Prof. Dr. Jairo Sinova
Institut für Physik, SPICE
sinova@uni-mainz.de

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Theory of Condensed Matter: Hard Condensed Matter

Jan. 21, 2020 at 2 p.m.
Galilei Room, 01-128 (Staudinger Weg 9)

Souvik Paul
Christian-Albrechts-Universität zu Kiel

First-Principles Study of Magnetic Skyrmions in Transition-Metal Ultrathin Films

Magnetic skyrmions, localized spin structure with topological protection, have become a research hotspot as they show promise for future memory and logic devices. The key challenges for applications are to achieve small bits and stability of those skyrmionic bits. Research shows that transition-metal interfaces (TMI) and multilayers are a very promising class of systems to realize nanometer-sized and stable magnetic skyrmions. Therefore, a lot of effort has been put to tailor the properties of these systems for application.
In this direction, using first-principles methods, we have proposed ultrathin films, Fe/Rh and Rh/Fe bilayers on Re(0001) substrate, which show various spin structures at the interface including isolated skyrmions, depending on the stacking order of Fe/Rh and Rh/Fe bilayers. This study would encourage the experimentalist to check our predictions and would generate more investigations on other bilayers on Re(0001).
The other topic I would focus on is the effect of higher-order exchange interactions (HOI) on the stability of skyrmions. HOI are shown to stabilize magnetic ground states in transition-metal ultrathin films, however, their role on the stability of metastable skyrmions has note been investigated yet. We showed that the HOI increase the stability of skyrmions by a large amount at TMI. This study opens up a route to tune skyrmions stability and lifetime in ultrathin films.

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[3] Nat. Commun. 5, 4652 (2014)
[4] arXiv:1912.03465
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[7] Phys. Rev. Lett. 120, 207202 (2018)
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Contact:
Hjördis Pusch
hjopusch@uni-mainz.de