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Local Density of States of Quasi-particles around a Vortex Core in a Square Superconducting Plate under Random Impurity Potentials

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For applications of superconductors, pinning of vortices is important. There are several kinds of pinning sites. A nanorod is one of examples of these pinning sites. On the other hand, there are superconductors such as amorphous superconductors where impurities uniformly distribute. In order to investigate behaviors of vortices in these superconductors into, we include the random impurity potential to the Bogoliubov-de Gennes (BdG) equation. We self-consistently solve this BdG equation for a square superconducting plate, using the Finite Element Method and obtain the order parameter $\Delta(\boldsymbol{r})$ and local density of states (LDOS) of quasi-particles. Examples of $\Delta(\boldsymbol{r})$ and LDOS are shown in Figs. 1 and 2. We find the deformation of a vortex and spatial variation of the LDOS from these figures.
In order to explain these results of the effect of impurity potential on the vortex core, we consider two simple impurity potentials, a Gaussian potential and a sinusoidal potential.
We solve the BdG equation with these two impurity potentials.
In this presentation, we will show $\Delta(\boldsymbol{r})$ and LDOS and *core radius of the vortex* under these impurity potentials.

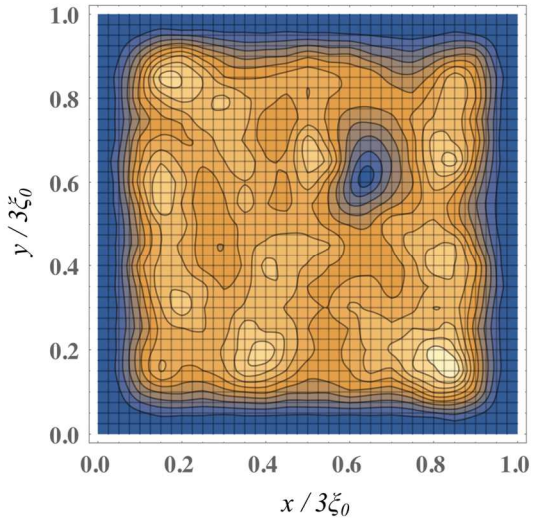

Fig. 1. $\Delta(\boldsymbol{r})$ in the case of $V_{impmax} / E_c = 0.5$

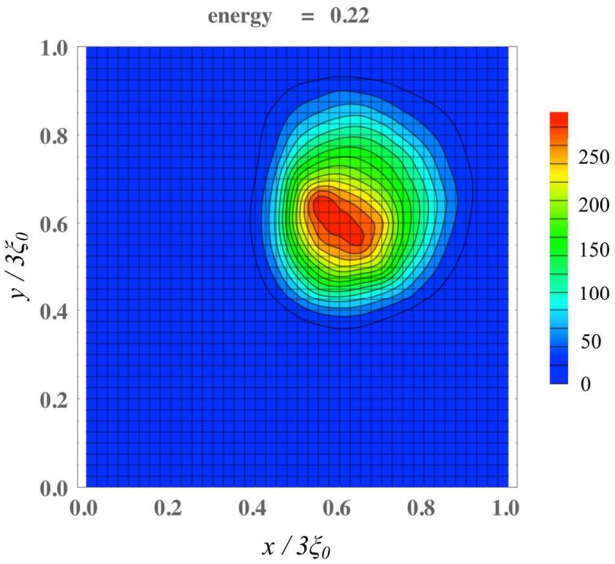

Fig. 2. LDOS in the case of $V_{impmax} / E_c = 0.5$

Keywords: Vortex, Bogoliubov-de Gennes equation, Local density of states, Finite element method