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Quantum Electron-Hole Droplets in Gallium Arsenide Quantum Wells ANDREW HUNTER, HEBIN LI, STEVEN CUNDIFF, Univ of Colorado - Boulder, MARTIN MOOTZ, MACKILLO KIRA, STEPHAN KOCH, Philipps-University Marburg — In a solid, the choice of appropriate quasiparticles greatly simplifies our understanding of the system. For example, (quasi)electrons allow one to disregard the interaction between an electron and the macroscopic number of ionic potentials in a solid, and instead treat the system as a free quasielectron with an effective mass. Similarly, we improve our understanding of the complex electronic many-body system in a solid if we can identify the stable many-body quasiparticles of the system, such as excitons, biexcitons, and trions. We present experimental and theoretical evidence for the existence of a new quasiparticle that we call a quantum droplet, a charge-neutral bound state of a few electrons and holes. Unlike the macroscopic electron-hole droplets observed in indirect-gap semiconductors, quantum droplets contain only a small number of particles, leading to quantization of binding energy, but with a two-particle correlation function characteristic of a liquid. Using transient-absorption spectroscopy with ultrafast pulses, we show that we can create quantum droplets in gallium arsenide quantum wells. Projection onto a correlated quantum optical state allows us to separate the effects of the droplet state from other multiple-particle states, such as biexcitons.

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