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Bilayer Graphene: Interaction-Induced Quantum Hall States and Unusual Excitations SHIVAJI SONDHI, D.A. ABANIN, S.A. PARAMESWARAN, Princeton University — Recently, new interaction-induced quantum Hall (QH) states were observed[1] in bilayer graphene (BG). In this talk we address the nature of these QH states, as well as their properties[2]. We focus on the ferromagnetic (FM) states at even filling factors, which, in the leading approximation, result from the spontaneous breaking of valley/spin $SU(4)$ symmetry. Calculating microscopic anisotropies of the QHFM, we find the order in which Landau level (LL) degeneracies are lifted. Furthermore, we discuss the phase diagram of the system as a function of perpendicular electric field and parallel magnetic field, and find that they can be used to drive transitions between different QH states. We show that, as a result of unusual LL structure of BG, some of the QHFM states support new type of excitations – spin/valley textures (skyrmions) that carry charge two, which provides a unique example of pairing of charges in a system with purely repulsive interactions. We propose several experiments to test our findings.

[1]B. Feldman et al., Nature Physics, doi:10.1038/nphys1406 (2009); Y. Zhao et al., arXiv:0910.0217 (2009).
[2]D. Abanin et al., Phys. Rev. Lett. 103, 076802 (2009), and to be published.

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