

Organic metals at the verge of the Mott insulating state explored by magnetic quantum oscillations

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The organic charge-transfer salts κ -(BEDT-TTF)₂X have since long been serving as a perfect versatile platform for exploring the bandwidth-controlled Mott metal-insulator transition (MIT) and related fascinating phenomena such as conventional and exotic charge- and spin-ordered state, quantum spin liquids, unconventional superconductivity, etc. For understanding the nature of the eventual ground state, a thorough knowledge of the underlying normal metallic state is pivotal. However, there are still significant blank spots in our vision of the charge carriers evolving in the immediate proximity to the MIT. For example, until very recently, there has been no systematic experimental information on the key parameters relevant to the insulating instability—the electronic correlation strength and spin frustration—in different κ -salts and on their response to pressure or to chemical pressure (i.e. tiny isoelectronic chemical changes). Moreover, it was even unclear to what extent the large coherent Fermi surface persists on the verge of the MIT.

In this talk, I will demonstrate the power of magnetoresistance quantum oscillations in elucidating these issues. We use the oscillations not only for proving the stability of a large Fermi surface till the very border of the insulating state but also for evaluating the electronic correlation strength and spin frustration. I will present data on several prominent members of the κ -salt family driven through the phase diagram by precisely controlled hydrostatic pressure. The experiment allows us to disentangle different mechanisms lying behind pressure- and chemical-pressure-induced tuning of the electronic ground state in the κ -salts. Furthermore, it provides a critical quantitative test for theoretical predictions concerning the evolution of the conduction system near the bandwidth-controlled MIT.

The results presented in the talk were obtained in collaboration with S. Erkenov, S. Oberbauer, W. Biberacher, T. Helm, J. Sourd, J. Wosnitzer, I. Sheikin, F. L. Pratt, N. D. Kushch, H. Müller, A. Pustogow, and A. Kawamoto. The work was supported by the German Research Foundation (DFG) via Grant No. KA 1652/5-1 and by HLD at HZDR and LNCMI-CNRS, members of the European Magnetic Field Laboratory (EMFL).