

Gapful electrons in a vortex core in granular superconductors

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We calculate the quasiparticle density of states (DoS) inside the vortex core in a granular superconductor[1], generalizing the classical solution applicable for dirty superconductors [2]. A discrete version of the Usadel equation for a vortex is derived and solved numerically for a broad range of parameters. Electron DoS is found to be gapful when the vortex size ξ becomes comparable to the distance between neighboring grains l . Minigap magnitude E_g grows from zero at $\xi \approx 1.4l$ to third of superconducting gap Δ_0 at $\xi \approx 0.5l$. The absence of low-energy excitations explains strong suppression of microwave dissipation in a mixed state of granular Al observed recently [3].

[1] D. E. Kiselov, M. A. Skvortsov and M. V. Feigel'man, arXiv:2212.01862v1 (2022)

[2] R. J. Watts-Tobin and G. M. Waterworth, Z. Physik 261, 249 (1973).

[3] B. L. T. Plourde, invited talk at the International Workshop "Localization, Interactions and Superconductivity", Chernogolovka, Russia, June 30 – July 4, 2018.