Laser Seminar
Friday, March 31st, 2017

Time	**14.00**
Location	ETH Zurich, Hönggerberg, HPF G6
Speaker	Sarah Houver, Ecole Normale Supérieure de Paris, France
Title	Resonant nonlinear optics in quantum cascade lasers

Abstract

Since the development of lasers in the 1960s, nonlinear optics with near infrared (NIR) beams has been widely explored thanks to these powerful and coherent sources. In the terahertz (THz) and Mid-Infrared (MIR) domains from 5 µm to 100 µm (3 meV to 200 meV), the lack of reliable sources has strongly limited investigations on THz nonlinear optics experiments. At the end of 1990s, the first THz nonlinear experiments demonstrated nonlinear frequency mixing[1] between a NIR beam and a THz beam from a Free Electron Laser (FEL).
Quantum Cascade Lasers (QCL) are compact powerful laser sources, operating throughout the MIR and THz regions. They are based on nanometric semiconductor layers and rely on intersubband transitions in semiconductor quantum wells. Since their first demonstration in 1994 for MIR QCLs[2] and in 2002 for THz QCLs[3], the performances of these devices have increased dramatically. Their intracavity powers can approach today those used in FELs. These developments are promising for the application of QCLs to THz nonlinear optics experiments and to study the interaction of strong THz fields with condensed matter systems.
In this seminar, I will present THz nonlinear optics studies[4], using QCLs simultaneously as sources for THz radiation as well as the nonlinear medium. We show how the optical nonlinearities of the system can be significantly enhanced through interband resonant excitations, permitting the generation of THz sidebands without considerations of phase matching. These experiments have been recently extended to MIR QCLs[5], excitation wavelengths in the telecom range, and sideband generation up to room temperature. This paves the way for potential applications of resonant nonlinearities to optical wavelength shifting and ultrafast modulation transfer for telecommunications.

1. J. Kono, et al., Phys. Rev. Lett. **79**, 1758–1761 (1997).
2. J. Faist, et al., Science **264**, 553-556 (1994).
3. R. Kohler, et al., Nature **417**, 156–159 (2002).
4. J. Madeo, et al. Nat Photonics **6**, 519-524 (2012).
5. S. Houver, et al. Opt Express **23**, 4012-4020 (2015).

Host	Steve Johnson, Ultrafast Dynamics, IQE
More Info	http://www.fastlab.ethz.ch/laser-seminar.html

Contact Daniela Hansen
E-Mail hansenda@phys.ethz.ch
Phone 044 633 33 47