

Inertial spin dynamics in ferromagnets

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The understanding of how spins move and can be manipulated at pico- and femtosecond timescales has implications for ultrafast and energy-efficient data-processing and storage applications. However, the possibility of realizing commercial technologies based on ultrafast spin dynamics has been hampered by our limited knowledge of the physics behind processes on this timescale. Recently, it has been suggested that inertial effects should be considered in the full description of the spin dynamics at these ultrafast timescales, but a clear observation of such effects in ferromagnets is still lacking. In this talk, I will report direct experimental evidence of intrinsic inertial spin dynamics in ferromagnetic thin films in the form of a nutation of the magnetization at a frequency of ~ 0.5 THz. This allows us to reveal that the angular momentum relaxation time in ferromagnets is on the order of 10 ps. I will conclude the presentation showing the first x-ray holography images of magnetism at the European XFEL, which lay the foundation for ultrafast x-ray imaging with combined 10 fs and 10 nm resolution.

Kumar Neeraj et al, Nat. Phys. (2020).

<https://doi.org/10.1038/s41567-020-01040-y>