



# Ion Gun for In Situ Resource Identification

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Technology Taxonomy Area (TX): 7.1.1 Destination Reconnaissance and Resource Assessment, 8.3 In-Situ Instruments and Sensors

TRL: Start 1 / Current 2

## FY22 ICA PROJECT OVERVIEW

Identification of surface resources localized to landing sites is a critical need for future lunar exploration. Crews will need small, lightweight instrumentation that can be easily carried to identify potential resources in situ without extraction of samples for testing. This project aimed to conduct a proof-of-concept of using ion sputtering coupled with mass spectroscopy to provide in situ composition analysis of surface materials with no need to collect and/or return samples. Ion beam sputtering is a mature ground-based technique that ablates material surfaces for analysis.

## INNOVATION

This project is innovative by: (1) Leveraging a highly mature ground-based technique to perform quick measurement of localized surface composition, and; (2) Leveraging a small, lightweight commercially-available ion source which can be flight certified with minimal effort.

- Analogue of Secondary Ion Mass Spectroscopy (SIMS)
- Similar to shining a spotlight on surface.



- Probe surface layers of rock/regolith in real-time without having to collect any samples for processing.

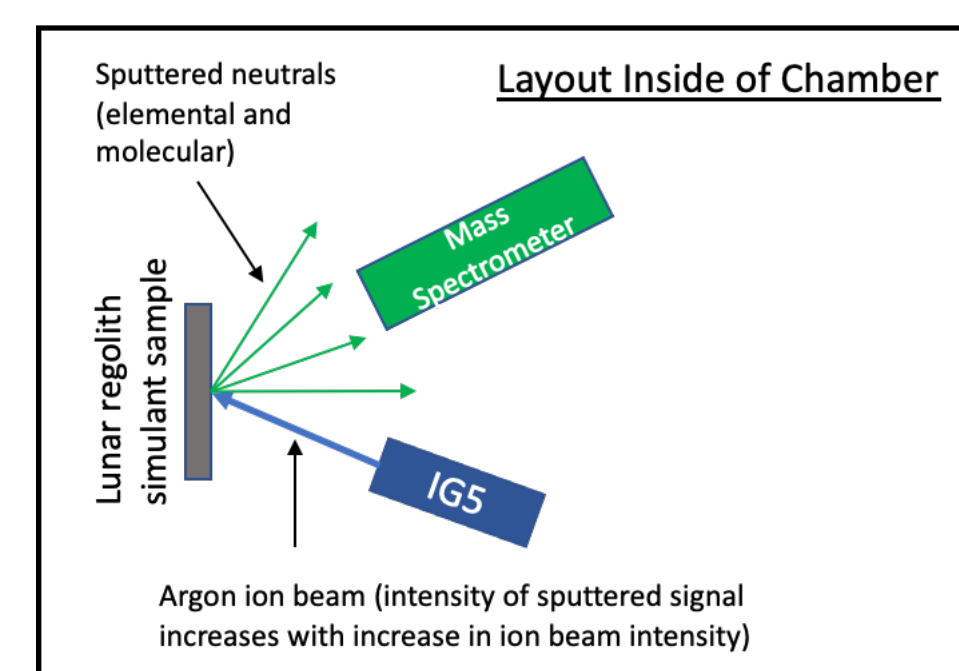
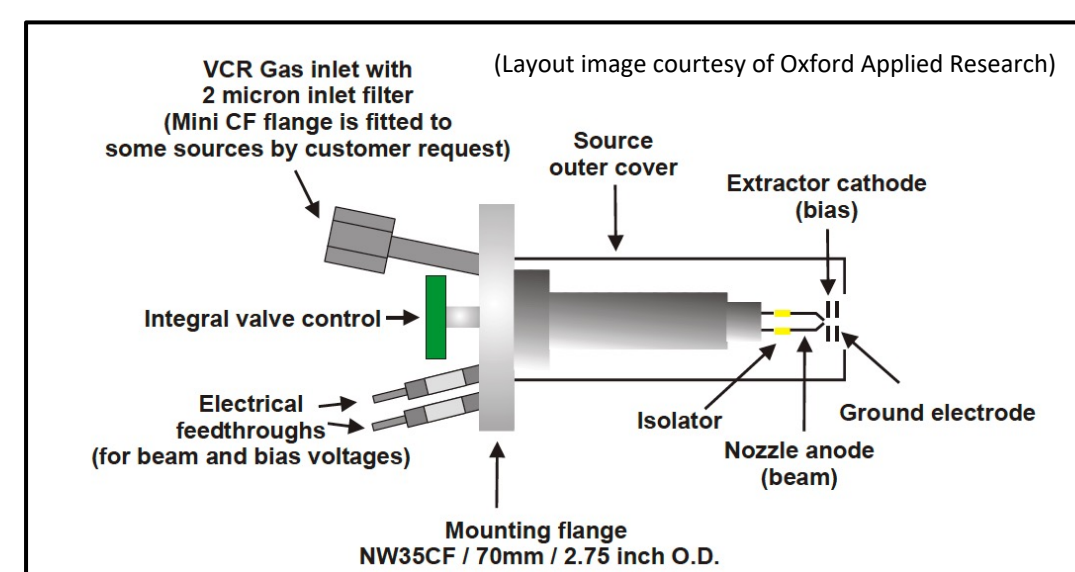
## OUTCOME

The following was completed during the 10-week project duration:

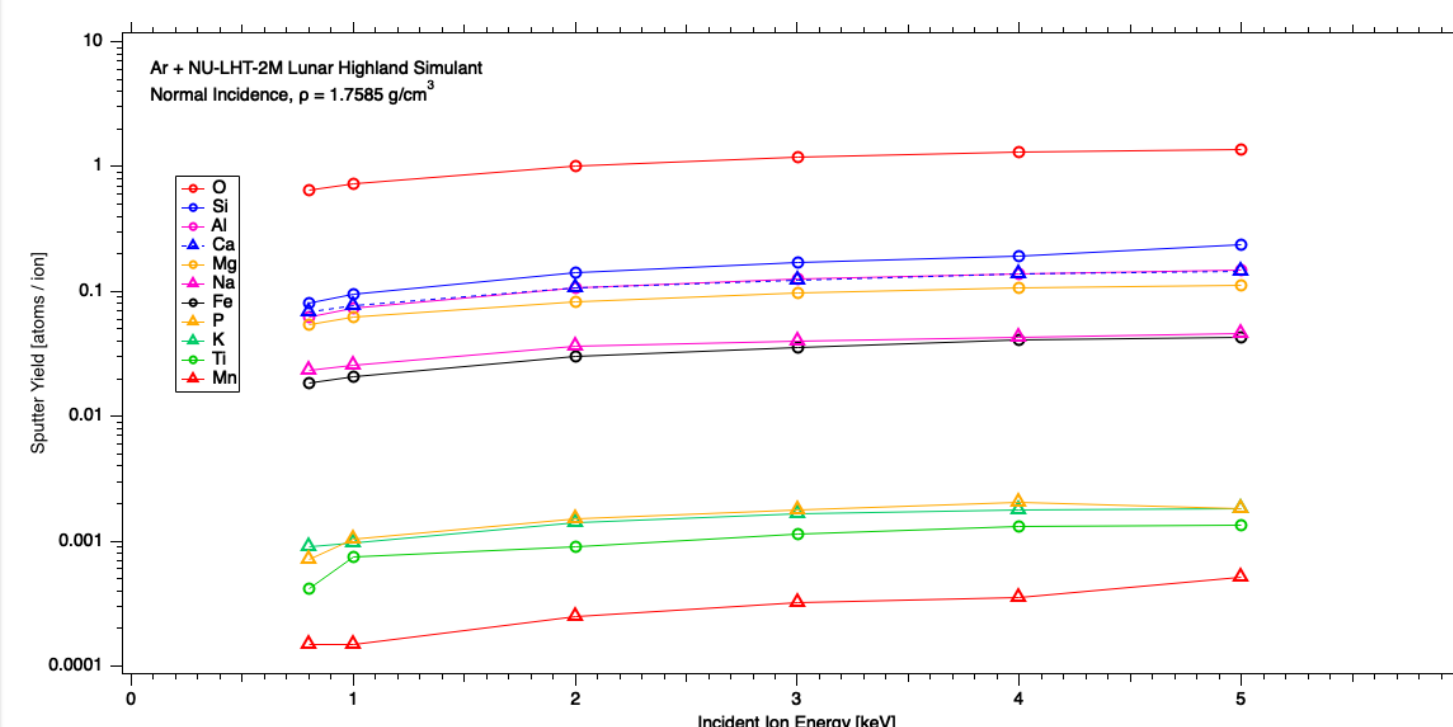
- Procurement of Oxford Applied Systems Ion source
- Modifications to vacuum chamber to support integration of ion source
- Design and fabrication of mount to hold lunar sample target
- Receipt of lunar simulant sample NU-LHT-2M (lunar highlands)
- Simulation of sputter yields for comparison to measurement and estimation of expected sputtered particle density
- Due to late arrival of ion source from vendor, measurements will be completed in October-November 2022.

## INFUSION SPACE / EARTH

Project overview was presented to the JSC Astromaterials Research and Exploration Science (ARES) group to compare sputtering techniques with other mature ground-based analysis methods.

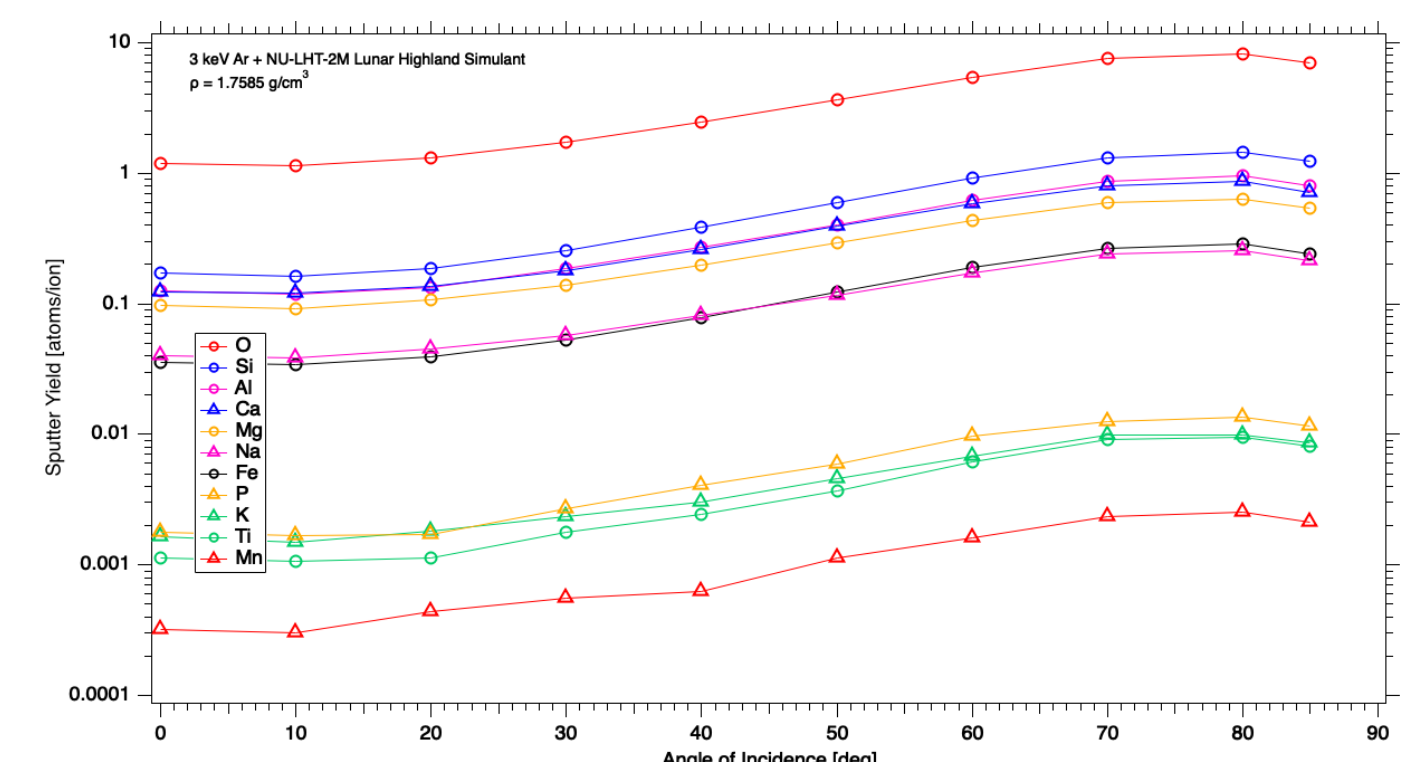


Ion Gun Source and Measurement Layout



Theoretical yields predict that standard ion gun source could result in large signal-to-noise ratios such that most major constituents could be measured within minutes sample duration.

Relatively weak dependence of yield on incident ion energy suggests ion source can be operated at low voltage, removing expensive and complex mitigation methods for operating at high voltage.



Simulated sputter yield as a function of ion energy (top) and incident angle (bottom). Calculated with SRIM-2013.

## FUTURE WORK

FY'23 (Year 1 IRAD): Will pursue an FY23 IRAD proposal submission to:

- Perform direct measurement of sputter yields – critically needed for accurate identification of surface composition
- Conduct environmental testing on ion source to identify