Exact results for disordered systems/superfluids I:

Theorem of inclusions and the weak disorder limit.

I will review two exact results concerning the topology of groundstate phase diagrams for disordered systems and how they project on properties of superfluids. The theorem of inclusions implies that compressible insulating states always intervene between the fully gaped and conducting phases, or, that direct phase transitions between the Mott insulator and superfluid states are forbidden. Moreover, any transition between the fully gapped and gapless state has to be of the Griffiths type, with important implications for how such a transition should be addressed numerically and experimentally in finite-size systems. For weak disorder, one can use general arguments based on the central limit theorem to establish the shape of the superfluid-to-Bose glass phase boundary in the disorder-interaction plane.

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Exact results for disordered systems/superfluids II:

superfluid-to-Bose glass transition in 1D

I will start by showing that the Giamarchi-Shultz criterion $K=3/2$ for the localization transition in 1D superfluids (where K is the Luttinger liquid parameter) has the same status as the Nelson-Kosterlitz formula for finite-temperature 2D superfluids---it is exact for finite disorder strength. However, in strongly disordered 1d superfluids there exists an alternative universality class, scratched-XY. The new universality class is characterized by another universal relation $K=1/z>3/2$, where z is the microscopic exponent characterizing the exponentially rare-exponentially weak power-law distribution of effective Josephson junctions. The RG equations for the scratched-XY behavior are asymptotically exact.