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

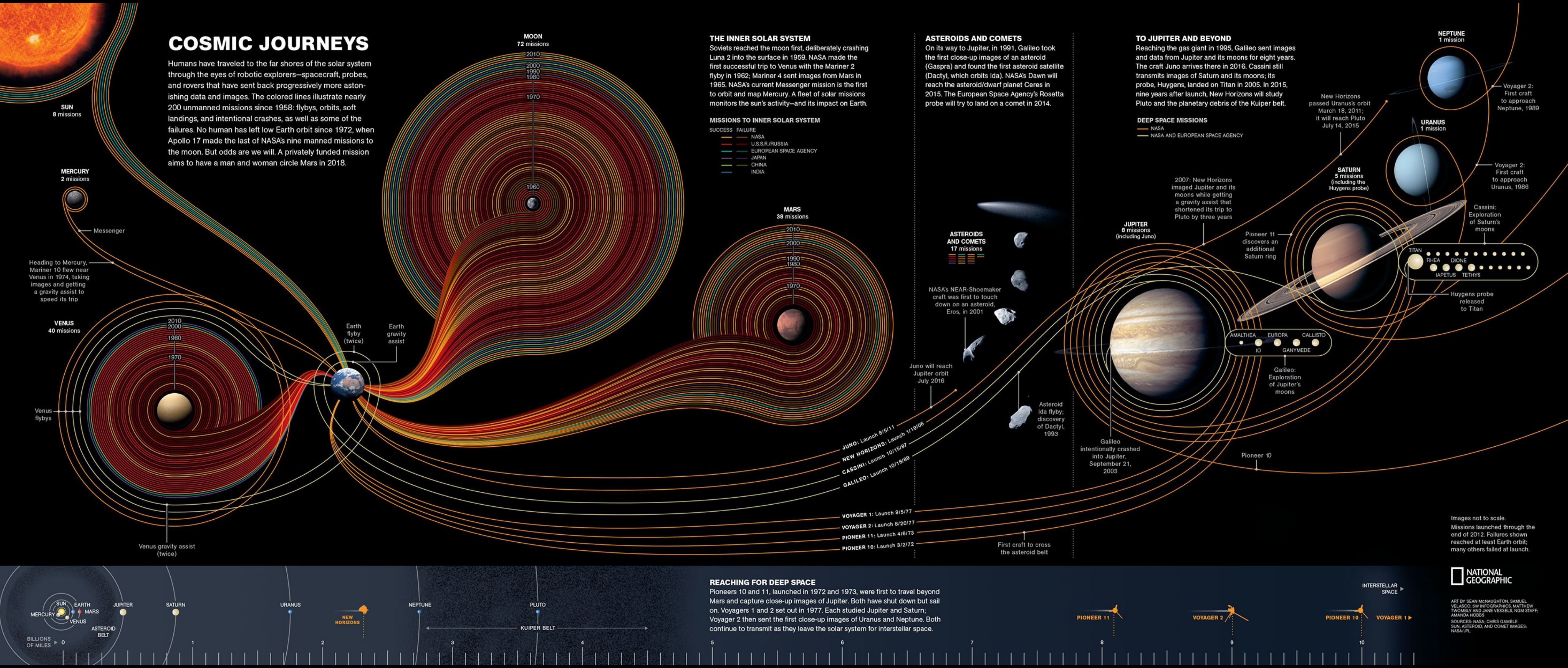
Deep Space Workshop
Panel Discussion (2)

Nov. 3, 2025

Outline

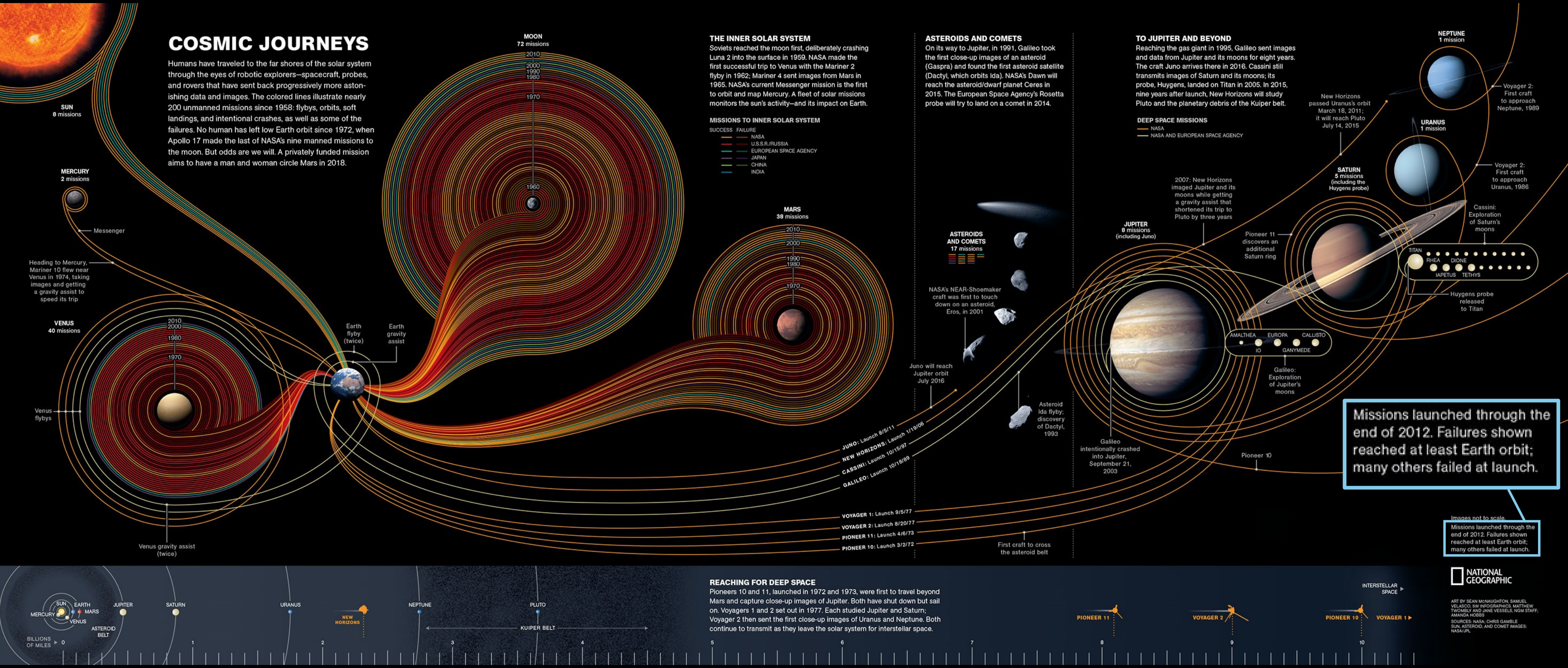
- Background
- Round 1: Experiences
- Round 2: Challenges and ways forward
- Q&A

Deep space missions 15 years ago:



(National Geographic)

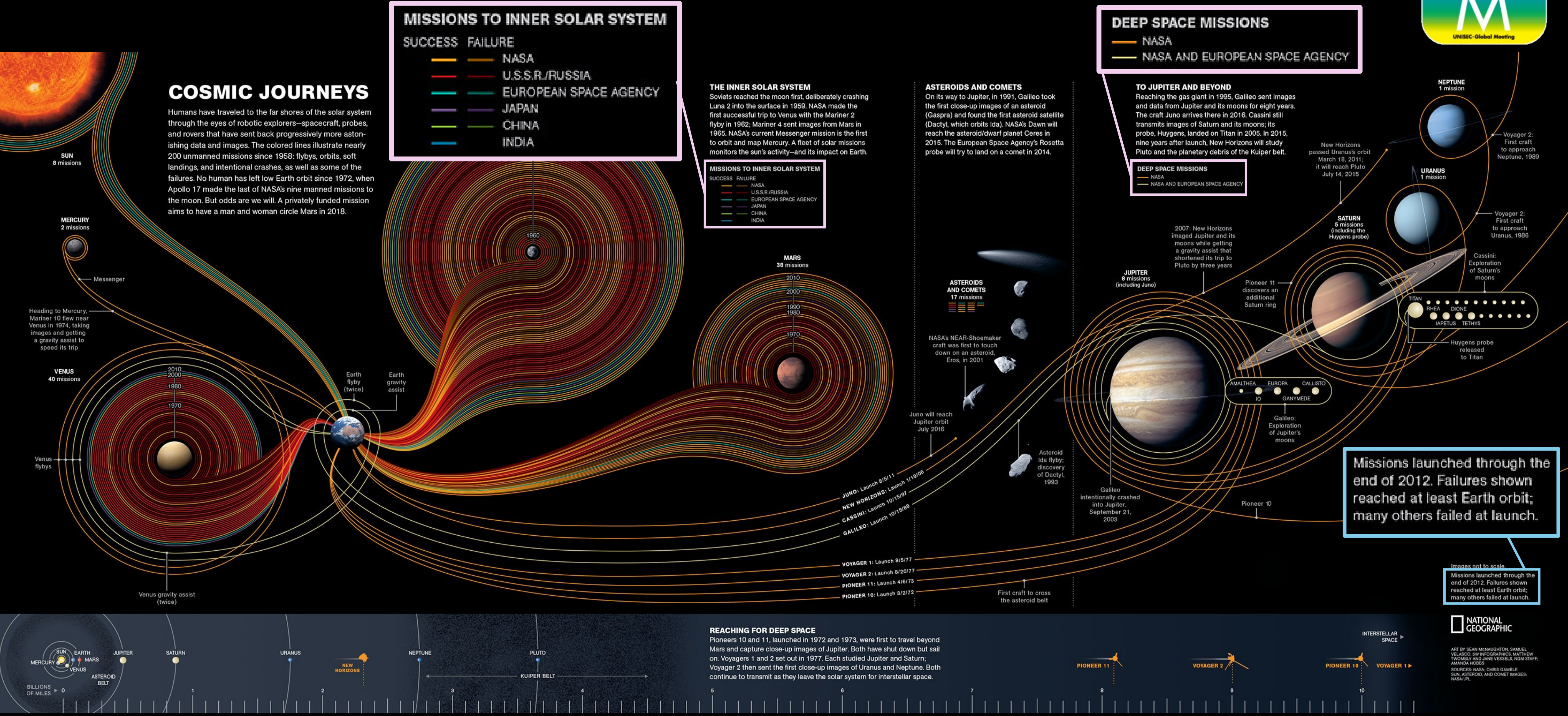
Deep space missions 15 years ago:



Missions launched through the end of 2012. Failures shown reached at least Earth orbit; many others failed at launch.

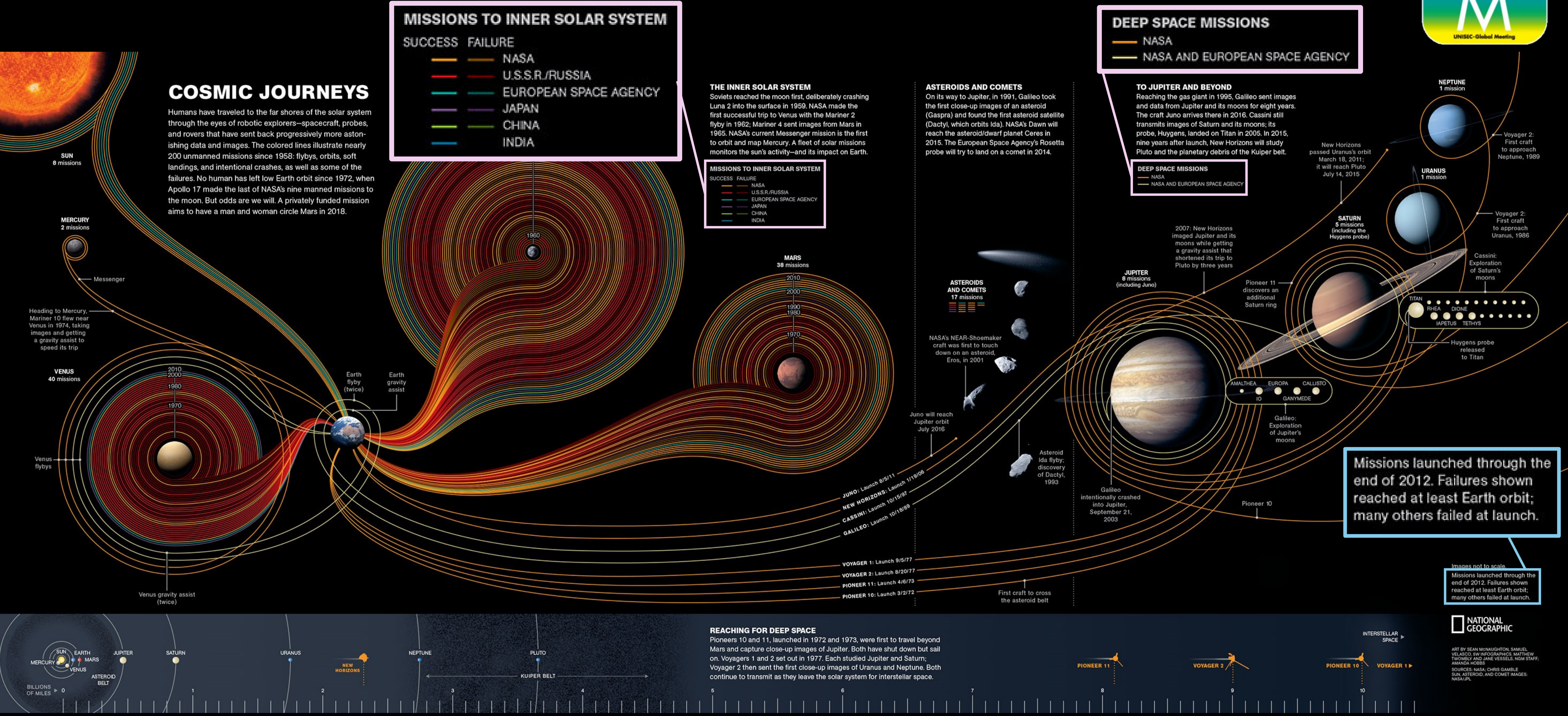
(National Geographic)

Deep space missions 15 years ago:



(National Geographic)

Deep space missions 15 years ago:



(National Geographic)

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

Since then, new efforts by:

Agencies

(ISRO)

(UAE Space Agency)

(JAXA)

(ESA)

(JAXA)

(JAXA)

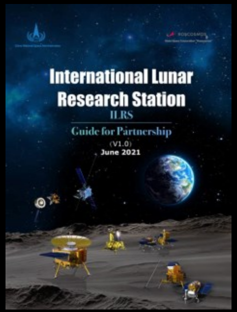
(ESA)

(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)

(JAXA)

(JAXA)

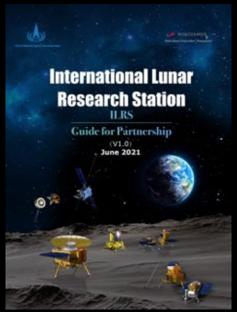
(ESA)

(ESA)

(ESA)

(JAXA)

(NASA)



(CNSA)

(CNSA)

(NASA)

(NASA)

Companies

(Intuitive Machines)

(Argotec)

(ispace)

(ArkEdge Space)

Deep space = more accessible than ever before

Since then, new efforts by:

Agencies

(ISRO)

(UAE Space Agency)

(JAXA)

(ESA)

(JAXA)

(JAXA)

(ESA)

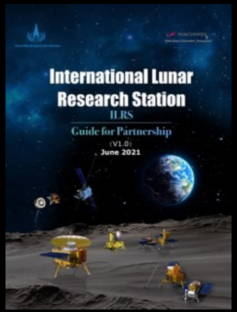
(ESA)

(ESA)

(JAXA)

(NASA)

(CNSA)



(CNSA)

(NASA)

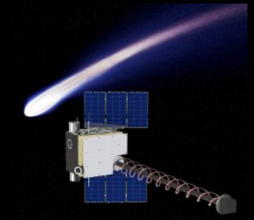
(NASA)

Companies

(Intuitive Machines)

(Argotec)

(ispace)



(ArkEdge Space)

Universities

(UTokyo)

(MSU)

(ASU)

(Princeton / JHU / NASA)

Deep space = more accessible than ever before

Since then, new efforts by:

Agencies

(ISRO)

(UAE Space Agency)

(JAXA)

(ESA)

(JAXA)

(JAXA)

(ESA)

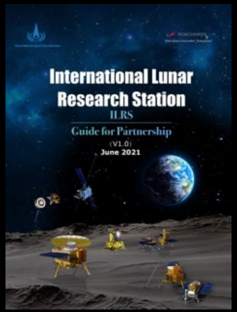
(ESA)

(ESA)

(JAXA)

(NASA)

(CNSA)



(CNSA)

(NASA)

(NASA)

Companies

(Intuitive Machines)

(Argotec)

(ispace)

(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

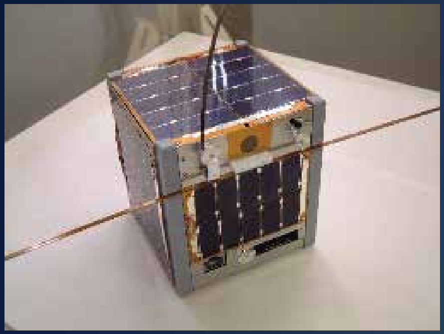
Mia Lee
Space BD

Benjamin Bonsu
ispace, inc.

Herman Steyn
Stellenbosch University

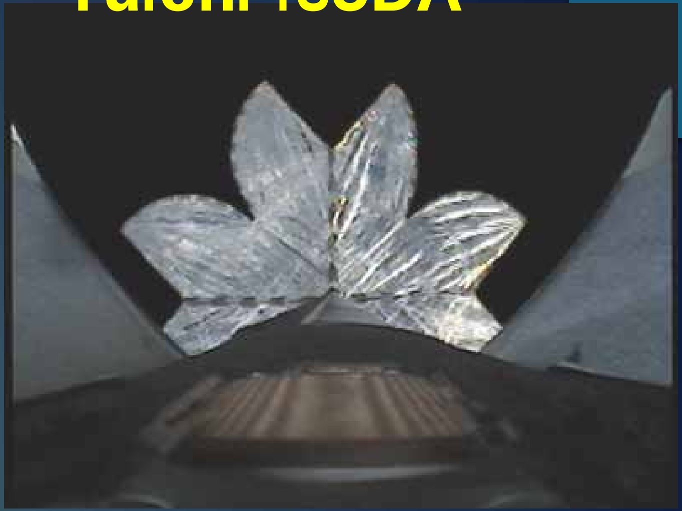
Abdulla Hil Kafi
Kyutech

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

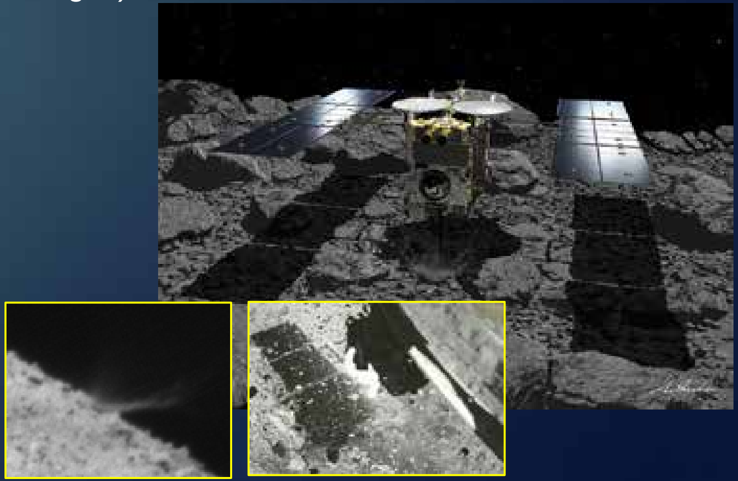


S310 Sounding rocket solar sail deployment experiment (Sail development, Mission PI) 2003-2004

World's first interplanetary solar sail mission IKAROS
(Trajectory design, Sail development, Deputy Project Manager) 2003-2013

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

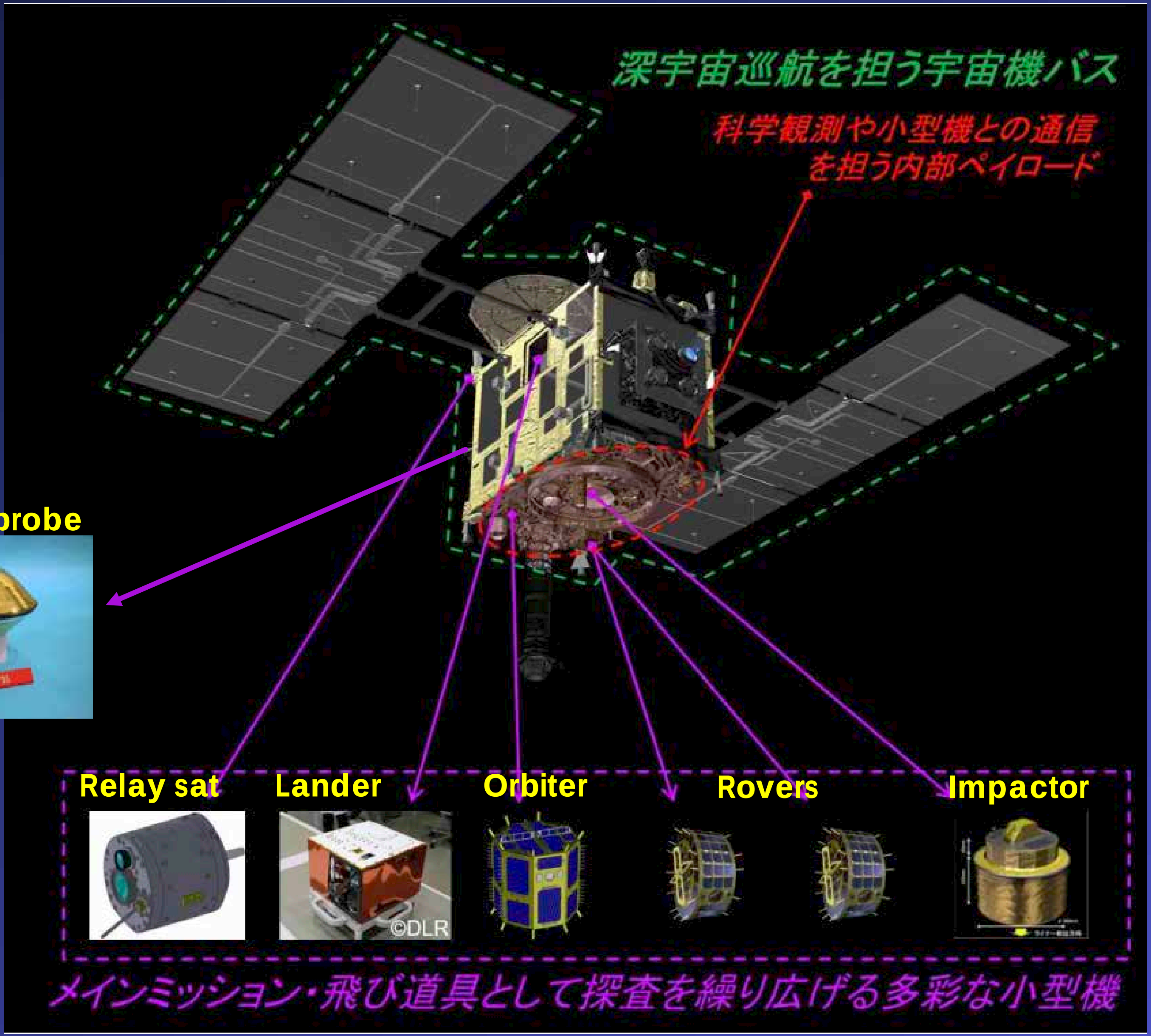
Hayabusa2 asteroid sample return mission (Trajectory design, Astrodynamics science member, Lead Engineer, Project Manager) 2010-



Cratering! Multi-landing!

Small sats can dramatically boost mission’s value !!

Reentry probe



Is it possible to ‘Democratize’ Deep Space missions?

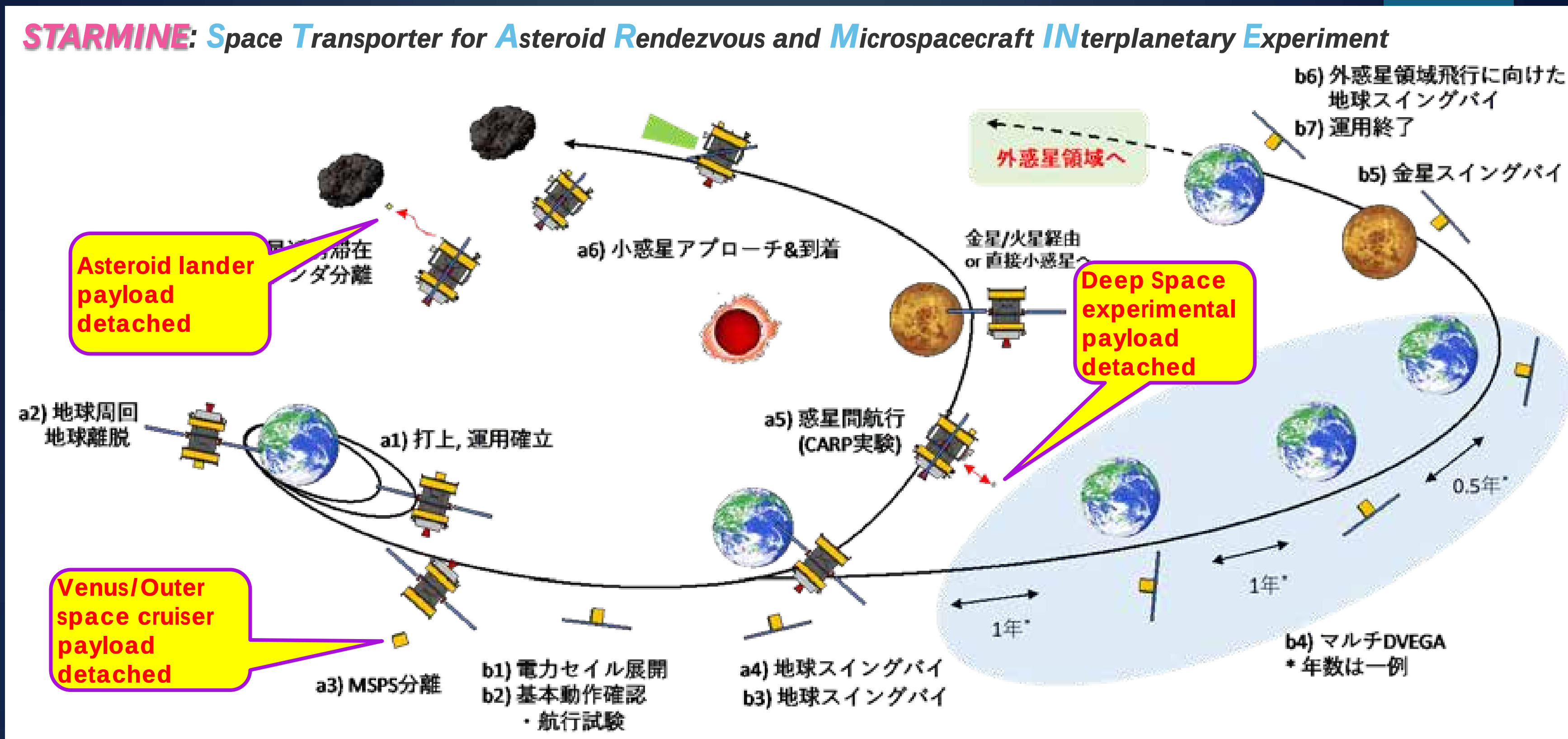
Breakthrough in “democratizing” Earth-orbiting CubeSats

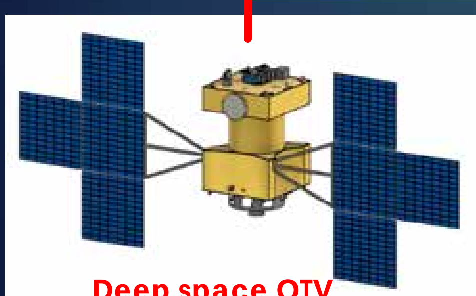
- COTS parts-based tech foundation to realize nano-satellites
- Regular space access established (Rideshare/ISS)

Breakthrough needed to democratize Deep Space missions

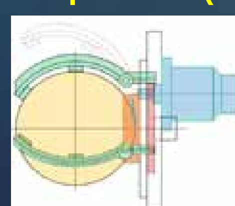
- Very long-distance communication
- Operation in extreme power & temperature conditions
- Efficient and reliable propulsion system
- Reliable against very long cruise
- Launch opportunity

STARMINE project proposed to ISAS in 2022

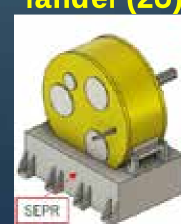




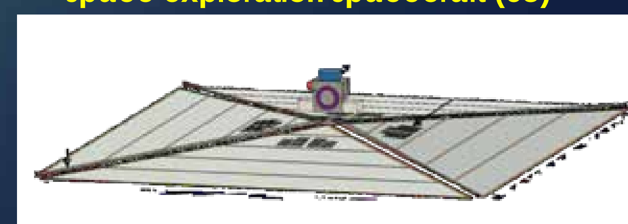
Deep space RVD experiment (1U)



Asteroid lander (2U)



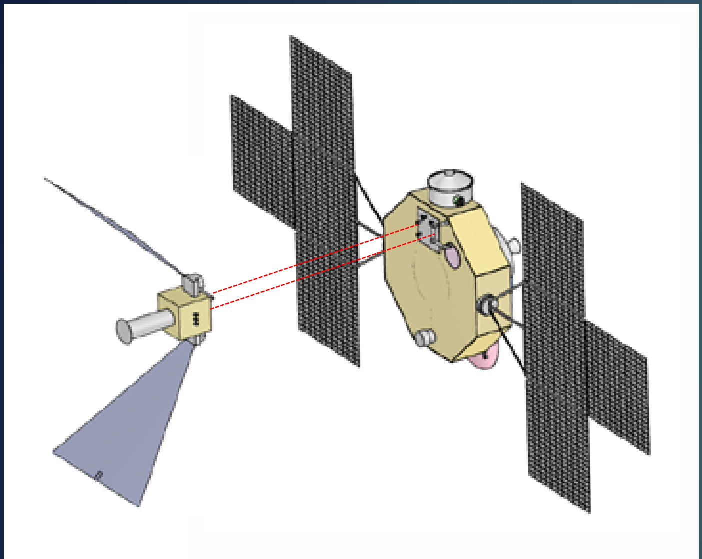
Independent Venus flyby/outer-space exploration spacecraft (6U)



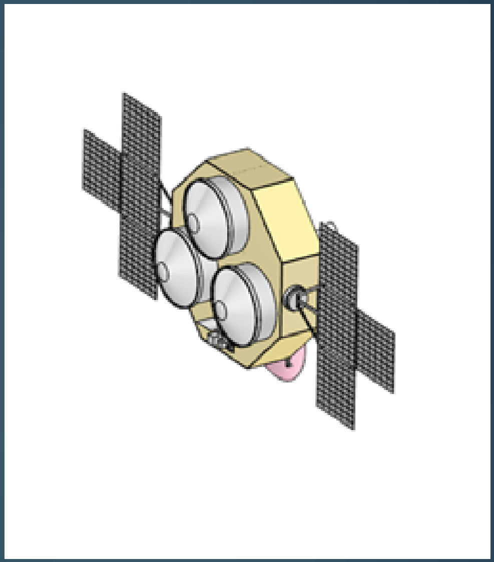
Communication, Propulsion and Launch Opportunity are provided by the OTV.

More democratized DS-OTV ?

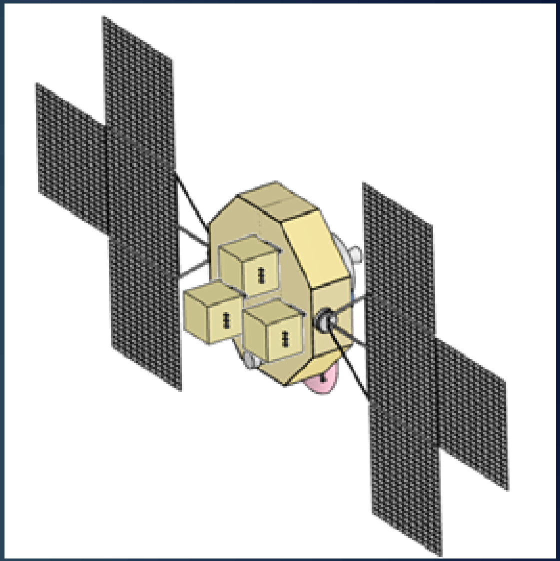
Now the Japanese Space Strategy Fund calls for industry's proposals to realize the commercial OTV concept which may cover Deep Space. ISAS is supporting the DS-OTV concept by proposing the following three types of near future missions.



Small body sample return
(Lander and Reentry Probe transportation)



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

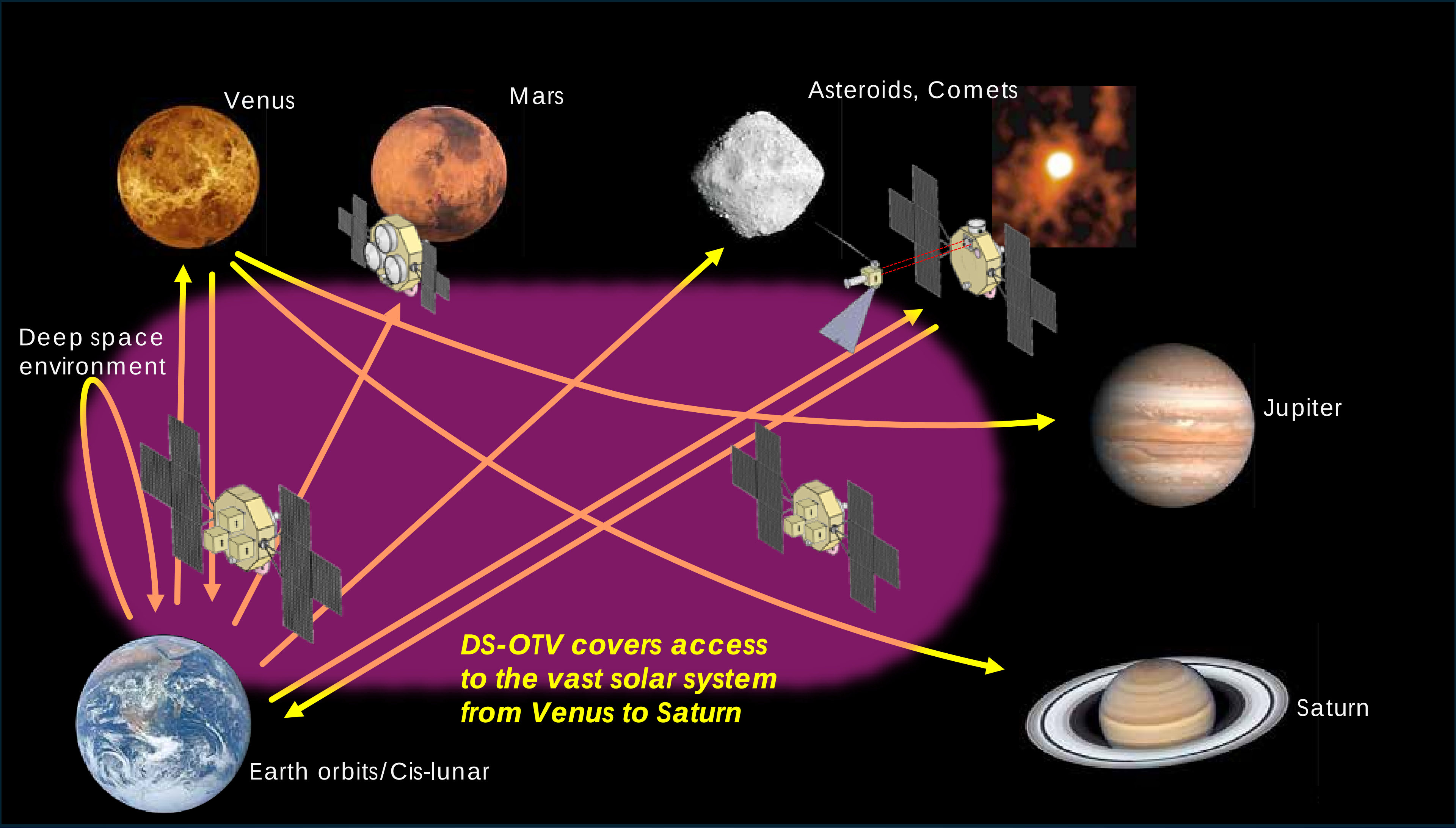


Cis-lunar/deep space ride share
(Small sats transportation and hosting payload services)

- DS-OTV can lower the cost of the deep space transportation by commonized system and increased frequency.
- 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.



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

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

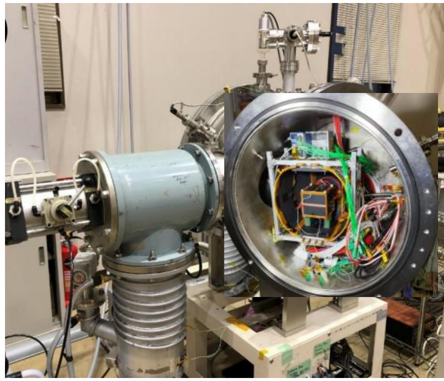
Benjamin BONSU
Engineering Office Administrative Coordinator
ispace – Japan

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

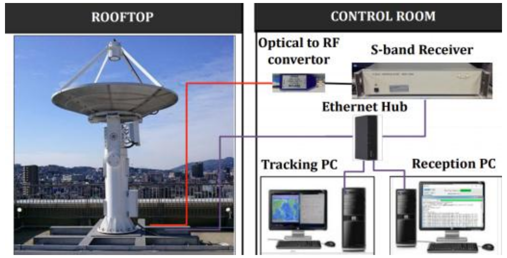

Pyxis Microsatellite (145kg)


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)

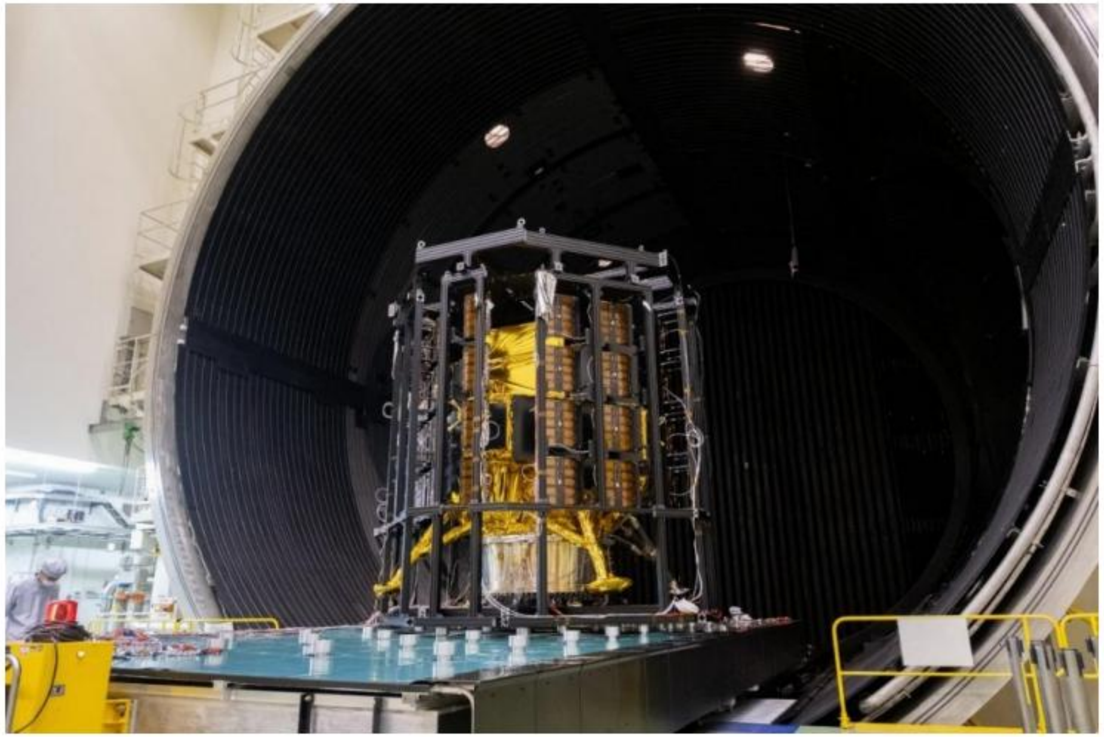

HORYU-4 Nanosatellite (10kg)

- 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

(1) ispace is developing the Series 3 lunar lander through a Small Business Innovation Research (SBIR) grant from Japan's Ministry of Economy, Trade, and Industry (METI).


Thank You

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

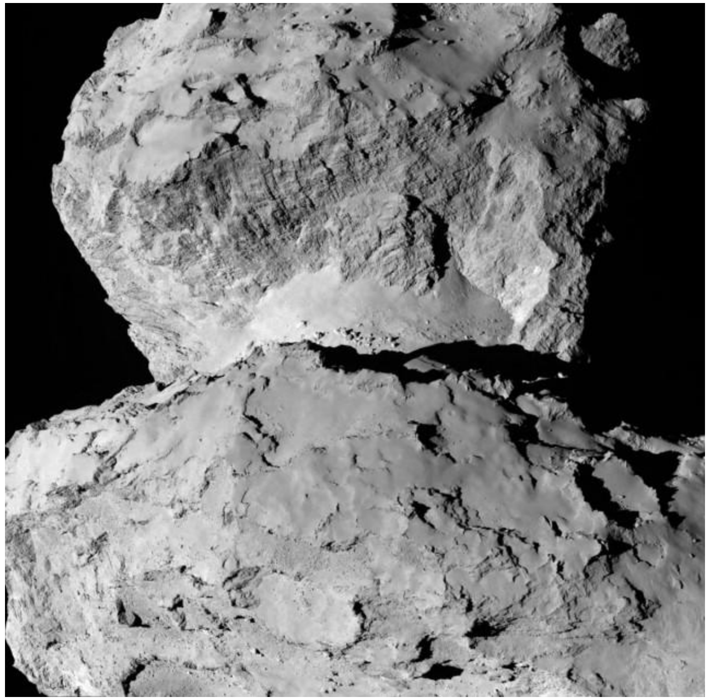
Abdulla Hil Kafi
Kyutech

Deep Space Missions

Experience Herman Steyn

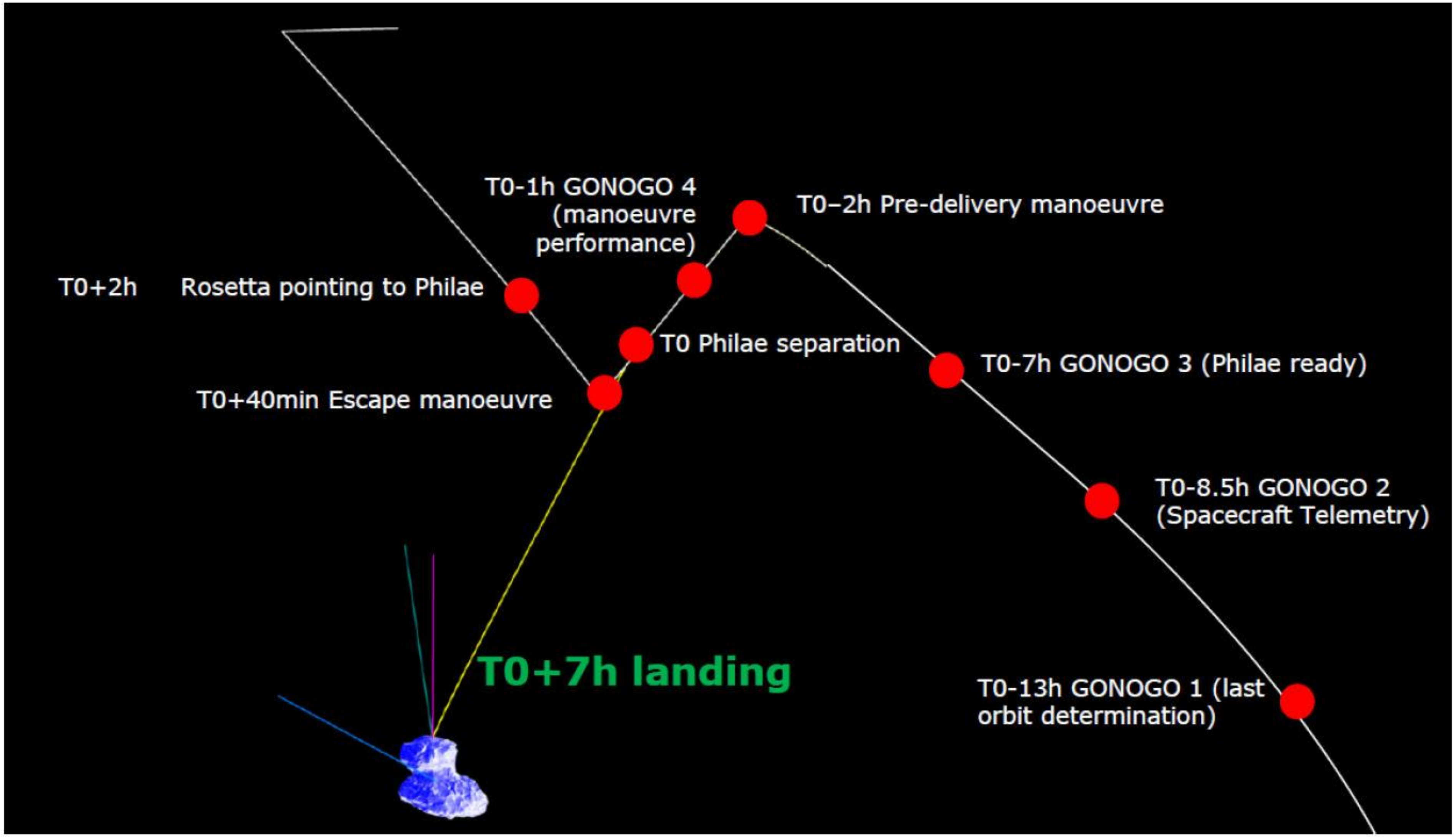
Rosetta mission 2004 - 2014

- **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 analize 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

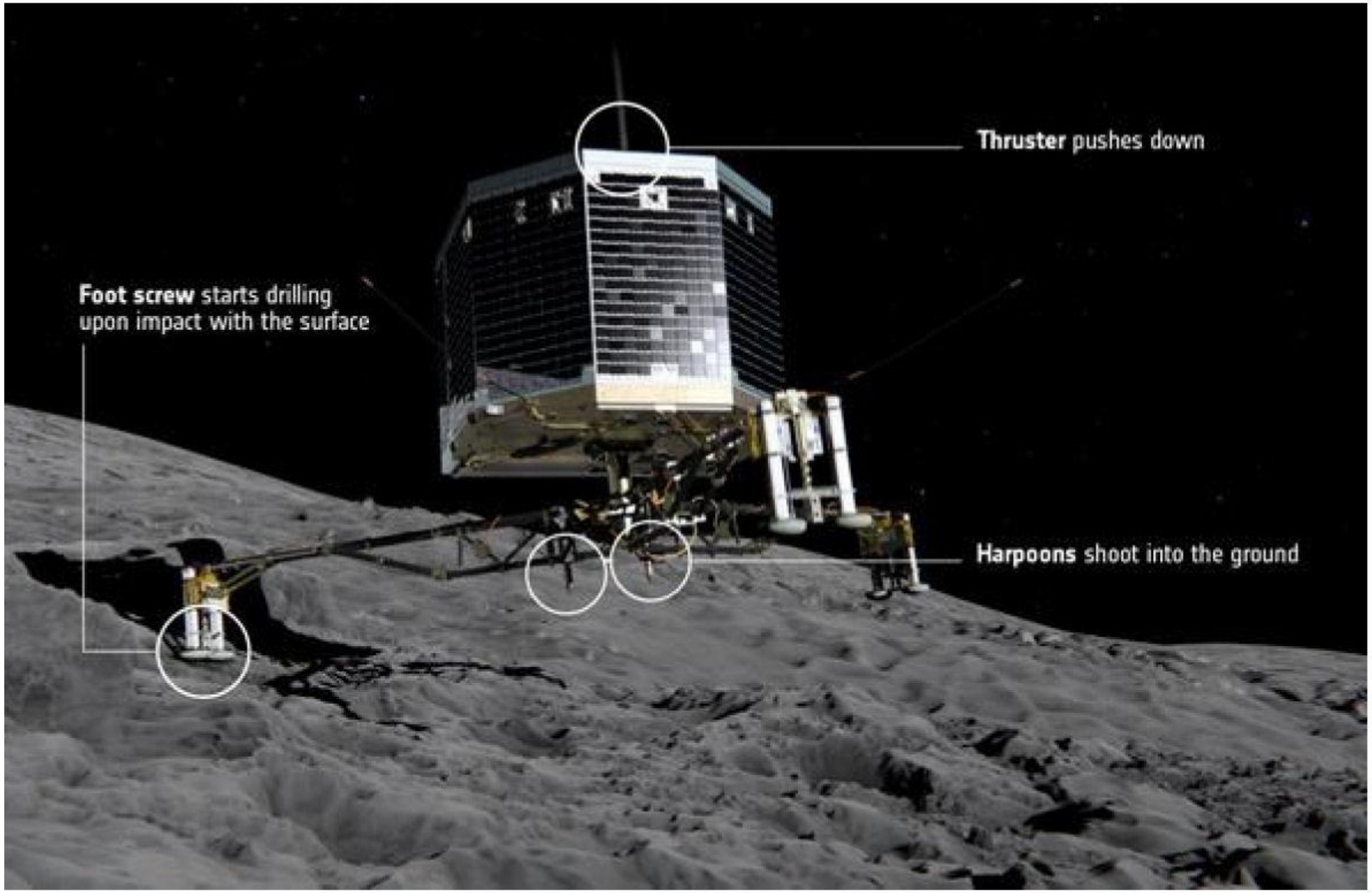
12 Nov 2014



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

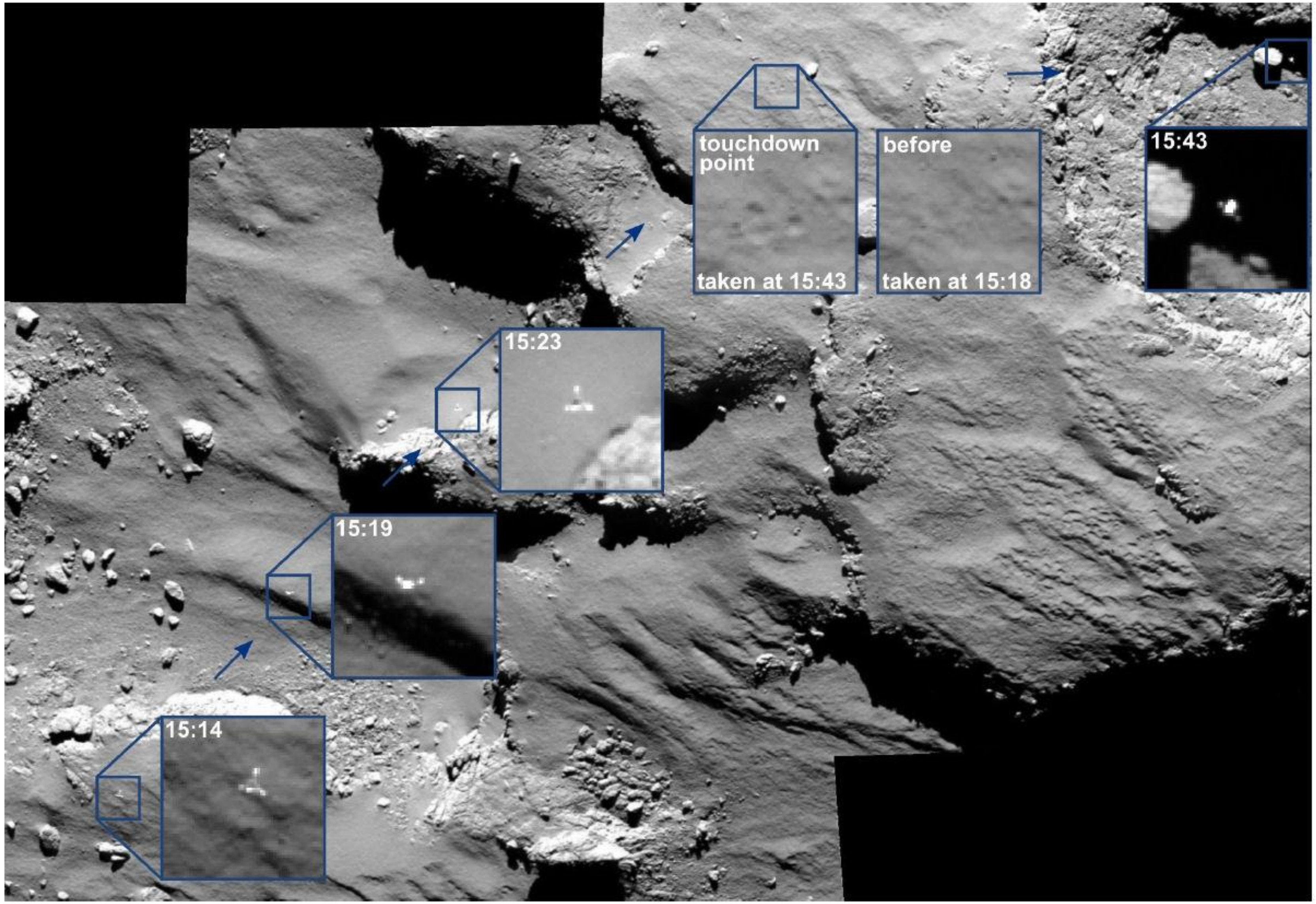


image credit: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA

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

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

Yuichi Tsuda
JAXA/ISAS

Naoya Ozaki
JAXA/ISAS

Nozomu Takaki
MELCO

Mia Lee
Space BD

Benjamin Bonsu
ispace, inc.

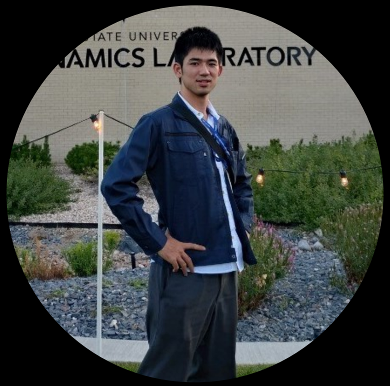
Herman Steyn
Stellenbosch University

Abdulla Hil Kafi
Kyutech

Closing

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

Acknowledgements



Tomoki Mochizuki
UTokyo

Yojiro Yamashiro
UTokyo

Hirotaka Sekine
UTokyo

Ten Arai
UTokyo

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)

Nov. 3, 2025