



ATLAS-TEIDE: THE NEXT GENERATION OF ATLAS UNITS FOR THE TEIDE OBSERVATORY



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Need for a new ATLAS design

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Telescopio ATLAS en el Observatorio del Teide - EQC2021-007122-P (Funding: **890.000 €**)

P. I.: Javier Licandro

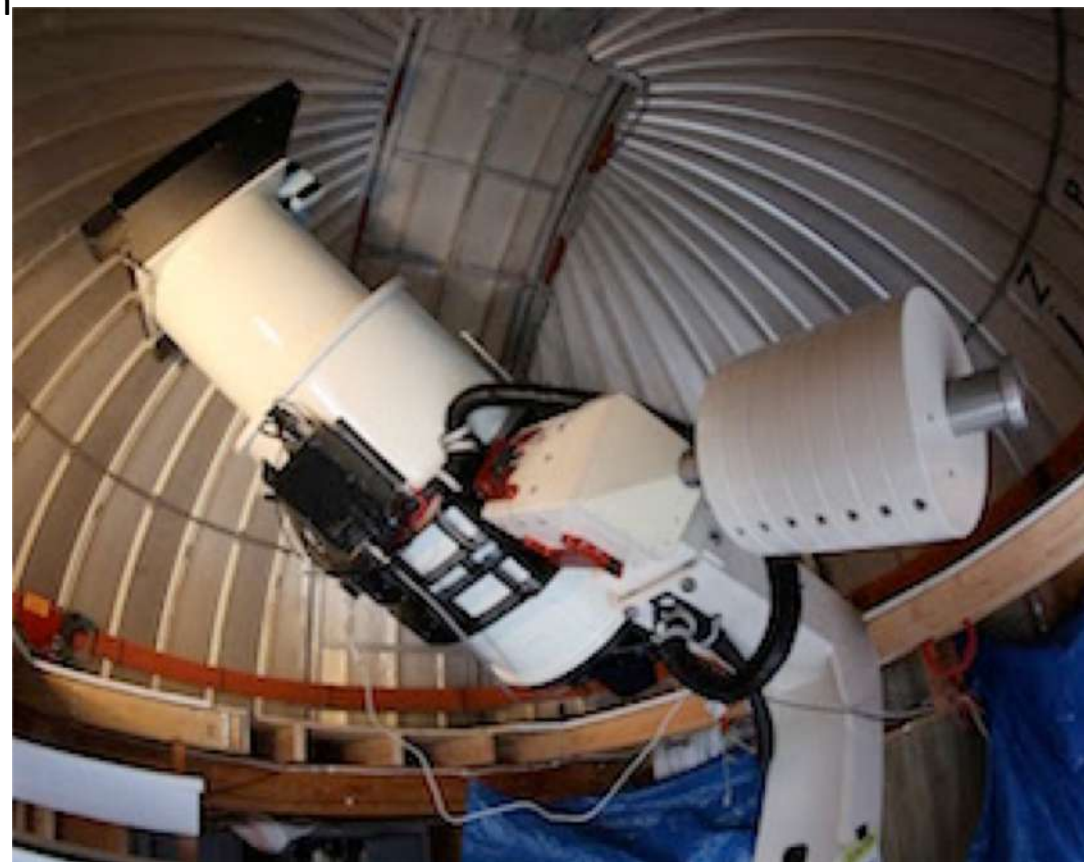
Operation and Science operation agreement of ATLAS-Teide between the IAC & the Institute for Astronomy (U. of Hawaii)

ATLAS uses **50cm f/D= 2.0 Wright Schmidt telescopes**

50cm OTAs are not anymore accessible

- > 30% price increase
- Not available in < 2yr

It forced us to look for an alternative design



ATLAS modules based on COTS :

- Optics: 4 x RASA11 OTAs.
- Cameras: QHY600PRO back-illuminated CMOS
- Mounts: improved Planewave L-500 (L-550 version)

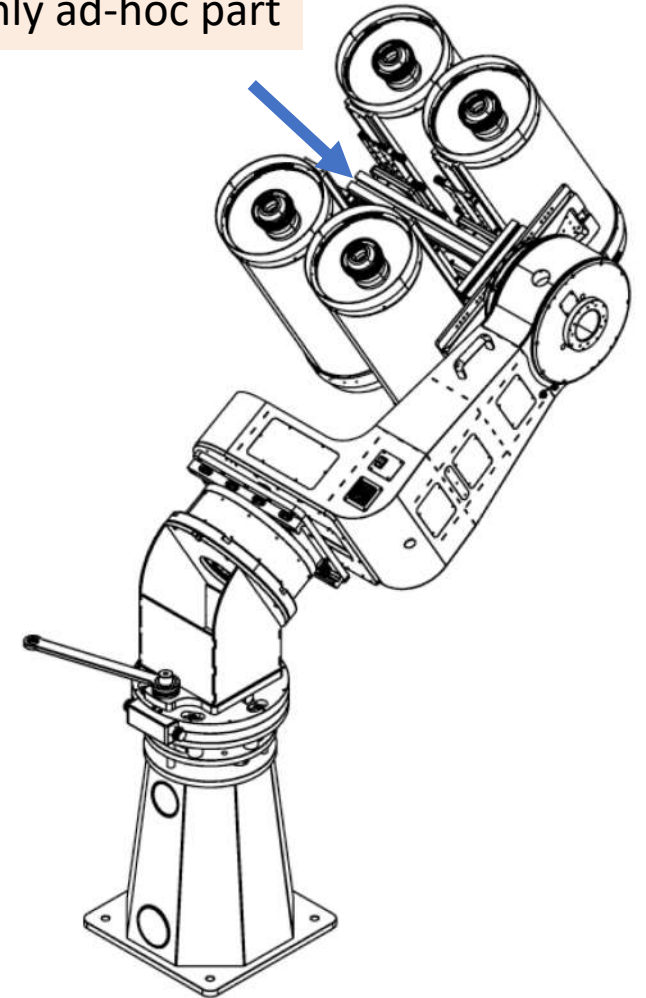
4 RASA 11 mounted on a Planewave L-550, aligned to observe the same field

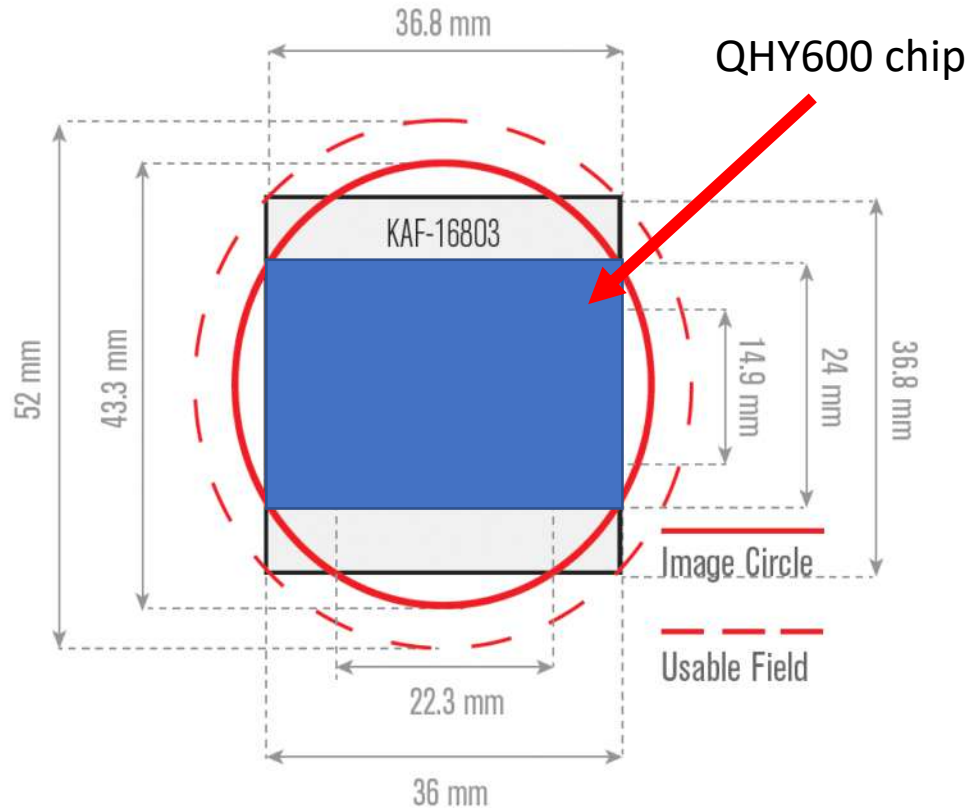
- Effective aperture combining the 4 images = 56cm
- Field of view $\sim 7,35 \text{ deg}^2$ (1,26 arcsec/pix)
- $V = 19.5$

With **4 ATLAS modules** we can cover the **same field of view of the actual ATLAS telescopes**, with similar sensitivity allowing to cover $\frac{1}{4}$ of the night sky 4 times / night

Cheaper, easier to install and maintain and allow more observing modes.

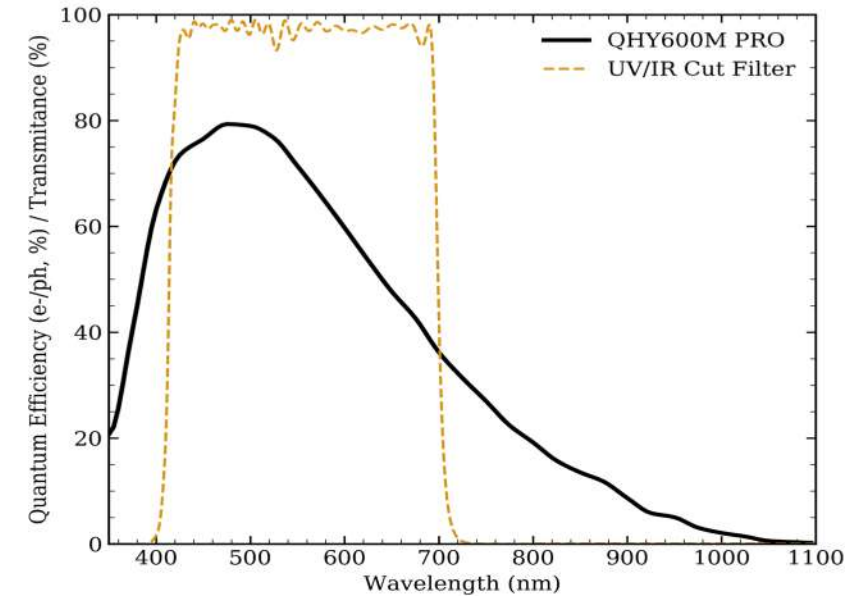
Support of 4 RASA11
is the only ad-hoc part





Sensor: Sony IMX455
 Sensor size: 9576 x 6388 px
 Pixel size: 3.76 x 3.76 px
 Read-out time: 0.15 ms

Mode #1 (High Gain 16-bits)
Gain Mode: 0
 Gain: 0.7930 +/- 0.0011 e-/ADU
 RON: 3.334 e-
 DC@-10°C: 0.002417 +/- 0.000004 e/px/s
 FWC: 51845 ke-



RASA 11 focal plane & QHY600

QHY600PRO
 Real 16bit, back-illuminated 9x6K CMOS camera
 No glowing, no persistence, almost no dark current
 (see Alarcón et al. Poster, this meeting)

ATLAS-Teide: domes

We will use 2 existing buildings in the OT robotic telescope area

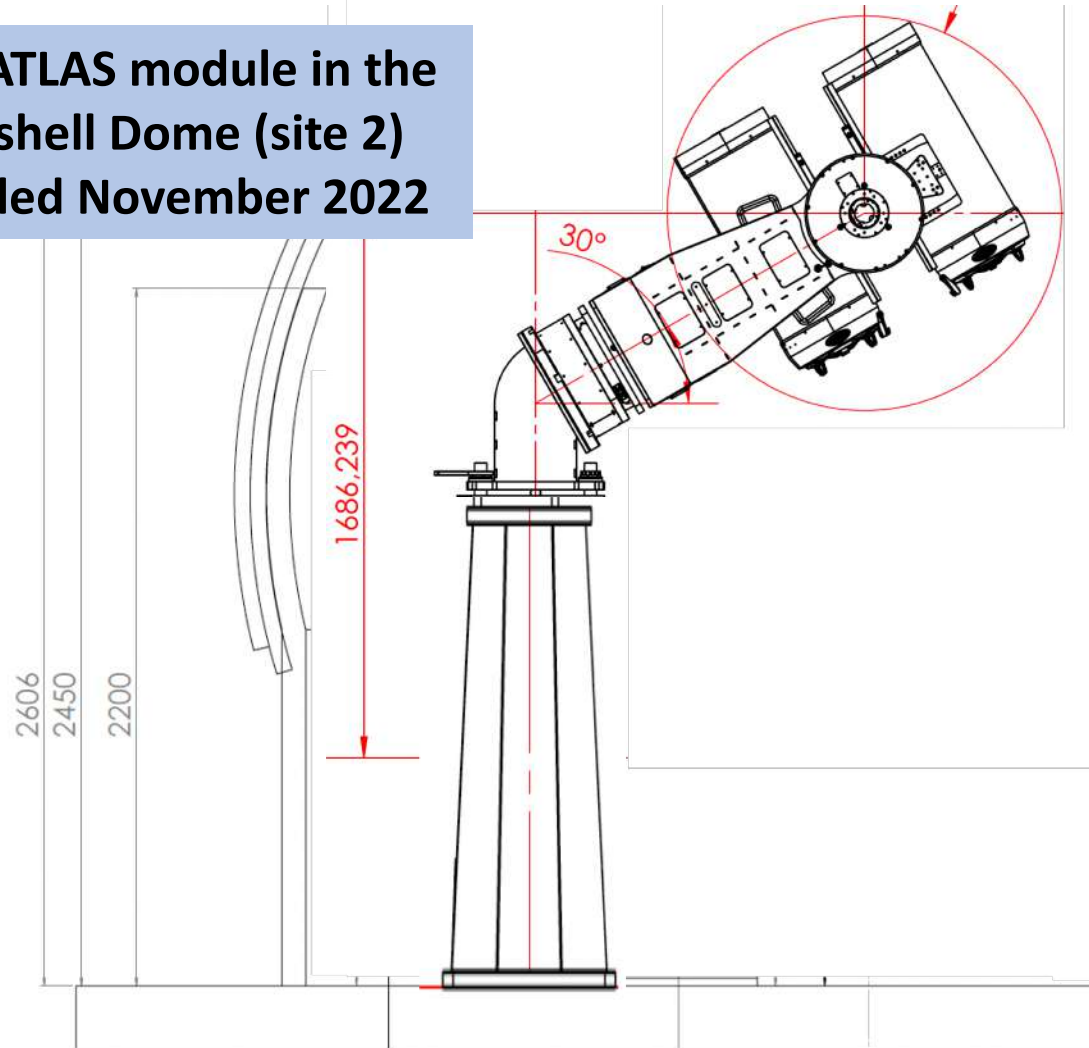


- 1- ATLAS-Teide dome
- 2- Prototype dome

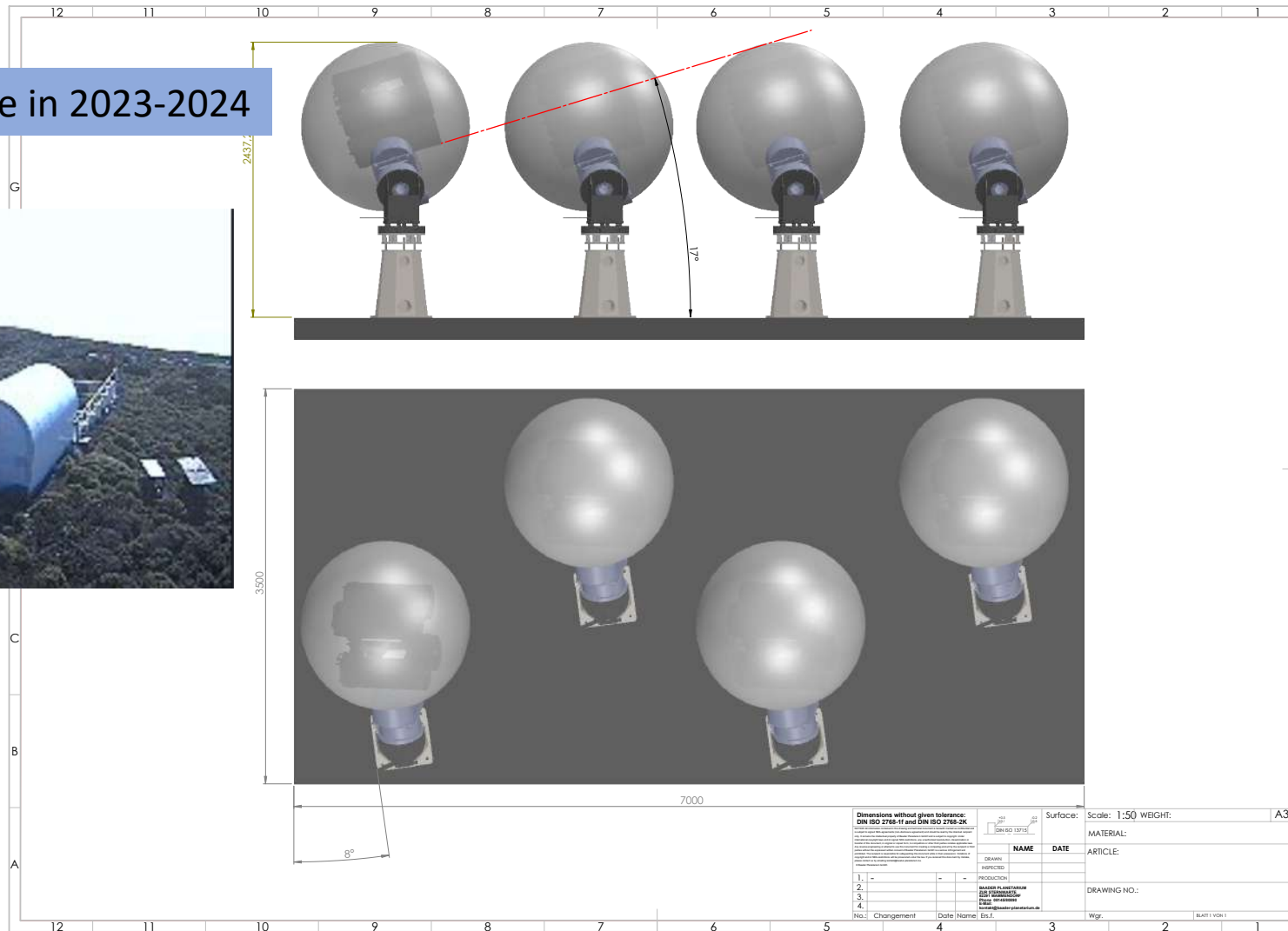


Phase 1– build the 1st ATLAS module (ATLAS-P, a prototype) to test hardware and develop software. Installed in November 2022 in Site 2.

**First ATLAS module in the Astroshell Dome (site 2)
Installed November 2022**



ATLAS-Teide in 2023-2024



4 ATLAS modules covering ~ 30 deg²

In a roll-off building (Site 1)

Minimum observing altitude 20 deg.

Telescope effective aperture and field similar to actual ATLAS ones.

Phase 2 – building of the 4 modules of ATLAS-Teide and installation in the Roll-off structure, site 1 around the end of 2023. This phase time-line strongly depends on the bidding process (“Licitación”)

A 7x3.5m platform with a roll-off structure we have been operating since 2019.

ATLAS-P: commisioning

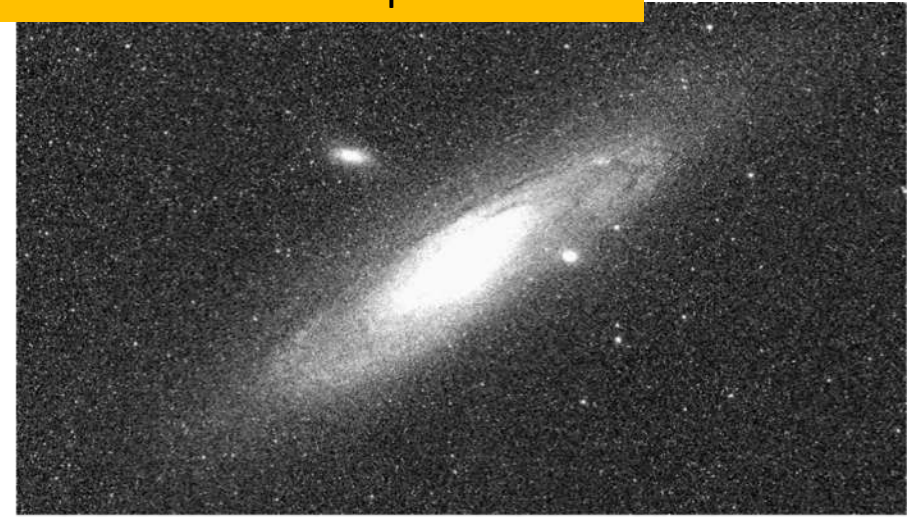
The tests done with ATLAS-P demonstrates that this design fulfil the ATLAS requirements

ATLAS-P saw its first light on November 14, 2022. Tpointing map and the first on sky-tests:

- RMS pointing 11 arcsec
- Good tracking in > 2m exposures



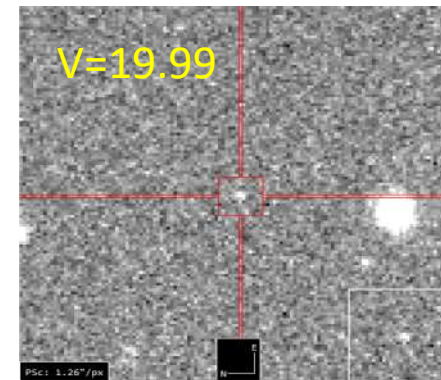
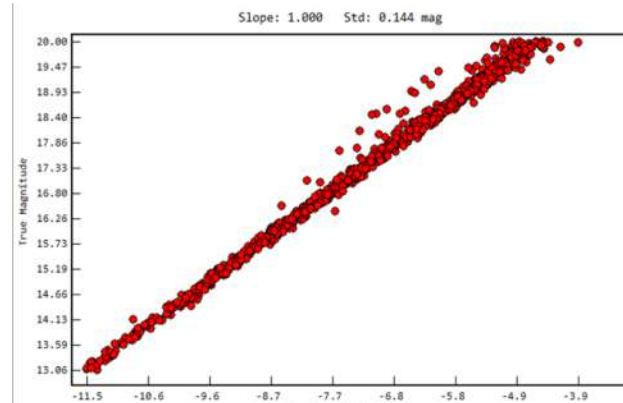
- Combined image using the 4 telescopes
- 5x6s exposure time with each RASA11
- Images aligned just with rotation and shifts
- Images were median combined w/sigma clipping only
- FWHM < 2pix



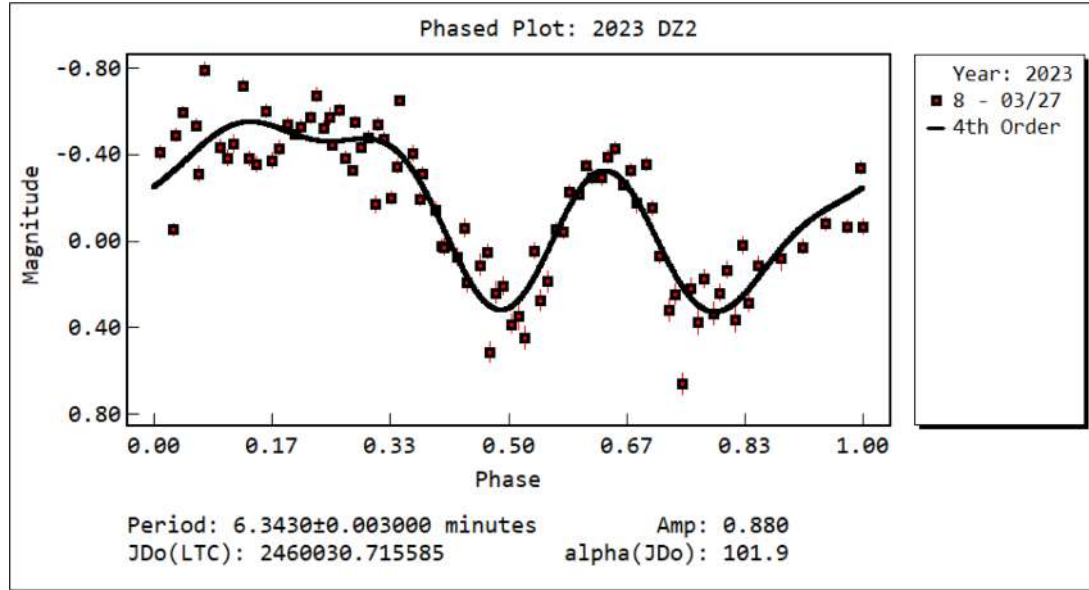
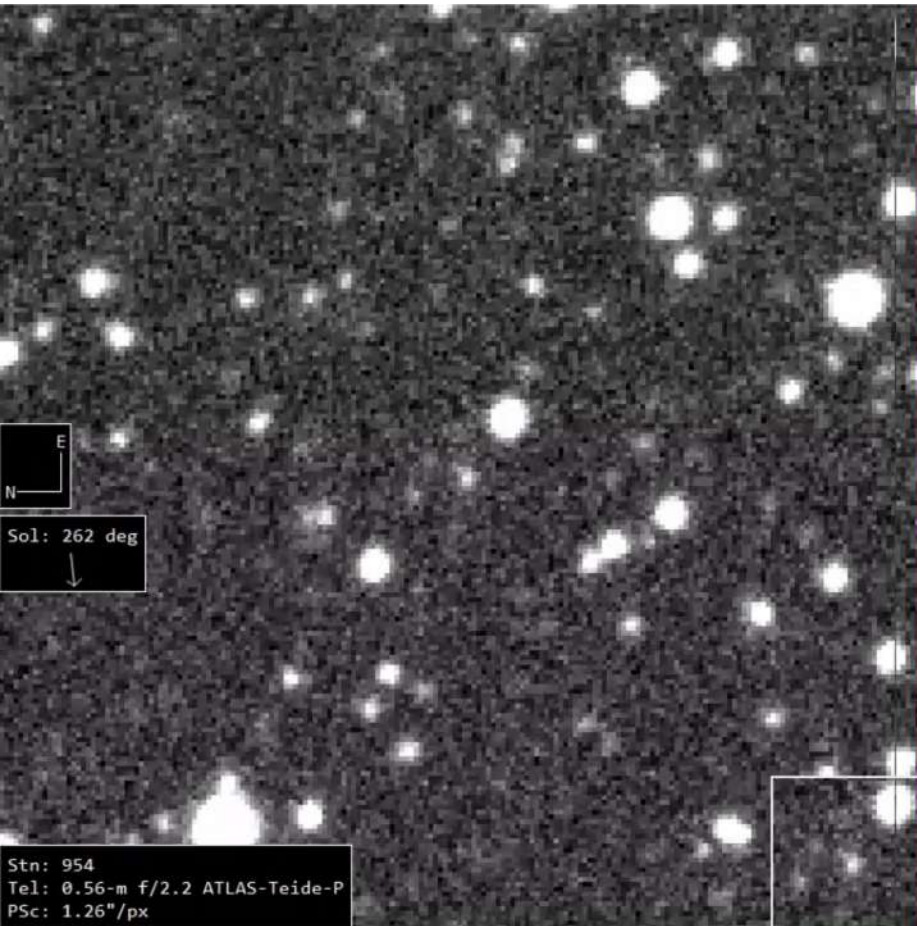
- Combined 5x6s exposures with one of the telescopes
- FWHM < 2pix – no significant field distorsion
- 4 Telescopes alignment better than 10 arcmin shift and rotation < 1 deg.

A simple analysis using Tycho Tracker demonstrate:

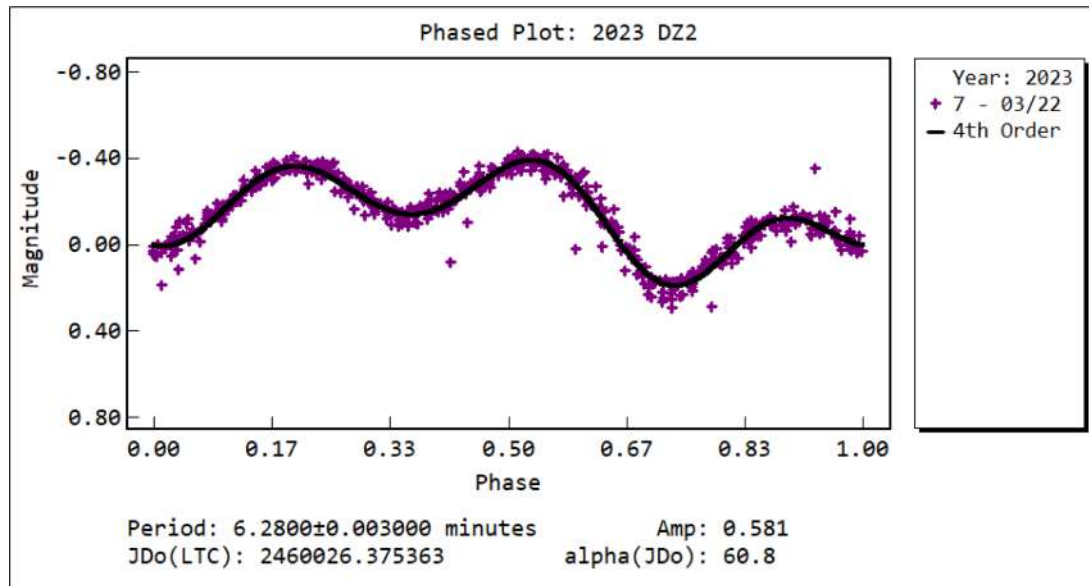
- Limiting magnitude detection > 20.0
- The Instrumental vs Calibrated magnitude plot is linear with slope = 1



Bonus track: 2023 DZ2

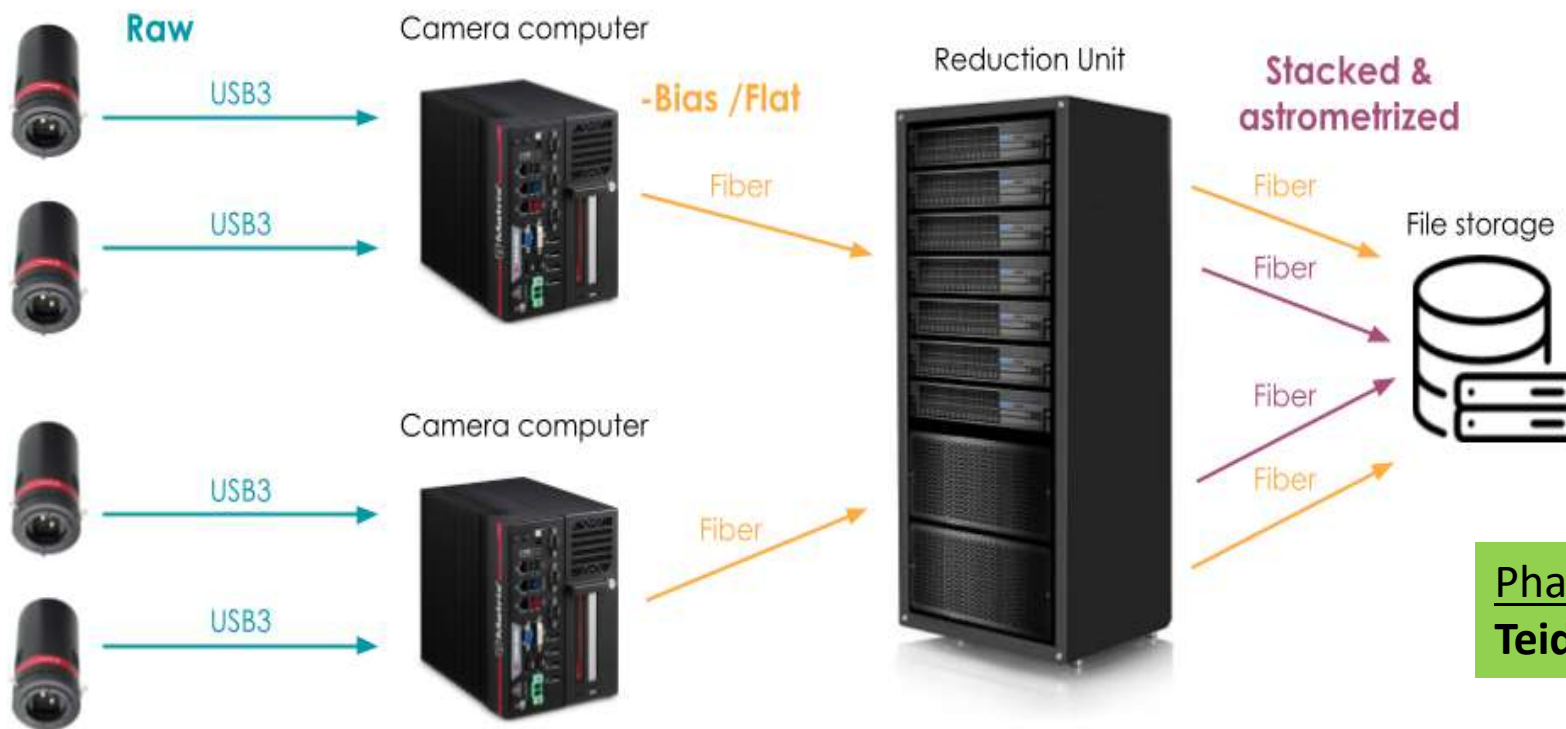


ATLAS-P
After close
encounter
2023-03-27



TTT- 80cm
Before close
encounter
2023-03-22

- The main challenge is the reduction, analysis “on the fly” and storage of a massive amount of data
- Also the maintenance of this database
- 16 cameras, 9x6K pixels each (120Mb images) every 6s is > 10 Tb/night
- Intensive use of GPUs



February we will start testing our Linux control system & reduction package

Phase 3 – complete integration of ATLAS-Teide in the ATLAS network (mid 2024)

- 1st ATLAS module (ATLAS-P) installed and 1st commissioning done – *fulfil ATLAS requirements*
- Complete the development of ATLAS-Teide software (summer 2023)
- ATLAS-Teide completed end 2023 – early 2024

Advantages of the new design:

- 1) the design is much **cheaper** than the old one, each module cost $\sim 1/10$ of the actual ATLAS units;
- 2) an observatory can have the number of modules that can fund, so **ATLAS network can easily grow**
- 3) it is **easier to build, install, maintain, and upgrade**.
- 4) the use of CMOS cameras allows to do **very short exposures** without a noticeable dead time allowing to use different strategies to detect very fast moving targets
- 5) the four modules **of ATLAS-Teide can be used in different ways**, e.g. observe all telescopes the same field, then having a system with 1.1m equivalent aperture (an detect up to $V \sim 21$ objects in 30s exposure times).

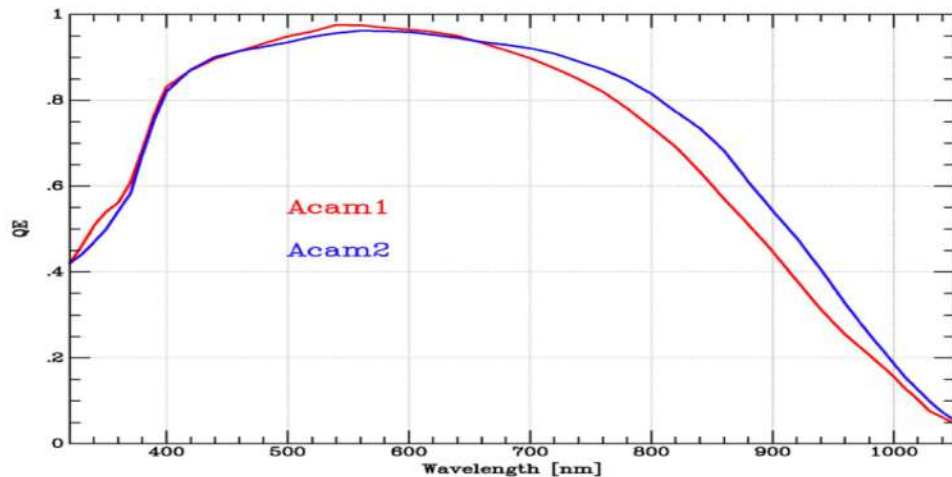
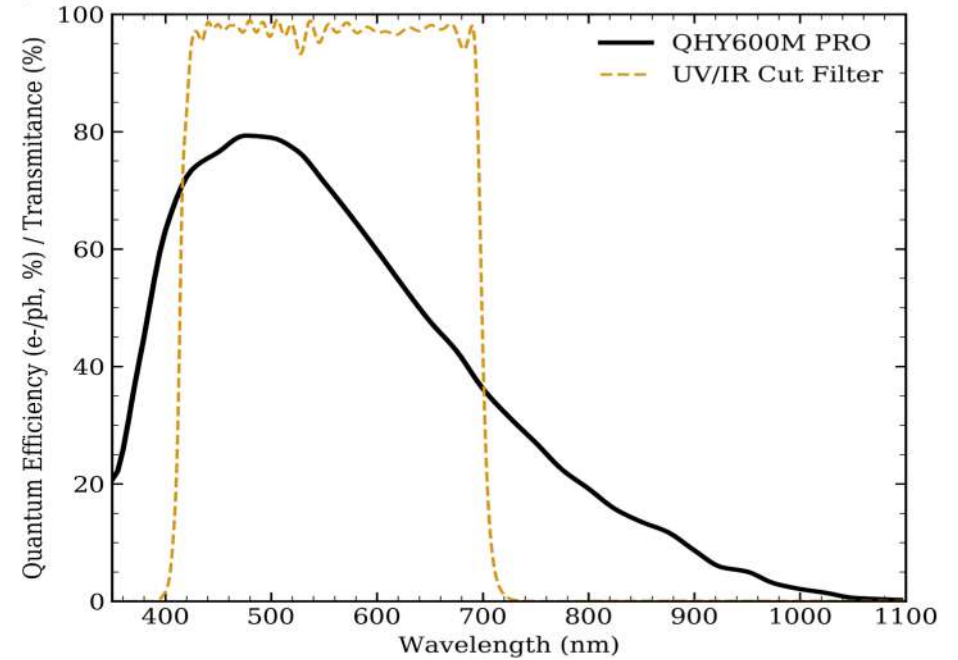
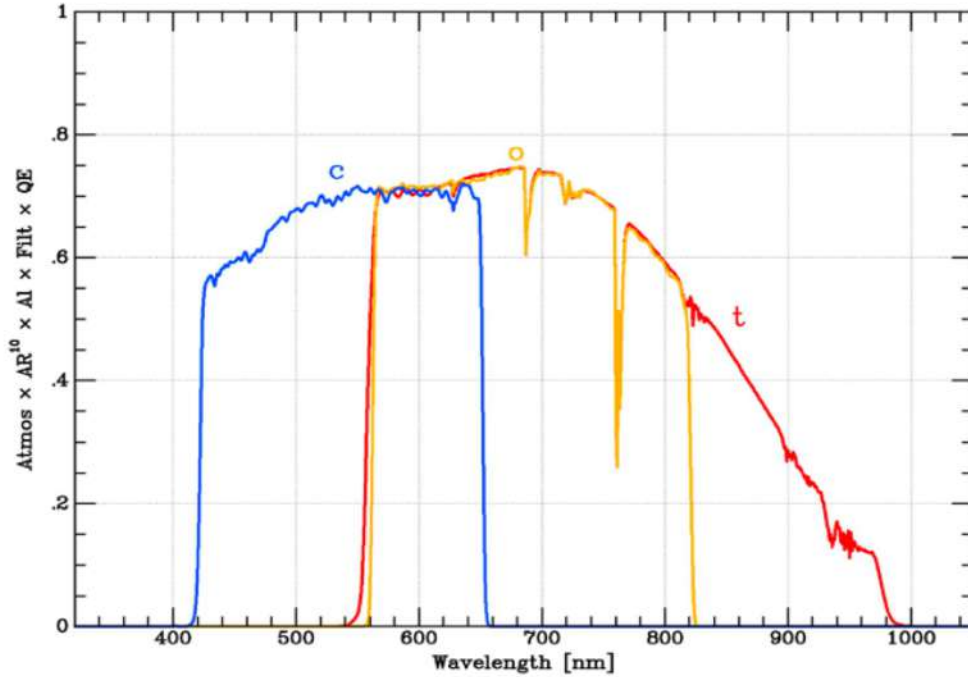
Other Benefits:

- 1) **Increase the capabilities on NEO research** of the Canary Islands Observatory
- 2) Impulse of the **role of the Teide Observatory in the SSA programs**
- 3) **Access for the Spanish community** to all ATLAS data products
- 4) Direct **comparison with Fly-Eye** (recommendation of the ESA SSA-AG)
- 5) **1st “Telescope-Array” based on COTS for NEO research in Europe**: experience in the design, operation and science exploitation of a Telescope-Array (recommendation of the ESA SSA-AG)
- 6) Experience in the NEO search, fundamental for the next cornerstone mission of the ESA SSA-PD, NEOMIR

THANK YOU!



QHY vs ACAM



QHY worst QE & narrower wl coverage than ACAM. This strongly affect the filter selection

Also no automatic filter changer

Only one filter (L ~ g+r)

300.000 vs 7500 €

ATLAS-P: commisioning

Reasonably
good image
quality even in
the border of
the images
(FWHM < 2pix)

