

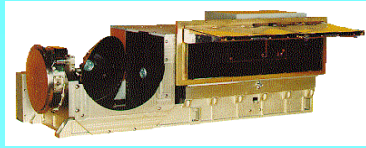
IASI

Infrared Atmospheric Sounding Interferometer





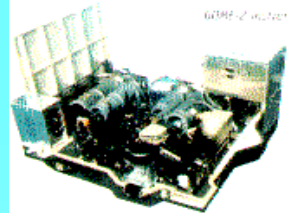
Metop: Satellite and Instruments



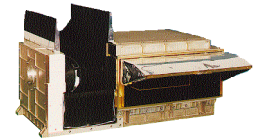
AVHRR-3



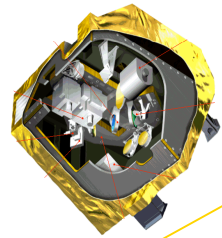
GRAS



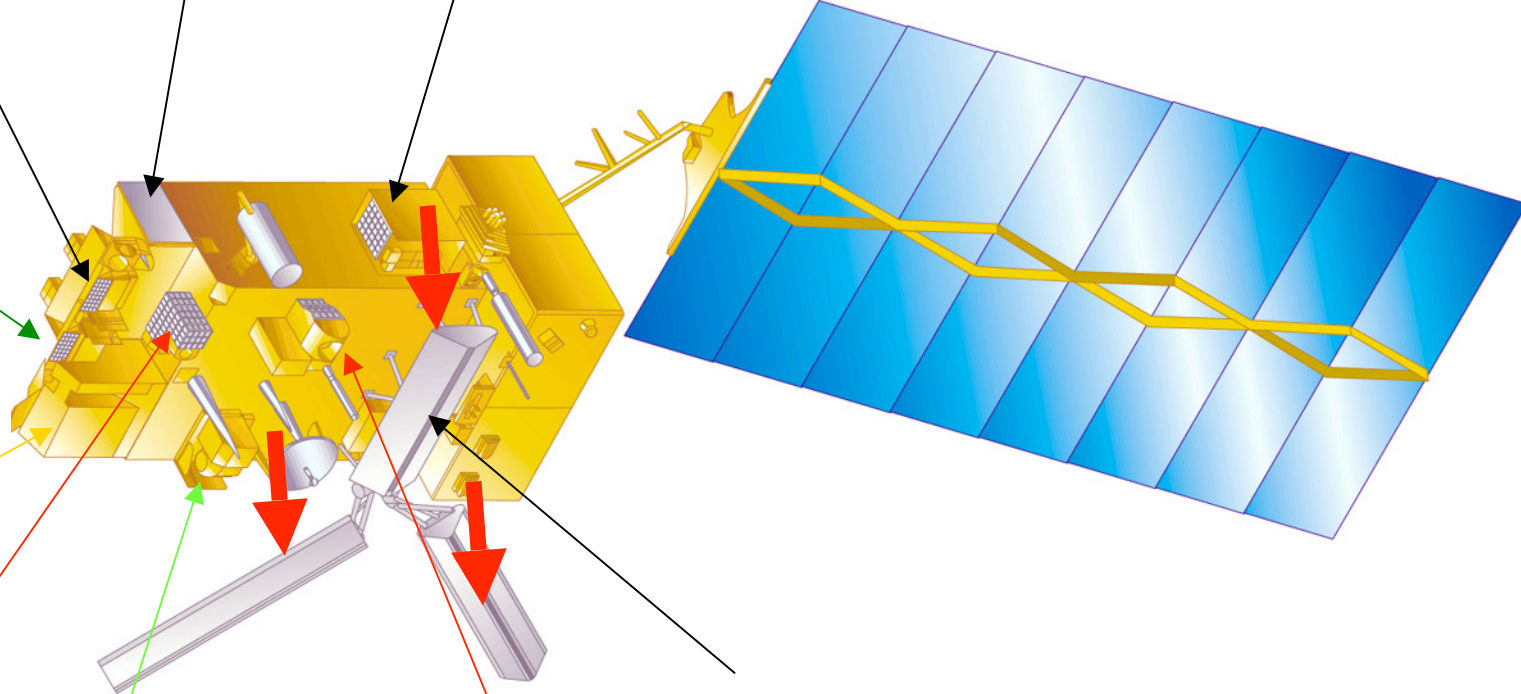
GOME-2



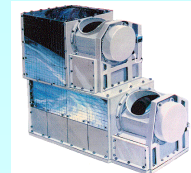
HIRS-4
Metop 1/2 only



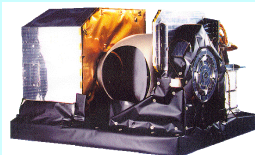
IASI



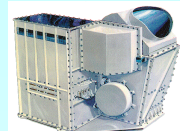
AMSU-A1



MHS



AMSU-A2



ASCAT

IASI

..... Main objectives of mission

Geophysical variables	Vertical resolution	Horizontal sampling	Accuracy
Température profile	1 km (low troposphere)	25 km (cloud free)	1 K (cloud free)
Humidity profile	1-2 km (low troposphere)	25 km (cloud free)	10 % (cloud free)
Ozone total amount	Content integrated	25 km (cloud free)	5 % (cloud free)
CO, CH ₄ , N ₂ O	Content integrated	100 km	10 % (cloud free)

The system

Ground segment EPS
(Eumetsat Polar System)

Command control IASI

Operational software IASI

METOP Satellite
IASI Instrument

IASI
Technical expertise
centre



IASI

Partnership : Cnes-Eumetsat

- ⇒ Cnes is leading the IASI program in association with Eumetsat.
- ⇒ Cnes has technical oversight responsibility for the instruments up to the end of in-orbit commissioning, and will develop the data processing software and operate a technical expertise centre.

- ⇒ Eumetsat contribute to the funding of the first flight model at the level of a recurrent model cost and fund the lasi 2 and lasi 3 models

- Eumetsat is responsible for the interfaces lasi/Métop risks and is in charge of operating lasi

- ⇒ Cnes and Eumetsat have jointly implemented a scientific group the ISSWG



IASI

Main characteristics.....

Pixel diameter	12 km au nadir
Sample	25 km au nadir
Field of view	$\pm 50^\circ$
Spectral range	645 to 2 760 cm^{-1}
Spectral resolution	0.35 to 0.5 cm^{-1}
Radiometric resolution	0.25 to 0.5 K
Lifetime	5 years
Power	210 W
Size	1.2 m x 1.1 m x 1.3 m
Mass	236 kg
Data rate	1.5 megabits per second



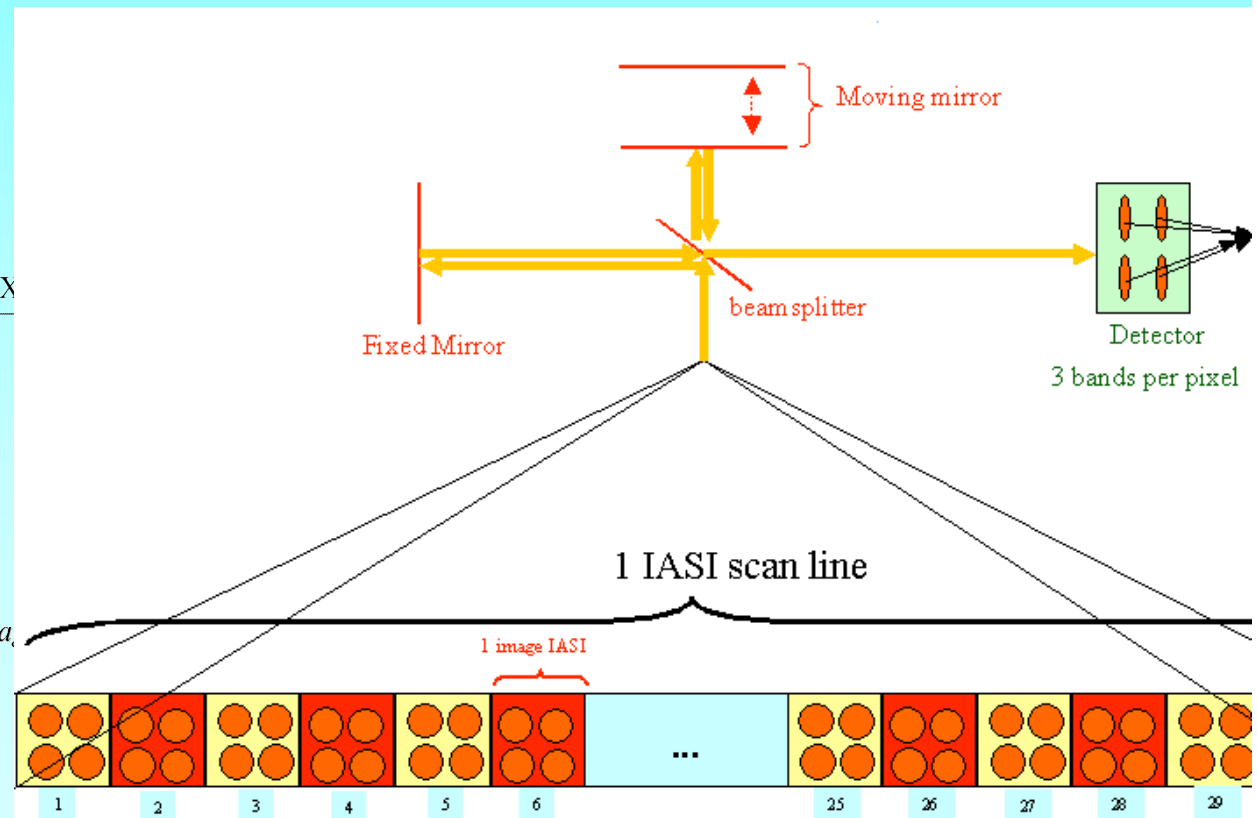
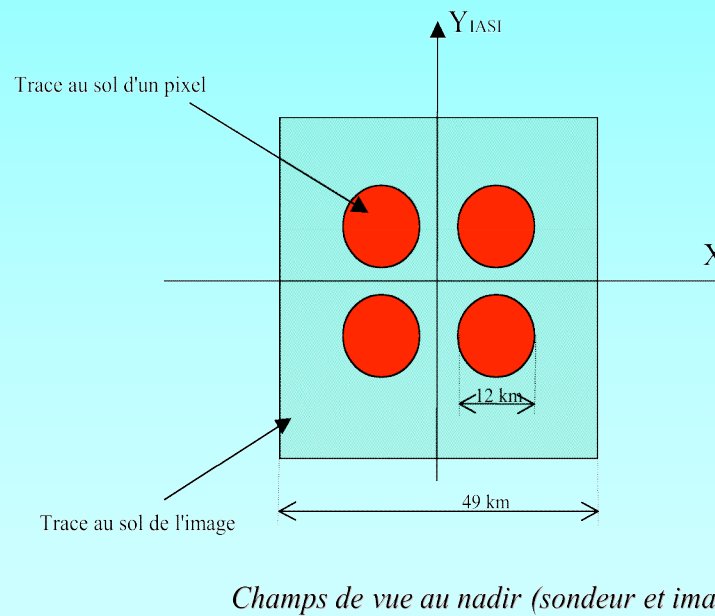


IASI characteristics

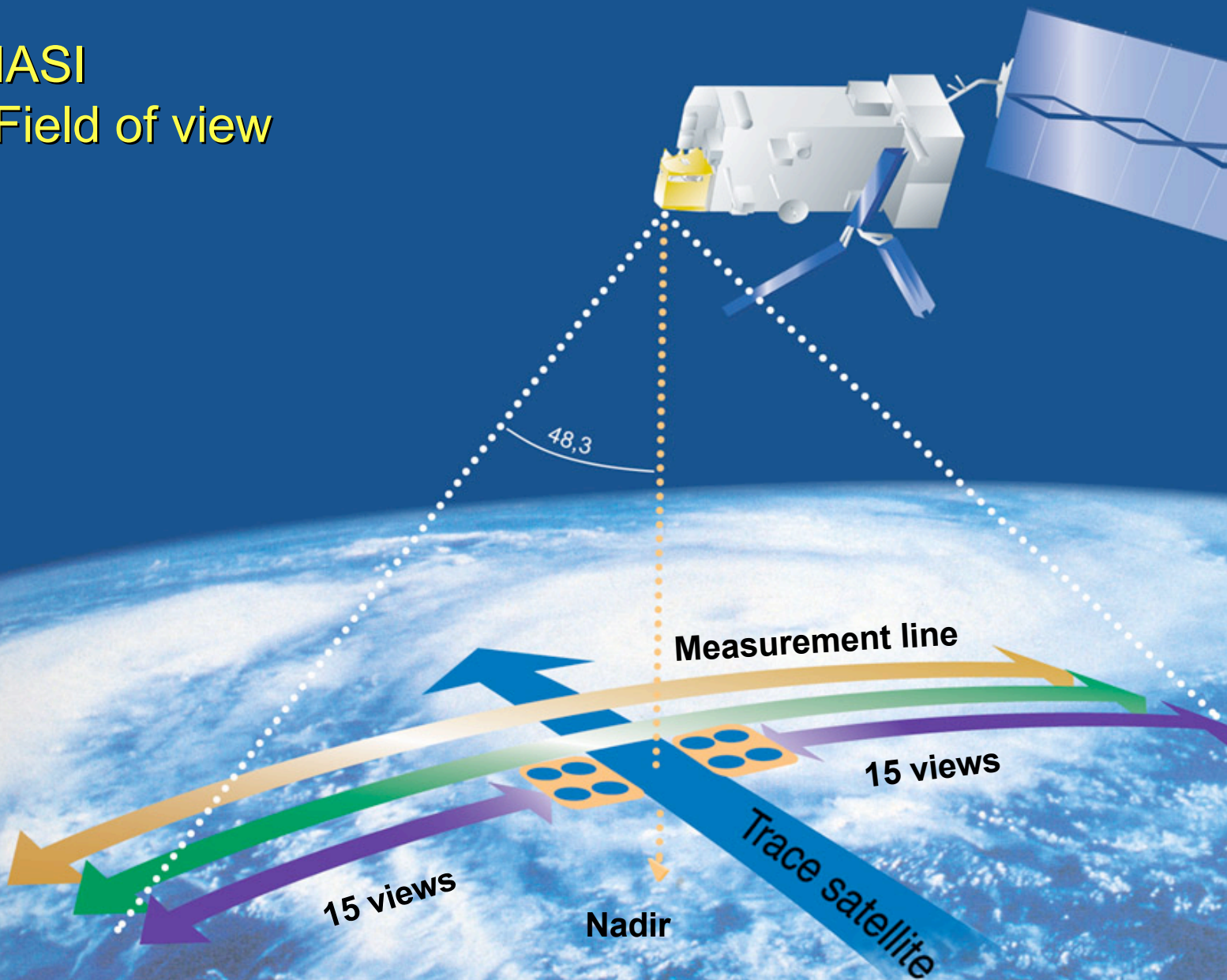
Sounder : Michelson interferometer with +/- 2cm OPD

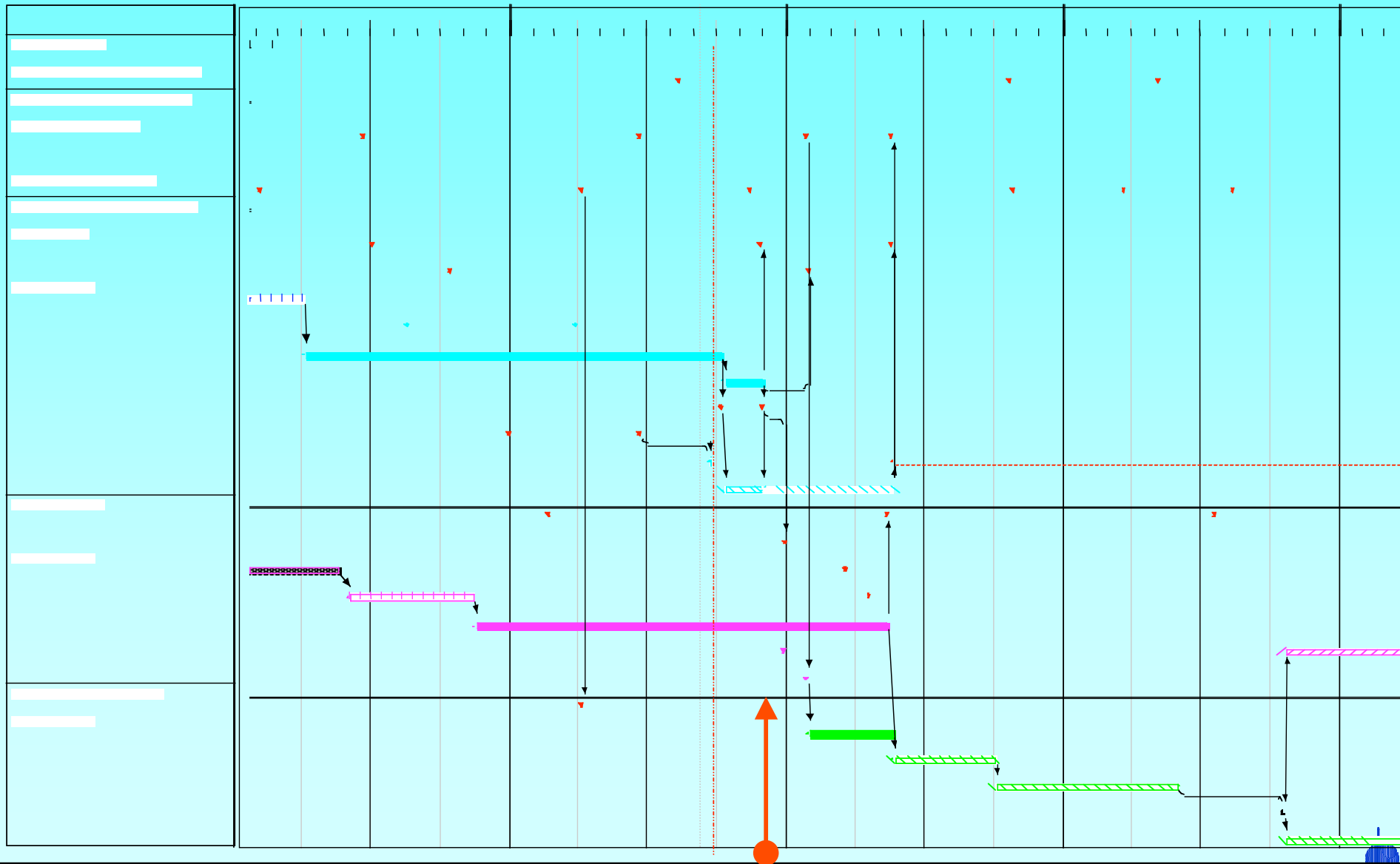
3 bands : B1[645; 1240 cm⁻¹], B2[1200; 2040], B3[1960; 2760]

Imager : Array of 64*64 0.9 km resolution pixels in 10.3-12.5 μm



IASI Field of view



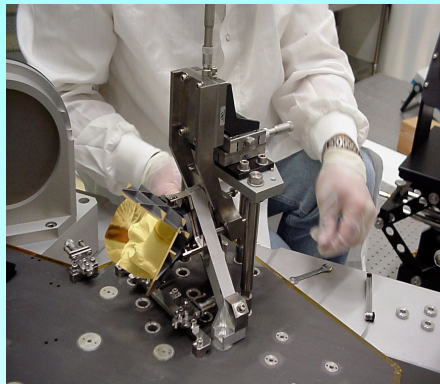
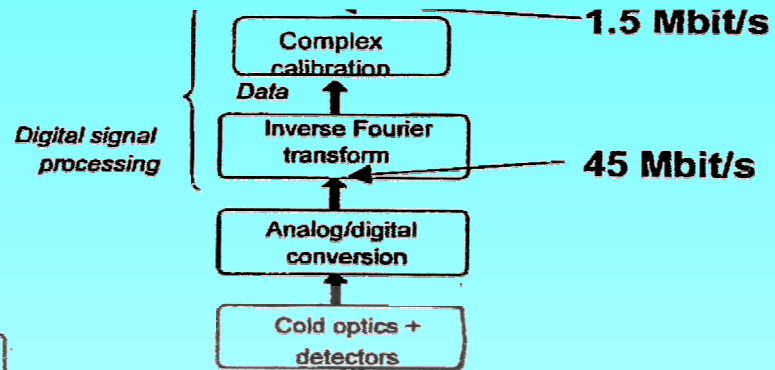
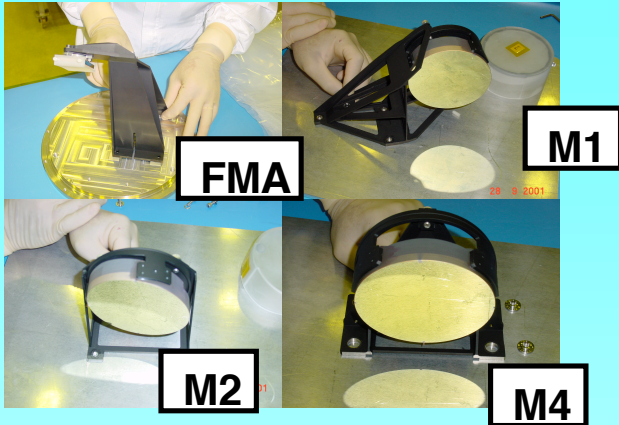


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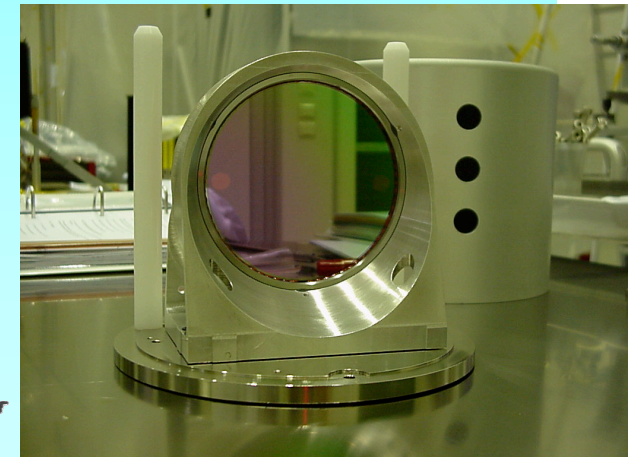
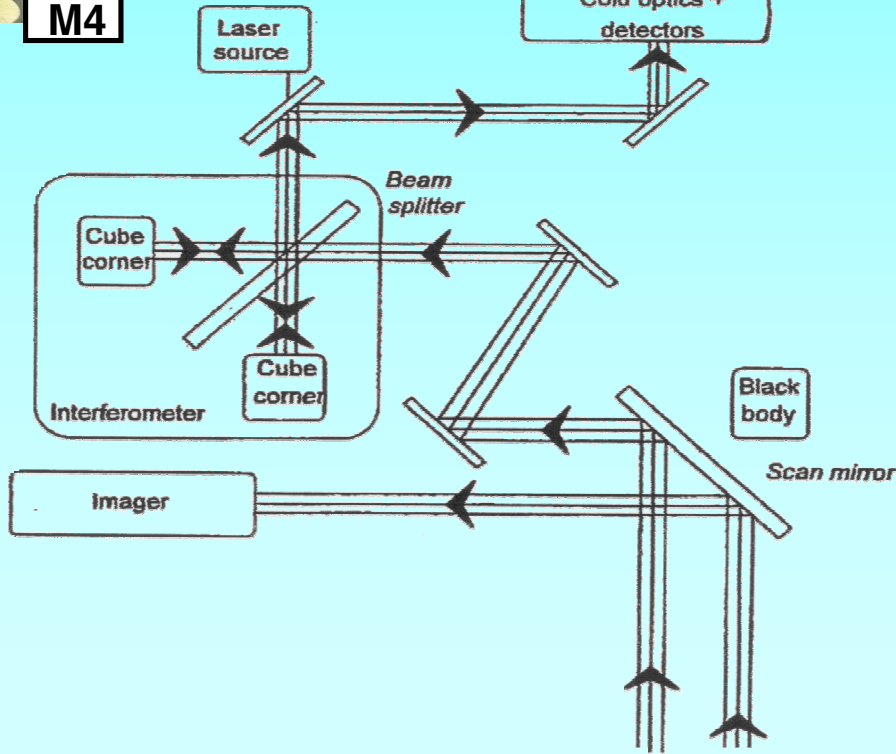
INSTRUMENT FUNCTIONAL DESCRIPTION



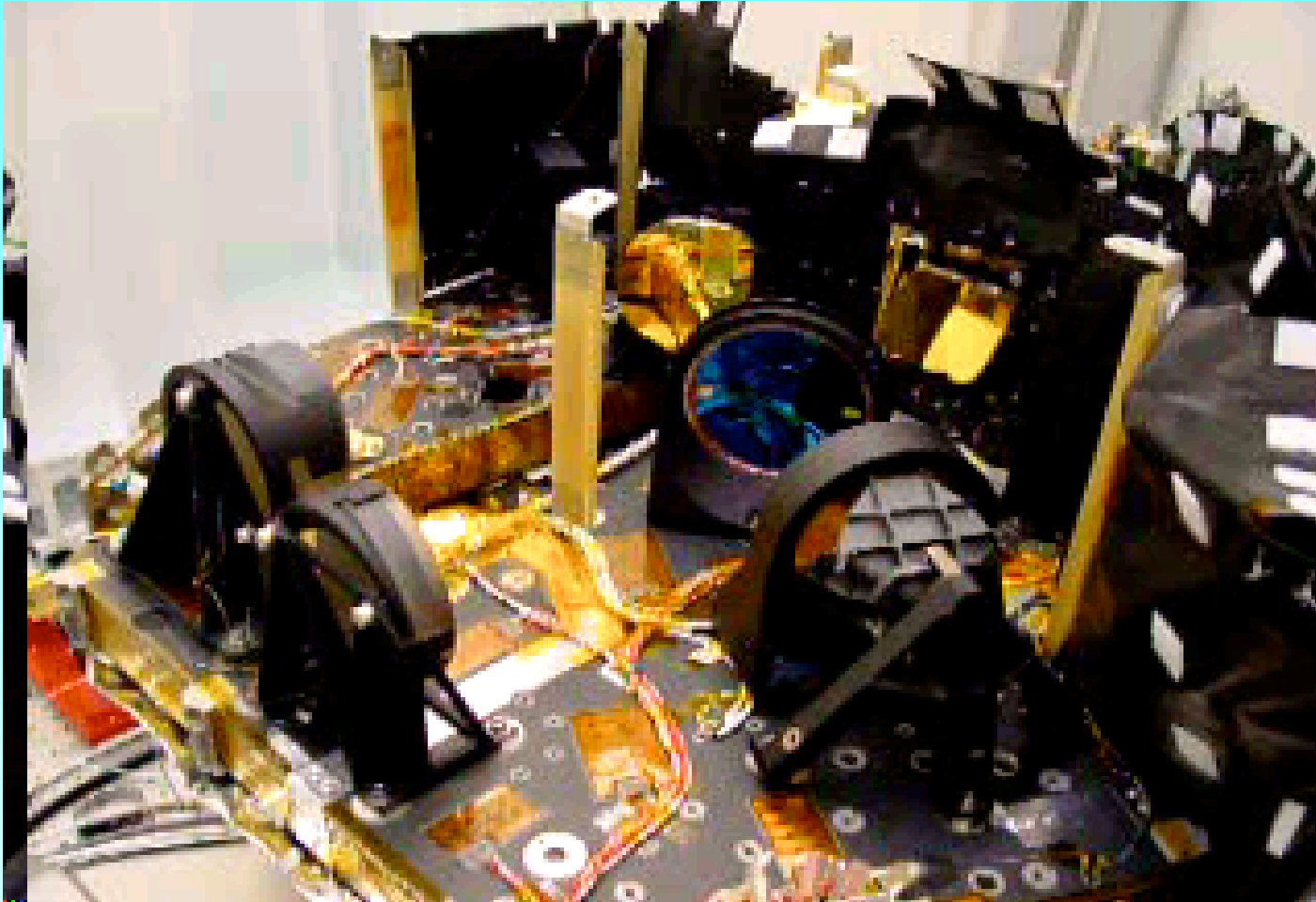
Hot mirrors



Corner cube



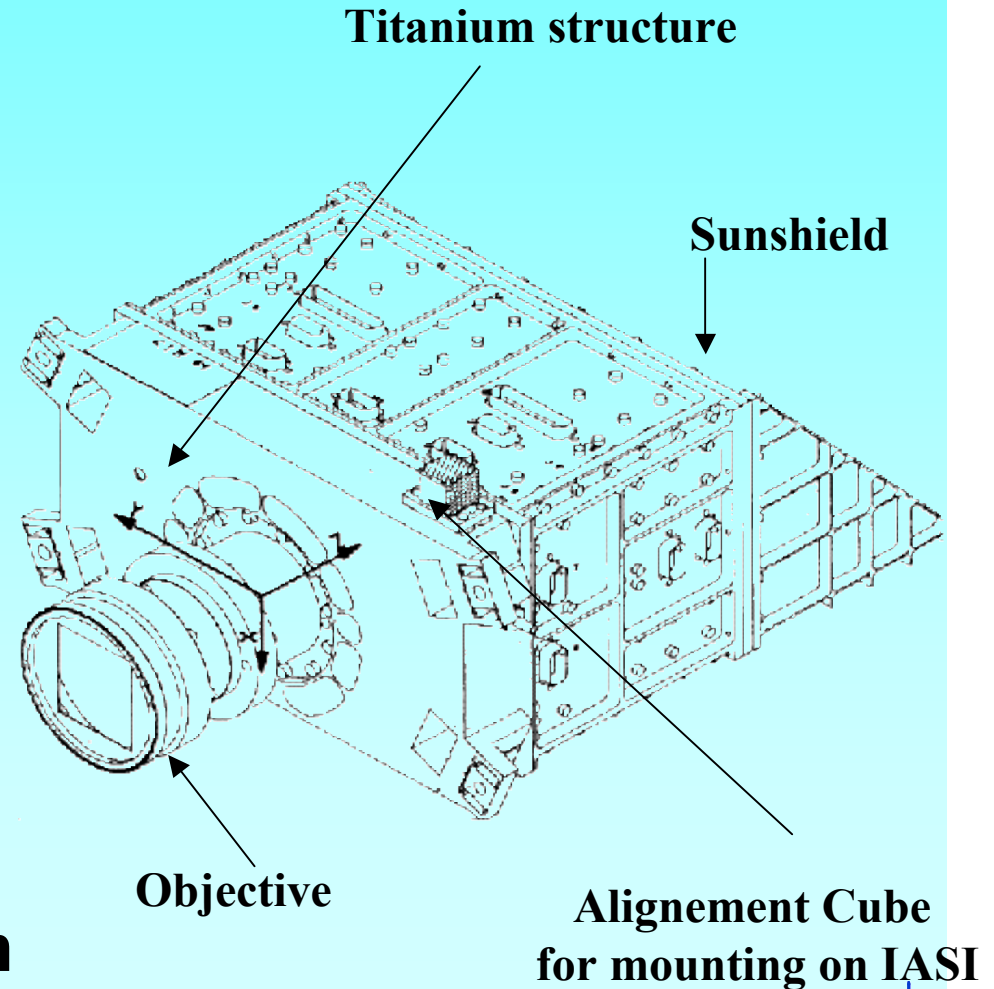
Beam-splitter



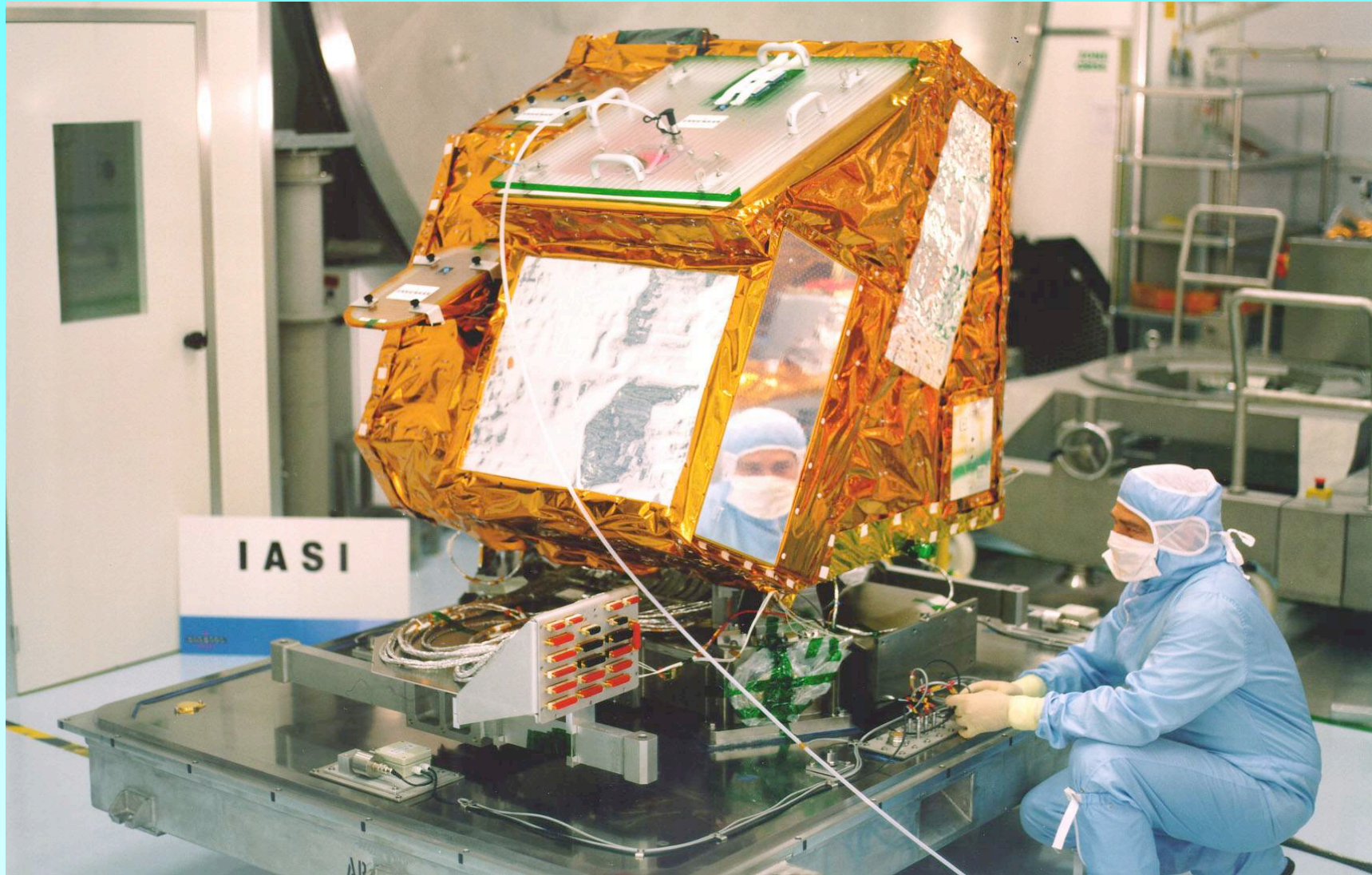
IMAGER SUBSYSTEM



- Unique 10,5 - 12,5 μm spectral channel
- 128 x 128 microbolometer matrix
- Focal plan, temperature controlled by a Peltier cooler



Integrated Imaging Subsystem

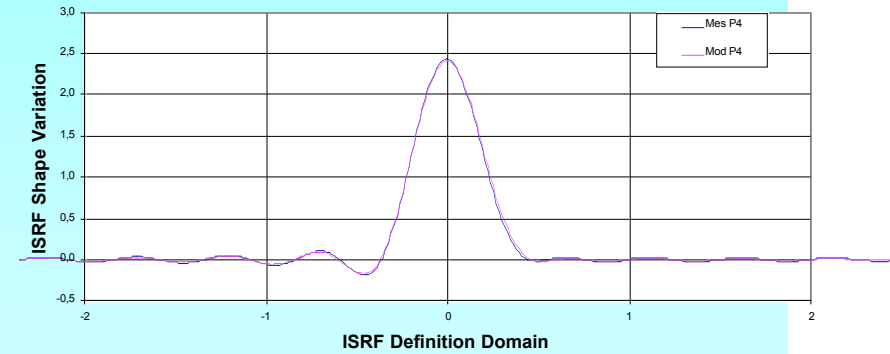
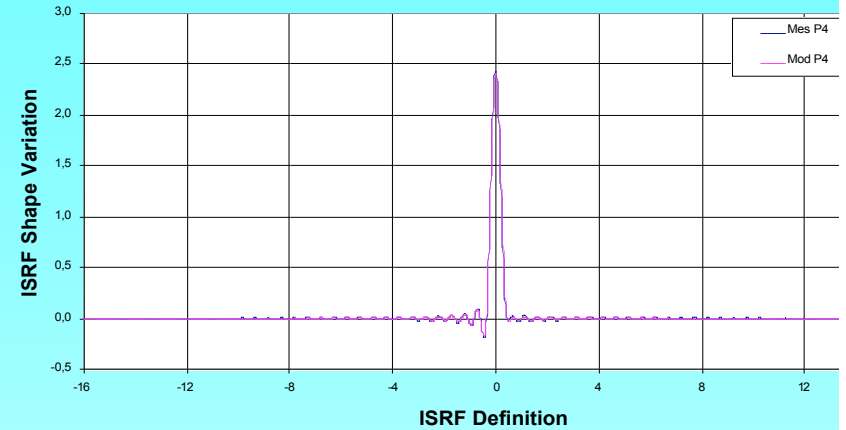
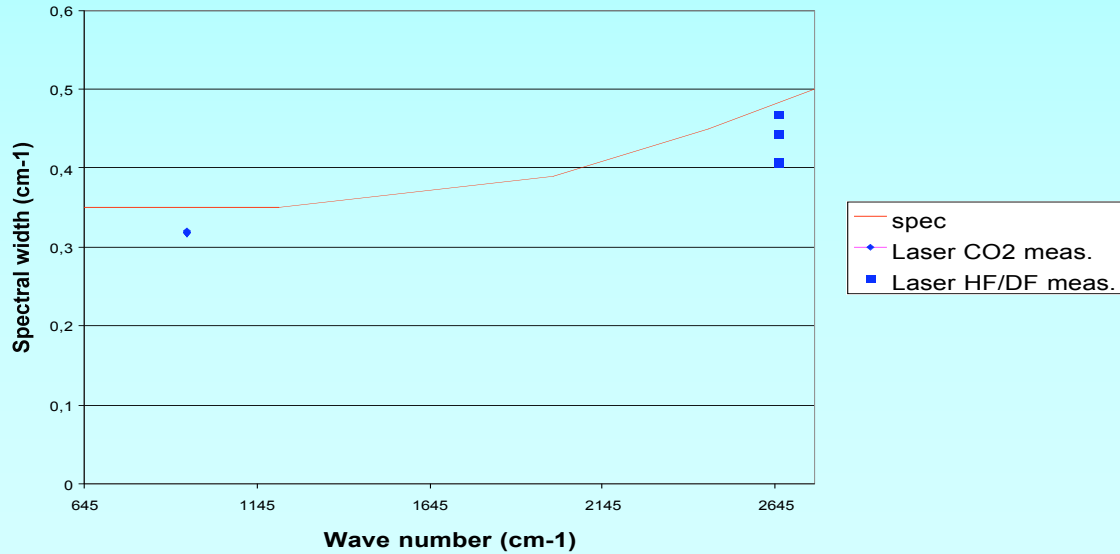


PERFORMANCE STATUS : SPECTRAL



The Instrument Spectral Resolution Function (ISRF) measured during the optical vacuum test is similar to the predicted one.

Spectral resolution



PERFORMANCE STATUS : SPECTRAL



⇒ ISRF CENTROID RELATIVE SHIFT

Within specification ($< 2 \cdot 10^{-4}$) for all bands

⇒ ISRF CENTROID STABILITY

less than $4 \cdot 10^{-7}$ in all bands ($< 10^{-6}$ specified)

⇒ SHAPE ERROR INDEX

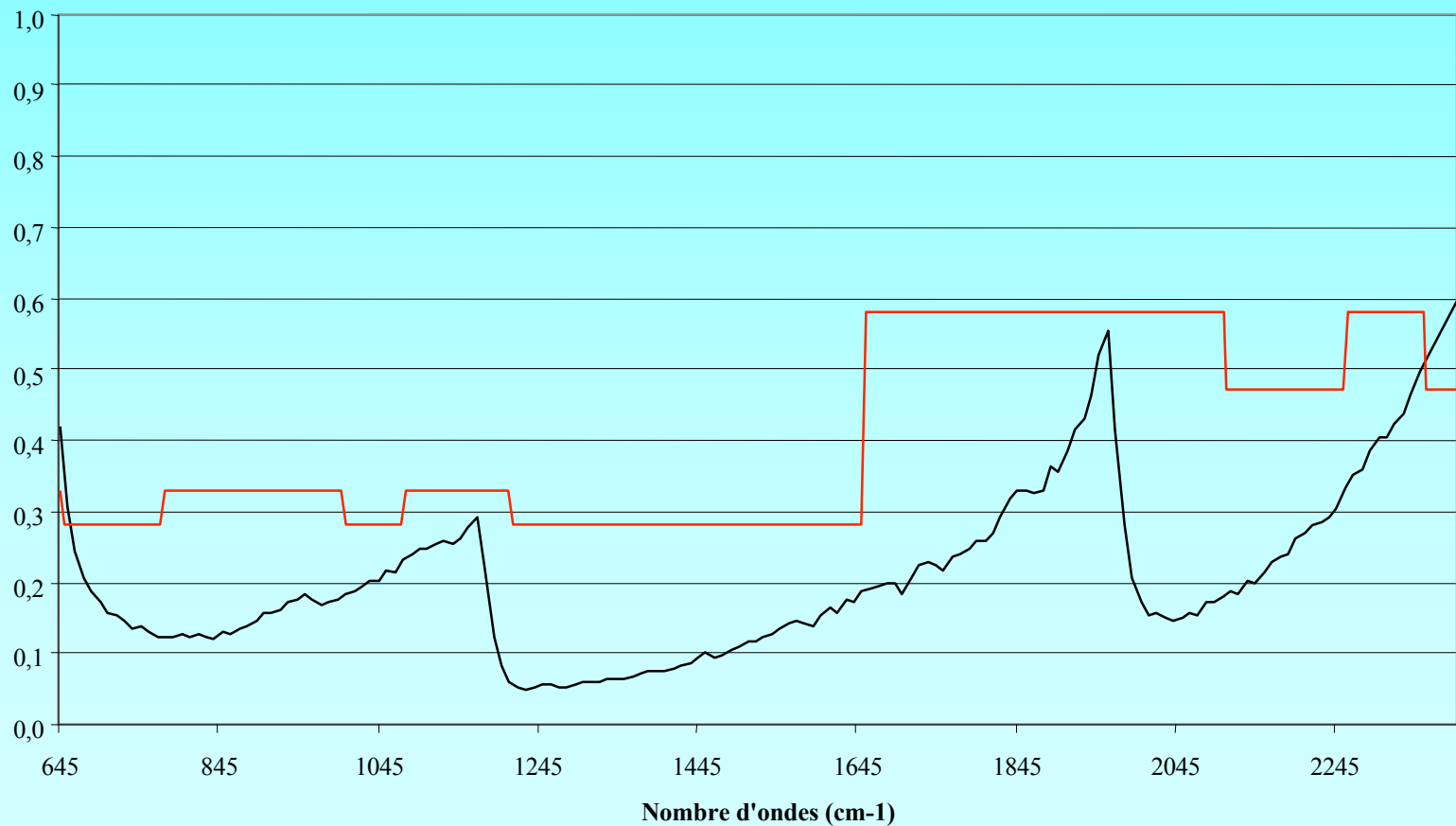
spectral band	σ_1	σ_2	specified
B1	In progress	0,012	< 0.046
B2	In progress	0,017	< 0.056
B3	In progress	0,017	< 0.070

PERFORMANCE STATUS : RADIOMETRY



Results of Optical vacuum test July 2003

Instrument radiometric performance in NeDT before contamination

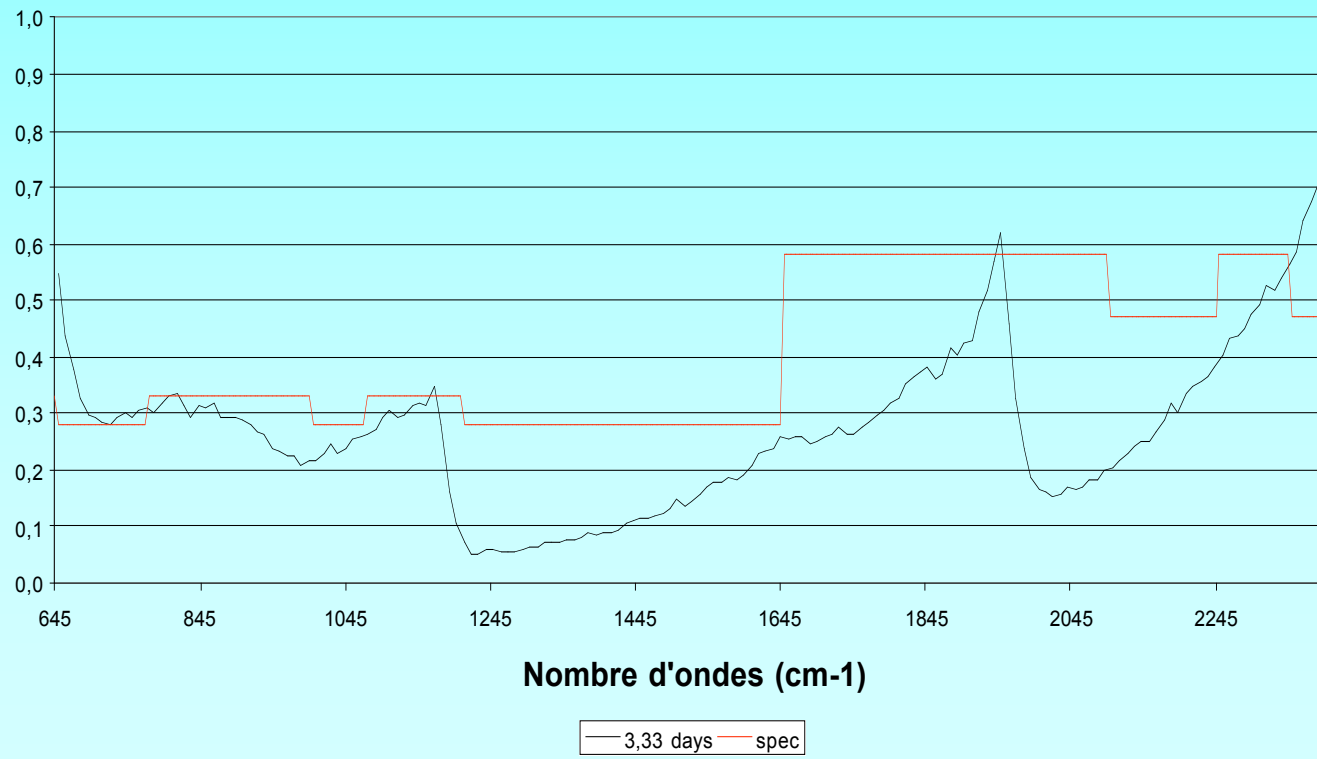


PERFORMANCE STATUS : RADIOMETRY



Results of Optical vacuum test July 2003

Instrument radiometric performance in NeDT after ice contamination





PERFORMANCE STATUS : RADIOMETRY

Results of Optical vacuum test July 2003

⇒ **ICE CONTAMINATION: 8% per day during the first test sequence, 4 % per day during the second test sequence.**

Bigger than expected.

A working group of experts from CNES and ALCATEL has analyzed the causes of the high level of icing and is proposing recommendations.

Preliminary outcomes of the WG :

- water outgasing from carbon fiber and MLI is responsible of contamination.

- identification of leakage between the interferometer cavity and the field lens cavity (100 K)

Hermeticity of the field lens cavity has to be improved.

⇒ **RADIOMETRIC CALIBRATION**

- **Absolute accuracy < 0.3 K(0.5 K specified)**

- **Calibration difference between pixels :**

PERFORMANCE STATUS : GEOMETRY



⇒ **Non Uniformity of the Instrument Point Spread Function (IPSF) : compliant with specification ($\pm 5\%$) except for pixel 4.**

⇒ **Pixels geometrical characterisation**

⇒ **Pixel diameter : compliant with the expected values (less than 0.1 mrd difference)**

⇒ **Angular distance (in mrd) between pixel radiometric centers (nominal value is 21.63 mrd)**

	P1P2	P2P3	P3P4	P4P1
B1	21,65	21,61	21,67	21,61
B2	21,52	21,68	21,57	21,55
B3	21,55	21,66	21,57	21,57

⇒ **Effective pixel centres included within circles of less than 0.15 mrd in radius centered on the reference square corners (specification is 2 mrd).**



PERFORMANCE STATUS : IMAGER

⇒ RADIOMETRIC PERFORMANCES

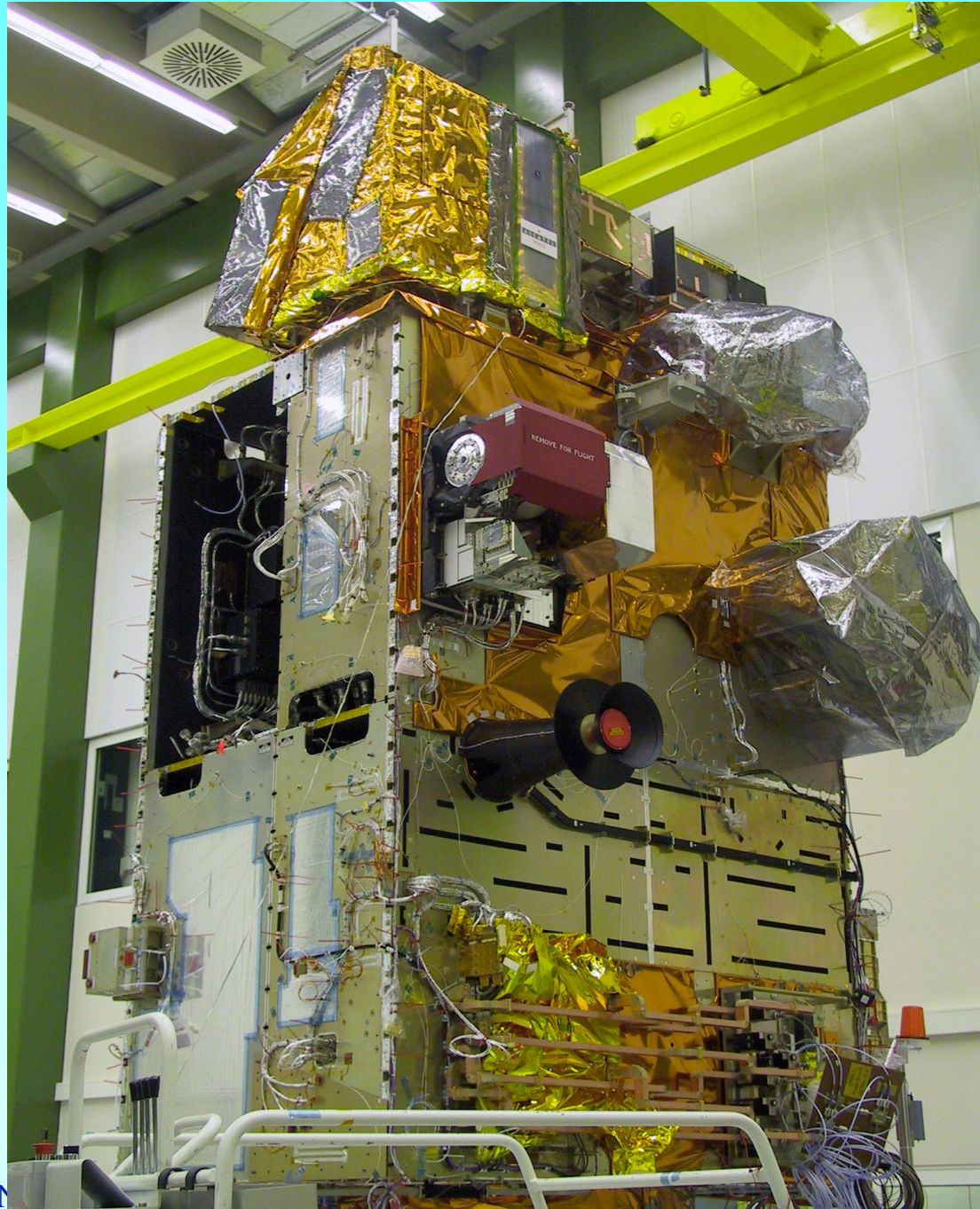
NEDT = 0.57 K (specified at 0.80 K).

Calibration accuracy < 1 K

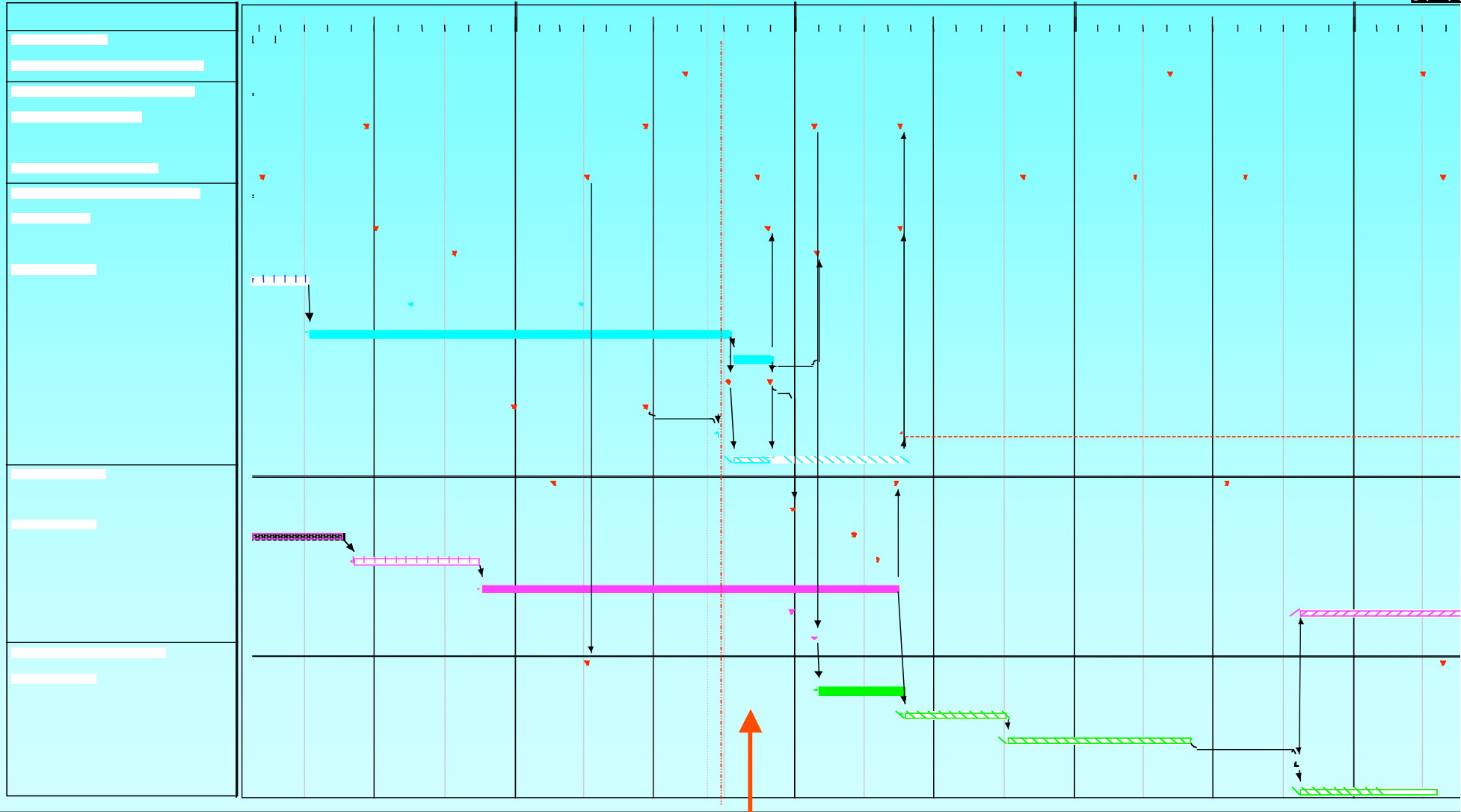
Dynamic range : noise better than specification from 200 K to 300 K of scene temperature

⇒ GEOMETRICAL PERFORMANCE

4 blind pixels (2 % specified)



ITSC 13- Ste Adèle (Canada)-N



ITSC 13- Ste Adèle (Canada)-Nov 2003



IASI level 0 and level 1 products

⇒ Level 0 : Raw IASI telemetry data

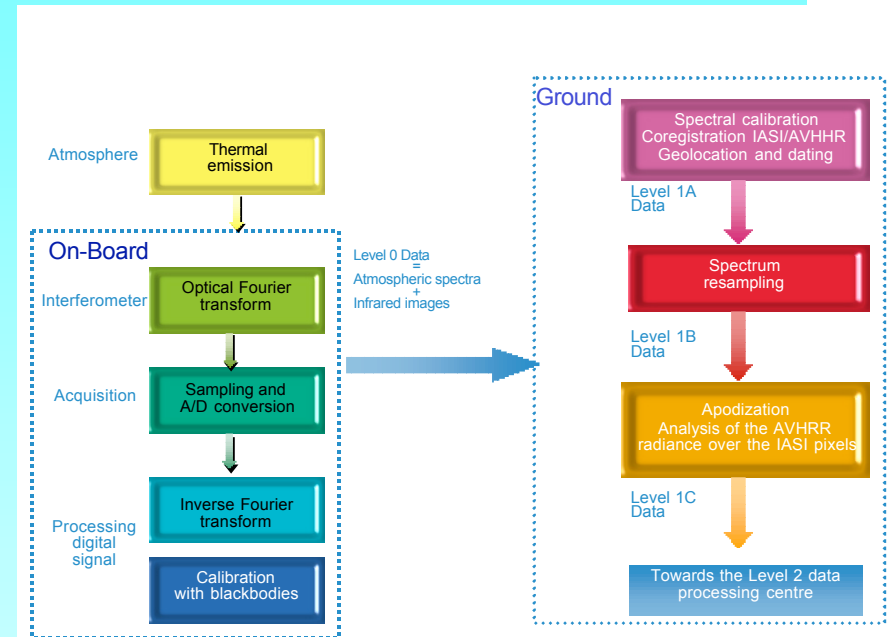
- on-board calibrated spectra (demultiplexed, time re-ordered)
- associated uncalibrated IIS images
- Housekeeping data and verification data

⇒ Level 1a : unapodized calibrated spectra and corresponding IIS images corrected from all geometrical and instrumental effects

*decoding, radiometric calibration, spectral calibration
IASI/AVHRR coregistration
georeferencement and dating*

⇒ Level 1b : Level 1a resampled at nominal spectral interval ($0,25 \text{ cm}^{-1}$)

⇒ Level 1c : Level 1b apodized to obtain the nominal ISRF
+ analysis of AVHRR radiances in the IASI FOVS



IASI Data processing



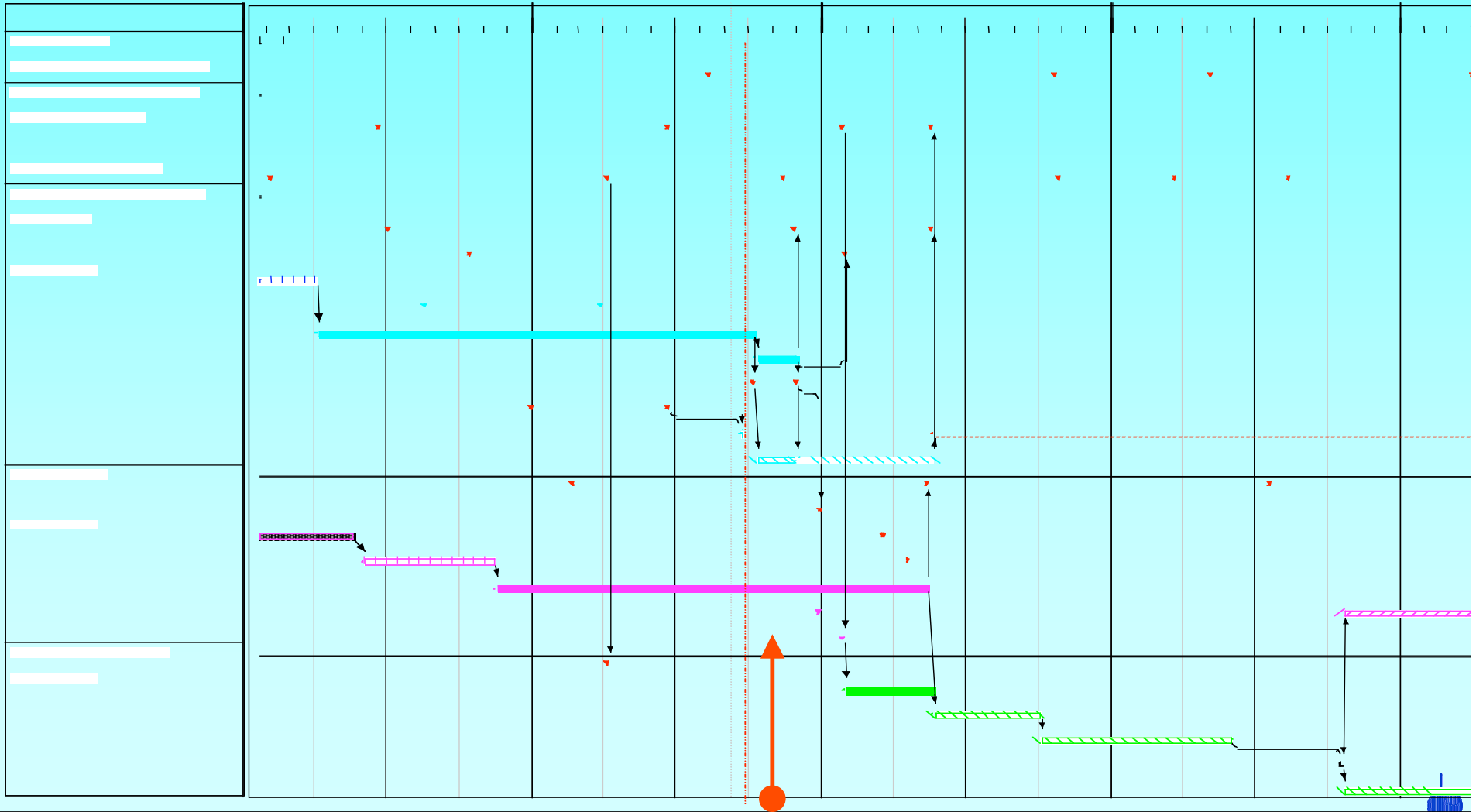
IASI instrument

Onboard

I Raw interferograms
 $I(x)$ Corrected interferograms (NL) + Zpd
 $S_b(n)$ Complex raw spectra
 $S(n)$ Real spectra after radiometric calibration

Onground

$S_c(n)$ Encoded spectra
 $S(n)$ Decoded spectra
 S_{1A} Level 1A spectra (spectral and radiometric calibration)
 S_{1B} Level 1B spectra (resampled at 0.25 cm^{-1})
 S_{1C} Level 1C spectra (after apodisation)





The Technical Expertise Center

- ⇒ **Dedicated to IASI performance verification (highest priority)**
- ⇒ **Objectives are :**
 - **in-flight update of instrument characteristics (firstly established by on ground tests)**
 - **monitoring of the instrument and level 1 processing in commissioning phase**
 - **operational monitoring in routine exploitation phase**
- ⇒ **Central for the Level1 Cal/Val**
- ⇒ **Functions are :**
 - **initialisation**
 - ◆ **for on board processing :**
 - ◆ **for level1 processing**
 - **Monitoring the performance of the system and investigation**
 - **providing information on quality**
 - **modify instrument modes**



Performances monitored by the TEC

- ⇒ Radiometric noise of the instrument
- ⇒ Calibration interferograms (BB and CS)
- ⇒ Contrast and gain of the interferometer
- ⇒ Spectral calibration performed by Level 1 processing
- ⇒ Detection chain offset and gain + non linearity
- ⇒ on-board complex radiometric calibration
- ⇒ Reduced spectra evolution
- ⇒ Cube corner offset evolution
- ⇒ spikes detection criteria
- ⇒ On-board coding tables change
- ⇒ Coregistration sounder/IIS and IIS/AVHRR
- ⇒ Dead pixels of IIS