LUNAR SURFACE REFLECTANCE OBSERVED BY THE CHANG'E-1 IMAGING INTERFEROMTER (IIM) Jiang Zhang[1] and Zongcheng Ling[1], [1]School of Space Science and Physics & Shandong Province Key Laboratory of Optical Astronomy & Solar-Terrestrial Environment, Shandong University at Weihai (180 Wenhua Xilu, Weihai 264209, China, zhang_jiang@sdu.edu.cn)

Introduction: The IIM imaging spectrometer aboard the Chang'E-1 lunar orbiter is designed to identify and map mineralogical and elemental abundances across the surface of the Moon. It obtained 706 orbits of multispectral data in 32 bands between 480 nm and 960 nm, covering 84% of the lunar surface from 70° S to 70° N [1]. To test the in-flight performance of the IIM, we convert the radiometrically calibrated Level 2A radiance data to reflectance and compare it with the orbital observations by the most recent lunar missions and the Earth-based telescopic measurements by the USGS Robotic Lunar Observatory (ROLO).

Data: The IIM raw data are calibrated to the Level 2A radiance through radiometric calibration pipeline developed based on the preflight laboratory measurements, and illumination-viewing geometries for each pixel, denoted by incidence angle i, emission angle e, and phase angle α, are calculated from the Chang'E-1 ephemeris data. The IIM 2A data has a spectral resolution of 325.5 cm^{-1} in wavenumber all through the IIM bands, equivalent to 7.62~29 nm in wavelength.

The solar irradiance spectra used in this study (Fig. 1) were measured by the Spectral Irradiance Monitor (SIM) aboard the Solar Radiation and Climate Experiment (SORCE) during the IIM observation. The SIM spectral irradiance data have a high absolute accuracy of 2% (http://lasp.colorado.edu/sorce/data), and have spectral resolutions between 6 nm and 30 nm within the IIM bands, comparable to that of the IIM 2A data [2].
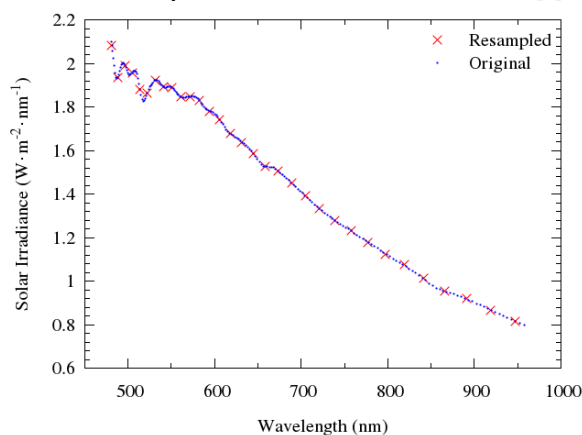

Figure 1. SORCE SIM solar spectral irradiance resampled at the IIM bands.

Procedure: The validation site is selected inside Cayley Plains west to the Apollo 16 landing site, which has been used by the Clementine UVVIS as calibration standard [3], and were coverd by the USGS ROLO, the Kaguya Multi-band Imager (MI), and the IIM. The IIM illumination-viewing geometries at this validation site are close to those taken by the laboratory measurements of lunar samples (i.e., $i = 30^o$, $e = 0^o$, and $\alpha = 30^o$) [4].
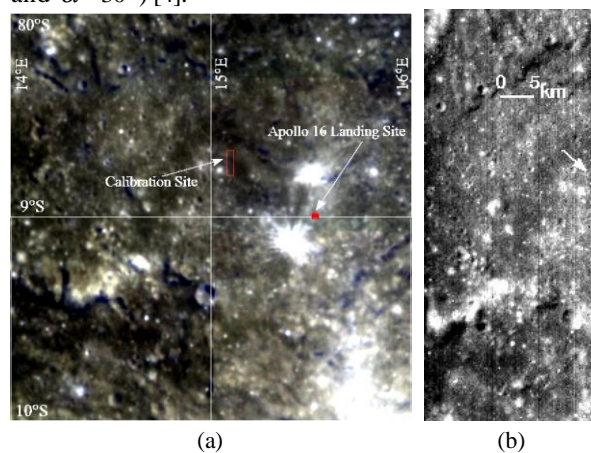

Figure 2. Apollo 16 calibration site used in this study. (a) Clementine UVVIS color composite (b) Chang'E-1 IIM Orbit 2225 data. The outlined area: Sample 11117-11134, Line 124-128.

The IIM 2A data at the validation site are then normalized to 1 AU Sun-Moon distance (D) to remove the radiance variation up to 4% caused by the change in D (Fig. 3).
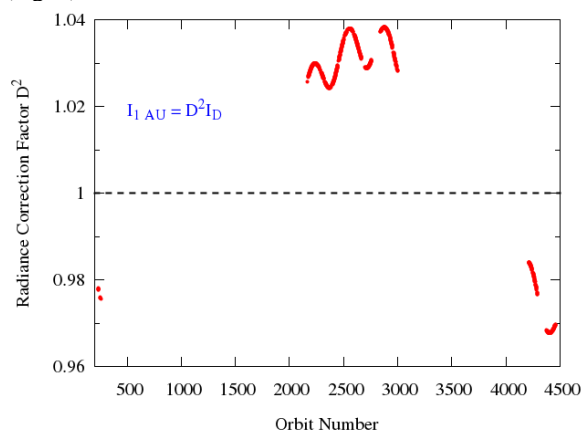

Figure 3. Correction factors used to normalize the IIM Level 2A radiance data to the Sun-Moon distance of 1 AU.

Then the IIM radiance factor (RADF) I/F is given by:
$$I / F = \pi I / J$$

Where I is the IIM radiance, J the SORCE SIM solar irradiance resampled at the IIM bands.

Results and Discussion: As shown in Fig. 4, the IIM RADF at the Apollo 16 validation site are consistent with those observed by the USGS ROLO [5] and the Kaguya MI, considering the uncertainty of 15% given by the preflight calibration.
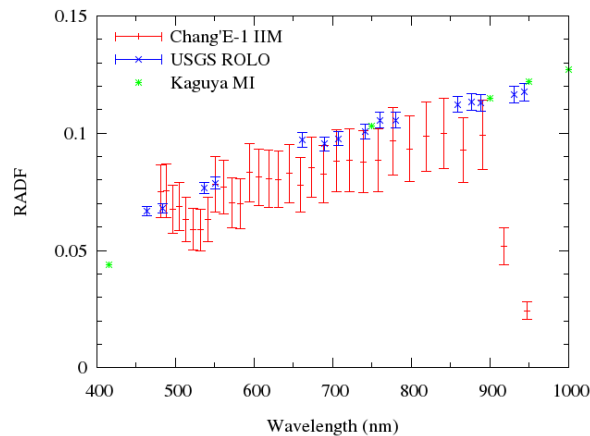

Figure 4. Validation site RADF for the IIM, MI, and ROLO.

References:

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