Ultrafast Magnetic Dynamics of Mott insulator Sr_2IrO_4

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Innovation of short-pulsed laser sources make it possible to observe the ultra fast phenomena that have never been reached so far. Recently X-ray Free-Electron Laser facilities, such as SACLA [1], have enabled us to observe the atomic states by using X-ray diffraction or X-ray scattering with ultra short time-resolution. Here, we implement magnetic resonant inelastic X-ray scattering at a free electron laser to directly determine the magnetization dynamics after photo-doping the Mott insulator Sr_2IrO_4 [2]. We find that the non-equilibrium state, 2 ps after the excitation, exhibits strongly suppressed long-range magnetic order, but hosts photo-carriers that induce strong, non-thermal magnetic correlations [3]. These two-dimensional (2D) in-plane N´eel correlations recover within a few picoseconds, while the three-dimensional (3D) long-range magnetic order restores on a fluence-dependent timescale of a few hundred pico-seconds. The dramatic difference in these two timescales implies that the dimensionality of magnetic correlations is vital for our understanding of ultrafast magnetic dynamics.

References

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