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Coherent Terahertz Magneto-Spectroscopy of High-Mobility Two-Dimensional Electron Gases QI ZHANG, TAKASHI ARIKAWA, Rice Univerisy, WEI PAN, JOHN RENO, Sandia National Laboratory, JOHN WATSON, MICHAEL MANFRA, Purdue University, JUNICHIRO KONO, Rice Univerisy, RICE UNIVERSITY TEAM, SANDIA NATIONAL LABORATORY COLLABORATION, PURDUE UNIVERSITY COLLABORATION — Landau-quantized high-mobility two-dimensional electron gases (2DEG) in GaAs quantum wells provide an ideal platform for studying and controlling the coherence of many-electron states. Here, we study the coherent dynamics of cyclotron resonance (CR) in a 2DEGin the terahertz range. It is well known that Kohn's theorem protects the CR frequency from the influence of electron-electron interactions, but how the coherence of CR decays via electron-electron interactions is an open question. Since the 1980s, studies have focused on CR decoherence time measurements, primarily using incoherent far-infrared spectroscopy, which fails to obtain the true CR linewidth due to the 'saturation effect' in high-mobility systems. By using coherent time-domain magneto-terahertz spectroscopy, we have systematically studied the CR decoherence time in an ultrahigh-mobility 2DEG as a function of both temperature and magnetic field. These results show a clear saturation of the CR decoherence time at low temperature, which decreases monotonically with increasing magnetic field. No filling-factor-dependent oscillations of CR dephasing time have been observed. Possible CR decoherence mechanisms will be discussed in light of these new findings.

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