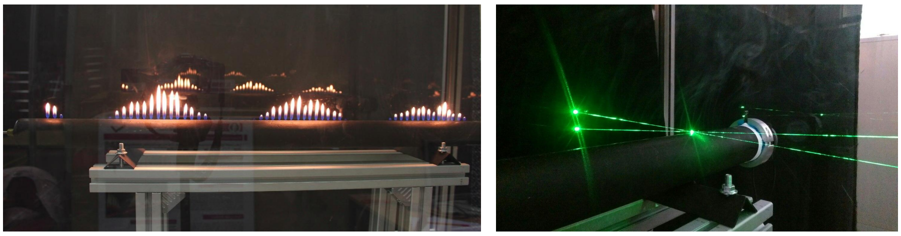
OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG
FAKULTÄT FÜR VERFAHRENS- UND SYSTEMTECHNIK

Experimental investigation of the fluid dynamics of a Rubens tube

Master's Thesis at the *Lehrstuhl für Strömungsmechanik und Strömungstechnik*

The *Rubens tube* is a device in which a combination of acoustics and fluid dynamics is used to produce visually attractive flame patterns above a cylindrical tube. One such device has been used in the institute for several years as a demonstration device for guests, students and visitors.



Flame patterns and LDA measurements on the laboratory's Rubens tube — Photos by Leyla Orunova

While the construction and operation of the one-dimensional Rubens tube are both rather simple, the physical processes at hand are not. Many phenomena contribute to the overall result: classical fluid mechanics (pipe flow, circular jets), basic acoustics, interference effects, combustion with unsteady pressure.

Typically, simple models based on the Bernoulli equation are used to explain and describe the observed flame patterns. Nevertheless, it is quite possible that the flow mechanics through the outlet holes —in particular the relationship between mass flow and pressure difference— must be described by other means in order to attain a satisfactory explanation.

The objective of this project is to investigate the flow mechanics governing the flame patterns observed on a Rubens tube. For this, precise measurements of the inner-tube pressure and burner hole outlet velocity should be conducted, and correlated with pressure distribution and flame height. Measurements can be conducted with and without combustion, using a microphone for pressure, and hot-wire (constant-temperature anemometry, CTA) or Doppler (laser-Doppler anemometry, LDA) for velocity. Ideally, a mass transfer function for the burner holes in the steady and oscillating-pressure flow cases would be obtained. In all cases, the results should provide a quantitative description of Rubens tube flow mechanics, by which to assess the validity of the popular Bernoulli-equation models.

For this exciting project, we are looking for an enthusiastic and autonomous candidate, ready to conduct delicate experimental measurements in order to tackle a phenomenon spanning multiple aspects of fluid mechanics.

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