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Spatially Indirect Exciton Condensates in Double Bilayer Graphene JUNG-JUNG SU, Department of Electrophysics, National Chiao Tung University, ALLAN H. MACDONALD, Department of Physics, University of Texas at Austin — Many-body interaction effects have a strong influence on the low-energy electronic properties of graphene bilayers because of the nearly quadratic dispersion at the K/K band-crossing points. In the single graphene bilayer systems, the ground state has an energy gap thought to be a consequence of spin-density wave order and other competing ordered states are believed to be nearby in energy. In systems with two closely spacing bilayer, spatially indirect exciton states are expected in neutral systems with inter-bilayer charge transfer. This transfer can be achieved by applying either a vertical electrical displacement fields or an interbilayer potential bias. Here we report that the different combinations of displacement field and potential bias can give rise to different types of indirect exciton condensate states that are distinguished by the two-dimensional momentum dependence of the spontaneous inter-bilayer coherence. In general a displacement field prefers an excitonic condensate in which the phase coherence between the inner two layers of the four layer system, while the potential bias prefers momentum-independent coherence between remote layers. The complete phase diagram reported exhibits excitonic coherence states mentioned above, and more interestingly, their mixtures.

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