

Observation of a Fractured Vortex Lattice Phase in Sr_2RuO_4 with $H \parallel a$

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The vortex lattice (VL) in Sr_2RuO_4 with $H \parallel a$ was studied by small-angle neutron scattering. Bragg reflections indicative of a highly distorted hexagonal VL were observed, and an analysis of the magnitude of the scattering vector yield a VL anisotropy ~ 30 , comparable with reports of the H_{c2} anisotropy. A conventional field dependence of the VL form factor, related to the magnitude of the magnetic field modulation in the mixed state, was observed, and does not support theoretical predictions of Pauli paramagnetic effects in Sr_2RuO_4 with $H \parallel a$ [K. Machida and M. Ichioka, Phys. Rev. B **77**, 184515 (2008)].

In contrast to the the anisotropy and form factor, the observed VL structure was highly unusual. For each VL Bragg reflection, rocking curves obtained by rotating around an axis perpendicular to the scattering vector, show two clearly separated peaks instead of one. The separation of the two maxima is found to increase with increasing field. While the exact VL structure is not yet resolved, these results suggest a fracturing of the VL and the introduction of an additional periodicity along the applied field direction.