Deep-Space Synchronous Two-way Laser Ranging Experiment Using the LIDAR on board Hayabusa2

Takahide Mizuno (1), Hirotomo Noda (2), Hiroki Senshu (3), ToshimichiOtsubo (4), Hiroshi Takeuchi (1), Clément Courde (5), HirooKunimori (6), Christopher Moore (7), Ulrich Schreiber (8), Naoko Ogawa (1), Takanao Saiki (1), Yuto Takei (1), MouradAimar (5), Julien Chabé (5), Johann Eckl (8), Shun'ichiKamata (9), Arika Higuchi (10), Takayuki Hirai (3), GrégoireMartinotLagarde (5), Hervé Mariey (5), Koji Matsumoto (2), Nicolas Maurice (5), Jun'ichiNakazon (6), Duy-HàPhung (5), Julien Scariot (5), Ryo Suetsugu (11), Jean-Marie Torre (5), Alex Pollard (7), Hervé Viot (5), Noriyuki Namiki (2)
(1) Japan Aerospace Exploration Agency, Sagamihara, Japan; (2) National Astronomical Observatory of Japan,Mizusawa, Japan; (3) Chiba Institute of Technology, Japan; (4) Hitotsubashi University, Tokyo, Japan; (5) Université Côte d'Azur, CNRS, Observatoire de la Côte d'Azur, Géoazur, France; (6) National Institute of Information and Communications Technology, Tokyo, Japan; (7) EOS Space Systems, Symonston ACT, Australia; (8) Technical University of Munich, Bad Koetzting, Germany; (9)Hokkaido University, Sapporo, Japan; (10) Kyoto Sangyo University, Kyoto, Japan; (11)National Institute of Technology Oshima College, Suo-Oshima, Japan

Altimeter (LIDAR) on board the deep-space explorer Hayabusa2 as an optical transponder, successfully establishing a 2-way link over a distance of up to 6.46 million kilometers. This demonstration experiment was conducted to explore new applications in which deep-space laser ranging is performed using LIDAR as an echo transponder. In the experiment, a laser pulse (uplink) was first emitted from a ground laser station and received by Hayabusa2's LIDAR. The LIDAR then transmitted a laser pulse (downlink) back immediately after reception. This downlink pulse was successfully detected at the Côte d'Azur Observatory in France.

The experimental conditions were difficult due to the low repetition rate of 0.5 Hz when the LIDAR functioned as an echo transponder, the large jitter from the passive Q-switch of the laser, and the large background noise due to the link time with Hayabusa2 being during the daytime. However, the high temporal coherence enabled detection of the laser on the ground. To confirm this coherent property, we measured the coherence in a preliminary experiment using the LIDAR's engineering model and distance image sensors. In this presentation we will also discuss this preliminary experiment.

We would like to thank the Koganei station of NICT, Mt. Stromlo station in Australia, the Wetzel station in Germany, the Cote d'Azur Observatory in France, the Hayabusa2 operation team, and the NASA/JPL Deep Space Network for their cooperation on the RF downlink for this experiment.