

# CTAO 小口径望遠鏡の量産に向けた開発状況

## Status of Mass Production of the CTAO Small-Sized Telescopes (SSTs)

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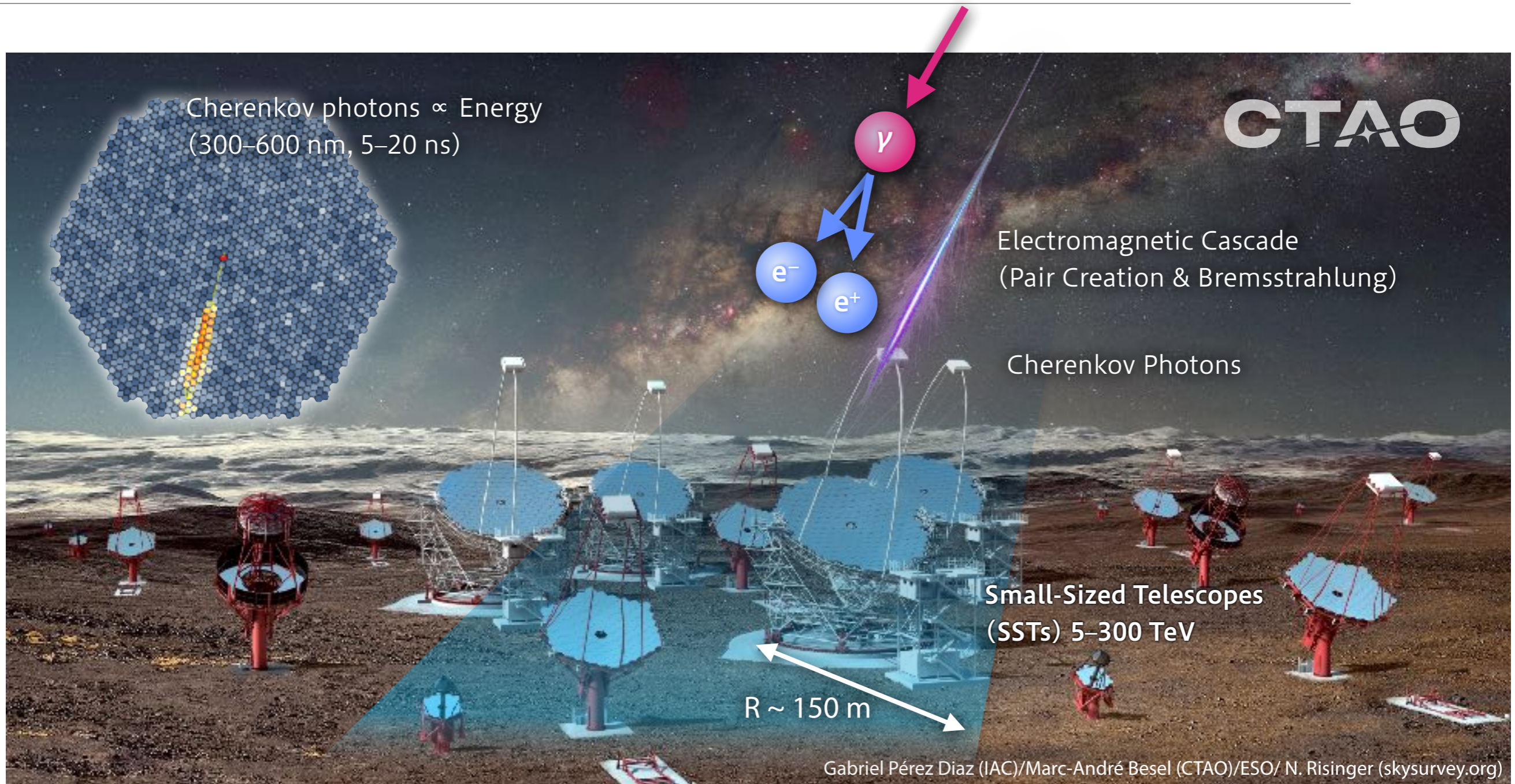
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<sup>3</sup> Nagoya University Southern Observatories  
Nagoya University

PeVatron Session @ ASJ Meeting 2026 Spring  
Mar 5, 2026

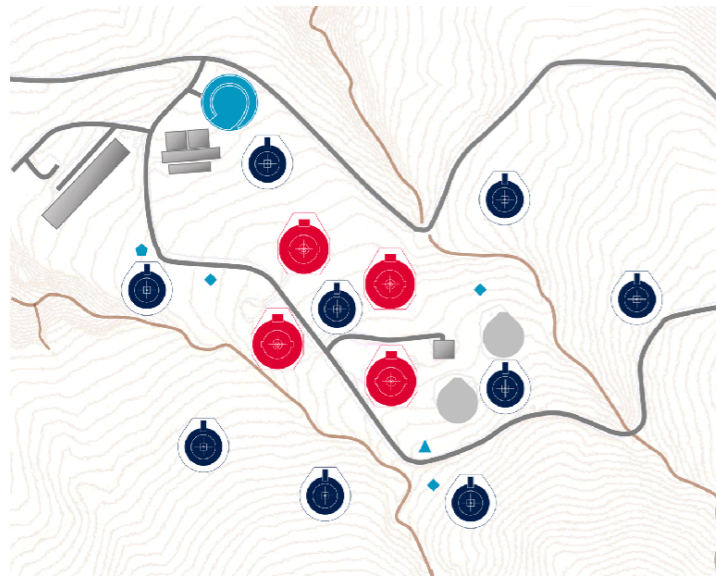
# Cherenkov Telescope Array Observatory (CTAO)



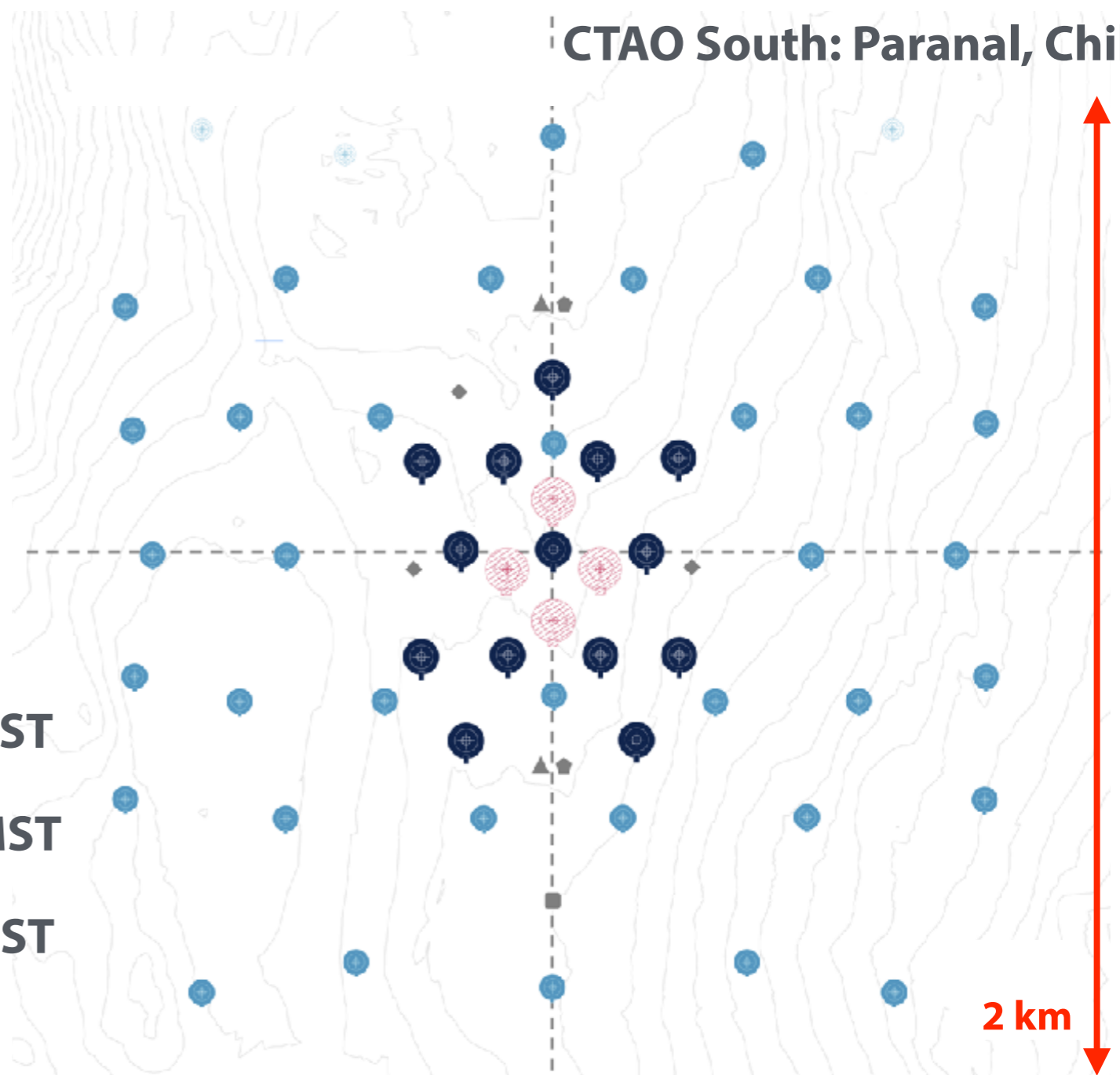
- Very-high-energy gamma rays generate electromagnetic cascades and Cherenkov emission in the atmosphere
- CTAO will observe the 20 GeV–300 TeV gamma-ray sky with  $\sim 100$  telescopes of three designs
- The energies and arrival directions are reconstructed from 2D-projected Cherenkov angles
- The highest-energy band, 5–300 TeV, is covered by **Small-Sized Telescopes (SSTs)**

# CTAO Northern & Southern Sites (Initial Configuration)

## CTAO North: La Palma, Spain

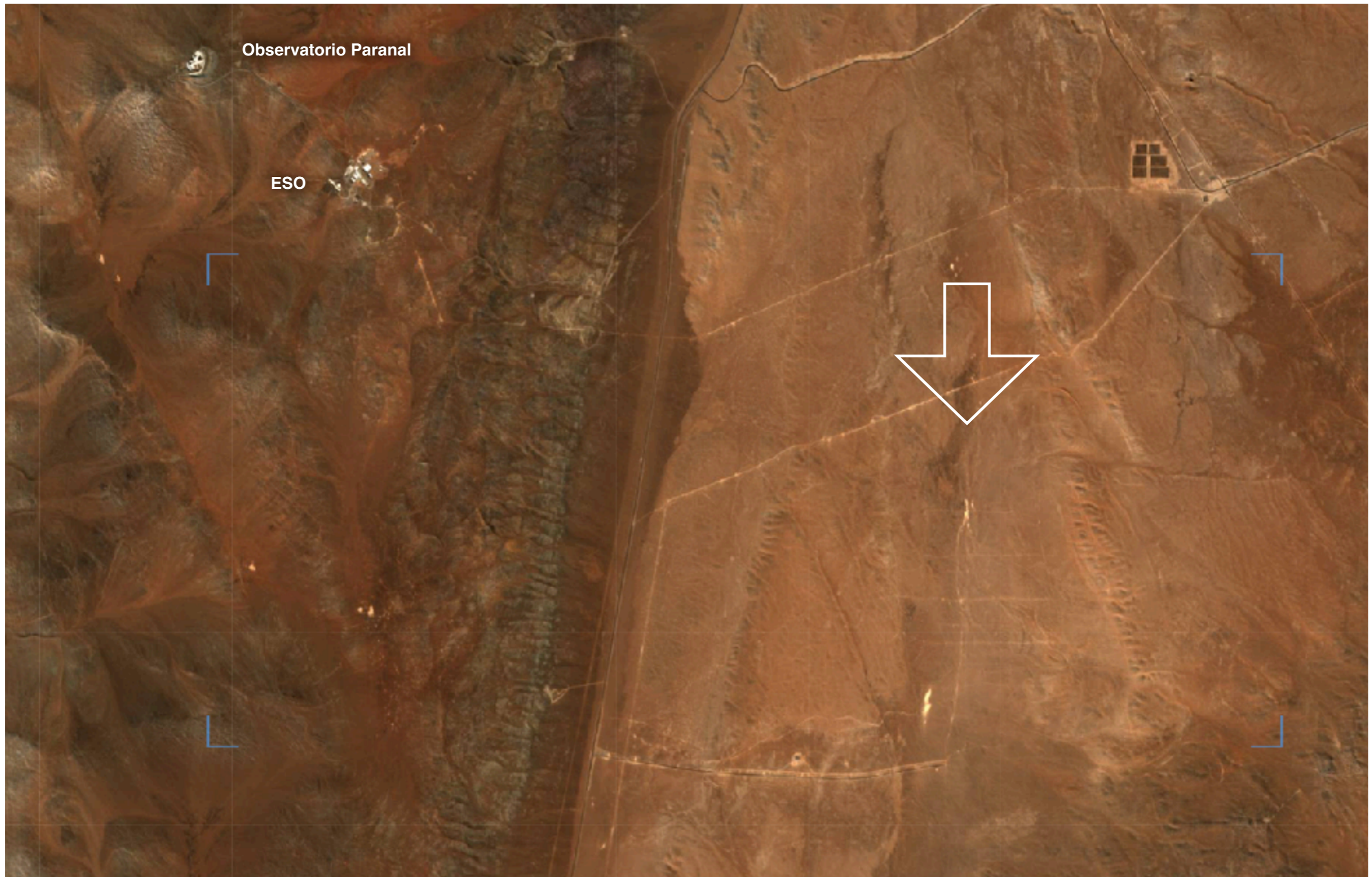


## CTAO South: Paranal, Chile



- Wide energy coverage of 20 GeV–300 TeV with three telescope sizes
- Spread over a few km<sup>2</sup> area to catch Cherenkov photons anywhere in the circle
- Construction phase to start with 4 LSTs + 9 MSTs (north) and 14 MSTs + 37 SSTs (south)

# CTAO South in Paranal Chile (Jul 5, 2025)



# CTAO South in Paranal Chile (Jul 29, 2025)



# CTAO South in Paranal Chile (Sep 22, 2025)



# CTAO South in Paranal Chile (Oct 12, 2025)



# CTAO South in Paranal Chile (Nov 21, 2025)

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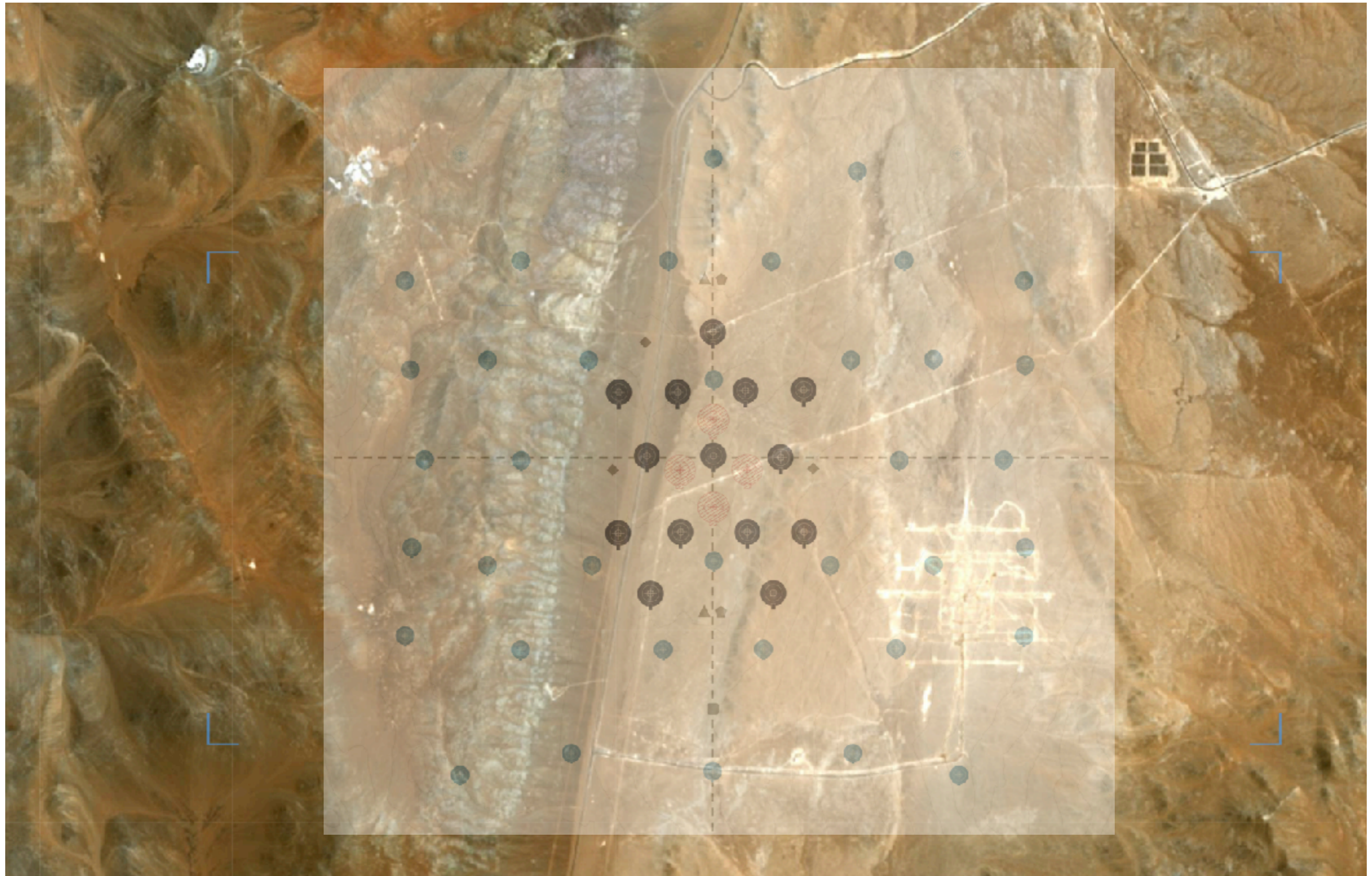


# CTAO South in Paranal Chile (Dec 31, 2025)

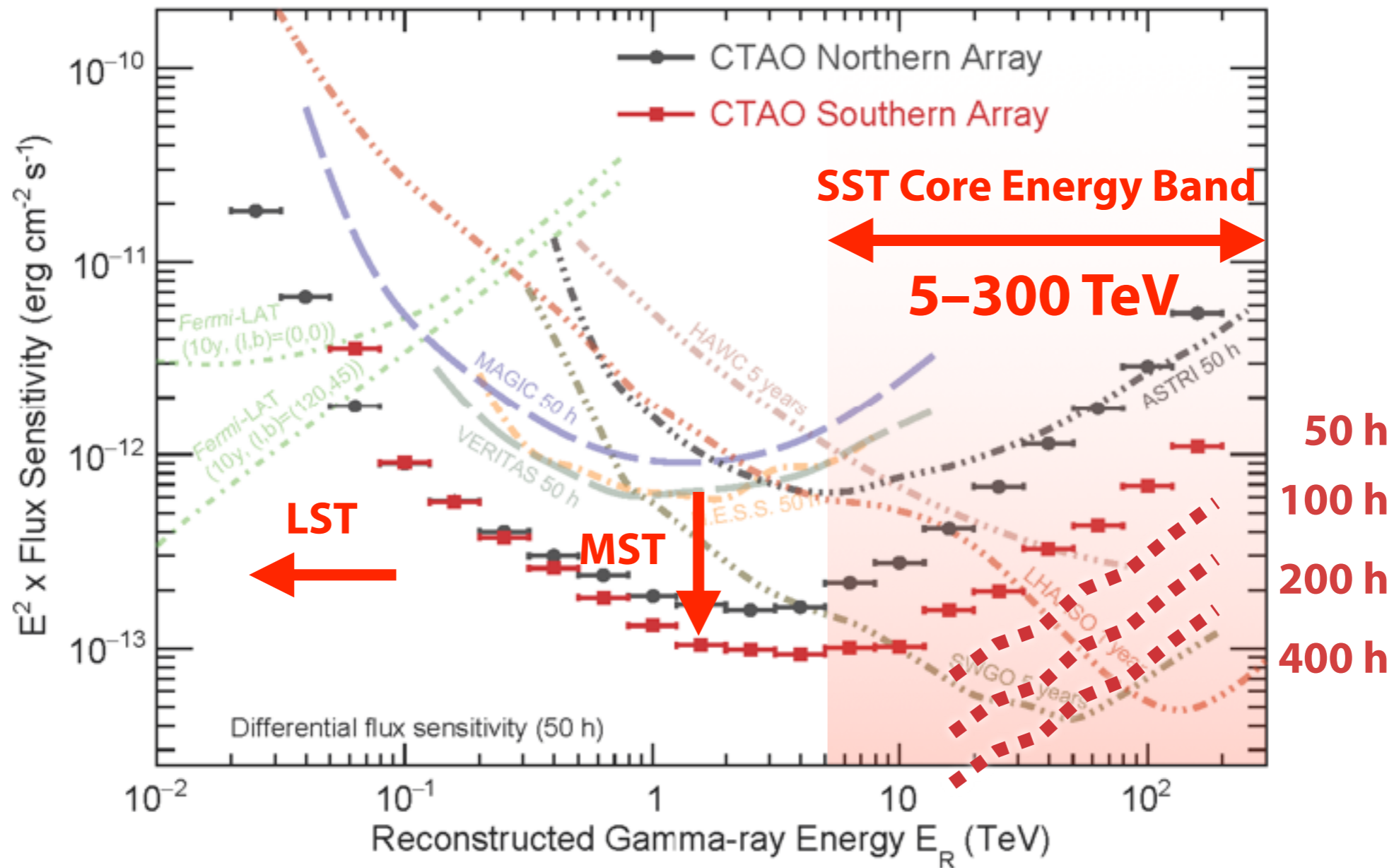
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# CTAO South in Paranal Chile (Feb 16, 2026)



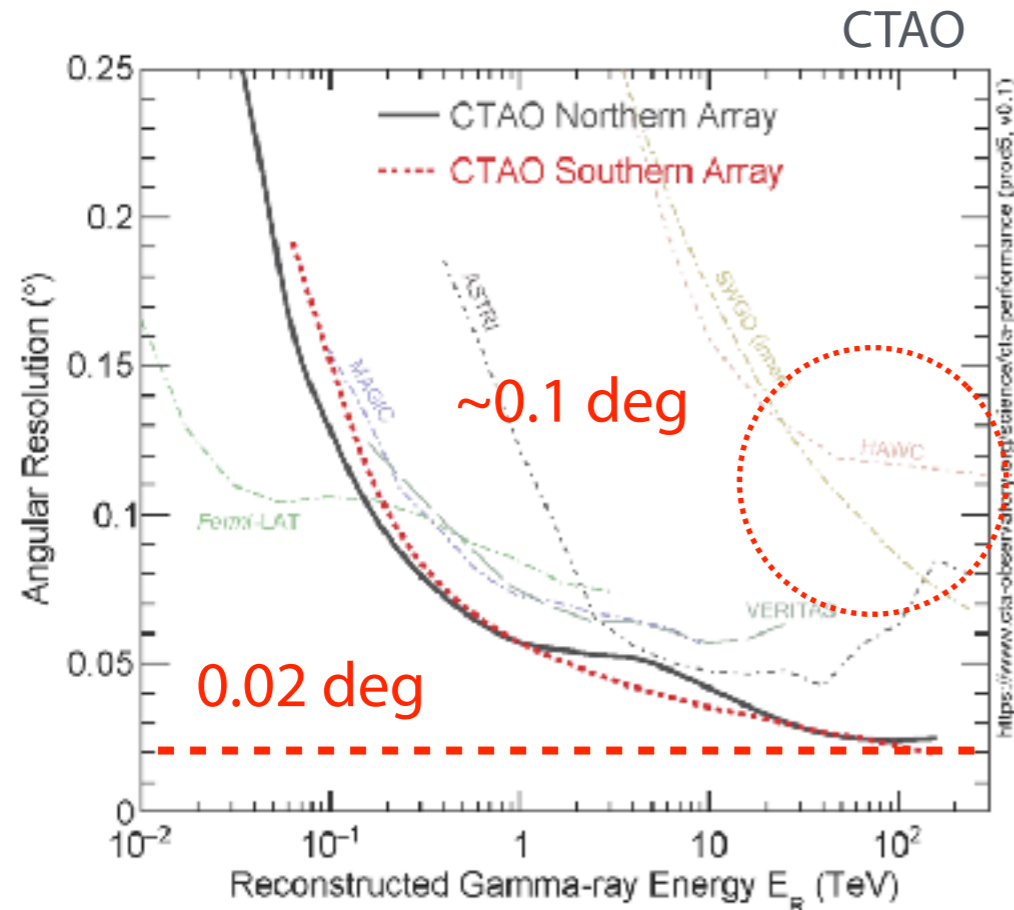
# High-energy Frontier by CTA SSTs (Initial Configuration)



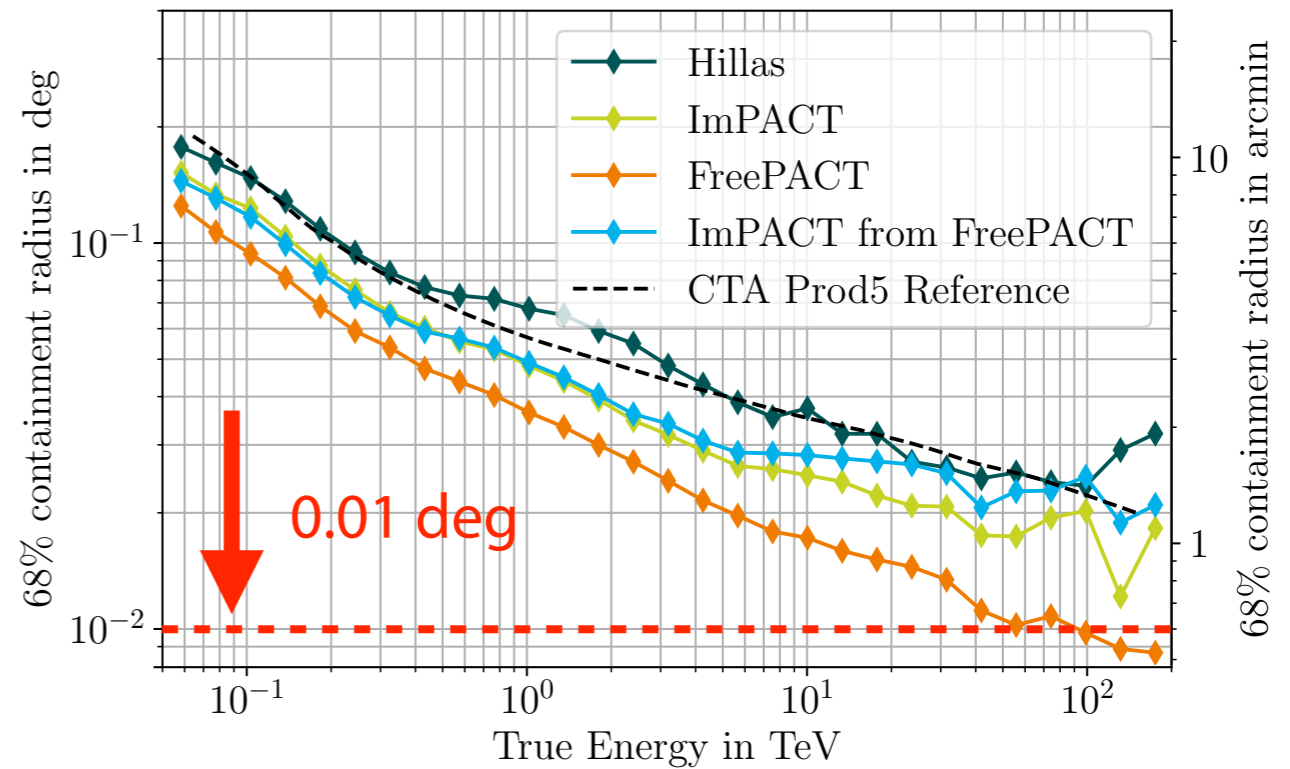
<https://www.cta-observatory.org/science/cta-performance> (prod5, v0.1)

- Covering up to 100–300 TeV is a key for PeVatron search
- Long observations of selected candidates (e.g., Gal. Center, microquasars)
- Observations under bright moon conditions will double the duty cycle

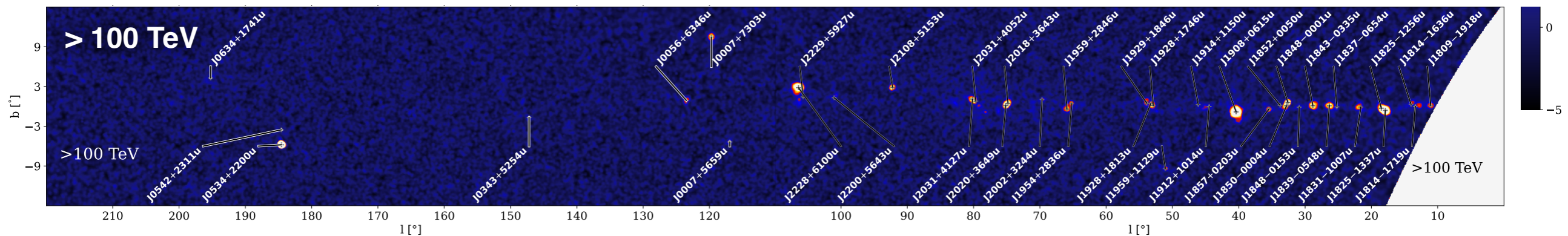
# Angular Resolution



Schwefer et al. (2024)



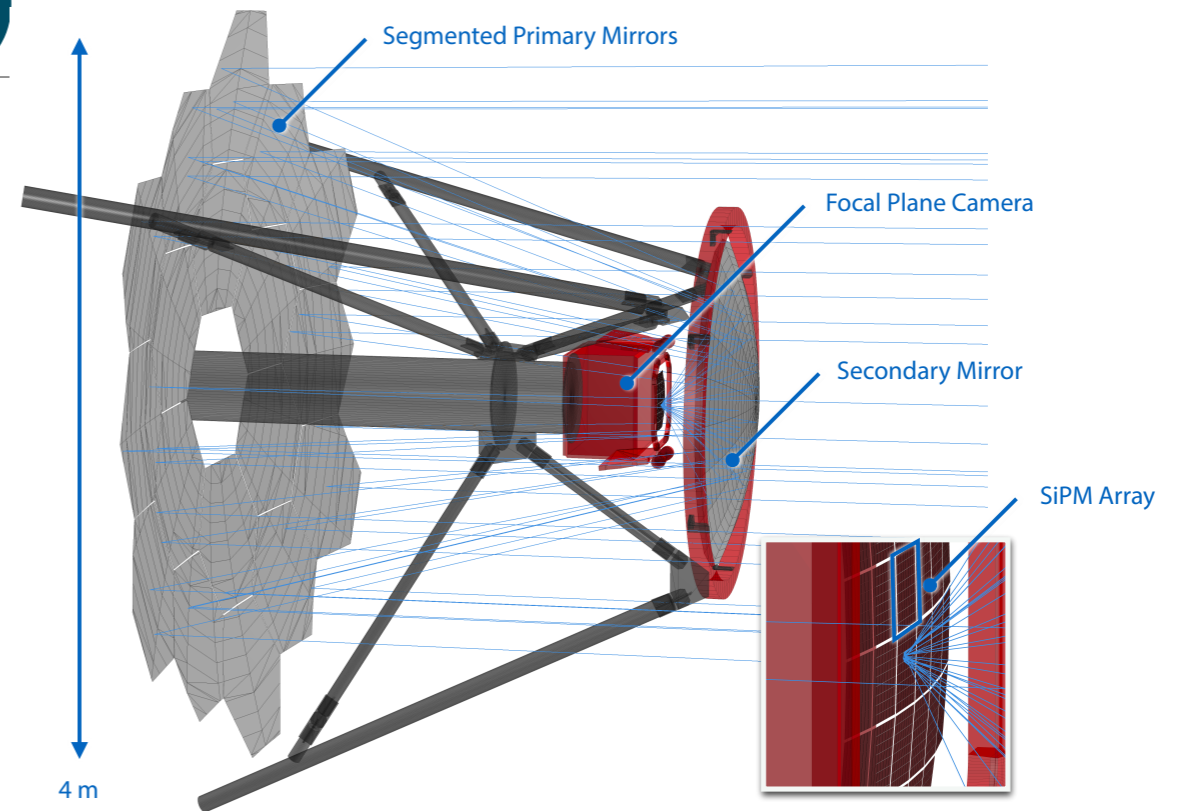
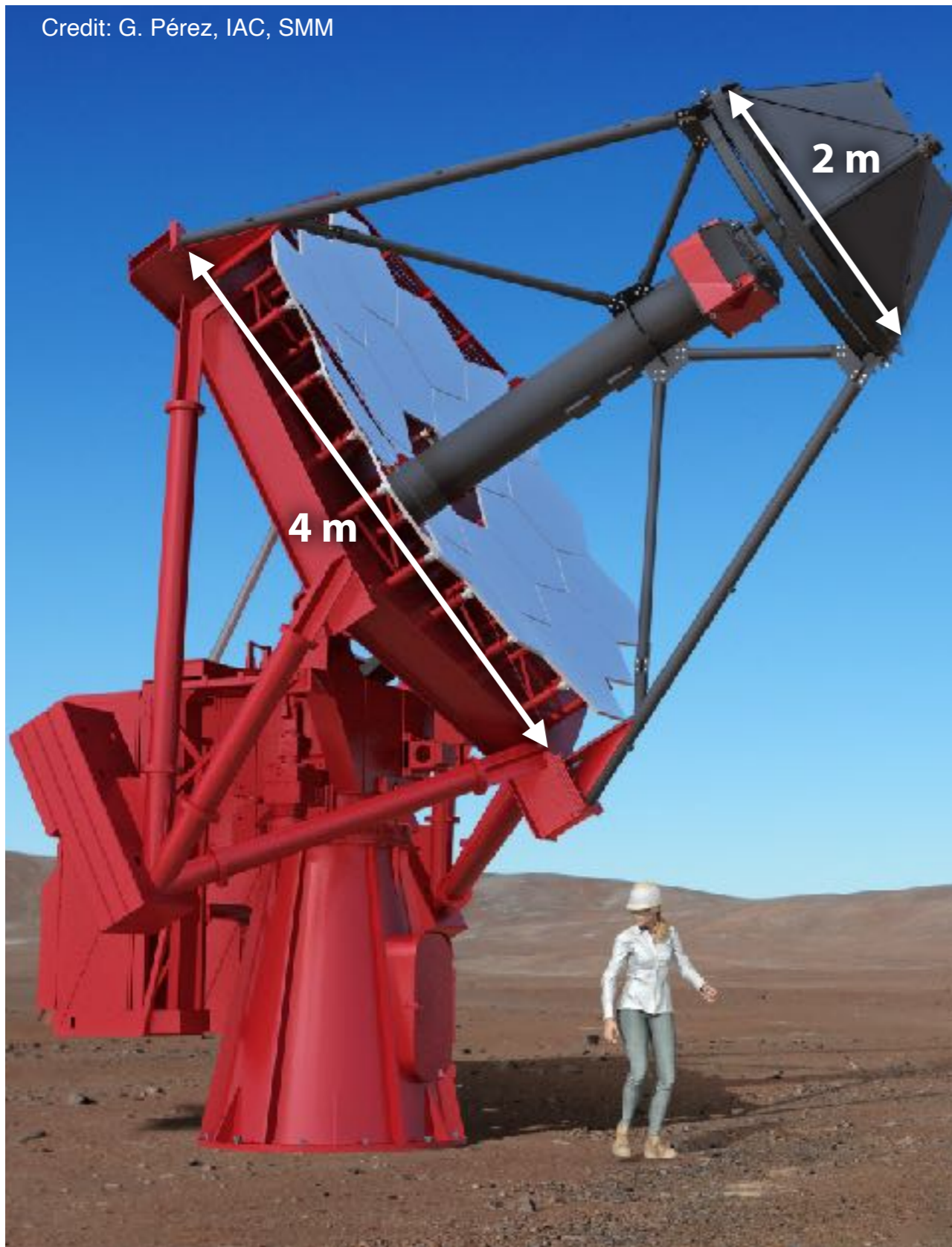
LHAASO (2023)



- Thanks to wide FOV ( $\sim 8^{\circ}$ ) of MSTs and SSTs, and recent software development, CTAO South angular resolution will reach down to  $0.01^{\circ}$  at 100 TeV
- Discoveries by ALPACA (exposure) and SSTs (follow up and resolution) are expected

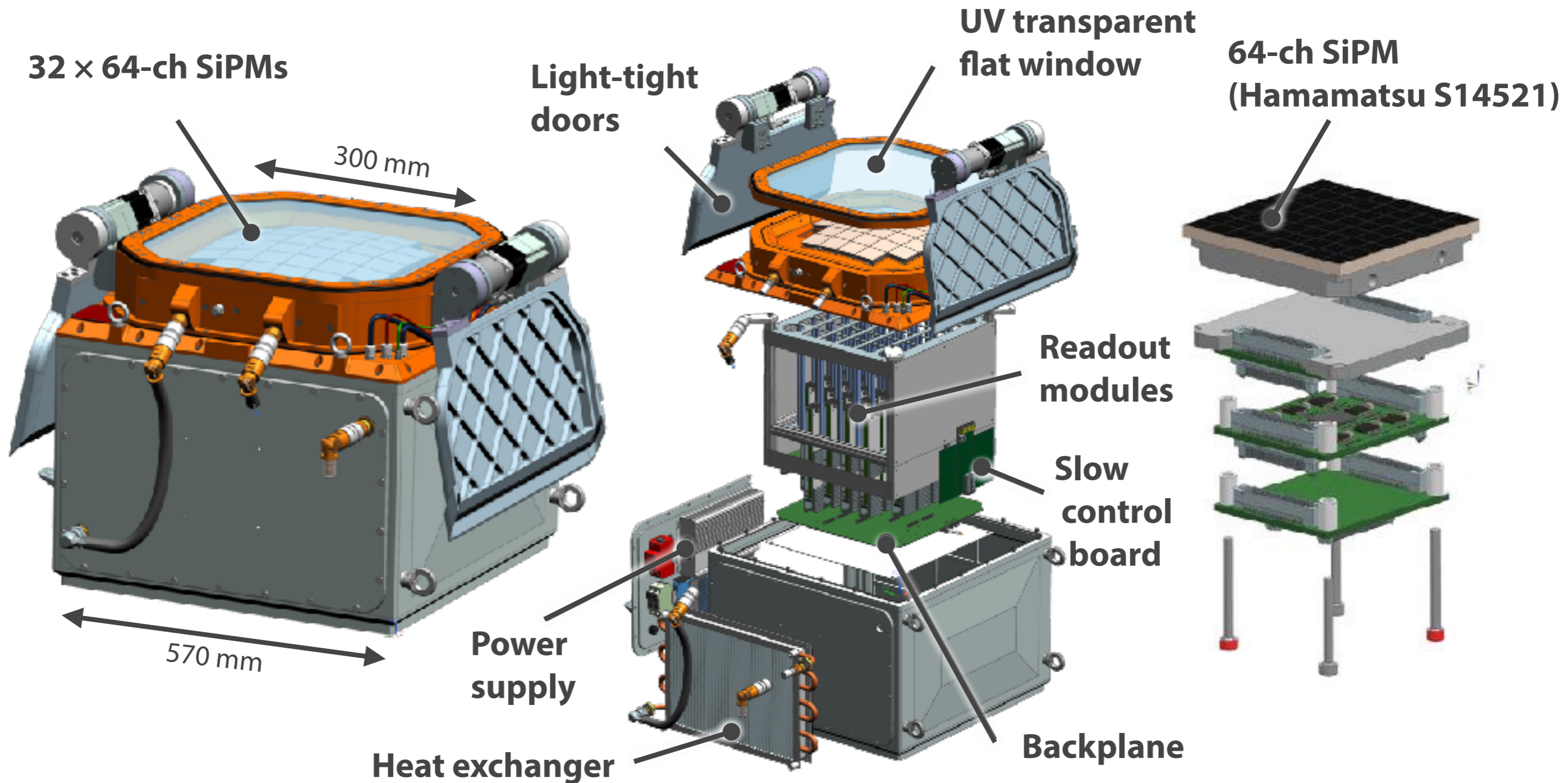
# Small-Sized Telescopes (SSTs)

Credit: G. Pérez, IAC, SMM

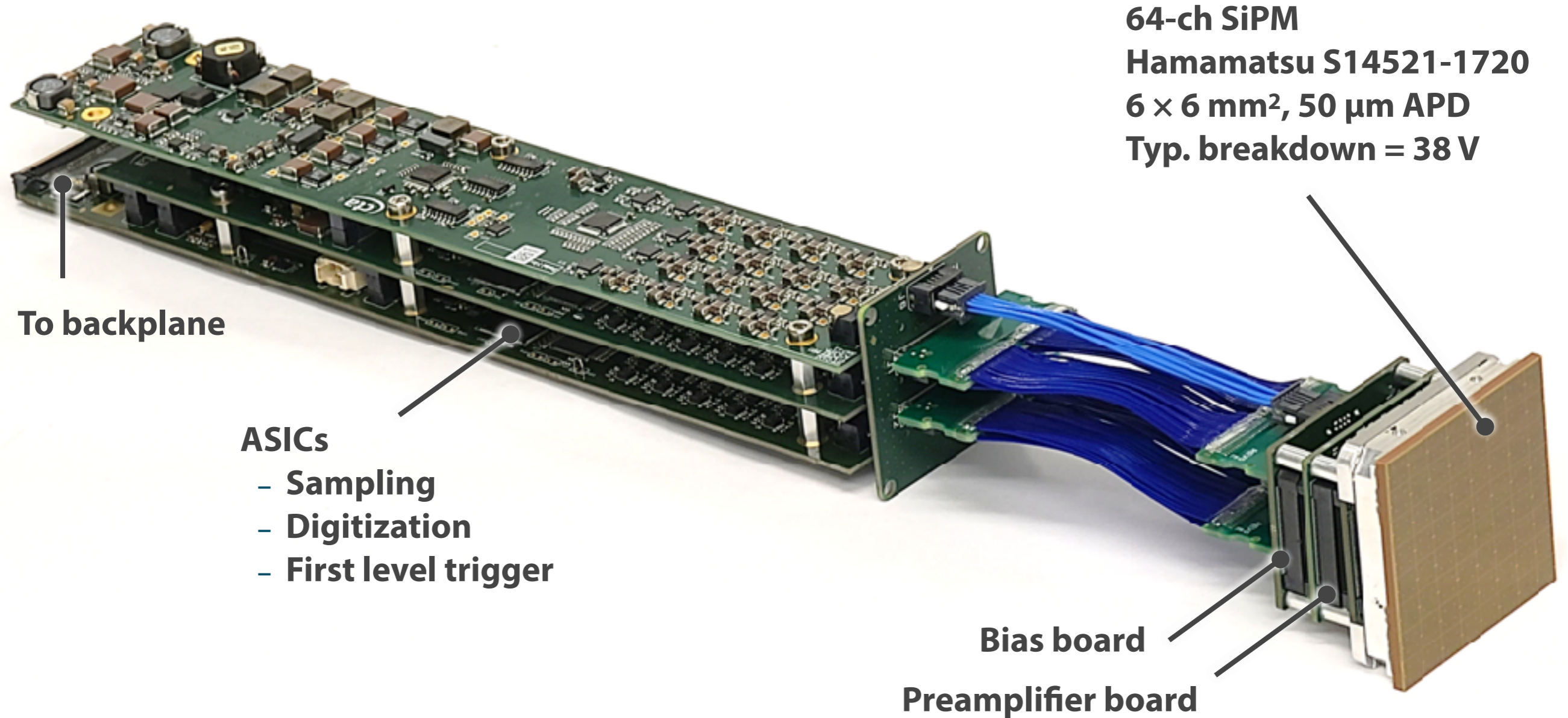


- Schwarzschild–Couder optical system
  - ▶ 4 m aspherical primary mirrors (segmented)
  - ▶ 2 m monolithic secondary mirror (monolithic)
  - ▶  $\sim 0.15^\circ$  PSF diameter over  $\sim 9^\circ$  FOV
- Compact focal-plane camera
  - ▶ 2048 SiPM pixels to form 300 mm focal plane
  - ▶  $32 \times 64$ -ch camera modules with dedicated ASICs
  - ▶ Large contributions from Nagoya University

# Camera Design

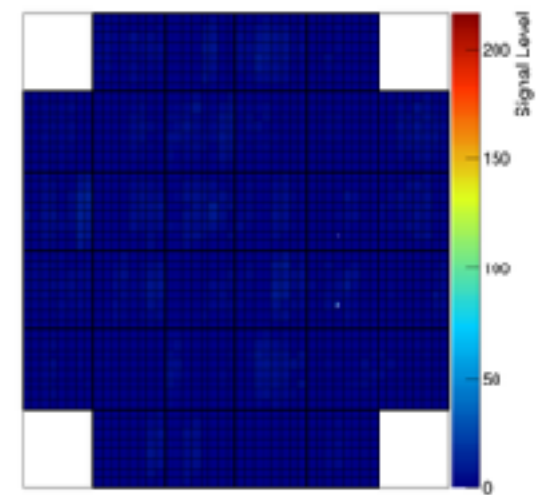
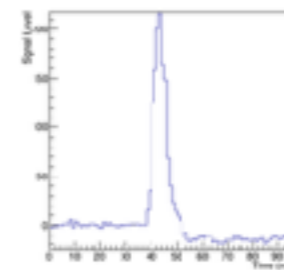
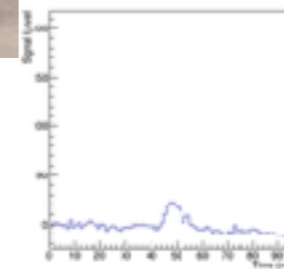
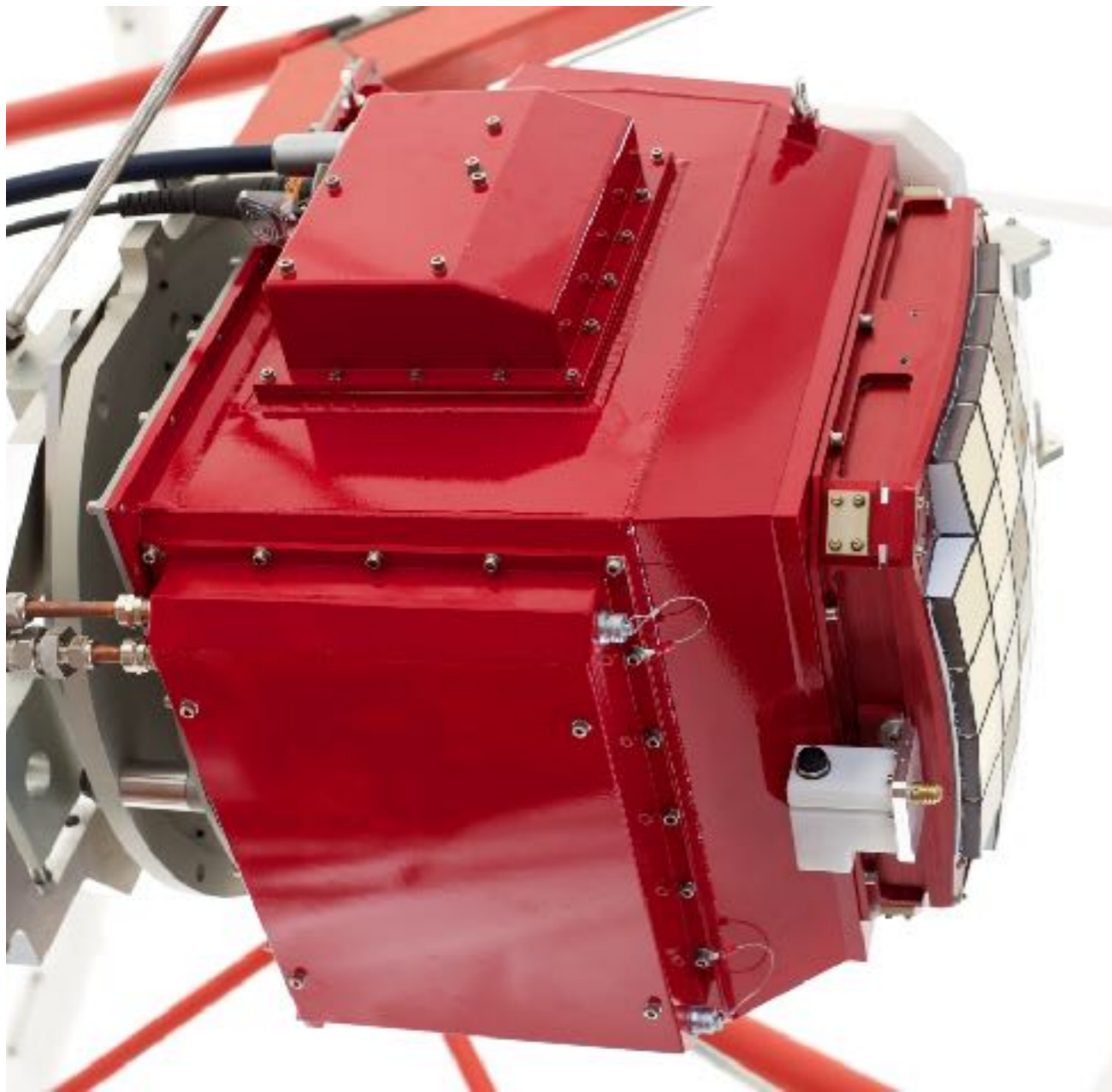


- The same concept: 32 × 64-ch SiPMs to form the spherical focal plane, read and triggered by dedicated ASICs (TARGET series), and controlled by backplane
- After the experience of two prototypes, the design is being finalized now



- Started with the first TARGET ASIC (16-ch sampling and trigger), and 64-ch MAPMTs in 2009
- Latest module uses 4 × sampling ASIC (TARGET-CTC) and 4 × trigger ASIC (TARGET-CT5TEA)
- UV-sensitive and uncoated low-optical-crosstalk 64-ch SiPMs

# First SST Camera Prototype (CHEC-M)

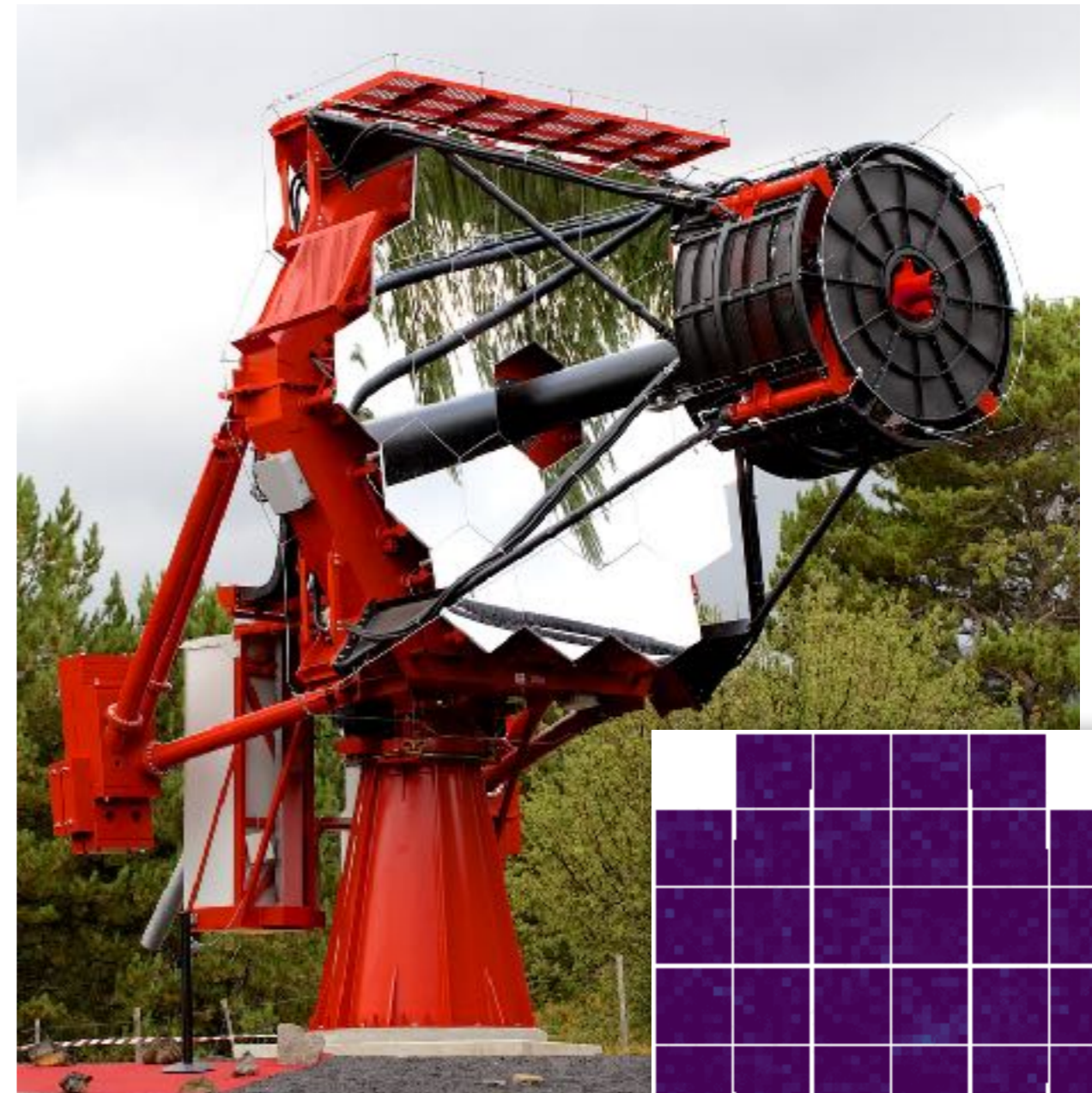


- TARGET 5 and multianode PMTs (MAPMTs)
- The very first CTA first light was achieved on a prototype optics in Paris in 2015

# Second SST Camera Prototype (CHEC-S)



Credit: Christian Föhr (MPIK)



- TARGET 7 and SiPMs
- Test observation campaign with the Italian optics design was held at Mt Etna, Sicily in 2019
- This combination was chosen to be the final SST design from 3 camera and 3 optics designs in 2019

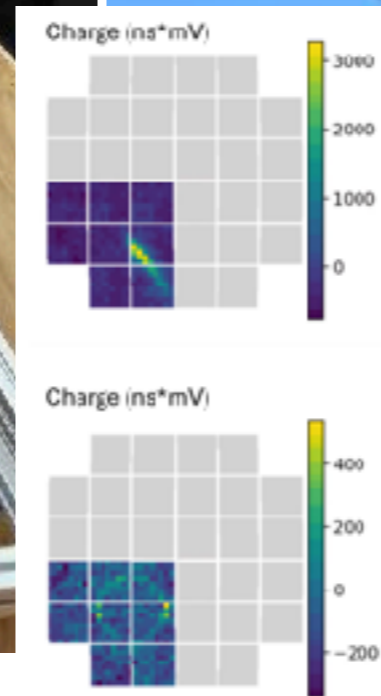
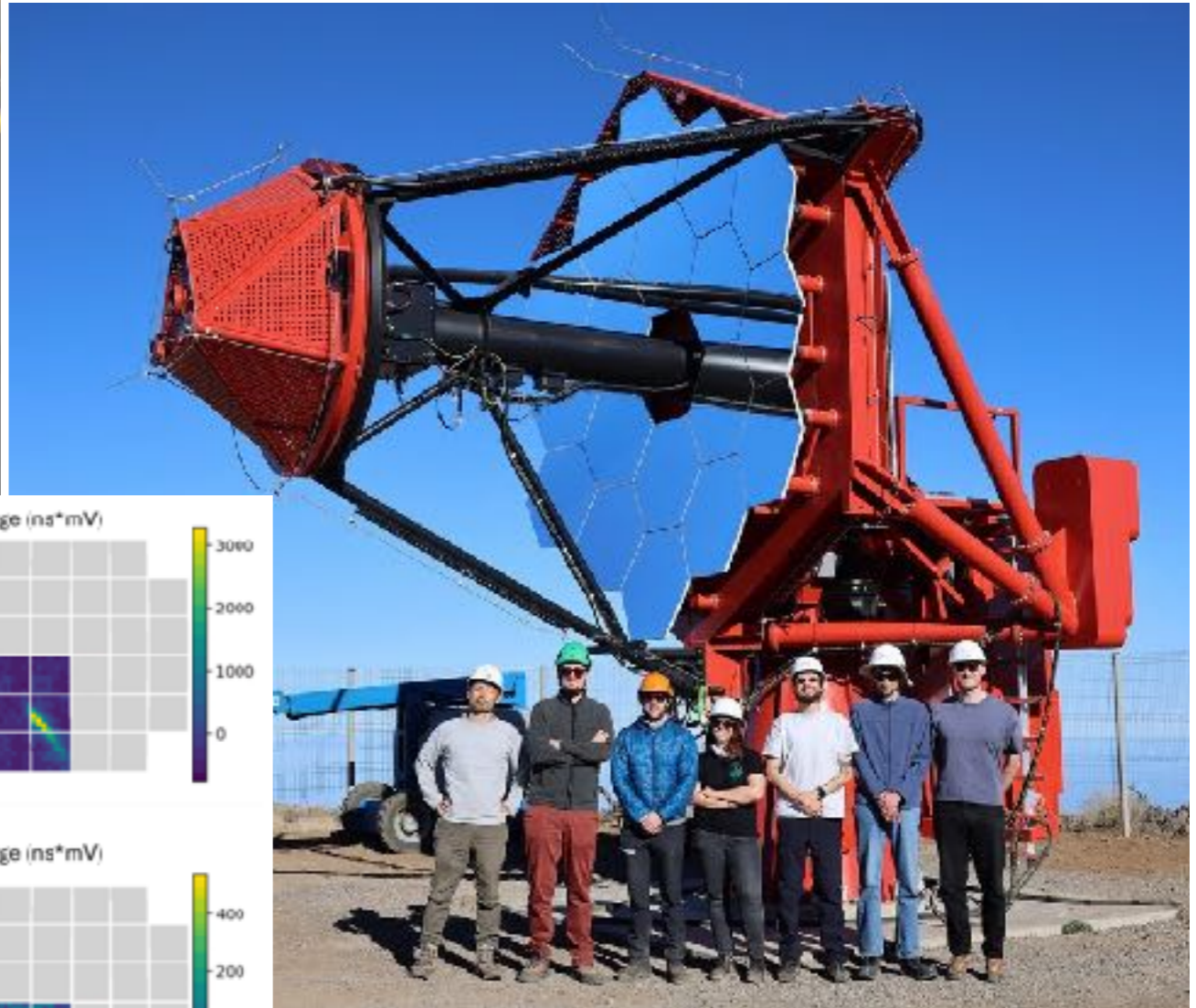
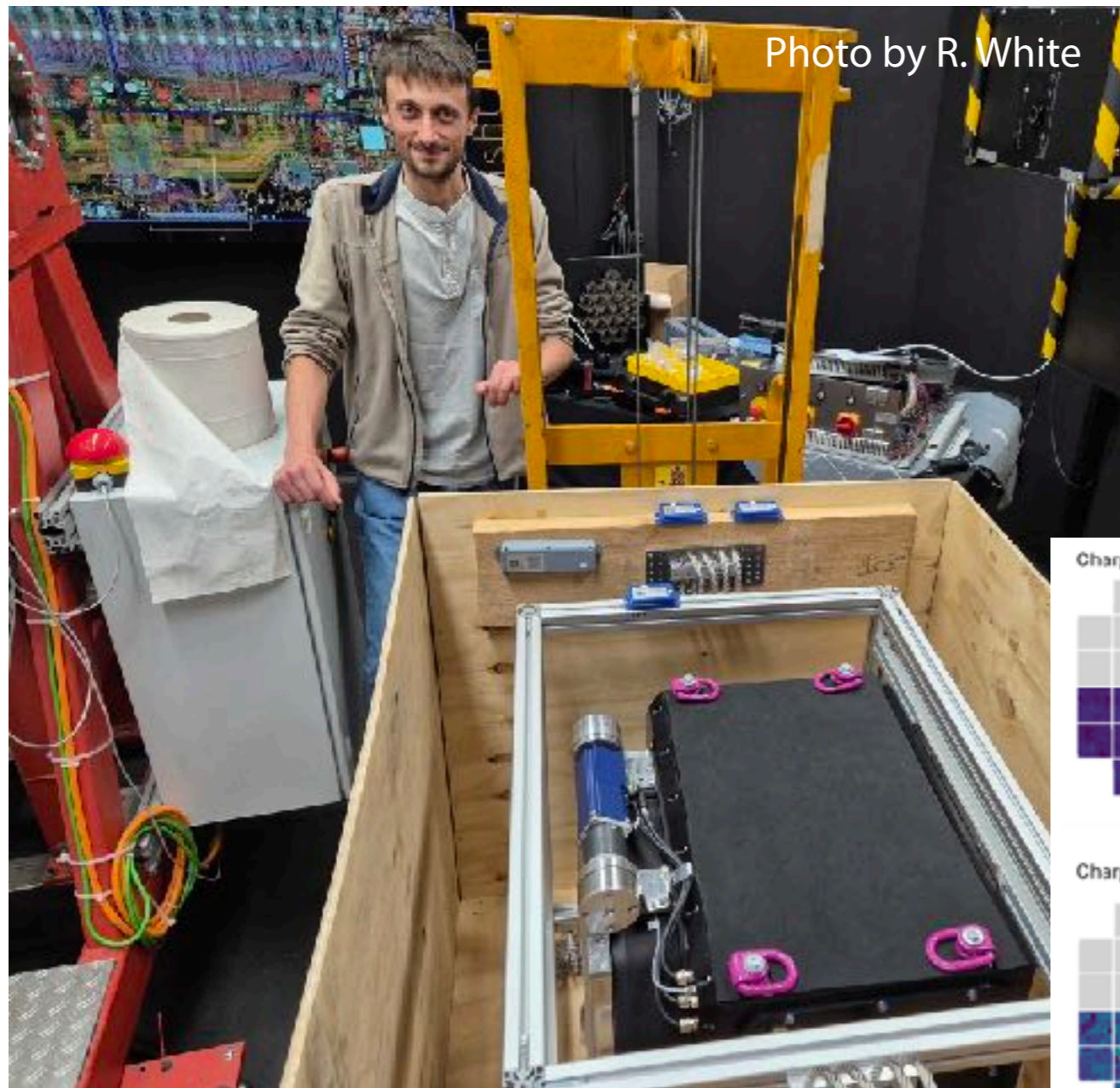
# Recent SST Camera Activity

Camera Integration at MPIK (Mar 2025)



- Populated only 8 camera modules out of 32 (“quarter camera”)
- Waiting for the full backplane board to be delivered in 2026

# Another Campaign at Teide Observatory, Tenerife



- Shipped the camera to Tenerife on July 8, 2026
- Two-week test observation campaign was held at Tenerife in July 2026

# Mass Production and Beyond

Dec 2025

Dec 2025

Jun 2025

**Small-Sized Telescopes Pass Readiness Review to Proceed to Factory Testing**

DATE: 17 December 2025  
TOPICS: Telescopes, Announcements, SST, CTAO-South, Central Organisation

CTAO Central Organisation and SST Collaboration representatives pictured with the SST at the Dal Ben facility in the Veneto region, Italy. Credit: INAF/G. Tagliaferri

On 2–3 December, the [CTAO Central Organisation's Telescope team](#) visited the facilities of the Italian company Dal Ben, located in the Veneto region, to conduct the Test Readiness Review (TRR) for the electromechanical structure of the [Small-Sized Telescope \(SST\)](#). After the [CTAO SST Collaboration](#) completed the integration of the first SST telescope at the facility, which includes a mechanical and electrical model

**Groundbreaking Ceremony Marks the Beginning of CTAO-South Array Construction in Chile**

DATE: 18 December 2025  
TOPICS: Press Releases, MST, SST, CTAO-South, Central Organisation

From Left: Thomas Klein, Director of the ESO La Silla Paranal Observatory; Ricardo Diaz, Governor of the Antofagasta Region; Alejandro Pizarro, Director of the National Agency for Research and Development (ANID); Stuart McMuldroch, CTAO Director General; Xavier Barcons, ESO Director General; Valeska Molina, Regional Secretary of the Ministry of Science, Technology and Innovation for Antofagasta Region; Francisco Colomer, Chair of the CTAO ERIC Council; and Volker Heinz, CTAO Construction Programme Manager

**Paranal, Chile, 17 December 2025** — Representatives from the Cherenkov Telescope Array Observatory (CTAO), the European Southern Observatory (ESO), and governmental authorities gathered today to celebrate the official

**Small-Sized Telescope Structure Advances to Serial Production**

DATE: 17 June 2025  
TOPICS: Telescopes, Announcements, SST

On 5 June, a delegation from the [CTAO SST Collaboration](#) and the [CTAO Central Organisation's Telescope team](#) visited the facilities of the Italian company Dal Ben, located in the Veneto region, to inspect the progress of the [Small-Sized Telescope \(SST\)](#) electromechanical structures' production. In a significant step forward, the SST structures have now officially entered serial production following the approval of their final design.

The approval to enter the new phase came two months ago with the successful

- The initial mass production of SST telescopes and site preparation started in 2025
- First telescope to be built in Paranal in mid 2026
- Proto engineering camera (ECAMi) will be installed in Chile in 2026
- Engineering camera (SST Cam 1) and mass production will follow in 2026 and 2027
- Completion of 37 SSTs is expected to be 2029
- Full CTAO South configuration (37 SSTs + 14 MSTs) in 2030