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Terahertz Coherent Control of Cyclotron Resonance in the Quantum Hall Regime T. ARIKAWA, X. WANG, J. KONO, Rice University, D.J. HILTON, University of Alabama at Birmingham, J.L. RENO, W. PAN, Sandia National Laboratories — We report on the creation and coherent control of a superposition of many-electron quantum states (or a qubit) in a Landau-quantized GaAs two-dimensional electron gas (2DEG) using a sequence of coherent terahertz (THz) pulses. The first pulse excites electrons from the highest-filled Landau level (LL) to the lowest-unfilled LL, creating a superposition of the two LLs which re-emits a coherent THz wave. We found that the second THz pulse incident within the decoherence time stops or enhances the THz re-emission depending on its arrival phase. These results show that an arbitrary coherent control of the LL qubit is possible using THz pulses. We also performed a simulation within the framework of single-particle optical Bloch equations, which reproduced the experimental results surprisingly well. This agreement shows that the 2DEG behaves in the same way as a single-electron two-level system despite the fact that it contains a large density of interacting electrons. This finding extends the Kohn's theorem to a more general level of coherent dynamics.

Takashi Arikawa
Rice University

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