Supporting Information for:

Approaches to *syn*-7-Substituted-2-azanorbornanes as Potential Nicotinic Agonists; Synthesis of *syn*- and *anti*-Isoepibatidine

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Selected Experimental Procedures

anti- and *syn*-2-Boc-7-phenyl-2-azabicyclo[2.2.1]heptane (11 and 12)

Using a procedure adapted from that described by Zhou and Fu.[9] Working in a glove box under nitrogen, $Ni(cod)_2$ (20 mg, 0.073 mmol) was placed in a two-necked flask. Bathophenanthroline (49 mg, 0.147 mmol), benzene boronic acid (57 mg, 0.467 mmol) and freshly sublimed ^{t}BuOK (103 mg, 0.918 mmol) were added, the reaction vessel was evacuated and refilled with nitrogen thrice. Dry *s*-BuOH (7 ml) was added and the reaction mixture stirred for 10 min at RT under nitrogen. The reaction mixture colour changed to deep-purple, indicating the formation of the active complex. A solution of the halide (**9c**) (105 mg, 0.380 mmol) in *s*-BuOH (2 ml) was added and the resulting mixture stirred under nitrogen at reflux for 48 h, then cooled and passed through a short pad of silica. Solvents were removed *in vacuo*, the resulting residue was flash chromatographed (diethylether:petrol; 1:1) to give **11** and **12** as a pale yellow oil (~ 40:60; *anti*-:*syn*-)(52 mg, 0.19 mmol, 50%) R_f 0.49. δ_H [300 MHz, $CDCl_3$; the signals corresponding to the minor (*anti*-) epimer are underlined; where there is signal duplication because of slow N-CO rotation (ratio ~45:55), the minor rotamer signal is shown in italics.] 1.37, 1.45, 1.48, 1.50 (4 × brs, 9H, Boc), 1.50-1.73, 1.73-2.01 (2 × m, 4H, H_5, H_6), *2.64*, 2.65, <u>2.86</u> (3 × brs, 1H, H_4), 2.86-3.02, 3.10-3.27 (2 × m, 2H, H_{3n}, H_7), <u>3.42-3.52</u>, 3.06 (m, ddd, $J \approx 9.9$, 2.7, 2.7 Hz, 1H, H_{3x}), <u>4.43</u>, *4.47*, <u>*4.59*</u>, 4.63 (4 × brs, 1H, H_1), 7.14-7.35 (m, 5H, Ph). δ_C (75.5 MHz, $CDCl_3$) 25.1, 25.2, 28.4, 30.8, 31.1 (C_5, C_6), 28.1, 28.2, 28.5, 28.6 (Boc CH_3), <u>*39.1*</u>, <u>39.6</u>, 41.6, *42.4* (C_4), *49.7*, 50.4, [<u>*51.9*</u>, 52.1, <u>52.3</u>, *52.5* (C_7)] <u>53.6</u>, *54.2* (C_3), 57.4, <u>*58.4*</u>, *58.6*, <u>59.4</u> (C_1), 78.8, 79.0, 79.1 (Boc C), 126.2, 126.3, 127.3, 127.5, 127.6, 128.2, 128.3, 128.4 (Ph CH), 138.1, 138.3, 138.4 (Ph C), 154.1, 154.5 (Boc CO). ν_{max} 2972s, 2879s, 1694s, 1498m, 1477m, 1407s, 1365s, 1161s, 1100s cm^{-1}. $^m/_z$ 274 (MH^+). $C_{17}H_{24}NO_2$ [MH^+] requires 274.18070; observed 274.18072.

anti- and *syn*-2-Boc-7-(6-chloro-pyridin-3-yl)-2-azabicyclo[2.2.1]heptane (15 and 16).

The procedure described for the synthesis of **11** and **12** was followed using: $Ni(cod)_2$ (95 mg, 0.35 mmol), bathophenanthroline (228 mg, 0.69 mmol), 4-chloro-3-pyridyl boronic acid[10] (148 mg, 0.94 mmol), ^{t}BuOK (136 mg, 1.22 mmol) and *anti*-2-Boc-7-bromo-2-azabicyclo[2.2.1]-heptane (**9c**) (210 mg, 0.76 mmol) except that the reaction mixture was stirred at 50°C for 12 h rather than 100°C for 48 h. Flash chromatography (diethyl ether) of the crude residue gave a mixture of **15** and **16** as a pale yellow oil (~ 25:75; *anti*-:*syn*-)(69 mg, 0.22 mmol, 30%) R_f 0.73. δ_H [300 MHz, $CDCl_3$; the signals corresponding to the minor (*anti*-) epimer are underlined; where there is signal duplication because of slow N-CO rotation (ratio ~45:55), the minor rotamer signal is shown in italics.] 1.39, 1.48, <u>1.50</u> (3 × brs, 9H, Boc), 1.44-2.04 (m, 4H, H_5, H_6), 2.69, <u>2.91</u> (2 × brs, 1H, H_4), 2.95, 3.02, <u>3.13-3.25</u>, <u>3.44-3.53</u> (brs, brs, m, m, 3H, H_{3x}, H_{3n}), <u>4.45</u>, *4.48*, 4.61 4 × brs, 1H, H_1), 7.22-

7.33 (m, 1H, $H_{5'}$), 7.47-7.60 (m, 1H, $H_{4'}$), 8.23-8.32 (m, 1H, $H_{2'}$). δ_C (75.5 MHz, $CDCl_3$) *28.1*, 28.2, *30.6*, 31.0 (C_5, C_6), 28.3, 28.5 (Boc CH_3), *39.0*, 39.4, 41.5, *42.4* (C_4), 49.1, *49.5* (C_7), 53.3, *53.8*, *49.4*, 50.0 (C_3), 57.2, *58.0*, *58.4*, 59.0 (C_1), 79.3, 79.5 (Boc C), 123.8, 123.9, 124.0 (C_5), 132.5, 132.8, 132.9 ($C_{3'}$), 138.0, 138.2 ($C_{4'}$), 148.8 ($C_{6'}$), 149.3, 149.4 ($C_{2'}$), 154.2, 154.3 (Boc CO). ν_{max} 2974m, 2878m, 2242w, 1684s,1586m, 1560m, 1462m, 1404s, 1365m cm^{-1}. $^m/_z$ 309 (MH^+) $C_{16}H_{22}N_2O_2Cl$ [MH^+] requires 309.13698; observed 309.13689 Further chromatographic separation (ether:petrol, 1:1) allowed the isolation of a sample of the major (*syn*-) epimer **16** as a yellow oil: δ_H [300 MHz, $CDCl_3$; where there is signal duplication because of slow N-CO rotation (ratio ~45:55), the minor rotamer signal is shown in italics.] 1.41, 1.50 (2 × brs, 9H, Boc), 1.61-2.04 (m, 4H, H_5, H_6), 2.97, 3.03 (brs, m, 3H, H_{3x}, H_{3n}, H_7), 2.69 (brs, 1H, H_4), *4.49*, 4.63 (2 × brs, 1H, H_1), 7.26 (m, 1H, $H_{5'}$), 7.55 (m, 1H, $H_{4'}$), 8.32 (m, 1H, $H_{2'}$). δ_C (75.5 MHz, $CDCl_3$) *28.2*, 28.3, 30.7, *31.1* (C_5, C_6), 28.4, *28.6* (Boc CH_3), 41.7, *42.5* (C_4), 49.2, *49.8* (C_7), *49.5*, 50.1 (C_3), 57.4, *58.5* (C_1), *79.4*, 79.6 (Boc C), *123.9*, 124.0, *138.0*, 138.2, 149.3, *149.5* (pyridyl CH), 132.9, *133.0* (pyridyl C), 154.3 (Boc CO). ν_{max} 2970s, 2934s, 1696s, 1606m, 1488s, 1406s, 1284s cm^{-1}. $^m/_z$ 309 (MH^+). $C_{16}H_{22}N_2O_2Cl$ [MH^+] requires 309.13698; observed 309.13692.

Compound Characterization Checklist

The checklist covering the data included in the paper for all new compounds is attached as an EXCEL file.

Copies of key ^1H and ^{13}C (+ DEPT) NMR spectra are included. Proton chemical shifts are relative to TMS; carbon shifts are relative to $CDCl_3$ at 77.00 ppm.

X-Ray Crystallographic data for compound **16 (page 1 of 7)**

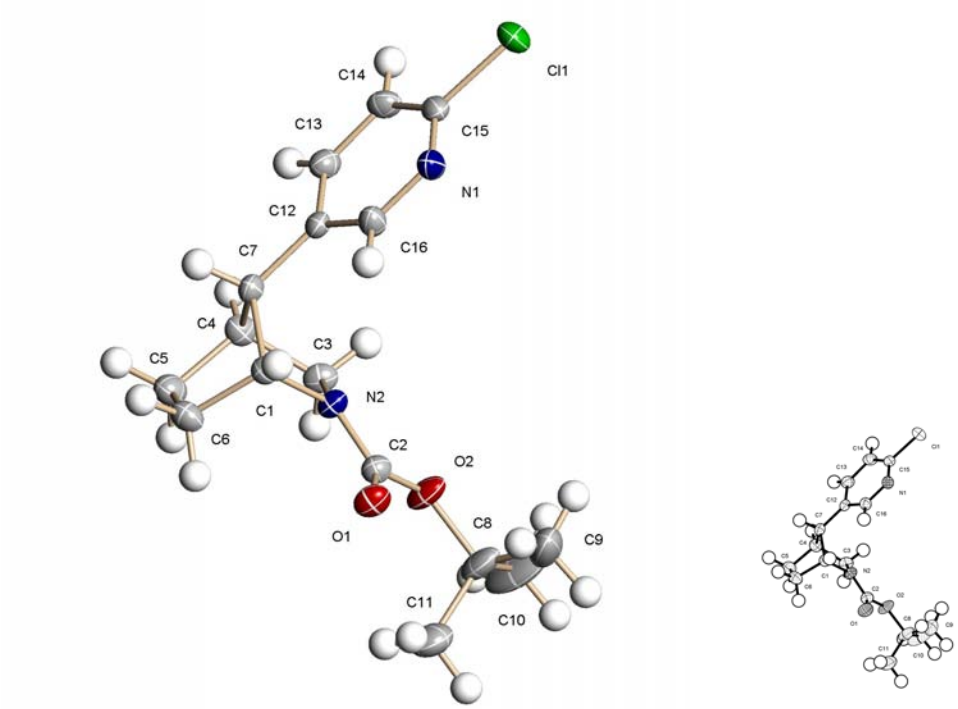


Fig shows the atom label scheme and 50% displacement ellipsoids

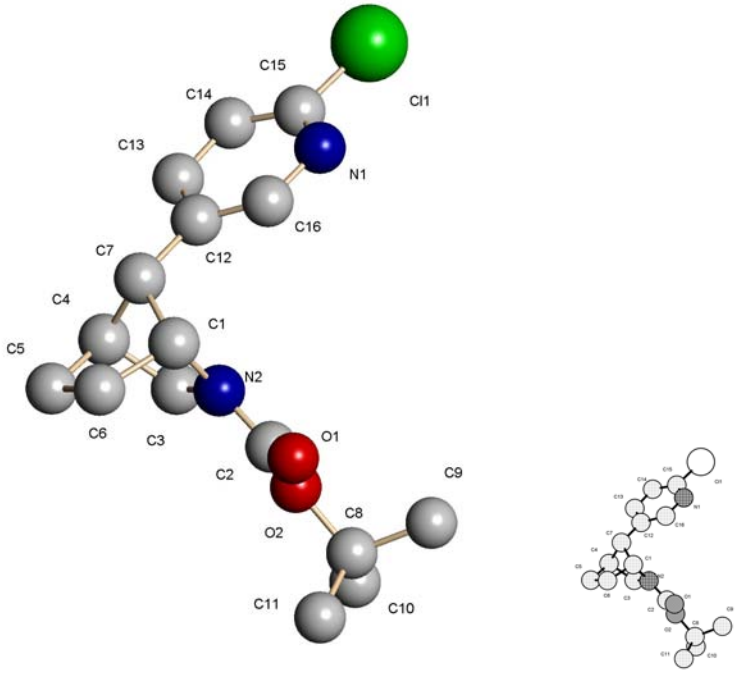


Fig shows the molecular structure as arbitrary spheres H atoms omitted for clarity

Table 1. Crystal data and structure refinement for **16**.

Identification code	05029	
Empirical formula	C16 H21 Cl N2 O2	
Formula weight	308.80	
Temperature	150(2) K	
Wavelength	0.71073 Å	
Crystal system	Monoclinic	
Space group	P2(1)/n	
Unit cell dimensions	a = 13.2093(17) Å	α= 90°.
	b = 6.6337(9) Å	β= 105.829(3)°.
	c = 18.646(3) Å	γ = 90°.
Volume	1571.9(4) $Å^3$	
Z	4	
Density (calculated)	1.305 Mg/m^3	
Absorption coefficient	0.249 mm^{-1}	
F(000)	656	
Crystal size	0.21 x 0.04 x 0.04 mm^3	
Theta range for data collection	1.69 to 25.00°.	
Index ranges	-15<=h<=15, -7<=k<=7, -22<=l<=22	
Reflections collected	9626	
Independent reflections	2770 [R(int) = 0.0565]	
Completeness to theta = 25.00°	100.0 %	
Absorption correction	Empirical	
Max. and min. transmission	0.981 and 0.767	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	2770 / 0 / 193	
Goodness-of-fit on F^2	0.851	
Final R indices [I>2sigma(I)]	R1 = 0.0426, wR2 = 0.0737	
R indices (all data)	R1 = 0.0752, wR2 = 0.0804	
Largest diff. peak and hole	0.325 and -0.232 e.$Å^{-3}$	

Table 2. Atomic coordinates (x 10^4) and equivalent isotropic displacement parameters ($Å^2$x 10^3) for **16**. U(eq) is defined as one third of the trace of the orthogonalized U^{ij} tensor.

	x	y	z	U(eq)
Cl(1)	9895(1)	11718(1)	12010(1)	40(1)
O(1)	5700(1)	9753(2)	8079(1)	33(1)
O(2)	5032(1)	8174(2)	8941(1)	38(1)
N(1)	9089(1)	11068(3)	10598(1)	30(1)
N(2)	6670(1)	7566(3)	8935(1)	24(1)
C(1)	7589(2)	7505(3)	8632(1)	24(1)
C(2)	5790(2)	8596(3)	8600(1)	26(1)
C(3)	6712(2)	5807(3)	9422(1)	29(1)
C(4)	7702(2)	4753(3)	9347(1)	29(1)
C(5)	7490(2)	3893(3)	8552(1)	33(1)
C(6)	7429(2)	5805(3)	8062(1)	32(1)
C(7)	8410(2)	6559(3)	9303(1)	25(1)
C(8)	3975(2)	9067(4)	8684(1)	43(1)
C(9)	4035(2)	11310(4)	8813(1)	62(1)
C(10)	3409(2)	8006(6)	9188(2)	86(1)
C(11)	3467(2)	8541(4)	7876(1)	51(1)
C(12)	8771(2)	7785(3)	10006(1)	23(1)
C(13)	9197(2)	6890(3)	10699(1)	29(1)
C(14)	9565(2)	8075(4)	11328(1)	30(1)
C(15)	9481(2)	10130(4)	11237(1)	27(1)
C(16)	8748(2)	9863(3)	10000(1)	30(1)

Table 3. Bond lengths [Å] and angles [°] for **16**.

Cl(1)-C(15)	1.748(2)
O(1)-C(2)	1.218(2)
O(2)-C(2)	1.353(2)
O(2)-C(8)	1.472(3)
N(1)-C(15)	1.319(3)
N(1)-C(16)	1.345(3)
N(2)-C(2)	1.347(3)
N(2)-C(3)	1.471(2)
N(2)-C(1)	1.472(2)
C(1)-C(6)	1.525(3)
C(1)-C(7)	1.547(3)
C(3)-C(4)	1.524(3)
C(4)-C(7)	1.535(3)
C(4)-C(5)	1.540(3)
C(5)-C(6)	1.553(3)
C(7)-C(12)	1.506(3)
C(8)-C(9)	1.506(3)
C(8)-C(11)	1.514(3)
C(8)-C(10)	1.523(3)
C(12)-C(16)	1.379(3)
C(12)-C(13)	1.393(3)
C(13)-C(14)	1.385(3)
C(14)-C(15)	1.374(3)
C(2)-O(2)-C(8)	121.41(17)
C(15)-N(1)-C(16)	115.4(2)
C(2)-N(2)-C(3)	124.83(18)
C(2)-N(2)-C(1)	122.29(17)
C(3)-N(2)-C(1)	108.64(16)
N(2)-C(1)-C(6)	108.42(17)
N(2)-C(1)-C(7)	99.84(16)
C(6)-C(1)-C(7)	101.33(17)
O(1)-C(2)-N(2)	125.0(2)
O(1)-C(2)-O(2)	125.6(2)
N(2)-C(2)-O(2)	109.41(19)
N(2)-C(3)-C(4)	101.23(16)

C(3)-C(4)-C(7)	101.41(18)
C(3)-C(4)-C(5)	108.88(18)
C(7)-C(4)-C(5)	101.04(17)
C(4)-C(5)-C(6)	103.31(18)
C(1)-C(6)-C(5)	102.62(17)
C(12)-C(7)-C(4)	115.35(18)
C(12)-C(7)-C(1)	118.06(18)
C(4)-C(7)-C(1)	93.26(16)
O(2)-C(8)-C(9)	110.0(2)
O(2)-C(8)-C(11)	110.8(2)
C(9)-C(8)-C(11)	112.1(2)
O(2)-C(8)-C(10)	101.27(19)
C(9)-C(8)-C(10)	111.8(2)
C(11)-C(8)-C(10)	110.4(2)
C(16)-C(12)-C(13)	115.8(2)
C(16)-C(12)-C(7)	122.1(2)
C(13)-C(12)-C(7)	122.0(2)
C(14)-C(13)-C(12)	120.2(2)
C(15)-C(14)-C(13)	117.4(2)
N(1)-C(15)-C(14)	125.3(2)
N(1)-C(15)-Cl(1)	114.69(18)
C(14)-C(15)-Cl(1)	119.97(18)
N(1)-C(16)-C(12)	125.9(2)

Symmetry transformations used to generate equivalent atoms:

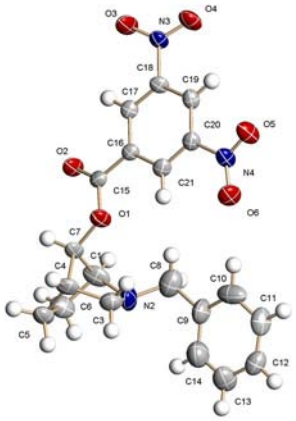
Table 4. Anisotropic displacement parameters ($Å^2 x\ 10^3$) for **16**. The anisotropic displacement factor exponent takes the form: $-2\pi^2[\ h^2\ a^{*2}U^{11} + ...\ + 2\ h\ k\ a^*\ b^*\ U^{12}\ ]$

	U^{11}	U^{22}	U^{33}	U^{23}	U^{13}	U^{12}
Cl(1)	39(1)	47(1)	30(1)	-12(1)	2(1)	0(1)
O(1)	30(1)	36(1)	33(1)	13(1)	8(1)	4(1)
O(2)	22(1)	56(1)	38(1)	18(1)	13(1)	10(1)
N(1)	30(1)	29(1)	28(1)	-4(1)	4(1)	6(1)
N(2)	20(1)	27(1)	25(1)	8(1)	8(1)	4(1)
C(1)	24(1)	25(1)	24(1)	2(1)	8(1)	-1(1)
C(2)	26(1)	29(2)	23(1)	1(1)	6(1)	0(1)
C(3)	29(2)	29(1)	27(1)	7(1)	6(1)	-1(1)
C(4)	35(2)	24(1)	27(1)	5(1)	7(1)	5(1)
C(5)	35(2)	29(2)	32(1)	-2(1)	4(1)	2(1)
C(6)	31(2)	38(2)	26(1)	-3(1)	6(1)	-4(1)
C(7)	24(1)	24(1)	27(1)	-1(1)	7(1)	5(1)
C(8)	22(2)	68(2)	40(2)	14(2)	11(1)	14(1)
C(9)	51(2)	81(3)	48(2)	-12(2)	6(1)	32(2)
C(10)	35(2)	157(4)	77(2)	51(2)	32(2)	20(2)
C(11)	27(2)	66(2)	55(2)	2(2)	4(1)	2(1)
C(12)	19(1)	25(1)	25(1)	-1(1)	6(1)	5(1)
C(13)	27(1)	26(1)	33(1)	2(1)	5(1)	2(1)
C(14)	27(1)	37(2)	23(1)	6(1)	2(1)	3(1)
C(15)	19(1)	36(2)	26(1)	-6(1)	6(1)	1(1)
C(16)	34(2)	32(2)	24(1)	0(1)	6(1)	8(1)

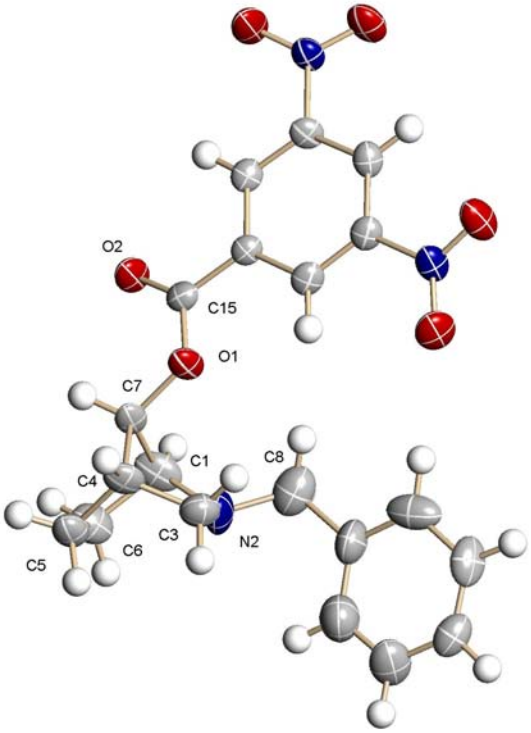
Table 5. Hydrogen coordinates (x 10^4) and isotropic displacement parameters ($Å^2$x 10^3) for **16**.

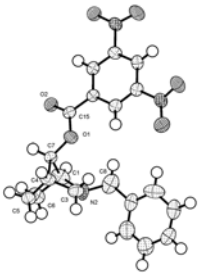
	x	y	z	U(eq)
H(1)	7795	8832	8460	29
H(3A)	6082	4941	9245	35
H(3B)	6779	6217	9944	35
H(4)	8016	3771	9754	35
H(5A)	6820	3132	8411	40
H(5B)	8070	2995	8509	40
H(6A)	7991	5804	7802	39
H(6B)	6736	5912	7689	39
H(7)	9034	6091	9142	30
H(9A)	4393	11585	9337	92
H(9B)	3322	11871	8691	92
H(9C)	4428	11933	8495	92
H(10A)	3431	6545	9115	130
H(10B)	2675	8456	9063	130
H(10C)	3756	8334	9710	130
H(11A)	3803	9314	7556	76
H(11B)	2716	8873	7749	76
H(11C)	3552	7097	7799	76
H(13)	9234	5463	10740	35
H(14)	9864	7491	11804	36
H(16)	8467	10501	9532	36

X-Ray Crystallographic data for 3,5-dinitrobenzoate of **18a (page 1 of 8)**



figs show the atom label scheme and 50% displacement ellipsoids





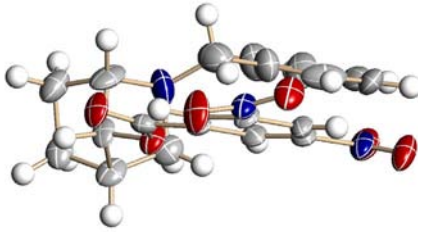


Table 1. Crystal data and structure refinement for 3,5-dinitrobenzoate of **18a**.

Identification code	04161	
Empirical formula	C20 H19 N3 O6	
Formula weight	397.38	
Temperature	150(2) K	
Wavelength	0.71073 Å	
Crystal system	Triclinic	
Space group	P-1	
Unit cell dimensions	a = 7.013(3) Å	α= 76.674(7)°.
	b = 11.227(5) Å	β= 84.349(7)°.
	c = 12.175(5) Å	γ = 84.149(7)°.
Volume	925.2(7) $Å^3$	
Z	2	
Density (calculated)	1.426 Mg/m^3	
Absorption coefficient	0.107 mm^{-1}	
F(000)	416	
Crystal size	0.32 x 0.11 x 0.08 mm^3	
Theta range for data collection	1.72 to 25.00°.	
Index ranges	-8<=h<=8, -13<=k<=13, -14<=l<=14	
Reflections collected	6517	
Independent reflections	3212 [R(int) = 0.0684]	
Completeness to theta = 25.00°	98.4 %	
Absorption correction	None	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	3212 / 0 / 262	
Goodness-of-fit on F^2	1.010	
Final R indices [I>2sigma(I)]	R1 = 0.1142, wR2 = 0.2749	
R indices (all data)	R1 = 0.1993, wR2 = 0.3233	
Largest diff. peak and hole	0.611 and -0.417 $e.Å^{-3}$	

Table 2. Atomic coordinates (x 10^4) and equivalent isotropic displacement parameters ($Å^2$x 10^3) for 3,5-dinitrobenzoate of **18a**. U(eq) is defined as one third of the trace of the orthogonalized U^{ij} tensor.

	x	y	z	U(eq)
N(3)	4418(7)	-3074(4)	5523(4)	36(1)
N(4)	8183(7)	-940(5)	7543(5)	39(1)
O(1)	2333(5)	1944(4)	6547(4)	39(1)
O(2)	342(6)	918(4)	5821(4)	46(1)
O(3)	3252(7)	-2974(4)	4834(5)	60(2)
O(4)	5434(6)	-3989(4)	5860(4)	52(1)
O(5)	9476(6)	-1731(4)	7480(4)	54(1)
O(6)	8185(6)	-135(4)	8067(4)	51(1)
C(1)	-65(9)	2875(6)	7792(6)	53(2)
N(2)	1568(8)	3063(5)	8437(5)	56(2)
C(3)	2845(10)	3778(6)	7606(6)	49(2)
C(4)	1730(9)	4120(5)	6583(6)	43(2)
C(5)	-57(9)	4942(6)	6783(6)	46(2)
C(6)	-1374(9)	4067(6)	7598(7)	56(2)
C(7)	857(8)	2939(5)	6619(6)	36(2)
C(8)	2478(11)	1989(8)	9140(7)	69(2)
C(9)	3969(11)	2308(8)	9850(6)	57(2)
C(10)	5742(13)	1616(7)	9964(6)	66(2)
C(11)	7068(9)	1915(8)	10667(6)	55(2)
C(12)	6588(10)	2908(7)	11128(6)	50(2)
C(13)	4932(11)	3595(7)	10958(7)	66(2)
C(14)	3567(13)	3312(8)	10357(7)	72(2)
C(15)	1861(9)	976(5)	6195(5)	31(1)
C(16)	3433(7)	-20(5)	6299(5)	28(1)
C(17)	3221(8)	-1047(5)	5857(5)	30(1)
C(18)	4643(8)	-1974(5)	5972(5)	32(1)
C(19)	6286(8)	-1972(5)	6510(5)	34(2)
C(20)	6449(8)	-955(5)	6942(5)	33(2)
C(21)	5061(8)	9(5)	6849(5)	34(2)

Table 3. Bond lengths [Å] and angles [°] for 3,5-dinitrobenzoate of **18a**.

N(3)-O(4)	1.202(6)
N(3)-O(3)	1.207(6)
N(3)-C(18)	1.489(7)
N(4)-O(5)	1.213(6)
N(4)-O(6)	1.221(6)
N(4)-C(20)	1.483(7)
O(1)-C(15)	1.337(7)
O(1)-C(7)	1.456(7)
O(2)-C(15)	1.212(7)
C(1)-C(7)	1.498(9)
C(1)-N(2)	1.509(9)
C(1)-C(6)	1.529(9)
N(2)-C(3)	1.437(9)
N(2)-C(8)	1.437(9)
C(3)-C(4)	1.490(9)
C(4)-C(7)	1.506(8)
C(4)-C(5)	1.513(9)
C(5)-C(6)	1.536(9)
C(8)-C(9)	1.538(10)
C(9)-C(14)	1.398(11)
C(9)-C(10)	1.398(10)
C(10)-C(11)	1.435(10)
C(11)-C(12)	1.360(10)
C(12)-C(13)	1.333(10)
C(13)-C(14)	1.363(10)
C(15)-C(16)	1.481(8)
C(16)-C(21)	1.387(8)
C(16)-C(17)	1.406(8)
C(17)-C(18)	1.359(8)
C(18)-C(19)	1.381(8)
C(19)-C(20)	1.382(8)
C(20)-C(21)	1.372(8)

O(4)-N(3)-O(3)	125.0(5)
O(4)-N(3)-C(18)	117.4(5)
O(3)-N(3)-C(18)	117.6(5)

O(5)-N(4)-O(6)	125.4(5)
O(5)-N(4)-C(20)	117.5(5)
O(6)-N(4)-C(20)	117.2(5)
C(15)-O(1)-C(7)	118.3(4)
C(7)-C(1)-N(2)	103.1(5)
C(7)-C(1)-C(6)	100.3(6)
N(2)-C(1)-C(6)	107.3(6)
C(3)-N(2)-C(8)	114.8(6)
C(3)-N(2)-C(1)	105.1(5)
C(8)-N(2)-C(1)	117.2(6)
N(2)-C(3)-C(4)	103.2(5)
C(3)-C(4)-C(7)	101.7(5)
C(3)-C(4)-C(5)	110.8(6)
C(7)-C(4)-C(5)	100.6(5)
C(4)-C(5)-C(6)	103.5(5)
C(1)-C(6)-C(5)	100.9(5)
O(1)-C(7)-C(1)	113.3(5)
O(1)-C(7)-C(4)	111.4(5)
C(1)-C(7)-C(4)	93.0(5)
N(2)-C(8)-C(9)	112.4(7)
C(14)-C(9)-C(10)	120.0(7)
C(14)-C(9)-C(8)	119.8(7)
C(10)-C(9)-C(8)	120.2(7)
C(9)-C(10)-C(11)	118.6(7)
C(12)-C(11)-C(10)	118.1(7)
C(13)-C(12)-C(11)	122.2(7)
C(12)-C(13)-C(14)	122.2(8)
C(13)-C(14)-C(9)	118.7(8)
O(2)-C(15)-O(1)	124.6(5)
O(2)-C(15)-C(16)	123.5(5)
O(1)-C(15)-C(16)	111.9(5)
C(21)-C(16)-C(17)	119.3(5)
C(21)-C(16)-C(15)	122.2(5)
C(17)-C(16)-C(15)	118.4(5)
C(18)-C(17)-C(16)	118.5(5)
C(17)-C(18)-C(19)	123.6(5)
C(17)-C(18)-N(3)	118.9(5)
C(19)-C(18)-N(3)	117.4(5)

C(18)-C(19)-C(20)	116.6(6)
C(21)-C(20)-C(19)	122.3(6)
C(21)-C(20)-N(4)	120.0(5)
C(19)-C(20)-N(4)	117.7(5)
C(20)-C(21)-C(16)	119.6(5)

Symmetry transformations used to generate equivalent atoms:

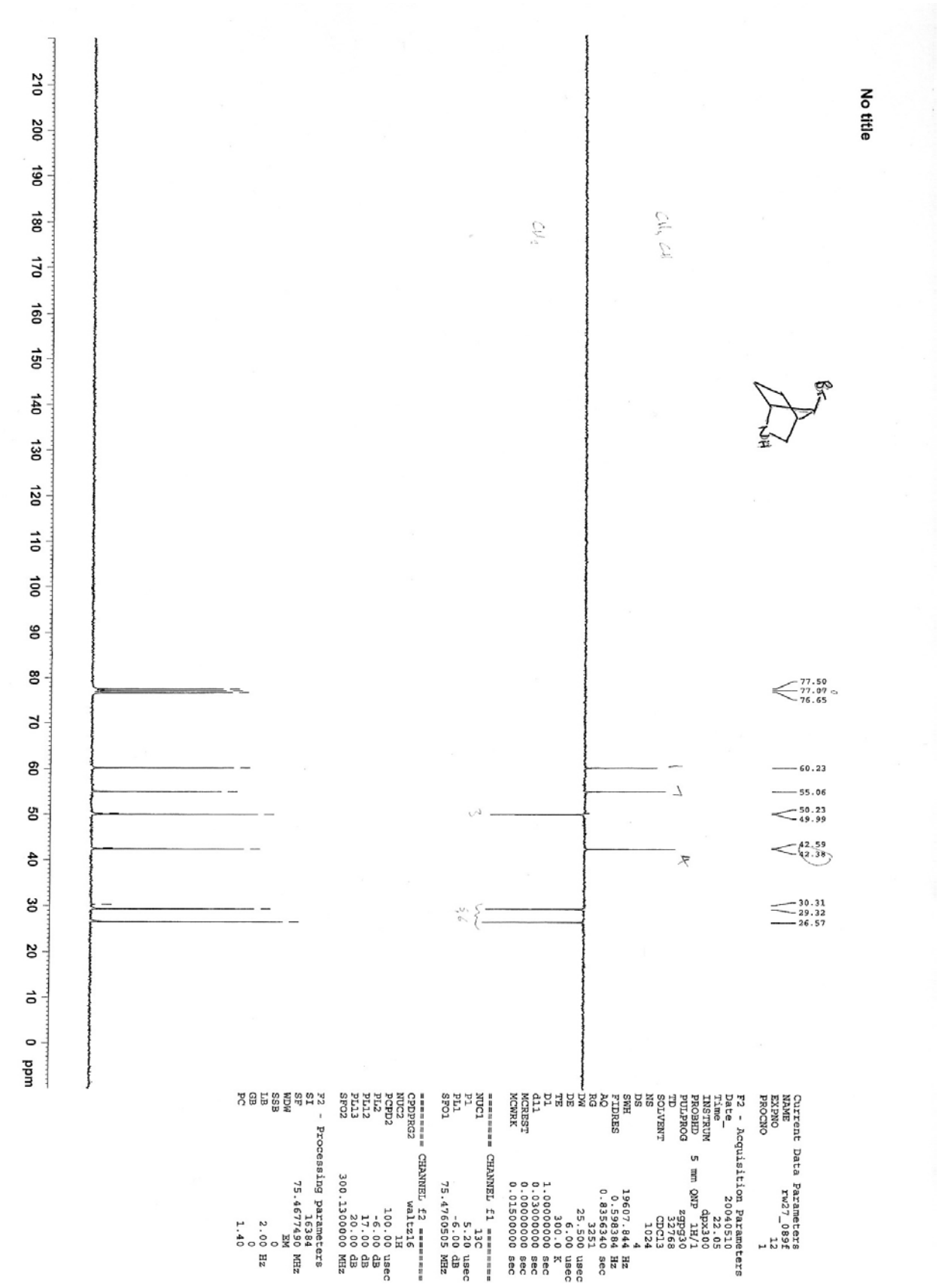
Table 4. Anisotropic displacement parameters ($Å^2 x\ 10^3$) for 3,5-dinitrobenzoate of **18a**. The anisotropic displacement factor exponent takes the form: $-2\pi^2[\ h^2\ a^{*2}U^{11} + ...\ + 2\ h\ k\ a^*\ b^*\ U^{12}\ ]$

	U^{11}	U^{22}	U^{33}	U^{23}	U^{13}	U^{12}
N(3)	32(3)	25(3)	51(4)	-6(2)	-6(3)	-10(2)
N(4)	27(3)	31(3)	59(4)	-6(3)	-9(3)	-11(2)
O(1)	32(2)	31(2)	61(3)	-16(2)	-11(2)	-10(2)
O(2)	33(2)	43(3)	69(3)	-20(2)	-22(2)	-8(2)
O(3)	53(3)	48(3)	92(4)	-30(3)	-40(3)	-3(2)
O(4)	50(3)	27(3)	82(4)	-11(2)	-13(3)	-9(2)
O(5)	31(2)	42(3)	92(4)	-15(3)	-18(3)	-4(2)
O(6)	41(3)	50(3)	68(3)	-17(3)	-13(2)	-19(2)
C(1)	42(4)	35(4)	80(6)	-10(4)	16(4)	-22(3)
N(2)	54(4)	54(4)	60(4)	-3(3)	-31(3)	0(3)
C(3)	50(4)	46(4)	55(5)	-19(4)	-4(4)	-11(3)
C(4)	41(4)	30(4)	64(5)	-18(3)	-1(4)	-16(3)
C(5)	45(4)	33(4)	65(5)	-16(3)	-16(4)	-8(3)
C(6)	35(4)	54(5)	80(6)	-19(4)	-1(4)	-7(3)
C(7)	31(3)	27(3)	55(4)	-13(3)	-16(3)	-11(3)
C(8)	66(5)	79(6)	60(5)	-1(4)	-9(4)	-28(4)
C(9)	48(4)	70(6)	53(5)	-7(4)	-19(4)	-2(4)
C(10)	92(6)	46(5)	59(5)	-17(4)	28(5)	-24(4)
C(11)	25(3)	76(6)	56(5)	3(4)	-2(3)	-10(4)
C(12)	43(4)	65(5)	42(4)	-3(4)	-3(4)	-24(4)
C(13)	58(5)	53(5)	91(7)	-11(4)	-23(5)	-19(4)
C(14)	71(6)	69(6)	74(6)	-9(5)	-18(5)	0(5)
C(15)	37(3)	30(3)	25(3)	-3(3)	1(3)	-11(3)
C(16)	26(3)	29(3)	30(3)	-4(3)	2(3)	-13(3)
C(17)	22(3)	36(4)	32(4)	-3(3)	3(3)	-13(3)
C(18)	26(3)	27(3)	43(4)	-7(3)	1(3)	-15(3)
C(19)	25(3)	33(4)	41(4)	0(3)	-3(3)	-10(3)
C(20)	31(3)	31(4)	37(4)	-1(3)	-2(3)	-15(3)
C(21)	31(3)	32(4)	39(4)	-4(3)	-3(3)	-17(3)

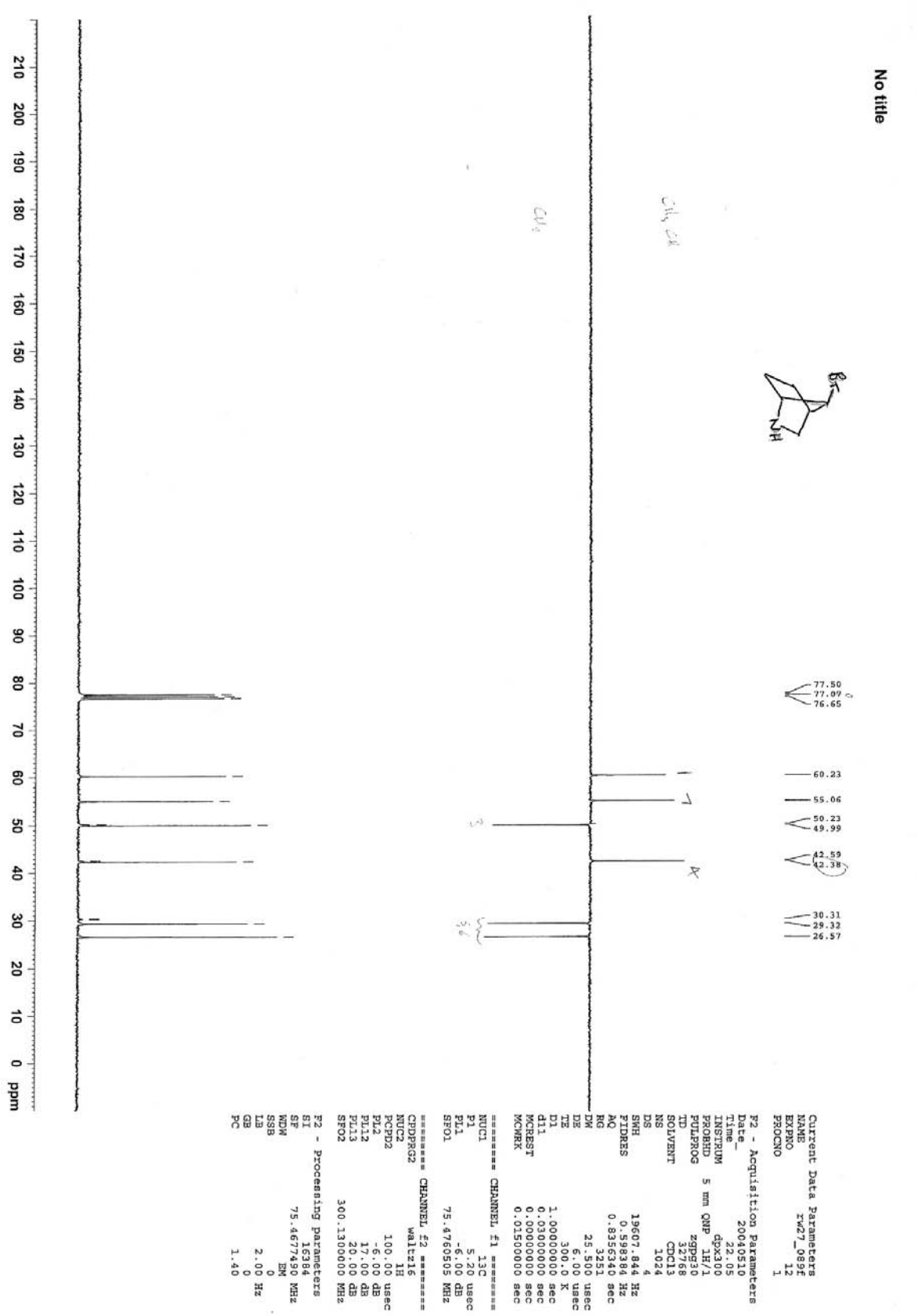
Table 5. Hydrogen coordinates (x 10^4) and isotropic displacement parameters ($Å^2$x 10^3) for 3,5-dinitrobenzoate of **18a**.

	x	y	z	U(eq)
H(1)	-738	2116	8128	64
H(3A)	4061	3287	7463	58
H(3B)	3142	4517	7850	58
H(4)	2519	4435	5863	51
H(5A)	-658	5309	6067	55
H(5B)	245	5609	7130	55
H(6A)	-1737	4343	8312	67
H(6B)	-2552	3980	7247	67
H(7)	-106	3036	6045	43
H(8A)	3120	1447	8654	82
H(8B)	1483	1532	9653	82
H(10)	6062	964	9585	79
H(11)	8249	1431	10805	66
H(12)	7461	3121	11586	60
H(13)	4694	4305	11265	79
H(14)	2368	3788	10284	86
H(17)	2109	-1091	5486	37
H(19)	7254	-2636	6579	40
H(21)	5214	692	7161	40

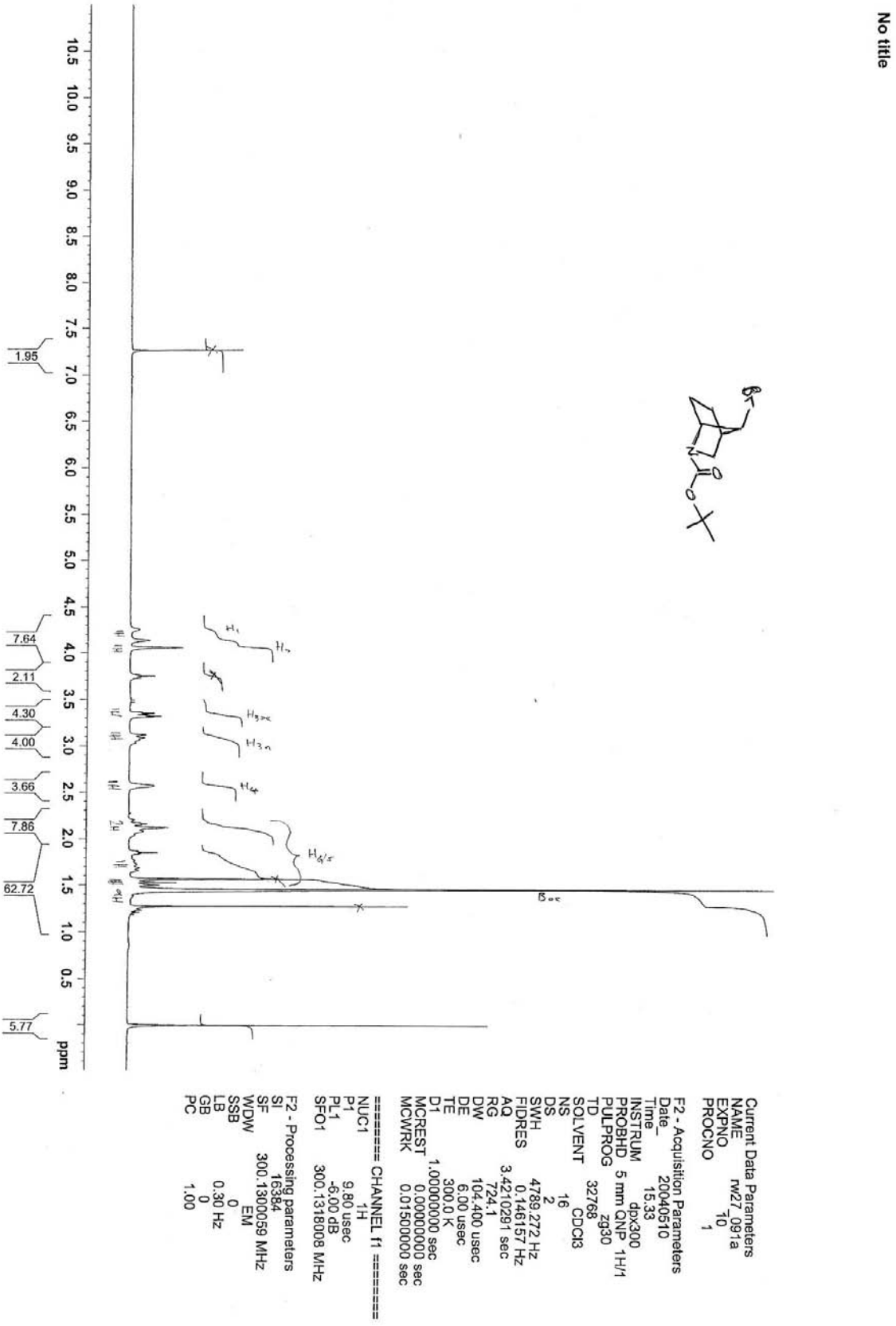
Compound 9b: ^{1}H NMR spectrum



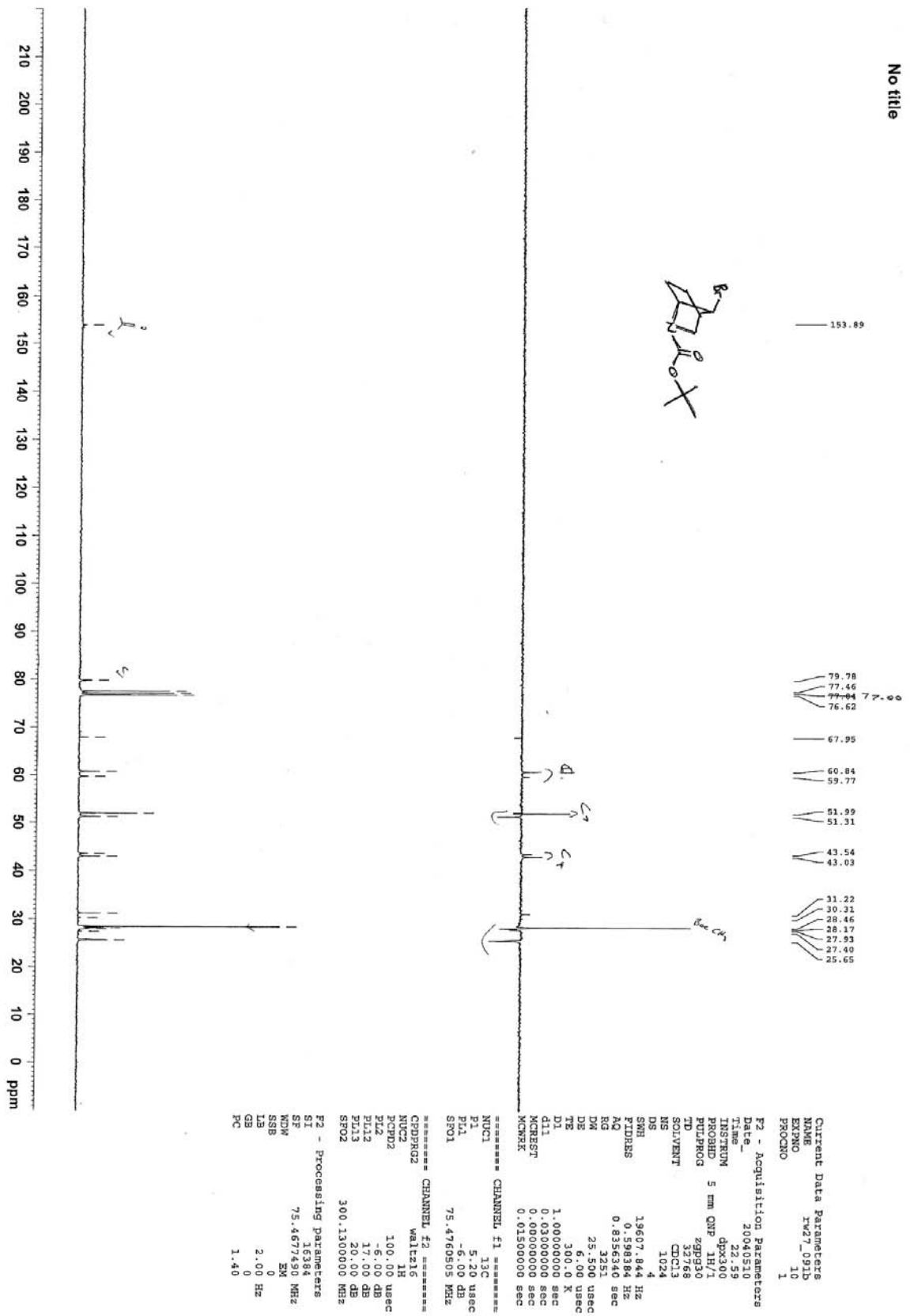
Compound 9b: ^{13}C NMR spectrum



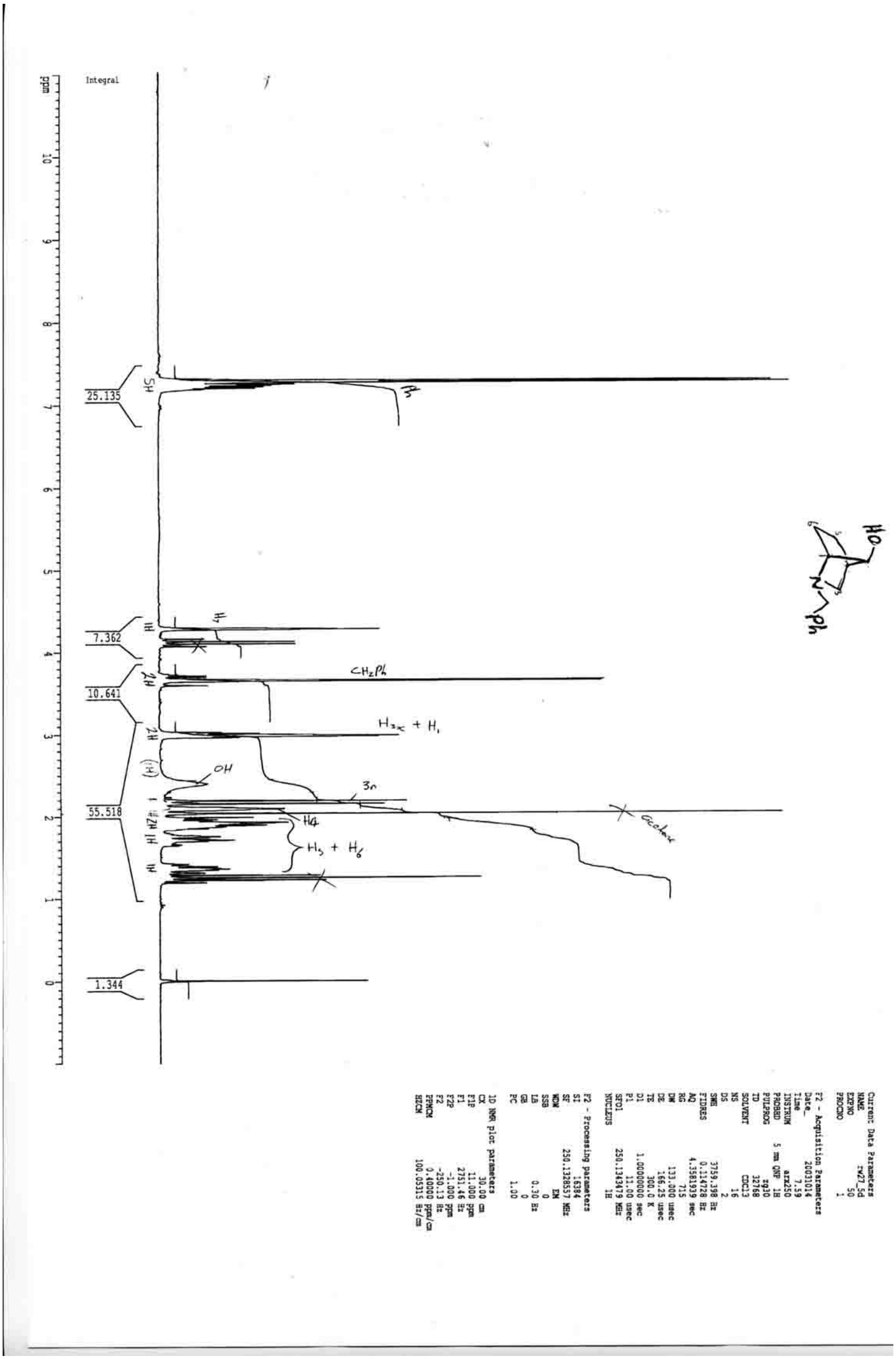
Compound 9c: ^{1}H NMR spectrum



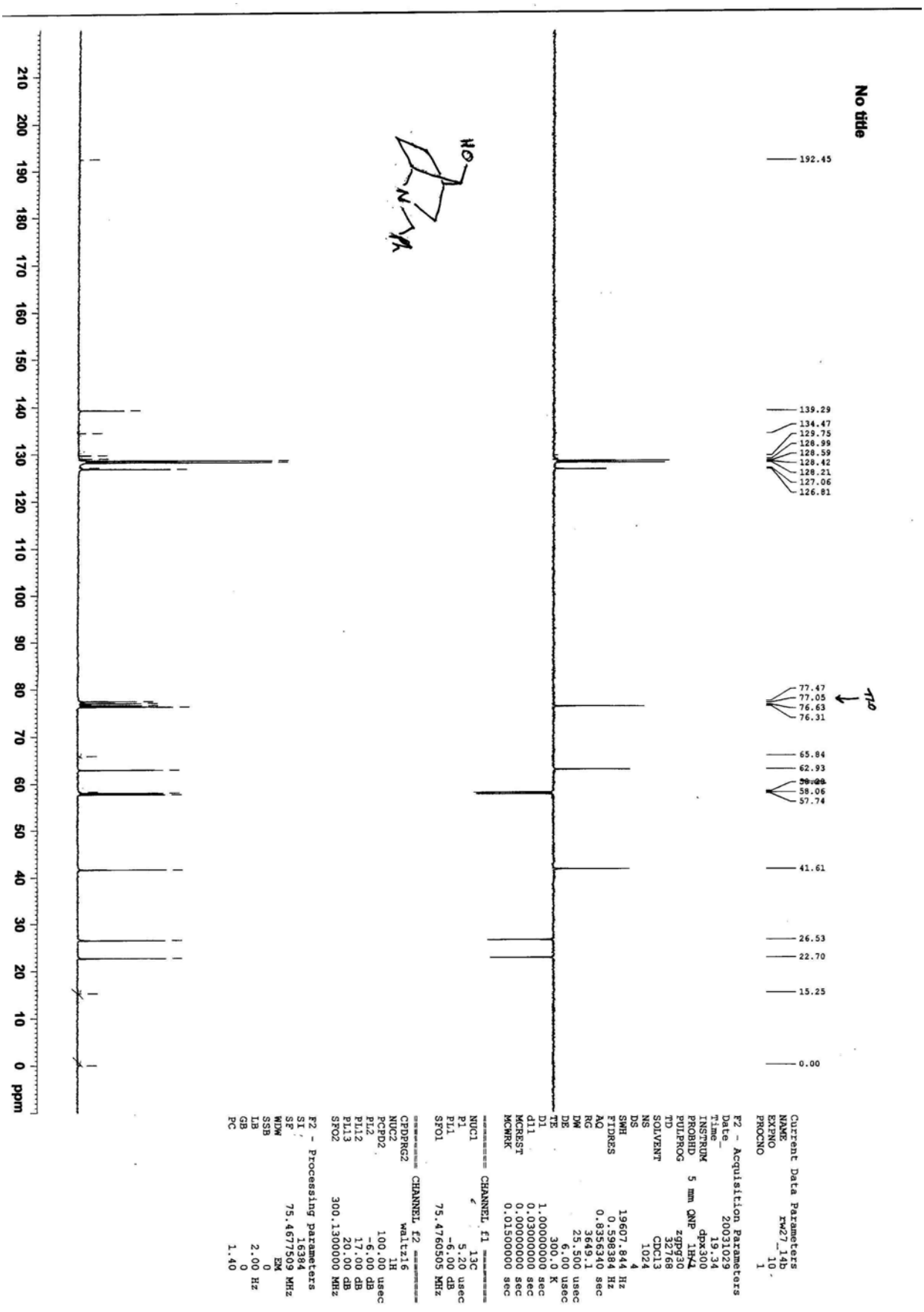
Compound 9c: ^{13}C NMR spectrum



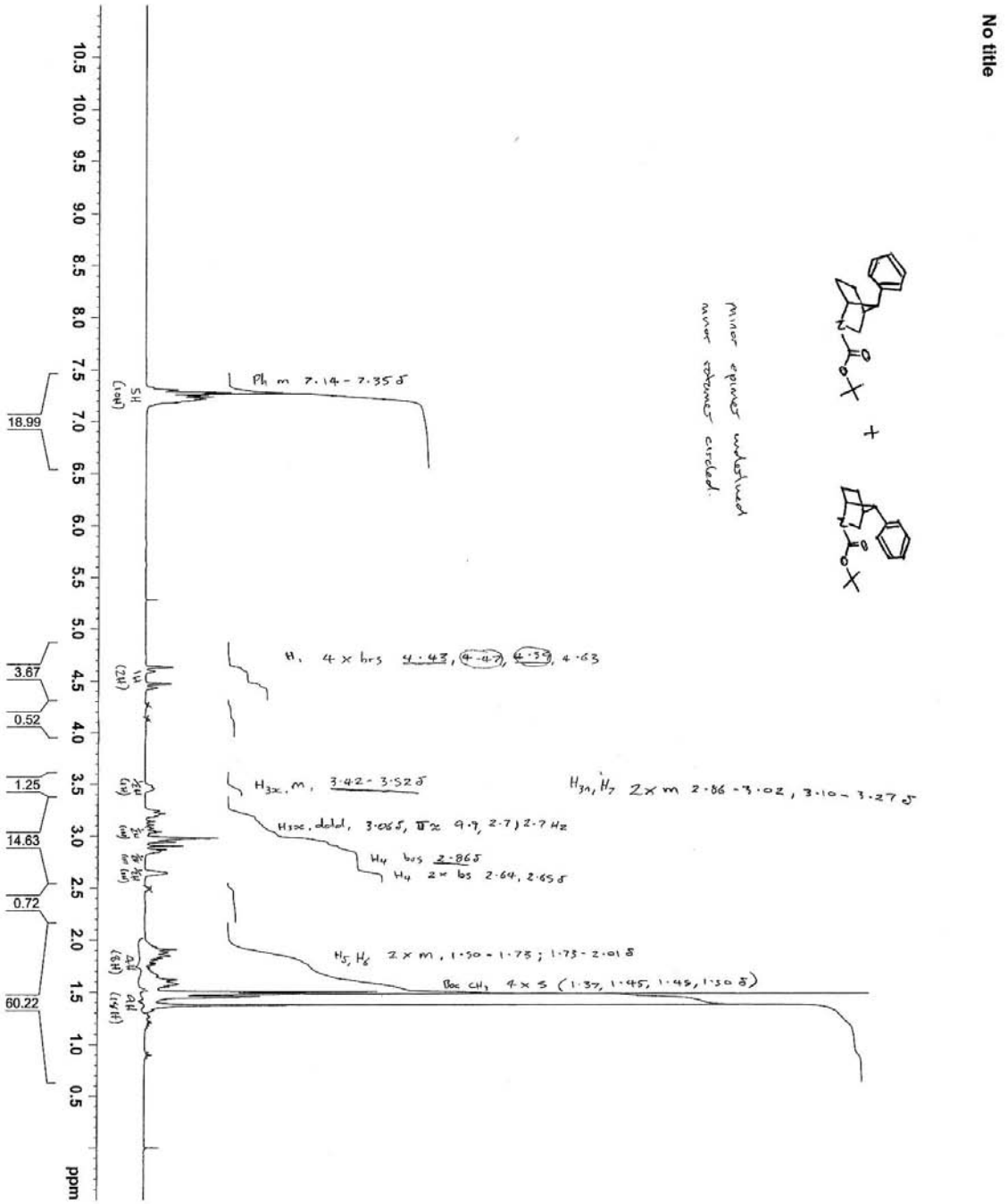
Compound 10a: ^{1}H NMR spectrum



Compound 10a: ^{13}C NMR spectrum



Compounds 11 & 12: ^{1}H NMR spectrum



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PROCNO 1

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Time_ 19.02
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TD 32768
SOLVENT CDCl3
NS 16
DS 2
SWH 4789.272 Hz
FIDRES 0.146157 Hz
AQ 3.42102912 sec
RG 71.8
DW 104.400 usec
DE 6.00 usec
TE 300.0 K
D1 1.00000000 sec
MCREST 0.00000000 sec
MCWRK 0.01500000 sec

======== CHANNEL f1 ========
NUC1 1H
P1 9.80 usec
PL1 -6.00 dB
SFO1 300.1318008 MHz

F2 - Processing parameters
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LB 0.30 Hz
GB 0
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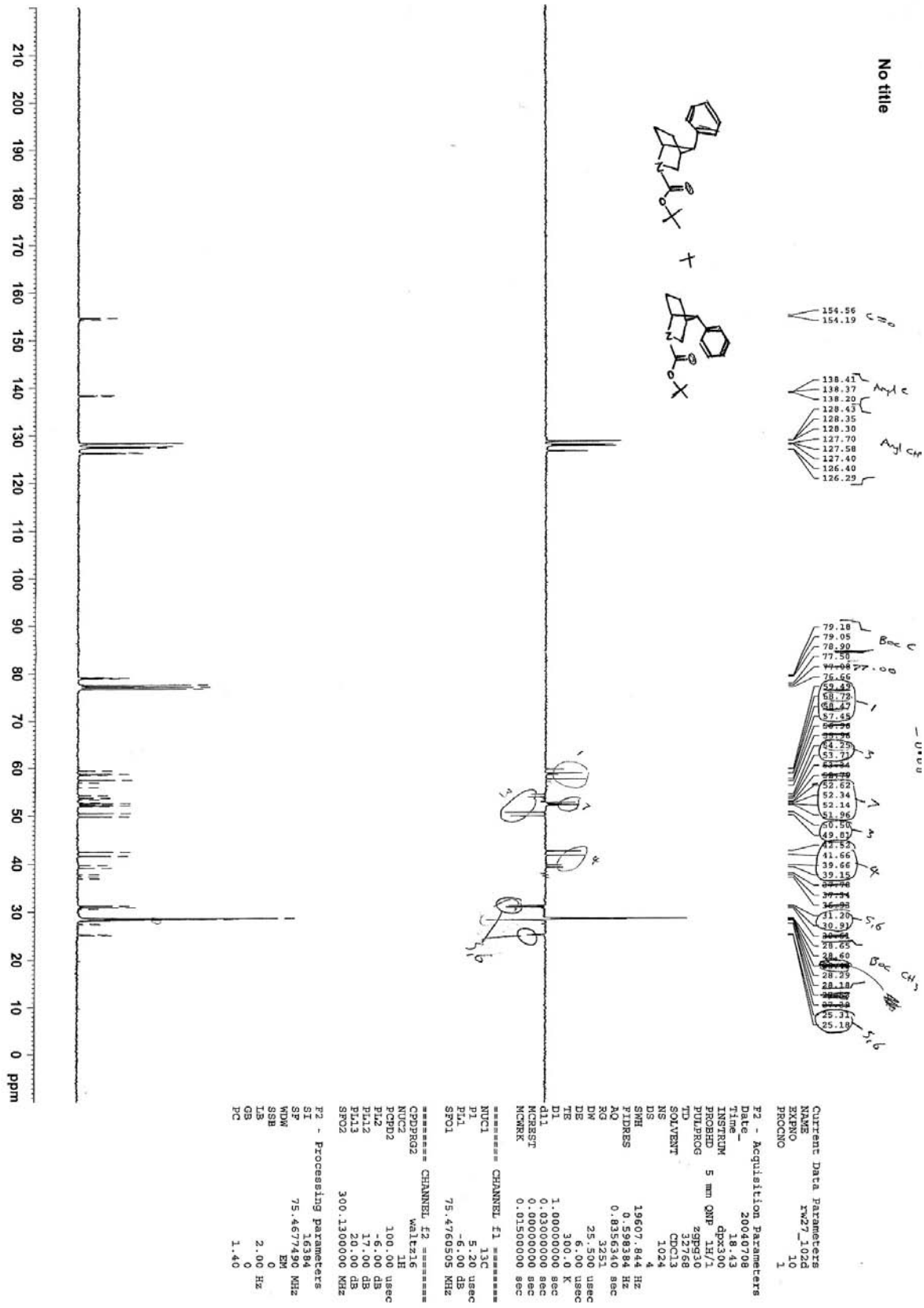
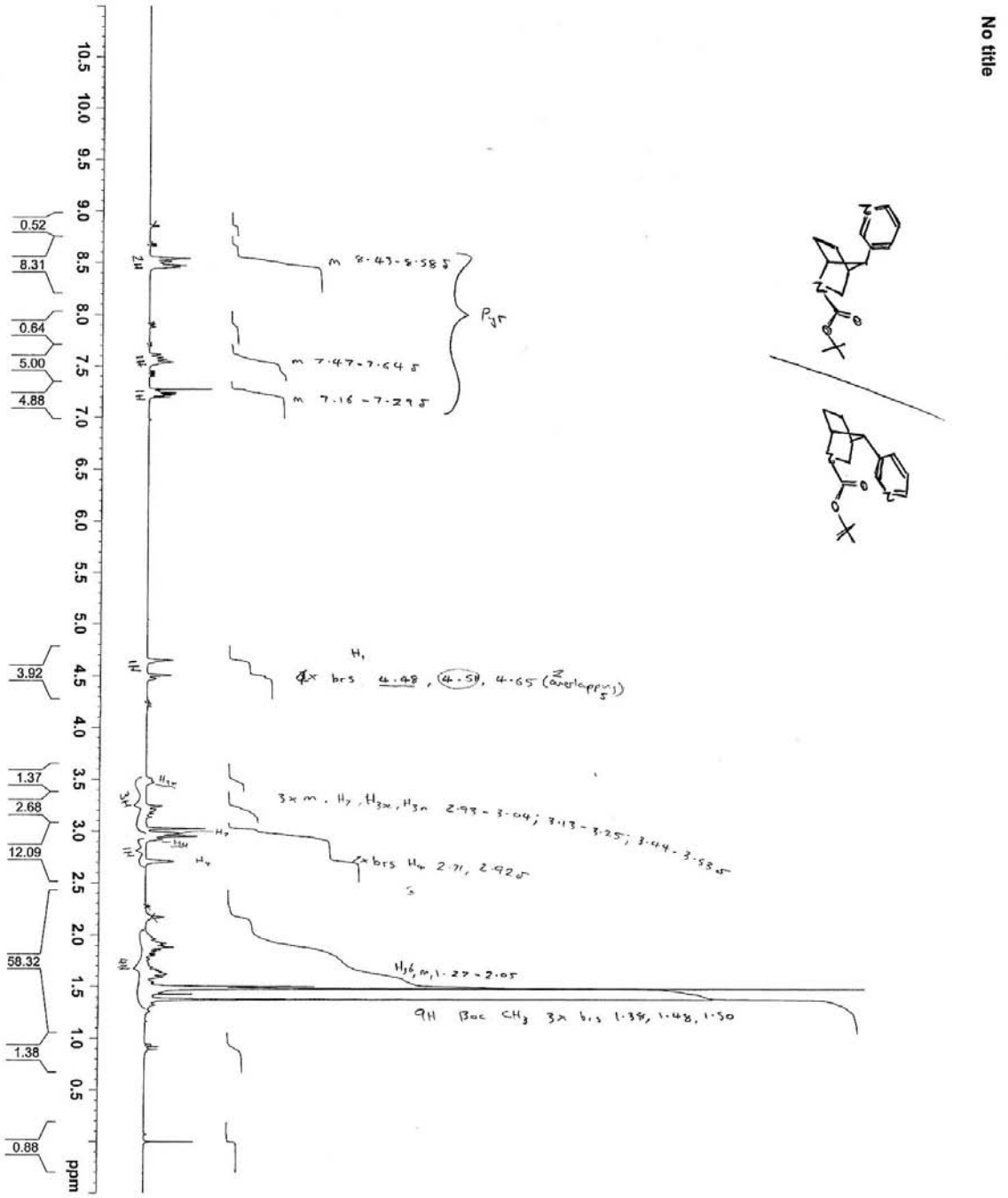
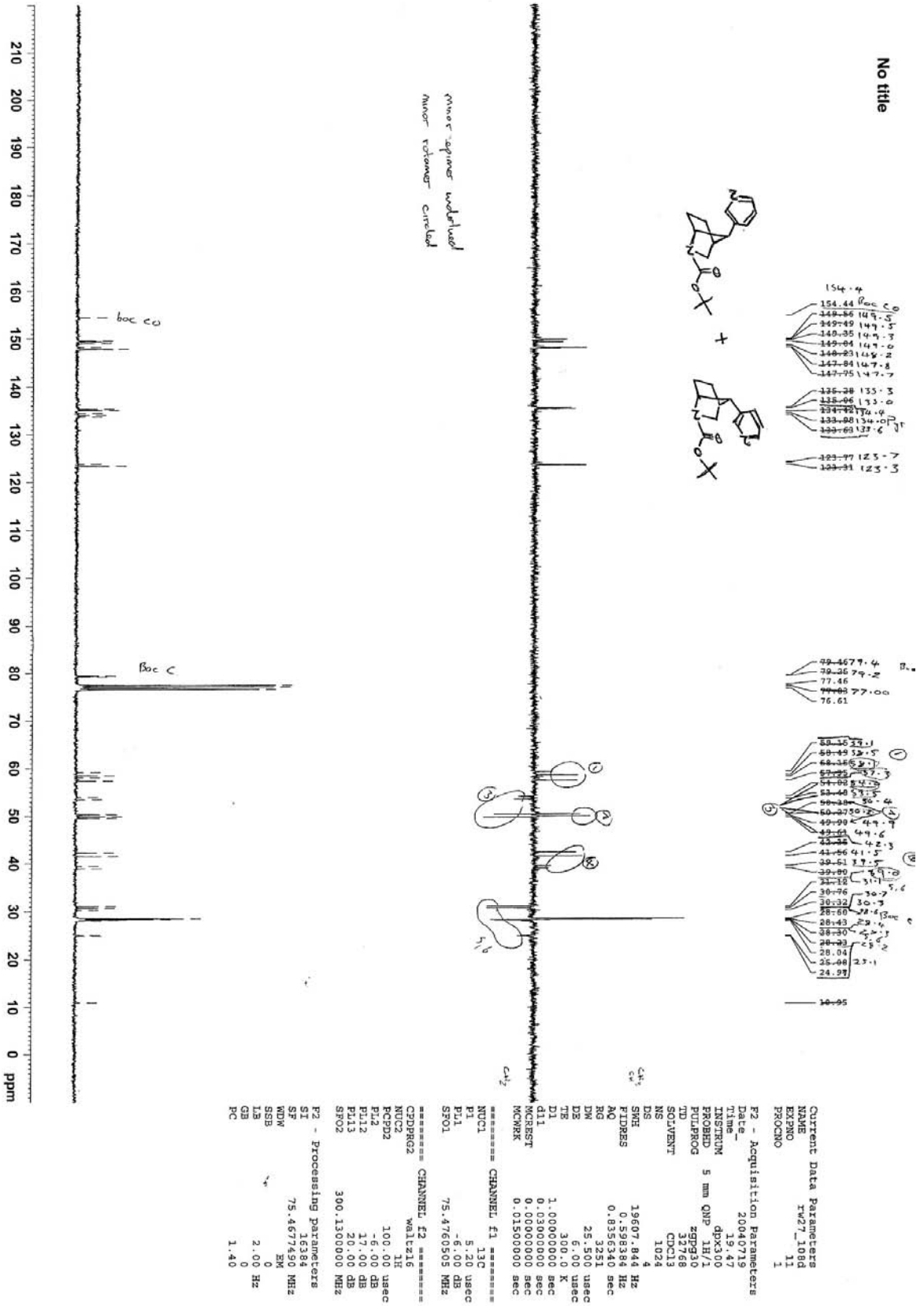
Compounds 11 & 12: ^{13}C NMR spectrum



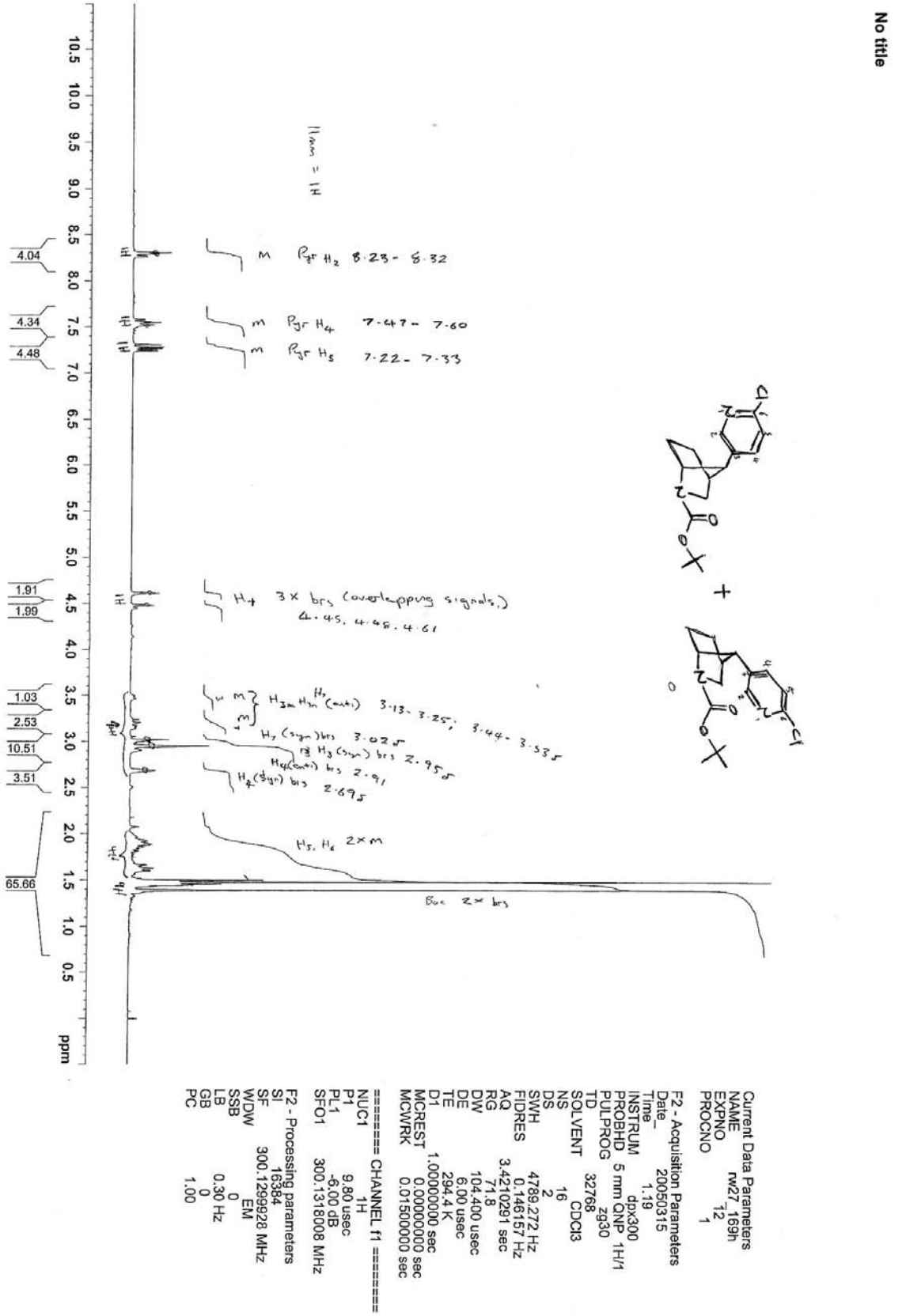
Compounds 13 & 14: ^{1}H NMR spectrum



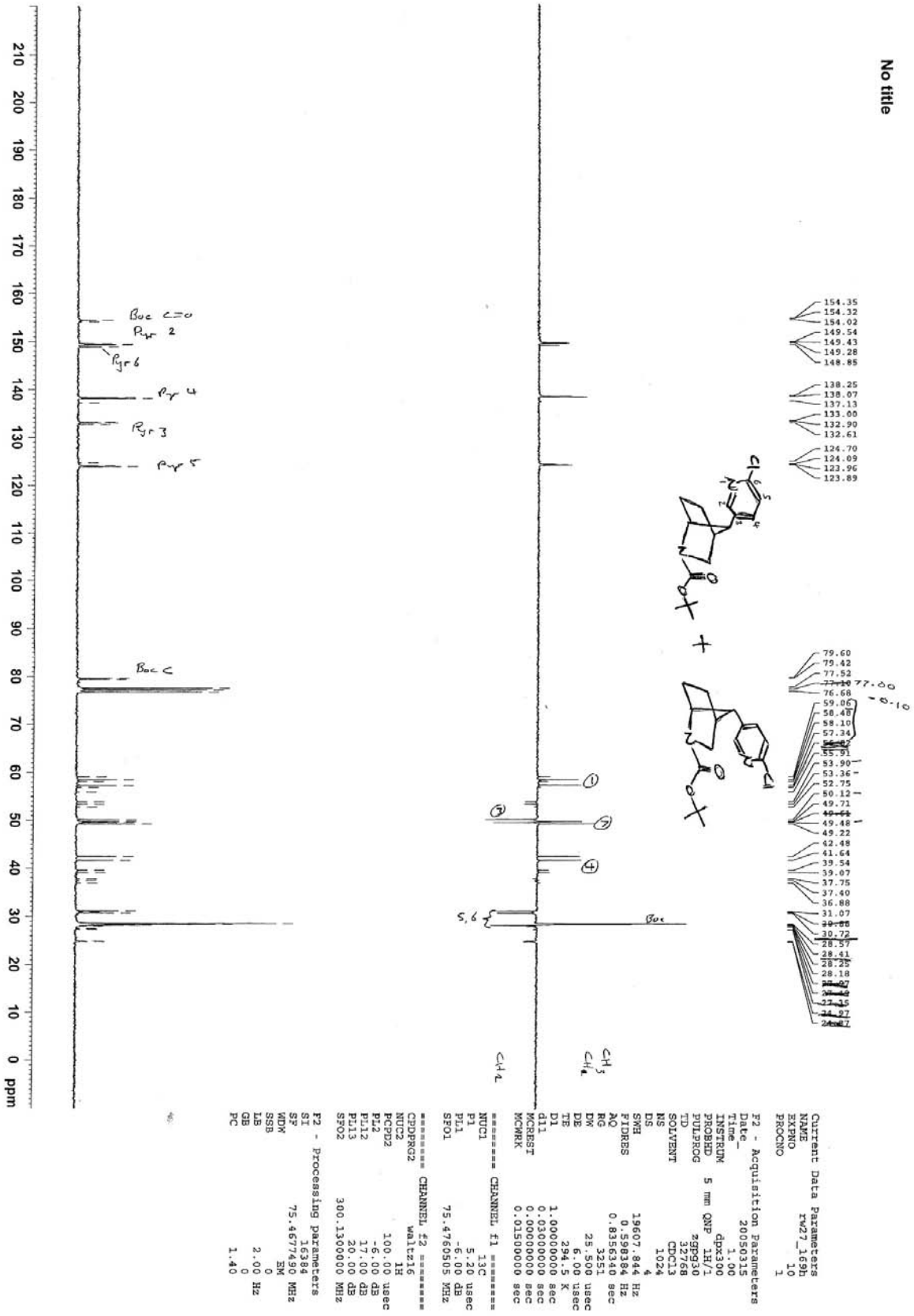
Compounds 13 & 14: ^{13}C NMR spectrum



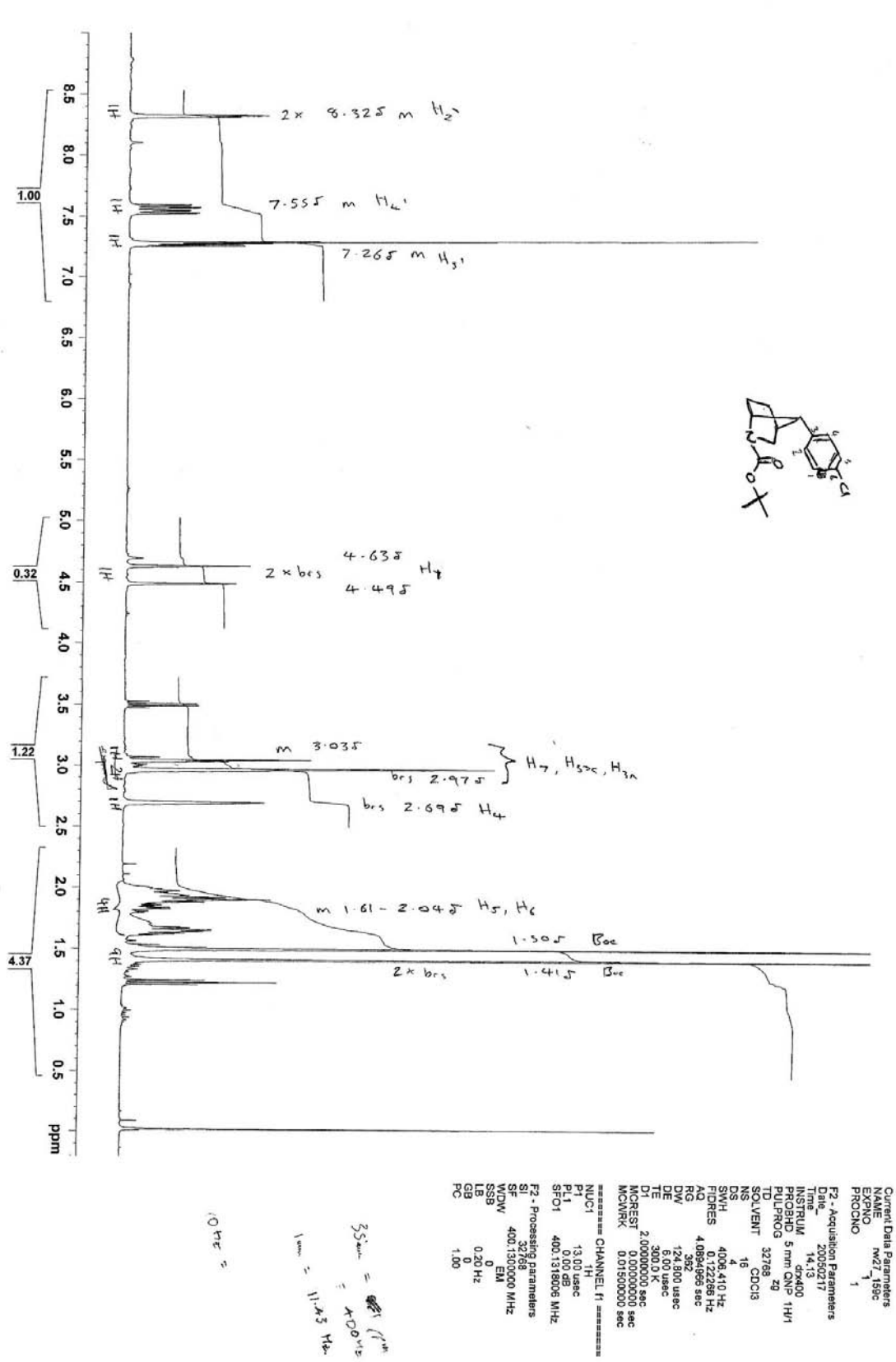
Compounds 15 & 16: ^{1}H NMR spectrum



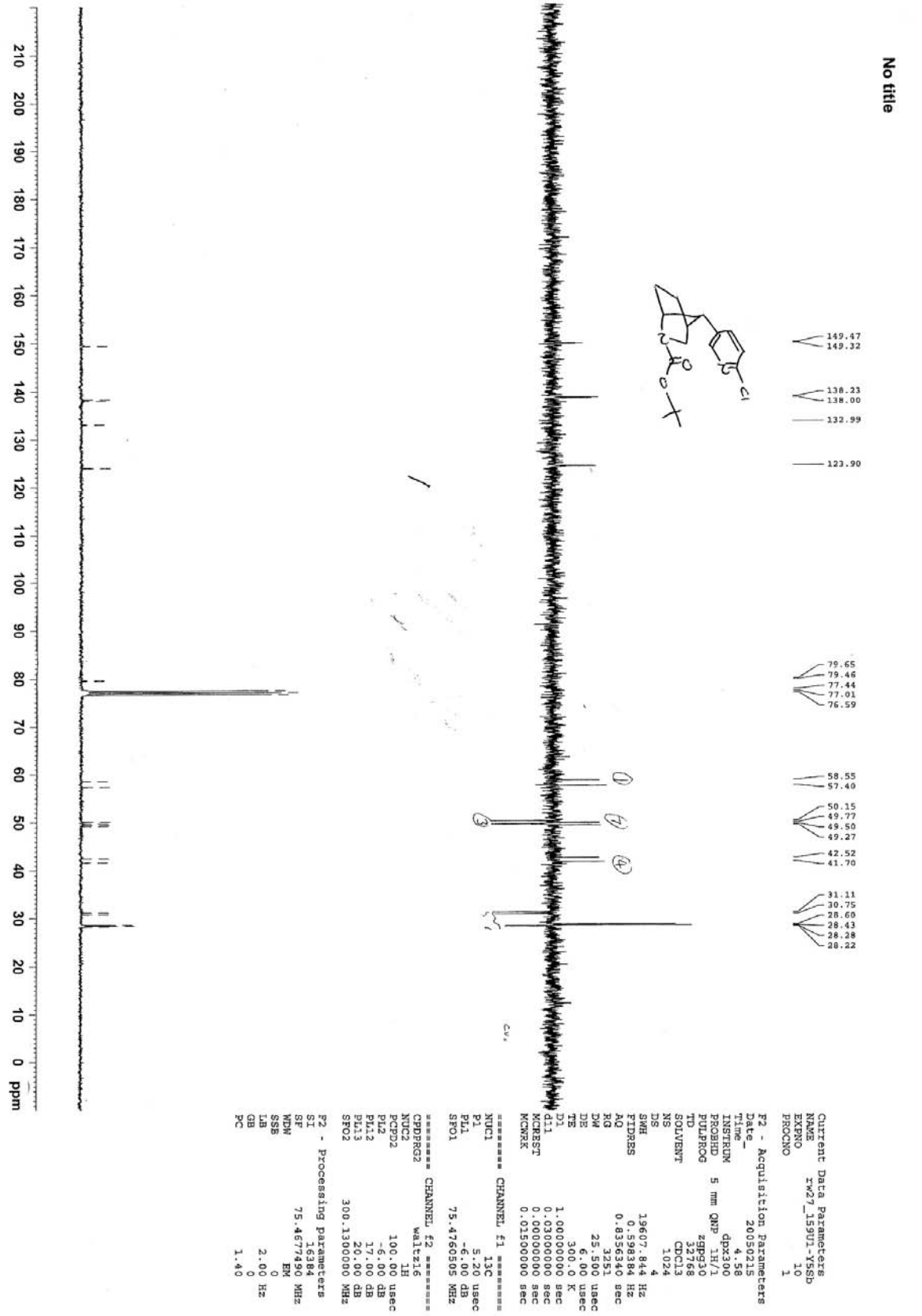
Compounds 15 & 16: ^{13}C NMR spectrum



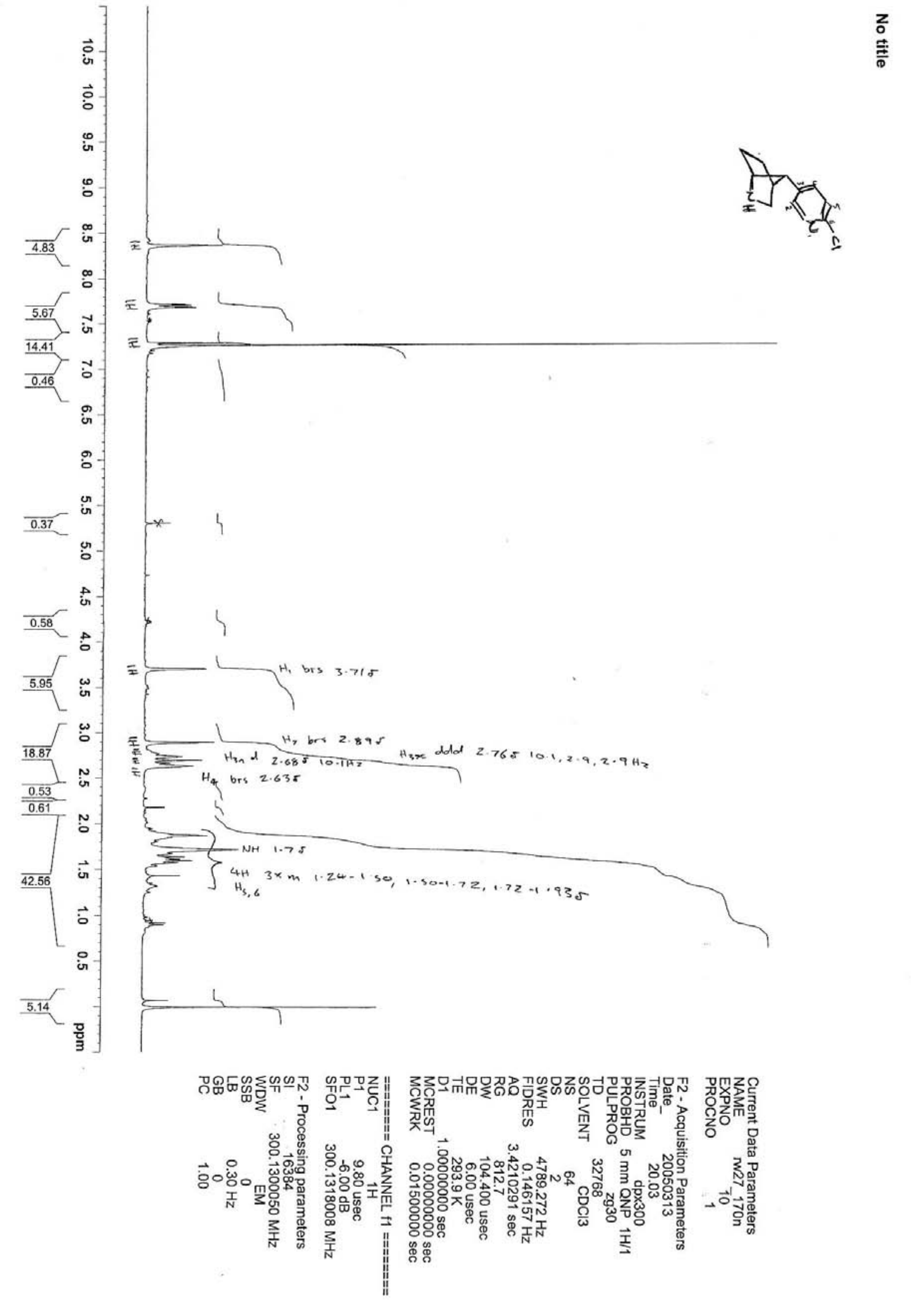
Compound 16: ^{1}H NMR spectrum



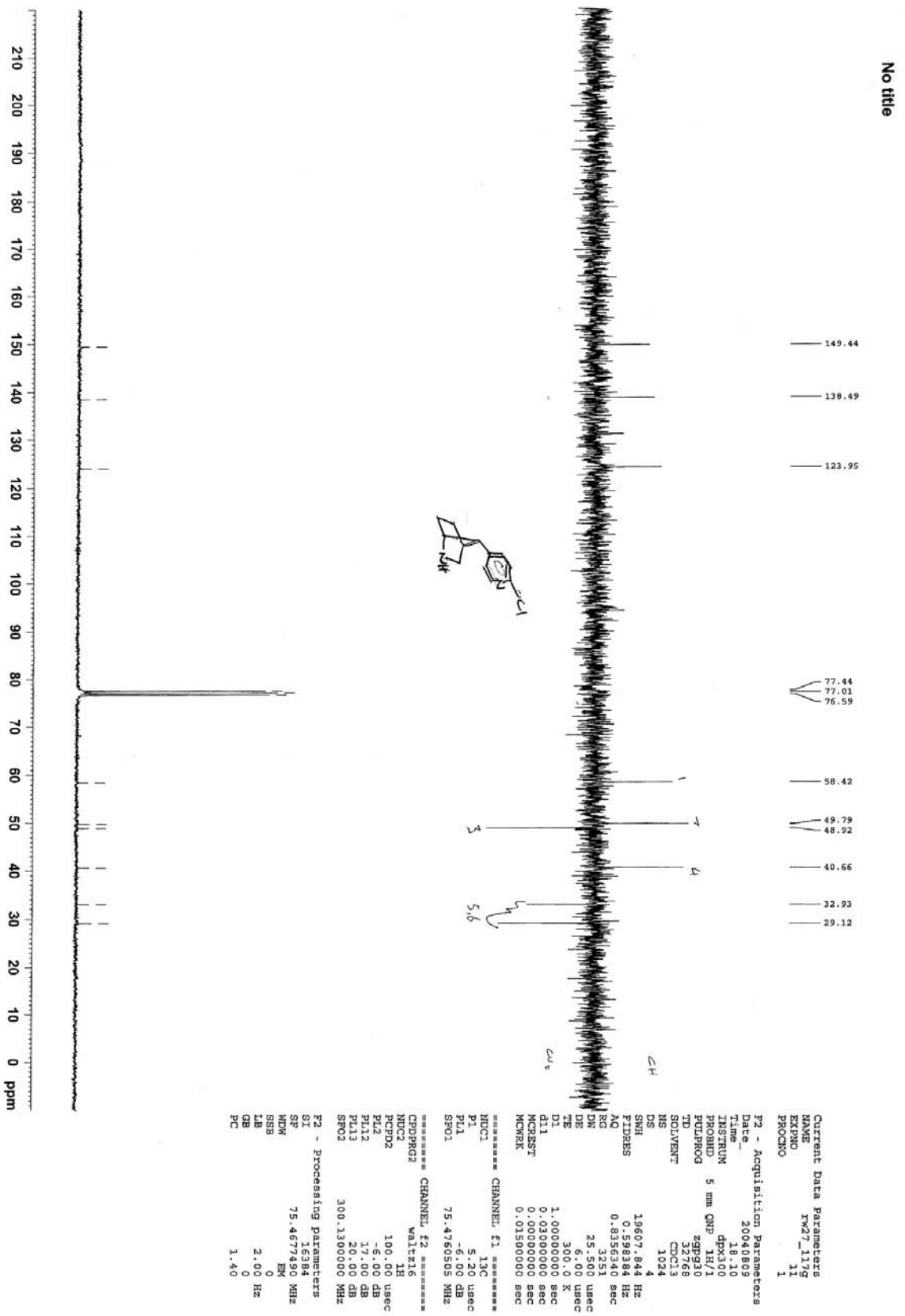
Compound 16: ^{13}C NMR spectrum



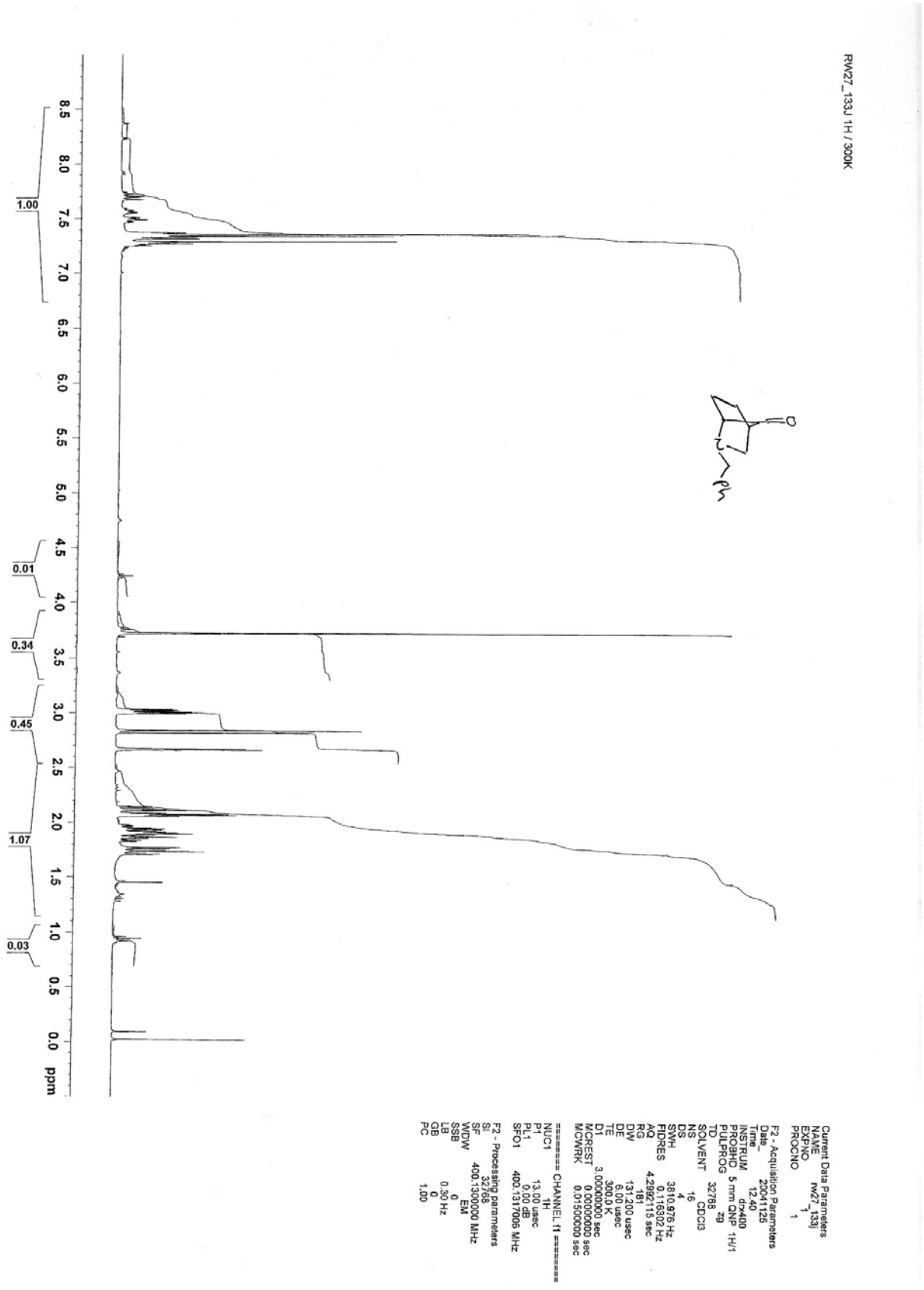
Compound 6 (*syn*-isoepibatidine): ^{1}H NMR spectrum



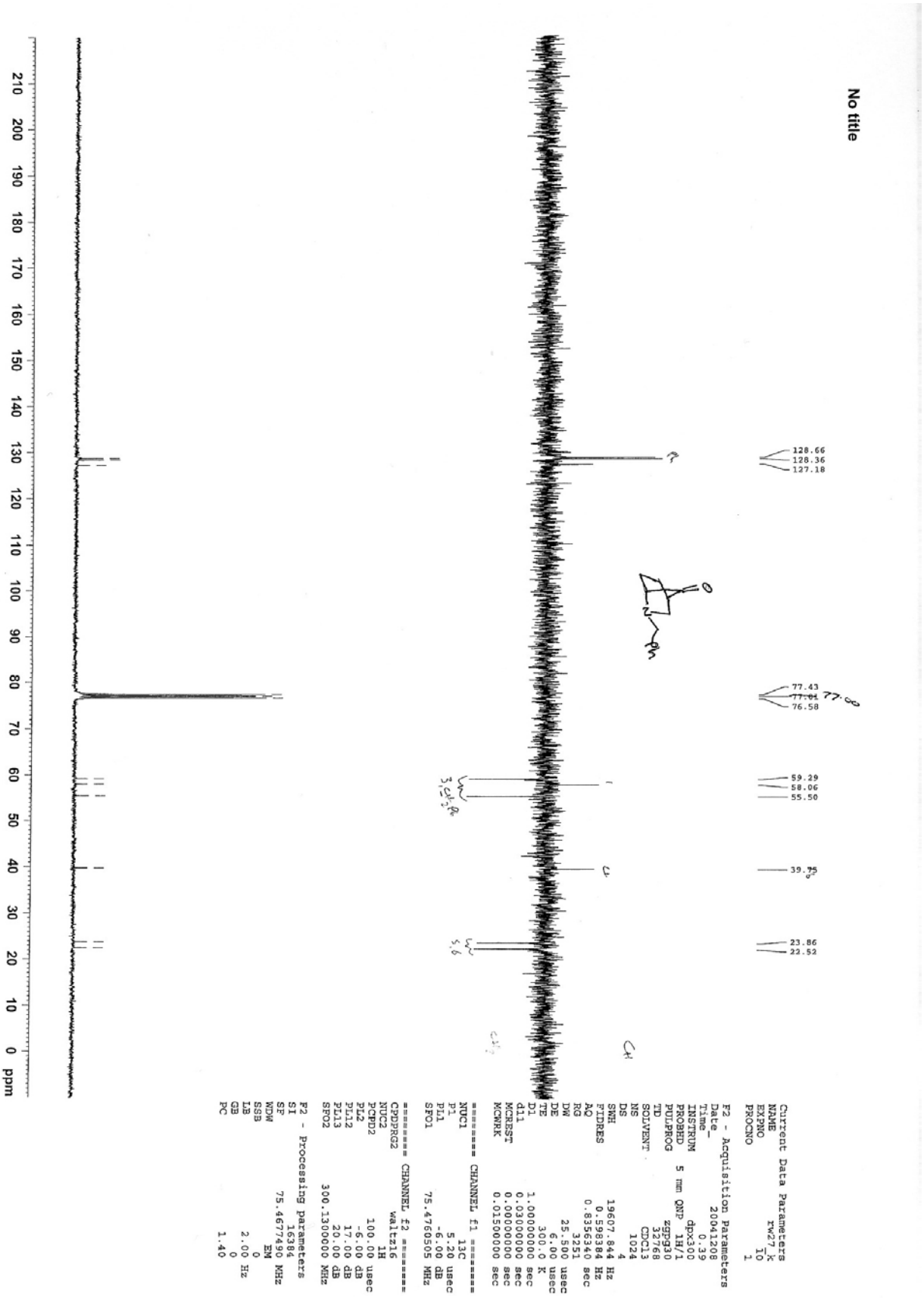
Compound 6 (*syn*-isoepibatidine): ^{13}C NMR spectrum



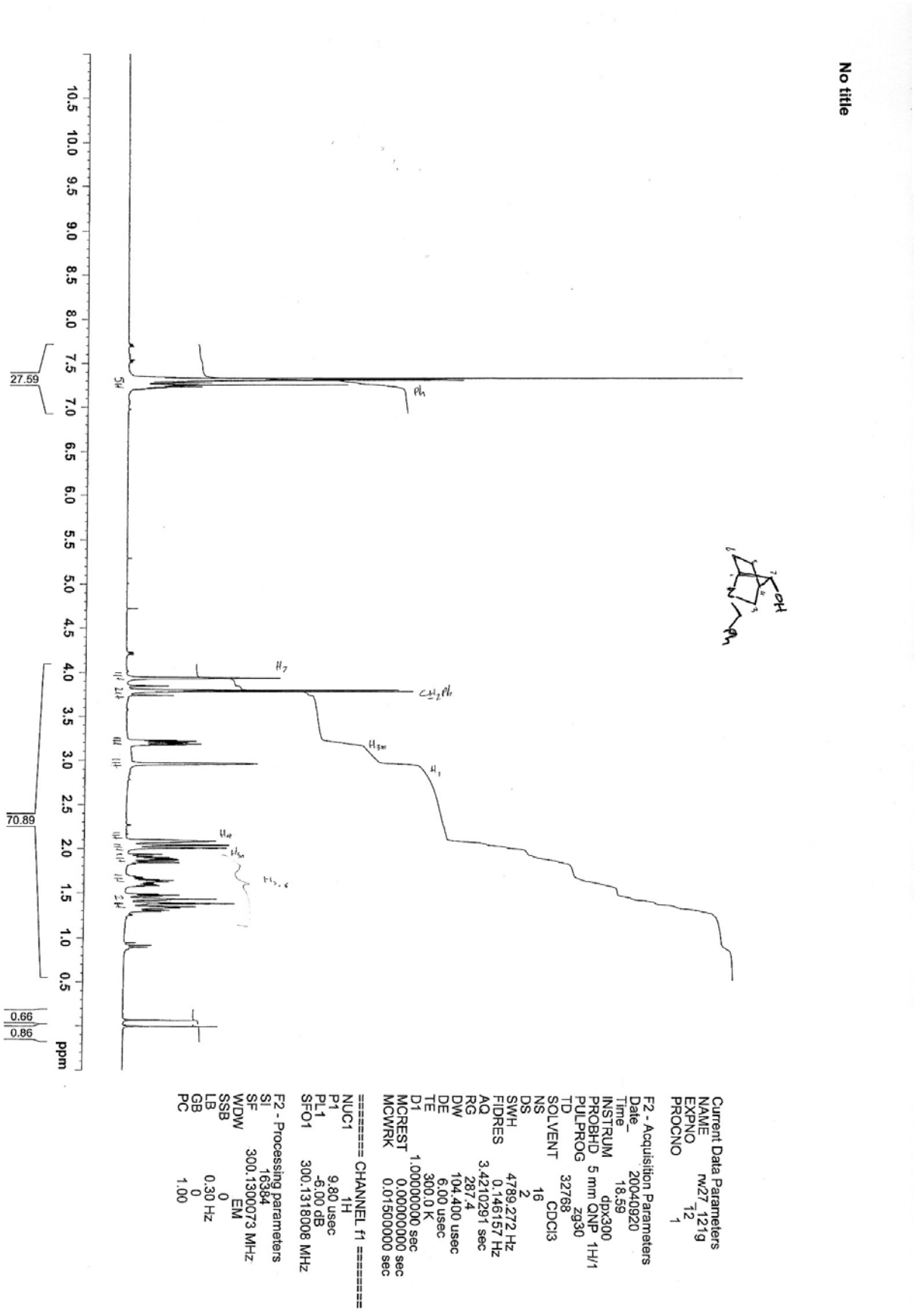
Compound 17a: ^{1}H NMR spectrum



Compound 17a: ^{13}C NMR spectrum



Compound 18a: ^{1}H NMR spectrum



Compound 18a: ^{13}C NMR spectrum