Dipolar skyrmions and antiskyrmions of arbitrary topological charge at room temperature

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Magnetic skyrmions are localized, stable topological magnetic textures that can move and interact with each other like ordinary particles when an external stimulus is applied. [1, 2] The efficient control of the motion of spin textures using spin-polarized currents opened an opportunity for skyrmionic devices such as racetrack memory and neuromorphic or reservoir computing. The coexistence of skyrmions with high topological charge in the same system promises further possibilities for efficient technological applications. In this work, we directly observe dipolar skyrmions and antiskyrmions with arbitrary topological charge in Co/Ni multilayers at room temperature. We explore the dipolar-stabilized spin objects with topological charges of up to 10 and characterize their nucleation process, their energy dependence on the topological charge and the effect of the material parameters on their stability. Furthermore, our micromagnetic simulations demonstrate spin-transfer-induced motion of these spin objects, which is important for their potential device application.

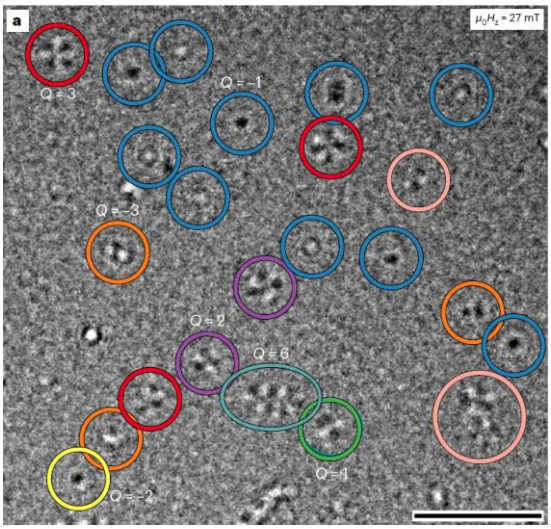

Figure 1. High-order SKs and ASKs at room temperature. LTEM image of a $[Co/Ni]_{10}$ multilayer sample taken in an applied OOP magnetic field of 27 mT showing different spin objects with topological-charge values up to 6. Some non-classified spin objects are marked with pink circles.

References

[1] S. Mühlbauer et al. *Science*, 2009, *323*, 915.
[2] X. Z. Yu et al. *Nature*, 2010, *465*, 901.