ITS@THE GRADUATE CENTER

Initiative for the Theoretical Sciences

"Dynamic Vortex Mott Transition"

V. M. Vinokur (Argonne National Lab)

Hosts: Lia Krusin-Elbaum (CCNY) and Vadim Oganesyan (CSI)

"Grand synthesis" of the 1970s unified quantum field theory with the statistical theory of fluctuations near a second order phase transition into a single theoretical framework in which the expression for a quantum amplitude, the Feynman path integral, appeared as an analytic continuation of statistical summing up all possible random walks (i.e. representing Schrödinger equation as a diffusion equation with an imaginary time and a diffusion constant). In the 1990s this unity materialized in the context of vortex physics as mapping of superconducting vortices pinned by structural disorder onto two-dimensional disordered bosons and lead to emergence of so-called non-Hermitean quantum mechanics that enables including dissipative processes into a standard quantum mechanical framework. Here we discuss further realization of quantum mechanics – statistical physics mapping. Transport measurements on a square array of superconducting islands placed on a normal metal substrate reveal vortex Mott insulator and dynamic vortex Mott insulator-to-metal transition. We demonstrate dynamic scaling behaviour of differential resistivity near the Mott critical points as function of the applied current and magnetic field and establish that Mott dynamic transitions at integer and fractional filling factors belong in different universality classes. We demonstrate that it is the thermally activated vortex motion that governs the dynamic vortex Mott transition, thus completing the quantum-statistical physics mapping where classical thermally activated dynamics corresponds to quantum tunnelling. Finally, using quantum-statistical physics mapping, we derive critical exponents for the dynamic Mott transition at integer filling factors, which coincide with those of thermodynamic Mott transition provided the temperature in the latter is replaced by the applied current. This establishes an interconnection between the dynamic and thermodynamic phase transitions in an excellent accord with the expectations following from the out-of-equilibrium mean field considerations.

Time and date: 11:00 AM, Thursday, 2/27/2015
Location: rm. 5209, GC – CUNY, 365 5th Ave. NY
Questions: voganesyan@gc.cuny.edu ; website: www.gc.cuny.edu/its