Michael Lang
(Goethe-University, Frankfurt (M), SFB/TRR 49, Germany)

Mott physics and quantum phase transitions in molecular solids

Solids, made up of molecular units containing open shell transition metal ions or stable organic π-radicals, provide flexible systems for exploring correlated electrons and spins under well-controlled conditions. In the course of an interdisciplinary research program performed within the SFB/TR 49, Frankfurt-Kaiserslautern-Mainz, a variety of molecule-based materials has been synthesized and investigated in detail.
One focus of the investigations lies on the quasi-twodimensional molecular metals of the κ-(BEDT-TTF)$_2$X family, where transitions between various states such as Mott-insulating, anomalous metallic and superconducting can be induced by small variations of chemical (substitution) or physical (pressure, temperature) parameters. The ability to fine-tune the materials' electronic parameters, i.e., the strength of the on-site Coulomb repulsion relative to the band width, enables one to explore fundamental aspects of strongly correlated electrons in reduced dimensions. In this talk I will address the Mott transition in BEDT-TTF-based materials, the question of its criticality [1, 2] and the recently observed multiferroic properties on the insulating side of the transition [3].
A second class of materials is formed by low-dimensional quantum magnets where the molecular components provide a magnetic exchange coupling, weak enough for laboratory magnets to tune the systems close to a field-induced quantum-critical point – a T = 0 phase transition. Here I will address the anomalous magnetocaloric effect observed in a Cu^{2+}-containing coordination polymer, a very good realization of a spin-1/2 antiferromagnetic Heisenberg chain. In a proof-of-principle demonstration it has been shown that the accumulation of entropy around a quantum phase transition can be used for realizing a very efficient and flexible magnetic cooling [4].

[1] M. de Souza et al, Phys. Rev. Lett. 99, 037003 (2007)
[2] L. Bartosch et al., Phys. Rev. Lett. 104, 245701 (2010)
[3] P. Lunkenheimer et al., Nat. Mater. 11, 755 (2012)
[4] B. Wolf et al., PNAS 108, 6862 (2011)

2. November 2012, 14:00 Uhr

Universität Stuttgart, Raum 2.136
Pfaffenwaldring 57, 70569 Stuttgart

CO.CO.MAT