# Magic-Angle Spinning NMR, Crystallograpy and Pharmaceutical Polymorphism

**Robin K. Harris**

Department of Chemistry, University of Durham, South Road, Durham DH1 3LE, U.K.

Solid-state NMR is increasingly contributing to our knowledge of crystal structures, forming a new sub-discipline that might be called NMR crystallography. The present talk will concentrate on chemical shift effects, and will demonstrate how a combined approach of experimental MAS NMR spectra, powder XRD patterns and DFT calculations can yield new or improved crystallographic information. Specific examples will include:

(a) cortisone acetate, where NMR information (from $^{13}C$ chemical shifts) on intermolecular hydrogen bonding can be used as a restraint in the algorithm for solving crystal structures from powder XRD data so as to increase the efficiency of the process;

(b) methylnitroacetanilide (MNA), for which high-speed MAS NMR determination of proton chemical shifts for hydrogen bonds, combined with density functional theory computations, can locate the hydrogen atom more effectively than single-crystal XRD work has done hitherto. The figure below shows the computed plot of shielding vs. N-H bond length for the white form of MNA. From this, the observed shift, converted to shielding, gives the N-H distance as 1.033 ;

(c) A range of local anaesthetic drugs such as oxybuprocain have been studied by MAS NMR. The results are discussed in relation to polymorphism and crystallography.