Electronic Supporting Information (ESI)

Continuous-Flow Si–H Functionalization of Hydrosilanes via Sequential Organolithium Reactions Catalyzed by Potassium *tert*-Butoxide

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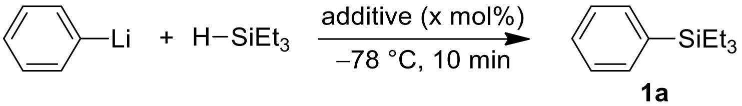
1. General Information

Nuclear magnetic resonance (NMR) spectra were recorded with Bruker Avance III (500 MHz for ^{1}H NMR, 125 MHz for ^{13}C NMR and 99 MHz for ^{29}Si NMR) and Bruker ASCEND 600 (119 MHz for ^{29}Si NMR). ^{1}H, ^{13}C and ^{29}Si chemical shifts are recorded in ppm downfield of tetramethylsilane and referenced to residual solvent peak ($CHCl_3$ = 7.26) unless otherwise noted. Multiplicities are reported using the following abbreviations: s = singlet, d= doublet, t = triplet, q = quartet, quint = quintet, sext = sextet, sept = septet, m = multiplet, br = broad resonance. GC chromatograph (GC) analysis was performed on an Agilent Technologies 7890A gas chromatograph (Agilent Tech., USA/Germany) using fused silica capillary column (column, 0.25mm x 30m). Mass spectra data were obtained from an Agilent Technologies 5675C VL MSD (EI), the Korea Basic Science Institute (Daegue) on a Jeol JMS 700 high resolution mass spectrometer (EI), and Organic Chemistry Research Center in Seogang university on a Bruker Ultra High Resolution ESI Q-TOF MS/MS Compact System (ESI). Melting points were determined from Stanford Research System OptiMelt MPA 100.

Tetrahydrofuran (THF, anhydrous), diethyl ether (Et_2O, anhydrous), hexane (anhydrous) were purchased from Sigma-Aldrich and used without further purification. *n*-Butyllithium (*n*-BuLi, 2.5 M in hexane), phenyllithium (PhLi, 1.9 M in diethyl ether) and methyllithium (MeLi, 1.6 M in diethyl ether) were purchased from Sigma-Aldrich. Sodium acetate (NaOAc), potassium acetate (KOAc), potassium bis(trimethylsilyl)amide (KHMDS), potassium trimethylsilanolate (KOTMS), lithium *tert*-butoxide (*t*-BuOLi), sodium *tert*-butoxide (*t*-BuONa), potassium *tert*-butoxide (*t*-BuOK) and *t*-BuOK soulution (1.0 M in THF) were purchased from Sigma-Aldrich and Tokyo Chemical Industry Co. LTD. Dimethylphenylsilane, diphenylsilane, methyldiphenylsilane, triethylsilane, triisopropylsilane and phenylsilane were purchased from Sigma-Aldrich and Tokyo Chemical Industry Co. LTD. Unless otherwise noted, all commercial materials were used without further purification.

Stainless steel (SUS316) tube reactors with inner diameters of 0.25 mm and 1 mm were purchased from GL Science and were cut into appropriate lengths. Stainless steel (SUS304) T-shaped micromixers with inner diameters of 300 and 500 μm were manufactured by YMC Co. and Valco Instruments Co. Inc. The micromixers and tube reactors were connected with stainless steel fittings (GL Science, 1/16" OUW) to construct the flow reaction system. The flow reaction system was dipped in water bath or cooling bath to control the temperature. The reagents were continuously injected to the flow reaction system using a syringe pumps (KD Scientific, Legato 200 and Legato 100), equipped with gas tight syringes (50 mL, inner diameter: 27.6 mm) purchased from SGE Analytical Science. After a steady state was reached (90 s), the product solution was collected for 30 s unless otherwise noted.

2. Direct silylation using a catalytic amount of additives in a flask



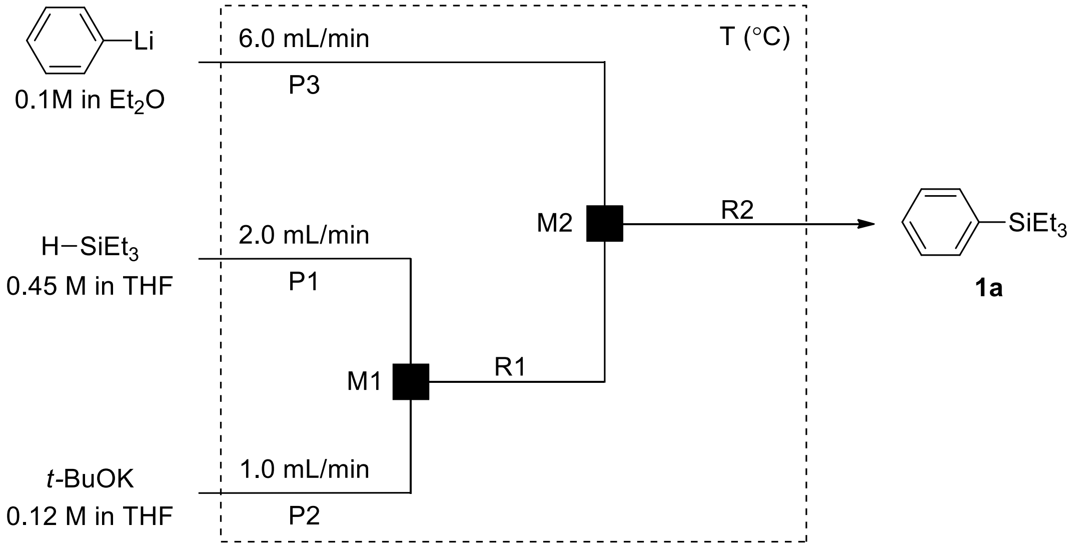
Triethylsilane (1.2 mmol, 1.2 equiv) was added to a solution of additives in THF (10 mL) in a 50 mL round bottom glass flask with magnetic stirring for 10 min at –78 °C under argon. After being stirred for 10 min, PhLi (0.53 mL, 1.9 M in Et_2O, 1 mmol) was added dropwise to a solution of triethylsilane with additives. The reaction mixture was stirred for specified time and quenched with saturated NH_4Cl aqueous solution (5 mL) and brine (5 mL) and the reaction bath was removed. After addition of 1,3,5-trimethoxybenzene (50 mg) as an internal standard and extracted with Et_2O, an aliquot (2 mL) of the organic phase was concentrated under vacuum and analyzed by ^{1}H NMR spectroscopy. Based on the relative intensities of peak at 0.96 ppm (9H of triethyl(phenyl)silane (**1a**)) and 6.09 ppm (3H of 1,3,5-trimethoxybenzene), the yield was determined by ^{1}H NMR spectroscopy.

Table S1. Direct silylation of PhLi using a catalytic amount of alkali-metal compounds

Entry	Additive	x (mol%)	Yield of **1a** (%)[a]
1	-	-	*n.d.*
2[b]	-	-	2
3	TMEDA	20	*n.d.*
4	HMPA	20	*n.d.*
5	$MeCO_2Na$	20	*n.d.*
6	EtOK	20	*n.d.*
7	$(Me_3Si)_2NK$	20	*n.d.*
8	Me_3SiOK	20	*n.d.*
9	*t*-BuOLi	20	2
10	*t*-BuONa	20	3
11	***t*-BuOK**	**20**	**82**
12	*t*-BuOK	10	40

n.d. = not detected. [a] Determined by ^{1}H NMR spectroscopy using 1,3,5-trimethoxy benzene as an internal standard. [b] The reaction was conducted for 1 h.

3. Si–H mono-functionalizations of hydrosilane by PhLi in a flow microreactor



A microfluidic system consisting of two T-shaped micromixers (M1 and M2), two tube reactors (R1 and R2) and three tube pre-temperature-retaining units (for P1, P2 and P3, inner diameter ø = 1 mm and length *L* = 100 cm) were used. The whole system was immersed in a temperature control bath. A solution of triethylsilane (0.45 M in THF, flow rate: 2.0 mL/min) and a solution of *t*-BuOK (0.12 M in THF, flow rate: 1.0 mL/min) were individually introduced to M1 (ø: 300 μm) by syringe pumps. The resulting solution was passed through R1 (ø = 250 or 1000 μm, *L*= 4.0 ~ 100 cm) and was mixed with a solution of PhLi (0.1 M in Et_2O, flow rate 6.0 mL/min) in M2 (ø: 500 μm). The resulting solution was passed through R2 (ø: 1 mm, *L*: 50~1000 cm). After a steady state was reached, the product solution was collected for 30 s while being quenched with saturated NH_4Cl aqueous solution (2 mL). Then, Et_2O (6 mL), brine (2 mL), and 1,3,5-trimethoxybenzene (50 mg) were added, and then an aliquot (2 mL) of the organic phase was concentrated and analyzed by ^1H NMR spectroscopy (Table S1). Based on the relative intensities of peak at 0.96 ppm (9H of triethyl(phenyl)silane (**1a**)) and 6.09 ppm (3H of 1,3,5-trimethoxybenzene), the yield was determined by ^1H NMR spectroscopy.

Table S2. The yield of **1a**.

Entry	t^{R1} (s)	t^{R2} (s)	T (°C)	Yield of **1a** (%) [a]
1	0.04	2.6	0	14
2	0.63	2.6	0	15
3	7.9	2.6	0	14
4	15.7	2.6	0	12
5	0.04	2.6	25	28
6	0.63	2.6	25	29
7	7.9	2.6	25	27
8	15.7	2.6	25	26
9	15.7	5.2	25	49
10	15.7	10.5	25	78
11	15.7	20.9	25	86
12	15.7	52.3	25	87
13	0.63	5.2	25	65
14	0.63	10.5	25	82

15	0.63	20.9	25	86
16	0.63	52.3	25	93
17	0.04	5.2	25	66
18	0.04	10.5	25	87
19	0.04	20.9	25	89
20	0.04	52.3	25	95

[a] Determined by ^{1}H NMR spectroscopy using 1,3,5-trimethoxybenzene as an internal standard.

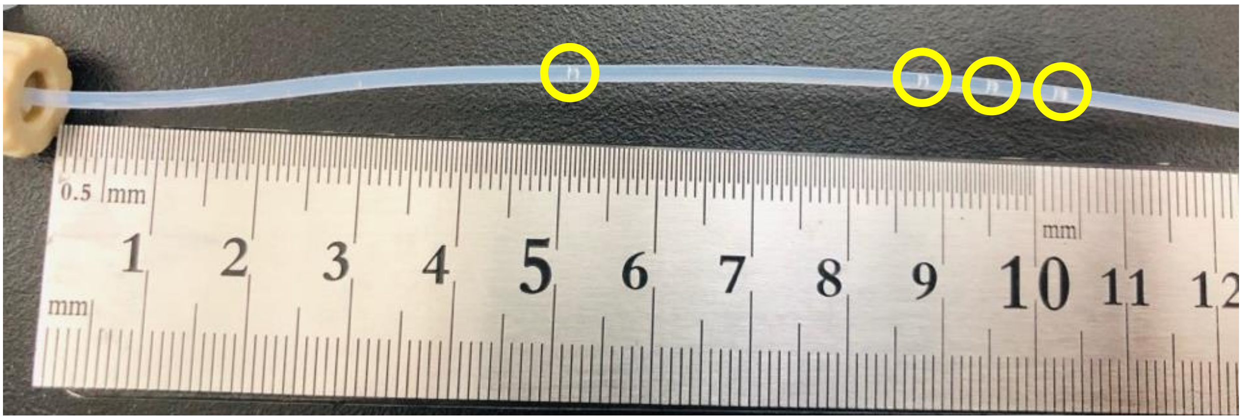
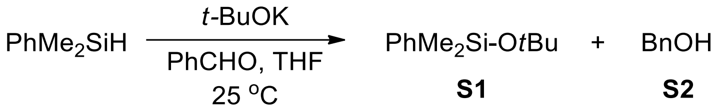


Figure S1. Gas generation during reaction of *t*-BuOK and hydrosilane in a capillary reactor.

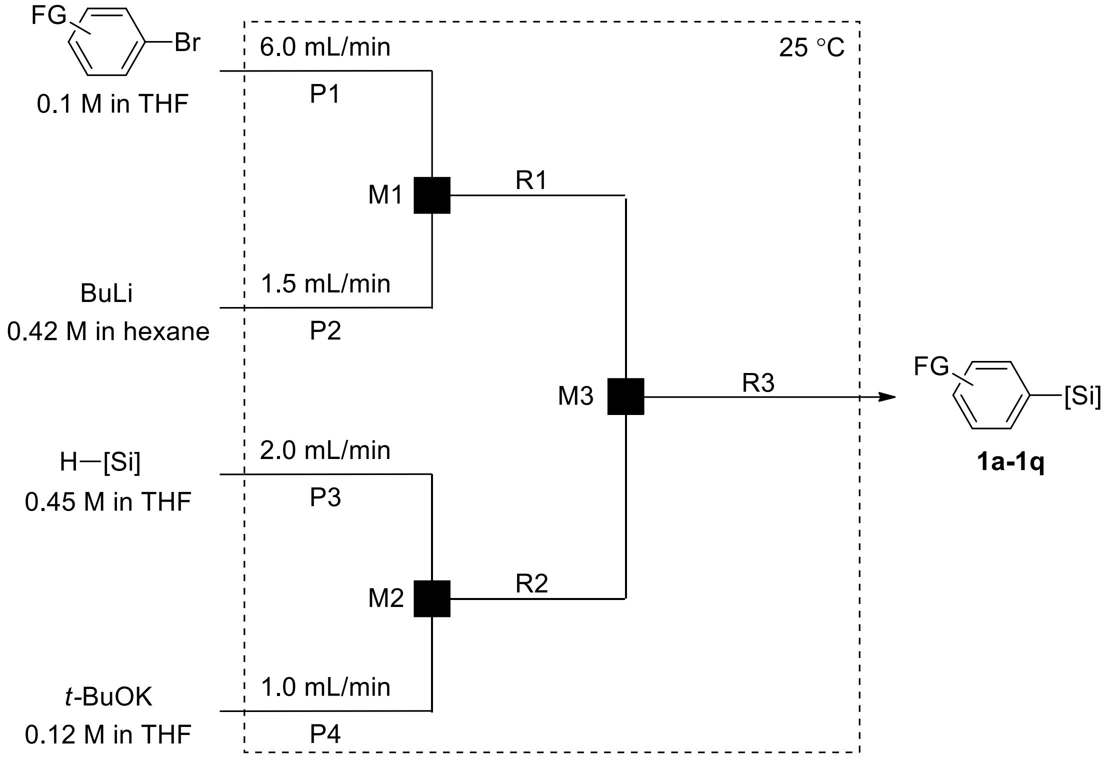
4. Reduction of benzaldehyde by hydrosilane and *t*-BuOK



$$\mathrm{PhMe_2SiH} \xrightarrow[\mathrm{PhCHO,\ THF}\ 25\ ^{\circ}\mathrm{C}]{t\text{-BuOK}} \underset{\textbf{S1}}{\mathrm{PhMe_2Si\text{-}O}t\mathrm{Bu}} + \underset{\textbf{S2}}{\mathrm{BnOH}}$$

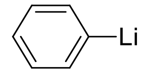
t-BuOK (1.2 equiv) was added to a solution of $PhMe_2SiH$ (1 mmol) in 10 mL of THF in a 50-mL round bottom glass flask at regular pace with magnetic stirring for 10 min at 25 ℃ under argon. After stirring, benzaldehyde (2 equiv) was added to the solution and stirred for 10 min. The reaction mixture was quenched with saturated NH_4Cl aqueous solution (5 mL) and brine (5 mL) and the reaction bath was removed. After addition of 1,3,5-trimethoxybenzene (50 mg) as an internal standard and extracted with Et_2O (6 mL), an aliquot (2 mL) of the organic phase was concentrated and analyzed by ^{1}H NMR spectroscopy. We could confirm that product and benzyl alcohol which was reduced from benzaldehyde, were obtained in 50% and 71%, respectively. This result supports the existence of hydride species which can be generated from penta-coordinate silyl intermediate.

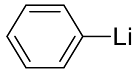
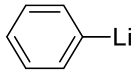
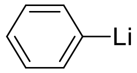
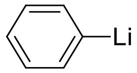
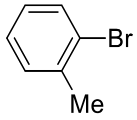
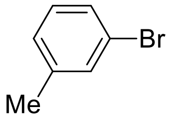
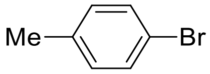
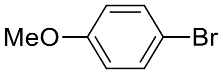
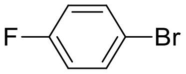
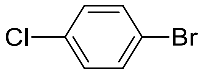
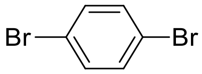
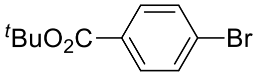
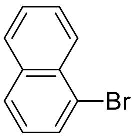
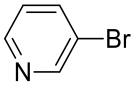
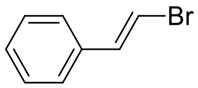
5. Si–H mono-functionalizations of various hydrosilanes by organolithiums in a flow microreactor



A microfluidic system consisting of three T-shaped micromixers (M1, M2 and M3), three tube reactors (R1, R2 and R3) and four tube pre-temperature-retaining units (for P1, P2, P3 and P4, ø = 1 mm and L = 100 cm) were used. The microfluidic system was immersed in a temperature control bath. A solution of aryl bromide (0.1 M in THF, flow rate: 6.0 mL/min) and a solution of alkyllithium (0.42 M in hexane, flow rate: 1.5 mL/min) were introduced to M1 (ø: 300 μm) by syringe pumps. The resulting solution passed through R1 (ø = 250 or 1000 μm, L= 4.0 ~ 10 cm) and was mixed in M3 (ø = 500 μm) with a mixing solution of hydrosilane in THF (flow rate: 2.0 mL/min) and *t*-BuOK in THF (flow rate: 1.0 mL/min) which was reacted in M2 (ø = 300 μm) and R2 (ø = 250 μm, L = 4.0 cm). PhLi or *n*-BuLi (0.1 M, 6.0 mL/min) were directly used, without the use of M1 and R1. The resulting solution was passed through R3 (ø = 1000 μm, L = 1000 cm). After a steady state was reached (90 s), the product solution was collected for 30 s while being quenched with saturated NH_4Cl aqueous solution (2 mL). The resulting mixture was extracted with Et_2O (5 mL×3), and washed with brine (5 mL). The organic phase was dried over sodium sulfate. The organic layer was concentrated on a rotary evaporator under reduced pressure. The crude product was purified by column chromatography to give the desired product.

Table S3. Flow silylation with various hydrosilanes and organolithiums.

Entry	Substrate	Silane	R1 (ø × L) (μm × cm)	t^{R1} (s)	Yield (%)[a]
1		$H\text{-}SiEt_3$	—[b]	—	93

2		H-SiMe$_2$Ph	—[b]	—	91
3		H-SiMePh$_2$	—[b]	—	89
4		H-SiPh$_2$	—[b]	—	88
5[j]		H-Si^{i}Pr$_3$	—[b]	—	81
6	*n*-BuLi	H-SiEt$_3$	—[e]	—	96
7[c,d]		H-SiEt$_3$	250 × 4	0.016	83
8		H-SiEt$_3$	250 × 4	0.016	81
9		H-SiEt$_3$	250 × 4	0.016	81
10		H-SiEt$_3$	1000 × 10	0.63	81
11		H-SiEt$_3$	250 × 4	0.016	76
12		H-SiEt$_3$	250 × 4	0.016	82
13		H-SiMe$_2$Ph	250 × 4	0.016	73
14[d,f,g]		H-SiMe$_2$Ph	1000 × 4	0.63	55
15[c,d]		H-SiEt$_3$	250 × 4	0.016	78
16		H-SiEt$_3$	1000 × 4	0.63	64
17		H-SiMe$_2$Ph	250 × 4	0.016	73

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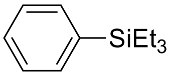
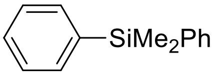
[a] Isolation yield. [b] PhLi (0.1 M in Et$_2$O) was used. [c] 0.5 equiv of *t*-BuOK was used. [d] 3.0 equiv of silane was used. [e] *n*-BuLi (0.1 M in hexane) was used. [f] Lithiation was conducted at 0 °C. [g] For Br-Li exchange, *s*-BuLi was used.



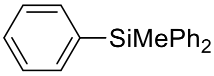
Triethyl(phenyl)silane (1a)

Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.51-7.47 (m, 2H), 7.35-7.34 (m, 3H), 0.96 (t, *J* = 7.5 Hz, 9H), 0.79 (q, *J* = 8.0 Hz, 6H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 137.5, 134.2, 128.7, 127.6, 7.4, 3.3 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ 1.88 ppm. The spectroscopic data were identical to those reported in the literature.[1]



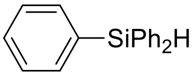
Dimethyldiphenylsilane (1b)

Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.57-7.55 (m, 4H), 7.40-7.38 (m, 6H), 0.59 (s, 6H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 138.2, 134.2, 129.1, 127.8, –2.4 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –8.02 ppm. The spectroscopic data were identical to those reported in the literature.[2]



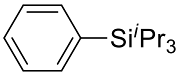
Methyltriphenylsilane (1c)

White solid; mp 67.1-67.5 °C; 1H NMR (500 MHz, $CDCl_3$) δ 7.55-7.53 (m, 6H), 7.45-7.42 (m, 3H), 7.40-7.37 (m, 6H), 0.87 (s, 3H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 136.1, 135.3, 129.4, 127.8, –3.4 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –11.03 ppm. The melting point was matched with those reported in the literature.[3] The spectroscopic data were identical to those reported in the literature.[4]



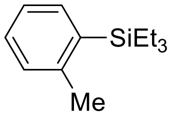
Triphenylsilane (1d)

Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.61 (dd, *J* = 7.9, 1.5 Hz, 6H), 7.47-7.39 (m, 9H), 5.50 (s, 1H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 135.8, 133.3, 129.8, 128.1 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –18.09 ppm. The spectroscopic data were identical to those reported in the literature.[5]



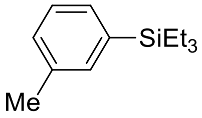
Triisopropyl(phenyl)silane (1e)

Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.53-7.51 (m, 2H), 7.38-7.36 (m, 3H), 1.43 (sept, *J* = 7.6 Hz, 3H), 1.10 (d, *J* = 7.5 Hz, 18H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 135.3, 134.8, 128.5, 127.4, 18.6, 10.7 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ 1.63 ppm. The spectroscopic data were identical to those reported in the literature.[6]



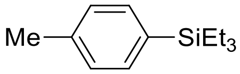
Triethyl(*o*-tolyl)silane (1f)

Colorless oil. ^{1}H NMR (500 MHz, CDCl$_3$) δ 7.45 (dd, J = 7.7, 1.5 Hz, 1H), 7.29-7.26 (m, 1H), 7.19-7.15 (m, 2H), 2.46 (s, 3H), 0.97 (t, J = 7.9 Hz, 9H), 0.88 (q, J = 7.8 Hz, 6H) ppm; ^{13}C NMR (125 MHz, CDCl$_3$) δ 143.9, 135.5, 135.4, 129.8, 128.9, 124.7, 23.0, 7.6, 4.0 ppm; ^{29}Si NMR (99 MHz, CDCl$_3$) δ 3.09 ppm. The spectroscopic data were identical to those reported in the literature.[7]



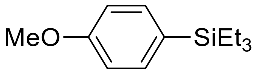
Triethyl(*m*-tolyl)silane (1g)

Colorless oil. ^{1}H NMR (500 MHz, CDCl$_3$) δ 7.32-7.31 (m, 2H), 7.27 (t, J = 7.5 Hz, 1H), 7.18 (d, J = 7.3 Hz, 1H), 2.38 (s, 3H), 0.99 (t, J = 8.0 Hz, 9H), 0.80 (q, J = 7.9 Hz, 6H) ppm; ^{13}C NMR (125 MHz, CDCl$_3$) δ 137.3, 136.9, 134.8, 131.2, 129.5, 127.6, 21.6, 7.4, 3.4 ppm; ^{29}Si NMR (99 MHz, CDCl$_3$) δ 1.75 ppm. The spectroscopic data were identical to those reported in the literature.[7]



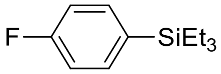
Triethyl(*p*-tolyl)silane (1h)

Colorless oil. ^{1}H NMR (500 MHz, CDCl$_3$) δ 7.42 (d, J = 7.9 Hz, 2H), 7.20 (d, J = 7.5 Hz, 2H), 2.38 (s, 3H), 0.99 (t, J = 8.1 Hz, 9H), 0.80 (q, J = 8.0 Hz, 6H) ppm; ^{13}C NMR (125 Hz, CDCl$_3$) δ 138.5, 134.3, 133.7, 128.5, 21.5, 7.4, 3.4 ppm; ^{29}Si NMR (99 MHz, CDCl$_3$) δ 1.66 ppm. The spectroscopic data were identical to those reported in the literature.[8]



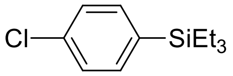
Triethyl(4-methoxyphenyl)silane (1i)

Colorless oil. ^{1}H NMR (500 MHz, CDCl$_3$) δ 7.44 (d, J = 8.6 Hz, 2H), 6.94 (d, J = 8.6 Hz, 2H), 3.84 (s, 3H), 0.98 (t, J = 8.1 Hz, 9H), 0.79 (q, J = 8.0 Hz, 6H) ppm; ^{13}C NMR (125 MHz, CDCl$_3$) δ 160.2, 135.6, 128.2, 113.5, 54.9, 7.4, 3.5 ppm; ^{29}Si NMR (99 MHz, CDCl$_3$) δ 1.47 ppm. The spectroscopic data were identical to those reported in the literature.[8]



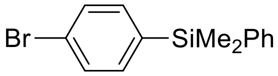
Triethyl(4-fluorophenyl)silane (1j)

Colorless oil. ^{1}H NMR (500 MHz, CDCl$_3$) δ 7.50-7.47 (m, 2H), 7.10-7.06 (m, 2H), 0.99 (t, J = 8.2 Hz, 9H), 0.81 (q, J = 8.0 Hz, 6H) ppm; ^{13}C NMR (125 MHz, CDCl$_3$) δ 163.6 (d, $J_{C\text{–}F}$ = 245 Hz), 136.0 (d, $J_{C\text{–}F}$ = 7.5 Hz), 132.8 (d, $J_{C\text{–}F}$ = 3.8 Hz), 114.8 (d, $J_{C\text{–}F}$ = 18.8 Hz), 7.3, 3.4 ppm; ^{29}Si NMR (119 MHz, CDCl$_3$) δ 2.05 ppm. The spectroscopic data were identical to those reported in the literature.[9]



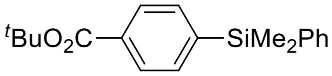
(4-Chlorophenyl)triethylsilane (1k)

Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.43 (d, *J* = 8.0 Hz, 2H), 7.35 (d, *J* = 8.2 Hz, 2H), 0.98 (t, *J* = 7.6 Hz, 9H), 0.80 (q, *J* = 7.6 Hz, 6H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 135.7, 135.5, 135.0, 127.9, 7.3, 3.3 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ 2.35 ppm. The spectroscopic data were identical to those reported in the literature.[10]



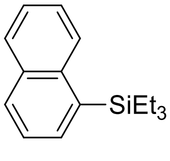
(4-Bromophenyl)dimethyl(phenyl)silane (1l)

White solid; mp 33.0-33.8 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.53-7.50 (m, 4H), 7.41-7.37 (m, 5H), 0.57 (s, 6H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 137.5, 137.1, 135.8, 134.1, 131.0, 129.3, 127.9, 124.0, –2.5 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –7.49 ppm; LRMS (EI) cald. For $C_{14}H_{15}BrSi$: 290.01; found: 290.0.



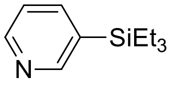
***tert*-Butyl 4-(dimethyl(phenyl)silyl)benzoate (1m)**

Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.87 (d, *J* = 8.5 Hz, 2H), 7.50 (d, *J* = 8.0 Hz, 2H), 7.43-7.41 (m, 2H), 7.31-7.26 (m, 3H), 1.51 (s, 9H), 0.49 (s, 6H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 165.9, 143.9, 137.5, 134.1, 134.0, 132.5, 129.3, 128.4, 127.9, 80.9, 28.2, –2.5 ppm; ^{29}Si NMR (119 MHz, $CDCl_3$) δ –7.59 ppm; HRMS (ESI) (*m/z*) cald. For $C_{19}H_{24}NaO_2Si^+$ $[M+Na]^+$: 335.1438; found: $C_{19}H_{24}NaO_2Si$: 335.1438.



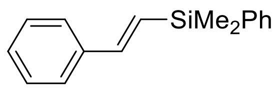
Triethyl(naphthalen-1-yl)silane (1n)

Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.12 (d, *J* = 9.0 Hz, 1H), 7.89-7.87 (m, 2H), 7.69 (d, *J* = 7.0 Hz, 1H), 7.53-7.48 (m, 3H), 1.05-0.97 (m, 15H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 137.5, 135.2, 134.5, 133.4, 129.6, 129.1, 127.9, 125.5, 125.2, 125.1, 7.7, 4.5 ppm; ^{29}Si NMR (119 MHz, $CDCl_3$) δ 3.27 ppm. The spectroscopic data were identical to those reported in the literature.[11]



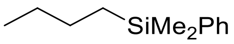
3-(Triethylsilyl)pyridine (1o)

Yellowish oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.68 (s, 1H), 8.60 (dd, *J* = 5, 1.7 Hz, 1H), 7.82 (dt, *J* = 7.5, 1.8 Hz, 1H), 7.33-7.30 (m, 1H), 0.99 (t, *J* = 7.5 Hz, 9H), 0.84 (q, *J* = 8.0 Hz, 6H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 154.0, 149.3, 142.5, 132.7, 123.4, 7.2, 3.1 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ 1.90 ppm. The spectroscopic data were identical to those reported in the literature.[8]



(*E*)-Dimethyl(phenyl)(styryl)silane (1p)

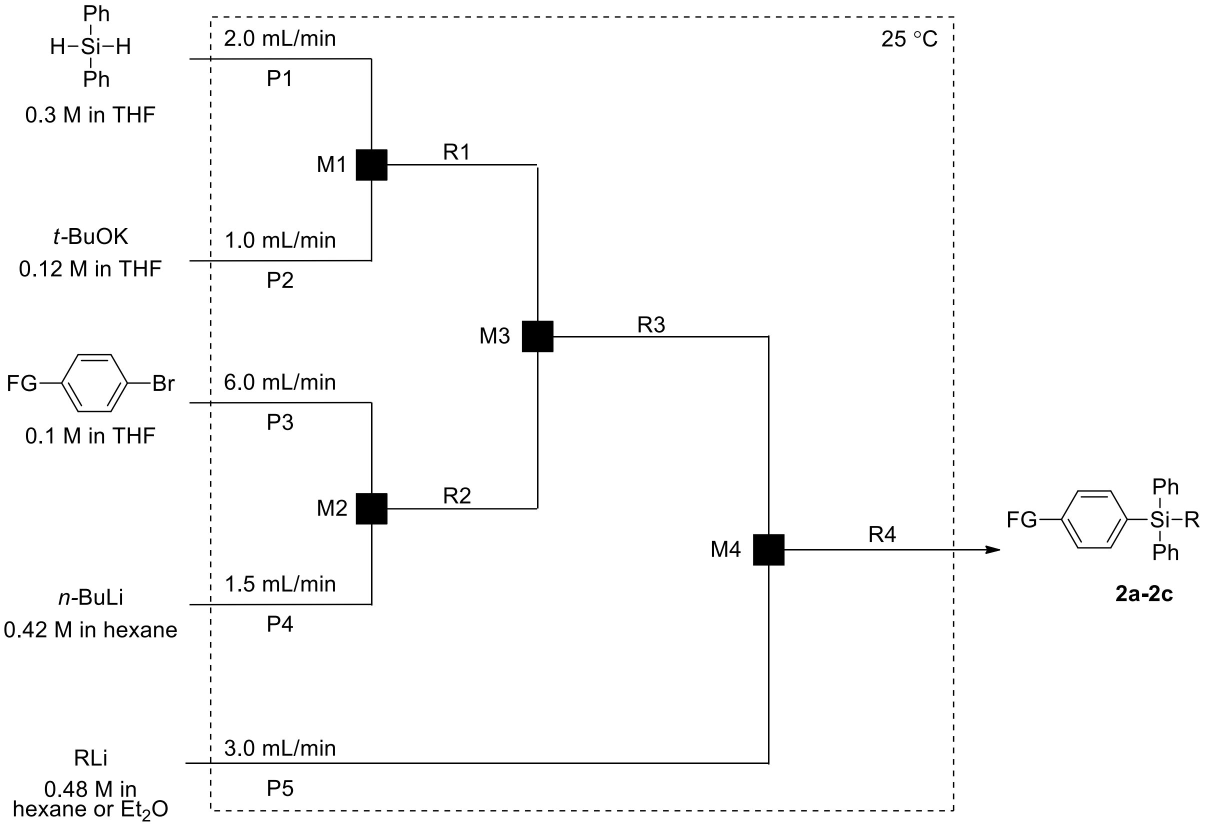
Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.58-7.56 (m, 2H), 7.45 (d, *J* = 8.1 Hz, 2H), 7.38-7.36 (m, 3H), 7.32 (t, *J* = 7.6 Hz, 2H), 7.27-7.25 (m, 1H), 6.94 (d, *J* = 19.2 Hz, 1H), 6.58 (d, *J* = 19.2 Hz, 1H), 0.43 (s, 6H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 145.3, 138.6, 138.2, 133.9, 129.1, 128.5, 128.2, 127.8, 127.1, 126.5, –2.5 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –10.28 ppm. The spectroscopic data were identical to those reported in the literature.[12]



Butyldimethyl(phenyl)silane (1q)

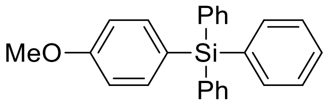
Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.55-7.53 (m, 2H), 7.39-7.37 (m, 3H), 1.37-1.29 (m, 4H), 0.89 (t, *J* = 6.8 Hz, 3H), 0.79-0.76 (m, 2H), 0.28 (s, 6H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 139.8, 133.6, 128.7, 127.7, 26.6, 26.1, 15.4, 13.8, –3.0 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –3.05 ppm. The spectroscopic data were identical to those reported in the literature.[2]

6. Si–H di-functionalizations of diphenylsilane by organolithiums in a flow microreactor



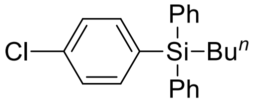
A microfluidic system consisting of four T-shaped micromixers (M1, M2, M3 and M4), four tube reactors (R1, R2, R3 and R4) and five tube pre-temperature-retaining units (for P1, P2, P3, P4 and P5, ø = 1 mm and *L* = 100 cm) were used. The microfluidic system was immersed in a temperature control bath. A solution of diphenylsilane

(0.3 M in THF, flow rate: 2.0 mL/min) and a solution of *t*-BuOK (0.12 M in THF, flow rate: 1.0 mL/min) were introduced to M1 (ø: 300 μm) by syringe pumps. The resulting solution flowed through R1 (ø = 250 μm, *L*= 4.0 cm) and was mixed in M3 (ø = 500 μm) with a mixing solution of aryl bromide (0.1 M in THF, flow rate: 6.0 mL/min) and a solution of *n*-BuLi (0.42 M in hexane, flow rate: 1.5 mL/min) which was reacted in M2 (ø = 250 μm) and R2 (ø = 250 or 1000 μm, *L* = 4.0 cm). PhLi (0.1 M in Et_2O, flow rate: 6.0 mL/min) was directly used, without the use of M2 and R2. The resulting solution was passed through R3 (ø = 1000 μm, *L* = 1000 cm) and mixed in M4 (ø = 500 μm) with a solution of organolithium (PhLi: 0.48 M in Et_2O, *n*-BuLi: 0.48 M in hexane, flow rate: 3.0 mL/min) and reacted in R4 (ø = 1000 μm, *L* = 1000 cm). After a steady state was reached (90 s), the product solution was collected for 30 s while being quenched with saturated NH_4Cl aqueous solution (2 mL). The resulting mixture was extracted with Et_2O (5 mL×3), and washed with brine (5 mL). The organic phase was dried over sodium sulfate. The organic layer was concentrated on a rotary evaporator under reduced pressure. The crude product was purified by column chromatography to give the desired product.



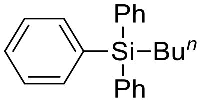
(4-Methoxyphenyl)triphenylsilane (2a)

White solid; mp 155.1-155.8 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.57-7.55 (m, 6H), 7.48 (d, *J* = 8.7 Hz, 2H), 7.44-7.40 (m, 3H), 7.38-7.35 (m, 6H), 6.93 (d, *J* = 8.5 Hz, 2H), 3.82 (s, 3H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 160.9, 137.9, 136.4, 134.6, 129.5, 127.9, 124.9, 55.0 ppm; ^{29}Si NMR (119 MHz, $CDCl_3$) δ –14.42 ppm. The spectroscopic data were identical to those reported in the literature.[13]



Butyl(4-chlorophenyl)diphenylsilane (2b)

Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.50-7.48 (m, 4H), 7.44-7.32 (m, 10H), 1.44-1.33 (m, 6H), 0.87 (t, *J* =7.1 Hz, 3H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 137.0, 135.8, 135.6, 134.9, 133.9, 129.5, 128.1, 127.9, 26.7, 26.1, 13.7, 12.9 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –10.61 ppm; HRMS (ESI) (*m/z*) cald. For $C_{22}H_{23}NaClSi^+$ $[M+Na]^+$: 373.1150; found: 373.1150.

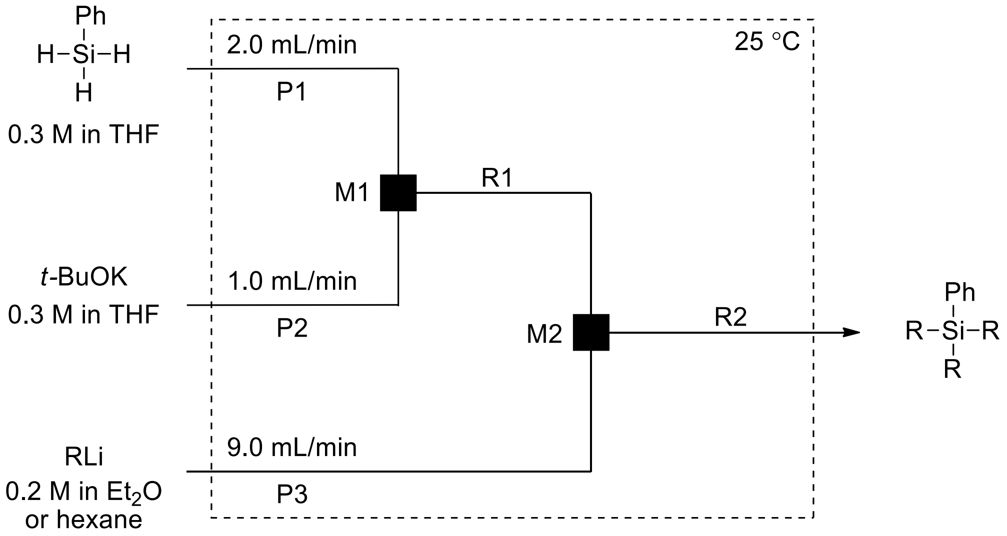


Butyltriphenylsilane (2c) collecting for 600 s.

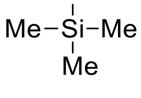
Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.53-7.51 (m, 6H), 7.41-7.38 (m, 3H), 7.37-7.34 (m, 6H), 1.48-1.42 (m, 2H), 1.40-1.35 (m, 4H), 0.87 (t, *J* = 7.1 Hz, 3H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 135.7, 135.4, 129.3, 127.8, 26.8, 26.1, 13.7, 13.0 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –10.71 ppm. The spectroscopic data were identical to those reported in the literature.[14]

7. Si–H tri-functionalizations of phenylsilane by organolithiums in a flow microreactor

7.1. Sequential tri-functionalization of phenylsilane with one organolithium



A microfluidic system consisting of two T-shaped micromixers (M1 and M2), two tube reactors (R1 and R2) and three tube pre-temperature-retaining units (for P1, P2 and P3, ø = 1 mm and *L* = 100 cm) were used. The microfluidic system was immersed in a temperature control bath. A solution of phenylsilane (0.3 M in THF, flow rate: 2.0 mL/min) and a solution of *t*-BuOK (0.12 M in THF, flow rate: 1.0 mL/min) were introduced to M1 (ø: 300 μm) by syringe pumps. The resulting solution flowed through R1 (ø = 250 μm, *L*= 4.0 cm) and was mixed in M2 (ø = 500 μm) with a solution of RLi (0.2 M, flow rate: 9.0 mL/min). The resulting solution was passed through R2 (ø = 1000 μm, *L* = 50 cm). After a steady state was reached (90 s), the product solution was collected for 30 s while being quenched with a saturated aqueous NH_4Cl aqueous solution (2 mL). The resulting mixture was extracted with Et_2O (5 mL×3), and washed with brine (5 mL). The organic phase was dried over sodium sulfate. The organic layer was concentrated on a rotary evaporator under reduced pressure. The crude product was purified by column chromatography to give the desired product. The crude product of **3i** was purified by recrystallization with hexane.

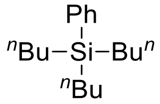


$\mathrm{Me{-}\overset{\displaystyle Ph}{\underset{\displaystyle Me}{Si}}{-}Me}$

Trimethyl(phenyl)silane (3a)

A solution of MeLi (0.2 M in Et_2O, flow rate: 9.0 mL/min) was used. The resulting solution was mixed in a flask for 10 min at 25 °C.

Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.53-7.52 (m, 2H), 7.36-7.34 (m, 3H), 0.27 (s, 9H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 140.5, 133.3, 128.8, 127.7, –1.1 ppm; ^{29}Si NMR (119 MHz, $CDCl_3$) δ –4.10 ppm. The spectroscopic data were identical to those reported in the literature.[15]

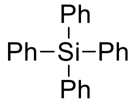


${}^{n}\mathrm{Bu}-\overset{\mathrm{Ph}}{\underset{{}^{n}\mathrm{Bu}}{\mathrm{Si}}}-\mathrm{Bu}^{n}$

Tributyl(phenyl)silane (3e)

A solution of *n*-BuLi (0.2 M in hexane, flow rate: 9.0 mL/min) was used. The resulting solution was mixed in a flask for 10 min at 50 °C.

Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.50-7.47 (m, 2H), 7.34-7.32 (m, 3H), 1.35-1.25 (m, 12H), 0.87 (t, *J* = 6.9 Hz, 9H), 0.79-0.76 (m, 6H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 138.2, 134.1, 128.6, 127.6, 26.8, 26.0, 13.8, 12.2 ppm; ^{29}Si NMR (119 MHz, $CDCl_3$) δ –2.06 ppm; HRMS (EI) (*m/z*) cald. For $C_{18}H_{32}Si$: 276.2273; found: $C_{18}H_{32}Si$: 276.2271



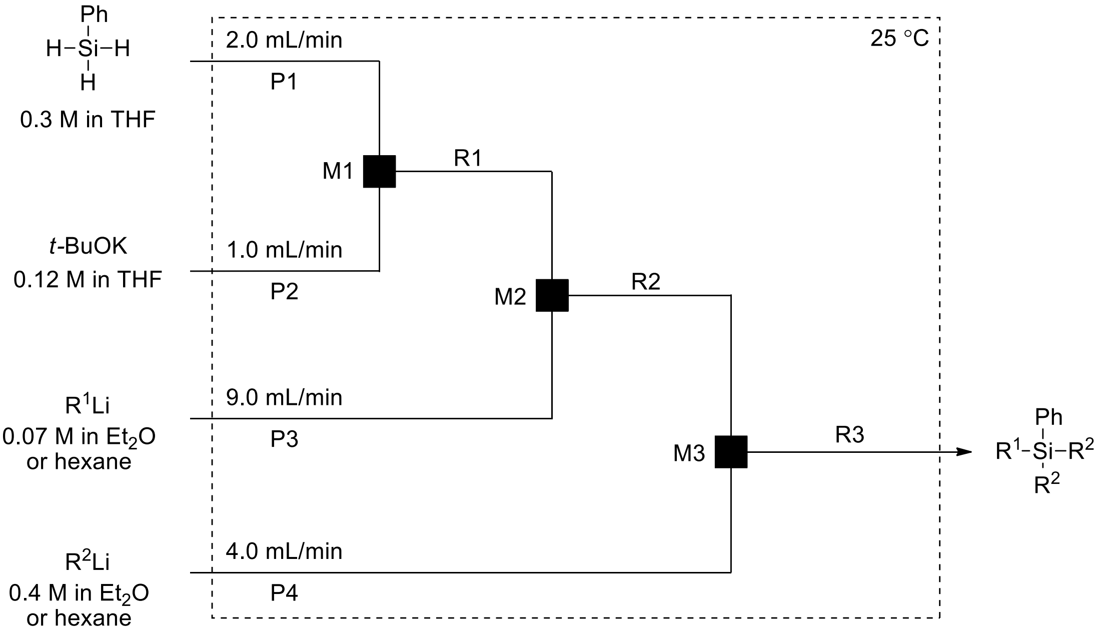
$\mathrm{Ph}-\overset{\mathrm{Ph}}{\underset{\mathrm{Ph}}{\mathrm{Si}}}-\mathrm{Ph}$

Tetraphenylsilane (3i)

A solution of PhLi (0.2 M in Et_2O, flow rate: 9.0 mL/min) was used. The resulting solution was mixed in a flask for 10 min at 25 °C.

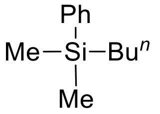
White solid; mp 232.6-233.4 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.58-7.56 (m, 8H), 7.45-7.41 (m, 4H), 7.39-7.35 (m, 8H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 136.4, 134.2, 129.6, 127.9 ppm; ^{29}Si NMR (119 MHz, $CDCl_3$) δ –14.51 ppm. The melting point was matched with those reported in the literature.[16] The spectroscopic data were identical to those reported in the literature.[17]

7.2. Sequential tri-functionalization of phenylsilane with two different organolithiums



A microfluidic system consisting of three T-shaped micromixers (M1, M2 and M3), three tube reactors (R1, R2 and R3) and four tube pre-temperature-retaining units (for P1, P2, P3 and P4, ø = 1 mm and *L* = 100 cm) were used. The microfluidic system was immersed in a temperature control bath. A solution of phenylsilane (0.3 M in

THF, flow rate: 2.0 mL/min) and a solution of *t*-BuOK (0.12 M in THF, flow rate: 1.0 mL/min) were introduced to M1 (ø: 300 µm) by syringe pumps. The resulting solution flowed through R1 (ø = 250 µm, *L*= 4.0 cm) and was mixed in M2 (ø = 500 µm) with a solution of R^1Li (0.07 M, flow rate: 9.0 mL/min). The resulting solution was passed through R2 (ø = 1000 µm, *L* = 1000 cm) and was mixed in M3 with a solution of R^2Li (0.4 M, flow rate: 4.0 mL/min). The resulting solution flowed through R3 (ø = 1000 µm, *L* = 1000 cm). After a steady state was reached (90 s), the product solution was collected for 80 s while being quenched with saturated NH_4Cl aqueous solution (2 mL). The resulting mixture was extracted with Et_2O (5 mL×3), and washed with brine (5 mL). The organic phase was dried over sodium sulfate. The organic layer was concentrated on a rotary evaporator under reduced pressure. The crude product was purified by column chromatography to give the desired product.

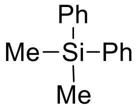


$\mathrm{Me{-}\overset{Ph}{\underset{Me}{Si}}{-}Bu^{\mathit{n}}}$

Butyldimethyl(phenyl)silane (3b)

A solution of R^1Li (*n*-BuLi: 0.07 M in hexane, 9.0 mL/min) and a solution of R^2Li (MeLi: 0.4 M in Et_2O, 4.0 mL/min) were used.

Colorless oil. ^1H NMR (500 MHz, $CDCl_3$) δ 7.55-7.53 (m, 2H), 7.39-7.37 (m, 3H), 1.37-1.29 (m, 4H), 0.89 (t, *J* = 6.8 Hz, 3H), 0.79-0.76 (m, 2H), 0.28 (s, 6H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 139.8, 133.6, 128.7, 127.7, 26.6, 26.1, 15.4, 13.8, –3.0 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –3.05 ppm. The spectroscopic data were identical to those reported in the literature.[2] The product **3b** is identical to product **1q**.

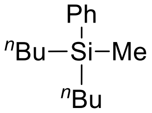


$\mathrm{Me{-}\overset{Ph}{\underset{Me}{Si}}{-}Ph}$

Dimethyldiphenylsilane (3c)

A solution of R^1Li (PhLi: 0.07 M in Et_2O, 9.0 mL/min) and a solution of R^2Li (MeLi: 0.4 M in Et_2O, 4.0 mL/min) were used.

Colorless oil. ^1H NMR (500 MHz, $CDCl_3$) δ 7.57-7.55 (m, 4H), 7.40-7.38 (m, 6H), 0.59 (s, 6H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 138.2, 134.2, 129.1, 127.8, –2.4 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –8.02 ppm. The spectroscopic data were identical to those reported in the literature.[2] The product **3c** is identical to product **1b**.

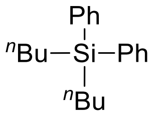


$\mathrm{{}^{\mathit{n}}Bu{-}\overset{Ph}{\underset{{}^{\mathit{n}}Bu}{Si}}{-}Me}$

Dibutyl(methyl)(phenyl)silane (3d)

A solution of R^1Li (MeLi: 0.07 M in Et_2O, 9.0 mL/min) and a solution of R^2Li (*n*-BuLi: 0.4 M in hexane, 4.0 mL/min) were used.

Colorless oil. ^1H NMR (500 MHz, $CDCl_3$) δ 7.54-7.48 (m, 2H), 7.36-7.33 (m, 3H), 1.34-1.26 (m, 8H), 0.88-0.85 (m, 6H), 0.77-0.74 (m, 4H), 0.24 (s, 3H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 134.3, 133.8, 128.7, 127.6, 26.7, 26.1, 13.9, 13.8 –5.1 ppm; ^{29}Si NMR (119 MHz, $CDCl_3$) δ –2.28 ppm; HRMS (EI) (*m/z*) cald. For $C_{15}H_{26}Si$: 234.1804; found: $C_{15}H_{26}Si$: 273.1801.

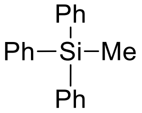


$^{n}\text{Bu}-\text{Si}(\text{Ph})_2-{}^{n}\text{Bu}$

Dibutyldiphenylsilane (3f)

A solution of R^{1}Li (PhLi: 0.07 M in Et_2O, 9.0 mL/min) and a solution of R^{2}Li (*n*-BuLi: 0.4 M in hexane, 4.0 mL/min) were used.

Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.50-7.48 (m, 4H), 7.37-7.34 (m, 6H), 1.35-1.32 (m, 8H), 1.09-1.06 (m, 4H), 0.88-0.85 (m, 6H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 136.7, 134.9, 129.0, 127.7, 26.7, 25.9, 13.7, 12.3 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –6.69 ppm; HRMS (EI) (*m/z*) cald. For $C_{20}H_{28}Si$: 296.1960; found: $C_{19}H_{28}Si$: 296.1961.

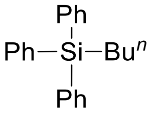


$\text{Ph}-\text{Si}(\text{Ph})_2-\text{Me}$

Methyltriphenylsilane (3g)

A solution of R^{1}Li (MeLi: 0.07 M in Et_2O, 9.0 mL/min) and a solution of R^{2}Li (PhLi: 0.4 M in Et_2O, 4.0 mL/min) were used.

White solid; mp 67.1-68.1 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.55-7.53 (m, 6H), 7.45-7.42 (m, 3H), 7.40-7.37 (m, 6H), 0.87 (s, 3H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 136.1, 135.3, 129.4, 127.8, –3.4 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –11.03 ppm. The melting point was matched with those reported in the literature.[3] The spectroscopic data were identical to those reported in the literature.[4] The product **3g** is identical to product **1c**.



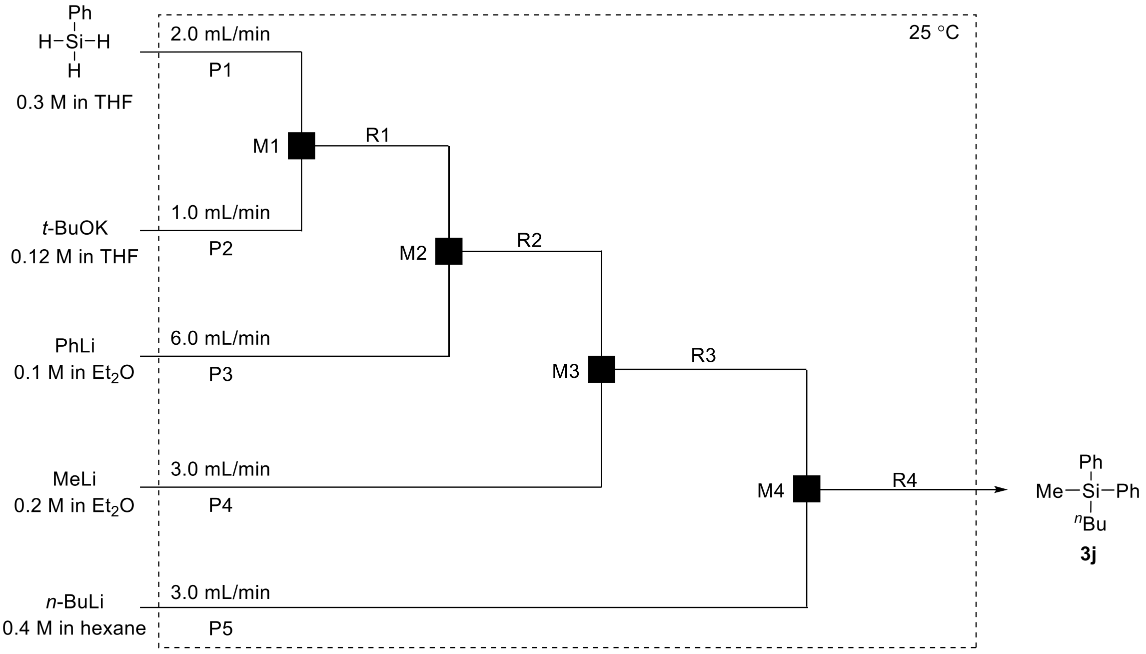
$\text{Ph}-\text{Si}(\text{Ph})_2-\text{Bu}^{n}$

Butyltriphenylsilane (3h)

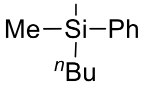
A solution of R^{1}Li (*n*-BuLi: 0.07 M in hexane, 9.0 mL/min) and a solution of R^{2}Li (PhLi: 0.4 M in Et_2O, 4.0 mL/min) were used.

Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.53-7.51 (m, 6H), 7.41-7.38 (m, 3H), 7.37-7.34 (m, 6H), 1.48-1.42 (m, 2H), 1.40-1.35 (m, 4H), 0.87 (t, J = 7.1 Hz, 3H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 135.7, 135.4, 129.3, 127.8, 26.8, 26.1, 13.7, 13.0 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –10.71 ppm. The spectroscopic data were identical to those reported in the literature.[14] The product **3h** is identical to product **2c**.

7.3. Sequential tri-functionalization of phenylsilane with three different organolithiums



A microfluidic system consisting of four T-shaped micromixers (M1, M2, M3 and M4), four tube reactors (R1, R2, R3 and R4) and five tube pre-temperature-retaining units (for P1, P2, P3, P4 and P5; ø = 1 mm and $L = 100$ cm) were used. The microfluidic system was immersed in a temperature control bath. A solution of phenylsilane (0.3 M in THF, flow rate: 2.0 mL/min) and a solution of *t*-BuOK (0.12 M in THF, flow rate: 1.0 mL/min) were introduced to M1 (ø: 300 μm) by syringe pumps. The resulting solution flowed through R1 (ø = 250 μm, $L = 4.0$ cm) and was mixed in M2 (ø = 500 μm) with a solution of PhLi (0.1 M in Et_2O, flow rate: 6.0 mL/min) and pass through R2 (ø = 1000 μm, $L = 1000$ cm). The resulting solution was mixed in M3 with a solution of MeLi (0.2 M in Et_2O, flow rate: 3.0 mL/min) and flowed through R3 (ø = 1000 μm, $L = 1000$ cm) and mixed in M4 with a solution of *n*-BuLi (0.4 M in hexane, flow rate: 3.0 mL/min). The resulting solution was passed through R4 (ø = 1000 μm, $L = 1000$ cm). After a steady state was reached (90 s), the product solution was collected for 4 min while being quenched with saturated NH_4Cl aqueous solution (16 mL). The resulting mixture was extracted with Et_2O (40 mL×3), and washed with brine (40 mL). The organic phase was dried over sodium sulfate. The organic layer was concentrated on a rotary evaporator under reduced pressure. The crude product was purified by column chromatography to give the desired product.



Butyl(methyl)diphenylsilane (3j)

Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.52-7.50 (m, 4H), 7.37-7.34 (m, 6H), 1.37-1.34 (m, 4H), 1.08-1.06 (m, 2H), 0.90-0.85 (m, 3H), 0.547 (s, 3H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 137.6, 134.5, 129.0, 127.8, 26.6, 26.0, 13.9, 13.7 –4.5 ppm; ^{29}Si NMR (99 MHz, $CDCl_3$) δ –7.09 ppm. The spectroscopic data were identical to those reported in the literature.[18]

8. References

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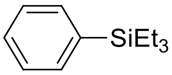
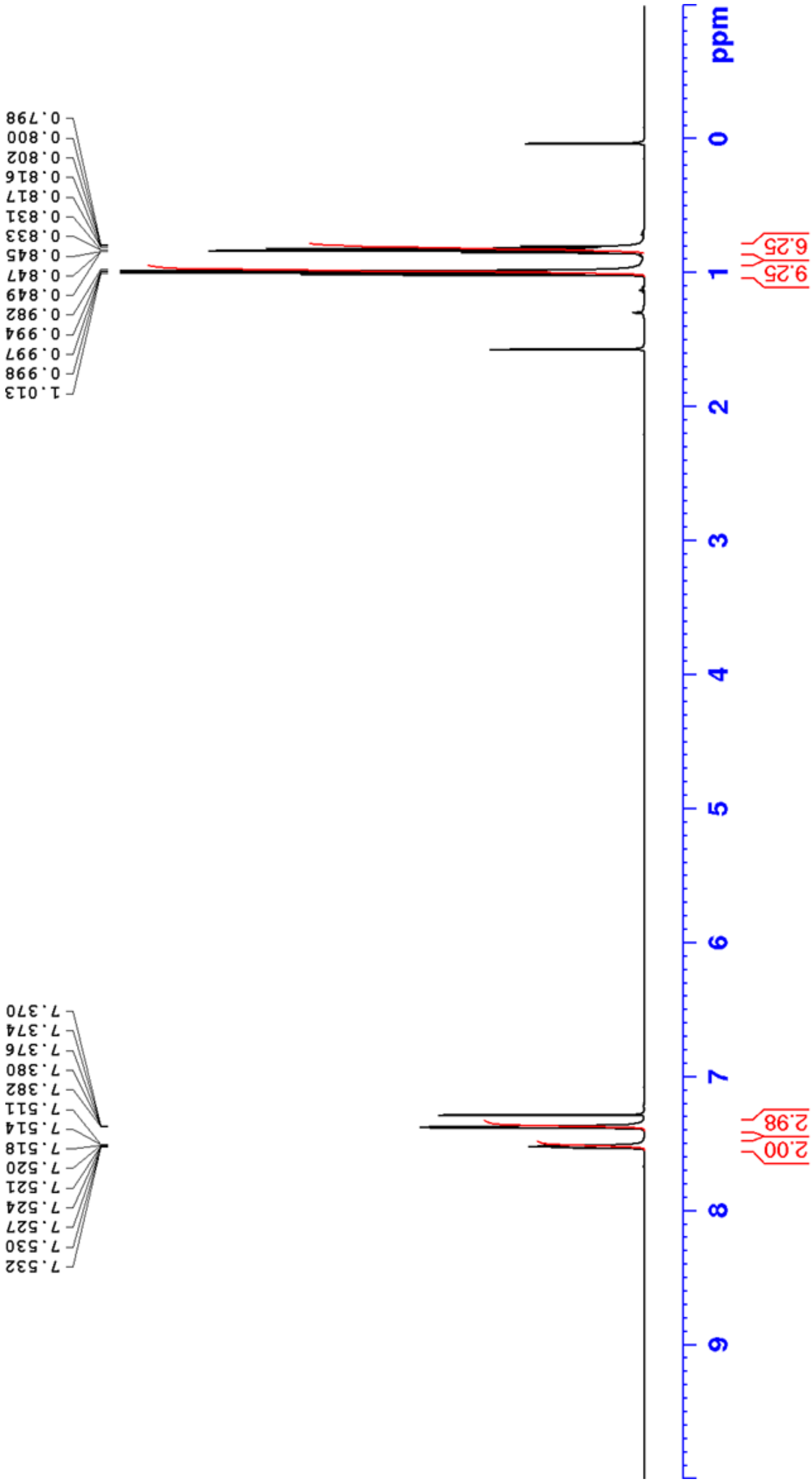
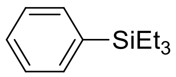
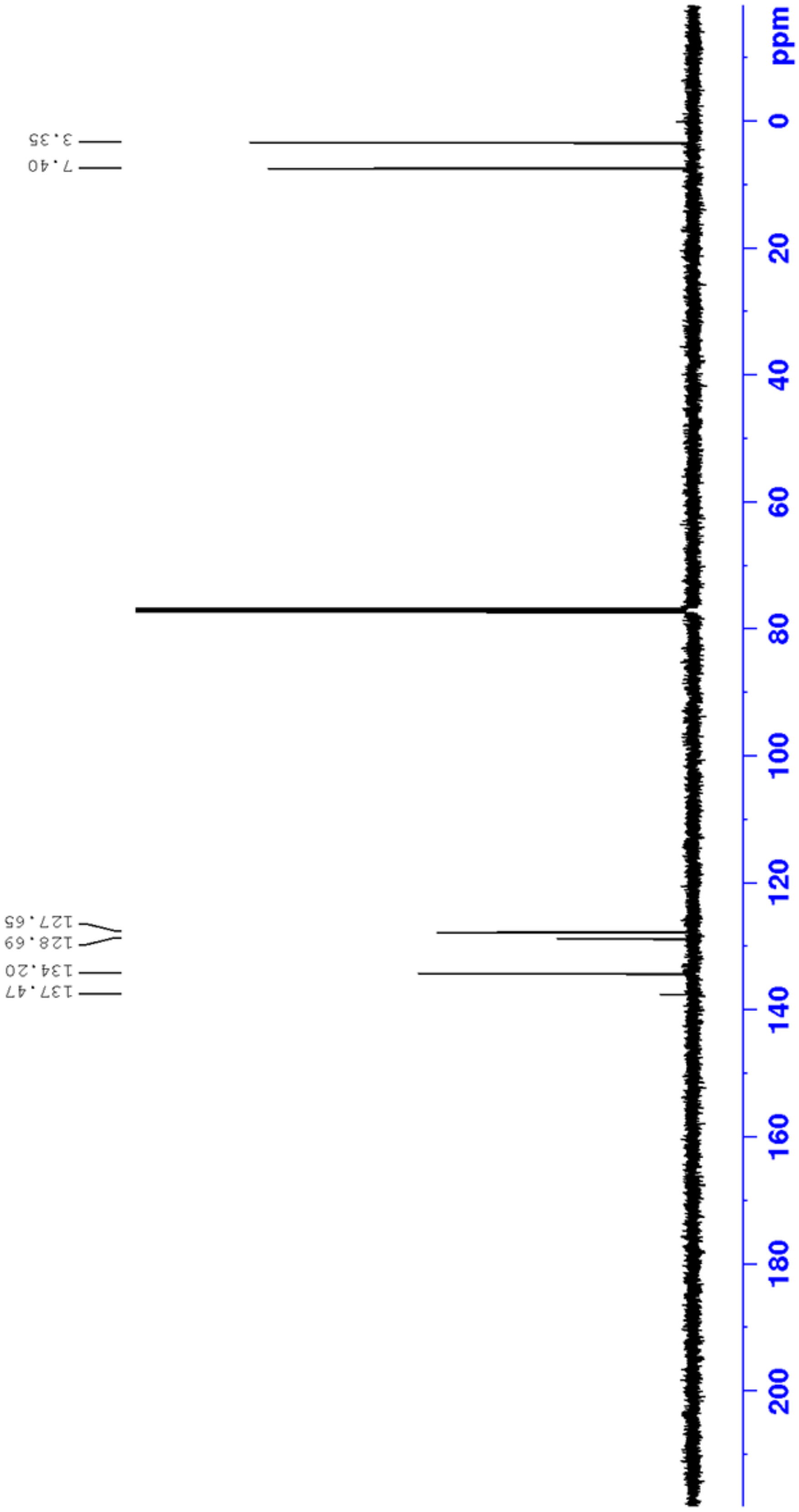
^{1}H NMR spectra of **triethyl(phenyl)silane (1a)**



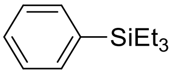


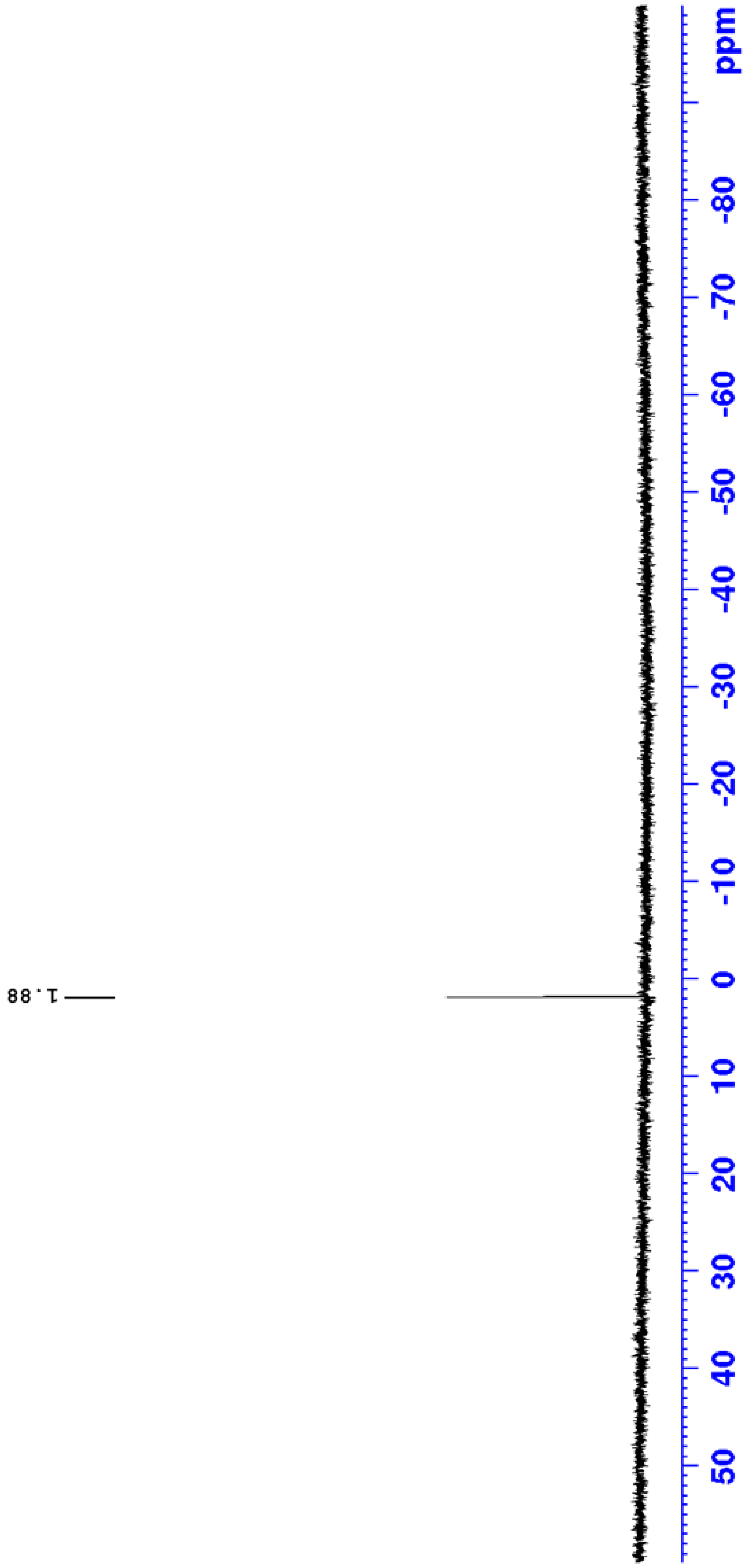
^{13}C and ^{29}Si NMR spectra of **triethyl(phenyl)silane (1a)**



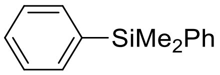


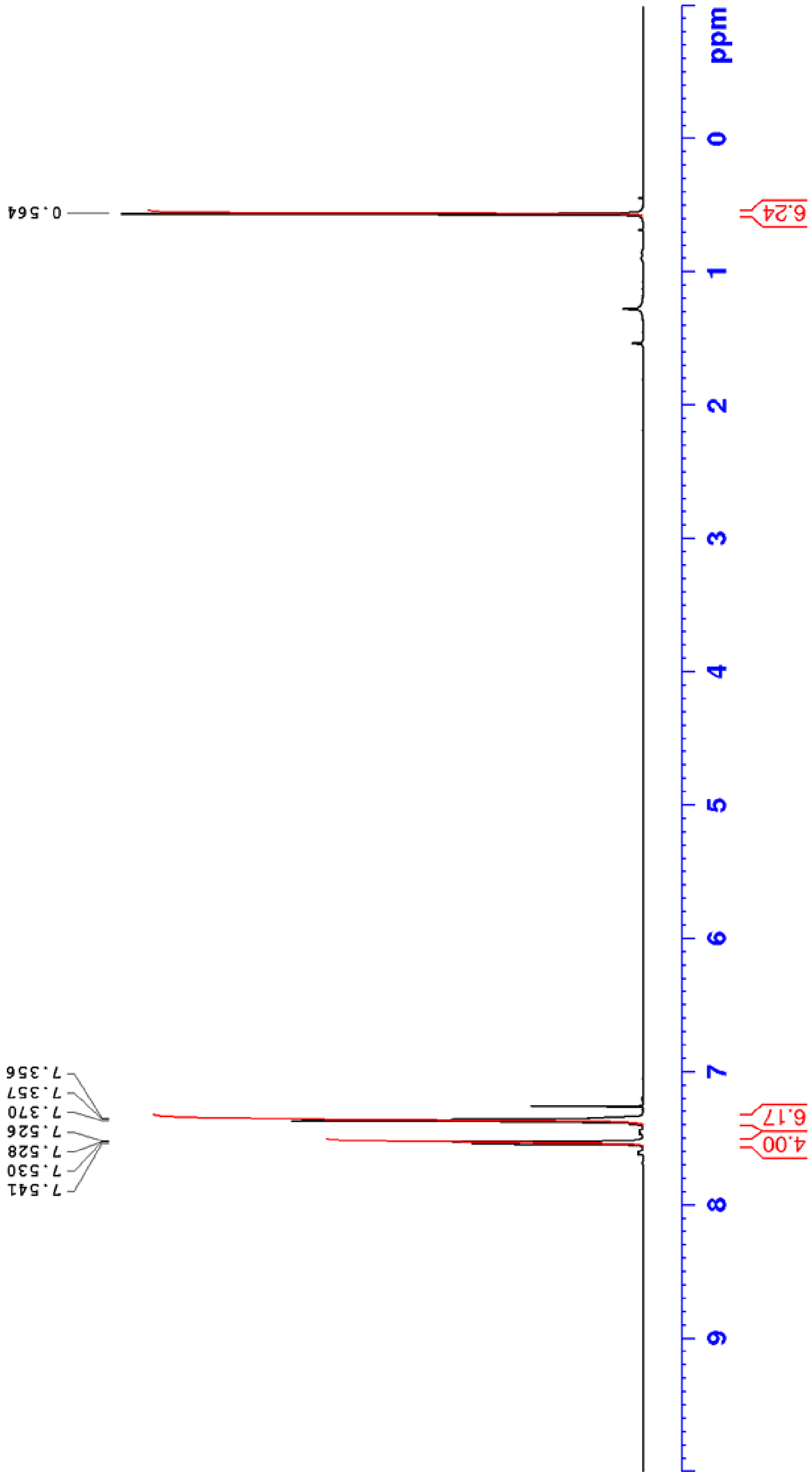
^{29}Si NMR spectra of **triethyl(phenyl)silane (1a)**



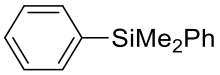


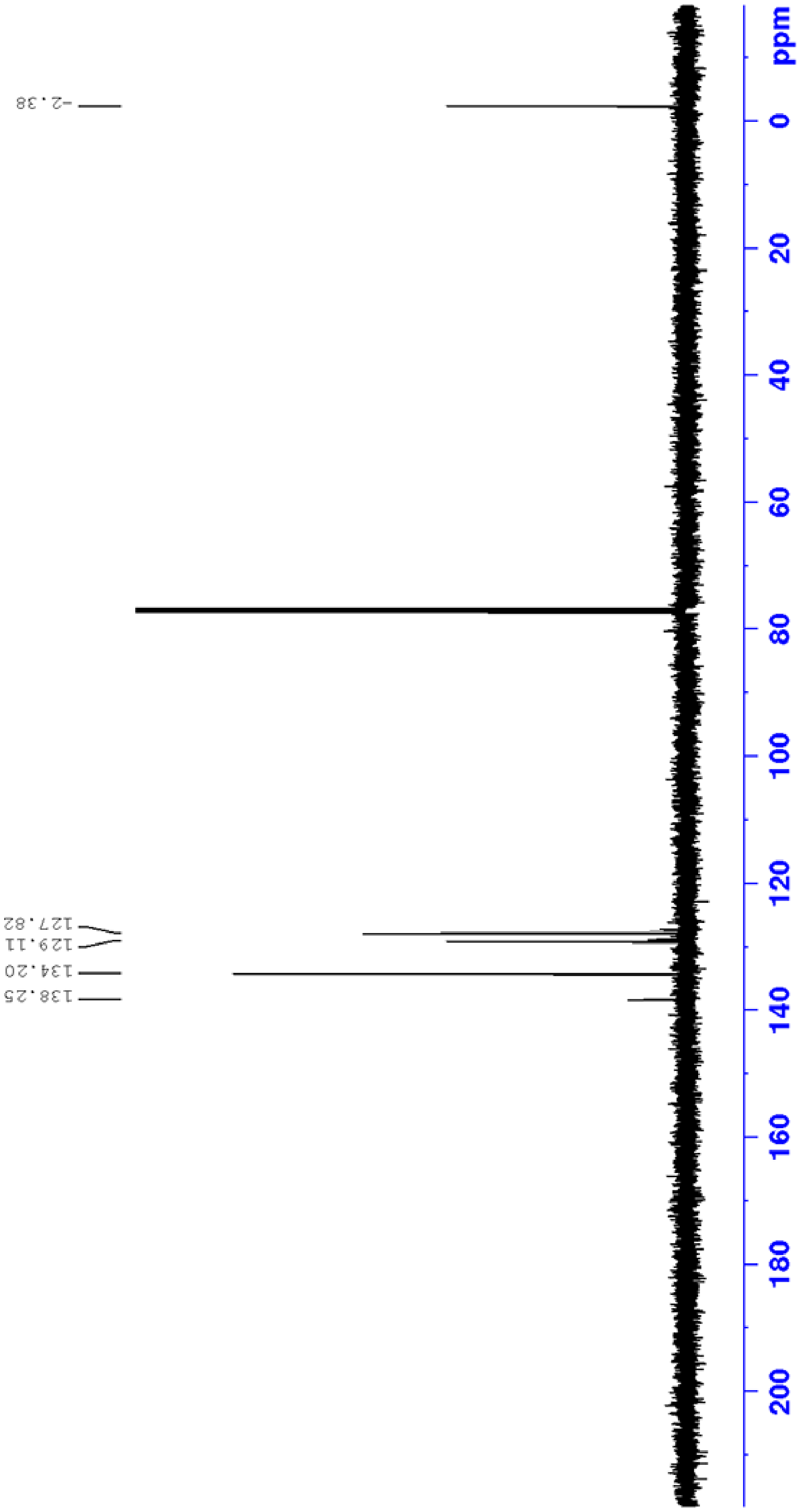
^{1}H NMR spectra of **dimethyldiphenylsilane (1b)**



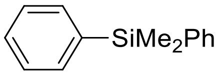


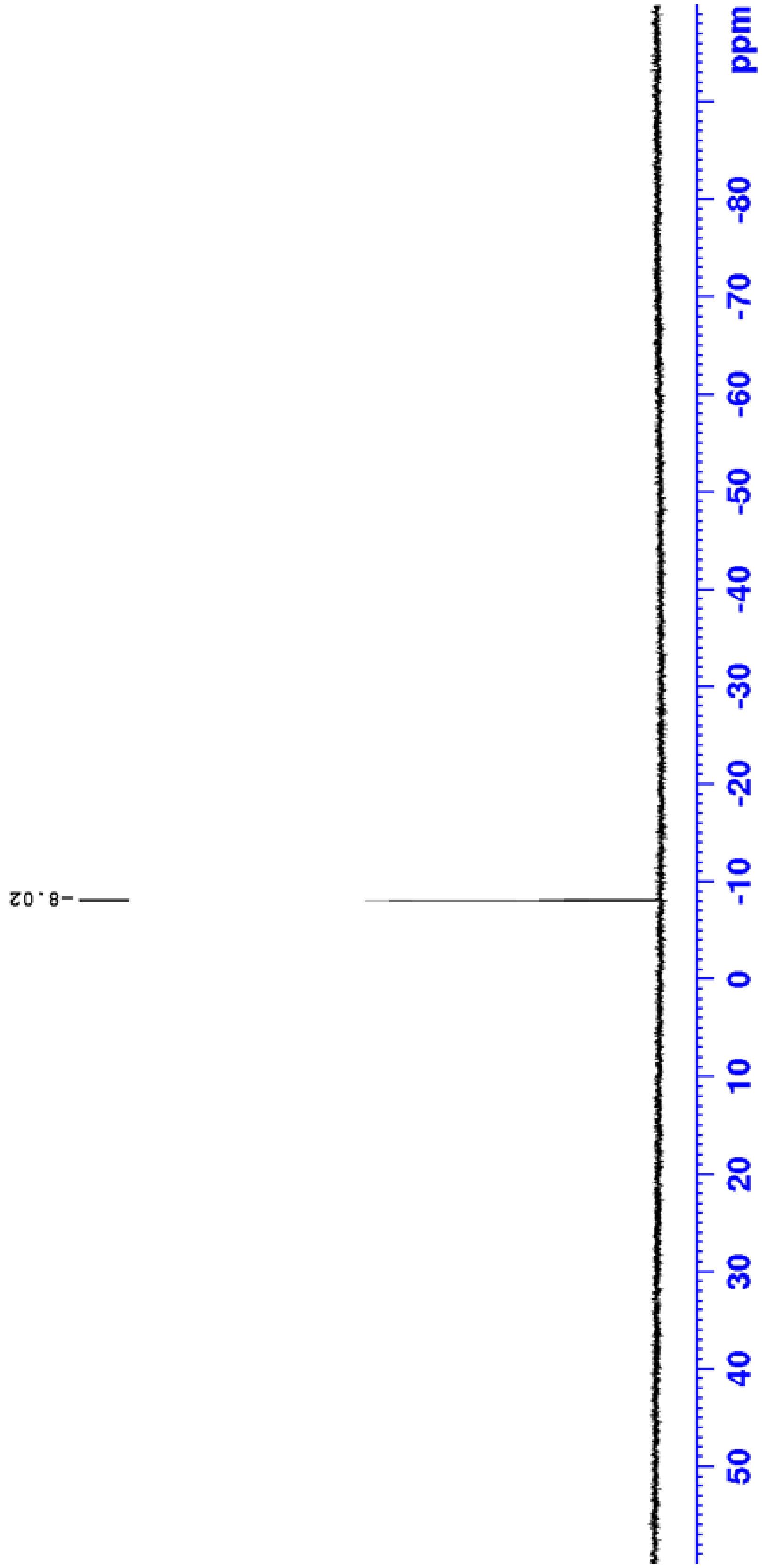
^{13}C NMR spectra of **dimethyldiphenylsilane (1b)**



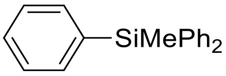


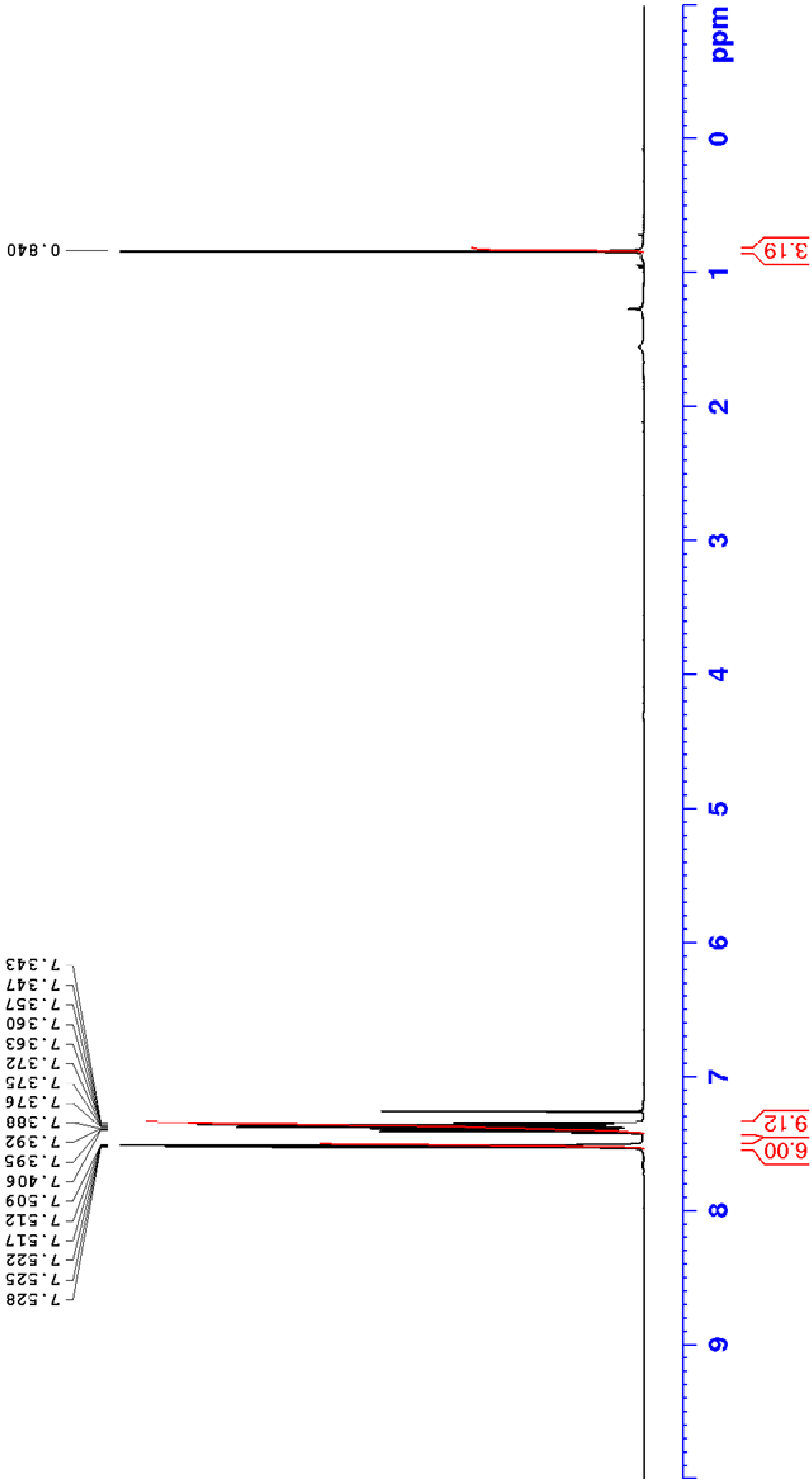
^{29}Si NMR spectra of **dimethyldiphenylsilane (1b)**



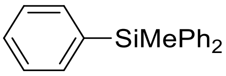


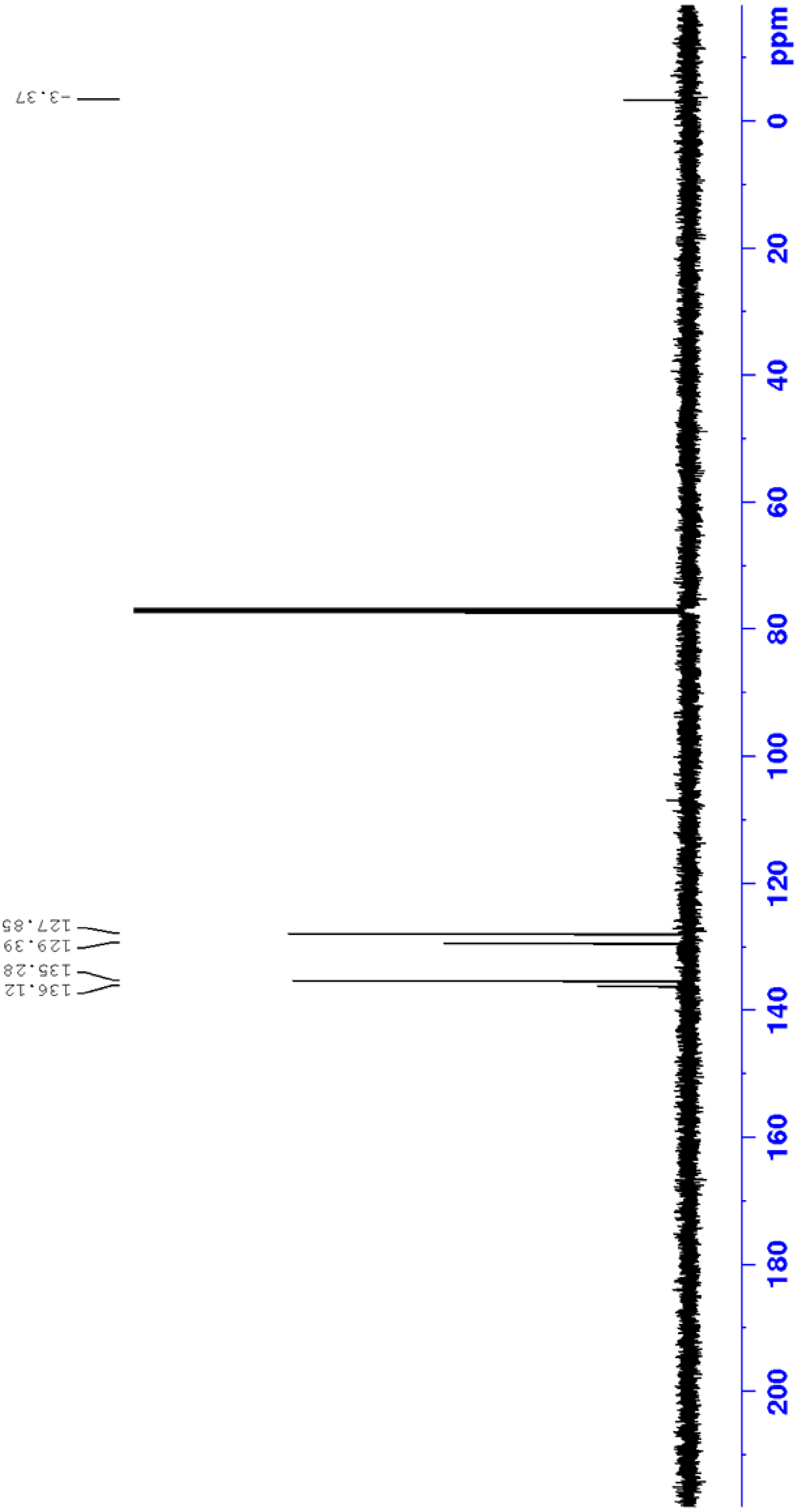
^{1}H NMR spectra of **methyltriphenylsilane (1c)**



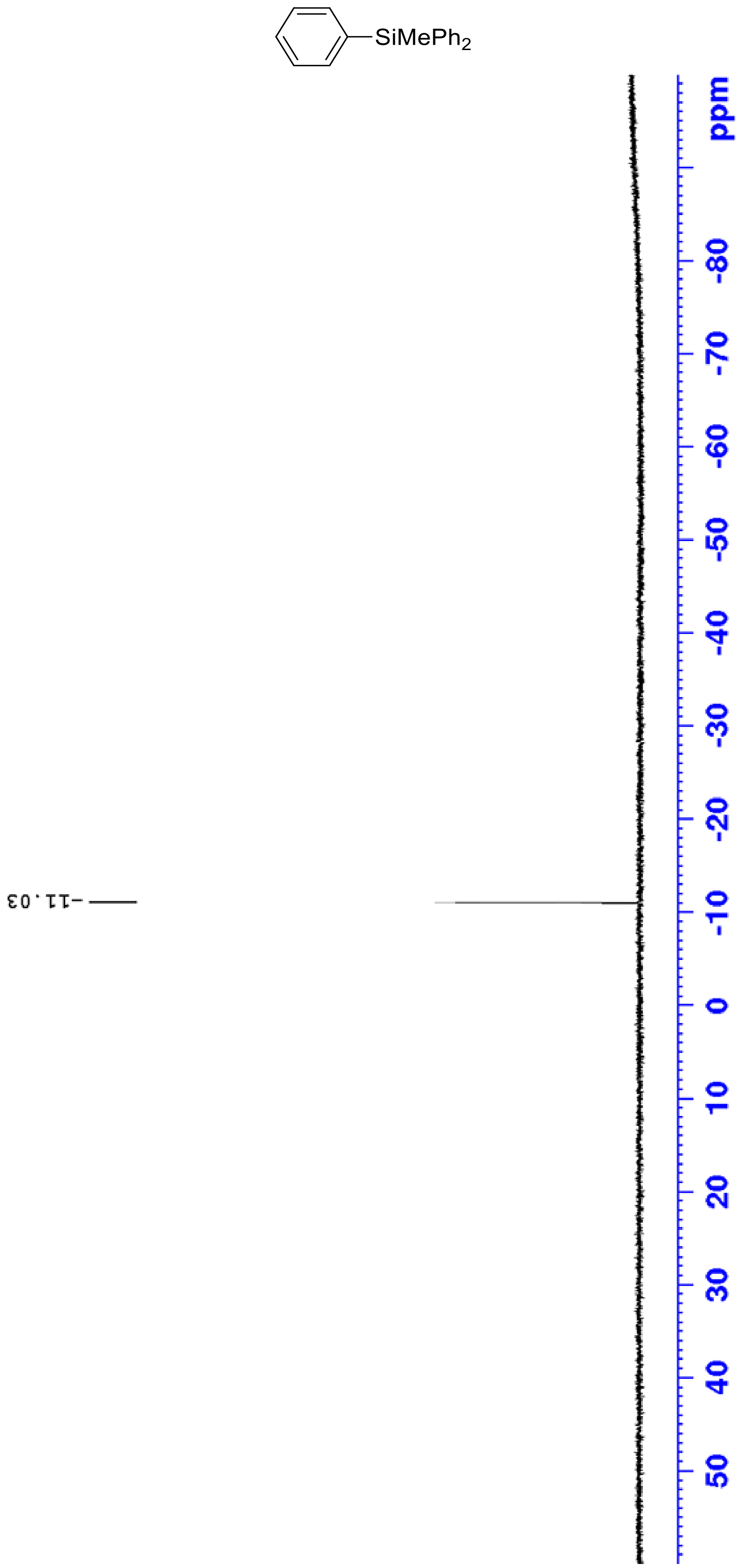


^{13}C NMR spectra of **methyltriphenylsilane (1c)**





^{29}Si NMR spectra of **methyltriphenylsilane (1c)**



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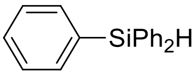

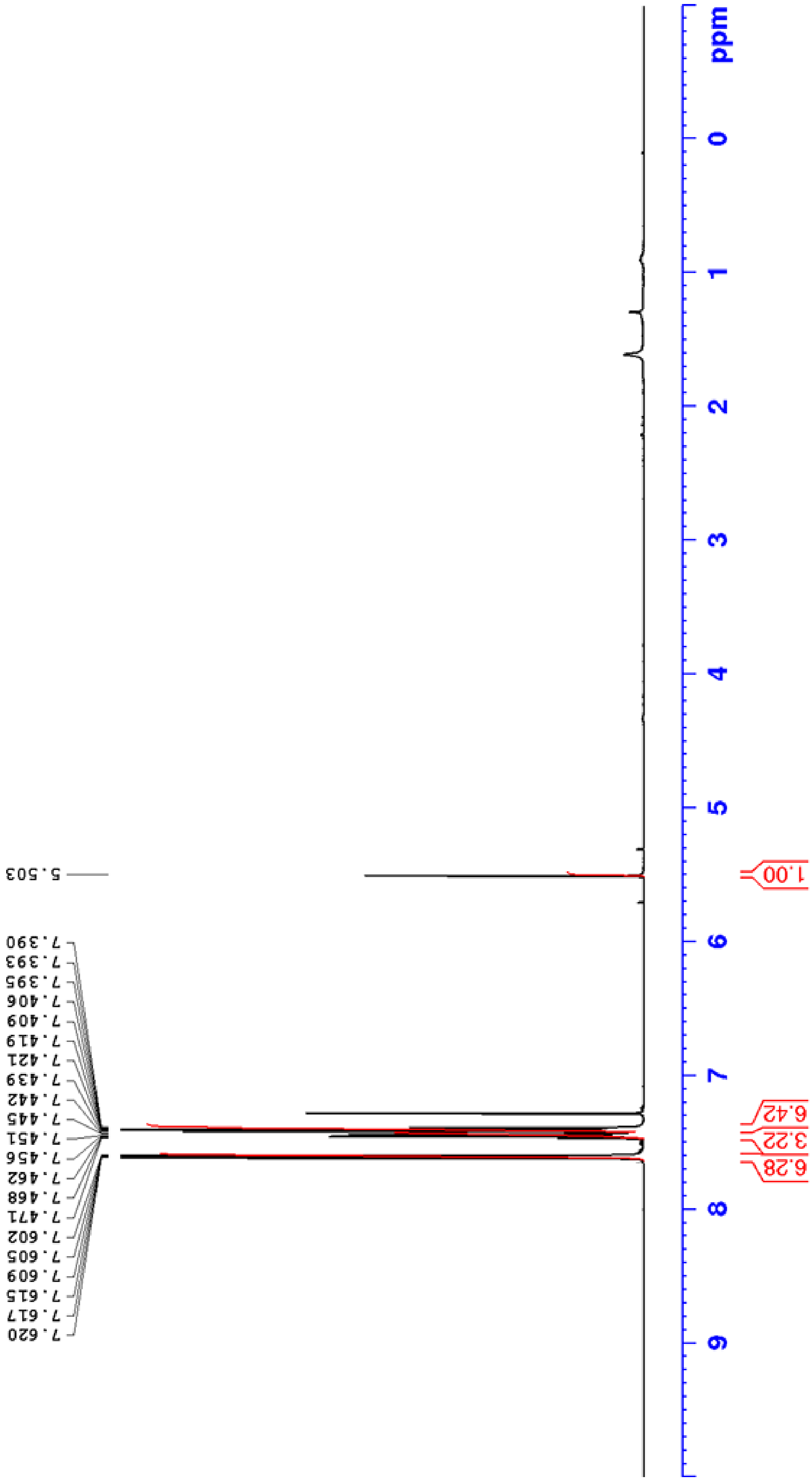

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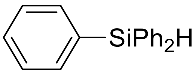

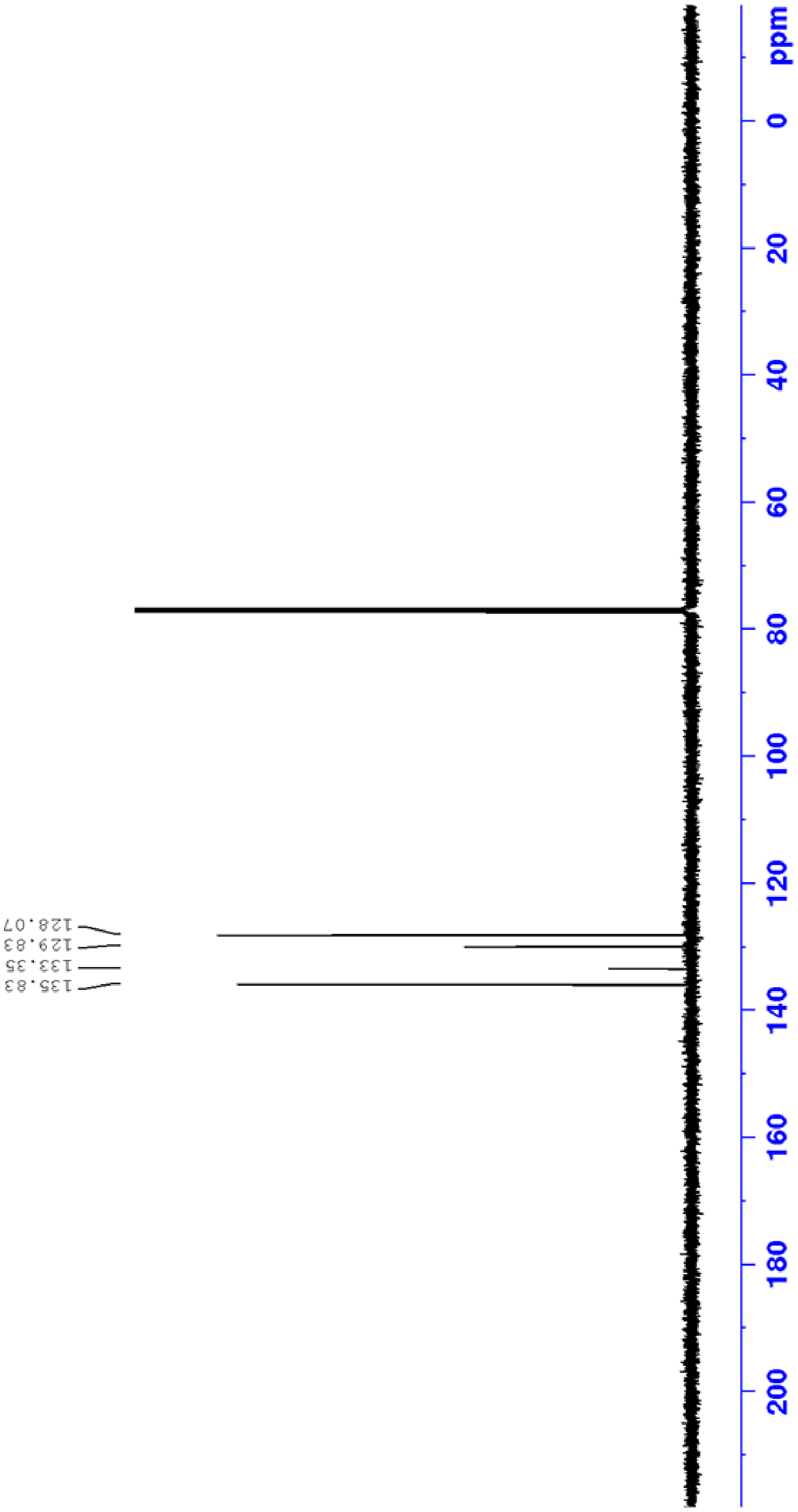

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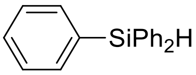
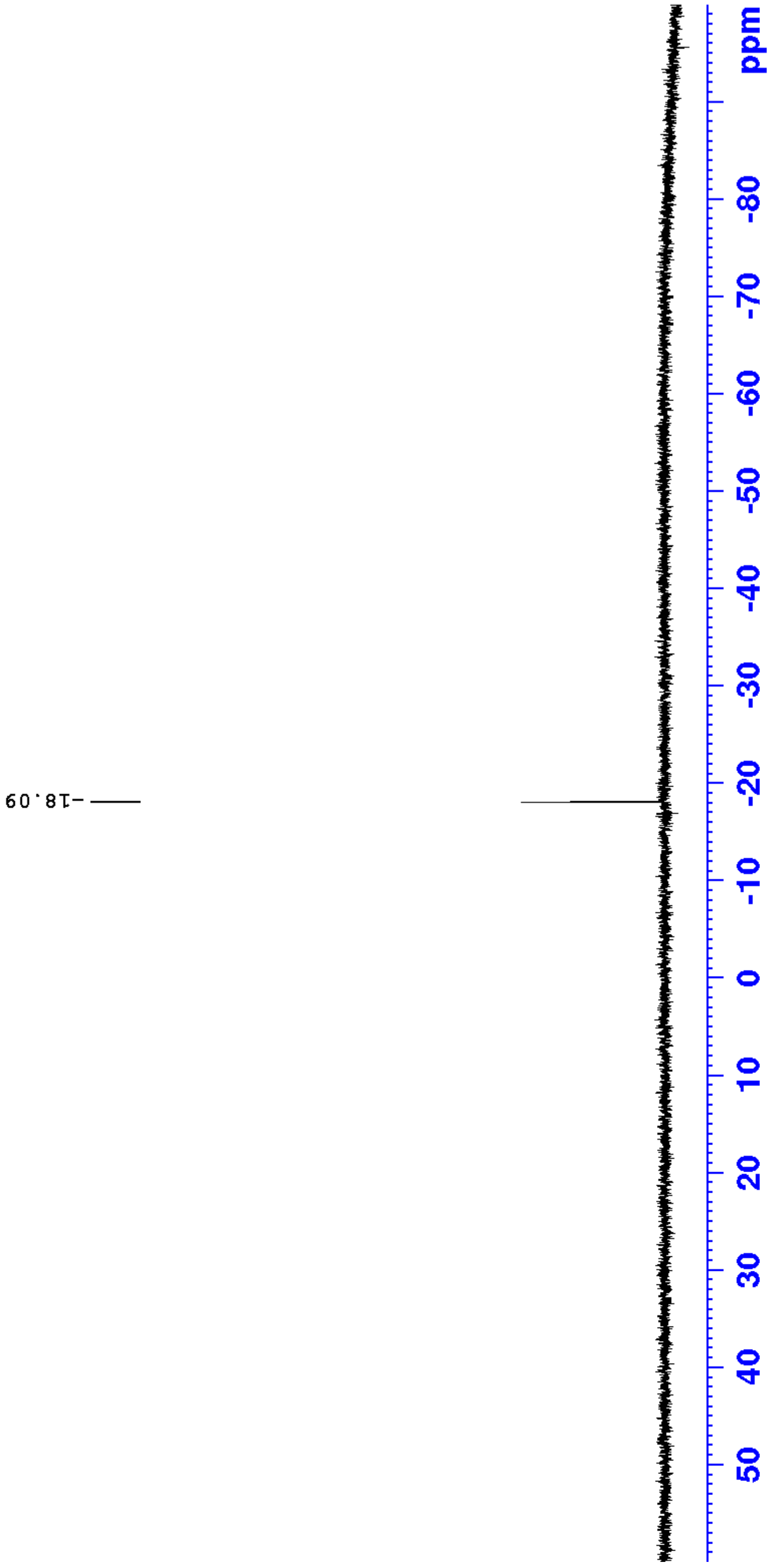
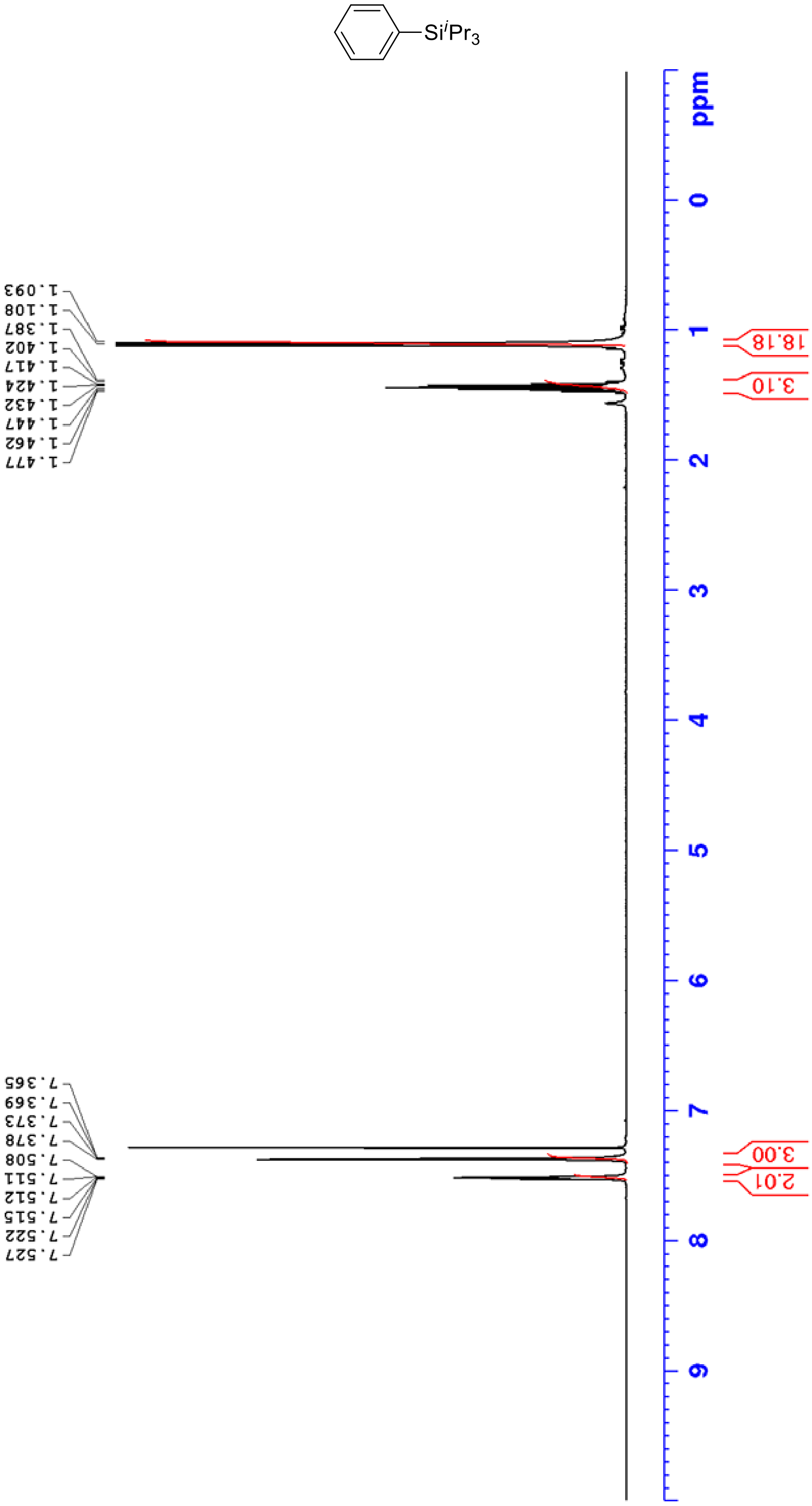
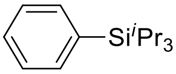


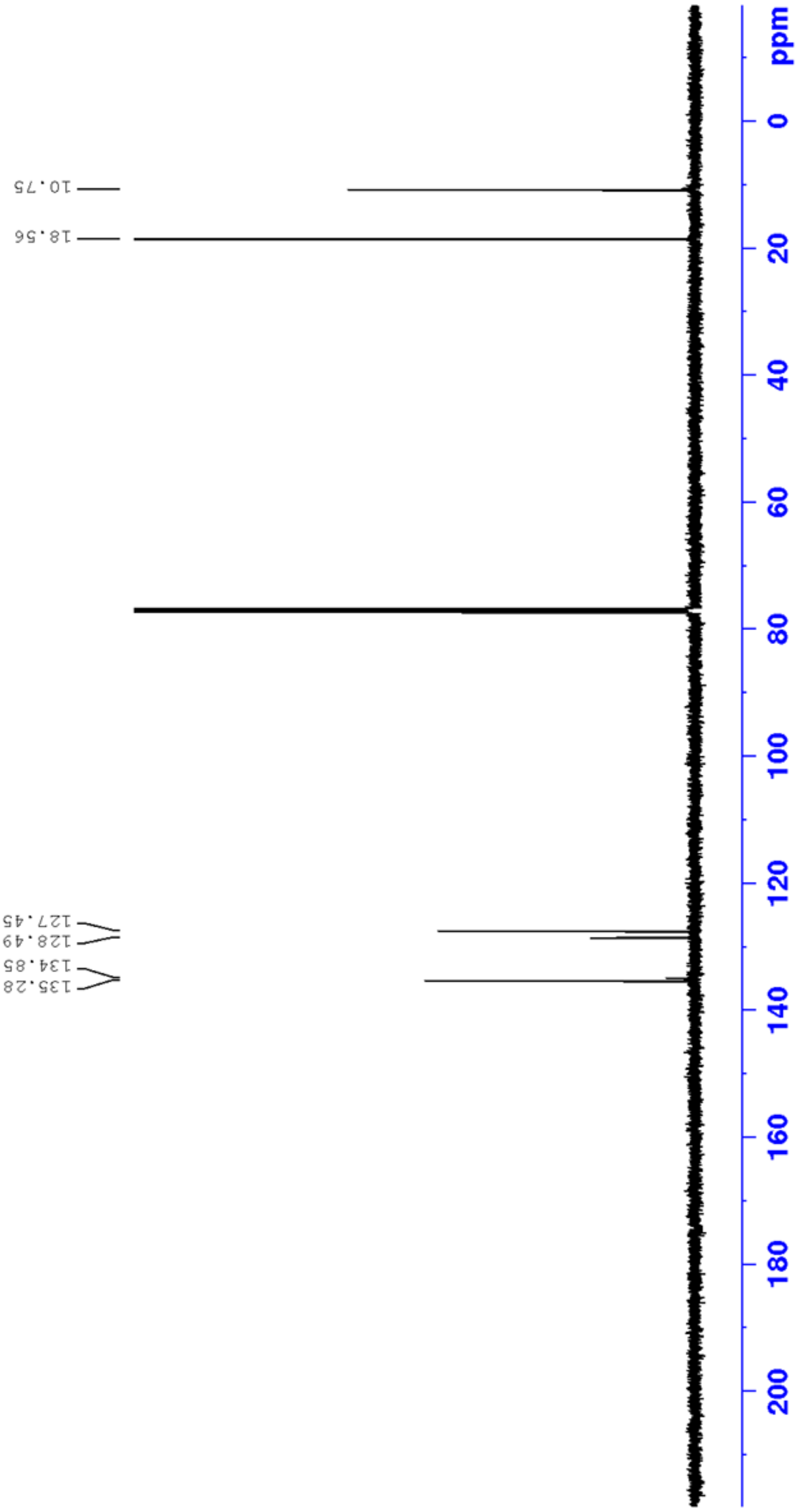


^{1}H spectra of **triisopropyl(phenyl)silane (1e)**

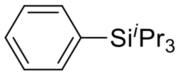


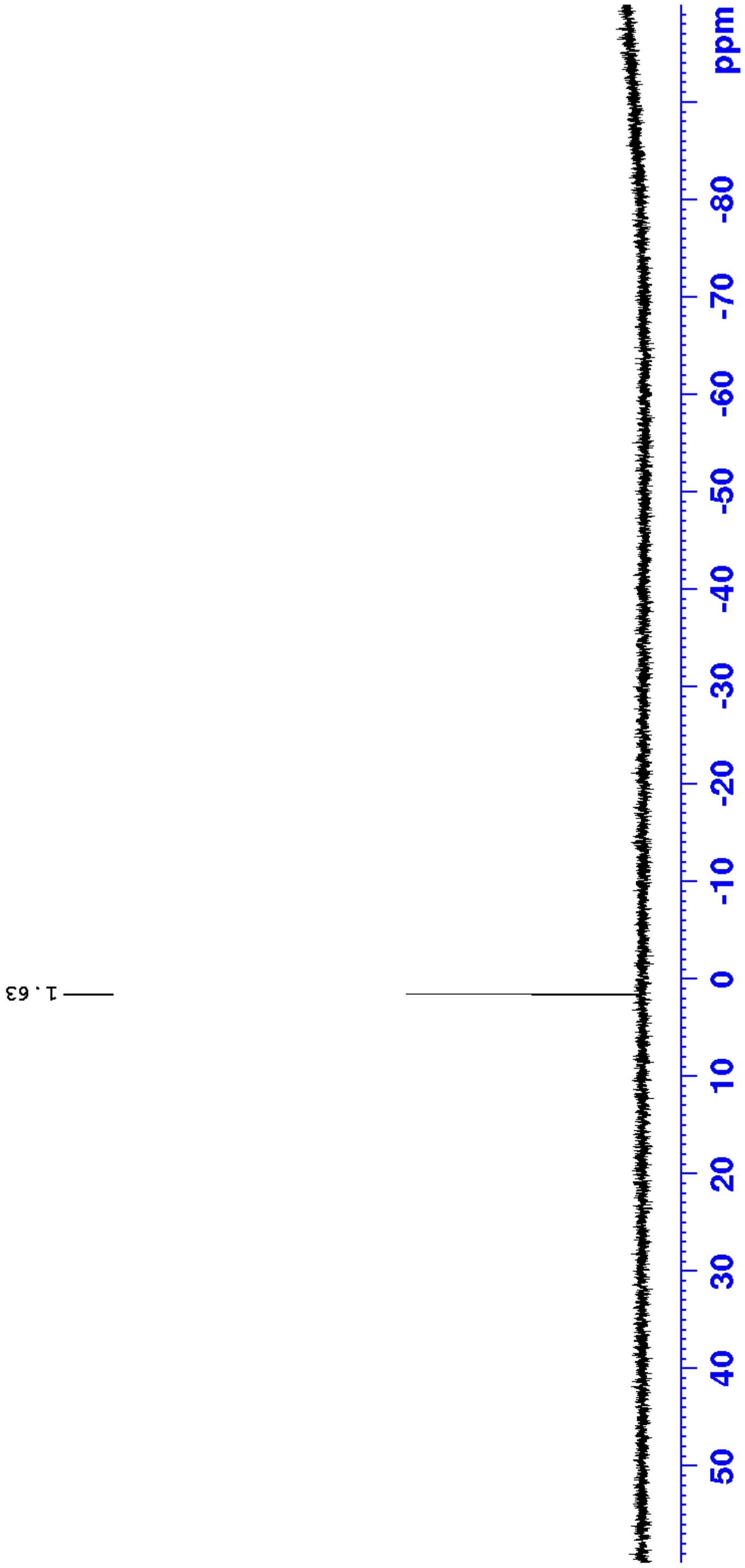
^{13}C NMR spectra of **triisopropyl(phenyl)silane (1e)**



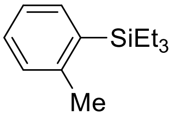


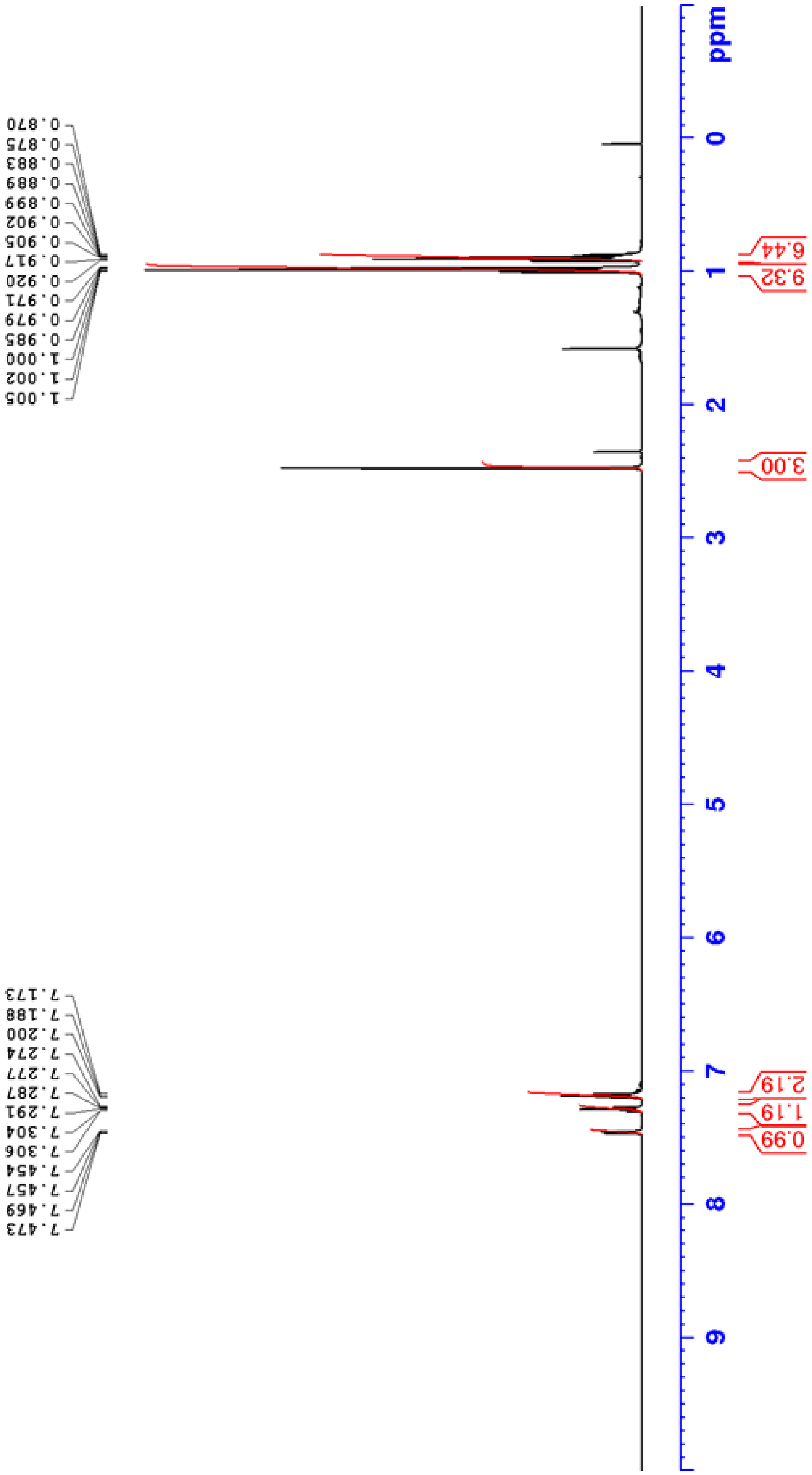
^{29}Si NMR spectra of **triisopropyl(phenyl)silane (1e)**



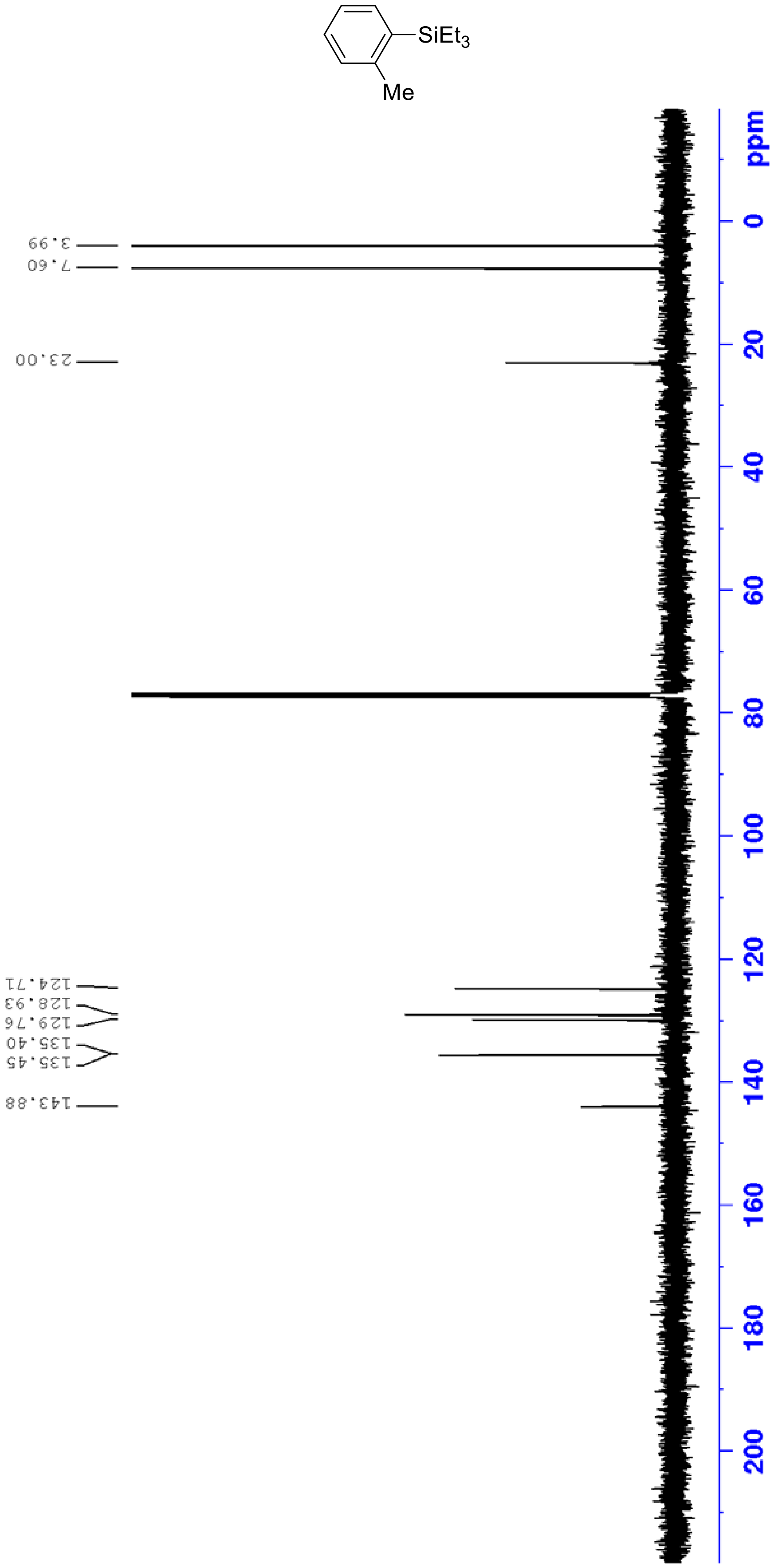


^{1}H, ^{13}C and ^{29}Si NMR spectra of **triethyl(*o*-tolyl)silane (1f)**

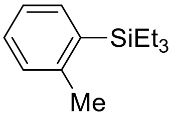


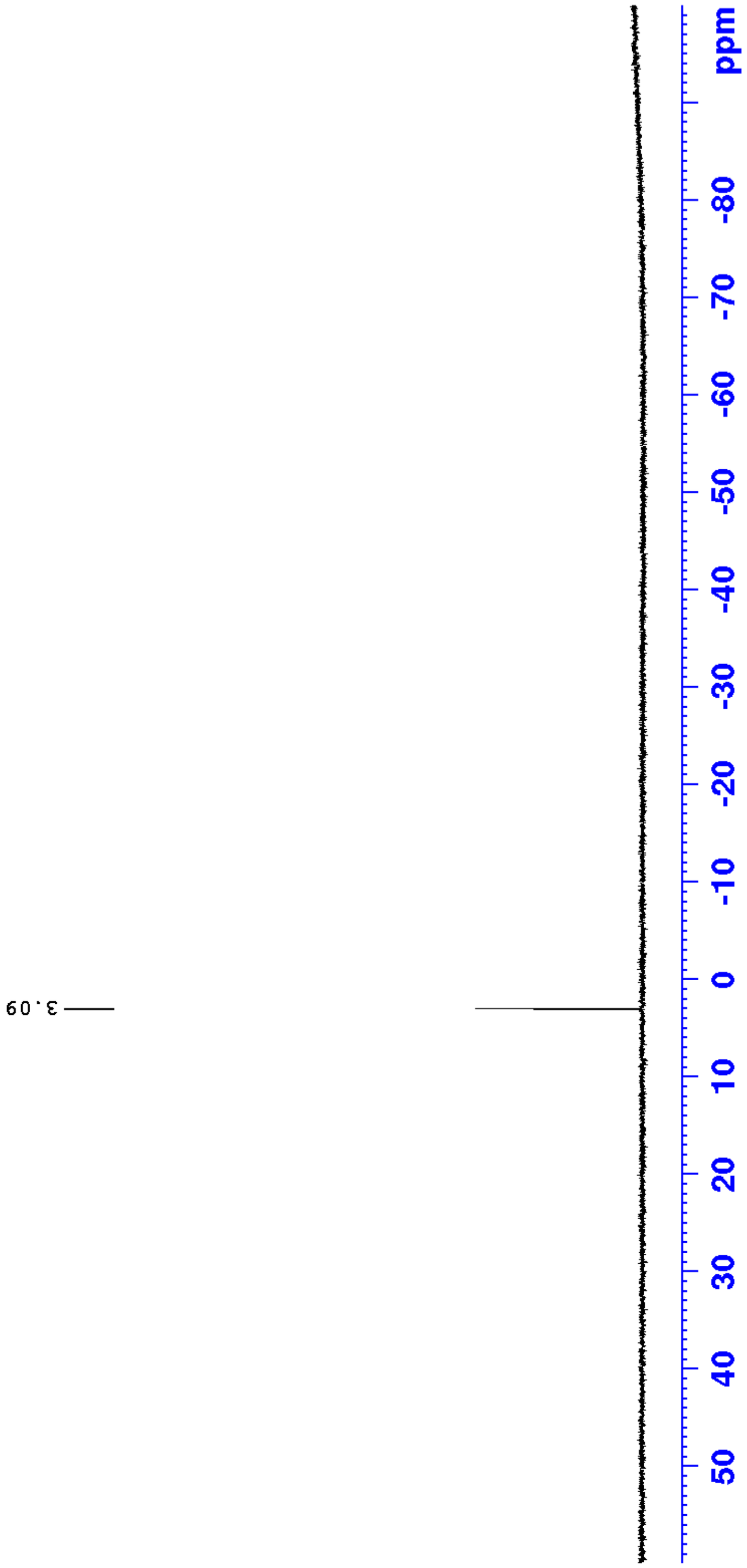


^{13}C NMR spectra of **triethyl(*o*-tolyl)silane (1f)**

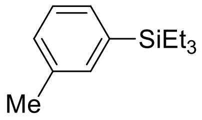


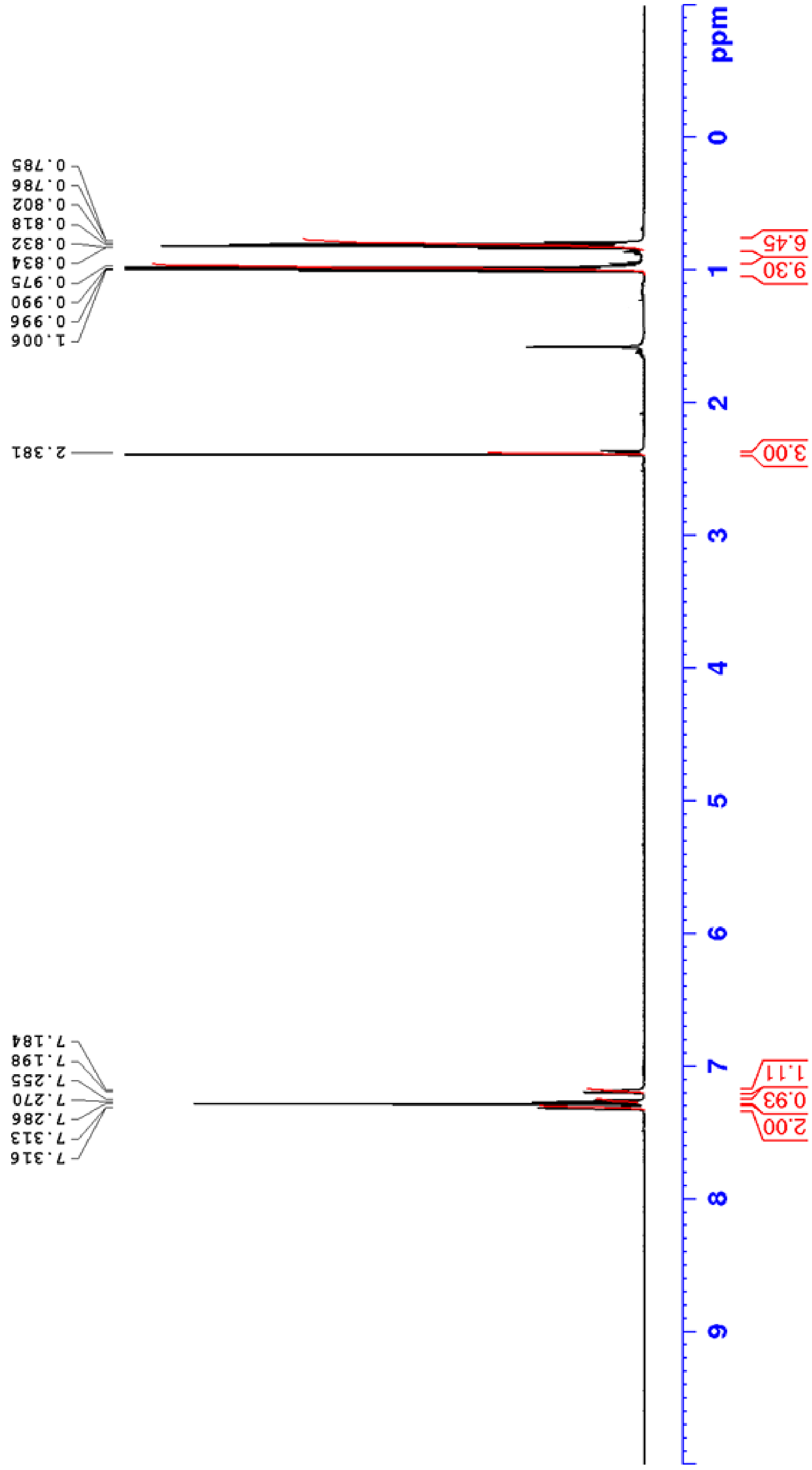
^{29}Si NMR spectra of **triethyl(*o*-tolyl)silane (1f)**



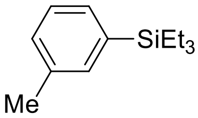


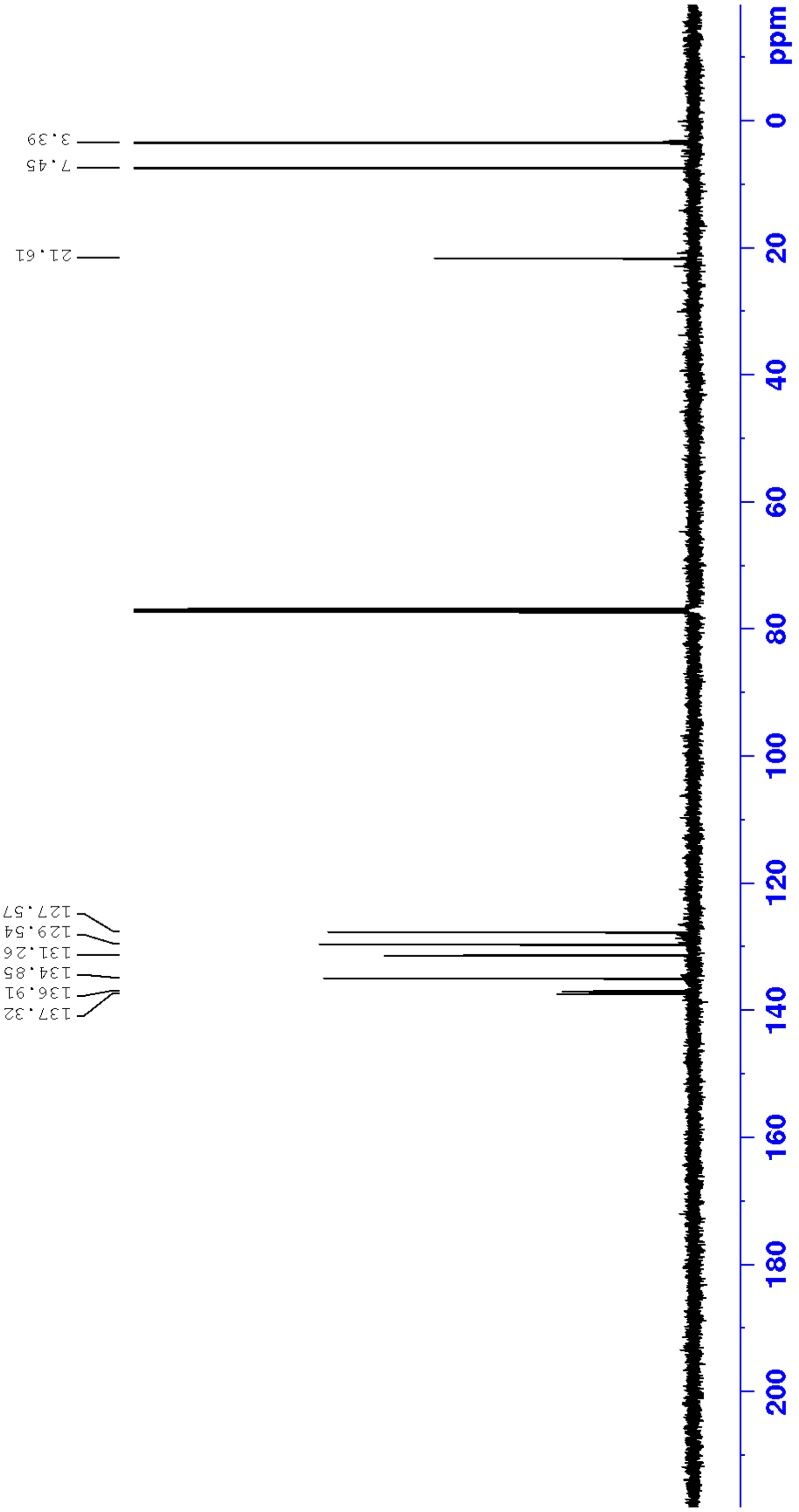
^{1}H, ^{13}C and ^{29}Si NMR spectra of **triethyl(*m*-tolyl)silane (1g)**



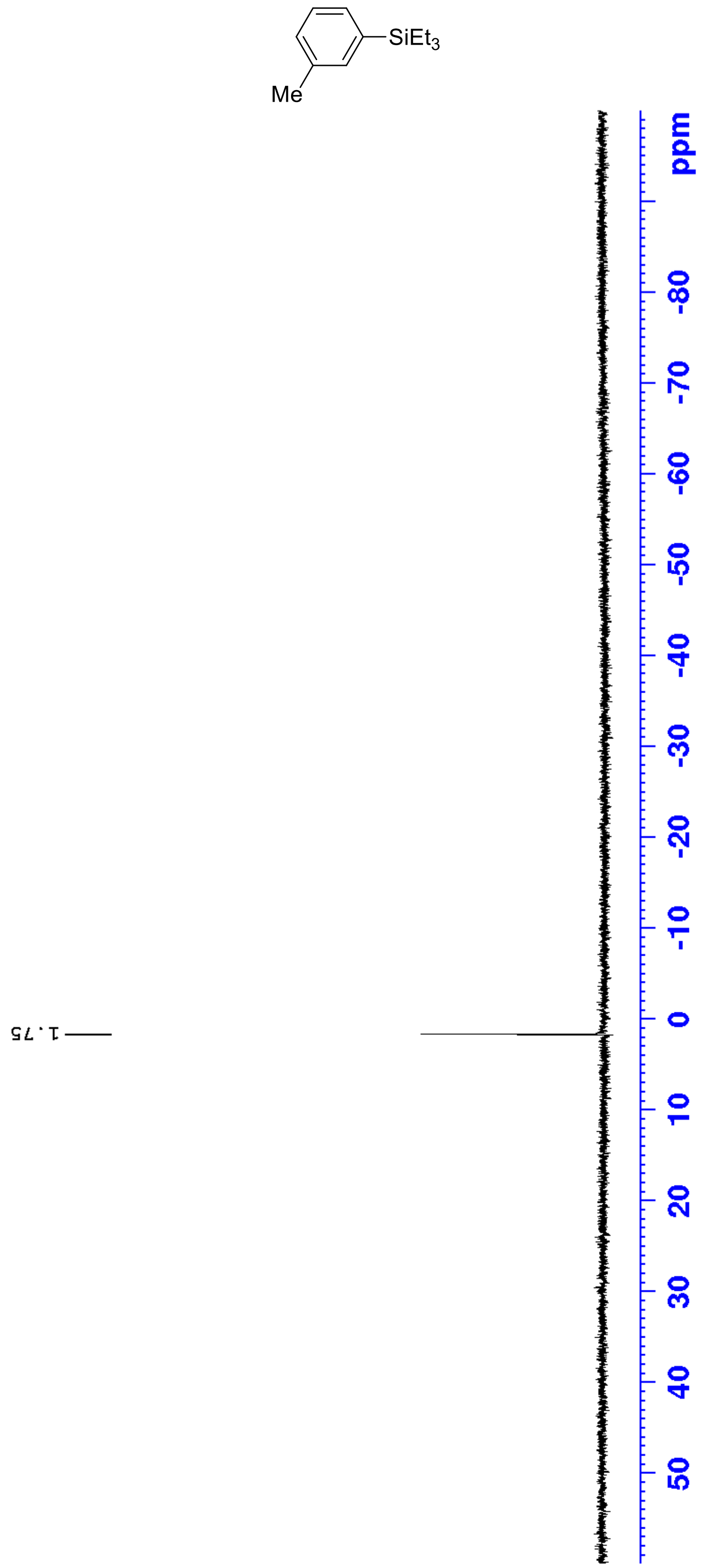


^{13}C NMR spectra of **triethyl(*m*-tolyl)silane (1g)**

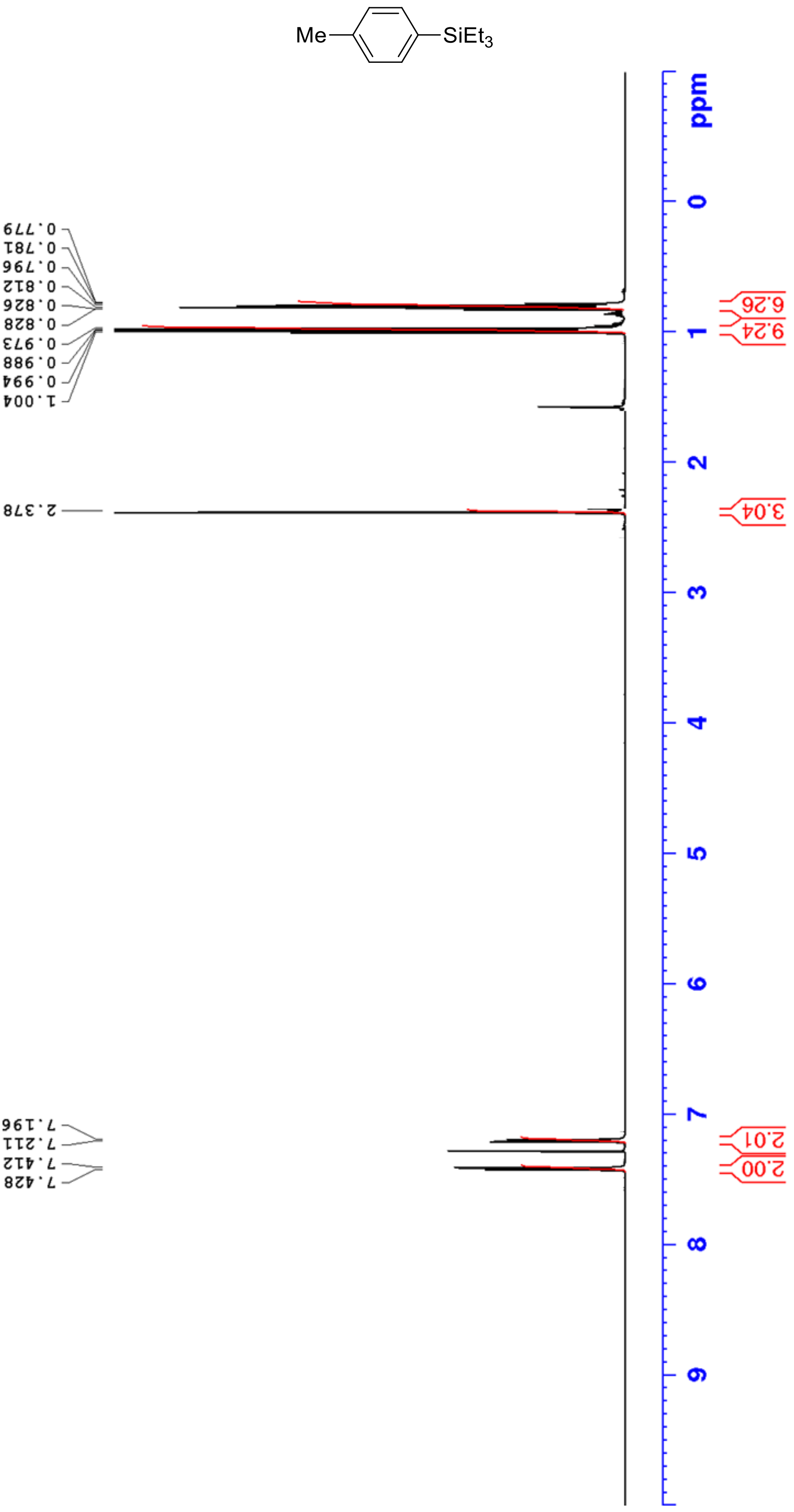




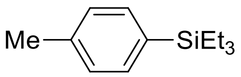
^{29}Si NMR spectra of **triethyl(*m*-tolyl)silane (1g)**

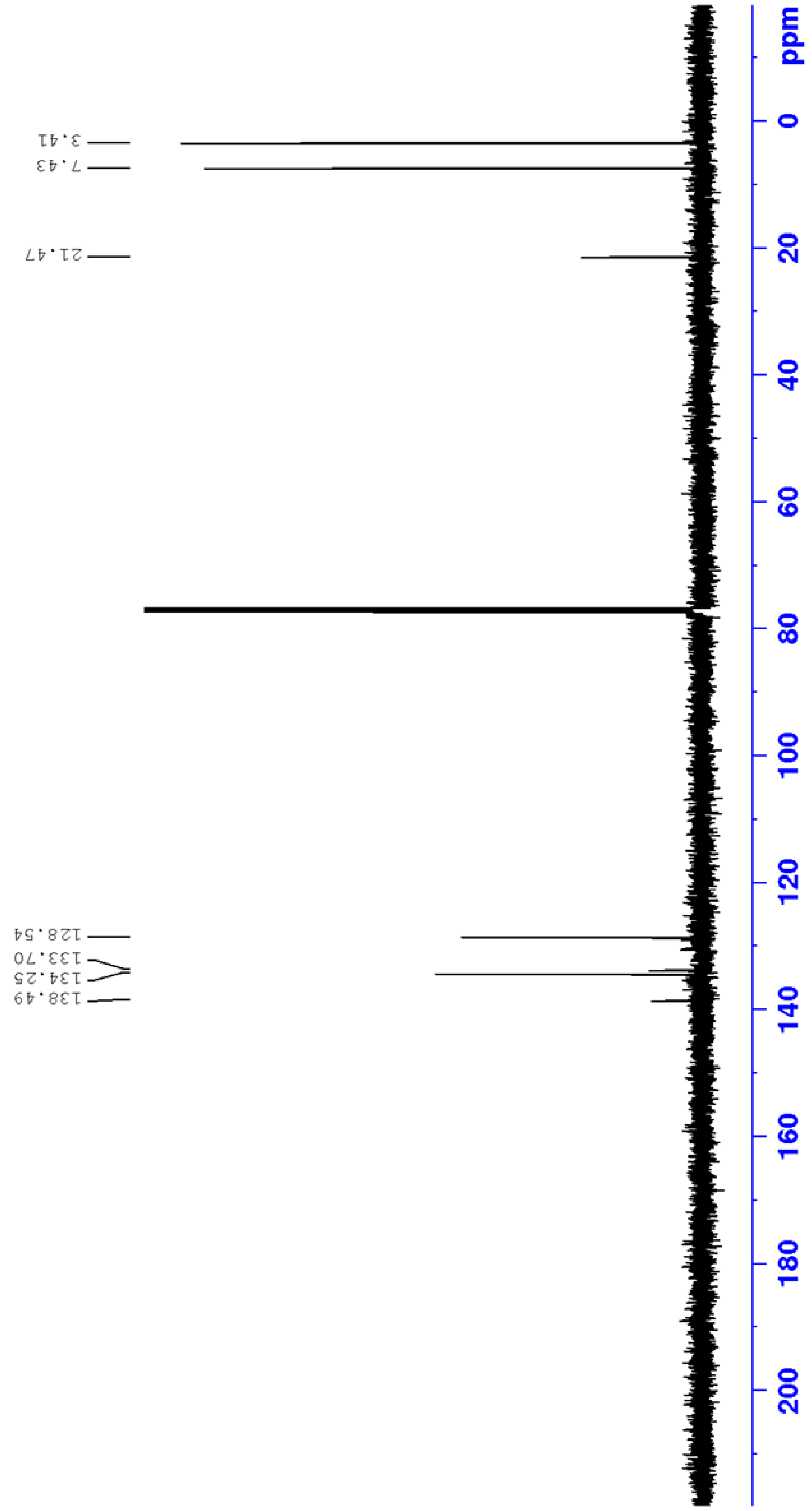


^{1}H, ^{13}C and ^{29}Si NMR spectra of **triethyl(*p*-tolyl)silane (1h)**

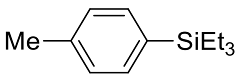


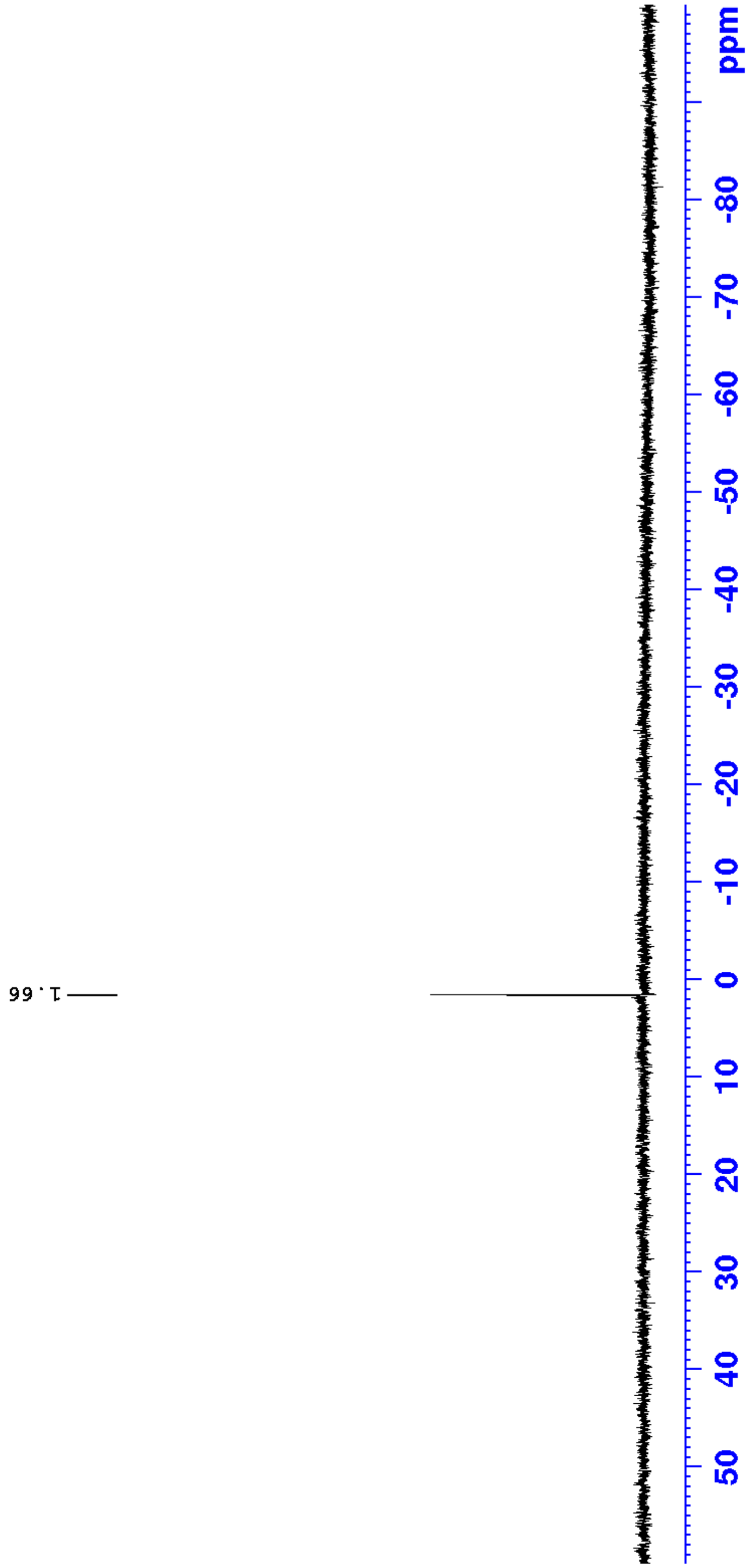
^{13}C NMR spectra of **triethyl(*p*-tolyl)silane (1h)**



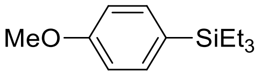


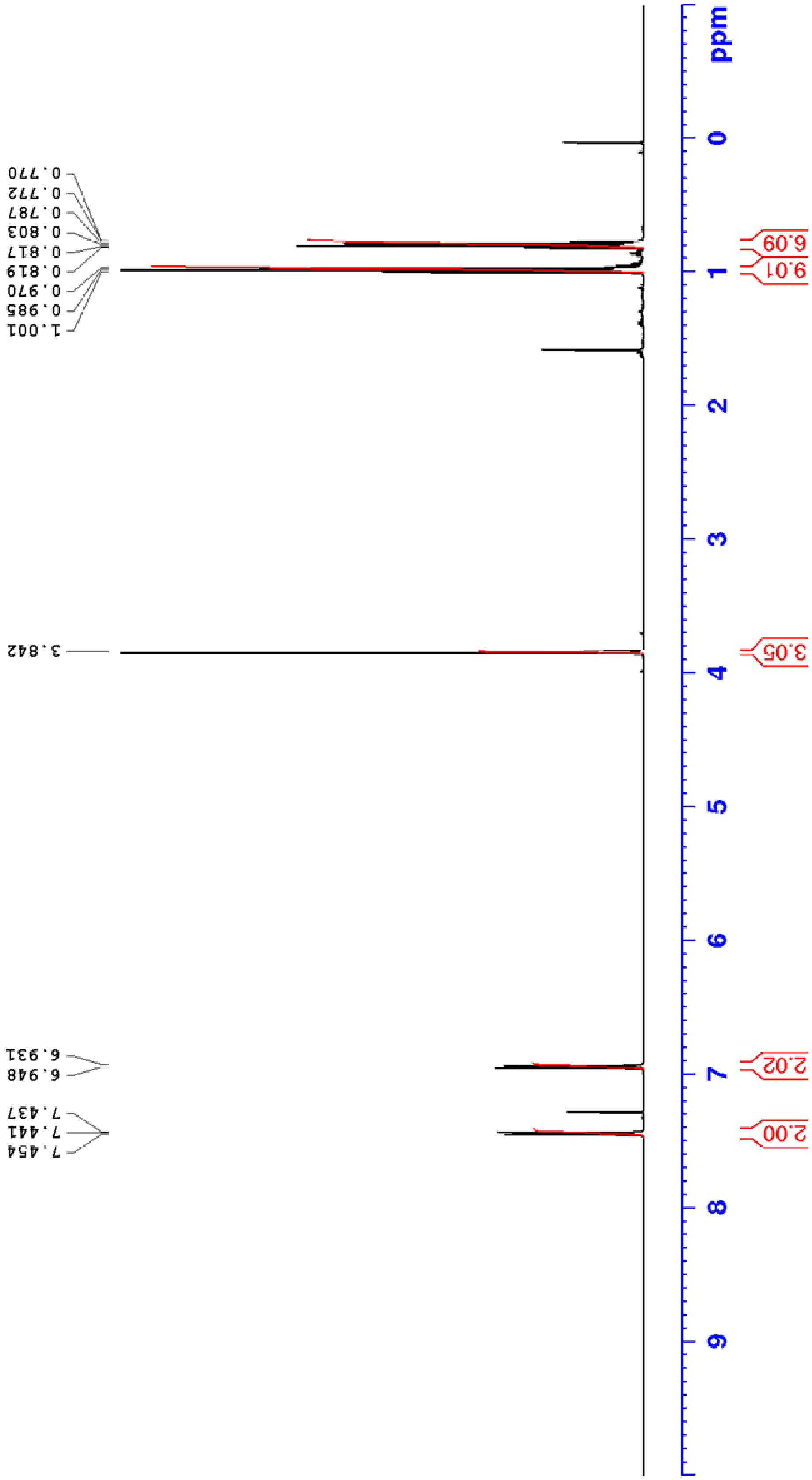
^{29}Si NMR spectra of **triethyl(*p*-tolyl)silane (1h)**



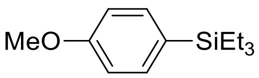


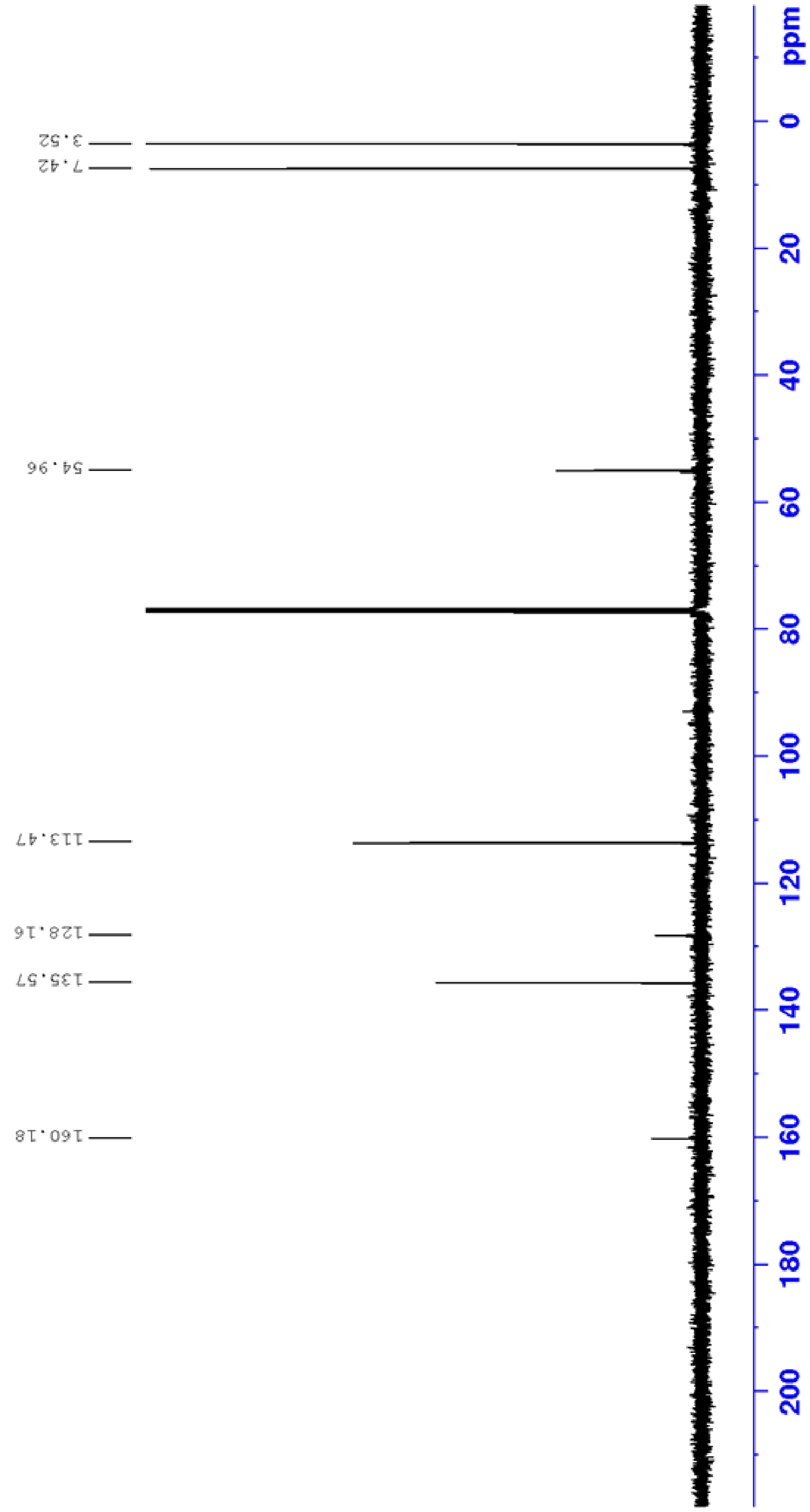
^{1}H NMR spectra of **triethyl(4-methoxyphenyl)silane (1i)**



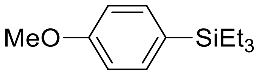


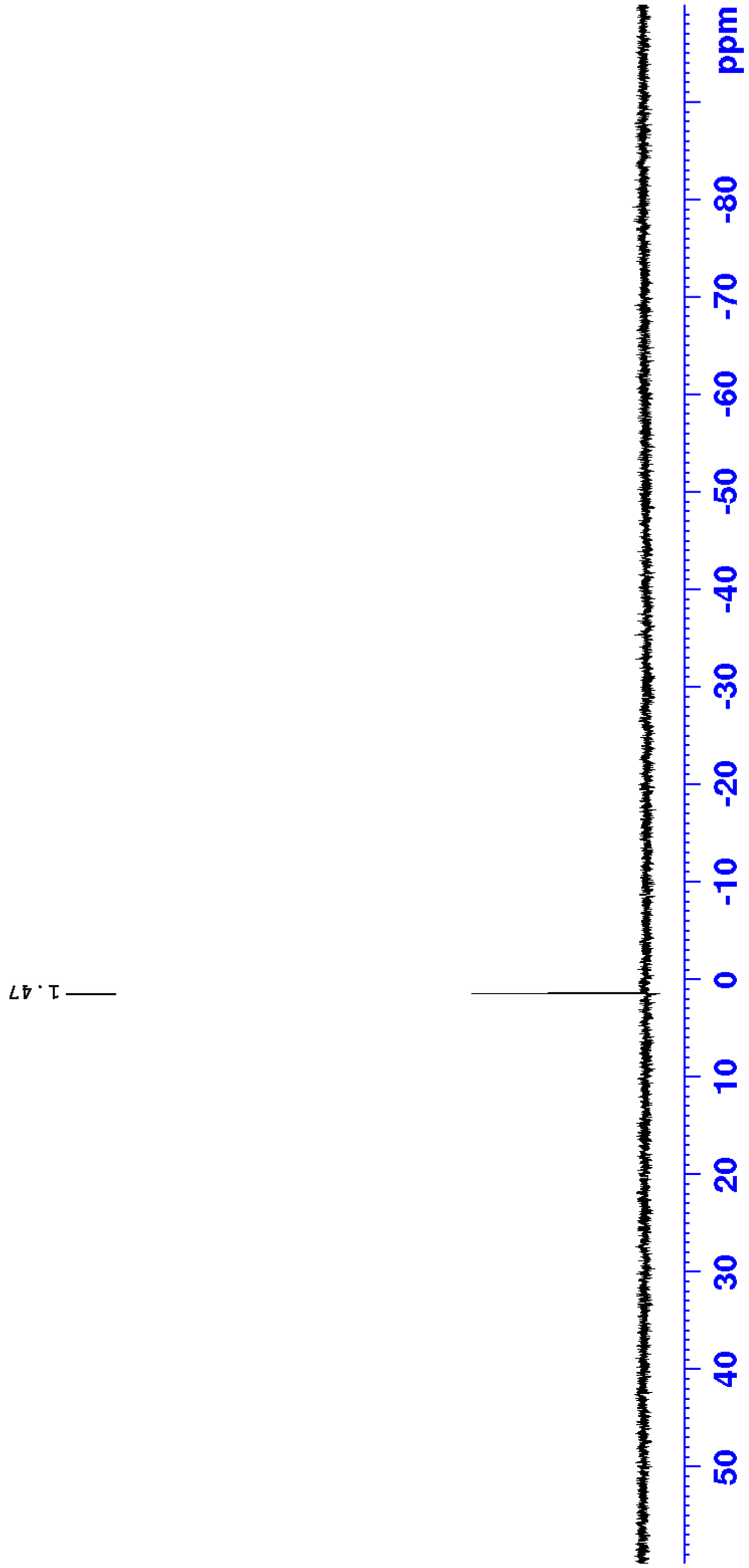
^{13}C and ^{29}Si NMR spectra of **triethyl(4-methoxyphenyl)silane (1i)**



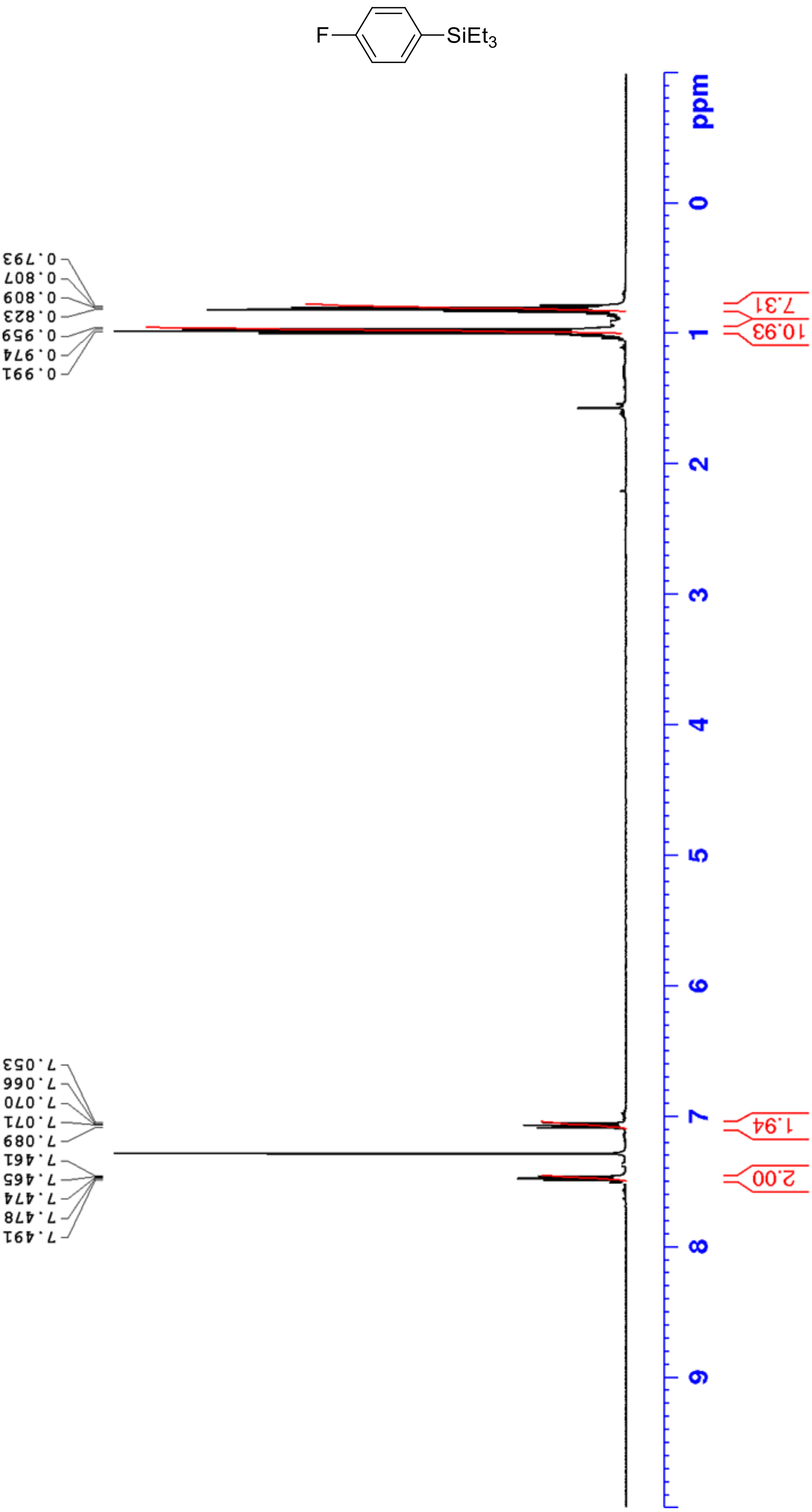


^{29}Si NMR spectra of **triethyl(4-methoxyphenyl)silane (1i)**

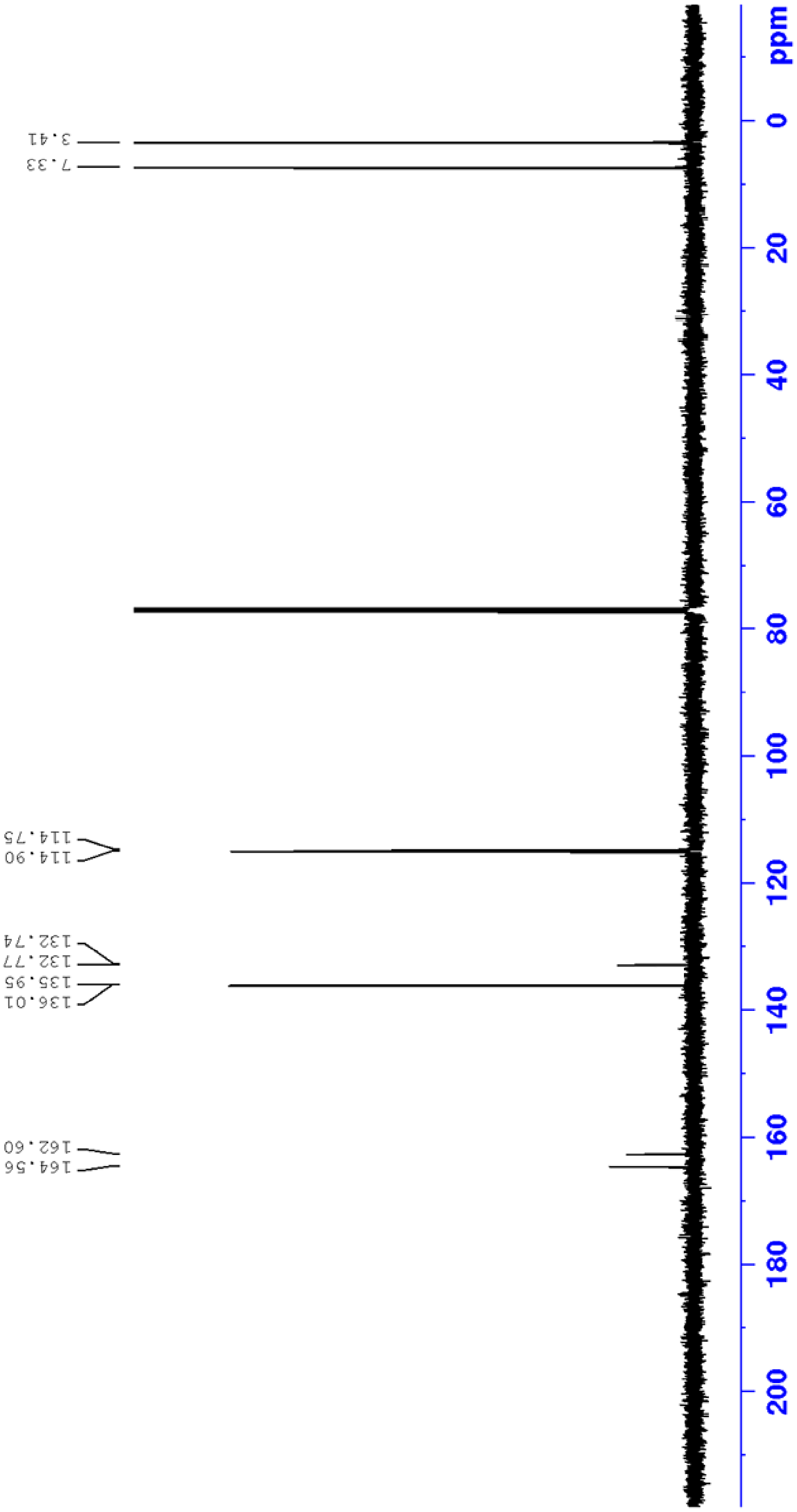




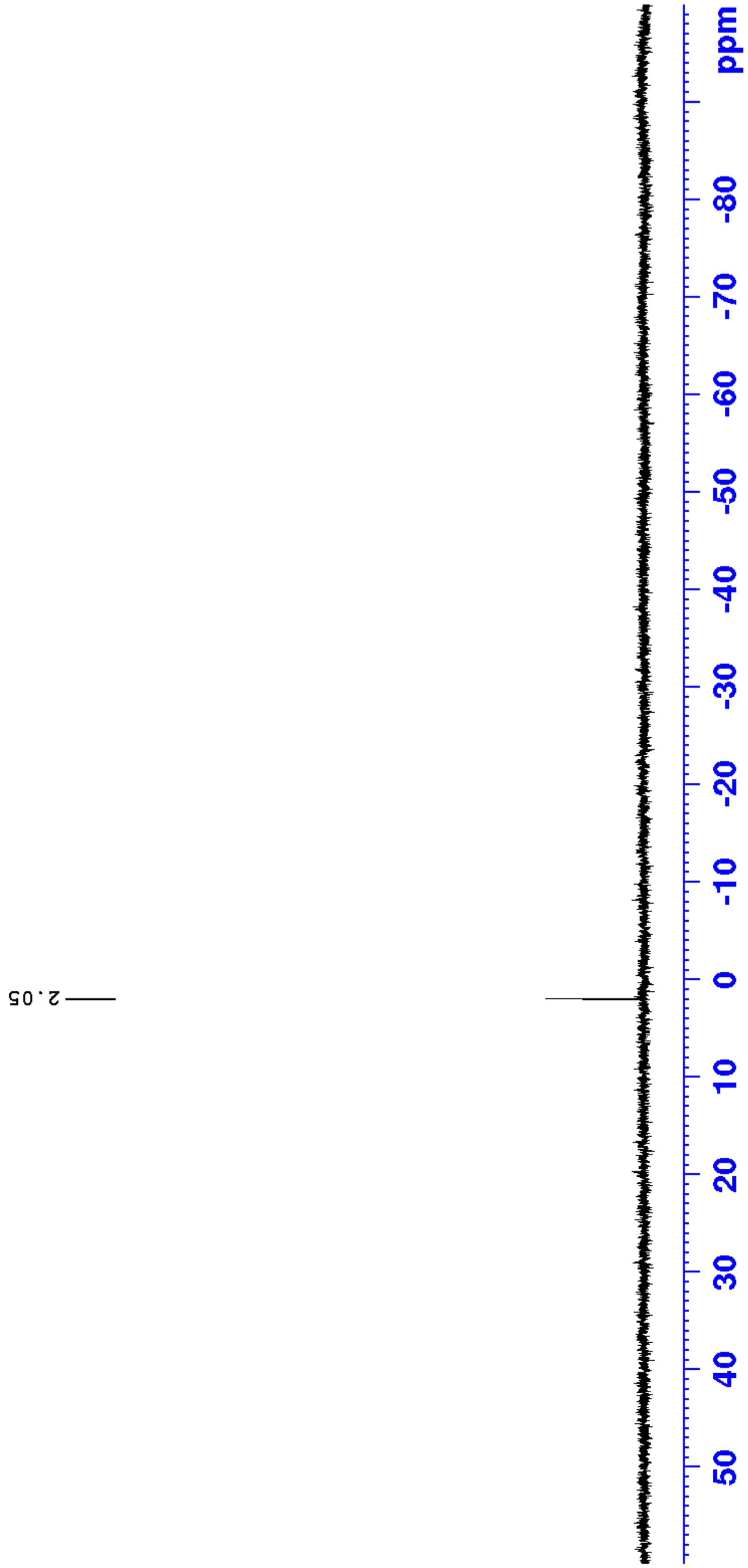
^{1}H NMR spectra of **triethyl(4-fluorophenyl)silane (1j)**



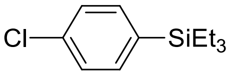
^{13}C NMR spectra of **triethyl(4-fluorophenyl)silane (1j)**

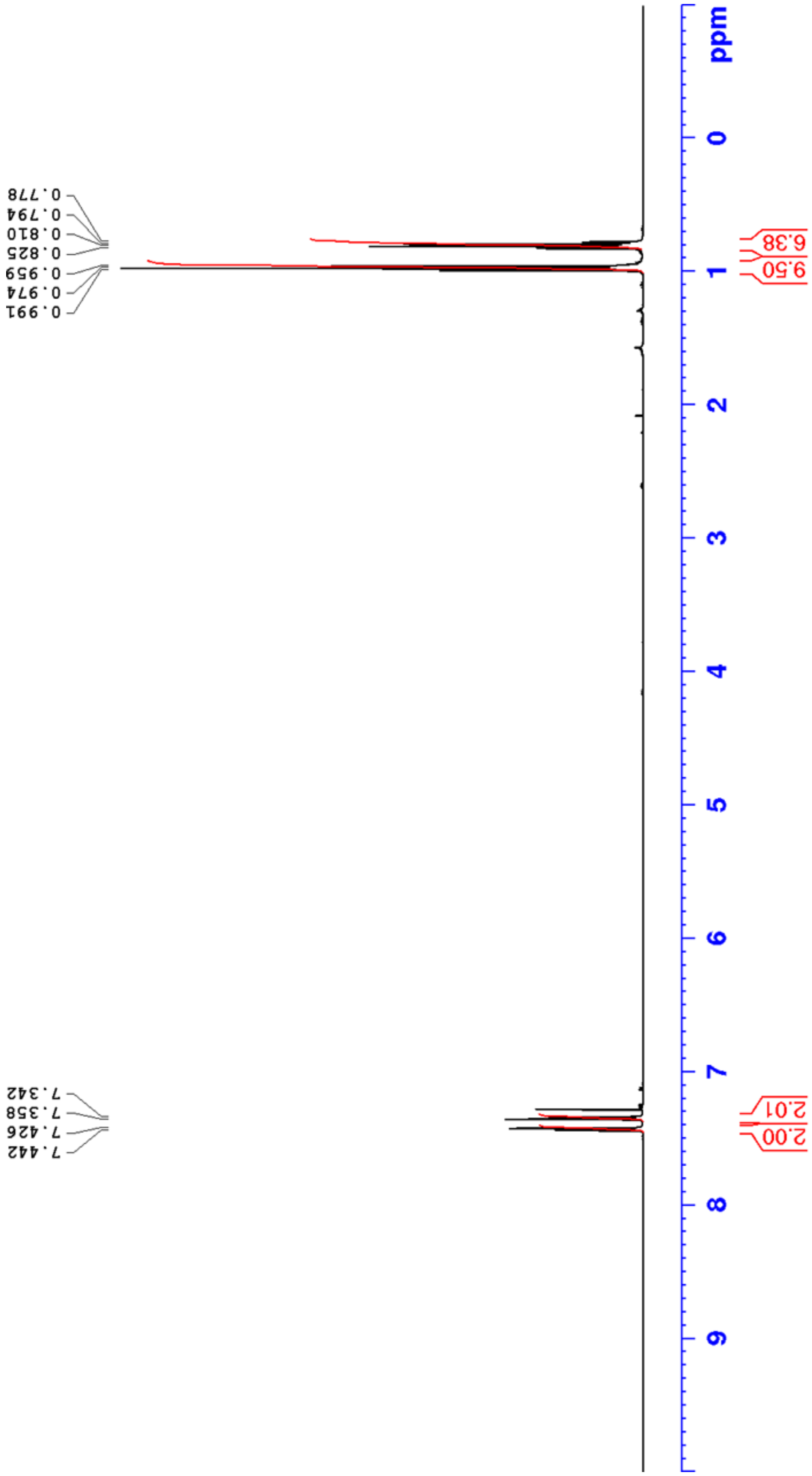


^{29}Si NMR spectra of **triethyl(4-fluorophenyl)silane (1j)**

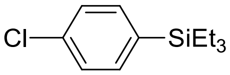


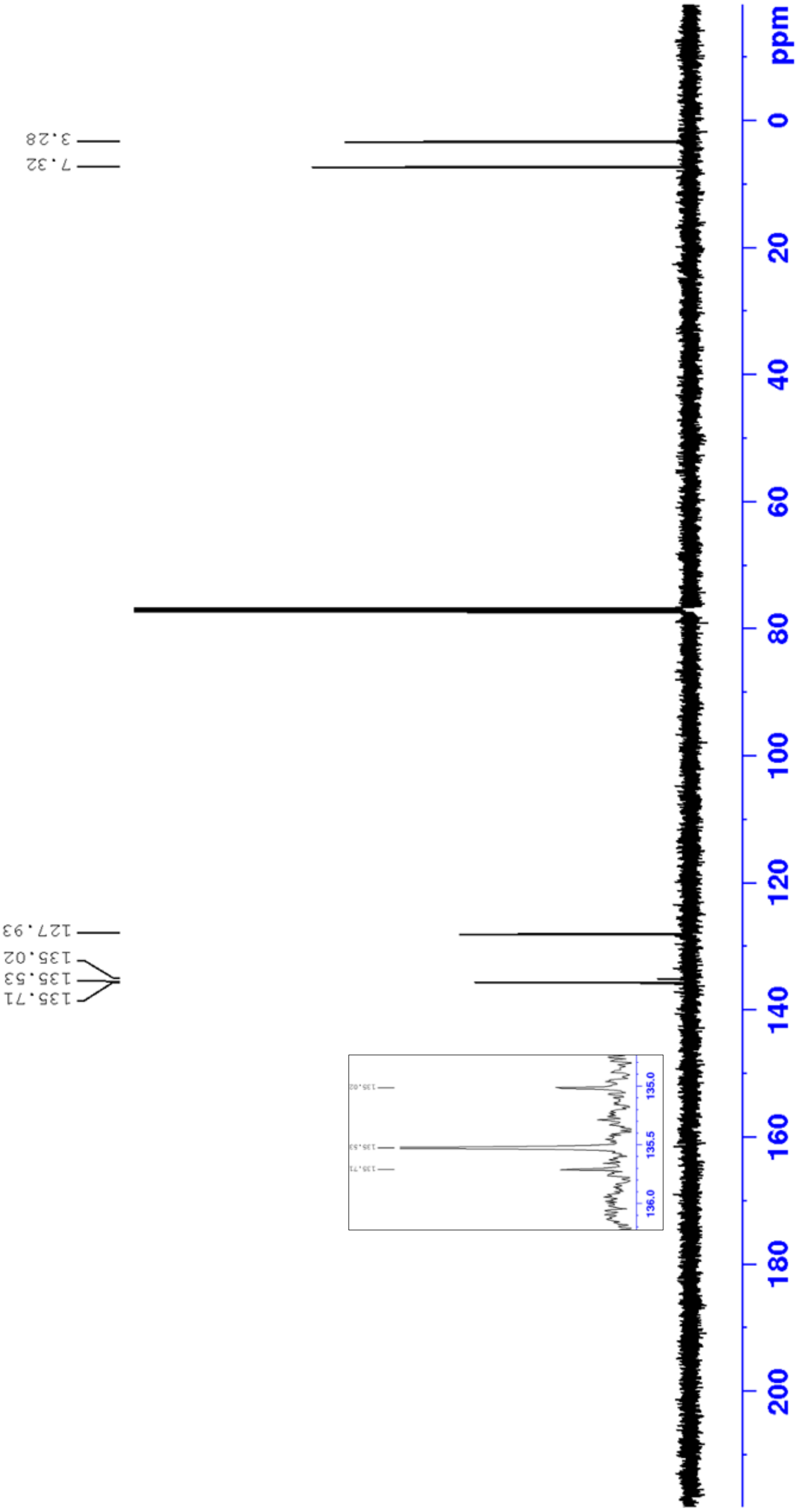
^{1}H NMR spectra of **(4-chlorophenyl)triethylsilane (1k)**



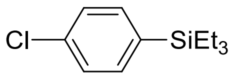


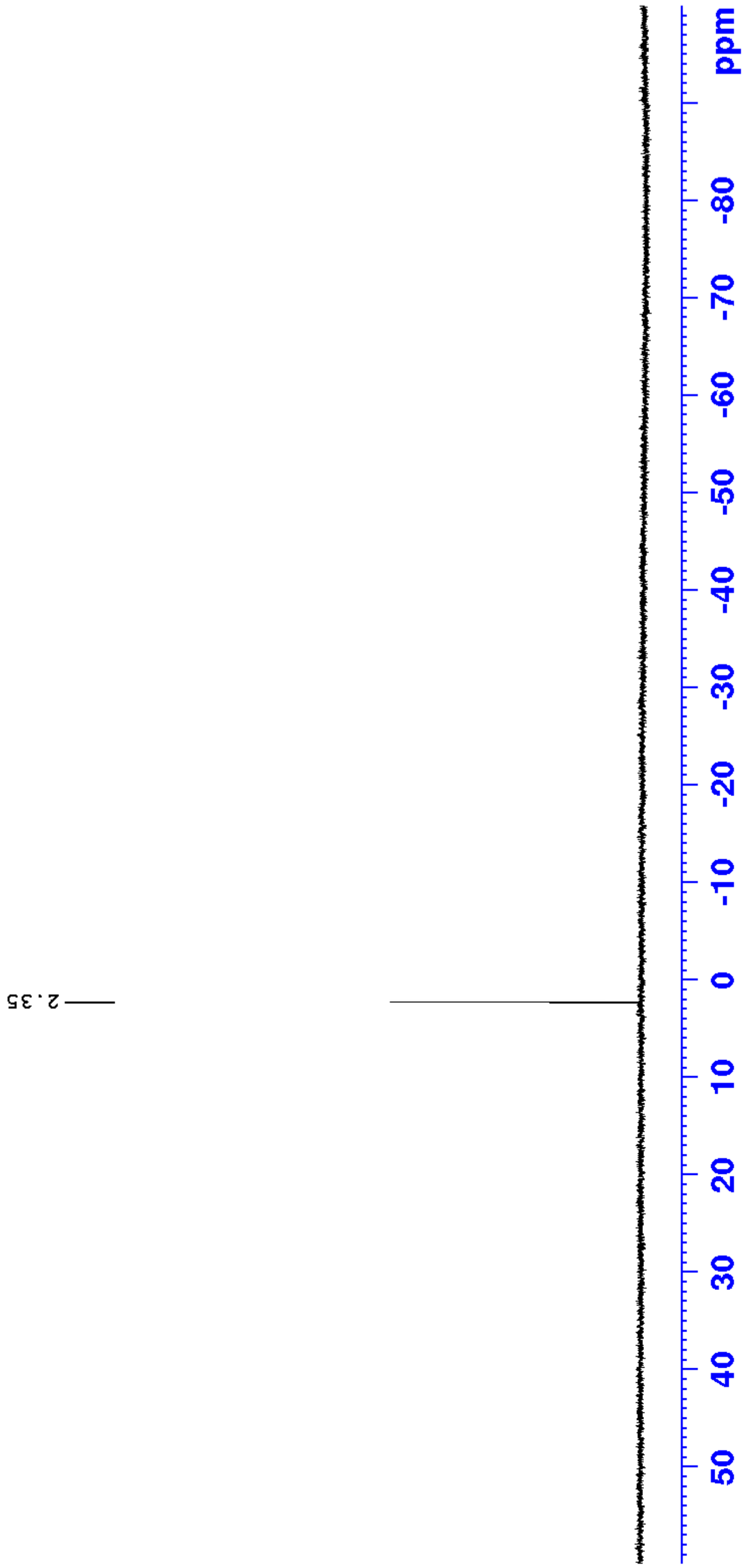
^{13}C and ^{29}Si NMR spectra of **(4-chlorophenyl)triethylsilane (1k)**



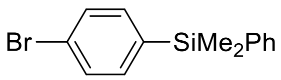


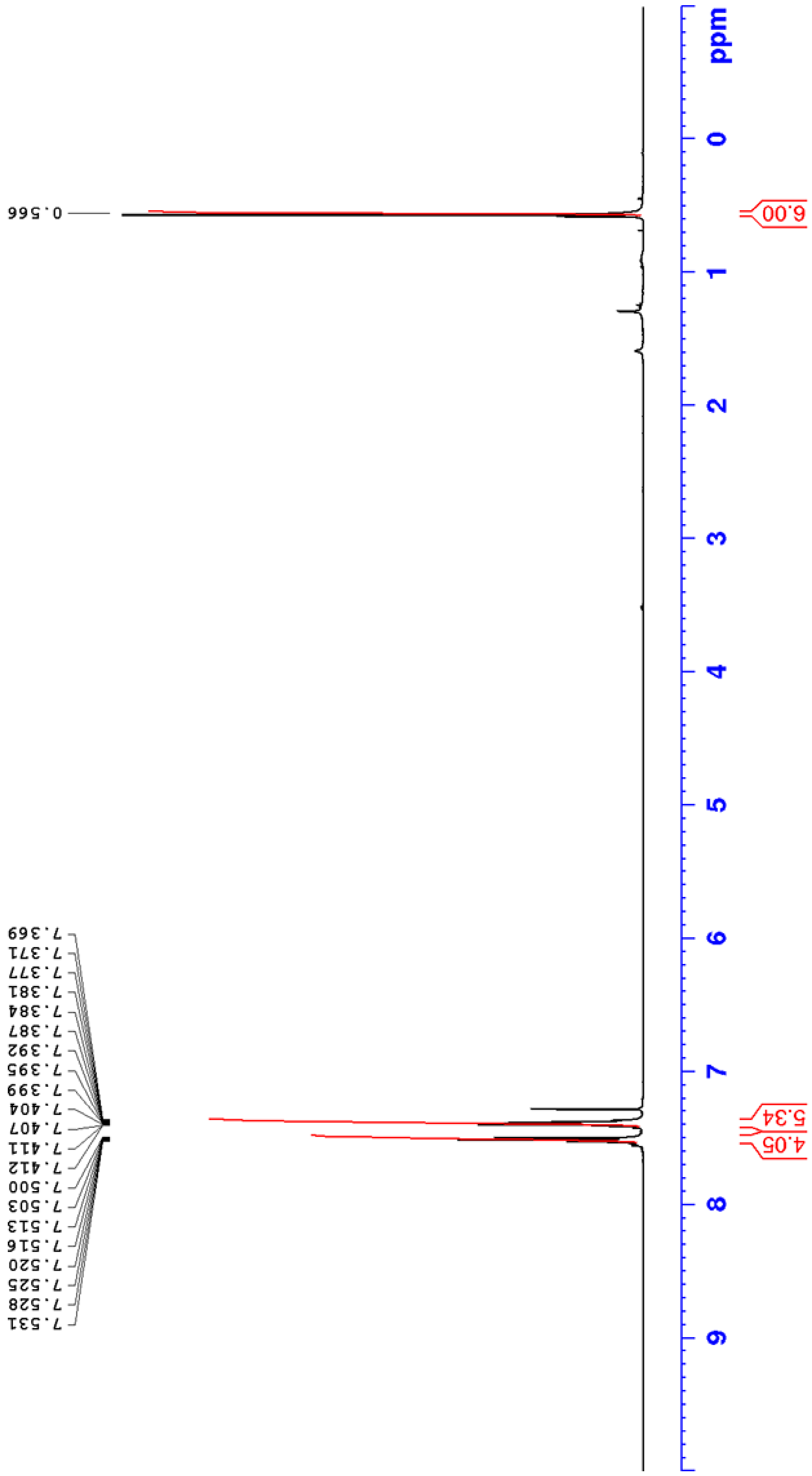
^{29}Si NMR spectra of **(4-chlorophenyl)triethylsilane (1k)**



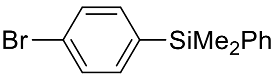


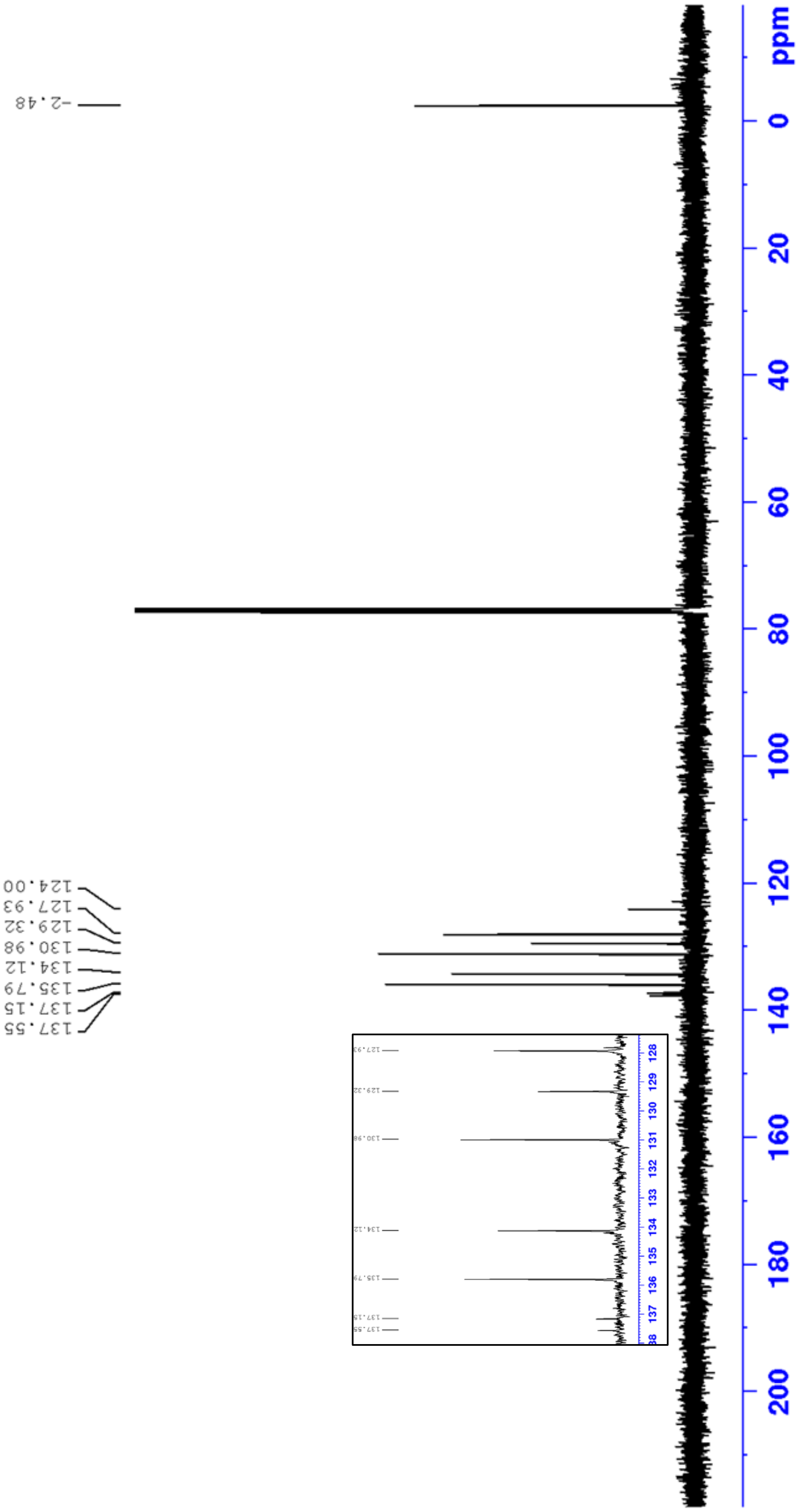
^{1}H NMR spectra of **(4-bromophenyl)dimethyl(phenyl)silane (1l)**



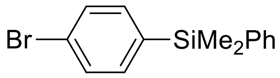


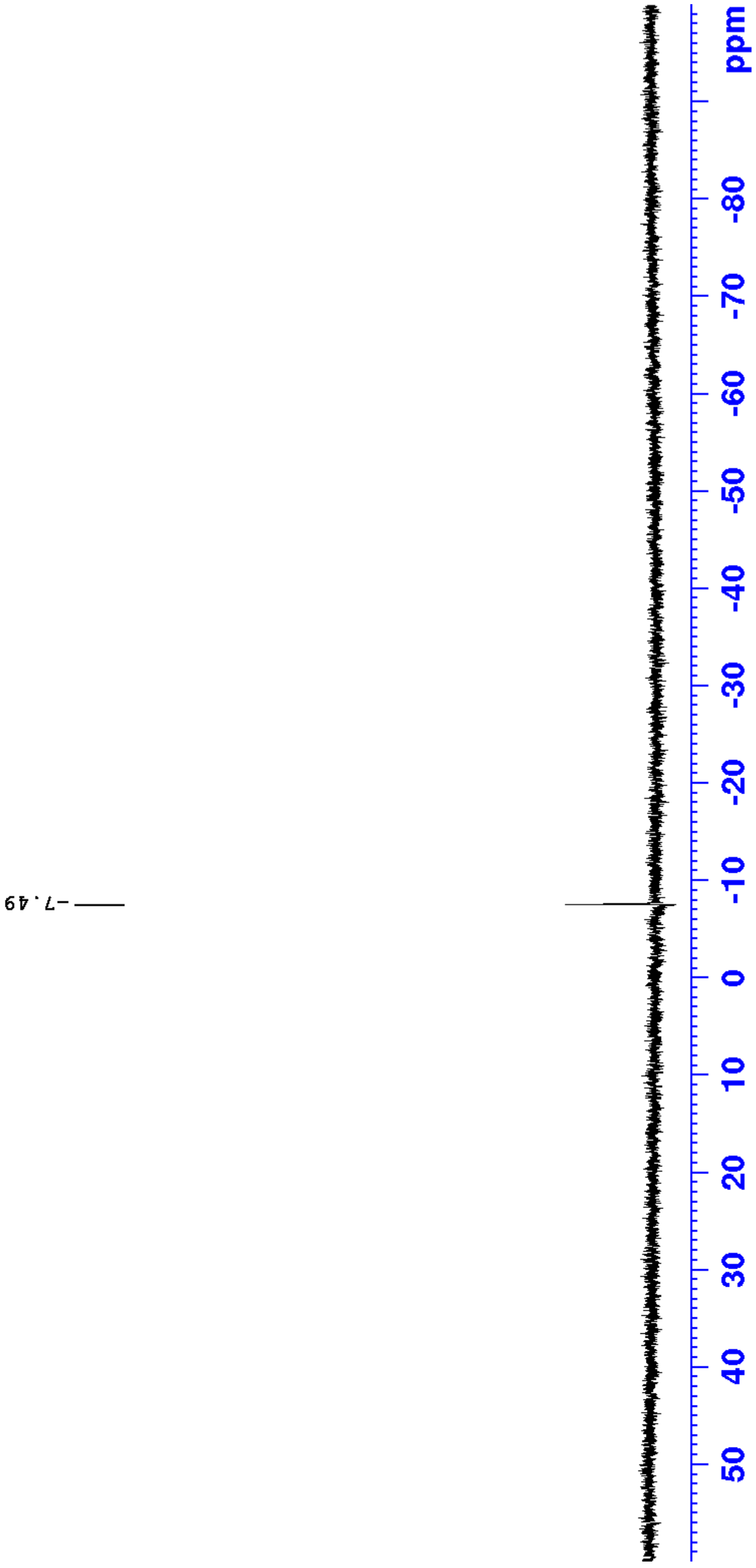
^{13}C NMR spectra of **(4-bromophenyl)dimethyl(phenyl)silane (1l)**



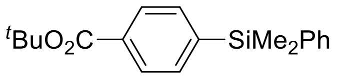


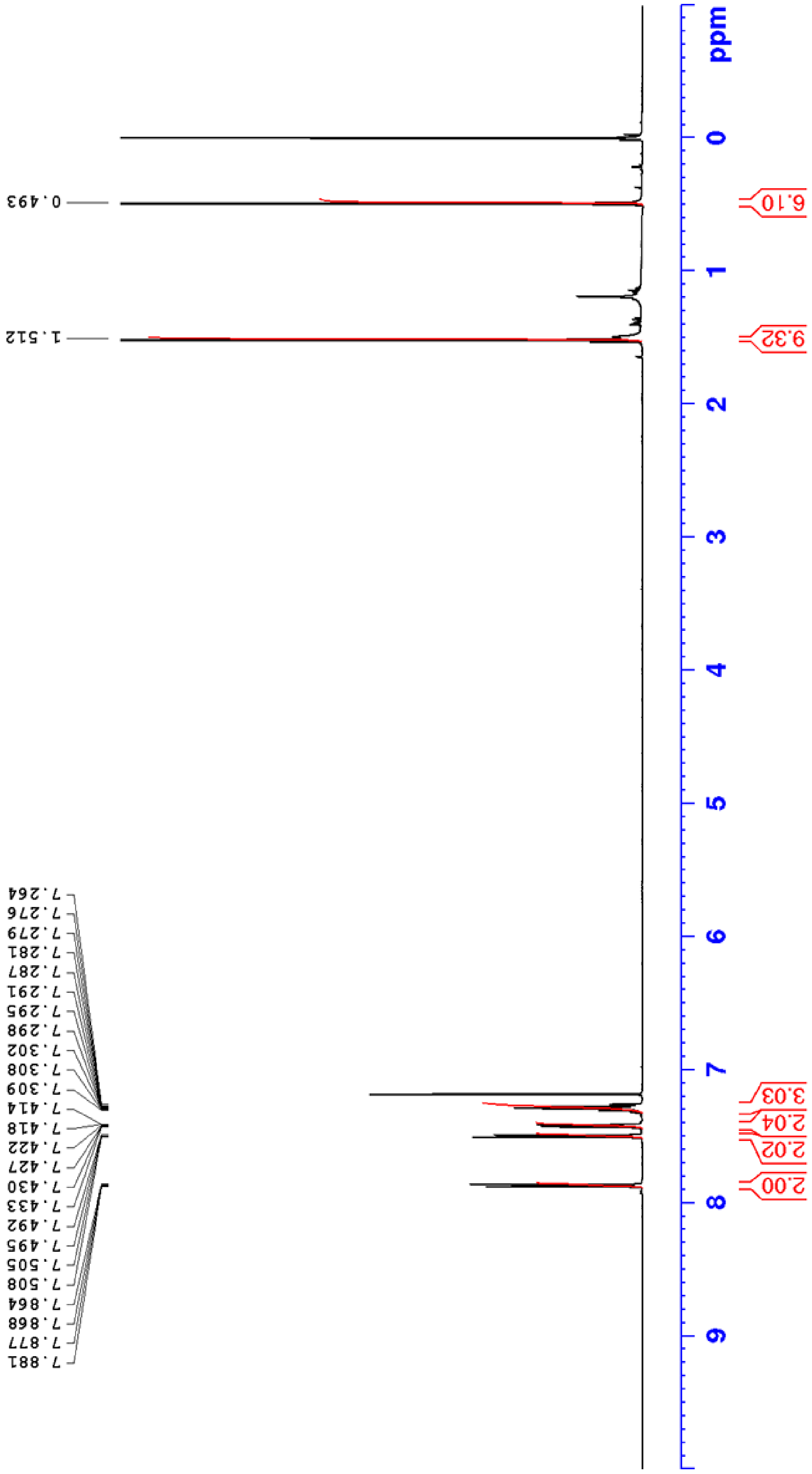
^{29}Si NMR spectra of **(4-bromophenyl)dimethyl(phenyl)silane (1l)**



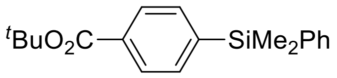


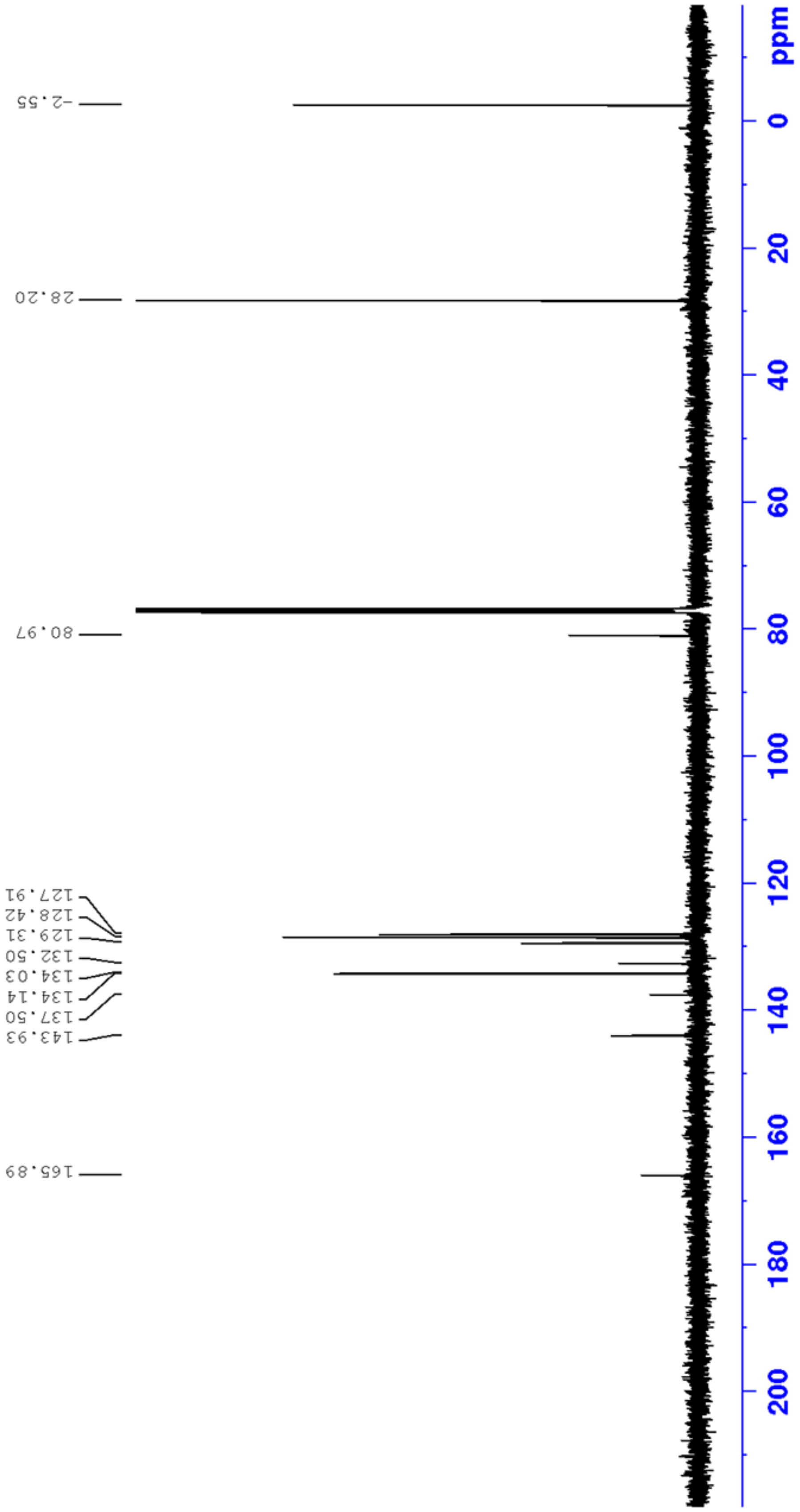
^{1}H NMR spectra of ***tert*****-butyl 4-(dimethyl(phenyl)silyl)benzoate (1m)**



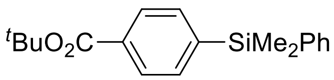


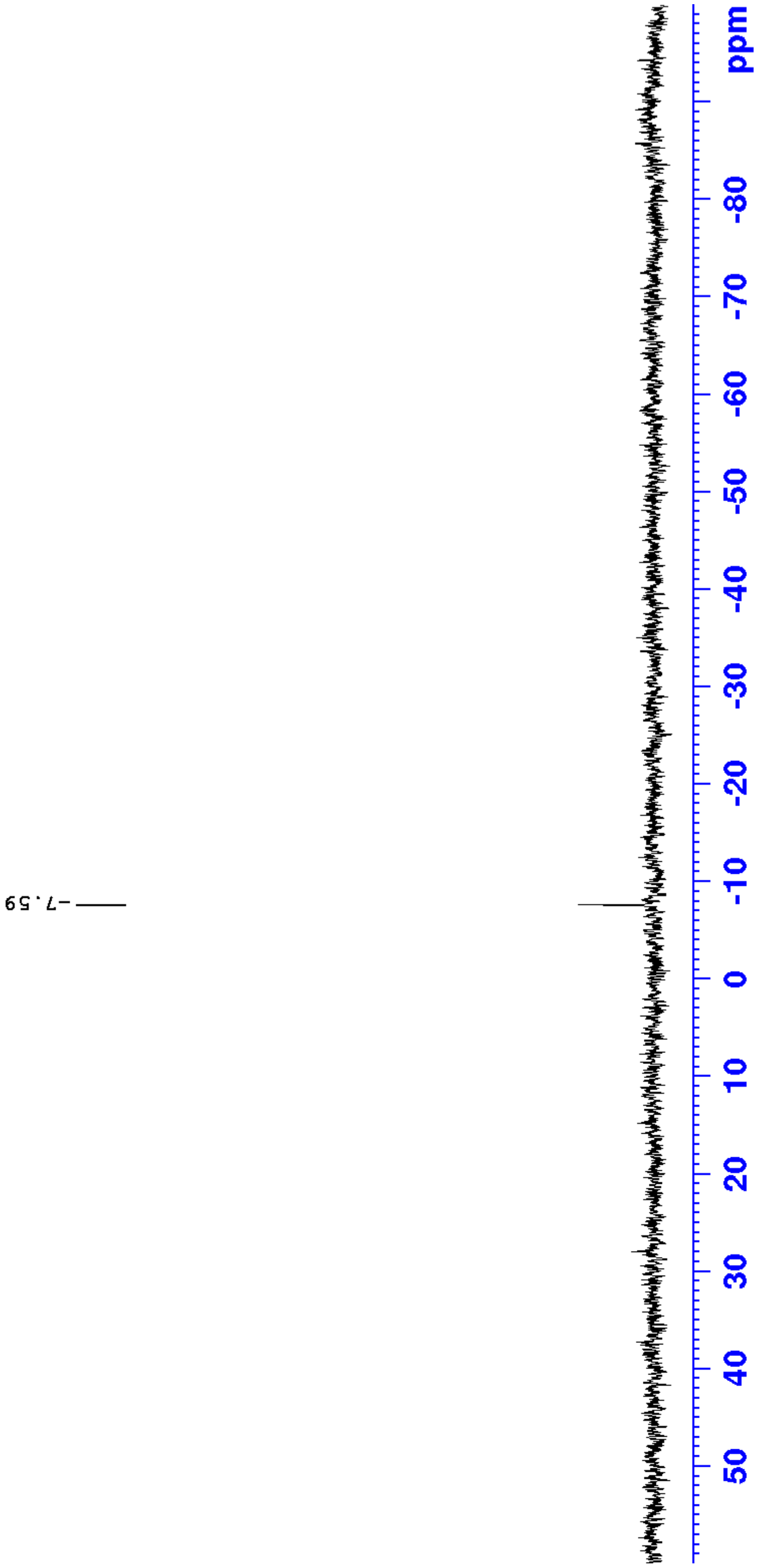
^{13}C NMR spectra of ***tert*-butyl 4-(dimethyl(phenyl)silyl)benzoate (1m)**



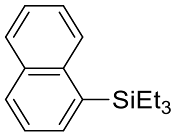


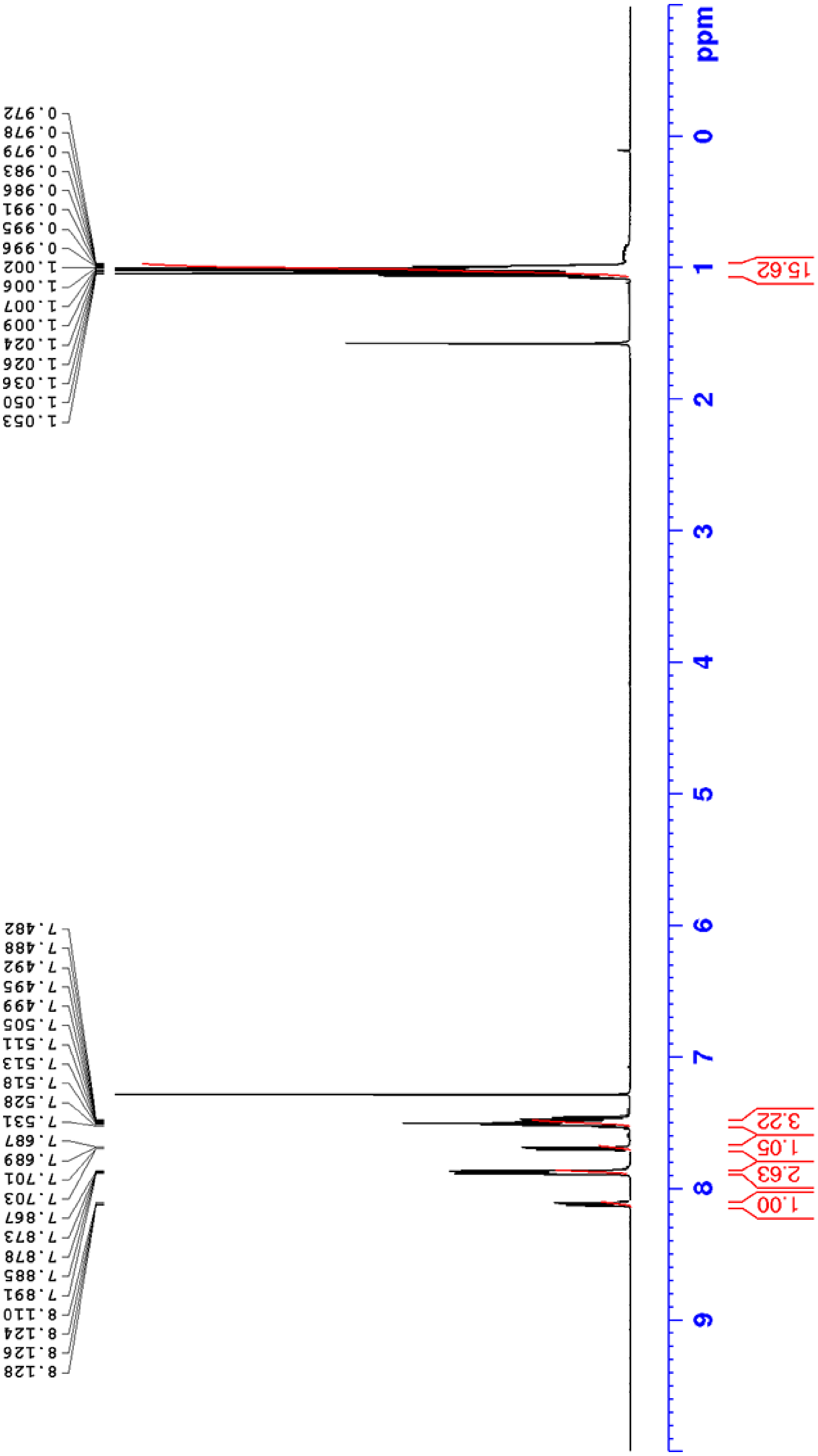
^{29}Si NMR spectra of ***tert*-butyl 4-(dimethyl(phenyl)silyl)benzoate (1m)**



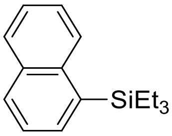


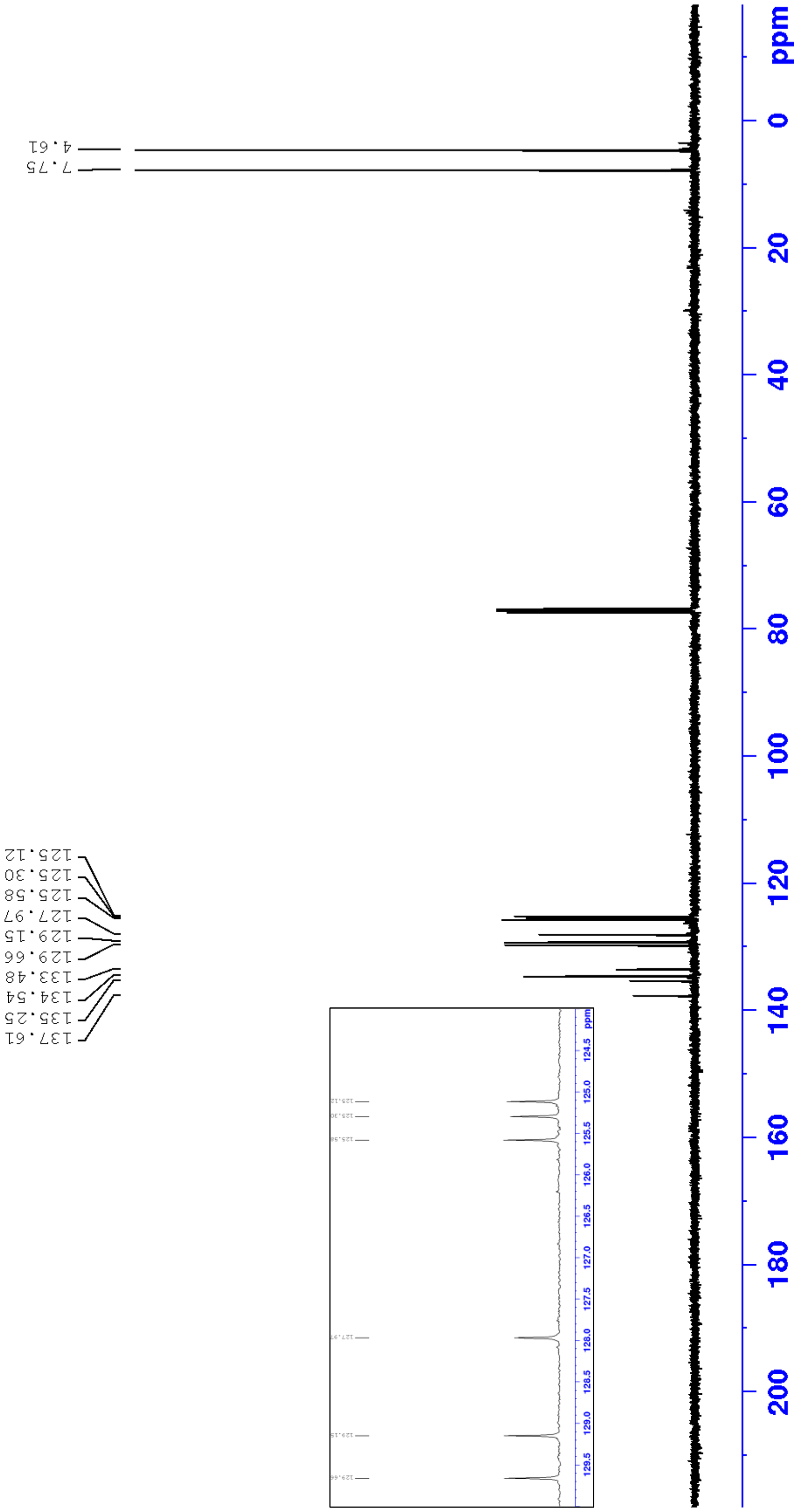
^{1}H NMR spectra of **triethyl(naphthalen-1-yl)silane (1n)**



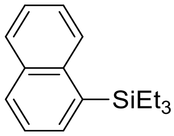


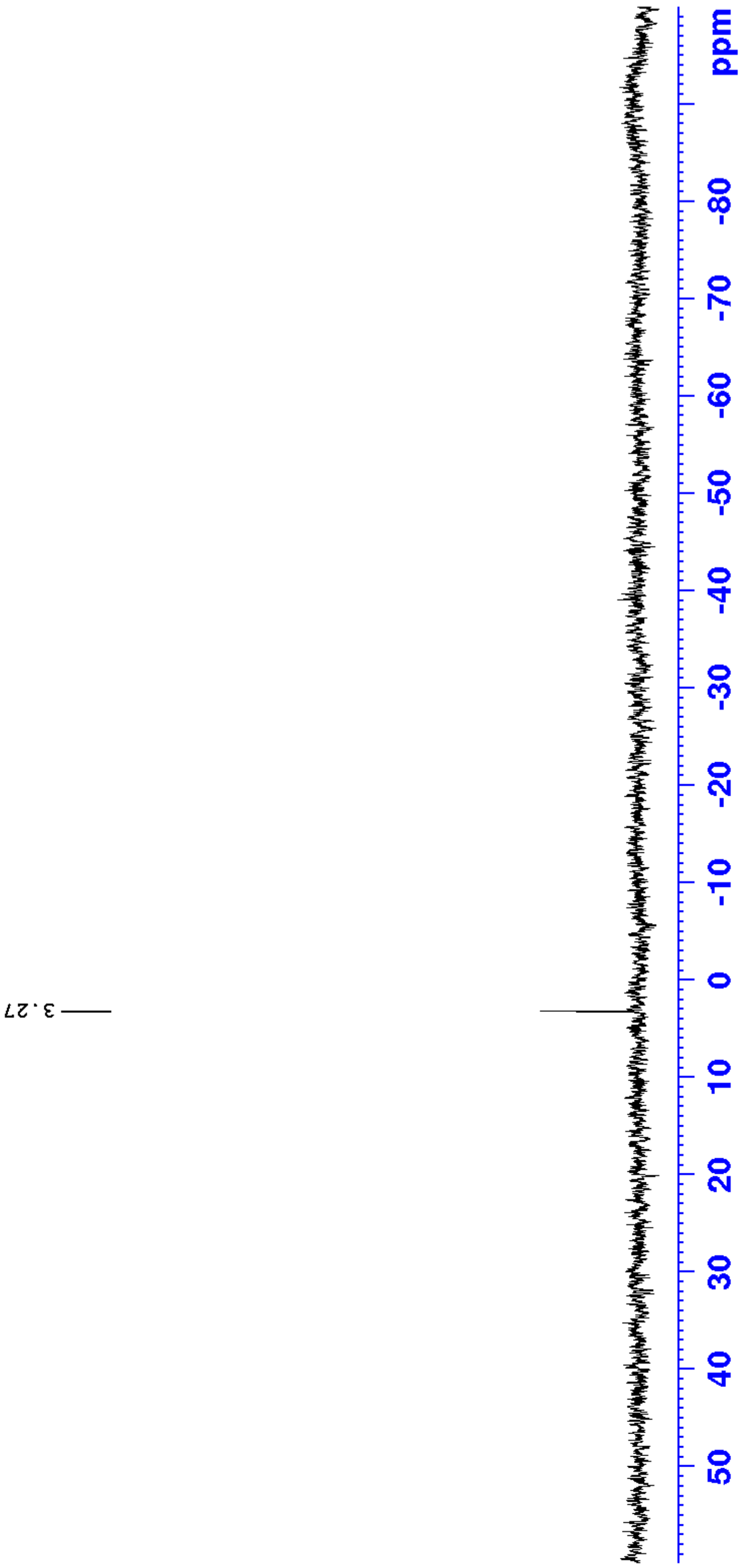
^{13}C NMR spectra of **triethyl(naphthalen-1-yl)silane (1n)**



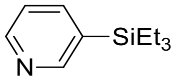


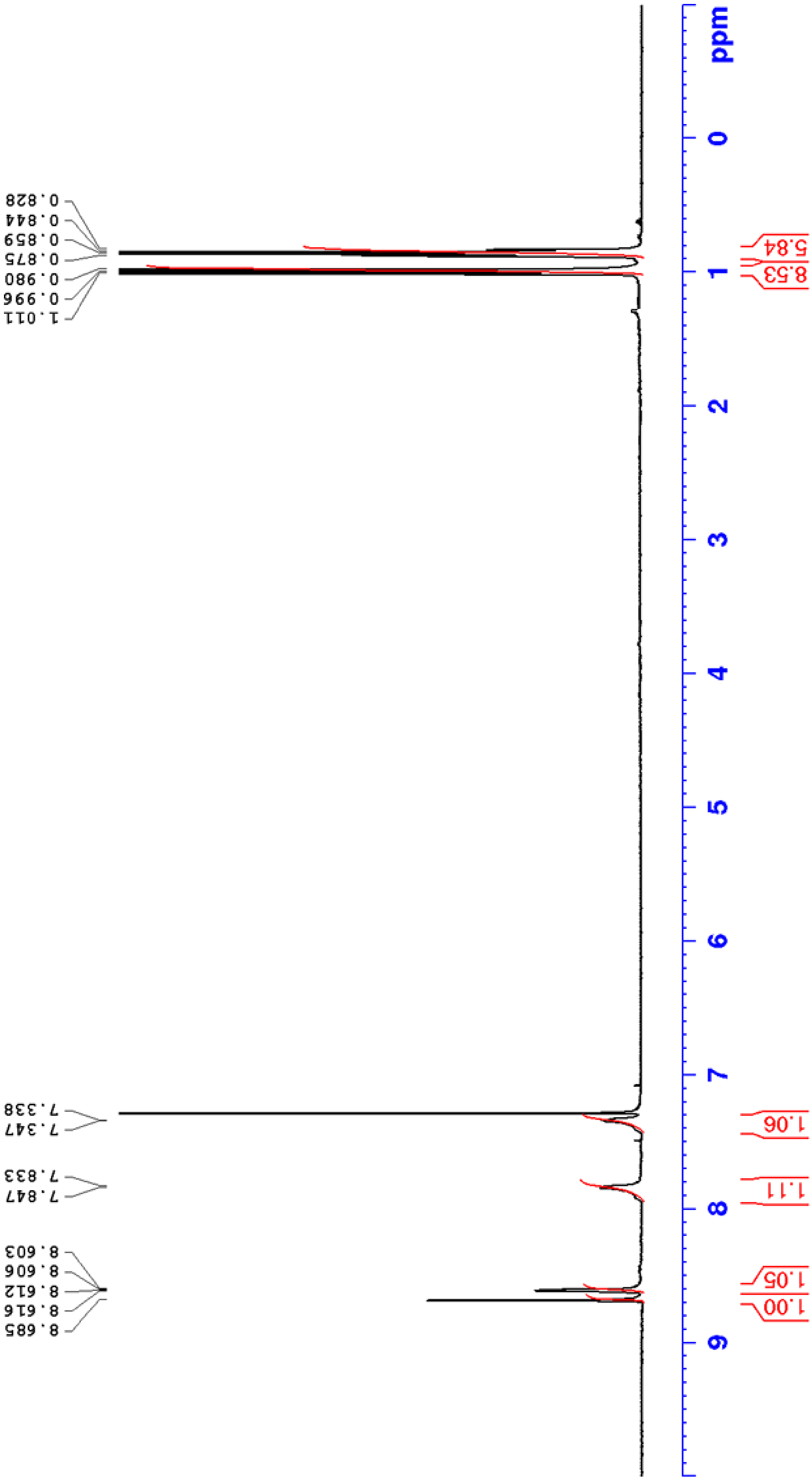
^{29}Si NMR spectra of **triethyl(naphthalen-1-yl)silane (1n)**



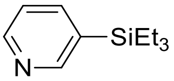


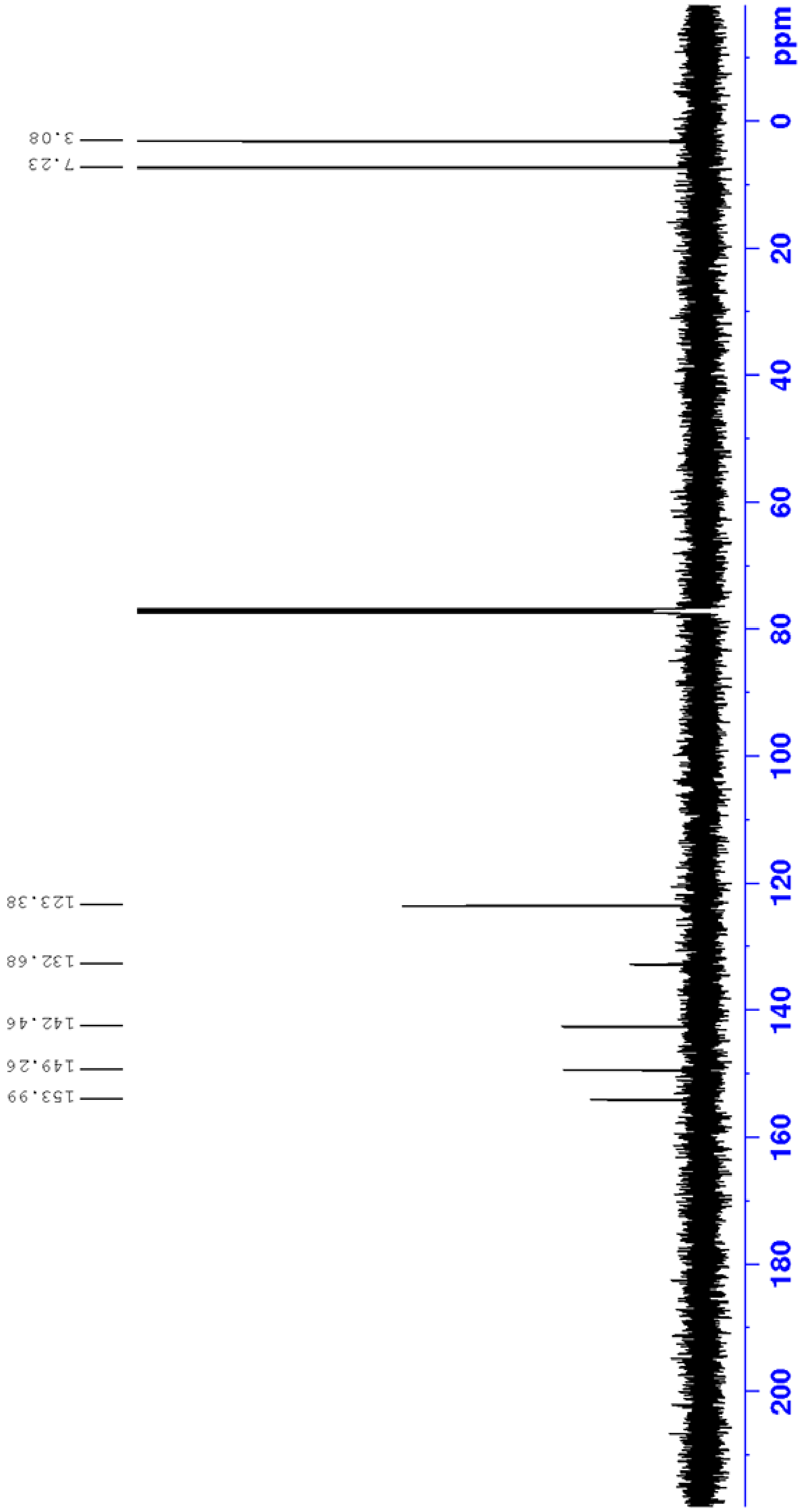
^{1}H NMR spectra of **3-(triethylsilyl)pyridine (1o)**



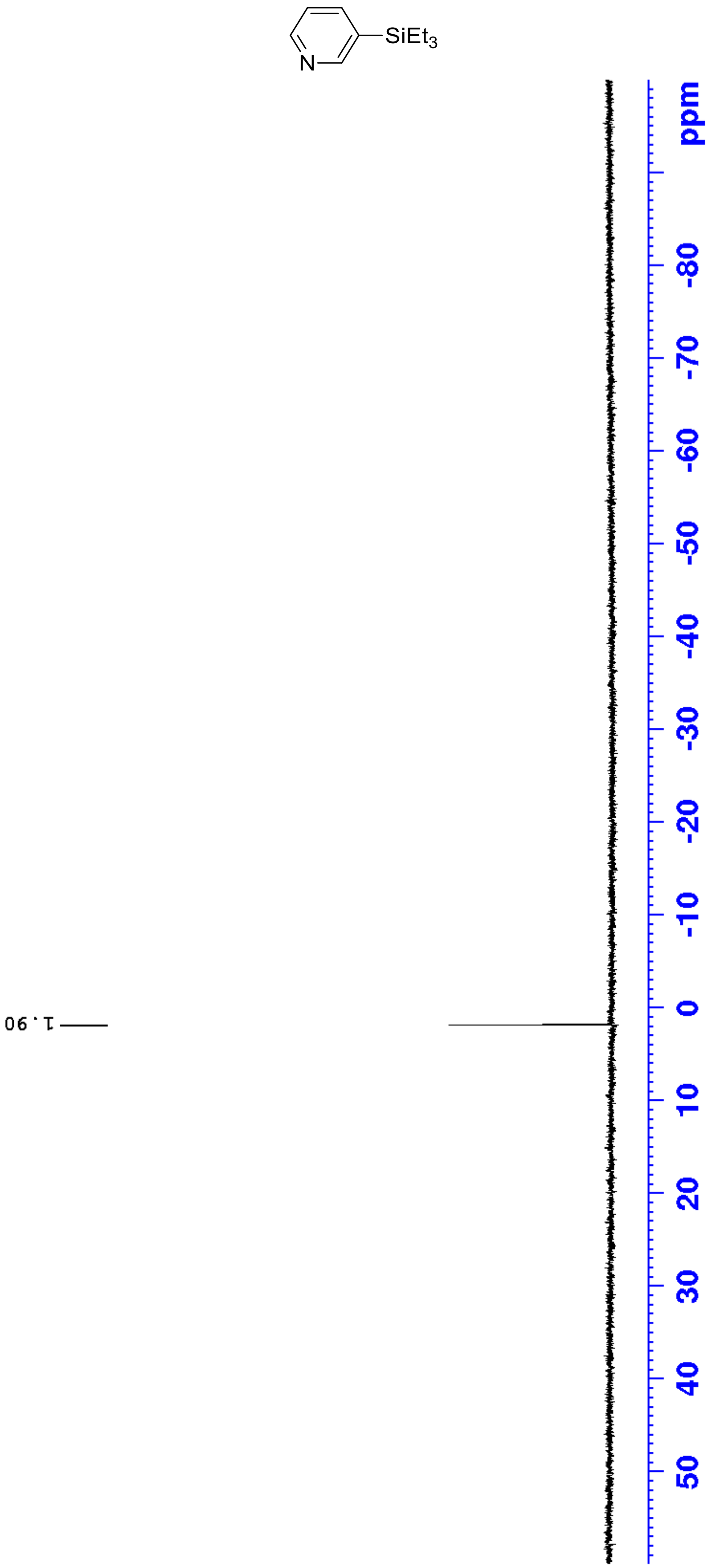


^{13}C NMR spectra of **3-(triethylsilyl)pyridine (1o)**

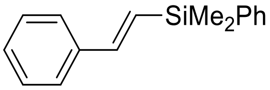


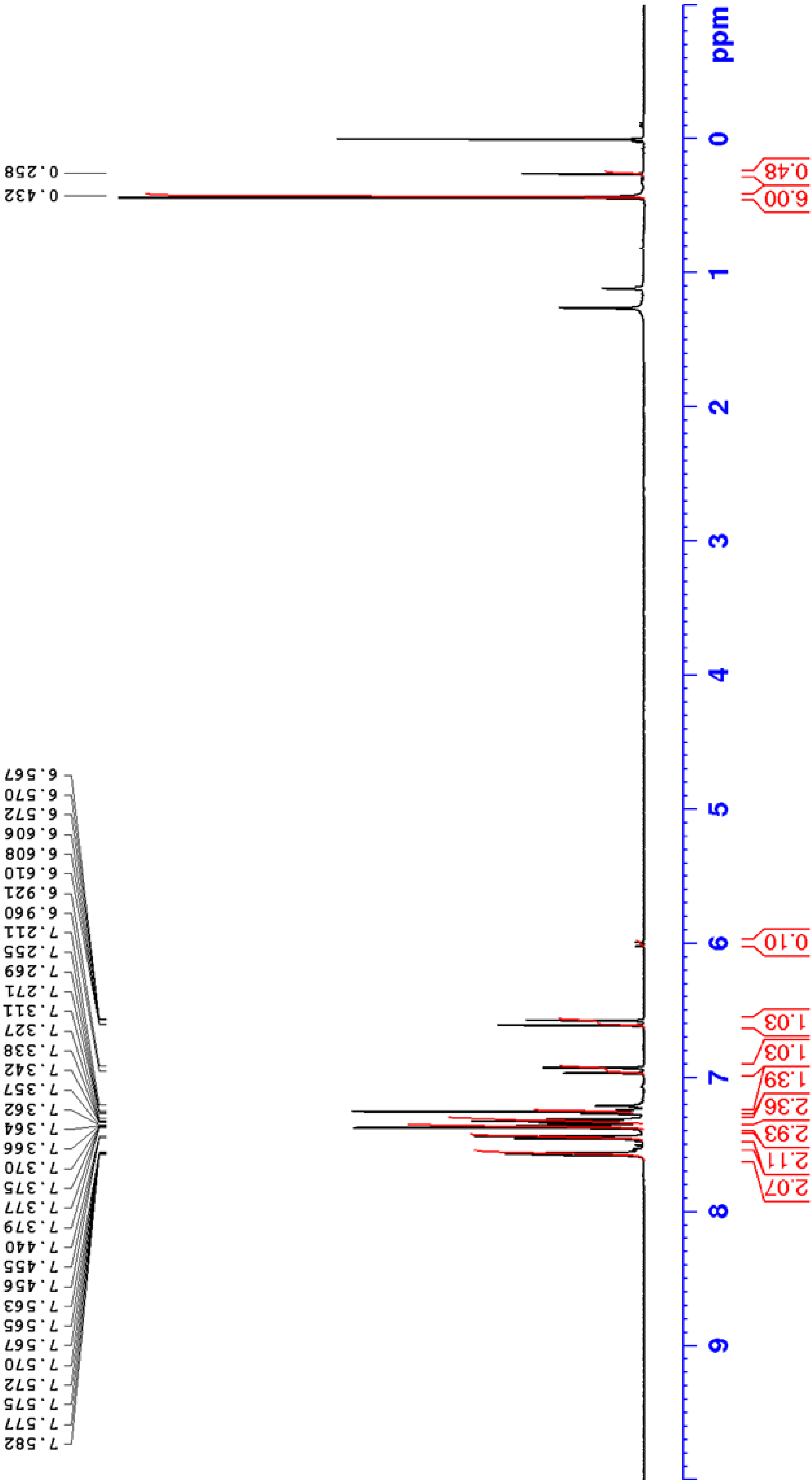


^{29}Si NMR spectra of **3-(triethylsilyl)pyridine (1o)**

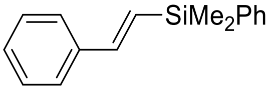


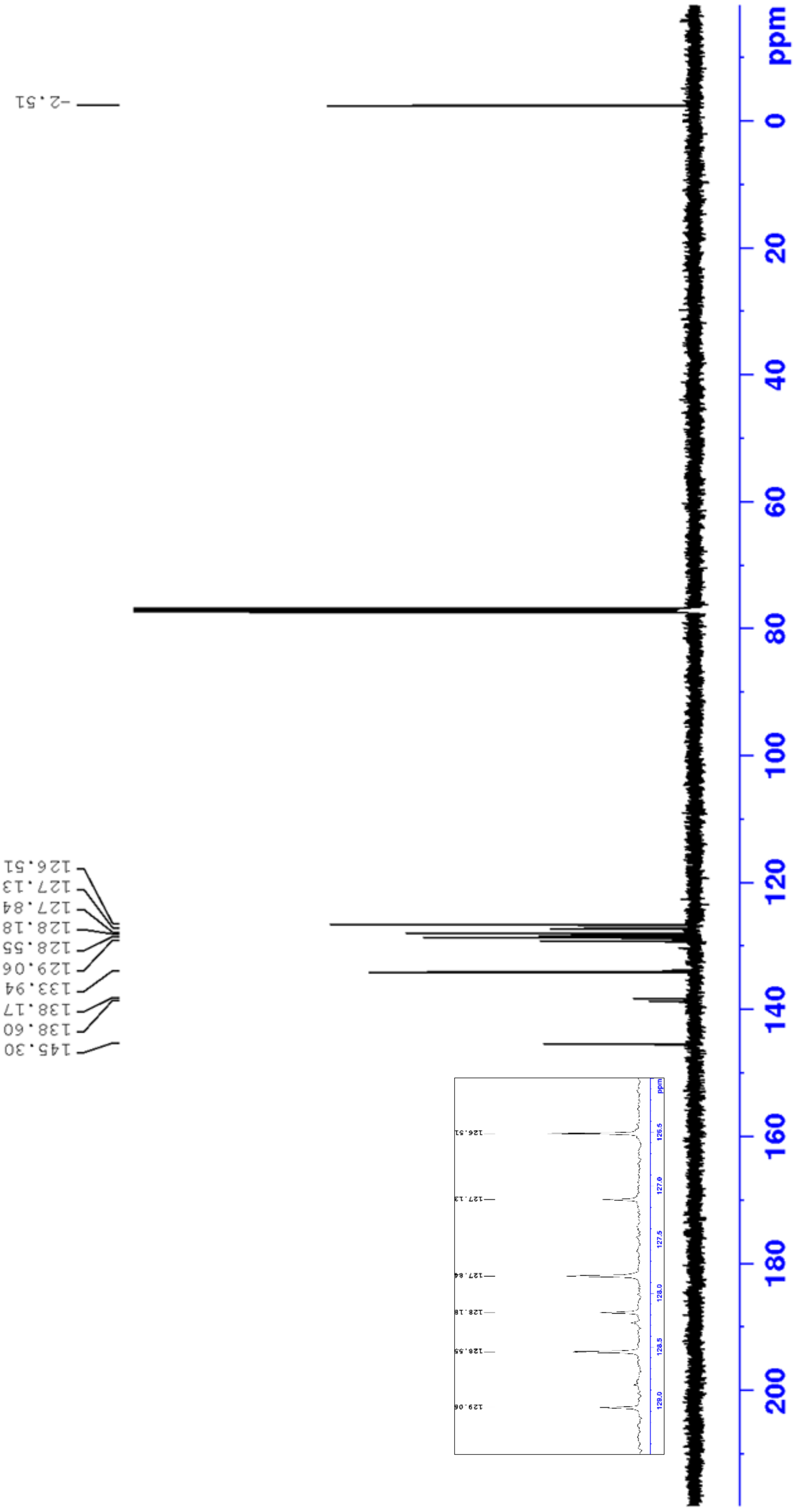
^{1}H NMR spectra of **(*E*)-dimethyl(phenyl)(styryl)silane (1p)**



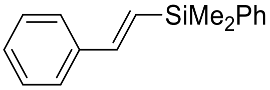


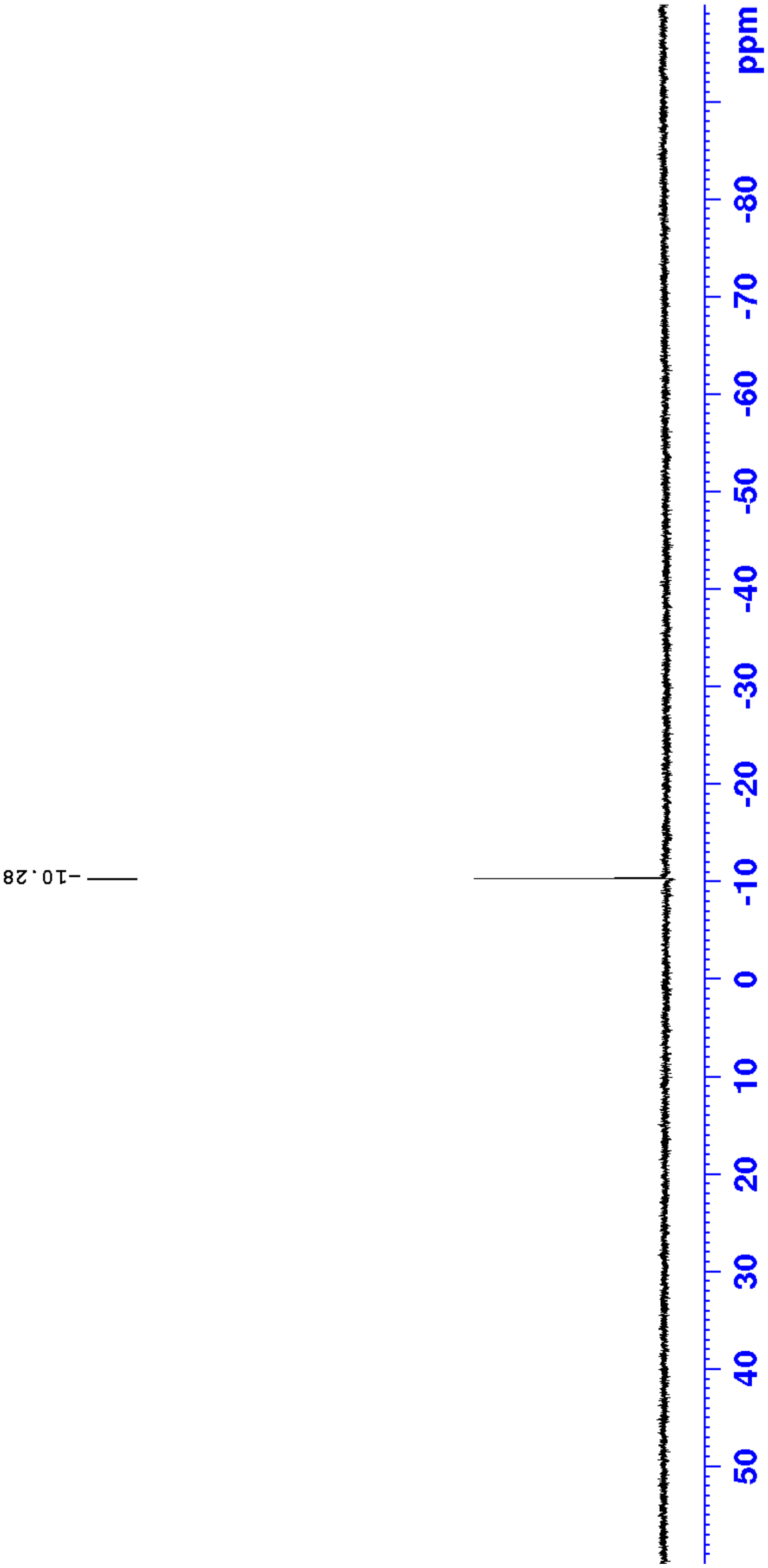
^{13}C NMR spectra of **(*E*)-dimethyl(phenyl)(styryl)silane (1p)**



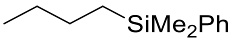


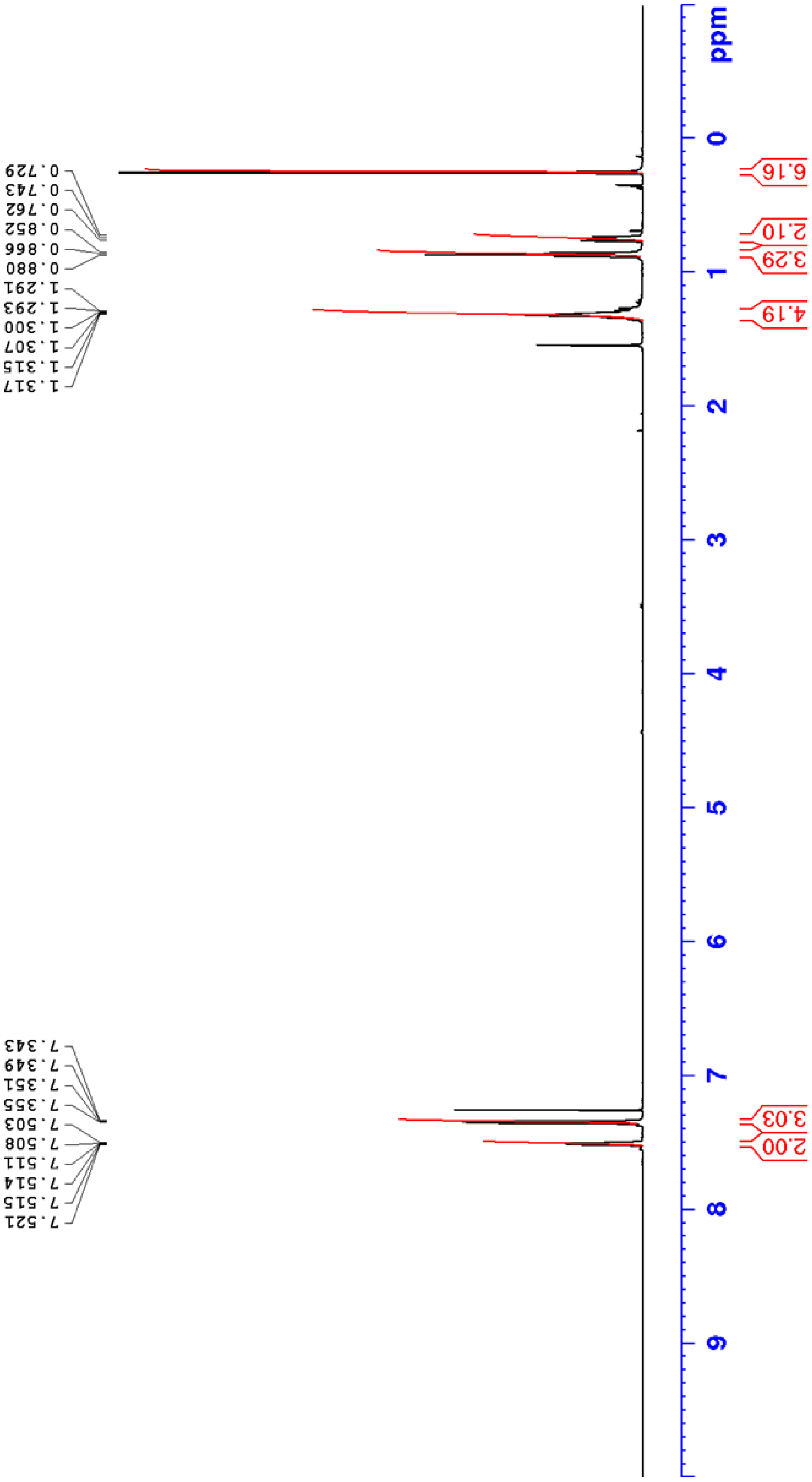
^{29}Si NMR spectra of **(*E*)-dimethyl(phenyl)(styryl)silane (1p)**



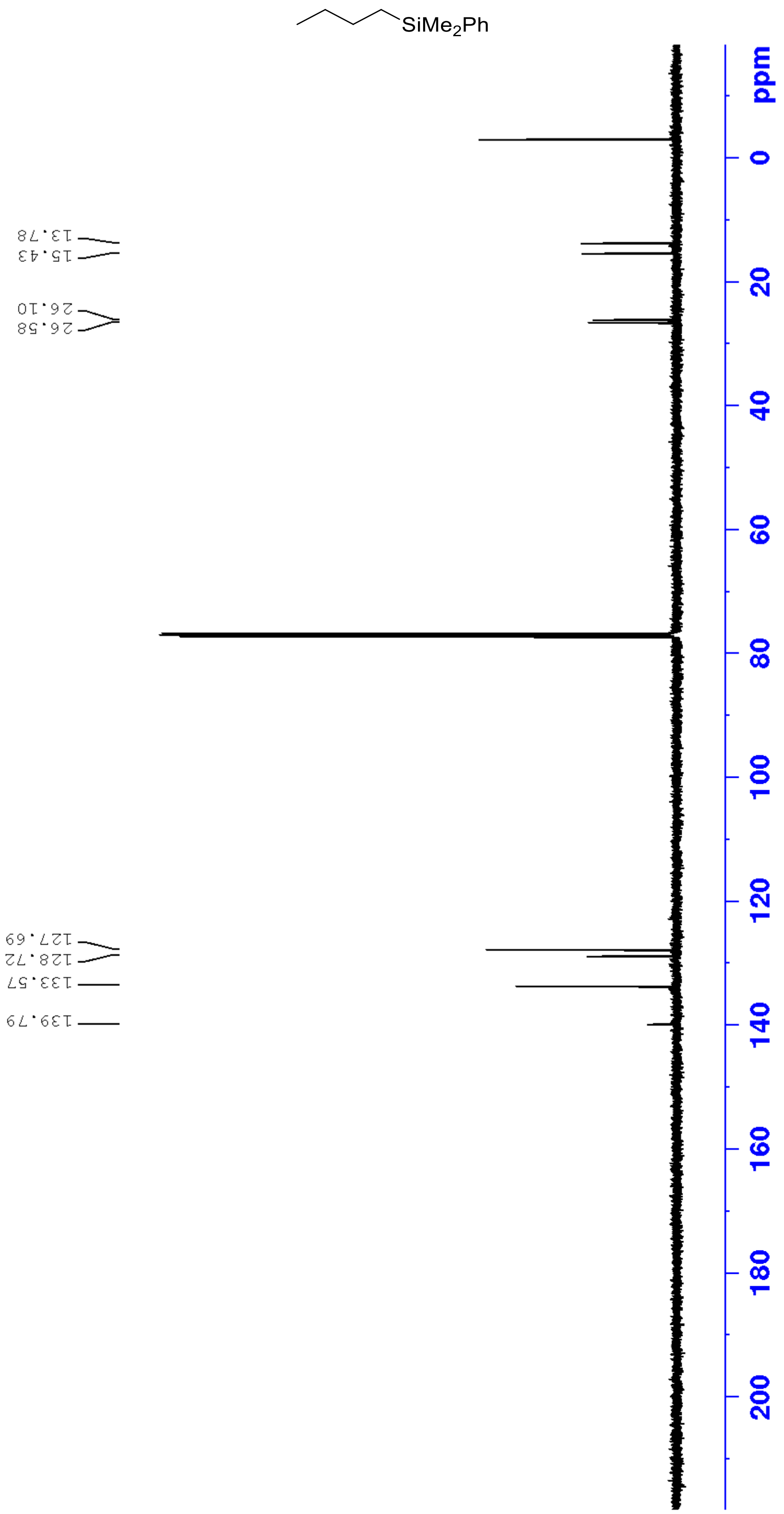


^{1}H NMR spectra of **butyldimethyl(phenyl)silane (1q)**

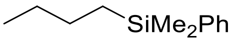


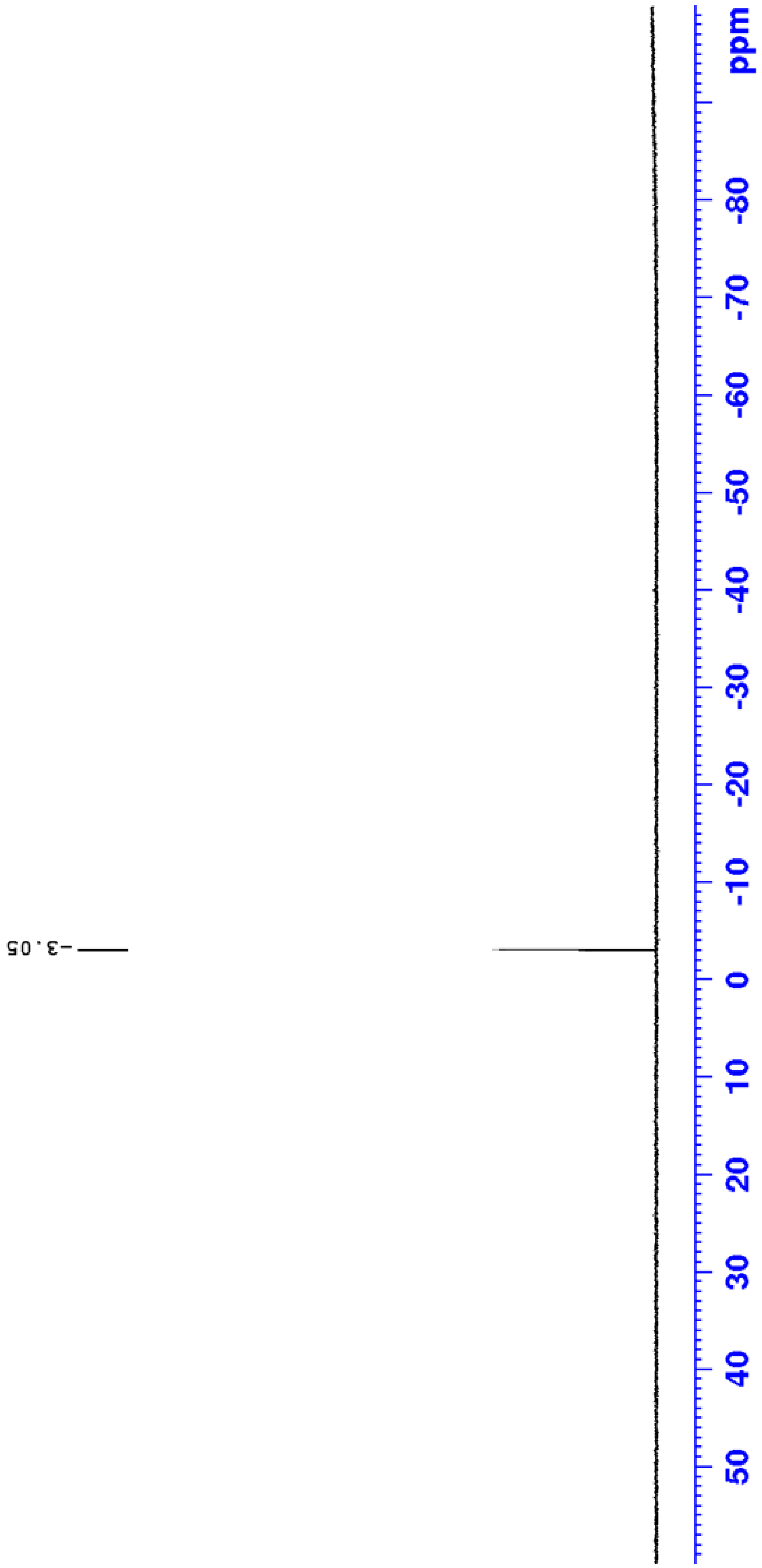


^{13}C NMR spectra of **butyldimethyl(phenyl)silane (1q)**

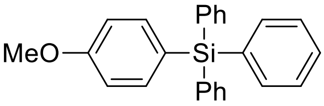


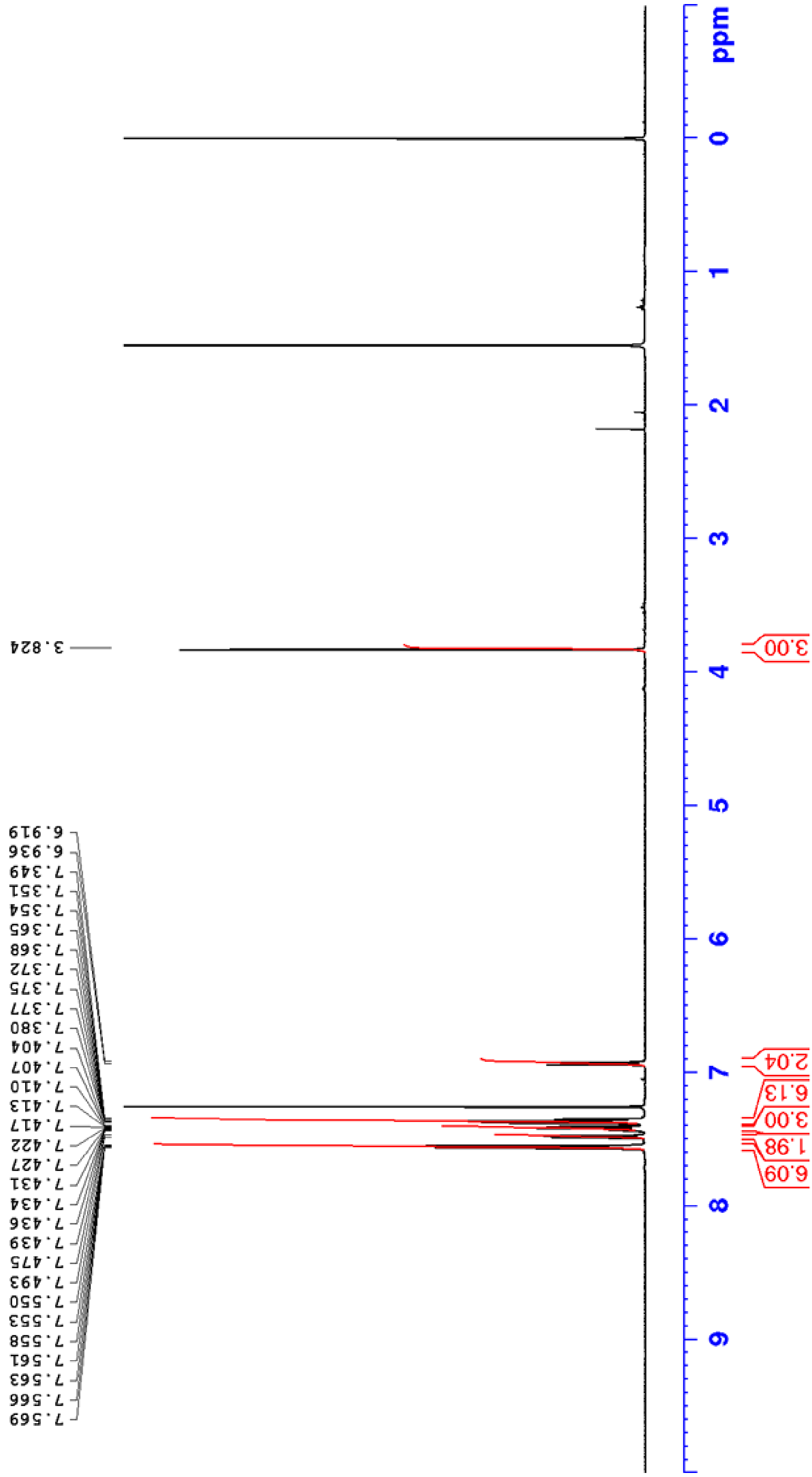
^{29}Si NMR spectra of **butyldimethyl(phenyl)silane (1q)**



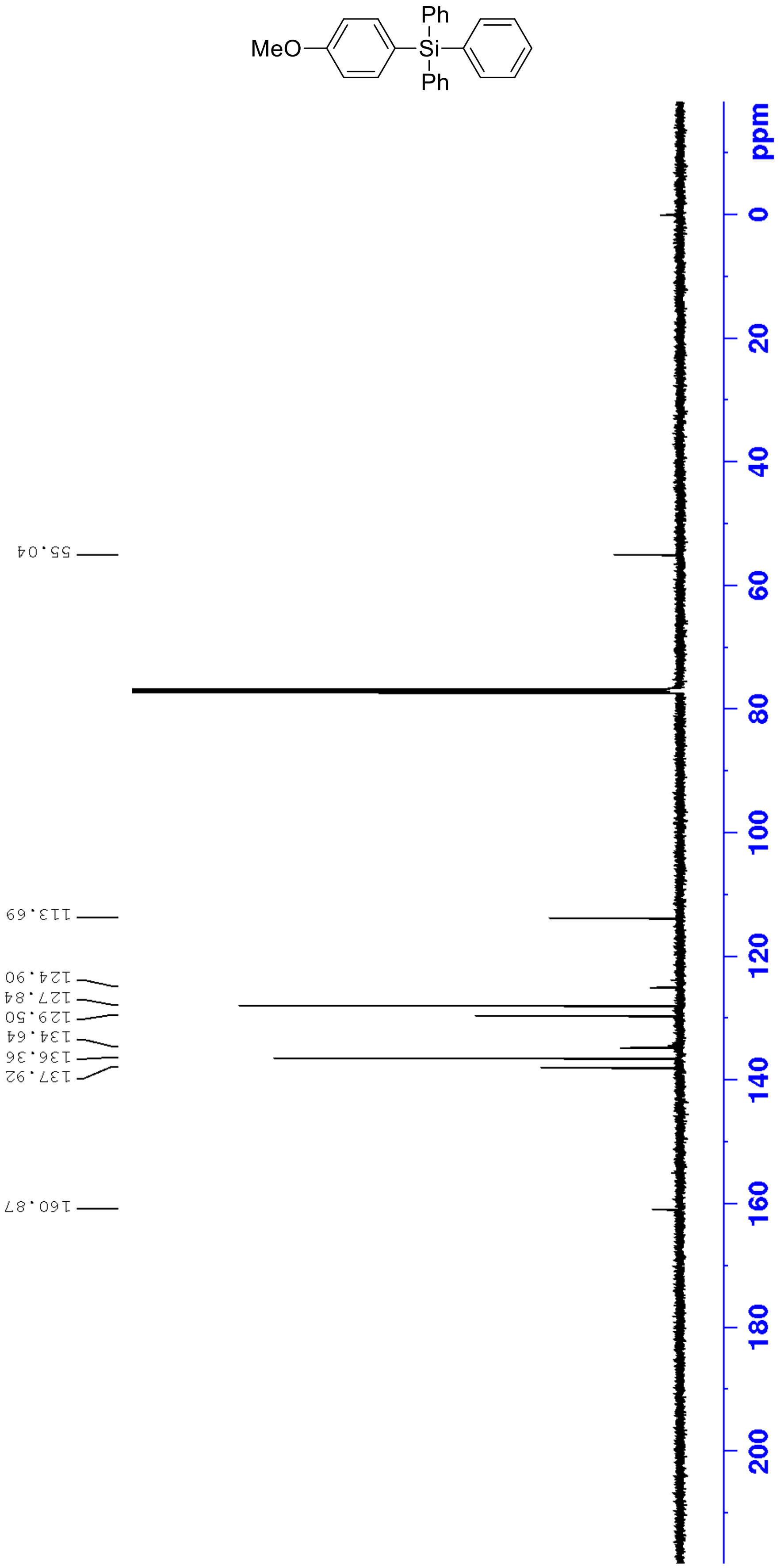


^{1}H NMR spectra of **(4-methoxyphenyl)triphenylsilane (2a)**

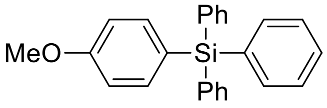


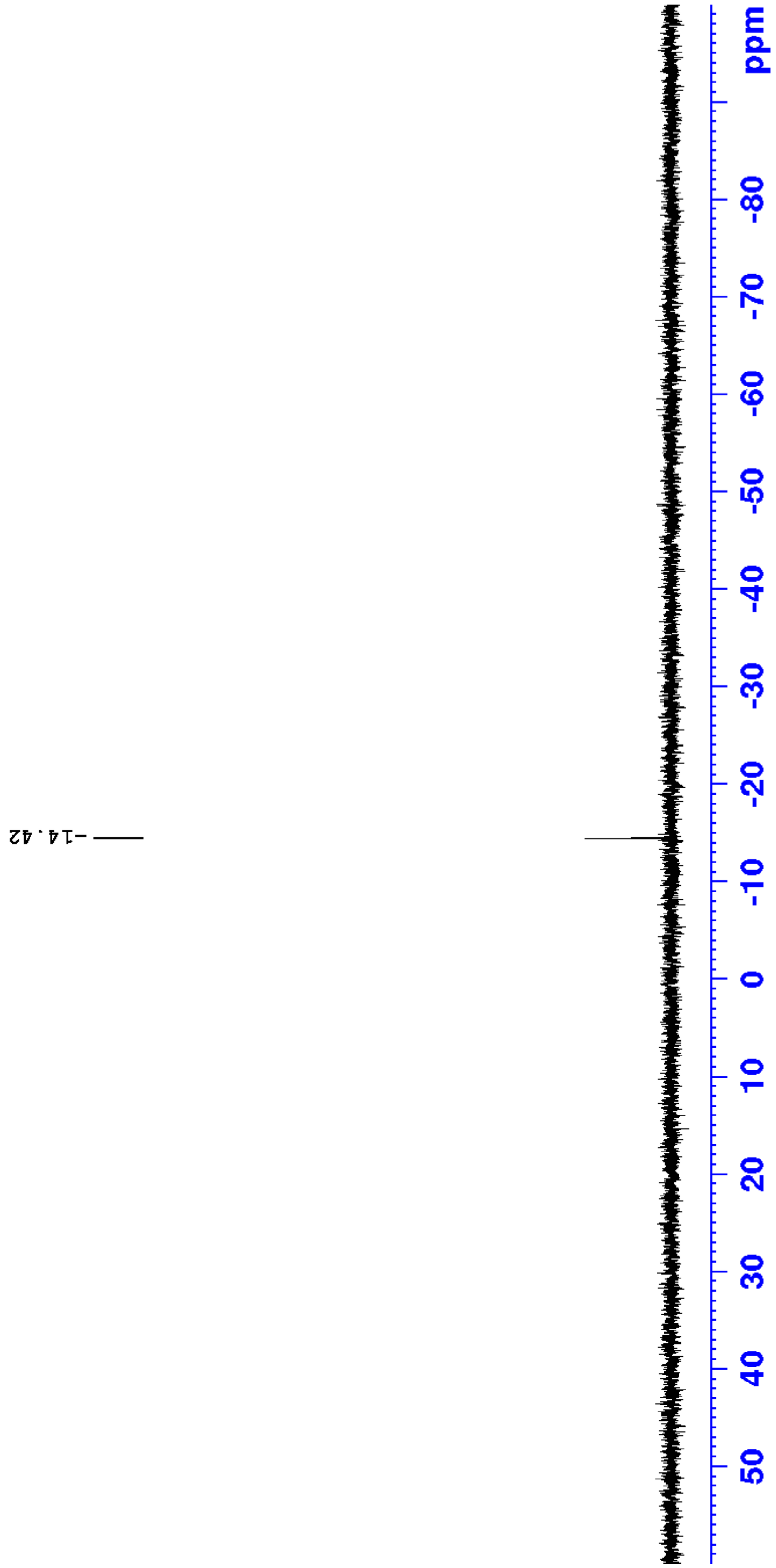


^{13}C NMR spectra of **(4-methoxyphenyl)triphenylsilane (2a)**

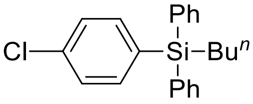


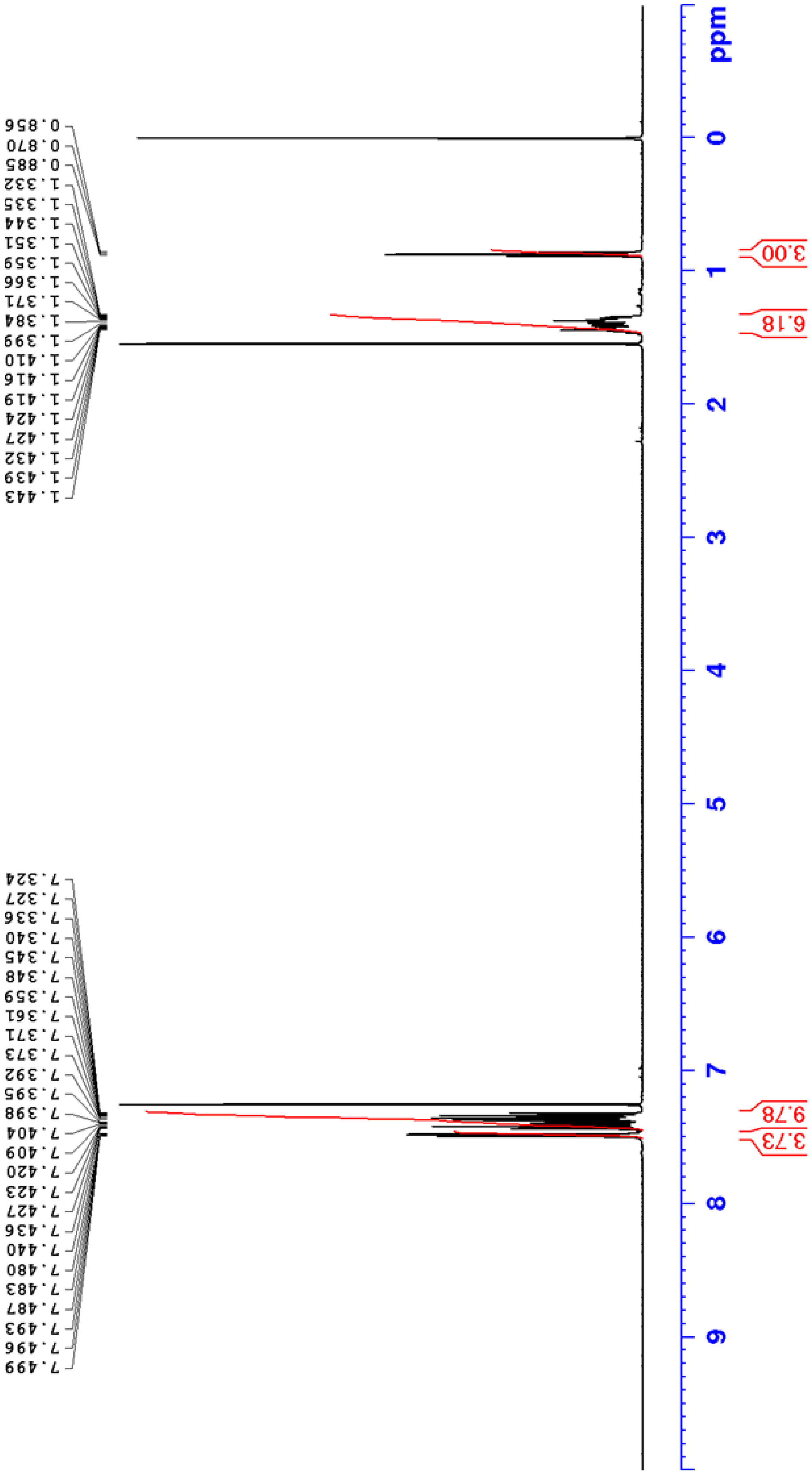
^{29}Si NMR spectra of **(4-methoxyphenyl)triphenylsilane (2a)**



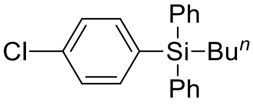


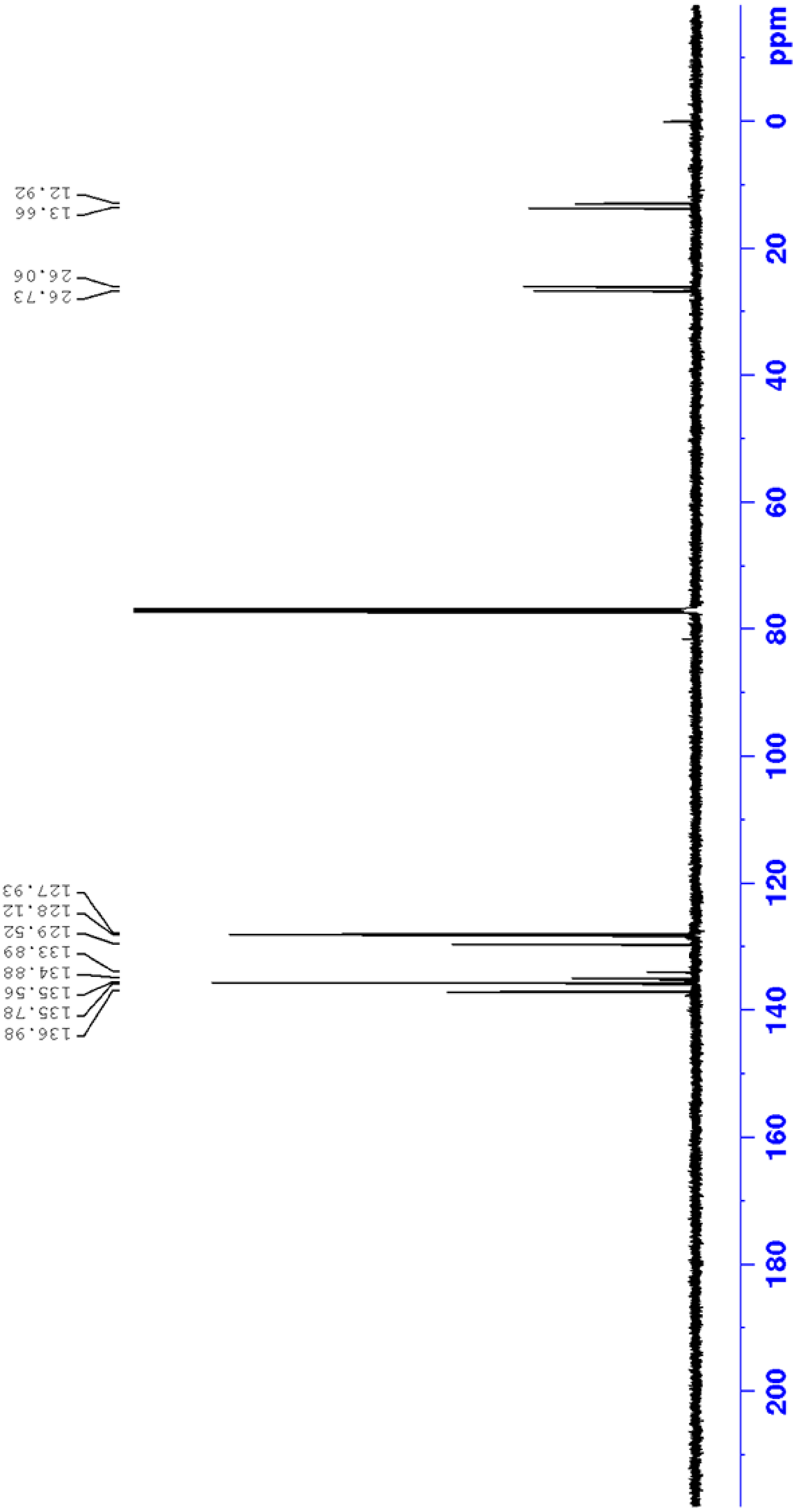
^{1}H NMR spectra **butyl(4-chlorophenyl)diphenylsilane (2b)**



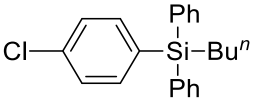


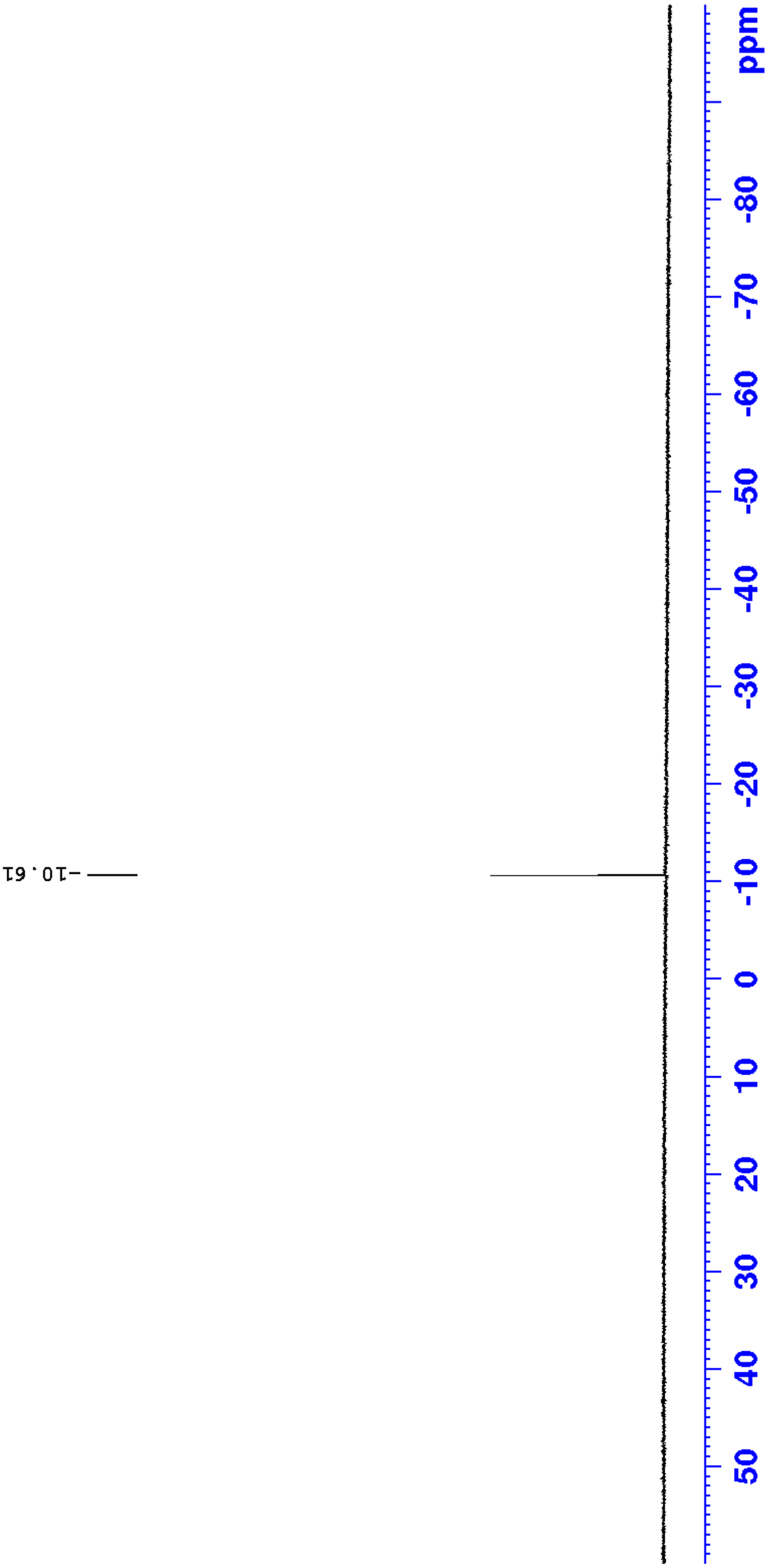
^{13}C NMR spectra **butyl(4-chlorophenyl)diphenylsilane (2b)**



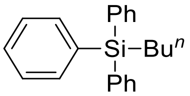


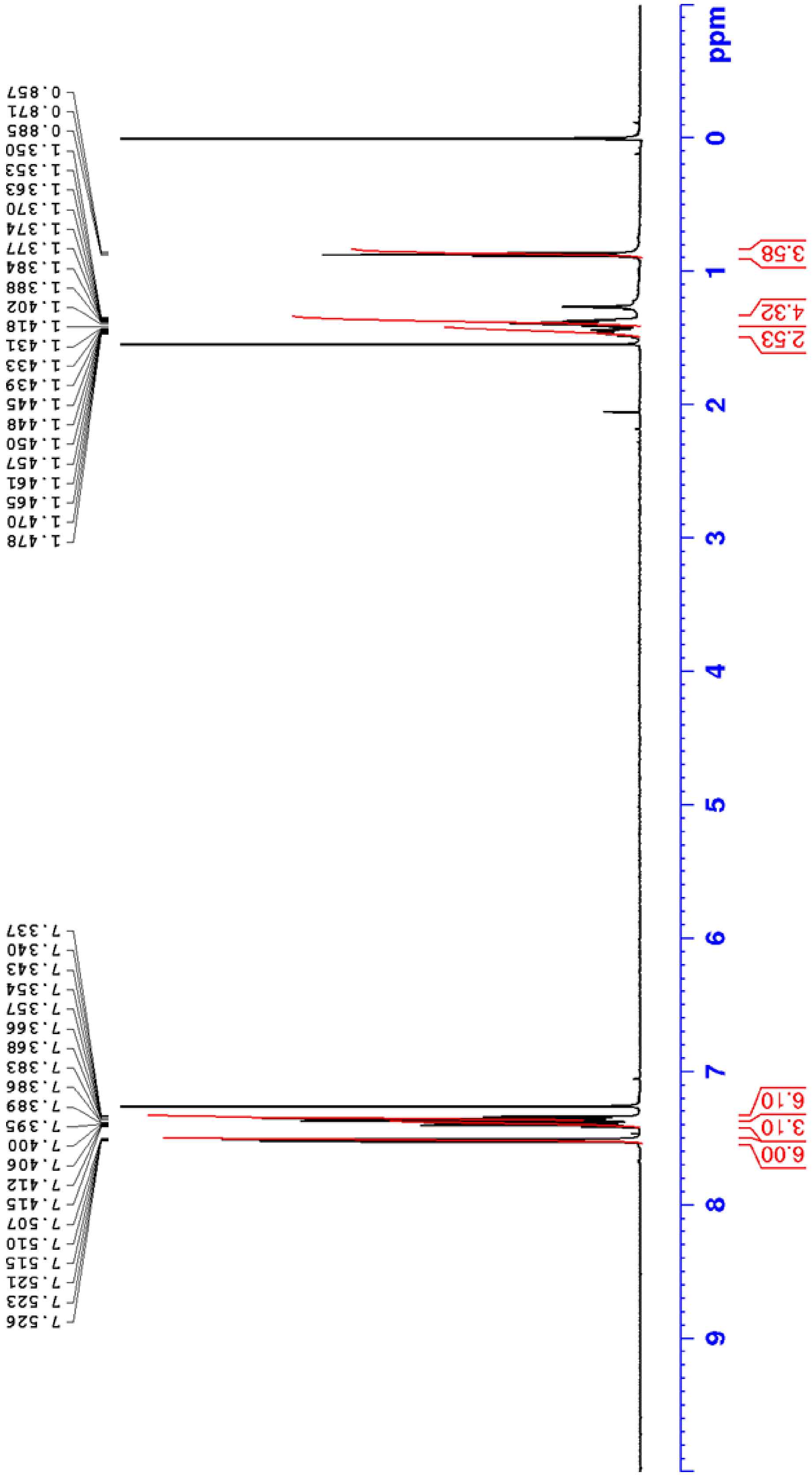
^{29}Si NMR spectra **butyl(4-chlorophenyl)diphenylsilane (2b)**



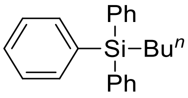


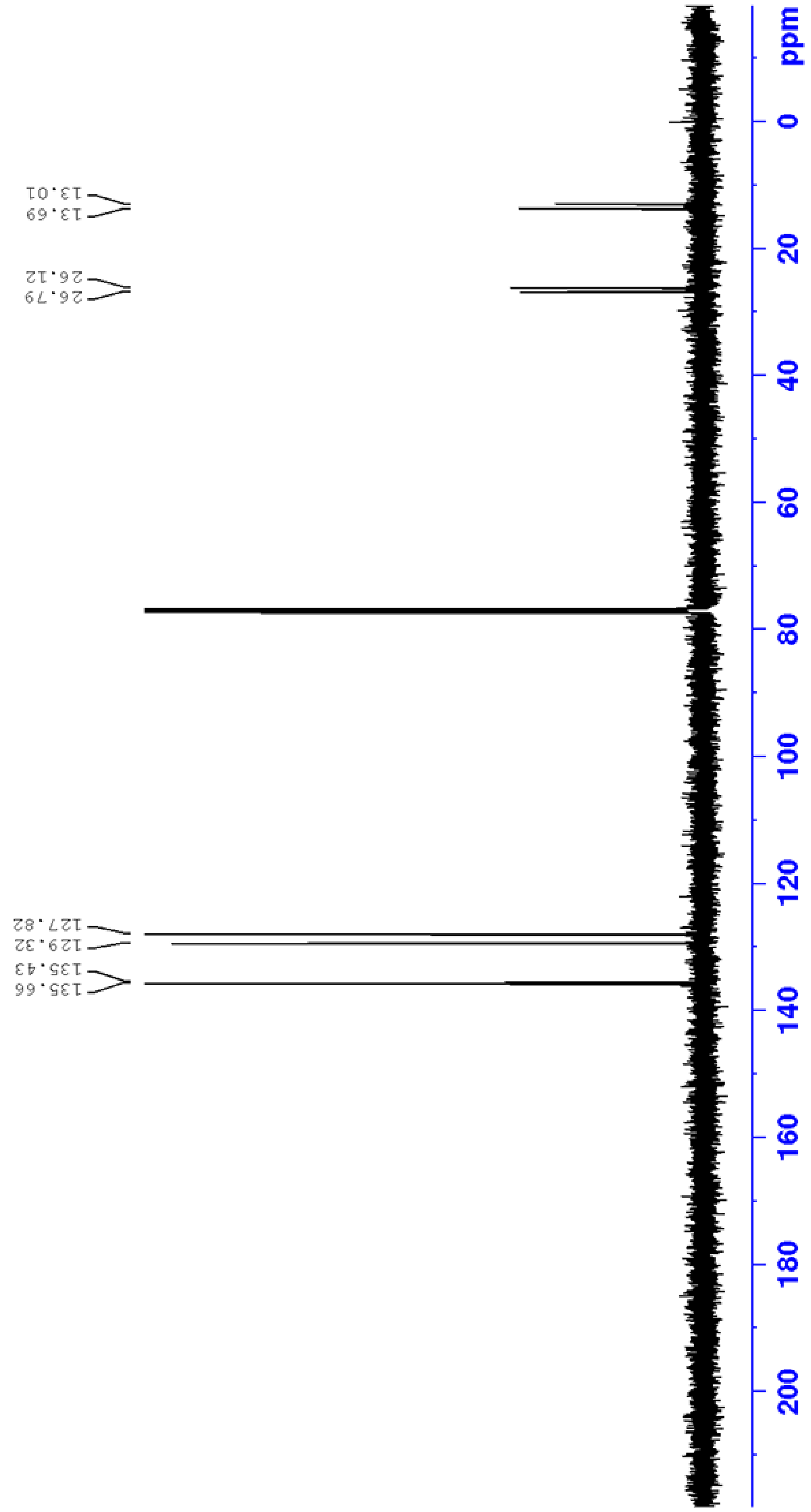
^{1}H, ^{13}C and ^{29}Si NMR spectra of **butyltriphenylsilane (2c)**



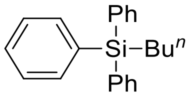


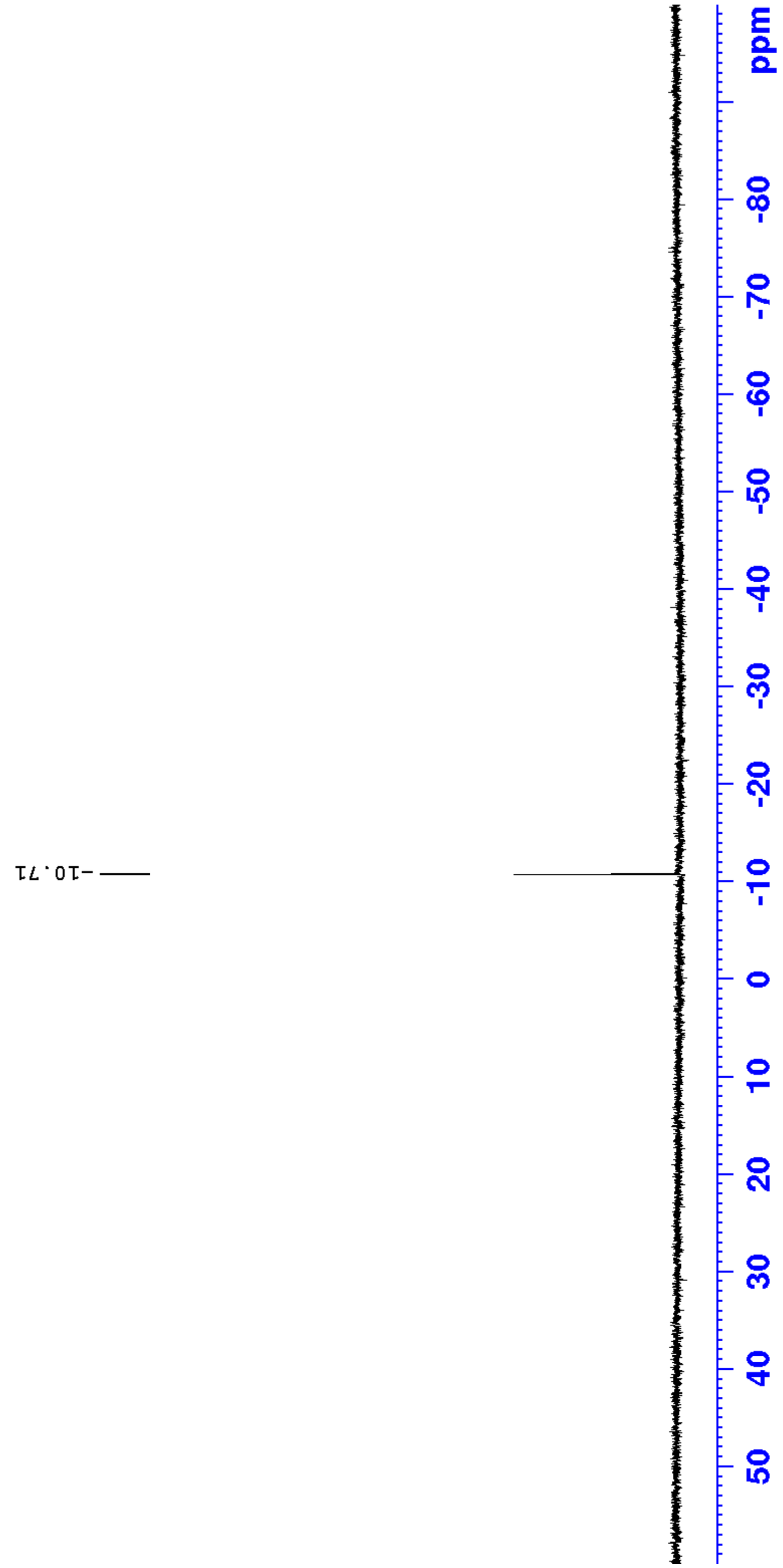
^{1}H, ^{13}C and ^{29}Si NMR spectra of **butyltriphenylsilane (2c)**



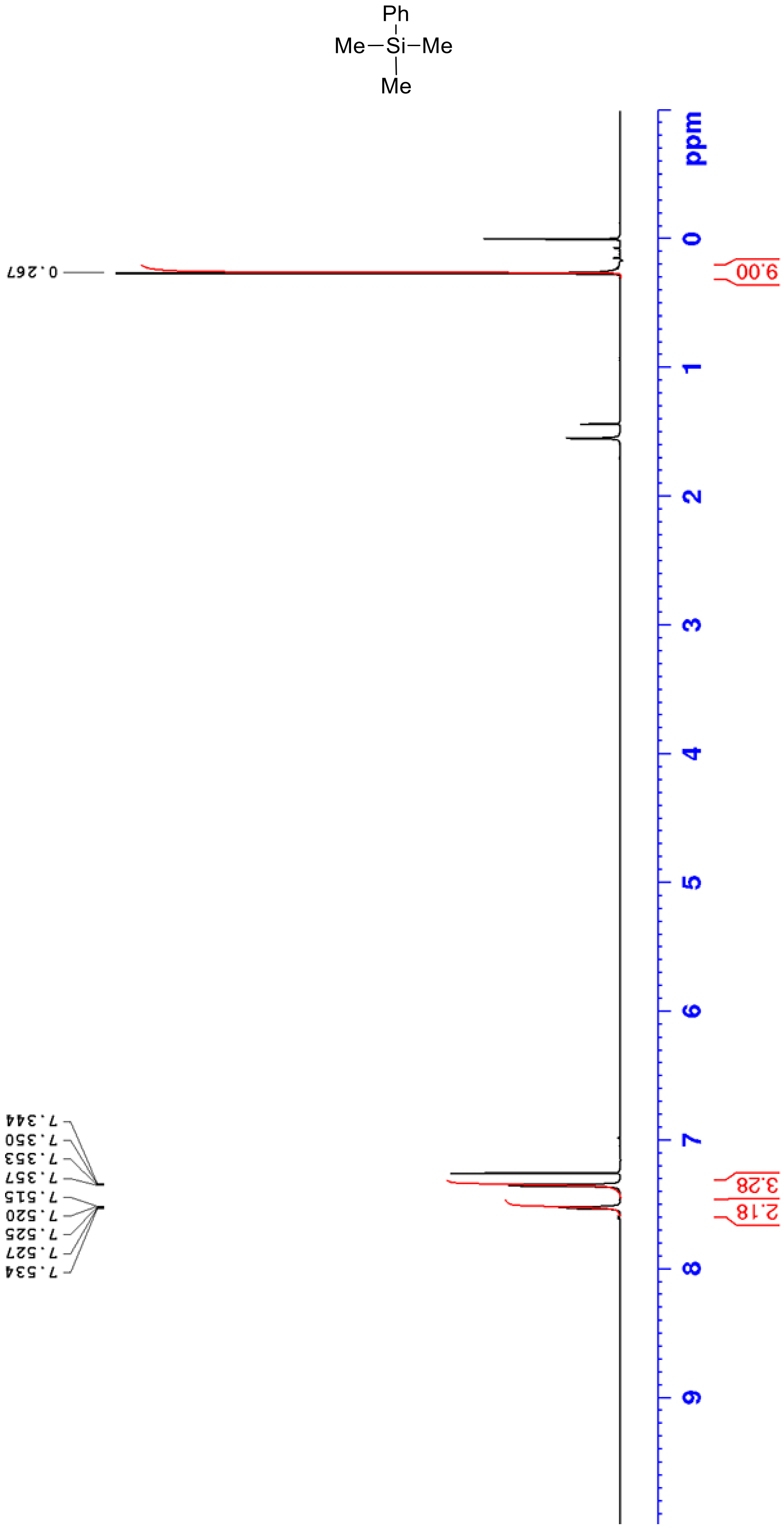


^{1}H, ^{13}C and ^{29}Si NMR spectra of **butyltriphenylsilane (2c)**

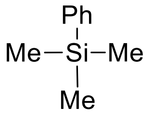




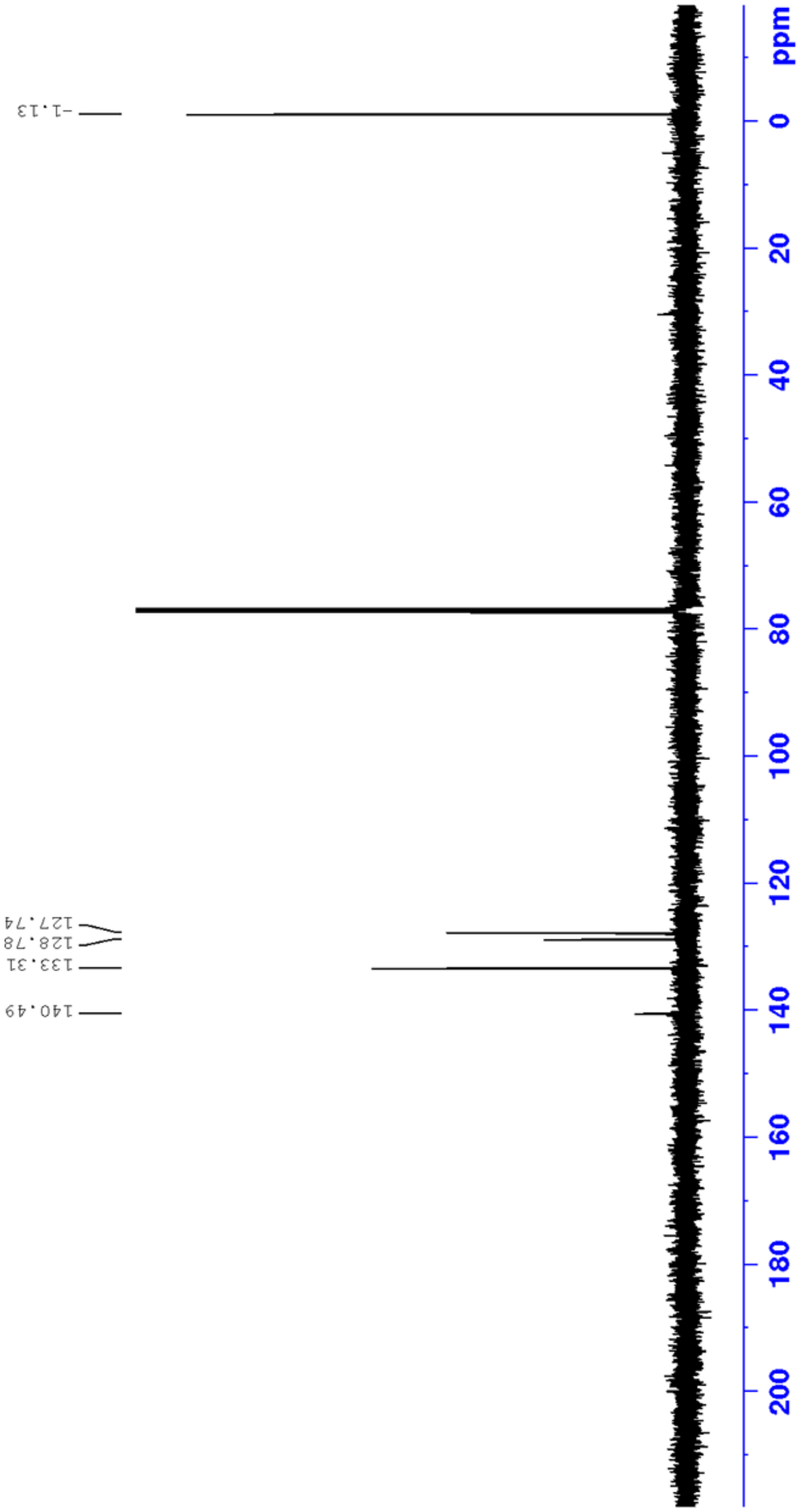
^{1}H NMR spectra of **trimethylphenylsilane (3a)**



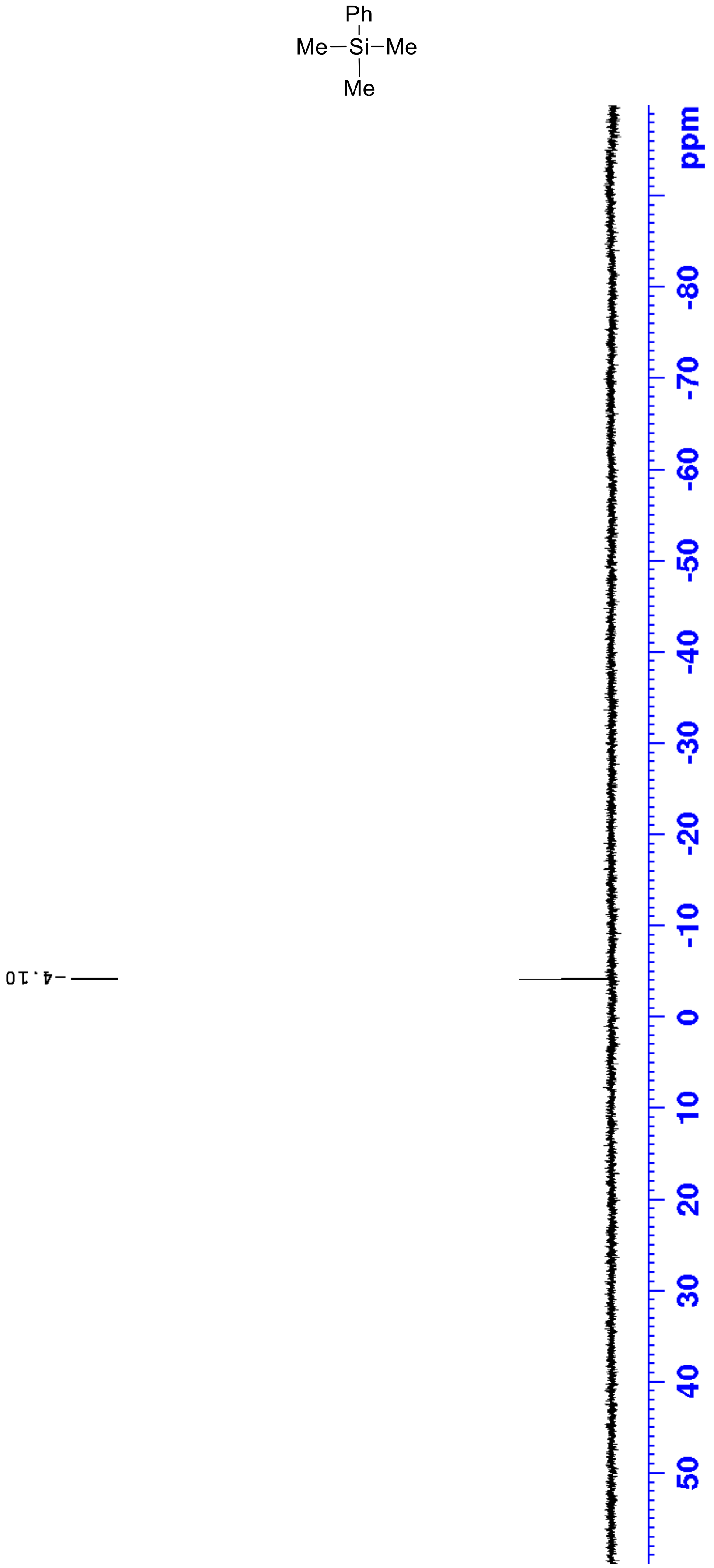
^{13}C NMR spectra of **trimethylphenylsilane (3a)**



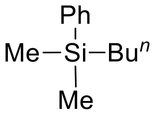
Me_3SiPh



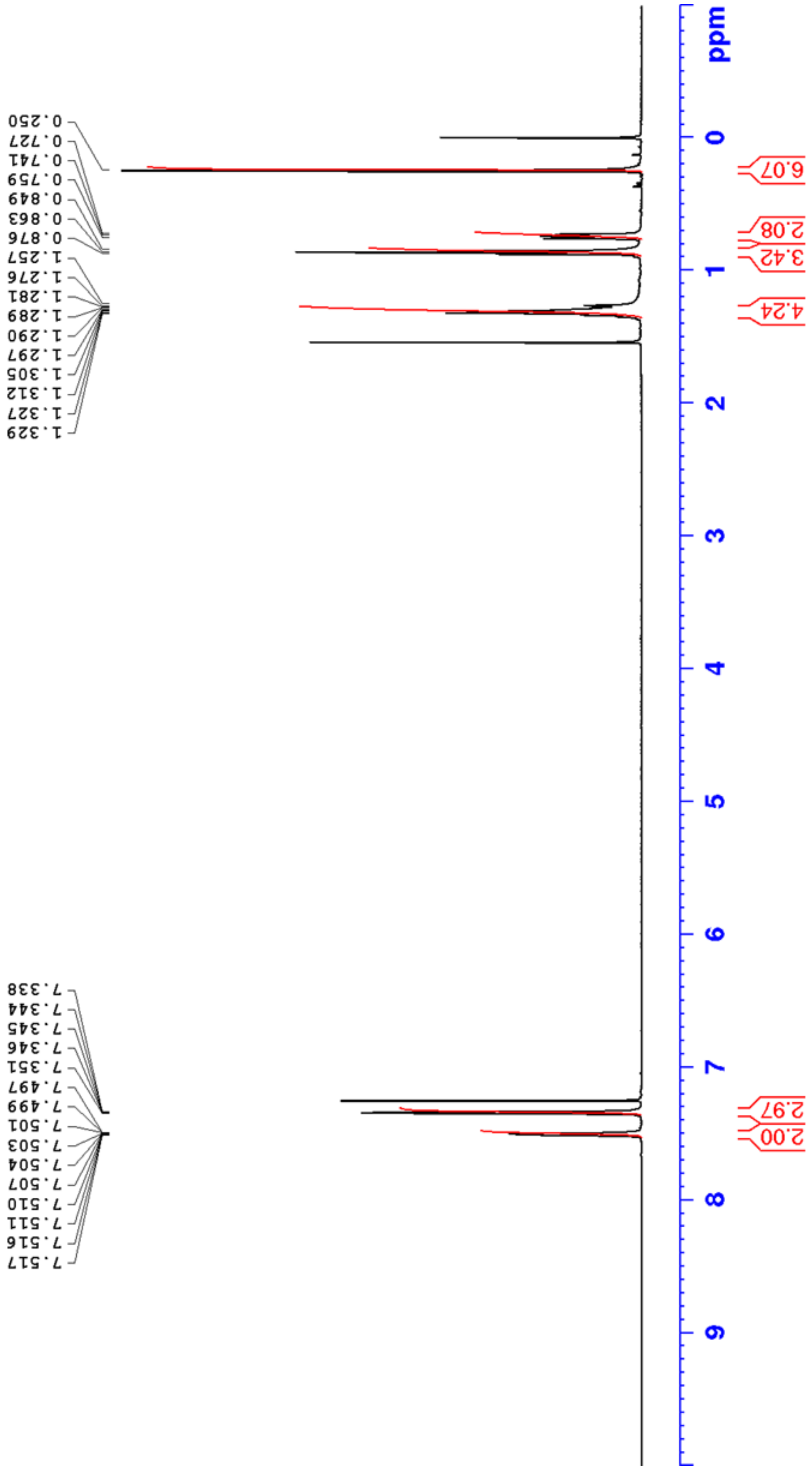
^{29}Si NMR spectra of **trimethylphenylsilane (3a)**



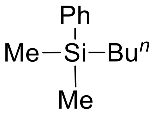
^{1}H NMR spectra of **butyl(dimethyl)(phenyl)silane (3b)**



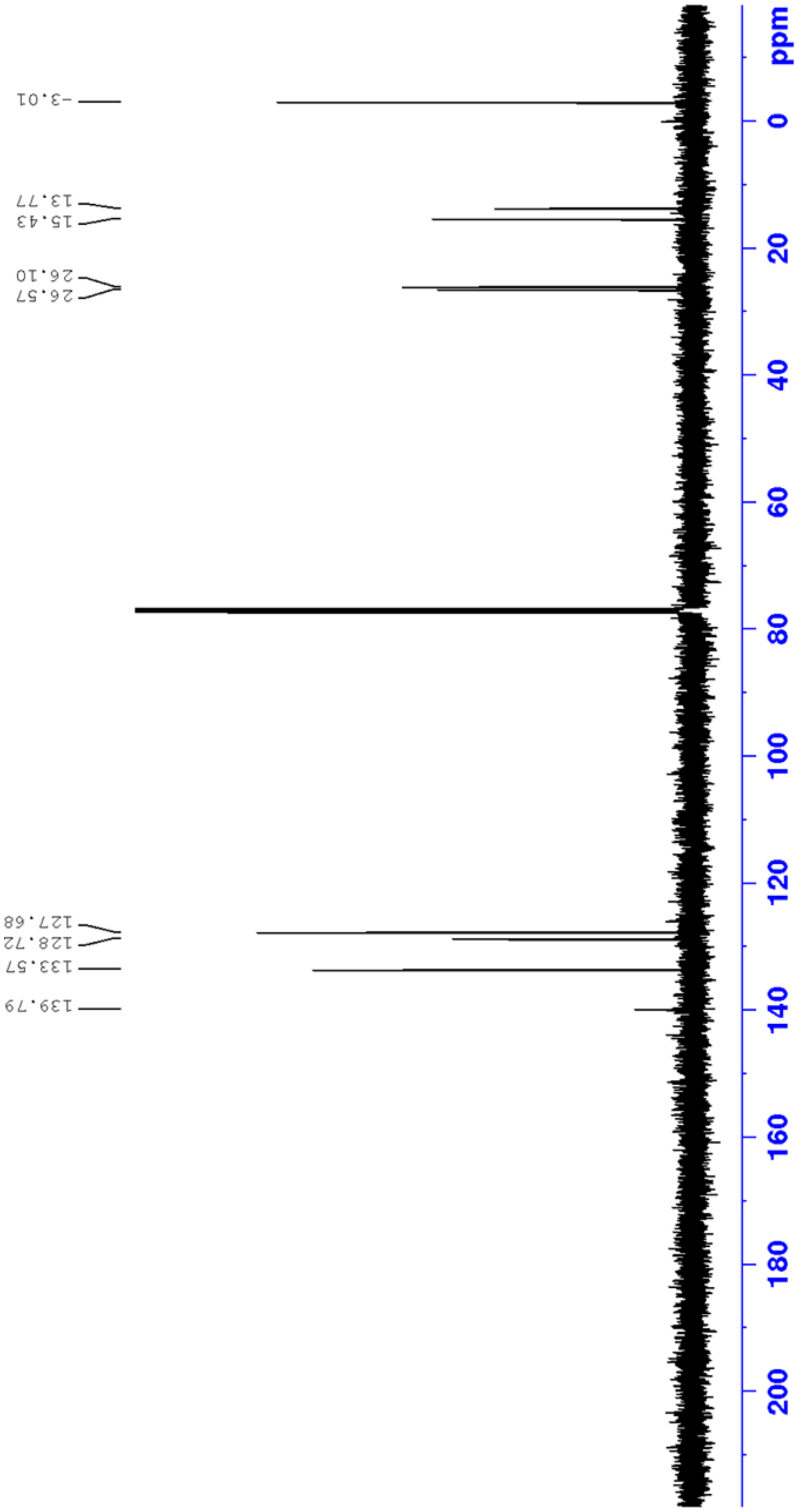
$Me-\overset{\displaystyle Ph}{\underset{\displaystyle Me}{Si}}-Bu^n$



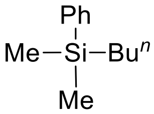
^{13}C NMR spectra of **butyl(dimethyl)(phenyl)silane (3b)**



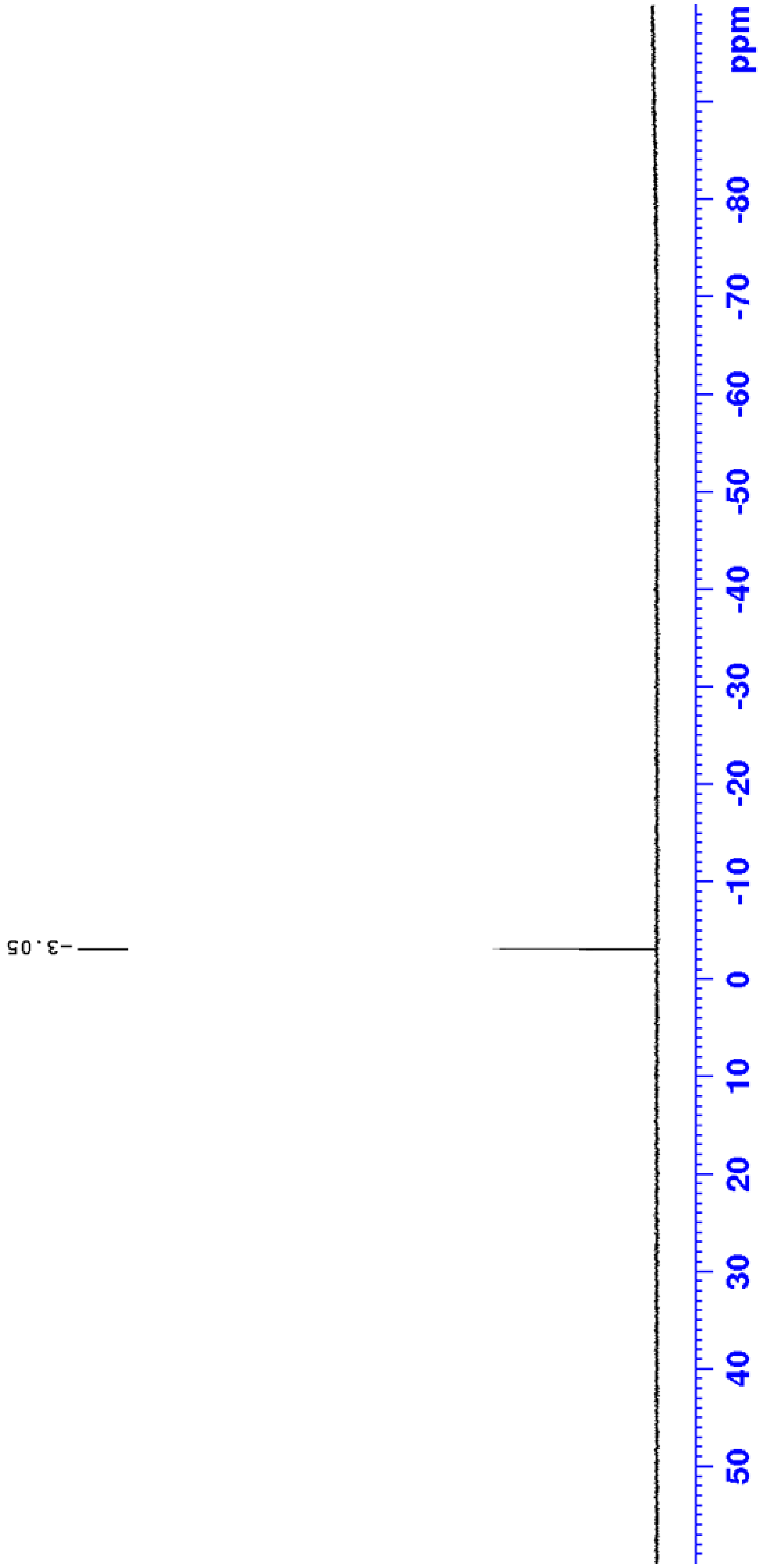
$$\mathrm{Me{-}\overset{\displaystyle Ph}{\underset{\displaystyle Me}{Si}}{-}Bu}^{n}$$



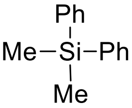
^{29}Si NMR spectra of **butyl(dimethyl)(phenyl)silane (3b)**



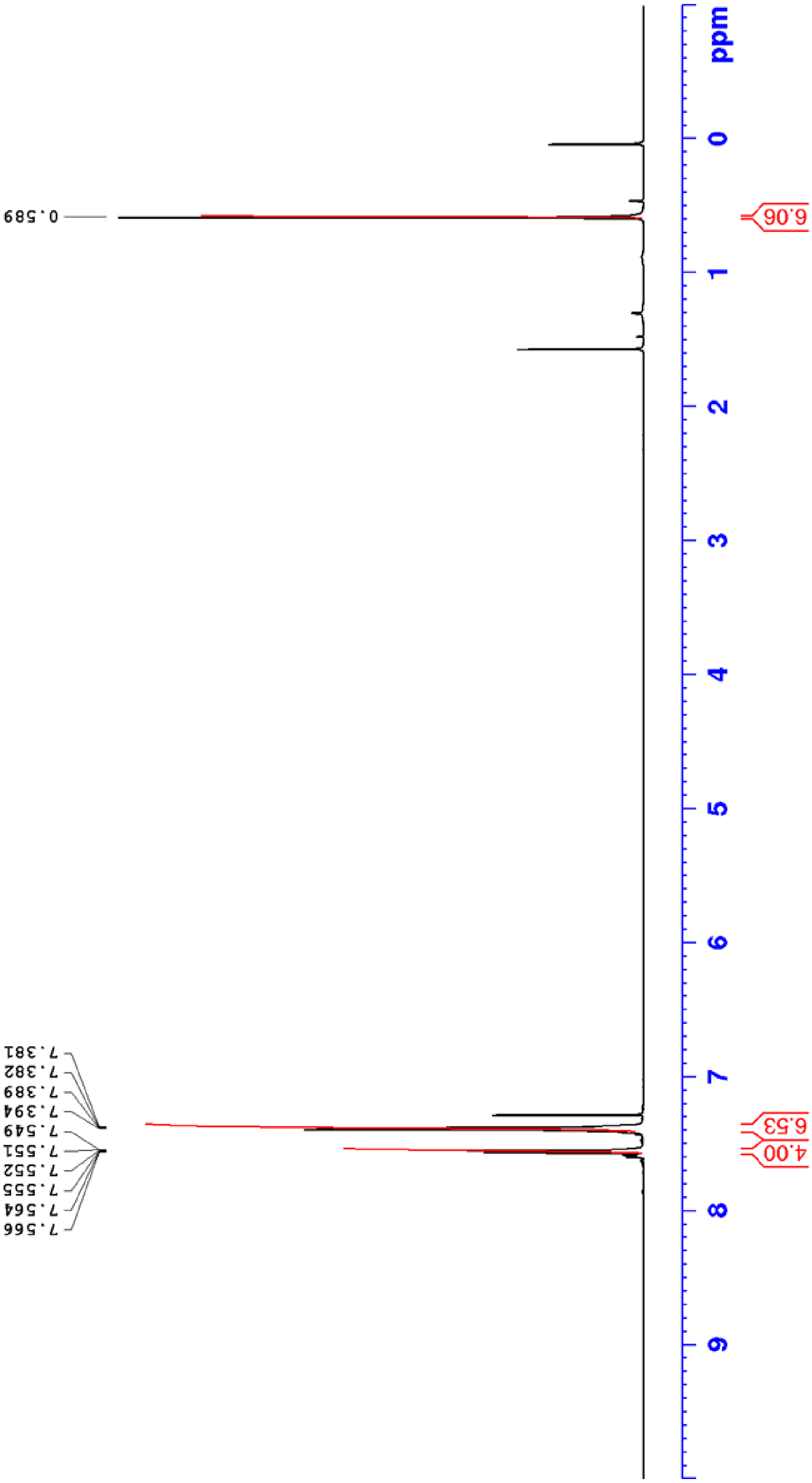
$\mathrm{Me{-}Si(Ph)(Me){-}Bu}^{n}$



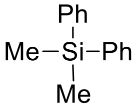
^{1}H, ^{13}C and ^{29}Si NMR spectra of **dimethyldiphenylsilane (3c)**

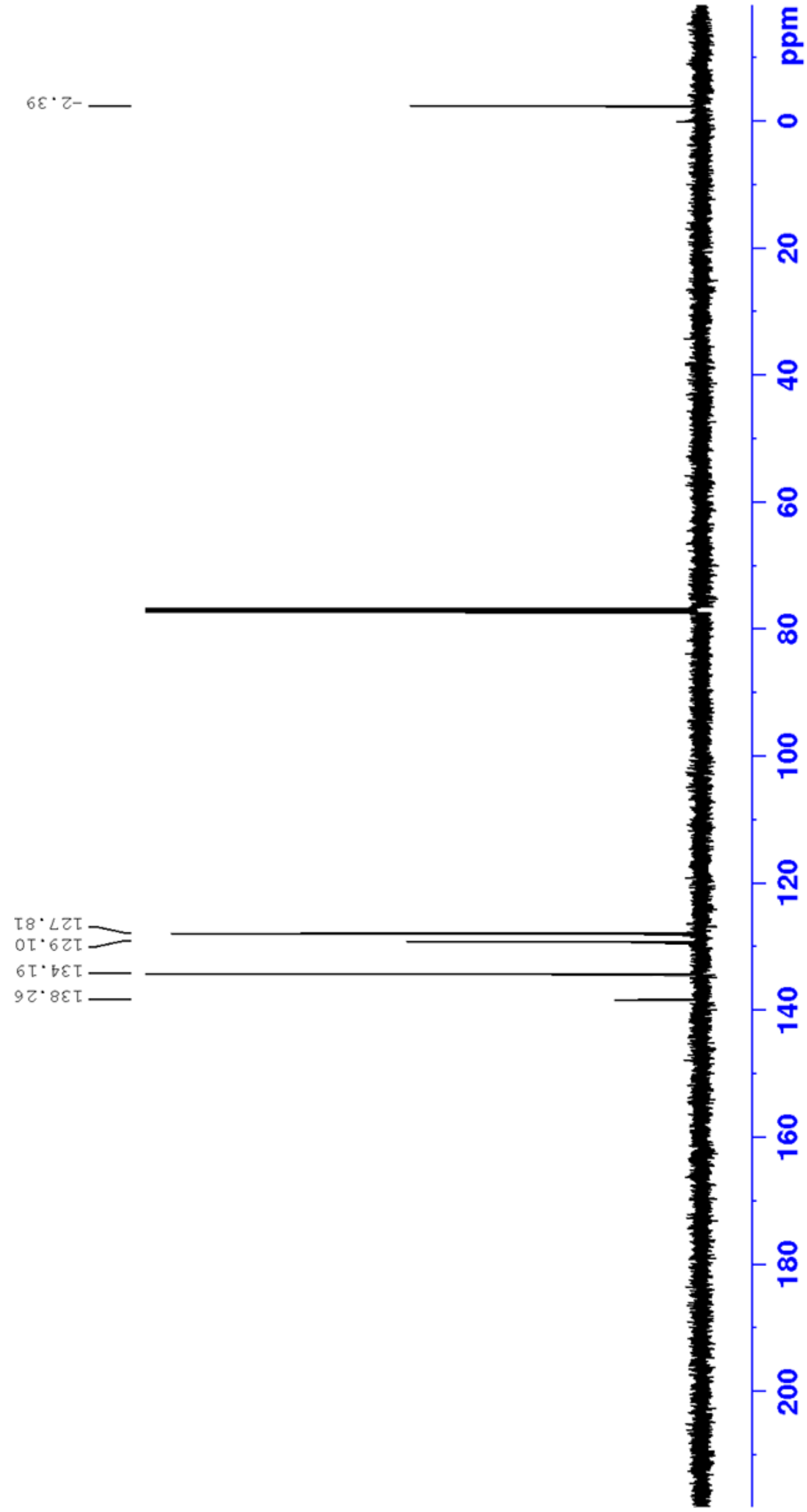


$\mathrm{Me}{-}\overset{\mathrm{Ph}}{\underset{\mathrm{Me}}{\mathrm{Si}}}{-}\mathrm{Ph}$

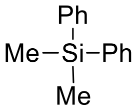


^{1}H, ^{13}C and ^{29}Si NMR spectra of **dimethyldiphenylsilane (3c)**

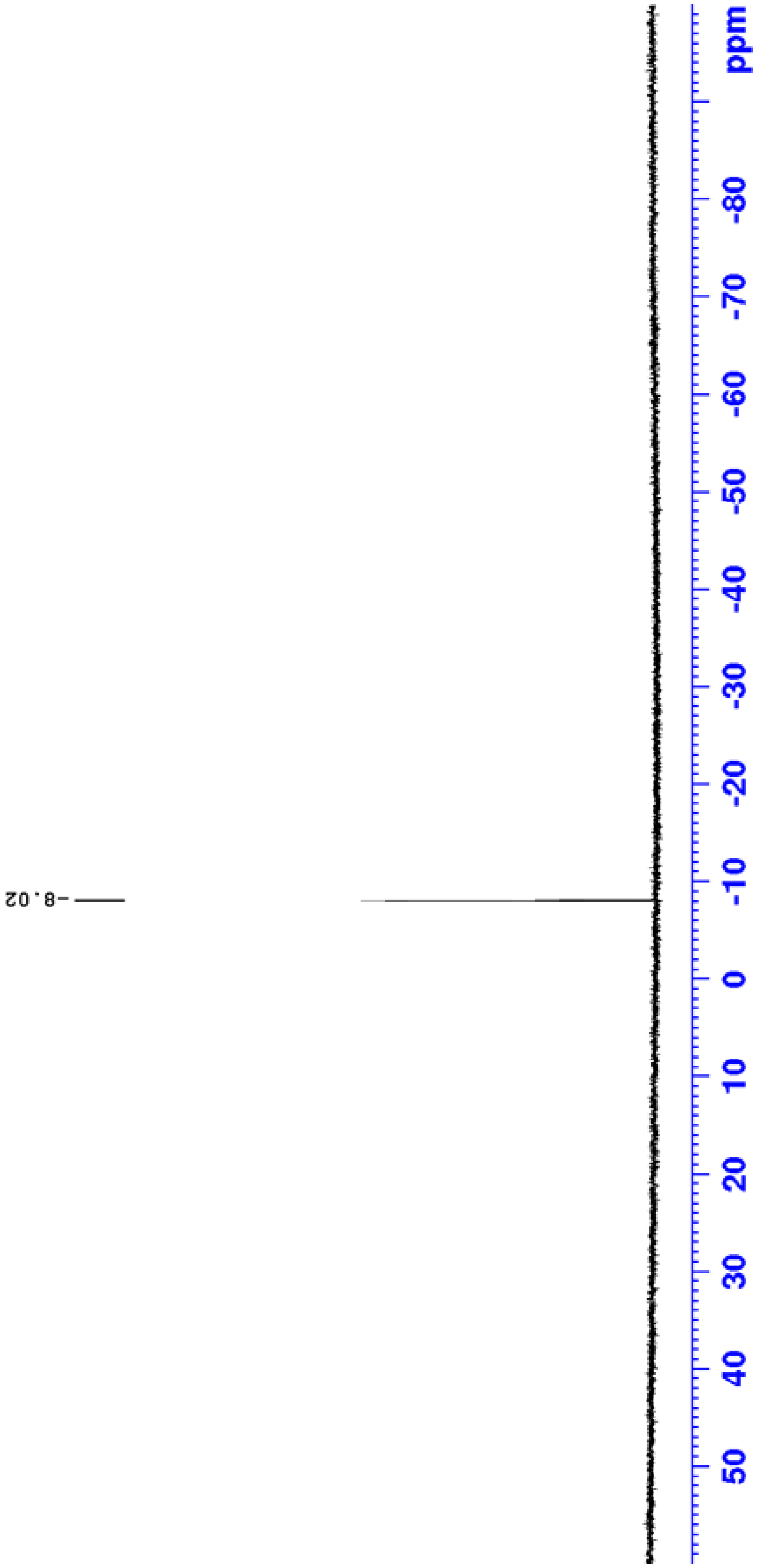




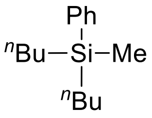
^{1}H, ^{13}C and ^{29}Si NMR spectra of **dimethyldiphenylsilane (3c)**

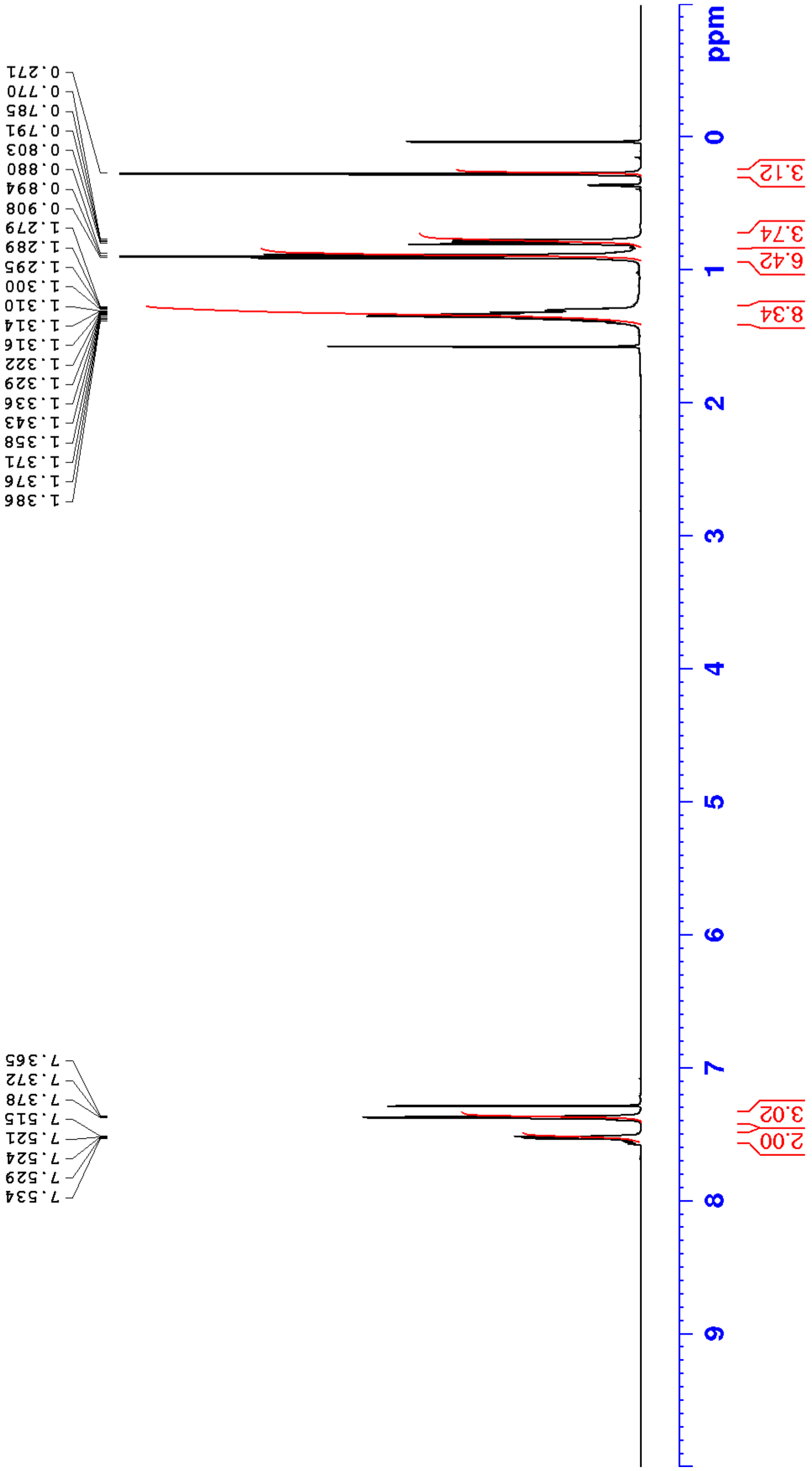


$\mathrm{Me{-}\overset{Ph}{\underset{Me}{Si}}{-}Ph}$

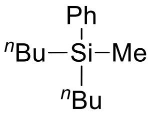


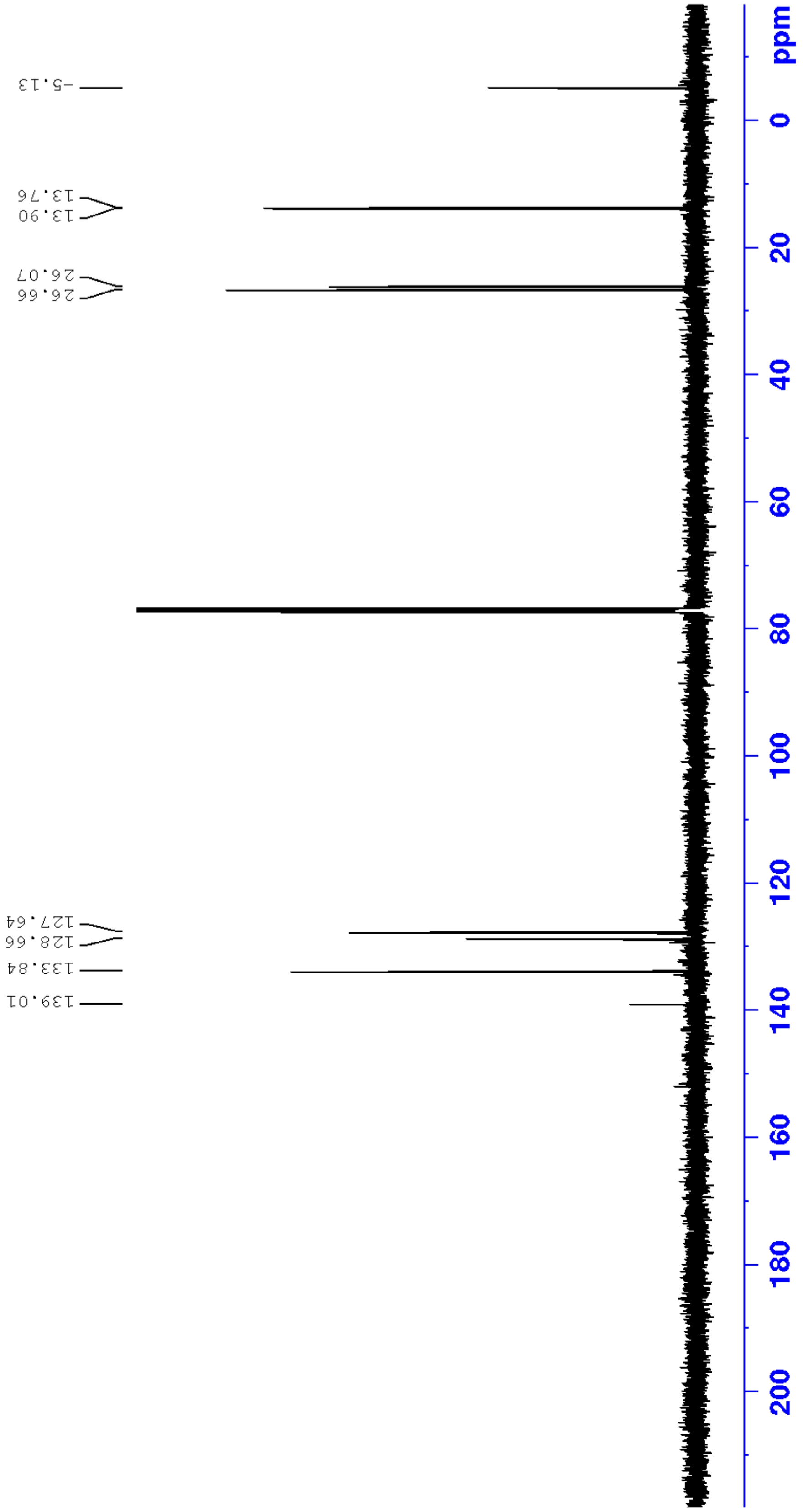
^{1}H NMR spectra of **dibutyl(methyl)(phenyl)silane (3d)**



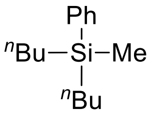


^{13}C NMR spectra of **dibutyl(methyl)(phenyl)silane (3d)**

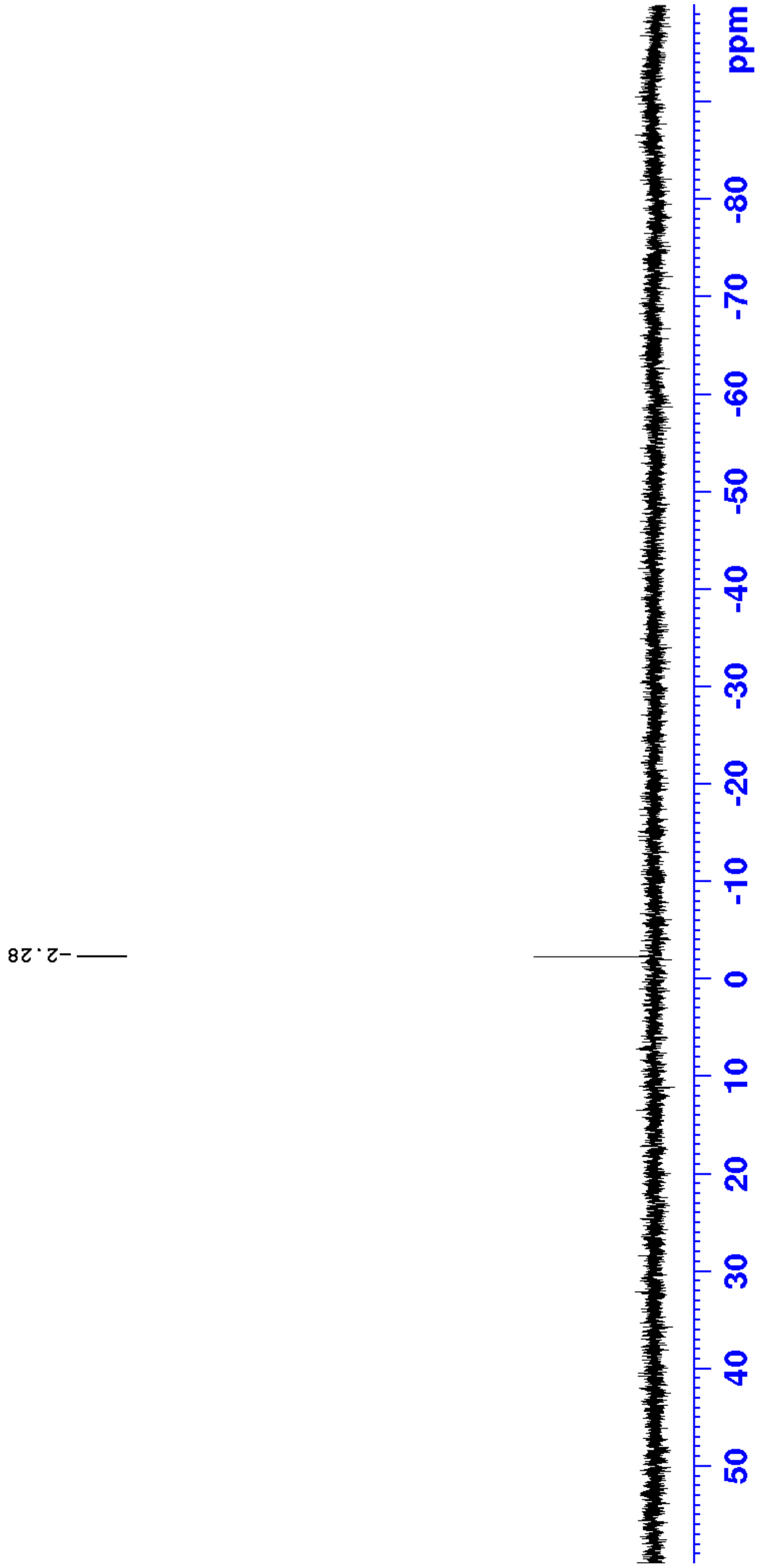




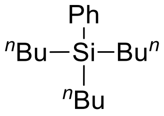
^{29}Si NMR spectra of **dibutyl(methyl)(phenyl)silane (3d)**



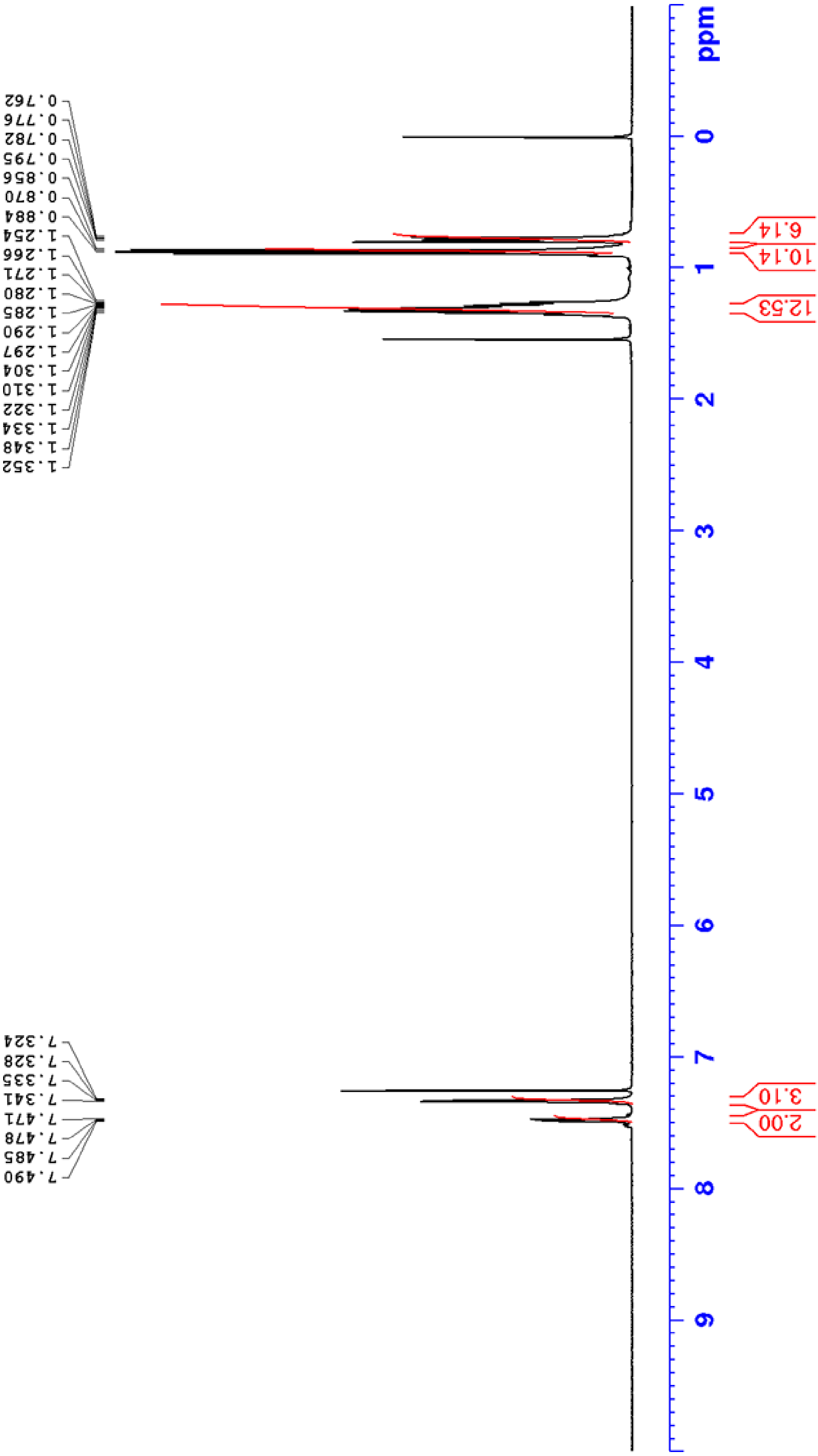
$^{n}\mathrm{Bu}{-}\overset{\mathrm{Ph}}{\underset{^{n}\mathrm{Bu}}{\mathrm{Si}}}{-}\mathrm{Me}$



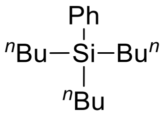
^{1}H, ^{13}C and ^{29}Si NMR spectra of **tributyl(phenyl)silane (3e)**

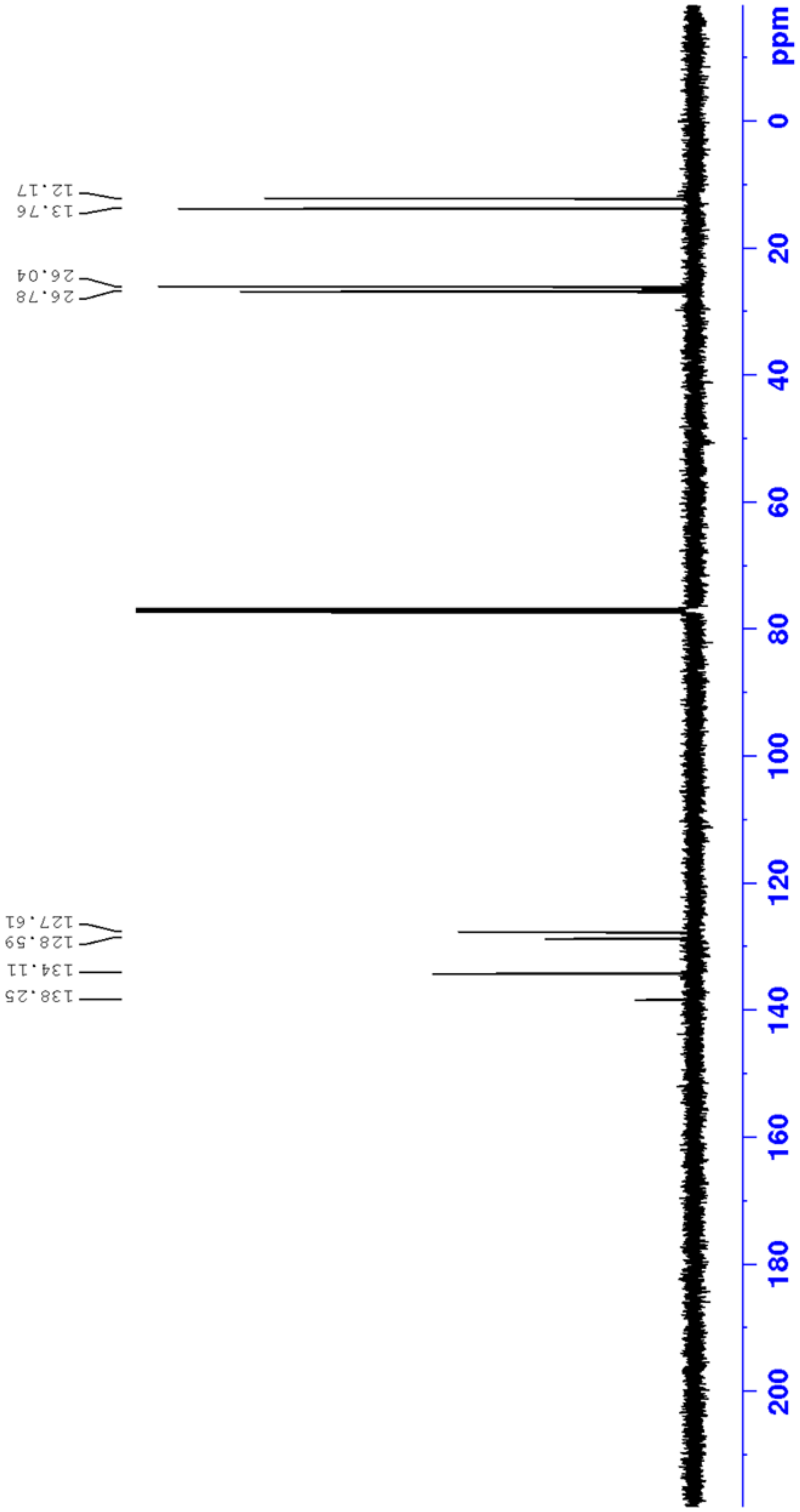


$$\begin{array}{c} \text{Ph} \\ | \\ {}^{n}\text{Bu}-\text{Si}-\text{Bu}^{n} \\ | \\ {}^{n}\text{Bu} \end{array}$$

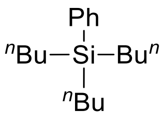


^{13}C NMR spectra of **tributyl(phenyl)silane (3e)**

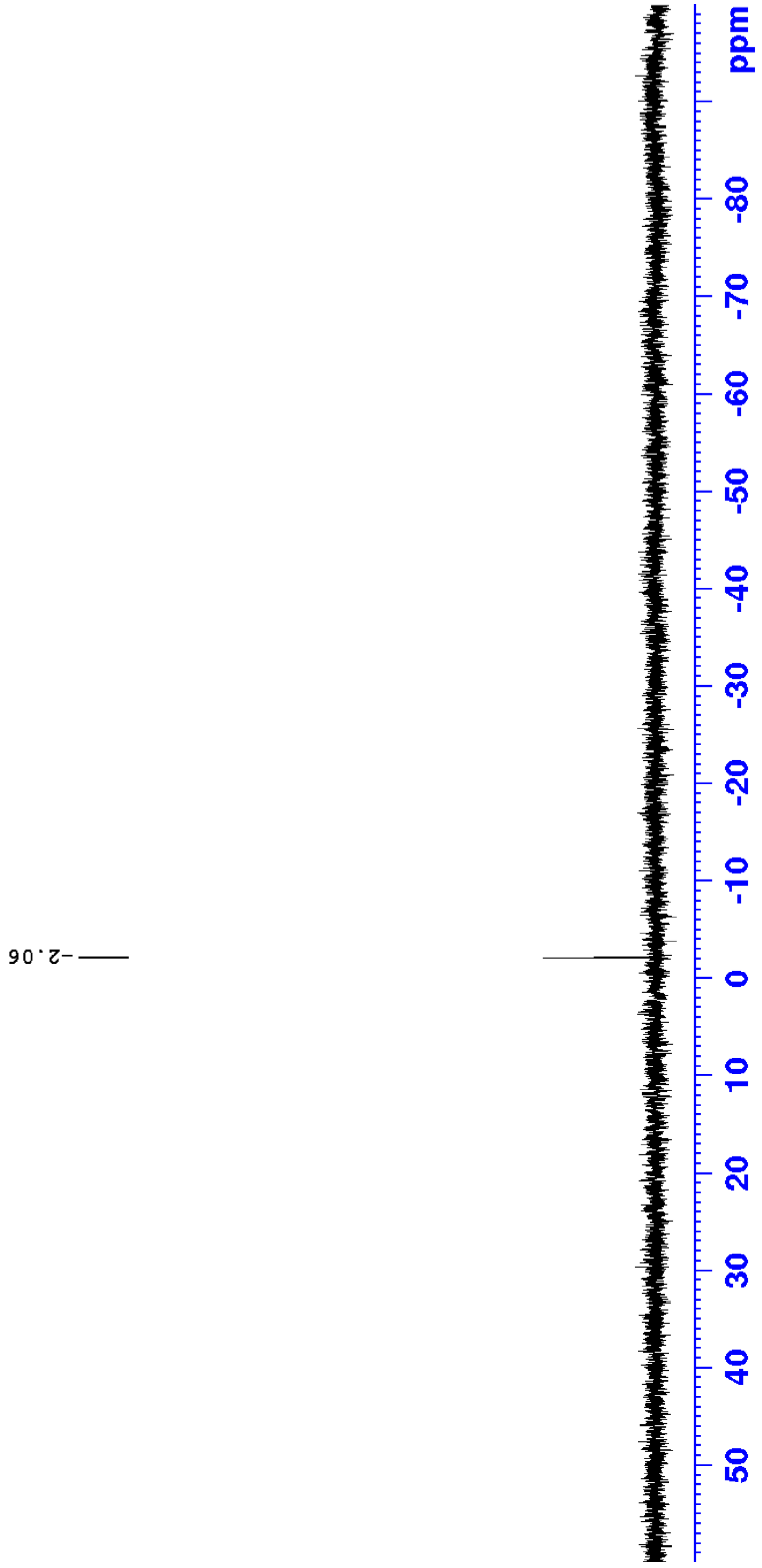




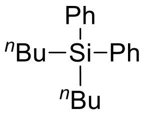
^{29}Si NMR spectra of **tributyl(phenyl)silane (3e)**

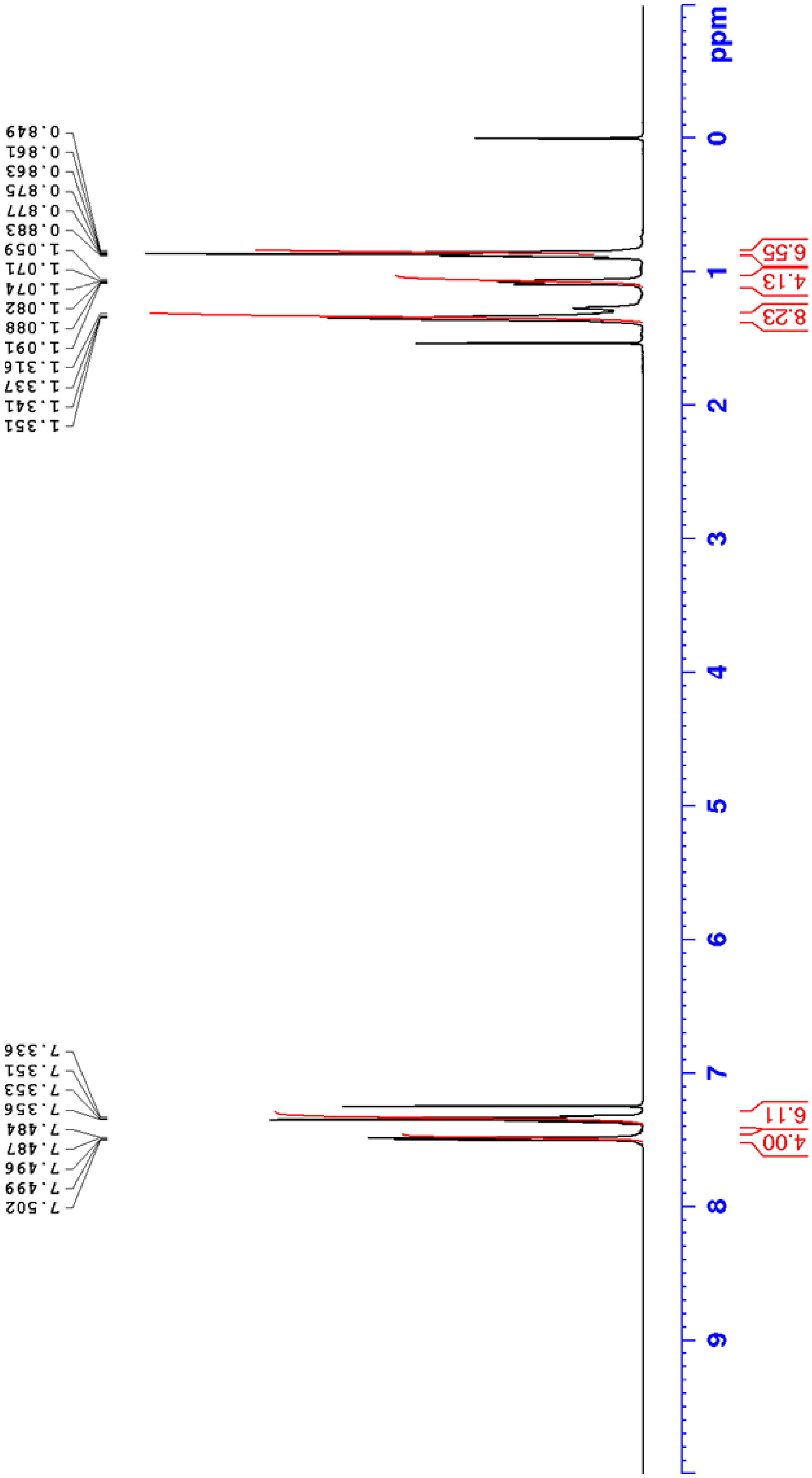


$$^{n}\mathrm{Bu}-\overset{\displaystyle\mathrm{Ph}}{\underset{\displaystyle {}^{n}\mathrm{Bu}}{\mathrm{Si}}}-\mathrm{Bu}^{n}$$

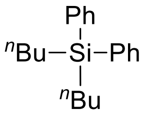


^{1}H, ^{13}C and ^{29}Si NMR spectra of **dibutyldiphenylsilane (3f)**

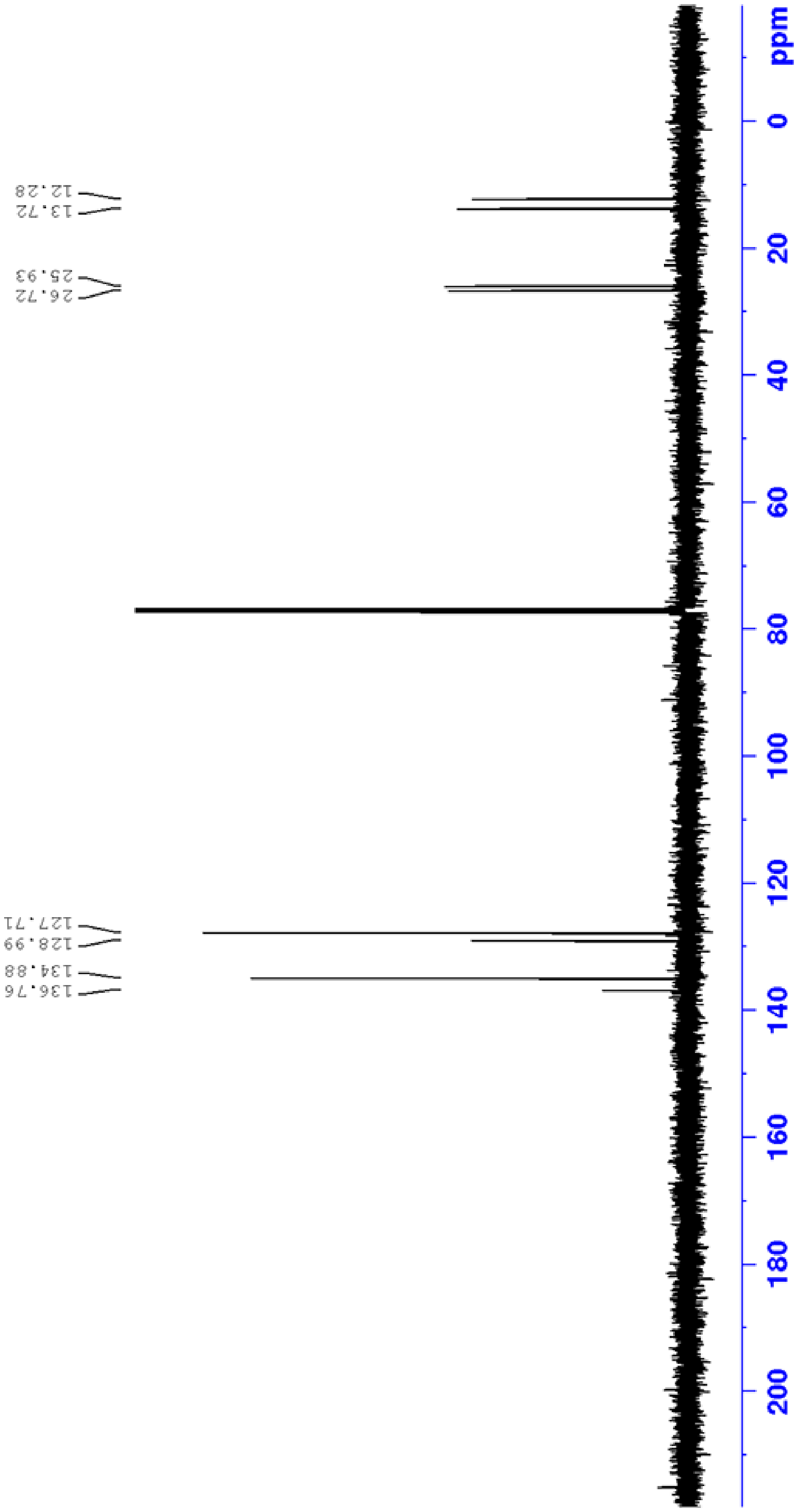




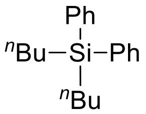
^{13}C NMR spectra of **dibutyldiphenylsilane (3f)**



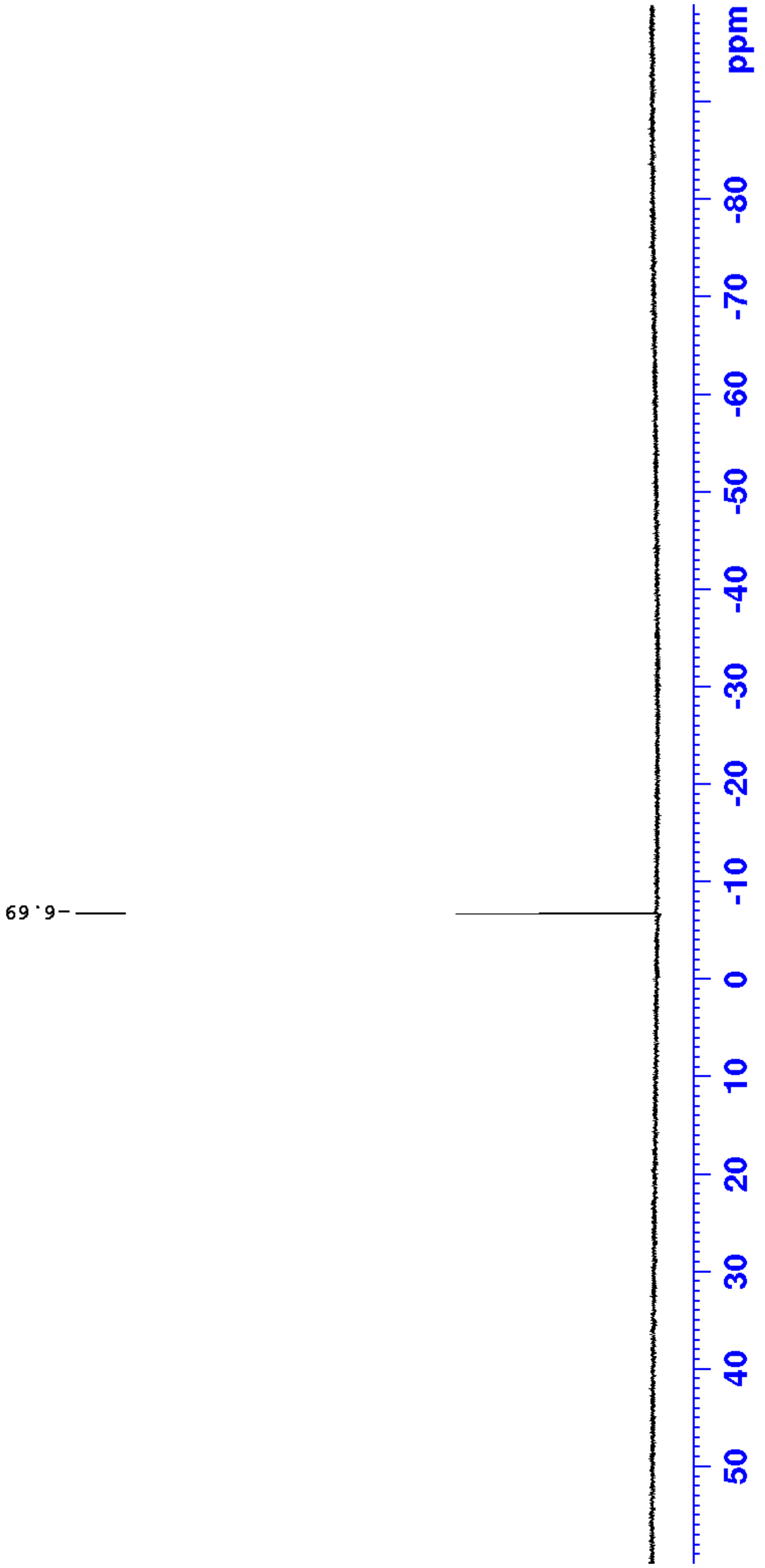
$^{n}\mathrm{Bu}-\overset{\mathrm{Ph}}{\underset{^{n}\mathrm{Bu}}{\mathrm{Si}}}-\mathrm{Ph}$



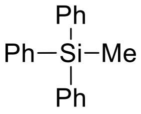
^{29}Si NMR spectra of **dibutyldiphenylsilane (3f)**

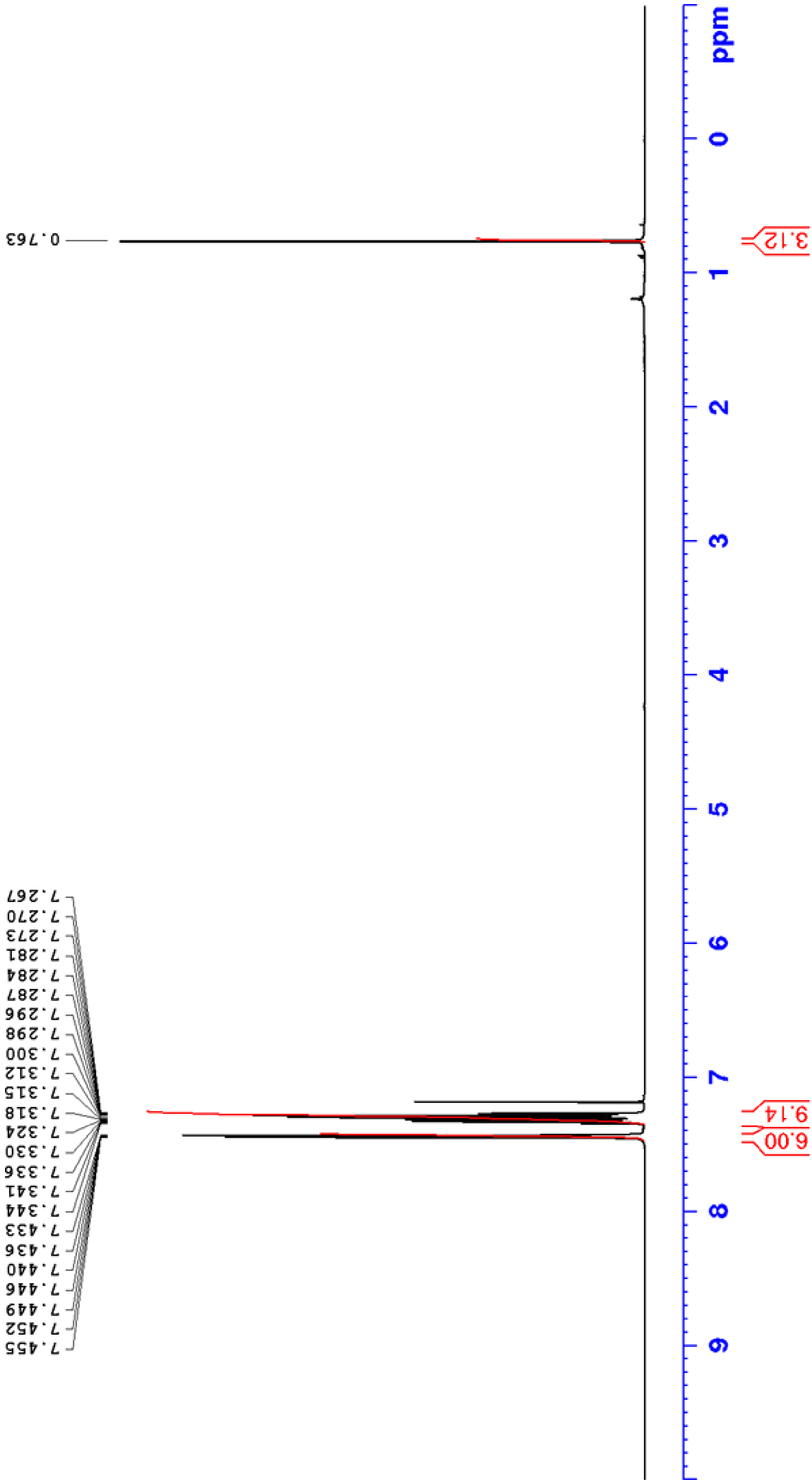


$$^{n}\mathrm{Bu}-\overset{\mathrm{Ph}}{\underset{^{n}\mathrm{Bu}}{\mathrm{Si}}}-\mathrm{Ph}$$

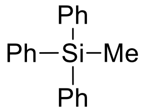


^{1}H NMR spectra of **methyltriphenylsilane (3g)**

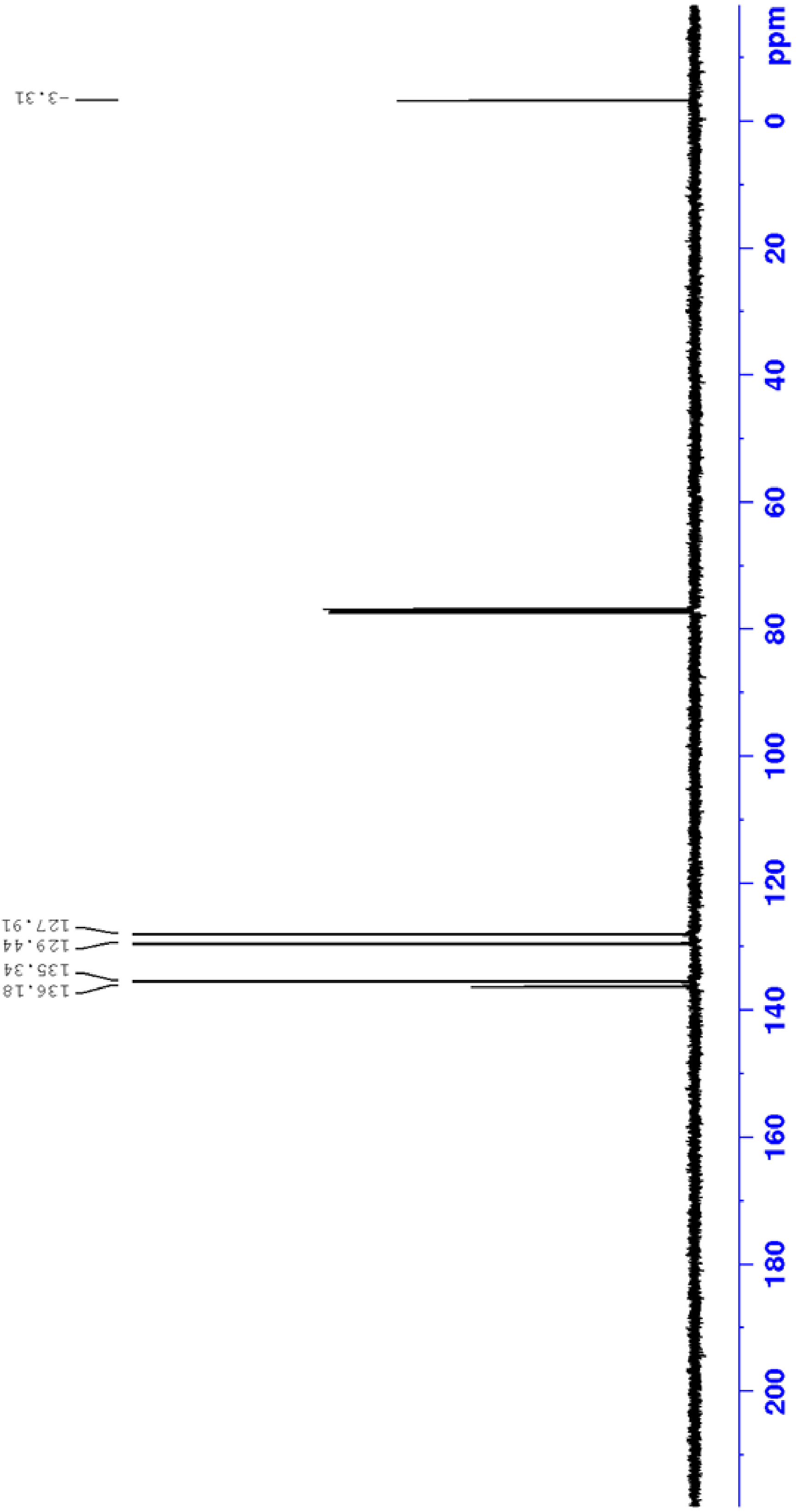




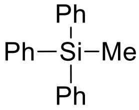
^{13}C and ^{29}Si NMR spectra of **methyltriphenylsilane (3g)**



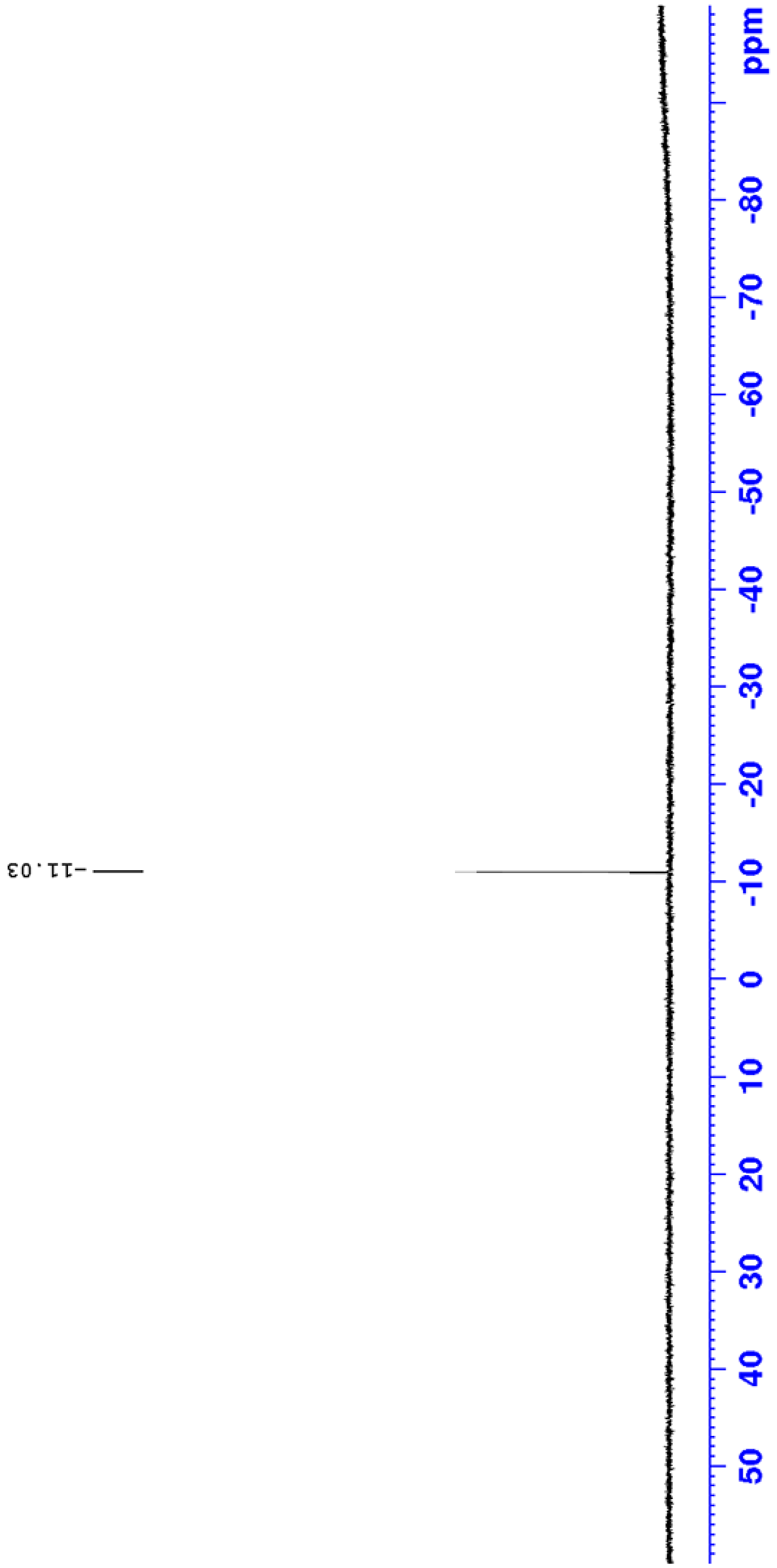
$$\mathrm{Ph-\underset{Ph}{\overset{Ph}{Si}}-Me}$$



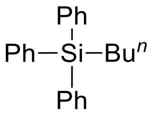
^{13}C and ^{29}Si NMR spectra of **methyltriphenylsilane (3g)**



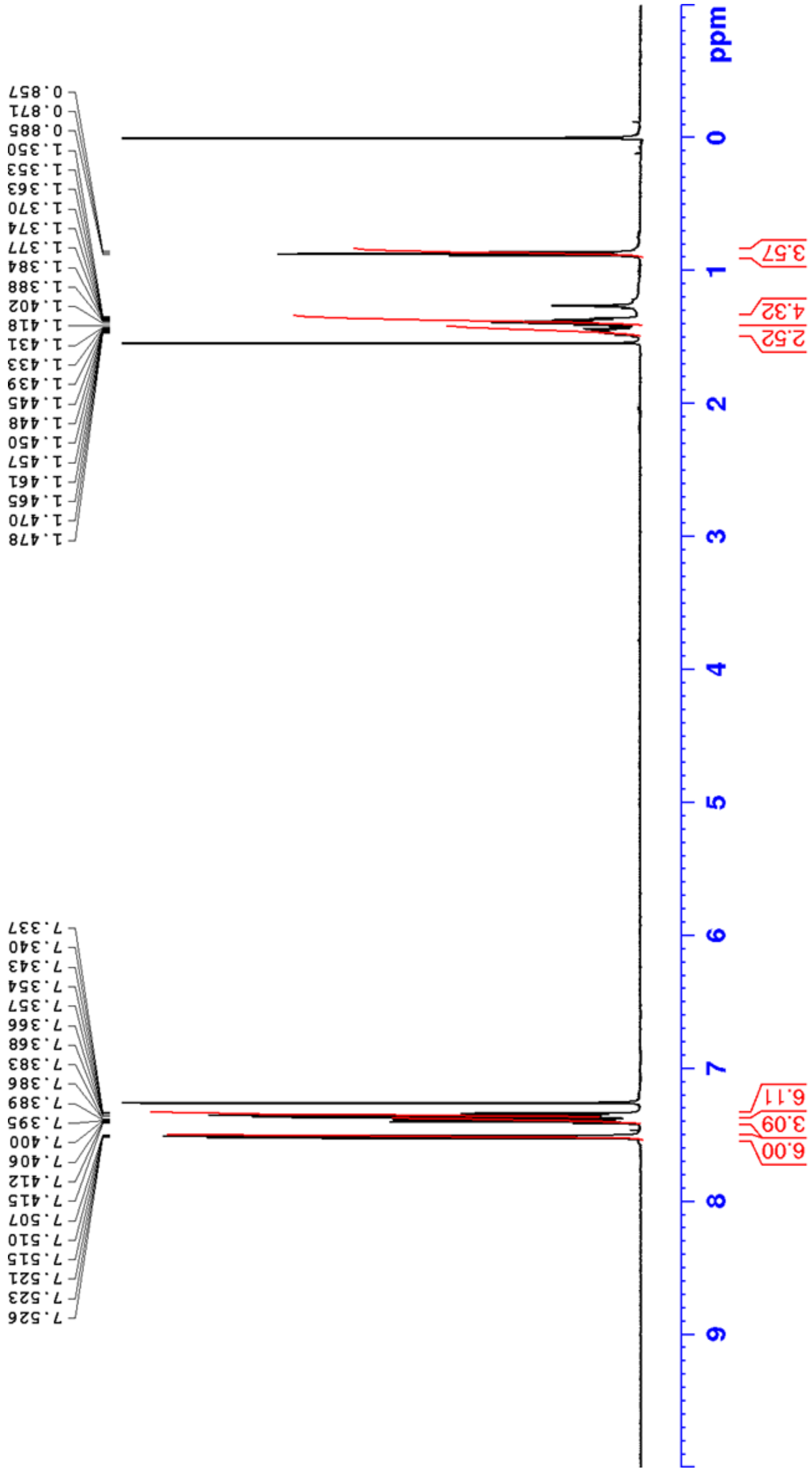
Ph_3SiMe



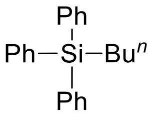
^{1}H NMR spectra of **butyltriphenylsilane (3h)**



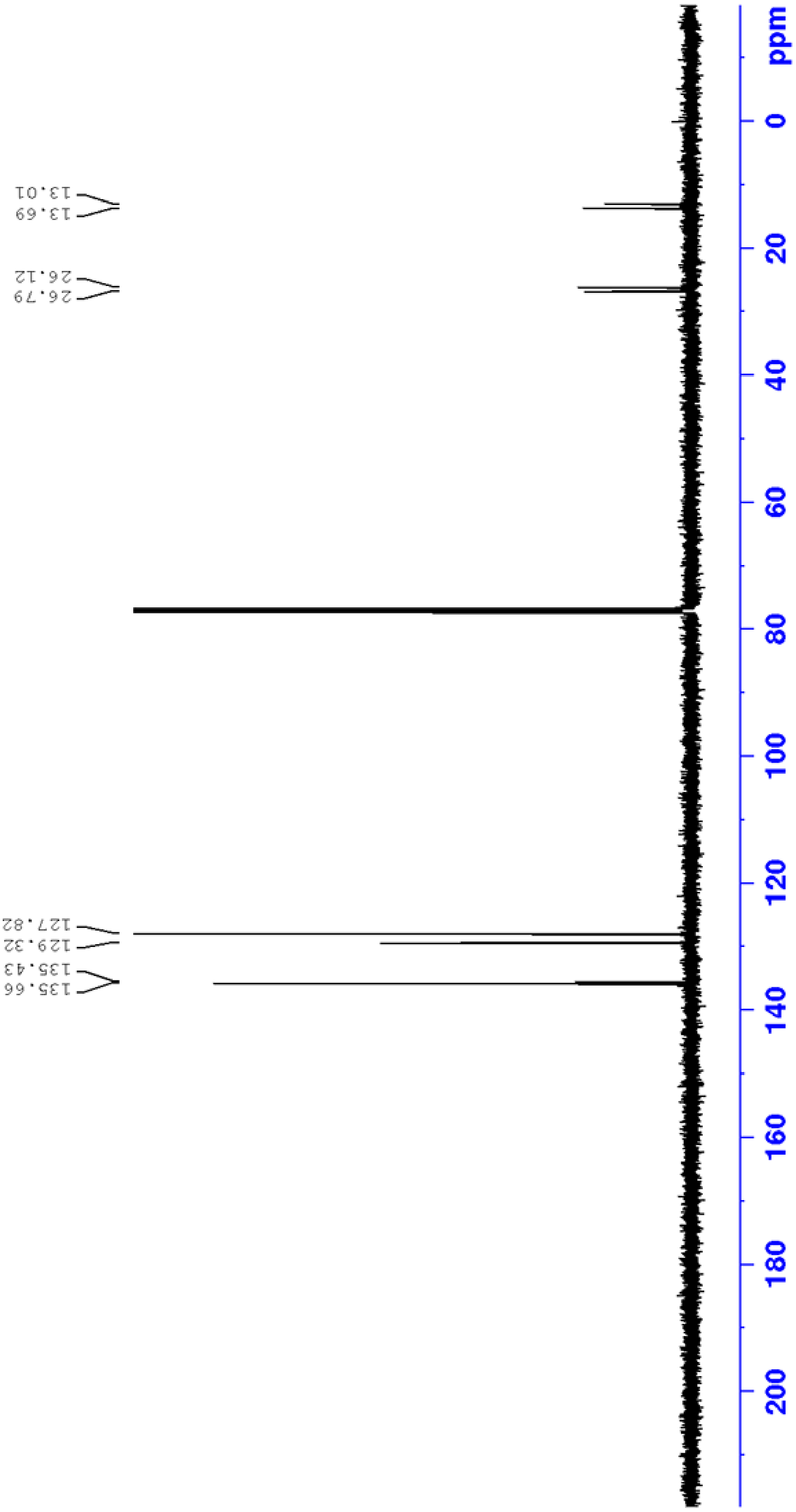
$$\mathrm{Ph{-}\overset{\displaystyle Ph}{\underset{\displaystyle Ph}{Si}}{-}Bu^{\mathit{n}}}$$



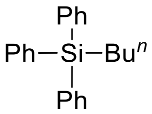
^{13}C and ^{29}Si NMR spectra of **butyltriphenylsilane (3h)**



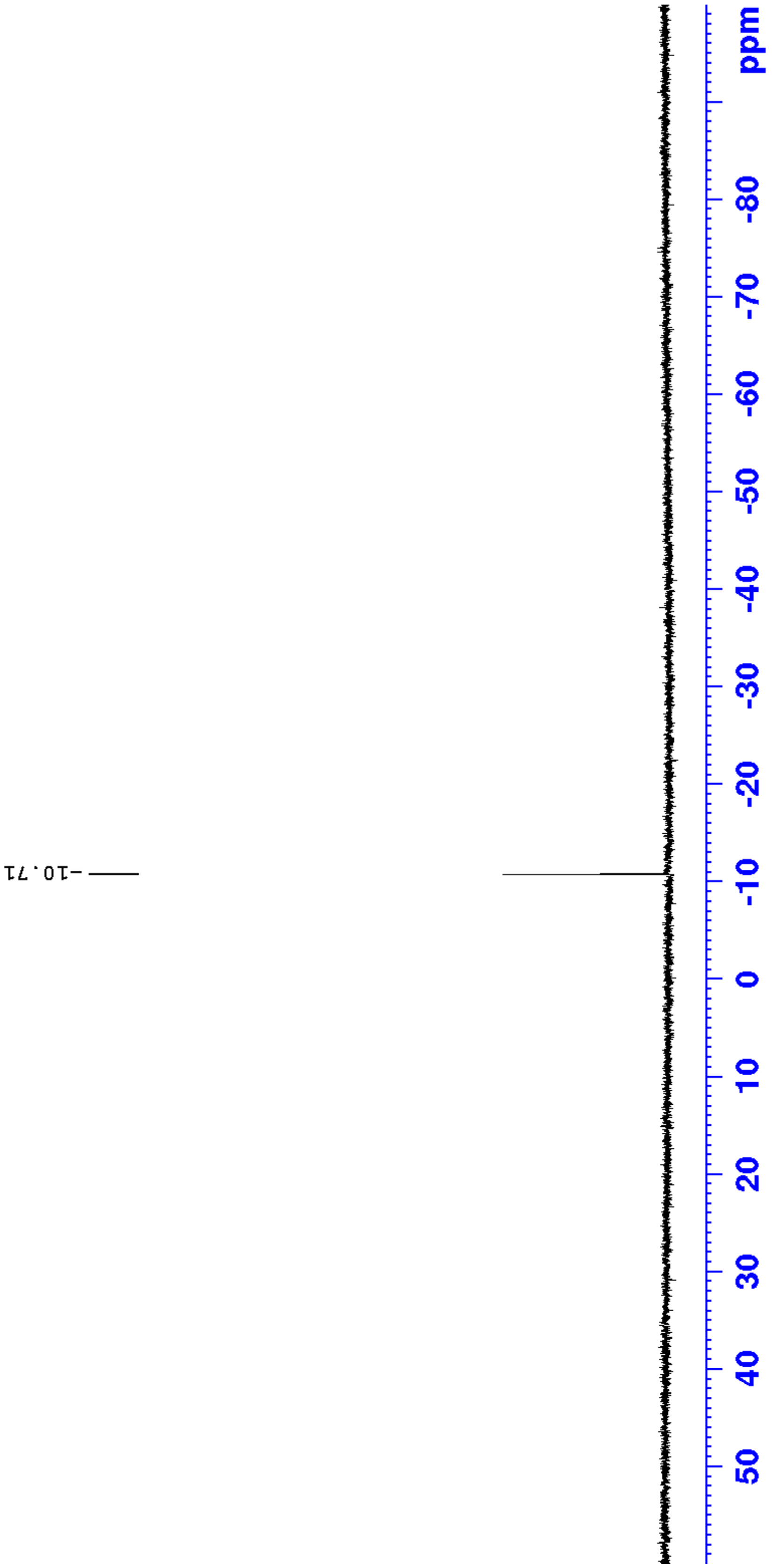
$$\mathrm{Ph{-}\overset{\displaystyle Ph}{\underset{\displaystyle Ph}{Si}}{-}Bu^{\mathit{n}}}$$



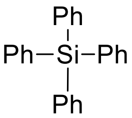
^{13}C and ^{29}Si NMR spectra of **butyltriphenylsilane (3h)**



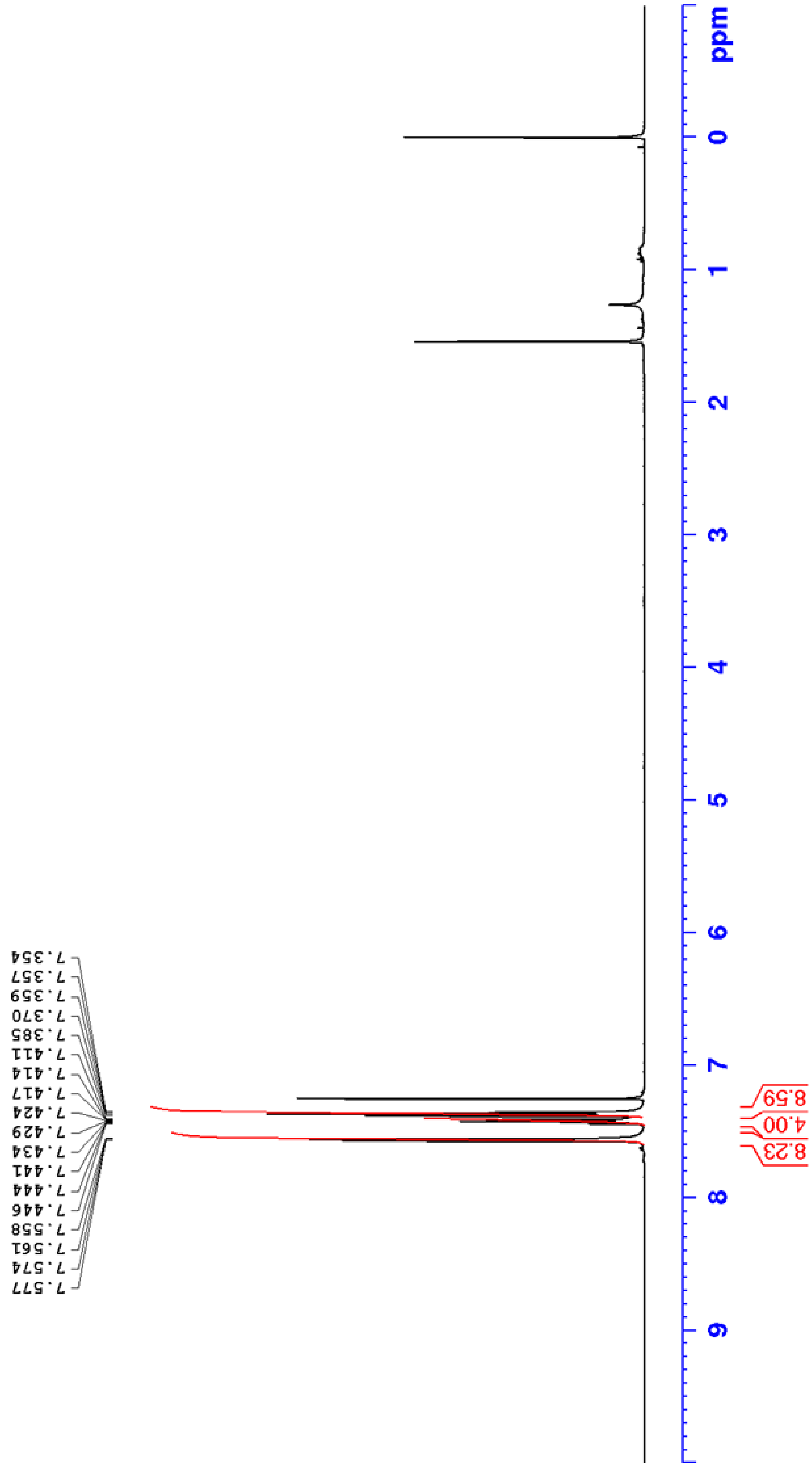
$\mathrm{Ph{-}\overset{Ph}{\underset{Ph}{Si}}{-}Bu}^{n}$



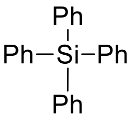
^{1}H NMR spectra of **tetraphenylsilane (3i)**



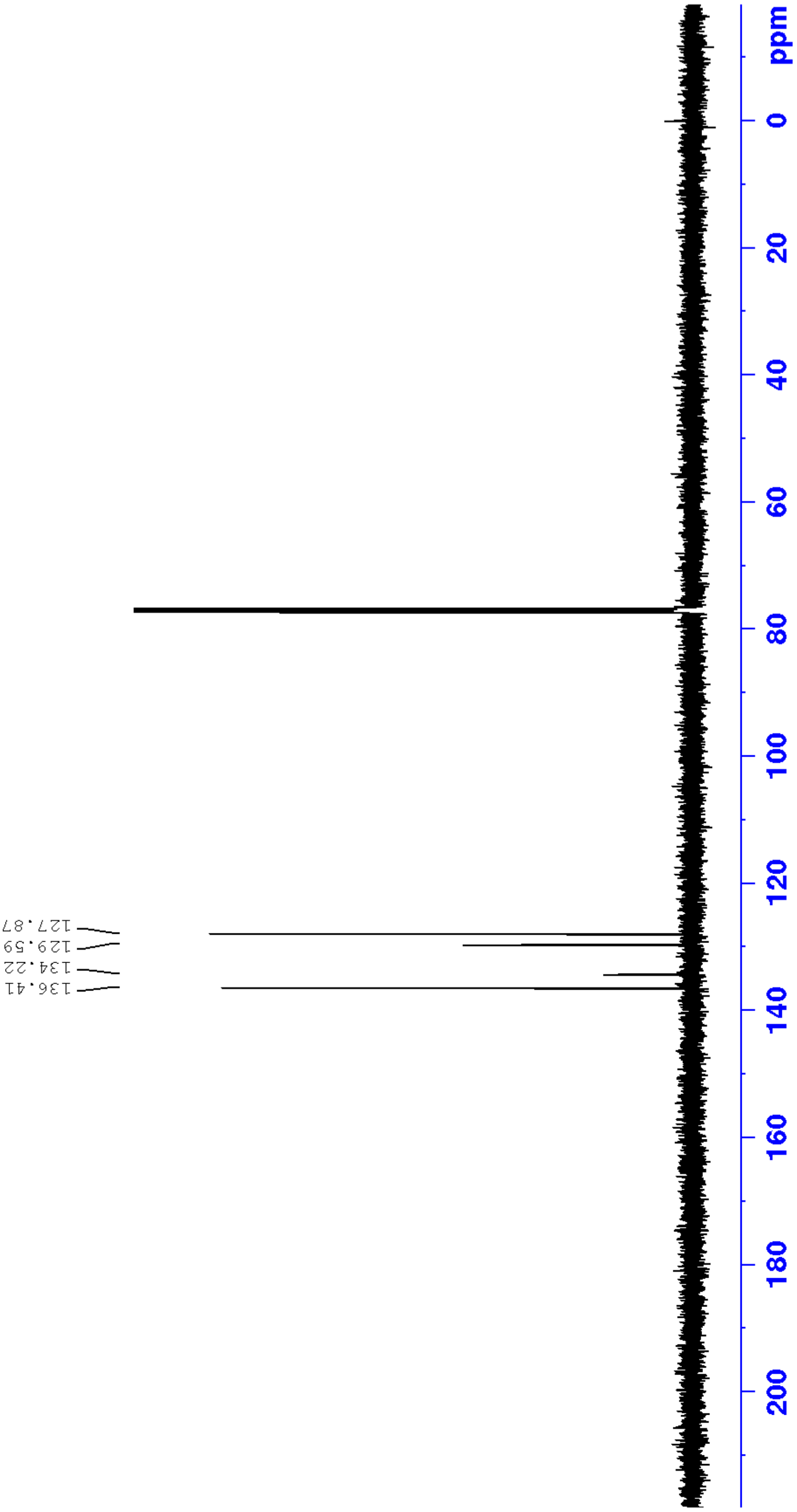
Ph_4Si



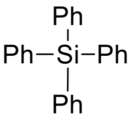
^{13}C NMR spectra of **tetraphenylsilane (3i)**

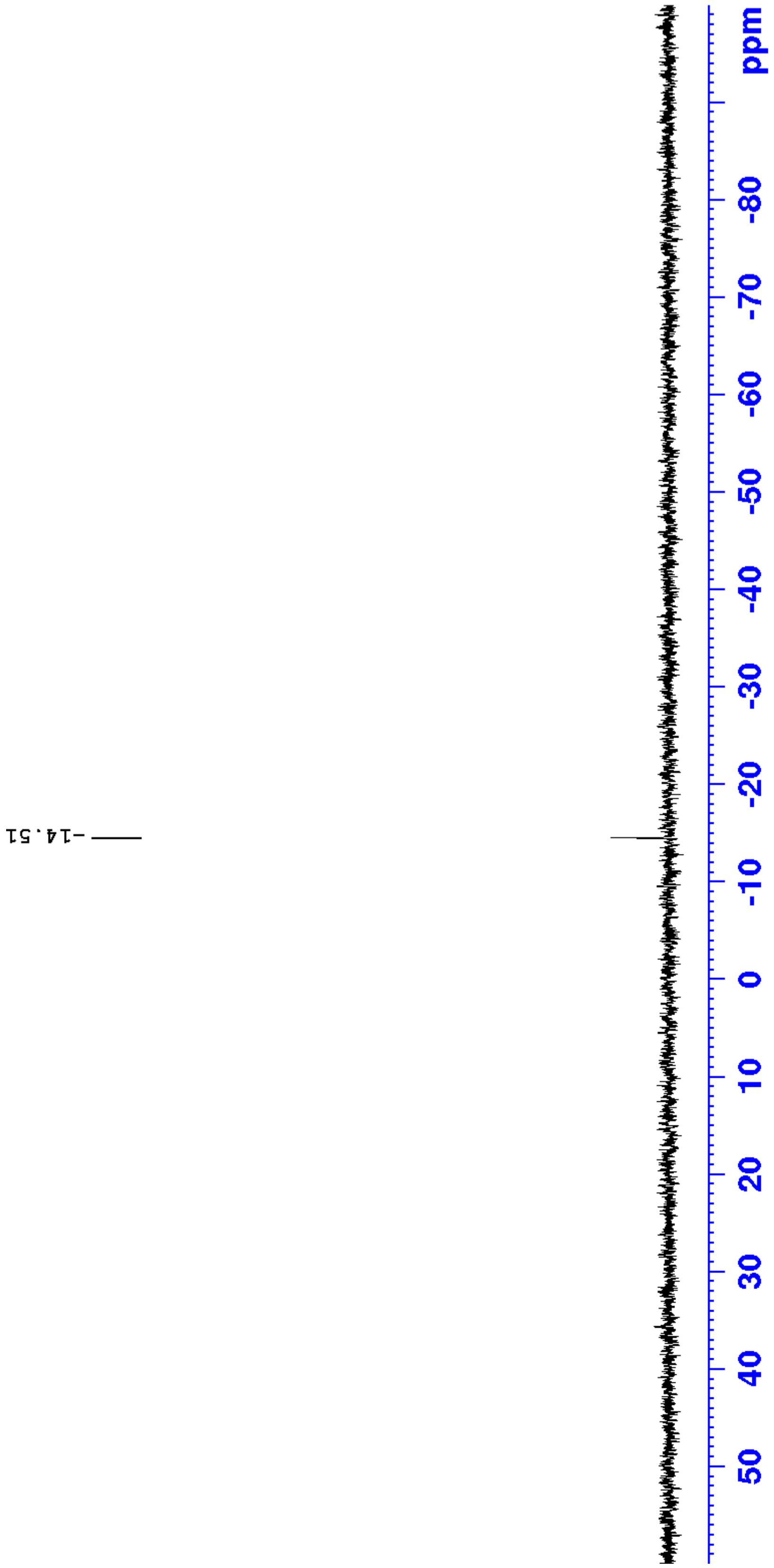


$\mathrm{Ph{-}\overset{\displaystyle Ph}{\underset{\displaystyle Ph}{Si}}{-}Ph}$

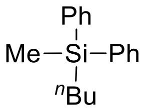


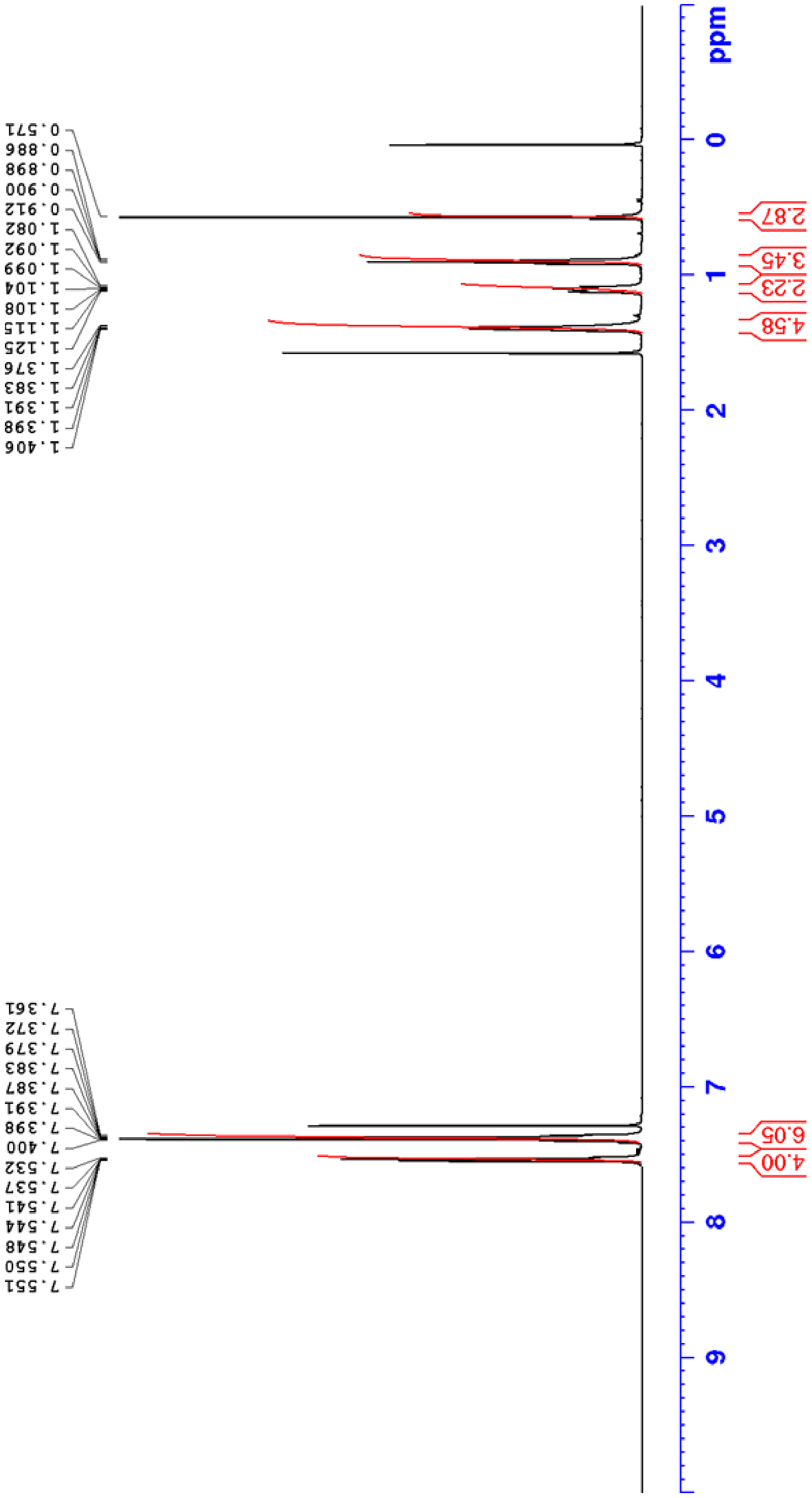
^{29}Si NMR spectra of **tetraphenylsilane (3i)**



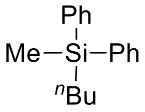


^{1}H NMR spectra of **butyl(methyl)diphenylsilane (3j)**

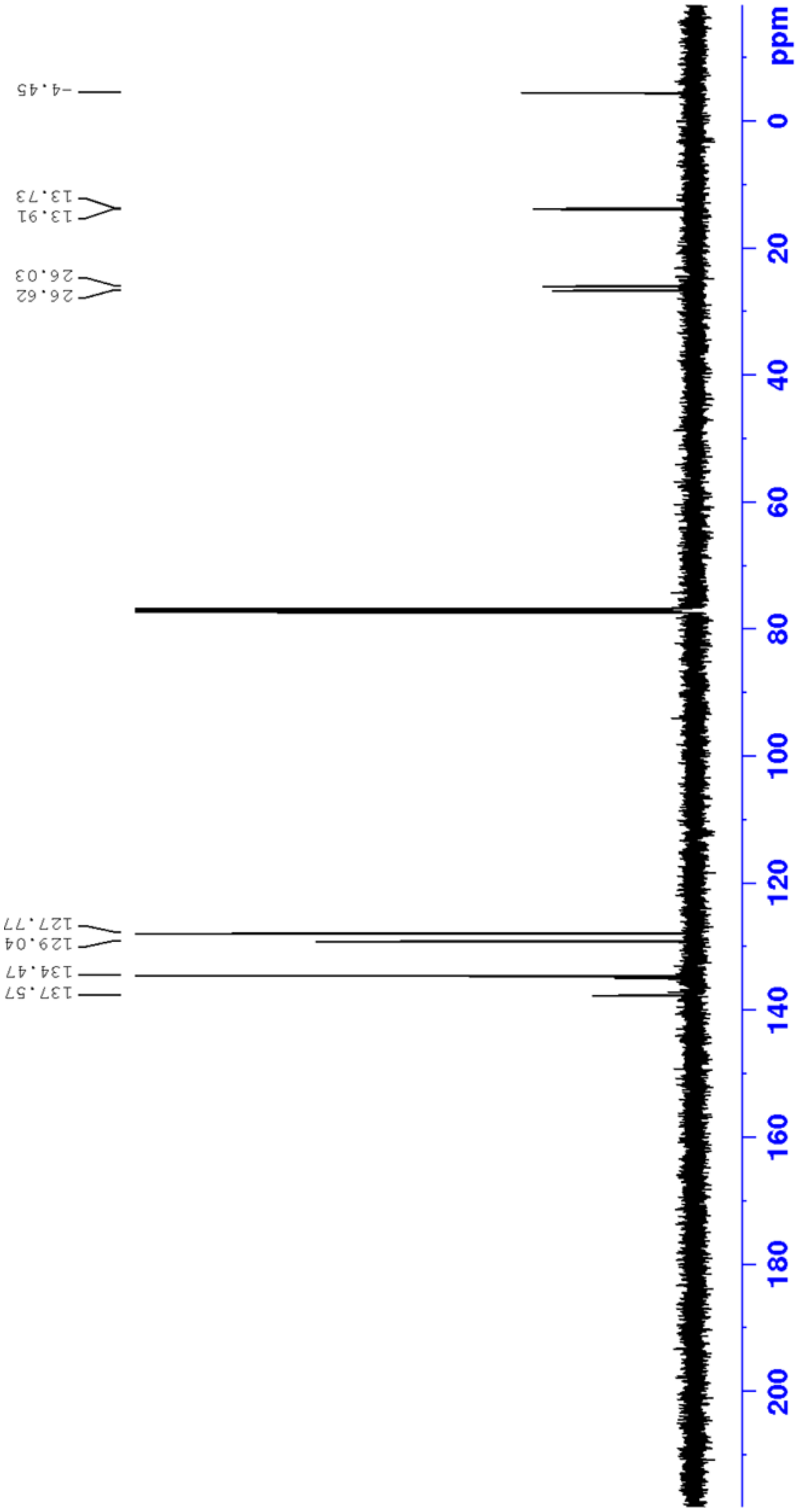




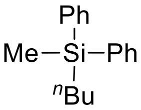
^{13}C NMR spectra of **butyl(methyl)diphenylsilane (3j)**



$\mathrm{Me{-}Si(Ph)_2{-}{}^{n}Bu}$



^{29}Si NMR spectra of **butyl(methyl)diphenylsilane (3j)**



$$\mathrm{Me{-}Si(Ph)_2{-}{}^{n}Bu}$$