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Master Thesis Work

of Mr. Name, Surname

Experimentelle Untersuchung Hochenthalper Luftplasmen mithilfe von Fabry-Perot Interferometrie

Experimental Study on High Enthalpy Air Plasma Flows with Fabry-Perot Interferometry

Motivation:

Within the EU project MEESST (Magnetohydrodynamic Enhanced Entry System for Space Transportation), research on magnetohydrodynamic air plasma systems will be performed. The project aims to study the feasibility of an active magnetic thermal protection shielding for highly elliptical or hyperbolic re-entry trajectories into the Earth's atmosphere. These trajectories generally have higher re-entry velocities and re-entry angles than re-entries from low Earth orbit performed by e.g., the Space Shuttle. During the re-entry, air plasma occurs due to the aerothermodynamic heating, dissociation and ionization of the atmosphere by hypersonic compression. Consequently, a bow shock forms ahead of the spacecraft. One goal of the MEESST project is to assess and measure the effects of a magnetic field generated by a superconductive coil on the structure of the bow shock and the boundary layer near a plasma probe. The preliminary test condition for MEESST is characterized by a high enthalpy and heat flux and shall be simulated in a plasma wind tunnel experiment. The high heat flux limits the choice of available intrusive measurement techniques to analyze the plasma flow. This is why, the non-intrusive Fabry-Perot interferometry shall be used to determine the atomic translational temperatures and velocities of the high enthalpy air plasma. The spectral analysis will be performed under the assumption of a local thermodynamic equilibrium, the aid of the NIST atomic spectra database, and the IRS in-house code PARADE.

Task description of the Master thesis work:

- Literature review of Fabry-Perot interferometry and familiarization with PARADE
- Assessment of the requirements and boundary conditions for Fabry-Perot measurements in plasma wind tunnel experiments with air plasma
- Support of an experimental test campaign
- Analysis of the measured interference spectra with the NIST atomic spectra database and PARADE
- Documentation in English

Supervisor: Johannes Oswald M.Sc.

Starting date: 01.10.2021

Submission until: 31.03.2022

Acknowledgement of receipt:
I hereby confirm that I read and understood the task of the master thesis, the juridical regulations as well as the study- and exam regulations.

_____
Date
PD Dr.-Ing. Georg Herdrich
(Responsible Professor)

_____
Date
Signature of the student

IRS Professors and Associate Professors:

Prof. Dr.-Ing. Stefanos Fasoulas (Managing Director) · Prof. Dr.-Ing. Sabine Klinkner (Deputy Director) · Prof. Dr. rer. nat. Alfred Krabbe · (Deputy Director) · Hon.-Prof. Dr.-Ing. Jens Eickhoff · Prof. Dr. rer. nat. Reinhold Ewald · PD Dr.-Ing. Georg Herdrich · Hon.-Prof. Dr. Volker Liebig · Hon.-Prof. Dr. rer.nat. Christoph Nöldeke · Prof. Dr.-Ing. Stefan Schlechtriem · PD Dr.-Ing. Ralf Srama

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