Supplemental Information

Pd-Catalyzed Suzuki Coupling Reactions of Aryl Halides Containing Basic Nitrogen Centers with Arylboronic Acids in Water in the Absence of Added Base

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Content

Supplemental Information S1

Comparison of reaction yields determined by various analytical methods employing 2-amino-6-chloropyridine as a model substrate.

The four-hour base-free Suzuki coupling of 2-amino-6-chloropyridine (**1m**) and phenylboronic acid (**2**) in water catalyzed by 2 mol% of $Pd(OAc)_2$ in the presence of 2 mol% PtB ligand (**Entry 21, Table 3**) was selected as model reaction for the comparison of various analytical method. As shown in **Figure S1**, the isolated yield of coupled product **3m** is consistent with the yields determined by GC and ^{1}H NMR. **As a consequence, GC and ^{1}H NMR were employed for in-situ determination of the yields for the coupling reactions for a wide variety of aryl substrates.**

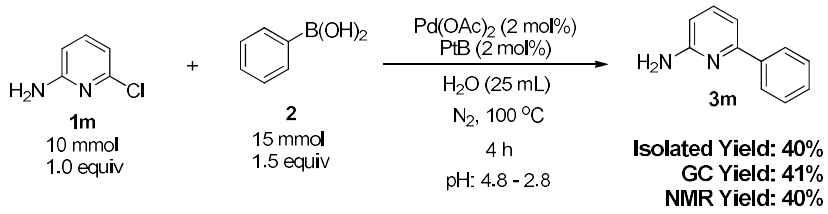


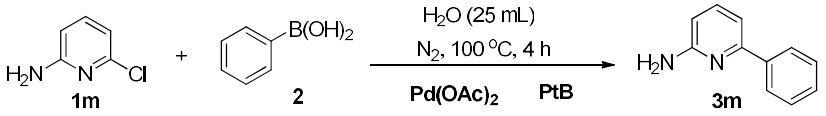
Figure S1. Model Reaction and Yield Determined by Various Analytic Methods

The experimental procedure for conducting the Suzuki coupling reaction with the model substrate 6-amino-2-chloropyridine, the detailed analytical procedures in the determination of the yields by GC (FID) and ^{1}H NMR, and the experimental details dealing the isolation of the product are discussed in the following Supplemental Information sections.

Supplemental Information S2

Experimental procedure

1. A mixture of 2-amino-6-chloropyridine (**1m**), phenylboronic acid (**2**), $Pd(OAc)_2$, PtB ligand and H_2O (**Figure S2**) in a 100-mL 3-neck round-bottom flask equipped with an Allihn condenser and an internal temperature sensor was stirred (600 – 800 rpm) by means of a magnetic stirrer at room temperature in N_2 for ca. 5 min. The heterogeneous reaction mixture became a light brown.



	1m	2	$Pd(OAc)_2$	PtB	3m
M.W.	128.56	121.93	224.51	287.38	170.21
equiv.	1.0	1.5	0.02	0.02	
expected	10 mmol	15 mmol	0.2 mmol	0.2 mmol	
	1.2856 g	1.8290 g	0.0449 g	0.0575 g	
actual	1.2850 g	1.8286 g	0.0445 g	0.0576 g	**1.7013 g**
	9.995 mmol	14.997 mmol			**Theoretical Yield**

		initial	final
"Concentration": 0.39981 M	pH of aqueous phase:	4.8	2.8

Figure S2. Reaction of 6-amino-2-chloropyridine (**1m**) with phenylboronic acid (**2**).

2. When the temperature of the reaction mixture stabilized at 25 – 27 °C, the pH of the aqueous phase was measured (**Initial pH = 4.8**).
3. The reaction was heated to 100 °C in approximately 15 – 20 minutes, and kept well stirring at 100 °C for 4 hours. Two phases were observed—an aqueous phase and a solid phase.
4. The reaction mixture was then cooled. The pH of the aqueous phase was measured at 25 – 27 °C (**Final pH = 2.8**).
5. 30% NaOH aqueous solution was slowly added to the dark brown reaction mixture utill the pH of aqueous phase ≥ 12.
6. The reaction mixture was extracted three times with CH_2Cl_2 (3×50 mL). The combined organic extract was then dried over anhydrous $MgSO_4$ and filtered.
7. The resulting light brown solution was transferred to a 250-mL volumetric flask and diluted to 250 mL by adding MeOH. An aliquot (~ 1 mL) of this solution was taken for **GC analysis**.
8. Solvent was removed *in vacuo* from the remaining solution. A brown gel (1.6080 g) was obtained as crude product which was analyzed by **^{1}H NMR.**
9. The **isolated yield** was calculated basing on the mass of pure product obtained from column chromatographic separation.

Supplemental Information S3

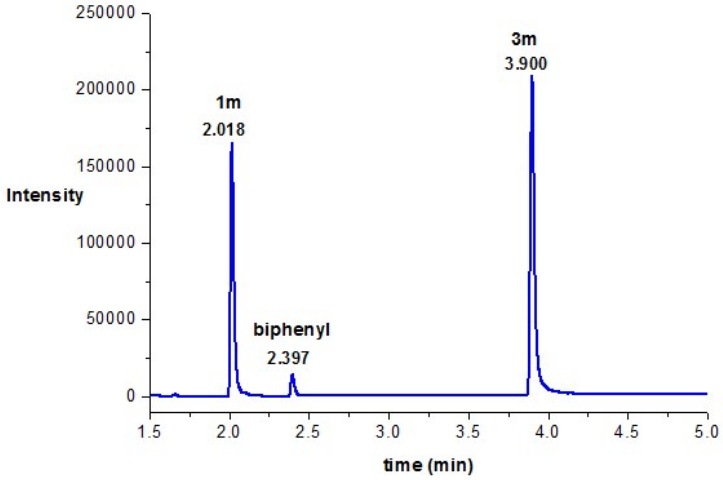
GC Analysis

GC analysis was carried out qualitatively on a Shimazu GCMS-QP2010S and quantitatively on a Shimazu GC-2010 GC-FID fitted with a Supelco PTA-5 capillary column (30 m × 0.32 mm × 1.00 µm, length × inside diameter × film thickness). Product yield was evaluated using the calibration curves of starting material (**1m**), product (**3m**) and related side product (biphenyl).

Calibration curves were created from pure standards of **1m** (commercial), biphenyl (commercial) and **3m** (isolated). Stock solutions (0.1 M, 5 mL) were made using methanol as solvent. Multiple samples of concentrations between 0.005 M and 0.05 M were then made from dilution of the stock solution with methanol and analyzed by GC-FID. Plots of concentration versus area were created for each compound using Microsoft Excel and a trendline analysis used to provide the calibration curve and confirm that the plot followed a straight line. See the tables below. The results are summarized in **Figures S3a, S3b, and S3c**.

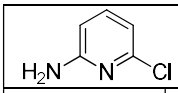
The result of GC analysis of the crude product was illustrated in **Scheme S1**. The peaks in GC chromatogram were identified by comparing the retention times with authentic samples, and double-checked by GC-MS. The side product, biphenyl, was detected in a very low concentration. Its formation is attributed to the homo-coupling of the excess phenylboronic acid (**2**) relative to the limiting reagent **1m**. The yield of coupled product **3m** and recovered yield of starting material **1m** were then calculated (**Scheme S1**).

Scheme S1. GC-FID Chromatogram and Analytic Report of Crude Product.



$[1m]_0 = 0.039981$ M, $[2]_0 = 0.059988$ M

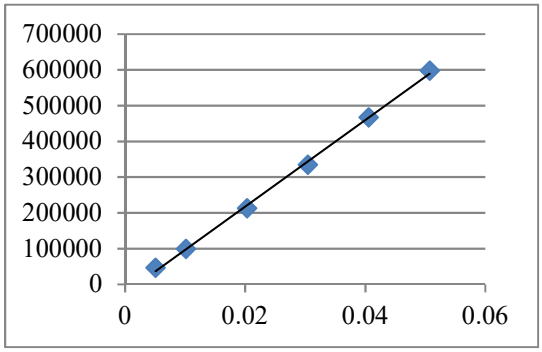
Peak#	Ret. Time	Area	Height	Conc. (M)	Name	Yield	
1	2.018	263507	162898	0.023790	1m	59.50%	
2	2.397	23098	14337	0.002235	biphenyl		
3	3.900	422461	207061	0.016584	3m	41.48%	
						100.98%	Total



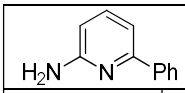
Chemical Formula: $C_5H_5ClN_2$
Molecular Weight: 128.56

Stock Solution in MeOH	Mass	Volume	Concentration
	0.0652 g	5 mL	0.1014 M

NO	Concentration (M)	Area	Retention Time (min)
1	0.0050716	46631.4	2.053
2	0.010143	99098.7	2.050
3	0.020286	212422.7	2.047
4	0.030429	334015.4	2.047
5	0.040572	466838.5	2.046
6	0.050716	597156.7	2.046



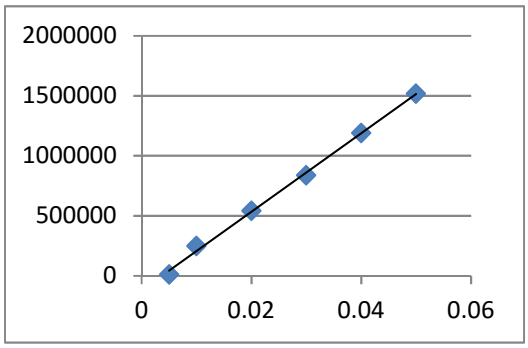
y = 12,094,437.636x – 24,217.495
(R^2 = 0.999)



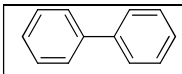
Chemical Formula: $C_{11}H_{10}N_2$
Molecular Weight: 170.21

Stock Solution in MeOH	Mass	Volume	Concentration
	0.0851 g	5 mL	0.09999 M

NO	Concentration (M)	Area	Retention Time (min)
1	0.0049994	10239.5	3.903
2	0.0099988	247880.3	3.888
3	0.019998	543523.0	3.882
4	0.029996	838553.7	3.882
5	0.039995	1191914.8	3.884
6	0.049994	1517516.2	3.886



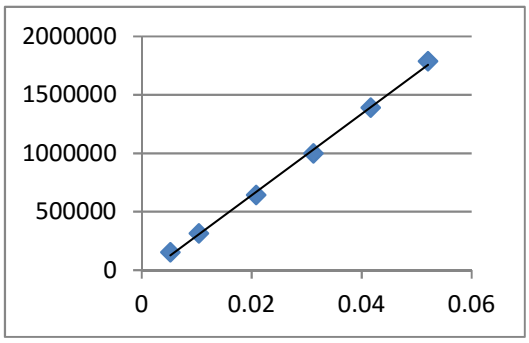
y = 32,712,290.490x – 120,030.296
(R^2 = 0.998)



Chemical Formula: $C_{12}H_{10}$
Molecular Weight: 154.21

Stock Solution in MeOH	Mass	Volume	Concentration
	0.0803 g	5 mL	0.1041 M

NO	Concentration (M)	Area	Retention Time (min)
1	0.0052072	154211.8	2.420
2	0.010414	315979.2	2.417
3	0.020829	642216.5	2.415
4	0.031243	998939.8	2.415
5	0.041657	1390222.5	2.415
6	0.052072	1789040.3	2.415



y = 34,807,666.401x – 54,689.770
(R^2 = 0.998)

Figure S3. Calibration curves for (a) 2-amino-6-chloropyridine (top); (b) 2-amino-6-phenylpyridine (middle); (c) biphenyl (bottom).

Supplemental Information S4

NMR Analysis

^{1}H NMR spectrum was used to determine amount of starting material and product in reaction mixtures after workup by comparison to authentic samples of each compound. The NMR yield was calculated according to the following:

$$Yield_{NMR} = \frac{I_{prod}}{I_{SM} + I_{prod}}$$

Where I_{prod}. and I_{SM} denote the area integrals of the product and starting material, respectively. The chemical shifts for each product and starting material were confirmed *via* prepared authentic samples and are consistent to reports in the literature.

For the model reaction between **1m** and **2**, the NMR sample was prepared from *ca* 50 mg of crude product and 0.5 – 0.6 mL of $CDCl_3$. The ^{1}H NMR (400 MHz) experiment was conducted on a Varian Mercury Vx 400 spectrometer; the spectrum is illustrated in **Figure S4**. The four dd peaks in the range of 6.3 – 7.1 ppm are attributed to the two H atoms on the pyridine moieties in starting material **1m** and products **3m**, respectively. The NMR yield of 40% was evaluated based on the area integrals of these peaks according to **the above equation**.

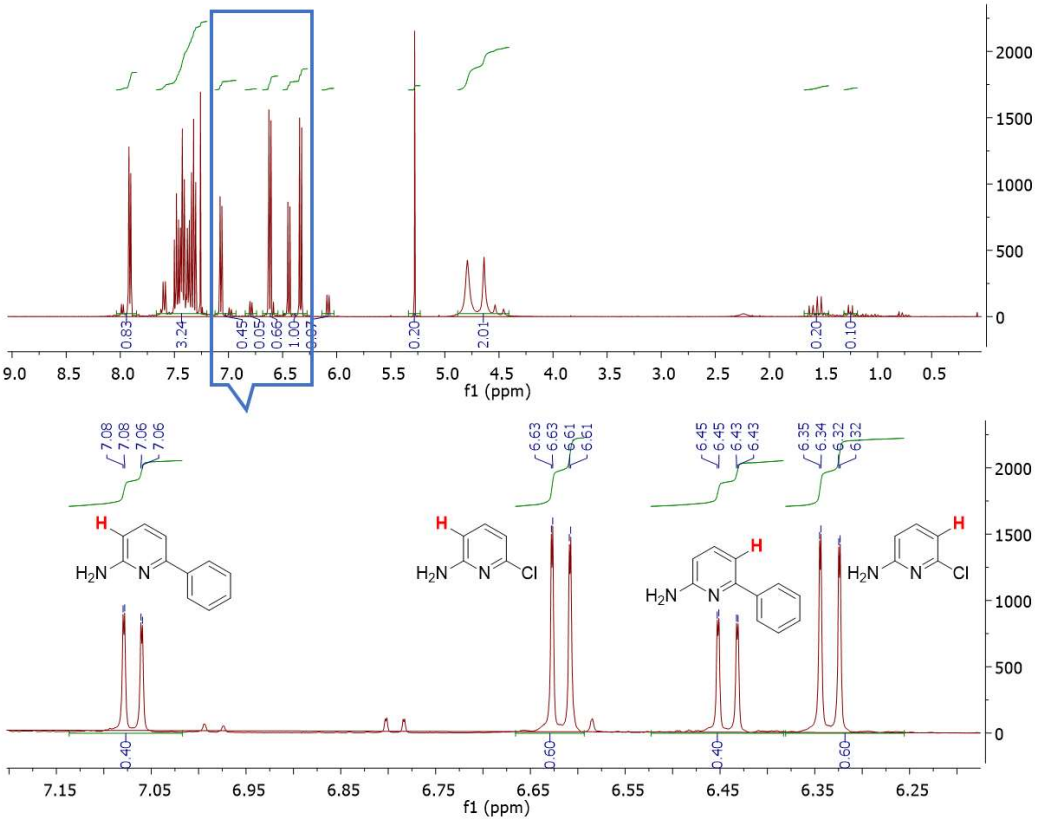


Figure S4. ^{1}H NMR (400 MHz) Spectrum of Crude Product in $CDCl_3$

Supplemental Information S5

Isolation of Product

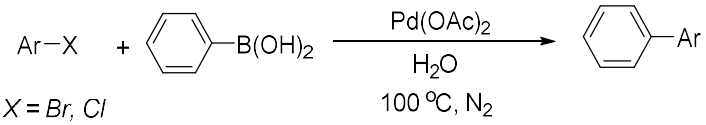
The crude product (including the used GC and NMR samples) was diluted by a small amount of CH_2Cl_2 (~3 mL) and added to a column packed with silica gel. A CH_2Cl_2/MeOH gradient was used. Biphenyl was removed first under 100% CH_2Cl_2. The MeOH concentration was gradually increased to 5% and then held at 5%. The unreacted **1m** and product **3m** were eluted successively. When the product had completely eluted from the column as indicated by TLC, the product fractions were combined and the solvent was removed *in vacuo* to yield 40% product as yellow solid (0.6804 g). The isolated product was characterized by m.p., ^{1}H NMR, ^{13}C NMR and MS, which are consistent to the literature reports.[1]

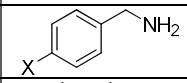
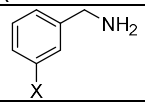
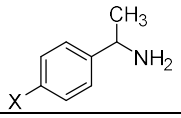
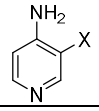
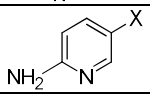
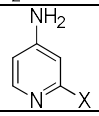
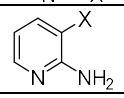
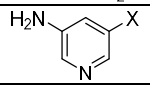
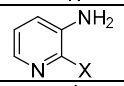
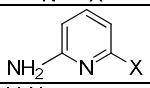
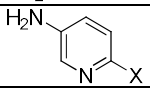
2-Amino-6-phenylpyridine (**3m**). CAS: 39774-25-9. Yellow solid. m.p.: 69-71 ºC (lit. 70-72 ºC) ^{1}H NMR (500 MHz, DMSO) δ 7.99 – 7.89 (m, 1H), 7.54 – 7.39 (m, 2H), 7.36 (dt, J = 9.4, 4.3 Hz, 1H), 7.04 (dd, J = 7.4, 0.7 Hz, 1H), 6.42 (dd, J = 8.2, 0.6 Hz, 1H), 5.97 (s, 1H). ^{13}C NMR (126 MHz, DMSO) δ 159.50, 154.27, 139.39, 137.91, 128.37, 128.33, 126.25, 108.22, 107.00. (**Figure S19**). MS (EI) m/z: Calcd for [M] $C_{11}H_{10}N_2$ 170.1; Found 170.1 (**Figure S49**).

[1] Darweesh, A. F.; Shaaban, M. R.; Farag, A. M.; Metz, P.; Dawood, K. M. *Synthesis* **2010**, *18*, 3163-3173.

Supplemental Information S6

Comparison of the yields determined by GC-FID and ^{1}H NMR for the arylbromides and aryl chlorides from **Table 1** in the main manuscript.

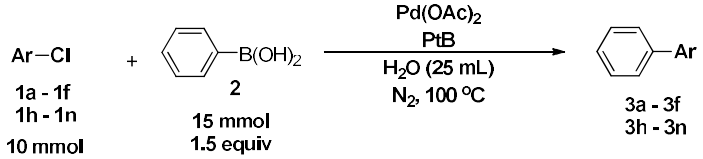


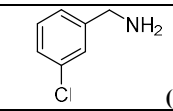
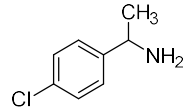
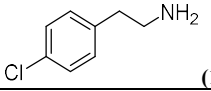
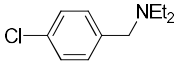
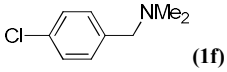
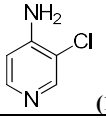
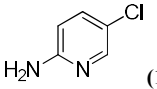
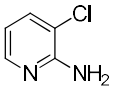
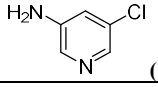
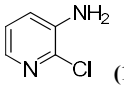
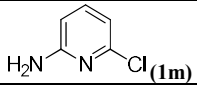
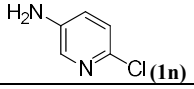
Entry	Ar-X	Time (h)	X = Br			X = Cl		
			Yield [b] (%)	Initial pH	Final pH	Yield [b] (%)	Initial pH	Final pH
1		4	**92 (92)**	9.2	2.5	**15 (11)**	9.3	7.6
2		4	**92 (91)**	9.2	3.1	**12 (10)**	9.4	7.4
3		4	**94 (95)**	9.3	1.5	**28 (23)**	9.0	7.2
4		4	**40 (37)**	7.9	6.0	**13 (14)**	7.8	6.4
5		4	**70 (71)**	7.4	4.1	**3 (2)**	7.0	4.7
6		**1**	**100 (100)** **100 (100)[c]**	**6.5**	**2.3**	**100 (100)** **62 (60)[c]**	**6.3**	**2.5**
7		4	**81 (83)**	5.6	4.4	**4 (<1)**	6.6	5.4
8		4	**56 (57)**	5.8	3.1	**5 (<1)**	5.5	4.7
9		4	**82 (81)**	4.8	2.6	**25 (23)**	5.3	2.5
10		4	**94 (93)**	4.6	2.7	**27 (25)**	5.1	3.1
11		4	**44 (39)**	4.6	2.7	**5 (4)**	5.1	3.5

[a] Reaction conditions: Ar-X (10 mmol), $PhB(OH)_2$ (15 mmol), $Pd(OAc)_2$ (4 mol%), H_2O (25 mL), N_2, 100 °C. Yields were determined by both GC-FID and ^{1}H NMR (Supplemental Information S3 and S4). [b] GC Yield (NMR Yield), average of 2-3 repetitions with an error < 5%. [c] 2 mol% $Pd(OAc)_2$, 30 minutes.

Supplemental Information S7

Comparison of the yields determined by GC-FID and ^{1}H NMR for the aryl chlorides from **Table 3** in the main manuscript.

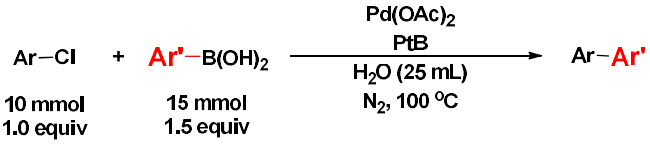


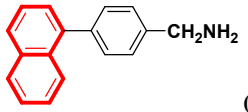
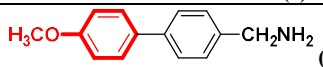
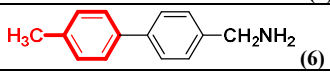
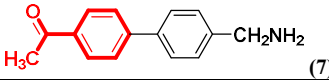
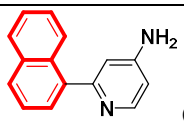
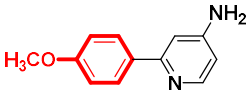
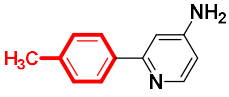
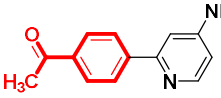
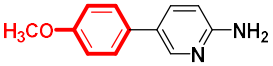
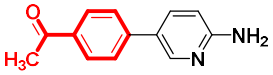
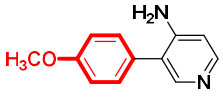
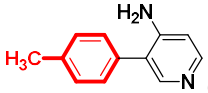
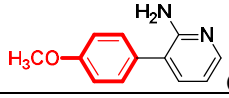
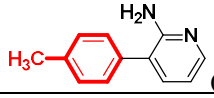
Entry	Ar-Cl	pK_a (Cl-ArH$^+$)[c]	Pd(OAc)$_2$ (mol%)	PtB (mol%)	Time (h)	Yield (%)[b]	pH initial	pH final
1	 **(1b)**	9.2	1	1	4	**95 (96)**	9.6	3.5
2	 **(1c)**	9.5	1	1	4	**95 (94)**	9.3	2.4
3	 **(1d)**	9.8	1	1	4	**95 (95)**	9.1	2.4
4	 **(1e)**	9.2	2	2	4	**97 (94)**	8.1	2.5
5			1	1	2	**46 (45)**	8.1	6.0
6	 **(1f)**	8.7	2	2	4	**83 (81)**	8.1	5.3
7			4	4	4	**79 (80)**	8.2	5.5
8			2	2	4	**74 (70)**	7.8	5.4
9	 **(1h)**	7.2	4	4	4	**95 (92)**	7.8	4.1
10			1	2	4	**90 (97)**	6.0	3.7
11	 **(1i)**	4.8	2	2	4	**75 (76)**	6.1	3.8
12			4	4	4	**88 (92)**	6.0	3.8
13			1	2	4	**70 (68)**	6.6	3.9
14	 **(1j)**	5.1	2	2	4	**64 (64)**	6.6	4.2
15			4	4	4	**92 (97)**	6.5	2.8
16			2	2	4	**65 (67)**	5.4	3.2
17	 **(1k)**	3.8	4	4	4	**90 (89)**	5.3	2.1
18			2	2	4	**28 (27)**	5.3	1.9
19	 **(1l)**	1.6	2	2	24	**44 (46)**	5.3	1.8
20			4	4	4	**38 (39)**	5.3	2.1
21		2.9	2	2	4	**41 (40)**	4.8	2.8
22	 **(1m)**		4	4	4	**62 (64)**	4.8	2.4
23		1.5	2	2	4	**17 (19)**	5.1	3.0
24	 **(1n)**		4	4	4	**25 (18)**	5.1	3.1

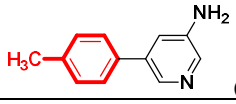
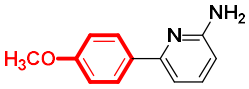
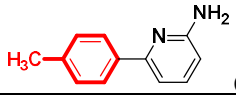
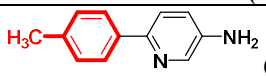
[a] Reaction conditions: Ar-Cl (10 mmol), PhB(OH)$_2$ (15 mmol), H_2O (25 mL), N_2, 100 °C. Yields were determined by both GC-FID and ^{1}H NMR (Supplemental Information S3 and S4). [b] GC Yield (NMR Yield), average of 2-3 repetitions with an error < 5%. [c] https://epoch.uky.edu/ace/public/pKa.jsp.

Supplemental Information S8

Comparison of the yields determined by GC-FID and ^{1}H NMR for the arylboronic acids from **Table 5** in the main manuscript.



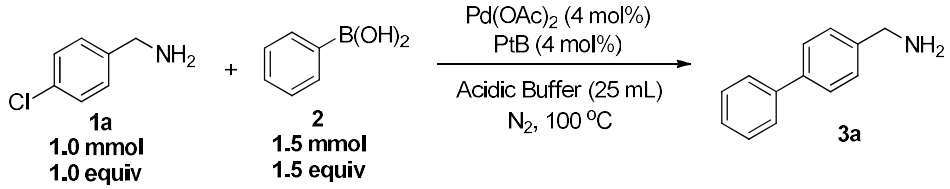
Entry	Product	Pd(OAc)$_2$ (mol%)	PtB (mol%)	Time (h)	GC Yield (%)	pH initial	pH final
1	 (4)	1	1	4	**99 (95)**	8.3	2.5
2	 (5)	1	1	4	**99[c](90)**	8.5	2.5
3	 (6)	1	1	4	**87[c](88)**	8.6	4.1
4	 (7)	1	1	4	**91[c](96)**	7.8	2.1
5	 (8)	4	0	2	**100 (100)**	7.1	3.3
6	 (9)	4	0	4	**84 (82)**	7.4	4.7
7	 (10)	4	0	2	**100 (100)**	6.7	2.7
8	 (11)	4	0	2	**100 (100)**	6.6	2.3
9	 (12)	2	2	4	**86 (92)**	6.5	4.0
10	 (13)	4	4	4	**85 (90)**	6.2	3.4
11	 (14)	4	4	4	**92 (88)**	7.9	3.6
12	 (15)	4	4	4	**88 (83)**	7.9	4.1
13	 (16)	4	4	4	**89 (92)**	6.6	3.3
14	 (17)	4	4	4	**82 (85)**	6.3	3.5

15	 **(18)**	4	4	4	**90 (90)**	5.5	2.2
16	 **(19)**	4	4	4	**65 (65)**	5.6	2.5
17	 **(20)**	4	4	4	**67 (68)**	5.4	2.1
18	 **(21)**	4	4	4	**41 (41)**	5.4	2.9

[a] Reaction conditions: Ar-Cl (10 mmol), **Ar'**B(OH)$_2$ (15 mmol), H_2O (25 mL), N_2, 100 °C. Yields were determined by both GC-FID and ^{1}H NMR (Supplemental Information S3 and S4). [b] GC Yield (NMR Yield), average of 2-3 repetitions with an error < 5%.[c] GC yield was evaluated basing on the conversion of reactants Ar-Cl due to the lack of product standards.

Supplemental Information S9

Suzuki Reactions in Buffered Acidic Media: The $Pd(OAc)_2$–PtB catalyzed Suzuki reaction of 4-chlorobenzyl amine with $PhB(OH)_2$ in phosphate-buffered acidic solutions.[a]

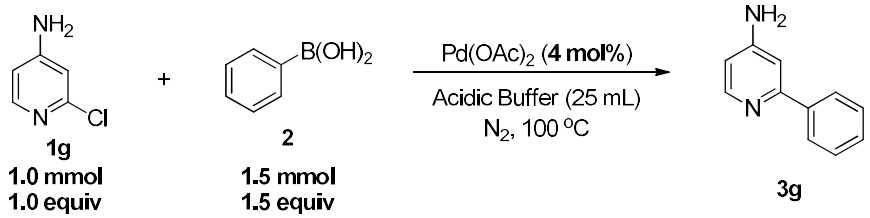


Entry	Buffer pH	Time (h)	GC Yield (%)[b]	Initial pH	Final pH
1	**6.0**	0.5	53	6.1	6.1
2	**6.0**	1	64	6.0	6.0
3	**6.0**	2	82	5.9	5.9
4	**6.0**	3	82	6.0	5.9
5	**6.0**	4	82	6.0	5.9
6	**5.0**	0.5	10	5.0	5.1
7	**5.0**	1	12	5.1	5.1
8	**5.0**	2	24	5.0	5.0
9	**5.0**	3	23	4.8	4.9
10	**5.0**	4	30	5.0	4.9

[a] Reaction conditions: **1a** (1.0 mmol), **2** (1.5 mmol), $Pd(OAc)_2$ (0.04 mmol), PtB (0.04 mmol), acidic buffer (25 mL), N_2, 100 °C. [b] Average of 2-3 repetitions with an error < 5%.

Supplemental Information S10

The Ligand-free $Pd(OAc)_2$ catalyzed Suzuki reaction of 4-amino-2-chloropyridine with $PhB(OH)_2$ in phosphate-buffered acidic solutions.[a]

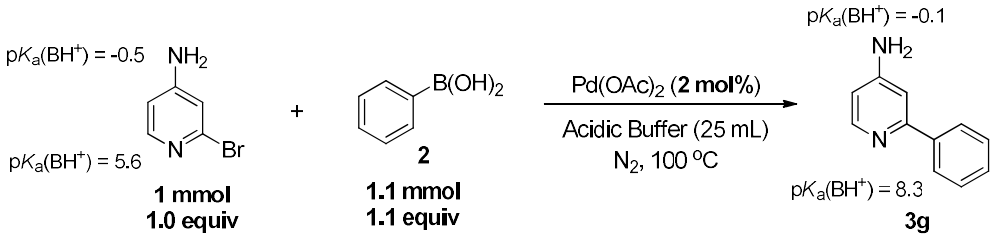


Buffer pH	Time (h)	NMR Yield (%)[b]	Initial pH	Final pH
7.0	1	45	7.0	7.0
	4	61	7.1	7.0
6.5	1	56	6.6	6.6
	4	64	6.7	6.6
6.0	1	70	6.1	6.1
	4	72	6.1	6.0
5.6	1	74	5.7	5.6
	2	76	5.8	5.6
	4	72	5.7	5.6
5.2	1	69	5.4	5.2
	4	90	5.5	5.2
4.5	1	85	5.1	4.5
	2	91	5.1	4.6
	3	98	5.2	4.6
	4	100	5.1	4.4
3.5	1	93	4.0	3.5
	4	100	4.0	3.4
3.1	1	16	3.4	3.3
	4	46	3.4	3.3
2.6	1	17	2.8	2.6
	4	56	2.6	2.5
2.0	1	38	2.2	2.0
	4	59	2.0	2.0
1.5	1	53	1.5	1.5
	4	59	1.6	1.5
1.3	1	33	1.2	1.2
	4	58	1.3	1.2
1.1	1	12	1.1	1.1
	4	36	1.0	1.0
0.7	1	11	0.8	0.7
	4	12	0.7	0.7

[a] Reaction conditions: **1g** (1.0 mmol), **2** (1.5 mmol), $Pd(OAc)_2$ (0.04 mmol), acidic buffer (25 mL), N_2, 100 °C. [b] Average of 2-3 repetitions with an error < 5%.

Supplemental Information S11

The ligand-free $Pd(OAc)_2$ catalyzed Suzuki reaction of 4-amino-2-bromopyridine with $PhB(OH)_2$ in phosphate-buffer acidic solutions.[a]



Buffer pH	Time (h)	GC Yield (%)[b]	Initial pH	Final pH
7.0	1	55	6.9	7.0
	2	59	6.9	7.0
	3	60	7.0	7.0
6.5	1	57	6.6	6.5
	3	63	6.5	6.5
6.0	1	75	6.0	5.9
	2	80	6.0	6.0
	3	78	6.0	5.9
5.6	1	79	5.6	5.5
	3	93	5.6	5.5
5.2	1	89	5.4	5.2
	2	97	5.4	5.1
	3	99	5.5	5.2
4.5	1	100	5.0	4.3
3.5	1	100	3.5	3.4
3.1	1	100	3.3	3.0
2.6	1	100	2.7	2.6
2.0	1	100	2.1	2.0
1.5	1	70	1.6	1.5
	2	97	1.5	1.5
	3	100	1.5	1.3
1.3	1	42	1.3	1.3
	3	70	1.3	1.2
1.1	1	10	1.1	1.0
	2	17	1.1	1.1
	3	35	1.1	1.0
0.7	1	1	0.7	0.7
	3	4	0.7	0.6

[a] Reaction conditions: 4-amino-2-bromopyridine (1.0 mmol), $PhB(OH)_2$ (1.1 mmol), $Pd(OAc)_2$ (0.02 mmol), acidic buffer (25 mL), N_2, 100 °C. [b] Average of 2-3 repetitions with an error < 5%.

Supplemental Information S12

^{1}H and ^{13}C NMR Spectra of Synthesized Compounds and Isolated Products

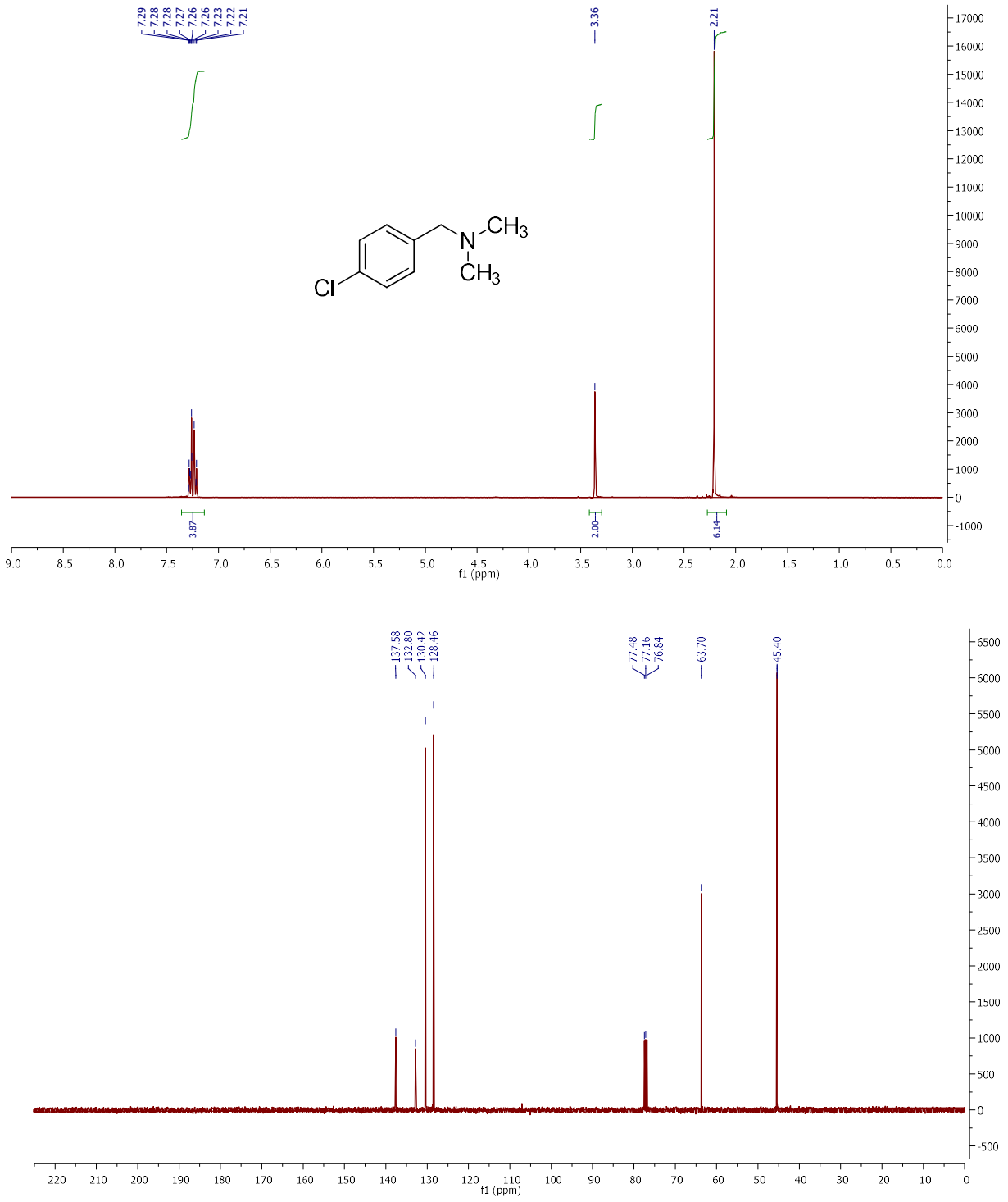


Figure S5. ^{1}H NMR (400 MHz) and ^{13}C NMR (101 MHz) spectra of 4-chloro-*N*,*N*-dimethylbenzylamine (**1f**) in $CDCl_3$.

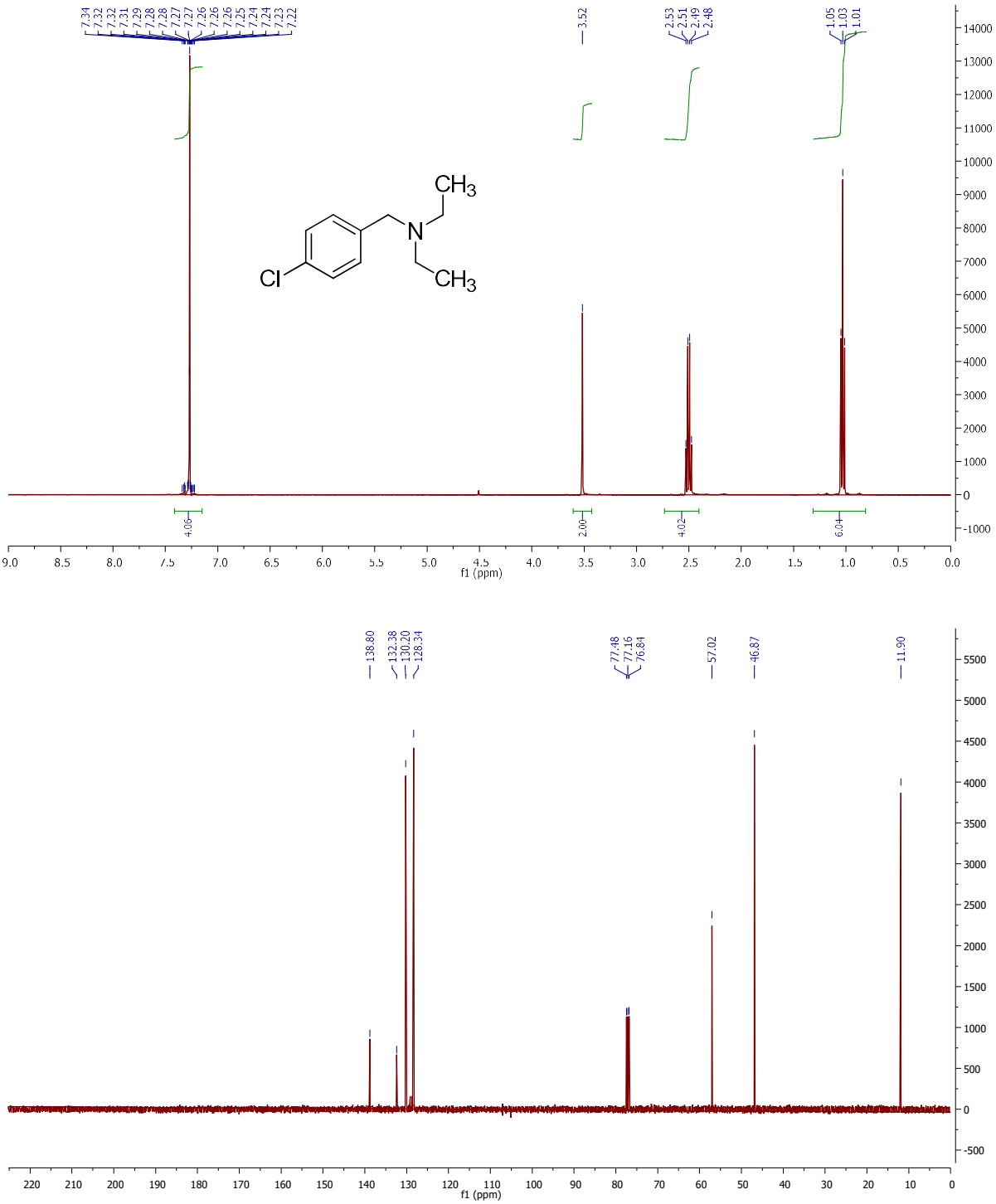


Figure S6. ^{1}H NMR (400 MHz) and ^{13}C NMR (101 MHz) spectra of 4-chloro-*N*,*N*-diethylbenzylamine (**1e**) in $CDCl_3$.

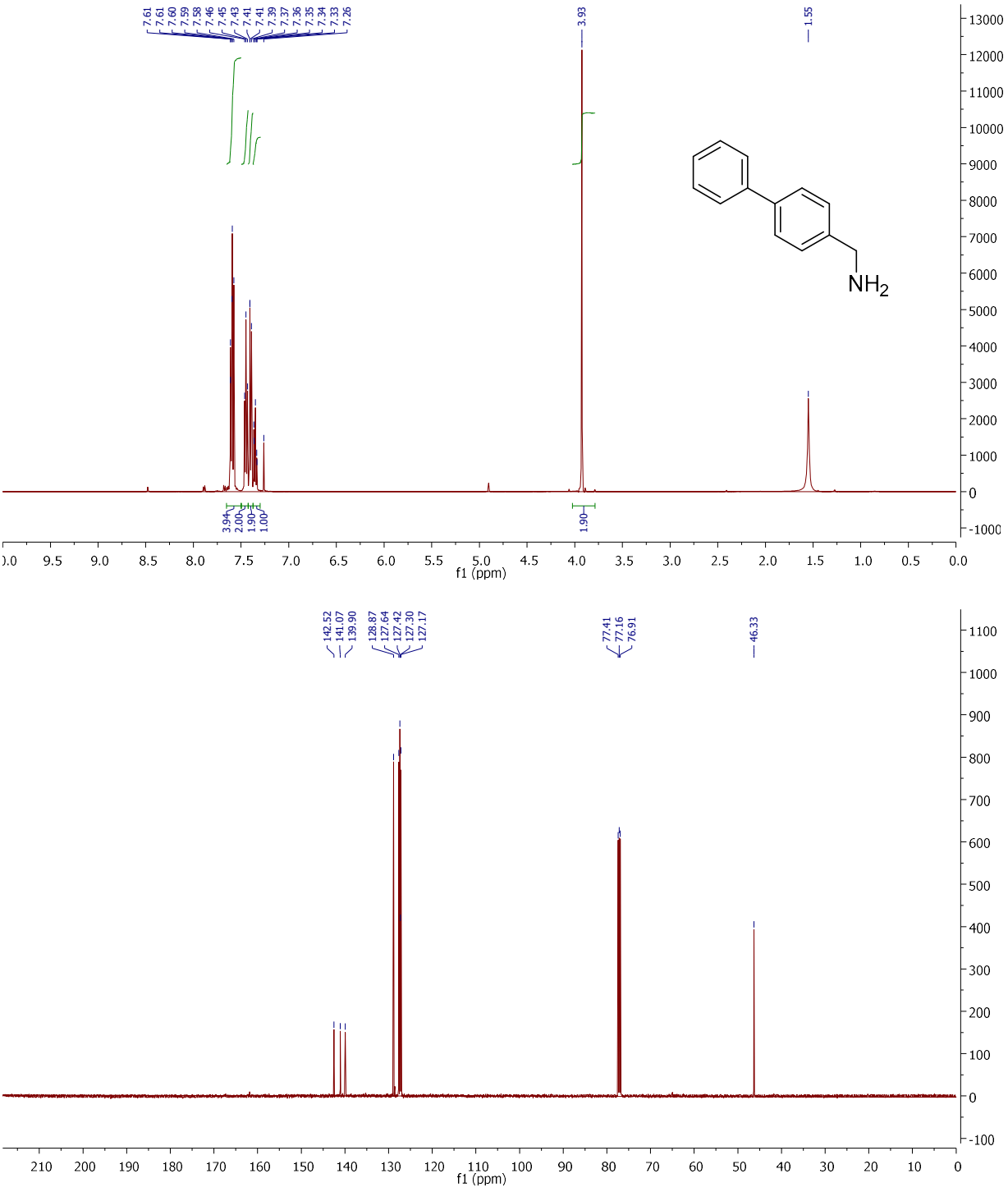


Figure S7. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 4-phenylbenzylamine (**3a**) in $CDCl_3$.

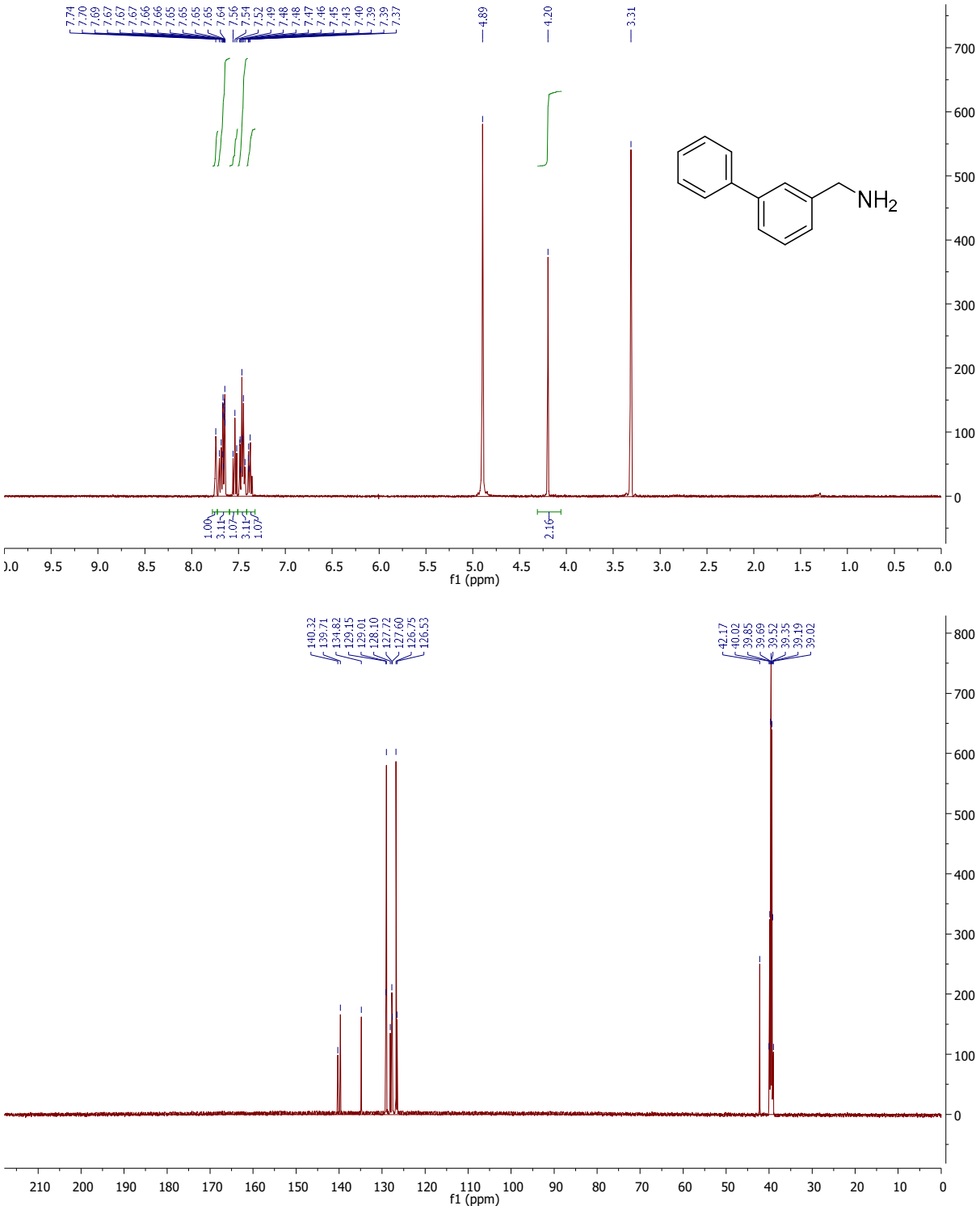


Figure S8. ^{1}H NMR (400 MHz, in CD_3OD) and ^{13}C NMR (126 MHz, in DMSO) spectra of 3-phenylbenzylamine (**3b**).

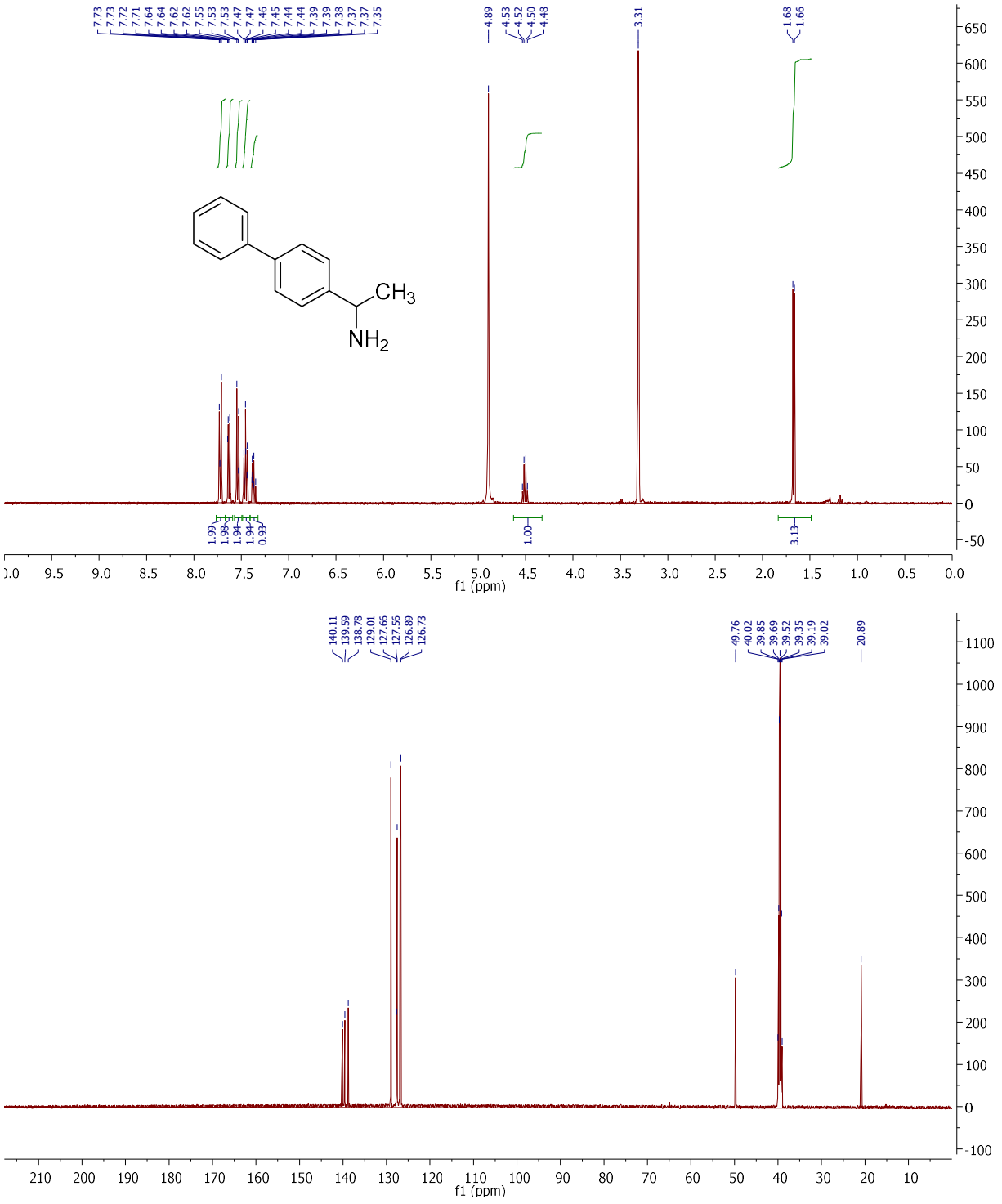


Figure S9. ^{1}H NMR (400 MHz, in CD_3OD) and ^{13}C NMR (126 MHz, in DMSO) spectra of 1-biphenyl-4-yl-ethylamine (**3c**).

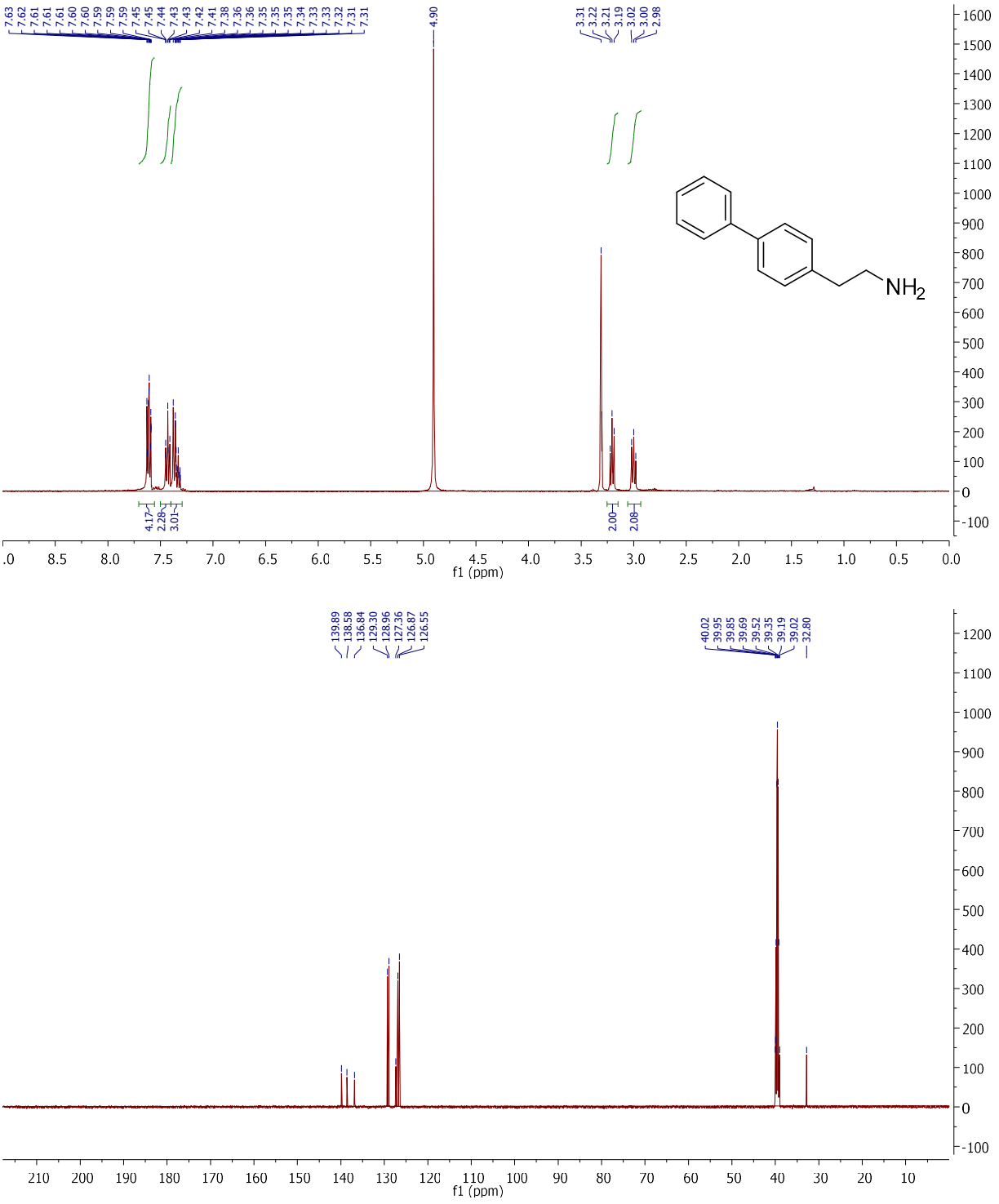


Figure S10. ^{1}H NMR (400 MHz, in CD_3OD) and ^{13}C NMR (126 MHz, in DMSO) spectra of 2-biphenyl-4-yl-ethylamine (**3d**).

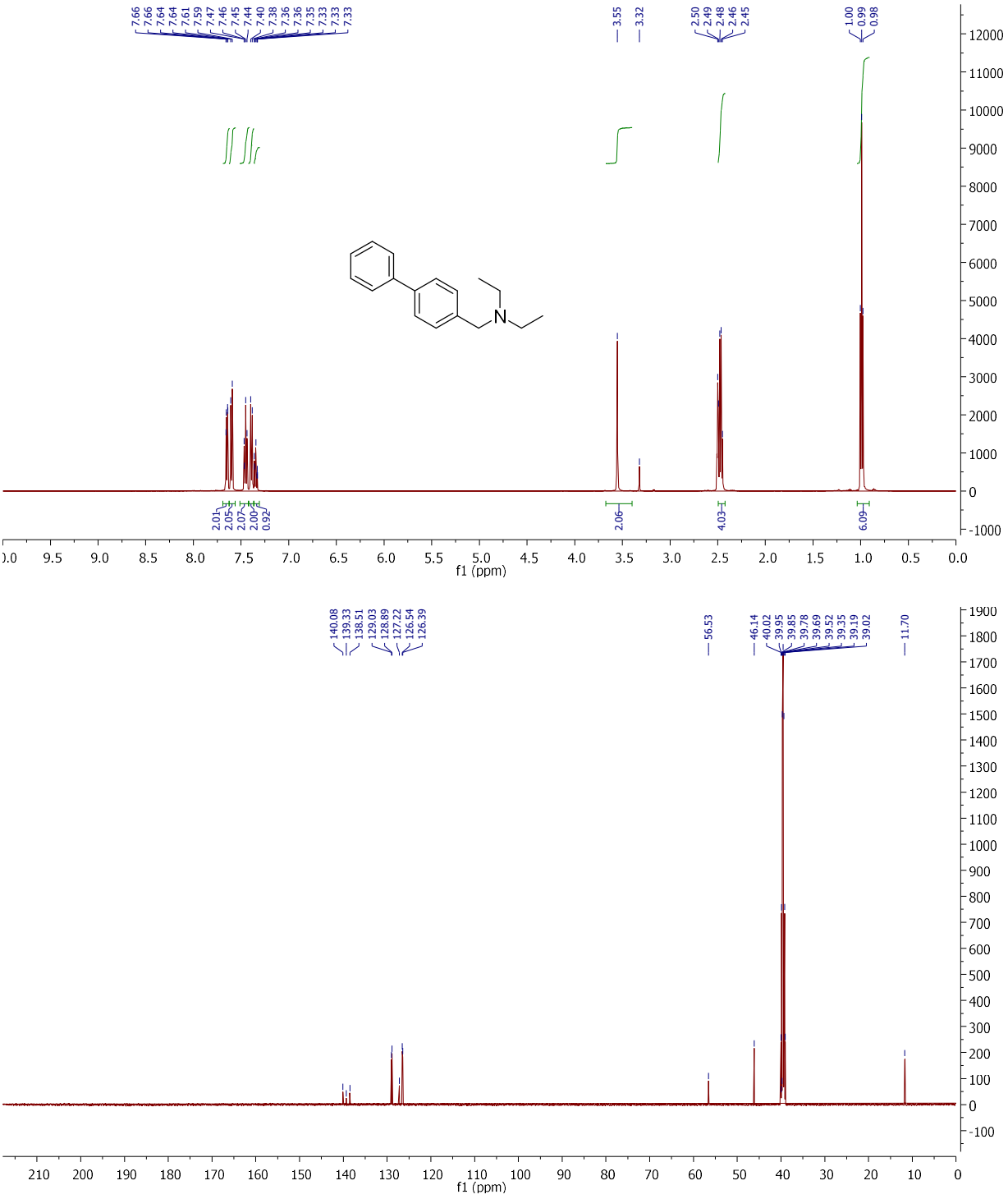


Figure S11. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 4-phenyl-*N*,*N*-diethylbenzylamine (**3e**) in DMSO.

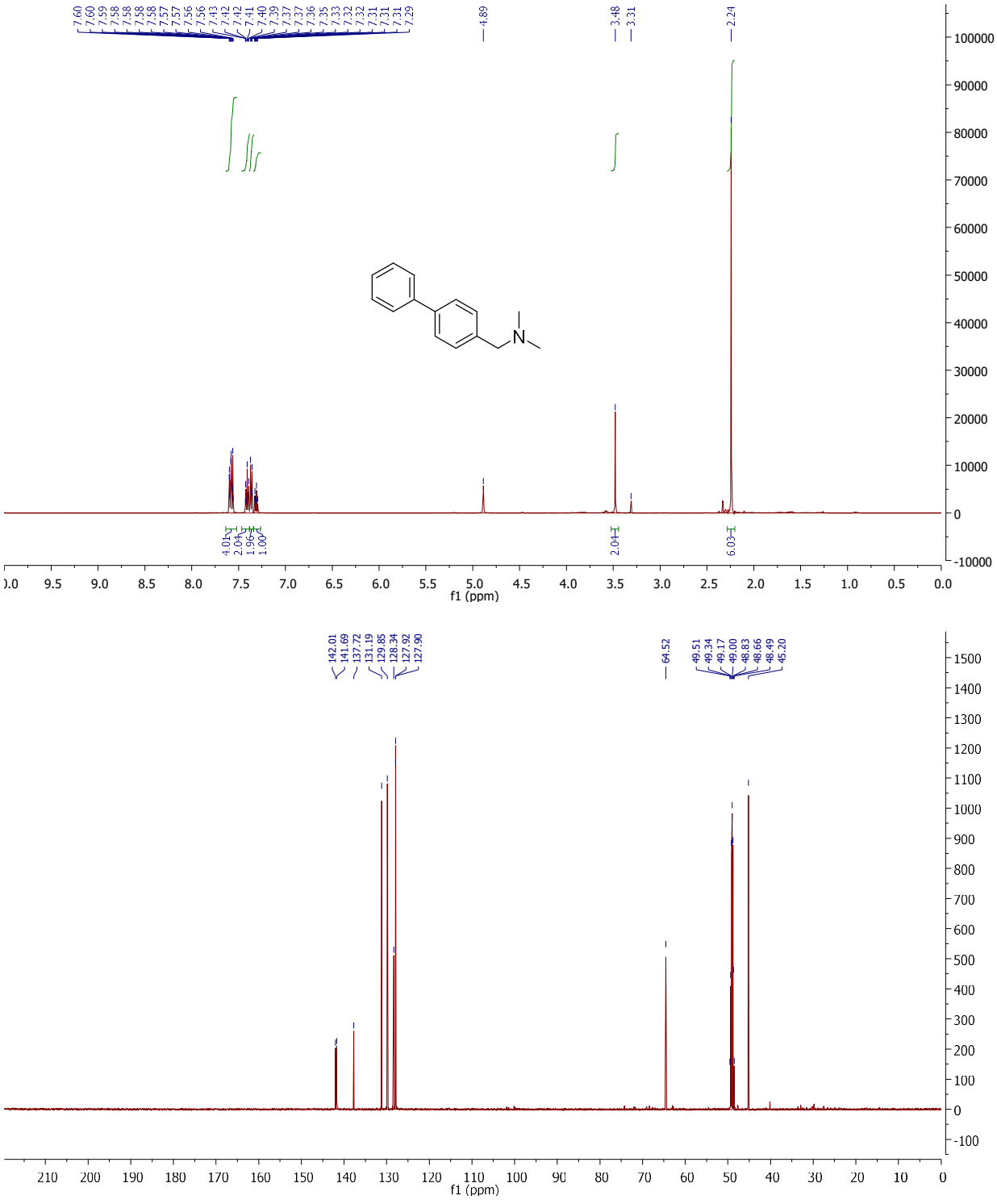


Figure S12. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 4-phenyl-*N*,*N*-dimethylbenzylamine (**3f**) in CD_3OD.

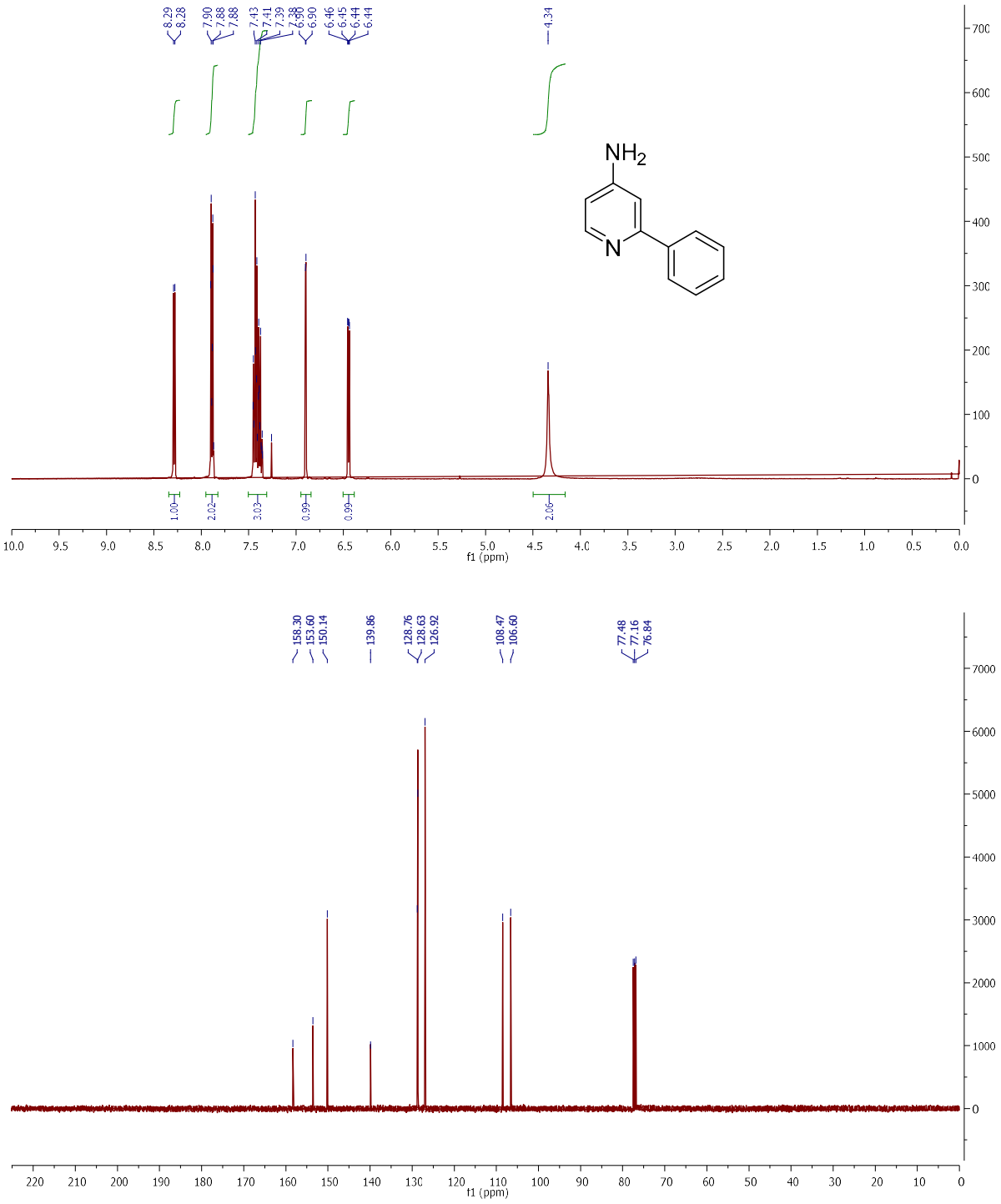


Figure S13. ^{1}H NMR (400 MHz) and ^{13}C NMR (101 MHz) spectra of 4-amino-2-phenylpyridine (**3g**) in $CDCl_3$.

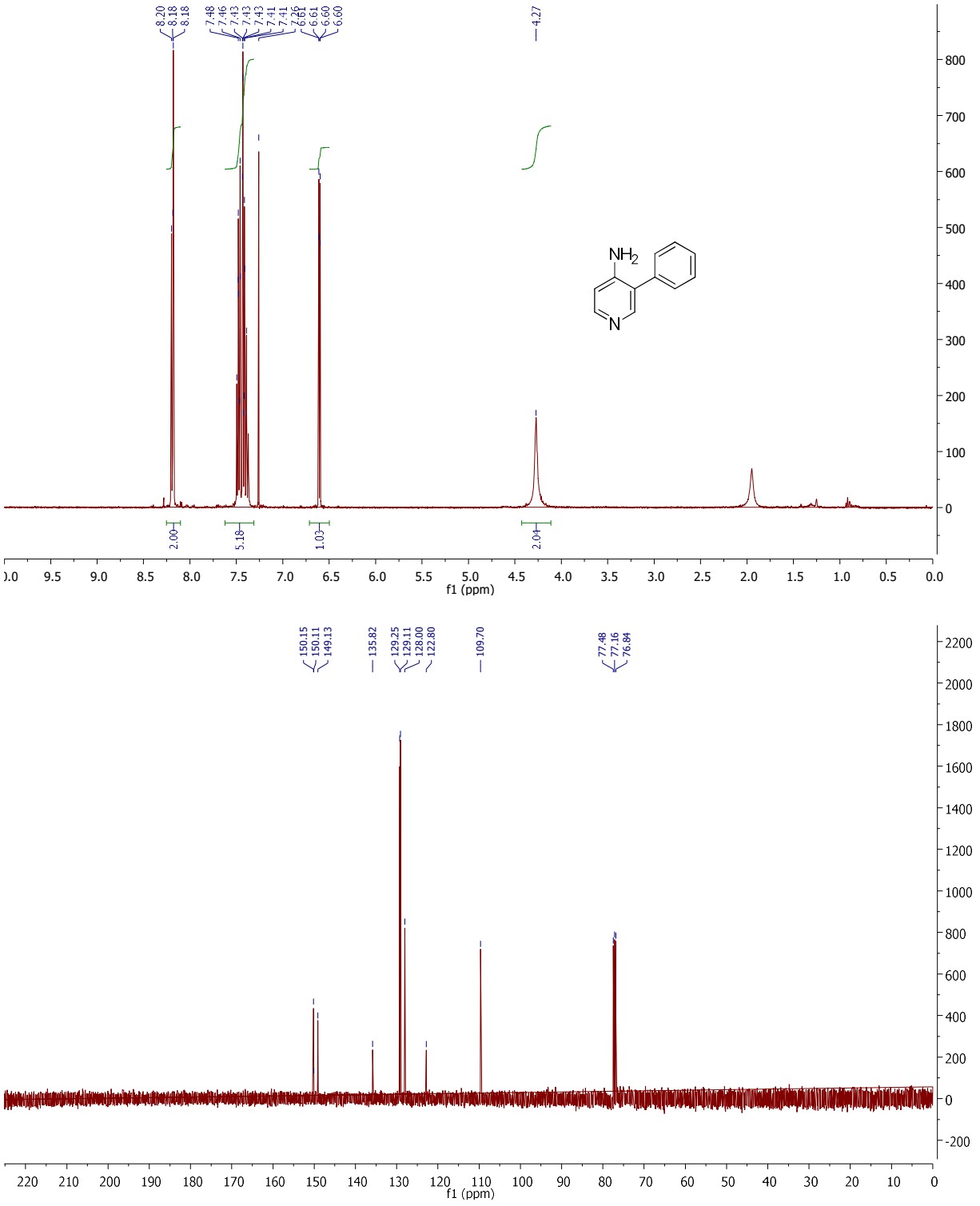


Figure S14. ^{1}H NMR (400 MHz) and ^{13}C NMR (101 MHz) spectra of 4-amino-3-phenylpyridine (**3h**) in $CDCl_3$.

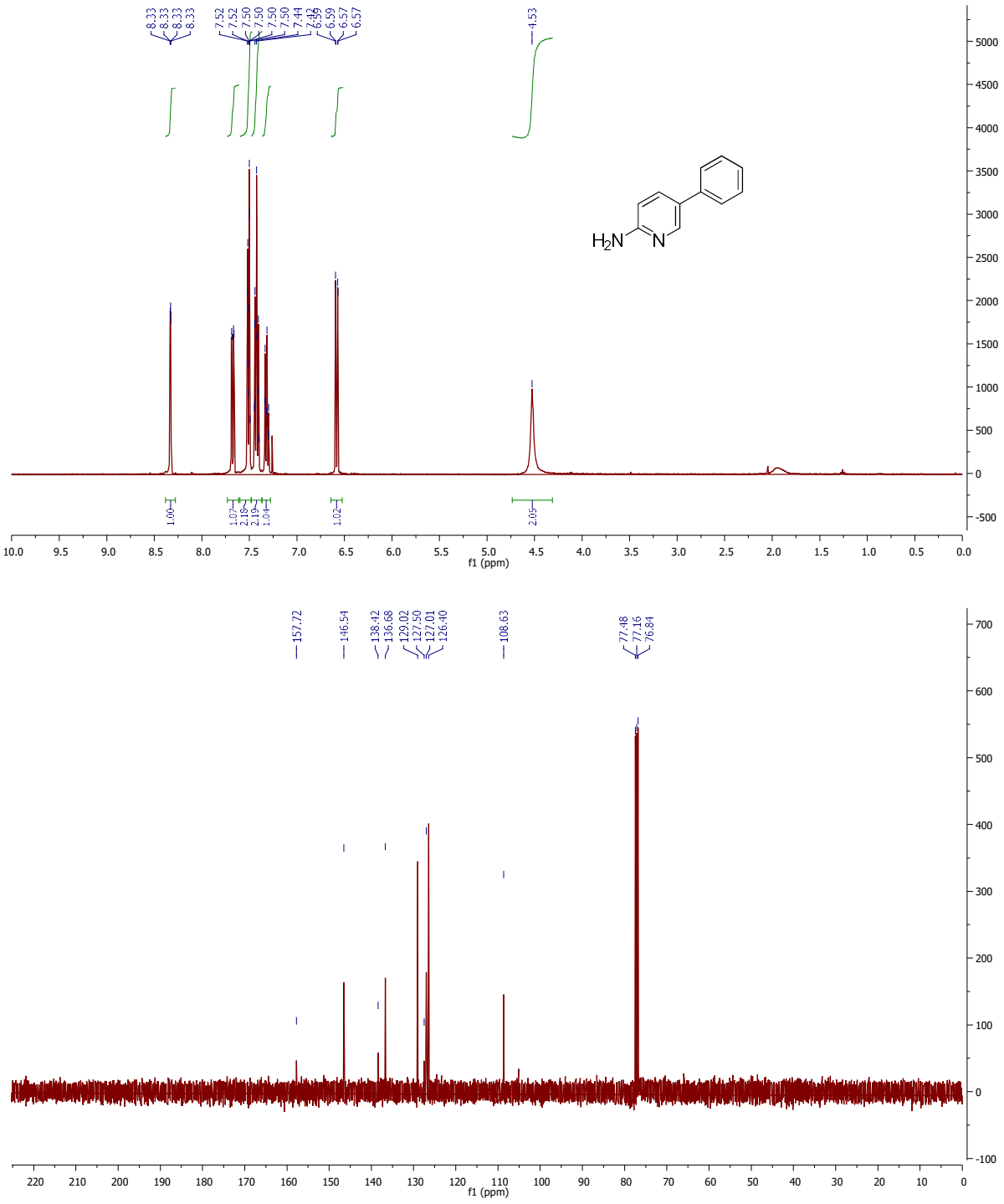


Figure S15. ^{1}H NMR (400 MHz) and ^{13}C NMR (101 MHz) spectra of 2-amino-5-phenylpyridine (**3i**) in $CDCl_3$.

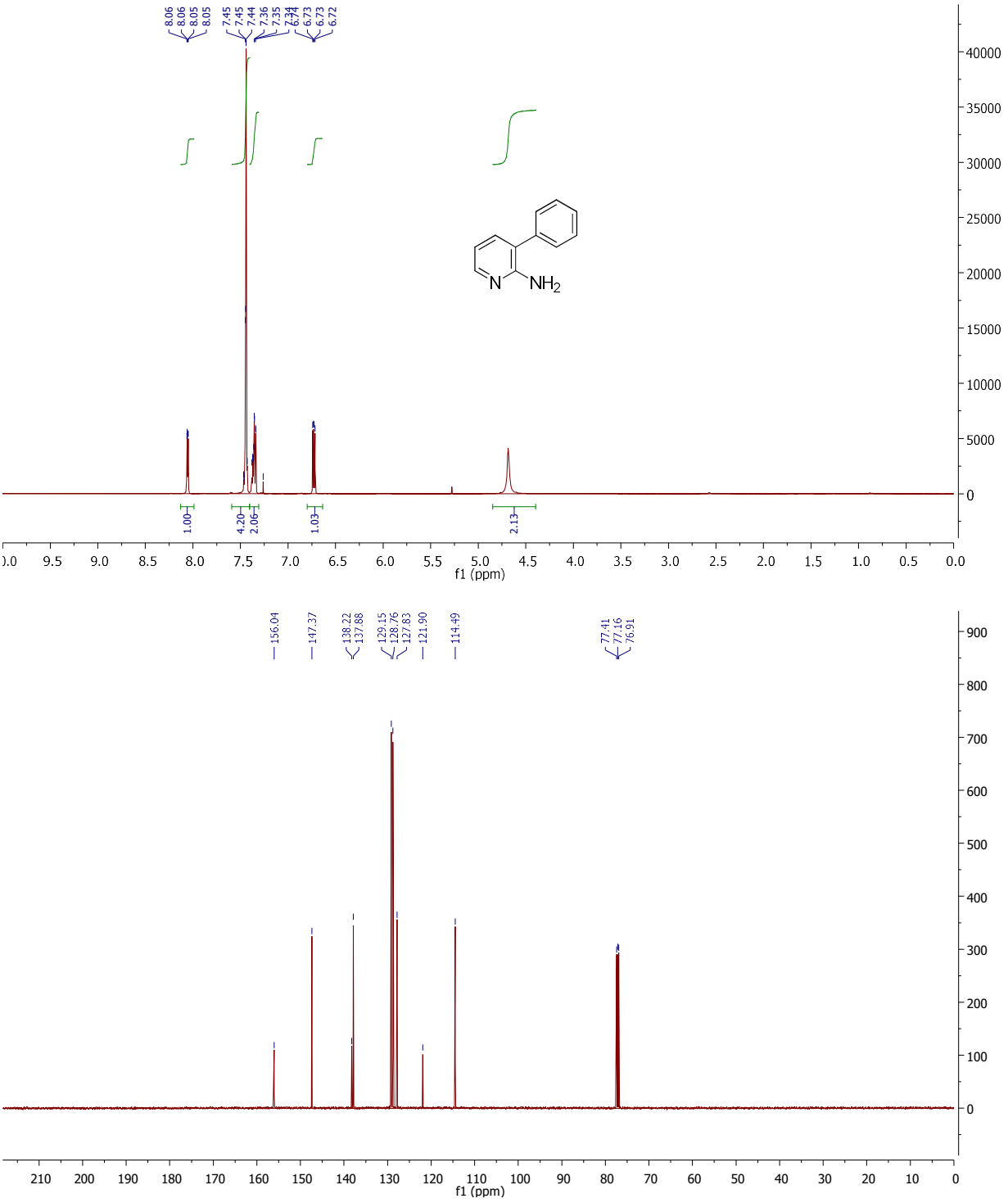


Figure S16. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 2-amino-3-phenylpyridine (**3j**) in $CDCl_3$.

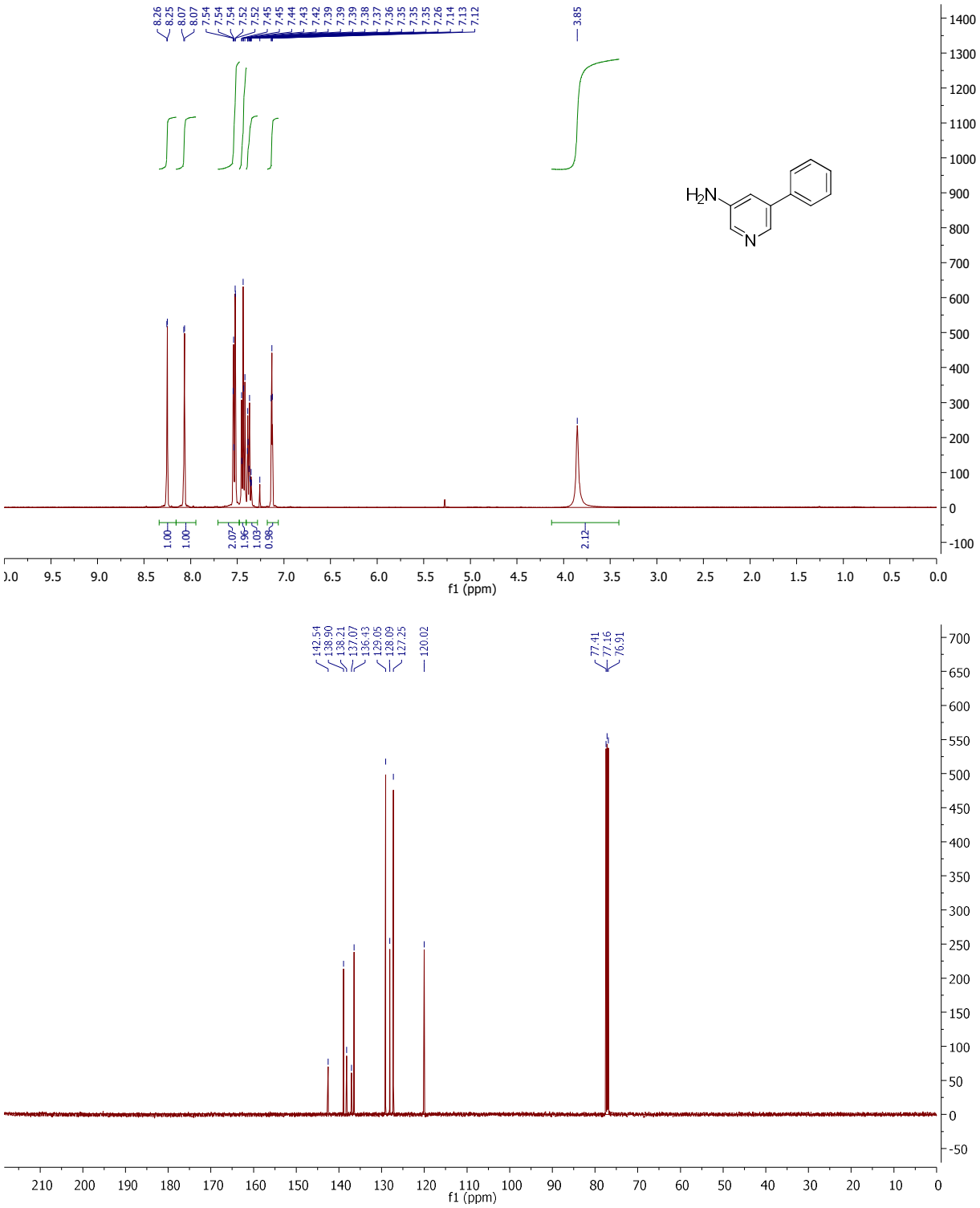


Figure S17. ^{1}H NMR (400 MHz) and ^{13}C NMR (126 MHz) spectra of 3-amino-5-phenylpyridine (**3k**) in $CDCl_3$.

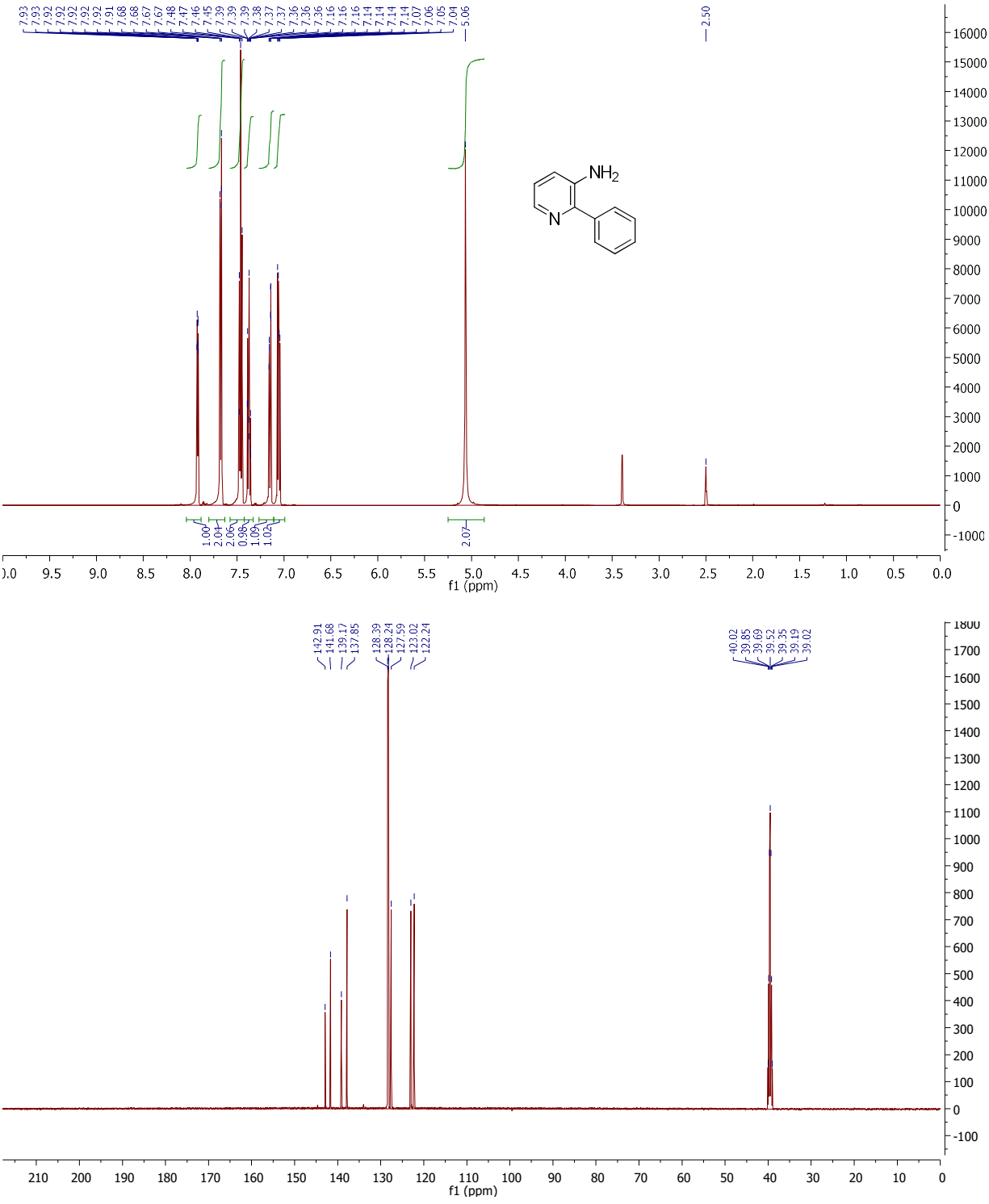


Figure S18. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 3-amino-2-phenylpyridine (**3l**) in DMSO.

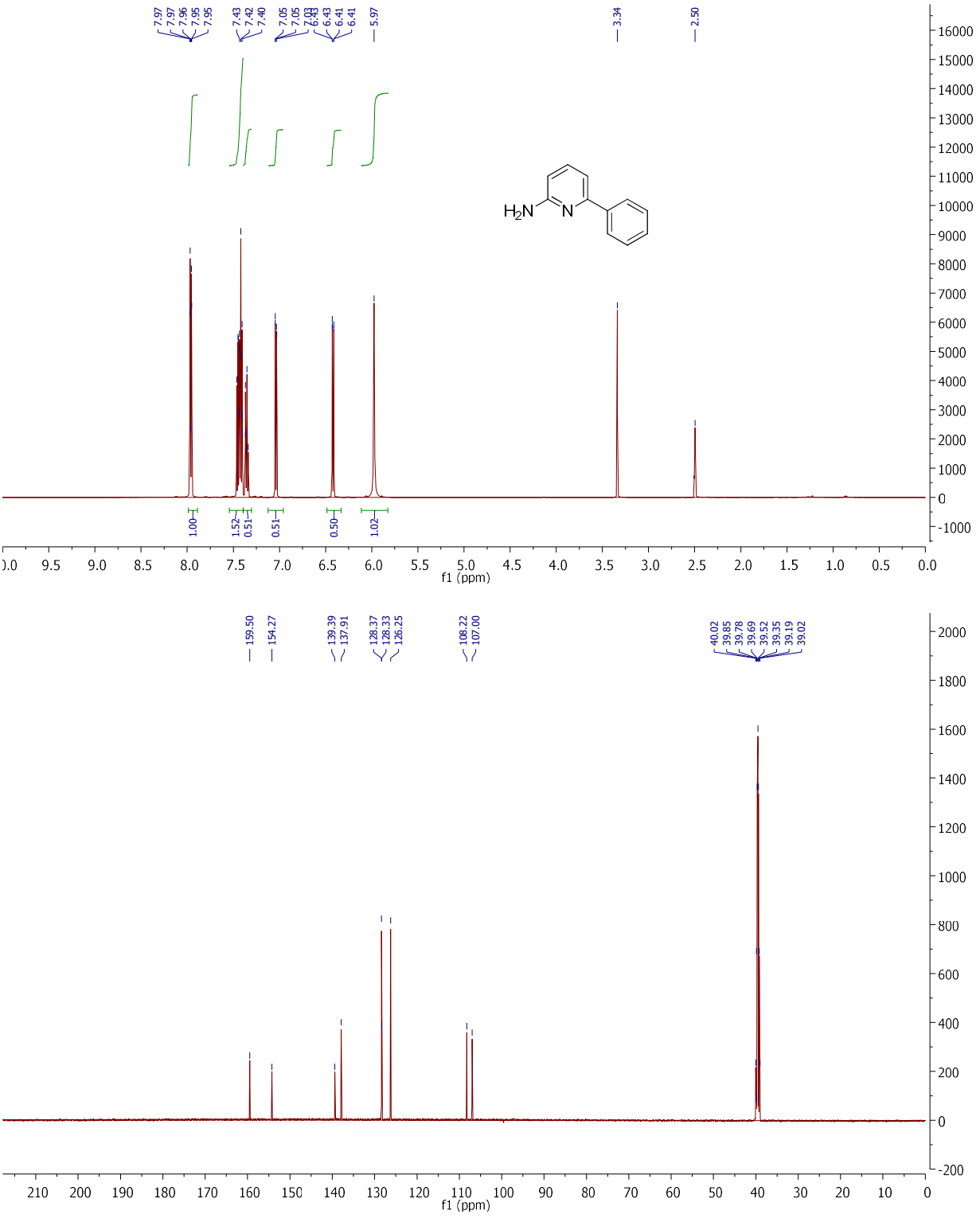


Figure S19. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 2-amino-6-phenylpyridine (**3m**) in DMSO.

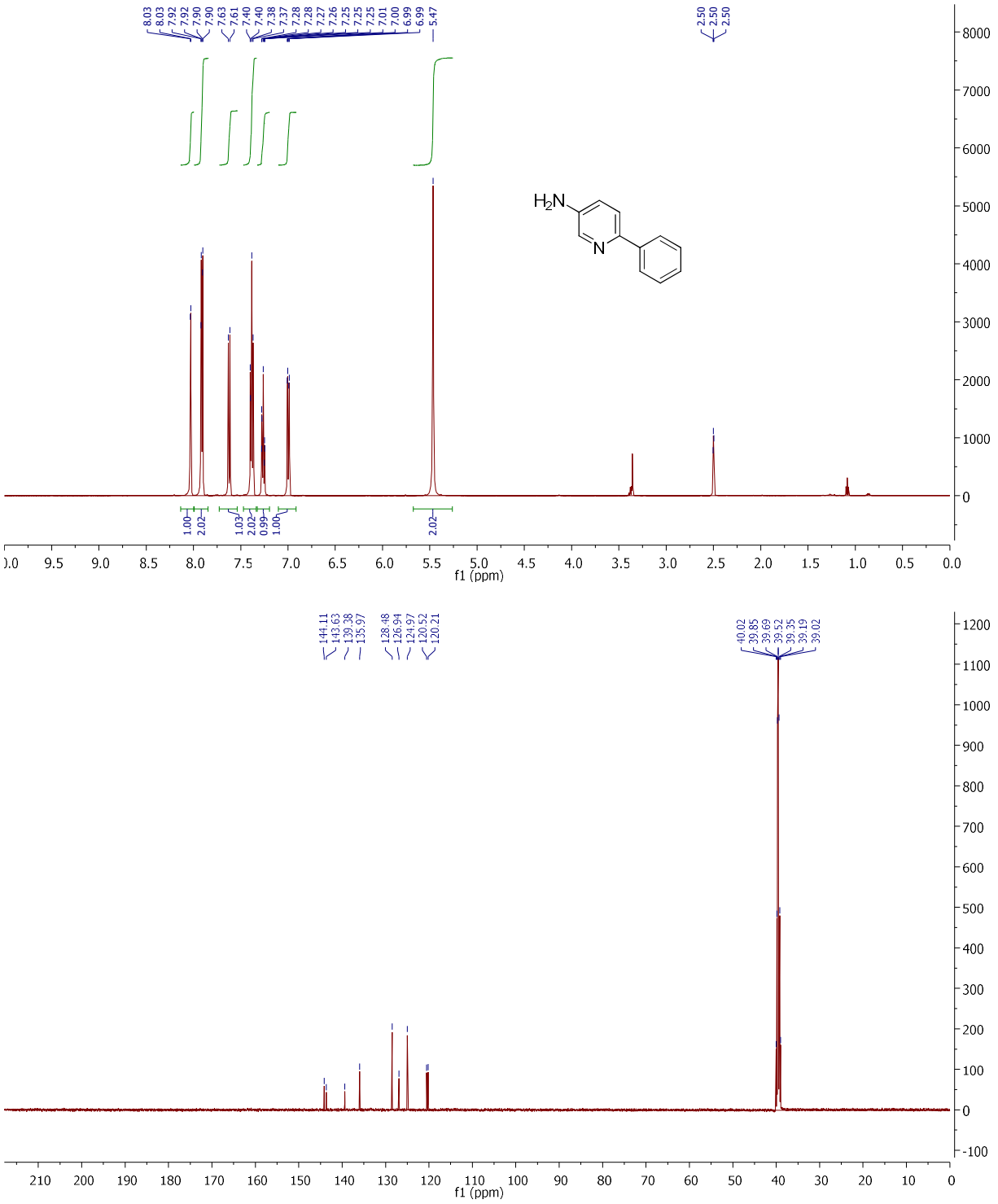


Figure S20. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 3-amino-6-phenylpyridine (**3n**) in DMSO

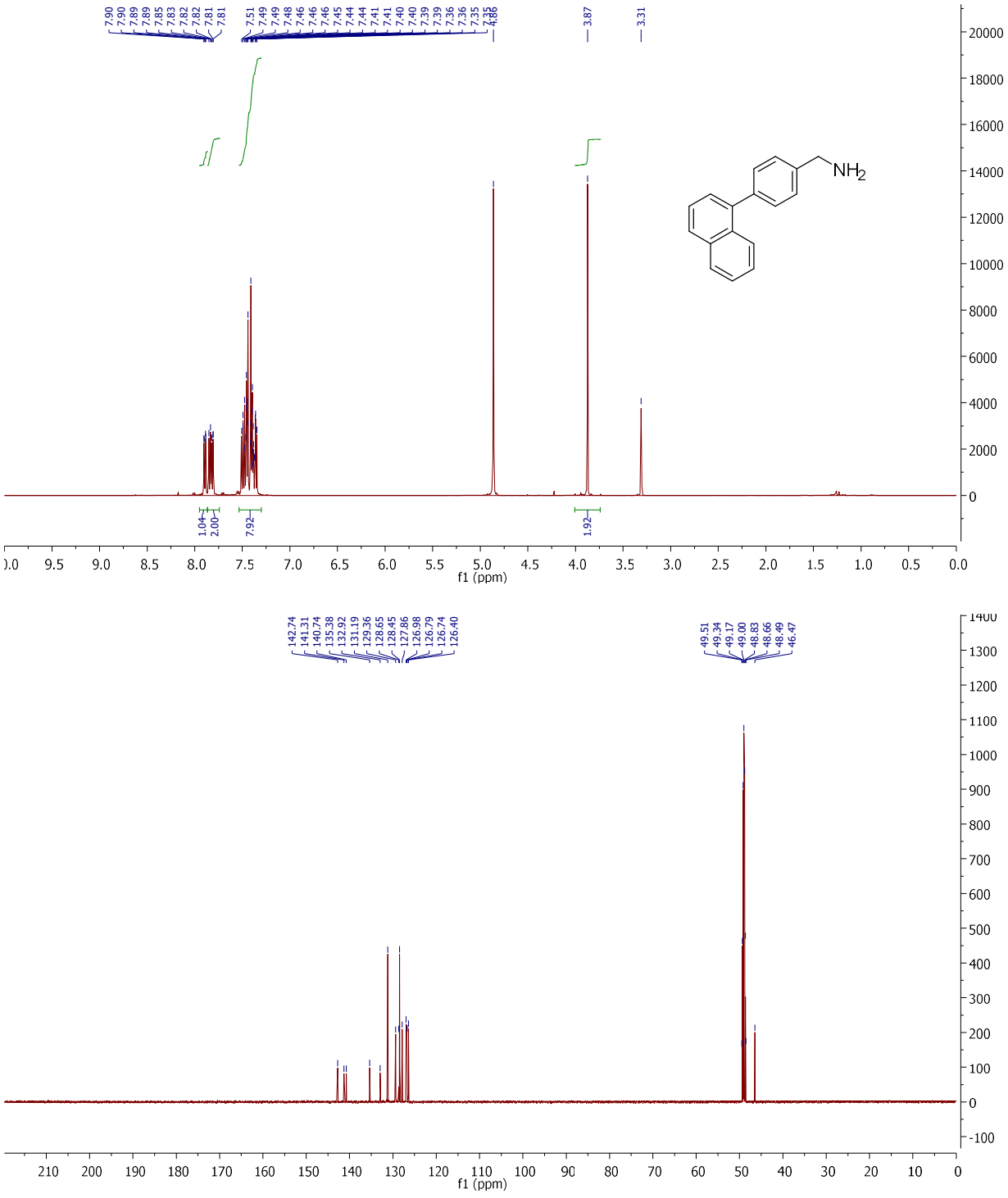


Figure S21. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 4-(1-naphthalenyl)benzylamine (**4**) in CD_3OD

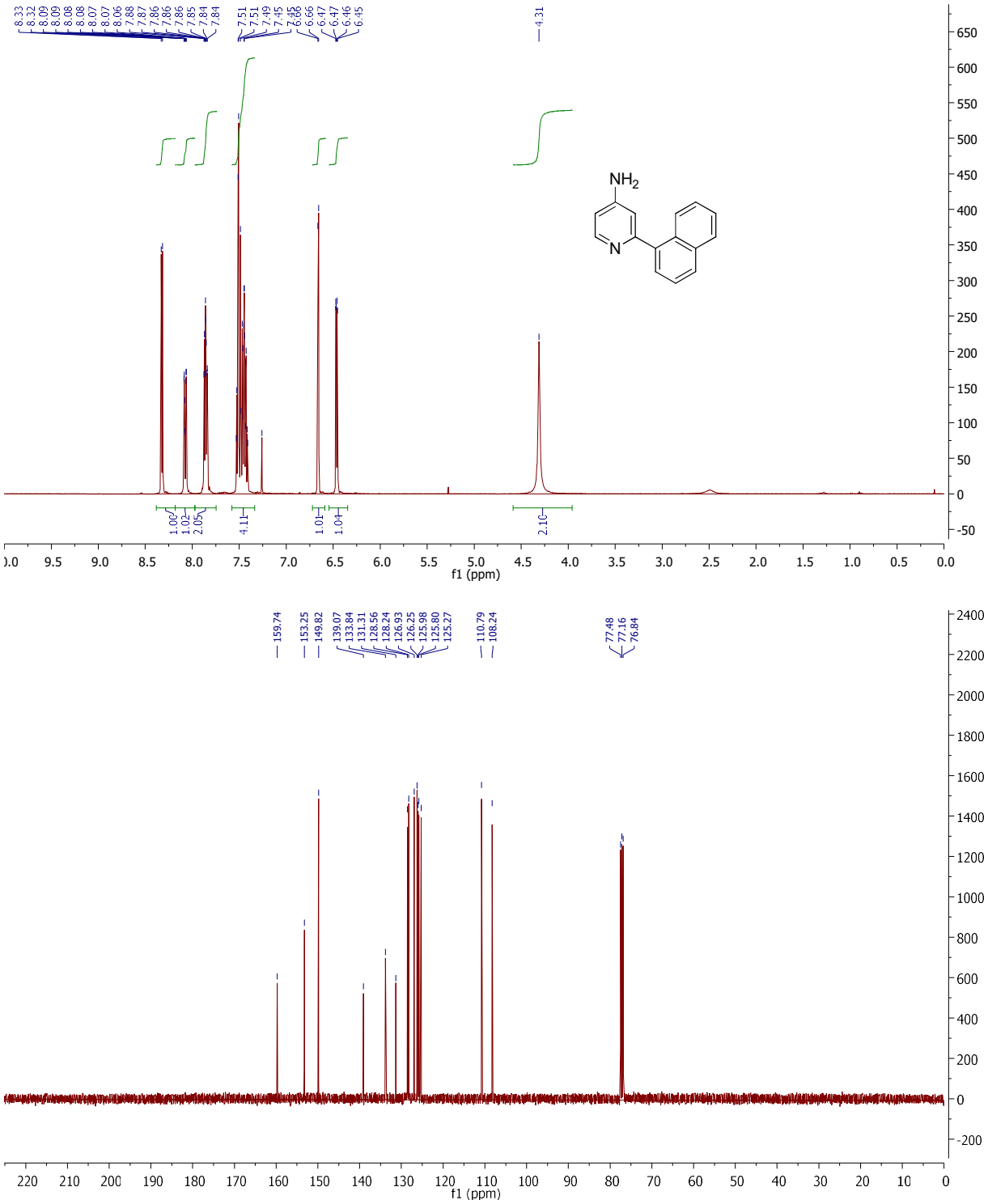


Figure S22. ^{1}H NMR (400 MHz) and ^{13}C NMR (101 MHz) spectra of 4-amino-2-(1-naphthalenyl)pyridine (**8**) in $CDCl_3$.

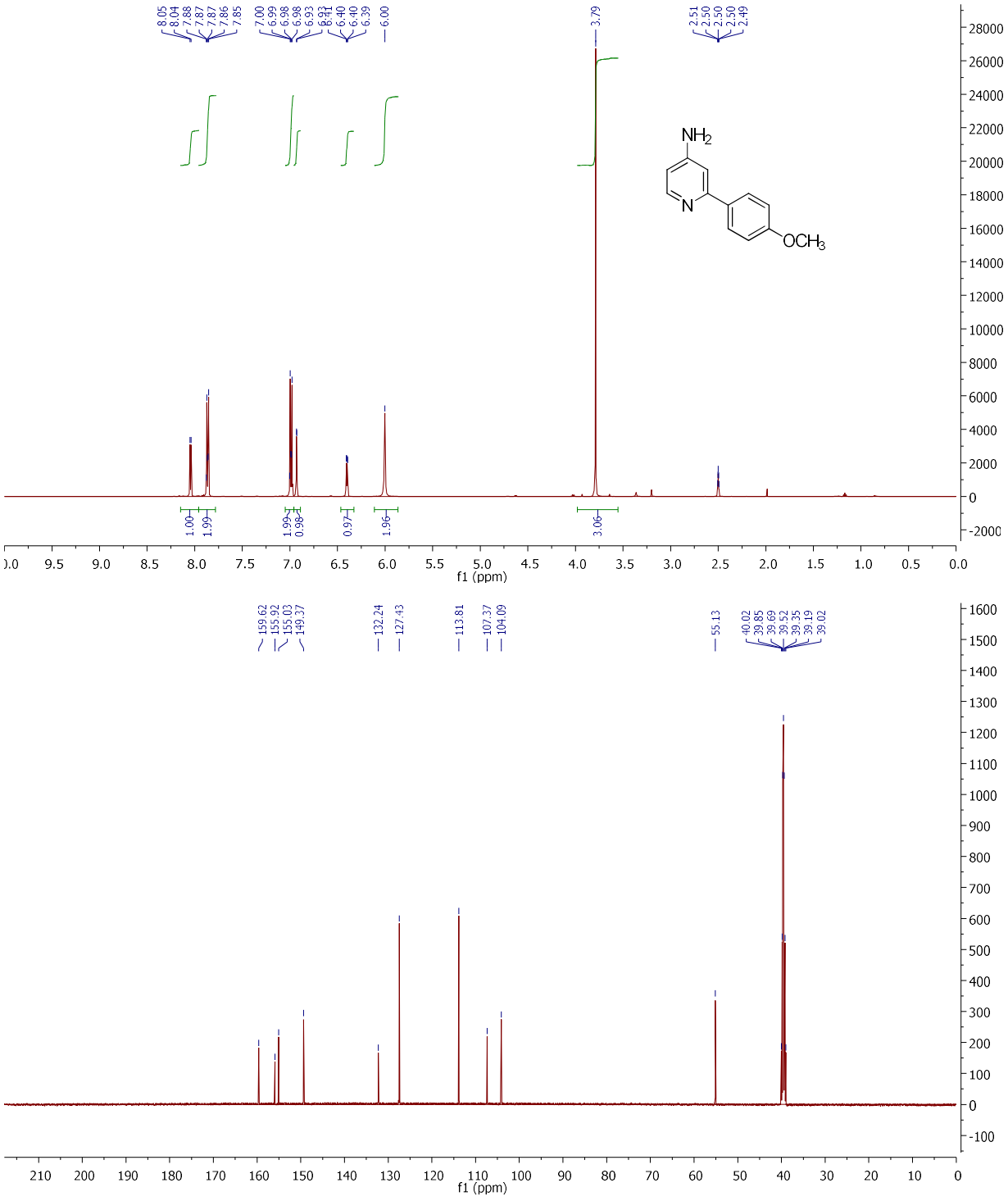


Figure S23. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 4-amino-2-(4-methoxyphenyl)pyridine (**9**) in DMSO.

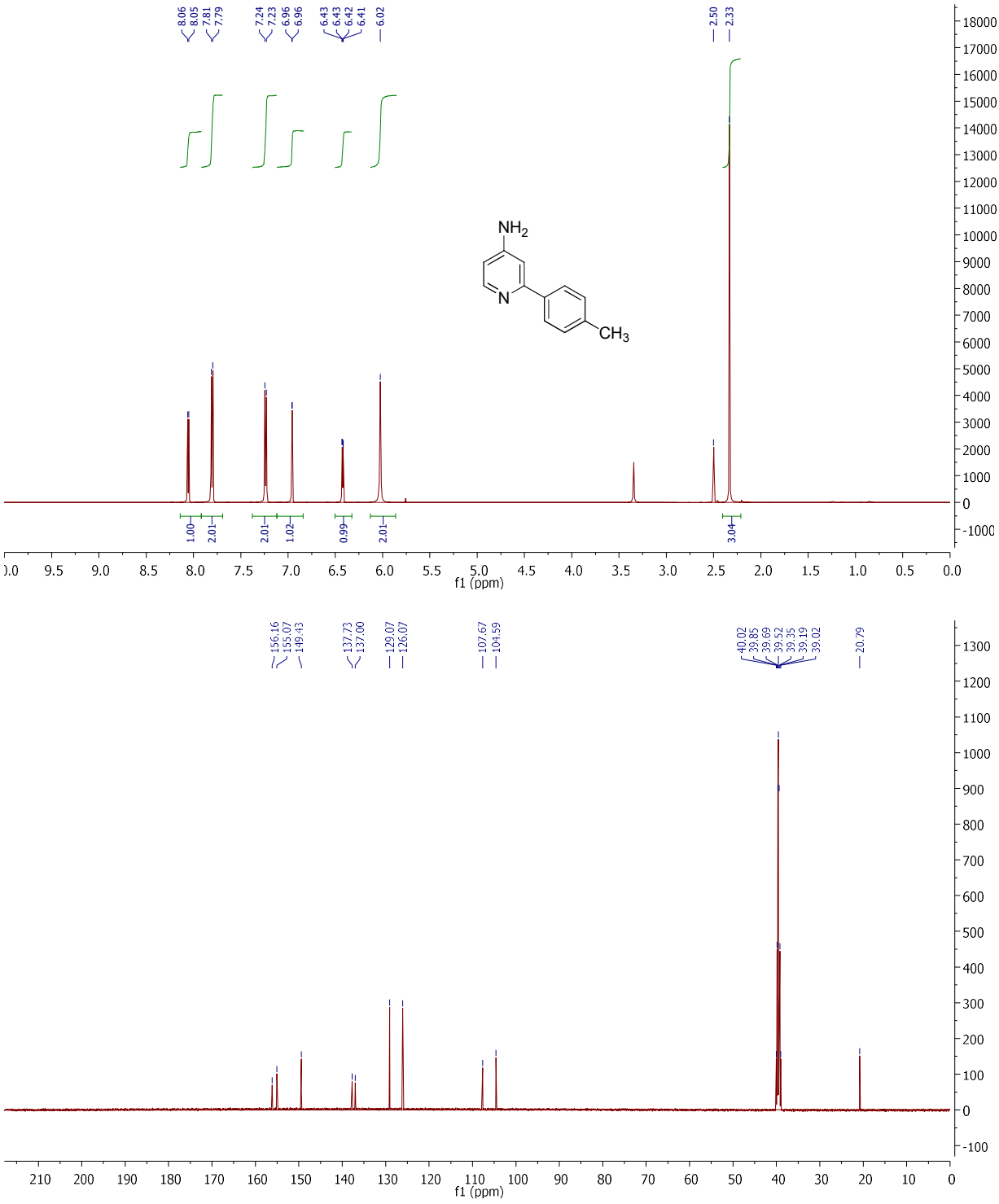


Figure S24. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 4-amino-2-(4-methylphenyl)pyridine (**10**) in DMSO.

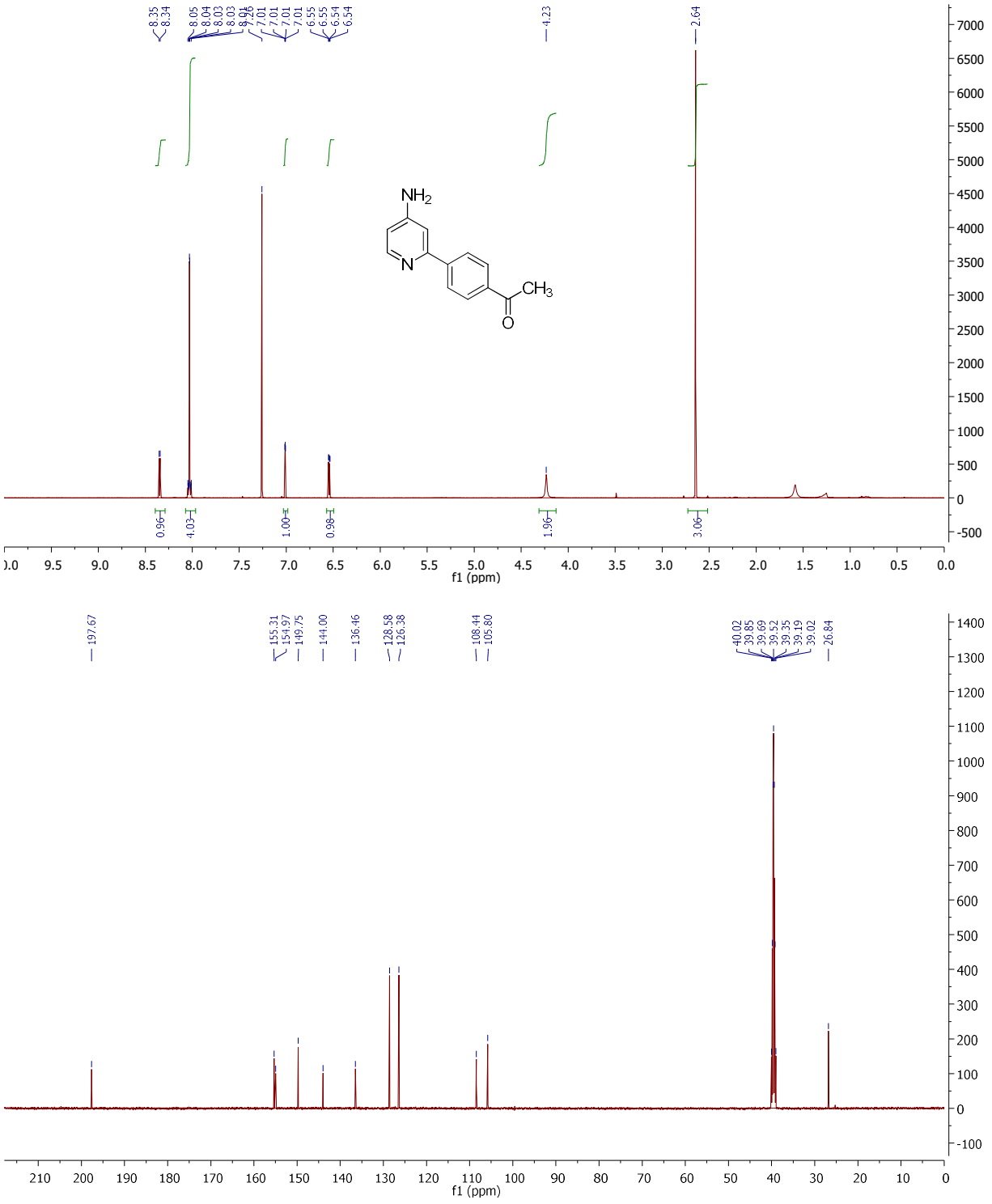


Figure S25. ^{1}H NMR (500 MHz, in $CDCl_3$) and ^{13}C NMR (126 MHz, in DMSO) spectra of 4-amino-2-(4-acetophenyl)pyridine (**11**), **new compound.**

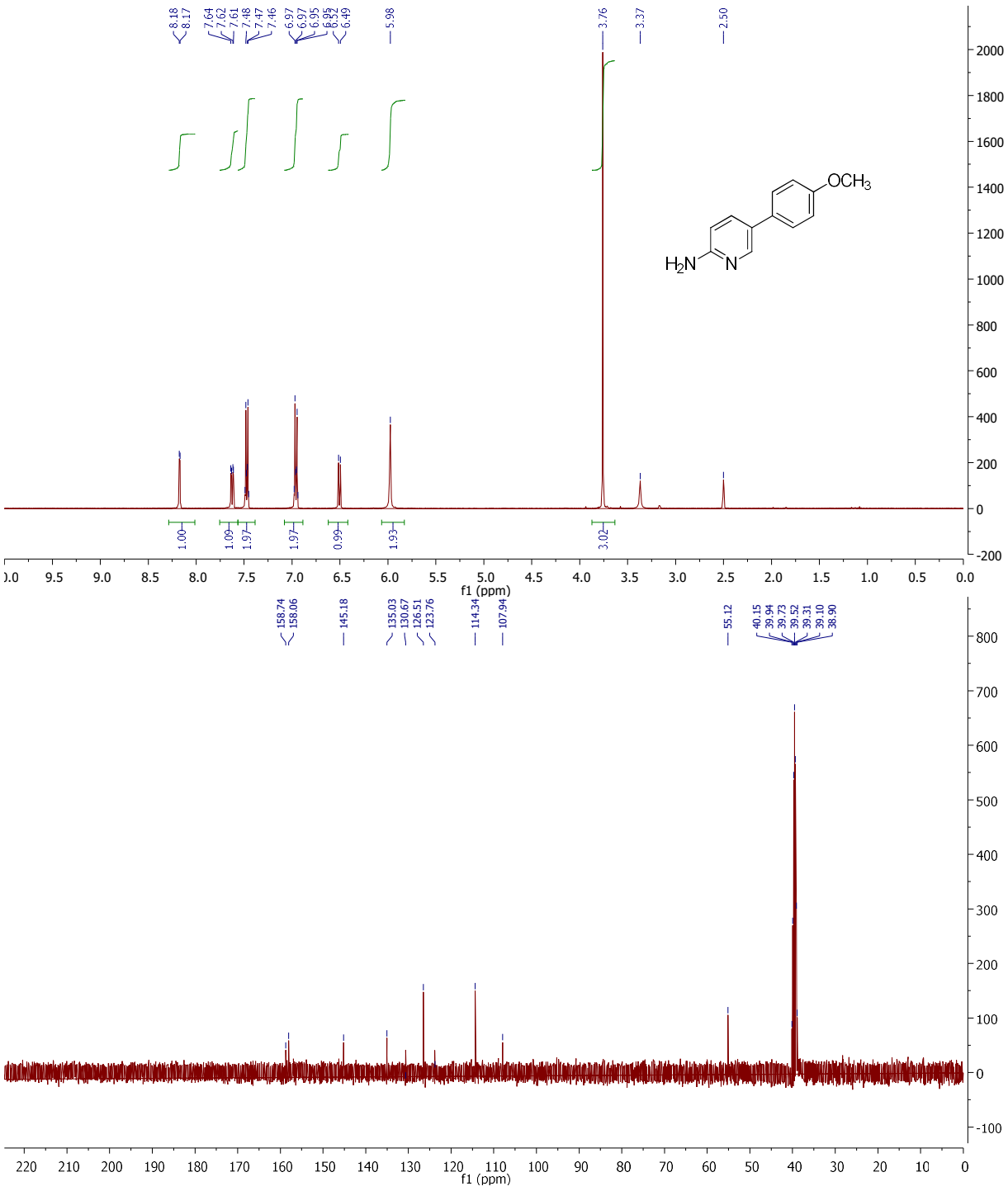


Figure S26. ^{1}H NMR (400 MHz) and ^{13}C NMR (101 MHz) spectra of 2-amino-5-(4-methoxyphenyl)pyridine (**12**) in DMSO.

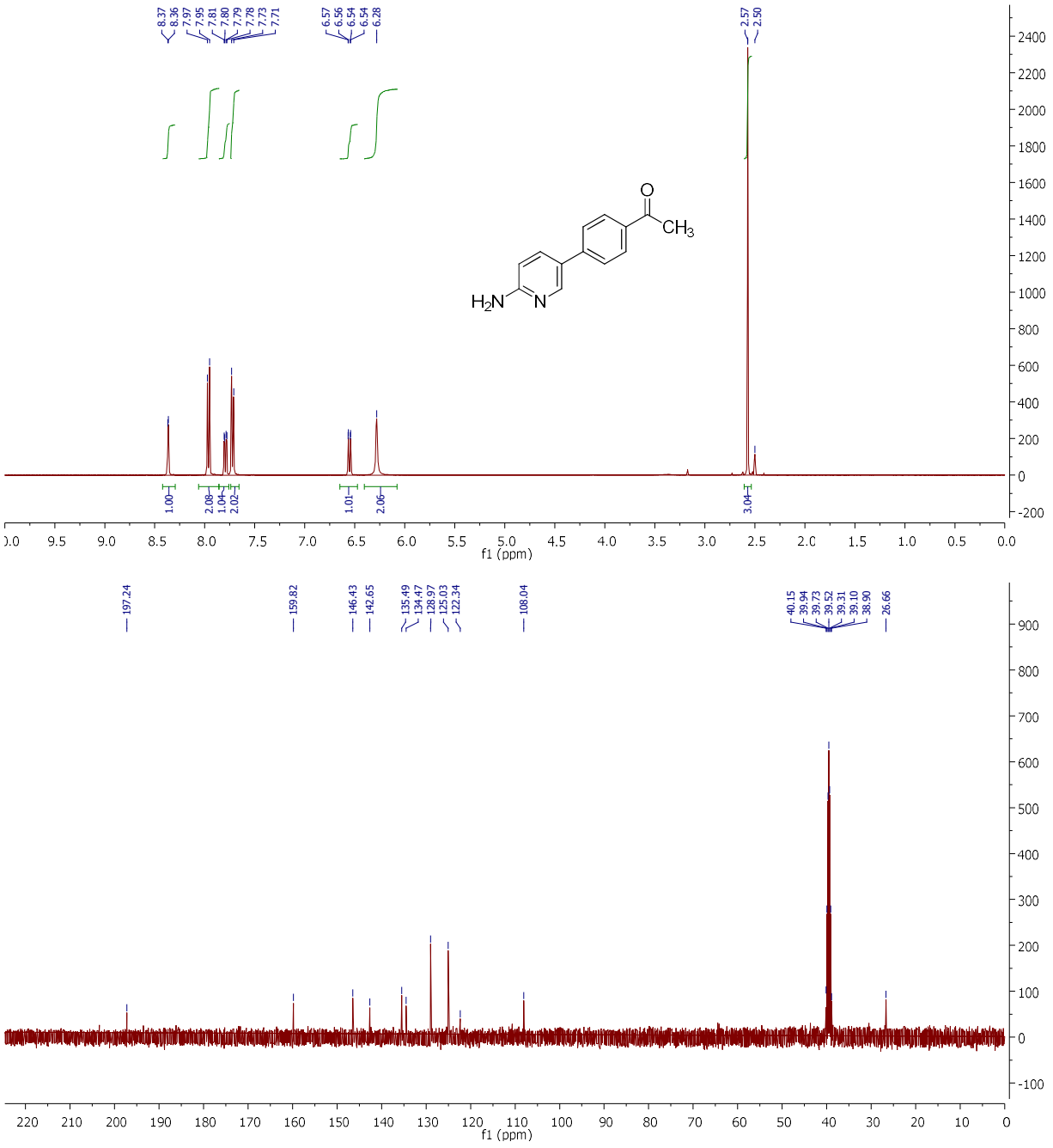


Figure S27. ^{1}H NMR (400 MHz) and ^{13}C NMR (101 MHz) spectra of 2-amino-5-(4-acetophenyl)pyridine (**13**) in DMSO.

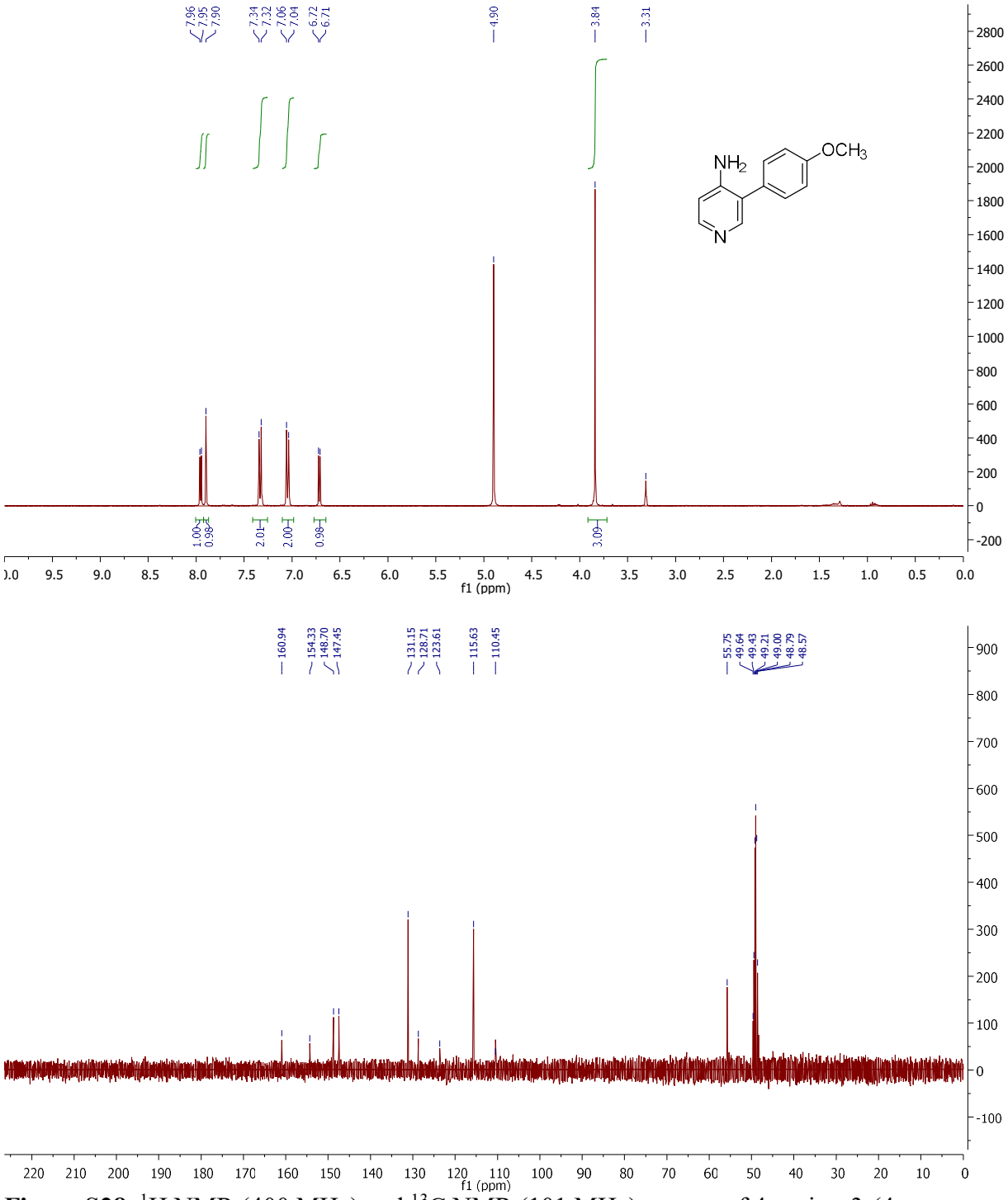


Figure S28. ^{1}H NMR (400 MHz) and ^{13}C NMR (101 MHz) spectra of 4-amino-3-(4-methoxyphenyl)pyridine (**14**) in CD_3OD

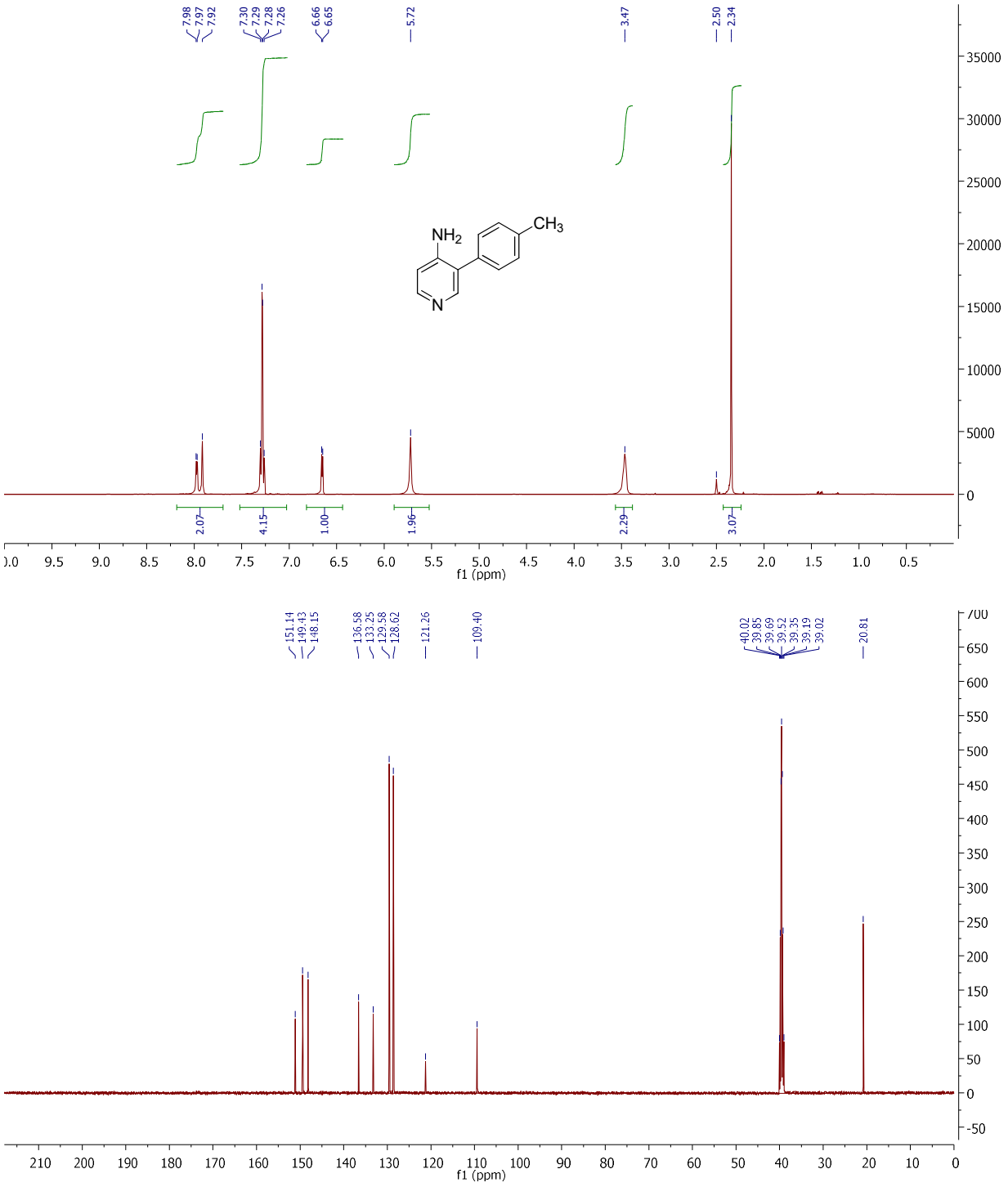


Figure S29. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 4-amino-3-(4-methylphenyl)pyridine (**15**) in DMSO.

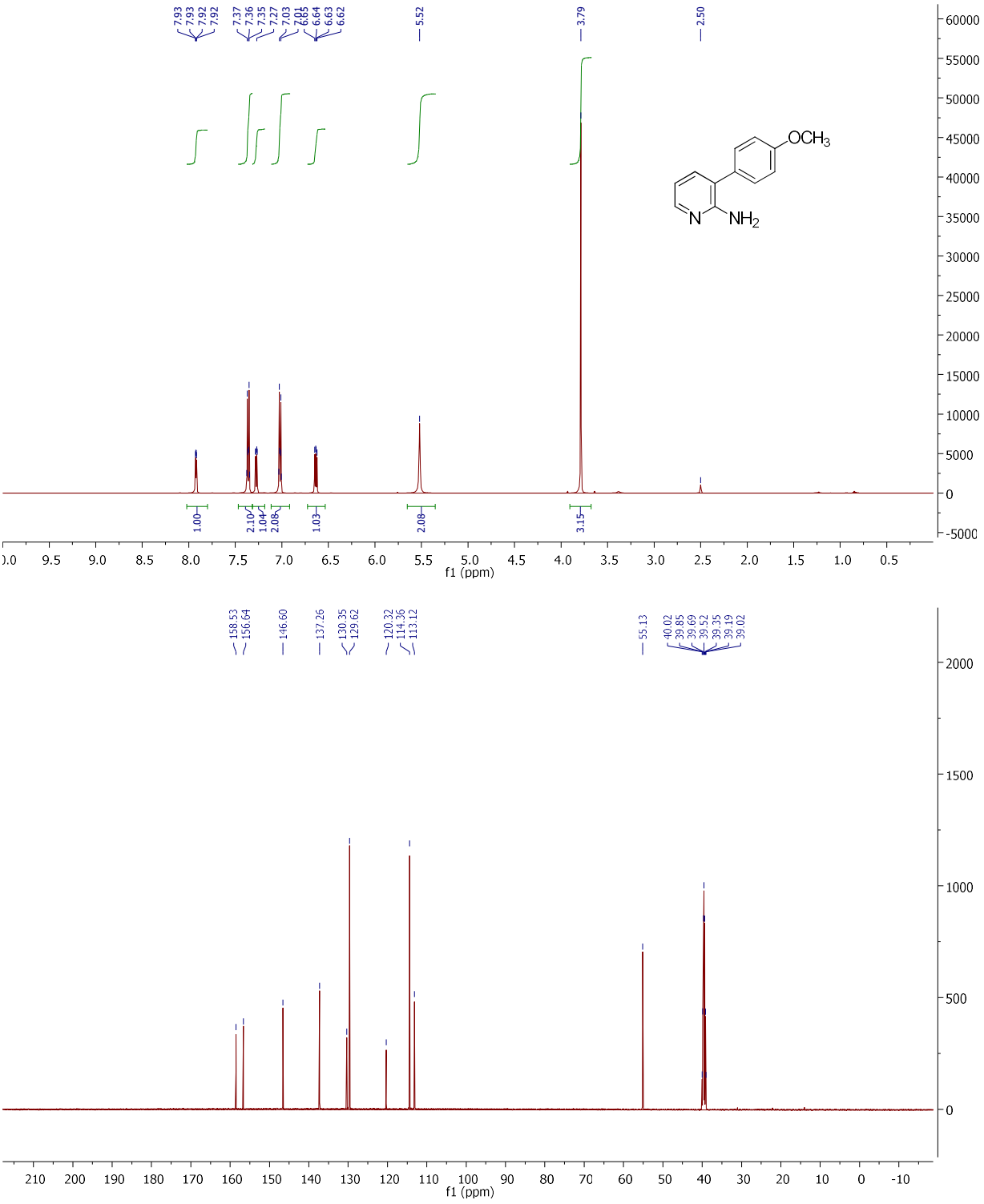


Figure S30. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 2-amino-3-(4-methoxyphenyl)pyridine (**16**) in DMSO.

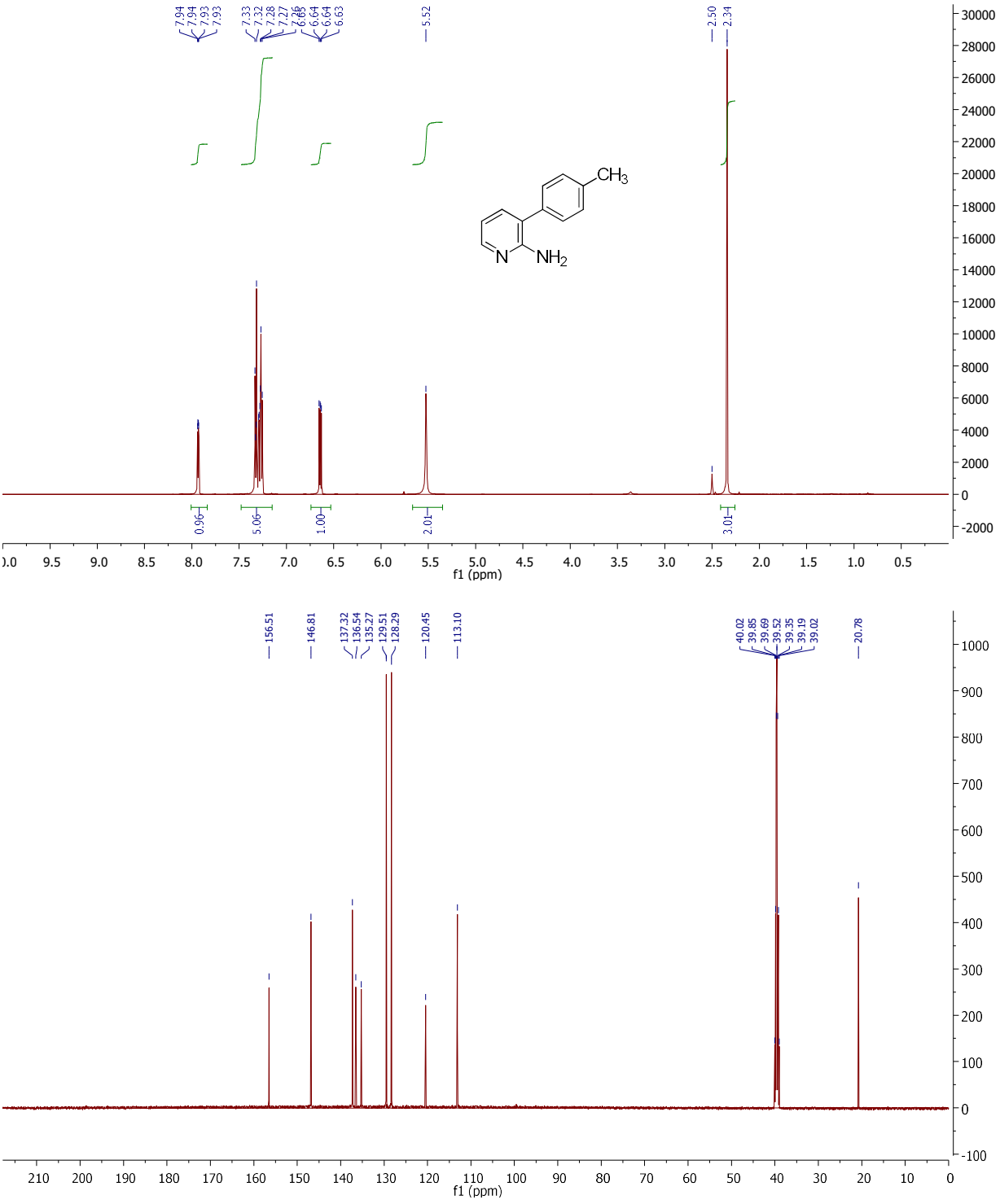


Figure S31. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 2-amino-3-(4-methylphenyl)pyridine (**17**) in DMSO.

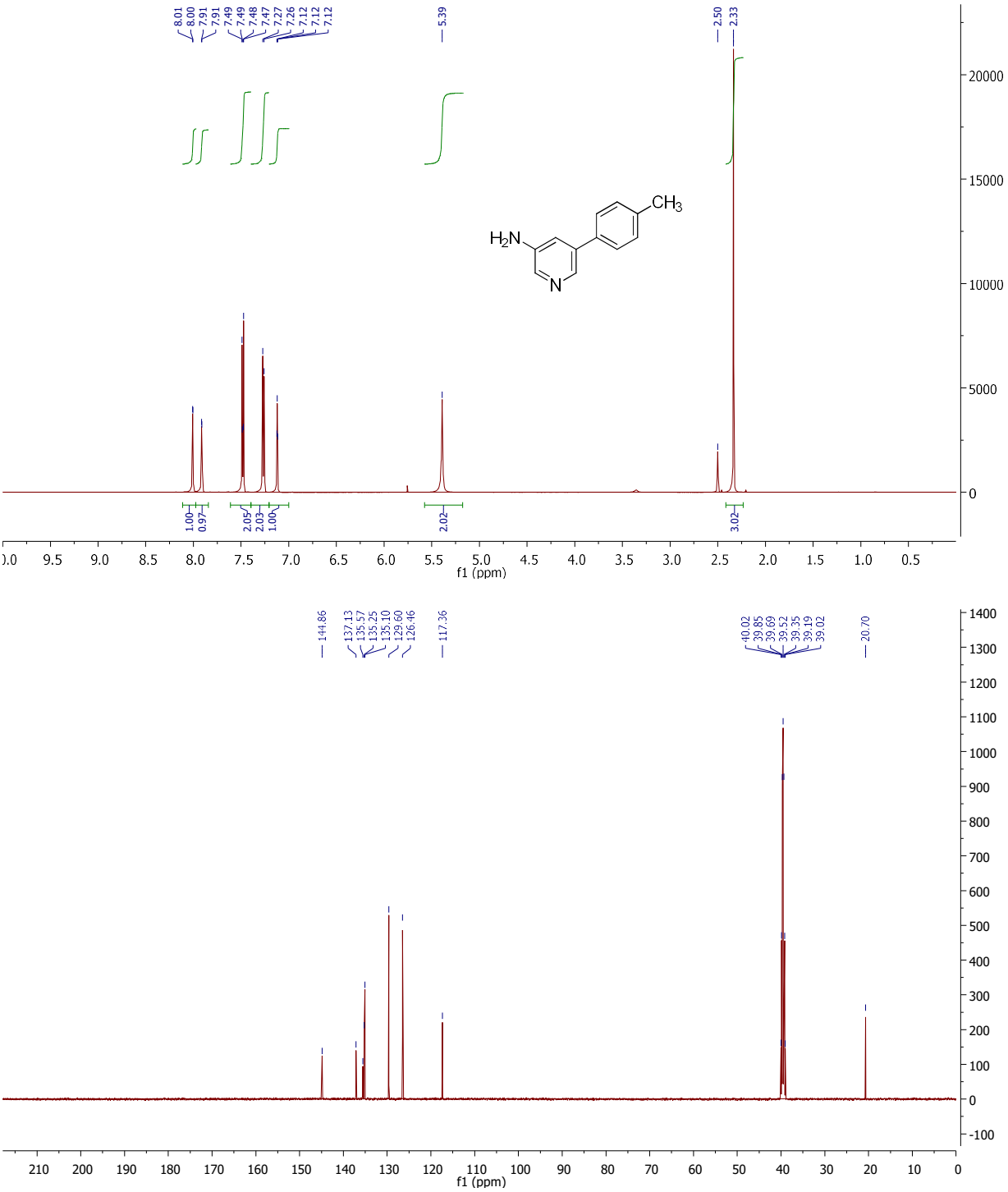


Figure S32. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 3-amino-5-(4-methylphenyl)pyridine (**18**) in DMSO.

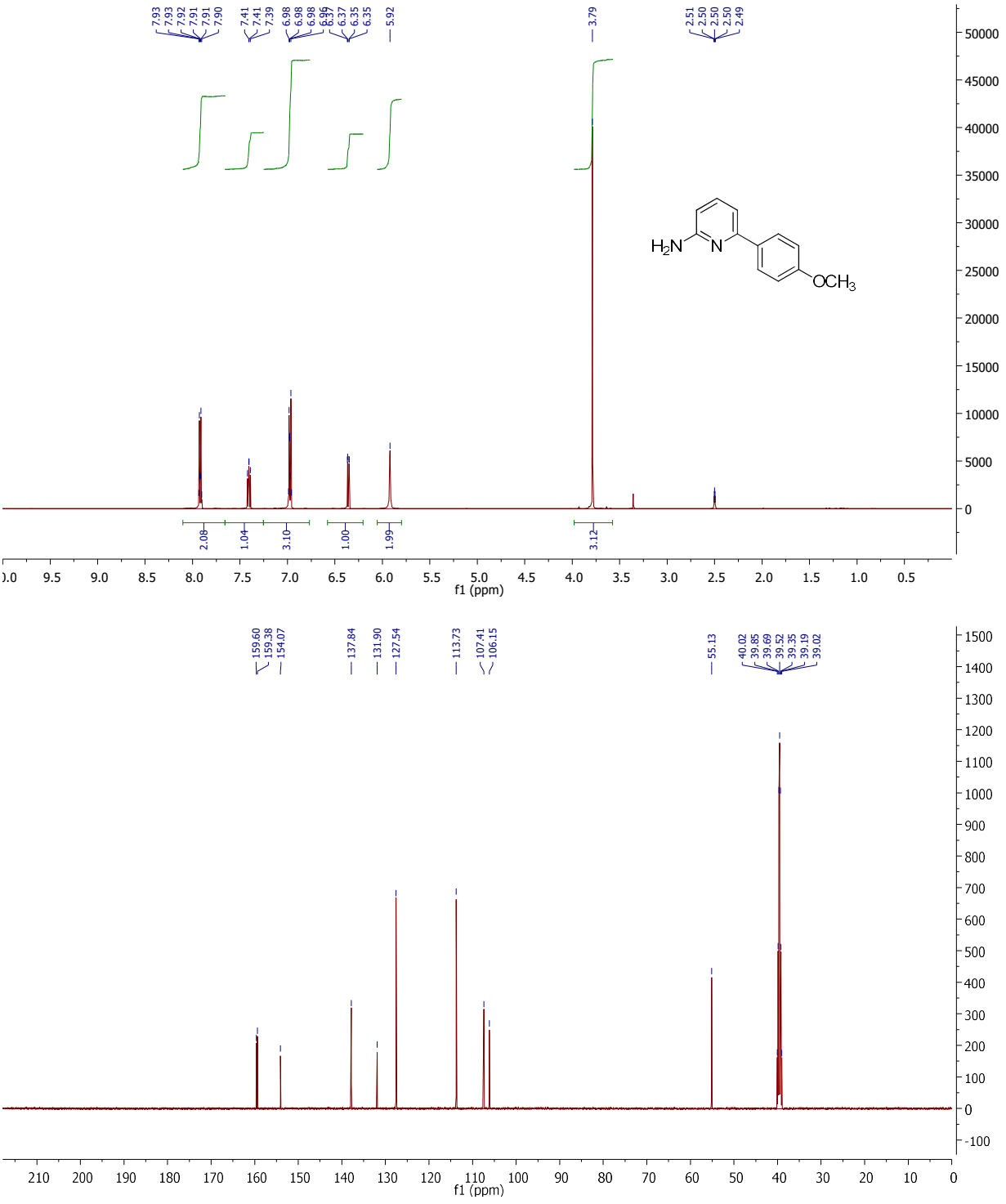


Figure S33. ^{1}H NMR (500 MHz) and ^{13}C NMR (126 MHz) spectra of 2-amino-6-(4-methoxyphenyl)pyridine (**19**) in DMSO

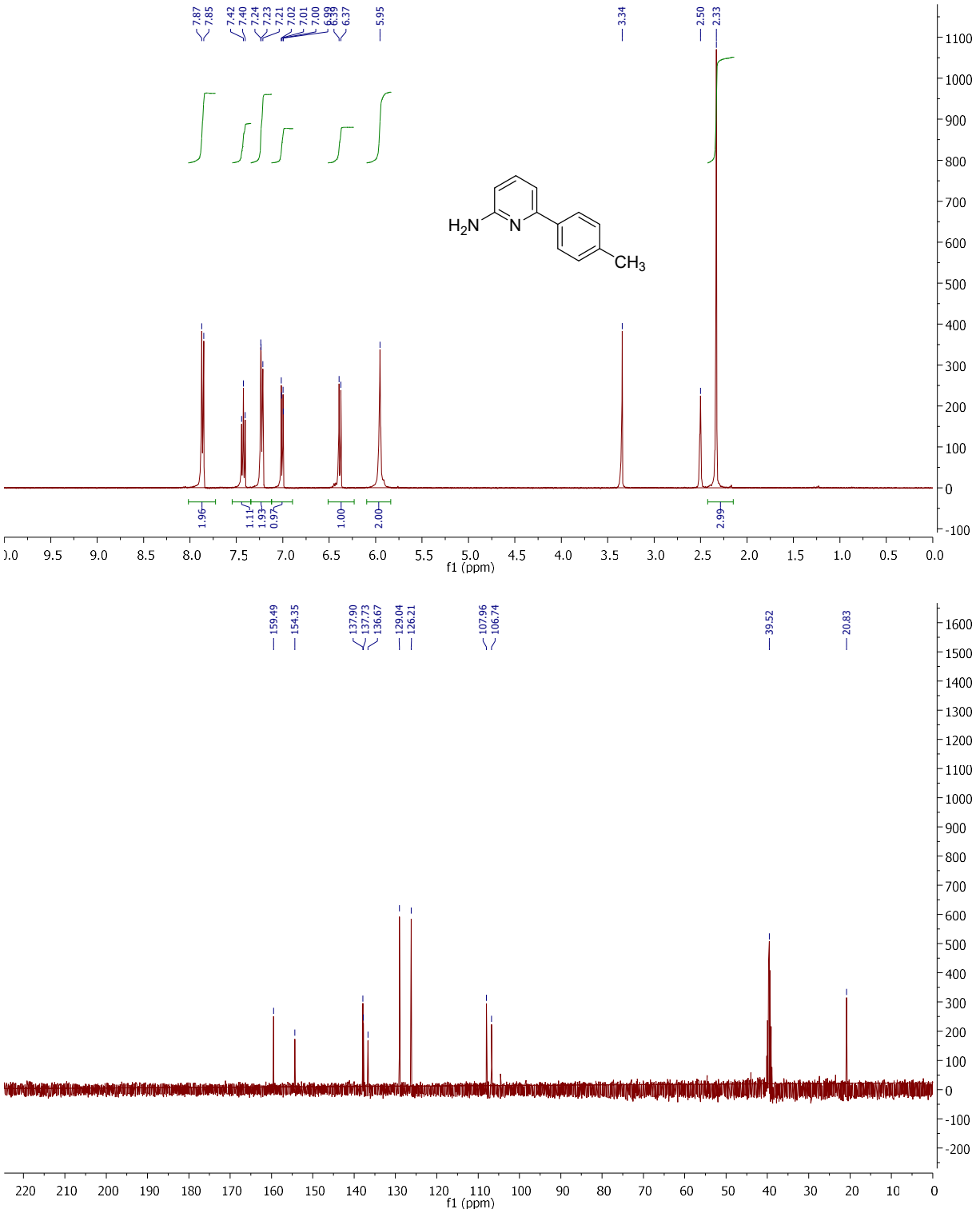


Figure S34. ^{1}H NMR (400 MHz) and ^{13}C NMR (101 MHz) spectra of 2-amino-6-(4-methylphenyl)pyridine (**20**) in DMSO

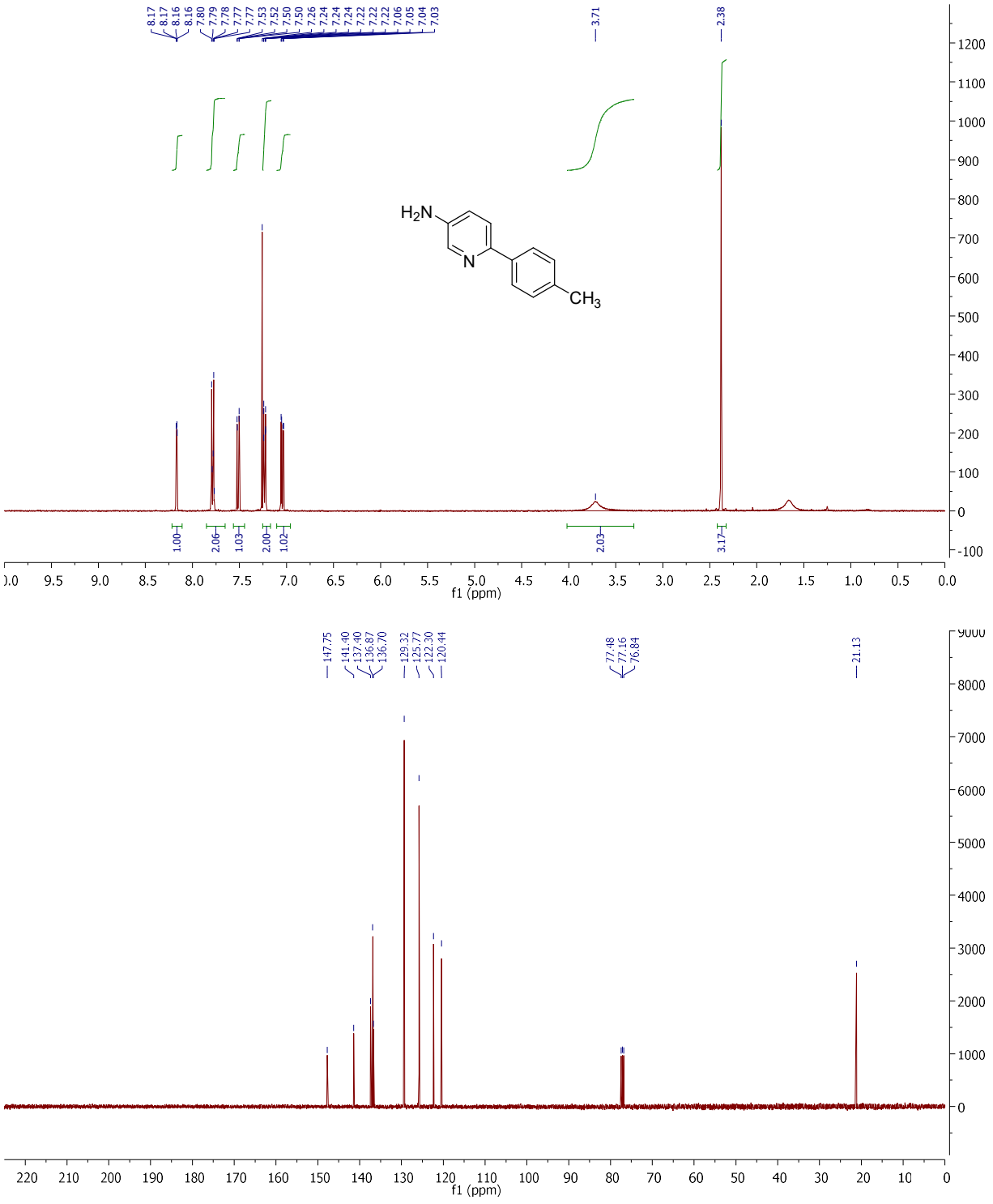


Figure S35. ^{1}H NMR (400 MHz) and ^{13}C NMR (101 MHz) spectra of 3-amino-6-(4-methylphenyl)pyridine (**21**) in $CDCl_3$

Supplemental Information S13

Mass Spectral Spectra of Isolated Products.

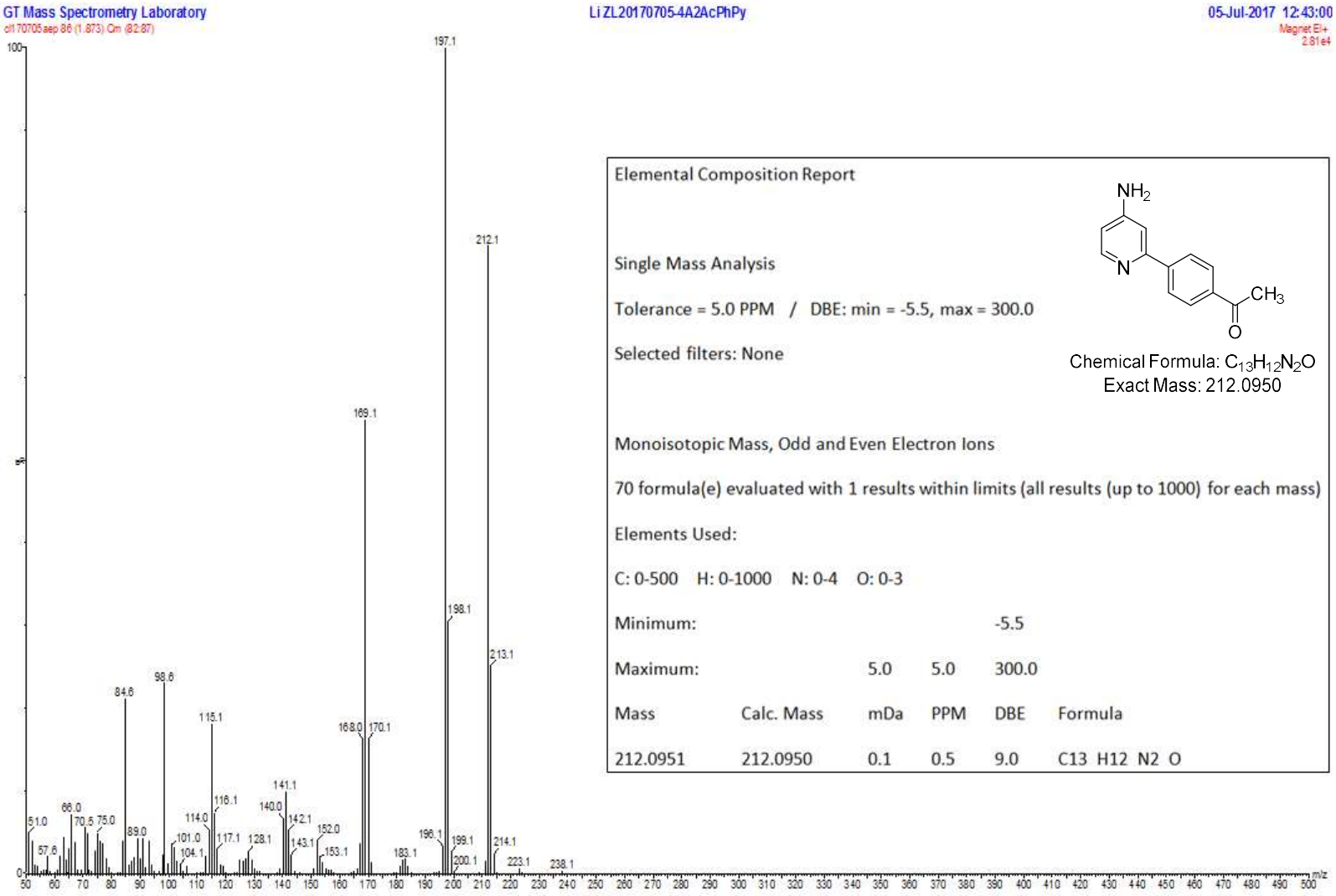


Figure S36. HRMS (EI) spectrum of 4-amino-2-(4-acetophenyl)pyridine (**11**), **new compounds.**

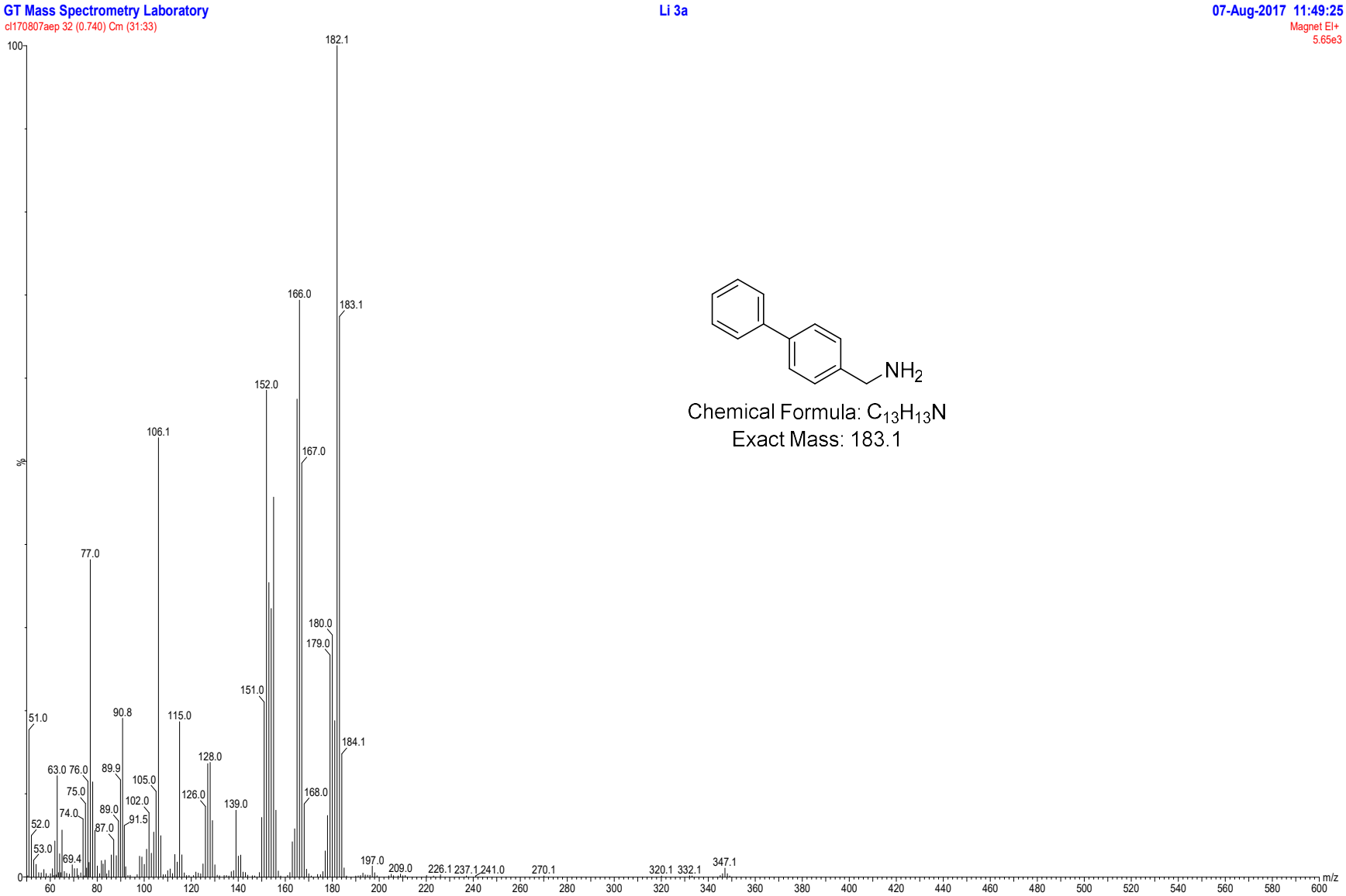


Figure 37. MS (EI) spectrum of 4-phenylbenzylamine (**3a**).

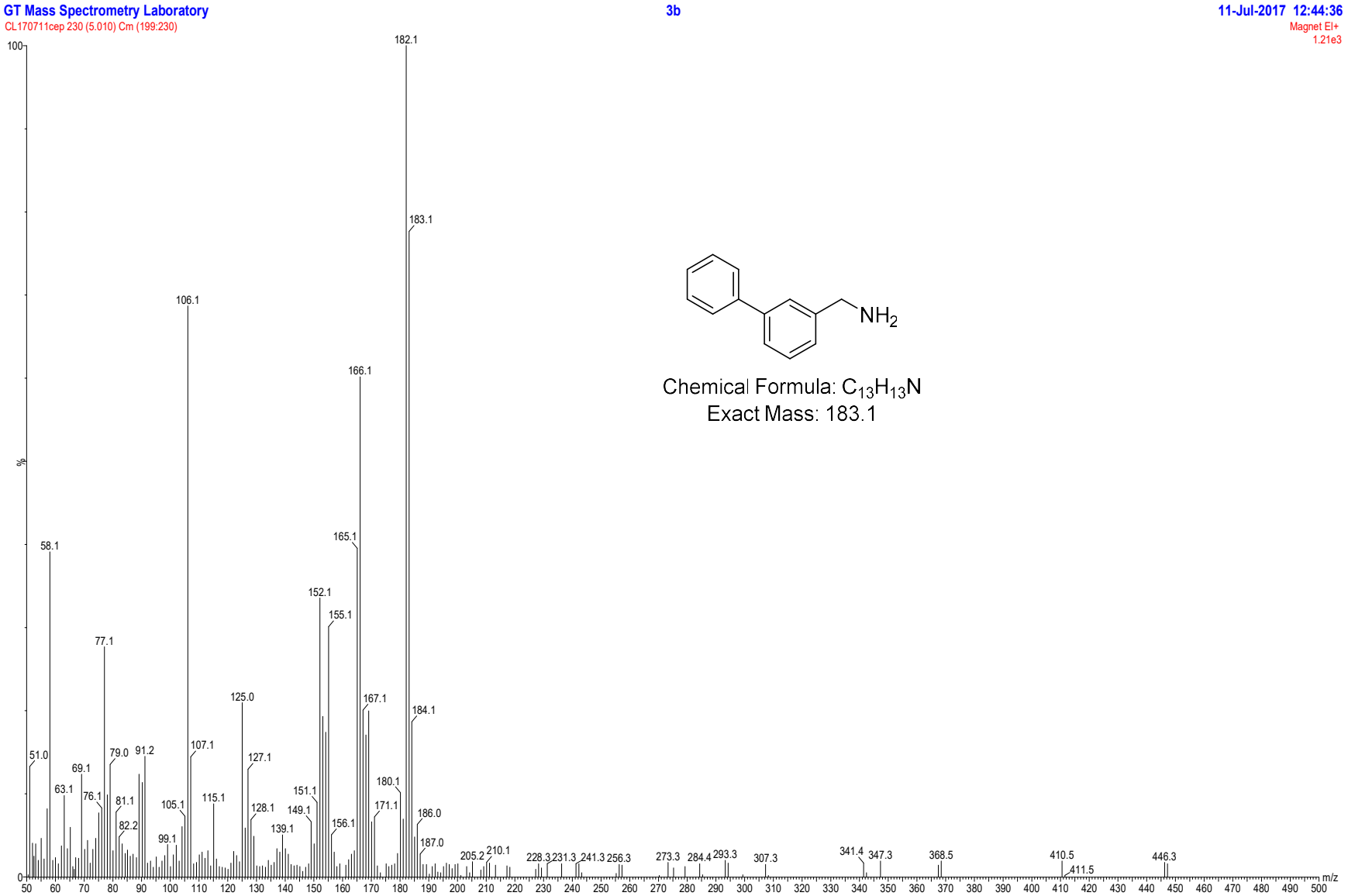


Figure 38. MS (EI) spectrum of 3-phenylbenzylamine (**3b**)

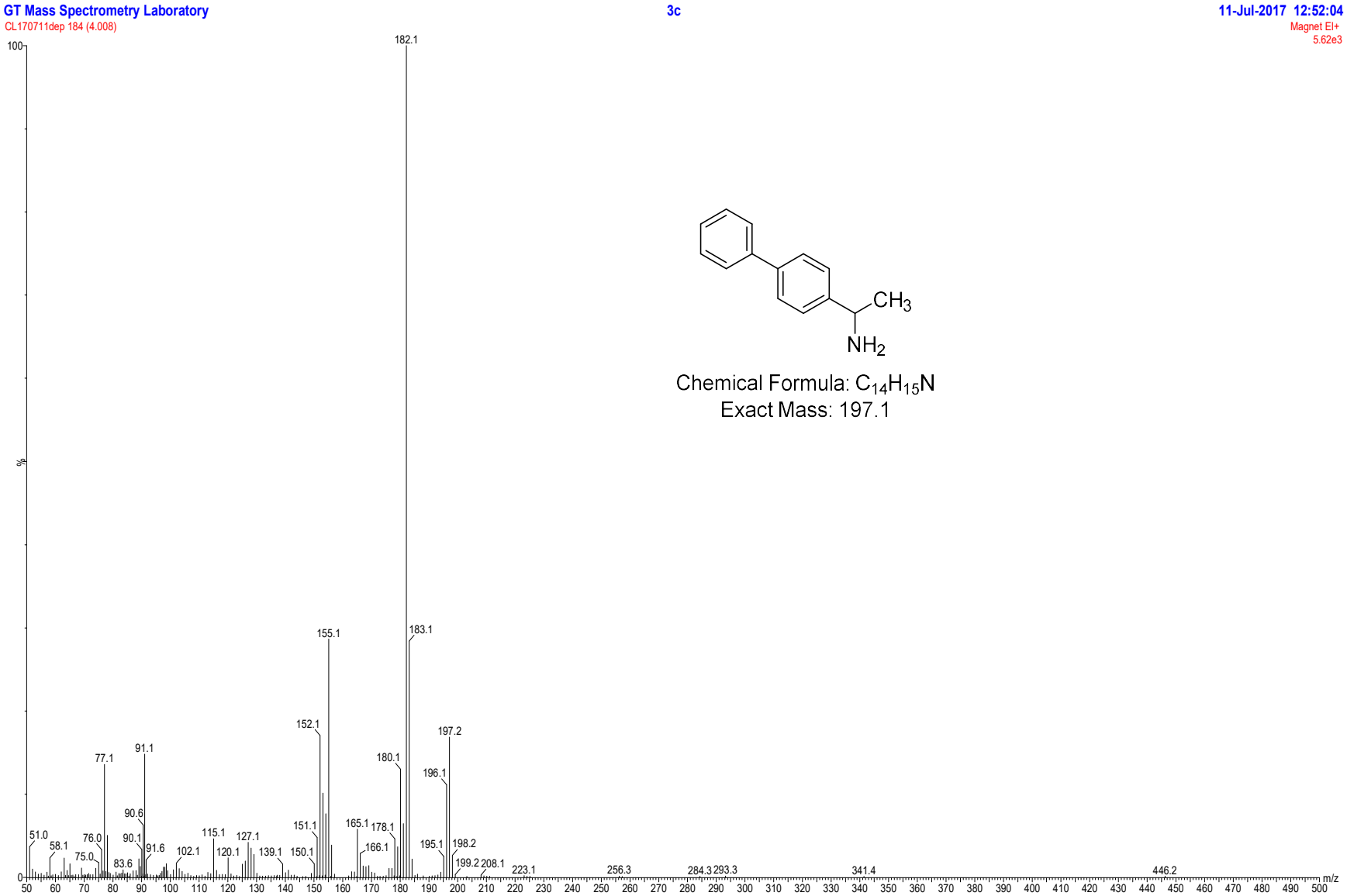


Figure 39. MS (EI) spectrum of 1-biphenyl-4-yl-ethylamine (**3c**)

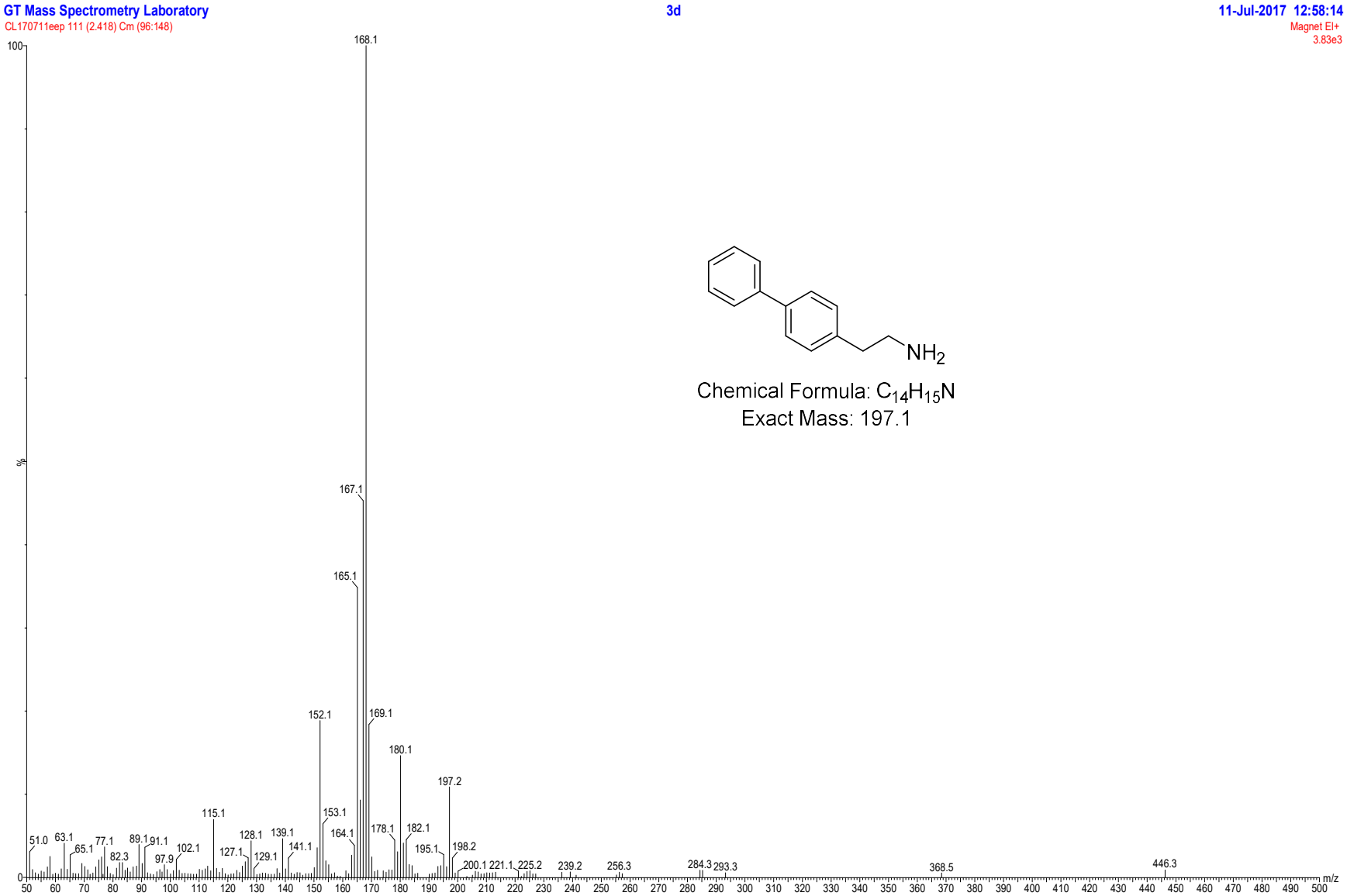


Figure S40. MS (EI) spectrum of 2-biphenyl-4-yl-ethylamine (**3d**)

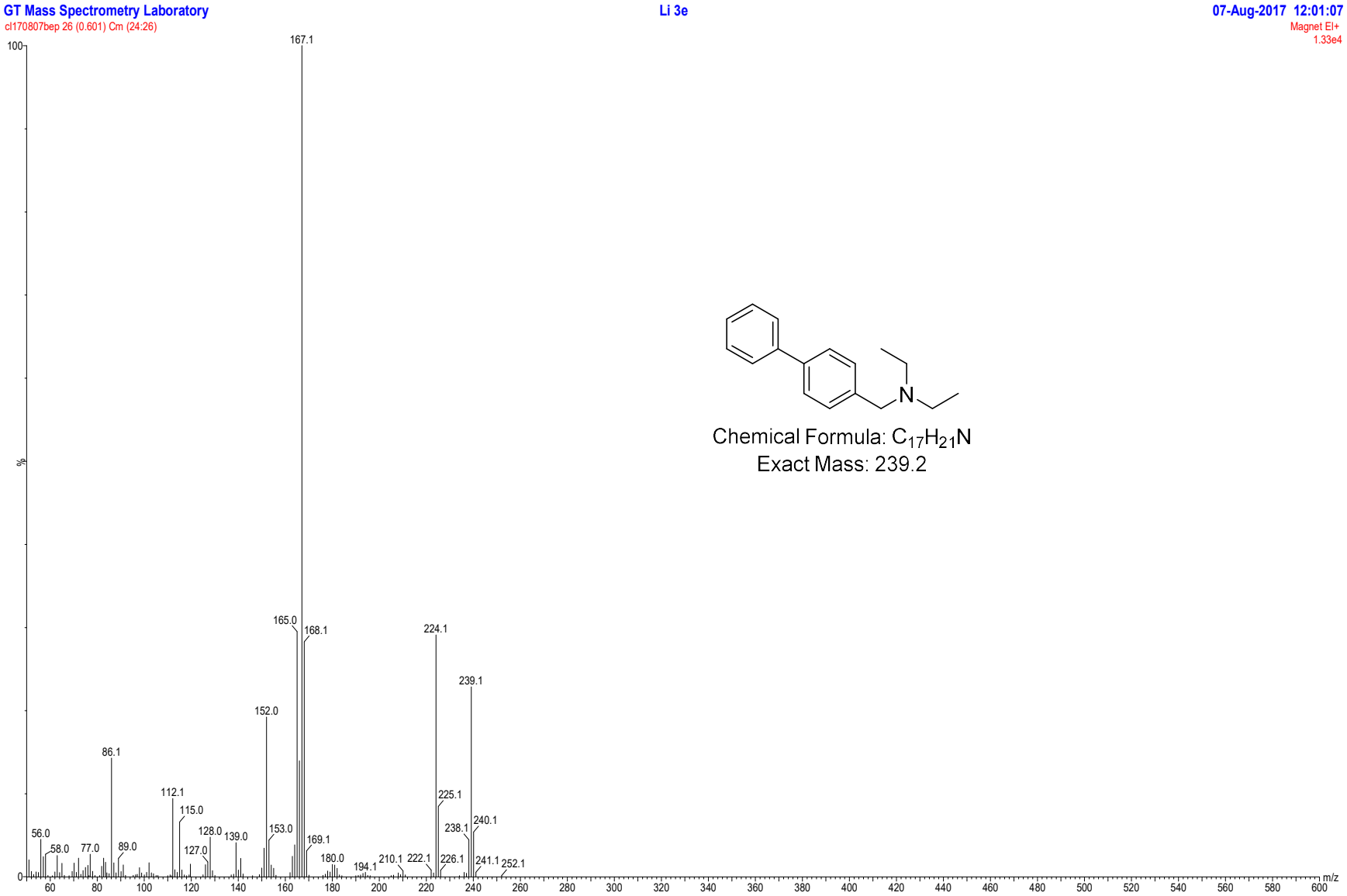


Figure S41. MS (EI) spectrum of 4-phenyl-*N*,*N*-diethylbenzylamine (**3e**).

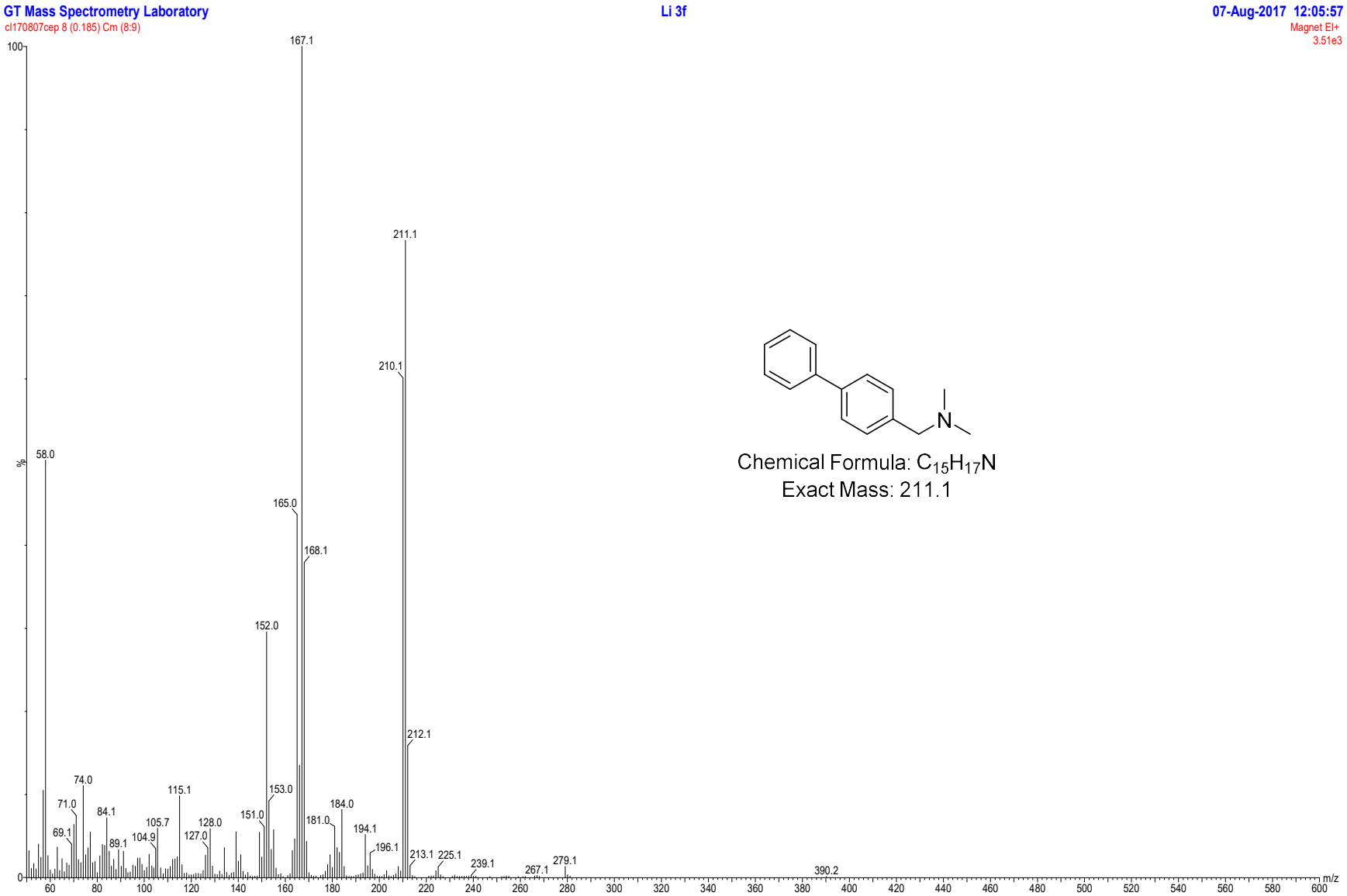


Figure S42. MS (EI) spectrum of 4-phenyl-*N*,*N*-dimethylbenzylamine (**3f**).

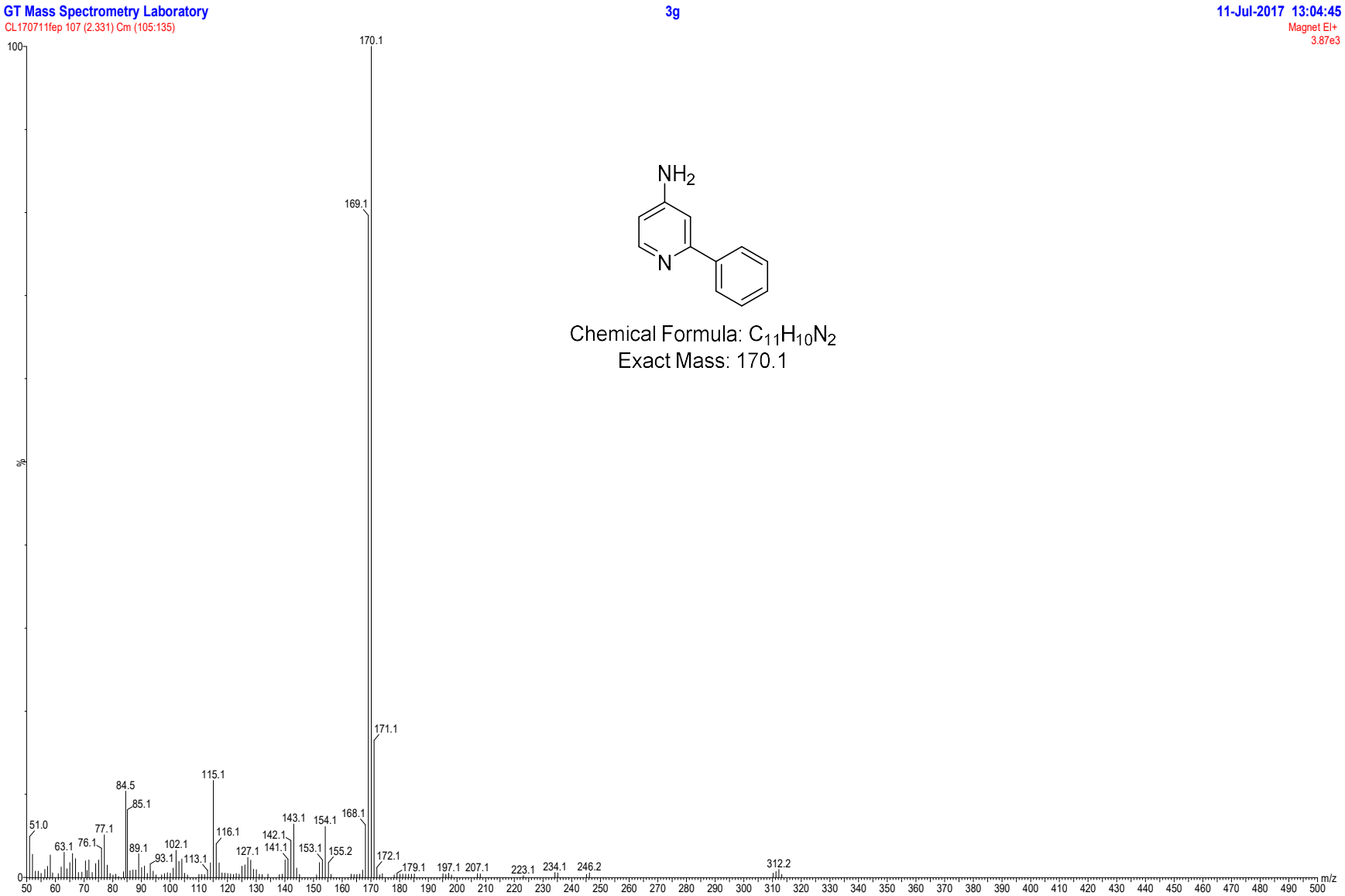


Figure S43. MS (EI) spectrum of 4-amino-2-phenylpyridine (**3g**)

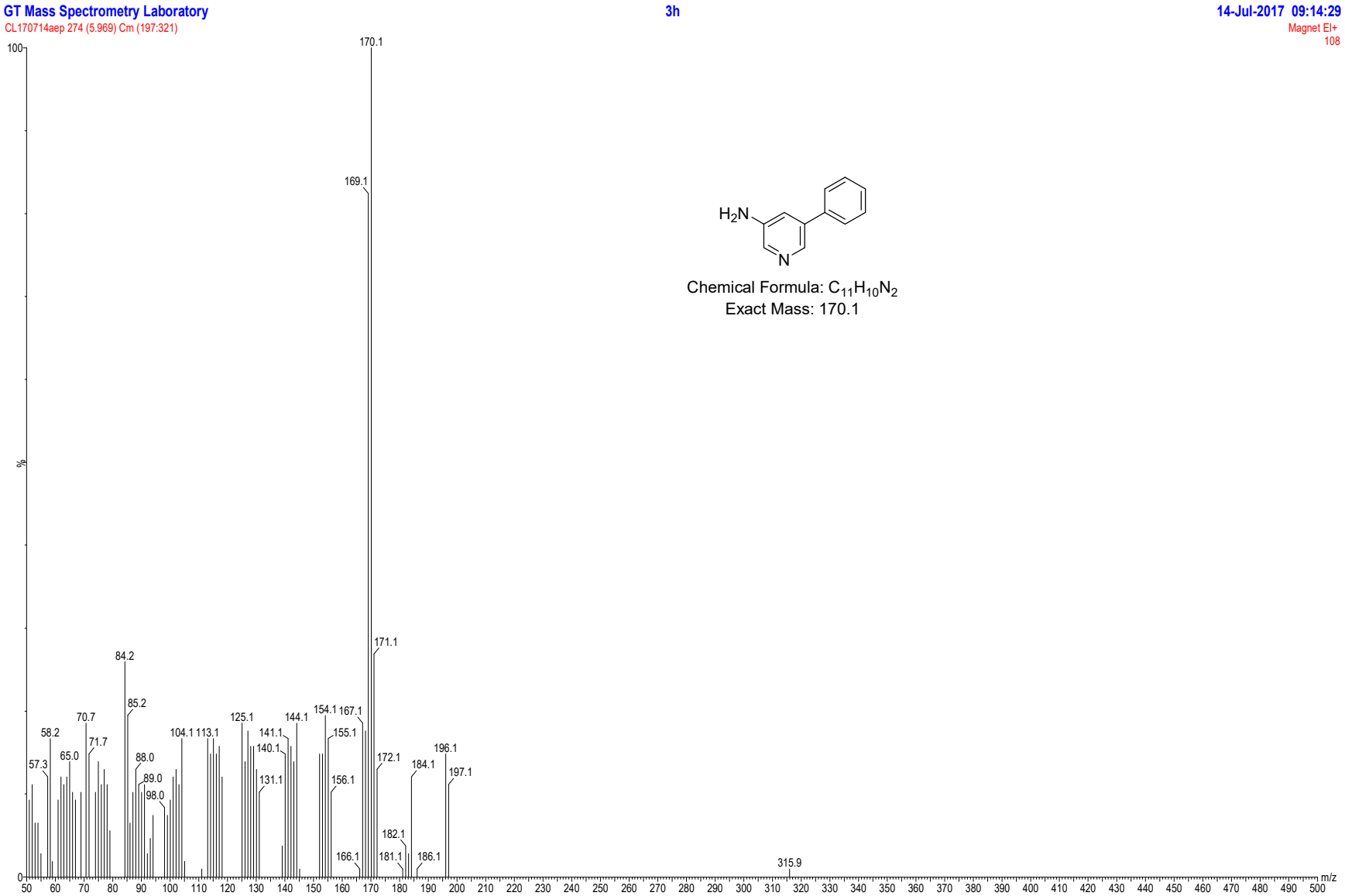


Figure S44. MS (EI) spectrum of 4-amino-3-phenylpyridine (**3h**)

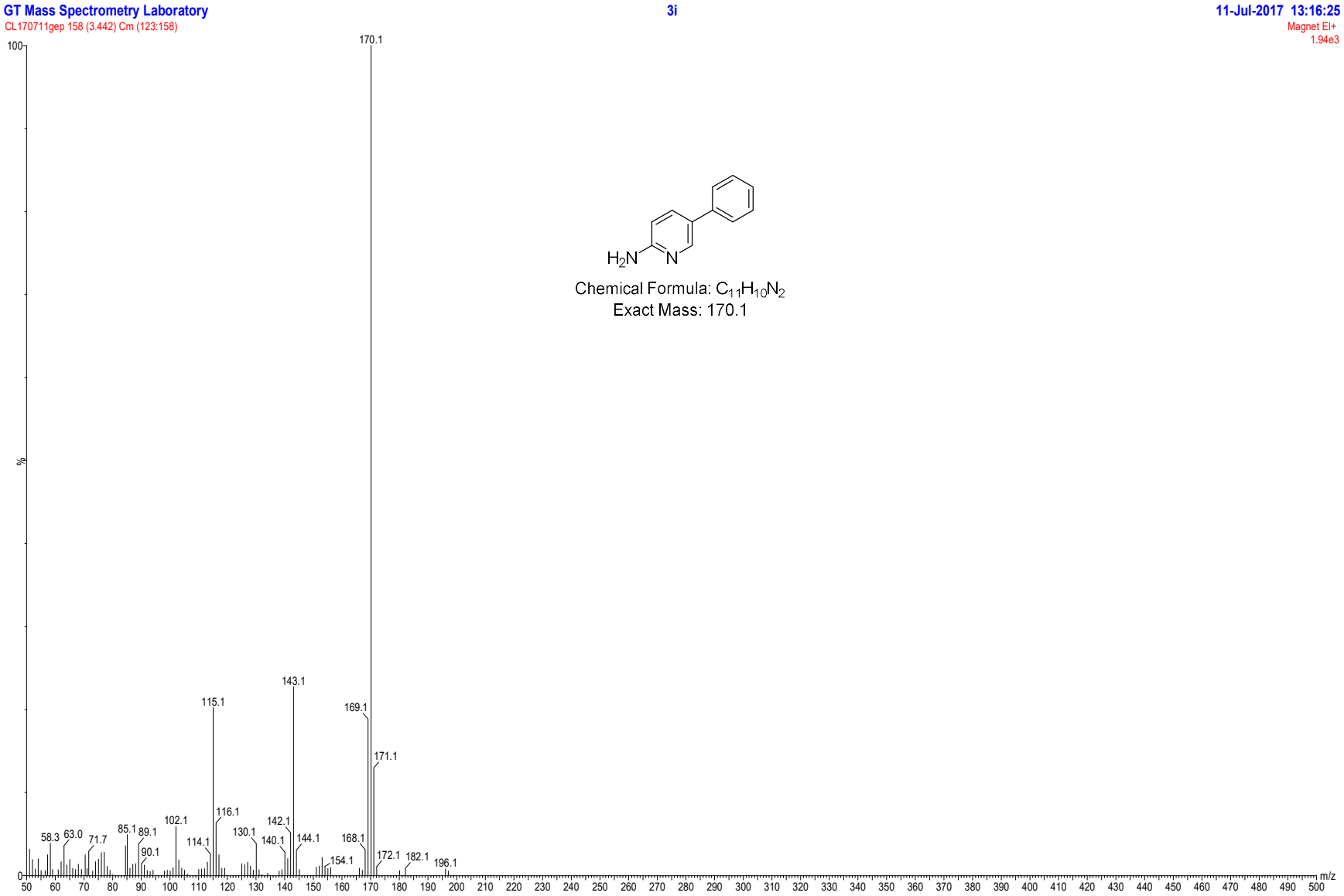


Figure S45. MS (EI) spectrum of 2-amino-5-phenylpyridine (**3i**)

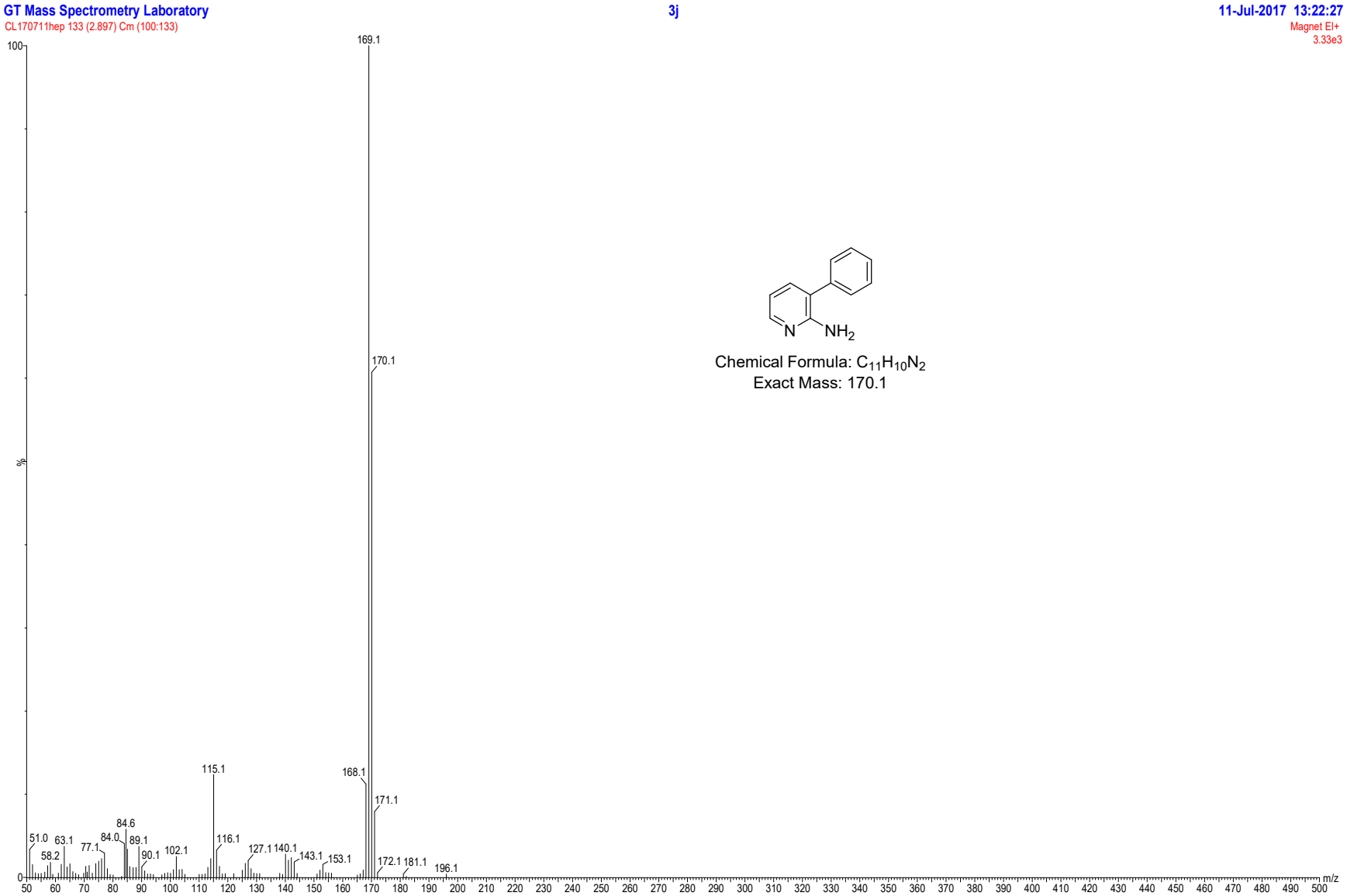


Figure S46. MS (EI) spectrum of 2-amino-3-phenylpyridine (**3j**)

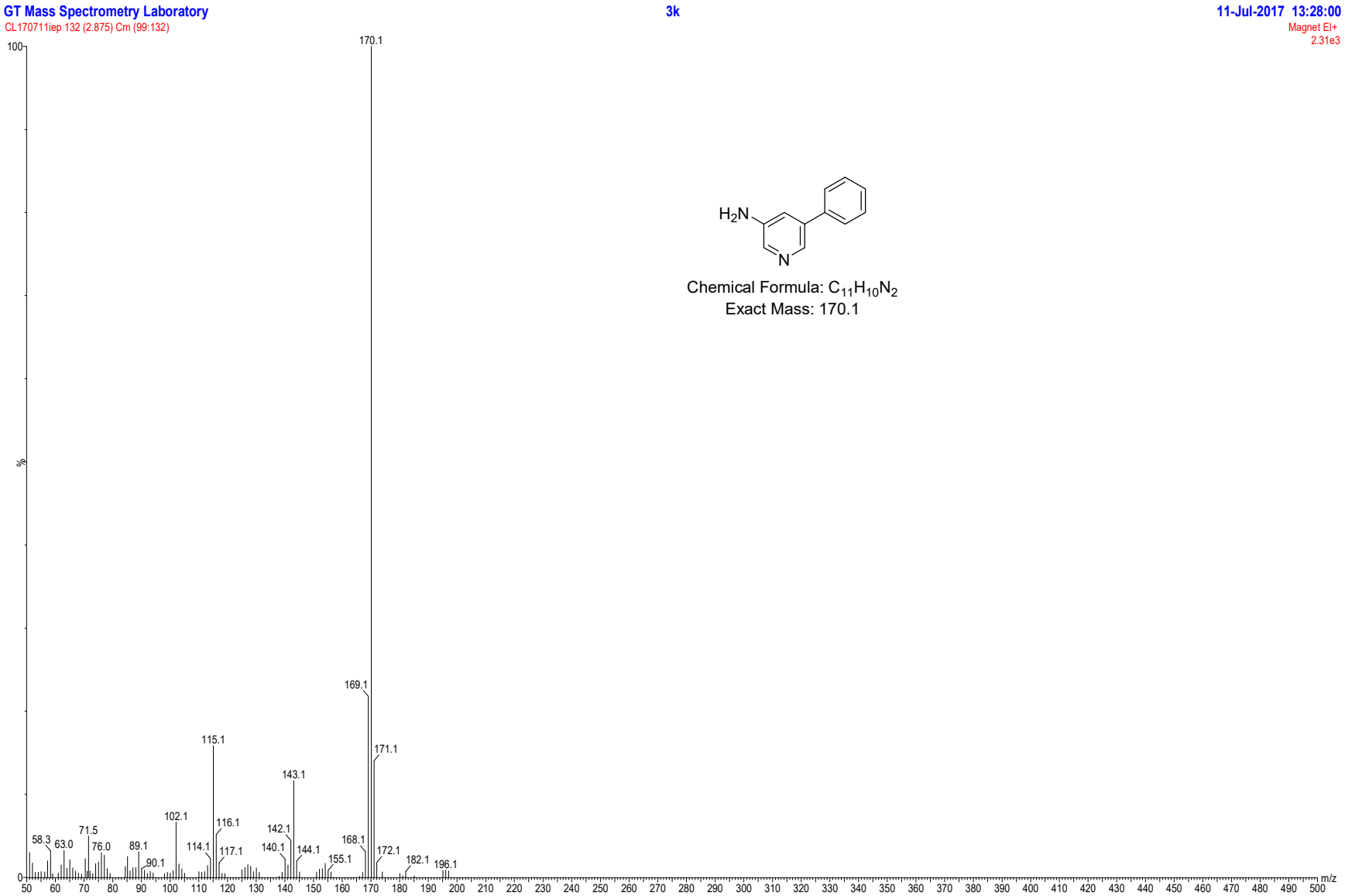


Figure S47. MS (EI) spectrum of 3-amino-5-phenylpyridine (**3k**)

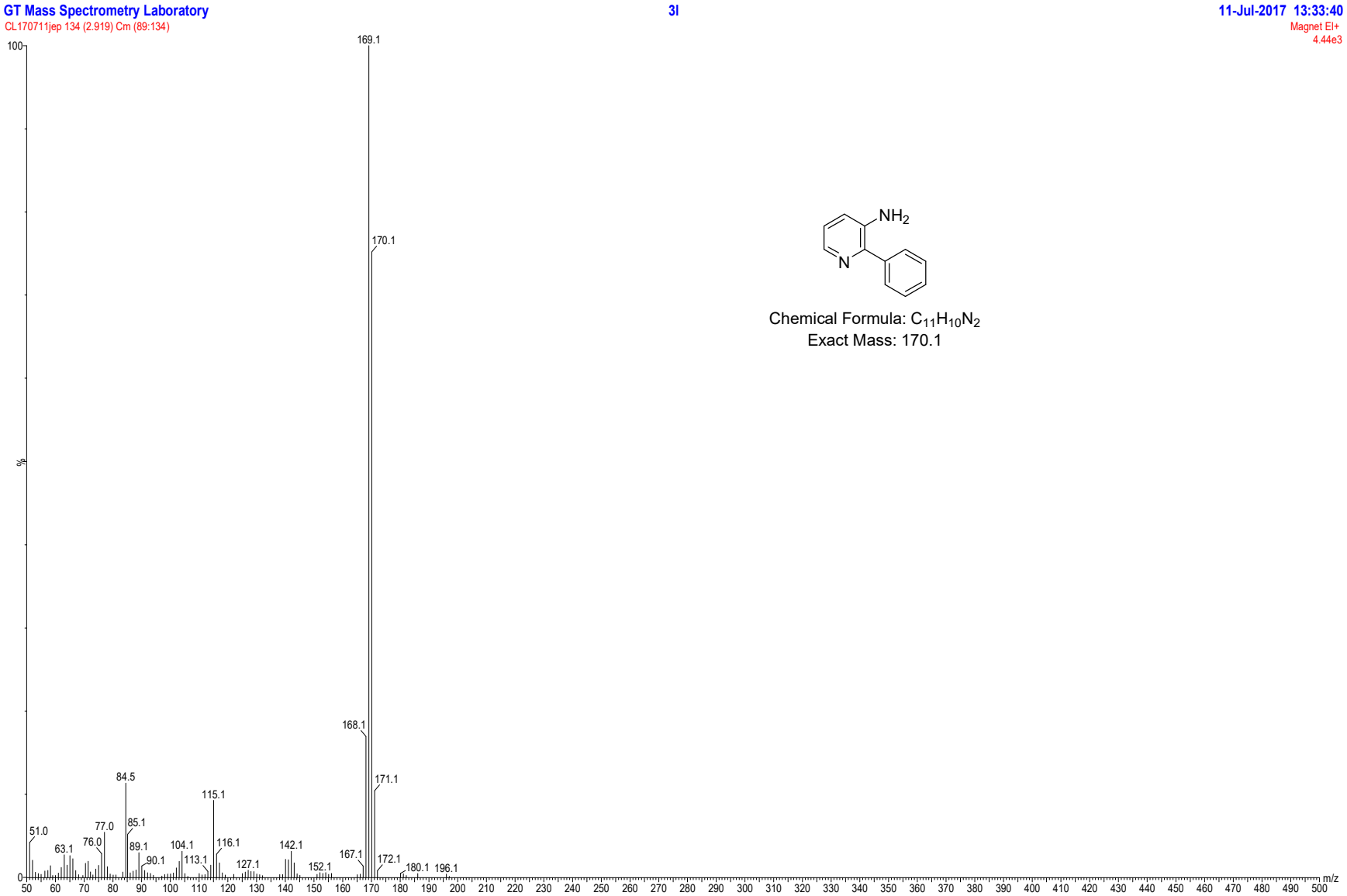


Figure S48. MS (EI) spectrum of 3-amino-2-phenylpyridine (**3l**)

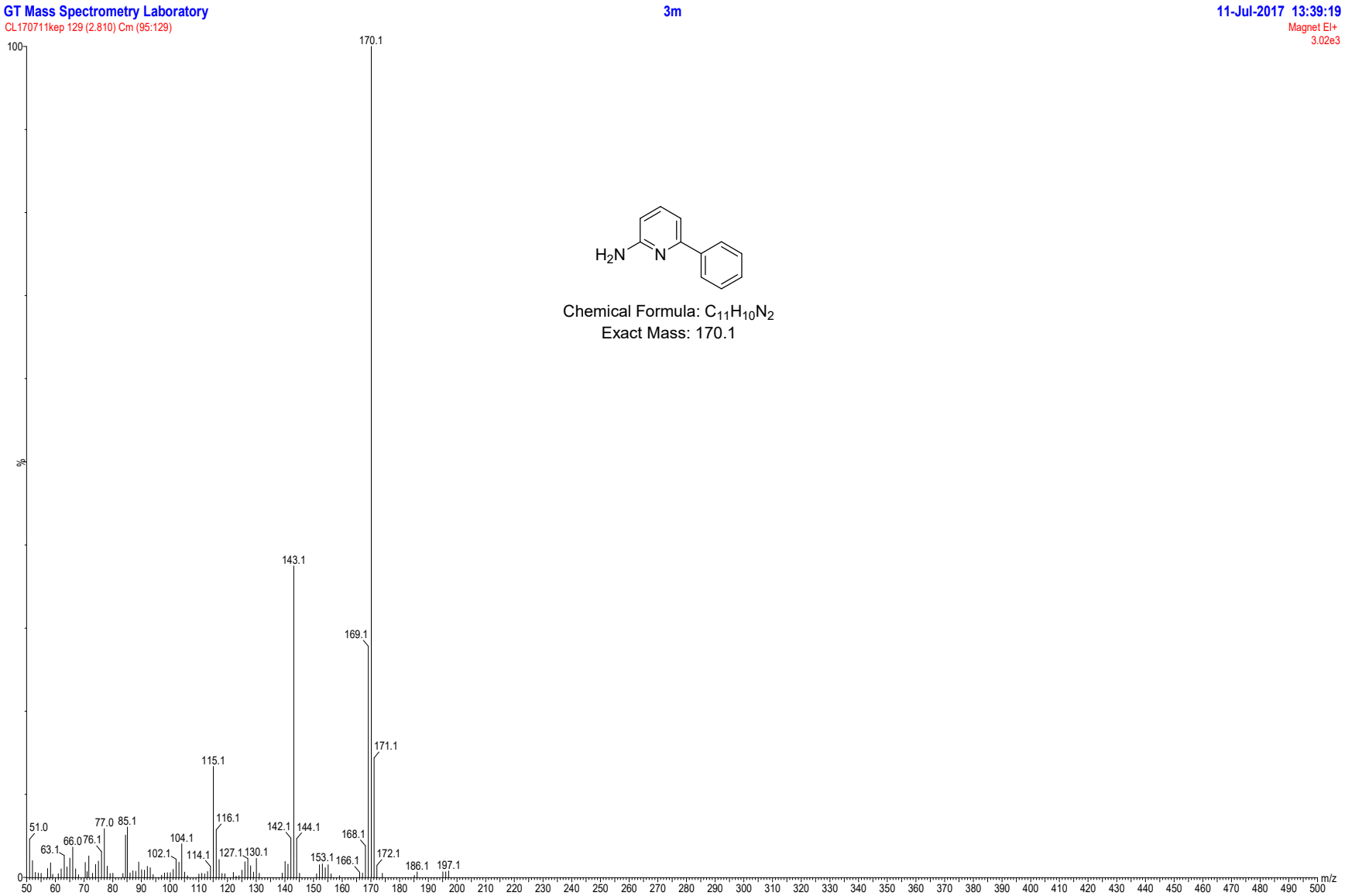


Figure S49. MS (EI) spectrum of 2-amino-6-phenylpyridine (**3m**)

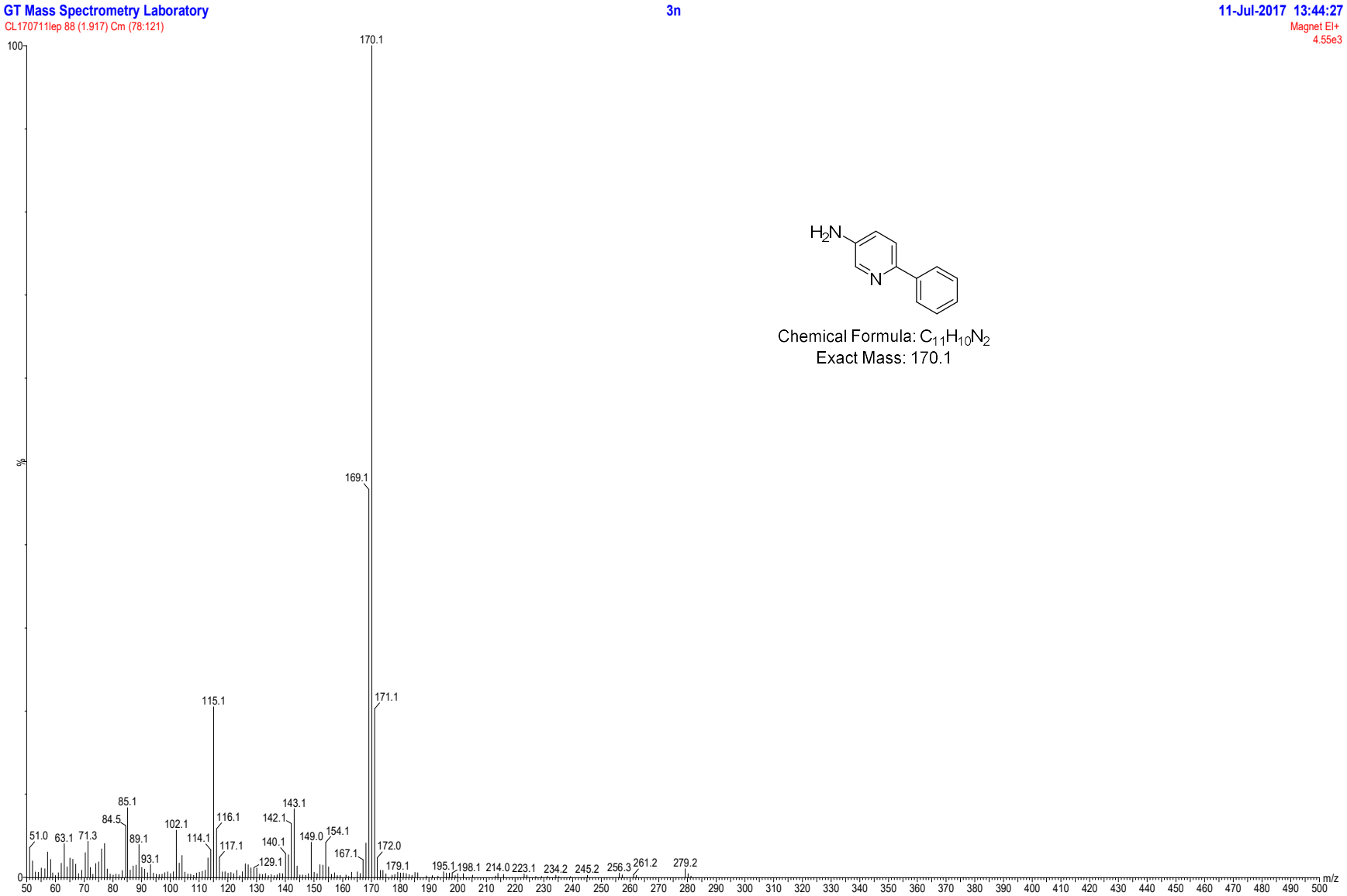


Figure S50. MS (EI) spectrum of 3-amino-6-phenylpyridine (**3n**)

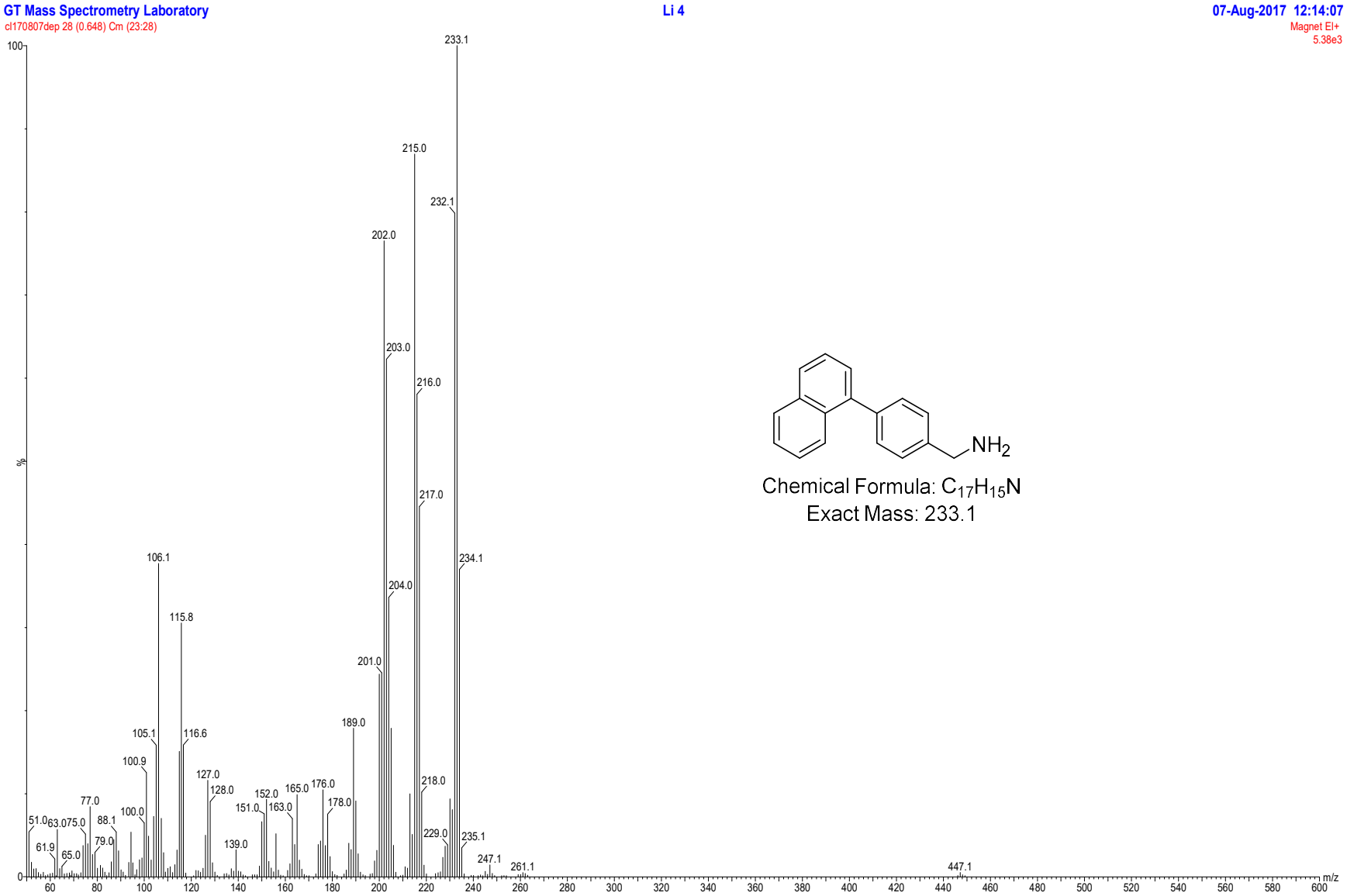


Figure S51. MS (EI) spectrum of 4-(1-naphthalenyl)benzylamine (**4**)

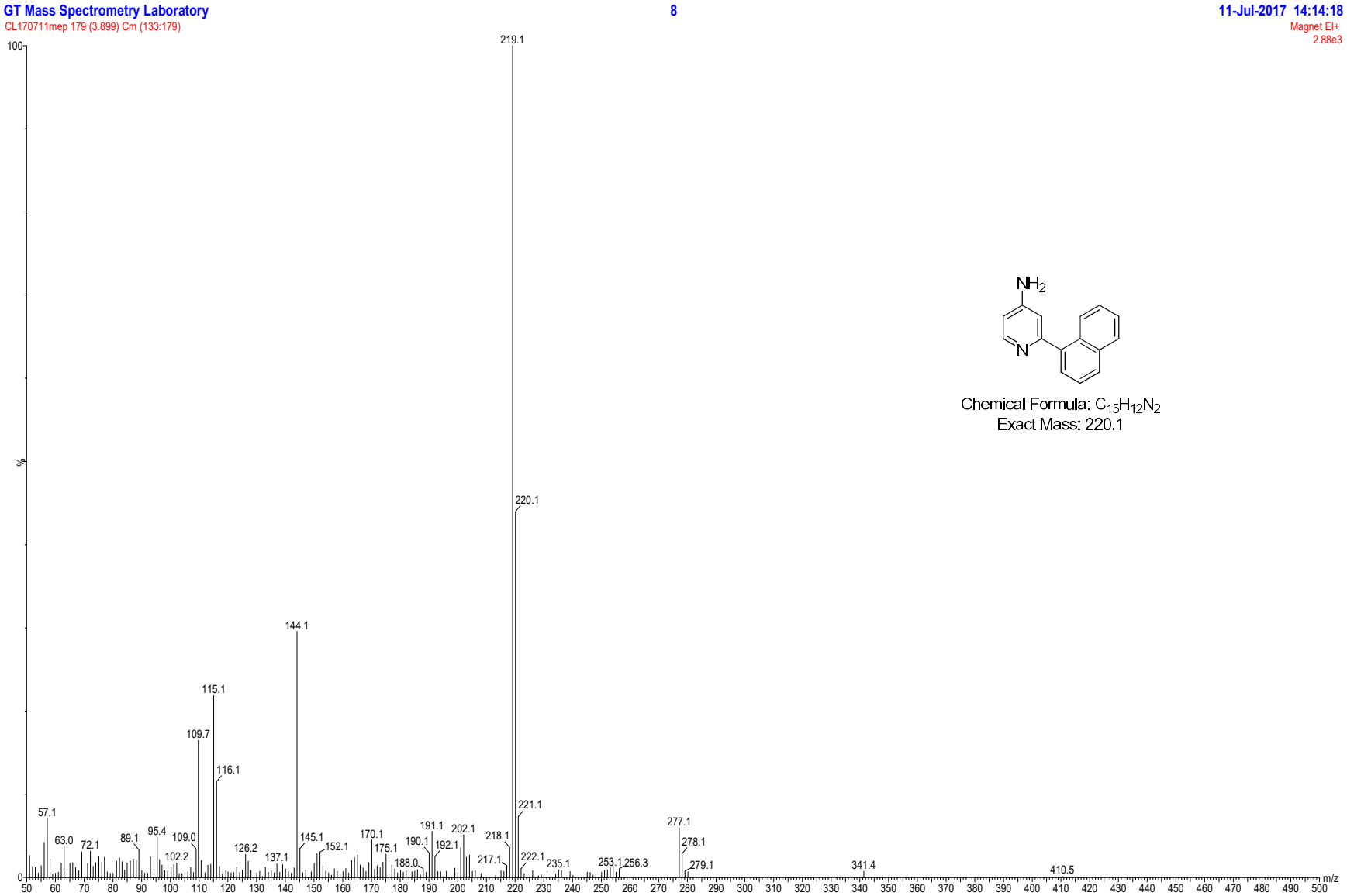


Figure S52. MS (EI) spectrum of 4-amino-2-(1-naphthalenyl)pyridine (**8**)

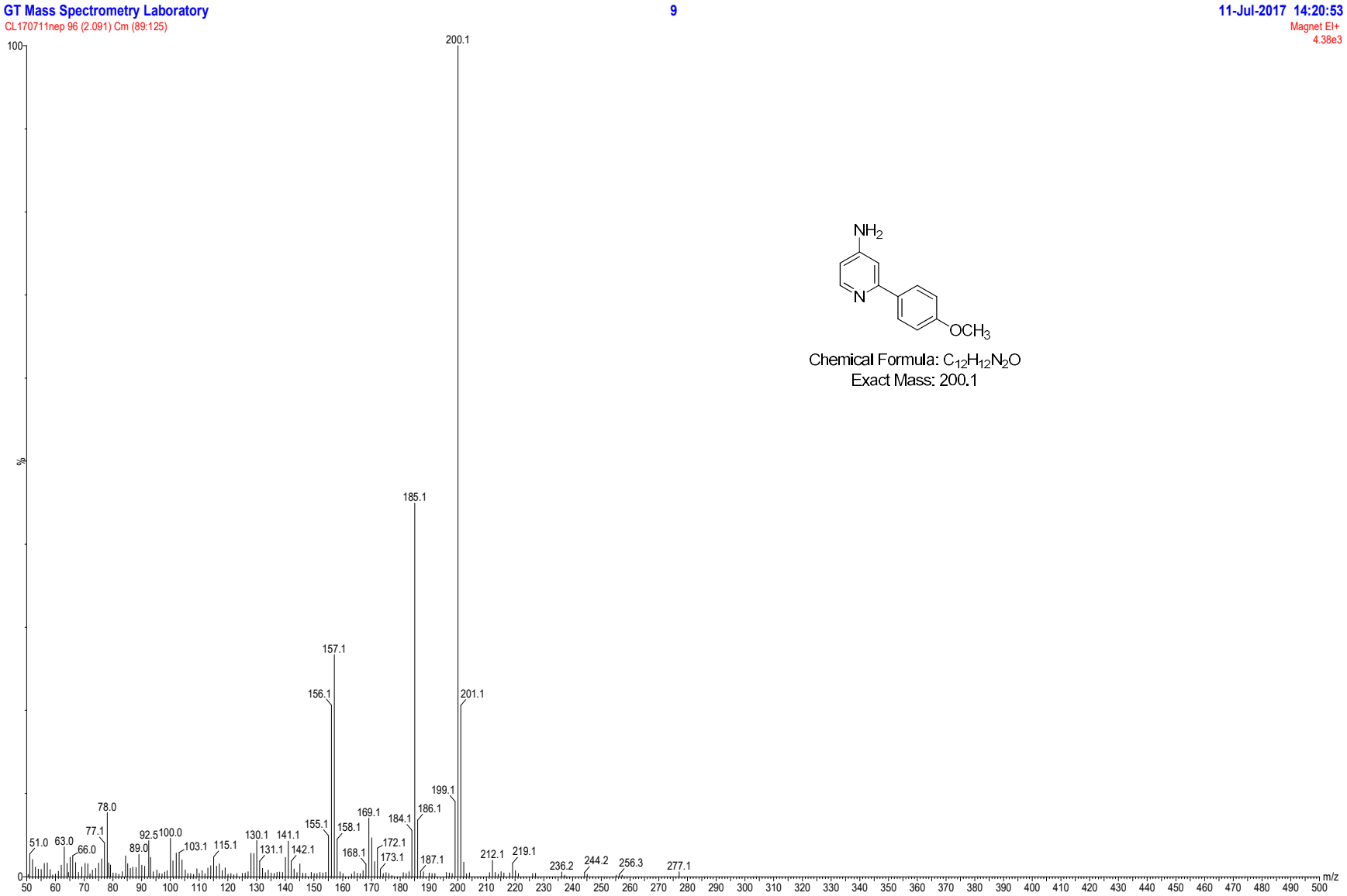


Figure S53. MS (EI) spectrum of 4-amino-2-(4-methoxyphenyl)pyridine (**9**)

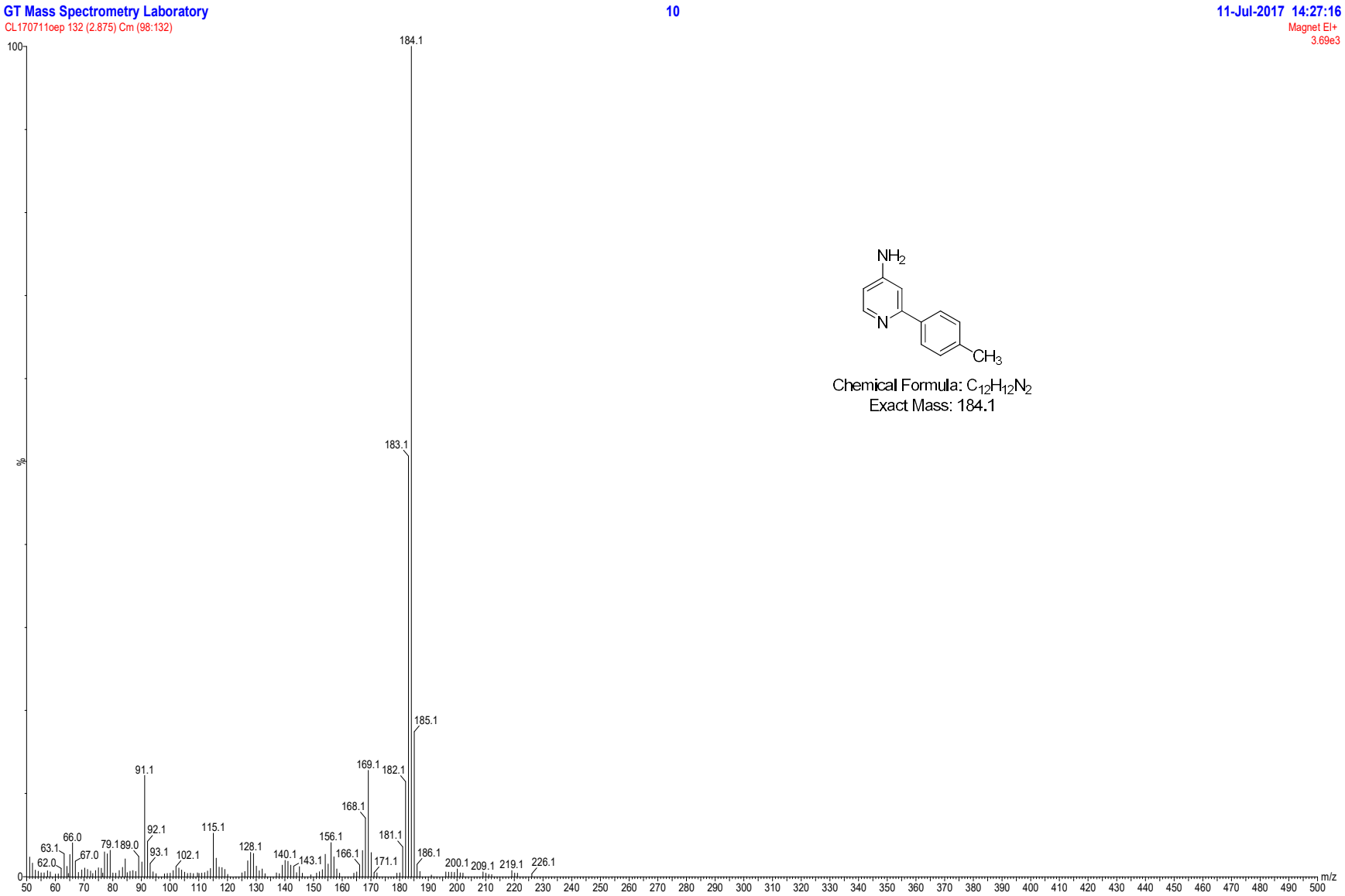


Figure S54. MS (EI) spectrum of 4-amino-2-(4-methylphenyl)pyridine (**10**)

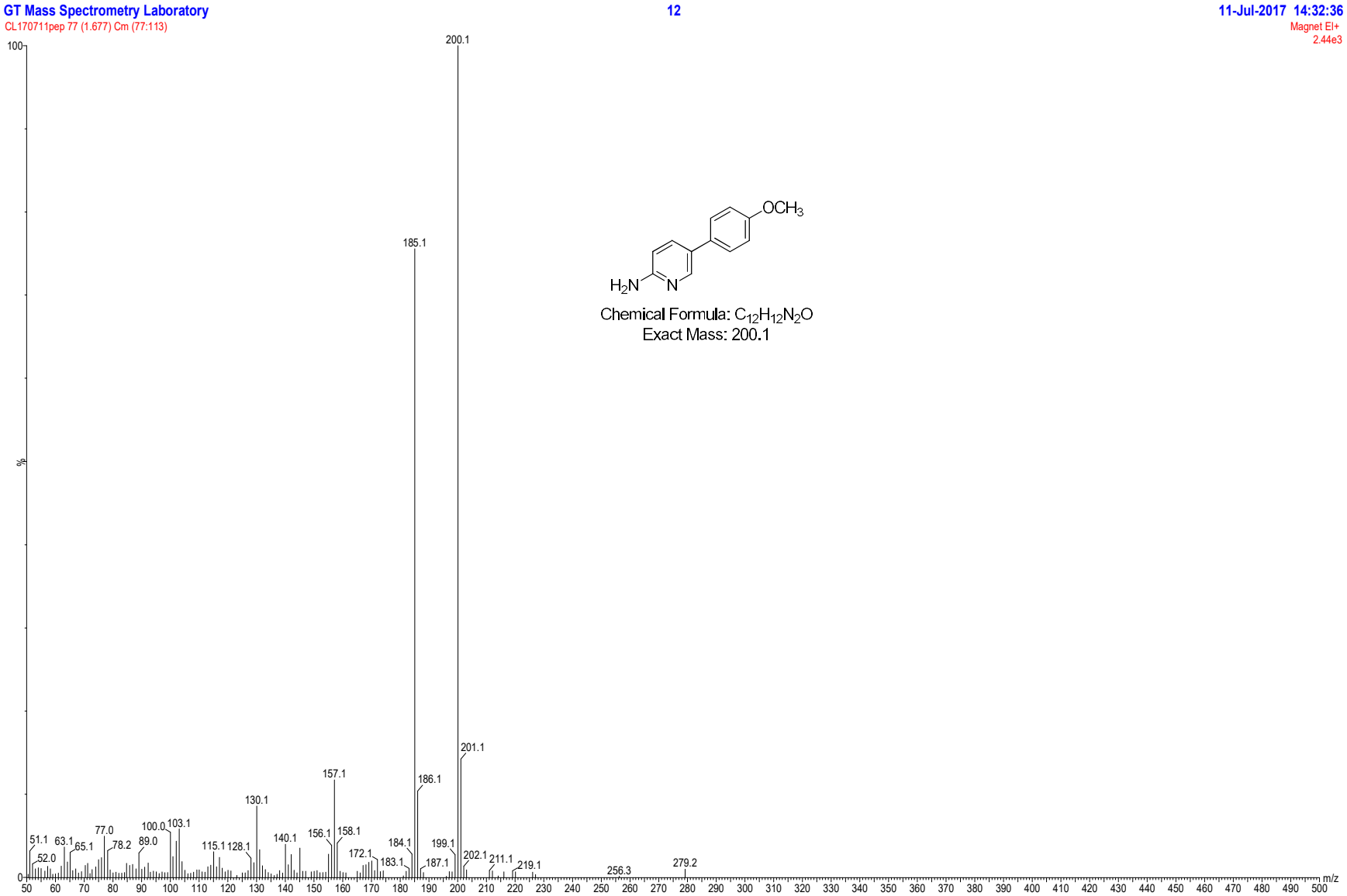


Figure S55. MS (EI) spectrum of 2-amino-5-(4-methoxyphenyl)pyridine (**12**)

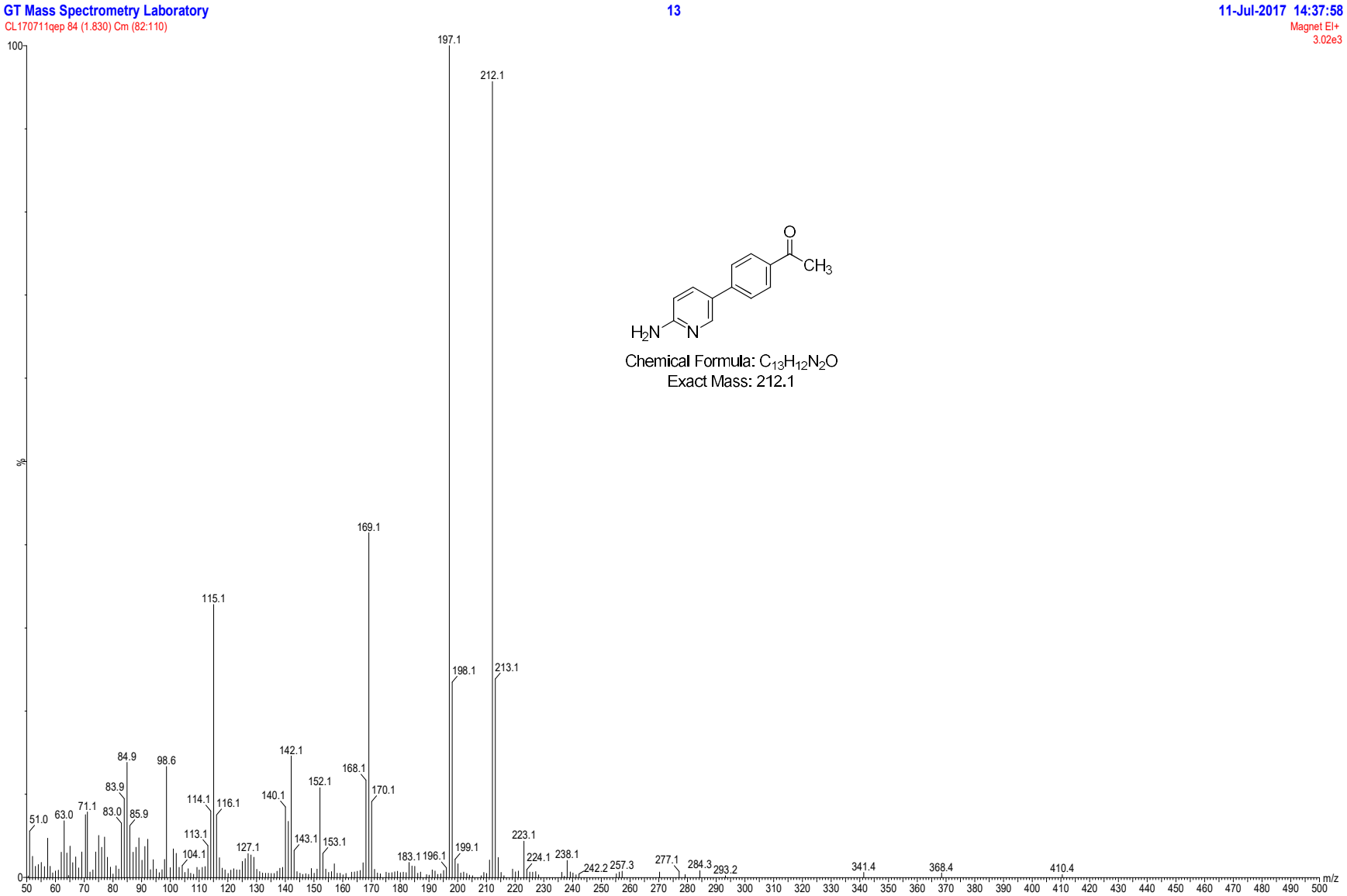


Figure S56. MS (EI) spectrum of 2-amino-5-(4-acetylphenyl)pyridine (**13**)

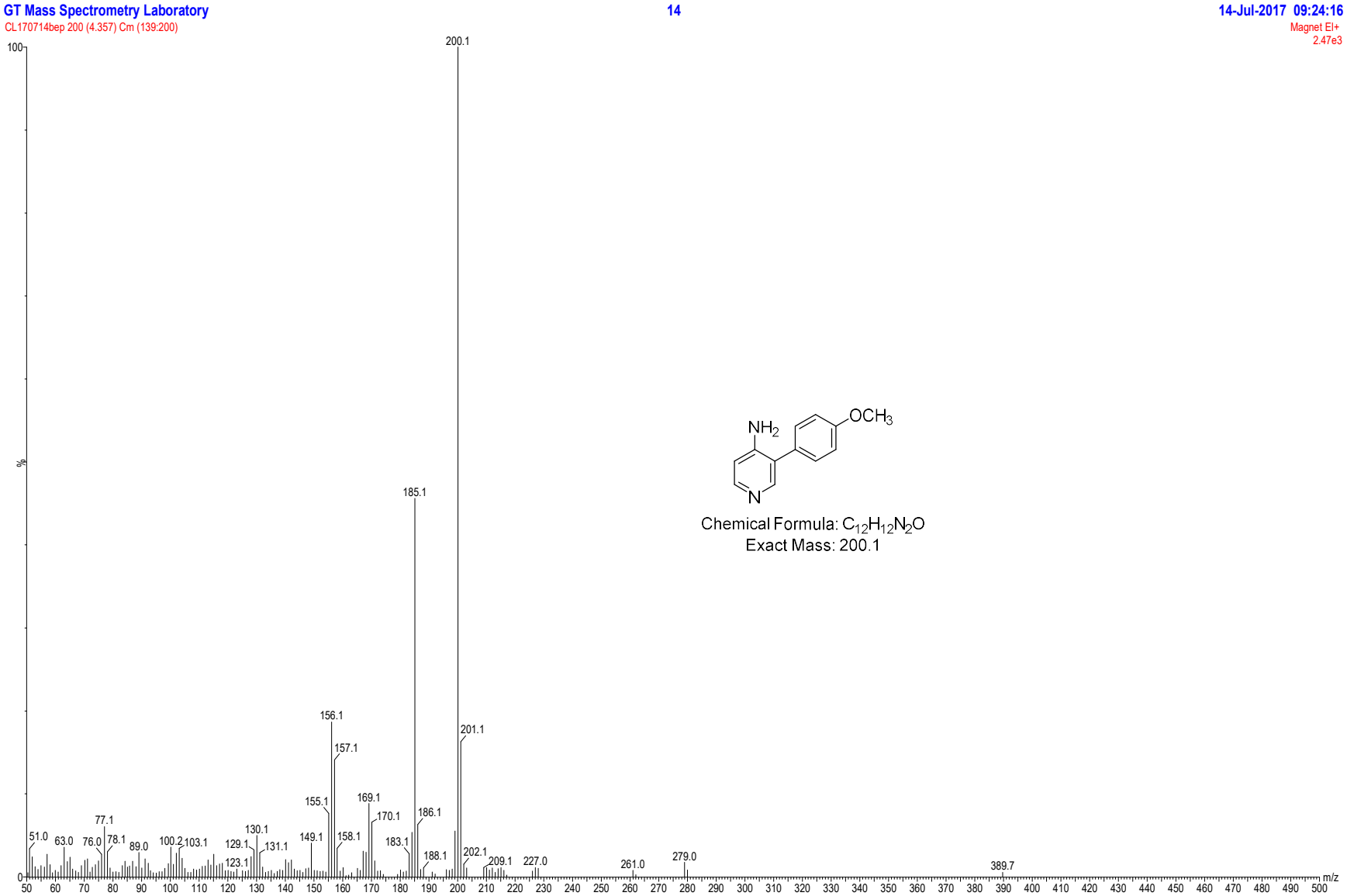


Figure S57. MS (EI) spectrum of 4-amino-3-(4-methoxyphenyl)pyridine (**14**)

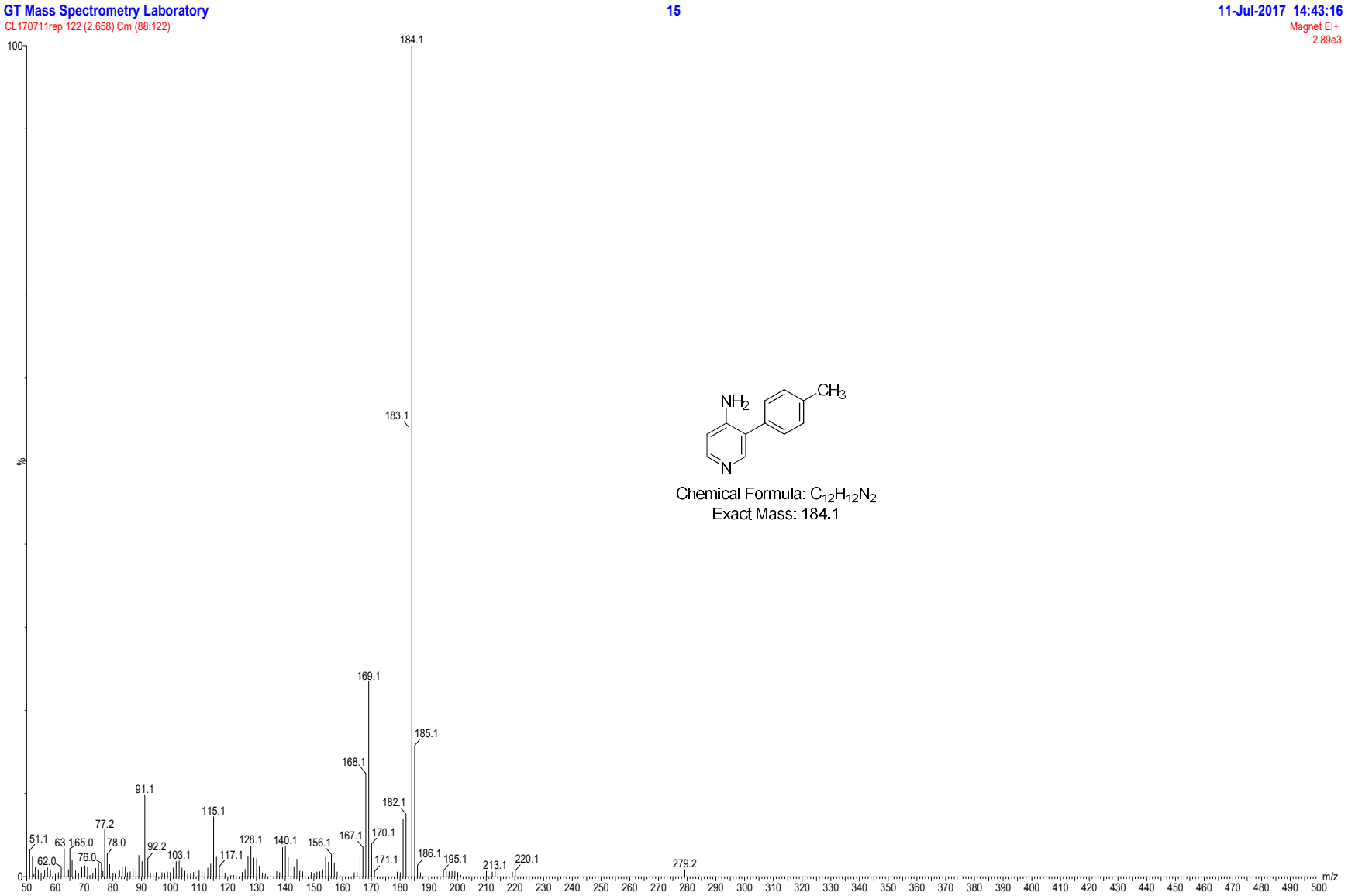


Figure S58. MS (EI) spectrum of 4-amino-3-(4-methylphenyl)pyridine (**15**)

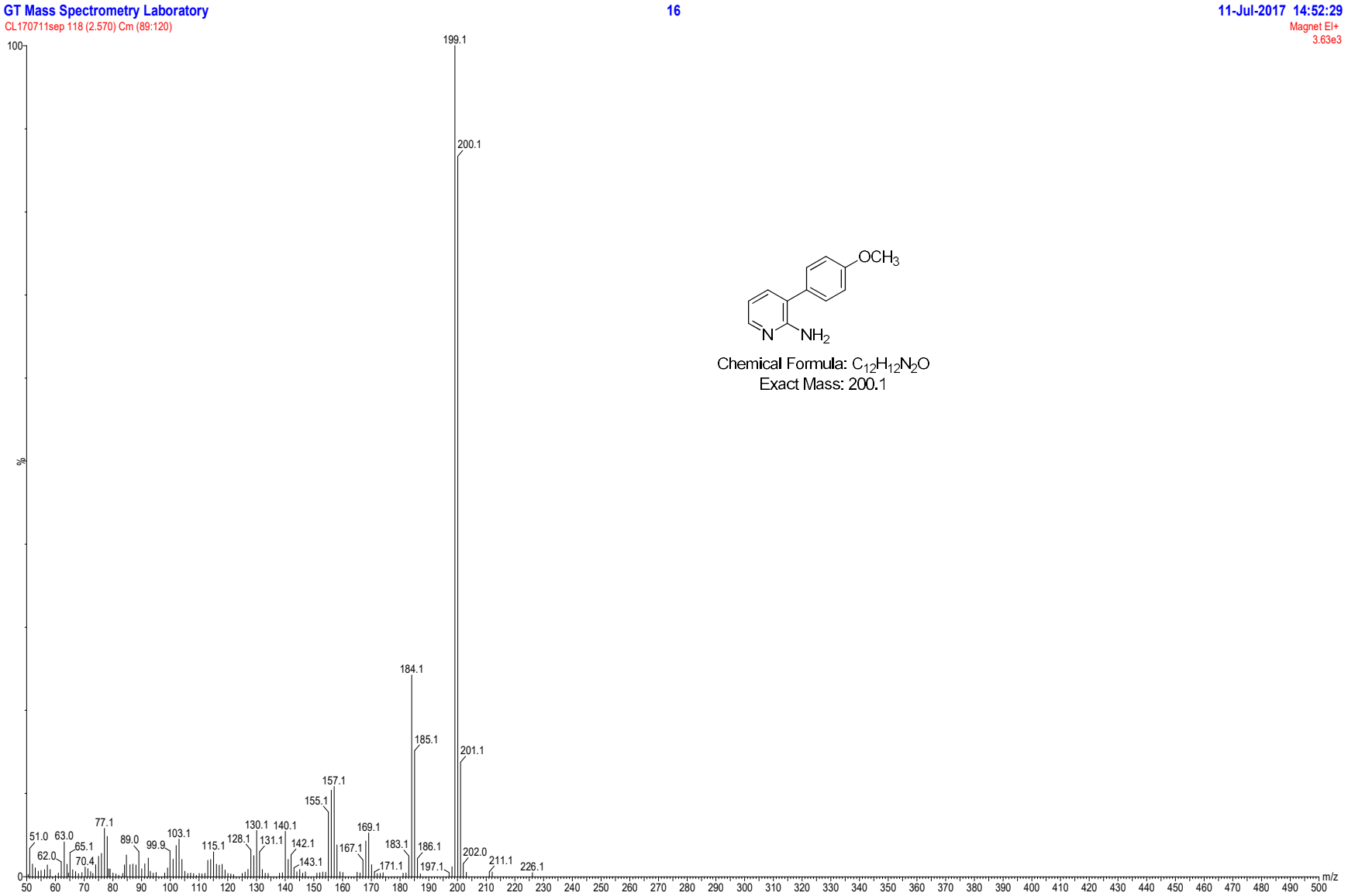


Figure S59. MS (EI) spectrum of 2-amino-3-(4-methoxyphenyl)pyridine (**16**)

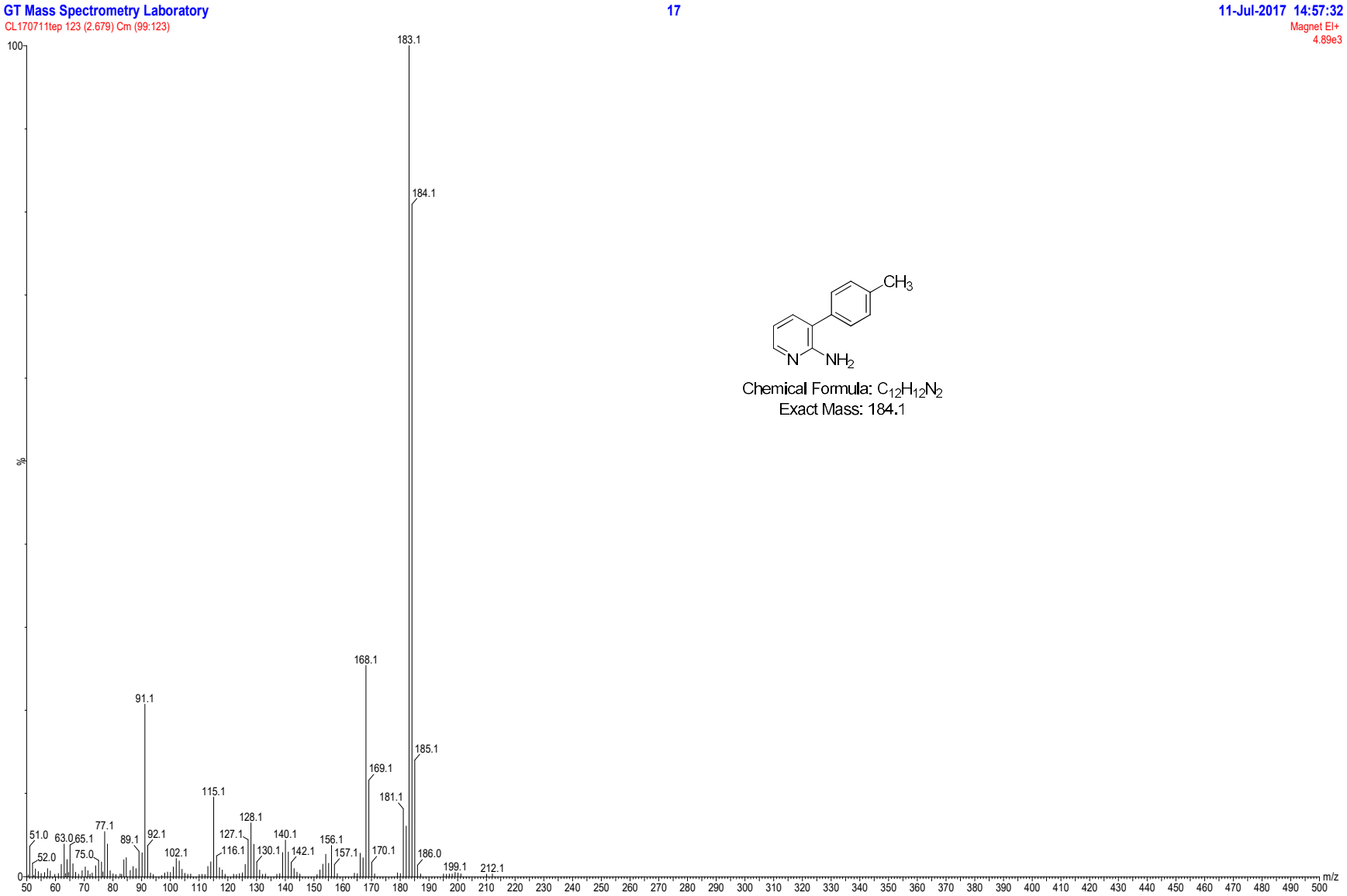


Figure S60. MS (EI) spectrum of 2-amino-3-(4-methylphenyl)pyridine (**17**)

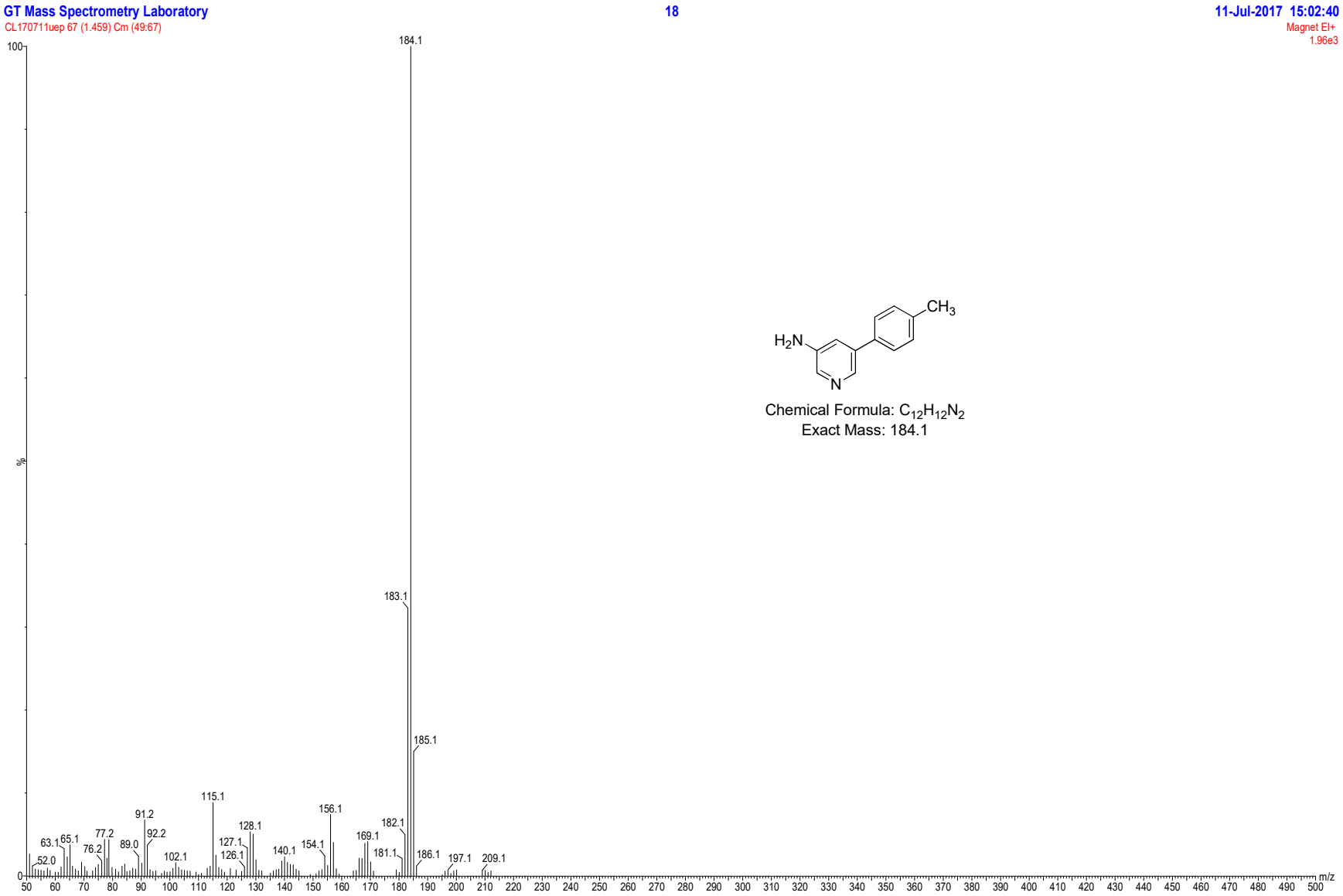


Figure S61. MS (EI) spectrum of 3-amino-5-(4-methylphenyl)pyridine (**18**)

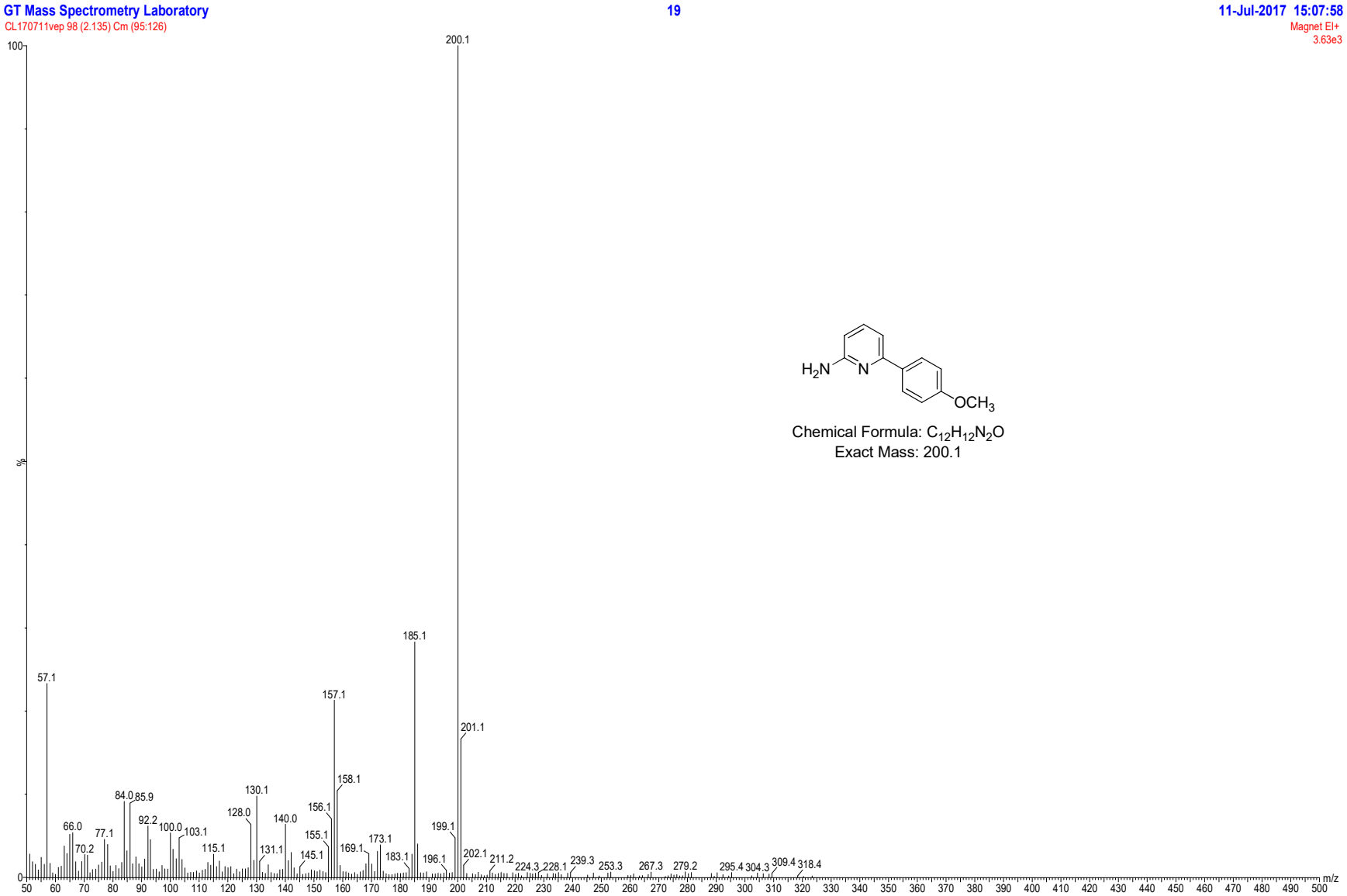


Figure S62. MS (EI) spectrum of 2-amino-6-(4-methoxyphenyl)pyridine (**19**)

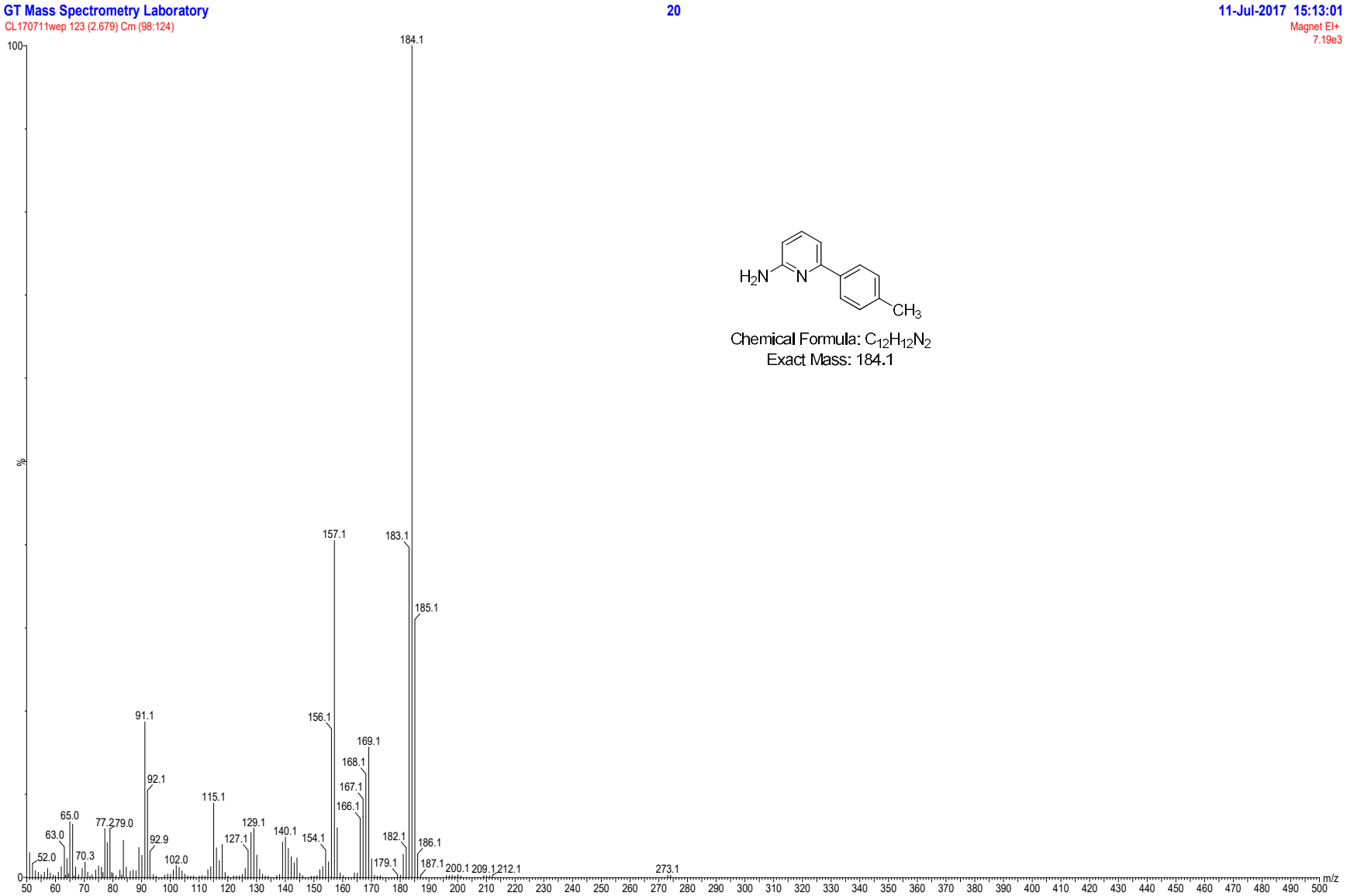


Figure S63. MS (EI) spectrum of 2-amino-6-(4-methylphenyl)pyridine (**20**)

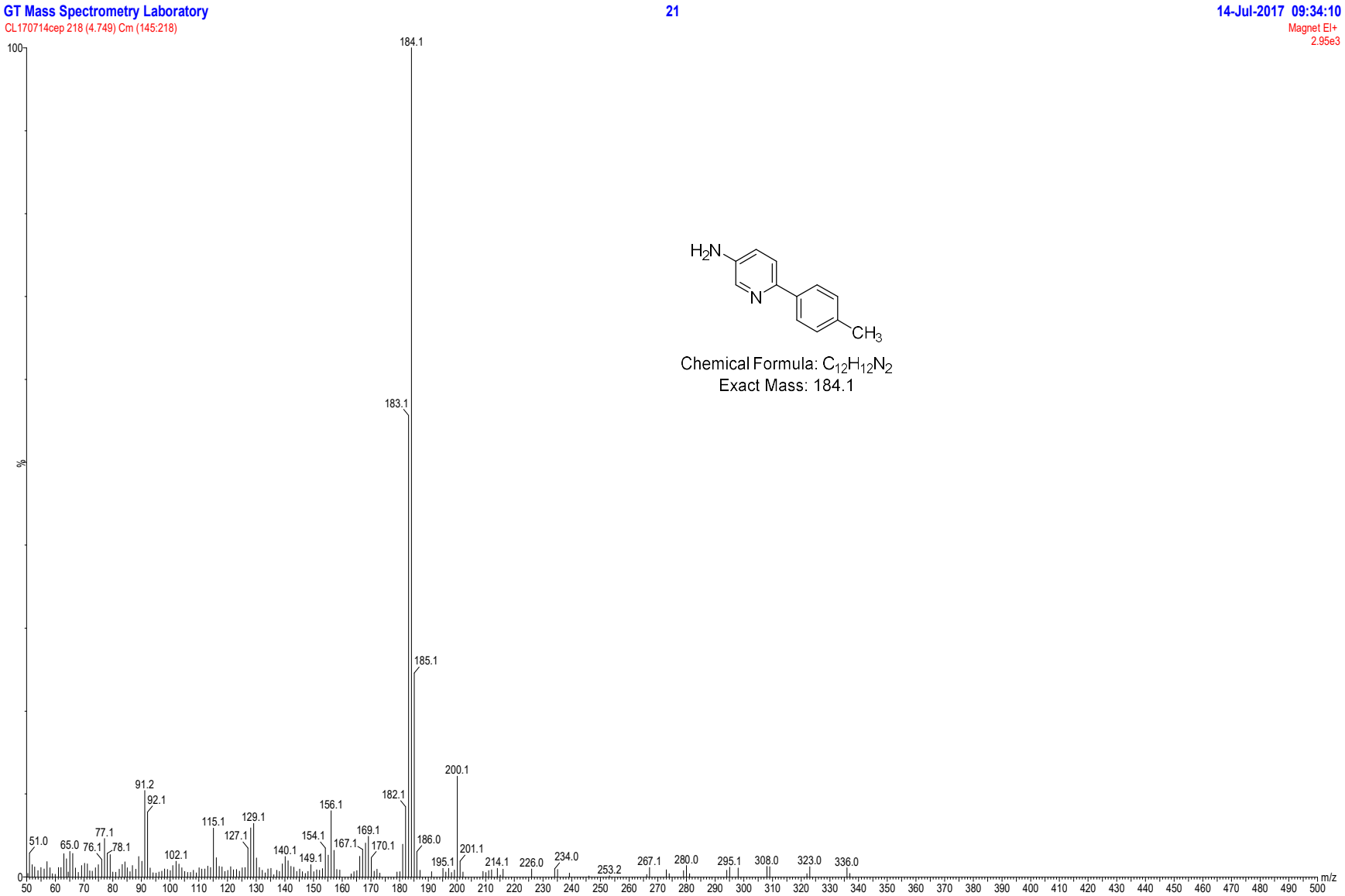


Figure S64. MS (EI) spectrum of 3-amino-6-(4-methylphenyl)pyridine (**21**)

Supplemental Information S14

NMR spectroscopic data for the products (5-7) that have not been successfully isolated

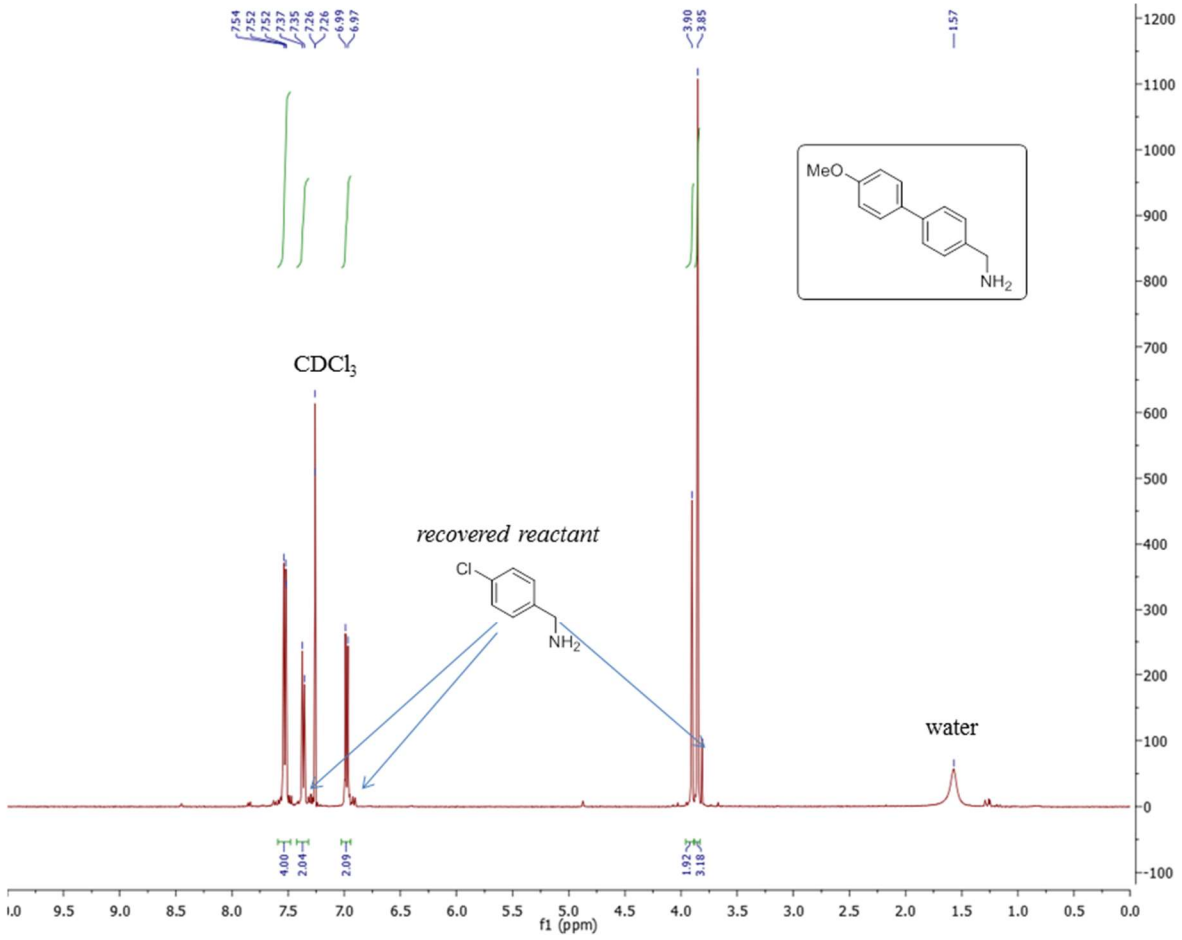


Figure S65. ^{1}H NMR (400 MHz, in $CDCl_3$) spectra of *crude and wet* 4-(4-methoxyphenyl)-benzylamine (**5**) after the chromatographic column separation before drying process.

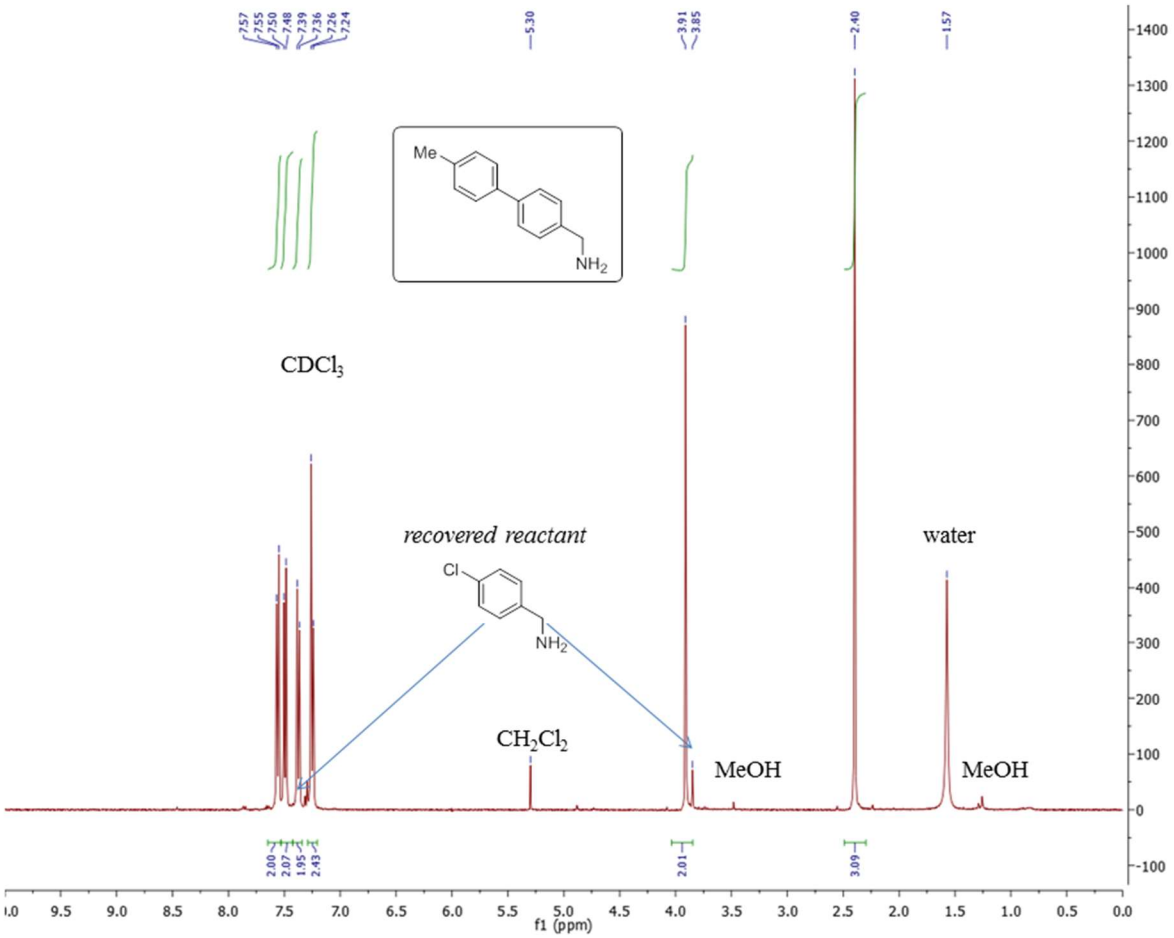


Figure S66. ^{1}H NMR (400 MHz, in $CDCl_3$) spectra of *crude and wet* 4-(4-methylphenyl)-benzylamine (**6**) after the chromatographic column separation before drying process.

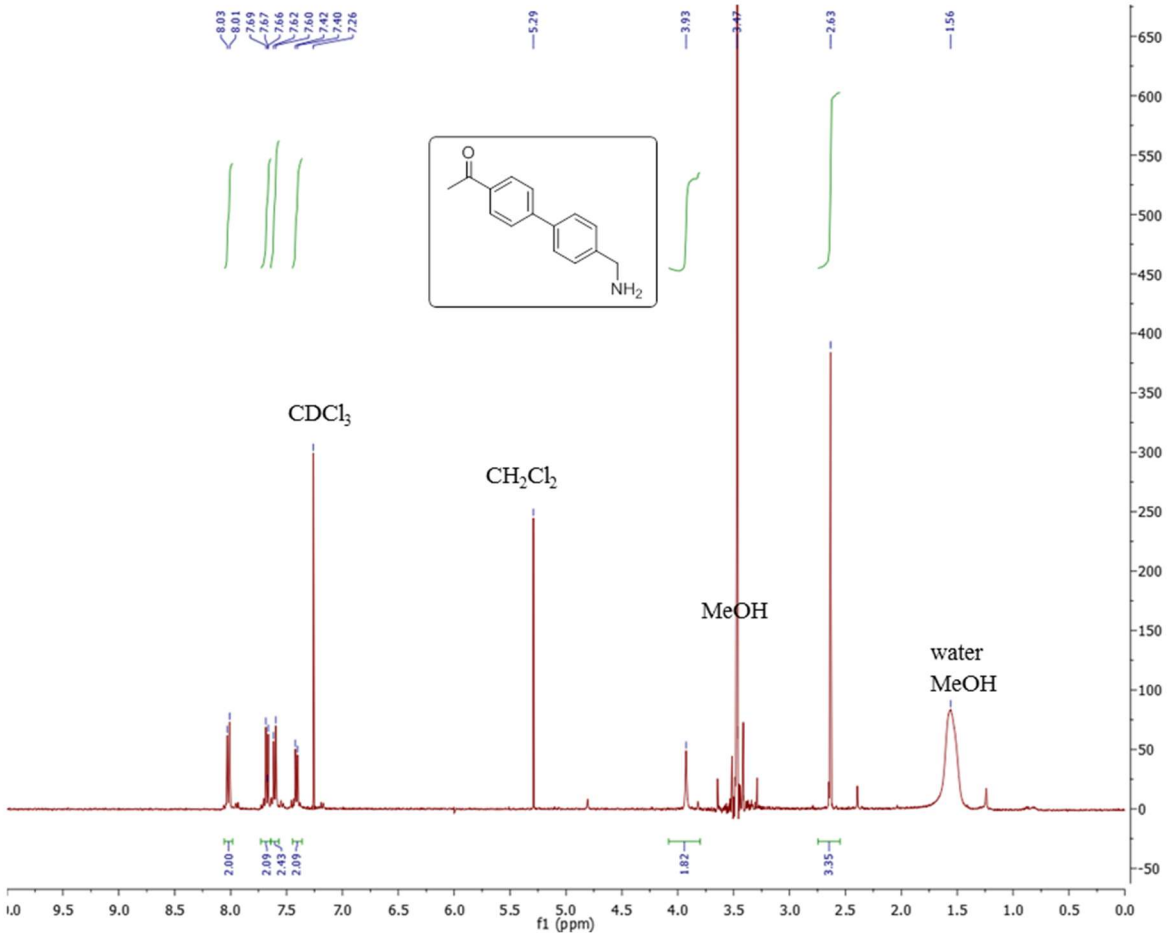


Figure S67. ^{1}H NMR (400 MHz, in $CDCl_3$) spectra of *crude and wet* 4-(4-acetophenyl)-benzylamine (**7**) after the chromatographic column separation before drying process.