

Quantum Phase transition in proximity induced superconducting Palladium/WTe₂ junction

Richa Mitra¹

Kuldeep Kuldeep¹, LD Varma Sangani, AA Zyuzin, Takashi Taniguchi, Kenji Watanabe, Pertti Hakonen, Manohar Kumar

Applied Physics Department, Aalto University, Espoo, Finland

richa.mitra@aalto.fi

Abstract

In 2D superconductors, the transition to the superconducting state is heavily influenced by quantum fluctuations and reduced dimensionality. The metallic phase transition can undergo quantum phase transitions driven by factors like magnetic field or temperature. These transitions involve changes in the ground state due to quantum fluctuations, offering valuable insights into the nature of 2D superconductivity.

Quantum Griffiths singularity (QGS) [1] is a fascinating phenomenon arising from the interplay between disorder and quantum fluctuations near a quantum critical point (QCP). QGS reveals the effect of quenched disorder with rare superconducting regions which support a vortex-glass-like phase near the phase boundary of the QCP.

We report the first observation of a magnetic field driven superconductor-metal transition (SMT) in a PdTe_x superconductor embedded in a WTe₂/Pd junction. Palladium (Pd), which is a normal metal, diffuses laterally within tungsten ditelluride to form intercalated PdTe_x, a superconducting compound [2]. Utilizing scaling analysis [1,3], we show that, the dynamical critical exponent diverges near the characteristic magnetic field $B_c^* = 7.8\text{T}$ in agreement with an infinite randomness critical point. Our $R(B,T)$ data also yields information on the nature of the anomalous

metallic state of inhomogeneous PdTe_x superconductor.

References

- [1] Xing, Ying, et al. *Science* 350.6260 (2015): 542-545.
- [2] Endres, Martin, et al. *Physical Review Materials* 6.8 (2022): L081201.
- [3] Liu, Yi, et al. *Physical Review Letters* 127.13 (2021): 137001.

Figures

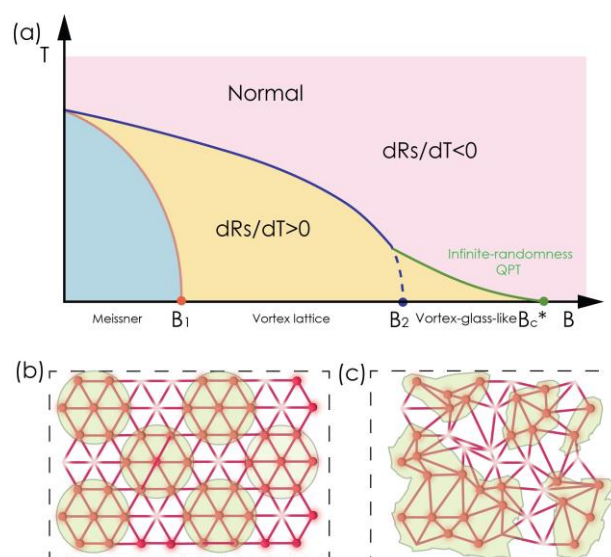


Figure 1: (a) Sketch of B-T phase diagram of demonstrating SMT in 2D superconductor with quenched disorder. Pictorial representation of the (b) vortex-lattice phase, (c) vortex-glass-like phase in such SMT phase transition.