Toward Multiview-Multispectral Sensing from the Martian Moons eXploration Spacecraft: Imaging Ryugu Samples with the Laboratory OROCHI Simulator

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Key Points

As part of preparations for imaging Phobos with the JAXA Martian Moons eXploration spacecraft multiview-multispectral imager (OROCHI), we present an imaging campaign of grains of asteroid Ryugu at multiple phase-angles and multiple visible-to-near-infrared wavelengths (400 – 950 nm), with a laboratory simulatory simulator of the OROCHI flight model.

Abstract

The JAXA Martian Moons eXploration (MMX) mission will address the question of the origin of Phobos and Deimos by launching a spacecraft to the Mars system in 2026, performing dedicated surveys of the moons, and by collecting a sample from the surface of Phobos and returning it to Earth in 2031. OROCHI is a wide-angle visible-to-near-infrared (VNIR) 8-channel 8-camera multispectral imaging system for MMX, with a key objective of characterising the surface spectral diversity of the moons from orbit, during descent, and once landed on the surface of Phobos. Operating a new imaging system in a new environment requires preparation, but the development timelines and protections required of spaceflight hardware rarely allow for extensive ground-based operation trials to be performed with the final Flight Model of an instrument. In preparation for multiview and multispectral imaging with the MMX spacecraft from the surface of Phobos, we have developed a laboratory simulator of the MMX OROCHI multispectral imager (LOROS), and have used it to image pristine grains of asteroid Ryugu collected in aggregate as an analogue of the surface scattering properties of Phobos, at the JAXA Extraterrestrial Sample Curation Centre (ISO-6 Cleanroom). We describe LOROS and demonstrate equivalent performance to OROCHI, and present the results of multi-phase multispectral imaging of the Ryugu C9003 aggregate sample. We discuss the implications of the surface bidirectional-reflectance distribution function on near-field imaging with the unique 8-camera 8-channel configuration of OROCHI, in the context of resolving the subtle VNIR features expected of Phobos.