

Skyrmion based Random Bit Generator

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Abstract

Magnetic skyrmion are topologically protected [1],[2] non-uniform configuration of the magnetization which can behave as particles [3]. They can be easily manipulated (nucleated, shifted and detected) by spin-polarized current, and for this reason they offer a wide range of applicability fields [2]. In this work, we study the skyrmion dynamics driven by the spin-Hall effect in a synthetic antiferromagnet within a micromagnetic framework. We show that, in presence of thermal fluctuations at room temperature, the skyrmion motion is not deterministic [4]. In other words, this motion follows stochastic law of motion (casual sequence of 0 and 1), and therefore it is natural to think skyrmions as building blocks of random bit generators if combined with a device designed for this scope (see figure 1(a)). The parameters used in our study are the same as in [5]. We have shown, via a full micromagnetic simulations, the possibility to move skyrmions randomly in presence of spin-Hall effect and thermal fluctuations in a synthetic antiferromagnet, where the skyrmion hall effect is absent [5]. We have observed that, under the steady action of the current, skyrmions stochastically divided in the two output branches of our device starting from a continuous nucleation in the input branches (see figure 1 (b)). Our results are also robust to the presence of defects in the form of randomly distributed grains of the perpendicular anisotropy. Our achievements open the path for the design of random bit generators based on skyrmions.



Biography:

Mr. Israa Medlej has completed her PhD at the age of 26 years from Messina University, Italy in collaboration with Lebanese University. For her Ph.D. studies she also received a scholarship sponsored by the University of Santiago de Compostela, Spain (Erasmus Project). Her main expertise includes magnetism, spintronics, and the implementation of experimental techniques for the characterization of magnetic microparticles. Israa also received a scholarship in 2016 sponsored by the University of Lorraine, Saint Avold (France) to do her internship of Matser 2 in Condensed Matter Physics. She has published papers in reputed journals.

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