⟨S|P|S⟩ swiss physical society

Österreichische Physikalische Gesellschaft

Gemeinsame Jahrestagung in Zürich
26. - 30. August 2019

Universität Zürich, Irchel Campus

Réunion annuelle commune à Zürich
26 - 30 août 2019

Programmübersicht
Aperçu du programme

in Zusammenarbeit mit - en collaboration avec

MaNEP SWITZERLAND

QSIT Quantum Science and Technology
National Centre of Competence in Research

SSSN SGN

Universität Zürich[UZH]

11:30	**132**	**Theoretical study of the intra-cavity dynamics behind phase locking of quantum cascade laser frequency combs** *Nikola Opačak [1], Gottfried Strasser [1,2]; Benedikt Schwarz [1]* *[1] Institute of Solid State Electronics, TU Wien, [2] Center for Micro- and Nanostructures, TU Wien* Quantum cascade laser (QCL) has established itself as the main laser source in the mid-infrared portion of the electromagnetic spectrum. Due to a substantial third-order non-linearity in the laser active region, QCLs can work in a self-starting frequency comb regime, making them interesting for spectroscopic applications. A model based on Maxwell-Bloch equations was developed in order to study phase locking dynamics of a free running mid-infrared QCL frequency comb. A thorough study of the impact of the dispersion and optical non-linearities on the cavity mode dynamics was conducted. Recent experimental findings, showing chirped frequency modulated output, were reproduced for the first time, giving important insight into the governing mechanisms responsible for the modal phase-locking.
11:45	**133**	**Dual-comb spectrometer by single Doppler shifted MIR QCL frequency comb** *Mehran Shahmohammadi, Andres Forrer, Pierre Jouy, Mattias Beck, Jérôme Faist, Giacomo Scalari, ETH Zürich, Institute for Quantum Electronics* We present a dual-comb spectrometer consisting of a free running frequency comb quantum cascade laser (QCL) and its Doppler shifted counterpart reflected from a fast scanning mirror. The stable multi-heterodyne signal is centered at 400 kHz and well defined by the linear scanning velocity of the reflector. This dual comb spectrometer features higher stability than the standard dual comb spectrometers, in which the mutual coherence of the two utilized combs limits the acquisition time to typically less than tens of μs. This brings indeed a great simplification compared to dual comb spectrometers, where the phase noise of the combs needs to be either actively suppressed or measured continuously and adaptively adjusted.
12:00	**134**	**Picosecond pulses from mid-infrared quantum cascade lasers** *Johannes Hillbrand [1], Aaron Maxwell Andrews [1], Hermann Detz [1], Harald Schneider [2], Gottfried Strasser [1], Federico Capasso [3], Benedikt Schwarz [1]* *[1] TU Wien, [2] Helmholtz-Zentrum Dresden, [3] Harvard University* Quantum cascade lasers (QCL) are a compact and electrically pumped source of coherent mid- infrared light. Recently, it was discovered that QCLs can operate as frequency combs whose out- put is characterized by suppression of amplitude modulation and strong frequency modulation. However, the generation of short pulses by mode-locking of mid-infrared QCLs remains challeng- ing to date due to their ultrafast gain dynamics. We report on active mode-locking of mid-infrared QCLs resulting in the emission of intense picosecond pulses. We investigate the temporal dynamics of the QCL using both linear and quadratic autocorrelation techniques. Both methods confirm independently that the QCL emits a train of isolated pulses.
12:15	**135**	**Interband and quantum cascade laser frequency combs: From fundamentals towards monolithic spectrometers** *Benedikt Schwarz [1], Johannes Hillbrand [1], Maximilian Beiser [1], Nikola Opačak [1], Aaron Maxwell Andrews [1], Hermann Detz [2], Anne Schade [3], Robert Weih [4], Sven Höfling [3]* *[1] TU Wien, [2] CEITEC, Brno University of Technology, CZ-Brno, [3] Würzburg University, [4] nanoplus Nanosystems and Technologies GmbH,* Frequency combs are ideal candidates to realize miniaturized spectrometers without moving parts. We present an overview of our current research on mid-infrared frequency comb generation using interband and quantum cascade lasers (ICLs and QCLs). Our work ranges from fundamental laser physics to the realization of monolithic devices. We will highlight similarities and differences between these two types of lasers and show how both frequency modulated and pulsed frequency combs can be realized. In the last part, we will discuss why the ICL comb platform is a perfect candidate for the realization of miniaturized and battery driven mid-infrared spectrometers.