
On solving a quantum many body problem by experiment

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Abstract

The knowledge of all correlation functions of a system is equivalent to solving the corresponding quantum many-body problem [1]. If one can identify the relevant degrees of freedom, the knowledge of a finite set of correlation functions is in many cases sufficient to determine a sufficiently accurate solution of the corresponding field theory. Complete factorization is equivalent to identifying the degrees of freedom where the Hamiltonian becomes diagonal. I will give examples how one can apply this powerful theoretical concept in experiment.

Interference in a pair of tunnel-coupled one-dimensional atomic super-fluids, which realize the quantum Sine-Gordon model, allows us to study if, and under which conditions the higher correlation functions factorize [2]. We characterize the essential features of the model solely from our experimental measurements: detecting the relevant quasi-particles, their interactions and the different topologically distinct vacuum-states.

This establishes a general method to analyse quantum systems through experiments and a crucial ingredient towards the implementation and verification of quantum simulators.

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