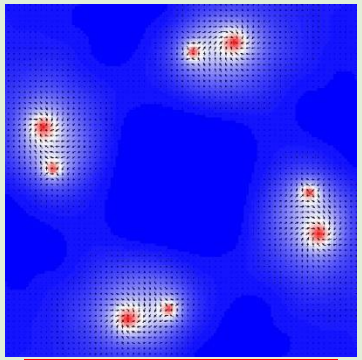
NanoMagnetism and Ultrafast Spintronics Group

We are working on magnetic thin films and nanostructures, micromagnetic simulation study of magnetic skyrmions, magnetic sensors, magnetization switching dynamics using external stimuli like ultrafast laser or current pulses in ~ns to ~ps range, memristors and photovoltaics for space applications.

Magnetic Skyrmions

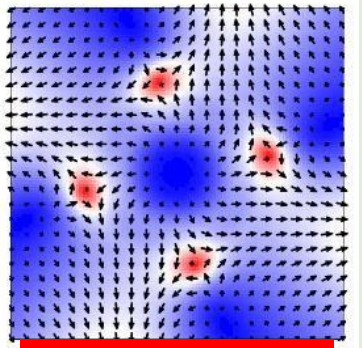
Skyrmions are promising candidates for the next generation energy-efficient spintronic applications due to their unique topological properties. We are studying the creation of magnetic skyrmions using spin-transfer torques in multilayer nanostructures. Our recent studies showed the formation of an isolated skyrmion, skyrmion lattice, and antiskyrmion lattice in Co/Pd nanostructure due to magnetization reversal from the system's edges **[*Sci Rep* 11, 18945 (2021)]**. Our micromagnetic studies suggest that the two distinct lattice phase evolution could help to design the topological spin textures based devices.



Lattice of skyrmion and antiskyrmion

Photovoltaics for Space Applications

Photovoltaics are crucial for space applications due to their ability to convert sunlight into electricity, which is essential for powering spacecraft, satellites, and other space missions. We are working on halide-based perovskite solar cells for space applications.



Antiskyrmion lattice

Memristors

A memristor is a non-linear, two-terminal electrical component that relates electric charge and magnetic flux linkage. It was first theorized by Leon Chua in 1971. Memristors are unique because they can remember the amount of charge that has previously flowed through them, even when the power is turned off.

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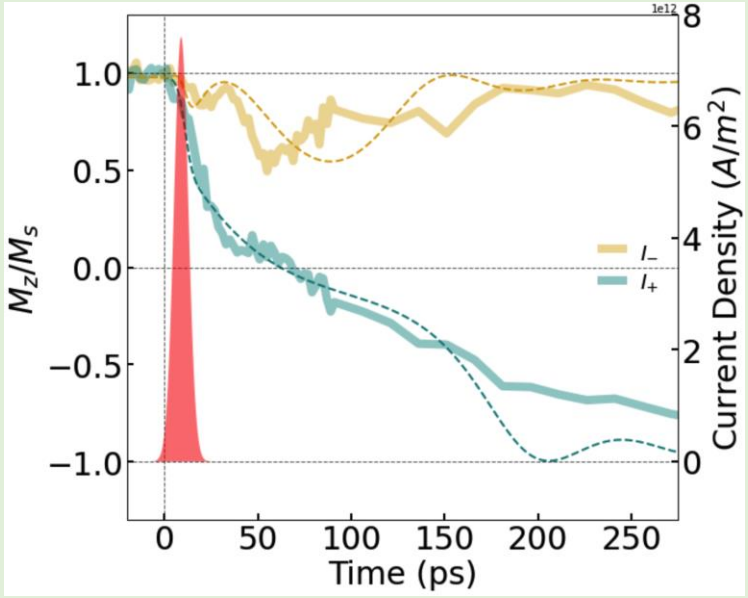
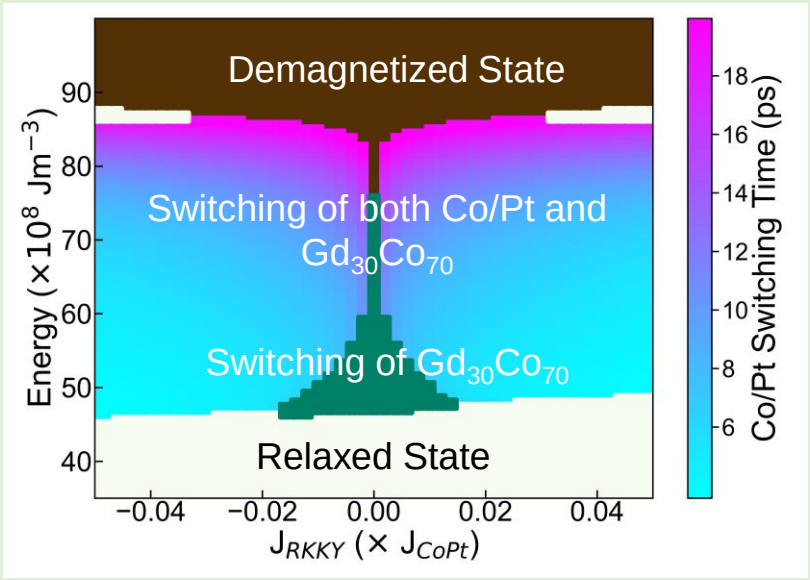
Domain-Wall Motion and Ultrafast Magnetization Switching

It has been observed that the current-induced magnetization switching is dominated via domain wall motion in the ~ns regime. However, the switching dynamics change into the coherent rotation of spins in the ~ps regime.

Optical pulse-induced magnetization switching in ferrimagnet/ferromagnet heterostructure depends on the time evolution of electronic temperature and the inter and intra-sublattice angular momentum transfer.



Polley. D. et al., *Sci. Adv.* **9**, eadh5562 (2023)



Polley. D. et al., *JMMM* **574**, 170680 (2023)

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