

CONDENSED MATTER SCIENCES SEMINAR

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Host

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Title

Magnetoresistive random access memories beyond spin transfer torque

Friday, October 31st, 2025

1st Floor – B101

15:00-16:00

Abstract

Magnetoresistive random access memory (MRAM) based on spin transfer torque (STT) switching has achieved commercial success as a non-volatile memory, replacing embedded Flash in many advanced applications [1]. In parallel, alternative MRAM technologies—such as those based on spin orbit torque (SOT) [2] and voltage-controlled magnetic anisotropy (VCMA) [3]—are being actively explored, primarily within academic research settings. The main motivation behind this research is to expand MRAM's applicability to domains requiring ultra-fast memory and/or low energy consumption, where static random access memory (SRAM) currently remains the dominant solution [4]. In this seminar, I will introduce the physical phenomena underlying the operation of SOT and VCMA MRAM, and describe the advantages these technologies offer over STT-based MRAM. I will then review recent progress in device fabrication methods, the development of advanced materials, and the optimization of device design and operation — all of which contribute to improved performance. Finally, I will discuss the remaining challenges and current research efforts aimed at overcoming them and conclude by providing an outlook on the successful implementation of these emerging technologies.

REFERENCES

- [1] D. C. Worledge et al., Nat. Rev. Electr. Eng. 1, 730 (2024).
- [2] V. D. Nguyen et al., npj Spintronics 2, 48 (2024).
- [3] Y. Shao et al., Adv. Mater. Technol. 8, 2300676 (2023).
- [4] A. Lu et al., Nat. Rev. Electr. Eng. 1, 24 (2024).