Universität Stuttgart
INSTITUT FÜR THERMODYNAMIK DER LUFT- UND RAUMFAHRT
Direktor: Professor Dr.-Ing. B. Weigand
Pfaffenwaldring 31, 70569 Stuttgart, Germany · http://www.uni-stuttgart.de/itlr/

15. January 2010

In the framework of the national Collaborative Research Programme SFB-TRR75 „Drop-Dynamic Processes under Extreme Environmental Conditions“, we have openings for

1 Ph.D. Candidate and 1 Postdoctoral Fellow (TV-L 13)

Profile:
We are seeking candidates with a Master-of-Science (or a Ph.D.) degree in mechanical/aerospace engineering or in (applied) physics. The ideal candidate should have a strong interest in developing new (unconventional) experimental approaches, aimed at the quantitative characterization of near-critical fluids. Strong analytic and technical capabilities in modern measurement techniques (e.g. infrared thermography and/or spectroscopic methods) are highly desired. Proficiency in (non-equilibrium) thermodynamic is also appreciated. The ability to become acquainted with new methods within short time and a good familiarity with scientific tools like MATLAB, Labview or Fortran programming are appreciated. The chosen candidate will be an enthusiastic person with good communication and teamwork skills and an interest in developing collaborative research within the project. Fluency in spoken and written English is required.

Application:
Your application should be sent to Dr. Grazia Lamanna (grazia.lamanna@itlr.uni-stuttgart.de), with the heading “**SFB-TRR75**” and before **February 15, 2010**. Please include in your application a motivation letter, your CV and name and address of two references.

Information:
The salary will be assigned according to the German university salary system. The PhD-student appointment is for the duration of four years. The Postdoctoral appointment will be for the duration of at least 2 years.
A more detailed description on the “SFB-TRR75 Research Programme” can be found at http://www.sfbtrr75.de/. Information about the ITLR department and Universität Stuttgart can be found at http://www.uni-stuttgart.de/itlr/.

The Universität Stuttgart intends to increase the recruitment of women in the scientific and technological academic areas where women have been traditionally underrepresented. Women candidates are therefore strongly encouraged to apply for these positions. Physically disabled candidates with equal qualifications will be given prior-ranking in the employment.

Project Description

Supercritical fluid injection holds many promises for meeting future emission targets, reducing fuel consumption and gaining increased control on combustion instabilities, as demonstrated by recent laboratory tests. Still, its practical application to current propulsion systems is hampered by a fundamental lack of understanding of the physical processes and key parameters controlling fluid disintegration and vaporisation at near-critical conditions and the absence of validated predictive tools to be included in engine design.

The proposed research activity **focuses** on the experimental characterisation of **transcritical vaporisation processes in isolated droplets**, embedded in a **near-critical environment**. From the point of view of understanding high-pressure fluid physics, the advantage of single droplets investigations over studies on sprays and/or supercritical jet is that the boundary conditions of the drop are easier to characterize, since the surrounding pressure and temperature are known, being set by the observer. In contrast, in sprays experiments interaction effects prevail and it is impossible to assess the quality of vaporisation models through quantitative comparison with experiments. For this purpose, the experiments will be conducted on single droplets, injected in a pressurized and temperature-controlled chamber. Quantitative and accurate data on **droplet morphology, size, velocity and temperature distributions** within the flow field will be provided. The availability of these data represents a fundamental prerequisite in order to obtain a full characterization of supercritical fluid behavior. This knowledge could then **be integrated** in the **development** of **predictive tools** for supercritical jet disintegration and vaporisation and, hence, lead the way in demonstrating the viability of supercritical injection technology.

The **challenging aspect** of this research project lies in the necessity of developing **alternative** and **innovative concepts** in order to **extend** the range of **applicability** of current **experimental techniques** for a quantitative characterisation of supercritical fluid behaviour. Spin-offs may derive from the adoption of such unconventional approaches, such as a novel drop generator, important physical insights on the transition from the liquid to the supercritical state or the development of novel experimental techniques.

In this context, the proposed activity requires an **interdisciplinary approach**, incorporating detailed knowledge on compressible fluid dynamics, non-equilibrium thermodynamics, electronics, light scattering techniques, thermography and spectroscopic methods. The interdisciplinary trait of the project is reflected in the **organisation of the research team**, which envisage an intense cooperation between the university of Stuttgart and Darmstadt to assure the necessary know-how and expertise for the successful implementation of the work program.