

Term project/ Master's thesis

Improvement and Characterisation of an Experimental Setup for Dielectric Spectroscopy

Experimental thesis

Start date: As soon as possible

Topic:

The Professorship of Lunar and Planetary Exploration develops instruments for future lunar missions and conducts fundamental research in planetary science. The project VOLARIS focuses on the experimental investigation of the lunar water cycle. Especially, the migration of water through the lunar subsurface is of interest. For this, the spatial and temporal water-ice content within a sample needs to be measured throughout the experiments. In the theoretical studies conducted in our research group, dielectric spectroscopy was identified as a promising measurement technique. Here, the permittivity of a sample is measured by applying an alternating electric field to the sample with electrodes and measuring its response. The ice content inside the sample is then derived from the measurement using inversion algorithms. So far, an experimental setup using a plate capacitor has been assembled to measure the dielectric properties of the samples. However, limitations due to the small 3 cm by 3 cm plates in the signal-to-noise ratio and in the analysis of the data were detected. Therefore, this setup should now be characterised and improved for better resolution. Besides, frequency sweeps rather than single-frequency measurements should be implemented to investigate dry samples and estimate water content in wet samples. The obtained measurements should be compared with the analytical solution of a plate capacitor, and optionally, the setup can be simulated in COMSOL to further investigate the experimental results.

Tasks:

- Characterising an already existing experimental setup with a plate capacitor using different reference materials
- Improving the electronics used, implementing shielding, etc., to improve the signal-to-noise ratio
- Implementing frequency sweeps to assess the water content in a sample

Requirements:

- Basic knowledge and interest in lunar and planetary exploration
- Basic knowledge of electrodynamics
- Experience with and interest in electronics
- Knowledge of data analysis (e.g. Python, MATLAB, Julia, etc.)
- Ideally, experience with circuit board design
- Ideally, previous experience with experimental lab work

Supervisor:



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