HL 37: Ultrafast Phenomena II

Time: Tuesday 14:45–16:00 Location: H10

HL 37.1 Tue 14:45 H10

Optical phonon relaxation and dynamic Fano effects of silicon (100) investigated by time-resolved spontaneous Raman scattering — •Jingyi Zhu, Rolf Baldwin Versteeg, Prashant Padmanabhan, Thomas Koethe, and Paul Herbertus Maria van Loosdrecht — II. Physikalisches Institut - Universität zu Köln, Zülpicher Straße 77, 50937 Cologne, Germany

The interaction of photo-induced charge carriers with photons initiates a complex dynamics including carrier cooling, carrier phonon scattering, and phonon relaxation. Here we revisit the incoherent optical phonons dynamics, electronic scattering, and hole-phonon interaction dynamics in silicon using time-resolved spontaneous Stokes and anti-Stokes Raman spectroscopy. Surprisingly, we observe a dynamic spectral asymmetry between the Stokes and anti-Stokes Raman scattering processes. The unusual asymmetry is thought to be mainly caused by the effects of the optically induced changes in the Fano interference between phonon and hole scattering.

HL 37.2 Tue 15:00 H10

Dynamics of exciton-polariton condensates in semiconductor microcavities with periodic potentials — •Xuekai Ma[1], Stefan Schumacher[1], and Oleg Egorov[2] — [1]Physics Department, Universität Paderborn, Warburger Strasse 100, 33098 Paderborn, Germany — [2]Institute of Condensed Matter Theory and Solid State Optics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, 07743 Jena, Germany

Exciton-polaritons are quasi-particles made of quantum well (QW) excitons coupled to cavity photons. They have very small effective mass (10-4me) and lifetimes on the tens of picoseconds scale. Due to their photonic properties, they can be excited by light and probed, respectively. Due to their excitonic properties, nonlinearity is introduced into this system at elevated densities. Polaritons, which are composite bosons, can undergo a condensation process (with similarities to Bose-Einstein condensation) under incoherent excitation. Many features in the dynamics of polariton condensates can be described by a modified Gross-Piteavskii equation (GPE). Here, we study the nonlinear dynamics of polariton condensates in periodic potentials. In the presence of a periodic potential, a band structure including a band-gap can be obtained. We show that polariton condensates can occupy and switch between different energy states by changing the pump excitation intensity and shape. Our simulation results agree very well with recent experimental results.

HL 37.3 Tue 15:15 H10

Controlling the optical spin Hall effect — •Przemyslaw Lewandowski[1], Ombline Lafont[2], Samuel Luk[3], Nai Kwong[3], Jerome Tignon[2], Stefan Schumacher[1], Emmanuel Baudin[2], and Rolf Binder[3] — [1]Universität Paderborn, Warburger Strasse 100, 33098 Paderborn, Germany — [2]Ecole Normale Supérieure, 75231 Paris Cedex 05, France — [3]University of Arizona, Tucson, AZ 85721, USA

As an optical counterpart of the spin Hall effect, the optical spin Hall effect (OSHE) describes a spatial spin-separation of ballistically propagating polaritons in planar semiconductor microcavities [1]. This remarkable feature is driven by a transverse-longitudinal cavity-mode splitting, which acts as an effective magnetic field and therefore gives rise to a pseudo-spin orbit coupling. Here, we present an approach to control the OSHE using only all-optical means [2]: For a sufficiently strong cw-excitation the effective magnetic field vector can be tilted out of the cavity plane to which it is otherwise confined. We show that this nonlinear effect, based on the polariton-polariton interaction, allows the modification of the spin-current, making the OSHE a promising candidate for potential spin-optotronic applications. Our experimental and numerical results confirm well our analytical predictions, based on a microscopic semiconductor theory.

[1] A. Kavokin, G. Malpuech and M. Glazov, Phys. Rev. Lett. 95, 136601 (2005). [2] O. Lafont, M.H. Luk, P. Lewandowski, N.H. Kwong, K.P. Chan, M. Babilon, P.T. Leung, E. Galopin, A. Lemaitre, J. Tignon, S. Schumacher, E. Baudin, R. Binder (submitted).

Invited Talk HL 37.4 Tue 15:30 H10

Blasting semiconductor electrons with terahertz fields — •Mackillo Kira — Univ. Marburg, Germany

Present-day experiments can generate terahertz (THz) pulses having peak-field strengths around 100MV/cm. By limiting the THz pulse to few-cycles, one can both avoid structural damage and dominance of electron scattering during an excitation creating roughly a 1eV gradient over a 1Å distance. I will overview a cluster-expansion-based theory[1,2] to systematically explain how electrons as well as Coulomb-bound electronhole clusters[3] are excited and transported by extremely strong THz pulses. I will explain how a strong THz field induces an interplay of interband polarization and intraband currents during high-harmonic generation[4] (HHG) and an electronic quantum interference yielding a massive reshaping of the time-resolved harmonic emission[5]. Coulombic effects are demonstrated with THz wave mixing among Landau electrons[6] and with harmonic sideband generation (HSG) around an excitonic resonance. The identified HHG, HSG, quantum interference, and many-body effects can be combined to steer ultrafast processes in solids and to develop new light sources.

[1] M. Kira and S.W. Koch, *Semiconductor Quantum Optics*, (Cambridge Univ. Press, 2011). [2] M. Kira, Nat. Comm. **6**, 6624 (2015). [3] O. Vänskä *et al.*, Phys. Rev. Lett. **114**, 116802 (2015). [4] O. Schubert *et al.*, Nat. Photon. **8**, 119 (2014). [5] M. Hohenleutner *et al.*, Nature **523**, 572 (2015). [6] T. Maag *et al.*, Nat. Phys., doi:10.1038/nphys3559 (2015).