physikalisches Kolloquium

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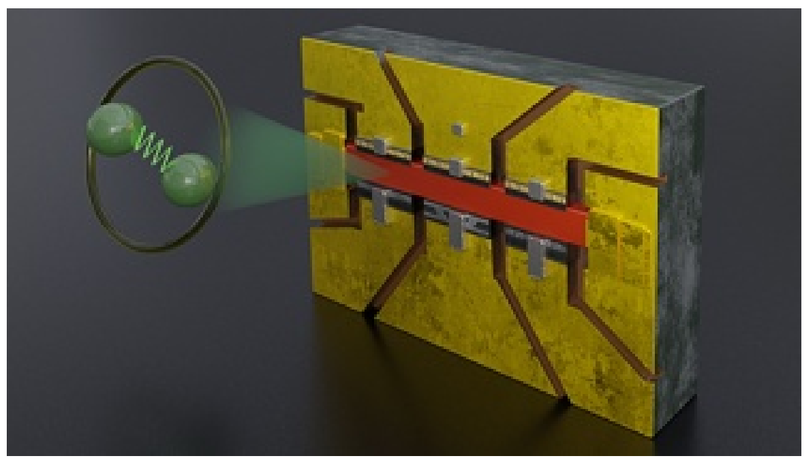
Superconductivity under Extreme Conditions

Mo. 17.11.25
16:00 Uhr
Ort: H34

High magnetic fields and superconductivity are usually incompatible. The magnetic field favors parallel electron spins, while superconductivity requires Cooper pairs with antiparallel spins. There exist, however, some superconductors, in which superconductivity survives to extraordinary high magnetic fields as we found in studies using static and pulsed magnetic fields up to 70 T provided at the Dresden High Magnetic Field Laboratory.

As a first example, I will present our robust evidence for the existence of the so-called Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) state in quasi-two-dimensional organic superconductors. Besides specific-heat and magnetization results, NMR studies give strong microscopic evidence for the realization of the FFLO state. A one-dimensional sinusoidal order-parameter modulation can favorably explain the NMR spectra in this high-field low-temperature phase. I will further discuss the recently discovered heavy-fermion superconductor UTe_2. This material shows multiple unconventional superconducting phases under field and pressure with unusually large upper critical fields. For certain field orientations, superconductivity even reappears at very high fields and survives to a record-breaking upper critical field of about 73 T. The Jaccarino-Peter effect is a likely mechanism for the appearance of this reentrant superconductivity.



Sketch of a microstructured superconducting sample (red) prepared for electrical-transport measurements. Electrons (green spheres) couple in pairs via vibrational or magnetic fluctuations (Picture: B. Schröder/HZDR).