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FNSNF

Noise investigation of a VECSEL prototype

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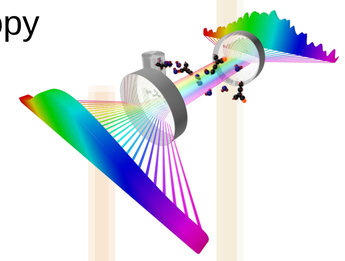
Motivation

Ultra-fast pulsed lasers with fs-pulse duration, such as SESAM-modelocked Vertical External Cavity Surface Emitting Lasers (VECSELs) with stabilized repetition rate generate a frequency comb that finds applications in many fields such as

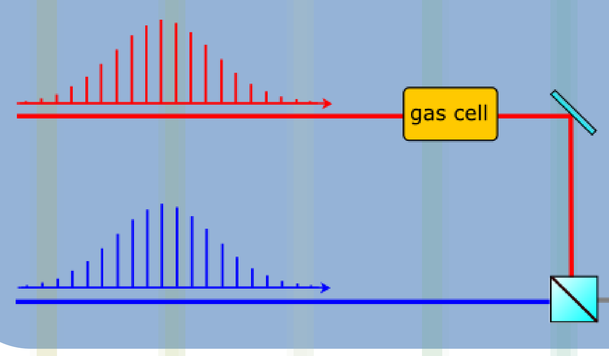
- Metrology applications for the measurement of absolute optical frequencies
- High-precision spectroscopy
- Biomedical imaging
- Distance measurement
- Telecommunications
- Dual comb spectroscopy



Dual comb spectroscopy

A demonstration of the use of a frequency comb will be done in collaboration with METAS and ABB by the development of a compact dual comb spectrometer for high resolution and traceable spectroscopy based on ultra-fast SESAM-modelocked VECSELs developed at ETH.

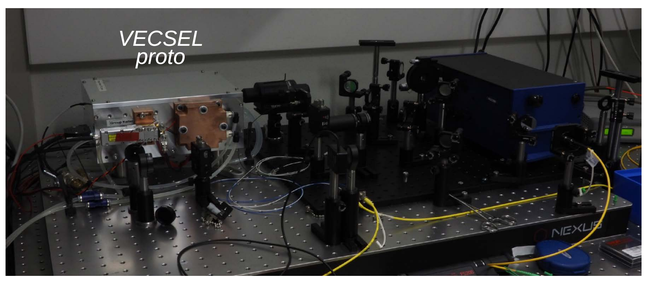
The spectrometer consists of two modelocked lasers that have a slightly different line-spacing. One probe comb interacts with the gas sample, the other one acts as a local oscillator. The two combs are then overlapped on a detector and the absorption spectrum is transferred from the optical to the radiofrequency domain where it is detected. Demonstration will be performed with acetylene, a gaseous species with strong absorption lines in the near infrared region around 1035 nm.



ETH METAS ABB

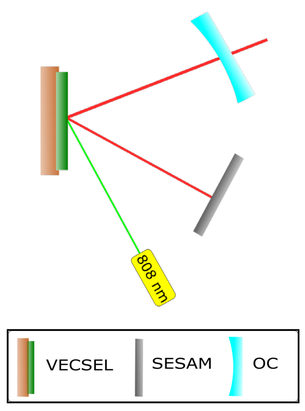
VECSEL characterization

A VECSEL prototype developed at ETH was transferred to UniNE for further studies to prepare a dual-comb setup.



VECSEL prototype installed at UniNE, surrounded by test devices

Laser setup



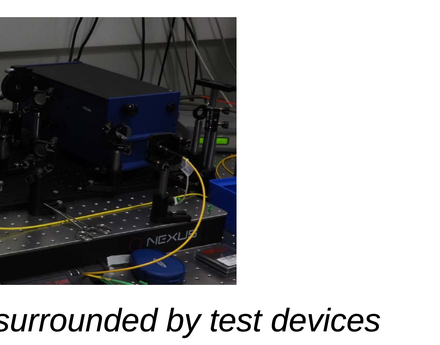
Radius of curvature: 100 mm

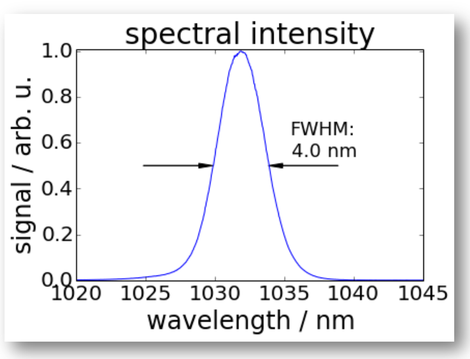
Transmission: 1.0%

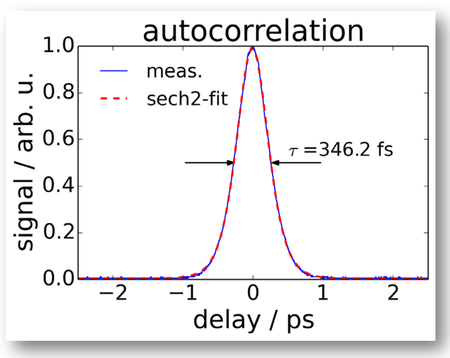
- The 2.5 mm OC is mounted on a ring piezo actuator for cavity length stabilization
- The SESAM and VECSEL are temperature-controlled for more stable operation

Laser performance

Pulse duration:	346 fs
Output power:	370 mW
Repetition rate:	1.77 GHz
Peak power:	531 W
Center wavelength:	1034 nm
TBP:	1.25 sech^2

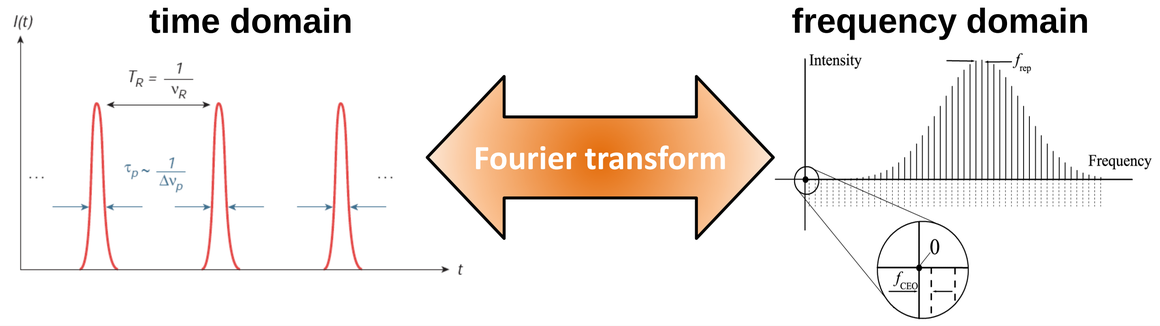






Optical Frequency Comb

An optical frequency combs is a frequency ruler made of several hundred of thousands of equidistant optical frequencies. It provides a phase-coherent link between the RF domain and optical frequencies

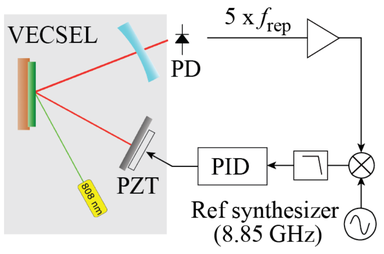


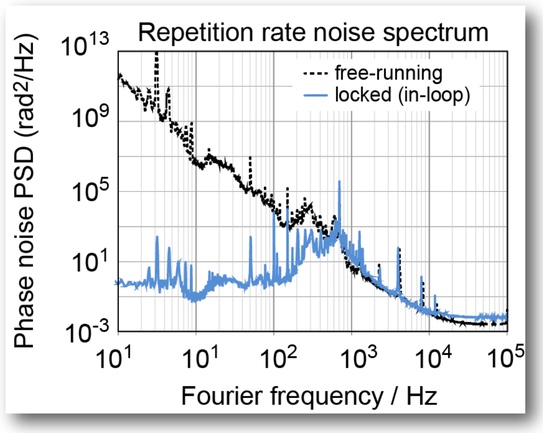
Stabilization and noise characterization

Stabilization of the VECSEL repetition rate with a piezo actuator (PZT)

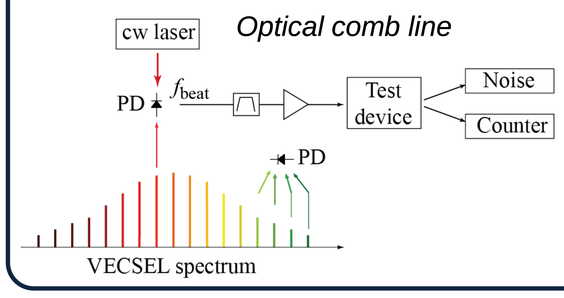
Locking bandwidth close to 1 kHz

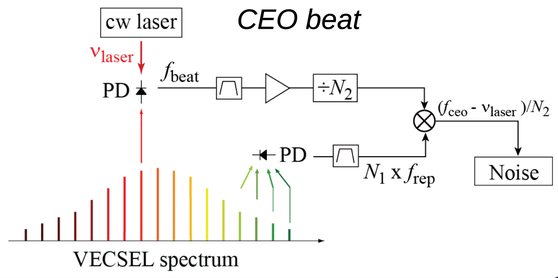
Stabilization scheme:





Future measurement schemes





Outlook

Next step:

- Generation and noise analysis of the laser carrier-envelop offset (CEO)
- Stabilization of the CEO of the VECSEL
- Develop a compact dual comb spectrometer (in collaboration with METAS and ABB) for high resolution and traceable spectroscopic measurement