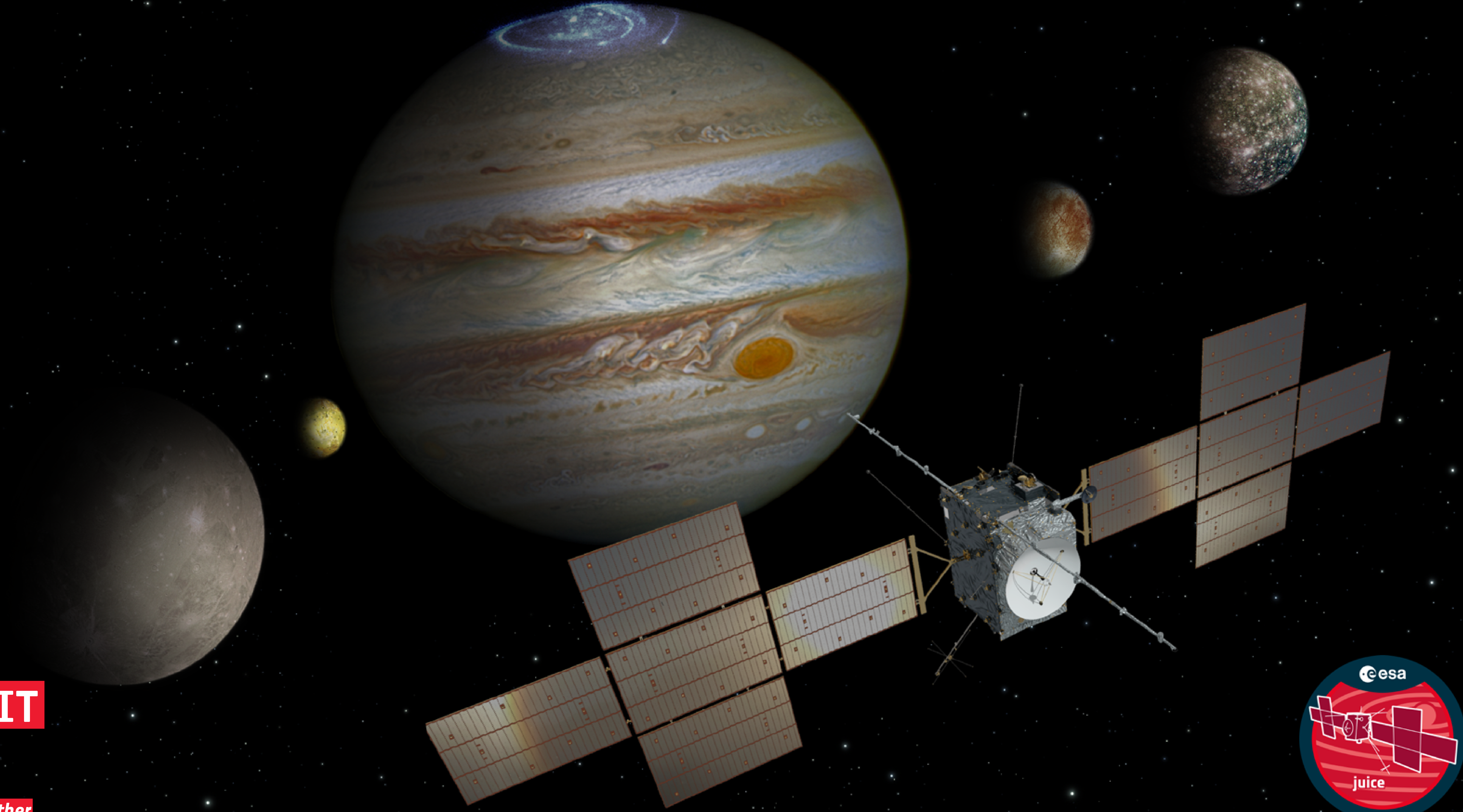


juice

LAUNCH KIT

#ESAJuice #ExploreFarther

JUICE: JUPITER ICY MOONS EXPLORER

ESA's Jupiter Icy Moons Explorer, Juice, will make detailed observations of the giant gas planet and its three large ocean-bearing moons – Callisto, Europa and in particular Ganymede – with a suite of ten unique science instruments, one experiment and one radiation monitor.

The mission will characterise these moons as both planetary objects and possible habitats. It will also explore Jupiter's complex environment in depth, and study the wider Jupiter system as an archetype for gas giants across the Universe.

Juice will complete a number of Solar System firsts. It will be the first spacecraft ever to orbit a moon other than our own – Jupiter's largest moon Ganymede. And en route to Jupiter it will perform the first ever lunar-Earth gravity assist to save propellant.

Juice will be the last ESA mission to launch on an Ariane 5 from ESA's Spaceport in Kourou, before Ariane 6 takes over.

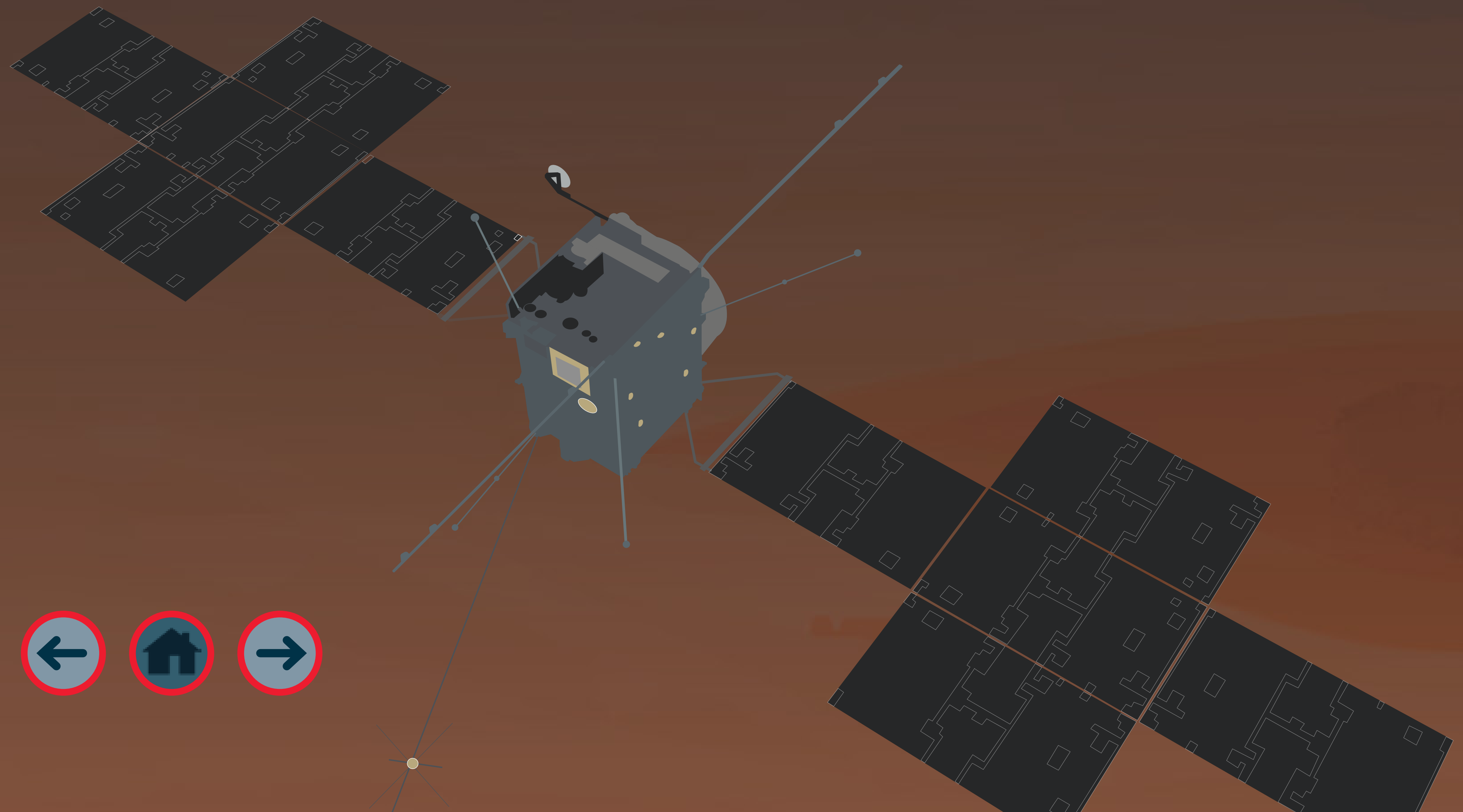
ABOUT THIS MEDIA KIT

This is an **interactive media kit**. Navigate between pages from the contents page or with the arrows at the bottom of each page.

Explore scientific and technological themes of the Juice mission through the series of infographics. **Roll over** the graphic elements to discover **hyperlinks** to more information on related webpages.

Click on the symbol to directly access the infographic download page. Links to recommended images, videos and animations are provided towards the end of this media kit.

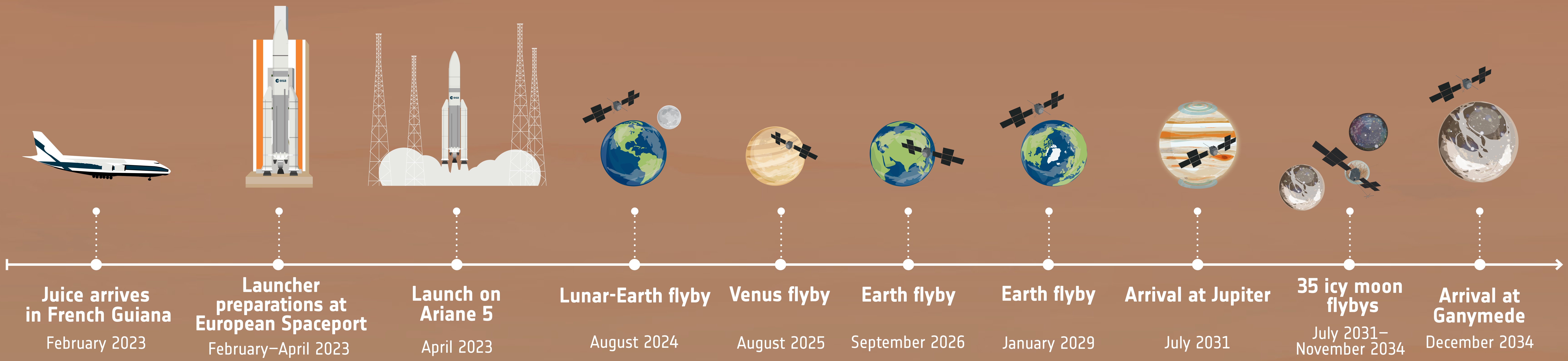
An internet connection is required to access the external webpages.



CONTENTS

JUICE MISSION MILESTONES

The main Juice mission milestones are listed below. Dates are approximate and more information will be provided via ESA's website (esa.int) and social media channels (Twitter: @ESA_JUICE) once details are confirmed.



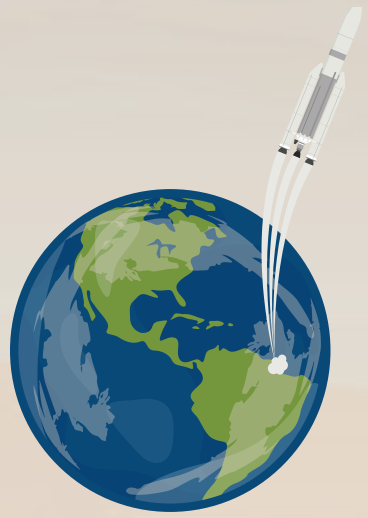
JUICE IN A NUTSHELL

Juice is an ESA-led mission

NASA has contributed one instrument (UVS) and hardware for two European-provided instruments (RIME, PEP)

JAXA has contributed hardware for various European-provided instruments (RPWI, GALA, PEP)

ISA has contributed hardware for one European-provided instrument (3GM)



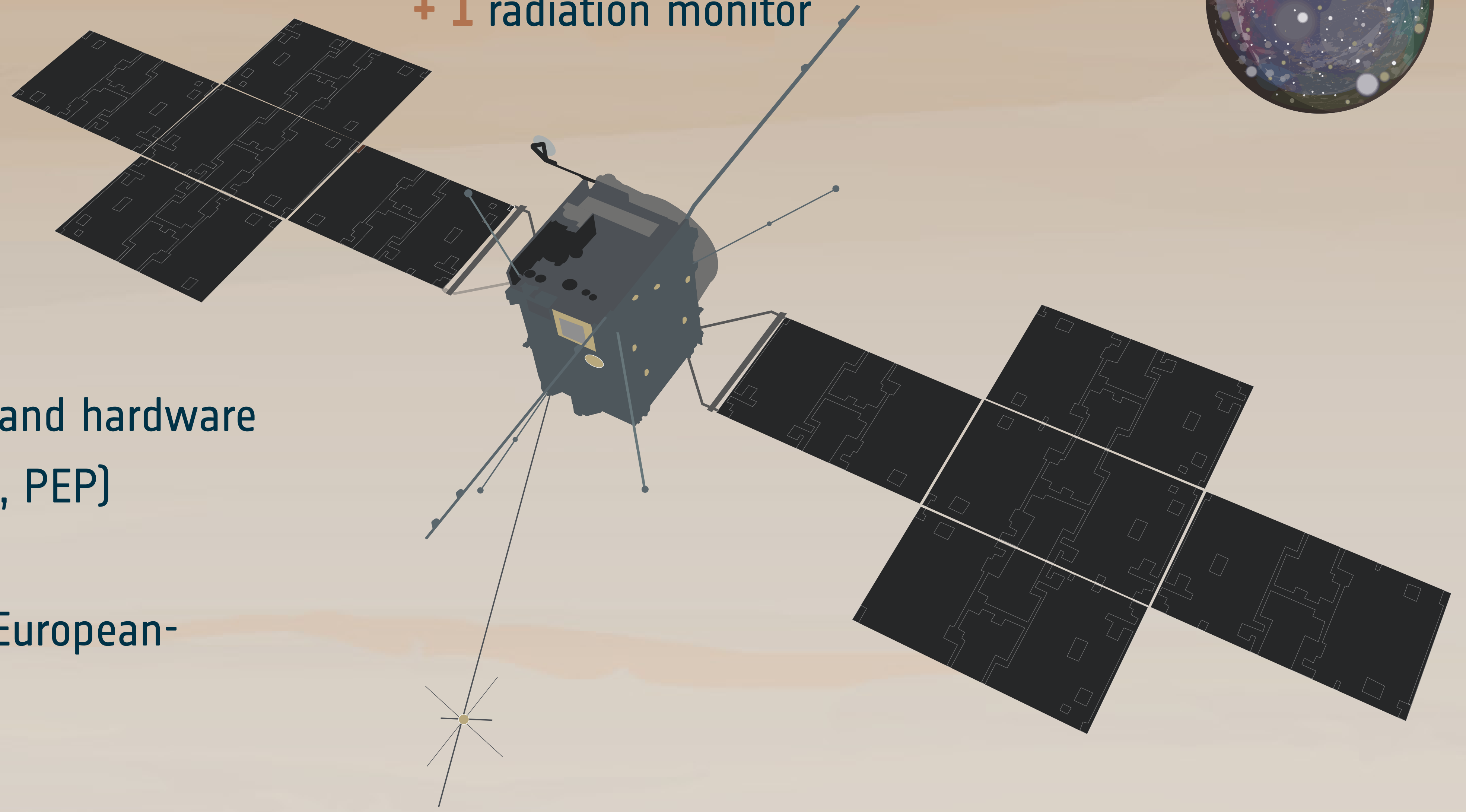
Juice will reach space on an **Ariane 5** from Europe's Spaceport in **French Guiana**

10

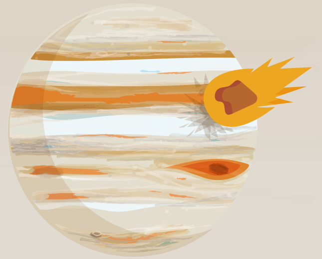
science instruments

+ 1 experiment

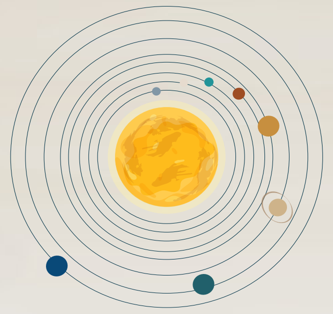
+ 1 radiation monitor



Juice will address two key themes of **ESA's Cosmic Vision 2015–2025**:



What are the conditions for planet formation and the emergence of life?

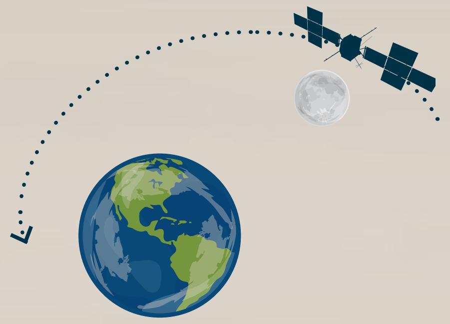


How does the Solar System work?

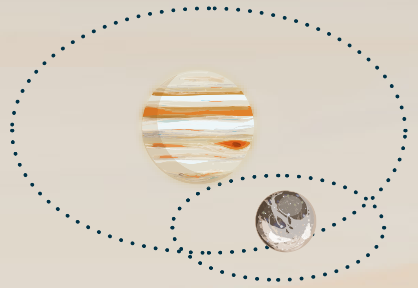
Juice will:

- Explore Jupiter's icy moons – in particular huge, magnetised, water-rich Ganymede
- Investigate Jupiter's complex environment in depth
- Study the Jupiter system as an archetype for gas giants across the Universe

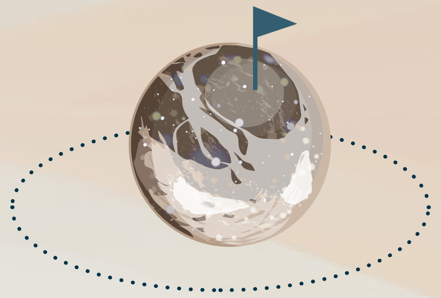
Juice will be the **first spacecraft** to:



- Perform a lunar-Earth gravity assist



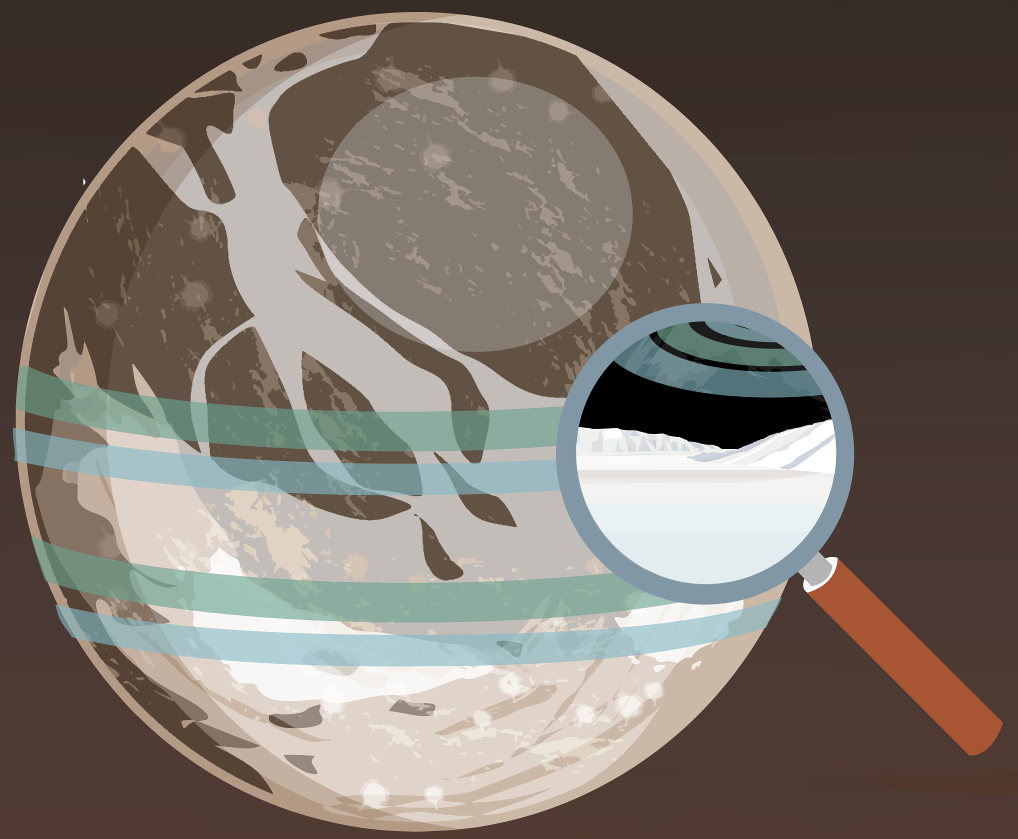
- Change orbit from another planet to one of its moons (Jupiter to Ganymede)



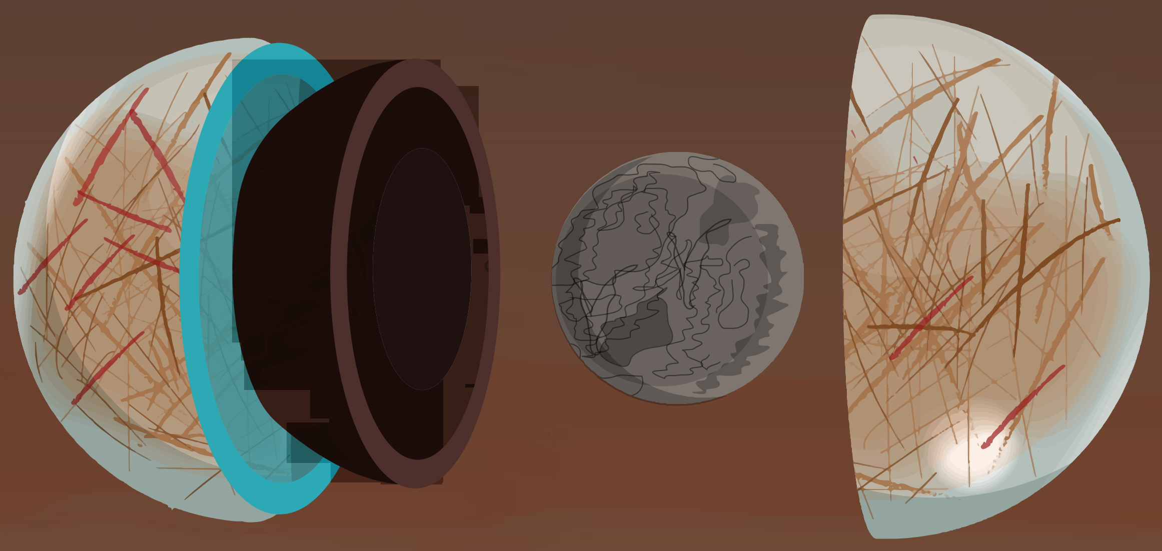
- Orbit a moon other than our own

JUICE SCIENCE: FIVE MYSTERIES JUICE WILL ADDRESS

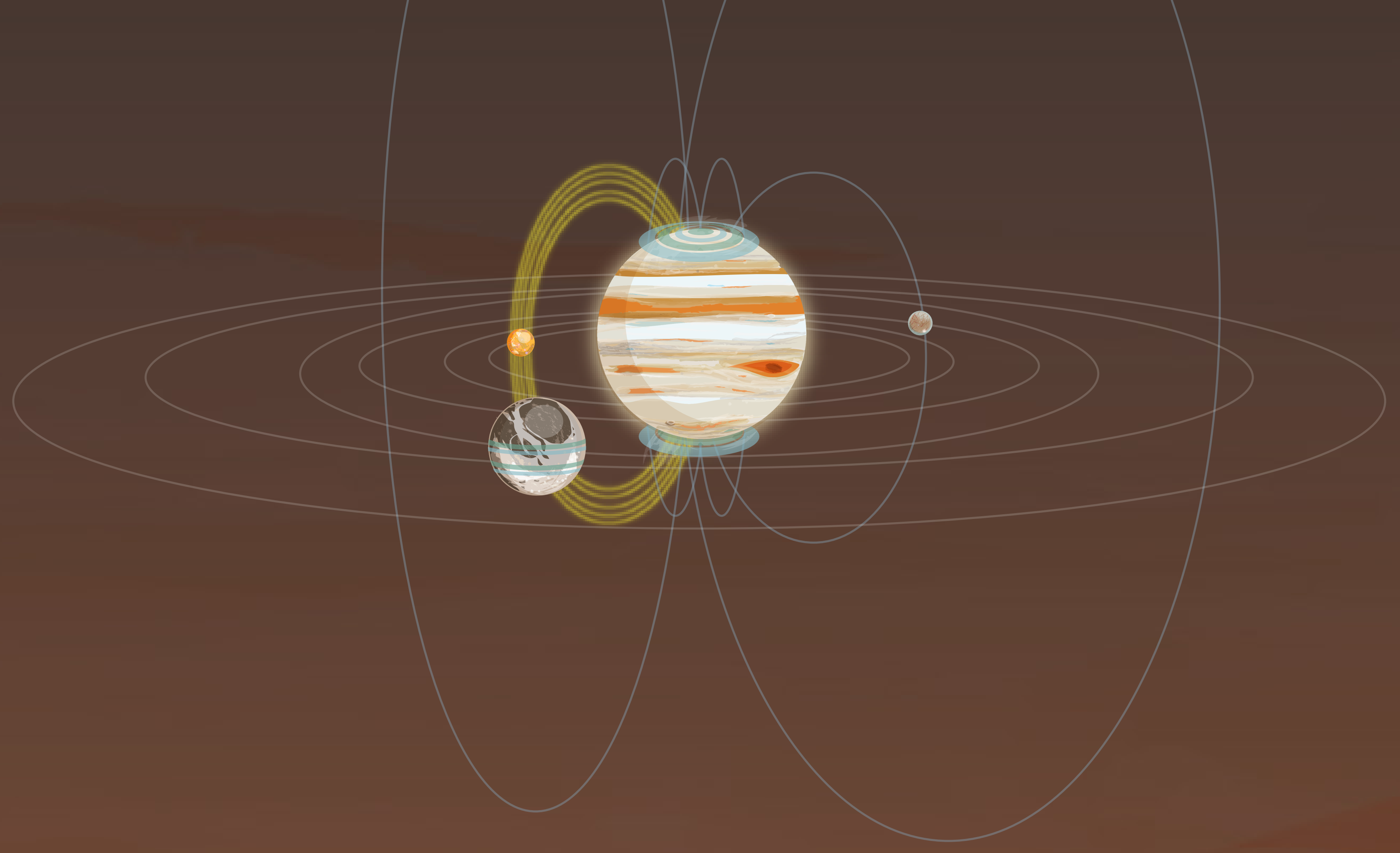
Why is Ganymede so unique?



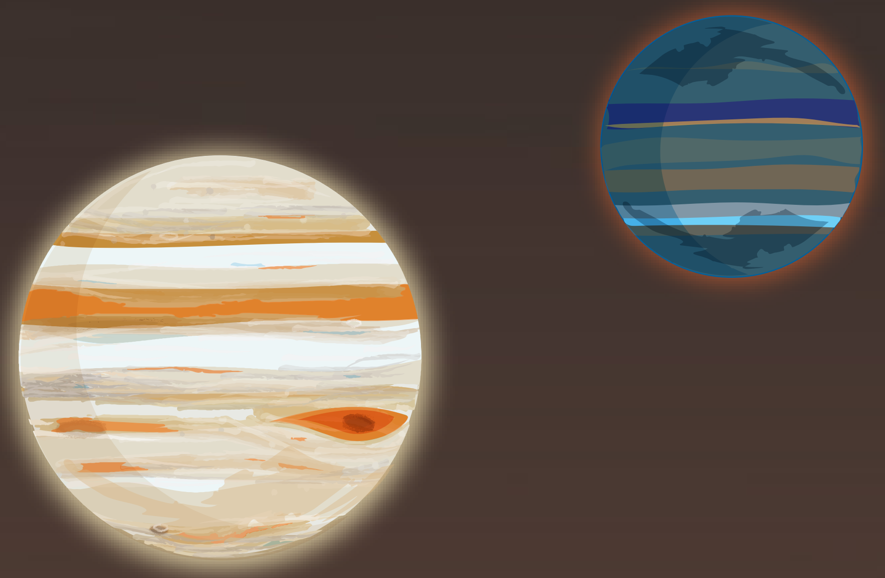
What are ocean worlds like?



How has Jupiter's complex environment shaped its moons, and vice versa?



What is a typical gas giant planet like – how did it form, and how does it work?



Could there be – or ever have been – life in the Jupiter system?

JUICE SCIENCE: JUPITER'S ICY MOONS

Jupiter's three large icy moons are thought to harbour oceans of liquid water beneath their icy crusts. Juice will explore these fascinating worlds and investigate whether life ever emerged in these oceans.

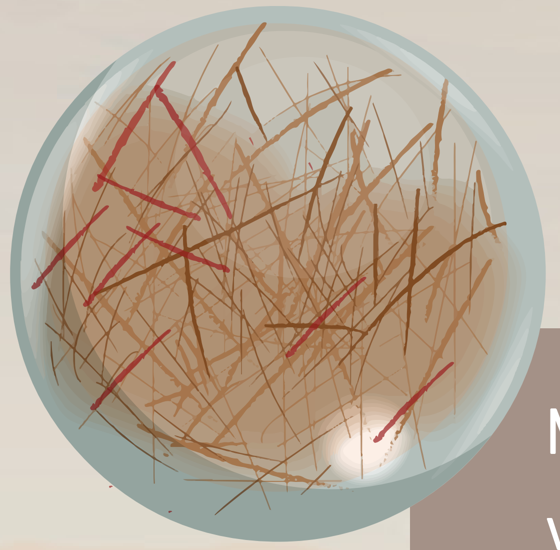
EUROPA

Surface: young, active

Juice flybys: 2

Juice's closest approach: 400 km

Juice's main goals: searching for biosignatures and pockets of water; exploring geology, surface, subsurface, activity, environment



May vent water vapour to space via 'plumes' and geysers

Only moon in the Solar System to generate its own magnetic field

GANYMEDE

Surface: varying, offering a geological record spanning billions of years

Juice flybys: 12

Juice's closest approach: 400 km during flybys, 500 km whilst in orbit (potentially aiming for 200 km)

Juice's main goals: exploring magnetic field, hidden ocean, complex core, ice content, shell, interaction with Jupiter, past and present activity, habitability

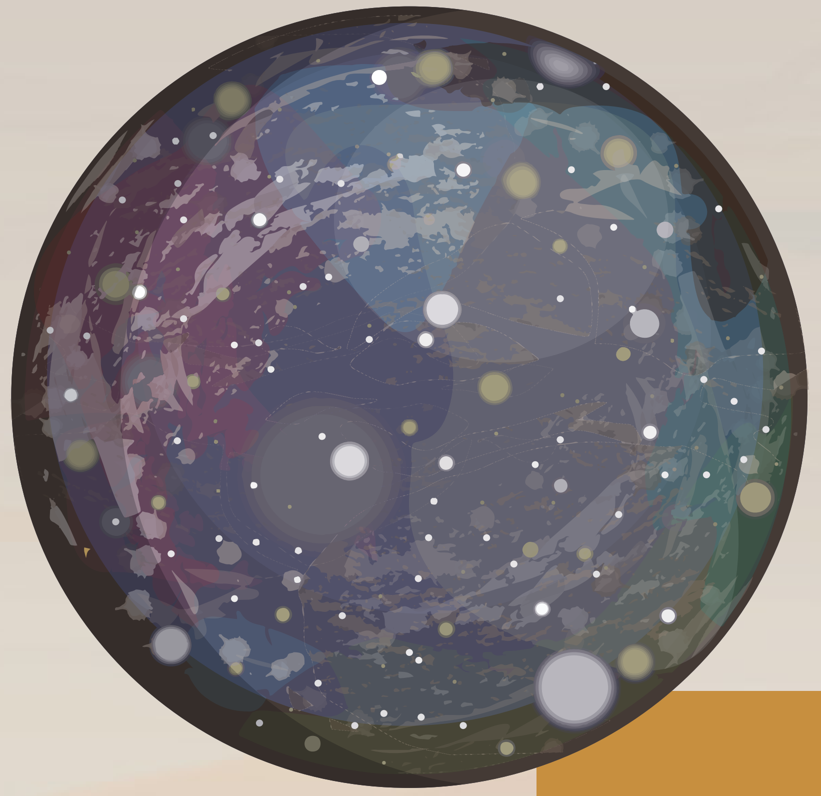
CALLISTO

Surface: oldest in Solar System, heavily cratered and inactive, remnant of the early Jovian system

Juice flybys: 21

Juice's closest approach: 200 km

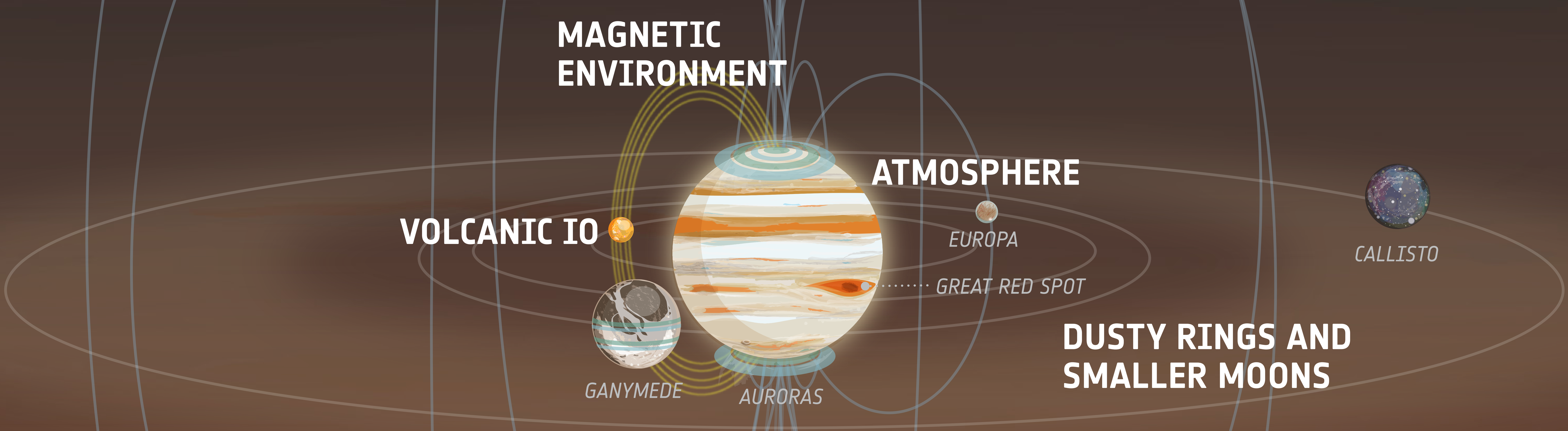
Main goals: glimpsing the environment around early Jupiter



May contain a salty subsurface ocean

JUPITER AND ITS COMPLEX ENVIRONMENT 1/2

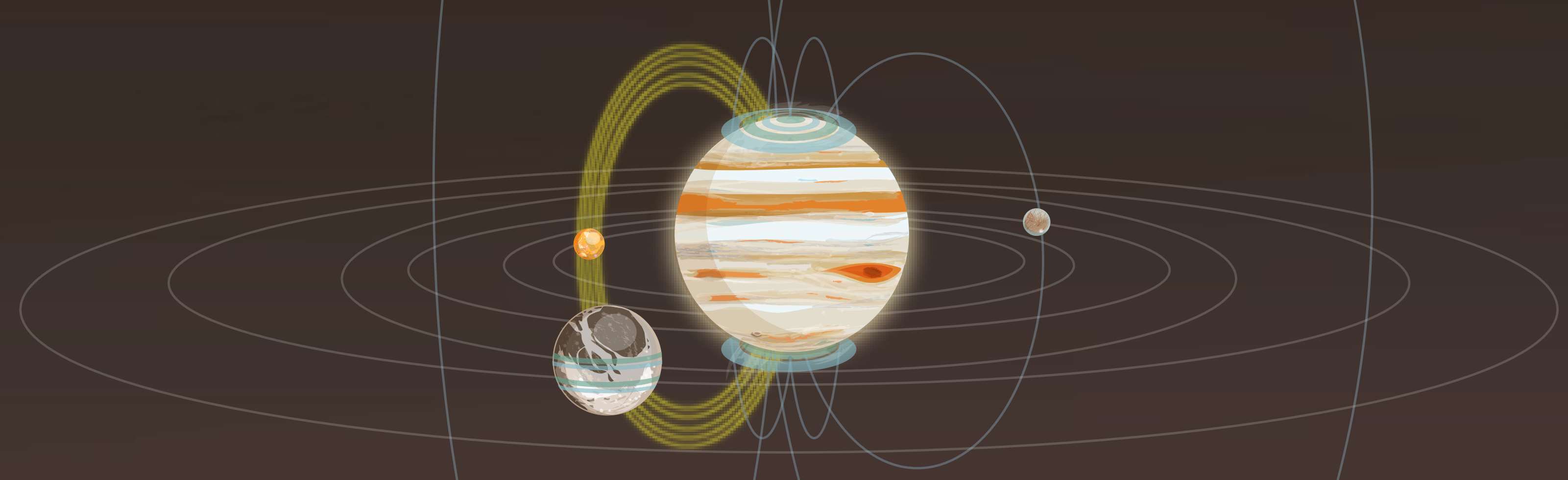
An investigation into how life-friendly worlds form around gas giants would be incomplete without also studying Jupiter's turbulent atmosphere, its enormous magnetic field, and the dusty rings and myriad smaller moons that orbit the planet. The following page gives the main questions that Juice seeks to answer about these parts of the Jovian system.



JUPITER AND ITS COMPLEX ENVIRONMENT 2/2

ATMOSPHERE

- How do temperatures, wind patterns and chemistry vary over time in Jupiter's upper atmosphere?
- How do waves, energy and material move between Jupiter's lower, middle and upper atmosphere?
- Why is the Great Red Spot shrinking, what does its future look like, and what chemical processes are taking place inside it?
- How does Jupiter's atmosphere respond to impacts from asteroids and comets?

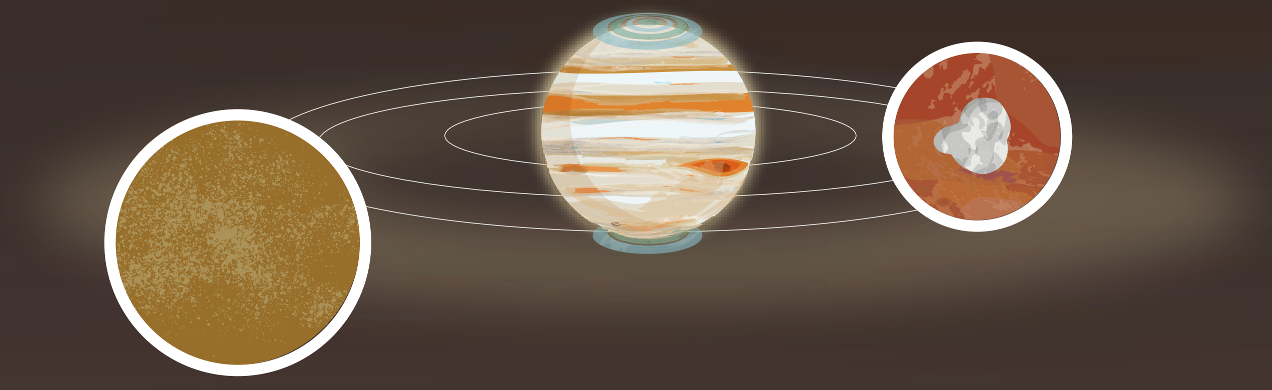


MAGNETIC ENVIRONMENT

- What can Jupiter's auroras tell us about how the planet's atmosphere and magnetic field interact?
- How does Jupiter's mighty magnetic field shape conditions on the icy moons?
- What can the acceleration of particles in Jupiter's magnetic field teach us about fundamental physics?
- How does Jupiter's magnetic field move sulphur and oxygen released by volcanoes on Jupiter's moon Io to the three icy moons?

VOLCANIC IO

- What is Io's surface made of?
- What is volcanic activity like on the most active body in the Solar System?
- How does the moon's intense volcanic activity shape Jupiter's plasma environment?
- Why is there such a stable relationship between the orbits of Ganymede, Europa and Io (1:2:4 ratio of orbital periods)?



DUSTY RINGS AND SMALLER MOONS

- How old are the rings, and are they continuously being replenished?
- What are the rings made of, and does the material come from the smaller moons?
- How and where did Jupiter's smaller moons form?
- How have the orbits of the smaller moons changed over time?

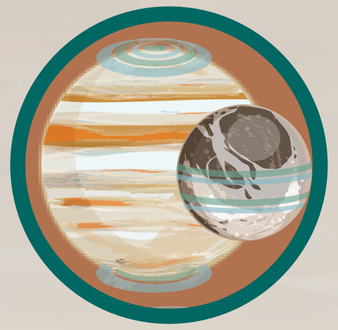
JUICE'S SCIENCE INSTRUMENTS

Juice will carry ten state-of-the-art instruments, including the most powerful remote sensing, geophysical and in situ payloads ever flown to the outer Solar System. Nine of the instruments are led by European partners, and one by NASA. Juice also includes an experiment called PRIDE, which will perform precise measurements using radio telescopes on Earth.

● In situ instruments ● Remote sensing instruments ● Geophysical instruments ● Experiment

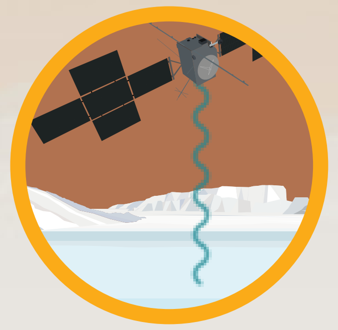
Optical camera system (JANUS)

Visible and infrared imaging spectrometer (MAJIS)

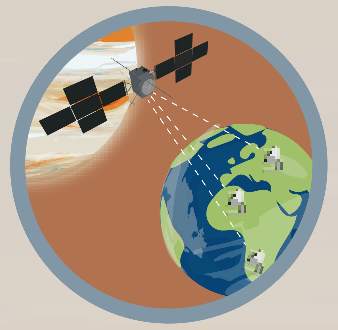


UV imaging spectrograph (UVS)

Sub-millimetre wave instrument (SWI)

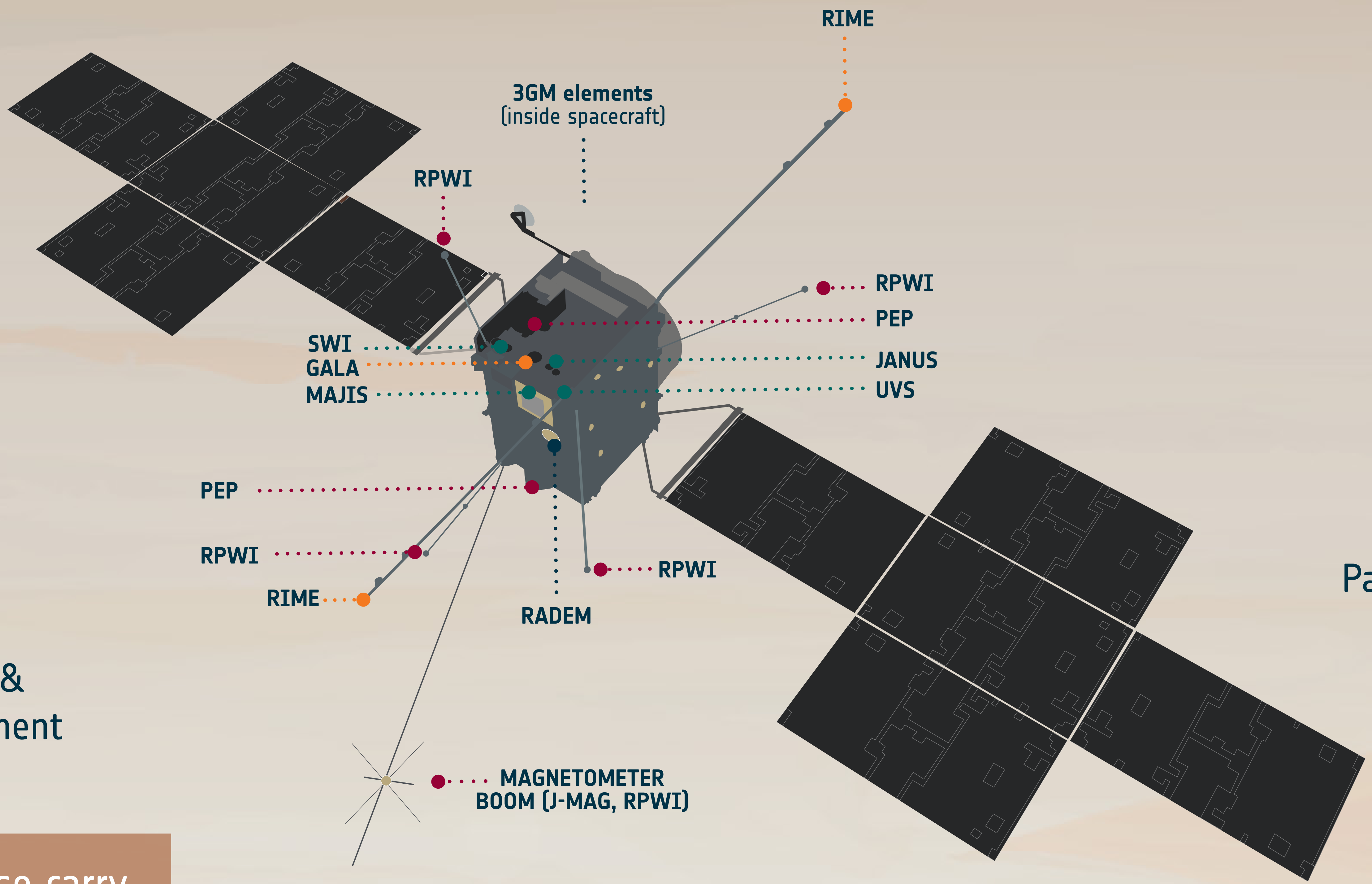


Radar sounder (RIME)

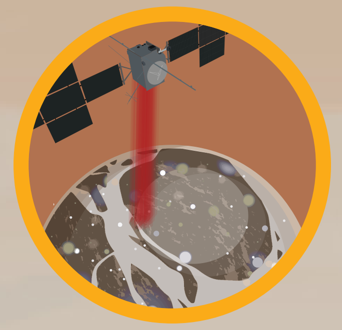


Planetary Radio Interferometer & Doppler Experiment (PRIDE)

Juice will also carry a radiation monitor (RADEM)

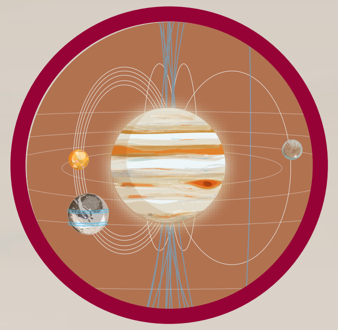


Laser altimeter (GALA)

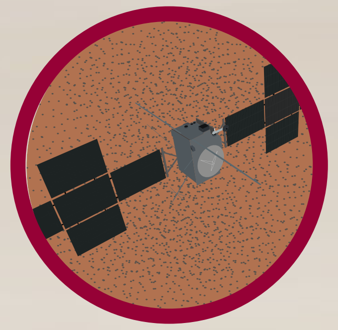


Radio science experiment (3GM)

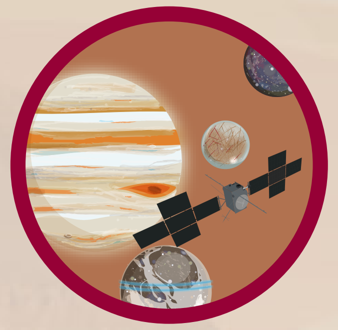
Magnetometer (J-MAG)



Particle environment package (PEP)

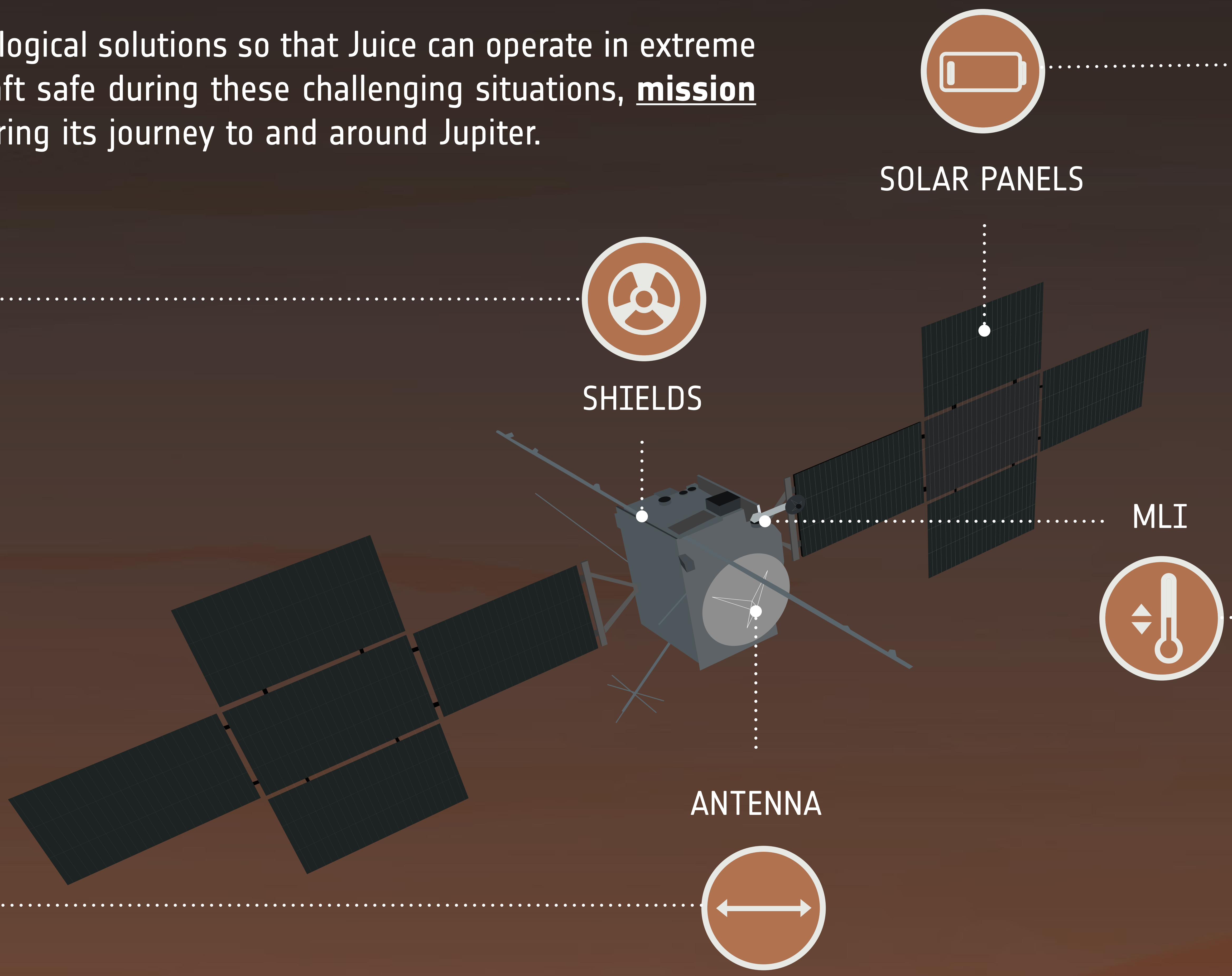


Radio and plasma wave instrument (RPWI)



OPERATING IN AN EXTREME ENVIRONMENT

Engineers have devised advanced technological solutions so that Juice can operate in extreme environments. To help keep the spacecraft safe during these challenging situations, **mission controllers** will constantly monitor it during its journey to and around Jupiter.



HIGH RADIATION

Challenge: One of the most intense radiation environments in the Solar System

Solution: Shields to protect sensitive electronics

LONG DISTANCE

Challenge: Hundreds of millions of kilometres from Earth

Solution: A 2.5-m antenna to send data back home, and a powerful onboard computer that solves some problems independently

LOW POWER

Challenge: Sunlight 25 times weaker than on Earth

Solution: Solar panels with an area of 85 m^2 to collect lots of light

HARSH TEMPERATURES

Challenge: +250°C during Venus flyby, -230°C at Jupiter

Solution: A blanket of novel Multi-Layer Insulation (MLI) to keep the internal temperature stable

MISSIONS TO JUPITER

JUPITER ORBITERS

- Galileo (1995–2003)
- Juno (2016–present)
- Europa Clipper (2030–2035)
- Juice (2031–2035)

JUPITER FLYBYS

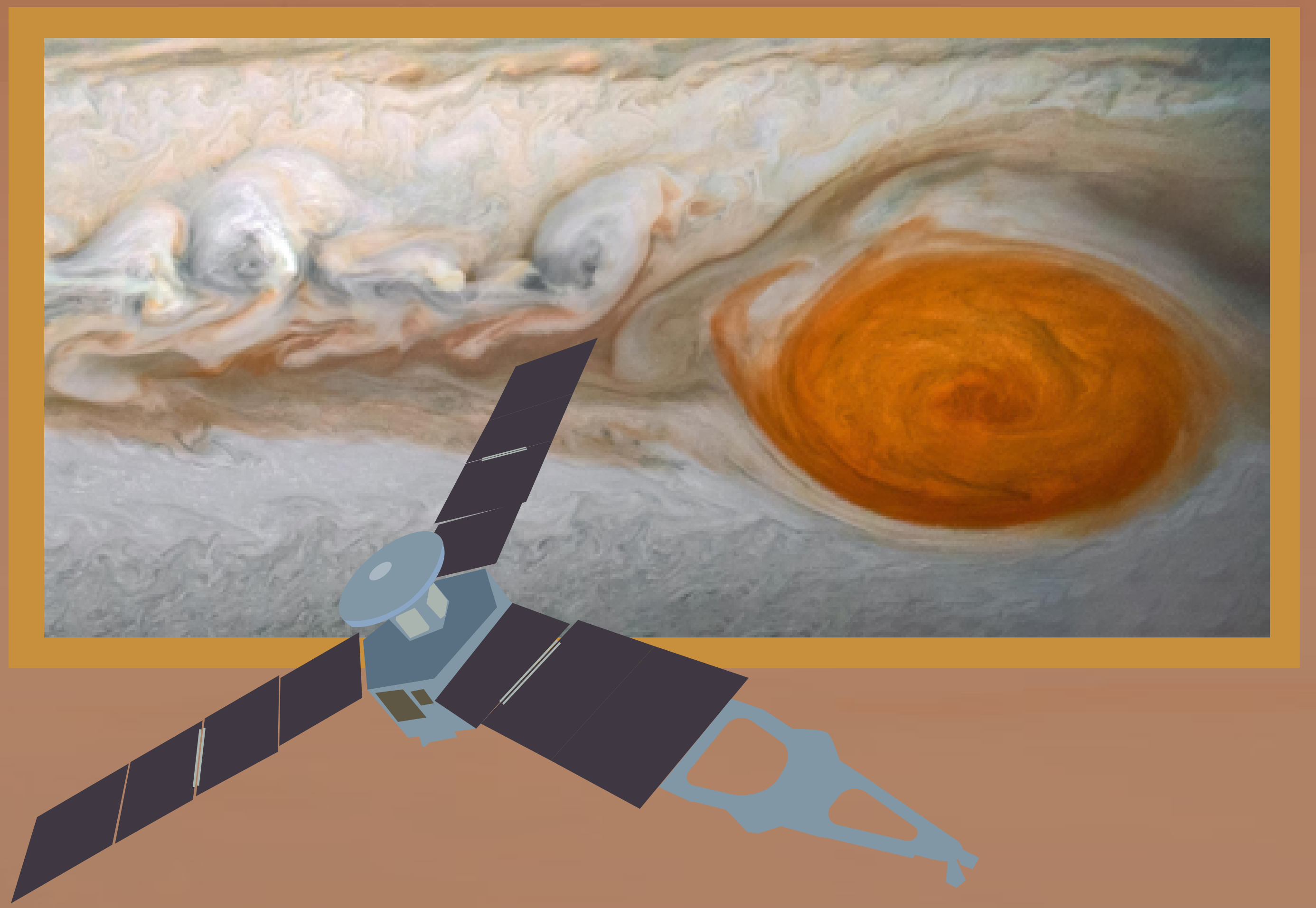
- 1973 Pioneer 10
- 1974 Pioneer 11
- 1979 Voyager 1
- Voyager 2
- 1992 Ulysses
- 2000 Cassini-Huygens
- 2007 New Horizons

ESA missions

NASA missions

A TRIO OF MISSIONS: JUNO, JUICE AND EUROPA CLIPPER

Their destination may be the same, but Juno, Juice and Europa Clipper are all unique missions with different goals and instruments. Juno's discoveries are being used to optimise plans for Juice and Europa Clipper.

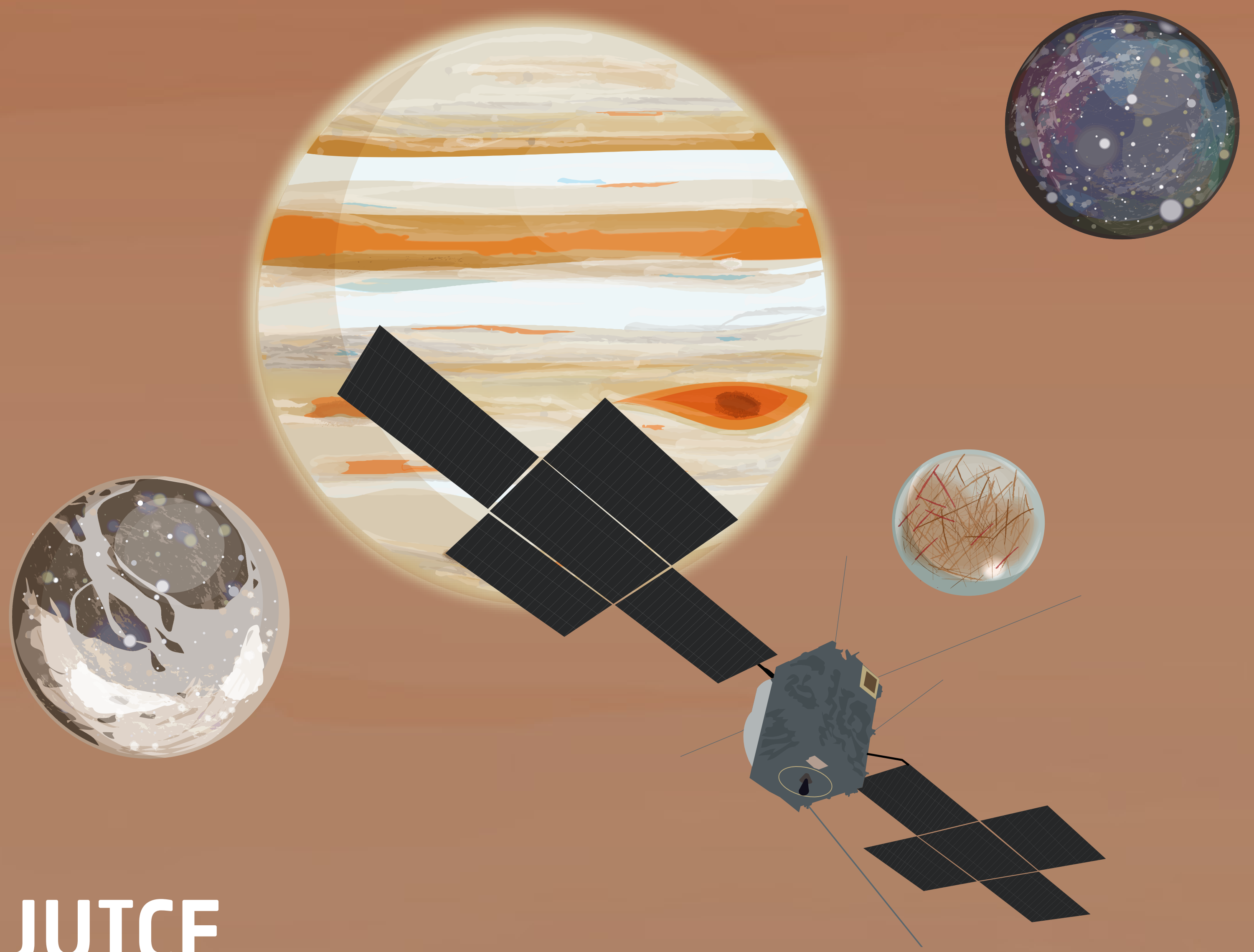


JUNO

Target: Jupiter

Arrival: 2016

Special skill: a polar orbit that goes very close to Jupiter, allowing deep mapping of its gravity and magnetic fields

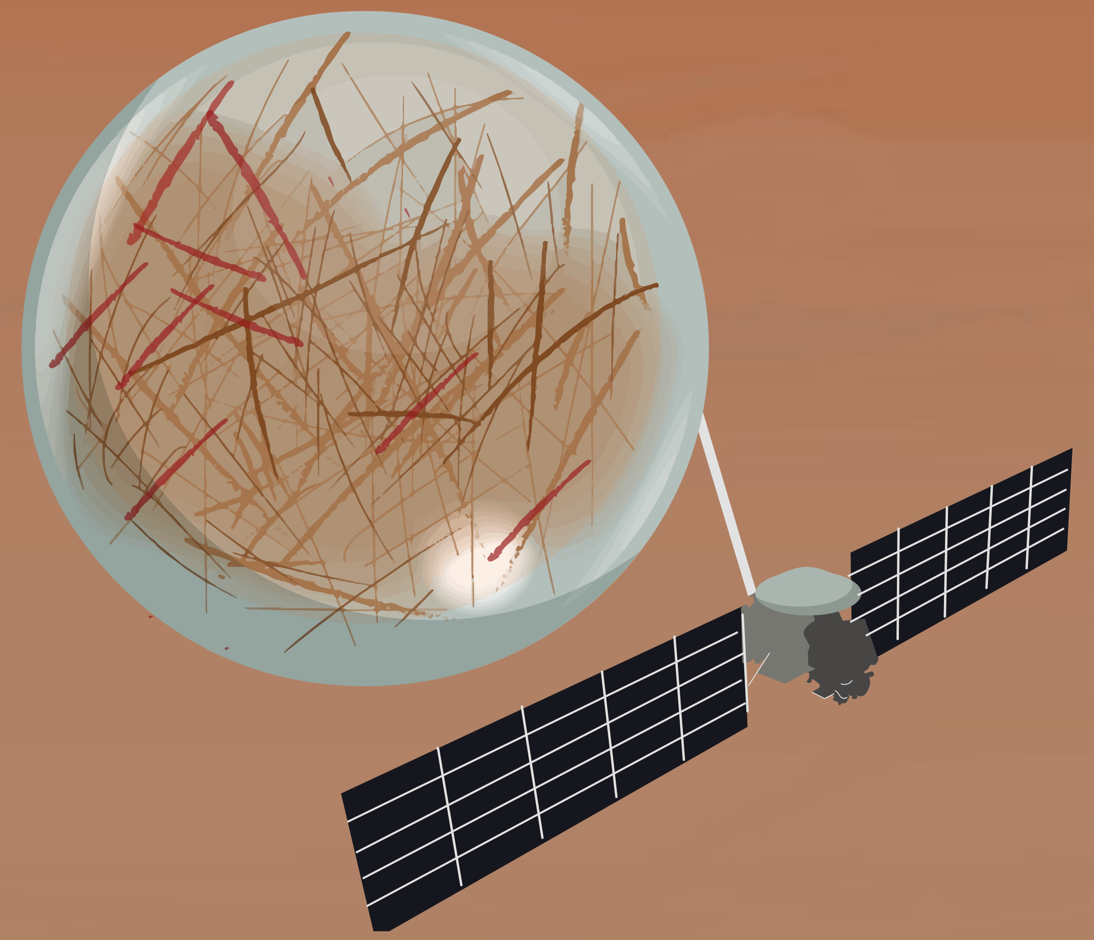


JUICE

Targets: Jupiter, Ganymede, Europa, Callisto

Arrival: 2031

Special skill: observing Jupiter and its icy moons to provide a complete view of habitable conditions in the Jovian system



EUROPA CLIPPER

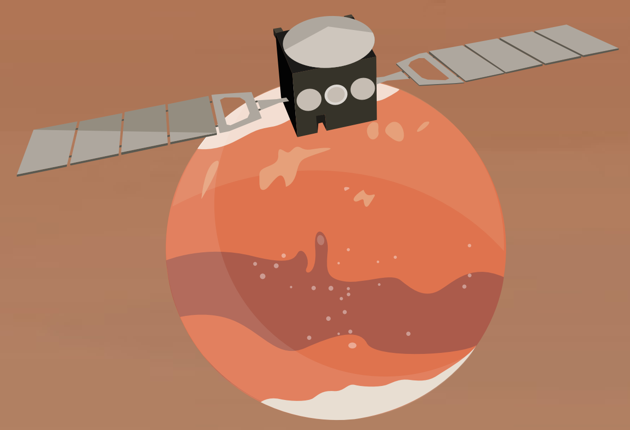
Target: Europa

Arrival: 2030

Special skill: investigating the potential for life on Europa; helping select a landing site for a future Europa lander

JUICE'S LEGACY

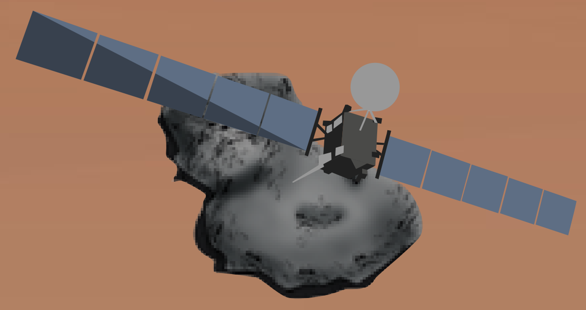
Juice builds on scientific and technological heritage from previous planetary science missions and will pave the way for future exploration of the outer Solar System.



Mars Express
2003–present

Smart-1
2003–2006

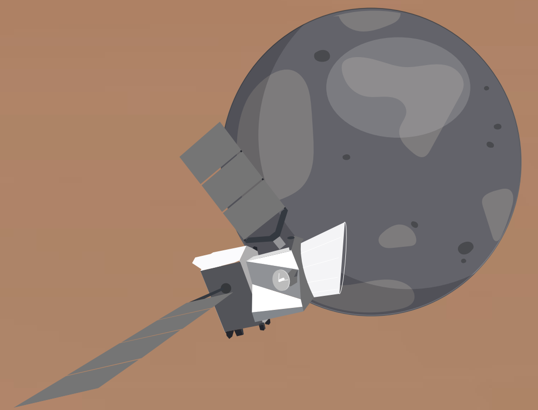
Venus Express
2005–2014

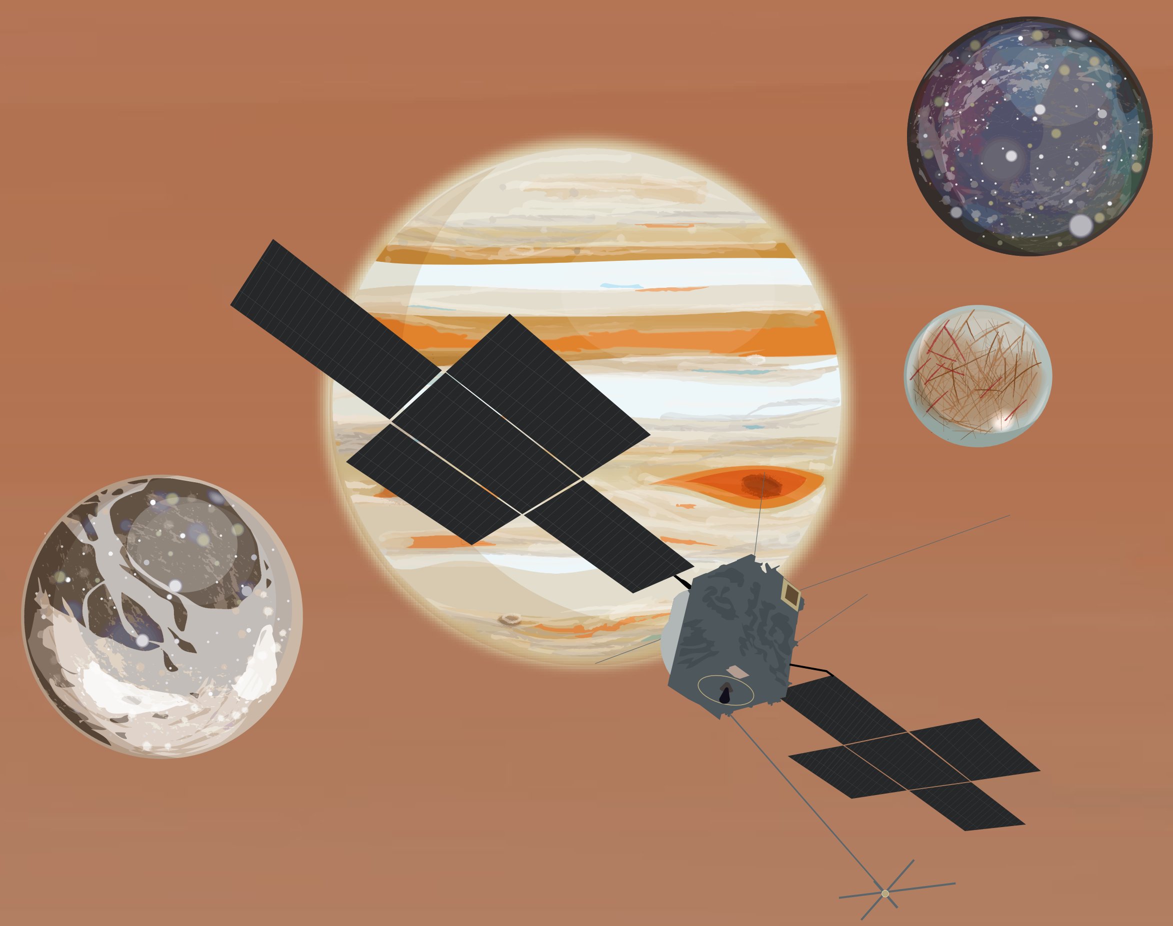


Rosetta
2004–2016

ExoMars Trace Gas Orbiter
2016–present

BepiColombo
2018–present

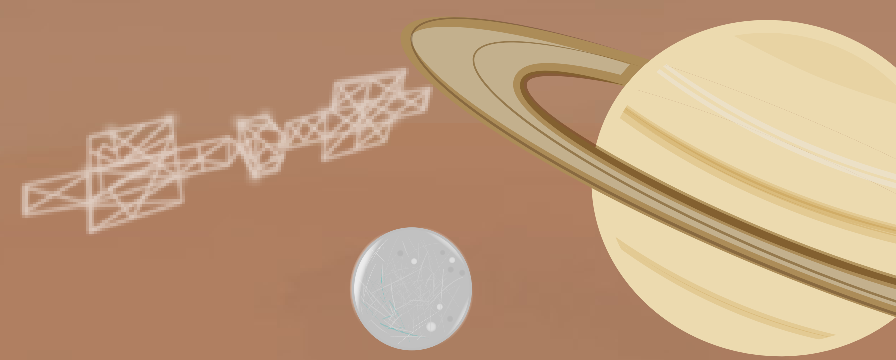




Juice
2023–2035

Icy moons mission
?

Icy Moons Sample Return
?

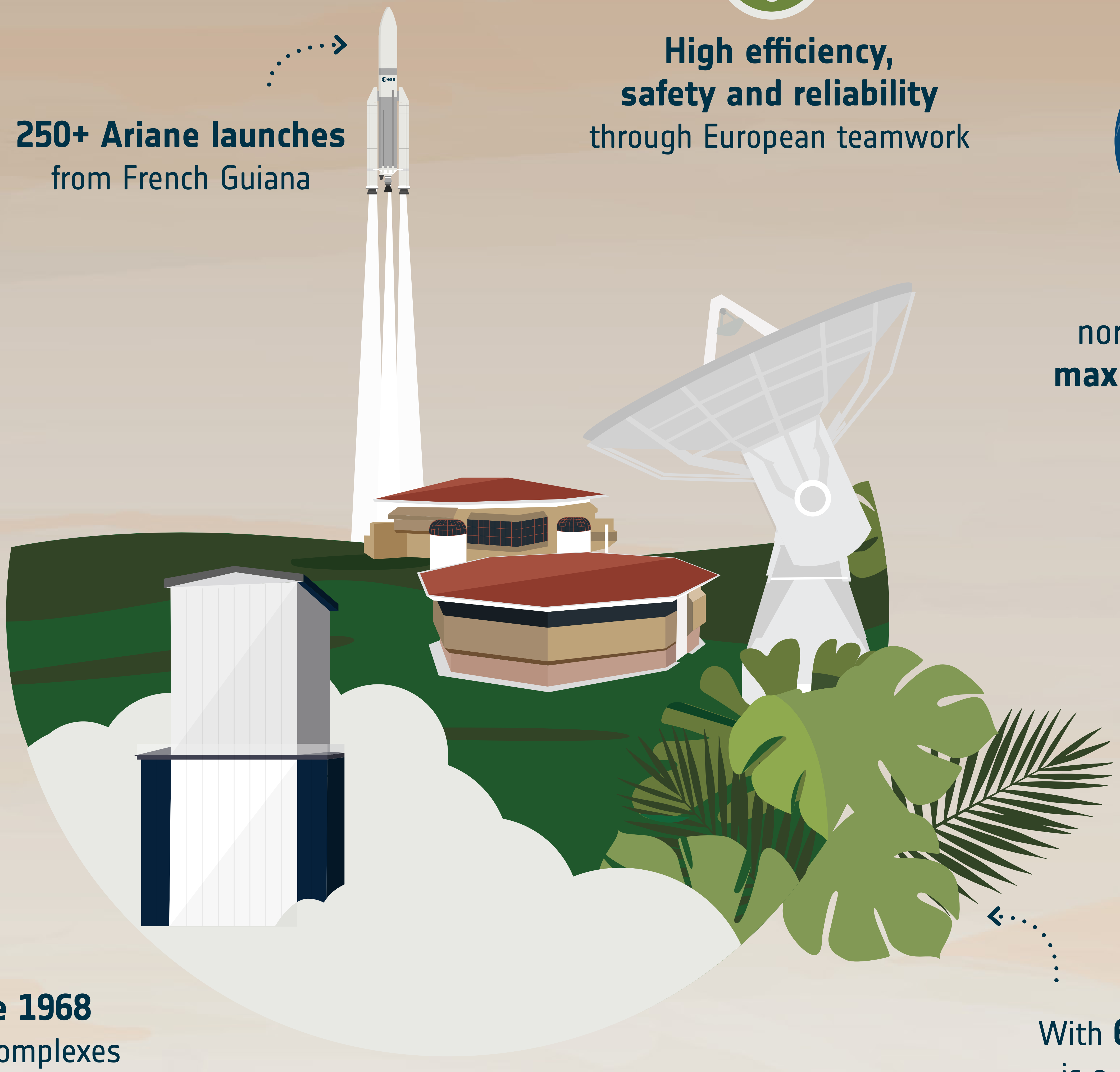


Juice will push beyond the capabilities of previous missions like **NASA's Galileo (1989–2003)** and **NASA/ESA/ASI Cassini-Huygens (1997–2017)**, and directly complement the results of **NASA's Juno (2011–)** and **Europa Clipper (2024–)** missions.

ARIANE 5'S LEGACY OF LAUNCHING SCIENCE MISSIONS

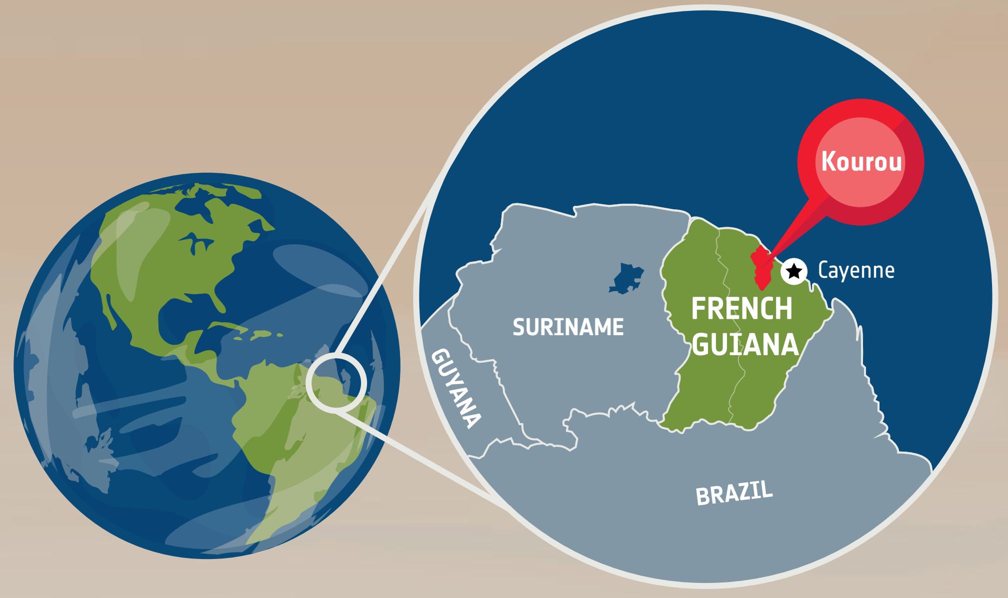
In operation since 1996, Ariane 5 has launched many ESA space science missions.
Juice will be the last ESA mission to launch on an Ariane 5 before Ariane 6 takes over.

EUROPE'S SPACEPORT: AN IDEAL LAUNCH SITE



250+ Ariane launches
from French Guiana

High efficiency,
safety and reliability
through European teamwork



Open sea to the
north and east means
maximum launch safety

Speed of Earth's rotation near
the equator gives **Ariane 5** an
extra boost during launch

No risk of cyclones
or earthquakes

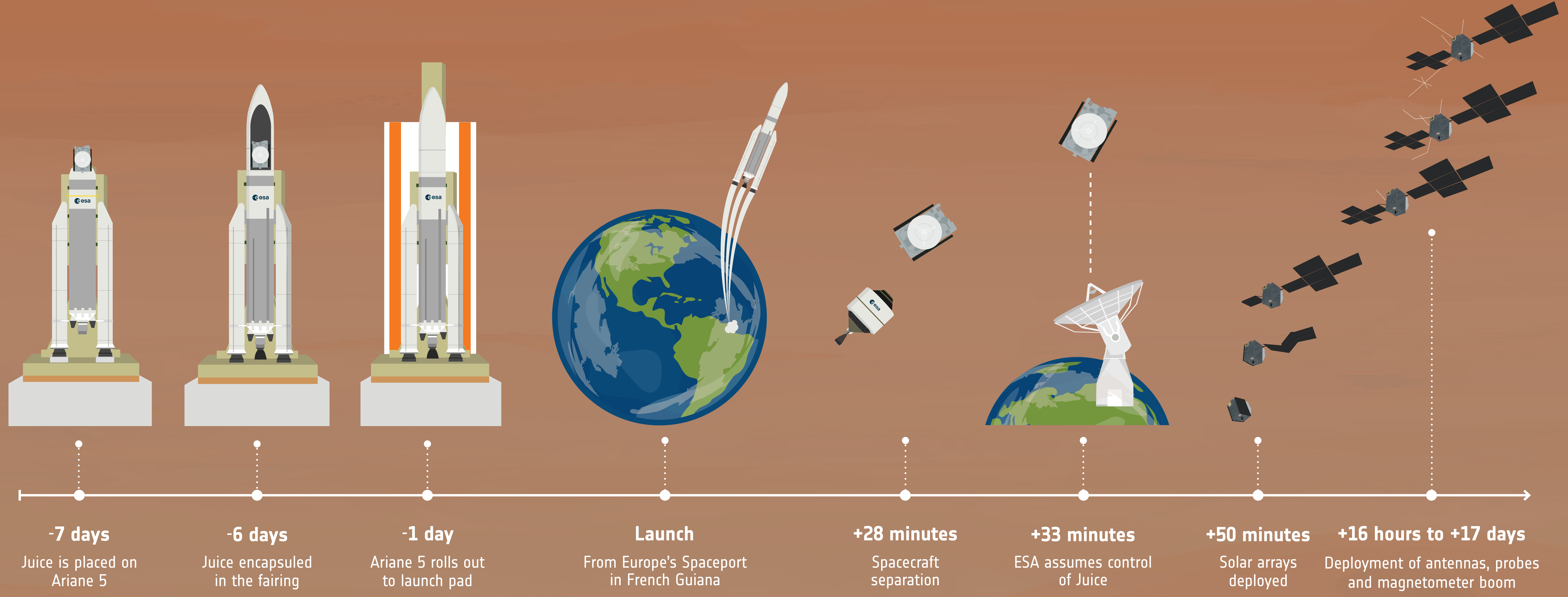
Customers from
all over the world

Working towards
90% renewable energy sources
by the end of 2025

Operational since 1968
with several launch complexes

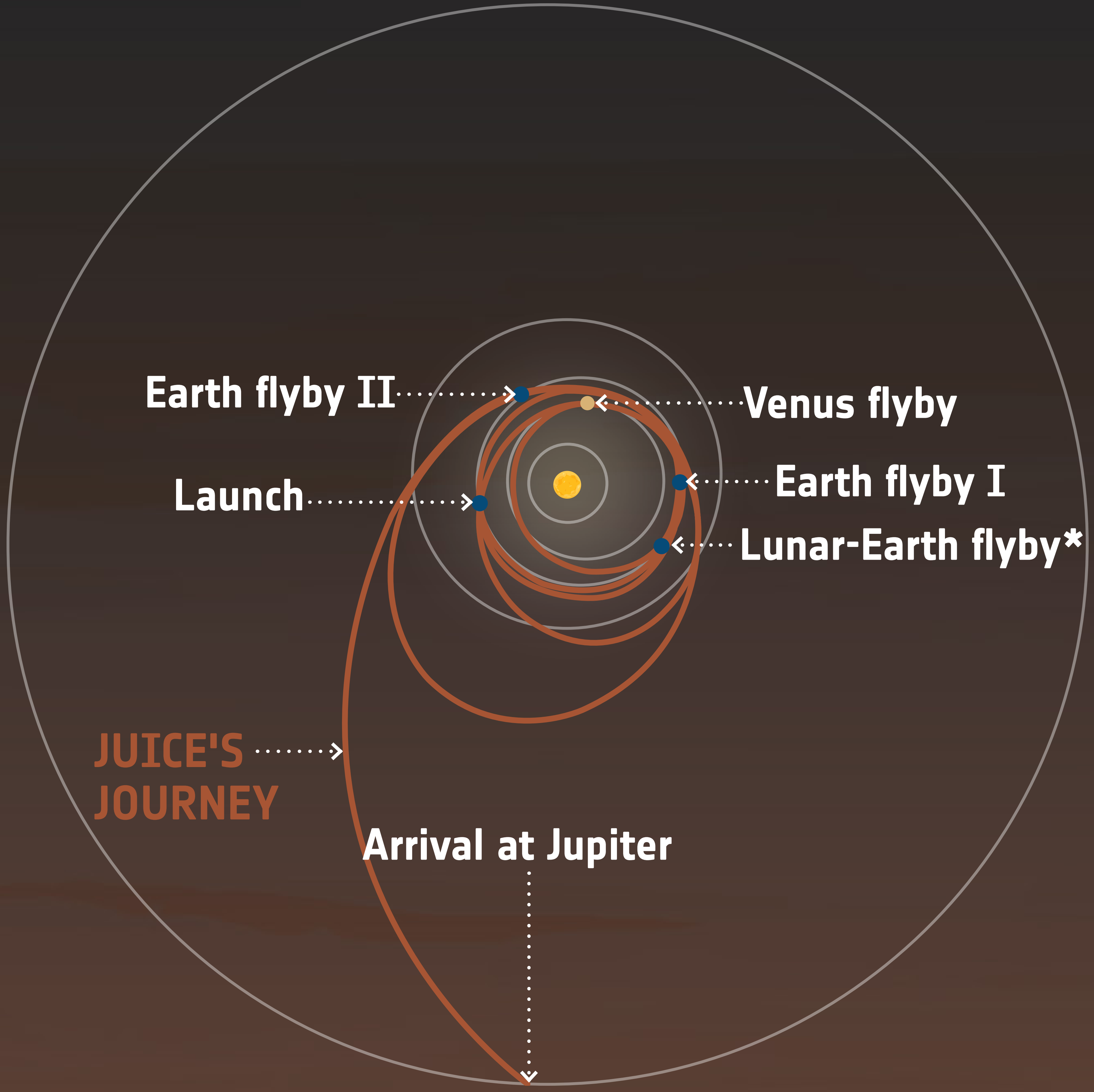
With **690 km²** jungle, the Spaceport
is a large natural area hosting an
abundance of wildlife and plants

LAUNCH AND DEPLOYMENT TIMELINE



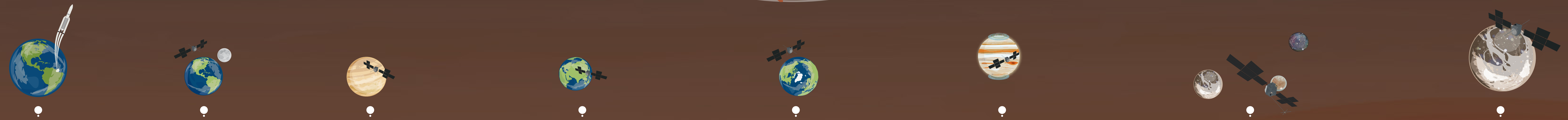
JOURNEY TO JUPITER

Juice will be operated by mission controllers at ESA ESOC (Germany)



A treacherous trip

Gravity will be a fickle friend, giving regular helping pushes along the way yet threatening derailment at any time. After Juice completes a record 35 flybys of Europa, Ganymede and Callisto, mission controllers will ingeniously make use of Jupiter's tremendous gravity to steer the spacecraft into orbit around the largest moon in the Solar System, planet-sized Ganymede.

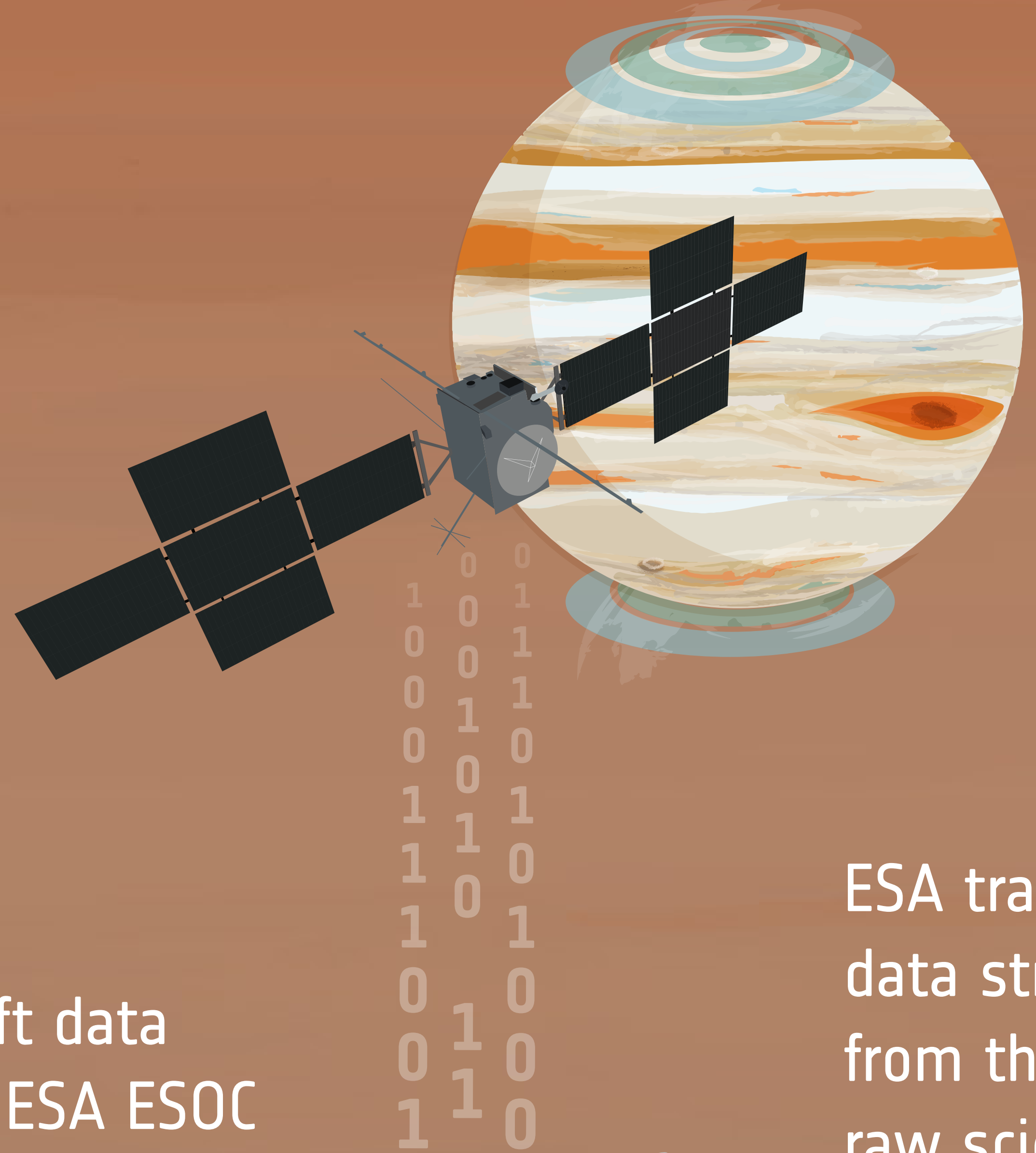


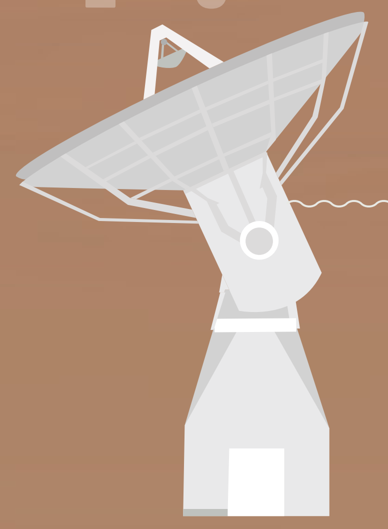
Launch	Lunar-Earth flyby*	Venus flyby	Earth flyby I	Earth flyby II	Arrival at Jupiter	Jupiter tour and 35 icy moon flybys	Ganymede orbit
April 2023	August 2024	August 2025	September 2026	January 2029	July 2031	July 2031 – November 2034	December 2034 – September 2035

*To be replaced by an Earth flyby if Juice launches after 18 April 2023

PLANETARY SCIENCE ARCHIVE: MAXIMISING SCIENCE FROM OUR MISSIONS

Data from all of ESA's Solar System missions are held in the free-to-access **Planetary Science Archive (PSA).**





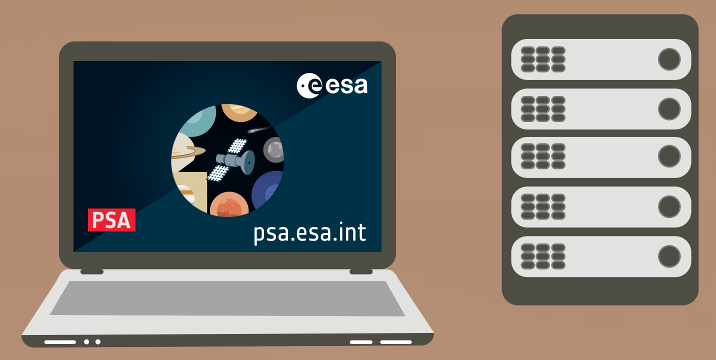
Spacecraft data arrive at ESA ESOC (Germany) via ground stations around the world

ESA transforms the data stream coming from the spacecraft into raw science data

Planetary Science Archive

Raw data

Processed data

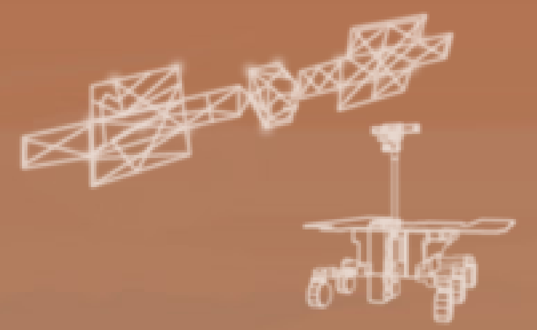


Raw data are calibrated by the instrument science team, transformed into a standard format, and stored in the PSA, hosted at ESA ESAC (Spain)

Instrument science team

Processed data are available in a format useful for science, including documentation on how to use them and information about how they are calibrated

Science



Planning future missions

Scientific community

Data are available to all for decades, ensuring long-term science return and supporting future missions

AN ESA-LED GLOBAL COLLABORATION

Through developing and implementing the Juice mission, ESA is leading a global collaboration that is already bringing socio-economic benefits to Europe and the rest of the world. These benefits are set to continue once the mission has launched.

18
institutions

23
countries

83
companies

116
industry contracts

>2000
people

~1.6
billion euros (mission cost)

EUROPEAN PARTNERS

Many agencies, organisations and companies have contributed to the development of Juice. This map highlights the main contributing ESA Member States and their funding agencies. Prime contractor for the building of Juice is Airbus.

Austria
Austrian Research Promotion Agency

Belgium
Belgian Science Policy Office

Czech Republic
Department of Research and Development, Ministry of Education

France
National Centre for Space Studies (CNES)

Germany
German Space Agency at DLR

Greece
Academy of Athens

Hungary
Centre for Energy Research

Italy
Italian Space Agency (ASI)

Poland
Ministry of Entrepreneurship and Technology

Spain
Ministry of Economy and Competitiveness

Sweden
Swedish National Space Agency

Switzerland
Swiss Space Office

United Kingdom
UK Space Agency

Beyond Europe:

United States
National Aeronautics and Space Administration (NASA)

Japan
Japan Aerospace Exploration Agency (JAXA)

Israel
Israel Space Agency (ISA)

MEET THE TEAM: KEY SPOKESPEOPLE

All spokespeople can be reached via ESA Media Relations: media@esa.int.

Flags represent spoken languages.

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ESAC, Spain

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Project Manager
ESTEC, Netherlands

Olivier Witasse
Project Scientist
ESTEC, Netherlands

Manuela Baroni
Assembly, Integration and Test Engineer
ESTEC, Netherlands

Mihaela Barbu
Senior Schedule Controller
ESTEC, Netherlands

Christian Erd
Spacecraft & System Manager
ESTEC, Netherlands

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Science Operations Scientist
ESAC, Spain

Alessandro Atzei
Payload System Engineer
ESTEC, Netherlands

Rosario Lorente
Science Operations Scientist
ESAC, Spain

Gaitee Hussain
Head of Science Division
ESTEC, Netherlands

Mark McCaughrean
Senior Advisor for Science and Exploration
ESTEC, Netherlands

Markus Kissler-Patig
Head of Science and Operations Department
ESAC, Spain

Ruedeger Albat
Head of Ariane 5 and Future Preparation
ESA HQ, France

Daniel de Chambure
Head of STS Kourou Office
ESA HQ, France

Ignacio Tanco
Spacecraft Operations Manager
ESOC, Germany

Angela Dietz
Operations Engineer
ESOC, Germany

Bruno Sousa
Flight Operations Director
ESOC, Germany

Andrea Accomazzo
Flight Operations Director
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Arnaud Boutonnet
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ESA Directors

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Director General
ESA HQ, France

Guenther Hasinger
Director of Science
ESAC, Spain

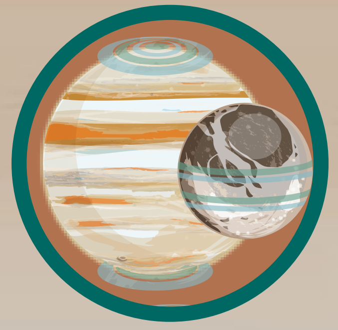
Rolf Densing
Director of Operations
ESOC, Germany

Daniel Neuenschwander
Director of Space Transportation
ESA HQ, France

MEET THE TEAM: INSTRUMENT PRINCIPAL INVESTIGATORS

Click here for a full list of Juice instruments with technical descriptions, principal investigators, co-principal investigators and lead funding agencies.

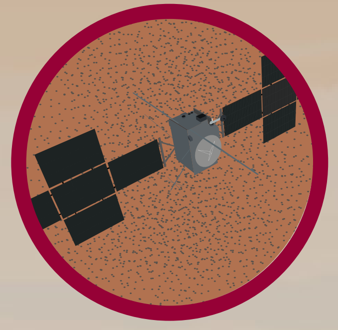
Optical camera system (JANUS)
Pasquale Palumbo
Università degli Studi di Napoli Parthenope
Italy



UV imaging spectrograph (UVS)
Randy Gladstone
Southwest Research Institute
USA

Radar sounder (RIME)
Lorenzo Bruzzone
Università degli Studi di Trento
Italy

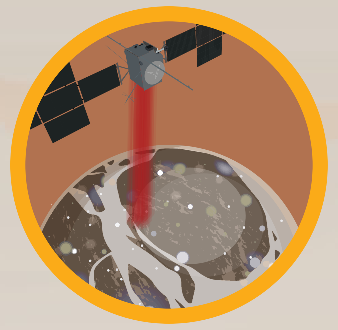
Radio science experiment (3GM)
Luciano Iess
Sapienza Università di Roma
Italy



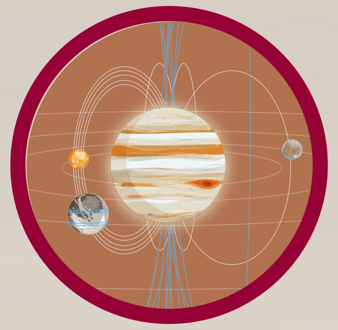
Particle environment package (PEP)
Stas Barabash
Institutet för rymdfysik
Kiruna, Sweden

Visible and infrared imaging spectrometer (MAJIS)
François Poulet
Institut d'Astrophysique Spatiale
France

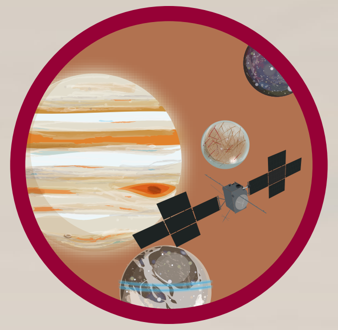
Sub-millimetre wave instrument (SWI)
Paul Hartogh
Max-Planck-Institut für Sonnensystemforschung
Germany



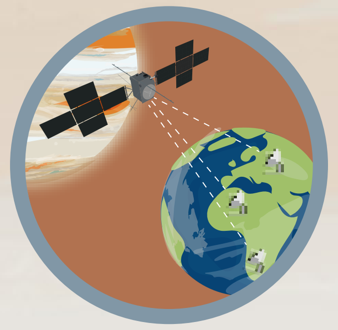
Laser altimeter (GALA)
Hauke Hussmann
DLR Institut für Planetenforschung
Germany



Magnetometer (J-MAG)
Michele Dougherty
Imperial College London
United Kingdom

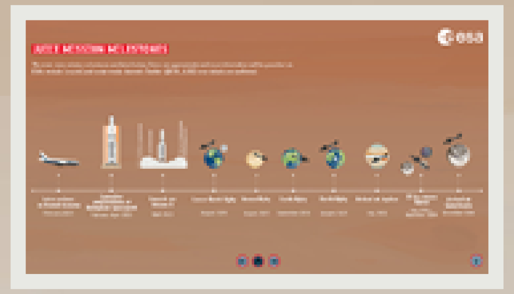


Radio and plasma wave instrument (RPWI)
Jan-Erik Wahlund
Institutet för rymdfysik
Uppsala, Sweden



Planetary Radio Interferometer & Doppler Experiment (PRIDE)
Leonid Gurvits
Joint Institute for VLBI ERIC and Technische Universiteit Delft
Netherlands

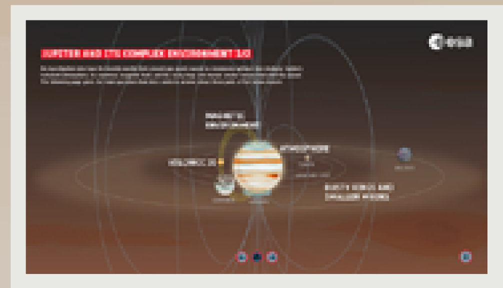
INFOGRAPHICS


Juice mission milestones

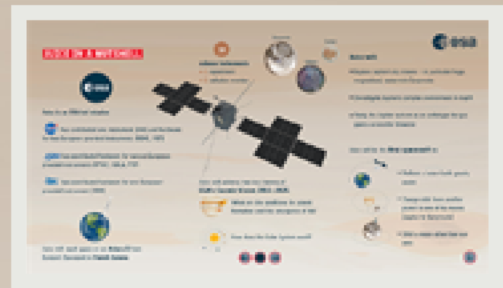

Juice in a nutshell

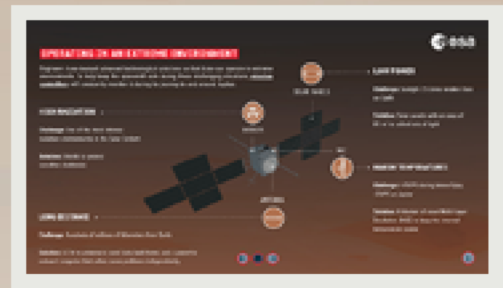

Five mysteries Juice will address

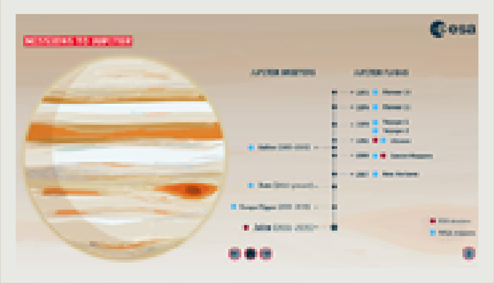

Jupiter's icy moons


Jupiter and its complex environment 1/2


Jupiter and its complex environment 2/2

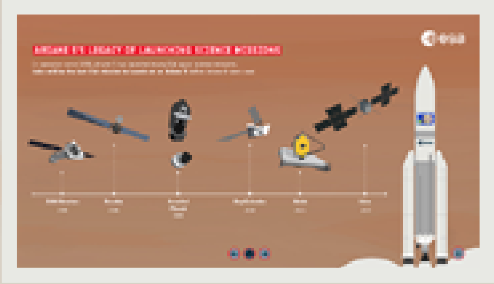

Juice's science instruments

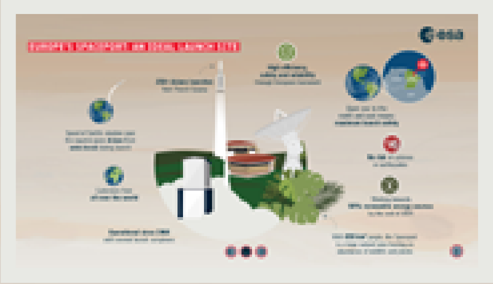

Operating in an extreme environment

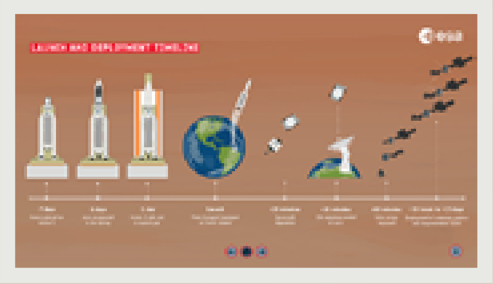

Missions to Jupiter


A trio of missions


Juice's legacy


Ariane 5's legacy


Europe's Spaceport


Launch and deployment timeline

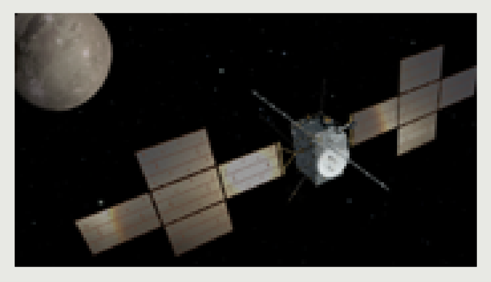

Journey to Jupiter

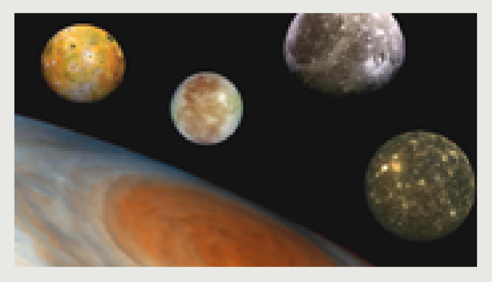

Planetary Science Archive


An ESA-led global collaboration


European partners

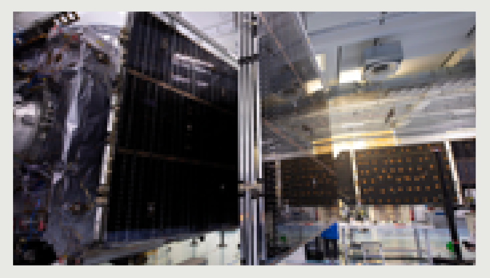

Exploring Jupiter

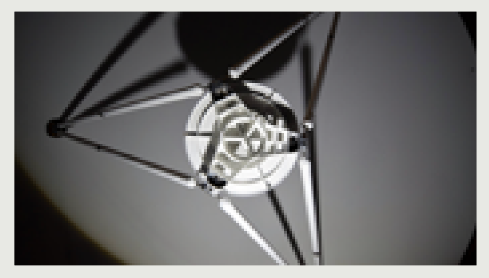

Juice mission

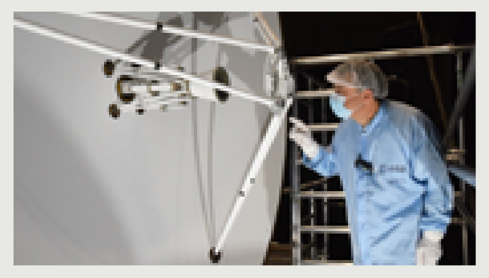

Jupiter's largest moons

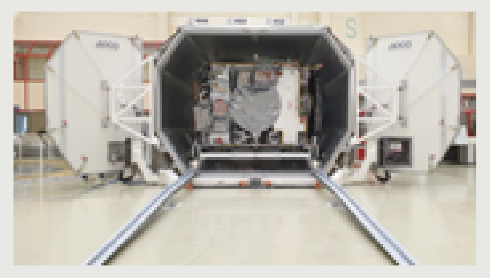
IMAGES AND VIDEOS

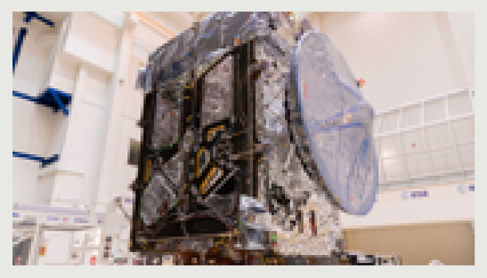
ESA images: www.esa.int/ESA_Multimedia/Images
ESA videos: www.esa.int/ESA_Multimedia/Videos


Juice solar array deployment test

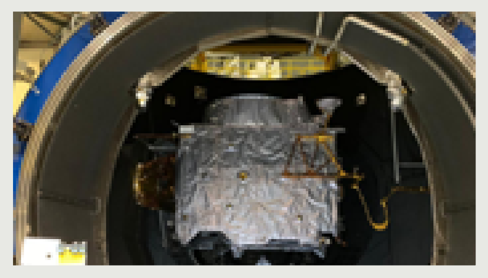

Juice antenna closeup

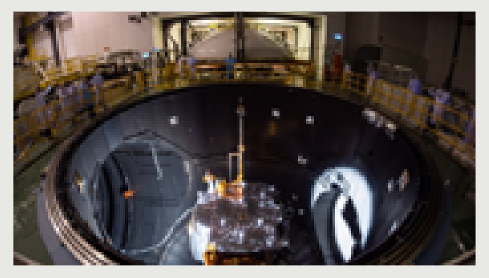

Juice antenna


Juice in transport container

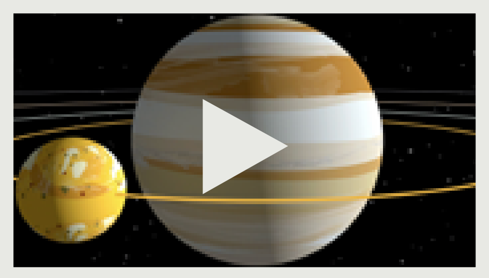

Installing Juice at ESTEC

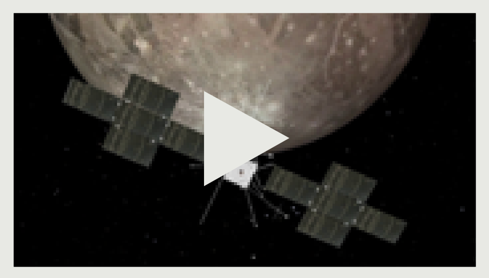

Testing radar to peer into Jupiter's moons


Jupiter mission passes space vacuum test


Juice in Large Space Simulator

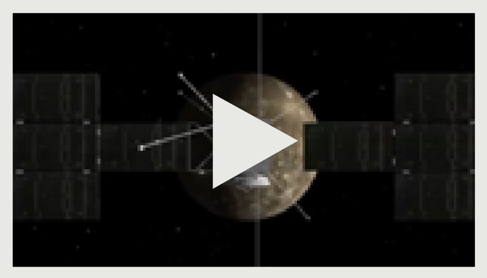

Juice antennas

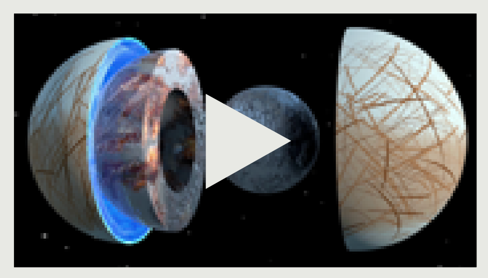

The orbits of the Galilean moons

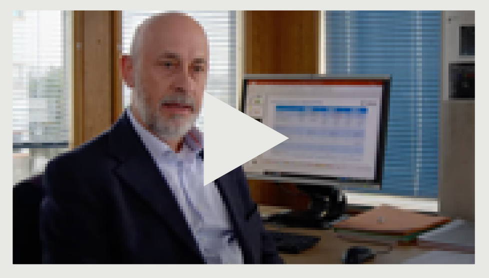

Juice's journey and Jupiter system tour


Juice's flyby of Europa

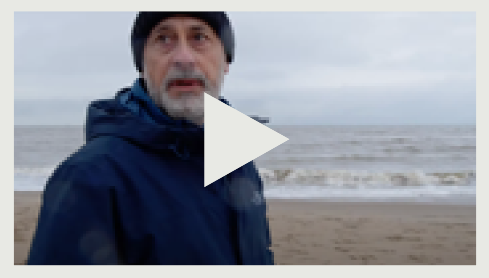

Juice's flyby of Ganymede


Juice's flyby of Callisto

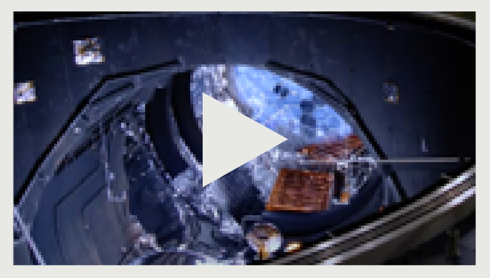

Inside the Galilean moons

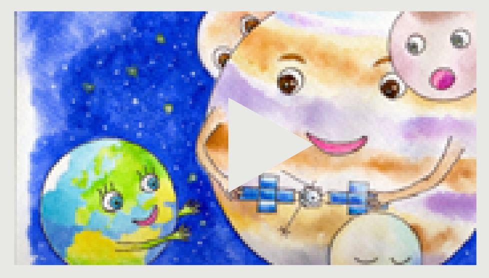

The Making of Juice – episode 1

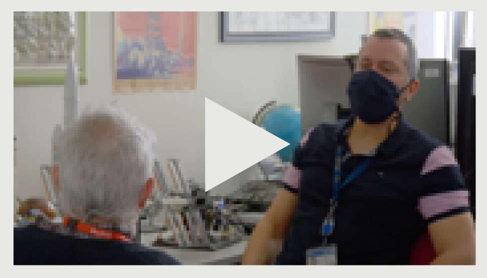

The Making of Juice – episode 2


The Making of Juice – episode 3


The Making of Juice – episode 4

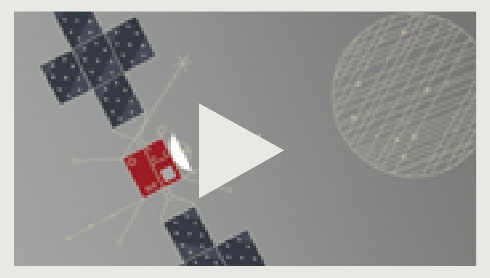

The Making of Juice – episode 5


The Making of Juice – episode 6


The Making of Juice – episode 7


The Making of Juice – episode 8


The Making of Juice – compilation 2020–2021


The Making of Juice – YouTube Channel

FREQUENTLY ASKED QUESTIONS 1/2

Is Juice able to detect life?

Juice is not equipped to detect life. The mission is designed to find out whether there could be places around Jupiter, inside the icy moons, where the necessary conditions (water, biological essential elements, energy, and stability) to sustain life are present.

Why will Juice orbit Ganymede and not Europa?

There are two reasons. Firstly, Ganymede is a unique and fascinating object; it is the largest moon in the Solar System, the only moon with an internal magnetic field, it has a unique geologic history and it harbours a large subsurface ocean. Secondly, the radiation environment is very harsh around Europa because it is much closer to Jupiter; this also explains why Juice will make only two flybys of Europa.

How is Juice powered?

Juice's power comes mainly from its large solar array. It was proven that a mission at Jupiter can be designed with solar panels, and therefore a radioisotope thermoelectric generator (RTG) – such as that used by the Cassini mission – was deemed unnecessary. The solar panels will generate around 700–900 Watts. The spacecraft is also equipped with batteries that allow it to survive eclipses of up to around five hours.

Will the spacecraft be sterilised? If not, could Juice bring life to Jupiter?

No, Juice will not be sterilised. The mission will therefore bring a miniscule number of cells (spores) from Earth with it. Icy moon Europa is the only target considered to have the potential for harbouring life, and that therefore needs to be protected. Juice has been designed to reliably maintain control of itself, so the likelihood of accidentally colliding with Europa and potentially contaminating it with cells from Earth is below the requirement for planetary protection.

If we discover, before entering into orbit around Ganymede, that the moon is habitable, we will follow the requirements for planetary protection. But as it stands, planetary protection rules allow a crash onto Ganymede, because there are no indications that the deep subsurface ocean on Ganymede can be in contact with the surface. Crashing into Europa would not be allowed because Europa's subsurface oceans are suspected to be less deep and therefore contamination from the surface to the ocean would in theory be possible.

FREQUENTLY ASKED QUESTIONS 2/2

Will you work together with Europa Clipper?

Whilst Europa Clipper is really focused on the moon Europa – including investigating whether the icy moon could have conditions suitable for life, Juice will study many targets (three icy moons, Jupiter's atmosphere, magnetosphere, Io, smaller moons, Jupiter's rings) with a special focus on Ganymede.

Having two missions in the Jupiter system at the same time is a great opportunity for science. The Europa Clipper science team and Juice science team are already working together to maximise the scientific harvest of the two missions. A joint meeting is organised approximately once per year and the two teams are in regular contact in between meetings. Recently, a steering group was formed that is dedicated to this collaboration, including members of both teams.

When will we get the first images and results?

The science mission will start around six months before arrival at Jupiter; images of Jupiter will be taken from a distance at that time and released soon afterwards. Juice's first science flyby of a Jovian moon (Ganymede) and first passage close to Jupiter will occur in February 2032. The first really interesting images will be taken and released at that time.

Concerning the first results, the science that Juice will undertake is very broad, covering Jupiter's atmosphere, magnetosphere and rings, the Galilean moons, and more. It is difficult to predict exactly when the first results will be available, but it will definitely be sometime in 2032.

Some images and data will also be collected during the journey to Jupiter, and this is when the first images from the mission will become available.

What makes flying Juice such a challenge?

Juice will face challenges like no other European mission, for example: sunlight collected by its solar panels will be 25 times weaker than what can be collected when orbiting Earth. The immense distances – hundreds of millions of kilometres from Earth – require a large 2.4 m-diameter antenna on board to ensure sufficient data rates to download scientific data. Furthermore, Juice's complex trajectory around the Galilean moons will include an extraordinary number of gravity assist flybys. Finally, entry into orbit around Ganymede will require precise navigation and deft manoeuvring.

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Kai Noeske
Science Communication Programme Officer
ESA ESTEC, Netherlands

Daniel Scuka
Operations Communication Programme Officer
ESA ESOC, Germany

esa.int/Juice

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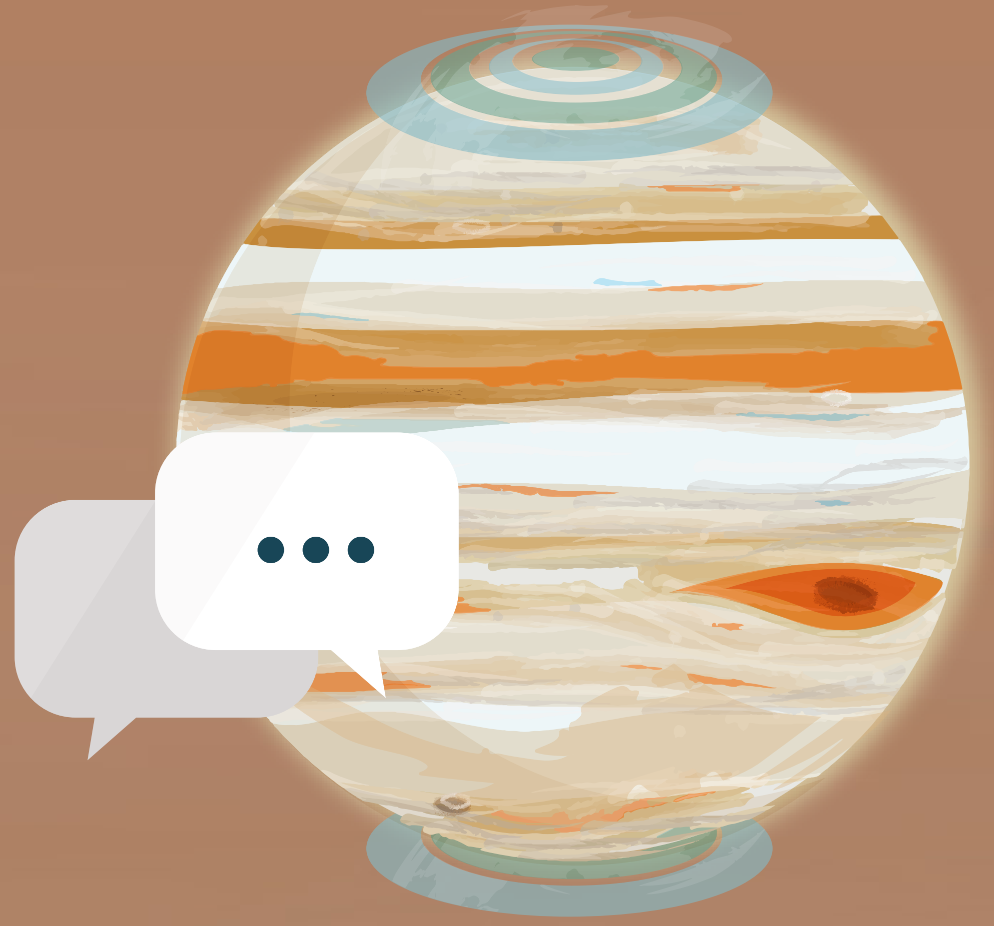

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