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Spontaneous atomic-scale magnetic skyrmion lattice in two dimensions

STEFAN HEINZE, Institute of Theoretical Physics and Astrophysics, University of Kiel, Germany

Skyrmions are topologically protected field configurations with particle-like properties that play an important role in various fields of science. They have been predicted to exist also in bulk magnets and in recent experiments it was shown that they can be induced by a magnetic field. A key ingredient for their occurrence is the Dzyaloshinskii-Moriya interaction (DMI) which was found to be strong also for magnetic nanostructures on substrates with large spin-orbit coupling [1]. In these systems the DMI stabilizes spin-spirals with a unique rotational sense propagating along one direction of the surface as observed for ultrathin films [1-3] and atomic chains [4]. Here, we go a step beyond and present an atomic-scale skyrmion lattice as the magnetic ground state of a hexagonal Fe monolayer on Ir(111) [5]. We develop a spin-model based on density functional theory that explains the interplay of Heisenberg exchange, DMI and the four-spin exchange as the microscopic origin of this intriguing magnetic state. Experiments using spin-polarized scanning tunneling microscopy confirm the skyrmion lattice which is incommensurate with the underlying atomic lattice. This work is a collaboration with G. Bihlmayer, S. Blügel, K. von Bergmann, M. Menzel, A. Kubetzka, J. Brede, and R. Wiesendanger.

[1] M. Bode et al., Nature 447, 190 (2007).
[2] P. Ferriani et al., Phys. Rev. Lett. 101, 027201 (2008).
[3] Y. Yoshida et al., Phys. Rev. Lett. 108, 087205 (2012).
[4] M. Menzel el al., Phys. Rev. Lett. 108, 197204 (2012).
[5] S. Heinze et al., Nature Phys. 7, 713 (2011).