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Excitonic Superfluid Phase in Double Bilayer Graphene Heterostructure[1] JIA LI, Columbia University, TAKASHI TANIGUCHI, KENJI WATANABE, National Institute for Materials Science, JAMES HONE, CORY DEAN, Columbia University — Spatially indirect excitons can be created when an electron and a hole, confined to separate layers of a double quantum well system, bind to form a composite Boson. Because there is no recombination pathway such excitons are long lived making them accessible to transport studies. With the ability to independently tune both the intralayer charge density and interlayer elecron-hole separation, graphene-Boron Nitride (BN) heterostructures provides access to the low-density, strongly interacting regime where a BEC-like phase transition into a superfluid ground state is anticipated. We observed the exciton condensate in the quantum Hall effect regime of double layer structures of bilayer graphene. Correlation between the layers is identified by quantized Hall drag appearing at matched layer densities, and the dissipationless nature of the phase is confirmed in the counterflow geometry. Independent tuning of the layer densities and interlayer bias reveals a selection rule for the condensate phase involving both the orbital and valley quantum number between the symmetry-broken states of bilayer graphene. Novel excitonic phases are also observed in higher order LLs and in the electron-hole bilayer regime.

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