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Experimental Monocrystalline Micromagnetics: A Vortex Spin Topology with Cubic Anisotropy in YIG LANCE C. PARSONS, JOSEPH E. LOSBY, FATEMEH FANI SANI, 1,2, DYLAN T. GRANDMONT, 1, ZHU DIAO, TAYYABA FIRDOUS, 1,2, DOUGLAS VICK, WAYNE K. HIEBERT, 2, MARK R. FREEMAN, 1,2, 1 Department of Physics, University of Alberta, Edmonton, Alberta, 2 National Institute for Nanotechnology, Edmonton, Alberta — The detailed magnetostatic characterization of an individual, single-crystalline yttrium iron garnet micromagnetic disk is reported. The crystalline orientation is such that a (111) direction of the cubic crystal structure is perpendicular to the disk surface. An easy axis is thus aligned with the core of the magnetic vortex state. The 600 nm-thick, 600 nm-radius disk is transferred to a nanomechanical torsional resonator for characterization by torque magnetometry. The experimental results show a pristine, Barkhausen-free low field response of the vortex magnetization to in-plane field. For angular measurements of magnetic hysteresis as a function of the in-plane direction of applied magnetic field, it is observed that the field strengths at which the vortex annihilation transition occurs are significantly less sensitive to magnetic anisotropy than are the nucleation fields. Micromagnetic simulation results show a rich, topologically stable structure owing to the disk thickness and monocrystalline nature. The comprehensive magnetostatic measurements yield an incisive determination of the degree to which ideal micromagnetic response has been approached in the fabricated disk, and of the role of magnetocrystalline anisotropy on vortex behavior and topological spin structure.

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