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Survival of superconducting correlations across the two-dimensional superconductor-insulator transition: A finite-frequency study

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The complex AC conductivity of thin amorphous InO 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 direct evidence for superconducting correlations in this insulating state. As these superconducting fluctuations are temperature independent at low temperatures, this also represents the first observations of quantum superconducting fluctuations around an insulating ground-state. 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.

[1] R. Crane et al. Phys Rev B 75, 094506 (2007)

[2] R. Crane et al. Phys Rev B 75, 184530 (2007)