Stuttgarter Physikalisches Kolloquium

Fachbereich Physik, Universität Stuttgart

Max-Planck-Institute für Festkörper- und Metallforschung

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Dienstag, 3. Juli 2007	17.15 Uhr	Hörsaal V 57.01

Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart-Vaihingen

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DISENTANGLING STRONGLY CORRELATED QUANTUM SYSTEMS

Prof. Ulrich Schollwoeck, RWTH Aachen

Abstract

Recent years have seen an emerging overlap between the physics of strongly correlated condensed matter systems and the physics of ultracold atomic lattice gases which provide a toolbox for the simulation of such systems. This has allowed unprecedented system control and tunability of interactions, giving new insights, for example, in the physics of quantum phase transitions or of quantum systems out of equilibrium. At the same time, old problems of strong correlations e.g. in the cuprates, or quantum dot systems, remain.

The purpose of my talk is to show that these old and new physical challenges have been accompanied by very recent methodological breakthroughs in computational simulation techniques (namely the density-matrix renormalization group) which are now understood to be situated on the boundary between conventional many-body physics and quantum information theory. This implies in particular progress beyond simulating static properties of one-dimensional systems, under good control for some time.

I want to show how the (out of equilibrium) dynamics of one-dimensional quantum systems is now under computational control, exemplifying it by various phenomena in ultracold atoms. At the same time, these new insights have also allowed progress far beyond Wilson renormalization for quantum impurity problems. In an outlook, I will discuss whether these new techniques may be on the brink of providing high-quality numerics for two-dimensional correlated quantum models such as the Hubbard model and perhaps even in the context of real materials simulations.

(Kolloquiums-Tee gibt es um 16.45 Uhr im Seminarraum des 4. Physikalischen Instituts, Raum 4.319. Studenten sind herzlich eingeladen.)