CARL VON OSSIETZKY universität OLDENBURG Institut für PHYSIK

PHYSICAL COLLOQUIUM

INVITATION

Monday, 04.07.2016, 4.15 p.m., W2-1-148

speaks

Prof. Dr. Hubert Krenner

Augsburg University, Germany

about

Rocking at the nanoscale – dynamic control of optically active nanostructures using a (more than) perfect wave

Surface acoustic waves (SAWs) are employed in everyday life devices in radio frequency filters for cellular phones and wireless communication systems. In fundamental research, these "nanoscale earthquakes on a chip" are an extremely versatile tool to dynamically probe and manipulate nanosystems. When excited on piezoelectric materials both the oscillating mechanical deformation of the SAW and its accompanying electric fields can be fully harnessed to establish strong interactions electrical and optical excitations, and sound on the nanoscale on sub-nanosecond timescales.

After brief introduction to SAWs, I highlight recent advances in their application in condensed matter physics and nanooptics. I show that the dynamic strain induced by the mechanical component of the sound wave dynamically tunes both excitonic transitions of semiconductor quantum dots [1] and the optical modes of membrane based photonic crystal nanocavities [2]. I demonstrate that this architecture allows us to deliberately couple nanophotonic elements [3] or control light-matter interactions [4]. In the final part of my talk, I present a Hammond organ for nanoscale sound waves: using Fourier synthesis, tailored nanomechanical waveforms are generated by a combination of a fundamental SAW and well-defined combinations of overtones [1]. We directly monitor the electrically excited nanomechanical waveforms in the time domain using single quantum dots as nanoscale pressure sensor. These experiments bring the paradigm of pulse shaping to nanomachanics and phononics. Our tailored nanomechanical pulses open a myrad of applications and techniques, developed for shaped electromagnetic pulses throughout the electromagnetic domain ranging from millisecond pulses at radio frequencies to femtosecond laser pulses at optical frequencies. Such shaped pulses are particularly suited for native mechanical manipulation and transduction schemes for emerging membrane-based nanophotonic optomechanical crystals [5].

[1] F. J. R. Schülein et al., Nature Nanotechnology **10**, 512-516 (2015).

[2] D. A. Fuhrmann et al., Nature Photonics **5**, 605-609 (2011).

[3] S. Kapfinger et al. Nature Communications **6**, 8540 (2015).

[4] M. Weiß et al., submitted (2016); arXiv:1605.04956

[5] M. Eichenfield et al., Nature **462**,78-82 (2009).

All interested persons are cordially invited.

Sgd. Prof. Christoph Lienau