Electronic transport in a bi-layer system of total Landau filling $\nu = 1$

– from Coulomb drag to a \textit{dc} voltage step-up transformer

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In this talk I will review several transport phenomena associated with a bi-layer electronic system at a total Landau filling $\nu = 1$. In particular,

1. I will discuss the transition of the bi-layer from the weak- to the strong- coupling regime. Making the assumption that in the transition region the system is made of puddles of the (1,1,1) phase embedded in a bulk of the weakly coupled state, I will show that the transition is accompanied by a strong increase in longitudinal Coulomb drag, that reaches a maximum of approximately $\hbar/2e^2$. In that regime the longitudinal drag is increased with decreasing temperature.

2. I will show that a properly designed geometry of a $\nu = 1$ bi-layer system may serve as a \textit{dc} voltage step-up transformer, in which the output \textit{dc} voltage may be made arbitrarily larger than the input \textit{dc} voltage.

3. If time permits, I will make a few comments regarding the physics of paired quantum Hall states, e.g., at a bi-layer of a total Landau filling of $\nu = 1/2$.

My collaborators in the works I will present are Bertrand I. Halperin (Harvard) and Steven M. Girvin (Yale).