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All-Optical observation of Nuclear Magnetic Resonance in a 2D electron system YANG JI, XUAN QIAN, SKLSM, Institute of Semiconductors, Chinese Academy of Sciences, Beijing 100083, PR China, VLADIMIR UMANSKY, Braun Center for Submicron Research, Department of Condensed Matter Physics, Weizmann Institute of Science,Rehovot 76100, Israel — Electron-nuclear spin interaction may be utilized to manipulate nuclear states coherently in quantum computation. Here we report on an all-optical observation of nuclear magnetic resonance (NMR) in a 2D electron system embedded in a GaAs/AlGaAs heterostructure. In analogy to radio-frequency fields used in traditional NMR, circularly polarized light creates electron spins in semiconductors whose hyperfine coupling with nucleis could tip nuclear moments. At a fixed time-delay ∼12.5ns, time-resolved Kerr-rotation (TRKR) signals were measured as a function of the modulation frequency (from 1 KHz to 100 kHz) of the pump laser. Spin-polarized carriers generated by the pump laser pulse train acts on the nuclear spins as an effective rf magnetic field synchronized at the pulse repetition frequency, which resonates nuclear spins at suitable frequencies in an external magnetic field in Voigt geometry. Several dips were observed in a TRKR trace at, which shift linearly with increasing magnetic field. They are ascribed to be NMR signals of elements As-75, Ga-69, Al-27 and Ga-71.

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