Lehrstuhl für Technische Thermodynamik
Friedrich-Alexander-Universität Erlangen-Nürnberg
Prof. Dr.-Ing. Stefan Will

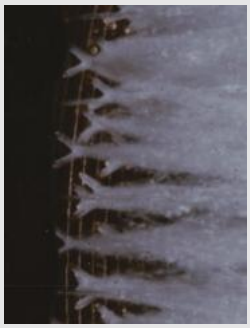
Bachelor thesis
Project thesis
Master thesis

Evaluation of the mixing zone of two impinging sprays via chemiluminescence

Supervisor: Benjamin Klevansky
Starting time: January 2026
Topics: Combustion, Diagnostics, Atomization

Chemiluminescence of luminol injected into a cuvette with a catalyst

Tested in two impinging sprays to visualize their interaction zone



Water-based test of impinging jets of a Rocketdyne F-1 liquid-propellant rocket engine [1].

The fundamental driver of high-performance liquid rocket propulsion is the efficient atomization and mixing of propellants. One prevalent injection strategy utilized in hypergolic and bi-propellant engines is the use of impinging jet injectors, where oxidizer and fuel streams collide to form a spray fan. However, the stability and efficiency of the subsequent combustion are strictly dictated by the local mixing quality within this impingement zone, a process that remains difficult to resolve with conventional shadowgraphy or scattering techniques.

To visualize and quantify these local mixing phenomena we seek to develop a chemiluminescence-based experimental method. This approach utilizes the reaction between Luminol, hydrogen peroxide (H_2O_2), and a specific catalyst to generate light emission exclusively in zones where the fluids actively mix on a molecular level.
To apply this method to propulsion research, an experimental campaign involving two impinging jets mimicking rocket injector geometries will be realized. High-speed imaging will be applied to capture the chemiluminescent footprint of the mixing sheet and the subsequent droplet breakup. Alternatively, in the context of motor engine applications, an experimental set-up will be realized in which two impinging fuel injectors are precisely triggered and captured via a high-speed camera.
Applicants should bring interest in aerospace propulsion and optical diagnostics. A high degree of initiative and independence is demanded for the realization of the experimental setup. Basic knowledge of image processing (e.g., Python or MATLAB) is highly advantageous.

[1] Chen, X. & Yang, V. (2019), Chinese Journal of Aeronautics, 32(1), 45–57.

Contact Details:

Benjamin Klevansky
Office: B.2.11
Tel.: 09131 85-20180
email: Benjamin.klevansky@fau.de

LEHRSTUHL FÜR TECHNISCHE THERMODYNAMIK
FRIEDRICH-ALEXANDER-UNIVERSITÄT ERLANGEN-NÜRNBERG
Professor Dr.-Ing. Alfred Leipertz

Lehrstuhl für Technische Thermodynamik, Am Weichselgarten 8, D-91058 Erlangen, Germany
Telefon: +49-9131-8 52 99 00, Fax: +49-09131-8 52 99 01, e-mail: sek@ltt.uni-erlangen.de, internet: http://www.ltt.uni-erlangen.de