Compact Optical Payload for Daily Survey of Vegetation from Small Satellites

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Végétation – Short Overview

Végétation is an ancillary payload flown on two subsequent French defense satellites Spot-4 and Spot-5.

In the last 10 years *Végétation* has provided a continuous stream of data on the status of crops, forest.

Végétation Requirements

User Requirements:

Cloud Free Vegetation World Map every two weeks ➔ Daily Coverage

Instrument Requirements:

Swath is 2200 km @ 800km the ➔ Field of View: 105 degrees

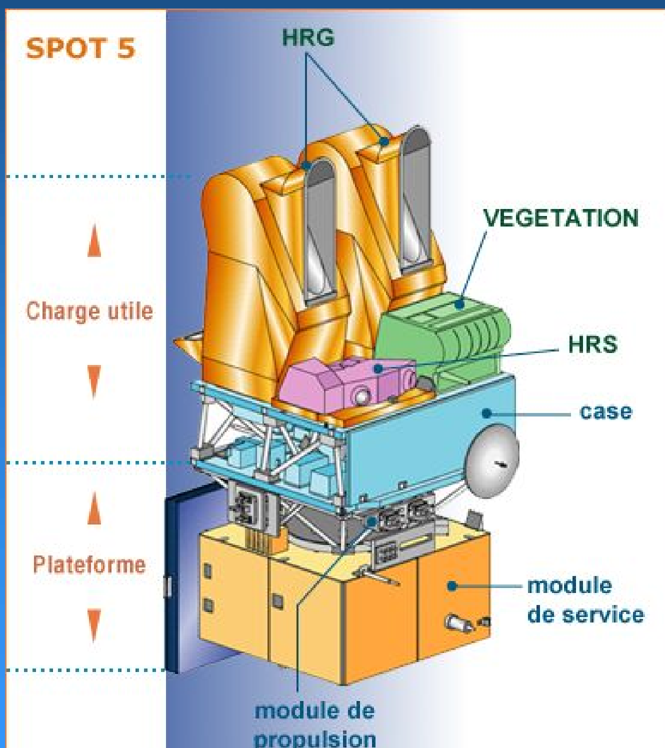
Multispectral Images: 4 bands (Blue, Red, NIR, SWIR), 1km resolution

Present Status

Spot-5 lifetime expires in 2012. The next French satellite, Pleiades, is solely dedicated to HiRes.

The Belgian Federal Science Policy Office (BELSPO) declared their interest to develop an instrument to ensure continuity of Végétation products provided that it could be flown on a Proba type satellite, a small satellite developed by the Belgian Verhaert Space.

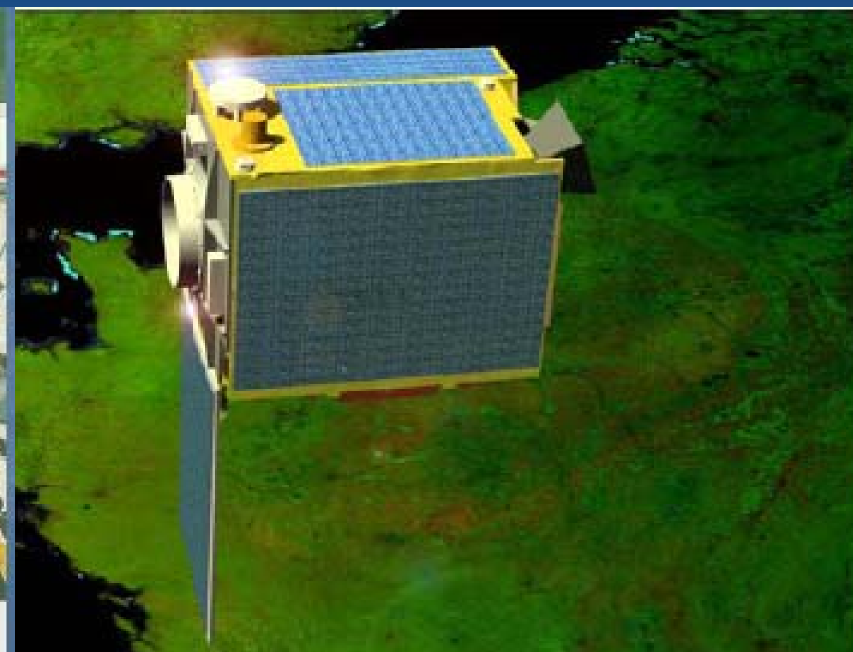
Végétation on Board of Spot-5



Mass of Spot-5: 3 tons

Mass of Végétation: 138 Kg

Végétation and Proba



Proba-V Dimensions:

800mm x 800mm x 1000m

The Problem: how do we squeeze it?

"… if you follow the same track it will take you in the same place"

What type of new tracks can we follow that will bring a mass & power reduction of a factor 10?

What changed since 1994?

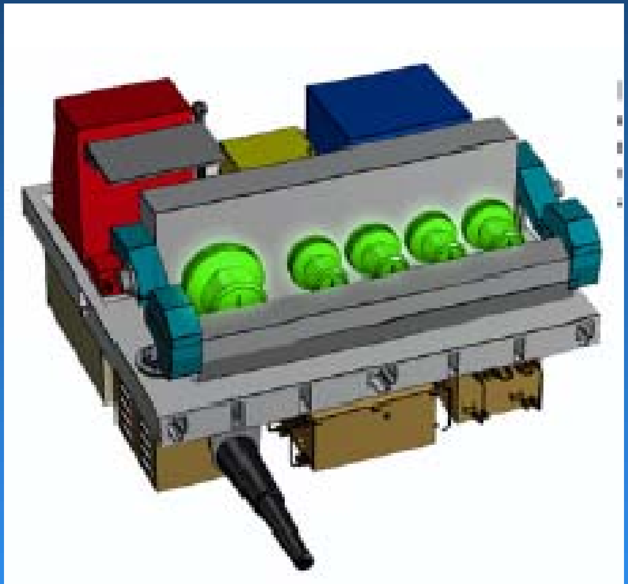
Glasses are still the same

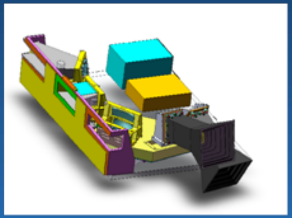
Photons still behave the same way

Larger scale of integration of electronics helps, but not enough.

We need to look for a different optical solution that brings a significant mass and volume reduction and get rid of the massive and power hungry cooling system of the MCT detector.

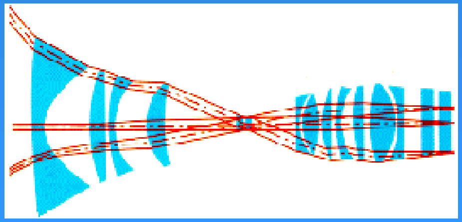
From refractive to reflective: the TMA Solution

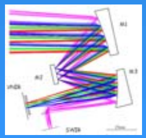




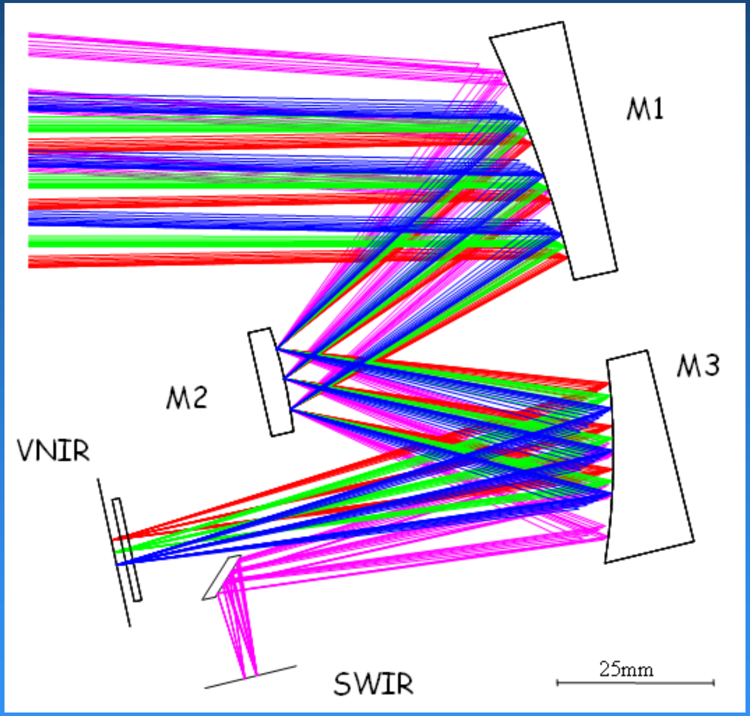
Nice on paper but…

Three Mirror Anastigmat





The Challenges



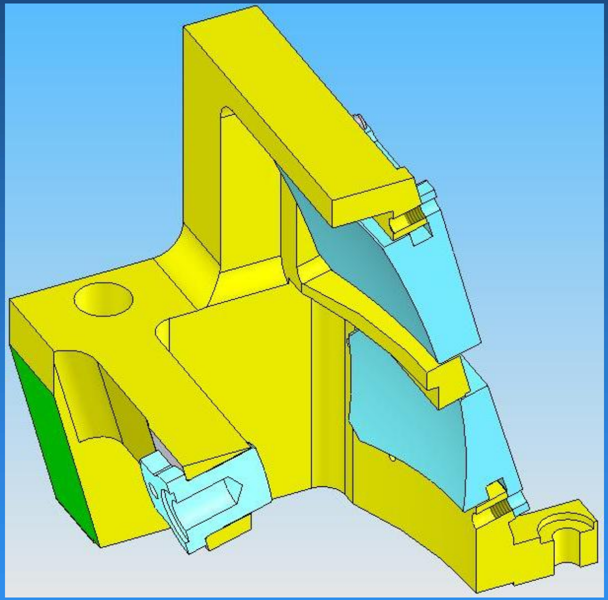
Technology Assessment

- *M1 & M3 Beyond Manufacturability*
- *M3 Can't be tested*
- *Alignment is critical*

"we are on the right track!"

The Challenges

A Technology Development was launched on 17 October 2008 to address the manufacturabily of the TMA



The Challenges

SWIR Detector

XenICs (B) had an InGaAs detector partially meeting the Vegetation Requirements.

We needed to bring the format from 512 pixels to 3000.

A specific design of the ROIC to optimize full well capacity and Dark Current to meet Vegetation requirements.

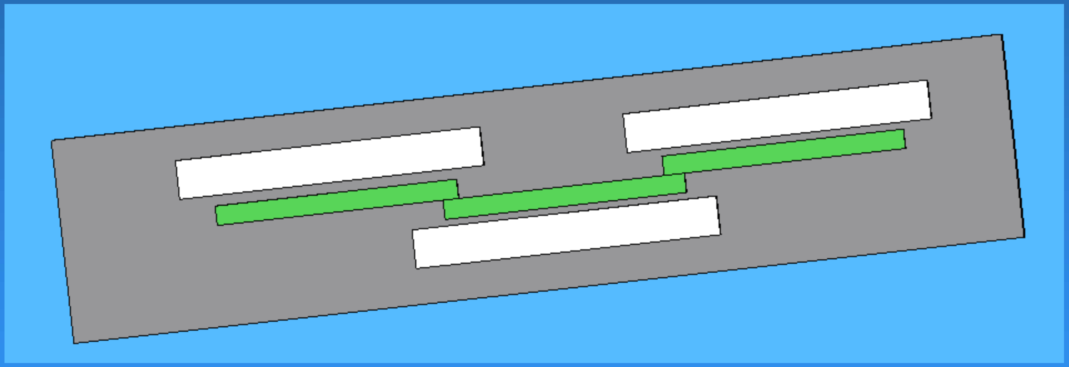
The Challenges

3000 pixels (25μm each) requires almost the full wafer.

InGaAs is a very brittle material, yield and handling of a linear array was considered too risky.

The Challenges: the SWIR Detector

A solution based on three detectors of 1024 mechanically butted was selected.



Status

TMA: the Telescope has been manufactured and tested

MTF=0.6 @ Nyquist (38lp/mm)

On the whole Field of View

SWIR Detector:

the ROIC Design is completed. The mechanical butting has been proved. Wafer fabrication is in progress. Tests on the wafer scheduled for September.

Proba-V Satellite Project Status

Satellite KO – Jan 2009

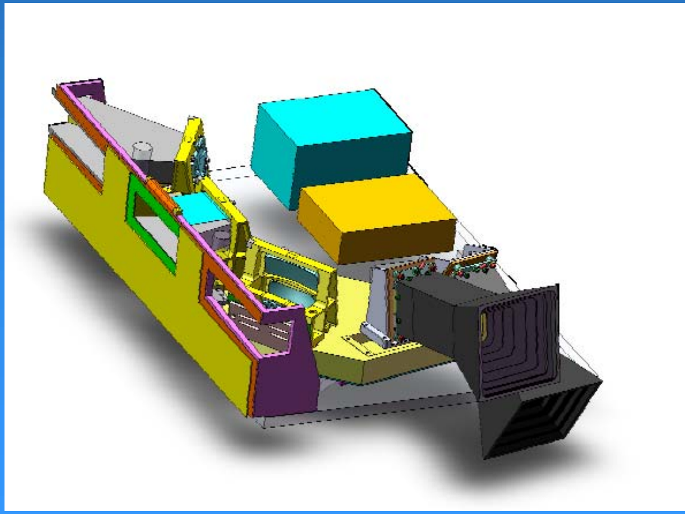
User & Data Retrieval

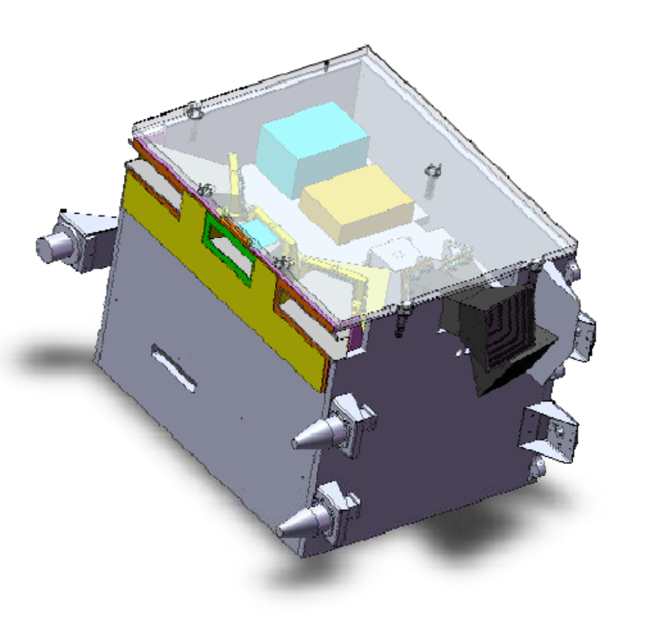
Satellite Prime

Payload Prime

Proba-V Satellite Project Status

The PDR in progress: ATP for C/D Phase awarded.





Technical Challenges laying ahead

Thermo-elastic Stability of the Optical Bench is the toll to be paid for the selection of the technology. The design, completely in Al, is athermal. Thermo-elastic deformation are stemming from the I/F with the Satellite.

The high CTE of Al requires that the thermal design needs to be a fine piece of art to achieve the Geolocation requirement while low keeping complexity.

The Improvements

	Spot VGT	*Proba-VGT*
Mass (Kg)	138	28
Volume (cm)	100x100x70	20x80x50
Power (W)	200	25
Resolution (m) (Nadir)	1,000	100
Resolution (m) (FoV Edges)	1,600	350