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Lithography patterns and data analysis for topologically frustrated artificial spin ice THOMAS MARSH, JASPER DRISKO, JOHN CUMINGS, University of Maryland, College Park — Artificial spin ices (ASIs), lattices composed of nanoscale single-domain magnetic islands, have been studied extensively for their insights on frustrated systems. Recently, the square and kagome geometries have received the most attention. We study a variation of the square lattice, where we include one or more edge dislocations in an otherwise perfect arrangement, resulting in topological frustration of the system. We create lithography patterns using a MATLAB script that models the system as a lattice of connected nodes and starts by removing partial rows or columns of elements. We then allow the system to relax, reshaping these patterns with an algorithm that attempts to equalize the angles of the elements at each node and also maintain identical island lengths throughout the lattice. We then analyze experimental Lorentz Transmission Electron Microscopy (TEM) images of these lattices using another program, which manipulates the images in order to find and index all of the individual magnetic islands, and then uses the Lorentz contrast of the element to determine the direction of each island's magnetic moment. These moment directions are then combined to determine the type of each lattice vertex, using the traditional type I-IV notation for square lattices. The script then marks the TEM images to reflect the vertex classification, which allows us to clearly identify chains of type II & III vertices in the Lorentz images. The chains carry net magnetic moment, in a direction defined by the type II vertices, which may then reverse at the type III vertices.

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