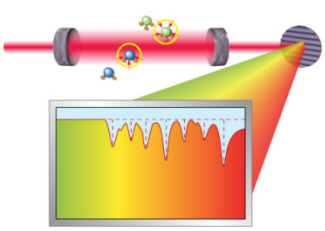
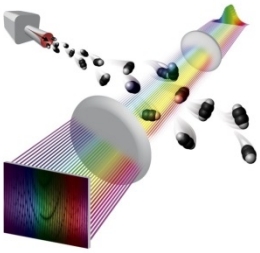
Optical Frequency Comb Spectroscopy Group announces thesis work:

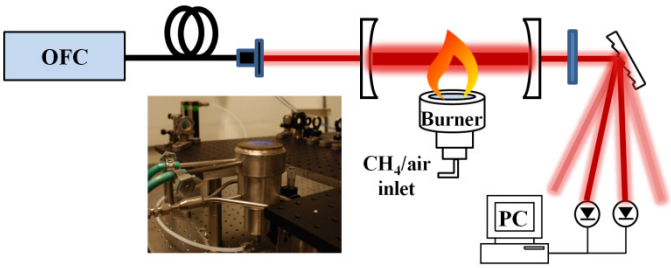
# Optical frequency comb Vernier spectroscopy in a flame



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 the technique has the potential to become the ultimate tool for trace gas detection in applications such as environmental monitoring, industrial process control or medical diagnostics.



Monitoring of combustion parameters such as temperature and product/reactant concentrations is essential for optimization and understanding of combustion processes. We are using optical frequency comb spectroscopy to detect broadband spectra of ***water and OH in a flame*** for concentration and flame temperature characterization. Our system is based on a near-infrared femtosecond laser coupled to a cavity that contains the flame. The cavity, which is made of two highly reflective mirrors, provides high sensitivity to absorption by enhancing the interaction length between the comb and the molecules in the flame. The light transmitted through the cavity is analyzed with a Fourier transform spectrometer. A disadvantage of this method is that it is relatively slow and bulky. It also requires rather complex stabilization of the comb to the cavity and is affected by the fluctuations in the flame. Therefore we want to implement a simpler, faster and more robust detection method, called ***Vernier spectroscopy***. A Vernier spectrometer exploits the filtering ability of the cavity to enable sequential transmission of selected parts of the frequency comb spectrum. Its technical simplicity and compact size make it extremely suitable for measurements in a turbulent environment.




The ***aim of this project*** is to implement a Vernier spectrometer in the exisiting setup for measurements of broadband spectra in a flame. Within this thesis project you will get hands-on experience with advanced spectroscopic techniques and learn about many aspects of lasers, cavities and spectroscopic measurements. 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).