MAR13-2012-005318

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Edge mode imaging in magnetic nanodisks using ferromagnetic resonance force microscopy

FENG GUO, National Institute of Standards and Technology, University of Maryland

Edge modes are trapped spin wave modes that can form at film edges. The spontaneous localization of edge modes makes them fine probes of edge properties and test objects for magnetic resonance imaging. We use ferromagnetic resonance force microscopy (FMRFM) to study the edge modes in magnetic nanodisks with an improved resolution of less than 100 nm. In this presentation we will describe imaging and spectroscopy of the normal modes in Permalloy disks, manipulation of edge modes to characterize the disk edges, and the disk-diameter dependence of the spectrum. Micromagnetic modeling of a 500 nm diameter, 25 nm thick disk predicts a main mode that is nearly uniform across the sample and three edge modes with higher resonance fields. The spectra measured with various tip positions are consistent with the modeling results. Besides the broad center mode, three distinct edge modes are observed and appear when the tip is near the disk edge. However, in contrast to the symmetric edge behavior predicted by the modeling, the measured left and right edge modes are detected at different resonance fields, suggesting inhomogeneity of the edge properties. By rotating the applied field, we are able to move the localized edge mode along the edge of a single structure and thus probe the inhomogeneity in edge properties. The fundamental edge mode with the highest resonance field is most sensitive to the edge inhomogeneity while the center mode is relatively isotropic. The disk size dependence of the edge mode is also investigated for disk diameters ranging from 100 nm to 750 nm. The number of trapped edge modes reduces with decreasing disk size in agreement with micromagnetic modeling.