Cooling a Band Insulator with a Metal: Fermionic Superfluid in a Dimerized Holographic Lattice

ARIJIT HALDAR, VIJAY B. SHENOY, Indian Institute of Science Bangalore — A cold atomic realization of a quantum correlated state of many fermions on a lattice, eg. superfluid, has eluded experimental realization due to the entropy problem. Here we propose a route to realize such a state using holographic lattice and confining potentials. The potentials are designed to produces a band insulating state (low heat capacity) at the trap center, and a metallic state (high heat capacity) at the periphery. The metal “cools” the central band insulator by extracting out the excess entropy. The central band insulator can be turned into a superfluid by tuning an attractive interaction between the fermions. Crucially, the holographic lattice allows the emergent superfluid to have a high transition temperature — even twice that of the effective trap temperature. The scheme provides a promising route to a laboratory realization of a fermionic lattice superfluid, even while being adaptable to simulate other many body states. Reference: Scientific Reports 4, 6665 (2014).

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