Master thesis / Semester thesis

Start: As soon as possible

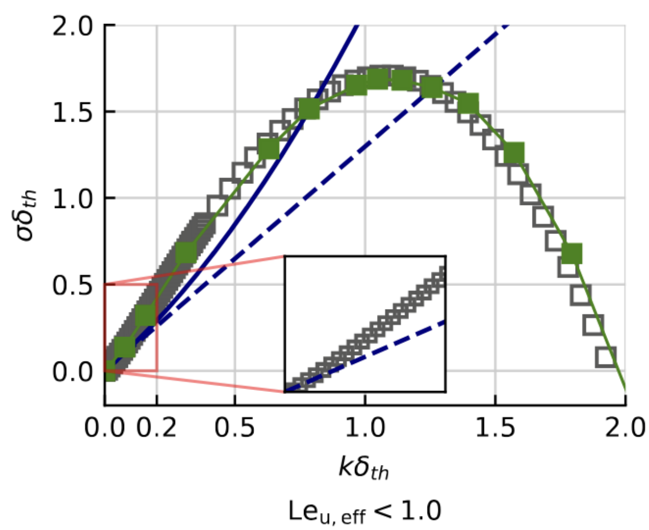
Add published: 24.08.2026

☒ theoretical
☒ numerical

Detailed kinematic mechanism for H2 combustion in a linearized flow solver

H2 combustion brings challenges to the design of new combustion systems due to its very high molecular diffusivity. As a consequence, small perturbations in lean premixed H2 flames are amplified by a mechanism called thermodiffusive instability (TDI) [2].

For predictive simulations of combustion chambers, it is crucial to model the interaction between turbulence and TDI. Some publications suggest models relying on the smallest supported length scale of TDI [3]. Recent work in the group developed an efficient way to compute this length scale based on the linearized reactive flow equations and a single-step reaction mechanism for hydrogen combustion.



Dispersion relation of a premixed planar hydrogen flame.

The objective of the proposed project is to extend this work by implementing the detailed *San Diegeo* [1] reaction mechanism for hydrogen combustion in order to compute relevant length scales of TDI for varying pressure. This is of particular interest as combustion occurs at elevated pressures for power generation.

[1] CERFACS. H2 San Diego. *https://www.cerfacs.fr/cantera/docs/mechanisms/hydrogen-air/UCSD/h2_sandiego.cti*, 2023.

[2] Heinz Pitsch. The transition to sustainable combustion: Hydrogen- and carbon-based future fuels and methods for dealing with their challenges. *Proc. Combust. Inst.*, 40(1-4):105638, 2024.

[3] Vinzenz Schuh, Christian Hasse, and Hendrik Nicolai. An extension of the artificially thickened flame approach for premixed hydrogen flames with intrinsic instabilities. *Proc. Combust. Inst.*, 40(1-4):105673, 2024.

Requirements:
Computational fluid dynamics
Interest in combustion modelling
Programming in python or similar
Working in linux

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