PHD GRANT

Exploring frustration in artificial magnetic architectures

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Frustration is a ubiquitous concept and can be defined as a competition between interactions which cannot all be satisfied simultaneously. Using modern nano-fabrication and characterization techniques, artificial magnetic systems exhibiting such behavior can be designed, visualized and controlled, enabling the exploration of magnetic frustration effects in a "statistical physics laboratory". Such nano-architectures facilitate the exploration of celebrated classical frustrated spin models characterized by non-conventional and exotic magnetic textures.
Our work has focused on two artificial realizations of the kagome geometry, with Ising-like magnetic islands having moments within the lattice plane (kagome spin ice) or perpendicular to it (kagome Ising). Using different experimental and numerical protocols, we highlighted how dipolar couplings, spanning beyond nearest-neighbors, drive the overall behavior of both these networks, each of them having its own story to tell (Fig. 1).

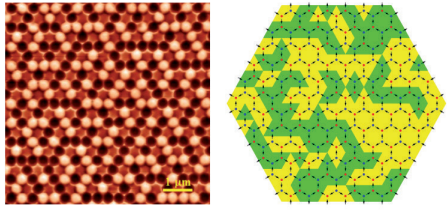

Fig. 1: A magnetic force microscopy image of an artificial kagome Ising network (left)[1] and the formation of magnetic charge crystallites in an artificial kagome spin ice (right) [2].

OUTCOMES

[1] Nonuniversality of artificial frustrated spin systems, Phys. Rev. B 90, 064411 (2014).

[2] Size distribution of magnetic charge domains in thermally activated but out-of-equilibrium artificial spin ice, Sci. Rep. 4, 5702 (2014).

[3] Ground-state candidate for the classical dipolar kagome Ising antiferromagnet, Phys. Rev. B 93, 214410 (2016);

[4] Fragmentation of magnetism in artificial kagome dipolar spin ice, Nat. Commun. 7, 11446 (2016);

[5] Kinetic pathways to the magnetic charge crystal in artificial dipolar spin ice, Phys. Rev. B 90, 220407 (2014);

Oral presentations: MSNOWS, Nancy, France, 2014; EMRS, Lille, France, 2015; ICM, Barcelona, Spain, 2015; MML, Uppsala, Sweden, 2016.

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