INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

In this work, the most singular contribution to the density density correlation functions (DDCF) of strongly inhomogeneous Luttinger liquids is derived and is shown to be expressible as compact analytical functions of position and time with second order poles and involving the scale independent bare reflection and transmission coefficients. The results are validated on comparison with standard fermionic perturbation theory. The DDCF is a crucial input to the powerful non-chiral bosonization technique (NCBT) that has been successfully used to obtain the correlation functions of inhomogeneous systems in one dimension whilst treating the impurity backscattering non-perturbatively, unlike conventional methods. The exact dynamical non-equilibrium Green functions (NEGF) for a system of noninteracting chiral quantum wires coupled through a point-contact is obtained analytically. The system considered is isomorphic to integer quantum Hall (IQHE) edge states coupled through a point-contact constriction. The tunneling I-V characteristics is obtained for an arbitrary time-dependent bias in the case of infinite bandwidth in the point-contact. The case of finite bandwidth in the point-contact is also studied and non-Markovian transients in the tunneling current is observed upon sudden switch on of a bias voltage. The transient phenomena is consistent with numerical simulations and is observed to be a consequence of the appearance of a short distance cutoff in the problem when a finite bandwidth is considered. In a subsequent work, an unconventional bosonization procedure similar to NCBT is introduced, and is used to reproduce the exact NEGF of noninteracting chiral quantum wires coupled through a point-contact driven out of equilibrium by application of a bias. The novel unconventional bosonization scheme is shown to be internally consistent with Wick's theorem used to obtain four-point functions. The proposed bosonization procedure can be extended to the case of fractional quantum Hall (FQHE) edge states with a point-contact wherein interparticle interactions become important. The FQHE edge states with single channel edge modes like in the Laughlin series, are modelled as chiral Luttinger liquids. In subsequent works, the DDCF for chiral Luttinger liquids with an impurity is computed using a generating functional method and is shown to be consistent with fermionic perturbation theory. The obtained interacting DDCF is used in conjunction with the unconventional bosonization procedure to derive the tunneling density of states (TDOS) at the point-contact for electron tunneling and quasiparticle tunneling cases, and the results agree with the accepted literature, thereby demonstrating the utility of the novel bosonization procedure in obtaining non-perturbatively, the correlation functions (most singular part) of inhomogeneous systems in one dimension.