UNIVERSITÄT DUISBURG ESSEN

Offen im Denken

Theorie-Kolloquium WS 2024/25
Fr 20.12.2024, 14:00-15:30
MC 351 & online (URL in E-Mail)

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Quantum Metal-Organic Frameworks and Correlated Superconductivity

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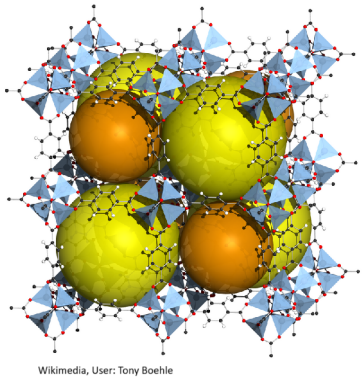

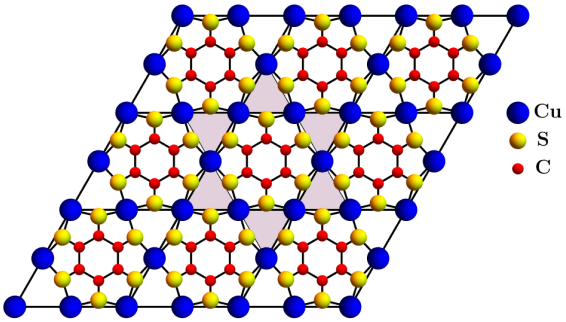

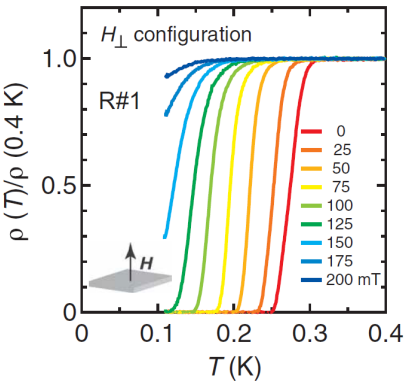

Metal-Organic Frameworks (MOFs) are composed of metallic clusters linked by organic ligands. While MOFs are often discussed in terms of their use in chemistry applications, the emerging field of Quantum MOFs explores their potential as quantum materials [1]. Unlike conventional quantum materials, whose properties rely on charge, spin, orbital, and lattice, MOFs introduce unique degrees of freedom, including molecular buckling, torsion, rotation, and interpenetration, which can be tailored via supramolecular chemistry.

One possible quantum effect is superconductivity, which has been observed in the two-dimensional MOF Cu-BHT and is governed by its strong electronic correlations [2]. The problem of correlated electrons, as captured by the Hubbard model, is notorious for its analytical intractability. One promising approach involves the use of exactly solvable models, such as the Hatsugai-Kohmoto (HK) model [3]. Recent work has demonstrated that the HK model is the minimal model that breaks the particle-hole symmetry of a Fermi liquid and falls within the same universality class as the Hubbard model [4]. This makes it an ideal framework for studying the universal properties of correlated systems, including correlated superconductors. This step was performed in [5] for an s-wave spin singlet pairing. We extend these results to more complicated pairing symmetries, such that the more refined electronic structure of MOFs can be taken into account.

[1] Z. Huang and M. Geilhufe, Small Sci. 4 2400161 (2024)
[2] T. Takenaka et al., Sci. Adv. 7 12 eabf3996 (2021)
[3] Y. Hatsugai and M. Kohmoto, J. Phys. Soc. Japan 61 6 2056 (1992)
[4] E. Huang et al., Nat. Phys. 18 5 511 (2022)
[5] P. Phillips et al., Nat. Phys. 16 12 1175 (2020)