

Quantum Cascade Laser Frequency Combs

Abstract: This tutorial introduces quantum cascade laser frequency combs as compact semiconductor sources for coherent mid-infrared photonics. We will discuss how ultrafast carrier dynamics, nonlinear wave mixing, cavity dispersion, and spatial hole burning determine comb formation and stability in semiconductor lasers. Different resonator geometries, including Fabry–Pérot and ring cavities, will be compared with respect to their dynamical behavior and coherent states. The lecture will further highlight recent progress in integrated mid-infrared photonics, nonlinear dissipative structures, and chip-scale frequency-comb platforms for spectroscopy and sensing applications. The presentation will include examples from recent experimental and theoretical developments in the field.



Lecturer: Benedikt Schwarz is Full Professor and Head of the Research Unit Optoelectronic Devices at TU Wien and Research Associate at Harvard University. His research focuses on quantum cascade laser frequency combs, nonlinear laser dynamics, integrated photonics, semiconductor lasers and detectors, and mid-infrared spectroscopy. He has authored more than 80 publications and delivered more than 45 invited conference and seminar talks. His work has been recognized through an ERC Starting Grant and several international awards in photonics and spectroscopy.