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Observation of a Sharp Band Edge Response in GaMnAs Using Nonlinear Spectroscopy[1] TRISTAN DE BOER, ANGELA GAMOURAS, SAM MARCH, Dalhousie University, VIT NOVAK, Institute of Physics AS CR, Czech Republic, KIMBERLEY HALL, Dalhousie University — Diluted magnetic semiconductors (DMS) have gained considerable interest over the last decade owing to their potential use in magneto-sensitive electrical and optical devices, in which the carrier-mediated nature of the ferromagnetism allows the magnetic properties to be controlled using optical or electrical gating techniques. The position of the Fermi level, which may lie within the valence band or within an impurity band, plays a critical role in current theories of ferromagnetism in DMS and has been the subject of intense controversy in recent years. Linear spectroscopy techniques are unable to address this issue due to strong band tailing in the vicinity of the fundamental band gap. Here we present results of time- and spectrally-resolved differential reflection measurements on GaMnAs, as well as low-temperature-grown GaAs and semi-insulating GaAs. Our results indicate a sharp band edge response due to the diminished contributions of band tail states in the nonlinear optical regime. We observe a blue shift of the band gap in GaMnAs, supporting a valence band model of ferromagnetism in DMS. Numerical simulations of the measured nonlinear response using an effective mass model support our conclusions.

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