

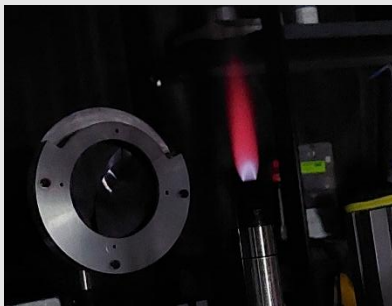
**Bachelor thesis**  
**Project thesis**  
**Master thesis**

## Simulation and Investigation of Flashbacks in Hydrogen Flames

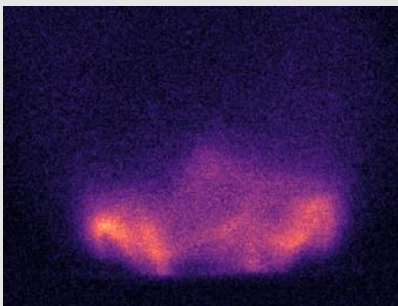
Supervisor: Alexander Fenk

Starting time: January 2026

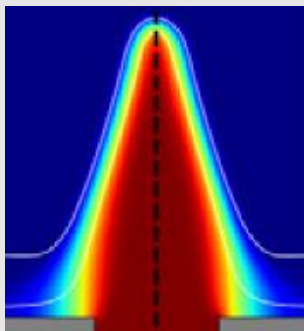
Topics: Flow Simulation, Combustion, Emissions



Example of a hydrogen flame



OH-Chemiluminescence Image of a Flashback taking place



Example of a reactive flow simulation taken from [1]

Hydrogen plays a key role in the fight against climate change due to its potential as a clean energy carrier [2]. Hydrogen combustion offers a promising way to convert stored chemical energy for applications in industry, mobility, and power generation. One of the challenges faced is the significantly higher laminar flame velocity compared to hydrocarbon fuels, hence, increasing the risk of hazardous flashbacks substantially [3]. Therefore, the LTT is conducting experimental studies to understand and predict these phenomena.

To supplement the findings in these experiments and gain deeper insights into the underlying chemistry, 1D simulations (Cantera) should be carried out. In a subsequent step, these results should be complemented by a CFD simulation (Ansys or OpenFOAM) that replicates an experimental flashback scenario. The focus is on identifying unstable states and corresponding characteristic properties in order to enable predictions of imminent flashback events.

Applicants should have an interest in greenhouse emissions, flow simulation and combustion. A high degree of initiative and independence is demanded.

- [1] F. Froberg, P. Kandel, und A. Ghani, „Physics-informed neural networks for reacting flows: Species reconstruction with finite rate chemistry from sparse and noisy velocity measurements“, *Proc. Combust. Inst.*, Bd. 41, S. 105957, 2025, doi: 10.1016/j.proci.2025.105957.
- [2] „EU Hydrogen Strategy under the EU Green Deal | European Hydrogen Observatory“. Zugegriffen: 21. November 2025. [Online]. Verfügbar unter: <https://observatory.clean-hydrogen.europa.eu/eu-policy/eu-hydrogen-strategy-under-eu-green-deal>
- [3] F. Fruzza, H. Chu, R. Lamioni, T. Grenga, C. Galletti, und H. Pitsch, „Three-dimensional numerical investigation of flashback in premixed hydrogen flames within perforated burners“, *Combust. Flame*, Bd. 274, S. 113987, Apr. 2025, doi: 10.1016/j.combustflame.2025.113987.

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