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Type-II Bose-Mott insulators: vortex lines of quantized electric current

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Date: April 18 (Wed), 2018

Time: 16:00 – 17:20

Place: Room 525, Science Bldg. 5 (Physics), Kyoto University

Abstract:
In two spatial dimensions there is a well-established particle-vortex duality that describes the superconductor-to-insulator quantum phase transition in terms of the unbinding of vortices. Quantum mechanically, the vortices are bosonic particles that form a condensate, and the insulator is dual to a Ginzburg-Landau superconductor, such that current is expelled from the insulator as a dual Meissner effect.

We extend this to three spatial dimensions. Although the quantum phase transition itself requires a quantum field theory of vortex *lines*, the properties of the 3D Bose-Mott insulator can be easily understood by translating ordinary Ginzburg-Landau theory using a duality dictionary, where current corresponds to magnetic field and so forth. This gives rise to interesting predictions. In particular, the insulator should host vortex lines of quantized electric current, the dual of the Abrikosov vortex lattice.

This phenomenological theory applies to in strongly-correlated insulators of (preformed) Cooper pairs that are on the brink of becoming superconducting. I will also discuss some experimental configurations that could test these predictions.

Reference: A.J. Beekman, J. Zaanen. Phys. Rev. B. 86, 125129 (2012).

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