Application of NMR to Strongly Correlated Electron Systems

Masashi Takigawa[1]

[1]*Institute for Solid State Physics, University of Tokyo*

The purpose of this pedagogical talk is to illustrate in a systematic way how one can use NMR to detect phase transitions, structure of various ordered phases, and dynamics of strongly correlated electron systems. In the first part, I will start with simple symmetry principles which relate NMR spectra to the local site symmetry. Then I will describe how the change of NMR spectra (line splitting or broadening) across the phase transition can be analyzed to identify the broken symmetry and the structure of the order parameter. The examples include not only the ordinary magnetic ordering but ordering of charge, quadrupole, and even higher order electronic multipoles. This methodology based on the local symmetry is complementary and contrasting to the diffraction technique and particularly powerful when a single crystal is available.

In the second part, I will explain what one can learn about dynamics from the measurements of spin-lattice relaxation rate and spin-echo decay rate, taking examples from quantum spin systems and superconductors with strongly anharmonic phonons.