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Centers
Summary of Achievement

Refereed Journal Papers


The Spectral Profiler (SP) is a visible-near infrared spectrometer onboard the Japanese Selenological and Engineering Explorer (SELENE), which was launched in 2007 and observed the Moon until June 2009. The SP consists of two gratings and three linear-array detectors: VIS (0.5-1.0 $\mu$m), NIR 1 (0.9-1.7 $\mu$m), and NIR 2 (1.7-2.6 $\mu$m). In this paper, we propose a new method for radiometric calibration of NIR 2, specifically for the dark output (background) estimate, which is different from the previous method used for VIS and NIR 1. We show that the reflectance spectra of NIR 2 derived from the new radiometric calibration show less noise than those of the previous method. Based on an analysis of the reflectance spectra at exposure sites of the end-member minerals on the lunar surface, we demonstrated that the spectral features of the 2-$\mu$m band in the NIR 2 spectra are consistent with those expected from the minerals inferred from the features of the 1-$\mu$m band in the VIS and NIR 1 spectra. Finally, we examined the repeatability of the radiometric calibration of NIR 2 using the SP data near the Apollo 16 landing site observed at four different times. The typical difference in the reflectance at wavelengths $\lambda \approx 2.1$ $\mu$m was a few percent, which is within the uncertainty due to the error in the background estimate, suggesting that there was no significant change in the sensitivity of NIR 2 over the mission period.


Based on observations from the Hubble Space Telescope and the Subaru Telescope, we have discovered that Europa, Ganymede, and Callisto are bright around 1.5 $\mu$m even when not directly lit by sunlight. The observations were conducted with non-sidereal tracking on Jupiter outside of the field of view to reduce the stray light subtraction uncertainty due to the close proximity of
Summary of Achievement

Jupiter. Their eclipsed luminosity was $10^{-6}$-$10^{-7}$ of their uneclipsed brightness, which is low enough that this phenomenon has been undiscovered until now. In addition, Europa in eclipse was $1/10$ of the others at 1.5 $\mu$m, a potential clue to the origin of the source of luminosity. Likewise, Ganymede observations were attempted at 3.6 $\mu$m by the Spitzer Space Telescope, but it was not detected, suggesting a significant wavelength dependence. It is still unknown why they are luminous even when in the Jovian shadow, but forward-scattered sunlight by hazes in the Jovian upper atmosphere is proposed as the most plausible candidate. If this is the case, observations of these Galilean satellites while eclipsed by the Jovian shadow provide us with a new technique to investigate the Jovian atmospheric composition. Investigating the transmission spectrum of Jupiter by this method is important for investigating the atmosphere of extrasolar giant planets by transit spectroscopy.


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decline using spectral-distortion measures and phylogenetic inference. 

SCI journal


We developed a web GIS system ”Gekko”. This paper mainly describes a web GIS system for viewing the hyperspectral data observed by Spectral Profiler (SP) onboard Kaguya, a Japanese lunar orbiter. Gekko means moon light in Japanese. Users can browse easily the observation points of SP on the lunar image, focusing on the interesting areas. Once an observation point is selected, then the spectral data are displayed in many graphs. The users can download the plotted SP data in the graphs, too. This system was developed by Hayashi and University of Aizu team. The SP data used in the system are provided by Japan Aerospace Exploration Agency and National Institute for Environmental Studies. Gekko will be extended beyond a viewing tool and develop into a new analysis tool which contributes to the science community.


We conducted bulk analysis of data obtained by Spectral Profiler (SP) on Lunar Exploration Satellite “Kaguya”, and examined global distribution of rock facies of rocks rich in olivine and low-Ca pyroxene. We conclude based on this research that (1) olivine is located mainly around relatively small impact basin such as Mare Moscovienne and Mare Crisium that have thin crust (2) low-Ca pyroxene is mainly located around three major impact basin on the Moon, South Pole-Aitken, Mare Imbrium and Procellarum basin.

Refereed Proceeding Papers
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IEEE conference


IEEE conference


IEEE conference


Springer LNEE


IEEE conference


IEEE conference


Global distributions of exposure sites of various lunar major minerals have been revealed from the global survey using the spectral data obtained by Spectral
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Profiler (SP) onboard SELENE/Kaguya [e.g., 1-4]. These studies are conducted based on the diagnostic absorption bands of $1 \mu m$ and $2 \mu m$. On the other hand, it has been reported that several sites on the Moon exhibit no absorption bands for $1 \mu m$ and $2 \mu m$ (hereafter featureless (FL) spectra) [e.g., 5,6]. For the interpretations for the origin of FL spectra, we need to understand the global occurrence trends of FL points on the Moon. Thus, we conducted the global survey using SP data to reveal the global distribution of FL points.


We made constant enhancement of WISE-CAPS system since start of its development in 2008. Currently, we are focusing our development on usability and web appearance.


This study investigated the mafic silicate phase and estimated its composition within the PAN layer globally by using remote sensing reflectance spectra of the lunar surface.


We have developed and calibrated Thermal Infrared Imager TIR for investigating thermo-physical properties of C-class near-Earth sub-km sized asteroid (162173) 1999JU3 in Hayabusa2 mission. TIR shows its performance as good as expected during the in-flight test after launch. We summarize development, pre-flight calibration, and in-flight performance of TIR, as well as its future observation plan.
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Unrefereed Papers


The Lunar and Planetary Data Analysis Practice Meeting is a hands-on and short-concentrated meeting held from 2009 once or twice annually aiming for cultivation of human resources dedicated to future lunar and planetary exploration and expansion of study of lunar and planetary science. In this 7th meeting, we set the theme “lunar surface information probing from visible - near-infrared spectral data”. The goal is to realize mineral composition and its weathering of rocks in lunar surface by self-analysis attempt using precise spectral data obtained by Japanese Lunar exploration satellite “Kaguya”. Satoru Yamamoto, National Institute of Environmental Studies, and Yoshiko Ogawa, CAIST/ARC-Space, The University of Aizu, initiated analysis of Kaguya’s spectral data.
Summary of Achievement

Grants


Academic Activities


Summary of Achievement

regular member

regular member

Ph.D and Others Theses

Thesis Advisor: K. Kitazato

Thesis Advisor: Y. Ogawa

Thesis Advisor: Y. Ogawa

Others

Working Group Member, MELOS (Mars Explorer) Project

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Working Group member, JUICE/GALA (Icy Satellite exploration) Project

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Working Group member, JUICE/GALA (Icy Satellite Exploration) Project.

Collaborative researcher, Hayabusa 2 Project (TIR/Operation Planning)

Part-time assistant professor, Shibaura Institute of Technology (Division of Applied Chemistry, “Applied Physics”)

Co-Investigator, Kaguya Project (LISM)