LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

ARNOLD SOMMERFELD CENTER FOR THEORETICAL PHYSICS

Sommerfeld Theory Colloquium

Prof. Jörg Schmiedmayer

Vienna Center for Quantum Science and Technology (VCQ), Atominstitut, TU-Wien

High order correlations and what we can learn about the solution for many body problems from experiment

The knowledge of all correlation functions of a system is equivalent to solving the corresponding quantum many-body problem. 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 relevant degrees of freedom where the Hamiltonian becomes diagonal. I will give examples how one can apply this powerful theoretical concept in experiment.
A detailed study of non-translation invariant correlation functions reveals that the pre-thermalized state a system of two 1-dimensional quantum gas relaxes to after a splitting quench [1], is described by a generalized Gibbs ensemble [2]. This is verified through phase correlations up to 10^{th} order.
Interference in a pair of tunnel-coupled one-dimensional atomic super-fluids, which realize the quantum Sine-Gordon / massive Thirring models, allows us to study if, and under which conditions the higher correlation functions factorize [3]. This allowed us to 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 the quasi-particles live in. The experiment thus provides a comprehensive insight into the components needed to solve a non-trivial quantum field theory.
Our examples establish a general method to analyse quantum systems through experiments. It thus represents a crucial ingredient towards the implementation and verification of quantum simulators.

Work performed in collaboration with E.Demler (Harvard), Th. Gasenzer und J. Berges (Heidelberg). Supported by the Wittgenstein Prize, the Austrian Science Foundation (FWF): SFB FoQuS: F40-P10 and the EU: ERC-AdG *QuantumRelax*

[1] M. Gring et al., Science, **337,** 1318 (2012);
[2] T. Langen et al., Science **348** 207-211 (2015).
[3] T. Schweigler et al., Nature **545**, 323 (2017), arXiv:1505.03126

Wednesday, January 17, 2018, 16.15 h, Room 348 / 349, Theresienstr. 37 / III

Prof. U. Schollwöck