IQST

IQST Colloquium by Prof. Ioan Pop

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Quantum coherent superconducting vortices

Abstract:

While superconductors generally aim to expel magnetic fields, some can still penetrate in the form of quantized vortices. These vortices are usually regarded as classical, dissipative objects, detrimental in applications ranging from high-current-density wires to quantum devices.

In this talk I will show that disorder and nanoscale granularity can fundamentally change their behavior, allowing vortices to become coherent quantum objects.

Using the tools of circuit quantum electrodynamics, we demonstrate coherent control and quantum non-demolition readout of individual vortex states in granular aluminum superconductors.

I will present evidence that these vortices behave as quantum two-level systems, exhibiting microsecond coherence and energy relaxation times approaching a millisecond [1]. These results open exciting opportunities for quantum information processing, materials characterization, and sensing.

[1] Nambisan et al. Nature 653, 63-67 (2026)