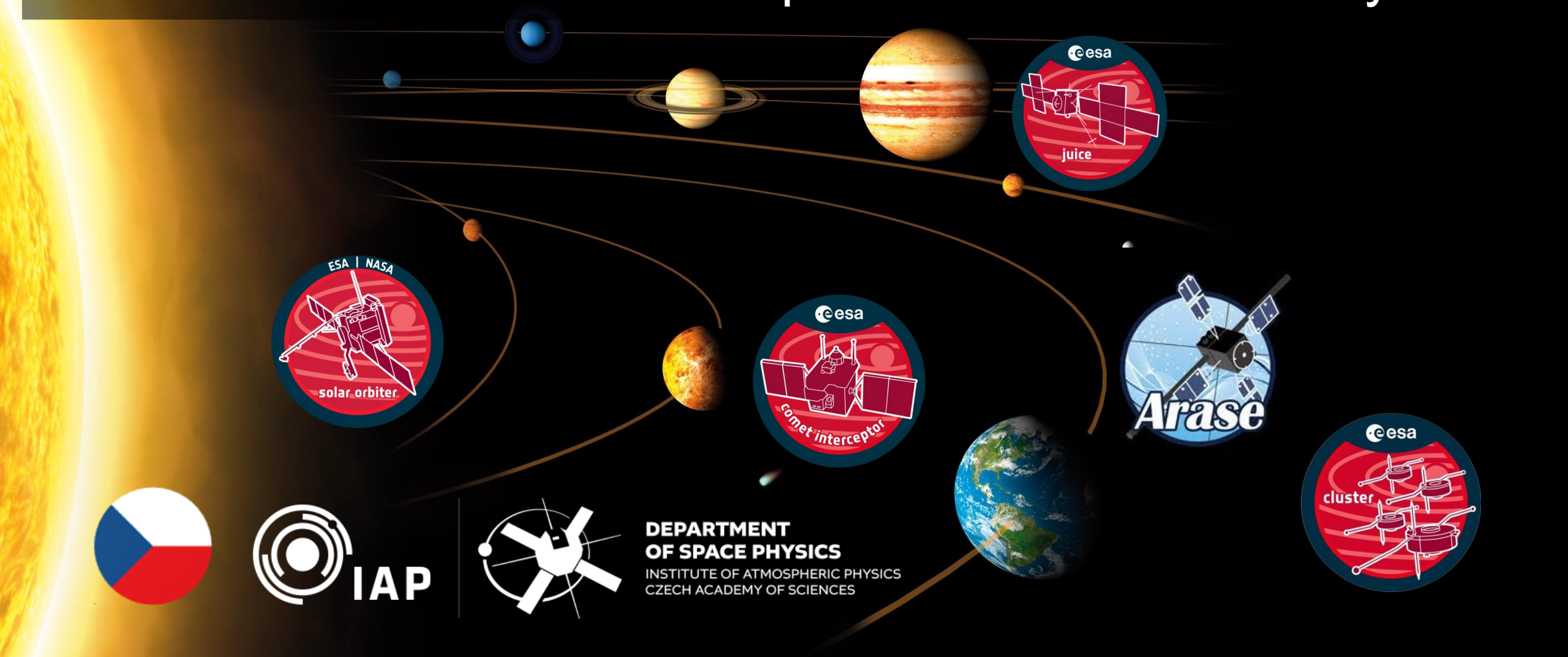
Czech Contribution to the Exploration of the Solar System



Masafumi Imai, Institute of Atmospheric Physics
of the Czech Academy of Sciences

esa

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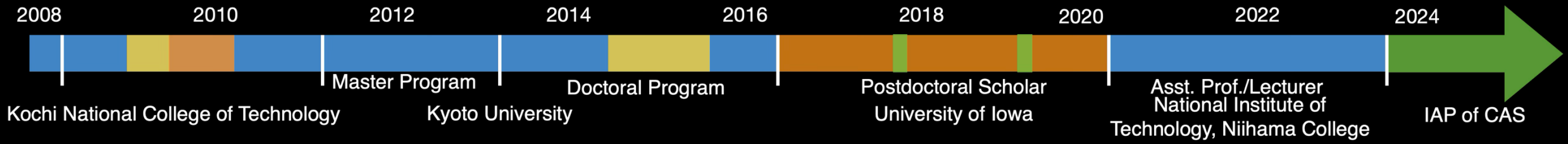

Masafumi Imai, Ph.D.

- Works in Czechia since 2024
- Co-investigator of NASA‘s Juno mission to Jupiter
- Awardee on the Lumina Quaeruntur fellowship in 2024 from the Czech Academy of Sciences

Jupiter & Juno

[NASA/JPL-Caltech]

LWA-Niyodo low-frequency radio telescope in Japan

KOSEN-1 CubeSat

At a ceremony on 25 October, 2024

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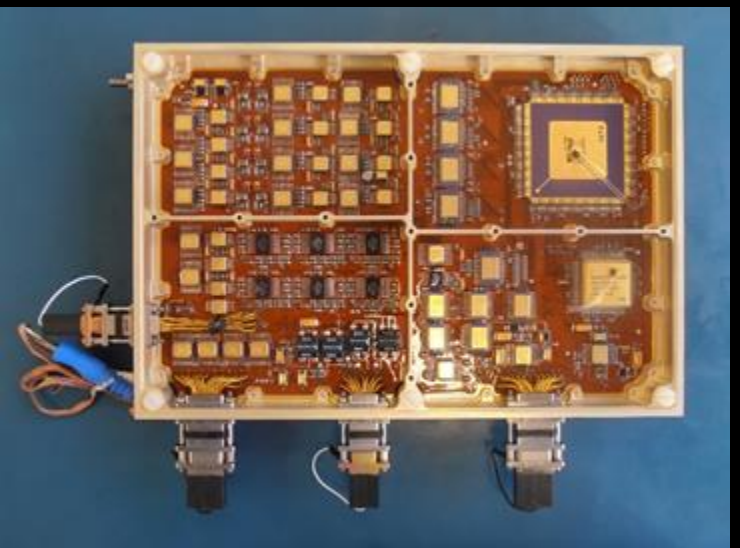
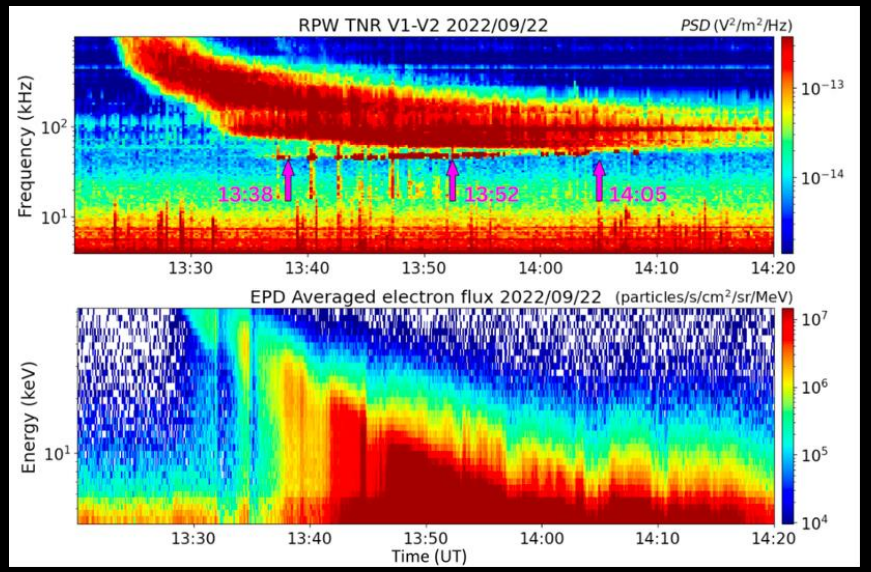
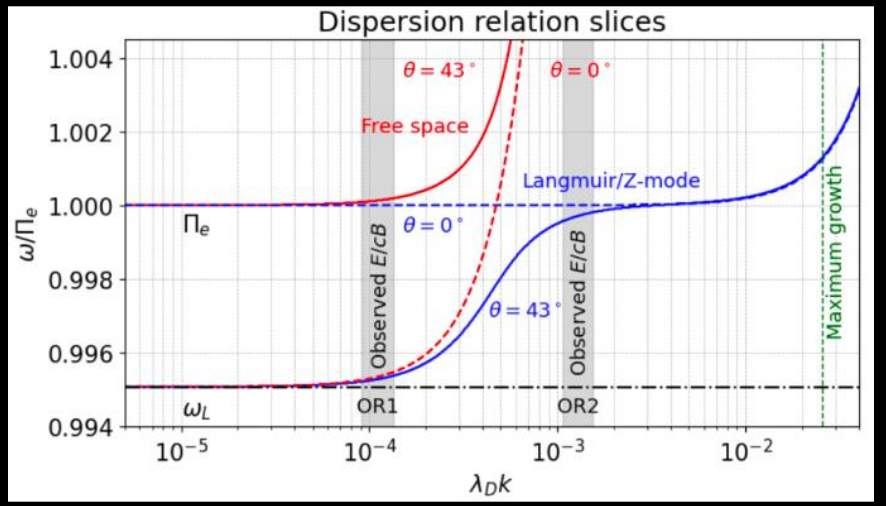
Solar Orbiter (2020-now, active)

- observes the Sun with a unique set of instruments and from a unique perspective, will move to higher inclination orbit
- Czech contribution to 4/10 scientific instruments

RPW/TDS: space electronics







[Formánek+, ApJ Lett., 2025]

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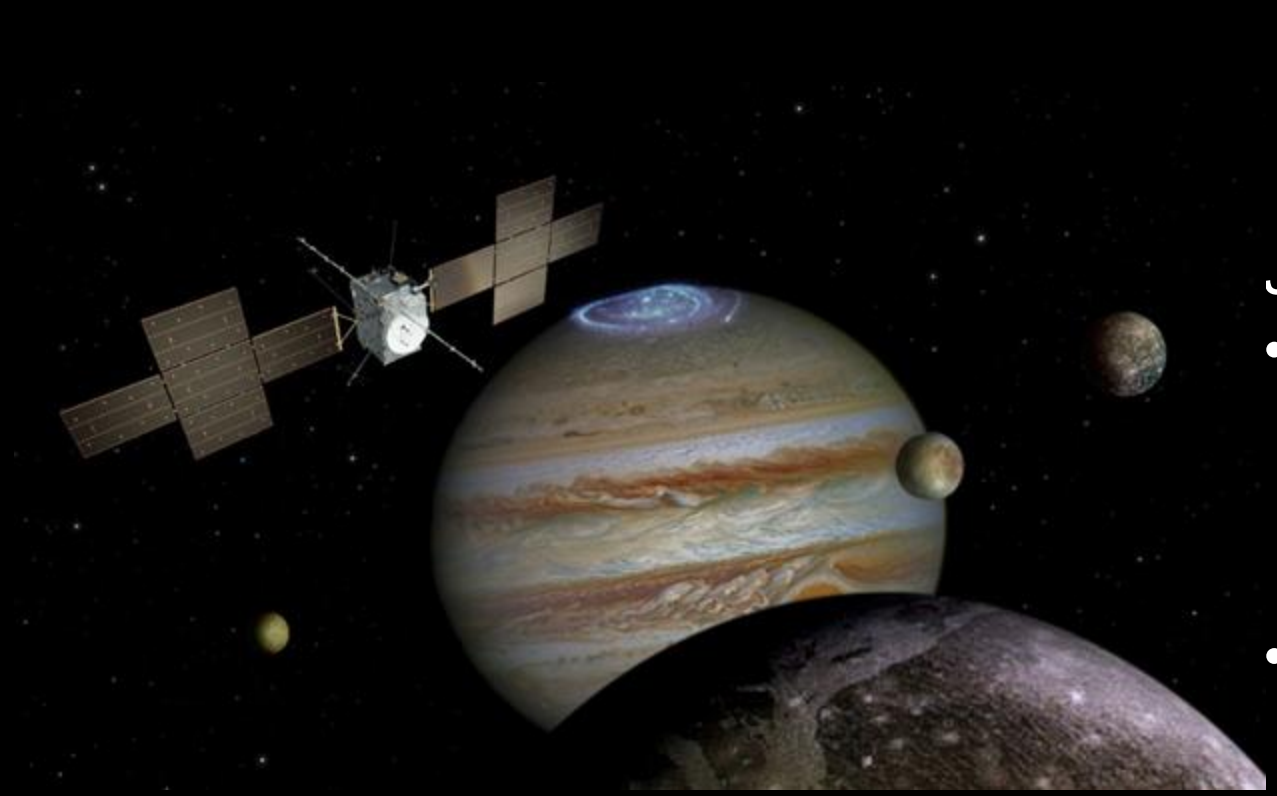
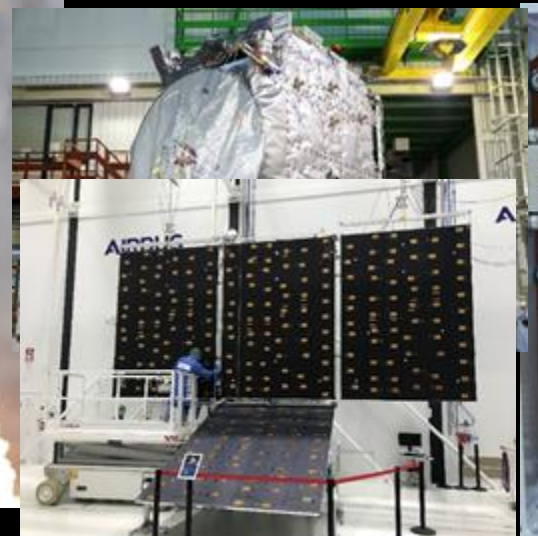


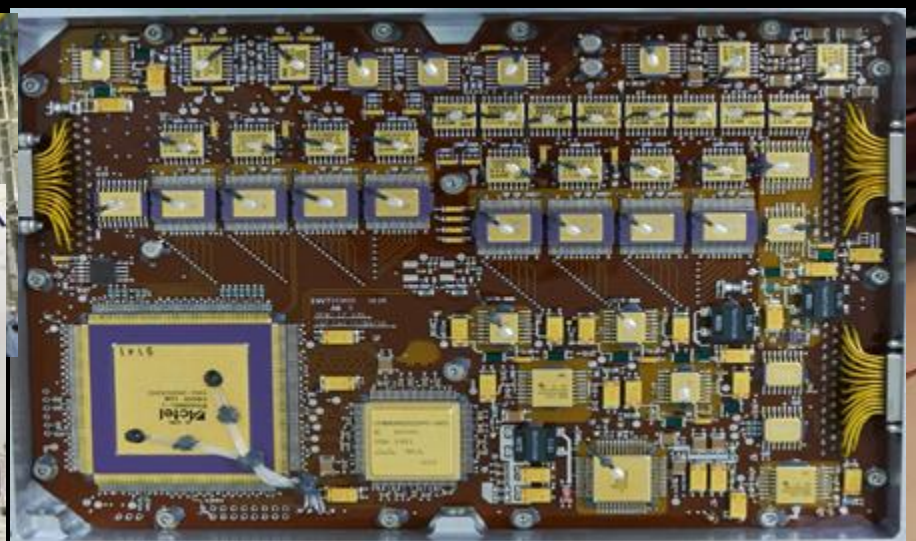
JUICE (2023-now, active)

- will explore the icy moons of Jupiter (with the focus on Ganymedes, the only moon in the Solar System with its own magnetic field)
- Czech Co-PI team of the Radio and Plasma Wave Investigation at IAP

Start JUICE, 14th April 2023



Low-Frequency Receiver: flight model



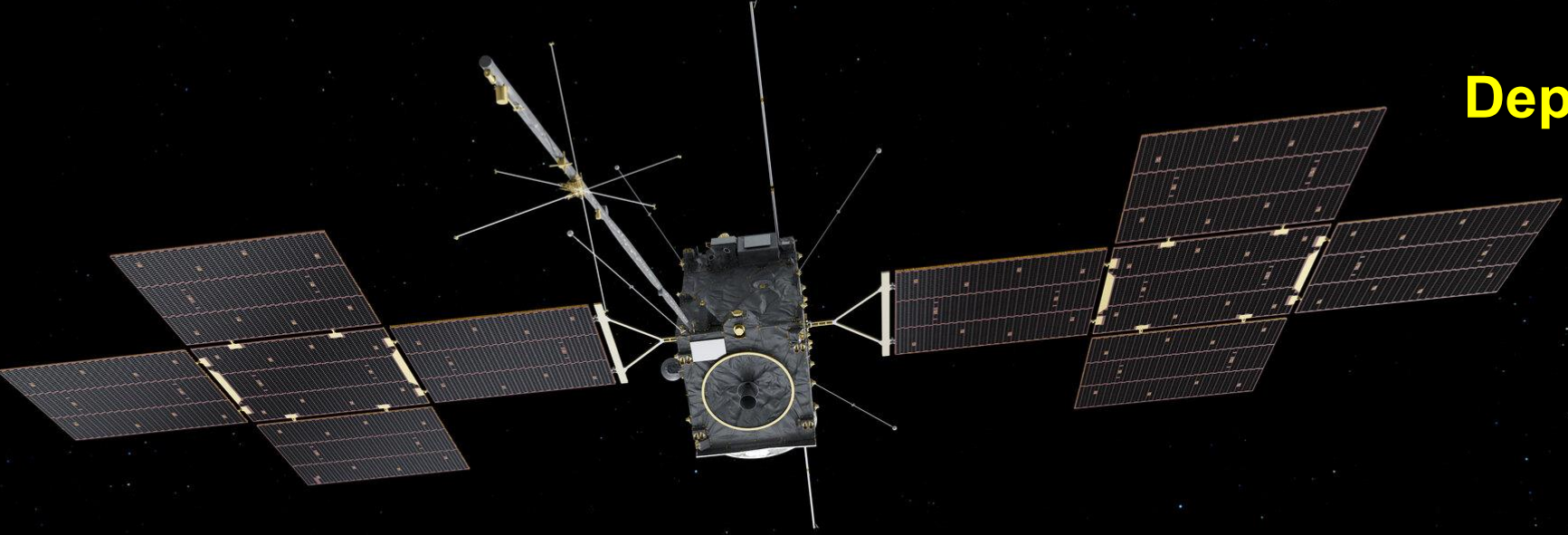
Low-Voltage Power Supply

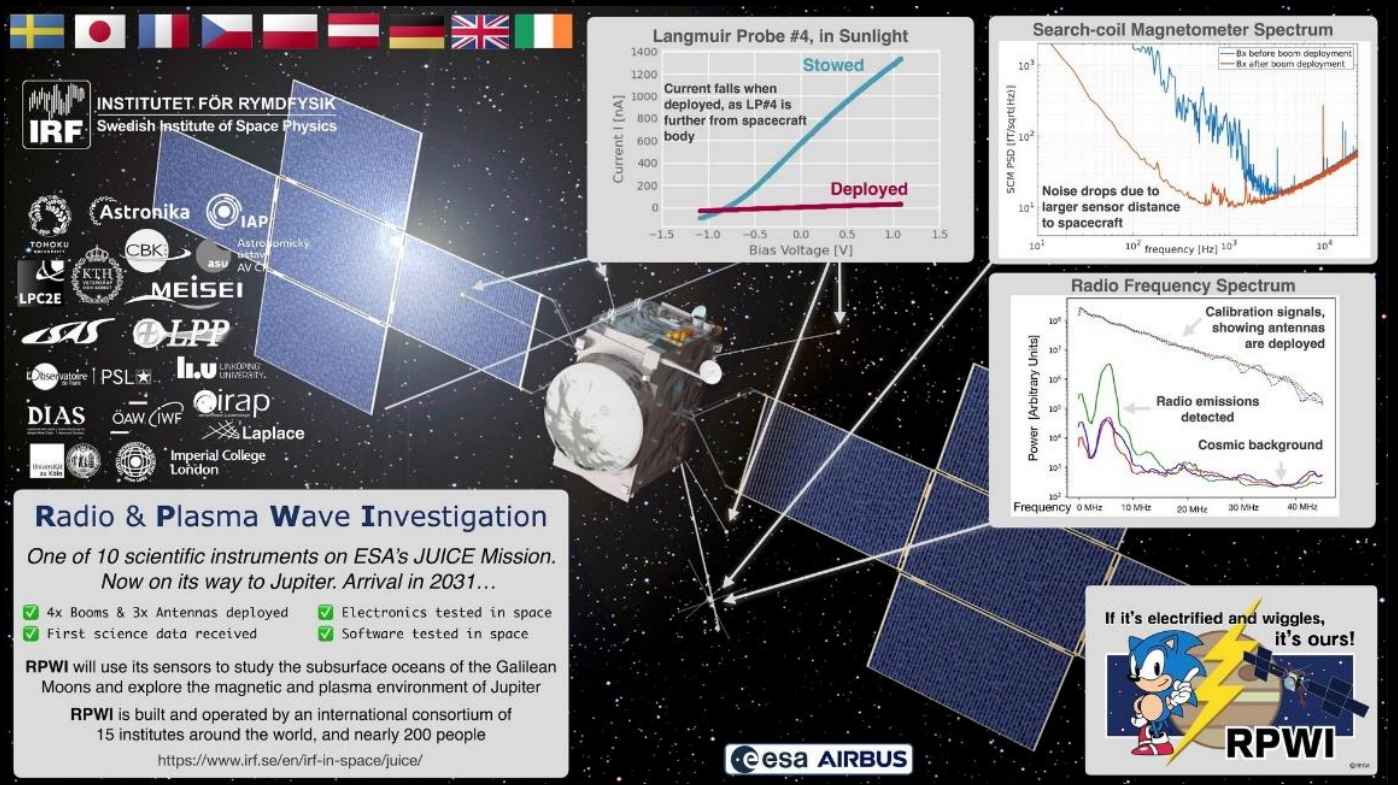
JUICE (JUpiter ICy moons Explorer)

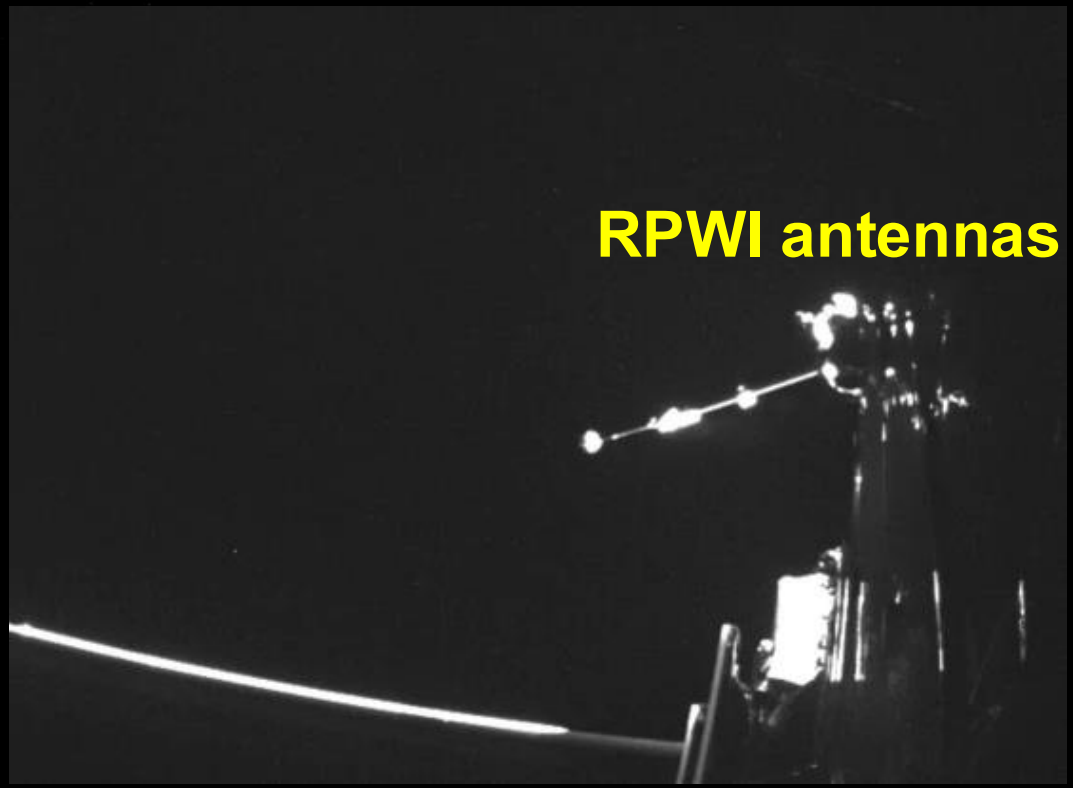
- Planetary mission of the European Space Agency
- Selected in May 2012 as the first L-class mission of the Cosmic Vision programme
- Successfully launched on 14 April 2023 at 14:14 CEST
- Travels to Jupiter (2031) a its moons Ganymede (2032), Europa a Callisto
- **RPWI** (Radio and Plasma Wave Investigation) instrument (15 institutions, 9 countries, led by IRF-U)
- **Czech contribution:** Low frequency receiver (**LFR**) for 3D mutlicomponent measurements of electromagnetic waves below 20kHz, power source
- **Japanese contribution:** High frequency receiver (**HFR**) cooperation with Tohoku U.

Deployment of RPWI antennas

26. May 2023







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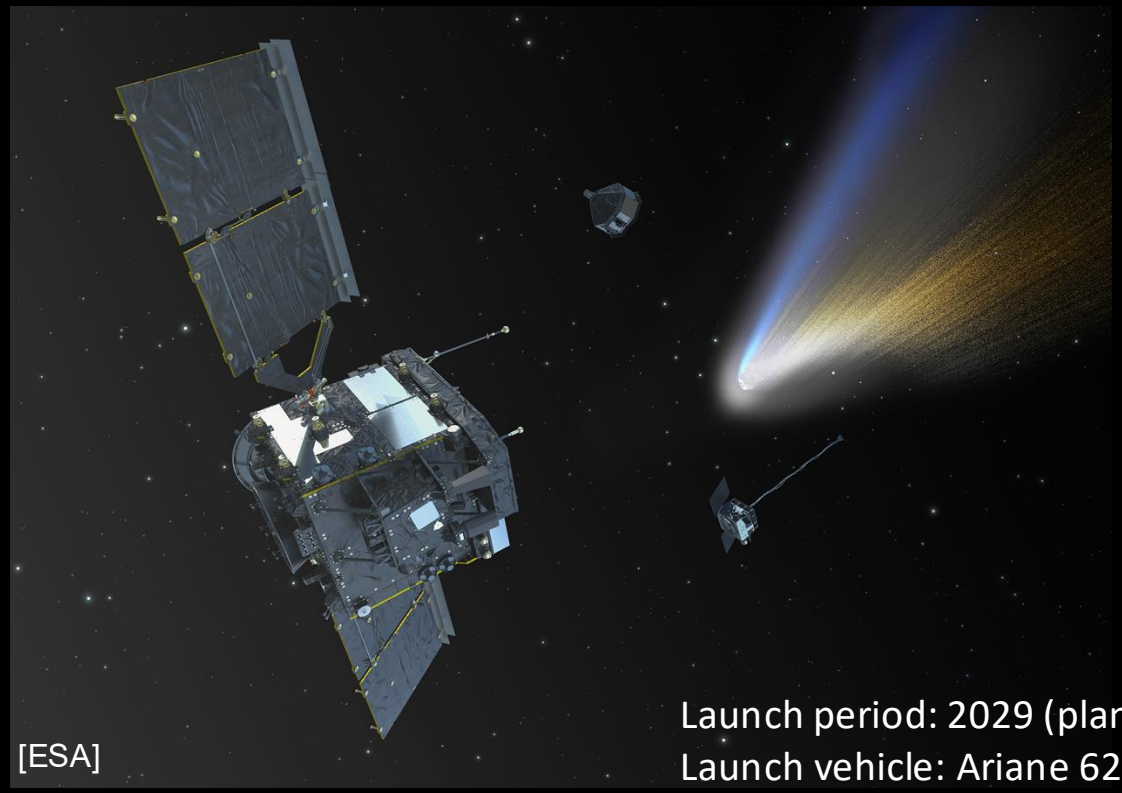
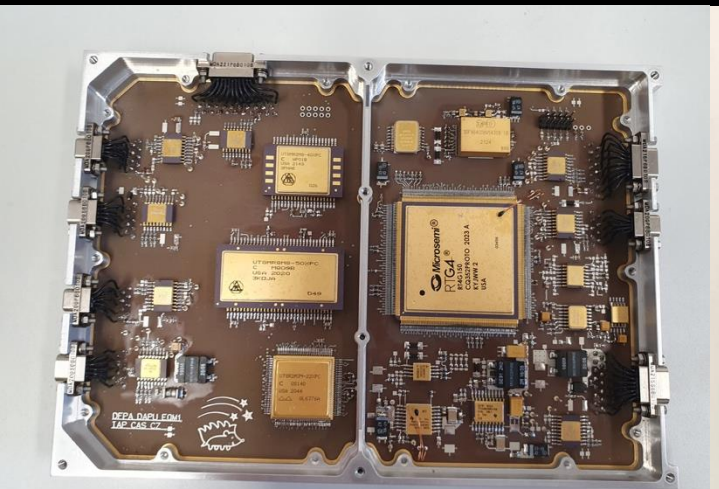


Launch period: 2029 (plan)
Launch vehicle: Ariane 62

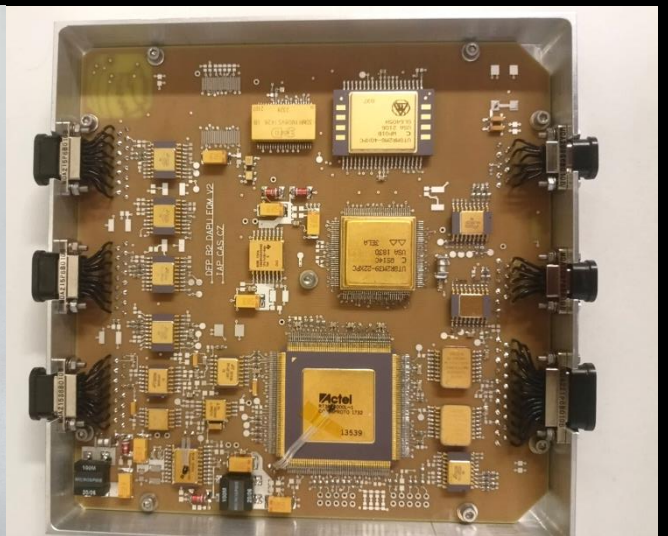
Comet Interceptor (in developement)

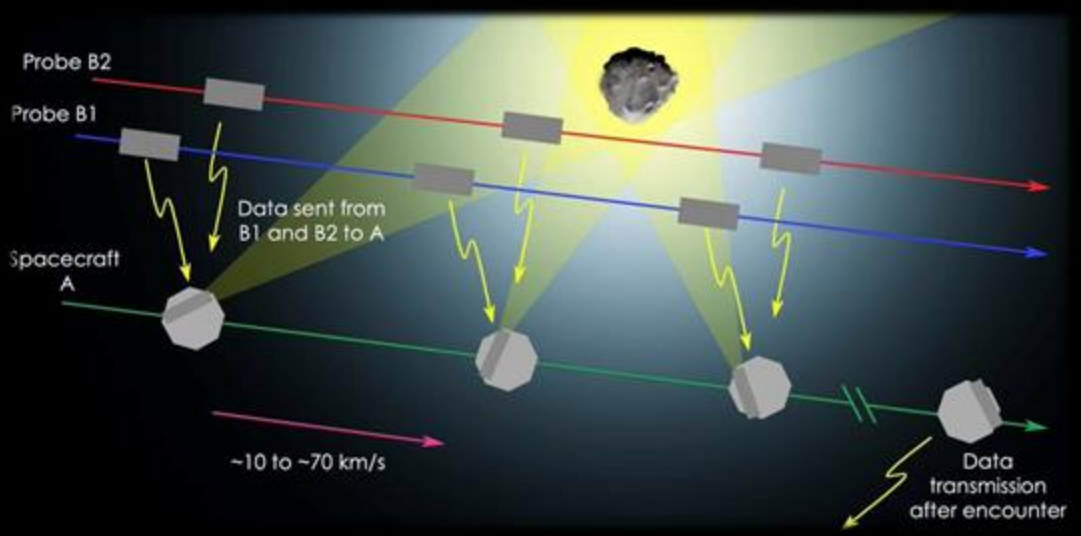
- will visit a comet coming directly from the outer reaches of the Sun‘s realm.
- ESA-lead F-class mission (selected in 2019) in collaboration with JAXA.
- Our group contributes Dust Analyzer & Processing Unit electronics and onboard software for Probes A and B2.

DAPU A: engineering model



DAPU B: engineering model





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Telemetry

Telemetry station of Institute of Atmospheric Physics in Panská Ves

Cluster (2000-2024)

- investigated small-scale structures of the magnetosphere and its environment in three dimensions using 4 spacecraft.
- The spacecraft, dubbed ‘Salsa’ (Cluster 2), reentered Earth’s atmosphere at 20:47 CEST on 8 September 2024 over the South Pacific Ocean.

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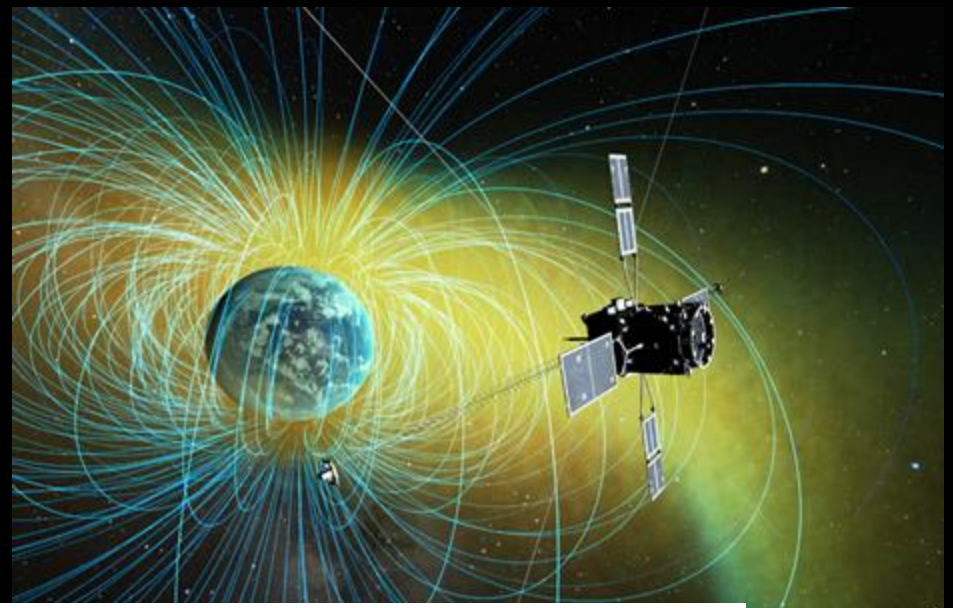
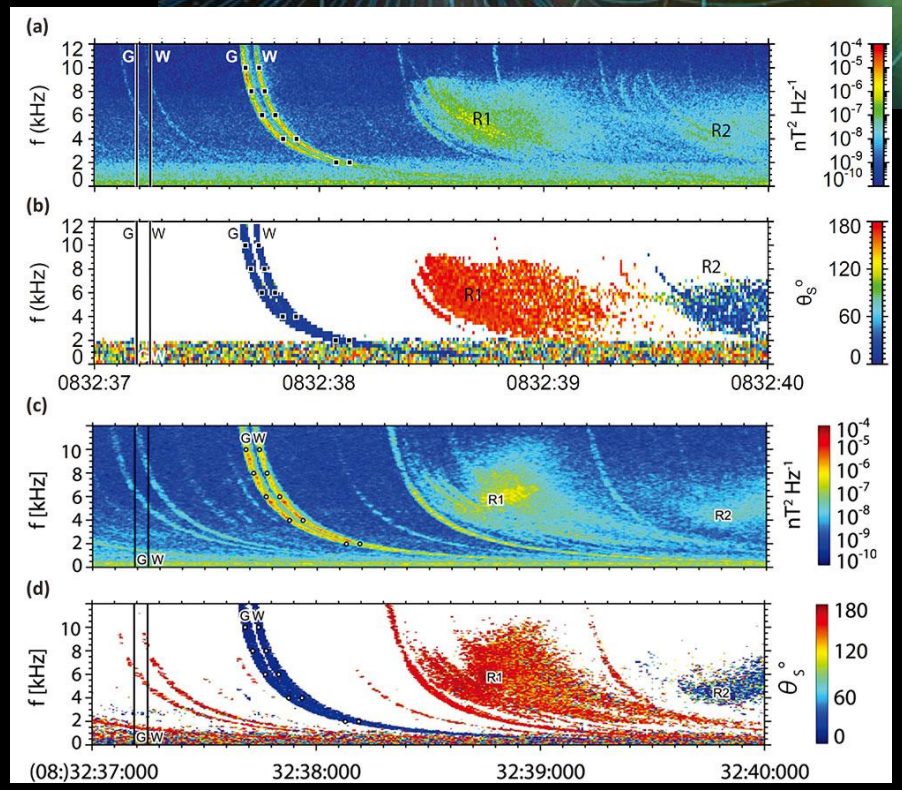
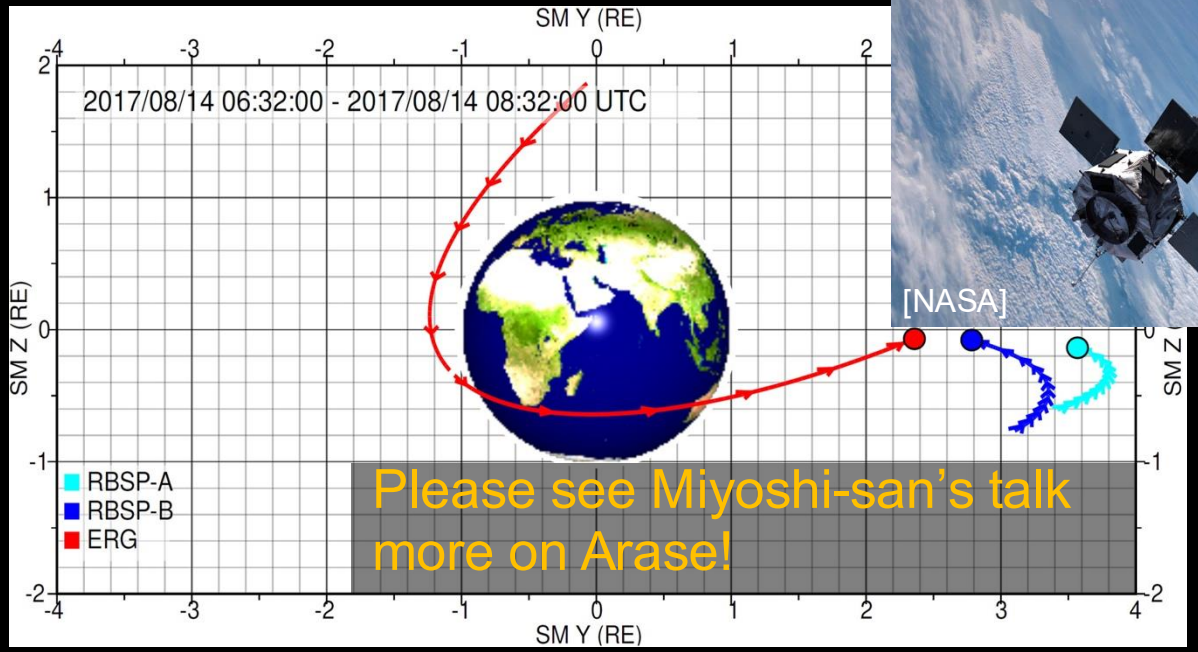


[ISAS/JAXA]

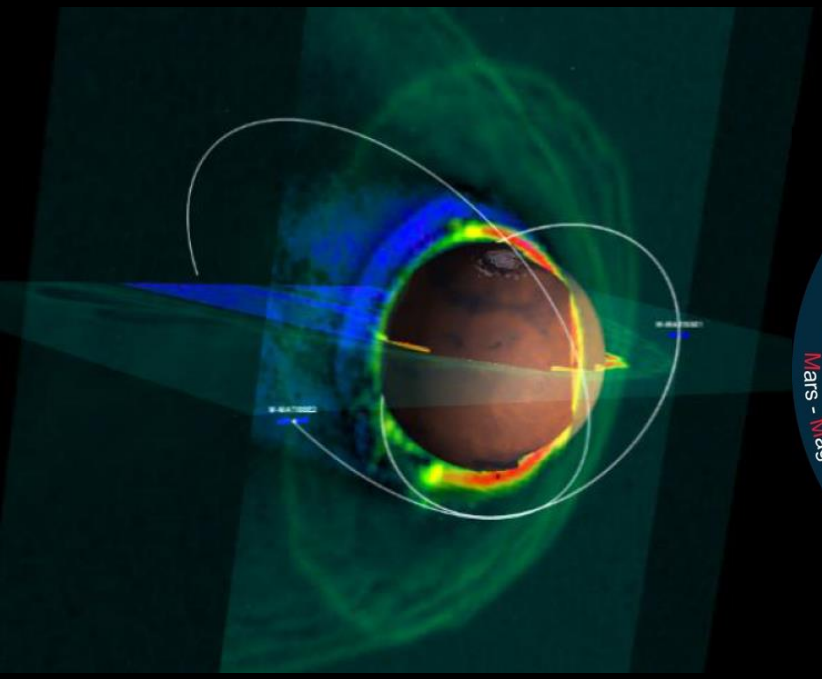
Arase (2016-now, active)

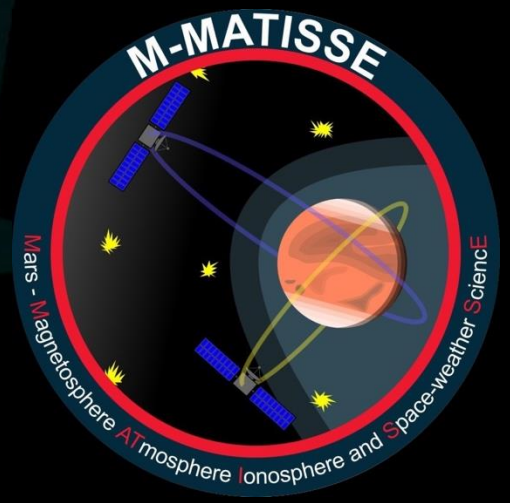
- studies the radiation belts and evolutions of space storms.
- For example, intercalibrated measurements of intense whistlers by Arase and Van Allen Probes were sucesfully carried out in Japanese-Czech collaboration

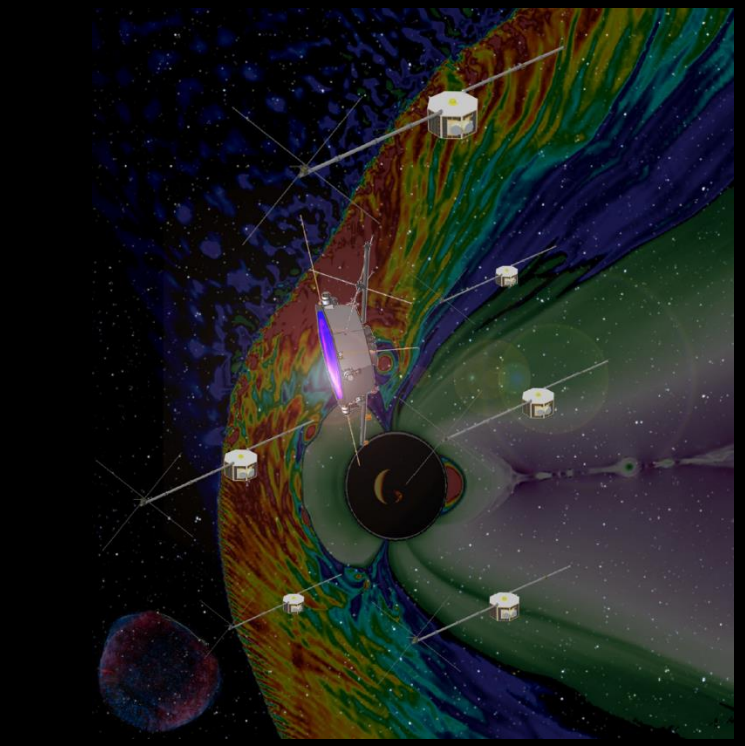




[Santolík+, JGR, 2021]







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ESA Medium class (M7) candidates
Involved in 2 of 3 downselected

M-Matisse

- would reveal on how the solar wind influences Mars‘s atmosphere, ionosphere and magnetosphere with two identical spacecraft.
- *COMPASS* (Combined Magnetic and Plasma Sensor Suite) is co-led by IAP.

Plasma Obsevatory

- is a seven-spacecraft mission to study the environment of electrically charged particles (called a plasma around Earth).
- IAP will be responsible for the development of the wave instrument and on-board software.

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Summary

As a member of the European Space Agency (ESA), Czechia contributes the exploration of the solar system

- By providing scitific instruments onboard spacecraft missions

The Czech-Japanese collaboration has been sucessfully carried out through

- Arase, JUICE, Comet Interceptor, etc.

Potential future Czech-Japanese collaboration

- Space plasma research, magnetosphere and radiation belts
- Solar system exploration
- Astronomy missions
- Earth observations: environmental monitoring
- Space safety and sustainability: Space situational awareness, debris mitigation and sustainable satellite technologies

[Tanabata 2025, Dolní Počernice,19 July, 2025]