NEAR-INFRARED SPECTROSCOPY OF MARS AND JUPITER FROM THE NIRS3 INSTRUMENT ON HAYABUSA2.
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Introduction: We present results from analysis of near-infrared observational data of Mars and Jupiter obtained by the NIRS3 instrument onboard the Hayabusa2 spacecraft. Hayabusa2 is the JAXA's second asteroid sample return mission and has been planned to reach the target asteroid (162173) Ryugu in 2018 [1]. Taking advantage of 3.5-years cruising phase after the launch in December 2014, we carried out observations of Mars and Jupiter using the NIRS3 for its calibration and scientific objectives. NIRS3 is a point spectrometer to measure water- and hydroxyl-related absorption bands in the 3-μm wavelength region. It has the spectral range of 1.8-3.2 μm (resolution: ~20 nm) and the field-of-view 0.1 degrees on a side [2].

Observations: We observed Mars with the NIRS3 instrument during May and June 2016 when Mars was at closer range (~0.3 AU) and low phase angle (4-8 degrees). Since the apparent angular diameter of Mars was much smaller than the NIRS3's field-of-view, the acquired data are disk-integrated spectra. But these data have covered 138 hours in total (including at least four full rotations) with 10-second time resolution. The predicted signal-to-noise ratio was ~30 at the wavelength of 2.2 μm. In addition, we observed Jupiter on two days in May 2017. Jupiter was dark compared to Mars and extremely low signal-to-noise ratio was predicted.

Results: Fig. 1 shows the NIRS3 raw data of Mars observation from 2017-06-03T15:00:00 to 2017-06-05T09:00:00. From this, it is found that signal intensity was changed with two period, roughly 3-hour and 24-hour. Since we performed spacecraft maneuvers at 3-hour intervals for tracking Mars, the cause of the former would be non-uniformity of sensitivity in the NIRS3's field-of-view and that of the latter would be rotation of Mars.

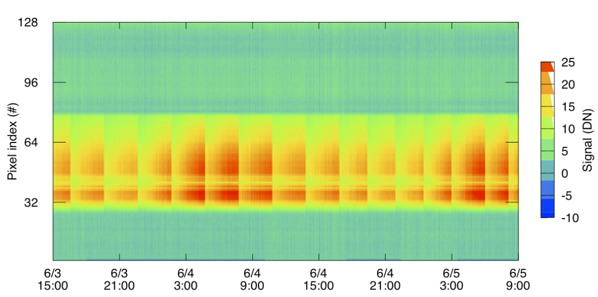

Fig. 1. A part of NIRS3 raw data of Mars observation.

As can be seen in Fig. 2, reflectance spectra converted from the data in Fig. 1 show strong absorption bands at the regions near 2.0 μm and 2.7-3.2 μm. Those bands would arise from CO_2 and H_2O ices [3].

In contrast to Mars, we confirmed detection of the Jupiter signal by integrating the whole data obtained in 10 minutes. Excesses at 1.88 μm and 2.7 μm shown in Fig. 3 indicate the Jupiter signal [4].

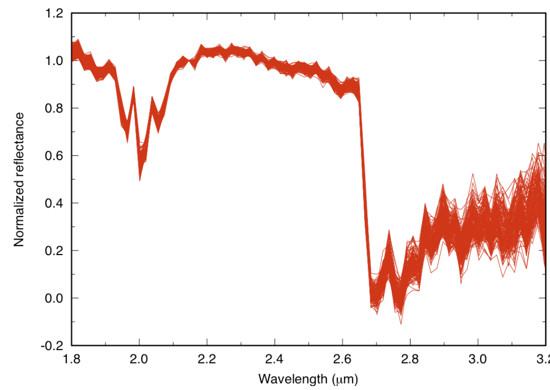

Fig. 2. Disk-integrated relfectance spectra of Mars obtained during July 3-5, 2016.

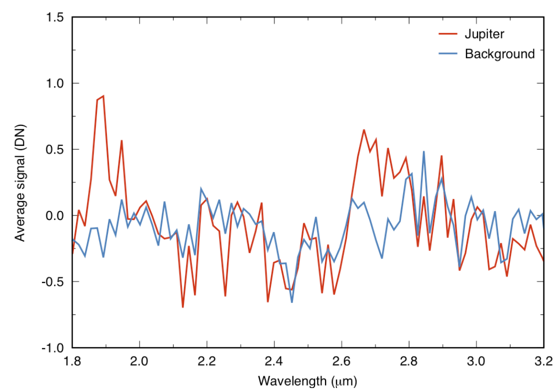

Fig. 3. Spectral data of Jupiter observation on May 16, 2017.

Summary: We confirmed instrument performance of NIRS3 from Mars and Jupiter observations, and will clarify non-uniformity of sensitivity and spectral features related to Mars surface by further analysis.

References: [1] Tsuda Y. et al. (2013) Acta Astronautica 19, 356-362. [2] Iwata T. et al. (2017) Space Sci. Rev. 208, 317-337. [3] Bell J. F. et al. (1996) JGR 101, E4, 9227-9237. [4] Irwin P. G. J. et al. (2001) Icarus 149, 397-415.