

# The Cherenkov Telescope Array Observatory (CTAO)

CTAO

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National  
Research  
Foundation



science & innovation

Department:  
Science and Innovation  
REPUBLIC OF SOUTH AFRICA

# Detecting Gamma-Rays with Cherenkov Telescopes

CTAO

Cherenkov light from air showers initiated by very-high-energy gamma-rays ( $> 100$  GeV) in the atmosphere.



# Current Generation Cherenkov Telescope Observatories



**VERITAS:**  
4 X 12 m  
Arizona



**MAGIC:**  
2 X 17 m  
La Palma



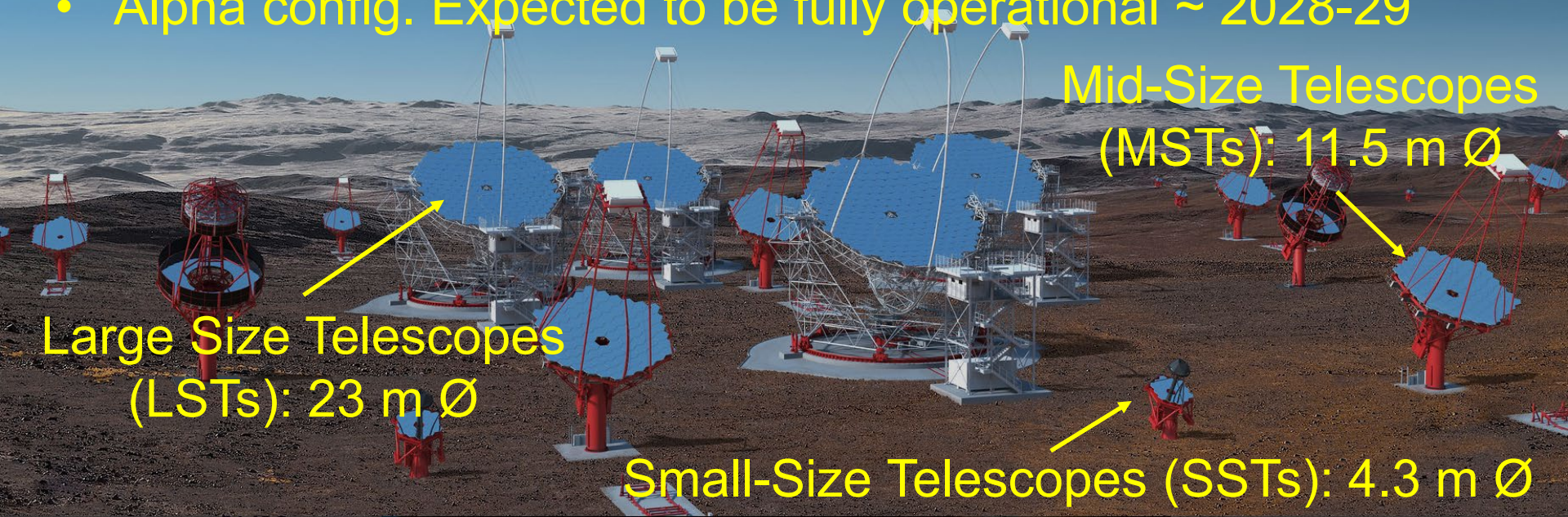
**H.E.S.S.**  
4 X 12 m + 1 X 28 m  
Namibia

# The Cherenkov Telescope Array (CTAO)



Next-generation Cherenkov Telescope Array facility

- Originally envisioned: ~ 100 telescopes of 3 different sizes
- Alpha configuration (defined 2022): 64 telescopes
- Expected to improve sensitivity by ~ factor 10 compared to existing facilities (H.E.S.S., MAGIC, VERITAS)
- Extend energy coverage: ~ 10 GeV - >100 TeV
- Alpha config. Expected to be fully operational ~ 2028-29



Mid-Size Telescopes  
(MSTs): 11.5 m  $\emptyset$

Large Size Telescopes  
(LSTs): 23 m  $\emptyset$

Small-Size Telescopes (SSTs): 4.3 m  $\emptyset$



# Sites



La Palma, Spain:  
CTA North

Zeuthen (Berlin),  
Germany:  
Science Data  
Management Center

Bologna, Italy:  
Headquarters

Paranal, Chile  
CTA South

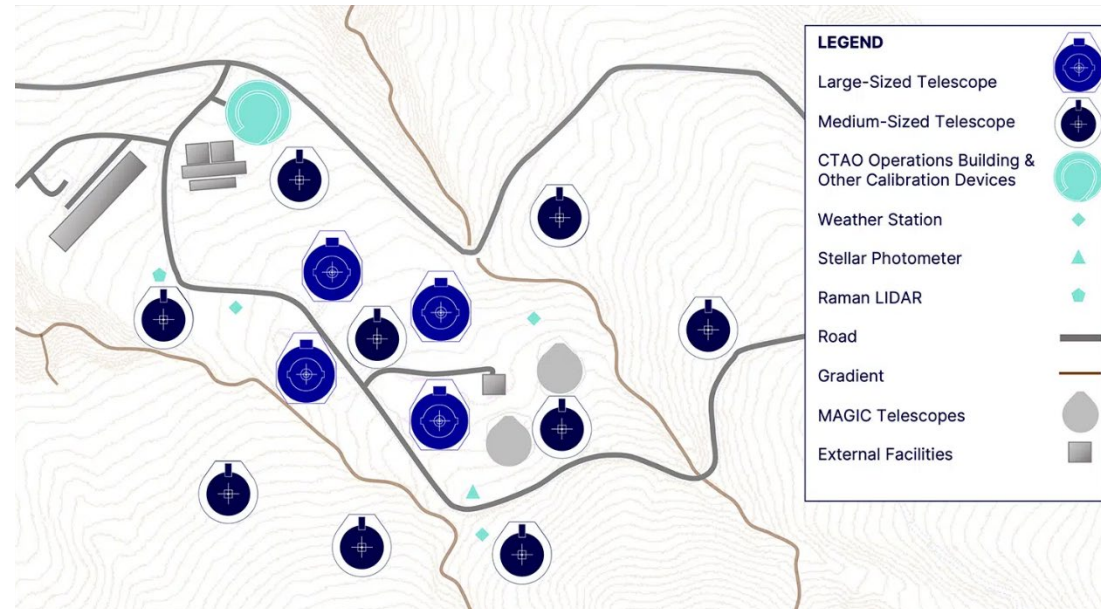
# CTAO-North

## La Palma, Canary Islands, Spain



### Alpha Configuration:

- $\sim 0.5 \text{ km}^2$
- 4 LSTs
- 9 MSTs

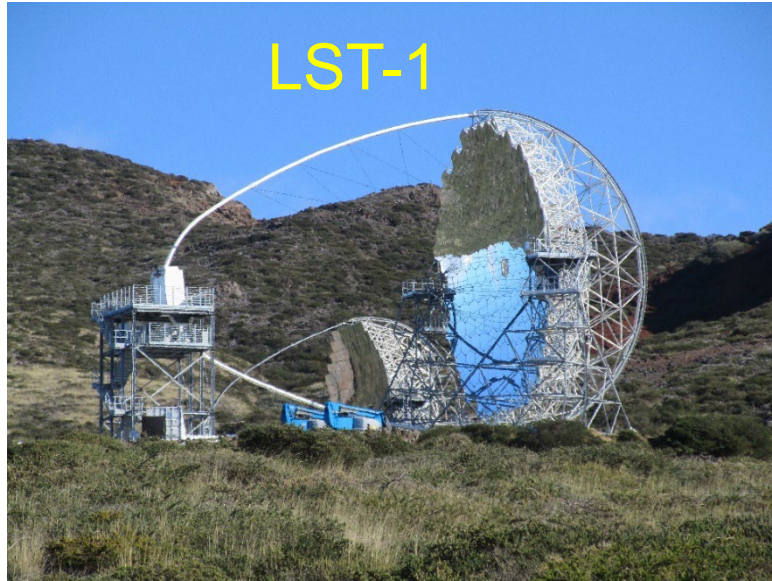


# CTAO-North

## La Palma, Canary Islands, Spain



LST-1



- Prototype LST (LST-1) inaugurated in September 2018
- Telescope mounts for LST 2 – 4 mostly completed
- LST-4 dish structure lifted into mount in May 2024.

LST-4



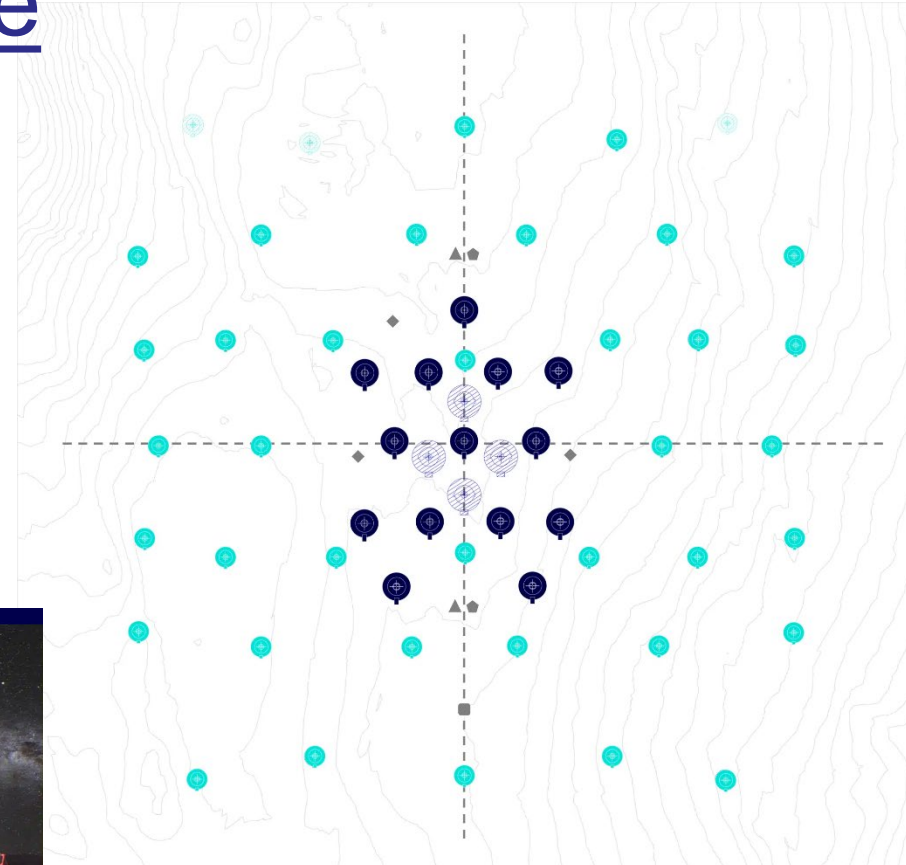
# CTAO-South

## ESO (Paranal), Chile

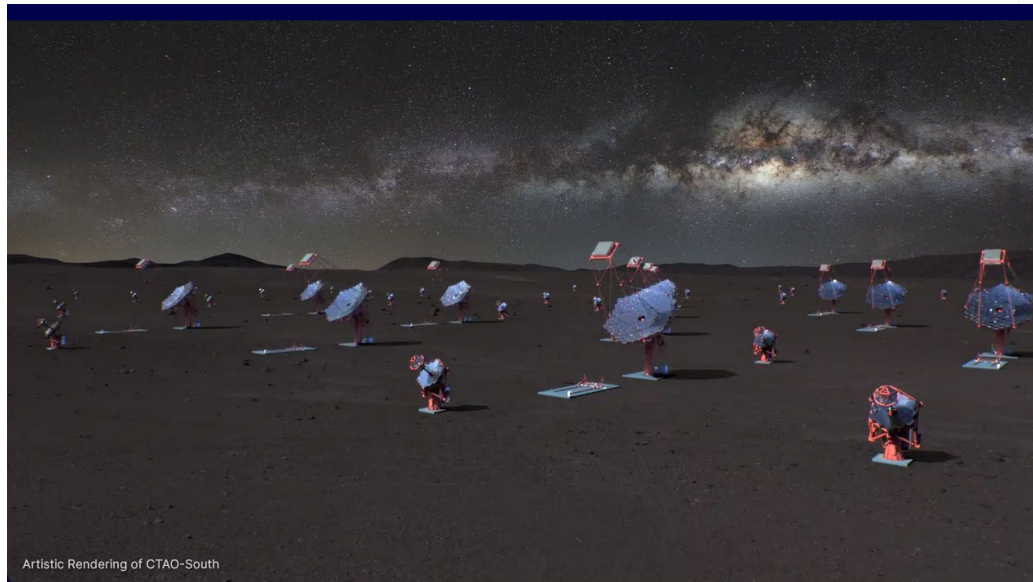


### Alpha Configuration:

- ~ 3 km<sup>2</sup>
- 14 MSTs
- 37 SSTs



LEGEND			
Medium-Sized Telescope (MST)		Weather Station	
Small-Sized Telescope (SST)		Stellar Photometer	
Large-Sized Telescope (LST) Foundation		Raman LIDAR	
SST Foundation		Other Calibration Devices	



Artistic Rendering of CTAO-South



# CTAO-South ESO (Paranal), Chile



First infrastructure (access road, power infrastructure) construction started in March 2022.

Access road completed in 2024.



# Science Data Management Centre

- At DESY Zeuthen (Berlin)
- Start of construction: March 2022
- Inauguration scheduled for 14 October 2024



# CTA Headquarters

CTAO

- Bologna, Italy
- Completed 2019



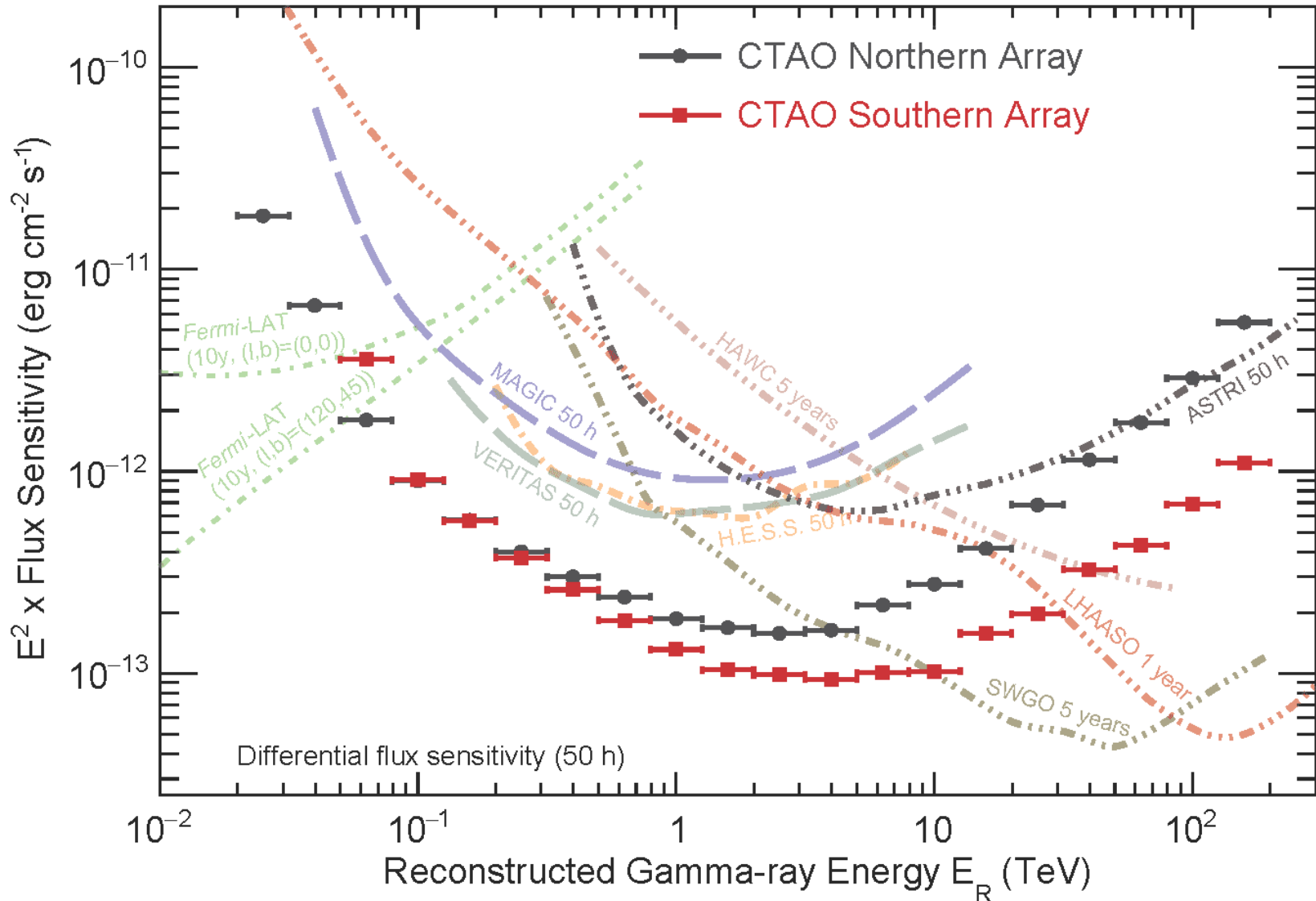
# The CTAO Consortium



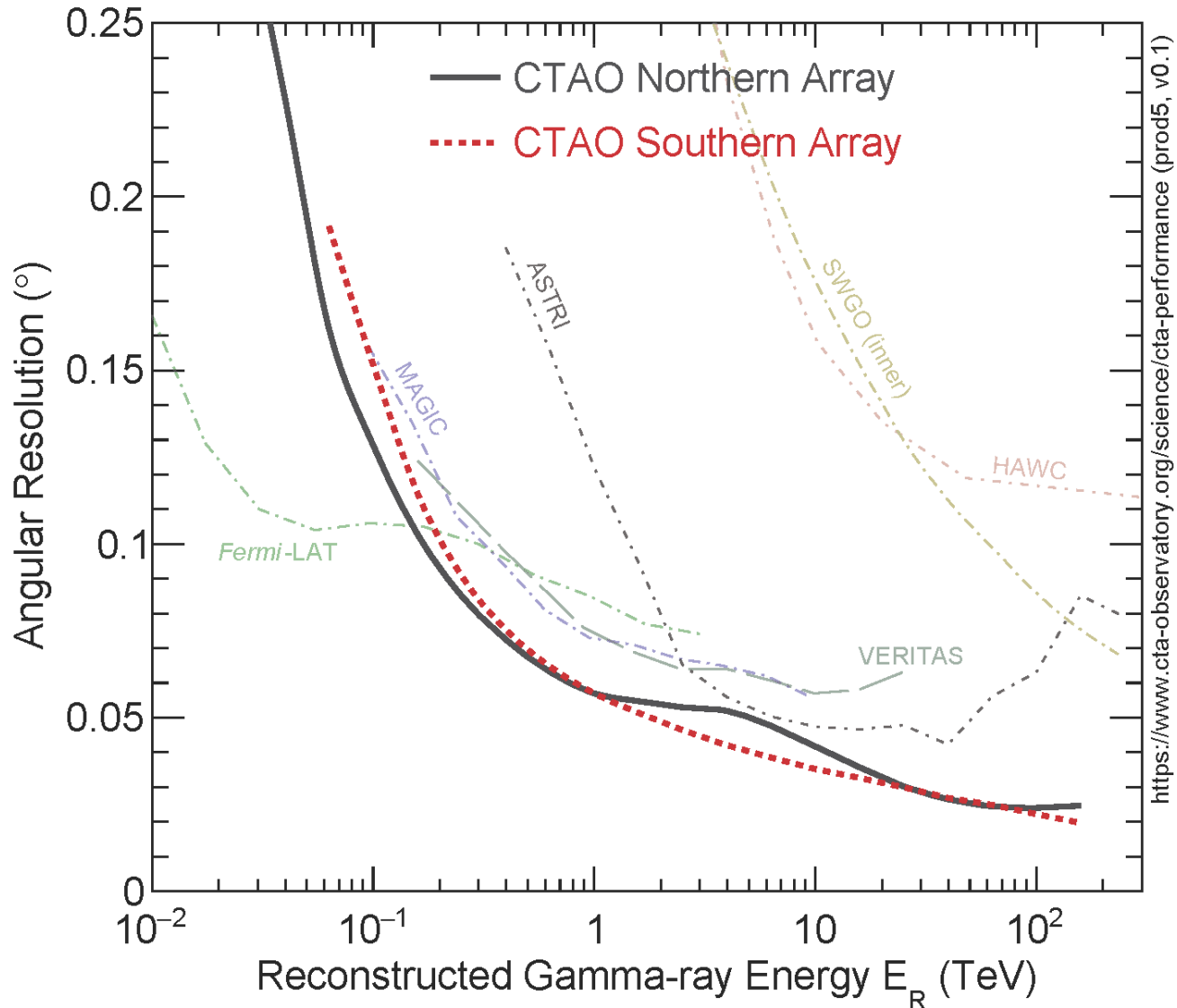
Masahiro Teshima  
(Tokyo) recently  
elected new  
spokesperson

- More than 1400 scientists
- ~ 200 institutes
- 25 countries on 6 continents





# Expected Angular Resolution





(CTA Consortium 2019)

- Indirect Dark Matter Searches
- Deep observations of the Galactic Centre
- Galactic Plane Survey
- Large Magellanic Cloud Survey
- Extragalactic Survey
- Transients
- Cosmic-Ray PeVatrons
- Star Forming Systems
- Active Galactic Nuclei
- Clusters of Galaxies



# Key Science Projects

## Science themes and questions

### 1. Understanding the origin and role of relativistic cosmic particles

- Sites and mechanisms of relativistic particle acceleration
- Role of accelerated particles in feedback mechanisms

### 2. Probing extreme environments

- Physical processes near black holes and neutron stars
- Physics of jets, winds, and explosions
- Radiation and magnetic fields in cosmic voids

### 3. Exploring frontiers in physics

- Nature of Dark Matter
- Quantum gravity
- Axion-like particles



# CTAO

# Thank you



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**Backup slides**

SSTs and possible additional MSTs:  
Schwarzschild-Couder design (2-mirror with camera behind the primary mirror)

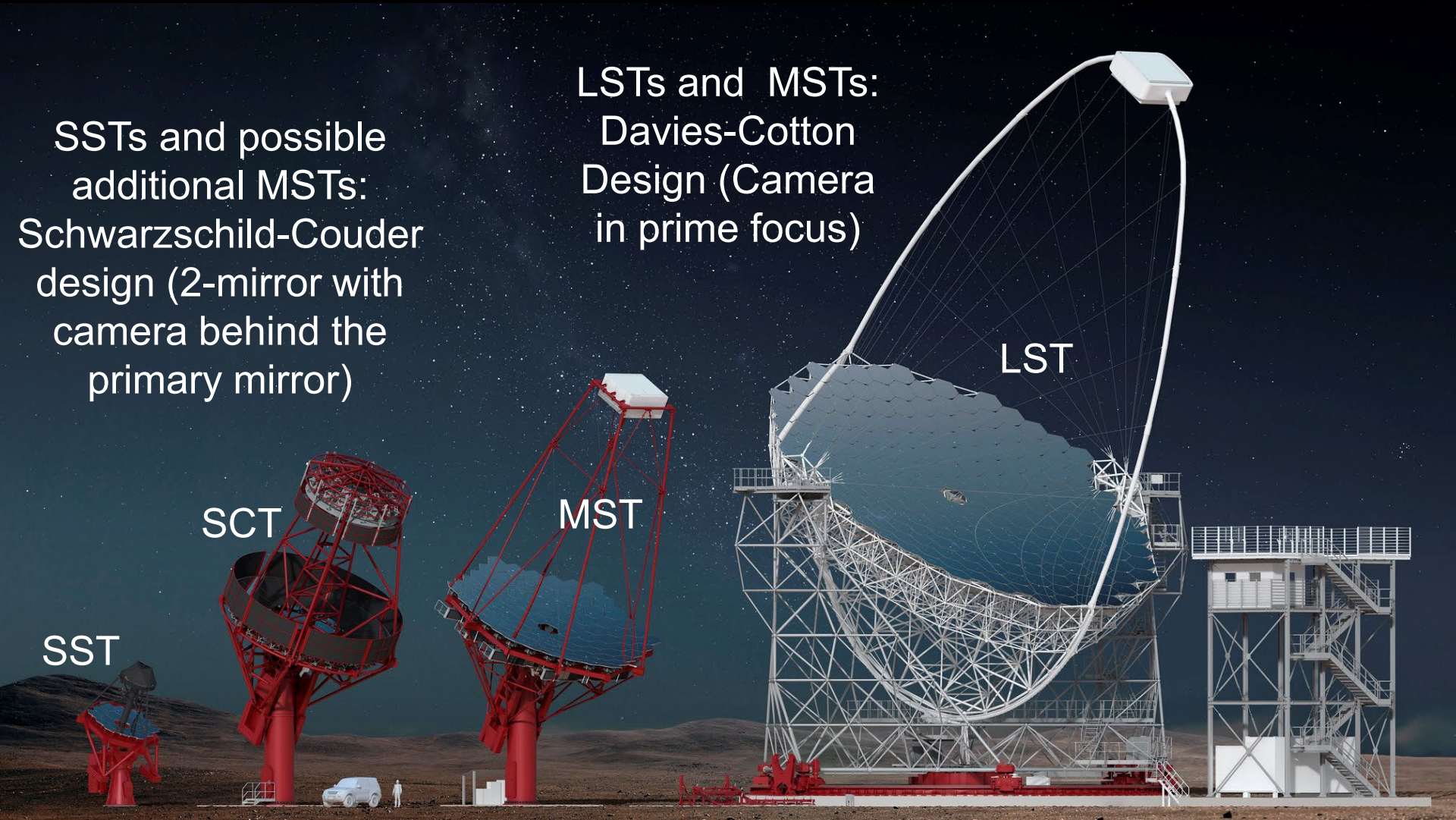
SST

SCT

MST

LSTs and MSTs:  
Davies-Cotton Design (Camera in prime focus)

LST



# The Very-High-Energy Gamma-Ray Sky **CTAO**

