

# QUANTUM OPTICS SEMINAR



**Title:** Single Ion-Photon Interfaces  
**Speaker:** Prof. Wolfgang Lange  
University of Sussex, Brighton  
**Time:** Friday, February 11 at 10:15  
**Room:** 1520-616

**Abstract:**

Interfacing the quantum states of ions and photons is a task of central importance in quantum information processing. A link between stationary and flying qubits is the basis for a range of applications, most importantly quantum networking and distributed quantum computation, but also local interactions between qubits can be mediated in this way. Coupling the quantum states of ions and photons with high fidelity requires an optical cavity with small mode volume to enhance the interaction.

At Sussex, we currently investigate three different regimes. In a cavity collinear with the axis of a linear trap, moderate ion-photon coupling strength can be achieved, which lends itself to probabilistic processes. We plan to entangle pairs of ions in a string by projective measurement of two orthogonally polarized photons emitted from the cavity. Stronger coupling is obtained in a cavity oriented transverse to the axis of the trap, which we are presently implementing. In this case, deterministic transfer of quantum states between ions and photons is possible. For example, photons can take the role of phonons and entangle ions simultaneously interacting with the cavity mode. Finally, for strongest interaction, we will employ ultra-small fiber cavities. We have developed a miniature endcap trap, in which a pair of optical fibers is tightly integrated. With this system, we have efficiently captured the fluorescence of a single calcium ion, measured its  $g(2)$  function and produced single photons on demand. The fact that injection and/or extraction of radiation by optical fibers require no adjustments makes this a "plug-and-play" ion-photon interface.

Michael Drewsen

**Coffee, tea and bread rolls from 10:05**