



## Master Thesis Work

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German thesis title

### Design and Development of Plasma Measurement System for Small Satellite ROMEO

#### Motivation:

The Institute of Space Systems (IRS) at the University of Stuttgart aims to advance the endeavour to gain a cost-efficient and reliable access to the Medium Earth Orbit (MEO) through its satellite mission ROMEO (Research and Observation in Medium Earth Orbit). The satellite will be launched into a Low Earth Orbit (LEO) and will use its propulsion engine to reach an elliptic orbit, whose apogee lies in a MEO altitude while its perigee remains in a LEO altitude. The apogee of the ROMEO satellite's target orbit is in the Van Allen radiation belt [1]. The radiation belt is of great importance for space weather and is to be investigated by the ROMEO mission. For this purpose, ROMEO would have two space weather payloads: one is the ESA Distributed Space Weather Sensor System (D3S) which would be used to measure space radiation and the Earth magnetic field. The second space weather payload is a double Langmuir probe (DLP) which is a joint project between IRS, Stuttgart, and the Space Payload Laboratory of the International Space University, (ISU). The DLP mission shall measure and characterise the plasma environment of ROMEO satellite throughout its orbital transition from LEO to MEO for a better understanding of the satellite in-situ plasma environment. The double probes shall be two spherical probes and its associated electronics to bias the tips of the probes and measure the current generated by the interaction with the plasma environment.

This thesis shall further analyse systems requirements and constraints from previous thesis at IRS [2], develop both the electronics and the mechanical parts of the probes and carry out intensive plasma test to validate the system. All the tasks shall be carried out in collaboration with satellite subsystems associated with structural system, power supply and management, command (ON and OFF control), data handling, and ground station.

#### Task description of the Master thesis work:

- Study/review of Plasma science and different plasma diagnostic techniques including pros and cons.
- Literature review of plasma measurement systems for small satellite missions.
- CAD Design of the mechanical parts with compliance with overall satellite structural requirements.
- Development of electronics for biasing and measurement of voltage between 0~5V.
- Development of electronics for pico-ampere level current measurement.
- Implementation: Test and verification (for Engineering and Flight models).
- Documentation.

Supervisor: Dr. TEJUMOLA Taiwo (External Supervisor), Thorben I öffler

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

Prof. Dr.-Ing. Sabine Klinkner  
(Responsible Professor)

Date

Signature of the student

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#### 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 Schleichriem · PD Dr.-Ing. Ralf Srama

References.

1. University of Stuttgart, Institute for Space Systems "The aim of the "Research and Observation in Medium Earth Orbit" (ROMEEO) mission is to develop a cost-efficient satellite bus that demonstrates new technologies in low (LEO) and medium earth orbit (MEO)" Accessed August 20,2021.

<https://www.irs.uni-stuttgart.de/forschung/satellitentechnik/kleinsatellitenprogramm/romeo/>

2. Yannick Eyner, 2021 "Analysis of Earth's Plasma Environment and Design of a Langmuir Probe for the Satellite ROMEEO" Bachelor thesis, University of Stuttgart, Stuttgart, Germany.