

Space physics  
Mechanical engineering >>

Credit: ESA, Jon Anders Dalan

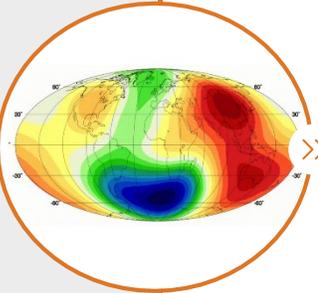
# In situ space science instruments

Dr. Sylvain Ranvier, Ir. Lars Jacobs

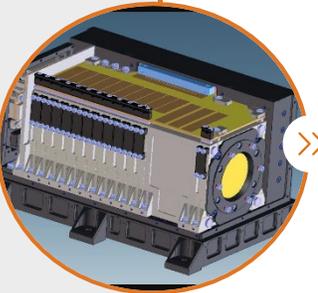
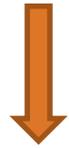




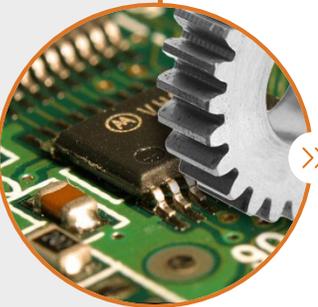
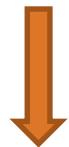
# Need for technology



BIRA-IASB main tasks: scientific research and public service



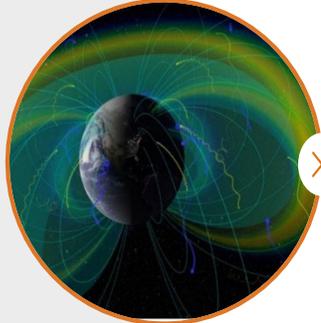
Instruments



Specific technologies, engineering services

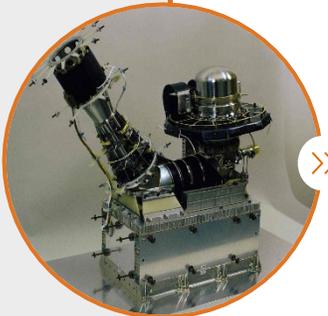


# In situ measurements

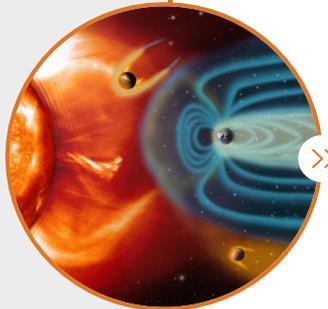


Strong link between instrument, S/C and measured environment

~~BLACK BOX~~



⇒ Need to perfectly know instrument design to interpret measured data





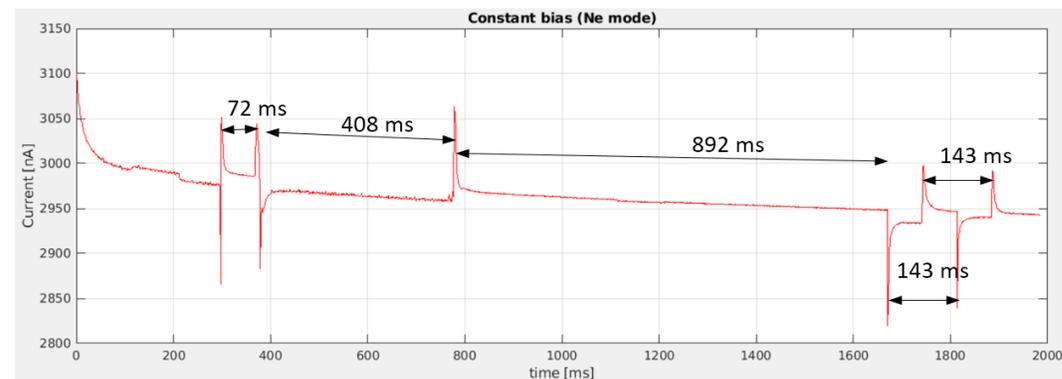
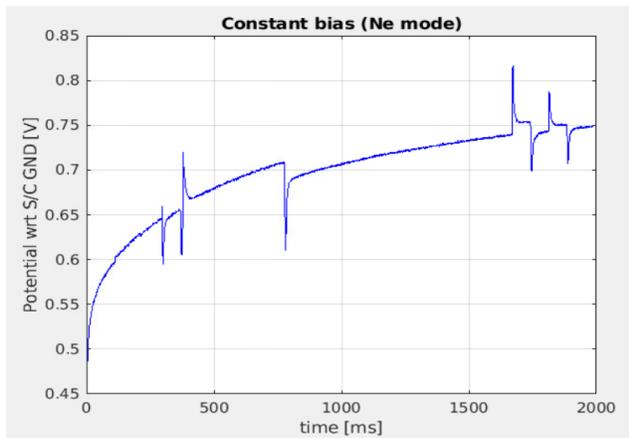
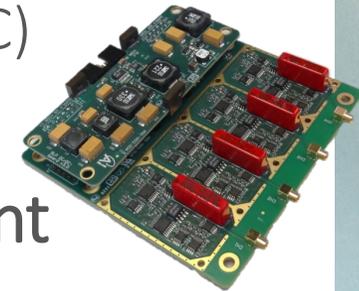
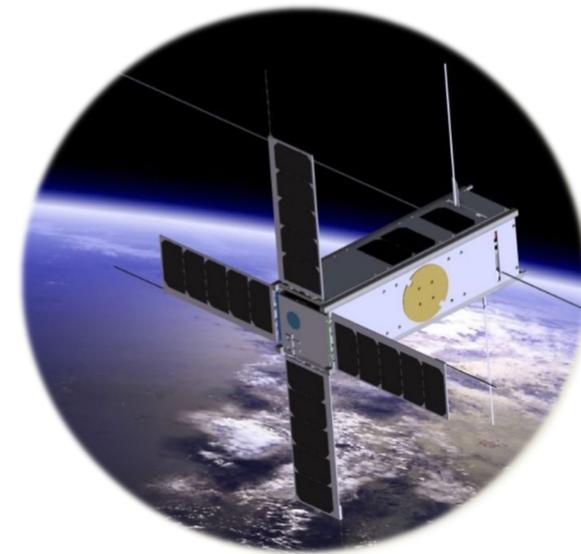
# Example: SLP/PICASSO

SLP: fully developed at BIRA-IASB (HW and SW)

Probe surface contamination, interferences with S/C BCR, S/C charging

⇒ Require in-depth knowledge of instrument (and S/C)

⇒ **Scientific institute needs to be strongly involved in the development of the instrument**





# Mechanical Engineering at BIRA-IASB

The BIRA-IASB engineering team plays a major role in achieving the scientific goals of BIRA-IASB. They are responsible for the design and manufacturing of the necessary instruments in collaboration with Belgian industrial partners and for the technical support of the scientists. Their know-how includes all the steps from an idea till a fully operational instrument:

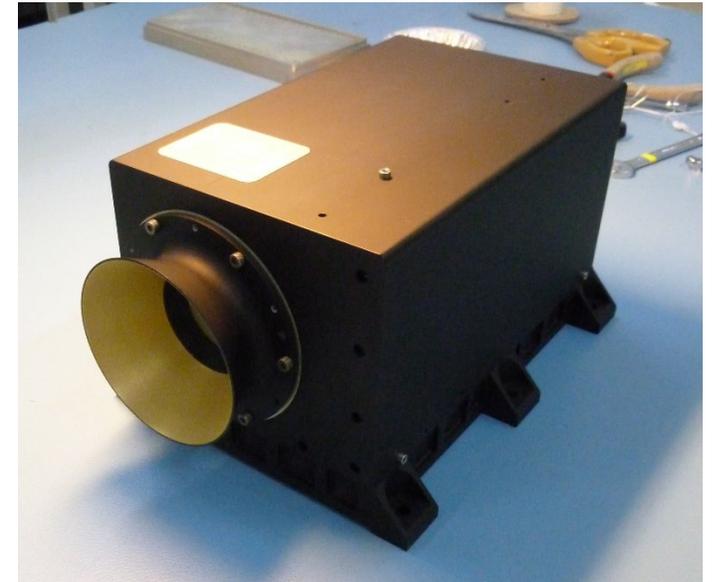
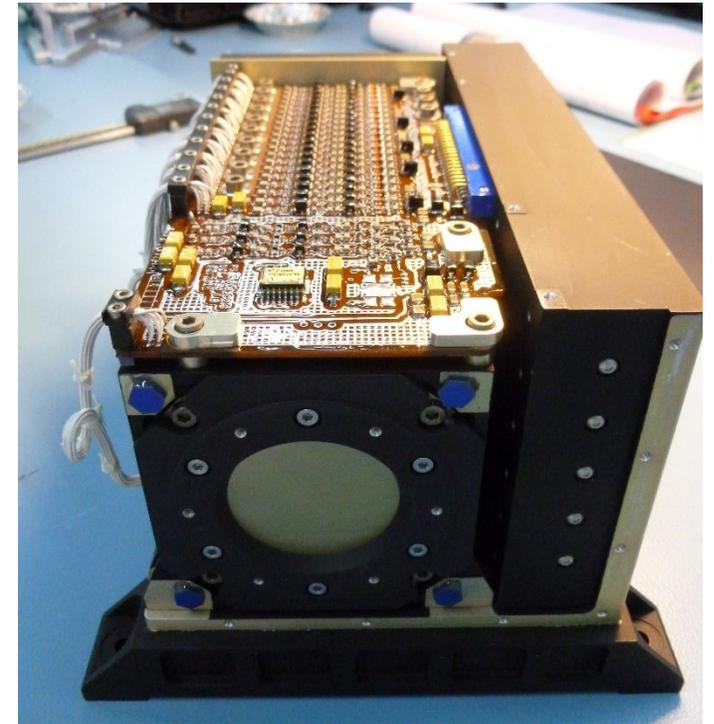
- Project management
- Electronic design and construction
- Mechanical design and construction
- Testing, software development
- Operations and data management
- Maintenance



# Past Achievements

## Energetic Particle Telescope (EPT)

- EPT is an instrument developed to measure high-energy particle fluxes with very good energy, angular and mass resolutions.
- Launched on Proba-V in 2013
- Collaboration with QinetiQ & CSR



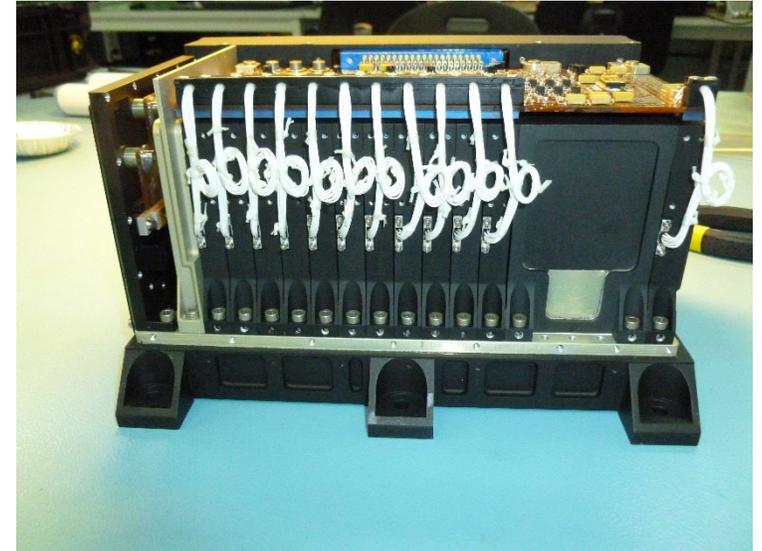


# Past Achievements

## Energetic Particle Telescope (EPT)

BIRA responsibilities:

- Mechanical design
- Integration instrument
- MGSE design and manufacturing
- Support during test campaigns

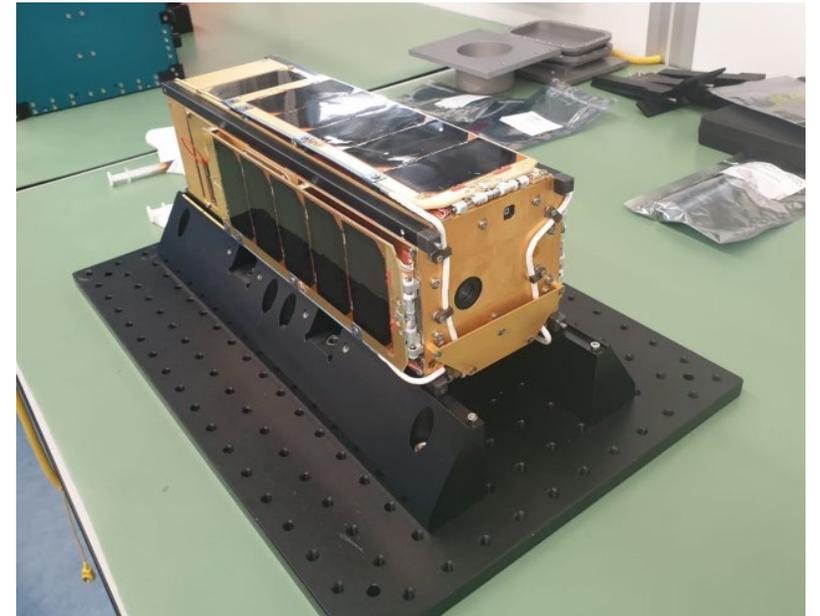
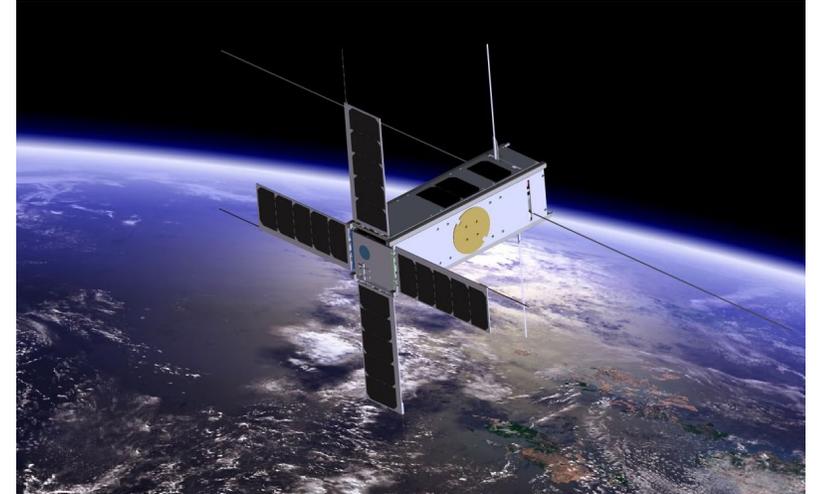




# Past Achievements

## PICASSO-SLP

- PICASSO-SLP is a langmuir probe developed to measure both the plasma density and electron temperature in the upper ionosphere
- Launched on a pico-satellite in 2020
- Collaboration with VTT



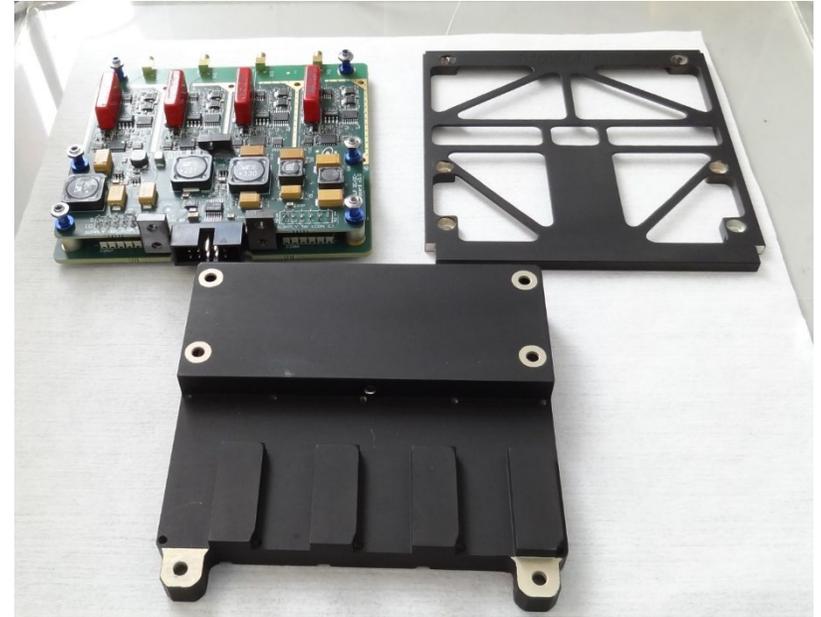


# Past Achievements

## PICASSO-SLP

### BIRA responsibilities:

- Mechanical design
- Manufacturing mechanical hardware
- Integration instrument
- Support during test campaign

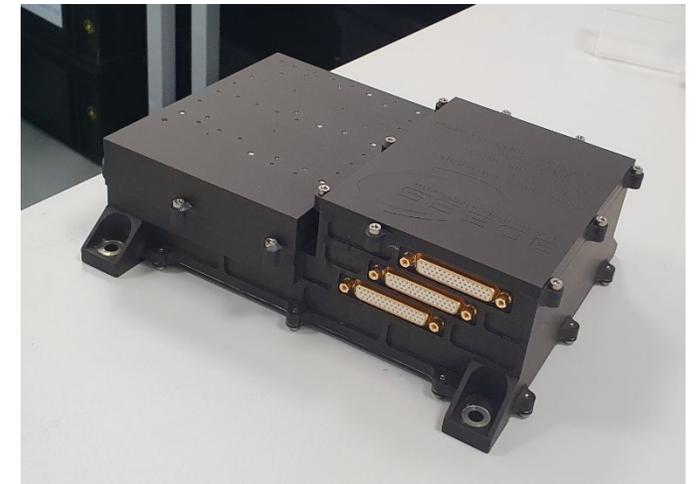
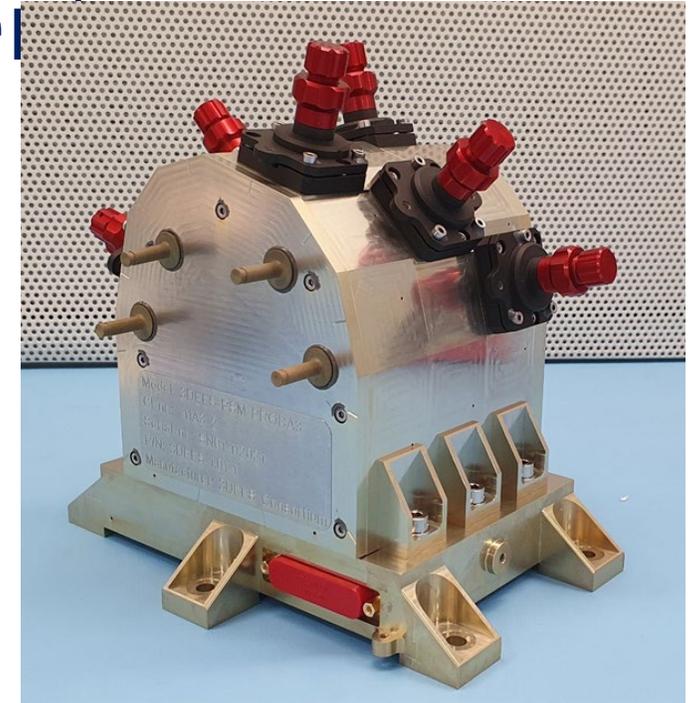




# Current and future instruments

## Three Dimensional Energetic Electron Spectrometer (3DEES)

- 3DEES is a compact and modular instrument developed to measure the high-energy particle fluxes with very good energy, angular and mass resolutions. It is a successor of EPT with additional possibility of measuring in six different directions.
- Targeted to fly on Proba-3, launch planned in 2023
- Collaboration with QinetiQ & CSR



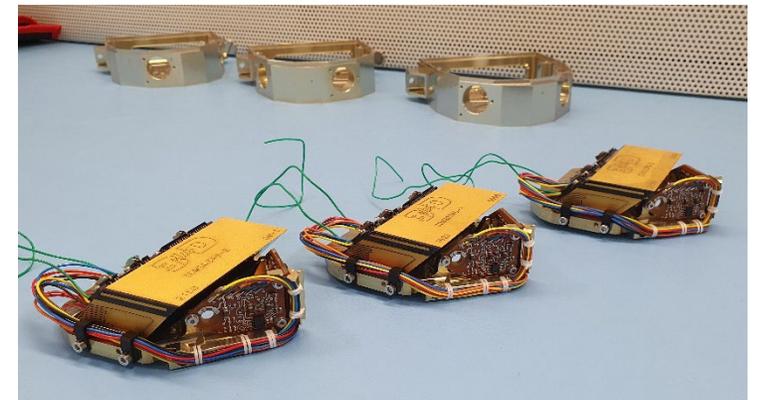
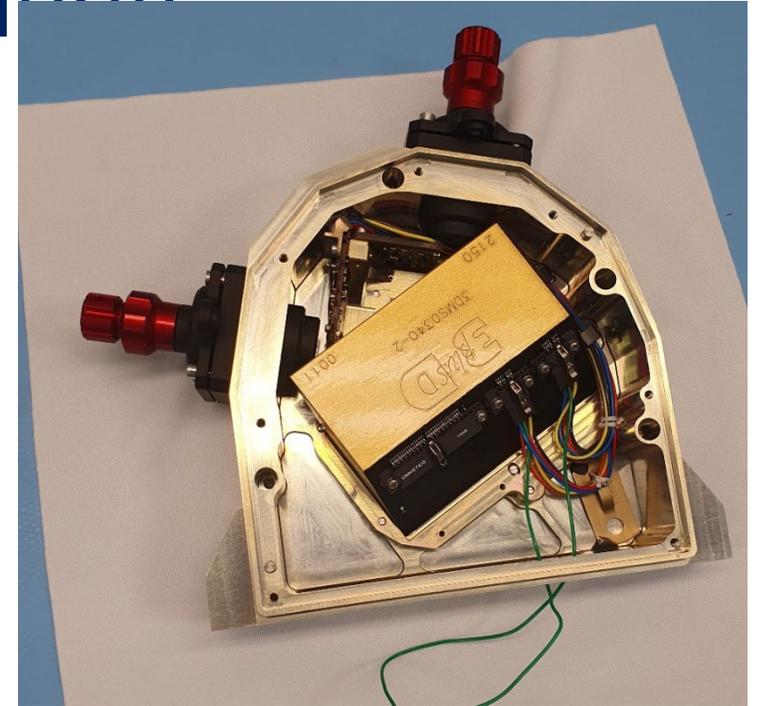


# Current and future instruments

## Three Dimensional Energetic Electron Spectrometer (3DEES)

### BIRA responsibilities:

- Mechanical prototyping
- Mechanical design
- Manufacturing mechanical hardware
- Integration instrument
- Support during test campaign





# Current and future instruments

## Comet Interceptor - Compliment

- COMPLIMENT exists out of two probes, one merged magnetometer and langmuir probe and one langmuir probe.
- Launch expected at the end of this decade



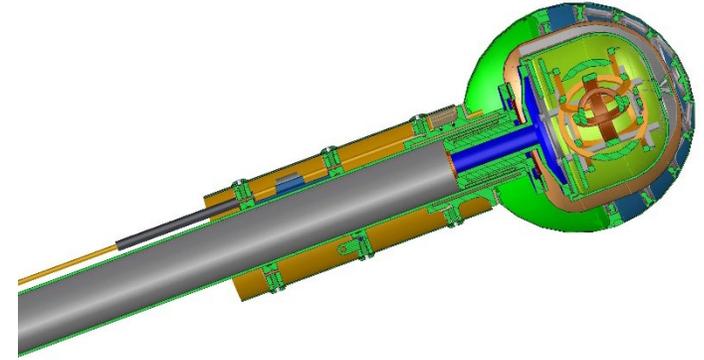


# Current and future instruments

## Comet Interceptor - Compliment

### BIRA responsibilities:

- Mechanical prototyping
- Mechanical design
- Manufacturing mechanical hardware
- Integration instrument





# Strengths of the mechanical department of BIRA

## Designing and prototyping

- We have a small motivated team experienced in developing mechanical hardware
- From small subsystems (Mechanism on NOMAD) to larger mechanical assemblies (Mechanical hardware for space and ground based instruments)
- We have a 3D printer for prototyping or for light structural ground based instrument parts



# Strengths of the mechanical department of BIRA

## Manufacturing of high precision hardware

- The team has highly experienced and skilled technicians
- We have experience in manufacturing parts in common materials such as aluminium and stainless steel, as well as in more exotic materials such as Tungsten, Ultem, PEEK, Copper, Vespel, lead, ...
- Facilities at our disposal:
  - Several high quality and precision machines: Milling and turning
  - Several sheet metal machines
  - Welding room
  - Joinery



# Strengths of the mechanical department of BIRA

## Integration and Testing

- Our team has experience in integrating and testing space and ground based instruments
- Facilities at our disposal
  - Ultrasonic baths for cleaning and decontaminating hardware
  - Grey room with laminar flux (ISO class 4) for integration and testing of space instruments
  - Cleanroom (ISO class 5) with thermal vacuum chamber
  - Integration room for smaller ground based instruments
  - Assembly hall for larger ground based instruments



# Collaboration opportunities with industrial partners

The following services are available but rather limited at BIRA. We are looking for possible partnerships to enhance these services

- Project management and System Engineering
- PA/QA activities (Expertise in house with B.USOC)
- Space qualified electronic manufacturing
- Space qualified mechanical manufacturing
- Testing (Vibrations, Shock, ...)
- Structural and thermal analysis
- Radiation analysis (Expertise in house with SPENVIS-team)



# BIRA-IASB – industry : complementarity

Engineering dpt of BIRA-IASB and industry : **complementary**

## **Continuity:**

Long project duration (can be > 10 years)

Industry: often changes project managers and engineers

BIRA-IASB: long term follow up of the project

## **Full picture:**

Several industrial partners (mechanics, electronics, SW)

BIRA-IASB: 1 team has complete overview

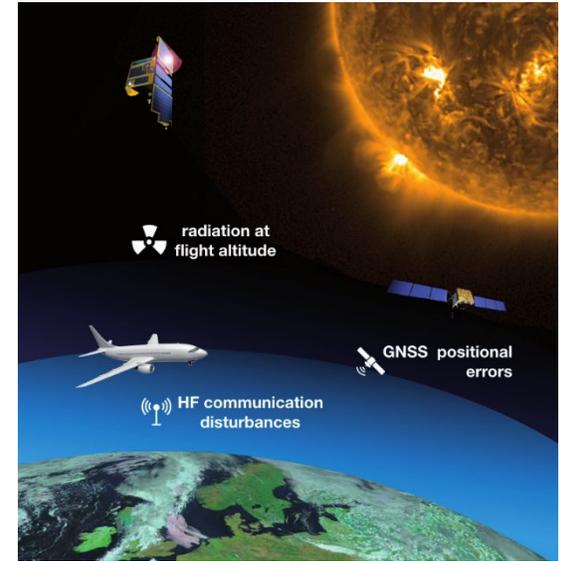
Interface with scientists



# Services for industry

For aviation actors: PECASUS

- International Civil Aviation Organisation (ICAO)
- Global Space Weather Information Service (24/7)
- Warning messages when extreme space weather events can impact :
  - aviation GNSS systems
  - satellite communications
  - HF communication
  - radiation levels at flight altitudes



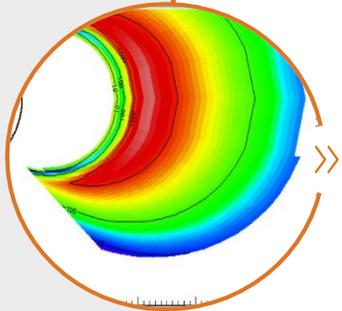
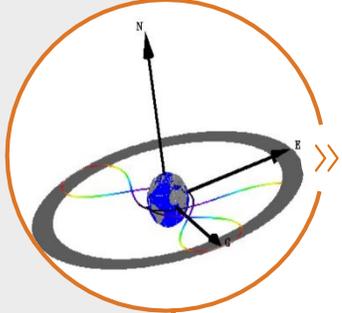


# Services for industry

For satellite or instrument designers: **SPENVIS**

Provides :

- trapped proton and electron fluxes and solar proton fluences
- radiation doses (ionising and non-ionising) for simple geometries
- a sectoring analysis for dose calculations in more complex geometries
- damage equivalent fluences for Si, GaAs and multi-junction solar cells
- Geant4 Monte Carlo analysis for doses and pulse height rates in planar and spherical shields
- atmospheric and ionospheric densities and temperatures
- atomic oxygen erosion depths





THANK YOU!  
MORE INFO?

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