Professorship of Lunar and Planetary Exploration Technologies
TUM School of Engineering and Design
Technical University of Munich

**Master Thesis**

# Development of a lunar surface model to predict particle behavior following solar wind proton implantation

*theoretical/numerical thesis*
Start date: July 8, 2022

## Topic:

After the discovery of the hydroxyl (OH) veneer on the Moon, many studies have proposed that the solar wind and its constant supply of protons must be one of the main source of $H_2O$ and OH on the lunar surface. Ever since then, researchers developed models to explain the measurements and to investigate the implantation process.

After the implantation, the fate of the incident proton can follow several different paths, like reflections towards space and reactions with the lunar regolith. While some of these processes have already been studied, a complete surface reaction model for solar wind particles does not exist. Such a model could be used to examine geochemical and -physical effects to determine their rates and probabilities.

This study aims towards a theoretical and numerical description of the interaction between the lunar surface and protons as well as hydrogen-bearing species like H, $H_2$, OH, and $H_2O$. One option would be to use the Monte-Carlo method, which offers an effective tool to model the surface processes which are often described by statistical events.

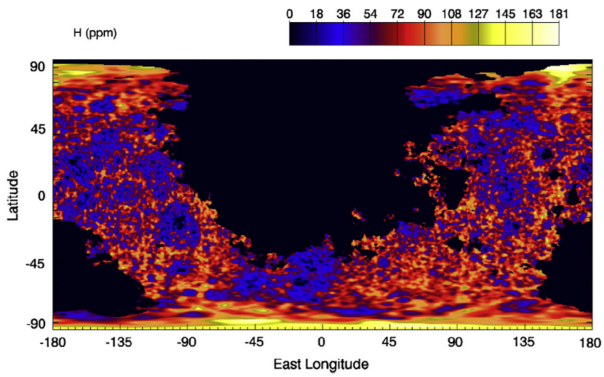


Figure 1: Global map of hydrogen abundance.

## Tasks:

- research and summarize previous work performed in the field of solar wind implantation and lunar surface based particle migration
- combine available models to describe several hydrogen-bearing species (H, $H_2$, OH, and $H_2O$)
- analyse the model to find sensitivities and extract the most important variables
- (*optional*) compare the model with measurements to investigate the input parameters

## Requirements:

- basic knowledge and interest in lunar and planetary exploration
- knowledge in thermodynamics, as well as heat and mass transport
- programming skills, preferably in Julia, Matlab, and/or Python
- (ideally) knowledge in the field of geochemistry
- good command of the English language

## Supervisor:

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