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Abstract for an Invited Paper
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Interlayer Coherence and Transport in Quantum Hall Bilayers and Dirac Materials

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I will discuss two phenomenological descriptions of low-current transport in bilayer quantum Hall system with exciton condensates [1], one based on a Landauer-Buttiker description of Andreev scattering at contacts to coherent bilayers, and one based on a simplified single-parameter p-ology description of the weak to strong interlayer coupling crossover. The Andreev scattering phenomenology is intended to apply when the condensate is well developed and is used to predict current-voltage relationships for a variety of two-contact geometries. I will also apply this formalism to circumstances in which the tunnel current exceeds its critical value and the condensate is time-dependent. The p-ology approach will establish the universal development of large longitudinal drags, even in homogeneous coherent samples, as the condensate weakens and the Hall drag is reduced. Further, I will discuss the interaction-enhanced coherence in layered Dirac systems: two graphene or topological insulator surface-state layers, and the estimates of its strength based on the imaginary-axis gap equations in the random phase approximation [2]. Using a self-consistent treatment of dynamic screening of Coulomb interactions in the gapped phase, I will show that the excitonic gap can reach values on the order of the Fermi energy at strong interactions. The gap will turn out to be a discontinuous function of the interlayer separation and effective fine structure constant, revealing a first-order phase transition between effectively incoherent and interlayer coherent phases.

[1] D. A. Pesin and A. H. MacDonald, Phys. Rev. B 84, 075308 (2011)
[2] Inti Sodemann, D. A. Pesin, and A. H. MacDonald, Phys. Rev. B 85, 195136 (2012)