Quantum Disordering of the 111 State and the Compressible–Incompressible Transition in Quantum Hall Bilayer Systems

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Abstract. We systematically investigate quantum disordered states of the quantum Hall bilayer at filling factor $\nu_T = 1$ using trial wave functions and the idea of composite boson–composite fermion mixture. For one of these wave functions, the so-called vortex metal state, we find ODLRO (off-diagonal long-range order) of *algebraic* kind, and derive its properties within the framework of Chern-Simons RPA response. It is shown that this state is able to reproduce the basic phenomenology of quantum Hall transport measurements and is furthermore relevant for the explanation of the "imperfect" superfluid behavior, and persistent intercorrelations, for large distances between layers, that were found in experiments. Additional properties of the model states are explored using Chern-Simons field theory and effective plasma calculations, thereby linking the physics of the vortex metal state to the predicted Kosterlitz-Thouless phase transition scenario in a bilayer.