

The Cherenkov Telescope Array Observatory (CTAO)

CTAO

Markus Böttcher

North-West University,

Potchefstroom, South Africa

Chair, The South African Gamma-Ray Astronomy Programme



National
Research
Foundation



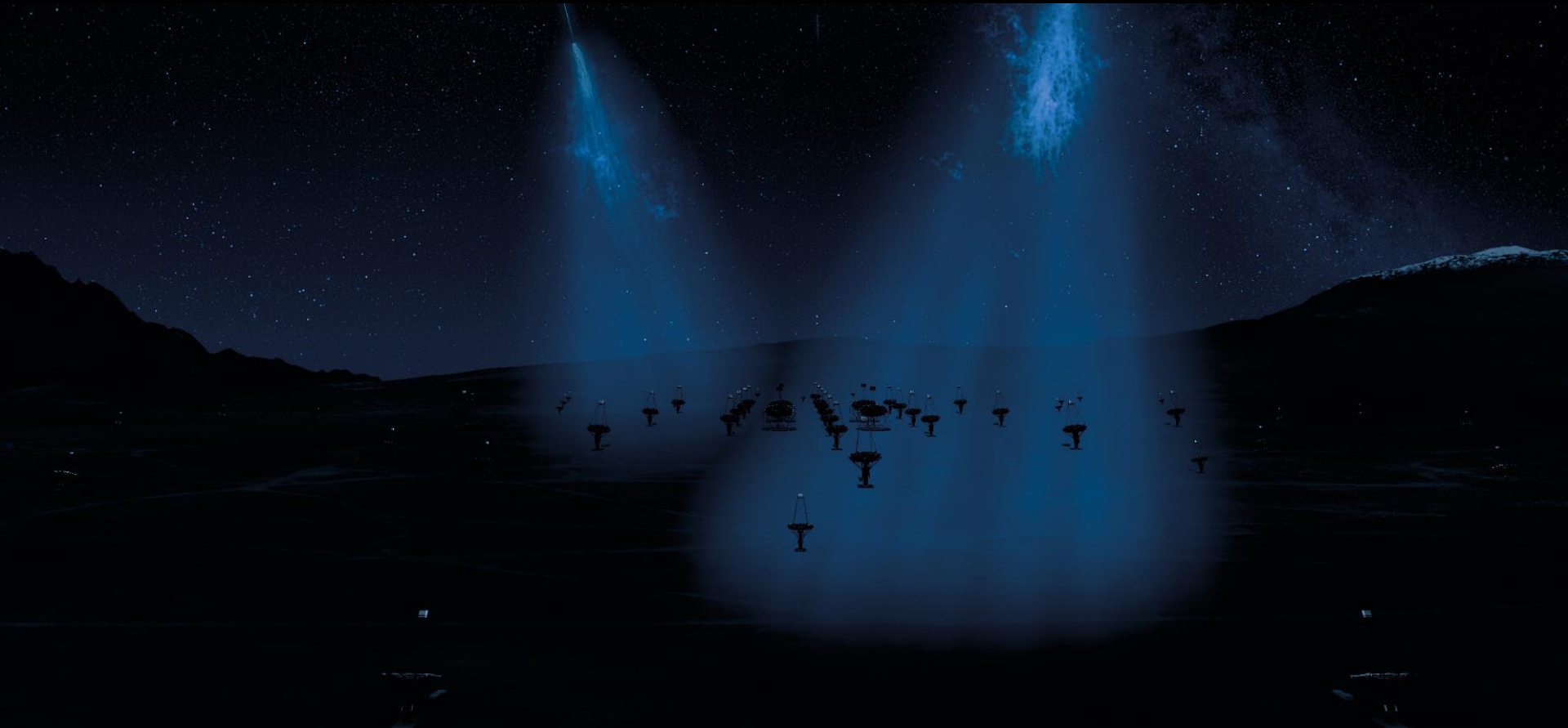
science & innovation

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



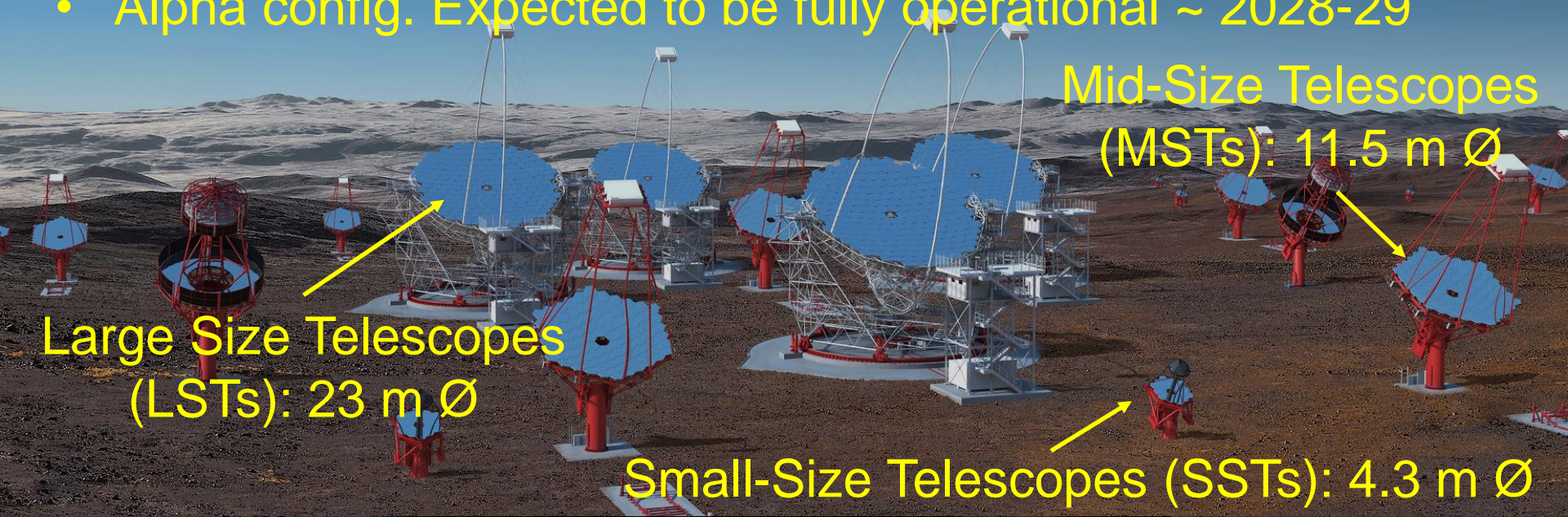
H.E.S.S.
4 X 12 m + 1 X 28 m
Namibia

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



Zeuthen (Berlin),
Germany:
Science Data
Management Center

La Palma, Spain:
CTA North

Bologna, Italy:
Headquarters

Paranal, Chile
CTA South

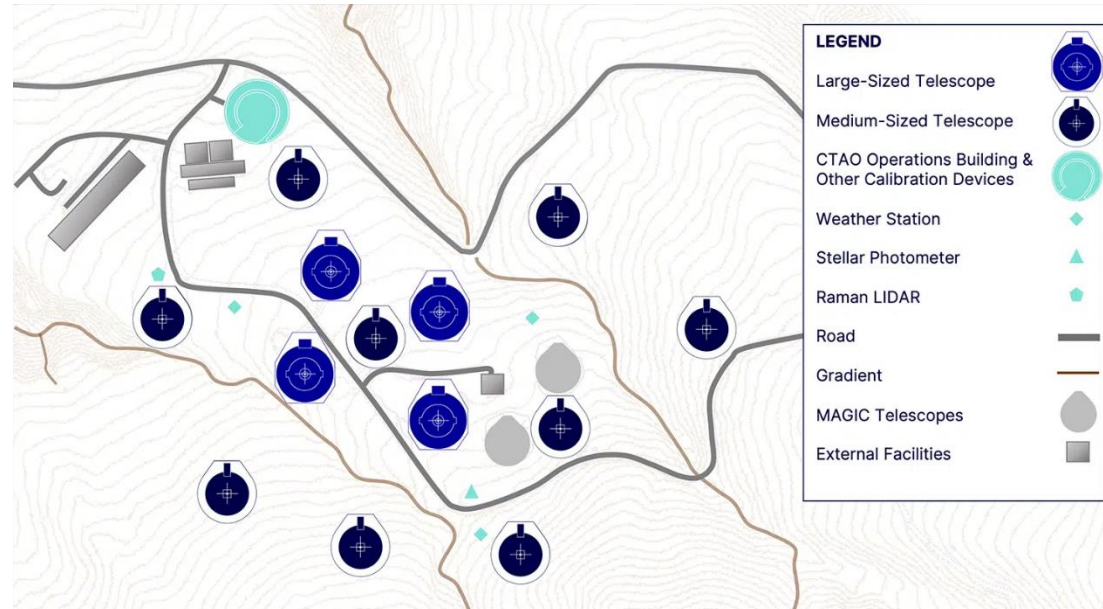
CTAO-North

La Palma, Canary Islands, Spain



Alpha Configuration:

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

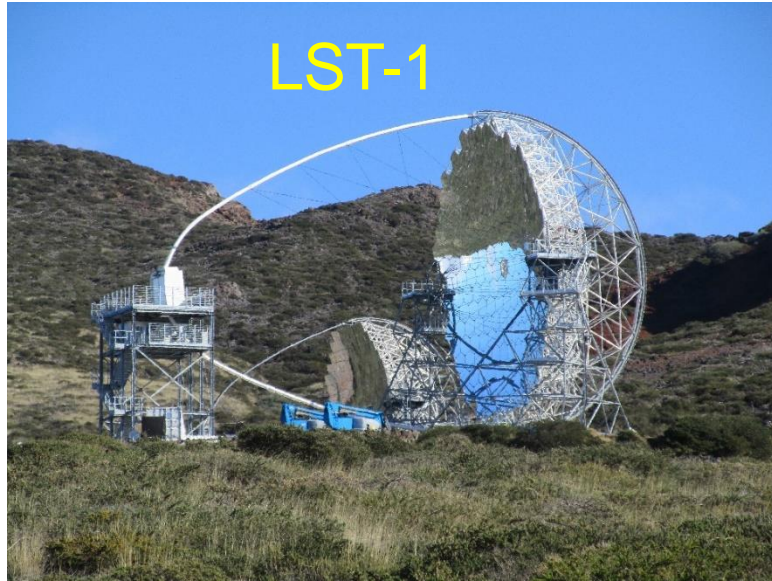


CTAO-North



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



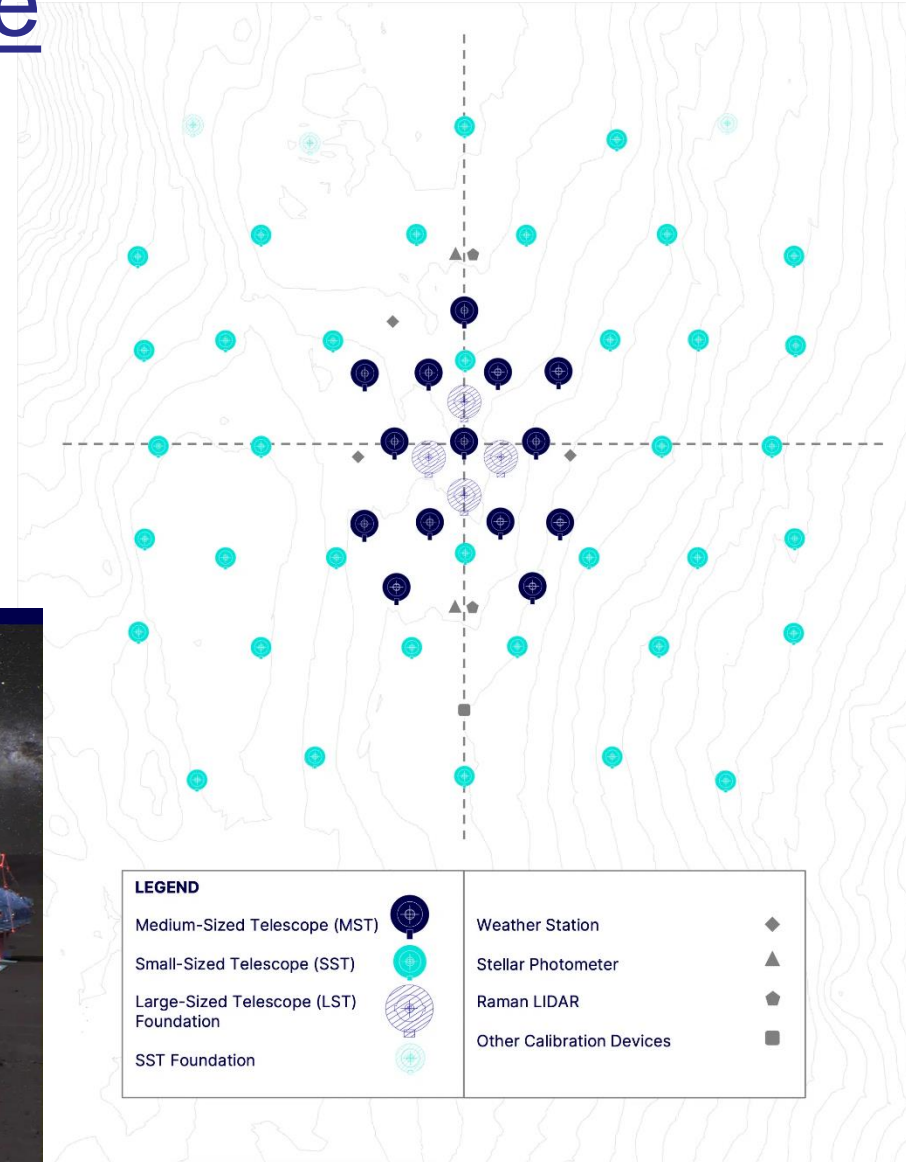
CTAO-South

ESO (Paranal), Chile

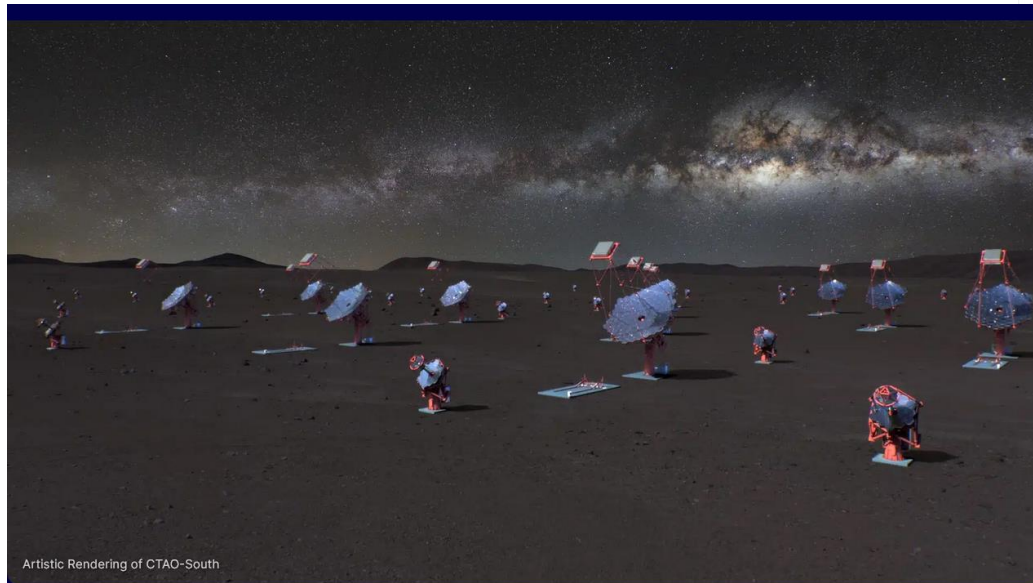


Alpha Configuration:

- ~ 3 km²
- 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



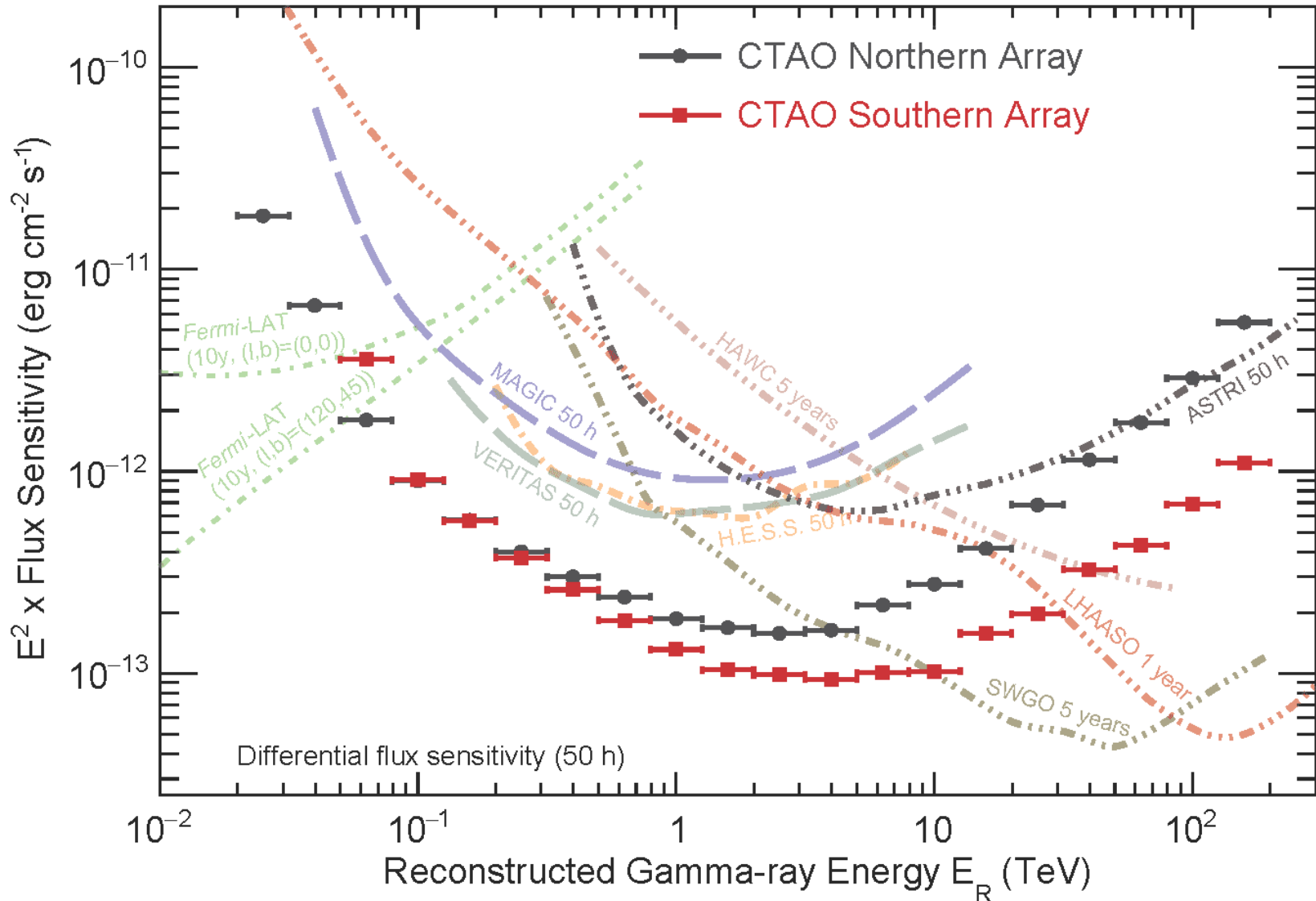
The CTAO Consortium



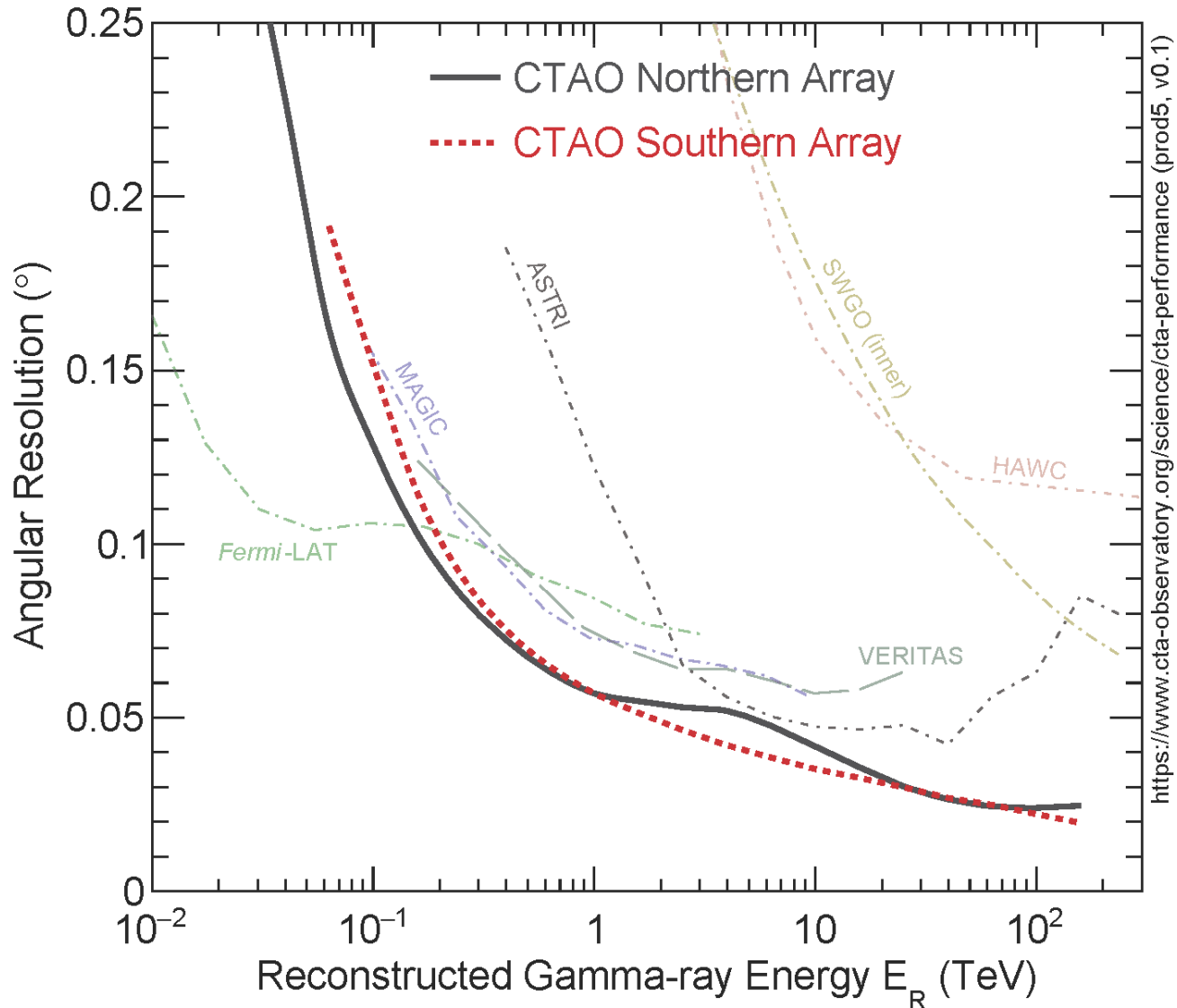
Masahiro Teshima
(Tokyo) recently
elected new
spokesperson

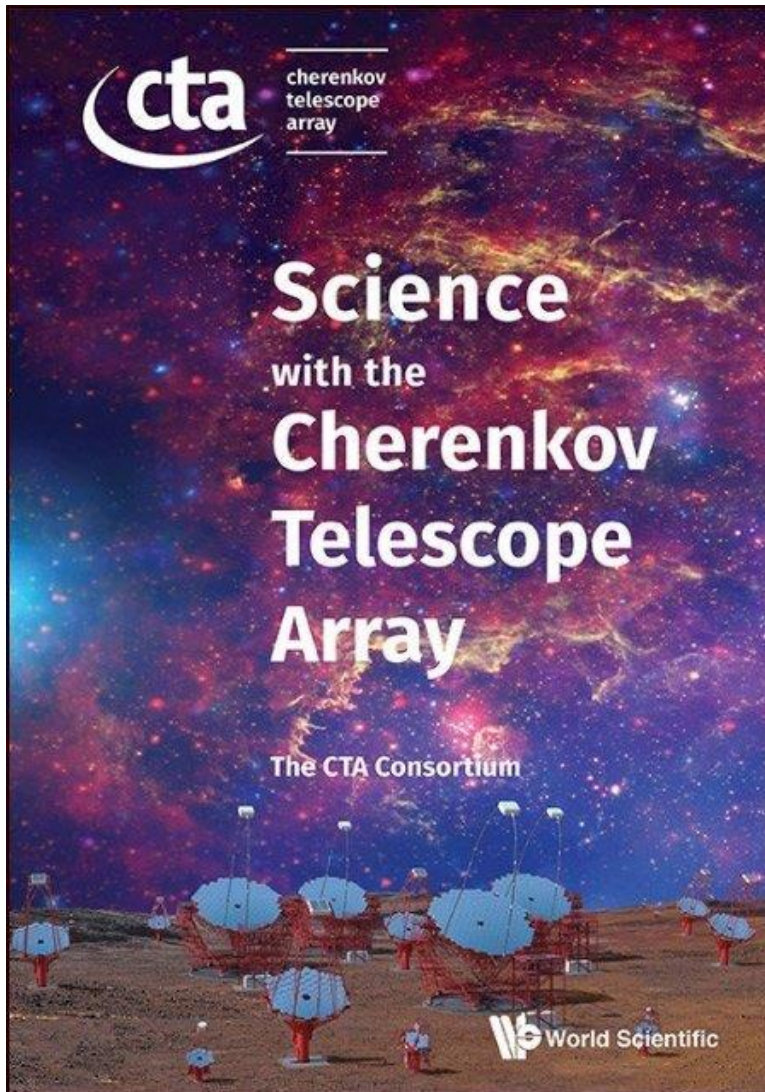
- More than 1400 scientists
- ~ 200 institutes
- 25 countries on 6 continents





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

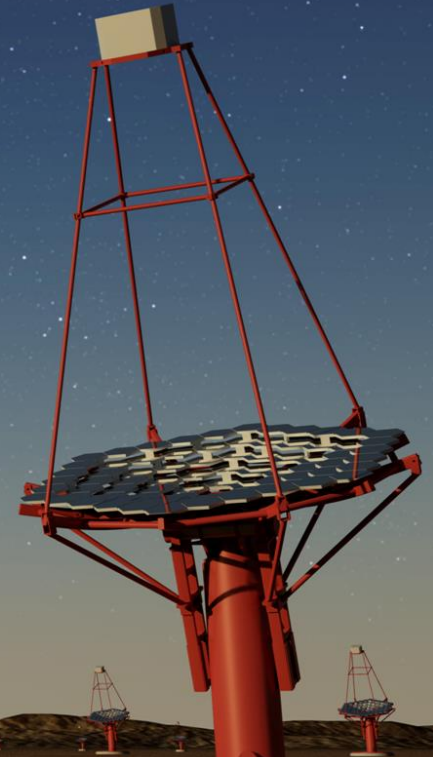
- Physical processes near black holes and neutron stars
- Physics of jets, winds, and explosions
- Radiation and magnetic fields in cosmic voids

3. Exploring frontiers in physics

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

CTAO

Thank you



National
Research
Foundation



science & innovation

Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

Backup slides

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

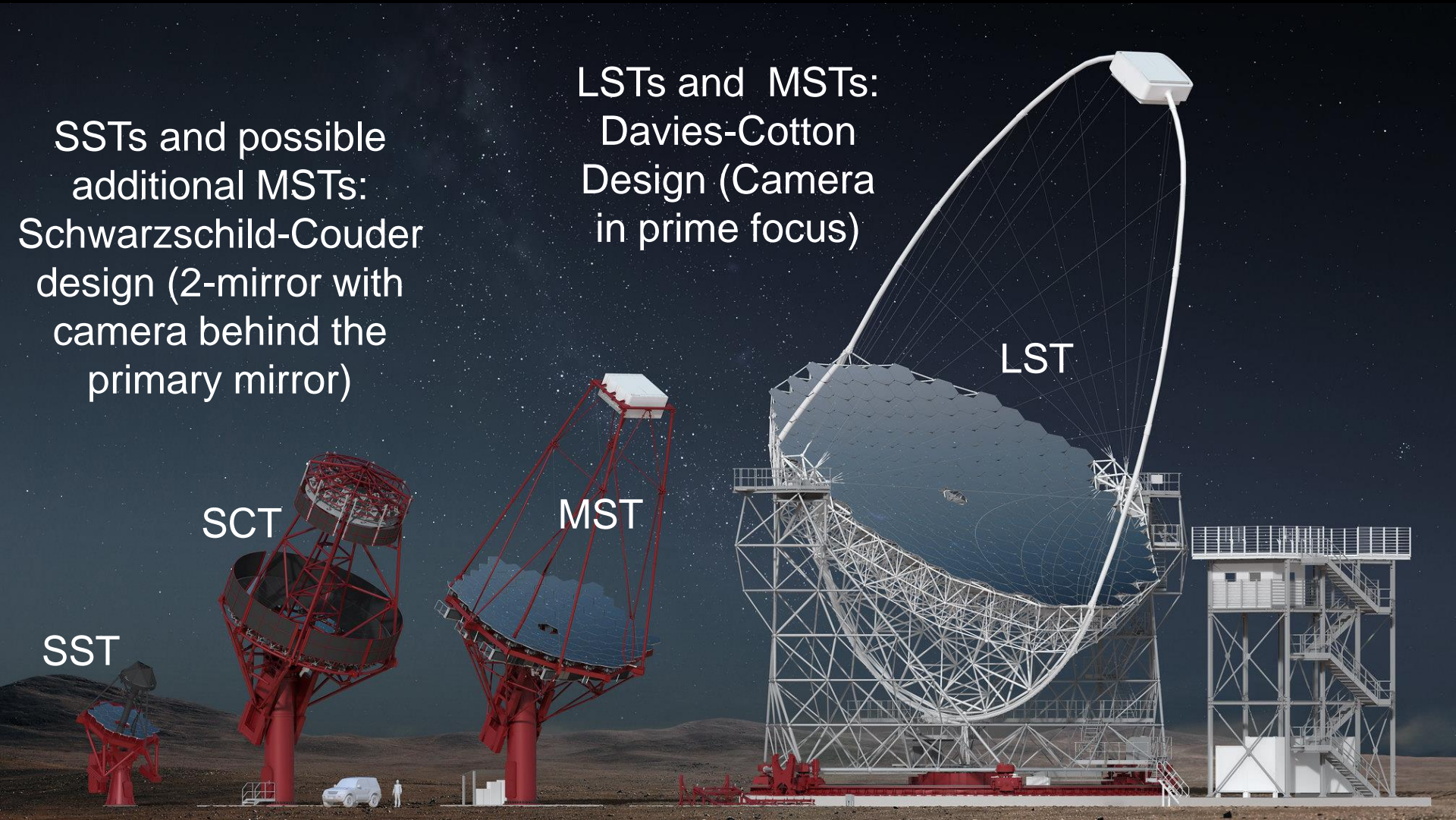
SST

SCT

MST

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

LST



The Very-High-Energy Gamma-Ray Sky

