MERIS US Workshop

Instrument Overview

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ENVISAT

Acknowledgement

To the ENVISAT Team
&
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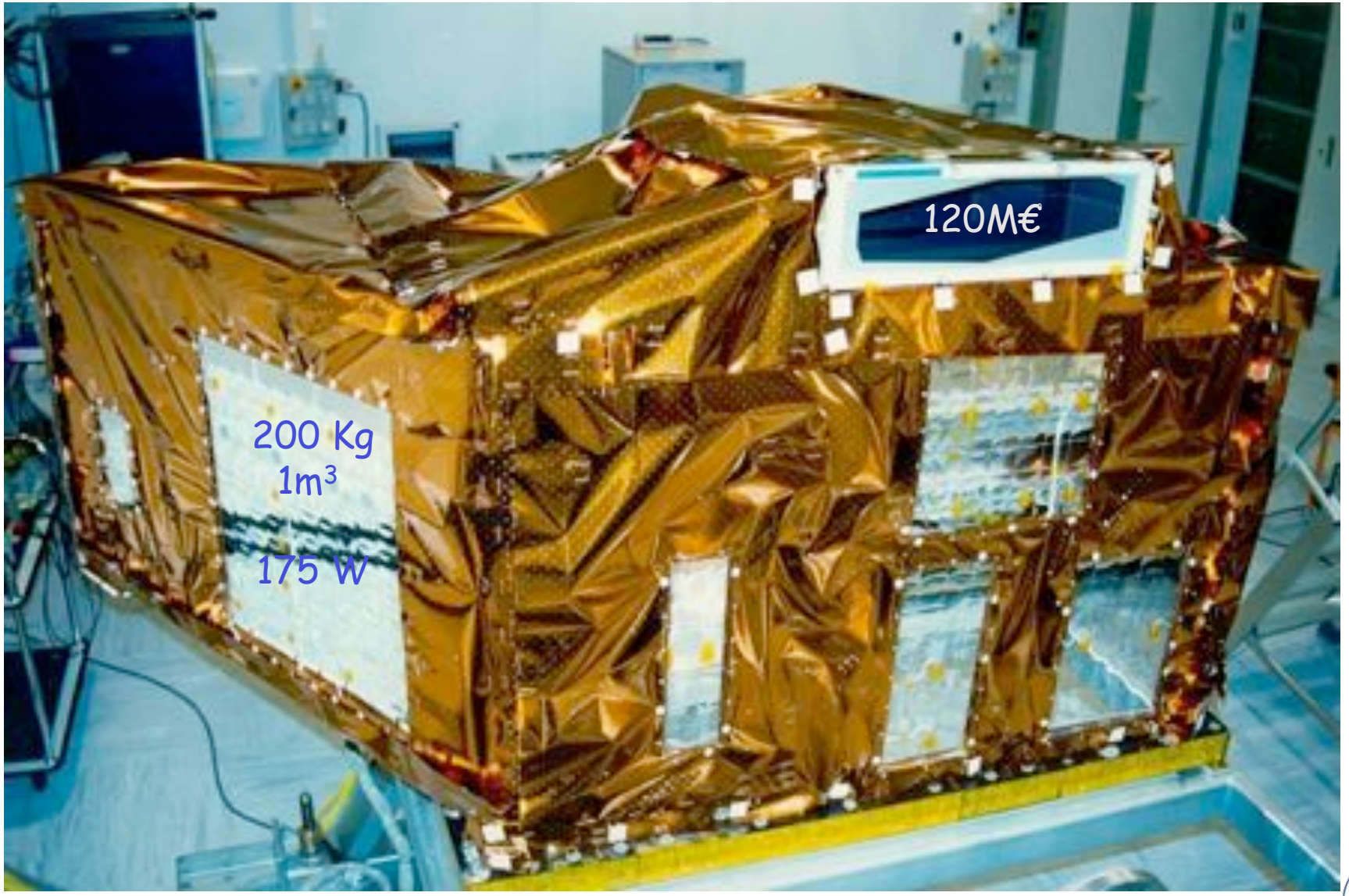
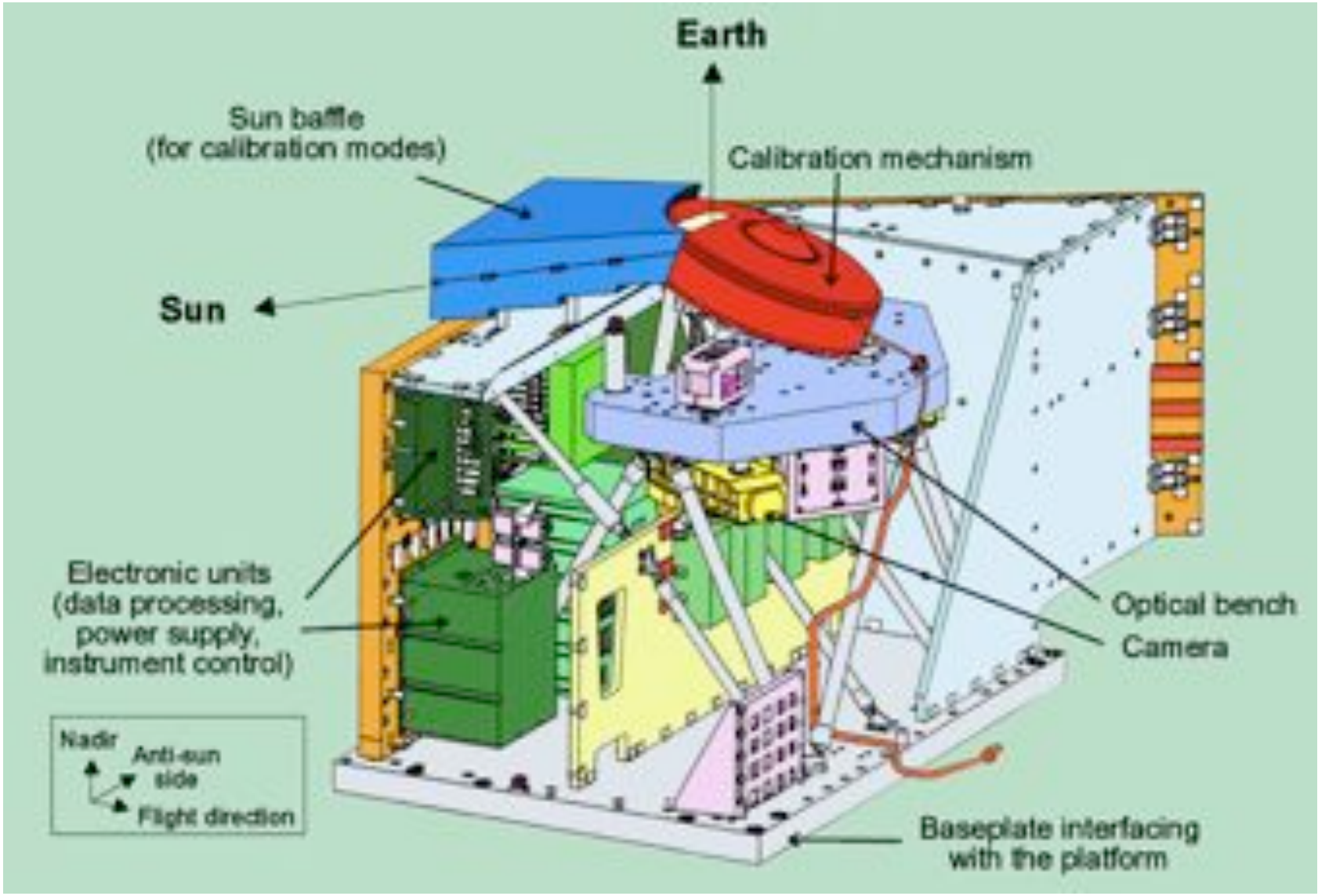
ENVISAT- MERIS

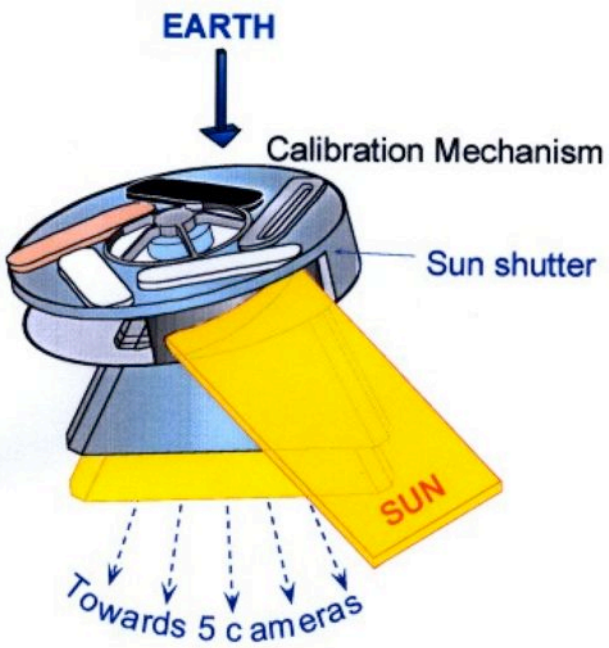


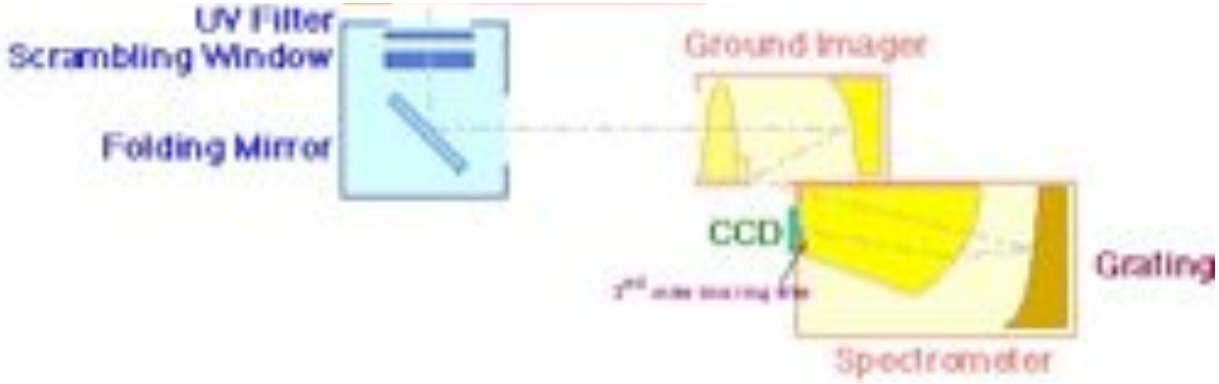
MERIS Layout



Optical Design

(Medium Resoution Imaging Spectrometer)





Pushbroom measurement:

-68.5 deg fov split into 5 cameras

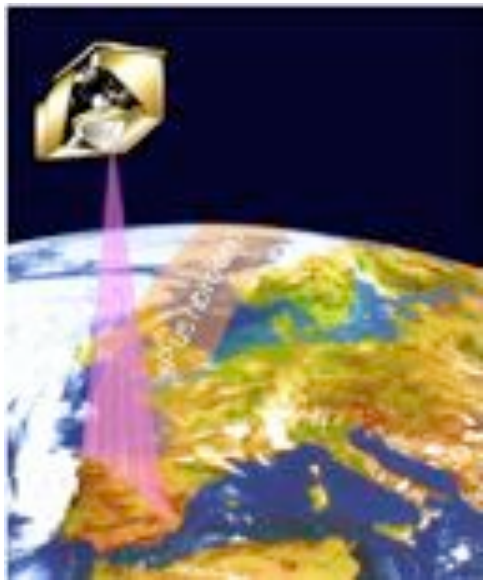
-1150 km swath width

- 300m resolution SSP (Regional)

-1200m resolution SSP (Global)

-15 Bands in range 390-1040nm

-Bandwidth ranging from 3.75-20nm



MERIS - BANDS

	Band	Band centre (nm)	Bandwidth (nm)	Primary Use
VISIBLE	1	412.5	10	Yellow substance and pigments detritus
	2	442.5	10	Chlorophyll absorption maximum
	3	490	10	Chlorophyll and other pigments
	4	510	10	Suspended sediment, red tides
	5	560	10	Chlorophyll absorption minimum
	6	620	10	Suspended sediment
	7	665	10	Chlorophyll absorption and fluo. reference
	8	681.25	7.5	Chlorophyll fluorescence peak
	9	708.75	10	Fluo. Reference, atmospheric corrections
INFRARED	10	753.75	7.5	Vegetation, cloud
	11	761.75	3.75	Oxygen absorption R-branch
	12	778.75	15	Atmosphere corrections
	13	865	20	Atmosphere corrections
	14	885	10	Vegetation, water vapour reference
	15	900	10	Water vapour, land

On-Board Processing

Programmable bands

- **Spectral lines** integrated in shift register to create **micro-bands**, remaining spectral lines dumped
- 45 micro-bands combined into
- 15 **Bands** in range 390-1040nm
- Bandwidth from 1.25 nm to 30nm

Programmable Gains

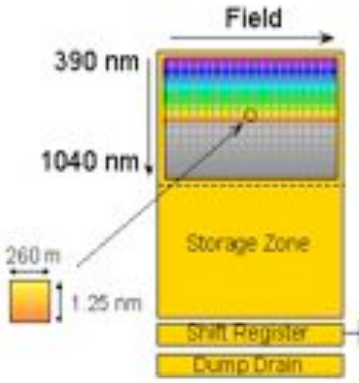
- Gain applied at micro-band level (analog)
- Single gain per band

CCD Architecture

Architecture	: Frame transfer
Size	: 780 (H) x [576 x 2] (V)
Pixel size	: 22.5 µm x 22.5 µm
Technology	: - Thinned CCD (thickness = 17 µm) - Back side illuminated

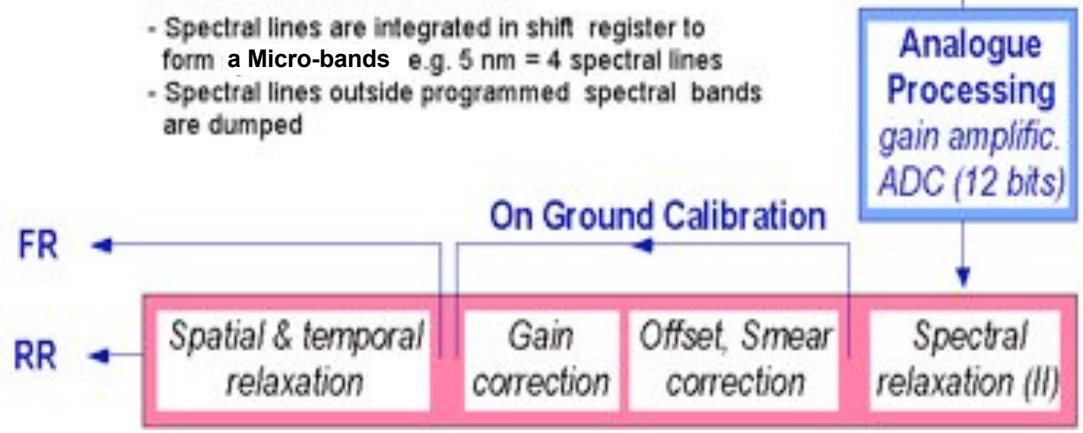
Operating Temperature

-22.5 °C via Peltier cooling



Spectral Bands Programming

- Spectral lines are integrated in shift register to form a Micro-bands e.g. 5 nm = 4 spectral lines
- Spectral lines outside programmed spectral bands are dumped



Band Configuration

Band Settings Methodology

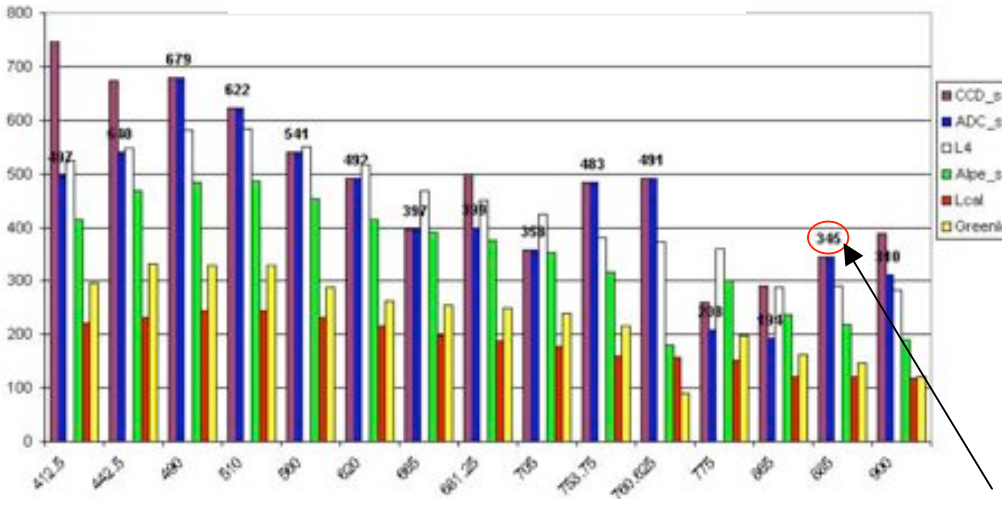
- No saturation at L4 at CCD level
- No saturation at Lcal at ADC level
- Minimum number of micro-bands
- Maximum gains within mission objectives

Objectives

- Max SNR over ocean
- Preferably no saturation over land (r=0.7)

SciHi

Det	Micro	Gain
4	2	1.5
4	2	1.25
4	2	1
4	2	1
4	2	1
4	2	1
4	2	1
3	2	1.25
4	2	1
3	2	1
3	1	1
6	2	1.25
8	2	1.5
8	1	1
8	1	1.25



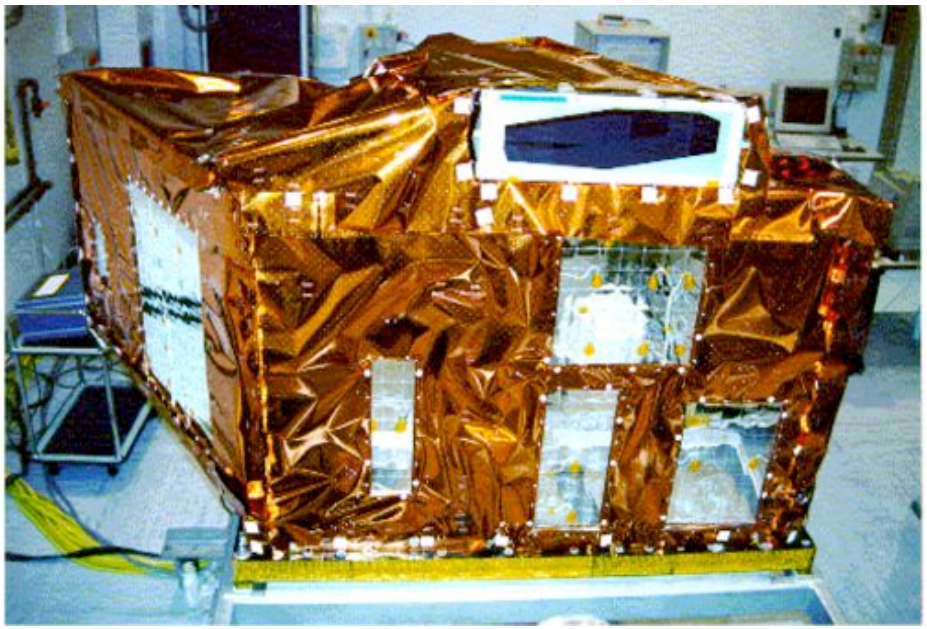
Definitions

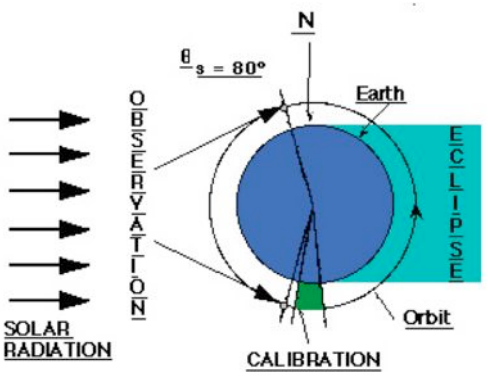
CCD_sat = Saturation level on CCD
ADC_sat= Saturation after gain applied
L4 = Max Signal level in swath for TOAρ=1
Lcal= Calibration signal (± L4*0.4)
Alps_snow and Greenland signal levels
Estimated saturation levels W/m2/sr/μm

Key Sub-Systems

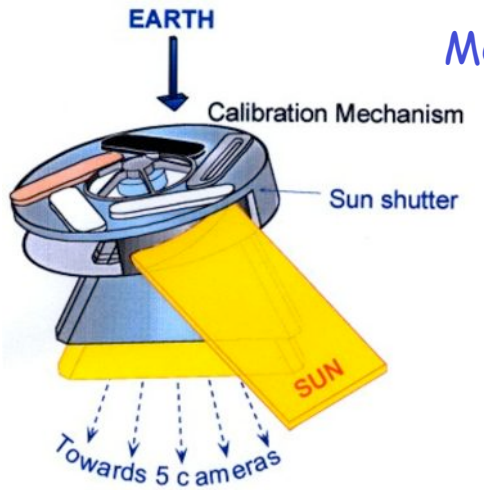
1. Calibration mechanism
   - Diffuser BRDF
   - Er spectral features
2. Scrambling Window (SWSA)
   - Polarisation scrambler
3. Optical System (OSA)
   - Anastigmatic Catadioptric design
   - Holographic Concave Grating
   - Second order filter & Inverse filter
4. Focal Plane (FPA)
   - Thinned (17μm) back-light Silicon CCD
   - Wedge AR coating
   - Peltier cooler
5. Video Electronic Unit (VEU)
   - Automatic offset control loop (OCL)
6. Secondary Data Processing (SDPSS)
   - Spectral relaxation
   - On-board averaging (Full Resolution (FR), Reduced Resolution (RR)
   - On-board corrections (not applied)

Calibration Mechanism

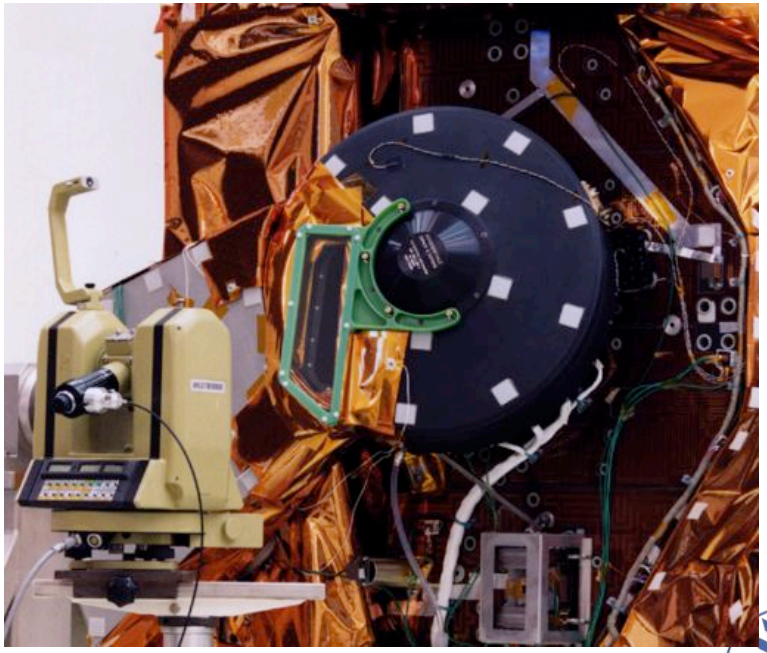




Calibration close to South orbital Pole

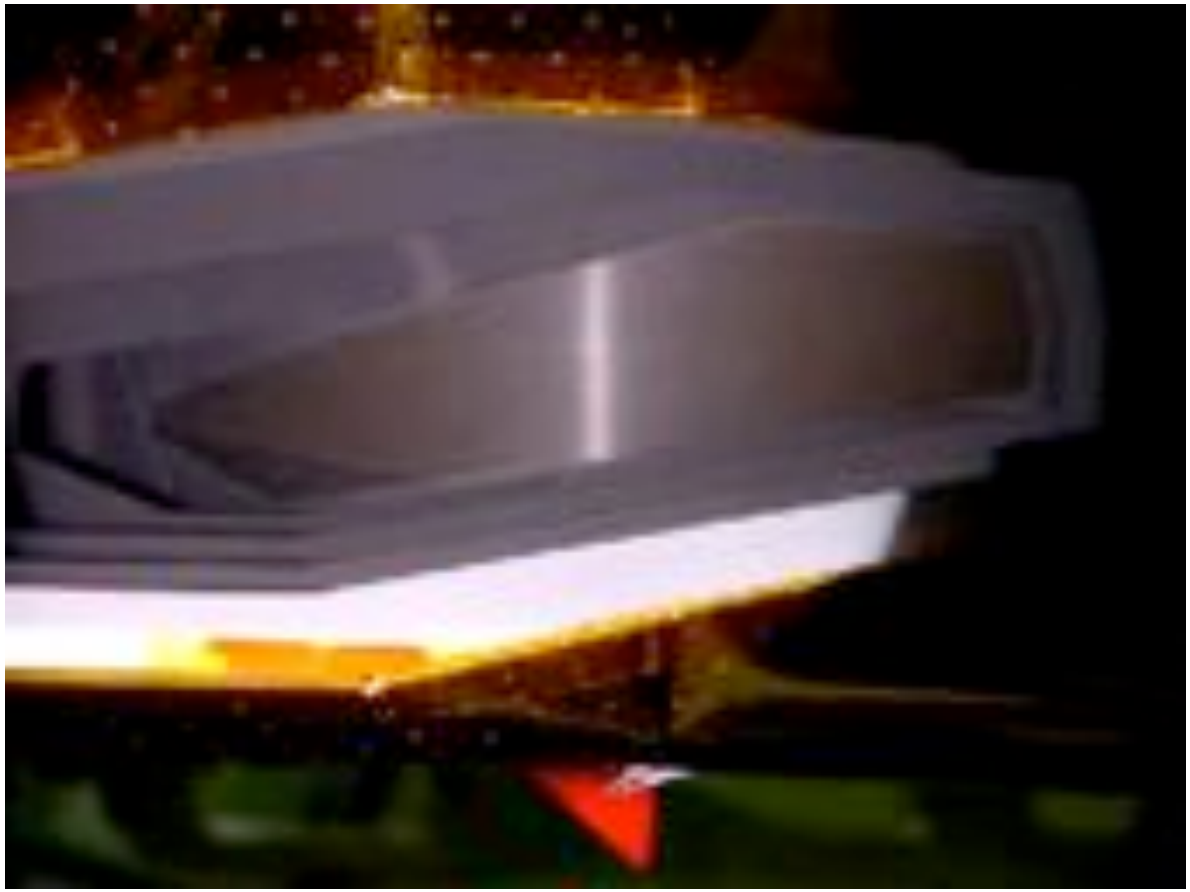


Mechanism = 5 positions
(Clockwise)
Radiometric Diff-1
Aging Diff-2
Spectral Diff-Er
Shutter
Aperture



Calibration Mechanism

Solar port



Scrambling Window

Sub Assembly (SWSA)

SWSA Consist of:

- Uncoated UV filter cut-off 390nm
  Tilted to aim ghost at baffles
- Polarisation scrambler
  Two wedge quartz crystals
  Wegde orientation at 90 degrees
  Optical e-axis at 45 deg
- Folding mirror

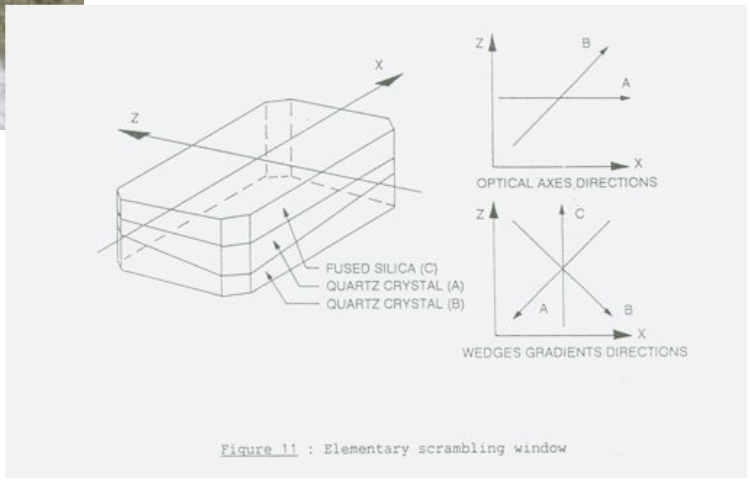
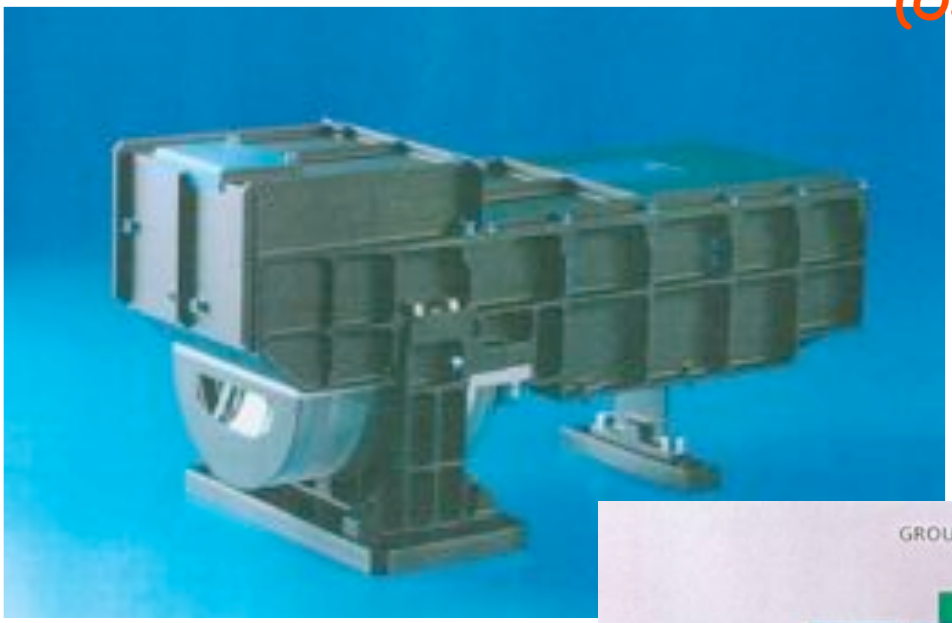


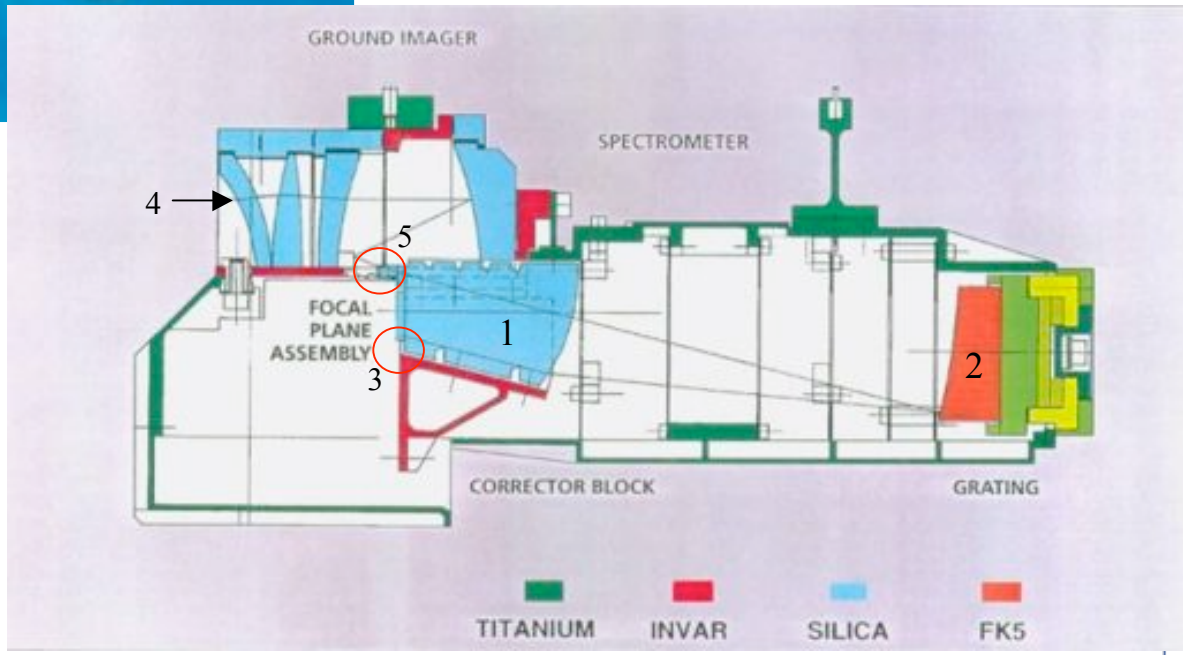
Figure 11 : Elementary scrambling window

Optical System Assembly (OSA)



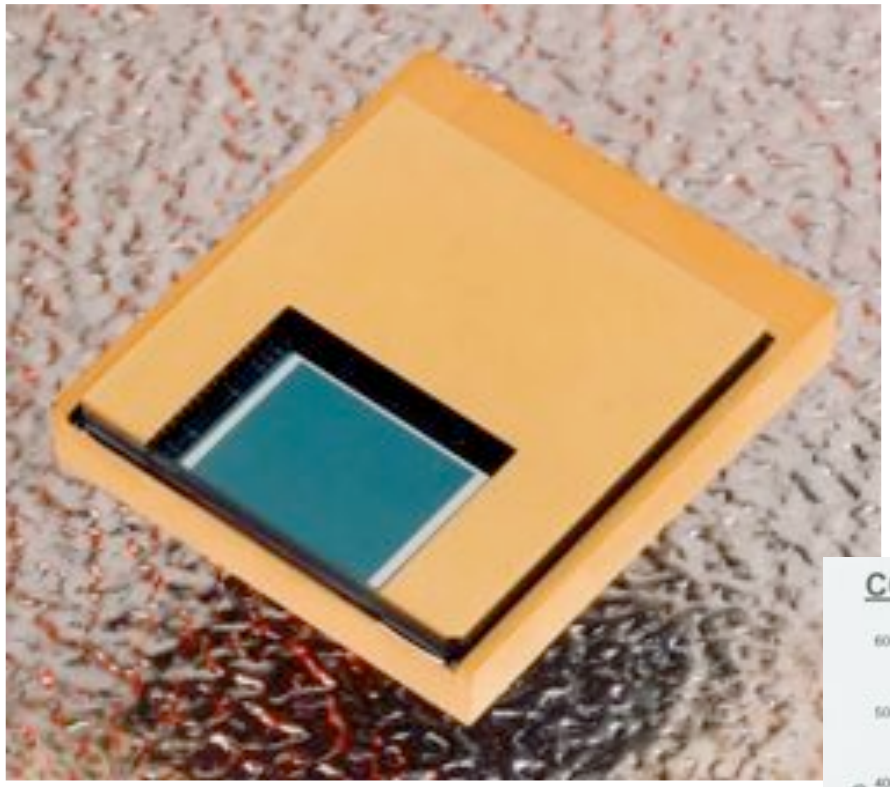
OSA Consist of:

- Anastigmatic Catadioptric design
- **Corrector block$_1$** & grating are spherical and confocal with the slit
- **Holographic Grating$_2$** with etched groves to reduce second order
- **Second order filter$_3$** is a absorption wedge glued on corrector block



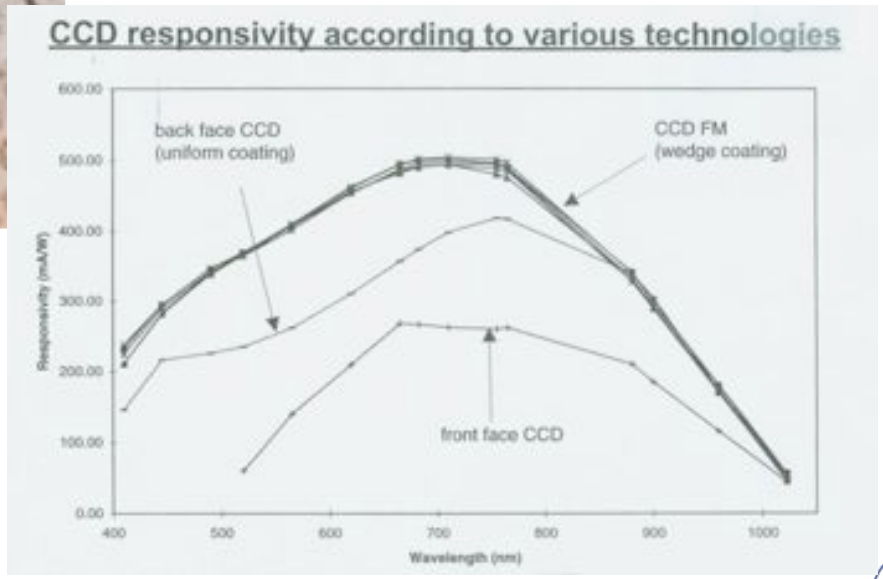
Inverse filter$_4$ on first surface of the imager to improve performances in the NIR.
Field lens$_5$ on slit to image the physical stop on the grating to the "entrance pupil" at the scrambling window

Focal Plane Assembly (FPA)



CCD Characteristics

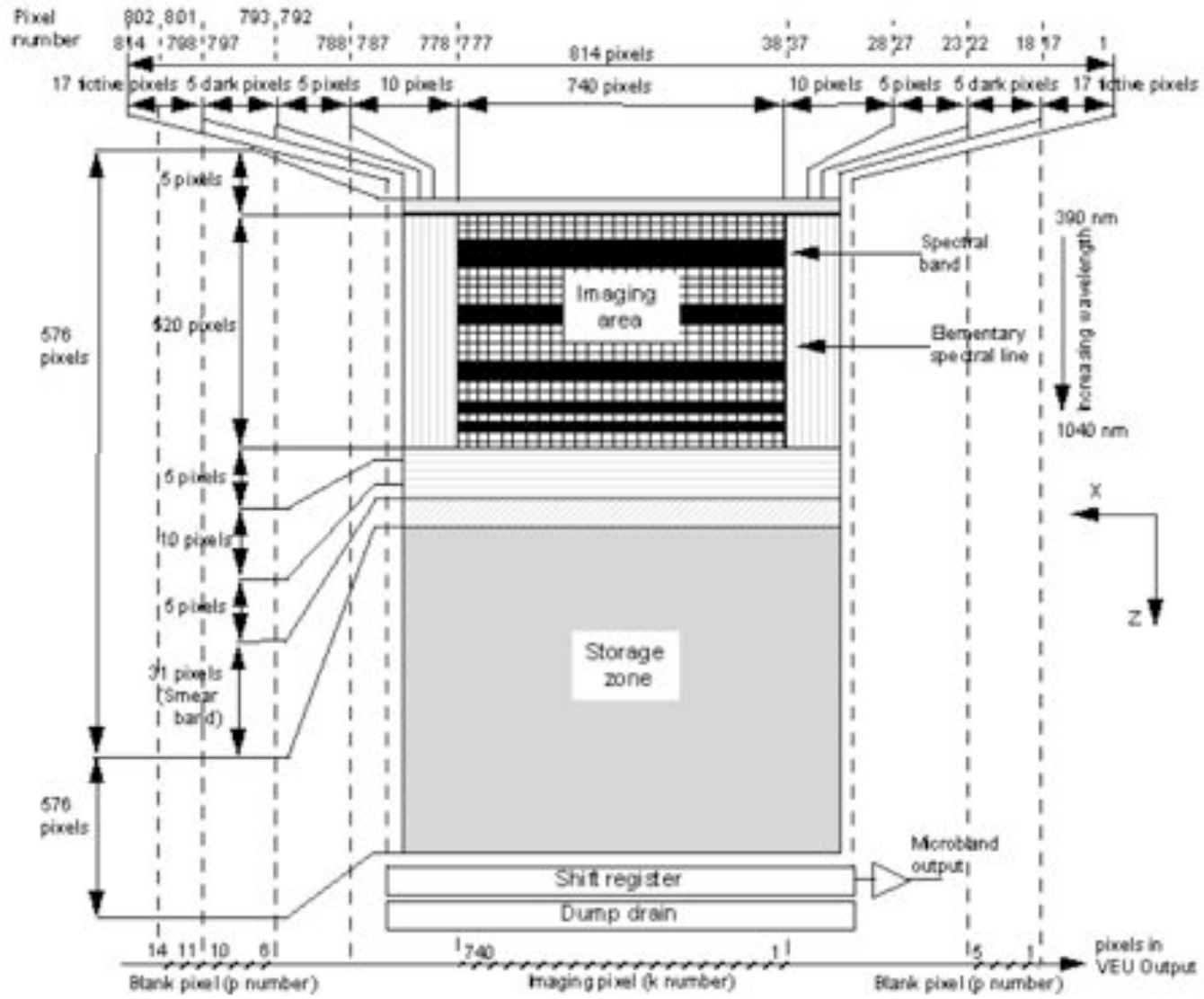
Frame Transfer
814 x 1152 detectors
Including storage area
Imaging area = 740 x 520
Smear band masked
Blank pixels masked
Operating at-22deg
Peltier cooler



E2V CCD 25-20

Pixel size 22.5μm x 22.5μm
Back illuminated - 17μm thick
Wedge AR coating
Dither clocking applied

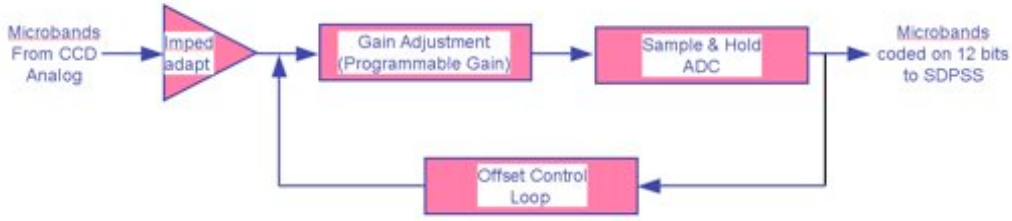
CCD Detailed Implementation

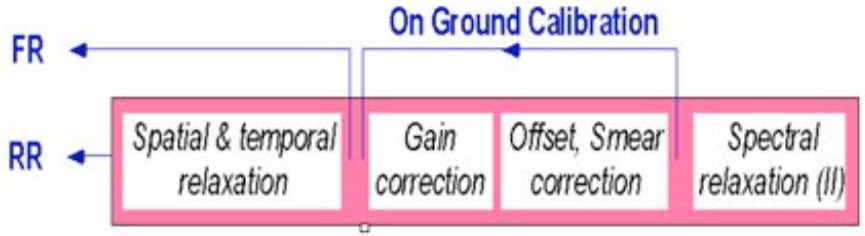


Electronic Units

Video Electronic Unit (VEU)

Offset control loop (**OCL**) sets the output DN level for the first five "blank" pixel of every microband to the transition 9-10. This offset voltage is then clamped for all remaining pixels in this microband. This offset is called **Coarse Offset**





Secondary Data Processing (SDPSS)

1. Spectral relaxation Microbands -> Band (ASIC)
   Two Modes: **On-Ground**& **On-Board** processing
   On-Board processing (not used) keeps the Offsets and gains computed from the last calibration, stored on board to correct the Measurements prior to averaging (DSP). On ground bypasses these steps.
2. Spatial and Temporal avaraging (DSP)
3. Formatting ISP per band (ASIC)

Instrument Control Unit (ICU)

The ICU is basically the on-board computer that Monitors all house keeping parameters, keeps the Instrument's themal controls and activates the calibration mechanism