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Supplemental Material

Experimental

All commercially obtained chemicals were used as received. Acetonitrile and 2,6-lutidine was purchased from Aldrich in a sure seal bottle and used as received. Methylene chloride was freshly distilled from calcium hydride. All reactions were performed under an argon atmosphere. Melting points were measured on a MelTemp apparatus and are uncorrected. Proton and carbon-13 NMR data were recorded at 300 and 75 MHz, respectively in CDCl₃ unless otherwise noted. Chemical shifts are reported in ppm downfield from TMS ($\delta=0$); coupling constants are given in Hertz. IR's were recorded on a Mattson Genesis series FT-IR. Optical rotations were measured with a Rudolph Research Autopol polarimeter.

1,3,5-Tri-*O*-benzoyl-2-*O*-(3-trifluoromethylbenzoyl)- α -D-ribofuranose (2). A stirred solution of 1,3,5-tri-*O*-benzoyl- α -D-ribofuranose (436 mg, 1.0 mmol) and 2,6-lutidine (0.14 mL, 1.2 mmol) in 10 mL of dry CH₂Cl₂ was cooled to 0 °C then 3-trifluoromethylbenzoyl chloride (0.23 mL, 1.5 mmol) was added dropwise. The solution was allowed to stir for 2.5 h at room temperature. The mixture was quenched with saturated aqueous NaHCO₃ (7 mL) and the aqueous layer was extracted with ethyl acetate (2x10 mL). The combined organic phases were then dried over anhydrous magnesium sulfate, and concentrated. The residue was purified by flash chromatography eluting with 25% ethyl acetate in hexanes. The resulting solid was recrystallized from ethyl acetate/hexane to give 615 mg (97%) of **2** as white prisms, mp 109-111 °C (lit.¹ mp 102 °C). $[\alpha]^{21}_D +89.5^\circ$ (c, 0.1, CHCl₃); ¹H NMR (CDCl₃) δ 8.11- 8.0 (m, 8H), 7.72 (d, *J* = 4.3Hz, 1H), 7.61-7.31 (m, 10H), 6.91 (d, *J* = 4.3Hz, 1H), 5.88 (dd, *J* = 2.1, 6.5Hz, 1H), 5.79 (dd, *J* = 4.4, 6.5 Hz, 1H), 4.93 (m, 1H), 4.71 (ABX, *J*_{AB} = 12.1, *J*_{AX} = 3.5, *J*_{BX} = 3.1, $\Delta\nu_{AB}$ = 32.6Hz, 2H); ¹³C NMR δ 166.0, 165.6, 165.1, 163.5, 133.7, 133.6, 133.4, 133.0, 130.0, 129.8, 129.7, 129.5, 129.3, 129.2, 128.9, 128.6, 128.5, 128.4, 126.4, 126.3, 94.9, 82.8, 71.5, 70.7, 64.0.

General Procedure for the Glycosidation Reaction.

2'-*O*-(3-Trifluoromethylbenzoyl)-3', 5'-di-*O*-benzoyluridine (3a). A stirred solution of **2** (1.0 g, 1.6 mmol) and freshly prepared 2,4-bis-trimethylsilyluracil (0.6 mL, 2.4 mmol) in dry CH₃CN (16 mL) was cooled to 0 °C then SnCl₄ (0.93 mL, 8.0 mmol) was added dropwise with vigorous stirring. The reaction was warmed to room temperature and stirred for 4 h after which time the reaction was quenched with saturated aqueous NaHCO₃. The mixture was filtered through a pad of Celite and extracted with ethyl acetate. The organic extracts were washed with brine, dried over anhydrous sodium sulfate and concentrated. The residue was chromatographed

to afford 932mg (95%) of **3a** as viscous oil which crystallized on standing, mp 134-5 °C. $[\alpha]^{21}_{\text{D}} -55.5^\circ$ (c , 0.1, CHCl_3); ^1H NMR (CDCl_3) δ 9.27 (br s, 1H), 8.16-8.08 (m, 4H), 7.99 (d, $J=7.6$ Hz, 2H), 7.79 (d, $J=7.8$ Hz, 1H), 7.63-7.39 (m, 8H), 6.30 (d, $J=5.3$ Hz, 1H), 5.90 (pseudo t, $J=5.8$ Hz, 1H), 5.81 (t, $J=5.7$ Hz, 1H), 5.63 (d, $J=8.0$ Hz, 1H), 4.77 (ABX, $J_{\text{AB}}=12.0$, $J_{\text{AX}}=2.6$, $J_{\text{BX}}=3.7$ Hz, $\Delta\nu_{\text{AB}}=49.9$ Hz, 2H), 4.75 (m, 1H); ^{13}C NMR δ 166.0, 165.3, 164.1, 162.8, 150.1, 139.5, 133.9, 133.7, 133.4, 133.1, 133.0, 130.3, 129.8, 129.7, 129.3, 129.2, 129.1, 128.7, 128.6, 128.3, 103.4, 88.2, 80.4, 74.1, 71.1, 63.7; IR (neat) 3387, 3201, 3020, 1726, 1697, 1453, 1264, 1216, 1131, 1095, 756 cm^{-1} .

2'-O-(3-Trifluoromethylbenzoyl)-3', 5'-di-O-benzoyl -5-methyluridine (3b). Obtained in 98% yield. mp 92-95 °C; $[\alpha]^{21}_{\text{D}} -78.0^\circ$ (c , 0.1, CHCl_3); ^1H NMR(CDCl_3) δ 8.78 (br s, 1H), 8.17-7.99 (m, 4H), 7.93 (d, $J=7.3$ Hz, 2H), 7.63-7.33 (m, 8H), 6.33 (d, $J=6.1$ Hz, 1H), 5.84 (dd, $J=3.8$, 6.0 Hz, 1H), 5.75 (t, $J=6.1$ Hz, 1H), 4.70 (ABX, $J_{\text{AB}}=12.3$, $J_{\text{AX}}=2.6$, $J_{\text{BX}}=3.5$, $\Delta\nu_{\text{AB}}=69.5$ Hz, 2H), 4.65 (m, 1H), 1.54 (s, 3H); ^{13}C NMR δ 166.2, 165.7, 164.4, 163.7, 150.6, 135.1, 134.0, 133.4, 130.6, 130.0, 129.9, 129.6, 129.4, 129.1, 128.9, 128.7, 127.0, 112.5, 87.3, 80.8, 74.0, 71.6, 64.2, 12.4; IR (KBr) 3373, 3276, 3074, 1725, 1619, 1452, 1267, 1128, 1095, 713 cm^{-1} .

2'-O-(3-(Trifluoromethyl)benzoyl)-3', 5'-di-O-benzoyl-5-fluorouridine (3c). Obtained in 91% yield. mp 187-188°; $[\alpha]^{21}_{\text{D}} -21.8^\circ$ (c , 0.1, CH_3CN); ^1H NMR (CD_3CN) δ 9.38 (br s, 1H), 8.16 (d, $J=6.4$ Hz, 2H), 8.05 (d, $J=8.0$ Hz, 2H), 7.91 (d, $J=8.0$ Hz, 3H), 7.70-7.37 (m, 8H), 6.19 (d, $J=4.5$ Hz, 1H), 5.91-5.82 (m, 2H), 4.79-4.61 (m, 3H); ^{13}C NMR δ 166.9, 166.0, 164.8, 157.9, 157.6, 149.8, 143.4, 140.3, 134.7, 134.5, 134.2, 131.7, 131.2, 130.9, 130.7, 130.4, 129.9, 129.7, 129.6, 127.1, 126.0, 125.6, 89.7, 80.9, 75.2, 71.5, 64.5; IR (KBr) 3400, 3205, 3077, 1726, 1675, 1452, 1267, 1128, 1095, 711 cm^{-1} .

2'-O-(3-Trifluoromethylbenzoyl)-3', 5'-di-O-benzoyl-5-trifluoromethyluridine (3d). Obtained in 97% yield. mp 115-7 °C; $[\alpha]^{21}_{\text{D}} -76.0^\circ$ (c , 0.1, CHCl_3); ^1H NMR (CDCl_3) δ 9.75 (br s, 1H), 8.15-8.02 (m, 8H), 7.78 (d, $J=7.8$ Hz, 1H), 7.62-7.40 (m, 6H), 6.29 (d, $J=5.5$ Hz, 1H), 5.93-5.90 (m, 1H), 5.84 (t, $J=5.7$ Hz, 1H), 4.82-4.71 (m, 3H); ^{13}C NMR δ 170.9, 165.8, 165.1, 164.0, 158.2, 148.9, 140.6, 133.8, 133.5, 132.9, 129.5, 129.3, 128.4, 128.2, 88.6, 80.9, 74.2, 71.0, 63.4; IR (KBr) 3423, 3250, 1727, 1461, 1336, 1267, 1130, 1095, 711 cm^{-1} .

2'-O-(3-Trifluoromethylbenzoyl)-3', 5'-di-O-benzoyl- 4-isobutyroylcytosine (3e). Obtained in 91% yield. mp 146-148°; $[\alpha]^{21}_{\text{D}} -36.4^\circ$ (c , 0.1, CHCl_3); ^1H NMR (CDCl_3) δ 8.58 (br s, 1H), 8.18-8.07 (m, 4H), 7.97-7.90 (m, 3H), 7.80 (d, $J=7.8$ Hz, 1H), 7.64-7.37 (m, 8H), 7.47 (d, $J=$

7.5 Hz, 1H), 6.41 (d, $J = 4.2$ Hz, 1H), 5.93-5.85 (m, 2H), 4.88-4.70 (m, 3H), 2.65-2.55 (m, 1H), 1.22 (d, $J = 6.9$ Hz, 6H); ^{13}C NMR δ 177.4, 166.0, 165.1, 163.8, 163.2, 154.9, 144.3, 133.7, 133.5, 133.0, 129.6, 129.5, 129.1, 128.6, 128.3, 97.4, 89.9, 80.4, 75.0, 70.9, 63.5, 36.4, 18.9; IR (KBr) 3450, 3021, 1728, 1692, 1627, 1494, 1266, 1131, 1097, 756 cm^{-1} .

General Procedure for the Photosensitized Deoxygenation Reaction.

3', 5'-di-*O*-benzoyluridine (4a). A solution of protected nucleoside **3a** (20 mg, 0.03 mmol), *N*-methylcarbazole (6 mg, 0.03 mmol) and magnesium perchlorate hexahydrate (10 mg, 0.03 mmol) in 9:1 isopropanol-water (21 mL) was degassed with argon. The reaction mixture was irradiated in a water jacketed pyrex reaction vessel with a Hanovia 450W medium-pressure mercury lamp for 10-15 h under an argon atmosphere at 25°C. The temperature was maintained by a circulating temperature bath. After the reaction was complete, the reaction mixture was washed with saturated aqueous NaHCO_3 and the aqueous phase extracted with ethyl acetate. The combined organic phases were washed with brine, dried over anhydrous sodium sulfate and concentrated. The residue was purified by preparative tlc to afford compound **4a** (9.8 mg, 70% yield). Recrystallized from ethyl acetate/hexanes, mp 221-223 °C (lit.² mp 225-6 °C). ^1H NMR(CDCl_3) δ 8.30 (br s, 1H), 8.04-8.00 (m, 4H), 7.63-7.58 (m, 2H), 7.52-7.44 (m, 5H), 6.39 (dd, $J = 5.6, 8.3$ Hz, 1H), 5.63-5.56 (m, 2H), 4.73-4.66 (m, 2H), 4.56-4.54 (m, 1H), 2.78-2.72 (m, 1H), 2.36-2.27 (m, 1H); ^{13}C NMR δ 166.0, 162.3, 150.0, 138.8, 133.8, 129.8, 129.5, 128.8, 128.2, 102.9, 85.4, 82.9, 74.8, 64.2, 38.3.

3', 5'-di-*O*-benzoylthymidine (4b). Obtained in 73% yield. mp 193-5 °C (lit.² mp 194-5 °C). ^1H NMR (CDCl_3) δ 8.50 (br s, 1H), 8.09-8.03 (m, 4H), 7.65-7.60 (m, 2H), 7.51-7.46 (m, 5H), 6.47 (dd, $J = 5.6, 8.7$ Hz, 1H), 5.66 (d, $J = 4.5$ Hz, 1H), 4.75 (ABX, $J_{\text{AB}} = 12.3$, $J_{\text{AX}} = 3.0$, $J_{\text{BX}} = 2.9$ Hz, $\Delta\nu_{\text{AB}} = 36.7$ Hz, 2H), 4.54 (d, $J = 2.0$ Hz, 1H), 2.73-2.67 (m, 1H), 2.37-2.35 (m, 1H), 1.62 (s, 3H); ^{13}C NMR δ 166.0, 163.2, 150.1, 134.4, 133.7, 129.8, 129.5, 129.3, 129.0, 128.8, 128.6, 111.7, 84.9, 82.7, 75.0, 64.3, 38.0, 12.7.

3', 5'-di-*O*-benzoyl-5-fluorouridine (4c). Obtained in 53% yield. Recrystallized from chloroform, mp 246 °C (dec.) (lit.³ mp >250 °C, dec.). ^1H NMR (CDCl_3) δ 8.07-8.02 (m, 4H), 7.65-7.60 (m, 3H), 7.51-7.46 (m, 4H), 6.40-6.38 (m, 1H), 5.62 (d, $J = 6.6$ Hz, 1H), 4.78-4.74 (m, 2H), 4.57 (d, $J = 2.6$ Hz, 1H), 2.79-2.72 (m, 1H), 2.32-2.25 (m, 1H); ^{13}C NMR ($\text{DMSO}-d_6$) δ 165.5, 165.2, 157.0 ($J_{\text{C-F}} = 104$ Hz), 149.0, 140.2 ($J_{\text{C-F}} = 920$ Hz), 133.7, 133.6, 129.4, 129.2, 128.8, 128.4, 124.8 ($J_{\text{C-F}} = 137$ Hz) 85.0, 81.2, 74.5, 64.3, 35.9.

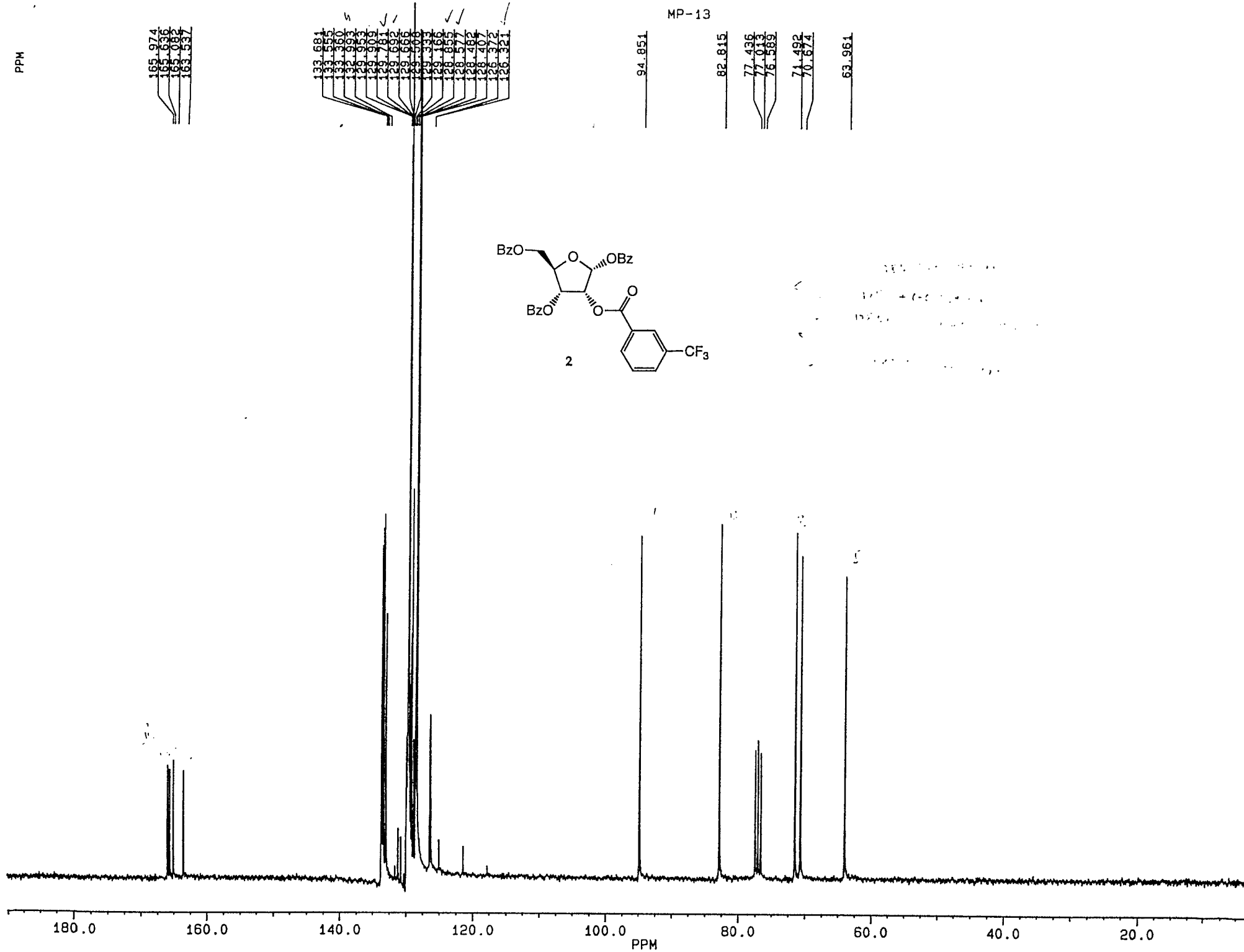
3', 5'-di-*O*-benzoyl-5 -trifluoromethyluridine (4d). Obtained in 44 % yield (71 % yield based on recovered starting material). Recrystallized from ethyl acetate/hexanes, mp 152-5 °C; $[\alpha]^{21}_{\text{D}} -28.3^{\circ}$ (*c*, 0.1, CHCl₃) ; ¹H NMR (CDCl₃) δ 8.68 (br s, 1H), 8.12-7.97 (m, 5H), 7.66-7.58 (m, 2H), 7.51-7.43 (m, 4H), 6.33 (dd, *J* = 5.5, 8.5 Hz, 1H), 5.64 (d, *J* = 6.4 Hz, 1H), 4.77-4.75 (m, 2H), 4.64 (d, *J* = 2.25 Hz, 1H), 2.90 (dd, *J* = 5.5, 14.2 Hz, 1H), 2.36-2.26 (m, 1H); ¹³C NMR δ 171.2, 166.0, 165.9, 158.6, 149.1, 140.1, 140.0, 133.8, 133.7, 130.2, 129.8, 128.9, 128.8, 86.6, 83.8, 74.9, 64.1, 39.0; IR (KBr) 3205, 3020, 1723, 1465, 1269, 1216, 1107, 758 cm⁻¹.

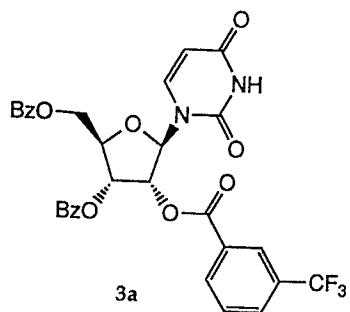
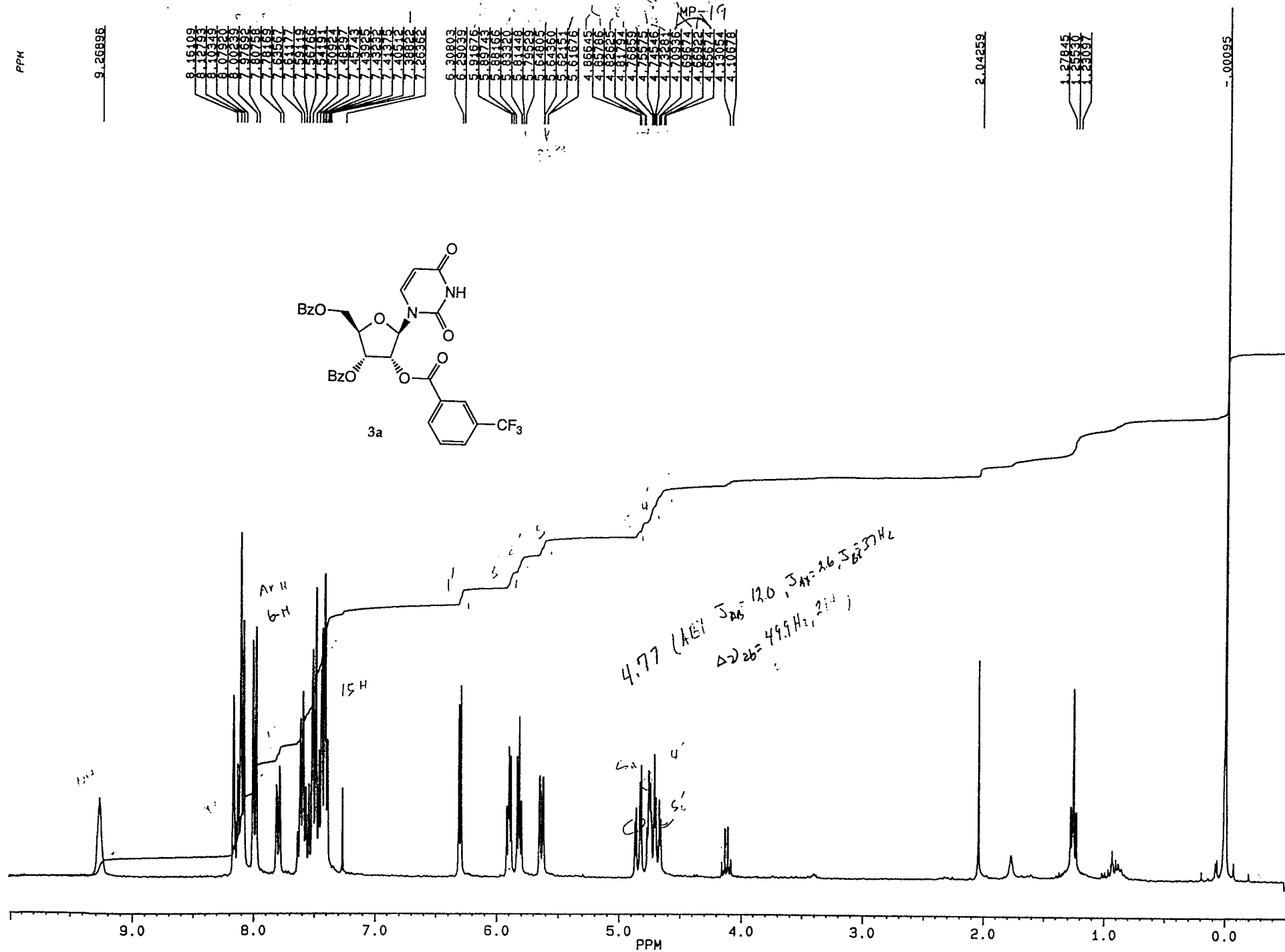
3', 5'-di-*O*-benzoyl-4-isobutyroylcytidine (4e). Obtained in 62% yield. Recrystallized from ethyl acetate/hexanes, mp 182-3 °C. $[\alpha]^{21}_{\text{D}} -24.0^{\circ}$ (*c*, 0.1, CHCl₃) ; ¹H NMR (CDCl₃) δ 8.62 (br s, 1H), 8.17-7.97 (m, 5H), 7.64-7.32 (m, 7H), 6.38 (dd, *J* = 5.7, 7.8 Hz, 1H), 5.62 (d, *J* = 6.36 Hz, 1H), 4.76-4.65 (m, 3H), 3.12-3.05 (m, 1H), 2.62-2.57 (m, 1H), 2.32-2.22 (m, 1H), 1.23 (d, *J* = 6.8 Hz, 6H); ¹³C NMR δ 176.9, 166.0, 165.9, 162.5, 154.9, 143.3, 133.6, 133.5, 129.7, 129.4, 128.6, 128.5, 96.6, 87.4, 83.4, 75.0, 64.1, 39.3, 36.6, 19.0, 18.9; IR (KBr) 3450, 2971, 1722, 1668, 1626, 1493, 1316, 1271, 1110, 1026, 711cm⁻¹.

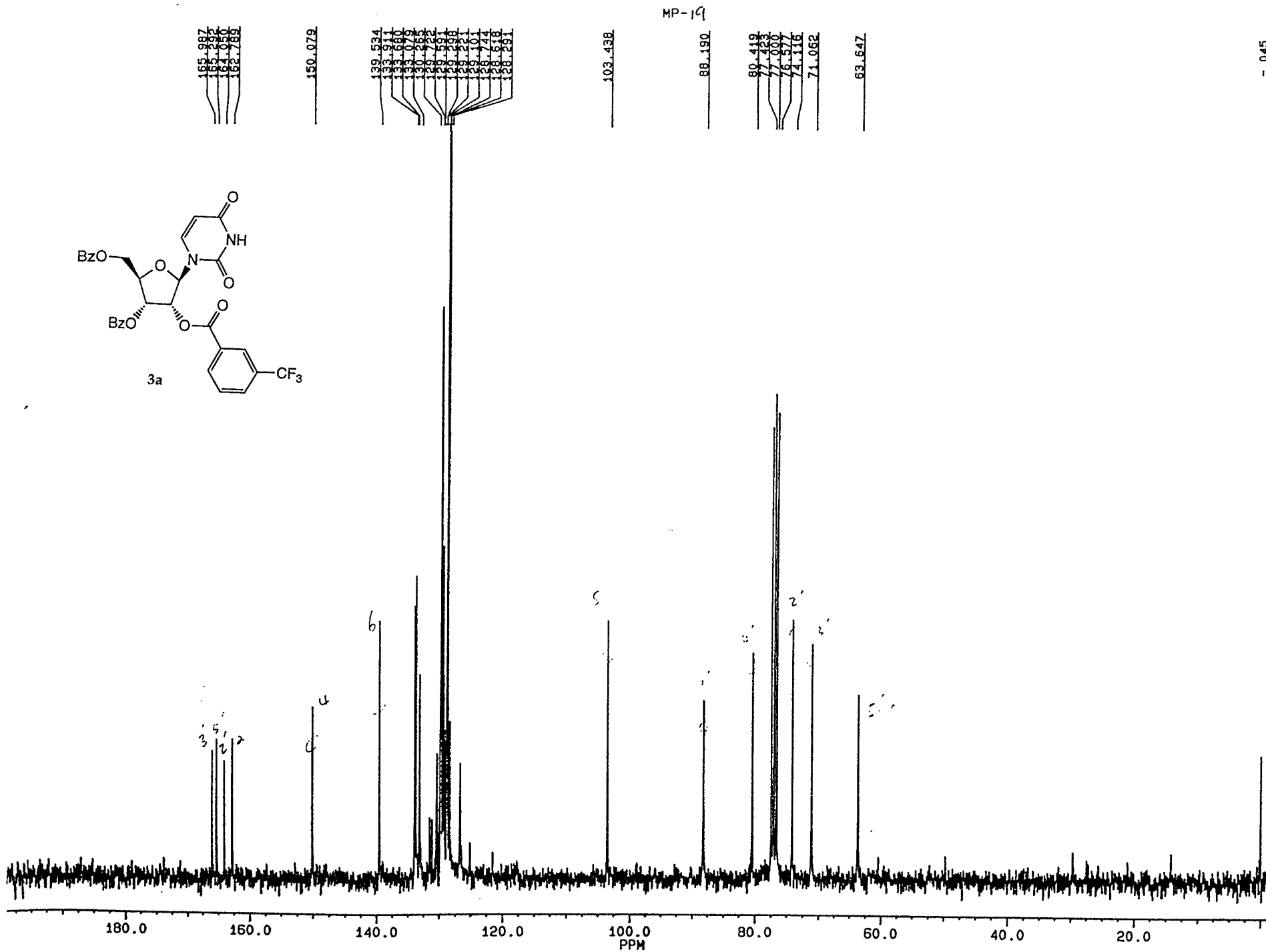
References for Supplemental Material

1. Koch, A.; Lamberth, C.; Wetterich, F.; Giese, B. *J. Org. Chem.* **1993**, 58, 1083.
2. Holy, A.; Soucek, M. *Tetrahedron Lett.* **1971**, 185.
3. Cech, D.; Holy, A. *Coll. Czech. Chem. Commun.* **1976**, 41, 3335.

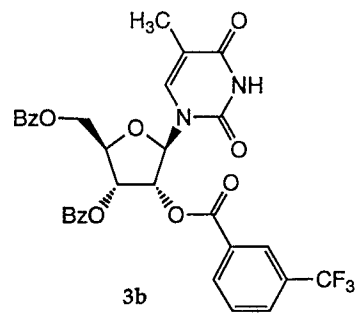




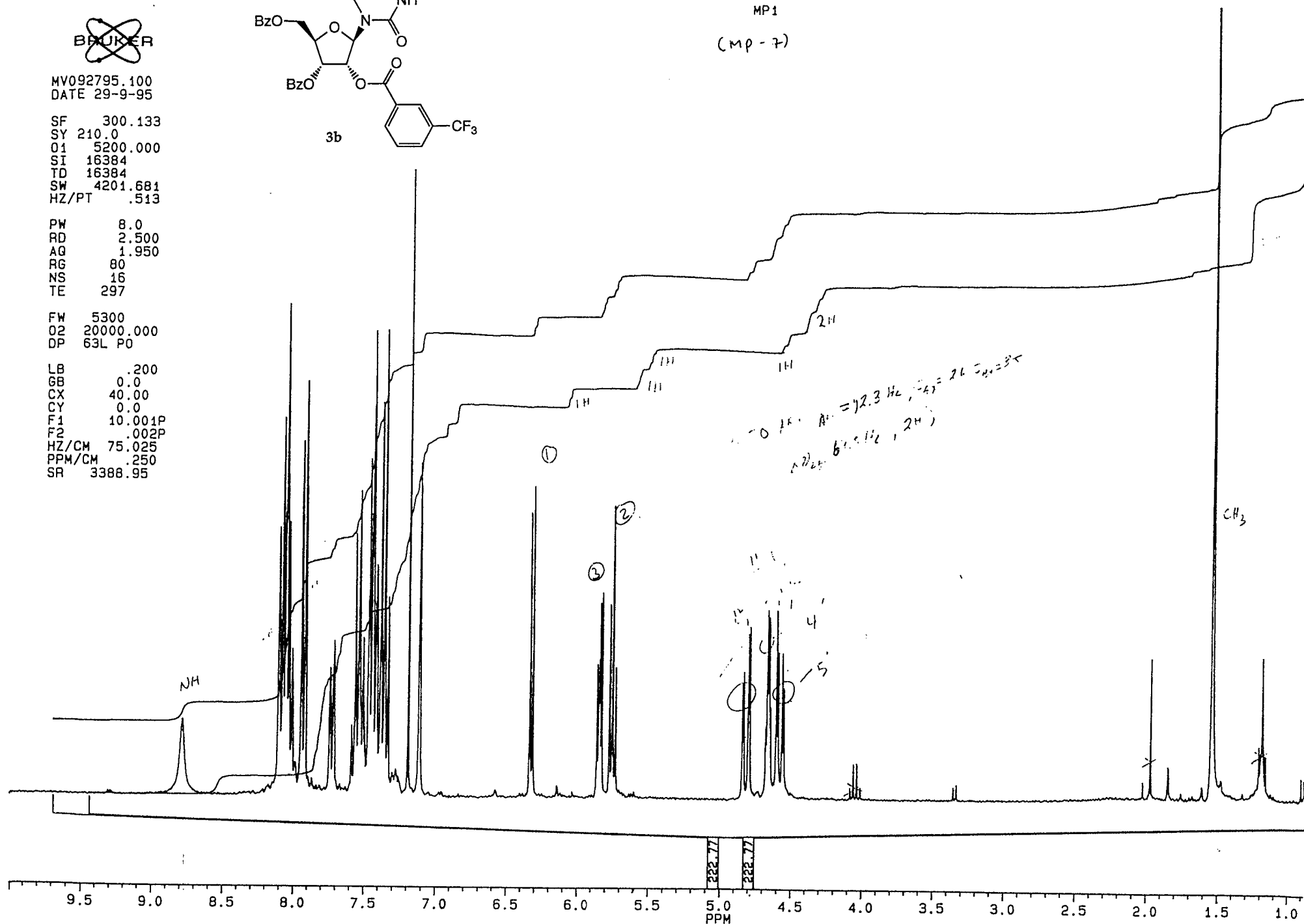




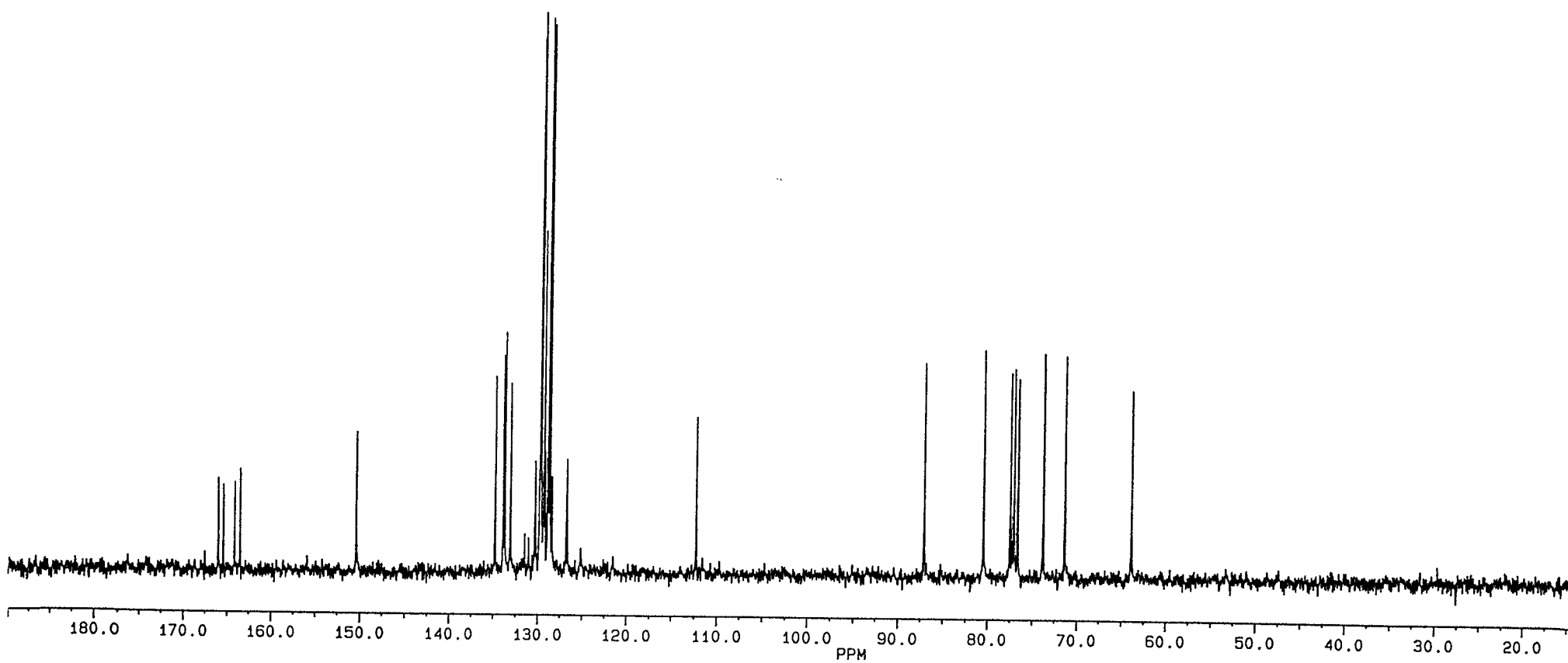
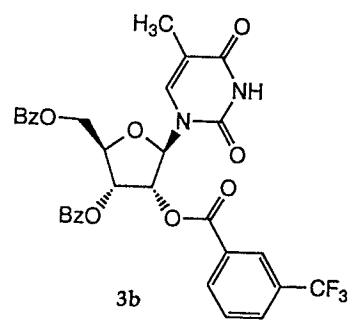
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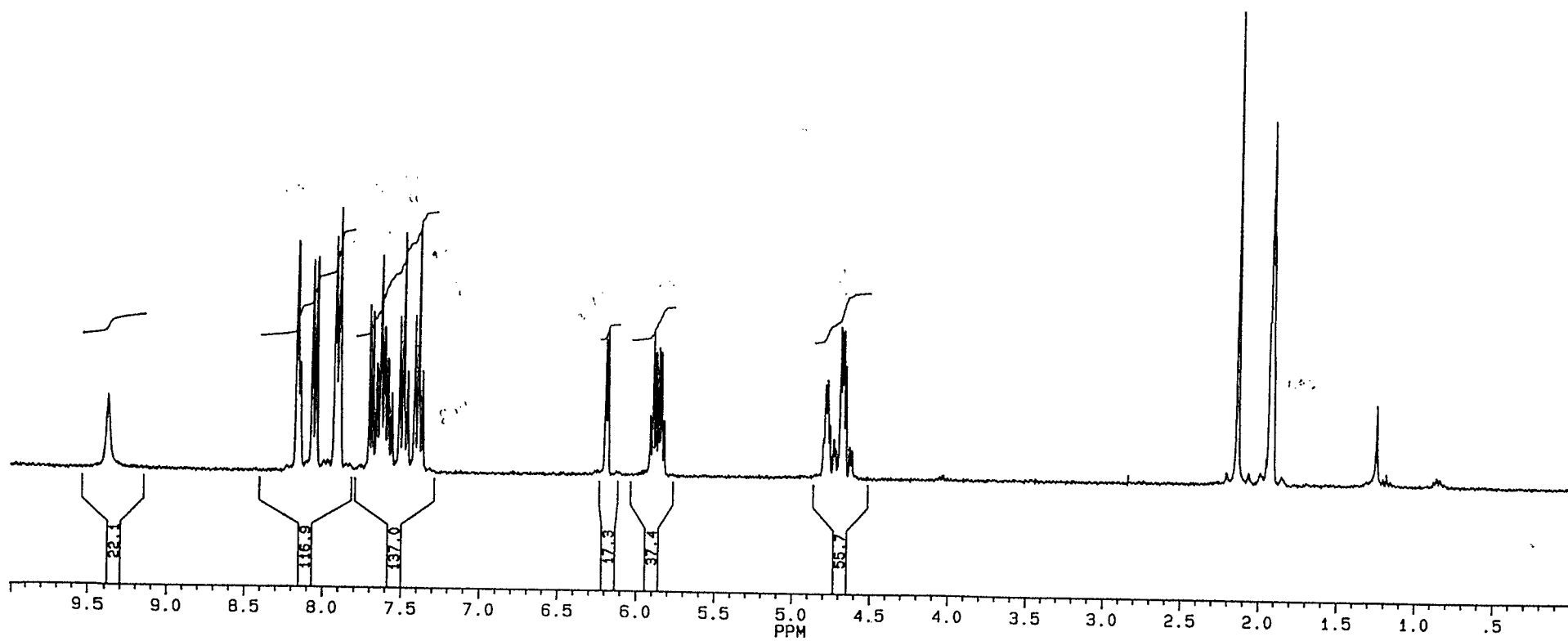
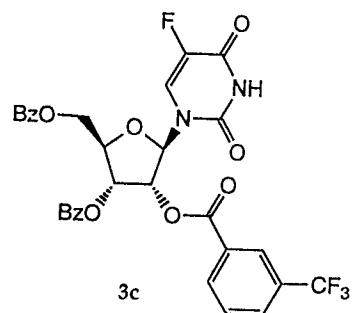


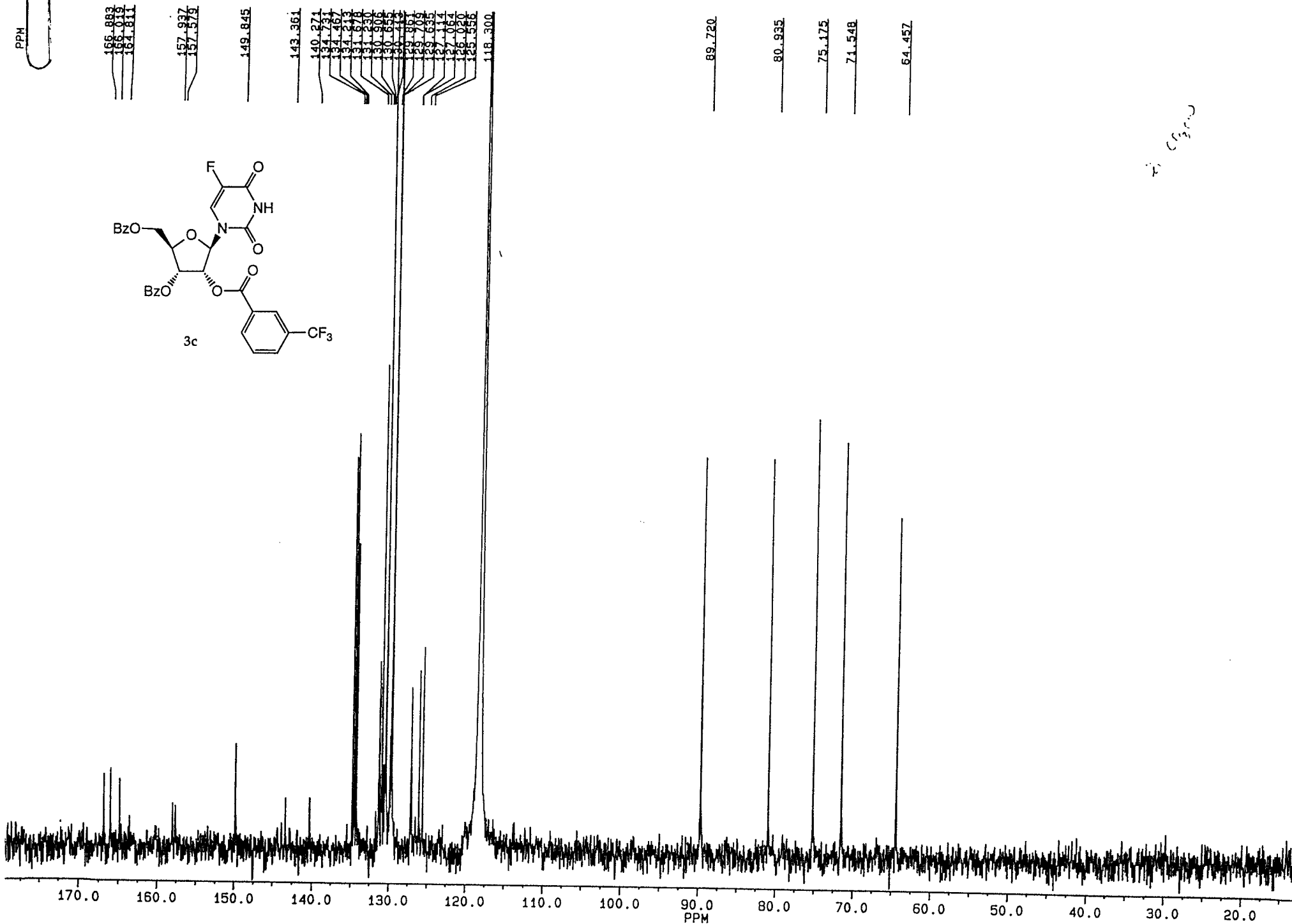
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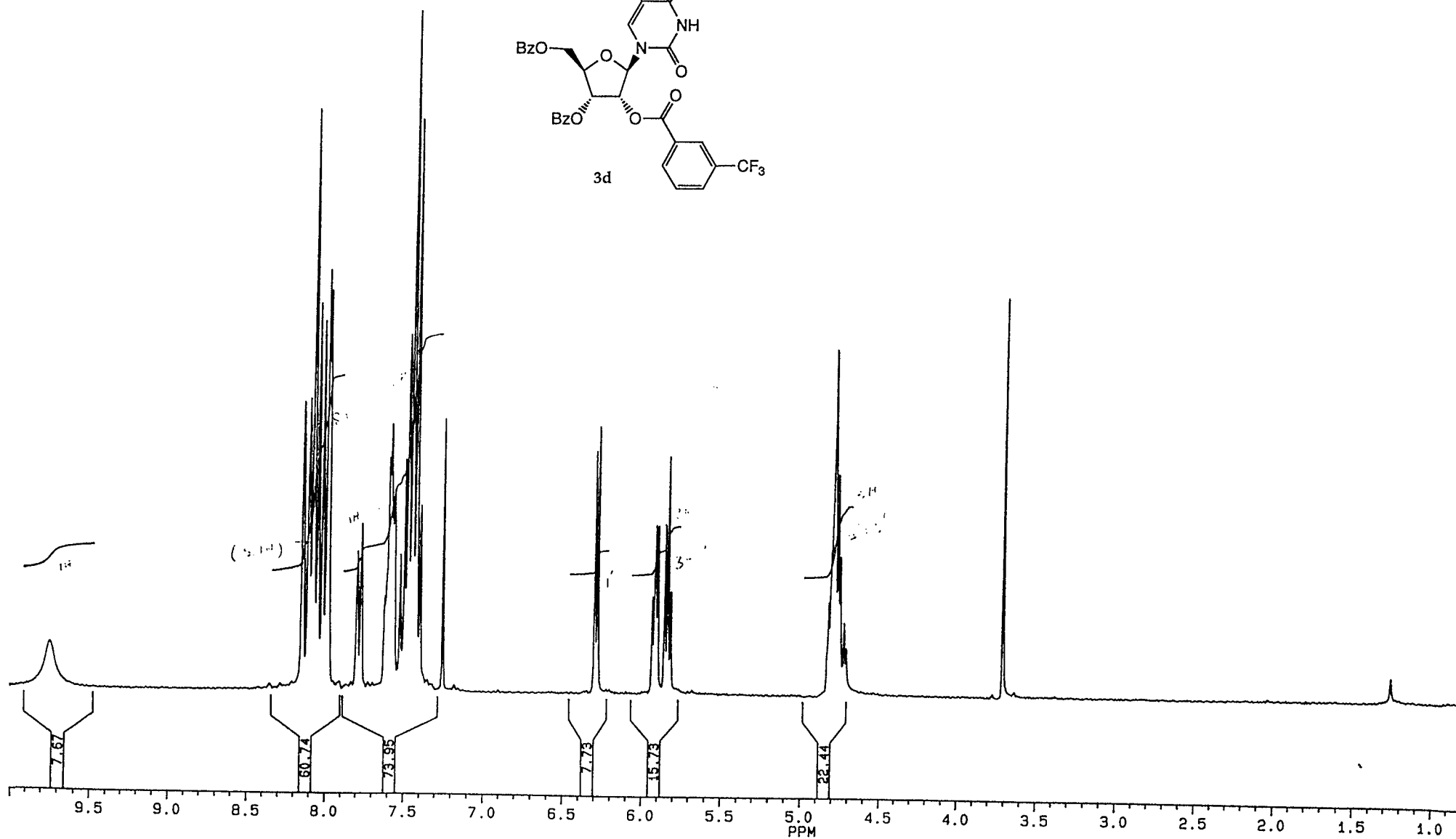
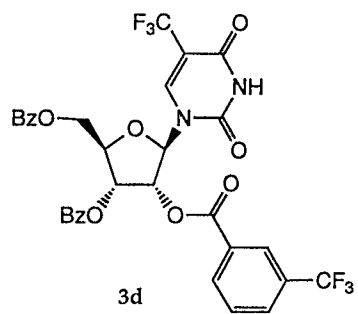
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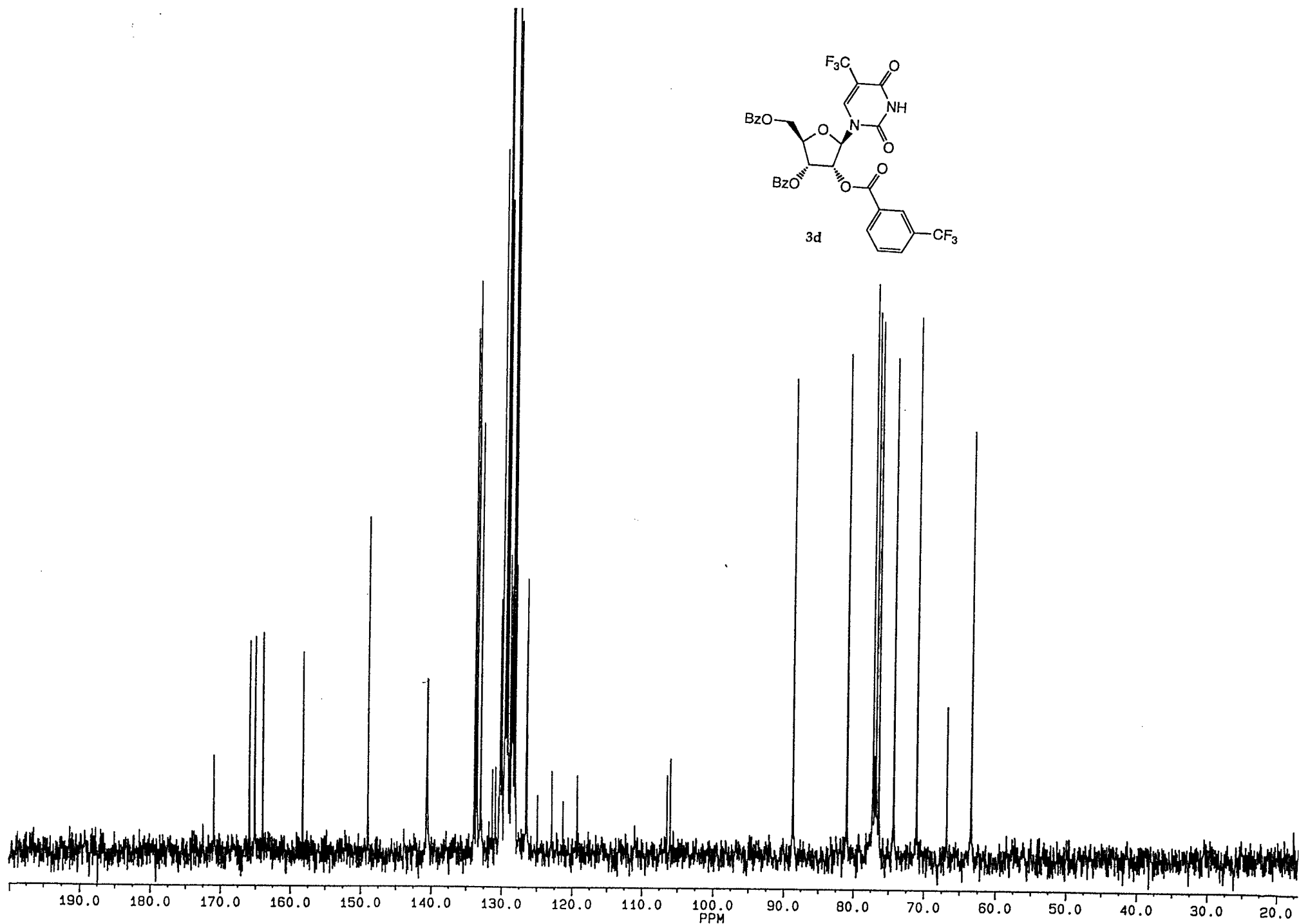
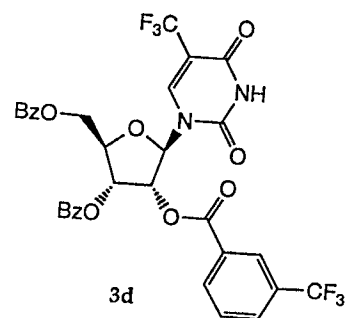


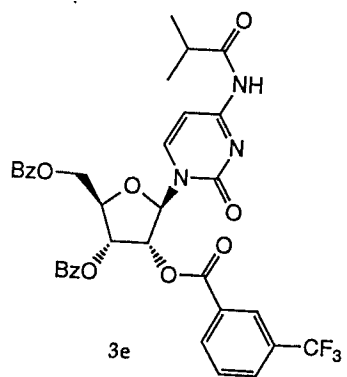




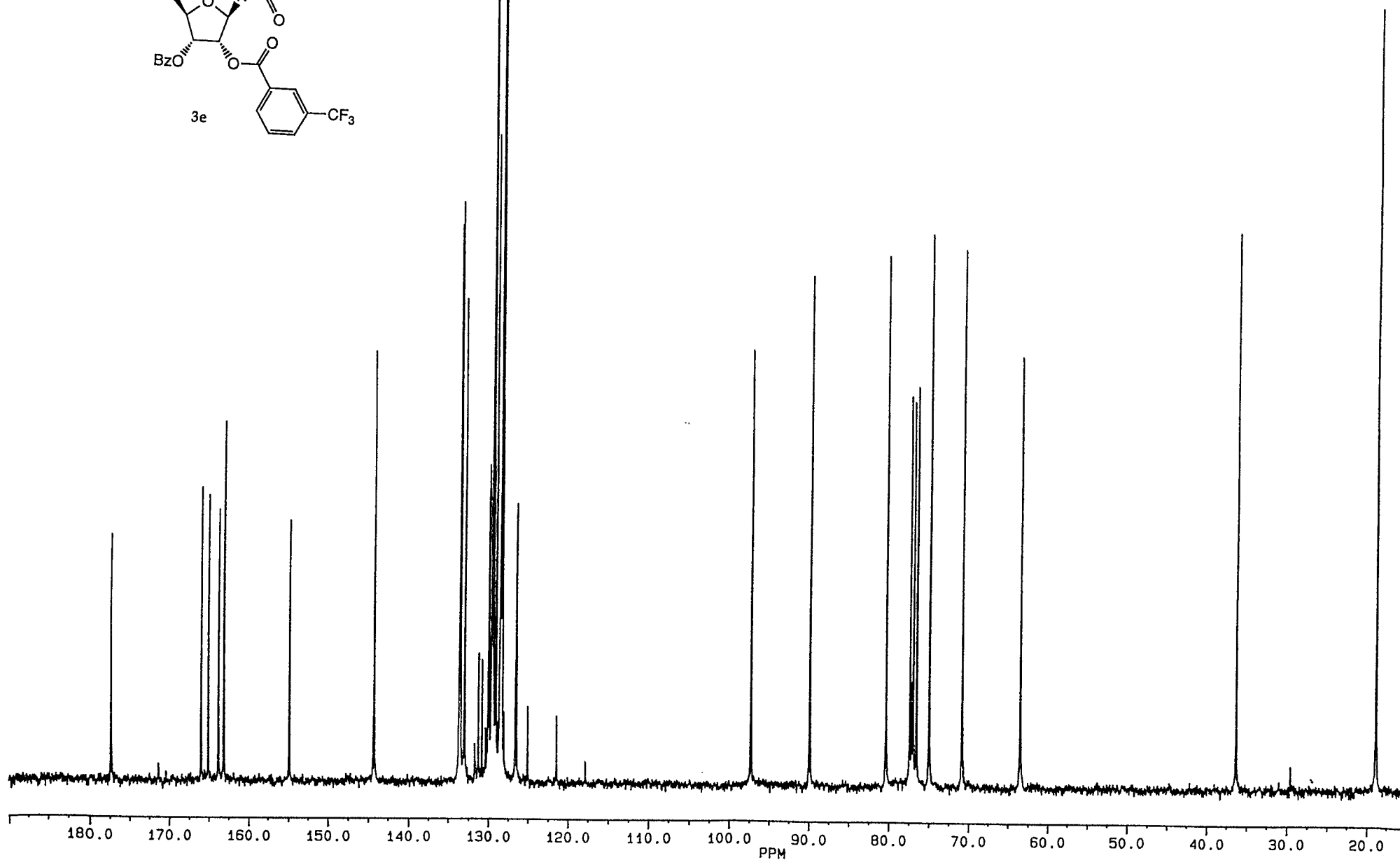
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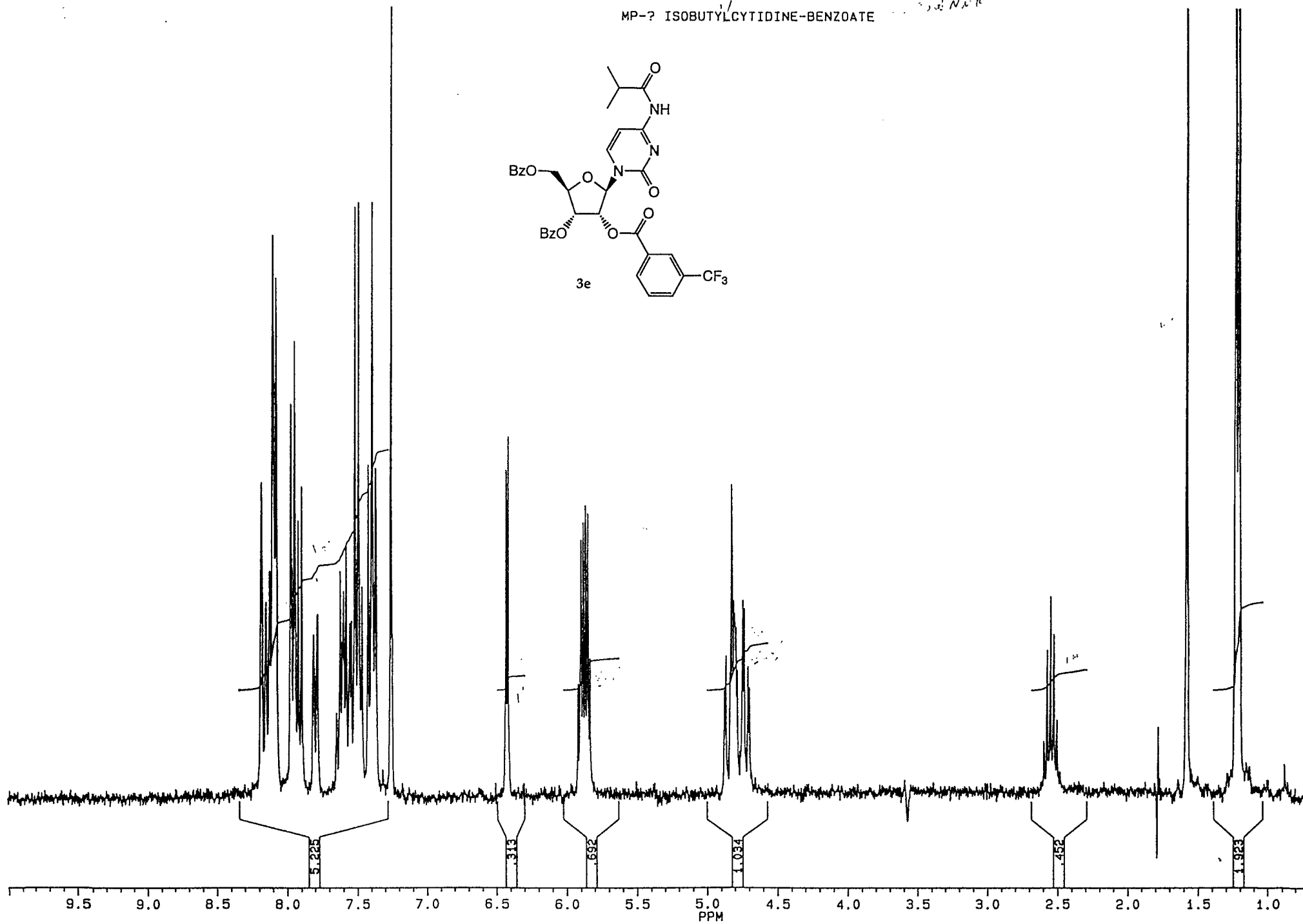
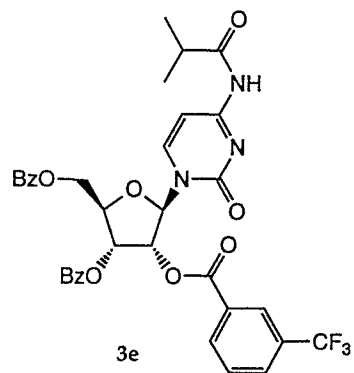


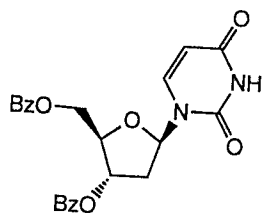


mp-73



MP-? ISOBUTYLCYTIDINE-BENZOATE





4a

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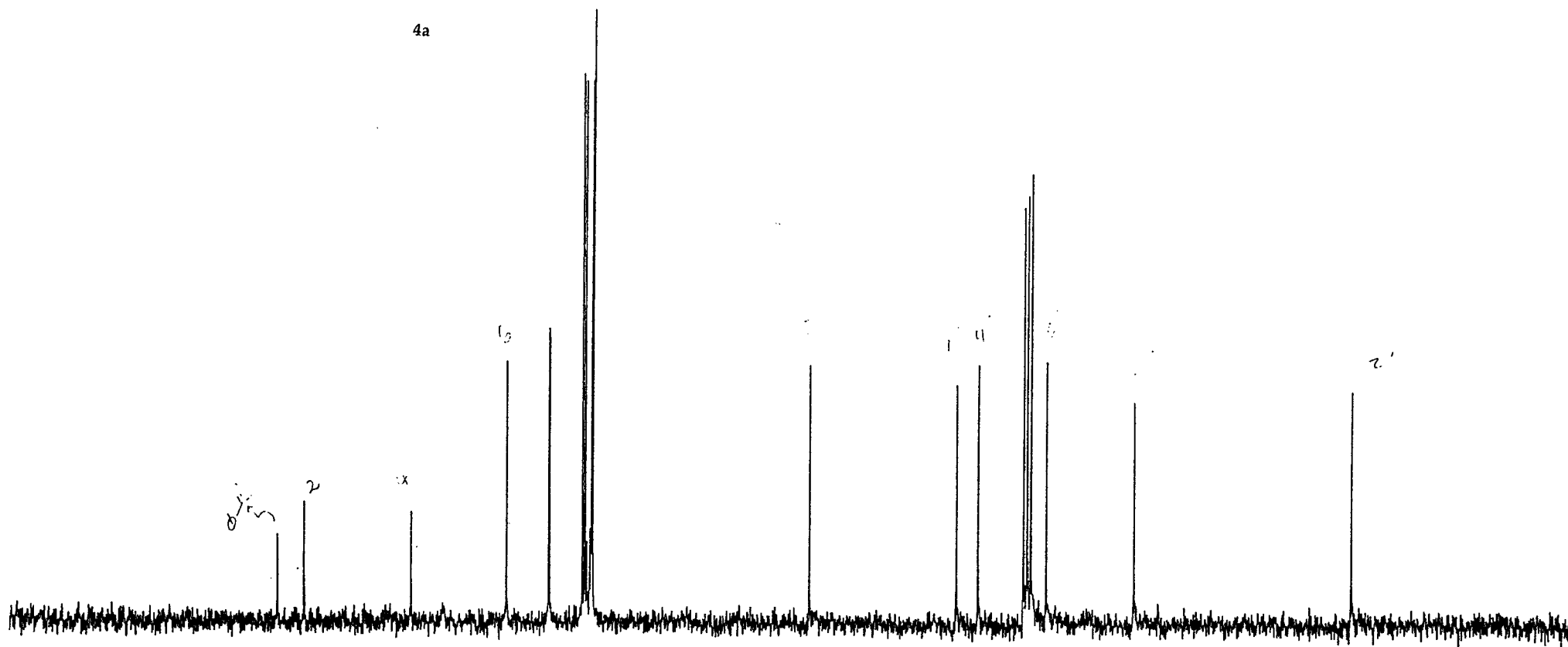
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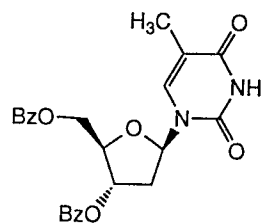
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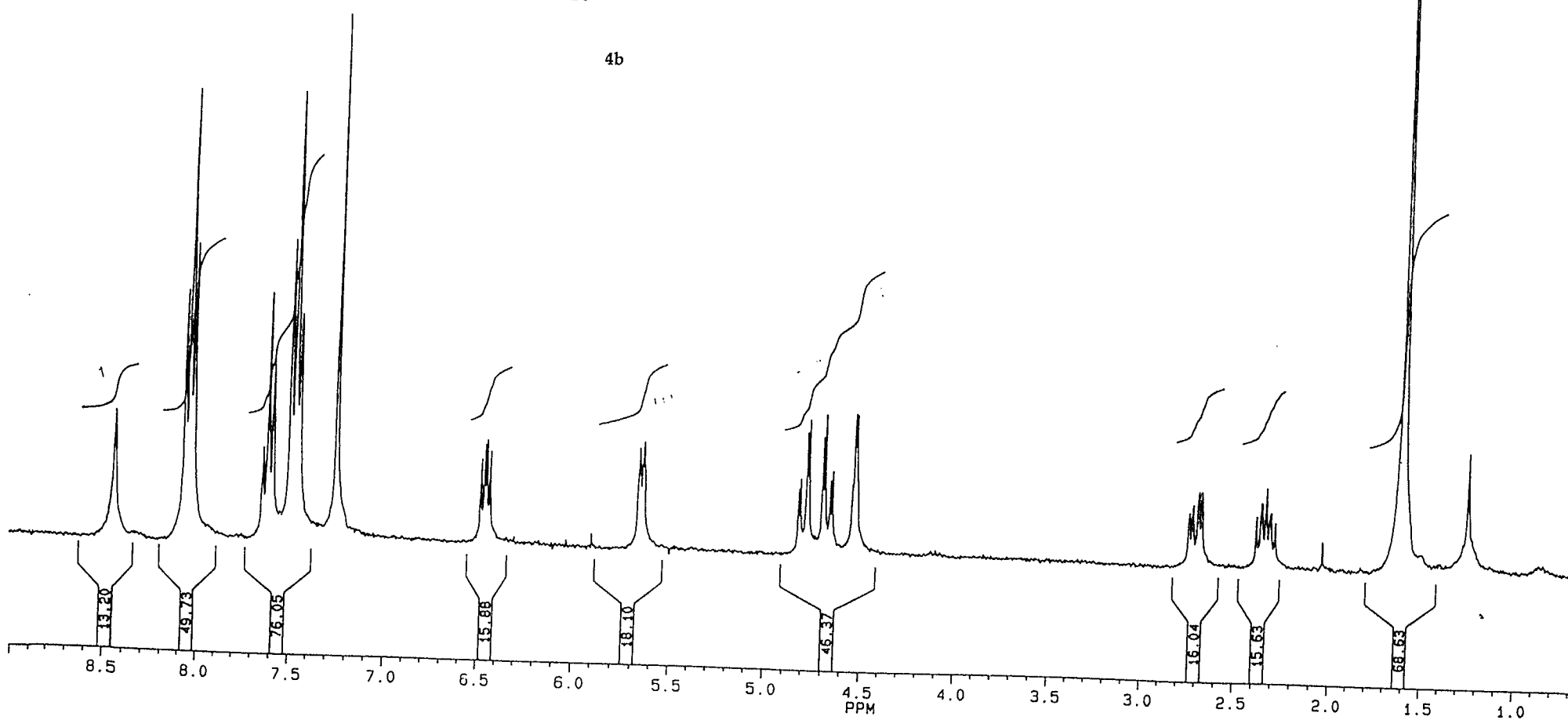
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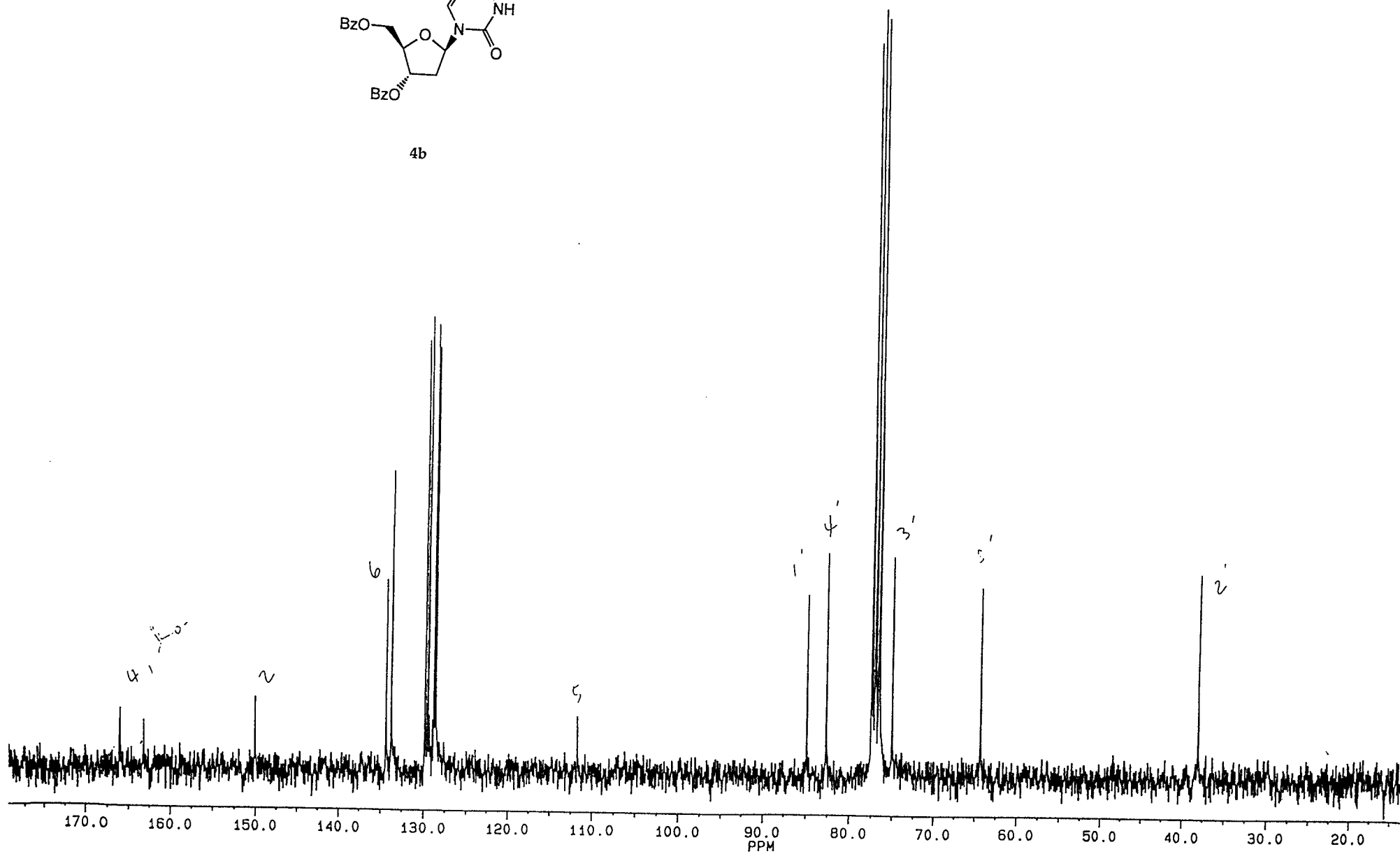
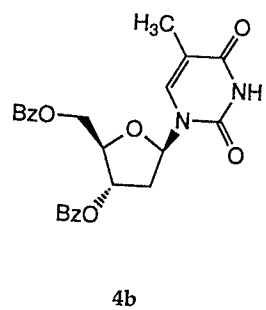


2-DEOXY-THYMIDINE-BENZOATE

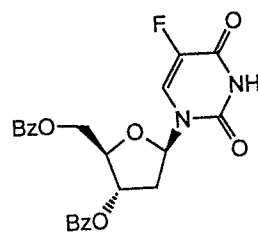


4b

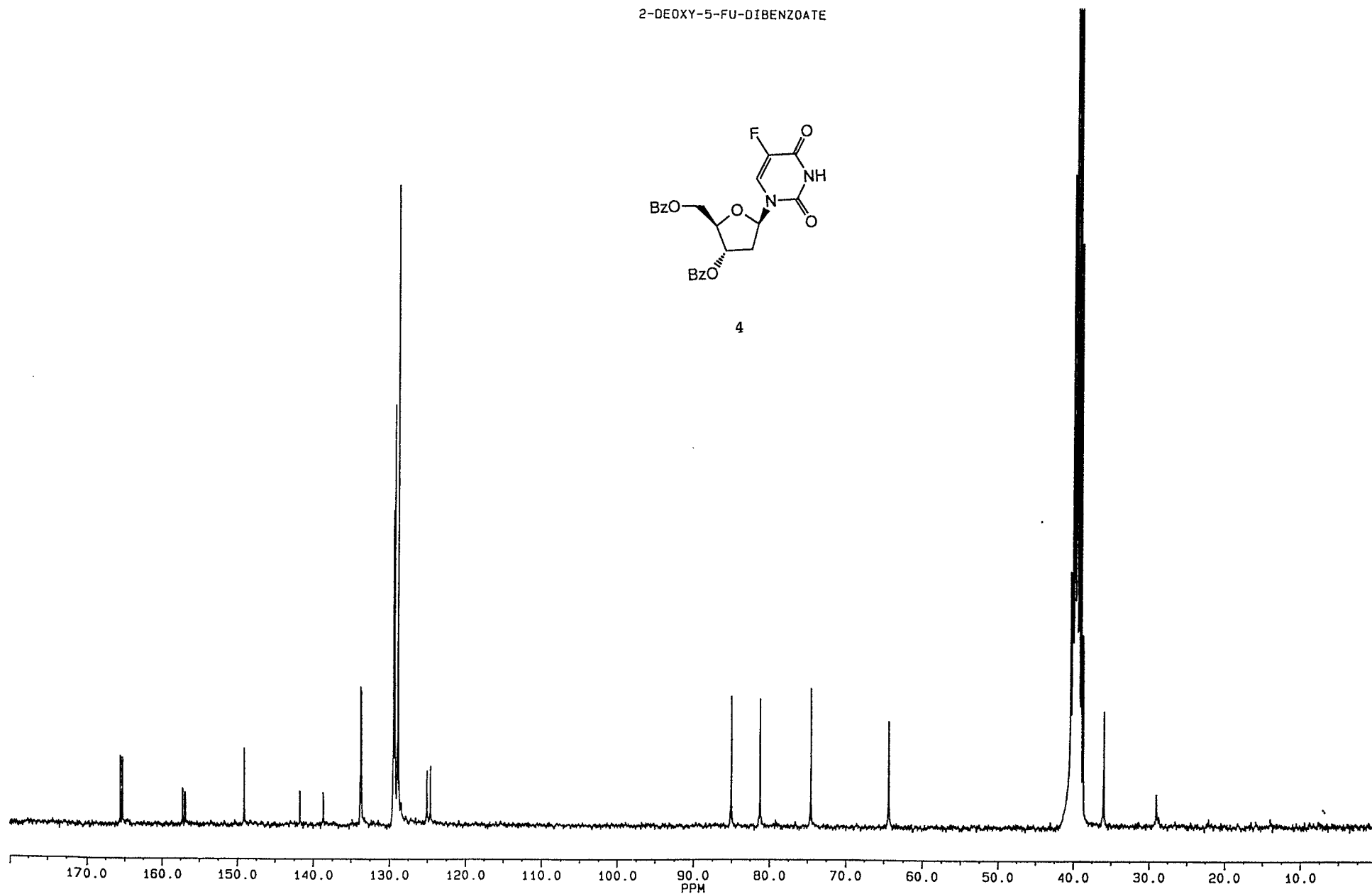




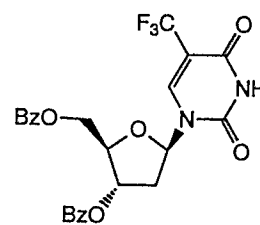
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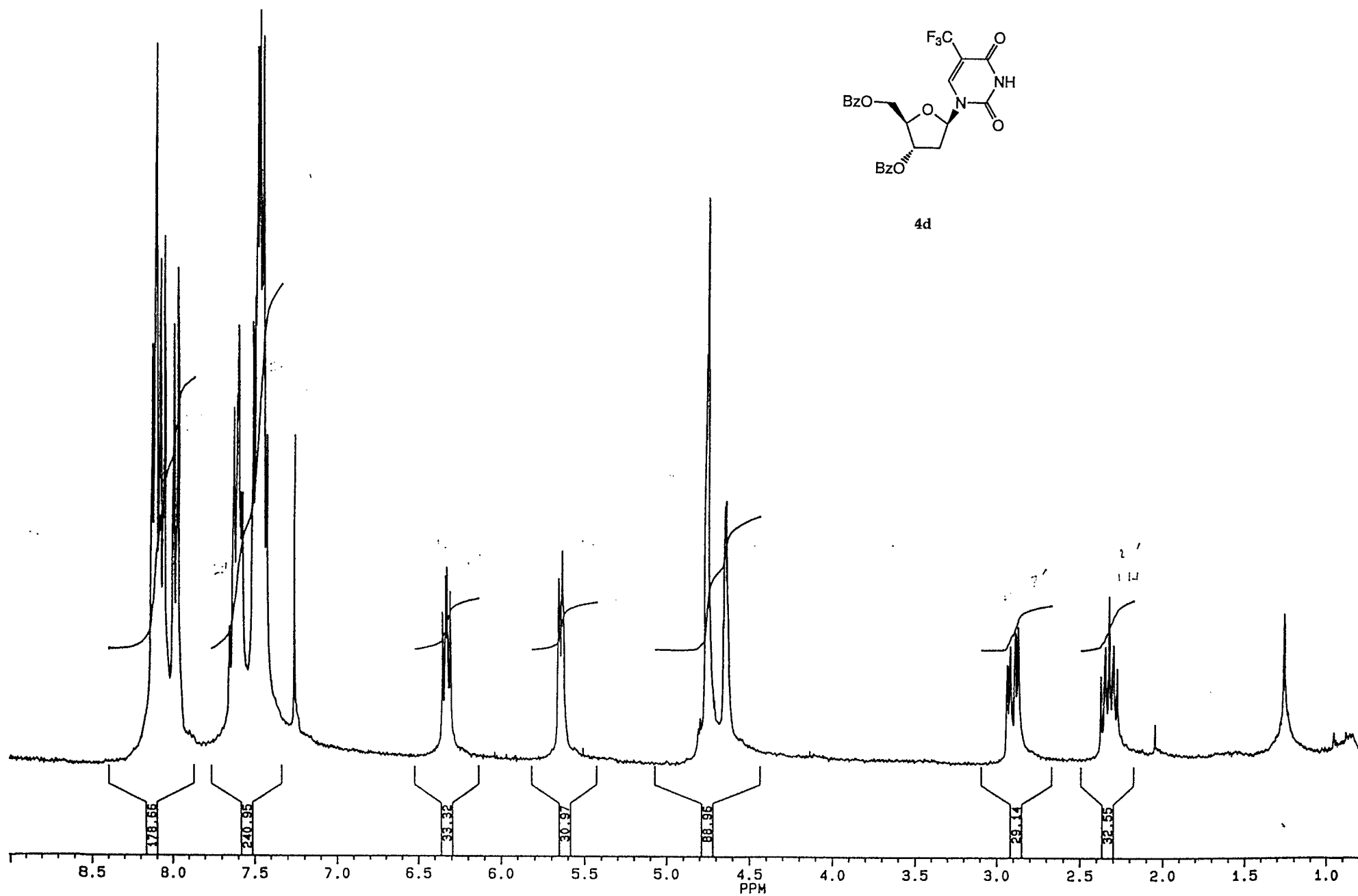
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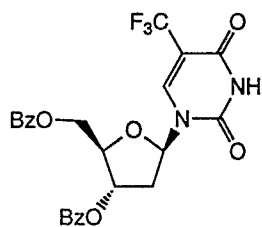
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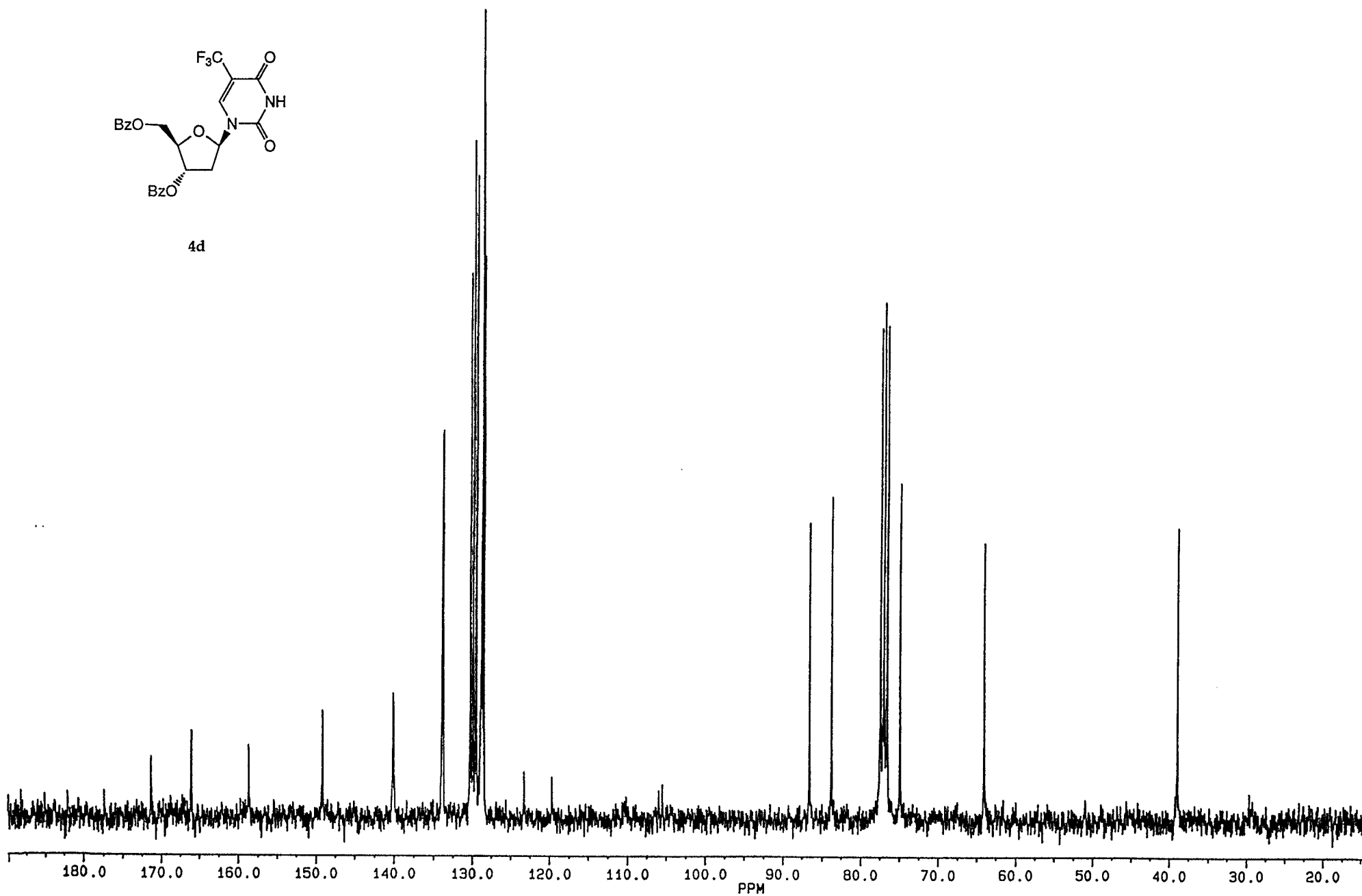
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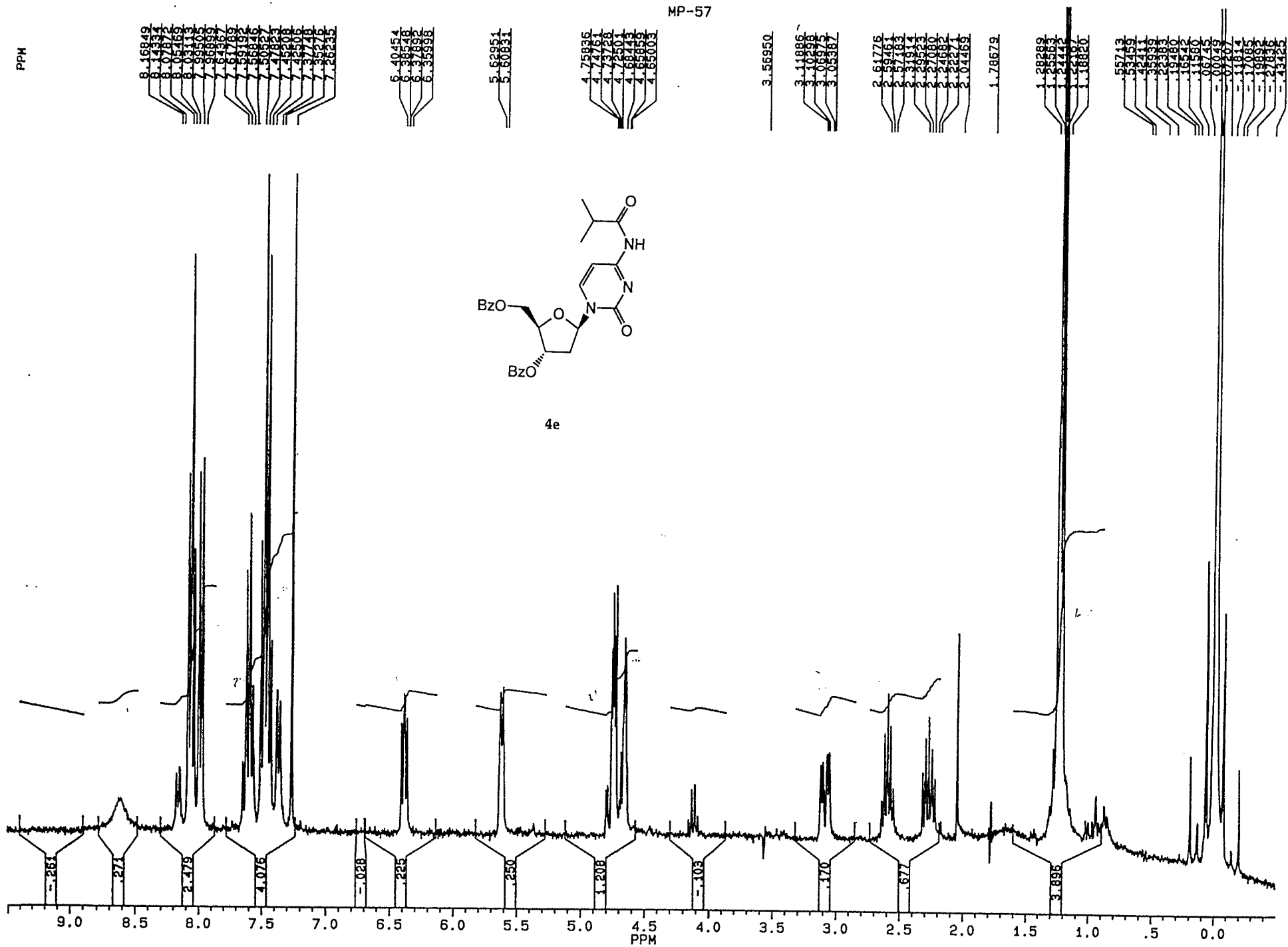


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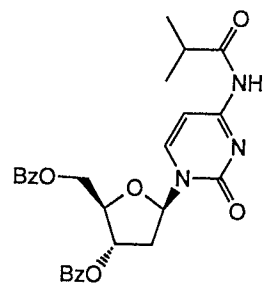


4d





MP-87



4e

