



Monday, September 26<sup>th</sup> 2016 - 10:30  
CFEL Seminar room I (Blgd. 99)

**Dr. Claudiu Genes**

Theoretical Physics, University of Innsbruck

## Collective dynamics in quantum emitter systems

Time evolution in ensembles of quantum emitters (atoms, molecules, ions, Rydberg atoms, quantum dots etc) at low vs. high densities is fundamentally different. As particles get closer together, strong environment-mediated interactions start playing an important role both in the coherent (such as dipole-dipole interactions) as well as in the incoherent evolution (super- /subradiance).

In the first part of my talk I will review recent efforts aimed at exploiting this inherent collective dynamics towards goals such as: i) to perform more precise frequency measurements in the context of Ramsey interferometry in the presence of dephasing and decay [1,2,4] and ii) to selectively and efficiently prepare robust multipartite entangled states [3]. The second part of the talk is concerned with energy transport in dense atomic chains in the presence of an artificial environment, namely an optical cavity. In the absence of the cavity, transport in such a system is mainly due to nearest-neighbour coupling and is very sensitive to disorder. In the so-called strong coupling regime of cavity QED, ultrafast atomic-exciton transport can occur via delocalized polariton modes [5], and which is very weakly dependent on the disorder in the system. This constitutes a first step towards explaining recent experimental results showing increased charge transport in organic semiconductor materials [6].

References:

[1] Protected State Enhanced Quantum Metrology with Interacting Two-Level Ensembles, L. Ostermann, H. Ritsch and C. Genes, Phys. Rev. Lett. 111, 123601 (2013).

[2] Protected subspace Ramsey spectroscopy, L. Ostermann, D. Plankensteiner, H. Ritsch, and C. Genes, Phys. Rev. A 90, 053823 (2014)

[3] Selective protected state preparation of coupled dissipative quantum emitters, D. Plankensteiner, L. Ostermann, H. Ritsch, and C. Genes, Sci. Reps 5, 16231 (2015).

[4] Laser noise imposed limitations of ensemble quantum metrology, D. Plankensteiner, J. Schachenmayer, H. Ritsch, and C. Genes, arxiv:1605.00874 (2016)

[5] Cavity Enhanced Transport of Excitons, J. Schachenmayer, C. Genes, E. Tignone and G. Pupillo, Phys. Rev. Lett. 114, 196403 (2015)

[6] Conductivity in Organic Semiconductors Hybridized with the Vacuum Field, E. Orgiu, J. George, J. Hutchison, E. Devaux, J. F. Dayen, B. Doudin, F. Stellacci, C. Genet, J. Schachenmayer, C. Genes, G. Pupillo, P. Samori and T. W. Ebbesen, Nat. Mat. 14, 1123 (2015).

Host: Angel Rubio

