# Possible French contributions to ILWS

- Microsatellite programme MYRIADE
- Instruments
- ARIANE 5 equipment bay
- Models
- Solar environment simulation facility

Jean-Yves Prado CNES
Karl Ludwig Klein Paris Meudon Observatory

## Microsatellite programme MYRIADE

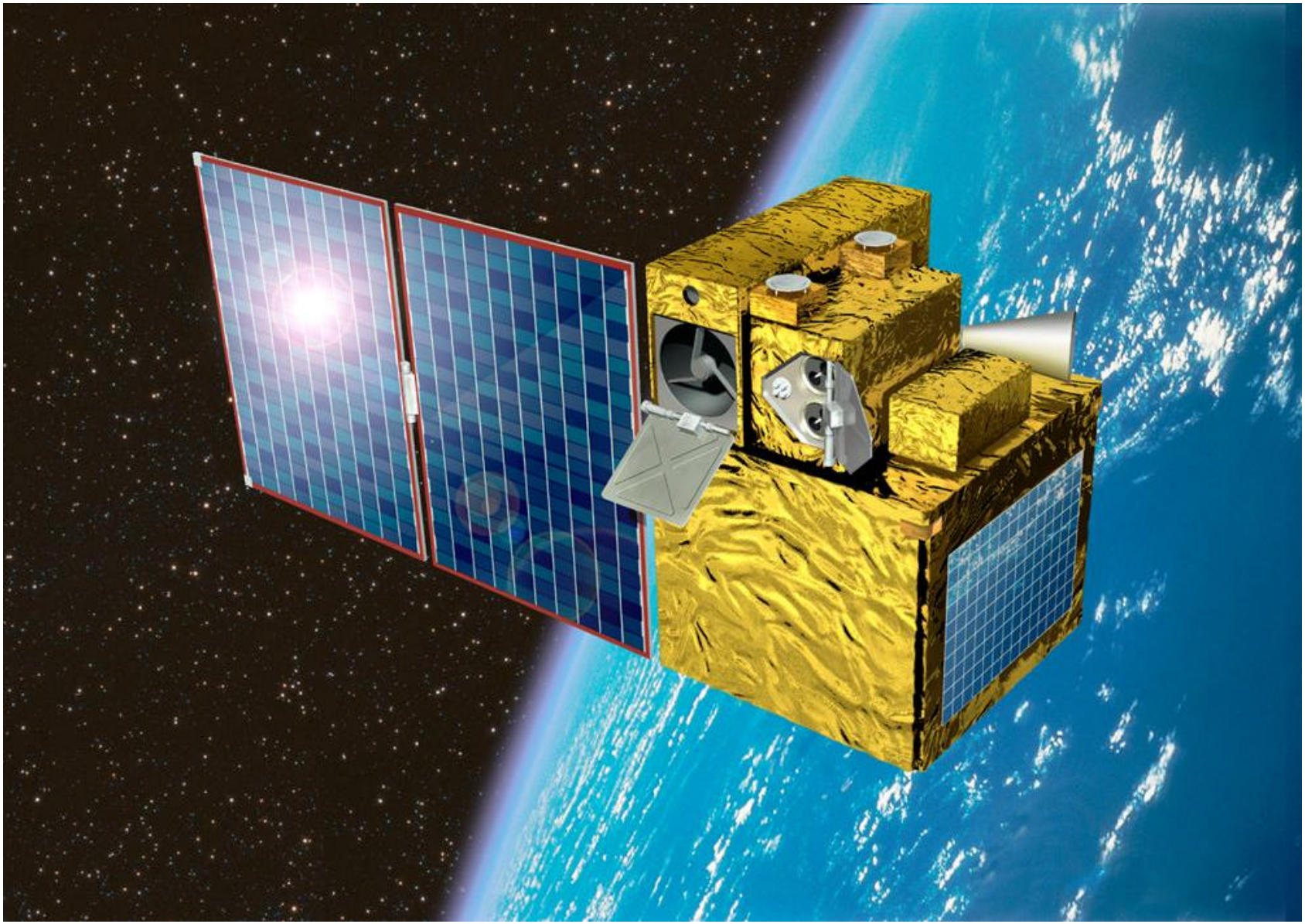
- Element of the ‘national’ (non ESA) programme of CNES

- 120kg, ARIANE 5 ASAP compatible (60x60x80 cm)
- 3 axis stabilized, ? V capacity ~200 m/s
- cost ~15 M € (industrial contracts only)

- Scientific missions selected through AOs
- PI experiments
- cooperation strongly encouraged, even needed

## Present status of MYRIADE

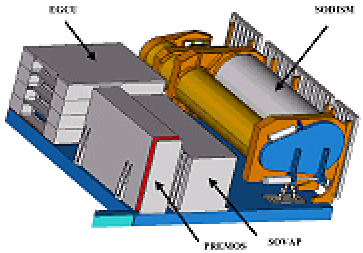
- First set of 4 missions in development phase 2003-2007
- DEMETER  Signature of Earthquakes
- PARASOL  Atmospheric science
- MICROSCOPE  Principle of equivalence
- PICARD



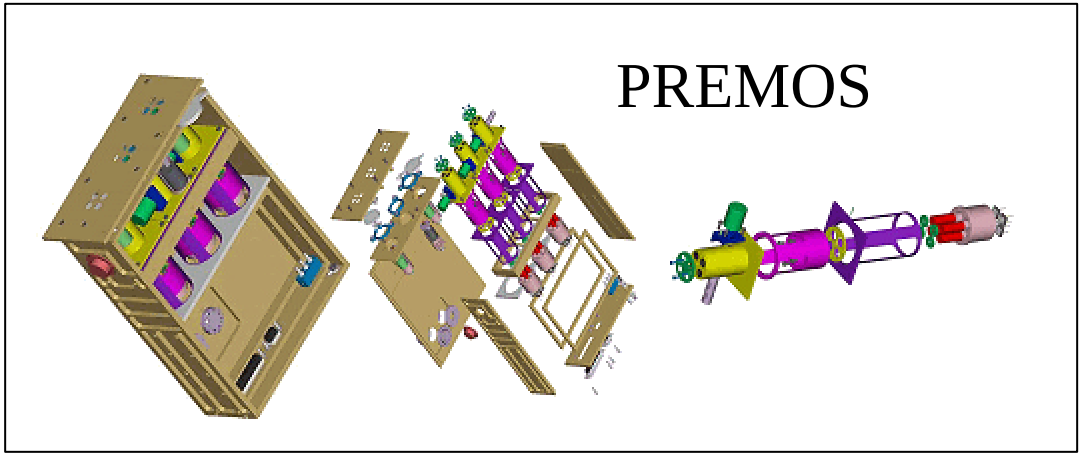
# PICARD Objectives

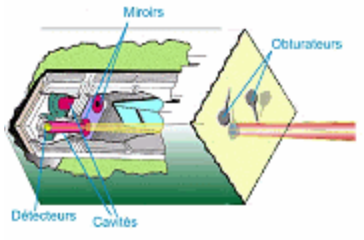
- Variation of the solar diameter
  - Relation diameter/ solar constant/ differential rotation
  - Heliosismology (g modes)
  - Solar shape (flattening)
  - UV variability
  - Space weather

  - Cooperation with Belgium and Switzerland
  - 4 US Co'Is (NRL, SEC, JPL, Kitt Peak)

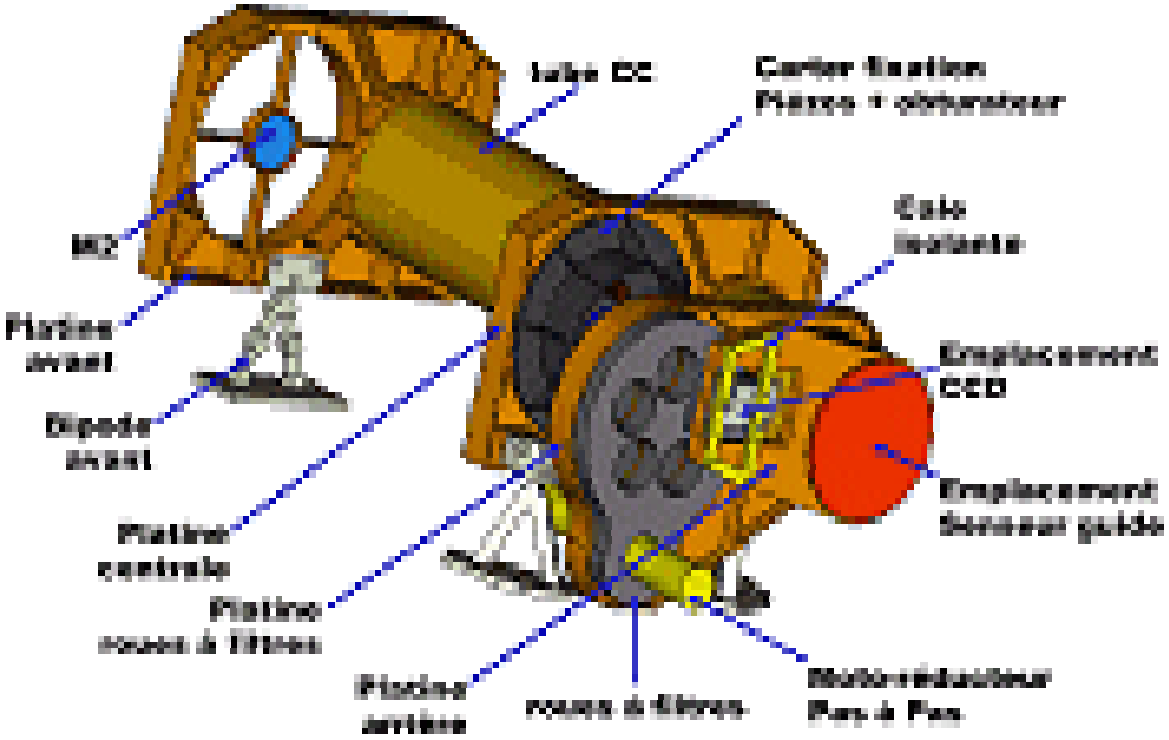



Payload




SOVAP




SODISM

http://smsc.cnes.fr/html-images/HomeGB.html

# MYRIADE next candidates

Preselection of 4 missions  for 2007 - 2009 time frame

2 Earth science projects

TARANIS

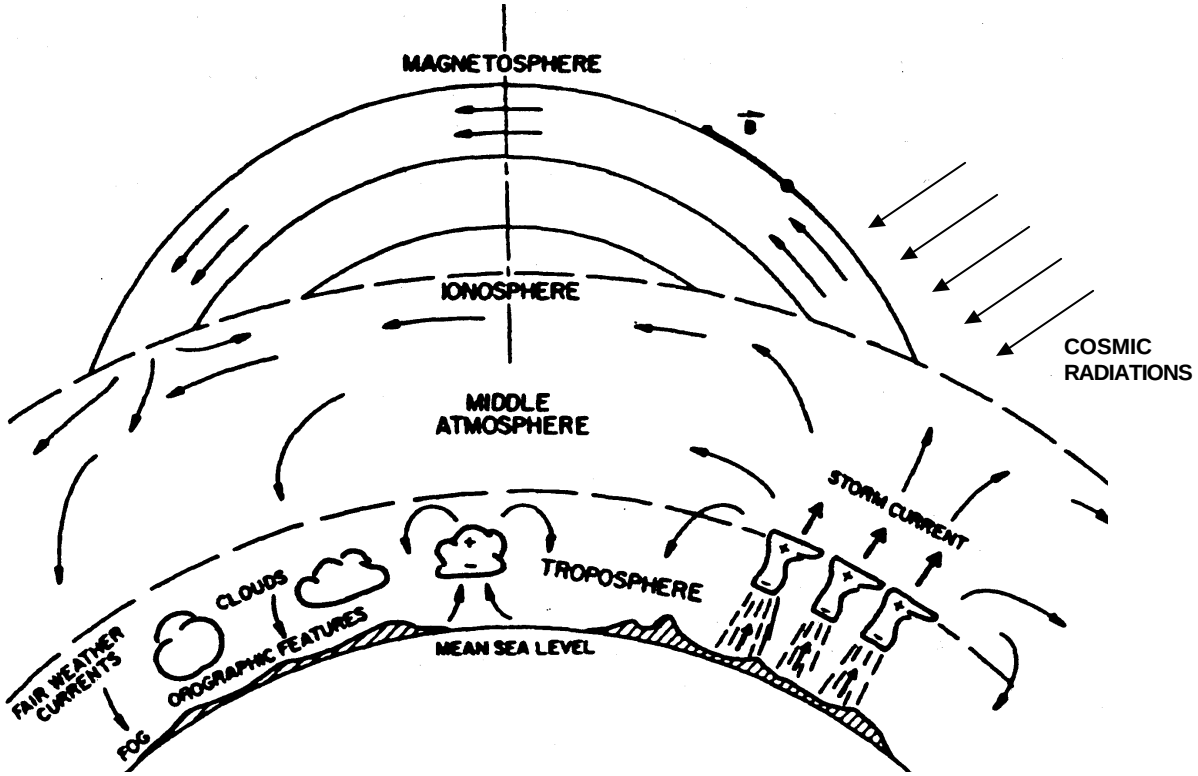
LYOT-T2L2

# Projet de microsatellite
# TARANIS*

## Tool for the Analysis of RAdiations from lightNIngs and Sprites

* Gallic god of lightning

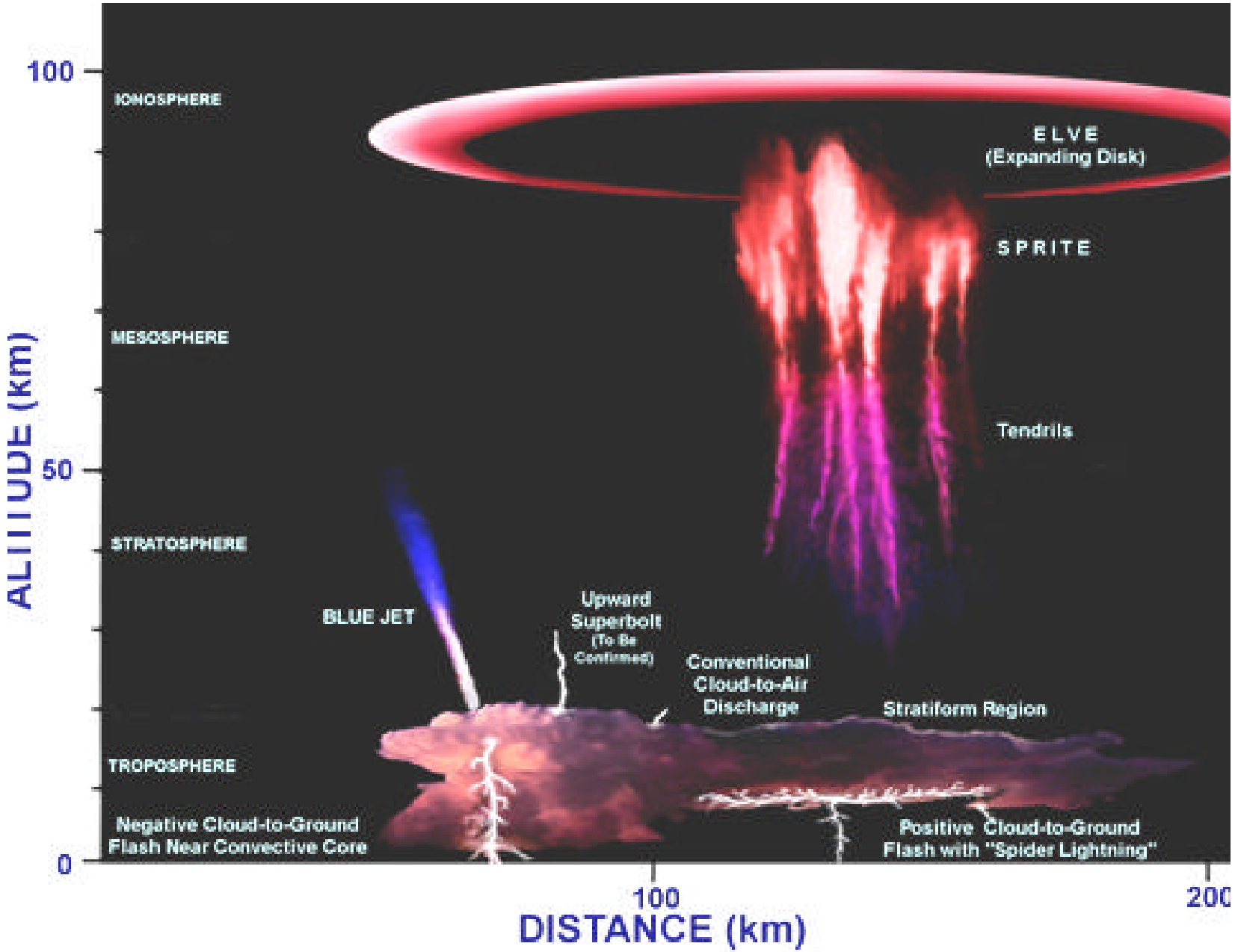
# coupling atmosphere-ionosphere-magnetosphere




Taranis proposes to study the coupling atmosphere-ionosphere-magnetosphere, submitted to different influences :

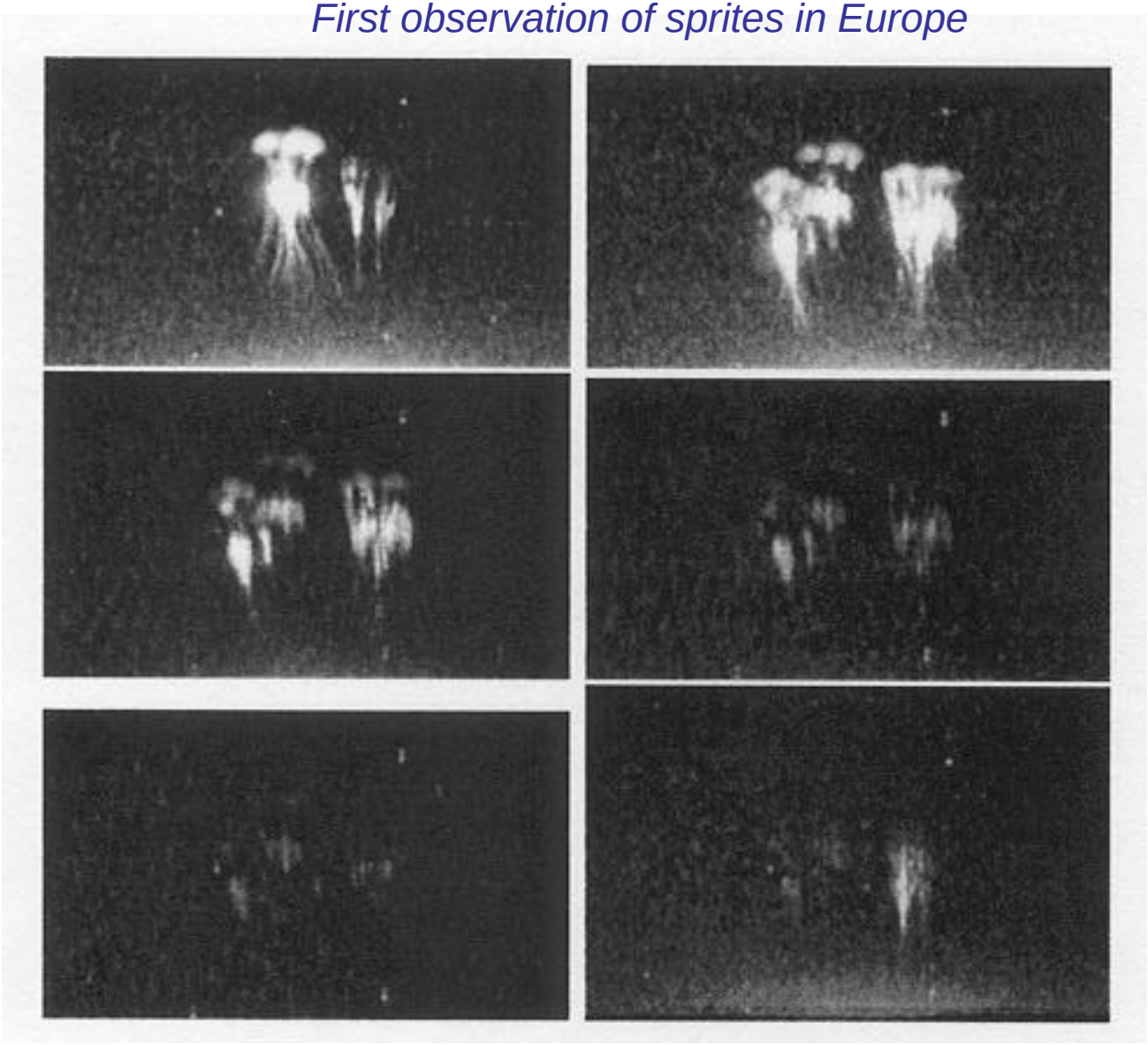
- from the lower atmosphere : atmospheric storms, meteorological activity, volcano human activity
- from space : solar wind, cosmic radiation

Sprites, jets and elves are manifestations of a transitory coupling



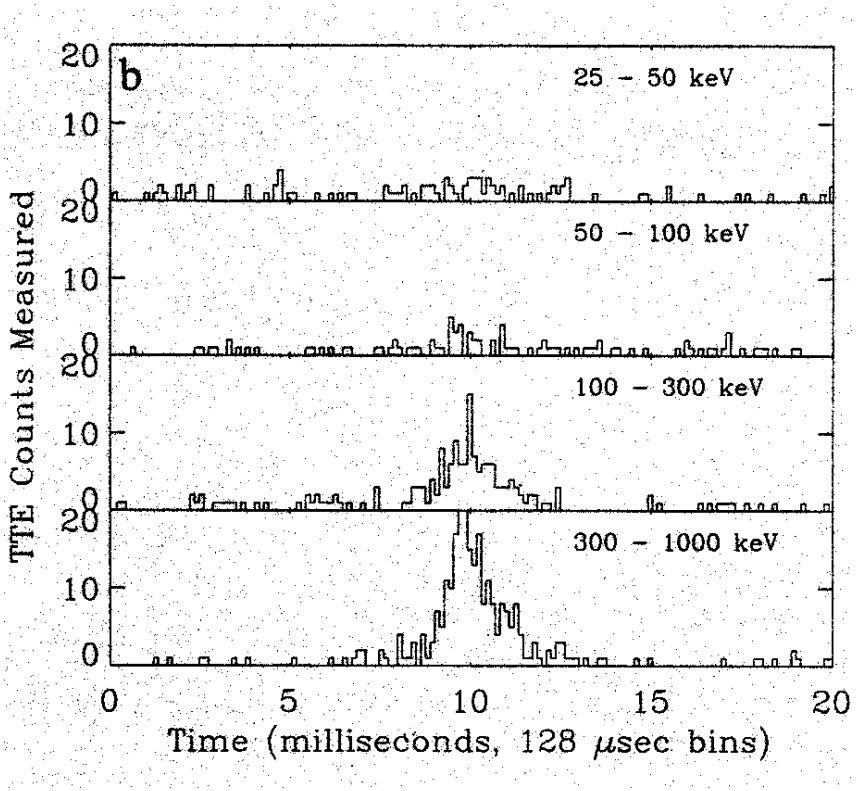
## EUROSPRITE2000 Pic du Midi Observatory

*First observation of sprites in Europe*



*Observation duration 300 ms*

# Observations of gamma ray emissions from the Earth atmosphere




- **Observations of the Compton gamma ray Observatory**

  - emissions from altitudes > 30 km above thunderstorms
  - hard spectra. The higher part has not been measured
  - compatible with bremsstrahlung processes

- **Observations of the satellite ABE**

  - 700 emissions in 2,5 years
  - atmospheric origin
  - the emissions are more numerous after volcano eruptions

# Scientific Objectives

## *Description*

**- characterization of the sprites and associated emissions, measurement of their occurrence frequency and of their distribution at the scale of the earth.** *(cameras, EM waves, X and g spectra, high energy electrons)*
**- study of the effects of the magnetic latitude and volcanic activity**

## *Implied mechanisms*

**- determination of the nature of the triggering processes** *(cosmic radiation)*
**- determination of the source mechanisms** *(EM waves, X and g spectra, high energy electrons)*
**- study of the explosive dissipation of energy in the ionosphere and magnetosphere** *(EM waves, X and g spectra, high energy electrons)*

## *Global impact*

**- determination of the effects produced on the upper atmosphere, ionosphere and magnetosphere** *(EM waves, high energy electrons, associated ground based measurements, other satellites)*
**- evaluation of the coupling atmosphere - ionosphere - magnetosphere and inter-planetary medium**

# Payload

**Microcameras + photometer *-MCM-*** — **CEA**

2 microcameras in the visible and with a filter 761 nm (sprites)
30 frames per second
512x512 pixels on 10 bits, ~100g/camera
processing — **LAM**
photometers, resolution 0,5 ms (triggering)

**EM measurements *-IEM-*** — **LPCE**

Electric measurements (3 components): 1 kHz- 30 MHz
Magnetic measurements : 1 kHz- 25 kHz
Magnetic measurements : 0,1Hz- 1 kHz
Langmuir probe
Data Processing Unit — **CETP**

**X-gamma Detector *-XGD-*** — **LANL (USA)**

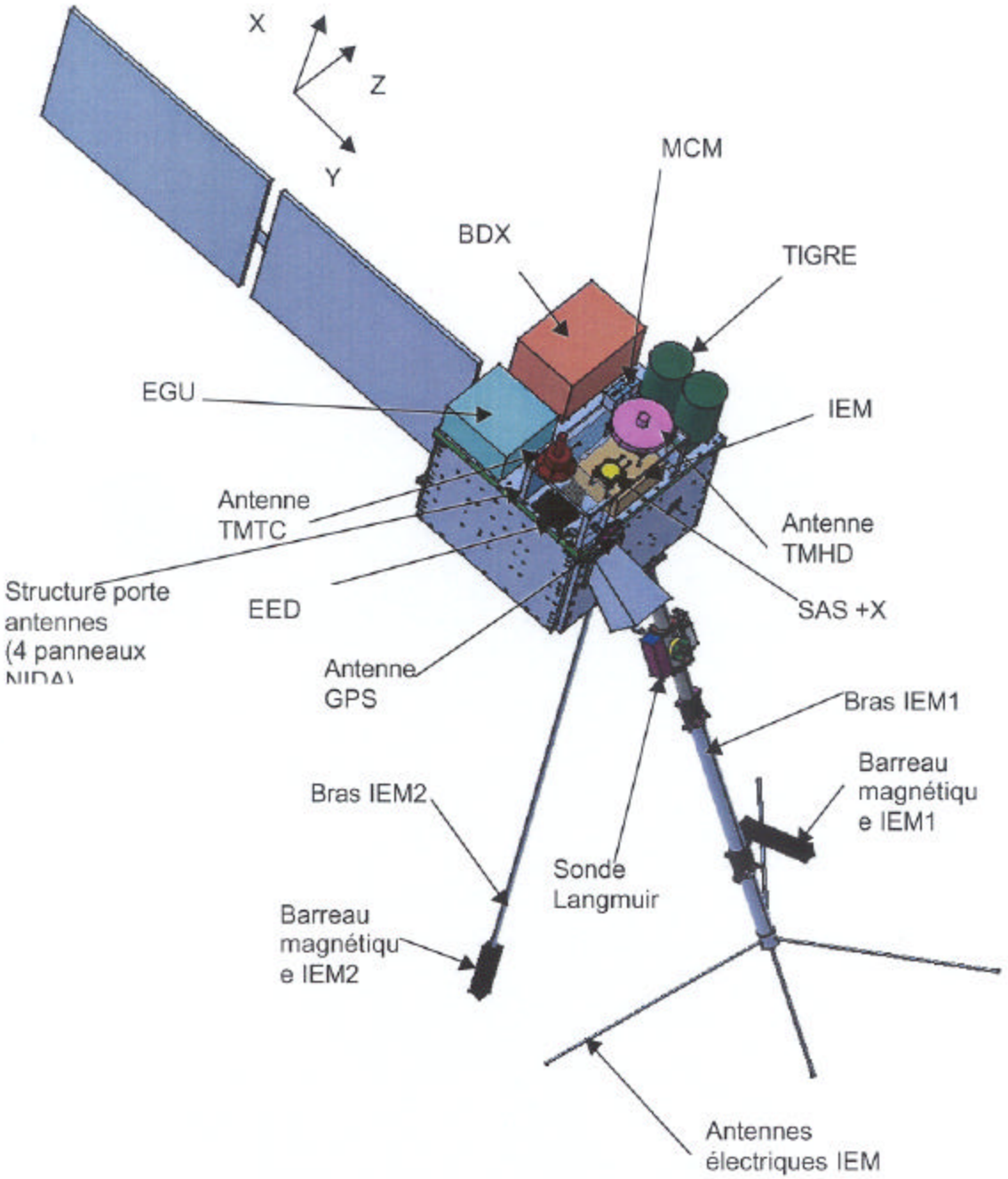
2 scintillators BC454 : 300 $cm^2$ , width : 5 cm — **CESR**
energy : 30 keV -2.55 MeV
Data Processing Unit — **DSRI (DK)**

**Detector of high Energy Electrons** — **CESR**

3 sensors 30 keV - 2 MeV, large field of view

**General Data Processing unit *-EGCU-*** — **CEA**

**total : weight 26 kg**
**power 80 W**


X
Z
Y
MCM
BDX
TIGRE
EGU
IEM
Antenne
TMTC
Antenne
TMHD
Structure porte
antennes
(4 panneaux
NIDA)
EED
SAS +X
Antenne
GPS
Bras IEM1
Barreau
magnétiqu
e IEM1
Bras IEM2
Sonde
Langmuir
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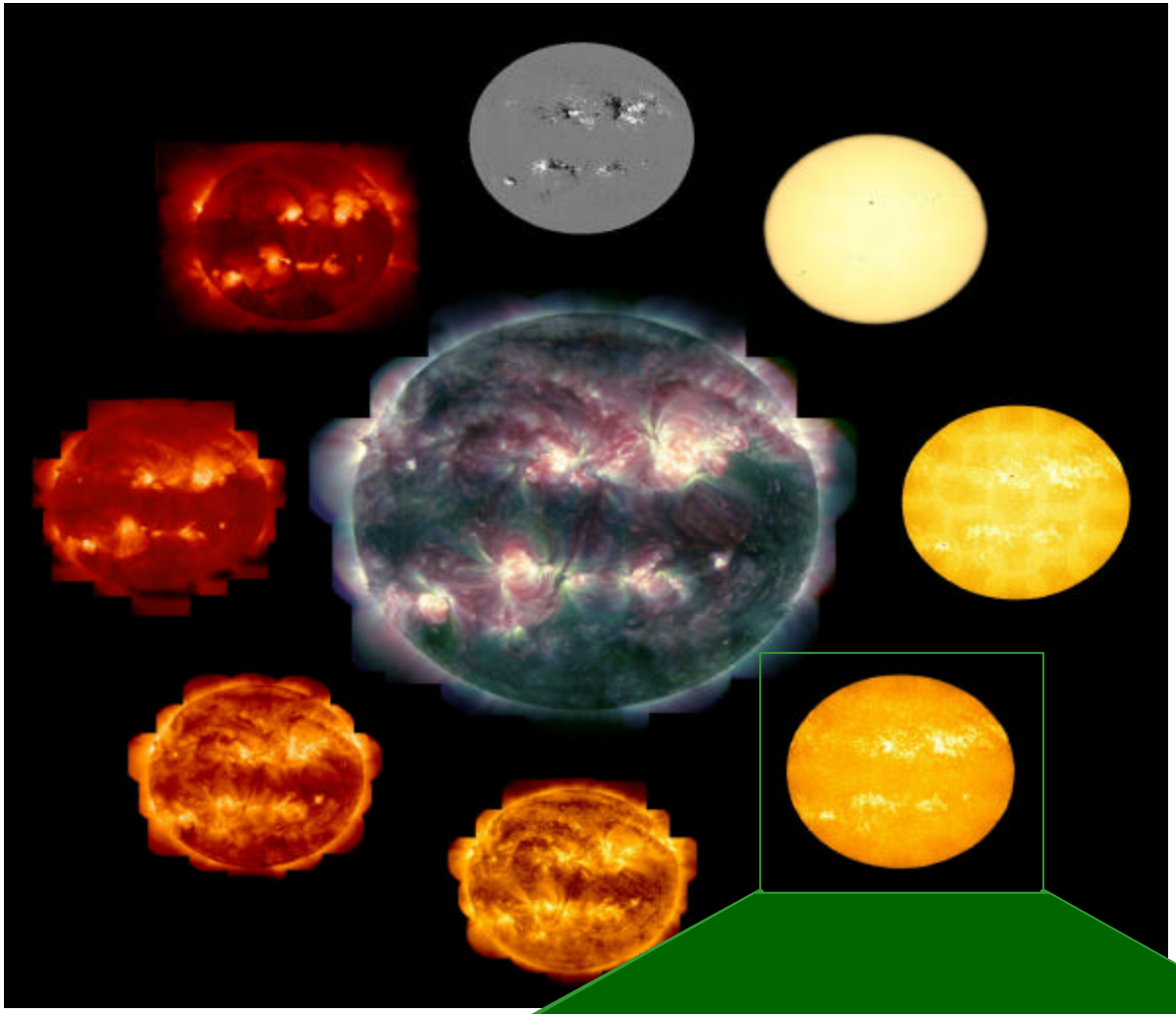
électriques IEM



Au Pic du Midi, 1937

Bernard Lyot (1897-1952)

# LYOT : LYman Orbiting Telescopes

E. Quemerais (Service d'Aeronomie)
J.-C. Vial (Institut d'Astrophysique Spatiale)

# LYOT Scientific objectives

Observation in Lα of cold and hot chromospheric and coronal material

Study of the plasma / magnetic field interaction in the chromosphere and corona (morphology, dynamics: CME onset)

Circumsolar activity (grazing and impacting comets)

Temporal and spatial variability in Lα

Monitoring of solar activity

In its present definition, LYOT occupies only 1/2 μsat capacity

# LYOT Scientific team

IAS : JC Vial ….

LAM : P. Lamy

IAP : S. Koutchmy

SA : E. Quemerais

SwRI : D. Hassler

NRL : D. Moses

LESIA

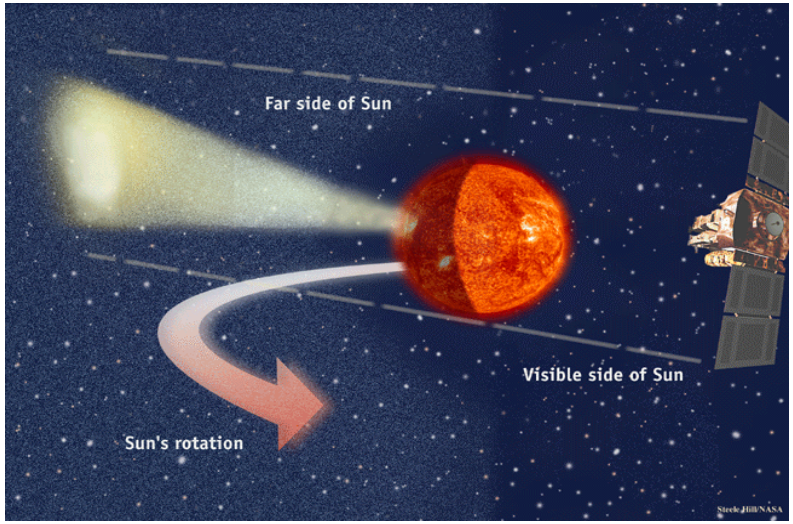
Centre de Phys. Théorique de l ’X : T. Amari)

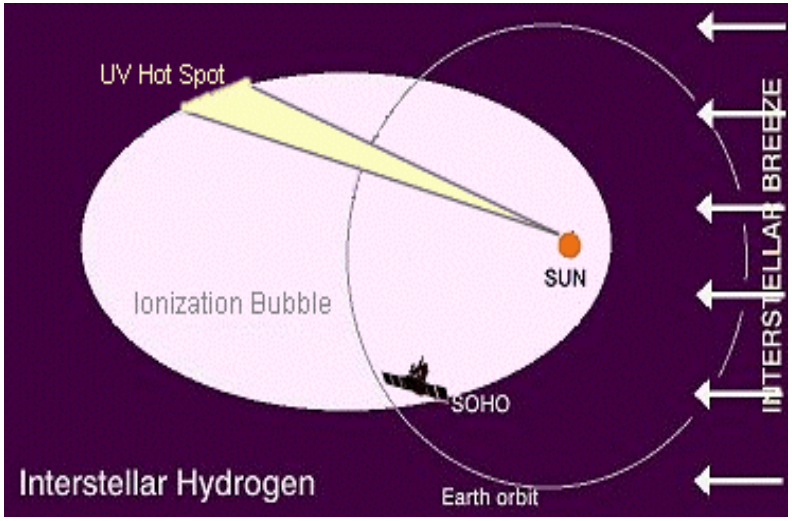
Aberystwith (UK) S. Habbal

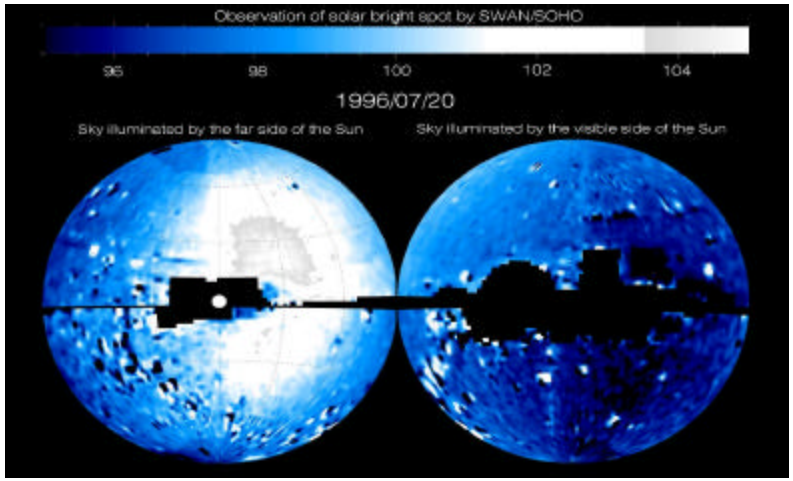
## Instruments

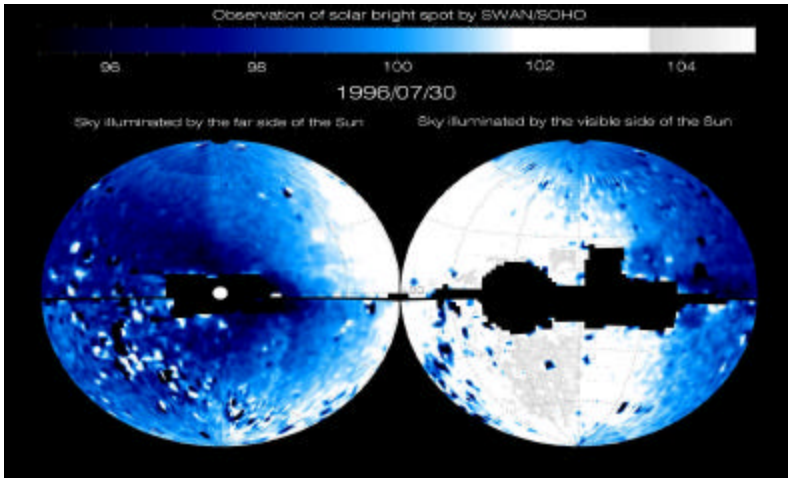
- SOHO/SWAN to monitor the solar activity of the farside
- 3 telescopes interferometry (visible UV) final phase of R&T
- far IR camera R&T to start
- Rogovsky coils (VARIANT, CUSP) for current density
- Spaceborne radio interferometry ongoing R&T
- ….

# Full sky Lα



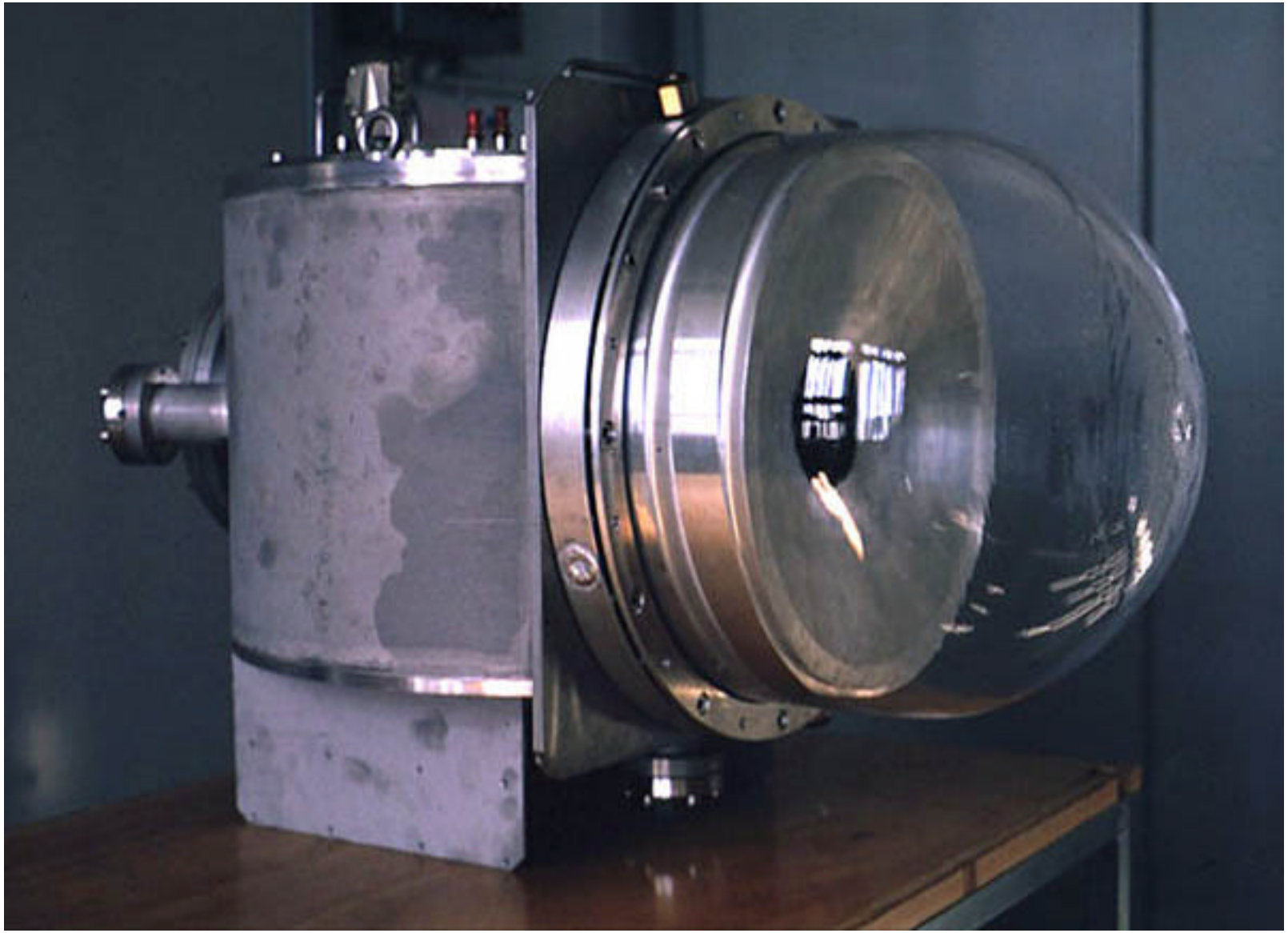

Example of 2 complete sky charts in Lα taken 10 days apart (SOHO/SWAN)

# Others

- Use of ARIANE 5 equipment bay as radiation monitor carrier

- Models
  - SALAMMBO radiation belts
  - FROMAGE French Online Magnetic field extrapolation

- Solar environment test facility SOLEMIO



## Preliminary conclusions

- CNES microsat programme can offer attractive opportunities for ILWS science

- ILWS would secure selected or planned missions

- Harmonization of instrument R&T should be considered

- Same for system architecture (S/C constellations, solar sails..)

- Policy for an optimal utilization of test and calibration facilities to be considered in the frame of ILWS