



How to involve more countries and more universities in a deep space exploration mission?

Deep Space Workshop
Panel Discussion (2)

Nov. 3, 2025

Outline



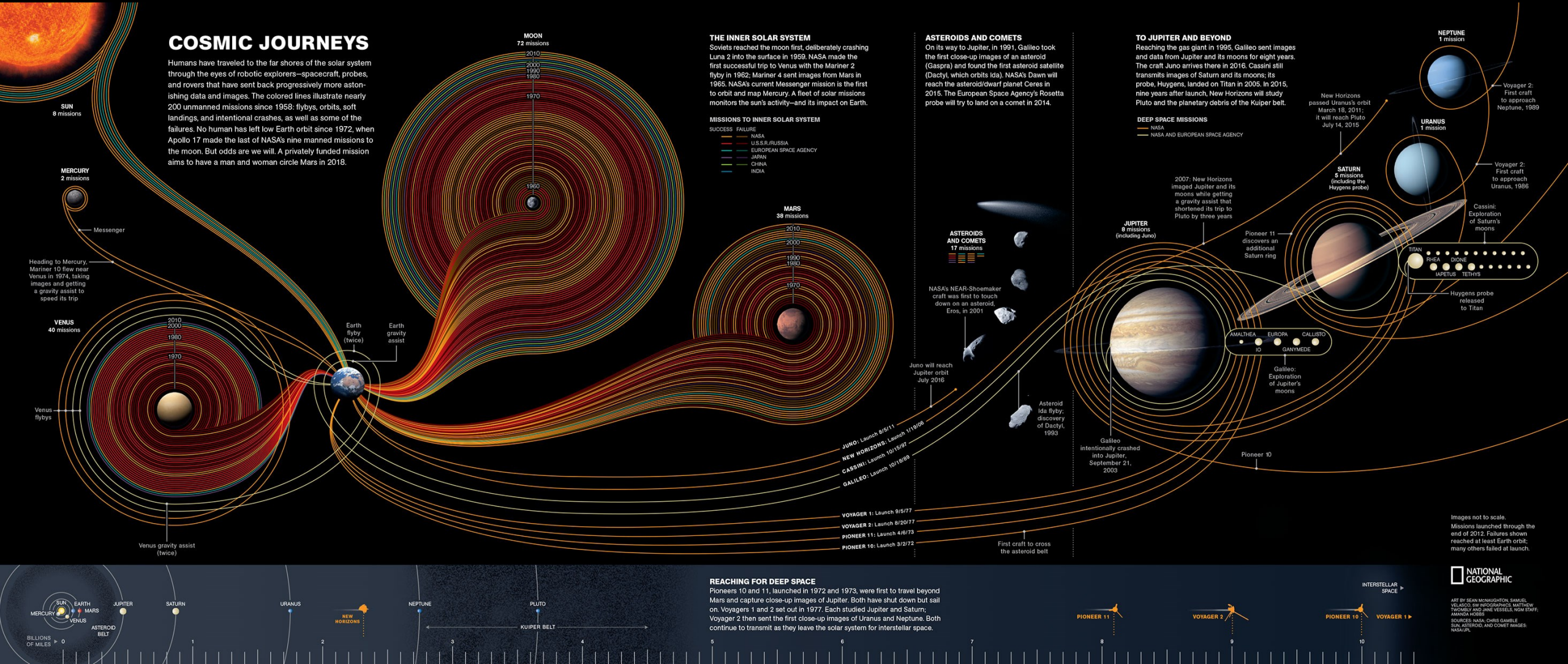
- **Background**
- **Round 1: Experiences**
- **Round 2: Challenges and ways forward**
- **Q&A**

Deep space missions 15 years ago:



COSMIC JOURNEYS

Humans have traveled to the far shores of the solar system through the eyes of robotic explorers—spacecraft, probes, and rovers that have sent back progressively more astonishing data and images. The colored lines illustrate nearly 200 unmanned missions since 1958: flybys, orbits, soft landings, and intentional crashes, as well as some of the failures. No human has left low Earth orbit since 1972, when Apollo 17 made the last of NASA's nine manned missions to the moon. But odds are we will. A privately funded mission aims to have a man and woman circle Mars in 2018.



Images not to scale.
Missions launched through the end of 2012. Failures shown reached at least Earth orbit; many others failed at launch.

NATIONAL GEOGRAPHIC

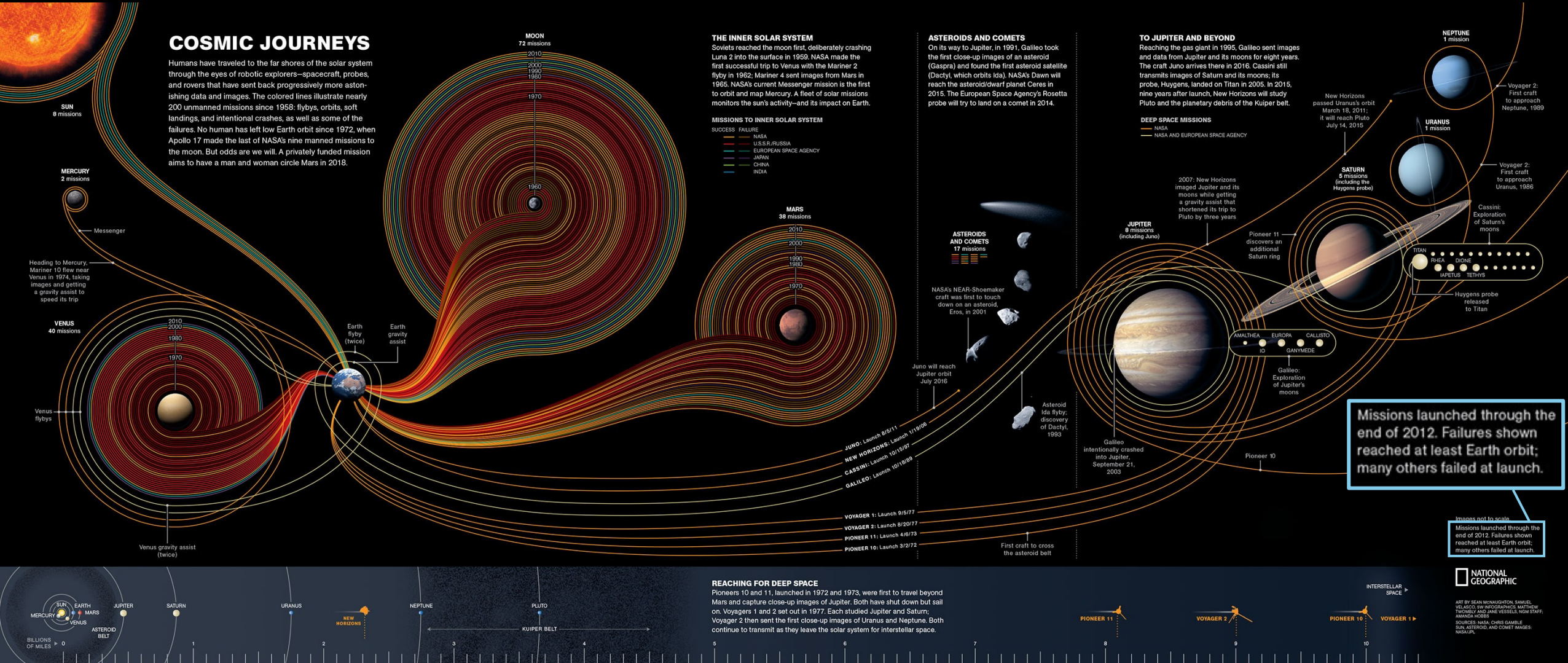
ART BY SEAN MCQUIGG, SAMUEL VELAZCO, SW INFOGRAPHICS, MATTHEW TWOMBLY AND JANE VESSELS, NGM STAFF, AMANDA HOBBS
SOURCES: NASA, CHRIS GAMBLE, SUN, ASTEROID, AND COMET IMAGES: NASA/JPL

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(National Geographic)

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MISSIONS TO INNER SOLAR SYSTEM

SUCCESS FAILURE

- NASA
- U.S.S.R./RUSSIA
- EUROPEAN SPACE AGENCY
- JAPAN
- CHINA
- INDIA

THE INNER SOLAR SYSTEM

Soviets reached the moon first, deliberately crashing Luna 2 into the surface in 1959. NASA made the first successful trip to Venus with the Mariner 2 flyby in 1962; Mariner 4 sent images from Mars in 1965. NASA's current Messenger mission is the first to orbit and map Mercury. A fleet of solar missions monitors the sun's activity—and its impact on Earth.

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ASTEROIDS AND COMETS

On its way to Jupiter, in 1991, Galileo took the first close-up images of an asteroid (Gaspra) and found the first asteroid satellite (Dactyl, which orbits Ida). NASA's Dawn will reach the asteroid/dwarf planet Ceres in 2015. The European Space Agency's Rosetta probe will try to land on a comet in 2014.

DEEP SPACE MISSIONS

- NASA
- NASA AND EUROPEAN SPACE AGENCY

TO JUPITER AND BEYOND

Reaching the gas giant in 1995, Galileo sent images and data from Jupiter and its moons for eight years. The craft Juno arrives there in 2016. Cassini still transmits images of Saturn and its moons; its probe, Huygens, landed on Titan in 2005. In 2015, nine years after launch, New Horizons will study Pluto and the planetary debris of the Kuiper belt.

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(National Geographic)

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Deep space = domain of major space agencies in a few countries

(National Geographic)

Since then, new efforts by:



Agencies



(ISRO)



(UAE Space Agency)



(JAXA)



(ESA)



(JAXA)



(JAXA)



(ESA)



(ESA)



(ESA)



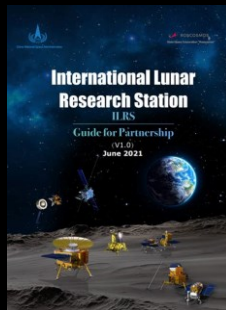
(JAXA)



(NASA)



(CNSA)



(CNSA)



(NASA)



(NASA)

Deep space = more accessible than ever before

Since then, new efforts by:

Agencies



(ISRO)



(UAE Space Agency)



(JAXA)



(ESA)



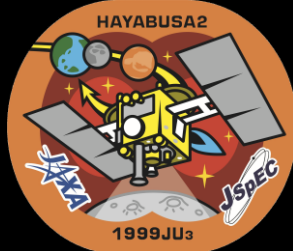
(Intuitive Machines)



(Argotec)



(JAXA)



(JAXA)



(ESA)



(ESA)



(ESA)



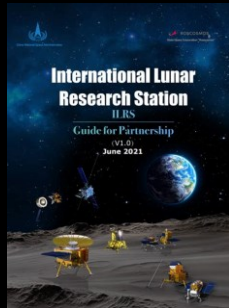
(JAXA)



(NASA)



(CNSA)



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(NASA)



(NASA)

Companies



(iSpace)



(ArkEdge Space)

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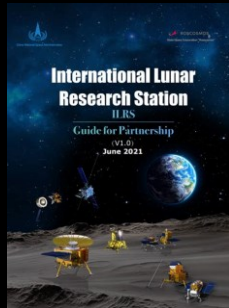
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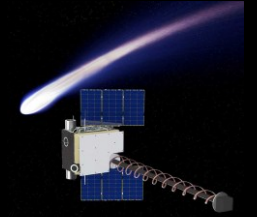


(NASA)

Companies

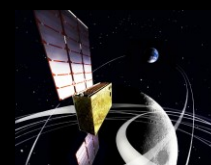


(ispace)



(ArkEdge Space)

Universities



(UTokyo)



(MSU)



(ASU)



(Princeton / JHU / NASA)

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(ISRO)



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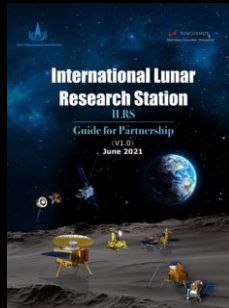
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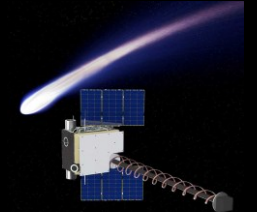


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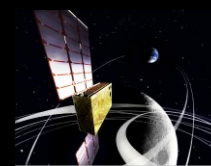


(i space)



(ArkEdge Space)

Universities



(UTokyo)



(MSU)



(ASU)



(Princeton / JHU / NASA)

+ Others

(foundations, NPOs, etc.)



(SpaceIL)

Deep space = more accessible than ever before

Panelists



Yuichi Tsuda
JAXA/ISAS



Naoya Ozaki
JAXA/ISAS



Nozomu Takaki
MELCO



Mia Lee
Space BD



Benjamin Bonsu
ispace, inc.



Herman Steyn
Stellenbosch University



Abdulla Hil Kafi
Kyutech

Round 1: Experiences

**Please tell us about your own involvement or interest
in deep space exploration missions**



Yuichi Tsuda
JAXA/ISAS



Naoya Ozaki
JAXA/ISAS



Nozomu Takaki
MELCO



Mia Lee
Space BD



Benjamin Bonsu
ispace, inc.

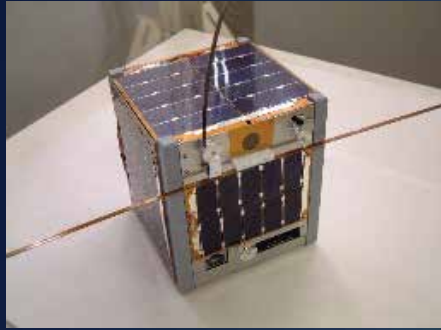


Herman Steyn
Stellenbosch University



Abdulla Hil Kafi
Kyutech

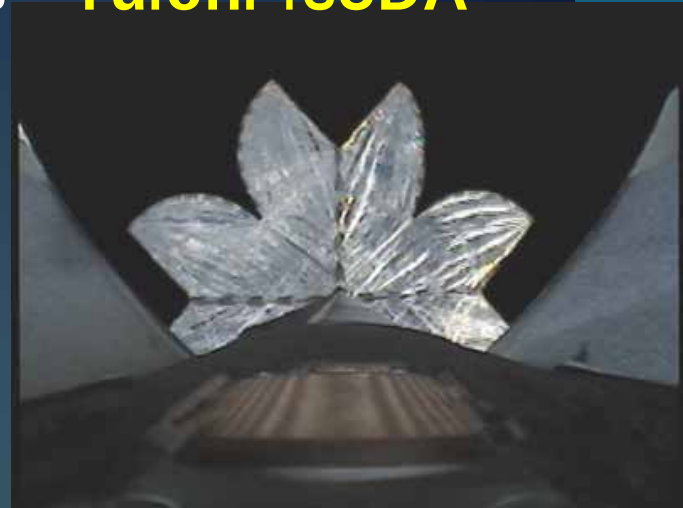
My Project/Mission Participations - **Yuichi TSUDA**



World's first CubeSat

(System design lead, Student Project Manager) 1998-2003

M-V Launch Vehicle (Attitude Control Engineer) 2003-2010



S310 Sounding rocket solar sail deployment experiment (Sail development, Mission PI) 2003-2004

World's first interplanetary solar sail mission IKAROS

(Trajectory design, Sail development, Deputy Project Manager) 2003-2013

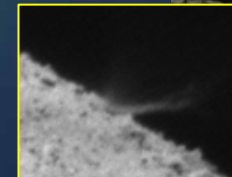


Solar-sailing!



Hayabusa asteroid sample return mission (Operation engineer, Mission planning engineer) 2003-2010

Hayabusa2 asteroid sample return mission (Trajectory design, Astrodynamics science member, Lead Engineer, Project Manager) 2010-

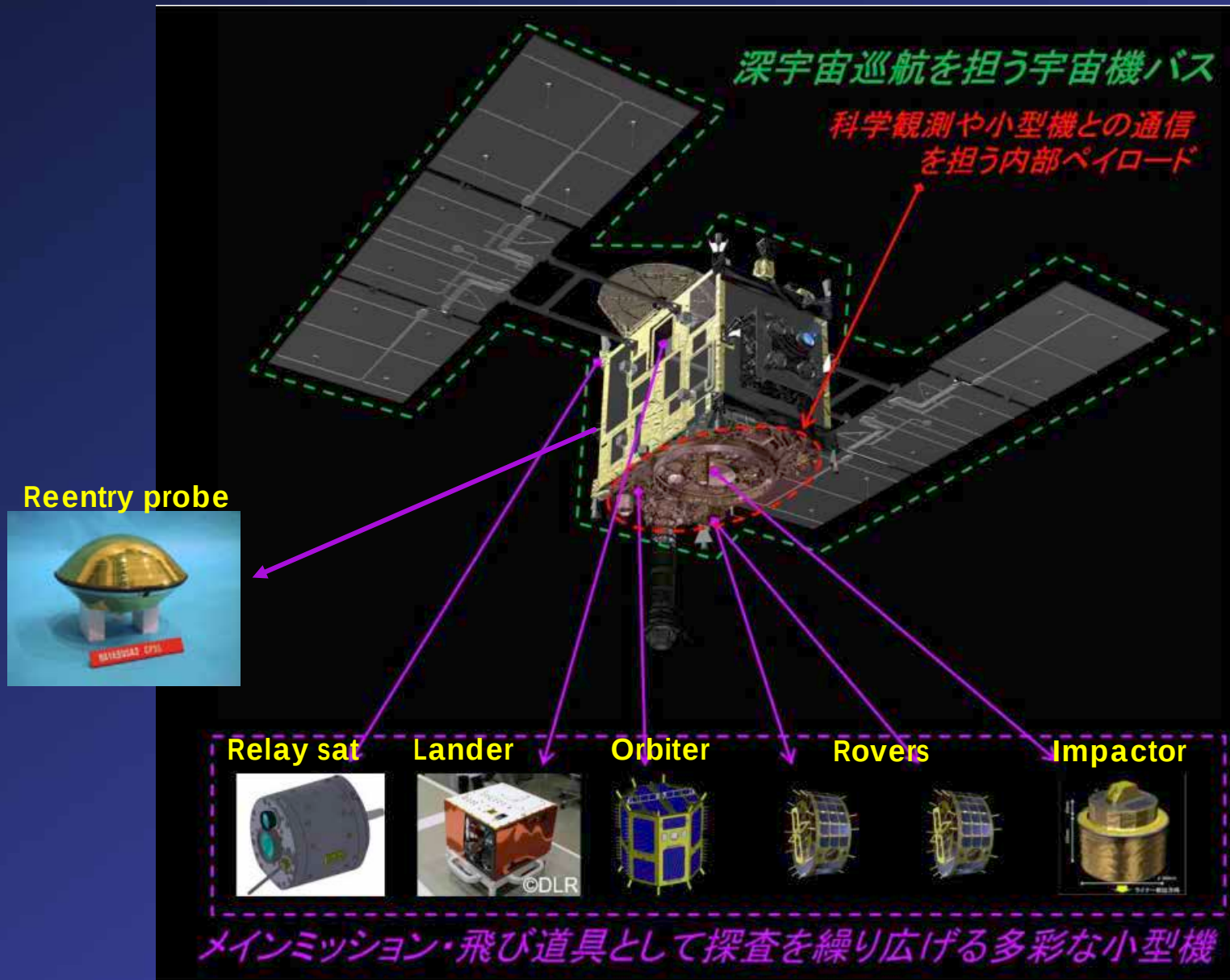


Cratering!



Multi-landing!

Small sats can dramatically boost mission's value !!



Is it possible to ‘Democratize’ Deep Space missions?

Breakthrough in “democratizing” Earth-orbiting CubeSats

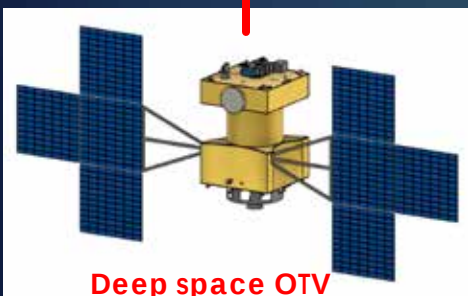
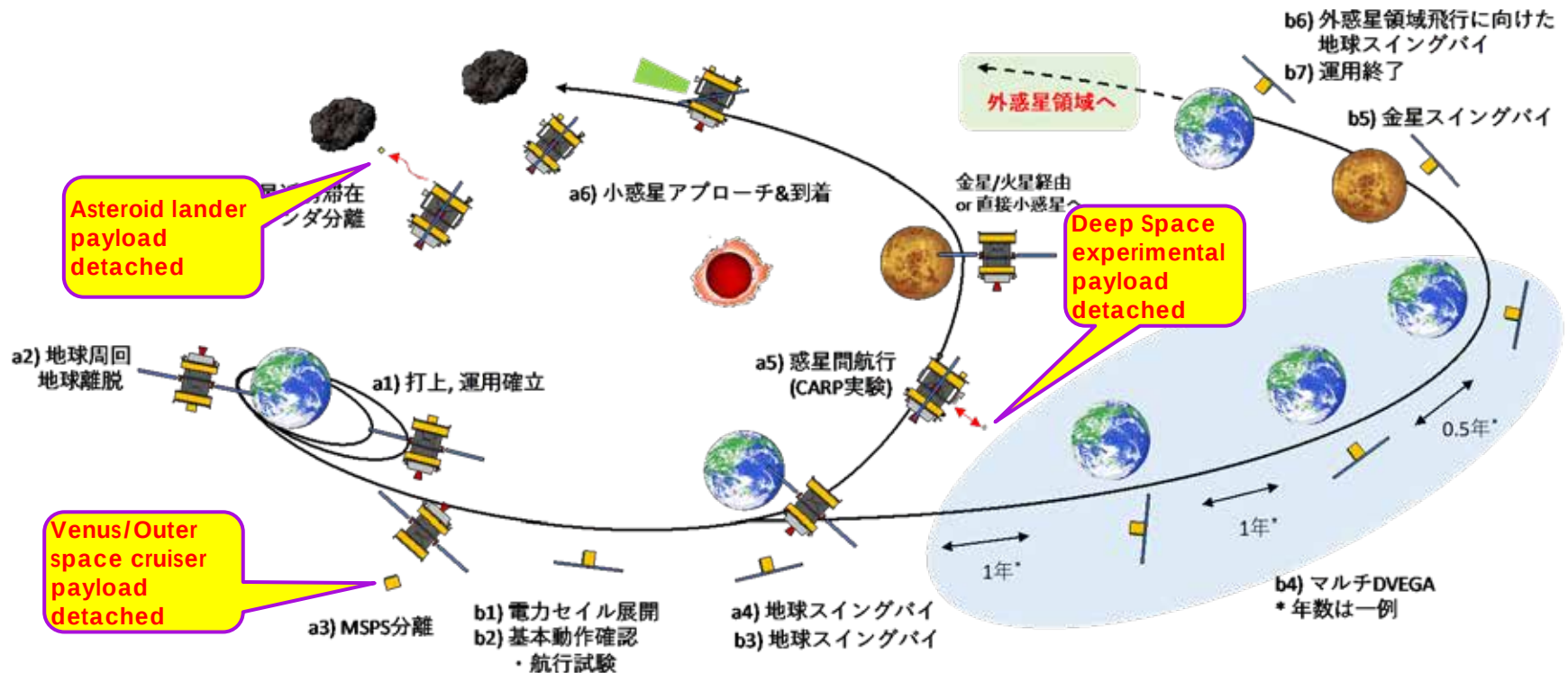
- u COTS parts-based tech foundation to realize nano-satellites
- u Regular space access established (Rideshare/ISS)

Breakthrough needed to democratize Deep Space missions

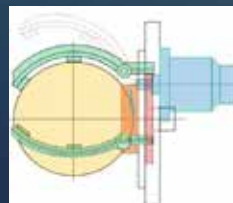
- u Very long-distance communication
- u Operation in extreme power & temperature conditions
- u Efficient and reliable propulsion system
- u Reliable against very long cruise
- u Launch opportunity

STARMINE project proposed to ISAS in 2022

STARMINE: Space Transporter for Asteroid Rendezvous and Microspacecraft Interplanetary Experiment



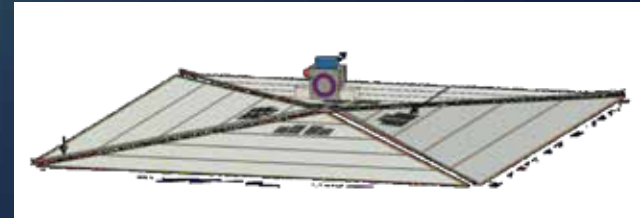
Deep space RVD experiment (1U)



Asteroid lander (2U)



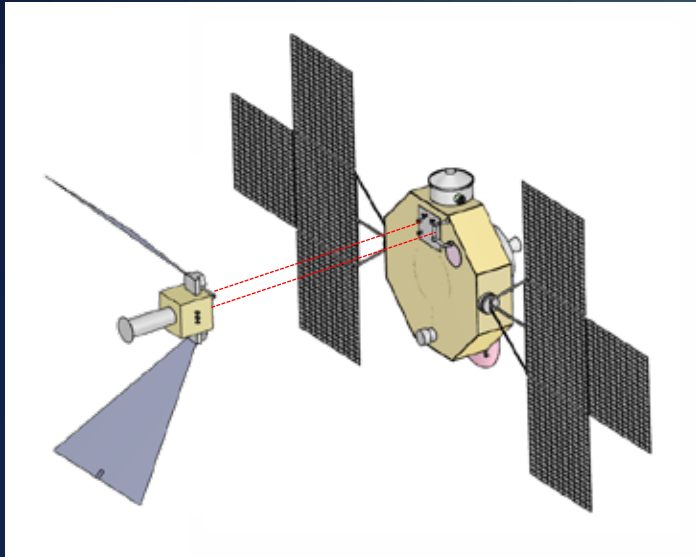
Independent Venus flyby/outer-space exploration spacecraft (6U)



Communication, Propulsion and Launch Opportunity are provided by the OTV.

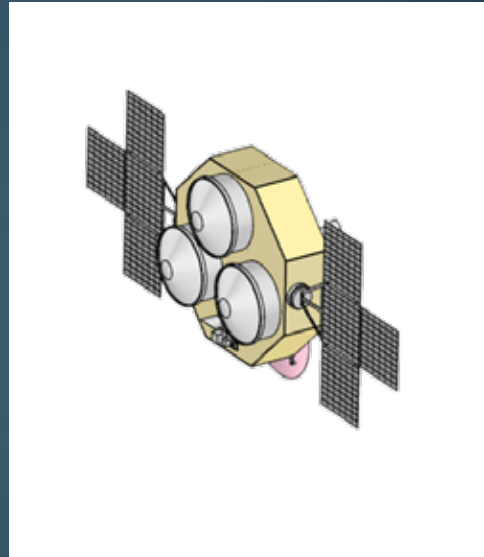
More democratized DS-OTV ?

Now the Japanese Space Strategy Fund calls for industry's proposals to realize the commercial OTV concept which may cover Deep Space. ISAS is supporting the DS-OTV concept by proposing the following three types of near future missions.



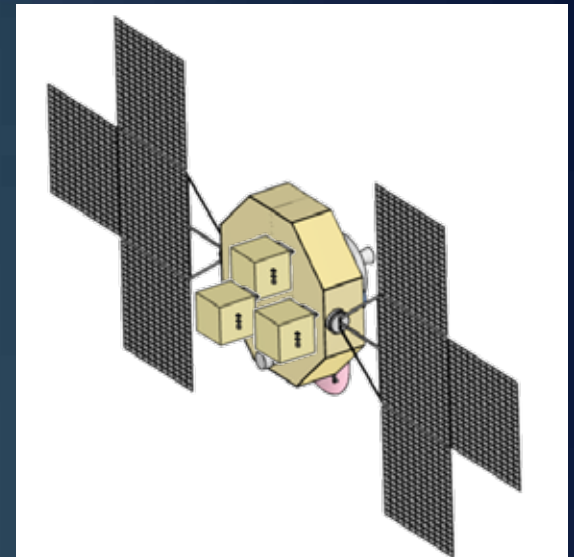
Small body sample return

(Lander and Reentry Probe transportation)



Mars multi-lander

(Lander transportation and Mars obs./comm relay services)



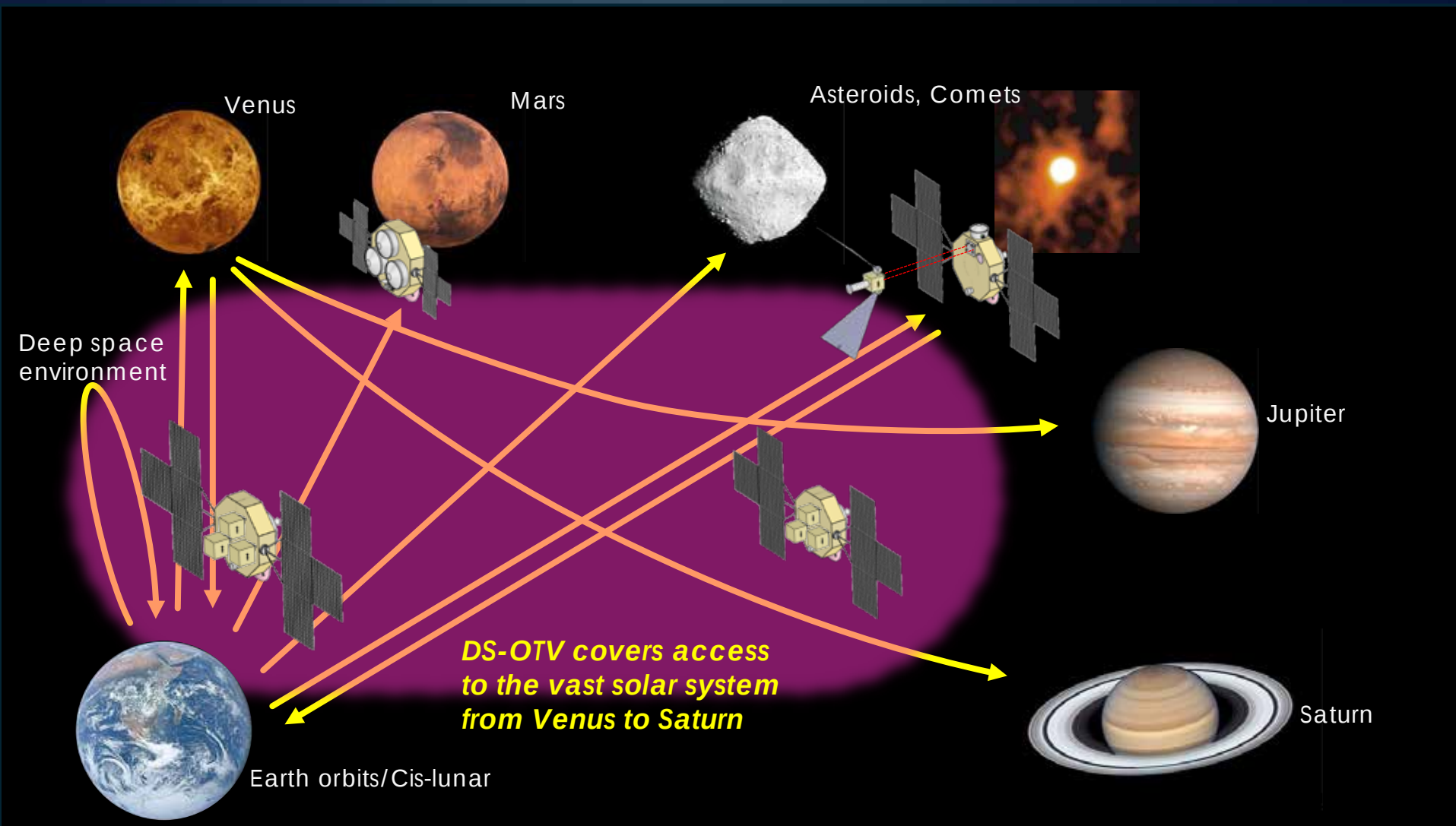
Cis-lunar/deep space ride share

(Small sats transportation and hosting payload services)

- u DS-OTV can lower the cost of the deep space transportation by commonized system and increased frequency.
- u DS-OTV can open the deep space opportunity wider to the community.

Separating “Cruise” from “Exploration”, Focus on challenges at destination planets,

— Like we do CubeSats without our own launcher.



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11th UNISEC-GLOBAL Meeting

November 1-4, 2025

Panel Discussion Round 1 : Tell us about your own involvement or interest in deep space exploration missions

Benjamin BONSU
Engineering Office Administrative Coordinator
ispace – Japan



ispace

How did my space career journey start?

- Space career started in 2012 at All Nations University in Ghana

- Projects

- Project manager

- CANSAT

- VHF/UHF Ground station

- 2013 ~ Present : UNISEC –Global Member

- 2014 ~ 2020 : Kyutech Experience

- Completed my Masters and PhD

- Projects : As RF Engineer

- Horyu-4 Nanosatellite

- Birds Project (Ghanasat-1)

- PeTT Vacuum Chamber

- 2020 ~2024 : Axelspace

- Projects : As RF Engineer

- GRUS1BCDE Microsatellite

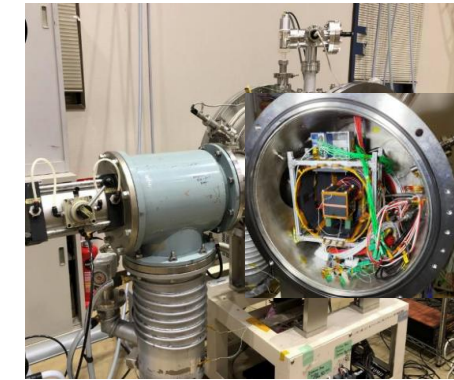
- Pyxis Microsatellite



Pyxis Microsatellite (145kg)



GRUS 1BCDE Microsatellite (100kg)



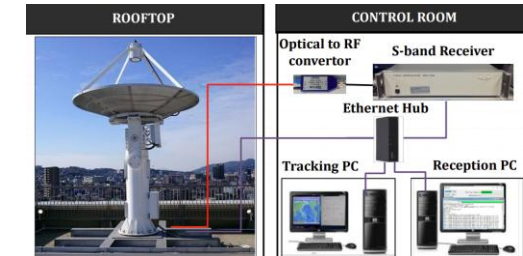
PeTT Vacuum Chamber



Birds – 1 Project Team Members



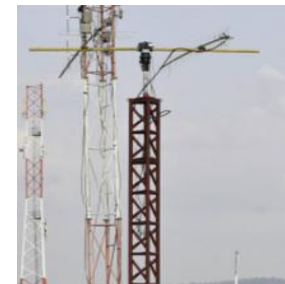
GHANASAT-1 (1U)



2.4m S-band Ground Station



CANSAT



VHF/UHF Ground station

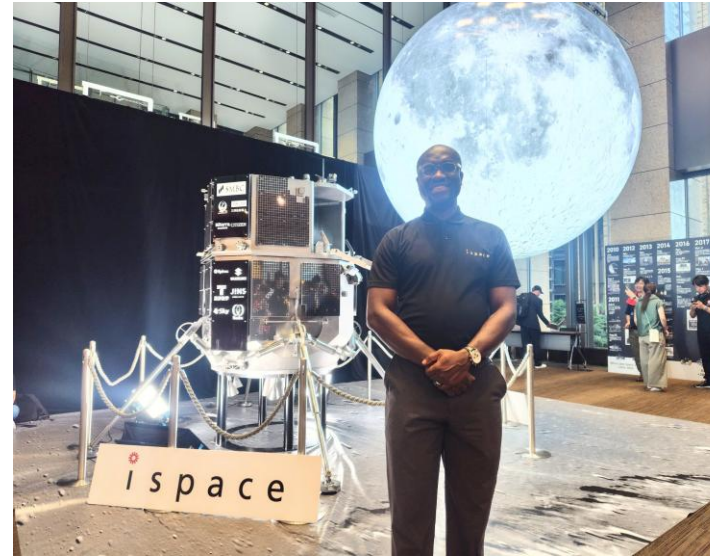


1st UNISEC-Global Meeting
(November 2013)



HORYU-4 Nanosatellite (10kg)

- Joined the ispace Japan crew as of September 2024 ~ Present
- Positions:
 - Senior RF/Comm Engineer
 - Japan Engineering Office Admin Coordinator (New)
- Projects :
 - Mission 2 (RESILIENCE) : Completed
 - Mission 4 : In progress

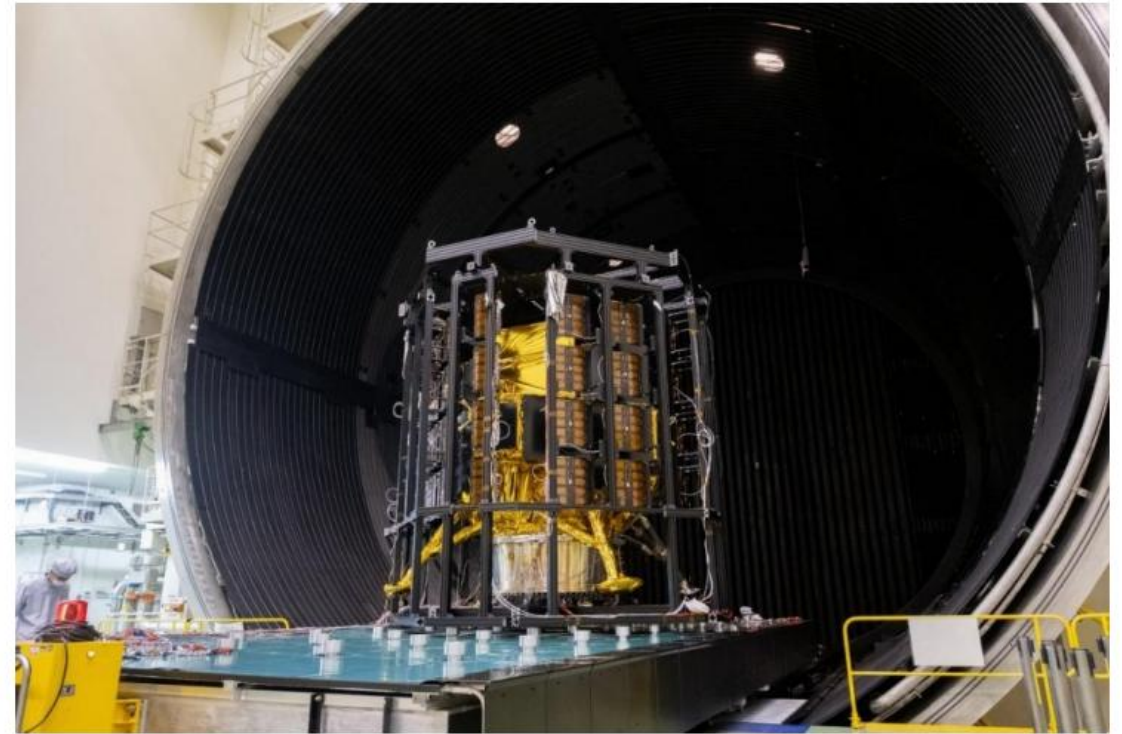


Mission 4 Progress : Structure Thermal Model (STM) Phase has been successfully completed

- At the Tsukuba Space Center of the Japan Aerospace Exploration Agency (JAXA), three types of environmental tests were conducted: vibration test, acoustic test, and thermal vacuum test using the thermal structure model (STM) of the Series 3 lander (tentative name) at the Environmental Test Facility in the center.
- Environmental testing thermally or mechanically replicates the launch and space environments to ensure that the lander's structural and thermal design performs as expected in the harsh space environments.



A thermal structure model (STM) of a Series 3 (tentative name) lander is transported from a large thermal vacuum chamber at a JAXA facility in Tsukuba



Thermal structure model (STM) of a Series 3 (tentative name) lander surrounded by a heater for thermal vacuum testing transported to a large 13-meter-diameter chamber at a JAXA facility in Tsukuba

A detailed illustration of a lunar base. In the foreground, a complex of structures is built on the moon's surface, including several large white parabolic satellite dishes, various modules, and a central tower. The base is situated in a cratered landscape. In the background, the Earth is a large, vibrant blue sphere with white clouds, dominating the horizon. A small satellite is visible in orbit above the Earth. The overall scene is set against the blackness of space.

Thank You

i s p a c e

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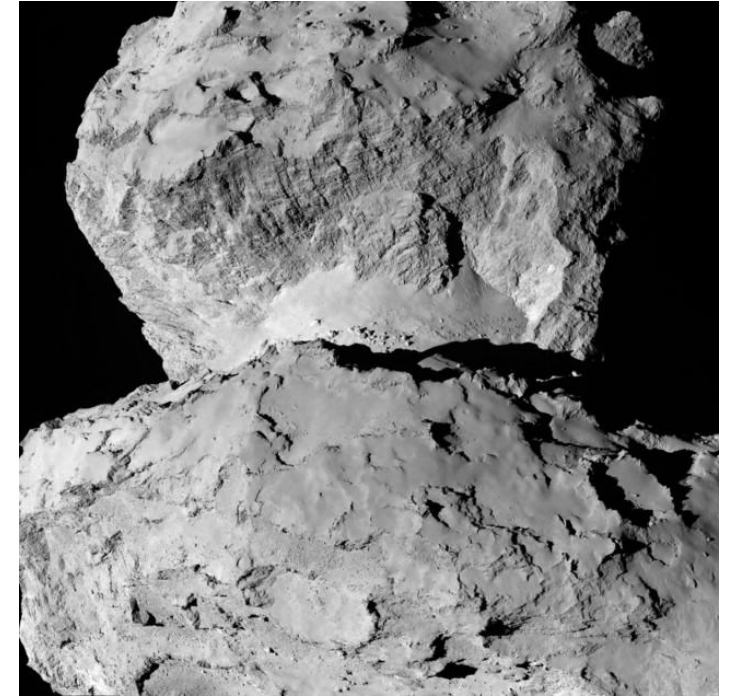
Abdulla Hil Kafi
Kyutech

Deep Space Missions

Experience Herman Steyn

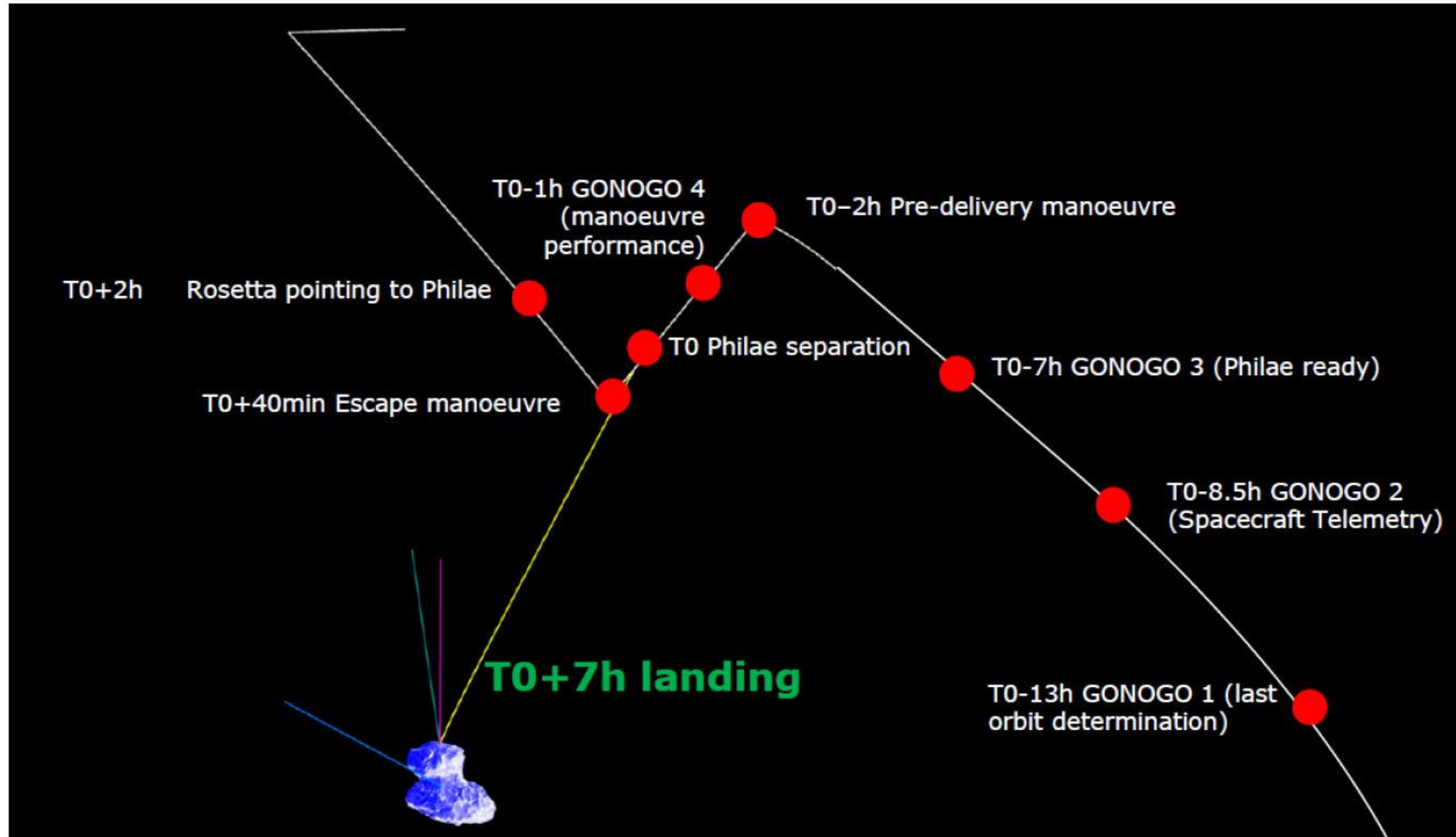
Rosetta mission 2004 - 2014

- **Comet science mission**
 - ESA project started in 1993 to develop a spacecraft to rendezvous with a comet and release a lander for in-situ experiments
 - Rosetta satellite was not ready for initial launch to comet Wirtanen in Jan 2003
 - Comet 67P/Churyumov-Gerasimenko was the new target when launched 2 March 2004
 - After 10.5 years the satellite reached the comet on 6 August 2014
 - Philae landed on the comet on 12 Nov 2014
 - Project Aims:
 - Be first spacecraft to rendezvous and land on a comet
 - To characterise and analyze the comet nucleus
 - Search for organic compounds
 - Study the comet activities and time developments
 - Determine if comets could have delivered vast quantities of water or contributed to life on earth



Philae delivery to landing

12 Nov 2014



Philae Lander Stability

- **Lander Momentum Wheel**

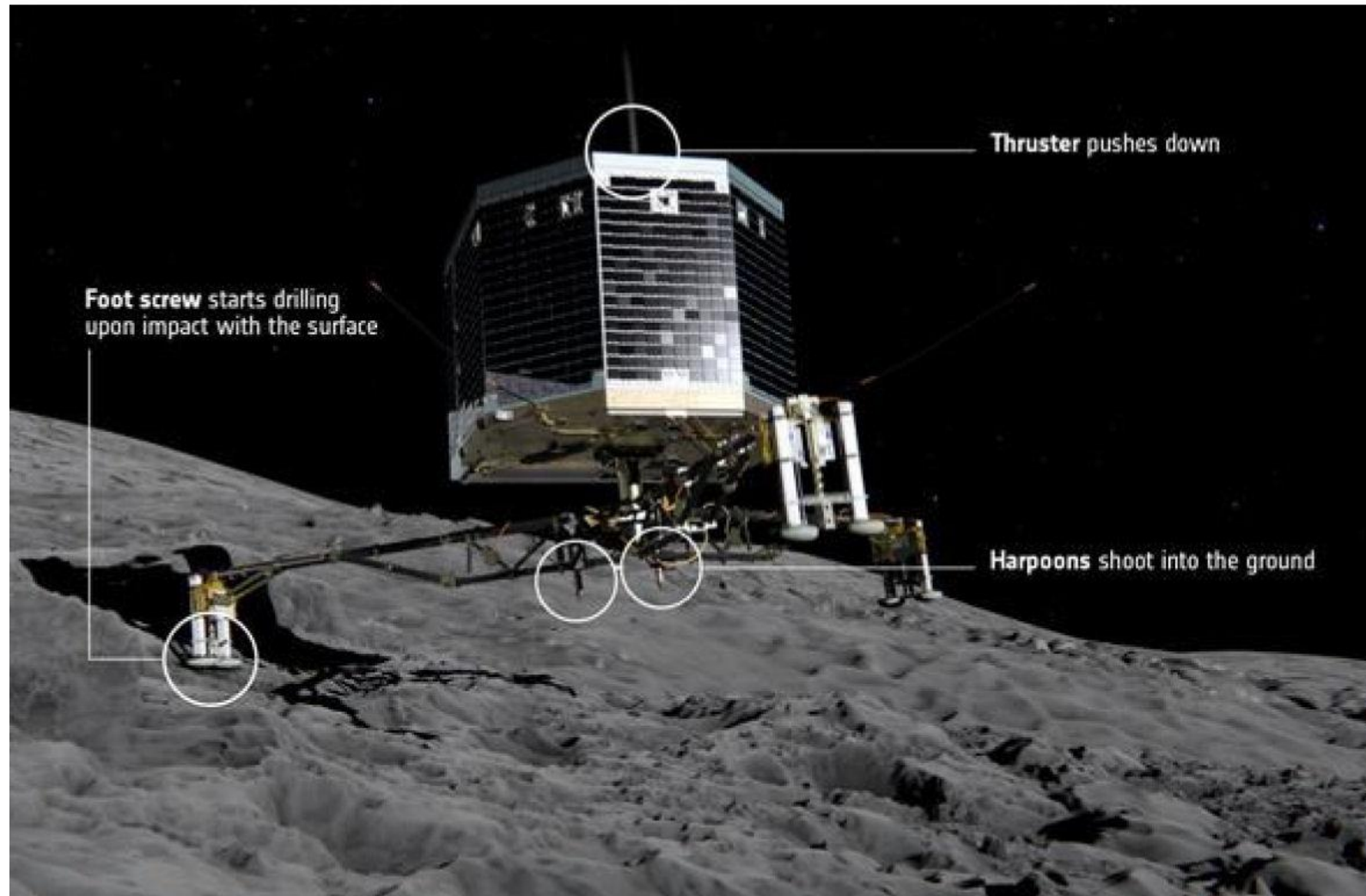
- In 2000 SSTL was approached by DLR to supply a momentum wheel for Philae
- I was asked to redesign a SSTL minisatellite wheel for this mission requirements:
 - Max wheel speed = 10 000 rpm (5.25 Nms angular momentum)
 - Average power at full speed = 3.3 Watt
 - Only analogue electronics to survive space radiation (max 15 krad dose)
 - Dry lubricated bearings to prevent cold welding of metals, must survive more than 10 years in a deep space environment
 - EMC testing under strict ESA specifications
 - Momentum wheel was developed and delivered in less than 12 months
- The wheel will be spun-up before release of the lander from the Rosetta spacecraft to give gyroscopic stiffness to the Lander's orientation – to ensure it will descent towards the comet and land on it's legs onto the comet's surface

- **Mission problems experienced**

- In 2006 a leak occurred in the Rosetta propulsion control system (24 x 10N thrusters for trajectory control)
 - Now operated at a lower pressure, still sufficient propellant for the mission
- Two of the 4 satellite reaction wheels show higher than expected vibration levels
 - New software to allow Rosetta to use only 2 reaction wheels was uploaded



Philae "Attachment" to Comet



Two
rebouncings

Touchdowns
at 15:34,
17:25 and
17:32 GMT

Philae Path to 2nd landing

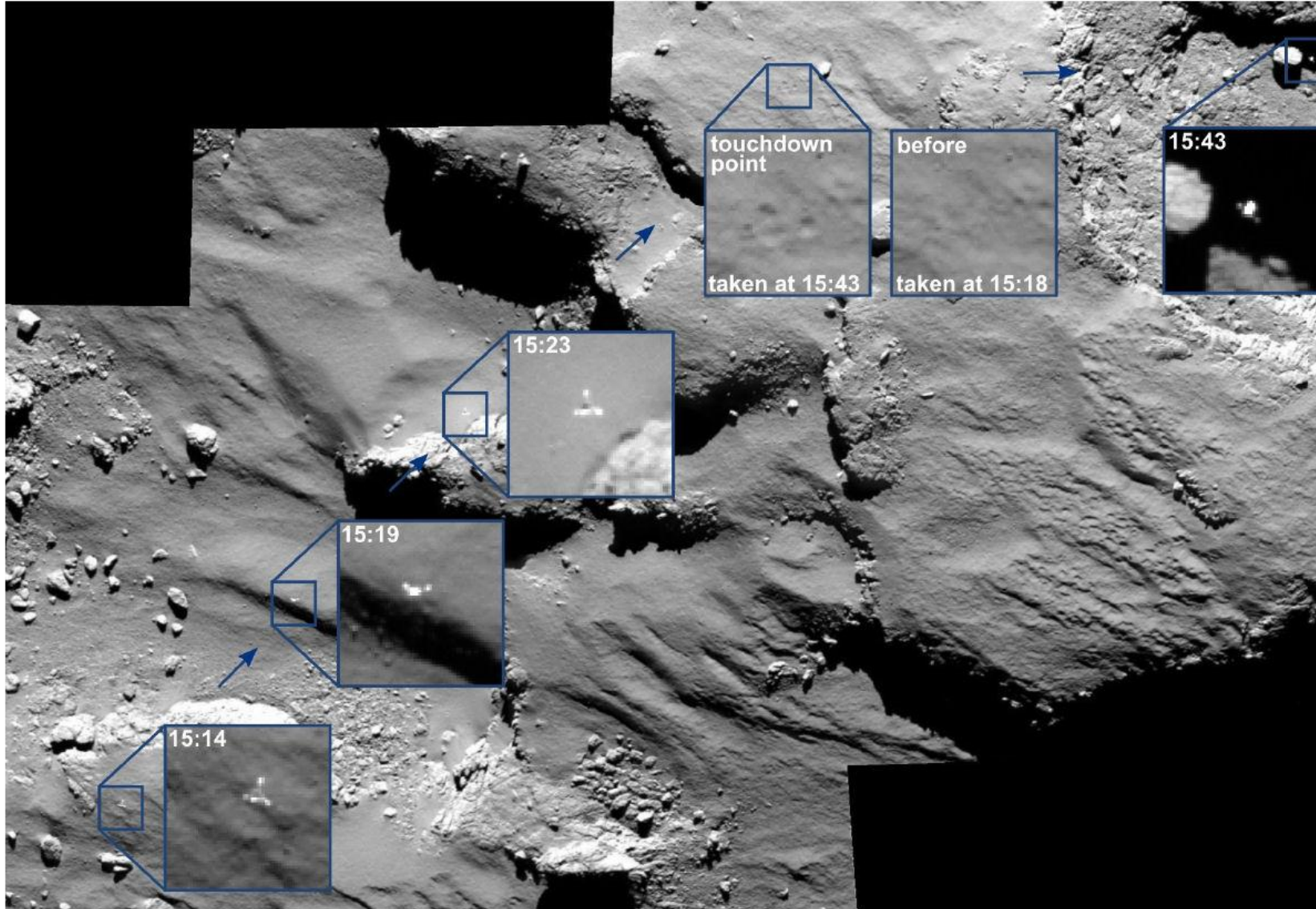


image credit: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA

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Benjamin Bonsu
ispace, inc.



Herman Steyn
Stellenbosch University



Abdulla Hil Kafi
Kyutech

Round 2: Challenges and ways forward



- **What infrastructure is needed, for more countries and universities to join deep space exploration missions? Could OTV be a game-changer?**



Yuichi Tsuda
JAXA/ISAS



Nozomu Takaki
MELCO

- **What are expectations from emerging space nations, to join a deep space mission?**



Herman Steyn
Stellenbosch Univ.



Abdulla Hil Kafi
Kyutech

- **How to grow the business case for deep space missions, in Japan and globally?**



Benjamin Bonsu
ispace, inc.



Mia Lee
Space BD



Naoya Ozaki
JAXA/ISAS

Expectations:

1. Must be part of an international team and not only a national activity
2. Cost/financial contribution must be affordable for a developing country with limited resources
3. Be able to demonstrate its own local capabilities and not only be a passive observer
4. Will be important to demonstrate the benefit of the mission for the scientific advancement of humankind for the ordinary man in the street to understand this benefit
5. PR outreach is important to e.g. inspire young kids to in future become involve in science and engineering

Audience Q&A



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Closing

**How to involve more countries
and more universities
in a deep space exploration mission?**

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How to involve more countries and more universities in a deep space exploration mission?

Thank you for your participation!

**Deep Space Workshop
Panel Discussion (2)**

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