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Bethe Ansatz approach to equilibrium and quench dynamics in the Richardson model

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Abstract

In the recently developed field of ultra cold fermionic gases, detuning from a Feshbach resonance allows one to control the effective interaction between fermions. It also becomes possible to modify the interaction on time scales short enough to make the change effectively instantaneous.

The feasibility of such experiments has resulted in a renewed interest in the quench dynamics of fermion pairing. This led to numerous theoretical studies of this problem using the Richardson (or reduced BCS) model but so far these calculations have only been carried out using a mean-field description.

Using properties specific to this integrable quantum model, I intend to show how the exact solution obtained through the algebraic Bethe Ansatz gives access to the full quantum dynamics of this system following a sudden change in the interaction between particles, i.e. an interaction quench.

This approach can be used for finite-size systems which are larger than those accessible to exact diagonalization methods, applies for quenches in which a large interaction change prevents the use of perturbative methods and, since no errors accumulate as time is evolved, it also allows us to study long-time behavior.

Moreover, since the Bethe Ansatz solution also gives access to the equilibrium dynamical properties of the system, the zero-temperature frequency dependent correlation functions will also be discussed.