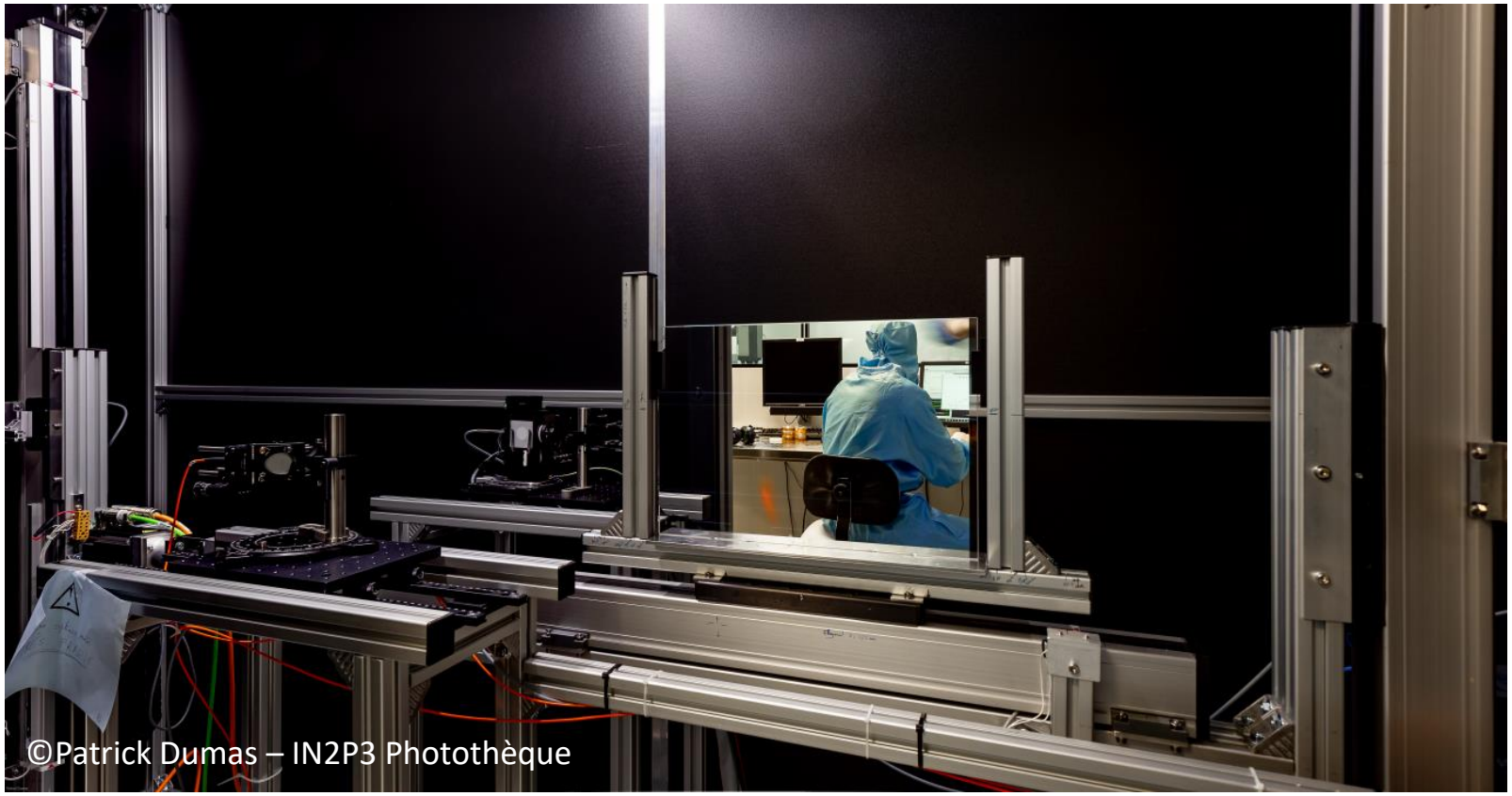


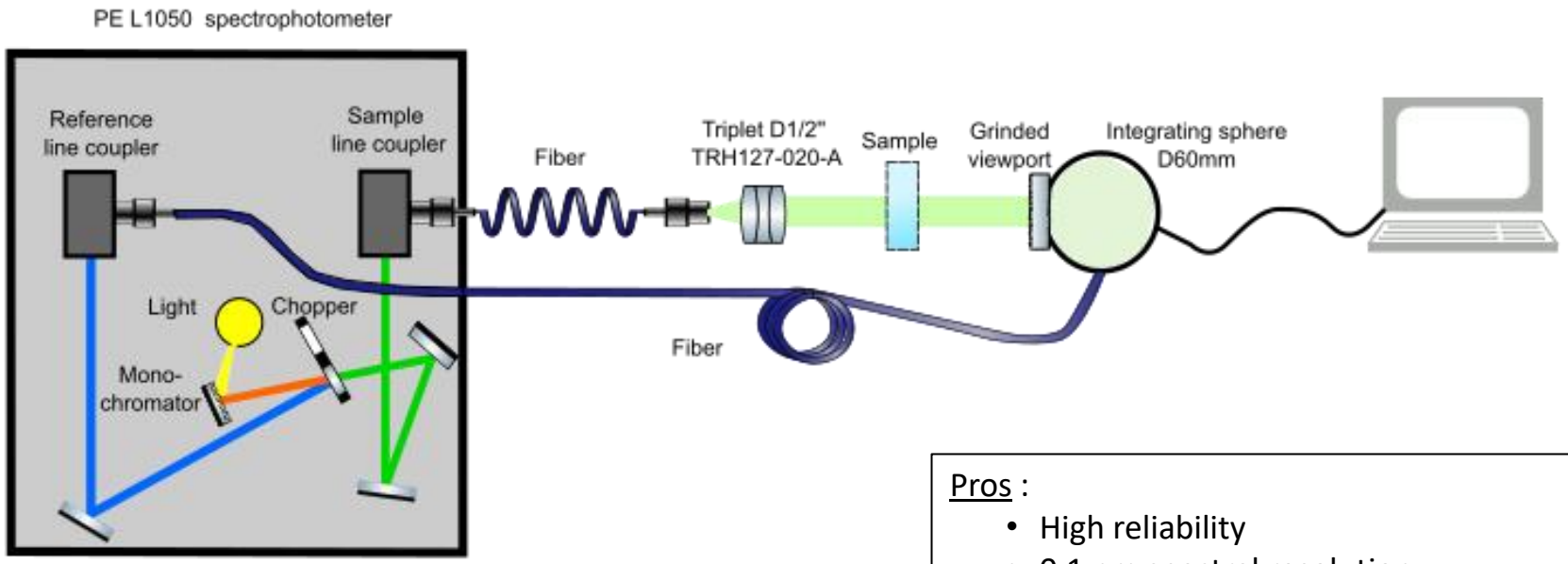
Mesure de la transmission des filtres

B. SASSOLAS, B. LAGRANGE, D. HOFMAN & L. PINARD,
Plateforme LMA-IP2I

Outlines

1. Description of the *Banc déporté*
2. *Banc déporté* vs Tabletop spectrophotometer
3. Lessons from the MegaCam filters
4. Moving elements : the major weakness
5. Towards the LSST filters ?

Description of the *Banc déporté*



Fully operational since January, 2017

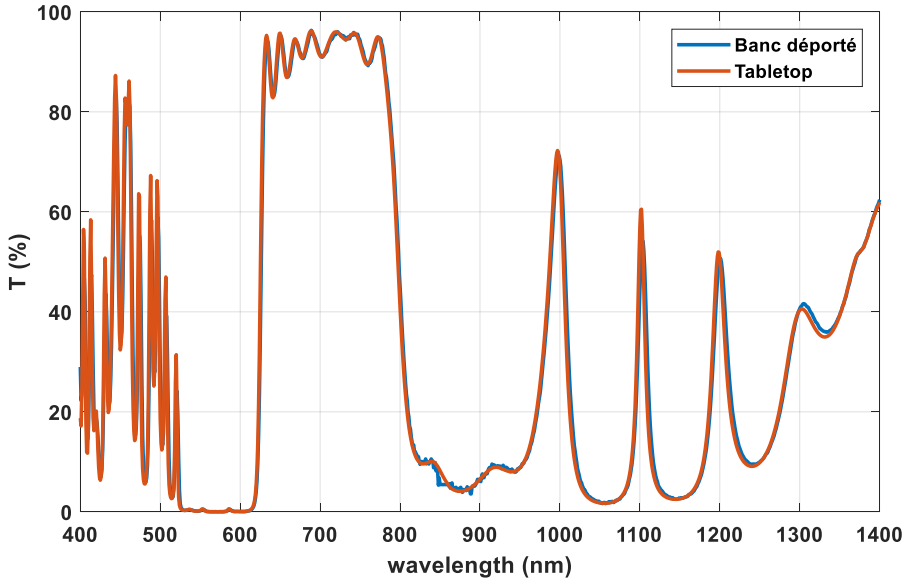
Pros :

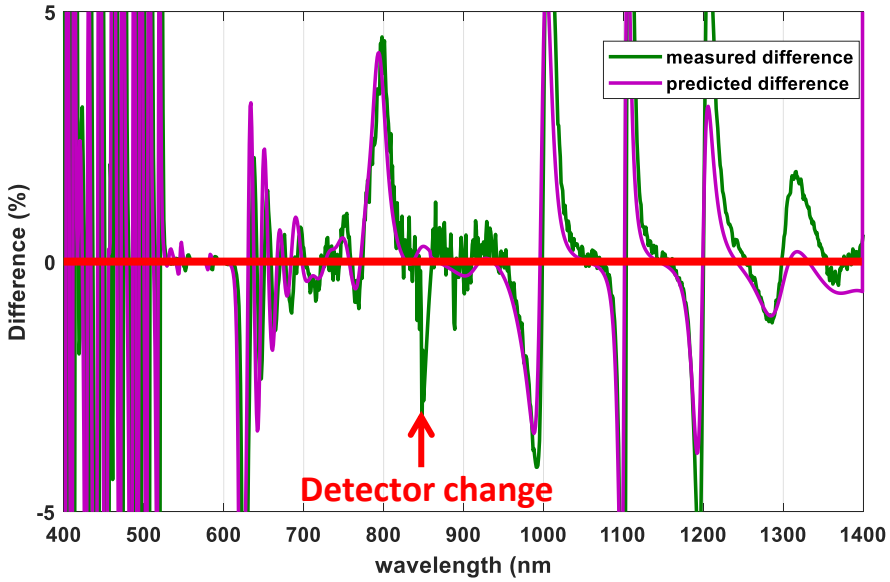
- High reliability
- 0.1 nm spectral resolution
- Wide spectral range (175-3300nm)
- Oblique incidence (integrating sphere)
- ∅500 mm optics

Cons :

- Slow
- Low sensitivity (integrating sphere)
- Caution with >∅500 mm optics

Banc déporté vs tabletop spectrophotometer





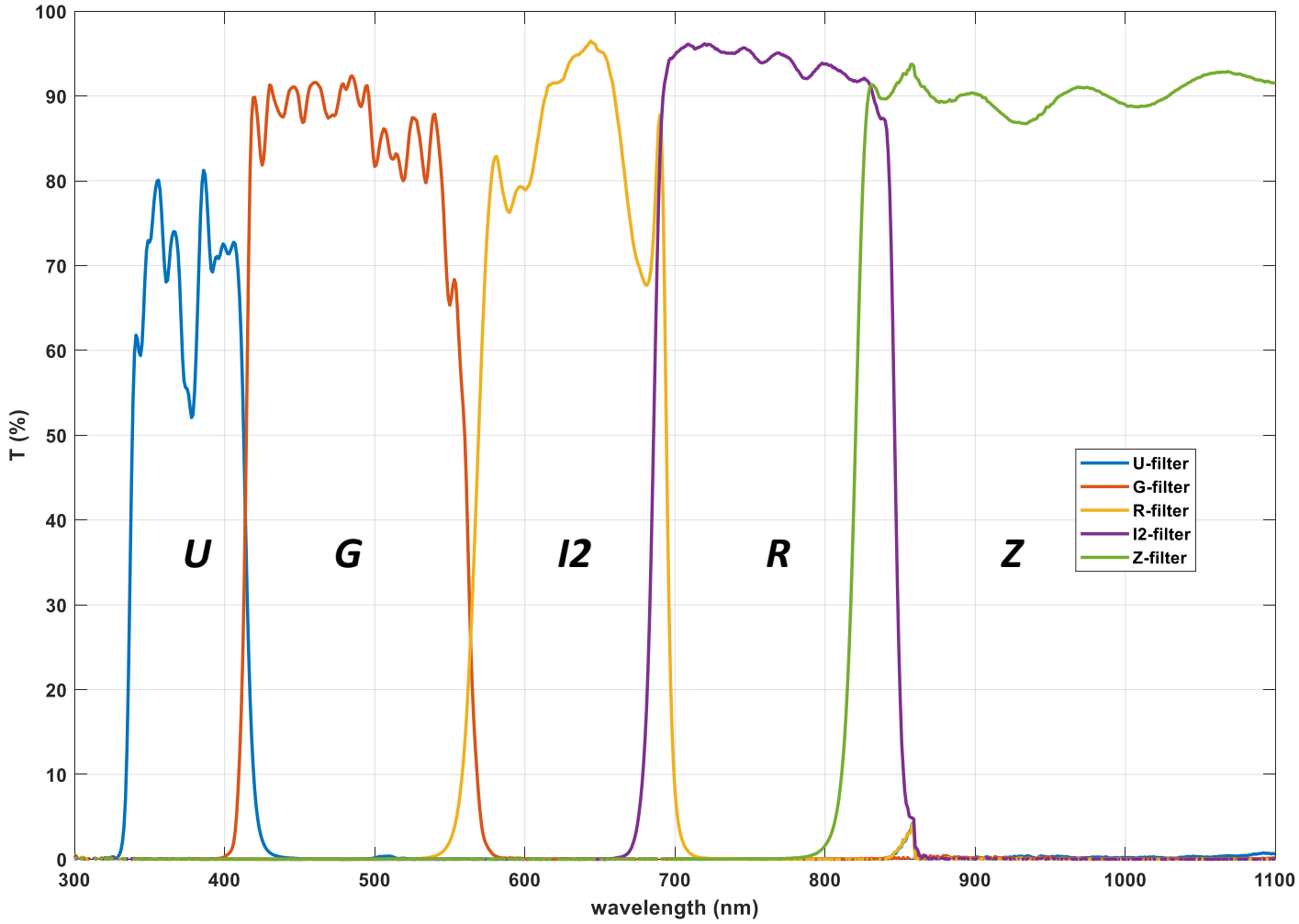
Sample : ∅25.4mm ; 6mm thick
Measurement at AOI 0°
Different cone-angle illumination : nearly collimated beam for the *Banc déporté*
+/-3° divergence beam for the Tabletop spectrophotometer
Different spectral bandwidth : $\Delta\lambda$ twice larger for the *Banc déporté*

Good agreement between both spectra → average difference ~0
The ripples in the «difference plot » arise from the different cone-angle and spectral resolution

Comparable performances wrt the state to the art of Tabletop spectrophotometers

Lessons from the MegaCam filters

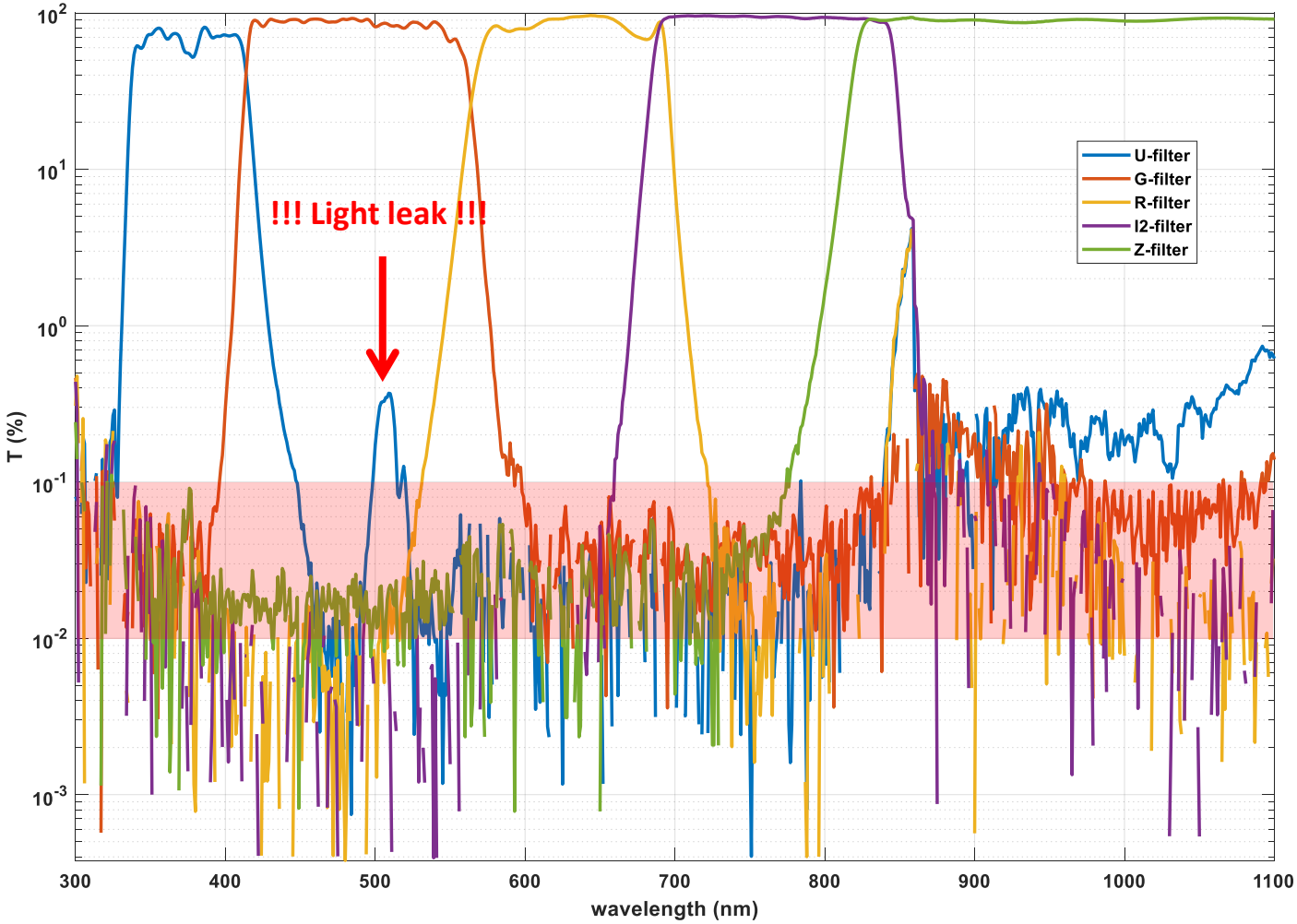
Nice spectra at normal incidence over the 300-1100 nm wavelength range



Position of the filters measured with an accuracy of +/-0.2nm

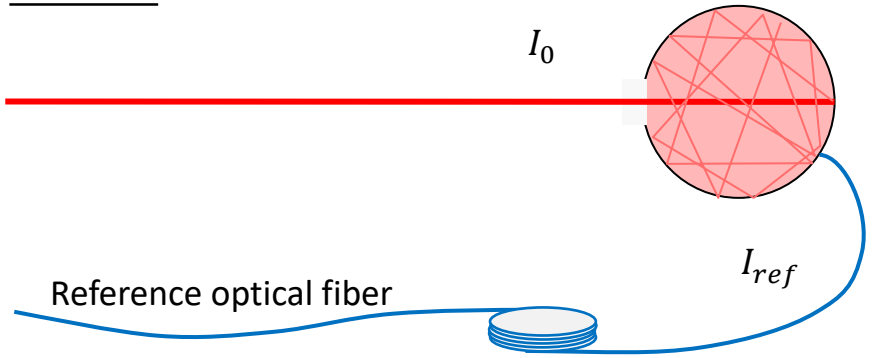
Lessons from the MegaCam filters

The same but in log scale : an estimation about the sensitivity → **between 0.01% and 0.1%**



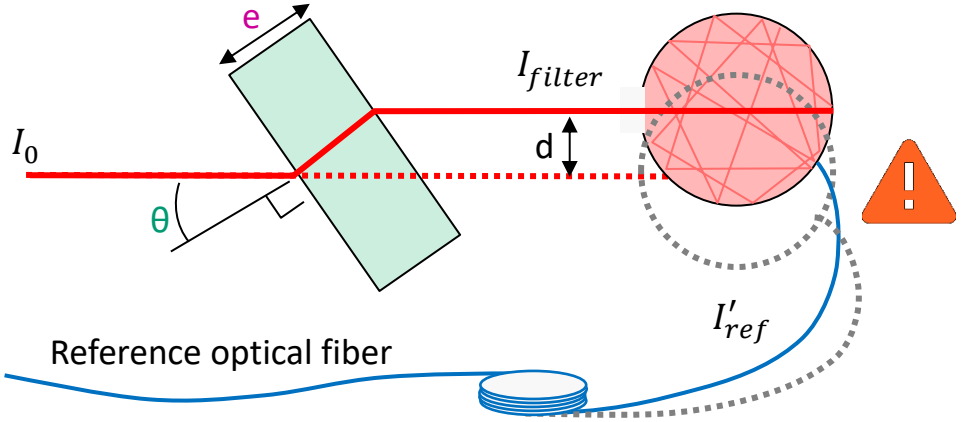
Moving elements : the major weakness

Baseline



- Straight line propagation
- Ratio between the intensity illuminating the filter and the reference intensity
- Baseline : $B_{100} = \frac{I_0}{I_{ref}}$

Filter measurement



- Transmissions : $T = \frac{I_{filter}}{I'_{ref}} \cdot \frac{I_{ref}}{I_0} = \frac{I_{filter}}{I'_{ref}} \cdot \frac{1}{B_{100}}$
- Beam displacement due to refraction effect
  d = *f*(e,θ)
- Realignment of the integrating sphere is required
- Different bending of the optical fiber → $I'_{ref} \neq I_{ref}$

The displacement of optical elements impacts the instrument response

Moving elements : the major weakness

Dichroic coating onto :

- Plate : 339x310 mm² , 25mm thick
- Witness : ∅25.4mm , 6mm thick

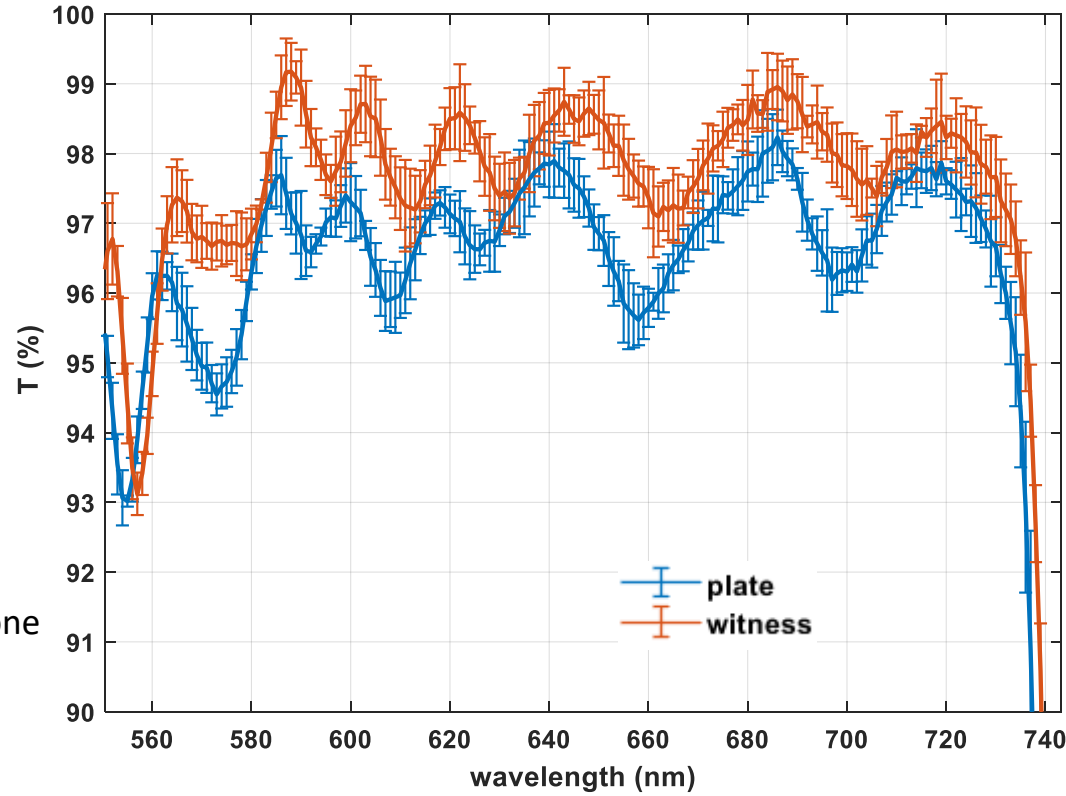
Transmission measurements at 45° AOI :

- Beam displacement for the Witness : ~2mm
- Beam displacement for the Plate : ~8mm

Same coating run ➡ alike spectra were expected

The Plate's spectrum is **~1-2% lower** than the Witness one

N.B : a dedicated effort will start in April 2020



The displacement of the sphere induces a strong error in the transmission value

Towards the LSST filters ?

Requirements

	Document & Revision#	Date Effective	Status
LSST Large Synoptic Survey Telescope	LSST-SOW-030 R0	Dec. 1, 2009	Approved
	Author(s): V. Riot, K. Gilmore, S. Olivier		
	Subsystem/Office: Camera Optics		
Document Title: **LSST Statement of Work – Optical Coating Design Study**			

- AOI 14.2°-23.6° : low-medium AOI
- Wavelength range 300 – 1200nm : compatible with the optical system
- In-band transmission >95% : compatible with the dynamic range of the detector

- Radius of Curvature ~5.60m : illumination system must be « dynamic » in order to match the curvature
- Out-of-band transmission <0.01% : below the present sensitivity
- Clear aperture ∅750 mm : modifications of the enclosure

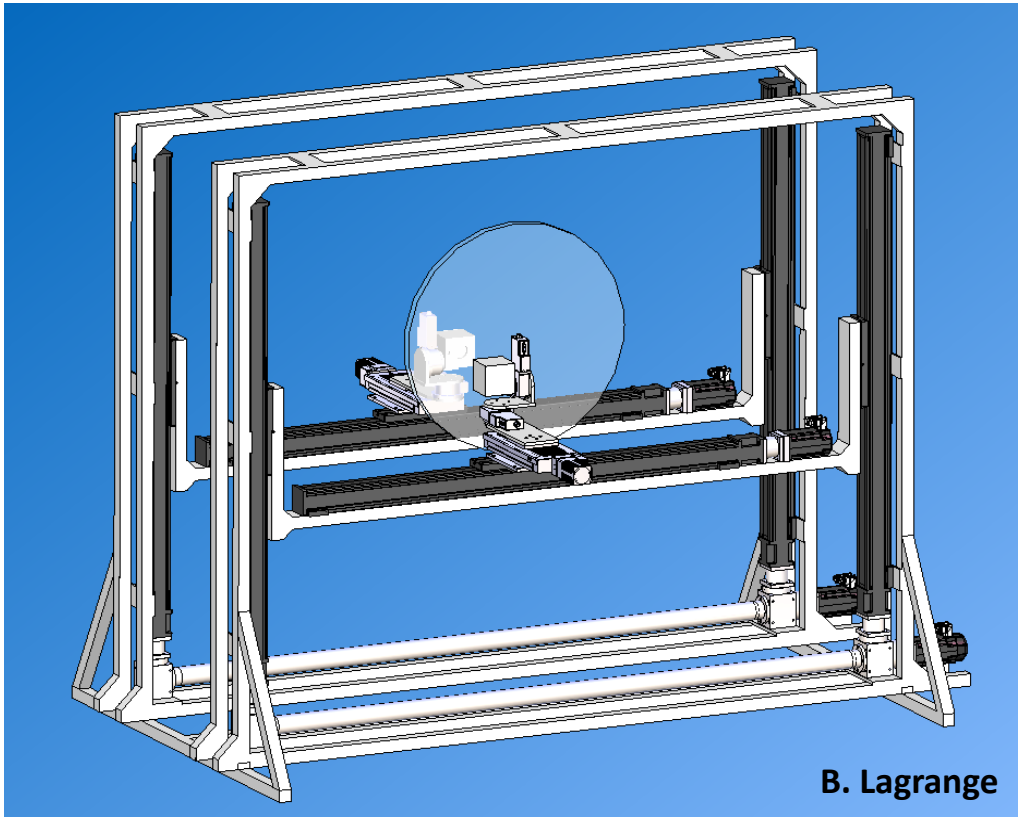
And relevant requirements for DESC are not included here …

Towards the LSST filters ?

The concept :

- Double “H” structure
- Moving illumination system
- Moving detection system

Designed in 2014 => developments stopped in 2016



Towards the LSST filters ?

Initial measurement strategy : the scan is performed in 3 steps

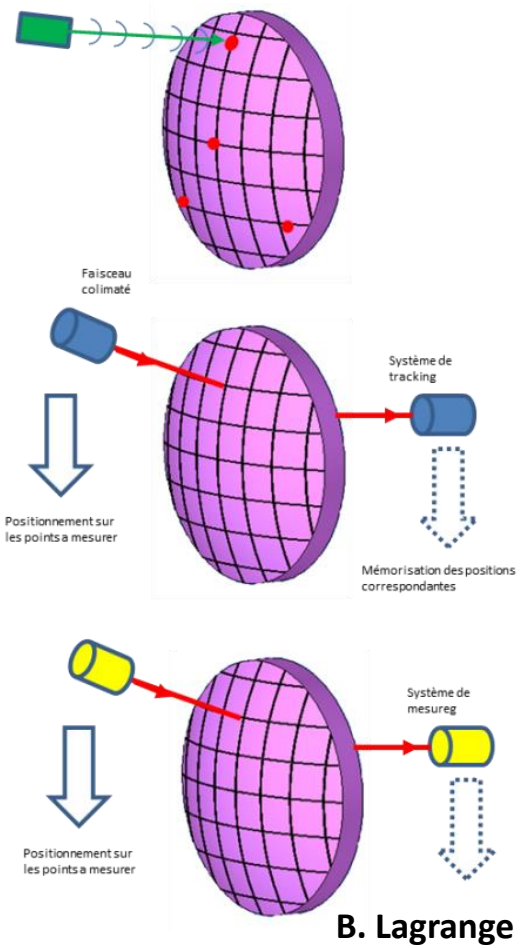
- Mapping of the front surface with ultrasonic sensor
  - Equation of the surface
  - Position of the illumination source

Prototype done

- Tracking system
  - Detection of the transmitted beam at each location and for AOI
  - Detector position saved

Prototype done

- Photometric detection system
  - T measurement at each location and for each AOI



B. Lagrange

Several moving elements can impact the accuracy. A carefull assessment is required.

Conclusion

***Banc déporté* present status**

- A lot of optics measured for 3 years
- Strong background in it
- A quite efficient facility
- Photometric sensivity ~0.01%-0.1%
- Limitations arise from the moving elements

Move forward the LSST filters

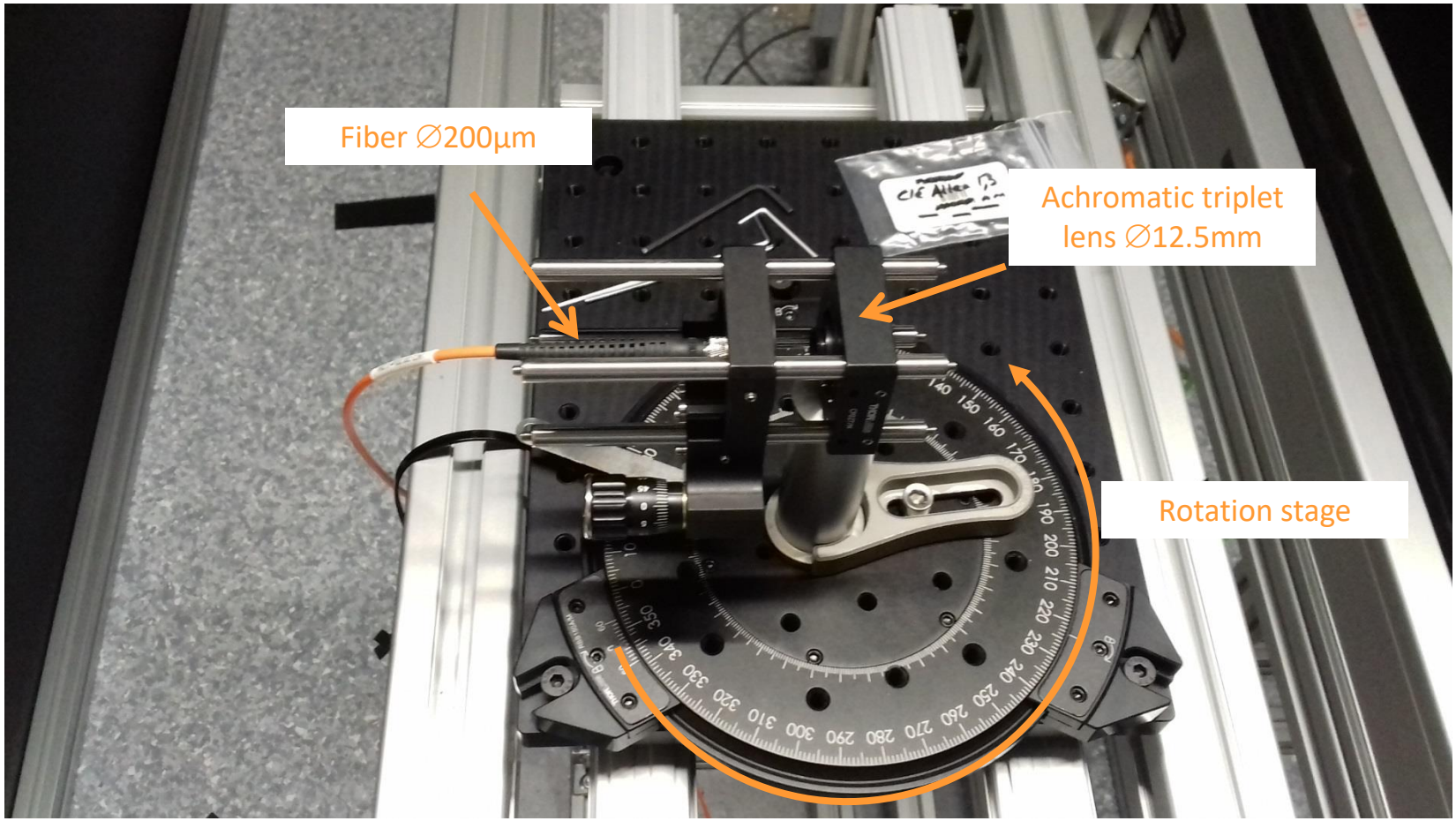
- Upgrade required
- Measurement of curved optics is not a straightforward task
- The « moving elements issue » can be a showstopper
- Dedicated study in order to assess the final performances of the system must be done

What next ?

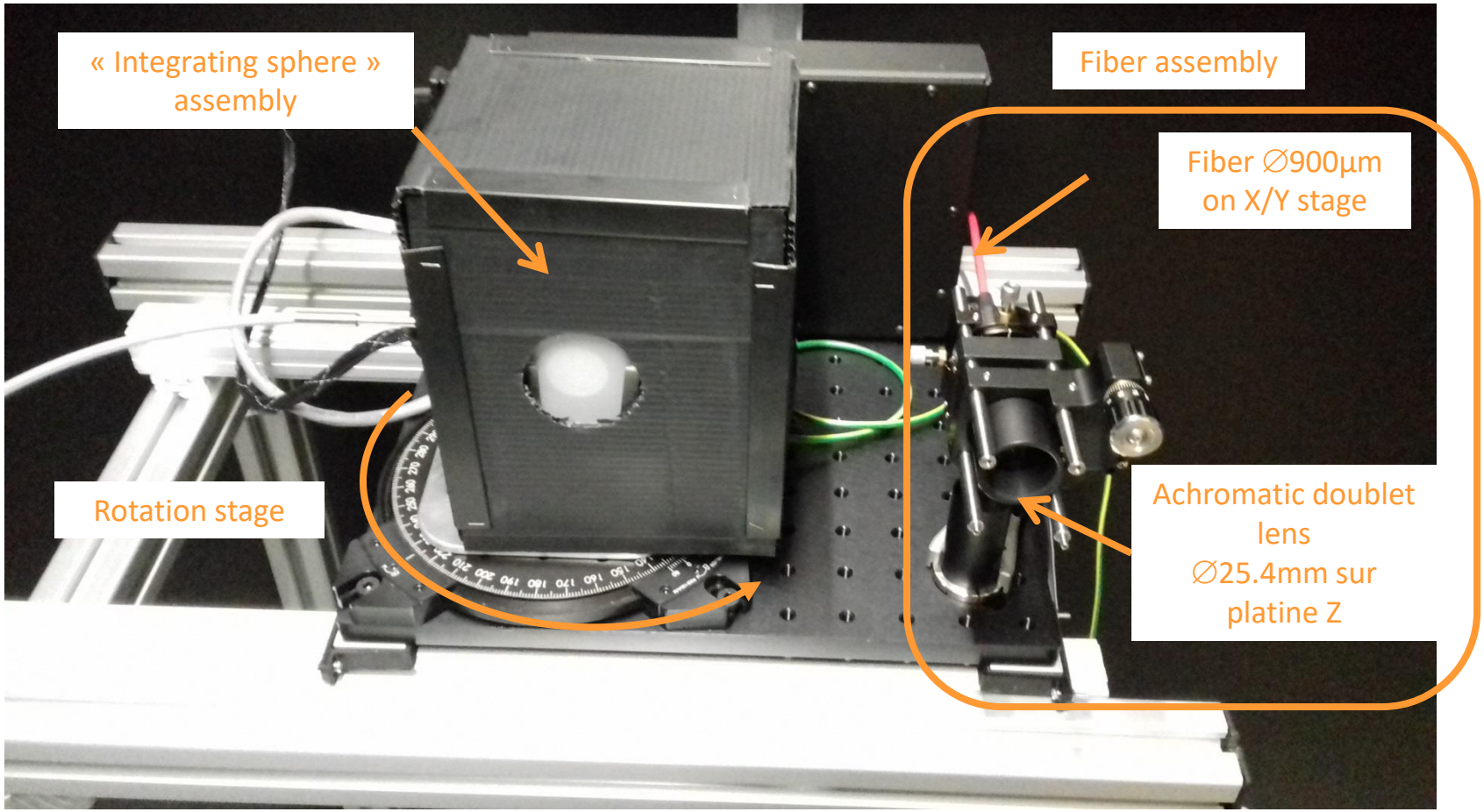
- Need to restart this activity
- Limited human ressources available at the moment
- What is the timescale ?
- What is all the specifications required by the community ?

SPARE SLIDES

Illumination stage



Detection stage



« Integrating sphere » assembly : works with high performance Perkin Elmer L1050 spectrophotometer

Fiber assembly : works with compact OCEAN OPTICS HR2000 spectrometer

Mapping

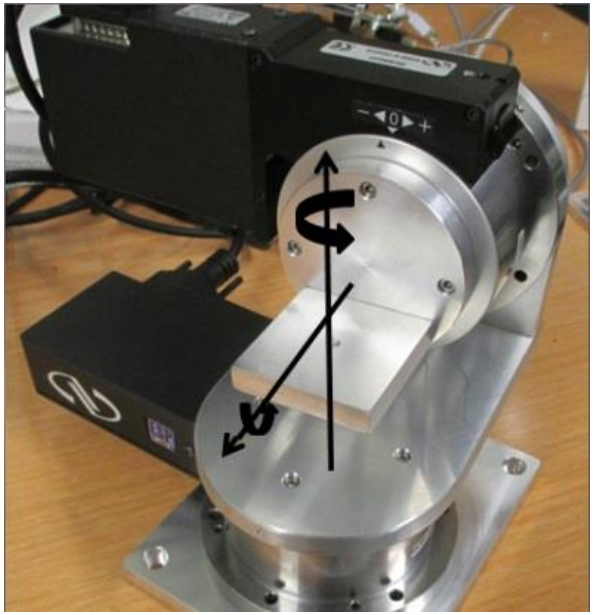
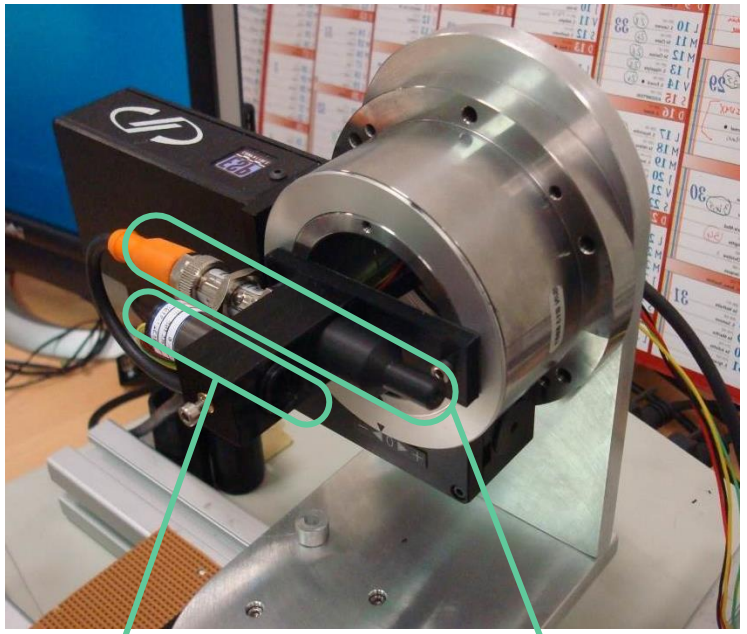
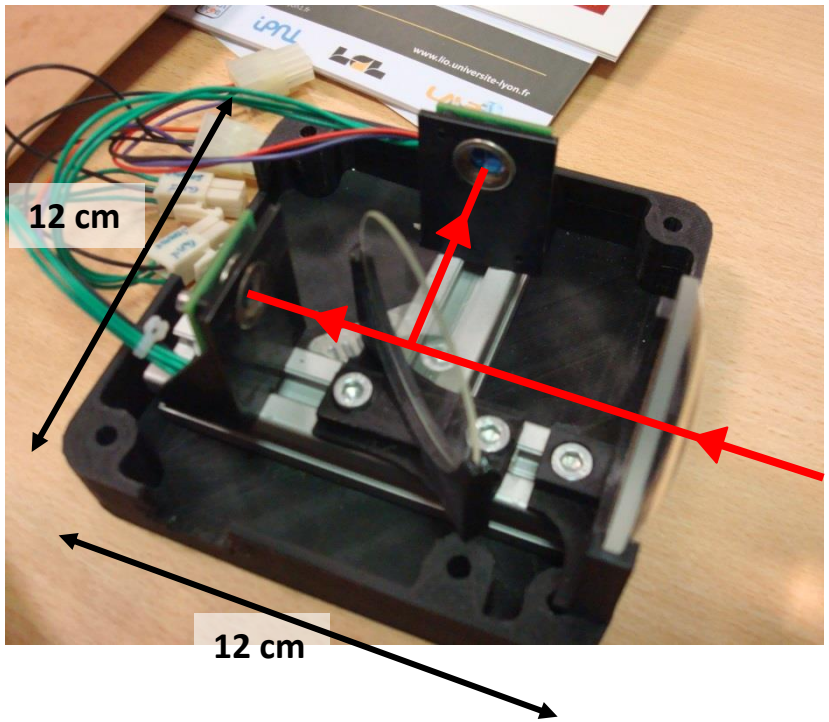


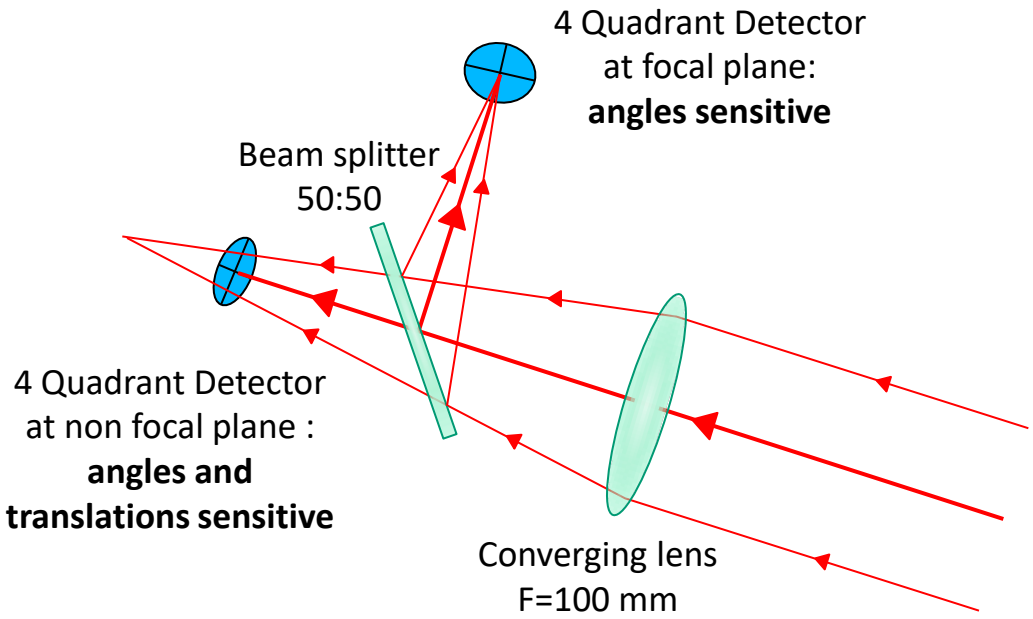
Table de rotation pour alignement télémètre et diode



- Intégration mécanique du télémètre et de la diode
- Pilotage du télémètre
- Pilotage des tables en RS232 (problème en cours de résolution avec port USB)

Tracking system





MegaCam filters

Strange behaviour near 860 nm → ▪ Detector change at 860nm ▪ Low QE near 860nm → **Limited sensitivity in this wavelength range**