はやぶさ2レーザ高度計（LIDAR）初期運用のまとめ

Initial operation of Hayabusa2 laser altimeter (LIDAR)

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The Hayabusa2 asteroid explorer was launched on December 3,2014. The spacecraft orbited around the Sun for a year, and after an Earth Gravity Assist operation, the spacecraft was inserted into a transfer orbit to the target asteroid 162173 Ryugu for the arrival at 2018. The first checkout of a laser altimeter called LIDAR onboard Hayabusa2 was done on January 23, 2015, and a rehearsal operation for the coming laser link experiment was done on August 27, 2015, and the laser link experiments had been done between October and December 2015. In this paper, we will discuss the following three issues of the LIDAR based on the result of the initial operation.i) Estimation of the boresight direction of the receiving telescope: We conducted an experiment in which laser pulses were transmitted toward the LIDAR from ground-based satellite laser ranging stations and the LIDAR bounced the laser toward the Earth. We call the experiment as laser link experiment. In this experiment, we set the observational mode as “optical transponder” mode. As the boresight direction was not determined well at first, the attitude of the spacecraft was scanned spirally outward from a center with 1 mrad separation, and the direction of the boresight of the receiving telescope was estimated when the LIDAR detected the laser pulses from the ground. Based on results of three days experiment, we found out that the boresight direction was closer with 0.2 degrees to the -Z axis of the spacecraft compared with what was measured before the launch with alignment cubes. However, the estimated boresight directions differs about 1 mrad for each day. So far we do not have any good reasons for that. Therefore, we concluded that the boresight was determined with the ambiguity of 1 mrad, and it must be updated after arriving at the target asteroid by detecting notable topographic features. The alignment between the transmitting and the receiving telescope has not been confirmed yet, because we have not detected the downlink laser pulses from the LIDAR on the ground station.ii) Confirmation of the ranging function: In the normal ranging, a gate is set just after the laser is transmitted to inhibit the detection of the laser. As a checkout of the instrument, however, we did not set the gate so that the scattered stray light can be detected to make the ranging circuit operated. We call this operation “non-gate ranging”. During the initial checkout, we conducted the non-gate ranging for three times, on January 23,August 27, and December 16. We confirmed that the ranging circuit worked without any problem on each day. The value of the pseudo range (the time between transmission and reception of the laser) did not show any change for each day. The averaged laser power was also confirmed normal, taking into account the deviation from the averaged value. The reception power changed in accordance with the transmission energy. Considering all these evidences, we concluded that the ranging function was normal.iii) Evaluation of the reception noise level: In both ranging mode and optical transponder mode, we observed such phenomenon that the detection flags became ON thought the reception power showed zero, and that the frequency of this phenomenon increased as the smaller threshold level of the reception was set. Assuming that this was because of the noise from the AD converter, we conducted a test operation on August 27 to clarify the boundary in which the frequency increased. As a result, we found that the threshold level at which noise increased as between 12 mV and 14 mV. In the ranging mode, the

recommended threshold level is 27 mV or 45 mV, therefore practically the influence of the noises will be insignificant. However, in the “dust counting mode” which aims to detect the levitation dust near the asteroid, the threshold will be set comparable or lower than this value, because the detection level estimated from the dust flux is expected to be low.

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