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Heisenberg vs. Stoner: Ultrafast magnon generation and exchange renormalization in the course of laser-induced demagnetization DMITRIY ZUSIN, EMRAH TURGUT, PATRIK GRYCHTOL, RONNY KNUT, JILA, University of Colorado - Boulder, DOMINIK LEGUT, Department of Condensed Matter Physics, Charles University, Prague, JUSTIN SHAW, HANS NEMBACH, THOMAS SILVA, Electromagnetics Division, NIST, Boulder, STEFAN MATHIAS, MARTIN AESCHLIMANN, Department of Physics, University of Kaiserslautern and Research Center OPTIMAS, CLAUS SCHNEIDER, Peter-Grunberg-Institut, Forschungszentrum Julich, KAREL CARVA, PETER OPPENEER, Department of Physics and Astronomy, Uppsala University, HENRY KAPTEYN, MARGARET MURNANE, JILA, University of Colorado - Boulder
— In this work, we access the microscopic mechanisms responsible for the ultrafast magnetization dynamics of ferromagnets following a femtosecond laser excitation. Using a tabletop high-harmonic source of extreme ultraviolet light, we perform magneto-optical pump-probe spectroscopic studies across the $M_{2,3}$ absorption edge of Cobalt with time, energy and angle resolution. This novel approach allows us to extract the time-dependent resonant magneto-optical properties of the Cobalt sample. In combination with ab-initio calculations of the density of states and the magneto-optical response, this gives us indirect access to ultrafast dynamics of the band structure. A comparison of our theoretical simulations with the experimental measurements suggests a variety of demagnetization mechanisms, which include ultrafast magnon excitations, enhanced electron temperature and transient renormalization of exchange splitting.

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