

# **Overview of space activities at**

## Institute of Atmospheric Physics of the Czech Academy of Science

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**INSTITUTE OF ATMOSPHERIC PHYSICS**  
ASCR

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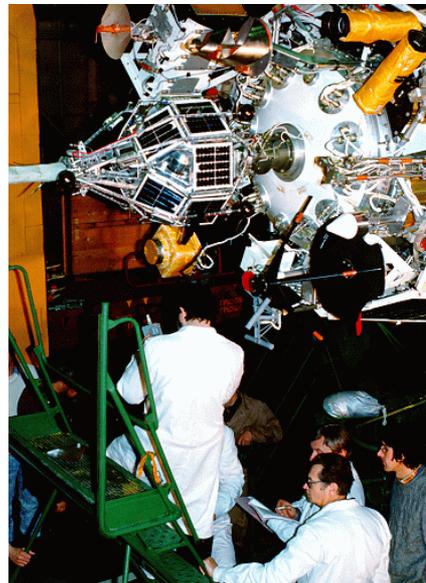
# Institute of Atmospheric Physics (short history)

- Conducts research in meteorology, climatology, aeronomy and space physics
- Space program started in 1962 at ionospheric observatory in Panska Ves
- Part of Intercosmos program, over 20 space instruments on Soviet spacecraft
- 1978: first Czechoslovak spacecraft **MAGION 1**.
- 1989-2002: Development, manufacturing and operations of Czech/Czechoslovak satellites **MAGION-2,3,4,5**

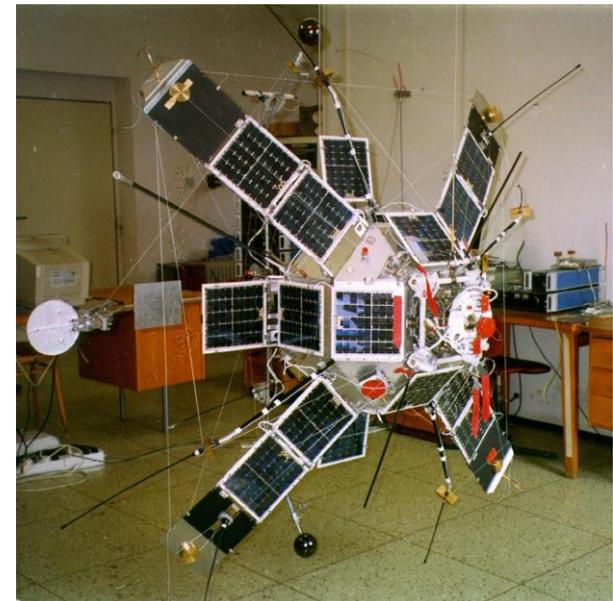
MAGION1



MAGION2



MAGION5



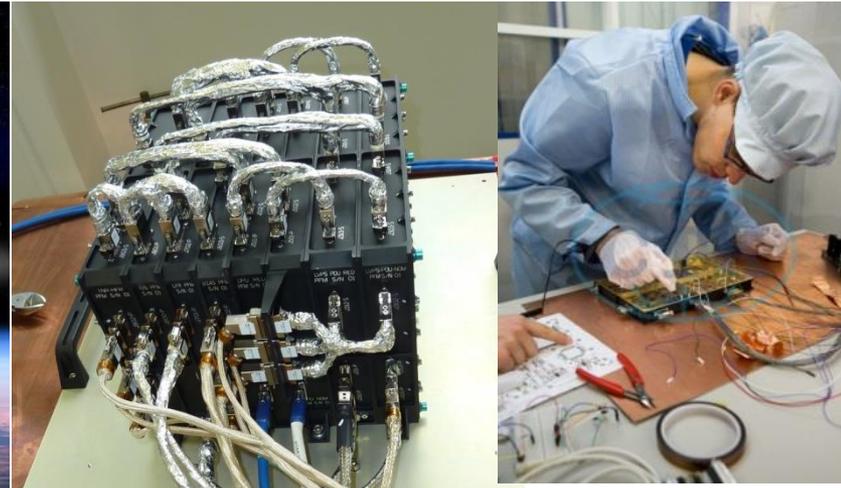
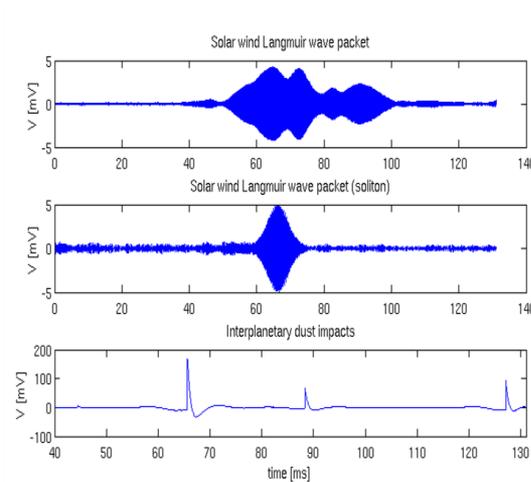


INSTITUTE OF ATMOSPHERIC PHYSICS  
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# Department of Space Physics

## Three main areas of research:

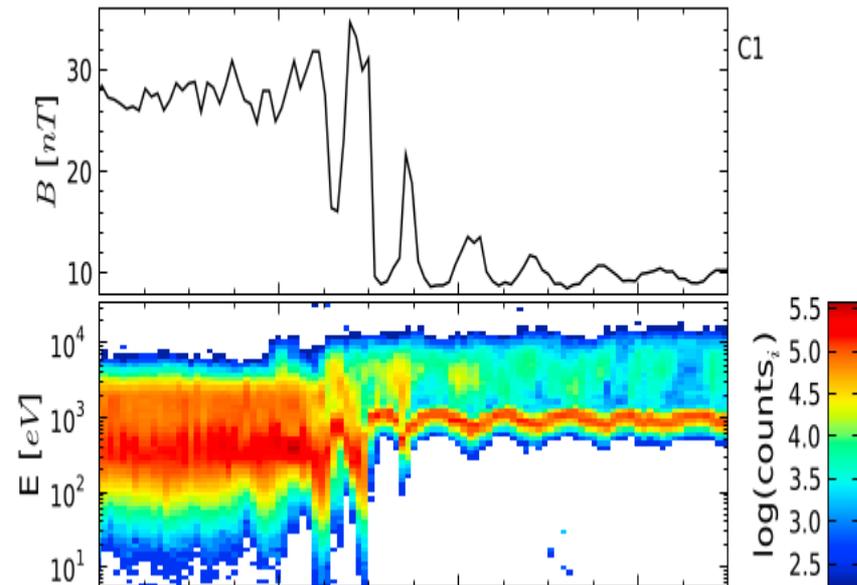
- Experimental space plasma physics
- Atmospheric electricity and lightning induced radio waves
- Development of scientific instruments for spacecraft



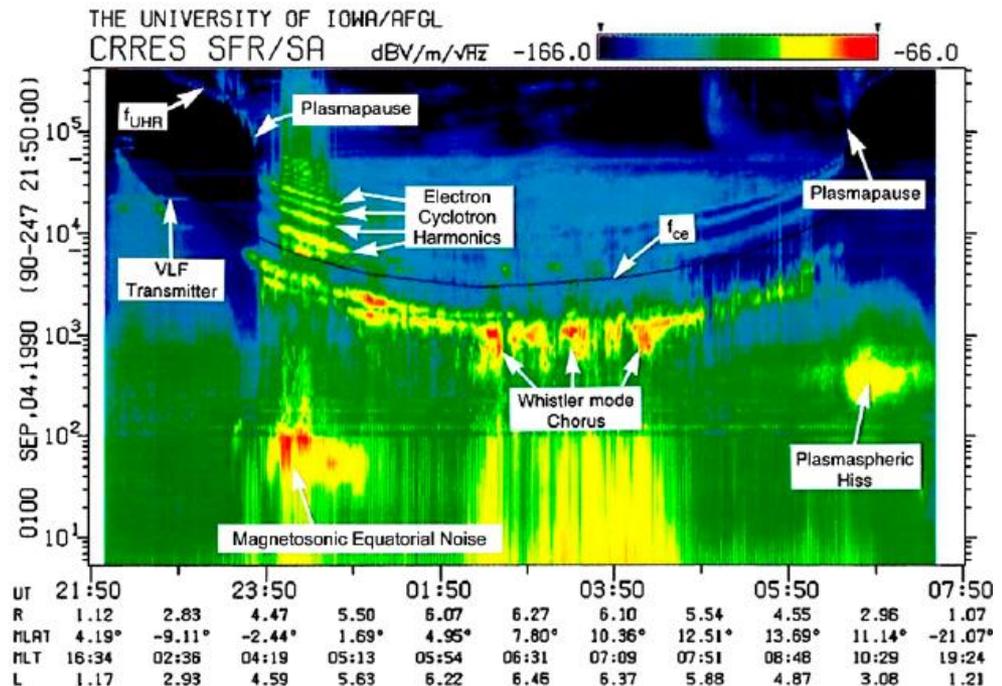
# Research in space plasma physics

Inter-planetary space and planetary magnetospheres are filled with ionized plasma. Charged plasma particles interact via electromagnetic fields, creating a great variety of complex electromagnetic phenomena in space

- electromagnetic waves of natural origin from very low frequencies to radio frequencies (solar radio emissions, auroral radiation etc).
- turbulence, magnetic reconnection, shock waves

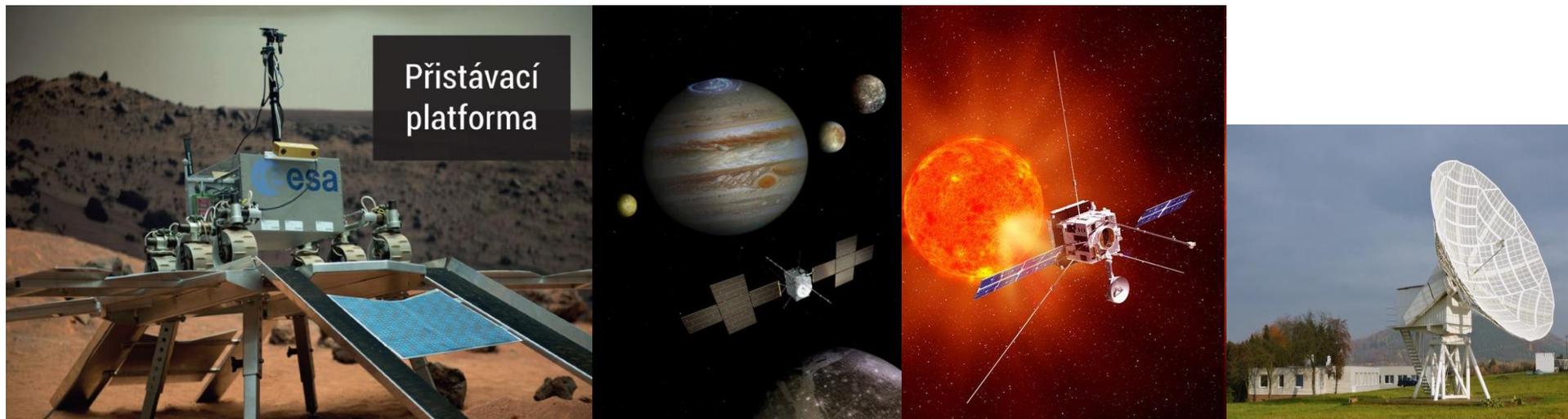


Lefebvre et al, 2007



# Development of Scientific instruments

- Our institute builds on its space heritage by participating in instrument development for ESA scientific missions (and not only ESA).
- We specialize in electronics for electromagnetic field measurements
  - **Solar Orbiter** (ESA): Time Domain Sampler wave analyzer for RPWI instrument
  - **JUICE** (ESA): Low Frequency Receive for the RPWI instrument
  - **TARANIS** (CNES): A high frequency wave receiver analyzer IME-HF.
  - **Exomars 2020** (ESA/Roskosmos): Wave Analyzer Module for landing platform
- Downlink of science telemetry from ESA Cluster satellites at a telemetry station in Panska Ves, including ground processing, calibration and delivery to ESA archive.

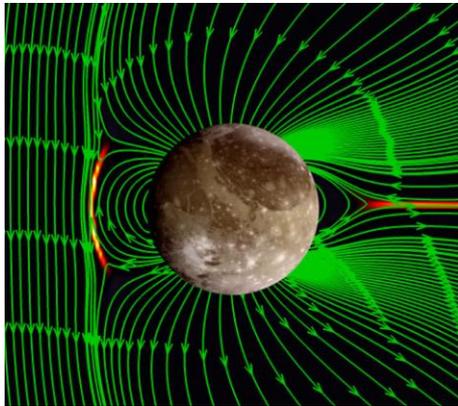


# JUICE mission and RPWI instrument

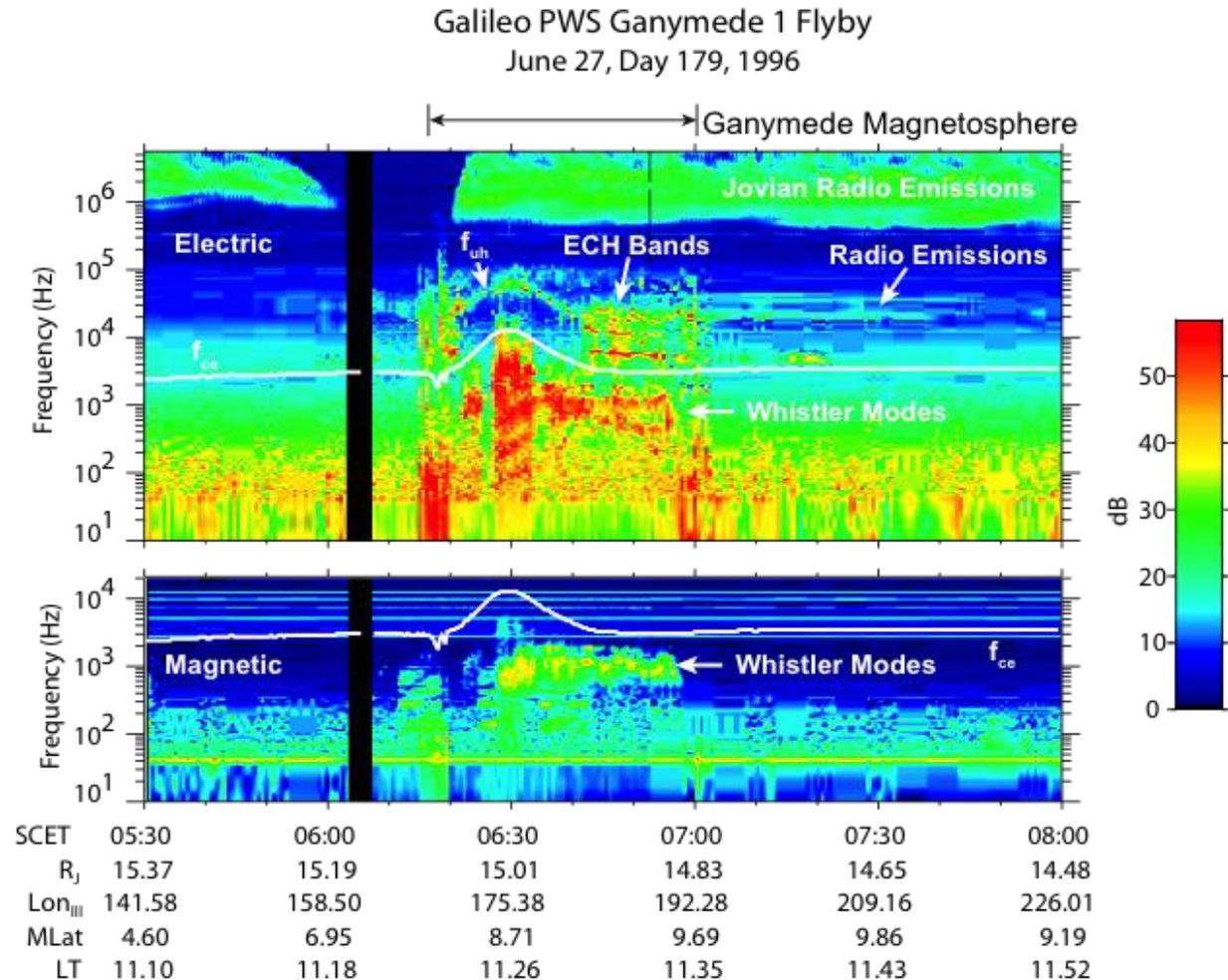


- Large mission of European Space Agency to study Jupiter and its largest moons Ganymede, Europa and Callisto
- Launch planned for 2022
- IAP is a Co-PI institute of Radio and Plasma Wave Instrument lead by IRF Uppsala, Sweden

# JUICE: Importance of electromagnetic field measurements



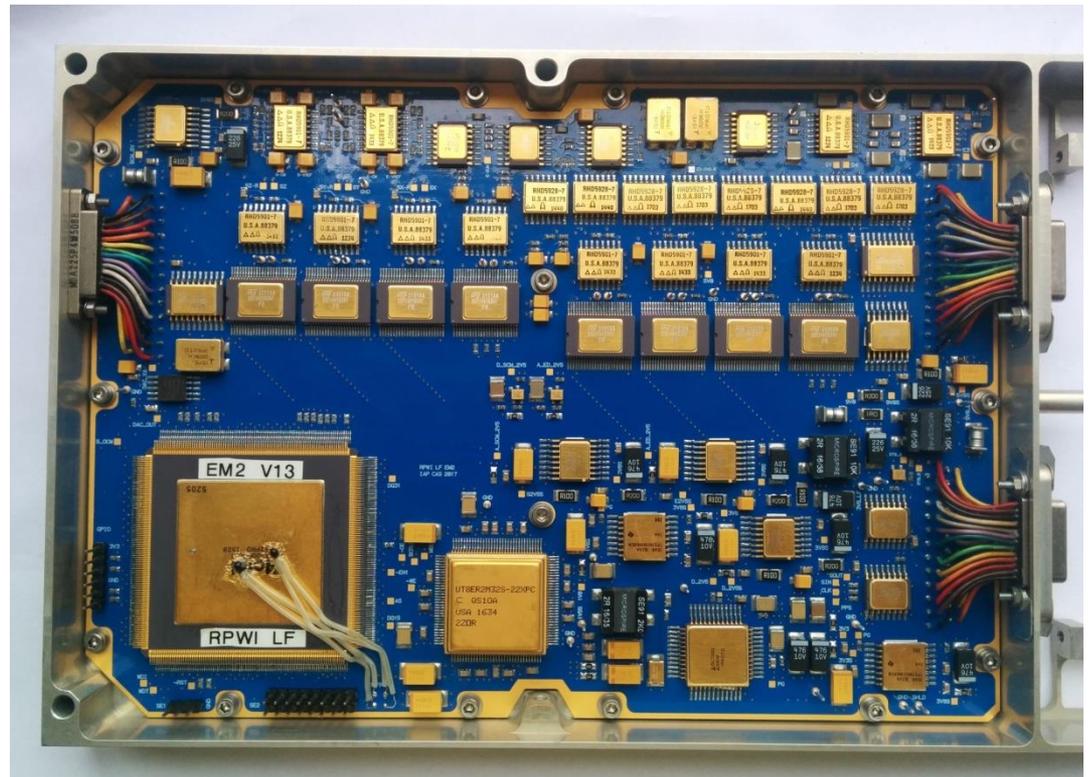
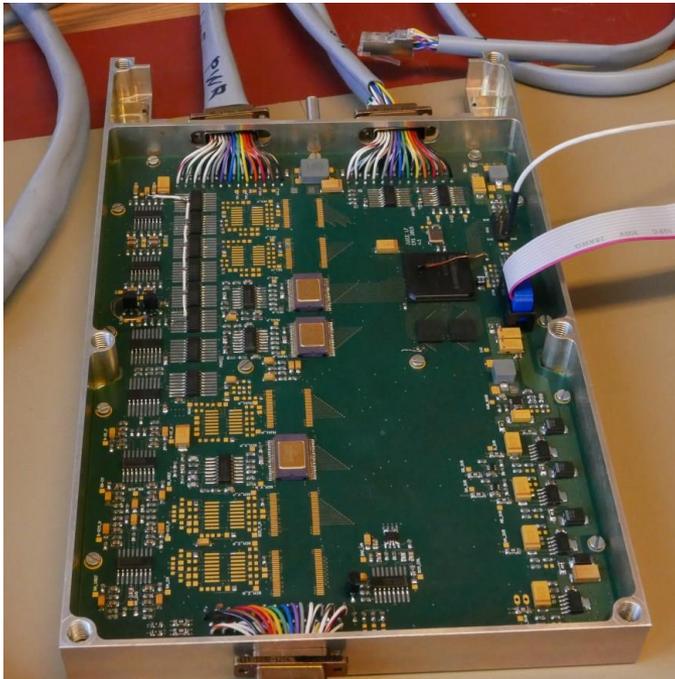
**Ganymede** is a unique object in the Solar system. It's magnetic field creates a magnetosphere immersed in the strong magnetic field of Jupiter.



Magnetosphere of Ganymede was first discovered in 1996 from wave measurements on the Galileo spacecraft.

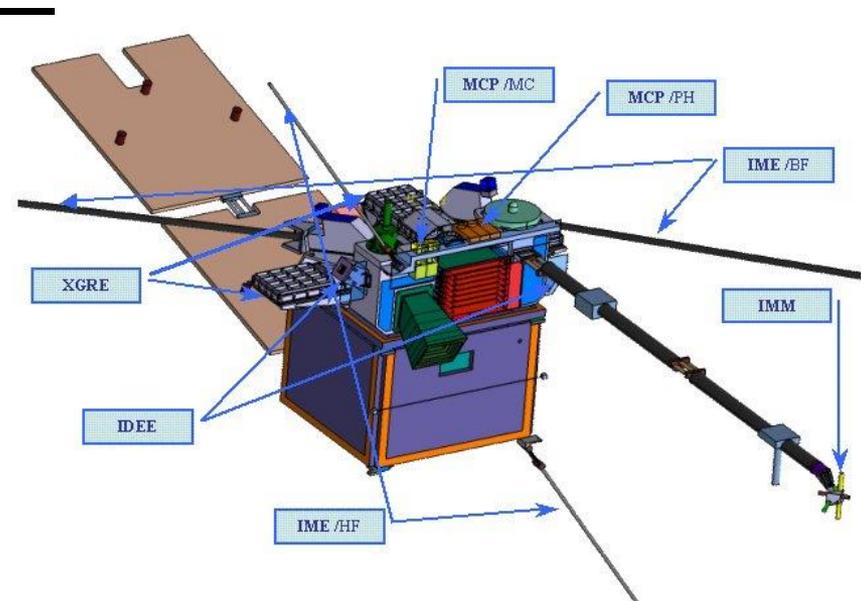
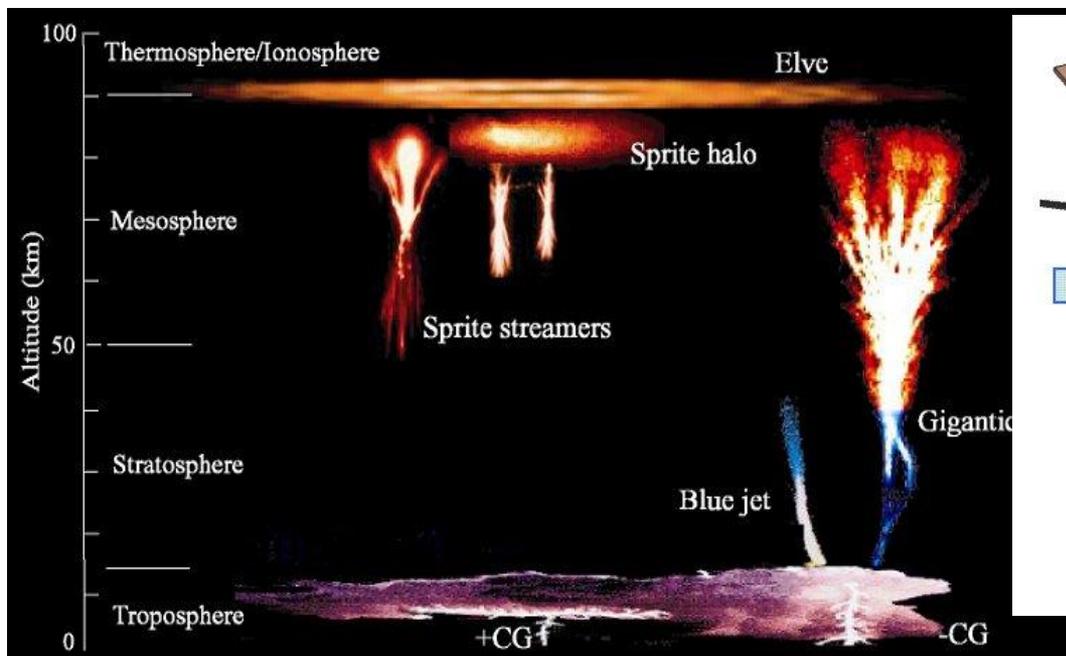
# JUICE/RPWI Low Frequency Receiver

- Instrument to digitize and process measurements of electric and magnetic fields up to 20 kHz (audio frequency range)
- Will study coherent plasma waves and electromagnetic interaction of Jovian moons with surrounding plasma
- Advanced FPGA-based digital signal processing: spectral analysis, wave polarization analysis and waveform measurements



# TARANIS mission

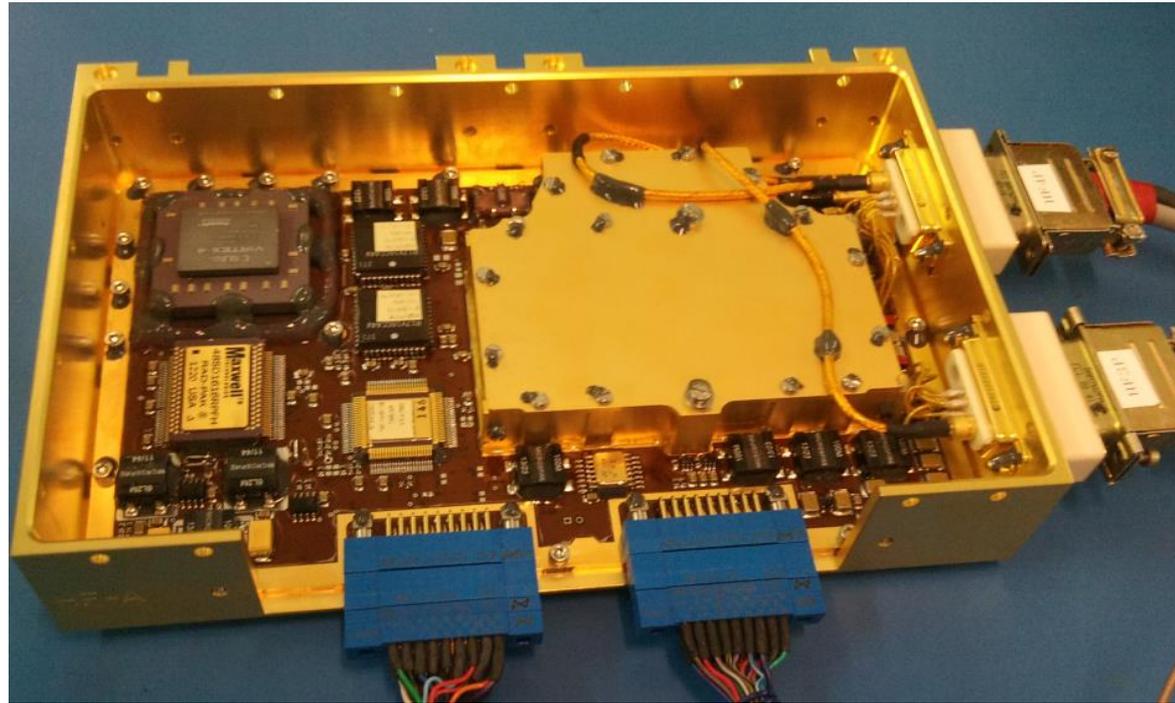
- Small spacecraft of French space agency CNES in low Earth orbit (700 km). Launch in 2019/2020
- Scientific objectives:
  - Atmospheric phenomena associated with lightning, such as transient luminous phenomena (sprites, elves) and terrestrial gamma ray flashes



# IME-HF instrument on TARANIS

A high frequency analyzer intended to study electromagnetic radiation originating in atmospheric lightning discharges and in transient luminous events.

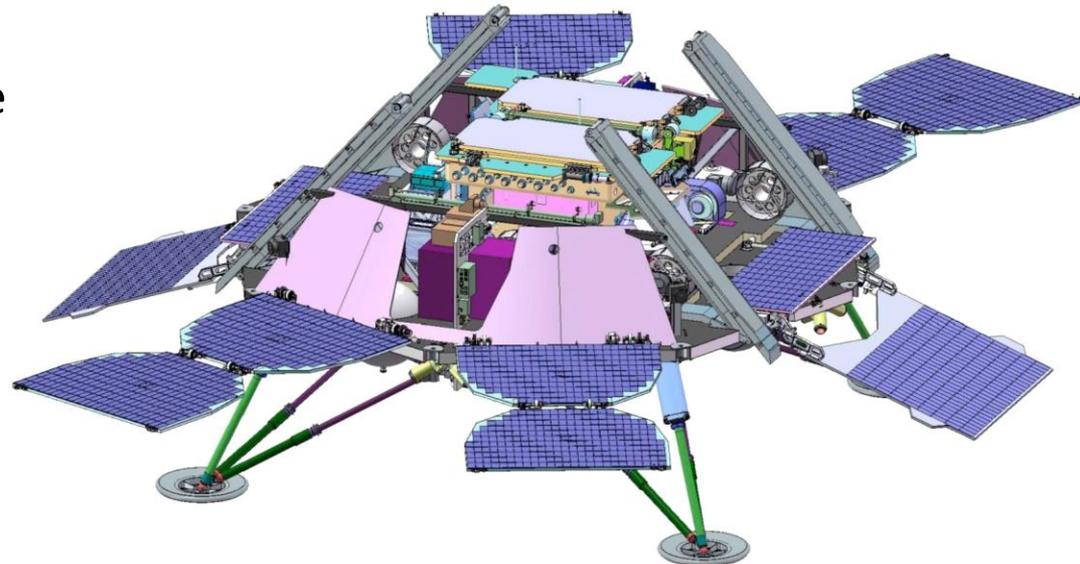
- Broadband electric field measurements of the HF electric field between 5 kHz and 37 MHz
- Fast on-board digital data processing and event detection.



Space measurements will be supported by our **network of ground measurement sites for lightning induced radio waves** (Czech Republic, Slovakia, France, Netherlands)

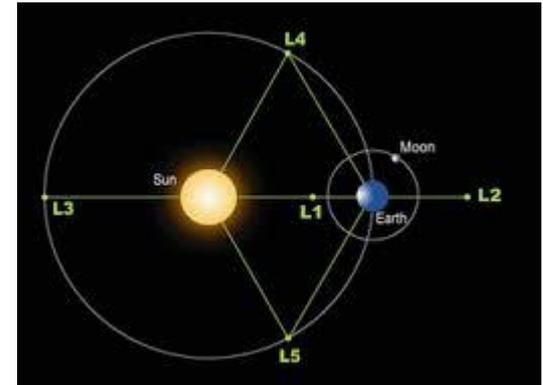
# ExoMars 2020: Wave analyzer module

- European contribution to the MAIGRET instrument on the ExoMars landing platform.
  - **PI institute of ESA-selected wave analyzer module: a wave receiver with advanced processing algorithms, electric and magnetic antennas.**
- Measurements of electric and magnetic field fluctuations at the surface of Mars.
- Main goals:
  - Verify whether lightning-like discharges exist in Martial dust devils.
  - Determine by experiment, whether space borne electromagnetic waves can reach the surface of Mars.



# Future participation in ESA projects

- Lagrange - a mission to the Earth-Sun L5 Lagrangian point.
  - A part of future space weather monitoring network (ESA Space Safety program).
  - We work on the definition of an on-board Data Processing Unit for science data.



- Athena X-ray observatory:
  - A future large space telescope, studying the universe in high energy part of electromagnetic spectrum.
  - In collaboration with Astronomical Institute, the IAP will develop a Remote Terminal Unit for the X-IFU instrument,
  - Scientific interest in the Solar system

