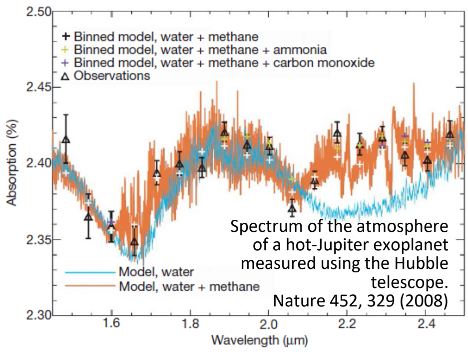
Are you interested in lasers and spectroscopy?

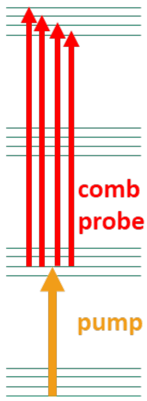
Optical Frequency Comb Spectroscopy Group announces thesis work:

‘Laser frequency stablization to a molecular transition’

Our group works with the development and applications of ***optical frequency comb spectroscopy*** for high-resolution measurements of broadband spectra of small molecules in gas phase. Optical frequency combs are produced by femtosecond mode-locked lasers, whose spectrum consists of equidistant narrow lines covering a very broad spectral range. Absorption spectroscopy performed with optical frequency combs is equivalent to a measurement with thousands of synchronized lasers and allows high-resolution measurements of entire molecular bands.



Methane plays an important role in atmospheric science, combustion, and astrophysics. It is a potent greenhouse gas, and the first organic molecule detected in the atmospheres of ***hot-Jupiter exoplanets*** [Nature 452, 329 (2008)]. The observed high-temperature spectra of methane are very congested and difficult to analyze. The existing theoretical models, needed to extract the quantitative information from the observed spectra, have insufficient accuracy. To improve this accuracy, high-precision laboratory measurements of ***hot-band transitions*** (i.e. transitions from excited molecular levels) are needed. Recently, we used ***double-resonance spectroscopy*** (DRS) with a frequency comb probe to measure hot-band transitions with unprecedented combination of resolution and bandwidth [Phys. Rev. Lett. 126, 063001 (2021)]. In DRS, a high-power continuous wave pump laser is tuned to a transition from the ground state to a selected excited energy level. Then, a comb probe laser measures transitions from this selectively populated level up to highly excited levels. To achieve high frequency accuracy for the probe transitions, the ***frequency of the pump laser needs to be actively stabilized*** to the center of the selected transition. This is done using a frequency modulated saturation spectroscopy signal from a reference cell.



The ***aim of this project*** is to stabilize the frequency of the pump laser used in our double-resonance spectroscopy experiment to a selected CH_4 transition using frequency modulated saturation spectroscopy, and to optimize the conditions for best frequency stability. Within this project you will get hands-on experience with advanced spectroscopic techniques and learn about many aspects of lasers, frequency stabilization, and spectroscopic techniques. The project is suitable for a student with interest in ***optics, lasers, electronics, and spectroscopy***.

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