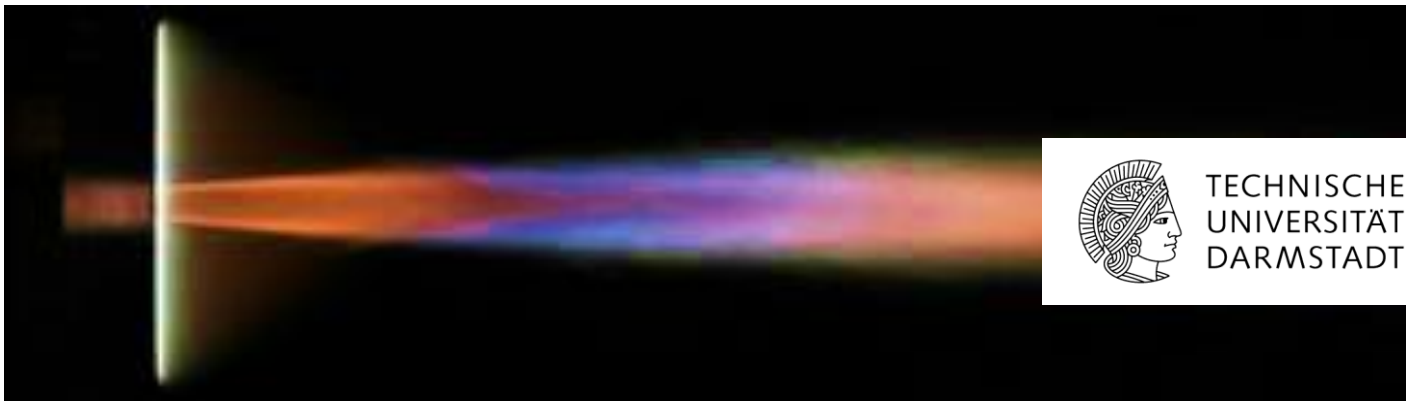

Master thesis

Experimental investigations of turbulent hydrogen/methane combustion using advanced laser diagnostics

Experimentelle Untersuchungen von turbulenter Wasserstoff/Methan-Verbrennung unter Verwendung fortschrittlicher Laserdiagnostik

Reaktive Strömungen und Messtechnik (RSM)

Reactive Flows and Diagnostics

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Motivation

Reducing the carbon footprint in the energy sector has become a key challenge of this century that requires global collaborative efforts. Chemical storage of renewable energy, such as wind and solar, followed by thermochemical conversion for energy utilization, is an important pathway to ensure a smooth transition to a carbon-neutral economy. In the future energy mix, hydrogen (H_2) will be widely used as a renewable clean fuel. However, its combustion characteristics still require extensive investigations, especially under lean and turbulent conditions, which is crucial for gas turbine applications.

Objectives

In this work, the turbulent H_2 flame and flow field structures should be experimentally investigated by using laser diagnostics measurements. For this purpose, a high-velocity flame supplied by H_2 or CH_4/H_2 mixtures from the central jet will be sustained by a pilot flat flame in a McKenna burner. The jet bulk velocity will be increased from 10 m/s (laminar) to approximately 200 m/s (highly turbulent) while the pilot remains at a constant exit velocity. Reactive mixtures with increasing H_2 mole fractions will be used to investigate the preferential diffusion effect of H_2 on the turbulent flame behavior. The flame reaction zone will be measured by single-shot planar laser-induced fluorescence of OH radicals (OH-PLIF). Simultaneously, the flow field will be determined by particle image velocimetry (PIV) or particle tracking velocimetry (PTV) measurements. From the OH-PLIF images, the curvature and flame surface density of the reactive flame front should be statistically determined. By combining PIV data, the local strain rate and its orientation to the flame front direction should be analyzed, providing insights into turbulence-chemistry interactions.

Tasks:

- Review the literature, especially on the relevant topics of H_2 combustion
- Adaption of the existing McKenna burner for CH_4/H_2 combustion
- Determination of operation conditions
- OH-LIF and PIV measurements and data evaluation
- Intermediate and final presentations, writing final theses

Requirements:

- Interest in lab work
- Knowledge in Siemens NX, Labview, and Matlab is preferred.

Are you interested?

Feel free to contact me!

(This work can be conducted either in English or German)