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Spin Dependent Onset of Exciton Condensation in Bilayer Quantum Hall Systems

L.A. TRACY, Caltech

At total filling factor $\nu_{tot} = 1$, a bilayer two- dimensional electron system at high perpendicular magnetic fields and small interlayer spacing can enter an exotic new collective phase displaying spontaneous interlayer quantum phase coherence. This phase can be viewed in various ways, including as a Bose condensate of interlayer excitons. Using a combination of heat pulse and NMR techniques we show that the location of the phase boundary between this phase and the weakly coupled, compressible phase at larger layer spacing is influenced by the spin polarization of the nuclei in the host semiconductor. Due to the hyperfine interaction between the electrons and nuclei, a reduction in the nuclear polarization increases the electronic Zeeman energy. By depolarizing the nuclei via thermal pulses or RF radiation tuned to a nuclear resonance frequency, we are able to temporarily create the excitonic phase at larger layer spacing than it exists in equilibrium. This result demonstrates that, contrary to the usual assumption, the transition from the compressible, weakly coupled bilayer phase to the excitonic phase is accompanied by a change in the electronic spin polarization.

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