Condensed Matter Theory Center Seminar

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Friday, February 26
11:00 AM-12:30 PM
2202 Physics Building

“Strongly correlated Cooper pair insulators and superfluids”

Abstract

Strong pairing correlations are responsible for unconventional properties of various important systems, ranging from cuprate high-temperature superconductors to ultra-cold atoms. This talk will explore a number of phenomena associated with strong pairing, with a special emphasis on universal (system-independent) effects. Universality is controlled by a renormalization group fixed point which gives rise to "unitarity", the most correlated regime of fermionic particles with attractive interactions. One of the main questions is what unconventional normal states can be obtained when quantum fluctuations destroy the superfluid in this regime; is there something we can learn about the "pseudogap" of cuprates? We try to find answers in two contexts. First, we examine the phase diagram of two-dimensional superfluids with violated time-reversal symmetry, and discover a rich phase diagram of vortex lattice Fulde-Ferrell-Larkin-Ovchinnikov phases formed in the background of quantum Hall states. We also point out the unavoidable existence of strongly correlated insulators which could be characterized as vortex liquids. Second, the pairing instability in a time-reversal symmetric band-insulator is unconventional and leads to a special kind of supersolid dubbed "pair density wave". Quantum fluctuations can reshape this instability and possibly produce Mott insulators even in the limit of weak pairing.