

Supporting Information

Magic Effect of Diphenylprolinol Silyl Ether for the Enantioselective Allenation of 2-Alkynals

Guolin Wu,^a Zhen Liu,^{b,c} Shiwen Fan,^a Wenyao Li,^a Xue Zhang,^{*b} Hui Qian ^{*a} and
Shengming Ma ^{*a,b}

^a Research Center for Molecular Recognition and Synthesis, Department of Chemistry, Fudan University, 220 Handan Lu, Shanghai 200433, P. R. China. E-mail: qian_hui@fudan.edu.cn.

^b State Key Laboratory of Organometallic Chemistry, Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences, 345 Lingling Lu, Shanghai 200032, P. R. China. E-mail: xzhang@sioc.ac.cn; masm@sioc.ac.cn. Homepage: <https://masm.fudan.edu.cn>

^c Henan Institute of Advanced Technology, Zhengzhou University, 97 Wenhua Lu, Zhengzhou, Henan Province, 450003, PR China.

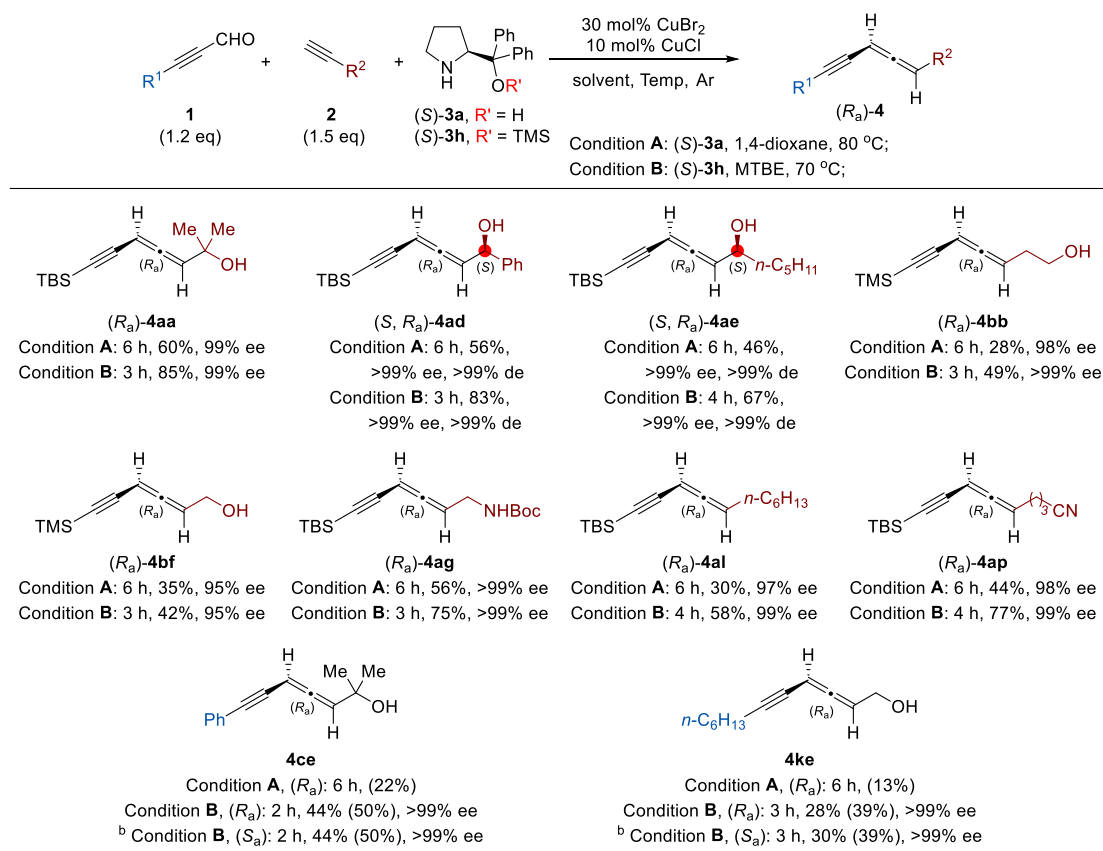
General information	S2
The comparison between (<i>S</i>)- 3a and (<i>S</i>)- 3h in EATA reaction	S3
Experimental details and analytical data	S4-S45
X-ray crystal structure and crystallographic data of 4ax	S46
Detailed information of the DFT calculations	S47-S94
References	S95-S96
NMR and HPLC spectra of the products	S97-S313

General information

NMR spectra were taken with the 400 MHz Bruker Avance III spectrometer (400 MHz for ^1H NMR, 100 MHz for ^{13}C NMR and 376 MHz for ^{19}F NMR). All ^1H NMR experiments were measured with tetramethylsilane (0 ppm) in CDCl_3 or the signal of residual CH_3CN (1.94 ppm) in CD_3CN as the internal reference; ^{13}C NMR experiments were measured in relative to the signal of CDCl_3 (77.0 ppm) or the signal of CD_3CN (1.32 ppm); ^{19}F NMR experiments were measured in relative to the signal of CFCl_3 (0 ppm) in CDCl_3 . (*S*)- and (*R*)-2-(diphenyl((trimethylsilyl)oxy)methyl)pyrrolidine (97%) were purchased from Bide Pharmatech Ltd.; CuCl was purchased from Acros Chemicals; CuBr_2 (99%) was purchased from Alfa Aesar; MTBE (methyl *t*-butyl ether) was dried over sodium wire with benzophenone as the indicator and distilled freshly before use. All the temperatures are referred to the oil baths used. Column chromatography was conducted on 300-400 mesh silica gel purchased from Huanghai Chemicals. Petroleum ether (b.p. 60-90 °C) purchased from Shanghai Titan Scientific Co., Ltd. was used for chromatography. Other reagents were purchased from commercial sources and used without further purification.

Scheme S1: The comparison between amino alcohol (*S*)-3a and its silyl ether

(*S*)-3h.^a



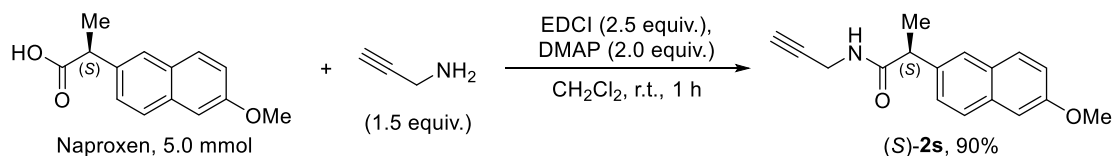
^a When (*S*)-3a was used, the reaction was conducted in 4.0 mL of 1,4-dioxane at 80 °C (Condition A); When (*S*)-3h was used, the reaction was conducted in 5.0 mL of MTBE at 70 °C (Condition B). NMR yield was shown in the parentheses. For more details about Condition A, see reference.¹ ^b (*R*)-3h was used instead of (*S*)-3h.

Experimental details and analytical data

1. Synthesis of terminal alkynes and 2-alkynals

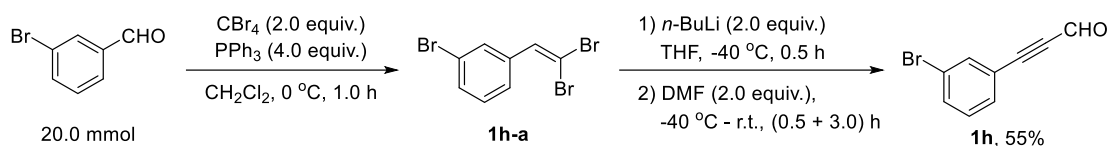
Terminal alkynes **2i**,² **2n**,³ (*S*)-**2u**,⁴ and 2-alkynals **1c**,⁵ **1d**,⁶ **1e**,⁶ **1f**,⁷ **1g**,⁸ **1j**,⁷ **1k**⁷ were prepared according to previous literatures.

(1) Preparation of (*S*)-2-(6-methoxynaphthalen-2-yl)-*N*-(prop-2-yn-1-yl)propanamide ((*S*)-**2s**, LWY-1-008)



To a round-bottom flask (250 mL) were added Naproxen (1.1745 g, 5.0 mmol), EDCI (2.4700 g, 12.5 mmol), DMAP (1.2202 g, 10.0 mmol), CH₂Cl₂ (50 mL), and propargyl amine (0.50 mL, 0.4300 g, 98% purity, $d = 0.86 \text{ g/cm}^3$, 7.7 mmol) sequentially. The resulting mixture was stirred at r.t. for 1 h and quenched with 15 mL of *sat.* NaHCO₃ (aq.). The aqueous layer was extracted with CH₂Cl₂ (10 mL x 2) and the combined organic layer was washed with H₂O (15 mL), brine (15 mL), and dried over anhydrous Na₂SO₄. After filtration and concentration under reduced pressure, the crude product was purified by column chromatography on silica gel to afford (*S*)-**2s** (1.2055 g, 90%) [first round eluent: petroleum ether / ethyl acetate = 4:1 (500 mL); second round eluent: petroleum ether / ethyl acetate = 2:1 (660 mL)] as a white solid: **m.p.** 128.3-129.9 °C (dichloromethane / petroleum ether); $[\alpha]_D^{22} = +3.6$ ($c = 1.10$, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 7.70 (t, $J = 8.8 \text{ Hz}$, 2 H, ArH), 7.65 (s, 1 H, ArH), 7.36 (dd, $J_1 = 8.4 \text{ Hz}$, $J_2 = 1.6 \text{ Hz}$, 1 H, ArH), 7.15 (dd, $J_1 = 9.0 \text{ Hz}$, $J_2 = 2.6 \text{ Hz}$, 1 H, ArH), 7.11 (d, $J = 2.0 \text{ Hz}$, 1 H, ArH), 5.78 (brs, 1 H, NH), 4.06-3.90 (m, 5 H, OCH₃ and CH₂), 3.69 (q, $J = 7.2 \text{ Hz}$, 1 H, CH), 2.14 (t, $J = 2.6 \text{ Hz}$, 1 H, $\equiv\text{CH}$), 1.59 (d, $J = 7.2 \text{ Hz}$, 3 H, CH₃); **¹³C NMR** (100 MHz, CDCl₃) δ 173.9, 157.7, 136.0, 133.7, 129.2, 128.9, 127.5, 126.2, 119.1, 105.6, 79.5, 71.4, 55.2, 46.7, 29.3, 18.4; **IR** (neat): $\nu = 3289$, 3059, 2975, 2933, 2900, 2838, 1650, 1533, 1508, 1457, 1266, 1216, 1093 cm⁻¹; **MS** (70 eV, EI) m/z (%): 267 (M^+ , 27.91), 185 (100); **Elemental analysis** calcd (%) for C₁₇H₁₇NO₂: C, 76.38; H, 6.41; found: C, 76.09; H, 6.13.

(2) Preparation of 3-(3-bromophenyl)propionaldehyde (**1h**, wgl-5-047, wgl-5-049)⁹

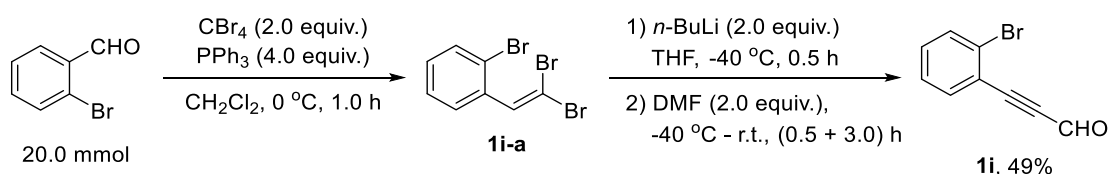


To an oven-dried round-bottom flask (250 mL) were added triphenylphosphine (20.9843 g, 80.0 mmol), tetrabromomethane (13.6761 g, 40.0 mmol), and CH₂Cl₂ (100 mL) under argon atmosphere. The mixture was stirred at 0 °C for 0.5 h. Then 3-bromobenzaldehyde (2.5 mL, 3.9750 g, 95% purity, d = 1.59 g/mL, 20.4 mmol) was added dropwise over 5 min. The resulting mixture was stirred at 0 °C for another 1.0 h and quenched with H₂O (50 mL). The aqueous layer was extracted with CH₂Cl₂ (10 mL x 2). The combined organic layer was washed with H₂O (25 mL), brine (25 mL), and dried over anhydrous MgSO₄. After filtration and concentration under reduced pressure, the crude product was purified by column chromatography on silica gel to afford the *gem*-dibromoolefine **1h-a** [eluent: petroleum ether / ethyl acetate = 20/1 (630 mL)] as a light-yellow oil, which was used for next step without further purification.

To an oven-dried round-bottom flask (125 mL) were added **1h-a** (the whole prepared above) and freshly distilled THF (40 mL). The resulting mixture was stirred at -40 °C and *n*-BuLi (16.0 mL, 2.5 M in hexane, 40.0 mmol) was added dropwise over 10 min. The resulting mixture was stirred at -40 °C for another 0.5 h. Then the freshly distilled DMF (3.1 mL, 2.9450 g, d = 0.95 g/mL, 40 mmol) was added in one portion. After stirring at -40 °C for 0.5 h, the resulting mixture was allowed to stir at room temperature for 3.0 h. The solution was poured into a vigorously stirred biphasic solution prepared from a 10% *w.t.* aqueous solution of KH₂PO₄ (40 mL) and MTBE (40 mL) cooled over ice-water bath (0-5 °C). The aqueous layer was extracted with MTBE (20 mL x 2), and the combined organic layer was washed with H₂O (10 mL), brine (10 mL), and dried over anhydrous Na₂SO₄. After filtration and concentration under reduced pressure, the crude product was purified by column chromatography on silica gel to afford the impure **1h** (2.5831 g) [eluent: petroleum ether / ethyl acetate = 30/1 (620 mL)]. The impure **1h** was further recrystallized in petroleum ether at -20 °C to give the target product **1h** (2.3331 g, 55%) as a light-yellow solid: **m.p.** 43.7-44.1 °C

(petroleum ether); ^1H NMR (400 MHz, CDCl_3) δ 9.42 (s, 1 H, CHO), 7.75 (s, 1 H, ArH), 7.63 (d, J = 8.0 Hz, 1 H, ArH), 7.54 (d, J = 7.6 Hz, 1 H, ArH), 7.29 (t, J = 8.4 Hz, 1 H, ArH); ^{13}C NMR (100 MHz, CDCl_3) δ 176.4, 135.7, 134.4, 131.7, 130.2, 122.5, 121.4, 92.6, 88.7; IR (neat) ν = 2884, 2191, 1646, 1471, 1394, 1300, 1276, 1243, 1174, 1091, 1073 cm^{-1} ; MS (70 ev, EI) m/z (%): 210 [$\text{M}^+(\text{}^{81}\text{Br})$, 98.96], 208 [$\text{M}^+(\text{}^{79}\text{Br})$, 100].

(3) Preparation of 3-(2-bromophenyl)propiolaldehyde (**1i**, wgl-5-048, wgl-5-050)¹⁰



Following the procedure of preparation of **1h-a**, the reaction of triphenylphosphine (20.9845 g, 80.0 mmol), tetrabromomethane (13.6758 g, 40.0 mmol), 2-bromobenzaldehyde (2.5 mL, 3.9750 g, 95% purity, d = 1.59 g/mL, 20.4 mmol), and CH_2Cl_2 (100 mL) afforded **1i-a** [eluent: petroleum ether / ethyl acetate = 20/1 (630 mL)] as a light-yellow oil, which was used for next step without further purification.

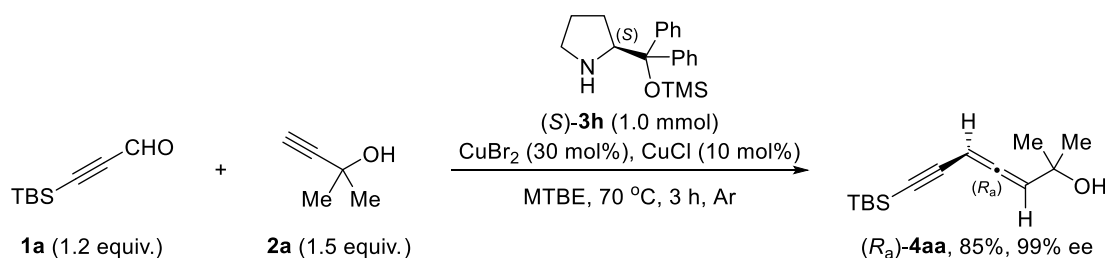
Following the procedure of preparation of **1h**, the reaction of **1i-a** (prepared above), $n\text{-BuLi}$ (16.0 mL, 2.5 M in hexane, 40.0 mmol), DMF (3.1 mL, 2.9450 g, d = 0.95 g/mL, 40 mmol), and THF (40 mL) afforded **1i** (2.1043 g, 49%) [eluent: first round, petroleum ether / ethyl acetate = 20/1 (630 mL); second round, petroleum ether / ethyl acetate / diethyl ether = 50/1/1 (780 mL)] as a colorless oil.

1i: ^1H NMR (400 MHz, CDCl_3) δ 9.48 (s, 1 H, CHO), 7.66-7.55 (m, 2 H, ArH), 7.36-7.29 (m, 2 H, ArH); ^{13}C NMR (100 MHz, CDCl_3) δ 176.4, 135.0, 132.8, 132.2, 127.3, 126.7, 121.8, 92.4, 91.2; IR (neat) ν = 2856, 2189, 1654, 1584, 1467, 1427, 1387, 1283, 1266, 1241, 1050, 1027 cm^{-1} ; MS (70 ev, EI) m/z (%): 210 [$\text{M}^+(\text{}^{81}\text{Br})$, 69.64], 208 [$\text{M}^+(\text{}^{79}\text{Br})$, 69.58].

2. Synthesis of allenynes.

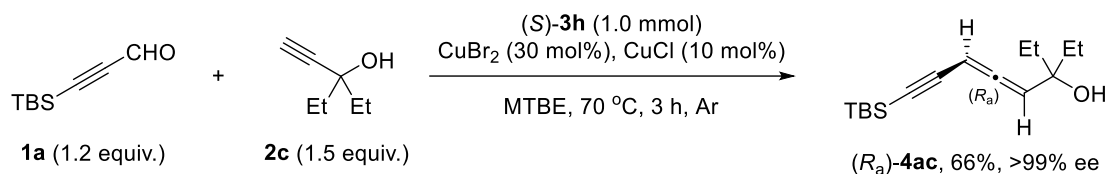
The analytical data of allenynes **4aa**, **4ad**, **4ae**, **4bb**, **4bf**, **4ag**, **4ag**, **4al**, and **4ap** match the previous reported in literature.¹

(1) Preparation of (*R_a*)-2-methyl-7-(*tert*-butyldimethylsilyl)hepta-3,4-dien-6-yn-2-ol ((*R_a*)-4aa**, wgl-3-155)**



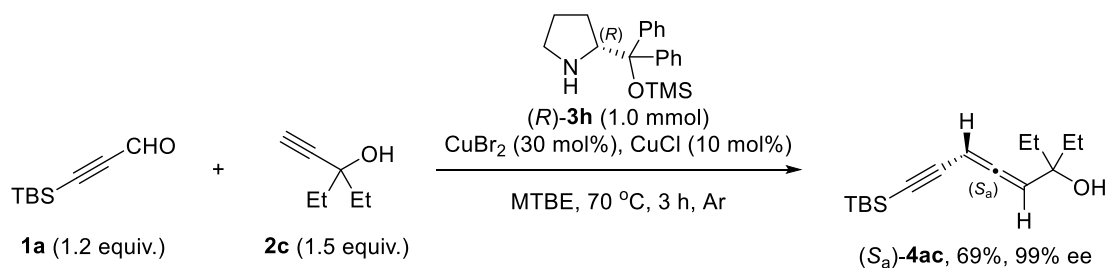
Typical Procedure I: To an oven-dried Schlenk tube (25 mL) were added CuBr₂ (67.7 mg, 0.3 mmol) and CuCl (10.0 mg, 0.1 mmol) in a glovebox. (*S*)-**3h** (335.8 mg, 1.0 mmol) was added. After replacing N₂ with argon for three times by using a vacuum line, **1a** (202.5 mg, 1.2 mmol) and **2a** (126.7 mg, 1.5 mmol) in freshly distilled MTBE (5.0 mL) were added sequentially. The Schlenk tube was then sealed by screwing the polytetrafluoroethylene plug tightly with the outlet connected to the vacuum line and the argon flow being closed. The resulting mixture was stirred in an oil bath preheated at 70 °C for 3 h as monitored by TLC (eluent: petroleum ether / ethyl acetate = 10/1). The resulting mixture was cooled to room temperature naturally, then filtered through a short pad of silica gel (3 cm) with Et₂O (30 mL) as the eluent. After removal of the solvent under vacuum, the remaining residue was purified by column chromatography on silica gel to afford (*R_a*)-**4aa**¹ (201.3 mg, 85%) [eluent: petroleum ether / ethyl ether = 20:1 (420 mL) to 10:1 (220 mL)] as a yellow oil: 99% ee (HPLC conditions: Chiralcel IA column, *n*-hexane/*i*-PrOH = 99.8/0.2, 1.0 mL/min, λ = 214 nm, *t_R* (major) = 12.9 min, *t_R* (minor) = 14.9 min; ¹H NMR (400 MHz, CDCl₃) δ 5.49 (d, *J* = 6.8 Hz, 1 H, =CH), 5.44 (d, *J* = 6.4 Hz, 1 H, =CH), 1.95 (brs, 1 H, OH), 1.31-1.23 (m, CH₃ x 2), 0.82 (s, 9 H, C(CH₃)₃), 0.00 (s, 6 H, Si(CH₃)₂); ¹³C NMR (100 MHz, CDCl₃) δ 210.0, 102.9, 97.8, 94.4, 79.0, 70.0, 29.8, 29.7, 26.0, 16.6, -4.7.

(2) Preparation of (*R_a*)-8-(*tert*-butyldimethylsilyl)-3-ethylocta-4,5-dien-7-yn-3-ol ((*R_a*)-4ac**, wgl-3-171)**

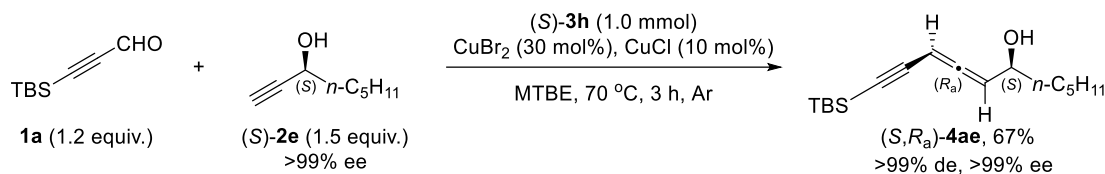


Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), (*S*)-**3h** (335.7 mg, 1.0 mmol), **2c** (173.8 mg, 1.5 mmol), and **1a** (202.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4ac** (174.1 mg, 66%) [first round eluent: petroleum ether / ethyl acetate = 30:1 (310 mL) to 20:1 (105 mL); second round eluent: petroleum ether / dichloromethane = 1:1 (400 mL)] as light yellow oil: >99% ee (HPLC conditions: Chiralcel IA column, *n*-hexane/*i*-PrOH = 99.8/0.2, 1.0 mL/min, λ = 214 nm, t_R (major) = 10.0 min; $[\alpha]_D^{26}$ = -203.9 (c = 1.44, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 5.44 (d, J = 6.4 Hz, 1 H, =CH), 5.30 (d, J = 6.8 Hz, 1 H, =CH), 1.67 (s, 1 H, OH), 1.58-1.40 (m, 4 H, 2 x CH₂), 0.85-0.78 (m, 15 H, C(CH₃)₃ and CH₃ x 2), 0.00 (s, 6 H, CH₃ x 2); **¹³C NMR** (100 MHz, CDCl₃) δ 211.0, 100.3, 98.0, 94.6, 79.0, 74.9, 32.9, 32.8, 26.0, 16.5, 7.9, 7.8, -4.7; **IR** (neat) ν = 3400, 2954, 2930, 2883, 2857, 2158, 1949, 1462, 1388, 1324, 1250, 1119, 1007 cm⁻¹; **MS** (ESI) m/z (%): 265 ($M + H^+$); **HRMS** (ESI) calcd for C₁₆H₂₉OSi⁺ ($M + H^+$): 265.1982, found: 265.1978.

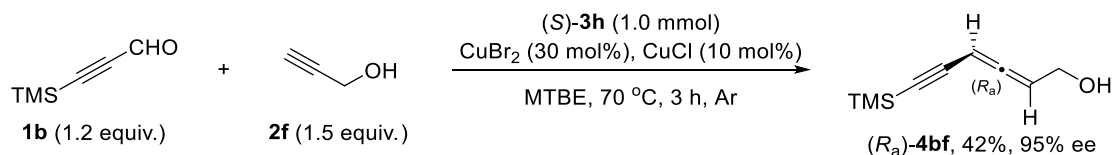
(3) Preparation of (*S_a*)-8-(*tert*-butyldimethylsilyl)-3-ethylocta-4,5-dien-7-yn-3-ol ((*S_a*)-4ac**, wgl-3-172)**



Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*R*)-**3h** (335.6 mg, 1.0 mmol), **2c** (174.1 mg, 1.5 mmol), and **1a** (202.8 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S_a*)-**4ac** (181.9 mg,

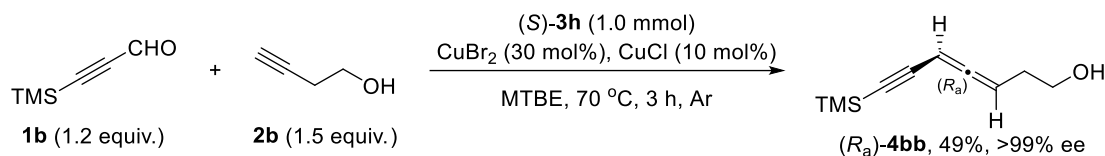
4ae, wgl-4-028)

Following **Typical Procedure I**, the reaction of CuBr_2 (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), $(S)\text{-}3\text{h}$ (335.7 mg, 1.0 mmol), $(S)\text{-}2\text{e}$ (189.8 mg, 1.5 mmol, >99% ee), and **1a** (202.5 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded $(S,R_a)\text{-}4\text{ae}^1$ (185.6 mg, 67%) [first round eluent: petroleum ether / ethyl acetate = 20:1 (210 mL) to 10:1 (165 mL); second round eluent: petroleum ether / diethyl ether = 10:1 (440 mL)] as a yellow oil: >99% de, >99% ee (HPLC conditions: Chiralcel OD-H column, *n*-hexane/*i*-PrOH = 99.7/0.3, 1.0 mL/min, λ = 214 nm, t_R (major) = 15.4 min); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 5.47-5.34 (m, 2 H, $\text{CH}=\text{C}=\text{CH}$), 4.15-4.04 (m, 1 H, CH), 1.92 (s, 1 H, OH), 1.54-1.43 (m, 2 H, CH_2), 1.37-1.12 (m, 6 H, $\text{CH}_2 \times 3$), 0.87-0.74 (m, 12 H, $\text{C}(\text{CH}_3)_3$ and CH_3), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 211.5, 97.7, 97.6, 94.7, 78.2, 69.6, 37.1, 31.6, 26.0, 24.9, 22.5, 16.6, 14.0, -4.7.

(6) Preparation of (R_a) -6-(trimethylsilyl)hexa-2,3-dien-5-yn-1-ol ($(R_a)\text{-}4\text{bf}$, wgl-3-140)

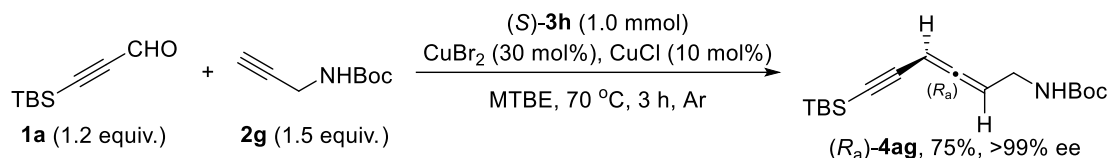
Following **Typical Procedure I**, the reaction of CuBr_2 (67.7 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), $(S)\text{-}3\text{h}$ (335.6 mg, 1.0 mmol), **2f** (84.7 mg, 1.5 mmol), and **1b** (156.5 mg, 97% purity, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded $(R_a)\text{-}4\text{bf}^1$ (70.1 mg, 42%) [eluent: petroleum ether / ethyl acetate = 10:1 (330 mL)] as a yellow oil: 95% ee [HPLC conditions: Chiralcel OJ-H column, *n*-hexane/*i*-PrOH = 99/1, 1.0 mL/min, λ = 214 nm, t_R (major) = 10.7 min, t_R (minor) = 12.9 min]; $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 5.52-5.34 (m, 2 H, $\text{CH}=\text{C}=\text{CH}$), 4.09-3.98 (m, 2 H, CH_2), 1.75 (brs, 1 H, OH), 0.17 (s, 9 H, $\text{Si}(\text{CH}_3)_3$); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 212.0, 96.9, 96.7, 94.1, 78.3, 59.8, -0.2.

(7) Preparation of (*R_a*)-7-(trimethylsilyl)hepta-3,4-dien-6-yn-1-ol ((*R_a*)-4bb**, wgl-3-105)**



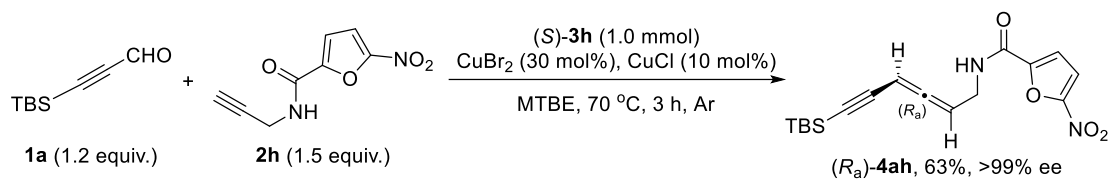
Following **Typical Procedure I**, the reaction of CuBr₂ (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*S*)-**3h** (335.7 mg, 1.0 mmol), **2b** (108.9 mg, 1.5 mmol), and **1b** (155.2 mg, 97% purity, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4bb**¹ (89.7 mg, 49%) [eluent: petroleum ether / ethyl acetate = 10:1 (220 mL) to 5:1 (240 mL)] as a yellow oil: >99% ee (HPLC conditions: Chiralcel OJ-H column, *n*-hexane/*i*-PrOH = 99/1, 1.0 mL/min, λ = 214 nm, *t_R* (major) = 10.3 min, *t_R* (minor) = 11.5 min; ¹H NMR (400 MHz, CDCl₃) δ 5.32-5.22 (m, 2 H, CH=C=CH), 3.62-3.50 (m, 2 H, CH₂), 2.20-2.12 (m, 2 H, CH₂), 1.46 (brs, 1 H, OH), 0.16 (s, 9 H, Si(CH₃)₃); ¹³C NMR (100 MHz, CDCl₃) δ 213.2, 97.5, 95.9, 89.8, 76.4, 61.6, 31.4, -0.2.

(8) Preparation of (*R_a*)-*tert*-butyl-*N*-(6-(*tert*-butyldimethylsilyl)hexa-2,3-dien-5-yn-1-yl)carbamate ((*R_a*)-4ag**, wgl-4-123)**



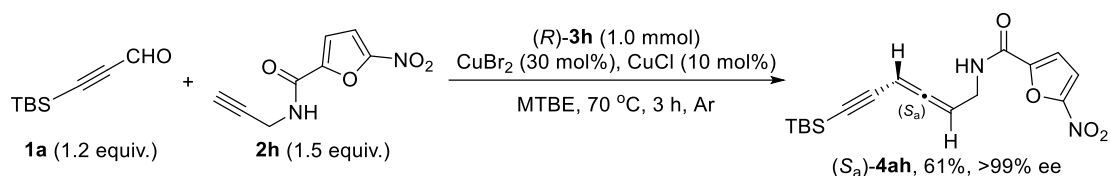
Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), (*S*)-**3h** (335.7 mg, 1.0 mmol), **2g** (233.5 mg, 1.5 mmol), and **1a** (202.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4ag**¹ (232.2 mg, 75%) [eluent: petroleum ether / ethyl acetate / diethyl ether = 30:1:1 (320 mL)] as a yellow oil: >99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane/*i*-PrOH = 99.5/0.5, 1.0 mL/min, λ = 214 nm, *t_R* (major) = 13.4 min]; ¹H NMR (400 MHz, CDCl₃) δ 5.50–5.30 (m, 2 H, CH=C=CH), 4.62 (brs, 1 H, NH), 3.67 (s, 2 H, CH₂), 1.33 (s, 9 H, CH₃ x 3), 0.82 (s, 9 H, C(CH₃)₃), 0.00 (s, 6 H, CH₃ x 2); ¹³C NMR (100 MHz, CDCl₃) δ 212.1, 155.5, 97.5, 94.6, 91.7, 79.4, 78.3, 38.5, 28.3, 26.0, 16.5, -4.8.

(9) Preparation of (*R_a*)-*N*-(6-(*tert*-butyldimethylsilyl)hexa-2,3-dien-5-yn-1-yl)-5-nitrofuran-2-carboxamide ((*R_a*)-4ah**, wgl-5-100)**



Following **Typical Procedure I**, the reaction of CuBr_2 (67.7 mg, 0.3 mmol), CuCl (9.8 mg, 0.1 mmol), **(S)-3h** (335.6 mg, 1.0 mmol), **2h** (291.5 mg, 1.5 mmol), and **1a** (202.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded **(R_a)-4ah** (217.6 mg, 63%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (220 mL) to 5:1 (600 mL)] as a brown solid: **m.p.** 133.9-134.4 °C (petroleum ether / dichloromethane); >99% ee [HPLC conditions: Chiralcel AS-H column, *n*-hexane/*i*-PrOH = 80/20, 0.3 mL/min, λ = 214 nm, t_R (minor) = 46.7 min, t_R (major) = 52.9 min]; $[\alpha]_D^{21} = -192.2$ (c = 1.27, CHCl_3); **¹H NMR** (400 MHz, CDCl_3) δ 7.25 (d, J = 3.6 Hz, 1 H, ArH), 7.16 (d, J = 3.6 Hz, 1 H, ArH), 6.88-6.64 (m, 1 H, NH), 5.56-5.36 (m, 2 H, $\text{CH}=\text{C}=\text{CH}$), 4.08-3.95 (m, 2 H, CH_2), 0.81 (s, 9 H, $\text{C}(\text{CH}_3)_3$), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); **¹³C NMR** (100 MHz, CDCl_3) δ 212.7, 156.1, 151.2, 147.7, 116.1, 112.3, 96.8, 95.7, 90.1, 79.0, 37.5, 26.0, 16.5, -4.8; **IR** (neat) ν = 3261, 3114, 2947, 2149, 1956, 1651, 1519, 1474, 1393, 1349, 1299, 1251, 1010 cm^{-1} ; **MS** (ESI) m/z (%): 347 ($\text{M} + \text{H}^+$); **Elemental analysis** calcd (%) for $\text{C}_{17}\text{H}_{22}\text{N}_2\text{O}_4\text{Si}$: C, 58.94; H, 6.40; Found: C, 58.89; H, 6.37.

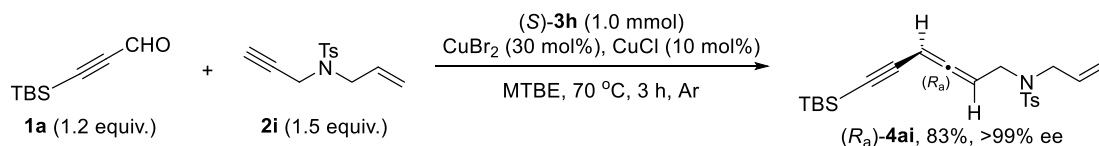
(10) Preparation of (S_a)-N-(6-(*tert*-butyldimethylsilyl)hexa-2,3-dien-5-yn-1-yl)-5-nitrofuran-2-carboxamide ((S_a)-4ah, wgl-5-103)



Following **Typical Procedure I**, the reaction of CuBr_2 (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), **(R)-3h** (334.8 mg, 1.0 mmol), **2h** (291.2 mg, 1.5 mmol), and **1a** (202.6 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded **(S_a)-4ah** (210.4 mg, 61%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (220 mL) to 5:1 (600 mL)] as a brown solid: **m.p.** 135.2-135.8 °C (petroleum ether / dichloromethane); >99% ee [HPLC conditions: Chiralcel AS-H column, *n*-hexane/*i*-PrOH = 80/20, 0.3 mL/min,

$\lambda = 214$ nm, t_R (major) = 46.2 min]; $[\alpha]_D^{22} = +196.4$ ($c = 1.13$, CHCl_3); **¹H NMR** (400 MHz, CDCl_3) δ 7.26 (d, $J = 3.6$ Hz, 1 H, ArH), 7.16 (d, $J = 3.6$ Hz, 1 H, ArH), 6.90-6.79 (m, 1 H, NH), 5.53-5.42 (m, 2 H, $\text{CH}=\text{C}=\text{CH}$), 4.05-4.00 (m, 2 H, CH_2), 0.81 (s, 9 H, $\text{C}(\text{CH}_3)_3$), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); **¹³C NMR** (100 MHz, CDCl_3) δ 212.7, 156.1, 151.2, 147.7, 116.1, 112.3, 96.8, 95.7, 90.1, 79.0, 37.5, 26.0, 16.5, -4.8; **IR** (neat) $\nu = 3263, 3114, 2946, 2152, 1956, 1652, 1567, 1519, 1475, 1393, 1350, 1301, 1254, 1011$ cm^{-1} ; **MS** (ESI) m/z (%): 347 ($\text{M} + \text{H}^+$); **Elemental analysis** calcd (%) for $\text{C}_{17}\text{H}_{22}\text{N}_2\text{O}_4\text{Si}$: C, 58.94; H, 6.40; Found: C, 59.23; H, 6.30.

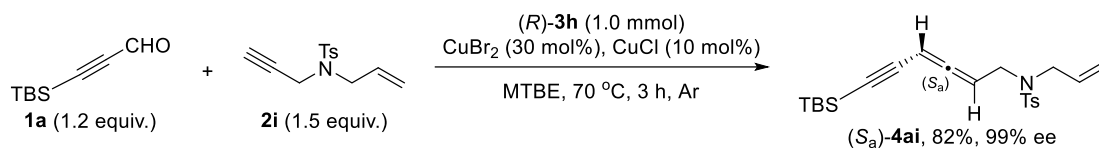
(11) Preparation of (R_a) -*N*-allyl-*N*-(6-(*tert*-butyldimethylsilyl)hexa-2,3-dien-5-yn-1-yl)-4-methylbenzenesulfonamide ((R_a) -**4ai**, wgl-5-022)



Following **Typical Procedure I**, the reaction of CuBr_2 (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (S) -**3** (335.6 mg, 1.0 mmol), **2i** (374.7 mg, 1.5 mmol), and **1a** (202.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (R_a) -**4ai** (334.2 mg, 83%) [eluent: petroleum ether / diethyl ether = 10:1 (330 mL)] as a light yellow oil: >99% ee [HPLC conditions: Chiralcel AS-H column, *n*-hexane/*i*-PrOH = 97/3, 1.0 mL/min, $\lambda = 214$ nm, t_R (minor) = 12.6 min, t_R (major) = 15.0 min]; $[\alpha]_D^{19} = -81.4$ ($c = 1.33$, CHCl_3); **¹H NMR** (400 MHz, CDCl_3) δ 7.60 (d, $J = 8.0$ Hz, 2 H, ArH), 7.20 (d, $J = 8.0$ Hz, 2 H, ArH), 5.60-5.45 (m, 1 H, CH), 5.32-5.22 (m, 1 H, one proton of $\text{CH}=\text{C}=\text{CH}$), 5.20-5.00 (m, 3 H, one proton of $\text{CH}=\text{C}=\text{CH}$ and CH_2), 3.89-3.66 (m, 4 H, $\text{CH}_2 \times 2$), 2.32 (s, 3 H, CH_3), 0.82 (s, 9 H, $\text{C}(\text{CH}_3)_3$), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); **¹³C NMR** (100 MHz, CDCl_3) δ 214.0, 143.4, 137.3, 132.1, 129.7, 127.1, 119.7, 97.0, 95.5, 88.5, 77.5, 49.2, 44.8, 26.0, 21.5, 16.5, -4.7; **IR** (neat) $\nu = 2953, 2930, 2856, 2149, 1951, 1598, 1495, 1347, 1251, 1159, 1092$ cm^{-1} ; **MS** (ESI) m/z (%): 402 ($\text{M} + \text{H}^+$); **HRMS** (ESI) calcd m/z for $\text{C}_{22}\text{H}_{32}\text{NO}_2\text{SSi}^+$ ($\text{M} + \text{H}^+$): 402.1918, found: 402.1909.

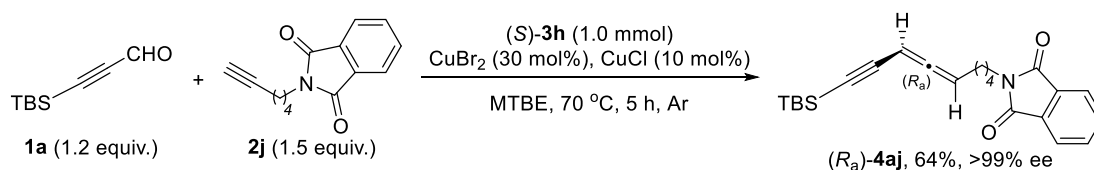
(12) Preparation of (S_a) -*N*-allyl-*N*-(6-(*tert*-butyldimethylsilyl)hexa-2,3-dien-5-yn-1-

yl)-4-methylbenzenesulfonamide ((*S_a*)-**4ai**, wgl-5-023)



Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (10.1 mg, 0.1 mmol), (*R*)-**3h** (335.9 mg, 1.0 mmol), **2i** (374.3 mg, 1.5 mmol), and **1a** (202.2 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S_a*)-**4ai** (329.7 mg, 82%) [eluent: petroleum ether / diethyl ether = 10:1 (330 mL)] as a light yellow oil: 99% ee [HPLC conditions: Chiralcel AS-H column, *n*-hexane/*i*-PrOH = 97/3, 1.0 mL/min, λ = 214 nm, t_R (major) = 12.5 min, t_R (minor) = 15.3 min]; $[\alpha]_D^{19}$ = +84.4 (c = 1.33, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 7.60 (d, J = 8.0 Hz, 2 H, ArH), 7.20 (d, J = 8.0 Hz, 2 H, ArH), 5.59-5.46 (m, 1 H, CH), 5.30-5.20 (m, 1 H, one proton of CH=C=CH), 5.20-5.00 (m, 3 H, one proton of CH=C=CH and CH₂), 3.92-3.65 (m, 4 H, CH₂ x 2), 2.33 (s, 3 H, CH₃), 0.82 (s, 9 H, C(CH₃)₃), 0.00 (s, 6 H, Si(CH₃)₂); **¹³C NMR** (100 MHz, CDCl₃) δ 214.0, 143.4, 137.3, 132.2, 129.8, 127.1, 119.7, 97.0, 95.6, 88.5, 77.5, 49.2, 44.8, 26.0, 21.5, 16.5, -4.7; **IR** (neat) ν = 2953, 2930, 2857, 2149, 1950, 1598, 1495, 1347, 1251, 1159, 1092 cm⁻¹; **MS** (ESI) m/z (%): 402 ($M + H^+$); **HRMS** (ESI) calcd m/z for C₂₂H₃₂NO₂SSi⁺ ($M + H^+$): 402.1918, found: 402.1917.

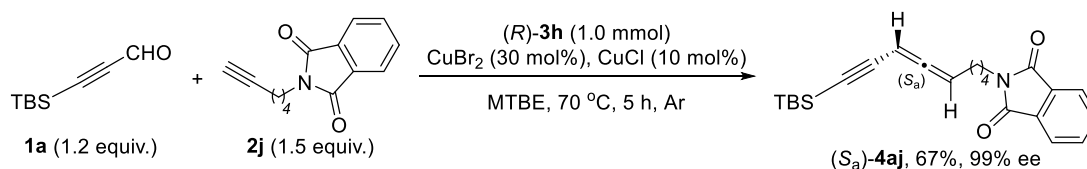
(**13**) Preparation of (*R_a*)-2-(9-(*tert*-butyldimethylsilyl)nona-5,6-dien-8-yn-1-yl)isoindoline-1,3-dione ((*R_a*)-**4aj**, wgl-4-117)



Following **Typical Procedure I**, the reaction of CuBr₂ (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*S*)-**3h** (335.4 mg, 1.0 mmol), **2j** (351.5 mg, 97% purity, 1.5 mmol), and **1a** (202.9 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4aj** (242.8 mg, 64%) [first round eluent: petroleum ether / ethyl acetate = 20:1 (420 mL); second round eluent: petroleum ether / dichloromethane = 3:1 (400 mL)] as a light yellow oil: >99% ee [HPLC conditions: Chiralcel OJ-H column, *n*-hexane/*i*-PrOH =

99/1, 0.5 mL/min, λ = 214 nm, t_R (minor) = 19.8 min, t_R (major) = 22.1 min]; $[\alpha]_D^{27} = -128.6$ (c = 1.33, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.79-7.68 (m, 2 H, ArH), 7.67-7.58 (m, 2 H, ArH), 5.37-5.22 (m, 2 H, $\text{CH}=\text{C}=\text{CH}$), 3.59 (t, J = 7.2 Hz, 2 H, CH_2), 2.09-1.98 (m, 2 H, CH_2), 1.64 (quintet, J = 7.5 Hz, 2 H, CH_2), 1.41 (quintet, J = 7.5 Hz, 2 H, CH_2), 0.82 (s, 9 H, $\text{C}(\text{CH}_3)_3$), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 212.7, 168.0, 133.7, 131.9, 122.9, 98.5, 93.1, 92.4, 76.0, 37.4, 27.6, 27.4, 25.9, 25.7, 16.4, -4.8; **IR** (neat) ν = 2950, 2930, 2856, 2151, 1948, 1773, 1710, 1467, 1437, 1395, 1361, 1250, 1038 cm^{-1} ; **MS** (ESI) m/z (%): 380 ($\text{M} + \text{H}^+$); **HRMS** (ESI) calcd m/z for $\text{C}_{23}\text{H}_{30}\text{NO}_2\text{Si}$ ($\text{M} + \text{H}^+$): 380.2040, found: 380.2035.

(14) Preparation of (S_a) -2-(9-(*tert*-butyldimethylsilyl)nona-5,6-dien-8-yn-1-yl)isoindoline-1,3-dione ((S_a) -**4aj**, wgl-4-116)



Following **Typical Procedure I**, the reaction of CuBr_2 (67.7 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), (R) -**3h** (335.7 mg, 1.0 mmol), **2j** (351.1 mg, 97% purity, 1.5 mmol), and **1a** (202.5 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (S_a) -**4aj** (253.6 mg, 67%) [first round eluent: petroleum ether / ethyl acetate = 20:1 (420 mL); second round eluent: petroleum ether / dichloromethane = 3:1 (400 mL)] as a light yellow oil: 99% ee [HPLC conditions: Chiralcel OJ-H column, *n*-hexane/*i*-PrOH = 99/1, 0.5 mL/min, λ = 214 nm, t_R (major) = 19.5 min, t_R (minor) = 22.2 min]; $[\alpha]_D^{25} = +130.4$ (c = 1.64, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.77-7.69 (m, 2 H, ArH), 7.67-7.58 (m, 2 H, ArH), 5.37-5.23 (m, 2 H, $\text{CH}=\text{C}=\text{CH}$), 3.59 (t, J = 7.0 Hz, 2 H, CH_2), 2.12-1.94 (m, 2 H, CH_2), 1.64 (quintet, J = 7.4 Hz, 2 H, CH_2), 1.40 (quintet, J = 7.5 Hz, 2 H, CH_2), 0.82 (s, 9 H, $\text{C}(\text{CH}_3)_3$), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 212.7, 168.0, 133.6, 131.9, 122.9, 98.5, 93.1, 92.3, 76.0, 37.4, 27.6, 27.4, 25.9, 25.6, 16.4, -4.8; **IR** (neat) ν = 2949, 2930, 2856, 2151, 1948, 1773, 1710, 1467, 1437, 1395, 1362, 1250, 1038 cm^{-1} ; **MS** (ESI) m/z (%): 380 ($\text{M} + \text{H}^+$); **HRMS** (ESI) calcd m/z for

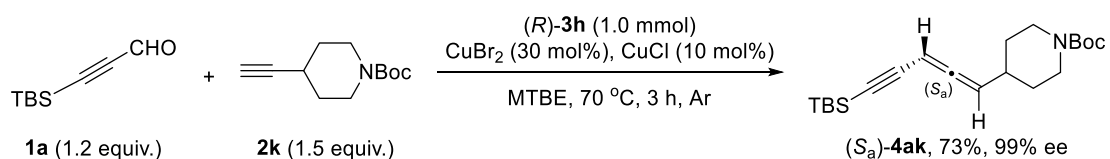
C₂₃H₃₀NO₂Si (M + H⁺): 380.2040, found: 380.2033.

(15) Preparation of (*R_a*)-*tert*-butyl-4-(5-(*tert*-butyldimethylsilyl)penta-1,2-dien-4-yn-1-yl)piperidine-1-carboxylate ((*R_a*)-**4ak**, wgl-5-150)



Following **Typical Procedure I**, the reaction of CuBr₂ (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*S*)-**3h** (335.7 mg, 1.0 mmol), **2k** (314.2 mg, 1.5 mmol), and **1a** (202.6 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4ak** (286.5 mg, 79%) [eluent: first round, petroleum ether / ethyl acetate = 50:1 (204 mL) to 30:1 (310 mL); second round, petroleum ether / dichloromethane = 2:1 (150 mL) to 1:1 (400 mL)] as a light yellow oil: >99% ee [HPLC conditions: Chiralcel IC column, *n*-hexane/*i*-PrOH = 99/1, 1.0 mL/min, λ = 214 nm, *t_R* (major) = 7.7 min, *t_R* (minor) = 8.5 min]; [α]_D²⁴ = -175.7 (*c* = 1.26, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 5.37-5.24 (m, 2 H, CH=C=CH), 3.97-3.77 (m, 2 H, CH₂), 2.74 (t, *J* = 11.8 Hz, 2 H, CH₂), 2.21-2.09 (m, 1 H, CH), 1.67-1.59 (m, 2 H, CH₂), 1.34 (s, 9 H, CO₂C(CH₃)₃), 1.29-1.17 (m, 2 H, CH₂), 0.82 (s, 9 H, C(CH₃)₃), 0.00 (s, 6 H, Si(CH₃)₂); ¹³C NMR (100 MHz, CDCl₃) δ 212.2, 154.7, 98.4, 97.2, 93.8, 79.3, 77.4, 43.3, 34.9, 31.4, 28.4, 26.0, 16.6, -4.7; IR (neat) ν = 2931, 2856, 2155, 1947, 1691, 1419, 1364, 1251, 1228, 1167, 1005 cm⁻¹; MS (ESI) *m/z* (%): 384 (M + Na⁺); HRMS (ESI) calcd *m/z* for C₂₁H₃₅NO₂SiNa⁺ (M + Na⁺): 384.2329, found: 384.2321.

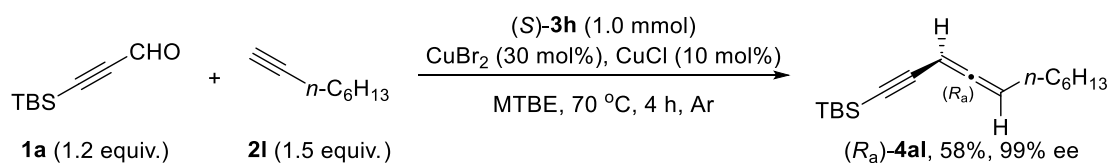
(16) Preparation of (*S_a*)-*tert*-butyl-4-(5-(*tert*-butyldimethylsilyl)penta-1,2-dien-4-yn-1-yl)piperidine-1-carboxylate ((*S_a*)-**4ak**, wgl-5-146)



Following **Typical Procedure I**, the reaction of CuBr₂ (67.8 mg, 0.3 mmol), CuCl (9.8 mg, 0.1 mmol), (*R*)-**3h** (335.2 mg, 1.0 mmol), **2k** (313.7 mg, 1.5 mmol), and **1a**

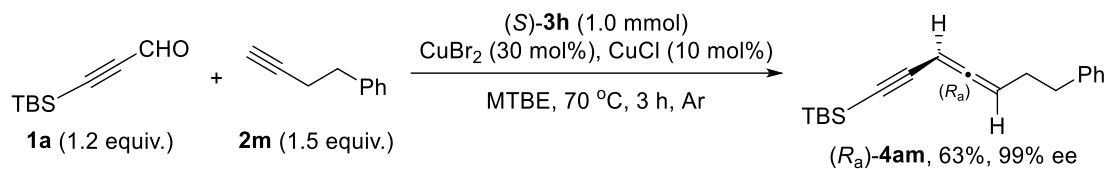
(202.7 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S_a*)-**4ak** (265.3 mg, 73%) [eluent: first round, petroleum ether / ethyl acetate = 50:1 (204 mL) to 30:1 (310 mL); second round, petroleum ether / dichloromethane = 2:1 (150 mL) to 1:1 (400 mL)] as a light yellow oil: 99% ee [HPLC conditions: Chiralcel IC column, *n*-hexane/*i*-PrOH = 99/1, 1.0 mL/min, λ = 214 nm, t_R (minor) = 7.8 min, t_R (major) = 8.4 min]; $[\alpha]_D^{23}$ = +178.3 (c = 1.27, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 5.39-5.24 (m, 2 H, CH=C=CH), 3.99-3.77 (m, 2 H, CH₂), 2.74 (t, J = 11.8 Hz, 2 H, CH₂), 2.22-2.07 (m, 1 H, CH), 1.68-1.58 (m, 2 H, CH₂), 1.34 (s, 9 H, CO₂C(CH₃)₃), 1.29-1.16 (m, 2 H, CH₂), 0.82 (s, 9 H, C(CH₃)₃), 0.00 (s, 6 H, Si(CH₃)₂); **¹³C NMR** (100 MHz, CDCl₃) δ 212.2, 154.7, 98.4, 97.2, 93.7, 79.3, 77.4, 43.3, 34.9, 31.3, 28.4, 26.0, 16.6, -4.7; **IR** (neat) ν = 2931, 2856, 2155, 1947, 1691, 1419, 1364, 1251, 1228, 1166, 1005 cm⁻¹; **MS** (ESI) m/z (%): 384 (M + Na⁺); **HRMS** (ESI) calcd m/z for C₂₁H₃₅NO₂SiNa⁺ (M + Na⁺): 384.2329, found: 384.2330.

(17) Preparation of (*R_a*)-*tert*-butyldimethyl(undeca-3,4-dien-1-yn-1-yl)silane ((*R_a*)-**4al**, wgl-3-193)



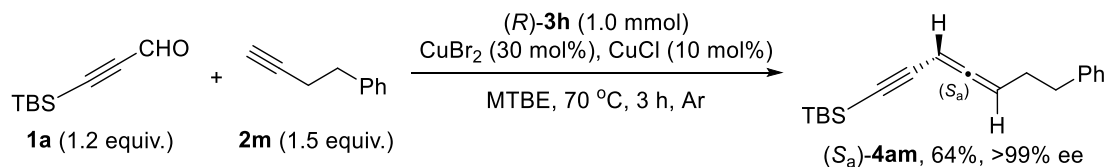
Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (9.8 mg, 0.1 mmol), (*S*)-**3h** (335.6 mg, 1.0 mmol), **2l** (169.1 mg, 1.5 mmol), and **1a** (202.7 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4al**¹ (157.6 mg, 58%, purity: 96%) [first round eluent: silica gel (300-400), petroleum ether (300 mL); second round eluent: HG silica gel, petroleum ether (300 mL)] as a pale yellow oil: 99% ee [HPLC conditions: Chiralcel OD-3 column, 100% CO₂, 1.0 mL/min, T = 30 °C, λ = 214 nm, t_R (major) = 6.7 min, t_R (minor) = 6.9 min]; **¹H NMR** (400 MHz, CDCl₃) δ 5.32-5.22 (m, 2 H, CH=C=CH), 1.99-1.91 (m, 2 H, CH₂), 1.37-1.13 (m, 8 H, CH₂ x 4), 0.86-0.75 (m, 12 H, C(CH₃)₃ and CH₃), 0.00 (s, 6 H, Si(CH₃)₂); **¹³C NMR** (100 MHz, CDCl₃) δ 213.0, 98.9, 93.2, 93.0, 75.8, 31.6, 28.7, 28.6, 28.1, 26.1, 22.6, 16.6, 14.1, -4.6.

(18) Preparation of (*R_a*)-tert-butyldimethyl(7-phenylhepta-3,4-dien-1-yn-1-yl)silane ((*R_a*)-4am, wgl-4-157)



Following **Typical Procedure I**, the reaction of CuBr₂ (67.8 mg, 0.3 mmol), CuCl (9.8 mg, 0.1 mmol), (*S*)-**3h** (335.6 mg, 1.0 mmol), **2m** (201.7 mg, 1.5 mmol), and **1a** (202.5 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4am** (178.8 mg, 63%) [HG silica gel, eluent: petroleum ether (300 mL)] as a light yellow oil: 99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane, 0.5 mL/min, λ = 214 nm, t_R (major) = 14.8 min, t_R (minor) = 21.5 min]; $[\alpha]_D^{20}$ = -193.6 (c = 1.38, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 7.18-7.03 (m, 5 H, ArH), 5.35-5.23 (m, 2 H, CH=C=CH), 2.61 (t, J = 7.8 Hz, 2 H, CH₂), 2.29-2.18 (m, 2 H, CH₂), 0.83 (s, 9 H, C(CH₃)₃), 0.00 (s, 6 H, Si(CH₃)₂); **¹³C NMR** (100 MHz, CDCl₃) δ 212.9, 141.2, 128.4, 128.3, 126.0, 98.6, 93.5, 92.5, 76.4, 35.0, 29.7, 26.1, 16.6, -4.6; **IR** (neat) ν = 2953, 2929, 2856, 2154, 1949, 1603, 1496, 1466, 1251, 1008 cm⁻¹; **MS** (ESI) m/z (%): 283 ($M + H^+$); **HRMS** (ESI) calcd for C₁₉H₂₇Si⁺ ($M + H^+$): 283.1877, found: 283.1882.

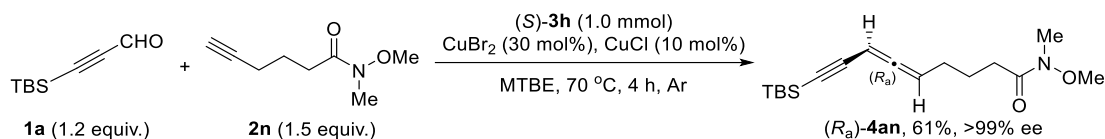
(19) Preparation of (*S_a*)-tert-butyldimethyl(7-phenylhepta-3,4-dien-1-yn-1-yl)silane ((*S_a*)-4am, wgl-4-158)



Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), (*R*)-**3h** (335.8 mg, 1.0 mmol), **2m** (201.7 mg, 1.5 mmol), and **1a** (202.8 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S_a*)-**4am** (179.8 mg, 64%) [HG silica gel, eluent: petroleum ether (300 mL)] as a light yellow oil: >99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane, 0.5 mL/min, λ = 214 nm, t_R

(minor) = 14.7 min, t_R (major) = 20.5 min]; $[\alpha]_D^{21} = +200.4$ ($c = 1.60$, CHCl_3); ^1H NMR (400 MHz, CDCl_3) δ 7.22-7.02 (m, 5 H, ArH), 5.37-5.22 (m, 2 H, $\text{CH}=\text{C}=\text{CH}$), 2.62 (t, $J = 7.8$ Hz, 2 H, CH_2), 2.30-2.16 (m, 2 H, CH_2), 0.83 (s, 9 H, $\text{C}(\text{CH}_3)_3$), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); ^{13}C NMR (100 MHz, CDCl_3) δ 212.9, 141.2, 128.4, 128.3, 126.0, 98.6, 93.5, 92.5, 76.4, 35.0, 29.7, 26.1, 16.6, -4.6; **IR** (neat) $\nu = 2953, 2930, 2856, 2154, 1949, 1603, 1496, 1466, 1251, 1008\text{ cm}^{-1}$; **MS** (ESI) m/z (%): 283 ($\text{M} + \text{H}^+$); **HRMS** (ESI) calcd for $\text{C}_{19}\text{H}_{27}\text{Si}^+$ ($\text{M} + \text{H}^+$): 283.1877, found: 283.1877.

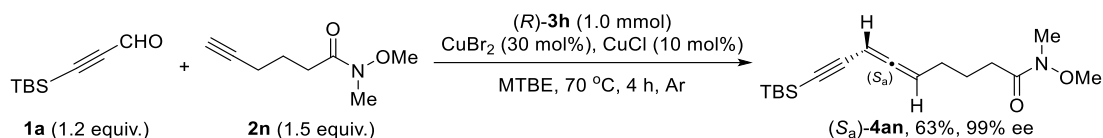
(20) Preparation of (R_a) -9-(*tert*-butyldimethylsilyl)-*N*-methoxy-*N*-methylnona-5,6-dien-8-ynamide ((R_a)-**4an**, wgl-5-094)



Following **Typical Procedure I**, the reaction of CuBr_2 (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*S*)-**3h** (335.6 mg, 1.0 mmol), **2n** (233.1 mg, 1.5 mmol), and **1a** (202.5 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (R_a)-**4an** (186.7 mg, 61%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (220 mL) to 5:1 (300 mL); second round, petroleum ether / ethyl acetate / diethyl ether = 20:1:1 (220 mL) to 10:1:1 (360 mL)] as a light yellow oil: >99% ee [HPLC conditions: Chiralcel IC column, *n*-hexane/*i*-PrOH = 99/1, 1.0 mL/min, $\lambda = 214$ nm, t_R (major) = 26.7 min, t_R (minor) = 29.0 min]; $[\alpha]_D^{26} = -155.4$ ($c = 1.26$, CHCl_3); ^1H NMR (400 MHz, CDCl_3) δ 5.37-5.24 (m, 2 H, $\text{CH}=\text{C}=\text{CH}$), 3.58 (s, 3 H, OCH_3), 3.07 (s, 3 H, CH_3), 2.37 (t, $J = 7.2$ Hz, 2 H, CH_2), 2.07-1.98 (m, 2 H, CH_2), 1.69 (quintet, $J = 7.3$ Hz, 2 H, CH_2), 0.83 (s, 9 H, $\text{C}(\text{CH}_3)_3$), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); ^{13}C NMR (100 MHz, CDCl_3) δ 212.8, 174.0, 98.5, 93.3, 92.4, 76.1, 61.1, 32.0, 30.8, 27.5, 26.0, 23.4, 16.5, -4.8; **IR** (neat) $\nu = 2953, 2932, 2856, 2147, 1948, 1665, 1463, 1385, 1361, 1250, 1177, 1000\text{ cm}^{-1}$; **MS** (ESI) m/z (%): 308 ($\text{M} + \text{H}^+$); **HRMS** (ESI) calcd m/z for $\text{C}_{17}\text{H}_{30}\text{NO}_2\text{Si}^+$ ($\text{M} + \text{H}^+$): 308.2040, found: 308.2034.

(21) Preparation of (*S*_a)-9-(*tert*-butyldimethylsilyl)-*N*-methoxy-*N*-methylnona-5,6-

dien-8-ynamide ((*S_a*)-**4an**, wgl-5-095)



Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), (*R*)-**3h** (335.8 mg, 1.0 mmol), **2n** (232.5 mg, 1.5 mmol), and **1a** (202.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S_a*)-**4an** (193.3 mg, 63%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (220 mL) to 5:1 (300 mL); second round, petroleum ether / ethyl acetate / diethyl ether = 20:1:1 (220 mL) to 10:1:1 (360 mL)] as a light yellow oil: 99% ee [HPLC conditions: Chiralcel IC column, *n*-hexane/*i*-PrOH = 99/1, 1.0 mL/min, λ = 214 nm, t_R (minor) = 26.6 min, t_R (major) = 28.7 min]; $[\alpha]_D^{27} = +154.3$ (c = 1.34, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 5.36-5.22 (m, 2 H, CH=C=CH), 3.58 (s, 3 H, OCH₃), 3.07 (s, 3 H, CH₃), 2.37 (t, J = 7.2 Hz, 2 H, CH₂), 2.08-1.98 (m, 2 H, CH₂), 1.69 (quintet, J = 7.3 Hz, 2 H, CH₂), 0.83 (s, 9 H, C(CH₃)₃), 0.00 (s, 6 H, Si(CH₃)₂); **¹³C NMR** (100 MHz, CDCl₃) δ 212.8, 174.0, 98.5, 93.3, 92.4, 76.1, 61.1, 32.0, 30.8, 27.5, 25.9, 23.4, 16.5, -4.8; **IR** (neat) ν = 2953, 2932, 2856, 2147, 1948, 1665, 1462, 1412, 1384, 1362, 1249, 1177 cm⁻¹; **MS** (ESI) m/z (%): 308 (M + H⁺); **HRMS** (ESI) calcd m/z for C₁₇H₃₀NO₂Si⁺ (M + H⁺): 308.2040, found: 308.2033.

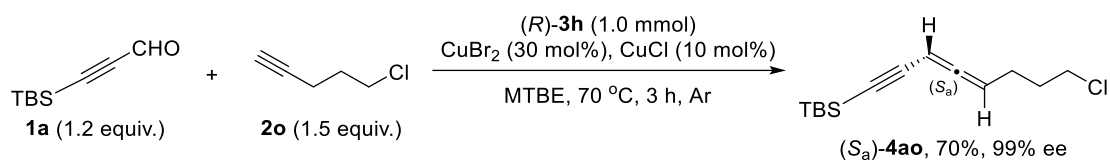
(22) Preparation of (*R_a*)-*tert*-butyl(8-chloroocta-3,4-dien-1-yn-1-yl)dimethylsilane ((*R_a*)-**4ao**, wgl-4-166)



Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), (*S*)-**3h** (335.8 mg, 1.0 mmol), **2o** (157.5 mg, 1.5 mmol), and **1a** (202.8 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4ao** (172.1 mg, 67%) [eluent: petroleum ether (300 mL)] as a colorless oil: >99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane, 0.5 mL/min, λ = 214 nm, t_R (major) = 10.2 min];

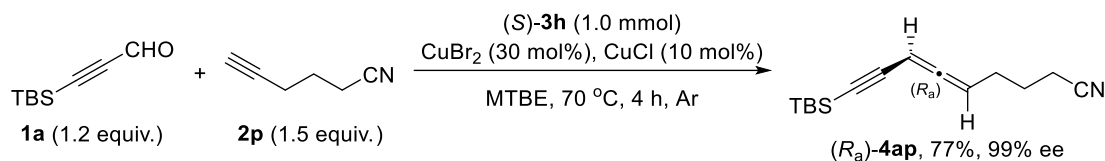
$[\alpha]_D^{22} = -179.3$ ($c = 1.61$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 5.40-5.24 (m, 2 H, $\text{CH}=\text{C}=\text{CH}$), 3.47 (t, $J = 6.6$ Hz, 2 H, CH_2), 2.17-2.05 (m, 2 H, CH_2), 1.81 (quintet, $J = 7.0$ Hz, 2 H, CH_2), 0.82 (s, 9 H, $\text{C}(\text{CH}_3)_3$), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 213.0, 98.2, 93.9, 91.7, 76.8, 43.9, 31.2, 26.0, 25.1, 16.6, -4.7; **IR** (neat) $\nu = 2954, 2930, 2890, 2857, 2150, 1950, 1467, 1251, 1011 \text{ cm}^{-1}$; **MS** (70 eV, EI) m/z (%): 199 [$\text{M}^+(\text{}^{37}\text{Cl}) - t\text{-Bu}$, 6.93], 197 [$\text{M}^+(\text{}^{35}\text{Cl}) - t\text{-Bu}$, 20.41], 93 (100); **HRMS** (70 eV, EI) calcd for $\text{C}_{10}\text{H}_{14}^{35}\text{ClSi}$ ($\text{M}^+ - t\text{-Bu}$): 197.0548, found: 197.0550.

(23) Preparation of (*S_a*)-*tert*-butyl(8-chloroocta-3,4-dien-1-yn-1-yl)dimethylsilane ((*S_a*)-**4ao**, wgl-4-167)



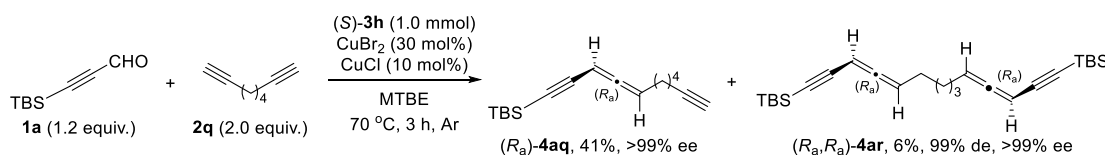
Following **Typical Procedure I**, the reaction of CuBr_2 (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*R*)-**3h** (335.7 mg, 1.0 mmol), **2o** (157.7 mg, 1.5 mmol), and **1a** (202.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S_a*)-**4ao** (178.1 mg, 70%) [eluent: petroleum ether (300 mL)] as a colorless oil: 99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane, 0.5 mL/min, $\lambda = 214 \text{ nm}$, t_R (minor) = 9.5 min, t_R (major) = 12.3 min]; $[\alpha]_D^{24} = +177.3$ ($c = 1.60$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 5.35-5.25 (m, 2 H, $\text{CH}=\text{C}=\text{CH}$), 3.47 (t, $J = 6.6$ Hz, 2 H, CH_2), 2.16-2.08 (m, 2 H, CH_2), 1.81 (quintet, $J = 7.0$ Hz, 2 H, CH_2), 0.82 (s, 9 H, $\text{C}(\text{CH}_3)_3$), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 213.0, 98.2, 93.9, 91.7, 76.8, 43.9, 31.2, 26.0, 25.1, 16.6, -4.7; **IR** (neat) $\nu = 2954, 2931, 2891, 2857, 2151, 1950, 1467, 1252, 1011 \text{ cm}^{-1}$; **MS** (70 eV, EI) m/z (%): 199 [$\text{M}^+(\text{}^{37}\text{Cl}) - t\text{-Bu}$, 8.57], 197 [$\text{M}^+ - t\text{-Bu}$, 24.5], 93 (100); **HRMS** (70 eV, EI) calcd for $\text{C}_{10}\text{H}_{14}^{35}\text{ClSi}$ ($\text{M}^+ - t\text{-Bu}$): 197.0548, found: 197.0550.

(24) Preparation of (*R_a*)-tert-butyl(8-chloroocta-3,4-dien-1-yn-1-yl)dimethylsilane ((*R_a*)-4ap**, wgl-3-160)**



Following **Typical Procedure I**, the reaction of CuBr_2 (67.7 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*S*)-**3h** (335.4 mg, 1.0 mmol), **2p** (142.8 mg, 1.5 mmol), and **1a** (203.3 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4ap**¹ (189.5 mg, 77%) [eluent: petroleum ether / ethyl ether / ethyl acetate = 40:1:1 (210 mL) to 30:1:1 (160 mL)] as a pale yellow oil: 99% ee (HPLC conditions: Chiralcel OD-H column, *n*-hexane/*i*-PrOH = 99.5/0.5, 1.0 mL/min, λ = 214 nm, t_R (major) = 10.1 min, t_R (minor) = 13.8 min); ¹H NMR (400 MHz, CDCl_3) δ 5.39-5.25 (m, 2 H, CH=C=CH), 2.30 (t, J = 7.0 Hz, 2 H, CH_2), 2.17-2.06 (m, 2 H, CH_2), 1.71 (quintet, J = 7.1 Hz, 2 H, CH_2), 0.82 (s, 9 H, $\text{C}(\text{CH}_3)_3$), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); ¹³C NMR (100 MHz, CDCl_3) δ 213.1, 119.3, 97.8, 94.5, 91.1, 77.3, 26.6, 26.0, 24.1, 16.5, 16.2, -4.7.

(25) Preparation of (*R_a*)-tert-butyl dimethyl(undeca-3,4-dien-1,10-diyn-1-yl)silane ((*R_a*)-4aq**, wgl-4-195)**



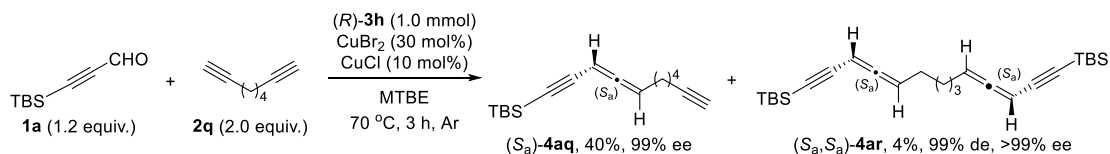
Following **Typical Procedure I**, the reaction of CuBr_2 (67.7 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), (*S*)-**3h** (335.5 mg, 1.0 mmol), **2q** (216.5 mg, 98% purity, 2.0 mmol), and **1a** (202.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4aq** (106.3 mg, 41%) and (*R_a,R_a*)-**4ar** (24.8 mg, 6%) [eluent: petroleum ether / dichloromethane = 4:1 (250 mL)].

(*R_a*)-**4aq**: light yellow oil; >99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane, 0.5 mL/min, λ = 214 nm, t_R (major) = 10.8 min, t_R (minor) = 12.6 min]; $[\alpha]_D^{15} = -193.9$ (c = 1.22, CHCl_3); ¹H NMR (400 MHz, CDCl_3) δ 5.33-5.23 (m, 2 H, CH=C=CH), 2.14-2.05 (m, 2 H, CH_2), 2.03-1.94 (m, 2 H, CH_2), 1.83 (t, J = 2.6 Hz, 1

H, CH), 1.52-1.41 (m, 4 H, CH₂ x 2), 0.82 (s, 9 H, C(CH₃)₃), 0.00 (s, 6 H, Si(CH₃)₂); ¹³C NMR (100 MHz, CDCl₃) δ 213.0, 98.7, 93.3, 92.7, 84.3, 76.1, 68.4, 27.6, 27.5, 26.1, 18.1, 16.6, -4.6; IR (neat) ν = 3307, 2931, 2857, 2150, 1949, 1466, 1251, 1030, 1008 cm⁻¹; MS (70 eV, EI) *m/z* (%): 201 (M⁺ - *t*-Bu, 100); HRMS (70 eV, EI) calcd for C₁₃H₁₇Si (M⁺ - *t*-Bu): 201.1094, found: 201.1093.

(*R*_a,*R*_a)-**4ar**: light yellow oil; 99% de, >99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane, 0.3 mL/min, λ = 214 nm, *t*_R (major) = 15.2 min, *t*_R (minor) = 23.2 min]; ¹H NMR (400 MHz, CDCl₃) δ 5.31-5.24 (m, 4 H, CH=C=CH x 2), 2.02-1.92 (m, 4 H, CH₂ x 2), 1.42-1.34 (m, 4 H, CH₂ x 2), 0.82 (s, 18 H, C(CH₃)₃ x 2), 0.00 (s, 12 H, Si(CH₃)₂ x 2); ¹³C NMR (100 MHz, CDCl₃) δ 212.9, 98.8, 93.3, 92.9, 75.9, 27.9, 27.8, 26.1, 16.6, -4.6.

(26) Preparation of (*S*_a)-*tert*-butyldimethyl(undeca-3,4-dien-1,10-diyn-1-yl)silane ((*S*_a)-4aq**, wgl-4-193)**



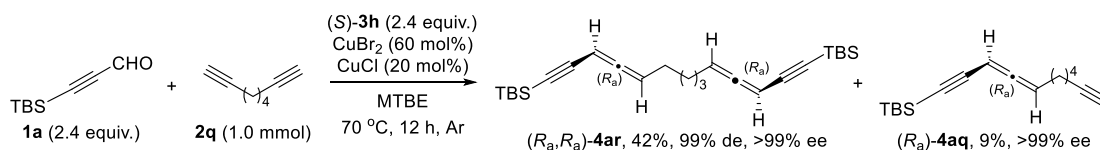
Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (9.8 mg, 0.1 mmol), (*R*)-**3h** (335.8 mg, 1.0 mmol), **2q** (217.2 mg, 98% purity, 2.0 mmol), and **1a** (202.5 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S*_a)-**4aq** (102.7 mg, 40%) and (*S*_a,*S*_a)-**4ar** (15.2 mg, 4%) [eluent: petroleum ether / dichloromethane = 4:1 (250 mL)].

(*S*_a)-**4aq**: light yellow oil; 99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane, 0.5 mL/min, λ = 214 nm, *t*_R (minor) = 10.6 min, *t*_R (major) = 12.7 min]; [α]_D¹⁶ = +196.3 (*c* = 1.40, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 5.31-5.25 (m, 2 H, CH=C=CH), 2.14-2.05 (m, 2 H, CH₂), 2.02-1.94 (m, 2 H, CH₂), 1.83 (t, *J* = 2.6 Hz, 1 H, CH), 1.52-1.41 (m, 4 H, CH₂ x 2), 0.82 (s, 9 H, C(CH₃)₃), 0.00 (s, 6 H, Si(CH₃)₂); ¹³C NMR (100 MHz, CDCl₃) δ 213.0, 98.7, 93.4, 92.7, 84.3, 76.1, 68.4, 27.6, 27.5, 26.1, 18.1, 16.6, -4.6; IR (neat) ν = 3309, 2931, 2857, 2150, 1949, 1466, 1251, 1030, 1009 cm⁻¹; MS (70 eV, EI) *m/z* (%): 201 (M⁺ - *t*-Bu, 100); HRMS (70 eV, EI) calcd

for C₁₃H₁₇Si (M⁺ – *t*-Bu): 201.1094, found: 201.1094.

(*S*_a,*S*_a)-**4ar**: light yellow oil; ¹H NMR (400 MHz, CDCl₃) δ 5.33-5.22 (m, 4 H, CH=C=CH x 2), 2.03-1.92 (m, 4 H, CH₂ x 2), 1.41-1.34 (m, 4 H, CH₂ x 2), 0.82 (s, 18 H, C(CH₃)₃ x 2), 0.00 (s, 12 H, Si(CH₃)₂ x 2).

(27) Preparation of (*R*_a,*R*_a)-1,14-bis(*tert*-butyldimethylsilyl)tetradeca-3,4,10,11-tetraen-1,13-diyne ((*R*_a,*R*_a)-**4ar**, wgl-4-196)

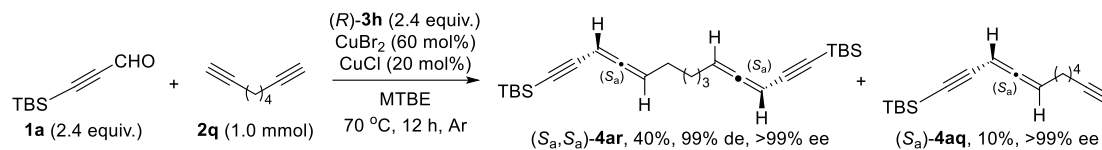


Following **Typical Procedure I**, the reaction of CuBr₂ (135.5 mg, 0.6 mmol), CuCl (19.8 mg, 0.2 mmol), (*S*)-**3h** (806.1 mg, 2.4 mmol), **2q** (108.5 mg, 98% purity, 1.0 mmol), and **1a** (404.5 mg, 2.4 mmol) in freshly distilled MTBE (10 mL) afforded (*R*_a,*R*_a)-**4ar** (174.2 mg, 42%, 99% purity) and (*R*_a)-**4aq** (22.6 mg, 9%) [eluent: petroleum ether / dichloromethane = 4:1 (250 mL)].

(*R*_a,*R*_a)-**4ar**: light yellow oil; 99% de, >99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane, 0.3 mL/min, λ = 214 nm, *t*_R (major) = 15.1 min, *t*_R (minor) = 23.2 min]; [α]_D²⁰ = -247.2 (*c* = 1.28, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 5.33-5.22 (m, 4 H, CH=C=CH x 2), 2.04-1.91 (m, 4 H, CH₂ x 2), 1.43-1.32 (m, 4 H, CH₂ x 2), 0.83 (s, 18 H, C(CH₃)₃ x 2), 0.00 (s, 12 H, Si(CH₃)₂ x 2); ¹³C NMR (100 MHz, CDCl₃) δ 212.9, 98.8, 93.2, 92.9, 75.9, 27.9, 27.8, 26.1, 16.6, -4.6; IR (neat) ν = 2952, 2929, 2890, 2856, 2151, 1949, 1466, 1251, 1030, 1009 cm⁻¹; MS (70 eV, EI) *m/z* (%): 410 (M⁺, 1.36), 73 (100); HRMS (70 eV, EI) calcd for C₂₆H₄₂Si₂ (M⁺): 410.2820, found: 410.2821.

(*R*_a)-**4aq**: light yellow oil; >99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane, 0.5 mL/min, λ = 214 nm, *t*_R (major) = 10.8 min, *t*_R (minor) = 12.8 min]; ¹H NMR (400 MHz, CDCl₃) δ 5.32-5.24 (m, 2 H, CH=C=CH), 2.15-2.05 (m, 2 H, CH₂), 2.03-1.93 (m, 2 H, CH₂), 1.83 (t, *J* = 2.6 Hz, 1 H, CH), 1.52-1.41 (m, 4 H, CH₂ x 2), 0.83 (s, 9 H, C(CH₃)₃), 0.00 (s, 6 H, Si(CH₃)₂).

(28) Preparation of (*S_a*,*S_a*)-1,14-bis(*tert*-butyldimethylsilyl)tetradeca-3,4,10,11-tetraen-1,13-diyne ((*S_a*,*S_a*)-4ar**, wgl-4-194)**

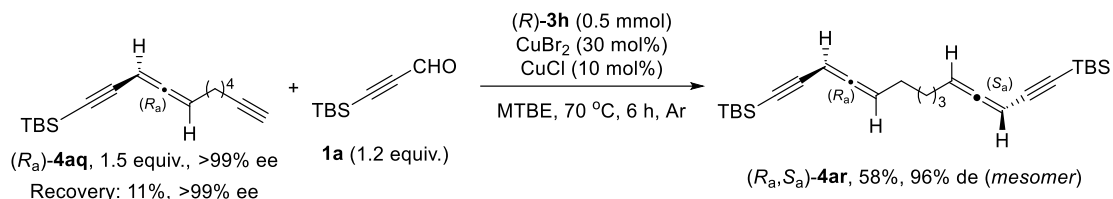


Following **Typical Procedure I**, the reaction of CuBr₂ (135.4 mg, 0.6 mmol), CuCl (19.7 mg, 0.2 mmol), (*R*)-**3h** (805.3 mg, 2.4 mmol), **2q** (108.5 mg, 98% purity, 1.0 mmol), and **1a** (404.1 mg, 2.4 mmol) in freshly distilled MTBE (10 mL) afforded (*S_a*,*S_a*)-**4ar** (164.4 mg, 40%) and (*S_a*)-**4aq** (26.2 mg, 10%) [eluent: petroleum ether / dichloromethane = 4:1 (250 mL)].

(*S_a*,*S_a*)-**4ar**: light yellow oil; 99% de, >99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane, 0.3 mL/min, λ = 214 nm, t_R (minor) = 15.6 min, t_R (major) = 23.8 min]; $[\alpha]_D^{23}$ = +249.2 (c = 1.32, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 5.31-5.22 (m, 4 H, CH=C=CH x 2), 2.03-1.90 (m, 4 H, CH₂ x 2), 1.43-1.32 (m, 4 H, CH₂ x 2), 0.83 (s, 18 H, C(CH₃)₃ x 2), 0.00 (s, 12 H, Si(CH₃)₂ x 2); **¹³C NMR** (100 MHz, CDCl₃) δ 213.0, 98.8, 93.2, 92.9, 75.9, 27.9, 27.8, 26.1, 16.6, -4.6; **IR** (neat) ν = 2952, 2930, 2889, 2856, 2151, 1949, 1466, 1251, 1030, 1009 cm⁻¹; **MS** (70 eV, EI) m/z (%): 410 (*M*⁺, 2.03), 73 (100); **HRMS** (70 eV, EI) calcd for C₂₆H₄₂Si₂ (*M*⁺): 410.2820, found: 410.2820.

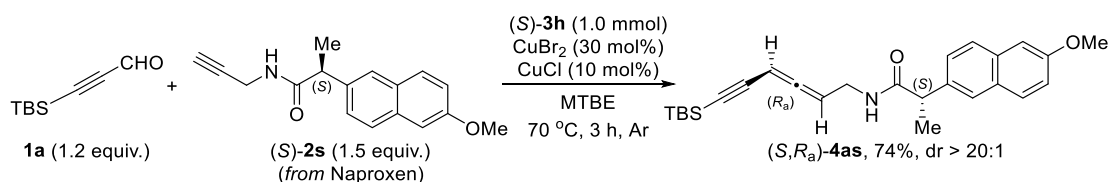
(*R_a*)-**4aq**: light yellow oil; >99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane, 0.5 mL/min, λ = 214 nm, t_R (minor) = 10.7 min, t_R (major) = 12.6 min]; **¹H NMR** (400 MHz, CDCl₃) δ 5.32-5.23 (m, 2 H, CH=C=CH), 2.14-2.04 (m, 2 H, CH₂), 2.02-1.93 (m, 2 H, CH₂), 1.83 (t, J = 2.6 Hz, 1 H, CH), 1.52-1.41 (m, 4 H, CH₂ x 2), 0.82 (s, 9 H, C(CH₃)₃), 0.00 (s, 6 H, Si(CH₃)₂).

(29) Preparation of (*R_a,S_a*)-1,14-bis(*tert*-butyldimethylsilyl)tetradeca-3,4,10,11-tetraen-1,13-diyne ((*R_a,S_a*)-4ar**, wgl-4-197)**



Following **Typical Procedure I**, the reaction of CuBr_2 (33.7 mg, 0.15 mmol), CuCl (5.1 mg, 0.05 mmol), (*R*)-**3h** (167.4 mg, 0.5 mmol), (*R_a*)-**4aq** (192.6 mg, 0.75 mmol), and **1a** (101.4 mg, 0.6 mmol) in freshly distilled MTBE (2.5 mL) afforded (*R_a,S_a*)-**4ar** (118.0 mg, 58%) [eluent: petroleum ether / dichloromethane = 8:1 (270 mL)] as a colorless oil; 96% de [HPLC conditions: Chiralcel OD-H column, *n*-hexane, 0.3 mL/min, λ = 214 nm, t_R (minor)₁ = 15.3 min, t_R (major) = 17.9 min, t_R (minor)₂ = 23.0 min]; $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 5.34-5.19 (m, 4 H, $\text{CH}=\text{C}=\text{CH} \times 2$), 2.02-1.89 (m, 4 H, $\text{CH}_2 \times 2$), 1.43-1.32 (m, 4 H, $\text{CH}_2 \times 2$), 0.82 (s, 18 H, $\text{C}(\text{CH}_3)_3 \times 2$), 0.00 (s, 12 H, $\text{Si}(\text{CH}_3)_2 \times 2$); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 212.9, 98.8, 93.2, 92.9, 75.9, 27.9, 27.7, 26.1, 16.6, -4.6; **IR** (neat) ν = 2951, 2930, 2856, 2151, 1949, 1466, 1251, 1031, 1009 cm^{-1} ; **MS** (70 eV, EI) m/z (%): 410 (M^+ , 1.51), 73 (100); **HRMS** (70 eV, EI) calcd for $\text{C}_{26}\text{H}_{42}\text{Si}_2$ (M^+): 410.2820, found: 410.2820.

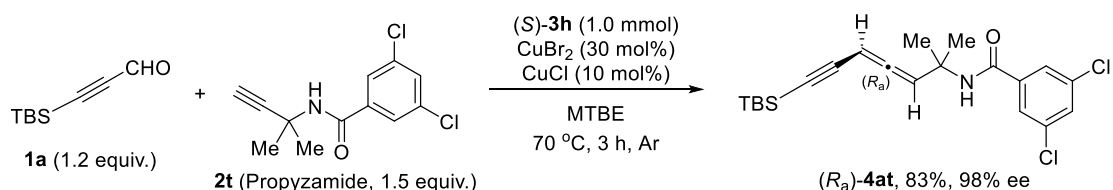
(30) Preparation of (*S,R_a*)-*N*-(6-(*tert*-butyldimethylsilyl)hexa-2,3-dien-5-yn-1-yl)-2-(6-methoxynaphthalen-2-yl)propanamide ((*S,R_a*)-4as**, wgl-4-089)**



Following **Typical Procedure I**, the reaction of CuBr_2 (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*S*)-**3h** (335.7 mg, 1.0 mmol), (*S*)-**2s** (401.3 mg, 1.5 mmol), and **1a** (202.5 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S,R_a*)-**4as** (309.1 mg, 74%) [eluent: petroleum ether / ethyl acetate = 10:1 (110 mL) to 5:1 (480 mL)] as a yellow oil; dr > 20:1 (determined by $^1\text{H NMR}$ analysis of the crude reaction mixture); $[\alpha]_D^{21} = -172.1$ (c = 1.43, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.63-7.52 (m, 3 H,

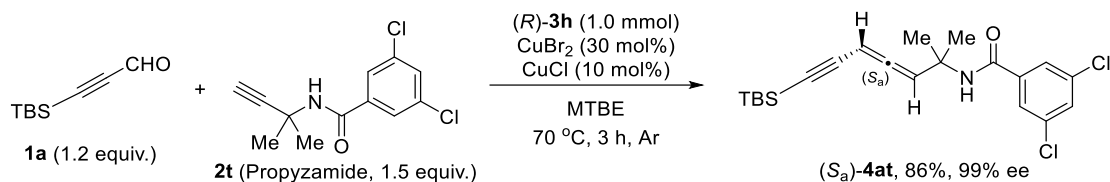
ArH), 7.26 (dd, $J_1 = 8.4$ Hz, $J_2 = 2.0$ Hz, 1 H, ArH), 7.04-6.97 (m, 2 H, ArH), 5.66 (t, $J = 5.4$ Hz, 1 H, NH), 5.34-5.18 (m, 2 H, CH=C=CH), 3.77 (s, 3 H, OCH₃), 3.73-3.64 (m, 2 H, CH₂), 3.57 (q, $J = 7.2$ Hz, 1 H, CH), 1.48 (d, $J = 7.2$ Hz, 3 H, CH₃), 0.82 (s, 9 H, C(CH₃)₃), 0.00 (d, $J = 2.8$ Hz, 6 H, Si(CH₃)₂); ¹³C NMR (100 MHz, CDCl₃) δ 211.8, 174.2, 157.6, 136.0, 133.7, 129.1, 128.8, 127.5, 126.3, 126.2, 119.1, 105.5, 97.4, 94.8, 91.4, 78.8, 55.2, 46.8, 37.0, 26.0, 18.3, 16.5, -4.7; IR (neat) $\nu = 3281, 2931, 2856, 2156, 1952, 1649, 1605, 1508, 1462, 1393, 1260, 1214, 1030, 1011$ cm⁻¹; MS (ESI) m/z (%): 420 (M + H⁺); HRMS (ESI) calcd m/z for C₂₆H₃₄NO₂Si (M + H⁺): 420.2353, found: 420.2350.

(31) Preparation of (*R_a*)-*N*-(7-(*tert*-butyldimethylsilyl)-2-methylhepta-3,4-dien-6-yn-2-yl)-3,5-dichlorobenzamide ((*R_a*)-**4at**, wgl-4-168)



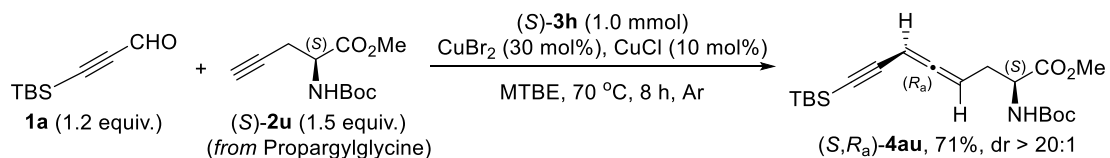
Following **Typical Procedure I**, the reaction of CuBr₂ (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*S*)-**3h** (335.6 mg, 1.0 mmol), **2t** (Propyzamide, 404.6 mg, 95% purity, 1.5 mmol), and **1a** (203.1 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4at** (339.2 mg, 83%) [eluent: petroleum ether / ethyl acetate / diethyl ether = 40:1:1 (420 mL)] as a light pink oil: 98% ee [HPLC conditions: Chiralcel AD-H column, *n*-hexane/*i*-PrOH = 99.5/0.5, 0.5 mL/min, $\lambda = 214$ nm, t_R (minor) = 23.3 min t_R (major) = 25.1 min]; $[\alpha]_D^{15} = -173.3$ ($c = 1.53$, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 7.45-7.40 (m, 2 H, ArH), 7.32-7.27 (m, 1 H, ArH), 6.34 (br, 1 H, NH), 5.84 (d, $J = 6.4$ Hz, 1 H, =CH), 5.51 (d, $J = 6.8$ Hz, 1 H, =CH), 1.49 (s, 6 H, CH₃ x 2), 0.82 (s, 9 H, C(CH₃)₃), 0.00 (s, 6 H, Si(CH₃)₂); ¹³C NMR (100 MHz, CDCl₃) δ 210.3, 164.3, 138.1, 135.2, 130.9, 125.5, 100.5, 97.4, 94.9, 79.7, 53.5, 27.8, 27.3, 26.0, 16.6, -4.8; IR (neat) $\nu = 3293, 2954, 2930, 2857, 2158, 1950, 1642, 1564, 1535, 1466, 1309, 1004$ cm⁻¹; MS (ESI) m/z (%): 412 [M(³⁷Cl₂) + H⁺], 408 [M(³⁵Cl₂) + H⁺]; HRMS (ESI) calcd for C₂₁H₂₈³⁵Cl₂NOSi⁺ (M + H⁺): 408.1312, found: 408.1307.

(32) Preparation of (*S_a*)-*N*-(7-(*tert*-butyldimethylsilyl)-2-methylhepta-3,4-dien-6-yn-2-yl)-3,5-dichlorobenzamide ((*S_a*)-4at**, wgl-4-169)**



Following **Typical Procedure I**, the reaction of CuBr_2 (67.8 mg, 0.3 mmol), CuCl (9.8 mg, 0.1 mmol), *(R)*-**3h** (335.7 mg, 1.0 mmol), **2t** (Propyzamide, 404.5 mg, 95% purity, 1.5 mmol), and **1a** (202.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S_a*)-**4at** (349.7 mg, 86%) [eluent: petroleum ether / ethyl acetate / diethyl ether = 40:1:1 (420 mL)] as a light pink oil: 99% ee [HPLC conditions: Chiralcel AD-H column, *n*-hexane/*i*-PrOH = 99.5/0.5, 0.5 mL/min, λ = 214 nm, t_R (major) = 22.2 min t_R (minor) = 26.4 min]; $[\alpha]_D^{14}$ = +175.2 (c = 1.51, CHCl_3); **¹H NMR** (400 MHz, CDCl_3) δ 7.44-7.38 (m, 2 H, ArH), 7.31-7.25 (m, 1 H, ArH), 6.39 (br, 1 H, NH), 5.84 (d, J = 6.4 Hz, 1 H, =CH), 5.51 (d, J = 6.4 Hz, 1 H, =CH), 1.49 (s, 6 H, $\text{CH}_3 \times 2$), 0.82 (s, 9 H, $\text{C}(\text{CH}_3)_3$), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); **¹³C NMR** (100 MHz, CDCl_3) δ 210.3, 164.3, 138.1, 135.2, 130.9, 125.5, 100.5, 97.4, 94.9, 79.7, 53.5, 27.8, 27.3, 26.0, 16.5, -4.8; **IR** (neat) ν = 3264, 2953, 2930, 2857, 2158, 1950, 1642, 1564, 1535, 1466, 1309, 1004 cm^{-1} ; **MS** (ESI) m/z (%): 408 [$\text{M}(^{35}\text{Cl}_2) + \text{H}^+$]; **HRMS** (ESI) calcd for $\text{C}_{21}\text{H}_{28}^{35}\text{Cl}_2\text{NOSi}^+$ ($\text{M} + \text{H}^+$): 408.1312, found: 408.1309.

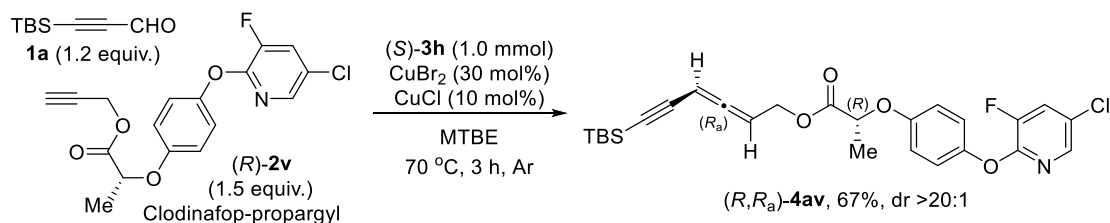
(33) Preparation of (*S,R_a*)-methyl-2-((*tert*-butoxycarbonyl)amino)-8-(*tert*-butyldimethylsilyl)octa-4,5-dien-7-ynoate ((*S,R_a*)-4au**, wgl-4-131)**



Following **Typical Procedure I**, the reaction of CuBr_2 (67.7 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), *(S)*-**3** (335.5 mg, 1.0 mmol), *(S)*-**2u** (340.5 mg, 1.5 mmol), and **1a** (202.8 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S,R_a*)-**4au** (271.3 mg, 71%) [eluent: petroleum ether / ethyl acetate / diethyl ether = 30:1:1 (320 mL) to 20:1:1 (220 mL)] as a yellow oil: dr > 20:1 (determined by ¹H NMR analysis of the

crude reaction mixture); $[\alpha]_D^{17} = -38.2$ ($c = 1.65$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 5.36-5.29 (m, 1 H, =CH), 5.20 (q, $J = 7.2$ Hz, 1 H, =CH), 5.07 (d, $J = 6.8$ Hz, 1 H, NH), 4.41-4.28 (m, 1 H, CH), 3.66 (s, 3 H, CH_3), 2.58-2.33 (m, 2 H, CH_2), 1.34 (s, 9 H, $\text{CH}_3 \times 3$), 0.83 (s, 9 H, $\text{C}(\text{CH}_3)_3$), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 213.6, 171.8, 155.0, 97.6, 94.5, 87.5, 79.9, 76.5, 52.9, 52.4, 31.4, 28.2, 26.0, 16.5, -4.8; **IR** (neat) $\nu = 2954, 2932, 2857, 2153, 1952, 1746, 1712, 1499, 1362, 1250, 1164, 1056, 1015 \text{ cm}^{-1}$; **MS** (ESI) m/z (%): 402 ($\text{M} + \text{Na}^+$); **HRMS** (ESI) calcd m/z for $\text{C}_{20}\text{H}_{33}\text{NNaO}_4\text{Si}$ ($\text{M} + \text{Na}^+$): 402.2071, found: 402.2062.

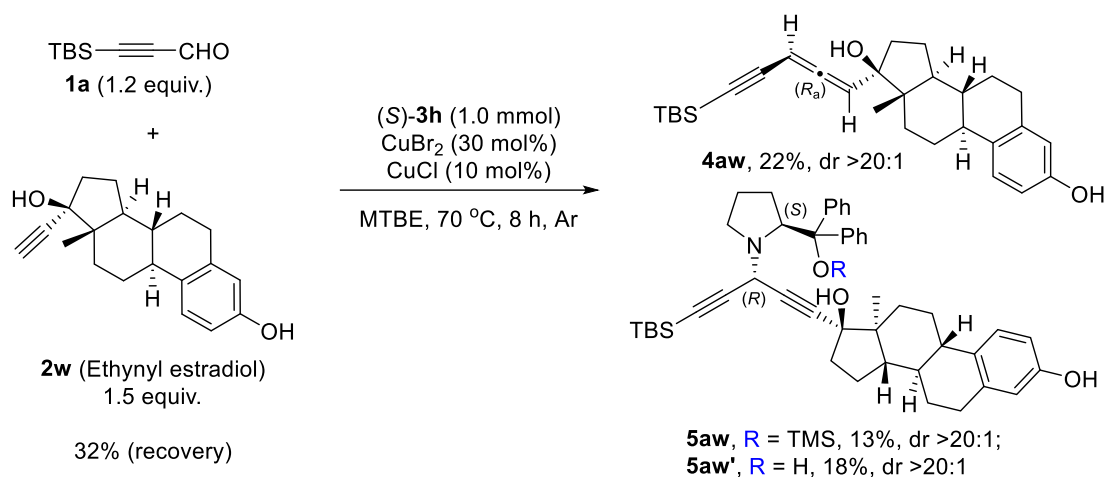
(34) Preparation of (*R,R*)-6-(*tert*-butyldimethylsilyl)hexa-2,3-dien-5-yn-1-yl-2-(4-((5-chloro-3-fluoropyridin-2-yl)oxy)phenoxy)propanoate ((*R,R*)-4av**, wgl-4-049)**



Following **Typical Procedure I**, the reaction of CuBr_2 (67.7 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*S*)-**3h** (335.4 mg, 1.0 mmol), (*R*)-**2v** (Clodinafop-propargyl, 540.7 mg, 97% purity, 1.5 mmol), and **1a** (202.8 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R,R*)-**4av** (336.0 mg, 67%) [eluent: petroleum ether / ethyl acetate = 20:1 (210 mL) to 15:1 (320 mL)] as a yellow oil; dr >20:1 (determined by $^1\text{H NMR}$ analysis of the crude reaction mixture); $[\alpha]_D^{24} = -49.3$ ($c = 1.35$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.72 (d, $J = 2.4$ Hz, 1 H, ArH), 7.34 (dd, $J_1 = 9.0$ Hz, $J_2 = 2.2$ Hz, 1 H, ArH), 6.98-6.91 (m, 2 H, ArH), 6.83-6.74 (m, 2 H, ArH), 5.53-5.36 (m, 2 H, $\text{CH}=\text{C}=\text{CH}$), 4.73-4.49 (m, 3 H, CH and CH_2), 1.51 (d, $J = 6.4$ Hz, 3 H, CH_3), 0.82 (s, 9 H, $\text{C}(\text{CH}_3)_3$), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 213.4, 171.3, 154.7, 151.1 (d, $J = 11.0$ Hz), 146.9, 146.7 (d, $J = 264.7$ Hz), 139.9 (d, $J = 6.4$ Hz), 124.7 (d, $J = 3.9$ Hz), 124.6, 122.1, 116.0, 96.6, 95.6, 89.0, 78.6, 72.9, 61.1, 25.9, 18.4, 16.4, -4.9; $^{19}\text{F NMR}$ (376 MHz, CDCl_3) δ -134.9; **IR** (neat) $\nu = 2937, 2857, 2154, 1956, 1754, 1587, 1502, 1448, 1242, 1194, 1128, 1096, 1046, 1013 \text{ cm}^{-1}$; **MS** (ESI) m/z (%): 502 [$\text{M}(^{35}\text{Cl}) + \text{H}^+$]; **HRMS** (ESI) calcd m/z for $\text{C}_{26}\text{H}_{30}^{35}\text{ClFNO}_4\text{Si}$ ($\text{M} + \text{H}^+$): 502.1611,

found: 502.1592.

(35) Functionalization of Ethynyl estradiol using (*S*)-**3h** in EATA reaction (**4aw**, **5aw**, **5aw'**, wgl-3-176)



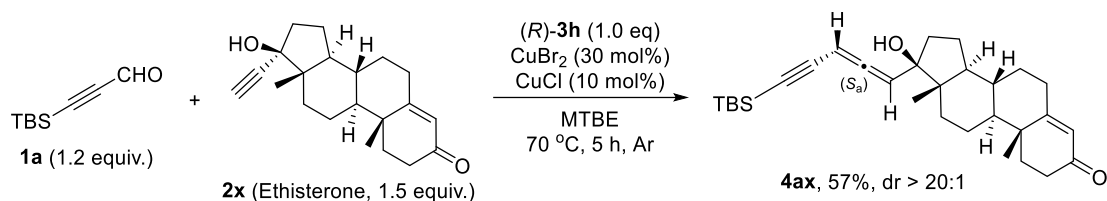
Following **Typical Procedure I**, the reaction of CuBr₂ (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*S*)-**3h** (335.6 mg, 1.0 mmol), **2w** (Ethynyl estradiol, 453.6 mg, 98% purity, 1.5 mmol), and **1a** (202.7 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded **4aw** (99.3 mg, 22%), **5aw** (102.3 mg, 13%) and **5aw'** (123.9 mg, 18%) [first round eluent: dichloromethane / ethyl ether = 30:1 (620 mL); second round eluent: petroleum ether / ethyl ether = 4:1 (500 mL) to 3:1 (400 mL)].

For **4aw**: (99.3 mg, 22%), white solid; **m.p.** 120.1-120.9 °C (petroleum ether / dichloromethane); $[\alpha]_D^{27} = -139.3$ ($c = 0.97$, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 7.00 (d, $J = 8.8$ Hz, 1 H, Ar-H), 6.49 (dd, $J_1 = 8.4$ Hz, $J_2 = 2.4$ Hz, 1 H, Ar-H), 6.43 (d, $J = 2.4$ Hz, 1 H, Ar-H), 5.56 (d, $J = 6.4$ Hz, 1 H, =CH), 5.47 (d, $J = 6.4$ Hz, 1 H, =CH), 4.78 (brs, 1 H, OH), 2.76-2.62 (m, 2 H), 2.21-2.11 (m, 1 H), 2.05-1.90 (m, 2 H), 1.86-1.68 (m, 3 H), 1.62-1.51 (m, 1 H), 1.46-1.10 (m, 6 H), 0.85-0.79 (m, 12 H, C(CH₃)₃ and CH₃), 0.00 (s, 6 H, Si(CH₃)₂); **¹³C NMR** (100 MHz, CDCl₃) δ 210.7, 153.3, 138.2, 132.6, 126.5, 115.2, 112.7, 100.3, 97.8, 94.8, 83.4, 79.1, 49.0, 47.4, 43.6, 39.4, 36.5, 32.3, 29.6, 27.4, 26.3, 26.1, 23.2, 16.6, 14.0, -4.7; **IR** (neat) $\nu = 3343, 3316, 2931, 2855, 2154, 1946, 1615, 1586, 1498, 1466, 1409, 1358, 1285, 1250, 1133, 1075, 1016$ cm⁻¹; **MS** (ESI) m/z (%): 449 [M + H]⁺; **Elemental analysis** calcd (%) for C₂₉H₄₀O₂Si: C, 77.62; H, 8.99; found: C, 77.75; H, 9.13.

For **5aw**: (102.3 mg, 13%), white solid; **m.p.** 111.1-111.4 °C (petroleum ether / ethyl ether); $[\alpha]_D^{33} = -82.2$ ($c = 1.02$, CHCl_3); **^1H NMR** (400 MHz, CDCl_3) δ 7.71-7.63 (m, 2 H, Ar-H), 7.63-7.55 (m, 2 H, Ar-H), 7.45-7.36 (m, 6 H, Ar-H), 7.32 (d, $J = 8.8$ Hz, 1 H, Ar-H), 6.81 (dd, $J_1 = 8.2$ Hz, $J_2 = 2.6$ Hz, 1 H, Ar-H), 6.74 (d, $J = 2.4$ Hz, 1 H, Ar-H), 5.37 (br, 1 H, OH), 5.02 (s, 1 H, CH), 4.15 (dd, $J_1 = 9.2$ Hz, $J_2 = 3.6$ Hz, 1 H, CH), 3.12-2.87 (m, 4 H), 2.61-2.47 (m, 2 H), 2.44-2.18 (m, 10 H), 1.74-1.39 (m, 4 H), 1.13-1.05 (m, 12 H, $\text{C}(\text{CH}_3)_3$ and CH_3), 0.81-0.65 (m, 1 H), 0.24 (d, $J = 2.0$ Hz, 6 H, $\text{Si}(\text{CH}_3)_2$), 0.00 (s, 9 H, $\text{Si}(\text{CH}_3)_3$); **^{13}C NMR** (100 MHz, CDCl_3) δ 153.4, 144.0, 143.5, 138.1, 132.3, 129.3, 129.2, 127.2, 126.9, 126.8, 126.5, 115.3, 112.8, 103.3, 87.3, 84.5, 84.4, 81.9, 80.1, 66.7, 50.1, 49.8, 47.4, 46.6, 43.9, 39.4, 39.1, 33.0, 29.64, 29.56, 27.3, 26.5, 26.0, 23.2, 22.8, 16.6, 12.8, 2.0, -4.8; **IR** (neat) $\nu = 2949, 2856, 2179, 1612, 1495, 1446, 1360, 1285, 1249, 1126, 1093, 1065, 1007\text{ cm}^{-1}$; **MS** (ESI) m/z (%): 772 $[\text{M} + \text{H}]^+$; **Elemental analysis** calcd (%) for $\text{C}_{49}\text{H}_{65}\text{NO}_3\text{Si}_2$: C, 76.21; H, 8.48; found: C, 75.99; H, 8.65.

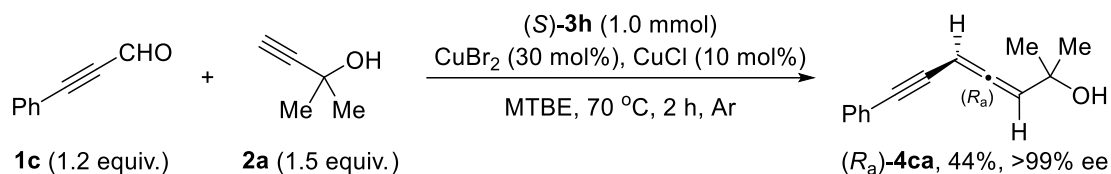
For **5aw'**: (123.9 mg, 18%) white solid; **m.p.** 127.3-127.7 °C (petroleum ether / ethyl ether); $[\alpha]_D^{28} = -59.7$ ($c = 0.92$, CHCl_3); **^1H NMR** (400 MHz, CDCl_3) δ 7.55 (d, $J = 7.2$ Hz, 2 H, Ar-H), 7.43 (d, $J = 7.2$ Hz, 2 H, Ar-H), 7.23-7.01 (m, 7 H, Ar-H), 6.59 (dd, $J_1 = 8.4$ Hz, $J_2 = 2.8$ Hz, 1 H, Ar-H), 6.52 (d, $J = 2.4$ Hz, 1 H, Ar-H), 5.25 (br, 1 H, OH), 4.41 (s, 1 H, OH), 4.11 (q, $J = 4.5$ Hz, 1 H, CH), 3.47 (s, 1 H, CH), 3.29-3.19 (m, 1 H), 2.92 (q, $J = 8.4$ Hz, 1 H), 2.83-2.70 (m, 2 H), 2.39-2.15 (m, 3 H), 2.10-1.57 (m, 10 H), 1.55-1.25 (m, 4 H), 0.88-0.82 (m, 12 H, CH_3 and $\text{C}(\text{CH}_3)_3$), 0.00 (d, $J = 3.2$ Hz, $\text{Si}(\text{CH}_3)_3$); **^{13}C NMR** (100 MHz, CDCl_3) δ 153.5, 147.2, 145.9, 138.1, 132.1, 128.3, 128.1, 126.8, 126.5, 126.4, 125.4, 125.2, 115.3, 112.8, 102.0, 87.9, 85.7, 80.6, 80.0, 77.6, 66.7, 51.2, 50.0, 47.4, 45.4, 44.0, 39.4, 39.2, 33.0, 30.0, 29.6, 27.4, 26.5, 26.0, 24.0, 22.8, 16.6, 12.7, -4.89, -4.91; **IR** (neat) $\nu = 3351, 3286, 2931, 2858, 2361, 2336, 2178, 1611, 1499, 1449, 1359, 1285, 1249, 1184, 1127, 1096, 1054, 1027\text{ cm}^{-1}$; **MS** (ESI) m/z (%): 700 $[\text{M} + \text{H}]^+$; **Elemental analysis** calcd (%) for $\text{C}_{46}\text{H}_{57}\text{NO}_3\text{Si}$: C, 78.92; H, 8.21; found: C, 78.70; H, 8.25.

(36) Functionalization of ethisterone using (*R*)-**3h** in EATA reaction (**4ax**, wgl-4-023)



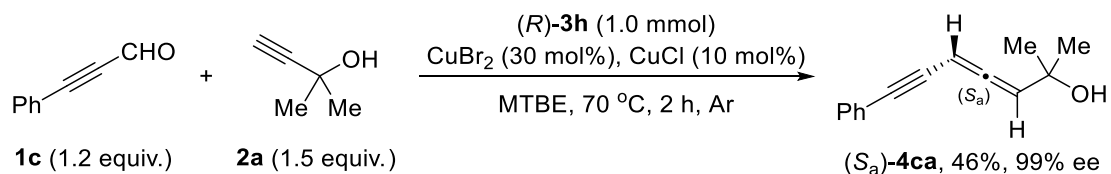
Following **Typical Procedure I**, the reaction of CuBr_2 (67.8 mg, 0.3 mmol), CuCl (9.8 mg, 0.1 mmol), (R) -**3h** (335.7 mg, 1.0 mmol), **2x** (Ethisterone, 478.1 mg, 98% purity, 1.5 mmol), and **1a** (202.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (S_a) -**4ax** (265.3 mg, 57%) [first round eluent: dichloromethane (400 mL) to dichloromethane / ethyl acetate = 30:1 (620 mL); second round eluent: petroleum ether / ethyl acetate = 5:1 (600 mL)] as a white solid: **m.p.** 157.8-158.1 $^\circ\text{C}$ (petroleum ether / diethyl ether); dr >20:1 (Determined by ^1H NMR analysis of the crude reaction mixture); $[\alpha]_{\text{D}}^{27} = +86.1$ ($c = 1.20$, CHCl_3); ^1H NMR (400 MHz, CDCl_3) δ 5.73 (s, 1 H, =CH), 5.57-5.52 (m, 1 H, one proton of $\text{CH}=\text{C}=\text{CH}$), 5.49-5.45 (m, 1 H, one proton of $\text{CH}=\text{C}=\text{CH}$), 2.42-2.12 (m, 5 H), 2.03-1.90 (m, 2 H), 1.85-1.73 (m, 2 H), 1.65-1.46 (m, 5 H), 1.42-1.19 (m, 4 H), 1.13 (s, 3 H, CH_3), 1.08-0.95 (m, 1 H), 0.91-0.79 (m, 13 H), 0.00 (s, 6 H, $\text{Si}(\text{CH}_3)_2$); ^{13}C NMR (100 MHz, CDCl_3) δ 210.9, 199.5, 171.2, 123.8, 100.2, 97.6, 94.7, 83.3, 78.2, 53.6, 48.7, 46.7, 38.5, 36.4, 36.0, 35.6, 33.8, 32.7, 31.7, 31.3, 26.0, 23.1, 20.6, 17.3, 16.5, 13.8, -4.6; **IR** (neat) $\nu = 3391, 2937, 2864, 2150, 1948, 1659, 1613, 1458, 1373, 1244, 1218, 1181, 1117, 1072, 1007\text{ cm}^{-1}$; **MS** (70 eV, EI) m/z (%): 407 [$\text{M}^+ - t\text{-Bu}$, 100]; **Elemental analysis** calcd (%) for $\text{C}_{30}\text{H}_{44}\text{O}_2\text{Si}$: C, 77.53; H, 9.54; found: C, 77.97; H, 9.89.

(37) Preparation of (*R_a*)-2-methyl-7-phenylhepta-3,4-dien-6-yn-2-ol ((*R_a*)-4ca**, wgl-3-178)**



Following **Typical Procedure I**, the reaction of CuBr₂ (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*S*)-**3h** (335.6 mg, 1.0 mmol), **2a** (126.7 mg, 1.5 mmol), and **1c** (163.1 mg, 96% purity, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4ca** (87.6 mg, 44%) [first round eluent: petroleum ether / ethyl acetate = 10:1 (440 mL); second round eluent: petroleum ether / dichloromethane = 1:2 (450 mL)] as a yellow oil: >99% ee (HPLC conditions: Chiralcel AS-H column, *n*-hexane/*i*-PrOH = 99/1, 1.0 mL/min, λ = 214 nm, t_R (minor) = 19.0 min, t_R (major) = 20.4 min; $[\alpha]_D^{28}$ = -233.6 (c = 1.44, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 7.47-7.40 (m, 2 H, Ar-H), 7.33-7.27 (m, 3 H, Ar-H), 5.75 (d, J = 6.4 Hz, 1 H, one proton of CH=C=CH), 5.66 (d, J = 6.8 Hz, 1 H, one proton of CH=C=CH), 2.00 (br, 1 H, OH), 1.41 (d, J = 1.2 Hz, 6 H, CH₃ x 2); **¹³C NMR** (100 MHz, CDCl₃) δ 209.4, 131.4, 128.25, 128.20, 123.2, 103.0, 90.6, 81.9, 79.0, 70.0, 29.8, 29.7; **IR** (neat) ν = 3361, 2975, 2929, 1949, 1597, 1490, 1461, 1442, 1363, 1213, 1148, 1069, 1027 cm⁻¹; **MS** (70 eV, EI) m/z (%): 198 (*M*⁺, 13.76), 140 (100); **HRMS** (70 eV, EI) calcd for C₁₄H₁₄O (*M*⁺): 198.1039, found: 198.1040.

(38) Preparation of (*S_a*)-2-methyl-7-phenylhepta-3,4-dien-6-yn-2-ol ((*S_a*)-4ca**, wgl-3-179)**



Following **Typical Procedure I**, the reaction of CuBr₂ (67.8 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), (*R*)-**3h** (335.6 mg, 1.0 mmol), **2a** (126.8 mg, 1.5 mmol), and **1c** (163.1 mg, 96% purity, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S_a*)-**4ca** (91.5 mg, 46%) [first round eluent: petroleum ether / ethyl acetate = 10:1 (440 mL);

second round eluent: petroleum ether / dichloromethane = 1:2 (450 mL)] as a yellow oil: 99% ee (HPLC conditions: Chiralcel AS-H column, *n*-hexane/*i*-PrOH = 99/1, 1.0 mL/min, λ = 214 nm, t_R (major) = 18.7 min, t_R (minor) = 20.2 min; $[\alpha]_D^{28}$ = +227.1 (c = 1.44, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 7.47-7.40 (m, 2 H, Ar-H), 7.34-7.27 (m, 3 H, Ar-H), 5.76 (d, J = 6.4 Hz, 1 H, one proton of CH=C=CH), 5.66 (d, J = 6.4 Hz, 1 H, one proton of CH=C=CH), 1.98 (brs, 1 H, OH), 1.41 (d, J = 1.2 Hz, 6 H, CH₃ x 2); **¹³C NMR** (100 MHz, CDCl₃) δ 209.4, 131.4, 128.25, 128.20, 123.2, 103.0, 90.6, 81.9, 79.0, 70.0, 29.8, 29.7; **IR** (neat) ν = 3364, 2975, 2929, 1949, 1597, 1490, 1461, 1442, 1364, 1270, 1213, 1149, 1070, 1027 cm⁻¹; **MS** (70 eV, EI) m/z (%): 198 (M⁺, 14.33), 140 (100); **HRMS** (70 eV, EI) calcd for C₁₄H₁₄O (M⁺): 198.1039, found: 198.1040.

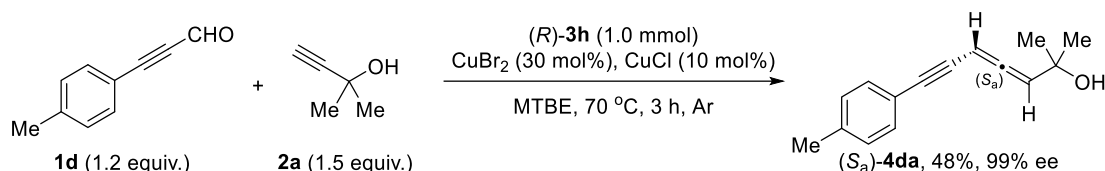
(39) Preparation of (*R_a*)-2-methyl-7-(*p*-tolyl)hepta-3,4-dien-6-yn-2-ol ((*R_a*)-**4da**, wgl-5-036)



Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), (*S*)-**3h** (335.7 mg, 1.0 mmol), **2a** (126.5 mg, 1.5 mmol), and **1d** (173.7 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4da** (95.8 mg, 45%) [eluent: first round, petroleum ether / ethyl acetate / diethyl ether = 10:1:1 (360 mL); second round, petroleum ether / dichloromethane = 1:2 (300 mL)] as a yellow oil: 99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane/*i*-PrOH = 95/5, 1.0 mL/min, λ = 214 nm, t_R (minor) = 8.1 min, t_R (major) = 9.1 min]; $[\alpha]_D^{20}$ = -221.3 (c = 1.20, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 7.32 (d, J = 8.0 Hz, 2 H, ArH), 7.11 (d, J = 8.0 Hz, 2 H, ArH), 5.75 (d, J = 6.4 Hz, 1 H, one proton of CH=C=CH), 5.65 (d, J = 6.4 Hz, 1 H, one proton of CH=C=CH), 2.33 (s, 3 H, CH₃), 1.99 (brs, 1 H, OH), 1.41 (s, 6 H, CH₃ x 2); **¹³C NMR** (100 MHz, CDCl₃) δ 209.3, 138.3, 131.3, 129.0, 120.1, 102.9, 90.8, 81.2, 79.1, 70.0, 29.8, 29.7, 21.4; **IR** (neat) ν = 3305, 2975, 2189, 1949, 1509, 1459, 1370, 1147 cm⁻¹; **MS** (ESI) m/z (%): 213 (M + H⁺); **HRMS** (ESI) calcd

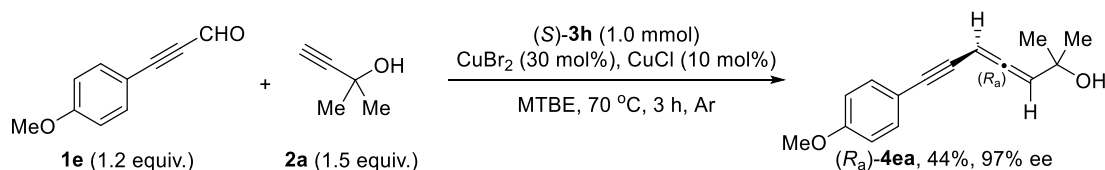
m/z for $C_{15}H_{17}O^+$ ($M + H^+$): 213.1274, found: 213.1274.

(40) Preparation of (*S*_a)-2-methyl-7-(*p*-tolyl)hepta-3,4-dien-6-yn-2-ol ((*S*_a)-**4da**, wgl-5-037)



Following **Typical Procedure I**, the reaction of $CuBr_2$ (67.8 mg, 0.3 mmol), $CuCl$ (9.9 mg, 0.1 mmol), (*S*)-**3h** (335.9 mg, 1.0 mmol), **2a** (127.1 mg, 1.5 mmol), and **1d** (173.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S*_a)-**4da** (102.4 mg, 48%) [eluent: first round, petroleum ether / ethyl acetate / diethyl ether = 10:1:1 (360 mL); second round, petroleum ether / dichloromethane = 1:2 (300 mL)] as a yellow oil: 99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane/*i*-PrOH = 95/5, 1.0 mL/min, $\lambda = 214$ nm, t_R (major) = 8.1 min, t_R (minor) = 9.1 min]; $[\alpha]_D^{21} = +226.8$ ($c = 1.38$, $CHCl_3$); **¹H NMR** (400 MHz, $CDCl_3$) δ 7.32 (d, $J = 7.6$ Hz, 2 H, ArH), 7.11 (d, $J = 7.6$ Hz, 2 H, ArH), 5.75 (d, $J = 6.4$ Hz, 1 H, one proton of $CH=C=CH$), 5.65 (d, $J = 6.4$ Hz, 1 H, one proton of $CH=C=CH$), 2.33 (s, 3 H, CH_3), 2.00 (brs, 1 H, OH), 1.41 (s, 6 H, $CH_3 \times 2$); **¹³C NMR** (100 MHz, $CDCl_3$) δ 209.3, 138.3, 131.3, 129.0, 120.1, 102.9, 90.8, 81.2, 79.1, 70.0, 29.8, 29.7, 21.4; **IR** (neat) $\nu = 3300, 2974, 2189, 1949, 1508, 1459, 1371, 1137$ cm^{-1} ; **MS** (ESI) m/z (%): 213 ($M + H^+$); **HRMS** (ESI) calcd m/z for $C_{15}H_{17}O^+$ ($M + H^+$): 213.1274, found: 213.1278.

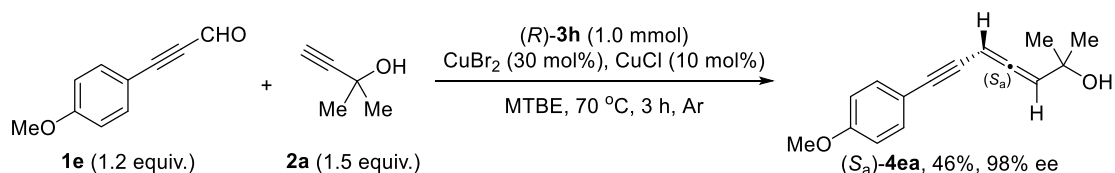
(41) Preparation of (*R*_a)-7-(4-methoxyphenyl)-2-methylhepta-3,4-dien-6-yn-2-ol ((*R*_a)-**4ea**, wgl-5-042)



Following **Typical Procedure I**, the reaction of $CuBr_2$ (67.7 mg, 0.3 mmol), $CuCl$ (9.8 mg, 0.1 mmol), (*S*)-**3h** (335.6 mg, 1.0 mmol), **2a** (126.8 mg, 1.5 mmol) and **1e**

(192.5 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R*_a)-**4ea** (100.2 mg, 44%) [eluent: first round, petroleum ether / ethyl acetate / diethyl ether = 10:1:1 (120 mL) to 5:1:1 (210 mL); second round, petroleum ether / dichloromethane = 1:3 (400 mL)] as a yellow oil: 97% ee [HPLC conditions: Chiralcel OJ-H column, *n*-hexane/*i*-PrOH = 85/15, 1.0 mL/min, λ = 214 nm, *t*_R (major) = 18.0 min, *t*_R (minor) = 20.3 min]; $[\alpha]_D^{23}$ = -196.6 (*c* = 1.38, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 7.37 (d, *J* = 8.4 Hz, 2 H, ArH), 6.83 (d, *J* = 8.4 Hz, 2 H, ArH), 5.75 (d, *J* = 6.8 Hz, 1 H, one proton of CH=C=CH), 5.65 (d, *J* = 6.8 Hz, 1 H, one proton of CH=C=CH), 3.80 (s, 3 H, CH₃), 1.99 (s, 1 H, OH), 1.41 (s, 6 H, CH₃ x 2); ¹³C NMR (100 MHz, CDCl₃) δ 209.1, 159.5, 132.8, 115.3, 113.9, 102.9, 90.6, 80.5, 79.2, 70.0, 55.2, 29.8, 29.7; IR (neat) ν = 3397, 2973, 2197, 1948, 1603, 1507, 1461, 1369, 1290, 1245, 1169, 1029 cm⁻¹; MS (ESI) *m/z* (%): 229 (*M* + H⁺); HRMS (ESI) calcd *m/z* for C₁₅H₁₇O₂⁺ (*M* + H⁺): 229.1223, found: 229.1223.

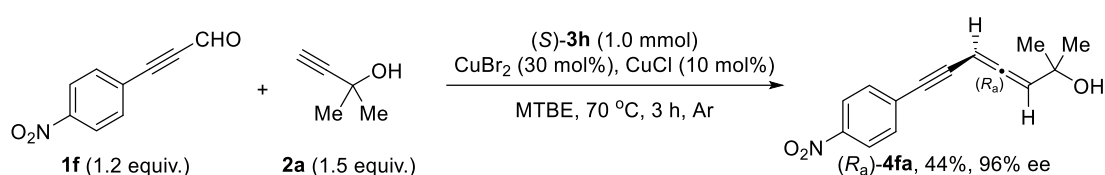
(42) Preparation of (*S*_a)-7-(4-methoxyphenyl)-2-methylhepta-3,4-dien-6-yn-2-ol ((*S*_a)-4ea**, wgl-5-043)**



Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), (*R*)-**3h** (335.8 mg, 1.0 mmol), **2a** (127.1 mg, 1.5 mmol), and **1e** (192.7 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S*_a)-**4ea** (104.1 mg, 46%) [eluent: first round, petroleum ether / ethyl acetate / diethyl ether = 10:1:1 (120 mL) to 5:1:1 (210 mL); second round, petroleum ether / dichloromethane = 1:3 (400 mL)] as a yellow oil: 98% ee [HPLC conditions: Chiralcel OJ-H column, *n*-hexane/*i*-PrOH = 85/15, 1.0 mL/min, λ = 214 nm, *t*_R (minor) = 18.1 min, *t*_R (major) = 19.9 min]; $[\alpha]_D^{22}$ = +192.1 (*c* = 1.27, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 7.37 (d, *J* = 8.4 Hz, 2 H, ArH), 6.83 (d, *J* = 8.4 Hz, 2 H, ArH), 5.75 (d, *J* = 6.4 Hz, 1 H, one proton of CH=C=CH), 5.65 (d, *J* = 6.8 Hz, 1 H, one proton of CH=C=CH), 3.79 (s, 3 H, CH₃),

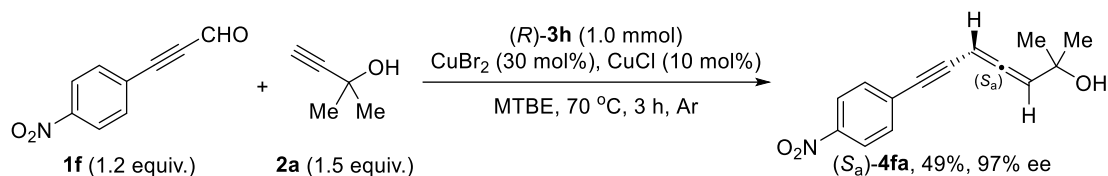
2.02 (br, 1 H, OH), 1.41 (s, 6 H, CH₃ x 2); ¹³C NMR (100 MHz, CDCl₃) δ 209.1, 159.5, 132.8, 115.3, 113.9, 102.9, 90.6, 80.5, 79.2, 70.0, 55.2, 29.8, 29.7; IR (neat) ν = 3385, 2973, 2197, 1948, 1604, 1507, 1461, 1369, 1290, 1245, 1169, 1029 cm⁻¹; MS (ESI) *m/z* (%): 229 (M + H⁺); HRMS (ESI) calcd *m/z* for C₁₅H₁₇O₂⁺ (M + H⁺): 229.1223, found: 229.1222.

(43) Preparation of (*R_a*)-2-methyl-7-(4-nitrophenyl)hepta-3,4-dien-6-yn-2-ol ((*R_a*)-**4fa**, wgl-5-122)



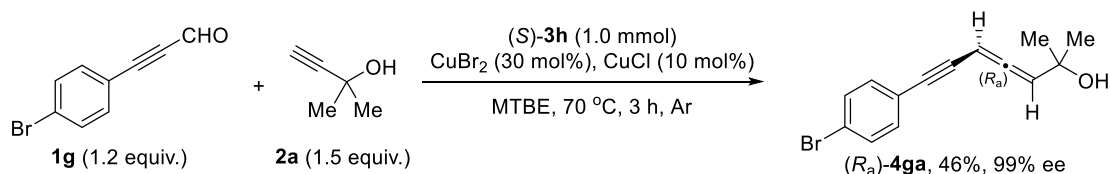
Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (9.8 mg, 0.1 mmol), (*S*)-**3h** (335.6 mg, 1.0 mmol), **2a** (126.8 mg, 1.5 mmol), and **1f** (210.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4fa** (107.2 mg, 44%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (220 mL) to 5:1 (360 mL); second round, petroleum ether / dichloromethane = 1:5 (240 mL) to 1:10 (330 mL)] as a yellow oil: 96% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane/*i*-PrOH = 85/15, 1.0 mL/min, λ = 214 nm, *t_R* (major) = 7.1 min, *t_R* (minor) = 8.4 min]; [α]_D²⁰ = -224.4 (*c* = 1.28, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 8.17 (d, *J* = 8.4 Hz, 2 H, ArH), 7.56 (d, *J* = 8.8 Hz, 2 H, ArH), 5.80-5.70 (m, 2 H, CH=C=CH), 1.91 (brs, 1 H, OH), 1.44 (s, 6 H, CH₃ x 2); ¹³C NMR (100 MHz, CDCl₃) δ 210.3, 146.9, 132.1, 130.2, 123.5, 103.5, 88.6, 87.6, 78.5, 70.1, 29.85, 29.79; IR (neat) ν = 2975, 2201, 1948, 1591, 1514, 1338, 1151, 1107 cm⁻¹; MS (70 eV, EI) *m/z* (%): 243 (M⁺, 11.91), 185 (100); HRMS (70 eV, EI) calcd *m/z* for C₁₄H₁₃NO₃⁺ (M⁺): 243.0890, found: 243.0893.

(44) Preparation of (*S_a*)-2-methyl-7-(4-nitrophenyl)hepta-3,4-dien-6-yn-2-ol ((*S_a*)-4fa**, wgl-5-119, fsw-2-069)**



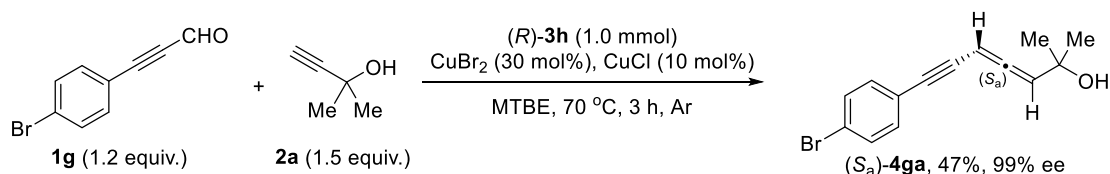
To an oven-dried Schlenk tube (25 mL) were added CuBr₂ (68.0 mg, 0.3 mmol) and CuCl (10.1 mg, 0.1 mmol) in a glovebox of nitrogen. The Schlenk tube was taken out of the glove box. After replacing N₂ with argon for three times by using a vacuum line, **1f** (210.3 mg, 1.2 mmol), **2a** (126.4 mg, 1.5 mmol), and a solution of (*R*)-**3h** in freshly distilled MTBE [335.8 mg of (*R*)-**3h** in 5.0 mL of MTBE, weighed and dissolved in the glovebox.] were added sequentially. The Schlenk tube was then sealed by screwing the polytetrafluoroethylene plug tightly with the outlet connected to the vacuum line and the argon flow being closed. The resulting mixture was heated with stirring in an oil bath preheated at 70 °C for 3 h as monitored by TLC (eluent: petroleum ether / ethyl acetate = 5/1). The resulting mixture was cooled to room temperature naturally and filtered through a short pad of silica gel (3 cm) eluted with Et₂O (30 mL). After removal of the solvent under vacuum, the residue was purified by column chromatography on silica gel to afford (*S_a*)-**4fa** (119.9 mg, 49%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (220 mL) to 5:1 (480 mL); second round, petroleum ether / dichloromethane = 1:5 (240 mL) to 1:10 (330 mL)] as a yellow oil: 97% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane/*i*-PrOH = 85/15, 1.0 mL/min, λ = 214 nm, *t_R* (minor) = 6.8 min, *t_R* (major) = 7.8 min]; [α]_D²⁰ = +233.8 (*c* = 0.19, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 8.17 (d, *J* = 8.4 Hz, 2 H, ArH), 7.55 (d, *J* = 8.4 Hz, 2 H, ArH), 5.81-5.70 (m, 2 H, CH=C=CH), 2.09 (brs, 1 H, OH), 1.44 (s, 6 H, CH₃ x 2); ¹³C NMR (100 MHz, CDCl₃) δ 210.2, 146.9, 132.0, 130.1, 123.5, 103.4, 88.5, 87.7, 78.4, 70.0, 29.8, 29.7; IR (neat) ν = 2977, 2202, 1948, 1591, 1514, 1338, 1151, 1107 cm⁻¹; MS (70 eV, EI) *m/z* (%): 243 (M⁺, 9.54), 185 (100); HRMS (70 eV, EI) calcd *m/z* for C₁₄H₁₃NO₃⁺ (M⁺): 243.0890, found: 243.0893.

(45) Preparation of (*R*_a)-7-(4-bromophenyl)-2-methylhepta-3,4-dien-6-yn-2-ol ((*R*_a)-4ga**, wgl-5-040)**



Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), (*S*)-**3h** (335.8 mg, 1.0 mmol), **2a** (126.7 mg, 1.5 mmol), and **1g** (250.5 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R*_a)-**4ga** (126.8 mg, 46%) [eluent: first round, petroleum ether / ethyl acetate / diethyl ether = 10:1:1 (360 mL); second round, petroleum ether / dichloromethane = 1:2 (300 mL)] as a yellow oil: 99% ee [HPLC conditions: Chiralcel AD-H column, *n*-hexane/*i*-PrOH = 95/5, 1.0 mL/min, λ = 214 nm, t_R (minor) = 9.7 min, t_R (major) = 10.5 min]; [α]_D²⁰ = -181.1 (c = 1.36, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 7.44 (d, J = 8.0 Hz, 2 H, ArH), 7.28 (d, J = 8.4 Hz, 2 H, ArH), 5.74 (d, J = 6.4 Hz, 1 H, one proton of CH=C=CH), 5.67 (d, J = 6.4 Hz, 1 H, one proton of CH=C=CH), 1.87 (brs, 1 H, OH), 1.42 (s, 6 H, CH₃ x 2); **¹³C NMR** (100 MHz, CDCl₃) δ 209.5, 132.8, 131.5, 122.4, 122.1, 103.2, 89.5, 83.1, 78.9, 70.1, 29.8, 29.7; **IR** (neat) ν = 3291, 2975, 2198, 1948, 1465, 1376, 1270, 1230, 1156, 1068, 1009 cm⁻¹; **MS** (ESI) m/z (%): 277 [$M(^{79}\text{Br}) + \text{H}^+$]; **HRMS** (ESI) calcd m/z for C₁₄H₁₄O⁷⁹Br⁺ ($M + \text{H}^+$): 277.0223, found: 277.0222.

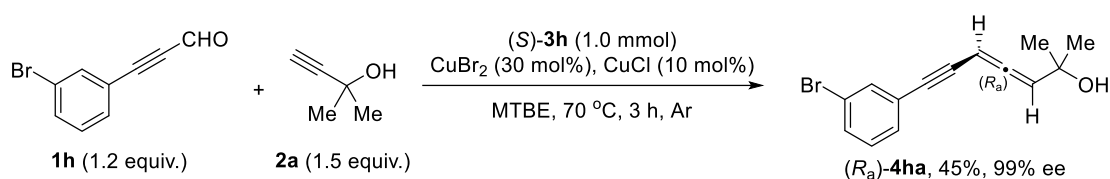
(46) Preparation of (*S*_a)-7-(4-bromophenyl)-2-methylhepta-3,4-dien-6-yn-2-ol ((*S*_a)-4ga**, wgl-5-041)**



Following **Typical Procedure I**, the reaction of CuBr₂ (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*R*)-**3h** (335.9 mg, 1.0 mmol), **2a** (126.6 mg, 1.5 mmol), and **1g** (251.1 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S*_a)-**4ga** (131.4 mg, 47%) [eluent: first round, petroleum ether / ethyl acetate / diethyl ether = 10:1:1 (360

mL); second round, petroleum ether / dichloromethane = 1:2 (300 mL)] as a yellow oil: 99% ee [HPLC conditions: Chiralcel AD-H column, *n*-hexane/*i*-PrOH = 95/5, 1.0 mL/min, λ = 214 nm, t_R (major) = 9.7 min, t_R (minor) = 10.6 min]; $[\alpha]_D^{21} = +178.9$ (c = 0.90, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 7.43 (d, J = 8.0 Hz, 2 H, ArH), 7.28 (d, J = 8.4 Hz, 2 H, ArH), 5.73 (d, J = 6.8 Hz, 1 H, one proton of CH=C=CH), 5.67 (d, J = 6.8 Hz, 1 H, one proton of CH=C=CH), 2.09 (brs, 1 H, OH), 1.41 (s, 6 H, CH₃ x 2); **¹³C NMR** (100 MHz, CDCl₃) δ 209.5, 132.8, 131.5, 122.4, 122.1, 103.1, 89.5, 83.1, 78.8, 70.0, 29.8, 29.7; **IR** (neat) ν = 3301, 2974, 2200, 1948, 1484, 1376, 1270, 1231, 1153, 1068, 1009 cm⁻¹; **MS** (ESI) m/z (%): 277 [M(⁷⁹Br) + H⁺]; **HRMS** (ESI) calcd m/z for C₁₄H₁₄O⁷⁹Br⁺ (M + H⁺): 277.0223, found: 277.0221.

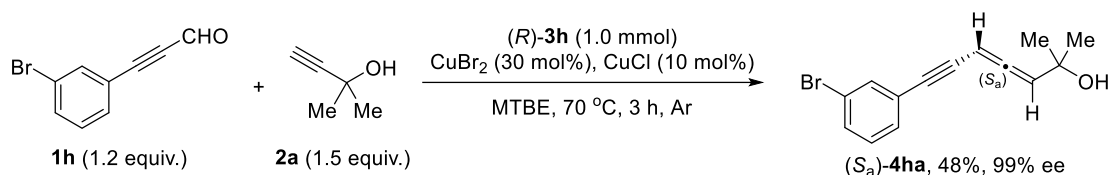
(47) Preparation of (*R_a*)-7-(3-bromophenyl)-2-methylhepta-3,4-dien-6-yn-2-ol ((*R_a*)-**4ha**, wgl-5-066)



Following **Typical Procedure I**, the reaction of CuBr₂ (67.8 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), (*S*)-**3h** (335.6 mg, 1.0 mmol), **2a** (127.1 mg, 1.5 mmol), and **1h** (250.5 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4ha** (125.5 mg, 45%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (110 mL) to 5:1 (240 mL); second round, petroleum ether / dichloromethane = 1:1 (200 mL) to 1:2 (300 mL)] as a yellow oil: 99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane/*i*-PrOH = 97/3, 1.0 mL/min, λ = 214 nm, t_R (minor) = 10.5 min, t_R (major) = 12.3 min]; $[\alpha]_D^{24} = -190.8$ (c = 1.24, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 7.58 (s, 1 H, ArH), 7.42 (d, J = 8.0 Hz, 1 H, ArH), 7.34 (d, J = 7.6 Hz, 1 H, ArH), 7.16 (t, J = 8.0 Hz, 1 H, ArH), 5.74 (d, J = 6.8 Hz, 1 H, one proton of CH=C=CH), 5.68 (d, J = 6.4 Hz, 1 H, one proton of CH=C=CH), 2.05 (s, 1 H, OH), 1.42 (s, 6 H, CH₃ x 2); **¹³C NMR** (100 MHz, CDCl₃) δ 209.7, 134.1, 131.3, 129.9, 129.7, 125.2, 122.0, 103.2, 88.9, 83.4, 78.7, 70.0, 29.8, 29.7; **IR** (neat) ν = 3340, 2974, 2204, 1947, 1588, 1554, 1473, 1364, 1148 cm⁻¹; **MS** (70 eV, EI) m/z (%): 278 [M⁺(⁸¹Br), 11.89], 276 [M⁺(⁷⁹Br), 11.53], 220 (100); **HRMS**

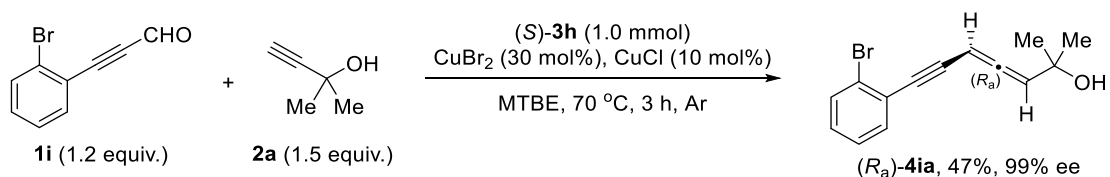
(70 eV, EI) calcd m/z for $C_{14}H_{13}O^{79}Br^+$ (M^+): 276.0144, found: 276.0147.

(48) Preparation of (*S_a*)-7-(3-bromophenyl)-2-methylhepta-3,4-dien-6-yn-2-ol ((*S_a*)-4ha**, wgl-5-067)**



Following **Typical Procedure I**, the reaction of $CuBr_2$ (67.8 mg, 0.3 mmol), $CuCl$ (9.9 mg, 0.1 mmol), (*R*)-**3h** (336.1 mg, 1.0 mmol), **2a** (126.7 mg, 1.5 mmol), and **1h** (251.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S_a*)-**4ha** (132.7 mg, 48%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (110 mL) to 5:1 (240 mL); second round, petroleum ether / dichloromethane = 1:1 (200 mL) to 1:2 (300 mL)] as a yellow oil: 99% ee [HPLC conditions: Chiralcel OD-H column, *n*-hexane/*i*-PrOH = 97/3, 1.0 mL/min, λ = 214 nm, t_R (major) = 10.4 min, t_R (minor) = 12.2 min]; $[\alpha]_D^{26} = +187.4$ (c = 1.26, $CHCl_3$); **¹H NMR** (400 MHz, $CDCl_3$) δ 7.57 (s, 1 H, ArH), 7.42 (d, J = 8.0 Hz, 1 H, ArH), 7.34 (d, J = 7.6 Hz, 1 H, ArH), 7.16 (t, J = 8.0 Hz, 1 H, ArH), 5.73 (d, J = 6.4 Hz, 1 H, one proton of $CH=C=CH$), 5.68 (d, J = 6.4 Hz, 1 H, one proton of $CH=C=CH$), 2.14 (brs, 1 H, OH), 1.41 (s, 6 H, $CH_3 \times 2$); **¹³C NMR** (100 MHz, $CDCl_3$) δ 209.7, 134.1, 131.3, 129.9, 129.7, 125.2, 122.0, 103.2, 88.9, 83.4, 78.6, 70.0, 29.73, 29.69; **IR** (neat) ν = 3351, 2974, 2205, 1947, 1588, 1554, 1473, 1364, 1148 cm^{-1} ; **MS** (70 eV, EI) m/z (%): 278 [$M^+(^{81}Br)$, 10.52], 276 [$M^+(^{79}Br)$, 10.75], 220 (100); **HRMS** (70 eV, EI) calcd m/z for $C_{14}H_{13}O^{79}Br^+$ (M^+): 276.0144, found: 276.0145.

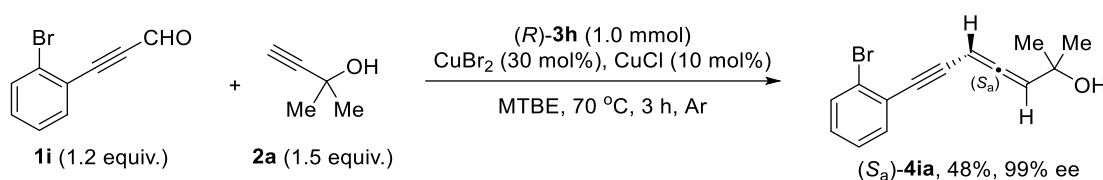
(49) Preparation of (*R_a*)-7-(2-bromophenyl)-2-methylhepta-3,4-dien-6-yn-2-ol ((*R_a*)-4ia**, wgl-5-056)**



Following **Typical Procedure I**, the reaction of $CuBr_2$ (67.7 mg, 0.3 mmol), $CuCl$

(10.0 mg, 0.1 mmol), (*S*)-**3h** (335.6 mg, 1.0 mmol), **2a** (126.6 mg, 1.5 mmol), and **1i** (250.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R*_a)-**4ia** (129.8 mg, 47%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (110 mL) to 5:1 (360 mL); second round, petroleum ether / dichloromethane = 1:2 (300 mL)] as a yellow oil: 99% ee [HPLC conditions: Chiralcel AD-H column, *n*-hexane/*i*-PrOH = 95/5, 1.0 mL/min, λ = 214 nm, t_R (minor) = 9.0 min, t_R (major) = 10.7 min]; $[\alpha]_D^{20}$ = -165.6 (c = 1.13, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 7.57 (d, J = 8.0 Hz, 1 H, ArH), 7.46 (d, J = 7.6 Hz, 1 H, ArH), 7.25 (t, J = 7.6 Hz, 1 H, ArH), 7.14 (t, J = 7.8 Hz, 1 H, ArH), 5.80 (d, J = 6.8 Hz, 1 H, one proton of CH=C=CH), 5.69 (d, J = 6.4 Hz, 1 H, one proton of CH=C=CH), 1.96 (s, 1 H, OH), 1.43 (s, 6 H, CH₃ x 2); ¹³C NMR (100 MHz, CDCl₃) δ 209.8, 133.2, 132.3, 129.3, 126.9, 125.33, 125.32, 103.2, 89.0, 86.6, 78.9, 70.1, 29.80, 29.76; IR (neat) ν = 3358, 2975, 2204, 1949, 1470, 1433, 1365, 1148, 1048, 1025 cm⁻¹; MS (70 eV, EI) m/z (%): 278 [M^+ (⁸¹Br), 6.24], 276 [M^+ (⁷⁹Br), 5.84], 139 (100); HRMS (70 eV, EI) calcd m/z for C₁₄H₁₃O⁷⁹Br⁺ (M^+): 276.0144, found: 276.0144.

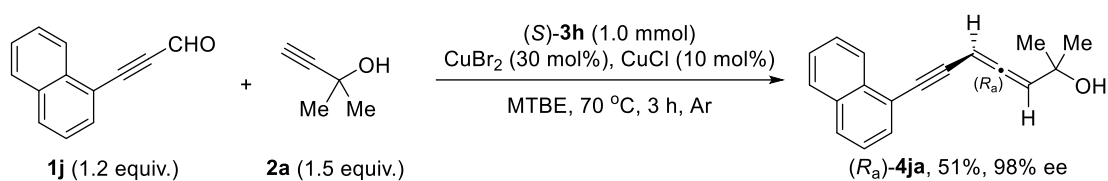
(50) Preparation of (*S*_a)-7-(2-bromophenyl)-2-methylhepta-3,4-dien-6-yn-2-ol ((*S*_a)-4ia**, wgl-5-057)**



Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (9.8 mg, 0.1 mmol), (*R*)-**3h** (336.1 mg, 1.0 mmol), **2a** (126.7 mg, 1.5 mmol), and **1i** (251.1 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S*_a)-**4ia** (133.7 mg, 48%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (110 mL) to 5:1 (360 mL); second round, petroleum ether / dichloromethane = 1:2 (300 mL)] as a yellow oil: 99% ee [HPLC conditions: Chiralcel AD-H column, *n*-hexane/*i*-PrOH = 95/5, 1.0 mL/min, λ = 214 nm, t_R (major) = 9.0 min, t_R (minor) = 10.7 min]; $[\alpha]_D^{21}$ = +168.3 (c = 1.29, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 7.56 (d, J = 8.0 Hz, 1 H, ArH), 7.45 (d, J = 7.6 Hz, 1 H, ArH), 7.24 (t, J = 7.6 Hz, 1 H, ArH), 7.13 (t, J = 7.6 Hz, 1 H, ArH),

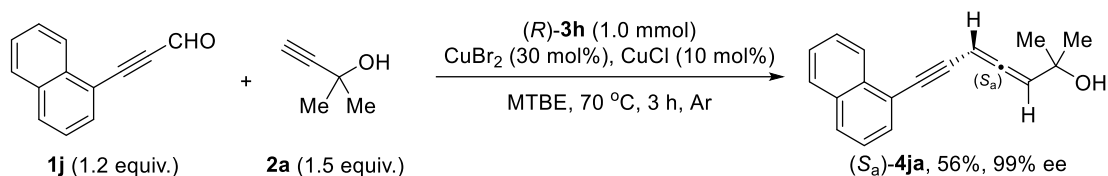
5.79 (d, $J = 6.4$ Hz, 1 H, one proton of CH=C=CH), 5.68 (d, $J = 6.8$ Hz, 1 H, one proton of CH=C=CH), 2.19 (s, 1 H, OH), 1.42 (s, 6 H, CH₃ x 2); ¹³C NMR (100 MHz, CDCl₃) δ 209.8, 133.1, 132.3, 129.3, 126.9, 125.3, 125.2, 103.1, 89.0, 86.6, 78.8, 70.0, 29.73, 29.70; IR (neat) $\nu = 3354, 2974, 2203, 1949, 1470, 1433, 1364, 1149, 1048, 1025$ cm⁻¹; MS (70 eV, EI) m/z (%): 278 [M⁺(⁸¹Br), 5.31], 276 [M⁺(⁷⁹Br), 5.85], 139 (100); HRMS (70 eV, EI) calcd m/z for C₁₄H₁₃O⁷⁹Br⁺ (M⁺): 276.0144, found: 276.0147.

(51) Preparation of (*R*_a)-2-methyl-7-(naphthalen-1-yl)hepta-3,4-dien-6-yn-2-ol ((*R*_a)-4ja**, wgl-6-010)**



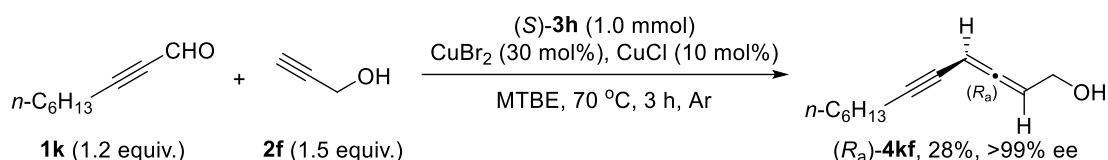
Following **Typical Procedure I**, the reaction of CuBr₂ (67.8 mg, 0.3 mmol), CuCl (9.9 mg, 0.1 mmol), (*S*)-**3h** (335.7 mg, 1.0 mmol), **2a** (126.5 mg, 1.5 mmol), and **1j** (216.8 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R*_a)-**4ja** (129.5 mg, 98% purity, 51%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (220 mL) to 5:1 (120 mL); second round, petroleum ether / dichloromethane = 1:1 (200 mL) to 1:2 (300 mL)] as a yellow oil: 98% ee [HPLC conditions: Chiralcel AD-H column, *n*-hexane/*i*-PrOH = 98/2, 1.0 mL/min, $\lambda = 214$ nm, t_R (minor) = 17.2 min, t_R (major) = 22.4 min]; [α]_D²¹ = -183.6 ($c = 1.32$, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 8.30 (d, $J = 8.4$ Hz, 1 H, ArH), 7.83-7.75 (m, 2 H, ArH), 7.65 (d, $J = 7.2$ Hz, 1 H, ArH), 7.57-7.51 (m, 1 H, ArH), 7.51-7.45 (m, 1 H, ArH), 7.41-7.35 (m, 1 H, ArH), 5.88 (d, $J = 6.4$ Hz, 1 H, one proton of CH=C=CH), 5.70 (d, $J = 6.4$ Hz, 1 H, one proton of CH=C=CH), 2.17 (br, 1 H, OH), 1.46-1.39 (m, 6 H, CH₃ x 2); ¹³C NMR (100 MHz, CDCl₃) δ 209.6, 133.1, 130.2, 128.7, 128.2, 126.7, 126.3, 126.1, 125.1, 120.8, 103.1, 88.7, 86.8, 79.1, 70.1, 29.8, 29.7; IR (neat) $\nu = 3368, 2975, 2181, 1947, 1581, 1504, 1405, 1366, 1147$ cm⁻¹; MS (70 eV, EI) m/z (%): 248 (M⁺, 19.32), 190 (100); HRMS (70 eV, EI) calcd m/z for C₁₈H₁₆O⁺ (M⁺): 248.1196, found: 248.1195.

(52) Preparation of (*S_a*)-2-methyl-7-(naphthalen-1-yl)hepta-3,4-dien-6-yn-2-ol ((*S_a*)-4ja**, wgl-6-011)**



Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (9.8 mg, 0.1 mmol), (*R*)-**3h** (336.1 mg, 1.0 mmol), **2a** (126.9 mg, 1.5 mmol), and **1j** (216.5 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S_a*)-**4ja** (139.0 mg, 56%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (220 mL) to 5:1 (120 mL); second round, petroleum ether / dichloromethane = 1:1 (200 mL) to 1:2 (300 mL)] as a yellow oil: 99% ee [HPLC conditions: Chiralcel AD-H column, *n*-hexane/*i*-PrOH = 98/2, 1.0 mL/min, λ = 214 nm, t_R (major) = 17.2 min, t_R (minor) = 22.4 min]; $[\alpha]_D^{21} = +180.8$ (c = 1.34, CHCl₃); **¹H NMR** (400 MHz, CDCl₃) δ 8.30 (d, J = 8.4 Hz, 1 H, ArH), 7.82-7.74 (m, 2 H, ArH), 7.68-7.63 (m, 1 H, ArH), 7.57-7.51 (m, 1 H, ArH), 7.50-7.44 (m, 1 H, ArH), 7.40-7.35 (m, 1 H, ArH), 5.88 (d, J = 6.4 Hz, 1 H, one proton of CH=C=CH), 5.69 (d, J = 6.8 Hz, 1 H, one proton of CH=C=CH), 2.21 (s, 1 H, OH), 1.45-1.39 (m, 6 H, CH₃ x 2); **¹³C NMR** (100 MHz, CDCl₃) δ 209.6, 133.07, 133.06, 130.2, 128.6, 128.2, 126.7, 126.3, 126.0, 125.1, 120.8, 103.1, 88.7, 86.8, 79.1, 70.1, 29.8, 29.7; **IR** (neat) ν = 3370, 2975, 2181, 1947, 1581, 1504, 1405, 1366, 1147 cm⁻¹; **MS** (70 eV, EI) m/z (%): 248 (M⁺, 18.76), 190 (100); **HRMS** (70 eV, EI) calcd m/z for C₁₈H₁₆O⁺ (M⁺): 248.1196, found: 248.1196.

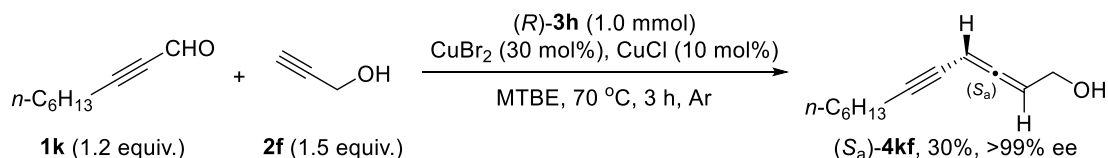
(53) Preparation of (*R_a*)-dodeca-2,3-dien-5-yn-1-ol ((*R_a*)-4kf**, wgl-5-028)**



Following **Typical Procedure I**, the reaction of CuBr₂ (67.8 mg, 0.3 mmol), CuCl (9.8 mg, 0.1 mmol), (*S*)-**3h** (335.5 mg, 1.0 mmol), **2f** (84.4 mg, 1.5 mmol), and **1k** (166.4 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*R_a*)-**4kf** (49.7 mg, 28%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (110 mL) to 5:1 (240

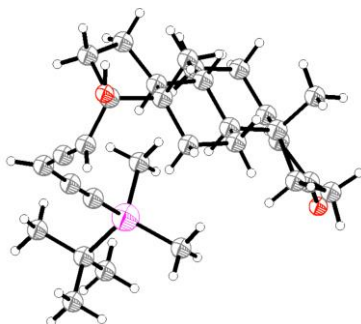
mL); second round, petroleum ether / dichloromethane = 1:10 (220 mL)] as a light yellow oil: >99% ee [HPLC conditions: Chiralcel OJ-H column, *n*-hexane/*i*-PrOH = 99/1, 1.0 mL/min, λ = 214 nm, t_R (major) = 14.7 min, t_R (minor) = 16.7 min]; $[\alpha]_D^{19}$ = -128.4 (c = 1.26, CHCl₃); **¹H NMR** (400 MHz, CD₃CN) δ 5.58-5.45 (m, 2 H, CH=C=CH), 4.08-3.99 (m, 2 H, CH₂), 3.15-2.93 (m, 1 H, OH), 2.29 (t, J = 7.0 Hz, 2 H, CH₂), 1.49 (quintet, J = 7.2 Hz, 2 H, CH₂), 1.41-1.25 (m, 6 H, CH₂ x 3), 0.89 (t, J = 6.8 Hz, 3 H, CH₃); **¹³C NMR** (100 MHz, CD₃CN) δ 212.0, 94.9, 92.7, 78.0, 73.6, 59.9, 32.1, 29.4, 29.3, 23.3, 19.9, 14.3; **IR** (neat) ν = 3323, 2927, 2860, 2218, 1952, 1717, 1458, 1415, 1271, 1214, 1095, 1016 cm⁻¹; **MS** (ESI) m/z (%): 179 (M + H⁺); **HRMS** (ESI) calcd m/z for C₁₂H₁₉O⁺ (M + H⁺): 179.1430, found: 179.1430.

(54) Preparation of (*S_a*)-dodeca-2,3-dien-5-yn-1-ol ((*S_a*)-4kf**, wgl-5-029)**



Following **Typical Procedure I**, the reaction of CuBr₂ (67.7 mg, 0.3 mmol), CuCl (10.0 mg, 0.1 mmol), (*R*)-**3h** (336.2 mg, 1.0 mmol), **2f** (83.8 mg, 1.5 mmol), and **1k** (166.6 mg, 1.2 mmol) in freshly distilled MTBE (5.0 mL) afforded (*S_a*)-**4kf** (53.5 mg, 30%) [eluent: first round, petroleum ether / ethyl acetate = 10:1 (110 mL) to 5:1 (240 mL); second round, petroleum ether / dichloromethane = 1:10 (220 mL)] as a light yellow oil: >99% ee [HPLC conditions: Chiralcel OJ-H column, *n*-hexane/*i*-PrOH = 99/1, 1.0 mL/min, λ = 214 nm, t_R (minor) = 14.6 min, t_R (major) = 16.6 min]; $[\alpha]_D^{18}$ = +124.7 (c = 1.00, CHCl₃); **¹H NMR** (400 MHz, CD₃CN) δ 5.62-5.44 (m, 2 H, CH=C=CH), 4.19-3.88 (m, 2 H, CH₂), 3.03 (brs, 1 H, OH), 2.29 (t, J = 7.0 Hz, 2 H, CH₂), 1.49 (quintet, J = 7.1 Hz, 2 H, CH₂), 1.42-1.23 (m, 6 H, CH₂ x 3), 0.89 (t, J = 6.6 Hz, 3 H, CH₃); **¹³C NMR** (100 MHz, CD₃CN) δ 212.0, 94.9, 92.7, 78.0, 73.6, 59.9, 32.1, 29.4, 29.3, 23.3, 19.9, 14.3; **IR** (neat) ν = 3327, 2928, 2857, 2219, 1952, 1722, 1461, 1378, 1272, 1214, 1095, 1013 cm⁻¹; **MS** (ESI) m/z (%): 179 (M + H⁺); **HRMS** (ESI) calcd m/z for C₁₂H₁₉O⁺ (M + H⁺): 179.1430, found: 179.1433.

X-ray crystal structure and crystallographic data of **4ax**



Crystal data for **4ax**: CCDC, 2039513; Empirical formula, C₃₀H₄₄O₂Si; Formula weight, 464.74; Temperature/K, 99.9(4); Crystal system, orthorhombic; Space group, P2₁2₁2₁; a/Å, 7.73005(4); b/Å, 16.35357(8); c/Å, 21.62262(12); α /°, 90; β /°, 90; γ /°, 90; Volume/Å³, 2733.40(2); Z, 4; ρ_{calc} /cm³, 1.129; μ /mm⁻¹, 0.922; F(000), 1016.0; Crystal size/mm³, 0.42 × 0.36 × 0.32; Radiation, CuK α (λ = 1.54184); 2 θ range for data collection/°, 6.776 to 134.16; Index ranges: -9 ≤ h ≤ 9, -19 ≤ k ≤ 19, -25 ≤ l ≤ 25; Reflections collected, 67451; Independent reflections, 4885 [R_{int} = 0.0368, R_{sigma} = 0.0121]; Data/restraints/parameters, 4885/0/306, Goodness-of-fit on F^2 , 1.094; Final R indexes [$I \geq 2\sigma(I)$], R_1 = 0.0257, wR_2 = 0.0681; Final R indexes [all data], R_1 = 0.0257, wR_2 = 0.0681; Largest diff. peak/hole / e Å⁻³, 0.15/-0.24; Flack parameter, 0.012(5).

Detailed information of the DFT calculations

Computational method

All calculations were performed with the Gaussian 16 program.¹¹ Geometries have been fully optimized by the B3LYP density functional,¹² including Grimme's D3 dispersion corrections (B3LYP-D3 with Becke-Johnson damping).^{13,14} The LANL2DZ¹⁵⁻¹⁷ basis set in conjunction with the LANL2DZ pseudopotential¹⁸ was used for Cu and Br atoms, while the 6-31G(d,p) basis set was used for carbon, hydrogen nitrogen, oxygen and silicon atoms. The solvent effects of 1,4-dioxane were simulated by the SMD model.¹⁹ Harmonic vibration frequency calculations were conducted at the same level of theory to verify the stationary points to be minima (no imaginary frequency) or saddle points (one imaginary frequency). Intrinsic reaction coordinate (IRC)²⁰⁻²² calculations were performed to confirm the connection of the transition structures with their corresponding reactants and products. Based on the optimized structures, all energies were refined by conducting single point energy calculations using the B3LYP-D3(BJ) functional and mixed basis set as SDD²³ for Cu and Br atoms, and 6-311+G(d, p) for other atoms. The solvent effects of 1,4-dioxane were also simulated by the SMD model. The reported energies are the solution-phase Gibbs free energies (ΔG_{sol}) in 1,4-dioxane.

The six competing 1,5-H transfer TSs from Int1_TMS

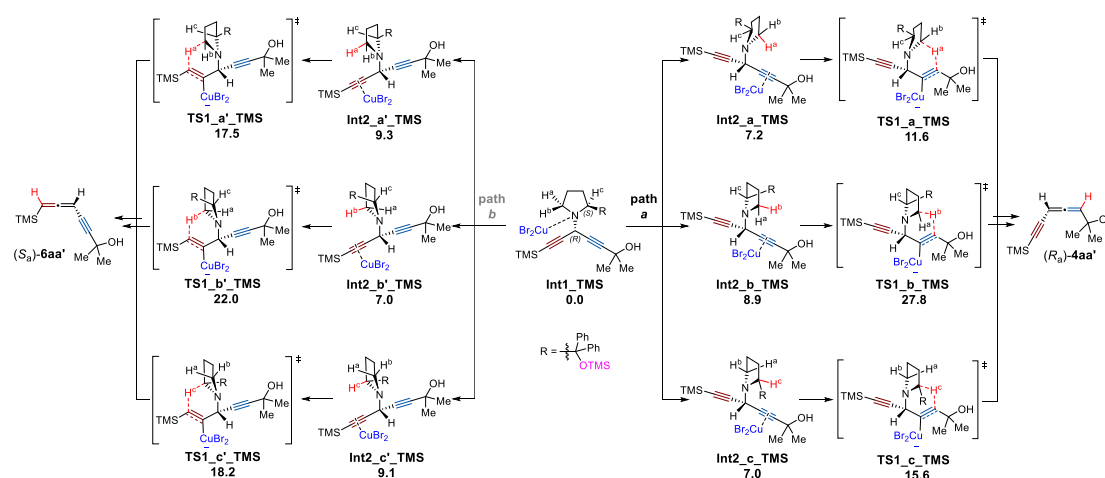


Figure S1. The 1,5-H transfer step from Int1_TMS. All energies (ΔG) are in kcal/mol with respect of Int1_TMS.

Energies of intermediates and transition states

Table S1. Electronic energies (E_{elec}), thermal correction to Gibbs free energy ($cor\ G_{gas}$), Gibbs free energies (G_{298}), solvation energies (E_{sol}), solvation free energies (G_{sol}) in 1,4-dioxane ($\epsilon=2.21$) for all stationary points of this process.

species	E_{elec} (a.u.)	$cor\ G_{gas}$ (a.u.)	G_{298} (a.u.)	E_{sol} (a.u.)	G_{sol} (a.u.)
Int1	-1805.482567	0.49167	-1804.990897	-1807.476629	-1806.984959
Int2_a	-1805.446753	0.487542	-1804.959211	-1807.44495	-1806.957408
TS1_a	-1805.429859	0.483609	-1804.94625	-1807.429109	-1806.9455
Int3	-1805.485371	0.489694	-1804.995677	-1807.479267	-1806.989573
Int1_TMS	-2214.219881	0.589184	-2213.630697	-2216.258906	-2215.669722
Int2_a_TMS	-2214.196631	0.581735	-2213.614896	-2216.239962	-2215.658227
TS1_a_TMS	-2214.181576	0.576189	-2213.605387	-2216.22744	-2215.651251
Int2_b_TMS	-2214.196881	0.583065	-2213.613816	-2216.23862	-2215.655555
TS1_b_TMS	-2214.165008	0.583242	-2213.581766	-2216.208633	-2215.625391
Int2_c_TMS	-2214.202199	0.583822	-2213.618377	-2216.242465	-2215.658643
TS1_c_TMS	-2214.181224	0.579802	-2213.601422	-2216.224638	-2215.644836
Int2_a'_TMS	-2214.19426	0.58219	-2213.61207	-2216.237167	-2215.654977
TS1_a'_TMS	-2214.174755	0.579562	-2213.595193	-2216.221471	-2215.641909
Int2_b'_TMS	-2214.193762	0.57902	-2213.614742	-2216.237566	-2215.658546
TS1_b'_TMS	-2214.168228	0.580662	-2213.587566	-2216.215403	-2215.634741
Int2_c'_TMS	-2214.202786	0.583339	-2213.619447	-2216.238506	-2215.655167
TS1_c'_TMS	-2214.178396	0.581986	-2213.59641	-2216.222651	-2215.640665
Int3_TMS	-2214.240031	0.585128	-2213.654903	-2216.281867	-2215.696739

Cartesian coordination for the optimized structures

Int1

C	1.30440700	-1.51819300	0.13466700
N	0.54988400	-0.51219600	-0.71615300
C	0.73573300	0.88847100	-0.21686700
H	1.00457000	0.81052600	0.83602600
C	0.98658200	-0.52902700	-2.14767300
H	0.09717100	-0.40773700	-2.76408000
H	1.41197000	-1.50505200	-2.37695400
C	1.96983000	0.64328200	-2.34020000
H	1.68128800	1.23083800	-3.21411800

C	1.88862400	1.48458100	-1.04716900
H	2.98722100	0.27856200	-2.49573600
H	2.81237700	1.38816200	-0.47547300
C	-0.62027200	1.65739800	-0.24215000
C	-1.12225200	1.92325100	-1.66240200
C	-0.56810200	2.96258300	-2.42250500
C	-2.12116400	1.13143900	-2.24308700
C	-0.94487200	3.15569700	-3.74983400
H	0.14173500	3.64328100	-1.96645000
C	-2.49689000	1.32235200	-3.57412000
H	-2.64662400	0.38418100	-1.65985700
C	-1.89926200	2.32321900	-4.33765800
H	-0.50020500	3.96521000	-4.32068000
H	-3.26582700	0.68797500	-4.00316400
H	-2.19069900	2.47042000	-5.37288700
C	-0.57476100	2.94168200	0.58264500
C	-1.76088000	3.68437000	0.68050000
C	0.55519700	3.37939200	1.28077300
C	-1.81614600	4.83527500	1.45927800
H	-2.63989800	3.34432100	0.14317400
C	0.50143300	4.54031500	2.05743700
H	1.48966700	2.83381300	1.22819400
C	-0.68151600	5.26923600	2.15038000
H	-2.74380400	5.39489800	1.52773500
H	1.38894900	4.86911500	2.58936600
H	-0.72220200	6.16912400	2.75625900
O	-1.59573100	0.78557700	0.37216900
H	-1.54472900	0.78117000	1.36193000
Cu	-1.44376200	-1.16055900	-0.31974600
Br	-1.21625900	-3.17213300	-1.67391400

Br	-3.57722200	-1.74072700	0.75119400
C	0.67432400	-1.47237600	1.45986400
C	0.00540000	-1.21058400	2.43345700
C	-0.87138300	-0.74637000	3.52975700
O	-1.90058200	0.08478700	2.94919900
H	-2.56630000	-0.50416400	2.52903700
C	-1.50727700	-1.92928500	4.26709200
H	-0.73637400	-2.55156600	4.72940400
H	-2.17550200	-1.55143600	5.04560800
H	-2.08069000	-2.54621600	3.57010300
C	-0.08302900	0.16992900	4.47071200
H	0.76123900	-0.36616000	4.91111900
H	0.29402400	1.03619600	3.92065700
H	-0.74381700	0.52133100	5.26703700
H	1.73883100	2.54332400	-1.25152600
H	1.09637300	-2.48774300	-0.33682700
C	2.75048600	-1.28794900	0.17782700
C	3.94800500	-1.07577900	0.17164500
Si	5.74462200	-0.67105300	0.12525000
C	5.93191800	1.12791200	0.65662400
H	5.38286500	1.79747800	-0.01368200
H	5.55269400	1.28126000	1.67186800
H	6.98492800	1.42963400	0.64118800
C	6.65359900	-1.81792200	1.30725700
H	6.52191600	-2.86560100	1.01986400
H	7.72723600	-1.59998700	1.30627600
H	6.28659200	-1.70131200	2.33166200
C	6.34707300	-0.90292300	-1.64347200
H	6.20936700	-1.93663600	-1.97520000
H	5.80192700	-0.25247100	-2.33521200

H	7.41245400	-0.66104000	-1.72489400
Int2_a			
C	0.42281900	-0.51481500	0.21490300
C	-0.51314000	-1.59092200	0.60794600
C	-1.37124500	-2.39011300	0.91821300
N	1.38473200	-0.84083200	-0.83483100
C	2.74118300	-1.22547200	-0.37675500
H	2.70446600	-1.66015700	0.62863000
C	0.92775200	-1.74852800	-1.90156800
H	0.20803000	-1.24267200	-2.54976300
H	0.42985000	-2.63536200	-1.48219900
C	2.23259300	-2.13420200	-2.59154400
H	2.56133600	-1.33641800	-3.26314400
C	3.21365300	-2.26941000	-1.41467400
H	2.13586500	-3.05351500	-3.17391900
H	4.25091000	-2.10717400	-1.70848000
H	3.14141600	-3.27003200	-0.97720900
C	3.61897200	0.07154800	-0.36003000
C	3.07965500	1.04274700	0.70743700
C	2.48515000	2.24928400	0.32836700
C	3.10500000	0.70747500	2.06907800
C	1.89984800	3.08736400	1.28135400
H	2.48933200	2.53132100	-0.71724600
C	2.51188100	1.53711000	3.02013700
H	3.59166000	-0.20732900	2.39128100
C	1.89733700	2.72935500	2.62823200
H	1.44474300	4.02191700	0.96616100
H	2.53208500	1.25411000	4.06815000
H	1.43319100	3.37420400	3.36777700
C	5.09278100	-0.21060400	-0.09967700

C	6.05638300	0.61562100	-0.68932300
C	5.51575900	-1.24042500	0.74927800
C	7.41187600	0.41815900	-0.43264700
H	5.73050500	1.40617700	-1.35449300
C	6.87288400	-1.43683700	1.00831500
H	4.79311100	-1.90907600	1.20546500
C	7.82610300	-0.60698800	0.41949800
H	8.14678600	1.06678700	-0.90025400
H	7.18242600	-2.24359600	1.66599600
H	8.88226500	-0.76022200	0.61919200
O	3.50763100	0.65245900	-1.65164100
H	2.55366000	0.59271100	-1.84336900
Cu	-2.62314400	-0.08087500	-0.24908000
Br	-3.87523100	0.36036600	1.74488700
Br	-2.78097000	-0.77427100	-2.52705000
H	0.98900100	-0.21236700	1.10342200
C	-0.39980700	0.65600500	-0.14656700
C	-1.13296300	1.61570600	-0.37843800
Si	-1.95086000	3.28217800	-0.60668500
C	-2.08106300	4.00783300	1.11838700
H	-2.72420000	3.37759800	1.73990700
H	-1.09812400	4.06694500	1.59508100
H	-2.51069500	5.01486600	1.08632200
C	-0.78723900	4.25269200	-1.72143300
H	0.21306300	4.32478600	-1.28371000
H	-0.69608800	3.77381000	-2.70113600
H	-1.16395600	5.26962200	-1.87578200
C	-3.62774000	3.00710400	-1.39778100
H	-3.54032100	2.42858100	-2.32204900
H	-4.28979300	2.46343800	-0.71656300

H	-4.09900900	3.96767200	-1.63289100
C	-2.39810100	-3.35851300	1.37557600
C	-1.73614100	-4.72363900	1.60206600
H	-2.49092800	-5.42155700	1.97330900
H	-1.31576800	-5.11024200	0.67035300
H	-0.94252800	-4.63662100	2.34724800
C	-3.53076300	-3.45829900	0.34032100
H	-4.04058900	-2.49701800	0.23297600
H	-3.15039200	-3.75018600	-0.64193100
H	-4.25842800	-4.19775200	0.68503700
O	-2.89999200	-2.95023000	2.64219200
H	-3.29740000	-2.06907600	2.53781800
TS1_a			
C	-0.75974500	-0.56140900	0.44212500
C	-0.81830200	0.97779100	0.52824100
C	-0.70015300	1.65524400	1.60476200
N	0.21041200	-0.98263000	1.45559200
C	1.63888400	-0.64385300	1.15999600
H	1.65391200	0.21442500	0.48530100
C	-0.10075800	-0.58372400	2.75298200
H	-1.03610900	-0.98819600	3.14242000
H	-0.39142300	0.63368500	2.60233000
C	1.17082400	-0.64729800	3.56931000
H	1.31423900	-1.67220900	3.92944900
C	2.23833700	-0.25859800	2.53239300
H	1.14520900	0.01669600	4.43574200
H	3.19180400	-0.75584500	2.70653700
H	2.39471900	0.82221700	2.56025700
C	2.31218000	-1.86072300	0.46789800
C	1.63849700	-2.07340100	-0.89894000

C	0.87807300	-3.21637600	-1.15167200
C	1.68060500	-1.06073700	-1.87082000
C	0.12993400	-3.32654900	-2.32773800
H	0.86598700	-4.01995200	-0.42451300
C	0.92792800	-1.16634900	-3.03870200
H	2.27853500	-0.17124300	-1.71157400
C	0.13689600	-2.29643100	-3.26565000
H	-0.46728800	-4.21672300	-2.50093800
H	0.95349600	-0.36149800	-3.76645100
H	-0.46279100	-2.37000500	-4.16695900
C	-0.47685800	2.97645400	2.27082500
C	3.81107500	-1.64891800	0.29183800
C	4.66703100	-2.75338300	0.36381800
C	4.35071400	-0.38684800	0.01253500
C	6.03718700	-2.59938000	0.15878100
H	4.24963600	-3.72796900	0.58616900
C	5.72211700	-0.23600600	-0.19487200
H	3.71596200	0.49124300	-0.04574800
C	6.57017900	-1.34065800	-0.12311800
H	6.68934400	-3.46573400	0.21917200
H	6.12333600	0.74959700	-0.41016600
H	7.63742800	-1.22166400	-0.28368800
O	2.13519100	-2.98978400	1.31781200
H	1.18346900	-3.03089600	1.49757200
Cu	-0.51334800	1.84197200	-1.25026600
Br	1.72153400	2.72834800	-0.99965900
Br	-2.49010400	1.30996900	-2.42582500
C	-1.07042000	2.98940600	3.68062900
H	-0.88200400	3.96419300	4.13587200
H	-2.14742500	2.80703100	3.65176700

H	-0.59327600	2.22423500	4.29886200
H	-0.38941300	-0.86597900	-0.53439800
C	-2.08750000	-1.12435600	0.64540300
C	-3.22089900	-1.54713400	0.76219700
Si	-4.98020100	-2.09629800	0.77620700
C	-5.05593200	-3.86940500	1.40866600
H	-4.47020000	-4.54063700	0.77287100
H	-4.66833700	-3.94691600	2.42950900
H	-6.09038000	-4.23027000	1.41483100
C	-5.94487400	-0.94720800	1.91515300
H	-5.56316500	-0.98792000	2.94036000
H	-5.87900800	0.08923700	1.56985700
H	-7.00366700	-1.22777100	1.93942400
C	-5.60409100	-1.97475500	-0.99352900
H	-5.45395300	-0.96478900	-1.38716500
H	-5.06500400	-2.66808000	-1.64649400
H	-6.67189300	-2.21300700	-1.05130300
C	-1.10188000	4.08622000	1.40207100
H	-0.63098100	4.11407500	0.41645600
H	-2.17545000	3.92723100	1.27514900
H	-0.93112400	5.04751100	1.89374200
O	0.92494400	3.17079200	2.42676800
H	1.31739800	3.19647900	1.53520800
Int3			
C	-0.46599000	0.69933600	0.21749600
C	-1.96473300	0.75081800	0.27705000
C	-2.73356400	1.83090300	0.23593200
N	-0.05411800	-0.36689700	-0.75379400
C	0.94826100	-1.42907900	-0.45270500
H	0.66270700	-1.88697000	0.49354000

C	-0.52055800	-0.42769500	-1.95659100
H	-1.21984000	0.32083800	-2.30670000
H	-2.31323800	2.83431400	0.12436200
C	0.09517200	-1.52672100	-2.74364500
H	0.85779600	-1.08188000	-3.39635300
C	0.72007500	-2.39632000	-1.63582800
H	-0.64514100	-2.04025800	-3.35698700
H	1.63981700	-2.88618700	-1.94762600
H	-0.00071100	-3.15731300	-1.32843700
C	2.38384400	-0.80637100	-0.38456500
C	2.66720500	-0.01704000	0.90126200
C	3.66517800	0.96575100	0.85388500
C	2.03726700	-0.27693100	2.12373200
C	3.99689300	1.70129600	1.98862600
H	4.18519300	1.14116600	-0.08109600
C	2.36393200	0.46776600	3.25983200
H	1.27369200	-1.04242400	2.21720400
C	3.33748100	1.46273200	3.19674300
H	4.77539300	2.45640800	1.93085000
H	1.84781400	0.26257500	4.19235900
H	3.58869700	2.03987500	4.08113900
C	-4.24283600	1.75108300	0.39712100
C	3.40642100	-1.93948600	-0.48103400
C	4.31198200	-1.99821400	-1.54276200
C	3.43155200	-2.93901200	0.49937400
C	5.23076200	-3.04691500	-1.62338500
H	4.29140500	-1.22203800	-2.29733200
C	4.34429400	-3.98754300	0.41258000
H	2.74627200	-2.89609500	1.33991300
C	5.24856800	-4.04499300	-0.65022600

H	5.93251500	-3.08139400	-2.45150700
H	4.35178300	-4.75695400	1.17839400
H	5.96212200	-4.86055000	-0.71585200
O	2.54796000	0.03547700	-1.52591500
H	2.15304300	0.89473200	-1.30680200
Cu	-2.84523300	-1.00219700	0.51501600
Br	-3.33474800	-1.67426400	-1.88121700
Br	-1.52550300	-2.06169200	2.26575900
C	-4.94468700	2.51361100	-0.73118400
H	-6.03014800	2.45452900	-0.61070900
H	-4.65113600	3.56768800	-0.72626300
H	-4.67279500	2.09206200	-1.70511500
H	-0.10627800	0.35552900	1.18954500
C	0.22712200	1.93470300	-0.14280300
C	0.83944200	2.94424000	-0.43972100
Si	1.86515000	4.44335900	-0.76531200
C	3.34526300	3.89742000	-1.79566000
H	3.95819600	3.17368600	-1.25073200
H	3.03055900	3.43416100	-2.73633100
H	3.97940400	4.75592100	-2.04215000
C	0.82350600	5.69349600	-1.71082000
H	0.48790200	5.28589000	-2.66962700
H	-0.06329200	5.98330300	-1.13858300
H	1.40260100	6.60063300	-1.91555600
C	2.41349600	5.12076800	0.90078100
H	1.55541100	5.46203400	1.48811600
H	2.92817900	4.34667100	1.47742000
H	3.09551100	5.96848900	0.77316800
C	-4.64226600	2.28545300	1.77464800
H	-4.19292300	1.66424500	2.55351900

H	-4.29236300	3.31392100	1.90456400
H	-5.72988200	2.26410400	1.88768200
O	-4.68118300	0.36955300	0.37706400
H	-4.77373200	0.08414200	-0.54951300
Int1_TMS			
C	-0.24020800	-1.73713900	1.30899800
N	-0.08895200	-0.21836400	1.38460100
C	-1.25457900	0.50653800	0.77458100
H	-1.70121900	-0.17274700	0.05430900
C	-0.05060600	0.24214000	2.80922200
H	0.46504300	1.20077100	2.82564200
H	0.53800200	-0.45317700	3.40312300
C	-1.51309000	0.38911000	3.23138100
H	-1.62495600	1.13402900	4.02331100
C	-2.24622200	0.78682100	1.93439200
H	-1.90007200	-0.56145500	3.60894400
H	-3.14347400	0.18249300	1.79648000
C	-0.77621700	1.72540900	-0.06811500
C	0.12434200	2.68211300	0.72389800
C	-0.37859300	3.42968000	1.80133700
C	1.47581400	2.82437300	0.39537700
C	0.46615000	4.22162000	2.57420500
H	-1.43569600	3.41074400	2.03371800
C	2.32895700	3.60741500	1.18022800
H	1.86870200	2.35135600	-0.49417800
C	1.83152100	4.29580900	2.28184200
H	0.05595800	4.78453700	3.40729600
H	3.37922400	3.66694900	0.91477800
H	2.49055100	4.90100600	2.89621200
C	-1.97105200	2.48918600	-0.65095300

C	-1.79104700	3.80757100	-1.09025800
C	-3.23385800	1.90353800	-0.80747200
C	-2.83635800	4.51621800	-1.67688800
H	-0.82051600	4.27646400	-0.97604900
C	-4.28388700	2.61081400	-1.39306400
H	-3.41862500	0.89006000	-0.47781800
C	-4.08898100	3.92002700	-1.83185200
H	-2.67131200	5.53434800	-2.01545600
H	-5.25313200	2.13389900	-1.50241200
H	-4.90538200	4.47167800	-2.28759300
O	0.03817200	1.13677700	-1.10938800
Cu	1.70893000	0.06323900	0.32214100
Br	3.12815500	-0.75983000	2.21138900
Br	3.65600700	0.33632500	-1.10349400
C	0.54456000	-2.27042000	0.18861700
C	1.30750300	-2.78532200	-0.59866600
C	2.32394600	-3.46001700	-1.44299300
O	2.74552300	-2.62346600	-2.51135700
H	3.18486600	-1.84000700	-2.13000000
C	3.51863100	-3.83127200	-0.54625600
H	3.21595000	-4.52279400	0.24516200
H	4.28539600	-4.30574900	-1.16517100
H	3.93383800	-2.93605000	-0.07614600
C	1.69972500	-4.69656500	-2.09973900
H	1.33059800	-5.39474600	-1.34436700
H	0.87150800	-4.39843000	-2.74696500
H	2.46003400	-5.19284900	-2.70841800
H	-2.56471300	1.82708400	1.94083900
H	0.23630300	-2.11242100	2.22167800
C	-1.62904400	-2.19893200	1.24712800

C	-2.79157100	-2.53408800	1.12146400
Si	-4.56267200	-2.92591800	0.80433100
C	-5.29840500	-1.42720400	-0.07645000
H	-5.23598400	-0.52862200	0.54631100
H	-4.76966200	-1.23080900	-1.01480800
H	-6.35432100	-1.59496800	-0.31486800
C	-4.64652100	-4.44752200	-0.29773300
H	-4.19153000	-5.31477600	0.19056500
H	-5.68654400	-4.69910500	-0.53267300
H	-4.11800900	-4.27673300	-1.24068100
C	-5.43015400	-3.22239700	2.44775700
H	-4.98667600	-4.06924600	2.98062300
H	-5.36141100	-2.34349100	3.09663000
H	-6.49176700	-3.44212800	2.29040100
Si	-0.46863500	0.58721400	-2.66367000
C	-1.22477100	1.96474200	-3.69915900
H	-2.24153400	2.23810800	-3.41525200
H	-0.60625900	2.86656800	-3.66707800
H	-1.24445300	1.61793900	-4.73941700
C	1.06181200	0.00372400	-3.54631200
H	1.45073500	-0.94073000	-3.16343300
H	0.79745700	-0.14884900	-4.60017100
H	1.86385300	0.74395800	-3.50073500
C	-1.68494200	-0.84189600	-2.48657300
H	-1.85087800	-1.27673600	-3.47936600
H	-1.28057900	-1.63121100	-1.84626500
H	-2.65969500	-0.53590600	-2.09827900
Int2_a_TMS			
C	0.13656500	-0.95539200	-0.75395100
C	1.33404900	-1.79124200	-0.98384700

C	2.37897200	-2.39668800	-1.09216500
N	-0.73215600	-1.48199100	0.27412100
C	-2.10465700	-1.85159500	-0.02570600
H	-2.14800400	-2.23450200	-1.05138100
C	-0.19053000	-2.11124500	1.46861100
H	0.34133700	-1.38063100	2.09255700
H	0.54304700	-2.88416200	1.19841700
C	-1.42293500	-2.70331300	2.15956600
H	-1.83326400	-1.98797200	2.87311300
C	-2.41579400	-2.94968900	1.00656400
H	-1.18097500	-3.62038000	2.70178300
H	-3.45806400	-2.93374600	1.33019800
H	-2.22881400	-3.92593000	0.54817600
C	-3.06209800	-0.59998000	-0.00151000
C	-4.48799800	-0.95001100	-0.44246000
C	-5.56420500	-0.13361900	-0.06238300
C	-4.74774900	-2.00086500	-1.33233400
C	-6.84986100	-0.35606100	-0.55211100
H	-5.39339900	0.68545900	0.62487200
C	-6.03355500	-2.23025100	-1.82173200
H	-3.94867600	-2.65220100	-1.66419700
C	-7.09121100	-1.40749300	-1.43664400
H	-7.66171800	0.29477600	-0.24179500
H	-6.20514700	-3.05248500	-2.50971800
H	-8.09124300	-1.58392700	-1.82044600
C	3.64579100	-3.14388600	-1.29055000
C	-2.99291100	0.03177400	1.38771400
C	-1.95451000	0.92156600	1.68333200
C	-3.84555100	-0.36704800	2.42622900
C	-1.76155200	1.38999700	2.98214700

H	-1.28684900	1.23328200	0.89399800
C	-3.66248000	0.11070600	3.72448900
H	-4.65457000	-1.06042000	2.22693600
C	-2.61456900	0.98634100	4.00985500
H	-0.93347000	2.05997000	3.19304400
H	-4.33629100	-0.21009800	4.51327100
H	-2.46378200	1.34878600	5.02198600
O	-2.46555600	0.26313400	-0.97792500
Cu	2.91867300	0.13883200	0.23659100
Br	4.48845800	0.74148600	-1.48693600
Br	2.82548100	-0.35939300	2.57257100
C	3.32049500	-4.61067000	-1.60145900
H	4.25633500	-5.14732300	-1.77735300
H	2.78991800	-5.07641900	-0.76712600
H	2.70497900	-4.67547000	-2.50133000
H	-0.45278600	-0.87365400	-1.67378500
C	0.64663200	0.40887000	-0.45692100
C	1.12767400	1.51539000	-0.22975500
Si	1.58100400	3.31331700	0.01060600
C	0.00895100	4.14828500	0.62785700
H	-0.80258900	4.05407400	-0.09956900
H	-0.33176100	3.71335900	1.57188600
H	0.18870800	5.21598300	0.79477700
C	2.96518200	3.40532500	1.27151600
H	2.70561600	2.87824800	2.19394800
H	3.87835400	2.95455400	0.87084100
H	3.18201100	4.45096600	1.51669500
C	2.10726100	3.95744000	-1.67023400
H	2.96620000	3.38664600	-2.03484100
H	1.29928400	3.87046500	-2.40276200

H	2.39521200	5.01227500	-1.60242300
C	4.52332700	-3.02742000	-0.03224400
H	4.80323700	-1.98610900	0.14664500
H	4.00118800	-3.39576300	0.85497200
H	5.43612000	-3.60953500	-0.18511700
O	4.32296400	-2.64197400	-2.43412000
H	4.51455600	-1.70026800	-2.28010100
Si	-3.05799700	1.57878800	-1.85197600
C	-3.75543100	2.91344000	-0.72315200
H	-3.07879400	3.12304600	0.11011900
H	-3.89490900	3.84132700	-1.28996000
H	-4.72561300	2.63575700	-0.30350500
C	-4.32289400	1.05693600	-3.14140200
H	-4.52593200	1.89647200	-3.81676000
H	-3.93833800	0.23005200	-3.74711400
H	-5.27020100	0.73852100	-2.70139200
C	-1.52177700	2.21419900	-2.72588700
H	-0.75459100	2.51835300	-2.01119400
H	-1.08442600	1.44456000	-3.37049100
H	-1.76332400	3.07707300	-3.35615700
TS1_a_TMS			
C	0.93559500	0.47974800	0.22956500
C	1.49920200	-0.86455300	0.74961400
C	1.61385100	-1.22079200	1.96507800
N	-0.11022400	0.86287500	1.15938800
C	-1.37990000	0.10870400	1.03474100
H	-1.16083200	-0.84080400	0.53826200
C	0.26992300	0.97476200	2.49429300
H	0.98767800	1.77246500	2.69397600
H	0.94130600	-0.04249700	2.68202000

C	-0.99144500	0.86256800	3.32728100
H	-1.47423700	1.84299600	3.39029500
C	-1.82345300	-0.12801700	2.49408800
H	-0.79247800	0.50700900	4.34042800
H	-2.89678000	-0.00138700	2.63127200
H	-1.55698900	-1.14880500	2.78092500
C	-2.36238300	0.88835500	0.10929300
C	-3.64408000	0.09670000	-0.14932400
C	-4.71879700	0.74942100	-0.77124000
C	-3.75994600	-1.27114000	0.12158200
C	-5.87088400	0.05307300	-1.12692100
H	-4.64435500	1.81177900	-0.97584200
C	-4.91784800	-1.96946300	-0.22628400
H	-2.94643500	-1.82259400	0.57623000
C	-5.97428800	-1.31321500	-0.85499600
H	-6.68852200	0.57695400	-1.61285100
H	-4.98180000	-3.03207800	-0.01419200
H	-6.87138900	-1.85912300	-1.13061300
C	1.81688800	-2.27334500	3.00395300
C	-2.63370100	2.26089500	0.72921100
C	-1.75948700	3.32166200	0.46475600
C	-3.67368700	2.45620400	1.64667600
C	-1.91784900	4.54775900	1.10949100
H	-0.95538800	3.17182400	-0.24403200
C	-3.83041100	3.68202500	2.29507100
H	-4.37413400	1.65261800	1.84629600
C	-2.95020900	4.73179900	2.03099700
H	-1.23110800	5.36057900	0.89196000
H	-4.64504600	3.81616500	3.00055800
H	-3.07255000	5.68696400	2.53287400

O	-1.63450800	1.08012300	-1.10244900
Cu	1.46163500	-2.30472500	-0.64470700
Br	-0.44140400	-3.61534300	0.05085600
Br	3.15769000	-1.61845700	-2.13394800
C	2.40100700	-1.67786100	4.28674200
H	2.52822000	-2.47599000	5.02158200
H	3.36841700	-1.20845200	4.09265600
H	1.71763400	-0.93269100	4.70208200
H	0.46773100	0.34332900	-0.74252500
C	1.99960300	1.46736200	0.10928500
C	2.90359800	2.26696500	-0.03303100
Si	4.31477100	3.40396700	-0.36005800
C	3.72390500	5.17546100	-0.10656200
H	2.89773700	5.41570800	-0.78310500
H	3.37780400	5.33669400	0.91938100
H	4.53607900	5.88423800	-0.30242500
C	5.69994700	2.99022800	0.84732000
H	5.37793900	3.12656400	1.88464500
H	6.02431500	1.95188600	0.72739100
H	6.56767900	3.63694100	0.67644200
C	4.86180300	3.11875100	-2.13689900
H	5.12072000	2.06772900	-2.29758600
H	4.06238300	3.37518100	-2.83899400
H	5.73778400	3.72985900	-2.38091100
C	2.74408300	-3.36688000	2.43537300
H	2.29218000	-3.83429700	1.55667400
H	3.71453800	-2.95144700	2.15316300
H	2.88441900	-4.13490500	3.20052500
O	0.54583500	-2.81183100	3.35663000
H	0.16490800	-3.21003400	2.55293800

Si	-1.78067200	0.58053200	-2.70818100
C	-3.00249800	1.67586800	-3.62900000
H	-2.81066400	2.73407200	-3.42267600
H	-2.90511000	1.52243900	-4.70986000
H	-4.03643400	1.45563000	-3.35192900
C	-2.23989700	-1.23071200	-2.88388600
H	-2.03654600	-1.54973500	-3.91323400
H	-1.64813600	-1.86791700	-2.21869400
H	-3.29548000	-1.41763400	-2.67324800
C	-0.04548500	0.87308900	-3.36887000
H	0.32312900	1.86582300	-3.08997600
H	0.67528100	0.13464400	-3.00074600
H	-0.03628600	0.80833300	-4.46262400

Int2_b_TMS

C	-0.33698000	-0.66123200	1.97578000
C	-1.20804700	-1.60107400	1.22893400
C	-1.97250200	-2.32435100	0.62146300
N	1.07270000	-1.03592400	1.94656900
C	2.10108100	-0.02203400	1.67115300
H	1.66684900	0.97758000	1.74616600
C	1.46523100	-1.92760000	3.03956900
H	1.17745100	-2.96335800	2.82508100
H	0.96597400	-1.63673600	3.98239200
C	2.97635100	-1.73622600	3.15236300
H	3.49263700	-2.36312600	2.42420700
C	3.15453300	-0.25911500	2.77608500
H	3.34791200	-1.97307500	4.15274700
H	4.16816500	-0.03458400	2.44639400
H	2.91970900	0.38009900	3.63574000
C	2.69969100	-0.14015600	0.21417500

C	1.59711700	-0.57197100	-0.75404900
C	0.73948200	0.35726800	-1.34736100
C	1.38249600	-1.93268800	-1.00324200
C	-0.31210800	-0.05853700	-2.16908600
H	0.89232700	1.41480500	-1.17290400
C	0.34370800	-2.35337800	-1.83158800
H	2.03259100	-2.65512900	-0.52636600
C	-0.51087400	-1.41989600	-2.41511500
H	-0.95667300	0.67534100	-2.63904900
H	0.17996400	-3.41204600	-2.00356900
H	-1.33507500	-1.74665300	-3.03614200
C	-2.87863000	-3.32225500	-0.01024200
C	3.34731000	1.18304500	-0.22623800
C	3.77925600	2.15530700	0.68504700
C	3.58892100	1.41227200	-1.58977800
C	4.43939800	3.30705800	0.25182100
H	3.61033000	2.03109700	1.74658200
C	4.25193500	2.55664700	-2.02670900
H	3.24123700	0.68916300	-2.31697800
C	4.68446900	3.51134600	-1.10474500
H	4.76125500	4.04422200	0.98116300
H	4.42444700	2.70456900	-3.08852900
H	5.19896700	4.40625300	-1.44089500
O	3.68331700	-1.17085800	0.28057200
Cu	-2.40514600	0.14637900	-0.09470000
Br	-4.29487700	0.71098600	1.41093200
Br	-3.89762500	0.10825400	-1.99225800
C	-2.30383800	-4.72074500	0.25219400
H	-2.95740500	-5.46138100	-0.21573500
H	-1.30658200	-4.80249800	-0.18590400

H	-2.24103800	-4.92028200	1.32462000
H	-0.69724800	-0.66238600	3.02295900
C	-4.29027200	-3.17259400	0.57931600
H	-4.28261000	-3.32396800	1.66224000
H	-4.68676800	-2.17386100	0.38169900
H	-4.94301500	-3.91715800	0.11546200
O	-2.90608500	-3.17703300	-1.42399100
H	-3.33641100	-2.33044900	-1.63495800
C	-0.62686100	0.68226900	1.44347800
C	-0.92556000	1.77091600	0.97325400
Si	-1.16200900	3.50430400	0.33653700
C	0.50918300	4.33948400	0.58404000
H	0.77468100	4.38103700	1.64518900
H	1.30807200	3.80478400	0.06070200
H	0.48404800	5.36646800	0.20333400
C	-1.60801700	3.41413200	-1.48549100
H	-0.78808100	2.99989600	-2.07985300
H	-2.49756900	2.79961100	-1.65330300
H	-1.81715000	4.42077200	-1.86418700
C	-2.52733800	4.29610900	1.34726000
H	-3.44905000	3.71462900	1.25299800
H	-2.26199600	4.33755900	2.40807200
H	-2.72082500	5.31762400	1.00232700
Si	5.12312400	-1.49250600	-0.51742700
C	6.43708300	-0.20075100	-0.13536600
H	7.40743800	-0.52831900	-0.52677800
H	6.20502200	0.77143300	-0.57669800
H	6.54619200	-0.06300300	0.94562400
C	5.61964500	-3.14505500	0.22824200
H	4.86428700	-3.91130700	0.02510200

H	6.57195500	-3.49534800	-0.18457900
H	5.73352400	-3.06766800	1.31445100
C	4.89318200	-1.68750800	-2.37782400
H	3.94038700	-2.17631200	-2.60440200
H	4.91563500	-0.72972400	-2.90332400
H	5.69659800	-2.30965700	-2.78858300

TS1_b_TMS

C	-0.70623200	0.21587700	1.75548200
C	-1.04890900	-1.03738300	0.90186300
C	-0.54081400	-2.20011400	1.05051700
N	0.65624300	0.11127400	2.22489300
C	1.86278500	0.85208100	1.79015900
H	1.66165400	1.91370100	1.95641700
C	0.94796000	-1.11268800	2.81384900
H	0.62566500	-1.94282700	1.96232000
H	0.25710700	-1.38555700	3.61839100
C	2.43274400	-1.14800600	3.12995600
H	2.94220600	-1.88408500	2.50962500
C	2.90096200	0.28193900	2.79463300
H	2.60874700	-1.40893000	4.17641100
H	3.90921100	0.28196300	2.38891800
H	2.89753400	0.89690500	3.69964400
C	2.33528300	0.68222400	0.30981400
C	1.29566800	1.17175400	-0.70833400
C	1.14973800	2.54855300	-0.92812800
C	0.56074600	0.28063400	-1.49060700
C	0.30035400	3.02483300	-1.91912200
H	1.72648900	3.25277800	-0.33774100
C	-0.29732000	0.75955600	-2.48687000
H	0.66944900	-0.78448000	-1.33497000

C	-0.42460800	2.12846900	-2.70725600
H	0.21915700	4.09333300	-2.09112000
H	-0.85261000	0.05234300	-3.09036800
H	-1.07174300	2.49385200	-3.49871900
C	-0.60139300	-3.68270600	0.79672100
C	3.61051500	1.51642700	0.03646400
C	4.26489100	2.32254500	0.97356300
C	4.10851500	1.50484200	-1.27594900
C	5.41603900	3.03767500	0.62792200
H	3.89096900	2.42367600	1.98403000
C	5.26124000	2.20090600	-1.62154400
H	3.56708200	0.95995400	-2.03844700
C	5.93093500	2.96593200	-0.66312700
H	5.90465200	3.65308700	1.37722400
H	5.62698300	2.16072700	-2.64308600
H	6.82870800	3.51578100	-0.92772300
O	2.56080500	-0.71310100	0.15153800
Cu	-2.56967200	-0.93660500	-0.40247900
Br	-4.30807800	-0.14080200	1.03111900
Br	-2.23474500	-2.22922600	-2.42033200
C	0.20115900	-4.44600600	1.85565200
H	0.14163500	-5.51366200	1.63407500
H	1.25002700	-4.14730400	1.83578500
H	-0.20789200	-4.26802100	2.85395600
H	-1.35430000	0.06725900	2.63326200
C	-2.07605400	-4.13823800	0.84237900
H	-2.52674100	-3.89968100	1.80891900
H	-2.66119000	-3.65870200	0.05631700
H	-2.10686600	-5.21953000	0.68354500
O	-0.00819400	-3.98847300	-0.45547100

H	-0.54462800	-3.56814900	-1.15339500
C	-1.11025300	1.49190300	1.18975600
C	-1.68508600	2.49346100	0.81425500
Si	-2.81602400	3.85239800	0.29561900
C	-4.07679000	4.06173400	1.67783400
H	-4.60004400	3.11606300	1.84840500
H	-3.59788200	4.36103000	2.61555700
H	-4.81946800	4.82418600	1.41758200
C	-1.83312500	5.44397100	0.06037100
H	-1.31454000	5.72610600	0.98236500
H	-1.08552900	5.34269800	-0.73036700
H	-2.50315200	6.26703700	-0.21155600
C	-3.66903400	3.30966100	-1.28879000
H	-2.94596900	3.12849400	-2.08753400
H	-4.21704700	2.37954500	-1.10822500
H	-4.38186000	4.06844300	-1.62992000
Si	3.78021900	-1.68540300	-0.49179500
C	5.46621600	-1.27331200	0.24263500
H	6.19379100	-2.02429200	-0.08783600
H	5.83728900	-0.29040500	-0.05382900
H	5.43732200	-1.31138700	1.33722700
C	3.81697600	-1.63786200	-2.37770400
H	4.08644300	-2.62812200	-2.76107200
H	2.83012000	-1.38780200	-2.78040900
H	4.54000300	-0.92073200	-2.77415000
C	3.29528800	-3.41527100	0.04037100
H	3.36046000	-3.54336200	1.12617700
H	2.27732200	-3.65872400	-0.27736400
H	3.97705700	-4.14527800	-0.41091700

Int2_c_TMS

C	-0.03025000	-0.72303600	-0.65419500
C	-1.08878400	-1.52032700	-1.32606500
C	-2.13094500	-2.04277300	-1.65259600
N	0.93442900	-0.05133600	-1.48199600
C	0.48256600	0.54707400	-2.73428900
H	-0.17896600	1.39749500	-2.53860800
C	2.30016400	-0.56610200	-1.55257800
H	2.29818100	-1.65666000	-1.43230600
C	2.75878600	-0.17615100	-2.97546300
H	2.64865900	-1.04484200	-3.63311700
C	1.79349400	0.94033300	-3.41368400
H	3.80544900	0.12838000	-3.01137500
H	1.69487300	1.00717400	-4.49997500
H	2.13535600	1.90703600	-3.03866000
C	-3.51676600	-2.51839600	-1.81339600
Cu	-3.14973000	-0.20100100	0.12922000
Br	-3.04766300	-1.64216300	2.08871200
Br	-3.91370700	1.54660100	-1.45491700
C	-3.71853300	-3.84956900	-1.08927200
H	-4.76014200	-4.16392000	-1.19288700
H	-3.06581700	-4.61259500	-1.52166900
H	-3.48397700	-3.73064400	-0.02983600
O	-4.36041000	-1.54604900	-1.10575900
H	-4.61743700	-0.83871000	-1.72886700
H	0.51047800	-1.37877800	0.02882700
H	-0.08138700	-0.17861000	-3.34432000
C	3.17163100	0.00492600	-0.37728400
C	4.59211000	-0.56604900	-0.35742700
C	4.96618100	-1.71302200	-1.06681400
C	5.54457700	0.03661500	0.47788400

C	6.25173900	-2.24557500	-0.94218600
H	4.26313800	-2.20681300	-1.72666400
C	6.82753900	-0.48817500	0.60189400
H	5.26661400	0.92262500	1.03767100
C	7.18671400	-1.63644600	-0.10756200
H	6.51892700	-3.13634700	-1.50269900
H	7.54583900	-0.00468100	1.25705900
H	8.18609700	-2.04971400	-0.01164600
C	3.17837100	1.53197300	-0.44317600
C	2.19333900	2.26066800	0.23238800
C	4.11091400	2.22652500	-1.22351400
C	2.13627500	3.64949100	0.12244600
H	1.48395700	1.72822100	0.85032800
C	4.04815000	3.61531000	-1.34376900
H	4.90099700	1.68366600	-1.73084900
C	3.05739700	4.33273400	-0.67288800
H	1.37343400	4.19971300	0.66508200
H	4.78047500	4.13509400	-1.95438100
H	3.01052000	5.41402400	-0.76030700
O	2.49566900	-0.35334900	0.83336800
C	-0.75185800	0.27113300	0.17111600
C	-1.38491300	1.10630800	0.81250800
Si	-1.90152200	2.55706700	1.87103400
C	-0.60858200	2.61691800	3.23836300
H	-0.81562400	3.43683800	3.93470900
H	-0.60938900	1.68021700	3.80421700
H	0.39582100	2.76455700	2.82904700
C	-1.84796200	4.06631500	0.75659700
H	-0.87016400	4.17161500	0.27799800
H	-2.60020700	3.96826800	-0.03097800

H	-2.05398200	4.97876900	1.32695000
C	-3.62200000	2.23422700	2.54081000
H	-4.34866900	2.20202900	1.72291900
H	-3.66243700	1.28112300	3.07558400
H	-3.91895300	3.03441700	3.22770500
C	-3.93921200	-2.56973600	-3.28241600
H	-3.32835000	-3.29689000	-3.82339200
H	-4.98818600	-2.86982400	-3.35345000
H	-3.80778200	-1.59215200	-3.75612000
Si	2.56795600	-1.65802500	1.89226300
C	4.16813800	-1.73140200	2.87589300
H	5.01449900	-2.06165900	2.26920100
H	4.41934700	-0.75490200	3.30131400
H	4.04784000	-2.43679100	3.70667100
C	2.34489200	-3.29879300	0.98579600
H	2.34528200	-4.11801500	1.71419300
H	1.40074800	-3.36044700	0.43435900
H	3.16482200	-3.48239400	0.28491400
C	1.12002500	-1.32402600	3.03722000
H	1.22741900	-0.33955600	3.50512800
H	0.15456100	-1.33945900	2.52155200
H	1.07592400	-2.07104800	3.83736100
TS1_c_TMS			
C	-0.45985400	0.78885100	0.04643600
C	-0.75375400	-0.70391400	-0.12977000
C	-0.00715500	-1.59006500	-0.65566500
N	0.42057700	1.19044000	-1.04723500
C	-0.22934200	1.53052600	-2.32839200
H	-0.82323600	2.43653000	-2.20578200
C	1.56920900	0.42109700	-1.28097500

H	1.15386300	-0.74875100	-1.09026500
C	1.91546700	0.57564600	-2.76973300
H	1.70835100	-0.36654900	-3.28578000
C	0.96672500	1.67992400	-3.26201800
H	2.96879600	0.80367600	-2.92914300
H	0.69585100	1.57274000	-4.31432600
H	1.43091800	2.65983400	-3.11618700
C	0.06984700	-3.03139500	-1.09104600
Cu	-2.65014600	-1.18757800	0.31715500
Br	-2.62445200	-1.26593300	2.68496100
Br	-3.56180700	-1.35036200	-1.91650200
C	1.05101500	-3.81307000	-0.21646200
H	1.06701400	-4.85727300	-0.53950600
H	2.05931600	-3.40105500	-0.28472600
H	0.71951900	-3.77144300	0.82317000
O	-1.20759700	-3.61178100	-0.85271800
H	-1.86384100	-3.18523000	-1.43474200
H	0.08120100	0.87390600	0.99062000
H	-0.90372800	0.71859500	-2.64034900
C	2.71880400	0.57567800	-0.22656500
C	3.93660000	-0.29201900	-0.55541200
C	3.81449100	-1.50386500	-1.24281300
C	5.19501100	0.05462600	-0.04522900
C	4.90788100	-2.35347500	-1.40720100
H	2.86018400	-1.80074400	-1.65317100
C	6.29049000	-0.79320400	-0.20142700
H	5.31722300	0.99537300	0.47708300
C	6.15094400	-2.00452100	-0.88010800
H	4.78367500	-3.28913400	-1.94364600
H	7.25388600	-0.50475800	0.20761700

H	7.00272300	-2.66627900	-1.00148600
C	3.05339300	2.07480700	-0.19102100
C	2.41740100	2.90508900	0.73775500
C	3.91142800	2.65500100	-1.13352800
C	2.63982600	4.28077400	0.73221400
H	1.74639100	2.46836800	1.46601100
C	4.12921100	4.03333600	-1.14561800
H	4.43480700	2.02932500	-1.84782200
C	3.49379600	4.85197600	-0.21242600
H	2.14076400	4.90688200	1.46548900
H	4.80297000	4.46296900	-1.88075300
H	3.66545200	5.92387400	-0.21825000
O	2.15447100	0.16420700	1.00230700
C	-1.70217300	1.55374600	0.08761400
C	-2.81768700	2.03415200	0.13451000
Si	-4.60398600	2.50472800	0.13886300
C	-4.82220800	4.05654000	1.18385900
H	-5.87436400	4.36126200	1.20476700
H	-4.50268600	3.88072900	2.21585500
H	-4.23780600	4.89220100	0.78571500
C	-5.10171700	2.80140100	-1.65153200
H	-4.53742900	3.62694200	-2.09711400
H	-4.91482600	1.89824300	-2.24098200
H	-6.16795900	3.04225500	-1.72492800
C	-5.53943700	1.04524700	0.86478700
H	-5.46169400	0.18041900	0.19798800
H	-5.13326000	0.75740100	1.83899500
H	-6.60153300	1.28551500	0.98715400
C	0.41496400	-3.12475700	-2.58475100
H	1.41195200	-2.72912400	-2.80039100

H	0.38588000	-4.17339400	-2.89114800
H	-0.31465600	-2.56326400	-3.17596400
Si	2.76166500	-0.39886300	2.47909600
C	4.04817100	0.77650300	3.19488800
H	5.02502900	0.66700000	2.71726500
H	3.73849400	1.82122600	3.09863900
H	4.17724000	0.56216700	4.26213500
C	1.22037600	-0.40973700	3.53980900
H	1.42604600	-0.83677800	4.52746100
H	0.83402300	0.60352800	3.69495200
H	0.41802400	-0.99775100	3.08314200
C	3.48290700	-2.12497700	2.31723000
H	3.79997000	-2.48056900	3.30462000
H	2.73553000	-2.82681000	1.93819800
H	4.35090900	-2.15611100	1.65403700

Int2_a'_TMS

C	-0.51850400	0.06072400	-1.90575600
C	-1.68326900	-0.81060800	-1.55000200
C	-2.56170100	-1.58165200	-1.16825600
N	0.77127100	-0.57834300	-1.68465200
C	1.11691800	-0.84652000	-0.27622700
H	0.42251700	-0.31161400	0.37087300
C	0.95890400	-1.80648500	-2.48947100
H	1.76122400	-1.65553900	-3.21862200
H	0.04081200	-2.02641300	-3.04862100
C	1.29171900	-2.94565300	-1.50099200
H	2.35344400	-3.18730400	-1.55007600
C	0.94444200	-2.37093900	-0.11911200
H	0.72210000	-3.85166300	-1.72824900
H	1.56011700	-2.78744700	0.67768800

H	-0.10049200	-2.56864800	0.13177800
C	2.55892900	-0.35192500	0.09275500
C	2.76544100	1.16064000	-0.12199000
C	2.63369400	1.70035200	-1.41219800
C	3.21673500	2.00878300	0.89791200
C	2.94868300	3.03241200	-1.67241100
H	2.29113800	1.05707800	-2.20966100
C	3.53829200	3.34280900	0.63799100
H	3.35382200	1.62401500	1.89978300
C	3.41142600	3.86115700	-0.64943000
H	2.83949300	3.42069900	-2.68098300
H	3.90134700	3.97079200	1.44623100
H	3.66629600	4.89677900	-0.85311300
C	2.78608100	-0.75385900	1.55386900
C	3.80571800	-1.63529000	1.91838600
C	1.92274200	-0.28006400	2.55301300
C	3.97629500	-2.01978600	3.25024700
H	4.45079500	-2.04356600	1.15237600
C	2.08647700	-0.66658500	3.88099400
H	1.11363000	0.39520100	2.29794100
C	3.11926300	-1.53634700	4.23725500
H	4.77692400	-2.70578700	3.51123600
H	1.40055700	-0.29171200	4.63441700
H	3.24790400	-1.83882300	5.27207200
O	3.43836400	-1.07410600	-0.76467900
Cu	-2.73567000	0.35294500	0.17095200
Br	-1.85029400	-0.57832100	2.19364900
Br	-4.57362000	1.62292100	-0.70047200
C	-2.73346800	-4.13659300	0.35754300
H	-3.35430500	-4.96999500	0.70398500

H	-1.91188000	-4.54925900	-0.23627600
H	-2.30805700	-3.63848900	1.23378500
C	-5.11260100	-2.13150600	0.39155600
H	-4.70418900	-1.71922600	1.31904000
H	-5.60980500	-1.32293000	-0.15155200
H	-5.86355000	-2.88421400	0.65631000
H	-0.59588800	0.30013200	-2.97474800
C	-0.68895200	1.30709500	-1.13711300
C	-0.94607400	2.28486000	-0.46532100
C	-1.23624000	3.55249800	0.25255800
C	0.02709300	4.41897900	0.25148700
H	-0.20334700	5.36970800	0.73957400
H	0.83873800	3.92063100	0.78333700
H	0.34986900	4.61471700	-0.77218400
Si	-3.75857300	-2.91849200	-0.63768100
C	-4.42985100	-3.66695400	-2.22684600
H	-4.97074700	-2.91777600	-2.81307200
H	-3.62687800	-4.07373000	-2.84918100
H	-5.12481900	-4.48202700	-1.99717400
O	-2.22426300	4.28025700	-0.46693600
H	-3.02227100	3.72814000	-0.52184300
C	-1.70285500	3.26415500	1.68813300
H	-2.64050200	2.70120400	1.68621100
H	-0.96038700	2.68290200	2.24082700
H	-1.87353900	4.21564400	2.19840000
Si	4.97714600	-0.78564100	-1.37540000
C	5.78236700	-2.48821400	-1.38077900
H	6.75564500	-2.45676700	-1.88316100
H	5.94464500	-2.87159500	-0.36833300
H	5.15621000	-3.21222300	-1.91301800

C	5.98422800	0.41340000	-0.33501800
H	5.91970400	0.16947000	0.72961500
H	7.03857200	0.35694000	-0.63035400
H	5.64906300	1.44533600	-0.46314300
C	4.86616700	-0.18545500	-3.15645600
H	4.17266500	-0.80548100	-3.73501400
H	4.52625100	0.85095300	-3.21606700
H	5.84828300	-0.24804400	-3.63914000

TS1_a'_TMS

C	-0.62577100	-0.06345500	-1.55170200
C	-1.89267500	-0.77664000	-1.02038400
C	-2.11862300	-2.03607200	-1.01976400
N	0.49040000	-0.96834100	-1.30092400
C	1.08670100	-0.96378400	0.05590500
H	0.41666500	-0.41563100	0.71605700
C	0.33994300	-2.26485000	-1.77812100
H	0.32595200	-2.37249000	-2.86543200
H	-0.86958100	-2.55242300	-1.49499800
C	1.17772500	-3.18889800	-0.91530700
H	2.19827800	-3.24585400	-1.30156400
C	1.13796300	-2.45734700	0.43657600
H	0.75951800	-4.19828800	-0.87917400
H	1.99264000	-2.68913900	1.06937600
H	0.22248400	-2.71043200	0.97756900
C	2.50998200	-0.29851600	0.12981400
C	2.63562900	1.02210600	-0.64622200
C	2.50244900	1.00270300	-2.04382300
C	3.00093200	2.22691400	-0.03857800
C	2.69962200	2.15248900	-2.80345700
H	2.25671700	0.07314200	-2.53768400

C	3.21177000	3.37842800	-0.79894000
H	3.14556600	2.27070900	1.03277100
C	3.05537700	3.35093600	-2.18294300
H	2.58289500	2.11014600	-3.88233000
H	3.50194600	4.29901300	-0.30202000
H	3.21567500	4.24838600	-2.77233900
C	2.76868600	-0.12899900	1.63209200
C	3.81890800	-0.78762000	2.27289000
C	1.89877700	0.65774100	2.40419200
C	4.01722600	-0.64597800	3.64854000
H	4.47005900	-1.43339600	1.69999500
C	2.09249000	0.79724300	3.77589200
H	1.06333000	1.16599600	1.93362600
C	3.15792100	0.14861300	4.40433500
H	4.84093600	-1.16735600	4.12715400
H	1.40302100	1.40501700	4.35337600
H	3.30804300	0.25470500	5.47429300
O	3.40892900	-1.24552900	-0.44183700
Cu	-2.95277700	0.38927700	0.22131400
Br	-2.04871400	-0.35942100	2.31830600
Br	-4.49000900	1.68658800	-1.05246600
C	-2.36405600	-4.34146200	0.90105100
H	-2.98782300	-5.14818400	1.30098800
H	-1.42972400	-4.78784800	0.54450100
H	-2.12905600	-3.65349300	1.71923600
C	-4.81284400	-2.56467100	0.16648000
H	-4.58188000	-1.98566600	1.06619000
H	-5.22731400	-1.88380800	-0.58301900
H	-5.57938800	-3.30375000	0.42468600
H	-0.75965700	0.03518600	-2.63646800

C	-0.51482000	1.26702800	-0.95695000
C	-0.71143700	2.35720100	-0.46964600
C	-1.07694000	3.68200800	0.08528100
C	0.13456200	4.61727100	0.11281200
H	-0.19155200	5.59819100	0.46844400
H	0.90780700	4.22793700	0.77785200
H	0.55392300	4.72067400	-0.88902100
Si	-3.26128700	-3.41379400	-0.46511800
C	-3.59159600	-4.51616000	-1.95397600
H	-4.08327900	-3.95761700	-2.75641400
H	-2.66411800	-4.94016400	-2.35326900
H	-4.24436300	-5.35047300	-1.67558400
O	-2.02541700	4.29433500	-0.78313700
H	-2.78804700	3.69593400	-0.86603000
C	-1.66627600	3.50634900	1.49601700
H	-2.57806500	2.90419600	1.46227100
H	-0.96125100	3.00709900	2.16626500
H	-1.91721300	4.49123900	1.89914400
Si	4.96798700	-1.12335900	-1.07285000
C	5.83873000	-2.67029100	-0.44400400
H	6.81578600	-2.78508600	-0.92644600
H	6.00622300	-2.64504900	0.63730400
H	5.25026300	-3.56649500	-0.66760400
C	5.88409400	0.42267900	-0.52573300
H	5.79788400	0.58096700	0.55314700
H	6.94842400	0.31734200	-0.76675800
H	5.50761900	1.31714700	-1.02735800
C	4.89434100	-1.22105900	-2.95158000
H	4.23621800	-2.03408300	-3.27764100
H	4.53084300	-0.29043200	-3.39358400

H	5.89201400	-1.42109800	-3.35867000
Int2_b'_TMS			
C	-0.14521800	-0.04395300	0.20544100
H	0.39516100	-0.29600600	1.12460200
C	-1.17516800	0.95546400	0.54715800
C	-2.11146700	1.69962900	0.81152200
N	0.81181500	0.48921900	-0.74770600
C	1.97708500	-0.36688900	-1.01740700
H	1.75228300	-1.41168500	-0.77205400
C	0.25240900	1.00954000	-2.00443400
H	-0.19497800	1.99322900	-1.84110500
H	-0.54034600	0.34733900	-2.38957300
C	1.45111600	1.02601900	-2.94949000
H	2.05675800	1.91955800	-2.78130000
C	2.21942400	-0.23757600	-2.53523000
H	1.14278600	1.01101600	-3.99759200
H	3.28248500	-0.20482900	-2.77360900
H	1.79336400	-1.11330800	-3.03492700
C	3.22912800	0.02507700	-0.14916000
C	3.65679400	1.44568100	-0.51963000
C	2.87225600	2.55818100	-0.17245900
C	4.78688100	1.65746700	-1.31566600
C	3.22288200	3.83921100	-0.59507000
H	1.97144000	2.41502700	0.40898000
C	5.13907500	2.93988200	-1.74053300
H	5.38083800	0.80771100	-1.62443600
C	4.35997800	4.03772400	-1.38042500
H	2.60088100	4.68370000	-0.31322300
H	6.02104600	3.07546500	-2.35949300
H	4.63129200	5.03598400	-1.71018800

C	2.92267800	-0.17736900	1.34494300
C	3.14418600	0.79782900	2.32279700
C	2.44883300	-1.43275100	1.76327400
C	2.86930800	0.54121700	3.66835300
H	3.54547700	1.76225800	2.04019400
C	2.16759800	-1.69088300	3.10306200
H	2.30890400	-2.22336500	1.03464700
C	2.37116100	-0.69828600	4.06419500
H	3.04937200	1.31701800	4.40645500
H	1.79235500	-2.66697800	3.39469300
H	2.15062700	-0.89413800	5.10883000
O	4.21459700	-0.92139300	-0.55191300
C	-0.86148500	-1.27734900	-0.23624000
C	-1.46891200	-2.28298200	-0.55147500
C	-2.17151700	-3.56322300	-0.82355900
Si	-3.43082600	2.90389900	1.35694000
Cu	-3.12265400	-0.22900800	-0.29234300
Br	-3.37535500	0.47326100	-2.56549600
Br	-4.31532000	-1.20592400	1.55561300
C	-4.96136200	2.62703500	0.30948300
H	-4.73732600	2.69938100	-0.75827600
H	-5.38858700	1.63796900	0.50108100
H	-5.72139500	3.37678200	0.55654800
C	-2.70497600	4.61881600	1.08426700
H	-1.78152700	4.75713700	1.65498200
H	-2.48031500	4.78418800	0.02598300
H	-3.41718500	5.38820900	1.40186700
C	-3.34829500	-3.34137600	-1.78661800
H	-3.81928100	-4.30637300	-1.99120400
H	-4.09366600	-2.68108400	-1.33507800

H	-3.01922800	-2.88799500	-2.72487900
C	-1.16391300	-4.56533600	-1.40251200
H	-0.76644500	-4.20855500	-2.35580300
H	-0.34002000	-4.71765300	-0.70187400
H	-1.67219600	-5.52017500	-1.55871700
O	-2.61657900	-4.11700300	0.40785200
H	-3.22358300	-3.47895900	0.82128900
C	-3.75204300	2.53596000	3.16886400
H	-2.84898600	2.67067400	3.77207200
H	-4.52903300	3.19890700	3.56498700
H	-4.09151600	1.50202100	3.28256500
Si	5.64123600	-1.43430400	0.18786500
C	5.34990400	-3.05162700	1.10267300
H	4.75142300	-2.90526500	2.00545500
H	4.83087600	-3.77494100	0.46479700
H	6.30672400	-3.49656600	1.39925600
C	6.36519200	-0.15091600	1.35656400
H	7.37767900	-0.45523900	1.64668700
H	6.43112500	0.83395700	0.88563300
H	5.76968900	-0.05100700	2.26734200
C	6.80623700	-1.74718200	-1.25467200
H	7.07788500	-0.81977800	-1.76924800
H	7.73325200	-2.21972900	-0.91160900
H	6.34327400	-2.41339200	-1.98986800
TS1_b'_TMS			
C	0.69178600	-0.92083600	1.05267600
H	0.25771300	-1.64521700	0.36799400
C	1.18104300	0.34229200	0.29966600
C	1.25530400	1.52172100	0.81034000
N	-0.31273200	-0.49166700	1.99573100

C	-1.74606200	-0.83581000	1.95792600
H	-1.82168100	-1.91997600	2.06235700
C	-0.00501200	0.57461300	2.81565300
H	0.49590100	1.43763200	2.00238600
H	0.88185400	0.43701400	3.44002400
C	-1.30044900	1.05632100	3.45491700
H	-1.66884200	1.94648900	2.93899500
C	-2.25378500	-0.13949300	3.23663800
H	-1.16719200	1.30549800	4.50981500
H	-3.29807000	0.15460400	3.15129800
H	-2.16583500	-0.83713200	4.07446500
C	-2.60977300	-0.51529300	0.66857400
C	-2.89433000	0.98759100	0.56976200
C	-1.94499000	1.90812100	0.10712500
C	-4.11698000	1.48808500	1.04008000
C	-2.22346200	3.27501700	0.08057500
H	-0.98028900	1.58068900	-0.24461300
C	-4.39080200	2.85533800	1.03182200
H	-4.85562600	0.79893700	1.42556400
C	-3.44613500	3.75804400	0.54453000
H	-1.47914500	3.95405100	-0.31877900
H	-5.34738400	3.21089000	1.40326000
H	-3.66146500	4.82196400	0.52216600
C	-1.96252900	-1.16575800	-0.56633000
C	-1.72032200	-2.55107100	-0.51384600
C	-1.59809300	-0.48428800	-1.73125800
C	-1.07832900	-3.21583600	-1.55520100
H	-2.03501900	-3.11574200	0.35643000
C	-0.95300600	-1.14923700	-2.78054600
H	-1.80369300	0.56941200	-1.84598800

C	-0.67263600	-2.51060100	-2.69056200
H	-0.88496400	-4.28082400	-1.47496000
H	-0.66456500	-0.58316900	-3.65971100
H	-0.14520100	-3.01629500	-3.49199900
O	-3.81456400	-1.21529200	0.98065500
C	1.89096200	-1.48733300	1.66933300
C	2.98657300	-1.89827900	1.97126000
C	4.37412700	-2.37666000	2.13662400
Si	2.25030200	3.11326200	0.87010000
Cu	1.70098700	0.17442900	-1.61933500
Br	3.12500400	-1.74138700	-1.76125800
Br	0.84383800	2.11889500	-2.75724200
C	3.74736000	2.86528800	-0.23459600
H	4.28557000	1.95299500	0.04072100
H	3.43871200	2.78311100	-1.28038300
H	4.43635700	3.71250200	-0.14487300
C	2.74973100	3.25566700	2.68451800
H	1.87466500	3.35673200	3.33564400
H	3.31746200	2.37729200	3.00827300
H	3.38065000	4.13739400	2.83946500
C	5.33083600	-1.18823600	1.91995100
H	6.36314100	-1.54026400	1.99918500
H	5.17755600	-0.76414600	0.92339100
H	5.16172100	-0.40226600	2.66292500
C	4.58431600	-3.02334700	3.50865400
H	4.40973200	-2.30081900	4.31025500
H	3.90206000	-3.86720000	3.63205500
H	5.61178100	-3.39086400	3.57560300
O	4.63271900	-3.39761500	1.17518900
C	1.20518500	4.57957400	0.34667000

H	0.32403600	4.69331600	0.98489900
H	1.79108000	5.50314700	0.40996800
H	0.87698000	4.45119900	-0.68860600
H	4.37220100	-3.05086100	0.30576800
Si	-5.09019600	-1.67656700	-0.03454100
C	-4.94390600	-3.50447000	-0.45101500
H	-4.12325700	-3.69999400	-1.14572100
H	-4.77544700	-4.10214400	0.45122700
H	-5.87148600	-3.85906900	-0.91492500
C	-6.62827000	-1.41828500	1.01700500
H	-6.52549100	-1.91560900	1.98709400
H	-6.82691200	-0.35793100	1.20217100
H	-7.50985000	-1.83747700	0.51958900
C	-5.17218300	-0.65088100	-1.60603200
H	-4.32500200	-0.85291500	-2.26614500
H	-6.09061200	-0.89772900	-2.15134300
H	-5.18482500	0.42098800	-1.39090500

Int2_c'_TMS

C	-0.12397700	-0.51091400	1.91738500
H	-0.56855600	-0.91788000	2.83656100
C	-0.86464500	0.74227100	1.62263600
C	-1.51114600	1.73171000	1.30129900
N	1.29831700	-0.36792300	2.16128800
C	1.70733900	-0.57161600	3.55846100
H	1.63403100	-1.63219700	3.82487600
C	2.07328500	0.71000700	1.53334200
H	1.43003500	1.55728900	1.27978200
C	3.07808800	1.14078800	2.62341200
H	2.68486000	2.02449000	3.13688900
C	3.13861900	-0.04502600	3.59572500

H	4.04414100	1.40988000	2.19791000
H	3.44446300	0.24505500	4.60423100
H	3.83076800	-0.80711900	3.23127500
C	-0.49375700	-1.47496700	0.84648300
C	-0.93985000	-2.26674400	0.03584800
C	-1.42873700	-3.37531900	-0.83137600
Si	-2.44495500	3.29370900	0.90083500
Cu	-2.33763500	-0.15678100	-0.01437200
Br	-3.80329100	0.01631100	-1.89538600
Br	-4.16014400	-0.86079300	1.50054800
C	-4.26569900	2.97892100	1.20810200
H	-4.64029100	2.19705400	0.54186400
H	-4.44692400	2.65262500	2.23590700
H	-4.84134500	3.89368600	1.02768400
C	-2.11988200	3.70014100	-0.90539000
H	-2.55798700	4.67261300	-1.15541400
H	-1.04991500	3.74701200	-1.13097400
H	-2.58370300	2.94906400	-1.55179900
C	-0.28166500	-4.37781200	-1.01984700
H	-0.62501400	-5.17976900	-1.67832400
H	0.57714400	-3.88487000	-1.47819900
H	0.01997500	-4.80438400	-0.06013500
C	-2.64482500	-4.03565000	-0.16020200
H	-2.38865800	-4.42228000	0.83018500
H	-3.45704900	-3.31479800	-0.04104500
H	-2.98434700	-4.86032500	-0.79264100
O	-1.76669900	-2.92263400	-2.13487400
H	-2.48670600	-2.27321100	-2.06908300
C	-1.74173300	4.61797900	2.03969100
H	-0.66888300	4.75723100	1.87341400

H	-2.23848400	5.57733800	1.85827300
H	-1.89166400	4.35401000	3.09103900
H	1.06702400	-0.00216300	4.25458400
C	2.78094400	0.28685700	0.19136300
C	1.74919300	-0.00206900	-0.90673700
C	1.82831600	-1.11056200	-1.75805800
C	0.73187000	0.93275900	-1.14132500
C	0.88744200	-1.31020700	-2.76803000
H	2.62788900	-1.82903800	-1.62959400
C	-0.21637400	0.73406100	-2.14464800
H	0.68432000	1.83732200	-0.55037400
C	-0.15171100	-0.40170900	-2.95254000
H	0.95326300	-2.18943800	-3.39973100
H	-0.99418600	1.47030600	-2.30592400
H	-0.90640200	-0.57540300	-3.71060600
C	3.72113600	-0.87942500	0.48254300
C	5.09927700	-0.67094300	0.59149000
C	3.21543800	-2.15939400	0.76359300
C	5.95564500	-1.70897400	0.96414700
H	5.49850000	0.31745600	0.40372500
C	4.06919900	-3.19628500	1.13509700
H	2.15027700	-2.33911500	0.69959500
C	5.44439000	-2.97629900	1.23877800
H	7.02253400	-1.52186800	1.04321100
H	3.65753600	-4.17918900	1.34536900
H	6.10835700	-3.78493300	1.52912500
O	3.51904600	1.45583700	-0.16494900
Si	4.14057500	1.98004500	-1.64053000
C	4.68303500	0.56922100	-2.76024100
H	5.26998800	0.97247800	-3.59381100

H	5.30646200	-0.15419400	-2.22713100
H	3.82742800	0.03407600	-3.17927900
C	5.62386100	3.01603800	-1.12808800
H	6.39764100	2.40327900	-0.65381100
H	6.07608400	3.51203800	-1.99393500
H	5.32875800	3.79146200	-0.41369500
C	2.89924100	3.07272000	-2.53796900
H	2.06350100	2.49385200	-2.93875700
H	2.49147000	3.83595900	-1.86644600
H	3.38567900	3.59002800	-3.37303700

TS1_c'_TMS

C	0.72928300	0.38598100	1.57154600
H	1.35949100	0.44066000	2.46494400
C	1.28245800	-0.72602800	0.68584000
C	0.62623800	-1.65043700	0.08557500
N	-0.59624400	-0.02946400	2.05184800
C	-0.53330100	-0.66093300	3.39326900
H	-0.34268800	0.11145300	4.14320600
C	-1.46628200	-0.74829500	1.22657100
H	-0.68907100	-1.38447500	0.44532200
C	-2.14358000	-1.82244800	2.09244000
H	-1.64240200	-2.77937900	1.91771400
C	-1.88929900	-1.34223800	3.52623500
H	-3.19391500	-1.94892200	1.83995900
H	-1.87800700	-2.15478300	4.25594800
H	-2.65107500	-0.61498700	3.82022200
C	0.87506000	1.66306000	0.87399900
C	1.34309600	2.62835000	0.31323200
C	2.01827300	3.75628500	-0.36248300
Si	0.73033800	-3.14825700	-1.04440600

Cu	3.22946300	-0.50340600	0.29455600
Br	3.52276200	0.25273400	-1.95157400
Br	3.98915500	-1.08645100	2.47996000
C	2.30120100	-4.04415300	-0.52952500
H	3.17754200	-3.42495700	-0.74777600
H	2.30550800	-4.26512600	0.54152600
H	2.40977300	-4.98491800	-1.08043500
C	0.84881200	-2.57891700	-2.82954100
H	1.06244300	-3.43814400	-3.47561000
H	-0.07445000	-2.11676400	-3.18651100
H	1.66390600	-1.85714000	-2.93959400
C	1.21755700	5.05084800	-0.18768600
H	1.72697500	5.85575400	-0.72422800
H	0.21546200	4.92801200	-0.60131800
H	1.13847600	5.31742900	0.86924800
C	3.43418800	3.89153500	0.23304300
H	3.39663200	4.09009200	1.30809300
H	4.00037400	2.97037000	0.06898500
H	3.95130700	4.71429600	-0.26835600
O	2.10600600	3.53298400	-1.76720200
H	2.52086300	2.66369900	-1.90324500
C	-0.83348600	-4.14699200	-0.72716400
H	-1.71697100	-3.50499800	-0.80633300
H	-0.93462900	-4.95929300	-1.45434000
H	-0.82734300	-4.59273700	0.27286300
H	0.29053000	-1.38864000	3.42757100
C	-2.44570700	0.00496700	0.25460700
C	-1.79220400	0.98952900	-0.71841800
C	-2.15597800	2.33764800	-0.80269800
C	-0.87830900	0.49343300	-1.65813300

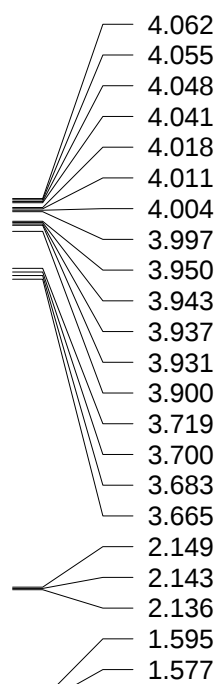
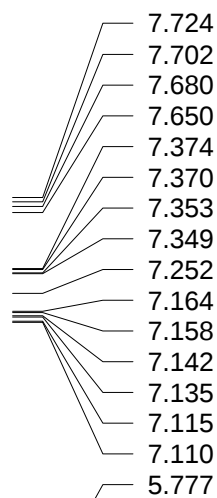
C	-1.58889300	3.16744900	-1.76969900
H	-2.89666200	2.74735000	-0.12948700
C	-0.29687400	1.32104200	-2.61135900
H	-0.61821700	-0.55211300	-1.65021300
C	-0.64391000	2.67050400	-2.66541200
H	-1.89038100	4.20944500	-1.81956600
H	0.44018500	0.91295500	-3.29471000
H	-0.17383500	3.32718200	-3.38747800
C	-3.45598100	0.66845200	1.20622400
C	-4.76470000	0.19120100	1.30862100
C	-3.05452500	1.71540700	2.05136800
C	-5.66546600	0.76163700	2.21079400
H	-5.07591800	-0.64184600	0.69345000
C	-3.95302400	2.28685300	2.94920900
H	-2.03423600	2.07724000	2.00667100
C	-5.26487100	1.81317500	3.03226600
H	-6.67865100	0.37595900	2.27150200
H	-3.62586200	3.10145600	3.58819700
H	-5.96327200	2.25696800	3.73499600
O	-3.04541300	-1.05918400	-0.47197500
Si	-3.97133700	-1.06286500	-1.89156100
C	-4.74993100	0.60318900	-2.27086500
H	-5.49444400	0.47881300	-3.06596100
H	-5.25666000	1.02679200	-1.39929200
H	-4.00548100	1.32625700	-2.61187900
C	-2.92443300	-1.63916000	-3.34101900
H	-2.18164900	-0.88974400	-3.62462900
H	-2.40281400	-2.57250400	-3.10703100
H	-3.56353300	-1.82712400	-4.21134200
C	-5.28714800	-2.36572100	-1.55537200

H	-4.82808400	-3.30133600	-1.21903800
H	-6.00278900	-2.05074900	-0.78931500
H	-5.85459800	-2.58245600	-2.46715100

References

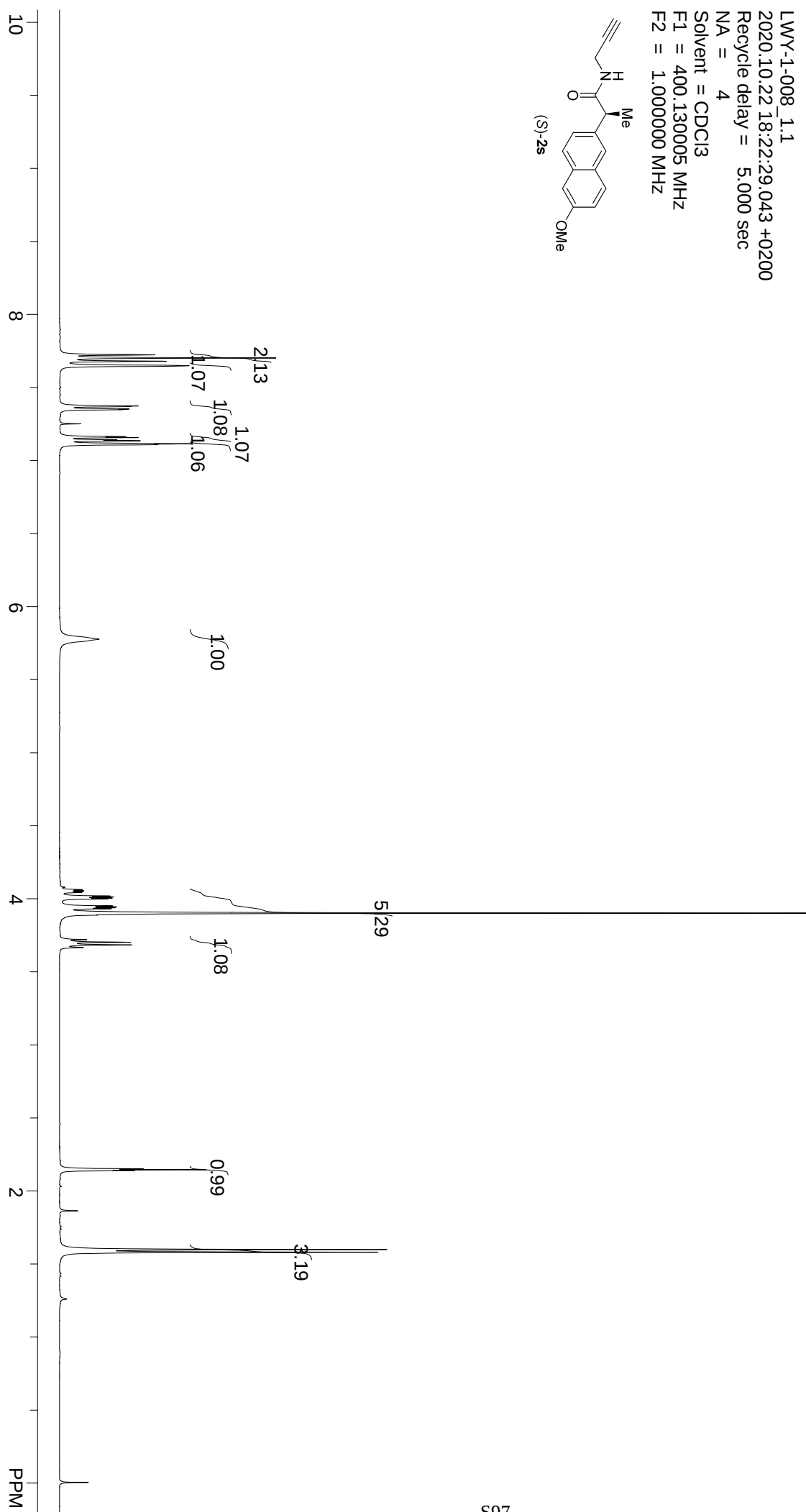
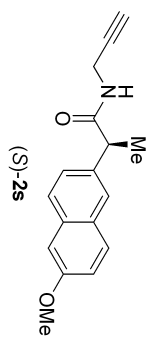
1. Wu, G.; Yao, Y.; Li, G.; Zhang, X.; Qian, H.; Ma, S., Enantioselective Allenation of Terminal Alkynes Catalyzed by Copper Halides of Mixed Oxidation States and Its Application to the Total Synthesis of Scorodinin. *Angew. Chem. Int. Ed.* **2022**, *61*, e202112427.
2. Kramm, F.; Teske, J.; Ullwer, F.; Frey, W.; Plietker, B., Annelated Cyclobutanes by Fe-Catalyzed Cycloisomerization of Enyne Acetates. *Angew. Chem. Int. Ed.* **2018**, *57*, 13335-13338.
3. García-Domínguez, P.; Lepore, I.; Erb, C.; Gronemeyer, H.; Altucci, L.; Álvarez, R.; de Lera, Á. R., Total synthesis of the proposed structures of the DNA methyl transferase inhibitors peyssonenyne, and structural revision of peyssonenyne B. *Org. Biomol. Chem.* **2011**, *9*, 6979-6987.
4. Kou, Q.; Wang, T.; Zou, F.; Zhang, S.; Chen, Q.; Yang, Y., Design, synthesis and biological evaluation of C(4) substituted monobactams as antibacterial agents against multidrug-resistant Gram-negative bacteria. *Eur. J. Med. Chem.* **2018**, *151*, 98-109.
5. Kuroda, H.; Hanaki, E.; Izawa, H.; Kano, M.; Itahashi, H., A convenient method for the preparation of α -vinylfurans by phosphine-initiated reactions of various substituted enynes bearing a carbonyl group with aldehydes. *Tetrahedron* **2004**, *60*, 1913-1920.
6. Romanov-Michailidis, F.; Besnard, C.; Alexakis, A., N-Heterocyclic Carbene-Catalyzed Annulation of α -Cyano-1,4-diketones with Ynals. *Org. Lett.* **2012**, *14*, 4906-4909.
7. Ma, S.; Liu, J.; Li, S.; Chen, B.; Cheng, J.; Kuang, J.; Liu, Y.; Wan, B.; Wang, Y.; Ye, J.; Yu, Q.; Yuan, W.; Yu, S., Development of a General and Practical Iron Nitrate/TEMPO-Catalyzed Aerobic Oxidation of Alcohols to Aldehydes/Ketones: Catalysis with Table Salt. *Adv. Synth. Catal.* **2011**, *353*, 1005-1017.
8. Hack, D.; Chauhan, P.; Deckers, K.; Hermann, G. N.; Mertens, L.; Raabe, G.; Enders, D., Combining Silver Catalysis and Organocatalysis: A Sequential Michael Addition/Hydroalkoxylation One-Pot Approach to Annulated Coumarins. *Org. Lett.* **2014**, *16*, 5188-5191.
9. McKerrow, J.; Dandapani, S.; Edwankar, R.; Tan, D. S.; Foley, C. N.; Moura-Letts, G.; Verano, A.; Chakrabarti, D.; Roberts, B. Anti-parasitic Compounds and Uses Thereof. WO 2017124087, 2017.
10. Solorio-Alvarado, C. R.; Echavarren, A. M., Gold-catalyzed annulation/fragmentation: formation of free gold carbenes by retro-cyclopropanation. *J. Am. Chem. Soc.* **2010**, *132*, 11881-11883.
11. Frisch, M. J.; Trucks, G. W.; Schlegel, H. B.; Scuseria, G. E.; Robb, M. A.; Cheeseman, J. R.; Scalmani, G.; Barone, V.; Petersson, G. A.; Nakatsuji, H.; Li, X.; Caricato, M.; Marenich, A. V.; Bloino, J.; Janesko, B. G.; Gomperts, R.; Mennucci, B.; Hratchian, H. P.; Ortiz, J. V.; Izmaylov, A. F.; Sonnenberg, J. L.; Williams; Ding,

- F.; Lipparini, F.; Egidi, F.; Goings, J.; Peng, B.; Petrone, A.; Henderson, T.; Ranasinghe, D.; Zakrzewski, V. G.; Gao, J.; Rega, N.; Zheng, G.; Liang, W.; Hada, M.; Ehara, M.; Toyota, K.; Fukuda, R.; Hasegawa, J.; Ishida, M.; Nakajima, T.; Honda, Y.; Kitao, O.; Nakai, H.; Vreven, T.; Throssell, K.; Montgomery Jr., J. A.; Peralta, J. E.; Ogliaro, F.; Bearpark, M. J.; Heyd, J. J.; Brothers, E. N.; Kudin, K. N.; Staroverov, V. N.; Keith, T. A.; Kobayashi, R.; Normand, J.; Raghavachari, K.; Rendell, A. P.; Burant, J. C.; Iyengar, S. S.; Tomasi, J.; Cossi, M.; Millam, J. M.; Klene, M.; Adamo, C.; Cammi, R.; Ochterski, J. W.; Martin, R. L.; Morokuma, K.; Farkas, O.; Foresman, J. B.; Fox, D. J. Gaussian 16 Rev. A.03, Wallingford, CT, 2016.
12. Hariharan, P. C.; Pople, J. A., The influence of polarization functions on molecular orbital hydrogenation energies. *Theor. Chim. Acta* **1973**, *28*, 213-222.
 13. Grimme, S.; Antony, J.; Ehrlich, S.; Krieg, H., A consistent and accurate ab initio parametrization of density functional dispersion correction (DFT-D) for the 94 elements H-Pu. *J. Chem. Phys.* **2010**, *132*, 154104.
 14. Grimme, S.; Ehrlich, S.; Goerigk, L., Effect of the damping function in dispersion corrected density functional theory. *J. Chem. Phys.* **2011**, *32*, 1456-1465.
 15. Hay, P. J.; Wadt, W. R., Ab initio effective core potentials for molecular calculations. Potentials for the transition metal atoms Sc to Hg. *J. Chem. Phys.* **1985**, *82*, 270-283.
 16. Wadt, W. R.; Hay, P. J., Ab initio effective core potentials for molecular calculations. Potentials for main group elements Na to Bi. *J. Chem. Phys.* **1985**, *82*, 284-298.
 17. Hay, P. J.; Wadt, W. R., Ab initio effective core potentials for molecular calculations. Potentials for K to Au including the outermost core orbitals. *J. Chem. Phys.* **1985**, *82*, 299-310.
 18. Schwerdtfeger, P., The Pseudopotential Approximation in Electronic Structure Theory. *ChemPhysChem* **2011**, *12*, 3143-3155.
 19. 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. *J. Phys. Chem. B* **2009**, *113*, 6378-6396.
 20. Fukui, K., The path of chemical reactions - the IRC approach. *Acc. Chem. Res.* **1981**, *14*, 363-368.
 21. Gonzalez, C.; Schlegel, H. B., An improved algorithm for reaction path following. *J. Chem. Phys.* **1989**, *90*, 2154-2161.
 22. Gonzalez, C.; Schlegel, H. B., Reaction path following in mass-weighted internal coordinates. *J. Phys. Chem.* **1990**, *94*, 5523-5527.
 23. Andrae, D. H., U.; Dolg, M.; Stoll H.; Preuß, H., Energy-adjusted ab initio pseudopotentials for the second and third row transition elements. *Theor. Chim. Acta* **1990**, *77*, 123.

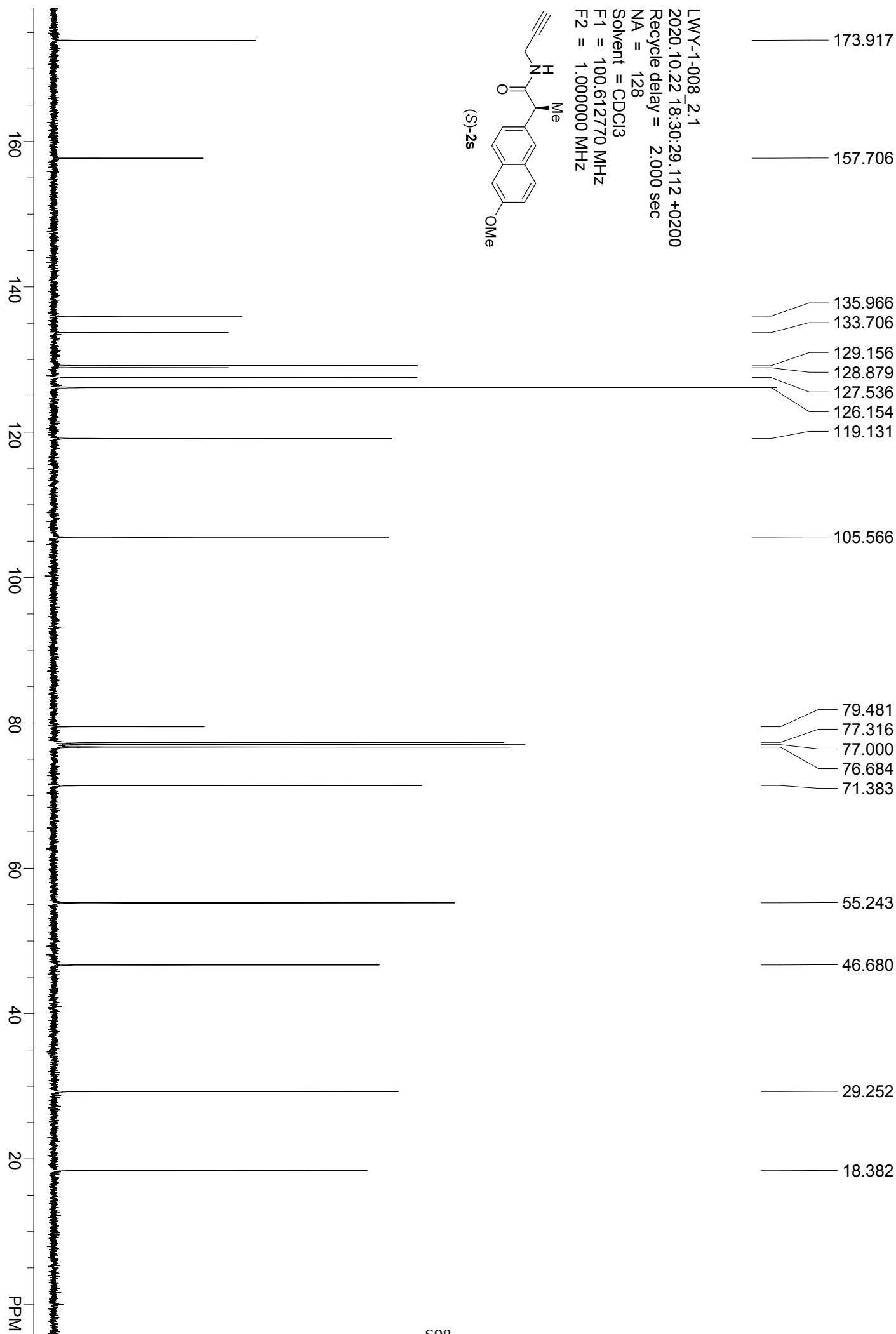
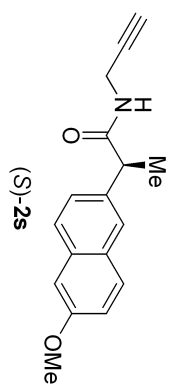


0.000

LWY-1-008_1.1
2020.10.22 18:22:29.043 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl₃
F1 = 400.130005 MHz
F2 = 1.000000 MHz



LWY-1-008_2.1
2020.10.22 18:30:29.112 +0200
Recycle delay = 2.000 sec
NA = 128
Solvent = CDCl₃
F1 = 100.612770 MHz
F2 = 1.000000 MHz



41. 9.420

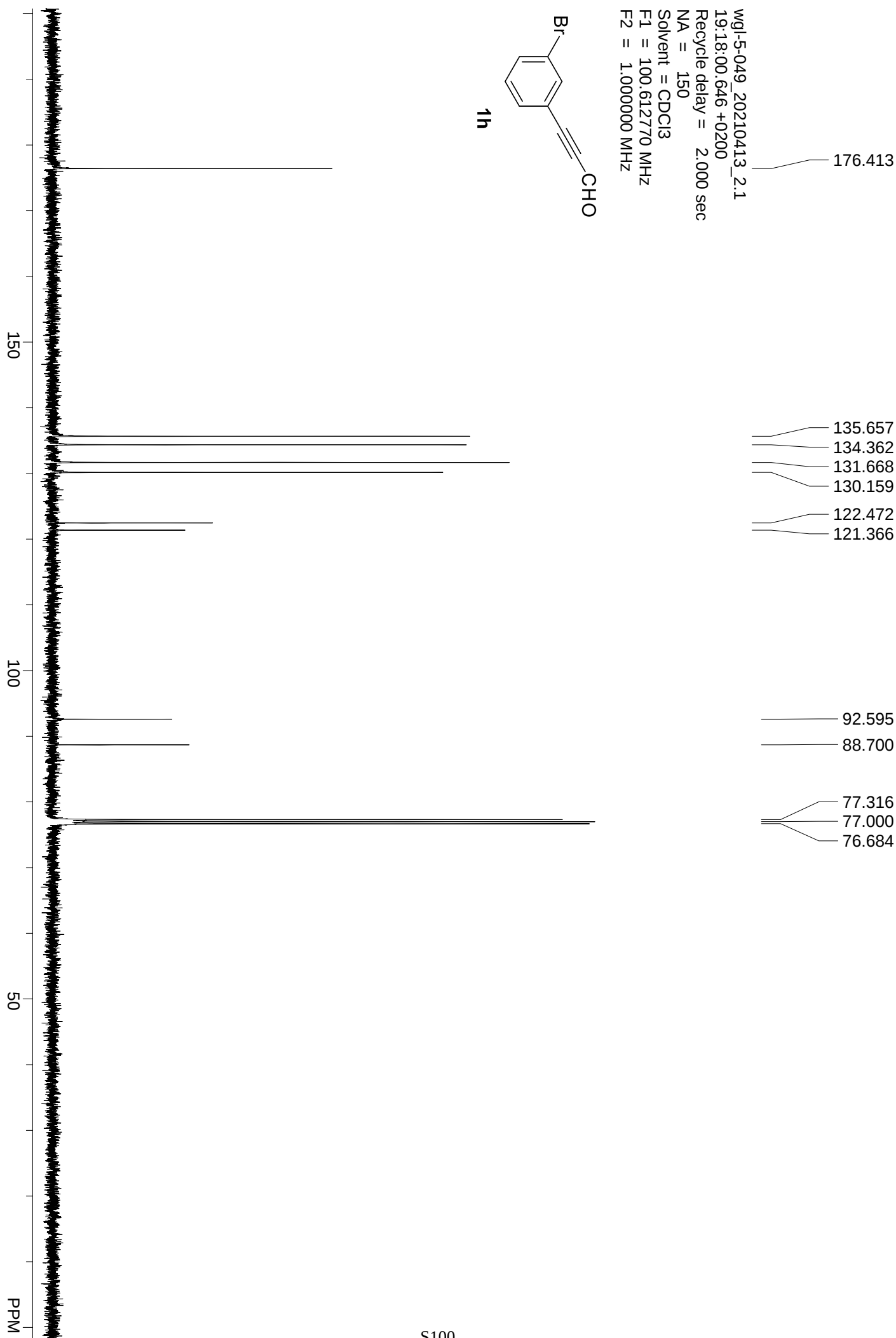
_____ -0.000

wgl-5-049_20210413_1.1

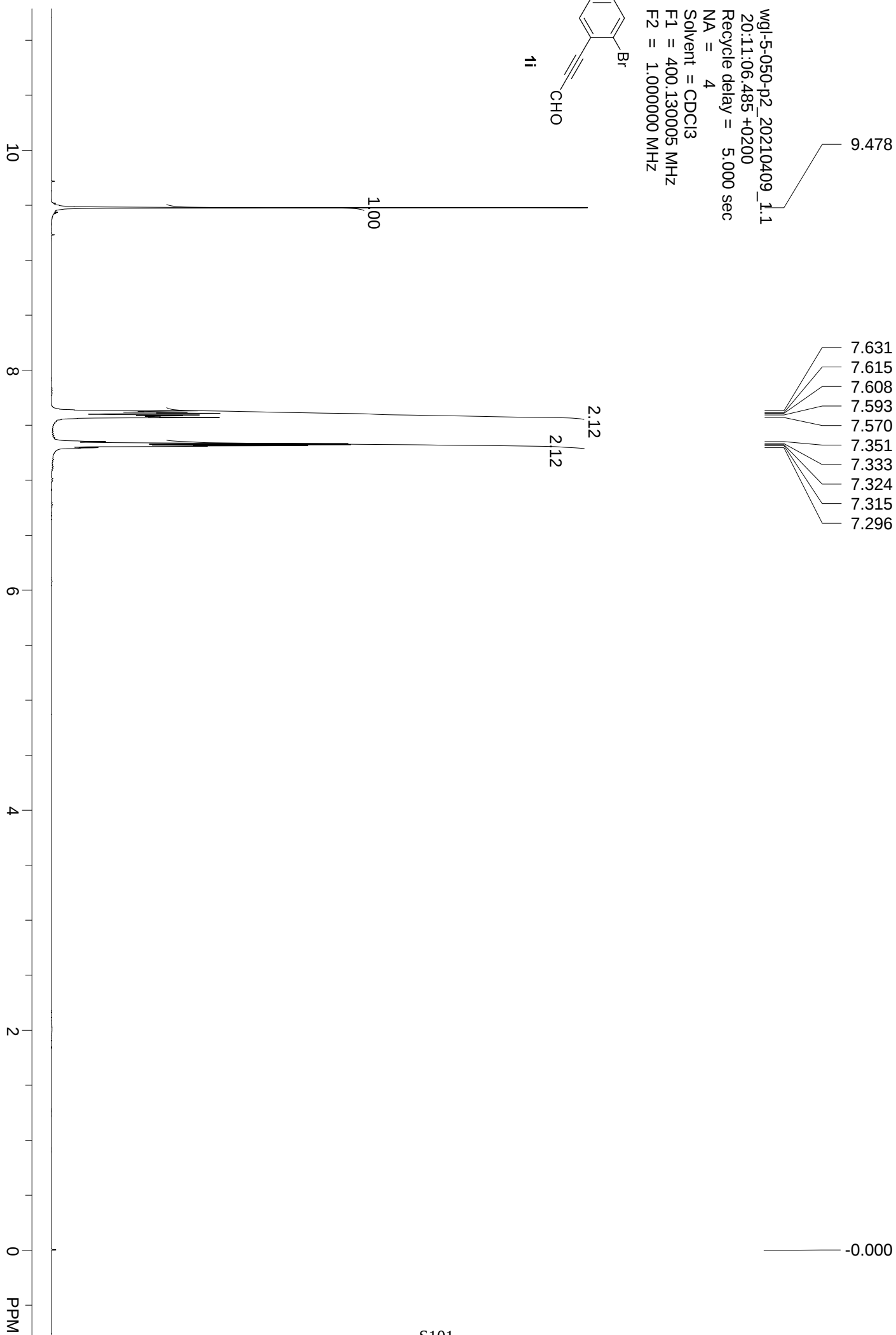
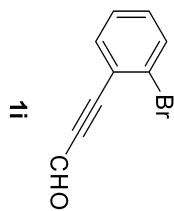


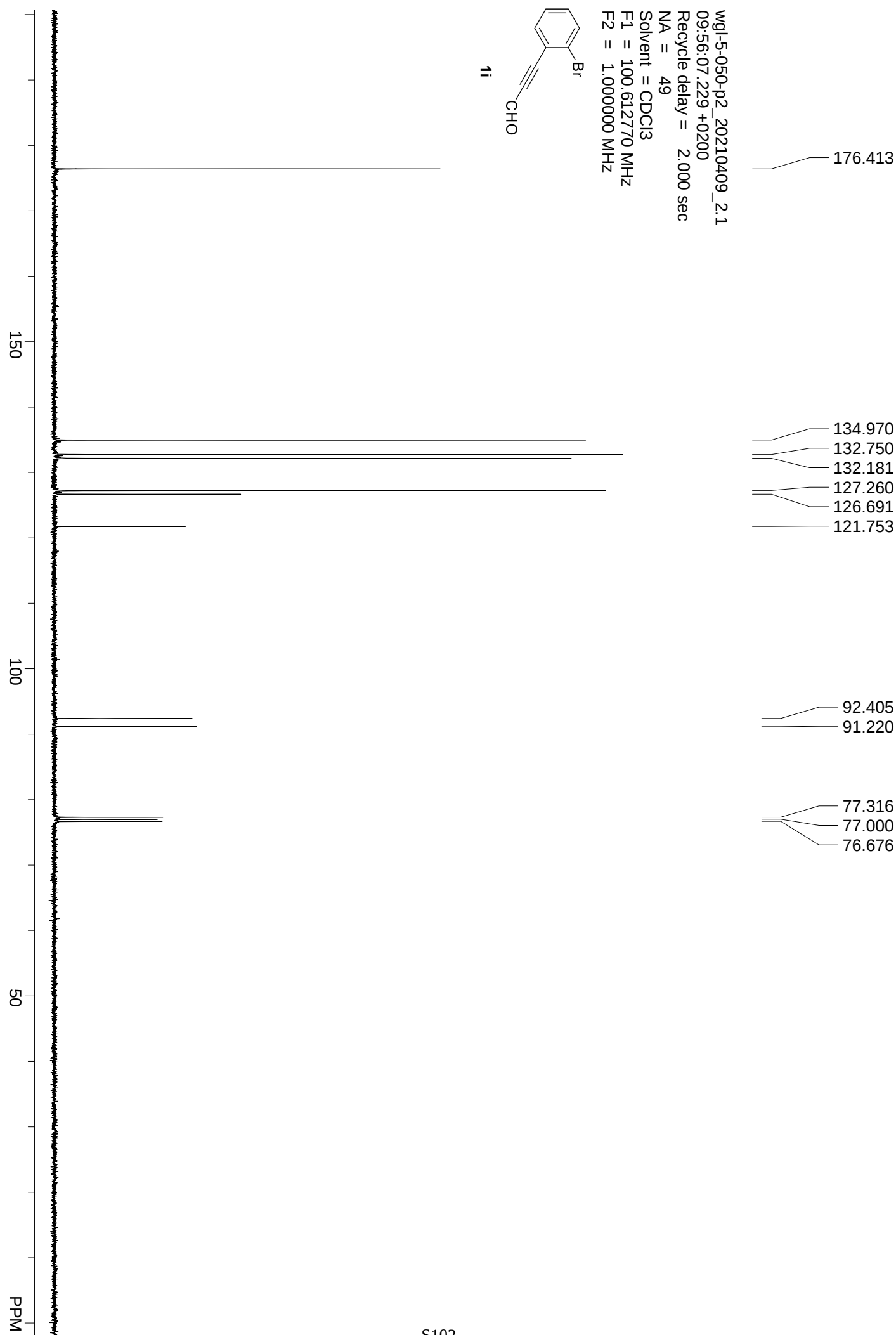
1.00 0.16
1.00

1.00

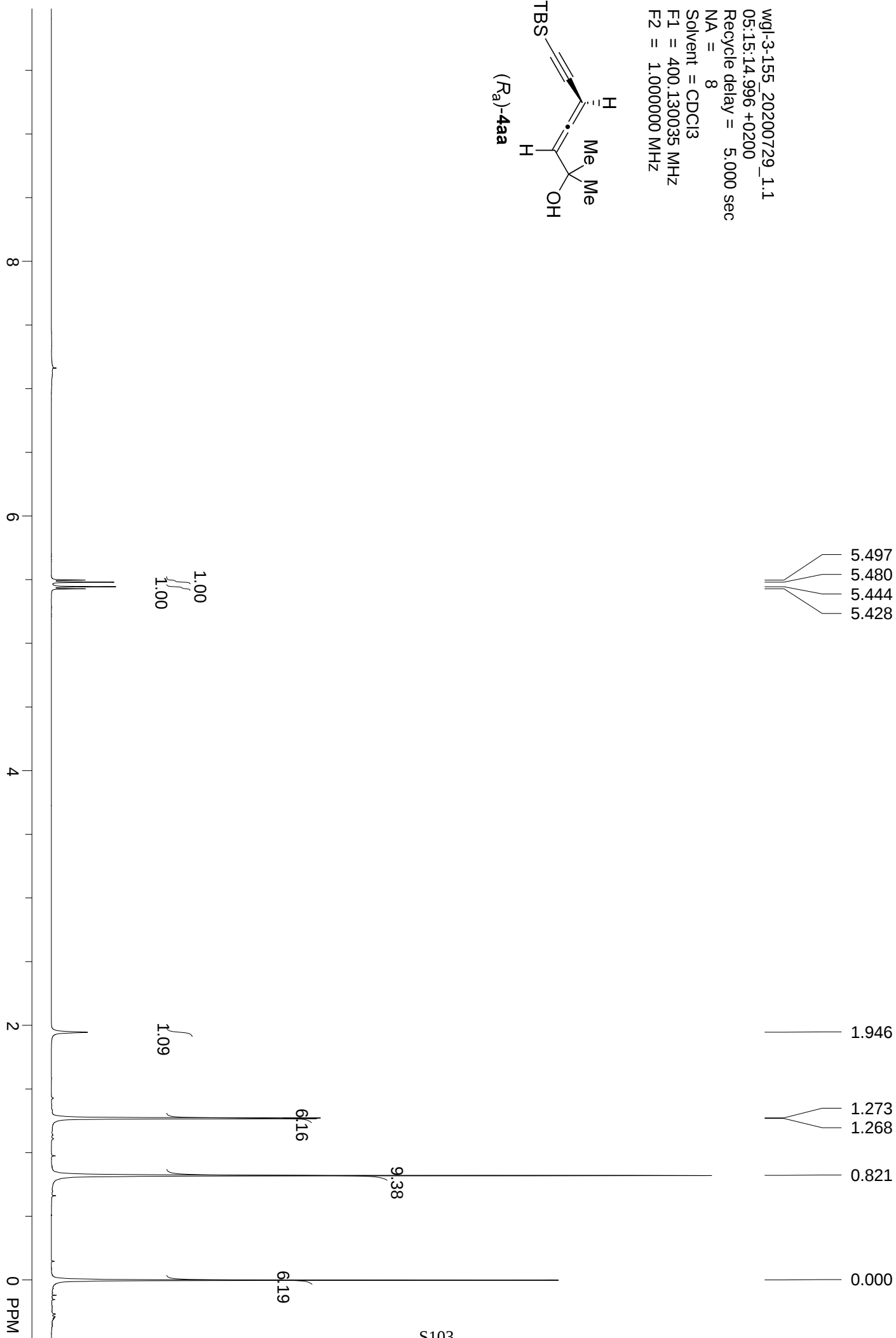
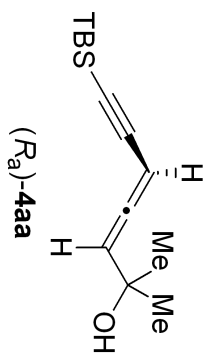


wjl-5-050-p2_20210409_1.1
20:11:06.485 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl3
F1 = 400.130005 MHz
F2 = 1.000000 MHz





wjl-3-155_20200729_1.1
05:15:14.996 +0200
Recycle delay = 5.000 sec
NA = 8
Solvent = CDCl₃
F1 = 400.130035 MHz
F2 = 1.000000 MHz



210.044

102.872
97.816
94.364

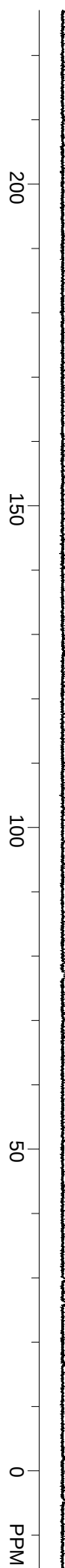
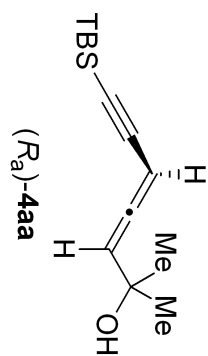
78.991
77.324
77.000
76.684
70.032

29.774
29.711
26.037

16.597

-4.702

wjl-3-155_20200729_2.1
05:24:23.894 +0200
Recycle delay = 2.000 sec
NA = 150
Solvent = CDCl₃
F1 = 100.612770 MHz
F2 = 1.000000 MHz

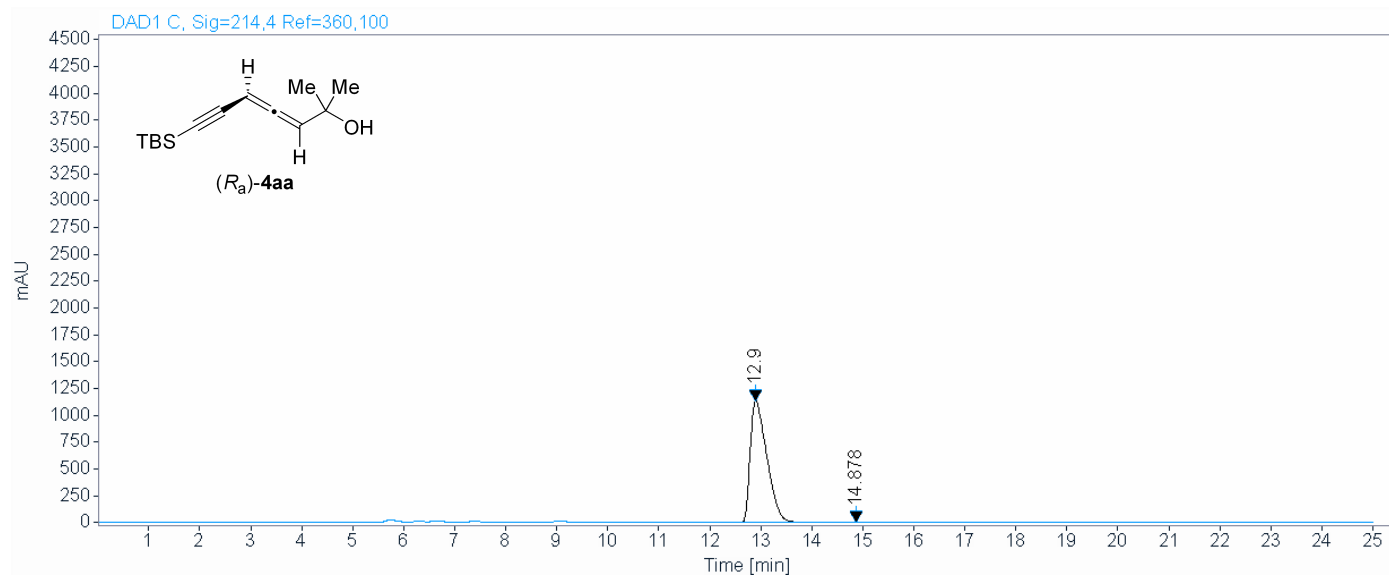


Area Percent Report

sample wgl-3-155-1A-99.8-0.2-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2020-07-29 00-05-13\003-P1-E2-wgl-3-155.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

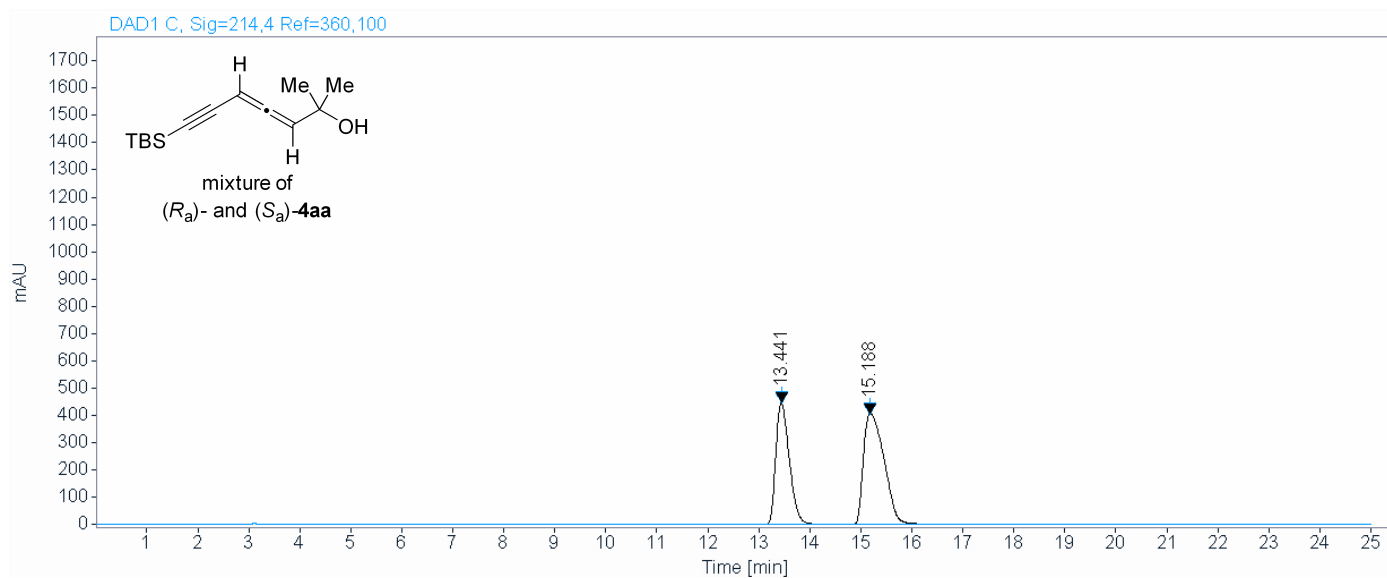
RT [min]	Width [min]	Height	Area	Area%
12.900	0.3578	1136.0074	25684.6328	99.7367
14.878	0.1954	5.2944	67.7987	0.2633
		Sum	25752.4315	100.0000

Area Percent Report

sample wgl-1-(125+129)-IA-99.8-0.2-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2020-07-29 00-05-13\002-P1-E1-wgl-1-(125+129).D

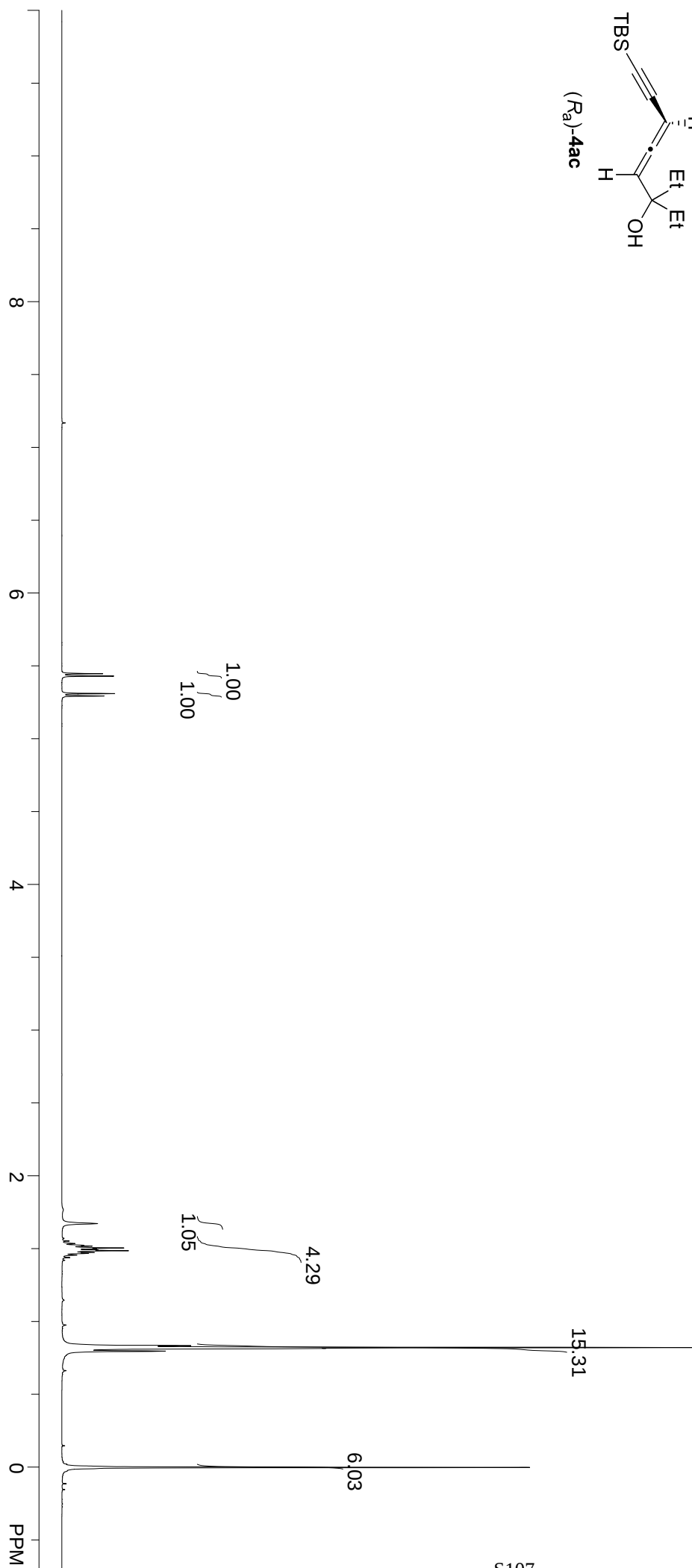
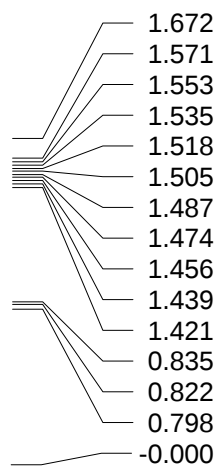
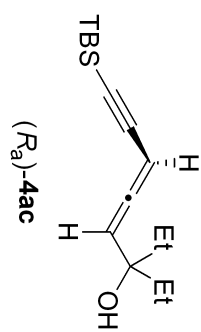
Acquisition Data:

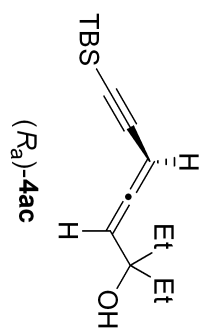


Signal: DAD1 C, Sig=214,4 Ref=360,100

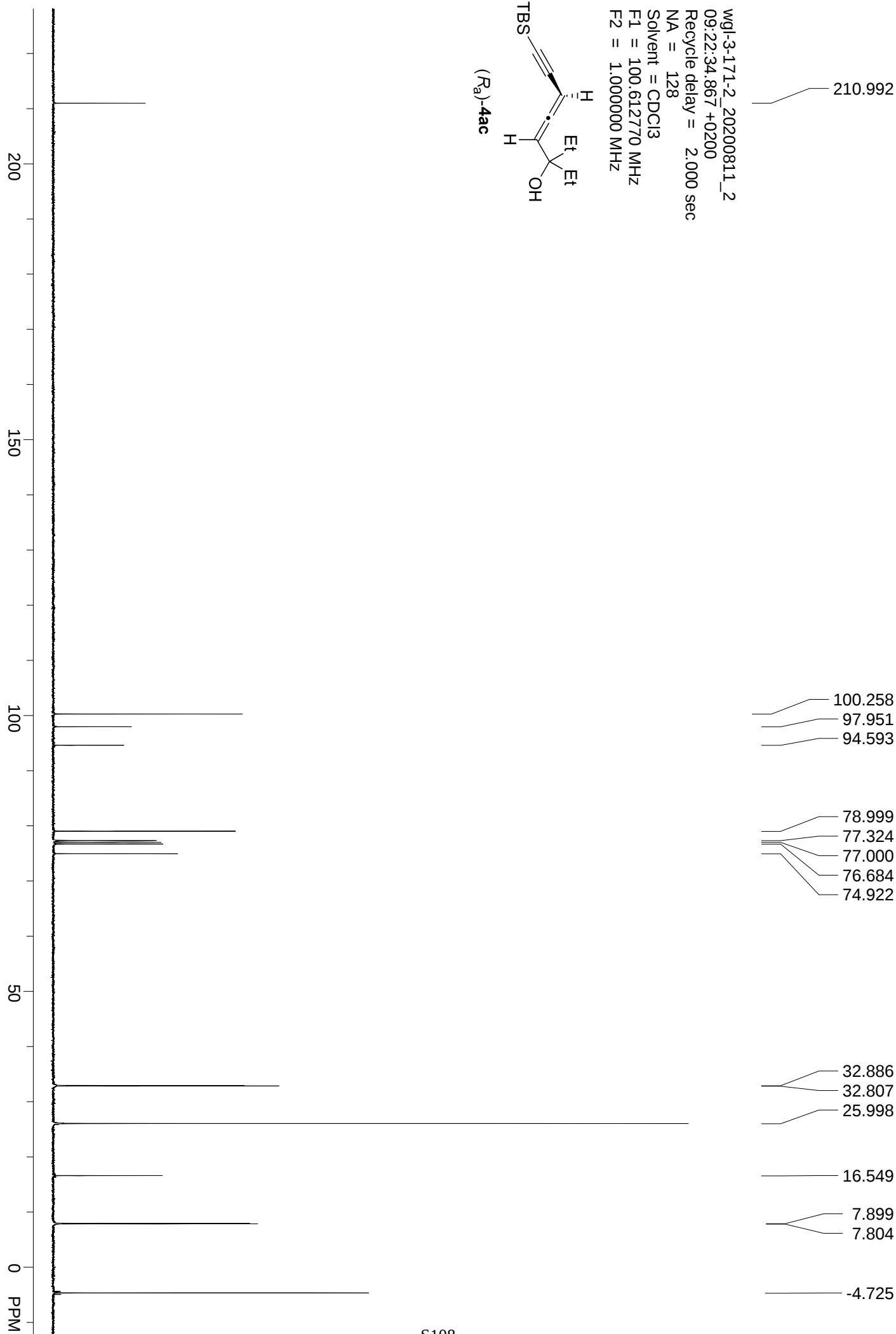
RT [min]	Width [min]	Height	Area	Area%
13.441	0.2886	447.2870	8226.1172	42.0257
15.188	0.4726	405.4076	11347.9004	57.9743
Sum			19574.0176	100.0000

wgl-3-171-2_20200811_1
09:14:39.136 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl₃
F1 = 400.130035 MHz
F2 = 1.000000 MHz





wjl-3-171-2_20200811_2
 09:22:34.867 +0200
 Recycle delay = 2.000 sec
 NA = 128
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

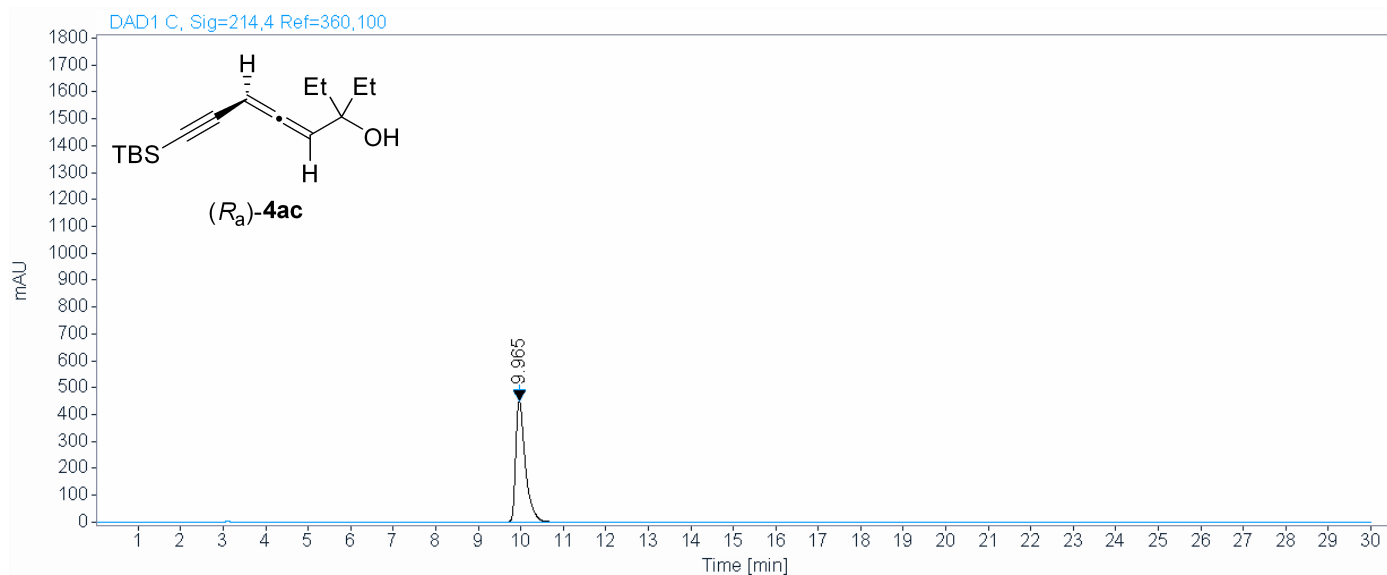


Area Percent Report

sample wgl-3-171-1A-99.8-0.2-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\inj 2020-08-11 08-32-42\052-P1-E2-wgl-3-171.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

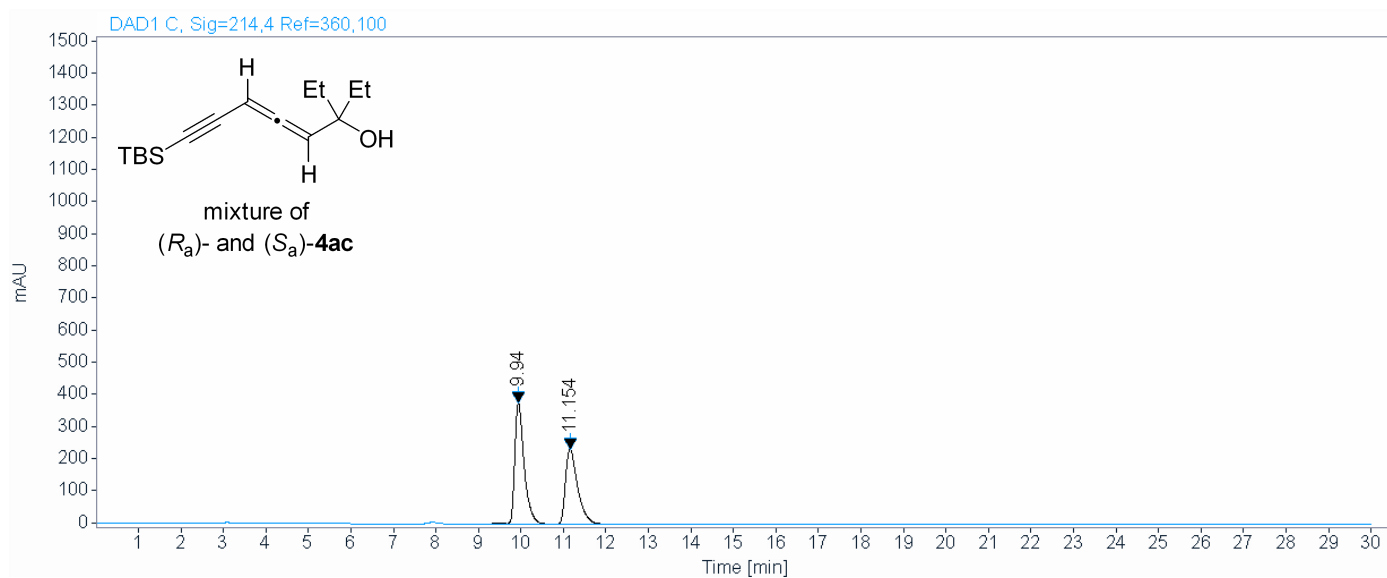
RT [min]	Width [min]	Height	Area	Area%
9.965	0.2373	452.9192	7195.5771	100.0000
Sum			7195.5771	100.0000

Area Percent Report

sample wgl-3-(171+172)-IA-99.8-0.2-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\linj 2020-08-11 08-32-42\051-P1-E1-wgl-3-(171+172).D

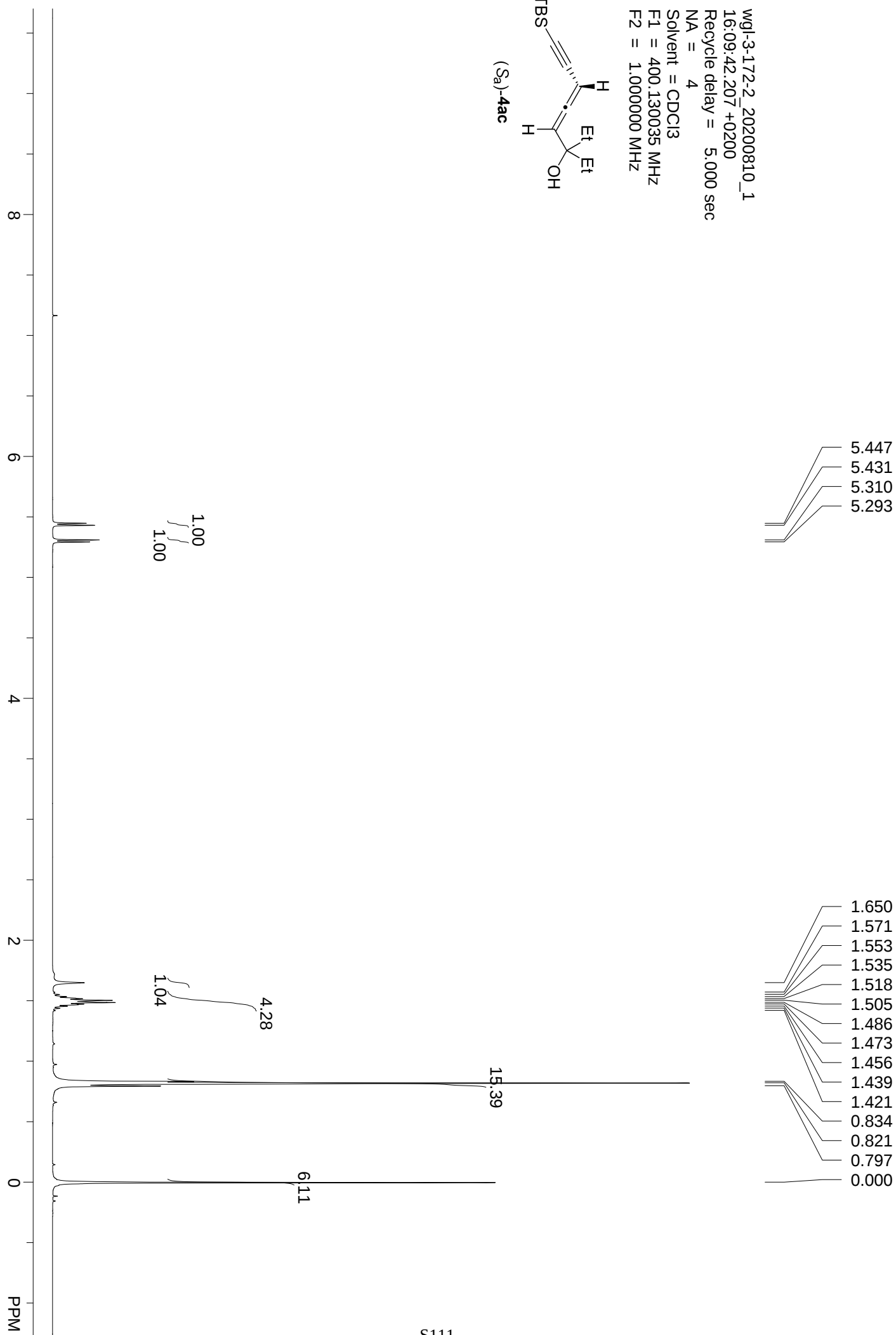
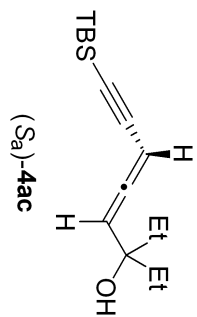
Acquisition Data:



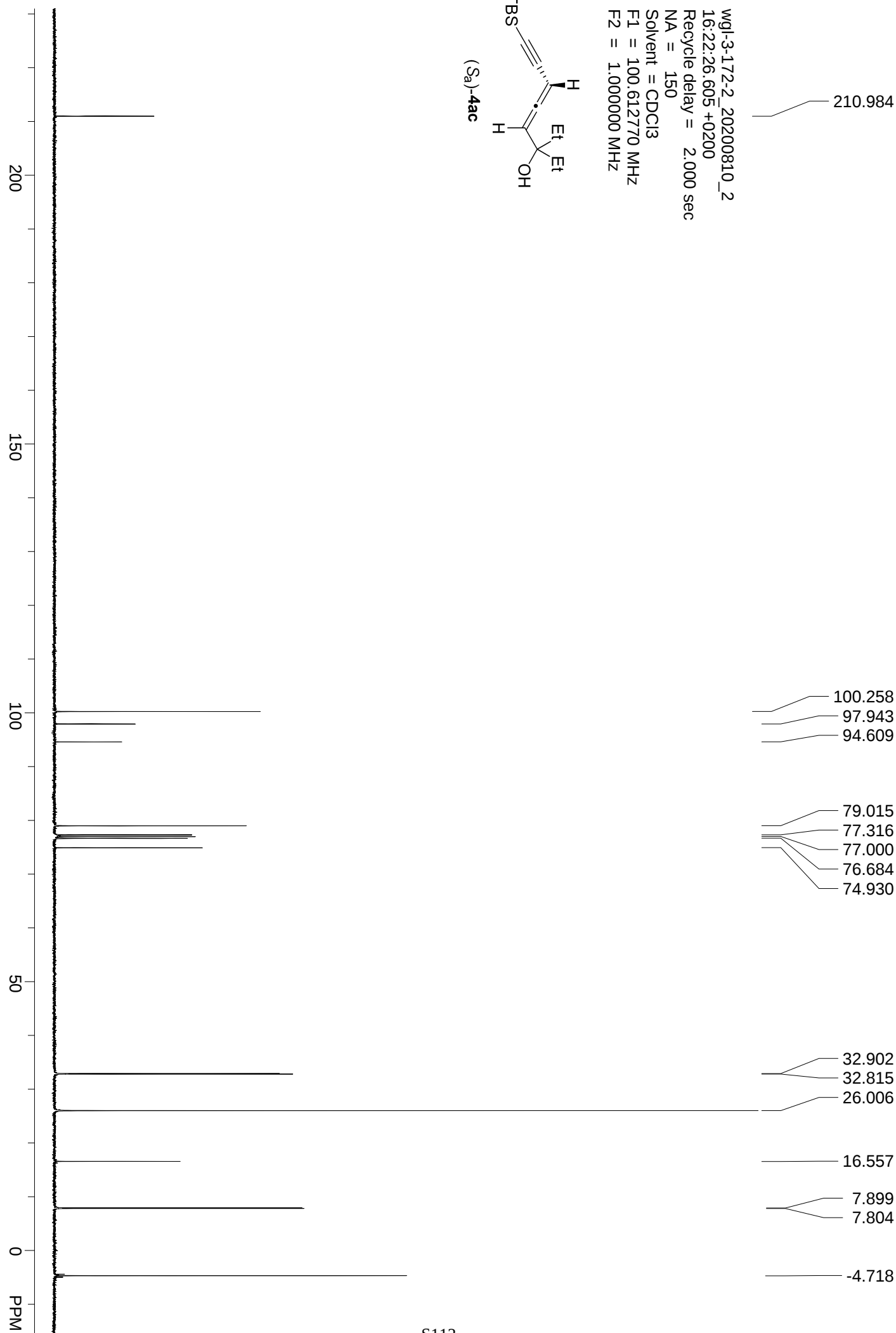
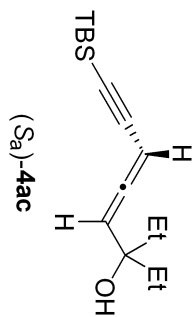
Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
9.940	0.2303	378.4306	5832.5605	55.9242
11.154	0.2976	233.6049	4596.8486	44.0758
		Sum	10429.4092	100.0000

wjl-3-172-2_20200810_1
 16:09:42.207 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130035 MHz
 F2 = 1.000000 MHz



wqf-3-172-2_20200810_2
 16:22:26.605 +0200
 Recycle delay = 2.000 sec
 NA = 150
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

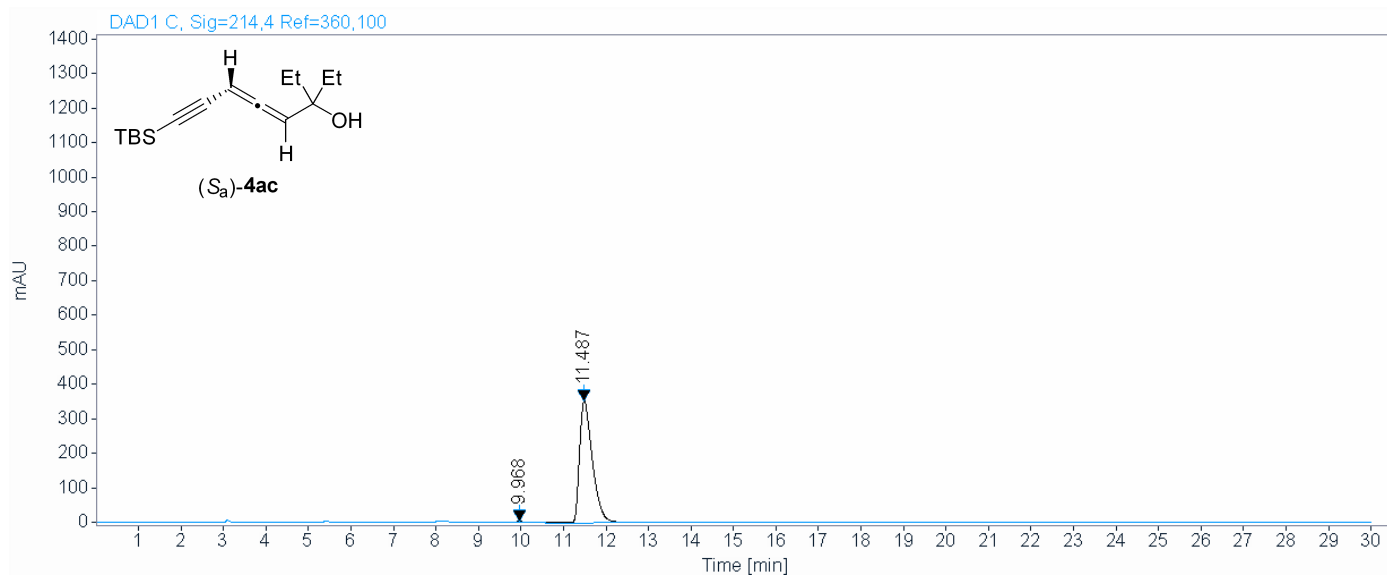


Area Percent Report

sample wgl-3-172-1A-99.8-0.2-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\linj 2020-08-11 08-32-42\053-P1-E3-wgl-3-172.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

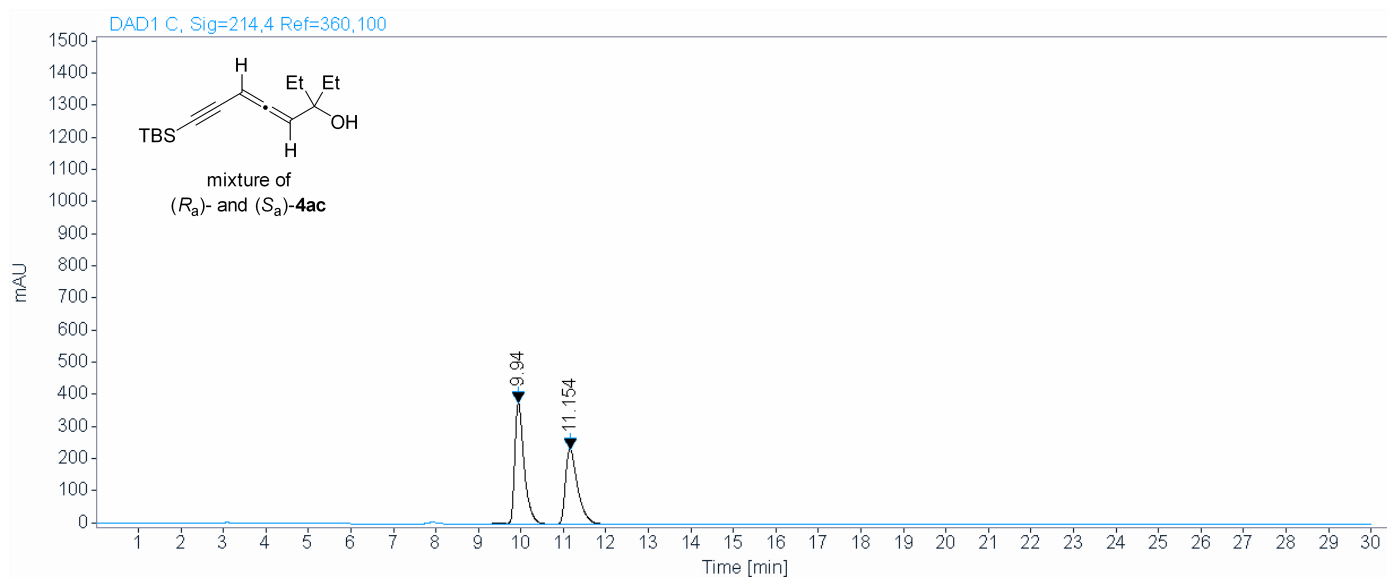
RT [min]	Width [min]	Height	Area	Area%
9.968	0.3678	1.9108	42.1720	0.5604
11.487	0.3521	354.2686	7483.7783	99.4396
		Sum	7525.9503	100.0000

Area Percent Report

sample wgl-3-(171+172)-IA-99.8-0.2-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\inj 2020-08-11 08-32-42\051-P1-E1-wgl-3-(171+172).D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
9.940	0.2303	378.4306	5832.5605	55.9242
11.154	0.2976	233.6049	4596.8486	44.0758
		Sum	10429.4092	100.0000

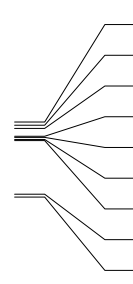
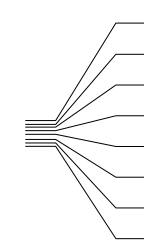
7.272
7.252
7.239
7.222
7.203
7.177
7.160
7.142

5.542
5.526
5.510
5.470
5.465
5.454
5.449
5.178
5.164

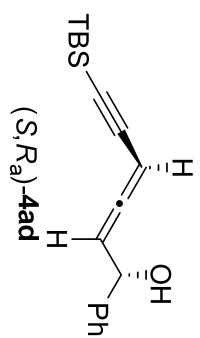
2.434

0.826

0.000



wgl-4-087_20201027_1.1
00:32:07.237 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl₃
F1 = 400.130066 MHz
F2 = 1.000000 MHz



5.55

1.00
1.00 1.00
1.00 1.00

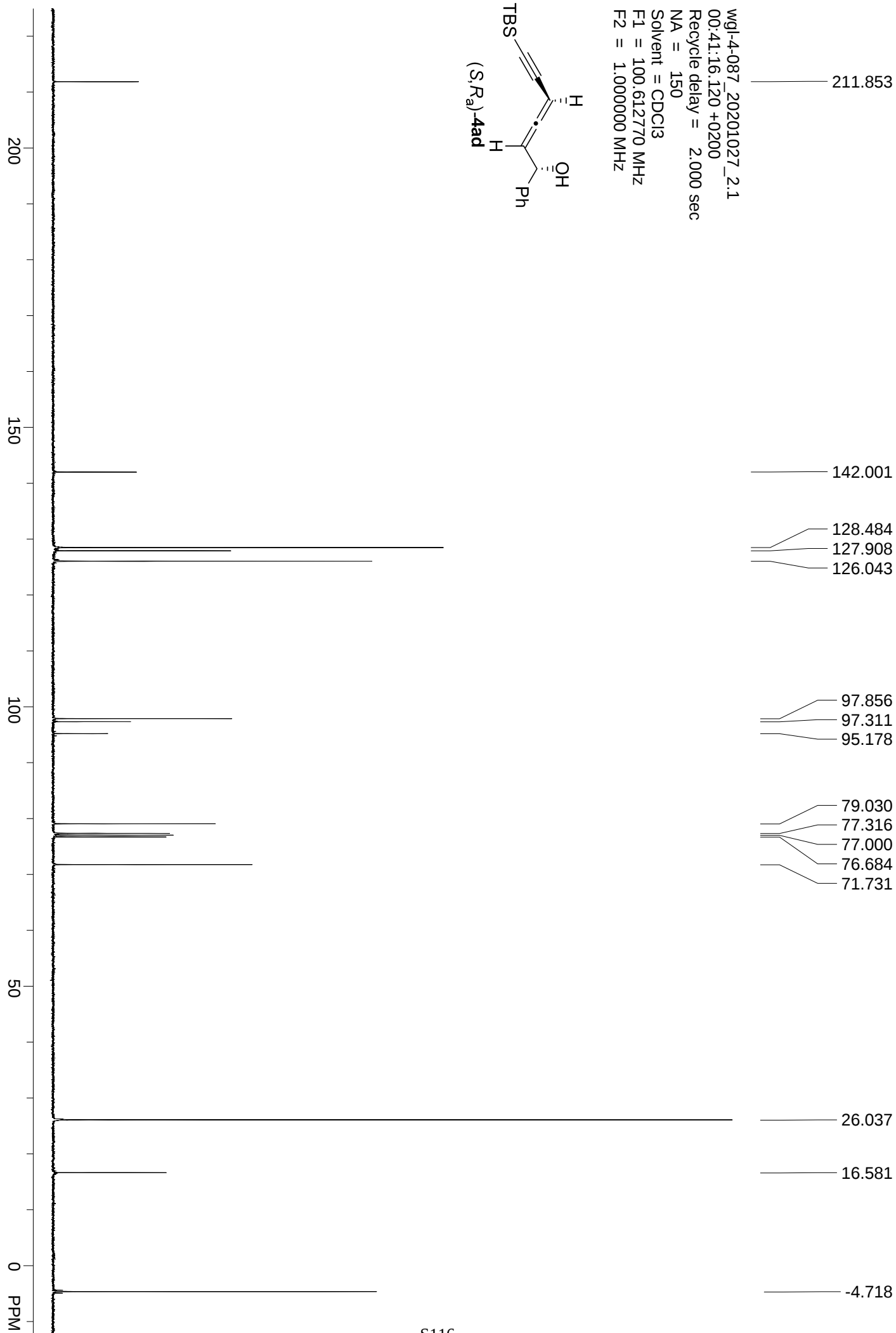
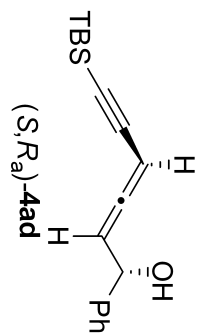
1.00

9.37

6.00



wj-4-087_20201027_2.1
00:41:16.120 +0200
Recycle delay = 2.000 sec
NA = 150
Solvent = CDCl₃
F1 = 100.612770 MHz
F2 = 1.000000 MHz



Area Percent Report

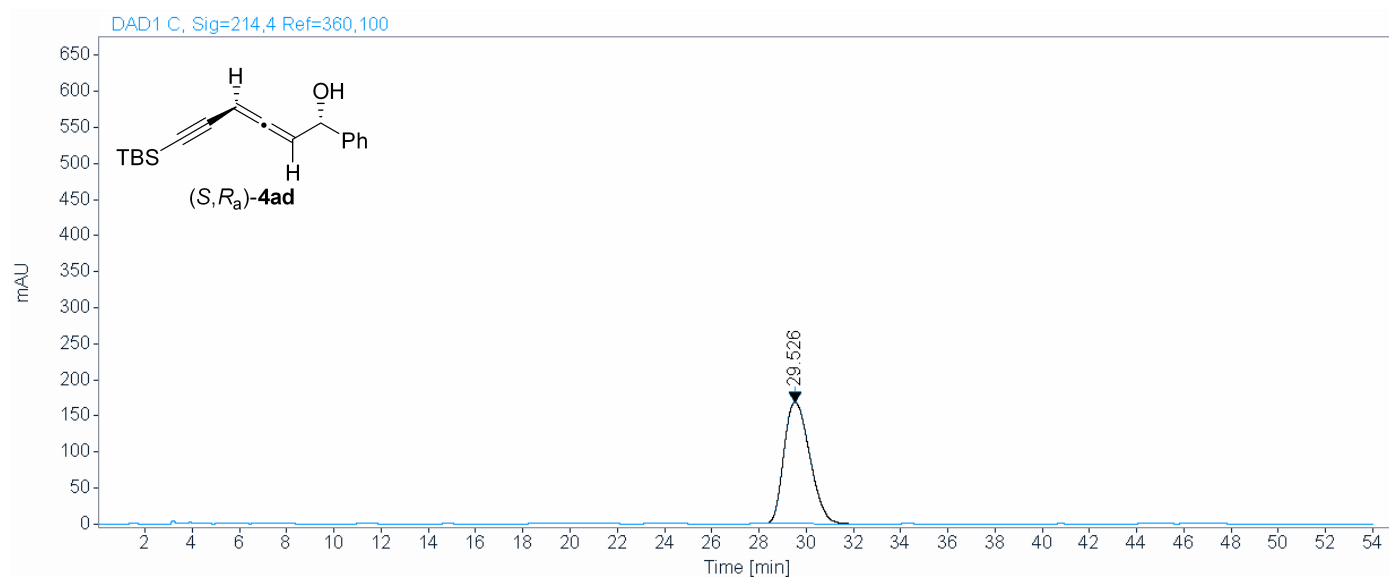


Agilent Technologies

sample wgl-4-087-OZ-H-99.7-0.3-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\WHN 2020-10-27 22-39-12\014-P1-E6-wgl-4-087.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
29.526	1.2133	168.1757	12819.4072	100.0000
Sum			12819.4072	100.0000

Area Percent Report

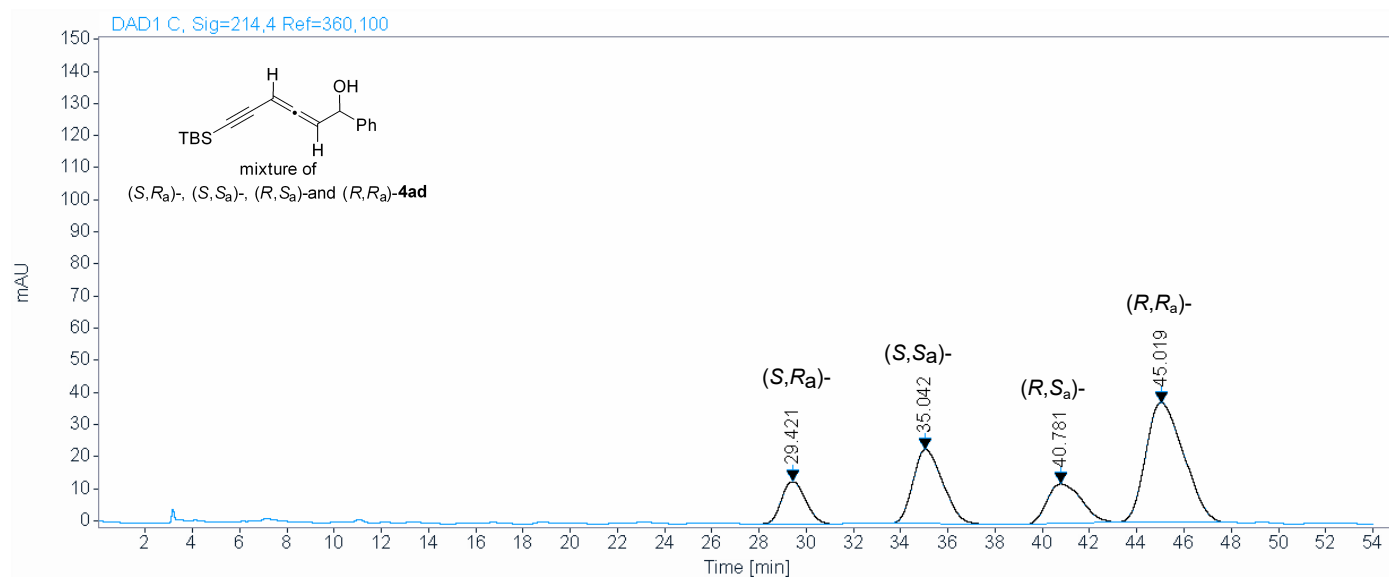


Agilent Technologies

sample wgl-1-(178+179+190+191)-OZ-H-99.7-0.3-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WHN 2020-10-27 22-39-12\022-P1-E1-wgl-1-(178+179+190+191).D

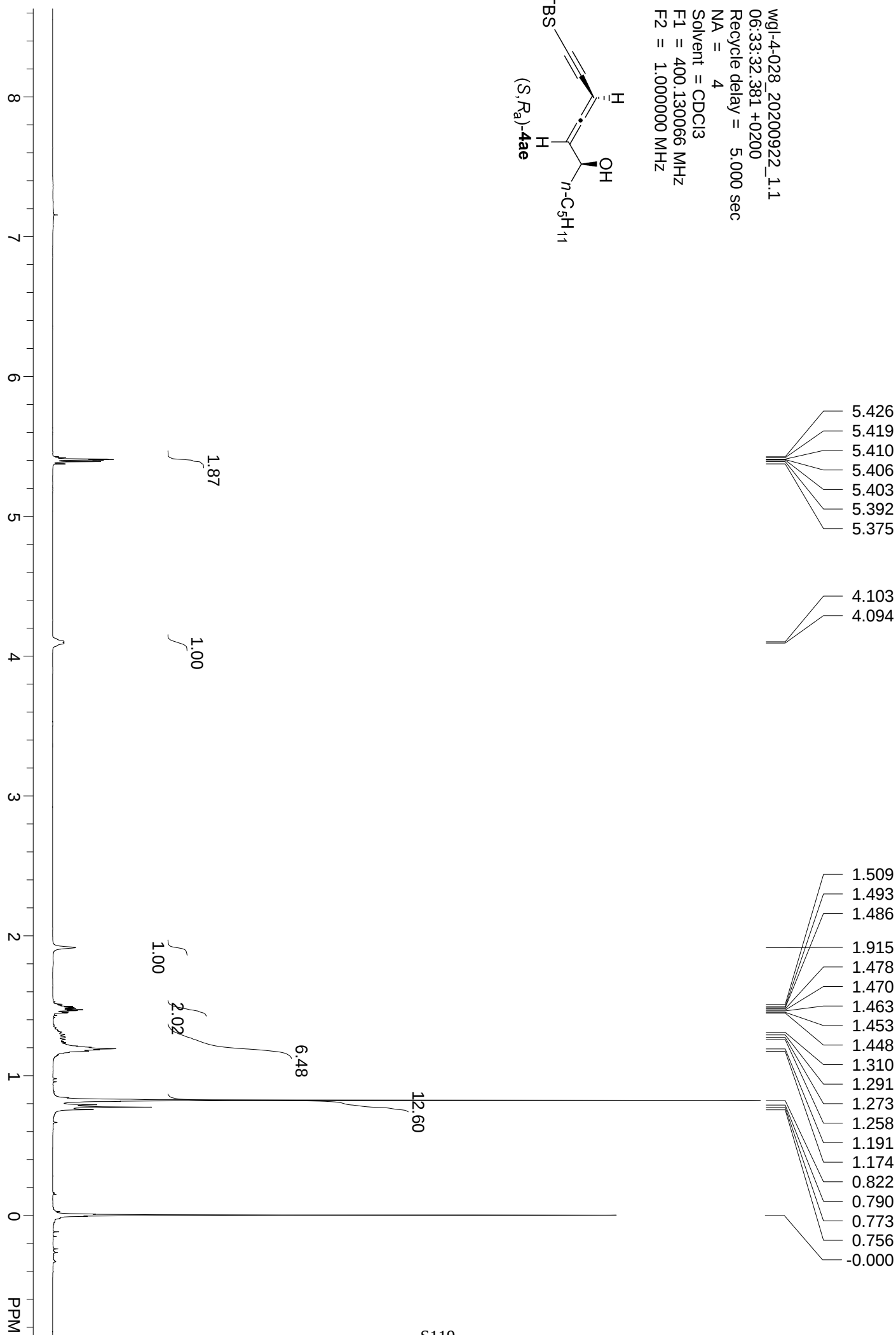
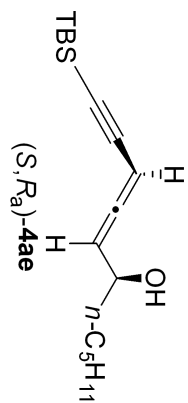
Acquisition Data:



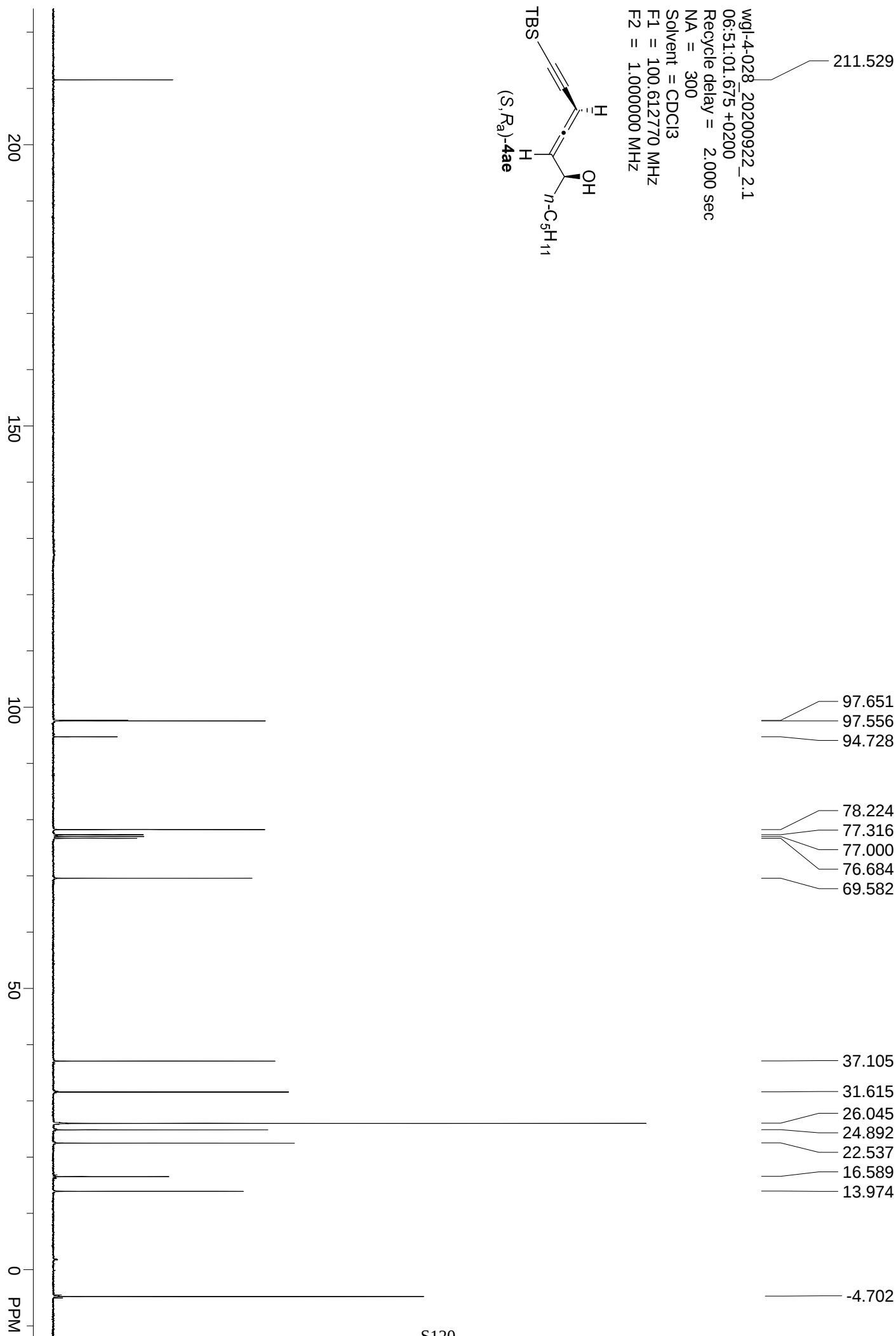
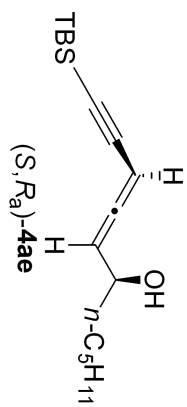
Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
29.421	1.1103	13.2534	952.3173	11.3864
35.042	1.2631	23.1845	2029.0760	24.2606
40.781	1.3497	12.3385	1247.6165	14.9171
45.019	1.5834	37.2375	4134.6650	49.4360
Sum			8363.6749	100.0000

wj-4-028_20200922_1.1
 06:33:32.381 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130066 MHz
 F2 = 1.000000 MHz



wgl-4-028_20200922_2.1
06:51:01.675 +0200
Recycle delay = 2.000 sec
NA = 300
Solvent = CDCl₃
F1 = 100.612770 MHz
F2 = 1.000000 MHz



Area Percent Report

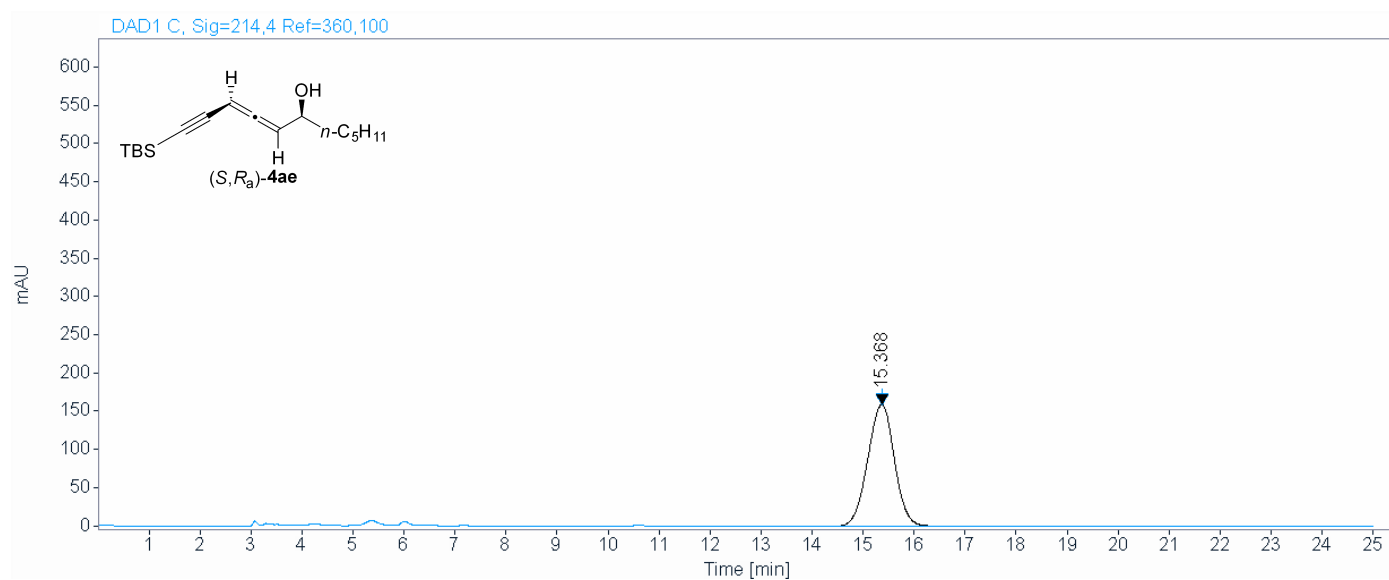


Agilent Technologies

sample wgl-4-028-OD-H-99.7-0.3-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\zwf-allenioc acid_LC 2020-09-22 16-45-37\032-P1-E2-wgl-4-028.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
15.368	0.5743	159.3170	5821.1616	100.0000
		Sum	5821.1616	100.0000

Area Percent Report

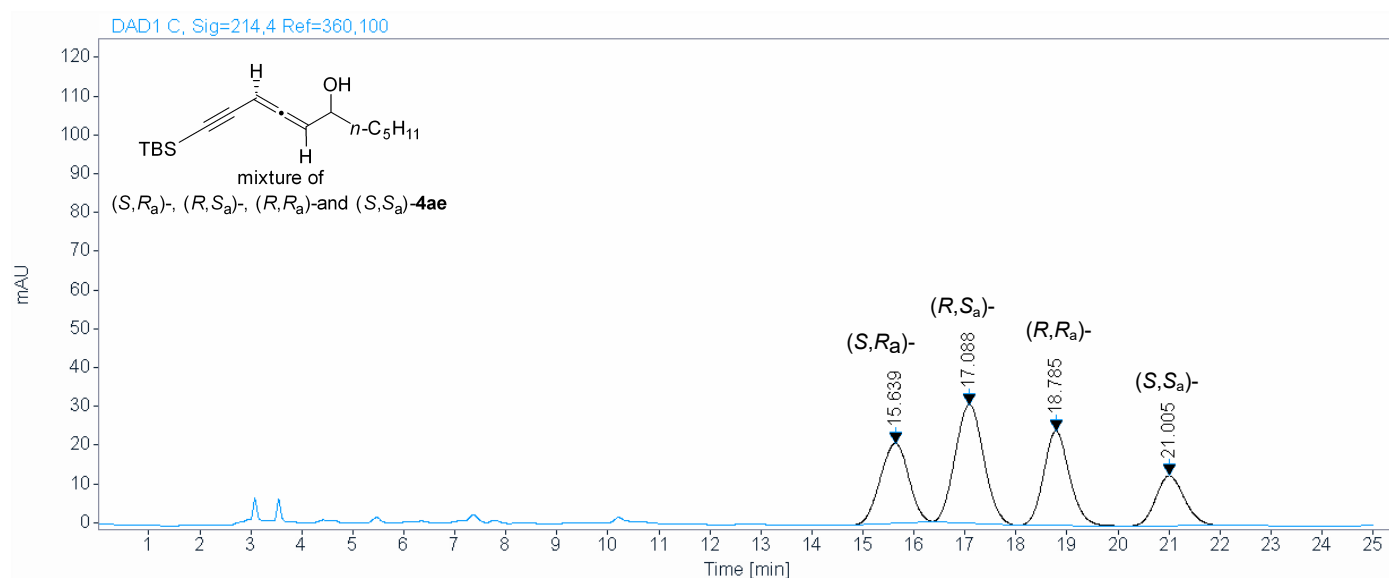


Agilent Technologies

sample wgl-1-(183+184+198+199)-OD-H-99.7-0.3-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\ZWF-ALLENIOC ACID_LC 2020-09-22
16-45-37\029-P1-E1-wgl-1-1834989.D

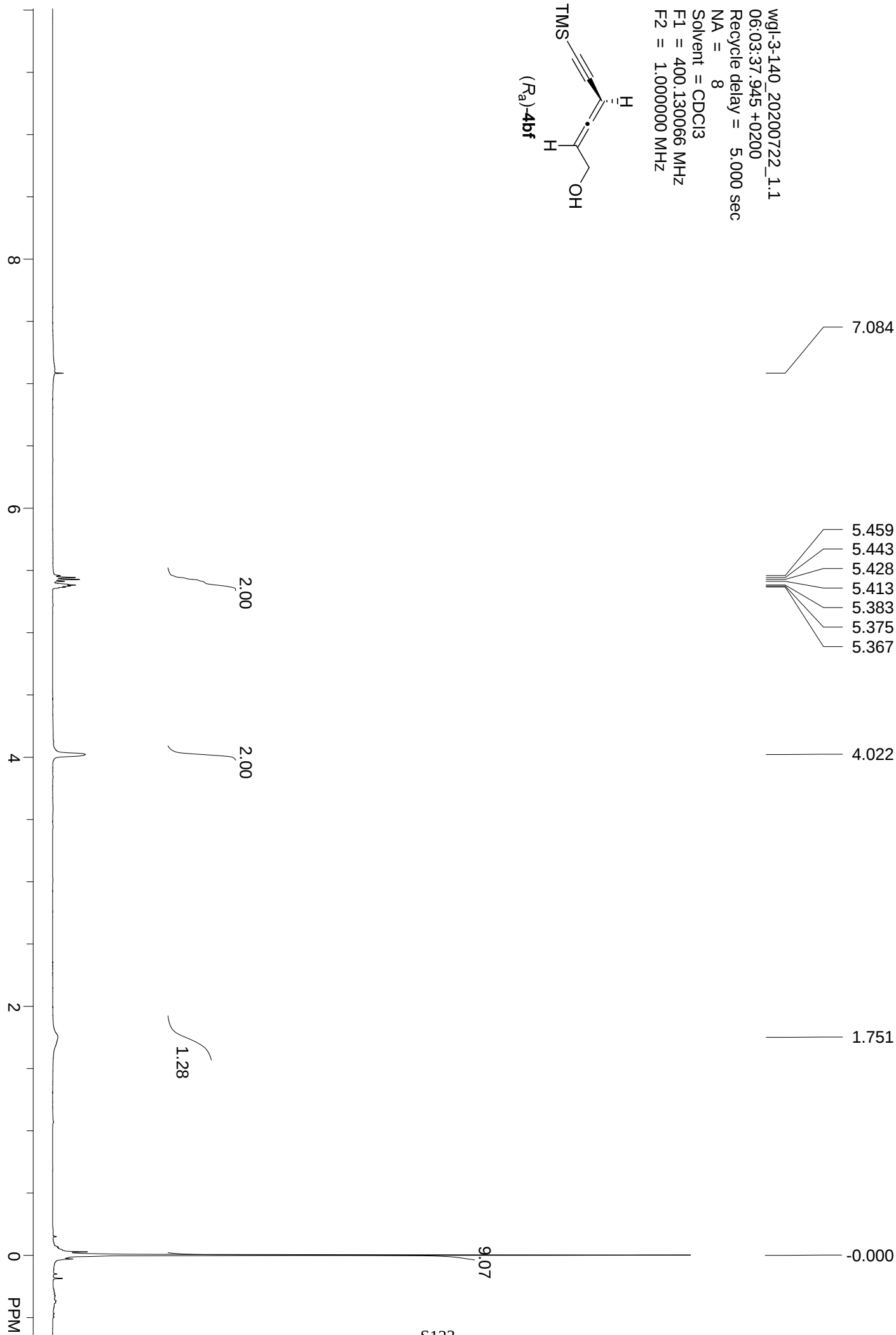
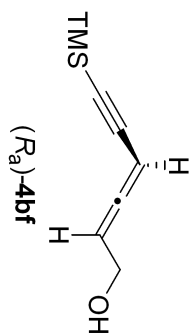
Acquisition Data:



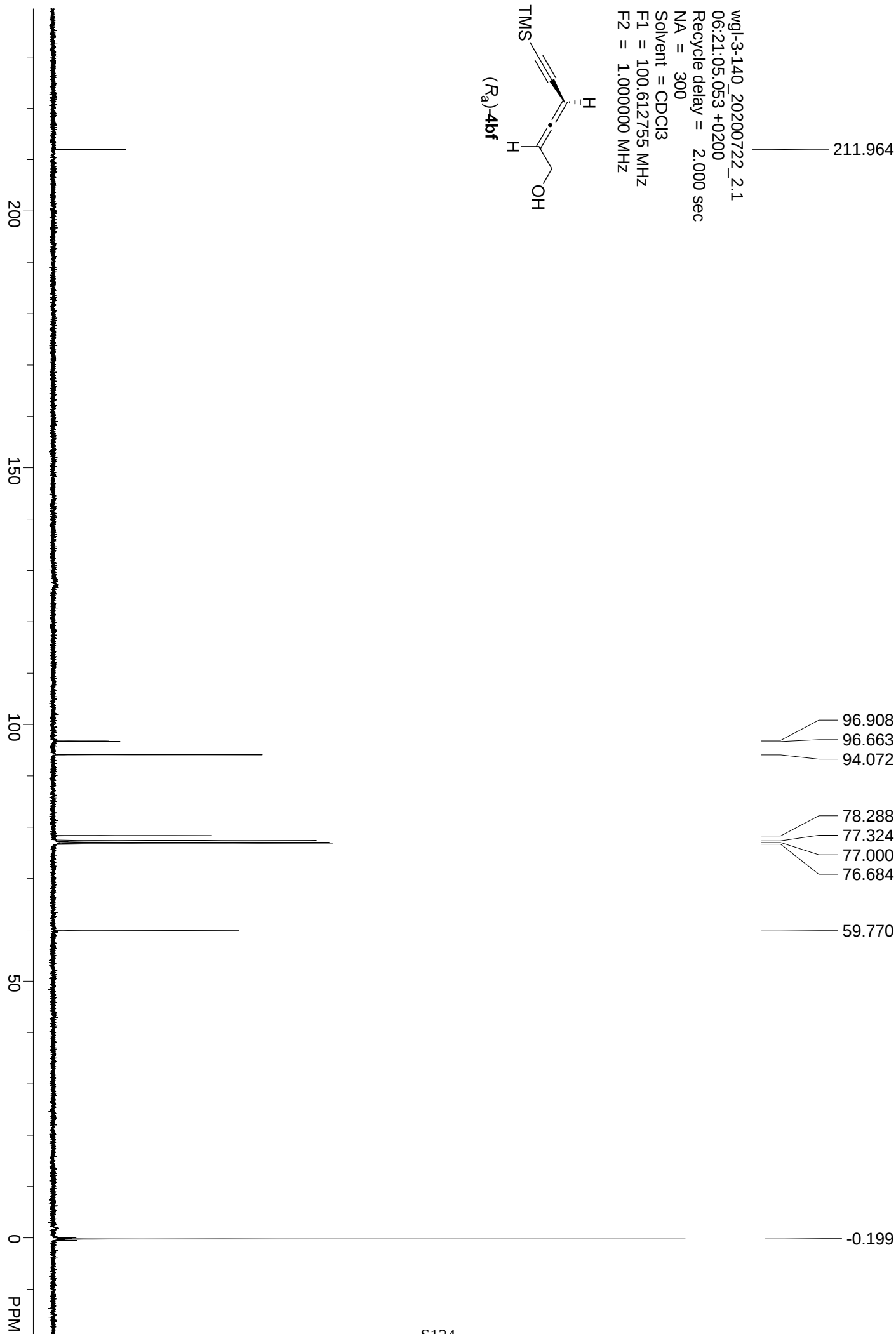
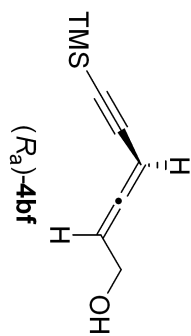
Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
15.639	0.6113	20.6053	793.4926	23.7510
17.088	0.6113	30.5489	1187.0430	35.5308
18.785	0.5437	24.3751	855.9716	25.6211
21.005	0.6096	12.9162	504.3726	15.0970
Sum			3340.8798	100.0000

wgl-3-140_20200722_1.1
06:03:37.945 +0200
Recycle delay = 5.000 sec
NA = 8
Solvent = CDCl₃
F1 = 400.130066 MHz
F2 = 1.000000 MHz



wj-3-140_20200722_2.1
06:21:05.053 +0200
Recycle delay = 2.000 sec
NA = 300
Solvent = CDCl₃
F1 = 100.612755 MHz
F2 = 1.000000 MHz

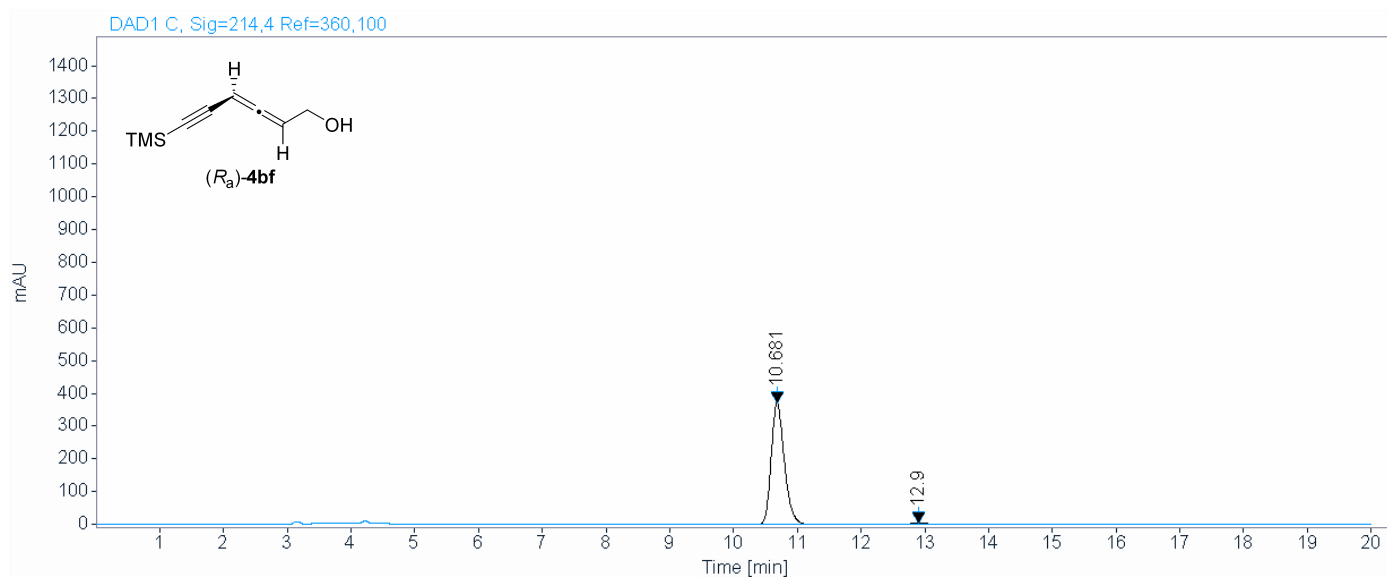


Area Percent Report

sample wgl-3-140-OJ-H-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\zwf-allenioc acid_LC 2020-07-21 15-33-47\051-P1-E6-wgl-3-140.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

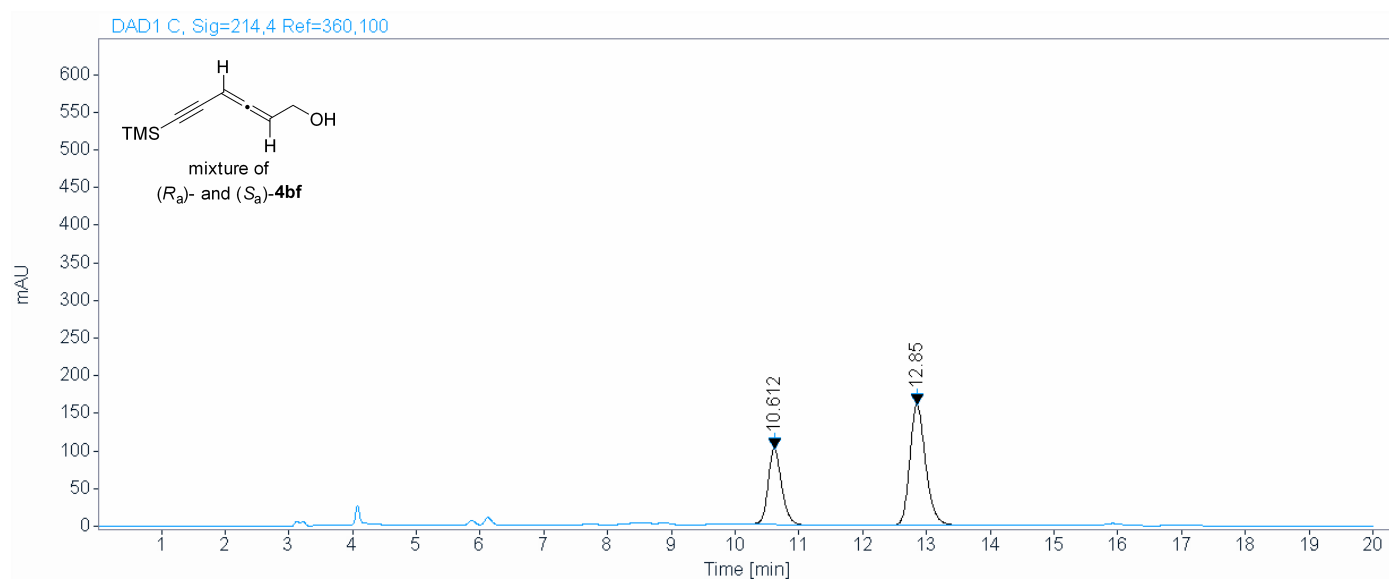
RT [min]	Width [min]	Height	Area	Area%
10.681	0.2184	372.2486	5309.7183	97.6505
12.900	0.4957	3.5343	127.7557	2.3495
Sum			5437.4739	100.0000

Area Percent Report

sample wgl-1-(149+150)-OJ-H-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\zwf-allenioc acid_LC 2020-07-21 15-33-47\054-P1-E5-wgl-1-(149+150).D

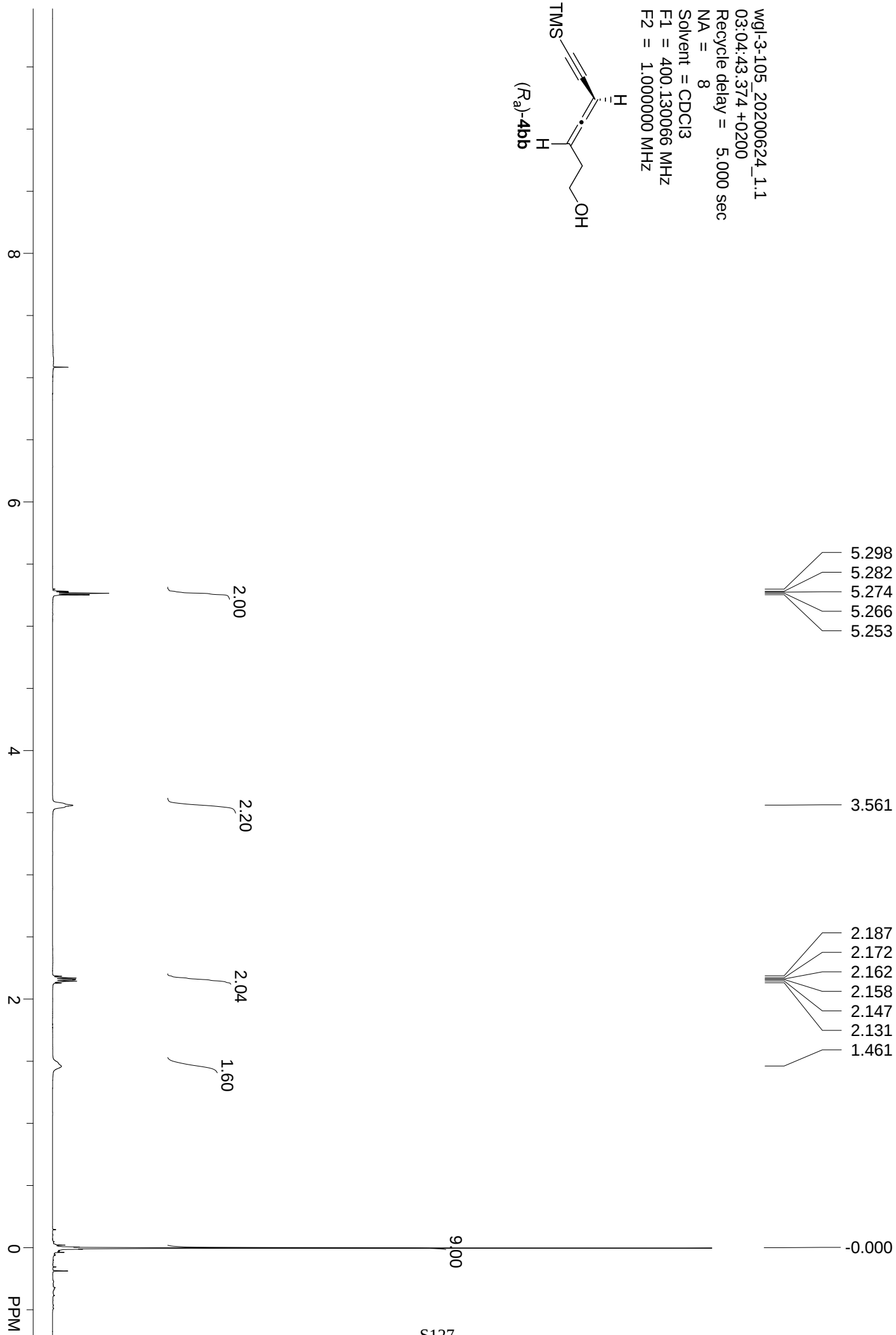
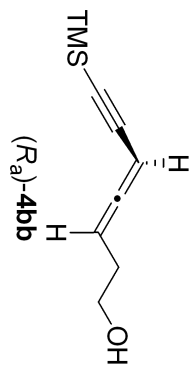
Acquisition Data:



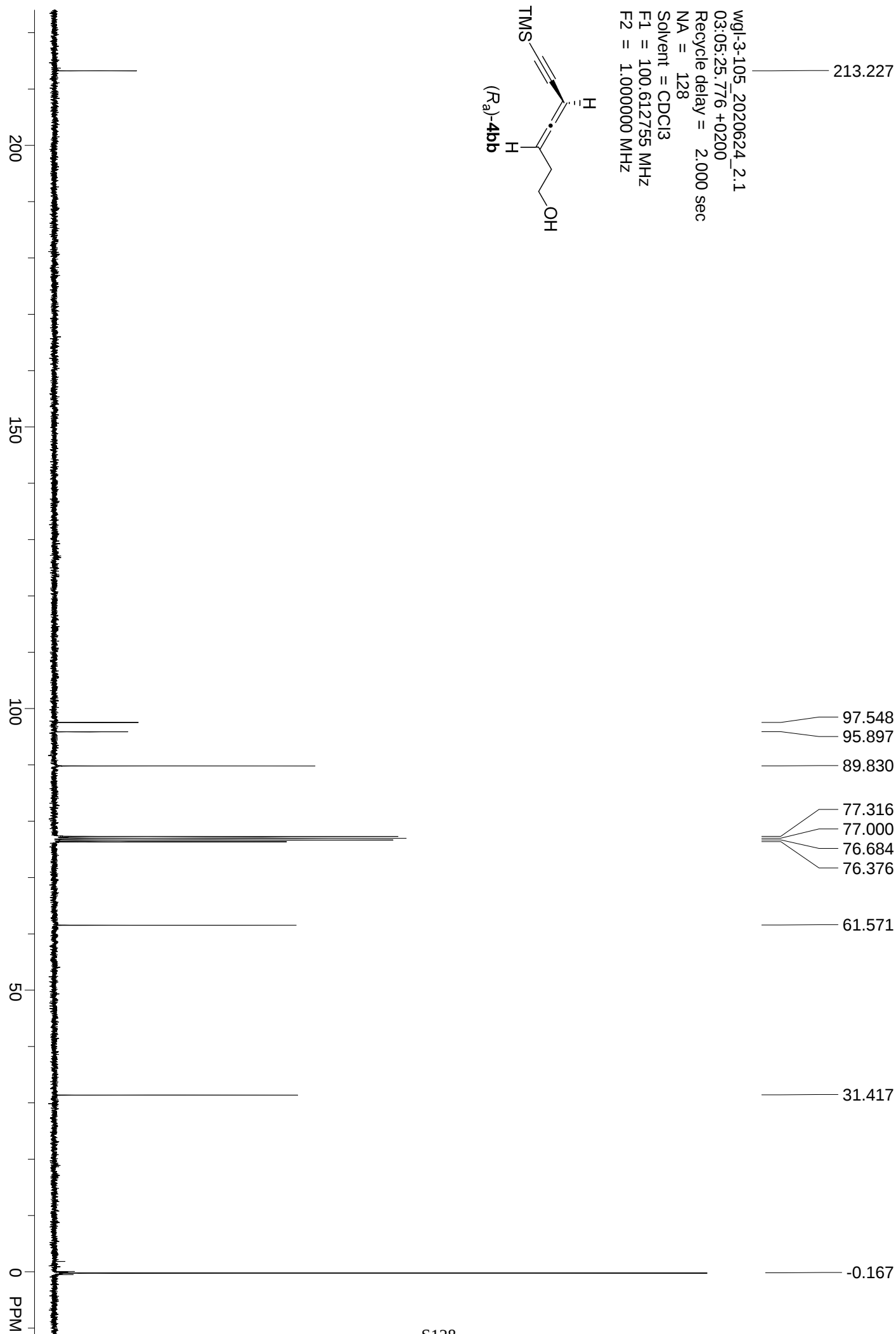
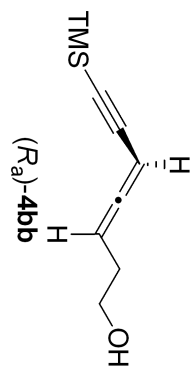
Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
10.612	0.2259	101.0488	1488.6071	34.9220
12.850	0.2658	160.3595	2774.0605	65.0780
		Sum	4262.6676	100.0000

wgl-3-105_20200624_1.1
03:04:43.374 +0200
Recycle delay = 5.000 sec
NA = 8
Solvent = CDCl₃
F1 = 400.130066 MHz
F2 = 1.000000 MHz



wjl-3-105_2020624_2.1
03:05:25.776 +0200
Recycle delay = 2.000 sec
NA = 128
Solvent = CDCl₃
F1 = 100.612755 MHz
F2 = 1.000000 MHz



Area Percent Report

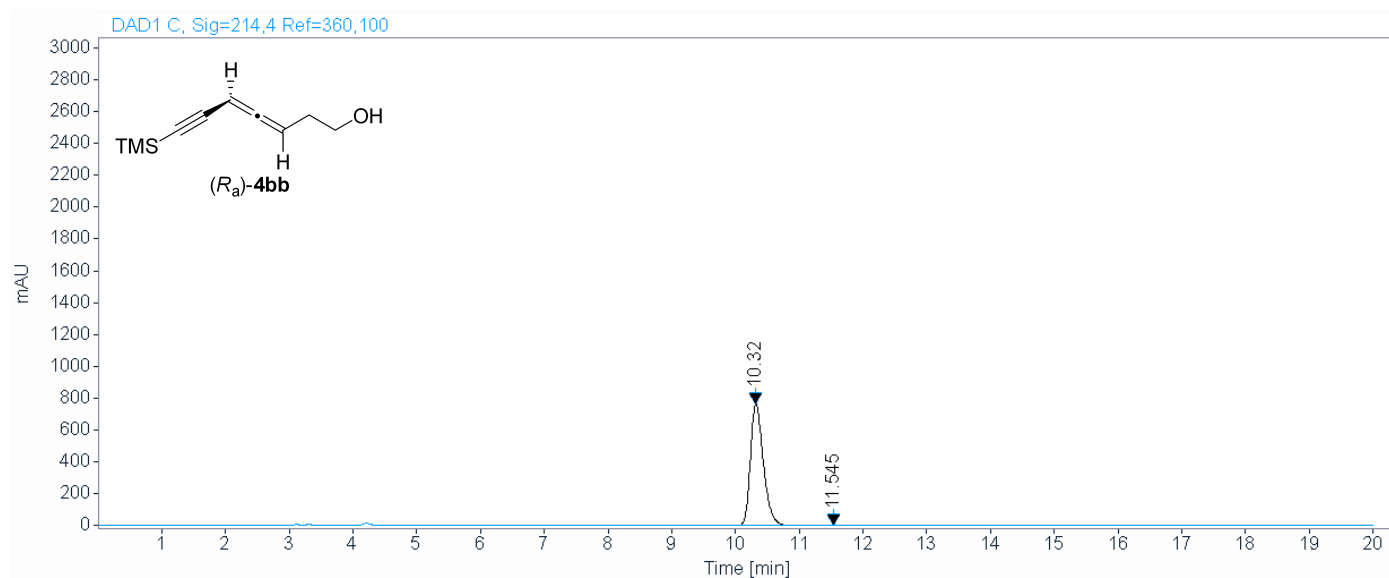


Agilent Technologies

sample wgl-3-105-OJ-H-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\linj 2020-06-24 15-01-30\034-P1-E2-wgl-3-105.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
10.320	0.2149	766.9684	10841.4082	99.7811
11.545	0.2388	1.5521	23.7852	0.2189
		Sum	10865.1934	100.0000

Area Percent Report

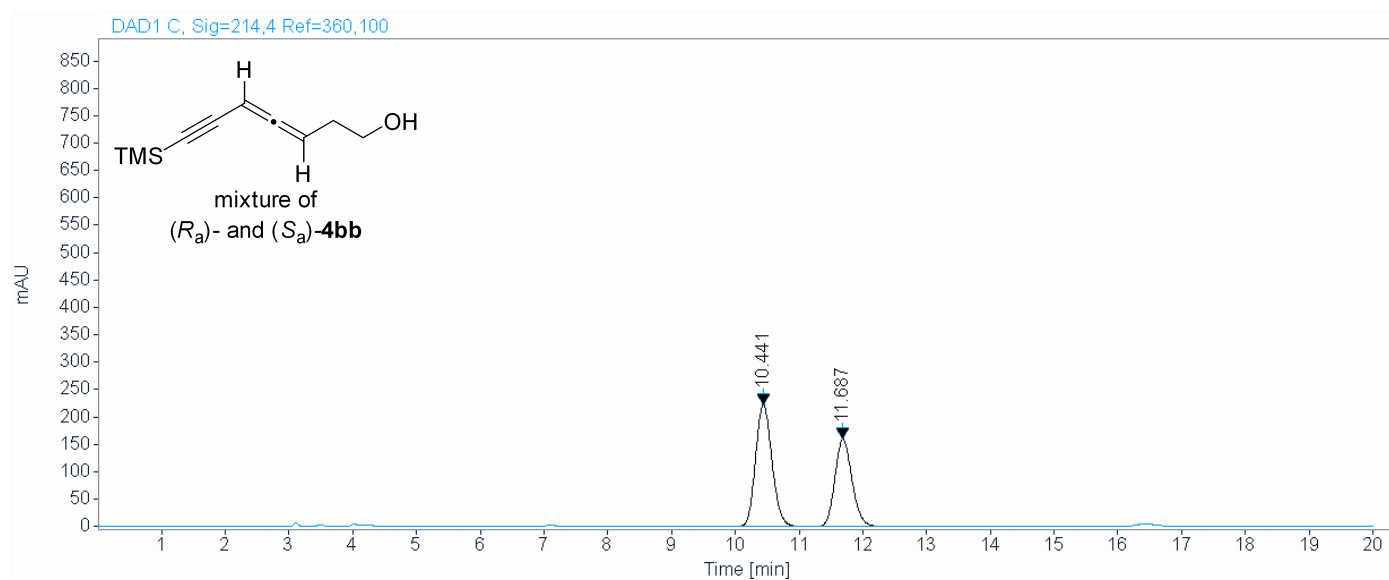


Agilent Technologies

sample wgl-1-(131+132)-OJ-H-99-1-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\LINJ 2020-06-24 15-01-30\033-P1-E1-wgl-1-(131+132).D

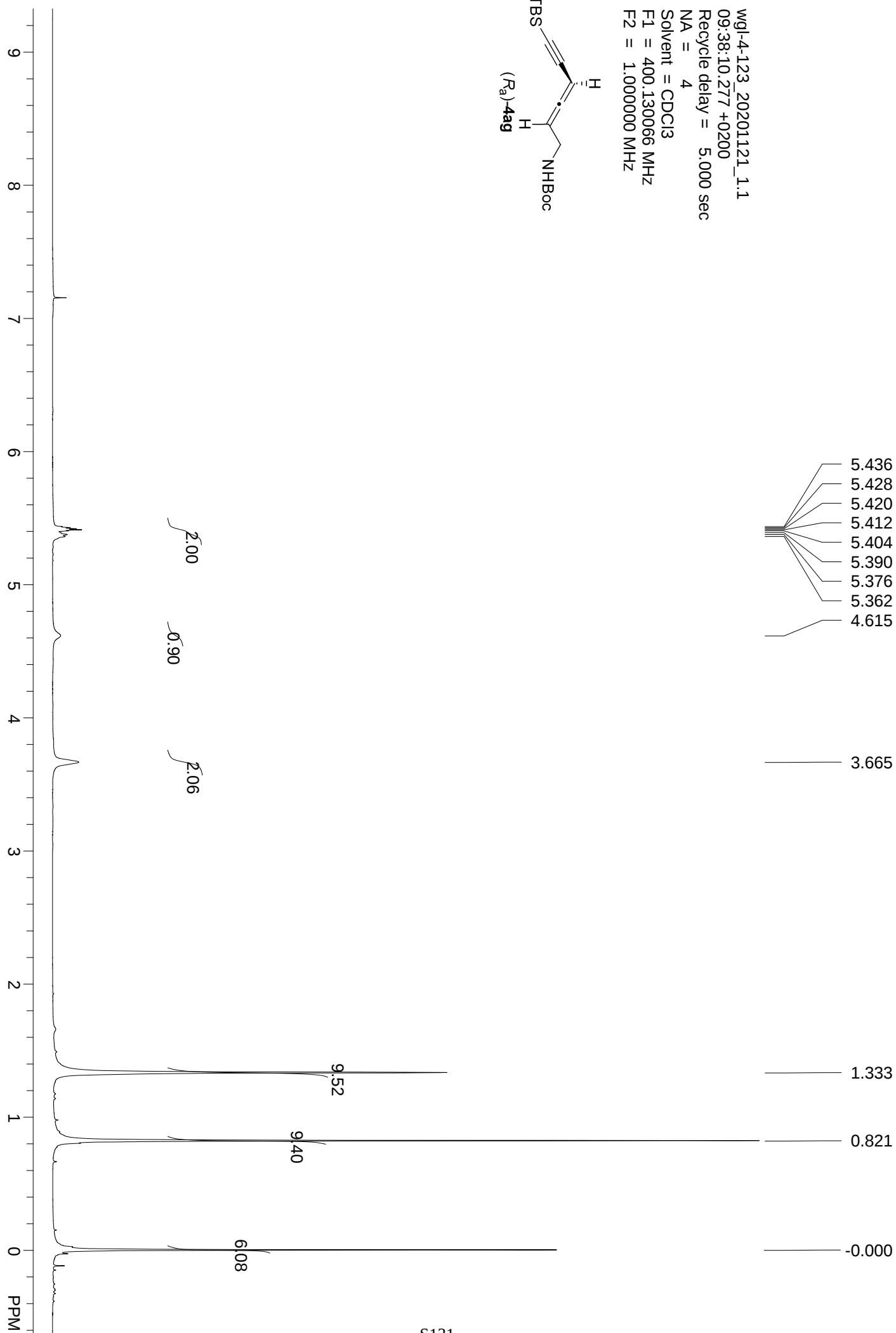
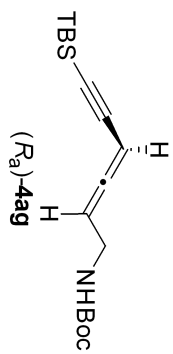
Acquisition Data:



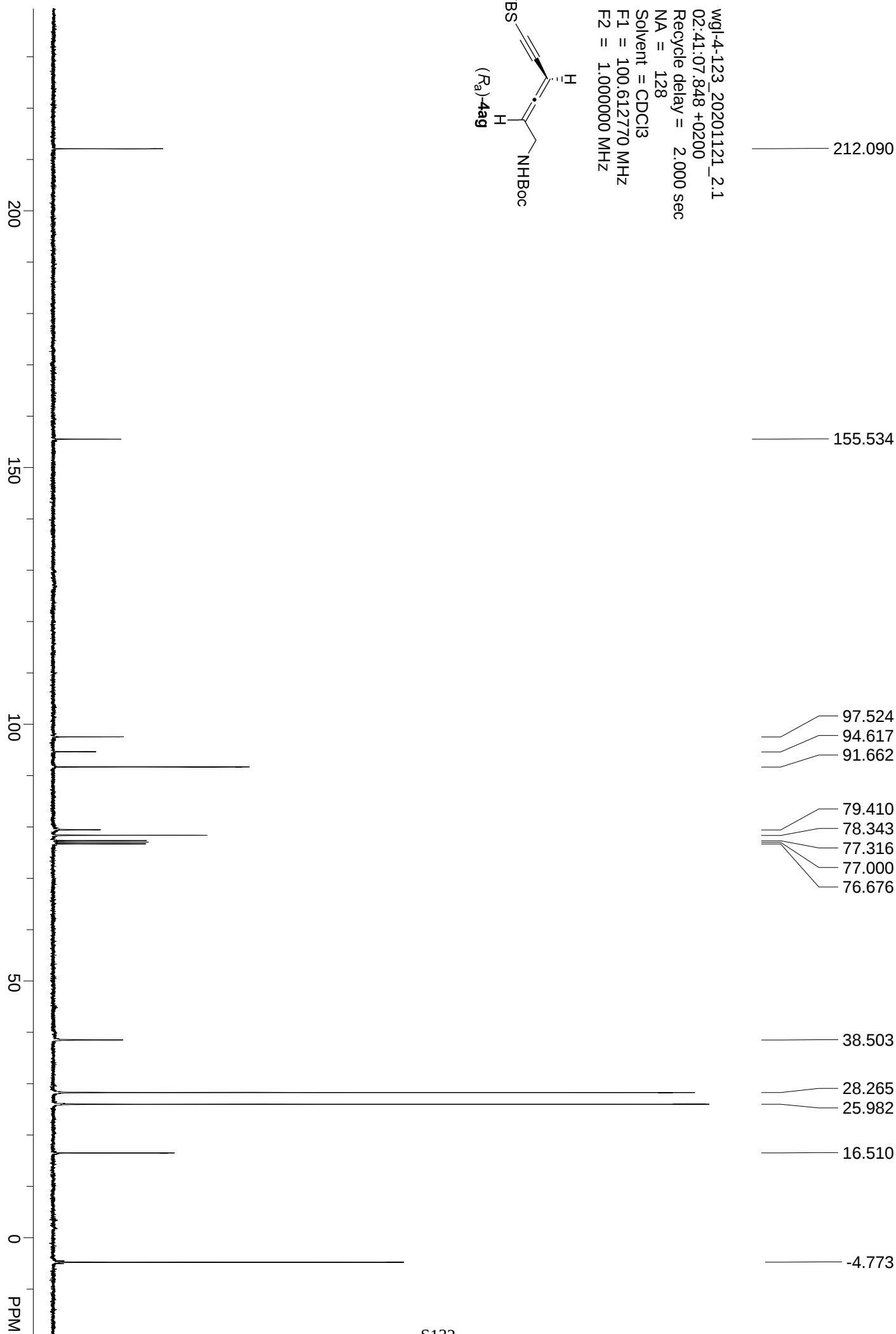
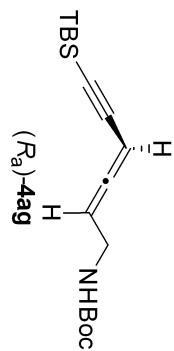
Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
10.441	0.2823	222.3837	3970.8333	57.0546
11.687	0.2923	159.7366	2988.8770	42.9454
		Sum	6959.7102	100.0000

wgl-4-123_20201121_1.1
 09:38:10.277 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130066 MHz
 F2 = 1.000000 MHz



wgl-4-123_20201121_2.1
02:41:07.848 +0200
Recycle delay = 2.000 sec
NA = 128
Solvent = CDCl₃
F1 = 100.612770 MHz
F2 = 1.000000 MHz

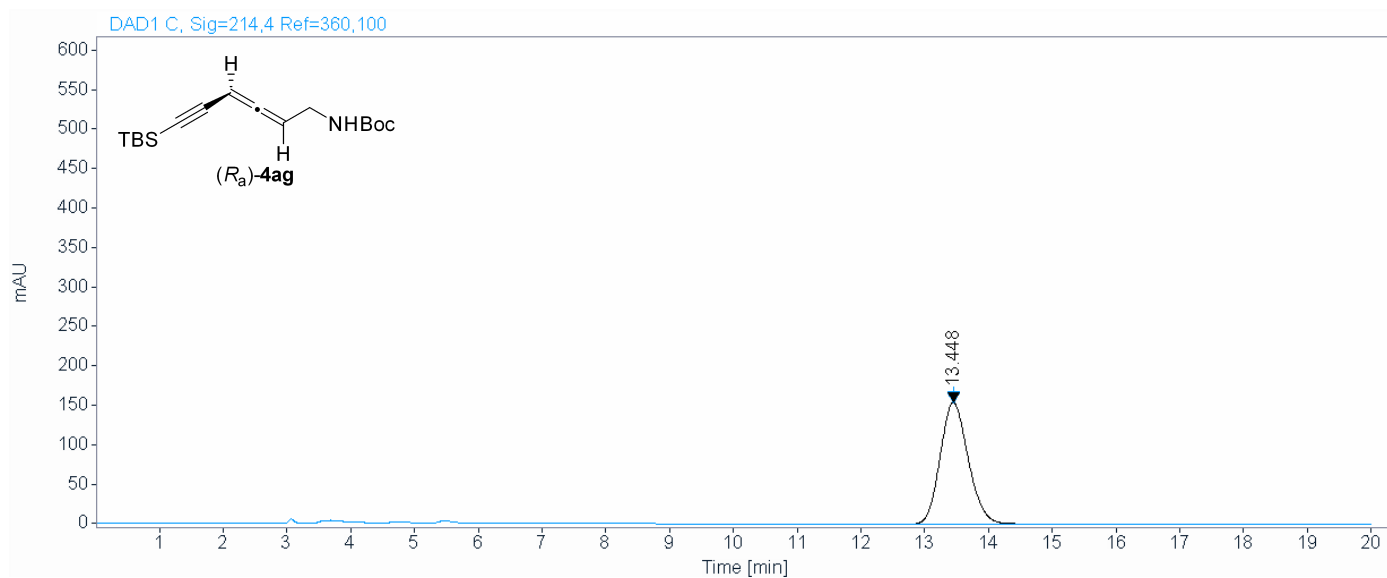


Area Percent Report

sample wgl-4-123-OD-H-99.5-0.5-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2020-11-21 22-23-04\003-P1-E2-wgl-4-123.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

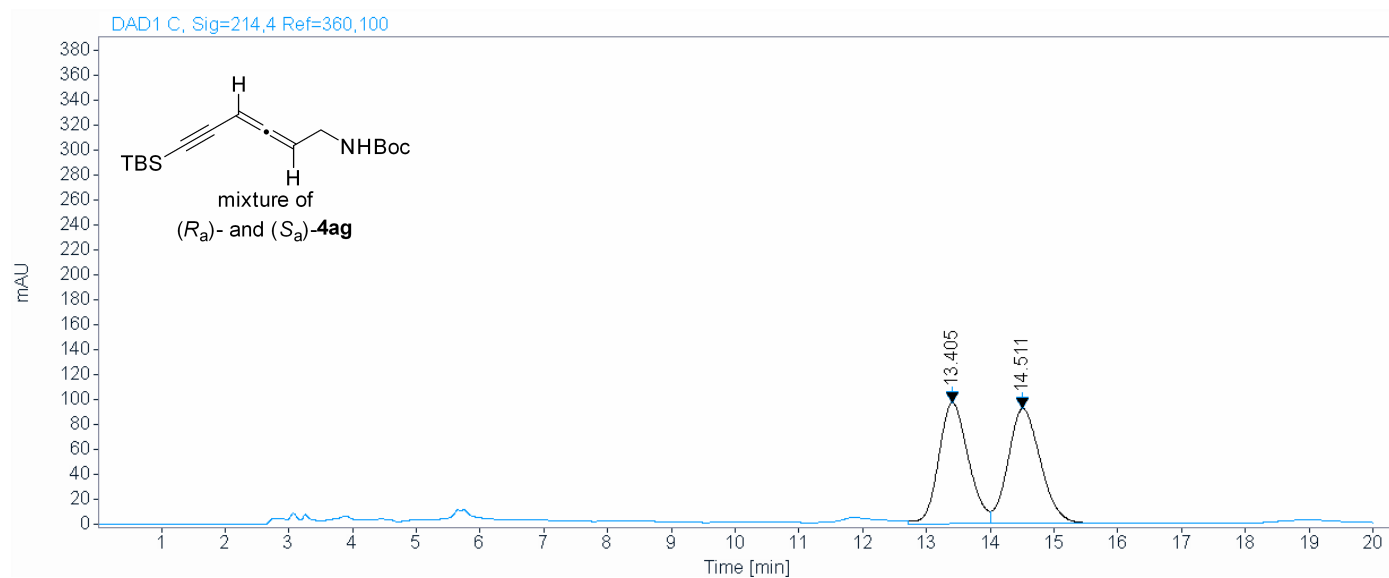
RT [min]	Width [min]	Height	Area	Area%
13.448	0.4774	154.1995	4771.6821	100.0000
Sum			4771.6821	100.0000

Area Percent Report

sample wgl-1-(145+146)-OD-H-99.5-0.5-1.0
-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2020-11-21 22-23-04\011-P1-E1
-wgl-1-(145+146).D

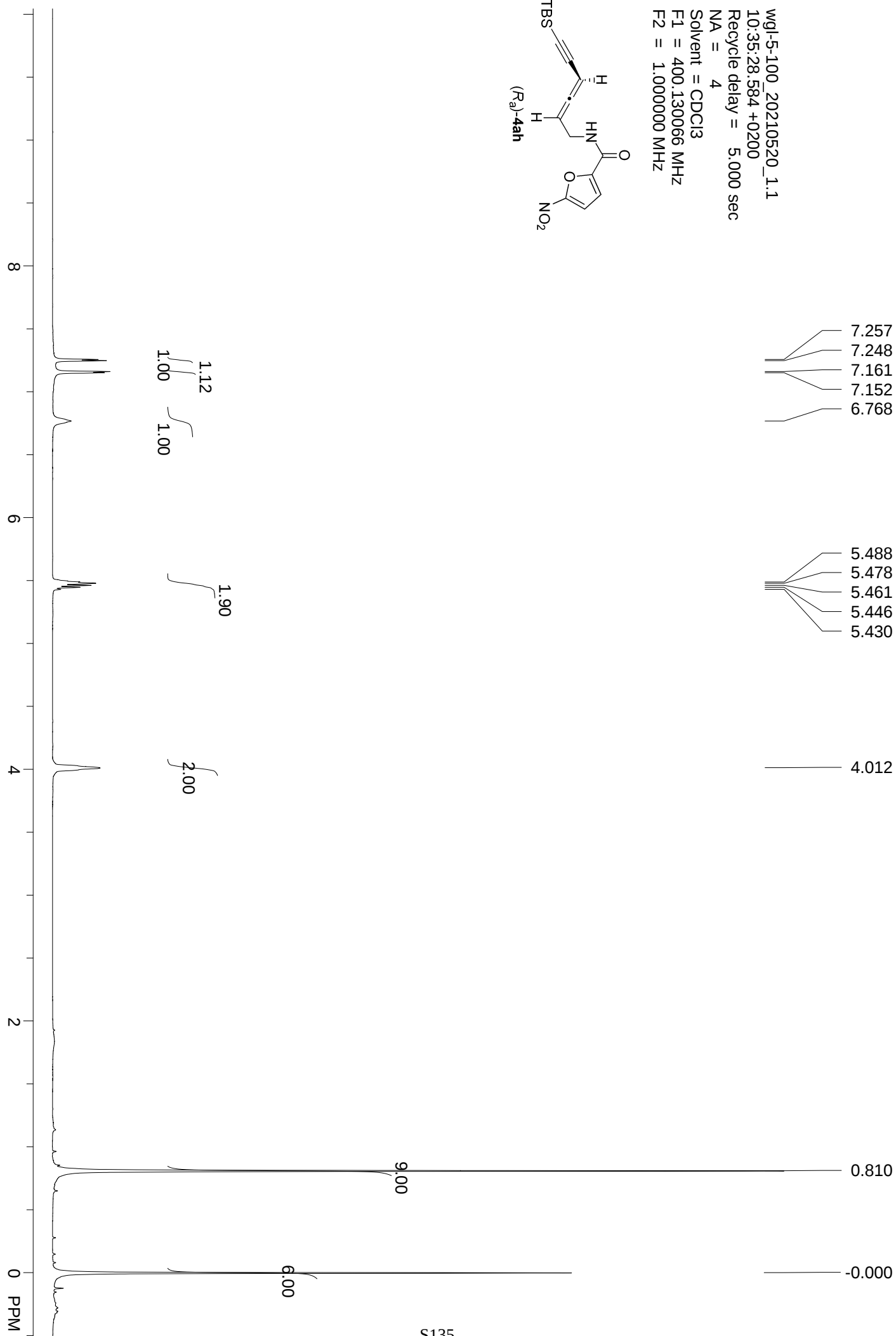
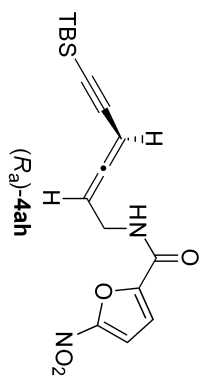
Acquisition Data:

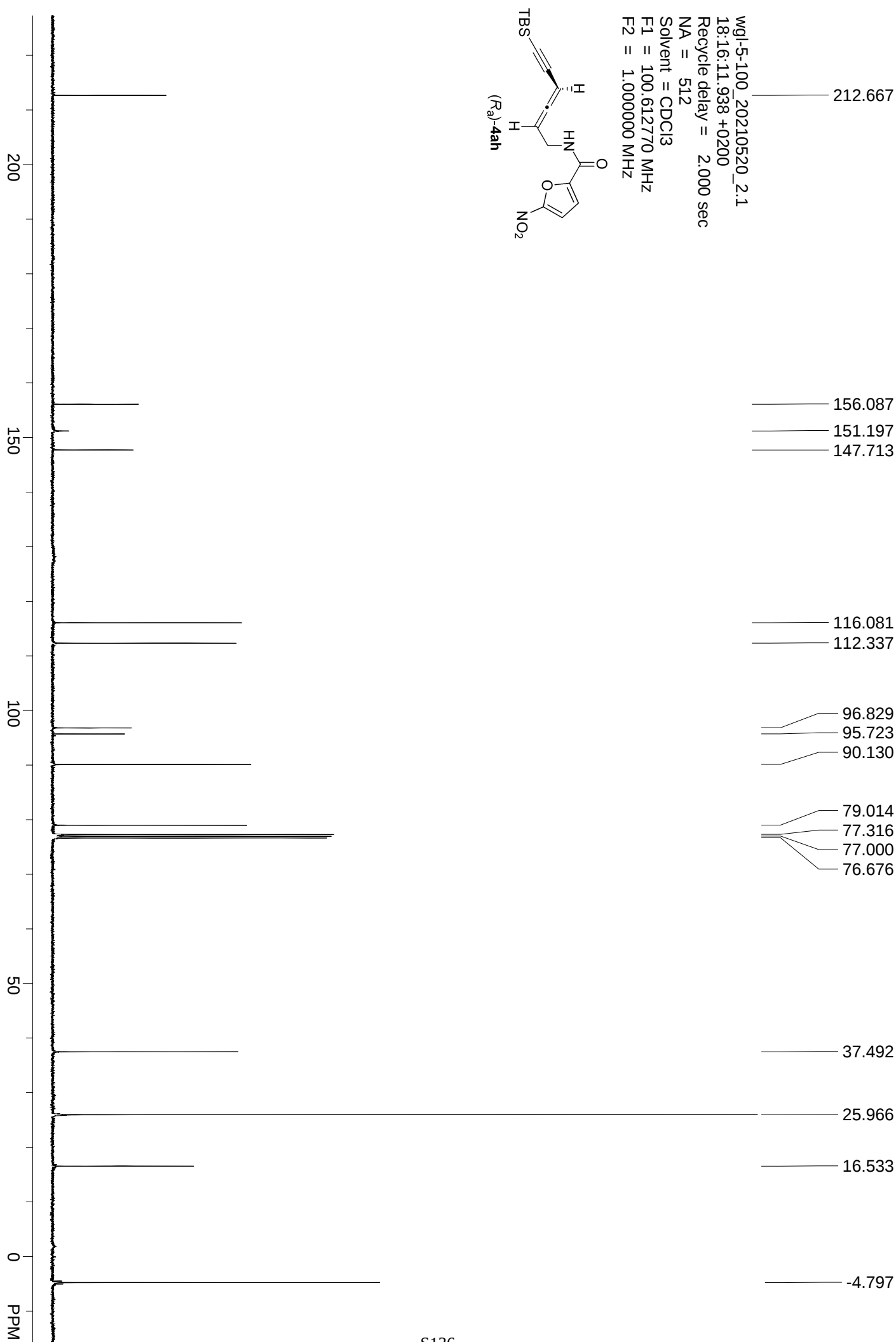


Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
13.405	0.5353	97.0198	3116.0916	49.1217
14.511	0.5602	91.7922	3227.5298	50.8783
Sum			6343.6213	100.0000

wgl-5-100_20210520_1.1
10:35:28.584 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl₃
F1 = 400.130066 MHz
F2 = 1.000000 MHz



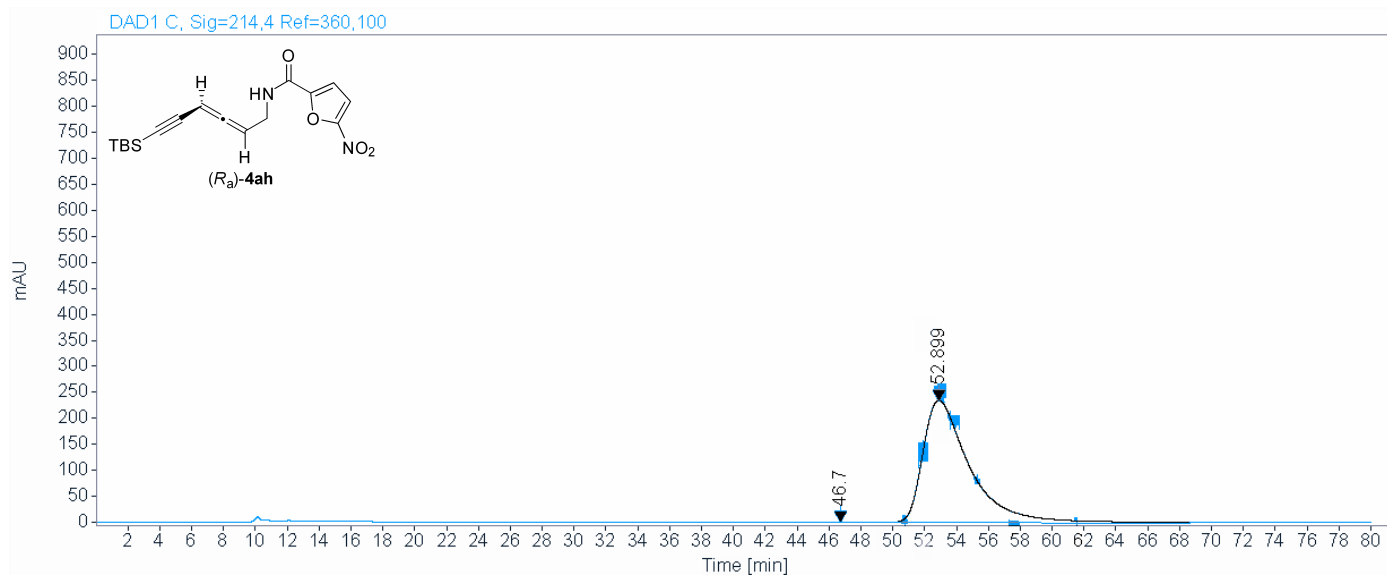


Area Percent Report

sample wgl-5-100-AS-H-80-20-0.3-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-05-22 08-53-51\003-P1-E2-wgl-5-100.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

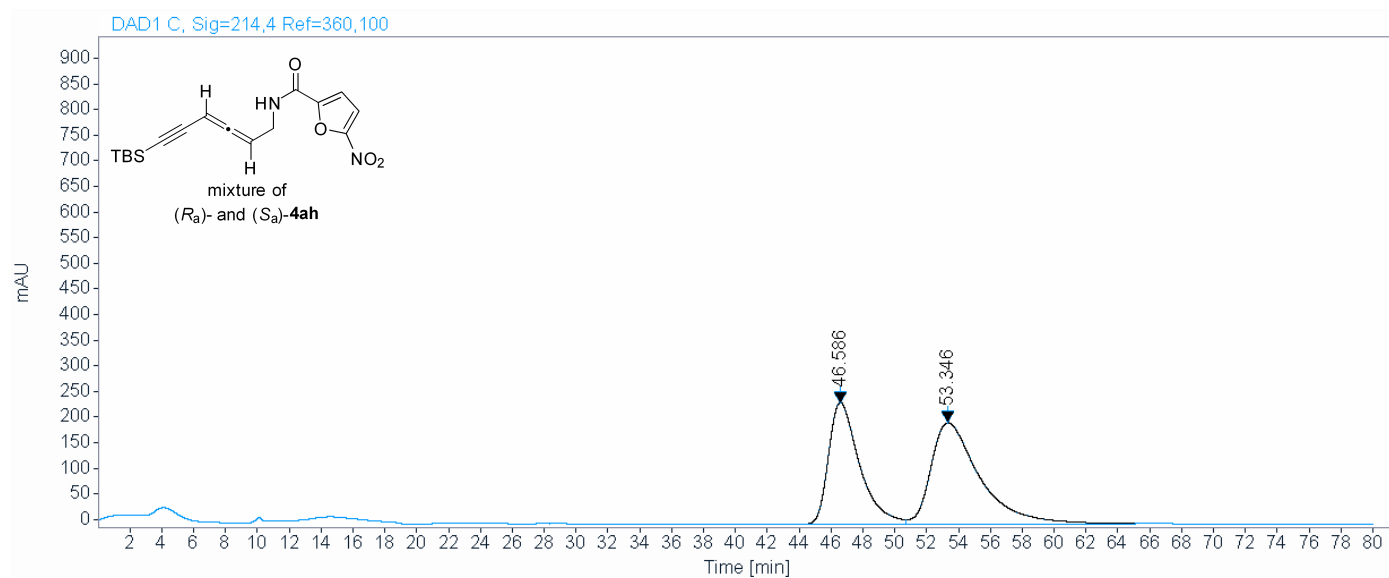
RT [min]	Width [min]	Height	Area	Area%
46.700	1.9484	0.8144	95.2032	0.1972
52.899	3.4200	234.7638	48173.9375	99.8028
Sum			48269.1407	100.0000

Area Percent Report

sample wgl-5-(100+103)-AS-H-80-20-0.3-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-05-22 08-53-51\002-P1-E1-wgl-5-(100+103).D

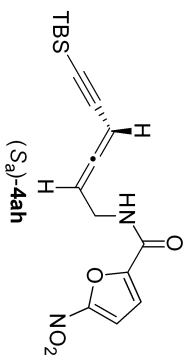
Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
46.586	2.2359	236.8733	31777.3066	43.1923
53.346	3.5251	197.6020	41794.4258	56.8077
		Sum	73571.7324	100.0000

wj-5-103_20210521_1.1
 04:15:35.284 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130035 MHz
 F2 = 1.000000 MHz



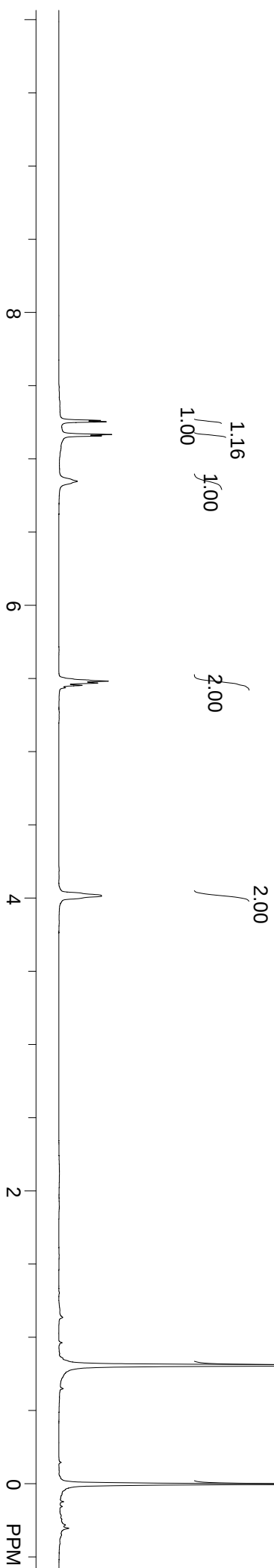
7.262
 7.253
 7.166
 7.157
 6.847

5.481
 5.468
 5.452
 5.437

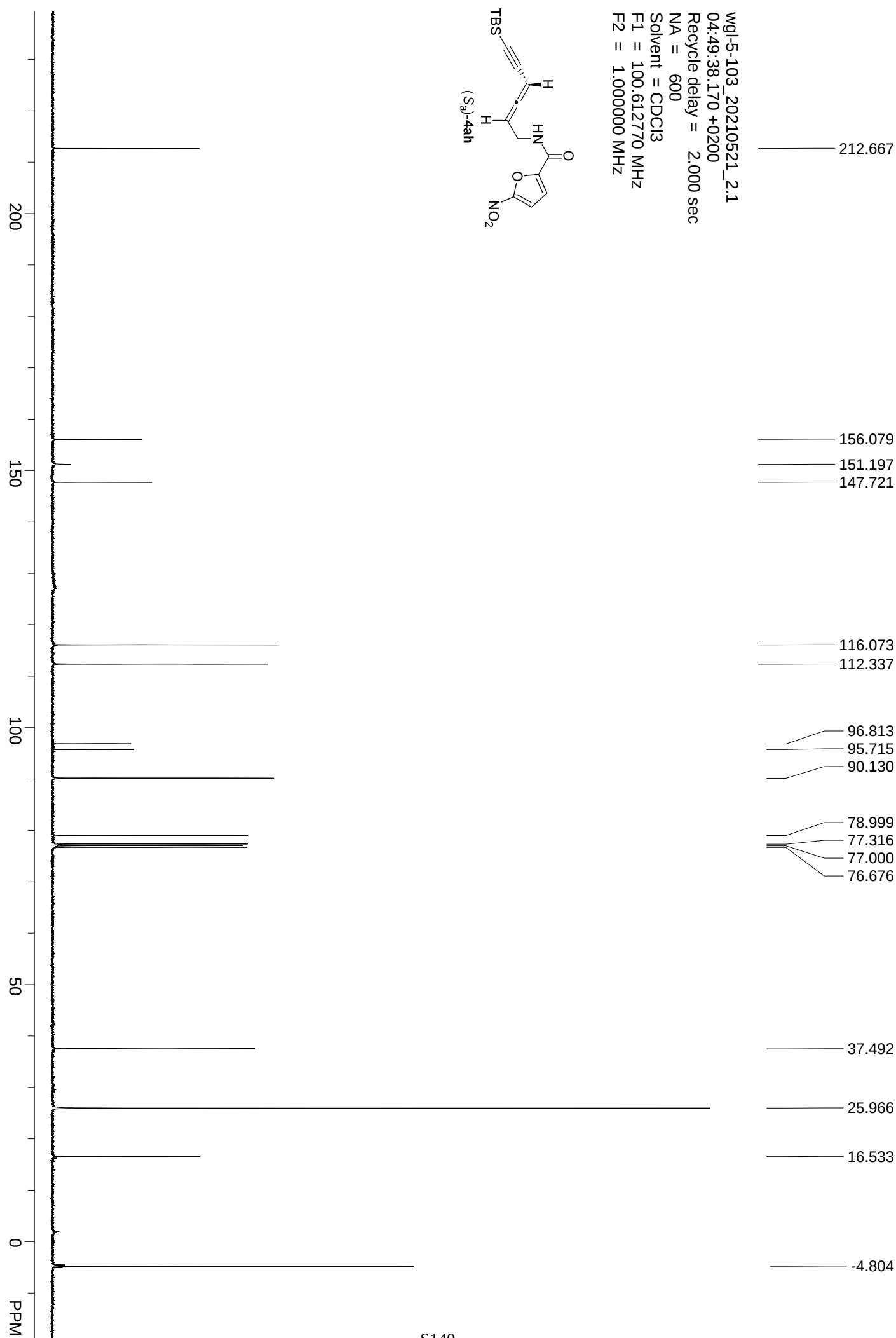
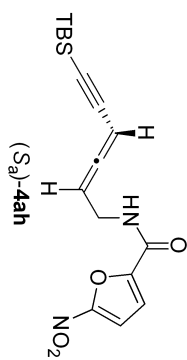
4.012

0.811

0.000



wgl-5-103_20210521_2.1
 04:49:38.170 +0200
 Recycle delay = 2.000 sec
 NA = 600
 Solvent = CDCl3
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

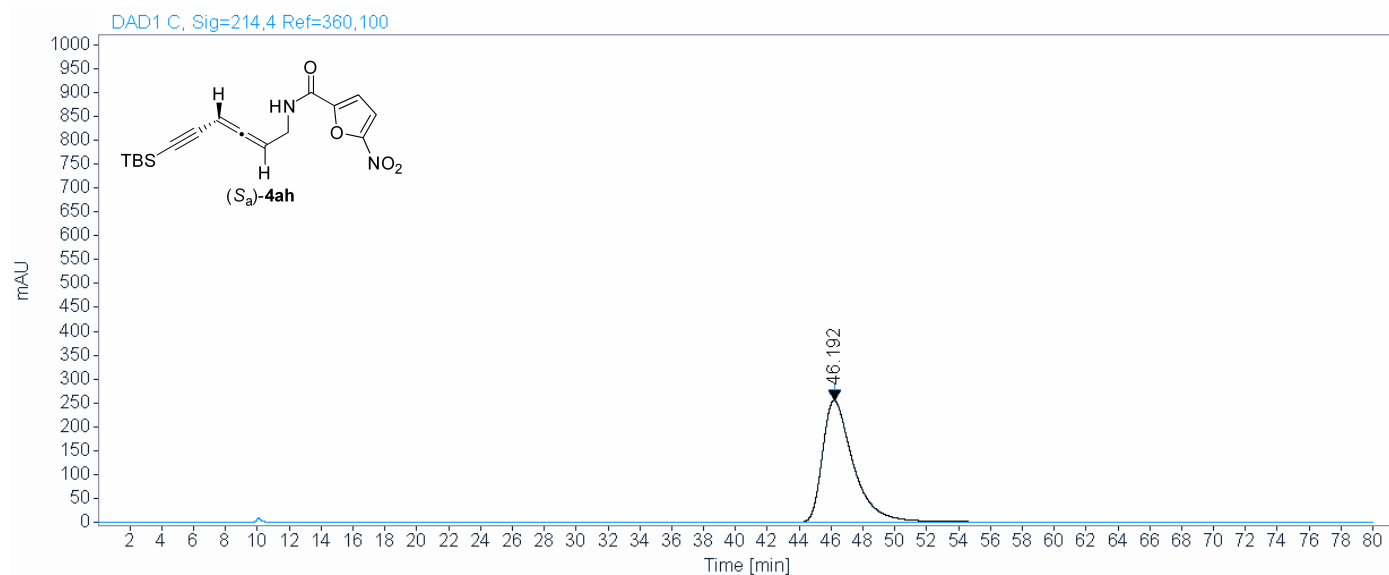


Area Percent Report

sample wgl-5-103-AS-H-80-20-0.3-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-05-22 08-53-51\004-P1-E3-wgl-5-103.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

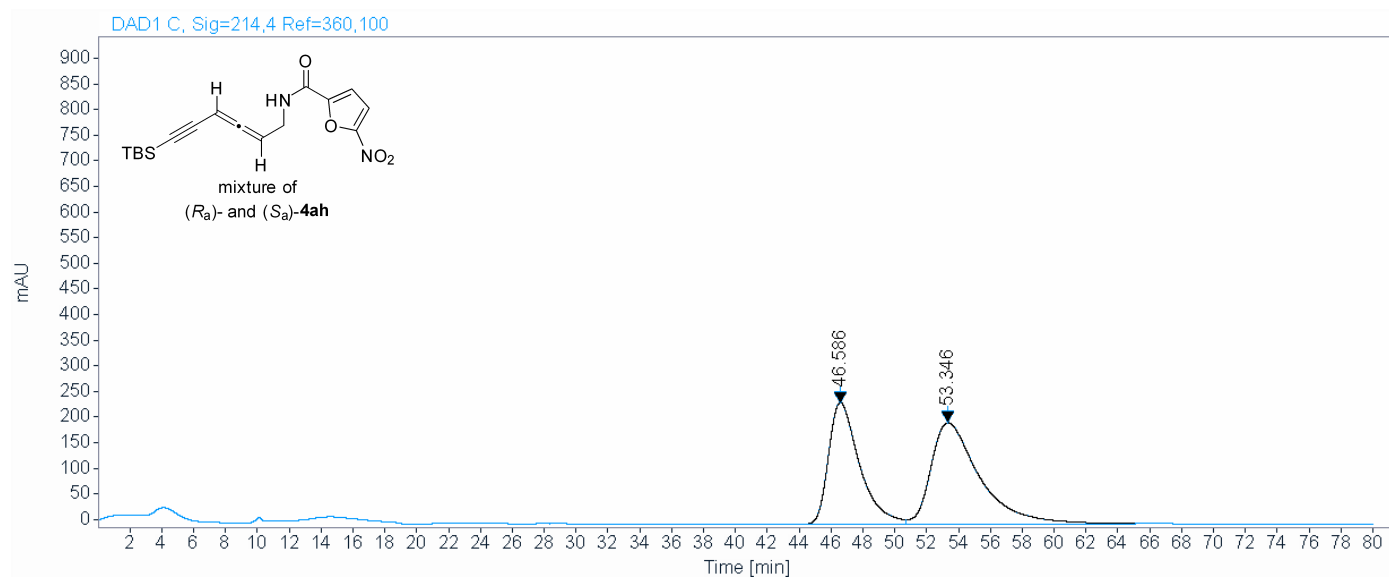
RT [min]	Width [min]	Height	Area	Area%
46.192	2.2830	255.2524	34963.8945	100.0000
		Sum	34963.8945	100.0000

Area Percent Report

sample wgl-5-(100+103)-AS-H-80-20-0.3-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-05-22 08-53-51\002-P1-E1-wgl-5-(100+103).D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
46.586	2.2359	236.8733	31777.3066	43.1923
53.346	3.5251	197.6020	41794.4258	56.8077
		Sum	73571.7324	100.0000

7.612
7.592
7.209
7.189
7.164

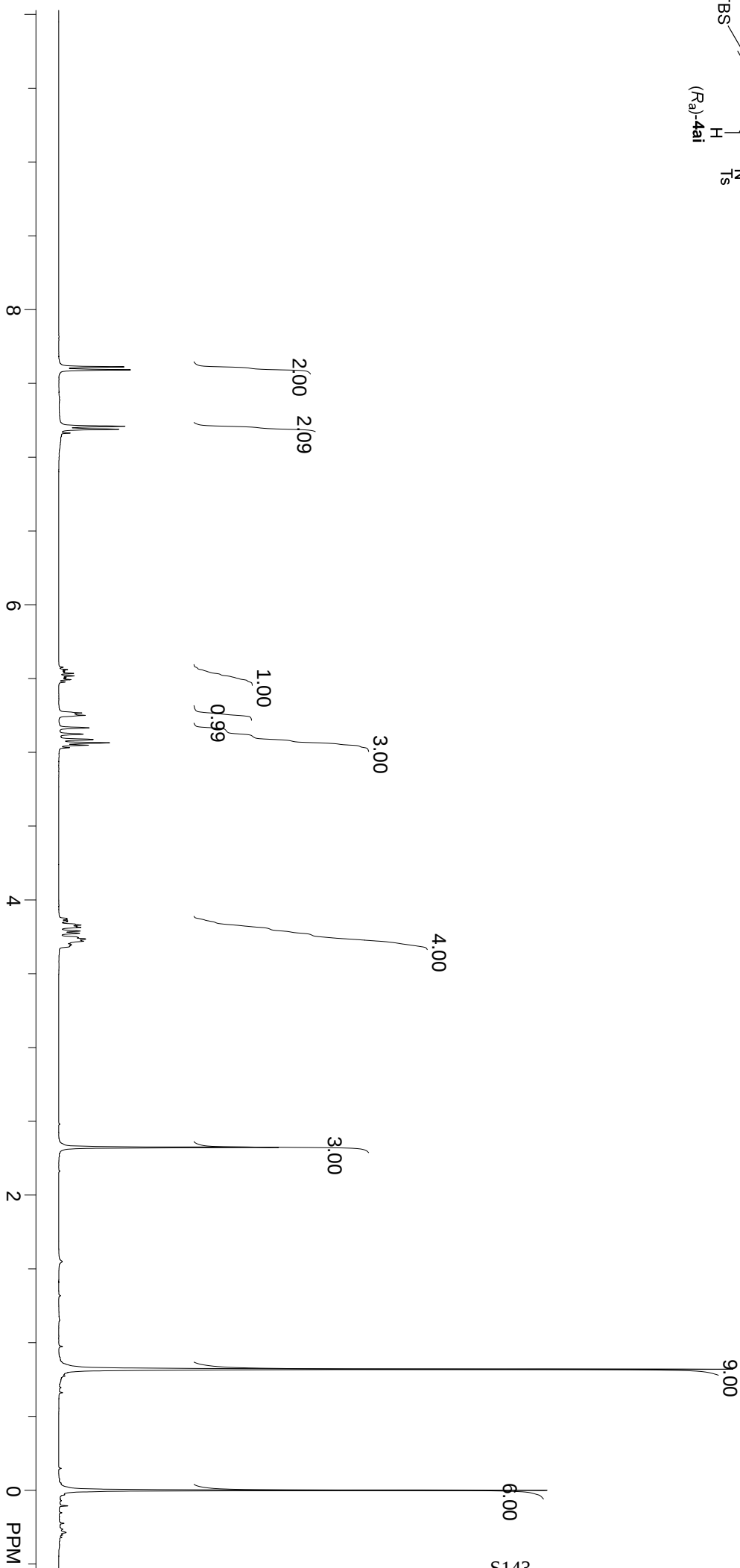
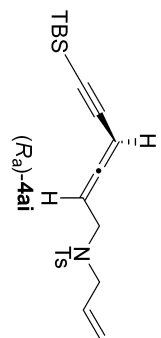
5.577
5.560
5.535
5.518
5.493
5.477
5.267
5.251
5.166
5.124
5.087
5.065
5.049
5.032
3.875
3.869
3.858
3.853
3.830
3.814
3.789
3.774
3.735
3.720
3.695
3.684
2.324

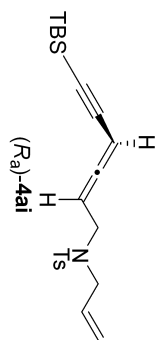
0.820

-0.000

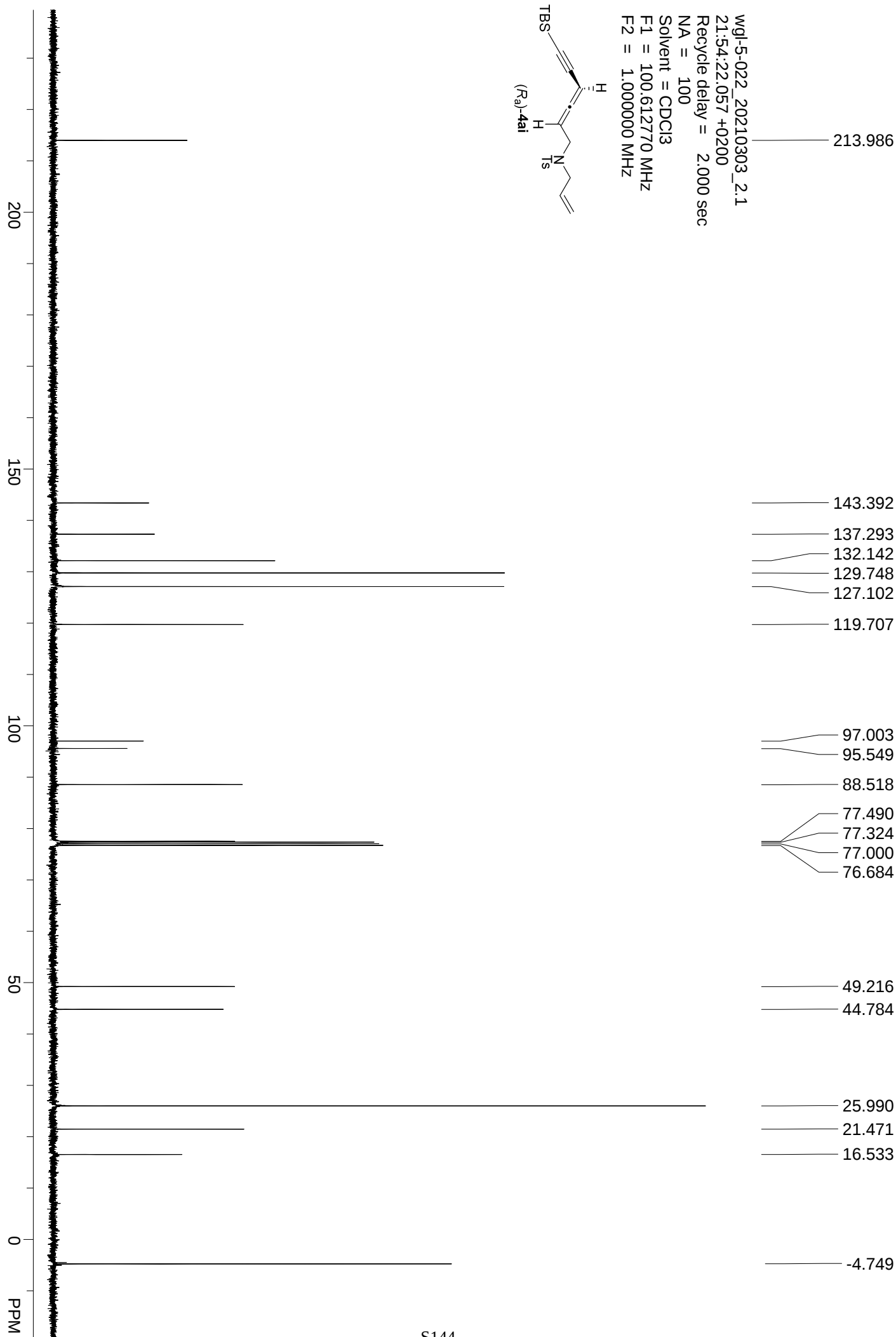
wgl-5-022_20210303_1.1
21:47:59.333 +0200
Recycle delay = 5.000 sec
NA = 4

Solvent = CDCl₃
F1 = 400.130035 MHz
F2 = 1.000000 MHz





wj-5-022_20210303_2.1
 21:54:22.057 +0200
 Recycle delay = 2.000 sec
 NA = 100
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

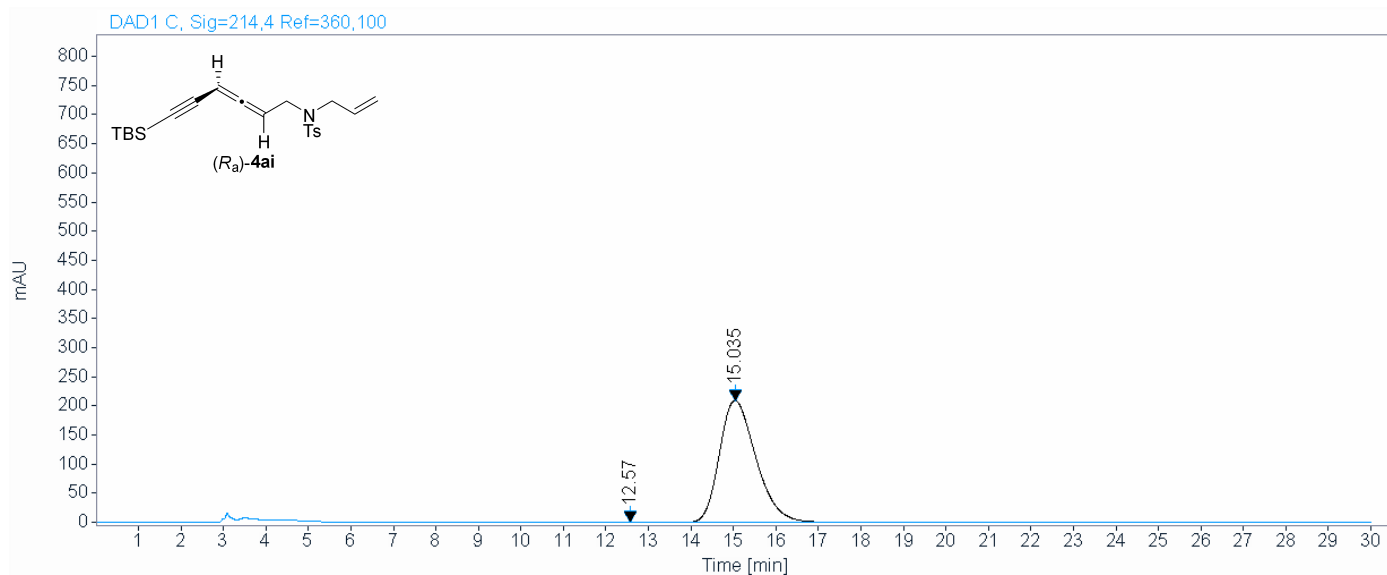


Area Percent Report

sample wgl-5-022-AS-H-97-3-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-03-04 15-25-21\016-P1-E2-wgl-5-022.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

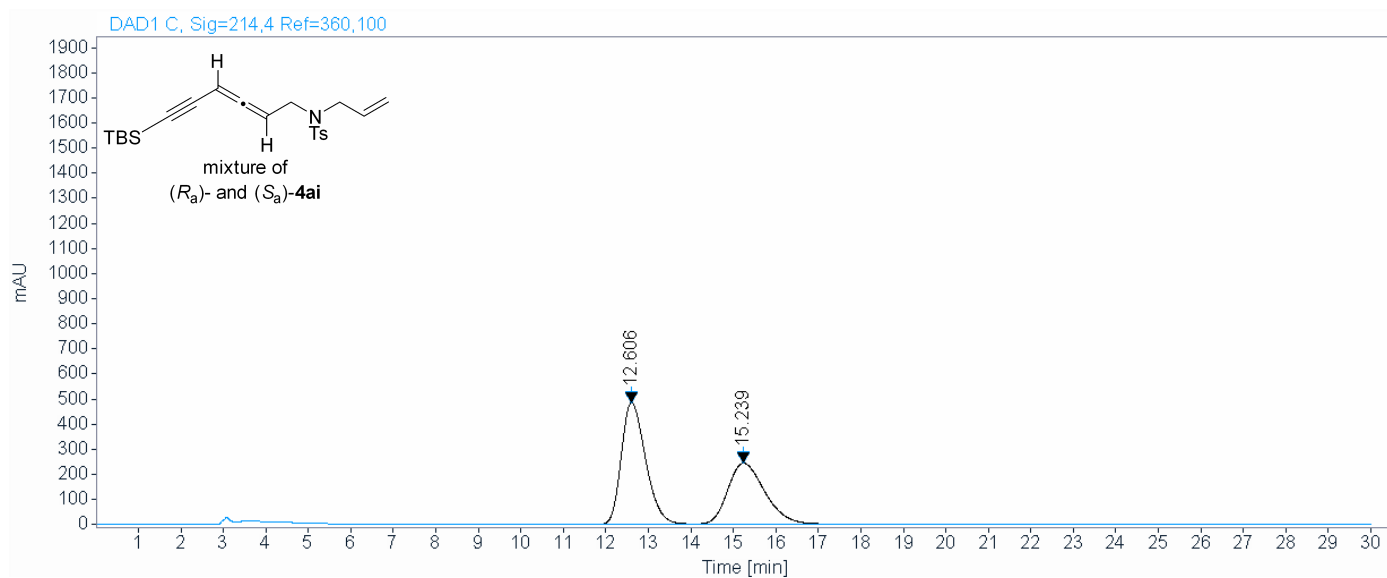
RT [min]	Width [min]	Height	Area	Area%
12.570	0.5994	0.7279	26.1788	0.2075
15.035	0.9255	209.4200	12592.6328	99.7925
		Sum	12618.8116	100.0000

Area Percent Report

sample wgl-5-(022+023)-AS-H-97-3-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2021-03-04 15-25-21\015-P1-E1-wgl-5-(022+023).D

Acquisition Data:



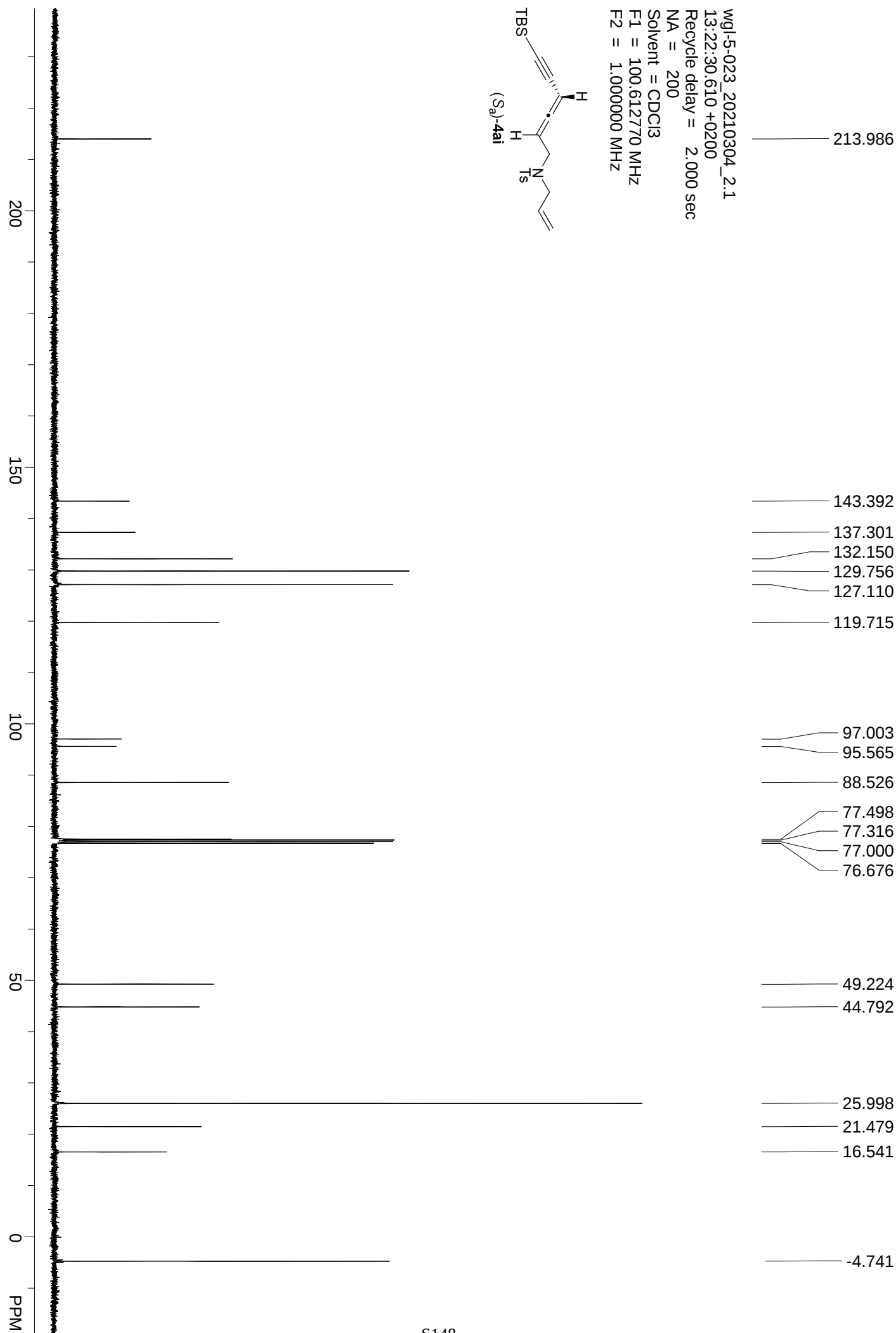
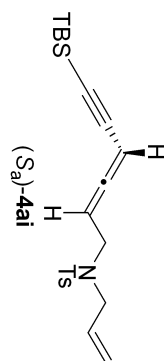
Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
12.606	0.6227	485.0163	19318.9805	56.8842
15.239	0.9371	242.2816	14642.9902	43.1158
Sum			33961.9707	100.0000

F2 = 1.000000 MHz



wjl-5-023_20210304_2.1
 13:22:30.610 +0200
 Recycle delay = 2.000 sec
 NA = 200
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

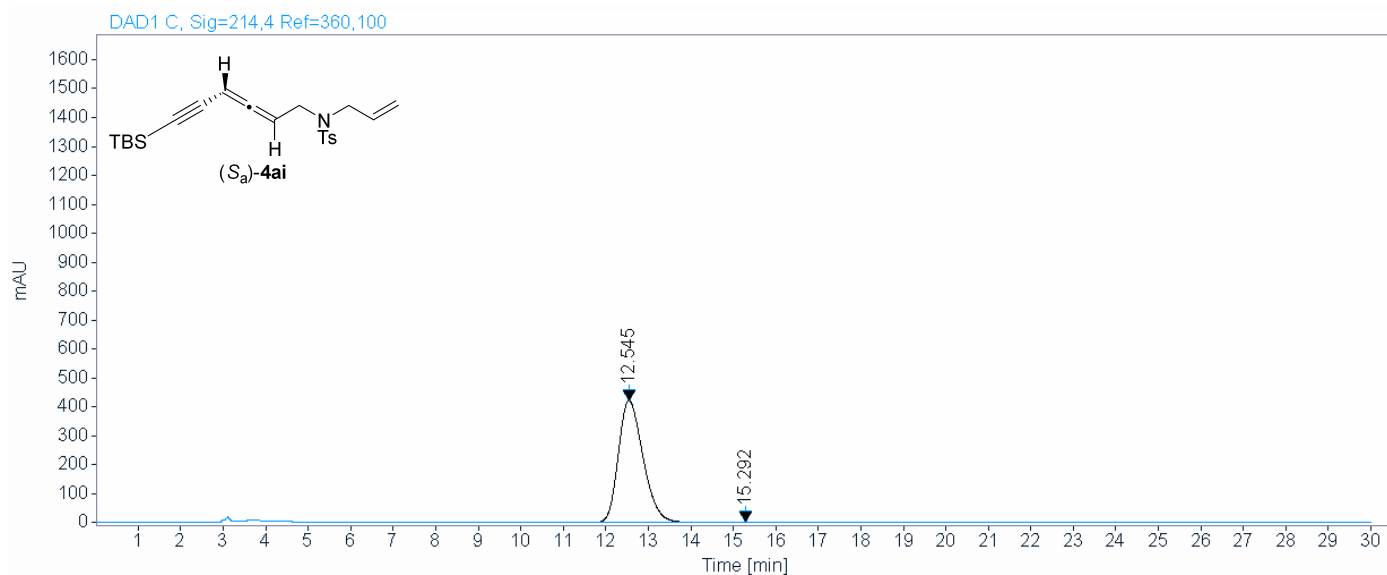


Area Percent Report

sample wgl-5-023-AS-H-97-3-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-03-04 15-25-21\017-P1-E3-wgl-5-023.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

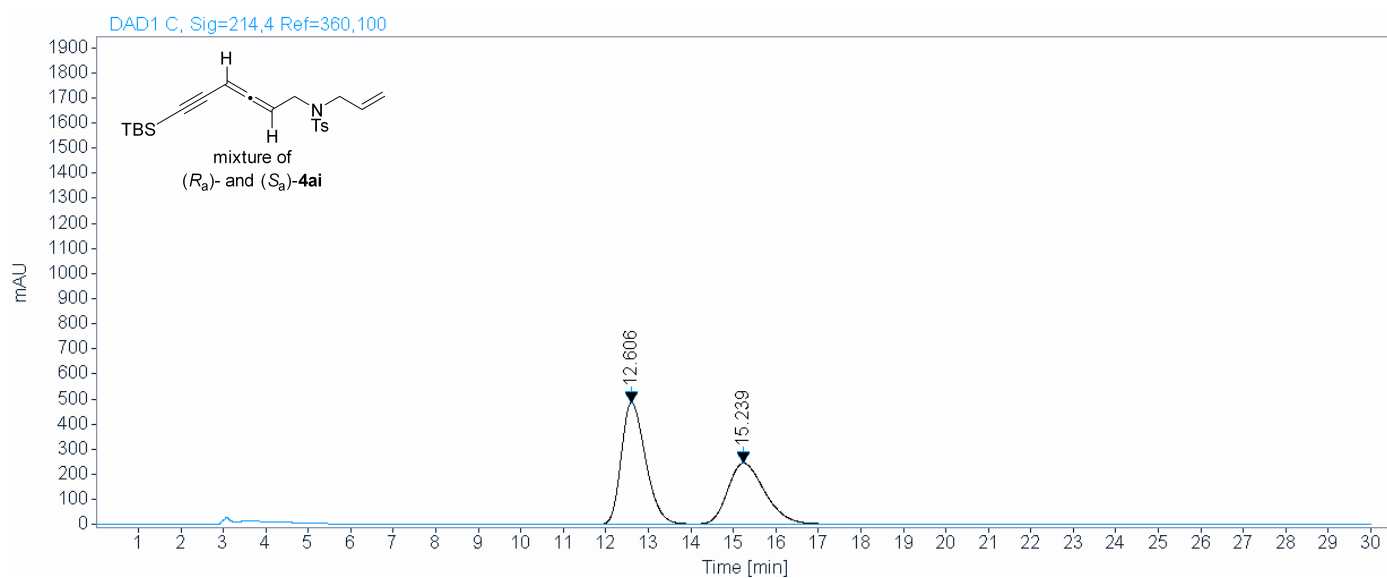
RT [min]	Width [min]	Height	Area	Area%
12.545	0.6308	421.7495	17093.0840	99.6715
15.292	0.8104	1.1586	56.3385	0.3285
Sum			17149.4225	100.0000

Area Percent Report

sample wgl-5-(022+023)-AS-H-97-3-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2021-03-04 15-25-21\015-P1-E1-wgl-5-(022+023).D

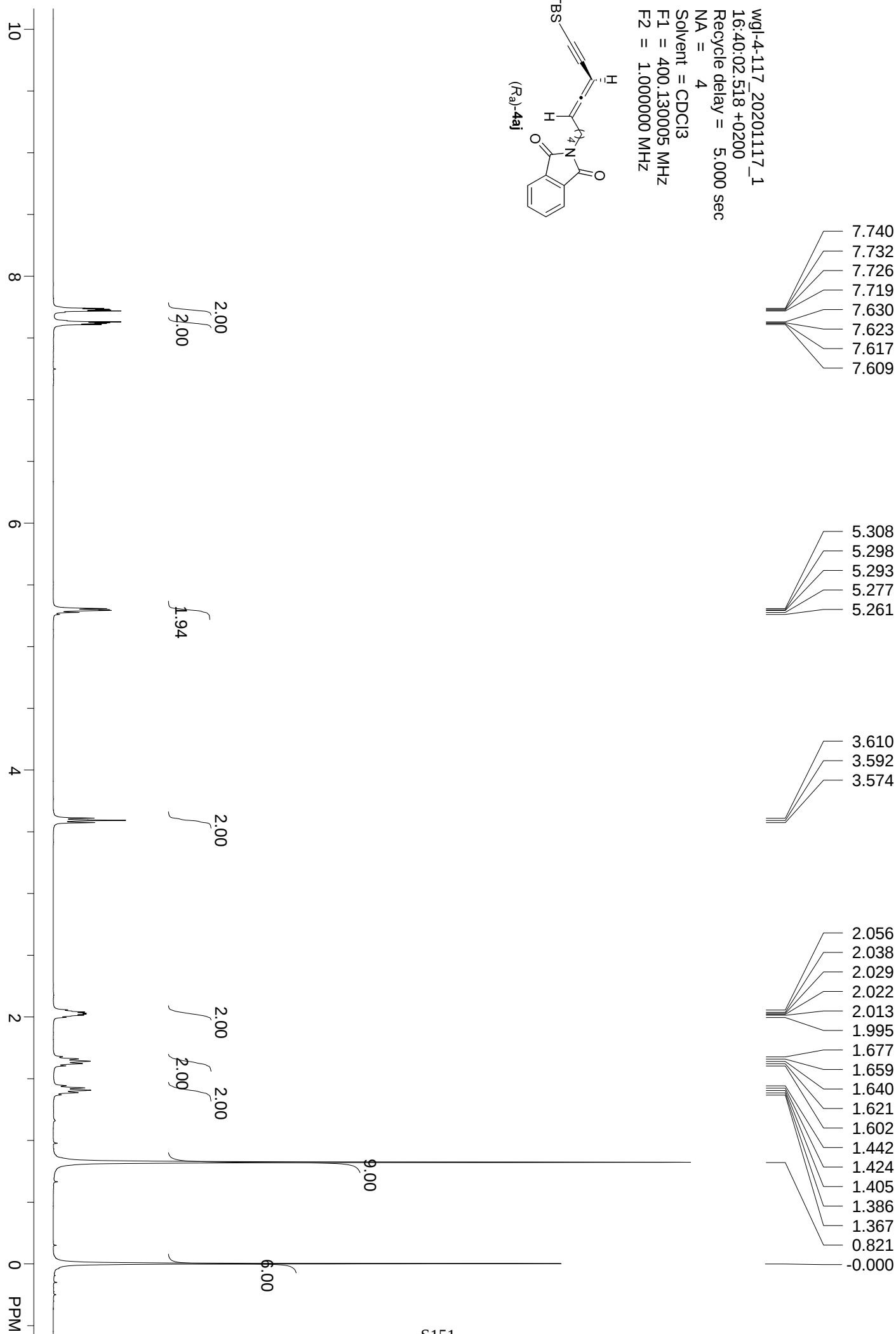
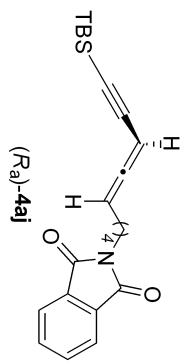
Acquisition Data:



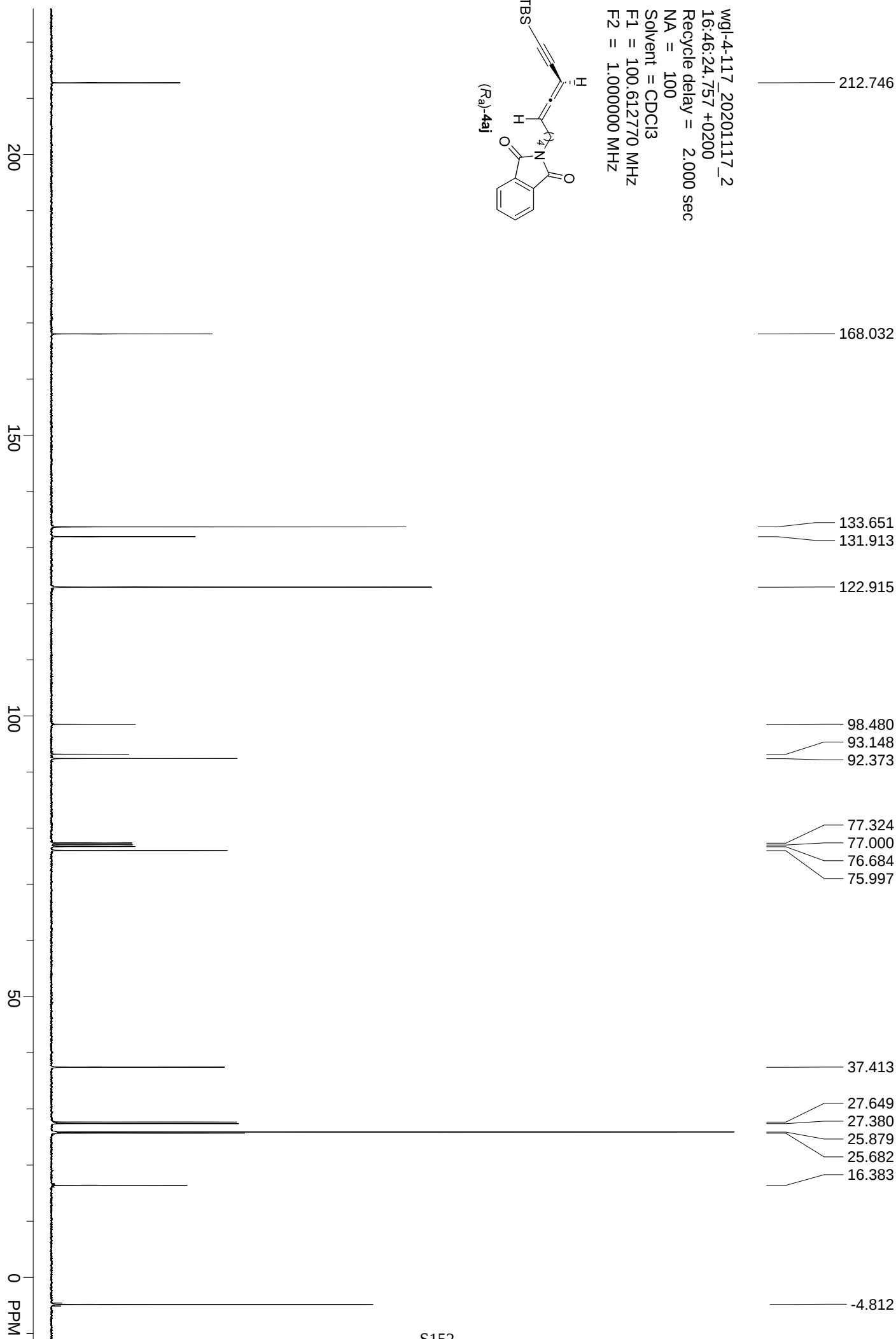
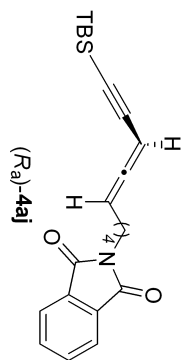
Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
12.606	0.6227	485.0163	19318.9805	56.8842
15.239	0.9371	242.2816	14642.9902	43.1158
Sum			33961.9707	100.0000

wgl-4-117_20201117_1
 16:40:02.518 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130005 MHz
 F2 = 1.000000 MHz



wqf-4-117_20201117_2
 16:46:24.757 +0200
 Recycle delay = 2.000 sec
 NA = 100
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

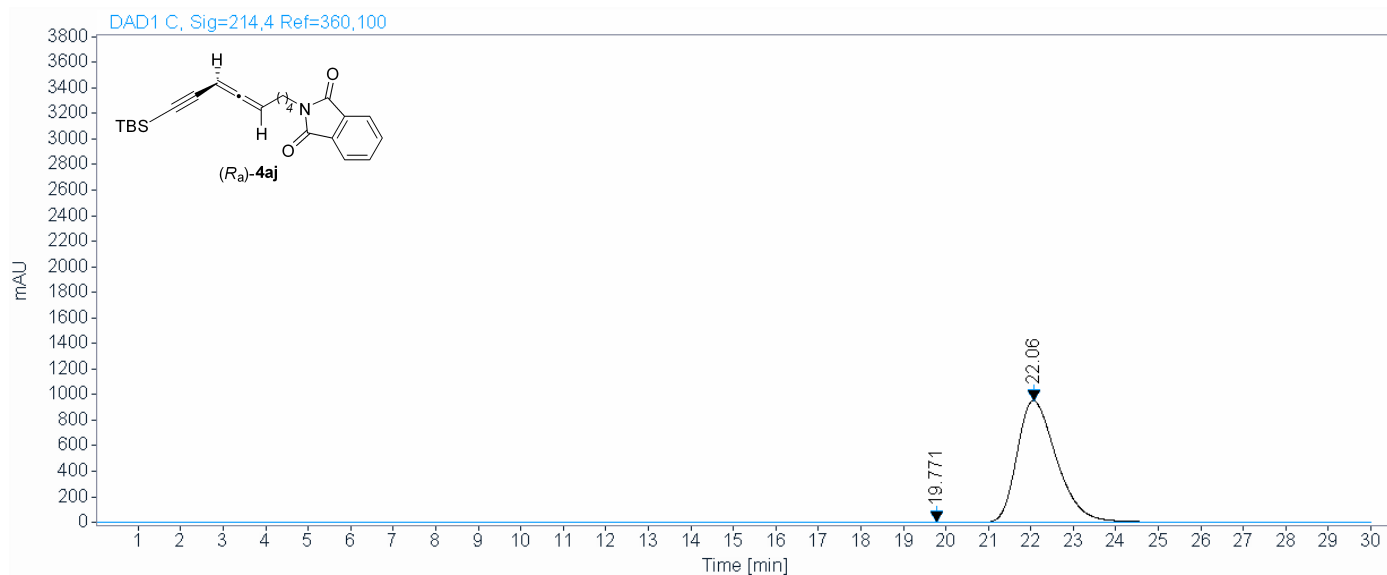


Area Percent Report

sample wgl-4-117-OJ-H-99-1-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2020-11-17 20-31-03\010-P1-E3-wgl-4-117.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

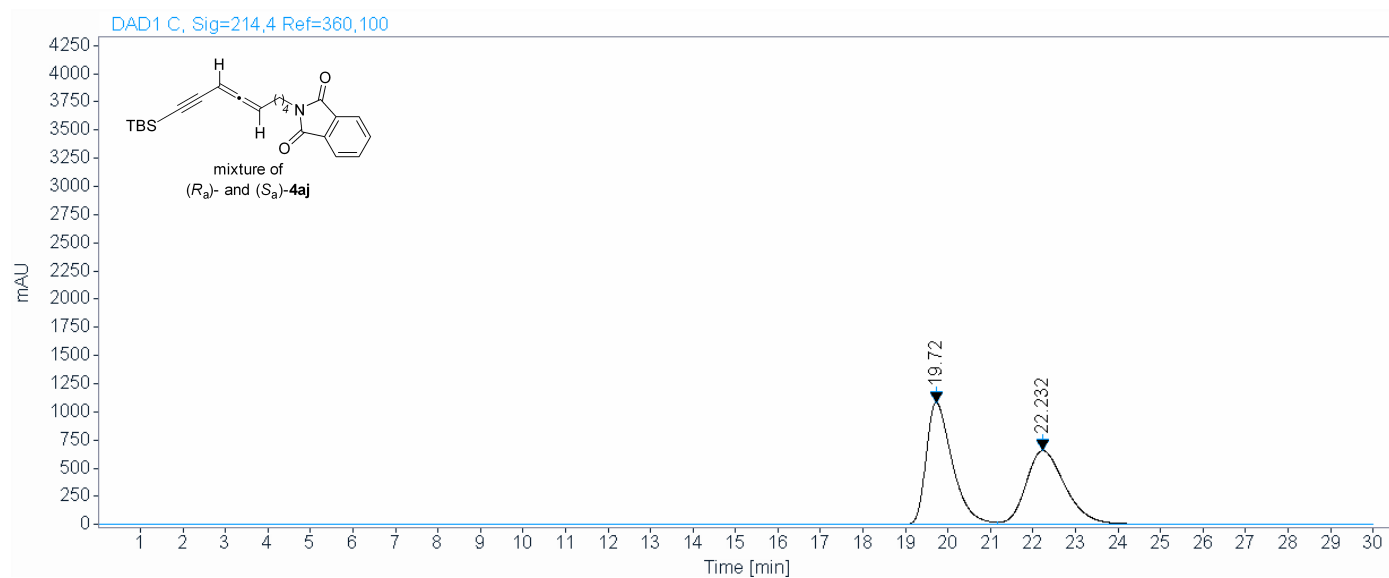
RT [min]	Width [min]	Height	Area	Area%
19.771	0.4874	1.1819	34.5651	0.0558
22.060	0.9953	954.3364	61944.4805	99.9442
		Sum	61979.0455	100.0000

Area Percent Report

sample wgl-4-(116+117)-OJ-H-99-1-0.5-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2020-11-17 20-31-03\011-P1-E1-wgl-4-(116+117).D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
19.720	0.6496	1081.5437	46130.0586	52.3072
22.232	0.9877	654.5428	42060.6367	47.6928
Sum			88190.6953	100.0000

7.736
7.729
7.723
7.715
7.631
7.623
7.618
7.610

5.310
5.301
5.295
5.279
5.263

3.607
3.590
3.572

2.056
2.038
2.029
2.013
1.995
1.676
1.658
1.639
1.620
1.602
1.442
1.423
1.404
1.385
1.367
0.821
0.000

wjl-4-116_20201117_1.1

18:47:31.276 +0200

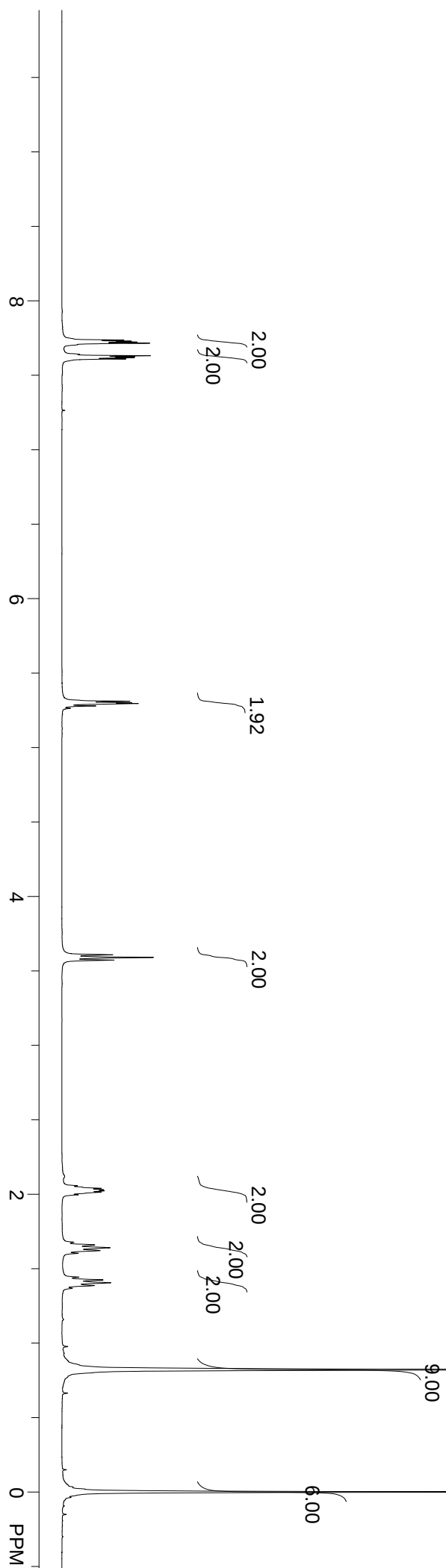
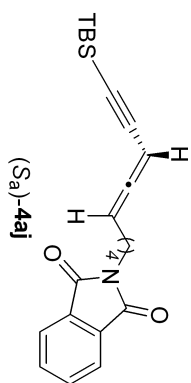
Recycle delay = 5.000 sec

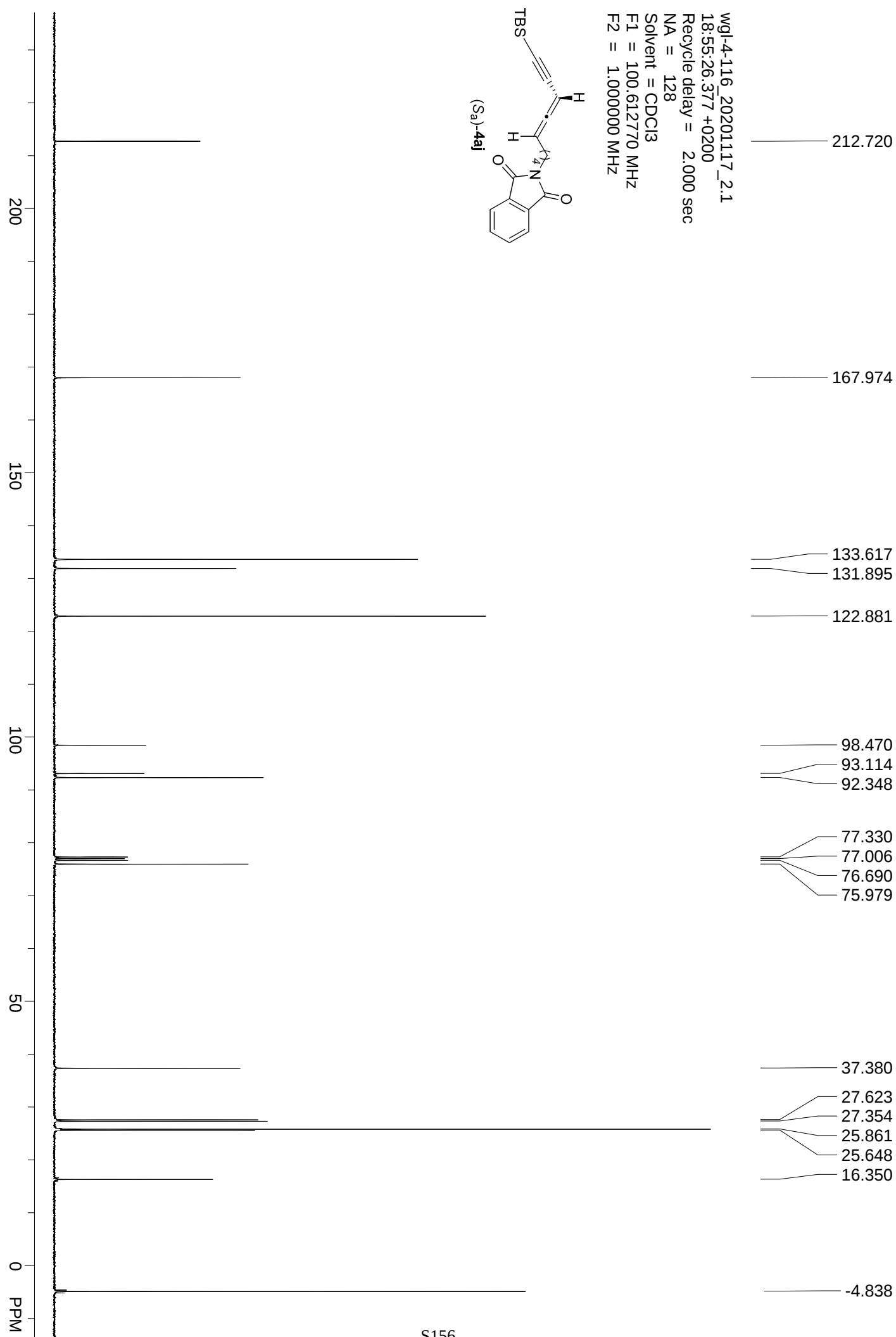
NA = 4

Solvent = CDCl₃

F1 = 400.13005 MHz

F2 = 1.000000 MHz



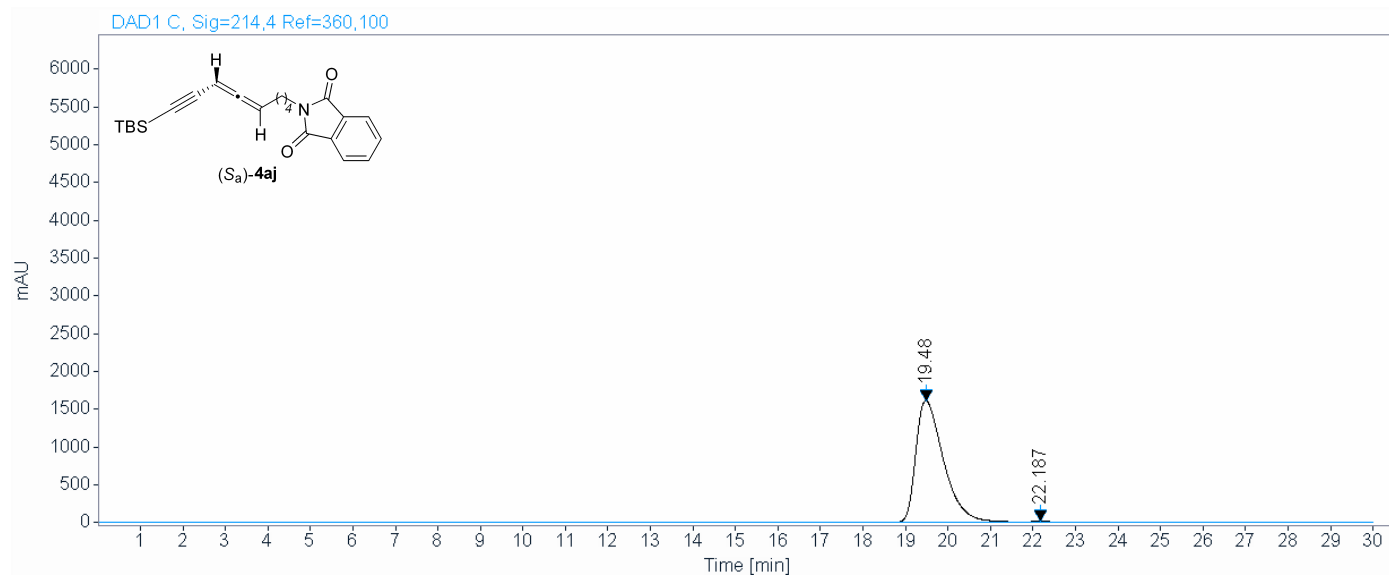


Area Percent Report

sample wgl-4-116-OJ-H-99-1-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2020-11-17 20-31-03\012-P1-E2-wgl-4-116.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

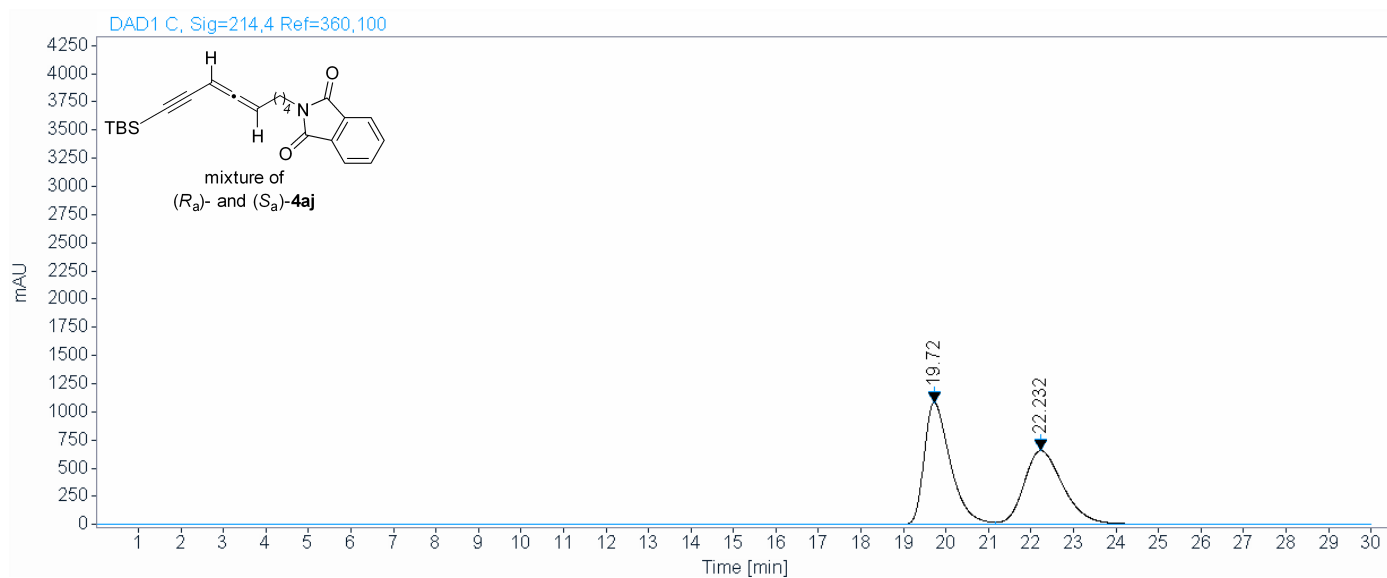
RT [min]	Width [min]	Height	Area	Area%
19.480	0.6844	1610.7528	72131.8047	99.7280
22.187	0.7253	4.0468	196.7671	0.2720
		Sum	72328.5718	100.0000

Area Percent Report

sample wgl-4-(116+117)-OJ-H-99-1-0.5-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2020-11-17 20-31-03\011-P1-E1-wgl-4-(116+117).D

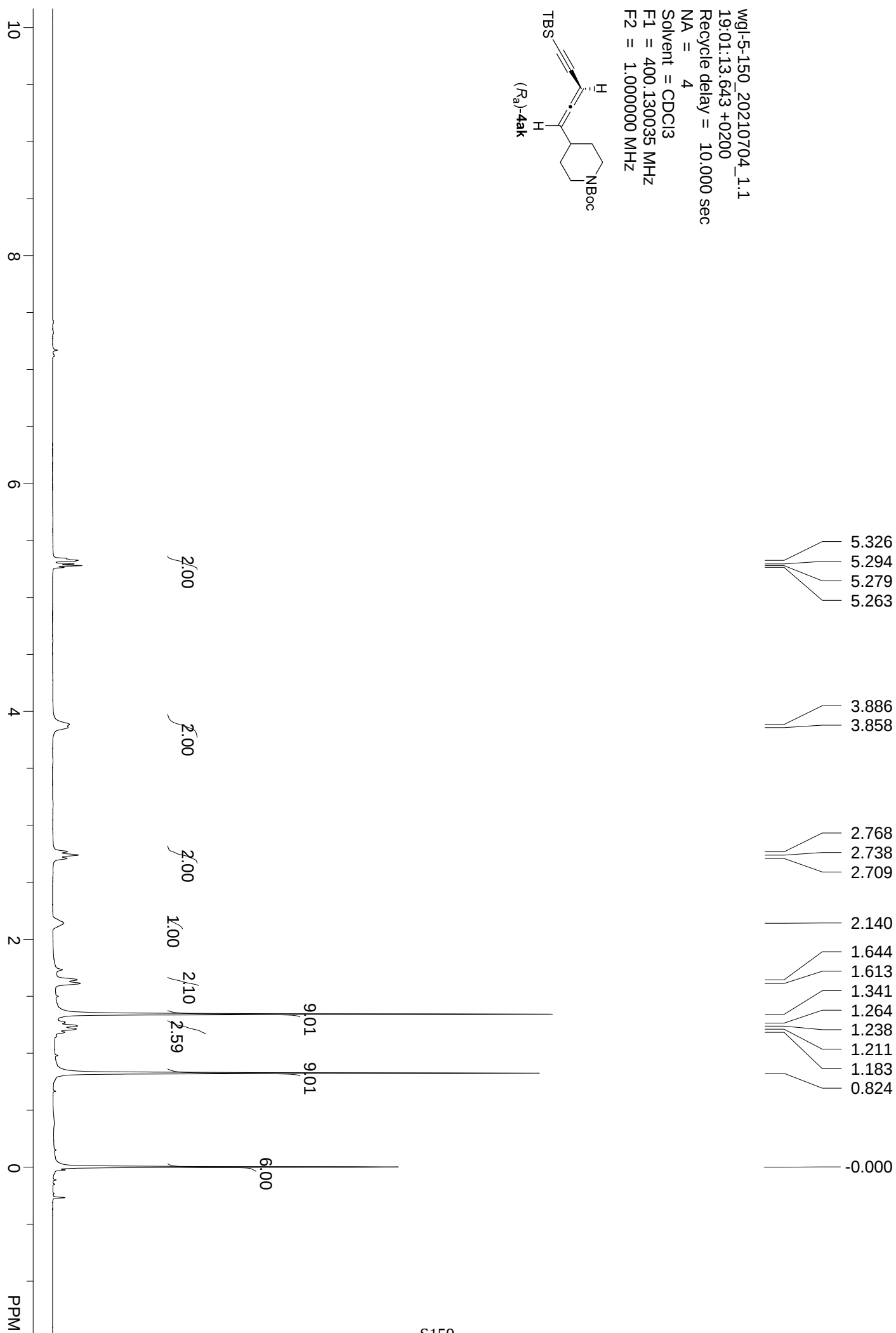
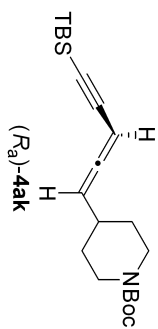
Acquisition Data:

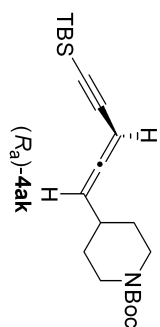


Signal: DAD1 C, Sig=214,4 Ref=360,100

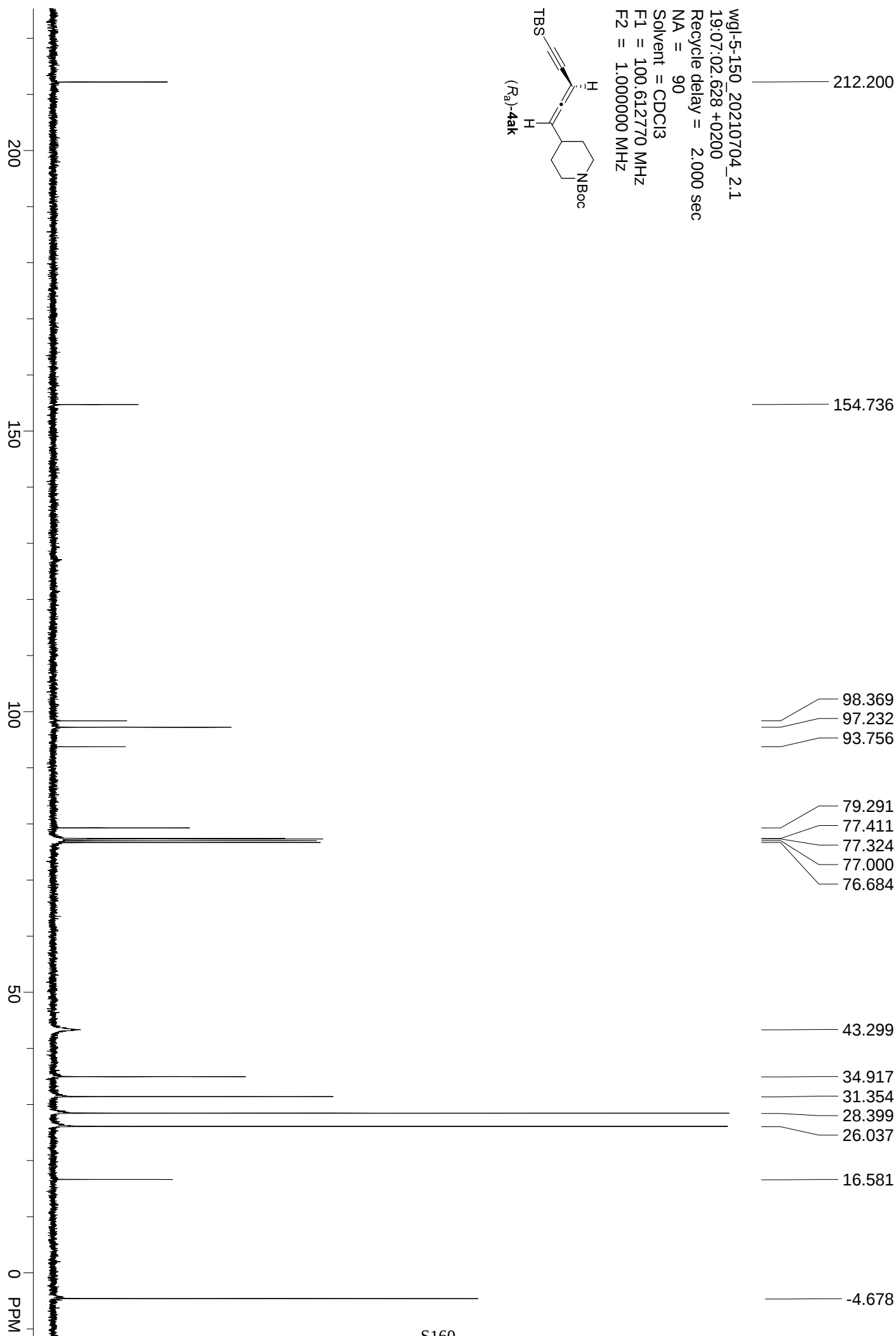
RT [min]	Width [min]	Height	Area	Area%
19.720	0.6496	1081.5437	46130.0586	52.3072
22.232	0.9877	654.5428	42060.6367	47.6928
		Sum	88190.6953	100.0000

wj-5-150_20210704_1.1
 19:01:13.643 +0200
 Recycle delay = 10.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130035 MHz
 F2 = 1.000000 MHz





wj1-5-150_20210704_2.1
 19:07:02.628 +0200
 Recycle delay = 2.000 sec
 NA = 90
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

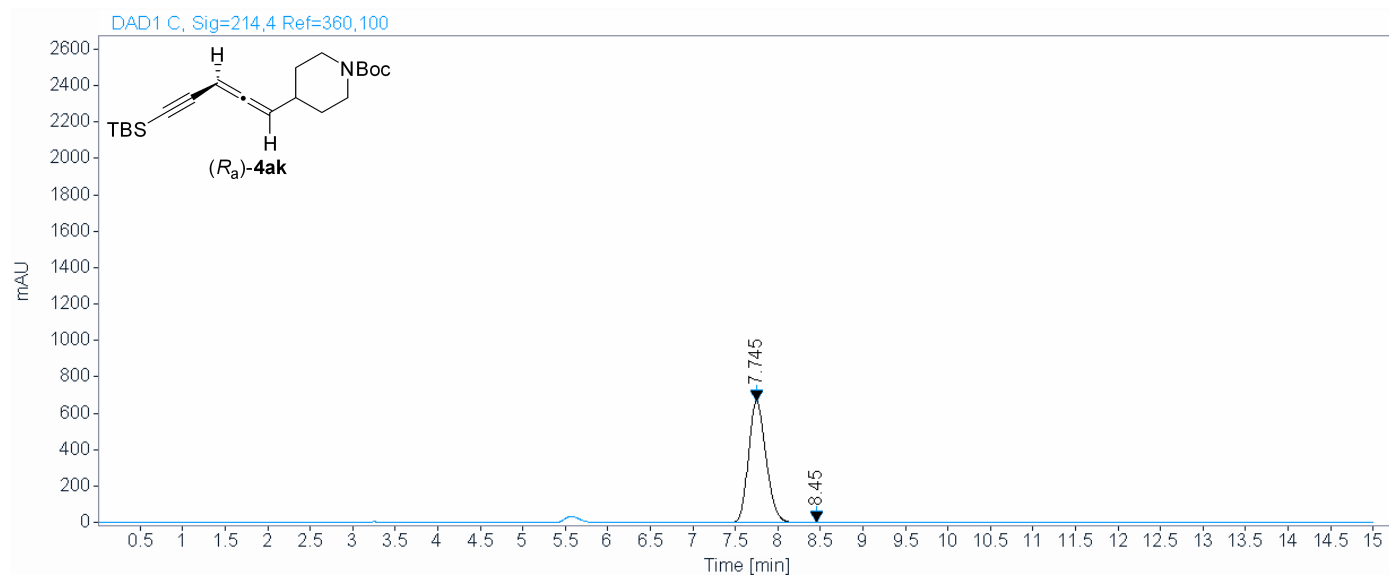


Area Percent Report

sample wgl-5-150-IC-99-1-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2021-07-06 08-23-31\004-P1-E6-wgl-5-150.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

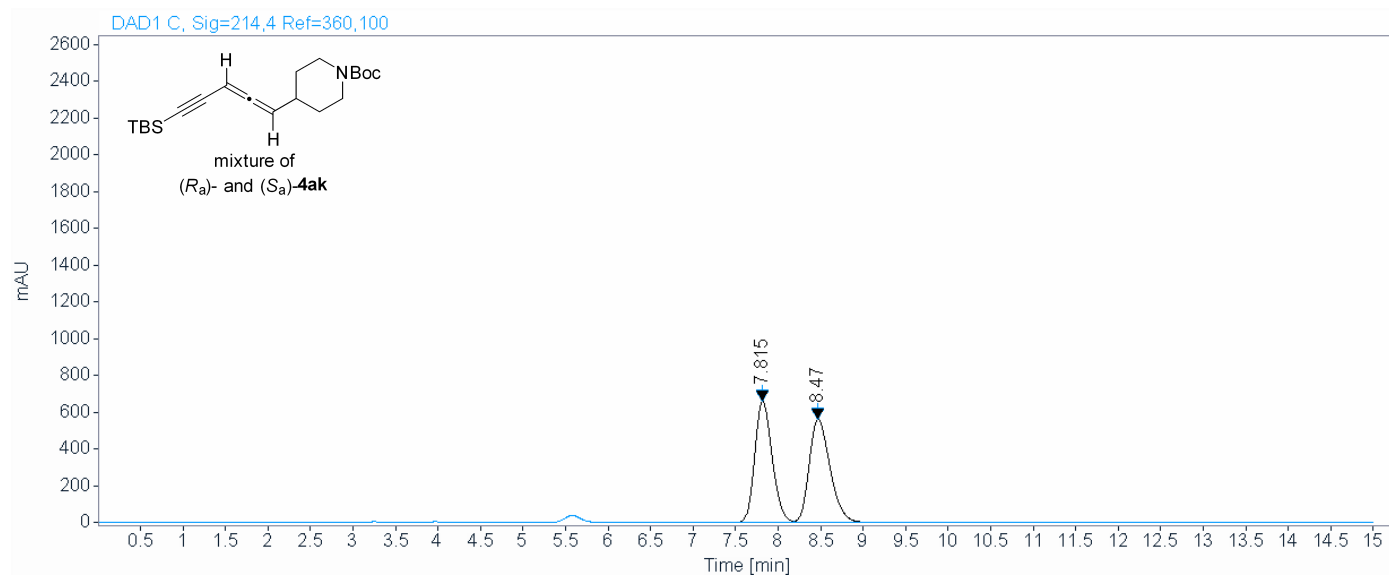
RT [min]	Width [min]	Height	Area	Area%
7.745	0.2373	669.2400	9528.5654	99.7810
8.450	0.3424	1.0178	20.9126	0.2190
		Sum	9549.4781	100.0000

Area Percent Report

sample wgl-5-(146+150)-IC-99-1-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2021-07-06 08-23-31\002-P1-E4-wgl-5-(146+150).D

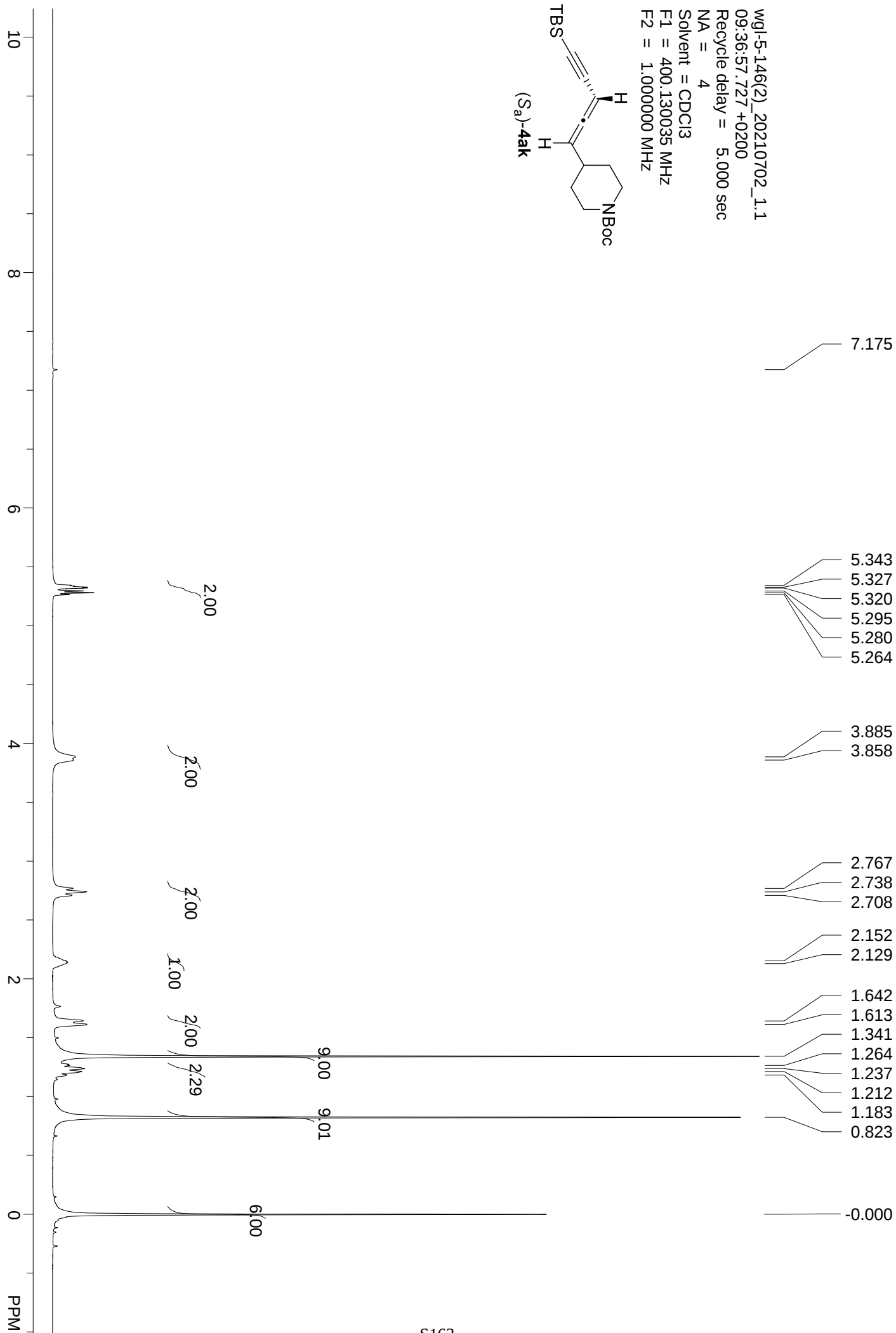
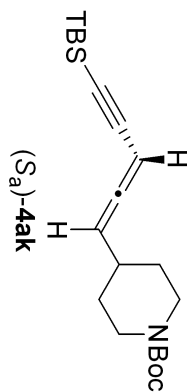
Acquisition Data:



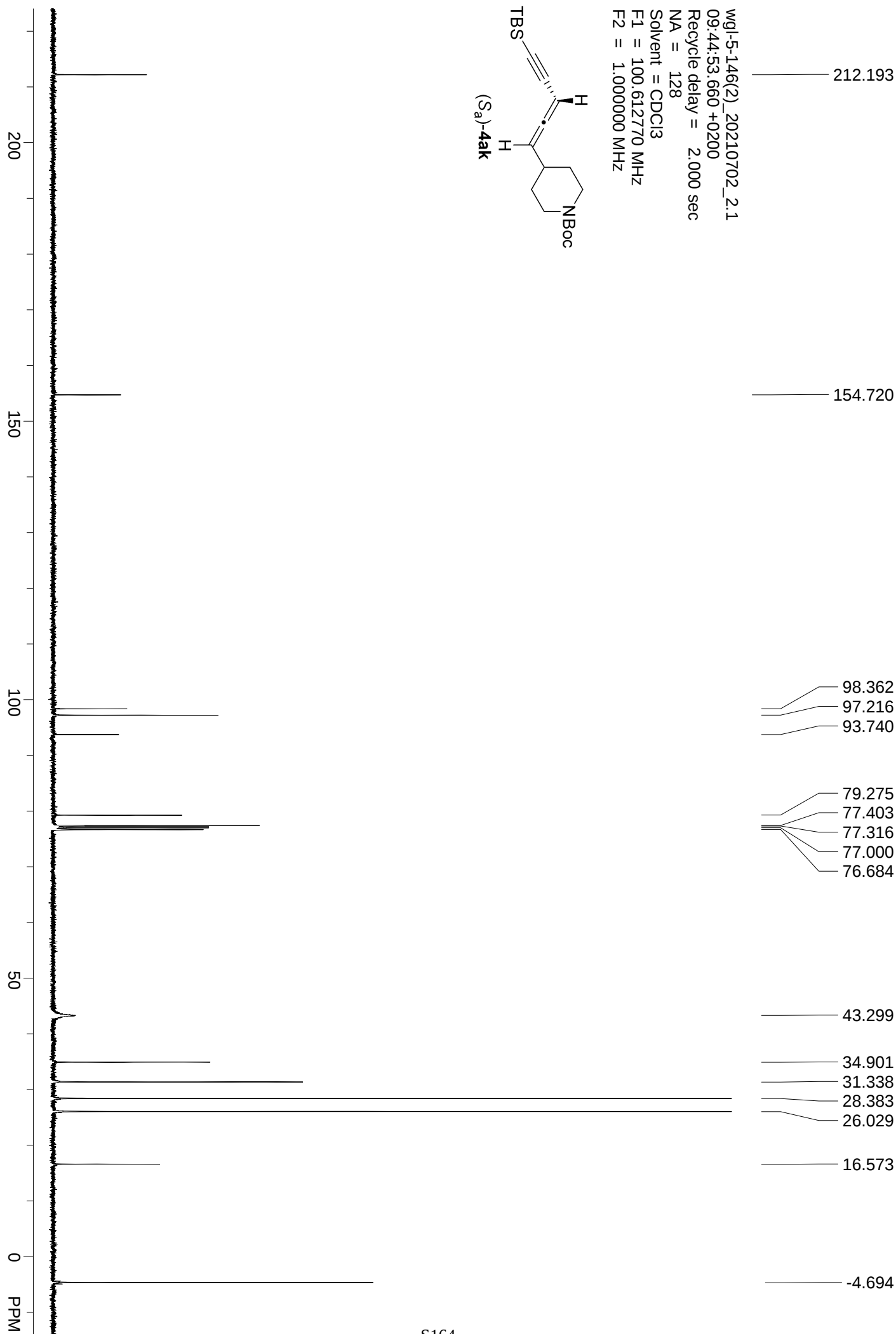
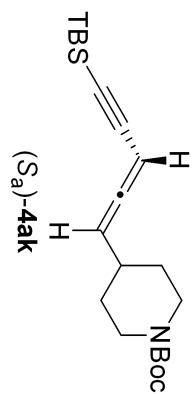
Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
7.815	0.2202	661.9419	9432.5381	49.2747
8.470	0.2651	563.2547	9710.2422	50.7253
		Sum	19142.7803	100.0000

wjl-5-146(2)_20210702_1.1
 09:36:57.727 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130035 MHz
 F2 = 1.000000 MHz



wj-5-146(2)_20210702_2.1
09:44:53.660 +0200
Recycle delay = 2.000 sec
NA = 128
Solvent = CDCl₃
F1 = 100.612770 MHz
F2 = 1.000000 MHz

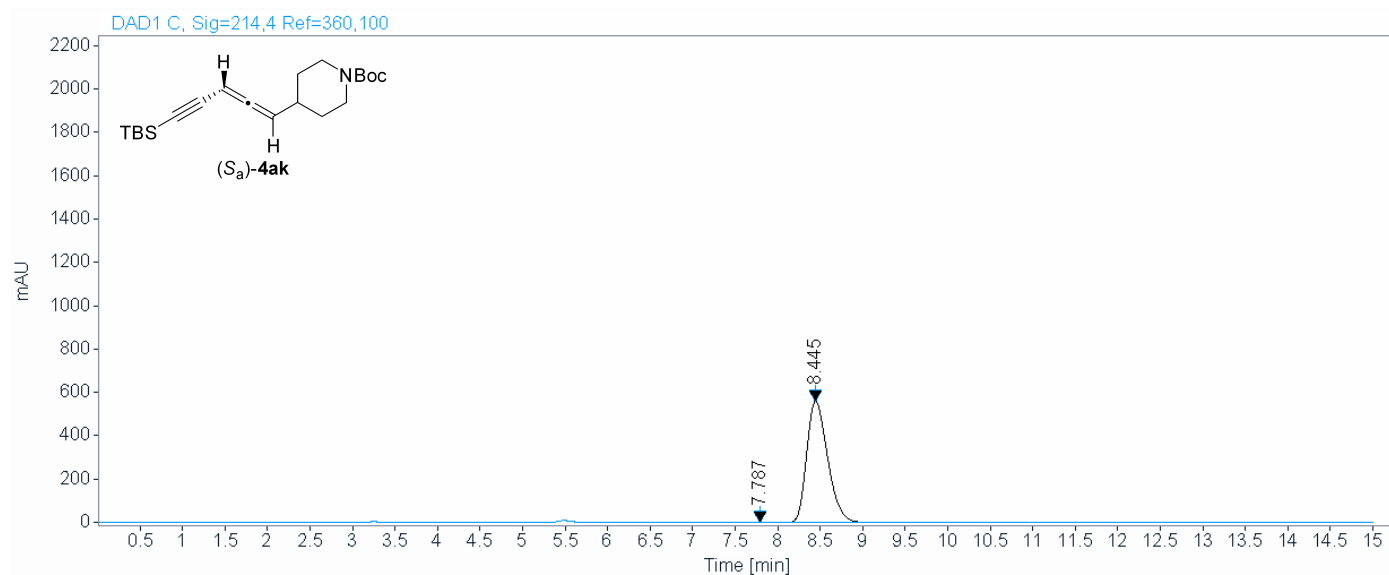


Area Percent Report

sample wgl-5-146-IC-99-1-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2021-07-06 08-23-31\003-P1-E5-wgl-5-146.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

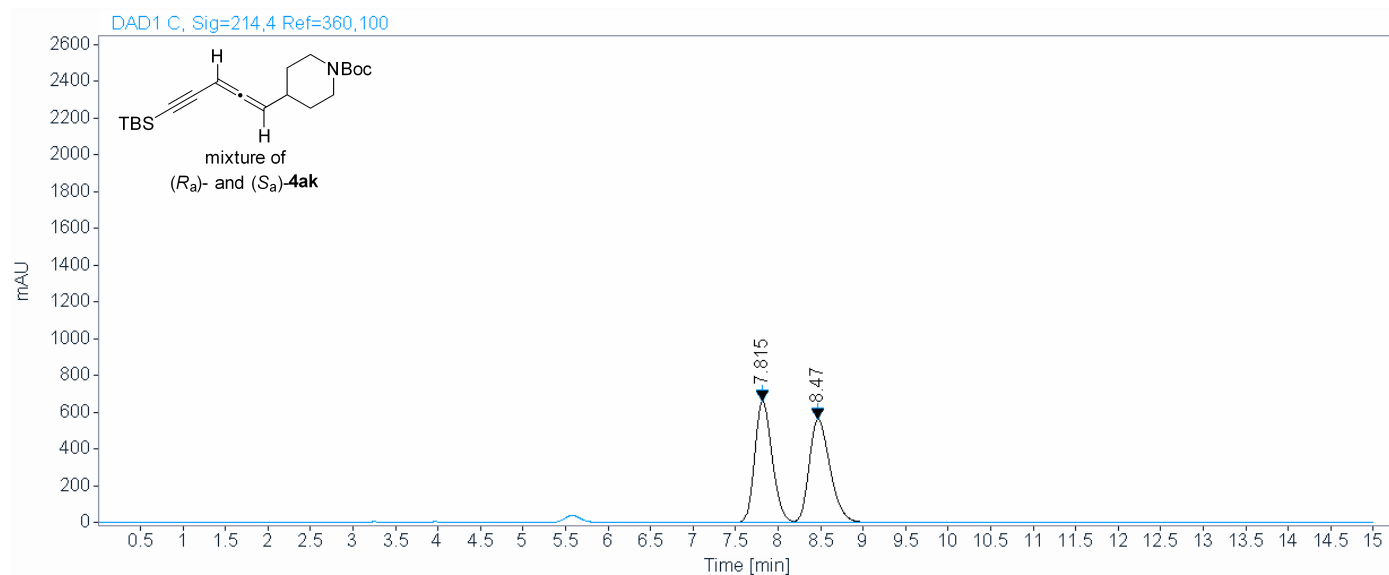
RT [min]	Width [min]	Height	Area	Area%
7.787	0.2039	2.4352	32.1313	0.3313
8.445	0.2667	561.9401	9665.5762	99.6687
		Sum	9697.7075	100.0000

Area Percent Report

sample wgl-5-(146+150)-IC-99-1-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2021-07-06 08-23-31\002-P1-E4-wgl-5-(146+150).D

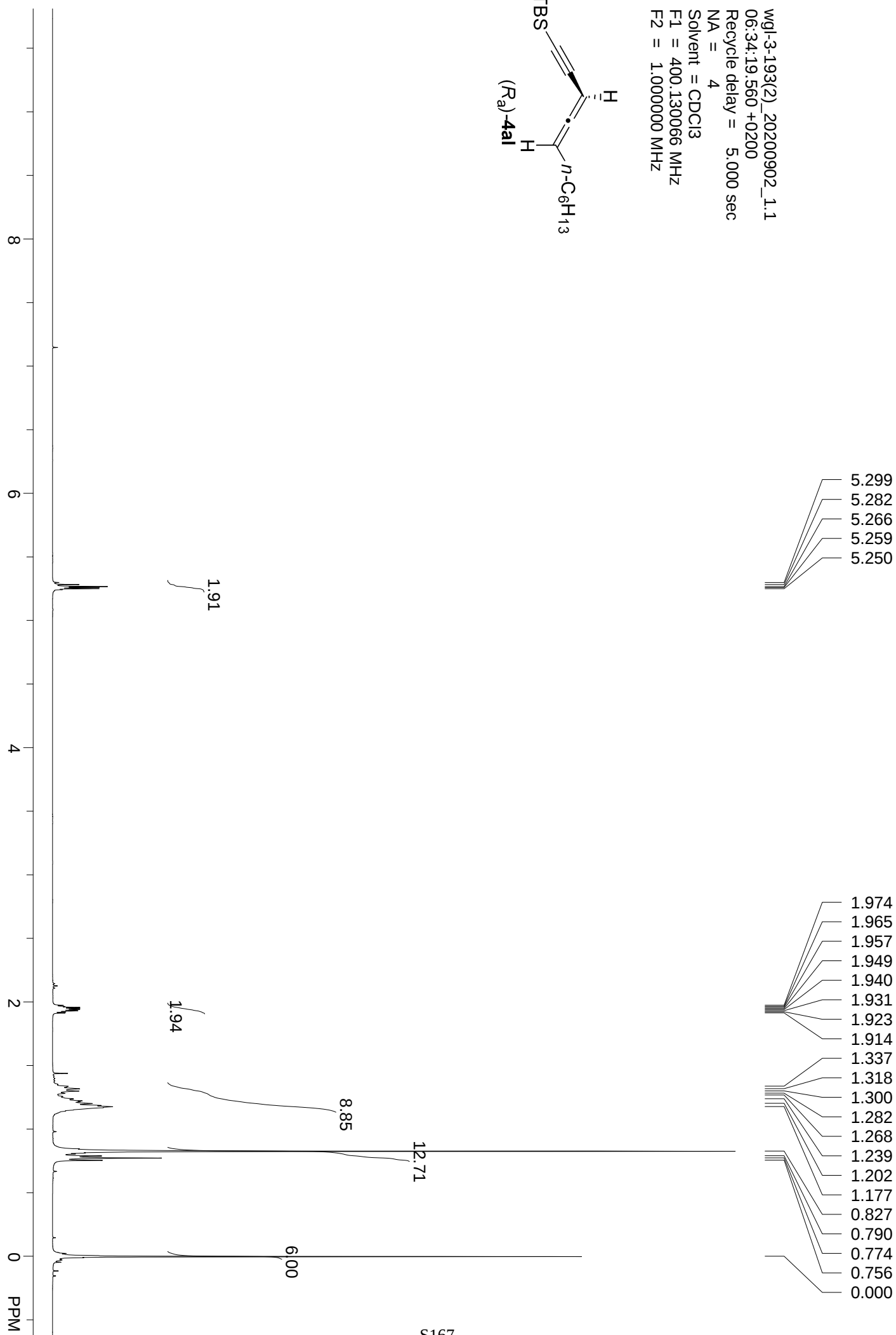
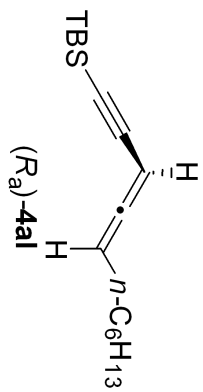
Acquisition Data:

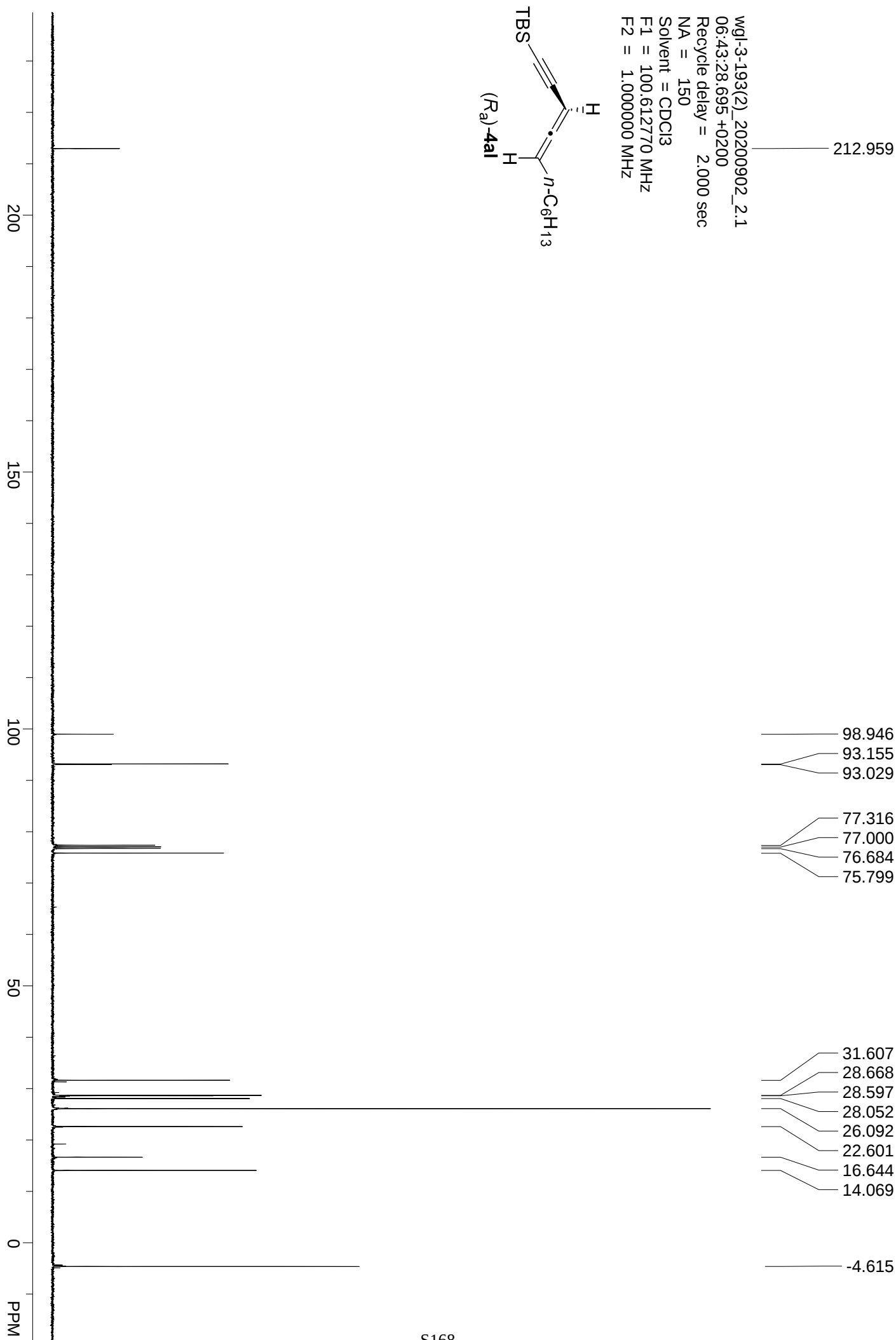


Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
7.815	0.2202	661.9419	9432.5381	49.2747
8.470	0.2651	563.2547	9710.2422	50.7253
Sum			19142.7803	100.0000

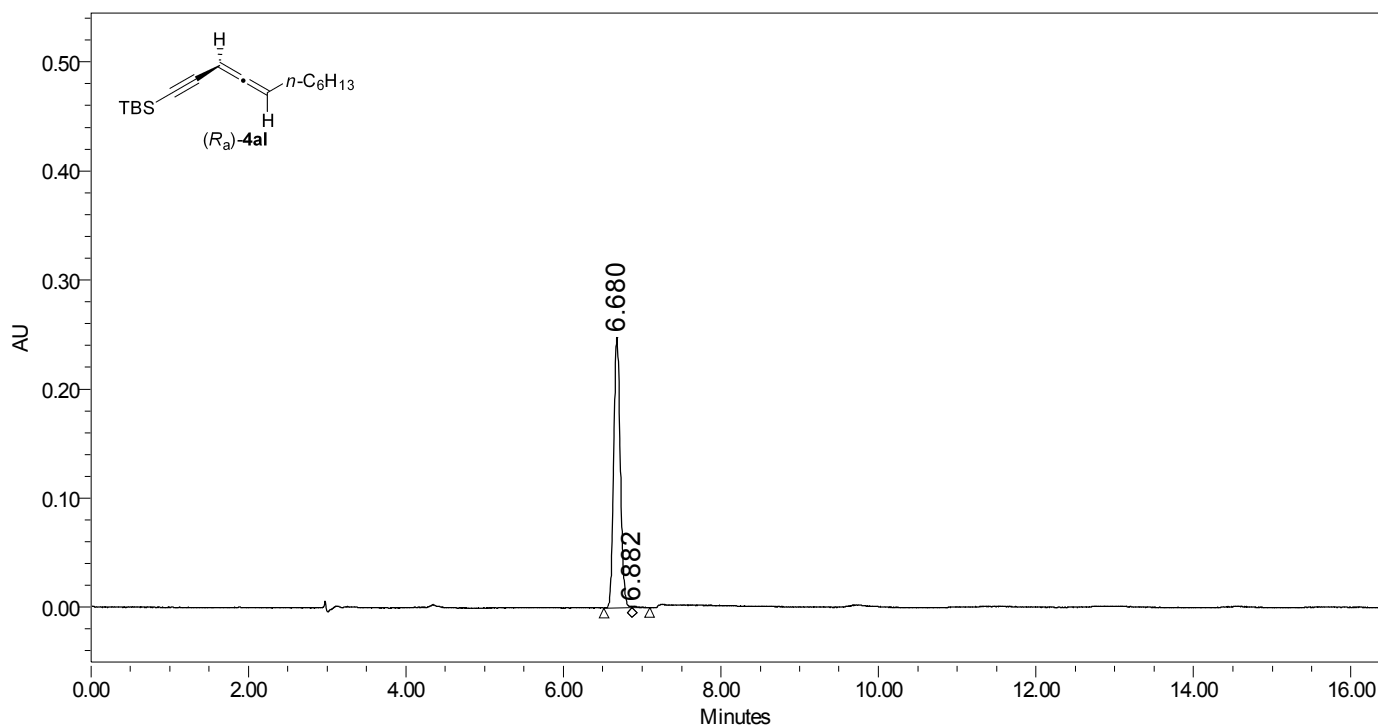
wgl-3-193(2)_20200902_1.1
06:34:19.560 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl3
F1 = 400.130066 MHz
F2 = 1.000000 MHz





SAMPLE INFORMATION

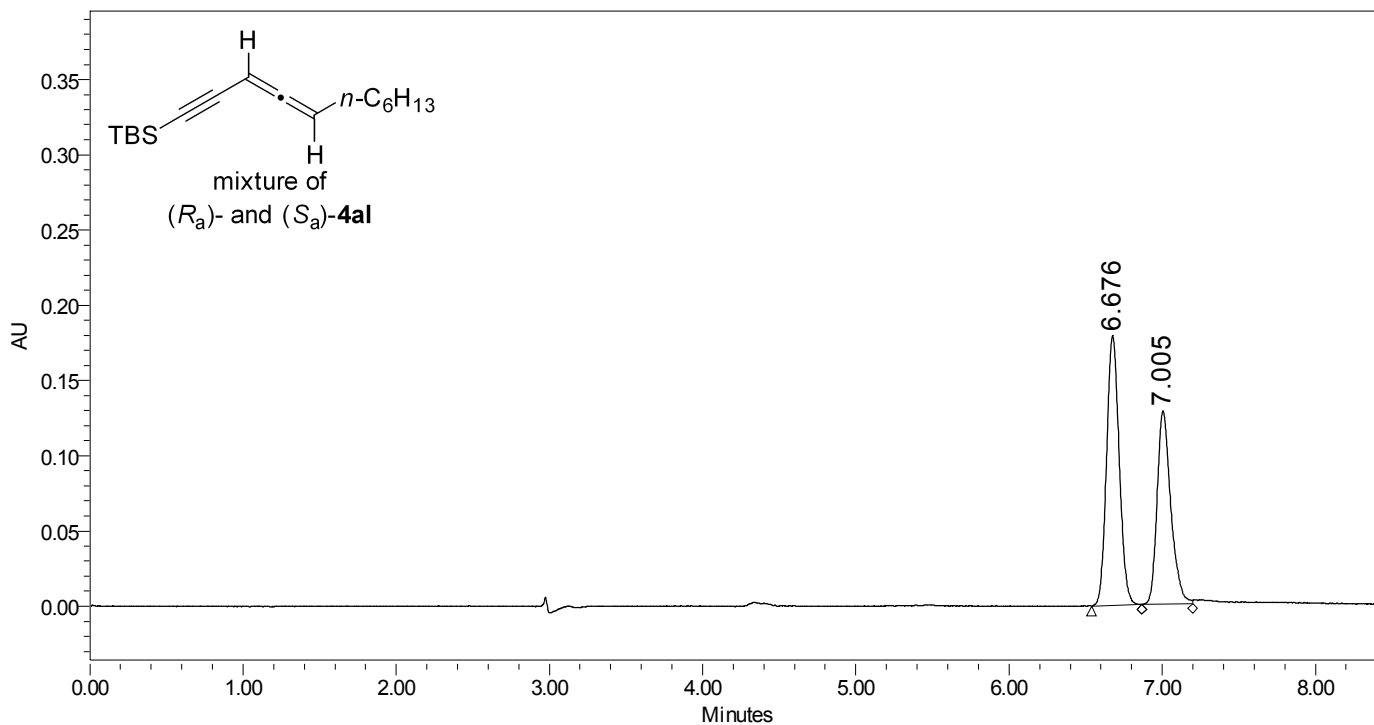
Sample Name:	WGL-3-193	Acquired By:	System
Sample Type:	Unknown	Sample Set Name:	
Vial:	2:F,5	Acq. Method Set:	upc_pda_2019m
Injection #:	1	Processing Method:	Default
Injection Volume:	3.00 ul	Channel Name:	PDA Ch1 214nm@4.8nm
Run Time:	30.0 Minutes	Proc. Chnl. Descr.:	PDA Ch1 214nm@4.8nm
Date Acquired:	9/16/2020 3:51:00 PM CST		
Date Processed:	9/16/2020 4:18:32 PM CST		



	RT	Peak Type	Height	Width (sec)	Area	% Area
1	6.680	Unknown	248028	21.300	1439594	99.49
2	6.882	Unknown	1378	13.500	7312	0.51

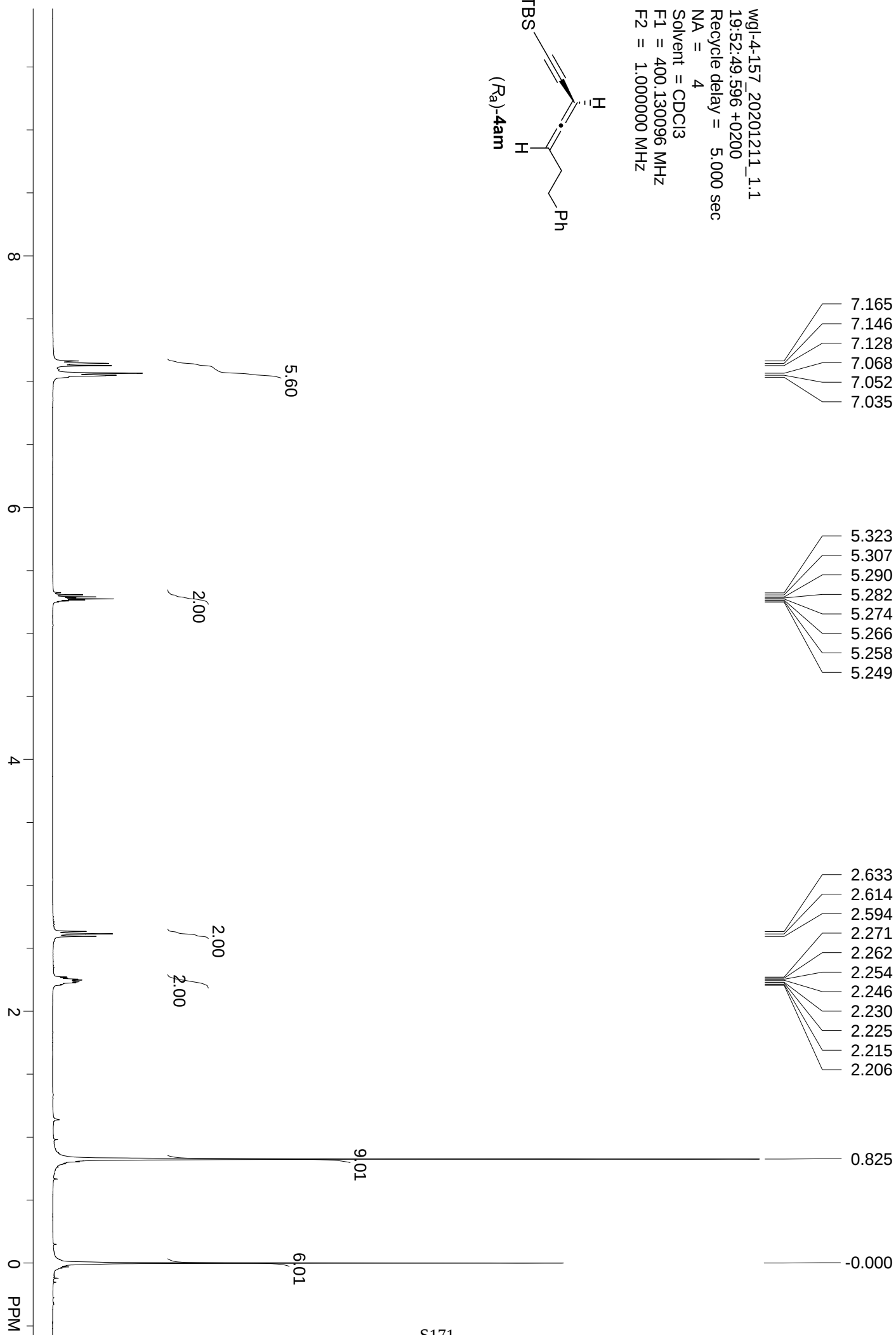
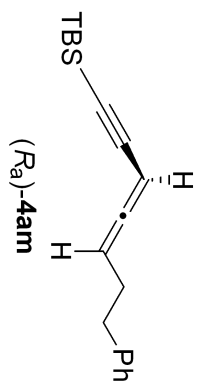
SAMPLE INFORMATION

Sample Name:	WGL-2-160+161	Acquired By:	System
Sample Type:	Unknown	Sample Set Name:	
Vial:	2:F,3	Acq. Method Set:	upc_pda_2019m
Injection #:	1	Processing Method:	Default
Injection Volume:	3.00 ul	Channel Name:	PDA Ch1 214nm@4.8nm
Run Time:	30.0 Minutes	Proc. Chnl. Descr.:	PDA Ch1 214nm@4.8nm
Date Acquired:	9/16/2020 4:08:32 PM CST		
Date Processed:	9/16/2020 4:17:23 PM CST		

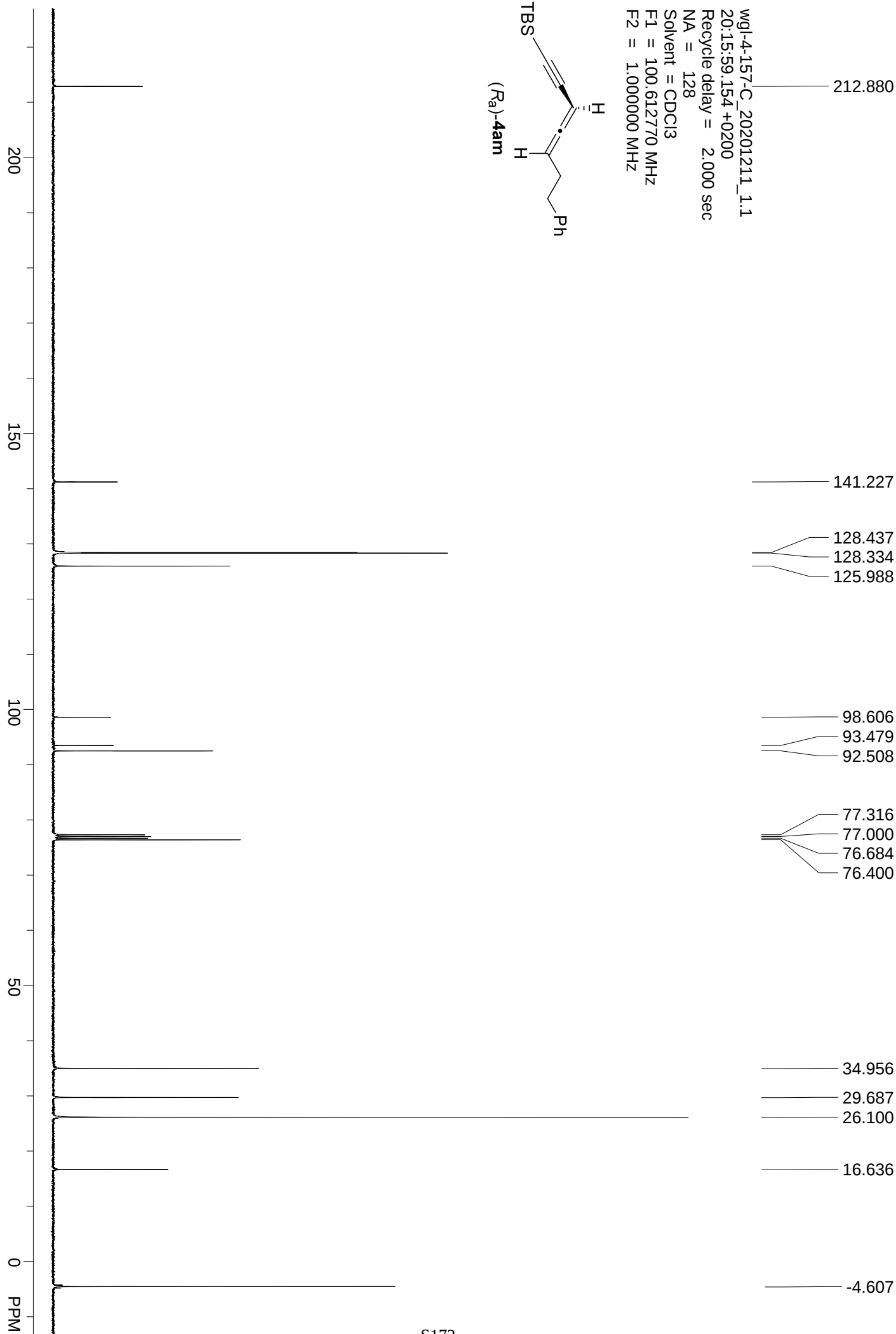
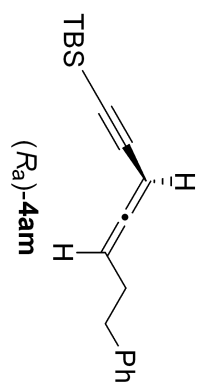


	RT	Peak Type	Height	Width (sec)	Area	% Area
1	6.676	Unknown	179133	19.600	1034883	56.32
2	7.005	Unknown	128413	19.900	802606	43.68

wj-4-157_20201211_1.1
 19:52:49.596 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130096 MHz
 F2 = 1.000000 MHz



wj-4-157-C_20201211_1.1
20:15:59.154 +0200
Recycle delay = 2.000 sec
NA = 128
Solvent = CDCl₃
F1 = 100.612770 MHz
F2 = 1.000000 MHz

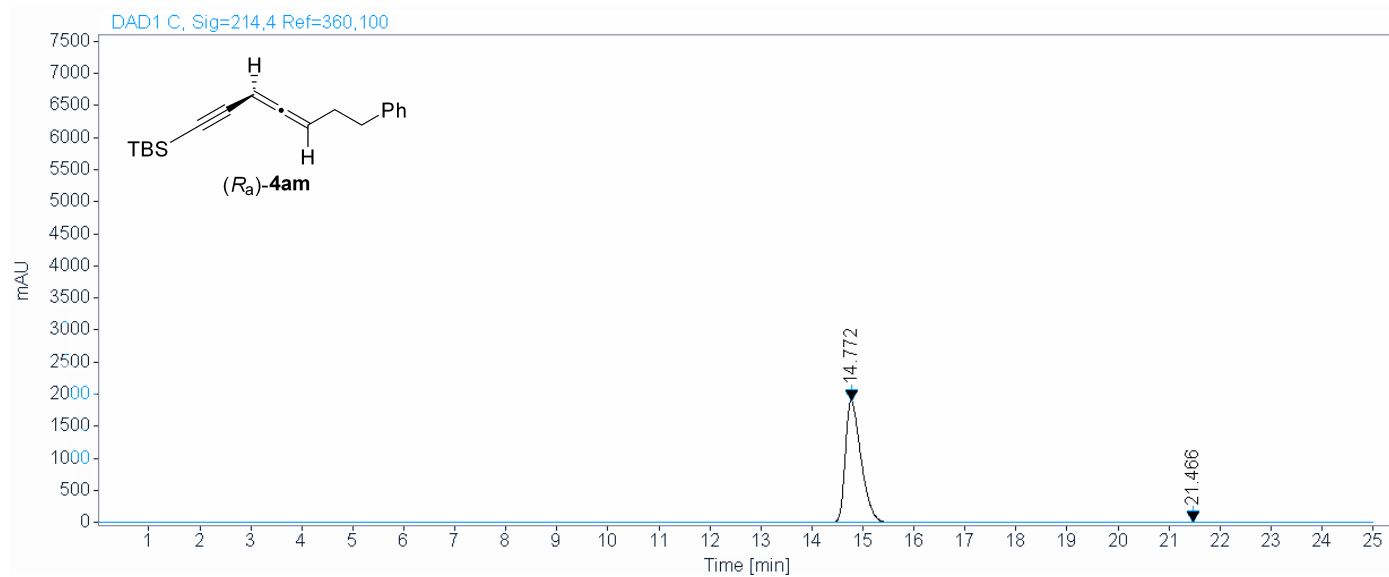


Area Percent Report

sample wgl-4-157-OD-H-100-0-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2020-12-12 08-22-51\006-P1-E2-wgl-4-157.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

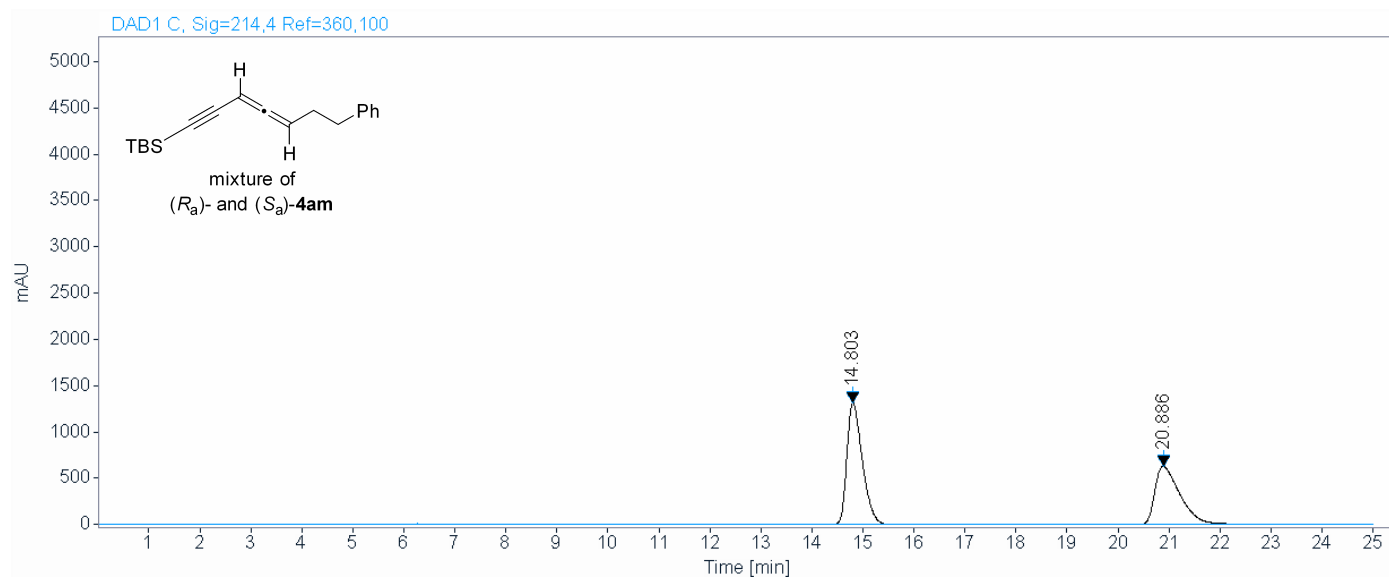
RT [min]	Width [min]	Height	Area	Area%
14.772	0.3285	1902.7323	40851.7266	99.3945
21.466	0.8462	4.9013	248.8629	0.6055
		Sum	41100.5894	100.0000

Area Percent Report

sample wgl-4-(157+158)-OD-H-100-0-0.5-214

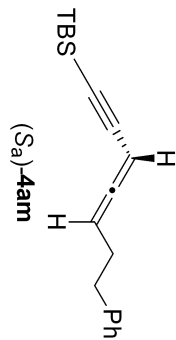
Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2020-12-12 08-22-51\008-P1-E1-wgl-4-(157+158).D

Acquisition Data:

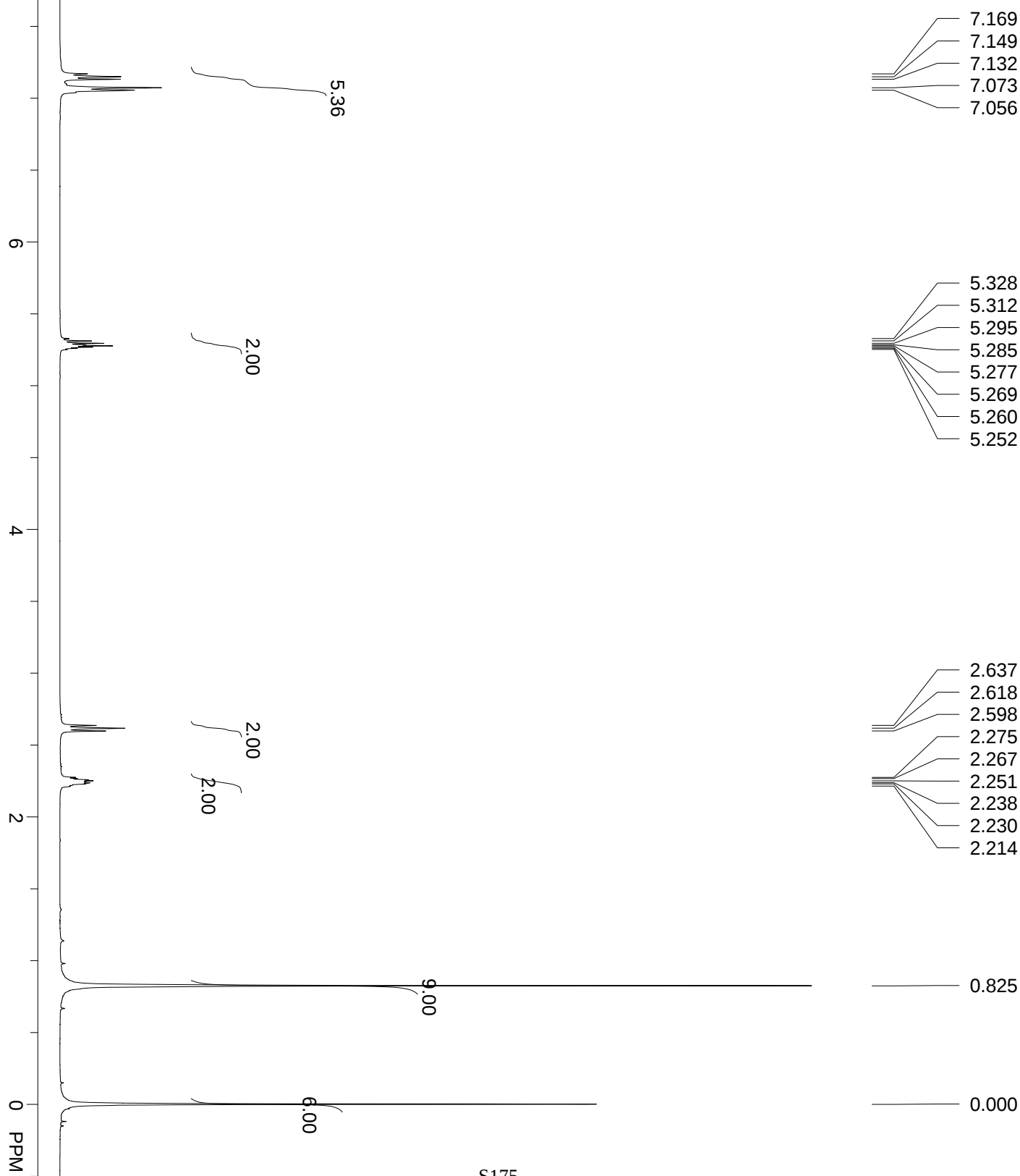


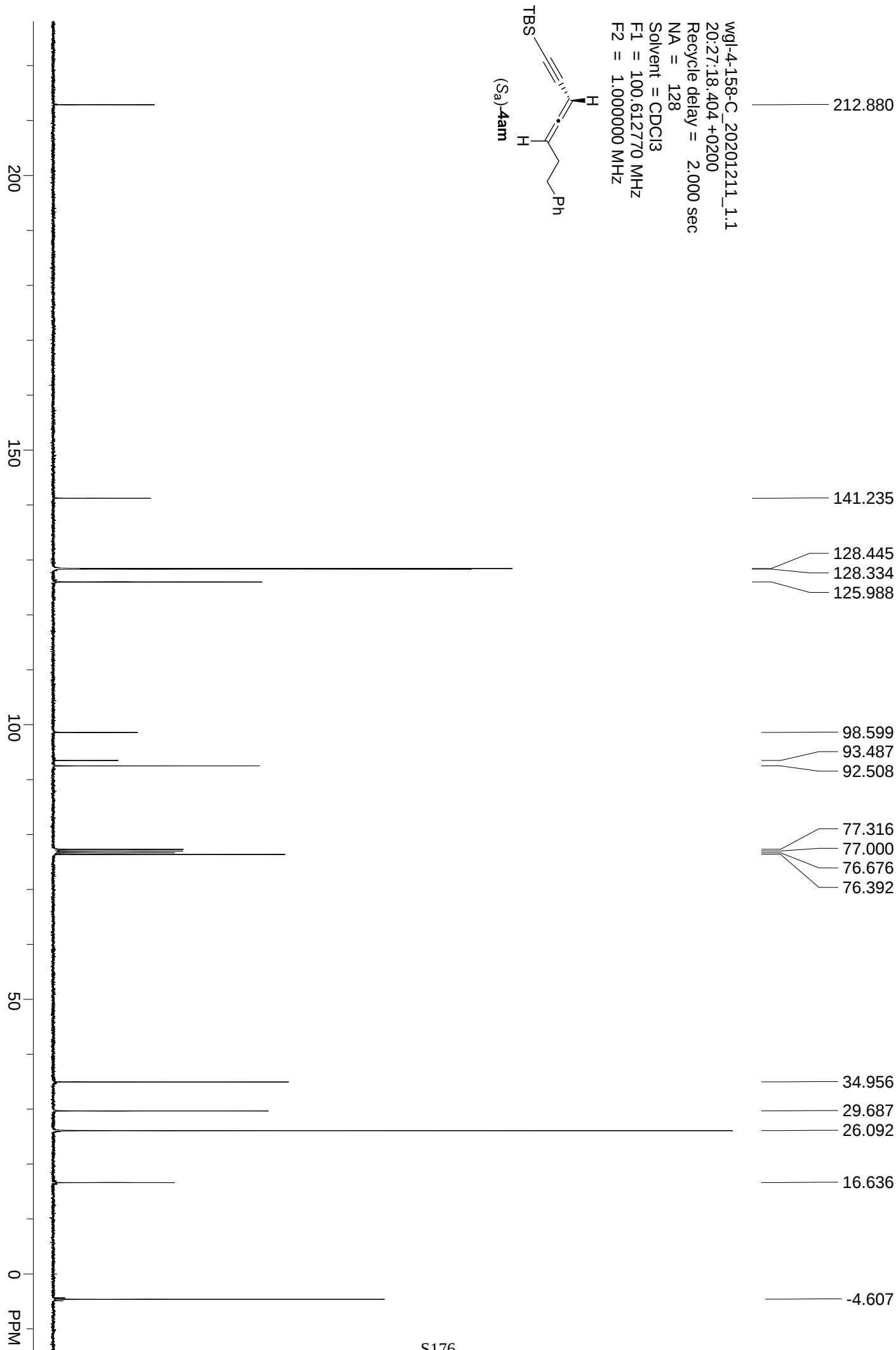
Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
14.803	0.3237	1318.4604	27771.3926	56.4081
20.886	0.5142	628.8109	21461.6211	43.5919
		Sum	49233.0137	100.0000



wgl-4-158_20201211_1.1
 19:57:25.921 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130066 MHz
 F2 = 1.000000 MHz



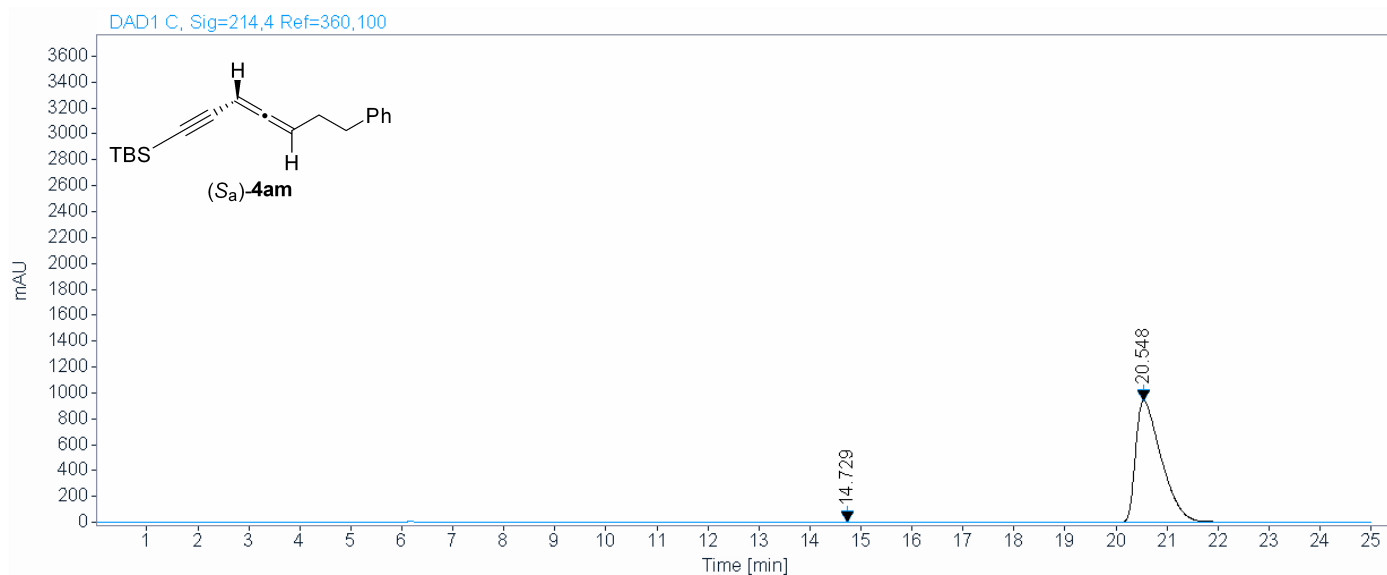


Area Percent Report

sample wgl-4-158-OD-H-100-0-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2020-12-12 08-22-51\007-P1-E3-wgl-4-158.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

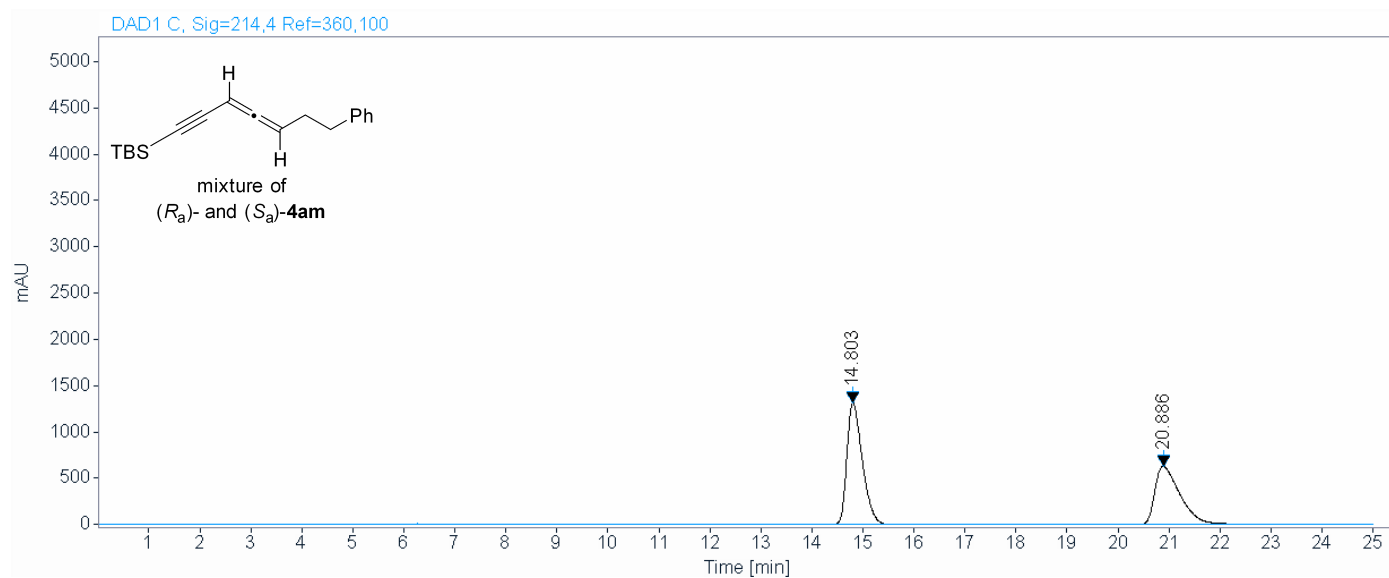
RT [min]	Width [min]	Height	Area	Area%
14.729	0.3628	2.9539	75.6487	0.2284
20.548	0.5294	941.7994	33049.7617	99.7716
		Sum	33125.4104	100.0000

Area Percent Report

sample wgl-4-(157+158)-OD-H-100-0-0.5-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2020-12-12 08-22-51\008-P1-E1-wgl-4-(157+158).D

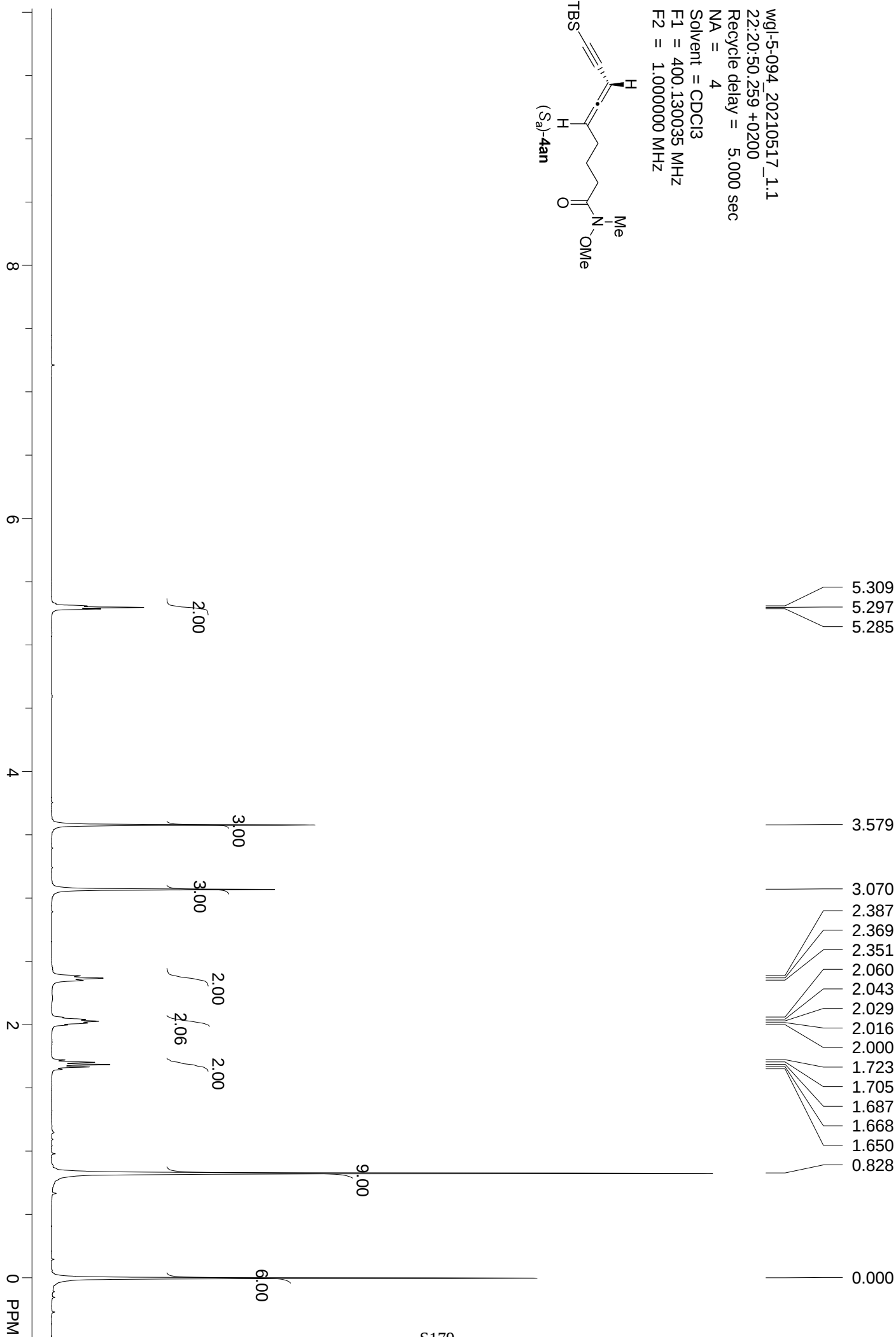
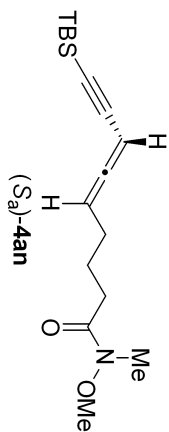
Acquisition Data:

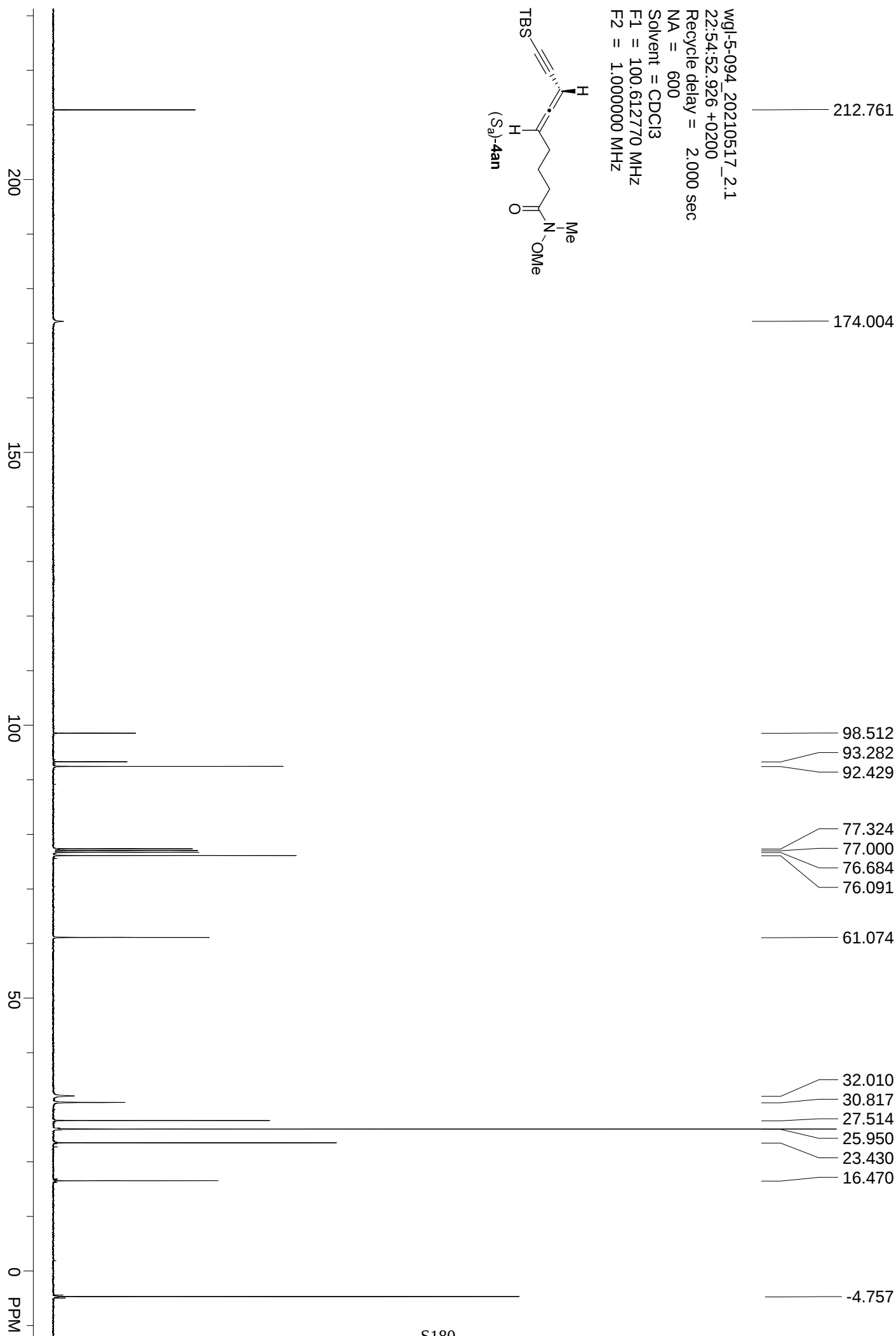


Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
14.803	0.3237	1318.4604	27771.3926	56.4081
20.886	0.5142	628.8109	21461.6211	43.5919
Sum			49233.0137	100.0000

wgl-5-094_20210517_1.1
 22:20:50.259 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130035 MHz
 F2 = 1.000000 MHz



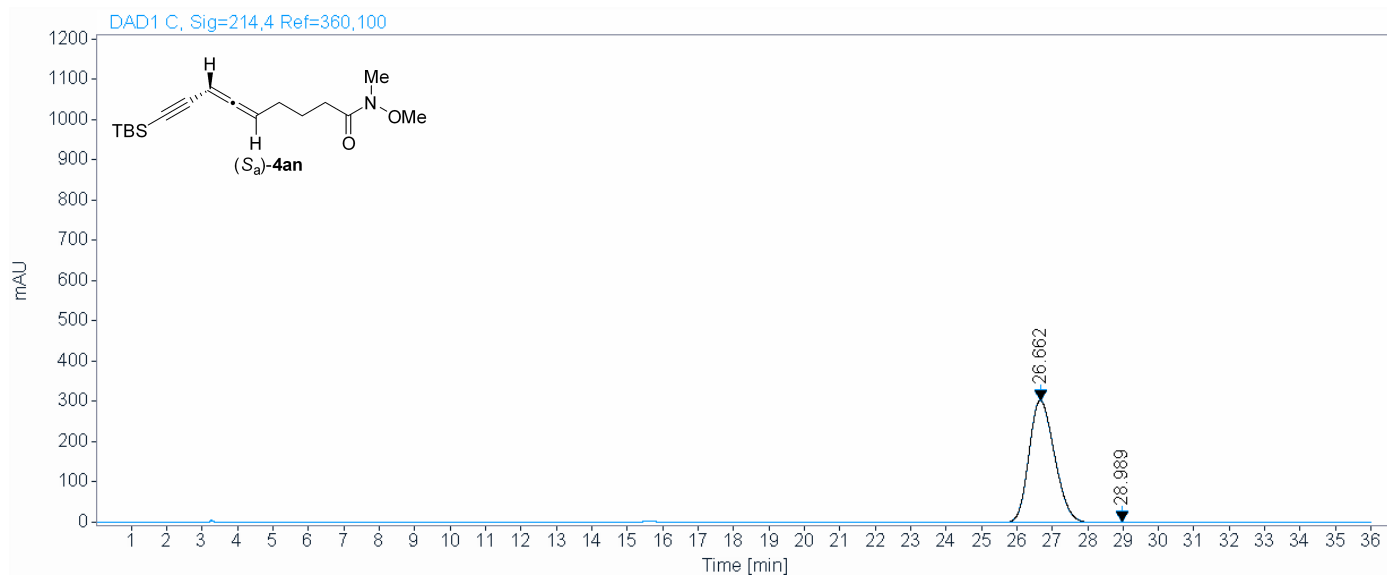


Area Percent Report

sample wgl-5-094-IC-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\inj 2021-05-18 09-56-04\009-P1-E2-wgl-5-094.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

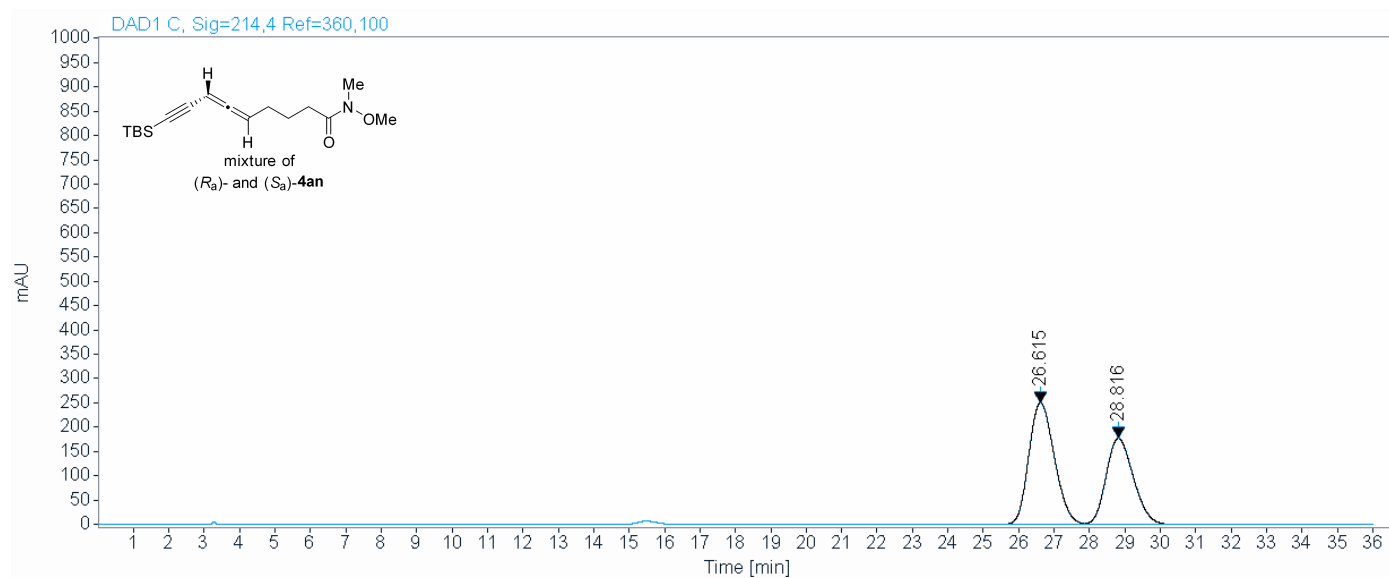
RT [min]	Width [min]	Height	Area	Area%
26.662	0.7843	302.9006	15169.5098	99.8574
28.989	0.9153	0.3944	21.6582	0.1426
		Sum	15191.1679	100.0000

Area Percent Report

sample wgl-5-(094+095)-IC-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\inj 2021-05-18 09-56-04\011-P1-E1-wgl-5-(094+095).D

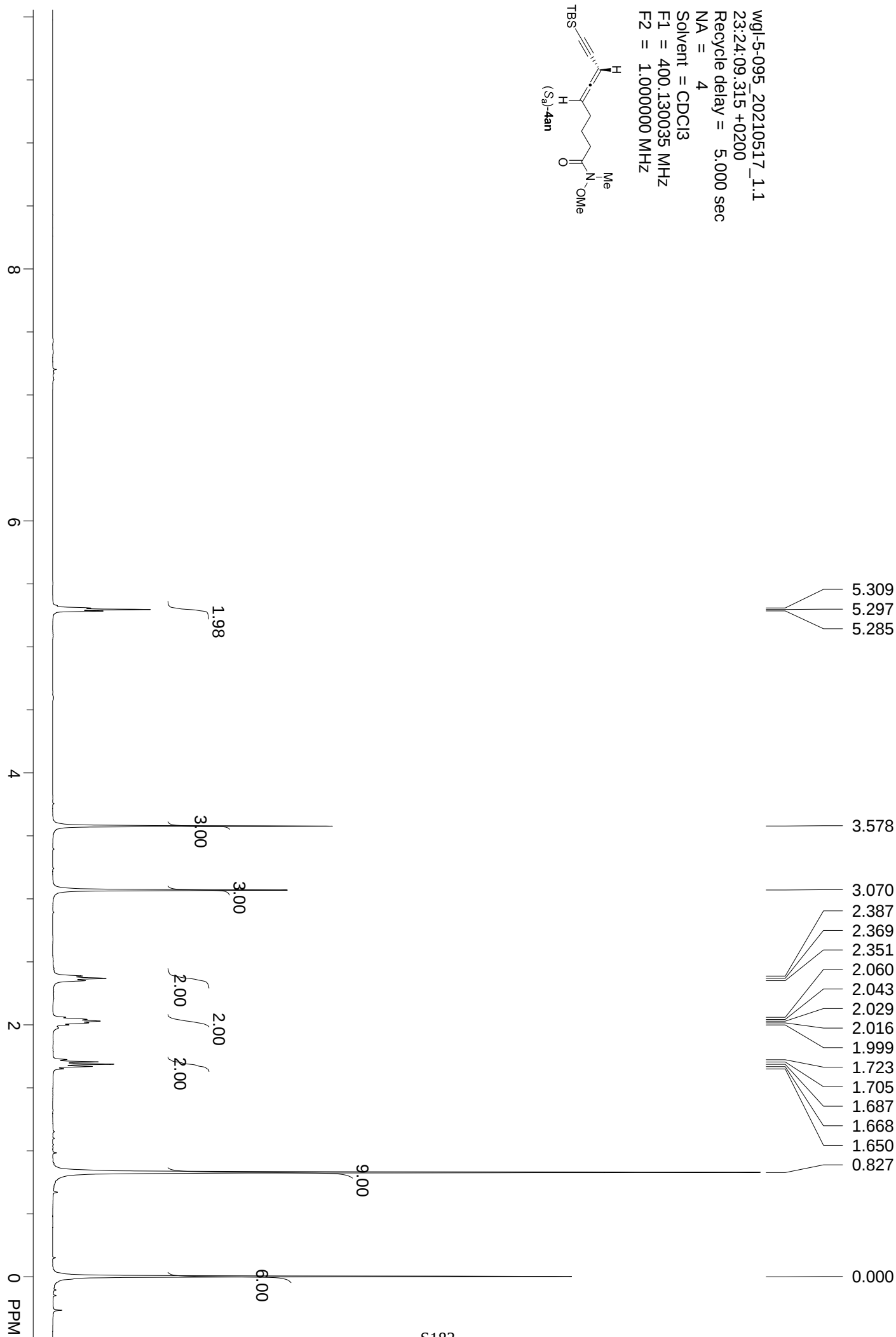
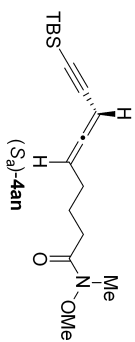
Acquisition Data:

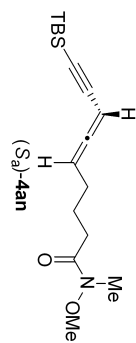


Signal: DAD1 C, Sig=214,4 Ref=360,100

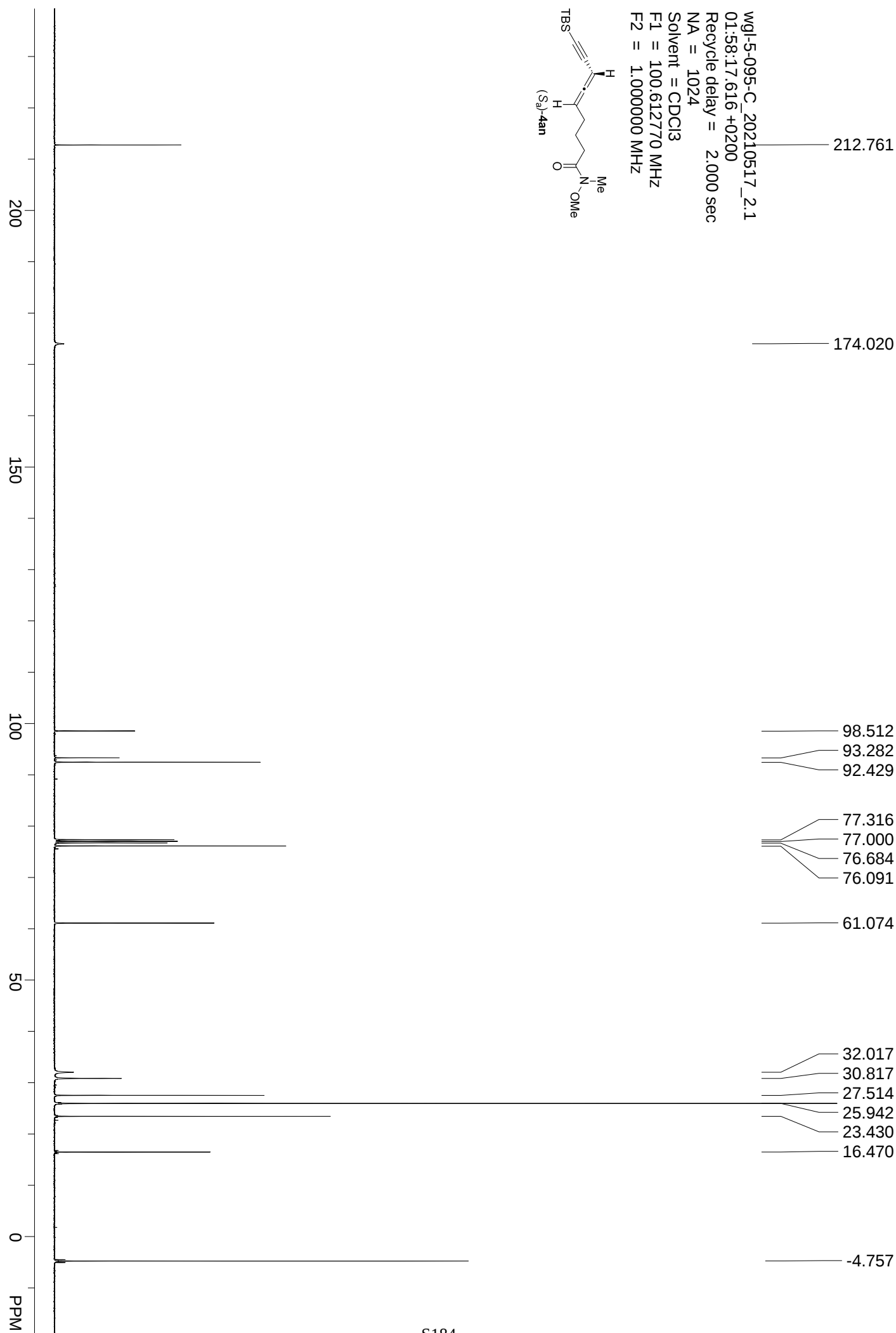
RT [min]	Width [min]	Height	Area	Area%
26.615	0.7918	250.7203	12546.9512	56.9593
28.816	0.8311	176.9531	9480.9883	43.0407
Sum			22027.9395	100.0000

wgl-5-095_20210517_1.1
 23:24:09.315 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130035 MHz
 F2 = 1.000000 MHz





wj1-5-095-C_20210517_2.1
 01:58:17.616 +0200
 Recycle delay = 2.000 sec
 NA = 1024
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

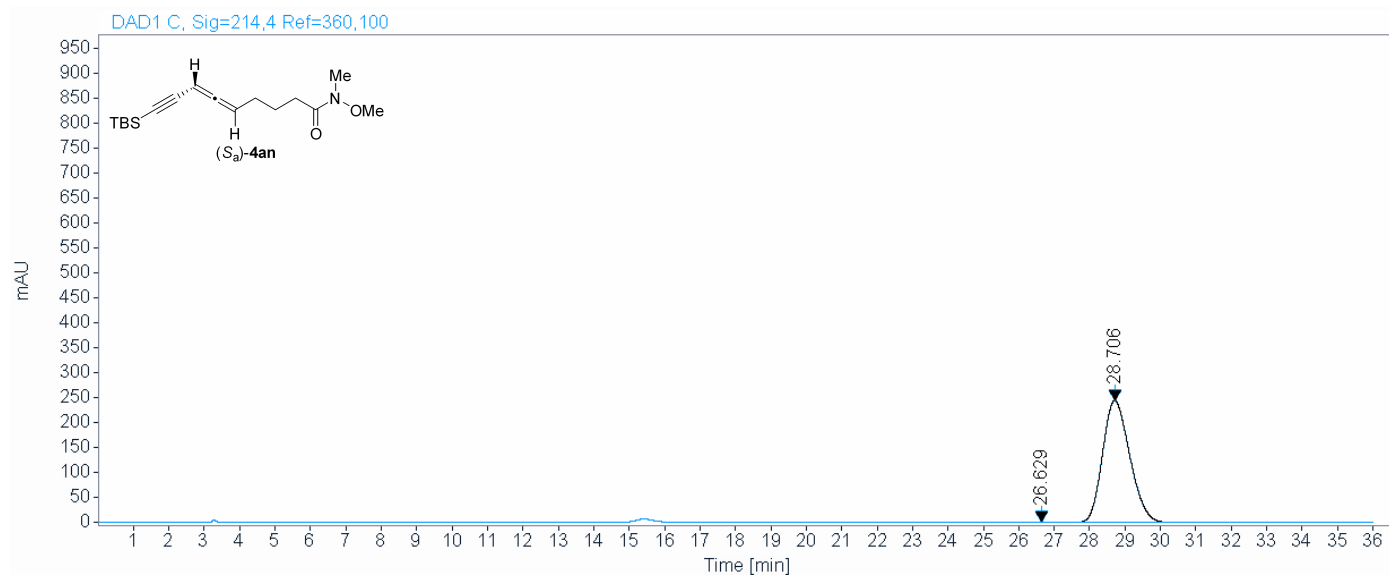


Area Percent Report

sample wgl-5-095-IC-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\inj 2021-05-18 09-56-04\010-P1-E3-wgl-5-095.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

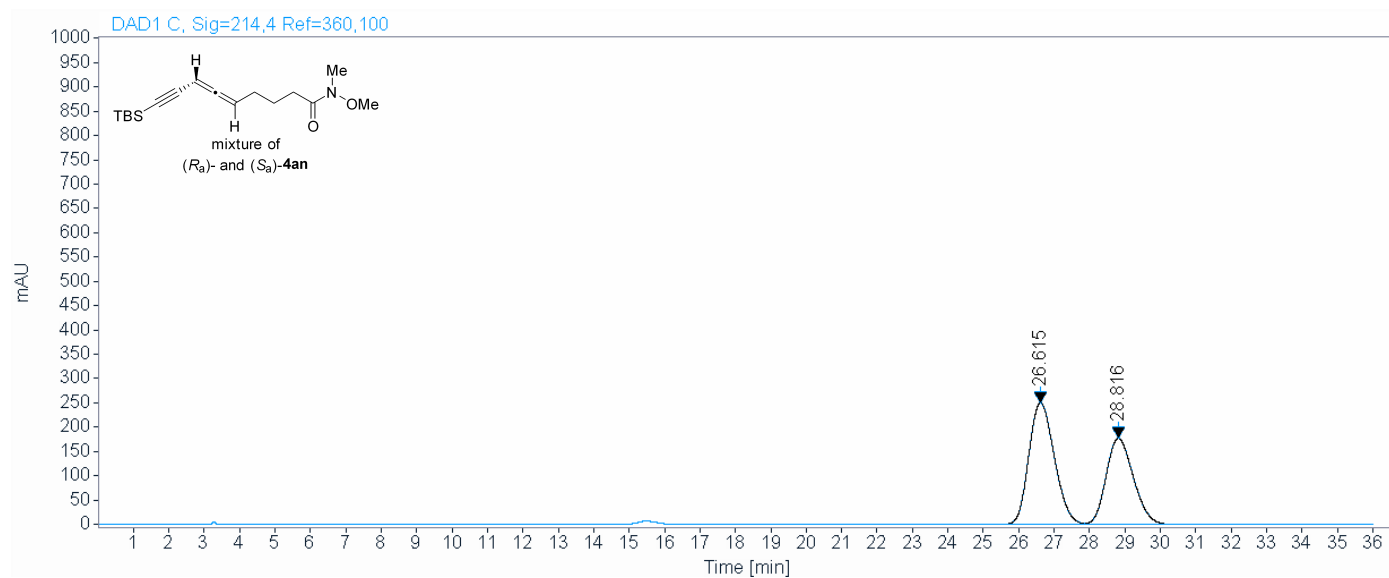
RT [min]	Width [min]	Height	Area	Area%
26.629	0.6172	1.0705	39.6430	0.3031
28.706	0.8345	244.3474	13038.0146	99.6969
		Sum	13077.6577	100.0000

Area Percent Report

sample wgl-5-(094+095)-IC-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\inj 2021-05-18 09-56-04\011-P1-E1-wgl-5-(094+095).D

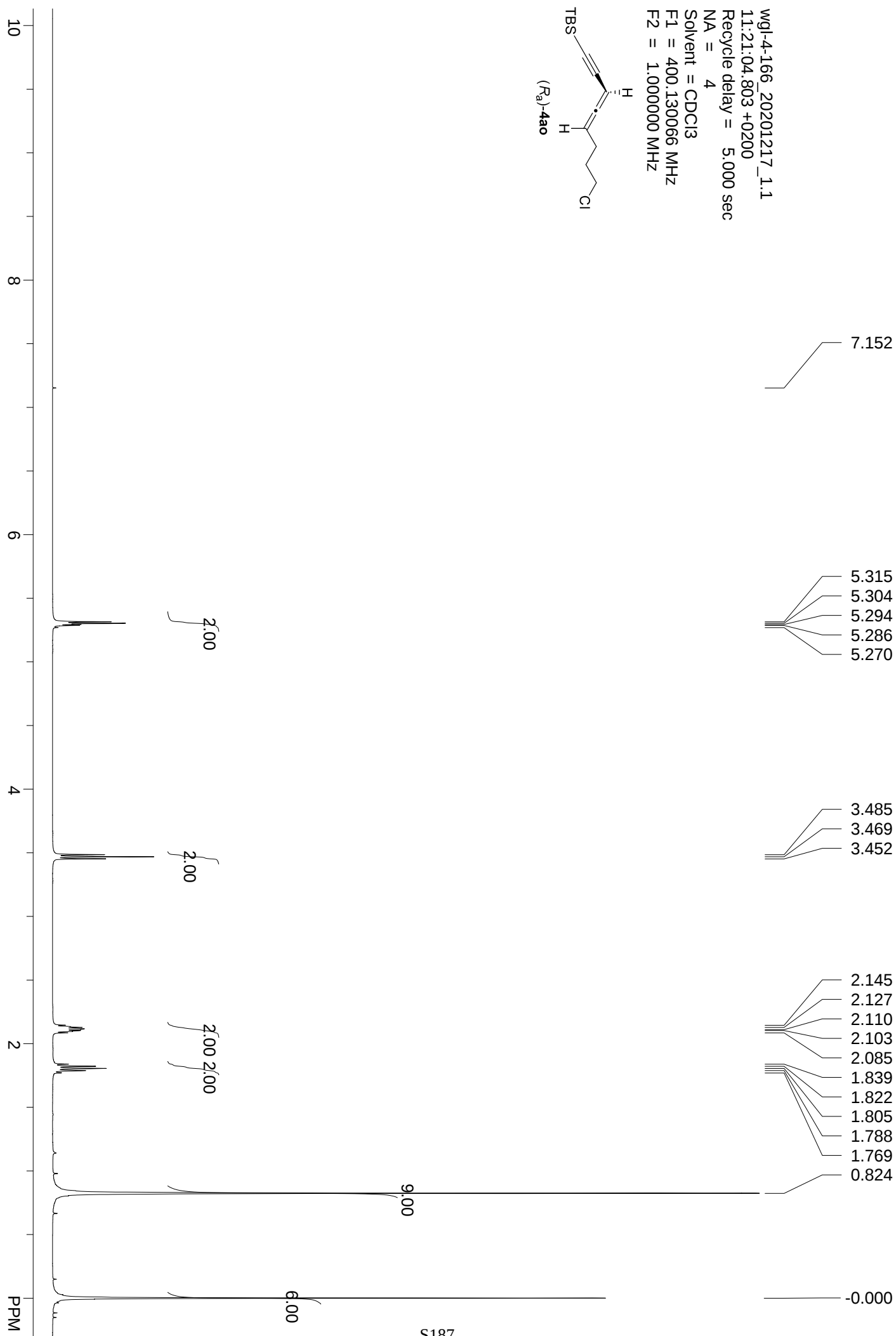
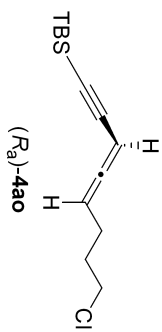
Acquisition Data:

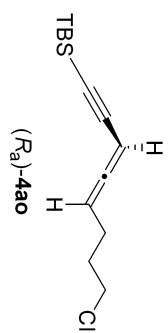


Signal: DAD1 C, Sig=214,4 Ref=360,100

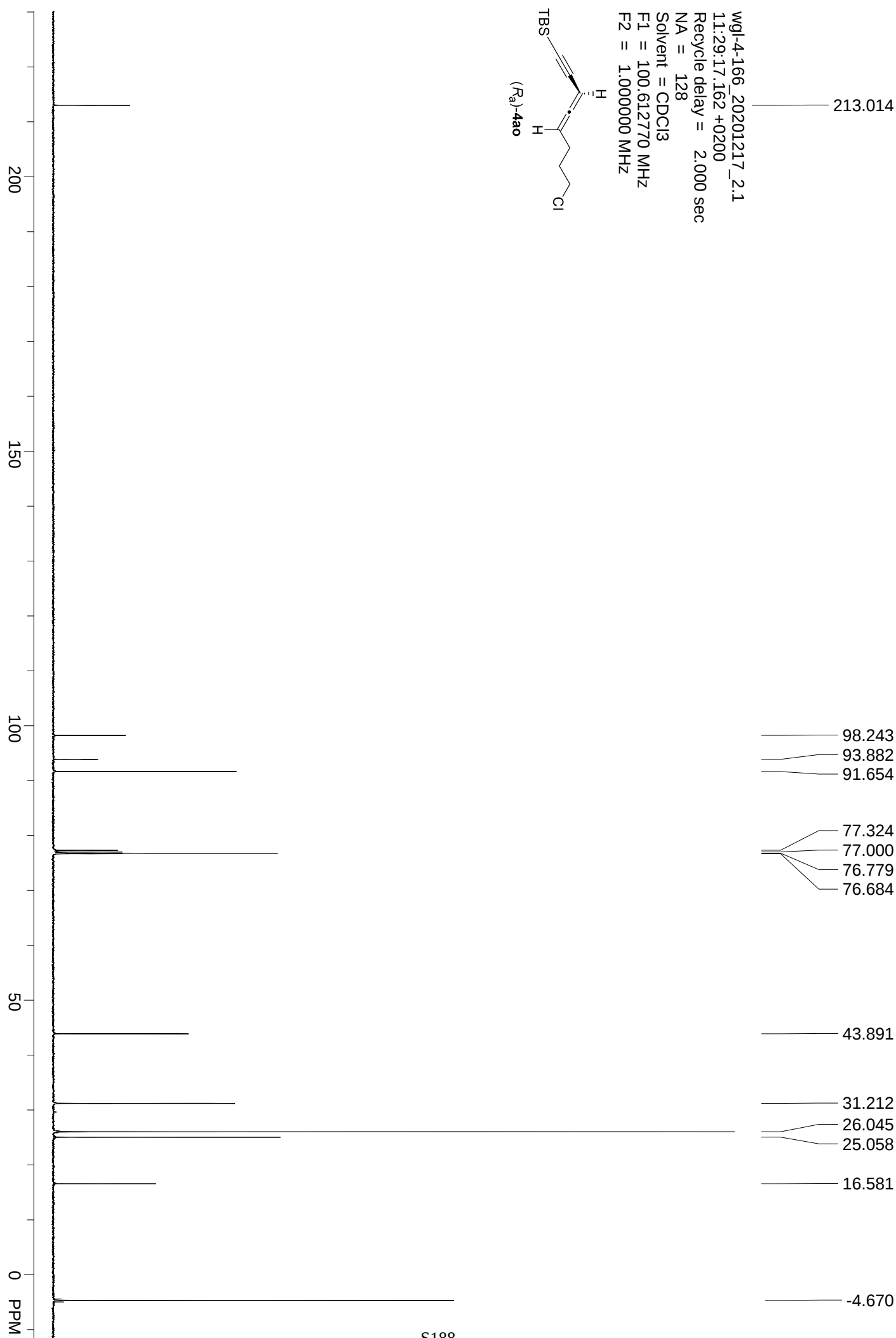
RT [min]	Width [min]	Height	Area	Area%
26.615	0.7918	250.7203	12546.9512	56.9593
28.816	0.8311	176.9531	9480.9883	43.0407
Sum			22027.9395	100.0000

wgl-4-166_20201217_1.1
 11:21:04.803 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130066 MHz
 F2 = 1.000000 MHz





wgl-4-166_20201217_2.1
 11:29:17.162 +0200
 Recycle delay = 2.000 sec
 NA = 128
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

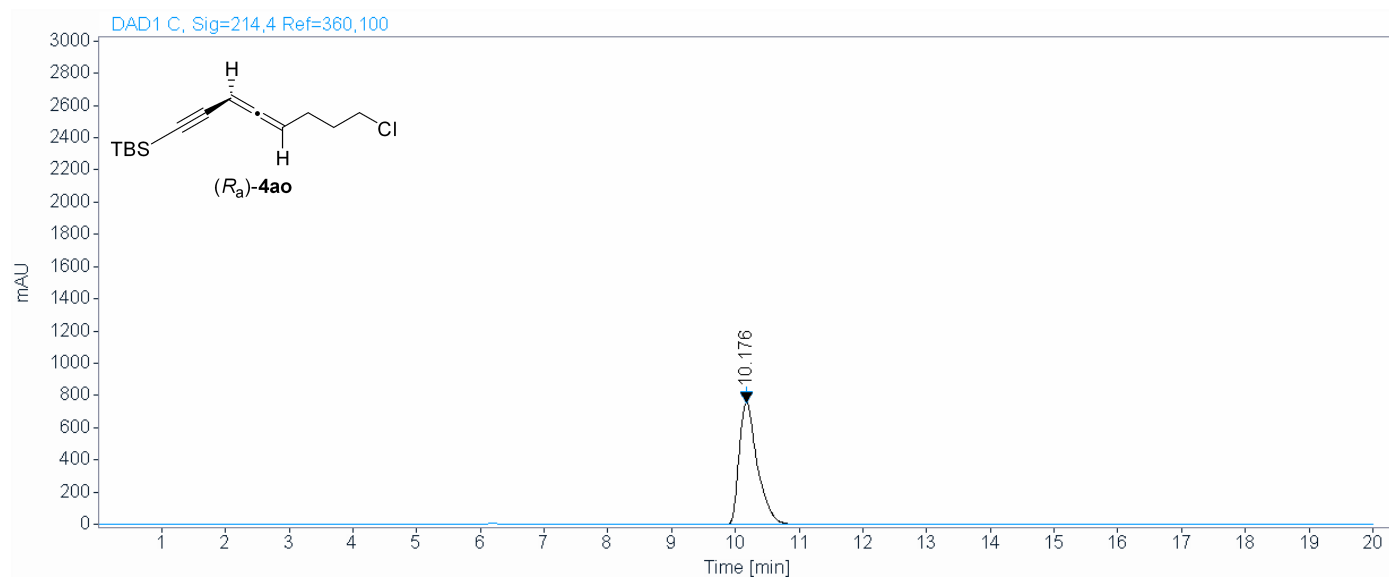


Area Percent Report

sample wgl-4-166-OD-H-100-0-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\hcf_LC 2020-12-16 21-52-23\077-P1-E2-wgl-4-166.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

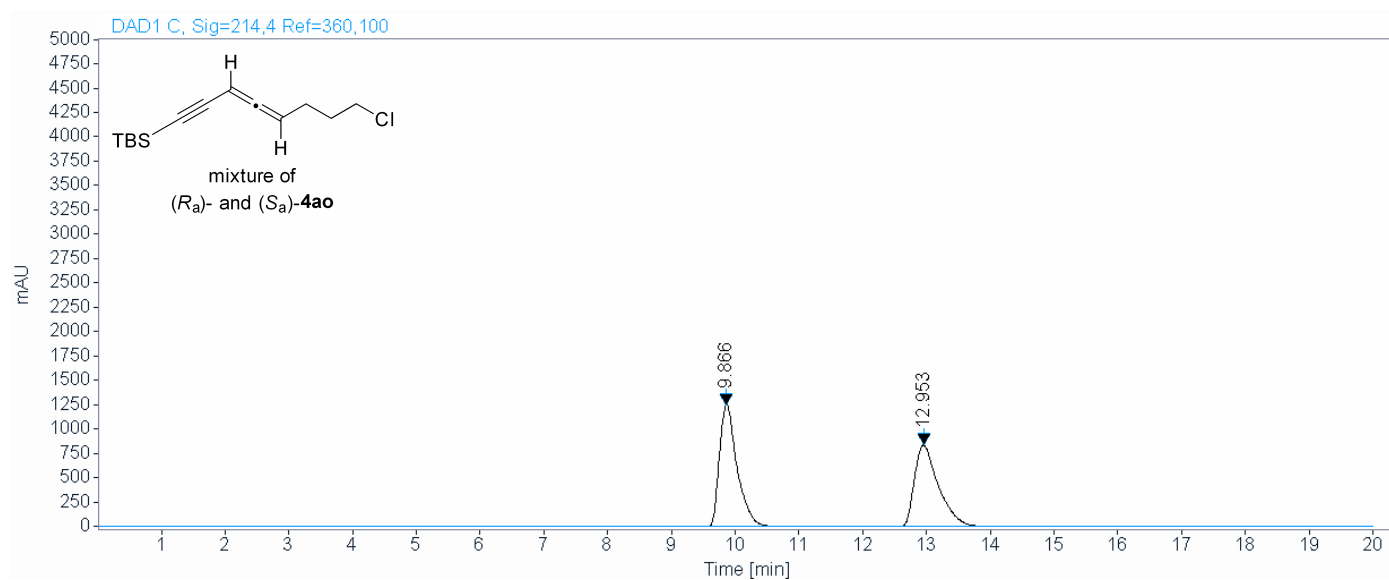
RT [min]	Width [min]	Height	Area	Area%
10.176	0.2987	757.3734	14978.5156	100.0000
Sum			14978.5156	100.0000

Area Percent Report

sample wgl-4-(166+167)-OD-H-100-0-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\hcf_LC 2020-12-16 21-52-23\076-P1-E1-wgl-4-(166+167).D

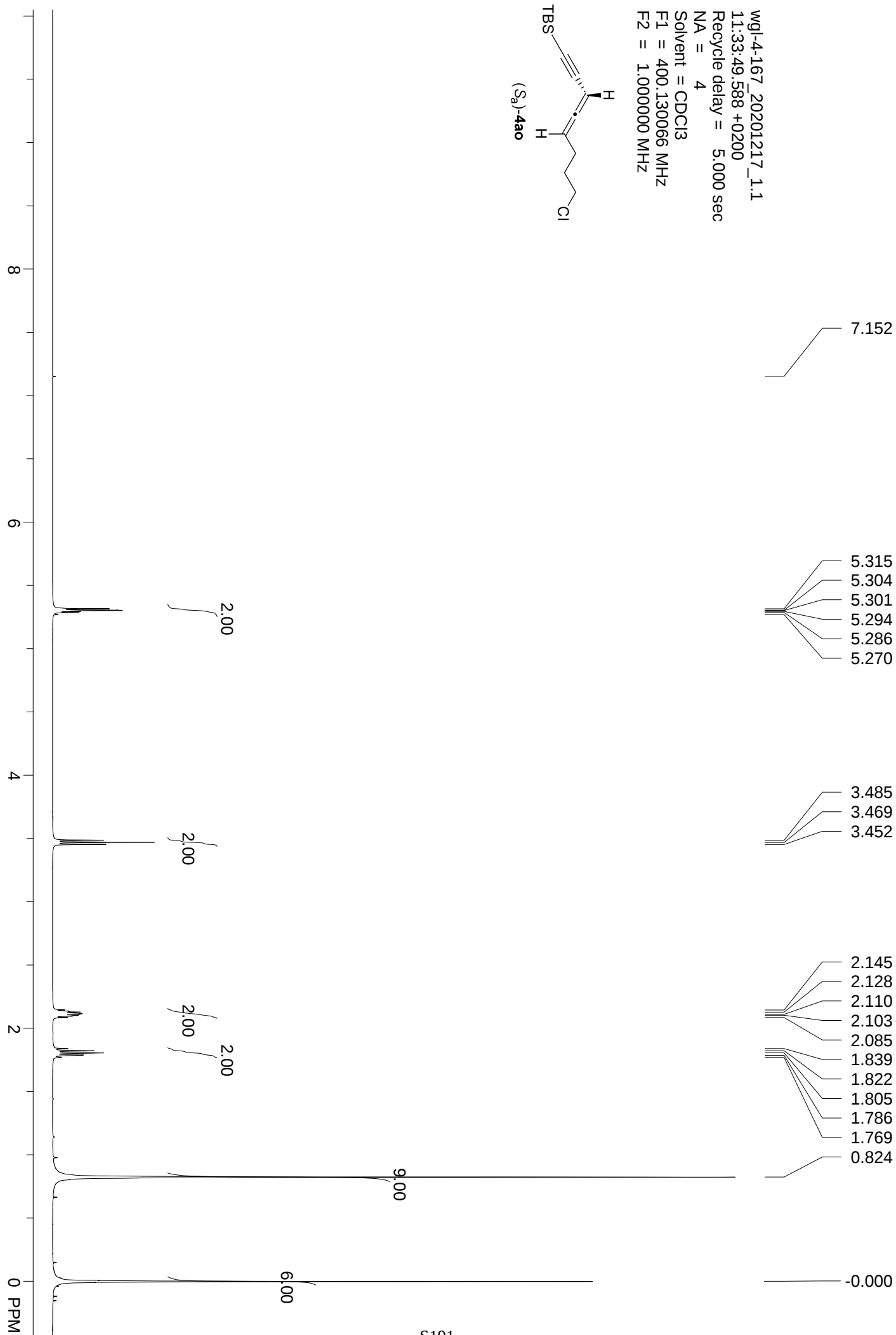
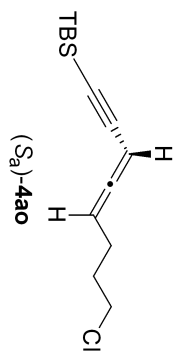
Acquisition Data:

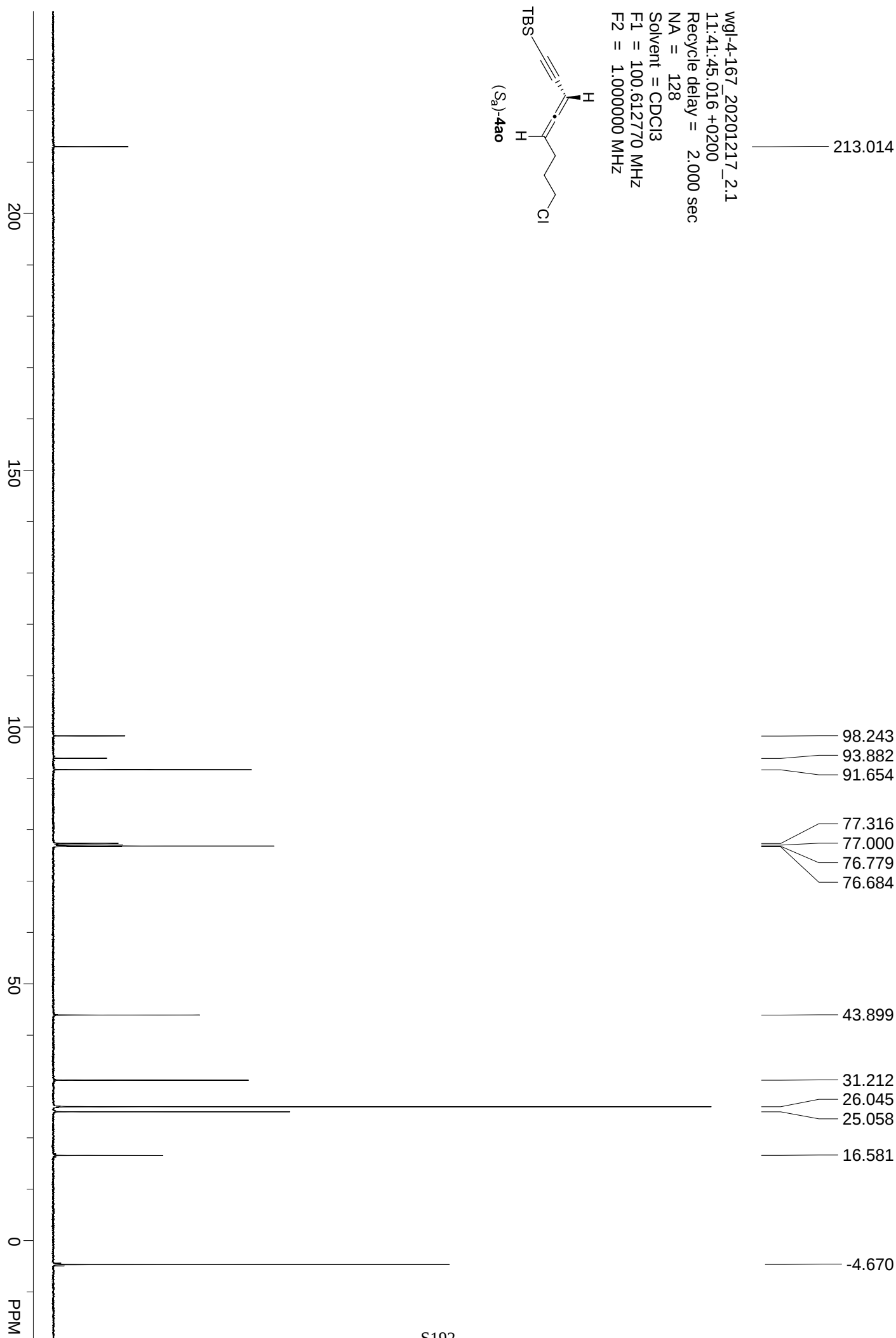


Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
9.866	0.2901	1252.7639	24132.4512	52.4328
12.953	0.3930	837.3411	21893.0781	47.5672
Sum			46025.5293	100.0000

wgl-4-167_20201217_1.1
 11:33:49.588 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130066 MHz
 F2 = 1.000000 MHz



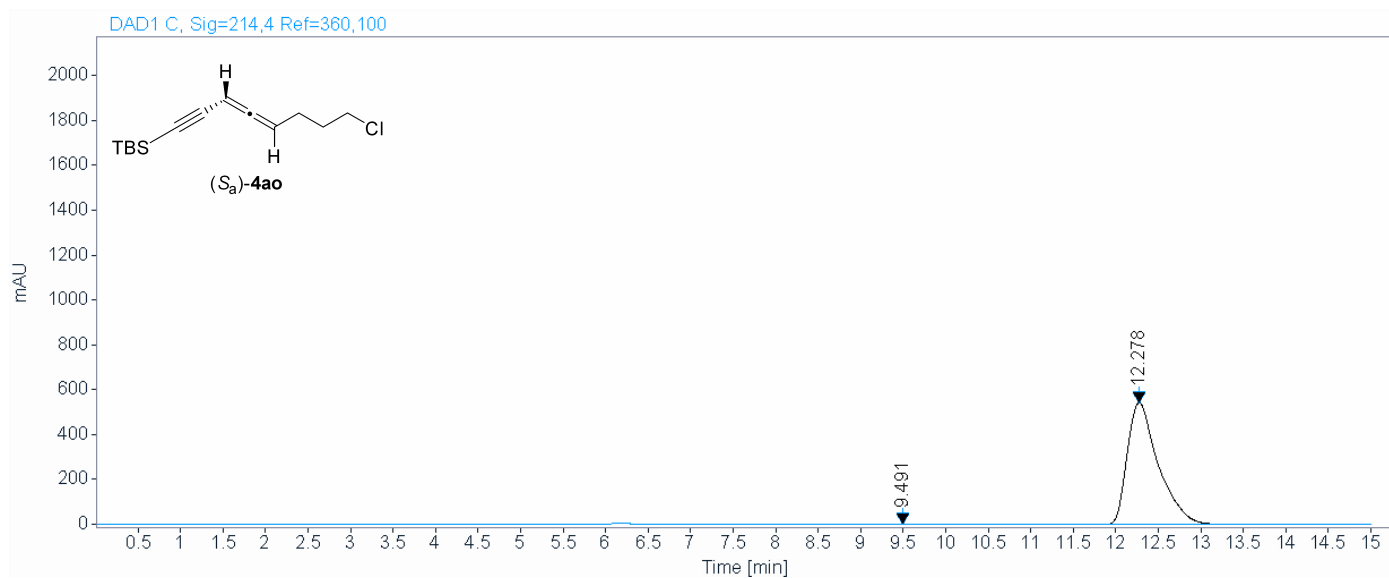


Area Percent Report

sample wgl-4-167-OD-H-100-0-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\hcf_LC 2020-12-16 21-52-23\075-P1-E3-wgl-4-167.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

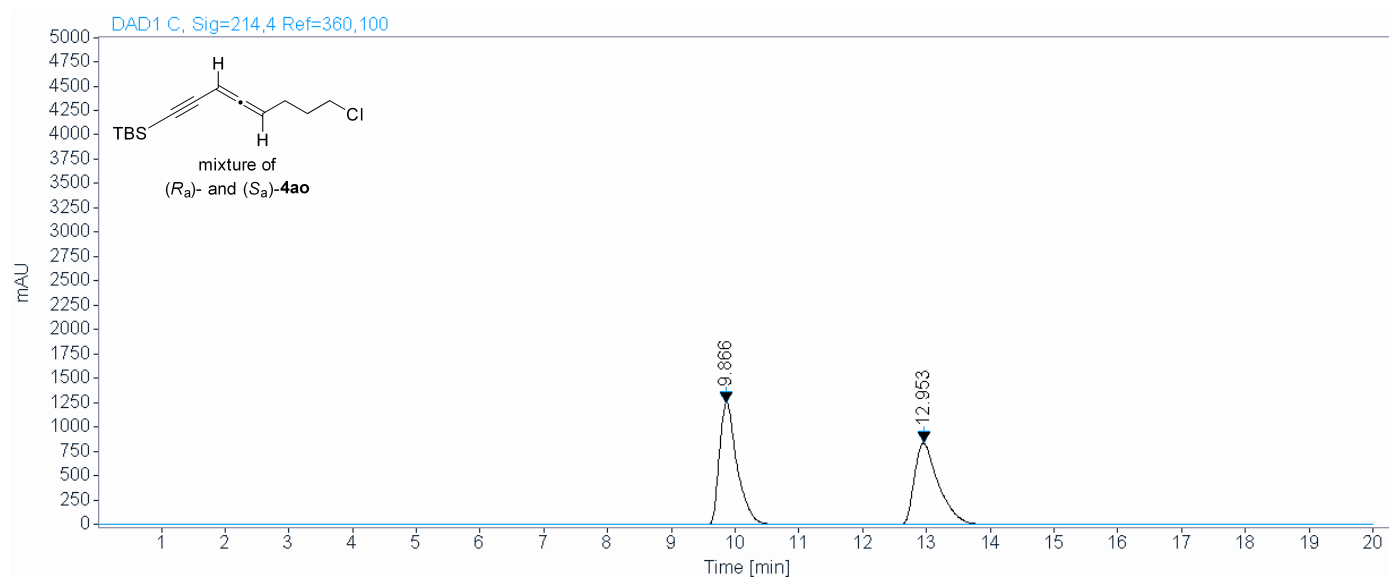
RT [min]	Width [min]	Height	Area	Area%
9.491	0.2778	2.1716	40.1768	0.2881
12.278	0.3821	544.1936	13904.4746	99.7119
		Sum	13944.6514	100.0000

Area Percent Report

sample wgl-4-(166+167)-OD-H-100-0-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\hcf_LC 2020-12-16 21-52-23\076-P1-E1-wgl-4-(166+167).D

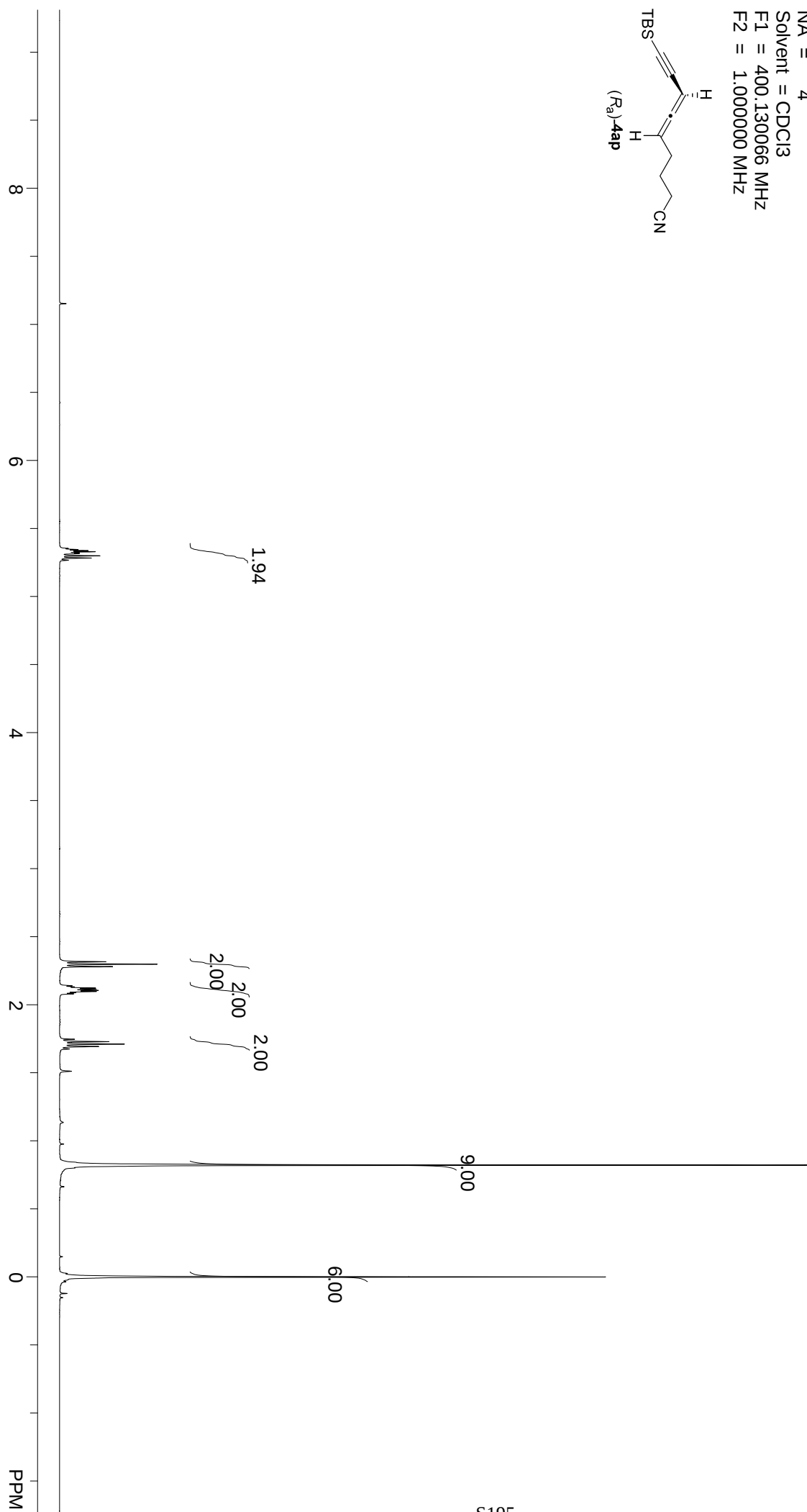
Acquisition Data:

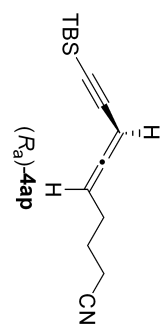


Signal: DAD1 C, Sig=214,4 Ref=360,100

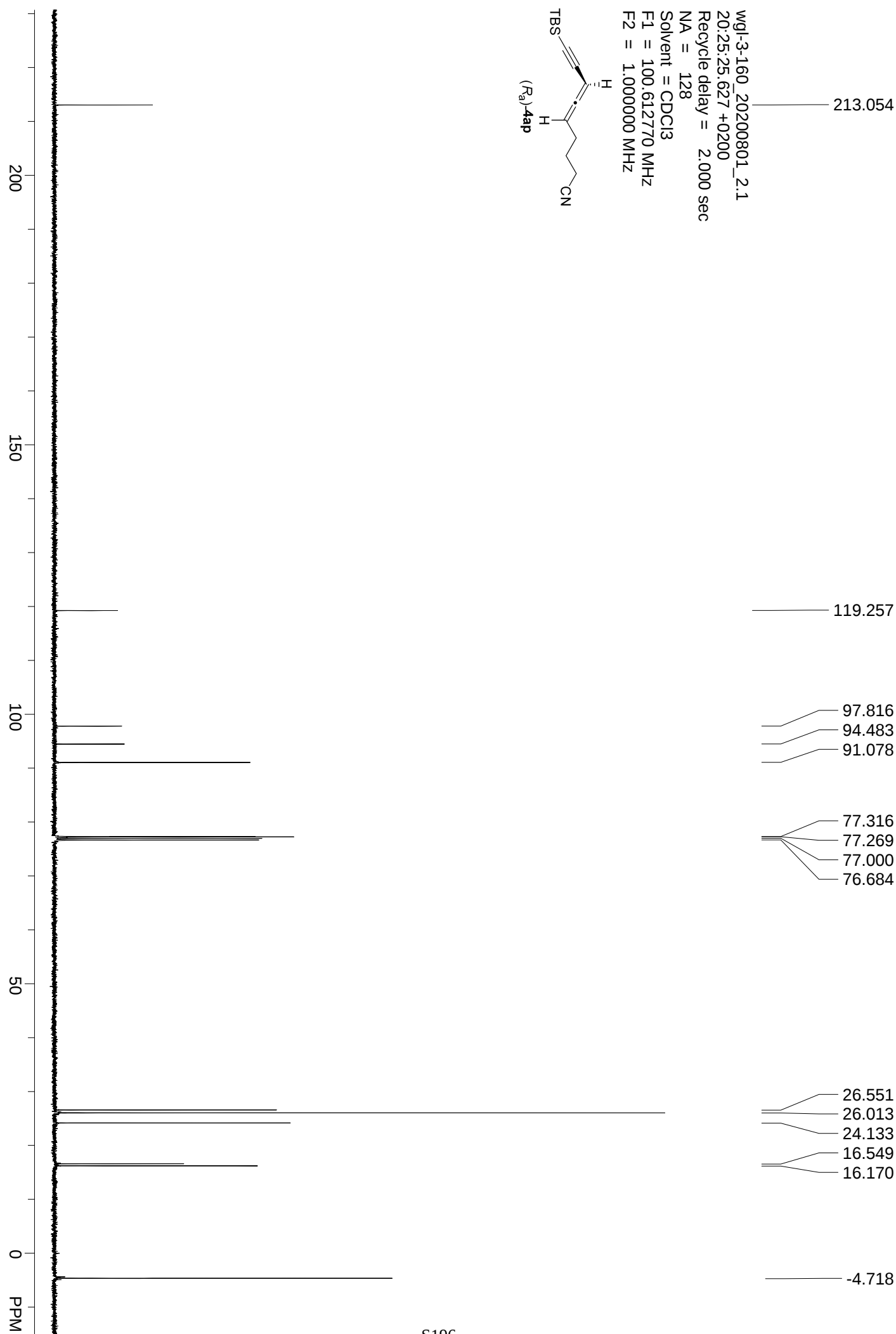
RT [min]	Width [min]	Height	Area	Area%
9.866	0.2901	1252.7639	24132.4512	52.4328
12.953	0.3930	837.3411	21893.0781	47.5672
Sum			46025.5293	100.0000

2.314
2.296
2.279
2.138
2.130
2.121
2.113
2.104
2.096
2.087
2.079
1.745
1.728
1.710
1.692
1.674
0.821
-0.000

C#CCCCC=C[C@H](C#N)C#C[Si](C)(C)C



wgl-3-160_20200801_2.1
 20:25:25.627 +0200
 Recycle delay = 2.000 sec
 NA = 128
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

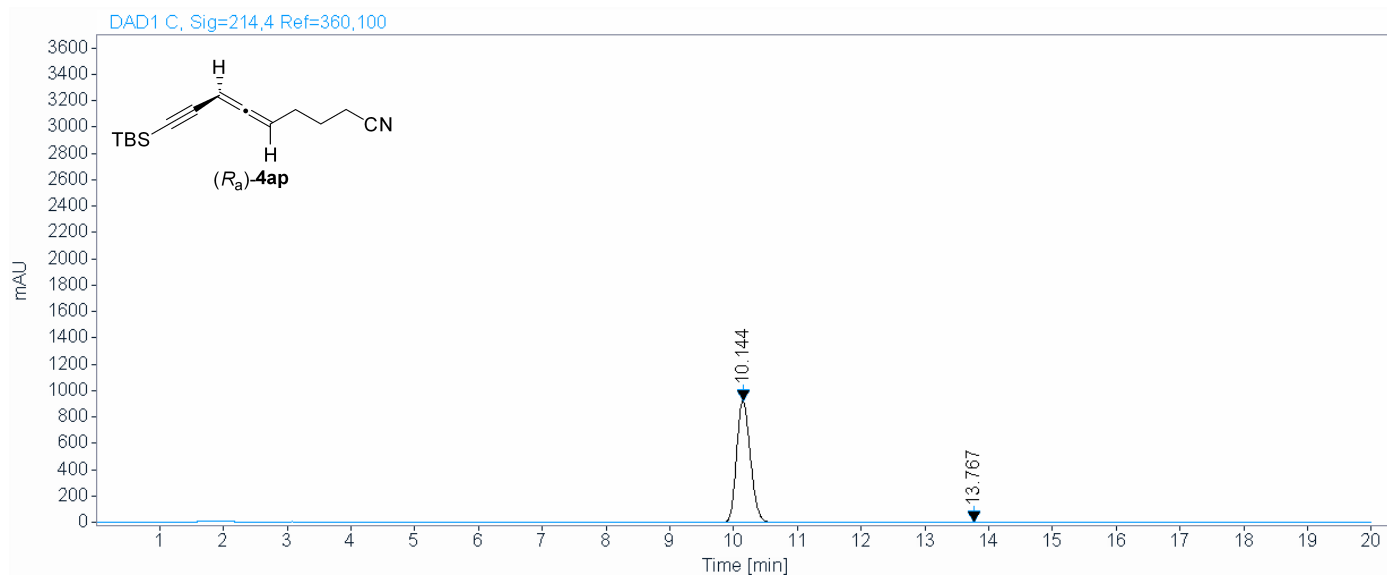


Area Percent Report

sample wgl-3-160-OD-H-99.5-0.5-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2020-08-02 00-05-08\003-P1-E2-wgl-3-160.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

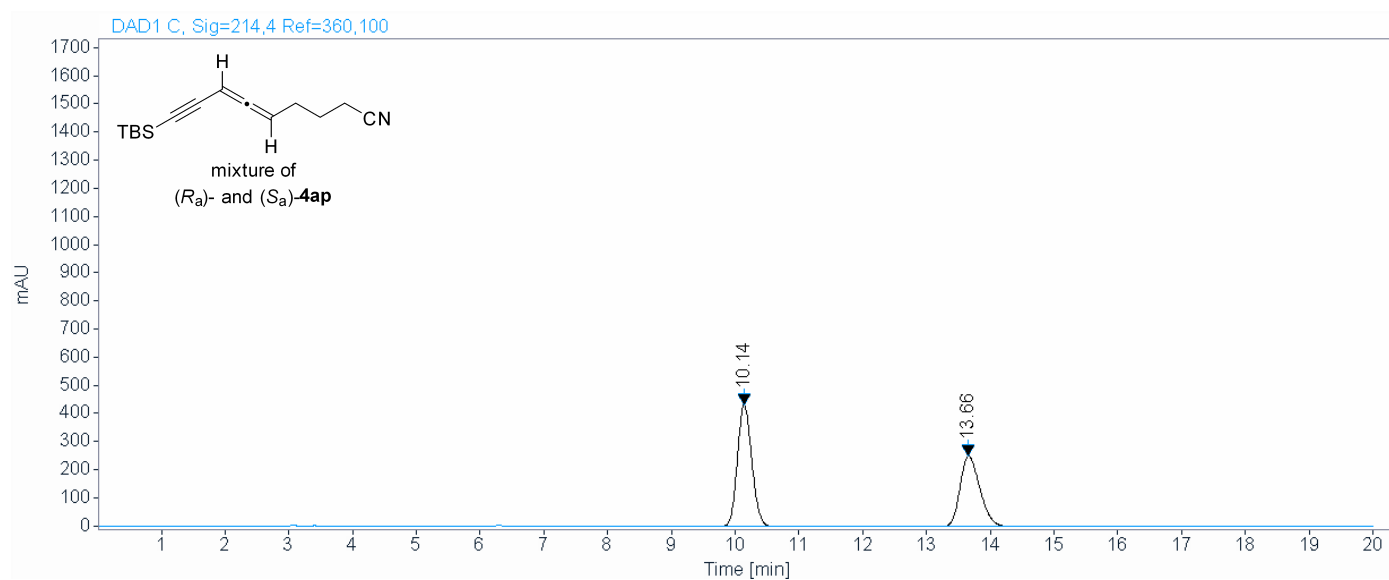
RT [min]	Width [min]	Height	Area	Area%
10.144	0.2356	925.7637	13933.0947	99.5361
13.767	0.4552	2.3774	64.9314	0.4639
		Sum	13998.0261	100.0000

Area Percent Report

sample wgl-2-(162+163)-OD-H-99.5-0.5-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2020-08-02 00-05-08\002-P1-E1-wgl-2-(162+163).D

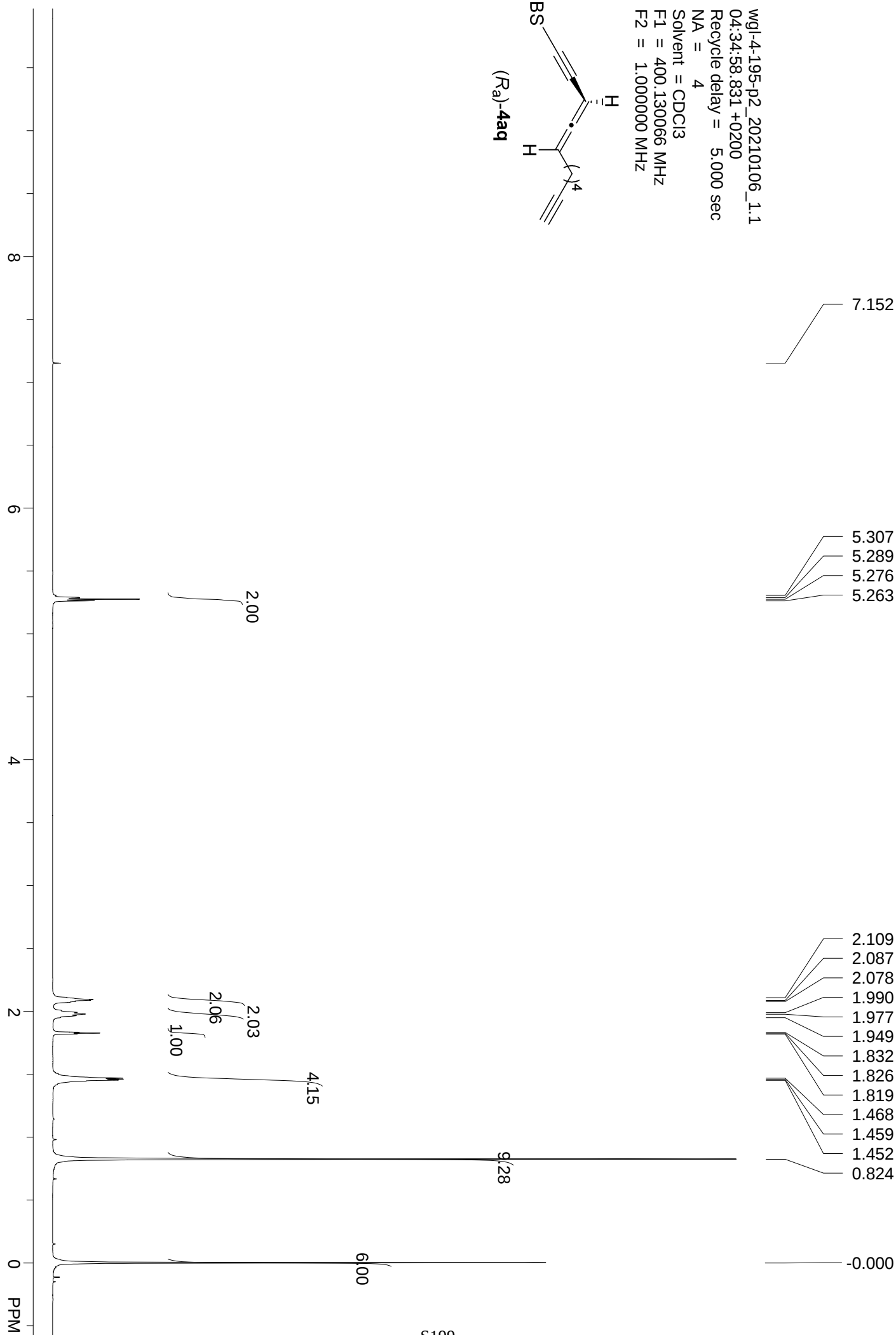
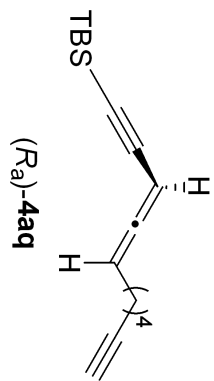
Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
10.140	0.2453	433.1601	6807.2505	55.6050
13.660	0.3395	250.1533	5434.9023	44.3950
		Sum	12242.1528	100.0000

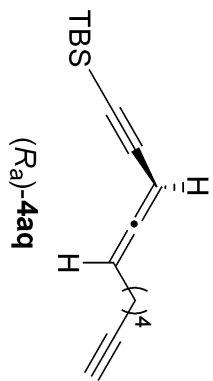
wj-4-195-p2_20210106_1.1
 04:34:58.831 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130066 MHz
 F2 = 1.000000 MHz



04:42:53.977 +0200

$$N_A = 128$$

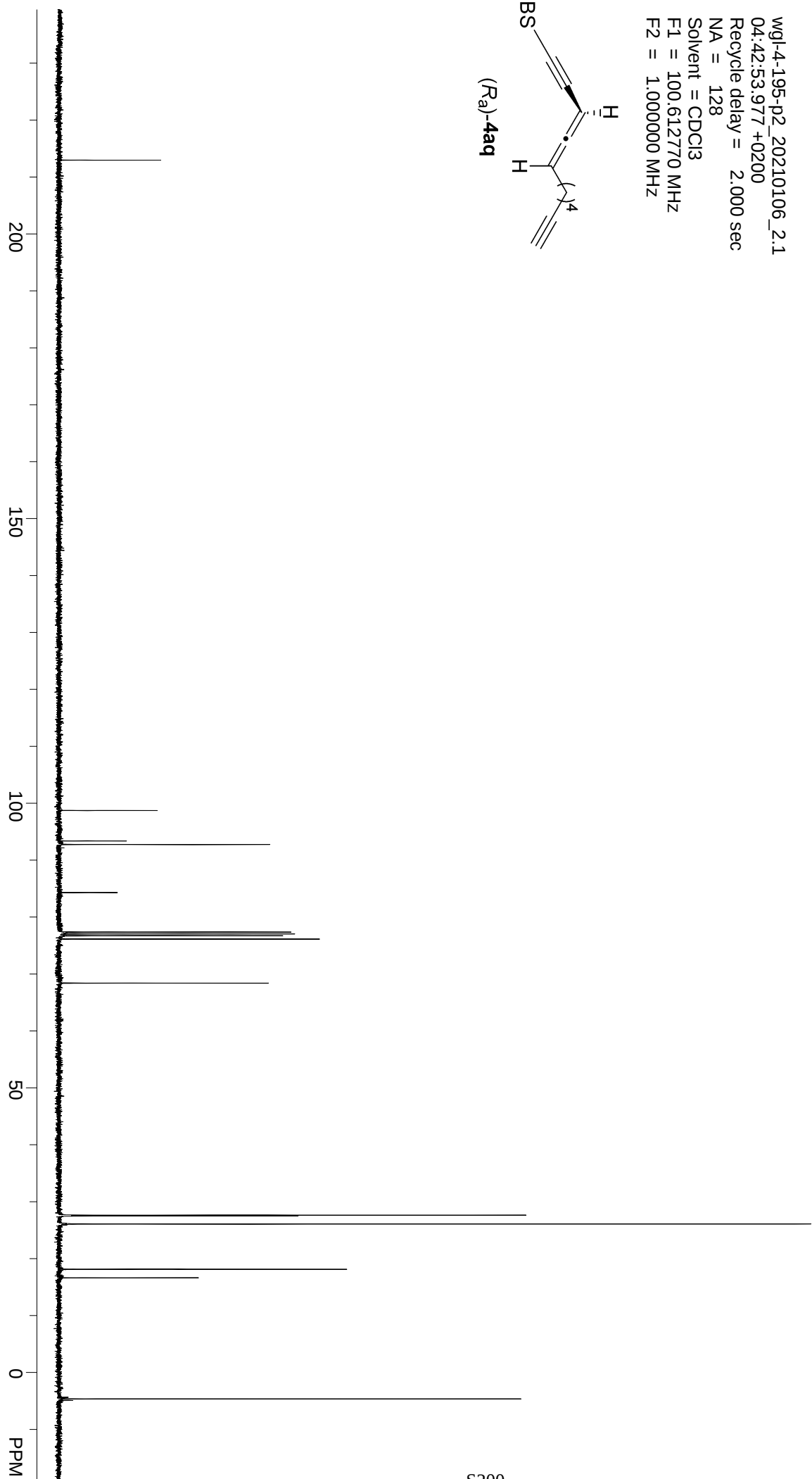
F1 = 100.612770 MHz



100

Year	Percentage of U.S. Population Aged 65 and Older
1980	11.5%
1990	13.5%
2000	15.5%
2020	18.5%

—

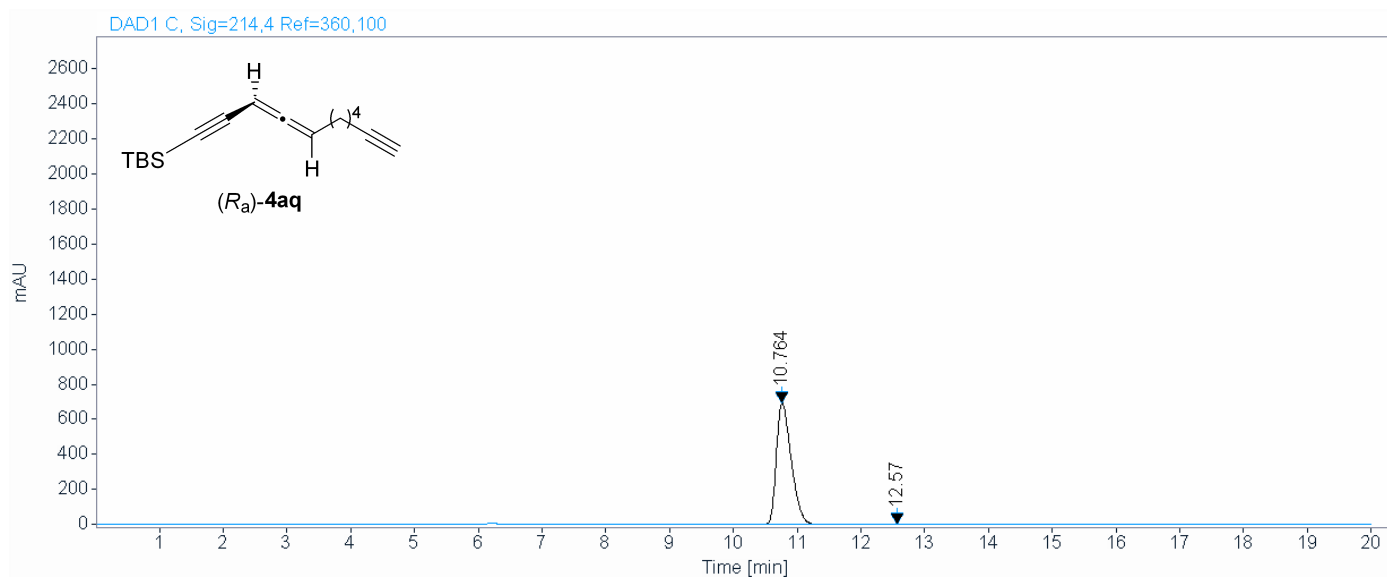


Area Percent Report

sample wgl-4-195-p2-OD-H-100-0-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-01-05 21-38-56\012-P1-E4-wgl-4-195-p2.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

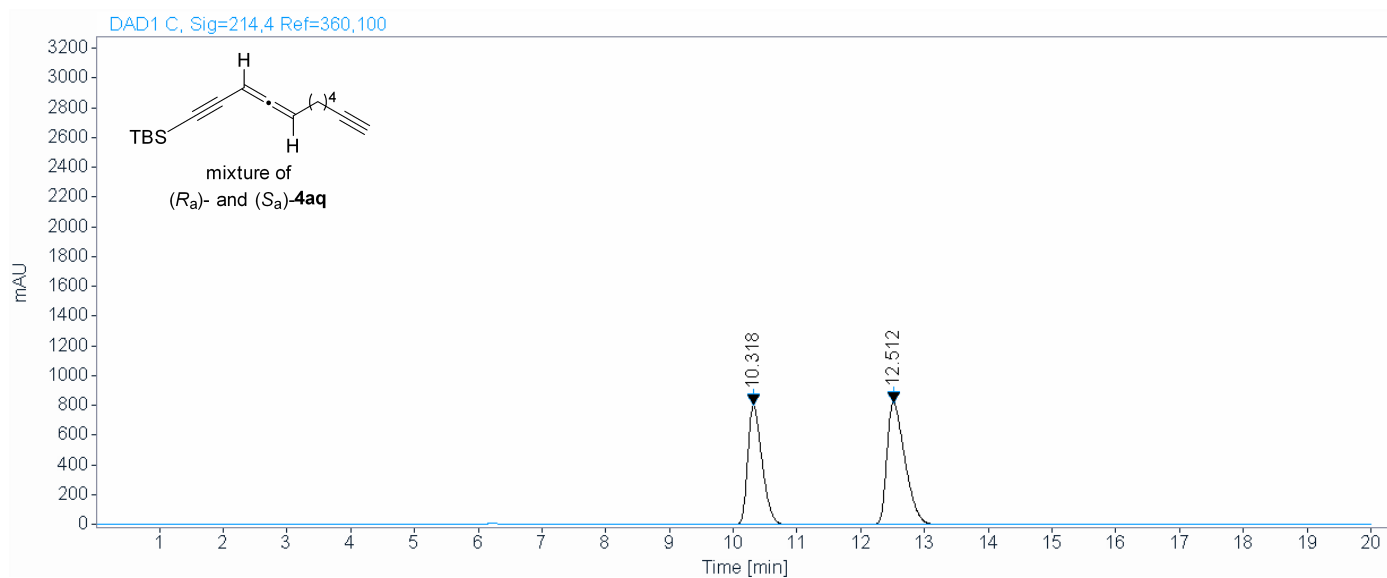
RT [min]	Width [min]	Height	Area	Area%
10.764	0.2491	696.0684	11280.2793	99.8682
12.570	0.3134	0.7914	14.8821	0.1318
Sum			11295.1614	100.0000

Area Percent Report

sample wgl-4-(193+195)-p2-OD-H-100-0-0.5-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2021-01-05 21-38-56\006-P1-E5-wgl-4-(193+195)-p2.D

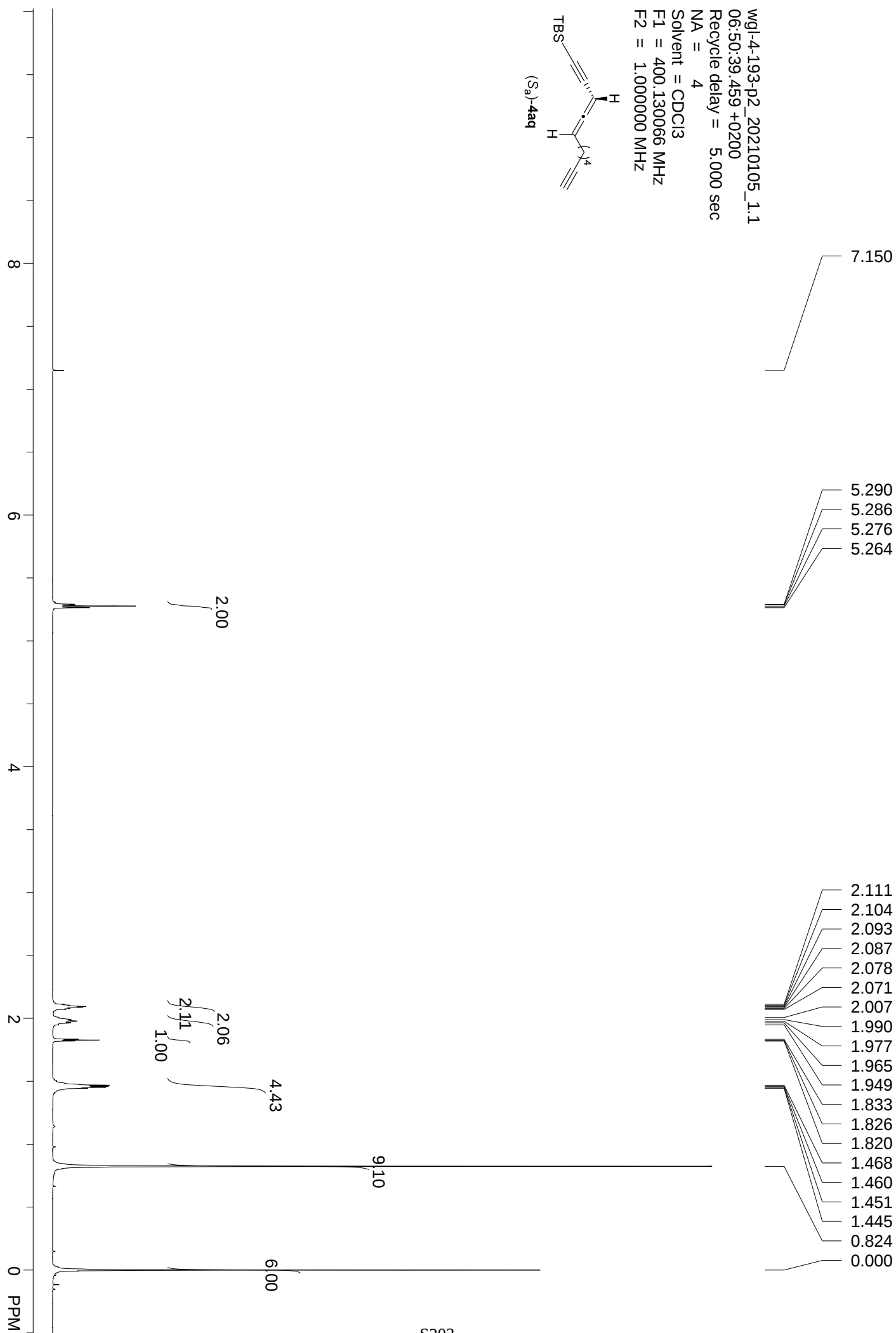
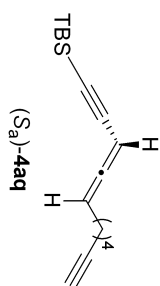
Acquisition Data:

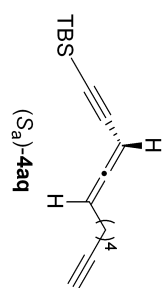


Signal: DAD1 C, Sig=214,4 Ref=360,100

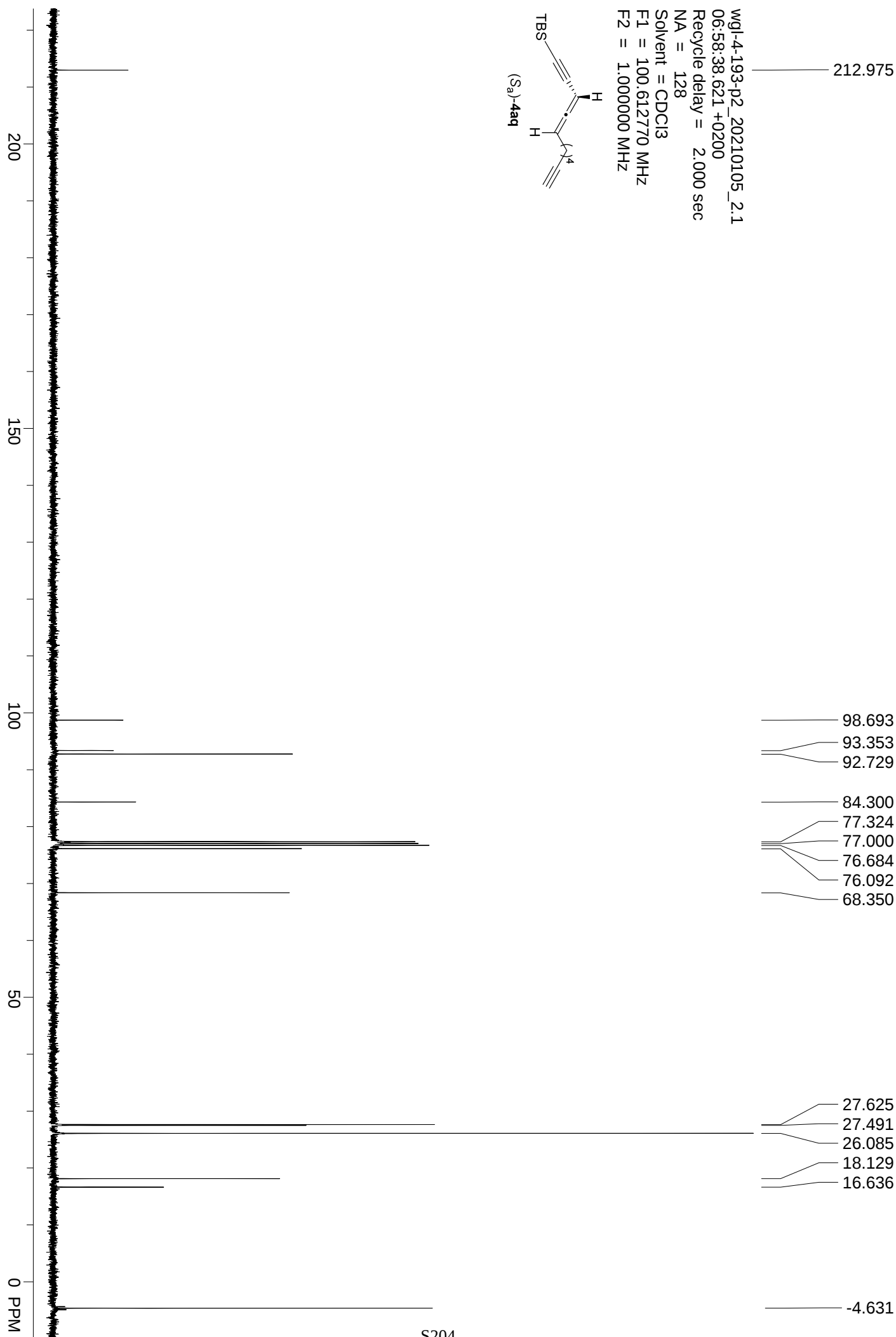
RT [min]	Width [min]	Height	Area	Area%
10.318	0.2355	803.2415	12517.9697	43.7787
12.512	0.3007	819.9577	16075.7656	56.2213
Sum			28593.7354	100.0000

wj-4-193-p2_20210105_1.1
 06:50:39.459 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130066 MHz
 F2 = 1.000000 MHz





wgl-4-193-p2_20210105_2.1
 06:58:38.621+0200
 Recycle delay = 2.000 sec
 NA = 128
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

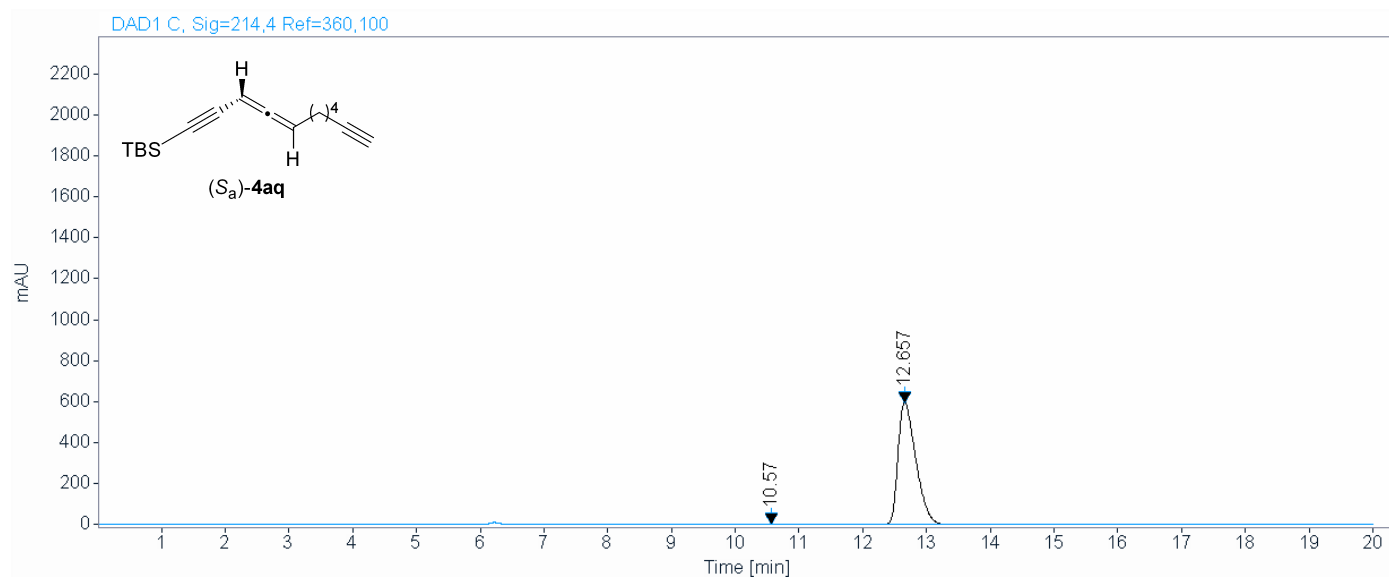


Area Percent Report

sample wgl-4-193-p2-OD-H-100-0-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-01-05 21-38-56\007-P1-E2-wgl-4-193-p2.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

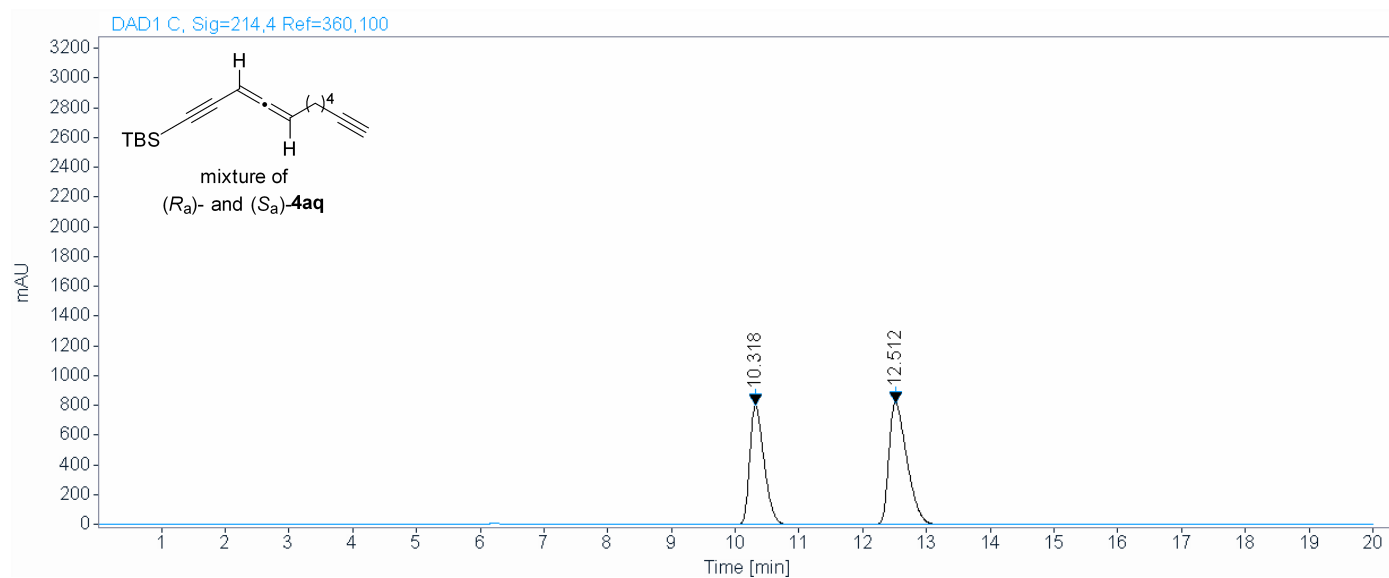
RT [min]	Width [min]	Height	Area	Area%
10.570	0.2277	2.0449	29.7490	0.2558
12.657	0.3010	596.2141	11602.2139	99.7442
Sum			11631.9629	100.0000

Area Percent Report

sample wgl-4-(193+195)-p2-OD-H-100-0-0.5-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2021-01-05 21-38-56\006-P1-E5-wgl-4-(193+195)-p2.D

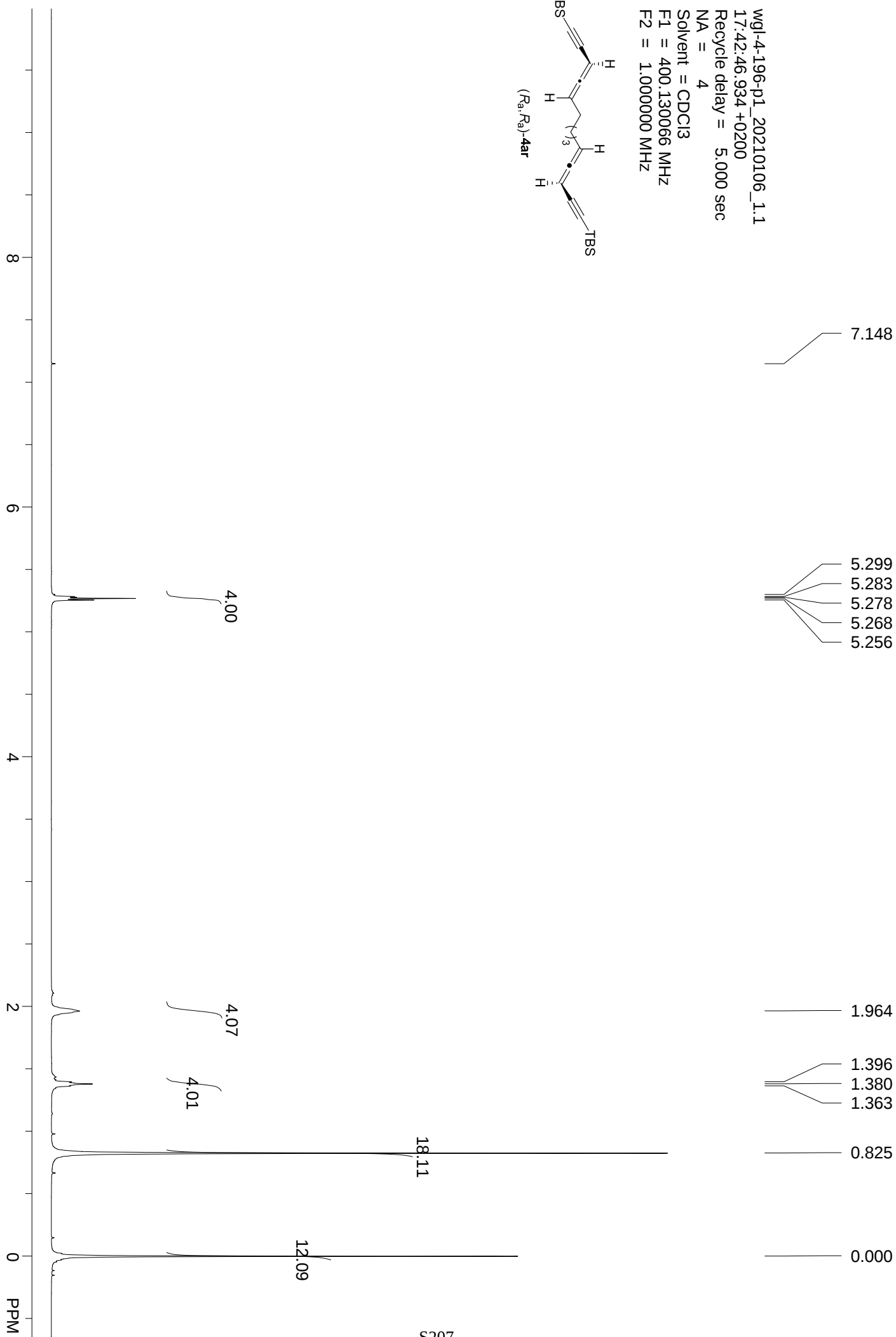
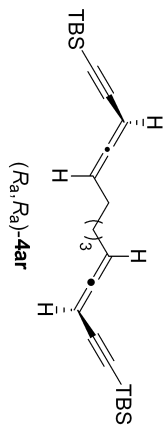
Acquisition Data:



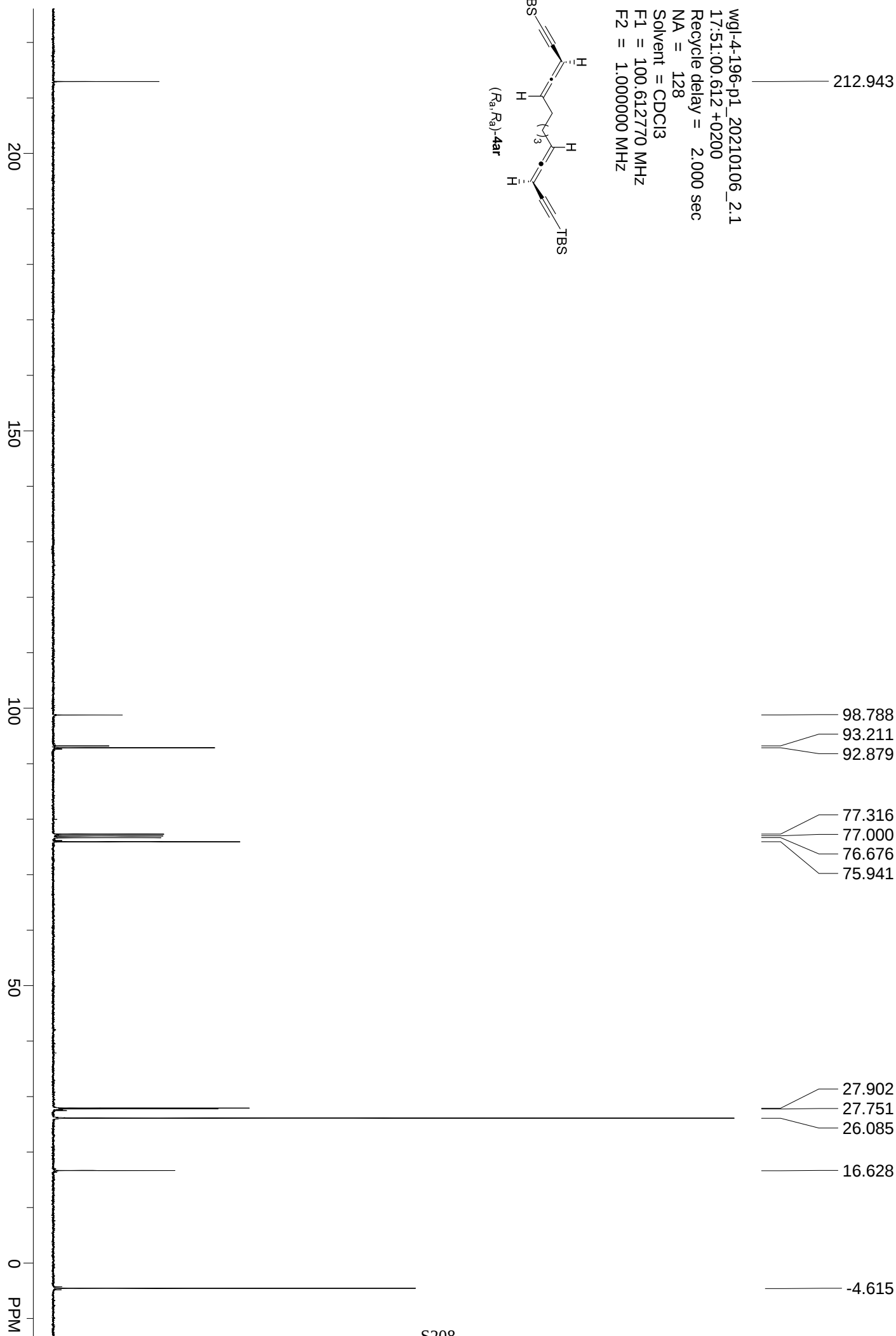
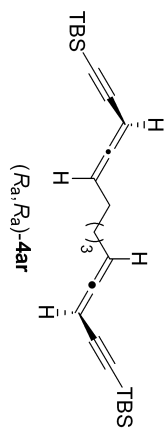
Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
10.318	0.2355	803.2415	12517.9697	43.7787
12.512	0.3007	819.9577	16075.7656	56.2213
Sum			28593.7354	100.0000

wjl-4-196-p1_20210106_1.1
17:42:46.934 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl3
F1 = 400.130066 MHz
F2 = 1.000000 MHz



wj-4-196-p1_20210106_2.1
17:51:00.612 +0200
Recycle delay = 2.000 sec
NA = 128
Solvent = CDCl₃
F1 = 100.612770 MHz
F2 = 1.000000 MHz

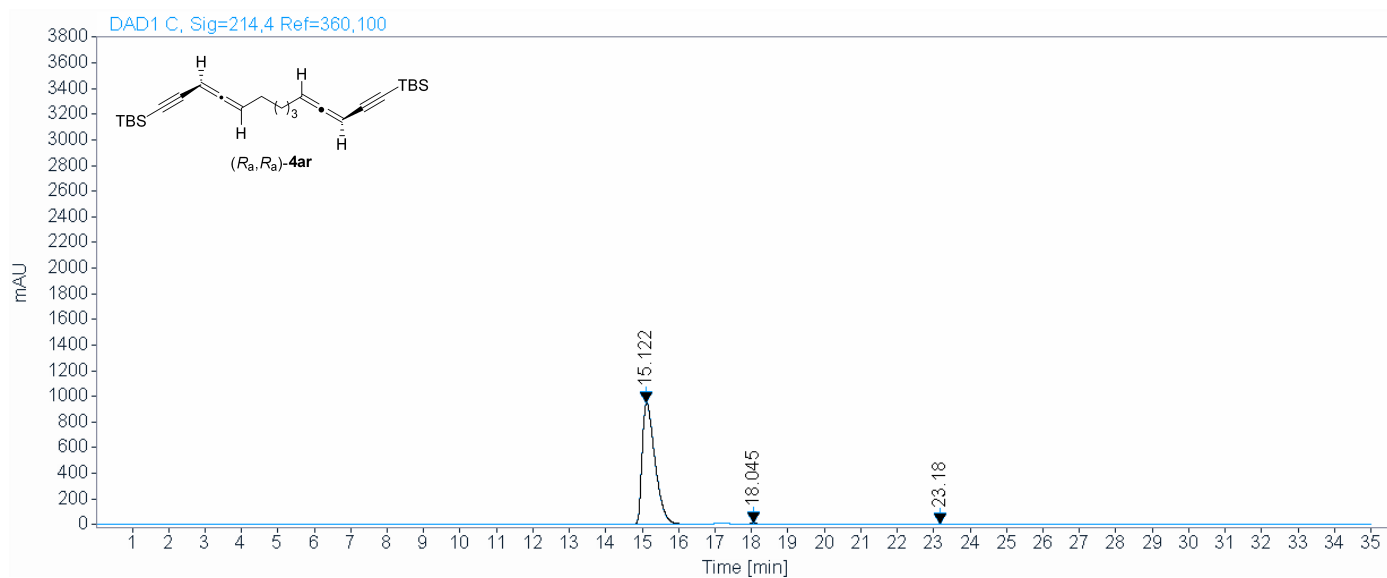


Area Percent Report

sample wgl-4-196-p1-OD-H-100-0-0.3-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-01-08 10-38-57\012-P1-E7-wgl-4-196-p1.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

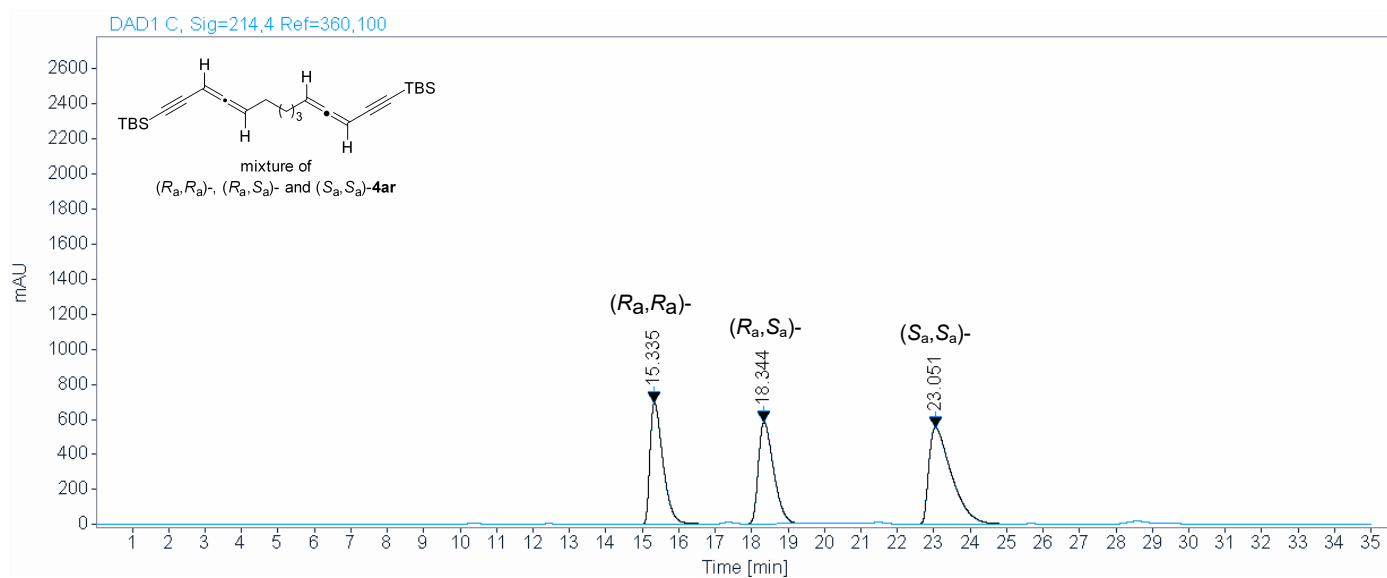
RT [min]	Width [min]	Height	Area	Area%
15.122	0.3766	950.7064	23355.6758	98.6487
18.045	0.6227	6.7770	271.0974	1.1450
23.180	0.8452	0.9628	48.8252	0.2062
		Sum	23675.5983	100.0000

Area Percent Report

sample wgl-4-(194+196+197)-p1-OD-H-100-0-0.3-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-01-08 10-38-57\014-P1-E1-wgl-4-(194+196+197)-p1.D

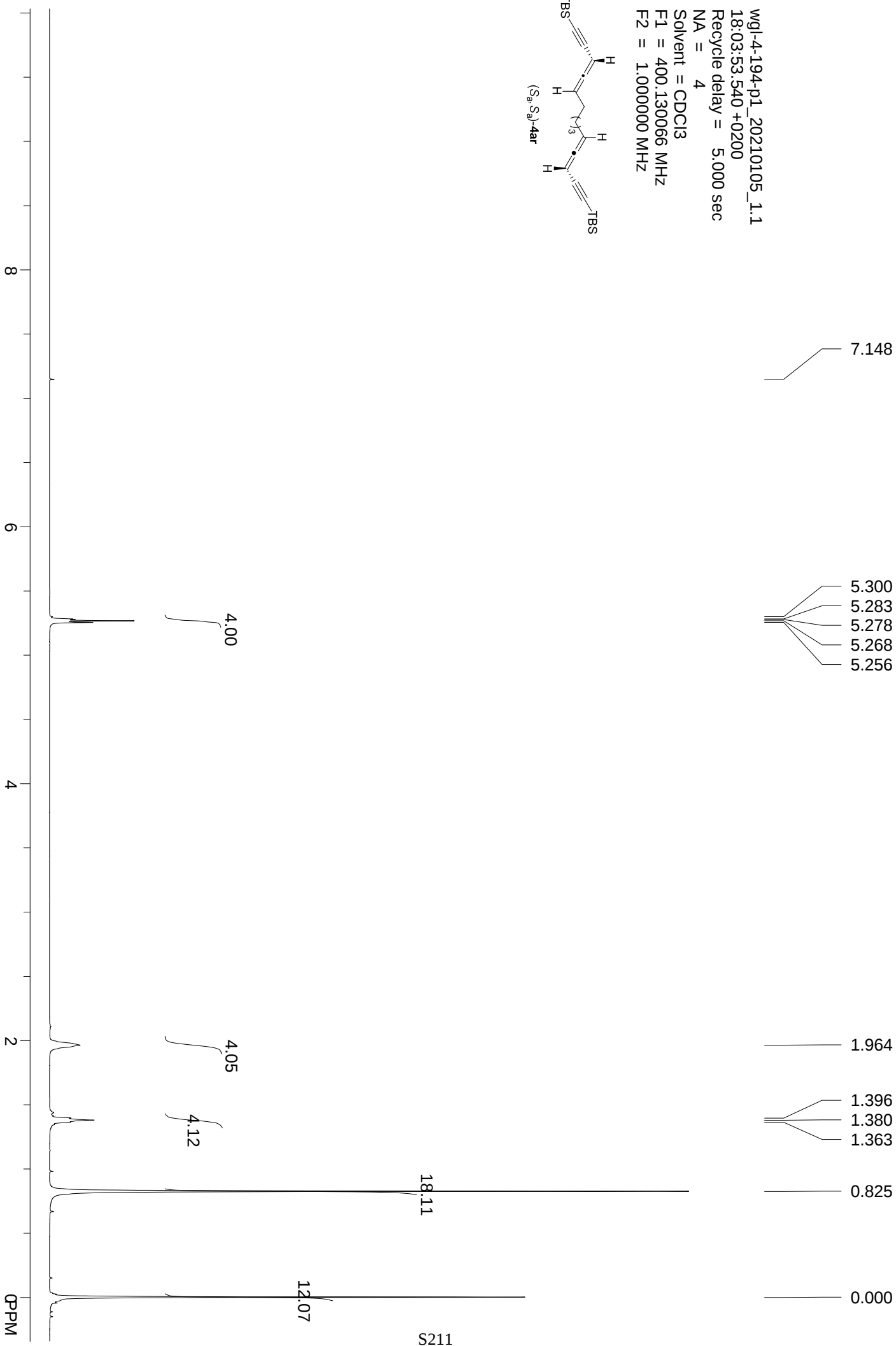
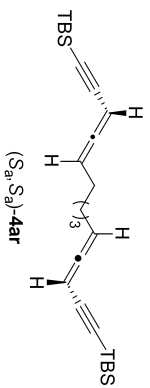
Acquisition Data:

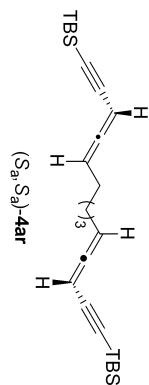


Signal: DAD1 C, Sig=214,4 Ref=360,100

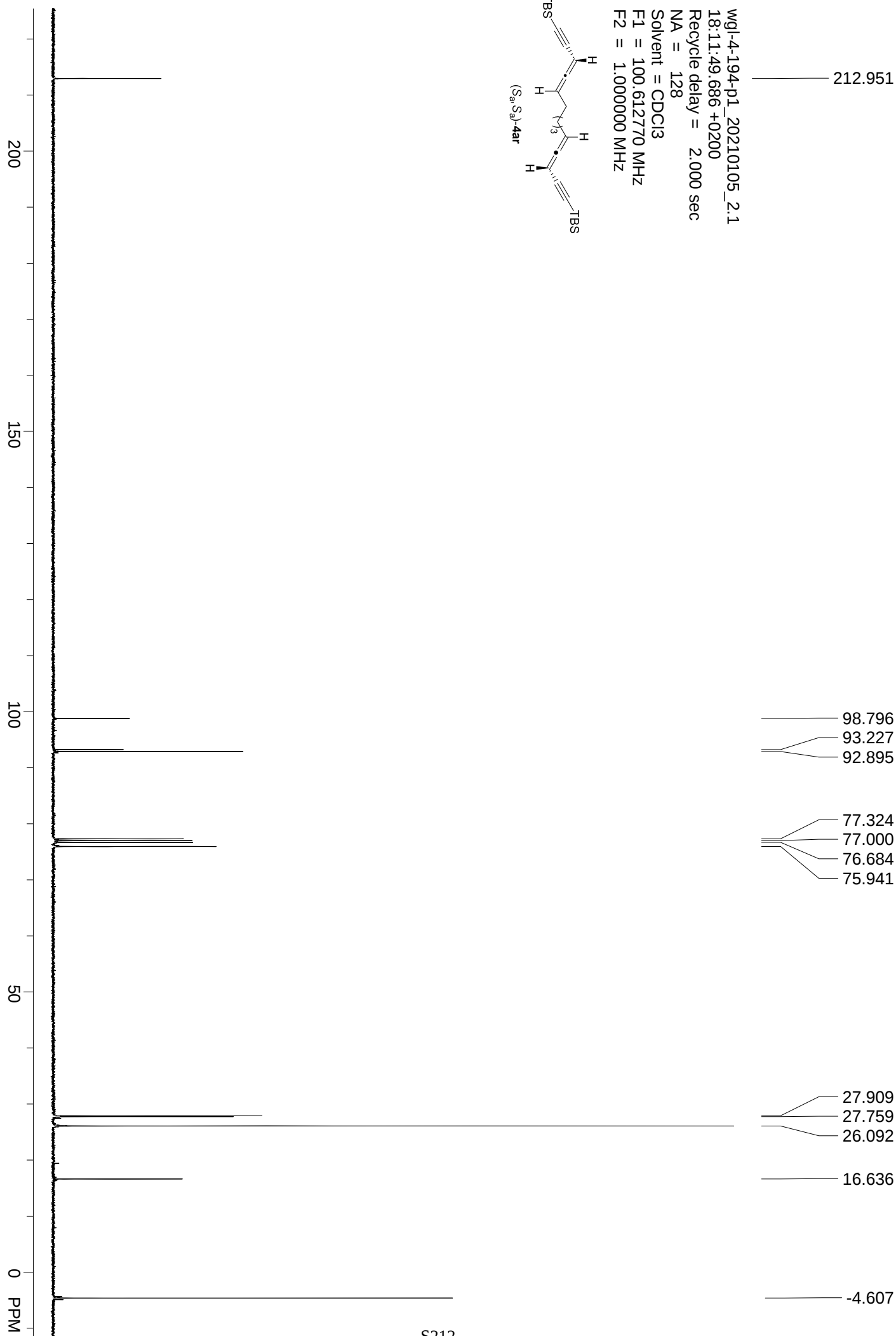
RT [min]	Width [min]	Height	Area	Area%
15.335	0.3798	694.3640	17248.0625	29.7204
18.344	0.4494	580.9656	16900.8828	29.1222
23.051	0.6538	553.1666	23885.3867	41.1573
Sum			58034.3320	100.0000

wgl-4-194-p1_20210105_1.1
18:03:53.540 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl3
F1 = 400.130066 MHz
F2 = 1.000000 MHz





wgl-4-194-p1_20210105_2.1
 18:11:49.686 +0200
 Recycle delay = 2.000 sec
 NA = 128
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

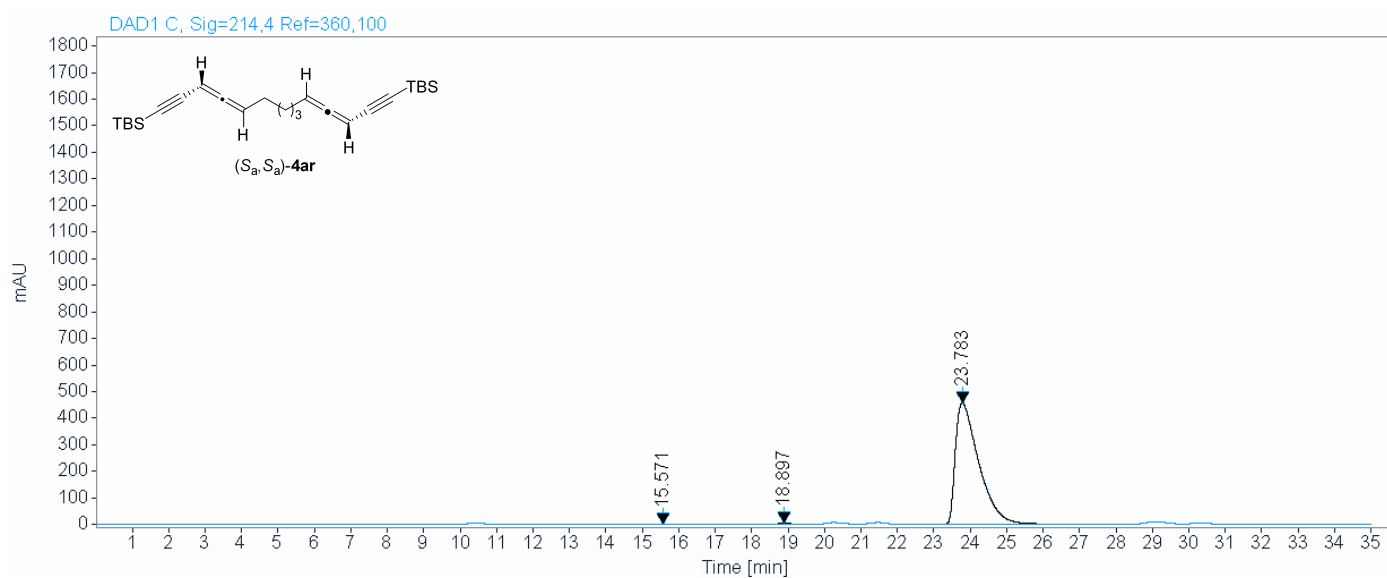


Area Percent Report

sample wgl-4-194-p1-OD-H-100-0-0.3-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-01-08 10-38-57\013-P1-E5-wgl-4-194-p1.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

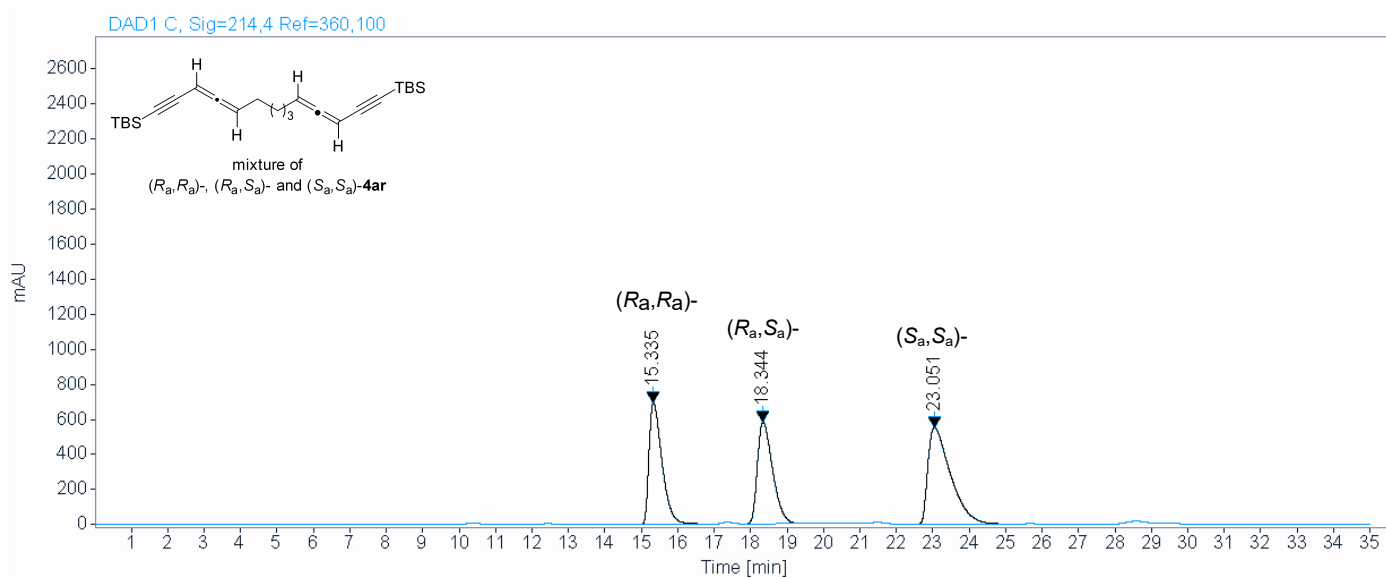
RT [min]	Width [min]	Height	Area	Area%
15.571	0.3974	0.3453	8.2319	0.0398
18.897	0.4743	3.9103	122.0997	0.5901
23.783	0.6714	458.3154	20560.6914	99.3701
Sum			20691.0229	100.0000

Area Percent Report

sample wgl-4-(194+196+197)-p1-OD-H-100-0-0.3-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-01-08 10-38-57\014-P1-E1-wgl-4-(194+196+197)-p1.D

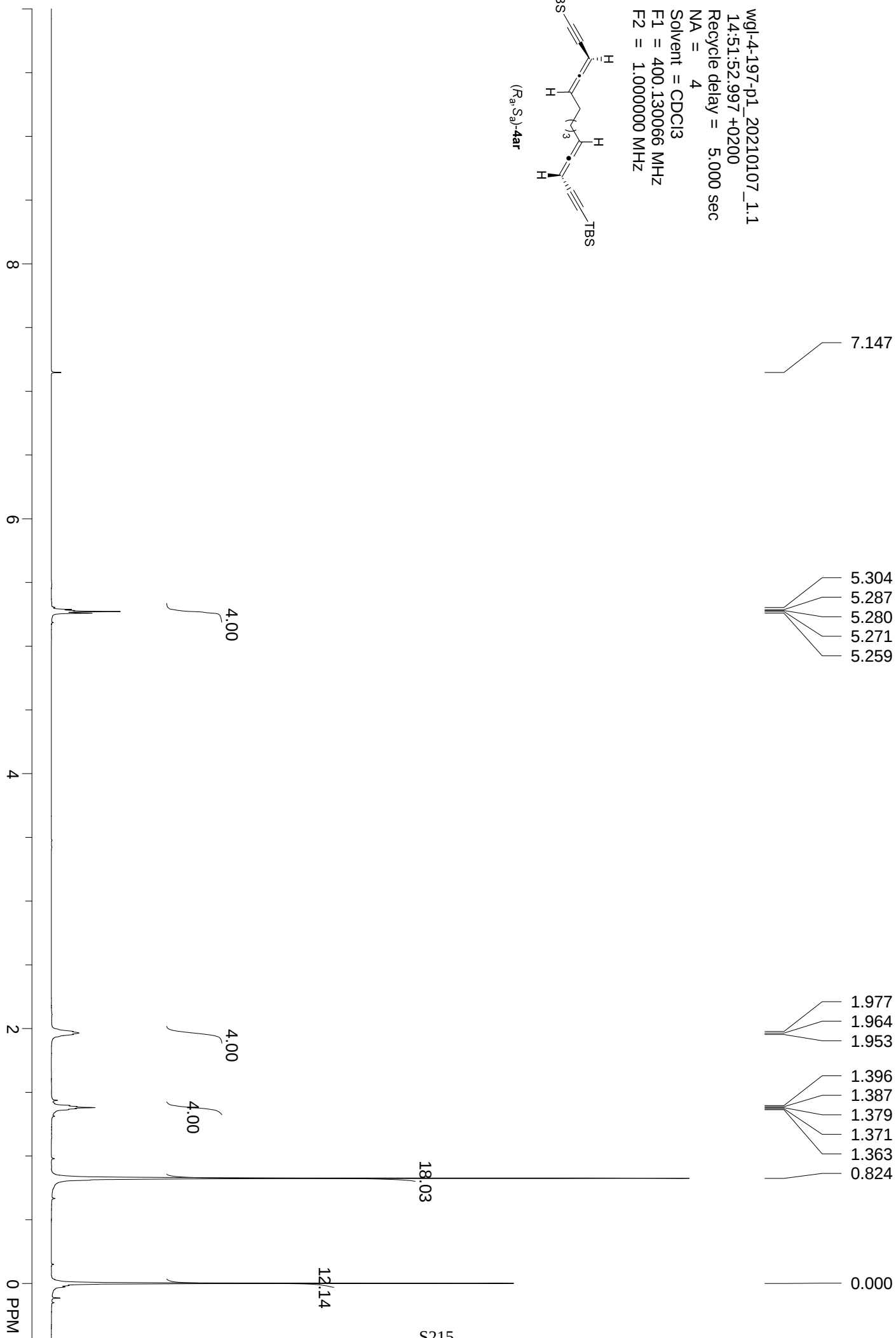
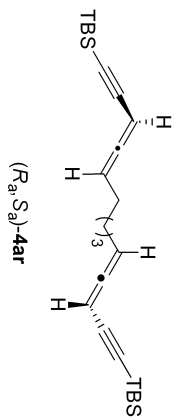
Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
15.335	0.3798	694.3640	17248.0625	29.7204
18.344	0.4494	580.9656	16900.8828	29.1222
23.051	0.6538	553.1666	23885.3867	41.1573
		Sum	58034.3320	100.0000

wgl-4-197-p1_20210107_1.1
14:51:52.997 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl₃
F1 = 400.130066 MHz
F2 = 1.000000 MHz



212.943

98.788
93.234
92.918

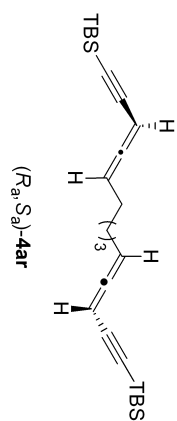
77.316
77.000
76.676
75.941

27.862
27.728
26.077

16.636

-4.615

wj-4-197-p1_20210107_2.1
16:53:05.482 +0200
Recycle delay = 2.000 sec
NA = 128
Solvent = CDCl₃
F1 = 100.612770 MHz
F2 = 1.000000 MHz

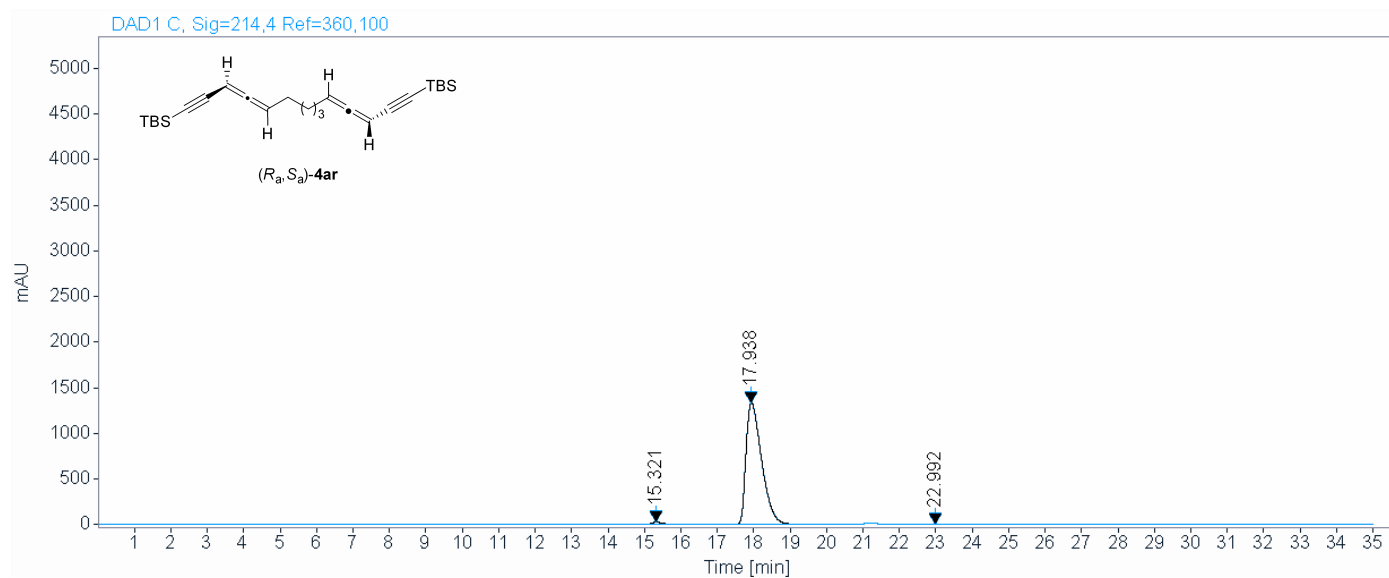


Area Percent Report

sample wgl-4-197-p1-OD-H-100-0-0.3-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-01-08 10-38-57\018-P1-E4-wgl-4-197-p1.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

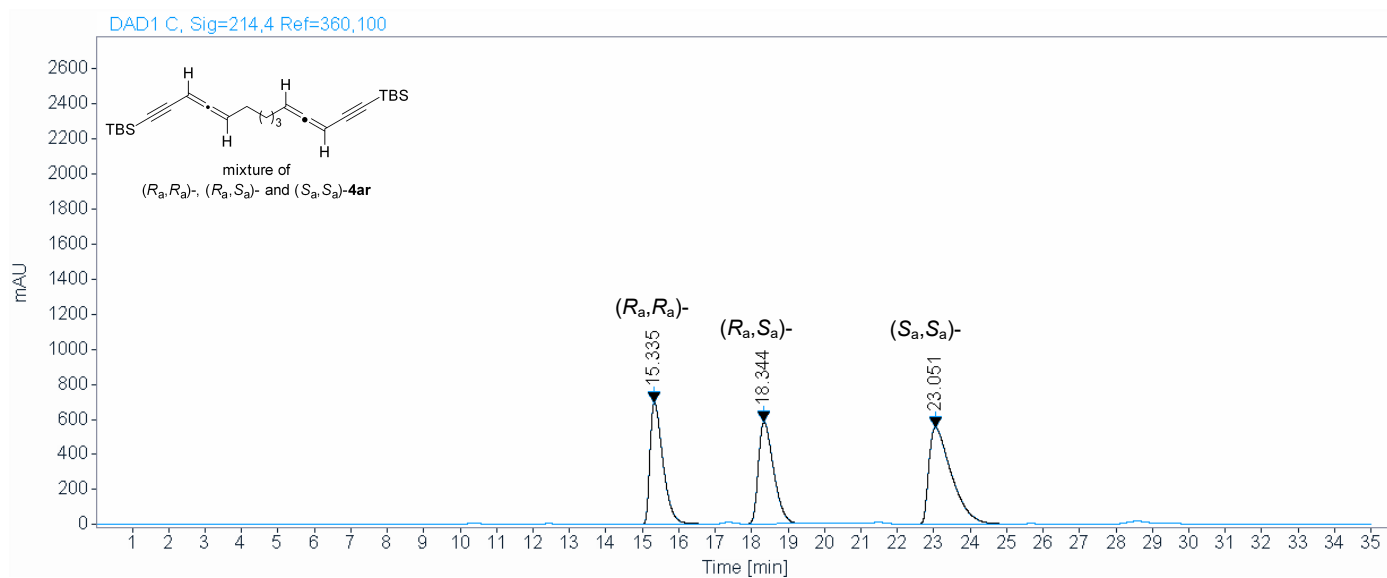
RT [min]	Width [min]	Height	Area	Area%
15.321	0.3642	25.6169	606.5703	1.4957
17.938	0.4590	1336.8490	39765.1133	98.0517
22.992	0.5916	4.5409	183.5661	0.4526
		Sum	40555.2497	100.0000

Area Percent Report

sample wgl-4-(194+196+197)-p1-OD-H-100-0-0.3-214

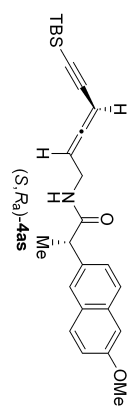
Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-01-08 10-38-57\014-P1-E1-wgl-4-(194+196+197)-p1.D

Acquisition Data:

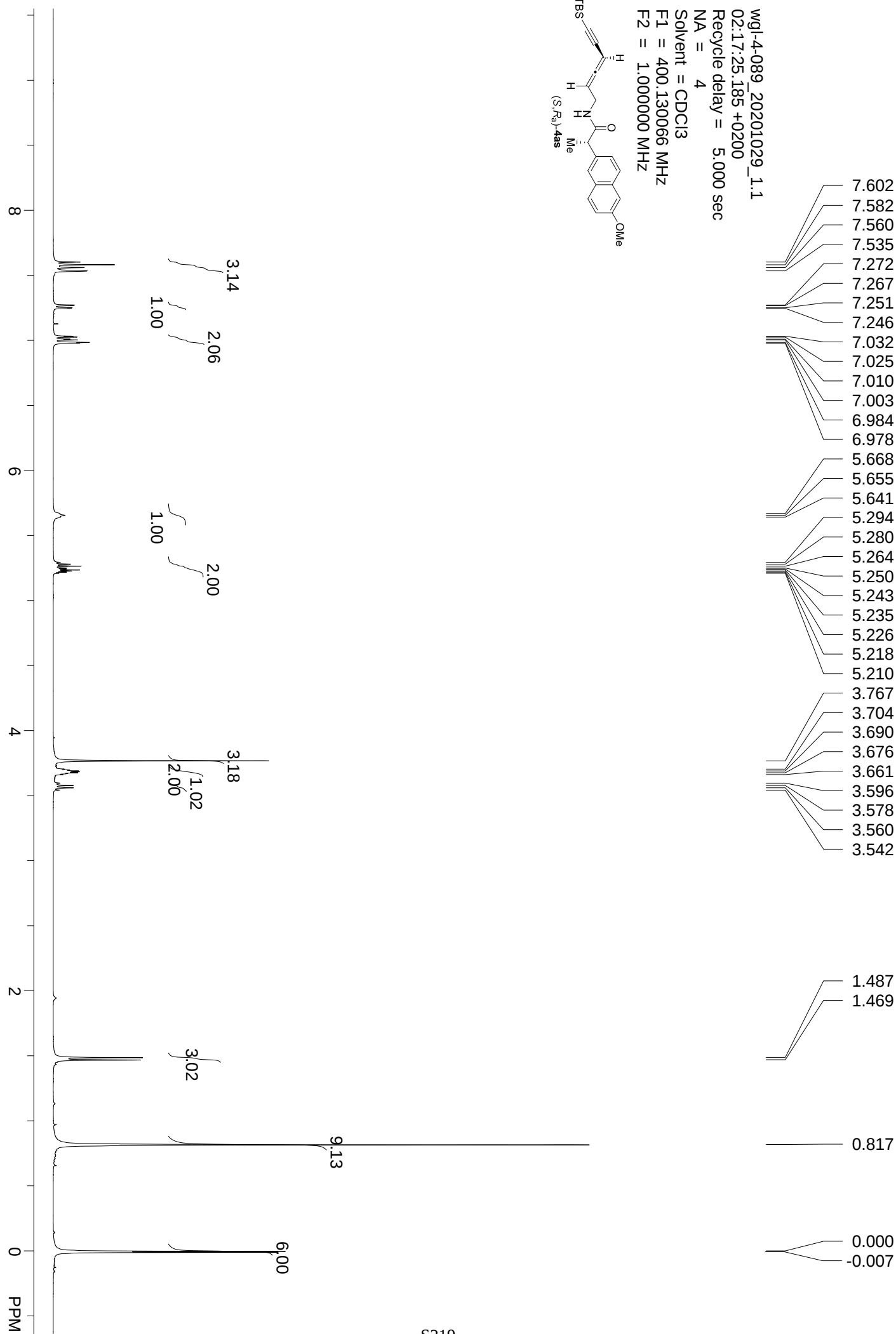


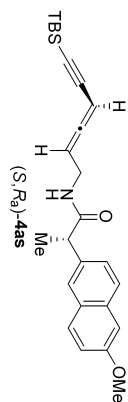
Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
15.335	0.3798	694.3640	17248.0625	29.7204
18.344	0.4494	580.9656	16900.8828	29.1222
23.051	0.6538	553.1666	23885.3867	41.1573
Sum			58034.3320	100.0000

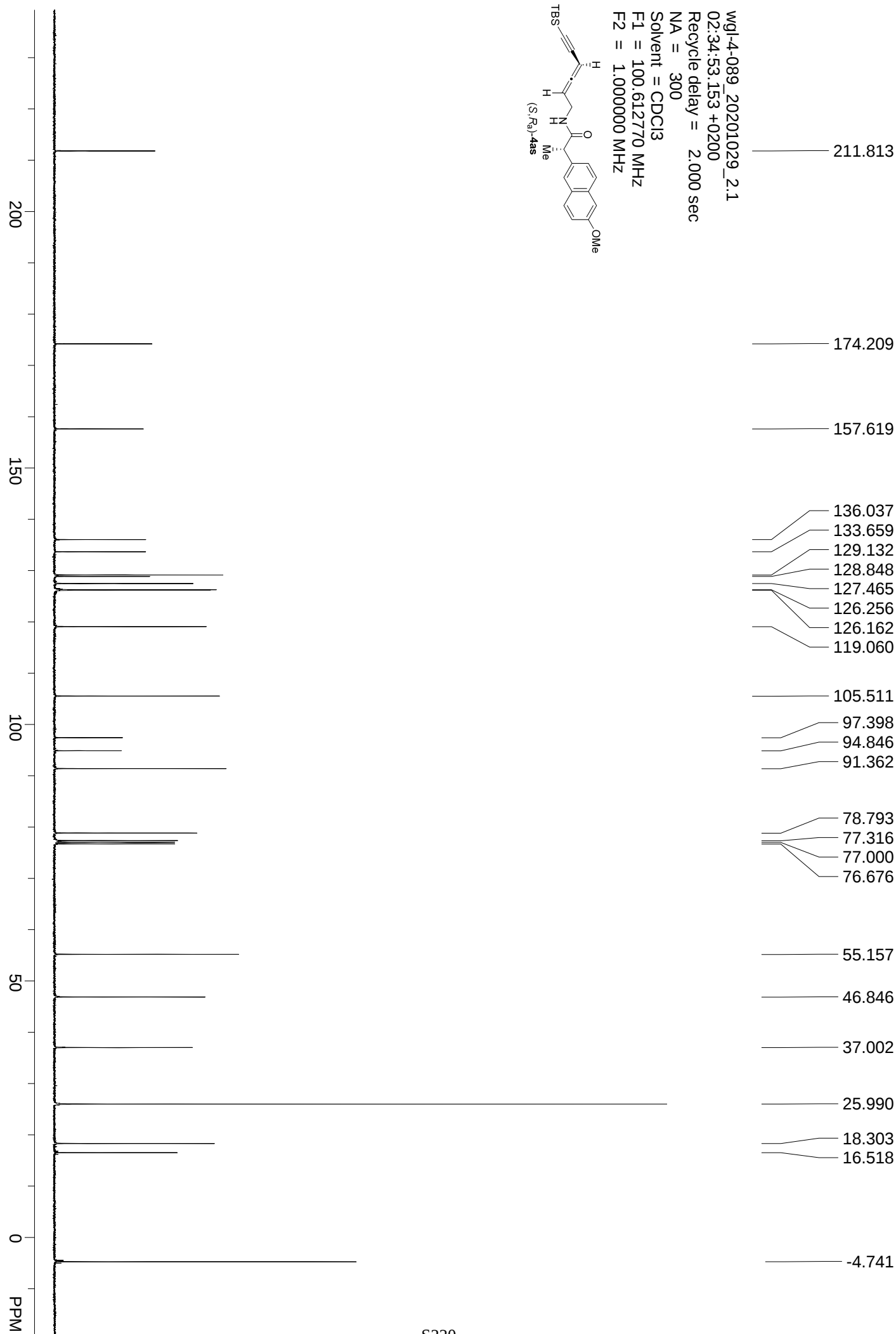


wj1-4-089_20201029_1.1
 02:17:25.185 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130066 MHz
 F2 = 1.000000 MHz





wgl-4-089_20201029_2.1
 02:34:53.153 +0200
 Recycle delay = 2.000 sec
 NA = 300
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz



7.416
7.410
7.297
7.292
7.281
7.277

_____ 6.340

5.844
5.828

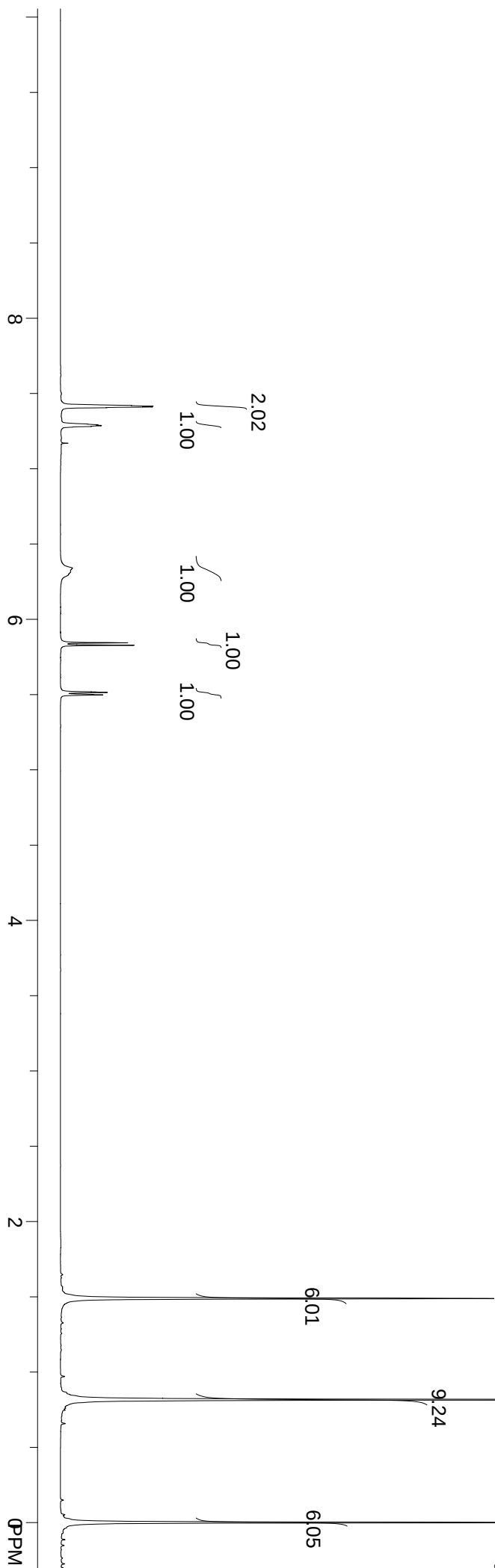
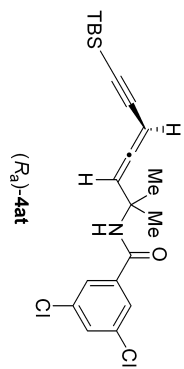
5.515
5.498

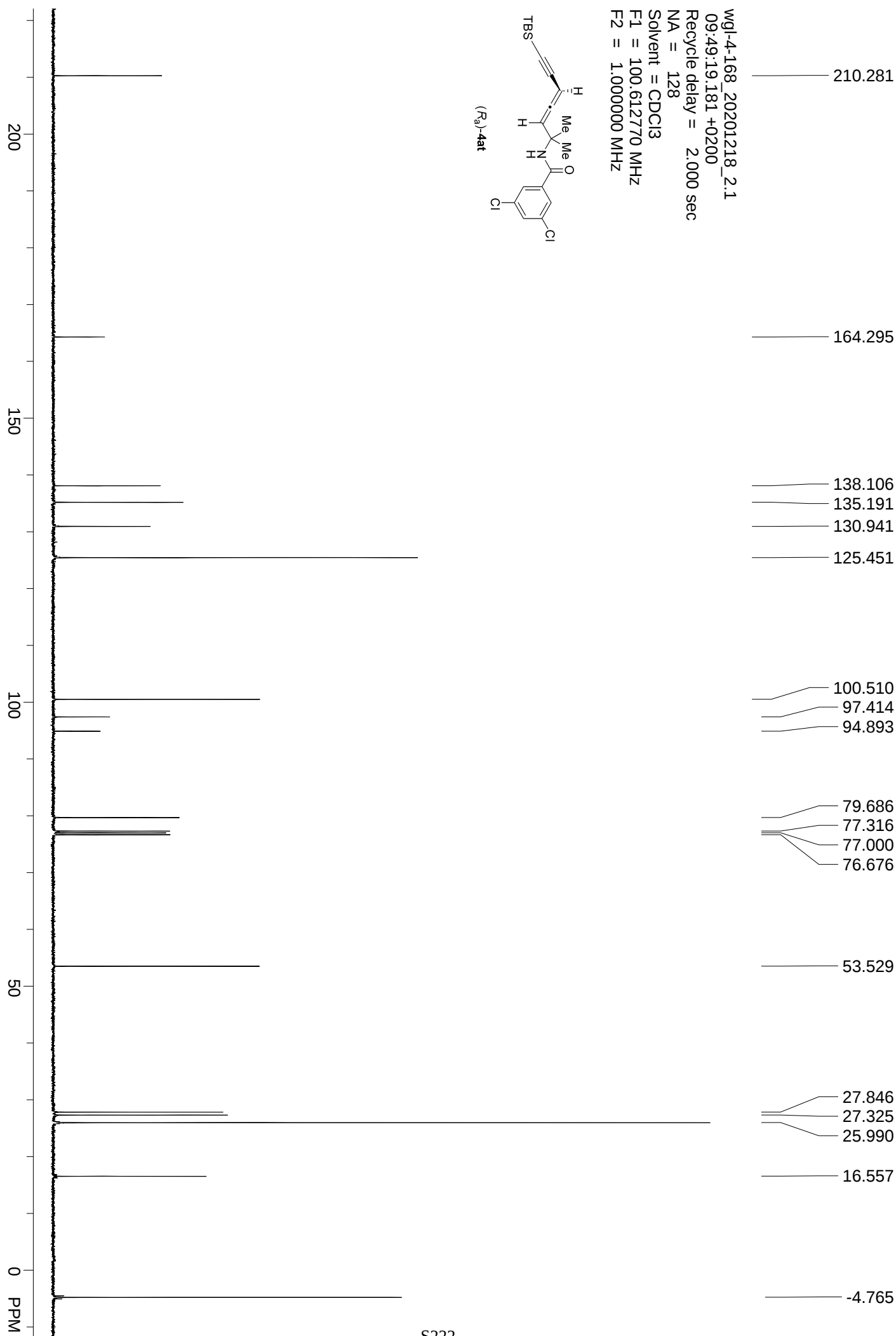
1.488

0.816

0.000

S221



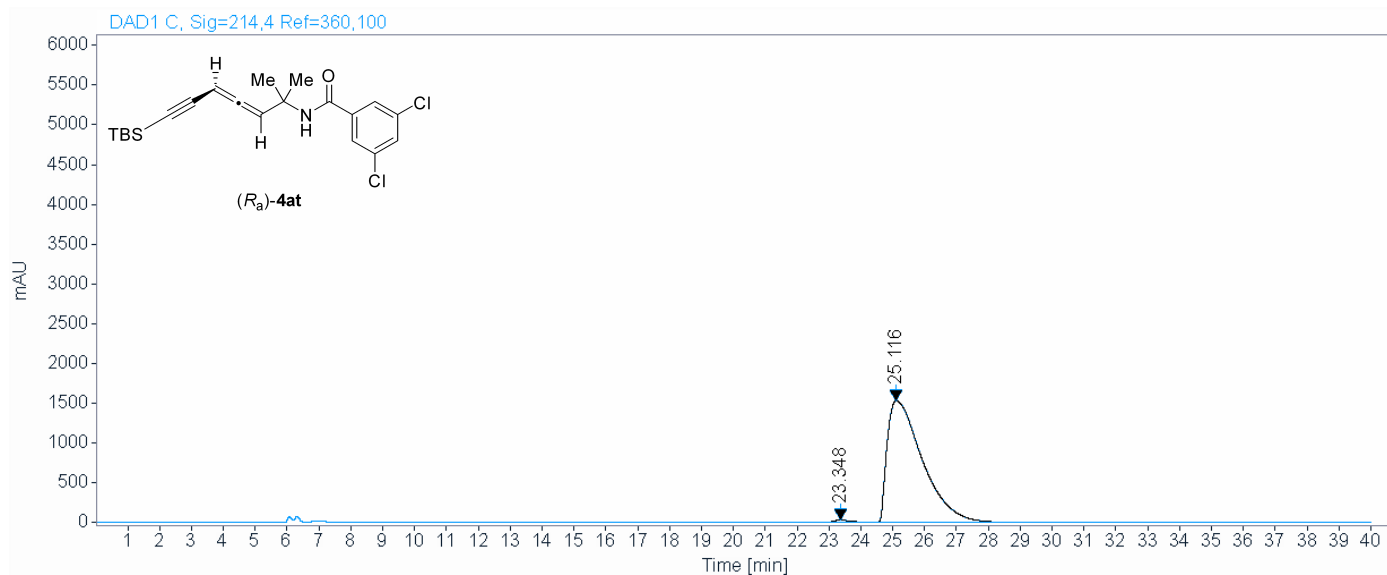


Area Percent Report

sample wgl-4-168-AD-H-99.5-0.5-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2020-12-18 08-41-25\005-P1-E5-wgl-4-168.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

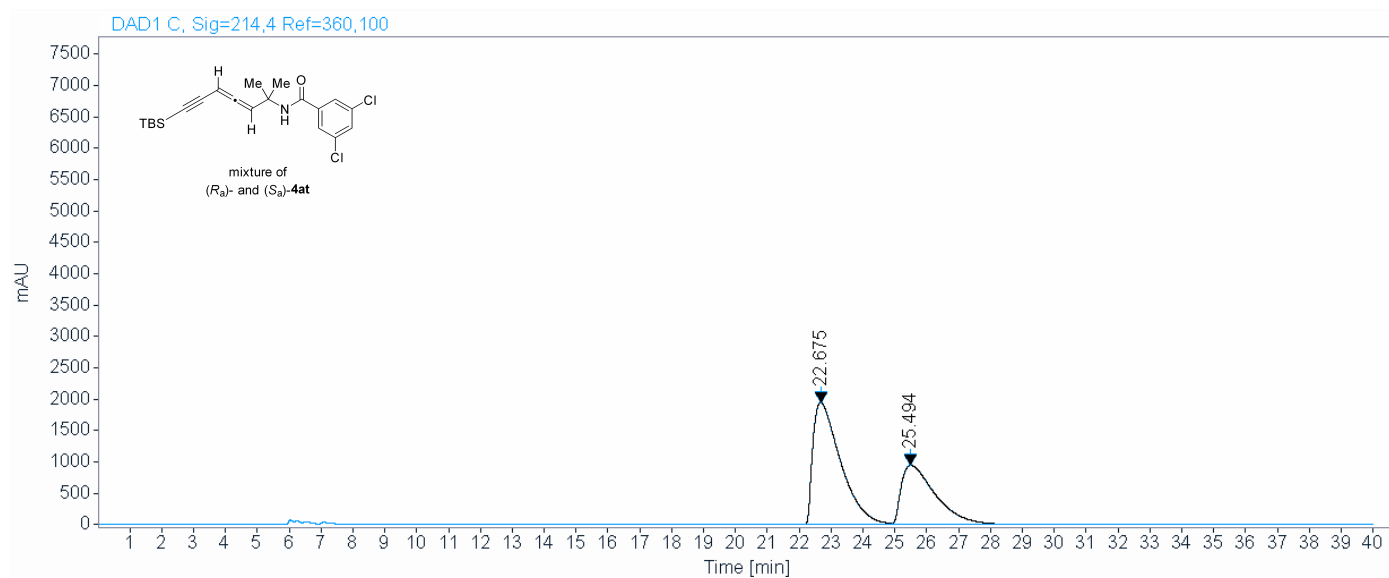
RT [min]	Width [min]	Height	Area	Area%
23.348	0.6221	31.0518	1293.8761	1.0844
25.116	1.1674	1534.3634	118019.1250	98.9156
Sum			119313.0011	100.0000

Area Percent Report

sample wgl-4-(168+169)-AD-H-99.5-0.5-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2020-12-18 08-41-25\007-P1-E4-wgl-4-(168+169).D

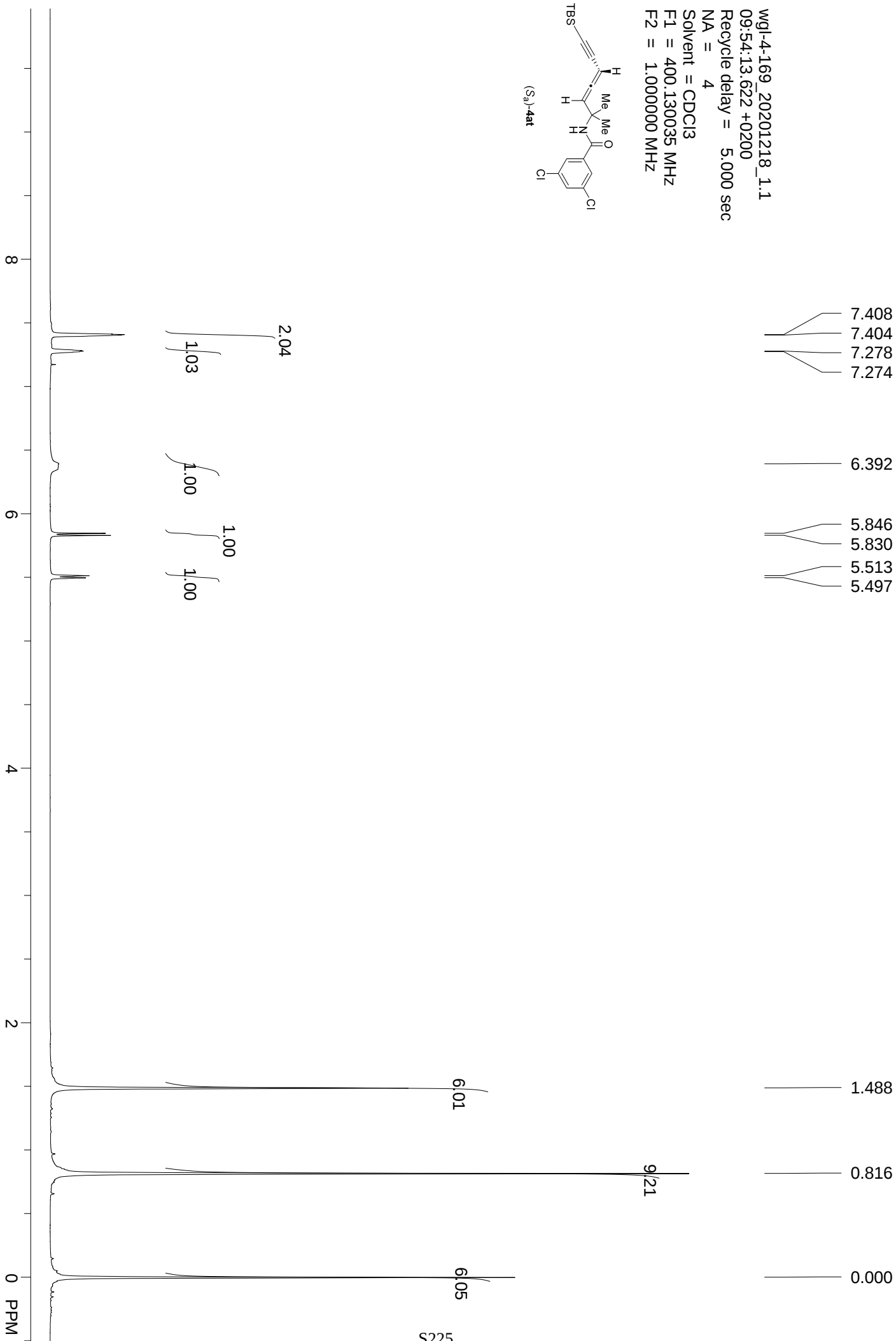
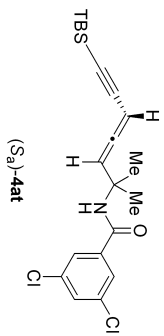
Acquisition Data:

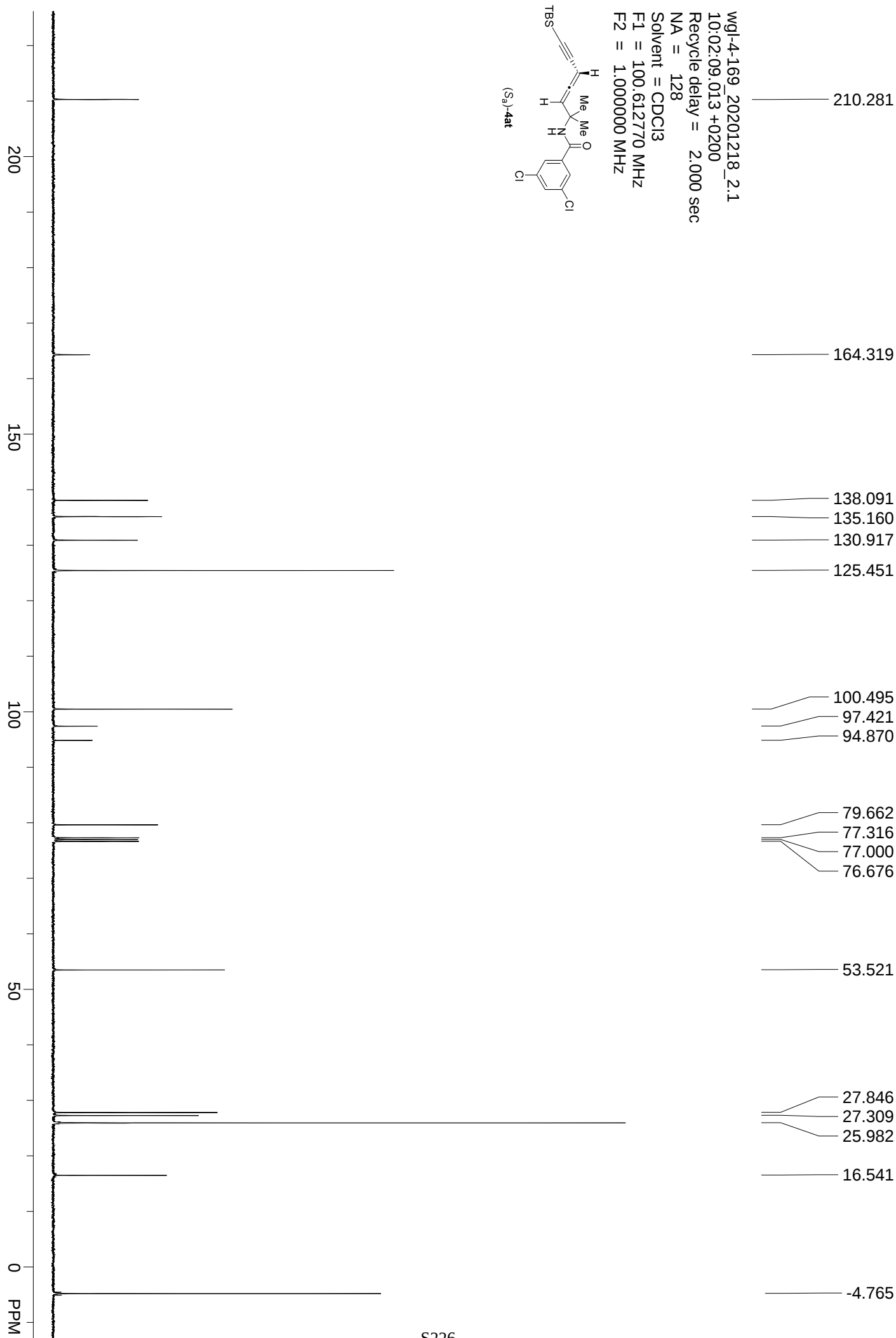


Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
22.675	0.9217	1946.6193	117747.0313	62.4012
25.494	1.1367	944.1677	70946.4297	37.5988
Sum			188693.4609	100.0000

wgl-4-169_20201218_1.1
09:54:13.622 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl₃
F1 = 400.130035 MHz
F2 = 1.000000 MHz



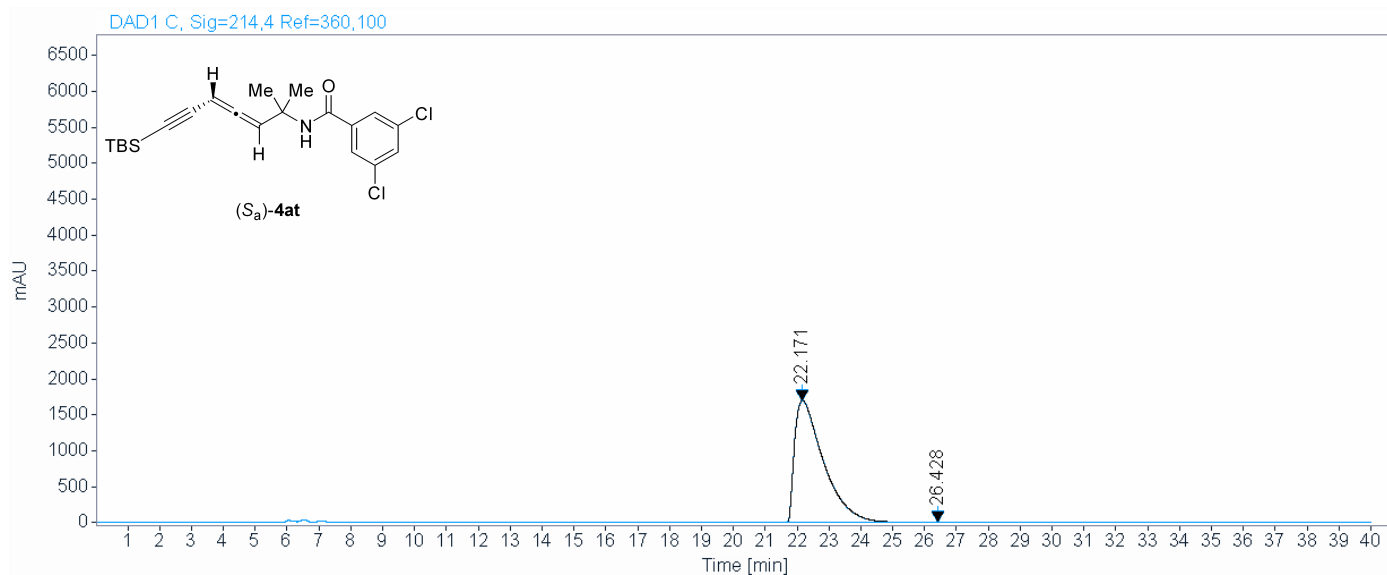


Area Percent Report

sample wgl-4-169-AD-H-99.5-0.5-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2020-12-18 08-41-25\006-P1-E6-wgl-4-169.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

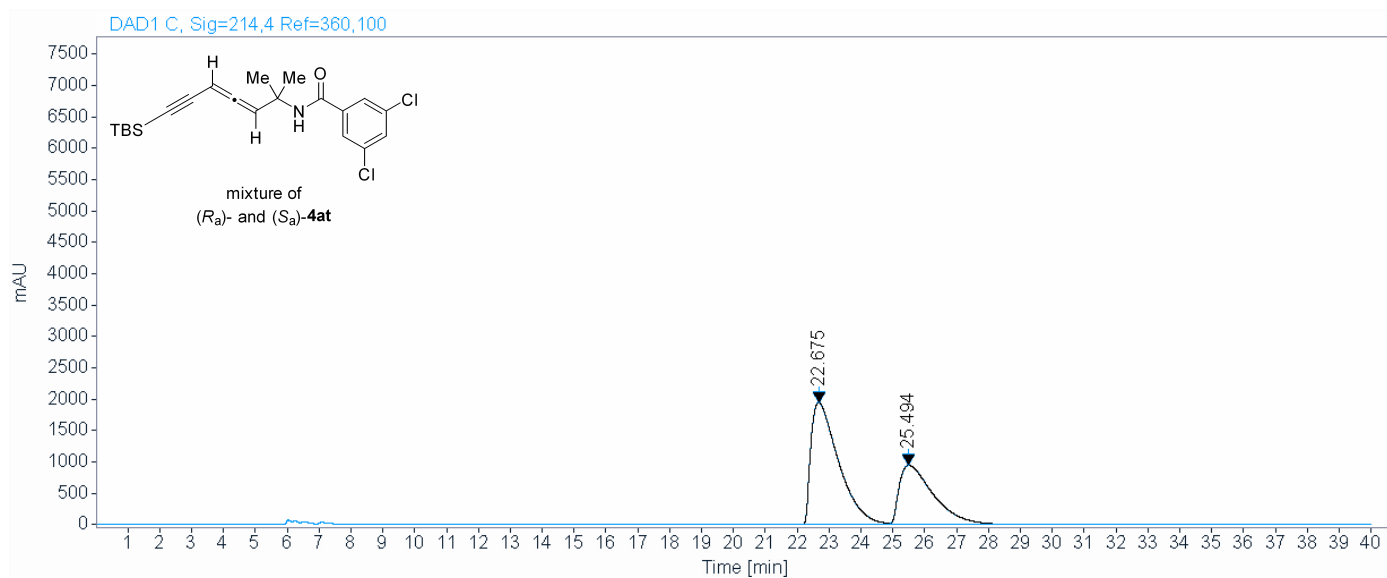
RT [min]	Width [min]	Height	Area	Area%
22.171	0.9469	1698.3600	107266.7500	99.5011
26.428	0.8452	9.4905	537.8858	0.4989
Sum			107804.6358	100.0000

Area Percent Report

sample wgl-4-(168+169)-AD-H-99.5-0.5-0.5-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2020-12-18 08-41-25\007-P1-E4-wgl-4-(168+169).D

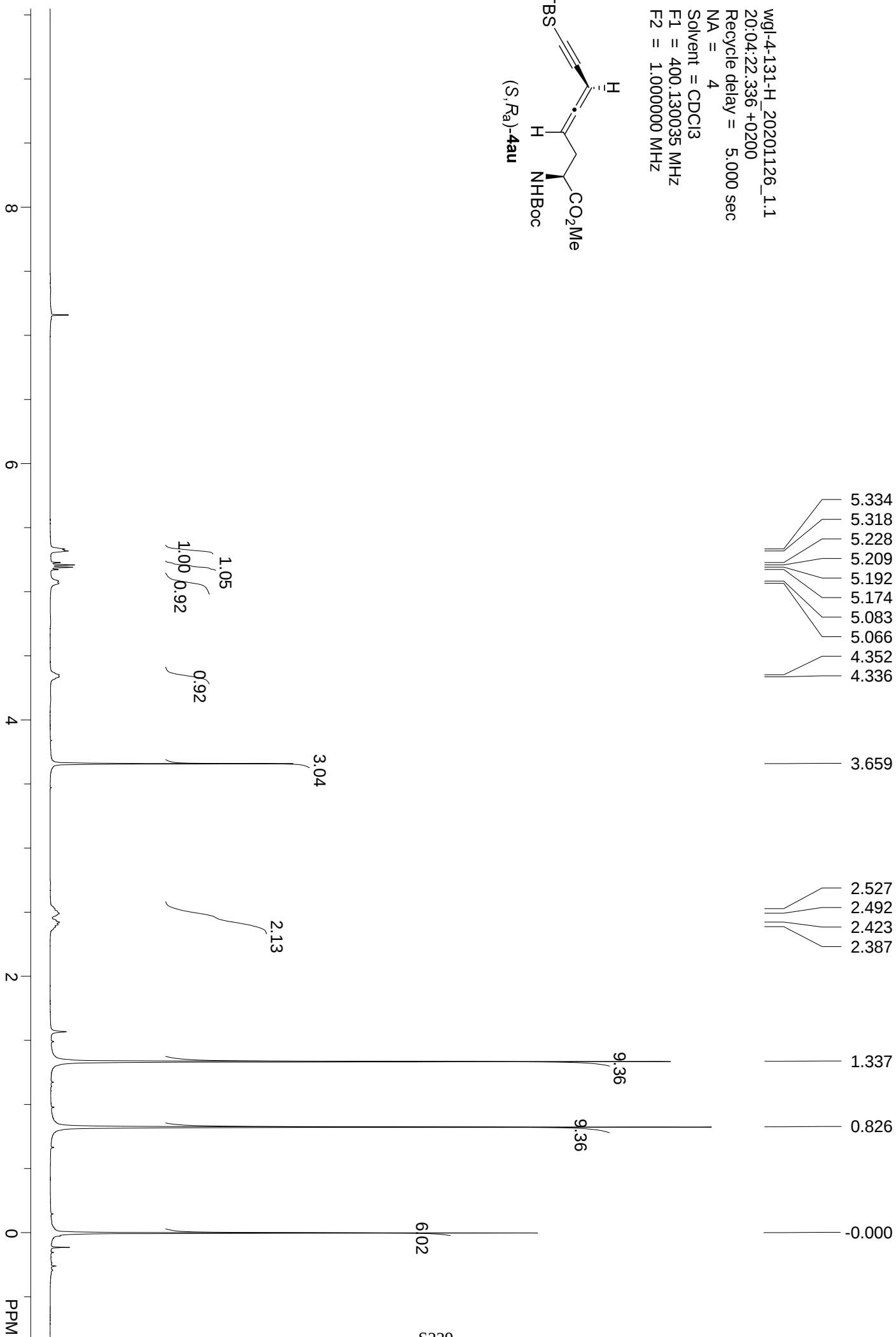
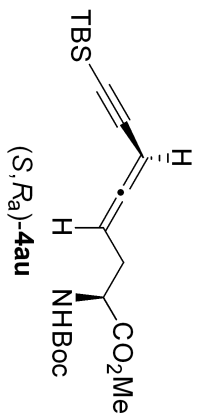
Acquisition Data:

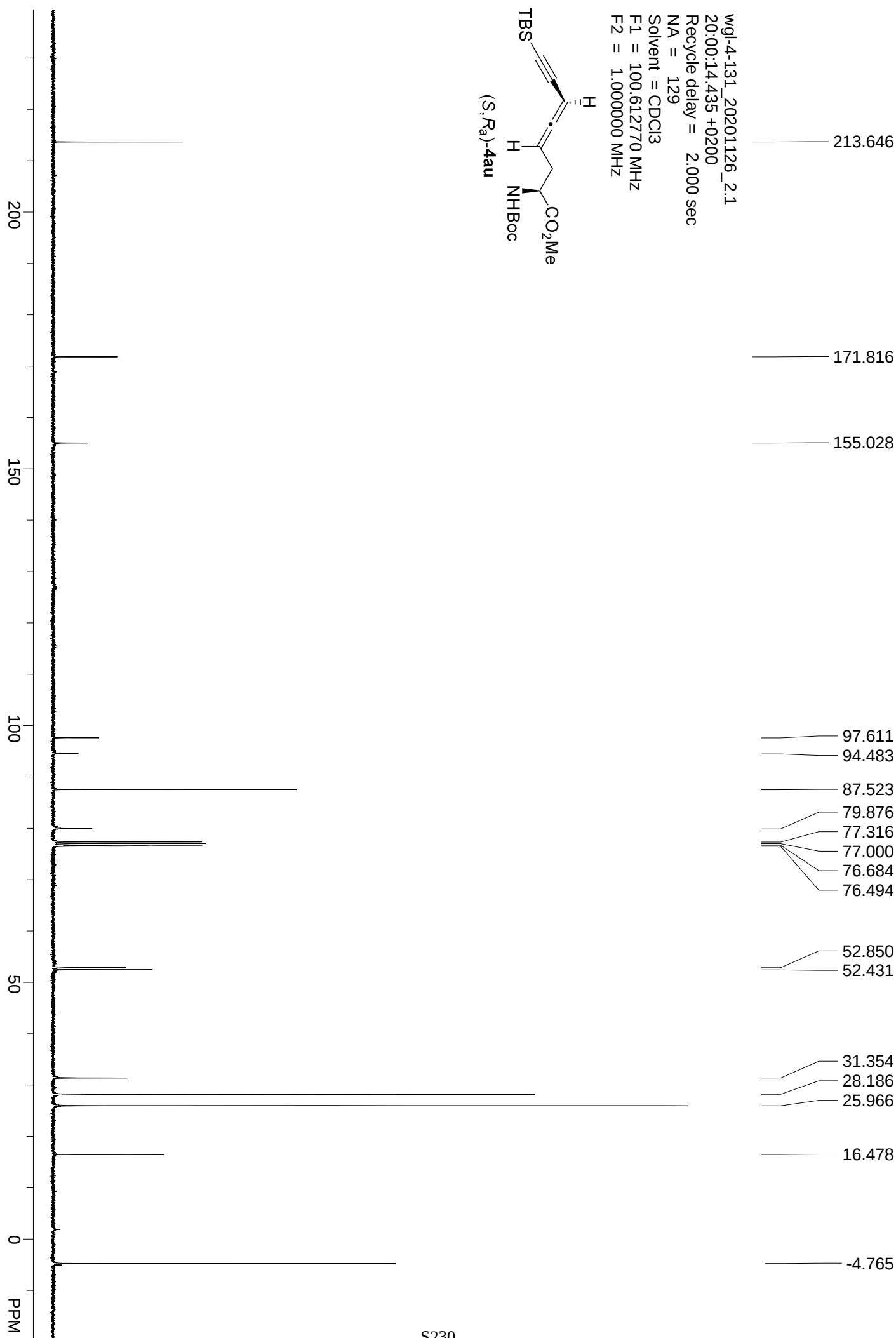


Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
22.675	0.9217	1946.6193	117747.0313	62.4012
25.494	1.1367	944.1677	70946.4297	37.5988
		Sum	188693.4609	100.0000

wjl-4-131-H_20201126_1.1
 20:04:22.336 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130035 MHz
 F2 = 1.000000 MHz





7.725
7.719
7.358
7.353
7.336
7.330
6.960
6.938
6.805
6.782

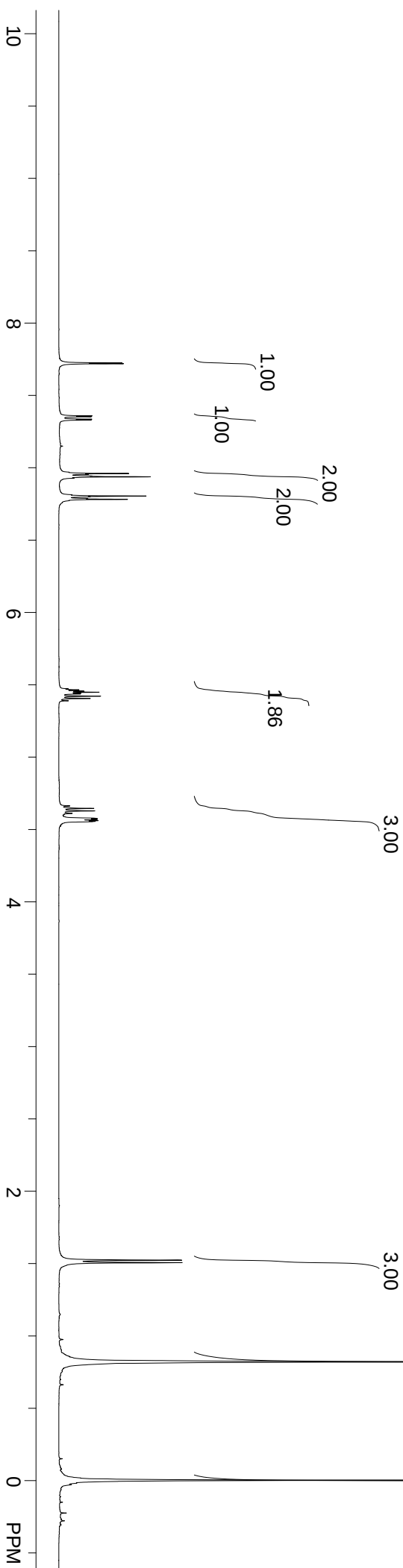
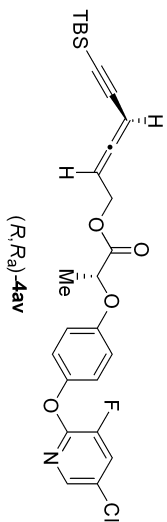
5.473
5.466
5.457
5.449
5.443
5.437
5.422
5.406
5.390
4.663
4.646
4.629
4.612
4.577
4.570
4.562
4.557

1.522
1.506

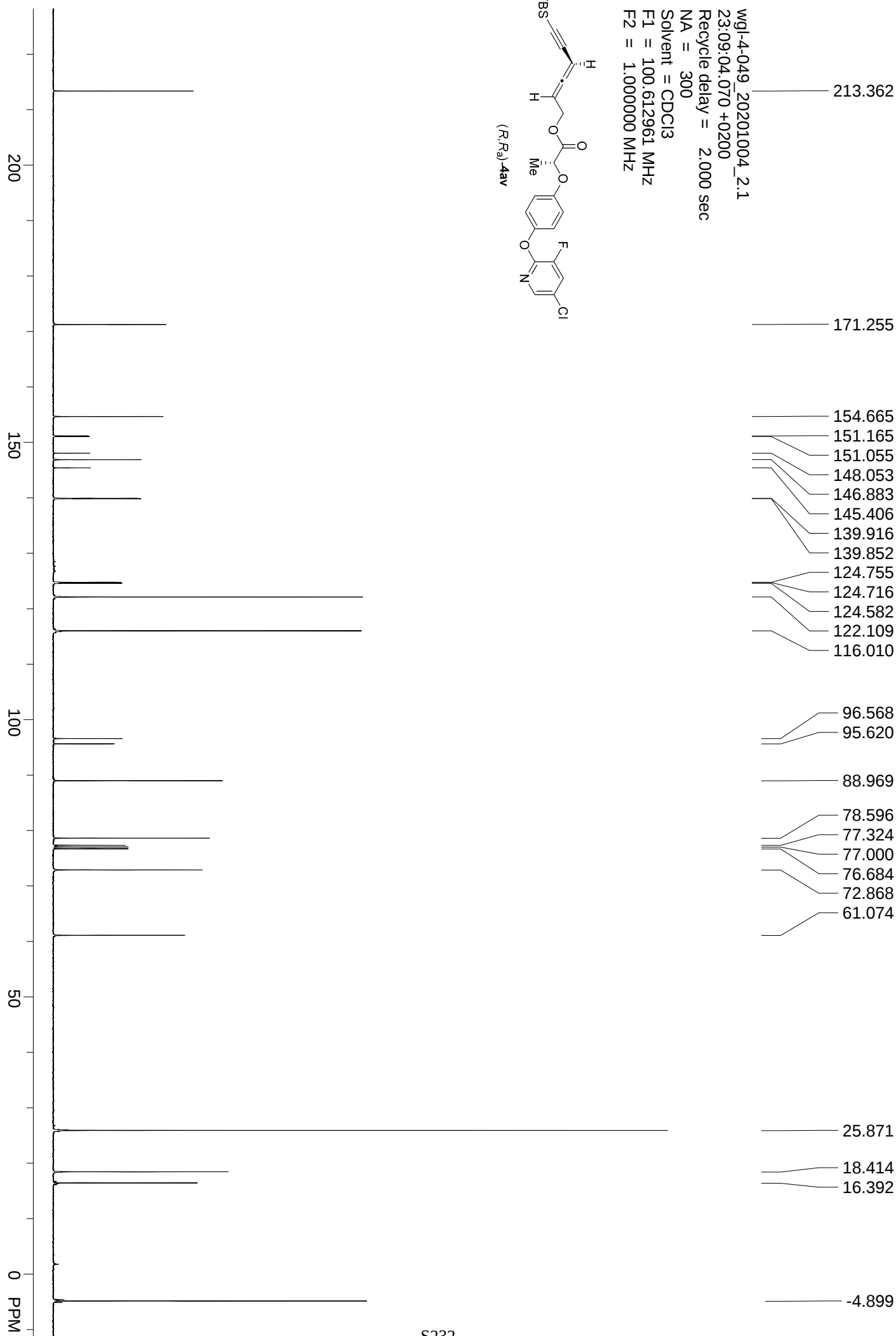
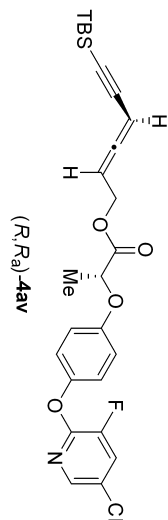
0.819

-0.000

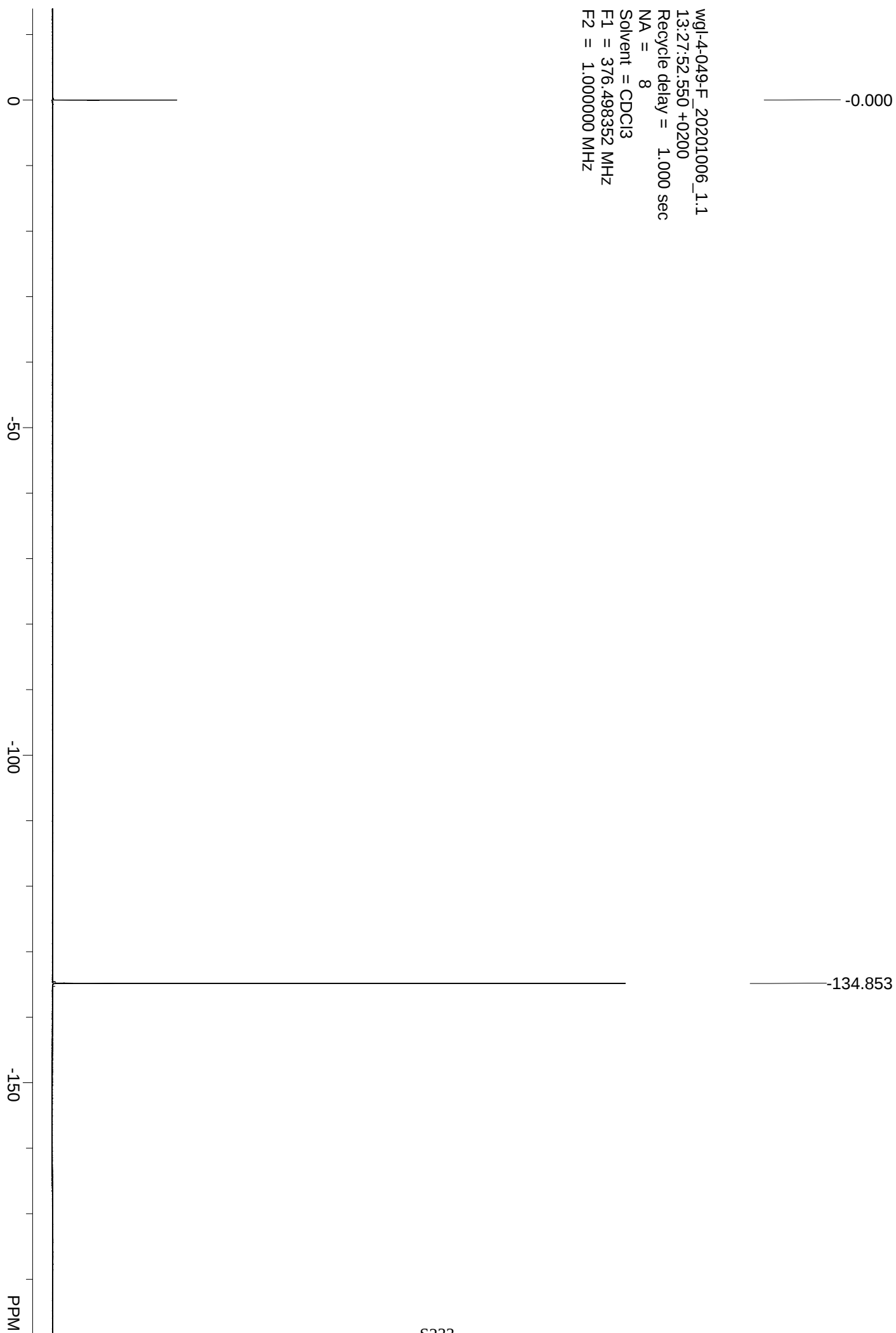
wjl-4-049_20201004_1.1
22:51:37.181 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl3
F1 = 400.130066 MHz
F2 = 1.000000 MHz



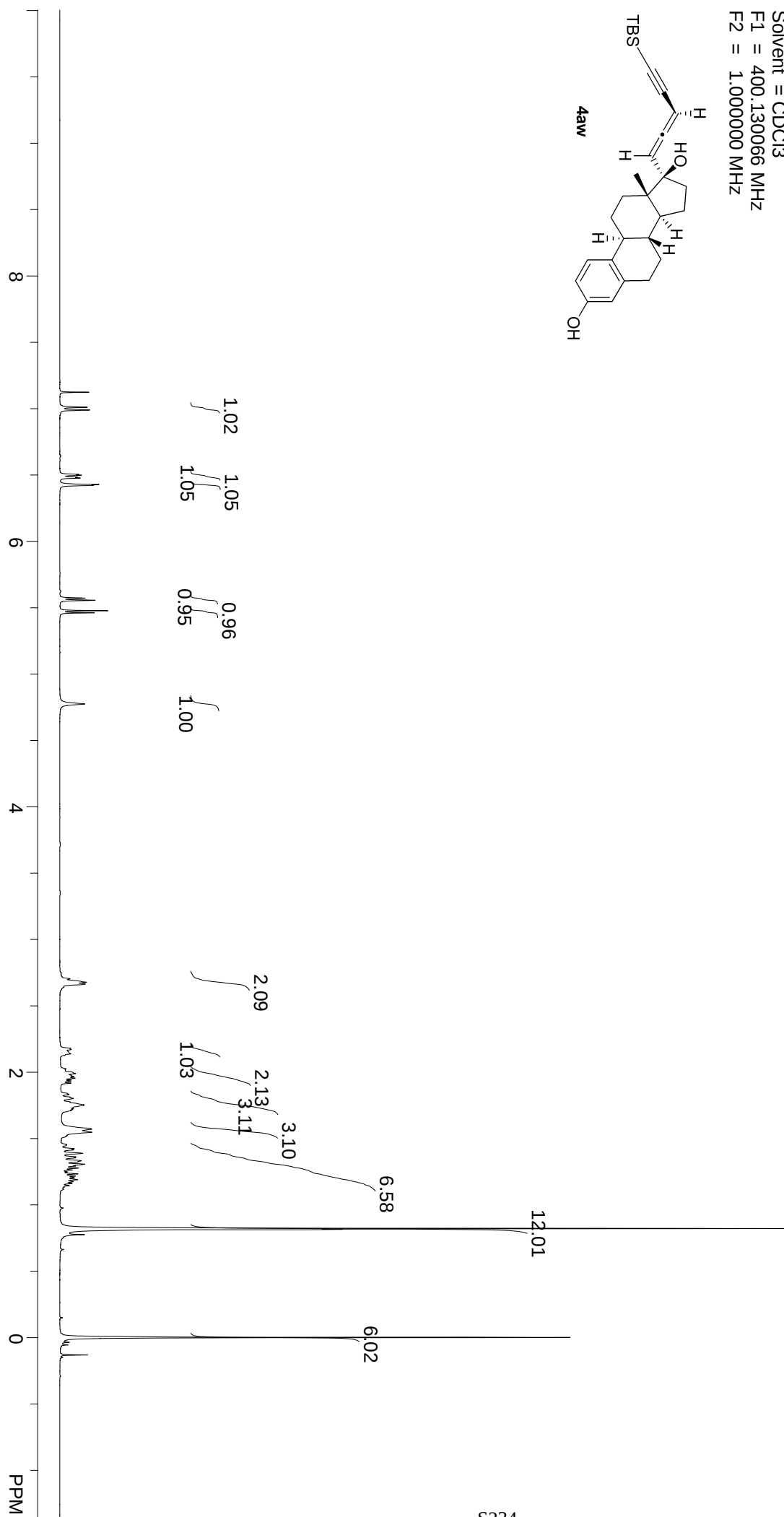
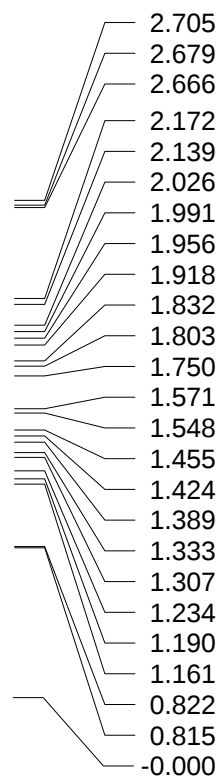
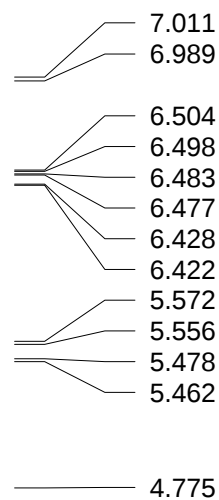
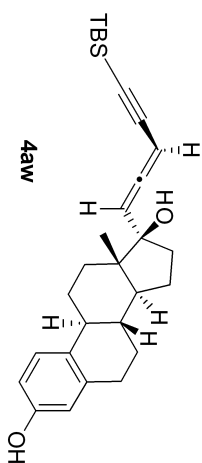
wgl-4-049_20201004_2.1
 23:09:04.070 +0200
 Recycle delay = 2.000 sec
 NA = 300
 Solvent = CDCl₃
 F1 = 100.612961 MHz
 F2 = 1.000000 MHz

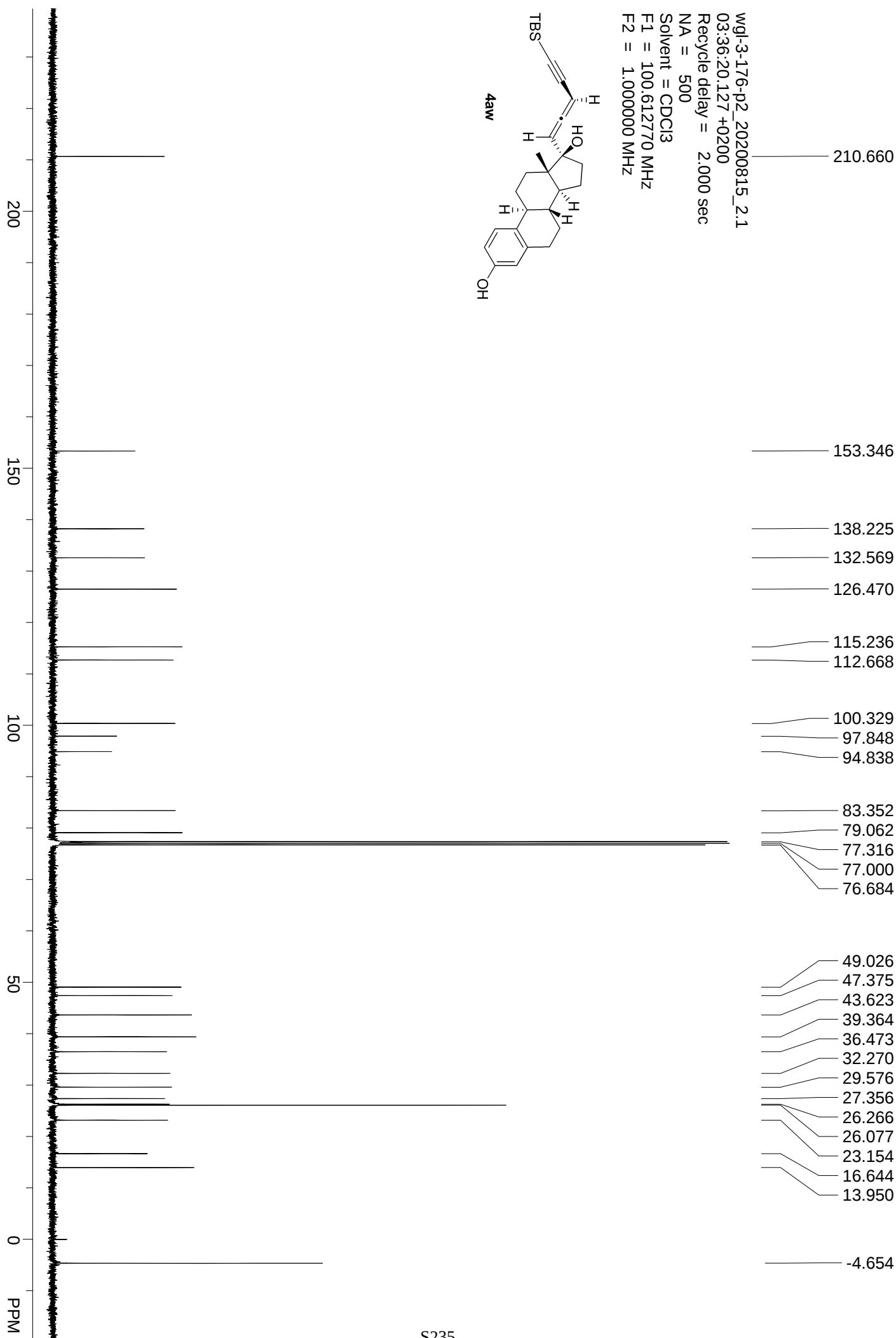


wgl-4-049-F_20201006_1.1
13:27:52.550 +0200
Recycle delay = 1.000 sec
NA = 8
Solvent = CDCl3
F1 = 376.498352 MHz
F2 = 1.000000 MHz

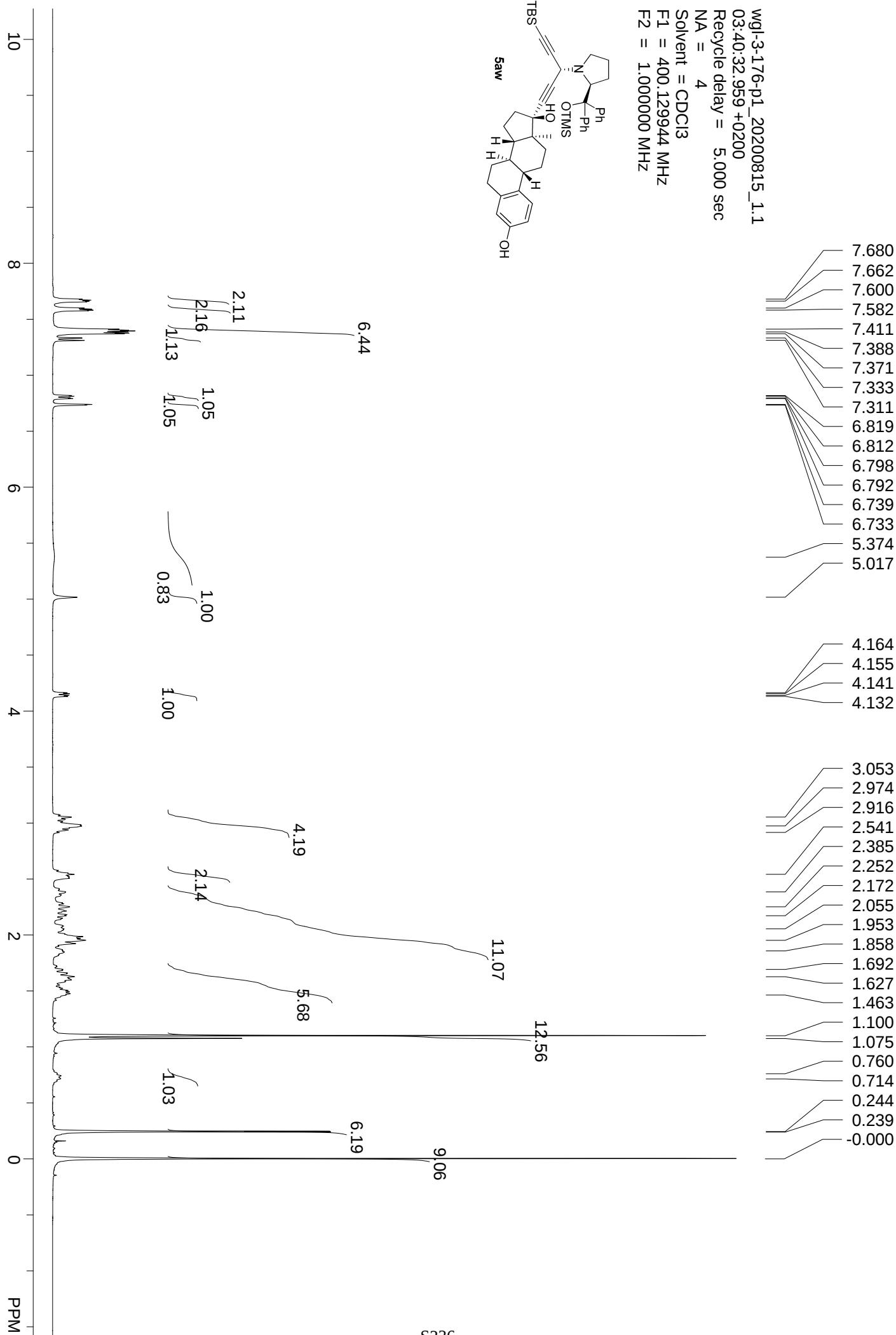
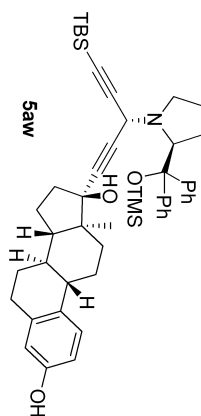


wjl-3-176-p2_20200816_1.1
 23:50:28.990 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130066 MHz
 F2 = 1.000000 MHz

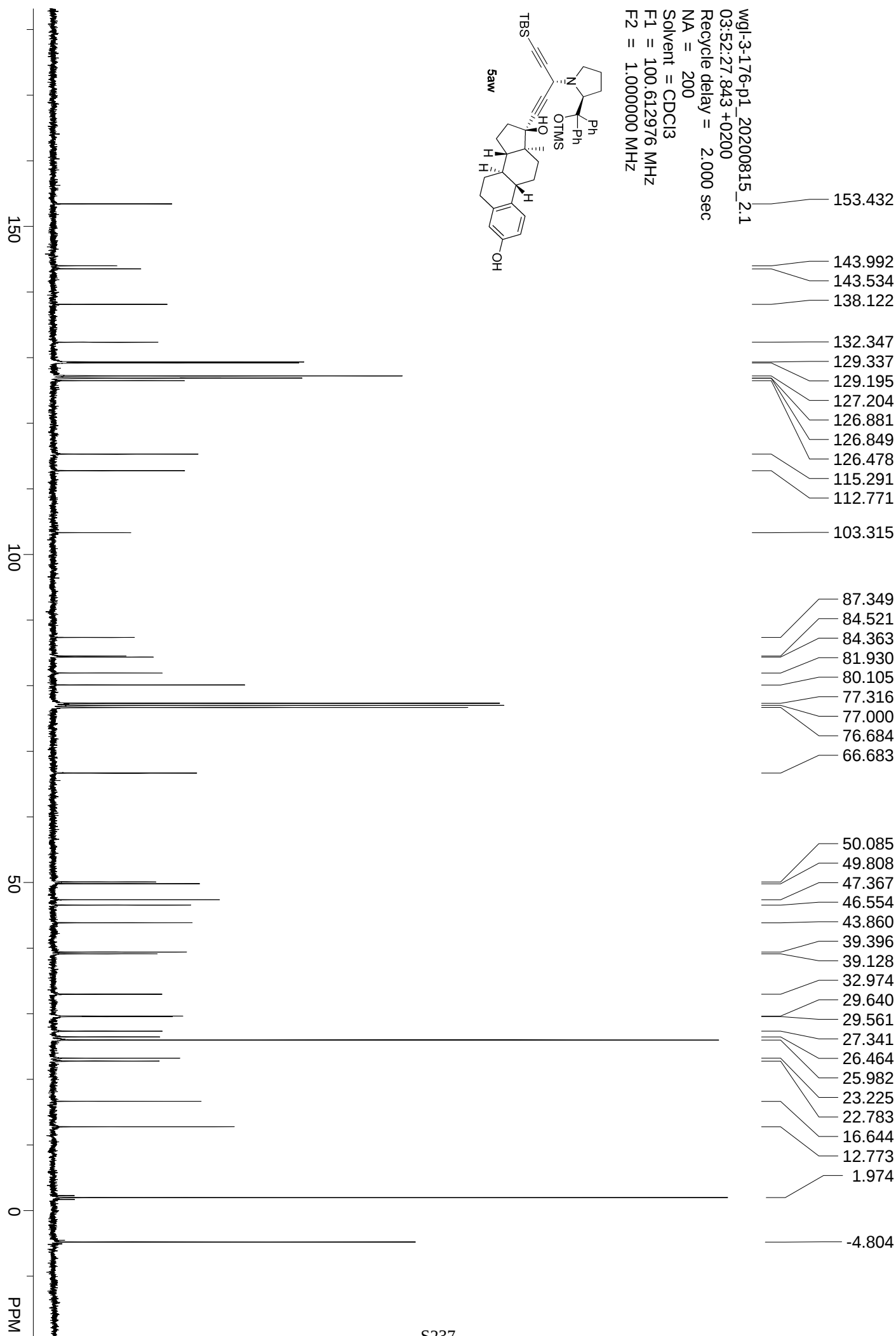
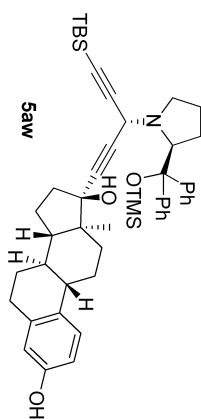


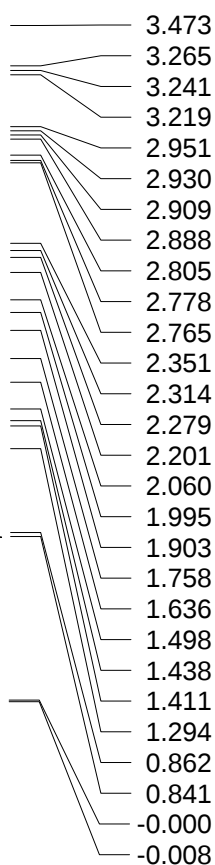
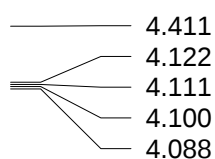
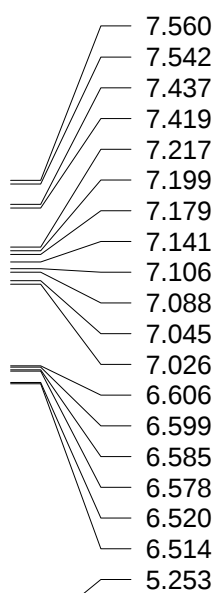


wgl-3-176-p1_20200815_1.1
 03:40:32.959 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.129944 MHz
 F2 = 1.000000 MHz

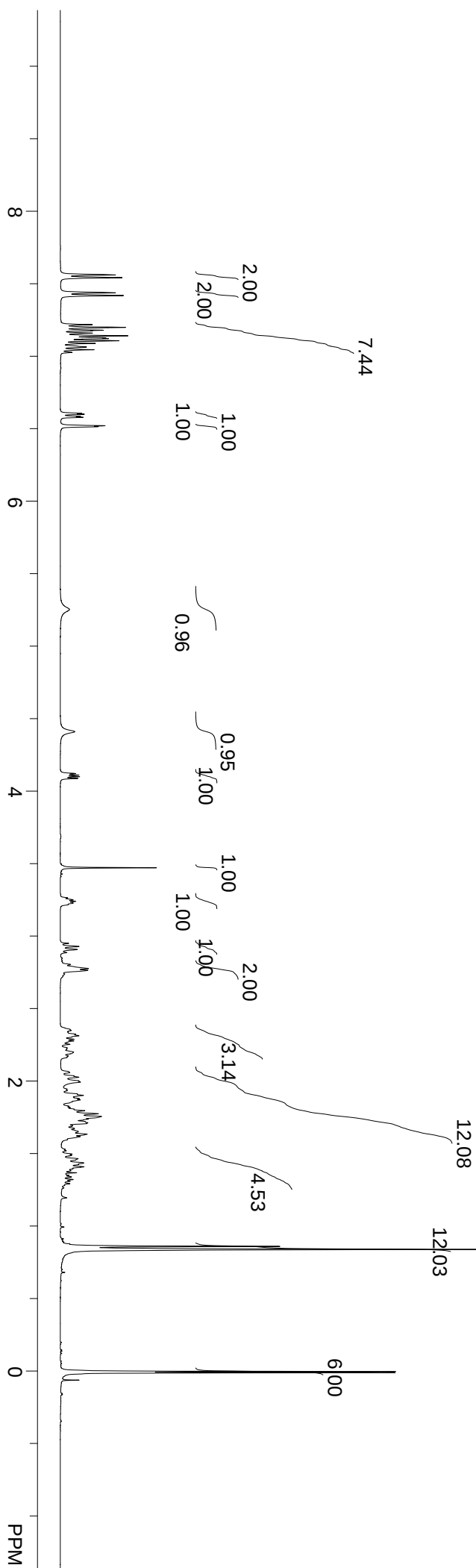
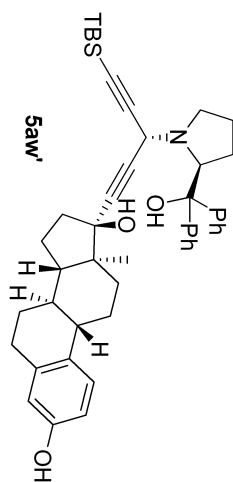


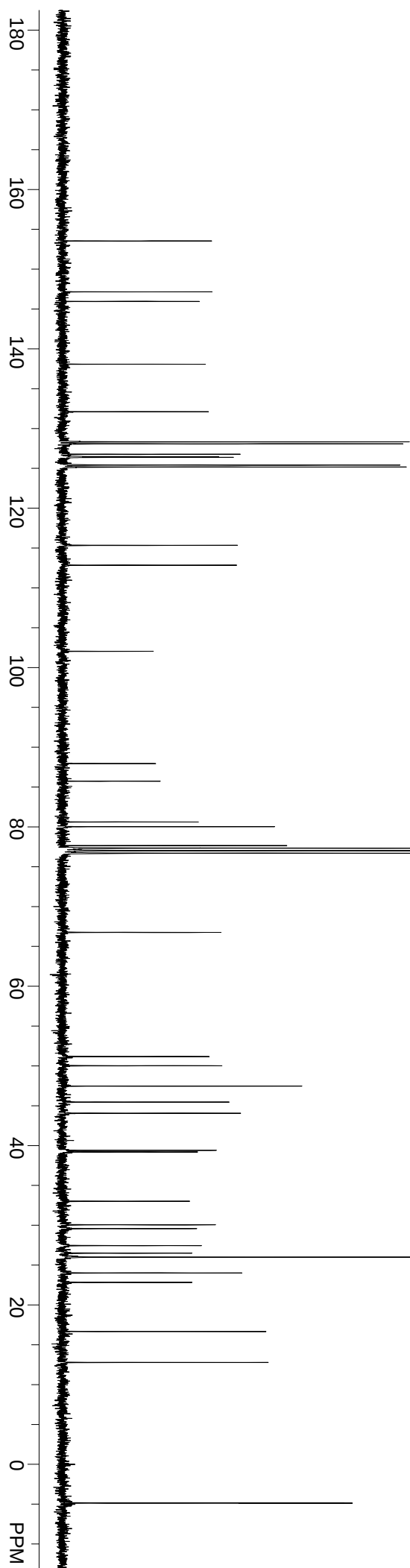
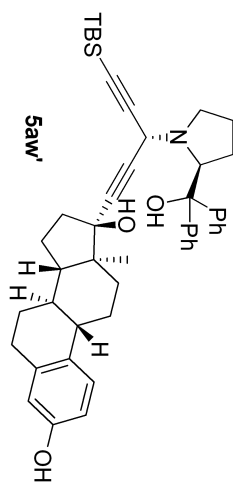
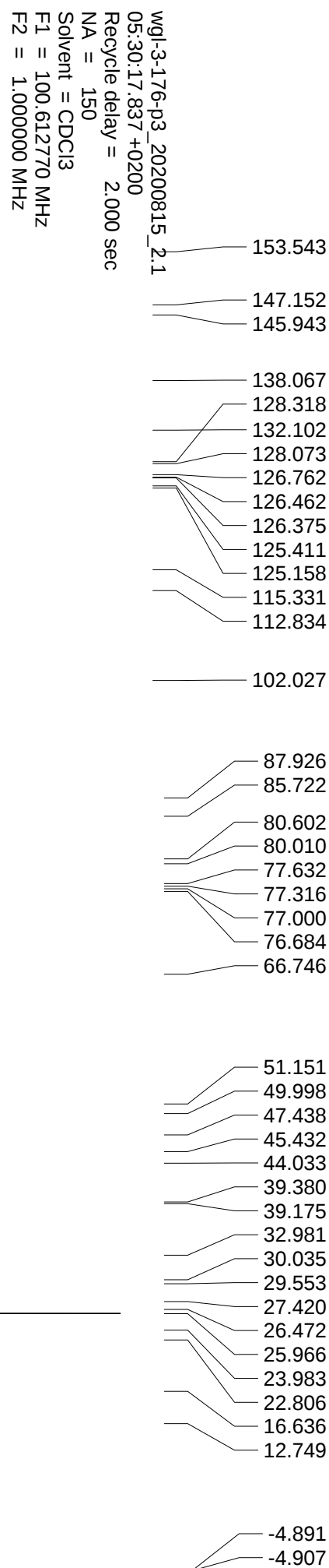
wj-3-176-p1_20200815_2.1
 03:52:27.843 +0200
 Recycle delay = 2.000 sec
 NA = 200
 Solvent = CDCl₃
 F1 = 100.612976 MHz
 F2 = 1.000000 MHz





wj-3-176-p3_20200815_1.1
05:21:09.095 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl₃
F1 = 400.130035 MHz
F2 = 1.000000 MHz





5.653
5.554
5.538
5.475
5.458

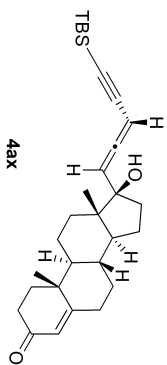
wgl-4-023_20200920_1.1
17:40:43.410 +0200
Recycle delay = 5.000 sec

NA = 4

Solvent = CDCl₃

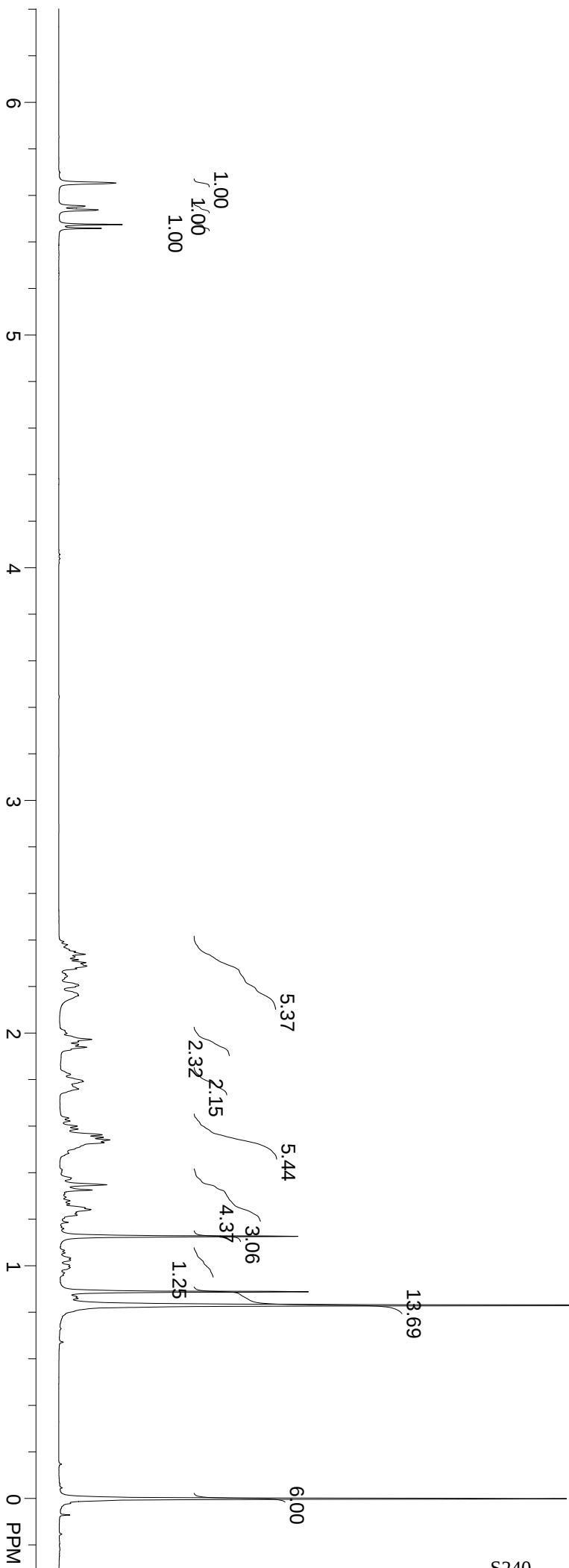
F1 = 400.130035 MHz

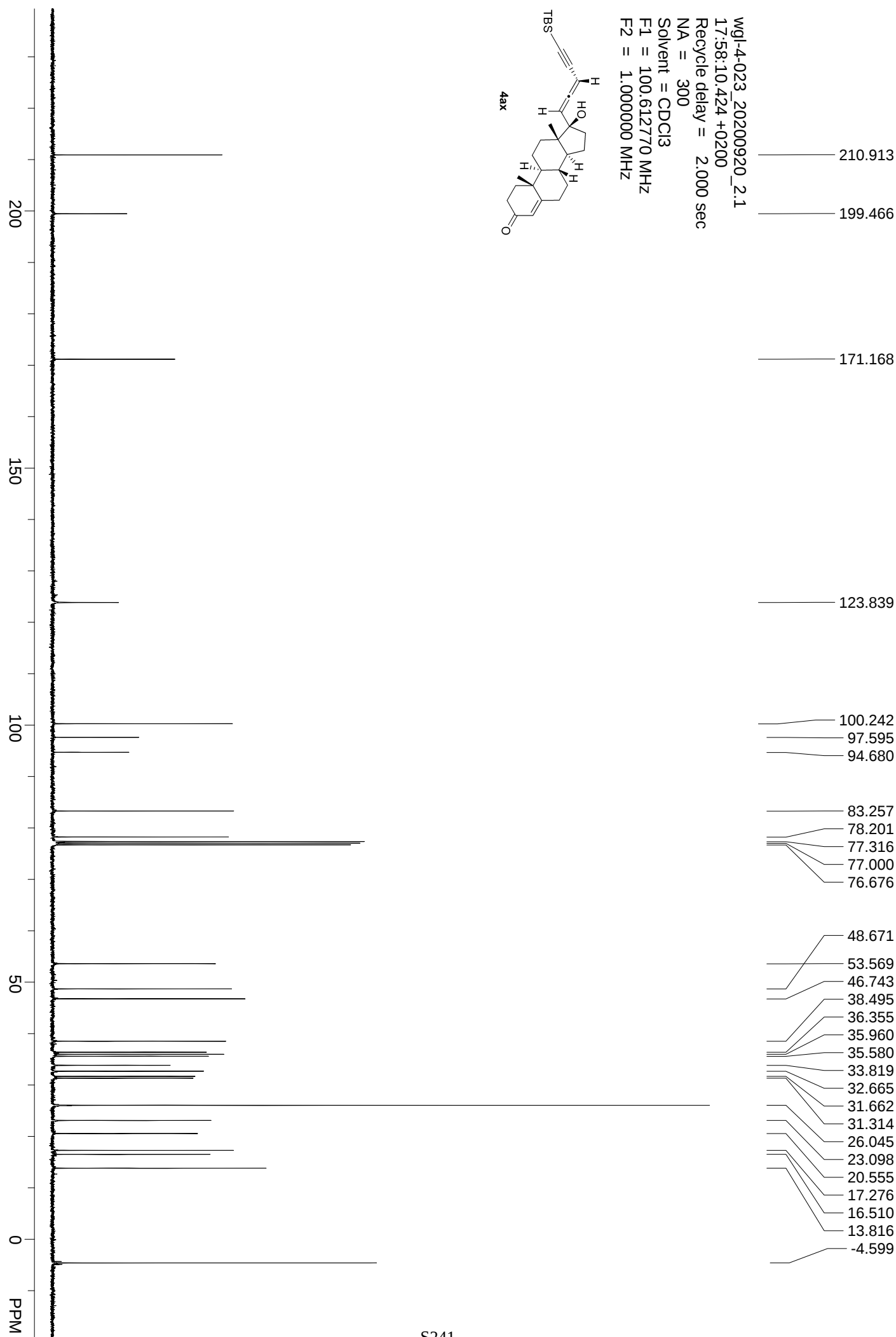
F2 = 1.000000 MHz

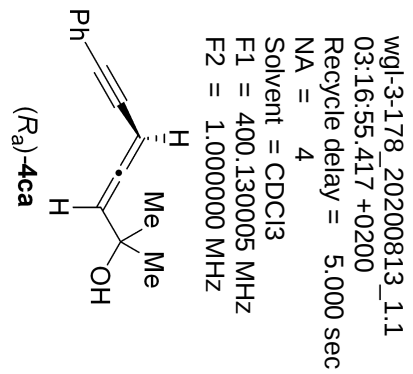


2.379
2.338
2.288
2.204
2.167
1.972
1.939
1.822
1.792
1.759
1.622
1.588
1.541
1.373
1.348
1.326
1.242
1.127
1.066
1.033
0.993
0.889
0.867
0.831

-0.000







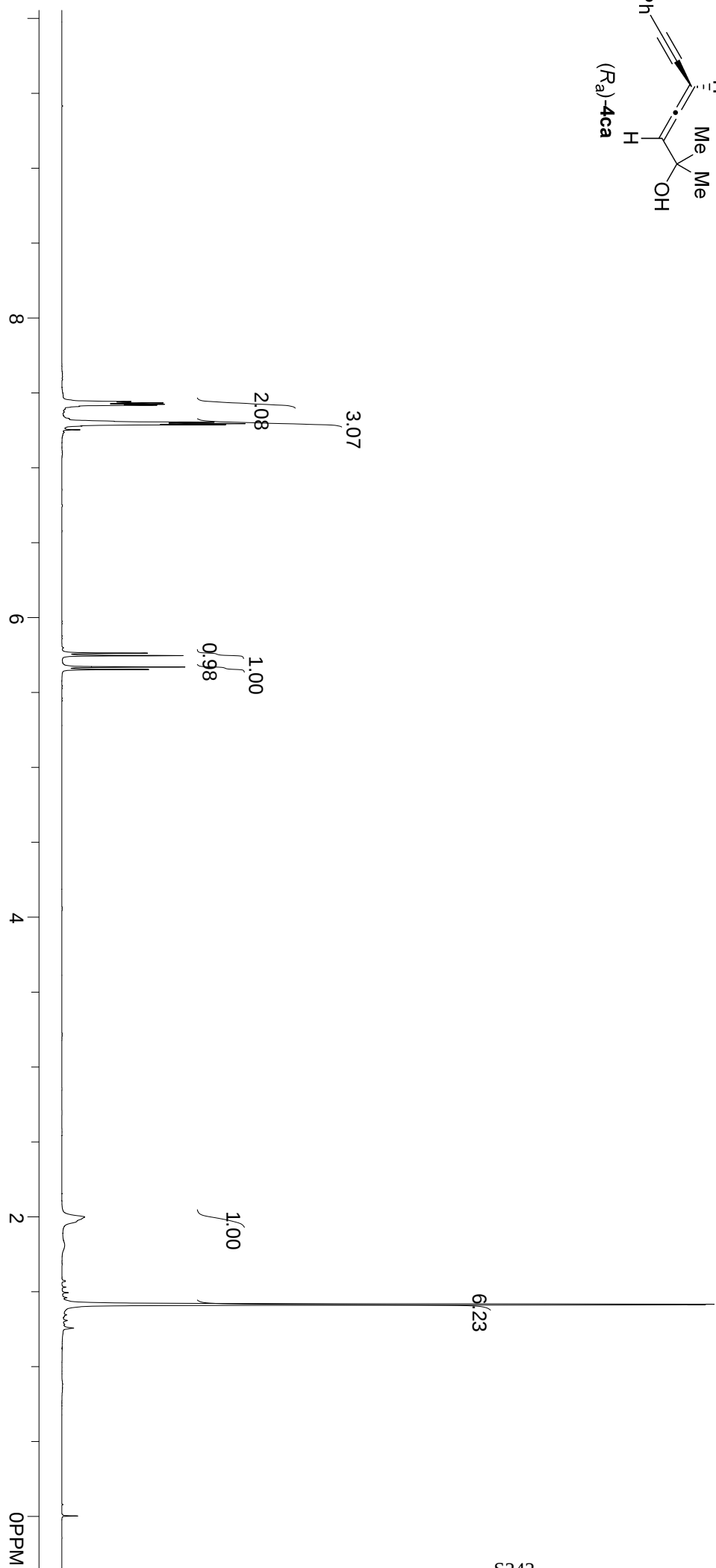
7.442
 7.433
 7.424
 7.418
 7.304
 7.295
 7.288

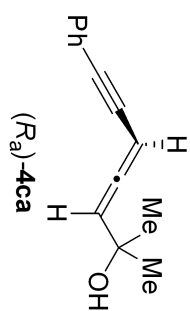
5.763
 5.747
 5.671
 5.654

1.998

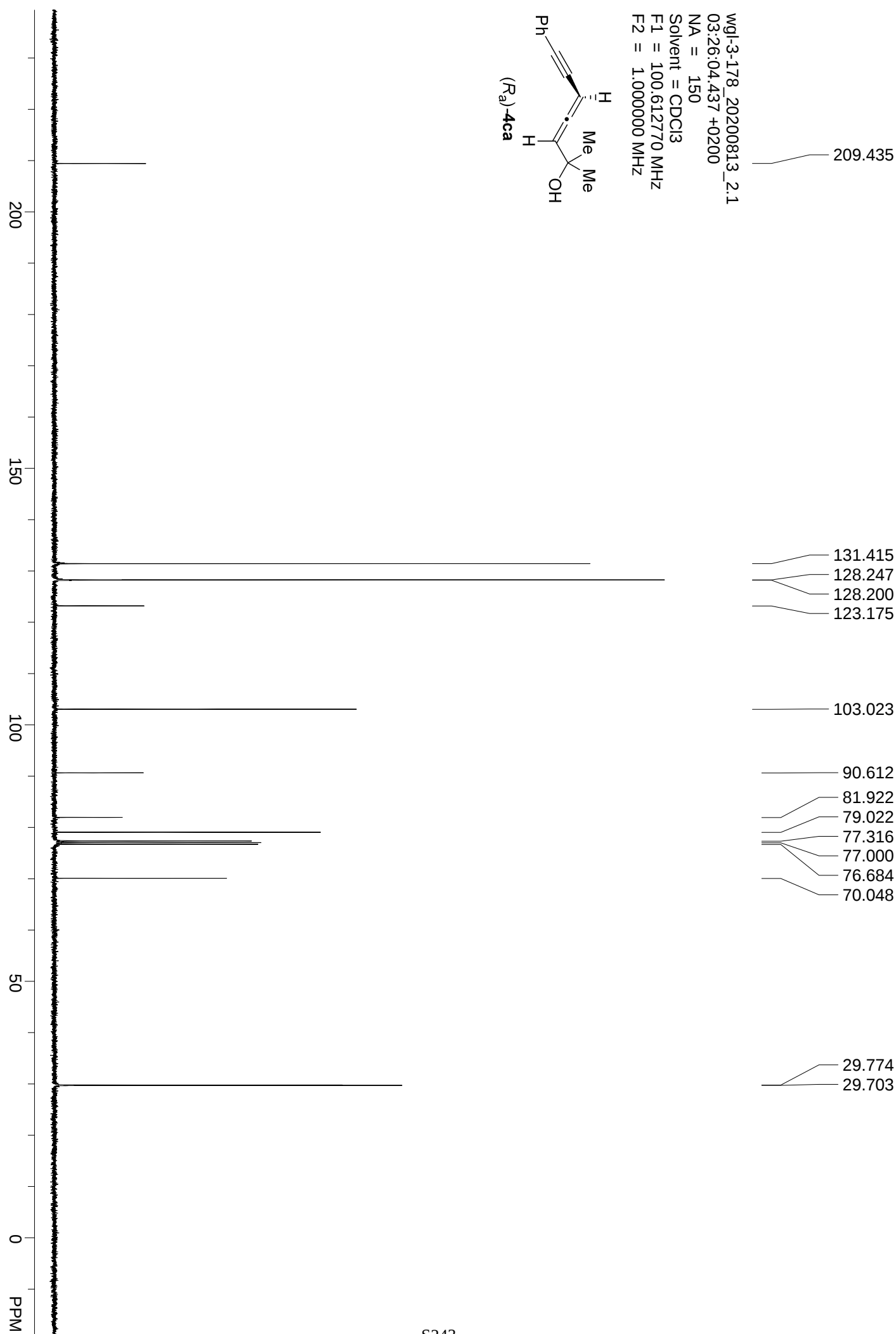
1.415
 1.412

0.000





wj-3-178_20200813_2.1
 03:26:04.437 +0200
 NA = 150
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

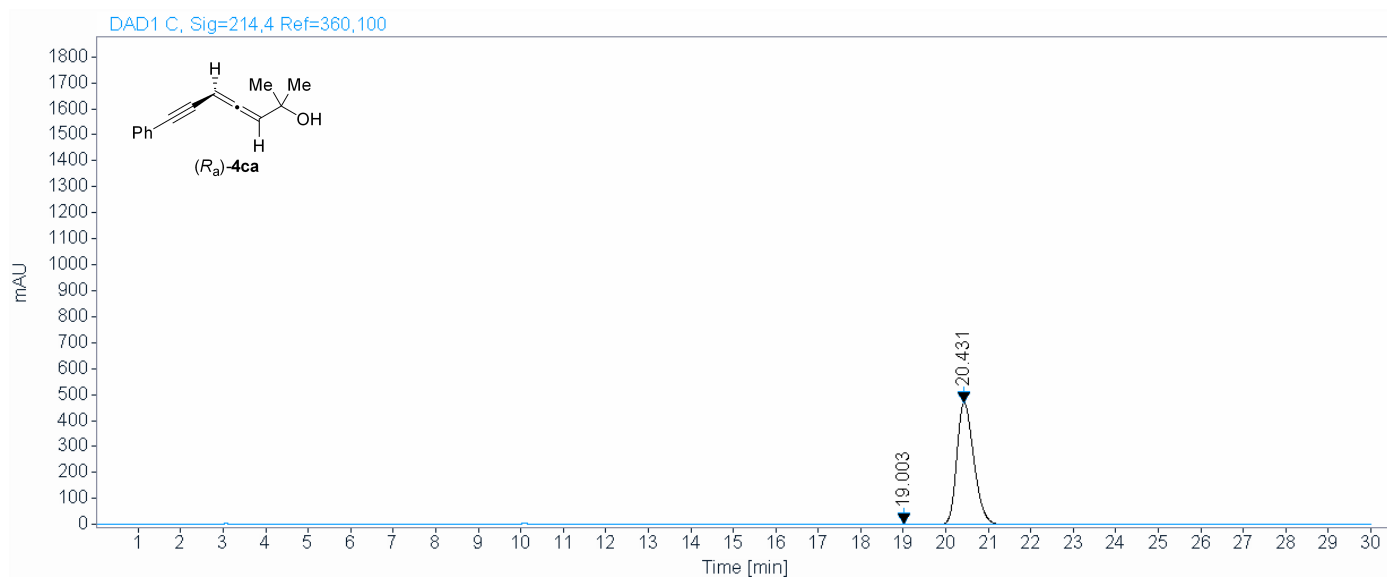


Area Percent Report

sample wgl-3-178-AS-H-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\zwf-allenioc acid_LC 2020-08-12 08-28-17\073-P1-E2-wgl-3-178.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

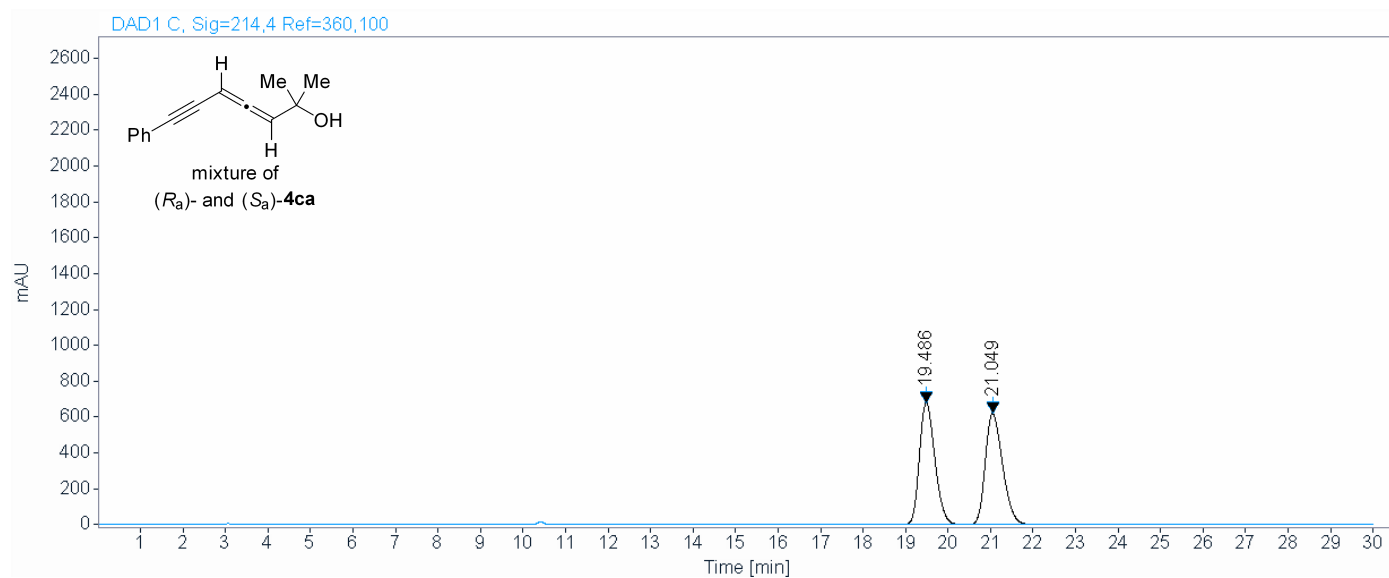
RT [min]	Width [min]	Height	Area	Area%
19.003	0.3683	0.6932	15.3204	0.1171
20.431	0.4327	469.7622	13073.3105	99.8829
Sum			13088.6309	100.0000

Area Percent Report

sample wgl-3-(178+179)-AS-H-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\zwf-allenioc acid_LC 2020-08-12 08-28-17\072-P1-E1-wgl-3-(178+179).D

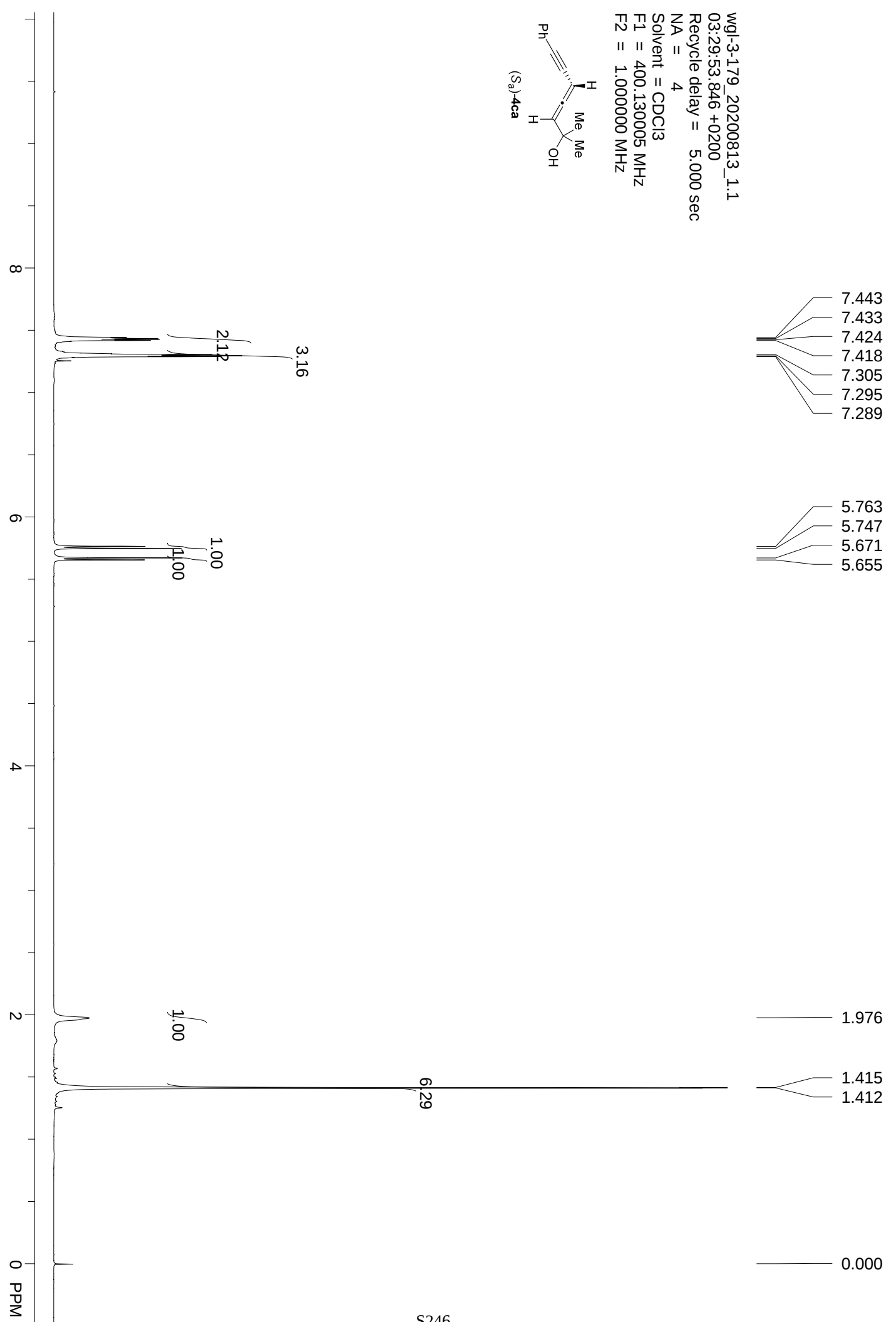
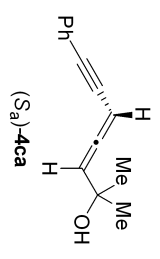
Acquisition Data:

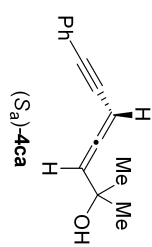


Signal: DAD1 C, Sig=214,4 Ref=360,100

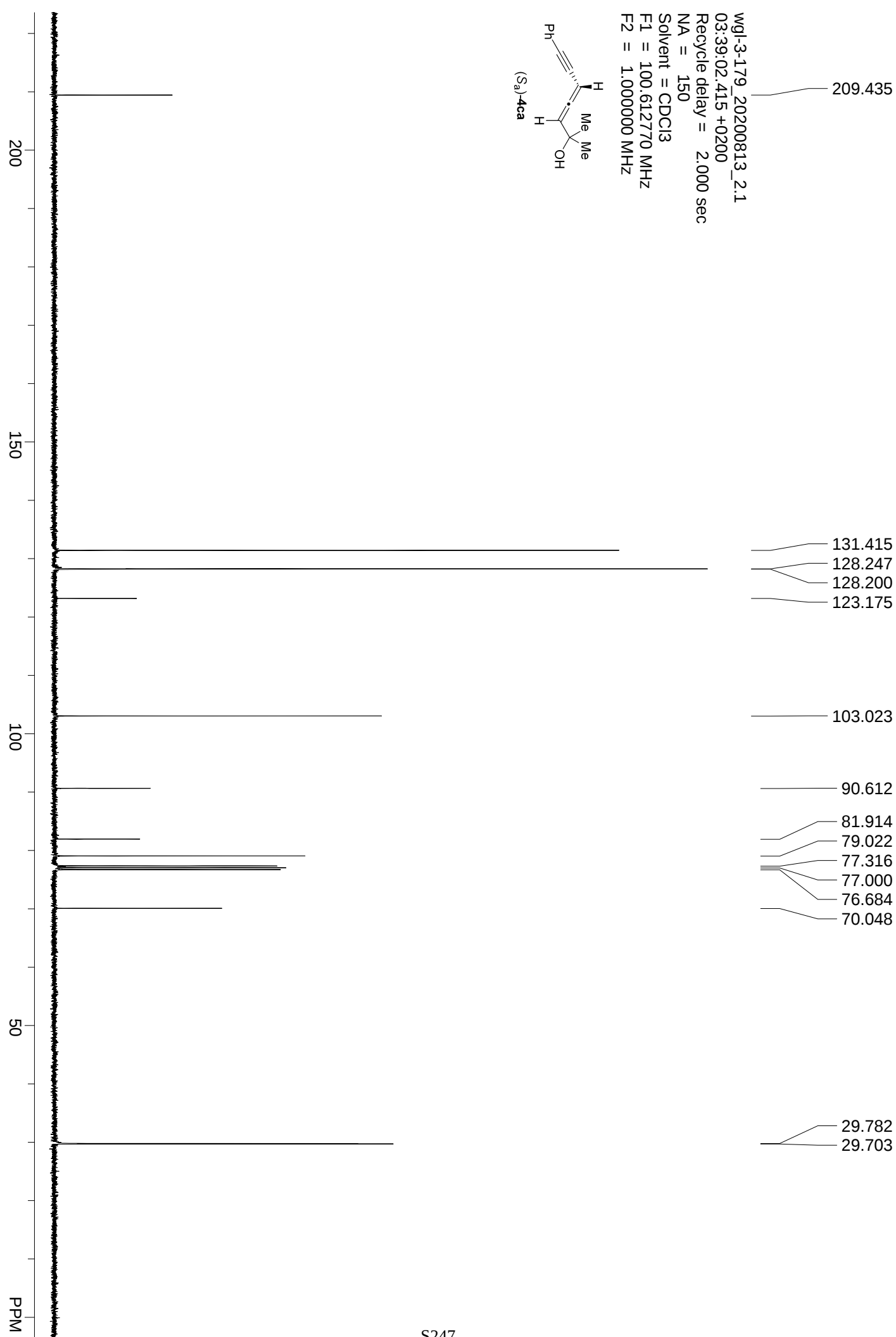
RT [min]	Width [min]	Height	Area	Area%
19.486	0.3874	681.0564	17010.0918	49.1632
21.049	0.4410	620.0201	17589.1172	50.8368
		Sum	34599.2090	100.0000

wgl-3-179_20200813_1.1
 03:29:53.846 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl3
 F1 = 400.130005 MHz
 F2 = 1.000000 MHz





wjl-3-179_20200813_2.1
 03:39:02.415 +0200
 Recycle delay = 2.000 sec
 NA = 150
 Solvent = CDCl3
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

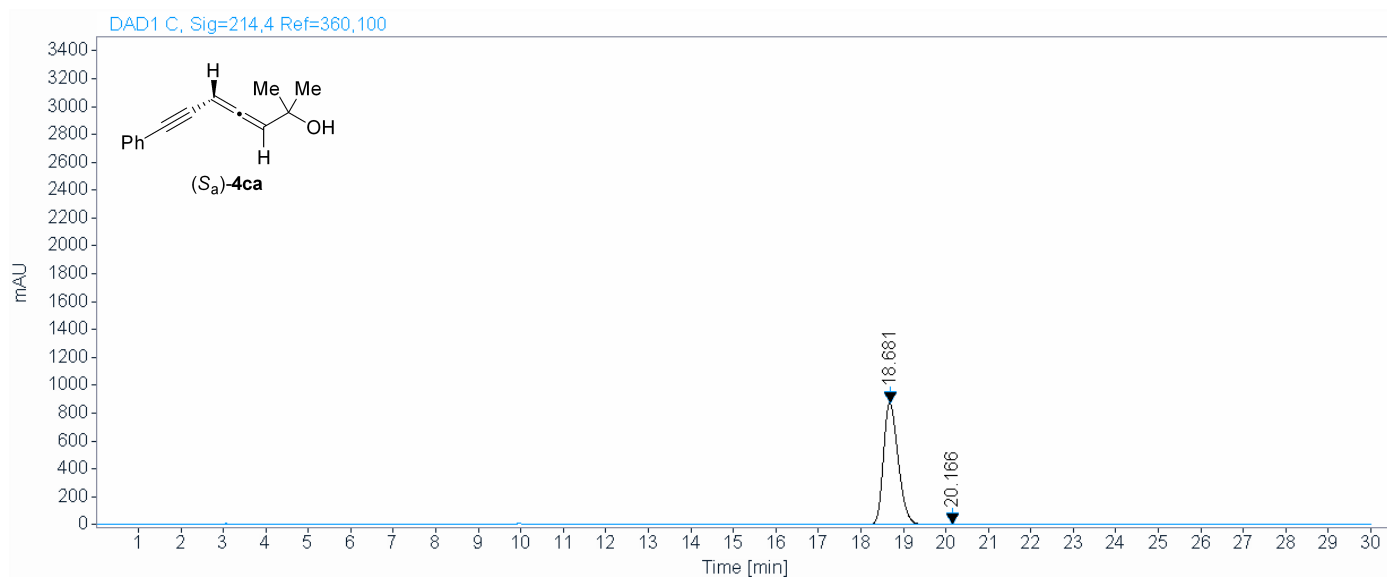


Area Percent Report

sample wgl-3-179-AS-H-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\zwf-allenioc acid_LC 2020-08-12 08-28-17\074-P1-E3-wgl-3-179.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

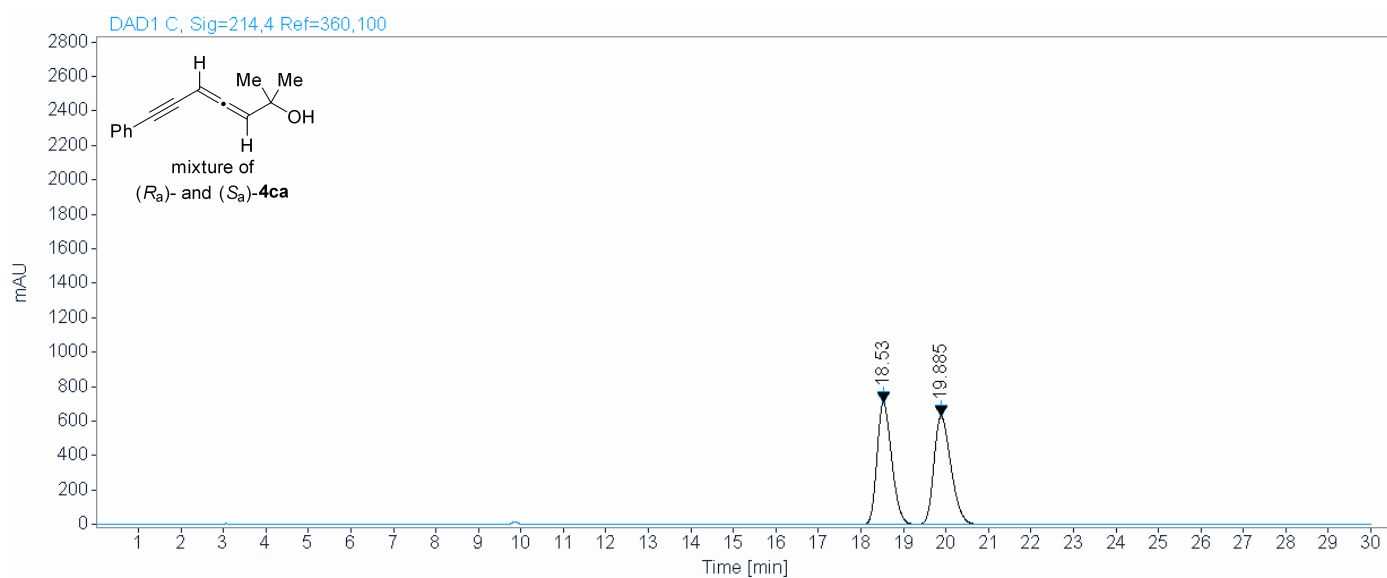
RT [min]	Width [min]	Height	Area	Area%
18.681	0.3728	875.8413	21079.8027	99.5016
20.166	0.3933	4.1714	105.5876	0.4984
Sum			21185.3904	100.0000

Area Percent Report

sample wgl-3-(178+179)-AS-H-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\zwf-allenioc acid_LC 2020-08-12 08-28-17\075-P1-E1-wgl-3-(178+179).D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
18.530	0.3752	708.3904	17075.0234	49.1489
19.885	0.4359	628.6310	17666.3594	50.8511
Sum			34741.3828	100.0000

7.333
7.313
7.253
7.116
7.096

5.759
5.743
5.660
5.644

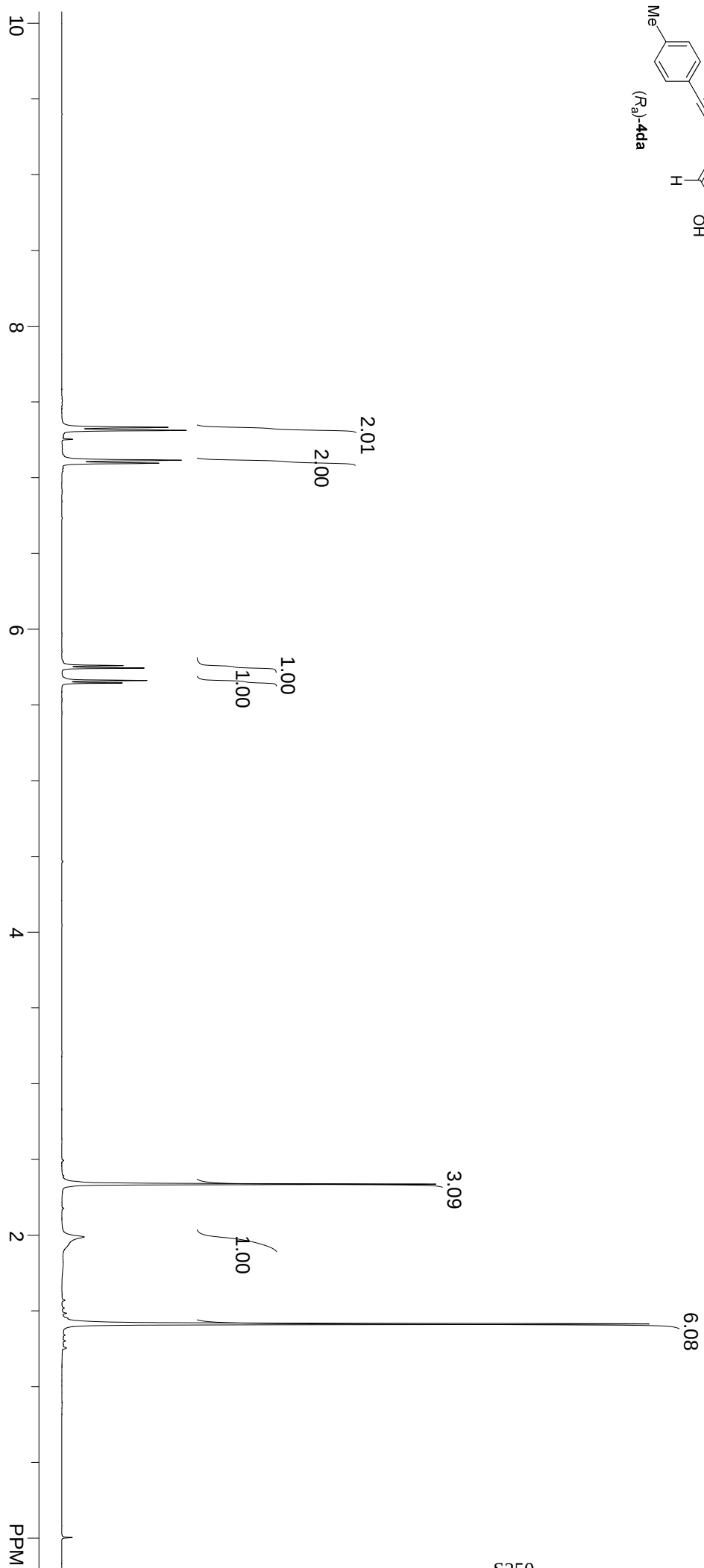
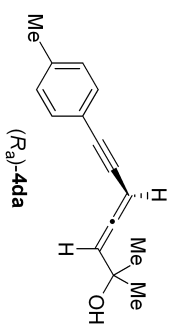
2.334

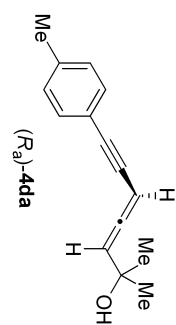
1.985

1.411

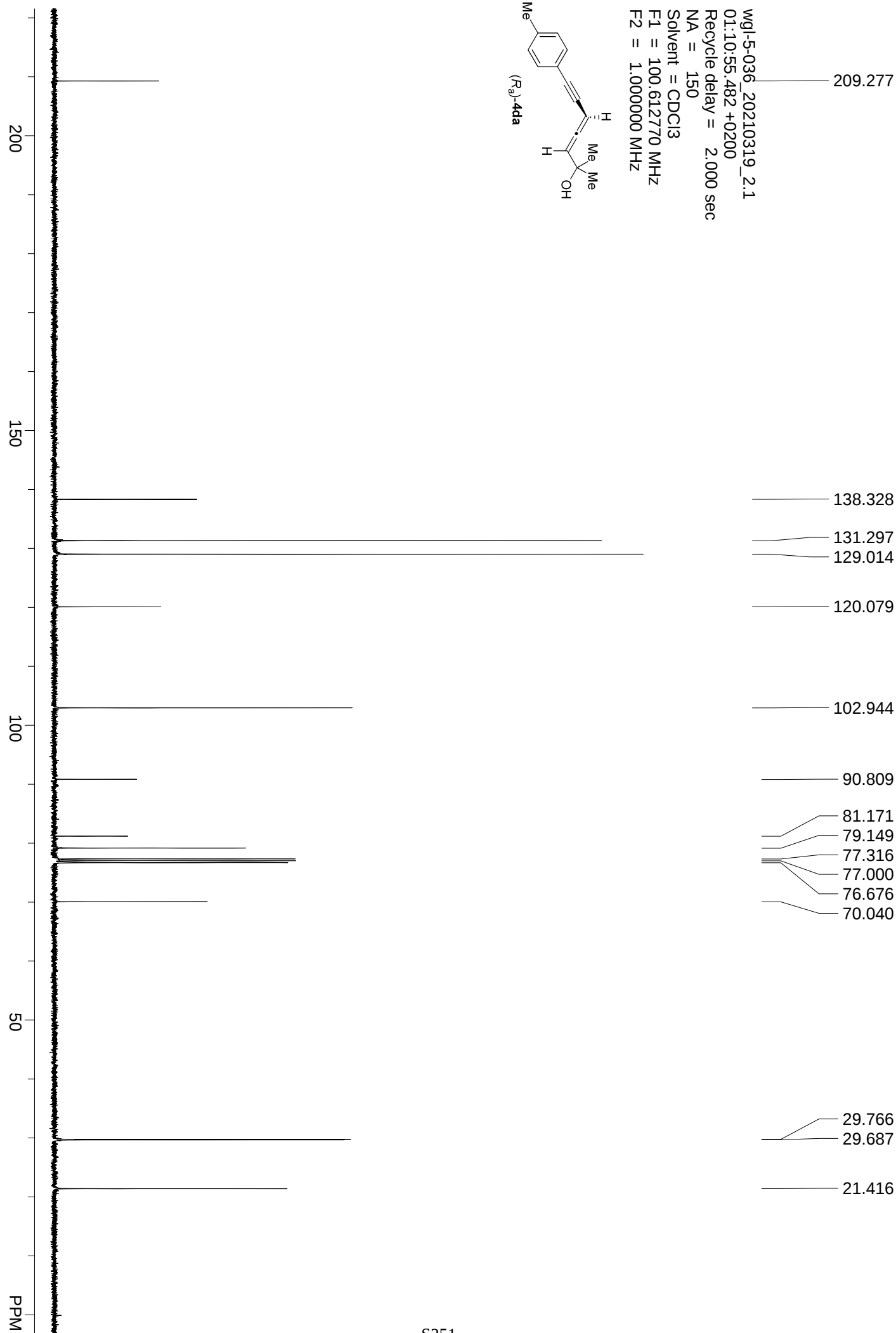
0.000

wjl-5-036_20210319_1.1
01:01:46.927 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl3
F1 = 400.130005 MHz
F2 = 1.000000 MHz





wj1-5-036_20210319_2.1
 01:10:55.482 +0200
 Recycle delay = 2.000 sec
 NA = 150
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

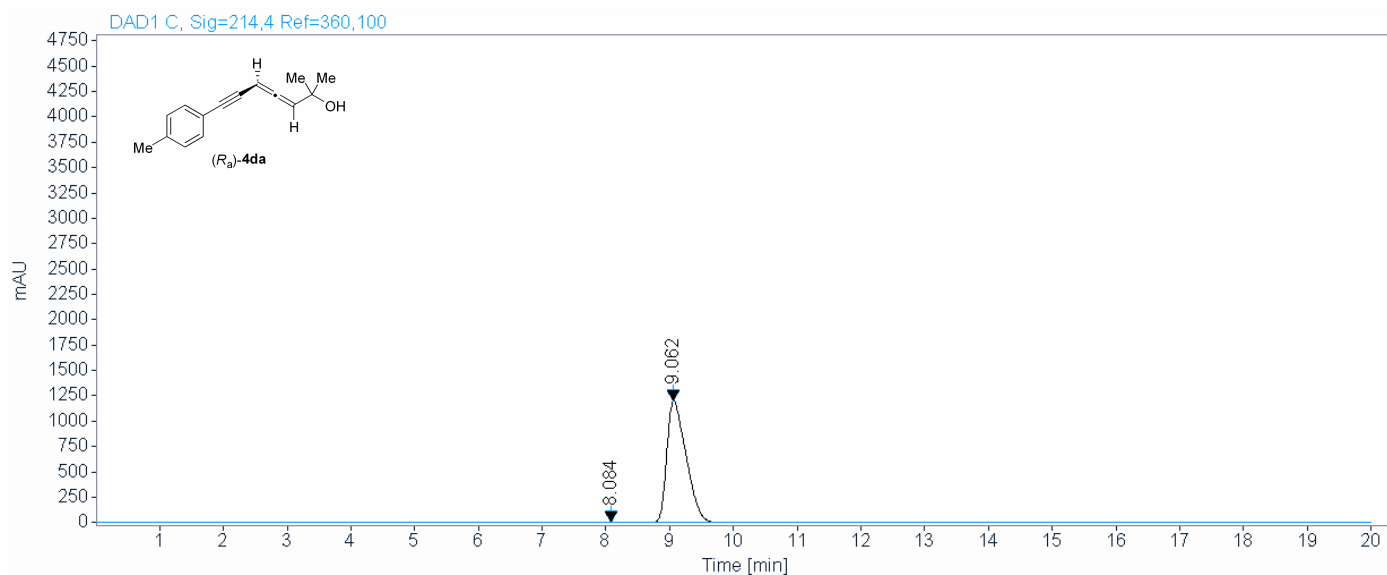


Area Percent Report

sample wgl-5-036-OD-H-95-5-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-03-19 09-01-24\039-P1-E2-wgl-5-036.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

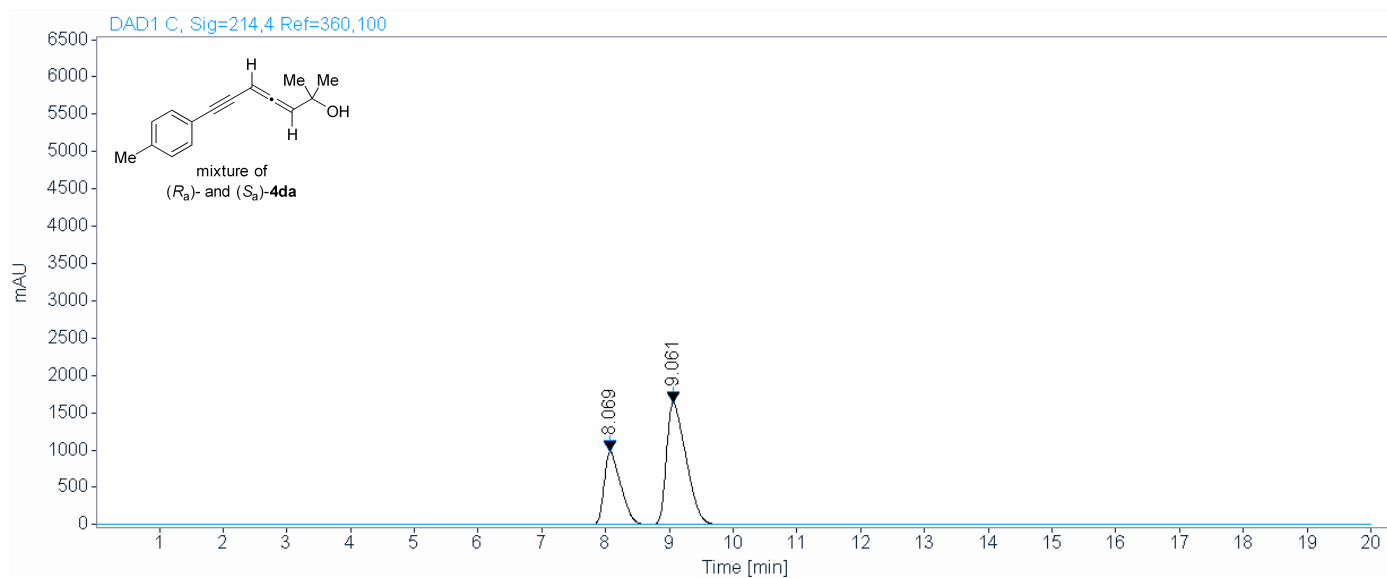
RT [min]	Width [min]	Height	Area	Area%
8.084	0.2397	5.0312	82.6543	0.3261
9.062	0.3388	1203.7401	25260.1055	99.6739
		Sum	25342.7597	100.0000

Area Percent Report

sample wgl-5-(036+037)-OD-H-95-5-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-03-19 09-01-24\041-P1-E1-wgl-5-(036+037).D

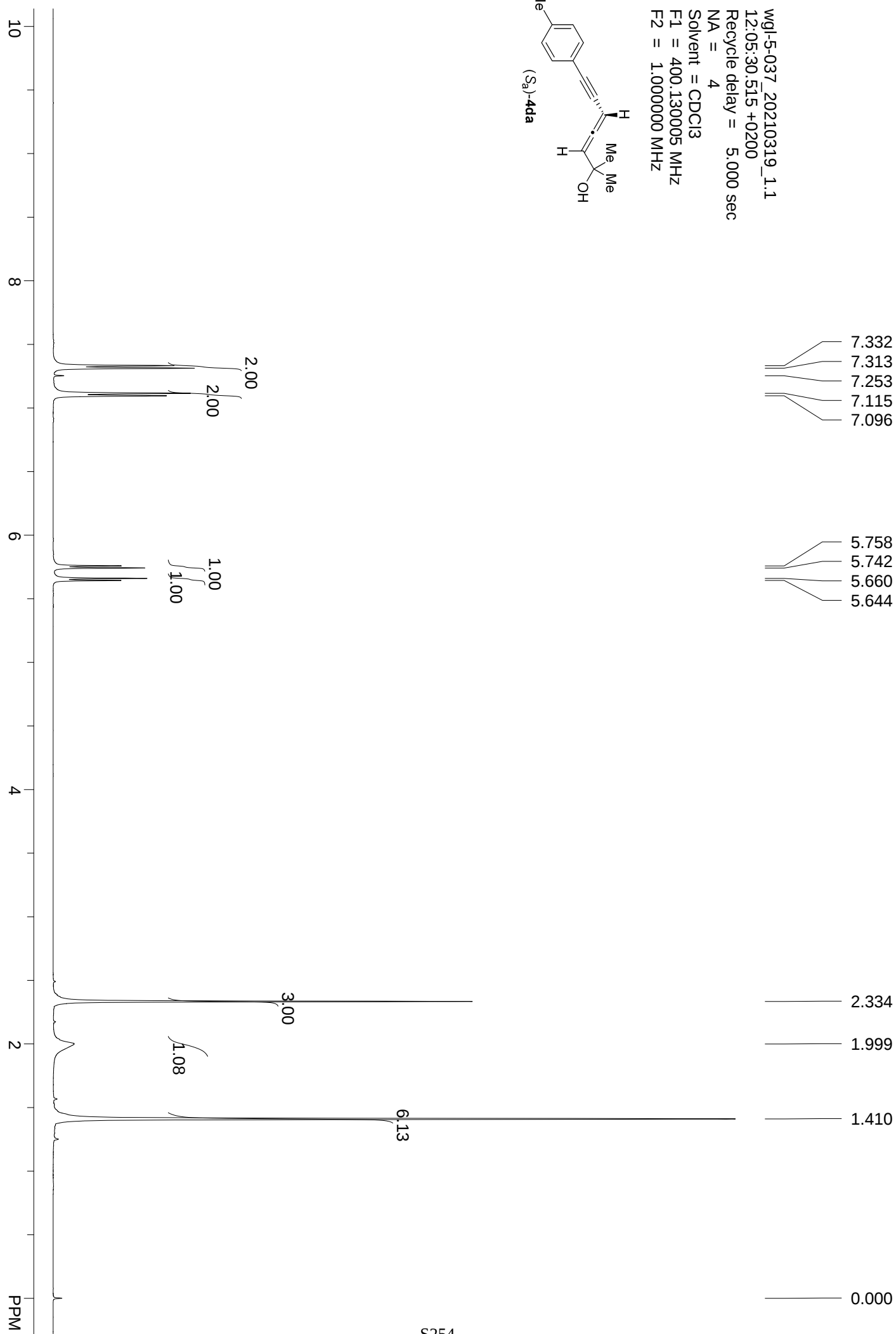
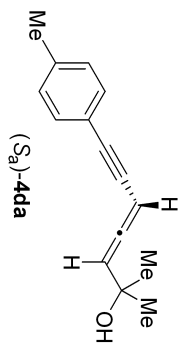
Acquisition Data:

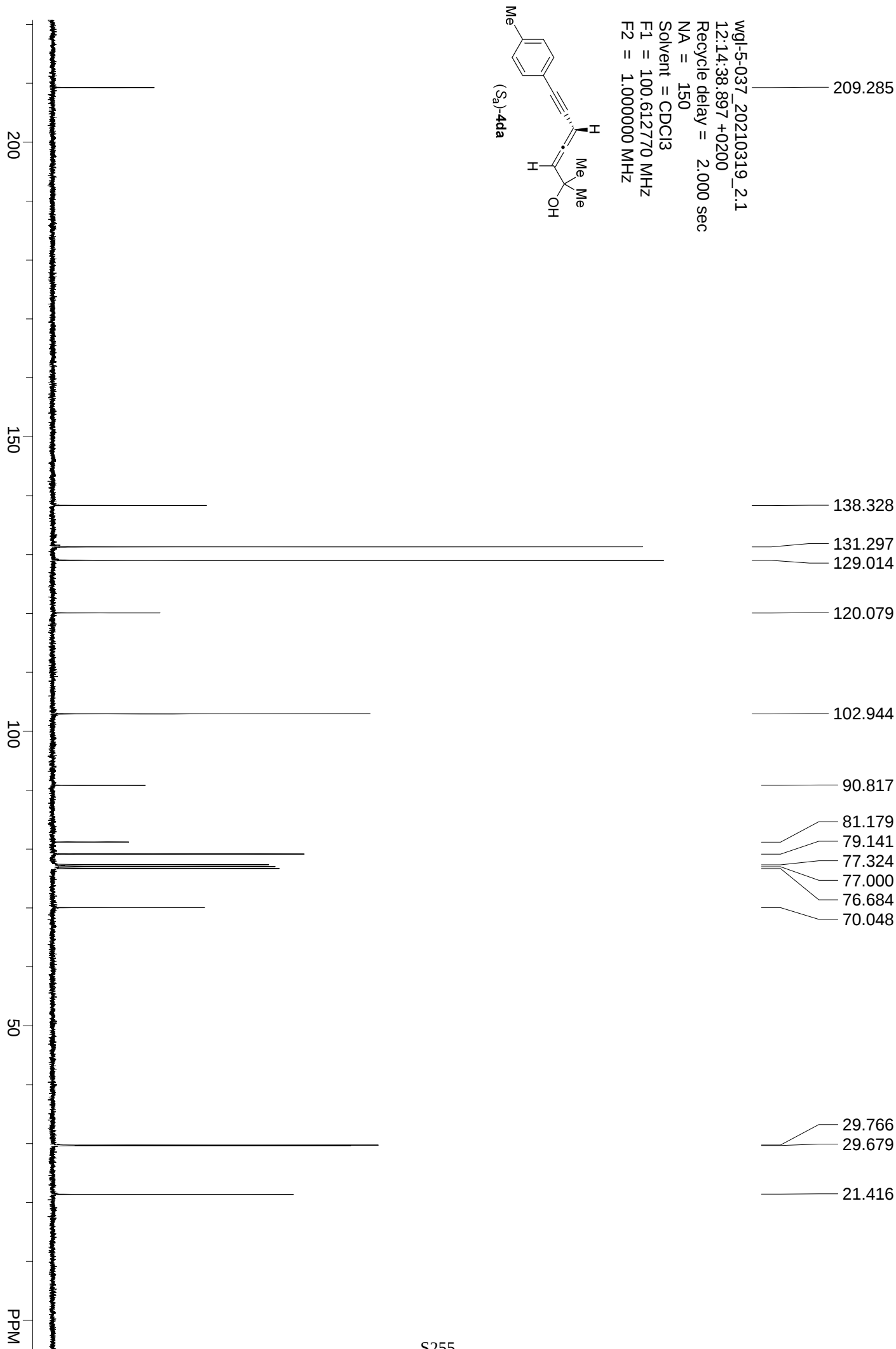


Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
8.069	0.2614	979.8770	17586.2637	33.5684
9.061	0.3444	1634.6931	34803.0391	66.4316
Sum			52389.3027	100.0000

wjl-5-037_20210319_1.1
12:05:30.515 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl3
F1 = 400.130005 MHz
F2 = 1.000000 MHz



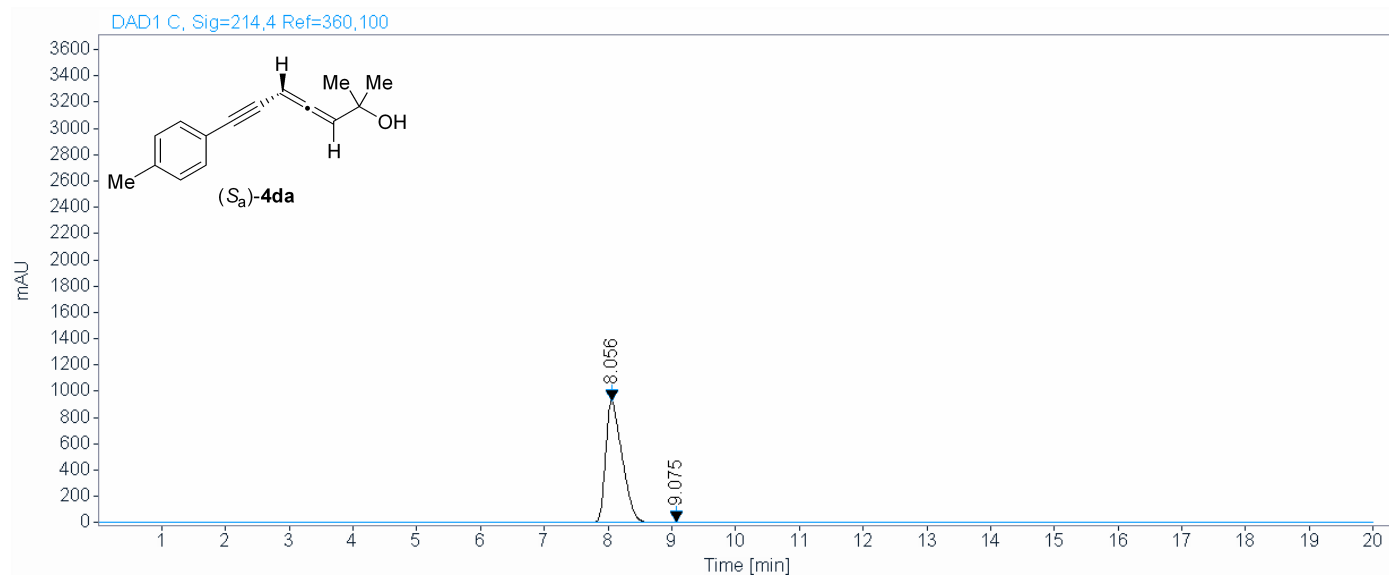


Area Percent Report

sample wgl-5-037-OD-H-95-5-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-03-19 09-01-24\040-P1-E3-wgl-5-037.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

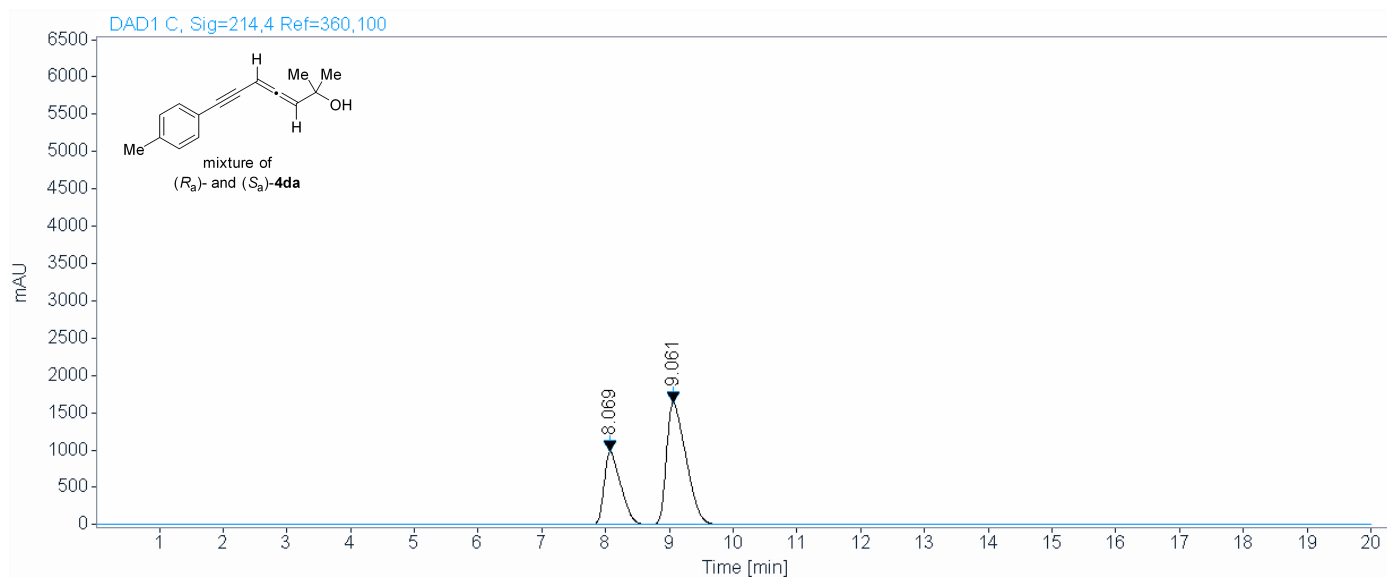
RT [min]	Width [min]	Height	Area	Area%
8.056	0.2599	929.2898	16559.7383	99.3053
9.075	0.3435	4.7002	115.8451	0.6947
		Sum	16675.5834	100.0000

Area Percent Report

sample wgl-5-(036+037)-OD-H-95-5-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-03-19 09-01-24\041-P1-E1-wgl-5-(036+037).D

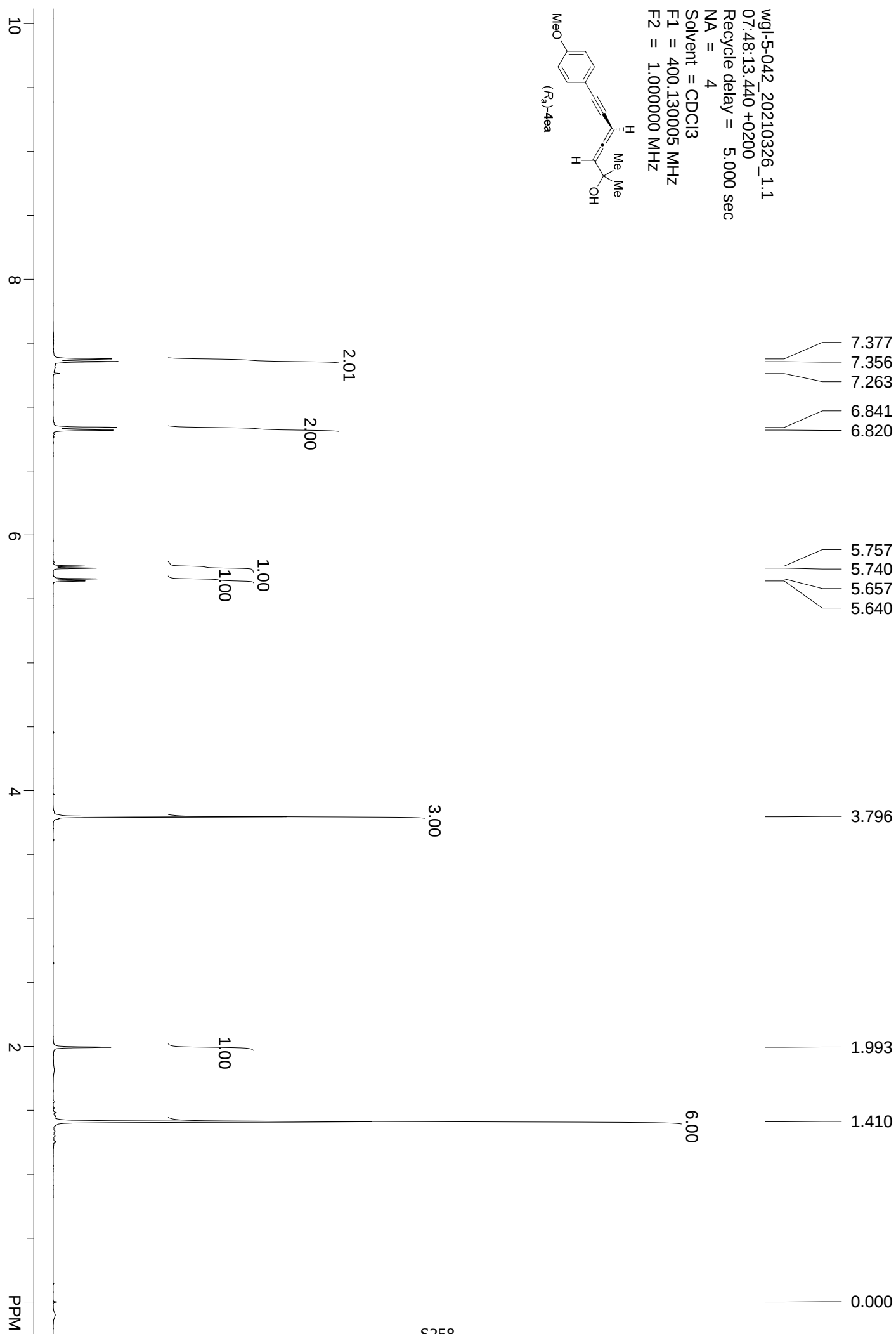
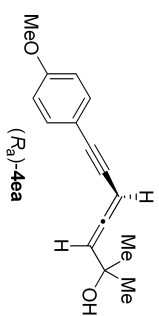
Acquisition Data:

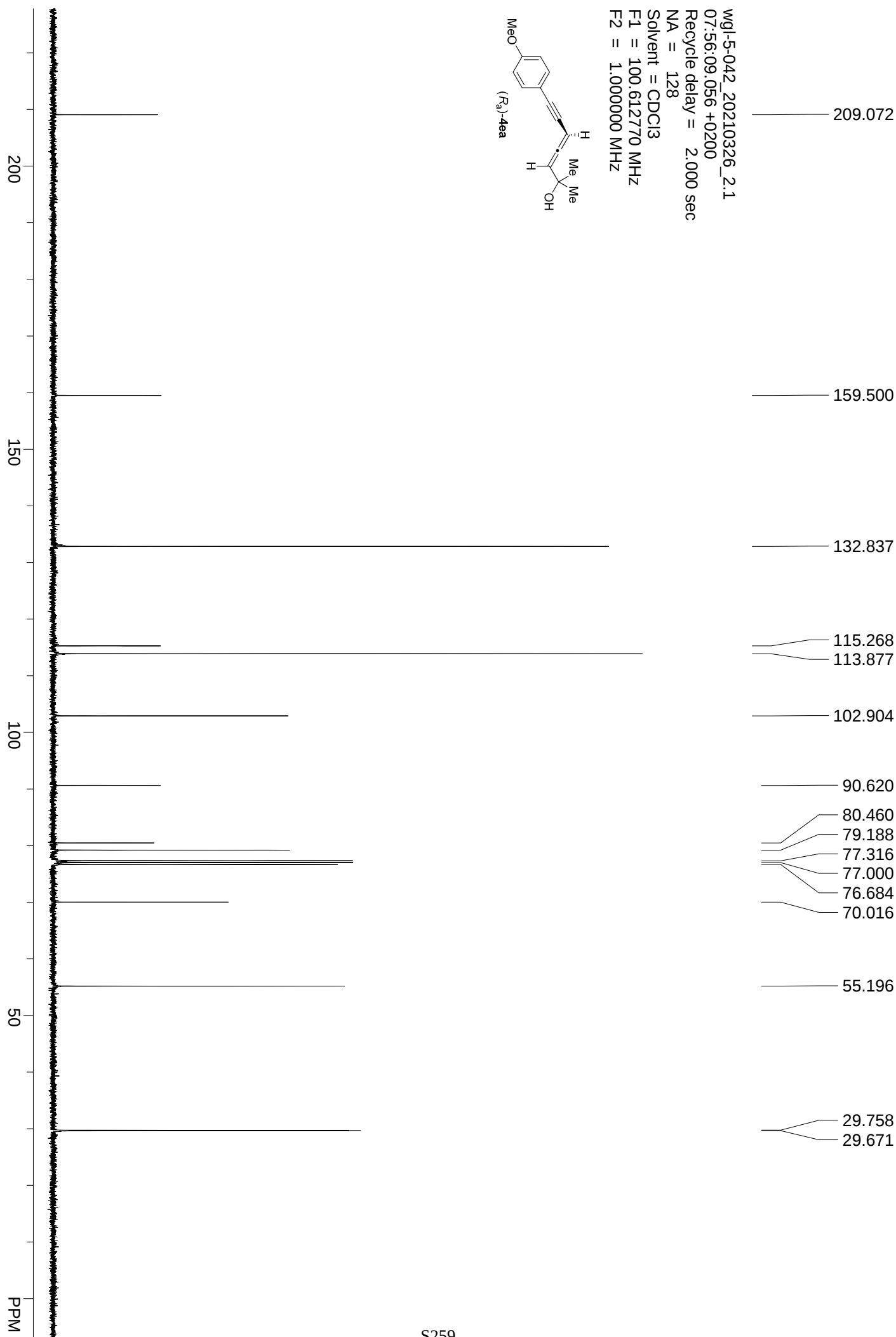


Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
8.069	0.2614	979.8770	17586.2637	33.5684
9.061	0.3444	1634.6931	34803.0391	66.4316
Sum			52389.3027	100.0000

wgl-5-042_20210326_1.1
07:48:13.440 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl₃
F1 = 400.130005 MHz
F2 = 1.000000 MHz



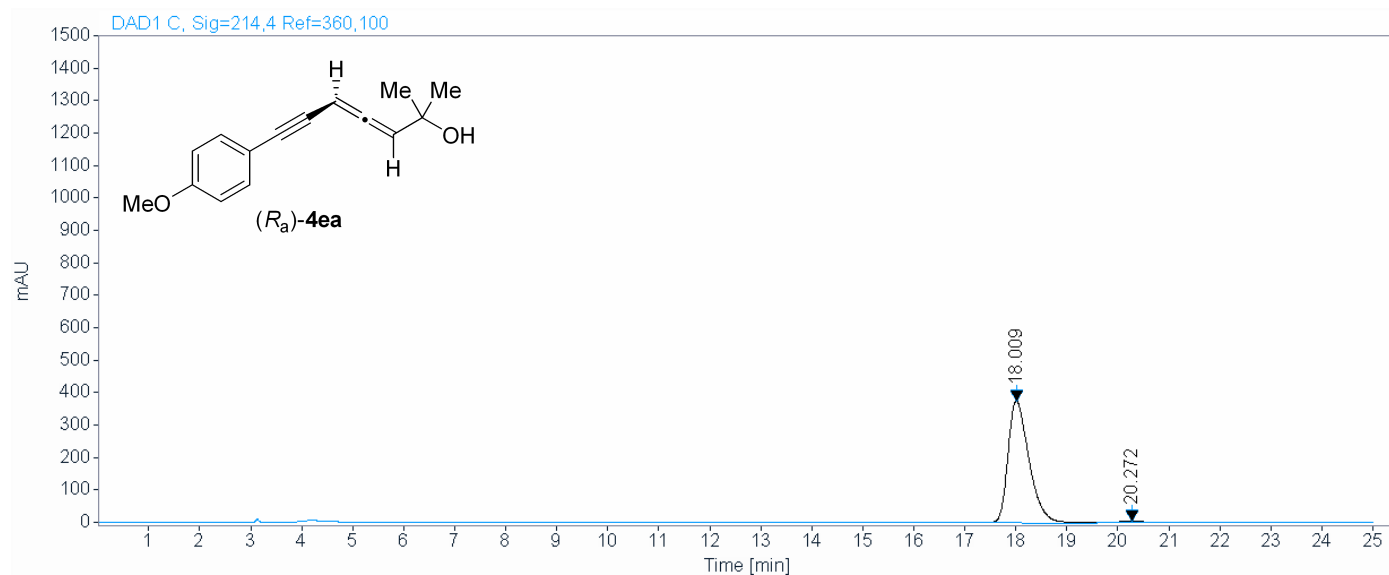


Area Percent Report

sample wgl-5-042-OJ-H-85-15-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL\WGL 2021-03-27 09-58-45\006-P1-E2-wgl-5-042.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

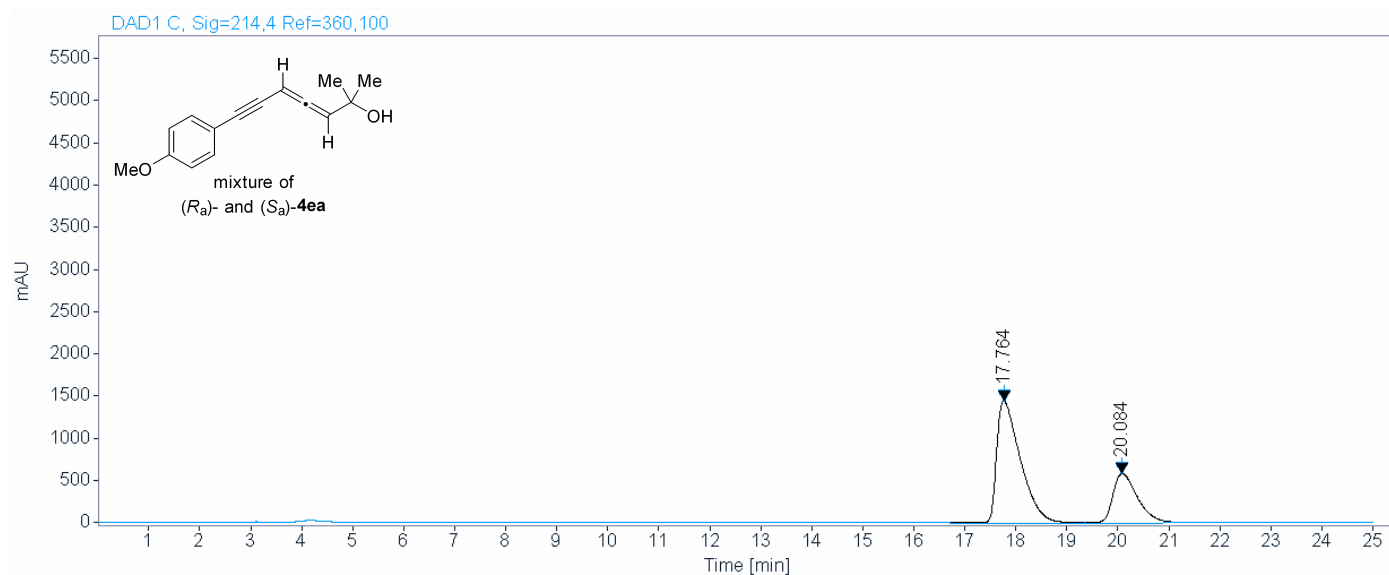
RT [min]	Width [min]	Height	Area	Area%
18.009	0.4814	376.0707	10863.5498	98.5370
20.272	0.5805	4.6313	161.2982	1.4630
Sum			11024.8480	100.0000

Area Percent Report

sample wgl-5-(042+043)-OJ-H-85-15-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL\WGL 2021-03-27 09-58-45\005-P1-E1-wgl-5-(042+043).D

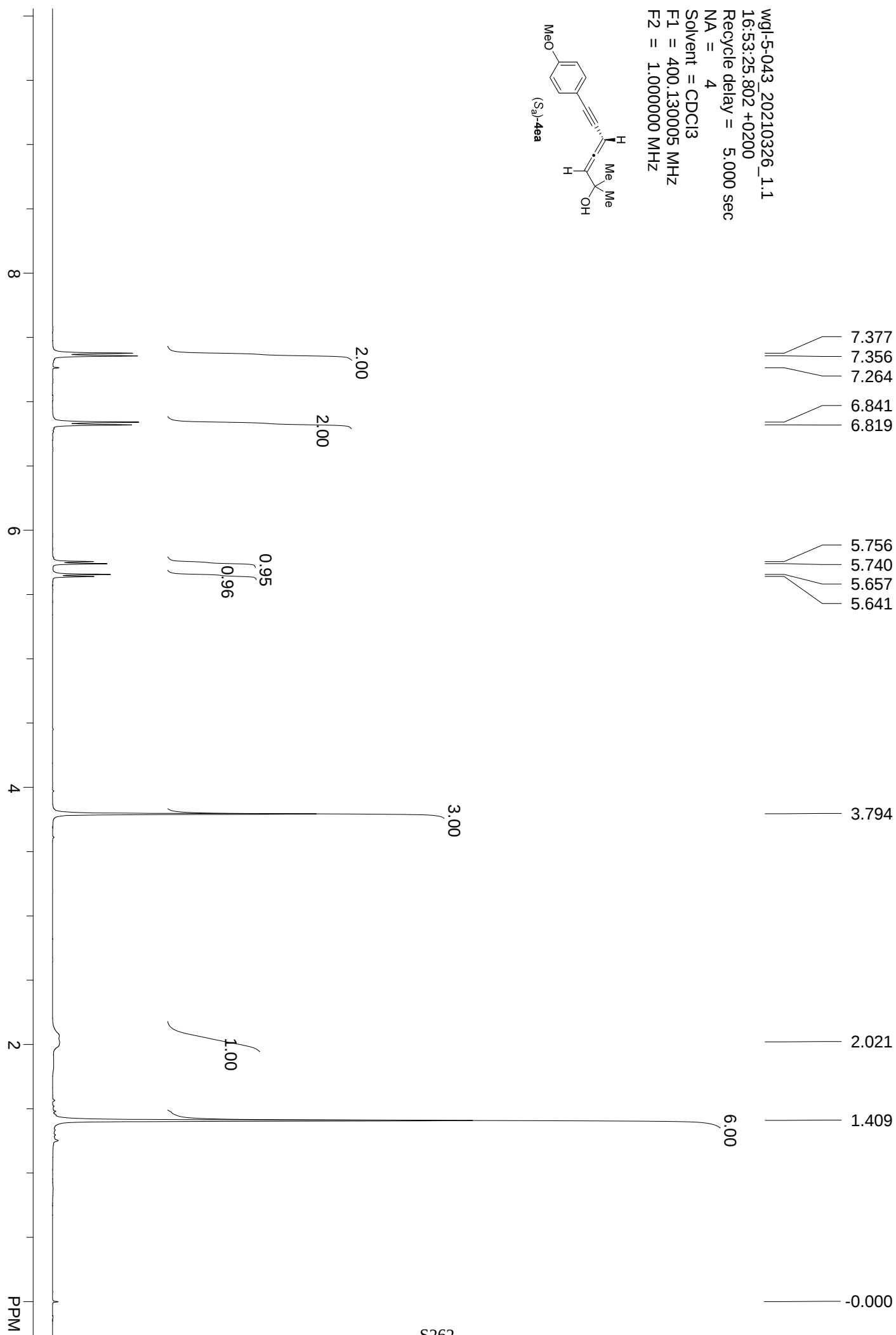
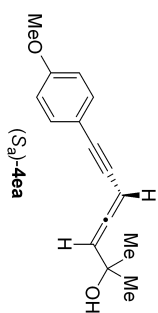
Acquisition Data:

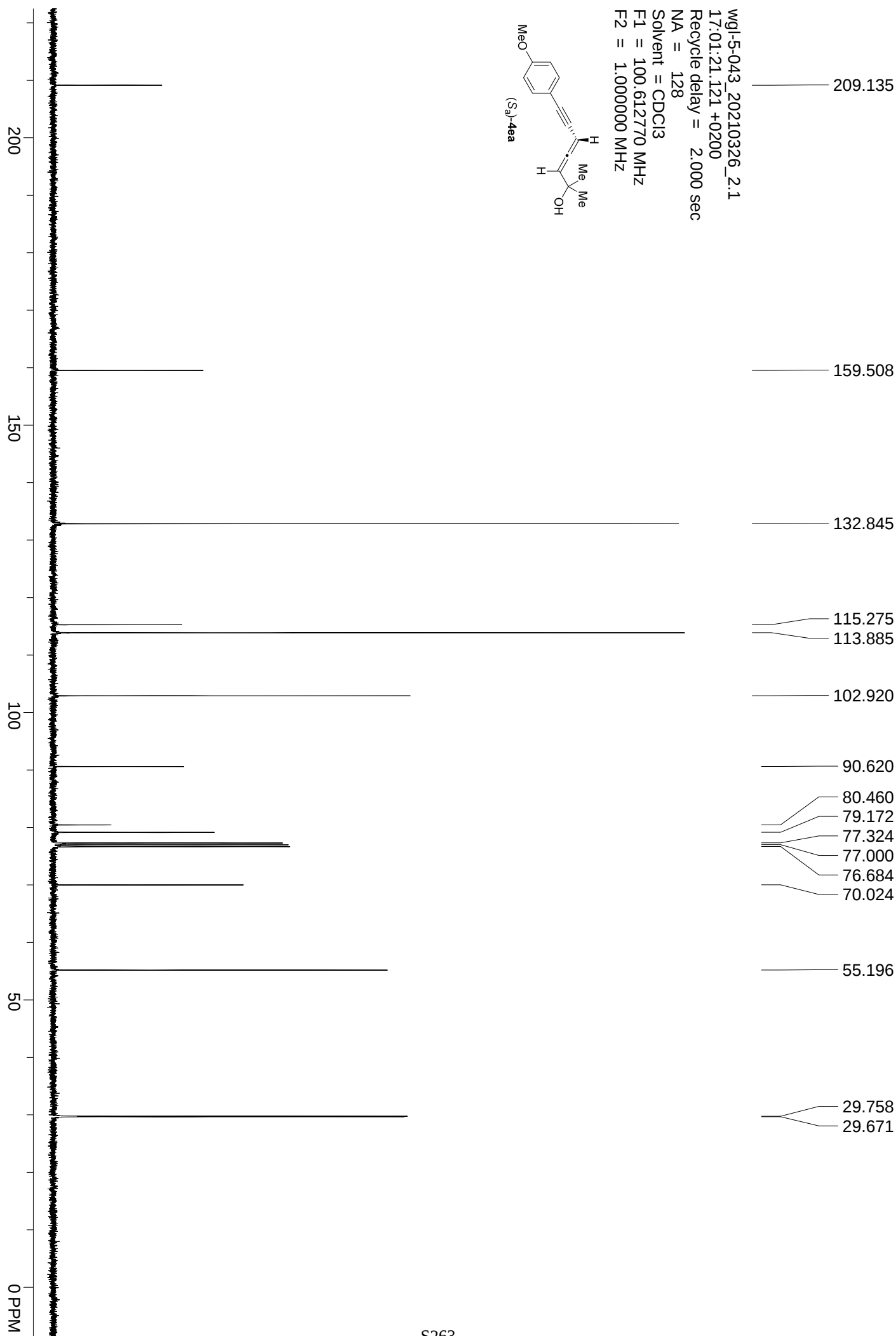


Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
17.764	0.5478	1451.3986	47703.8320	70.3704
20.084	0.5700	587.3151	20085.7578	29.6296
		Sum	67789.5898	100.0000

wgl-5-043_20210326_1.1
16:53:25.802 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl₃
F1 = 400.130005 MHz
F2 = 1.000000 MHz



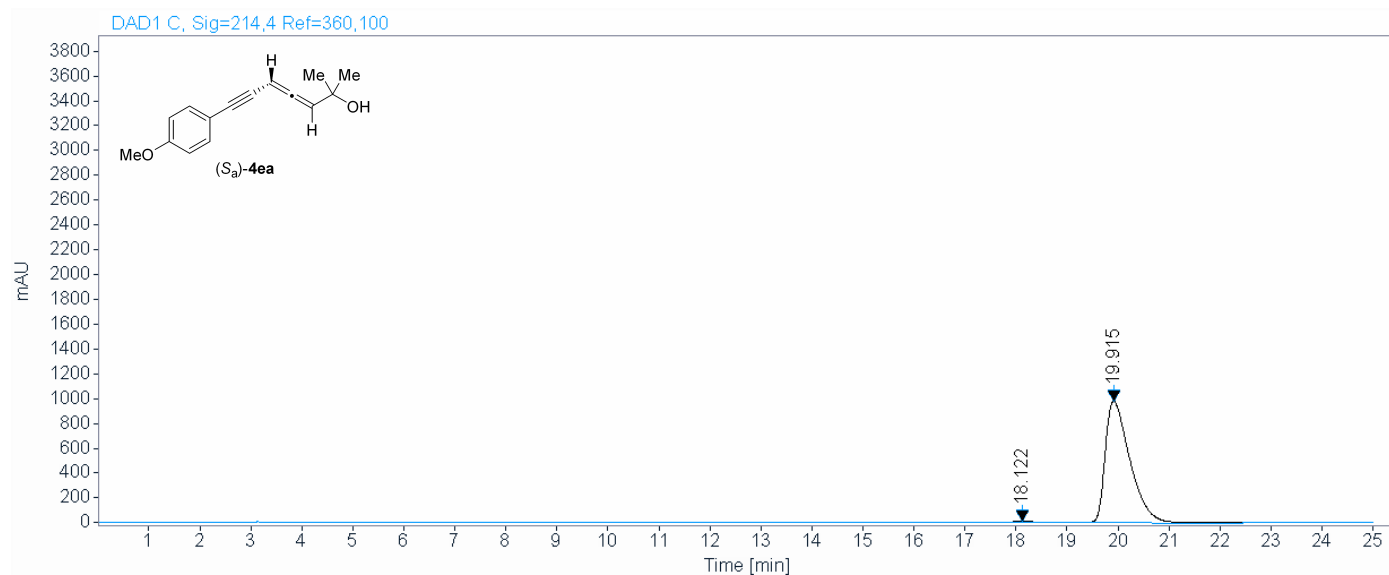


Area Percent Report

sample wgl-5-043-OJ-H-85-15-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL\WGL 2021-03-27 09-58-45\007-P1-E3-wgl-5-043.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

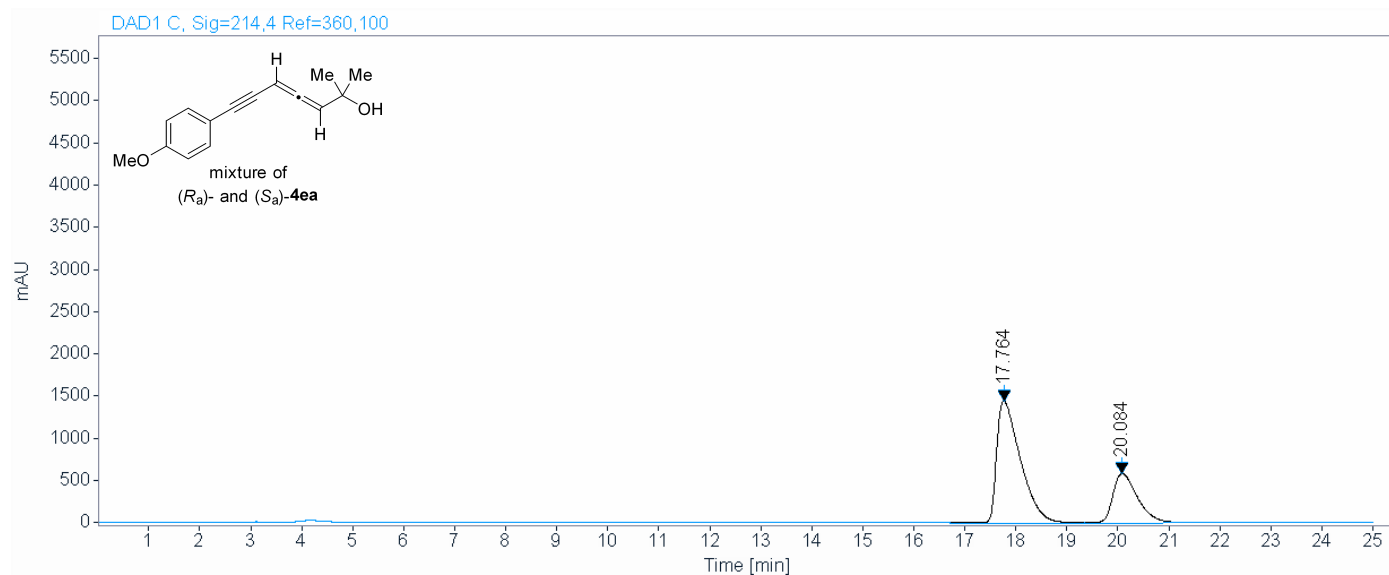
RT [min]	Width [min]	Height	Area	Area%
18.122	0.4983	10.9146	326.3249	0.9769
19.915	0.5610	982.6046	33076.6914	99.0231
Sum			33403.0163	100.0000

Area Percent Report

sample wgl-5-(042+043)-OJ-H-85-15-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL\WGL 2021-03-27 09-58-45\005-P1-E1-wgl-5-(042+043).D

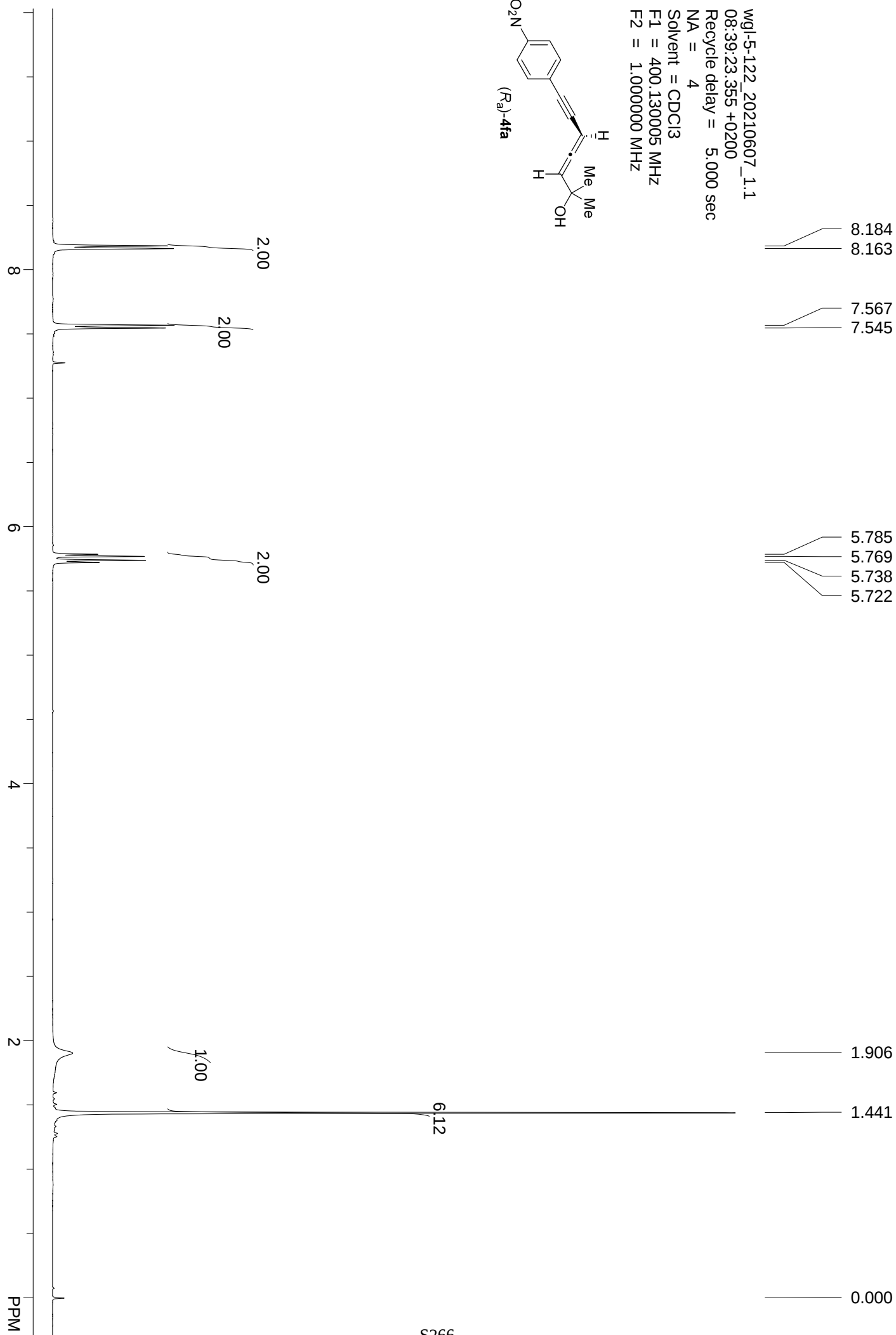
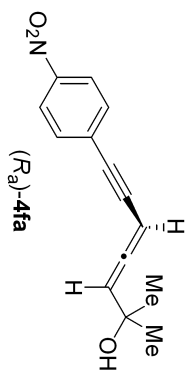
Acquisition Data:



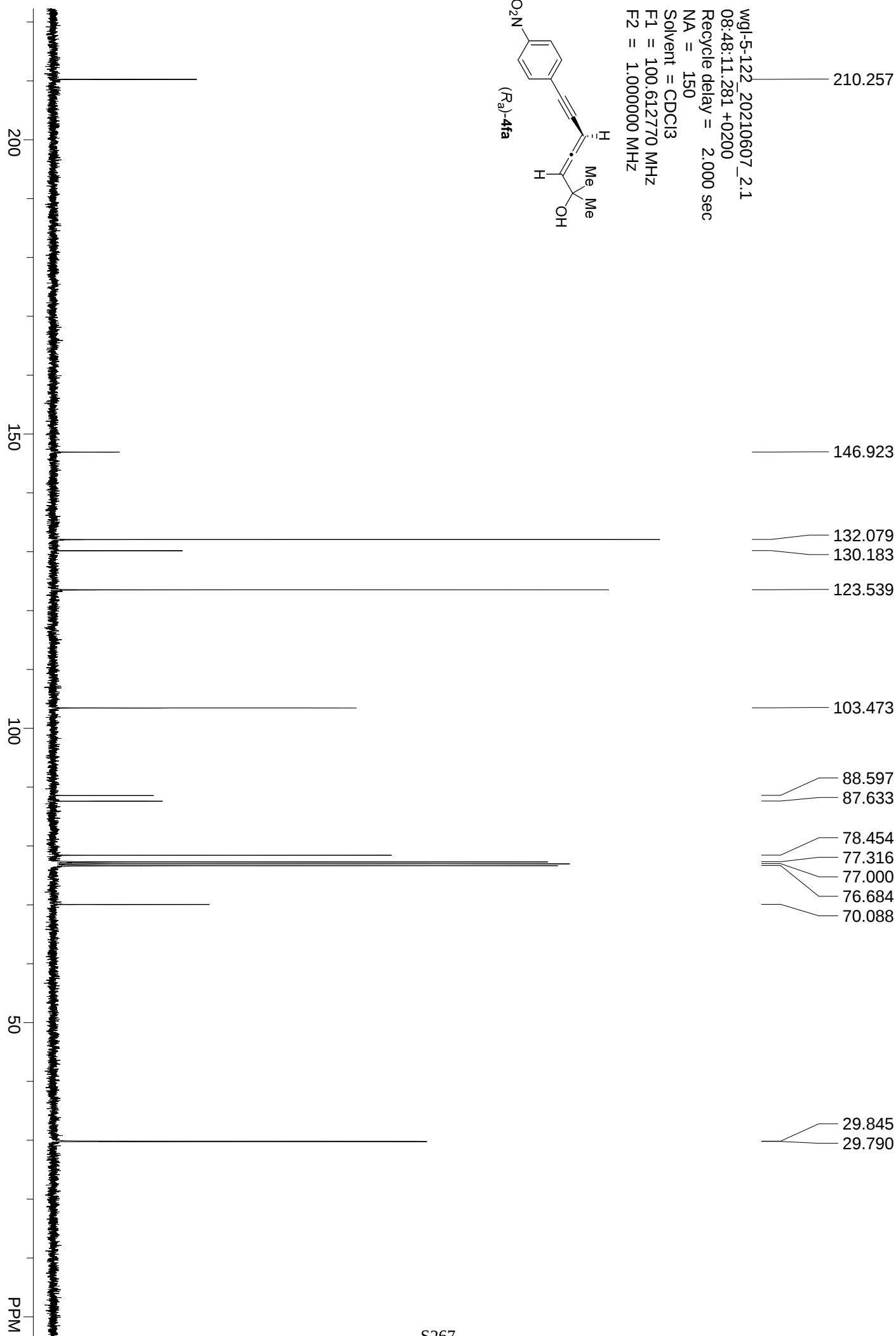
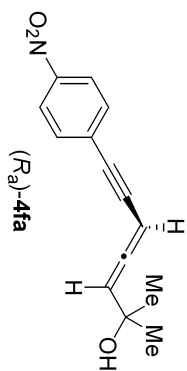
Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
17.764	0.5478	1451.3986	47703.8320	70.3704
20.084	0.5700	587.3151	20085.7578	29.6296
		Sum	67789.5898	100.0000

wjl-5-122_20210607_1.1
08:39:23.355 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl3
F1 = 400.130005 MHz
F2 = 1.000000 MHz



wj-5-122_20210607_2.1
08:48:11.281 +0200
Recycle delay = 2.000 sec
NA = 150
Solvent = CDCl₃
F1 = 100.612770 MHz
F2 = 1.000000 MHz

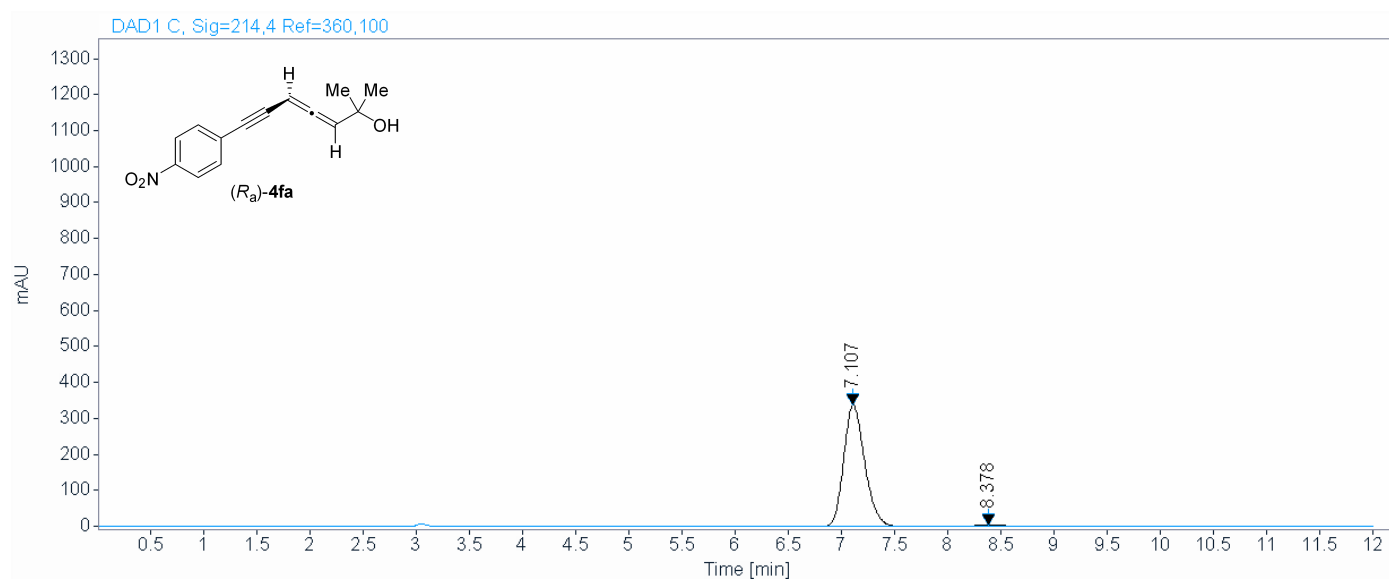


Area Percent Report

sample wgl-5-122-OD-H-85-15-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2021-06-07 14-51-30\006-P1-E2-wgl-5-122.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

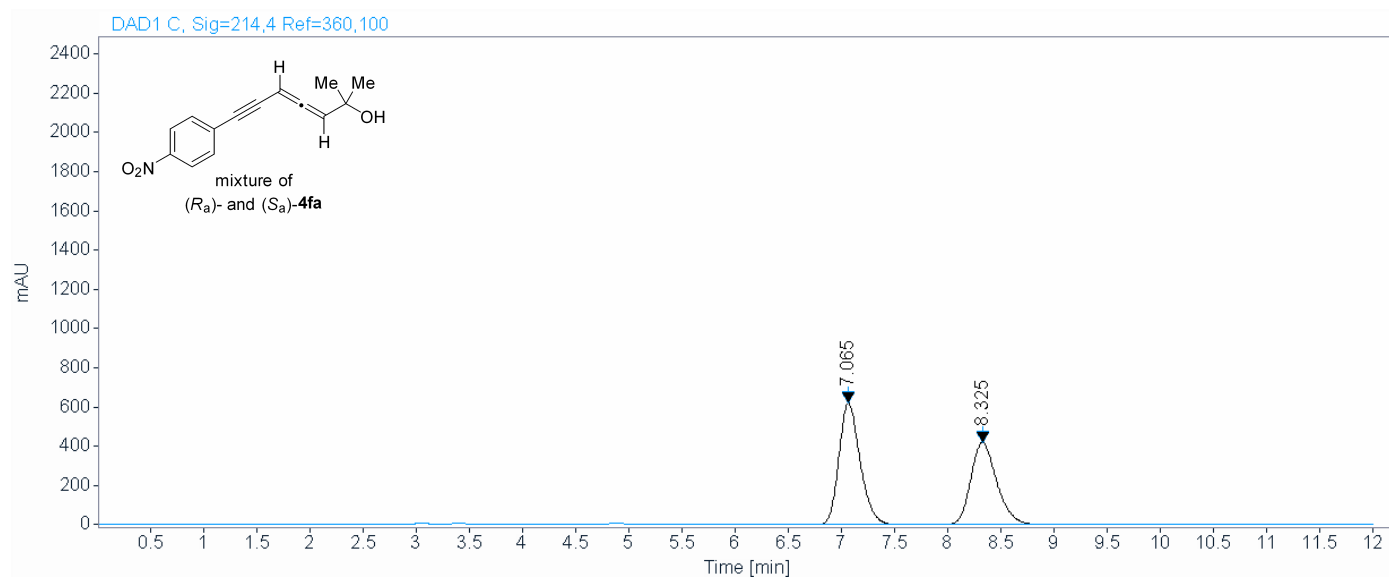
RT [min]	Width [min]	Height	Area	Area%
7.107	0.2128	339.0651	4674.7109	98.0653
8.378	0.2824	4.9730	92.2244	1.9347
		Sum	4766.9354	100.0000

Area Percent Report

sample wgl-5-(119+122)-OD-H-85-15-1.0-214

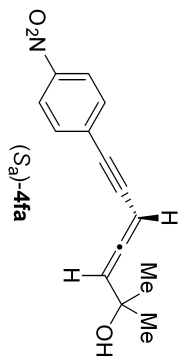
Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\WGL 2021-06-07 14-51-30\005-P1-E1-wgl-5-(119+122).D

Acquisition Data:

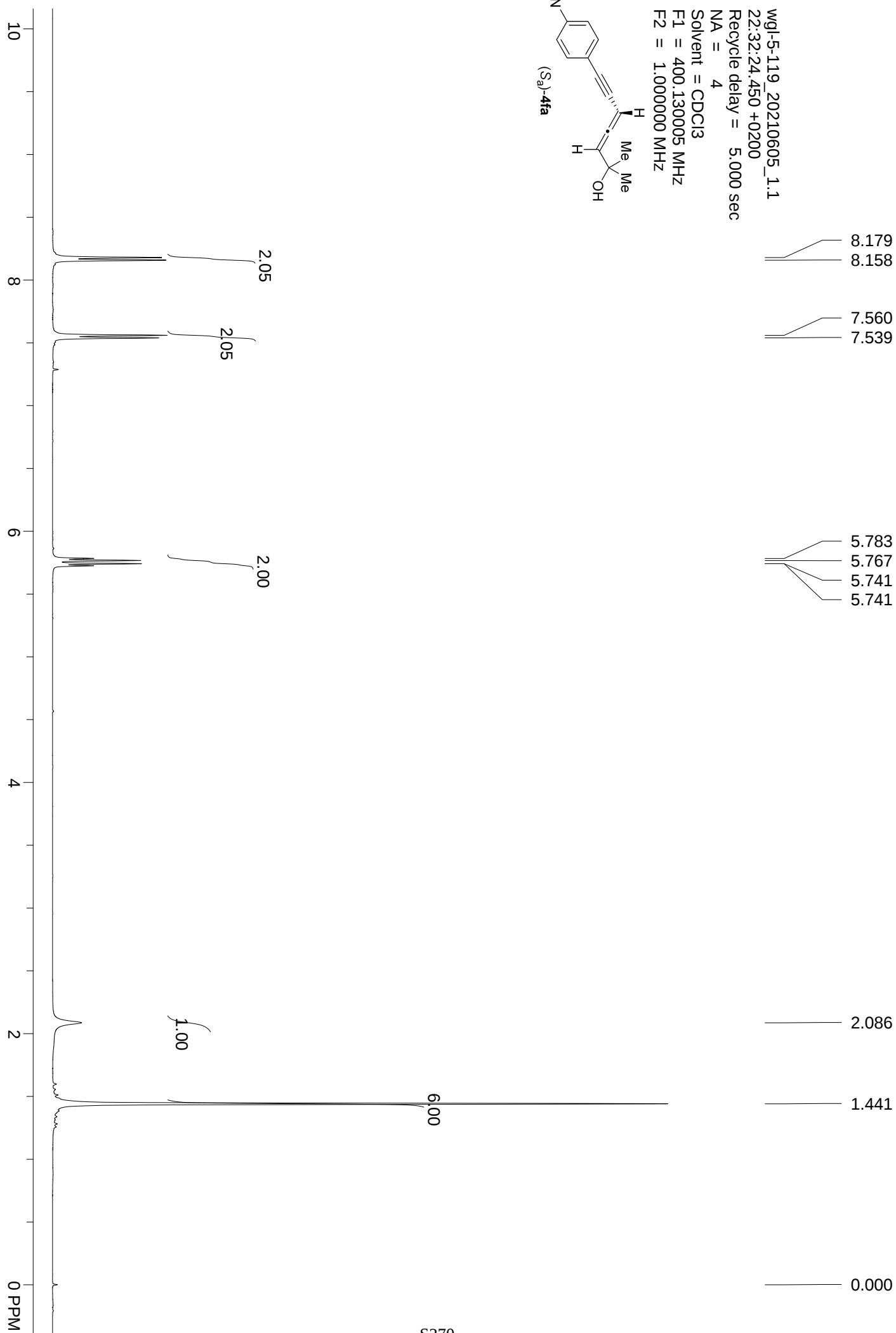


Signal: DAD1 C, Sig=214,4 Ref=360,100

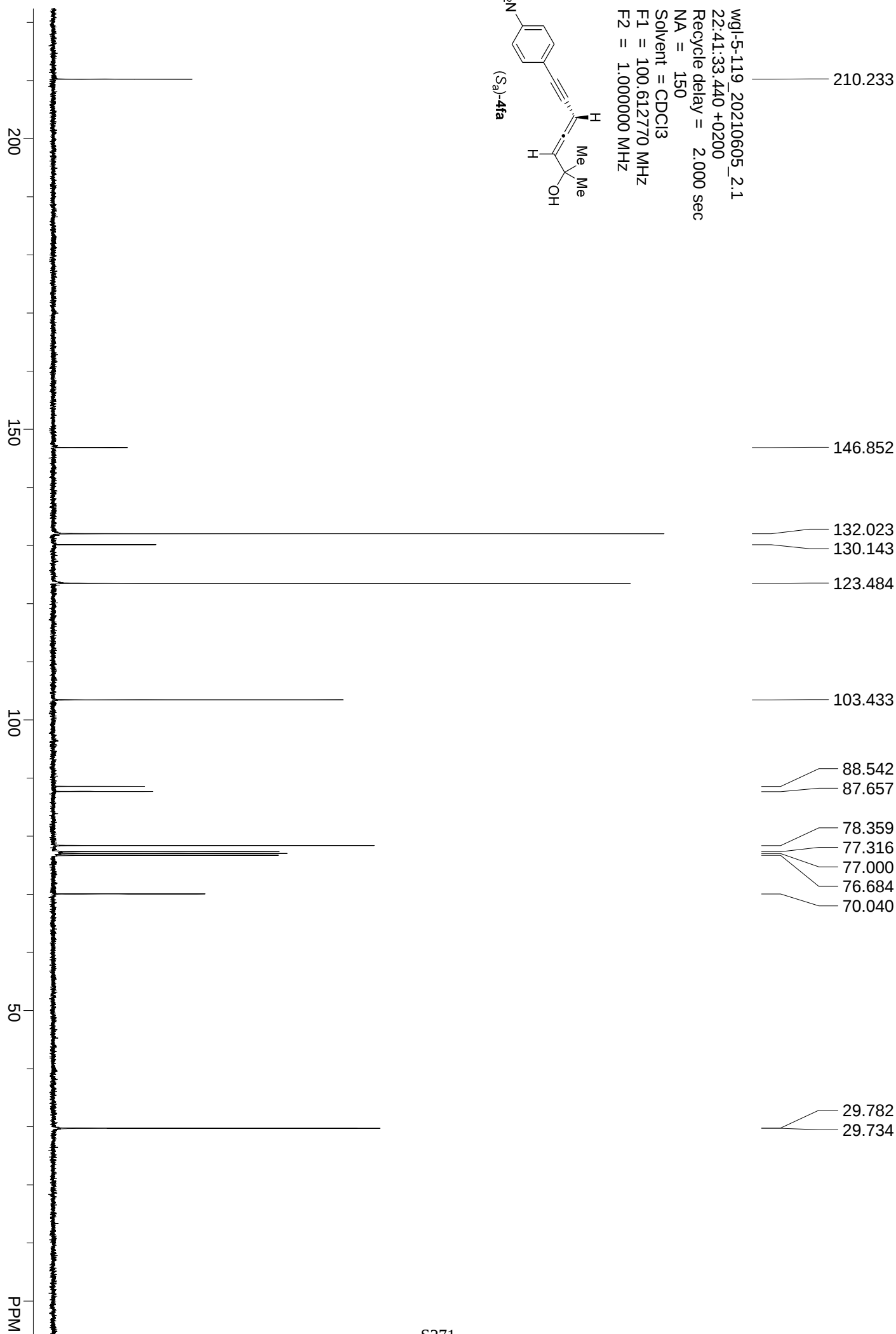
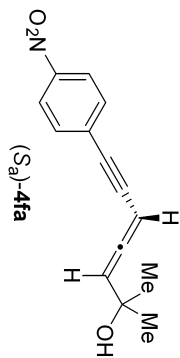
RT [min]	Width [min]	Height	Area	Area%
7.065	0.2111	621.4083	8580.5381	54.7446
8.325	0.2591	419.9266	7093.2241	45.2554
Sum			15673.7622	100.0000



wgl-5-119_20210605_1.1
 22:32:24.450 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130005 MHz
 F2 = 1.000000 MHz



wqf-5-119_20210605_2.1
22:41:33.440 +0200
Recycle delay = 2.000 sec
NA = 150
Solvent = CDCl₃
F1 = 100.612770 MHz
F2 = 1.000000 MHz





SHIMADZU
LabSolutions

Analysis Report

<Sample Information>

Sample Name : fsw-2-069
Sample ID :
Data Filename : fsw-2-069.lcd

Method Filename : OD-H,1ml 15%IPA in Hex;20min.lcm

Batch Filename : 140.lcb

Vial # : 1-34

Injection Volume : 10 uL

Date Acquired : 9/27/2024 3:00:51 AM

Date Processed : 9/27/2024 5:06:18 AM

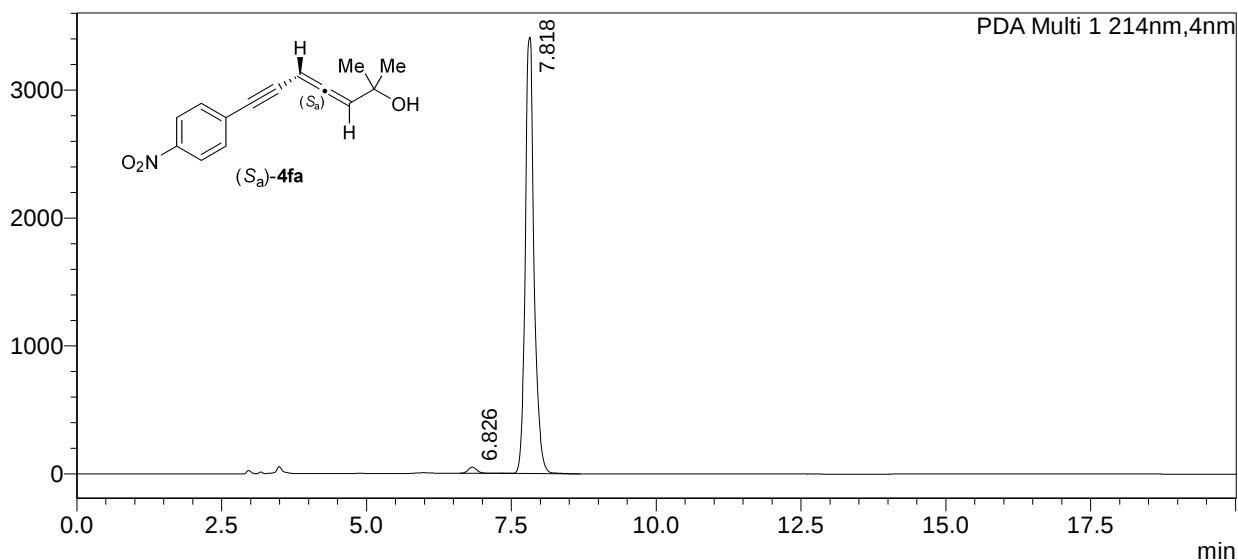
Sample Type : Unknown

Acquired by : System Administrator

Processed by : System Administrator

<Chromatogram>

mAU



<Peak Table>

PDA Ch1 214nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	6.826	500119	47197	1.364			
2	7.818	36164547	3409990	98.636			
Total		36664666	3457187				



SHIMADZU
LabSolutions

Analysis Report

<Sample Information>

Sample Name : fsw-rac-9-27
Sample ID :
Data Filename : fsw-rac-9-27.lcd

Method Filename : OD-H,1ml 15%IPA in Hex;20min.lcm

Batch Filename : 140.lcb

Vial # : 1-33

Injection Volume : 10 uL

Date Acquired : 9/27/2024 2:40:18 AM

Date Processed : 9/27/2024 3:00:21 AM

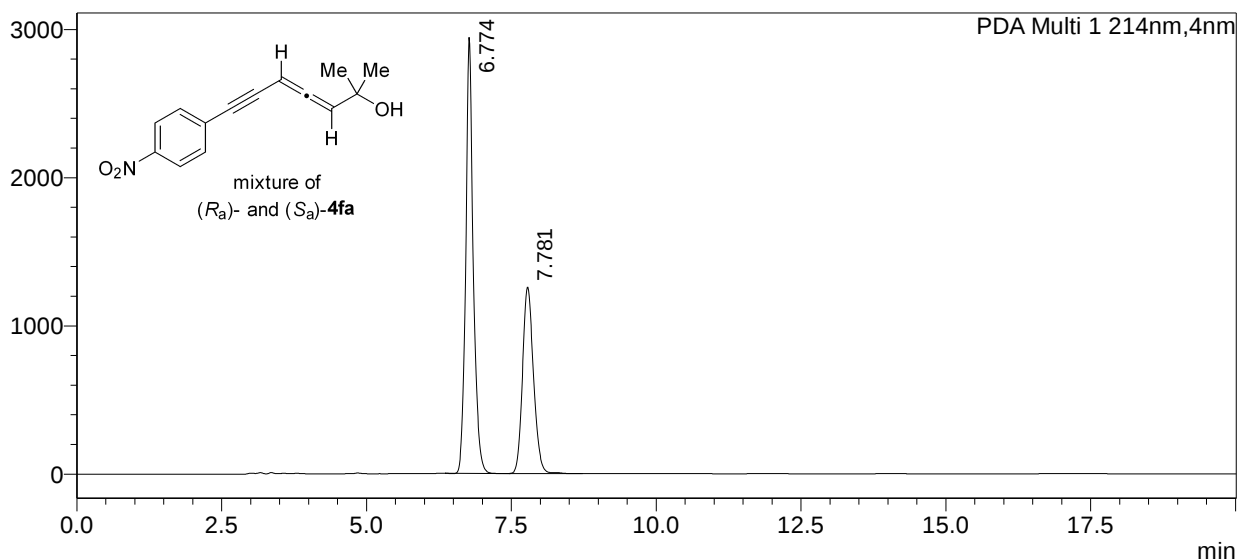
Sample Type : Unknown

Acquired by : System Administrator

Processed by : System Administrator

<Chromatogram>

mAU



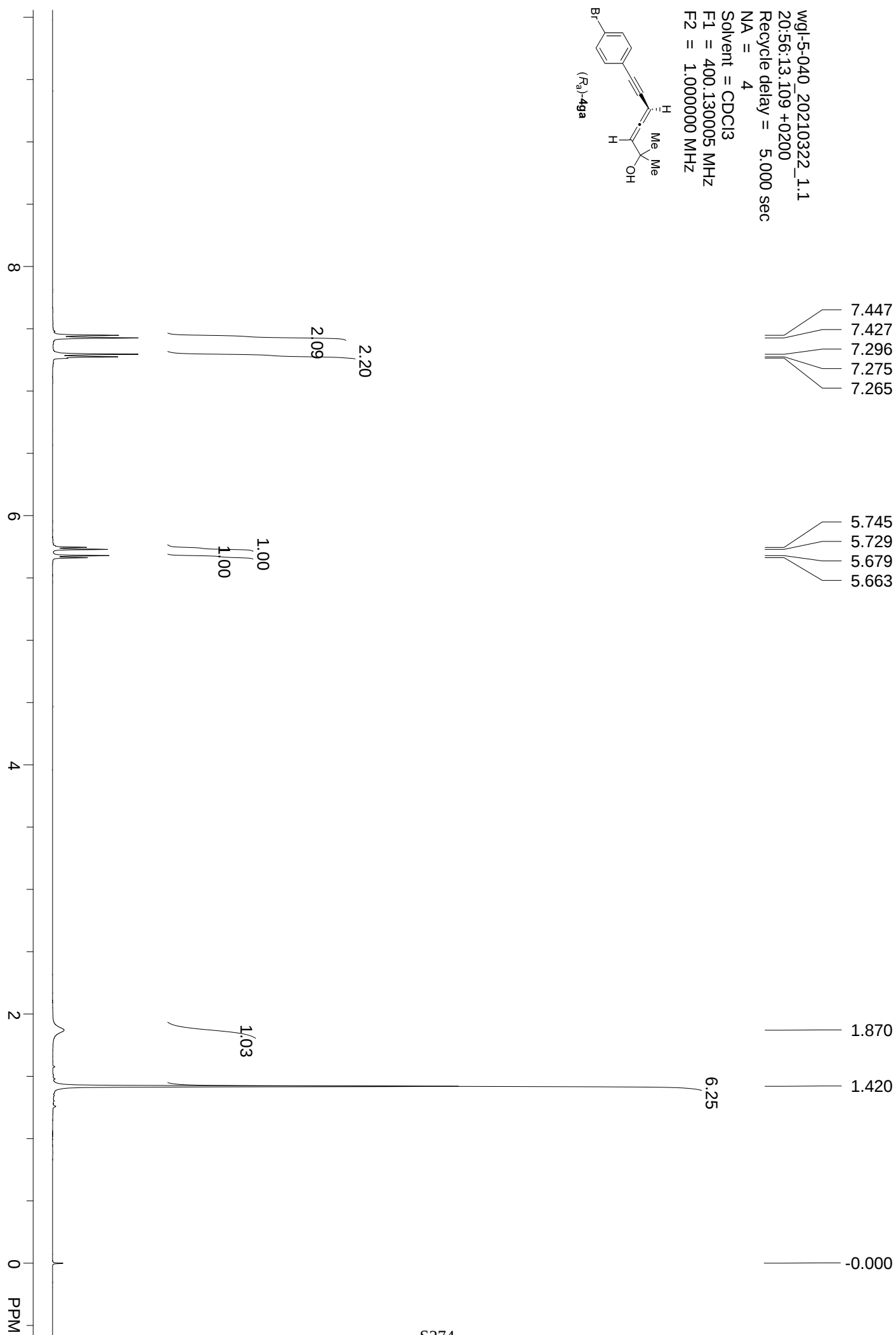
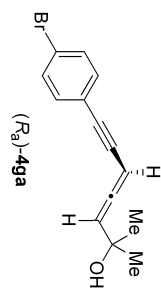
<Peak Table>

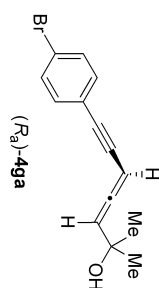
PDA Ch1 214nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	6.774	26636523	2941301	61.583			
2	7.781	16616459	1257155	38.417			
Total		43252981	4198456				

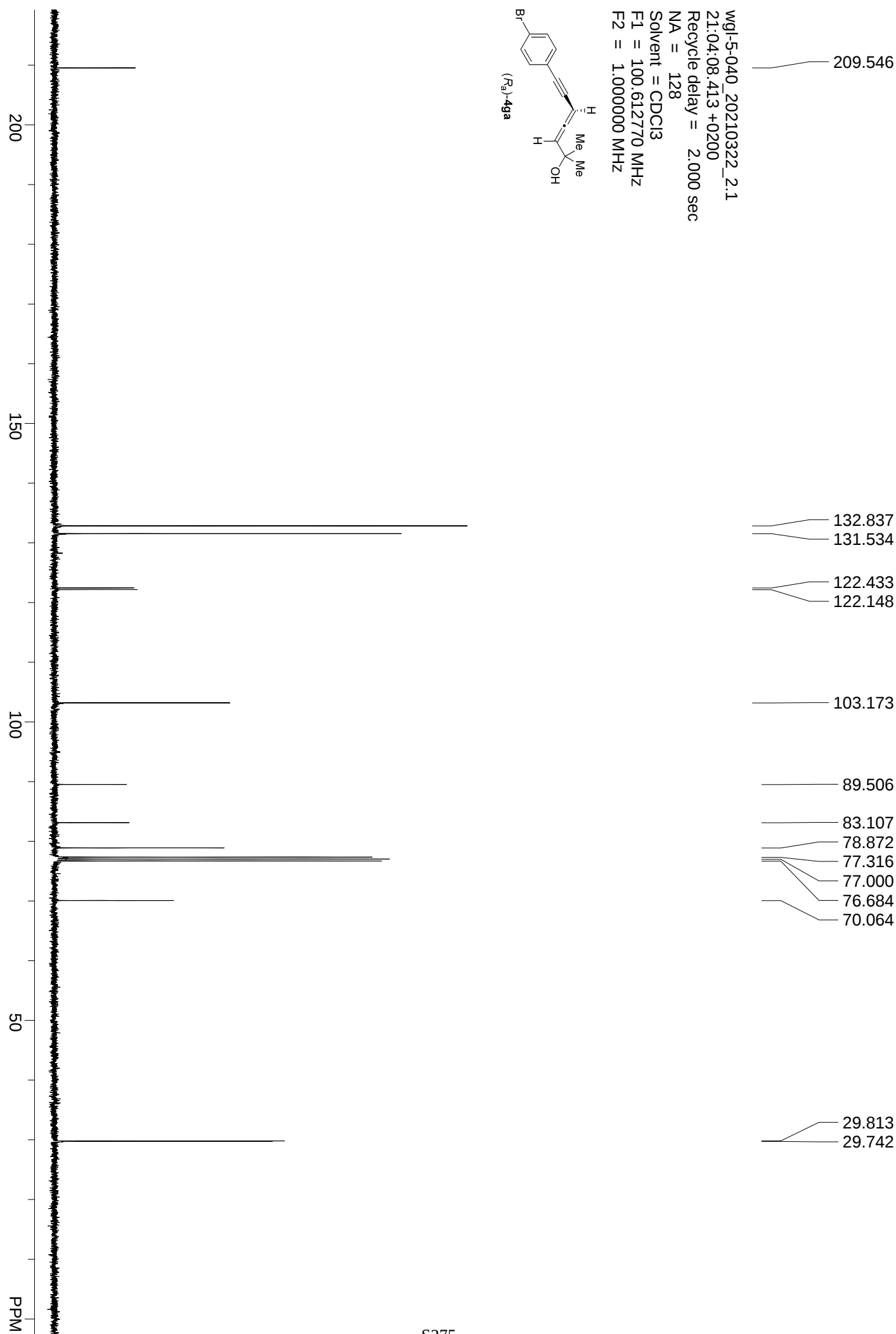
wgl-5-040_20210322_1.1
20:56:13.109 +0200
Recycle delay = 5.000 sec
NA = 4

Solvent = CDCl₃
F1 = 400.130005 MHz
F2 = 1.000000 MHz





wjl-5-040_20210322_2.1
 21:04:08.413 +0200
 Recycle delay = 2.000 sec
 NA = 128
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

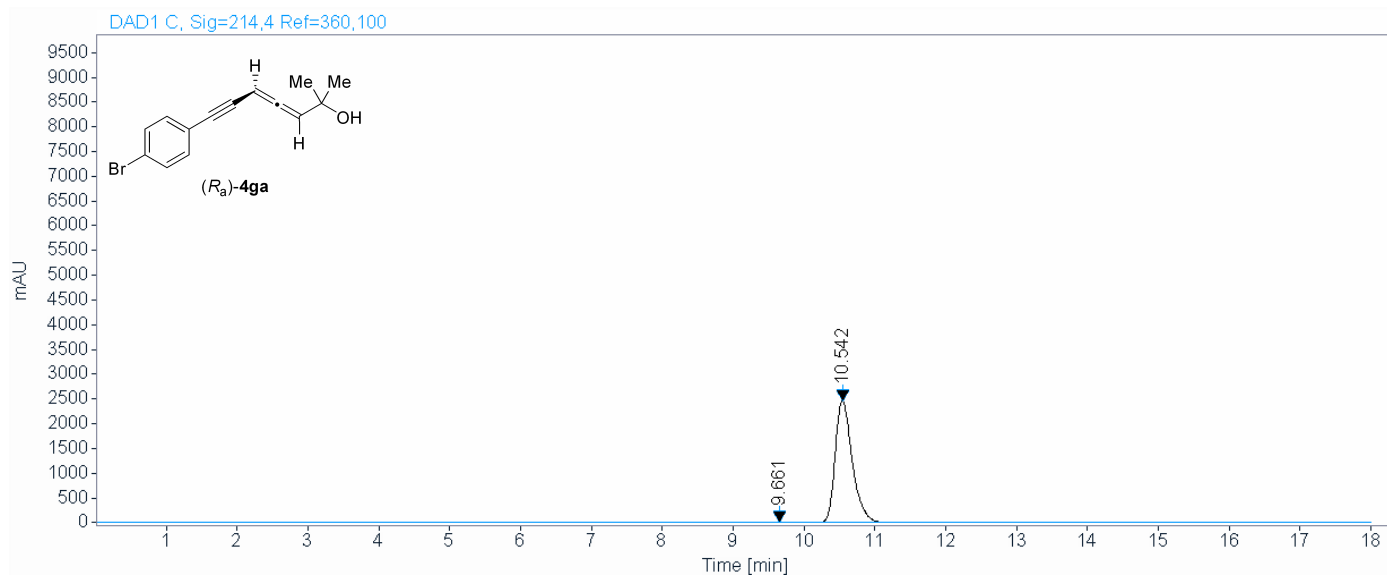


Area Percent Report

sample wgl-5-040-AD-H-95-5-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-03-23 13-09-39\006-P1-E2-wgl-5-040.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

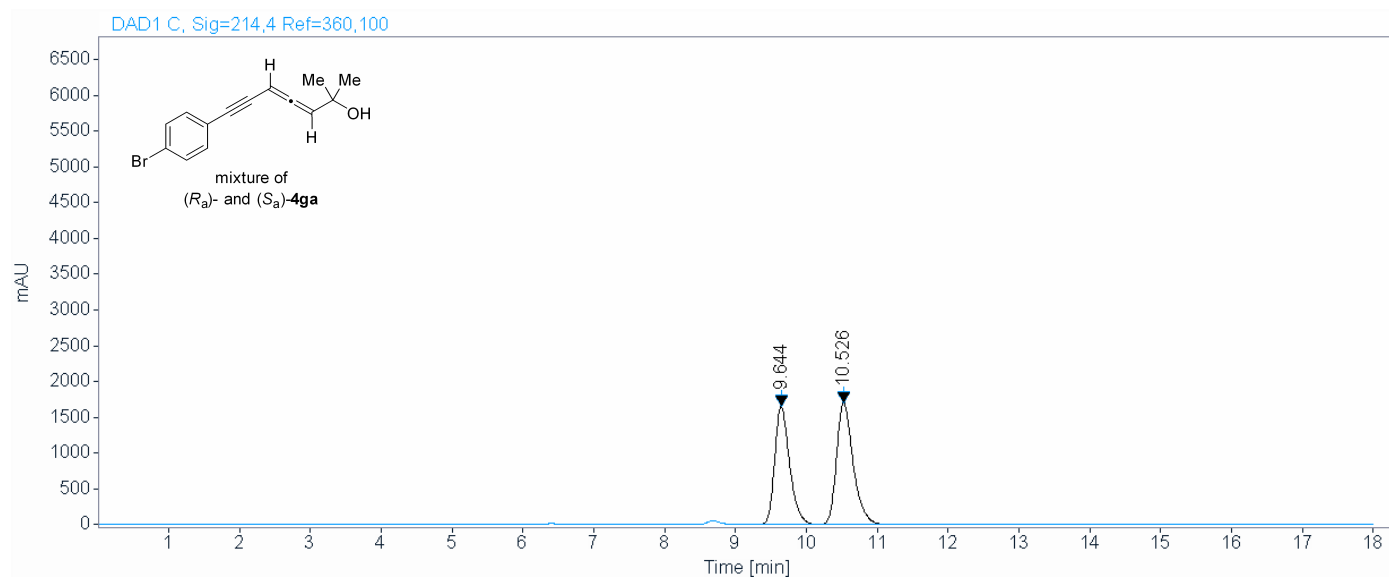
RT [min]	Width [min]	Height	Area	Area%
9.661	0.2201	13.4139	193.2655	0.4666
10.542	0.2549	2467.9368	41223.0000	99.5334
Sum			41416.2655	100.0000

Area Percent Report

sample wgl-5-(040+041)-AD-H-95-5-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-03-23 13-09-39\005-P1-E1-wgl-5-(040+041).D

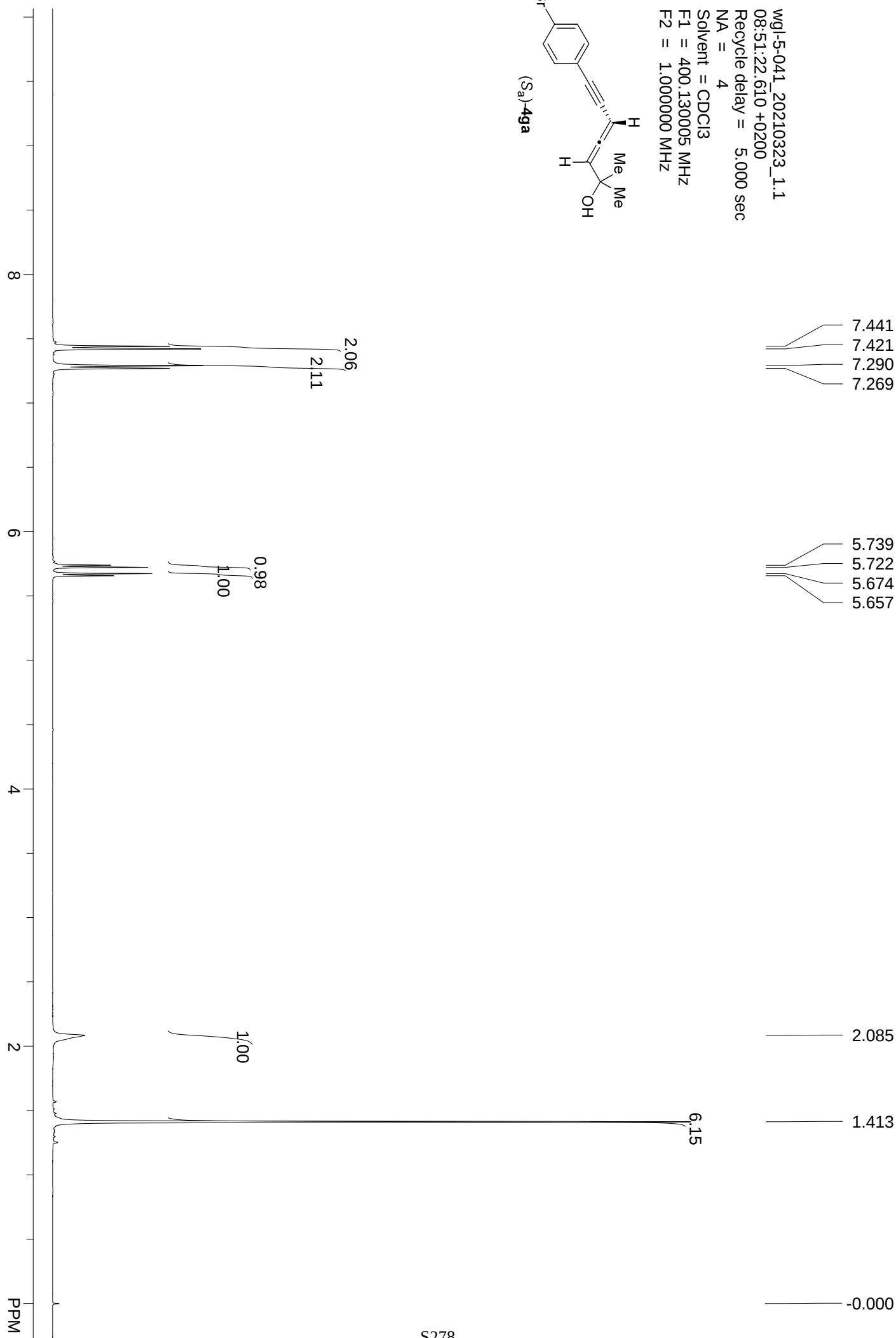
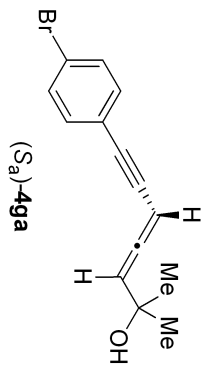
Acquisition Data:

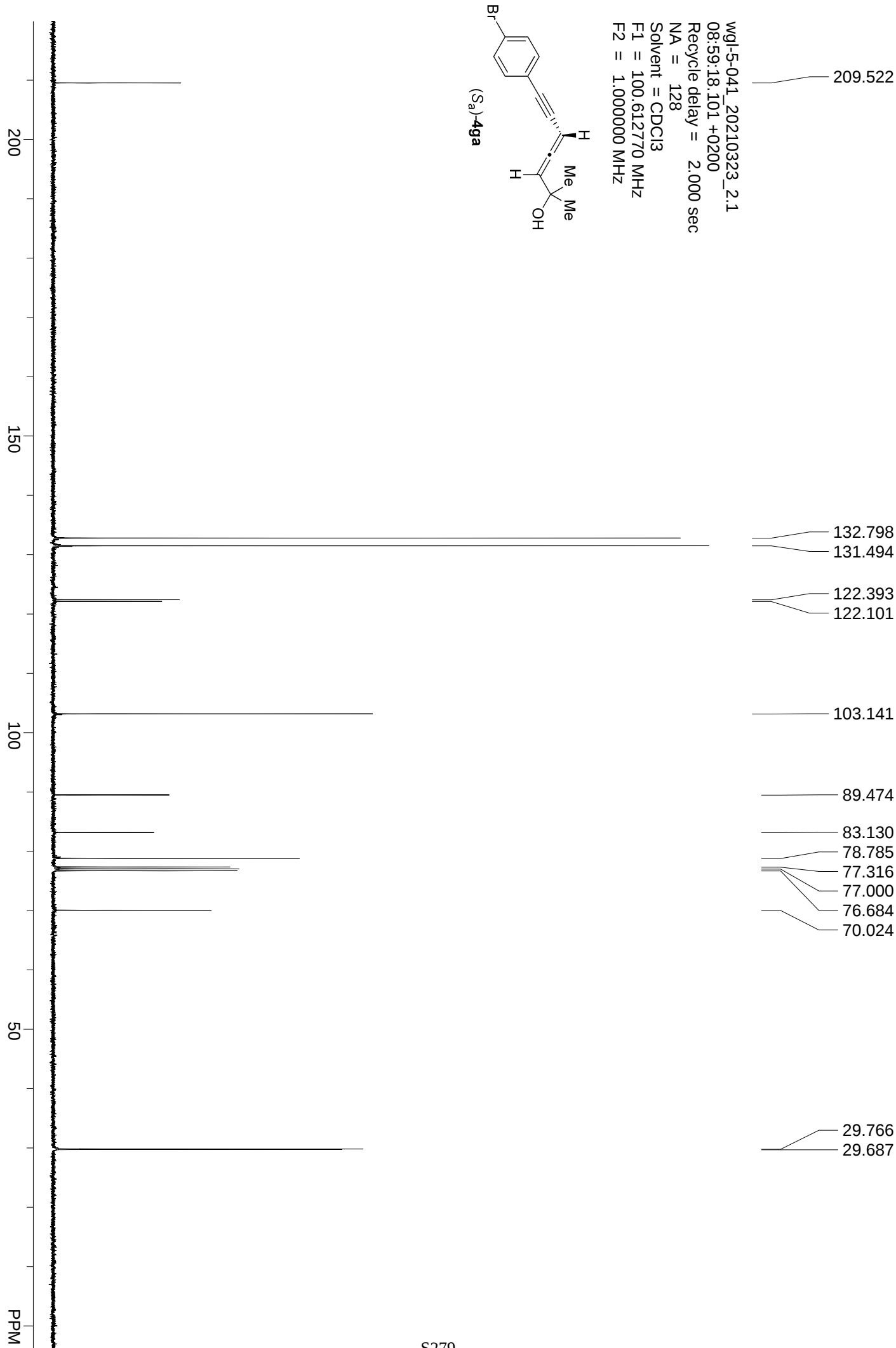


Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
9.644	0.2226	1651.7501	24158.3672	46.5928
10.526	0.2456	1704.0261	27691.6230	53.4072
Sum			51849.9902	100.0000

wjl-5-041_20210323_1.1
08:51:22.610 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl3
F1 = 400.130005 MHz
F2 = 1.000000 MHz



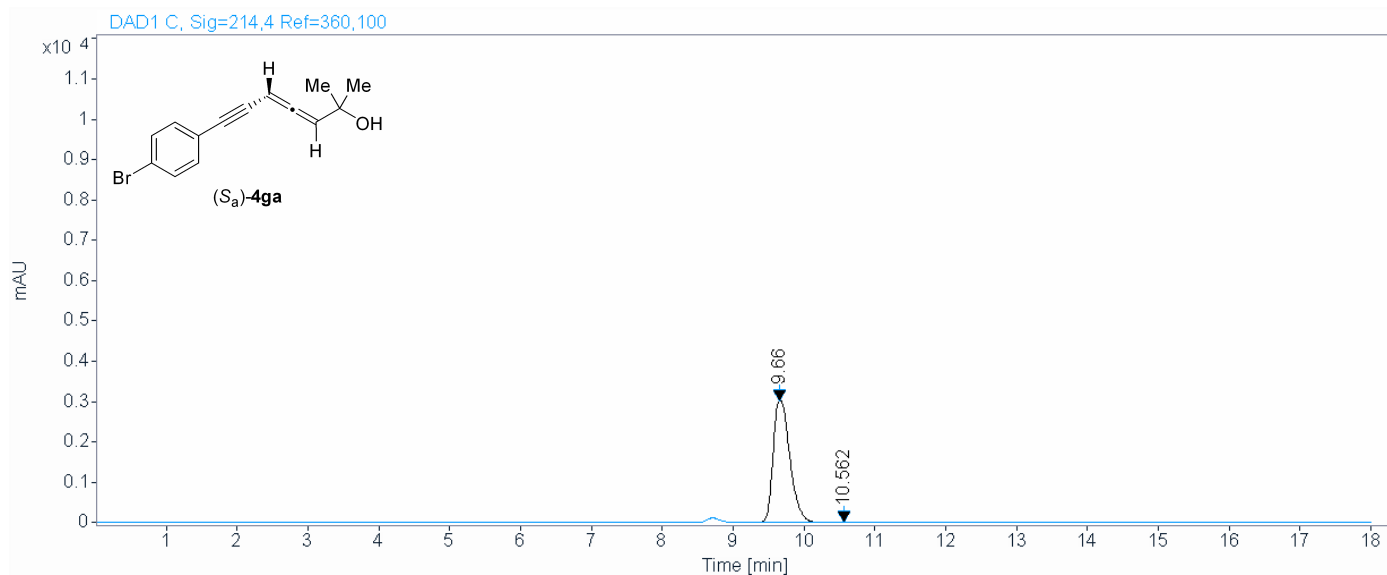


Area Percent Report

sample wgl-5-041-AD-H-95-5-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-03-23 13-09-39\007-P1-E3-wgl-5-041.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

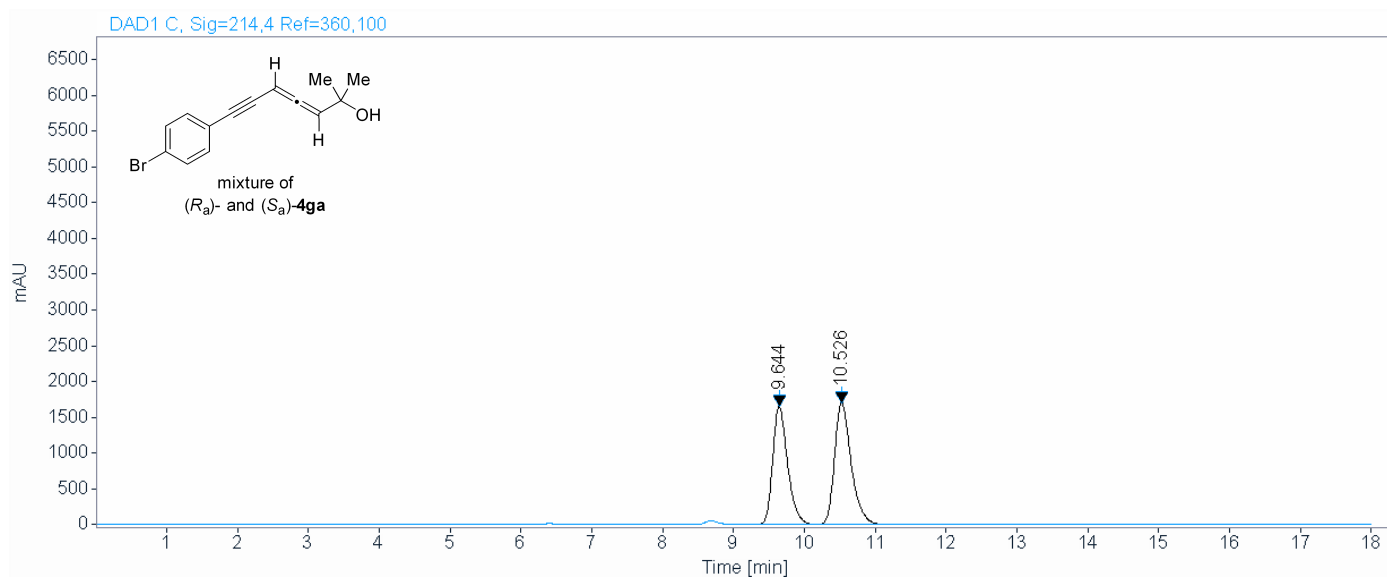
RT [min]	Width [min]	Height	Area	Area%
9.660	0.2545	3027.2583	49949.0352	99.4830
10.562	0.2662	14.4113	259.6020	0.5170
Sum			50208.6372	100.0000

Area Percent Report

sample wgl-5-(040+041)-AD-H-95-5-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\wgl 2021-03-23 13-09-39\005-P1-E1-wgl-5-(040+041).D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
9.644	0.2226	1651.7501	24158.3672	46.5928
10.526	0.2456	1704.0261	27691.6230	53.4072
Sum			51849.9902	100.0000

7.575
7.432
7.412
7.353
7.334
7.182
7.162
7.142

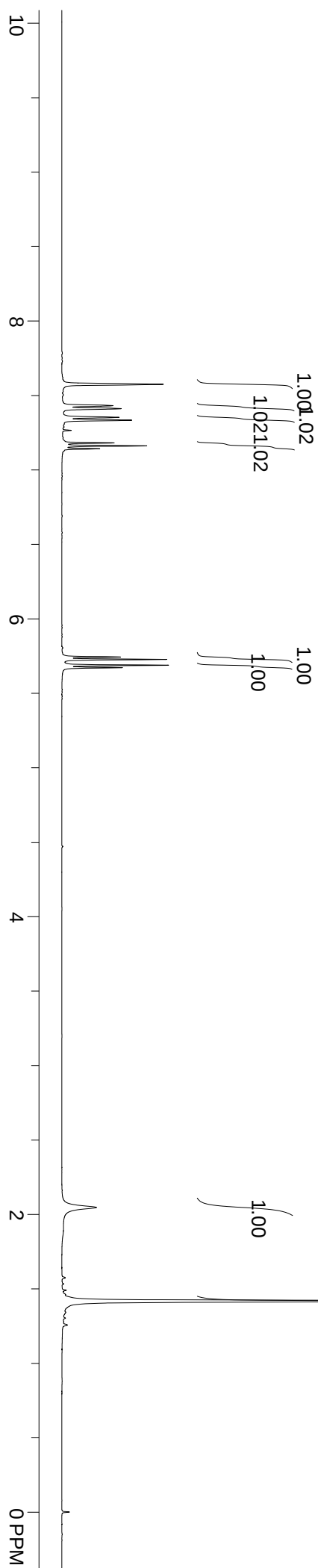
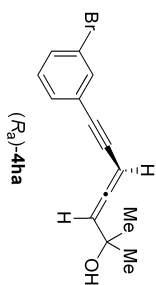
5.744
5.727
5.688
5.672

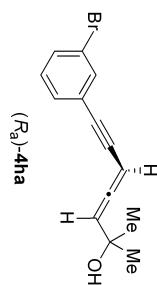
2.046

1.417

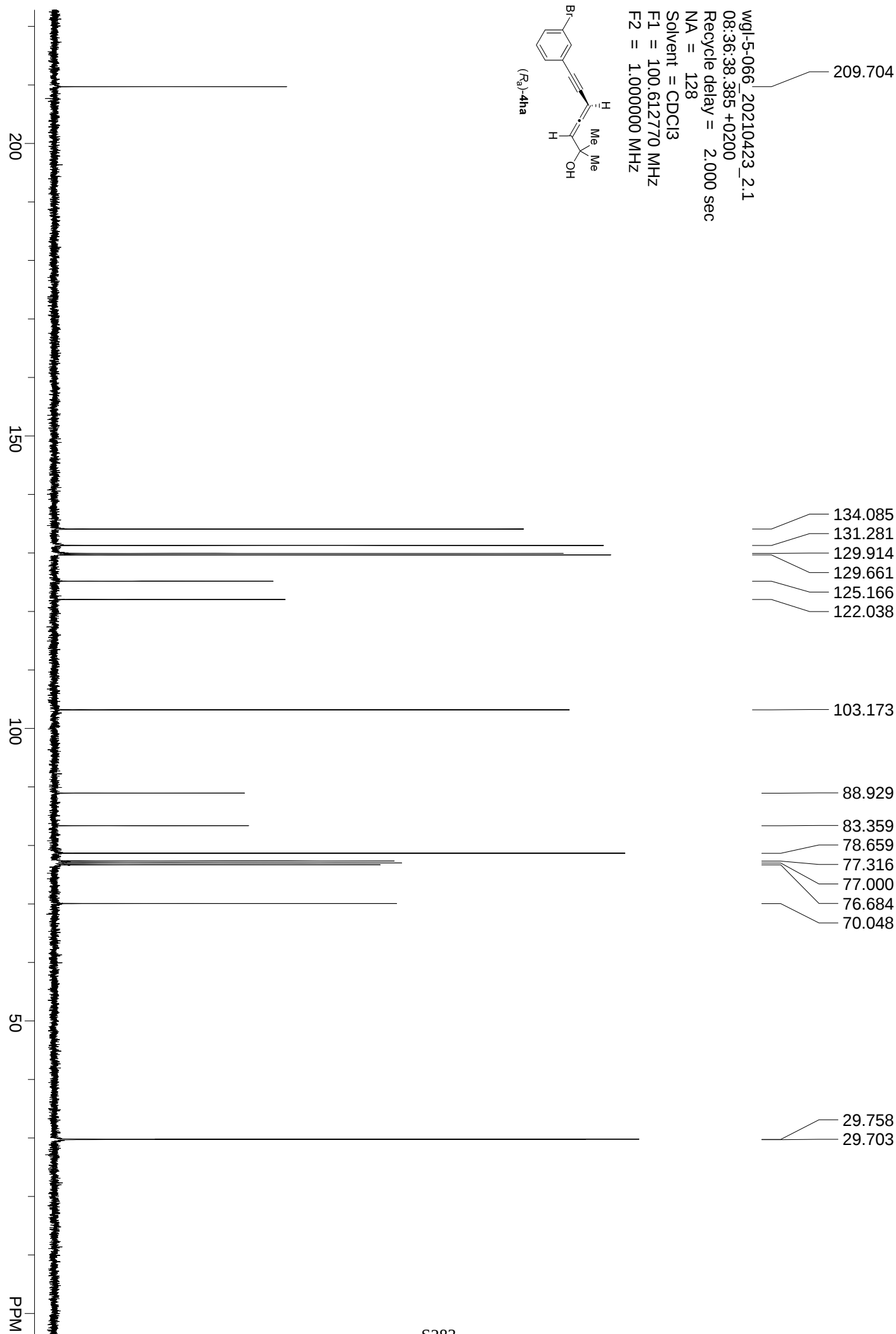
-0.000

wgl-5-066_20210423_1.1
08:28:43.348 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl₃
F1 = 400.130005 MHz
F2 = 1.000000 MHz





wj1-5-066_20210423_2.1
 08:36:38.385 +0200
 Recycle delay = 2.000 sec
 NA = 128
 Solvent = CDCl₃
 F1 = 100.612770 MHz
 F2 = 1.000000 MHz

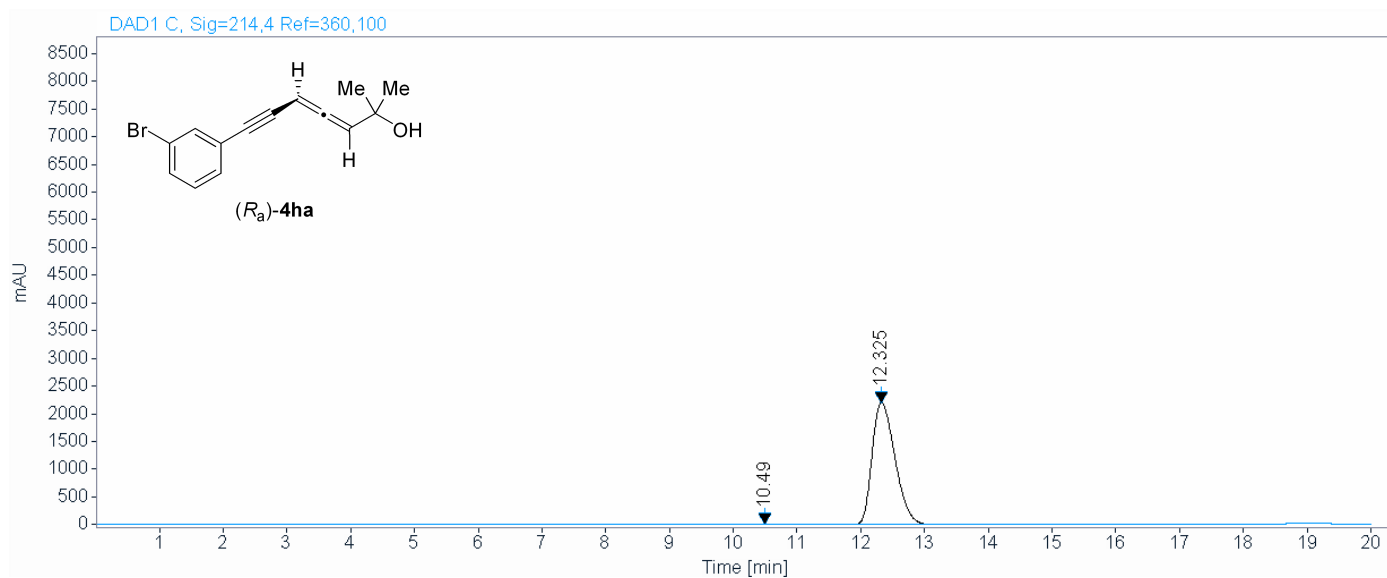


Area Percent Report

sample wgl-5-066-OD-H-97-3-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\zhangq 2021-04-23 18-01-41\015-P1-E2-wgl-5-066.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

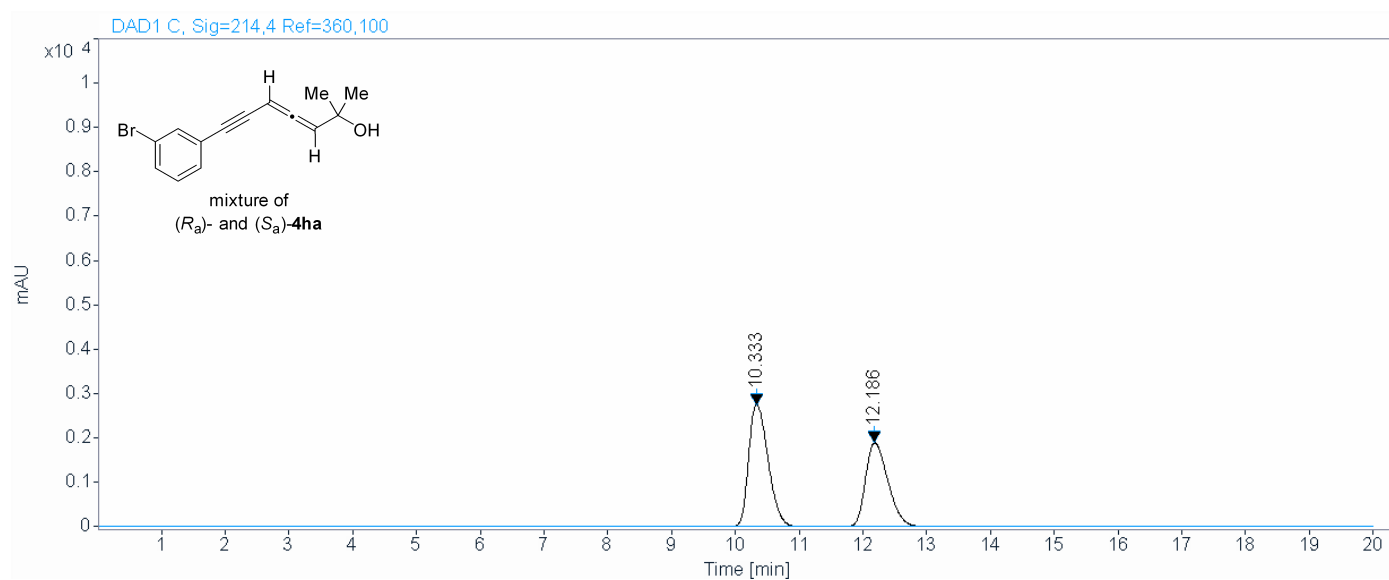
RT [min]	Width [min]	Height	Area	Area%
10.490	0.3555	10.0133	224.4049	0.4064
12.325	0.3932	2203.1223	54993.0273	99.5936
Sum			55217.4322	100.0000

Area Percent Report

sample wgl-5-(066+067)-OD-H-97-3-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\ZHANGQ 2021-04-23 18-01-41\014-P1-E1-wgl-5-(066+067).D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
10.333	0.3315	2751.5010	58381.6172	55.8410
12.186	0.3829	1887.1367	46168.0820	44.1590
		Sum	104549.6992	100.0000

7.572
7.428
7.408
7.350
7.331
7.178
7.158
7.138

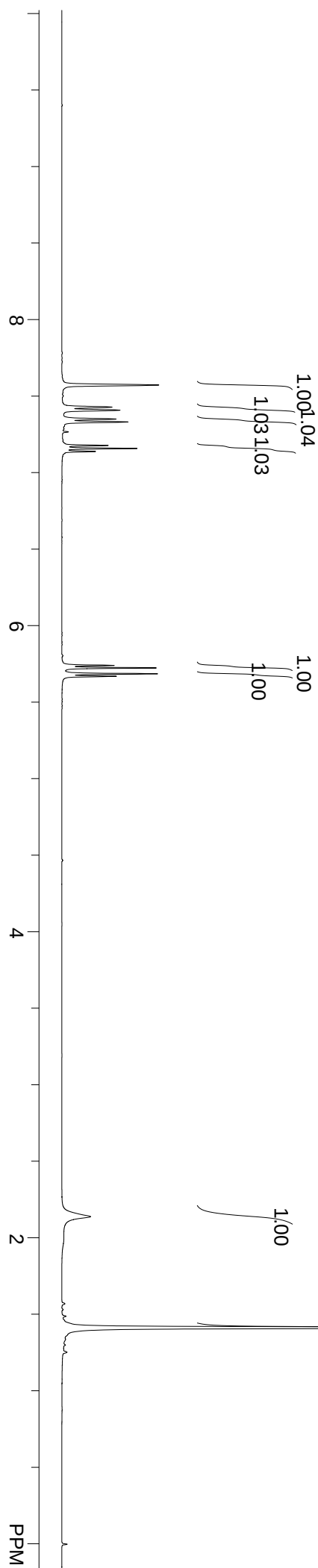
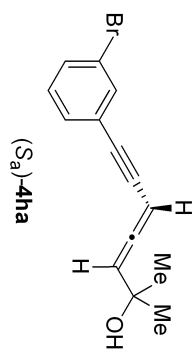
5.741
5.725
5.686
5.670

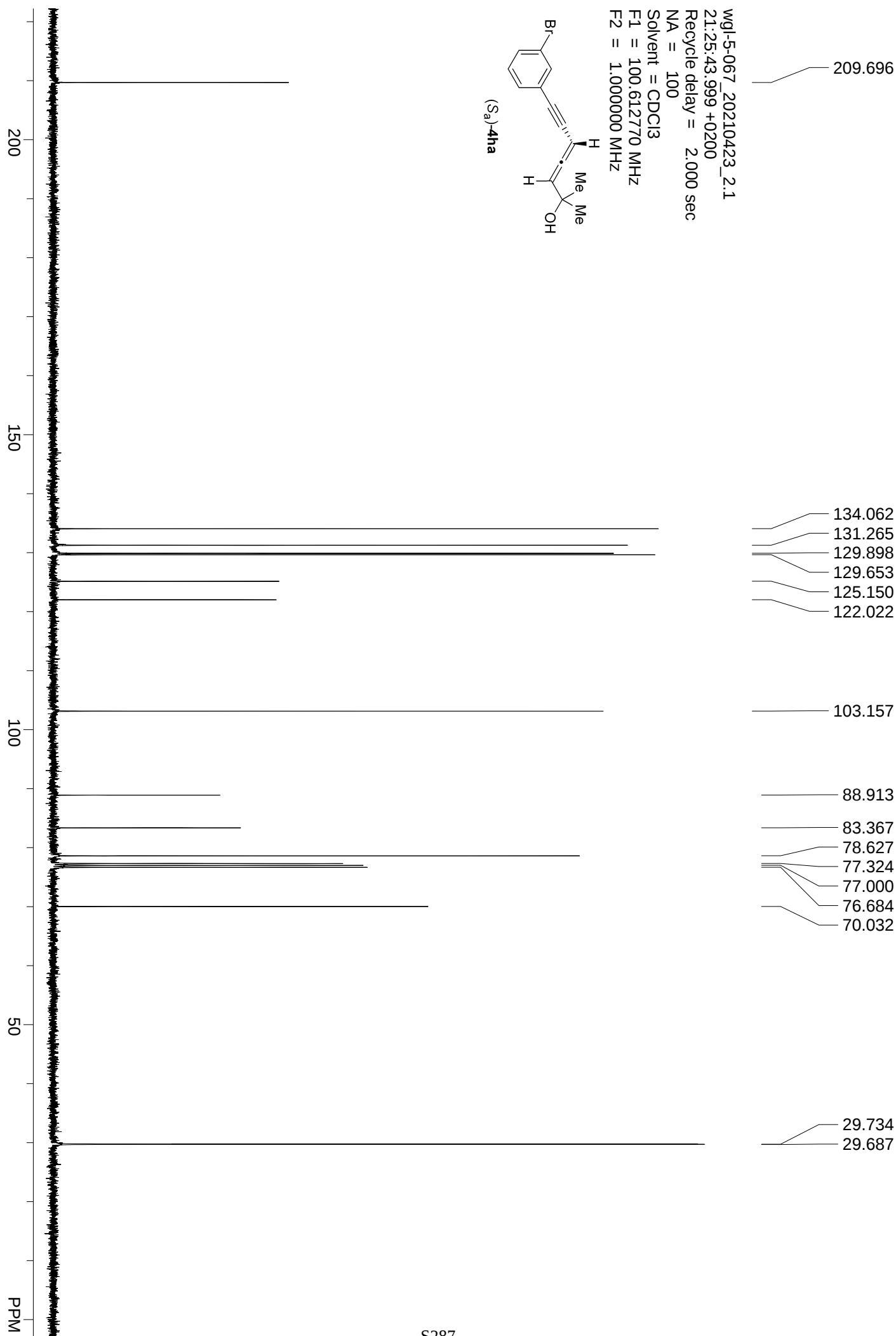
2.140

1.414

0.000

wjl-5-067_20210423_1.1
21:19:07.277 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl3
F1 = 400.130005 MHz
F2 = 1.000000 MHz



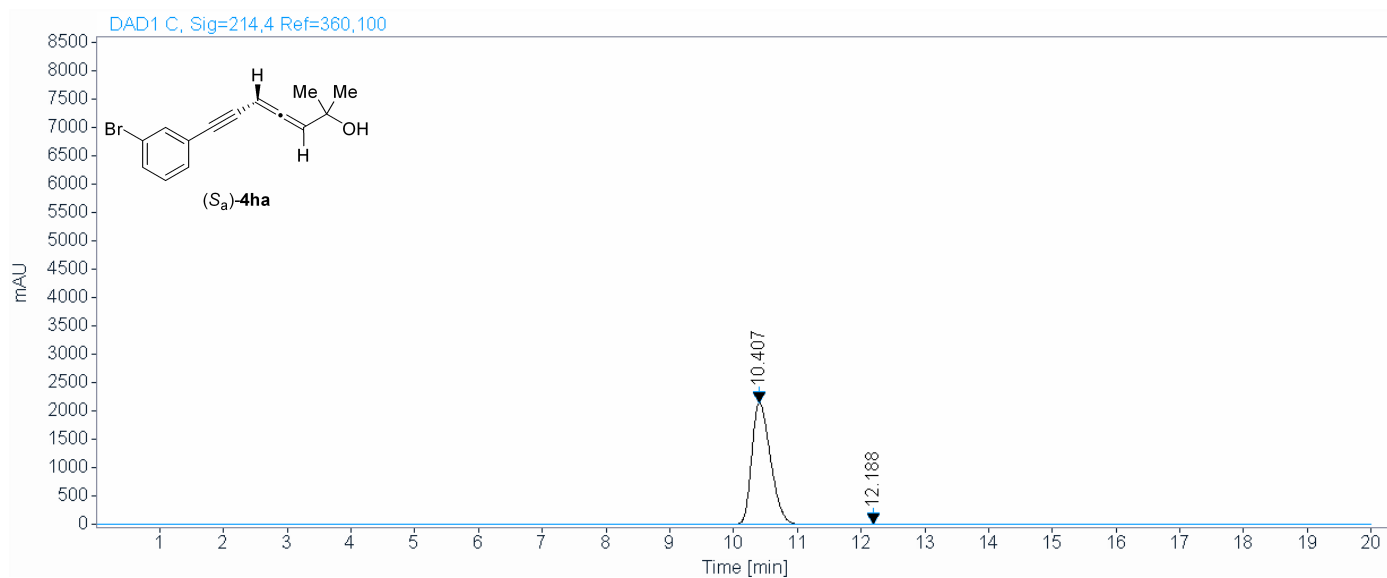


Area Percent Report

sample wgl-5-067-OD-H-97-3-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\zhangq 2021-04-23 18-01-41\016-P1-E3-wgl-5-067.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

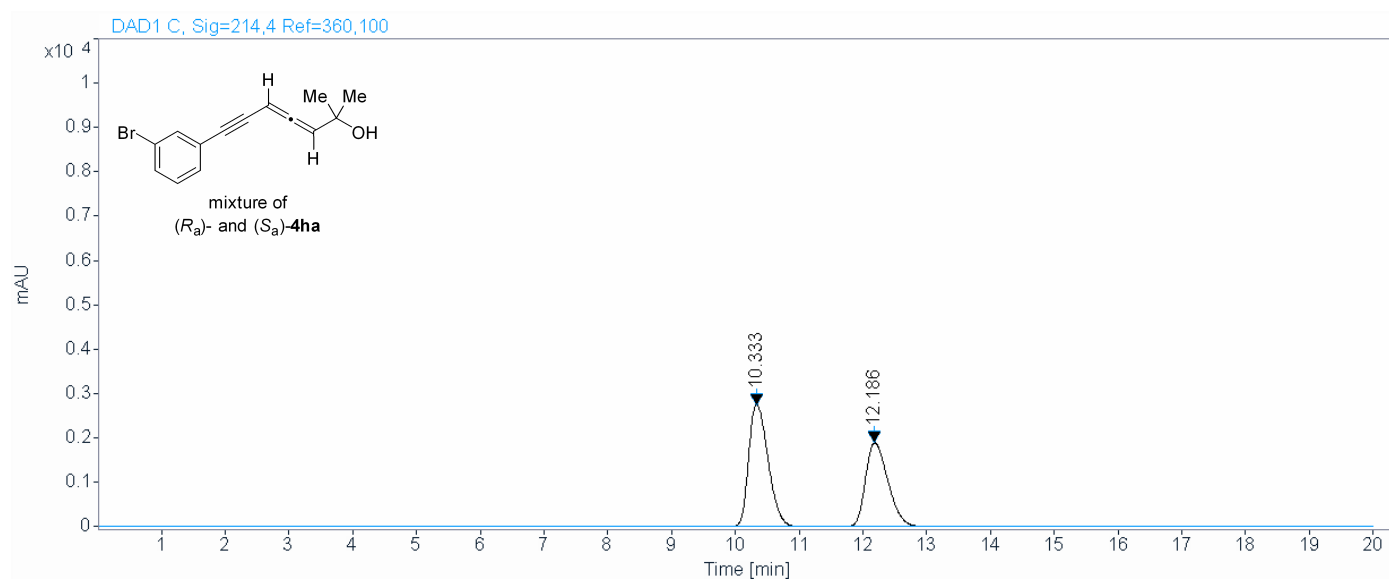
RT [min]	Width [min]	Height	Area	Area%
10.407	0.3196	2151.7534	44190.3047	99.5391
12.188	0.4583	6.2436	204.6051	0.4609
Sum			44394.9098	100.0000

Area Percent Report

sample wgl-5-(066+067)-OD-H-97-3-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\ZHANGQ 2021-04-23 18-01-41\014-P1-E1-wgl-5-(066+067).D

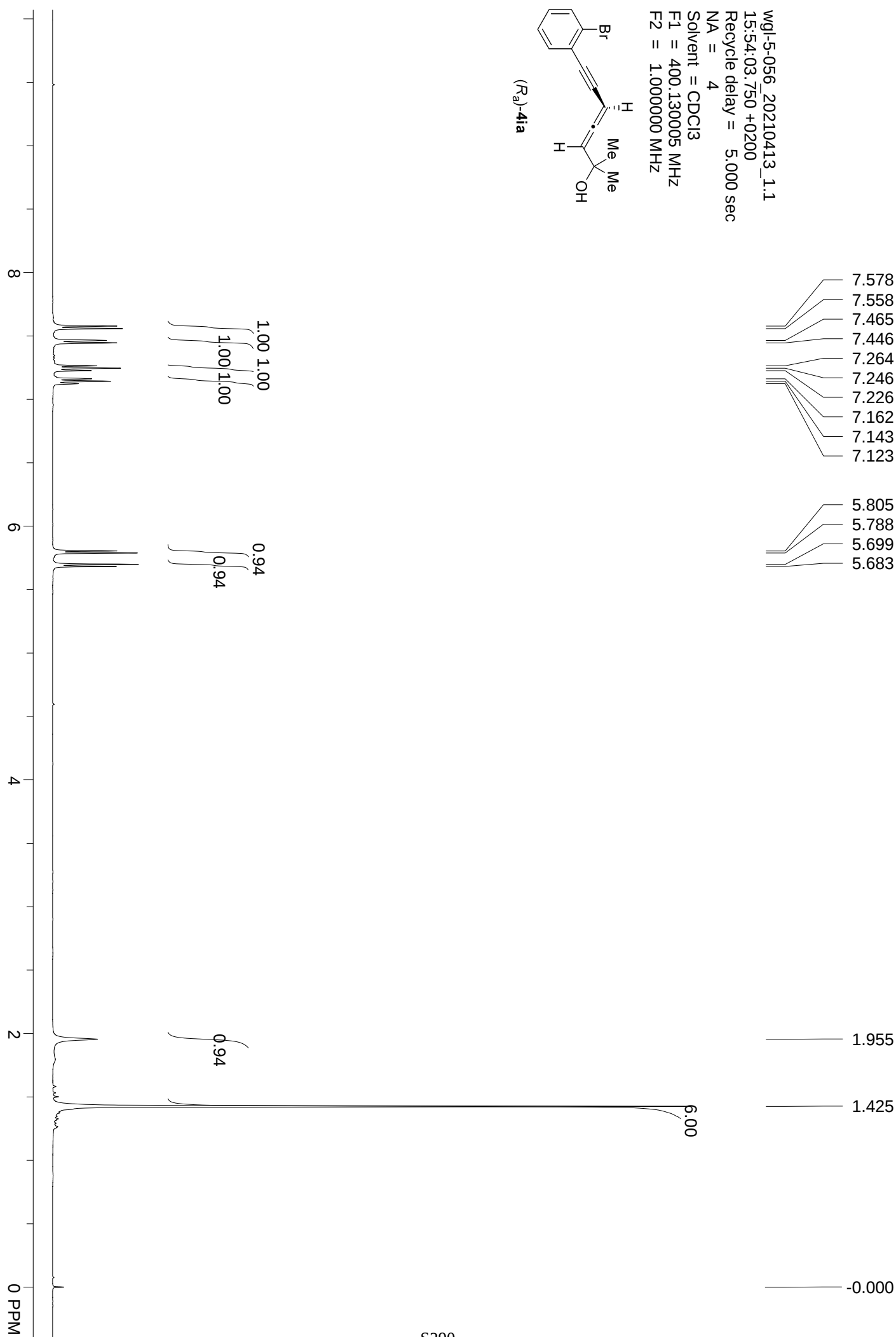
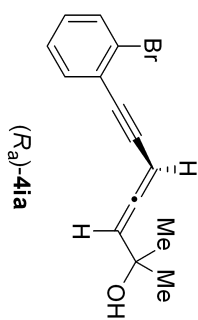
Acquisition Data:

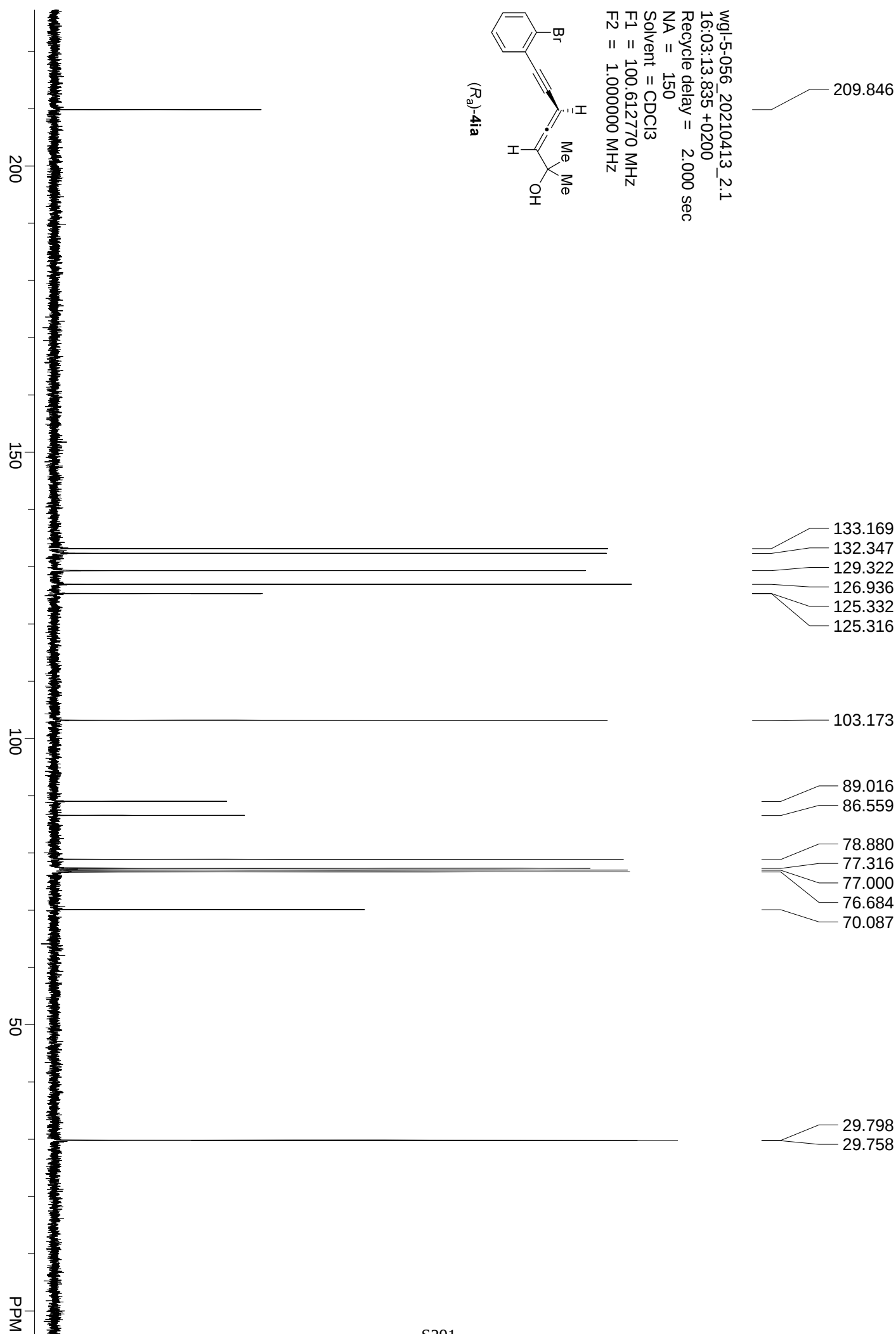


Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
10.333	0.3315	2751.5010	58381.6172	55.8410
12.186	0.3829	1887.1367	46168.0820	44.1590
		Sum	104549.6992	100.0000

wjl-5-056_20210413_1.1
 15:54:03.750 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CDCl₃
 F1 = 400.130005 MHz
 F2 = 1.000000 MHz



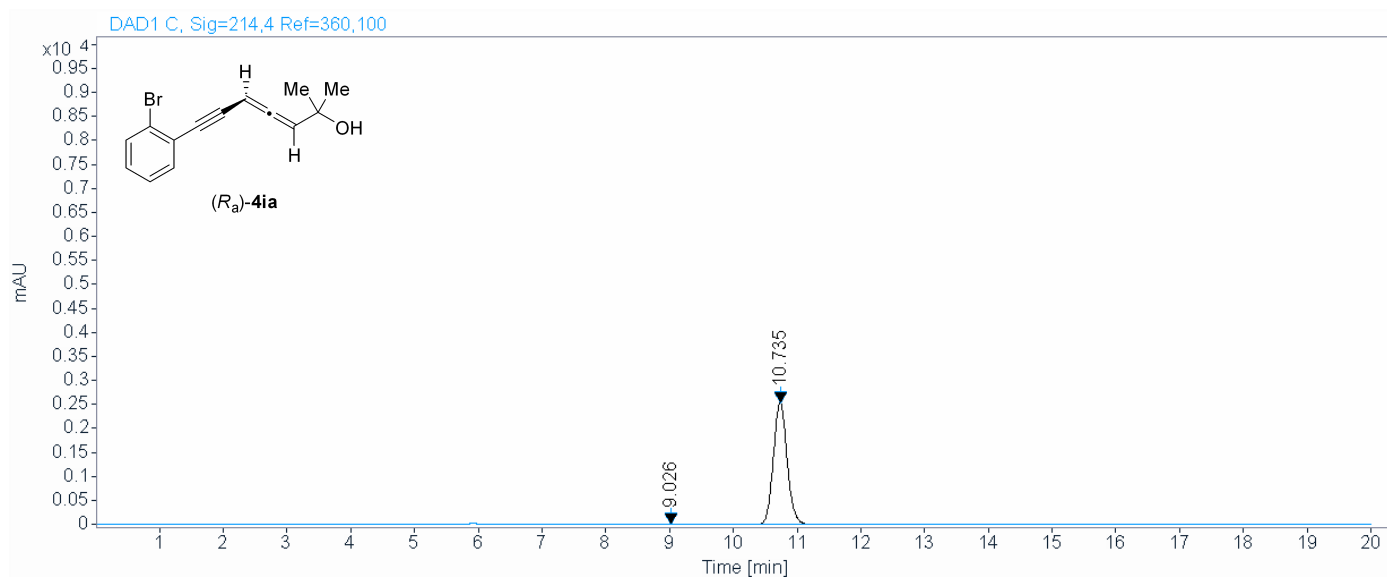


Area Percent Report

sample wgl-5-056-AD-H-95-5-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\hcf_LC 2021-04-14 14-06-35\009-P1-E2-wgl-5-056.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

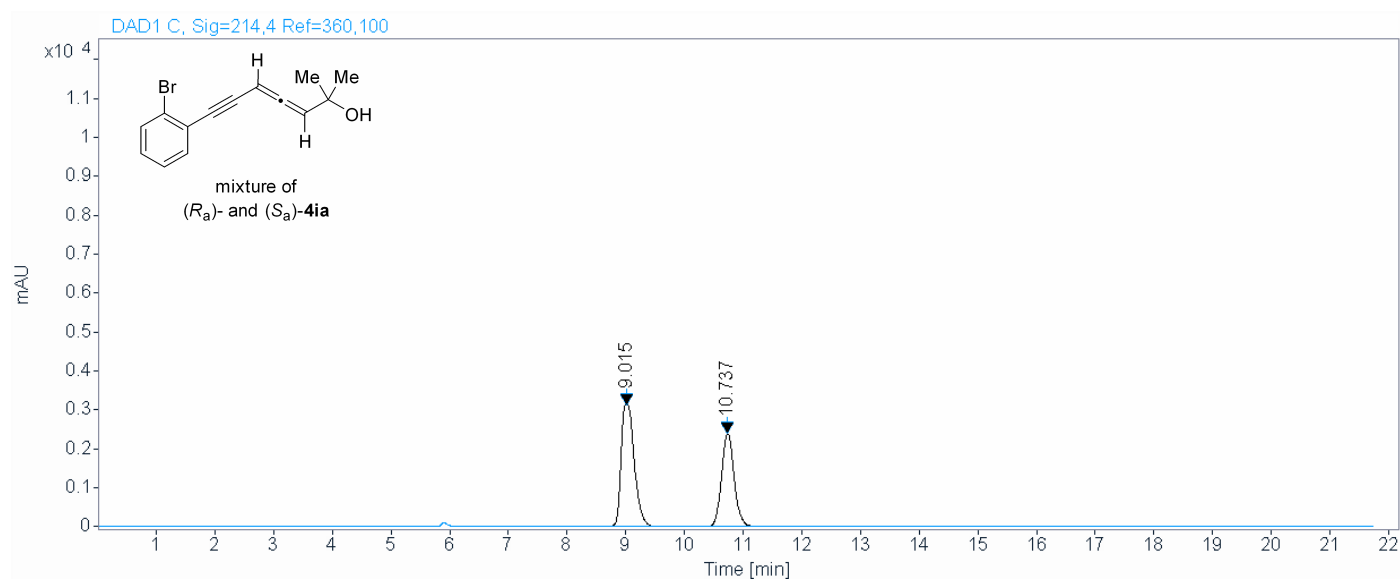
RT [min]	Width [min]	Height	Area	Area%
9.026	0.1968	7.5460	97.5690	0.2550
10.735	0.2311	2542.9666	38159.1680	99.7450
Sum			38256.7370	100.0000

Area Percent Report

sample wgl-5-(056+057)-AD-H-95-5-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\hcf_LC 2021-04-14 14-06-35\008-P1-E1-wgl-5-(056+057).D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

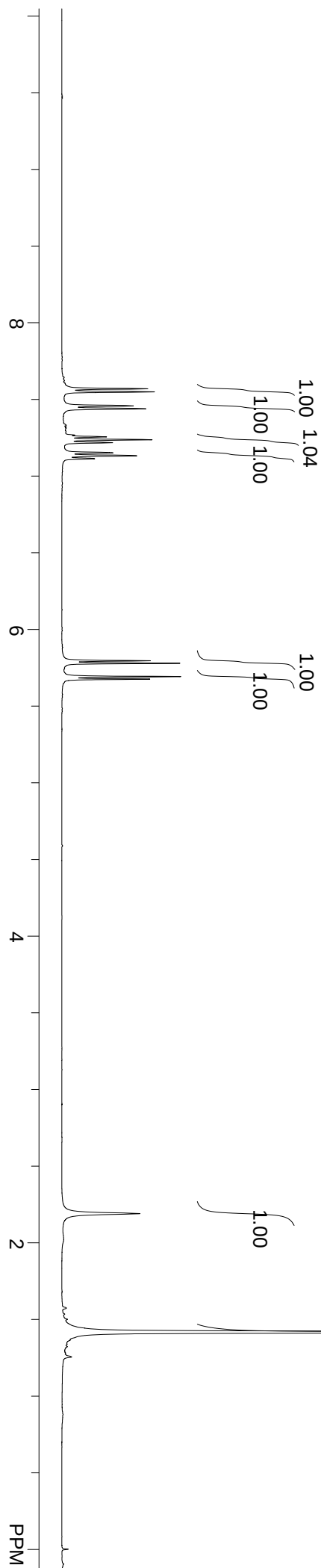
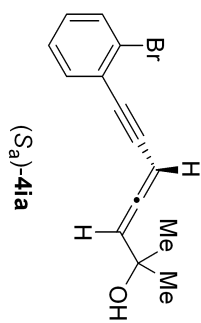
RT [min]	Width [min]	Height	Area	Area%
9.015	0.2419	3136.8076	49101.3750	57.9016
10.737	0.2305	2387.2578	35700.0078	42.0984
Sum			84801.3828	100.0000

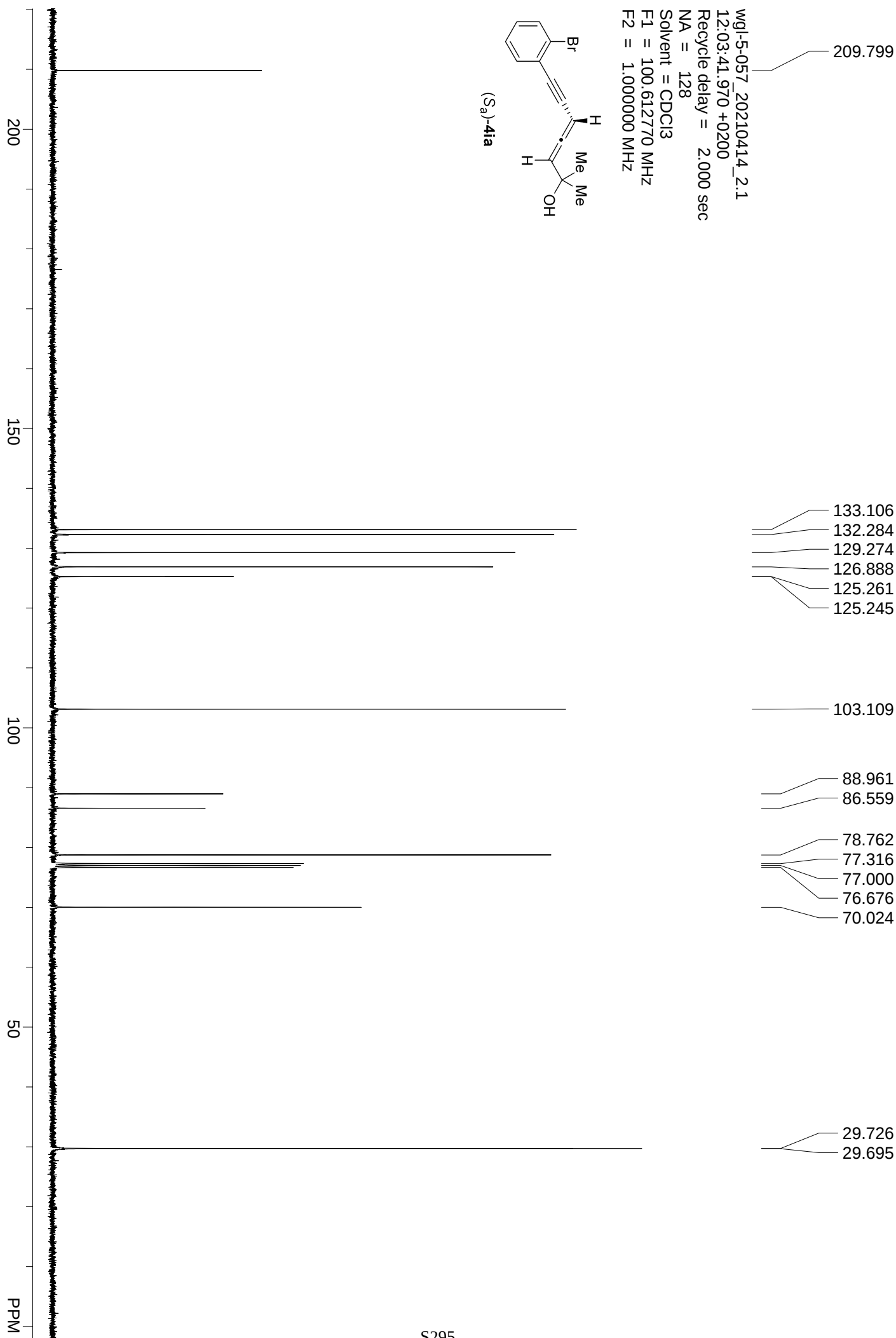
5.796
5.780
5.693
5.676

1.416

-0.000

F2 = 1.000000 MHz



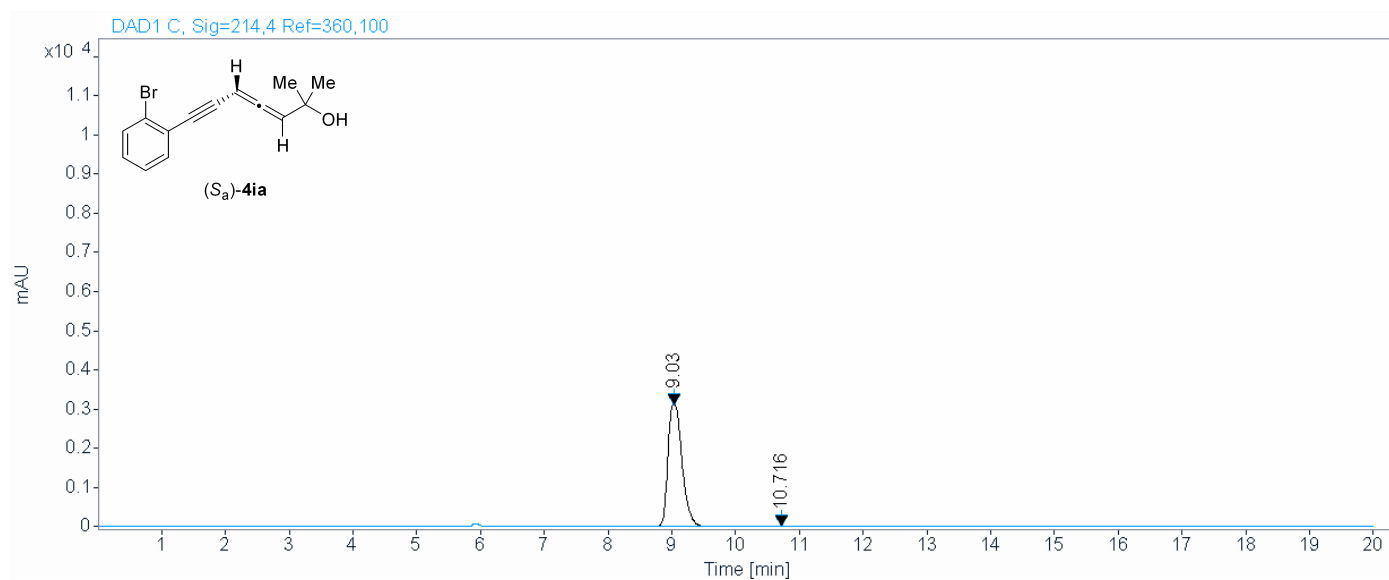


Area Percent Report

sample wgl-5-057-AD-H-95-5-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\hcf_LC 2021-04-14 14-06-35\010-P1-E3-wgl-5-057.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

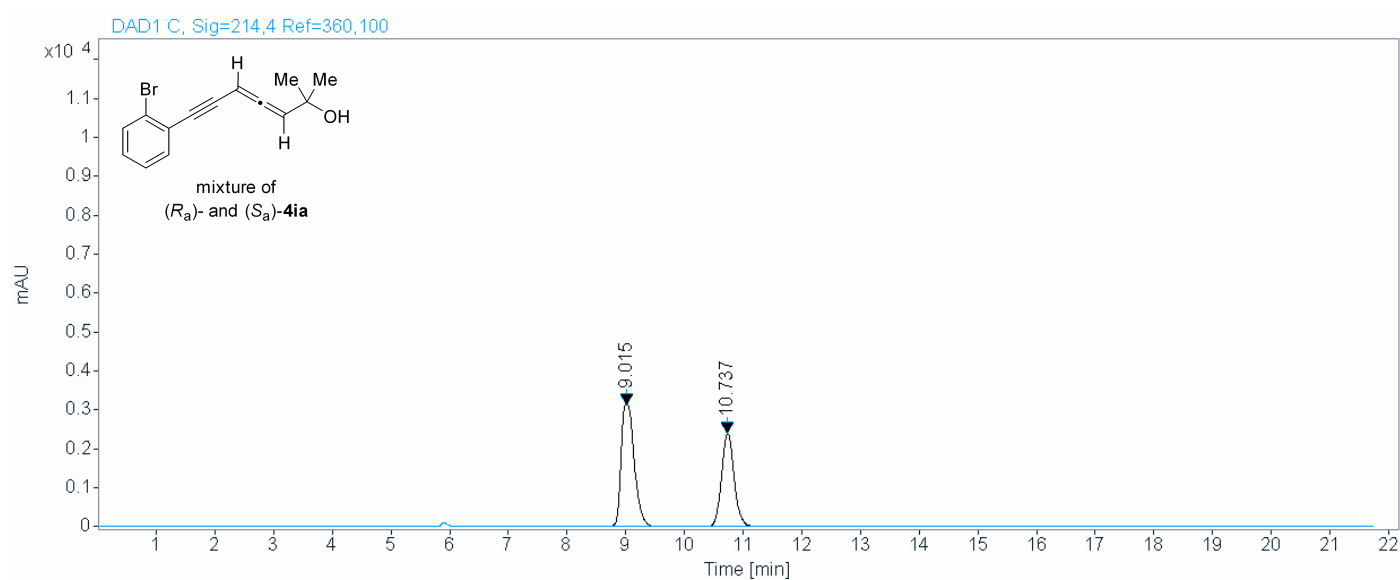
RT [min]	Width [min]	Height	Area	Area%
9.030	0.2399	3115.9607	48218.6172	99.4892
10.716	0.2278	16.6150	247.5760	0.5108
Sum			48466.1932	100.0000

Area Percent Report

sample wgl-5-(056+057)-AD-H-95-5-1.0-214

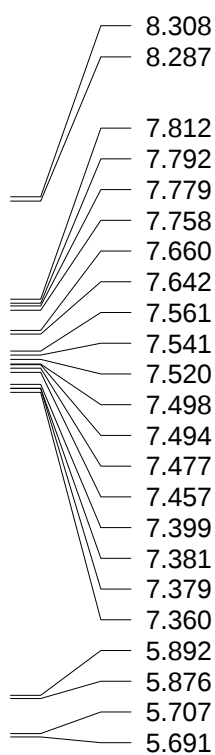
Data file: C:\Users\Public\Documents\ChemStation\1\Data\hcf_LC 2021-04-14 14-06-35\008-P1-E1-wgl-5-(056+057).D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
9.015	0.2419	3136.8076	49101.3750	57.9016
10.737	0.2305	2387.2578	35700.0078	42.0984
Sum			84801.3828	100.0000

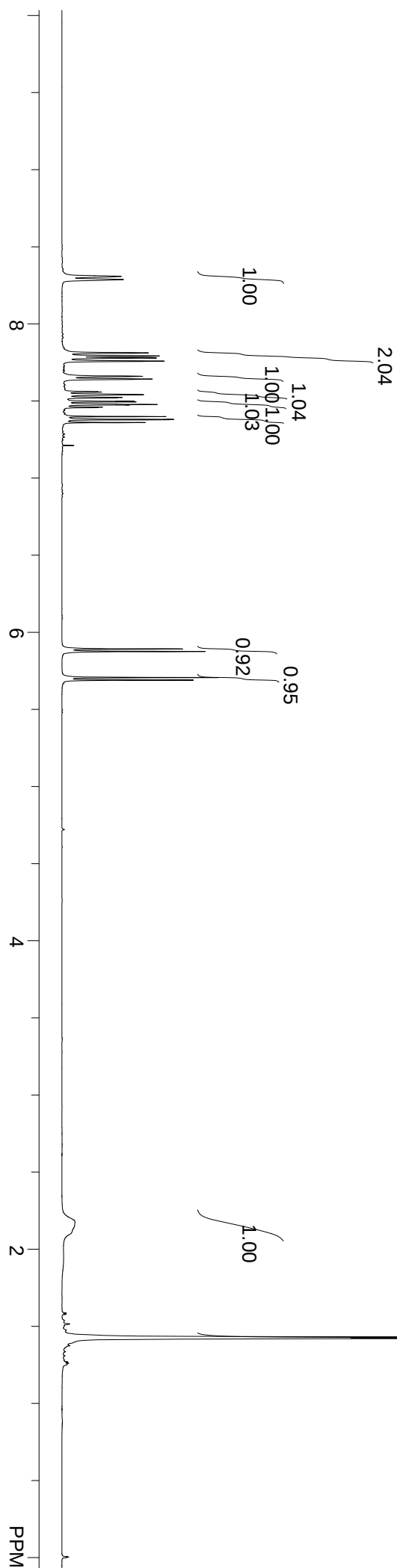
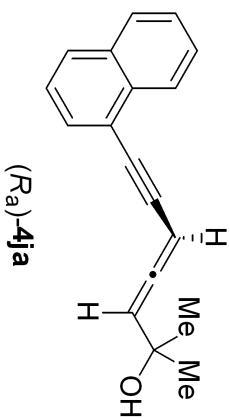


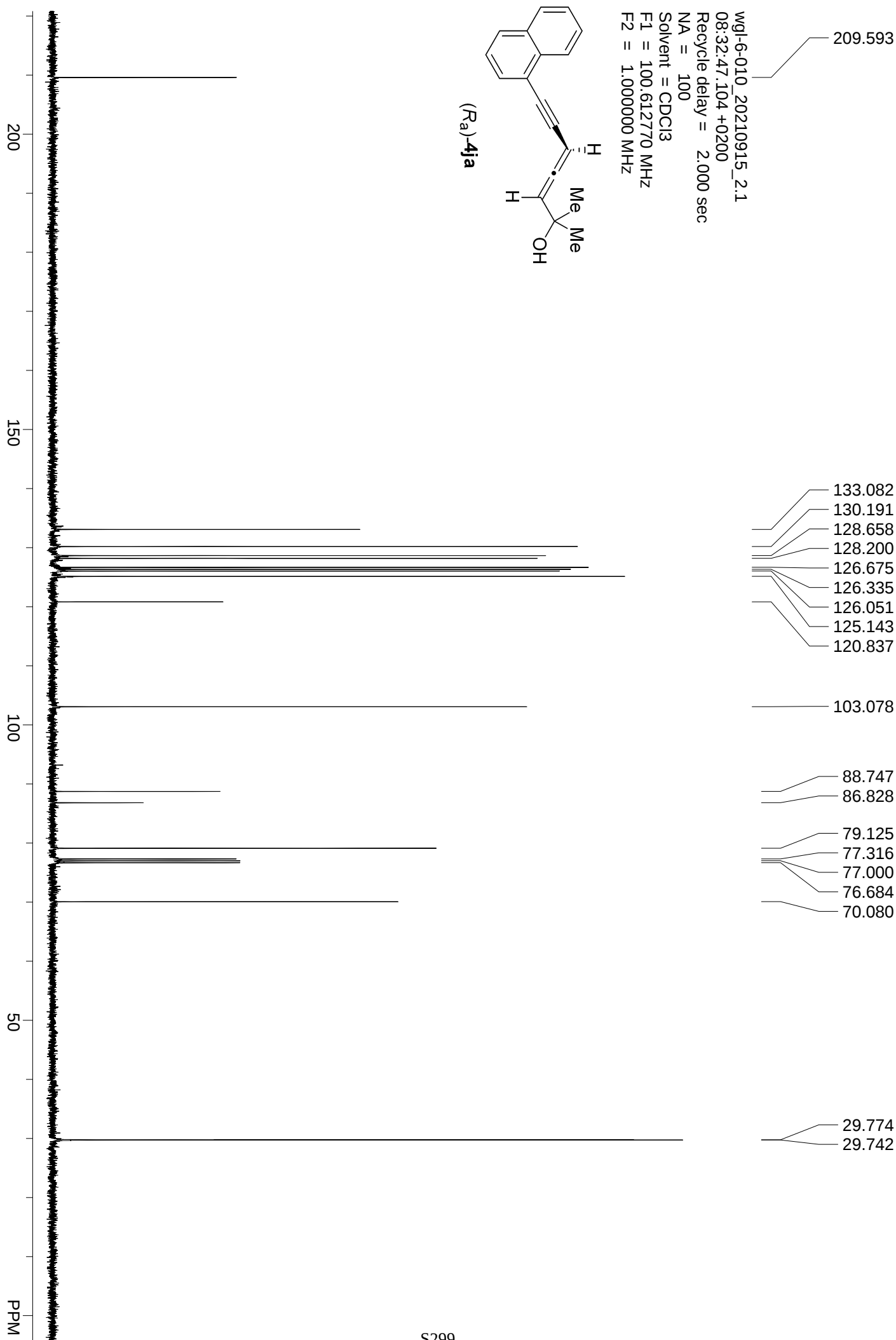
2.173

1.428
1.420

0.000

wj-6-010_20210915_1
08:26:24.257 +0200
Recycle delay = 5.000 sec
NA = 4
Solvent = CDCl₃
F1 = 400.130035 MHz
F2 = 1.000000 MHz



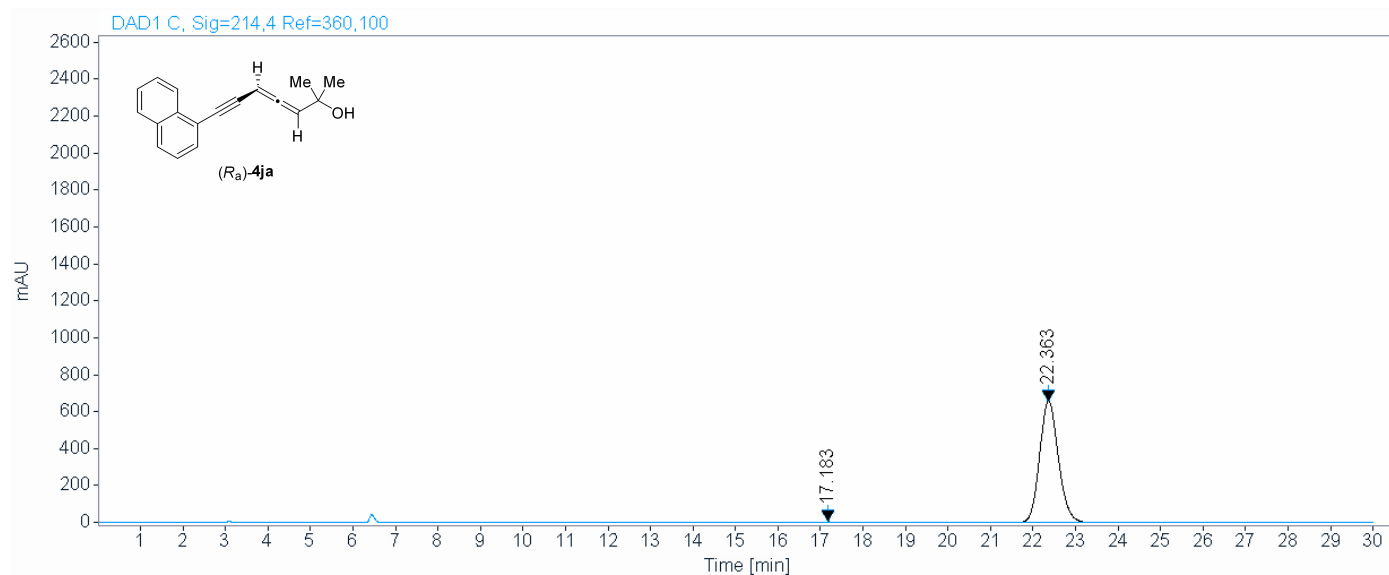


Area Percent Report

sample wgl-6-010-AD-H-98-2-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\QAN 2021-09-15 10-15-12\009-P1-E2-wgl-6-010.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

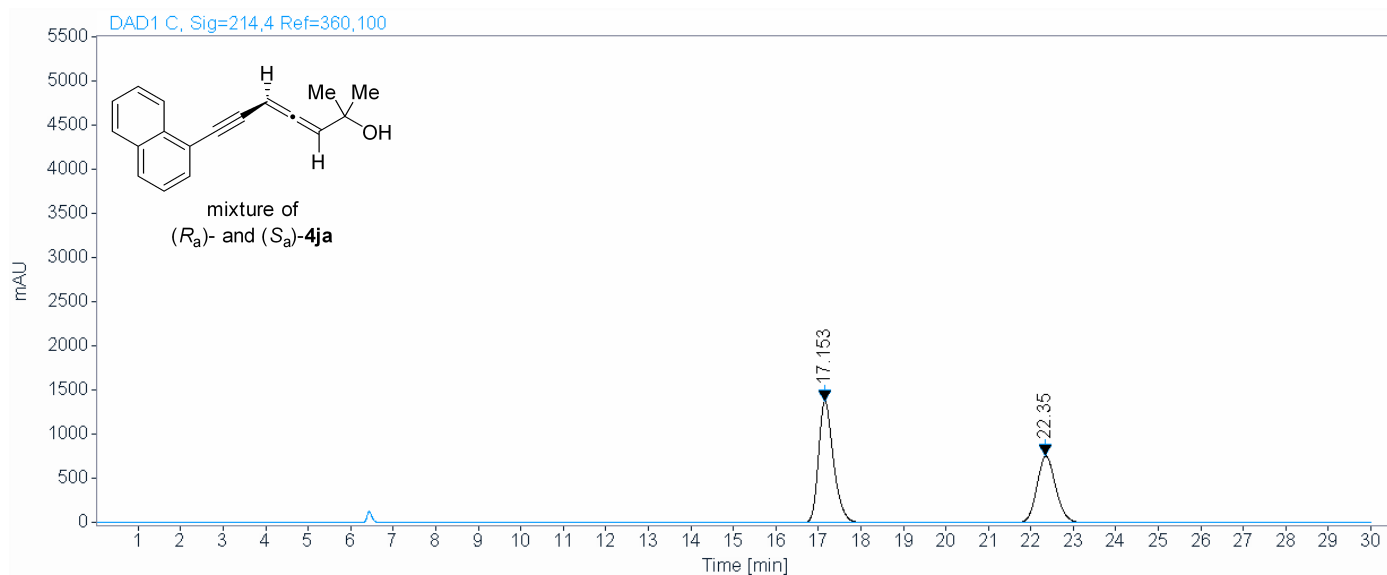
RT [min]	Width [min]	Height	Area	Area%
17.183	0.5169	4.1917	160.5808	0.7924
22.363	0.4701	658.7348	20104.3730	99.2076
		Sum	20264.9538	100.0000

Area Percent Report

sample wgl-6-(010+011)-AD-H-98-2-1.0-214

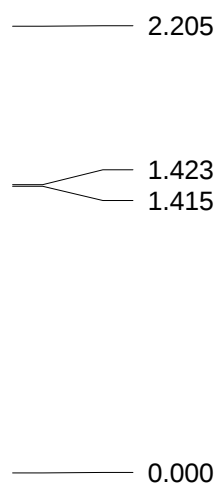
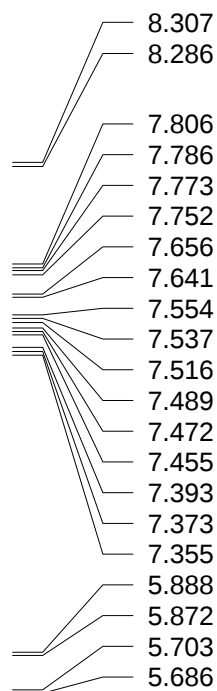
Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\QAN 2021-09-15 10-15-12\008-P1-E1-wgl-6-(010+011).D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
17.153	0.3726	1378.4124	33626.9805	59.4286
22.350	0.4668	754.8550	22956.8340	40.5714
Sum			56583.8145	100.0000



wgl-6-011_20210915_1.1

08:37:00.917+0200

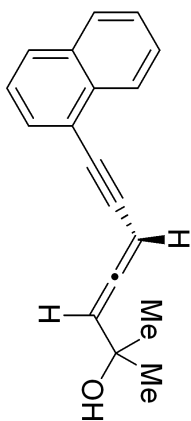
Recycle delay = 5.000 sec

NA = 4

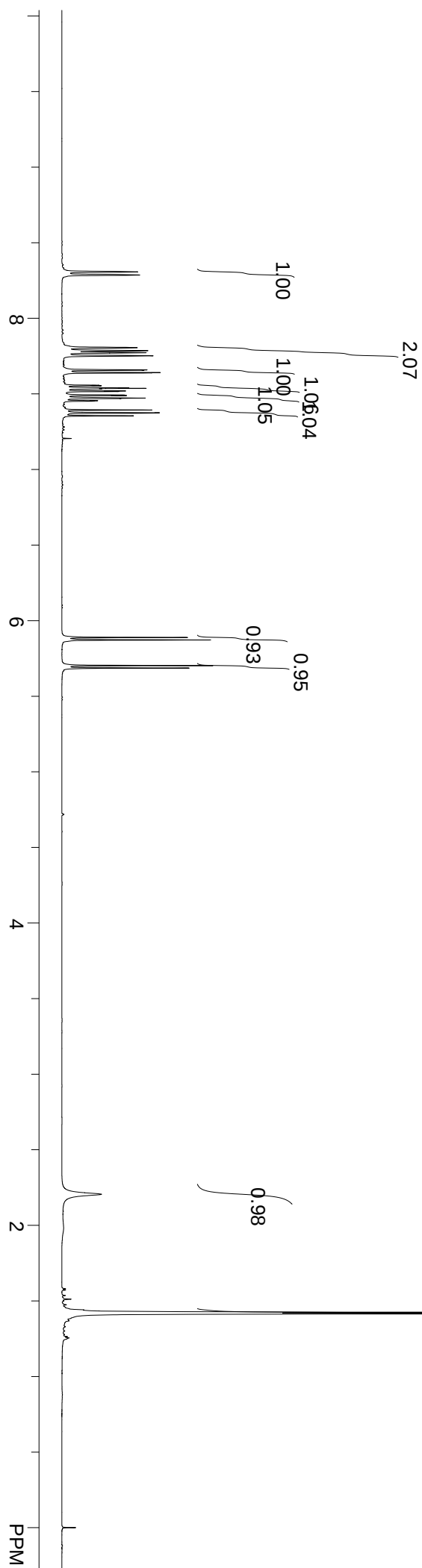
Solvent = CDCl₃

F1 = 400.130035 MHz

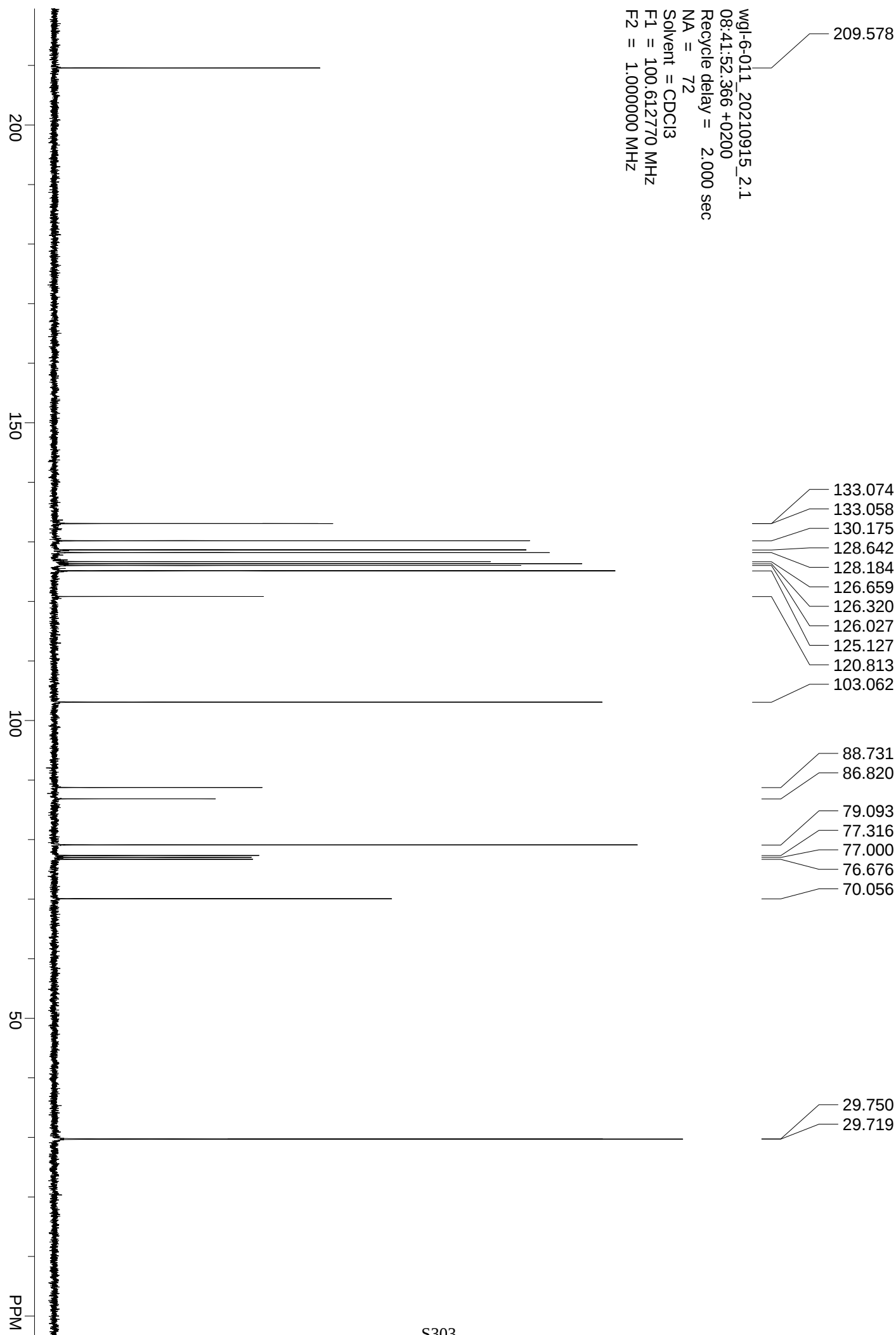
F2 = 1.000000 MHz



(S)-4ja



wj-6-011_20210915_2.1
08:41:52.366 +0200
Recycle delay = 2.000 sec
NA = 72
Solvent = CDCl₃
F1 = 100.612770 MHz
F2 = 1.000000 MHz

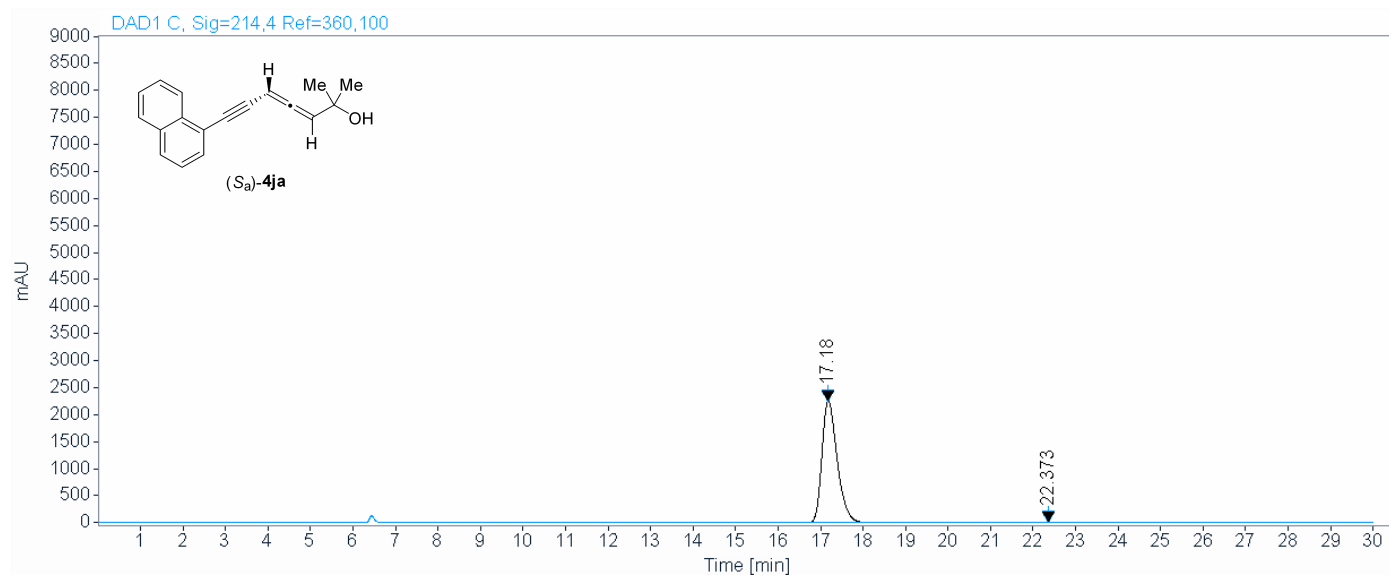


Area Percent Report

sample wgl-6-011-AD-H-98-2-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\QAN 2021-09-15 10-15-12\010-P1-E3-wgl-6-011.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

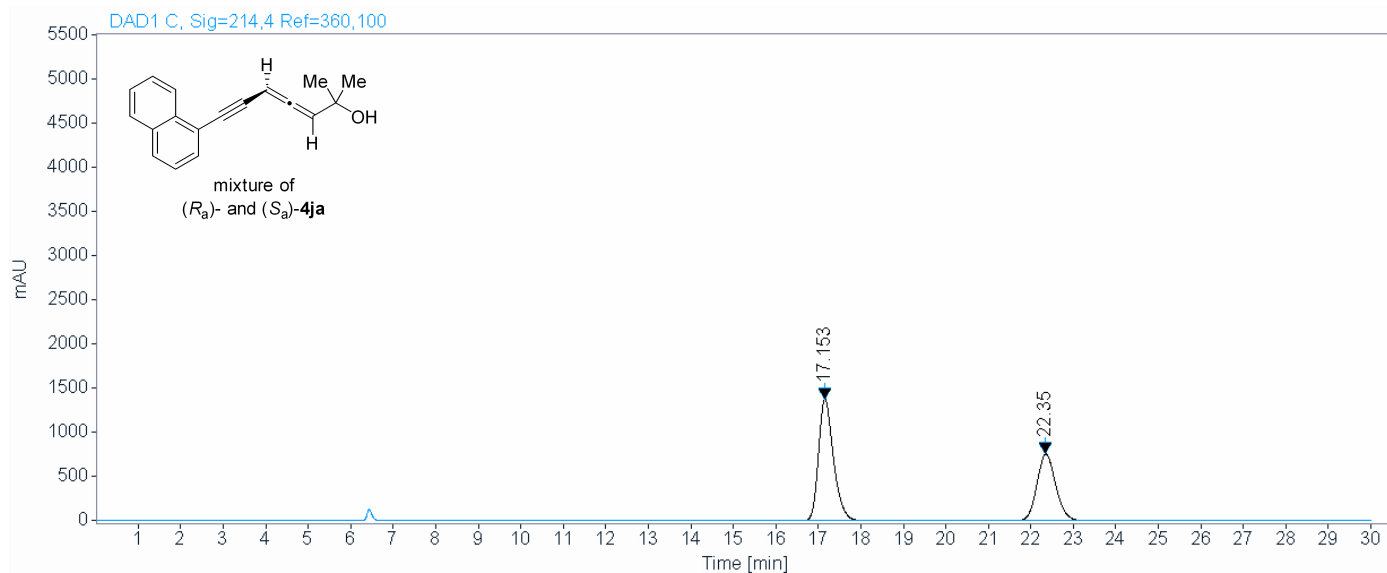
RT [min]	Width [min]	Height	Area	Area%
17.180	0.3833	2254.4639	56293.4648	99.3492
22.373	0.4733	12.0399	368.7349	0.6508
Sum			56662.1997	100.0000

Area Percent Report

sample wgl-6-(010+011)-AD-H-98-2-1.0-214

Data file: C:\USERS\PUBLIC\DOCUMENTS\CHEMSTATION\1\DATA\QAN 2021-09-15 10-15-12\008-P1-E1-wgl-6-(010+011).D

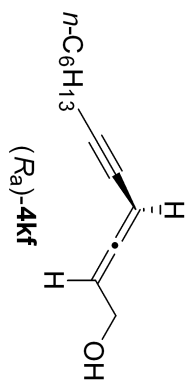
Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
17.153	0.3726	1378.4124	33626.9805	59.4286
22.350	0.4668	754.8550	22956.8340	40.5714
Sum			56583.8145	100.0000

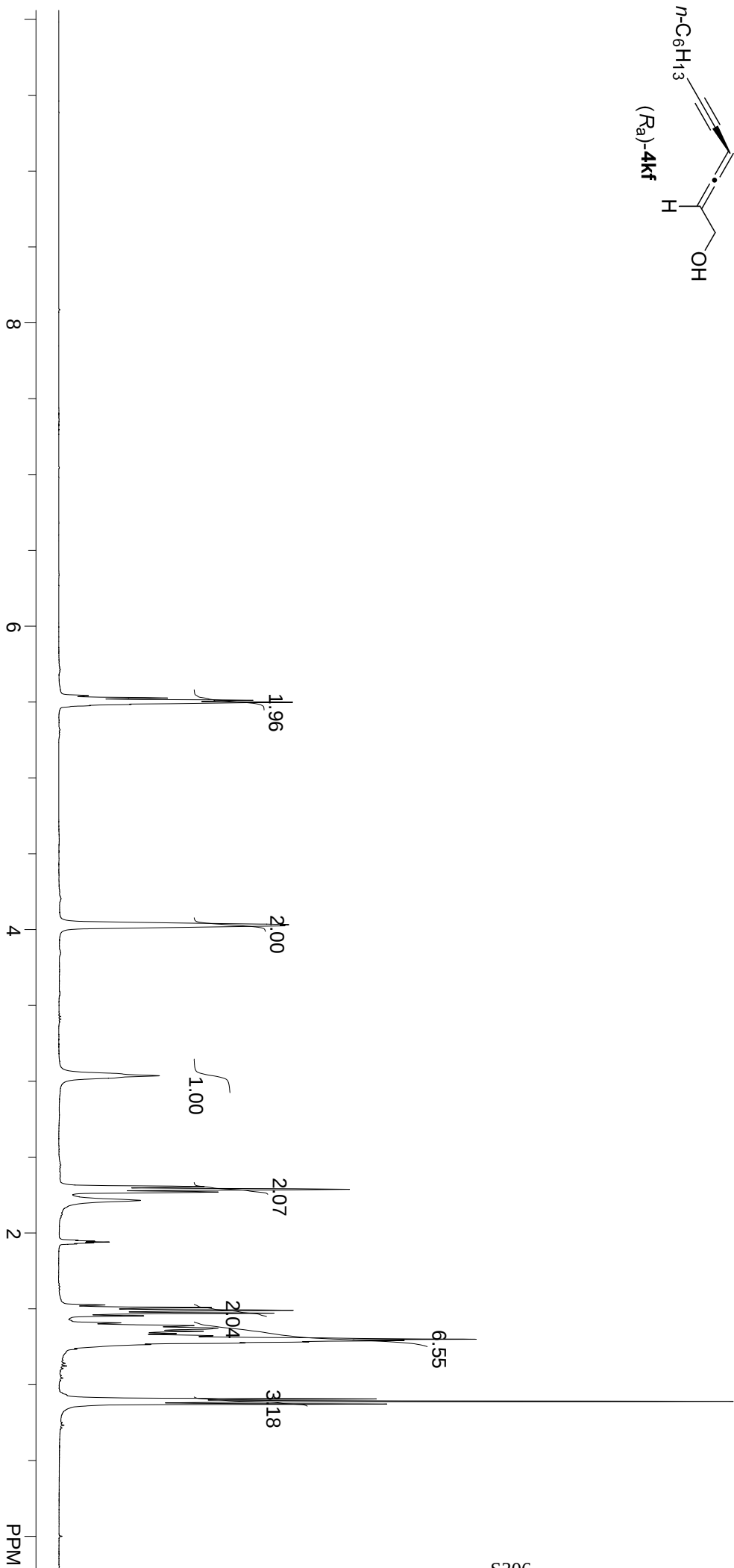
wjl-5-028(MeCN)_20210311_1
 17:41:41.142 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CD3CN
 F1 = 400.130005 MHz
 F2 = 1.000000 MHz

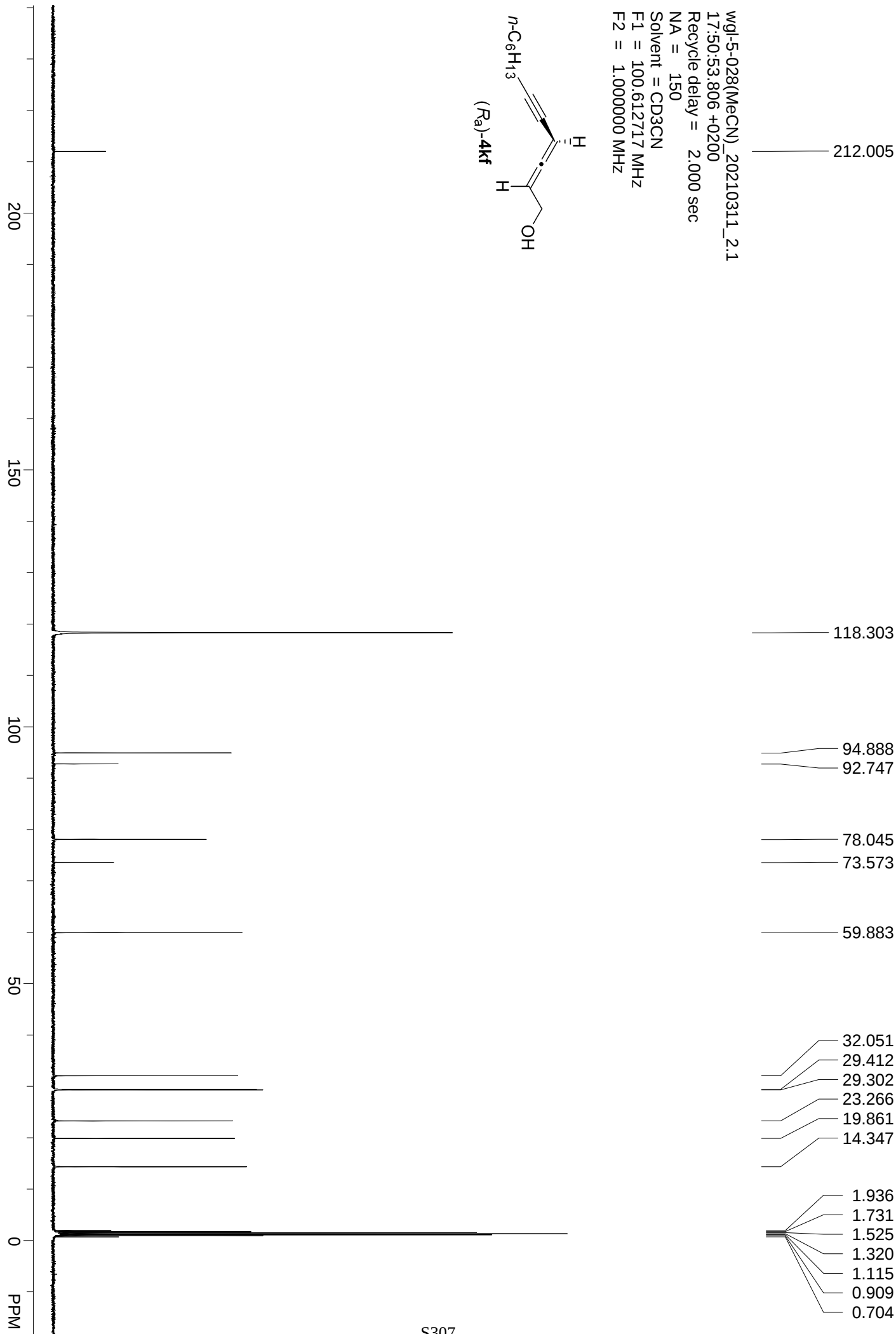


5.543
 5.527
 5.512
 5.499

4.033
 4.026

2.305
 3.037
 2.288
 2.270
 2.215
 1.952
 1.946
 1.940
 1.934
 1.928
 1.525
 1.508
 1.490
 1.471
 1.453
 1.406
 1.372
 1.351
 1.299
 1.290
 1.264
 0.905
 0.889
 0.871



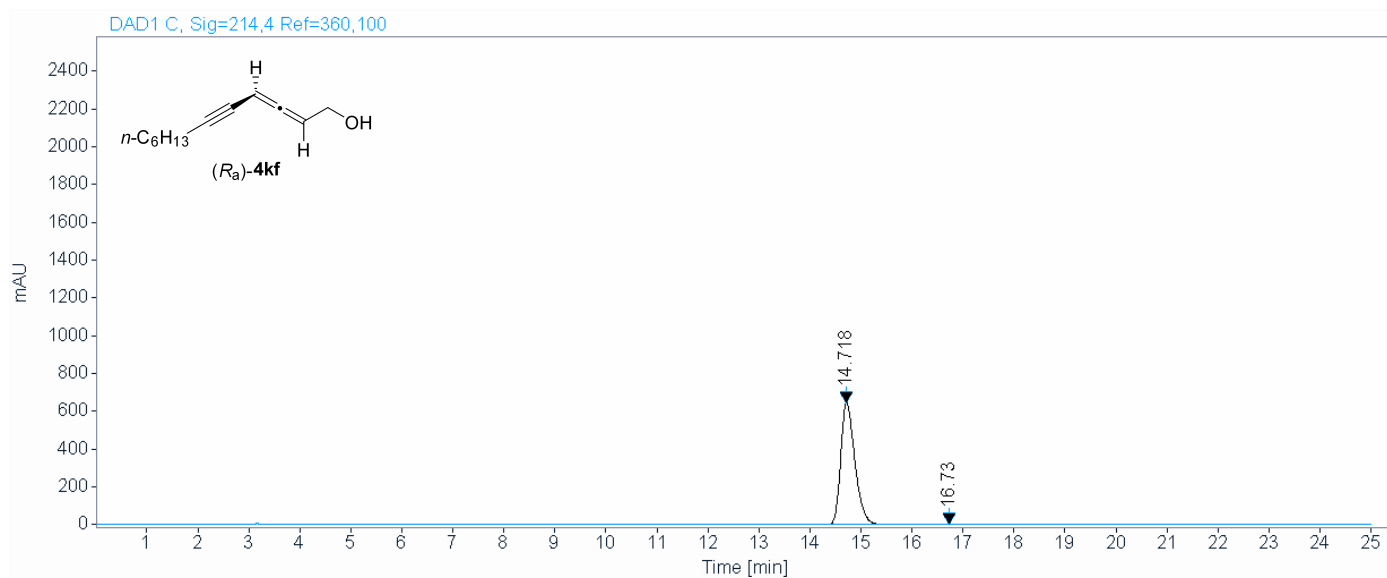


Area Percent Report

sample wgl-5-028-OJ-H-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\zwf-allenioc acid_LC 2021-03-12 13-10-14\013-P1-E2-wgl-5-028.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

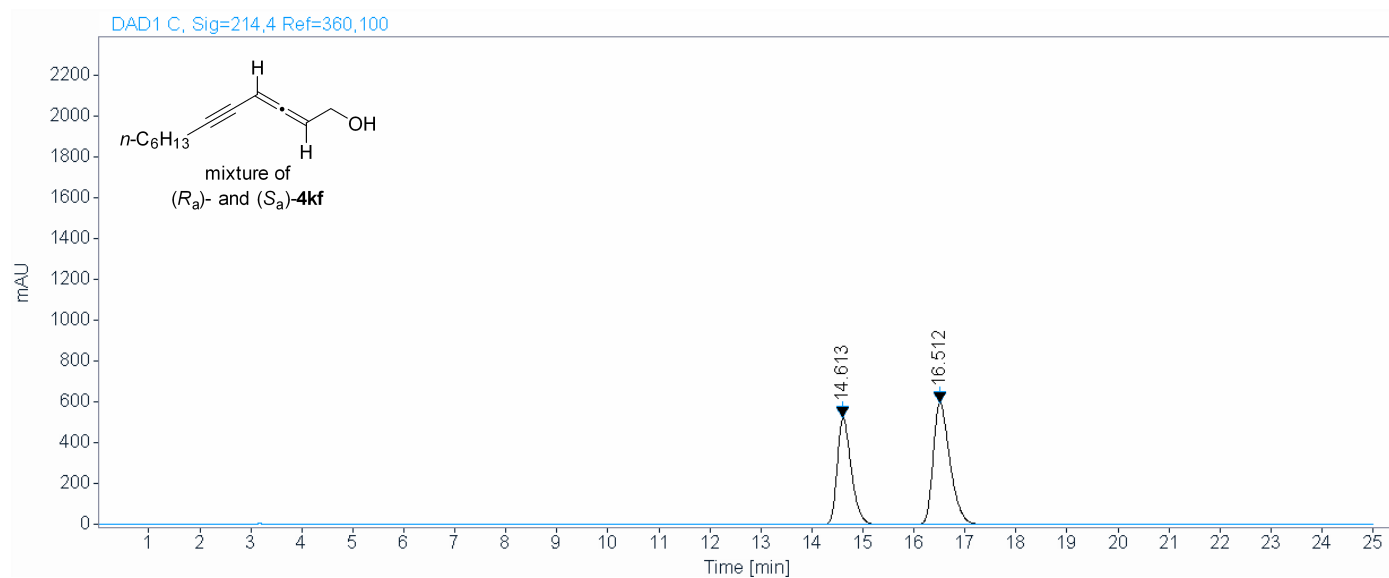
RT [min]	Width [min]	Height	Area	Area%
14.718	0.2945	646.1656	12435.2793	99.7882
16.730	0.3603	1.2208	26.3894	0.2118
Sum			12461.6687	100.0000

Area Percent Report

sample wgl-5-(028+029)-OJ-H-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\zwf-allenioc acid_LC 2021-03-12 13-10-14\015-P1-E1-wgl-5-(028+029).D

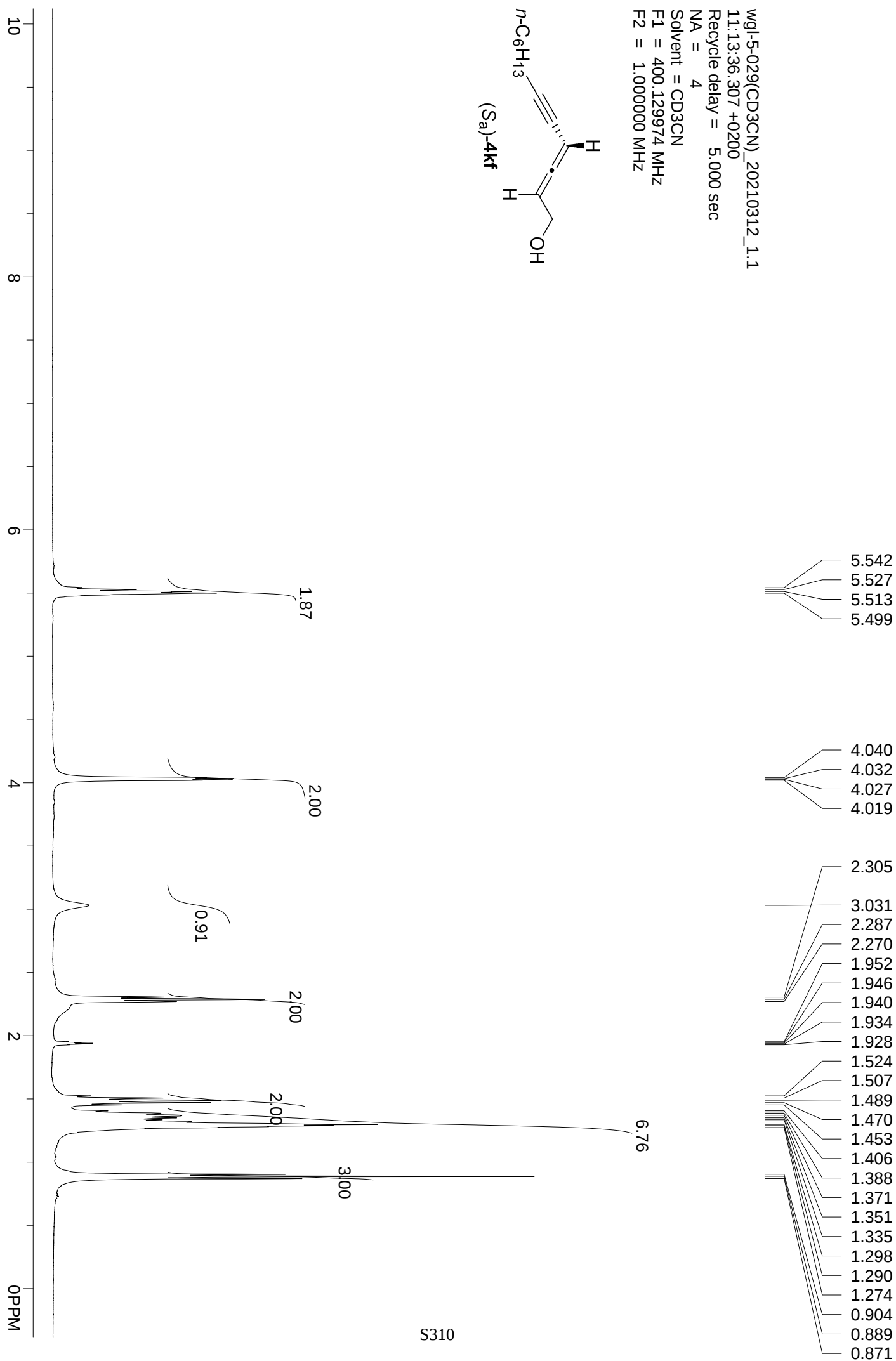
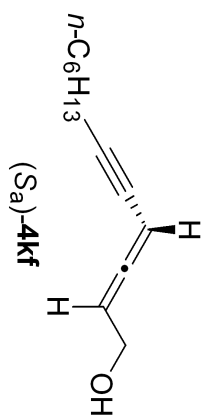
Acquisition Data:



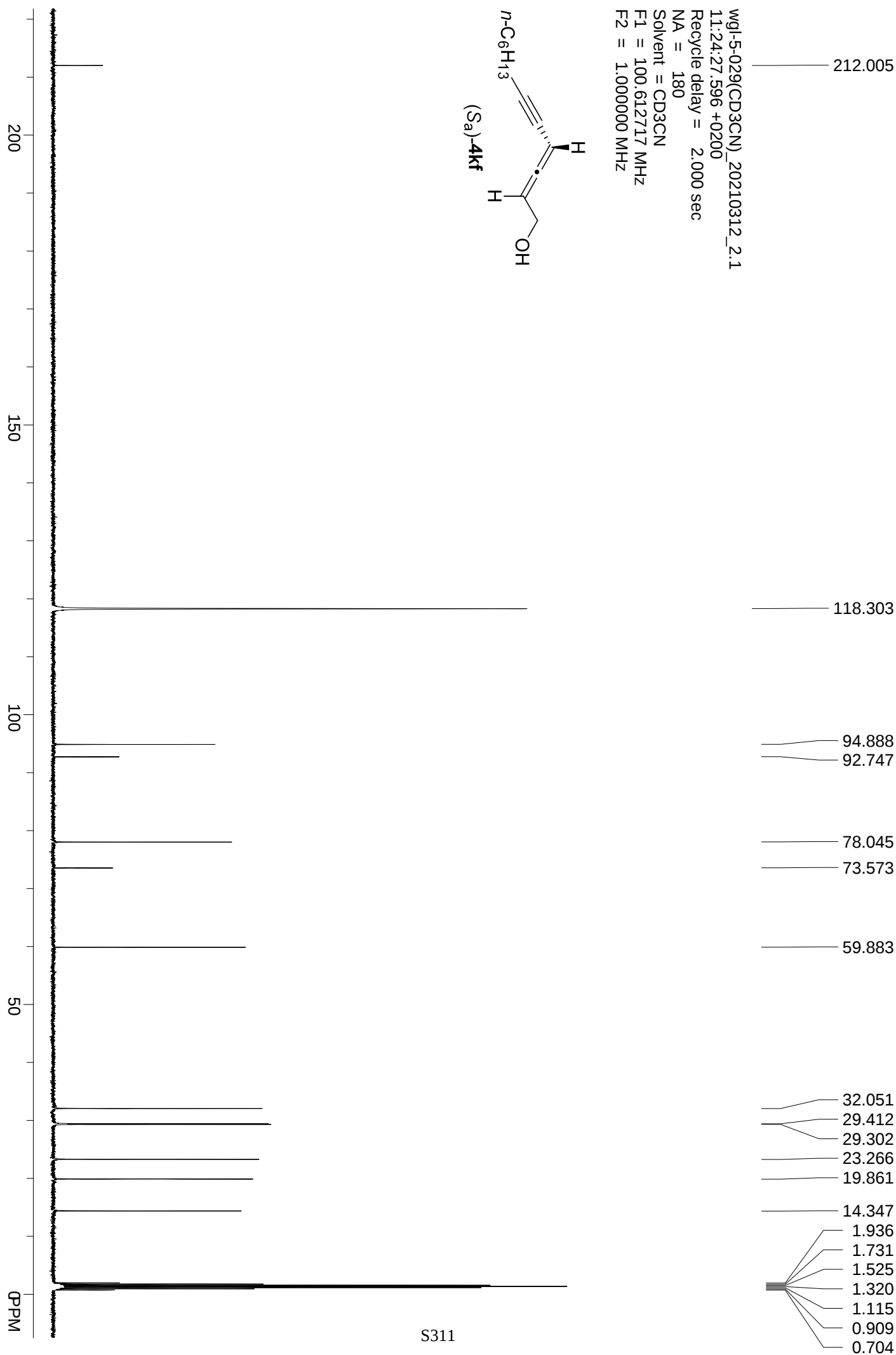
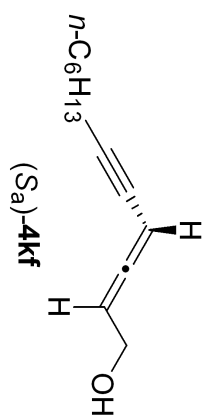
Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
14.613	0.2907	522.7861	9979.1719	42.1168
16.512	0.3515	598.0861	13714.8545	57.8832
Sum			23694.0264	100.0000

wgl-5-029(CD3CN)_20210312_1.1
 11:13:36.307 +0200
 Recycle delay = 5.000 sec
 NA = 4
 Solvent = CD3CN
 F1 = 400.129974 MHz
 F2 = 1.000000 MHz



wj-5-029(CD3CN)_20210312_2.1
11:24:27.596 +0200
Recycle delay = 2.000 sec
NA = 180
Solvent = CD3CN
F1 = 100.612717 MHz
F2 = 1.000000 MHz

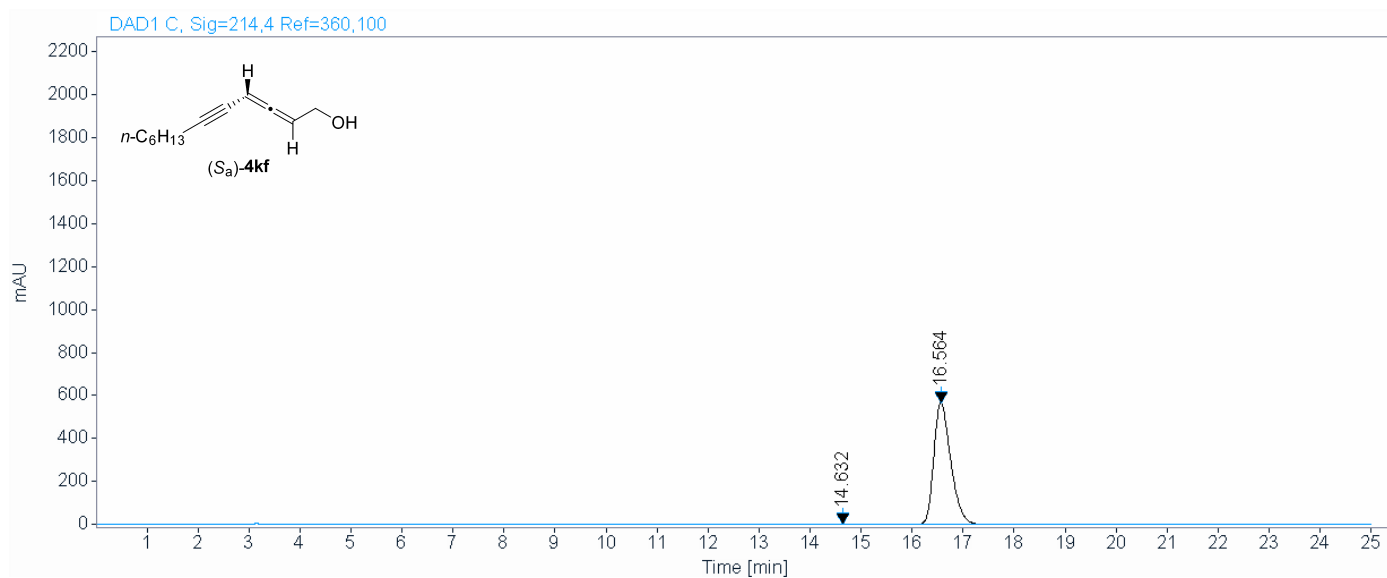


Area Percent Report

sample wgl-5-029-OJ-H-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\zwf-allenioc acid_LC 2021-03-12 13-10-14\014-P1-E3-wgl-5-029.D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

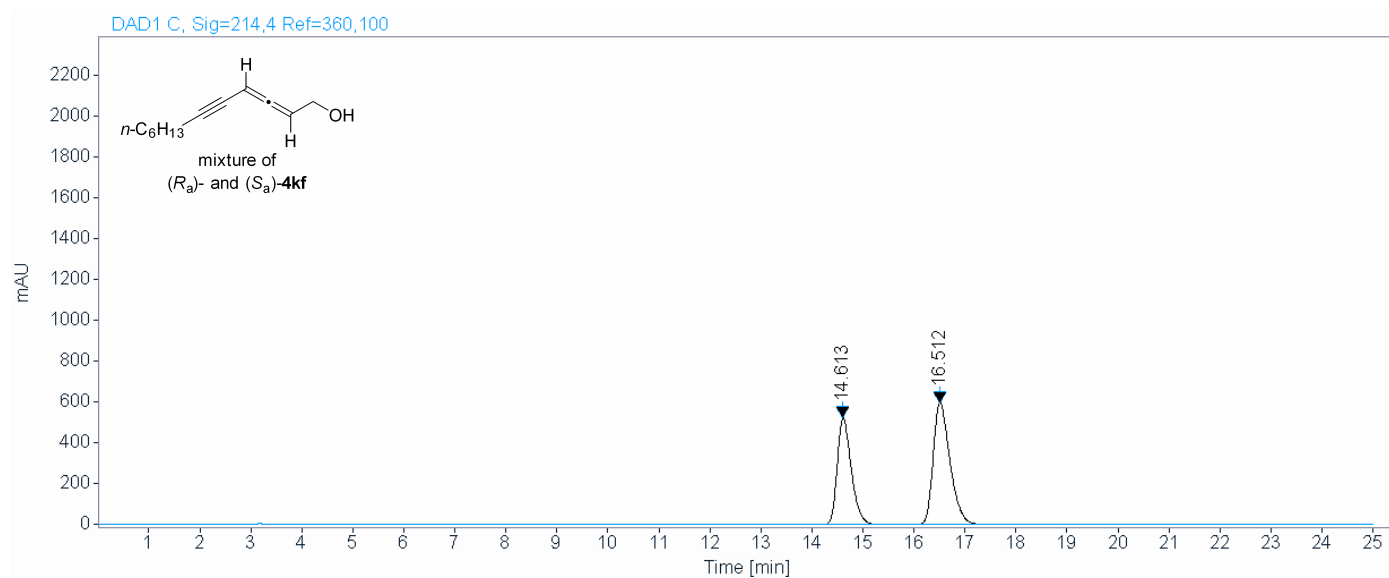
RT [min]	Width [min]	Height	Area	Area%
14.632	0.2777	1.7585	31.0070	0.2351
16.564	0.3564	567.5744	13155.0713	99.7649
Sum			13186.0782	100.0000

Area Percent Report

sample wgl-5-(028+029)-OJ-H-99-1-1.0-214

Data file: C:\Users\Public\Documents\ChemStation\1\Data\zwf-allenioc acid_LC 2021-03-12 13-10-14\015-P1-E1-wgl-5-(028+029).D

Acquisition Data:



Signal: DAD1 C, Sig=214,4 Ref=360,100

RT [min]	Width [min]	Height	Area	Area%
14.613	0.2907	522.7861	9979.1719	42.1168
16.512	0.3515	598.0861	13714.8545	57.8832
Sum			23694.0264	100.0000