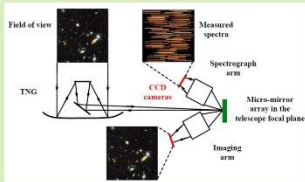


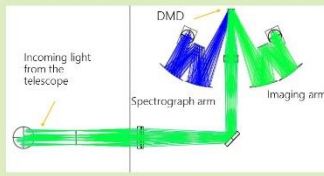
#1 Spectro-imagers

BATMAN at TNG

Spectro-imagers are instruments able to record both the image and the spectrum of any point in the field of view. In the BATMAN instrument, a MOEMS device is used to split the light to either the spectrograph arm or the imaging arm.



A spectro-imager concept : BATMAN at TNG



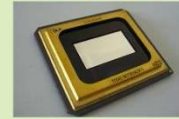
BATMAN optical design

#2 The use of MOEMS

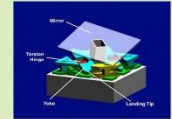
MOEMS = Micro – Opto – Electro – Mechanical – Systems

The Digital Micromirror Device (DMD)

For the instrument BATMAN, the largest DMD from Texas Instrument is used, size 28 mm x 14 mm, composed by more than 2 million micro-mirrors (13 μm mirrors in an array of 2048 x 1080 pixels).

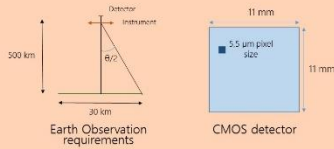


Digital Micromirror Device (TI)



Schematic view of a single 13 μm micro-mirror

#3 Requirements & Methodology



Mission requirement (discussed with CNES)

Image quality	< 2 pixels = 11 μm
Field of view	3° x 1°, 2D
Allocated volume	50 cm x 50 cm x 50 cm

Methodology

- Look for new designs of MOEMS based spectro-imagers for Earth Observation, using optical design softwares such as Zemax and CodeV
- Understand the advantages and drawbacks of MOEMS based instruments



1D linear field of view



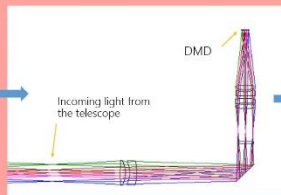
2D field of view (of Marseille !)

#4 Results

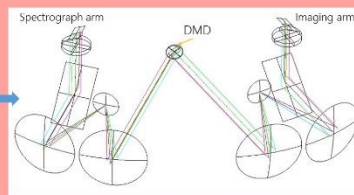
Universe observation : Design of a new fore-optics for the BATMAN instrument



Telescopio Nazionale Galileo



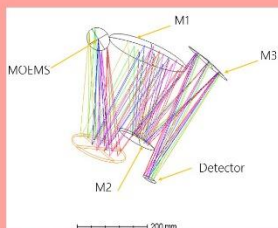
New fore-optics



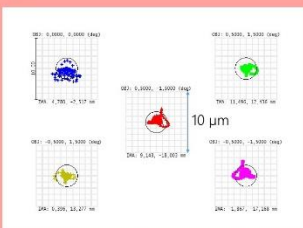
BATMAN instrument

	New fore-optics
Spot diameter, center of the FoV	10,2 μm
Spot diameter, edge of the FoV	8,7
Image quality after tolerancing	< 1 pixel (13,5 μm)
Number of lenses	6
Aspheric surfaces	2
Total track (TNG focal plane – DMD)	1636 mm

Imager



3-surface imager for Earth Observation



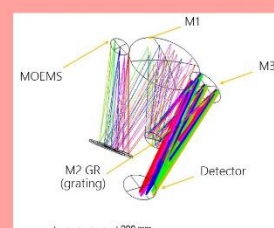
Spot diagram of the imager (diffraction limited)

Parameter	Value
F# (MOEMS)	N = 6
F# (Detector)	N = 3,5
Wavelength range	400 nm – 800 nm
Magnification MOEMS-Detector	0,58

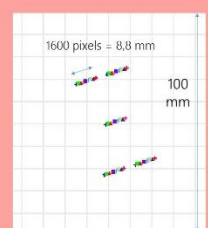
Surface

M1	Concave, aspheric
M2	Convex, aspheric
M3	Concave, aspheric

Spectrograph



3-surface spectrograph for Earth Observation



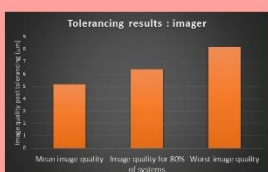
Spectrograph's full field display

Surface

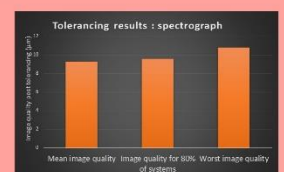
M1	Concave, aspheric
M2 GR	Convex, aspheric
M3	Concave, conic

Results

- Image quality after tolerancing < 2 pixels
- Feasibility of the optics : confirmed
- Volume : < 50 cm x 50 cm x 50 cm



Spot diameter after tolerancing



Spot diameter after tolerancing