

Joint Seminar (量子物性&物性基礎論)

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Skyrmions in Spin-Orbitronics and Orbitronics – novel science and applications in memory & non-conventional computing –

Novel spintronic devices can play a role in the quest for GreenIT if they are stable and can transport and manipulate spin with low power. Devices have been proposed, where switching by energy-efficient approaches is used to manipulate topological spin structures [1,2].

We combine ultimate stability of topological states due to chiral interactions [3,4] with ultra-efficient manipulation using novel spin torques [3-5]. In particular orbital torques [6] increase the switching efficiency by more than a factor 10.

We use skyrmion dynamics for non-conventional stochastic computing applications, where we developed skyrmion reshuffler devices [7] based on skyrmion diffusion, which also reveals the origin of skyrmion pinning [7]. Such diffusion can furthermore be used for Token-based Brownian Computing and Reservoir Computing [8].

References

- [1] G. Finocchio et al., J. Phys. D: Appl. Phys., vol. 49, no. 42, 423001, 2016.
- [2] K. Everschor-Sitte et al., J. Appl. Phys., vol. 124, no. 24, 240901, 2018.
- [3] S. Woo et al., Nature Mater., vol. 15, no. 5, pp. 501–506, 2016.
- [4] K. Litzius et al., Nature Phys., vol. 13, no. 2, pp. 170–175, 2017.
- [5] K. Litzius et al., Nature Electron., vol. 3, no. 1, pp. 30–36, 2020.
- [6] S. Ding et al. Phys. Rev. Lett. 125, 177201, 2020; Phys. Rev. Lett. 128, 067201, 2022.
- [7] J. Zázvorka et al., Nature Nanotechnol., vol. 14, no. 7, pp. 658–661, 2019;
R. Gruber et al., Nature Commun. vol. 13, pp. 3144, 2022.
- [8] K. Raab et al., Nature Commun. vol. 13, pp. 6982, 2022;
M. Brems et al., Appl. Phys. Lett. 119, 132405, 2021.

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