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$\nu = 1/2 + 1/2$ Quantum Hall Bilayers

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Quantum Hall bilayer systems at filling fractions near $\nu = 1/2 + 1/2$ undergo a transition from a compressible phase with strong intralayer correlation to an incompressible phase with strong interlayer correlations as the layer separation d is reduced below some critical value. Deep in the intralayer phase (large separation) the system can be interpreted as a fluid of composite fermions (CFs), whereas deep in the interlayer phase (small separation) the system can be interpreted as a fluid of composite bosons (CBs). The focus of this paper is to understand the states that occur for intermediate layer separation by using trial variational wavefunctions. We consider two main classes of wavefunctions. In the first class, previously introduced in we consider interlayer BCS pairing of two independent CF liquids. We find that these wavefunctions are exceedingly good for $d \gtrsim \ell_0$ with ℓ_0 the magnetic length. The second class of wavefunctions naturally follows the reasoning of [2] and generalizes the idea of pairing wavefunctions by allowing the CFs also to be replaced continuously by CBs. This generalization allows us to construct exceedingly good wavefunctions for interlayer spacings of $d \lesssim \ell_0$, as well. The accuracy of the wavefunctions discussed in this work, compared with exact diagonalization, approaches that of the celebrated Laughlin wavefunction. More details can be found online in [3].

[1] G. Moller, S. H. Simon, and E. Rezayi PRL **101**, 176803 (2008).
[2] S. H. Simon, E. Rezayi, and M. Milovanovic PRL **91**, 046803 (2003)
[3] G. Moller, S. H. Simon, and E. Rezayi, arXiv:0811.4116