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Intrinsic chiral field as vector potential of the magnetic current in the zig-zag lattice of magnetic dipoles.

Paula Mellado[1*], Kevin Hofhuis[2], Ignacio Tapia[3†] and Andres Concha[1]
[1]Facultad de Ingeniería y Ciencias, Universidad Adolfo Ibáñez, Santiago, Chile.
[2a]Laboratory for Mesoscopic Systems, Department of Materials, ETH Zurich, Switzerland.
[2b]Laboratory for Multiscale Materials Experiments, Paul Scherrer Institute, Switzerland.
[2c]Department of Applied Physics, Yale University, New Haven, USA
[3]Facultad de Ciencias, Universidad de Chile, Santiago, Chile.
∗paula.mellado@uai.cl, †ign.tap@outlook.com

Introduction

Chiral magnetic insulators manifest novel phases of matter where the sense of rotation of the magnetization is associated with exotic transport phenomena. Effective control of such phases and their dynamical evolution points to the search and study of chiral fields like the Dzyaloshinskii-Moriya interaction. Here we combine experiments, numeric results, and theory to study a zig-zag dipolar lattice as a model of an interface between magnetic in-plane layers with a perpendicular magnetization. The zig-zag lattice comprises two parallel sublattices of dipoles with perpendicular easy plane of rotation. The dipolar energy of the system is exactly separable into a sum of symmetric and antisymmetric long-range exchange interactions between dipoles, where the antisymmetric coupling generates a nonlocal Dzyaloshinskii-Moriya field which stabilizes winding textures with the form of chiral solitons. The Dzyaloshinskii-Moriya interaction acts as a vector potential or gauge field of the magnetic current and gives rise to emergent magnetic and electric fields that allow the manifestation of the magnetoelectric effect in the system.

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References

[1] T. Moriya, Physical Review Letters 4, 228 (1960)
[2] K.-S. Ryu, L. Thomas, S.-H. Yang, and S. Parkin, Nature 434 nanotechnology 8 , 527 (2013)