Polish participation in current satellite scientific missions

Piotr Orleański, CBK PAN

- Solar Orbiter / STIX
- JUICE / RPWI & SWI
- PROBA-3 / ASPIICS
- IMAP / GLOWS
- ARIEL / FGS
- Comet Interceptor / DFP

Copernican Congress, Feb. 20-21, Toruń

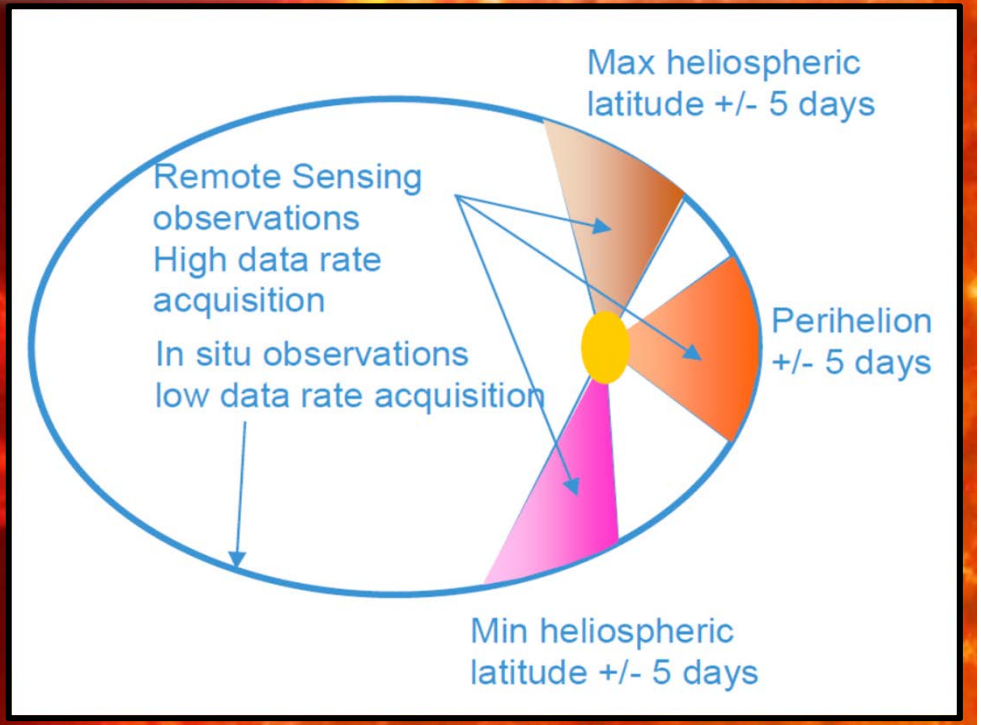
Ilustrations: ESA

Mission: Solar Orbiter / ESA M3

Mission highlights: close (0.28AU) images of the Sun, the first ever close-up images of the Sun's polar regions, measuring the composition of the solar wind and linking it to its area of origin on the Sun's surface.

Launched: in February 2020. First images released: in July 2020. Beginning of routine science operations: in November 2021. Observations: 7 years nominal plus 3 years extended.

Six remote-sensing instruments and four sets of in situ instruments.



Ilustrations: ESA, FHNW, CBK PAN

Instrument: STIX

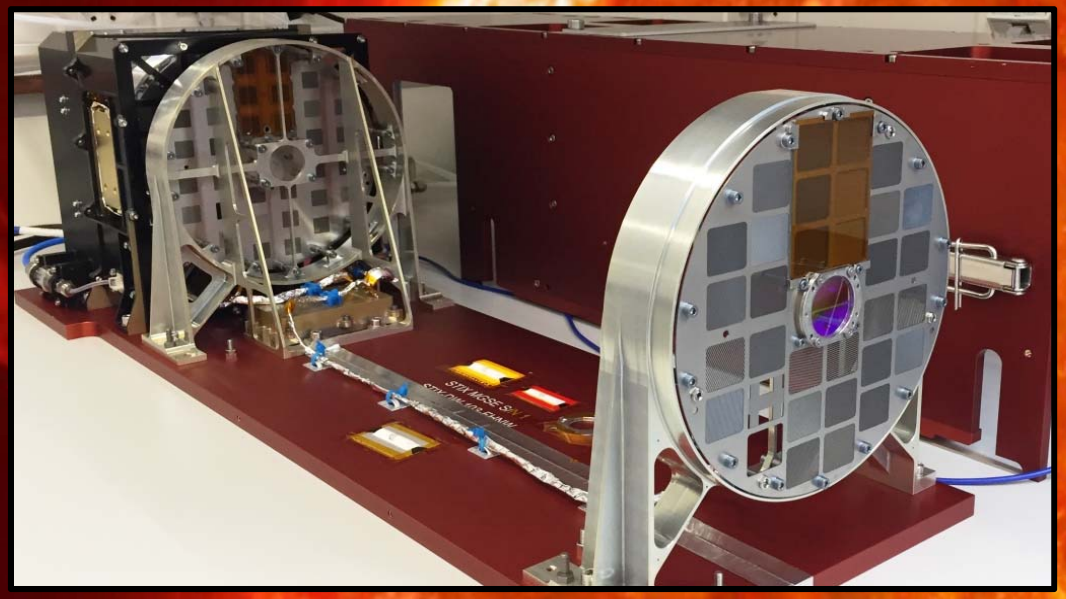
(Solar orbiter Telescope and Imager for X-ray)

PI: Säm Krucker, FHNW, Windisch, Switzerland

X-ray imaging spectrometr using indirect (Fourier) imaging to achieve 7arcsecond imaging with high spatial resolution from 4 to 50keV. Dynamic range: 1 to 2x10^4 counts/s, further extended to above 10^5 by use of moveable X-ray attenuators and selected pixel disablement. Bi-grid collimators with tungsten X-rays Grids, FOV 2º, solar pointed.

Polish contribution :

- scientific program,
- Instrument DPU,
- EGSE,
- thermal calculations and simulations



Ilustrations: ESA, FHNW, CBK PAN

Mission: JUICE, JUpiter Icy moon Explorer / ESA L1

Juice will make detailed observations of the Jupiter and its three large ocean-bearing moons – Ganymede, Callisto and Europa – with a suite of 10 remote sensing, geophysical and in situ instruments.

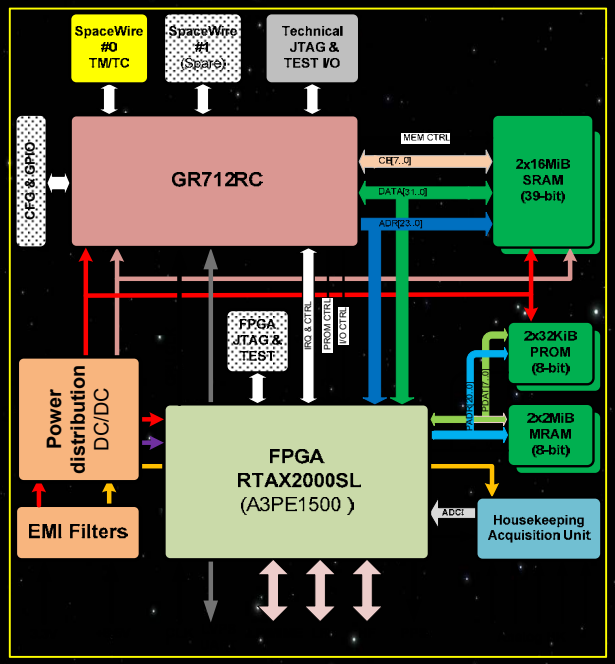
Launch window: April 2023, French Guiana. JUICE will journey for eight years before starting its complex maneuvers in the Jupiter system making 35 flybys of Europa, Ganymede and Callisto before orbiting Ganymede

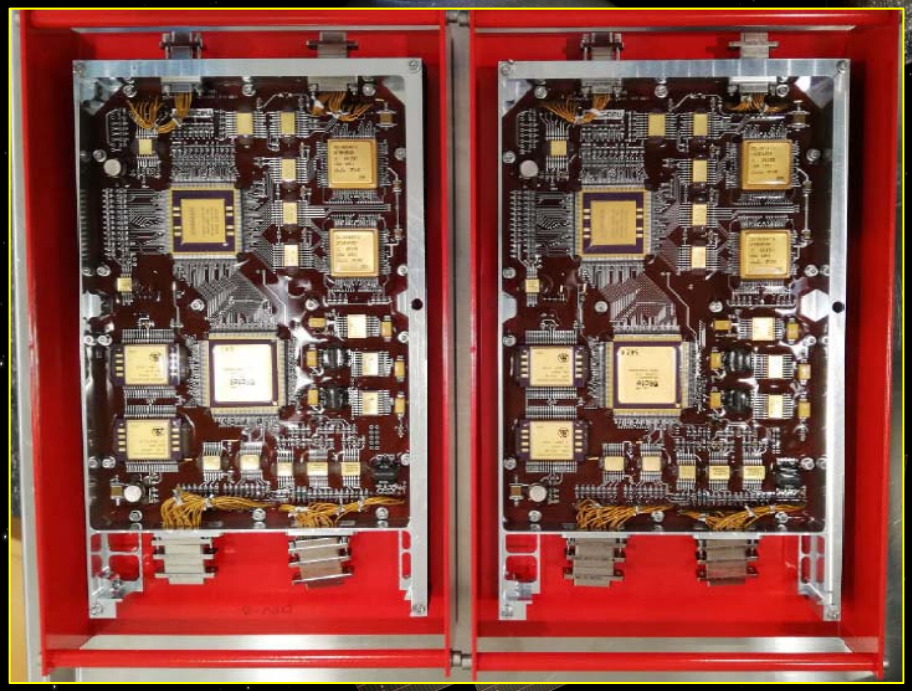
Ilustrations: ESA, CBK PAN

Instrument: RPWI / JUICE (Radio and Plasma Wave Investigation)

PI: J.-E. Wahlund (Swedish Institute of Space Physics)

Co-PI: Hanna Rothkaehl (CBK PAN)





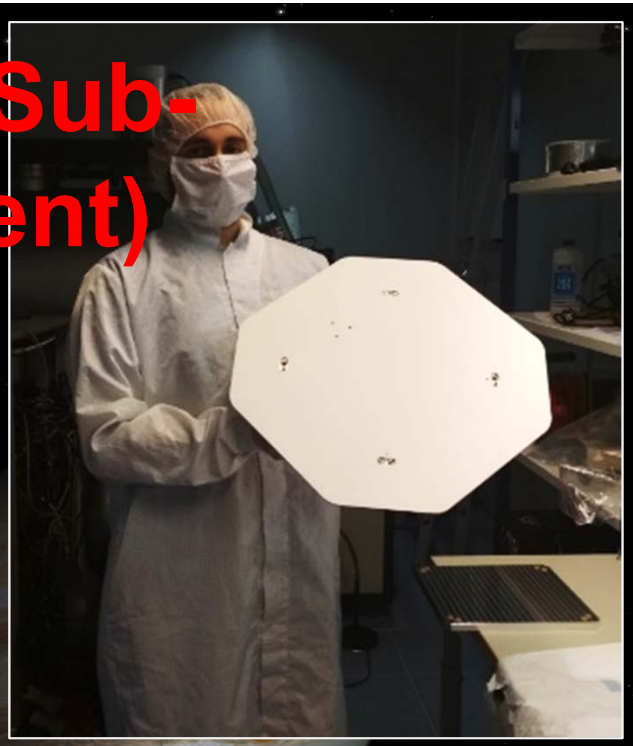
Polish contribution:

Science, Instrument DPU, Boom, Antennas

Ilustrations: ESA, CBK PAN

Instrument: SWI / JUICE (Sub-millimeter Wave Instrument)

PI: JP. Hartogh, MPIfS, Germany



A sub-millimeter wave instrument to investigate the temperature structure, composition and dynamics of Jupiter's stratosphere and troposphere, and the exospheres and surfaces of the icy moons.

SWI is a heterodyne spectrometer using a 30 cm antenna and working in two spectral ranges 1080-1275 GHz and 530-601 GHz with spectral resolving power of ~10^7.

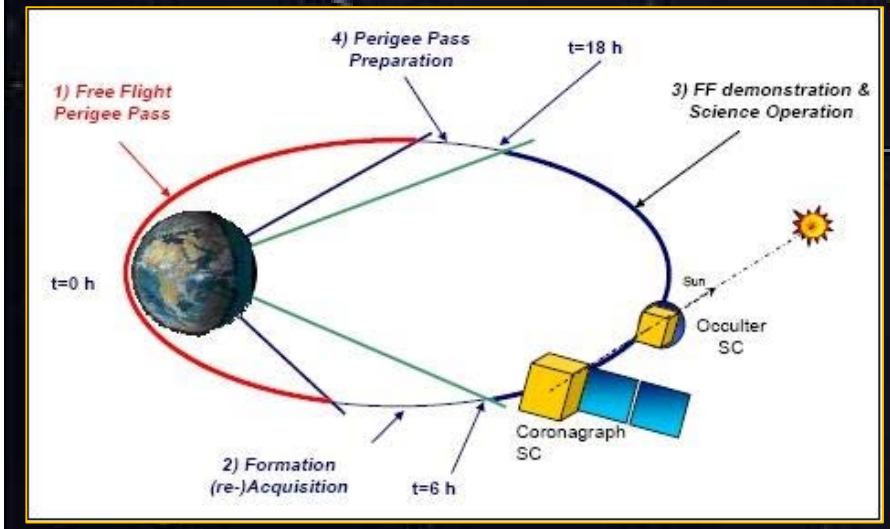
Polish contribution:

- Science,
- Radiator,
- Instrument DPU,
- Instrument PSU

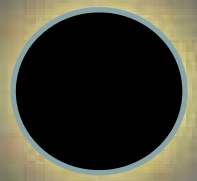
Ilustrations: ESA, CBK PAN

Mission: PROBA-3 / ESA

Proba-3 consists of two small satellites launched together that will separate apart to fly in tandem. Normal operations will then include both: formation flying maneuvers and scientific observations using a giant solar coronagraph.



Coronagraph satellite, 340kg, and Occulter satellite, 200kg, will be kept at the distance of 150m with precision of 1.5 mm and 10 arcsec (Coronograph) and 90 arcsec (Occulter).
Launch planned in 2024



Ilustrations: ESA, CBK PAN

Instrument: ASPIICS / PROBA-3 / ESA

(Association of Spacecraft for Polarimetric and Imaging Investigation of the Corona of the Sun)

PI: Andrei Zhukov, Royal Observatory of Belgium

ASPIICS will observe the solar corona through refractive optics, able to select 3 different spectral bands: Fe XIV line @ 530.4 nm, He I D3 line @587.7 nm, and the white-light spectral band [540;570 nm].

Polish contribution :

- **Coronograph Control Box (DPU, PSU, …)**
- **ASPIICS Software,**
- **Filter Wheel Assembly**

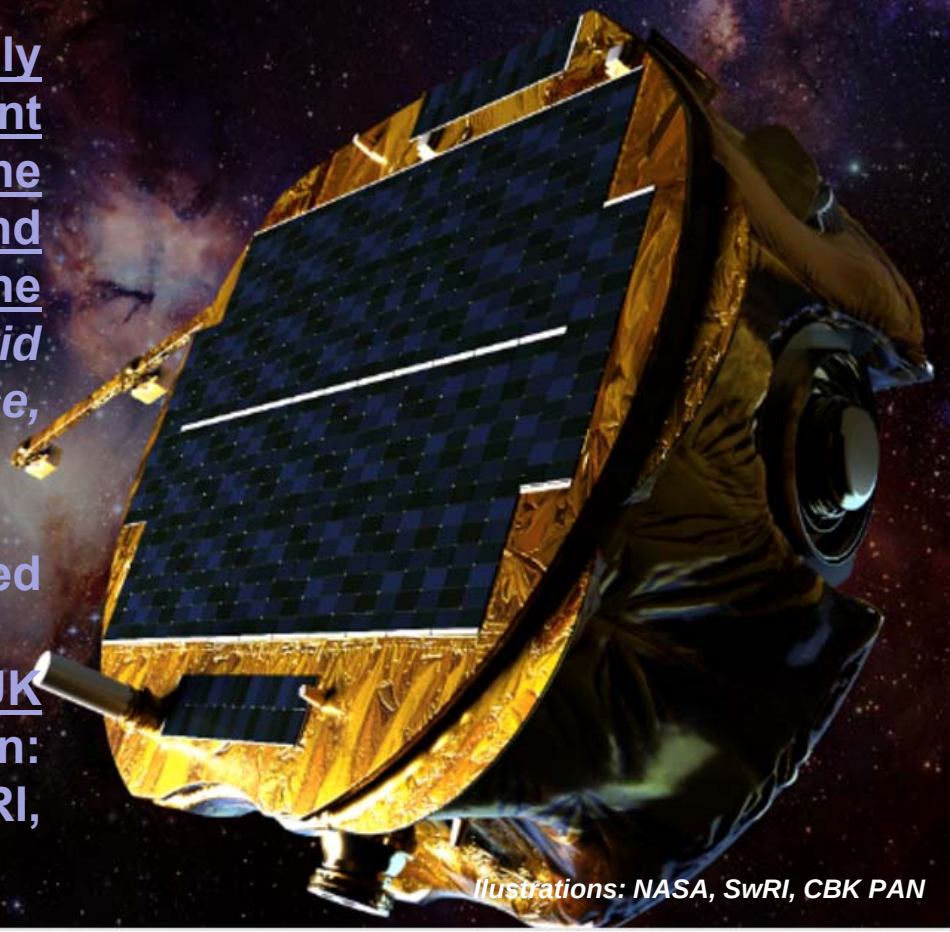
Ilustrations: ESA, CBK PAN

Mission: IMAP / NASA (Interstellar Mapping and Accelleration Probe)

This is the fifth mission in NASA's Solar Terrestrial Probes (STP) Program portfolio. Satellite will be positioned around Lagrange point L1, launch: February 2025 (Falcon 9).

„IMAP mission simultaneously investigates two of the most important issues in space physics today — the acceleration of energetic particles and interaction of the solar wind with the interstellar medium." *(Prof. David McComas, Princeton University Space, mission PI)*.

Spacecraft : Johns Hopkins Applied Physics Laboratory,
Payload: 10 instruments (8 US, one UK and one Polish). Payload coordination: Southwest Research Institute, SwRI, San Antonio, Teksas



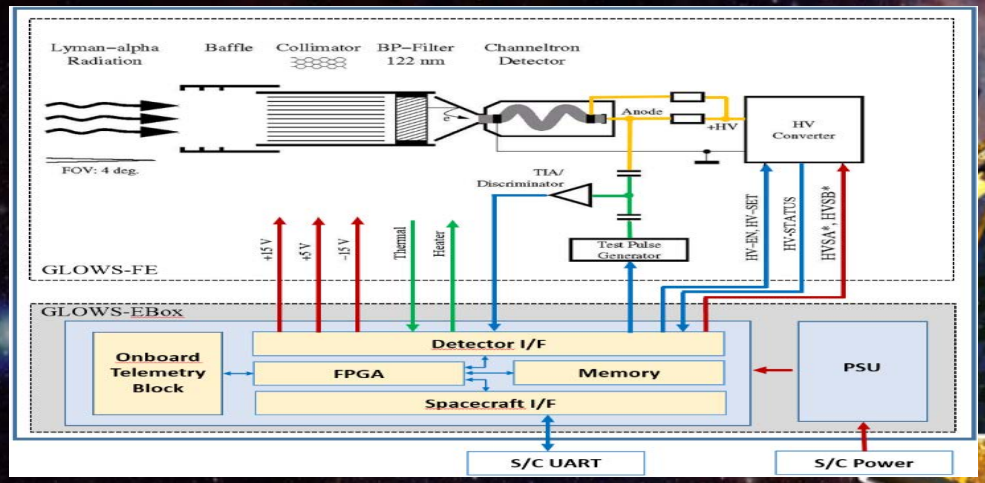
Ilustrations: NASA, SwRI, CBK PAN

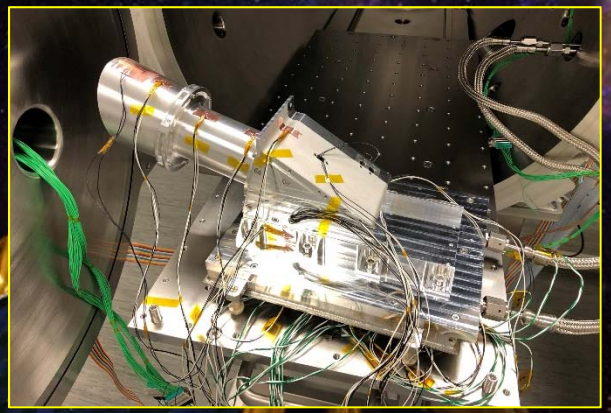
Instrument: GLOWS / IMAP

(GLObal solar Wind Structure)

PI: Maciej Bzowski, CBK PAN

GLOWS is a Lyman-α (121.567 nm) 1-pixel photometer that provides measurements of the heliospheric backscatter UV glow and the heliolatitudinal structure of solar wind. Mass: 2.78kg, power 5.5W (avg), data stream: 1200bps (avg)





Polish contribution:

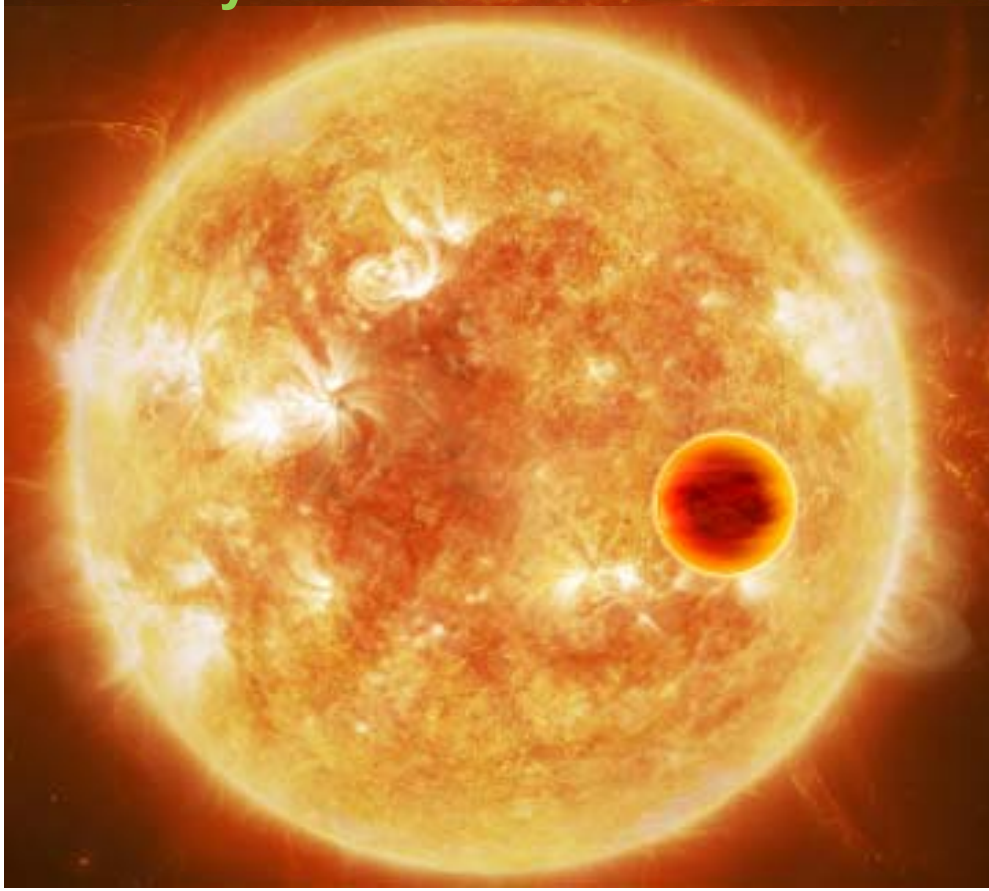
- **IMAP Science**
- **Complete GLOWS instrument**

Ilustrations: NASA, SwRI, CBK PAN

Mission: ARIEL / ESA M4

(Atmospheric Remote-sensing Infrared Exoplanet Large-survey)

Ariel is the first mission dedicated to measuring the chemical composition and thermal structures of hundreds of transiting exoplanets, enabling planetary science far beyond the boundaries of the Solar System.



Ariel is foreseen to launch in 2029 by Ariane 62.

Nominal 4-year operational timeline is planned, with a potential extended science operations phase lasting for two further years.

Ariel will be launched into an (Earth-Moon) eclipse-free orbit around the Sun-Earth L2 point.

Ilustrations: ESA, CBK PAN

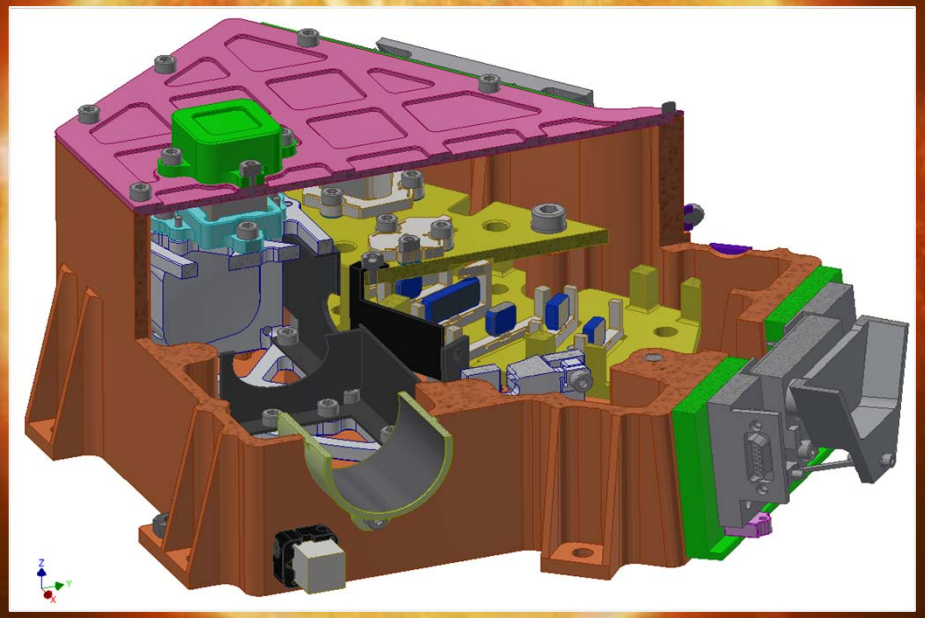
Instrument: ARIEL FGS

(Fine Guidance System)

Mission PI: Giovanna Tinetti, University College of London

FGS CoPI: Mirosław Rataj, CBK PAN

FGS setup includes a Gregorian telescope and the set of four-channel photometer / spectrometer. Three photometers present narrow spectral bands channels spanning 0.50–0.55 μm, 0.8–1.0 μm and 1.0–1.2 μm channels. A low-resolution spectrometer covers 1.25–1.95 μm.



FGS consortium:

- CBK PAN (leader),
- JPL (USA),
- OHB (IT),
- UniVienna (A),
- DIAS (IR).

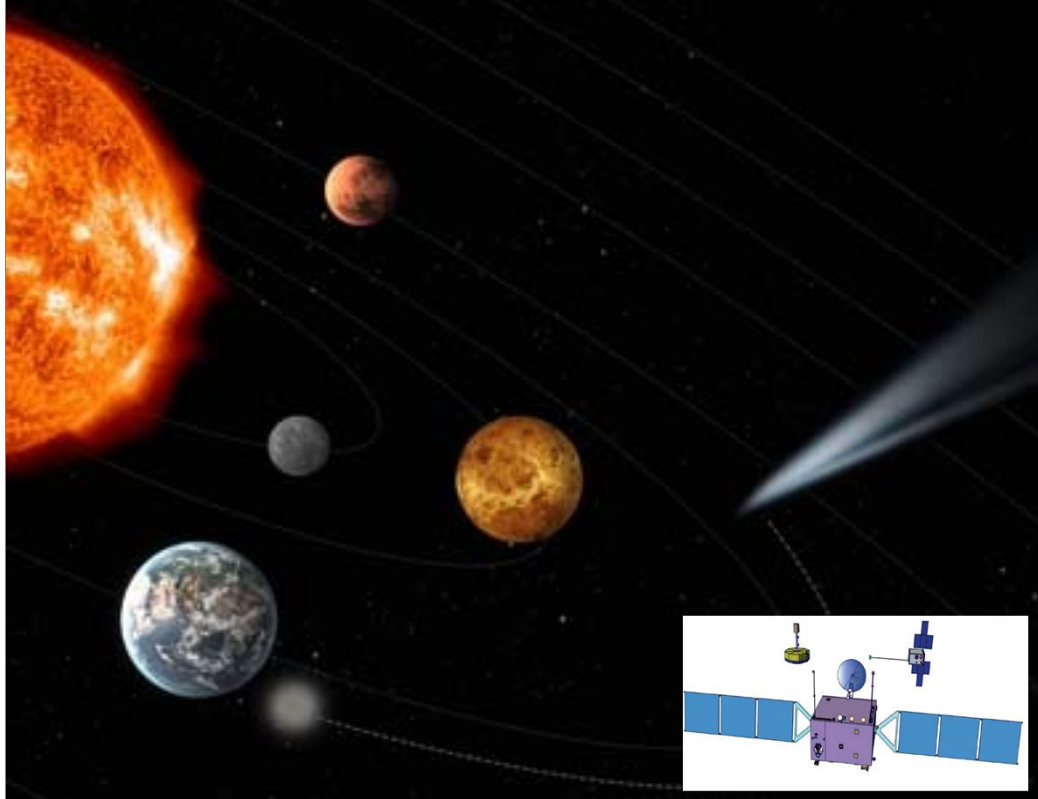
Polish contribution:

- Science,
- Integrated FGS.

Ilustrations: ESA, CBK PAN

Mission: Comet Interceptor / ESA F1

The mission will travel to an as-yet undiscovered comet, making a flyby of the chosen target when it is on the approach to Earth's orbit. Its three spacecrafts (S/C A, ESA, S/C B1, JAXA, S/C B2, ESA) will perform simultaneous observations from multiple points around the comet, creating a 3D profile of a 'dynamically new' object that contains unprocessed material surviving from the dawn of the Solar System.



Comet Interceptor is planned to be launched with the ESA ARIEL spacecraft in 2029, and delivered to the Sun-Earth Lagrange Point L2.

The 3 spacecrafts will remain connected to each other at L2, where they will wait for up to three years for a long-period comet to fly by at a reachable trajectory and speed.

Ilustrations: ESA, CBK PAN

Instrument: DFP

(Dust, Fields, Plasma)

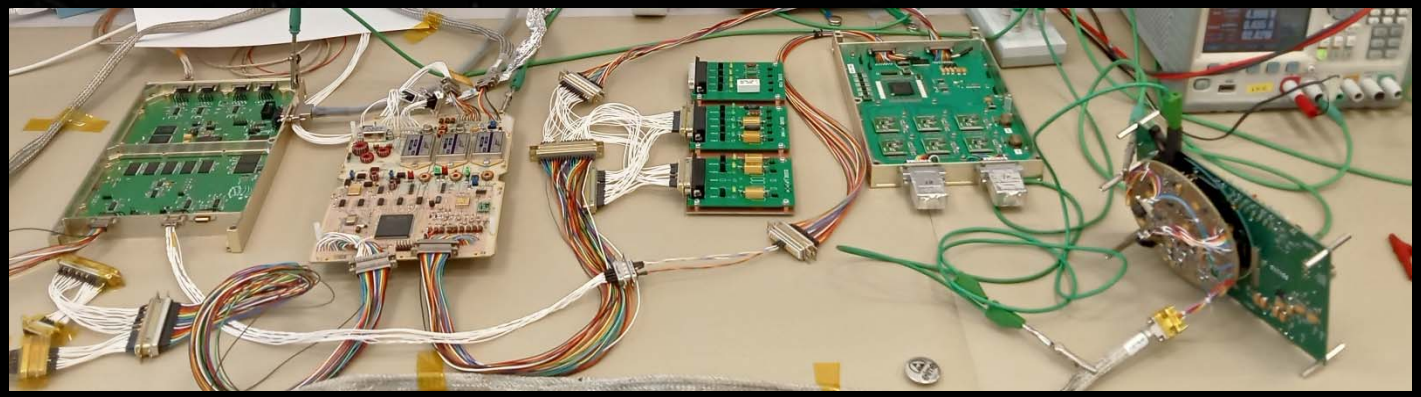
DFP PI: Hanna Rothkaehl, CBK PAN

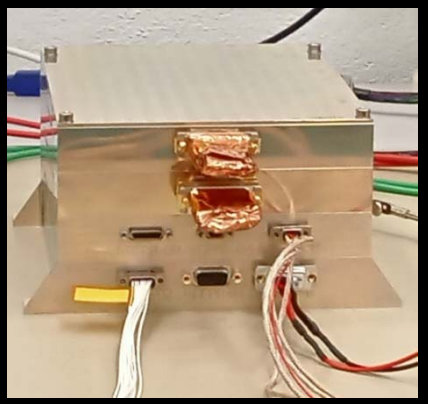
DFP integrates different plasma instruments:

- **FGM (3D magnetic sensors on A and B2),**
- **SCIENA (Solar wind and Cometary Ions and Energetic Neutral Atoms on A),**
- **LEES (Low Energy Electron Spectrometer, on A),**
- **COMPLIMENT (COMetary Plasma Light InstruMENT on A)**
- **DISC (Dust Impact Sensor and Counter on A and B2).**

Polish contribution:

Science, PSU for all DFP instruments, mechanical structure for DFP PSU & DPU.





Ilustrations: ESA, CBK PAN

Due to the time limit many of current and planned space projects, Poland is involved in, are not mentioned in this presentation, sorry for this.

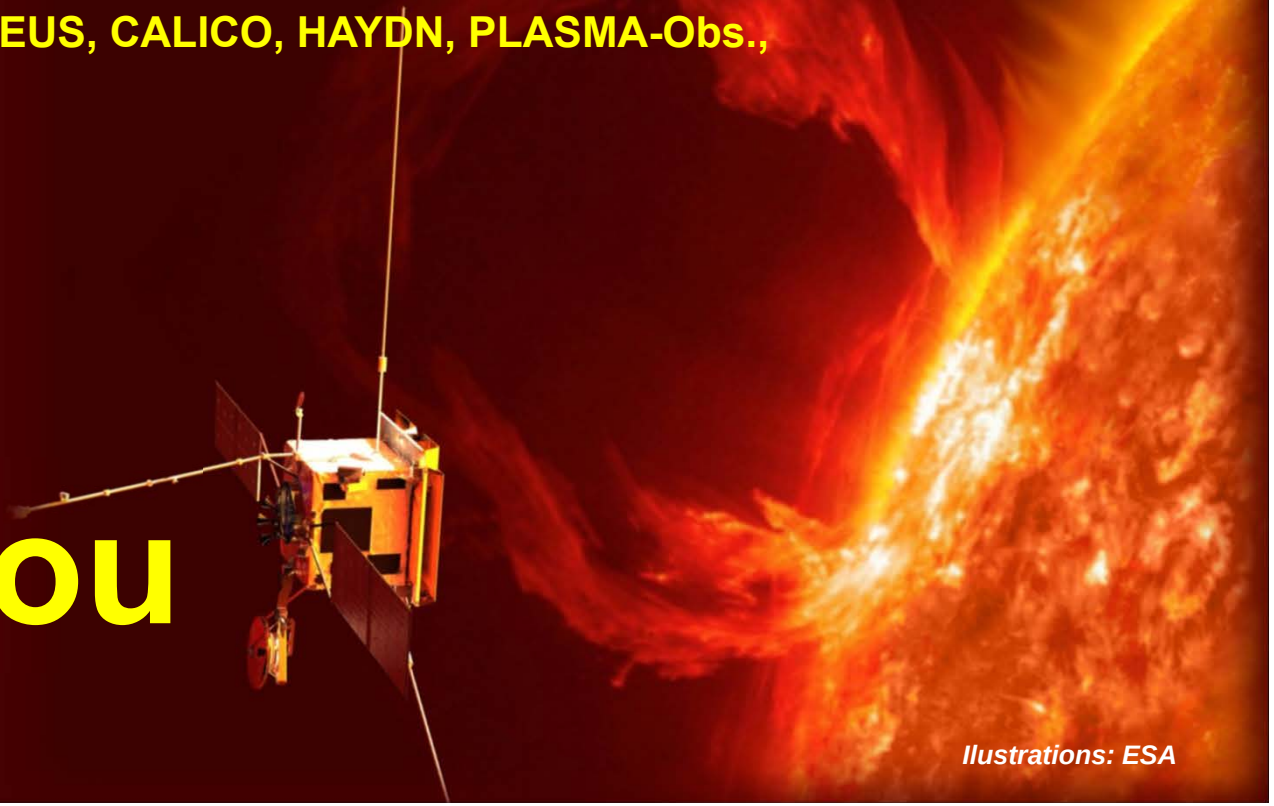
Already working in space:

- INTEGRAL
- Mars Express,
- BRITE,
- ExoMars,
- BeppiColombo,
- ASIM.

In preparation (or discussed):

- ATHENA,
- eXTP,
- ESA M7 candidates – THESEUS, CALICO, HAYDN, PLASMA-Obs.,
- LISA,
- ADRIOS Clear Space 1,
- HYADES (ERC),
- and a few more, …..,.

Thank you



Ilustrations: ESA