Dynamics of Magnetic Skyrmions and Skyrmioniums Driven by Spin Waves The Chinese Univ. of Hong Kong, Shenzhen¹, Shinshu Univ.², The Univ. of Tokyo³, (D)Jing Xia¹, (D)Xichao Zhang², Motohiko Ezawa³, Yan Zhou¹, Xiaoxi Liu² E-mail: jingxia0817@gmail.com

Magnetic skyrmions and skyrmioniums are quasiparticle-like nanoscale spin textures in chiral magnetic materials [1], which can be used to carry information in future non-volatile magnetic memory and logic computing devices [2]. The dynamics of skyrmions and skyrmioniums are thus fundamental to the design and development of skyrmionic devices. Here, we theoretically and numerically study the dynamics of a skyrmion and a skyrmionium driven by spin waves in ultrathin films and nanotracks [3, 4]. For the skyrmion, which carries a unity topological charge, we found it shows the skyrmion Hall effect, and its trajectory is determined by an interplay of the spin wave driving force and the edge-skyrmion force. The skyrmion is first attracted to the spin wave source and then is accelerated by the repulsive force. For the skyrmionium, which carries a zero topological charge but actually consists of two skyrmions with opposite polarities, we found its mobility is much better than that of the skyrmion at the same condition, while it only shows a tiny skyrmion Hall effect. The skyrmionium dynamics depends on the sample geometry and damping parameter, which can also be controlled by an external out-of-plane magnetic field. Our results show that skyrmions and skyrmioniums are promising building blocks for spin-wave-driven spintronic devices.



Figure 1. (a) Exemplary trajectories of skyrmions and skyrmioniums driven by spin waves in a thin film.(b) Velocities as functions of time for skyrmions and skyrmioniums driven by spin waves.

References

- [1] Jiang, W. et al. Phys. Rep. 704, 1 (2017).
- [2] Kang W. et al. Proc. IEEE 104, 2040 (2016).
- [3] Zhang X. et al. New J. Phys. 19, 065001 (2017).
- [4] Li S. et al. Appl. Phys. Lett. 112, 142404 (2018).