Cavity quantum electrodynamics with two-dimensional electron systems.

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Reversible coupling of excitons and photons in intrinsic semiconductor quantum wells embedded inside a microcavity has been used to study non-equilibrium condensation and superfluidity of cavity polaritons. The attempts to use this system to observe polariton blockade on the other hand, has been hindered by the relatively weak electron-exchange dominated interaction that scales linearly with the exciton Bohr radius. I will present experiments on a high-mobility two-dimensional electron gas (2DEG) simultaneously exhibiting strongly correlated phases and non-perturbative coupling to a microcavity mode. Tuning the cavity into resonance with the electron gas when magnetic field $B_z = 0$ allows us to demonstrate a new dynamic regime of Fermi-edge physics where many-body excitations are delocalized trion Fermi-edge polaritons. With $B_z \neq 0$, the cavity-polariton excitations show unique signatures of both integer and fractional quantum Hall states. The system is potentially of interest for realizing strongly correlated photonic systems since it may be possible to exploit strong electron density dependence of 2DEG-polariton splitting, or equivalently the trion Bohr radius, to enhance polariton-polariton interactions.