Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Collective magneto-polariton excitation in a terahertz photonic cavity QI ZHANG, MINHAN LOU, XINWEI LI, Rice University, ANDREY CHABANOV, University of Texas at San Antonio, JOHN RENO, WEI PAN, Sandia National Laboratory, JOHN WATSON, MICHAEL MANFRA, Purdue University, JUNICHIRO KONO, Rice University — Collective excitations in solids offer new opportunities for quantum optical studies. Many-body interactions inherent to condensed matter systems can lead to novel phenomena that cannot be achieved in traditional atomic systems. Here, we report collective ultrastrong light-matter coupling in a two-dimensional electron gas in a high-Q terahertz photonic-crystal cavity in a magnetic field. We directly observed time-domain vacuum Rabi oscillations, whose frequency was found to be proportional to the square root of N (where N is the carrier density), evidence for the *collective* nature of ultrastrong coupling. In addition, a small but definite blue shift due to the diamagnetic term in the Hamiltonian was observed for the polariton frequencies, which is another signature of ultrastrong light-matter coupling. Furthermore, the high-Q cavity suppressed the superradiant decay of cyclotron resonance, which resulted in unprecedentedly narrow intrinsic cyclotron resonance linewidths ($\sim$5.6 GHz at 2 K). Our method is also applicable to many classes of strongly correlated systems with collective many-body excitations in the terahertz range, opening a door to the fascinating physics of terahertz many-body cavity QED.

Qi Zhang
Rice University

Date submitted: 02 Nov 2015 Electronic form version 1.4