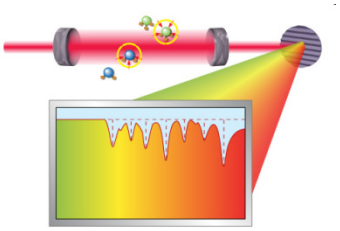
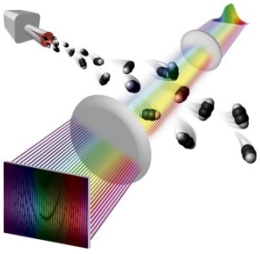
Optical Frequency Comb Spectroscopy Group announces thesis work:

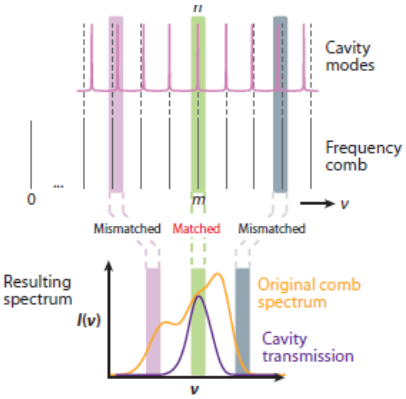
Characterization of cavity dispersion with a frequency comb



Our group works with the development and applications of ***optical frequency comb spectroscopy*** for broadband ultrasensitive detection of molecular species in gas phase. Optical frequency combs are produced by femtosecond mode-locked lasers, whose spectrum consists of a comb of narrow laser lines covering a very broad spectral range. Spectroscopy performed with optical frequency combs is equivalent to a measurement with thousands of synchronized laser lines and allows highly sensitive simultaneous detection of many molecular species in short acquisition times. Therefore it has the potential to become the ultimate tool for trace gas detection in applications such as environmental monitoring, industrial process control or medical diagnostics.



The sensitivity of optical frequency comb spectroscopy can be increased by placing the gas sample in an optical cavity. Such ***optical cavity*** is made of two highly reflective mirrors between which the light bounces back and forth thousands of times, which increases the interaction length of the light with the sample. The transmission spectrum of a cavity has a resonance grid structure with modes separated by the free spectral range, FSR. The comb can be efficiently coupled into the cavity by precisely matching the comb line spacing to the cavity FSR. However, this is only possible over a limited frequency range. While the comb line spacing is constant, the FSR varies with optical frequency because of the ***dispersion in the cavity mirrors and the gas sample***. The mismatch between comb line spacing and cavity FSR limits the available optical bandwidth and distorts the shape of the measured absorption lines. Therefore it is extremely important to know the dispersion of the cavity.



The ***aim of this project*** is to develop a new method for characterization of the cavity dispersion with the help of an optical frequency comb and a Fourier transform spectrometer. This method will be implemented and tested in our existing system based on an Er:fiber femtosecond laser. Within this project you will get hands-on experience with advanced laser-based techniques and learn about the many issues involved in sensitive absorption spectroscopy. The project is suitable for a student with interest in ***optics, lasers and spectroscopy***.

If you wish to obtain more information about the project and visit our lab please contact Aleksandra Foltynowicz (aleksandra.foltynowicz@umu.se).