Centre de Nanosciences et de Nanotechnologies

Séminaire/ Seminar

Lundi 11 mars 2019

14 heures
Amphithéâtre du C2N site Palaiseau

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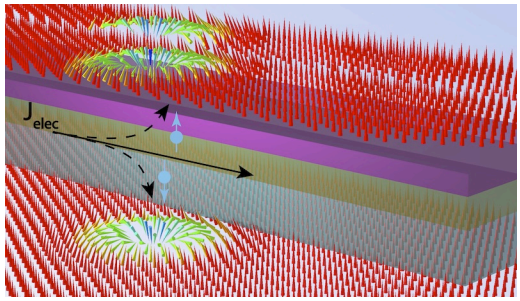
"A multiscale approach to interfacial magnetism"

Abstract:



Interface phenomena are becoming crucial for devices such as magnetic random-access memories (MRAM) [1]. Interfaces can host a wide range of phenomena: the changes of chemical potential can induce large electric fields and the breaking of inversion symmetry allows the emergence of new transport properties or new interactions. The study of material properties at this scale requires to understand the interplay between chemical, structural and functional properties at the microscopic scale. This can be achieved based on atomistic simulations parametrized via density functional theory (DFT) calculations. Recently, magnetism interfaces have been attracting lots of attention due to the presence of a chiral interfacial interaction called the Dzyaloshinskii-Moriya interaction (DMI). The DMI stabilizes chiral non-collinear magnetic textures such as domain-walls or skyrmions which can be manipulated efficiently by electrical currents and offer attractive perspectives for future spintronic applications [2].

I will describe how density functional theory can be used to accurately describe the stability of non-collinear magnetic textures at surfaces [3] and interfaces [4]. In particular, I will show that atomistic Hamiltonians parametrized via DFT calculations can be used to engineer the magnetic properties of interfaces and explain the occurrence of skyrmions and their transport properties [5]. Our microscopic models reveal that a new type of magneto-resistance, called the non-collinear magnetoresistance (NCMR), can emerge depending on the skyrmion radius [10]. Our methods further allow the exploration of the stabilization mechanisms of skyrmions. We also show that the competition between magnetic interactions can give rise to the simultaneous stabilization of both skyrmion and anti-skyrmions with peculiar dynamical properties [6]. Our findings suggest new mechanisms to nucleate skyrmions such as magnetization quenching [7] or ultra-fast laser pulses [8]. These achievements show that Hamiltonians parametrized via DFT are a powerful tool to design materials with tuned magnetic, ferroelectric, and optical properties.

[1] B. Dieny *et al*., *Reviews of Modern Physics* **89**, 025008 (2017).
[2] A. Fert *et al*., *Nature Nanotechnology* **8**, 152 (2013).
[3] M. Hervé, B. Dupé *et al*., *Nature Communications* **9**, 1015, (2018).
[4] B. Dupé, *et al*., *Nature Communications* **7**, 11779 (2016).
[5] C. Hanneken, B. Dupé *et al*., *Nature Nanotechnology* **10**, 1039 (2015).
[6] U. Ritzmann, B. Dupé *et al*. *Nature Electronics* **1**, 451 (2018).
[7] I. Lemesh, B. Dupé *et al*., *Advanced Materials* **30**, 1805461 (2018).
[8] B. Pfau, B. Dupé *et al*., in preparation.

***** IMPORTANT *****

Participants external to the C2N laboratory ***must*** register using the form below in order to attend the seminar:
https://framaforms.org/registration-c2n-seminar-dr-bertrand-dupe-1551881586

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