Laser-induced Fluorescence spectroscopy (LIF) in combustion reaction

This experiment will expose you to tools and approaches, common in modern laser spectroscopy. During the following weeks we will cover several important chapters in the field of modern optics and experimental laser spectroscopy:

• Basic principles of laser operation.

• Laser-induced spectroscopy.

• Combustion chemical reaction.

• Charged Coupled Device (CCD) camera.

Introduction:

Laser Diagnostics in Combustion and Environmental Research

The availability and high reliability of lasers, laser spectroscopy is assuming an ever-expanding role in the diagnostic probing of combustion and environmental processes. Laser–based techniques supply the researcher with the capability of remote, nonintrusive, in-situ, spatially and temporally precise measurements of important chemical parameters. Laser diagnostics are facilitating improved understanding of a wide variety of combustion phenomena that, in turn, will lead to improved efficiency and cleanliness in the energy conversion devices so vital to modern day life.

LIF- the methodology of the experiment:

In this technique a laser is tuned so that its frequency matches that of an absorption line of some atom or molecule of interest. The absorption of the laser photons by these species produces an electronically excited state which then radiates. Temperature measurement is important both for modeling and for calculation of absolute concentration of species in combustion reaction.

Experimental procedure

During the following weeks you will use the Laser-induced Fluorescence to measure the temperature in combustion reaction. In this experiment we will use a flat flame base on CH_4\O_2. Specifically, you will perform the following tasks:

1. Measure the emission spectra using LIF technique in the flame in different positions
2. Compare emission spectra of flat flame under different conditions
3. Learn how to obtain temperature from experimental spectra
4. Compare the experimental results to simulation