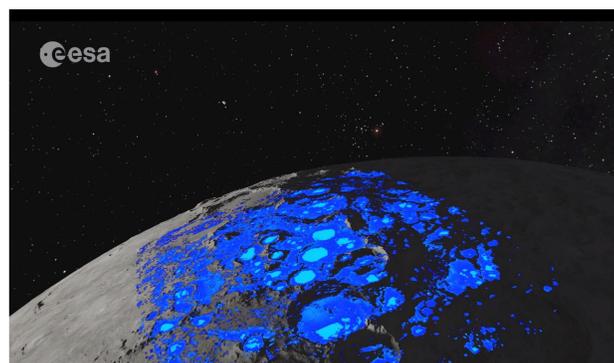


Background and Research Aims

ISRU is key to the future of lunar exploration. However, there is still a great deal of work to be done in assessing the abundance and type of useful materials on the lunar surface.



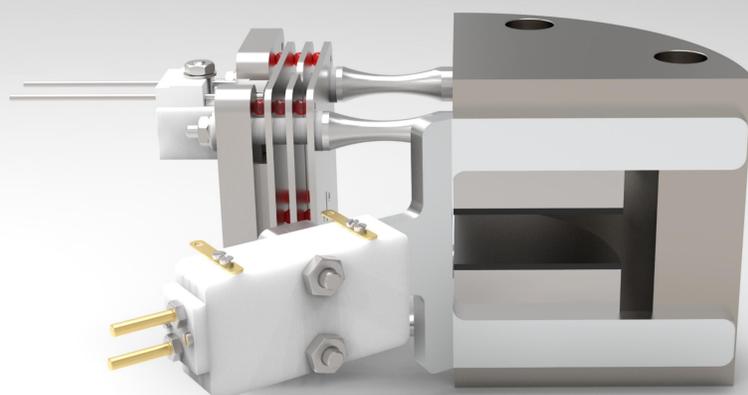
Water under the surface of the Moon - Image Copyright: ESA1

Inspired by successful research into ISRU systems such as PROSPECT² and LUVMI³, this research looks towards the development of a **miniature mass spectrometer system**, that could be deployed cheaply and easily across different lunar terrains in order to:

1. **Assess the local volatile content and ISRU potential**
2. **Provide ground truth scientific data**

The small scale magnetic sector mass spectrometer device at the heart of this system will be **compatible with the CubeSat form-factor**, allowing for simpler integration to future mission systems, and the potential for interchangeability of wider system components and operational environments.

Magnetic Sector Device



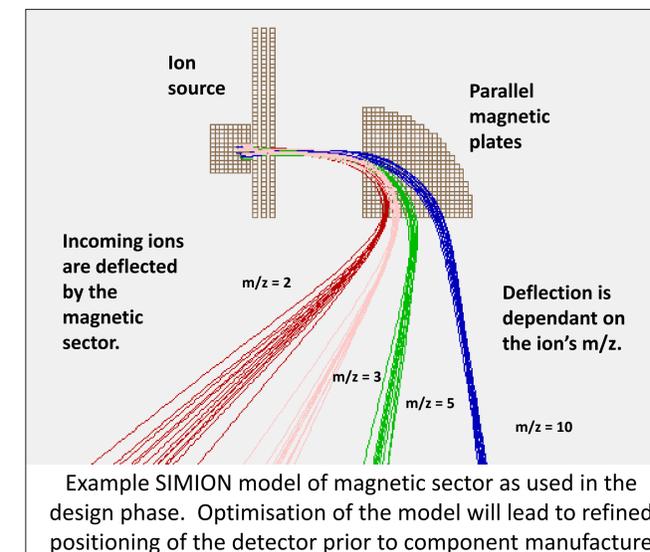
CAD model of miniature magnetic sector spectrometer with simple filament source and electron multiplier detector in place to detect $m/z = 2$ and 3

In addition to **cataloguing useful volatiles** across different locations and terrains, the system will also be able to gather **important in-situ scientific data**. Adding value to prospecting missions and allowing identification and preservation of sites of key scientific interest.

This research aims to initially develop a system capable of **determining D/H ratio** of samples – providing data on the potential origin and therefore sustainability of water sources. With the potential to extend to other key science objectives.

Current Status and Future Work

- The system is currently in the design phase, with modelling work being undertaken using 'SIMION' software⁴.



- Following on, a benchtop demonstration model will be developed and optimised to show **proof of concept**.
- Lunar simulants will be used to develop the system for use with **mare, highland and polar regolith**.
- The **full ISRU prospecting lifecycle** will be considered, working towards a self contained sampling and analysis system to accompany ISRU precursor missions to the lunar surface.

References:

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2. Heather, D. et al., The ESA PROSPECT Payload for Luna 27: Development Status (2021) in *Lunar Planet. Sci. Conf.*, LPI, Abs #. 2548
3. Gancet, J. et al., Lunar Volatiles Mobile Instrumentation (LUVMI) Project Results (2019) in *Proc. Int. Astronaut. Congr. IAC*, Vol. 2019-October
4. Scientific Instrument Services. (2021). *SIMION® Ion and Electron Optics Simulator*. Available at: <https://simion.com/>