IASI-NG INSTRUMENT PERFORMANCES STATUS

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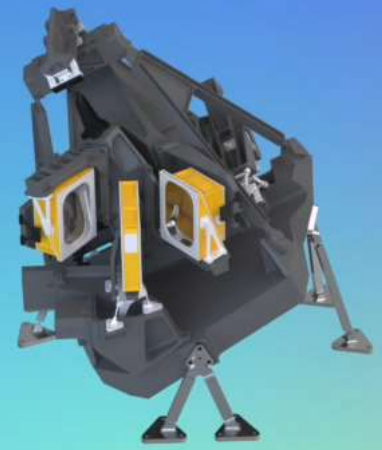
IASI CONFERENCE 2024

December 02 > 06 2024
NANCY

IASI-NG INSTRUMENT CONCEPT

- Significant performance improvement with wider field of view (factor 4), allowed by innovative instrumental concept proposed by Airbus Defence and Space
- Associated field effects are compensated in pupil by inserting dynamically variable glass thickness
- Achieved through 2 pairs of KBr prisms, synchronized via an unique device movement
- First implementation in space of a Mertz Interferometer



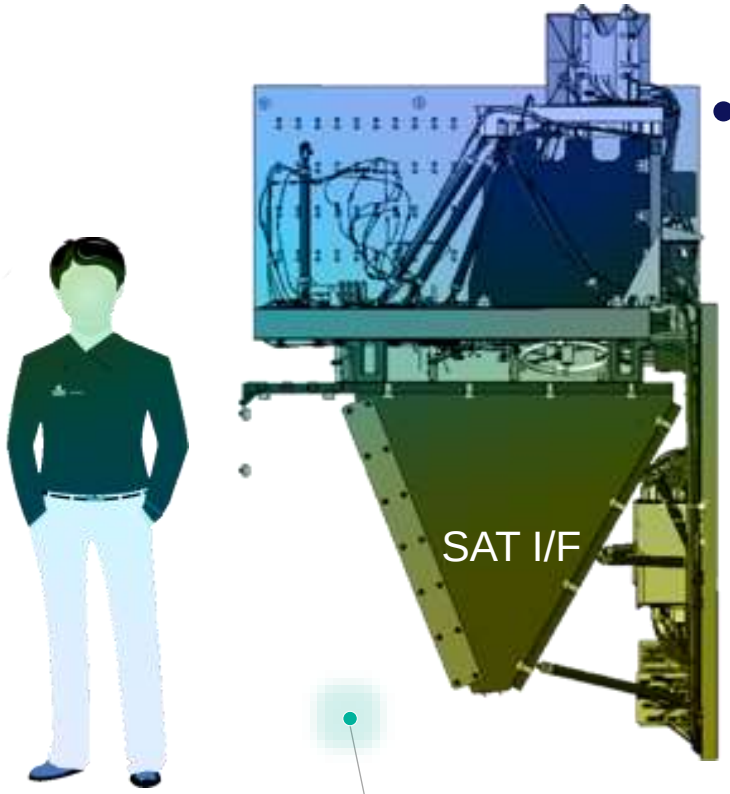
IASI-NG OVERALL DESIGN

- **Afocal and Imaging Telescopes**
- **Mertz Interferometer**
- **Focal Plane :** 4 detectors for 4 spectral bands /16 sounding pixels per detector
- **5 metrology lasers:**
  - 1 central metrology to give the Optical Path Difference constant triggering
  - 4 lateral lasers to monitor in real time the pupil effects (tilt, focus and astigmatism) for correction through on ground processing

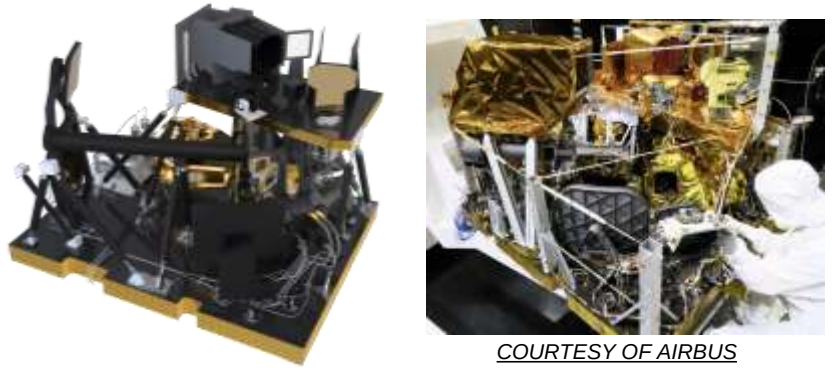
SPECIFICATIONS			
GEOMETRY	SOUNDER PIXEL SIZE	~12 km	SAME AS IASI
	SPATIAL SAMPLING	~25 km	
	GEOLOCATION ERROR	0.5 km	
SPECTRAL	BAND	645 cm-1 to 2760 cm-1	
	RESOLUTION	0,25 cm^{-1}	2 TIMES BETTER THAN IASI
	SAMPLING	0,12 cm^{-1}	
	CALIBRATION ERROR	$d\sigma/\sigma = 5.10^{-7}$	
RADIOMETRY	CALIBRATION ERROR	0,25K @ 280 K	
	NEDT	NedT ~0.1 K to 0.4 Kwithin spectrum	

MAIN CHARACTERISTICS	
SWATH	~ 2000 KM
FOR	+/- 3°
PUPIL DIAMETER	~ 90 MM
ATA MAGNIFICATION	2.3
MAXIMUM OPTICAL PATH DIFFERENCE	4,2 CM
ACQUISITION DURATION	~730 MS
SCAN LINE DURATION	15.6 s : 14 EARTH VIEWS + 1BB + 1CS
CO-REGISTRATION	INTEGRATED IMAGER
SPECTRAL CALIBRATION	FABRY PEROT SOURCE

IASI-NG INSTRUMENT BUDGET

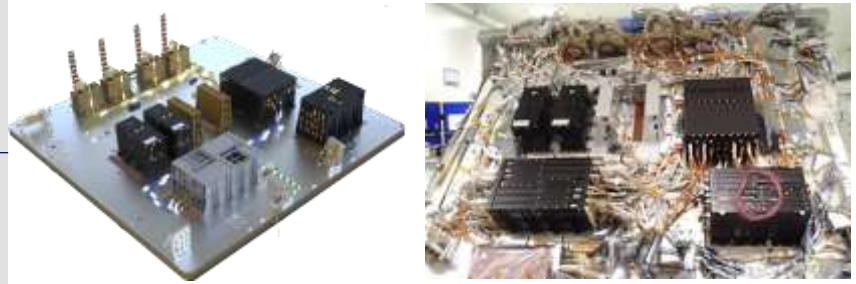


I-OH (OPTICAL MODULE)



COURTESY OF AIRBUS

I-EM (ELECTRONICS MODULE)



COURTESY OF AIRBUS

MASS	430 KG
POWER	~520 W
I/F DATA RATE	~6 MB/S

IASI-NG CURRENT CONTEXT

- Proto-Flight Model integrated and tested in 2022. Verification incomplete due to issues during TVAC, and an anomaly in B4 band was found
- PFM delivered and mounted on Satellite to give priority to qualification at Satellite level (mainly mechanical and thermal); and then dismounted for open work activities
- In the meantime, FM2 integration and tests were done. Confirmation that no B4 anomaly on FM2 and **formal decision to deliver FM2 as the first IASI-NG instrument for flight**
- Handover to Satellite held on 10th September 2024 and mechanical mounting performed on 12th September

IASI-NG

METOP SG-A1 ON SHAKER
(courtesy of AIRBUS)

METOP SG-A1 IN FRONT OF TV CHAMBER
(courtesy of AIRBUS)

IASI-NG CURRENT CONTEXT

2023 FEB MAR APR MAY JUN JULY AUG SEP OCT NOV DEC

2024 JAN FEB MAR APR MAY JUN JULY AUG SEP OCT NOV DEC

PFM

TVAC SAT

PFM DISMOUNTING

PFM Investigations

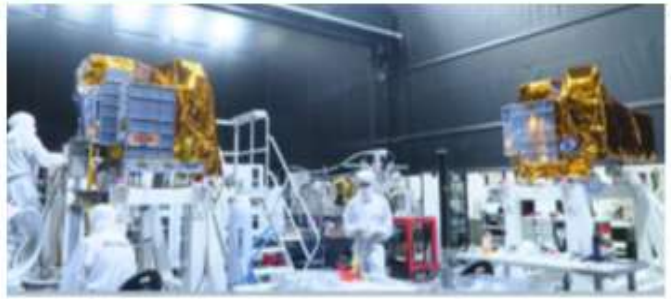
SW 2.3.1 FFT

PFM open work activities

FM2

FPCA FM2

FM2 AIT



FM2 MEC TEST

FM2 TVAC

EMC CE

Amb. Tests

Packing Transport

EMC RE

CTS FM2

FM2 Acceptance Review

FM3

FPCA FM3

Instrument FM3 AIT

IFM FM3

IASI-NG FM2 PERFORMANCE VERIFICATION

- **Performance verification is done in two steps**
- **TVAC for assessment of spectral and radiometric fine performances**
  - 2 external warm black bodies and 1 cold black body for radiometric performances
  - 4 lasers for Instrument Spectral Response (+spectral calibration stability)
  - Gas Cell (+cold black body) for spectral calibration
  - Cold black body in front of Fabry Perot view
- **Ambient test for geometric performances (LOS, IPSF, crosstalk)**
  - Warm black body and collimator OGSE

FM2 INSTRUMENT IN TVAC CHAMBER
(COURTESYOFAIRBUS)

THERMAL TENT INSTALLATION
(COURTESYOFAIRBUS)

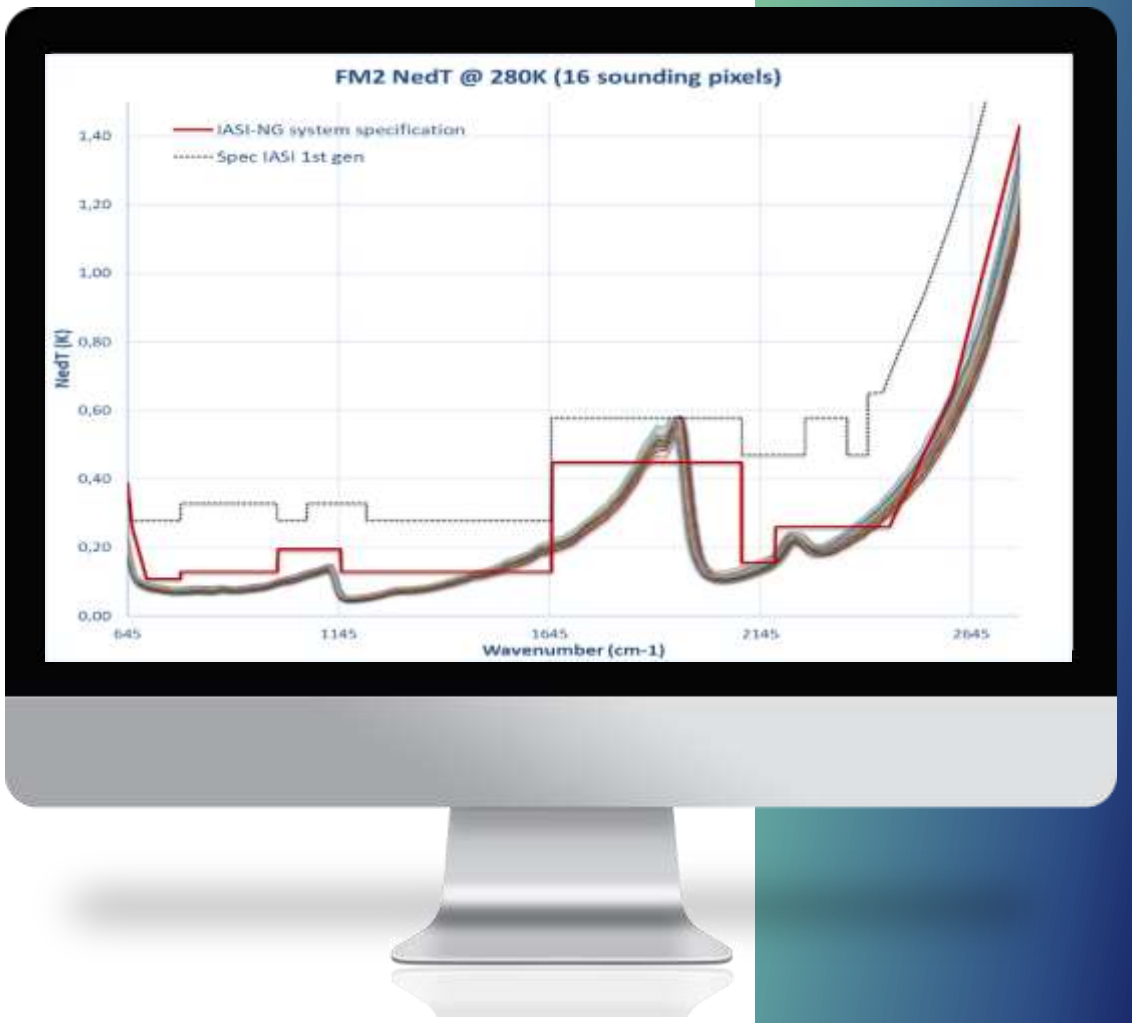
AMBIENT TEST SET-UP
(COURTESYOFAIRBUS)

RADIOMETRIC PERFORMANCES

- NedT higher than CDR prediction due to higher background flux (in phase opposition compared to usefull signal)

- Nevertheless, NedT @ 280K compliant with system specification over the whole spectrum excepted in limited spectral area

- Confirmation of strong improvement with regard to IASI 1st generation specification (on top of the 2 times better spectral resolution)



RADIOMETRIC PERFORMANCES

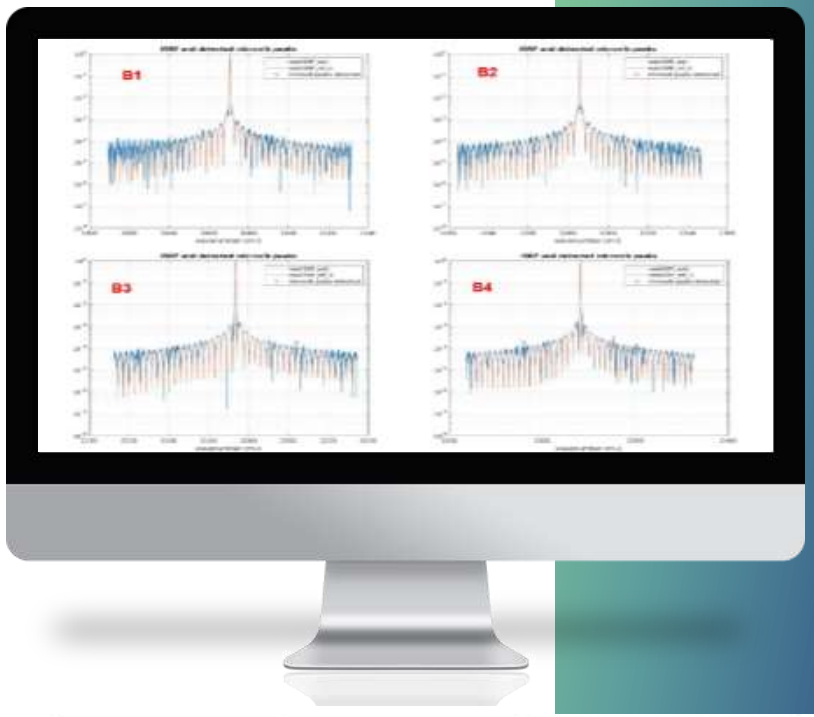
- **Absolute calibration error in line with specification (+/-0.25K) for all tested cases (from 210K to 310K)**

- **Residual errors gives non compliances on inter-channel and inter-pixel calibration error due to two major phenomena:**
  - vignetting effect on extreme views due to scan sizing issue with regard to pupil real size
  - difficulty to correct detector NL: due to high background level in phase opposition, internal BB view does not cover the whole useful dynamic

- **These NC have been presented at ISSWG and are acceptable**

SPECTRAL PERFORMANCES

- **ISRF with very good performances:**
  - Very low µvibration peaks
  - No significant parasitic interferogram peak
  - Shape error index globally in line with CDR WC budget (this contributor is mainly a fixed one and induces a radiometric bias on atmospheric scenes)

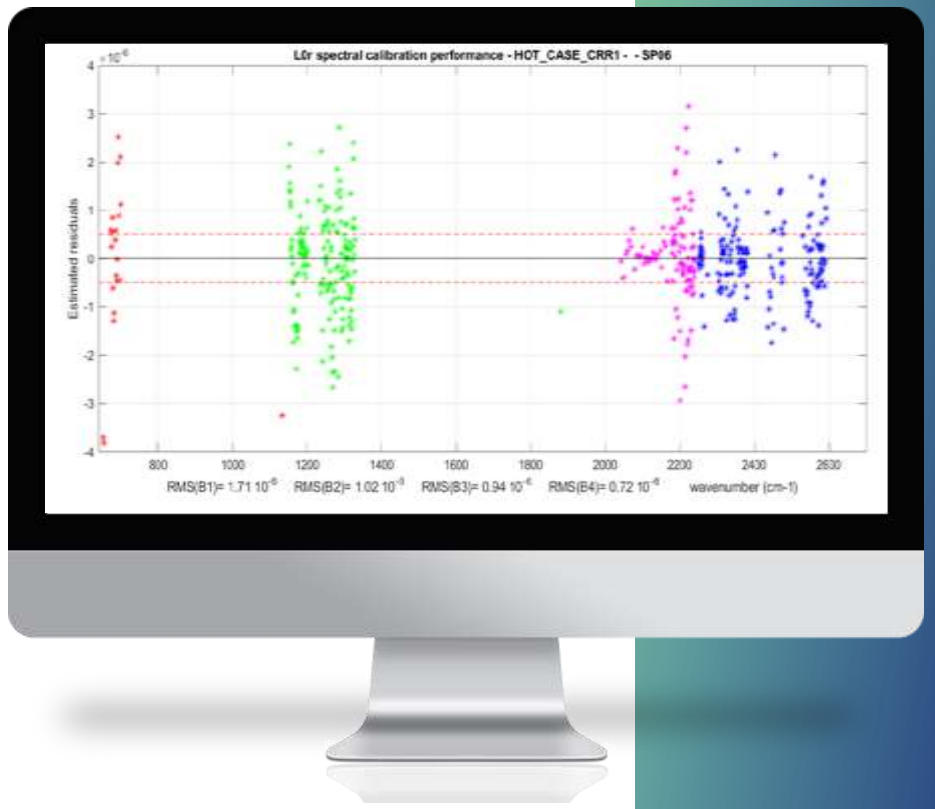


- **Improvement still possible by optimizing the model in the ground processing:**
  - Beam Splitter mechanism sine mode used during TVAC allows an optimization of the model parameters by checking the correction efficiency of induced tilt by the sinus vibration
  - Could improve the shape error index

Performance	CDR WC budget	Measured Performance
Shape Error Index	B1: 1.7% B2: 1.8% B3: 2.5% B4: 3%	B1: 2.2% B2: 2.0% B3: 2.3% B4: 2.7%
Un-modelled parameters	0.39%	<0.10%
OPD µvibrations	0.8% (0.5% RSS)	<0.33% (<0.2% RSS)
Contrast µvibrations	0.5% (0.44% RSS)	<0.40% (<0.2% RSS)

SPECTRAL PERFORMANCES: CALIBRATION

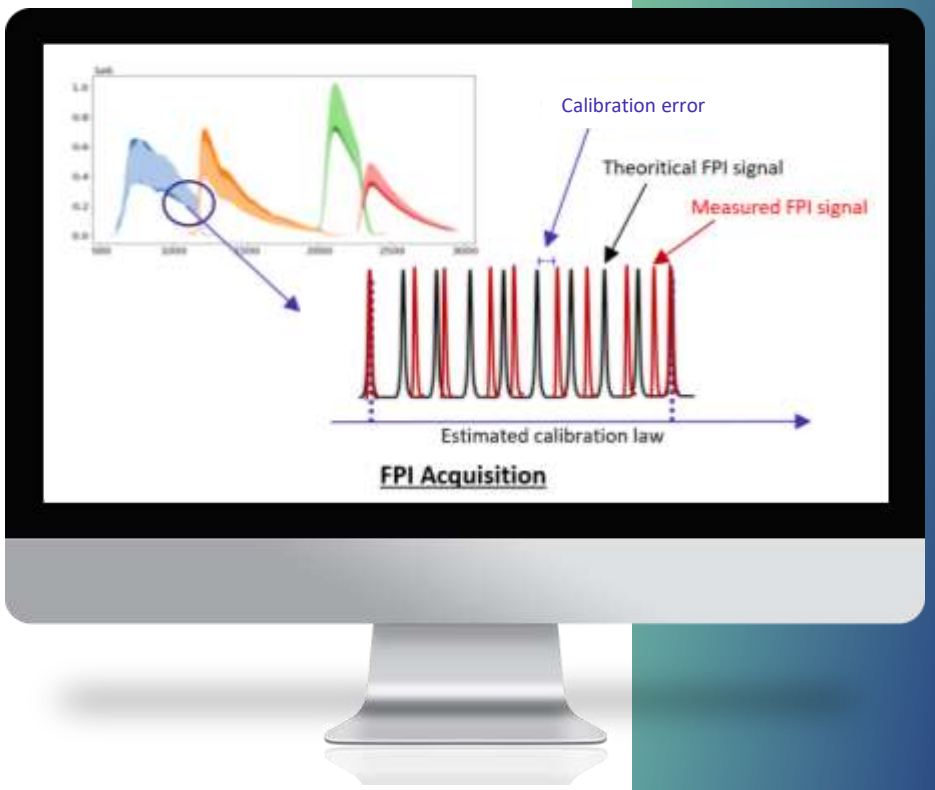
- **Spectral calibration based on 6 parameters KBr index law applied over the full spectrum**
- **Gas Cell used to fit the law on reference lines, and centroid shift (spectral calibration error) is estimated with verification lines :**
  - Mean residual error is only few 10^{-7}
  - Rms residual errors is around 1 to 3.10-6 in B1 in WC, due to Gas Cell line knowledge and lack of lines in B1



- **This very good results with “all bands” approach confirm the validity of the spectral law modelling**
- **It shows the compliance to the “a priori” knowledge of the centroid shift (10^{-4})**

SPECTRAL PERFORMANCES: CALIBRATION

- The “a posteriori” knowledge specification supposing using perfectly known lines is 5.10^{-7}
- Verification by using gas cell lines is limited
- On board Fabry Perot Interferometer is used on this purpose, as the Free Spectral Range is almost constant



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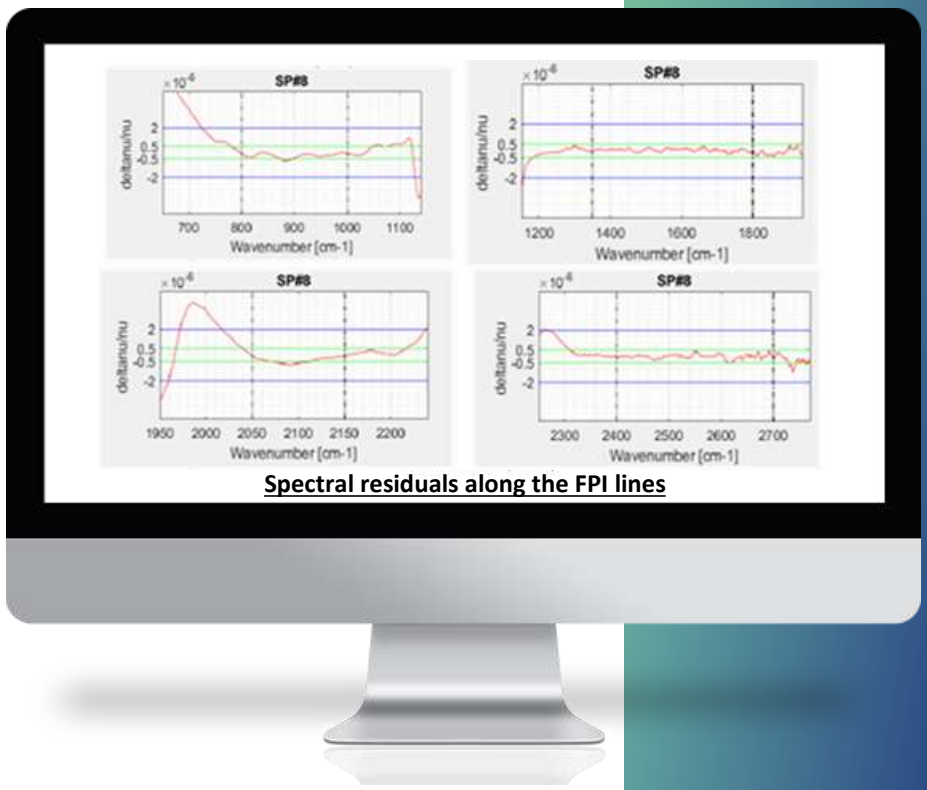
Residuals between two reference FPI peaks is very low and $<5.10^{-7}$

- Residuals higher in inter-bands but suspected to be due to IPSF impact on FPI FSR (under analysis)
- It shows that residuals not directly linked to KBr index law are compliant with specification, and then that **“a posteriori” specification is well achievable**



Spectral residuals along the FPI lines

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THANK YOU FOR YOUR ATTENTION