



IASI-NG Status Summary after PDR

Frédéric BERNARD¹, Bertrand CALVEL²,

CNES¹ and AIRBUS² DS IASI-NG TEAM

Please see also poster
IASI-New Generation Program Status:
Moving to Phase C/D

IASI-NG Instrument

In the frame of the Second Generation of the Eumetsat Polar System (EPS-SG), a **New Generation of Infrared Atmospheric Sounding Interferometer (IASI-NG)** will be developed by CNES in collaboration with EUMETSAT to continue and improve the IASI mission on METOP.

IASI-NG is a Fourier Interferometer analysing Infrared signal from 3,6 to 15,5 μm for Atmospheric Sounding. It is one of the main payload on-board METOP-SG Satellite A. It provides temperature & Humidity data along altitude, Atmospheric chemistry data and Essential Climate Variable monitoring.

The major performances are:

- Sounding Pixel Size : 12 km
- Spectral Resolution : 0,25 cm^{-1}
(2 times better than IASI)
- Radiometric Noise : $\text{NedT} \sim 0,1\text{K}$ (2 times better than IASI)
- Radiometric Calibration : $\sim 0,25\text{K}$ (2 times better than IASI)
- Mission lifetime 7,5 years for each of the 3 satellites.

IASI-NG on METOP SG



Instrument Field of View

METOP-SG Orbit

(IASI like)

Sun Synchronous Orbit

Altitude = 835 km

Local time : 09h30

(descending node)

IASI-NG characteristics

16 sounder pixels

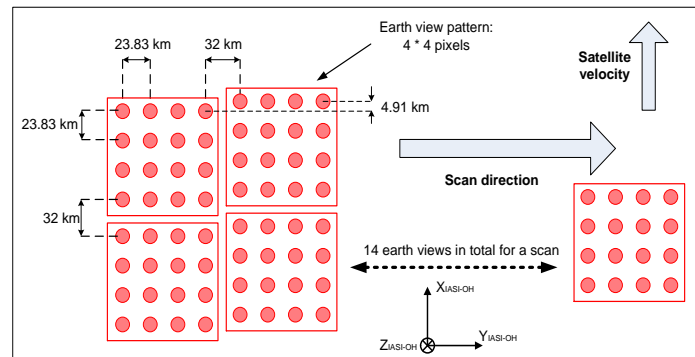
each 12 km diameter

~ 25 km sampling

Acquisition ~ 740 ms

Full Scan line in 15,6s

(=14 Earth Views +
1 Blackbody + 1 Cold Space
per line)

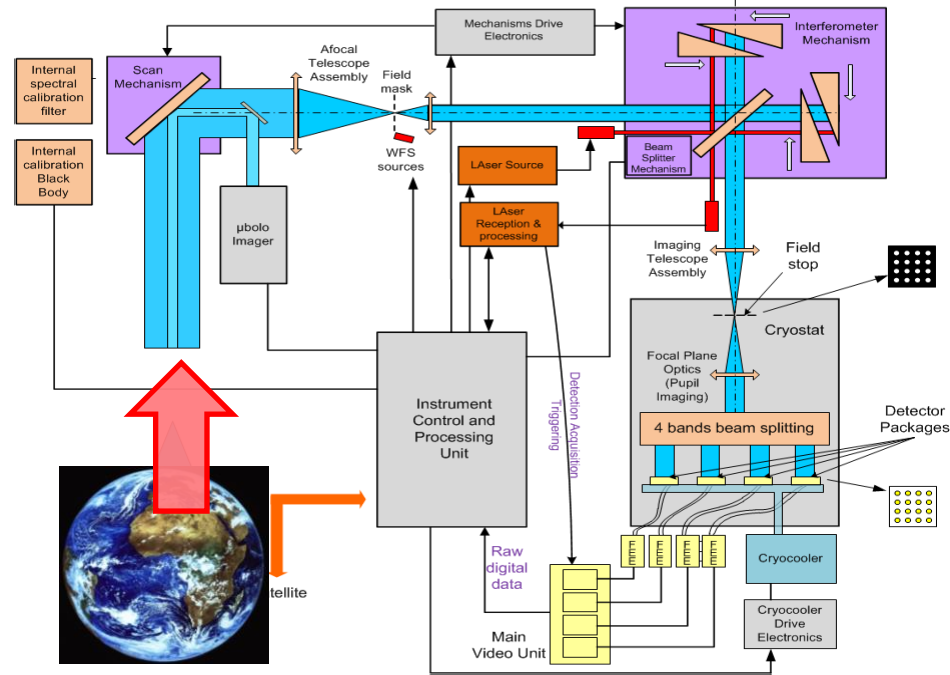


**Ground pattern
corresponding to
detectors**

IASI-NG Instrument

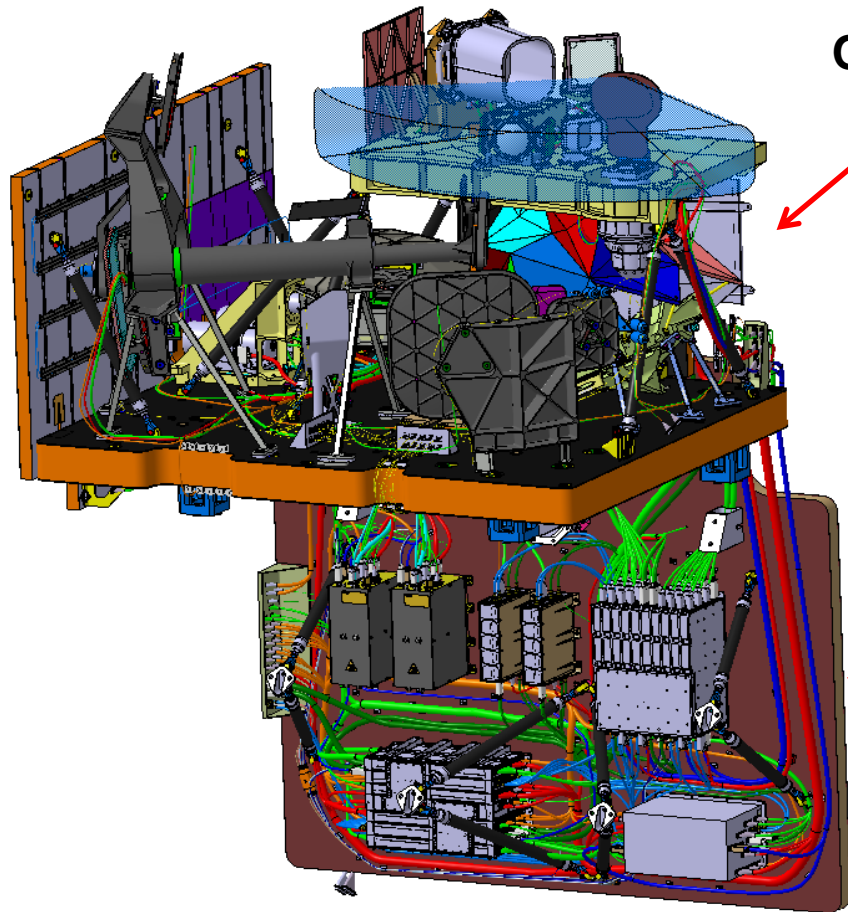
Major Characteristics of the IASI-NG concept :

- An Innovative Interferometer optical concept with nearly perfect self apodisation compensation over a large Field of View.
The Optical Path Difference Scan and compensation are performed using a single Dual Swing Mechanism (Airbus/Cnes patent).
- A multiple-beam laser Metrology monitors OPD and tilts for post processing compensation of errors.
- A Microbolometer Imager for coregistration with the MetImage instrument
- An active Cooled Focal Plane at 75K with 4 separate bands
- An Afocal and an Imaging full SiC 3-mirrors telescopes
- A new bi-axis Scan mechanism scanning the field of view and compensating satellite velocity with low induced torques



- On-board radiometric and spectral calibration targets. On-board processing for flow rate reduction with FFT and compression of all data
- Total Mass is around 420 kg with electronics. Dissipated Power is around 530W. Data flow 6Mb/s.

IASI-NG Instrument



**Instrument
Optical Head**



**Instrument
Electronics
Module**

**Both Modules on
top of METOP-SG**

IASI-NG Instrument at PDR : Optical Head

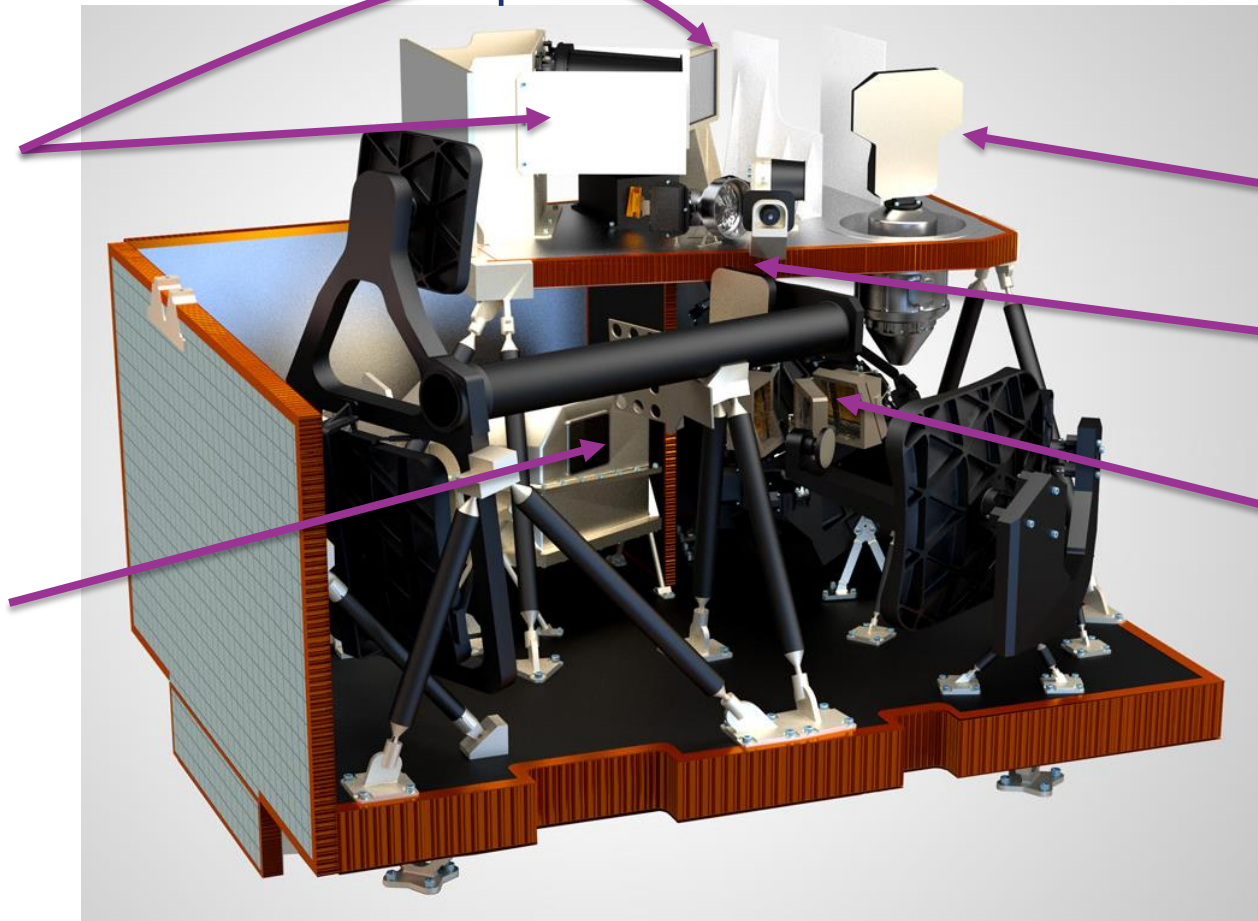
Calibration
devices

Bi-axis
Scan mirror

Imager

Interferometer

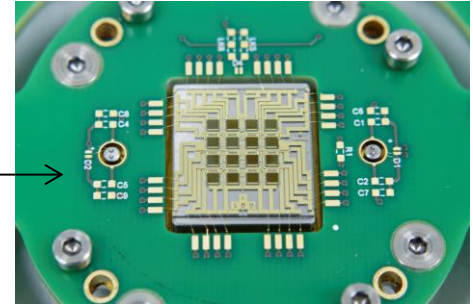
Cryostat with
focal plane



Intensive Breadboarding activities

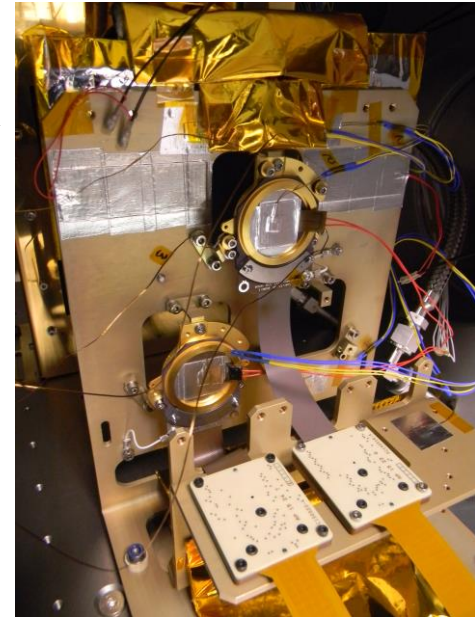
- On Detector Packages (at SELEX ES level)

- ✓ Detectors Pre-evaluations on mock-ups representatives of materials are tested
- ✓ Multi Layer Anti Reflecting Coating, providing higher transmission is validated
- ✓ Representative Detectors have been delivered in September 2015 to the instrument Prime



- On Acquisition Chain (at Airbus DS level)

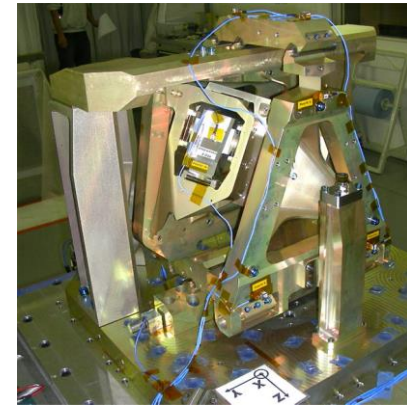
- ✓ Acquisition chain validation at instrument prime level
- ✓ Validation is running on BBM and mock-up
- ✓ Incremental validation with EM coming soon



Intensive Breadboarding activities

■ On the Interferometer →

- ✓ A Kinematic Demonstrator in Phase A validated the design and proved concept performances on real hardware in the visible range (worse case for apodisation)
- ✓ Polishing, coating and mounting of Optics is demonstrated
- ✓ The Demonstrator is now refurbished with infrared optics to support tests in the IASI-NG bands
- ✓ Mechanisms pivots have been manufactured and tested for life time validation (200 million cycles)
- ✓ A Beam Splitter Mechanism fine adjustment mechanism was developed. The breadboard has proved the capability for fine adjustment, even in flight, with few 10's nm resolution

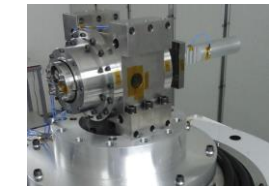


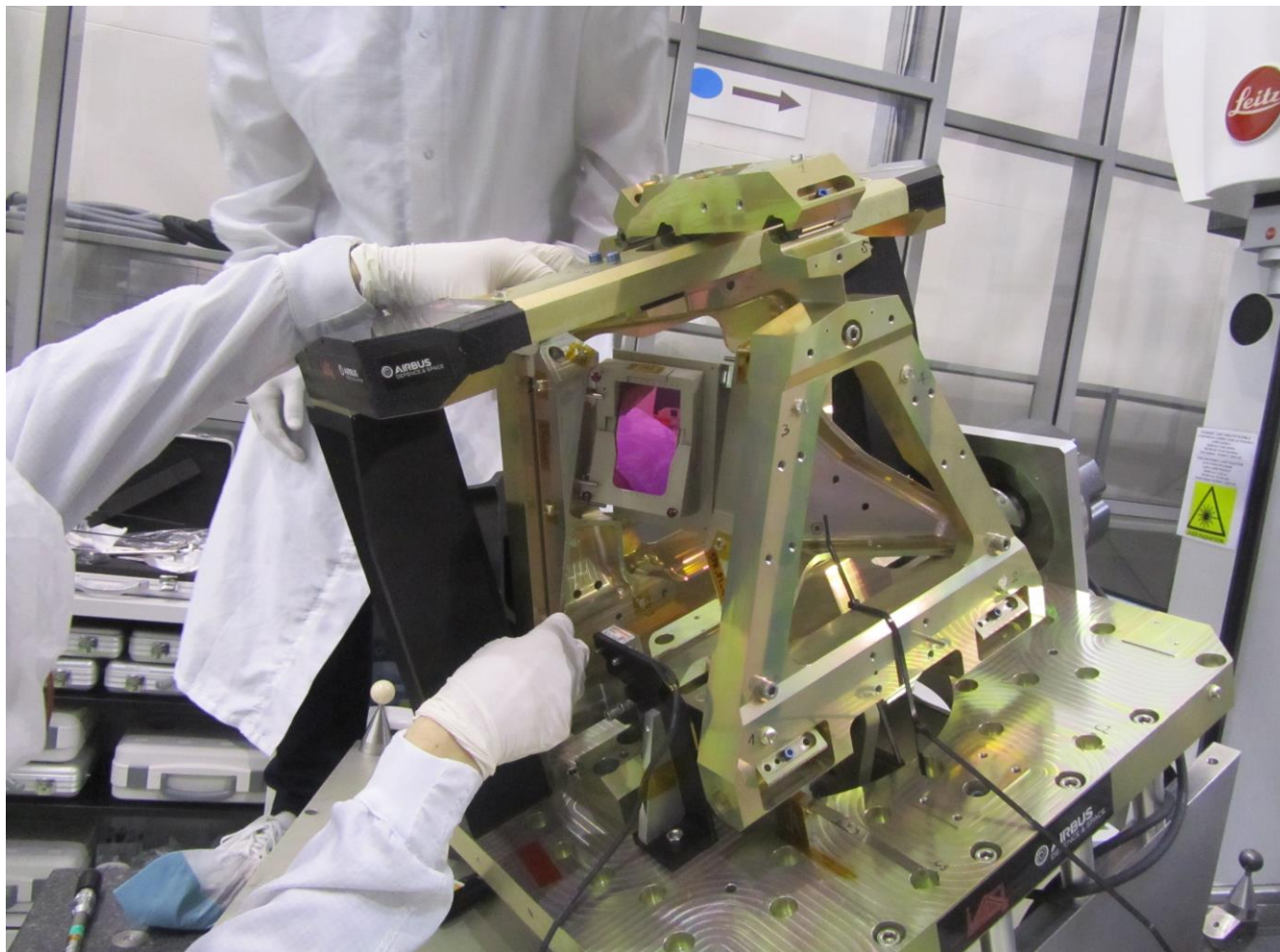
■ On the Metrology →

- ✓ Validation of the metrology has started with BBM model and dedicated test bench



■ On the new 2 axis Scan Mechanism concept, pivots and kinematics were validated on breadboards →





Major Performance Status :

Geometric performances

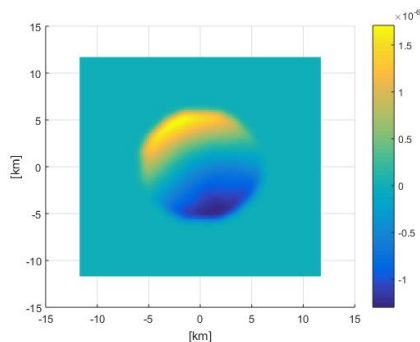
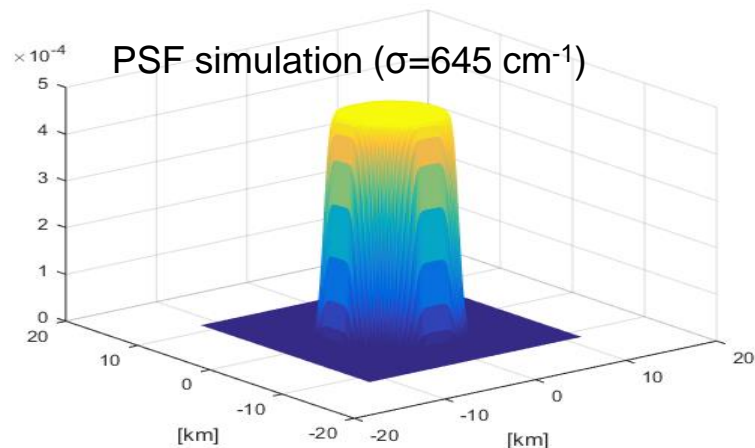
Pointing perfos well compliant :

- Pointing accuracy: 0.9 mrad (spec: 3 mrad)
- Pointing stability: 62 μ rad (spec: 100 μ rad)
- Pointing knowledge error: 0.9 mrad (spec: 3 mrad)

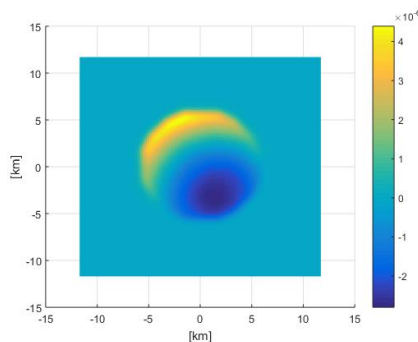
Instrument Point Spread Function (PSF)

- Spatial and spectral uniformity are within specification

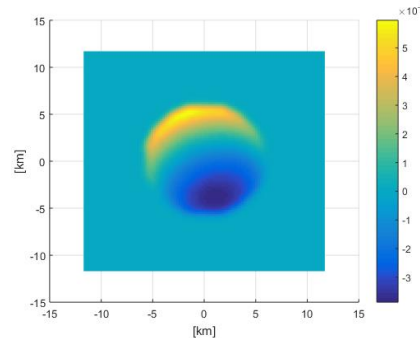
PSF spectral uniformity map (compared with 645 cm^{-1})



$\sigma = 1180 \text{ cm}^{-1}$



$\sigma = 2130 \text{ cm}^{-1}$



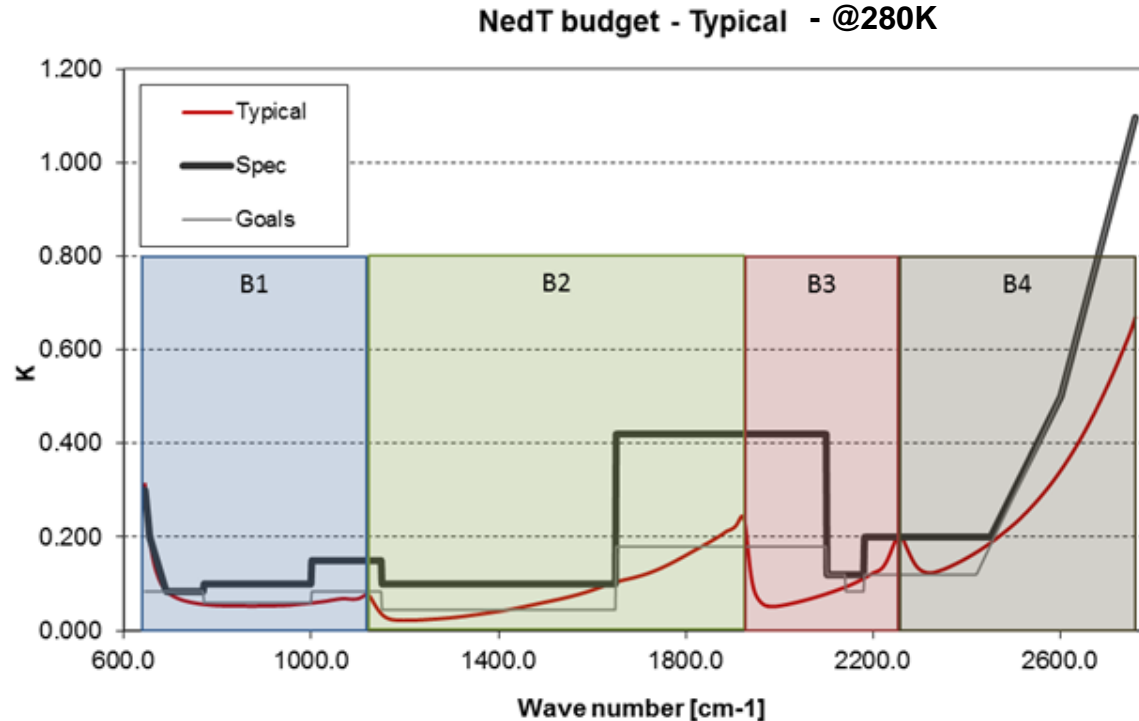
$\sigma = 2500 \text{ cm}^{-1}$

Major Performance Status:

Radiometric Noise performances

Noise equivalent delta Temperature:

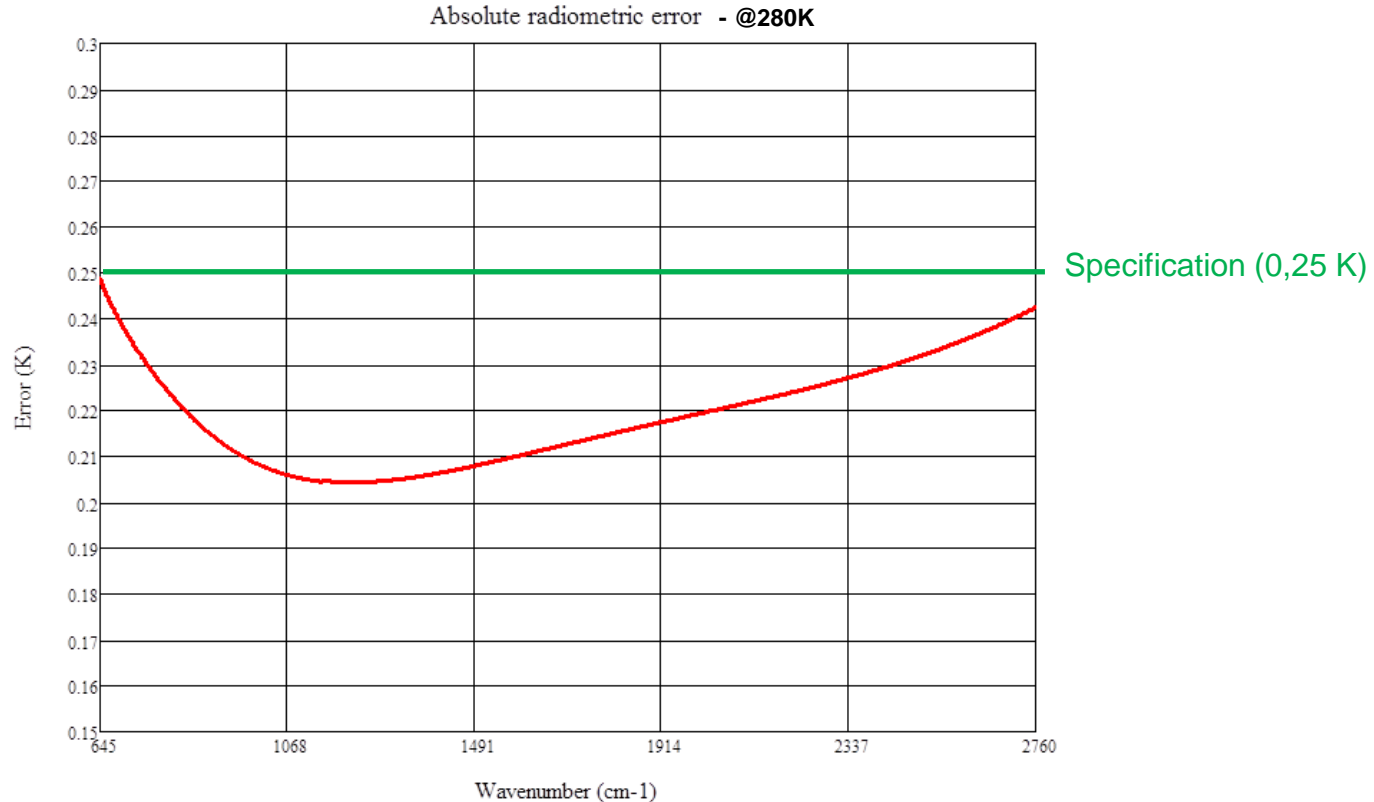
- The performance is within the specification



Major Performance Status:

Absolute Radiometric Calibration

- The performance is within the specification



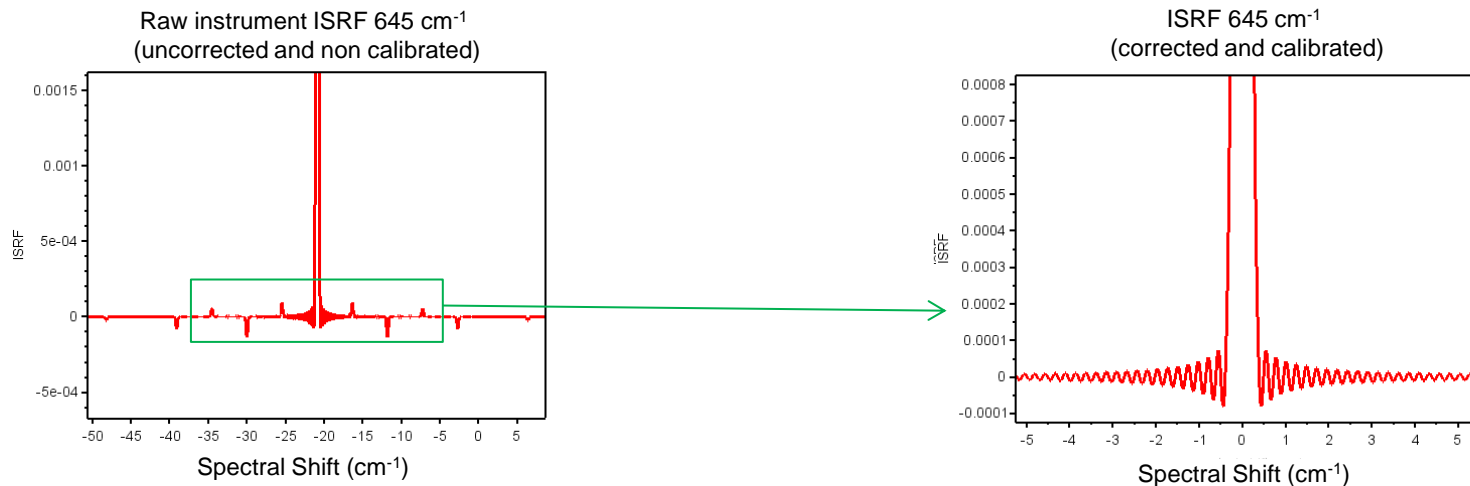
Major Performance Status:

Spectral Performances

The two main spectral performances are within specification :

- Centroiding accuracy (location of the spectral lines)
- Shape error index (profile of the spectral lines)

Example of correction of the ISRF function in a high perturbation case thanks to the auxiliary laser metrology data prior to spectra retrieval from interferograms :



Conclusion : near future outlook

Instrument performances were confirmed at PDR and supported through Technological programs.

- Engineering Model has started and first assemblies will be available from coming weeks until 2017
- Full performances demonstration and measures will be done along the next two years on this model
- Instrument CDR is planned Q3 2017

Bibliography : <https://iasi-ng.cnes.fr/>

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C. Luitot, J. Boyadjian, C. Buil, F. Pasternak, “Optical Architecture of the new generation Infrared Atmospheric Sounder Interferometer (IASI-NG),” **SPIE 8841-22, Current Developments in Lens Design and Optical Engineering XIV, San Diego, August 2013.**

F. Bernard, B. Calvel, F. Pasternak, R. Davancens, C. Buil, E. Baldit, C. Luitot, A. Penquer, “Overview of IASI-NG the new generation of infrared atmospheric sounder”, **International Conference on Space Optics (ICSO), October 2014**