

Stuttgarter Physikalisches Kolloquium

Fachbereich Physik, Universität Stuttgart
Max-Planck-Institut für Festkörperforschung
Max-Planck-Institut für Intelligente Systeme

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Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart-Vaihingen

Gastgeber: Prof. Peter Michler, Universität Stuttgart, Telefon: 0711 - 685-64660

Exploring Quantum Processes with Few Atom Systems: A Route Towards Quantum Technology?

Dieter Meschede

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Abstract

In the so called bottom-up approach to controlled atomic quantum matter small quantum systems are synthesized involving single, few or many atom systems. We will discuss two examples: I will discuss that controlled interaction of atoms with a high finesse optical resonator can lead to a strongly preferred emission of light into optical wave guides (Purcell effects) which is useful for future interconnects in hybrid quantum networks.

With quantum walks – i. e. driven discrete transport on a lattice conditioned on the spin state - we operate a new tool realizing coherent transport of atoms over tens of lattice sites – up to the so called quantum speed limit. I will present the experimental realization of “ideal negative measurements” showing strong violation of the Leggett-Gard inequality. The experiment distinguishes quantitatively the macro realist’s world from the quantum world. The new transport device also allows transport in 2D space promising to retro engineer low entropy Mott states. Quantum indistinguishability is now opening up a new window to study interacting few body systems in unusual lattice settings including very strong pseudo magnetic fields, topologically interesting situations, and a scheme to create entanglement without interaction. The ultimate aim of these experiments is the creation of quantum cellular automata.