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Gauge Fields and Interlayer Coherence in Bilayer Composite Fermion Metals ROBERT CIPRI, N.E. BONESTEEL, Florida State University, NHMFL — The v= 1 (=1/2+1/2) bilayer quantum Hall system exhibits at least two distinct phases as a function of layer spacing, d. In the limit of large layer spacing ($d >> l$, where l is magnetic length) the system decouples into two distinct compressible v= 1/2 "composite Fermi liquid" states. In the opposite limit of small layer spacing ($d << l$) the system enters an incompressible bilayer quantum Hall state (the "111" state). After decades of study, the transition between these two states is still poorly understood. Recently, Alicea et al. [1] have proposed an interesting new state which might exist in this system for intermediate layer spacing ($d \sim$ l). In this so-called "interlayer phase coherent" state, composite fermions tunnel coherently between layers and form well-defined bonding and antibonding Fermi seas, despite the fact that there is no actual tunneling of physical electrons. We study the effect of the Chern-Simons gauge fields associated with the composite fermions on the formation of such an interlayer phase coherent state. We show that scattering from these gauge fields leads to layer-dependent fluctuations in the Aharonov-Bohm phase of the composite fermions which strongly suppress interlayer phase coherence. This suppression manifests itself through the appearance of a contribution to the ground state energy which is logarithmically singular in the order parameter characterizing this interlayer coherence.

[1] J. Alicea, O. I. Motrunich, G. Refael, M. P. A. Fisher, Phys. Rev. Lett. 103, 256403 (2009)

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