## Simulation of Vortex Penetration into Square Superconducting Network

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The patterns of flux penetration into the superconducting anti-dot arrays and networks depend mainly on the geometry of the samples, as well as on temperature, current, and magnetic field. The motion of vortices is described by the vortex channeling model in which the vortices can move only along the direction between nearest anti-dots. However, anomalous mesoscopic flux penetration patterns appear in the square superconducting networks with a relatively large scale of periodic length. The patterns are enhanced along the diagonal direction of square lattice when the networks have a smaller line width than the holes[1]. Nakai *et al.* have reproduced the anomalous flux penetrations by the TDGL simulation[2]. Though the phenomenon is confirmed experimentally and theoretically, its origin remains an open issue, To clarify the origin, the pinning in superconducting lines should be considered. Hence, we have simulated the flux penetration into the square superconducting networks by considering the nonlinear current-voltage dependence[3]. A simulation with relatively small holes have shown a pattern enhanced along the parallel direction of networks which is described by the vortex channeling model. Further simulations with larger square holes are in progress.

[1]Y. Tsuchiya *et al.*, Physica C **470**, S788 (2010).
[2]N. Nakai and M. Machida, Physica C **470**, 1148 (2010).
[3]J. I. Vestgården *et al.*, Phys. Rev. B **77**, 014521 (2008).