universität innsbruck
Department of Theoretical Physics

# Seminar Talk

Jonah Peter, Harvard University(MA), USA
Oriol Rubies-Bigorda, Harvard University(MA), USA

Abstract

Jonah Peter:
**Examining the quantum signatures of optimal excitation energy transfer**

Light-harvesting via the transport and trapping of optically-induced electronic excitations is of fundamental interest to the design of new energy efficient quantum technologies. Using a paradigmatic quantum optical model, we study the influence of coherence, entanglement, and cooperative dissipation on the transport and capture of excitation energy. In particular, we demonstrate that the rate of energy extraction is optimized under conditions that minimize the quantum coherence and entanglement of the system. We show that this finding is not limited to disordered or high temperature systems but is instead a fundamental consequence of spontaneous parity time-reversal symmetry breaking associated with the quantum-to-classical transition. We then examine the effects of vibrational fluctuations, revealing a strong dephasing assisted transport enhancement for delocalized excitations in the presence of cooperative interactions. Our results highlight the rich, emergent behavior associated with decoherence and may be relevant to the study of biological photosynthetic antenna complexes or to the design of room-temperature quantum devices.

Oriol Rubies-Bigorda:
**Collectively enhanced ground-state cooling in subwavelength atomic arrays**

Closely spaced arrays of emitters exhibit light-induced dipole-dipole interactions, resulting in modified radiative properties and the emergence of collective resonances with a narrowed linewidth. These modifications significantly impact the optomechanical response of the array. In this work, we theoretically demonstrate the implications of these collective resonances on laser cooling techniques. Our findings reveal a novel approach to leverage collective resonances for enhanced cooling of the motional degrees of freedom of atoms in subwavelength arrays. Notably, the collective line-narrowing effect allows for ground state cooling, even in the case of bare atomic transitions within the unresolved sideband regime. This work contributes to the understanding of how collective resonances can be harnessed to achieve unprecedented control over the cooling dynamics in nanoscale systems.

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