# Telescope performances for COLIBRI

**Simona Lombardo**

# TELESCOPE MAIN RESULTS @OHP

**Me:** joined in Dec 2021
Project scientist since 2022

## THE TELESCOPE ALONE VALIDATION (TAV)

- Validate the telescope performances, optical and mechanical
- Started spring last year at OHP
- Responsibility of Samuel Ronayette (WP leader of AITV) and Pascal Gallais (CEA Saclay).

# TELESCOPE MAIN RESULTS @OHP – tools for tests

## OGSE MECHANICAL INTERFACE

- OGSE connects the derotator and the camera for tests
- Mimics the weight of the instrument and the center of mass
- Allows to mount cameras.

## TOOLS FOR TESTS

- SH
- Manta camera for fast images
- FLI camera (1/4 fov)
- SBIG camera (1/8 fov)
- New CMOS camera (1/4 fov)
- Translation stage to move the camera

# TELESCOPE MAIN RESULTS @OHP – overview

| Requirement | Description | Associated test(s) | Req. Can be fully verified | Value measured | Compliant |
|---|---|---|---|---|---|
| GFT-REQ-31 | Diffraction limited at 500nm at the center of the FoV, seeing limited beyond 5arcmin | TAV-02, TAV-03, TAV-04, TAV-05 | Y | Test to be done | |
| GFT-REQ-36 | throughput | TAV-08 | N | Data to be analysed | |
| GFT-REQ-38 | Straylight < 25% of sky bckgrd | TAV-09 | N | Not enough data for the analysis | n/a |
| GFT-REQ-39 | Ghost < 10% of main image, spread on >1000 pixels | TAV-09 | N | | n/a |
| GFT-REQ-132 | Circular FoV>26arcmin | TAV-06 | Y | >26' | C |
| GFT-REQ-143 | Distortion: scale constant +/-5% | TAV-06 | Y | 0.20% | C |
| GFT-REQ-148 | Pointing acceleration/deceleration >10deg/s² | TAV-14 | Y | Data missing. Test to redo | |
| GFT-REQ-149 | In ready state, on target in <30sec | TAV-14 | Y | pointing <15sec | C |
| GFT-REQ-195 | Vignetting <5% | TAV-02, TAV-06, TAV-07 | Y | Test to redo | |
| GFT-REQ-208 | Stability of focusing | TAV-10 | N | Focus variation dominated by seeing | C |
| GFT-REQ-210 | M3 rotation in <30 sec | TAV-13 | n/a | Can't be done with AstelOS | n/a |
| GFT-REQ-216 | Observations between 15° and 89° in elevation | TAV-15 | Y | Test to do | |
| GFT-REQ-217 | Observations between 0° and 540° in azimuth | TAV-15 | Y | Test to do | |
| GFT-REQ-218 | Absolute pointing acc. <2.5arcsec. | TAV-11, TAV-12, TAV-13 | Y | Pointing +/-3" Repeatability <2.5" | PC |
| GFT-REQ-218 | Differential pointing acc. <0.18arcsec within 2° | Not done. Could be integrated in TAV-12 | N | n/a | n/a |
| GFT-REQ-219 | Pointing speed >30°/sec | TAV-14 | N | n/a | n/a |
| GFT-REQ-220 | After pointing, optimal obs. in <1sec | TAV-14 | Y | Damping time <1sec | C |
| GFT-REQ-221 | Tracking accuracy:<br>0.45 arcsec over 30 min.<br>0.25 arcsec over 10 min.<br>0.18 arcsec over 90 sec. | TAV-16 | Y | <0.6" over 30 min<br><0.4" over 10 min<br><0.3" over 90 sec | PC |

# TELESCOPE MAIN RESULTS @OHP – **overview**

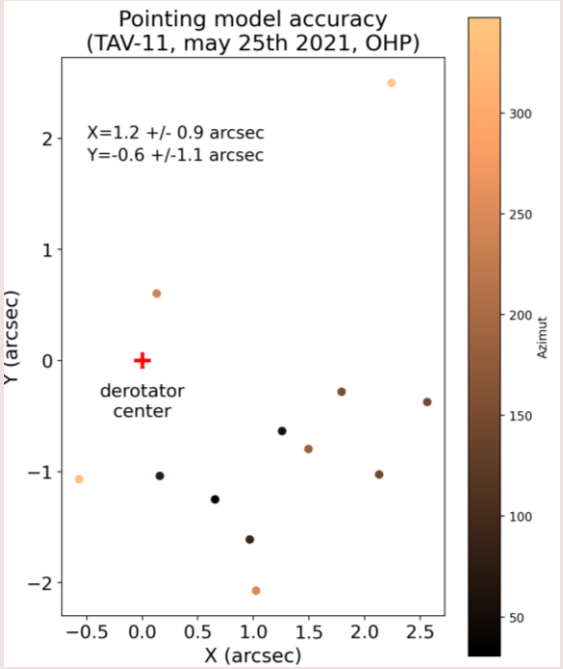
## STATUS

- Several tests done in spring/ summer 2021
- Some unconclusive
- Some needs to be redone (new alignment in December 2021)
- Credit for plots of tests to Samuel Ronayette

# TELESCOPE MAIN RESULTS @OHP – Mechanical tests

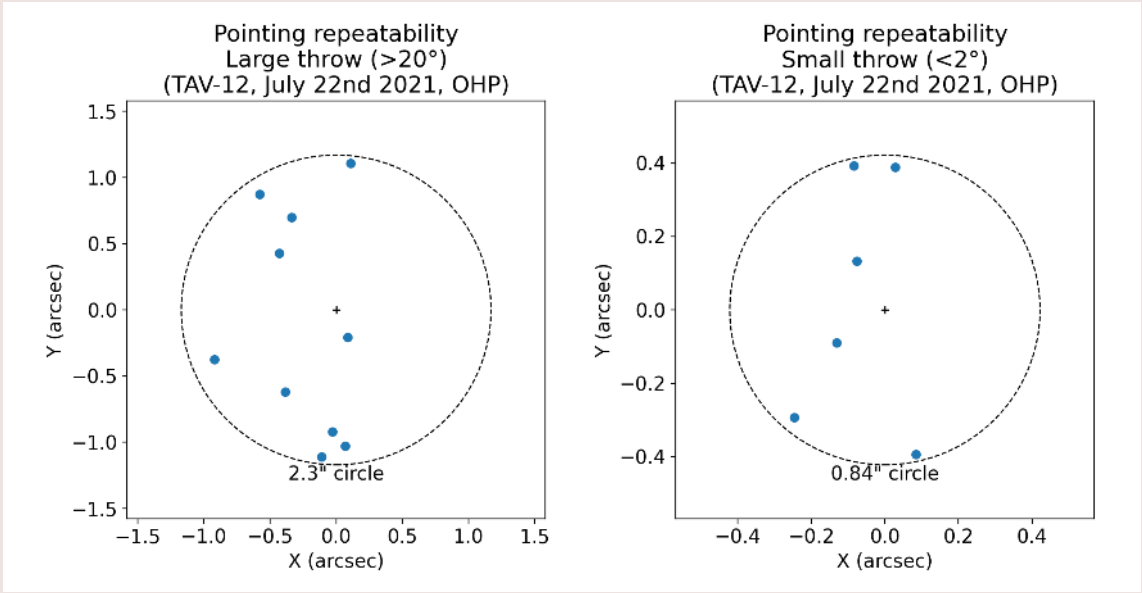
## MECHANICAL TESTS

- Pointing accuracy (spring/summer 2021), to redo (highly depending on pointing model)
- Pointing repeatability (spring/summer 2021)




Requirement on absolute:

<2.5” RMS




Good repeatability:

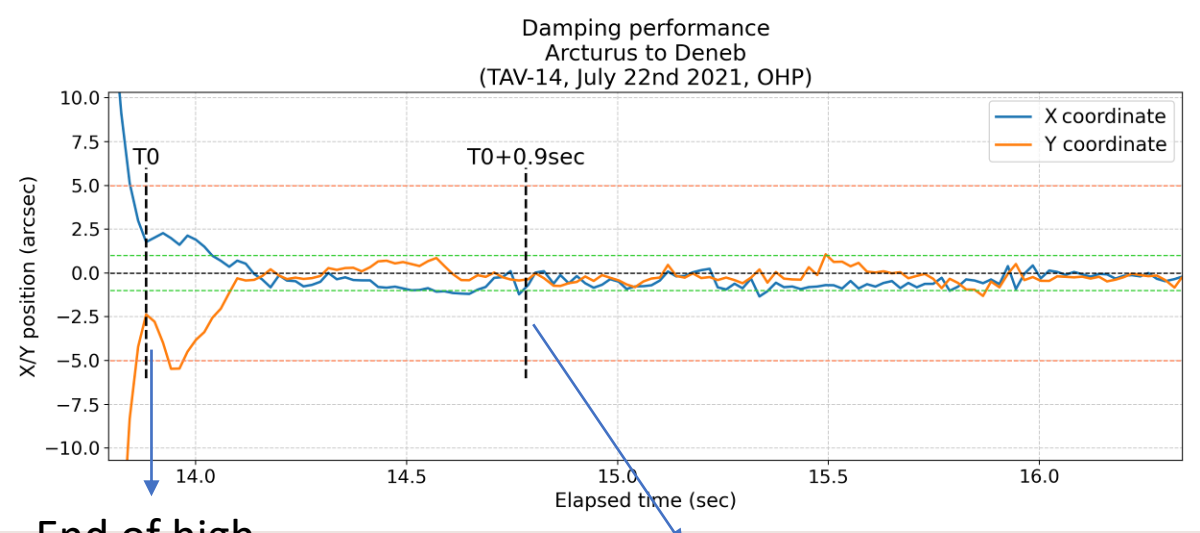
2.3” circle (large throw), 0.84” circle (small throw)

**Good!!**

# TELESCOPE MAIN RESULTS @OHP – Mechanical tests

## MECHANICAL TESTS

- Pointing accuracy (spring/summer 2021), to redo (highly depending on pointing model)
- Pointing repeatability (spring/summer 2021)
- Pointing speed & damping (summer 2021)




End of high speed pointing

Optimal tracking

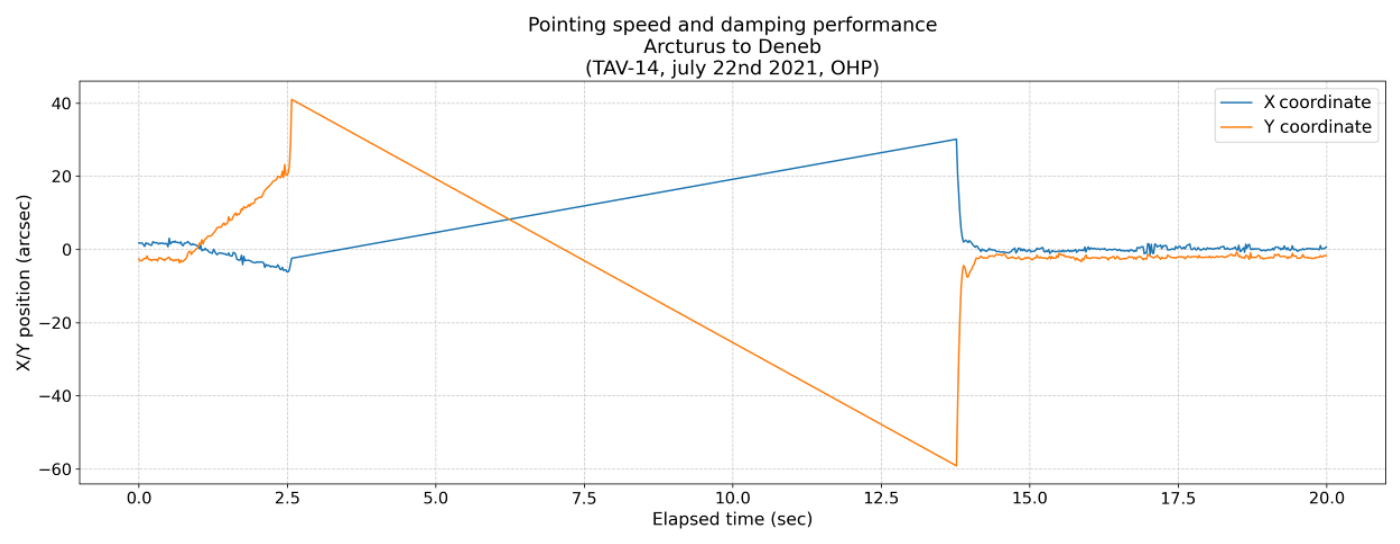
Requirement: <1 s
Measured: 0.9 s

**Good!!**

# TELESCOPE MAIN RESULTS @OHP – Mechanical tests

## MECHANICAL TESTS

- Pointing accuracy (spring/summer 2021), to redo (highly depending on pointing model)
- Pointing repeatability (spring/summer 2021)
- Pointing speed (summer 2021)




Measured: 16.7°/s

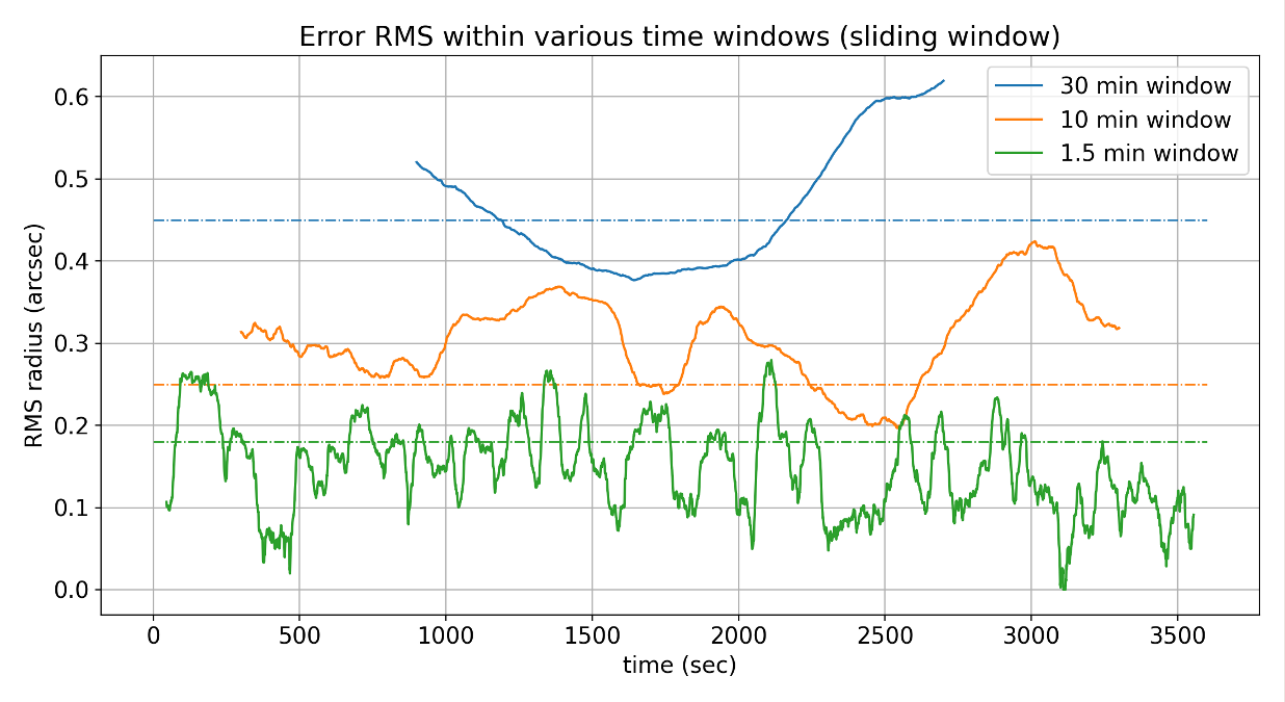
On target < 15s
(req. < 30s)

**Redo maybe testing separately elevation and azimuthal axes.**

# TELESCOPE MAIN RESULTS @OHP – Mechanical tests

## MECHANICAL TESTS

- Pointing accuracy (spring/summer 2021), to redo (highly depending on pointing model)
- Pointing repeatability (spring/summer 2021)
- Pointing speed (summer 2021)
- Tracking stability (summer 2021)

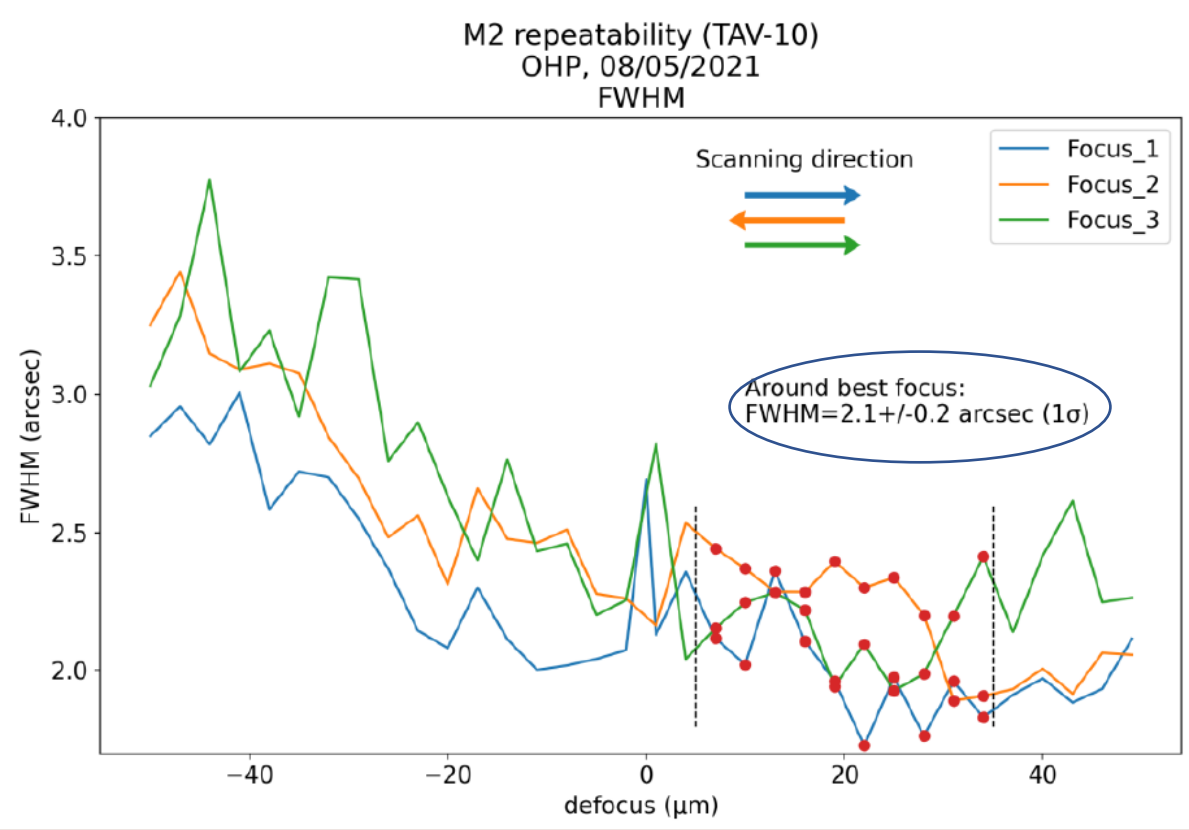



Influence of misalignment?
**To redo**

# TELESCOPE MAIN RESULTS @OHP – Mechanical tests

## MECHANICAL TESTS

- M2 repeatability (to focus the image)



# TELESCOPE MAIN RESULTS @OHP

## AFTER SUMMER 2021

- Astelco performed a new alignment end 2021 (many tests must be redone)
- General need to revise some of the tests and requirements

## OPTICAL TESTS

- Focus test (spring/summer 2021), to redo
- Image quality, to do
- Wavefront quality → dominated by astigmatism → source?

# TELESCOPE MAIN RESULTS @OHP – Optical tests

## CURRENT HYPOTHESIS

- Mechanical origin (some mechanical contact where there should be none)
- Alignment issue

## WFE BUDGET

- Better results in the past
- Optical quality of mirrors checked in several ways and in spec.

| Component | Tolerance | Surface error RMS | WFE RMS (nm) |
|---|---|---|---|
| Nominal | | | 3 |
| M1 *RoC* | ±5 mm | | |
| M2 *RoC* | ±2 mm | | |
| M1 $k$ | ±0.001 | | |
| M2 $k$ | ±0.0045 | | |
| M1 and M2 *Roc* and $k$ | | | 63 |
| M1 Polish (astigmatism) | | $\lambda/14$ @ 633 nm | 89 |
| M2 Polish (astigmatism) | | $\lambda/14$ @ 633 nm | 89 |
| M3 Polish (astigmatism) | | $\lambda/28$ @ 633 nm | 64 |
| M1 Polish (coma) | | 0⋆ | 0⋆ |
| M2 Polish (coma) | | 0⋆ | 0⋆ |
| M3 Polish (coma) | | 0⋆ | 0⋆ |
| Others (astigmatism) | | | 65 |
| Others (coma) | | | 0⋆ |
| Total | | | 168 |

⋆ Corrected by shifting M2.

COLIBRI Optical Design Document by Jorge Fuentes-Fernández

# TELESCOPE MAIN RESULTS @OHP – Next steps

## DDRAGUITO

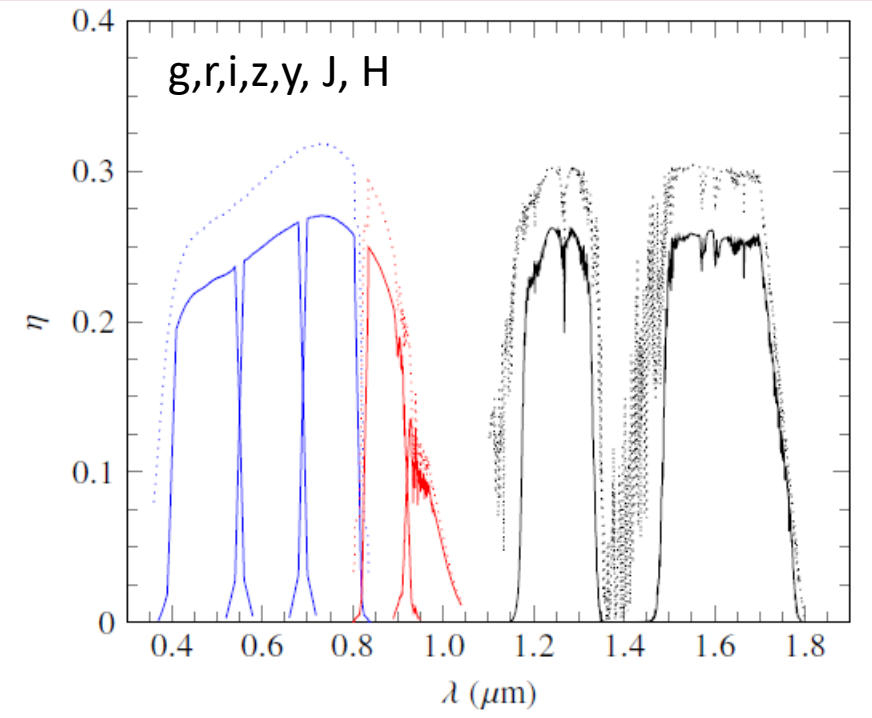
- Installation foreseen as soon as possible
- We will be able to test more performances (**full field of view accessible!**)
- Throughput test more easily performed

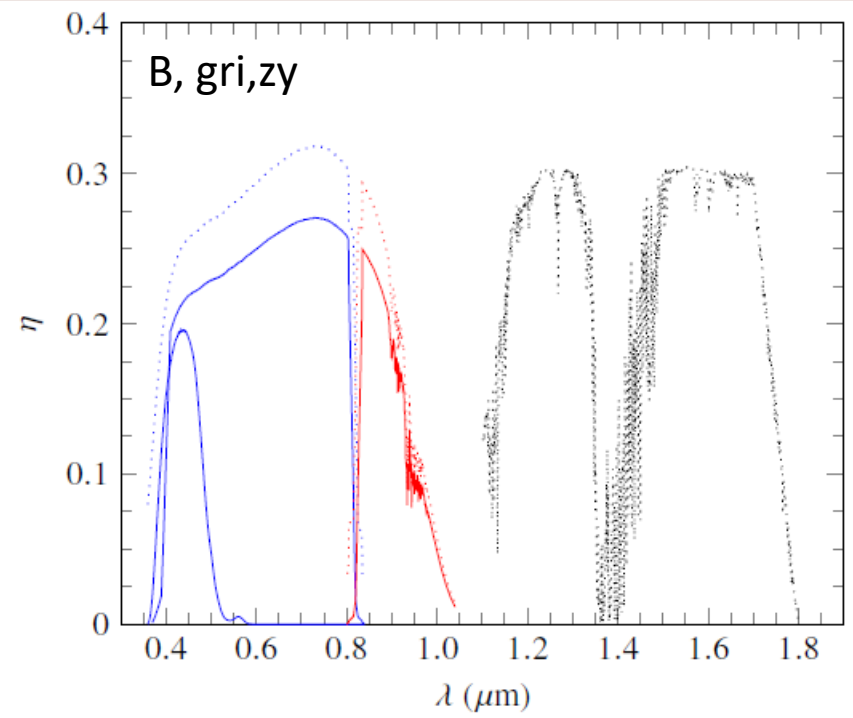
**What do we expect from the complete telescope+instruments?**

# COLIBRI EXPECTED PERFORMANCES

## DDRAGO + CAGIRE

- Efficiency expected on different channels

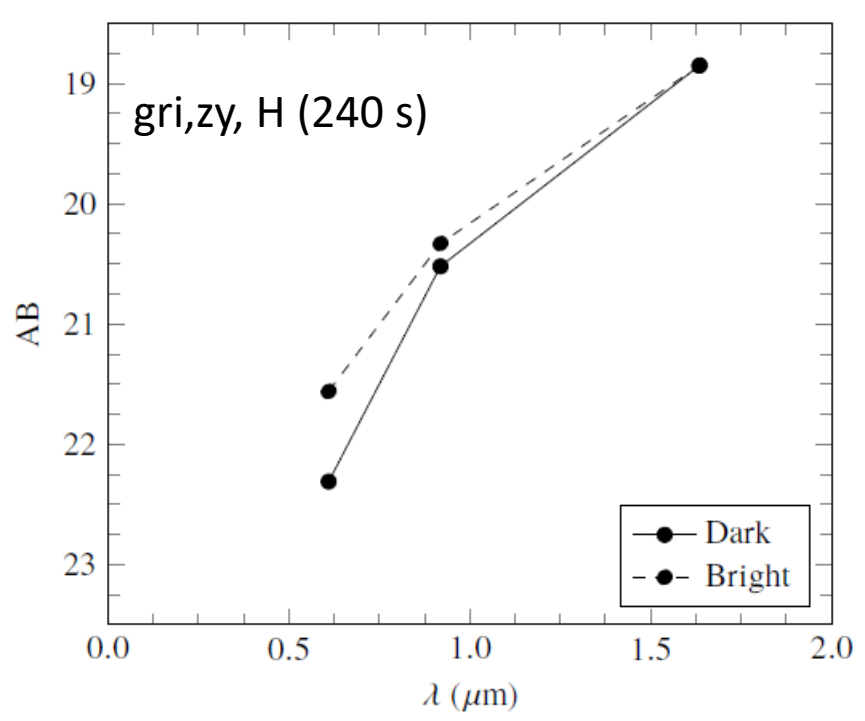


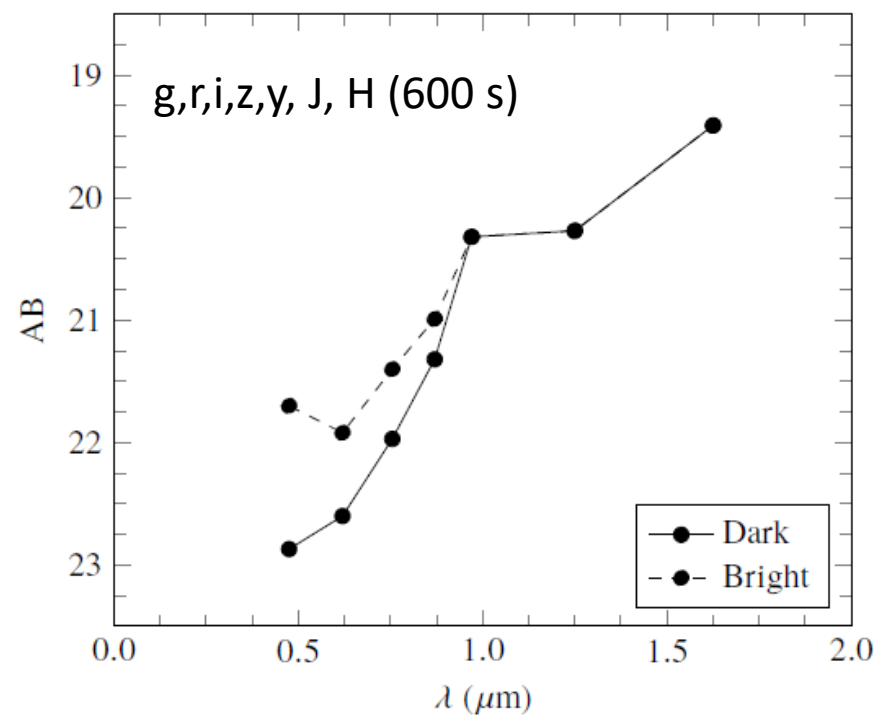



# COLIBRI EXPECTED PERFORMANCES

## DDRAGO + CAGIRE

- Limiting mag (10 $\sigma$)



**QUESTIONS?**