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Observation of a Photon Echo and Measurement of Interband Dephasing in GaMnAs KIMBERLEY HALL, MURAT YILDIRIM, SAM MARCH, REUBLE MATHEW, ANGELA GAMOURAS, Dalhousie University, XINYU LIU, MARGARET DOBROWOLSKA, JACEK FURDYNA, University of Notre Dame — The carrier-mediated ferromagnetism exhibited by III-V diluted magnetic semiconductors (DMS), together with their large magneto-optical response, makes these materials promising for applications in optoelectronics, including integrated optical isolators and ultrafast optically-addressable memory elements. The time scale for decay of coherence in the carrier system (T_2) is a key parameter in models of coherent magnetization rotation [1], yet very little is known about the coherent response in DMS. We present results of four-wave mixing measurements of T_2 in GaMnAs. We observe a dramatic reduction in the dephasing time with the incorporation of Mn, consistent with earlier experiments in CdMnTe [2]. This fast dephasing process, which leads to an upper bound on T_2 of 40 fs for $x \geq 0.014\%$, is attributed to spin-flip scattering between the optically excited holes and Mn ions, providing new insight into exchange coupling and nonequilibrium magnetization dynamics in these materials. Direct measurement of the envelope of the four-wave mixing emission reveals a photon echo in GaMnAs, despite the complexity of exchange coupling and defect-induced band tailing.

[1] J. Chovan et al., Phys. Rev. Lett. 96, 057402 (2006).

[2] S. T. Cundiff et al. J. Opt. Soc. Am. B 13, 1263 (1996).

Kimberley Hall
Dalhousie University

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