

UNL Department of Physics and Astronomy presents:

# 3D Nano Magnetism: A Modern Perspective on Magnetism

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**THURSDAY**  
**NOVEMBER 21**  
**4:00 PM**  
**IN JH 136**

Refreshments will be served in the JH 1st Floor Vending Area at 3:30

## ABSTRACT

3D nano magnetism [1,2] has evolved to a vital research area concerning 3D chiral spin textures and curved geometries. The appeal is fueled by a fundamental fascination in vector spin exchange and vector spin frustration in heterogeneous materials, and the manifestation of topological magnetization vector fields on the nano scale, that may function as versatile information entities in future electronics. Applications to life science as self-propelled motors for targeted drug delivery [3], and reconfigurable, reshapeable ferromagnetic liquid droplets [4] showcase the potential for multidisciplinary research.

I will discuss how symmetry breaking allows for tailoring magnetic exchange interactions and stabilizing 3D non-collinear spin textures in complex, multi-component systems. In particular, I will present experimental evidence of chiral ferrimagnetism in amorphous thin GdCo films sandwiched between heavy-element materials [5], and a potential temperature control of internal domain wall properties. The stabilization of chiral spin textures proves that the vector spin exchange interaction originating from an inversion symmetry breaking at the interfaces prevails in disordered materials. In fact, chemical disorder in amorphous thick films can cause a random vector spin exchange interaction between adjacent atoms; the corresponding spontaneous symmetry breaking with respect to the spin chirality favors helical spin lattices, skyrmions, and anisotropic solitary spin textures [6]. These observations indicate that, contrary to common understanding, a well-defined symmetry is not required to stabilize topological vector fields, and pave the way toward higher-order topological states. A similar formation of vortices was observed in stray field coupled nano disk arrays [7].

## References

- [1] A. Fernandez-Pacheco, RS et al., Nat. Commun. 8, 15756 (2017)
- [2] RS et al., J. Phys. D: Appl. Phys. 49, 363001 (2016)
- [3] L. Baraban, RS et al., ACS Nano 6, 3383 (2012)
- [4] X. Liu, RS et al., Science 365, 264 (2019)
- [5] RS et al., Adv. Mater. 30, 1800199 (2018)
- [6] RS et al., in preparation
- [7] RS et al., Nano Lett. 18, 7428 (2018)

