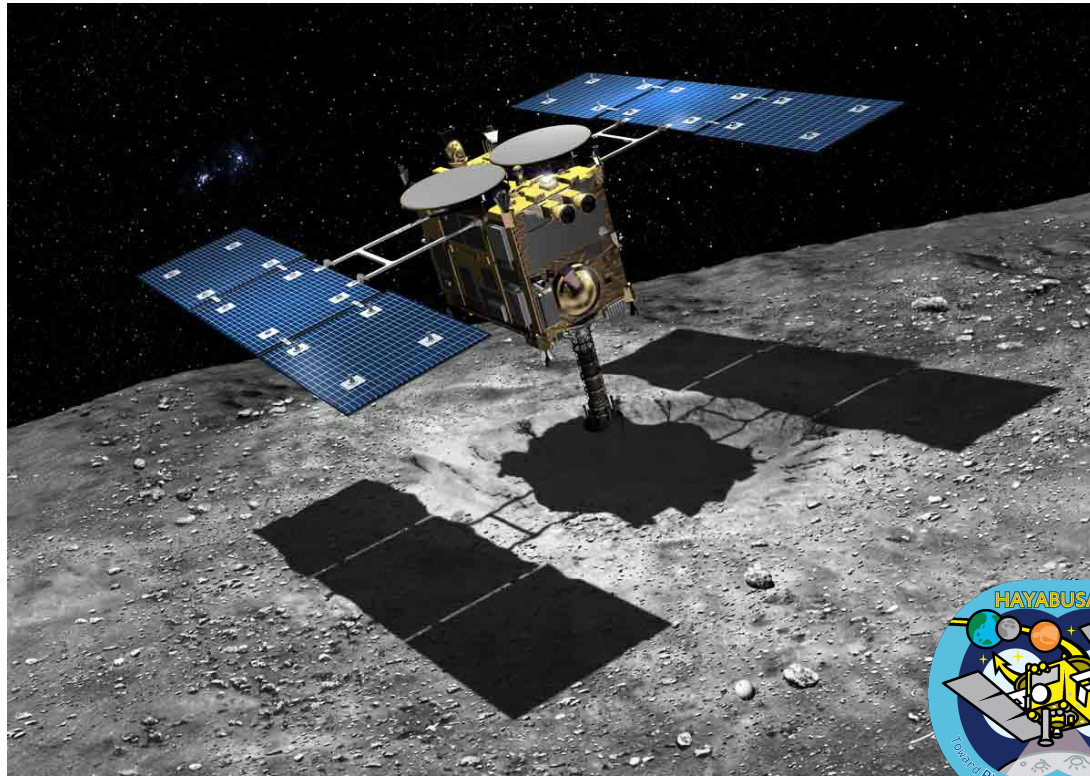


Current Status of Hayabusa2



Space Mission Planning Advisory Group (SMPAG) 7th Meeting

Pasadena, CA, USA

October 14, 2016

Makoto Yoshikawa (JAXA)

Mission Scenario of Hayabusa2

Launch

03 Dec. 2014



03 Dec. 2015



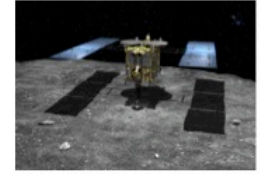
Earth swing-by

Arrival at Ryugu

June-July 2018



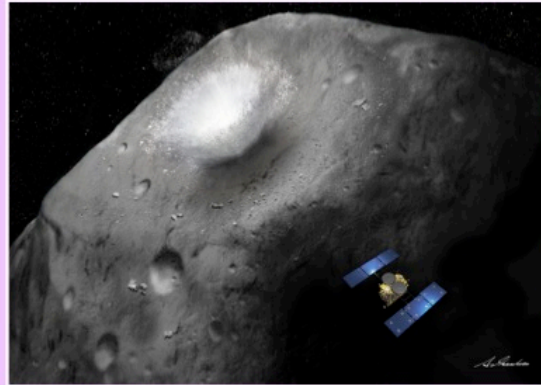
The spacecraft observes the asteroid, releases the small rovers and the lander, and executes multiple samplings.



2019



New Experiment



The impactor collides to the surface of the asteroid.

The sample will be obtained from the newly created crater.

Sample analysis



Earth Return

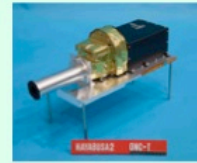
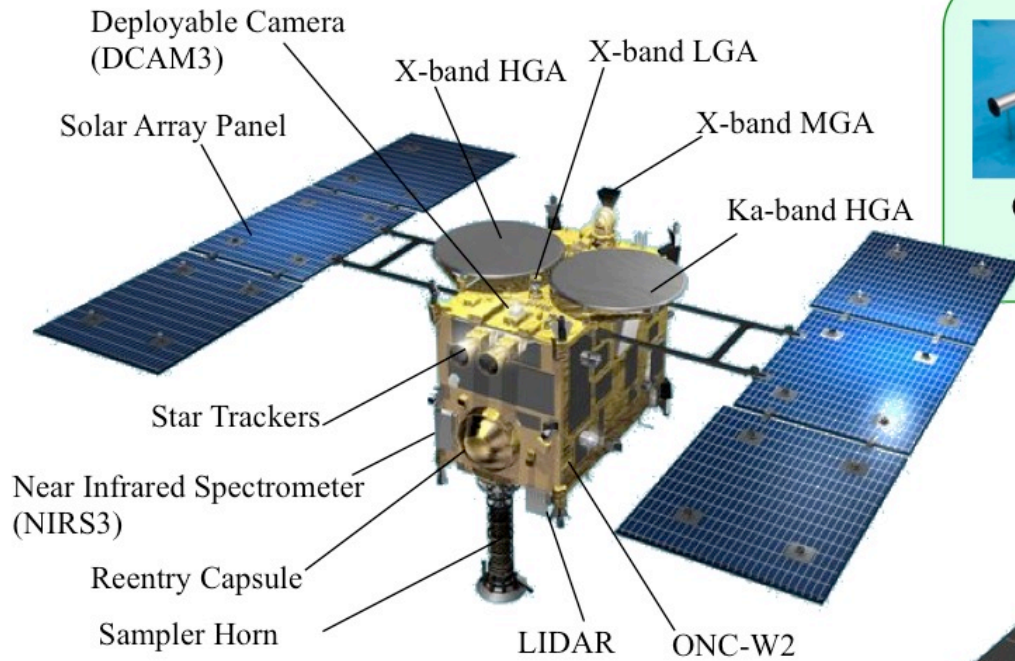
Nov.-Dec. 2020



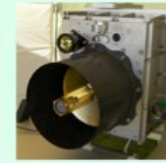
Nov.-Dec. 2019 : Departure



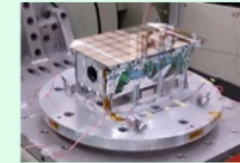
Hayabusa2 Spacecraft



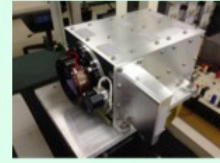
ONC-T



LIDAR



NIRS3



TIR

Science Instruments

Small Lander and Rovers

MASCOT



by DLR and CNES

MINERVA-II



II-1A



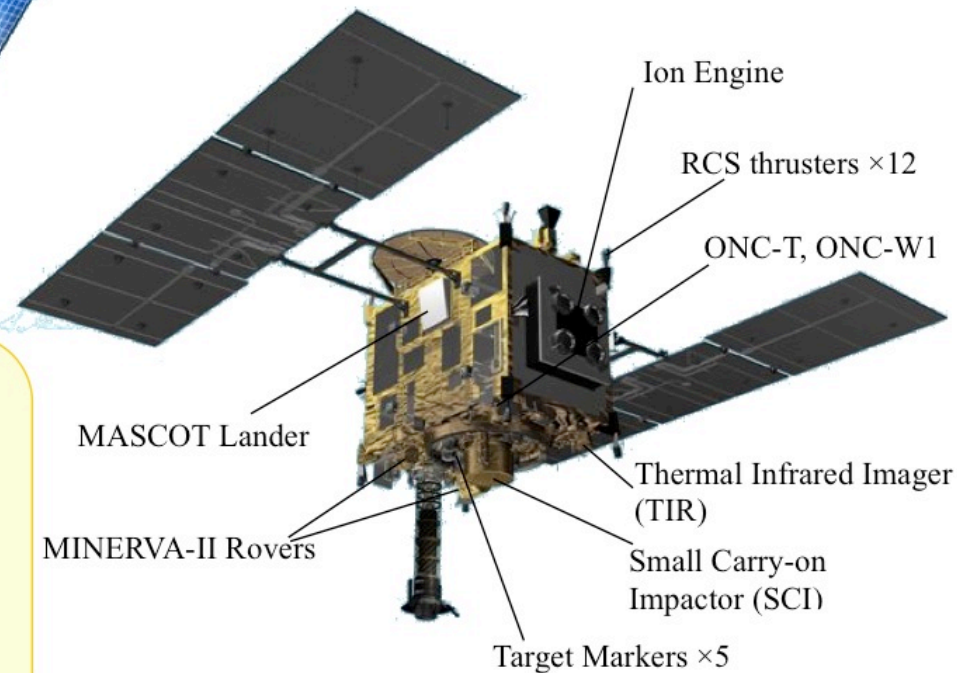
II-1B



II-2

II-1 : by JAXA MINERVA-II Team

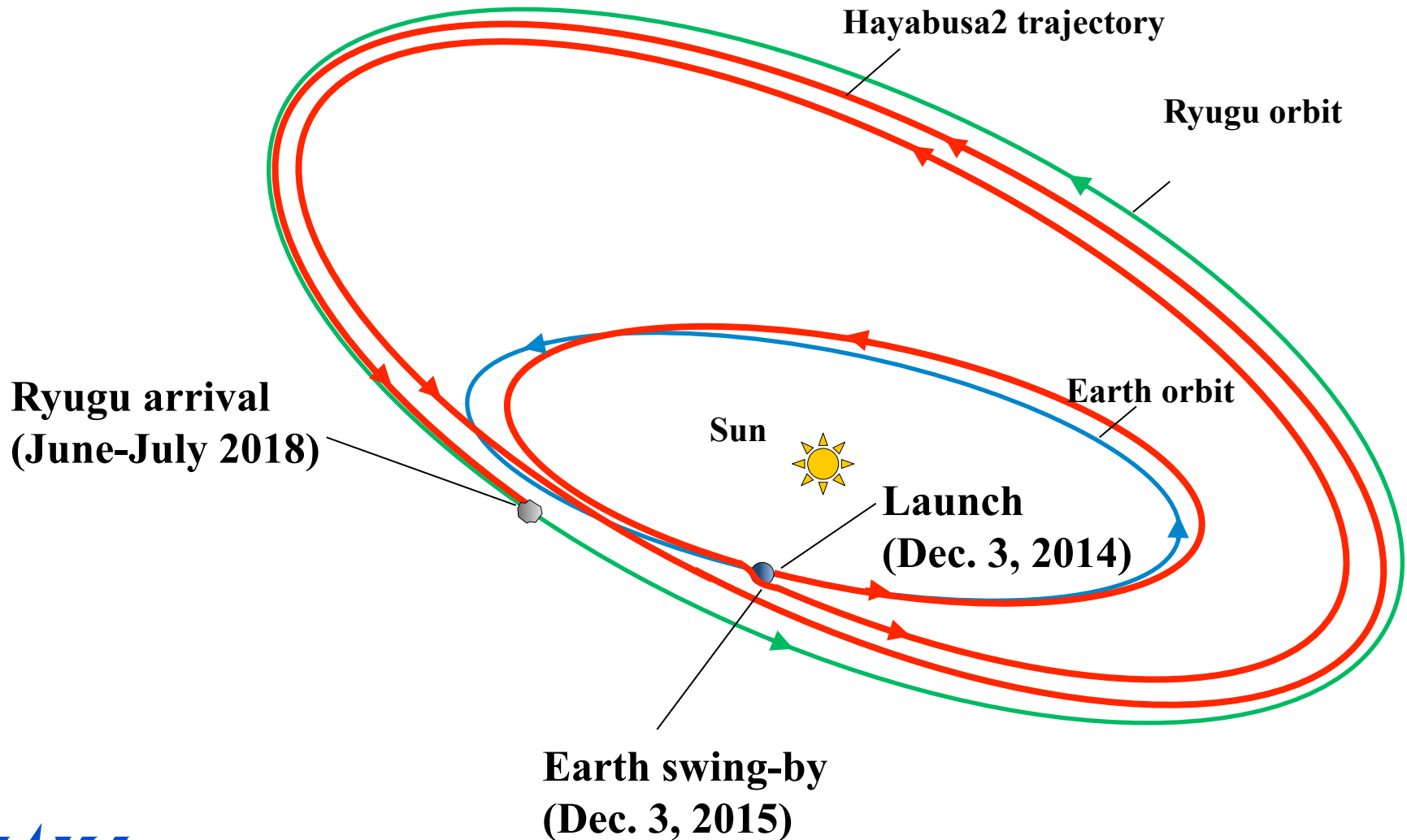
II-2 : by Tohoku Univ. & MINERVA-II consortium



Size : 1m×1.6m×1.25m (body)

Mass : 600kg (Wet)

Trajectory Design for the way to Ryugu



Launch and Initial Operations



2014/12/3

04:22:04 Launch

06:09:25 Separation

06:14:53 SAP deployment

06:16:31 Sun acquisition maneuver

09:06:51 Single spin established

1st, 2nd, 3rd tracking passes

- Three axis attitude stabilization established
- Sampler horn deployed
- Ion engine gimbal launch lock released
- Moon photo taken by ONC-W2, benefit for scientific calibration purpose

PAF interface



Commissioning Phase

Date		Event	
2014	Dec. 3-6	LEOP	
	Dec. 7-8	XMGA pointing calibration, X-band COMM characterization/testing	DSN GDS/CAN/MAD
	Dec. 9	EPS/BAT testing	
	Dec. 10	NIRS3 health check	
	Dec. 11	TIR/DCAM3/ONC health check	
	Dec. 12-15	AOCS characterization/testing	
	Dec. 16	MINRVA-II/MASCOT health check	
	Dec. 17	CPSL/SCI health check	
	Dec. 18	XHGA pointing calibration, IES turn-on preparation	
	Dec. 19-22	IES baking	DSN MAD
	Dec. 23-26	IES testing (ITR-A/B/C/D, single-thruster-at-once operation)	DSN MAD
2015	Dec. 27-Jan. 4	Precision OD, DDOR testing	DSN GDS/CAN/MAD
	Jan. 5-10	Ka-band COMM characterization/testing, KaHGA pointing calibration	DSN GDS/CAN/MAD
	Jan. 11	IES turn-on preparation	
	Jan. 12-15	IES testing (<A+C>,<C+D>,<A+D>,<A+C>, dual thrusters operation)	
	Jan. 16	IES testing (<A+C+D>, triple thrusters operation)	
	Jan. 19-20	IES 24hr continuous operation demonstration (<A+D>)	DSN MAD
	Jan. 23	LIDAR/LRF/FLA health check	
	Jan. 24-Mar. 2	IES-AOCS coordinated operation testing SRP dynamics characterization / “Solar Sail Mode” demonstration	
	Mar. 2	Commissioning phase completed	

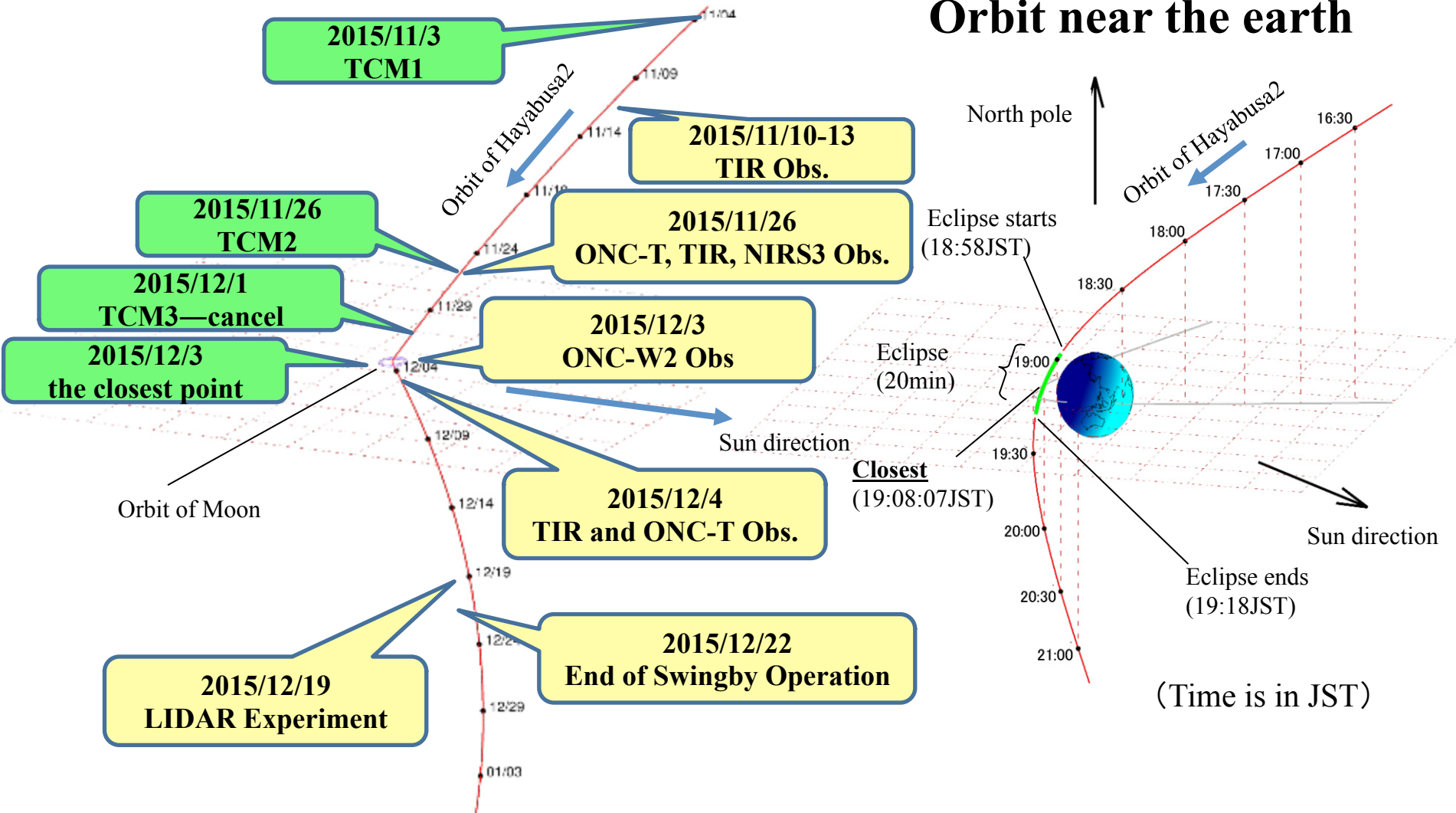
Regular Operation Phase to Earth Swing-by

2015	
Mar. 3	Regular Operation Phase started
Mar. 3-21	First IES Operation in EDVEGA Phase : 409 hours
Mar. 27 – May 7	Attitude control in the solar sail mode (One RW operation)
May 12-13	Three IES operation for 24hours
June 2-6	Second IES Operation in EDVEGA Phase : 102 hours
June 9-	The solar sail mode operation
Sep. 1,2	TCM by IES
- mid Sep.	Precise OD
Oct.-Dec.	Precise TCM by RCS
Dec. 3	Earth swingby
Dec. 2015-Apr. 2016	Post-Swingby southern hemisphere operation

Earth Swing-by

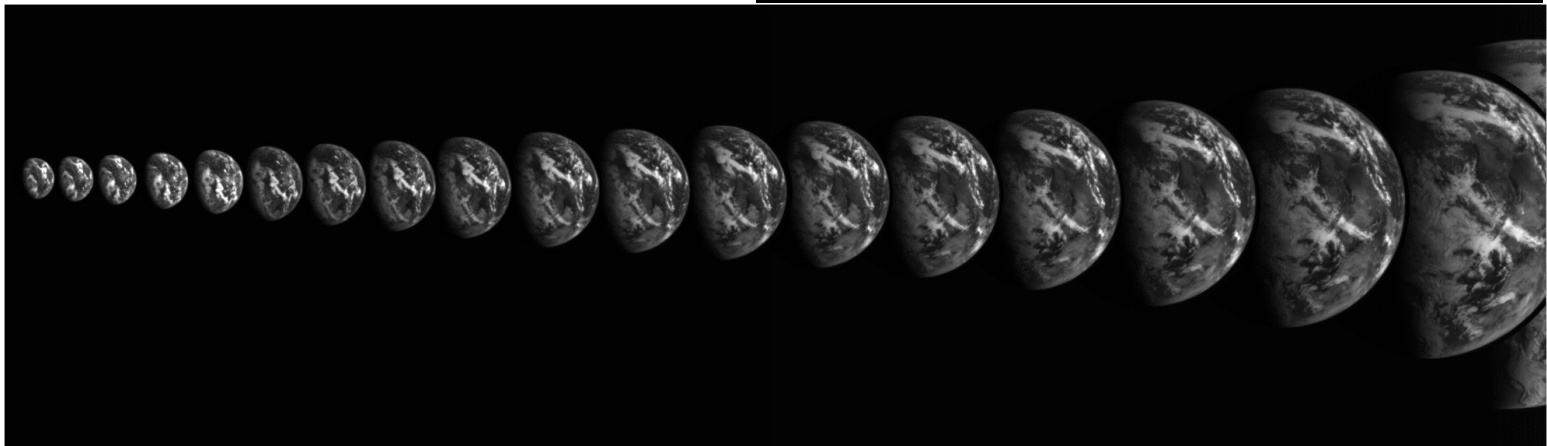
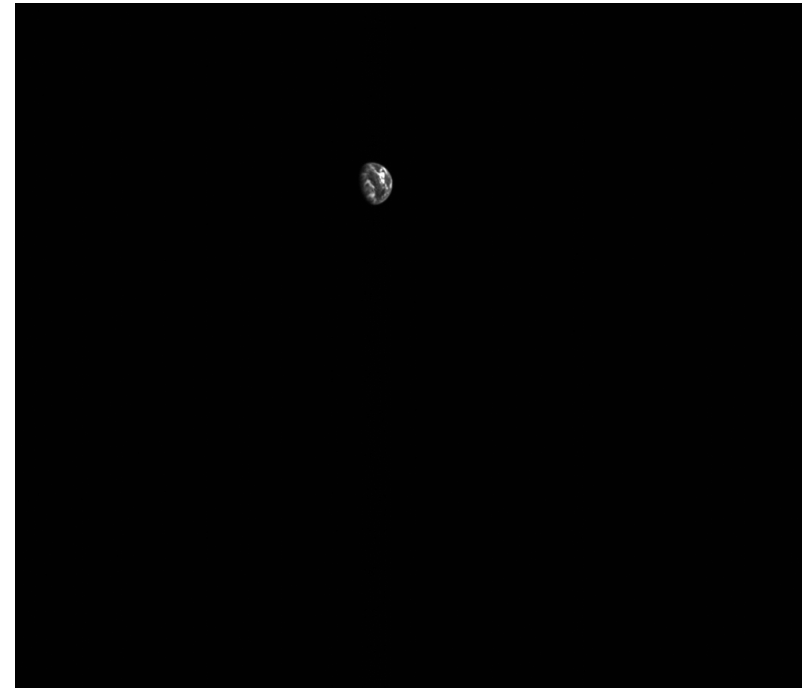
Approach to the Earth

Orbit near the earth



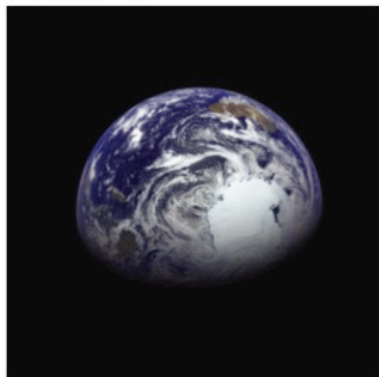
The Earth images at swing-by (animation)

The images of the Earth taken by ONC-W2. The time (UTC) of each image and the distance from the Earth are shown in the photo. The images were taken from 00:00 to 09:15 (UTC) on December 3, 2015. The viewing angle is at about 60 degrees.

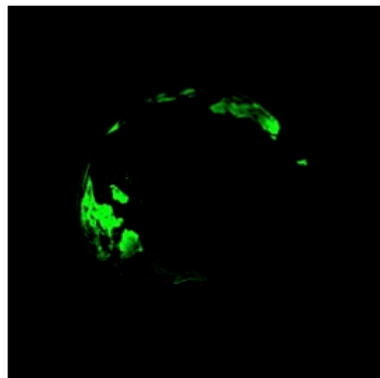


Operations of Science Instruments

ONC-T

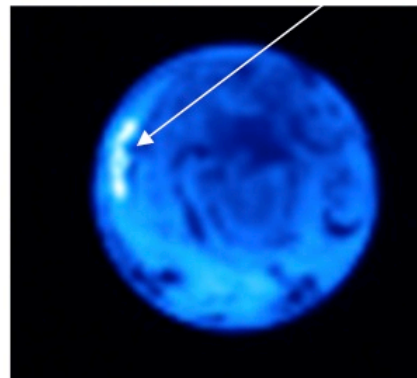


Color image



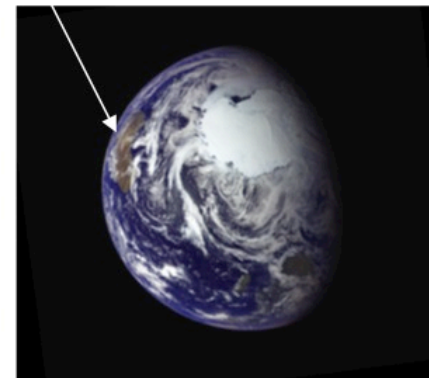
Plants exist reason

TIR

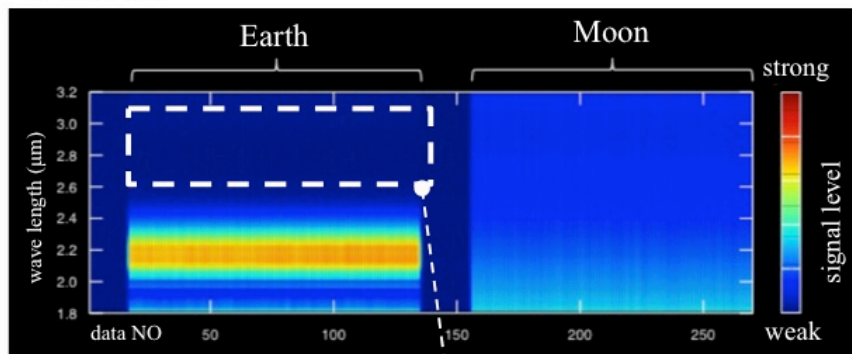


Thermal Image

Australia

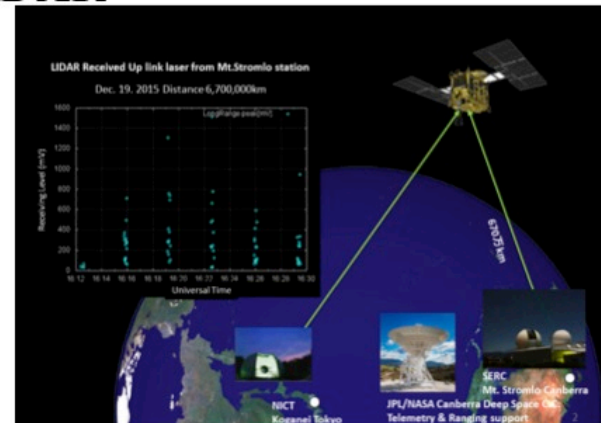


NIRS3



Absorption by water on the earth

LIDAR



Optical Link Experiment at 6,700,000 km from Earth

Operations and Experiments after Earth Swing-by

2016	
Jan. - April	Southern hemisphere operation
March 22 – May 21	1st long-term IES operation after Earth Swing-by : 798 h
May 24 – June 9	Mars Observation (by ONC-T, NIRS3, TIR)
June 22, 23	Experiment of uplink transfer
June 29 – July 8	Experiments of Ka-band communication
:	
<i>Dec. – May 2017 ?</i>	<i>2nd long-term IES operation</i>
<i>Nov. 2017 - June 2018 ?</i>	<i>3rd long-term IES operation</i>

Target Asteroid : 1999 JU3 = Ryugu

Asteroid (162173) 1999 JU3

Discovered in May 1999 by LINEAR Team

Shape : almost spherical

Size : 900 m

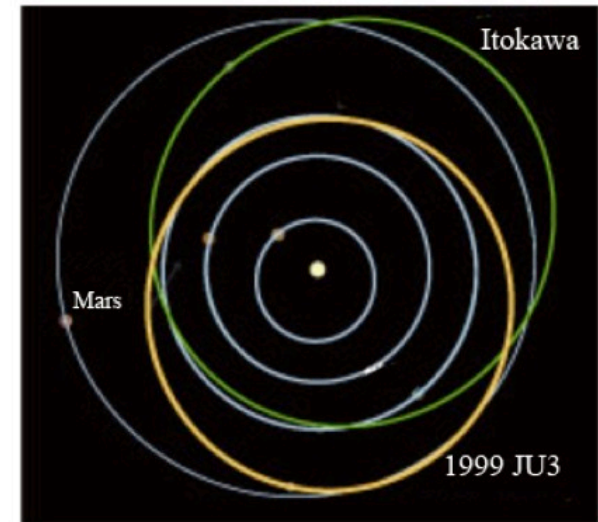
Rotation period: 7.6 h

Pole orientation (320° , -40°) : current estimate

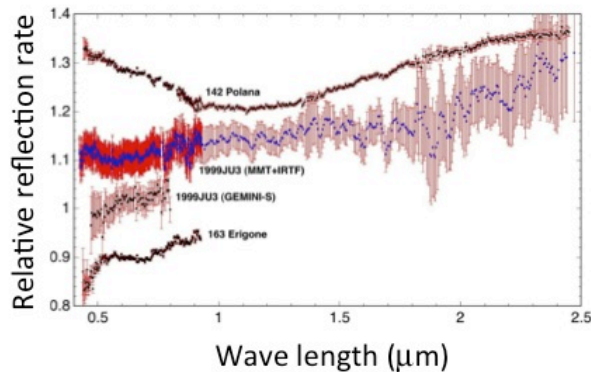
Albedo : 0.05

Type : Cg

Orbit

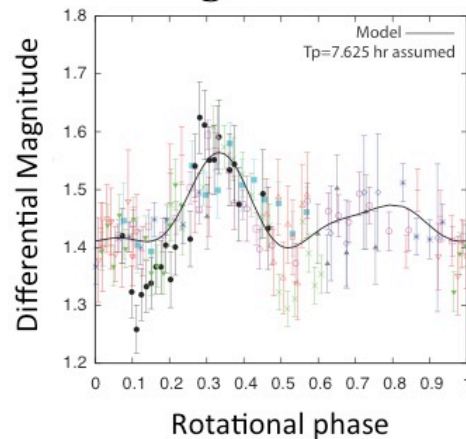


Spectrum



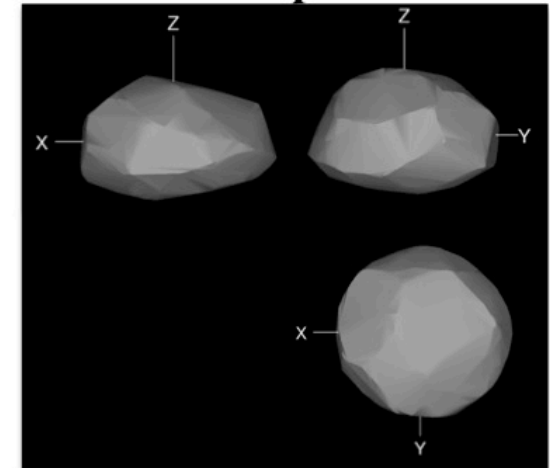
(Data by Viras 2008, Sugita+ 2012, Abe+ 2008)

Light curve



(by Kim, Choi, Moon et al. A&A 550, L11, 2013)

Shape



(by T. Müller)

International Cooperation Structure of Hayabusa2

