Spin liquid, Mott transition and BEC-BCS crossover exhibited by interacting electrons on triangular lattices

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The interacting spins on geometrically frustrated lattices may exhibit non-trivial magnetic states called spin liquids. The triangular lattice is the representative of such stages.[1] In this symposium, after briefly reviewing the experimental status of the spin-liquid research, I focus on interacting electrons in organic materials with triangular lattices, which provided the first example of electronic spin liquid. I discuss anomalous spin excitations observed in a spin liquid[1] and their possible relevance to the peculiar Mott transition of the spin liquid.[2] Remarkably, an antiferromagnetic order in a less frustrated material, when X-ray irradiated, disappears and gapless spin excitations emerge.[3] Randomness appears to act for rather than against the emergence of the spin liquid. This issue will be theoretically discussed by Kawamura in this symposium. I also talk about a triangular-lattice material, in which a half-filled band is 11% hole doped. Spin susceptibility is nearly perfectly scaled to that of a non-doped spin liquid insulator in spite of a metallic sttae, indicating the realization of a doped spin liquid.[4] This material undergoes superconductivity, which shows a pressure-induced BEC-BCS crossover. The work presented here was performed in collaboration with T. Furukawa, H. Oike, J. Ibuka, M. Urai, Y. Suzuki, Y. Seki, K. Miyagawa, Y. Shimizu, M. Ito, H. Taniguchi and R. Kato, M. Saito, S. Iguchi and T. Sasaki.

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