Chasing the Cooper Solid: Electrodynamics of the Superconductor Insulator Transitions

ABSTRACT

The complex AC conductivity of thin highly disordered InOx films was studied as a function of magnetic field through the nominal 2D superconductor-insulator transition. We have resolved a significant finite frequency superfluid stiffness well into the insulating regime, giving the first direct evidence for superconducting correlations in the insulating state of an amorphous film. A phase diagram is established that includes the superconducting state, a transition to a ‘Bose’ insulator and an eventual crossover to a ‘Fermi’ insulating state at high fields. We speculate on the consequences of these observations, their impact on our understanding of the insulating state and its relevance as a prototype for other insulating states of matter that derive from superconductors.