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Direct imaging of interacting vortex orbits and deformations with Lorentz transmission electron microscopy[1] SHAWN POLLARD, State Univ of NY- Stony Brook, Department of Physics and Astronomy, JAVIER PULECIO, YIMEI ZHU, Brookhaven National Laboratory, Condensed Matter Physics and Materials Science Department — Understanding the interactions between confined, interacting magnetic quasiparticles, such as magnetic vortices, is essential towards developing both an understanding of their mutual coupling, as well as limitations for a variety of spintronic devices. However, due to a lack of spatial resolution afforded by traditional techniques, direct observation of the changes of vortex orbits in real space has been lacking. Utilizing high resolution Lorentz TEM, we image the time averaged vortex trajectories in multi-vortex permalloy rectangles and ellipses while applying an oscillating in-plane field tuned to the vortex gyrotropic mode. Using an additional in-plane DC field, we observe a transition of the vortex orbits from circular to heavily distorted as the vortices are driven together, a result of increased interaction strength in laterally coupled vortex pairs. Furthermore, in closely spaced vortex pairs, the strong coupling results in a single resonance frequency. As the vortices are moved apart, pinning effects begin to dominate, and the peak frequency is no longer singular. Micromagnetic simulations are utilized to further elucidate the coupled behavior and obtain time-resolved information of the dynamic process.

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