KAGUYA(SELENE) / SPECTRAL PROFILER : IN-FLIGHT PERFORMANCE AND FUTURE PLAN.

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Introduction: The Spectral Profiler (SP) is a visible - near infrared spectrometer onboard Japanese lunar orbiter, "KAGUYA (SELENE)" which was launched on September 14, 2007 and started its normal operation from December 21, 2007. SP will obtain continuous reflectance spectra of the lunar surface with broad spectral coverage (500-2600 nm) , high spectral resolution (6-8 nm) , and high spatial resolution (500 m)(See Figure 1 and Table 1). SP is one of components consisting Lunar Imager/Spectrometer(LISM) optical instrument suite. Other instruments in LISM are Terrain Camera(TC) and Multi-band Imager(MI).

First Light of Spectral Profiler: "First light" data of SP were acquired for four orbits on November 2, 2007. One of "first light" data of SP and MI is shown in Figure 2. These data were acquired over a 10km-wide crater in the highland in the farside of the Moon. These SP data, after applying a simple correction scheme for detector-to-detector sensitivity variation and lunar surface albedo change, clearly shows the spectral differences between fresh materials exposed at the inner wall of the crater and weathered materials outside the crater. Also, signatures probably due to iron-bearing minerals are also shown around 950 nm.

In-flight performance of SP: In-flight performance of SP are now being evaluated using the "first light" data as well as other data acquired during the initial checkout period.

"Dark" and its noise level are being investigated for every pixel of three detectors using data acquired during nighttime. So far no new dead/damaged pixels have been found.

The radiometric sensitivity and spectral location of each pixel is being monitored using internal calibration lamp data. It is confirmed that overall difference of sensitivity between in-flight and pre-flight data is small although modifications of spectral parameters may be needed to compensate the change of instrument temperatures.

As for absolute radiometric calibration, data of integrating spheres acquired during pre-flight tests at JAXA's Tsukuba Space Center will be used as primary standard. To cross-check these pre-flight data, SP data at Apollo 16 landing site will be used. The first observation of the site was conducted on November 19, 2007 and data were successfully obtained.

Together with instrument performance evaluation, the data processing systems developed at JAXA/ISAS were being tested using data acquired during initial checkout period. Routine generation of SP L2A products was already started. Other higher level products are now being evaluated.

Future Plan:

Instrument operation. During the normal operation of KAGUYA, SP will observe the lunar surface from all the daytime passes. Total number of daytime passes will be around 3,000. To correct "Dark" level, nighttime observation just before and after every daytime observation will be conducted. For cross-check of radiometric calibration, two more observations of Apollo 16 landing sites are now planned.

Data processing. SP L2A products are now being generated several days after observation. SP L2B products(Lunar surface spectral radiance) will be generated several months after generation of corresponding L2A products. This time delay is necessary to evaluate changes of radiometric and spectral calibration coefficients with time.

Science. SP is a first instrument which can provide visible - near infrared continuous reflectance spectra for both sides of the Moon. Also, with its very high radiometric sensitivity, SP can reveal subtle spectral signatures which previous orbital and earth-based instruments could not detect. In addition, SP's internal calibration lamps will provide radiometric calibration information which are independent of lunar surface calibration sites such Apollo 16 landing site. Using these characteristics of SP, many new scientific researches are being planned by LISM Working Group members. Latest results from these researches will be presented at the conference.

Table 1. Specifications of Spectral Profiler.

Fore optics	80mm diameter reflective(Cassegranian) telescope
Spectral dispersion	Two plane gratings with a low-pass filter and a dichroic mirror.
Detectors	Three 128-element detectors. Si-PIN for VIS, InGaAs for NIR1 and NIR2. NIR2 detector is cooled by three-stage peltier cooler
A/D conversion	16 bits
In-flight calibration source	Two halogen lamps. One of them is equipped with a filter for spectral calibration
Spectral coverage	500 - 2600 nm
Spectral sampling interval	6 nm in 500-1000 nm(VIS), 8 nm in 900-2600 nm(NIR1 and NIR2)
Signal-to-noise ratio	>2300@810-860 nm, >1000@550-700 nm and 1300-1600 nm
Footprint size	500 m x 500 m

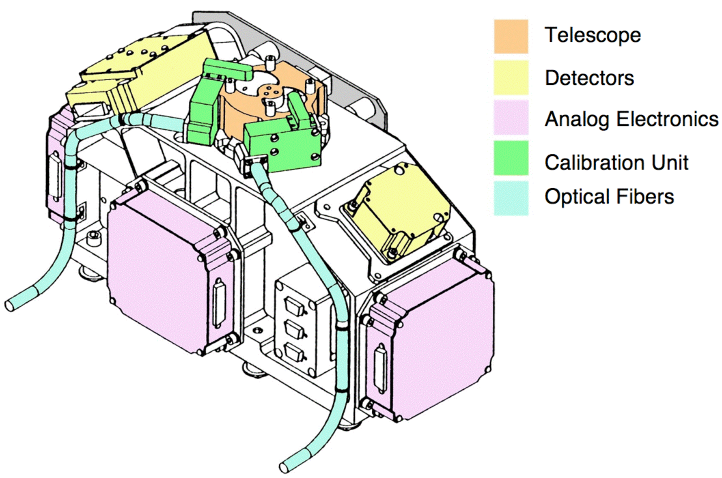

Figure 1. Schematic of Spectral Profiler (MLI and cables are not shown.).

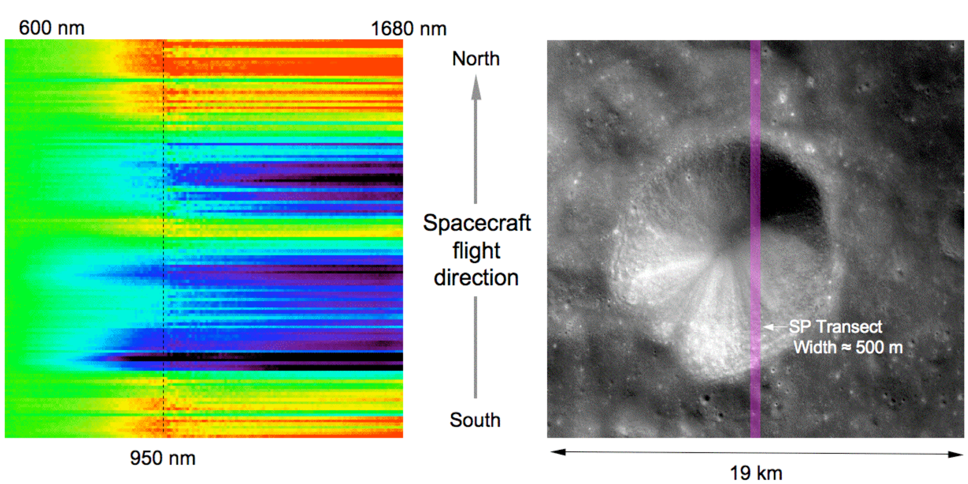

Figure 2. One of "first light" data of SP(left) and MI(right) acquired at highland in the farside of the Moon on November 2, 2007. The location of SP data is shown as a pink thick line in the MI image. SP data from 600 nm to 1680 nm were normalized at 600 nm and a simple correction scheme to cancel detector-to-detector sensitivity variation and lunar surface albedo change were applied. In SP image, red and blue/black color indicate relatively higher and lower reflectance respectively. Areas with strong space weathering were appeared in red in longer wavelength. Fresh materials at inner wall of a crater appeared in blue/black. Subtle color change around 950 nm indicate variarion of the amount or the type of iron-bearing minerals on the lunar surface.