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Ultrafast Magnetization Enhancement in Metallic Multilayers Driven by Superdiffusive Spin Current EMRAH TURGUT, CHAN LA-O-VORAKIAT, PATRIK GRYCHTOL, HENRY C. KAPTEYN, MARGARET M. MURNANE, JILA/University of Colorado Boulder, USA, DENNIS RUDOLF, ROMAN ADAM, CLAUS M. SCHNEIDER, Peter Grünberg Institute, Jülich, Germany, MARCO BATTIATO, PABLO MALDONADO, PETER M. OPPENEER, Uppsala University, Sweden, STEFAN MATHIAS, MARTIN AESCHLIMANN, OPTIMAS/University of Kaiserslautern, Germany, JUSTIN M. SHAW, HANS T. NEMBACH, THOMAS J. SILVA, National Institute of Standards and Technology, Boulder, USA — We report on the surprising enhancement in the magnetization of iron in Ni:Fe based multilayer structures following the excitation by an ultrafast laser pulse. Few femtosecond extreme ultraviolet pulses from tabletop high harmonic generation, tuned to the M-edges of Ni and Fe, are used to probe the layer- and element- specific spin dynamics in multilayer structures of Ni/X/Fe, where X is Ru, Ta, W, or Si3N4. We find that both the Ni and Fe moments demagnetize on timescales of 100 fs when excited by an ultrafast optical pulse, for good spin scattering and insulating spacer layers consisting of Ta, W, and Si3N4. However, we also find that the Fe magnetization is enhanced by 16% for Ru spacer layers of 1.7 nm thickness, when the magnetizations of the Fe/Ni layers are initially aligned parallel. Our observations can be explained by a laser-generated superdiffusive spin current between the Ni and Fe layers, whereby a substantial current of majority spins injected into the Fe layer enhances its magnetization. [1] [1] D. Rudolf et. al. Nat. Comm. 3, 1037 (2012)

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