Electronic supplementary information (ESI)

Novel 3-substituted fluorine imidazolium/triazolium salt derivatives: Synthesis and antitumor activity

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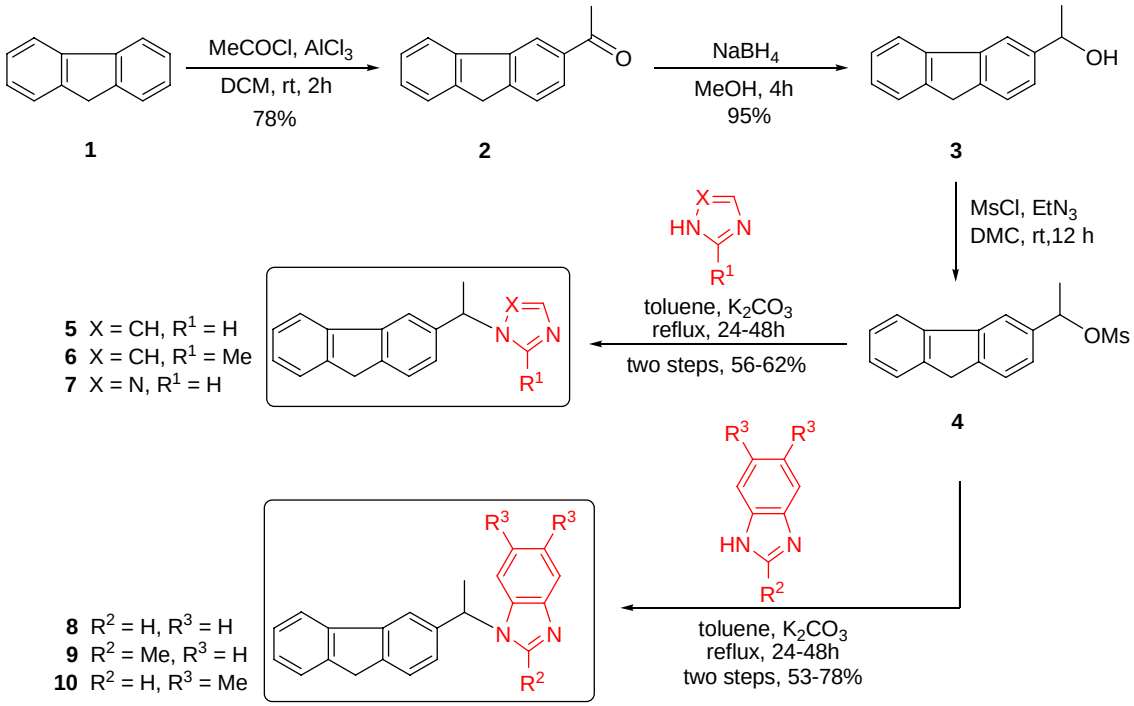
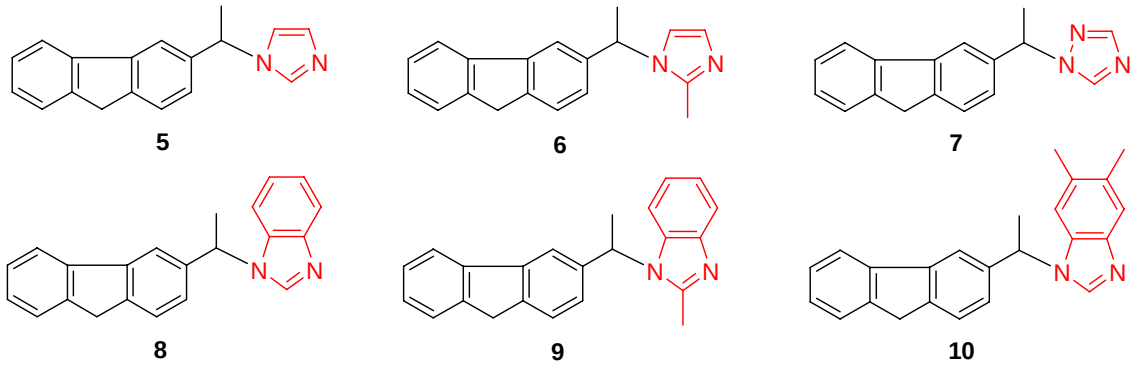
1. General Experimental

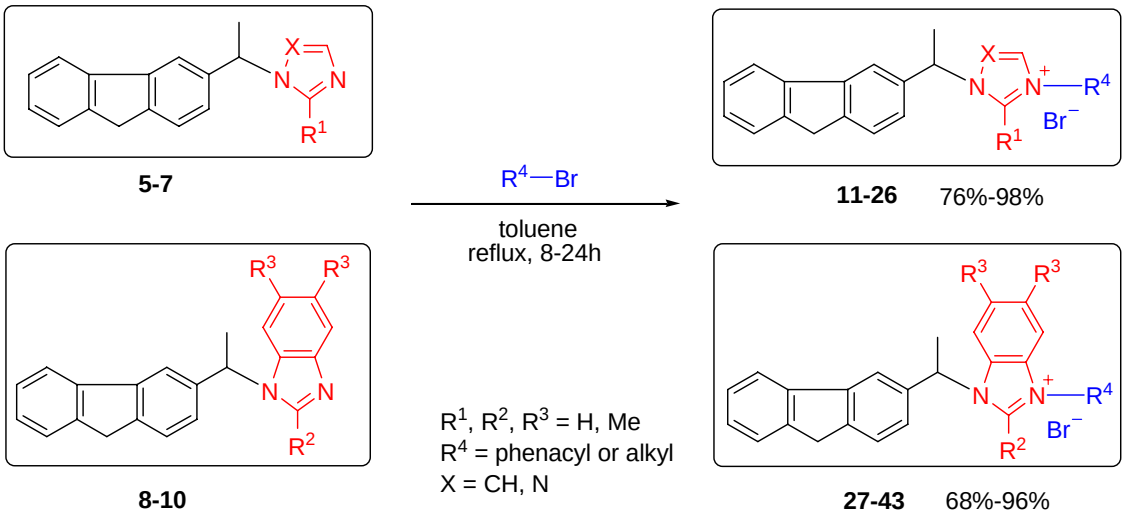
Melting points were obtained on a XT-4 melting-point apparatus and were uncorrected. Proton nuclear magnetic resonance (^{1}H-NMR) spectra were recorded on a BrukerAvance 300 spectrometer at 300 MHz. Carbon-13 nuclear magnetic resonance (^{13}C-NMR) was recorded on BrukerAvance 300 spectrometer at 75 MHz. Chemical shifts are reported as δ values in parts per million (ppm) relative to tetramethylsilane (TMS) for all recorded NMR spectra. Low-resolution Mass spectra were recorded on a VG Auto Spec-3000 magnetic sector MS spectrometer. High Resolution Mass spectra were taken on AB QSTAR Pulsar mass spectrometer.

Silica gel (200–300 mesh) for column chromatography and silica GF_{254} for TLC were produced by Qingdao Marine Chemical Company (China). All air- or moisture-sensitive reactions were conducted under an argon atmosphere. Starting materials and reagents used in reactions were obtained commercially from Acros, Aldrich, Fluka and were used without purification, unless otherwise indicated.

2. Experimental Procedures and Analytical Data



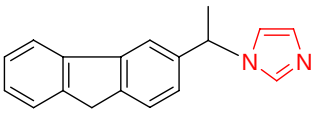




Synthesis of 3-substituted fluorene–imidazolium/triazolium salt derivatives **11-43**.

Entry	Compound no.	Imidazole/triazole ring	R^4	Molecular formula	Mp (^oC)	Yields (%)
1	**5**	imidazole	–	$C_{18}H_{16}N_2$	188-190	62
2	**6**	2-methyl-imidazole	–	$C_{19}H_{18}N_2$	134-136	56
3	**7**	triazole	–	$C_{17}H_{15}N_3$	108-110	58
4	**8**	benzimidazole	–	$C_{22}H_{18}N_2$	179-181	78
5	**9**	2-methyl-benzimidazole	–	$C_{23}H_{20}N_2$	166-168	53
6	**10**	5,6-dimethyl-benzimidazole	–	$C_{24}H_{22}N_2$	182-184	60
7	**11**	imidazole	4-bromobenzyl	$C_{25}H_{22}Br_2N_2$	173-175	98
8	**12**	imidazole	phenacyl	$C_{26}H_{23}BrN_2O$	220-222	97
9	**13**	imidazole	4-bromophenacyl	$C_{26}H_{22}Br_2N_2O$	229-231	96
10	**14**	imidazole	4-fluorophenacyl	$C_{26}H_{22}BrFN_2O$	228-230	86
11	**15**	imidazole	4-methoxyphenacyl	$C_{27}H_{25}BrN_2O_2$	234-236	95
12	**16**	imidazole	naphthylacyl	$C_{30}H_{25}BrN_2O$	219-221	94
13	**17**	2-methyl-imidazole	4-bromobenzyl	$C_{26}H_{24}Br_2N_2$	215-217	85
14	**18**	2-methyl-imidazole	phenacyl	$C_{27}H_{25}BrN_2O$	158-160	80
15	**19**	2-methyl-imidazole	4-bromophenacyl	$C_{27}H_{24}Br_2N_2O$	193-195	89
16	**20**	2-methyl-imidazole	4-methoxyphenacyl	$C_{28}H_{27}BrN_2O_2$	195-197	88
17	**21**	2-methyl-imidazole	naphthylacyl	$C_{31}H_{27}BrN_2O$	170-172	90
18	**22**	triazole	4-bromobenzyl	$C_{24}H_{21}Br_2N_3$	112-114	80

19	**23**	triazole	phenacyl	$C_{25}H_{22}BrN_3O$	150-152	78
20	**24**	triazole	4-bromophenacyl	$C_{25}H_{21}Br_2N_3O$	190-192	76
21	**25**	triazole	4-methoxyphenacyl	$C_{26}H_{24}BrN_3O_2$	172-174	85
22	**26**	triazole	naphthylacyl	$C_{29}H_{24}BrN_3O$	153-155	80
23	**27**	benzimidazole	4-bromobenzyl	$C_{29}H_{24}Br_2N_2$	182-184	90
24	**28**	benzimidazole	phenacyl	$C_{30}H_{25}BrN_2O$	149-151	83
25	**29**	benzimidazole	4-bromophenacyl	$C_{30}H_{24}Br_2N_2O$	174-176	86
26	**30**	benzimidazole	4-methoxyphenacyl	$C_{31}H_{27}BrN_2O_2$	163-165	92
27	**31**	benzimidazole	naphthylacyl	$C_{34}H_{27}BrN_2O$	164-166	88
28	**32**	2-methyl-benzimidazole	4-bromobenzyl	$C_{30}H_{26}Br_2N_2$	191-193	80
29	**33**	2-methyl-benzimidazole	phenacyl	$C_{31}H_{27}BrN_2O$	203-205	76
30	**34**	2-methyl-benzimidazole	4-bromophenacyl	$C_{31}H_{26}Br_2N_2O$	165-167	76
31	**35**	2-methyl-benzimidazole	4-fluorophenacyl	$C_{31}H_{26}BrFN_2O$	165-167	70
32	**36**	2-methyl-benzimidazole	4-methoxyphenacyl	$C_{32}H_{29}BrN_2O_2$	157-159	89
33	**37**	2-methyl-benzimidazole	naphthylacyl	$C_{35}H_{29}BrN_2O$	165-167	80
34	**38**	5,6-dimethyl-benzimidazole	4-bromobenzyl	$C_{31}H_{28}Br_2N_2$	172-174	95
35	**39**	5,6-dimethyl-benzimidazole	phenacyl	$C_{32}H_{29}BrN_2O$	173-175	82
36	**40**	5,6-dimethyl-benzimidazole	4-bromophenacyl	$C_{32}H_{28}Br_2N_2O$	176 -178	70
37	**41**	5,6-dimethyl-benzimidazole	4-fluorophenacyl	$C_{32}H_{29}BrFN_2O$	172-174	82
38	**42**	5,6-dimethyl-benzimidazole	4-methoxyphenacyl	$C_{33}H_{31}BrN_2O_2$	239-241	96
39	**43**	5,6-dimethyl-benzimidazole	naphthylacyl	$C_{36}H_{31}BrN_2O$	244-246	92



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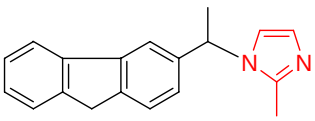

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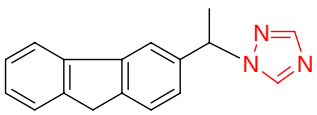

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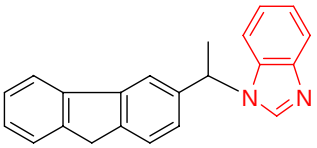

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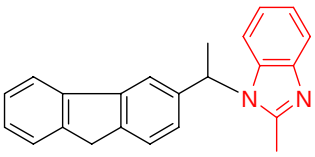

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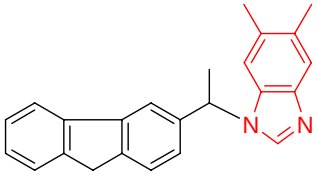

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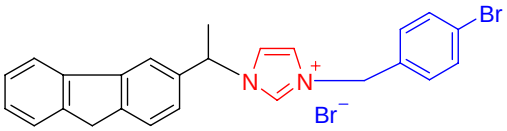

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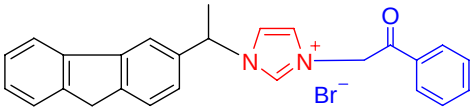

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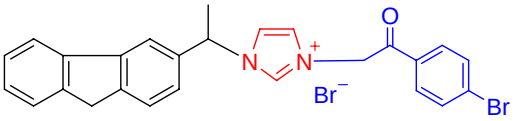

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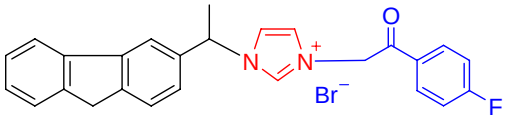

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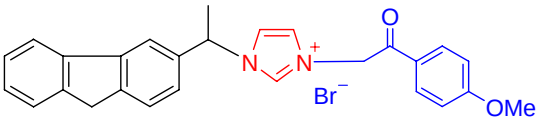

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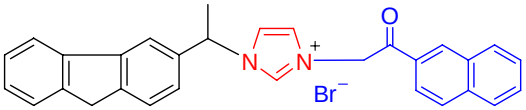

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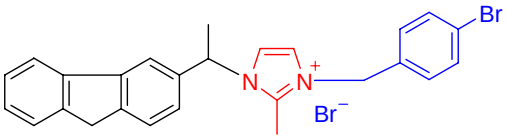

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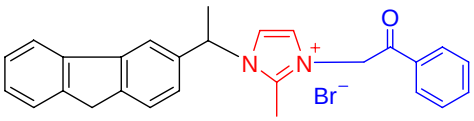

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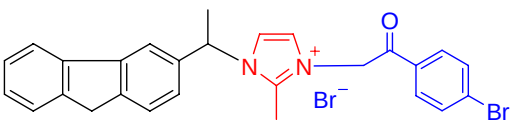

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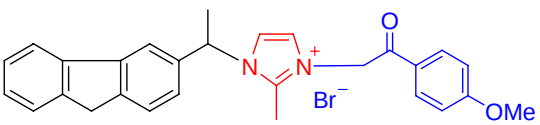

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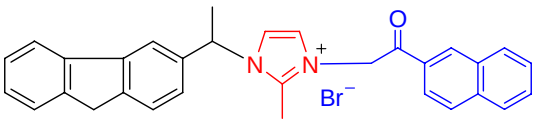

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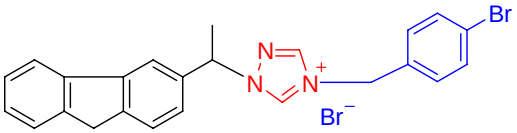

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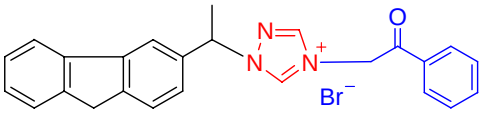

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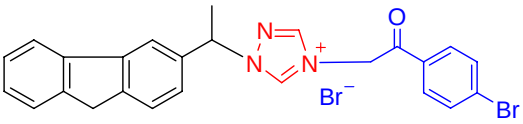

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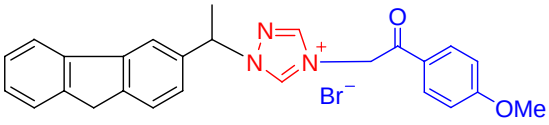

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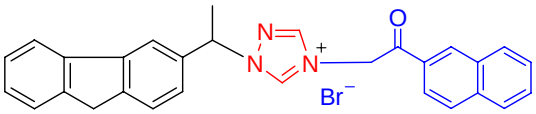

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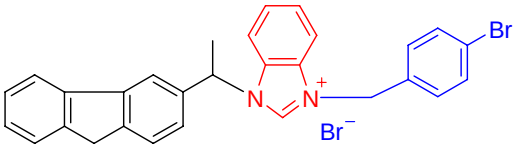

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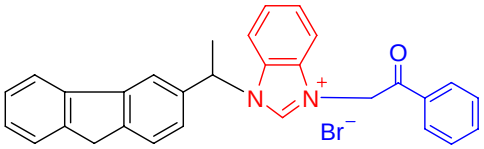

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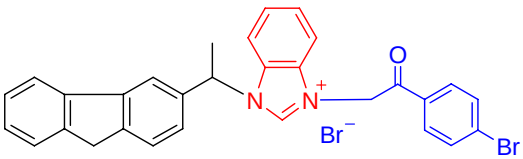

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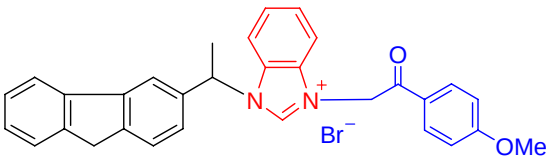

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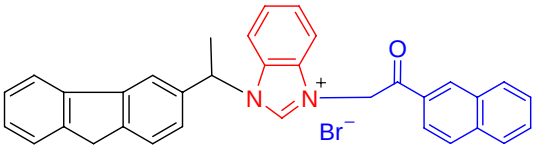

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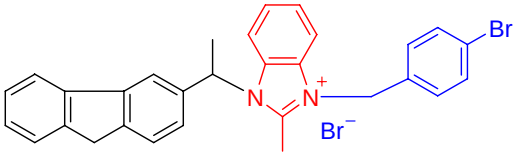

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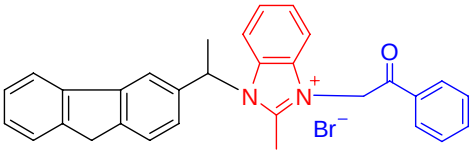

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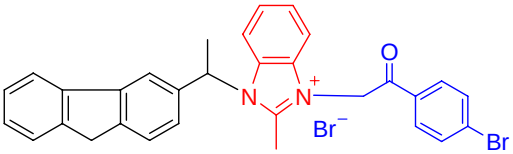

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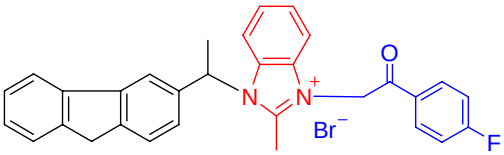

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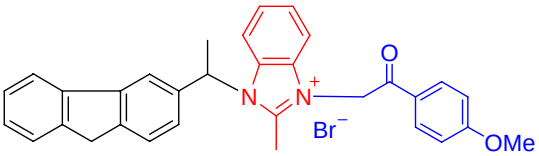

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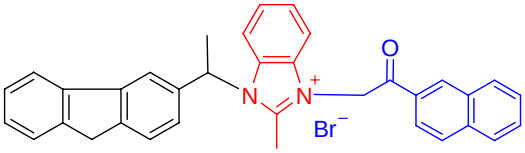

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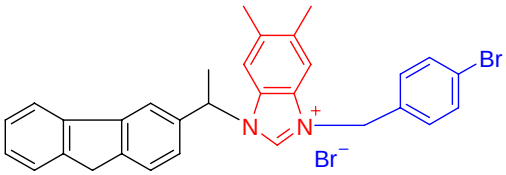

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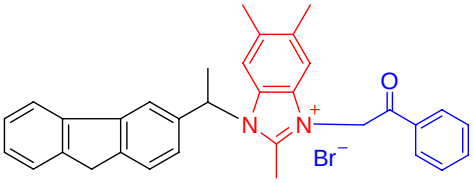

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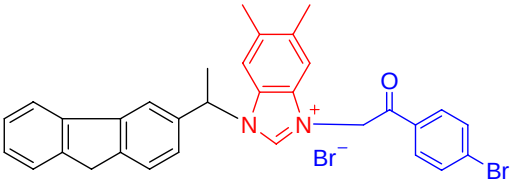

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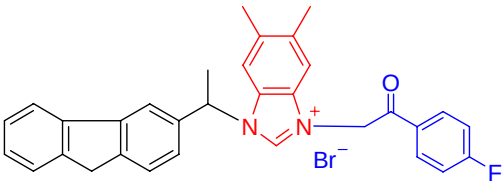

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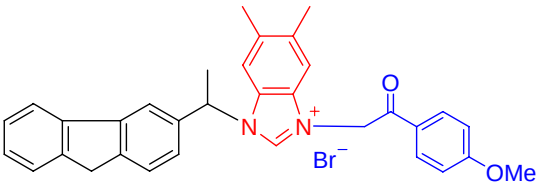

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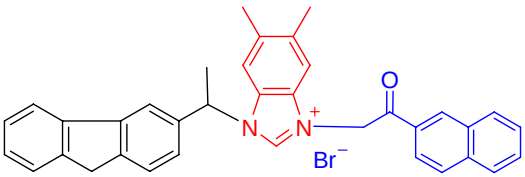

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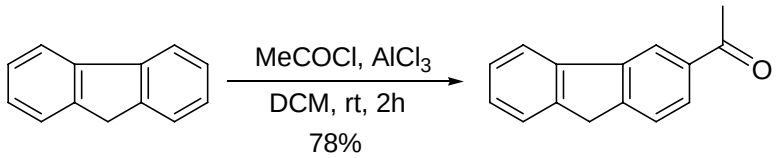
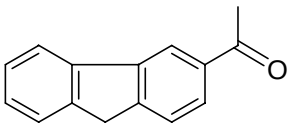
2.1 Synthesis of compound 2



1 **2**

Anhydrous $AlCl_3$ (4.83 g, 36.20 mmol) in dichloromethane (50 mL) was added to acetyl chloride (1.71 g, 21.70 mmol) at 0 °C and then fluorene **1** (3.00 g, 18.10 mmol) in dichloromethane (100 mL) slowly, and then at ambient temperature for 2 h. After the reaction (TLC) was completed, the reaction mixture was quenched with 1 N HCl and extracted with dichloromethane (3 × 100 mL). The combined organic extracts were washed with H_2O, dried over anhydrous Na_2SO_4, filtered, and concentrated in vacuum. The residue was chromatographed on silica gel (petroleum ether 60-90 °C : EtOAc = 15:1) to afford the product **2** (2.94 g, 78%) as white powder.

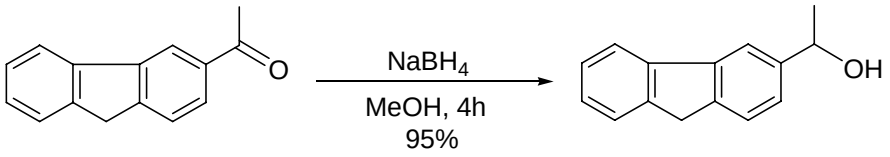


1-(9*H*-fluoren-3-yl)ethanone

2

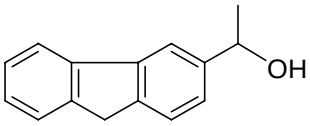
Yield 78%. White solid. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.11 (1H, s), 7.98 (1H, d, J = 7.8 Hz), 7.78-7.83 (2H, dd, J = 12.6, 5.1 Hz), 7.56 (1H, d, J = 6.9 Hz), 7.36-7.40 (2H, m), 3.91 (2H, s), 2.63 (3H, s). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 197.91 (C), 146. 41 (C), 144.51 (C), 143.30 (C), 140.49 (C), 135.66 (C), 128.01 (CH), 127.73 (CH), 12 7.06 (CH), 125.24 (CH), 124.93 (CH), 120.87 (CH), 119.63 (CH), 36.88 (CH_2), 26.72 (CH_3).

2.2 Synthesis of compound 3



2 **3**

To a stirred solution of 1-(9*H*-fluoren-3-yl)ethanone **2** (2.30 g, 11.10 mmol) in methanol (25 mL) at 0 °C was added $NaBH_4$ (0.63 g, 16.65 mmol) in small portions over a period of 20 minutes, and then at ambient temperature for 4 h. Reaction progress was monitored by TLC. A small amount of water was added and the mixture was stirred for 15 min before rotary evaporation. The solvent was evaporated under reduced pressure and the residue was chromatographed on silica gel (petroleum ether 60-90 °C : EtOAc = 10:1) to afford the products **3** (2.21 g, 95%) as white powder.

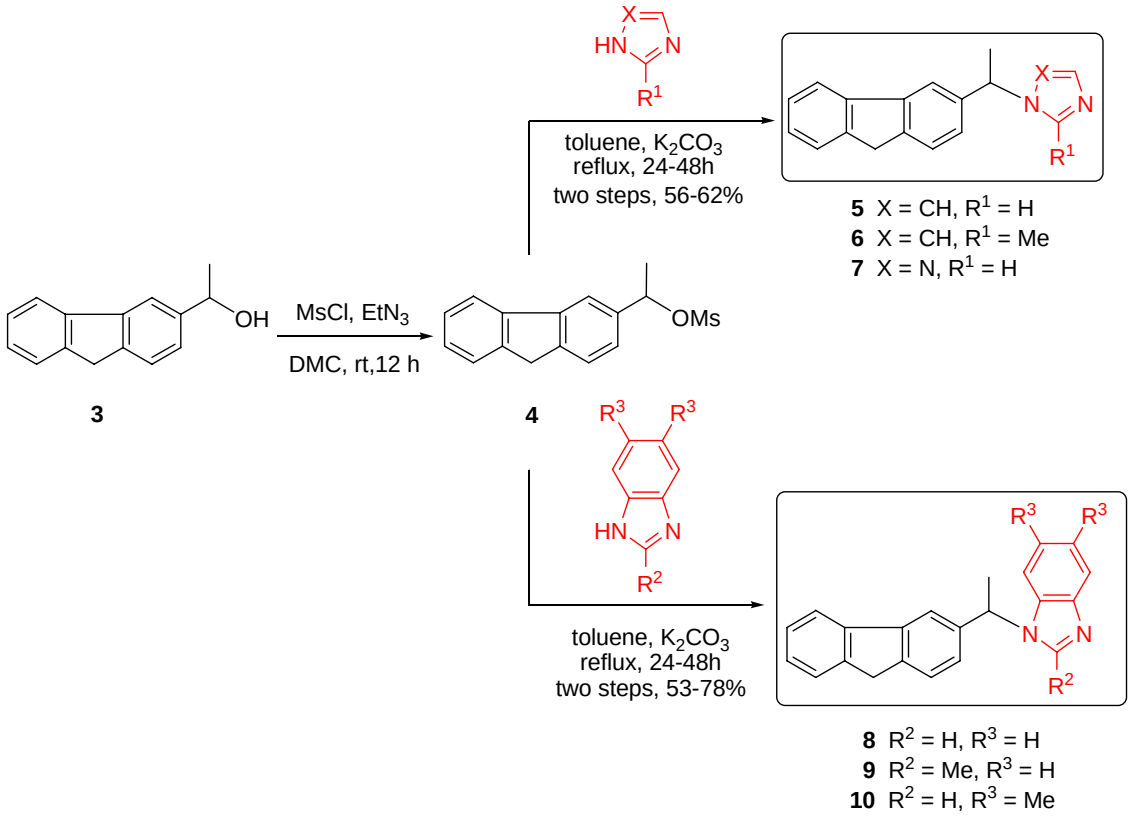


1-(9*H*-fluoren-3-yl)ethanol

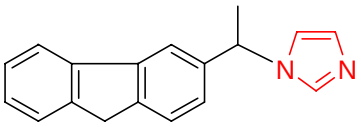
3

Yield 95%. White solid. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.74 (2H, dd, J = 16.2, 8.1 Hz), 7.54 (1H, s), 7.51 (1 H, s), 7.37 (2H, d, J = 6.3 Hz), 7.24-7.33 (1H, m), 4.92-4.98 (1H, m), 3.86 (2H, s), 1.95 (1H, s), 1.53 (3H, d, J = 6.3 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 144.56 (C), 143.62 (C), 143.38 (C), 141.45 (C), 141.17 (C), 126.75 (CH), 1126.65 (CH), 125.03 (CH), 124.20 (CH), 122.07 (CH), 119.84 (CH), 70.65 (CH), 36.90 (CH_2), 25.31 (CH_3).

2.3 Synthesis of hybrid compounds 5-10



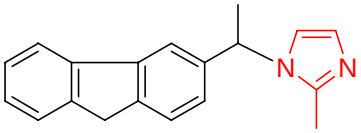
To a solution of 1-(9*H*-fluoren-3-yl)ethanol **3** (210 mg, 1.00 mmol) in dichloromethane (50 mL) was added methanesulfonyl chloride (1.2 mmol) and triethylamine (2 mmol) at 0 ^{o}C. The resulting mixture was stirred at room temperature for 12 h. After quenching the reaction with water (50 mL), the layers were separated. The organic phase was dried over anhydrous Na_2SO_4 and concentrated, and used for the next synthetic step. A mixture of the previous methanesulfonate **4** and various substituted imidazole, benzimidazole or triazole (6 mmol) and K_2CO_3 (3 mmol) was stirred in tuloene (20 ml) at reflux for 24–48 h (monitored by TLC). After cooling to room temperature, the solvent was concentrated, and the residue was diluted with EtOAc (20 mL). The organic layer was washed with water (20 mL) and brine (20 mL), dried over anhydrous Na_2SO_4 and concentrated. The residue was purified by column chromatography (silica gel, petroleum ether 60–90 ^{o}C : EtOAc = 1:1) to afford **5-10** in 53-78% yield as white powder.



(±)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-imidazole

5

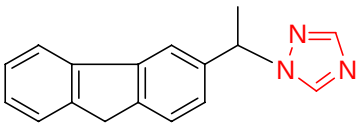
Yield 62%. White solid, Mp 188-190 °C. IR ν_{max} (cm^{-1}): 2971, 1605, 1498, 1397, 1225, 1085, 740. ^1H NMR (300 MHz, $CDCl_3$) δ: 7.70-7.75 (2H, m), 7.62 (1H, s), 7.51 (1H, d, *J* = 7.2 Hz), 7.31-7.38 (3H, m), 7.16 (1H, d, *J* = 7.8 Hz), 7.09 (1H, s), 6.95 (1H, s), 5.34-5.41 (1H, m), 3.83 (2H, s), 1.87 (3H, d, *J* = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 143.97 (C), 143.34 (C), 141.75 (C), 140.94 (C), 140.03 (C), 136.08 (CH), 129.32 (CH), 127.02 (CH), 126.86 (CH), 125.08 (CH), 124.85 (CH), 122.68 (CH), 120.11 (CH), 120.00 (CH), 118.03 (CH), 56.78 (CH), 36.87 (CH_2), 22.21 (CH_3). Anal. Calcd for $C_{18}H_{16}N_2$: C, 83.04; H, 6.19; N, 10.76. Found: C, Found: C, 82.74; H, 5.81; N 10.65. HRMS (ESI-TOF) *m/z* Calcd for $C_{18}H_{17}N_2$ $[M+1]^+$ 261.1392, found 261.1395.



(±)-1-(1-(9*H*-fluoren-3-yl)ethyl)-2-methyl-1*H*-imidazole

6

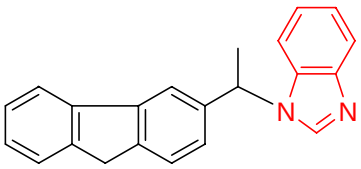
Yield 56%. White solid, Mp 134-136 °C. IR ν_{max} (cm^{-1}): 3161, 2974, 1660, 1490, 1268, 1105, 990, 737. ^1H NMR (300 MHz, $CDCl_3$) δ: 7.70-7.76 (2H, m), 7.53 (1H, d, *J* = 7.2 Hz), 7.26-7.39 (2H, m), 7.18 (1H, s), 7.01-7.10 (3H, m), 5.33-5.40 (1H, m), 3.84 (2H, s), 2.31 (3H, s), 1.85 (3H, d, *J* = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 143.99 (C), 143.31 (C), 141.42 (C), 140.99 (C), 140.31(C), 126.95 (CH), 126.84 (CH), 125.07 (CH), 124.55 (CH), 122.32 (C), 120.09 (CH), 119.95 (CH), 116.78 (CH), 55.27 (CH), 36.89 (CH_2), 22.55 (CH_3), 13.52 (CH_3). Anal. Calcd for $C_{19}H_{18}N_2$: C, 83.18; H, 6.61; N, 10.21. Found: C, 83.13; H, 6.65; N 9.69. HRMS (ESI-TOF) m/z Calcd for $C_{19}H_{19}N_2$ $[M+1]^+$ 275.1548, found 275.1553.



(±)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-1,2,4-triazole

7

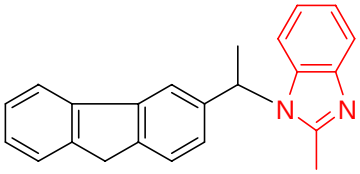
Yield 58%. White solid, Mp 108-110 ^{o}C. IR ν_{max} (cm^{-1}): 3118, 3085, 2968, 2933, 1678, 1614, 1499, 1269, 1140,1005, 946, 841, 734. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.07 (1H, s), 7.99 (1H, s), 7.70-7.74 (2H, m), 7.50 (1H, d, *J* = 7.2 Hz), 7.40 (1H, s), 7.37 (1H, s), 7.24-7.35 (2H, m), 5.55-5.61 (1H, m), 3.83 (2H, s), 1.95 (3H, d, *J* = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 151.93 (CH), 144.01 (CH), 143.39 (C), 142.11 (C), 140.91 (C), 138.38 (C), 127.10 (CH), 126.87 (CH), 125.37 (CH), 125.08 (CH), 123.23 (CH), 120.21 (CH), 120.07 (CH), 59.87 (CH), 36.88 (CH_2), 21.47 (CH_3). Anal. Calcd for $C_{17}H_{15}N_3$: C, 78.13; H, 5.79; N, 16.08. Found: C, 78.03; H, 5.72; N 15.80. HRMS (ESI-TOF) *m/z* Calcd for $C_{17}H_{16}N_3$ $[M+H]^+$ 262.1344, found 262.1349.



(±)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-benzo[*d*]imidazole

8

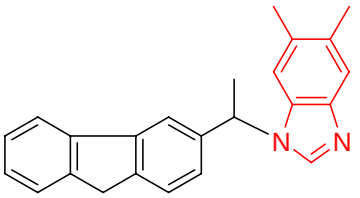
Yield 68%. White solid, Mp 179-181 ^{o}C. IR ν_{max} (cm^{-1}): 3051, 2970, 1607, 1484, 1223, 744. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.15 (1H, s), 7.83 (1H, d, *J* = 7.8 Hz), 7.71 (2H, dd, *J* = 15.0, 7.2 Hz), 7.48 (1H, d, *J* = 6.9 Hz), 7.27-7.36 (3H, m),7.14-7.23 (4H, m), 5.61-5.68 (1H, m), 3.78 (2H, s), 2.00 (3H, d, *J* = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 144.11 (C), 143.71 (C), 143.35 (C), 141.85 (C), 141.03 (CH), 140.93 (CH), 139.11 (C), 133.64 (C), 127.05 (CH) , 126.87 (CH), 125.08 (CH), 124.84 (CH), 122.99 (CH), 122.63 (CH), 122.44 (CH), 120.22 (CH), 120.00 (CH), 110.82 (CH), 55.57 (CH), 36.87 (CH_2), 21.80 (CH_3). Anal. Calcd for $C_{22}H_{18}N_2$: C, 85.13; H, 5.85; N, 9.03. Found: C, 85.03; H, 5.89; N 8.86. HRMS (ESI-TOF) *m/z* Calcd for $C_{22}H_{19}N_2$ $[M+1]^+$ 311.1548, found 311.1551.



(±)-1-(1-(9*H*-fluoren-3-yl)ethyl)-2-methyl-1*H*-benzo[*d*]imidazole

9

Yield 53%. White solid, Mp 166-168 °C. IR ν_{max} (cm^{-1}): 3048, 2991, 2880, 1609, 1520, 1391, 1283, 1145, 1007, 737. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.71-7.76 (3H, m), 7.52 (1H, d, *J* = 7.2 Hz), 7.25-7.39 (3H, m), 7.16-7.22 (2H, m), 7.07 (2H, d, *J* = 3.6 Hz), 5.80-5.87 (1H, m), 3.83 (2H, s), 2.64 (3H, s), 2.01 (3H, d, *J* = 7.2 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 151.50 (C), 143.97 (C), 143.39 (C), 141.71 (C), 141.57 (C), 140.92 (C), 137.67 (C), 133.67 (C), 127.07 (CH), 126.89 (CH), 125.11 (CH), 124.95 (CH), 123.07 (CH), 122.24 (CH), 122.14 (CH), 120.07 (CH), 118.79 (CH), 111.25 (CH), 53.74 (CH), 36.92 (CH_2), 18.84 (CH_3), 14.45 (CH_3). Anal. Calcd for $C_{23}H_{20}N_2$: C, 85.15; H, 6.21; N, 8.63. Found: C, 84.97; H, 6.17; N 8.36. HRMS (ESI-TOF) m/z Calcd for $C_{23}H_{21}N_2$ $[M+1]^+$ 325.1705, found 325.1705.



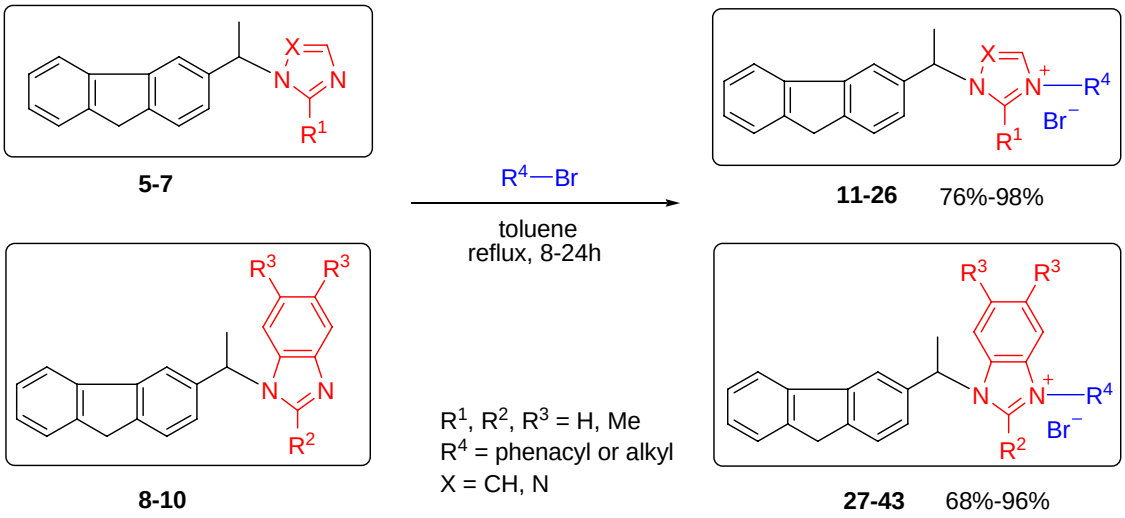
(±)-1-(1-(9*H*-fluoren-3-yl)ethyl)-5,6-dimethyl-1*H*-benzo[*d*]imidazole

10

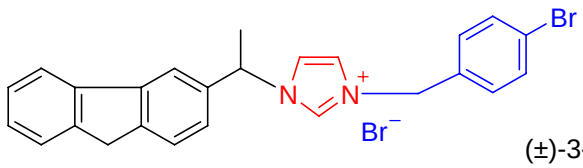
Yield 60%. White solid, Mp 182-184 °C. IR ν_{max} (cm^{-1}): 3007, 2969, 2933, 2876, 1617, 1480, 1392, 1224, 1030, 839, 743. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.00 (1H, s), 7.73 (2H, t, *J* = 7.2 Hz), 7.58 (1H, s), 7.50 (1H, d, *J* = 7.2 Hz), 7.24-7.37 (2H, m), 7.21 (2H, d, *J* = 7.8 Hz), 6.98 (1H, s), 5.58-5.65 (1H, m), 3.80 (2H, s), 2.33 (3H, s), 2.27 (3H, s), 2.00 (3H, d, *J* = 7.2 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 144.04 (C), 143.35 (C), 142.80 (C), 141.66 (C), 141.01 (C), 140.30 (CH), 139.57 (C), 132.31 (C), 131.96 (C), 131.13. (C), 126.97 (CH), 126.84 (CH), 125.06 (CH), 124.77 (CH), 122.55 (CH), 120.33 (CH), 120.16 (CH), 119.96 (CH), 110.77 (CH), 55.25 (CH), 36.87 (CH_2), 21.88 (CH_3), 20.59 (CH_3), 20.22 (CH_3). Anal. Calcd for $C_{24}H_{23}N_2$: C, 85.17; H, 6.55; N, 8.28. Found: C,

84.79; H, 6.39; N 7.98. HRMS (ESI-TOF) m/z Calcd for $C_{24}H_{23}N_2$ $[M+1]^+$ 339.1861, found 339.1863.

2.4 Synthesis of compounds 11-43



A mixture of (±)-3-substituted fluorene–imidazole hybrids **5**–**10** (0.2 mmol) and phenacyl bromides or alkyl bromides (0.24 mmol) was stirred in toluene (5 ml) at refluxat for 8-12 h. An insoluble substance was formed. After completion of the reaction as indicated by TLC, the precipitate was filtered through a small pad of Celite, and washed with toluene (3 × 10 ml), then dried to afford imidazolium salts **11-43** in 68–98% yields.

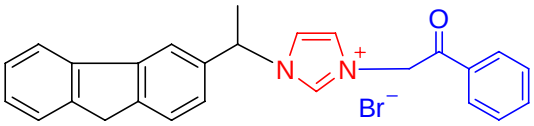


11

(±)-3-(4-bromobenzyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-imidazol-3-ium bromide

Yield 98%. White solid, Mp 173-175 °C. IR ν_{max} (cm^{-1}): 3012, 1646, 1553, 1150, 1011, 918, 759. ^1H NMR (300 MHz, $CDCl_3$) δ: 10.82 (1H, s), 7.70 (2H, d, J = 6.9 Hz), 7.59 (2H, s), 7.48-7.50 (3H, m), 7.40-7.42 (3H, m), 7.29-7.37 (3H, m), 5.88 (1H, m), 5.66 (2H, m), 3.82 (2H, s), 2.03 (3H, s). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 144.39 (C), 143.44

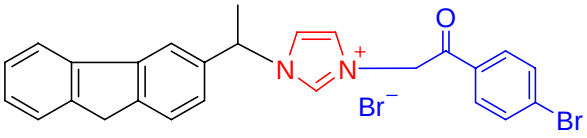
(C), 142.96 (C), 140.43 (C), 135.97 (C), 132.41 (CH), 131.03 (CH), 127.40 (CH), 126.91 (CH), 125.75 (CH), 125.12 (CH), 123.64 (CH), 122.32 (CH), 121.09 (CH), 120.57 (CH), 120.22 (CH), 60.41 (CH), 52.30 (CH_2), 36.89 (CH_2), 21.58 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{25}H_{22}BrN_2$ $[M-Br]^+$ 429.0961, found 429.0973.



12

(±)-3-(2-oxo-2-phenylethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-imidazol-3-ium bromide

Yield 97%. White solid, Mp 220-222 °C. IR ν_{max} (cm^{-1}): 3048, 2929, 1699, 1605, 1564, 1441, 1234, 1002, 826, 753. ^1H NMR (300 MHz, $CDCl_3$) δ: 9.27 (1H, s), 8.08 (2H, d, J = 7.5 Hz), 7.86 (2H, dd, J = 14.4, 8.1 Hz), 7.80 (1H, d, J = 5.1 Hz), 7.67-7.71 (3H, m), 7.56-7.61 (3H, m), 7.48 (1H, d, J = 7.8 Hz), 7.32-7.38 (2H, m), 6.03 (2H, s), 5.88-5.95 (1H, m), 3.90 (2H, s), 2.05 (3H, d, J = 6.6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 192.06 (C), 145.80 (C), 144.95 (C), 144.07 (C), 141.95 (C), 138.40 (C), 138.16 (CH), 135.74 (CH), 135.14 (C), 130.22 (CH), 129.40 (CH), 128.48 (CH), 128.05 (CH), 126.82 (CH), 126.22 (CH), 125.76 (CH), 124.66 (CH), 122.28 (CH), 121.62 (CH), 121.28 (CH), 61.66 (CH), 56.75 (CH_2), 37.73 (CH_2), 21.59 (CH_3). HRMS (ESI-TOF) *m/z* Calcd for $C_{26}H_{23}N_2O$ $[M-Br]^+$ 379.1805, found 379.1809.

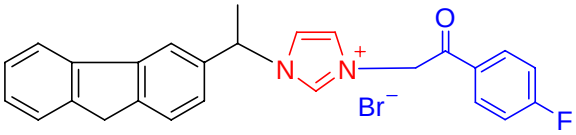


13

(±)-3-(2-(4-bromophenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-imidazol-3-ium bromide

Yield 96%. White solid, Mp 229-231 °C. IR ν_{max} (cm^{-1}): 3078, 1694, 1577, 1458, 1393, 1153, 1070, 997, 825, 746. ^1H NMR (300 MHz, $CDCl_3$) δ: 9.35 (1H, s), 7.88 (2H, d, J = 6.6 Hz), 7.74 (2H, dd, J = 11.4, 8.1 Hz), 7.62 (2H, d, J = 8.1 Hz), 7.48-7.53 (3H, m), 7.39 (1H, s), 7.24-7.35 (3H, m), 6.00 (2H, s), 5.74-5.76 (1H, m), 3.86 (2H, s), 1.99 (3H, d, J = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 189.47 (C), 144.20 (C), 143.13 (C),

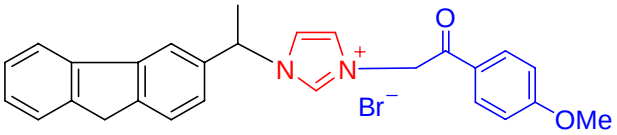
142.77 (C), 136.27 (C), 135.67 (C), 132.07 (CH), 129.72 (CH), 129.49 (CH), 127.08 (C), 126.57 (CH), 125.21 (CH), 124.74 (CH), 124.11 (CH), 123.08 (CH), 120.25 (CH), 119.82 (CH), 60.20 (CH), 55.21 (CH_2), 36.44 (CH_2), 20.63 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{26}H_{22}BrN_2O$ $[M-Br]^+$ 457.0910, found 457.0911.



14

(±)-3-(2-(4-fluorophenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-imidazol-3-ium bromide

Yield 86%. White solid, Mp 228-230 °C. IR ν_{max} (cm^{-1}): 3052, 1698, 1600, 1558, 1455, 1232, 1160, 1003, 836, 746. ^1H NMR (300 MHz, $CDCl_3$) δ: 9.48-9.53 (1H, m), 8.09 (2H, dd, J = 2.1, 2.4 Hz), 7.76 (2H, dd, J = 9.3, 16.5 Hz), 7.51 (2H, d, J = 9 Hz), 7.46 (1H, s), 7.27-7.34 (4H, m), 7.17 (2H, dd, J = 8.4, 15.6 Hz), 6.07-6.10 (2H, m), 5.74-5.76 (1H, m), 3.88 (2H, s), 2.02 (3H, d, J = 5.1 Hz). ^{13}C NMR (75 MHz, $CDCl_3$), δ : 189.16 (C), 144.52 (C), 143.11 (C), 140.35 (C), 136.72 (C), 135.78 (C), 131.39 (CH), 131.27 (CH), 129.86 (C), 127.41 (CH), 126.89 (CH), 125.55 (CH), 125.07 (CH), 123.34 (CH), 123.45 (CH), 120.58 (CH), 120.16 (CH), 116.46 (CH), 116.16 (CH), 60.52 (CH), 55.63 (CH_2), 36.79 (CH_2), 21.08 (CH_3). Anal. Calcd for $C_{26}H_{22}BrFN_2O$: C, 65.42; H, 4.65; N, 5.87. Found: C, 65.44; H, 5.05; N 5.85. HRMS (ESI-TOF) m/z Calcd for $C_{26}H_{22}FN_2O$ $[M-Br]^+$ 397.1711, found 397.1715.

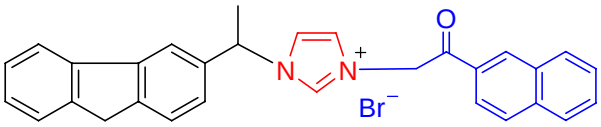


15

(±)-3-(2-(4-methoxyphenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-imidazol-3-ium bromide

Yield 95%. White solid, Mp 234-236 °C. IR ν_{max} (cm^{-1}): 2976, 1686, 1602, 1563, 1251, 1168, 1023, 836, 741. ^1H NMR (300 MHz, $CDCl_3$) δ: 9.53 (1H, s), 8.07 (2H, d, J = 1.5 Hz), 8.05 (1H, s), 7.92-8.02 (2H, m), 7.84 (1H, s), 7.44 (1H, s), 7.59 (1H, d, J = 7.2 Hz), 7.53 (1H, d, J = 7.8 Hz), 7.33-7.41 (2H, m), 7.13 (2H, d, J = 8.7 Hz), 6.05-6.09 (3H, m),

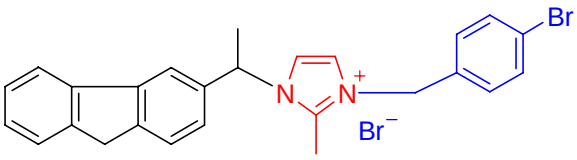
3.94 (2H, s), 3.87 (3H, s), 1.97 (3H, d, J = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 189.49 (C), 164.08 (C), 143.75 (C), 143.26 (C), 141.69 (C), 140.27 (C), 137.69 (C), 136.65 (CH), 130.58 (CH), 127.17 (CH), 126.84 (CH), 126.44 (CH), 125.56 (CH), 125.18 (CH), 124.44 (CH), 123.52 (CH), 120.76 (CH), 120.48 (CH), 120.31 (CH), 114.32 (CH), 58.89 (CH), 55.75 (CH_3), 55.16 (CH_2), 36.43 (CH_2), 20.69 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{27}H_{25}N_2O_2$ $[M-Br]^+$ 409.1911, found 409.1898.



16

(±)-3-(naphthalen-2-ylmethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-imidazol-3-ium bromide

Yield 94%. White solid, Mp 219-221 °C. IR ν_{max} (cm^{-1}): 3030, 2295, 1693, 1617, 1562, 1458, 1170, 919, 816, 734. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 9.55 (1H, s), 8.60 (1H, s), 7.89 (3H, dd, J = 17.4, 8.4 Hz), 7.65-7.76 (5H, m), 7.44-7.46 (4H, m), 7.20-7.28 (3H, m), 6.15 (2H, s), 5.65-5.71 (1H, m), 3.43 (2H, s), 1.90 (3H, d, J = 6.6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 190.42 (C), 144.35 (C), 143.38 (C), 142.88 (C), 140.33 (C), 136.63 (CH), 136.02 (C), 135.79 (C), 132.25 (C), 130.97 (CH), 130.49 (C), 129.81 (CH), 129.23 (CH), 128.23 (CH), 127.57 (CH), 127.27 (CH), 127.03 (CH), 126.76 (CH), 125.47 (CH), 124.96 (CH), 124.28 (CH), 123.38 (CH), 122.94 (CH), 120.44 (CH), 120.16 (CH), 120.05 (CH), 60.30 (CH), 55.63 (CH_2), 36.69 (CH_2), 21.03 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{30}H_{25}N_2O$ $[M-Br]^+$ 429.1961, found 429.1960.

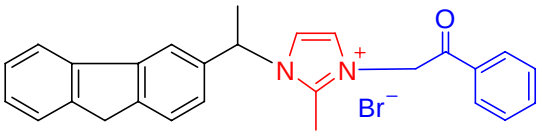


17

(±)-3-(4-bromobenzyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-2-methyl-1*H*-imidazol-3-ium bromide

Yield 85%. White solid, Mp 215-217 °C. IR ν_{max} (cm^{-1}): 3056, 1582, 1512, 1456, 1189, 1004, 834, 766. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.01 (1H, s), 7.89-7.94 (3H, m),

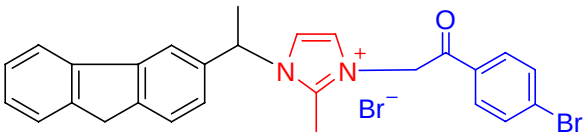
7.57-7.64 (4H, m), 7.30-7.45 (5H, m), 5.92-5.95 (1H, m), 5.45 (2H, s), 3.92 (2H, s), 2.70 (3H, s), 1.90 (3H, d, J = 6.6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 144.07 (C), 143.75 (C), 143.21 (C), 141.40 (C), 140.25 (C), 137.52 (C), 133.72 (C), 131.88 (CH), 130.23 (CH), 127.13 (CH), 126.82 (CH), 125.42 (CH), 125.17 (CH), 123.36 (CH), 122.12 (CH), 121.85 (CH), 120.41 (CH), 120.27 (CH), 119.20 (CH), 57.11 (CH), 49.97 (CH_2), 36.40 (CH_2), 20.79 (CH_3), 10.11 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{26}H_{24}BrN_2$ $[M-Br]^+$ 443.1117, found 443.1129.



18

(±)-3-(2-oxo-2-phenylethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-2-methyl-1*H*-imidazol-3-ium bromide

Yield 80%. White solid, Mp 158-160 °C. IR ν_{max} (cm^{-1}): 3054, 2907, 1695, 1587, 1453, 1228, 992, 832, 744. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.08 (3H, dd, J = 17.7, 1.5 Hz), 7.95 (2H, dd, J = 11.4, 8.1 Hz), 7.76 (2H, dd, J = 13.5, 6.0 Hz), 7.68 (1H, s), 7.59-7.65 (3H, m), 7.33-7.46 (3H, m), 6.15 (2H, s), 6.01-6.08 (1H, m), 3.95 (2H, s), 2.62 (3H, s), 1.96 (3H, d, J = 6.6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 191.09 (C), 145.41 (C), 143.81 (C), 143.23 (C), 141.44 (C), 140.27 (C), 137.60 (C), 134.49 (CH), 133.64 (C), 128.95 (CH), 128.35 (CH), 127.15 (CH), 126.84 (CH), 125.28 (CH), 125.18 (CH), 123.29 (CH), 123.13 (CH), 120.48 (CH), 120.28 (CH), 118.73 (CH), 57.18 (CH), 54.56 (CH_2), 36.43 (CH_2), 20.83 (CH_3), 9.86 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{27}H_{25}N_2O$ $[M-Br]^+$ 471.1067, found 471.1082.

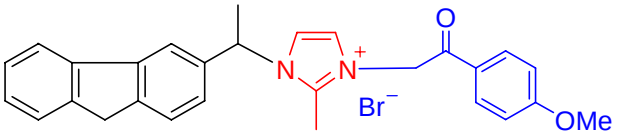


19

(±)-3-(2-(4-bromophenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-2-methyl-1*H*-imidazol-3-ium bromide

Yield 89%. White solid, Mp 193-195 °C. IR ν_{max} (cm^{-1}): 3050, 2894, 1696, 1579, 1455, 1392, 1227, 1061, 993, 872, 742. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.11 (1H, s), 7.91-8.10

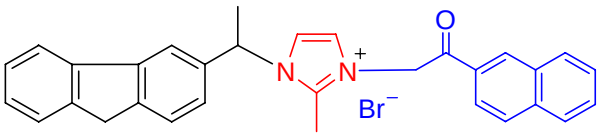
(4H, m), 7.85 (2H, d, J = 8.4 Hz), 7.78 (1H, d, J = 1.5 Hz), 7.68 (1H, s), 7.60 (1H, d, J = 7.2 Hz), 7.33-7.46 (3H, m), 6.15 (2H, s), 6.03-6.08 (1H, m), 3.95 (2H, s), 2.62 (3H, s), 1.95 (3H, d, J = 6.6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 190.51 (C), 145.43 (C), 143.80 (C), 141.44 (C), 140.27 (C), 137.58 (C), 132.72 (C), 132.02 (CH), 130.33 (CH), 128.59 (CH), 127.15 (CH), 126.83 (CH), 125.29 (CH), 125.18 (CH), 123.30 (CH), 123.11 (CH), 120.47 (CH), 120.28 (CH), 118.75(CH), 57.19 (CH), 54.55 (CH_2), 36.43 (CH_2), 20.83 (CH_3), 9.90 (CH_3). Anal. Calcd for $C_{27}H_{24}Br_2N_2O$: C, 58.72; H, 4.38; N, 5.07. Found: C, 59.15; H, 4.34; N 5.01. HRMS (ESI-TOF) m/z Calcd for $C_{27}H_{24}BrN_2O$ $[M-Br]^+$ 393.1961, found 393.1968.



20

(±)-3-(2-(4-methoxyphenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-2-methyl-1*H*-imidazol-3-ium bromide

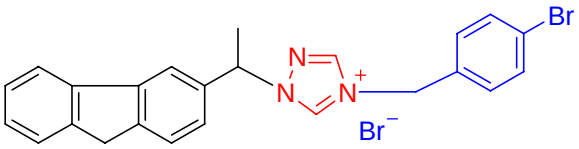
Yield 88%. White solid, Mp 195-197 °C, IR ν_{max} (cm^{-1}): 3059, 1681, 1600, 1585, 1451, 1265, 1179, 1021, 997, 835, 736. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.08 (1H, s), 8.02 (2H, d, J = 7.5 Hz), 7.95 (2H, dd, J = 10.5, 8.1 Hz), 7.75 (1H, s), 7.67 (1H, s), 7.60 (1H, d, J = 7.2 Hz), 7.33-7.45 (3H, m), 7.14 (2H, d, J = 8.4 Hz), 6.01-6.06 (3H, m), 3.95 (2H, s), 3.87 (3H, s), 2.58 (3H, s), 1.95 (3H, d, J = 6.6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 189.26 (C), 164.13 (C), 145.36 (C), 143.81 (C), 143.22 (C), 141.43 (C), 140.26 (C), 137.60 (C), 130.79 (CH), 127.15 (CH), 126.84 (CH), 126.46 (CH), 125.25 (CH), 123.27 (CH), 123.14 (CH), 120.47 (CH), 120.28 (CH), 118.66 (CH), 114.23 (CH), 57.15 (CH_3), 55.76 (CH), 54.15 (CH_2), 36.42 (CH_2), 20.80 (CH_3), 9.83 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{28}H_{27}N_2O_2$ $[M-Br]^+$ 423.2067, found 423.2062.



21

(±)-3-(naphthalen-2-ylmethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-2-methyl-1*H*-imidazol-3-ium bromide

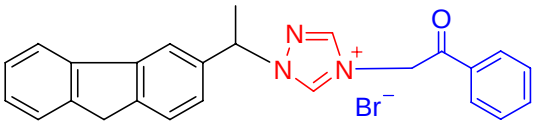
Yield 90%. White solid, Mp 170-172 °C. IR ν_{max} (cm^{-1}): 3049, 1688, 1624, 1584, 1469, 1270, 1038, 996, 826, 735. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.78 (1H, s), 8.12 (1H, d, J = 7.8 Hz), 7.94-8.06 (3H, m), 7.81-7.88 (3H, m), 7.55-7.66 (4H, m), 7.32-7.39 (4H, m), 7.13-7.21 (1H, m), 6.18 (2H, s), 5.96-5.98 (1H, m), 3.91 (2H, s), 2.59 (3H, s), 2.03 (3H, d, J = 6.6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$), δ : 191.79 (C), 147.35 (C), 145.82 (C), 144.87 (C), 143.73 (C), 141.97 (C), 138.55 (C), 137.66 (C), 133.90 (C), 132.34 (C), 132.14 (CH), 130.94 (CH), 130.53 (CH), 130.02 (CH), 129.24 (CH), 128.99 (CH), 128.41 (CH), 128.05 (CH), 126.33 (CH), 126.21 (CH), 124.34 (CH), 124.20 (CH), 121.59(CH), 121.23 (CH), 120.10 (CH), 59.73 (CH), 55.90 (CH_2), 37.74 (CH_2), 21.67 (CH_3), 10.62 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{31}H_{27}N_2O$ $[M-Br]^+$ 443.2112, found 443.2132.



22

(±)-3-(4-bromobenzyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-imidazol-4-ium bromide

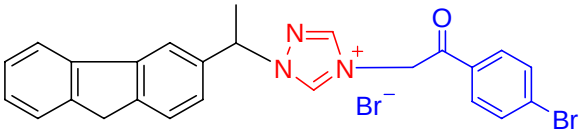
Yield 80%. White solid, Mp 112-114 °C. IR ν_{max} (cm^{-1}): 2985, 1573, 1498, 1143, 1006, 836, 755, 622. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 10.50 (1H, s), 9.36 (1H, s), 7.93 (2H, dd, J = 7.5, 14.4 Hz), 7.67 (2H, dd, J = 3.9, 12.3 Hz), 7.60 (1H, d, J = 7.2 Hz), 7.50-7.53 (3H, m), 7.31-7.42 (3H, m),5.92-6.07 (1H, m), 5.52 (2H, s), 3.93 (2H, s), 1.94 (3H, d, J = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 144.73 (CH), 143.56 (C), 143.27 (C), 142.08 (CH), 141.73 (C), 140.25 (C), 136.49 (C), 132.75 (C), 131.93 (CH), 131.25 (CH), 127.18 (CH), 126.83 (CH), 126.03 (CH), 125.18 (CH), 123.91 (CH), 122.51 (CH), 120.29 (CH), 61.85 (CH), 49.89 (CH_2), 36.38 (CH_2), 20.14 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{24}H_{21}BrN_3$ $[M-Br]^+$ 430.0913, found 430.0917.



23

(±)-3-(2-oxo-2-phenylethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-1,2,4-triazol-4-ium bromide

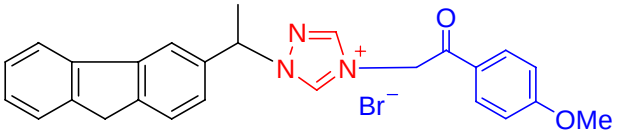
Yield 78%. White solid, 150-152 ^{o}C. IR ν_{max} (cm^{-1}): 3043, 1694, 1568, 1443, 1235, 1153, 994, 830, 752. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 10.41 (1H, s), 9.29 (1H, s), 8.07 (2H, d, J = 4.5 Hz), 7.96 (2H, dd, J = 14.7, 7.8 Hz), 7.76-7.81 (2H, m), 7.54- 7.67 (4H, m), 7.32-7.42 (2H, m), 6.22-6.29 (3H, m), 3.96 (2H, s), 2.01 (3H, d, J = 6.9Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 190.35 (C), 145.92 (CH), 143.66 (C), 143.30 (C), 142.94 (CH), 141.86 (C), 140.25 (C), 136.35 (C), 134.71 (CH), 133.34 (C), 129.15 (CH), 128.22 (CH), 127.22 (CH), 126.85 (CH), 126.00 (CH), 125.20 (CH), 123.92 (CH), 120.41 (CH), 120.35 (CH), 61.71 (CH), 53.98 (CH_2), 36.43 (CH_2), 20.08 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{25}H_{22}N_3O$ $[M-Br]^+$ 380.1757, found 380.1763.



24

(±)-3-(2-(4-bromophenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-imidazol-4-ium bromide

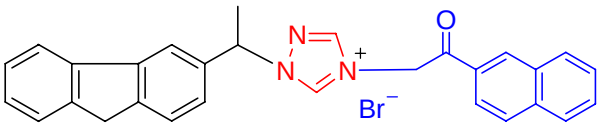
Yield 76%. White solid. Mp 190-192 ^{o}C. IR ν_{max} (cm^{-1}): 3039, 2964, 1697, 1575, 1460, 1393, 1231, 1153, 1067, 992, 823, 749. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 10.54 (1H, s), 9.37 (1H, s), 7.92-8.04 (6H, m), 7.81 (1H, s), 7.63 (2H, dd, J = 12.0, 6.0 Hz), 7.41 (2H, dd, J = 16.5, 8.1 Hz), 6.30 (3H, m), 3.98 (2H, s), 2.09 (3H, d, J = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 189.84 (C), 145.94 (CH), 143.71 (C), 143.36 (C), 142.98 (CH), 141.90 (CH), 140.31 (C), 136.41 (C), 132.30 (CH), 130.25 (CH), 128.91 (C), 127.27 (CH), 126.90 (CH), 126.06 (CH), 125.25 (CH), 123.98 (CH), 120.42 (CH), 61.75 (CH), 54.07 (CH_2), 36.49 (CH_2), 20.16 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{25}H_{21}BrN_3O$ $[M-Br]^+$ 458.0863, found 458.0871.



25

(±)-3-(2-(4-methoxyphenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-1,2,4-triazol-4-ium bromide

Yield 85%. White solid, Mp 172-174 °C, IR ν_{max} (cm^{-1}): 3043, 2944, 1685, 1601, 1512, 1457, 1252, 1170, 981, 838, 740. ^1H NMR (300 MHz, $CDCl_3$) δ: 10.36 (1H, s), 9.25 (1H, s), 8.05 (2H, d, J = 8.7 Hz), 7.96 (2H, dd, J = 14.4, 7.8 Hz), 7.75 (1H, s), 7.61 (1H, d, J = 6.9 Hz), 7.54 (1H, d, J =7.8 Hz), 7.34-7.40 (2H, m), 7.16 (2H, d, J = 8.7 Hz), 6.21-6.28 (1H, m), 6.12 (2H, s), 3.96 (2H, s), 3.88 (3H, s), 2.00 (3H , d, J = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 188.52 (C), 164.26 (C), 145.94 (CH), 143.67 (C), 143.30 (C), 142.95 (CH), 141.86 (C), 140.25 (C), 136.36 (C), 130.69 (CH), 128.85 (CH), 128.16 (CH), 127.22 (CH), 126.85 (CH), 126.12 (CH), 125.98 (CH), 125.20 (CH), 123.90 (CH), 120.40 (CH), 114.42 (CH), 61.72 (CH), 55.77 (CH_3), 53.54 (CH_2), 36.41 (CH_2), 20.06 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{26}H_{24}N_3O_2$ $[M-Br]^+$ 410.1863, found 410.1869.

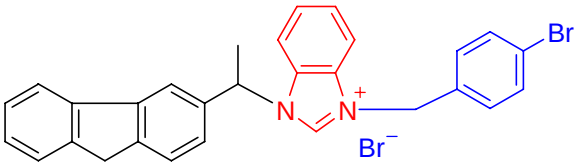


26

(±)-3-(naphthalen-2-ylmethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-1,2,4-triazol-4-ium bromide

Yield 80%. White solid, Mp 153-155 °C. IR ν_{max} (cm^{-1}): 2953, 1692, 1576, 1459, 1167, 978, 817, 740, 637. ^1H NMR (300 MHz, $CDCl_3$) δ: 10.45 (1H, s), 9.32 (1H, s), 8.86 (1H, s), 8.22 (1H, d, J = 7.2 Hz), 8.13 (1H, d, J = 8.4 Hz), 7.93-8.05 (4H, m), 7.69-7.77 (3H, m), 7.58 (2H, dd, J = 14.1, 6.9 Hz), 7.37 (2H, dd, J = 17.1, 9.0 Hz), 6.28-6.34 (3H, m), 3.96 (2H, s), 2.02 (3H, d, J = 5.7 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 190.28 (C), 145.98 (CH), 143.67 (C), 143.30 (C), 143.02 (C), 141.86 (CH), 140.25 (C), 136.37 (C), 135.57 (C), 131.98 (C), 130.70 (CH), 129.71 (CH), 129.44 (CH)， 128.84 (CH), 127.85 (CH), 127.40 (CH), 127.22 (CH), 126.85 (CH), 126.01 (CH), 125.20 (CH), 123.93 (CH), 123.10 (CH), 120.41 (CH), 120.35 (CH), 61.73 (CH), 54.00 (CH_2), 36.42 (CH_2), 20.08

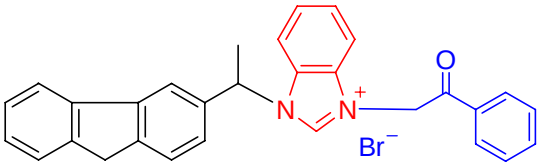
(CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{29}H_{24}N_3O$ $[M-Br]^+$ 430.1914, found 430.1934.



27

(±)-3-(4-bromobenzyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-benzo[*d*]imidazol-3-ium bromide

Yield 90%. White solid, Mp 182-184 °C. IR ν_{max} (cm^{-1}): 2975, 1608, 1553, 1480, 1207, 1067, 1011, 837, 746. ^1H NMR (300 MHz, $CDCl_3$) δ: 11.89 (1H, s), 7.75 (2H, dd, J = 14.4, 7.5 Hz), 7.65 (1H, s), 7.46-7.57 (10H, m), 7.28-7.38 (2H, m), 6.01-6.16 (3H, m), 3.88 (2H, s), 2.35 (3H, s). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 144.64 (C), 143.50 (C), 142.89 (C), 142.08 (CH), 140.50 (C), 136.01 (C), 132.45 (CH), 132.14 (C), 131.61 (C), 131.05 (C), 130.35 (CH), 127.39 (CH), 127.19 (CH), 127.03 (CH), 126.90 (CH), 125.33 (CH), 125.14 (CH), 123.36 (C), 123.16 (CH), 120.65 (CH), 120.16 (CH), 114.38 (CH), 113.79 (CH), 59.77 (CH), 50.79 (CH_2), 36.96 (CH_2), 22.26 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{29}H_{24}BrN_2$ $[M-Br]^+$ 479.1117, found 479.1119.

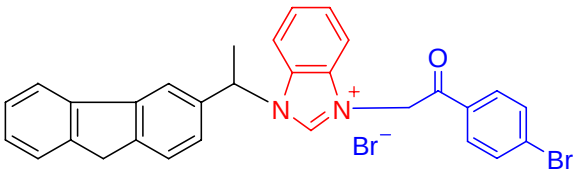


28

(±)-3-(2-oxo-2-phenylethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-benzo[*d*]imidazol-3-ium bromide

Yield 83%. White solid, Mp 149-151 °C. IR ν_{max} (cm^{-1}): 3056, 2884, 1696, 1605, 1561, 1477, 1230, 1072 987, 763. ^1H NMR (300 MHz, $CDCl_3$) δ: 11.26 (1H, s), 8.18 (2H, d, J = 7.5 Hz), 7.75 (2H, dd, J = 16.8, 8.1 Hz), 7.58-7.64 (3H, m), 7.43-7.51 (7H, m), 7.28-7.35 (2H, m), 6.75 (2H, s), 5.97-5.99 (1H, m), 3.88 (2H, s), 2.26 (3H, d, J = 6.6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 190.47 (C), 144.70 (C), 143.54 (C), 142.91 (C), 142.53 (C), 140.54 (C), 135.93 (C), 134.83 (CH), 133.58 (C), 132.72 (C), 130.65 (C), 129.20 (CH), 128.76 (CH), 127.36 (CH), 126.89 (CH), 125.27 (CH), 125.13 (CH),

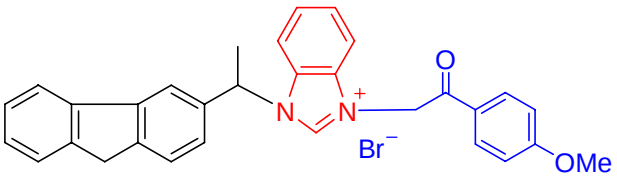
123.04 (CH), 120.68 (CH), 120.16 (CH), 114.12 (CH), 113.49 (CH), 59.60 (CH), 53.83 (CH_2), 36.94 (CH_2), 22.18 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{30}H_{25}N_2O$ $[M-Br]^+$ 429.1961, found 429.1968.



29

(±)-3-(2-(4-bromophenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-benzo[*d*]imidazol-3-ium bromide

Yield 86%. White solid. Mp 174-176 °C. IR ν_{max} (cm^{-1}): 3015, 2917, 1695, 1617, 1572, 1474, 1220, 1072, 990, 824, 744. ^1H NMR (300 MHz, $CDCl_3$) δ: 9.92 (1H, s), 8.11 (2H, d, J = 8.1 Hz), 7.92 (1H, d, J = 7.5 Hz), 7.79-7.863 (5H, m), 7.69 (1H, s), 7.62 (2H, d, J = 5.4 Hz), 7.48-7.56 (2H, m), 7.29-7.35 (2H, m), 6.37-6.39 (2H, m), 6.26-6.28 (1H, m), 3.87 (2H, s), 2.18 (3H, d, J = 6.6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 191.31 (C), 145.92 (C), 144.89 (C), 144.02 (C), 143.35 (CH), 141.91 (C), 138.05 (C), 134.10 (C), 133.58 (CH), 132.28 (C), 131.33 (CH), 130.88 (C), 128.58 (CH), 128.45 (CH), 128.21 (CH), 128.02 (CH), 126.49 (CH), 126.17 (CH), 124.30 (CH), 121.67 (CH), 121.222 (CH), 115.45 (CH), 114.73 (CH), 60.11 (CH), 54.3 (CH_2), 37.70 (CH_2), 21.91 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{30}H_{24}BrN_2O$ $[M-Br]^+$ 507.1067, found 507.1090.

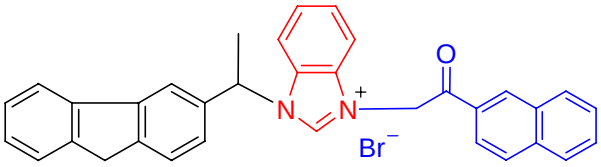


30

(±)-3-(2-(4-methoxyphenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-benzo[*d*]imidazol-3-ium bromide

Yield 92%. White solid. Mp 163-165 °C. IR ν_{max} (cm^{-1}): 3015, 2974, 2932, 1683, 1601, 1458, 1564, 1260, 1176, 1021, 984, 836, 748. ^1H NMR (300 MHz, $CDCl_3$) δ: 11.22 (1H, s), 8.17 (2H, d, J = 8.4 Hz), 7.75 (2H, dd, J = 16.5, 8.1 Hz), 7.64 (1H, s), 7.60 (1H, s), 7.51 (2H, d, J = 7.2 Hz), 7.42-7.46 (5H, m), 7.28-7.39 (2H, m), 6.97 (2H, d, J = 8.4 Hz), 6.68 (2H, s), 5.95-5.97 (1H, m), 3.88 (2H, s), 3.86 (3H, s), 2.27 (3H, d, J = 6.3 Hz).

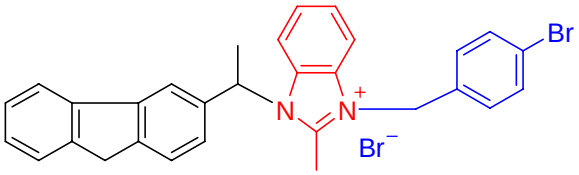
^{13}C NMR (75 MHz, $CDCl_3$) δ : 188.65 (C), 164.88 (C), 144.70 (C), 143.54 (C), 142.89 (C), 142.55 (CH), 140.54 (C), 135.97 (C), 132.81 (C), 131.25 (CH), 130.63 (C), 127.35 (CH), 127.18 (CH), 126.87 (CH), 126.53 (CH), 125.26 (CH), 125.13 (CH), 123.04 (CH), 120.66 (CH), 120.16 (CH), 114.46 (CH), 114.02 (CH), 113.63 (CH), 59.58 (CH), 55.65 (CH_3), 53.44 (CH_2), 36.94 (CH_2), 22.19 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{31}H_{27}N_2O_2$ $[M-Br]^+$ 459.2067, found 459.2057.



(±)-3-(naphthalen-2-ylmethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-1*H*-benzo[*d*]imidazol-3-ium bromide

31

Yield 88%. White solid, Mp 164-166 ^{o}C. IR ν_{max} (cm^{-1}): 3012, 2925, 1694, 1558, 1486, 1217, 987, 826, 749. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 11.21 (1H, s), 8.99 (1H, s), 8.05 (2H, dd, J = 16.2, 6.9 Hz), 7.71-7.80 (5H, m), 7.67 (1H, m), 7.54-7.61 (2H, m), 7.41-7.50 (5H, m), 7.32 (2H, dd, J = 10.8, 8.7 Hz), 6.89 (2H, s), 5.92-5.94 (1H, m), 3.84 (2H, s), 2.23 (3H, d, J = 6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 190.54 (C), 144.66 (C), 143.52 (C), 142.83 (C), 142.54 (CH), 140.55 (C), 136.14 (C), 136.02 (C), 132.72 (C), 132.44 (C), 131.65 (CH), 130.76 (CH), 130.60 (CH), 130.17 (CH), 129.31 (CH), 128.94 (CH), 127.65 (CH), 127.24 (CH), 127.08 (CH), 126.86 (CH), 125.23 (CH), 123.31 (CH), 123.00 (CH), 120.65 (CH), 120.15 (CH), 114.03 (CH), 113.71 (CH), 59.54 (CH), 53.98 (CH_2), 36.92 (CH_2), 22.17 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{34}H_{27}N_2O$ $[M-Br]^+$ 479.2118, found 479.2117.

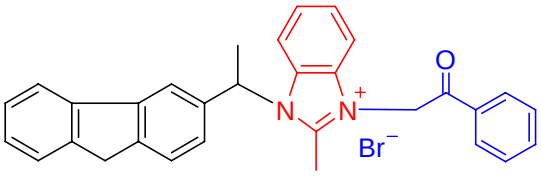


(±)-3-(4-bromobenzyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-2-methyl-1*H*-benzo[*d*]imidazoll-3-ium bromide

32

Yield 80%. White solid, Mp 191-193 ^{o}C. IR ν_{max} (cm^{-1}): 3026, 2896, 1606, 1515, 1472,

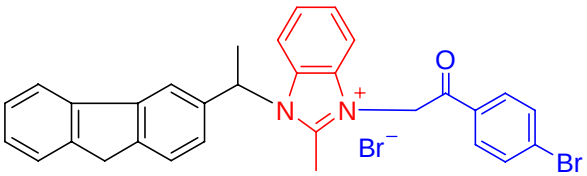
1138, 1066, 841, 752. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.80 (3H, dd, J = 16.2, 8.7 Hz), 7.54-7.59 (5H, m), 7.31-7.48 (5H, m), 7.21 (2H, d, J = 7.8 Hz), 6.34-6.36 (1H, m), 5.82 (2H, s), 3.93 (2H, s), 3.10 (3H, s), 2.21 (3H, d, J = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 150.78 (C), 144.30 (C), 143.27 (C), 142.54 (C), 140.22 (C), 134.08 (C), 132.43 (CH), 131.91 (C), 131.65 (C), 129.82 (C), 128.48 (CH), 127.27 (CH), 126.82 (CH), 126.75 (CH), 126.63 (CH), 125.11 (CH), 124.91 (CH), 123.15 (CH), 122.85 (C), 120.31 (CH), 119.99 (CH), 114.25 (CH), 112.92 (CH), 57.10 (CH), 48.54 (CH_2), 36.64 (CH_2), 17.98 (CH_3), 11.84 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{30}H_{26}BrN_2$ $[M-Br]^+$ 493.1274, found 493.1280.



33

(±)-3-(2-oxo-2-phenylethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-2-methyl-1*H*-benzo[*d*]imidazol-3-ium bromide

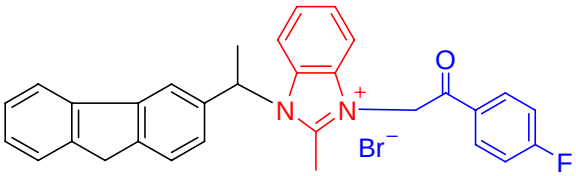
Yield 76%. White solid, Mp 203-205 °C, IR ν_{max} (cm^{-1}): 3002, 1682, 1603, 1520, 1473, 1228, 1073, 991, 828, 748, 683. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.32 (2H, d, J = 7.5 Hz), 7.80 (2H, dd, J = 17.7, 8.1 Hz), 7.65-7.69 (2H, m), 7.53-7.59 (4H, m), 7.31-7.46 (5H, m), 7.28 (1H, s), 6.82 (2H, s), 6.25-6.32 (1H, m), 3.91 (2H, s), 3.20 (3H, s), 2.21 (3H, d, J = 7.2 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 190.68 (C), 152.67 (C), 144.57 (C), 143.55 (C), 142.70 (C), 140.48 (C), 135.05 (CH), 134.11 (C), 133.37 (C), 132.28 (C), 129.83 (C), 129.27 (CH), 129.10 (CH), 127.48 (CH), 126.97 (CH), 126.61 (CH), 126.36 (CH), 125.15 (CH), 123.39 (CH), 120.59 (CH), 120.26 (CH), 114.08 (CH), 112.87 (CH), 57.03 (CH), 54.14 (CH_2), 36.99 (CH_2), 18.61 (CH_3), 13.53 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{31}H_{27}N_2O$ $[M-Br]^+$ 443.2118, found 443.2130.



34

(±)-3-(2-(4-bromophenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-2-methyl-1*H*-benzo[*d*]imidazol-3-ium bromide

Yield 76%. White solid, Mp 165-167 ^{o}C. IR ν_{max} (cm^{-1}): 3019, 2917, 1692, 1579, 1470, 1228, 1071, 1071, 990, 825, 746. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.13 (2H, d, J = 8.1 Hz), 7.71-7.82 (6H, m), 7.51-7.54 (2H, m), 7.33-7.37 (5H, m), 6.47 (2H, s), 6.24-6.27 (1H, m), 3.89 (2H, s), 2.96 (3H , s), 2.18 (3H, d, J = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 189.61 (C), 152.02 (C), 144.32 (C), 143.26 (C), 142.50 (C), 140.22 (C), 133.95 (C), 132.34 (CH), 131.94 (C), 130.39 (CH), 130.19 (CH), 129.59 (C), 127.25 (CH), 126.75 (CH), 126.54 (CH), 126.34 (CH), 124.93 (CH), 123.03 (CH), 120.34 (CH), 120.00 (CH), 113.86 (CH), 112.60 (CH), 56.83 (CH), 52.62 (CH_2), 36.67 (CH_2), 17.92 (CH_3), 11.93 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{31}H_{26}Br_2N_2O$ $[M-Br]^+$ 521.1223, found 521.1218.

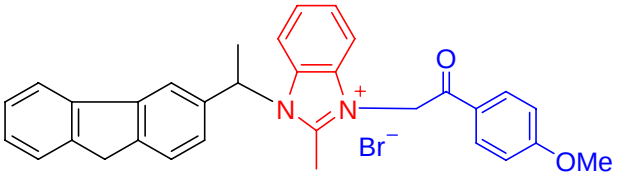


35

(±)-3-(2-(4-fluorophenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-2-methyl-1*H*-benzo[*d*]imidazol-3-ium bromide

Yield 70%. White solid, Mp 165-167 ^{o}C. IR ν_{max} (cm^{-1}): 3037, 1689, 1598, 1469, 1228, 991, 836, 749. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.37-8.38 (2H, m), 7.82-7.89 (3H, m), 7.58-7.61 (3H, m), 7.34-7.44 (7H, m), 6.48 (2H, s), 6.36-6.41 (1H, m), 3.97 (2H, s), 3.00 (3H, s), 2.25-2.27 (3H, d, J = 6.6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 188.73 (C), 151.98 (C), 144.30 (C), 143.24 (C), 142.49 (C), 140.22 (C), 134.01 (C), 131.94 (C), 131.69 (CH), 131.57 (CH), 129.62 (C), 127.22 (CH), 126.71 (CH), 126.57 (CH), 126.39 (CH), 124.87 (CH), 123.01 (CH), 120.29 (CH), 119.95 (CH), 116.34 (CH), 116.05 (CH),

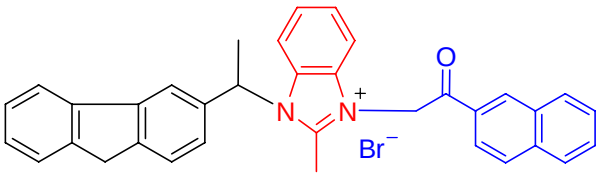
113.91 (CH), 112.53 (CH), 56.84 (CH), 52.14 (CH_2), 36.61 (CH_2), 17.77 (CH_3), 11.49 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{31}H_{26}FN_2O$ $[M-Br]^+$ 461.2024, found 461.2006.



36

(±)-3-(2-(4-methoxyphenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-2-methyl-1*H*-benzo[*d*]imidazol-3-ium bromide

Yield 89%. White solid. 157-159 °C. IR ν_{max} (cm^{-1}): 2925, 1679, 1601, 1517, 1469, 1023, 990, 835, 746. ^1H NMR (300 MHz, $CDCl_3$) δ: 8.32 (2H, d, J = 8.4 Hz), 7.79 (2H, dd, J = 15.9, 8.1 Hz), 7.72 (1H, d, J = 8.1 Hz), 7.54 (2H, d, J = 7.5 Hz), 7.32-7.38 (3H, m), 7.27-7.30 (3H, m), 7.02 (2H, d, J = 8.1 Hz), 6.73 (2H, s), 6.27-6.29 (1H, m), 3.89 (2H, s), 3.87 (3H, s), 3.15 (3H, s), 2.19 (3H, d, J = 6.6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 188.79 (C), 165.04 (C), 152.53 (C), 144.50 (C), 143.53 (C), 142.61 (C), 140.48 (C), 134.20 (C), 132.32 (C), 131.65 (CH), 129.76 (C), 127.44 (CH), 126.95 (CH), 126.54 (CH), 126.29 (CH), 125.17 (CH), 123.38 (CH), 120.56 (CH), 120.24 (CH), 114.49 (CH), 114.02 (CH), 113.02 (CH), 56.94 (CH_3), 55.69 (CH), 53.59 (CH_2), 36.97 (CH_2), 18.59 (CH_3), 13.35 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{32}H_{29}N_2O_2$ $[M-Br]^+$ 473.2224, found 473.2231.

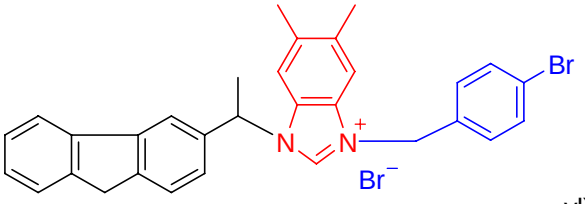


37

(±)-3-(naphthalen-2-ylmethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-2-methyl-1*H*-benzo[*d*]imidazol-3-ium bromide

Yield 80%. White solid, Mp 165-167 °C. IR ν_{max} (cm^{-1}): 3021, 1685, 1623,1520, 1470, 1075, 926, 823, 739. ^1H NMR (300 MHz, $CDCl_3$) δ: 9.24 (1H, s), 8.21 (1H, d, J = 8.1 Hz), 8.12 (1H, d, J = 7.2 Hz), 7.92 (1H, d, J = 8.4 Hz), 7.74-7.86 (4H, m), 7.53-7.65 (4H, m), 7.27-7.46 (5H, m), 7.25 (1H, s), 6.95 (2H, s), 6.25-6.31 (1H, m), 3.91 (2H, s), 3.21

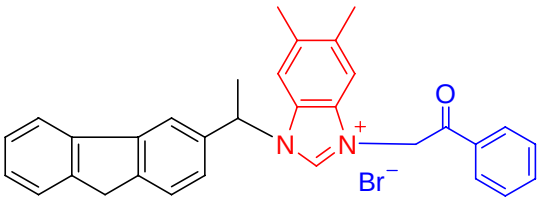
(3H, s), 2.21 (3H, d, J = 7.2 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 190.66 (C), 152.64 (C), 144.58 (C), 143.55 (C), 142.72 (C), 140.49 (C), 136.37 (C), 134.14 (C), 132.60 (C), 132.48 (CH), 130.59 (CH), 130.49 (CH), 129.84 (C), 129.54 (CH), 129.04 (CH), 127.66 (CH), 127.48 (CH), 127.19 (CH), 126.97 (CH), 126.64 (CH), 126.35 (CH), 125.19 (CH), 123.40 (CH), 123.25 (CH), 120.60 (CH), 120.26 (CH), 114.03 (CH), 113.06 (CH), 57.03 (CH), 54.07 (CH_2), 36.99 (CH_2), 18.60 (CH_3), 13.52 (CH_3). Anal. Calcd for $C_{35}H_{29}BrN_2O$: C, 73.30; H, 5.10; N, 4.88. Found: C, 72.97; H, 5.29; N 4.47. HRMS (ESI-TOF) m/z Calcd for $C_{35}H_{29}N_2O$ $[M-Br]^+$ 493.2274, found 493.2277.



38

(±)-3-(4-bromobenzyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-5,6-dimethyl-1*H*-benzo[*d*]imidazol-3-ium bromide

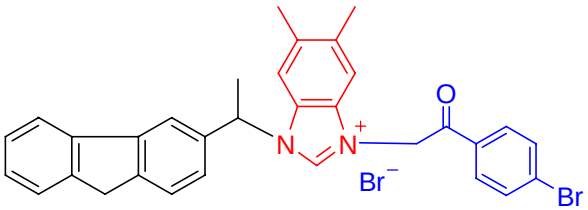
Yield 95%. White solid, Mp 172-174 °C. IR ν_{max} (cm^{-1}): 2975, 1607, 1554, 1483, 1211, 1009, 843, 738. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 11.69 (1H, s), 7.75 (2H, dd, J = 14.4, 7.5 Hz), 7.62 (1H, s), 7.48-7.53 (5H, m), 7.23-7.43 (4H, m), 7.20 (1H, s), 5.98-6.06 (2H, m), 5.91-5.93 (1H, m), 3.88 (2H, s), 2.31 (3H, s), 2.29 (3H, s), 2.26 (3H, s). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 144.61 (C), 143.51 (C), 142.78 (C), 140.71 (CH), 140.56 (C), 137.52 (C), 137.29 (C), 136.21 (C), 132.40 (CH), 130.14 (CH), 129.55 (C), 127.34 (CH), 126.88 (CH), 125.14 (CH), 123.21 (CH), 123.00 (CH), 120.57 (CH), 120.13 (CH), 113.86 (CH), 113.21 (CH), 59.38 (CH), 50.41 (CH_2), 36.95 (CH_2), 22.25 (CH_3), 20.68 (CH_3). HRMS (ESI-TOF) *m/z* Calcd for $C_{31}H_{28}BrN_2$ $[M-Br]^+$ 507.1430, found 507.1427.



39

(±)-3-(2-oxo-2-phenylethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-5,6-dimethyl-1*H*-benzo[*d*]imidazol-3-ium bromide

Yield 82%. White solid, Mp 173-175 ^{o}C. IR ν_{max} (cm^{-1}): 2964, 1695, 1558, 1482, 1222, 994, 735, 687. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 11.16 (1H, s), 8.19 (2H, d, J = 7.5 Hz), 7.77 (2H, dd, J = 17.4, 8.1 Hz), 7.62-7.66 (2H, m), 7.51- 7.56 (3H, m), 7.43 (1H, d, J = 7.8 Hz), 7.16-7.39 (4H, m), 6.60-6.75 (2H, m), 5.88-5.90 (1H, m), 3.90 (2H, s), 2.33 (3H , s), 2.29 (3H, s), 2.25 (3H, d, J = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 190.55 (C), 144.69 (C), 143.56 (C), 142.8 1(C), 141.28 (CH), 140.60 (C), 137.55 (C), 137.12 (C), 136.17 (C), 134.77 (CH), 133.67 (C), 131.23 (C), 129.20 (CH), 129.01 (CH), 128.73 (CH), 128.20 (CH), 127.31 (CH),126.86 (CH), 125.18 (CH), 122.91 (CH), 120.62 (CH), 120.14 (CH), 113.65 (CH), 112.96 (CH), 59.27 (CH), 53.61 (CH_2), 36.95 (CH_2), 22.25 (CH_3), 20.65 (CH_3), 20.52 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{32}H_{29}BrN_2O$ $[M-Br]^+$ 457.2274, found 457.2282.

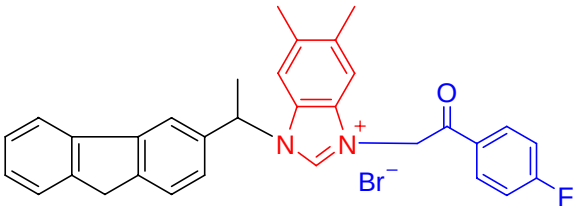


40

(±)-3-(2-(4-bromophenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-,6-dimethyl-1*H*-benzo[*d*]imidazol-3-ium bromide

Yield 70%. White solid, Mp 176 -178 ^{o}C. IR ν_{max} (cm^{-1}): 2973, 2929, 1691, 1557, 1442, 1224, 1138, 996, 841, 746, 688. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 11.10 (1H, s), 8.18 (2H, d, J = 7.8 Hz), 7.76 (2H, dd, J = 17.7, 8.4 Hz), 7.61-7.68 (2H, m), 7.51-7.56 (3H, m), 7.42 (1H, d, J = 7.8 Hz), 7.22-7.38 (3H, m), 6.65-6.68 (2H, m), 5.86-5.92 (1H, s), 3.89 (2H, s), 2.32 (3H, s), 2.28 (3H, s), 2.24 (3H, d, J = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 190.57 (C), 144.68 (C), 143.56 (C), 142.80 (C), 141.25 (CH), 140.60 (C), 137.55 (C),

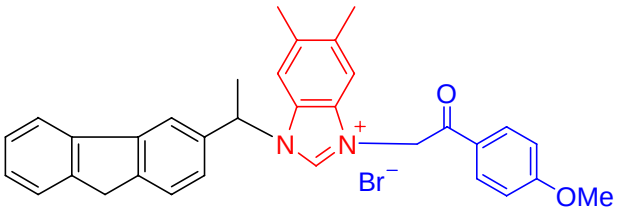
137.11 (C), 136.16 (C), 134.78 (CH), 133.66 (C), 131.22 (C), 129.19 (CH), 128.73 (CH), 127.31 (CH), 126.86 (CH), 125.18 (CH), 122.91 (CH), 120.61 (CH), 120.13 (CH), 113.66 (CH), 112.95 (CH), 59.27 (CH), 53.62 (CH_2), 36.94 (CH_2), 22.21 (CH_3), 20.66 (CH_3), 20.52 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{32}H_{28}BrN_2O$ $[M-Br]^+$ 535.1380, found 535.1372.



41

(±)-3-(2-(4-fluorophenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-5,6-dimethyl-1*H*-benzo[*d*]imidazol-3-ium bromide

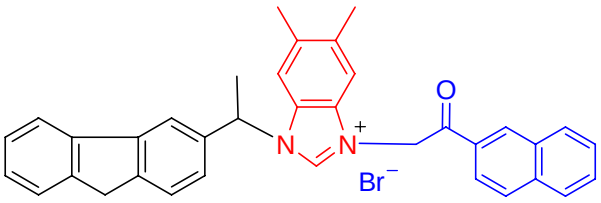
Yield 82%. White solid, Mp 172-174 °C. IR ν_{max} (cm^{-1}): 2971, 1696, 1598, 1557,1496, 1230, 997, 839, 733. ^1H NMR (300 MHz, $CDCl_3$) δ: 11.09 (1H, s), 8.26 (2H, dd, J = 12.3, 6.6 Hz), 7.74 (2H, dd, J = 15.9, 8.1 Hz), 7.58 (1H, s), 7.49 (1H, d, J = 6.6 Hz), 7.26-7.42 (4H, m), 7.22 (1H, s), 7.13 (2H, dd, J = 7.8, 15.6 Hz), 6.66-6.81 (2H, m), 5.85-5.92 (1H, m), 3.86 (2H, s), 2.31 (3H, s), 2.27 (3H , s), 2.21 (3H, d, J = 6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 189.31 (C), 164.87 (C), 144.65 (C), 143.52 (C), 142.77 (C), 141.07 (CH), 140.57 (C), 137.63 (C), 137.18 (C), 136.16 (C), 131.80 (CH), 131.67 (CH), 130.22 (C), 130.18 (C), 129.13 (C), 127.30 (CH), 126.85 (CH), 125.13 (CH), 122.85 (CH), 120.61 (CH), 120.12 (CH), 116.49 (C), 116.20 (C), 113.56 (C), 113.20 (C), 59.217 (CH), 53.68 (CH_2), 36.91 (CH_2), 22.25 (CH_3), 20.63 (CH_3), 20.49 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{32}H_{28}FN_2O$ $[M-Br]^+$ 475.2180, found 475.2191.



42

(±)-3-(2-(4-methoxyphenyl)-2-oxoethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-5,6-dimethyl-1*H*-benzo[*d*]imidazol-3-ium bromide

Yield 96%. White solid, Mp 239-241 °C. IR ν_{max} (cm^{-1}): 3191, 2986, 1682, 1597, 1450, 1018, 838, 740. ^1H NMR (300 MHz, $CDCl_3$) δ: 11.13 (1H, s), 8.17 (2H, d, J = 8.1 Hz), 7.77 (2H, dd, J = 16.5, 8.4 Hz), 7.61 (1H, s), 7.52 (1H, d, J = 7.2 Hz), 7.30-7.43 (3H, m), 7.28 (1H, s), 7.20 (1H, s), 6.99 (2H, d, J = 8.1 Hz), 6.60 (2H, s), 5.85-5.87 (1H, m), 3.89 (2H, s), 3.88 (3H, s), 2.32 (3H, s), 2.28 (3H, s), 2.25 (3H, d, J = 6.6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 188.76 (C), 164.85 (C), 144.69 (C), 143.57 (C), 142.79 (C), 141.24 (CH), 140.60 (C), 137.48 (C), 137.04 (C), 136.20 (C), 131.22 (CH), 129.17 (C), 127.31 (C), 126.86 (CH), 126.62 (CH), 125.14 (CH), 122.91 (CH), 120.61 (CH), 120.14 (CH), 114.44 (CH), 113.56 (CH), 113.11 (CH), 59.25 (CH), 55.66 (CH_3), 53.21 (CH_2), 36.95 (CH_2), 22.30 (CH_3), 20.68 (CH_3), 20.55 (CH_3). Anal. Calcd for $C_{33}H_{31}BrN_2O_2$: C, 69.84; H, 5.51; N, 4.94. Found: C, 69.77; H, 5.52; N 4.46. HRMS (ESI-TOF) m/z Calcd for $C_{33}H_{31}BrN_2O_2$ $[M-Br]^+$ 487.2380, found 487.2389.



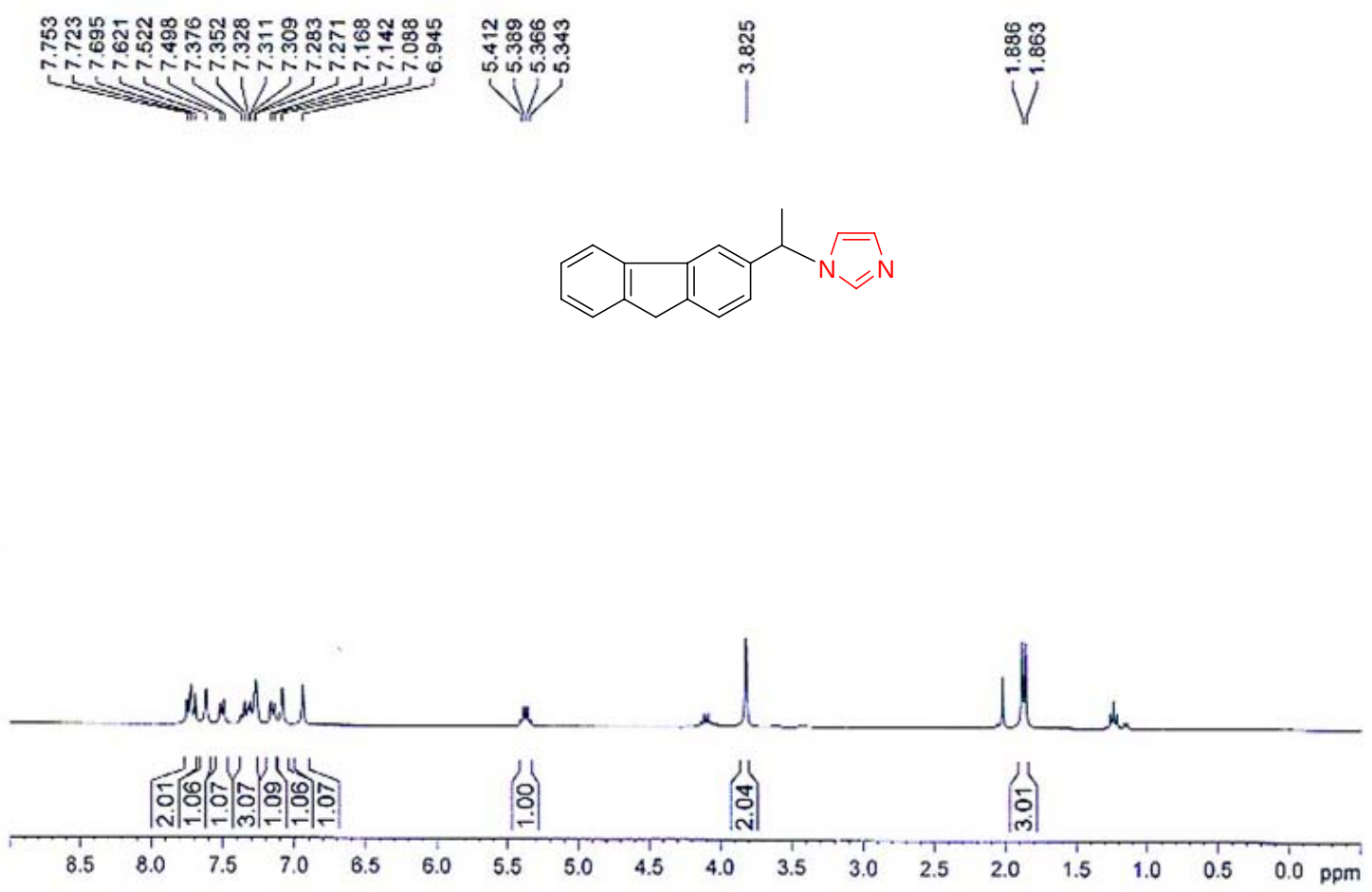
43

(±)-3-(naphthalen-2-ylmethyl)-1-(1-(9*H*-fluoren-3-yl)ethyl)-5,6-dimethyl-1*H*-benzo[*d*]imidazol-3-ium bromide

Yield 92%. White solid, Mp 244-246 °C. IR ν_{max} (cm^{-1}): 3192, 3007, 1681, 1555, 1459, 1186, 1011, 837, 743. ^1H NMR (300 MHz, $CDCl_3$) δ: 10.44 (1H, s), 8.92 (1H , s), 8.13 (2H, dd, J = 11.4, 8.1 Hz), 7.93 (2H, dd, J = 18.6, 8.4 Hz), 7.79 (2H, dd, J = 11.1, 8.1 Hz), 7.63-7.67 (3H, m), 7.60 (1H, s), 7.54 (1H, d, J = 7.2 Hz), 7.43 (1H, d, J = 7.8 Hz), 7.31-7.37 (3H, m), 7.17 (1H, d, J = 7.5Hz), 6.61 (2H, s), 5.89-5.96 (1H, m), 3.91 (2H, s), 2.33 (3H, s), 2.30 (3H, s), 2.23 (3H, d, J = 6.9 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ : 190.54 (C), 144.63 (C), 143.49 (C), 142.77 (C), 140.93 (CH), 140.56 (C), 137.62 (CH), 137.14 (C), 136.27 (C), 136.16 (C), 132.51 (C), 131.43 (C), 131.21 (C), 130.77 (C), 130.09 (CH), 129.43 (CH), 129.23 (CH), 129.03 (CH), 128.15 (CH)，127.74 (CH), 127.30 (CH), 127.23 (CH), 126.85 (CH), 125.08 (CH), 123.24 (CH), 122.83 (CH), 120.59 (CH), 120.10 (CH), 113.61 (CH), 112.95 (CH), 59.15 (CH), 53.56 (CH_2), 36.86

(CH_2), 21.77 (CH_3), 20.55 (CH_3), 20.39 (CH_3). HRMS (ESI-TOF) m/z Calcd for $C_{36}H_{31}BrN_2O$ $[M-Br]^+$ 507.2431, found 507.2440.

3. ^{1}H-NMR and ^{13}C-NMR Spectral of New Compounds



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EXPNO	90
PROCNO	1
Date_	20120706
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PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	16
DS	2
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	114
DW	81.000 usec
DE	6.50 usec
TE	298.7 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1300084 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00


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141.751
140.944
140.029
136.079
129.324
127.021
126.861
125.076
124.852
122.678
120.111
120.002
118.033
77.556
77.132
76.708
56.782
36.871
22.210
N
N
145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 ppm

NAME	ljm1
EXPNO	1
PROCNO	1
Date_	20121107
Time	8.45
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PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	8
DS	0
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	128
DW	81.000 usec
DE	6.50 usec
TE	296.5 K
D1	1.00000000 sec
TD0	1
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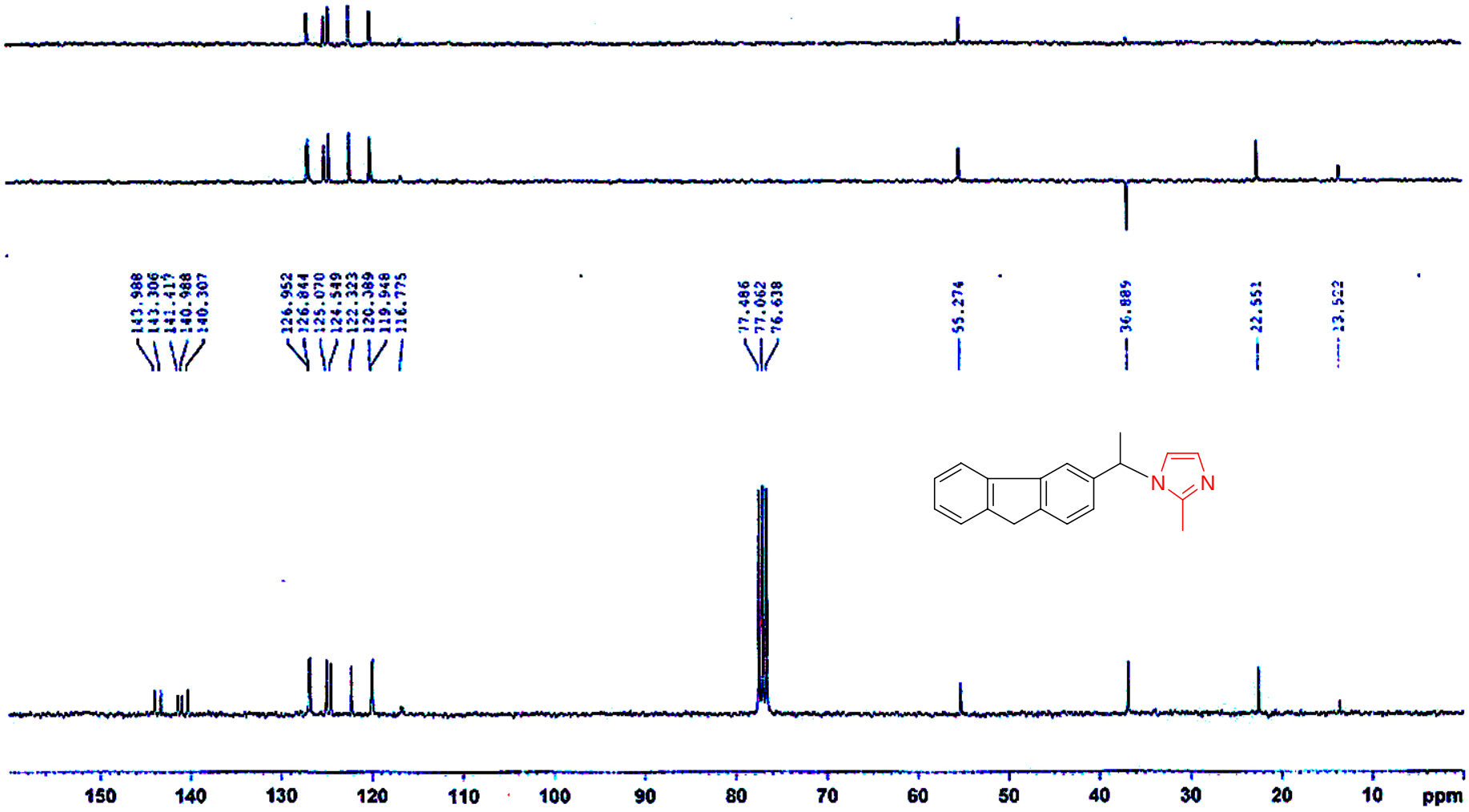
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1300067 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00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141.417
140.988
140.307
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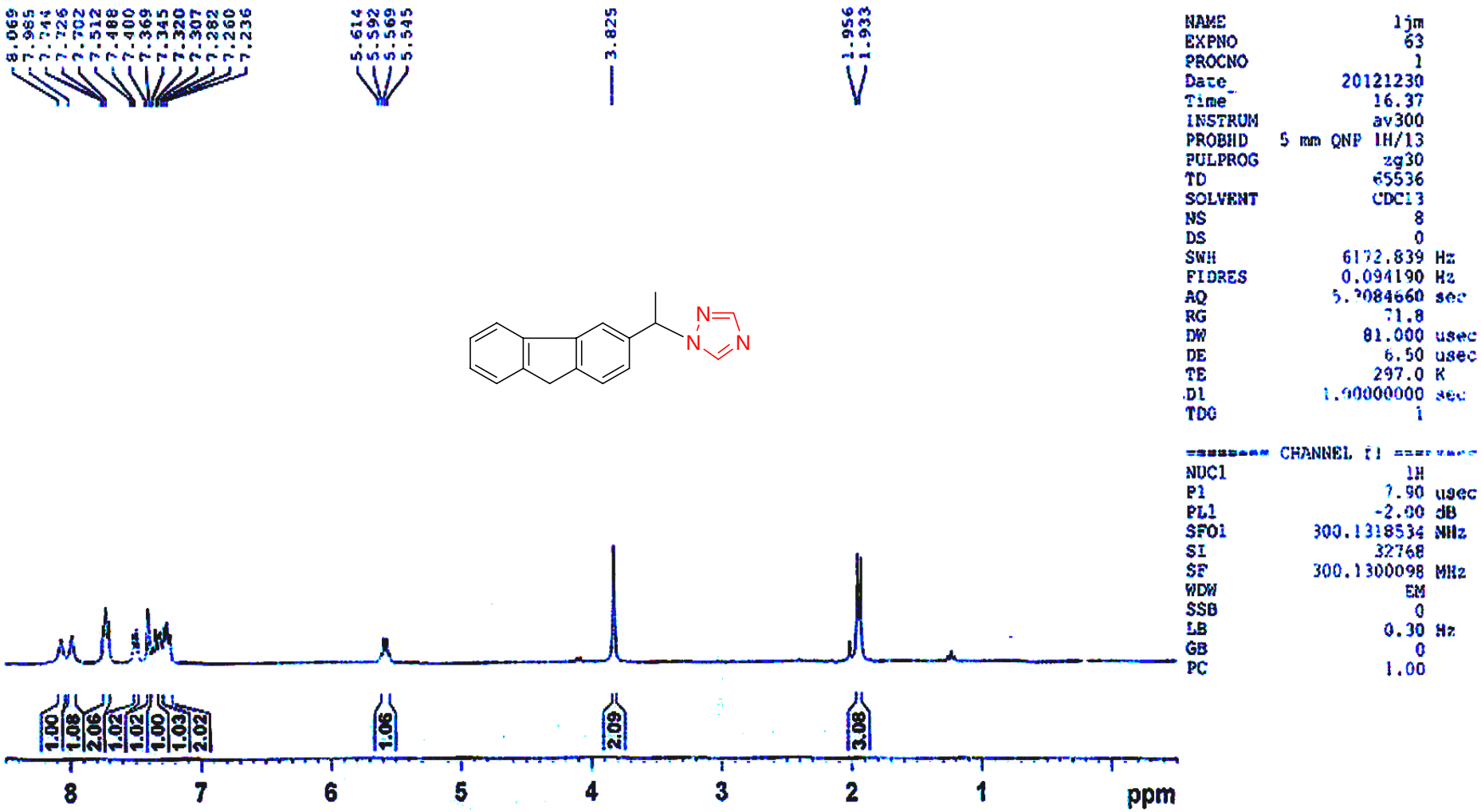
126.844
125.070
124.549
122.323
120.389
119.948
116.775
77.486
77.062
76.638
55.274
36.889
22.551
13.522
N
N
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


8.069
7.985
7.744
7.726
7.702
7.512
7.488
7.400
7.369
7.345
7.320
7.307
7.282
7.260
7.236
5.614
5.592
5.569
5.545
3.825
1.956
1.933
N
N
N
NAME 1jm
EXPNO 63
PROCNO 1
Date_ 20121230
Time 16.37
INSTRUM av300
PROBHD 5 mm QNP 1H/13
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 8
DS 0
SWH 6172.839 Hz
FIDRES 0.094190 Hz
AQ 5.?084660 sec
RG 71.8
DW 81.000 usec
DE 6.50 usec
TE 297.0 K
D1 1.00000000 sec
TDG 1
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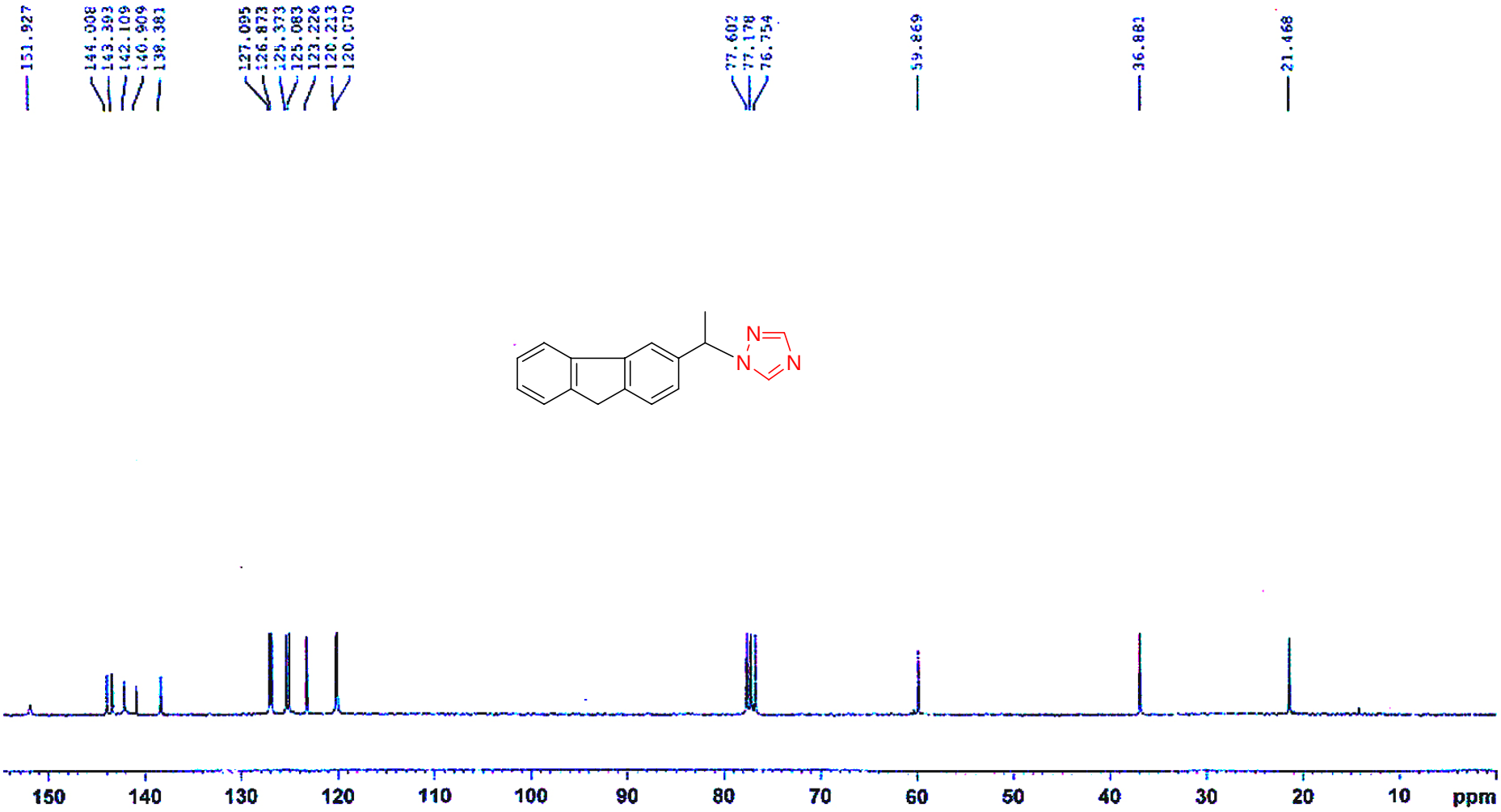
NUC1 1H
P1 7.90 usec
PL1 -2.00 dB
SFO1 300.1318534 MHz
SI 32768
SF 300.1300098 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00
1.00
1.08
2.06
1.02
1.02
1.00
1.03
2.02
1.06
2.09
3.08
8
7
6
5
4
3
2
1
ppm


151.927
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143.393
142.109
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127.095
126.873
125.373
125.083
123.226
120.213
120.070
77.602
77.178
76.754
59.869
36.881
21.468
N
N
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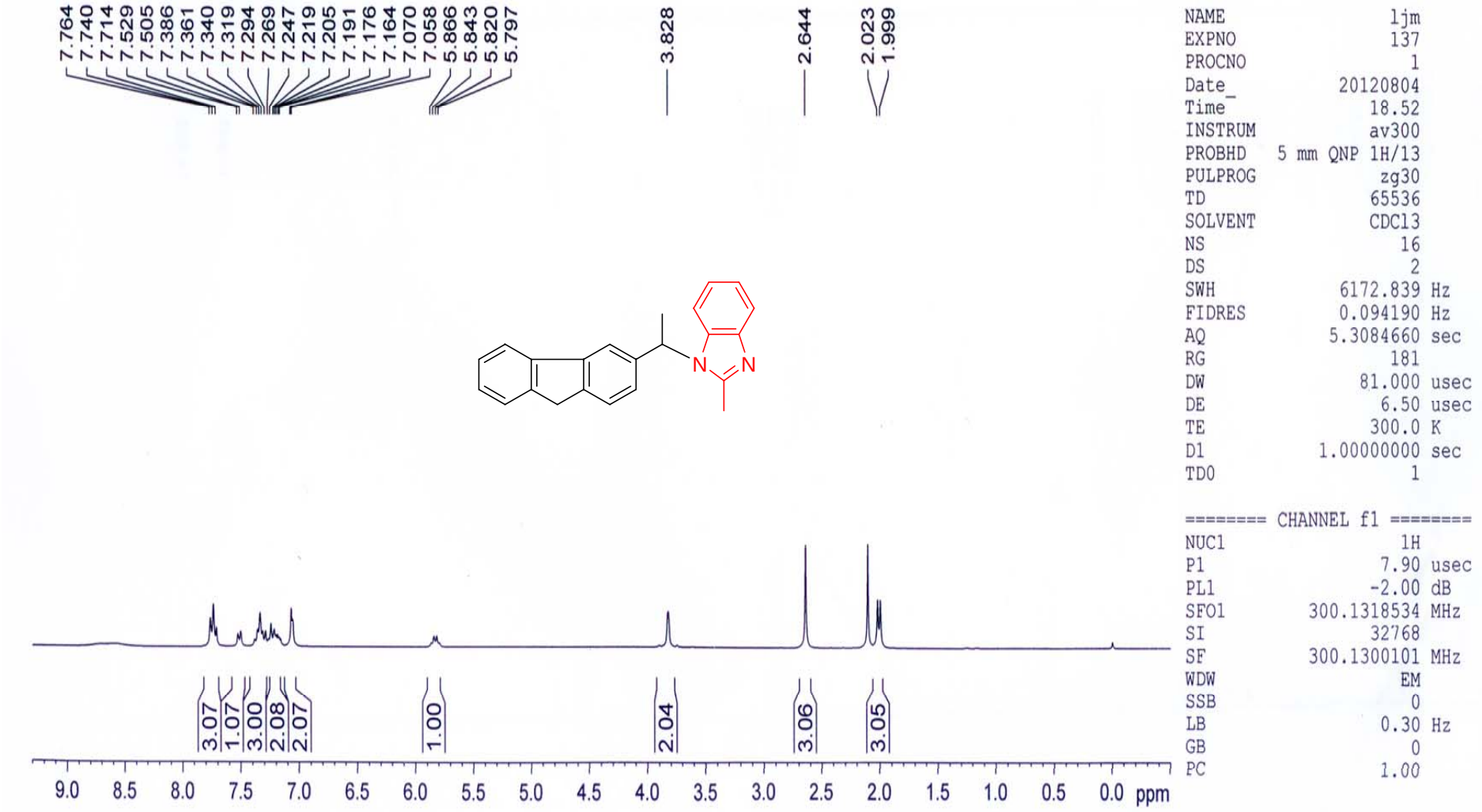
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm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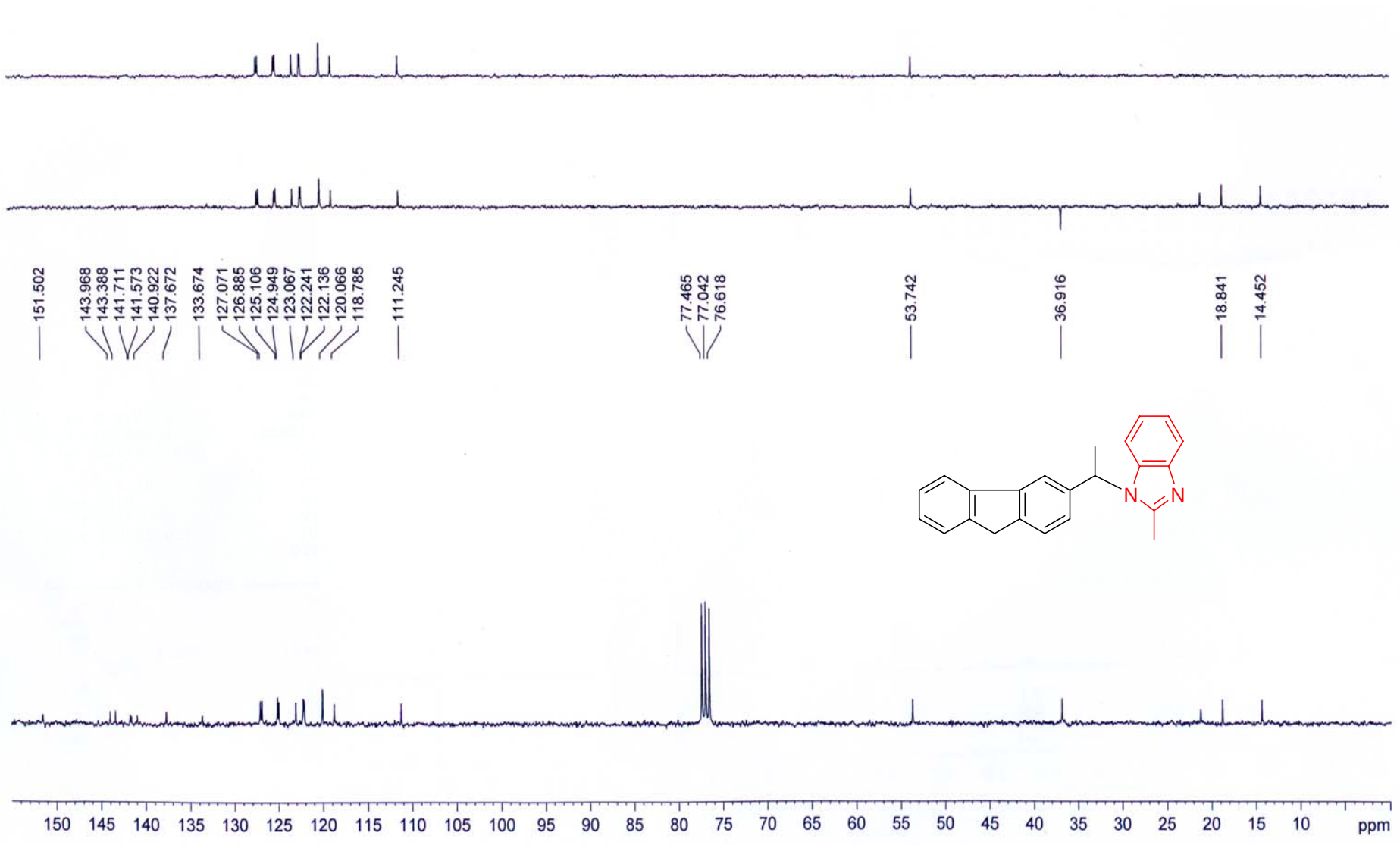
7.714
7.529
7.505
7.386
7.361
7.340
7.319
7.294
7.269
7.247
7.219
7.205
7.191
7.176
7.164
7.070
7.058
5.866
5.843
5.820
5.797
3.828
2.644
2.023
1.999
N
N
3.07
1.07
3.00
2.08
2.07
1.00
2.04
3.06
3.05
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
NAME ljm
EXPNO 137
PROCNO 1
Date_ 20120804
Time 18.52
INSTRUM av300
PROBHD 5 mm QNP 1H/13
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 6172.839 Hz
FIDRES 0.094190 Hz
AQ 5.3084660 sec
RG 181
DW 81.000 usec
DE 6.50 usec
TE 300.0 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 7.90 usec
PL1 -2.00 dB
SFO1 300.1318534 MHz
SI 32768
SF 300.1300101 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00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141.573
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125.106
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123.067
122.241
122.136
120.066
118.785
111.245
77.465
77.042
76.618
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36.916
18.841
14.452
N
N
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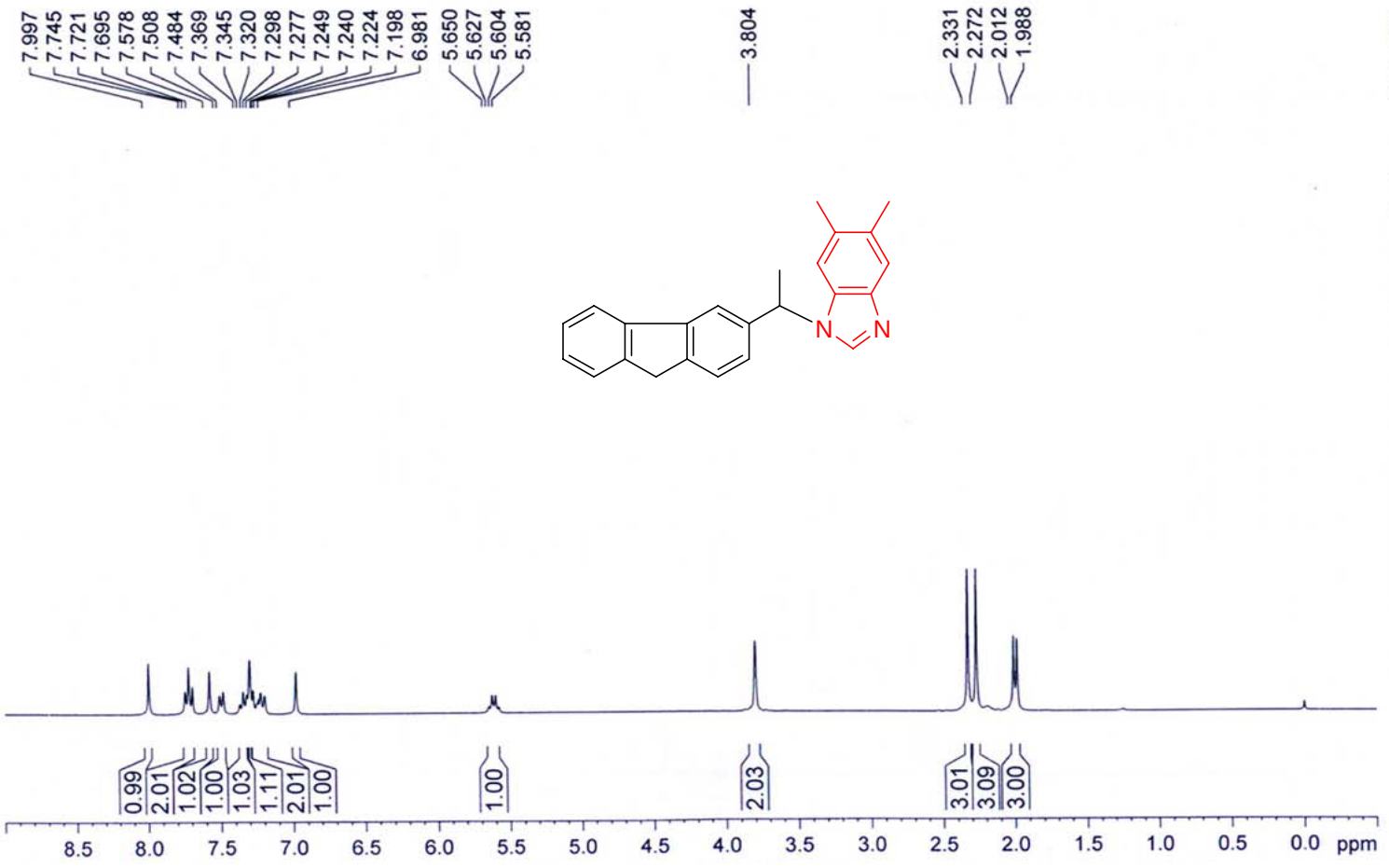

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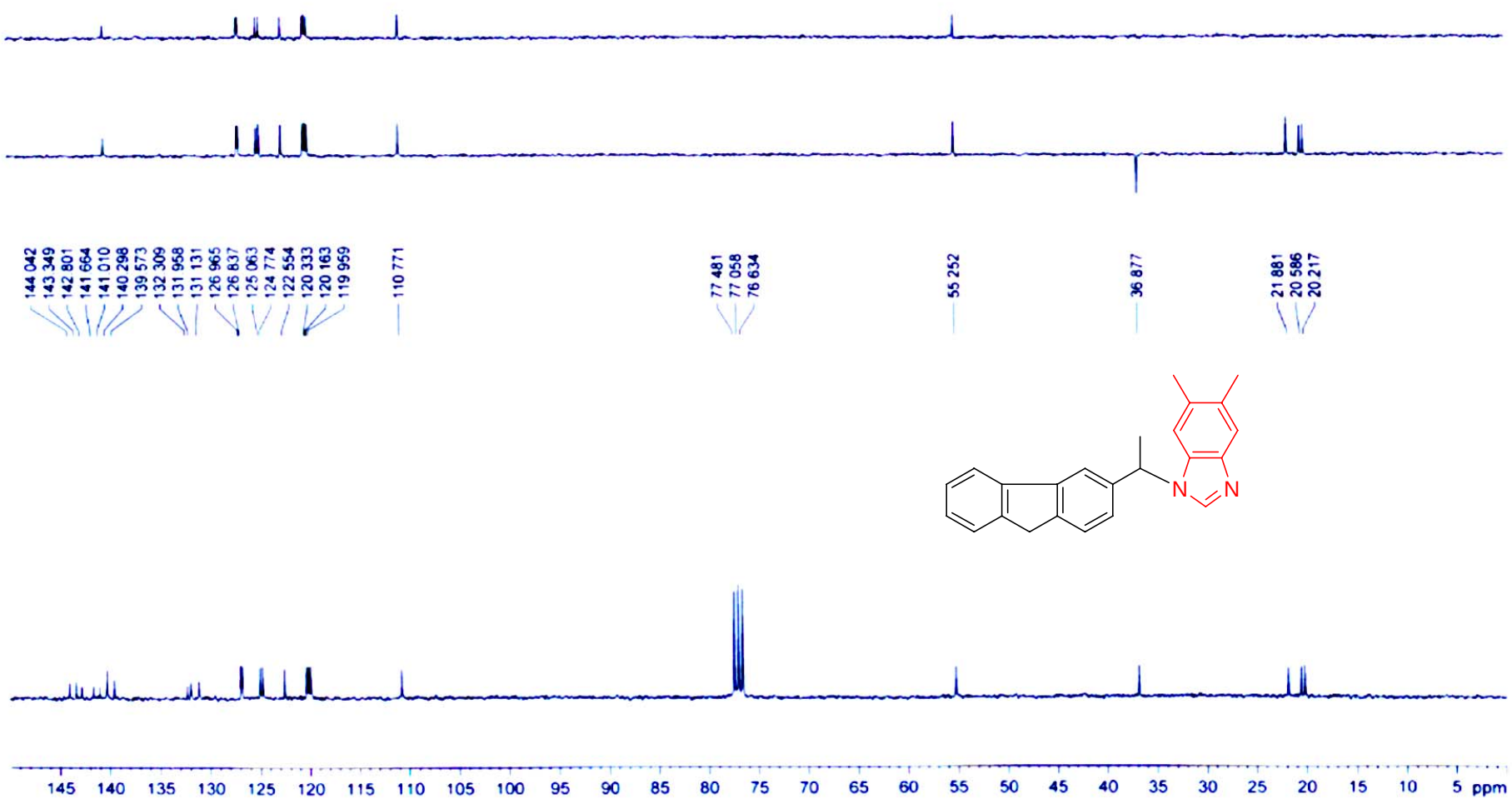
EXPNO	106
PROCNO	1
Date_	20120716
Time	12.12
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	16
DS	2
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	181
DW	81.000 usec
DE	6.50 usec
TE	299.0 K
D1	1.00000000 sec
TD0	1

======== CHANNEL f1 ========	
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1300120 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00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140.298
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132.309
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131.131
126.965
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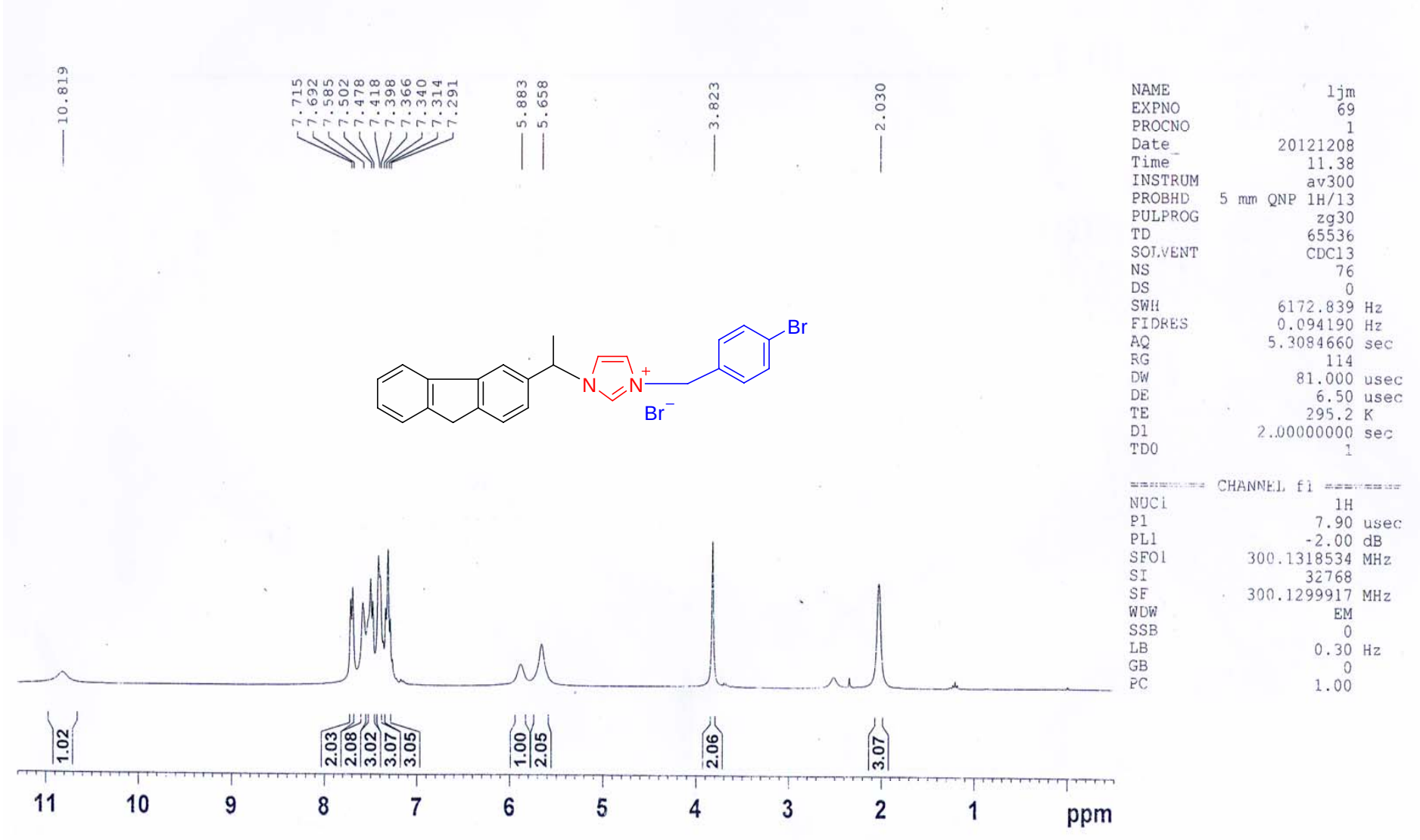
124.774
122.554
120.333
120.163
119.959
110.771
77.481
77.058
76.634
55.252
36.877
21.881
20.586
20.217
N
N
145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 ppm



NAME	ljm
EXPNO	69
PROCNO	1
Date_	20121208
Time	11.38
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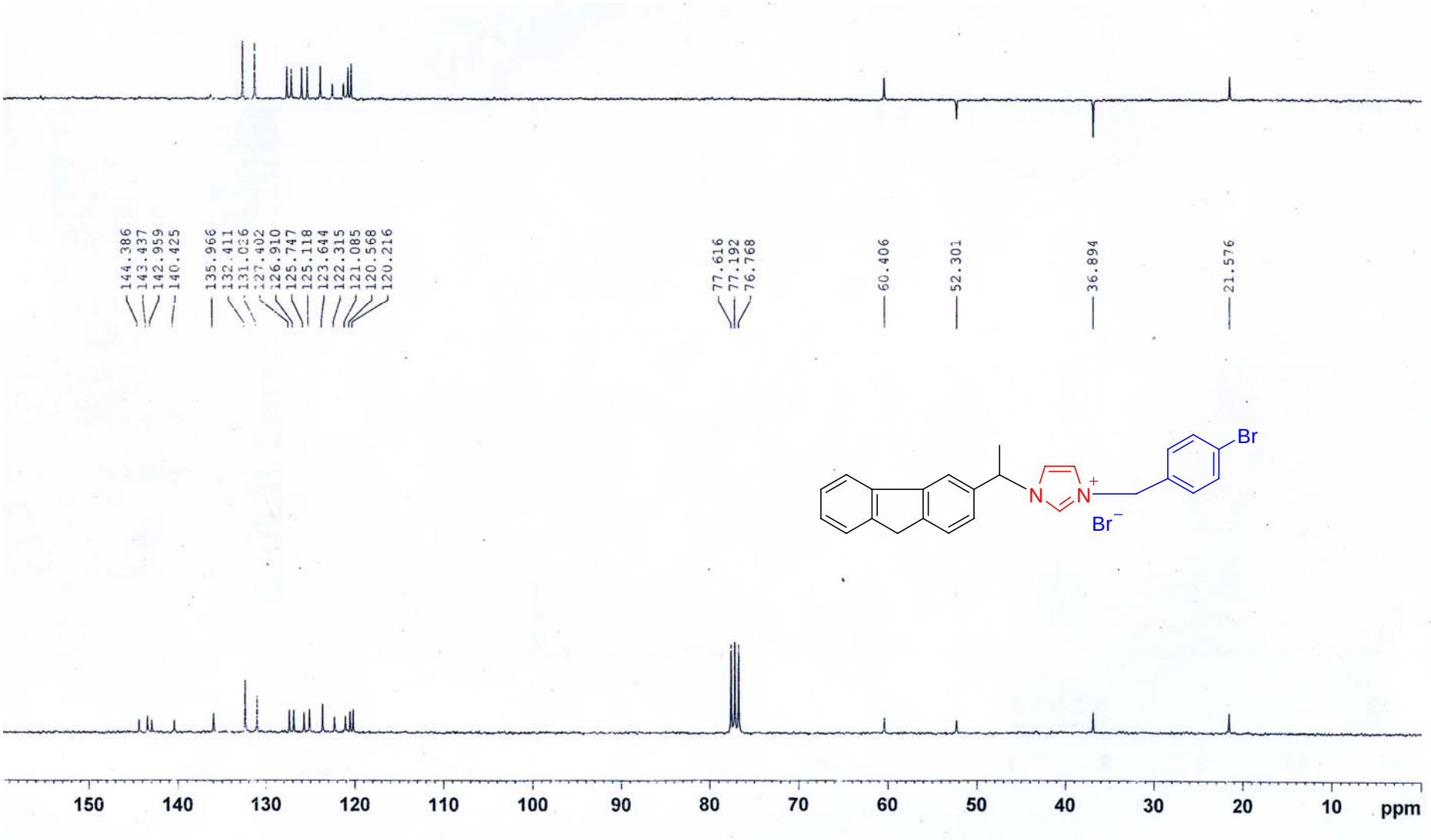
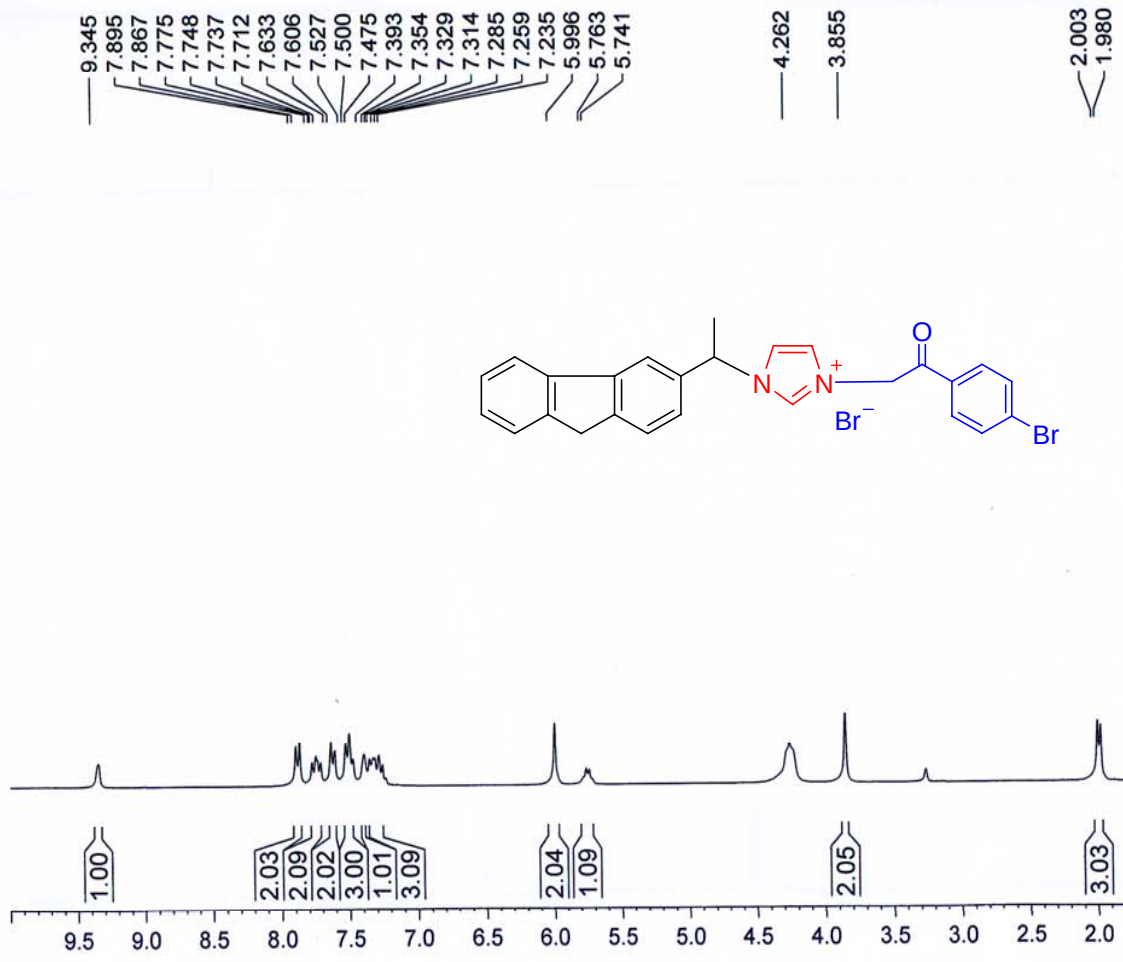
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	76
DS	0
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	114
DW	81.000 usec
DE	6.50 usec
TE	295.2 K
D1	2.00000000 sec
TD0	1
========	CHANNEL f1 ========
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1299917 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00

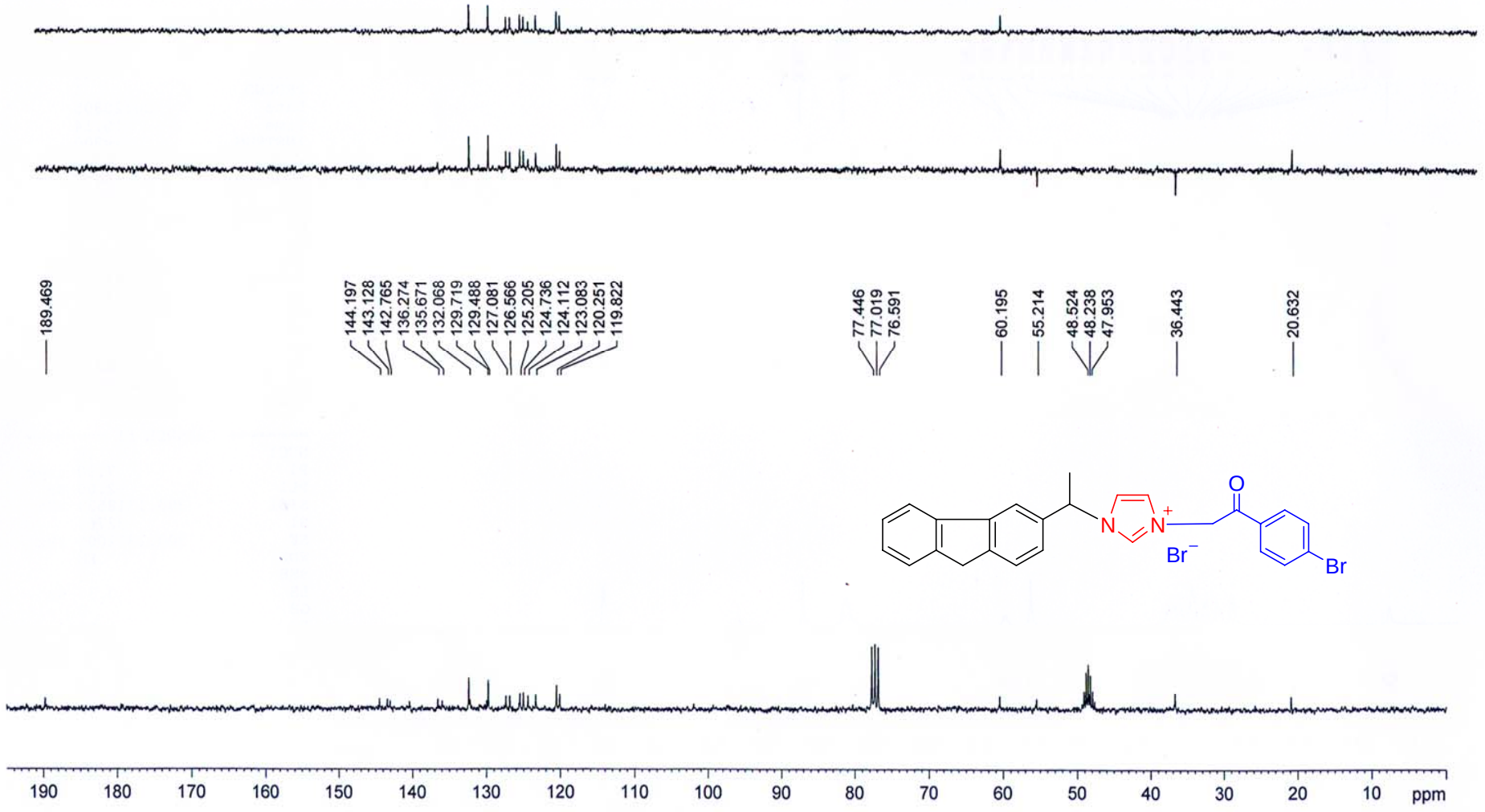

144.386
143.437
142.959
140.425
135.966
132.411
131.026
127.402
126.910
125.747
125.118
123.644
122.315
121.085
120.568
120.216
77.616
77.192
76.768
60.406
52.301
36.894
21.576
Br
N
N
+
Br
−
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

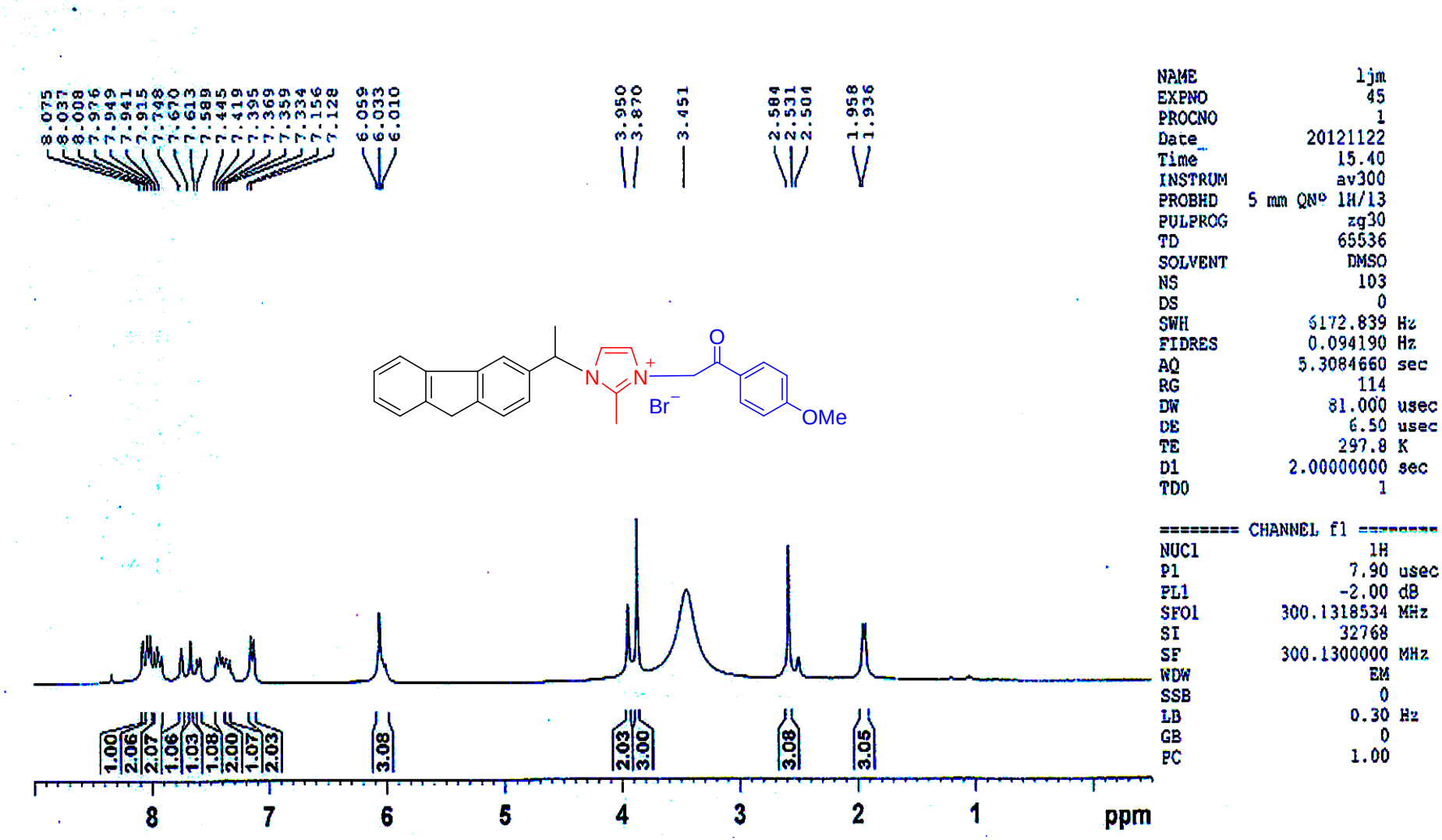


NAME	ljm
EXPNO	141
PROCNO	1
Date_	20120805
Time	15.14
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	16
DS	2
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	256
DW	81.000 usec
DE	6.50 usec
TE	300.1 K
D1	1.00000000 sec
TD0	1

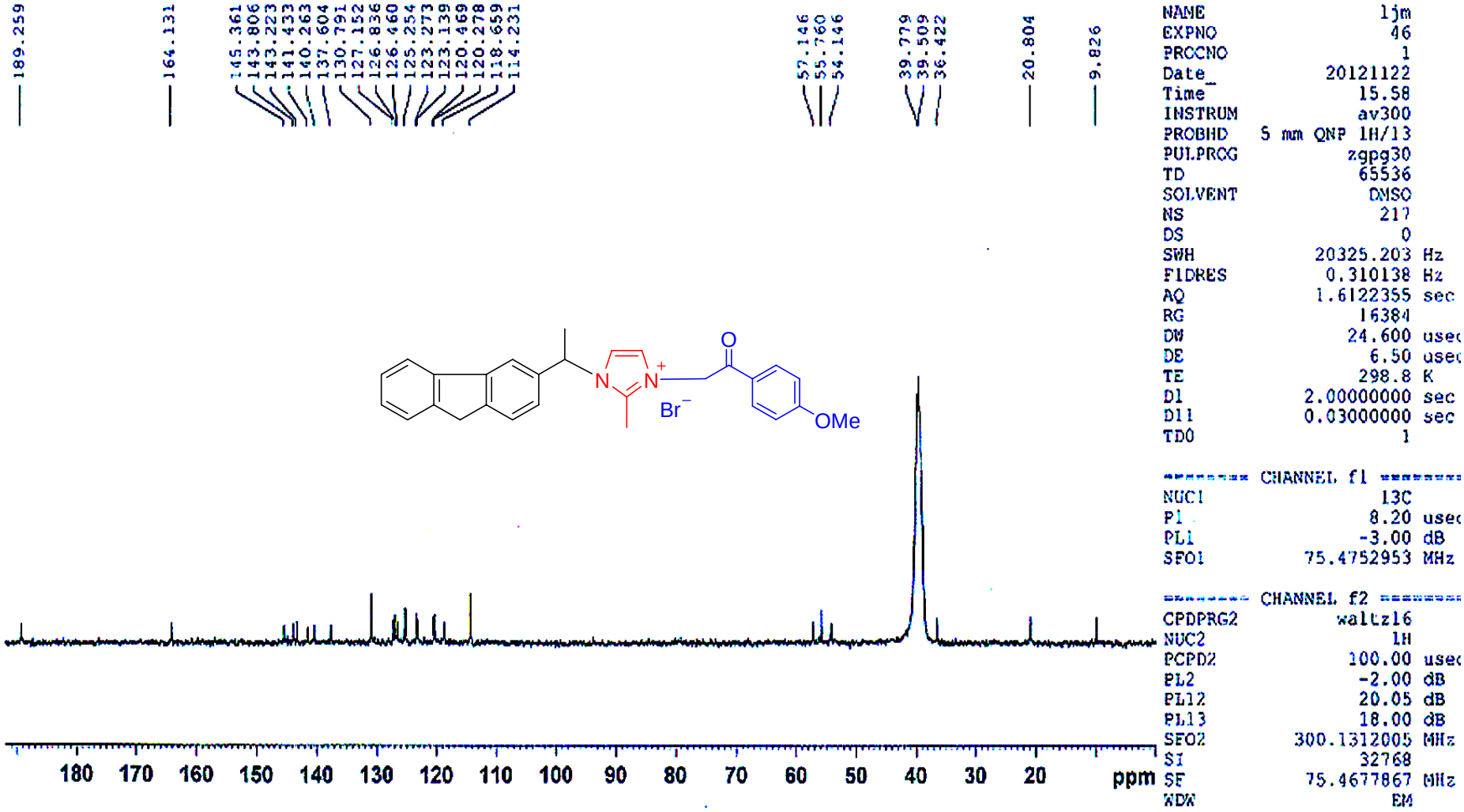
======== CHANNEL f1 ========

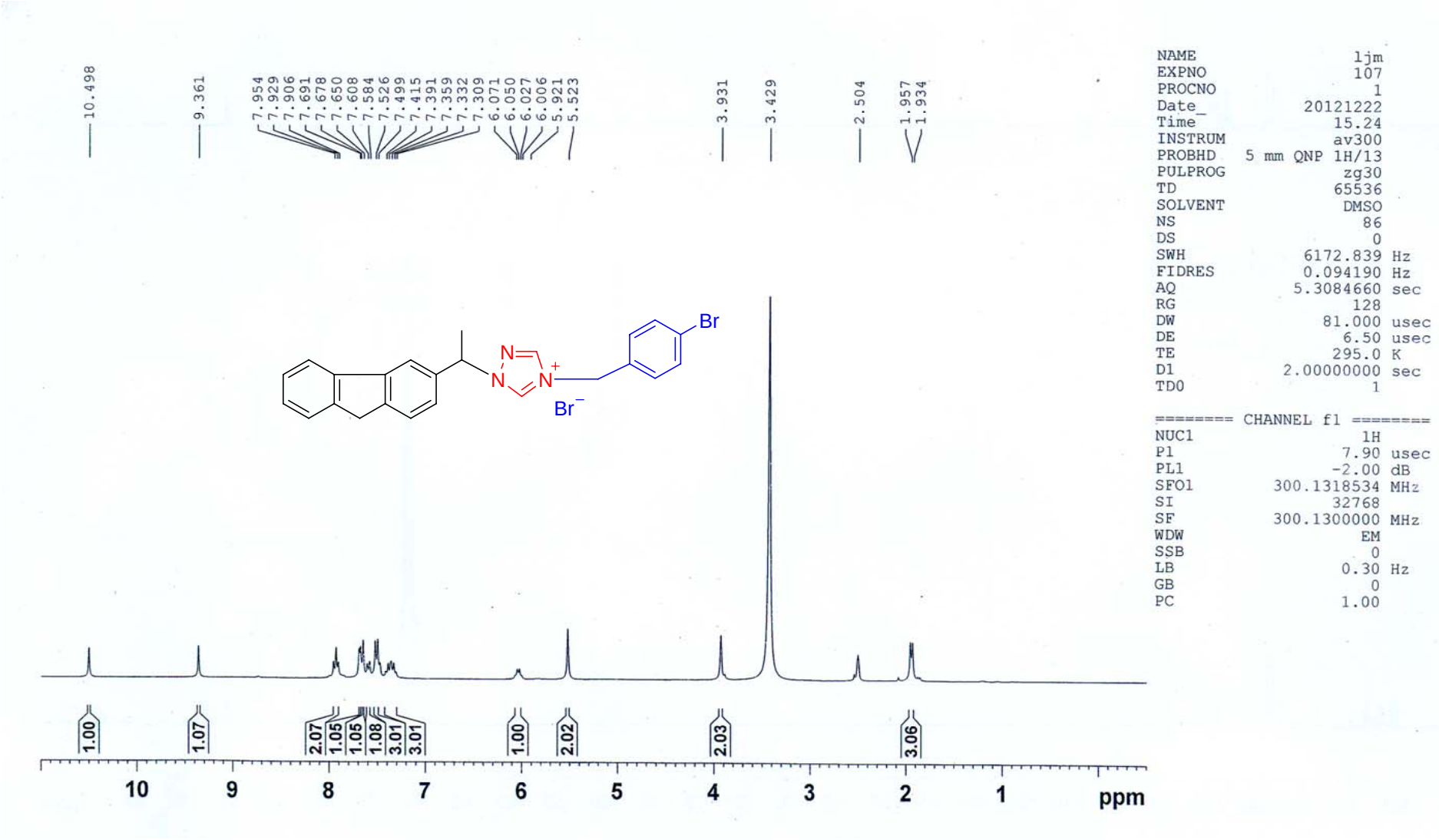
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1312005 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00


189.469
144.197
143.128
142.765
136.274
135.671
132.068
129.719
129.488
127.081
126.566
125.205
124.736
124.112
123.083
120.251
119.822
77.446
77.019
76.591
60.195
55.214
48.524
48.238
47.953
36.443
20.632
O
N
N+
Br−
Br
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

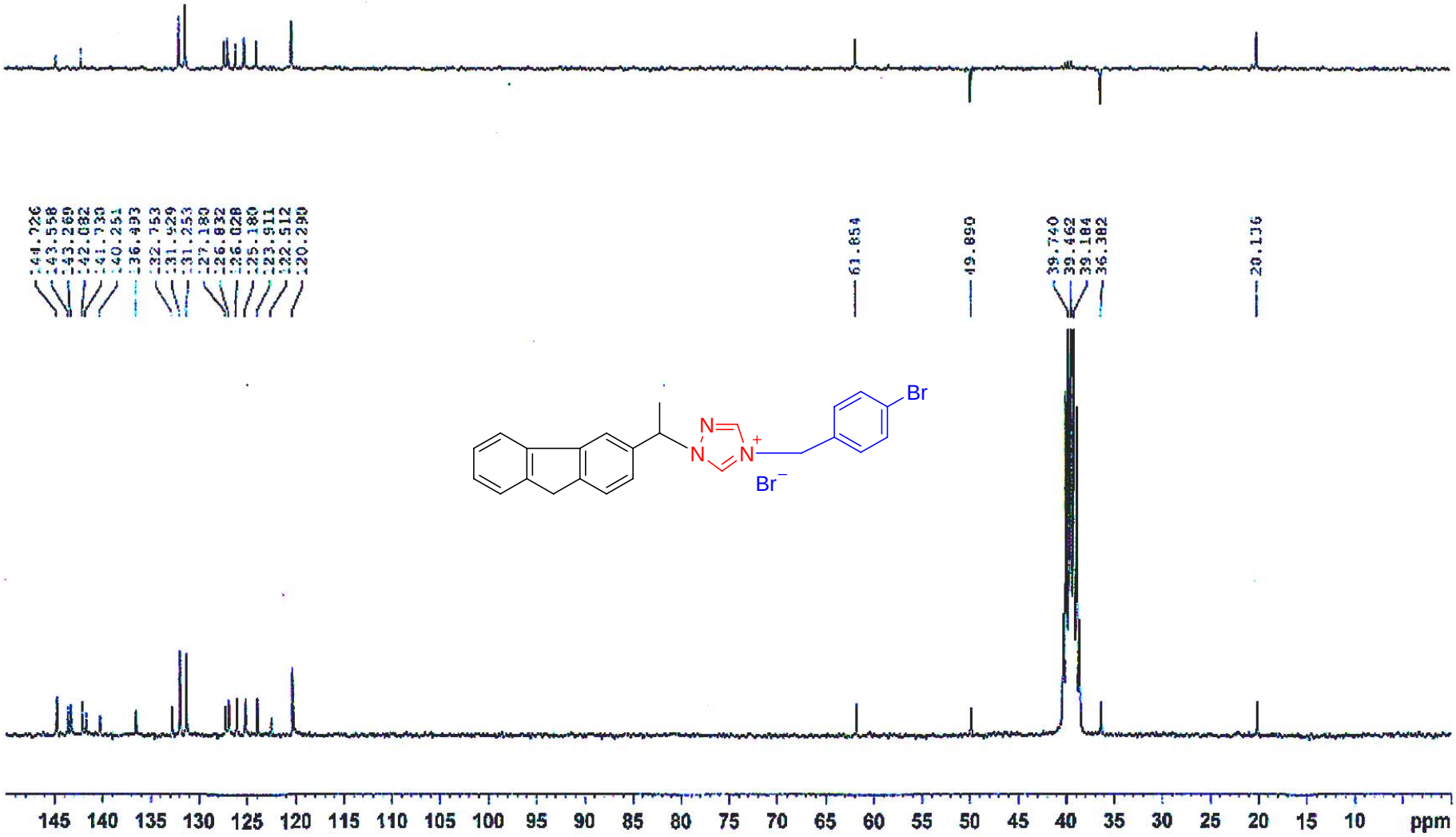


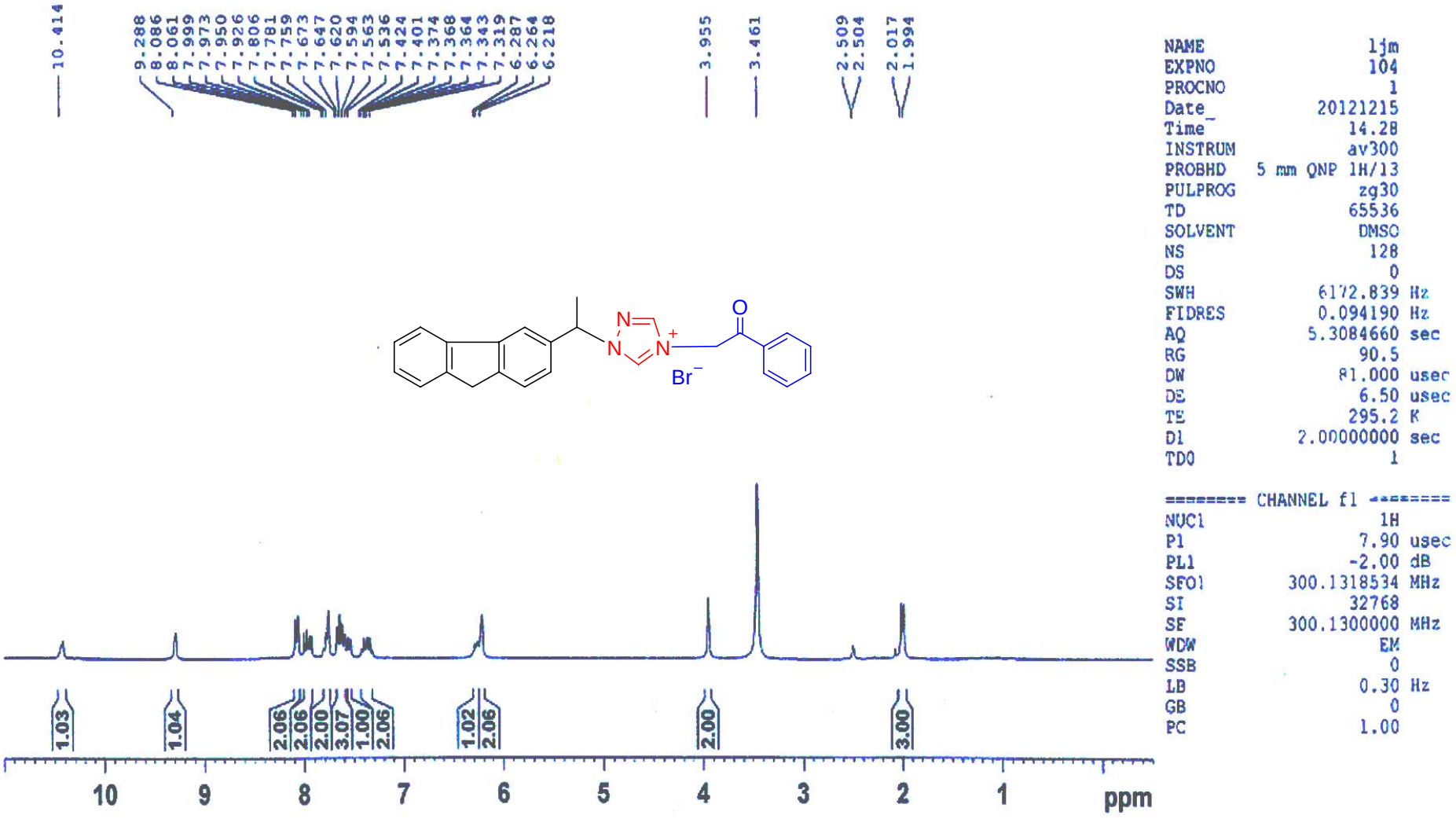
NAME	ljm
EXPNO	45
PROCNO	1
Date_	20121122
Time	15.40
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	DMSO
NS	103
DS	0
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	114
DW	81.000 usec
DE	6.50 usec
TE	297.8 K
D1	2.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1300000 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00


189.259
164.131
145.361
143.806
143.223
141.433
140.263
137.604
130.791
127.152
126.836
126.460
125.254
123.273
123.139
120.469
120.278
118.659
114.231
57.146
55.760
54.146
39.779
39.509
36.422
20.804
9.826
Br⁻
OMe
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm
NAME ljm
EXPNO 46
PROCNO 1
Date_ 20121122
Time 15.58
INSTRUM av300
PROBHD 5 mm QNP 1H/13
PULPROG zgpg30
TD 65536
SOLVENT DMSO
NS 217
DS 0
SWH 20325.203 Hz
FIDRES 0.310138 Hz
AQ 1.6122355 sec
RG 16384
DW 24.600 usec
DE 6.50 usec
TE 298.8 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 13C
P1 8.20 usec
PL1 -3.00 dB
SFO1 75.4752953 MHz
======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 100.00 usec
PL2 -2.00 dB
PL12 20.05 dB
PL13 18.00 dB
SFO2 300.1312005 MHz
SI 32768
SF 75.4677867 MHz
WDW EM
SSB 0
LB 3.00 Hz

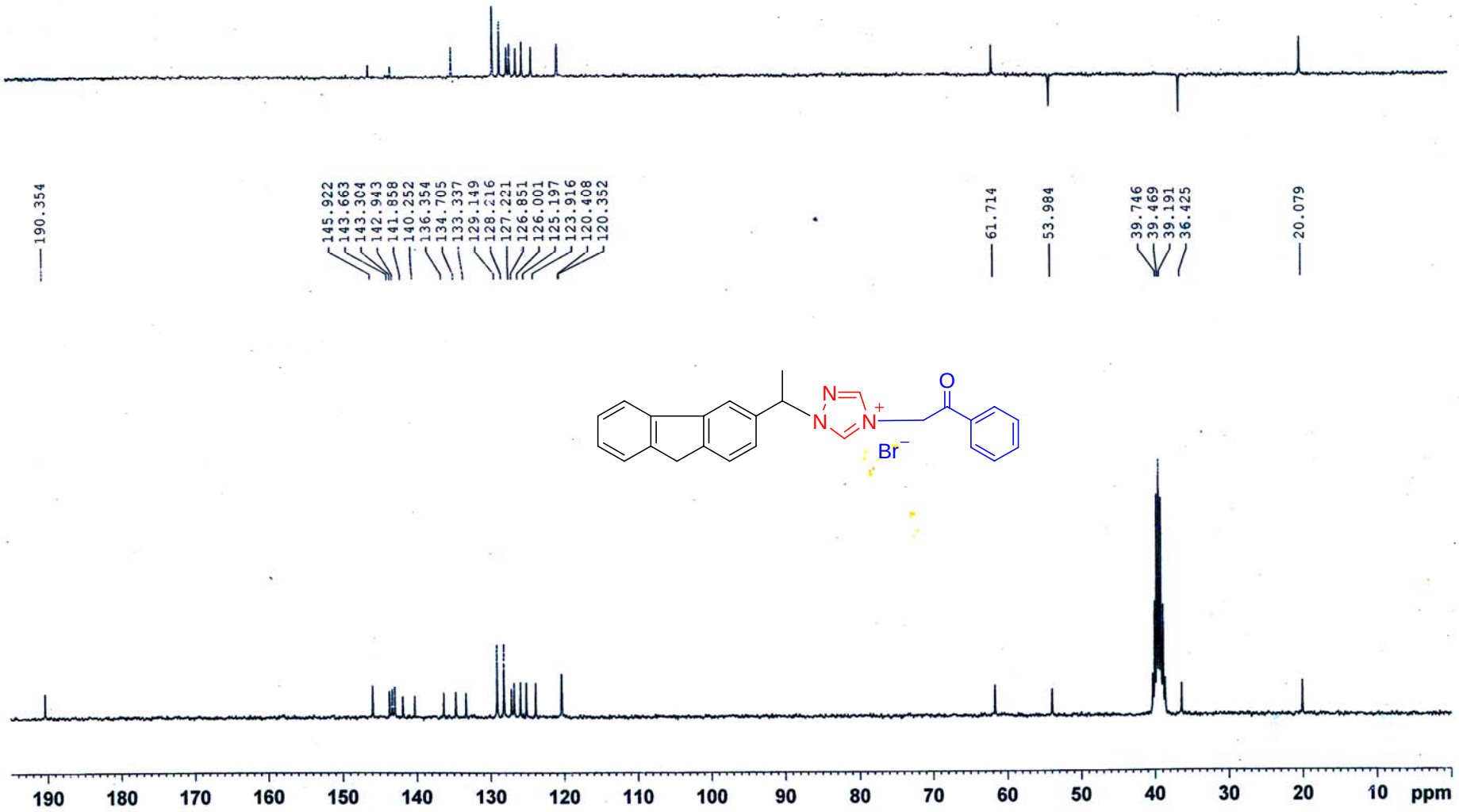


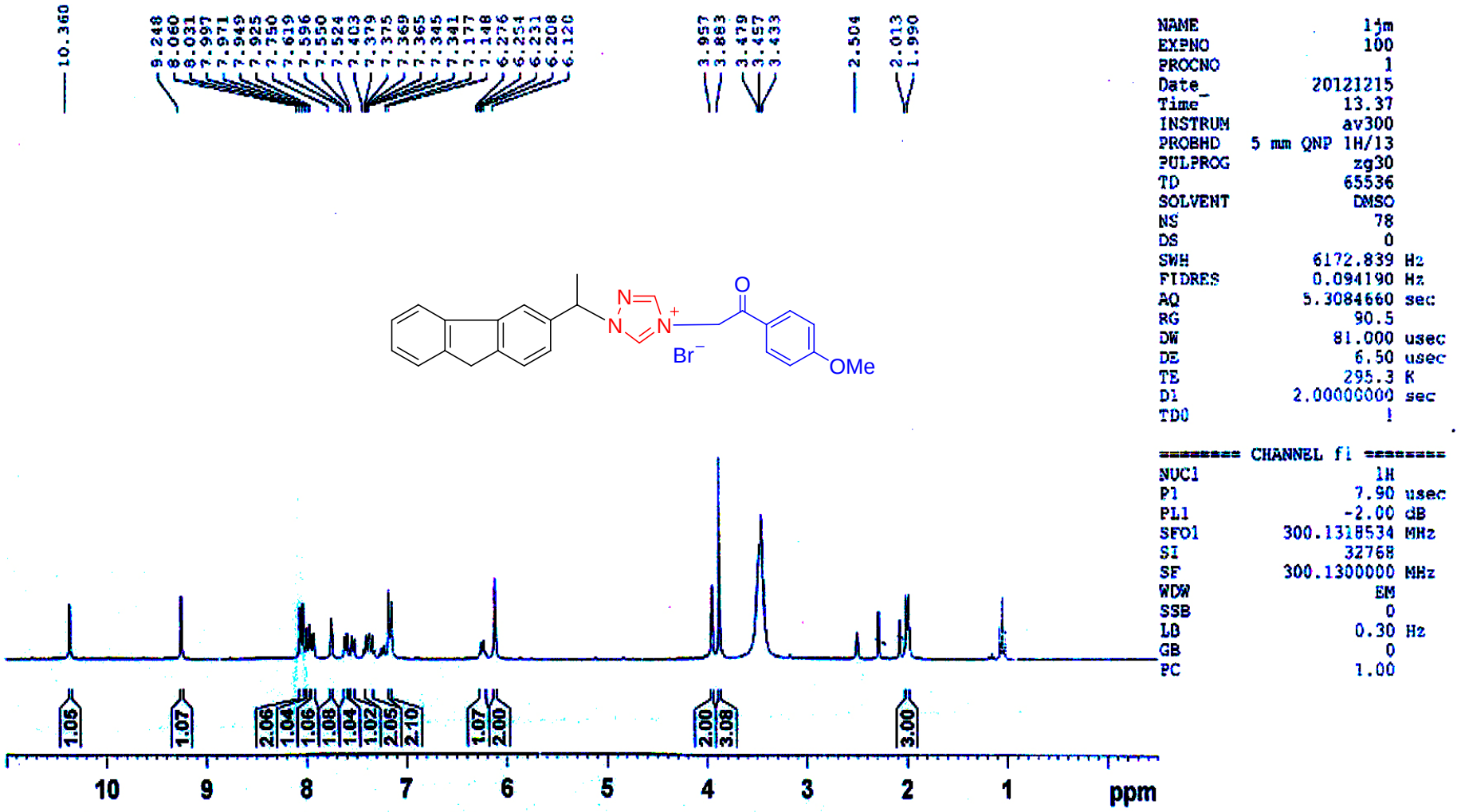

```
NAME                    ljm
EXPNO                   107
PROCNO                  1
Date_                   20121222
Time                    15.24
INSTRUM                 av300
PROBHD     5 mm QNP 1H/13
PULPROG                 zg30
TD                      65536
SOLVENT                 DMSO
NS                      86
DS                      0
SWH                     6172.839 Hz
FIDRES                  0.094190 Hz
AQ                      5.3084660 sec
RG                      128
DW                      81.000 usec
DE                      6.50 usec
TE                      295.0 K
D1                      2.00000000 sec
TD0                     1

======== CHANNEL f1 ========
NUC1                    1H
P1                      7.90 usec
PL1                     -2.00 dB
SFO1                    300.1318534 MHz
SI                      32768
SF                      300.1300000 MHz
WDW                     EM
SSB                     0
LB                      0.30 Hz
GB                      0
PC                      1.00
```

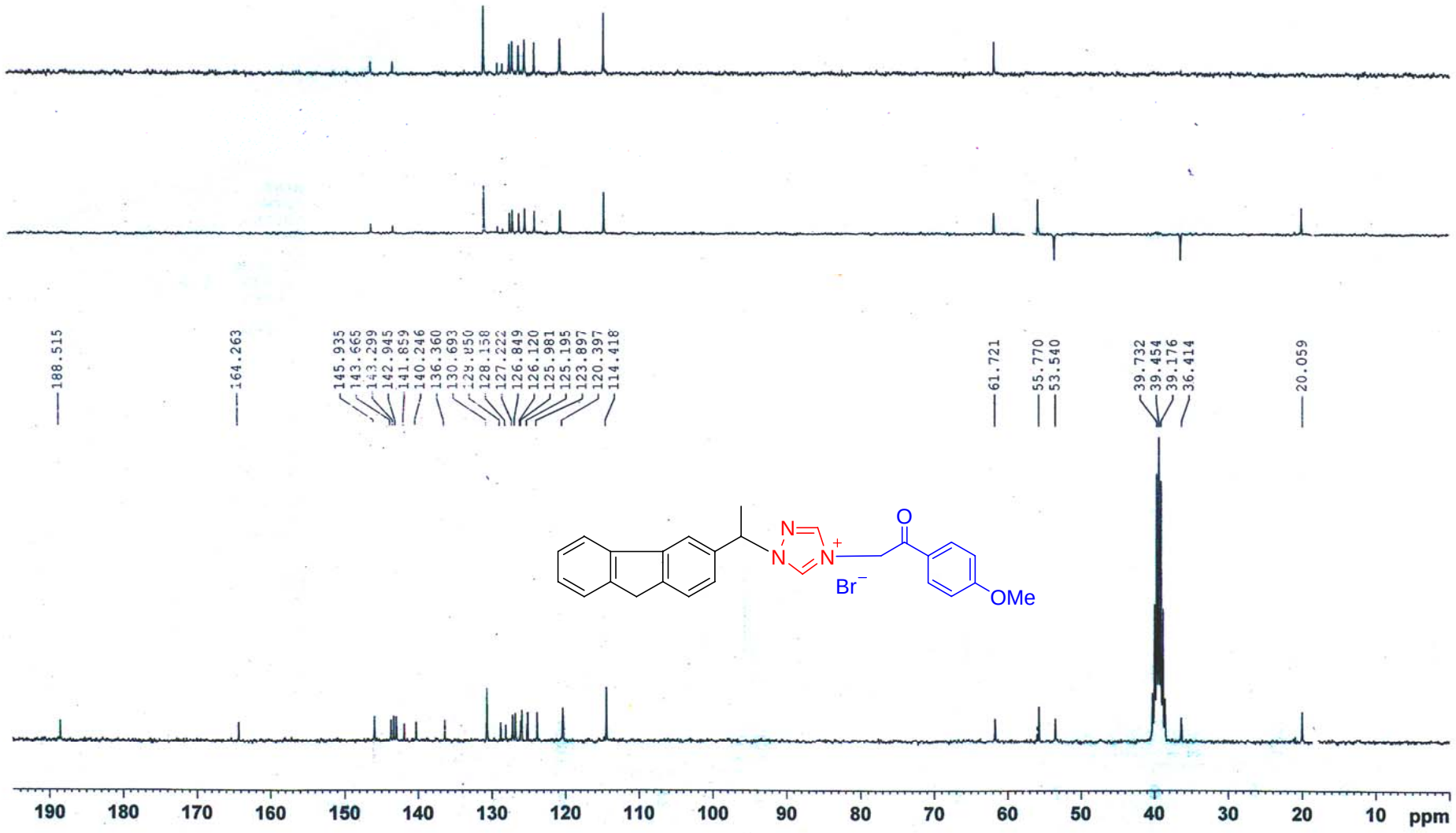

144.726
143.558
143.269
142.082
141.730
140.251
136.493
132.753
131.929
131.253
127.180
126.832
126.028
125.180
123.911
122.512
120.290
61.654
49.890
39.740
39.462
39.184
36.382
20.136
Br
N
N
N
Br⁻
145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 ppm

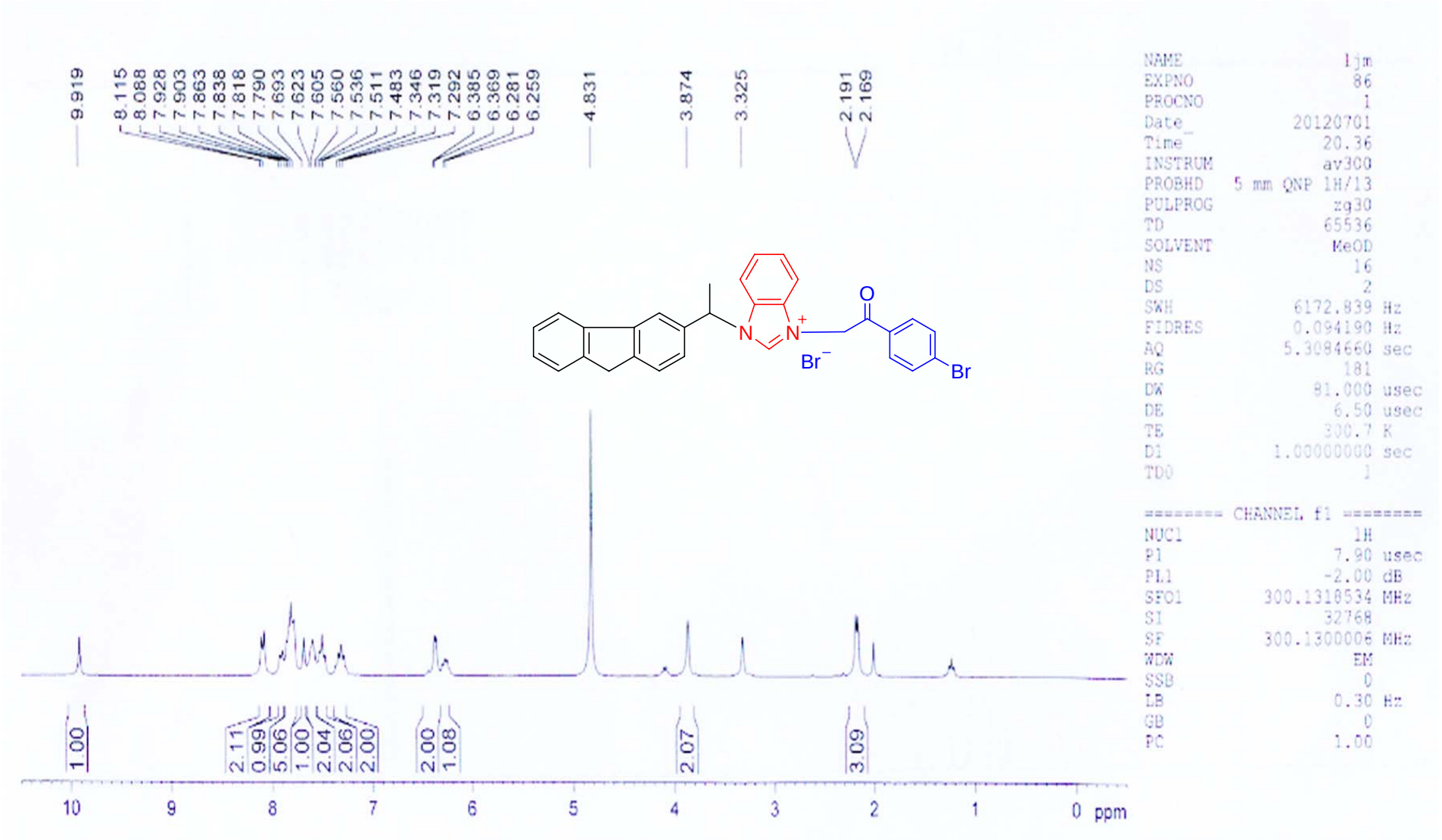


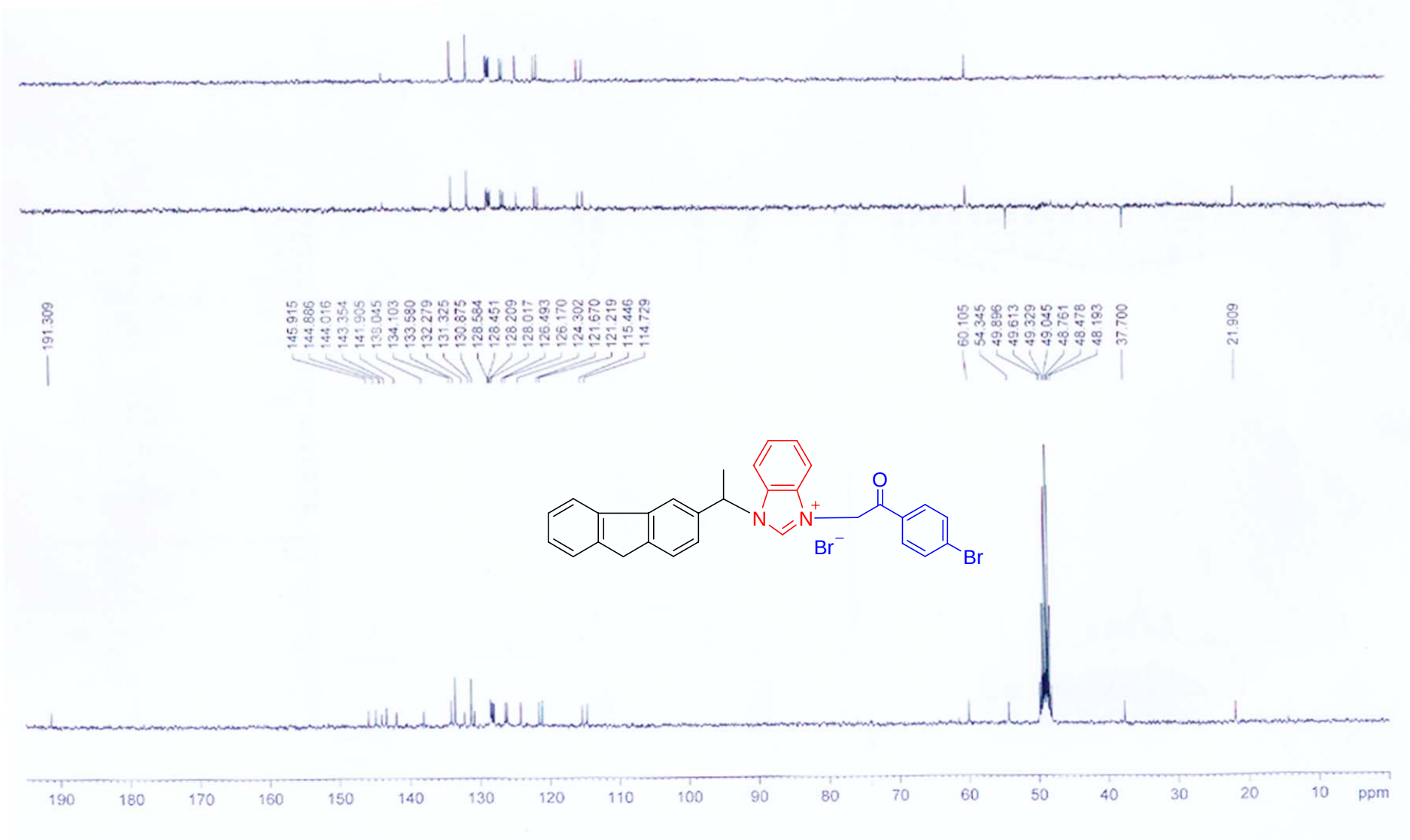
NAME	ljm
EXPNO	104
PROCNO	1
Date_	20121215
Time	14.28
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	DMSO
NS	128
DS	0
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	90.5
DW	81.000 usec
DE	6.50 usec
TE	295.2 K
D1	2.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1300000 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00

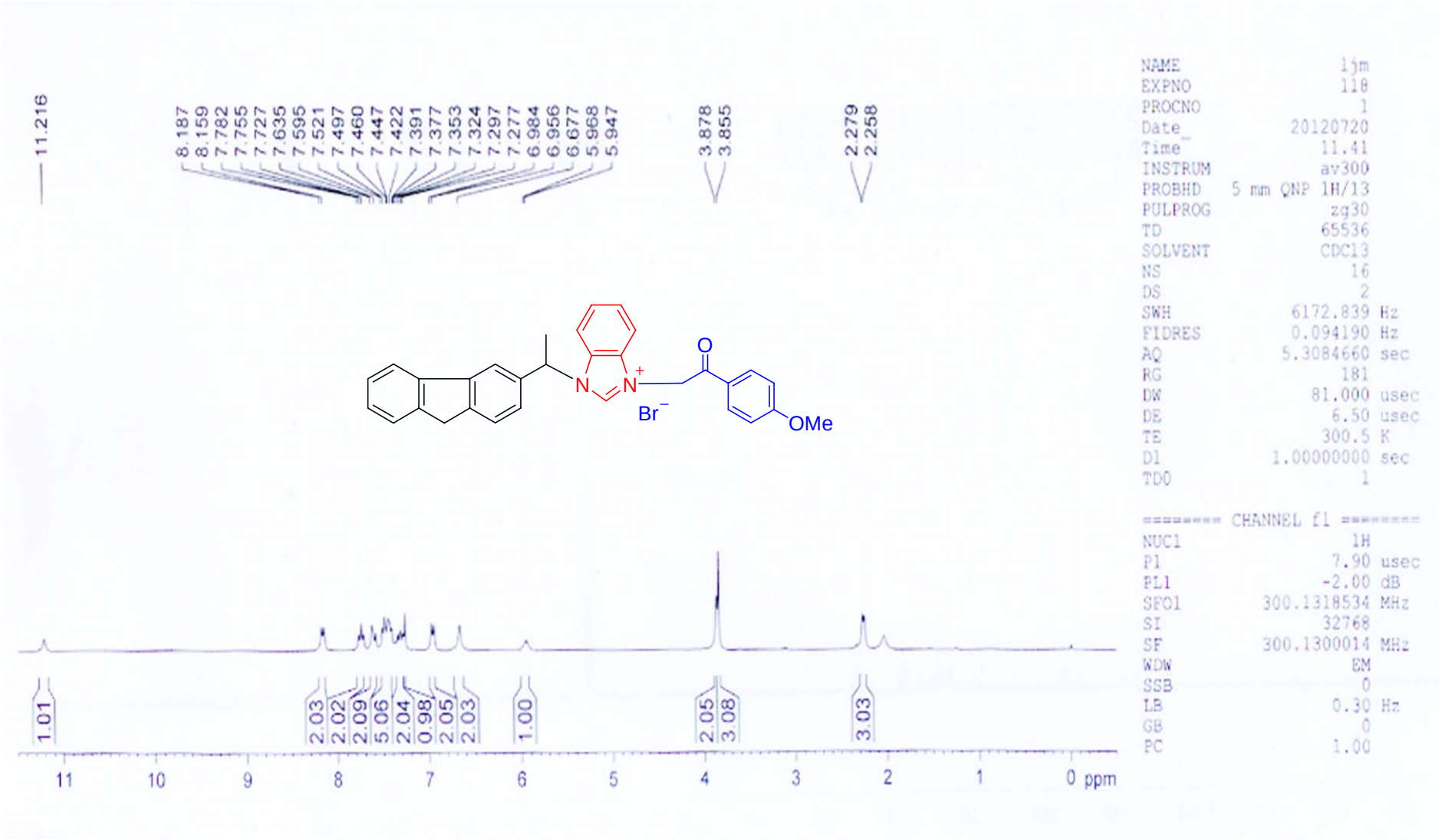

190.354
145.922
143.663
143.304
142.943
141.858
140.252
136.354
134.705
133.337
129.149
128.216
127.221
126.851
126.001
125.197
123.916
120.408
120.352
61.714
53.984
39.746
39.469
39.191
36.425
20.079
N
N
N+
O
Br−
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

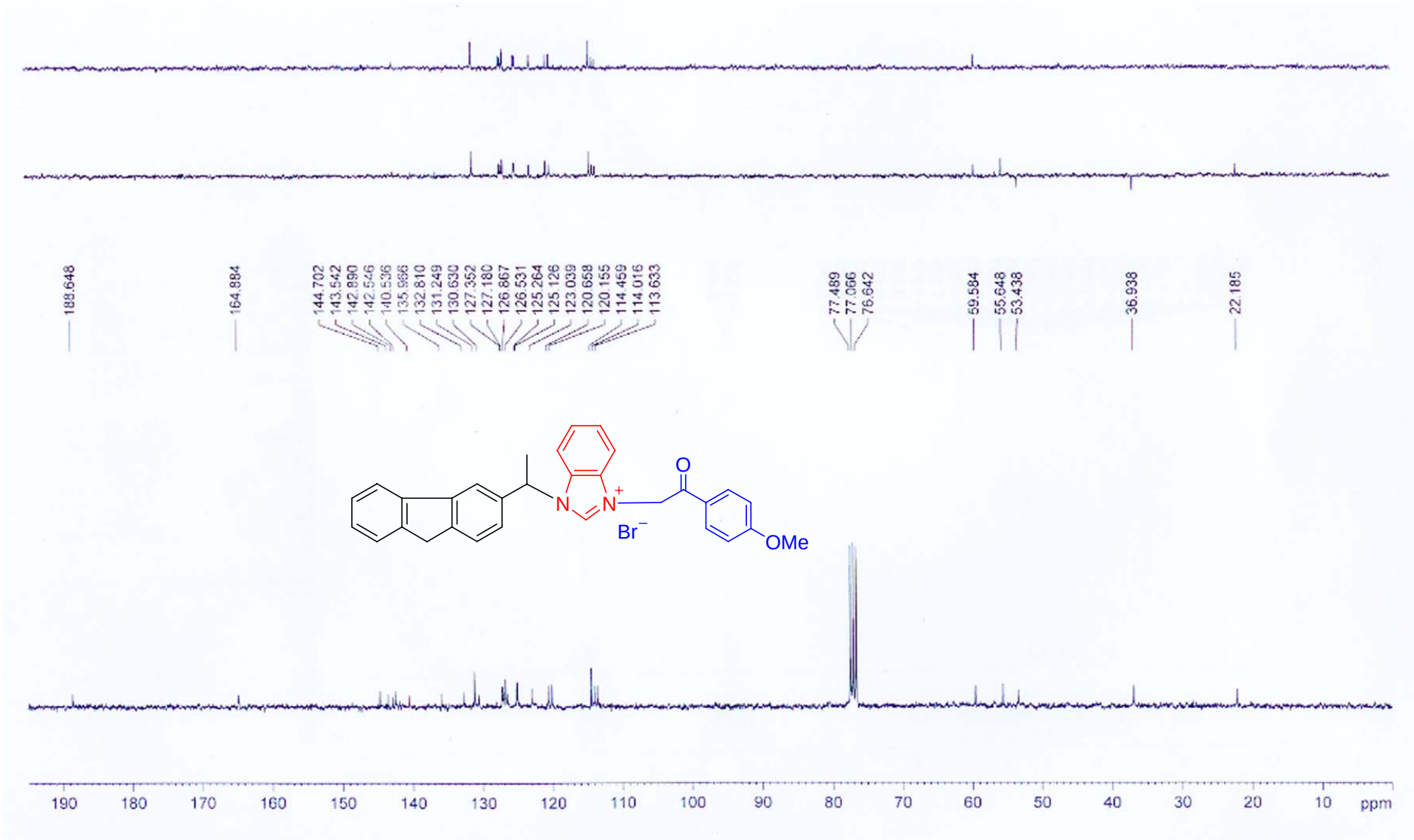

10.360
9.248
8.060
8.031
7.997
7.971
7.949
7.925
7.750
7.619
7.596
7.550
7.524
7.403
7.379
7.375
7.369
7.365
7.345
7.341
7.177
7.148
6.276
6.254
6.231
6.208
6.120
3.957
3.883
3.479
3.457
3.433
2.504
2.013
1.990
N
N
N+
Br−
O
OMe
NAME 1jm
EXPNO 100
PROCNO 1
Date_ 20121215
Time_ 13.37
INSTRUM av300
PROBHD 5 mm QNP 1H/13
PULPROG zg30
TD 65536
SOLVENT DMSO
NS 78
DS 0
SWH 6172.839 Hz
FIDRES 0.094190 Hz
AQ 5.3084660 sec
RG 90.5
DW 81.000 usec
DE 6.50 usec
TE 295.3 K
D1 2.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 7.90 usec
PL1 -2.00 dB
SFO1 300.1318534 MHz
SI 32768
SF 300.1300000 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00
1.05
1.07
2.06
1.04
1.06
1.08
1.04
1.02
2.05
2.10
1.07
2.00
2.00
3.08
3.00
10
9
8
7
6
5
4
3
2
1
ppm

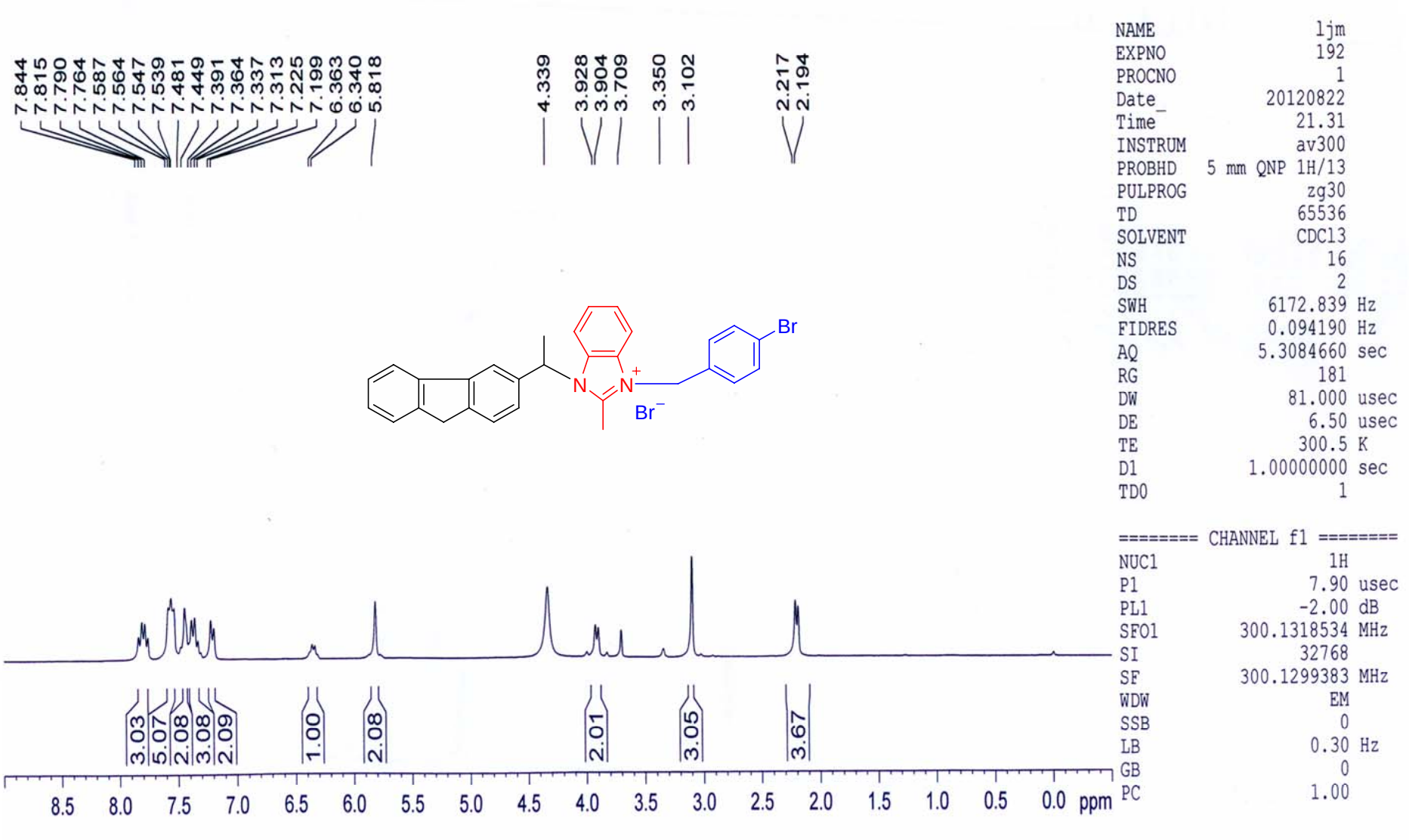

188.515
164.263
145.935
143.665
143.299
142.945
141.859
140.246
136.360
130.693
129.050
128.158
127.222
126.849
126.120
125.981
125.195
123.897
120.397
114.418
61.721
55.770
53.540
39.732
39.454
39.176
36.414
20.059
N
N
N
+
Br⁻
O
OMe
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


9.919
8.115
8.088
7.928
7.903
7.863
7.838
7.818
7.790
7.693
7.623
7.605
7.560
7.536
7.511
7.483
7.346
7.319
7.292
6.385
6.369
6.281
6.259
4.831
3.874
3.325
2.191
2.169
N
N+
Br−
O
Br
1.00
2.11
0.99
5.06
1.00
2.04
2.06
2.00
2.00
1.08
2.07
3.09
10
9
8
7
6
5
4
3
2
1
0 ppm
NAME ljm
EXPNO 86
PROCNO 1
Date_ 20120701
Time_ 20.36
INSTRUM av300
PROBHD 5 mm QNP 1H/13
PULPROG zg30
TD 65536
SOLVENT MeOD
NS 16
DS 2
SWH 6172.839 Hz
FIDRES 0.094190 Hz
AQ 5.3084660 sec
RG 181
DW 81.000 usec
DE 6.50 usec
TE 300.7 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 7.90 usec
PL1 -2.00 dB
SFO1 300.1318534 MHz
SI 32768
SF 300.1300006 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00


191.309
145.915
144.886
144.016
143.354
141.905
139.045
134.103
133.580
132.279
131.325
130.875
128.584
128.451
128.209
128.017
126.493
126.170
124.302
121.670
121.219
115.446
114.729
60.105
54.345
49.896
49.613
49.329
49.045
48.761
48.478
48.193
37.700
21.909
N
N+
O
Br−
Br
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


11.216
8.187
8.159
7.782
7.755
7.727
7.635
7.595
7.521
7.497
7.460
7.447
7.422
7.391
7.377
7.353
7.324
7.297
7.277
6.984
6.956
6.677
5.968
5.947
3.878
3.855
2.279
2.258
O
N
N+
Br−
OMe
1.01
2.03
2.02
2.09
5.06
2.04
0.98
2.05
2.03
1.00
2.05
3.08
3.03
11
10
9
8
7
6
5
4
3
2
1
0 ppm
NAME 1jm
EXPNO 118
PROCNO 1
Date_ 20120720
Time 11.41
INSTRUM av300
PROBHD 5 mm QNP 1H/13
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 6172.839 Hz
FIDRES 0.094190 Hz
AQ 5.3084660 sec
RG 181
DW 81.000 usec
DE 6.50 usec
TE 300.5 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 7.90 usec
PL1 -2.00 dB
SFO1 300.1318534 MHz
SI 32768
SF 300.1300014 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

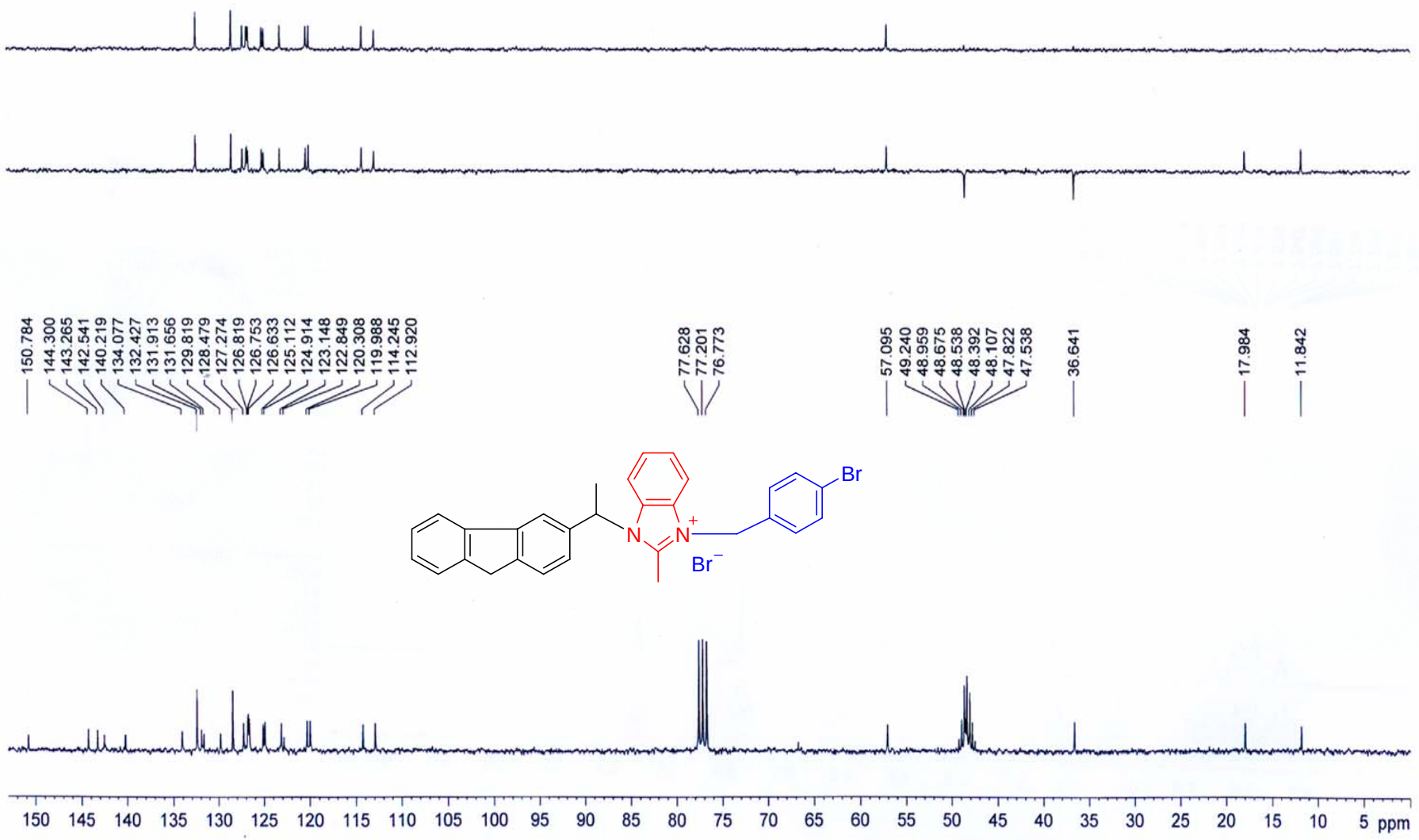

188.648
164.884
144.702
143.542
142.890
142.546
140.536
135.966
132.810
131.249
130.630
127.352
127.180
126.867
126.531
125.264
125.126
123.039
120.658
120.155
114.459
114.016
113.633
77.489
77.066
76.642
59.584
55.648
53.438
36.938
22.185
O
N
N+
Br−
OMe
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

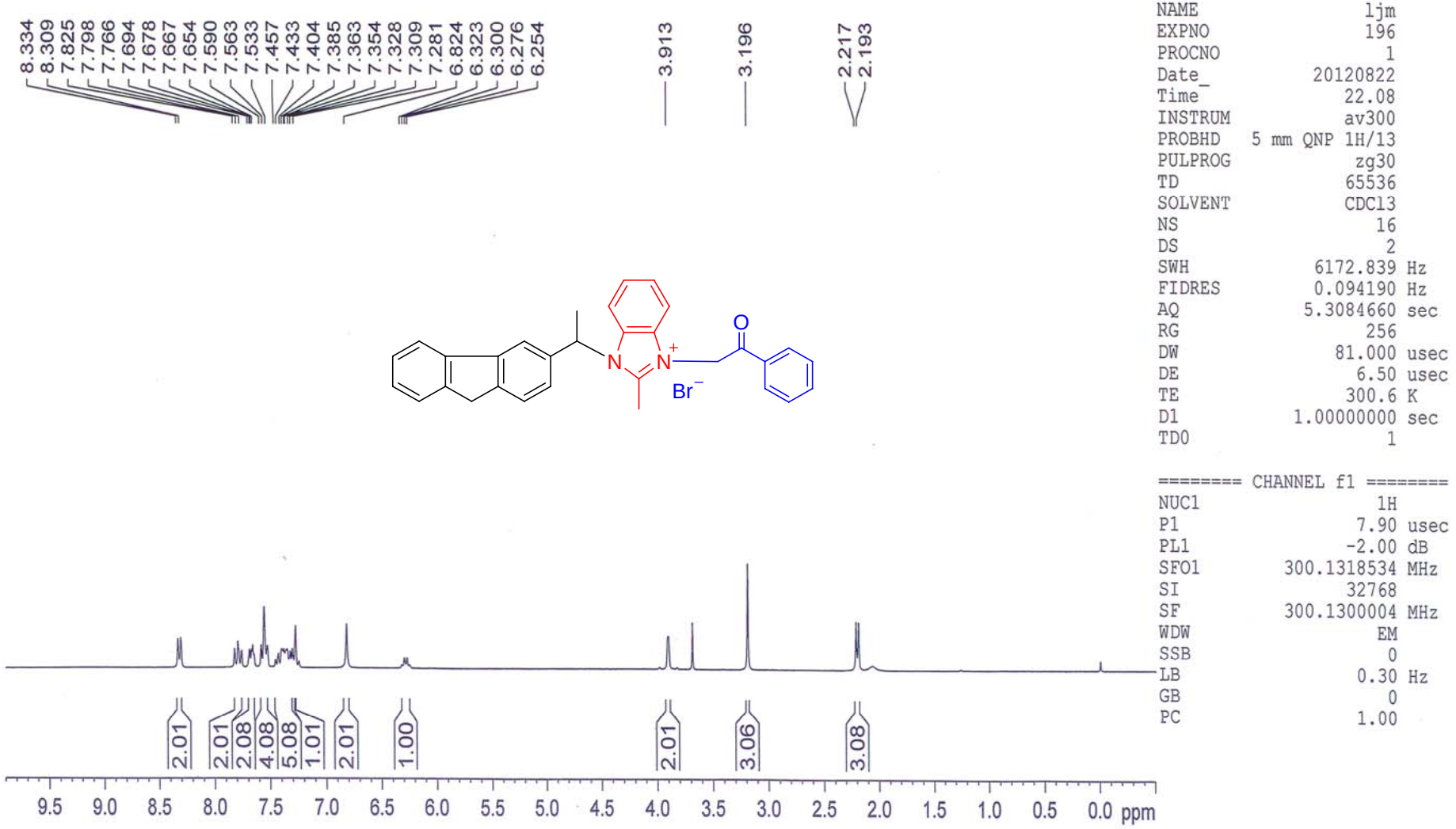


NAME	ljm
EXPNO	192
PROCNO	1
Date_	20120822
Time	21.31
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	16
DS	2
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	181
DW	81.000 usec
DE	6.50 usec
TE	300.5 K
D1	1.00000000 sec
TD0	1

======== CHANNEL f1 ========

NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1299383 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00

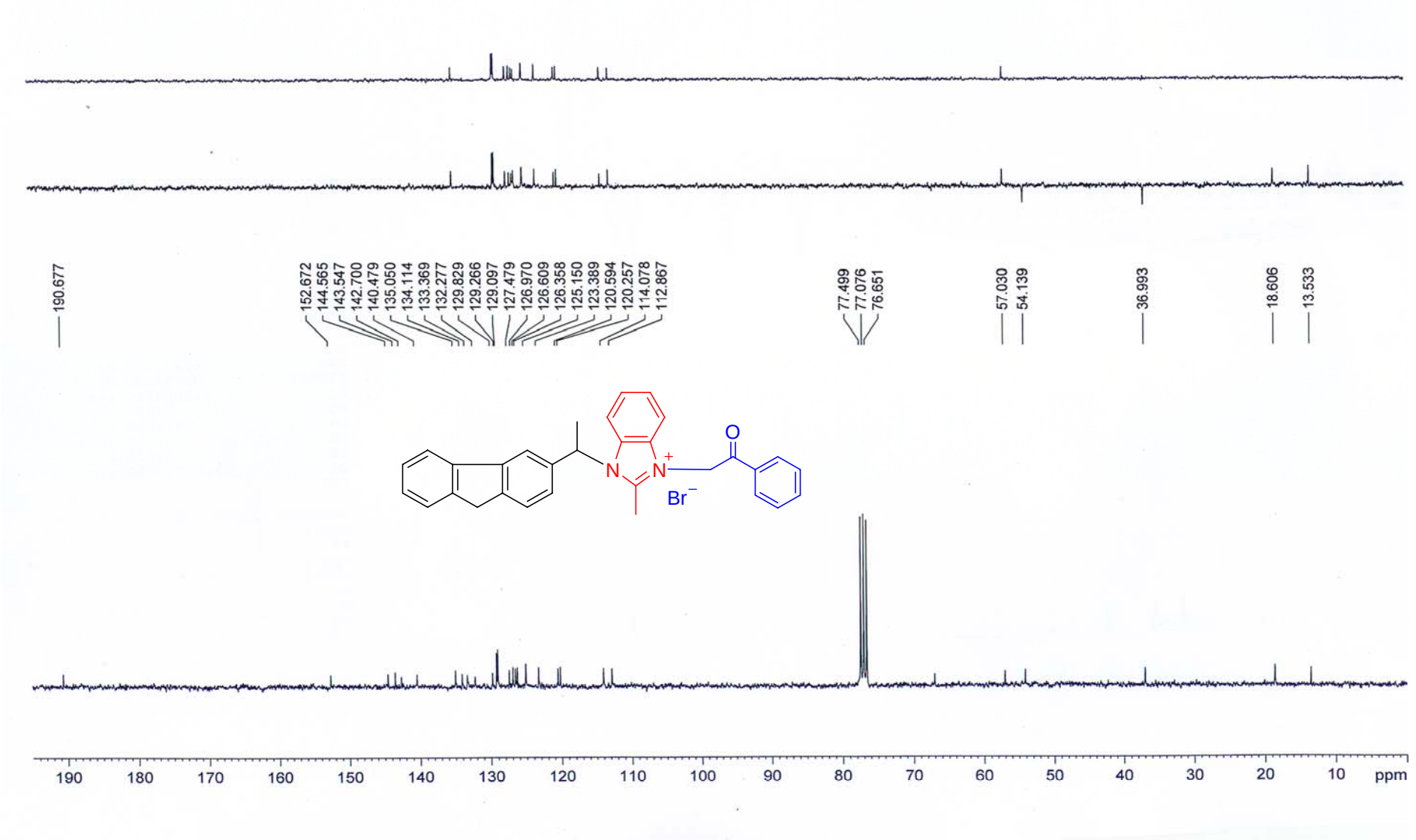

150.784
144.300
143.265
142.541
140.219
134.077
132.427
131.913
131.656
129.819
128.479
127.274
126.819
126.753
126.633
125.112
124.914
123.148
122.849
120.308
119.988
114.245
112.920
77.628
77.201
76.773
57.095
49.240
48.959
48.675
48.538
48.392
48.107
47.822
47.538
36.641
17.984
11.842
Br
N
N+
Br−
150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 ppm

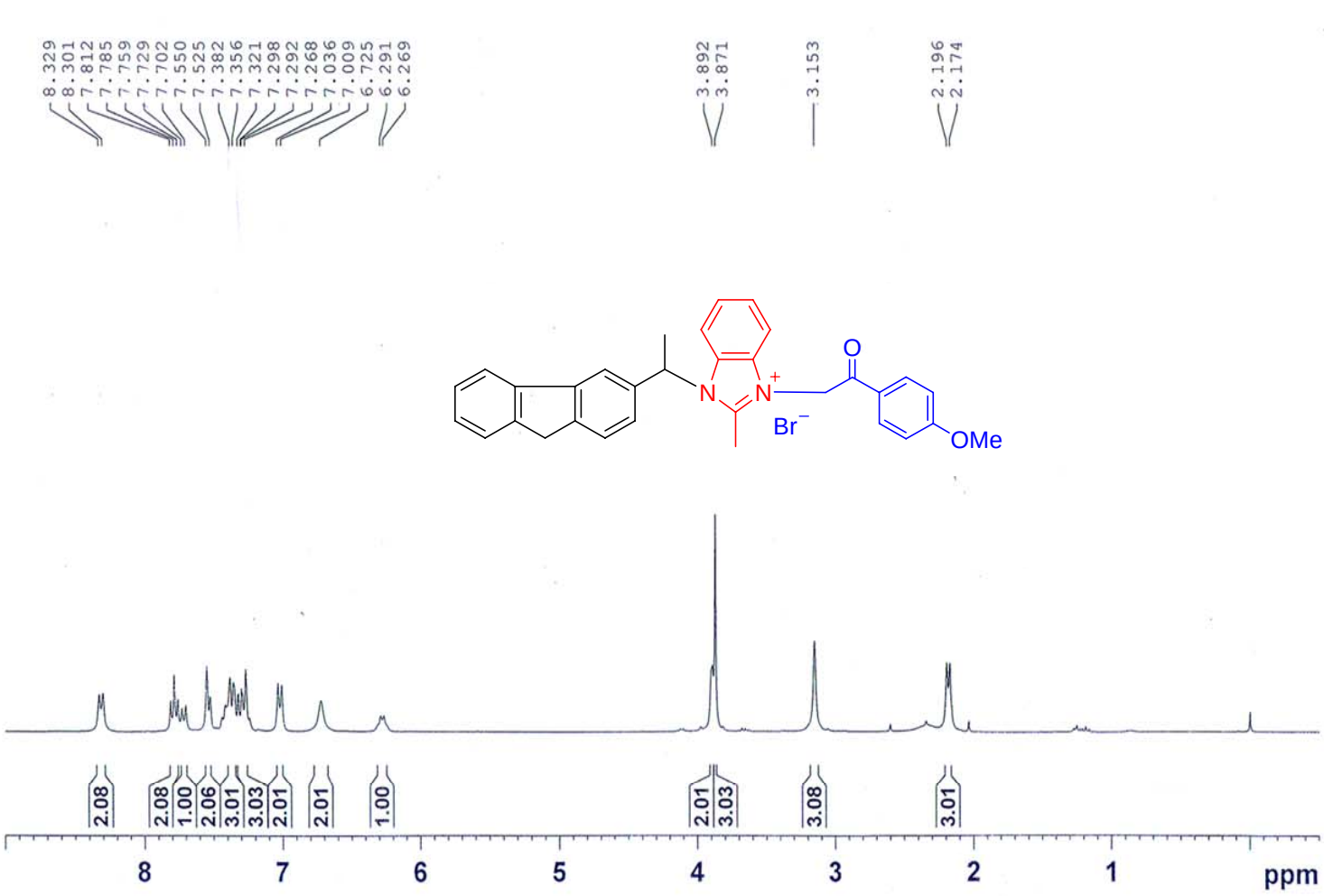


NAME	ljm
EXPNO	196
PROCNO	1
Date_	20120822
Time	22.08
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	16
DS	2
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	256
DW	81.000 usec
DE	6.50 usec
TE	300.6 K
D1	1.00000000 sec
TD0	1

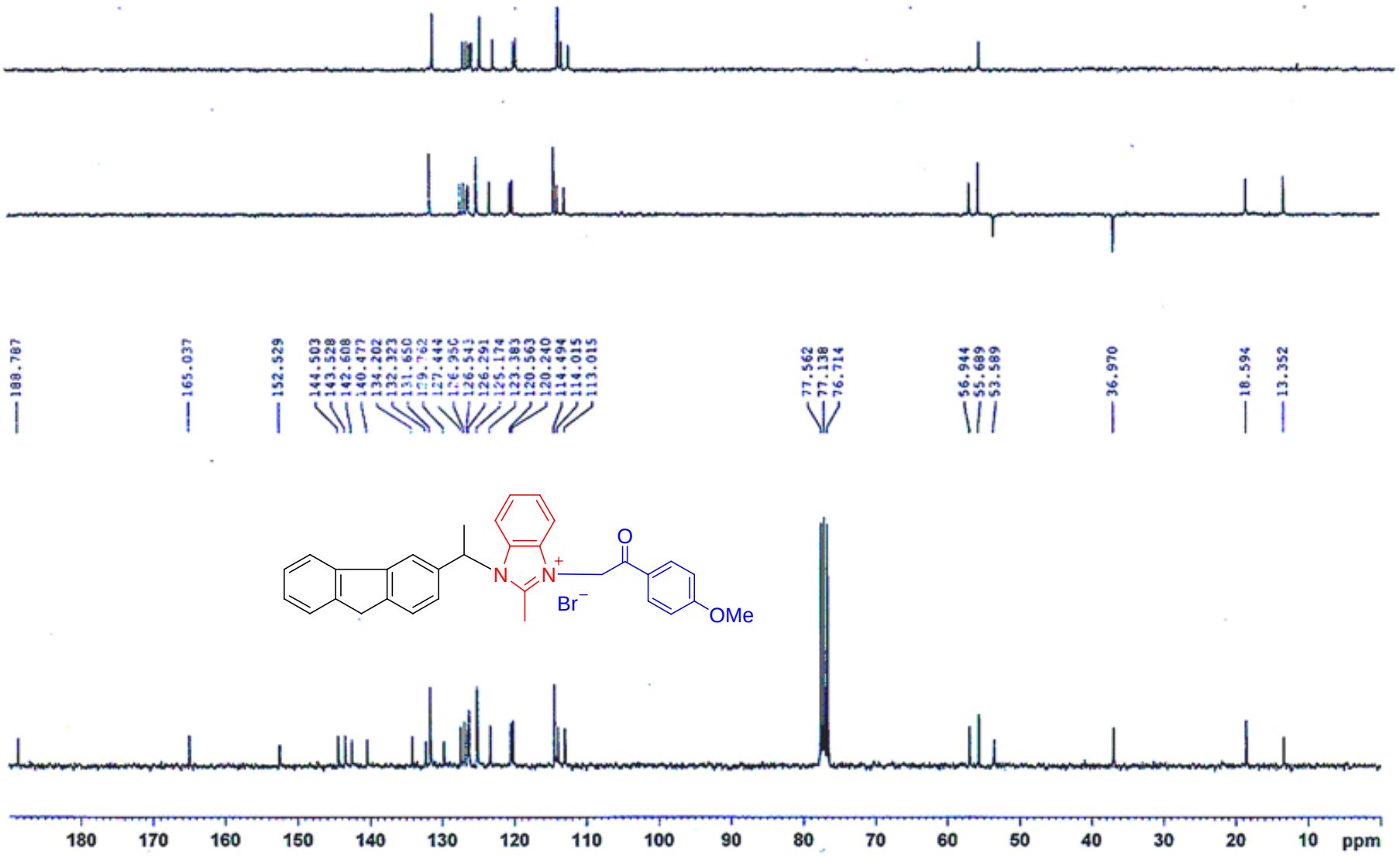
======== CHANNEL f1 ========

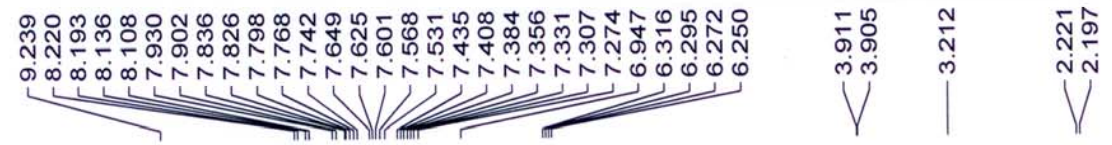
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1300004 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00

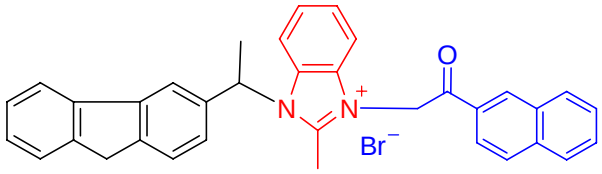

190.677
152.672
144.565
143.547
142.700
140.479
135.050
134.114
133.369
132.277
129.829
129.266
129.097
127.479
126.970
126.609
126.358
125.150
123.389
120.594
120.257
114.078
112.867
77.499
77.076
76.651
57.030
54.139
36.993
18.606
13.533
N
N+
O
Br−
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

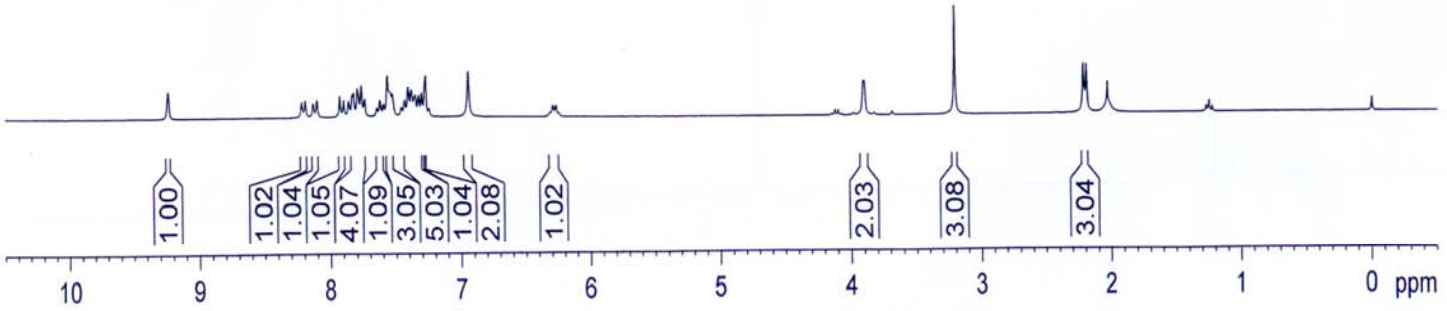


NAME	ljm
EXPNO	110
PROCNO	1
Date_	20121222
Time	16.39
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	104
DS	0
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	128
DW	81.000 usec
DE	6.50 usec
TE	295.4 K
D1	2.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1299952 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00

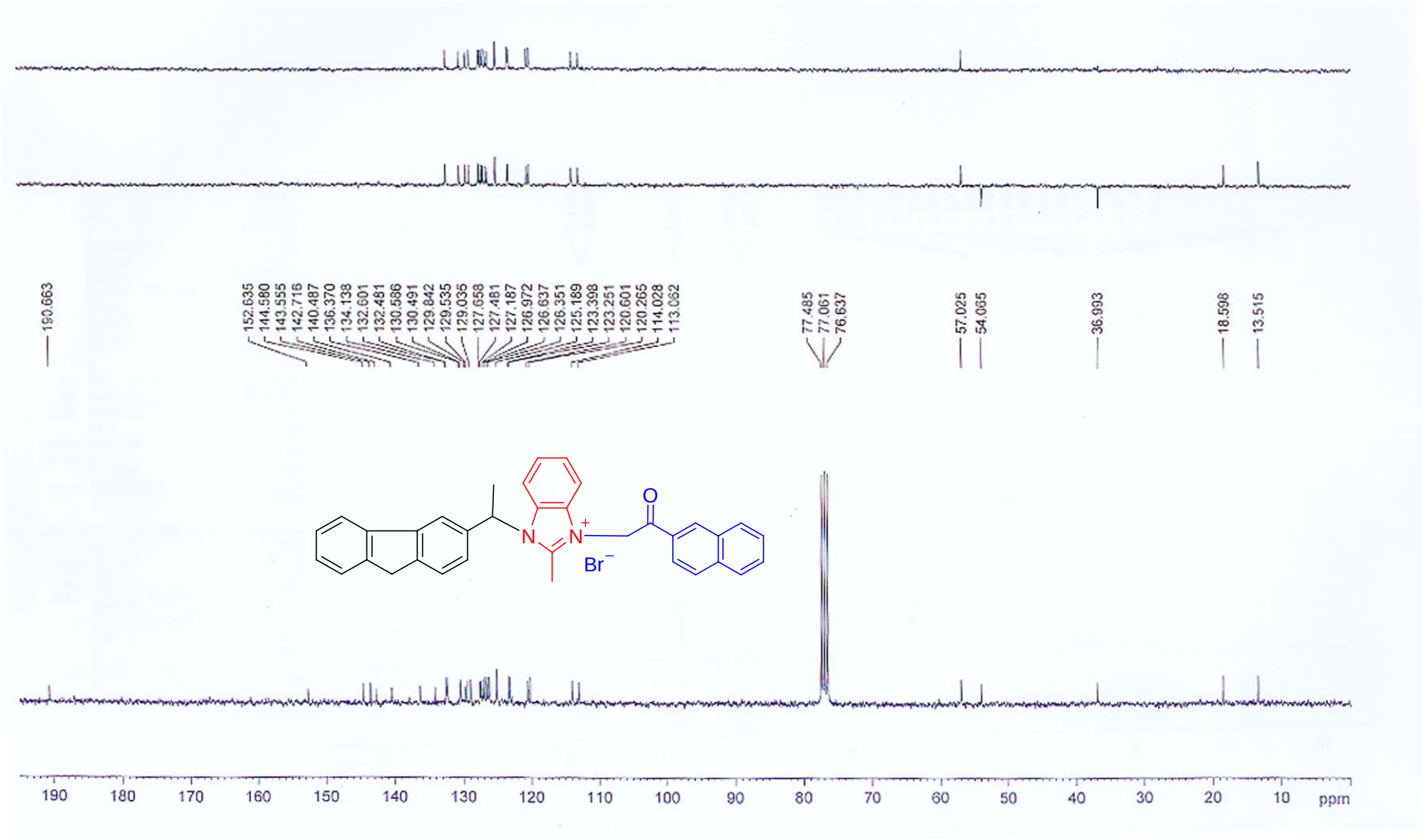

188.787
165.037
152.529
144.503
143.528
142.608
140.477
134.202
132.323
131.650
77.562
77.138
76.714
56.944
55.689
53.589
36.970
18.594
13.352
N
N+
O
Br−
OMe
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

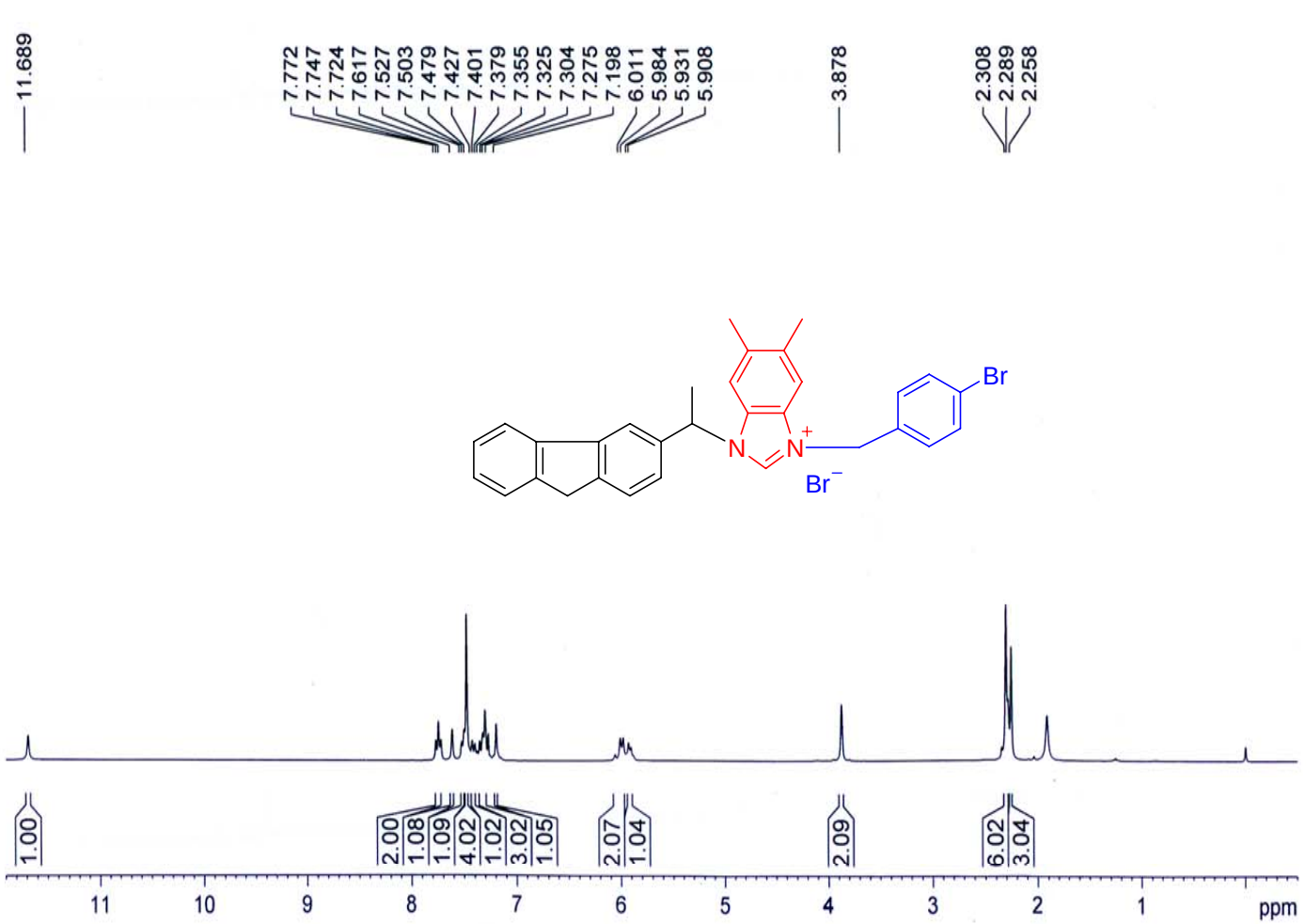






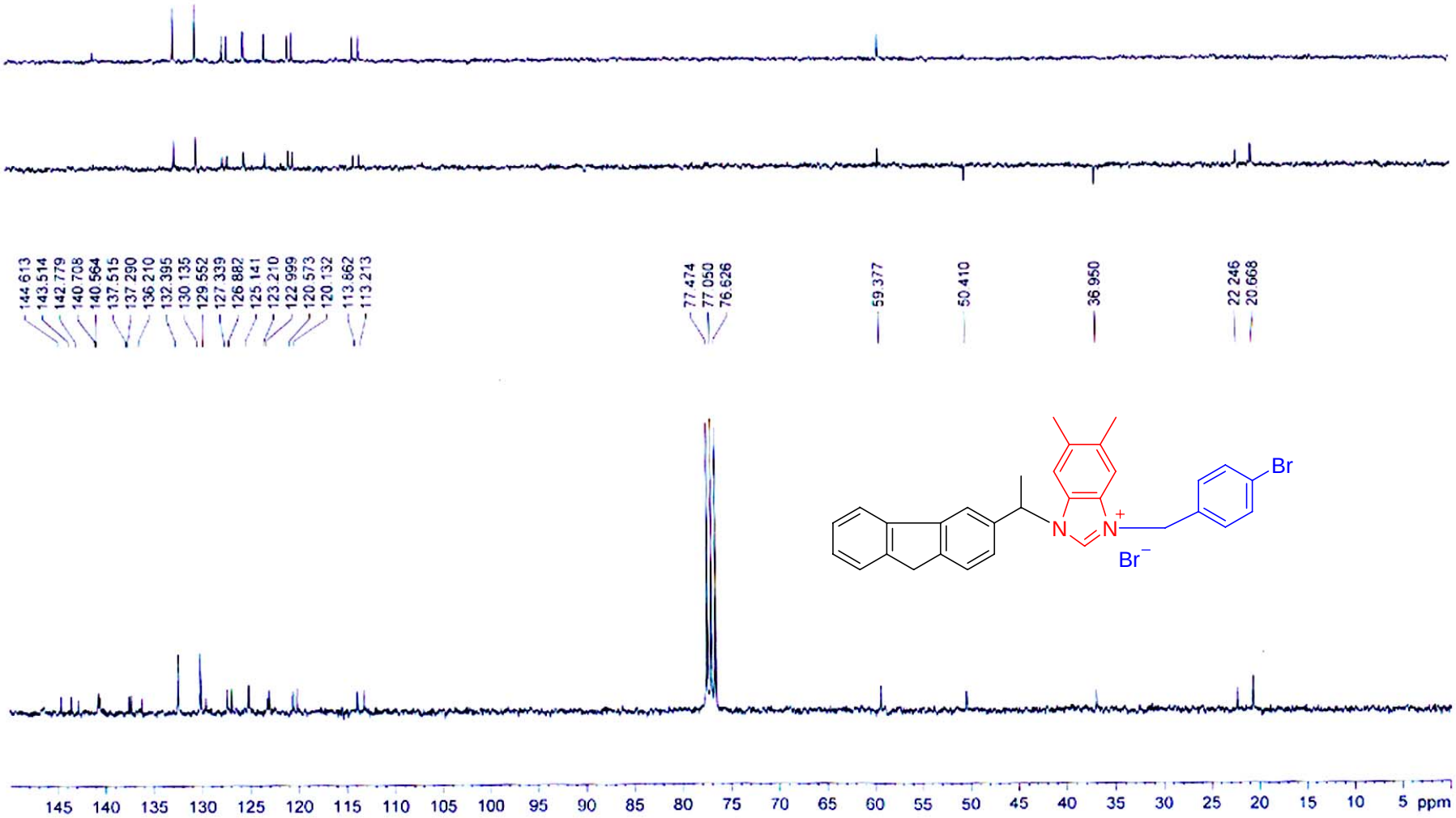
NAME	ljm
EXPNO	188
PROCNO	1
Date_	20120822
Time	20.49
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	16
DS	2
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	256
DW	81.000 usec
DE	6.50 usec
TE	300.5 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1300021 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00

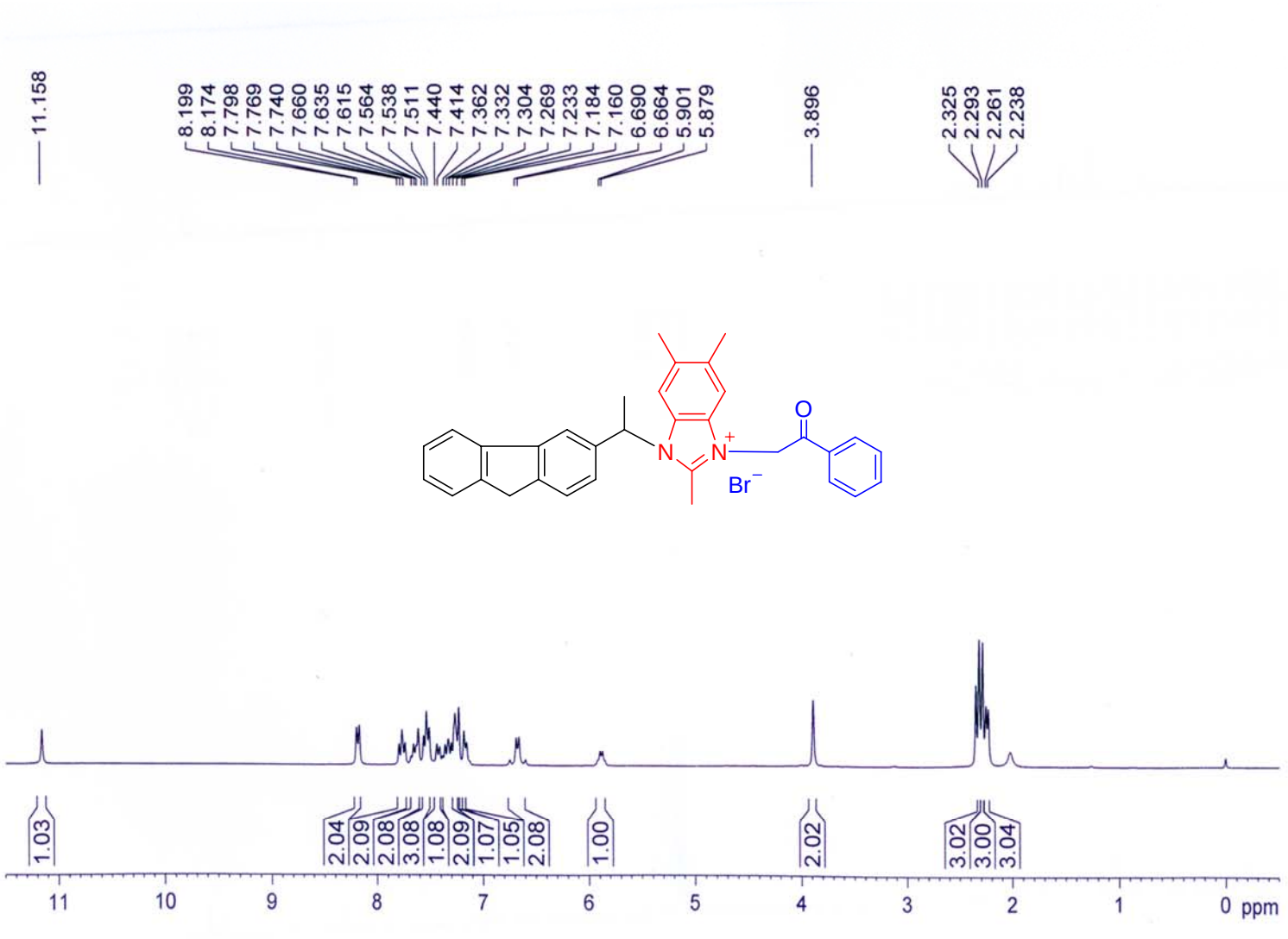

190.663
152.635
144.580
143.555
142.716
140.487
136.370
134.138
132.601
132.481
130.586
130.491
129.842
129.535
129.035
127.658
127.481
127.187
126.972
126.637
126.351
125.189
123.398
123.251
120.601
120.265
114.028
113.062
77.485
77.061
76.637
57.025
54.065
36.993
18.598
13.515
O
N
N+
Br−
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm



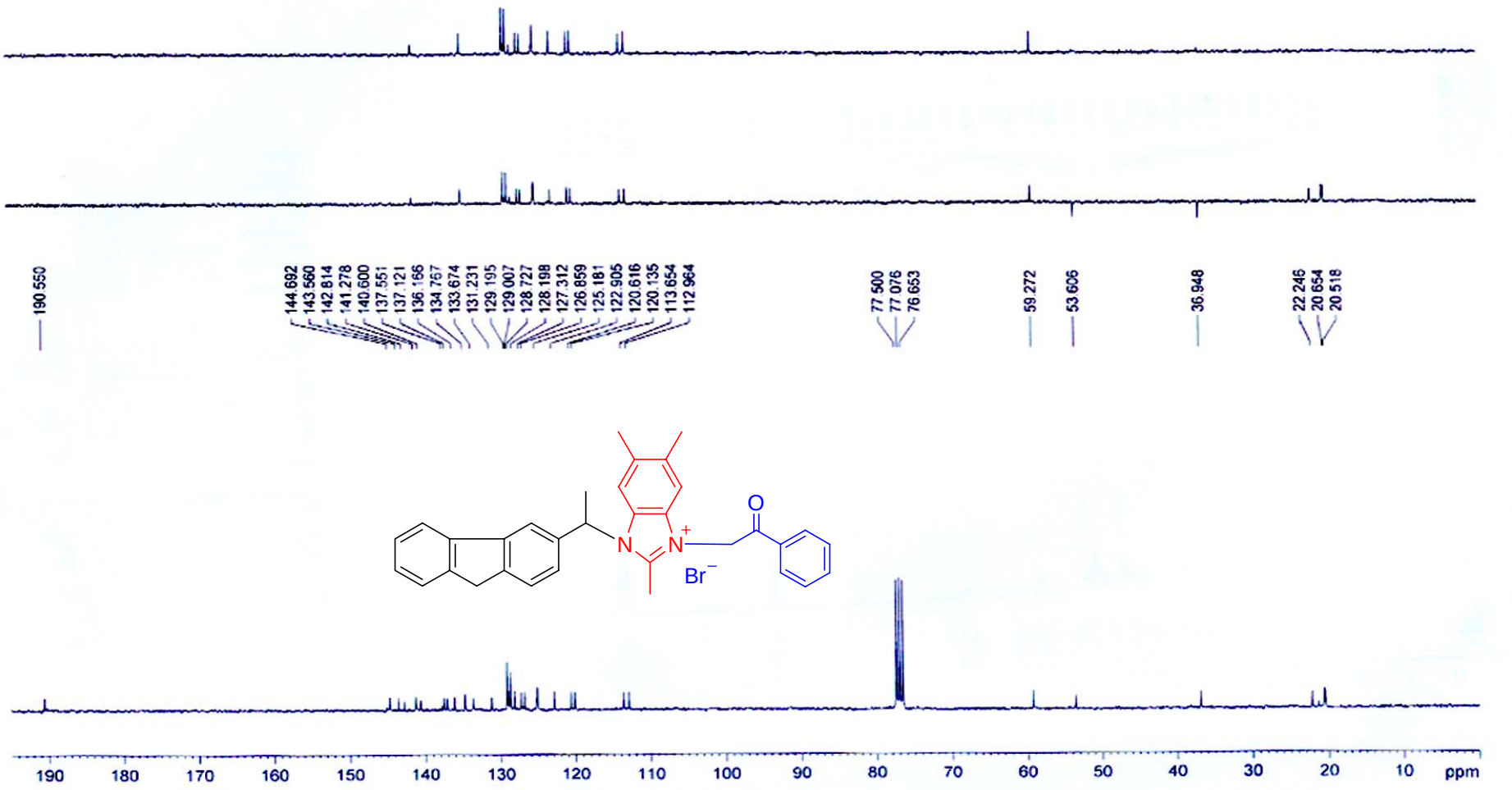
NAME	ljm
EXPNO	164
PROCNO	1
Date_	20120820
Time	12.48
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	16
DS	2
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	322.5
DW	81.000 usec
DE	6.50 usec
TE	299.5 K
D1	1.00000000 sec
TD0	1

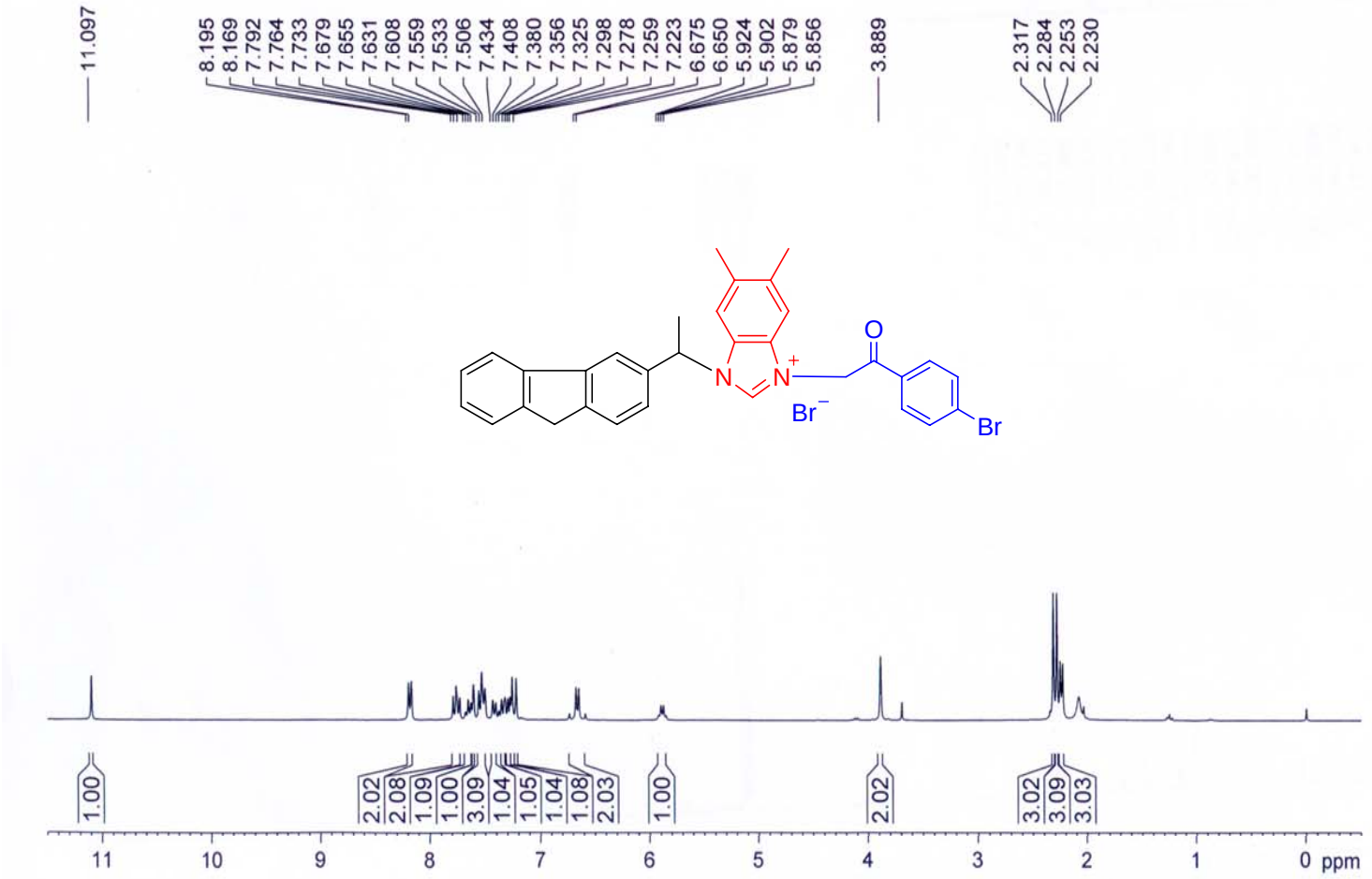
======== CHANNEL f1 ========	
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1300022 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00


144.613
143.514
142.779
140.708
140.564
137.515
137.290
136.210
132.395
130.135
129.552
127.339
126.882
125.141
123.210
122.999
120.573
120.132
113.862
113.213
77.474
77.050
76.626
59.377
50.410
36.950
22.246
20.668
Br
N
N+
Br−
145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 ppm

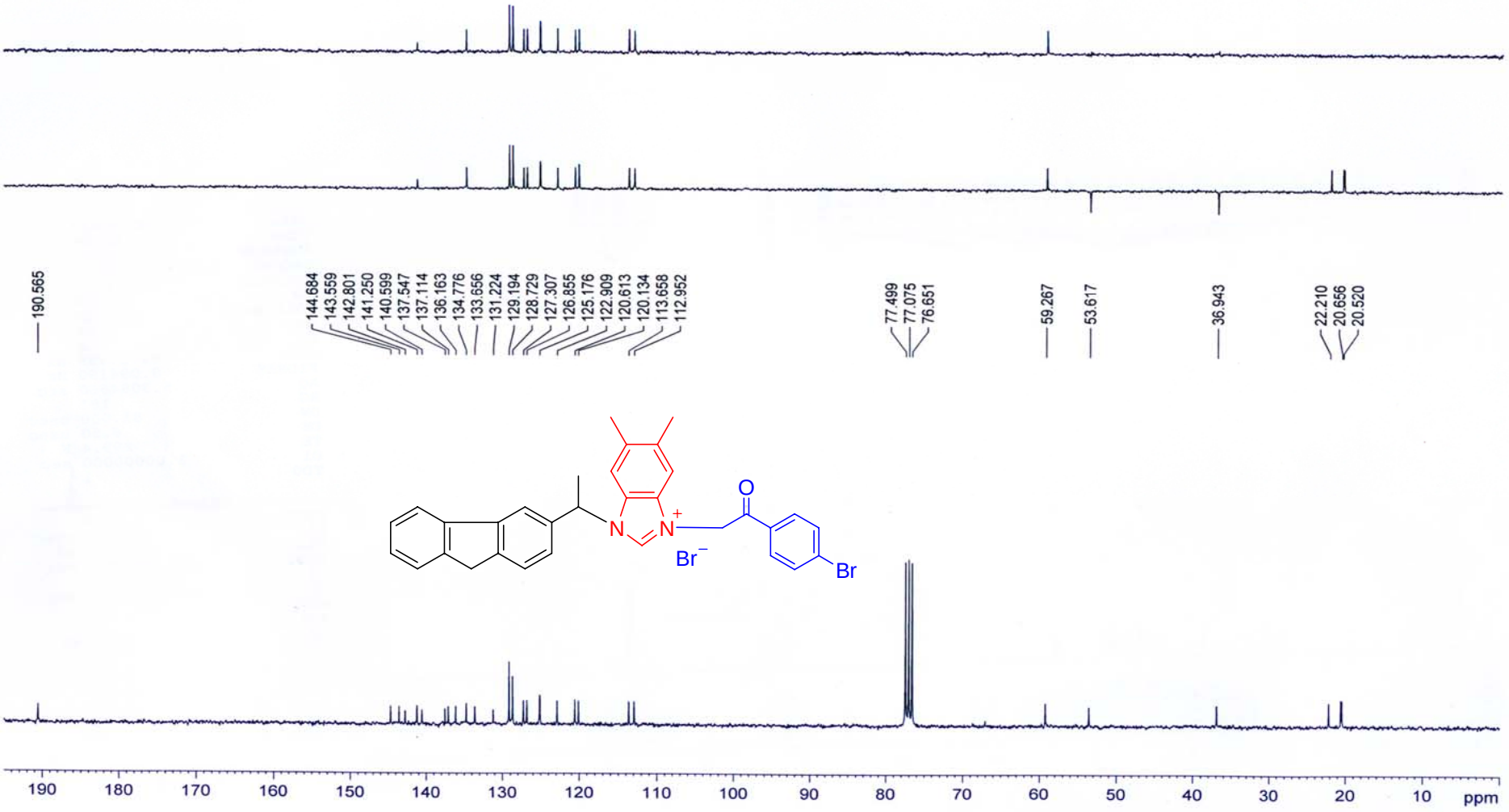


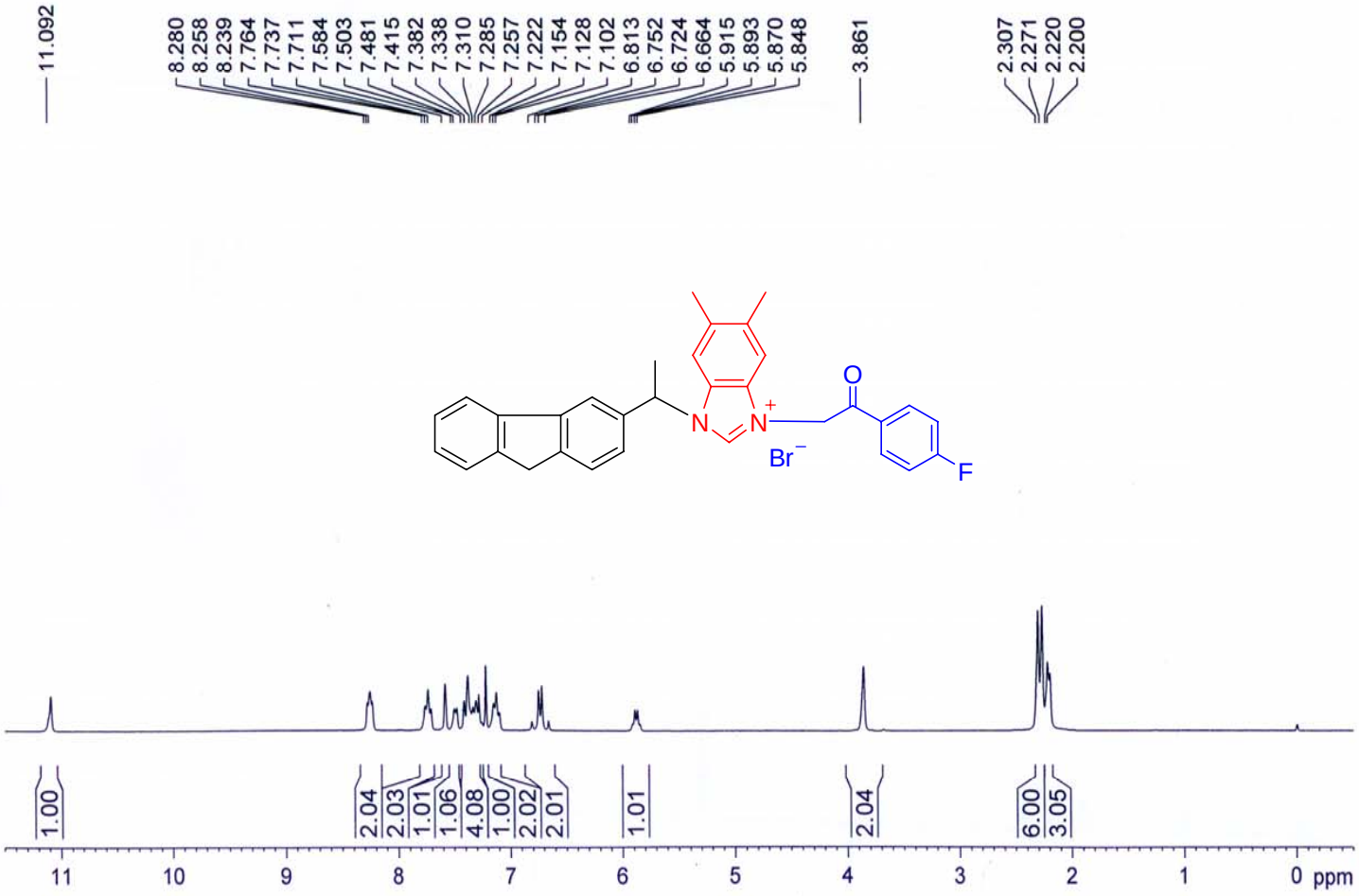
NAME	ljm
EXPNO	176
PROCNO	1
Date_	20120822
Time	18.50
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	16
DS	2
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	181
DW	81.000 use
DE	6.50 use
TE	300.5 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 =======	
NUC1	1H
P1	7.90 use
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1300000 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00


190.550
144.692
143.560
142.814
141.278
140.600
137.551
137.121
136.166
134.767
133.674
131.231
129.195
129.007
128.727
128.198
127.312
126.859
125.181
122.905
120.616
120.135
113.654
112.964
77.500
77.076
76.653
59.272
53.606
36.948
22.246
20.654
20.518
O
N
N+
Br−
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

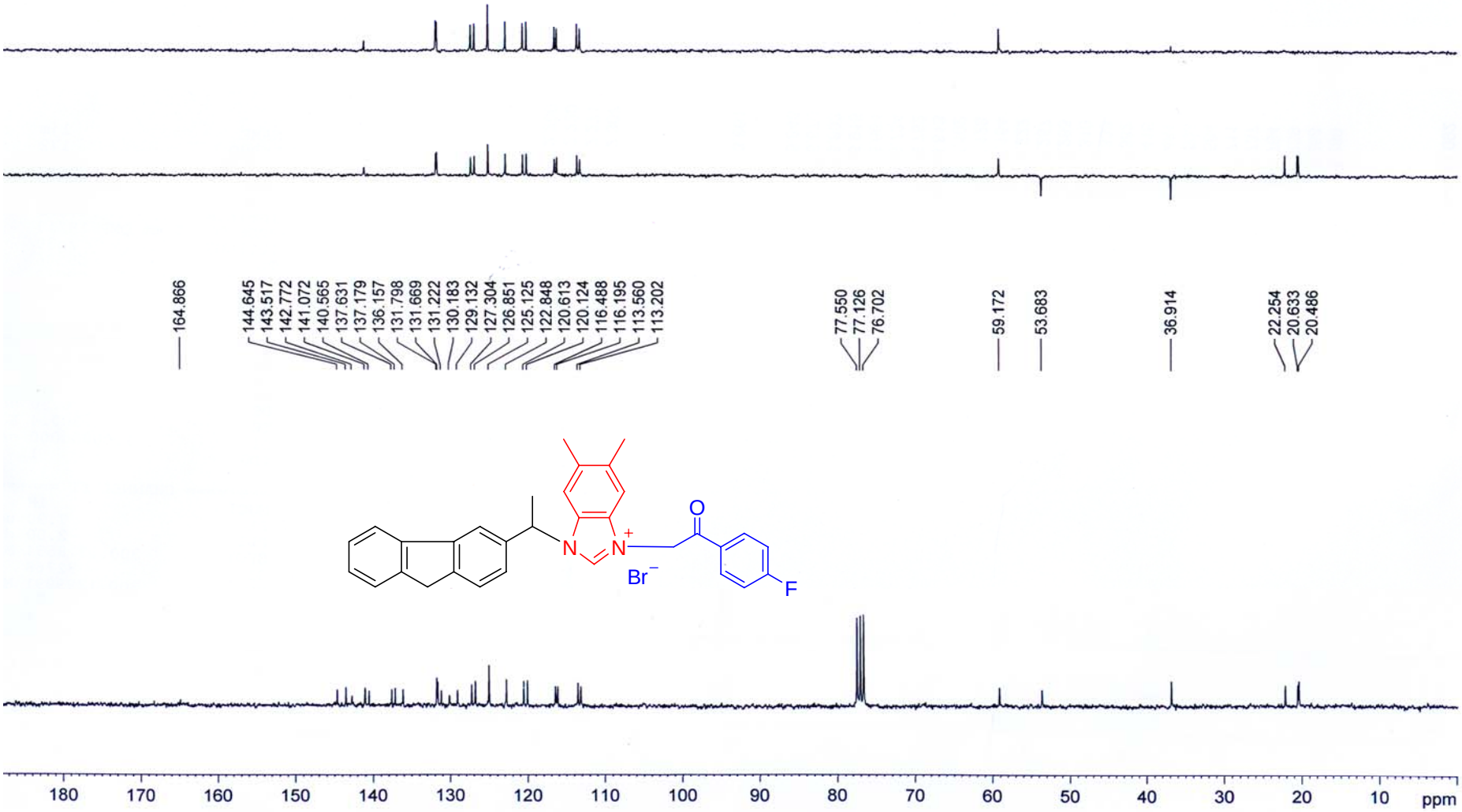


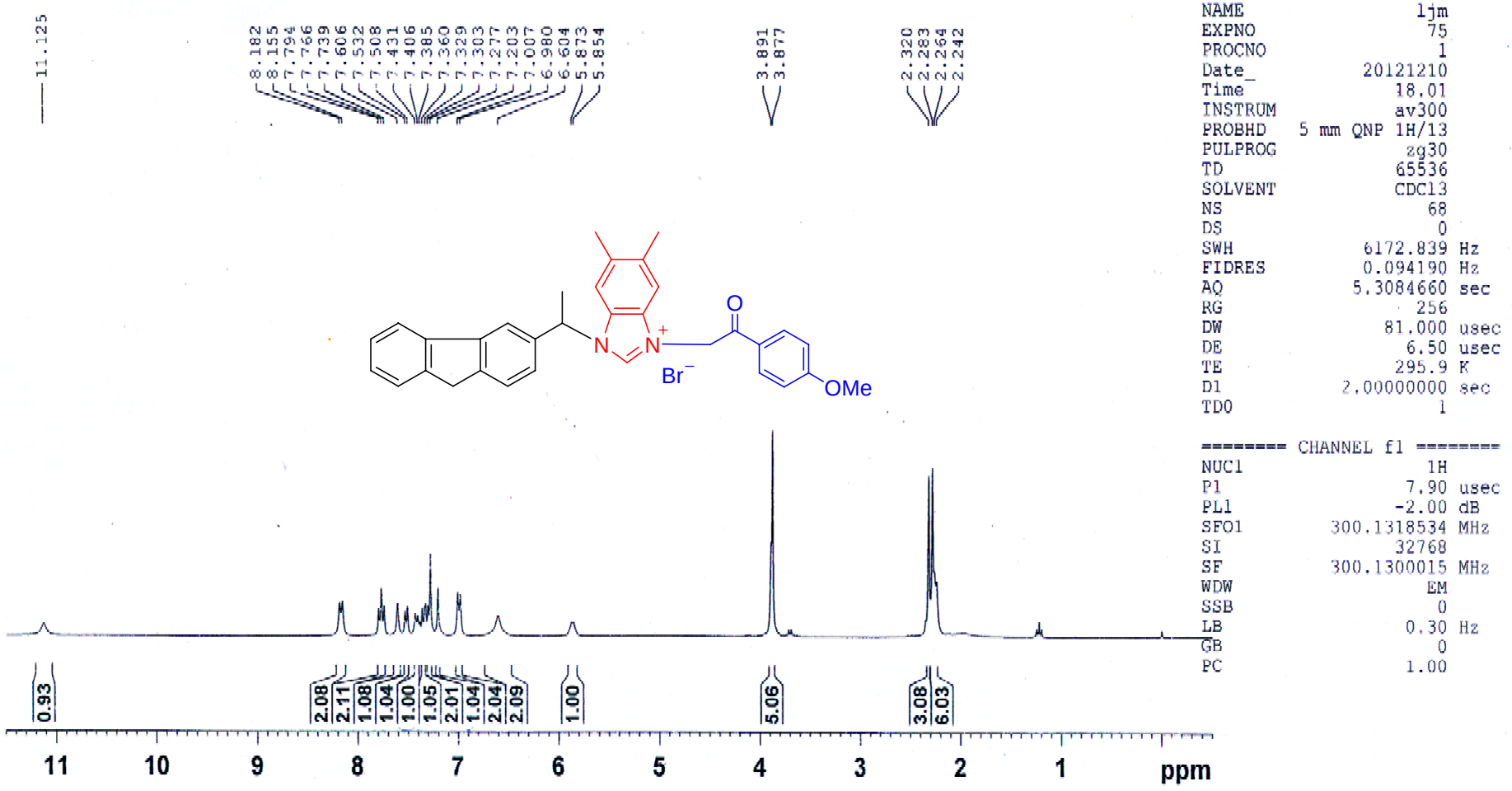
NAME	1jm
EXPNO	160
PROCNO	1
Date_	20120820
Time	12.08
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	16
DS	2
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	181
DW	81.000 usec
DE	6.50 usec
TE	299.4 K
D1	1.00000000 sec
TD0	1
========	CHANNEL f1 ========
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1300008 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00


190.565
144.684
143.559
142.801
141.250
140.599
137.547
137.114
136.163
134.776
133.656
131.224
129.194
128.729
127.307
126.855
125.176
122.909
120.613
120.134
113.658
112.952
77.499
77.075
76.651
59.267
53.617
36.943
22.210
20.656
20.520
N
N
+
O
Br
−
Br
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm



NAME	ljm
EXPNO	172
PROCNO	1
Date_	20120822
Time	18.13
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	15
DS	2
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	161.3
DW	81.000 usec
DE	6.50 usec
TE	300.4 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1299991 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00

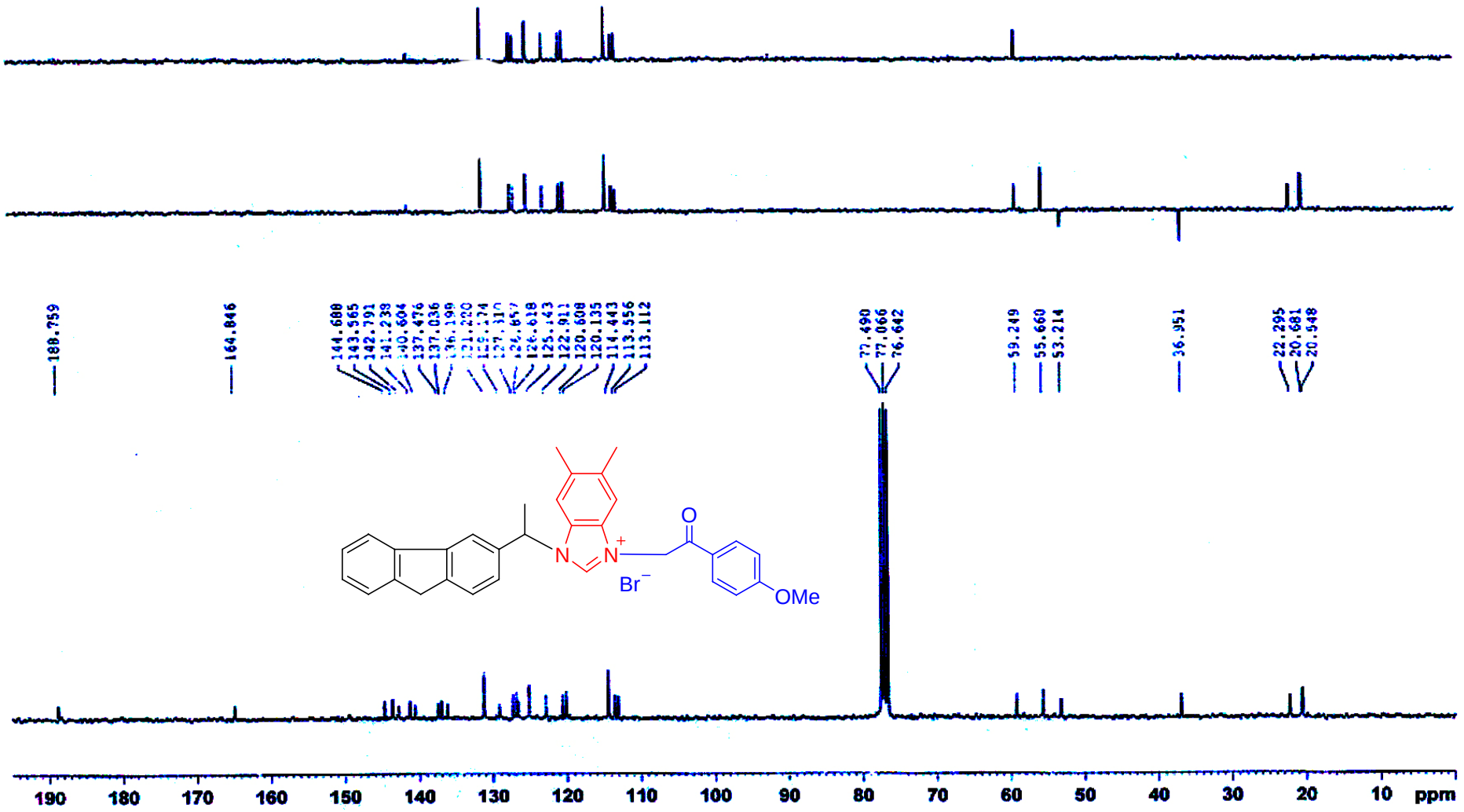

164.866
144.645
143.517
142.772
141.072
140.565
137.631
137.179
136.157
131.798
131.669
131.222
130.183
129.132
127.304
126.851
125.125
122.848
120.613
120.124
116.488
116.195
113.560
113.202
77.550
77.126
76.702
59.172
53.683
36.914
22.254
20.633
20.486
N
N+
Br−
O
F
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

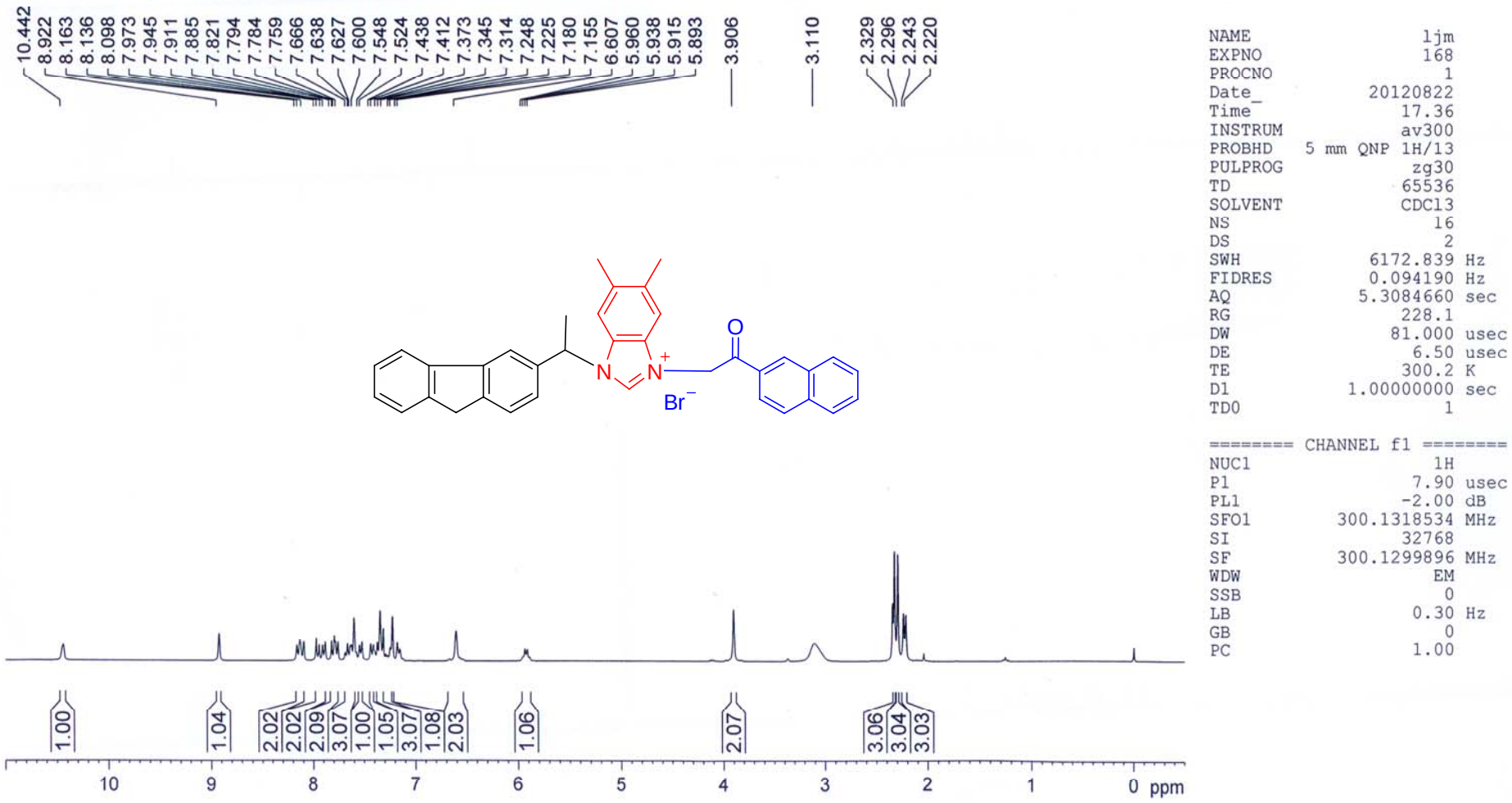


NAME	ljm
EXPNO	75
PROCNO	1
Date_	20121210
Time	18.01
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	68
DS	0
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	256
DW	81.000 usec
DE	6.50 usec
TE	295.9 K
D1	2.00000000 sec
TD0	1

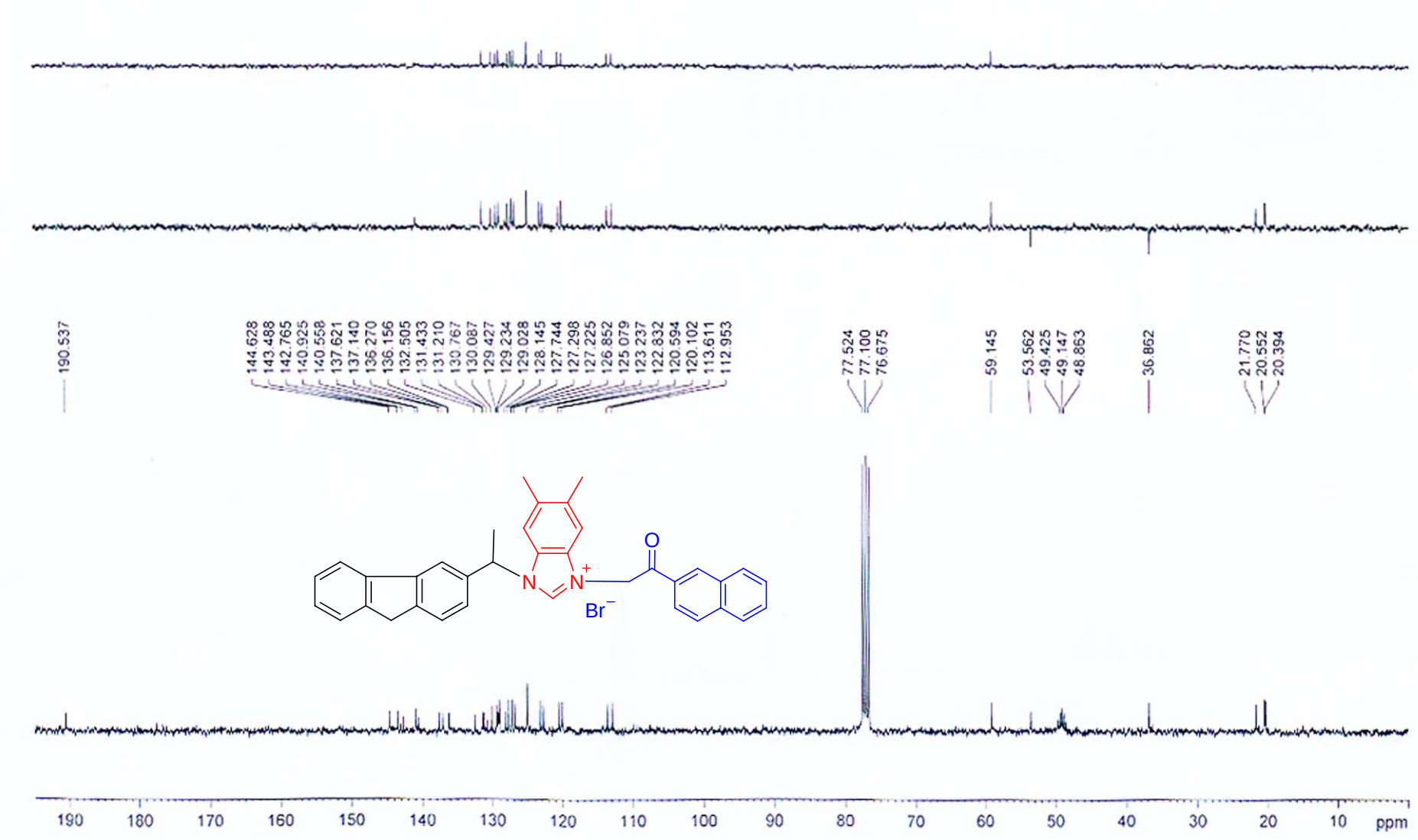
======== CHANNEL f1 ========

NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1300015 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00


188.759
164.846
144.680
143.565
142.791
141.238
137.476
137.036
77.490
77.066
76.642
59.249
55.660
53.214
36.951
22.295
20.681
20.548
Br⁻
OMe
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm



NAME	ljm
EXPNO	168
PROCNO	1
Date_	20120822
Time	17.36
INSTRUM	av300
PROBHD	5 mm QNP 1H/13
PULPROG	zg30
TD	65536
SOLVENT	CDCl3
NS	16
DS	2
SWH	6172.839 Hz
FIDRES	0.094190 Hz
AQ	5.3084660 sec
RG	228.1
DW	81.000 usec
DE	6.50 usec
TE	300.2 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	7.90 usec
PL1	-2.00 dB
SFO1	300.1318534 MHz
SI	32768
SF	300.1299896 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00


190.537
144.628
143.488
142.765
140.925
140.558
137.621
137.140
136.270
136.156
132.505
131.433
131.210
130.767
130.087
129.427
129.234
129.028
128.145
127.744
127.298
127.225
126.852
125.079
123.237
122.832
120.594
120.102
113.611
112.953
77.524
77.100
76.675
59.145
53.562
49.425
49.147
48.863
36.862
21.770
20.552
20.394
O
N
N+
Br−
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm