Current patterns and optical conductivity in disordered superconductors

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We study the disordered attractive Hubbard model by solving the BdG equations on two-dimensional finite clusters at zero temperature. By coupling the sample to an external field we find that the current density is strongly inhomogeneous, with almost one-dimensional patterns, in rough agreement with Ioffe and Mezard recent proposal of a low temperature glassy phase in disorder superconductors.

The optical conductivity besides the quasi-particle contribution shows an intra-gap absorption due to collective modes. These excitations are related to the phase of the superconducting (SC) order parameter and for clean systems they are optically inactive. Here we show that for strongly disordered superconductors the phase modes acquire a dipole moment and appear as a subgap spectral feature in the optical conductivity. In the strongly disordered regime, where the system displays an effective granularity of the SC properties, the optically active dipoles are linked to the isolated SC islands, offering a new perspective for microwave measurements and optical devices.

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