

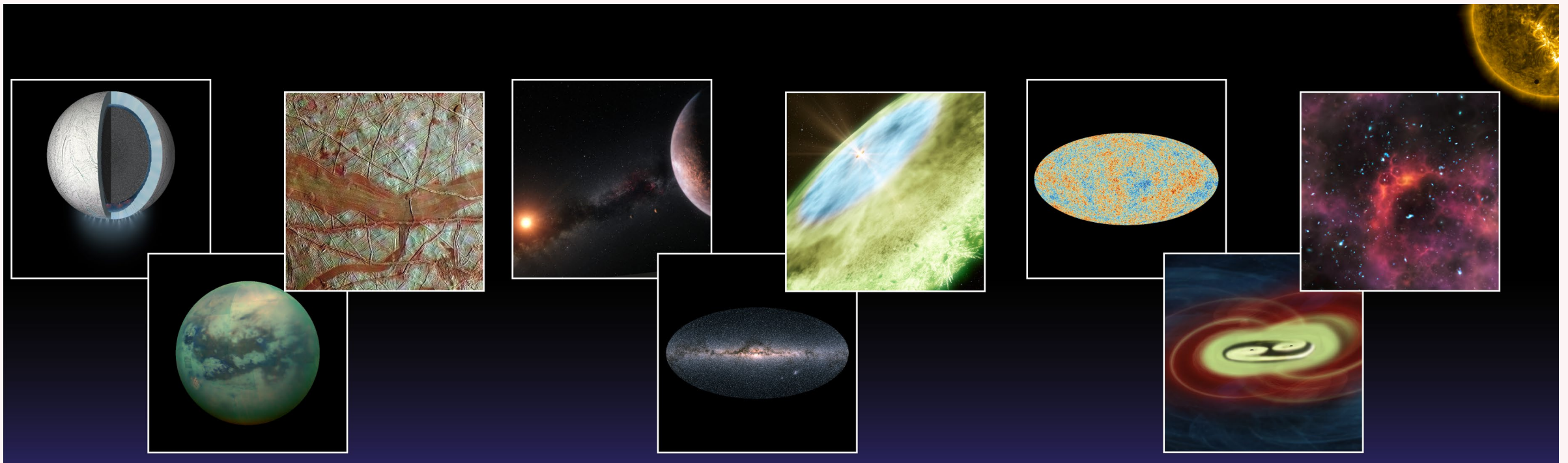
ESA VOYAGE 2050

CHRIS ARRIDGE

DEPARTMENT OF PHYSICS, LANCASTER UNIVERSITY, UK

EMAIL: C.ARRIDGE@LANCASTER.AC.UK

SOCIAL MEDIA: [@CHRISARRIDGE](https://twitter.com/CHRISARRIDGE)



WHAT IS ESA'S VOYAGE 2050

- ESA plans its Programme in planning cycles; previous cycles include **HORIZON 2000** (e.g., leading to *Rosetta*, *Huygens*, *SOHO*), **HORIZON 2000+** (e.g., leading to *BepiColombo*), and **Cosmic Vision** (e.g., leading to *JUICE*).
- **Voyage 2050** is the next planning cycle for **ESA**.
- Goals:
 - Recommend the **three science themes of three Large** missions.
 - Identify **science themes that could be implemented in a Medium** mission.
 - Identify compelling **science themes but where technology would not be ready before 2050**.
- Bottom up process that involved the community at multiple stages.

Linda Tacconi (Chair)

Max Planck Institute for Extraterrestrial Physics,
Garching, Germany



Christopher Arridge (Co-Chair)

Lancaster University,
United Kingdom



Alessandra Buonanno

Max Planck Institute for Gravitational Physics,
Potsdam, Germany



Mike Cruise

Retired,
United Kingdom



Olivier Grasset

University of Nantes,
France



Amina Helmi

University of Groningen,
The Netherlands



Luciano Iess

Sapienza University of Rome,
Italy



Eiichiro Komatsu

Max Planck Institute for Astrophysics,
Garching, Germany



Jérémy Leconte

CNRS/Bordeaux University,
France



Jorrit Leenaarts

Stockholm University,
Sweden



Jesús Martín-Pintado

Spanish Astrobiology Center (CAB),
Madrid, Spain



Rumi Nakamura

Space Research Institute,
Austrian Academy of Sciences, Austria



Darach Watson

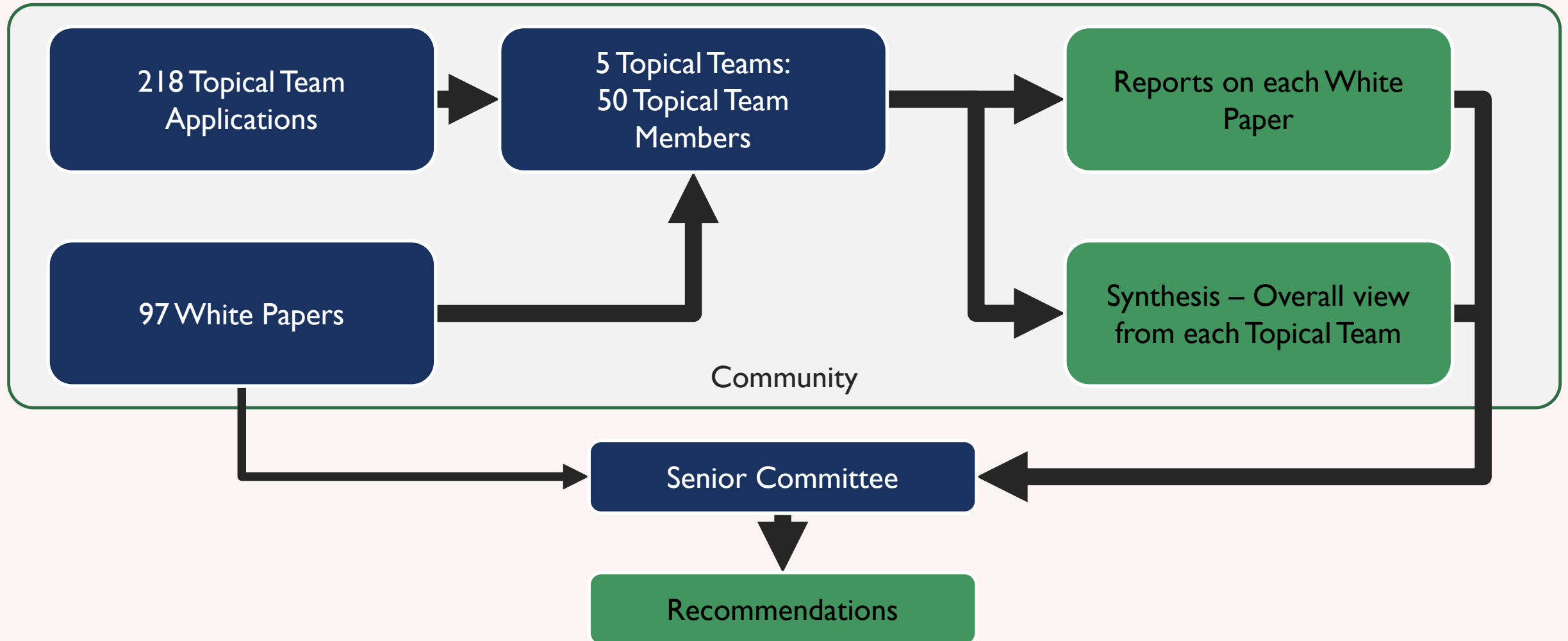
University of Copenhagen
Denmark



Observers: S. Vitale (SPC), J. Zarnecki,
M. Hewitt (SSAC)

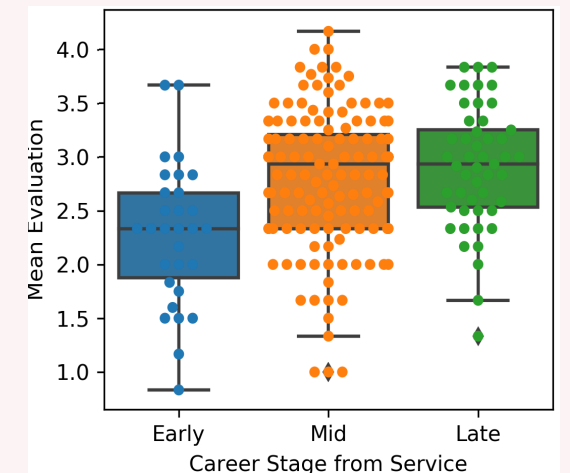
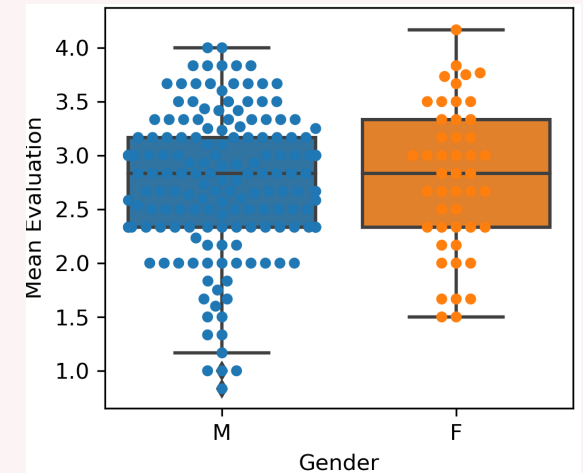
ESA: F. Favata, K. O'Flaherty, L. Colangeli

PROCESS OVERVIEW



TOPICAL TEAMS: A CRUCIAL PART OF THE PROCESS

- Topical Teams: groups of 5-10 experts to help evaluate and synthesise:
 - (1) Solar and Space Plasma Physics
 - (2) **Solar System and Planetary Evolution**
 - (3) Planet, Star and Galaxy Formation and Evolution
- **Connections** between topics were explicitly considered – White Papers were often considered by multiple Topical Teams.
- Open call for Topical Team members: oversubscribed by ×4.
- Applications scored by Senior Committee; scoring and team selection checked for biases in gender, career stage, country and various points in selection.



TOPICAL TEAM 2: SOLAR SYSTEM AND PLANETARY EVOLUTION

- Co-Chairs: Olivier Grasset (Nantes) and Luciano Iess (La Sapienza)
- Members: Feargus **Abernathy** (OU), Benjamin **Charnay** (LESIA), Mohamed **Ramy El-Maarry** (Birkbeck), Jessica **Flahaut** (CNRS), Caroline **Freissinet** (LATMOS), Antonio **Garcia Munoz** (Technical University Berlin), Antonio **Genova** (La Sapienza), Simon **Green** (OU), Benoit **Langlais** (Laboratory of Planetology and Geodynamics), Matteo **Massironi** (Padova), Alessandro **Mura** (INAF), Gabriel **Tobie** (LPG CNRS/Nantes), Josep **Trigo-Rodrigues** (CSIC/IEEC).

LARGE MISSION THEME DOWN-SELECTION

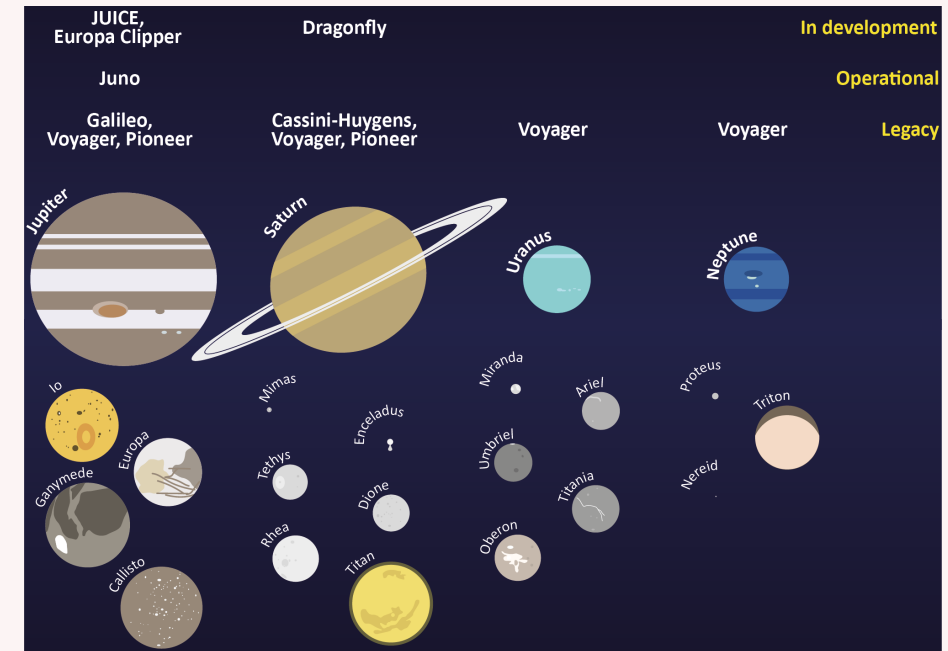
- Input from Topical Teams synthesised into selection of **14 potential Large missions** (flagships).
- Down-selection considered:
 - Scientific excellence
 - Risk of the science being done by other space missions or ground-based facilities.
 - Technological feasibility.
 - Existence of viable mission concepts that could address theme and fit with a Large mission.

MOONS OF THE GIANT PLANETS

SUGGESTED FIRST THEME TO FLY FOLLOWING THE LAUNCH OF LISA IN THE LATE 2030S

- Mission to move beyond discovery/initial exploration to characterisation, addressing:

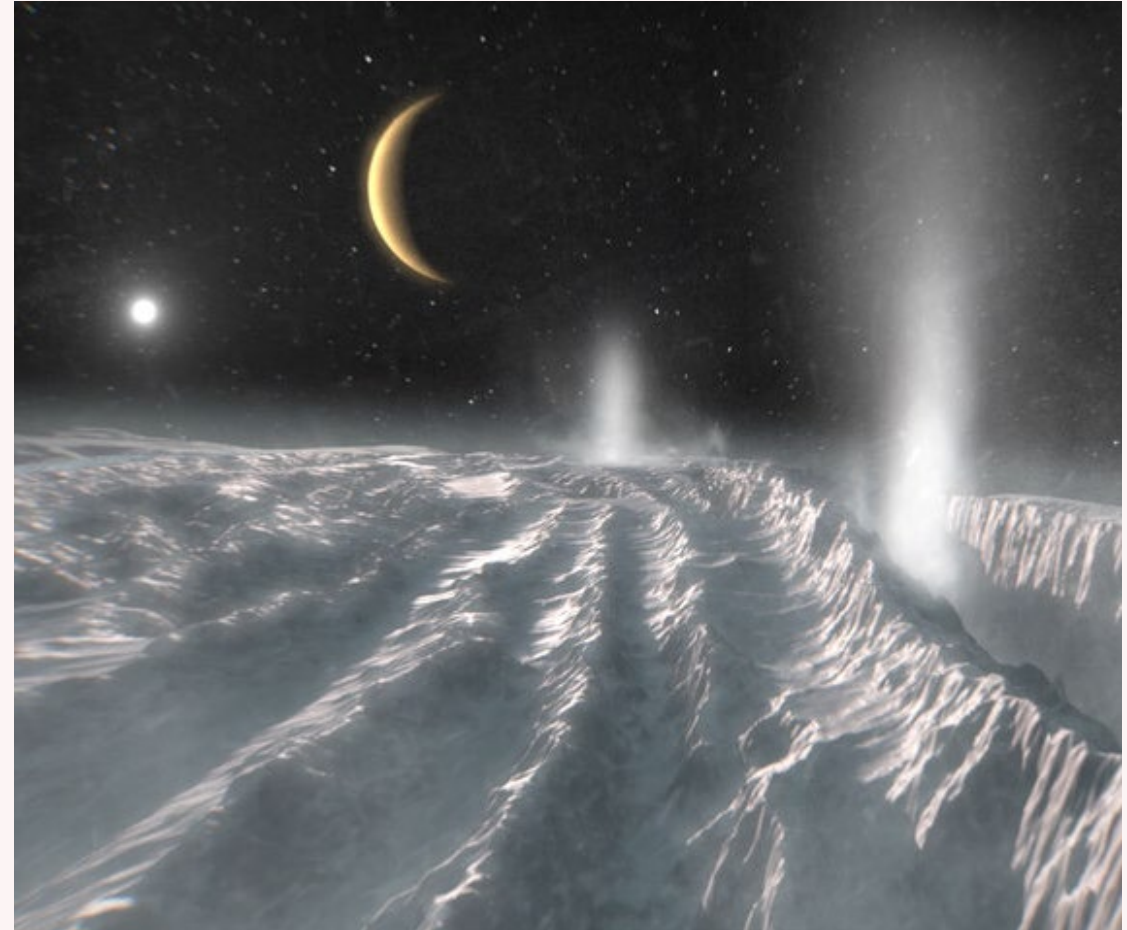
- **Habitability:** characterisation of the interior structure and subsurface oceans with instrumentation; full tomography of the moons' interiors.
- **Biosignatures:** identification of prebiotic chemistry at the surface/in atmospheres/within plumes.
- **Coupling:** connection of interior/near-surface environment; how this is driven by dynamical forcing; exchange of mass/energy.



- Connections to Medium mission recommendations; e.g., **Magnetospheric Systems.**

POSSIBLE CONFIGURATIONS

- The exact configuration and target for such a mission will be developed through an open call.
- Might involve focus on global perspective with single/dual spacecraft with multiple flybys and/or orbit insertions.
- Alternatively, might include in situ elements e.g., landers, drones or sample return.
- Can be shaped by the community and international collaboration.



MEDIUM CONTRIBUTIONS TO INTERNATIONAL MISSIONS

Mission to the Ice Giants

- Mission to Uranus or Neptune with ESA providing a lander or entry probe, for example.
- Examples: *Cassini/Huygens*, *BepiColombo*.

Large space observatories: NASA LUVOIR, Origins, HABEX, or Lynx Concepts

- Contribution to next generation space telescope far beyond Large mission envelope.
- Examples: *Hubble Space Telescope (HST)*, *James Webb Space Telescope (JWST)*.

NASA Interstellar Probe concepts

- Mission to explore interstellar space beyond our Solar System.
- Examples: *SOHO*, *Ulysses* and *Solar Orbiter*.

Missions Focused on Origins of the Solar System

- Returning pristine samples to Earth from comets or sending entry probes to atmospheres of Jupiter or Saturn.

SUMMARY

- Recommendations were adopted by the ESA Science Programme Committee and are now officially part of ESA's Science Programme.
- **Moons of the Giant Planets** looks set to be the first Large mission in the Programme but exact configuration/scientific goals will be subject to an open call.
- Identified numerous themes that were not compatible with the Large mission envelope – potential for international collaboration explicitly identified – encourage OPAG to examine these recommendations.
- **Report and White Papers are publicly accessible**; White Papers in the process of being published in special volumes of Experimental Astronomy.

<https://www.cosmos.esa.int/web/voyage-2050>

