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Einladung zum Vortrag

Discrete-time quantum machines with neutral atoms in state-dependent optical lattices

von

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Termin: **Donnerstag, 01.02.2018, 08:30 Uhr**

Ort: **Christian-Doppler-Hörsaal**
9. Boltzmanngasse 5 / Strudlhofgasse 4, 3. Stock

Abstract:

I will report on discrete-time quantum walk experiments carried out using neutral atoms in state-dependent optical lattices: A Caesium atom in two possible spin states of its outermost valence electron behaves like a pseudo spin-1/2 particle. Depending on the spin state, the atom is moved at regular time steps either one site to the left or to the right, delocalizing it over multiple quantum paths. The fact that the dynamical rules of a quantum walk can be "reprogrammed" at will makes them very versatile quantum systems. We use this flexibility to reproduce the behaviour of charged particles in external fields [1] and to simulate novel topological phases of periodically driven topological insulator materials [2]. By making use of ideal negative measurements, we obtain insight into the "quantumness" of the walk by demonstrating a 6σ violation of the Leggett-Garg inequality [3]. This result strictly rules out any physical interpretation based on well-defined trajectories.

Underlying these experiments are polarization-synthesized optical lattices—a novel implementation of state-dependent optical lattices [4]. The key elements for their realization are two perfectly superimposed, yet independently controllable optical standing waves with opposite circular polarizations, which allow us to shift atoms in either spin-up or spin-down states with a precision of 1Å.

I will conclude with an outlook towards Hong-Ou-Mandel-like interference experiments, which allow the detection of quantum statistics using a pair of distant atoms [5]. Generalizations to a higher number of identical atoms hold the promise to realize quantum cellular automata in complex quantum circuits.

References

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