Posters

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The maximally entangled set of tripartite qutrit states & examples of pure state transformations which are possible via separable operations but not via LOCC

The Maximally Entangled Set (MES) introduced in [1] generalizes the idea of maximally entangled states from the bipartite to the multipartite setting. In the bipartite setting there exists a so-called maximally entangled state with the property, that this state cannot be reached from any other state via Local Operations and Classical Communication (LOCC). However, any other state can be obtained from the maximally entangled one. In the multipartite setting, however, there is no such state, but the property can be generalized to a set of states, the MES. As in the bipartite case we expect that studying the MES will enhance our understanding of quantum entanglement. The MES has been characterized for three and generic four qubit states in [1]. Here, the notion of the MES will be reviewed and the characterization of the MES for tripartite qutrit states will be presented.
We will also present surprising examples of pure state transformations which can be implemented via separable opertaions (SEP), but not via LOCC.

[1] J.I. de Vicente, C. Spee and B. Kraus, PRL 111, 110502 (2013)

Kosmas Kepesidis*, ATI Wien*

PT-symmetry breaking phenomena in the steady state of coupled phonon lasers

The breaking of a combined PT (parity- and time-reversal) symmetry in non-Hermitian systems with equal gain and loss is conventionally associated with a transition from a purely oscillatory to an exponentially amplified dynamical regime. In this work we analyze the stationary phases of systems with an underlying PT symmetry and show that nonlinear saturation effects and the presence of noise in real systems result in an unexpected behavior, which differs significantly from the usual dynamical picture. In particular, we observe additional phases with preserved or ‘weakly’ broken PT symmetry and an unconventional transition from a high-noise thermal to a low-amplitude coherent state. In the present analysis these effects are illustrated for the specific example of coupled mechanical resonators with optically induced loss and gain, but the basic mechanisms described in this work will be important for understanding more generally the steady state of realistic physical systems with PT symmetry.

Marco Mattioli, *IQOQI Innsbruck*

From classical to quantum non-equilibrium dynamics of Rydberg excitations in optical lattices

The glass phase and its quantum analog are prominent challenges of current non-equilibrium statistical mechanics and condensed matter physics. As a model system to study the transition from classical to quantum glassy dynamics, we propose a setup of laser driven three-level atoms trapped in an optical lattice. Tuning the strength of the laser driving to the intermediate level allows one to study the transition from a classical Kinetically Constrained Model to the coherent regime. For strong driving, Rydberg excitations evolve analogously to defects in the One-Spin Facilitated Model, a minimal model known to exhibit glassy dynamics. In our setup, the constraints result from the interplay between Rydberg interactions and the laser detuning from the Rydberg state. The emerging heterogeneous relaxation timescales are tuneable over several orders of magnitudes. In the opposite limit of weak driving of the intermediate level, we find an effective cluster model which describes the dynamics in a reduced subspace of the allowed number and positions of Rydberg excitations. This subspace is uniquely determined by the initial state and is characterized by a fixed number of clusters of Rydberg excitations. In addition, we investigate the influence of random fields on the classical relaxation. We find that the glassy dynamics can relax faster in the presence of weak random fields.

Alexey Melnikov, *IQOQI Innsbruck*

Generalization mechanism within projective simulation

The generalization mechanism is an important part of any intelligent agent. It empowers the agent to handle previously unencountered perceptual stimuli and allows to cope with large amount of data. We present a dynamic, flexible and autonomous machinery that enables projective simulation agent to meaningfully generalize. Both projective simulation, a novel physical approach to artificial intelligence based on stochastic processing of data, and the presented generalization mechanism are based on very simple principles. Due to this simplicity we were able to provide an extensive analytical analysis of the agent's performance.

Davide Orsucci, *ITP Innsbruck*

Noise field estimation by means of stabilizer measurement

In quantum information processing and quantum computation the capability of detecting and correcting errors is essential - task which is achived by quantum error correction. In

Measurement Based Quantum Computation coherence in the Graph State (GS) can be preserved with a Stabilizer Code (SC). We investigate if it is possible, given access only to the syndrome measurement of the SC, to detect and characterize a unitary component in the noise, i.e. the effect of a “stray field”, coherently and constant in time, that drives the GS away from the original state. When the stray field varies from site to site, the syndrome measurements correlate different parameters of the field; we show how to recover from them the information about these parametrs. It turns out that the possibilty to recover partial or complete information depends non trivially on the topology of the GS.

Bernhard Rauer, *ATI Wien*

Cooling of a one-dimensional Bose gas

Degenerate atomic gases are among the most versatile tools to study fundamental many-body physics. Almost all realizations of these systems rely on the technique of evaporative cooling. Highly energetic particles are selectively removed from the trap reducing the average energy per particle. A crucial ingredient in this scheme is the continuous rethermalization of the system to an equilibrium energy distribution. However, for one-dimensional Bose gases it has been shown that thermalization is strongly inhibited rendering standard evaporative cooling ineffective.
In our experiment we study the effects of uniform particle dissipation on a one-dimensional quasi-condensate created on an atom chip. We observe a cooling process which is reminiscent but distinctly different from standard evaporative cooling. This process proceeds through many-body dephasing without the need for thermalization or an energy-selective out-coupling mechanism. Furthermore we discuss the effects of quantum noise which is expected to enter the system through the dissipation process.

Prasanna Venkatesh, *IQOQI Innsbruck*

Backaction-Driven Transport of Bloch Oscillating Atoms in Ring Cavities

We predict that an atomic Bose-Einstein condensate strongly coupled to an intracavity optical lattice can undergo resonant tunneling and directed transport when a constant and uniform bias force is applied. The bias force induces Bloch oscillations, causing amplitude and phase modulation of the lattice which resonantly modifies the site-to-site tunneling. For the right choice of parameters a net atomic current is generated. The transport velocity can be oriented oppositely to the bias force, with its amplitude and direction controlled by the detuning between the pump laser and the cavity. The transport can also be enhanced through imbalanced pumping of the two counter-propagating running wave cavity modes. Our results add to the cold atoms quantum simulation toolbox, with implications for quantum sensing and metrology.

Stefan Walser*, ATI Wien*

Directional photon emission - beyond paraxial approximation

Electromagnetic radiation is typically considered as a fully transverse polarized wave, where the electric field is always perpendicular to the propagation direction. However this is only valid in the paraxial approximation. Beyond this approximation longitudinal polarization components can appear in highly confined light fields.

Together with the transversal components this leads to local circular polarization where the sense of rotation (spin) of the electric field vector depends on the propagation direction. Thus the internal spin of photons gets coupled to their propagation direction and photons obtain chiral character. This effect breaks the mirror symmetry of the scattering of light. Positioning a gold nano-particle on the surface of a nano-photonic waveguide we thereby realize a chiral waveguide coupler in which the polarization of the incident light determines the propagation direction in the waveguide. With this chiral waveguide coupler we demonstrate an practical way of directly probing the local polarization state, in particular, the focus region of a highly focused beam.