



Seminarankündigung

**Donnerstag, 20. Dezember 2012
13:00 Uhr**

ZNN, Seminarraum EG 0.001

“Direct observation of the coherent light-matter interaction in room-temperature semiconductors”

Observation of coherent quantum light matter interactions requires that in the medium where the interaction takes place, the de-phasing time is much longer than the time needed for the observation.

In semiconductors, the de-phasing time is determined by scattering processes; at room temperature, it is about 1 ps. Therefore, experiments which probe coherent phenomena are always done at cryogenic temperatures. However, it is also possible, in principle, to sufficiently shorten the observation time so that it is not required to cool the material. This is the approach we have taken in this work which resulted in a direct observation of Rabi oscillations and self-induced transparency in a room-temperature semiconductor laser amplifier.

In this talk I will start by describing an investigation of the dynamical response of InAs/InP nanostructured quantum-dot and quantum-dash (wire-like) gain media following a perturbation of a short 150 fs pulse. In order to study the inhomogeneous nature of the gain broadening, we used a unique ultrafast multi-wavelength pump-probe setup. We then further increase the temporal resolution of our observation up to a few femtoseconds by using a highly sensitive FROG (Frequency resolved optical gating) setup which is capable of measuring the complete electro-magnetic field (phase and amplitude) of the short pulse after propagation. The work is accompanied by an extremely general numerical model of the Maxwell and Schrödinger equations describing the co-evolution of the electronic wavefunction together with the electro-magnetic field and has great novelty in its own right.

With these experimental and theoretical tools we have discovered a novel two-photon induced instantaneous gain mechanism that is also capable of initiating laser oscillations and identify a cascaded four wave mixing process induced of short pulses propagating within a laser. The highlight of the work is the direct observation of the co-evolution of the electronic wavefunction in the semiconductor together with the electro-magnetic field with a nearly single femto-second resolution. These are revealed in the form of Rabi oscillations and self-induced transparency, all occurring at room temperature and at the important optical-communication wavelength of 1.55 μm .

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