Physics & Astronomy PhD Project Proposal

Project Title: Robotic and Human Exploration Lunar Mission Studies

Groups: Planetary

Project reference: STFC – Lerman

Supervision Team:

- 1st Supervisor: Dr Hannah Lerman (hnl4@leicester.ac.uk)
- 2nd Supervisor: Prof Ian Hutchinson (ibh1@leicester.ac.uk)
- 3rd Supervisor: Dr Melissa McHugh (mm875@leicester.ac.uk)

Three Key Points

- Instrument design and development for robotic and human lunar exploration
- Training in the interpretation of spectral data and context images using Lunar analogue samples
- Training in the operation of analytical instruments during of surface operations

Project Description:

Missions to the Moon enable us to study formation processes and materials that were present in the early history of rocky bodies in the inner Solar System. Lunar petrology provides the opportunity to study the processes that took place during the first stages of planetary formation, processes that result in a diversity of rocks that are due to be thoroughly characterised by in-situ analytical payloads onboard planned Space Resource Utilisation (SRU) and astronaut exploration missions.

Both robotic and human missions to the Moon (and Mars) are the next step in both ESA and NASA planetary exploration roadmaps, as well as for a number of private/commercial companies; for example:
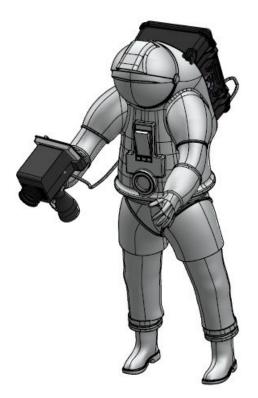
1) The commercial company, ispace, is developing a series of small commercial lander and rover missions (HAKUTO-R) to explore the lunar surface (the first of which launched in 2022).
2) NASA Artemis is a lunar exploration programme, which aims to restore human exploration on the Moon by mid-2020s.
3) PANGAEA is ESA's current astronaut training programme which aims to provide astronauts with the fundamental knowledge and training to become field scientists during future lunar (and Mars) exploration missions.

This project involves the development, build and testing of a new instrument package concept that would be suitable for rapid elemental, molecular, and mineralogical characterisation of lunar surface material. The work builds on ongoing prototype development programmes with European/Canadian partners and with the Jet Propulsion Laboratory (as part of the ESA PANGAEA and NASA lunar programmes respectively), and through collaborations with ispace. The work will involve the verification of instrument performance, using a range of recently commissioned characterisation facilities and Lunar analogue samples.

Further Reading:

- *Rull et al., The Raman Laser Spectrometer for the ExoMars Rover Mission to Mars, 2017, Astrobiology 17, 6-7*
- *Lunar Exploration Analysis Group (LEAG), 2016, The Lunar Exploration Roadmap v1.3*
- *Moral et al., 2024, PHOENIX: Novel portable handheld combined spectrometers for Lunar surface exploration, IAC-24-A3.2C.12*
- *Lambert et al., 2020, Adapting the Compact Integrated Raman Spectrometer(CIRS) for the Europa Lander Mission Concept, AGU*

Images/Graphics:

Design of a handheld multi-analytical spectrometer for use by astronauts during Lunar exploration missions. Credit: University of Leicester and ESA.

Application advice: Please see web page

https://le.ac.uk/study/research-degrees/funded-opportunities/stfc