# Isophthalamides and pyridine-2,6-dicarboxamides with pendant indole groups: a 'twisted' binding mode for selective fluoride recognition

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## Synthesis

### Pyridine-2,6-dicarboxylic acid bis-[(2,3-dimethyl-1*H*-indol-7-yl)-amide], 1

2,3-Dimethyl-7-nitroindole (0.7 g, 3.7 mmol) was dissolved in ethanol (100 mL) with 10% Pd/C (100 mg) and hydrazine monohydrate (2 mL). The reaction was refluxed for 2 hours then filtered through celite and washed with ethanol. The filtrate was concentrated *in vacuo* and the solid residue was used immediately. The solid was dissolved in acetonitrile (50 mL) with triethylamine (5 mL) and a catalytic amount of DMAP. To this was added a solution of pyridine-2,6-dicarbonylchloride (0.37 g, 1.8 mmol) in acetonitrile (50 mL) and the reaction was stirred overnight during which time a solid precipitate had formed. This was collected by filtration and washed with further acetonitrile followed by ether. The product was isolated as a yellow solid. Yield 0.52g (63 %, 1.2 mmol)
$^{1}$H NMR (400 MHz, DMSO-$d_6$) δ: 2.19 (s, 3H, $CH_3$), 2.36 (s, 3H, $CH_3$), 6.99 (t, 2H, *J*= 7.5Hz, Ar-H), 7.15 (d, 2H, *J*= 7.3Hz, Ar-H), 7.30 (d, 2H, *J*= 7.5Hz, Ar-H), 8.32 (q, 1H, *J*= 7, 8.5Hz, Ar-H), 8.43 (d, 2H, *J*= 7.5Hz, Ar-H), 10.55 (s, 2H, amide NH), 11.13 (s, 2H, indole NH); $^{13}$C NMR (100 Mhz, DMSO-$d_6$) δ: 8.22 ($CH_3$), 11.02 ($CH_3$), 105.26 (C), 115.20 (Ar-CH), 116.84 (Ar-CH), 117.57 (Ar-CH), 120.54 (Ar-C), 124.68 (Ar-CH), 129.98 (Ar-C), 130.12 (Ar-C), 131.35 (Ar-C), 139.40 (Ar-CH), 148.77 (Ar-C), 161.63 (C=O); LRMS ES$^+$: 450.2 $(M+H)^+$; IR ν $cm^{-1}$ 3381s, 3256s, 2915s, 1644s, 1544s, 1456s, 1412s, 1343s, 1148s, Microanalysis for $C_{27}H_{25}N_5O_2$+0.15$CH_2Cl_2$. Calc. (%) C = 70.20, H = 5.49, N = 15.07. Found (%) C = 70.19, H = 5.60, N = 15.02; Mp: decomposed ~220°C

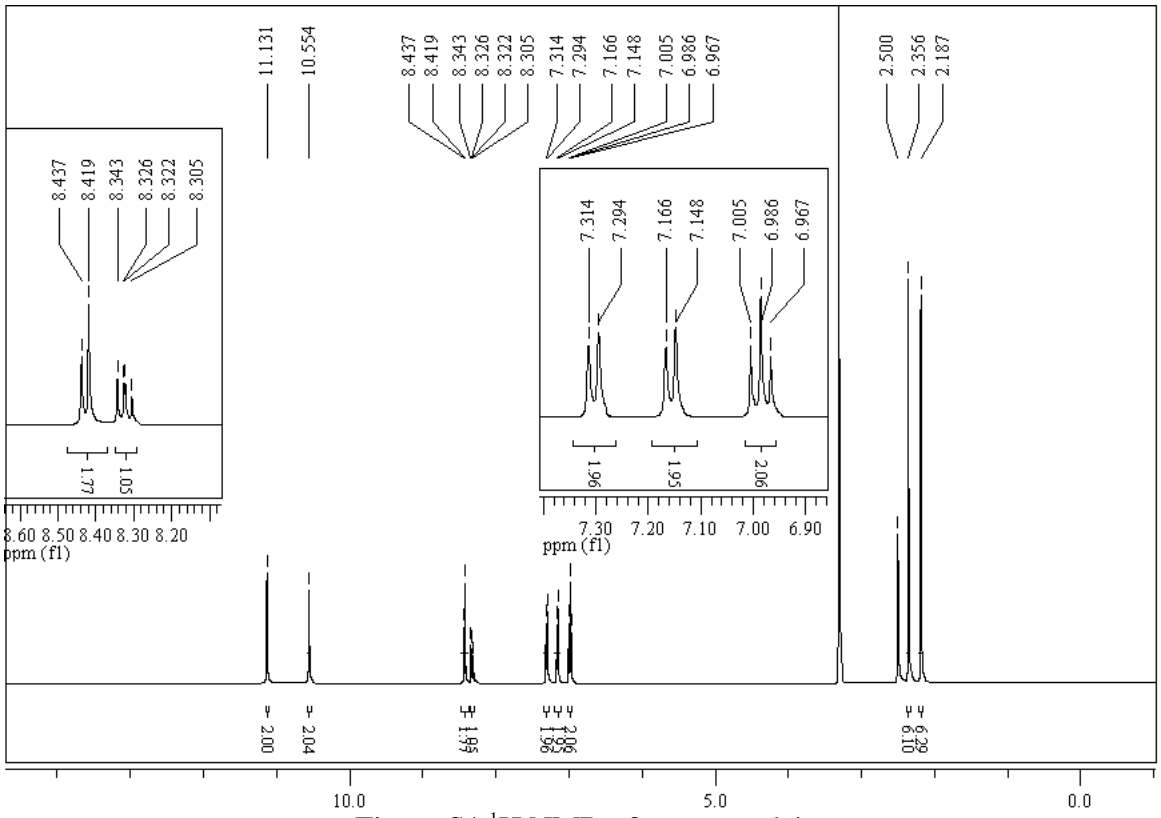


Figure S1 $^{1}$H NMR of compound **1**

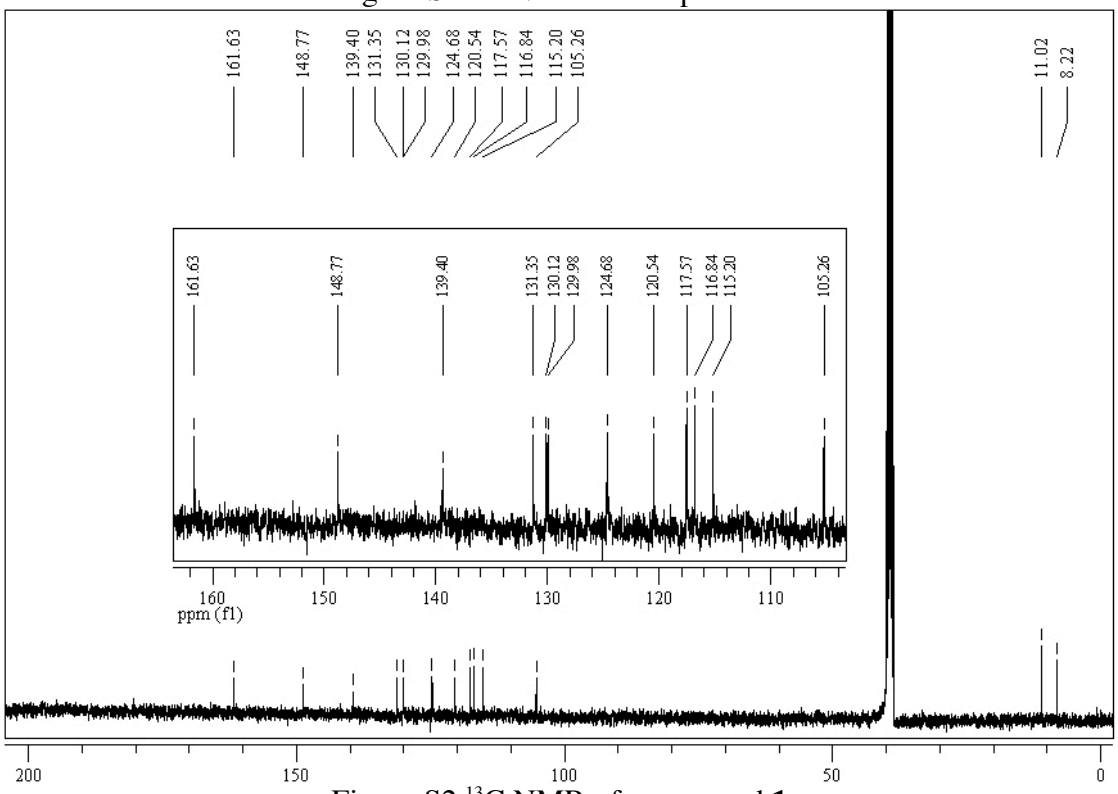


Figure S2 $^{13}$C NMR of compound **1**

**_N_,_N_'-Bis-(2,3-dimethyl-1_H_-indol-7-yl)-isophthalamide, 2**

2,3-Dimethyl-7-nitroindole (0.7 g, 3.7 mmol) was dissolved in ethanol (100 mL) with 10% Pd/C (100 mg) and hydrazine monohydrate (2 mL). The reaction was refluxed for 2 hours then filtered through celite and washed with ethanol. The filtrate was concentrated *in vacuo* and the solid residue was used immediately. The solid was dissolved in acetonitrile (50 mL) with triethylamine (5 mL) and a catalytic amount of DMAP. To this was added a solution of isophthaloyl chloride (0.37 g, 1.8 mmol) in acetonitrile (50 mL) and the reaction was stirred overnight during which time a solid precipitate had formed. This was collected by filtration and washed with further acetonitrile followed by ether. The product was isolated as a white solid. Yield 0.49g (60 %, 1.1 mmol)
$^{1}$H NMR (400 MHz, DMSO-$d_6$) δ: 2.18 (s, 3H, $CH_3$), 2.34 (s, 3H, $CH_3$), 6.96 (t, 2H, *J*= 7.8Hz, Ar-H), 7.24 (d, 2H, *J*= 7.5Hz, Ar-H), 7.33 (d, 2H, *J*= 7.5Hz, Ar-H), 7.73 (t, 1H, *J*= 7.8Hz, Ar-H), 8.24 (d, 2H, *J*= 7.6Hz, Ar-H), 8.70 (s, 1H, Ar-H), 10.14 (s, 2H, amide NH), 10.47 (s, 2H, indole NH); $^{13}$C NMR (100 Mhz, DMSO-$d_6$) δ: 8.40 ($CH_3$), 11.20 ($CH_3$), 105.58 (C), 114.67 (Ar-CH), 115.01 (Ar-CH), 117.93 (Ar-CH), 121.93 (Ar-C), 127.42 (Ar-CH), 128.35 (Ar-CH), 128.72 (Ar-C), 130.43 (Ar-C), 130.69 (Ar-CH), 131.28 (Ar-C), 135.08 (Ar-C), 161.85 (C=O); LRMS ES$^+$: 473.3 $(M+Na)^+$, LRMS ES$^-$: 485.2, 487.2 $(M+Cl)^-$; IR ν $cm^{-1}$ 3415s, 3271s, 2916s, 1631s, 1544s, 1456s, 1413s, 1346s, Microanalysis for $C_{28}H_{26}N_4O_2$+0.12$CH_2Cl_2$. Calc. (%) C = 73.33, H = 5.74, N = 12.17. Found (%) C = 73.30, H = 5.88, N = 12.17; Mp: decomposed ~215°C

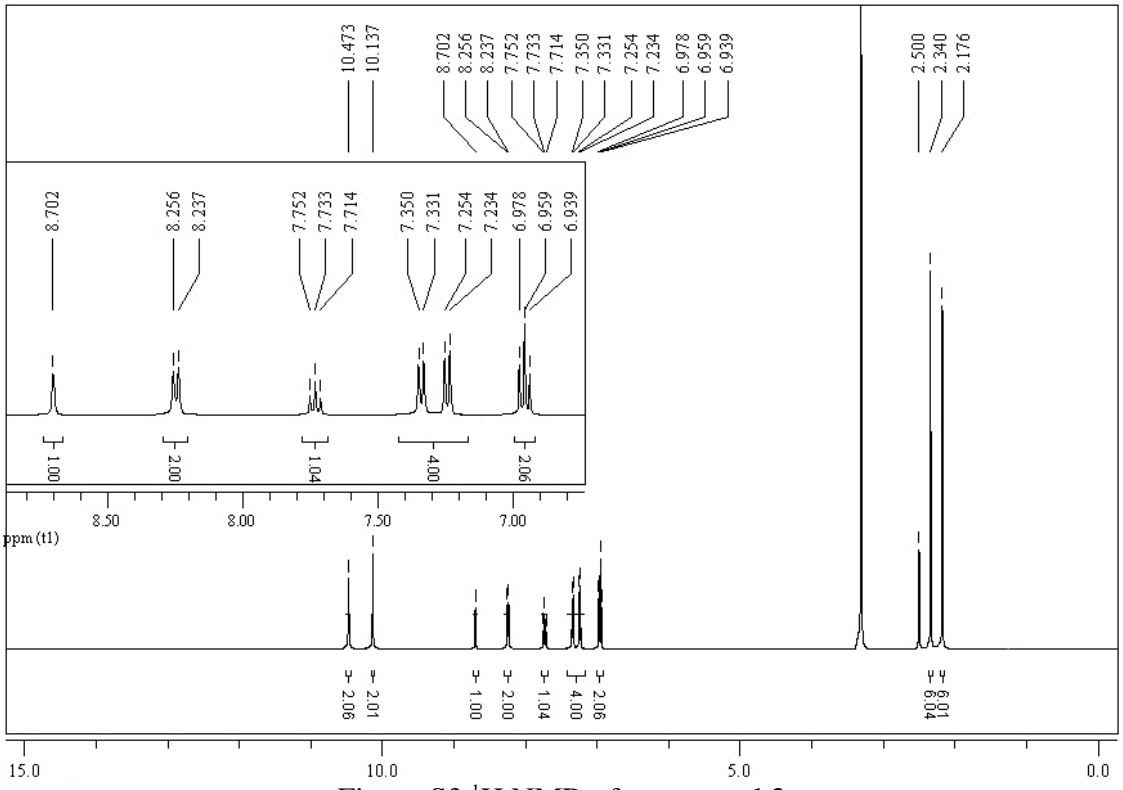

Figure S3 $^{1}$H NMR of compound 2

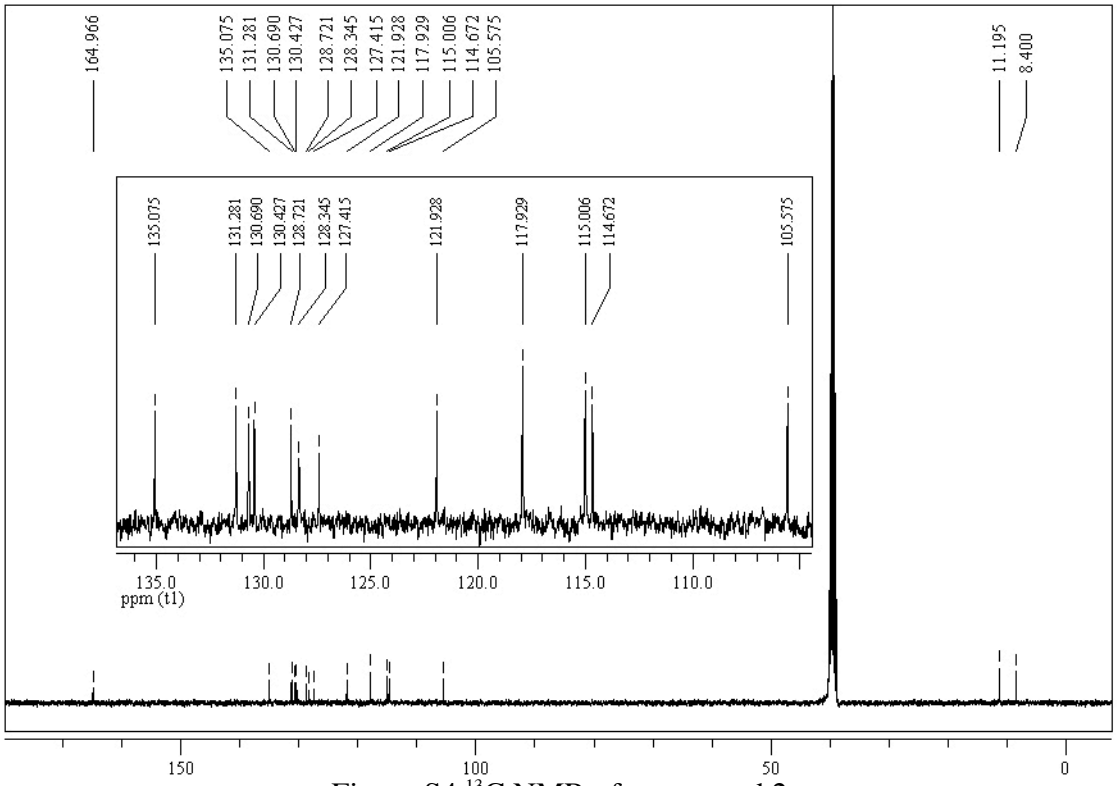


Figure S4 $^{13}$C NMR of compound 2

## Anion Binding Experiments

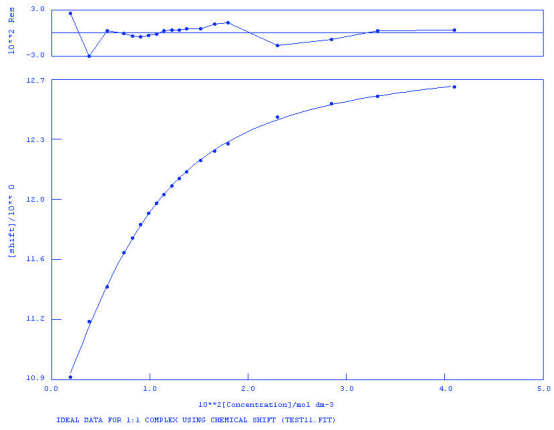


Figure S5 Fit plot for titration experiment of **1** with TBA acetate in DMSO/0.5% water

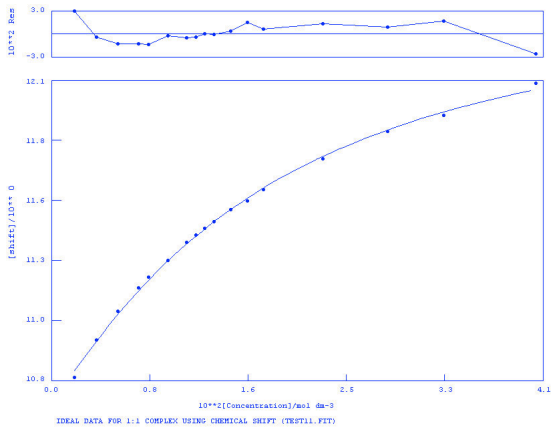


Figure S6 Fit plot for titration experiment of **1** with TBA dihydrogen phosphate in DMSO/0.5% water

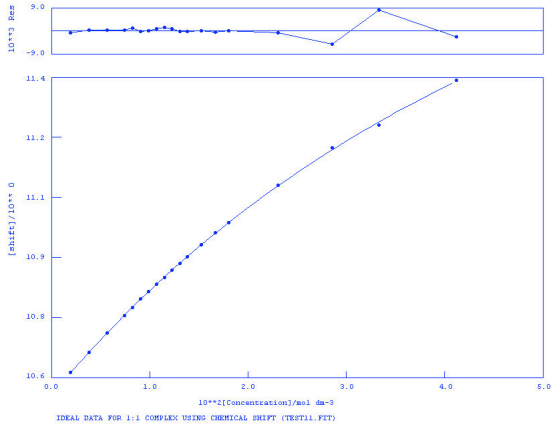


Figure S7 Fit plot for titration experiment of **1** with TBA benzoate in DMSO/0.5% water

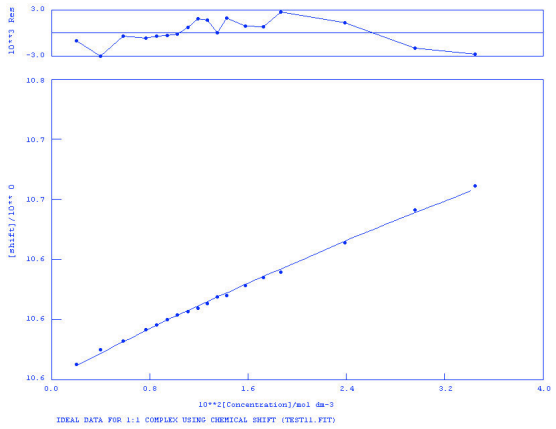


Figure S8 Fit plot for titration experiment of **1** with TBA chloride in DMSO/0.5% water

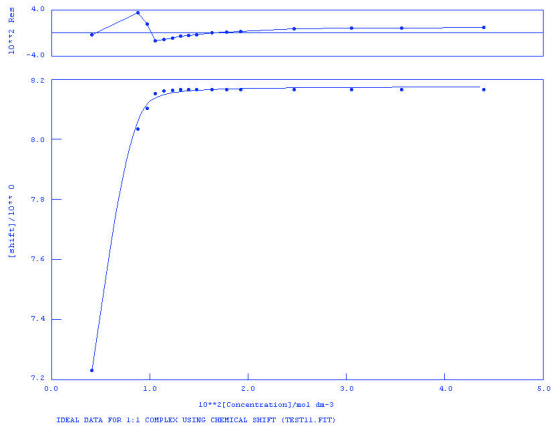


Figure S9 Fit plot for titration experiment of **1** with TBA fluoride in DMSO/0.5% water

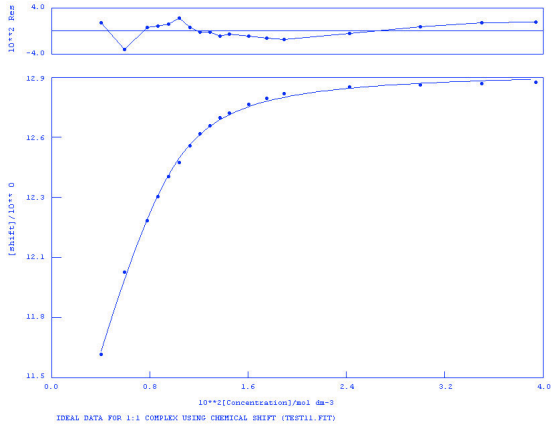


Figure S10 Fit plot for titration experiment of **1** with TBA fluoride/5% water

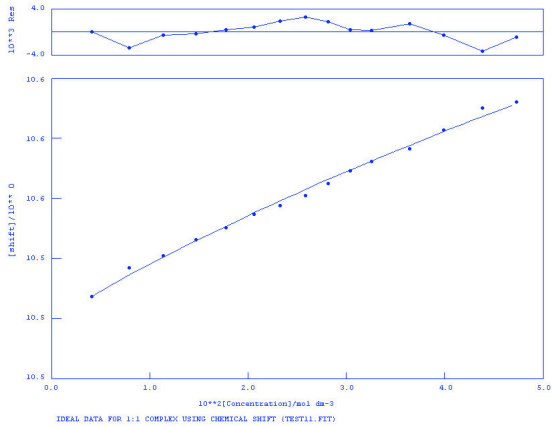


Figure S11 Fit plot for titration experiment of **1** with TBA chloride/5% water

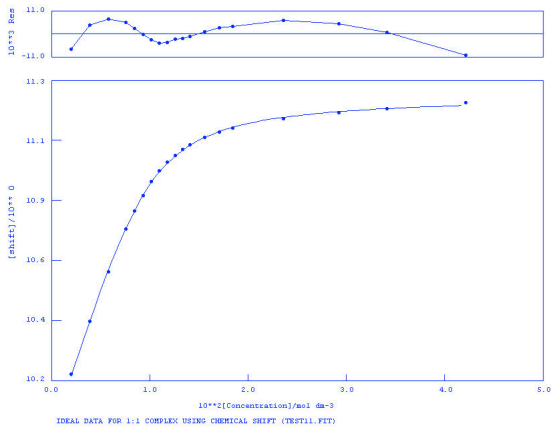


Figure S12 Fit plot for titration experiment of **2** with TBA acetate in DMSO/0.5% water

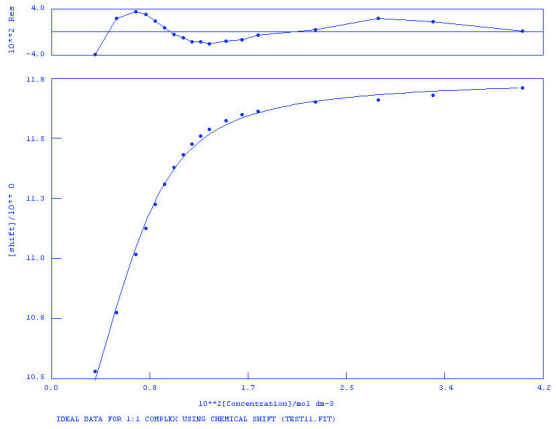


Figure S13 Fit plot for titration experiment of **2** with TBA dihydrogen phosphate in DMSO/0.5% water

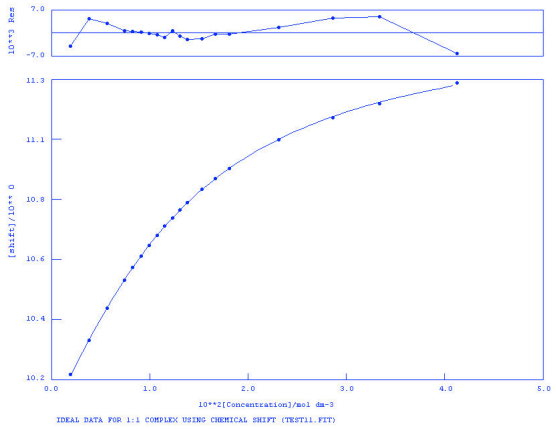


Figure S14 Fit plot for titration experiment of **2** with TBA benzoate in DMSO/0.5% water

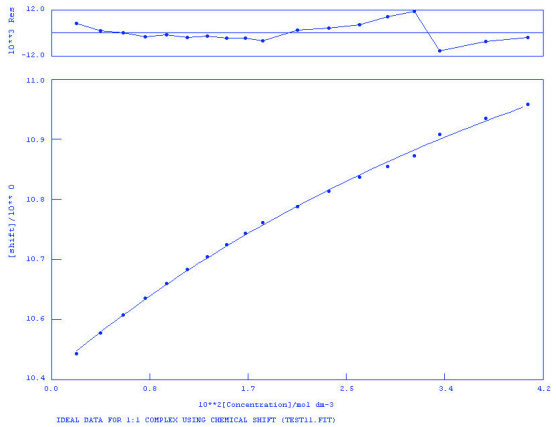


Figure S15 Fit plot for titration experiment of **2** with TBA chloride in DMSO/0.5% water

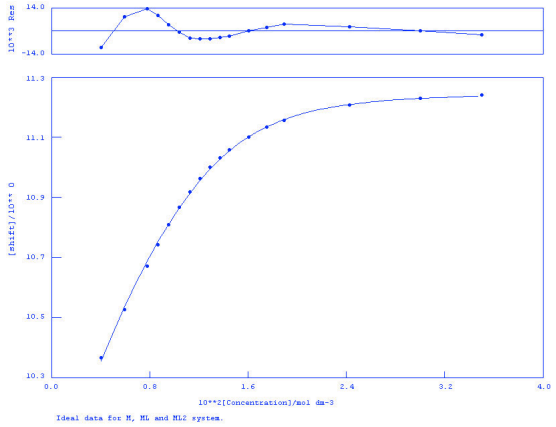


Figure S16 Fit plot for titration experiment of **2** with TBA fluoride/5% water

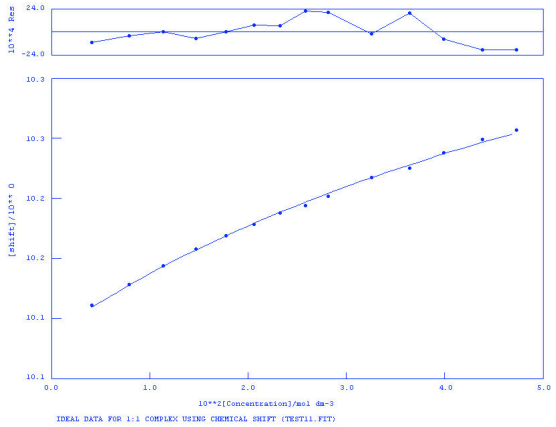


Figure S17 Fit plot for titration experiment of **2** with TBA chloride/5% water

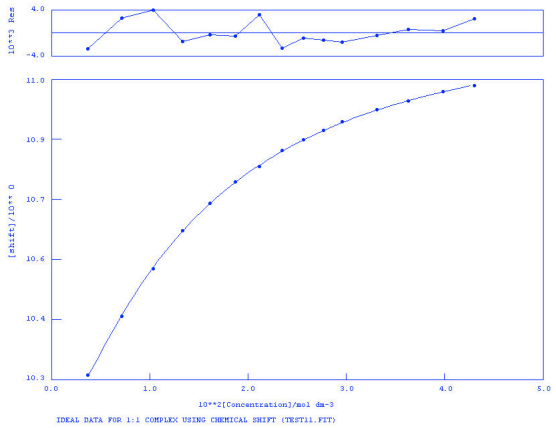


Figure S18 Fit plot for titration experiment of **2** with TBA acetate/5% water

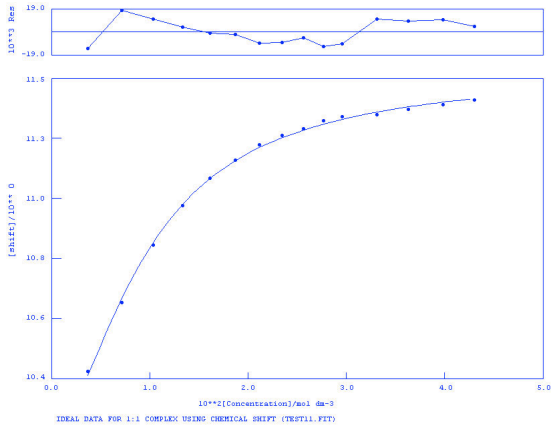


Figure S19 Fit plot for titration experiment of **2** with TBA dihydrogen phosphate/5% water

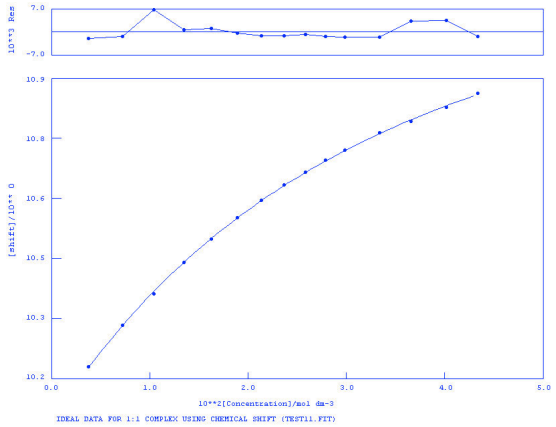


Figure S20 Fit plot for titration experiemnt of **2** with TBA benzoate/5% water

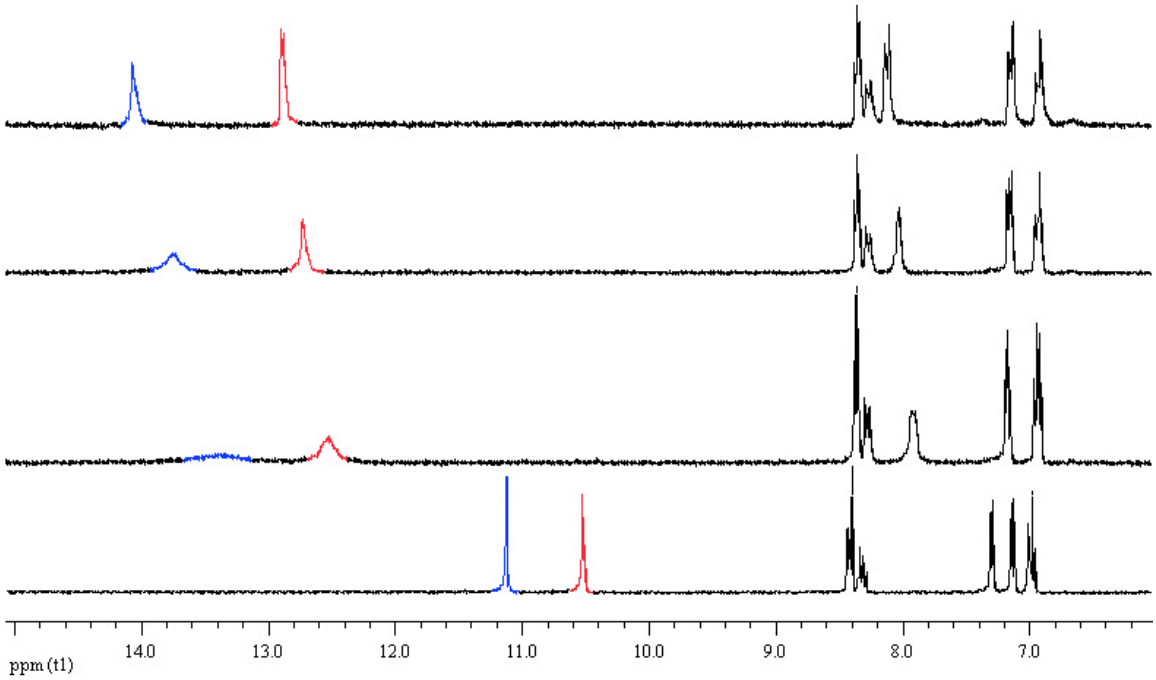


Figure S21 $^{1}$H NMR stack plot of compound **1** with increasing concentrations of TBAF in DMSO/5% water (from bottom – free ligand, 1 eq., 1.5 eq, 5 eq)..

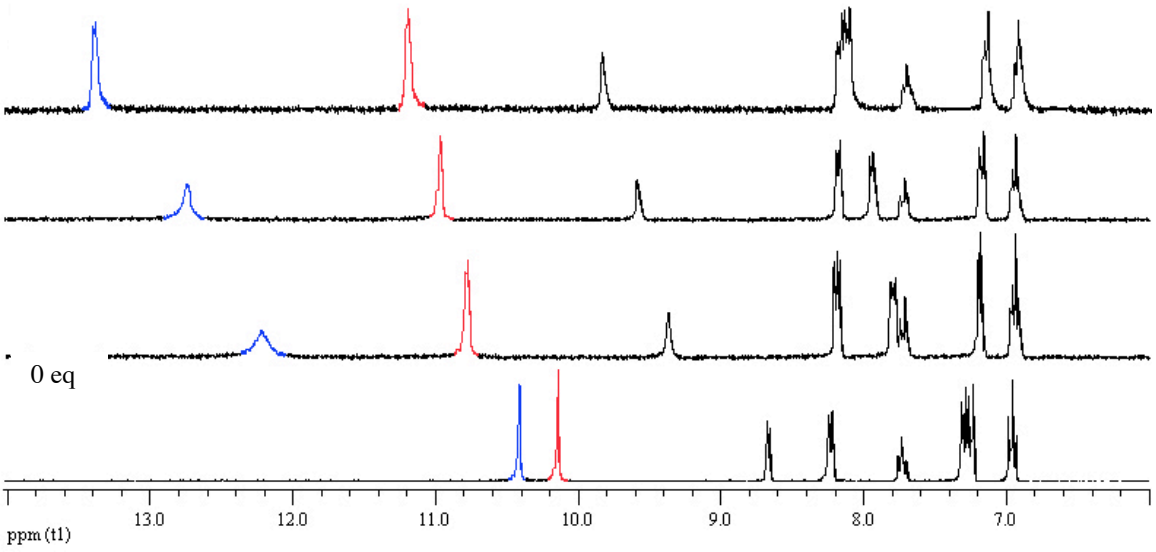


Figure S22 $^{1}$H NMR stack plot of compound **2** with increasing concentrations of TBAF in DMSO/5% water (from bottom – free ligand, 1 eq., 1.5 eq, 5 eq).

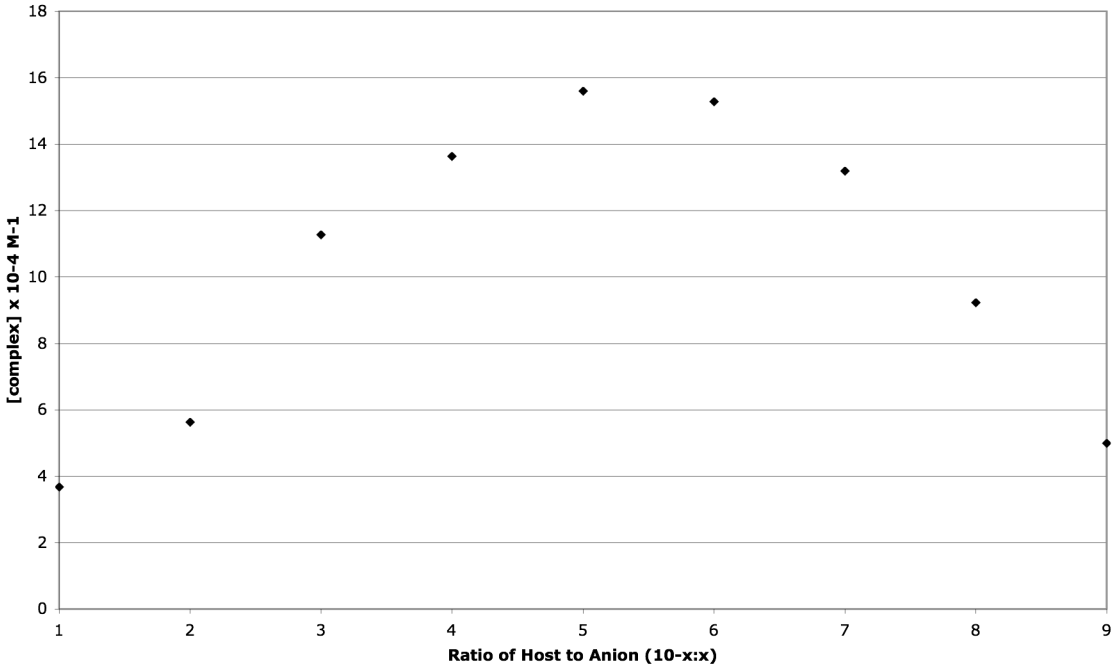


Figure S23 Job plot of Compound **2** with fluoride showing predominant 1:1 binding in DMSO-$d_6$/0.5% water

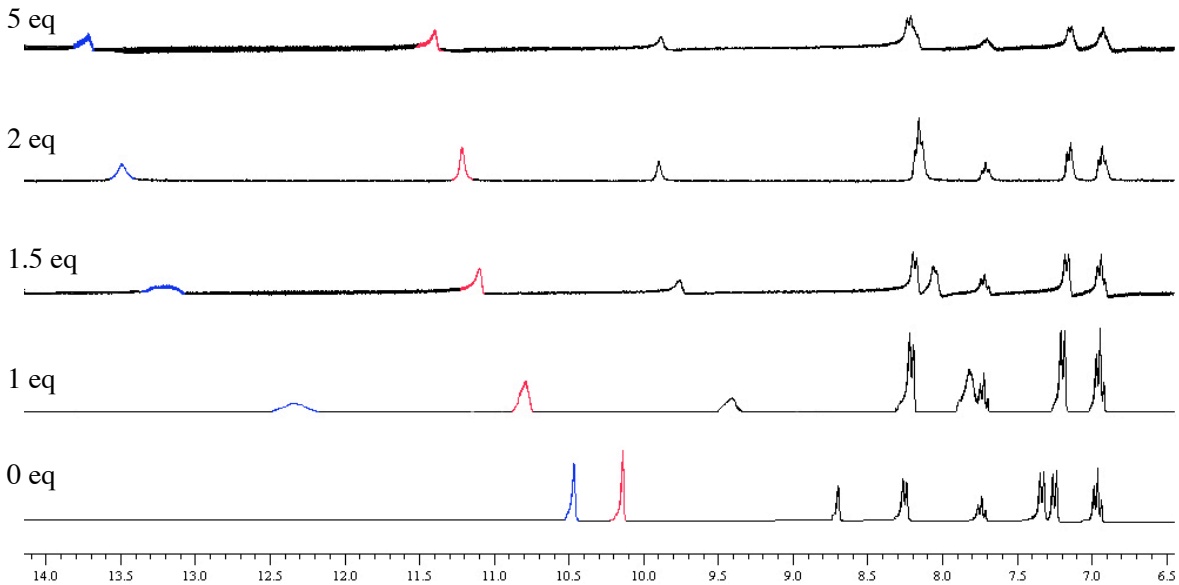


Figure S24 $^1$H NMR stack plot of compound **2** with increasing concentrations of TBAF in DMSO-$d_6$/ 0.5% water.

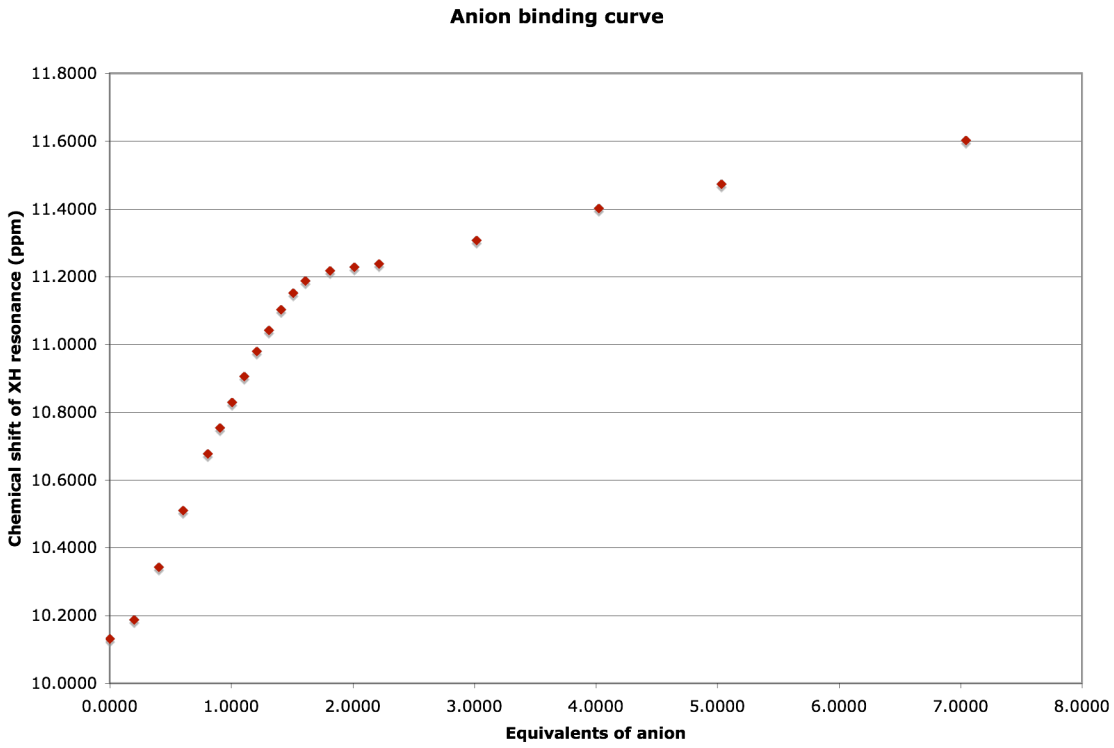


Figure S25 $^{1}$H NMR titration data plot of compound **2** with TBAF DMSO-$d_6$/ 0.5% water. Following amide NH (red proton on above spectra).

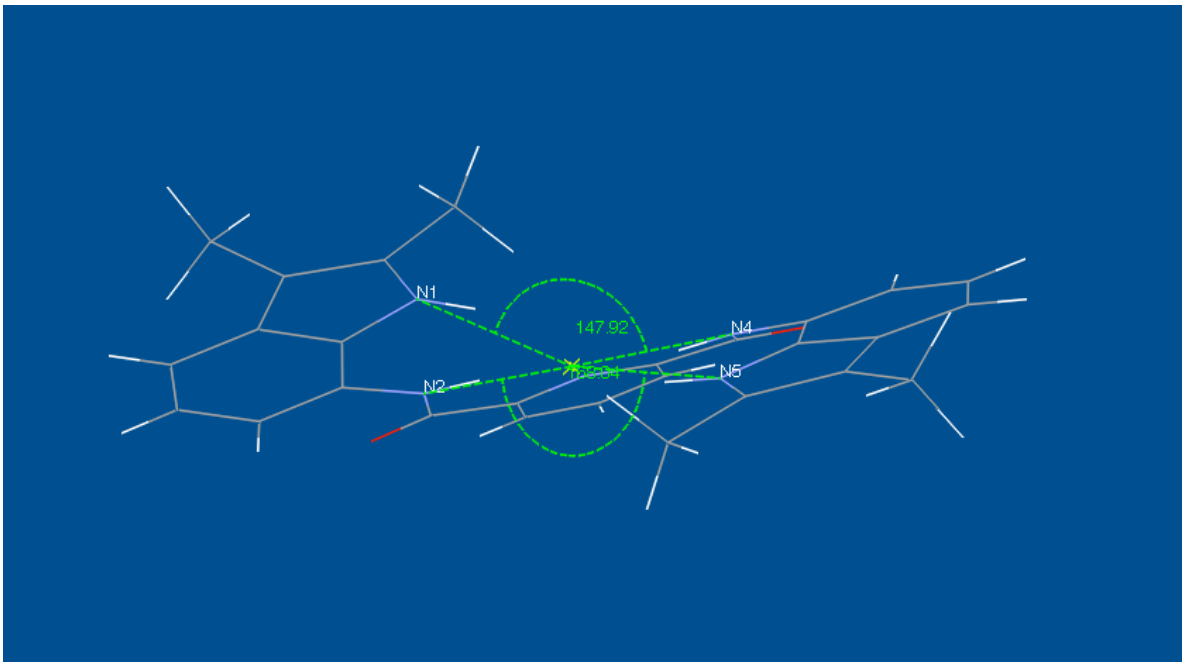


Figure S26 N···F···N angles in **1**-F$^-$

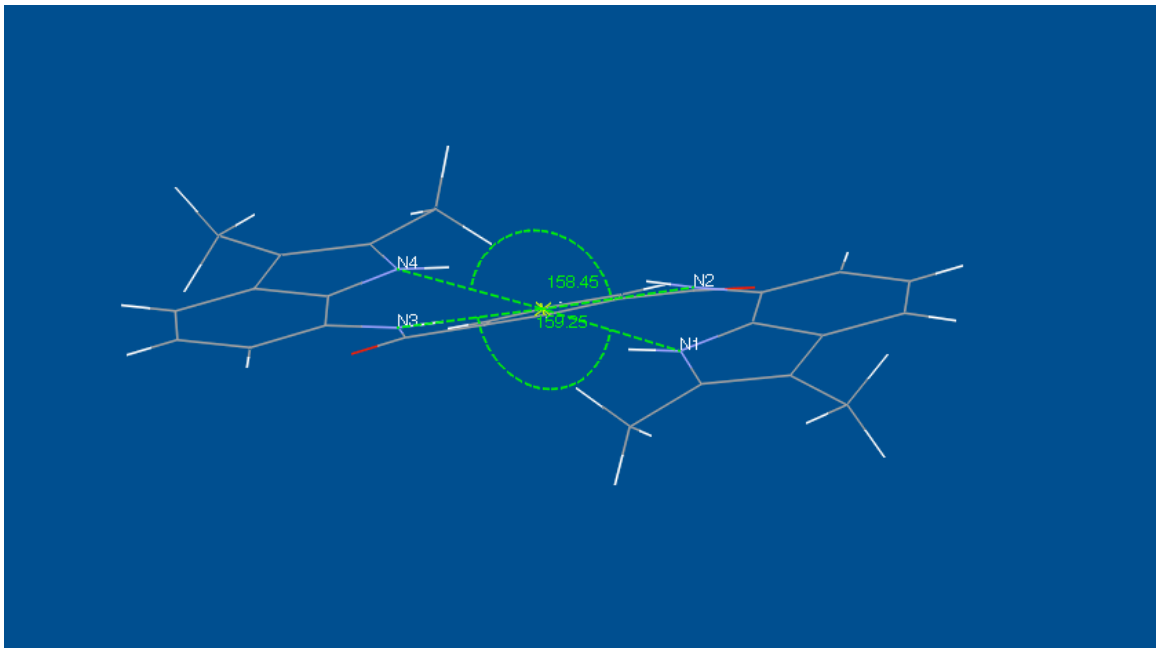


Figure S27 N···F···N angles in **2**-$F^-$