



UMEÅ UNIVERSITY

IRF Scientific Report no. 320

# Observing Solar Wind Interacting with Regolith

Romain Canu-Blot

## **Academic dissertation**

Which, with the due permission of the Vice-Chancellor of Umeå University for the examination for the Degree of Doctor of Philosophy in Science, is presented for public defence in Ljusårssalen (Aula) at IRF Kiruna on Monday, 23 March, 2026 at 09:00.

The thesis will be defended in English.

Faculty opponent:

Prof. Dr.-Ing. Ralf Srama, University of Stuttgart, Stuttgart, Germany

**Organisation**  
Umeå University  
Physics

**Document type**  
Doctoral thesis

**Date of publication**  
2 March 2026

**Author**  
Romain Canu-Blot

**Title**  
Observing Solar Wind Interacting with Regolith

## **Abstract**

This thesis aims to deepen our understanding of *regolith*--the layer of unconsolidated solid material that covers the bedrock of planetary bodies. For airless bodies, regolith forms the primary interface between the body and the energy and matter that permeate the solar system. One way to investigate regolith is by studying the products of its interactions with incident atomic particles. We develop a physical model of these interactions, derive observational predictions, and test them against measurements in order to evaluate and refine the model. As new data become available, this iterative, model-driven approach progressively constrains our knowledge of the physical properties of regolith.

To validate or refute such models, measurements of particles emitted from regolith are required. We addressed this need by developing a dedicated particle instrument, calibrating it, and deploying it on the lunar surface, where it directly measured particles emitted from lunar regolith. When exposed to precipitating ions and photons, lunar regolith responds by anisotropically emitting a zoo of particles spanning multiple charge states, species, and energies. The instrument was specifically designed to detect negatively charged ions emitted from the surface. It successfully performed this measurement and produced valuable observational data which, when interpreted through predictive modelling, indicate that lunar regolith is a surprisingly efficient emitter of negative ions.

**Keywords:** Particle instrument; solar wind; particle-surface interactions; geometric factor; Bayesian statistics; inference; lunar regolith; cometary regolith; Chang'e-6

**Language**  
English

**ISBN**  
978-91-8070-943-9 (print)  
978-91-8070-944-6 (pdf)

**ISSN**  
0284-1703

**Number of pages**  
48 + 4 delarbeten/papers