Dynamical Phenomena of Magnetic Skyrmions
~ How to Create Nanometric Topological Spin Textures ~

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We will report on our recent theoretical studies on dynamical phenomena of magnetic skyrmions in chiral lattice magnets, particularly focusing on how to create nanoscale, topological skyrmion spin textures using external parameters such as electric fields, magnetic fields, lights and heats. This talk consists of the following two topics mainly.

[1]: Skyrmion creation by local application of electric fields

Swirling spin structure of magnetic skyrmion can induce electric polarizations in insulating magnets such as Cu_2OSeO_3 and GaV_4S_8 via relativistic spin-orbit interactions. We theoretically propose that in these multiferroic chiral-lattice magnets, skyrmions can be electrically created on a thin-film specimen within a few nanoseconds by applying an electric field via an electrode tip taking advantage of coupling between noncollinear skyrmion spins and electric polarizations [1,2]. This finding will pave a route to utilizing multiferroic skyrmions as information carriers for low-energy-consuming magnetic storage devices without Joule-heating energy losses.

[2]: Local creation of nanometric skyrmions by *global* application of external field

It has been theoretically proposed that *local* applications of external field such as magnetic field, light, and heat within a region comparable to or smaller than a skyrmion size are a possible efficient way to create nanometric skyrmions. However, since it is technically difficult to squeeze their spot size within a nanometric region actually, these methods are rather unrealistic and impractical. To utilize nanometric magnetic skyrmions as information carriers in high-density storage devices, it is necessary to establish a method to create intended number of skyrmions at intended places in a specimen with low energy cost even by global application of external field to entire specimen. We discuss how to overcome this seemingly unsolvable problem.

[1] M. Mochizuki, Advanced Electronic Materials **2**, 1500180 (2015).
[2] M. Mochizuki and Y. Watanabe, Applied. Physics Letters **107**, 082409 (2015).