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Local Compressibility Measurements of Correlated States in Suspended Bilayer Graphene[1]

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Bilayer graphene has attracted considerable interest due to the important role played by many-body effects, particularly at low energies. The exceptional quality of suspended devices has enabled the observation of interaction-driven broken-symmetry states and the fractional quantum Hall effect. Here we report local compressibility measurements of a suspended graphene bilayer. We find that the energy gaps at filling factors +/- 4 do not vanish at low fields, but instead merge into an incompressible region near the charge neutrality point at zero electric and magnetic field. These results indicate the existence of a zero-field ordered state and are consistent with the formation of either an anomalous quantum Hall state or a nematic phase with broken rotational symmetry. At higher fields, we measure the intrinsic energy gaps of broken-symmetry states at filling factor 0, +/- 1 and +/-2, and find that they scale linearly with magnetic field, yet another manifestation of the strong Coulomb interactions in bilayers.

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