Special Seminar
MPQ/LMU

Date: **Monday, December 14, 2015**

Time: **10 a.m. s.t.**

Presentation: **Dr. Bernardo Adalberto Casabone**
Research Group of Professor Dr. Rainer Blatt
University of Innsbruck, Austria

Title: **Entanglement of Two Ions Coupled to an Optical Cavity and Collective Enhancement of Ion-Photon State Transfer Process**

Location: **Discussion Room H 311**
Schellingstr. 4/IIIrd. Floor, LMU

Division of Laserspectroscopy & LMU/Chair of Laser Spectroscopy, LMU
Director Professor Professor Theodor W. Hänsch

Abstract:

Distributed quantum computing, an approach to scale up the computational power of quantum computers, requires high-fidelity entanglement between nodes of a quantum network. In our research group we have already developed a quantum node consisting of electromagnetically trapped ions coupled to the mode of a high-finesse optical cavity. In this talk I summarize the experiments that have been performed in this quantum node in the context of my doctoral thesis work.

First, I describe the cavity-mediated entanglement of two ions located in the same ion trap. The entanglement generated by this protocol is efficient and heralded, and as it does not rely on the fact that ions interact with the same cavity, our results are a stepping stone towards the efficient generation of remote entanglement between cavity-based quantum nodes.

Then, I discuss how collective effects can be used to improve the performance of the node. In this context, I describe the creation of the sub- and superradiant states of a two-ion crystal interacting with the optical cavity. The first state shows an effective enhancement in the coupling rate, whereas the second state is effectively decoupled. Finally, I show the implementation of a protocol that benefits from the superradiant enhancement to improve the fidelity of the transfer process of information from the ions onto a single photon. These results demonstrate that high-fidelity remote entanglement can be achieved by extending the two-ion entanglement protocol described here and using in each node a superradiant state as a resource.