Joint Quantum Theory Seminar with VKR Centre of Excellence QMATH (University Copenhagen)

Time: November 7, 13:15-16:30

Place: Department of Physics and Astronomy. Room 1525-626 “Det Skæve Rum”.

Programme:

13:15 Welcome by Klaus Mølmer

13:20 Presentation of the QMATH center by Jan Philip Solovej

13:30 Astronomical Interferometry with Quantum Networks

Abstract: Whereas high-resolution imaging in the microwave and RF domains using large telescope arrays is a well-established technique, extending these techniques to the optical domain comes with its own set of challenges. In particular, optical sources are typically weak and transmission losses between the telescopes pose a serious limitation to the resolution. I will discuss how small scale-quantum networks can be employed to overcome this limitation. By storing both the quantum state and the arrival time of photons in quantum memories at the telescopes using a binary qubit encoding and reading out via entanglement-assisted non-local parity checks, transmission losses can be completely circumvented allowing for imaging of faint objects with improved angular resolution. Compared with prior work, such a scheme offers an exponential decrease in entanglement resources, making its experimental implementation feasible with near-term technology.

Johannes Borregaard (Copenhagen).

14:00 Decoherence in a nonlinear quantum memory

Abstract: Storing light as collective spin wave excitations in atomic ensembles has been successfully used to implement few-photon operations by exploiting strong atomic interactions. This includes entanglement generation, two-photon phase gates or single-photon switches of subsequently illuminated photons. While the underlying interaction has no direct influence on the stored spin-wave density, inevitable photon scattering events, however, do affect the optical memory. Upon analyzing this problem we derive a closed solution of the general many-body problem that accounts for the interplay of coherent photon propagation, strong spin wave interactions and dissipative processes in an exact fashion. The found solution reveals an N-body protection mechanism, in which decoherence of one excitation can preserve the spatial coherence of others. We show how such correlated decoherence processes can be employed as single-photon subtractors, and discuss first experimental indications of this capability.

Thomas Pohl (Aarhus).

14:30 Coffee

15:00 Harnessing quantum entanglement

Abstract: The phenomenon of entanglement is one the key features of quantum mechanics. It lies at the heart of cryptographic applications of quantum technologies and is also necessary for computational speedups. I will overview some of the key scenarios where entanglement assistance leads to classically unattainable functionality. In particular, we will see an example of how entanglement can be used to certify certain characteristics of an uncharacterized quantum device.

Laura Mancinska (Copenhagen).

15:30 Spectral properties of Spin Boson type models.

Abstract: Spin-Boson type models are popular models for qubits interacting with a scalar bosonic field. One example is the Rabi-model which is used to model a qubit interacting with a field of monochromatic photons. The key symmetry in these models is the so called spin parity symmetry, which can be used to decompose the Hamiltonian into two so called fiber operators. Using this decomposition one can deduce spectral properties such as the existence of ground states and exited states. Under certain conditions one can find asymptotic limits of the fiber operators as the strength of the field interaction goes to infinity. One consequence is that the Spin-Boson model becomes trivial as the ultraviolet cutoff is removed.

Thomas Norman Dam (Aarhus).

16:00 Discussion of the future of the centers