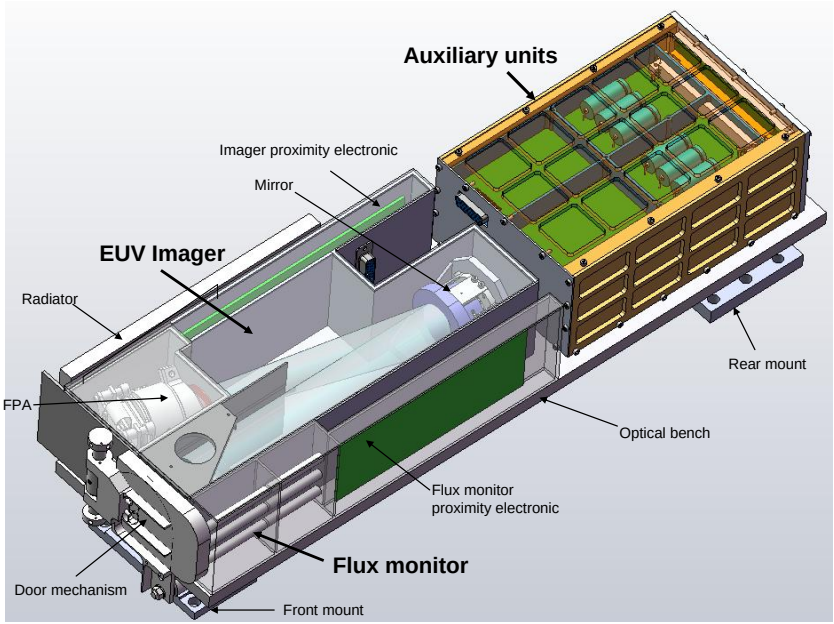
ESA
GSP

ESIO : an introduction



T. Thibert, B. Nicula

03/05/12

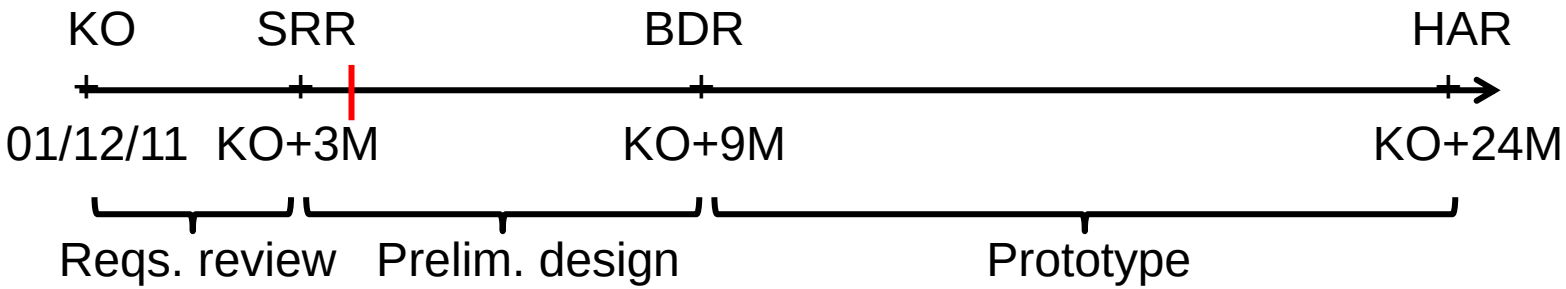
ESIO in a nutshell

ESA GSP

ESIO objective

A compact Space Weather monitoring instrument
providing regular data with low latency (“near real time”)
for 10 year lifetime
with resources reduction as the main design driver.

ESIO timeline (Phase B)

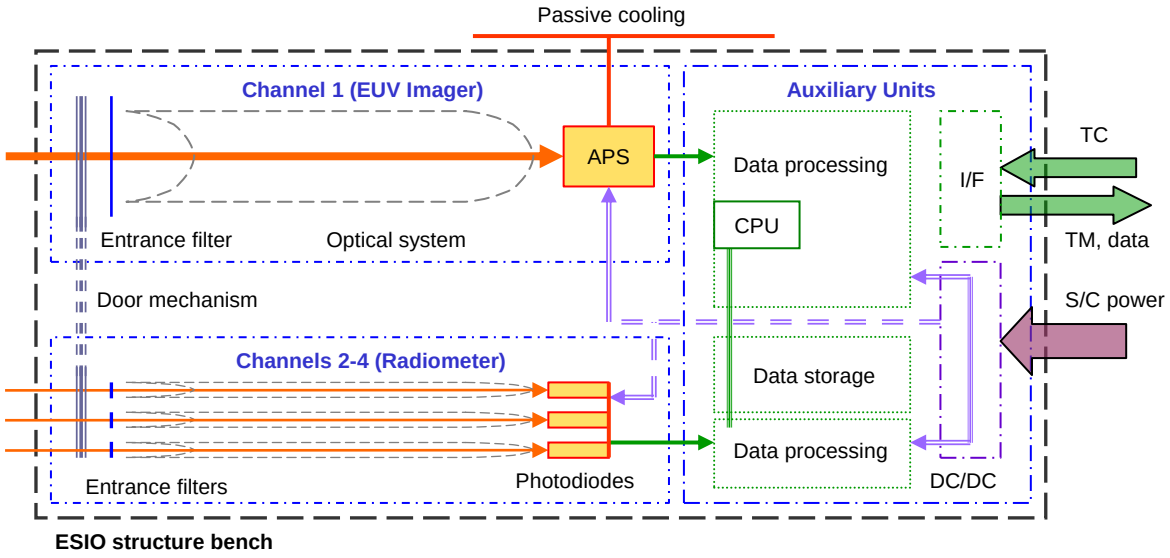


ESIO team

CSL (Instrument), ROB (Science & S/W)

ESIO subunits and functions

ESA GSP



Sub-units

Full Sun EUV imager

- Solar transition region and corona (2 solar Φ)
- 20 arcsec. resolution
- 1 image / 2 min
- Timeliness of delivery of 1-5 min

Auxiliary units

- TM/TC
- Power conditioning
- S/C interface
- Data handling and processing

UV radiometer

- Full-sun radiometric measurements

Auxiliary unit : data processing

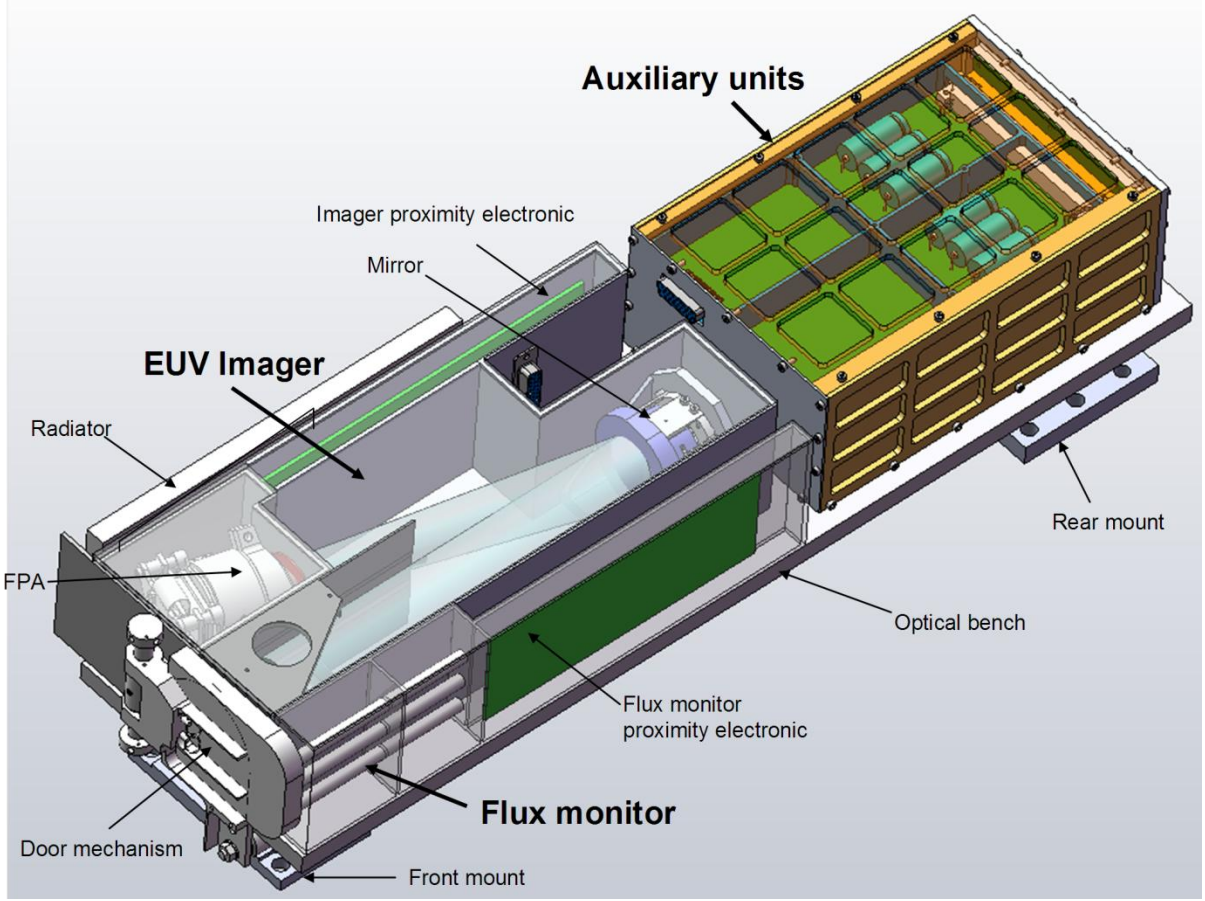
ESA GSP

Additional autonomy in data processing

- Data conditioning :
  - bad pixels masking (abnormal / dead / hot / cosmic ray),
  - flat fielding,
  - gain non uniformity correction,
  - variance stabilization
- Solar events and features automated recognition :
  - coronal dimming,
  - flares,
  - CMEs
- Data flagging :
  - SEP,
  - SAA,
  - blurry images
- Data management :
  - compression (lossy / lossless),
  - prioritization,
  - storage,
  - telemetry

ESIO design preview

ESA
GSP



EUV imager

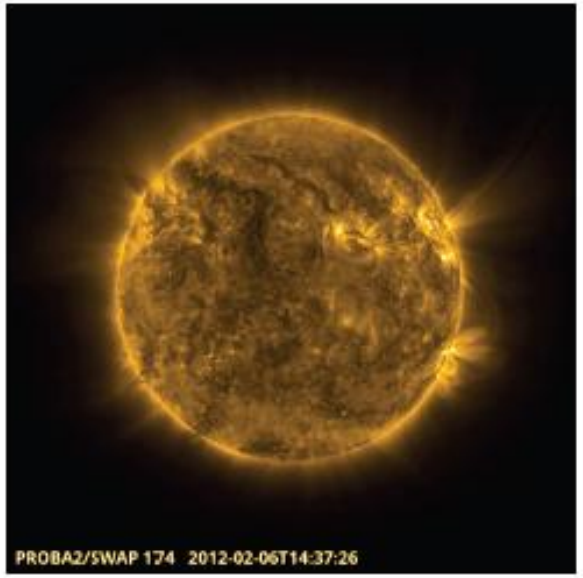
ESA
GSP

Structures:

- **Active regions**
- **Filaments**
- **Coronal holes**

Low resolution is sufficient:

- **Time: 1 image/many hours**
- **Space: 25-50 arcsec**



EUV imager

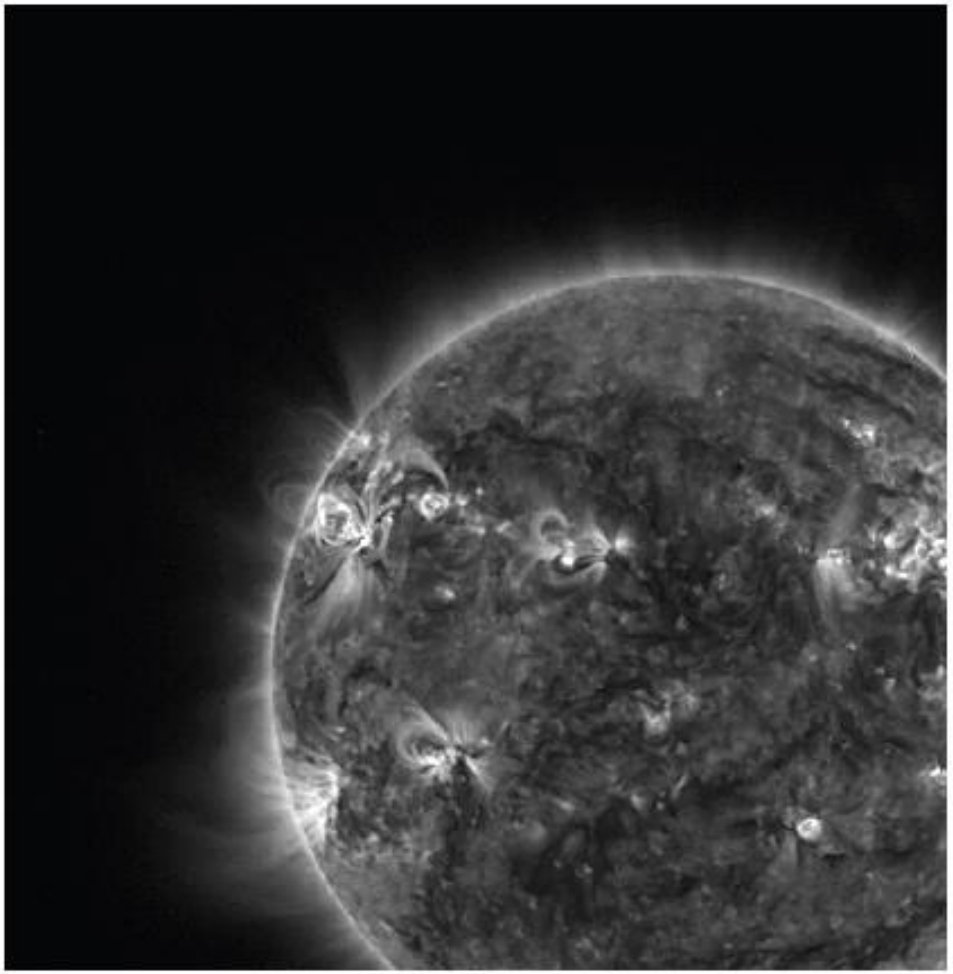
ESA
GSP

Events & dynamics:

- Flares
- off-limb eruptions
- Active region dynamics
- Filament activation

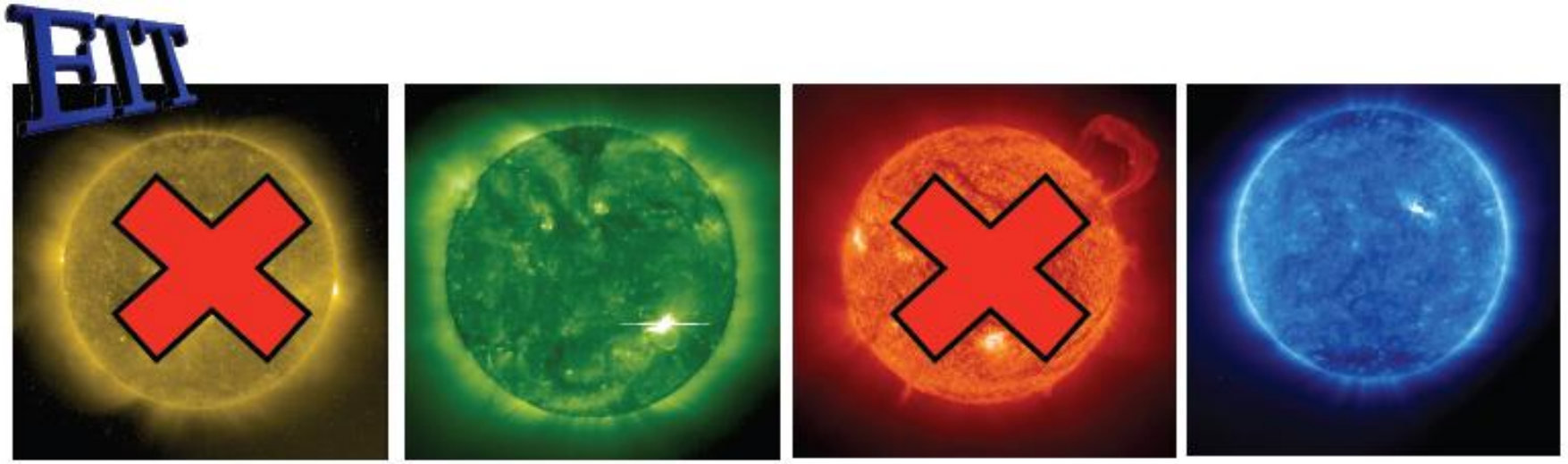
Medium res needed:

- Time: 1 image/5min
- Space: 12-25 arcsec



EUV imager bandpass

ESA
GSP



28.4nm	19.5nm	30.4nm	17.1nm
Hot corona weak line	low corona medium strong line good contrast Flare line	Transition region Strong line No dimmings Poor coronal holes	Low corona Strong line Medium contrast No flare line

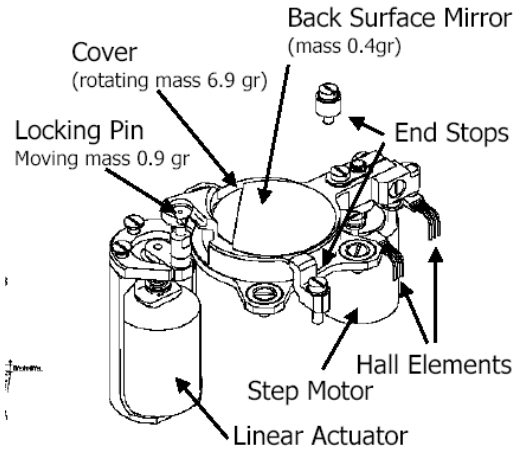
1 mirror ! Selectivity not critical

UV flux monitor

ESA
GSP

- **Full Sun radiometric measurements, large dynamic range**
- **3 compact channels**

- **Spectral selection (requirement) :**
  - **2x EUV region (10-100 nm), identical for redundancy/backup**
  - **1x Lyman-alpha line (121.6 nm)**
- **Reclosable doors !**
- **Cleanliness !!**



SOVIM door mechanism

UV flux monitor : Lyman-alpha

ESA GSP

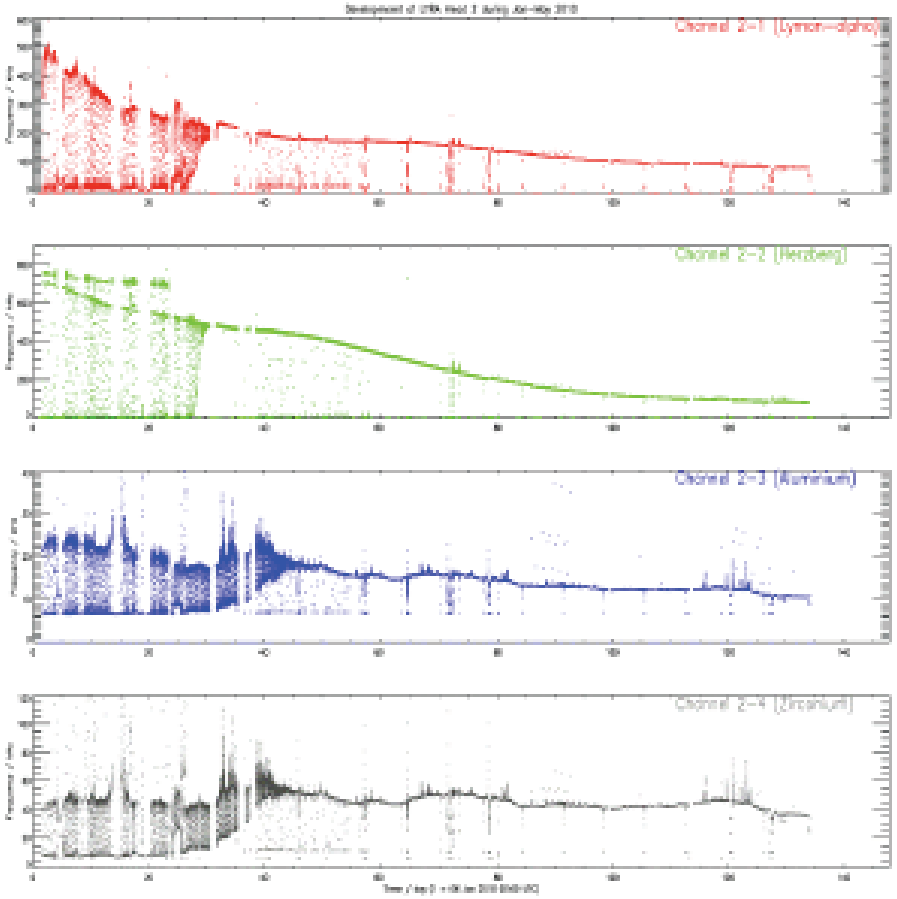
Lyman-alpha line (121.6 nm)

- Variation in flares: few percent
- Variation over solar rotation: few tens of percent
- Variation over solar cycle: ~ 100%

A measurement per few hours, per day is probably sufficient

- Ly-alpha is an important contributor the creation of the ionospheric D layer.
- none of the atmosphere and ionosphere models in e.g. SPENVIS use Lyman-alpha or any other UV wavelength.
- Serious degradation problems

UV flux monitor : LYRA degradation



After 2 years non-stop exposure:

- Lyman-alpha >99% loss
- Hertzberg > 99% loss
- Aluminium 89% loss
- Zirconium 28% loss

ESIO baseline design

ESA
GSP

For the EUV imager

- **Medium resolution (12 arcsec), 5 min imaging cadence**
- **19.5nm preferred, 17nm or mix acceptable**

For the UV flux monitor

- **10 year stability seems realistic with 2x Zirconium with independent doors**
- **1x Lyman-alpha with reduced exposition time : lower cadence and independent door**

Combination of the above two will monitor all coronal space weather events. There are no show stoppers and the results are directly usable in the SSA system