Colloquium on Solid-State Physics

Department of Physics
SS 2024

Thursday, 20th June 2024, 17.15 h
Lecture Hall III, Department of Physics, Garching

Emergent states of interacting electrons in triangular-lattice organics: quantum spin liquid, charge glass, and unconventional superconductivity

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Abstract:
Coulomb interactions among electrons have huge impacts on their behavior through competition of charge localization/delocalization and spin order/disorder. Layered organic compounds host flexible lattice geometries and appreciable Coulomb interactions, both of which are varied by pressure or chemical substitution to display diverse emergent phenomena like a showcase of correlation physics. In this colloquium, I review a variety of electron correlation-derived phenomena that show up on the molecular triangular lattices, which exert geometrical frustration on the spins and charges of interacting electrons. These include quantum-critical Mott metal-insulator transition [1], quantum spin liquid [2], BEC-like superconductivity in a doped spin liquid [3], charge glass [4], and massless Dirac electrons with dynamic mass generation [5]. Some of these phenomena have links to soft-matter physics and particle physics beyond the conventional discipline of solid-state physics.

[1] F. Kagawa *et al*., *Nature* **436**, 03806 (2005): T. Furukawa *et al*., *Nat. Phys*. **11**, 221 (2015).
[2] Y. Shimizu *et al*., *Phys. Rev. Lett.* **91**, 107001 (2003): Y. Zhou *et al.*, *Rev. Mod. Phys***. 89**, 025003 (2017).
[3] Y. Suzuki *et al*, *Phys. Rev*. X **12**, 011016 (2022): H. Oike *et al*., *J. Phys. Soc. Jpn*. **93**, 042001 (2024).
[4] F. Kagawa *et al.*, *Nat. Phys*. **9**, 419 (2013): T. Sato *et al*., *Science* **357**, 1378 (2017): H. Murase *et al.*, *Nat. Commun.* **14**, 6011 (2023): H. Murase *et al.*, arXiv:2205.10795.
[5] M. Hirata *et al*., *Nat. Commun*. **7,** 12666 (2016): *Science* **358**, 1403 (2017): *Rep. Prog. Phys.* **84**, 036502 (2021).

There will be coffee, tea, and cookies in front of the lecture hall at 17.00 h

gez:
Mark Kartsovnik (Host)