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**All-optical four-state magnetization reversal in (Ga,Mn)As ferromagnetic semiconductors** MYRON KAPETANAKIS[1], ILIAS PERAKIS, Physics Department, University of Crete, Greece, JINGANG WANG, Department of Physics and Astronomy, Iowa State University, and Ames Laboratory US-DOE, CARLO PIERMAROCCHI, Department of Physics and Astronomy, Michigan State University — The emerging field of femtomagnetism has revealed the central role of non-equilibrium interactions and transient optical coherence in determining photoinduced spin dynamics. However the many-body theory of such effects remains controversial. A microscopic theory that engages the elements of coherence, correlation and nonlinearity on an equal footing is needed. We propose here such a theory, based on density matrix equations of motion and a tight-binding band calculation. We prepare the system within 100fs, via coherent nonlinear photoexcitation close to the strong peak of the density of states for interband transitions along the eight equivalent directions {111} of the GaAs BZ in the vicinity of 3eV. It then selectively relaxes to one of the four local minima of the magnetic free energy with biaxial anisotropy. We thus propose a non–thermal mechanism for all-optical switching between four metastable magnetic states, initiated non-thermally within 100fs and completed within 100ps. Our predicted switching comes from magnetic nonlinearities triggered by a femtosecond magnetization tilt that is sensitive to un-adiabatic light-induced spin interactions and controlled via the optical and the external magnetic field.

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