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Resonant Soft X-Ray Scattering On Artificial Spin Ice

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Artificial spin ice comprises coupled dipolar magnetic nanoislands placed at the sites of a square or kagome planar lattice [1,2]. These particular geometries prevent the dipolar interactions to be simultaneously satisfied at the vertices where the islands meet, making the system magnetically frustrated. Microscopy techniques (magnetic force microscopy [3], photoelectron microscopy [4], Lorentz microscopy [5]) are usually employed to investigate such systems and to directly resolve the magnetic configuration of the islands. In contrast, scattering is a complementary method which provides information on magnetic correlations over length and time scales not accessible with microscopy [6].

In the present work, we employ soft x-ray resonant magnetic scattering with circularly-polarized light to study the organization of the magnetic configurations in artificial square spin ice. The scattering patterns are recorded by a CCD camera, providing an extended picture of the reciprocal space in two dimensions. By varying the applied magnetic field, we track the variations of the Bragg peaks intensity using the dichroic contrast.

Pure magnetic Bragg peaks observed in as-grown samples indicate the presence of a long-range antiferromagnetic ordered phase [3], which is subsequently destroyed by orienting the magnetic moments with an applied field. Numerical simulations based on the kinematical approach can correctly reproduce the experimental scattering patterns, allowing us to estimate the number of reversed moments along the two directions of the square lattice.

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