# Complementary use of neutron scattering and $\mu$SR for high-$T_c$ research

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In strongly correlated electron systems, magnetism often shows an inherent dual nature due to the energy and momentum dependences of the itinerancy of electrons which contribute to the magnetism. For microscopic study on such systems, complementary use of several probes with different energy and momentum scales are indispensable. In the case of high-$T_c$ cuprates, such dualities sometimes prohibit us from understanding the physics of high-$T_c$ cuprates, particularly the interplay between superconductivity and magnetism.

My talk is mainly focused on the novel magnetism and its interplay with superconductivity. Particularly, I would like to emphasize that neutron scattering (NS) and muon spin rotation/resonance (MS) have been providing complementary information on high-$T_c$ cuprates.

For example, the magnetic phase diagram of high-$T_c$ cuprates determined by NS was refined by MS. MS first discovered a magnetic order in the underdoped superconducting phase, and later, NS clarified that the spin order consists of a long period spin modulation with the Q-vector either parallel or diagonal direction to the Cu-O bonding. Then, MS discovered an interesting similarity of the phase diagram between La-based single layered cuprates and Y-based double layered cuprates. Based on the information on charge/spin stripes from NS combined with the observed field distribution by MS, a model simulation has been performed to clarify the detailed spatial shape of spin density modulation. Furthermore, due to the difference in time window between MS and NS we can understand the character of magnetic order of this system.

In addition to the review of these studies, I would like to discuss the remaining issues by presenting the recent data from NS and the possible complementary use of both techniques to solve these issues.