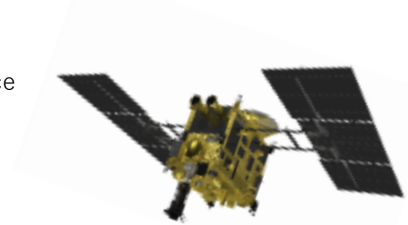
3. Result of the laser ranging experiment

A 2-way laser link between Hayabusa2 and ground stations was successful using the echo transponder method.

University of Cote d'Azur, France
CNRS Cote d'Azur Observatory



The Cote d'Azur Observatory in France received the downlink signal from the Hayabusa2 LIDAR and successfully established the 2-way link.

Dec. 9, 2020: 1 million km
Dec. 21, 2020 : 6 million km

The signals detected by other stations are under analysis.

Australia
EOS Space Systems Pty Ltd
Mt. Stromlo Satellite Laser Ranging facility

Germany
Technical University of Munich,
Wettzell Observatory

国立研究開発法人
情報通信研究機構
Telecommunications
JPL/NASA
Deep Space Network
Canberra, Madrid

National Astronomical Observatory of Japan

Chiba Inst. Tech.
PREC

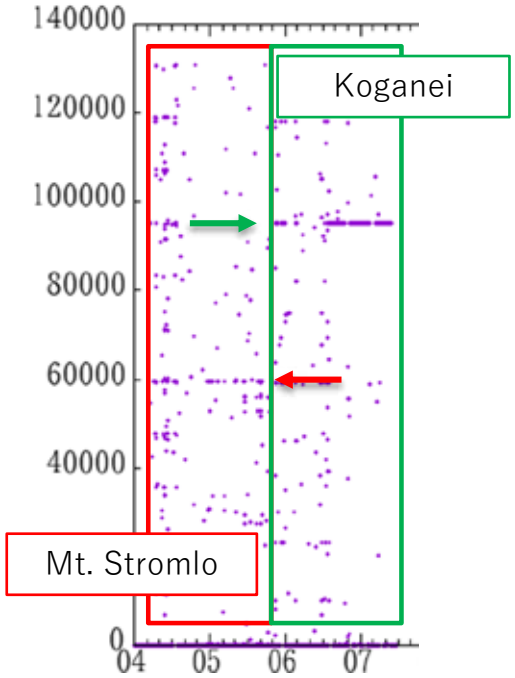
Hitotsubashi Univ.
Geoscience Lab.

LIDAR

3. Result of the laser ranging experiment

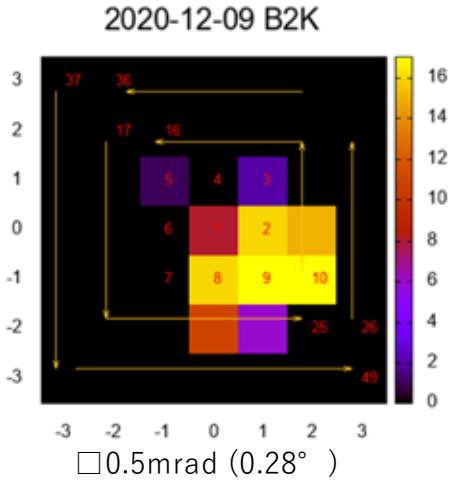
Uplink

Three stations (Koganei, Mt.Stromlo, Grasse) successful.



Laser pulse intervals measured by LIDAR from NICT Koganei station and EOS Stromlo station.

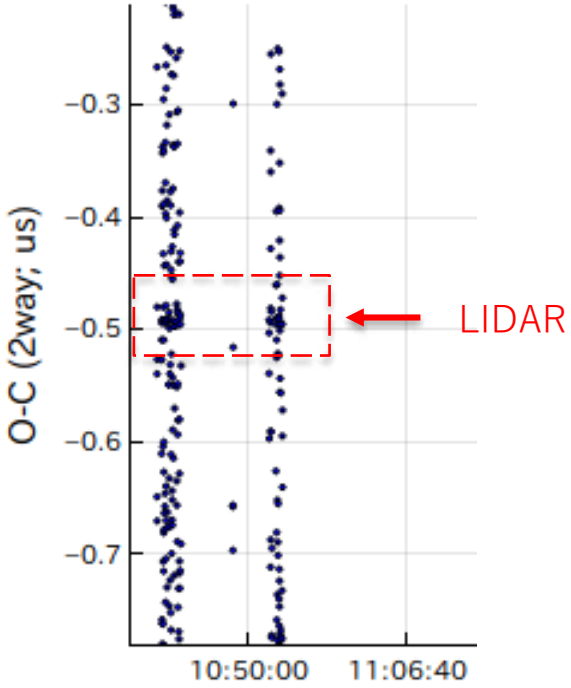
Frequency distribution of Uplink detection from Koganei



The result of measuring the field of view range of LIDAR by scanning Hayabusa2's attitude in a spiral pattern. In this figure, attitude positions with high frequency of signal detection by LIDAR are shown in bright colors.

Downlink

Grasse station successful.



Timing of the signal received by the CNRS Côte d'Azur Observatory.
The random scatter is noise caused by sunlight and heat from the detector. Signals with constant timing can be seen in the red dashed frame.

3. Result of the laser ranging experiment

Example of a successful laser link between a planetary explorer and ground stations

2005 Messenger 24million km Asynchronous 2-Way
2005 Mars Global Surveyor 80million km 1-Way
2009 Lunar Reconnaissance Orbiter 0.385million km 2-Way
2013 Lunar Laser Communication Demonstration 0.385million km 622Mbps
2015 Hayabusa2 6.6million km 1-Way
2020 Hayabusa2 6million km Synchronous 2-Way

The 2-way link between Hayabusa2 and the Earth station is rare success example that could be achieved in cooperation with foreign institutions.

Results and Significance
- One station succeeded in 2-way link and three stations succeeded in 1-way link.
- First example of 2-way link between a planetary probe and a ground station by a echo transponder.
- Successful downlink detection in daytime when there is a lot of noise from the Sun.
- Measurement of LIDAR's field-of-view by the stable uplink.
- Technology accumulation for future deep space laser ranging and high precision orbit determination.
- The successes was achieved by cooperation with foreign laser stations.