Acousto-mechanical control of optically active nanosystems

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Radio frequency control of the quantum mechanical, electronic and optical properties of nanostructures lies at the forefront of contemporary nanoscale research. Towards this challenging goal, surface acoustic waves (SAWs) provide a particularly versatile tool to manipulate and probe a broad variety of nanosystems. These "nanoquakes on a chip" promise massively parallel manipulation of optically active nanosystems via acousto-mechanical and acousto-electric couplings.

In the first part of my tutorial, I will introduce the fundamental concepts of excitation, propagation and detection of SAWs in piezoelectrics and semiconductors. I will discuss the resulting modulations of the electronic and optical properties, underpinned by examples of key experiments demonstrating e.g. acoustically-driven spatio-temporal carrier dynamics in low-- dimensional semiconductor systems. In the second part, I will present recent progress towards full dynamic control of the quantum-confined energy levels and the occupancy state of quantum dots and gigahertz tuning of nanophotonic resonators for the implementation of SAW-controlled dynamic quantum gates.