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Incipient Superconductivity in Metallic and Insulating Phases of Indium Oxide Near the Superconductor-Insulator Transition[1]

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Disordered thin films of indium oxide undergo a magnetic field-tuned superconductor-to-insulator transition at low temperatures. Concentrating on the nature of the insulating phase, our study reveals a wide range of insulator strength above the transition field Hc, depending on the disorder. Isotherms of the resistivity cross at a temperature-independent transition, then peak at a higher field and decay slowly to very high magnetic fields. We suggest that at this peak the film crosses over from a boson-dominated insulating phase at lower fields to a Fermi-dominated insulating phase at higher fields, a result of an increased depairing rate which destroys the Bose-insulator. Despite the increased depairing rate, pairing susceptibility persists to the highest accessible fields, approximately 32T, as the normal state does not appear to be fully recovered and a vestige of superconductivity remains. The behaviour of the films in some regime of parameters is similar to reported behaviour of the high-temperature superconductor LaSrCuO, suggesting a common underlying mechanism. In particular, we suggest that upon increasing the magnetic field in the cuprate, a tendency towards a Bose-insulating phase appears before a true "normal state" is recovered at much higher fields. We shall explore the possibility that disordered films like InOx can be used as model systems for further study of high-Tc phenomena.

[1]in collaboration with Aharon Kapitulnik