UNIVERSITÄT DUISBURG ESSEN

Offen im Denken

Theorie-Kolloquium WS 2021/22

Fr 22.10.2021, **14:00**-15:30

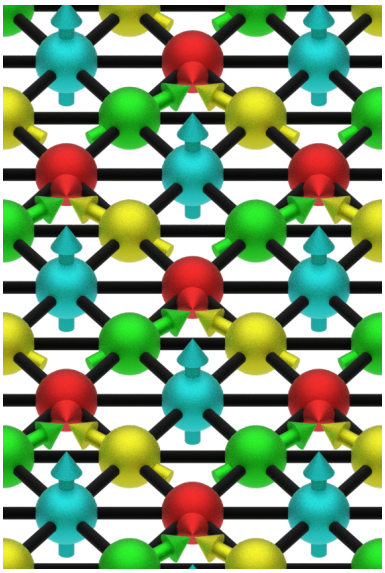
Online (URL in E-Mail)

udue.de/TheoKoll

Chiral multi-spin multi-site magnetic interactions

Dr. Manuel dos Santos Dias

UDE & Peter Grünberg Institut, FZ Jülich



Atomistic spin models have found enormous success in addressing the properties of magnetic materials, grounded on the identification of the relevant underlying magnetic interactions. The Heisenberg model led to the theoretical prediction of the existence of spin waves and of antiferromagnetic materials, and our understanding of the chiral Dzyaloshinskii-Moriya interaction is central to the huge development in the field of magnetic skyrmions and other noncollinear magnetic structures. Recently, various works have proposed new types of chiral interactions with seemingly different forms [1,2,3], but the big picture is still emerging.

In this talk, I will present a systematic overview of our recent work on chiral multi-spin multi-site interactions. I will start with a systematic construction of a generalized spin model containing isotropic and chiral multi-site interactions [4], motivated by a microscopic electronic model that incorporates local spin moments and the spin-orbit interaction. I will then discuss their symmetry properties, by showing that the chiral interactions arise solely from the spin-orbit interaction and that the multi-site interactions do not have to follow Moriya's rules, unlike the Dzyaloshinskii-Moriya and chiral biquadratic interactions [1]. These theoretical considerations are then illustrated with density functional theory calculations for prototypical magnetic systems. These are dimers, trimers and tetramers built out of Cr, Mn, Fe and Co adatoms on the Re(0001), Pt(111), Pt(001) and Au(111) surfaces [1,4,5]. The multi-site interactions are substantial in magnitude and can stabilize interesting magnetic ground states. Finally, I will discuss the recent literature in the light of our findings, and clarify several unclear or confusing points [5].

[1] S. Brinker et al., New. J. Phys. 21, 083015 (2019)
[2] A. Lászlóffy et al., Phys. Rev. B 99, 1844 (2019)
[3] S. Grytsiuk et al., Nat. Commun. 11, 511 (2020)
[4] S. Brinker et al., Phys. Rev. Research 2, 033240 (2020)
[5] M. dos Santos Dias et al., Phys. Rev. B 103, L140408 (2021)