

# COLIBRI

## Telescope validation

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# The « TAV » phase

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## Telescope Alone Validation

### **Goal**

- validate the telescope without instruments

### **When**

- after the telescope acceptance at Munich and commissioning at OHP
- Before mounting DDRAGUITO.

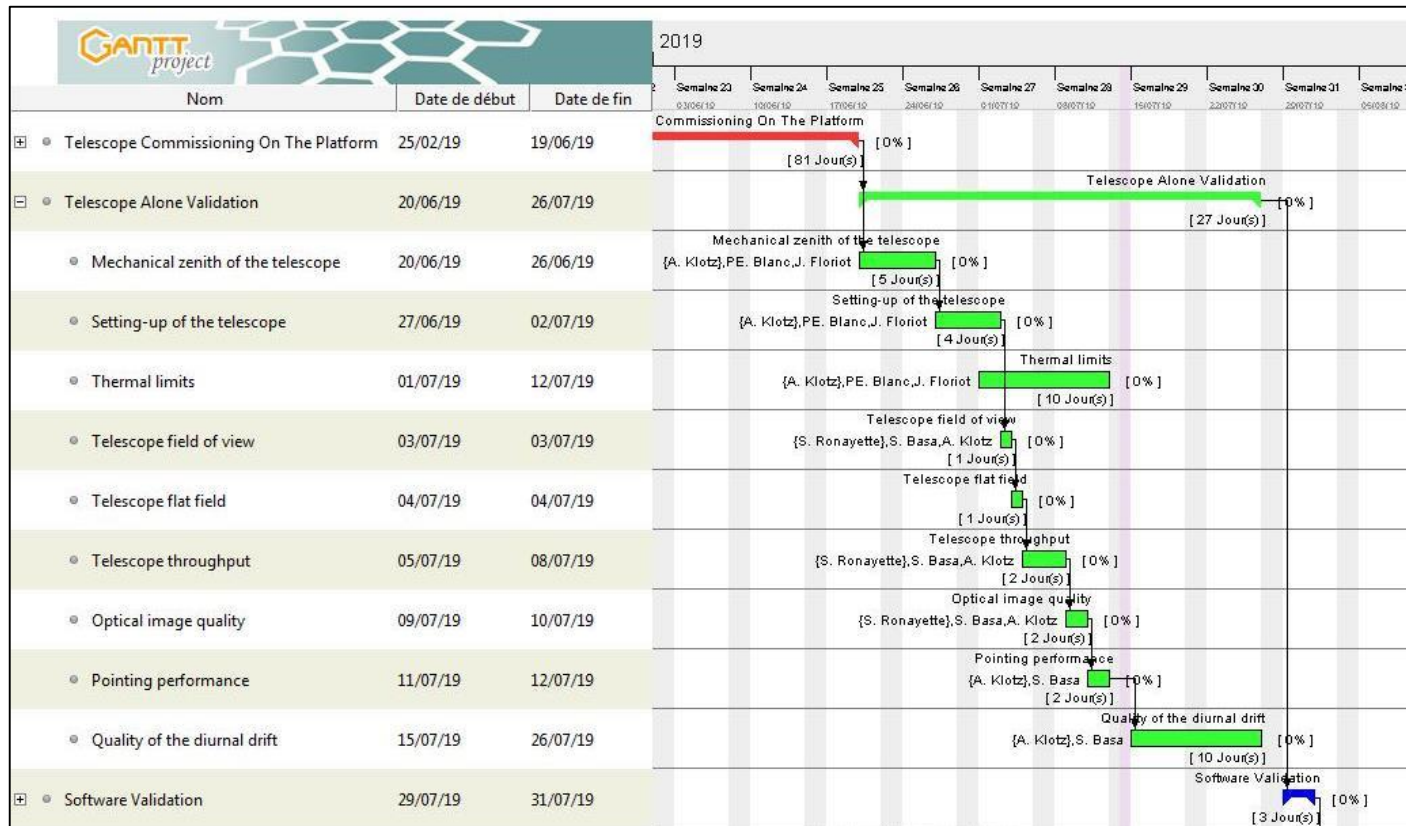
### **Where**

- at OHP: a comprehensive list of tests performed.
- at OAN: many tests to repeat, not necessarily all of them.

### **How**

- A set of dedicated tool (cameras, filters, acquisition software...).
- Detailed test procedures.
- Data analysis with:
  - astronomy software: ds9, pixinsight, sextractor
  - custom made programs: python

# Test Overview



Initial planning: ~1 month

# Test Overview

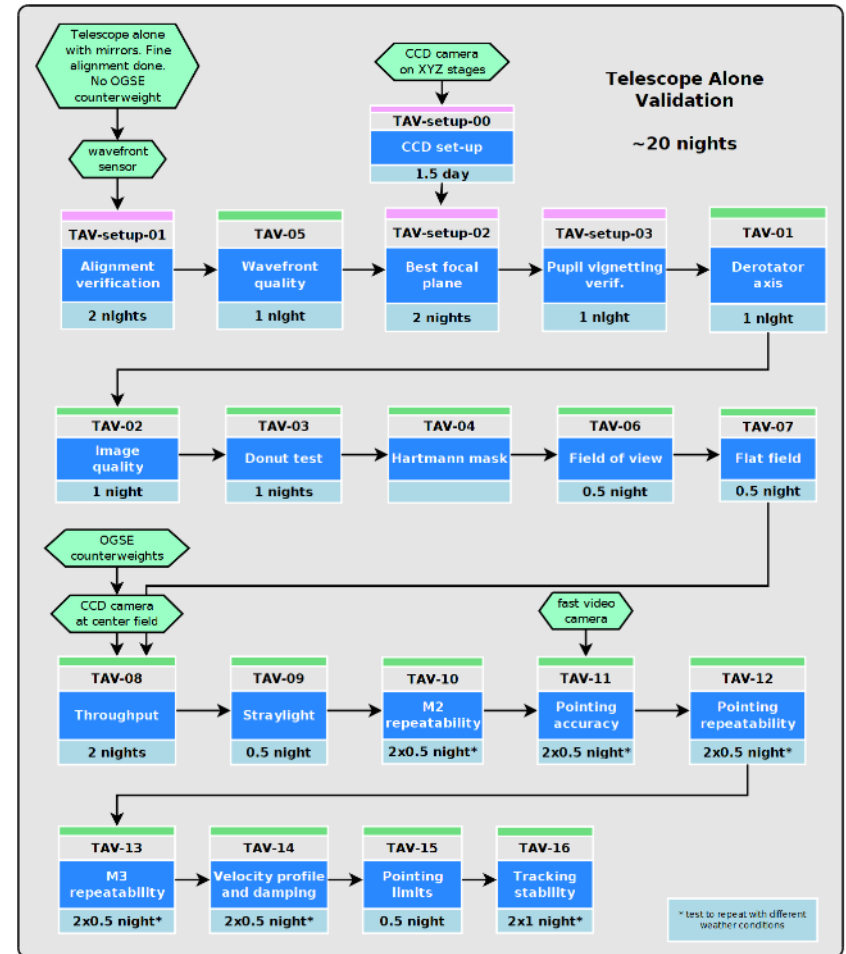


## Mechanical tests

- Pointing model accuracy
- Pointing repeatability
- Pointing speed
- Tracking stability

## Optical tests

- Image quality, field of view
- Vignetting, flat field
- Throughput



Test flowchart: 20 nights foreseen

# Verification matrix



Req. →	GFT-REQ-31	GFT-REQ-132	GFT-REQ-143	GFT-REQ-195	GFT-REQ-36	GFT-REQ-38	GFT-REQ-39	GFT-REQ-208	GFT-REQ-218	GFT-REQ-210	GFT-REQ-216	GFT-REQ-217	GFT-REQ-219	GFT-REQ-148	GFT-REQ-149	GFT-REQ-220	GFT-REQ-221	
Test ID ↓	Test name ↓	Image quality central field and off-axis	FoV size	Distortion	Vignetting	Average throughput	Scattered light level	ghost intensity	stability and resolution of M2 foc.	Absolute and differential pointing acc.	M3 rotation speed and settling time	Min an max reachable elevations	Min an max reachable azimuths	Pointing speed	Pointing acceleration	Time for obs. start after alert	time for optimal observation after pointing	Tracking accuracy over time
TAV-01	Derotator axis																	
TAV-02	Image quality	X			X													
TAV-03	Donut test	X																
TAV-04	Hartmann mask	X																
TAV-05	Wavefront quality	X																
TAV-06	Field of view		X	X	X													
TAV-07	Flat field				X													
TAV-08	Throughput					X												
TAV-09	Straylight						X	X										
TAV-10	M2 repeatability								X									
TAV-11	Pointing model accuracy									X								
TAV-12	Pointing model repeatability									X								
TAV-13	M3 repeatability									X	X							
TAV-14	Velocity profile and damping												X	X	X	X		
TAV-15	Limits of pointing										X	X						
TAV-16	Tracking stability																	X

# Progress in the test plan



optical

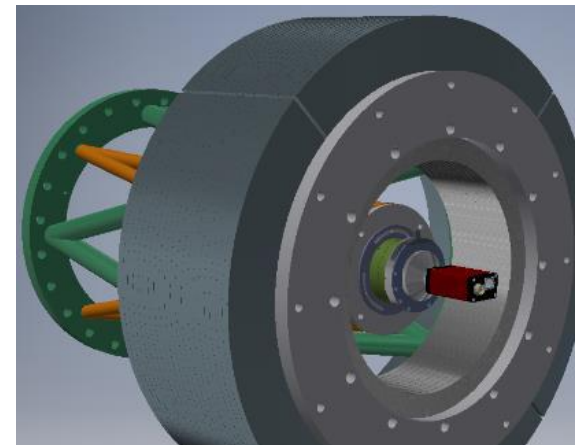
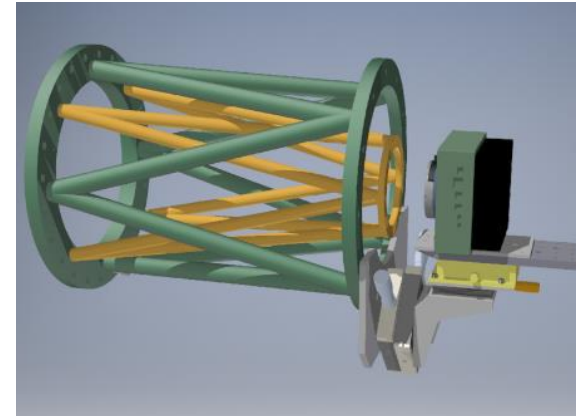
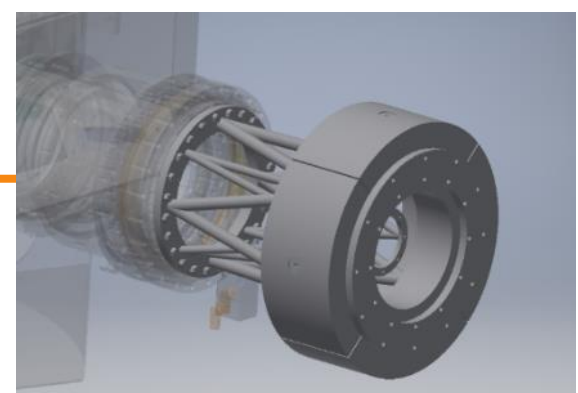
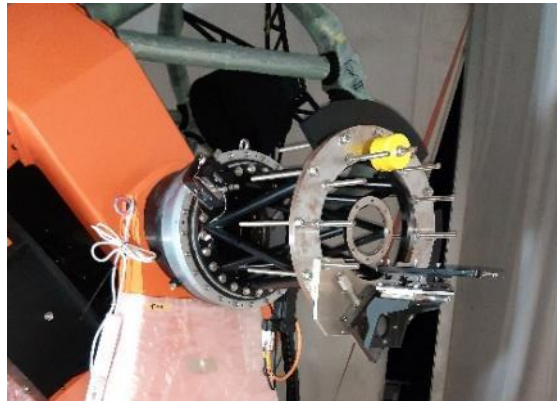
mechanical

Req. →	GFT-REQ-31	GFT-REQ-132	GFT-REQ-143	GFT-REQ-195	GFT-REQ-36	GFT-REQ-38	GFT-REQ-39	GFT-REQ-208	GFT-REQ-218	GFT-REQ-210	GFT-REQ-216	GFT-REQ-217	GFT-REQ-219	GFT-REQ-148	GFT-REQ-149	GFT-REQ-220	GFT-REQ-221	
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<del>TAV-01</del>	<del>Derotator axis</del>																	
TAV-02	Image quality	X			X													
TAV-03	Donut test	X																
<del>TAV-04</del>	<del>Hartmann mask</del>	X																
TAV-05	Wavefront quality	X																
TAV-06	Field of view		X	X	X													
TAV-07	Flat field				X													
TAV-08	Throughput					X												
TAV-09	Straylight						X	X										
TAV-10	M2 repeatability								X									
TAV-11	Pointing model accuracy									X								
TAV-12	Pointing model repeatability									X								
TAV-13	M3 repeatability									X	X							
TAV-14	Velocity profile and damping												X	X	X	X		
TAV-15	Limits of pointing											X	X					
TAV-16	Tracking stability																	X

Done  
 Partially done  
 To do  
 dropped

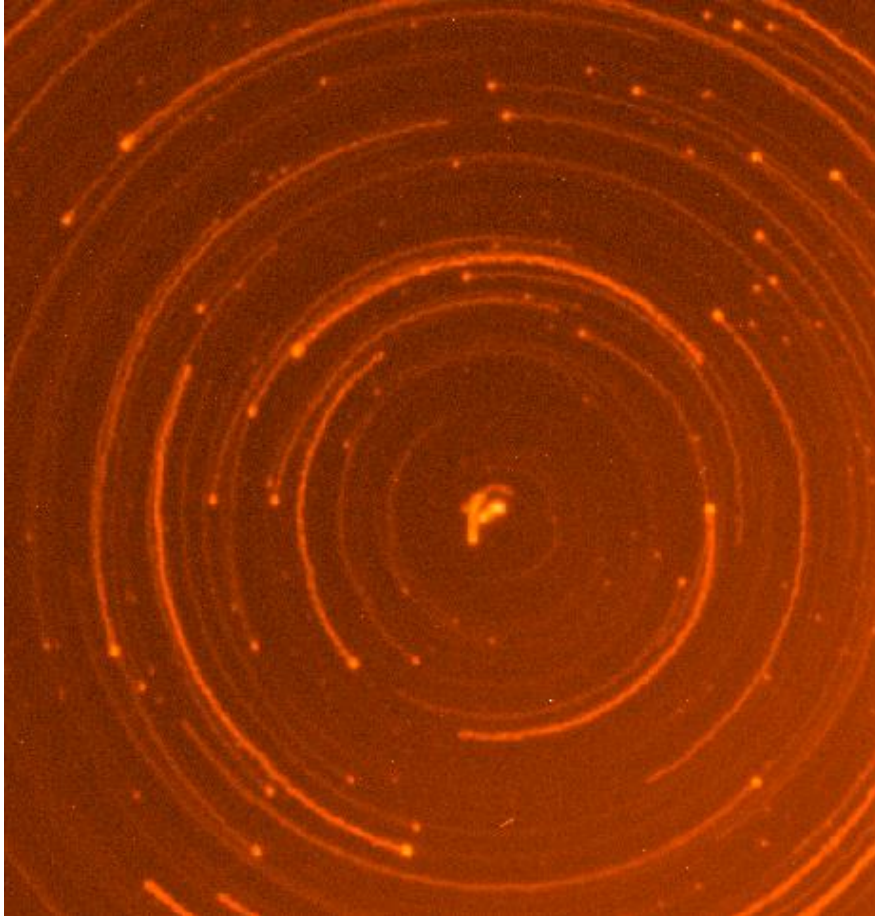
# The test equipment (OGSE)

- The **OGSE structure**: a mechanical I/F between the derotator and the cameras.
- **Weights** to mimic the instrument load, with center of mass at the correct position
- **FLI CCD camera** for wide field imaging + translation stages
- Set of RGBL filters
- **Manta video camera** for high acquisition rate



# Identifying the derotator axis

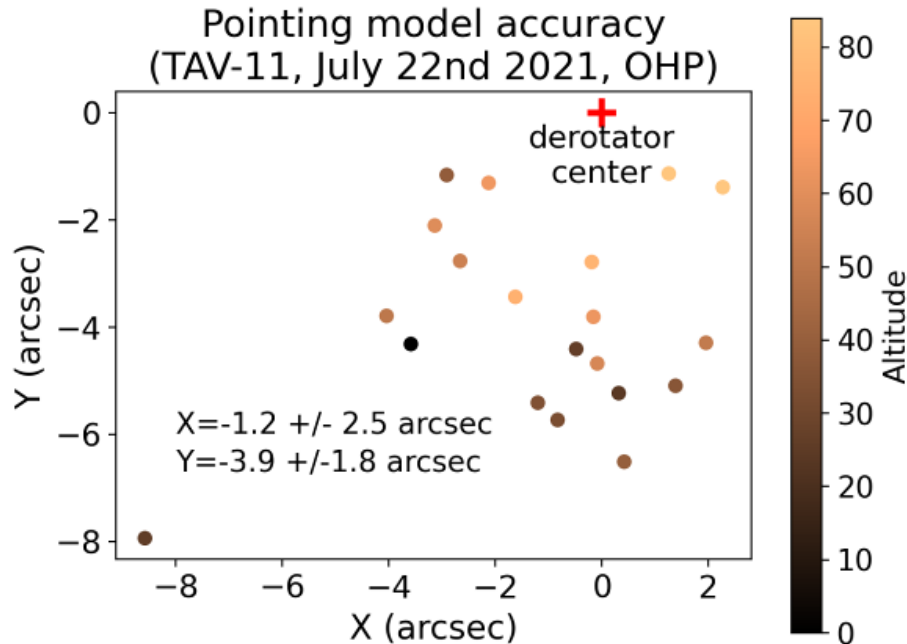
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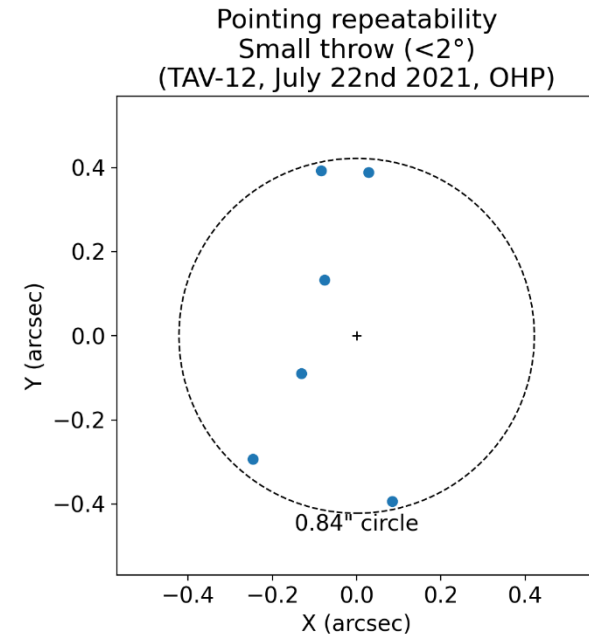
“Manually” turning the derotator during 30 seconds exposure



# Pointing accuracy



Satisfactory dispersion ( $< 2.5''$ ), but unexpected offset  
-> need to learn how to do a better pointing model  
-> to redo after proper telescope alignment

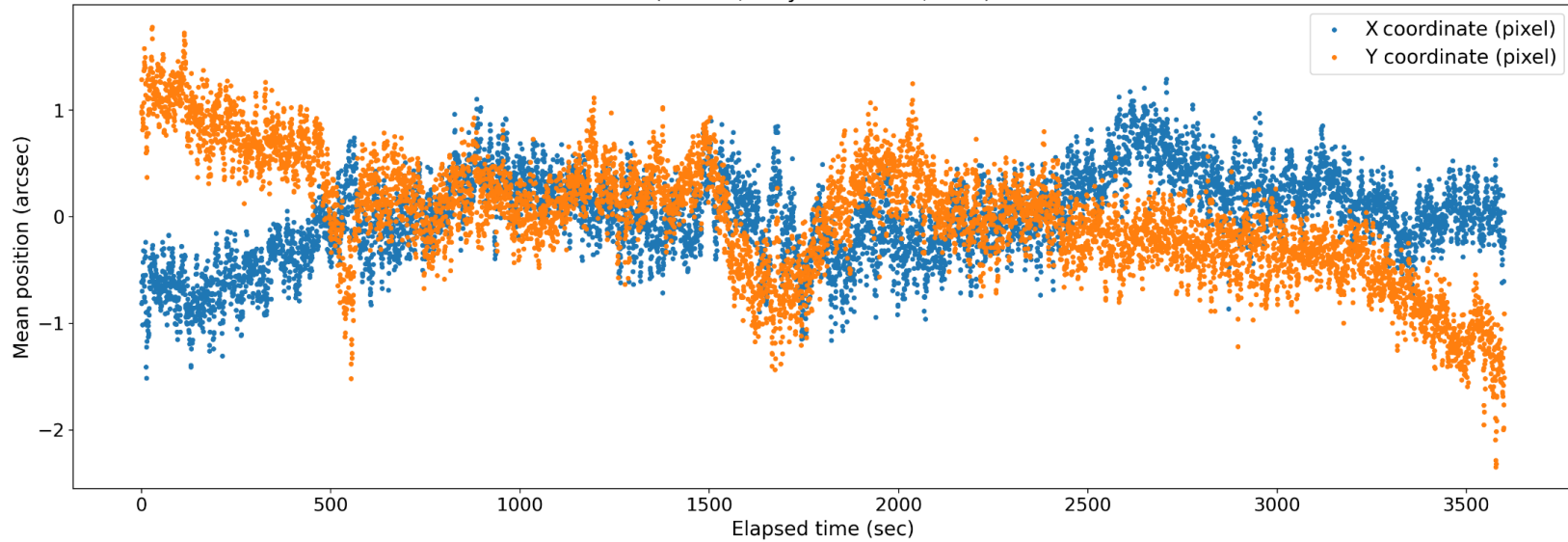


Very good pointing repeatability

# Tracking stability

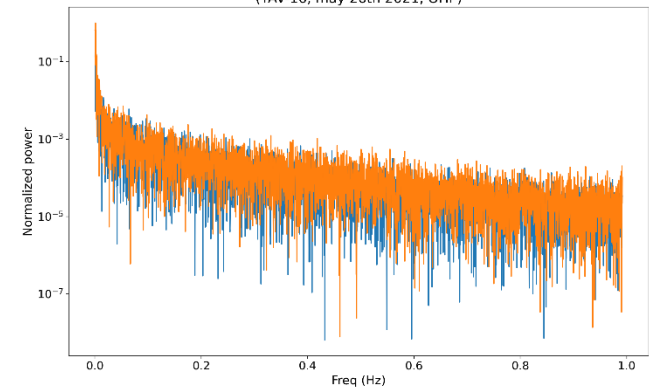


Tracking on Lyrae star (mag 8.85)  
(TAV-16, may 26th 2021, OHP)



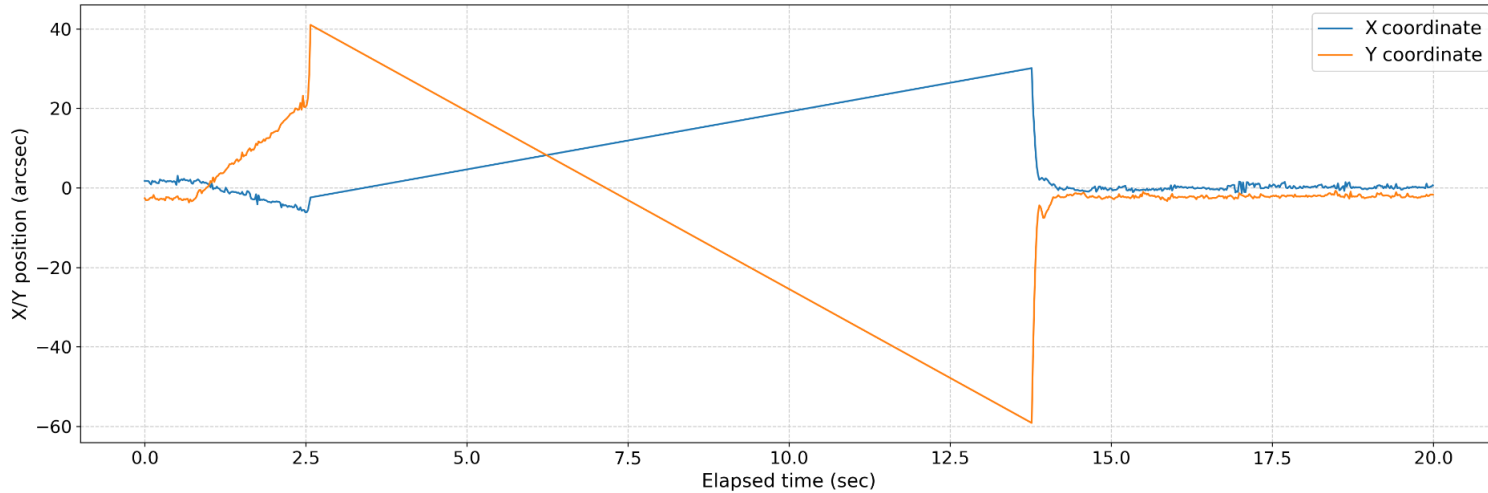
## Tracking over 1h

Tracking on Lyrae star (mag 8.85). Power Spectrum  
(TAV-16, may 26th 2021, OHP)

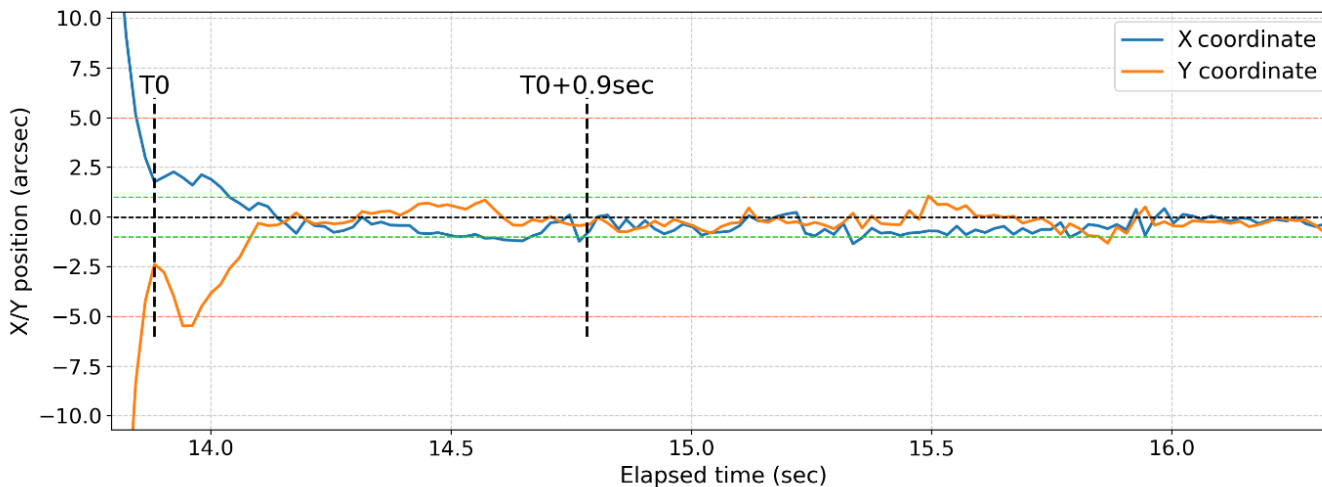


Power  
spectrum

# Pointing speed and damping



$\Delta az = 190^\circ$ , in 11.5sec  
→ 16.5°/sec average



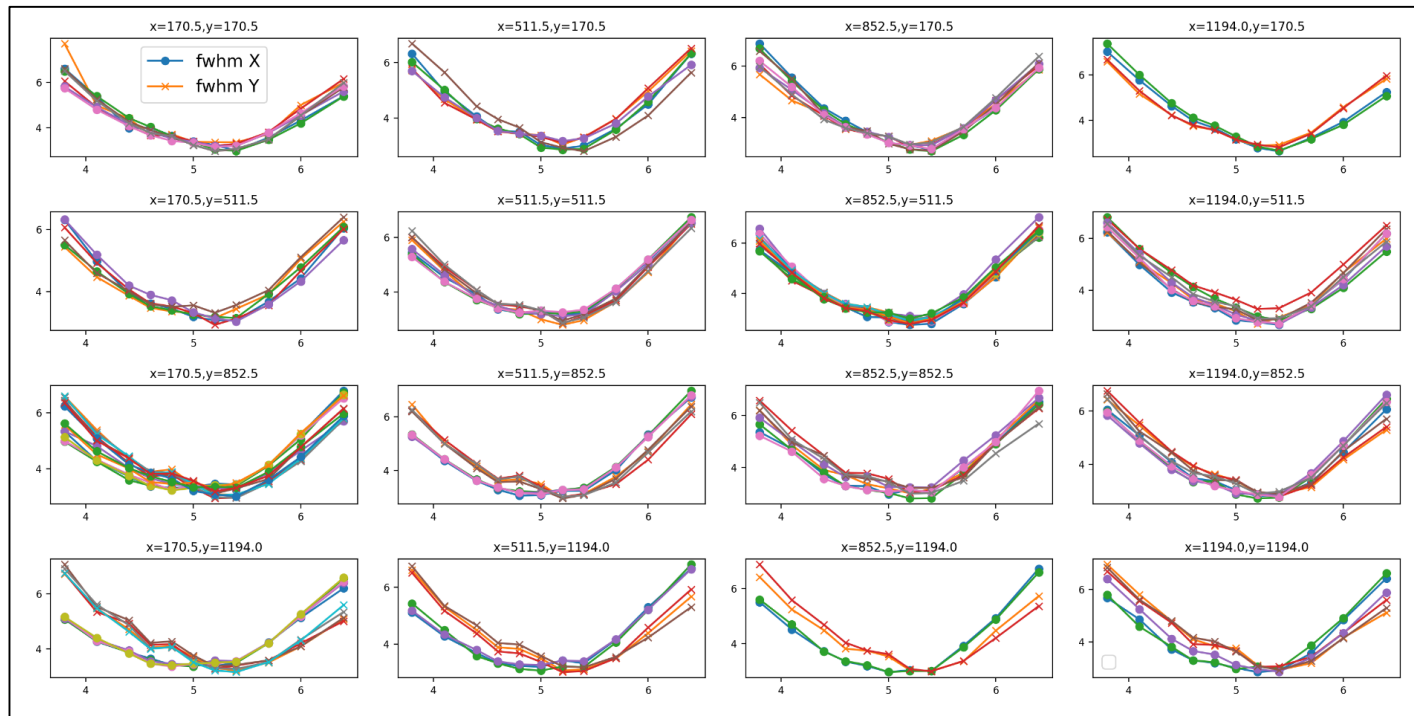
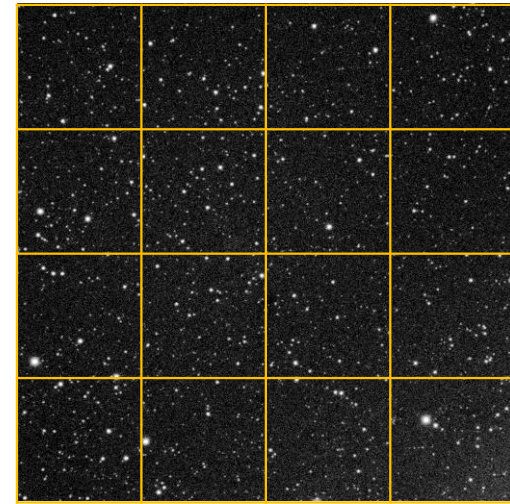
Good damping  
performance (<1 sec)

# Focus test

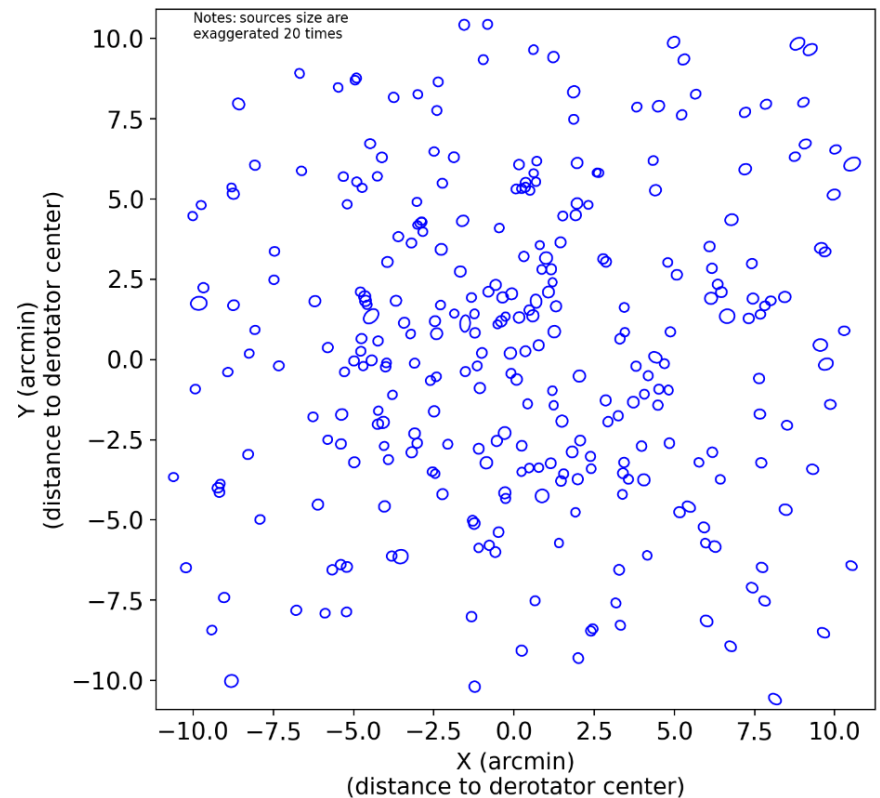
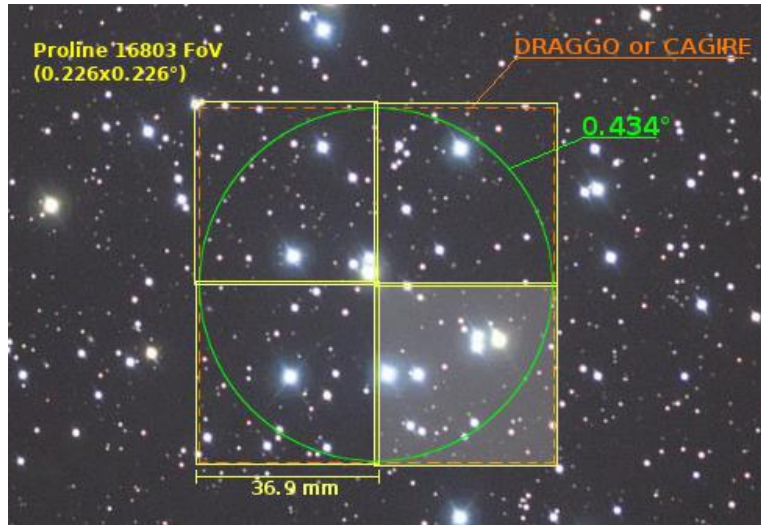
- Images of random stars extracted in 4x4 zones across FoV.
- FWHMs measured in X and Y

→ Astigmatism

→ Test to be repeated after finer alignment

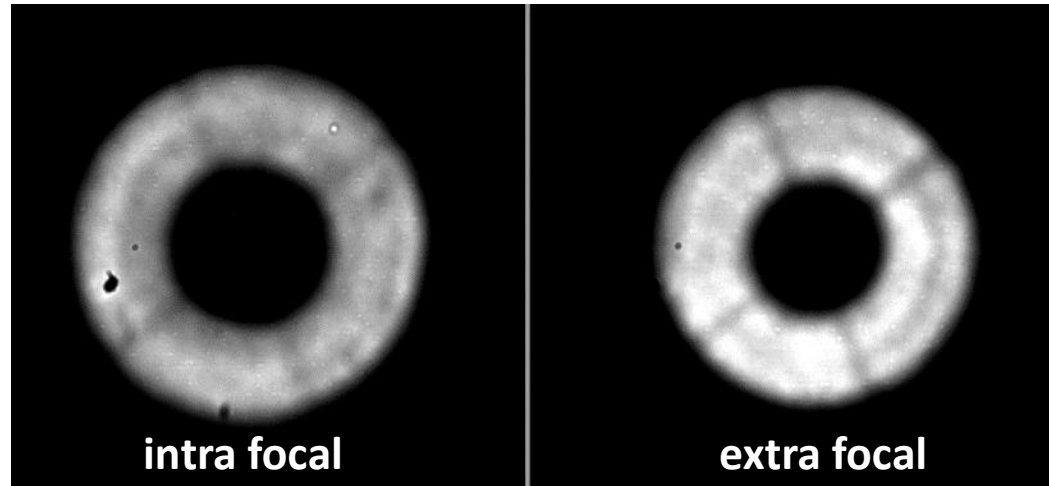


# Over large FoV...



- FLI field: 13.5' x 13.5'
- Full Colibri FoV covered by 2x2 FLI fields
  - Elongated star images off-axis
  - Non-symmetrical pattern

# Roddier test



- Many Roddier tests performed, at various elevation
  - $\lambda/(7.6 \pm 1)$  RMS at 500nm
  - Without coma and sphere 3:  $\lambda/(14.7 \pm 0.8)$  RMS at 500nm
- room for improvement with better alignment

# Conclusion

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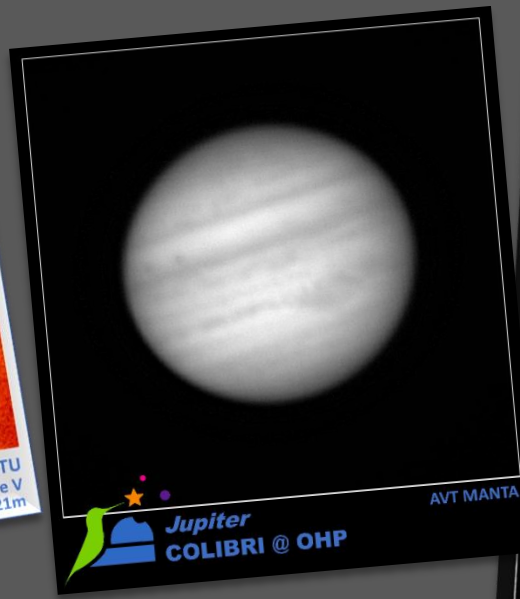


- 42 entries in elog, about 20 nights done so far
- The telescope is good, but alignment is complicated.
- Telescope alignment being revised by Astelco
  - Many optical quality tests done... but to be repeated
- Delays in the building at OAN
  - time to do more tests.



08/05/2021 21:32TU  
SBIG ST-8300 + Filtre V  
21m

 **M51**  
**COLIBRI @ OHP**



AVT MANTA

 **Jupiter**  
**COLIBRI @ OHP**



 Colibri @ OHP

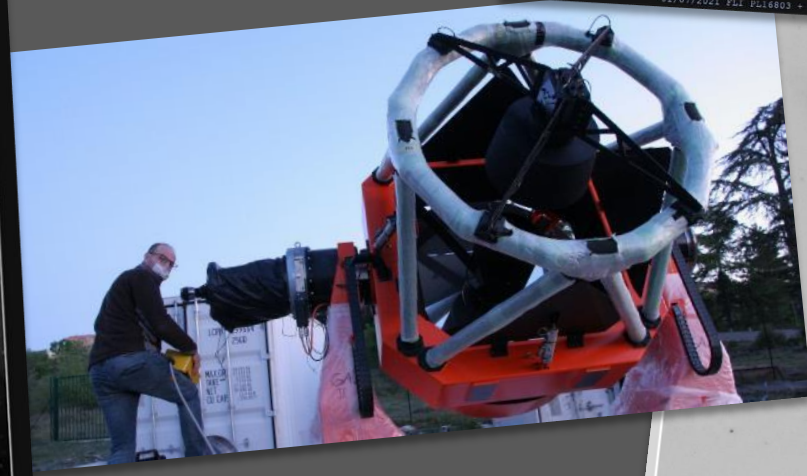
*Galaxie du feu d'artifice*  
**(NGC 6946)**

01/07/2021 FLI PL16803 + filtre L 12 x 3 min (Benjamin Schneider, Samuel Ronayette)



16/06/2021  
FLI PL16803 + filtre V  
8 x 3 min

 **M17**  
**Colibri @ OHP**



SVOM-COLIBRI Workshop, 8-11 Nov. 2021, OHP



 **NGC 4565**  
**COLIBRI @ OHP**

10/10/2021 23h40TU  
FLI PL 16803  
10 min