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# PSI Condensed Matter Colloquium

## Friday, November 27, 2020, 11:15 h

https://psich.zoom.us/j/97009380311?pwd=b1RaakE4TXovK2FQcitFdmFwRFhJZz09

Meeting ID: 970 0938 0311
Passcode: 821499

## Zero-field magnetic skyrmions in model-type systems studied with STM


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Magnetic skyrmions can be stabilized in thin films by interface-induced Dzyaloshinskii-Moriya interactions that compete with exchange interactions. Such skyrmions can become lowest energy states in applied magnetic fields but are typically only metastable in zero magnetic field. Spin-polarized scanning tunneling microscopy is a powerful tool to characterize such magnetic textures down to the atomic scale [1].
We have studied the magnetic properties of a Rh/Co atomic bilayer on Ir(111) using spinresolved scanning tunneling microscopy. Depending on the stacking of the Rh monolayer we observe a significant number of domain walls with unique rotational sense in the otherwise out-of-plane magnetized film. We also identify circular magnetic objects on the order of 4 nm in the virgin state. They coexist in both oppositely magnetized ferromagnetic domains and resemble zero-field magnetic skyrmions with up- or down-pointing core. Ab-initio calculations in combination with spin dynamics simulations shed light on the origin of these unusual properties [2]. The domain walls and skyrmions can be imaged also with non-spinpolarized probe tips due to the contribution of the non-collinear magnetoresistance (NCMR) [3,4]. It arises from spin-mixing and leads to variations in the differential conductance depending on the details of the local spin texture.


### References


[1] K. von Bergmann et al., J. Phys.: Condens. Matter **26**, 394002 (2014).
[2] S. Meyer et al., Nature Commun. **10**, 3823 (2019).
[3] C. Hanneken et al., Nature Nanotech. **10**, 1039 (2015).



Contact: Ales Hrabec (Tel. 2120)

[4] M. Perini et al., Phys. Rev. Lett. **123**, 237205 (2019).

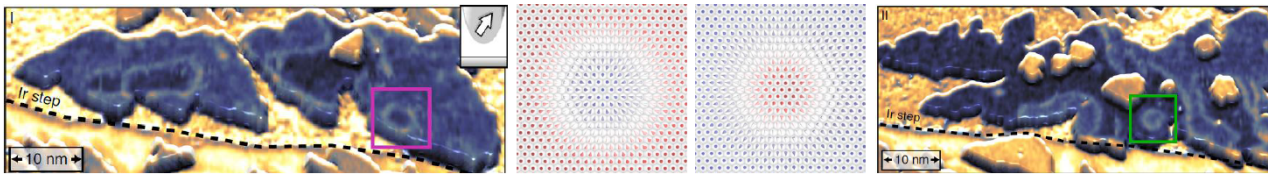


FIG: Maps of differential conductance, in which Rh/Co islands appear darker. At this bias voltage domain walls appear brighter compared to the out-of-plane domains due to the NCMR. The two boxes indicate meta-stable zero-field magnetic skyrmions of opposite direction, as sketched in the two central images. The diameter of the skyrmions is on the order of 4 nm, the sketches are to scale and each dot represents one atomic magnetic moment.