IASI Conference 2010

Status of IASI instruments: FM2 after 3 years in orbit PFM-R and FM3 on ground

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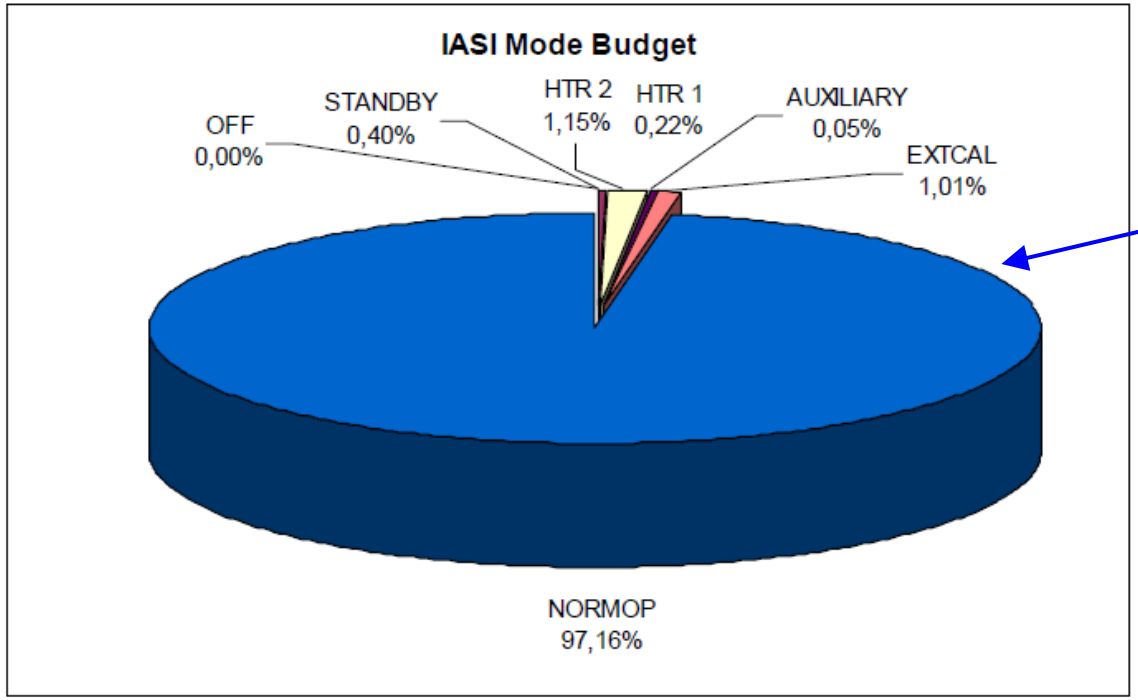
Status of IASI instruments: FM2 after 3 years in orbit PFM-R and FM3 on ground

- **IASI FM2**
  - More than 3 years in orbit
  - Very good instrument health
  - Very good instrument availability

- **IASI PFM-R and FM3**
  - 2 next IASI flight models on Metop-B and Metop-C
  - Will be launched in 2012 and 2016

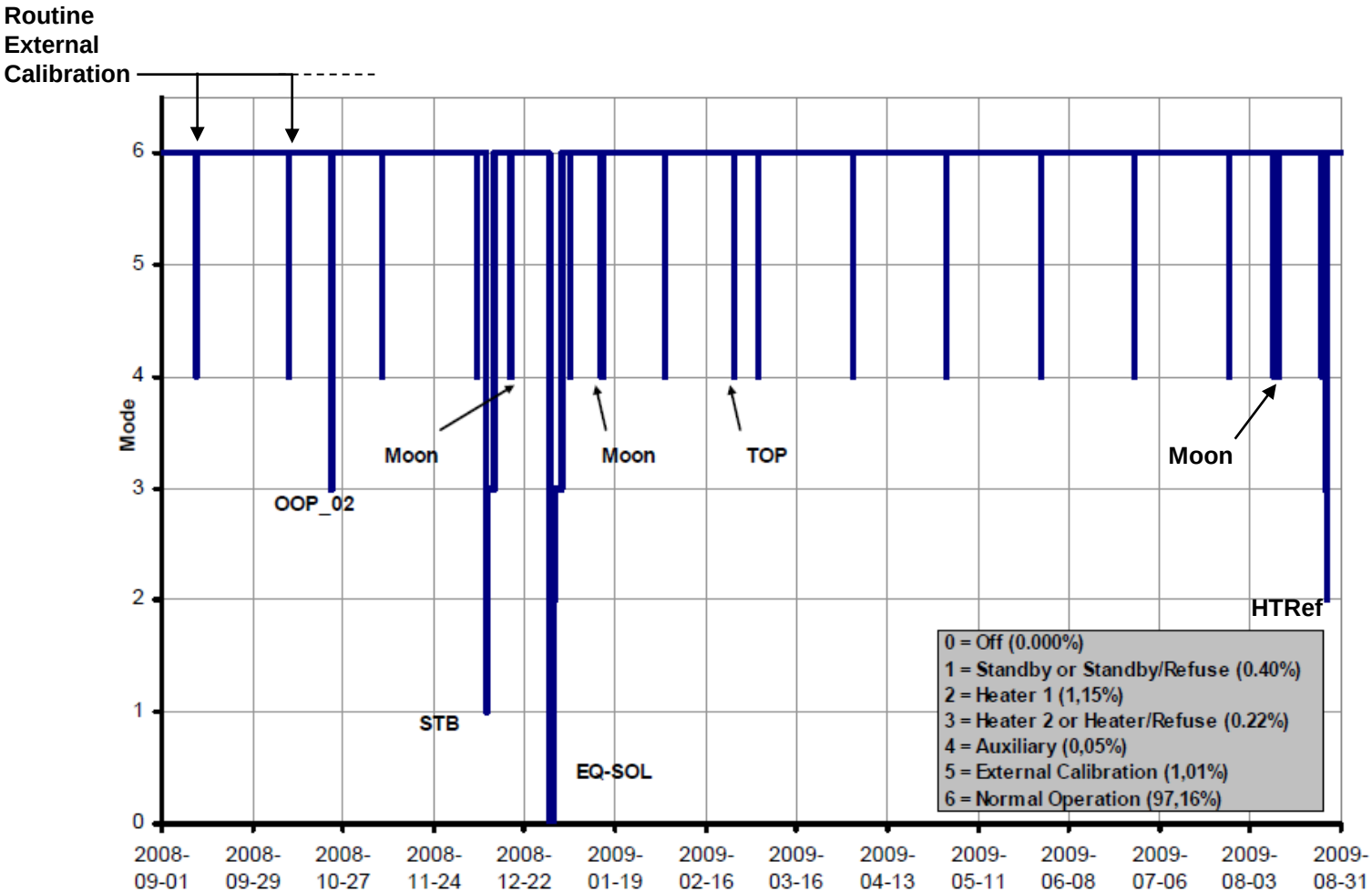
IASI FM2: instrument availability



Instrument mode repartition
from 01/09/2008 to 31/08/2009

- **Time spent in Normal Operation mode**
  - **97,1% over year 2008/2009**
  - **94,1% over year 2007/2008**
- **Time spent in External Calibration mode**
  - **1% over year 2008/2009**
  - **1,1% over year 2007/2008**
  - **Routine External Calibrations: 2 orbits/month.**
    Moon pass in 1st Cold Space view: 2 or 3 occurrences/year

IASI FM2: instrument availability



Year 2008/2009 Main events

- 3 IASI anomalies
- External calibrations
  - Routine
  - 3 Moon passes (CS1)
- 1 TOP update
  - Reduced spectra
- 1 METOP OOP manoeuver

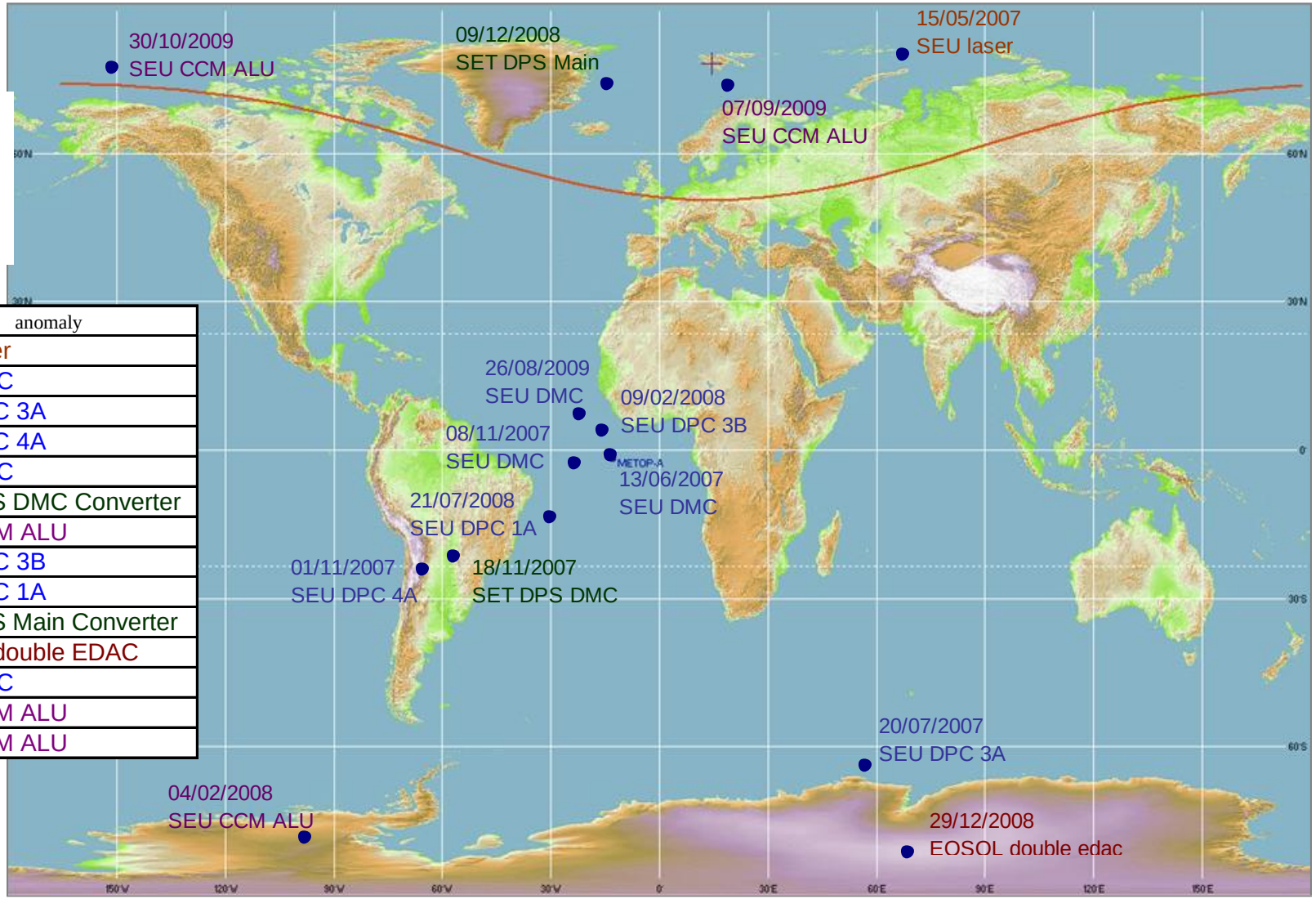
IASI FM2: instrument availability

- **Since beginning of life, instrument outages are due to**
  - **Anomalies**
    - **IASI anomalies : all related to radiative environment** (SEU/MEU – Single/Multiple Event Upset, SET – Single Event Transient)
      Mainly 2 equipments are impacted : DPS (Data Processing Subsystem) and CCE (Cube Corner Electronics). SRAM memory parts used in these equipments are sensitive to SEU.
    - **Metop anomalies** (4 occurrences in 2007-2008)
  - **External events (Moon pass, satellite manœuvre)**
  - **Monthly routine external calibrations**
  - **Ice decontamination**
    - Done in March 2008. The next one is expected before end 2010.
      ➔ needed to restore instrument radiometric performance @850cm-1

IASI FM2: instrument availability

IASI anomalies since end of SIOV

date		anomaly
15/05/2007	13:18:09	SEU laser
13/06/2007	10:23:03	SEU DMC
20/07/2007	4:30:47	SEU DPC 3A
01/11/2007	13:35:46	SEU DPC 4A
08/11/2007	11:02:57	SEU DMC
18/11/2007	01:31:32	SET DPS DMC Converter
04/02/2008	12:46:11	SEU CCM ALU
09/02/2008	10:37:06	SEU DPC 3B
21/07/2008	23:43:54	SEU DPC 1A
09/12/2008	20:28:10	SET DPS Main Converter
29/12/2008	22:50:19	EQSOL double EDAC
26/08/2009	11:08:59	SEU DMC
07/09/2009	18:17:20	SEU CCM ALU
30/10/2009	4:49:50	SEU CCM ALU



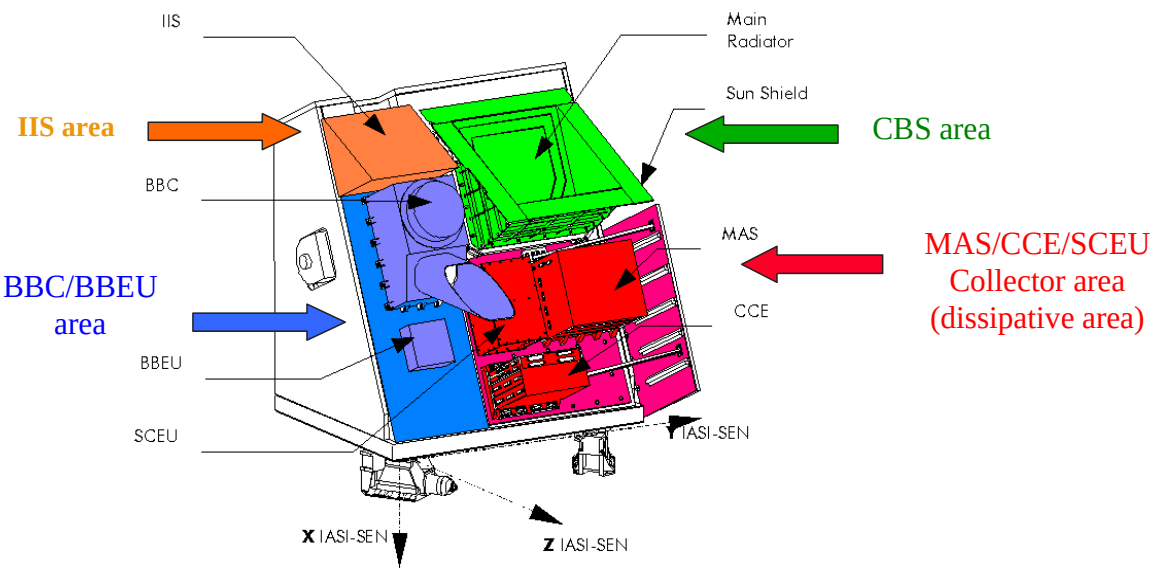
IASI FM2: instrument availability

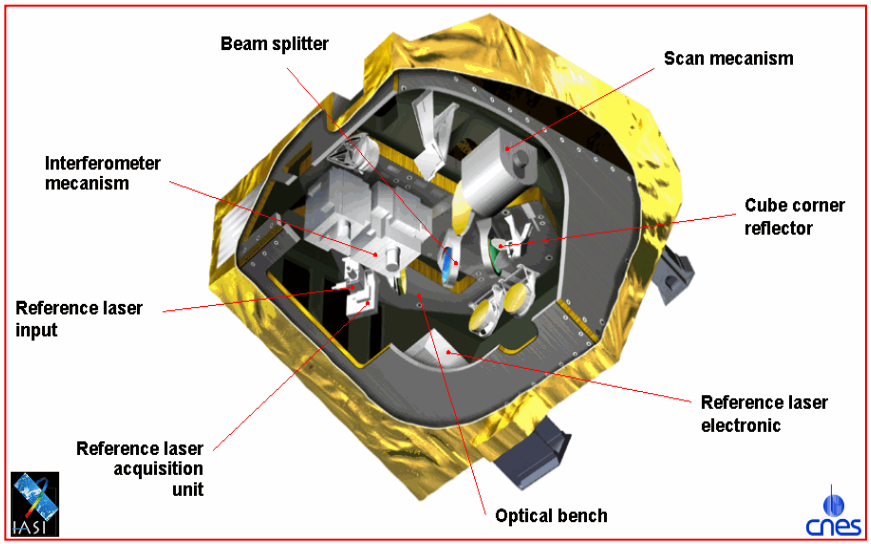
- **Improvement of the availability over 3 years**
  - **Anomalies**
    - Joint work with Eumetsat to improve anomaly recovery procedures : systematic procedures in case of SEU
      ➔ **Outage time was significantly reduced**
      For a typical SEU anomaly : 1,5 day outage in 2007, 3 orbits max (5h) outage in 2009 with the « turbo » procedure.
    - A software patch developed by TAS was implemented onboard FM2 on September 2009. It allows an automatic reinitialisation in case of SEU anomaly on the DPS (Data Processing Subsystem).
      ➔ **The outage time will be reduced to almost zero for DPS SEU anomalies**
  - **Moon avoidance strategy**
    - New strategy applied in 2009 : switch to External Cal only during the part of orbit where the Moon appears in CS1 view
      ➔ **Reduced time in External Cal**

➔ Instrument availability is very good and is still improving !

IASI FM2 : functional status

- **Up to now, very good functional behaviour of IASI FM2**
  - **No hardware anomaly**
  - **No use of redundancy**
  - **All functional anomalies have SEU or SET origin**





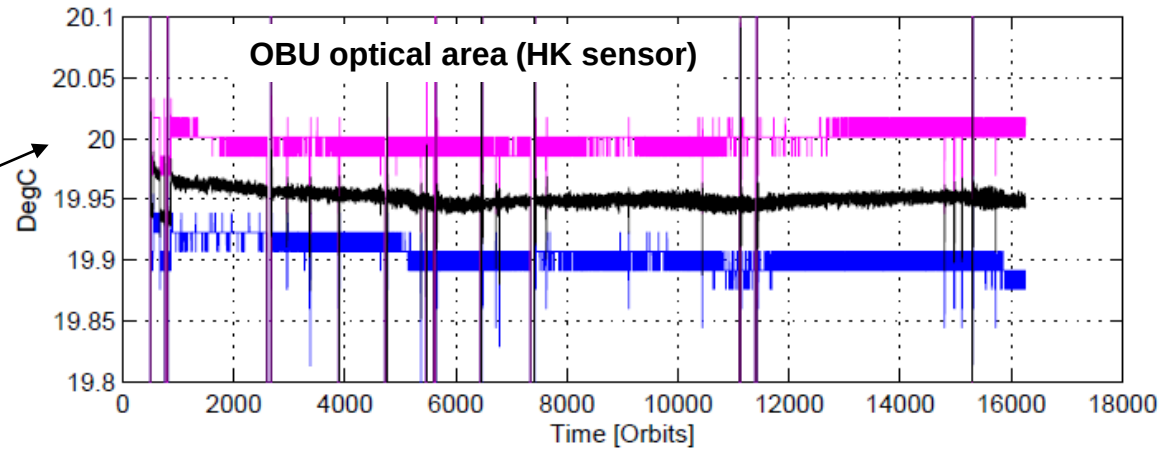
IASI FM2 : functional status

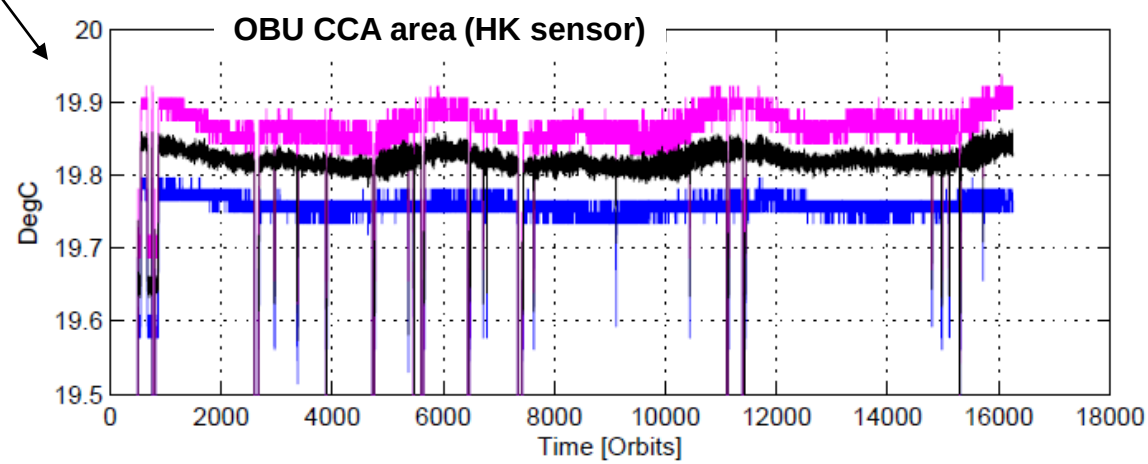
- **Very good health of all subsystems**
  - **Interferometer**
    - Optical Bench
    - Reference Laser
    - Cube Corner Mechanism
  - **Scan Subsystem**
  - **Hot Blackbody**
  - **Integrated Imager**
  - **Cold Box subsystem**
  - **Instrument Management Subsystem & Data Processing Subsystem**
  - **Active Thermal Control**
  - **Equipments power consumption**

IASI FM2 : functional status

- **Optical bench (OBU)**
  - Thermal status
    - OBU perfectly regulated
  - Alignment stability
    - Low drift of CC offset
    - Stability of interferometric contrast

  ➔ no impact on spectral performances

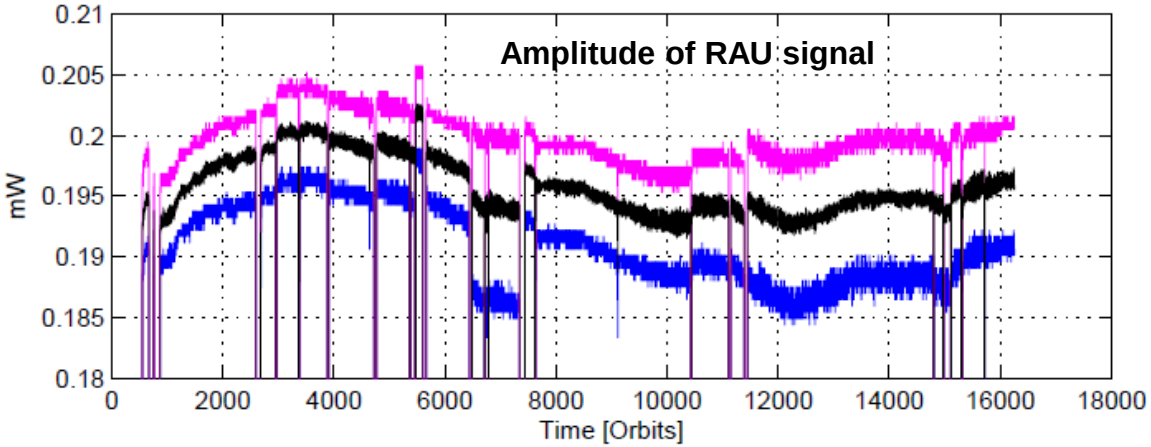


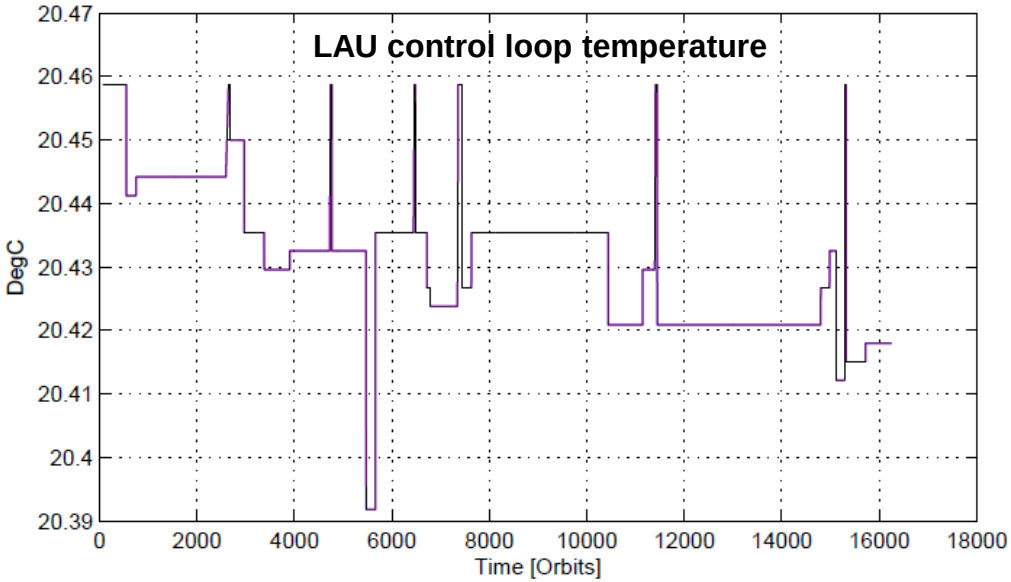


IASI FM2 : functional status

- **RPD system : Laser + RAU (Reference Acquisition Unit)**
  - Amplitude of OPD reference signal received by RAU :

    low variations of the RAU amplitude but large margin w.r.t. the minimum functioning value (<100 mW)

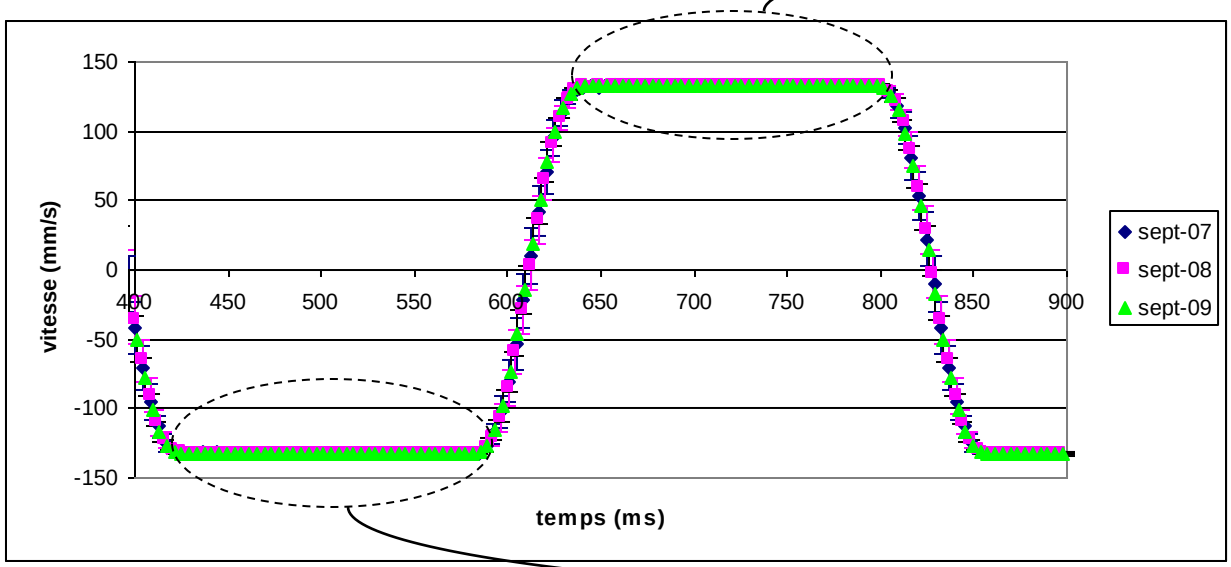




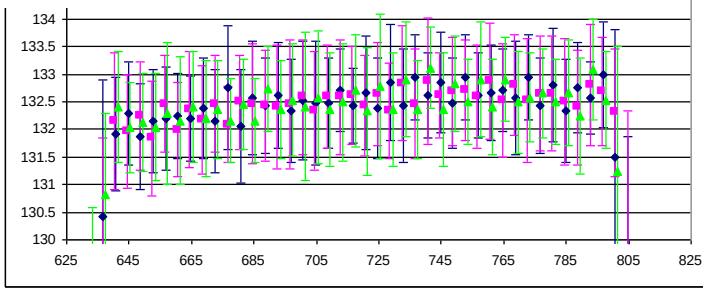
- Very good stability of the functioning point of the laser control loop

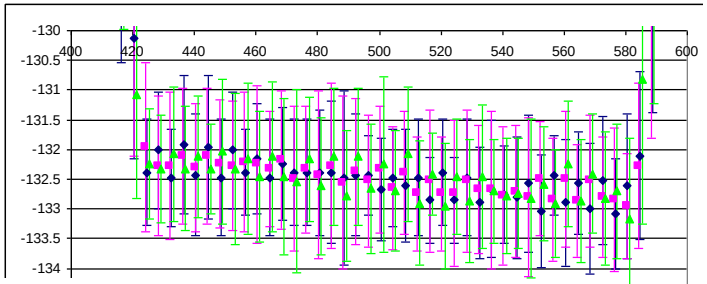
IASI FM2 : functional status

- **Cube Corner Mechanism (CCM)**
  Position Data Diagnostic telemetry (CCFD only)
  No change in the speed profile during the period
  ➔ **very good health status of the CCFD**



Backward





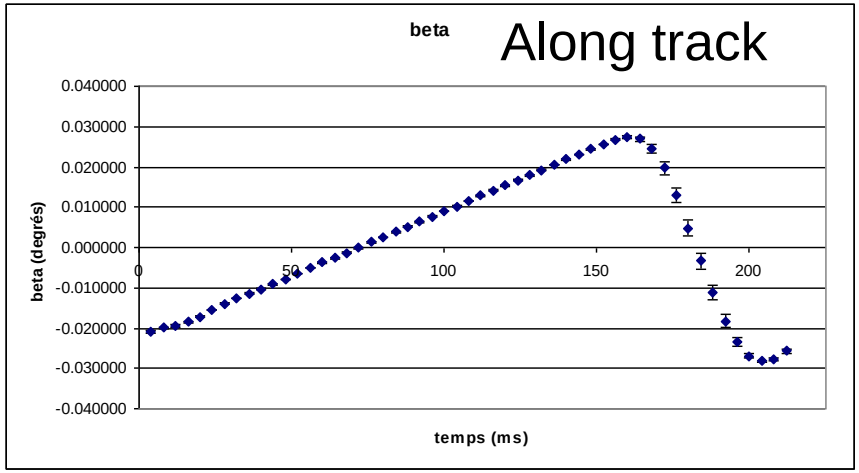
Forward

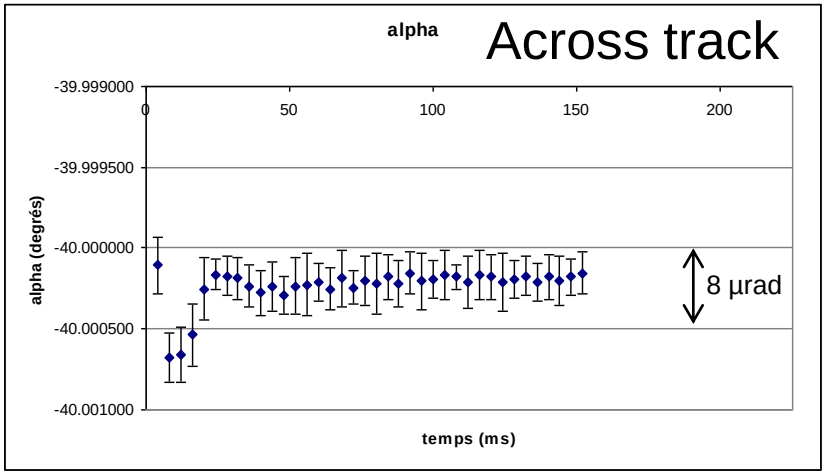
IASI FM2 : functional status

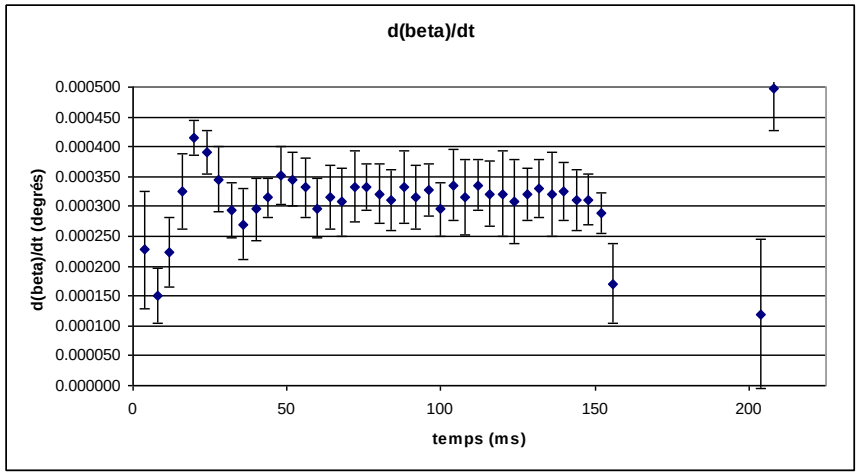
- **Scan Mechanism Subsystem**
  - Position Data Diagnostic allow to check the stability of the positioning control loop.

Across track pointing stability better than 30 µrad (25m on ground
Along track compensation speed = 5.49 mrad/s (target = 5.56 mrd/s)
Along track compensation error < 30 µrad (25m on ground)

➔ **Perfect behaviour of the scan**

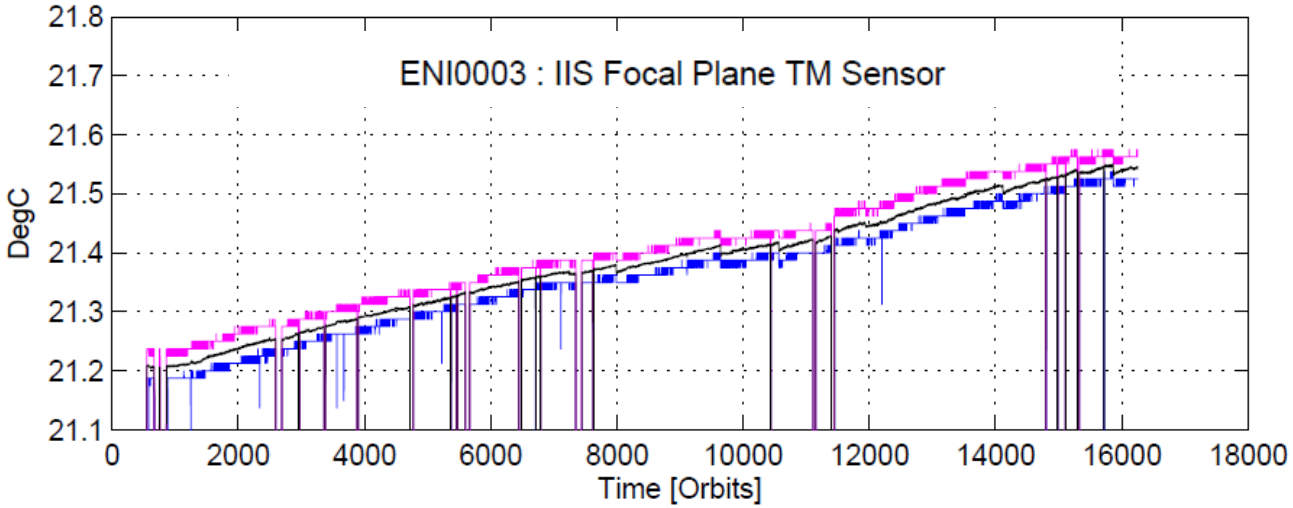






IASI FM2 : functional status

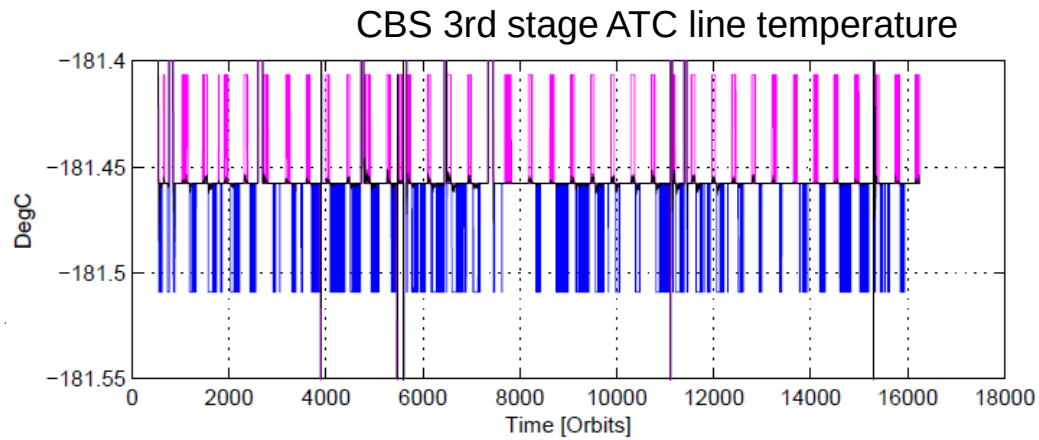
- **Blackbody Subsystem**
  - **Stability of BB temperature measurement**
- **Integrated Imager**
  - **Focal plane temperature**
    - **Drift of 0.13 K / year observed in orbit**
      - Same drift observed for the models still on ground (while IIS OFF or ON)
      - Root cause under investigation (detector or telemetry measurement)
    - **Analysis is ongoing (a working group was set up). We expect no impact on imager performance.**

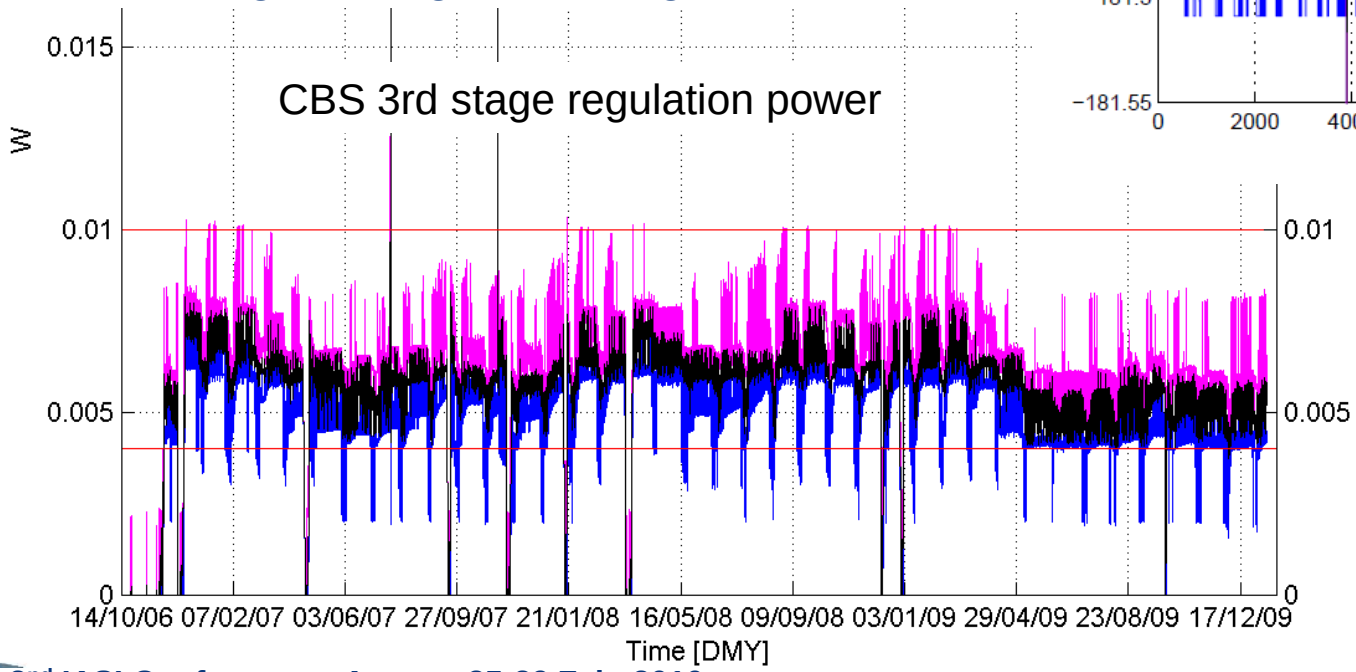


IASI FM2 : functional status

Cold Box Subsystem

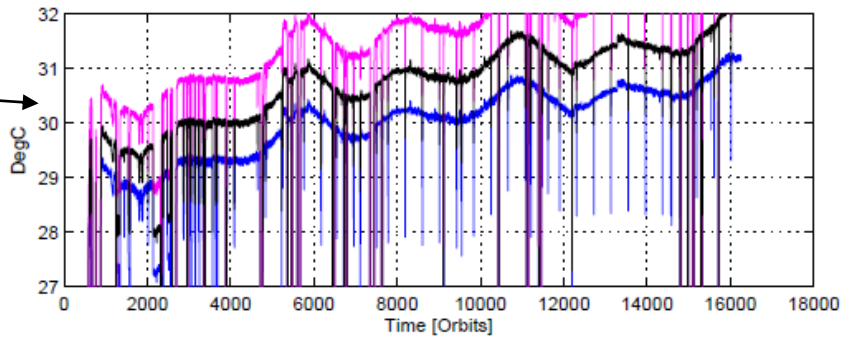
- 3rd stage ATC regulation line
  - CBS average ATC power regulation : around 5mW
- **Nominal thermal behaviour. No need to change the regulation target.**



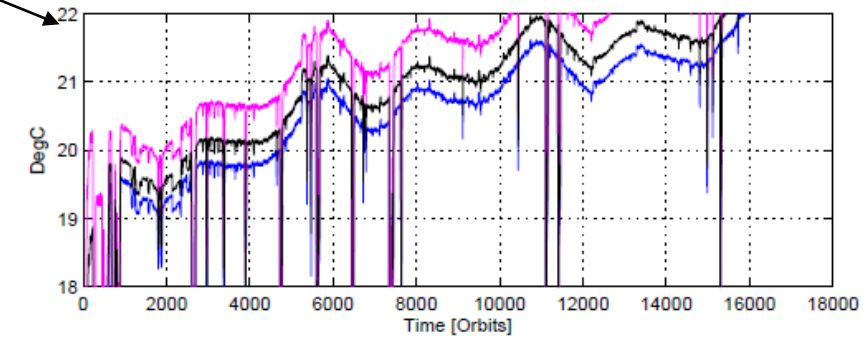


IASI FM2 : functional status

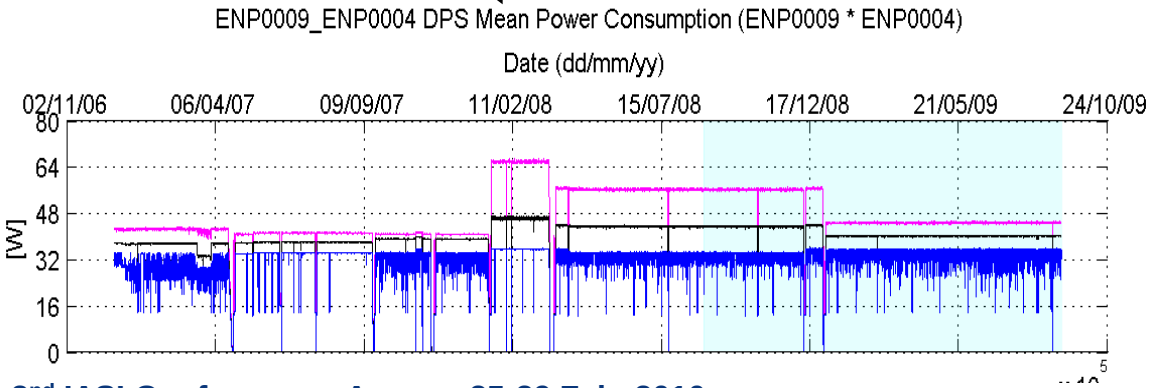
- **IMS & DPS**
  - **DPS converter temperature**
    - ≈ + 0.5 K / year
  - **IMS temperature**
    - ≈ +0.7 K / year
  - **Evolution correlated with Metop panel temperature**
  - **Stability of DPS mean power consumption**



END0001 : DPS Active Converter Sensor



ENH0002 : IMU Temperature



IASI FM2 : functional status

- **Active Thermal Control**
  - **14 regulation lines (including CBS)**
  - The 14 IASI ATC lines consumption is stable with margin on min and max power of each line
  - **Nominal behaviour of IASI thermal control**

		Power consumption of IASI FM2 ATC lines			
PI line number	Reference	September 2008,01&02	+1 year	September 2009,01&02	Status
ATC_1	USP (IIS area)	5.36 W + 0.37 W - 0.54 W	+ 0.05 W	5.41 W + 0.36 W - 0.52 W	OK
ATC_2	IIS objective	0.57 W + 0.20 W - 0.22 W	- 0.01 W	0.56 W + 0.19 W - 0.25 W	OK
ATC_3	ACW support	0.71 W + 0.01 W - 0.02 W	+ 0.00 W	0.71 W + 0.03 W - 0.03 W	OK
ATC_4	O.B.U. (optics area)	2.36 W + 0.17 W - 0.17 W	- 0.06 W	2.30 W + 0.19 W - 0.19 W	OK
ATC_5	MAS/ CCE/ SCEU area	10.39 W + 2.14 W - 2.23 W	- 0.32 W	10.07 W + 2.35 W - 2.26 W	OK
ATC_6	MAS/ CCE/ SCEU area	10.39 W + 2.14 W - 2.23 W	- 0.32 W	10.07 W + 2.35 W - 2.26 W	OK
ATC_7	O.B.U. (CCA area)	5.06 W + 0.28 W - 0.29 W	- 0.07 W	4.99 W + 0.30 W - 0.33 W	OK
ATC_8	CD	0.67 W + 0.12 W - 0.09 W	- 0.03 W	0.64 W + 0.15 W - 0.11 W	OK
ATC_9	LAU support	5.44 W + 0.91 W - 1.00 W	- 0.11 W	5.33 W + 1.00 W - 1.09 W	OK
ATC_10	C.B.S.	6.44 mW + 3.59 mW - 2.15 mW	-1.0 mW	5.43 mW + 1.33 mW - 3.30 mW	OK
ATC_11	USP (MAS area)	3.72 W + 0.24 W - 0.24 W	- 0.08 W	3.63 W + 0.33 W - 0.32 W	OK
ATC_12	USP (BBC area)	13.36 W + 0.79 W - 0.56 W	- 0.01 W	13.35 W + 0.80 W - 0.62 W	OK
ATC_15	USP (CBS area)	8.48 W + 0.23 W - 0.27 W	- 0.01 W	8.47 W + 0.23 W - 0.27 W	OK
ATC_16	-Y wall	4.75 W + 0.42 W - 0.42 W	- 0.03 W	4.71 W + 0.36 W - 0.43 W	OK

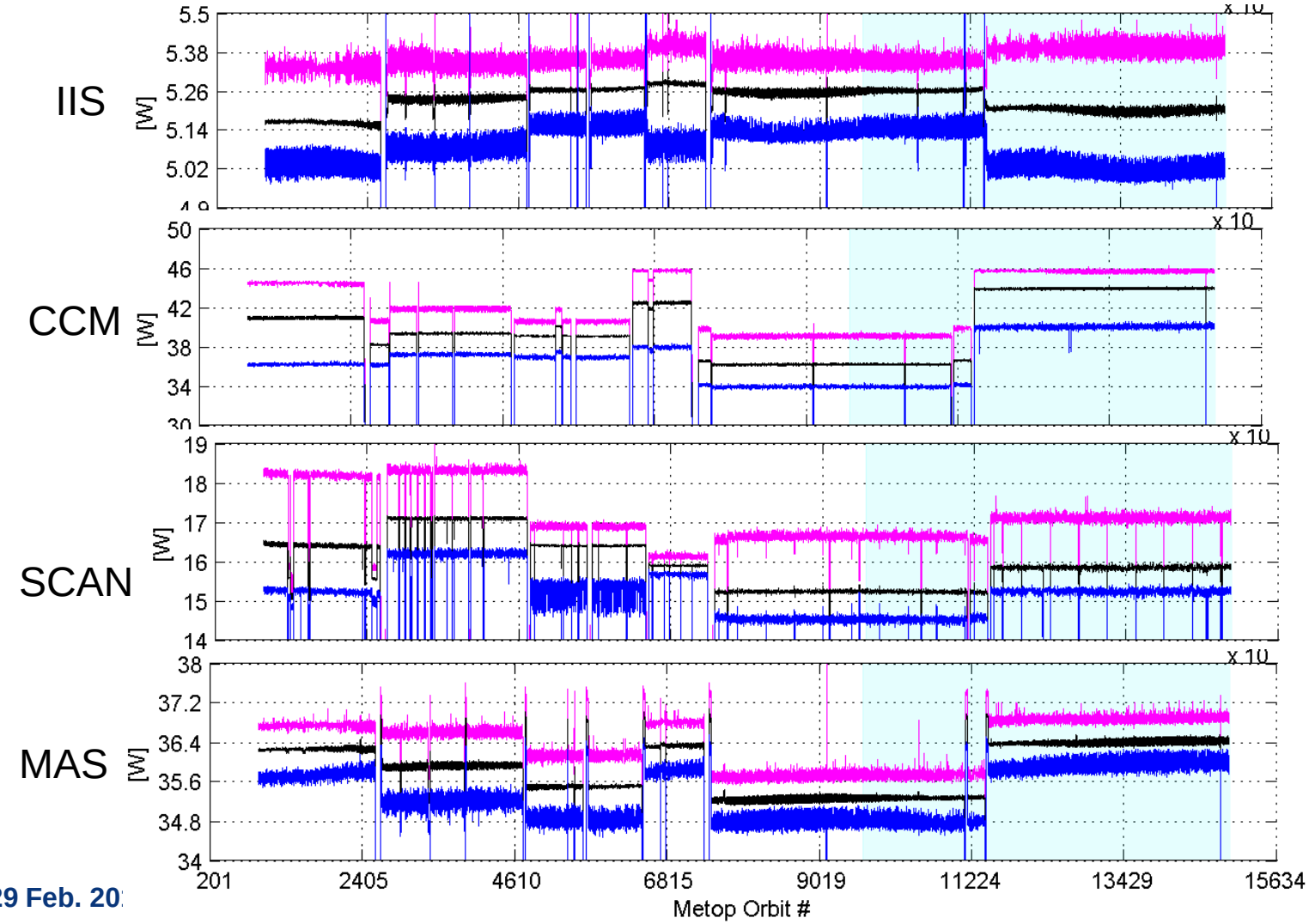
IASI FM2 : functional status

- **Equipments power consumption**

  No significant evolution

  Telemetry level change after a new switch on correspond to a different phasing of the telemetry sampling w.r.t. the functioning cycle of the subsystem.

➔ **good status for all units**



IASI FM2 : functional status

Conclusion

- All appears as nominal on IASI
- No symptom of degradation can be observed
- Ageing effects appear very low

IASI instruments on ground

Two other IASI flight models in storage phase, already integrated on satellite: IASI PFM-R on Metop-B and IASI FM3 on Metop-C

- **Metop-B : de-storage activities have started…**
  - December 2009: IASI IMS & DPS EEPROM update
  - February 2010: SFT test (System Functional Test) at Astrium (Friedrichshafen)
  - April-June 2010: Thermal Vacuum test at ESTEC (Noordwijk)
  - 2011: Metop PLM and SVM coupling, SSVT test
  - April 2012: launch from Baïkonour

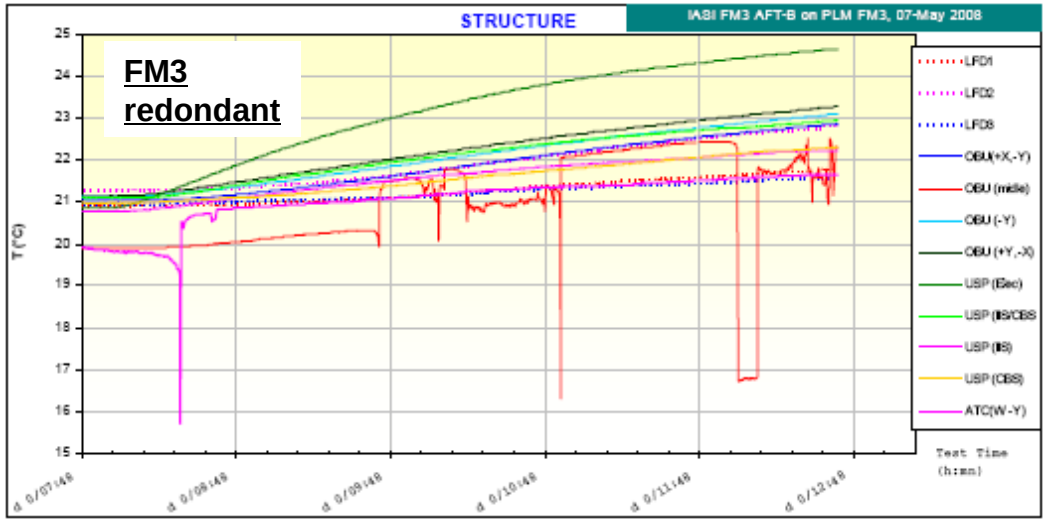
- **Metop-C**
  - Annual health checks (AFT tests) until de-storage
  - 2016: launch

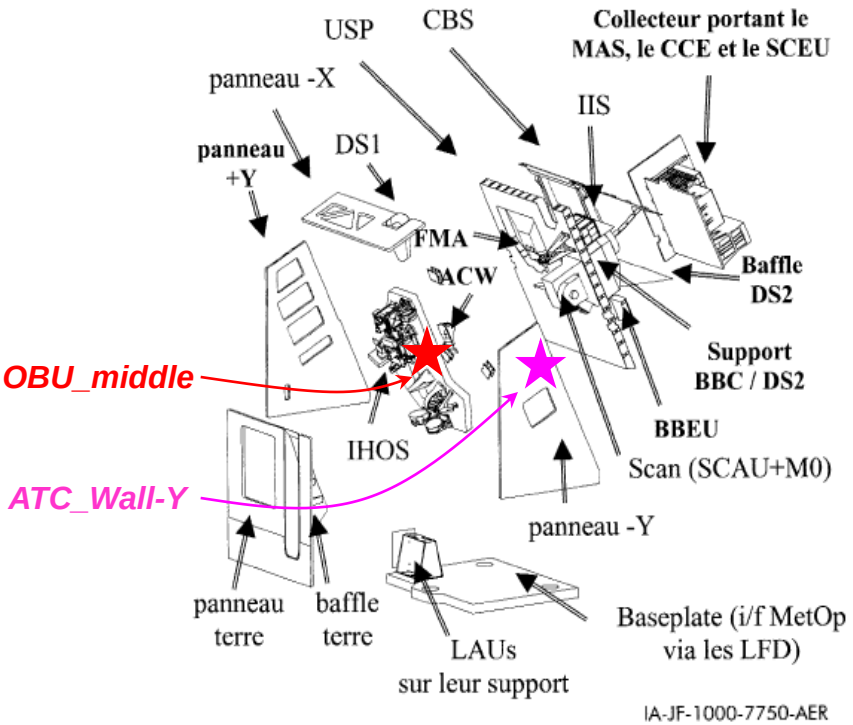
IASI instruments on ground

- **Annual health checks overview**
  - **AFT (Abbreviated Functional Test)**
  - **Ambiant functional test, with detectors OFF and CCM locked**
  - **Objectives : check system integrity, electrical interfaces, heater lines activation (ATC, SMA and DEC), activation of scan mechanism**

IASI instruments on ground

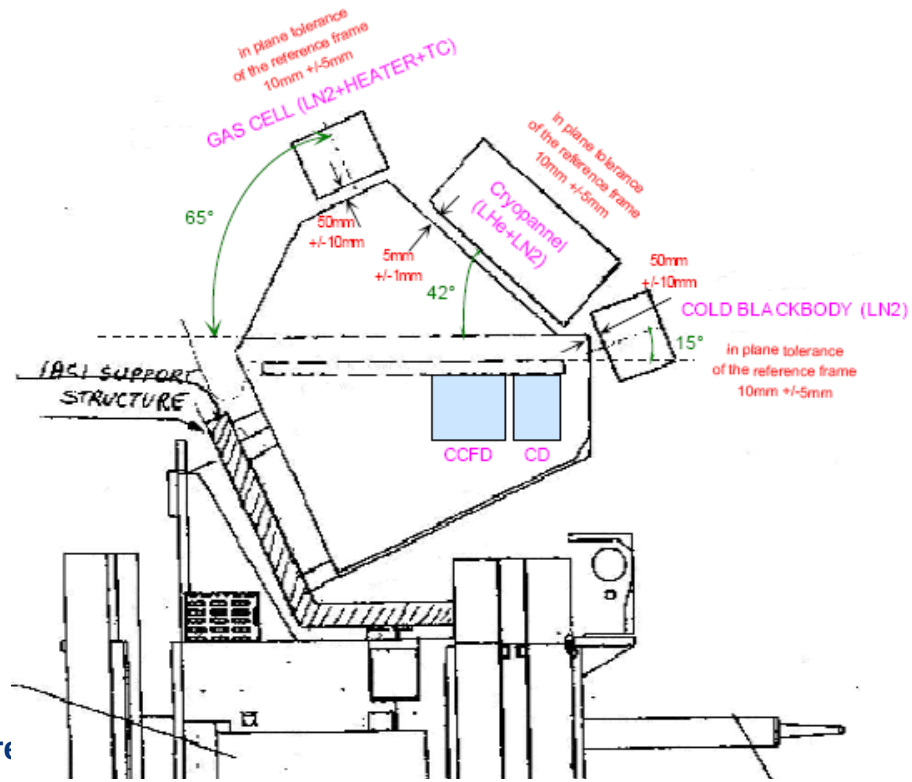
- **IASI FM3**
  - **Anomalies on 2 thermistors (Fenwall thermistors) : erratic behaviour of the measured temperature**
    - 1 thermistor used for ATC line will be replaced
    - 1 thermistor used for monitoring will not be replaced (monitoring function will be addressed to another thermistor)





IASI instruments on ground

- **Incoming Thermal Vacuum test with IASI PFM-R**
  - **Objective : verification of IASI spectral and radiometric performances**
    - No evolution since last Optical Vacuum Test at TAS Cannes (2006)
    - No impact of perturbations coming from other instruments



Conclusions

- **IASI FM2**
  - Nominal behaviour
  - Very good health of the instrument
  - Instrument availability is very good and still improving

- **IASI PFM-R and FM3**
  - De-storage activities have started for PFM-R. Launch 2012.
  - FM3 in storage. Launch 2016.
  - No functional anomaly on PFM-R. Fenwall anomalies on FM3 will be treated before launch.

- **Thanks to all the IASI team at CNES, TAS & EUMETSAT !**