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Im Rahmen der Besetzung der Professur aus Angewandte Quantenphysik laden wir zum Berufungsvortrag von Herrn

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Quantum Memories for Quantum Networks

Quantum networks hold the promise for revolutionary advances in information processing with quantum resources distributed over remote locations via quantum-repeater architectures [1]. Quantum networks are composed of nodes for storing and processing quantum states, and of channels for transmitting states between them. An essential requirement for the realization of quantum networks is the control of light–matter interaction at the quantum level, in particular the implementation of quantum memories enabling the reversible exchange of quantum information between photons and atoms. In recent years, atomic ensembles have emerged as a promising candidate to realize this goal. Photons can be easily absorbed in ensembles; moreover the atomic systems can be engineered such that the light is reemitted in a well defined spatio-temporal mode after the storage, thanks to a collective interference between the atoms. In this talk, I will describe the experimental realization of the first enabling steps towards the implementation of quantum networks using ensemble quantum memories, based on the one hand on cold atomic gases and on the other hand on solid state systems.

The first part of the talk will be devoted to experiments with cold atomic ensembles where single collective spin excitations are created by spontaneous Raman scattering and efficiently converted to single photons by collective interference [2]. In particular, I will describe experiments demonstrating entanglement between remote ensembles [3] and elementary segments of quantum repeaters [4]. In the second part of the talk, I will focus on quantum memories for single photons in a solid state environment. Some solid state systems have properties that make them very attractive for quantum storage applications. In particular, rare-earth ion doped solids provide a unique system where a large number of atoms with excellent coherence properties are naturally trapped in a solid state matrix. I will describe the physical systems and explain how single photons can be stored and retrieved using modified photon echo techniques. Finally, I will present the first experimental steps towards solid-state quantum storage, including the realization of a solid-state light matter interface at the single photon level [5].

[1] H.J. Kimble, Nature **453**, 1023 (2008)
[2] L.M. Duan, M.D. Lukin, J.I Cirac and P. Zoller, Nature **414**,413 (2001)
[3] C.W. Chou, H. de Riedmatten, … and H.J. Kimble, Nature **438**, 828 (2005)
[4] C.W. Chou, H. de Riedmatten, … and H.J. Kimble, Science **316**, 1316 (2007)
[5] H. de Riedmatten, M.Afzelius, M.U. Staudt, C.Simon and N.Gisin, Nature **456**, 773 (2008)

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um 11:00 Uhr
im Hörsaal des
Atominstitutes der Österreichischen Universitäten.

Jörg Schmiedmayer