

Seminar : Ao DU
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Electrical manipulation of magnetic moments via spin-orbit torque



The discovery of spin-orbit torques (SOT) a decade ago revolutionized spintronics by providing an efficient means to manipulate magnetic moments through electrical currents. Current-induced magnetization switching driven by SOT offers a promising route toward ultrafast and energy-efficient spintronic devices for both computing and memory applications.

By employing electrical probes with sub-nanosecond resolution, we investigate the efficient manipulation of magnetic moments via SOT in conventional ferromagnets [1], antiferromagnets [2–5], and two-dimensional van der Waals materials [6], and explore their potential in computing and memory technologies.

Recently, a fundamentally new direction has emerged in which orbital angular momentum (OAM) and its associated orbital current can be efficiently utilized to manipulate magnetic moments. We further explore and discuss the role of orbital currents and orbital torques for achieving even more efficient electrical control of magnetism.

These results provide valuable insights and guidance for the future design of efficient SOT-based spintronic devices.

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- [2] D. Zhu, A. Du, et al. IEEE International Electron Devices Meeting, pp. 17-5. (2021).
- [3] A. Du, et al. Nature Electronics, 6(6), 425-433, (2023).
- [4] A. Du, et al. Advanced Electronic Materials, 10(6), 2300779, (2024).
- [5] Z. Chen, A. Du, et al. Under review.
- [6] A. Du, et al. Advanced Materials, e05190, (2025).

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