

I^{P}-Ac-9 -1 1 -1353.5900442 0.2934552 0 RB3LYP-D3/6-311+G**
P -0.4278762273 0.27896044 -0.1155356767
O -0.2704314663 -0.0417639283 -1.5702614782
O -0.8423259777 1.7036012125 0.5418780527
O 1.2857824394 0.731689914 0.2508222895
C 2.3995192033 0.0472120586 -0.0400686212
C 3.5951106827 0.5298226203 0.5279924296
C 2.4671392988 -1.0937897087 -0.8614127063
C 4.8096800276 -0.1039594773 0.2919878979
C 3.6904764585 -1.7213310122 -1.0840399079
C 4.8717154041 -1.2411192357 -0.5165952114
H 3.5358205849 1.408240576 1.1609903989
H 1.5650957214 -1.4552299768 -1.3323657029
H 5.7138484412 0.2902733523 0.747109899
H 3.7179798117 -2.6016117836 -1.7199051408
H 5.817385142 -1.7403106695 -0.6993390964
N -2.2178829888 -0.2343115329 0.0915346872
C -2.3327796727 -1.6131169938 0.5249257924
H -3.1784822926 -1.7723231467 1.1990654874
C -1.0710704248 -1.8634032014 1.33351326
O -0.1216034296 -0.9600508229 1.0804321245
O -0.9148513481 -2.7858559765 2.097628781
C -3.2783753721 0.4853775516 -0.3709293567
O -3.1890075194 1.5648191323 -0.9471712339
H -4.8399323404 -0.2211549364 0.9814402088
H -5.4042912184 0.6151795637 -0.4845264888
H -4.8270184783 -1.0619471911 -0.5717803726
C -4.6745135737 -0.0916471802 -0.0928683438
C -0.2450195232 2.9487197455 0.1458003569
H 0.4360997885 2.7942277231 -0.6929236638
H -1.0785565502 3.5705673285 -0.1937827569
C 0.4805541647 3.5693626309 1.3274094522
H 1.2925121316 2.912093427 1.6408496013
H -0.2066071798 3.7080742181 2.1670801399
H 0.8929702715 4.5464103758 1.0507734207
C -2.3843031466 -2.6297080626 -0.6366054053
H -1.5443499532 -2.4507603595 -1.3107715844
H -2.3407881513 -3.650842383 -0.2490218674
H -3.3059705374 -2.506329961 -1.2091435025

38

C-Ac-1 -1 1 -1353.6055142 0.293189 0 RB3LYP-D3/6-311+G**
P 0.0981769135 0.1798340612 0.5182877111
O -0.2493413656 0.6431175576 1.8987472528
O -0.4612706409 1.0787102404 -0.7261417752
O -1.085654822 -1.0680925257 0.1668948585
C -0.4819012001 2.515354382 -0.6461211238
H -0.4946721443 2.8203845413 0.4035018077
H 0.434304621 2.9042201942 -1.0965057092
C -1.7251897935 2.9910374025 -1.3784235497
H -1.7073352254 2.6592275772 -2.4202693657
H -2.6239161325 2.5853132253 -0.9075743934
H -1.7773548303 4.0851438881 -1.3621304222

C -2.4200451864 -0.8703835955 0.1201171392
C -3.1597287888 -1.7188267214 -0.7179540502
C -3.099534345 0.1022459689 0.8725584844
C -4.5430413121 -1.5984000495 -0.8075933036
C -4.4836629969 0.2168134869 0.7661527342
C -5.2190400779 -0.6250739765 -0.0694223538
H -2.6211187461 -2.4613711132 -1.2955836104
H -2.5298278778 0.7372677 1.5376100869
H -5.0950119346 -2.2641231137 -1.4642625431
H -4.994108935 0.974294721 1.3534667259
H -6.2968027215 -0.5265775121 -0.1426994555
N 1.2545630314 -0.9806659585 0.1528346293
C 2.6853468069 -0.7648954163 0.263025401
C 3.1589110173 -1.450692934 1.5741904031
O 3.7628485457 -2.5047286229 1.5450457573
C 2.8730080436 0.7683496155 0.3792495502
O 1.7526921239 1.3875078389 0.4391935053
O 4.0012696851 1.2492777106 0.4172975406
H 0.9128965427 -1.9180051434 0.0102688445
C 2.7886488445 -0.7678793196 2.8695115804
H 1.7613954066 -0.3938637107 2.8533473986
H 2.9440330726 -1.4546889896 3.701885627
H 3.441548793 0.1037555754 2.9863129125
C 3.4349705258 -1.3069702718 -0.9523529114
H 4.4949054384 -1.064600217 -0.8670858712
H 3.3290746734 -2.3924341876 -1.0144400141
H 3.031407585 -0.8477836359 -1.8573347751

38

C-Ac-2 -1 1 -1353.6044948 0.2930504 0 RB3LYP-D3/6-311+G**
P -0.5123497814 0.5546932663 -0.8613256759
O 0.0157853734 1.3443090964 -2.0123474414
O -0.1389265874 1.0913358056 0.6459416333
O 0.645237996 -0.7666984189 -0.7017706927
C -0.0815161155 2.5028347249 0.920238213
H 0.0629602841 3.0492503192 -0.0151986853
H -1.0398704957 2.8148186684 1.3439821965
C 1.0704128081 2.7337460925 1.8834112908
H 0.919748338 2.1669358754 2.8064771274
H 2.011246042 2.4073627005 1.4338258875
H 1.1453978791 3.7969804687 2.1361147789
C 1.965191613 -0.6177829792 -0.4708960107
C 2.6155264631 -1.6762643499 0.1840559801
C 2.7178339773 0.503955035 -0.858259264
C 3.9794186399 -1.6165301301 0.4510728216
C 4.0814267572 0.5531254408 -0.5765789332
C 4.7263442789 -0.4975805502 0.0774356105
H 2.0218076074 -2.5336237403 0.4801892389
H 2.2207612715 1.3054062758 -1.3877251544
H 4.4599730208 -2.445983183 0.9612068218
H 4.6485956343 1.4275822942 -0.8815529448
H 5.7888748286 -0.4471792249 0.2899643235
N -1.6835791879 -0.6479117161 -0.8809232883
C -3.1096534679 -0.4186150621 -0.7599317197
C -3.8972032123 -0.9832182146 -1.941220659
H -3.5118591051 -0.5511889524 -2.8669236364
H -4.9528582444 -0.7297014947 -1.8348592099
H -3.8012847178 -2.0706490626 -1.9792406797
C -3.2868790617 1.1183035849 -0.6708800618
O -2.1656926909 1.7368051286 -0.7100743369
O -4.4090108248 1.6008741681 -0.5564039542
H -1.3400140234 -1.595386102 -0.8849373512
C -3.5556969787 -1.0567837661 0.5816258055
O -4.2099839435 -2.0792855644 0.6089171477
C -3.0937997894 -0.3646046927 1.8453152772
H -3.7122997033 0.5286287865 1.9815613805
H -3.225015244 -1.0320694639 2.6972044122
H -2.0563381316 -0.0339512877 1.7631716376

38

C-Ac-3 -1 1 -1353.595314 0.2919456 0 RB3LYP-D3/6-311+G**
P -0.2339945356 0.6544480231 -0.3580040726
O -0.0405467498 1.564647448 -1.5646781058
O 0.5121715708 1.2673200071 0.9601053427
O 0.756566356 -0.6810564771 -0.5192694636
C -0.020088619 2.473153258 1.5227737042
H -0.1372437291 3.2258022116 0.7339803297
H -1.009327203 2.2637391379 1.9439217074
C 0.9468998972 2.951386311 2.5909727865
H 1.0655002594 2.1885918267 3.3647895914
H 1.9284135229 3.1525465403 2.1543265845
H 0.5745481689 3.8692558054 3.0574196843
C 2.1057795192 -0.6798486214 -0.7447214185
C 2.8054509158 -1.8059218368 -0.2984460767
C 2.7871826435 0.3448789218 -1.4116692551
C 4.1772006565 -1.9067153611 -0.5104702769
C 4.1620759461 0.2326744243 -1.6104113532
C 4.8674531759 -0.8861656883 -1.1664249819
H 2.2514634304 -2.583274345 0.2140537997
H 2.2300827984 1.2020111318 -1.7666318074
H 4.7087241642 -2.7849186447 -0.1577837786
H 4.685185332 1.0317280769 -2.1263410939

H 5.9371490441 -0.9622009127 -1.3290666338
N -1.6810880743 0.2281473096 0.0589662364
C -2.7706328805 -0.0501437157 -0.8582883991
C -2.415402122 -1.0303126665 -1.995758631
H -1.6623474348 -0.5847862421 -2.6496214628
H -3.3003101162 -1.2858031681 -2.5827965804
H -2.0101381683 -1.9434431632 -1.558726715
C -3.3996894955 1.205828835 -1.5383269941
O -2.5771441433 2.1194426214 -2.0482661286
O -4.6045374242 1.3299992573 -1.6433257409
C -3.8670805586 -0.6851847645 0.0472524595
O -4.2785484108 -1.8103415127 -0.1406825451
C -4.3565650003 0.1554251963 1.2082871125
H -5.0551962471 0.8974613482 0.8126440041
H -4.8686108187 -0.4839382575 1.9284659065
H -3.5190434205 0.677731625 1.6709380693
H -1.6020152389 1.9224953736 -1.9019738397

38

P-Ac -1 1 -1353.5690331 0.2928221 0 RB3LYP-D3/6-311+G**
P -0.6577025456 -0.8682021915 -2.2246541137
O -0.0943460897 0.0712381513 -3.542896171
O 0.7524753534 -1.2538911861 -1.4993013615
O -0.6410471903 -2.2754552964 -3.1889276067
C 1.8189045911 -0.3399920038 -1.1886200315
H 1.9417002955 0.3671088071 -2.0134975027
H 1.5571456848 0.2314474245 -0.2964306132
C 3.0689756918 -1.1777470179 -0.9842013354
H 2.9272112612 -1.8809346591 -0.1591769904
H 3.2959442605 -1.7507907431 -1.8859489163
H 3.9199597047 -0.5299086658 -0.7486883557
C 0.4072331804 -2.9081416068 -3.7646572626
C 0.2662757765 -4.2954748045 -3.9248495676
C 1.5758929671 -2.2876311152 -4.2330531699
C 1.2665419994 -5.0462703298 -4.5328293303
C 2.5729790146 -3.0530080138 -4.8350594528
C 2.4339634143 -4.4319967851 -4.9907981411
H -0.6423601972 -4.7558232623 -3.5552768485
H 1.6862554653 -1.2179410339 -4.1412825243
H 1.1357804607 -6.11839281 -4.6440496083
H 3.4695477367 -2.5560971996 -5.1930473432
H 3.2172084394 -5.0159428983 -5.4620633766
N -2.1169387977 -1.1146797421 -1.6882847803
C -2.6098524753 -0.1980951293 -0.6841283404
C -4.0551795293 0.2396753884 -0.9528912753
H -4.129019532 0.7596075388 -1.9113696625
H -4.3975428612 0.9147552921 -0.1648641697
H -4.7057095479 -0.6377178522 -0.9929929884
C -1.6732083374 1.0176793341 -0.5369935763
O -0.5973258412 0.8764339089 -1.254987572
O -1.9333687153 1.9830368023 0.1712091598
H -2.5991044032 -0.6891429732 0.3034858979
C -0.5901591529 1.1646288399 -4.1619546739
O 0.1196498486 1.7706043631 -4.9296412162
C -2.0250623389 1.5412881285 -3.8878504694
H -2.6464049516 0.6590819953 -3.7334210997
H -2.0551173039 2.1365361289 -2.9728273931
H -2.3915344726 2.1427108915 -4.7188981511

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I² -1 1 -893.297766 0.149195 0 RB3LYP-D3/6-311+G**
N 1.4288107695 -0.0009859505 -2.0892074871
C 2.313411541 -0.1546978427 -0.9495684951
C 1.5405371085 0.1296344671 0.3643826445
O 0.2279324998 0.2871460151 0.1268047797
P -0.0649887957 0.0401621759 -1.5863726539
H 2.6778136492 -1.1940095978 -0.8372580589
O 2.0245473988 0.1956812762 1.4733415123
O -1.1423043737 0.9442015167 -2.0790359989
O -0.6828696811 -1.4989646624 -1.4754797202
C -2.0316967357 -1.6796279323 -1.0356190288
H -2.701751942 -1.0659372796 -1.6468984535
H -2.1262375866 -1.343886351 0.0056803161
C -2.3695066091 -3.1569657906 -1.1554405213
H -1.6923354245 -3.7552782484 -0.5398308031
H -2.2668818947 -3.4850387099 -2.1933981639
H -3.3981446879 -3.3446036304 -0.8279330688
C 3.5455235211 0.7548798578 -1.0455555344
H 4.184637861 0.6422112277 -0.164827804
H 4.1130503826 0.5001699429 -1.9442553267
H 3.2288310424 1.7982228593 -1.1300583841

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I²-2 -1 1 -893.2976834 0.1493258 0 RB3LYP-D3/6-311+G**
N 1.4798329699 0.0151079349 -1.9570769359
C 2.3355240747 -0.2021222528 -0.8047455097
C 1.5384692447 0.0491619694 0.4996347805
O 0.2302471451 0.2131260036 0.2417251687
P -0.0250195198 0.0446516527 -1.4874961692
H 3.1611455962 0.5257075901 -0.7940310213

O 2.0025532757 0.0854399387 1.6184226086

O -1.083826229 0.9798164429 -1.9621108073

O -0.6609716465 -1.4932645244 -1.4594788696

C -2.0206062925 -1.6790149841 -1.0557332366

H -2.6686878974 -1.0088147504 -1.6300913954

H -2.1258713557 -1.4186045599 0.0060442034

C -2.3844057578 -3.136430182 -1.2893156931

H -1.7249421915 -3.7922317338 -0.7143196934

H -2.2771886119 -3.3879548389 -2.347989519

H -3.4196482668 -3.3284683766 -0.9859713531

C 2.9567845324 -1.6129628559 -0.7499298574

H 3.5925889531 -1.7316913341 0.1336743286

H 2.1638709981 -2.3659586925 -0.7304819821

H 3.5529132008 -1.7737797051 -1.6518602386

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I²-3 -1 1 -893.2972684 0.1492283 0 RB3LYP-D3/6-311+G**

N 1.3261289019 -0.2003514284 -1.8926918224

C 2.4347620756 -0.1886726952 -0.9635640999

C 1.9172900766 0.005741275 0.482771115

O 0.5779681065 0.0843419844 0.508314549

P -0.0551566783 -0.0936686316 -1.1209478646

H 2.9707898169 -1.1568866101 -0.9423869819

O 2.6045327529 0.0710836173 1.4789851838

O -1.1490303035 0.87062375 -1.3970196779

O -0.7980976101 -1.5665330608 -0.9352331641

C 0.0090144918 -2.7174897186 -0.6964473095

H 0.3992899852 -2.6872476194 0.3302253997

H 0.8632292441 -2.7162732717 -1.3844866577

C -0.852158714 -3.9531425866 -0.9017805508

H -1.2309030019 -3.9831166704 -1.9267757808

H -1.7079746975 -3.9411367919 -0.2215233466

H -0.2692704297 -4.8618900077 -0.7153668036

C 3.4751242372 0.8957012244 -1.290986548

H 4.2956365419 0.8846755982 -0.56678527

H 3.8706530512 0.7222600796 -2.294910781

H 2.9980938614 1.8797457134 -1.2818530598

20

I2-4 -1 1 -893.2970495 0.1492803 0 RB3LYP-D3/6-311+G**

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H 2.9323070612 -2.2827780913 -0.7370713456

H 3.8557920782 -1.3571205348 -1.9287889254

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