

Space instrumentation for lunar photometric measurement

Summary

The Máni mission has just been selected by ESA in December 2025 to explore the lunar surface. The mission will be the first to employ a targeted multi-angular photoclinometric mapping approach to map key regions of interest of the Lunar surface. It aims to acquire the highest resolution orbital images of the Lunar surface (down to 20 cm/pixel), including the Polar regions, across a wide range of viewing geometries. The Máni consortium is lead by University of Copenhagen and the launch is planed for 2029. GEOPS (F. Schmidt, F. Andrieu) will contribute by developing the scientific pipeline for photometric analysis. Scanway S.A (Michał Zięba) will design and build the telescope and the camera system. The objective of the thesis is to construct a laboratory instrument analogous to Máni and to establish a precise calibration of the ground-based and Máni instruments in order to perform accurate radiometric measurements. The second objective is to determine the rocks microtexture on analogous samples.



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The aim of the PhD project is to prepare for the Máni mission

The first objective is to build a laboratory instrument in GEOPS with multi-angular capabilities to measure the light reflected back by the sample. This kind of instrument is not available in the market and must be built up. This instrument will allow to characterize the photometric behavior of the sample that will then be used to characterize the microtexture of the sample (grain size, roughness, porosity...). This task requires absolute calibration, including of the geometry and quantum efficiency of the optical/camera system. We aim at describing the spectral dependence of the reflectance in the visible and near-infrared wavelength in order to prepare the Máni mission (spectral dependency influence on panchromatic photometry) but also to understand the micro-texture influence on the spectro-photometric behaviour.

The second objective is to calibrate the Máni camera with a high level of precision in order to get the best scientific outcome of the mission. This includes radiometric, linearity, flat field calibration. This task will be done with the equipment available at Scanway S.A. This task will benefit from experience gained in the first objective on a laboratory instrument that is much simpler in comparison to the space qualified instrument but require the same principle.

The final objective is to use those two system (laboratory and flying instruments) to study natural rock samples, either from analogs in the laboratory or from actual observations of the Moon. At GEOPS, we already possess rocks sampled from various analog fields worldwide (such as volcanic rock from various islands, sedimentary rock...). We expect to validate the analysis and determine the microtexture of the sample remotely.

Data dissemination

All developments of this PhD will be public, as well as the defense. The results will be communicated in international conferences and scientific articles.

Reference

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Program of the PhD

2026-2027 : 1st year in GEOPS, Paris : Creation of the multi-angular instrumental facilities, calibration and validation of the equipment.

2027-2028 : 2nd year in Scanway, Poland : calibration and validation of the camera system for Máni.

2028-2029 : 3rd year in GEOPS, Paris : Expected launch of the Máni mission. Analysis of rock sample and lunar data. Writing of the PhD dissertation

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