Bose metal as a bosonic topological insulator

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Transport measurements of the superconductor-insulator transition (SIT) in disordered two-dimensional films and Josephson junction arrays showed the existence of an anomalous metallic phase that persists to low temperatures. The nature of this mysterious phase, often referred to as "Bose metal," remains unclear. We develop a gauge theory of the Bose metal as the phase in which Cooper pairs and vortices are out of the Bose condensate due to strong quantum fluctuations and form an incompressible liquid of intertwined Aharonov-Bohm-Casher loops. As a result, the Bose metal emerges as an integer (Z) bosonic topological insulator in which bulk transport is suppressed by topological mutual statistics interactions, the Hall resistance vanishes, and longitudinal charge transport is mediated by U(1)-symmetry-protected gapless edge modes. The transport measurements in NbTiN films across the disorder- and magnetic field-driven SIT and observe a disorder and magnetic field–tuned transition from a true superconductor to a metallic phase with saturated longitudinal resistivity.

References

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