Skyrmions in synthetic antiferromagnetic multilayers: Room temperature stabilization of skyrmions in the 10-nm-diameter range

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In ferromagnetic metallic multilayers, skyrmions are stabilized by a delicate balance of different interactions, namely the usual exchange, the Dzyaloshinskii-Moriya interaction (DMI), the anisotropies and the internal (dipolar) and external (Zeeman) fields. The skyrmion size reduction in multilayers based on Pt|Co is notably limited by the dipolar fields. The use of synthetic antiferromagnetic (SAF) multilayers is a possible means to reduce the skyrmion size and its potential alteration by external fields. In SAF systems, the so-called skyrmion Hall effect that might have detrimental effects in diverse device concepts should incidentally be reduced or canceled.

Lead by micromagnetic calculations, we focus on systems with nearly vanishing perpendicular anisotropy and a bias layer that turns the spin spiral ground state into a uniform SAF system with metastable skyrmions. These “antiferromagnetic skyrmions” are then observed using magnetic force microscopy, NV-center microscopy or scanning transmission X-ray microscopy, suggesting diameters as small as 30 nm. For such small objects, an electrical detection will be more suitable, even necessary for potential applications in integrated circuits. We will present our efforts in this direction.

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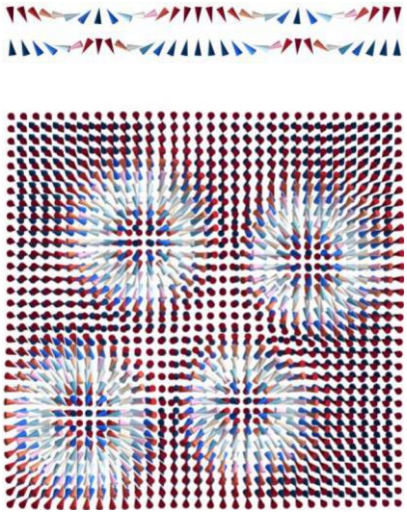

FIG: Side view (top) and top view (bottom) of the calculated magnetic texture of a biased SAF system made of two magnetic layer antiferromagnetically coupled.