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Disorder-Driven Superconductor-Insulator Transition in d-Wave Superconductors[1] YUN SONG, LONG HE, Department of Physics, Beijing Normal University — We study the superconductor-insulator transition (SIT) in d-wave superconductors. By means of the kernel polynomial method, the Bogoliubov-de Gennes equations are solved self-consistently, making it possible to observe fully the nanoscale spatial fluctuations of the superconducting order parameters. It is shown that Anderson localization can not entirely inhibit the occurrence of the local superconductivity in strongly-disordered d-wave superconductors. Separated by an insulating "sea" completely, a few isolated superconducting "islands" with significant enhancement of the local superconducting order parameters can survive across the SIT. The disorder-driven SIT, therefore, is a transition from a d-wave superconductor to a boson insulator which consists of localized Cooper pairs. Unlike an s-wave superconductor which presents a robust single-particle gap across the SIT, the optical conductivity of a d-wave superconductor reveals a gapless insulating phase, where the SIT can be detected by observing the disappearance of the Drude weight with the increasing disorder.

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