SFB/TRR 21 - Seminar
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Exotic phases in organics: spin liquid, superconductivity and massless Dirac fermions

Organic conductors seem to have complicated structure in real space, but the electronic structure is quite simple in k-space because the band structure is well described by tight-binding picture of “molecular orbital”; no need to look into the interior of the molecular orbital. A series of layered conductors, $(ET)_2X$, have various arrangements of ET molecules in the two-dimensional layer, where monovalent anion X^{-1} with closed shell gives a half of hole to ET on average. Depending on the molecular arrangement, one can enjoy different kinds of physics. In this seminar, I will pick up two types of molecular arrangements.
The first case is dimeric arrangements where ET’s form strong dimers in the layer. As a dimer $(ET)_2$ is regarded as a single site accommodating a hole, the band turns out to be half-filled. Under electron correlation, this serves as a model system for Mott physics. Actually, by tuning electron correlation with pressure, the Mott transition from correlation-induced insulator to superconductor is observed. In case that the lattice of $(ET)_2$ is triangular, the issue of spin frustration comes into the physics of this material. I show that spin ordering, spin liquid and superconductivity with and without pseudo-gap are emergent under variation of lattice geometry and electron correlation.
The second one is non-dimeric arrangements with quarter-filled band nature. In particular, a molecular lattice called type is attractive in that it gives a cone-like band dispersion (Dirac cone) as in graphene. However, this system is distinctive in that i) the cone is tilted in *k*-space, ii) a charge-ordered phase resides nearby, and iii) NMR experiments are available owing to the bulky nature of the system. We performed NMR study on this tilted-cone system with strong electron correlations and found i) a reshape of the Dirac cone very probably electron correlation, ii) anomalous Landau quantization and its spin splitting under perpendicular magnetic fields, and iii) a signature for novel symmetry-breaking at high magnetic fields.

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