Paper 12141-31

Interband cascade laser frequency combs

In person: 7 April 2022 • 11:00 - 11:30 CEST | Etoile A, Niveau/Level 1

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Abstract | Authors

Frequency combs are ideal candidates to build chip integrated spectrometers without moving parts. I will give an overview on comb generation in the mid-infrared using interband cascade lasers. We demonstrate that ICLs naturally show the same frequency comb characteristics as QCL frequency combs and shed light into previous experiments. To generate the comb, we utilize the intrinsic fast time dynamics of the laser gain medium to enable phase-locking via four-wave mixing that is due to anti-phase oscillations of the population inversion. The observed comb state, the frequency modulated state, is fundamentally different to traditional mode-locking, where short pulses are generated. As a main characterization technique, we use the linear RF phase measurement technique shifted wave interference Fourier transform spectroscopy (SWIFTS). A detailed comparison between SWIFTS and the intensity autocorrelation for the pulse shape characterization will be presented. A more intuitive picture of the synchronization states in frequency combs is provided by the analogy to coupled clocks, which reveals a illustrative understanding of how these lasers can be switched to the pulsed regime. Using this knowledge we demonstrate the active mode-locked mid-infrared ICLs with picosecond pulse emisson. A key feature of ICLs is that the very same layer structure can also be used as sensitive photodetectors. The fact that ICLs utilize fast carrier transport via intersubband scattering is a great advantage for the high frequency response of the on-chip photodetectors. Combined with the low power requirements of the laser this makes ICL technology an ideal platform to realize future miniaturized dual-comb spectrometers for hand-held and battery driven devices. [1] B. Schwarz et al. Optica 6, 890 (2019) [2] J. Hillbrand et al. Optica 6, 1334 (2019) [3] H. Lotfi et al. APL 109, 151111 (2016)

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