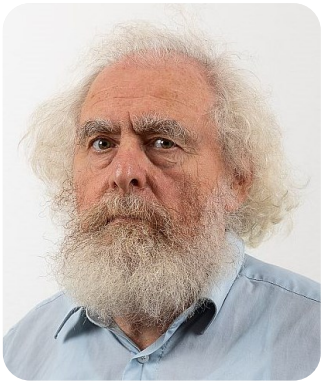
Sonderforschungsbereich 1277

Emergent Relativistic Effects in Condensed Matter -
From Fundamental Aspects to Electronic Functionality

SFB – Colloquium



Speaker: **Prof. Dr. Mikhail V. Feigel'man**
Nanocenter CENN, Ljubljana, Slovenia

Date: Tuesday, 28.05.2024, 14:15, H34

Topic: Mean-field theory of first-order quantum superconductor-insulator transition

Abstract:

Recent experimental studies of strongly disordered Indium Oxide films revealed an unusual first-order quantum phase transition between superconducting and insulating state (SIT), with the jump between nonzero and zero values of superfluid stiffness at the transition [1]. This finding is in sharp contradiction with a "scaling scenario" discussed usually in relation to SIT.

In the present talk I will make introduction to the subject and then propose a simple theory of this first-order transition. It is based upon an idea of competition between two intrinsically different ground states that can be formed by initially localized (due to strong disorder) electron pairs: superconducting state and Coulomb glass insulator. These two ground states are characterized by two crucially different order parameters, thus it is natural to expect a discontinuous transition between them at $T = 0$. The transition happens when magnitudes ofsuperconducting gap Δ and Coulomb gap E_C are comparable. We also extend our analysis tolow nonzero temperatures and provide a mean-field "phase diagram" in the plane (T/Δ, E_C/Δ). Our results demonstrate the existence of a natural upper bound for the kinetic inductance of a strongly disordered superconductor.

[1] T. Charpentier, D. Perconte, S. Léger, K. R. Amin, F. Blondelle, F. Gay, O. Buisson, L. Ioffe, A. Khvalyuk, I. Poboiko, M. Feigel'man, N. Roch, and B. Sacépé, *First-order quantum breakdown of superconductivity in amorphous superconductors*, arXiv:2404.09855 (2024)

Host: Prof. Dr. Ferdinand Evers and Prof. Dr. Christoph Strunk