

Discussion Meeting and Special Lecture by Prof. Mathias Kläui

Date: 2023/05/31 (Wed)

Place: Meeting Room No.2, Building 55N 1F, Nishi-waseda campus, Waseda university

11:30-11:50 Collins Akosa Ashu

Title: Role of Chiral damping in current-induced skyrmion dynamics



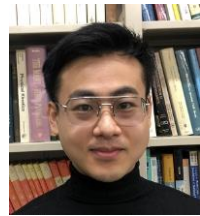
11:50-12:10 Rintaro Eto

Title: Collective spin excitations in the quadruple-Q magnetic hedgehog lattices



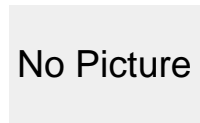
12:10-12:30 Lan Bo

Title: Controllable Creation of Skyrmion Bags in a Ferromagnetic Nanodisk



12:30-13:00 Le Zhao (Tsinghua University, China)

Title: Deterministic Generation and Transportation of Skyrmion Strings



13:00-13:30 Lunch (Lunch boxes will be served.)

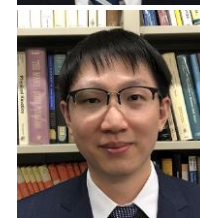
13:30-14:00 Yuya Ominato

Title: Theory of spin tunneling into atomic layer materials and anisotropic superconductors at magnetic interfaces



14:00-14:30 Xichao Zhang

Title: Frustrated Magnetic skyrmions: from two dimensions to three dimensions



14:30-15:00 Mu-Kun Lee

Title: Reservoir Computing with Spin Waves in a Skyrmion Crystal.



15:15- Special Lecture by Prof. Mathias Kläui

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



17:00-18:00 Tea break & Free discussions

【Abstract of the Seminar Talk】

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

Mathias Kläui^{1,2}

¹*Institute of Physics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany*

²*Centre for Quantum Spintronics, Department of Physics, Norwegian University of Science and Technology, 7034 Trondheim, Norway.*

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.