Soliton pair dynamics in patterned ferromagnetic ellipses

Kristen S. Buchanan,[1] Pierre E. Roy,[2,1] Marcos Grimsditch,[1] Frank Y. Fradin,[1]
Konstantin Yu. Guslienko,[1] Sam D. Bader,[1] and Valentyn Novosad[1]

[1]Materials Science Division and Center for Nanoscale Materials,
Argonne National Laboratory, Argonne, IL 60439
[2]Uppsala University, Department of Engineering Science, Uppsala, Sweden

A magnetic vortex in a ferromagnet with restricted geometry, an example of a nonlocalized soliton, possesses a characteristic translational excitation mode that corresponds to spiral-like motion of the vortex core around its equilibrium position. Elliptical nanodots can take on a single vortex or vortex pair magnetization state, providing a convenient model system for investigating the effects of vortex interactions on their dynamics. Experimentally we have investigated the dynamics of magnetic soliton pairs confined in lithographically defined Permalloy ellipses using a microwave reflection technique. Strong resonances were detected experimentally in the sub-GHz frequency range and, by comparing with micromagnetic simulations, assigned to the translational modes of vortex pairs with parallel or antiparallel core polarizations. Although the vortex polarizations play a negligible role in the static interaction between two vortices, their effect dominates the dynamics.