Stray-Light Analysis and Improvement Method of Wide-Angle Multiband Camera OROCHI onboard MMX

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The Martian Moons eXploration (MMX) is planned to survey two Martian moons, Phobos and Deimos, and return samples from Phobos. MMX will be launched in 2024 and carries several scientific instruments. The OROCHI (Optical RadiOmeter composed of Chromatic Imagers) is wide-angle multiband camera which consists of 7 cameras with bandpass filter in specific visible wavelength (e.g., 730nm; Phyllosilicate feature). The specification is 12.22 mm/F4, 3296(H) x 2472(V) pix, 73(H) x 58(V) deg, 20 m/pix@20km, MTF@Nyquist>0.3. The OROCHI is aimed to constrain the global surface composition and physical structure of Phobos. In our scientific goals, Signal-to-Noise ratio of the OROCHI needs to be S/N > 100 in order to detect faint absorption clearly. Origins of the noise are mainly electrical noise from a CCD sensor and stray light from a optical system, and we focused on the latter. Stray light is generated by reflected lights at sensor, filter, and lens surfaces, therefore, the S/N ratio depends on these reflectance. We designed a similar optical system of the OROCHI in software and performed stray light analysis by measuring the reflectance of a sensor candidate and assuming that of filter and lens. Then, we estimated the S/N ratio. Although the S/N did not reach 100 at the beginning of analysis, we could achieve finally over 100 by following approaches; decreasing the reflectance of the filter and lens, keeping the filter away from the sensor, and reducing the number of lenses. In this study, we propose the OROCHI’s optical design, results of stray light analysis, and the improvement method.

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