Physics Department Seminar

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NMR Across the Periodic Table: Observing "Invisible" Nuclides in Solid Materials

Recent developments in pulse sequences and NMR hardware have opened up many "exotic" nuclides in the periodic table to experimentation by solid-state NMR. Many of these nuclides are classified as unreceptive, and have been avoided by NMR spectroscopists and chemists in general, due to factors such as low Larmor frequencies, low natural abundances, inconveniently short or long relaxation times, etc. In addition, there are numerous systems in which these nuclides have extremely broad NMR patterns resulting from large anisotropic chemical shielding or quadrupolar interactions. Such nuclei have long been classified as "invisible", since their NMR spectra cannot be observed using standard NMR pulse sequences. In this lecture, I will show that there are several robust strategies one can apply to acquire high quality solid-state NMR spectra of a variety of nuclei, including 10B, 14N, 27Al, 35/37Cl, 47/49Ti, 59Co, 63/65Cu, 69/71Ga, 91Zr, 93Nb, 139La, 195Pt, and 209Bi. Ultra-wideline NMR spectra, when coupled with X-ray crystallography and ab initio methods, provide powerful probes of molecular structure in inorganic, organic and organometallic materials. New advances in dynamic nuclear polarization (DNP) NMR for the acquisition of ultra-wideline NMR spectra will also be discussed.