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Landau level crossing and charging instabilities in a double-gated graphene bilayer[1] L.M. ZHANG, UCSD, M.M. FOGLER, D.P. AROVAS, UCSD, F. GUINEA, ICMM CSIC, Spain — We show that the "Mexican-hat" band structure of a graphene bilayer in zero magnetic field leads to multiple Landau level (LL) crossings in a finite field. We present an intuitive picture of this phenomena based on a semiclassical quantization and explain the role of the Berry phase therein. We propose that the LL crossings would produce distinct experimental signatures, such as bistability, hysteresis, and transport anisotropy due to quantum Hall Ising ferromagnetism and the domain formation. A two-gate experimental setup for independent control of the band structure and chemical potential is proposed. The corresponding electrostatic problem is solved self-consistently and the LL spectrum is computed numerically. In ultraclean samples the nonlinearity of the electrostatic equations may result in bistability even in the absence of quantum Hall ferromagnetism. It would show up every time a new LL is populated.

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