Strong Bulk–Edge Coupling in the Compressible Half–Filled Quantum Hall State

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We studied analytically static correlators in the compressible half–filled quantum Hall state, which characterize the nature of charged excitations in the bulk and on the edge of the system. We employ a modified version of the plasma analogy - namely, a mapping to a classical two–dimensional system of interacting particles - similarly to what has been done in studies of the incompressible (Laughlin) states. However, the 'fake plasma' corresponding to the half–filled state is found to have *anomalously weak* screening properties. As a consequence, the correlations along the edge do not decay algebraically as in the incompressible case, thus indicating the breakdown of Wen's edge theory. On the other hand, the bulk correlator (which parallels the Girvin–MacDonald algebraic off–diagonal long range order) decays algebraically in a similar way as in the incompressible states, signifying the presence of some kind of bosonic order even in the compressible state.
The above results suggest that due to the strong coupling between charged modes on the edge and the neutral Fermions (dipoles) in the bulk, the (attractive) correlation hole is not well defined on the edge. Hence, the system there can be modeled as a free Fermi gas of *electrons* (with an appropriate boundary condition). A possible experimental indication of a strong bulk–edge coupling at half–filling has been indeed observed in non–local resistance measurements [1]. We also suggest, that while our results contradict the validity of an effective one–dimensional description of the edge excitations on the *static* level, the *dynamics* may decouple the edge and bulk so as to recover the Laughlin–like behavior apparent in the experiment of Grayson *et al* [2].

[1] J. K. Wang and V. J. Goldman, Phys. Rev. Lett. **67**, 749 (1991); and Phys. Rev. B **45**, 13479 (1992).
[2] M. Grayson *et al*, Phys. Rev. Lett. **80**, 1062 (1998).