TECHNISCHE UNIVERSITÄT DRESDEN

Institut für Festkörper- und Materialphysik

IFMP Institut für Festkörper- & Materialphysik

IFMP Seminar

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BigBlueButton: https://bbb.tu-dresden.de/b/dar-mbs-me8-gsc

Speaker **Jianfeng Ge**
MPI-CPfS

Title **Imaging putative Majorana modes and quasiparticle poisoning in superconducting vortices**

Abstract For a superconductor in the vortex state, quasiparticles can localize as bound states in the vortex cores where the superconducting order parameter vanishes, but they can also escape the cores. Understanding localized quasiparticles, such as distinguishing between Majorana and trivial vortex bound states, is one of the prime tasks in quantum condensed matter physics, since Majorana bound states are predicted as promising candidates for error-resistant qubits. On the other hand, tracing the delocalized quasiparticles is crucial in minimizing quasiparticle poisoning of Majorana bound states for qubit applications. Local shot noise measurements have been suggested to distinguish different vortex bound states, and more generally, as a probe into vortex physics, but despite much theoretical work, no local measurement of the shot noise of a vortex core exists.

In this talk, I will show the first local shot-noise spectroscopy to study the tunneling process into the vortex cores of both a conventional superconductor $NbSe_2$ and the putative Majorana platform $FeTe_{0.55}Se_{0.45}$. We find that tunneling into vortex bound states in both cases exhibit charge transfer of a single electron charge. Our data for the zero-energy bound states in $FeTe_{0.55}Se_{0.45}$ excludes the possibility of Yu-Shiba-Rusinov states and is consistent with Majorana bound states. However, it is also consistent with trivial vortex bound states. As a step further, we visualized, for the first time, the delocalized quasiparticles around vortices in $NbSe_2$ by shot-noise imaging. We find that quasiparticle poisoning dominates when vortices are less than 4 times the coherence length apart. Our results set a new length scale for quasiparticle poisoning in vortex-based Majorana qubits and yield information on the effect of vortices in quantum circuits.

Host: D. Peets