



Bose Colloquium

S. N. Bose National Centre for Basic Sciences
(An Autonomous Research Institute established under DST, GOI)



Title: Spintronics with magnetic skyrmions

Abstract:

In the last decade, magnetic multilayers have proven to be essential structures for creating and investigating complex, topologically non-trivial spin textures through the ability to tune their composition and properties [1-2]. Two-dimensional magnetic textures such as skyrmions (or chiral domain walls) have been the focus of a strong interest both in upstream research and for the development of novel spintronic devices.

First, I will make a short introduction to topology and chirality in thin films as well as the micromagnetic modelling of skyrmions and review the material systems in which these fascinating topological spin textures can be expected. In the second part of my presentation, I will describe how by relying on our ability to perform fully-electrical nucleation, manipulation and detection of magnetic skyrmions in multilayers, we have recently designed and tested a skyrmion-based device for performing a neuromorphic weighted sum with magnetic skyrmions, that is one of the basic unconventional computation operation in hardware [3]. Finally, I will present our recent results on 3D spin textures, called skyrmionic cocoons [6], that have a typical ellipsoidal shape and that can be stabilized in a periodic magnetic multilayers with a variable thickness for the ferromagnetic elements. These novel 3D topological textures can be detected through MFM, electrical measurements or using x-ray holography and x-ray laminography that gives a precise insight into the 3D distribution of the magnetization which demonstrate the 3D nature of skyrmionic cocoons.

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- [1] A. Fert, N. Reyren and V. Cros, "Magnetic skyrmions; advances in physics and potential applications" Nat. Rev. Materials 2, 17031 (2017)
- [2] C. Back, V. Cros *et al.*, "The 2020 Skyrmionic Roadmap", J. Phys. Appl. D, 53, 363001 (2020);
- [3] T. Da Camara Santa Clara Gomes *et al.*, unpublished (2024)
- [4] M. Grelier, VC *et al.* Nature Comm, 13, 6843 (2022)

Speaker: Dr. Vincent Cros

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Short Biography of the Speaker:

Dr. Vincent Cros is a CNRS Senior Researcher with the CNRS/Thales Research Laboratory, Université Paris-Saclay, Palaiseau, Gif-sur-Yvette, France. Since 1998, he has been working on magnetization dynamics and spin torque phenomena and its related potential applications, for example, for radio frequency spintronic devices. He has coordinated several national, European, and international projects, including the large national project on spintronics called PEPR SPIN, being part of the France 2030 Investment Plan. His research interests include nonlinear phenomena and synchronization of spin torque nano-oscillators, spin transfer dynamics generated by spin-orbit torques, and more recently the physics of magnetic skyrmions in nanostructures. Dr. Cros received the Carnot Prize from the French Academy of Sciences for his work in spintronics in 2013.



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4.00 PM



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