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XUV transient grating spectroscopy of electronic dynamics in spinel cobalt oxide

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Four wave mixing experiments in the extreme ultraviolet were pioneered at the free electron laser FERMI.1 In these experiments two coherent FEL pulses are overlapped on the solid sample creating a transient grating pattern which time evolution is probed by diffracting a delayed visible pulse. On solid samples, the XUV excitation creates a complicated phonons dynamics which dominates the diffracted signal. Observing electronic dynamics using this technique is a challenge and only smalls effects have been observed so far.2
In this presentation we report on the monitoring of electronic dynamics induced by excitation at the cobalt M2,3 edge of a Co3O4 sample in its spinel structure. Excitation of the cobalt core-levels at 63.5 eV is followed by monitoring the first and second orders of a diffracted 400 nm beam. To confirm the core-level excitation the FEL photon energy is tuned bellow and above the cobalt M2,3 edge. The time evolution of the diffracted first order shows very little changes with the excitation energy. On the other hand, the second order of diffraction shows large changes in its time evolution depending if the excitation is performed bellow or above the cobalt edge. These changes are tentatively described in terms of the evolution of the spatial profile of the XUV transient grating. The results demonstrate a new sensitive probe to follow XUV induced electronic dynamics with high spatial and temporal accuracies.

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