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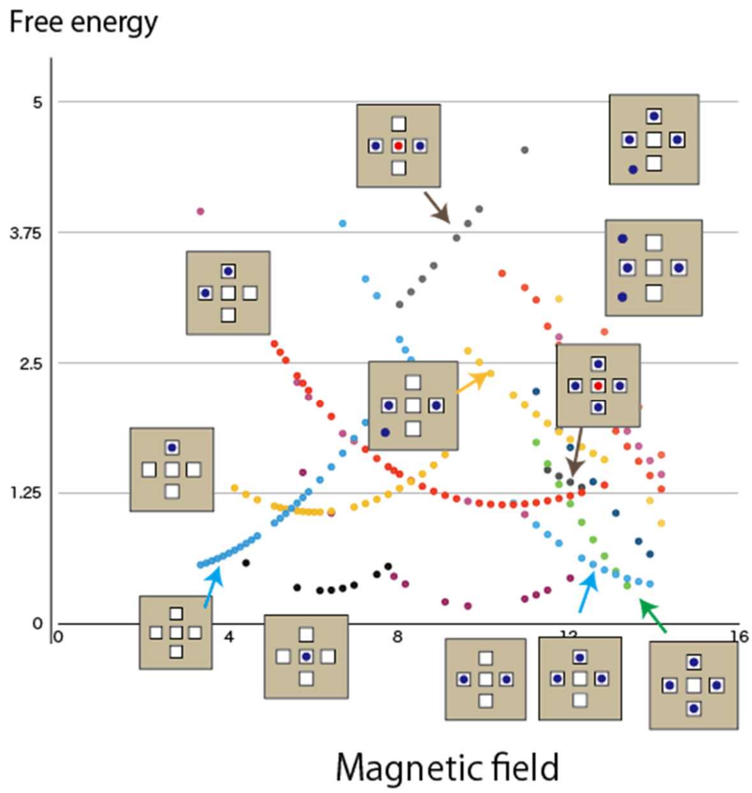
Peculiar vortex states in mesoscopic superconductors with antidots

*Osamu Sato[1], Masaru Kato[2]

Osaka Prefecture University College of Technology[1]
Osaka Prefecture University[2]

The vortex configurations in a mesoscopic superconducting square plate with antidots under uniform magnetic fields are obtained by solving the Ginzburg-Landau(GL) equation using the finite element method(FEM). In this study, dimensions of the samples are $30\xi_0 \times 30\xi_0$, where ξ_0 is the coherence length at zero temperature, and the Ginzburg Landau parameter and temperature set to $\kappa=10$ and $T=0.8T_c$ where T_c is the superconducting transition temperature. The sample has 5 antidots, one is located at the center of the sample, and the other four antidots are located away from the center point in the directions parallel to the four sides of the square sample. Generally, the GL equation has not only the most stable state solution but also metastable state solutions. In the most stable states in each magnetic field, the number of vortices that pass through the sample n increases monotonically as increasing the field H. The most stable states where n=3 is realized in very narrow field region, this is because the sample has four-fold rotational symmetry. It is predicted theoretically anti-vortex can appears in the most stable state near below transition temperature from the discussion of the symmetry. We found metastable states where anti-vortex appears in a certain magnetic field region even in rather low temperature condition.



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