# Current driven nanosecond skyrmion dynamics

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Magnetic skyrmions are topologically-protected small cylindrical swirling spin structures with fascinating physical properties. Its predicted small size, high mobility, and small current required to displace suggests that magnetic skyrmions are suitable for high-density and low-power spintronics device applications. Magnetic skyrmions can be stabilized in materials with strong spin-orbit coupling and large Dzyaloshinskii-Moriya interaction (DMI). Recent studies have shown the creation of chiral magnetic skyrmion at room temperature in metallic thin film heterostructures [1-3] and their static motion on nanotracks [4]. However, the experimental observation of ultrafast dynamics of the chiral texture in real space has so far remained elusive due to the difficulty of experimentally obtaining nanosecond time resolution and sub-100nm spatial resolution simultaneously.

In this work, nanosecond-dynamics of a 100 nm-size magnetic skyrmions driven by current-induced spin-orbit torque is revealed. By using a time-resolved pump-probe soft X-ray imaging technique, the skyrmion dynamics during a current pulse application is measured. By changing the magnitude of the current pulse, the dynamic states of magnetic skyrmions, such as the breathing mode or the translational mode, can be reliably tuned. This shows that the dynamics of magnetic skyrmions can be controlled by the applied current density. We believe these observations open the door to versatile and novel skyrmionic applications.

## References

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