Crossover between Types I and II in Diffusive Superconductors: Perturbative Study

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A common feature of both single- and multiband superconductors is the presence of a crossover between conventional type I and type II superconductivity through an intertype (IT) domain in the magnetic response phase diagram. In diffusive single-band superconductors, this domain is extremely narrow due to scattering by nonmagnetic impurities. Recent work [1] has shown that in multiband superconductors the IT domain can significantly expand when the band diffusion coefficients differ substantially. In our research we demonstrate that this expansion is a general feature of diffusive multiband superconductors and is accompanied by a qualitative change in vortex-vortex interaction. This interaction shifts from the combination of short-range attraction and long-range repulsion, typical of diffusive single-band IT superconductors, to the inverse configuration of short-range repulsion and long-range attraction (see Fig.1). Strikingly, this latter behavior resembles the vortex interaction in clean IT superconductors. Consequently, a corresponding rearrangement of vortex configurations is expected – from the mixtures of Abrikosov and giant vortices, expected in diffusive single-band IT superconductors, to vortex chains and clusters, which are characteristic of vortex matter in clean IT superconducting materials [2].

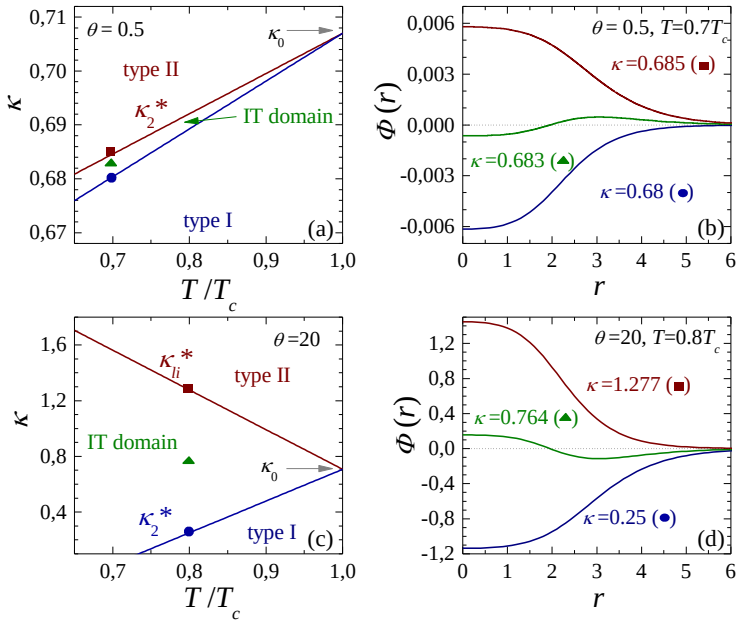

Fig. 1**:** The IT domain for a diffusive two-band system with the microscopic parameters of MgB_2. (a) and (c) The upper and lower boundaries of the IT domain for the ratio of the band diffusivities θ=0.5 and θ=20, correspondingly. (b) and (d) The vortex-vortex potential Φ(r) for the three points marked in panel (a) and (c) by the circle, triangle, and square, respectively.

Bibliography

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