



The Cherenkov Telescope Array

Overview and Status

Sabrina Einecke

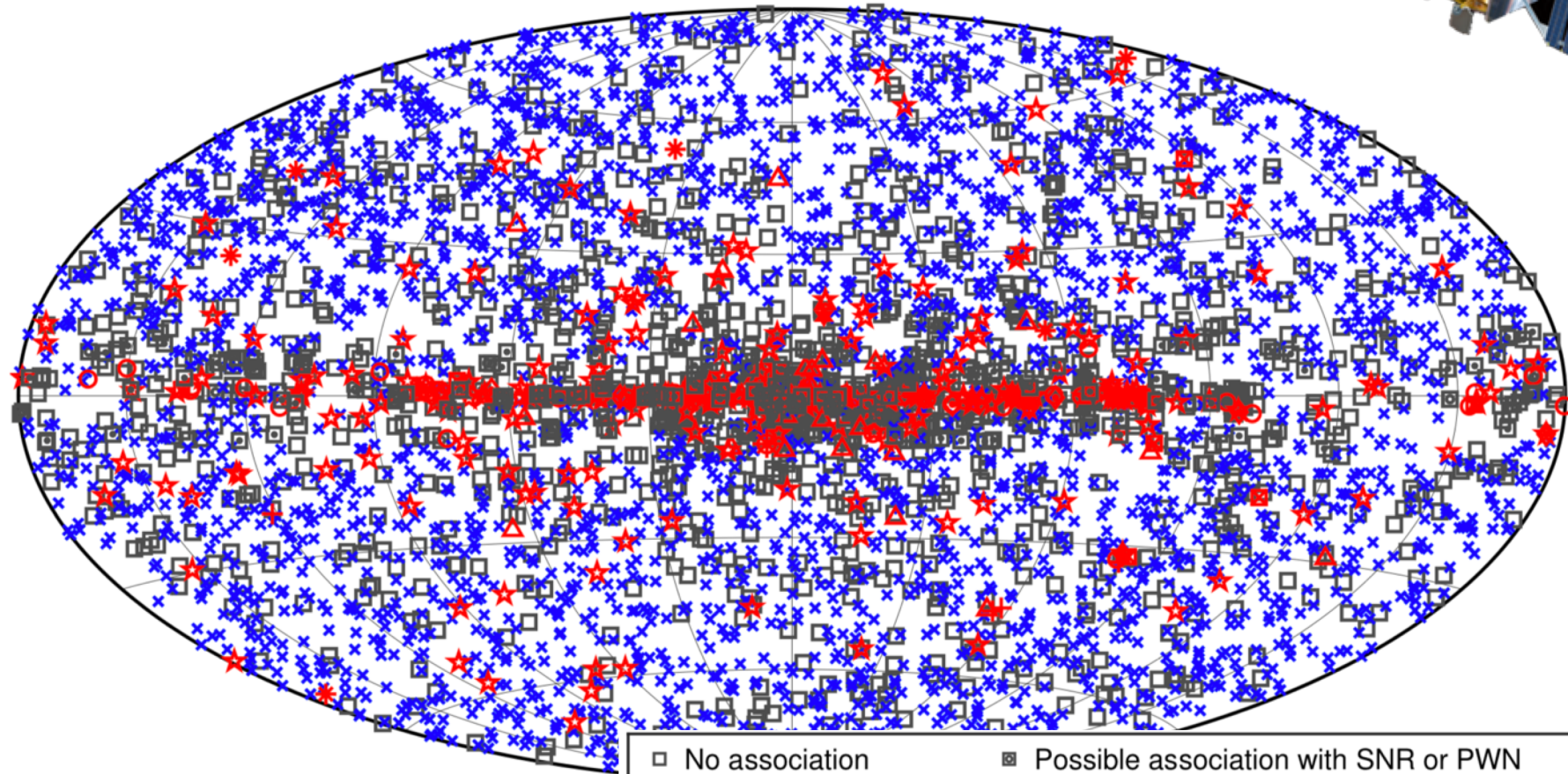
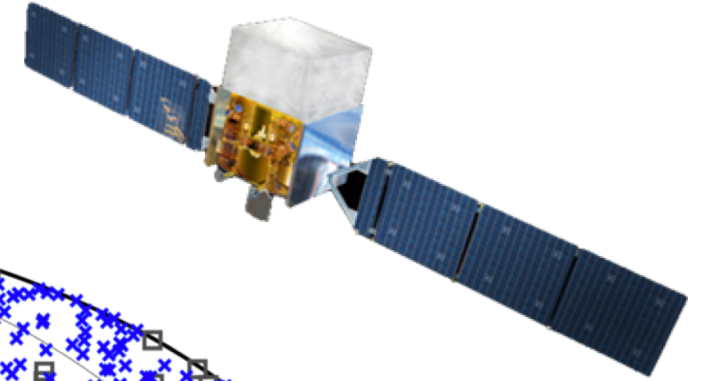
for the CTA consortium

The University of Adelaide

April 23, 2019

The High-Energy Gamma-Ray Sky

Space-based Detection from 50 MeV to 1 TeV

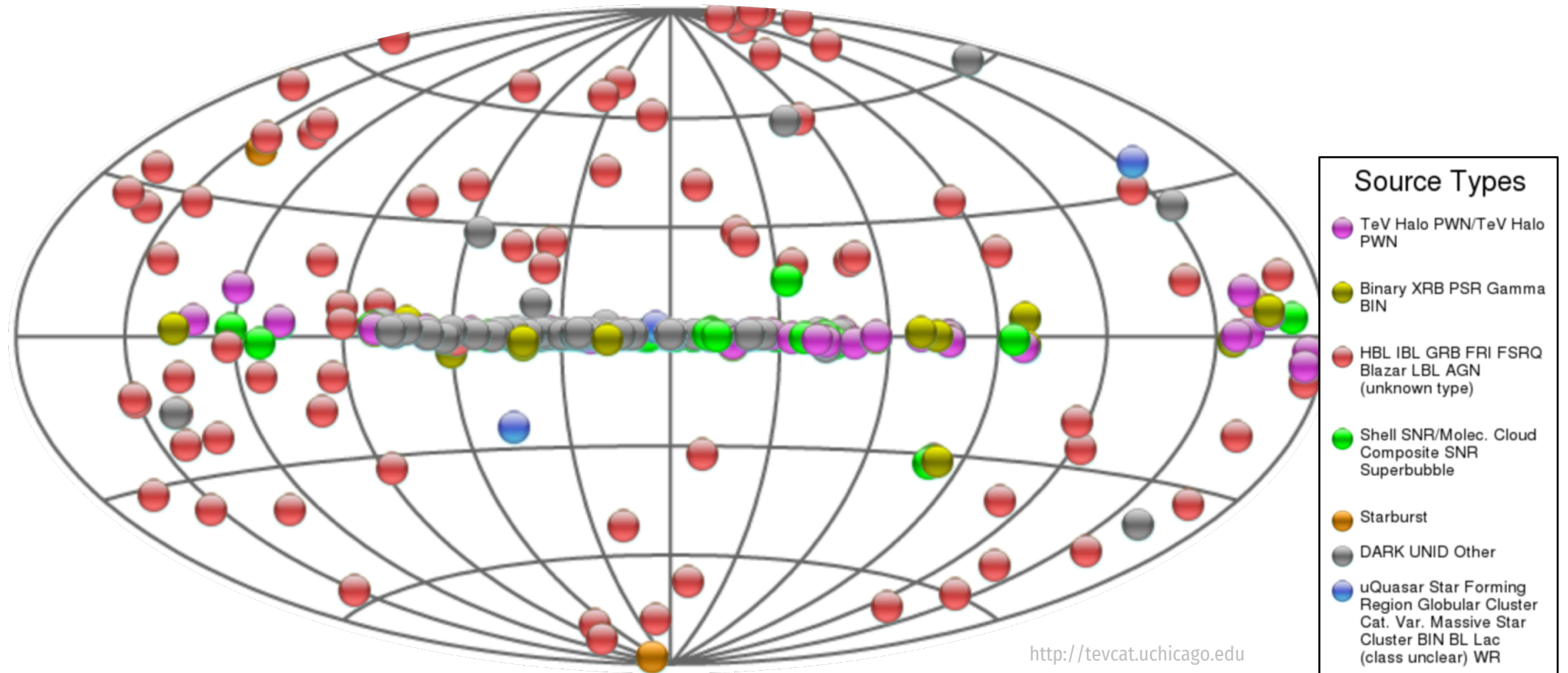


Fermi-LAT Collaboration

□ No association	■ Possible association with SNR or PWN	× AGN
★ Pulsar	△ Globular cluster	◆ PWN
⊠ Binary	+ Galaxy	○ SNR
★ Star-forming region	□ Unclassified source	★ Nova

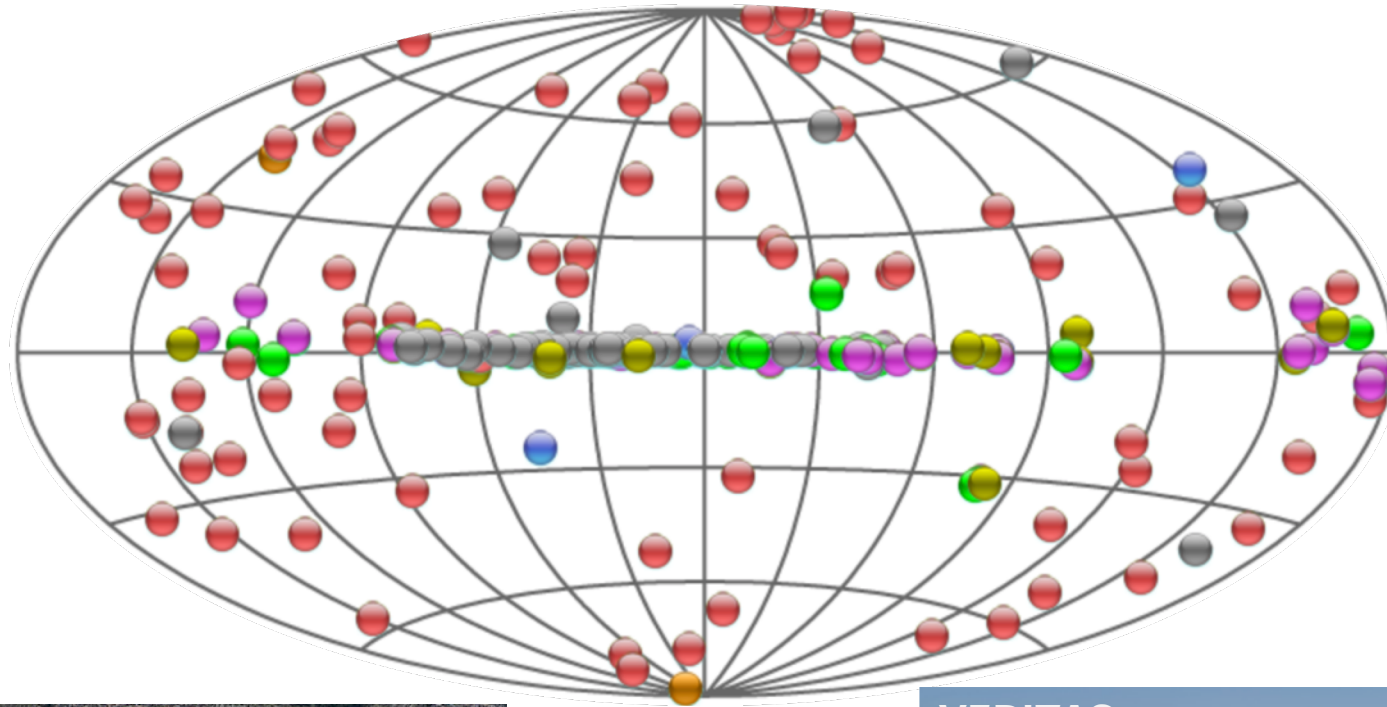
The Very-High-Energy Gamma-Ray Sky

Ground-based Detection from 30 GeV to 500 TeV

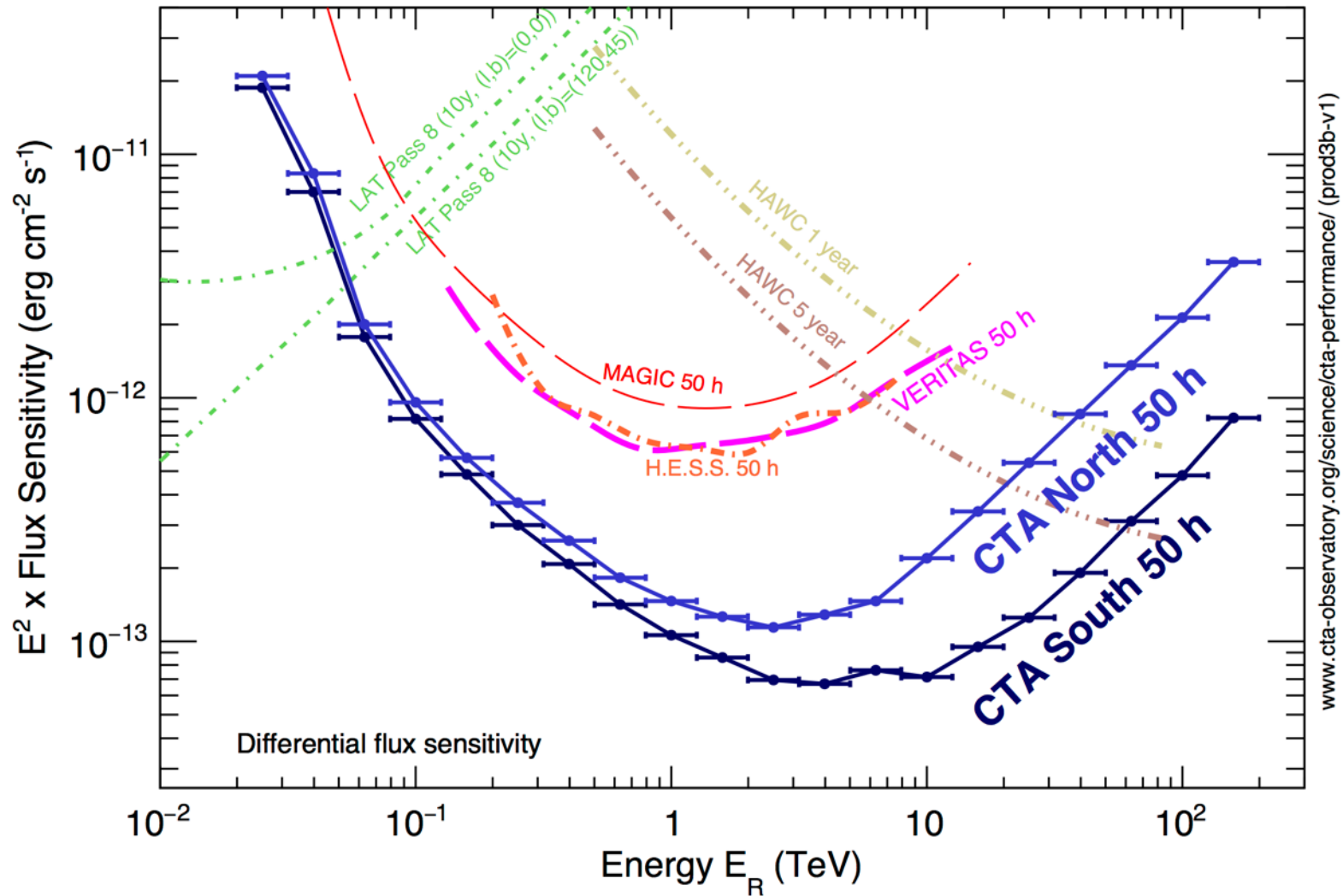


The Very-High-Energy Gamma-Ray Sky

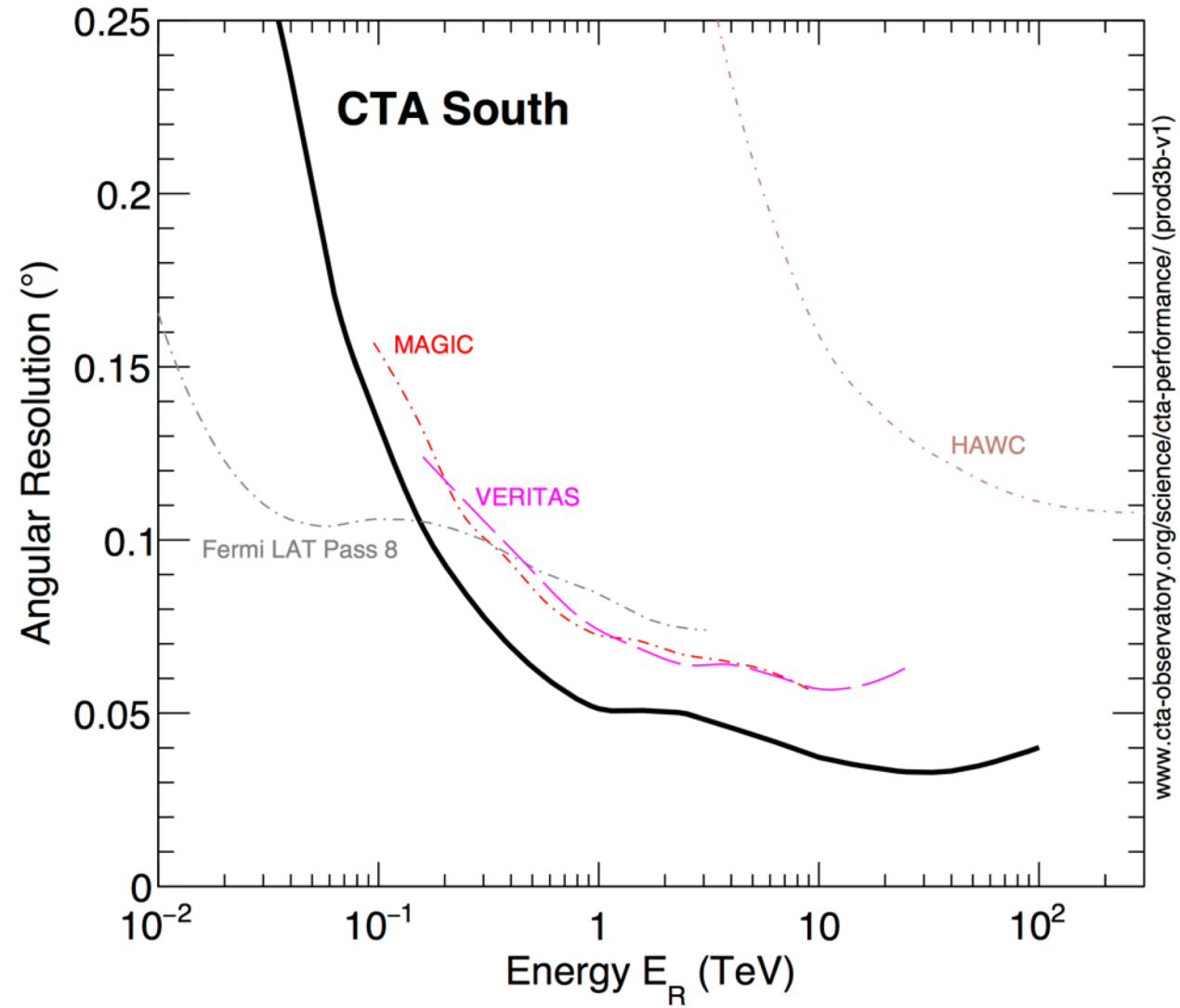
Ground-based Detection from 30 GeV to 500 TeV



Sensitivity



Angular Resolution



Science with CTA

Key Science Projects

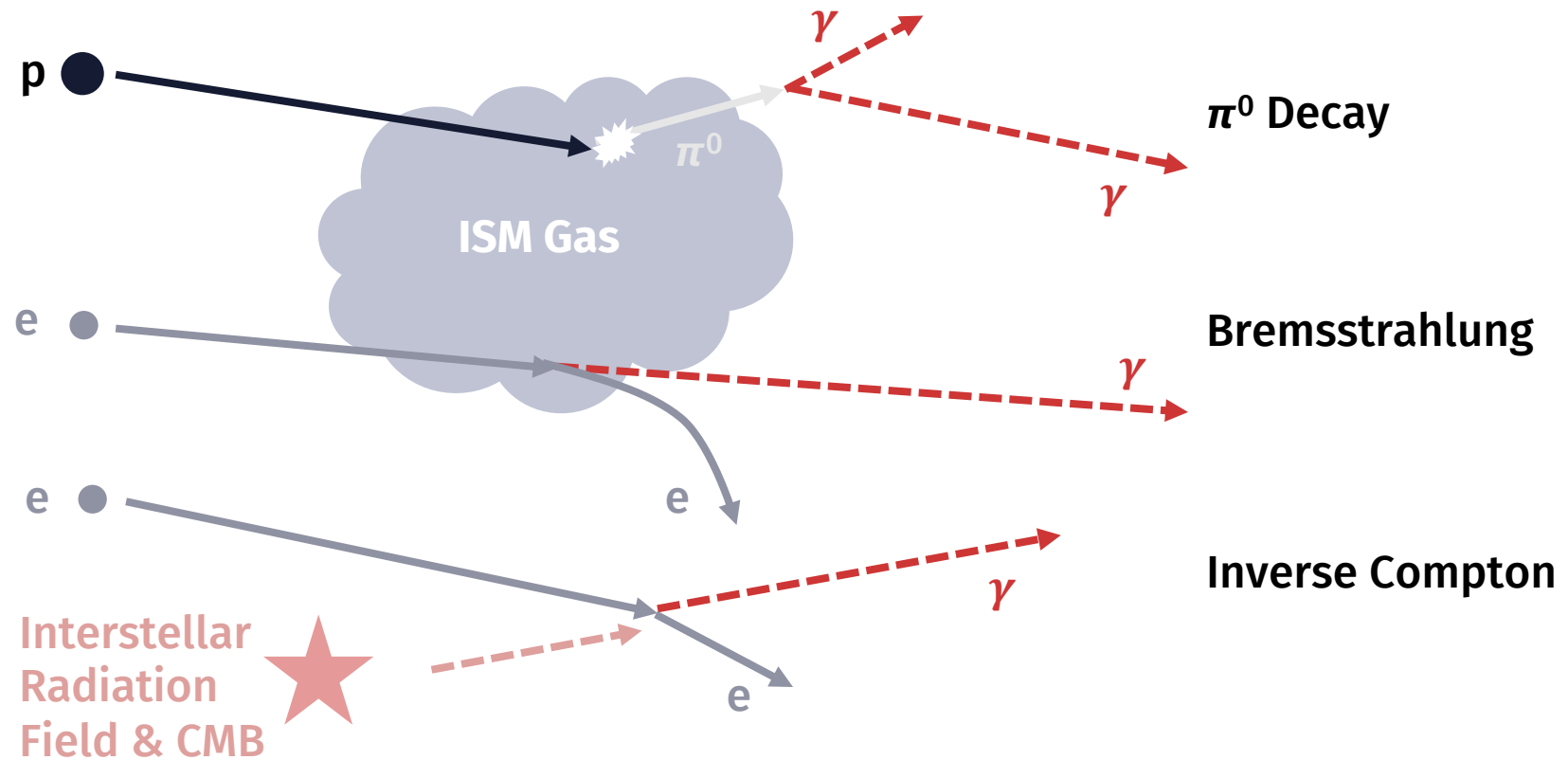
- Dark Matter Programme
- Galactic Centre
- Galactic Plane Survey
- Large Magellanic Cloud Survey
- Extragalactic Survey
- Transients
- Cosmic-Ray PeVatrons
- Star-forming Systems
- Active Galactic Nuclei
- Cluster of Galaxies
- Beyond Gamma Rays



CTA's Themes

Understanding the Origin and Role of Relativistic Cosmic Particles

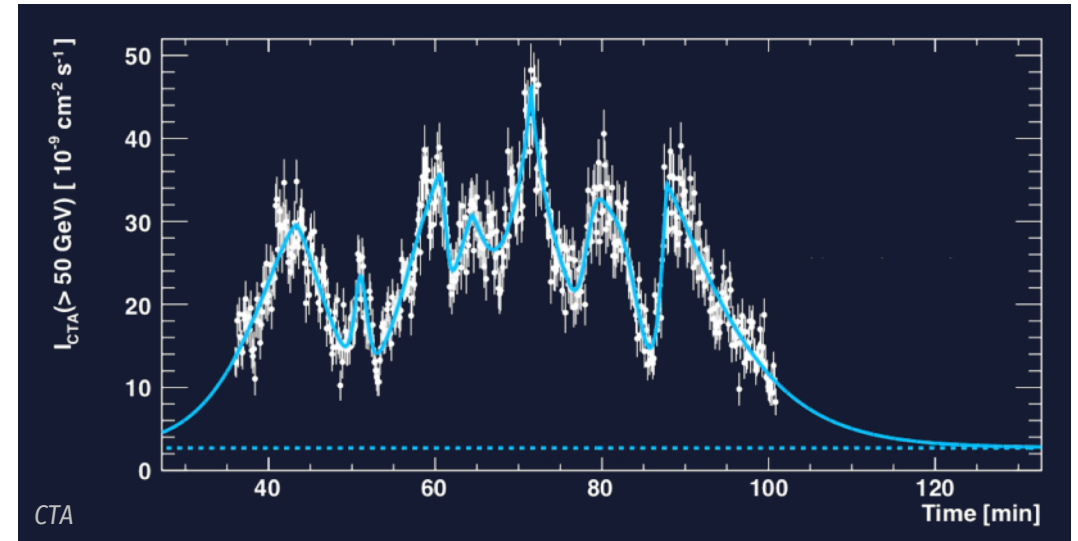
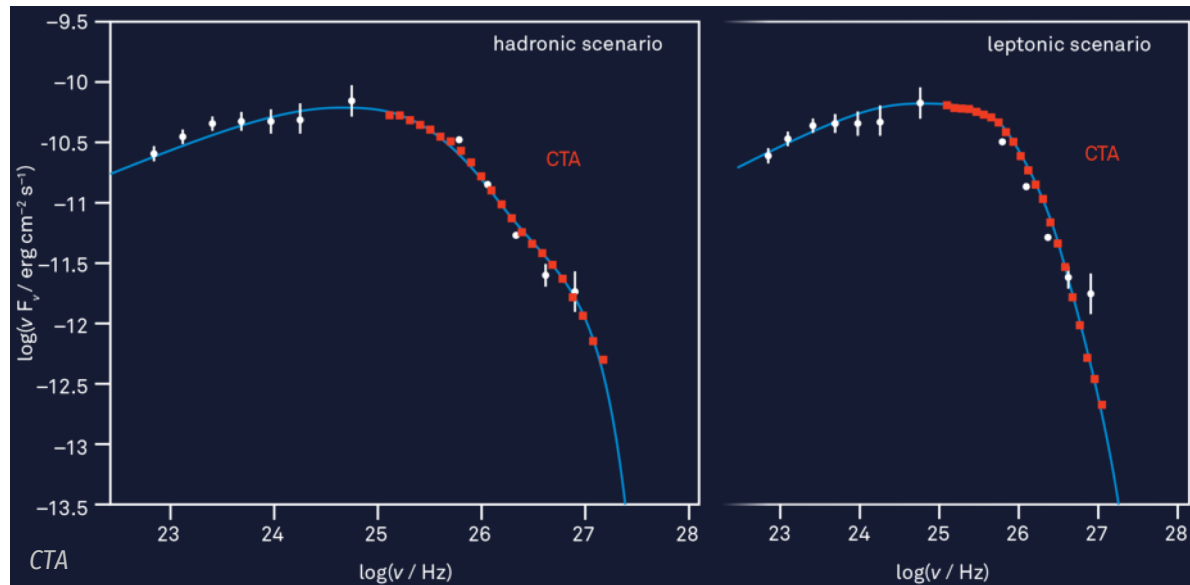
- What are the sites of high-energy particle acceleration in the Universe?
- What are the mechanisms for cosmic particle acceleration?
- What role do accelerated particles play in feedback on star formation and galaxy evolution?



CTA's Themes

Probing Extreme Environments

- What physical processes are at work close to neutron stars and black holes?
- What are the characteristics of relativistic jets, winds and explosions?
- How intense are radiation fields and magnetic fields in cosmic voids?



CTA's Themes

Physics Frontiers

- What is the nature of Dark Matter?
- Are there quantum gravitational effects on photon propagation?
- Do axion-like particles exist?



Australia's Linkages

CTA Hardware & Software

- Telescope hardware & commissioning (ARC LIEF funding)
- Development and improvement of analysis techniques
- Atmospheric studies (cloud monitoring & correction)

Multi-Wavelength & Multi-Messenger

- ISM survey (Mopra, ATCA, ASKAP, SKA)
- Radio continuum (ATCA, MWA, UTMOST, ASKAP, SKA)
- X-ray astronomy (e-ROSITA, XMM-Newton, Chandra)

Beyond Gamma Rays

- Intensity interferometry

Theory

- High-energy astrophysics (e.g. Galactic Centre, jets/outflows)
- Dark matter

Linkages

- Radio (ASKAP-EMU/POSSUM/CRAFT/GASKAP, MWA, UTMOST)
- Optical (e.g.. GALAH, Skymapper), interferometry, transients
- Cosmic rays (Pierre Auger Observatory)
- Gravitational waves (Advanced LIGO)
- Neutrinos (IceCube)
- High Performance Computing, machine learning, ASVO

CTA-Australia

Consortium

- **The University of Adelaide**
G. Rowell, S. Einecke, J. Bellido, R. Clay, B. Dawson, K. Feijen, S. Lee, D. Ottaway, P. Veitch, F. Voisin, M. White, N. Wild
- **University of New South Wales**
M. Ashley, C. Braiding, N. Maxted, I. Seitzzahl
- **Western Sydney University**
M. Filipovic, N. Tothill
- **Australian National University**
G. Bicknell, R. Crocker
- **Monash University**
C. Balazs, D. Galloway, J. Lazendic-Galloway
- **The University of Sydney**
C. Boehm, S. Breen, A. Green, A. Kobakhidze

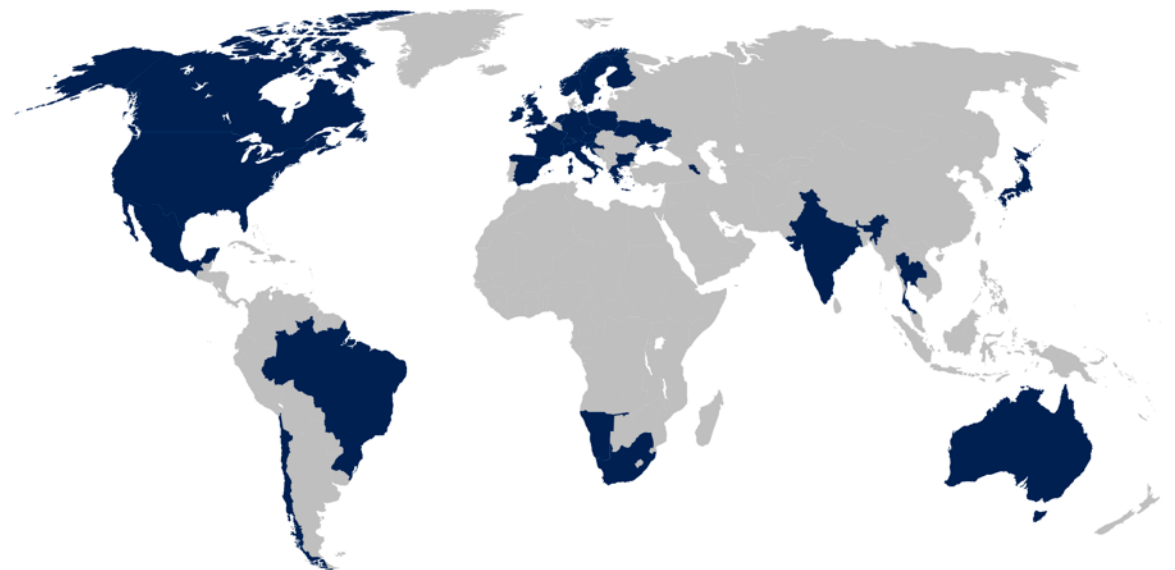
Funding:

- ARC LIEF 2015 + 2017-2021 (hardware & commissioning)
- NCRIS/AAL (travel & meetings)



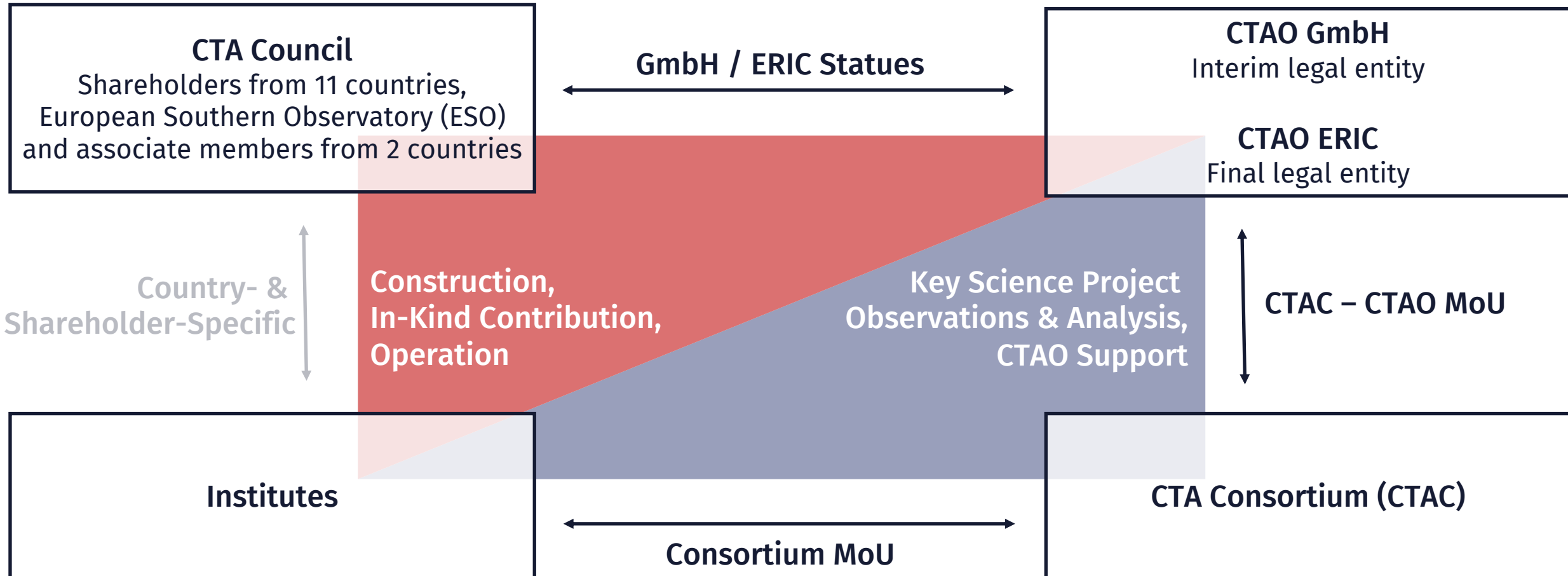
CTA Consortium

- 31 countries
- Over 200 institutes
- Over 1400 members

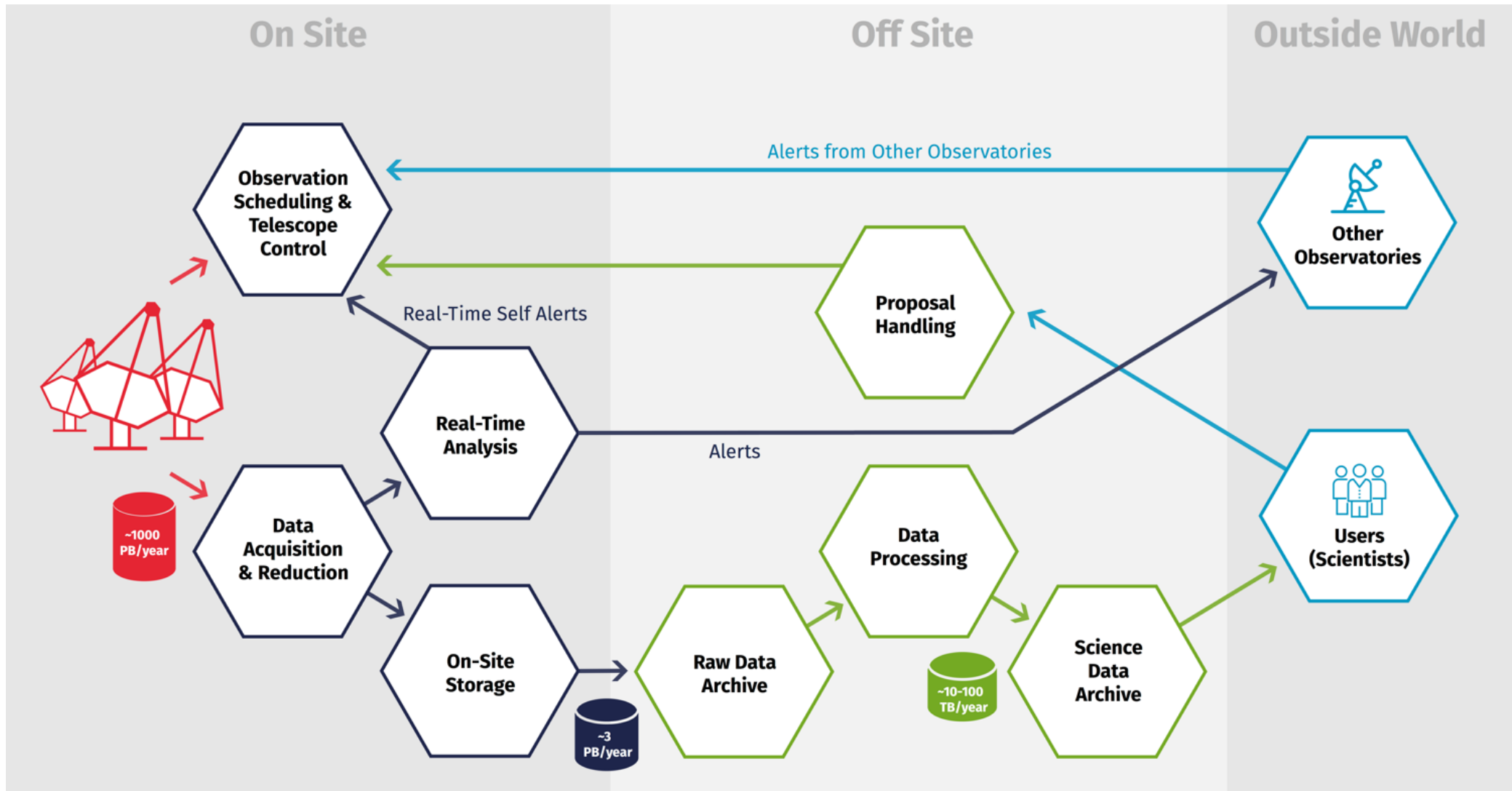


Organisation of CTA

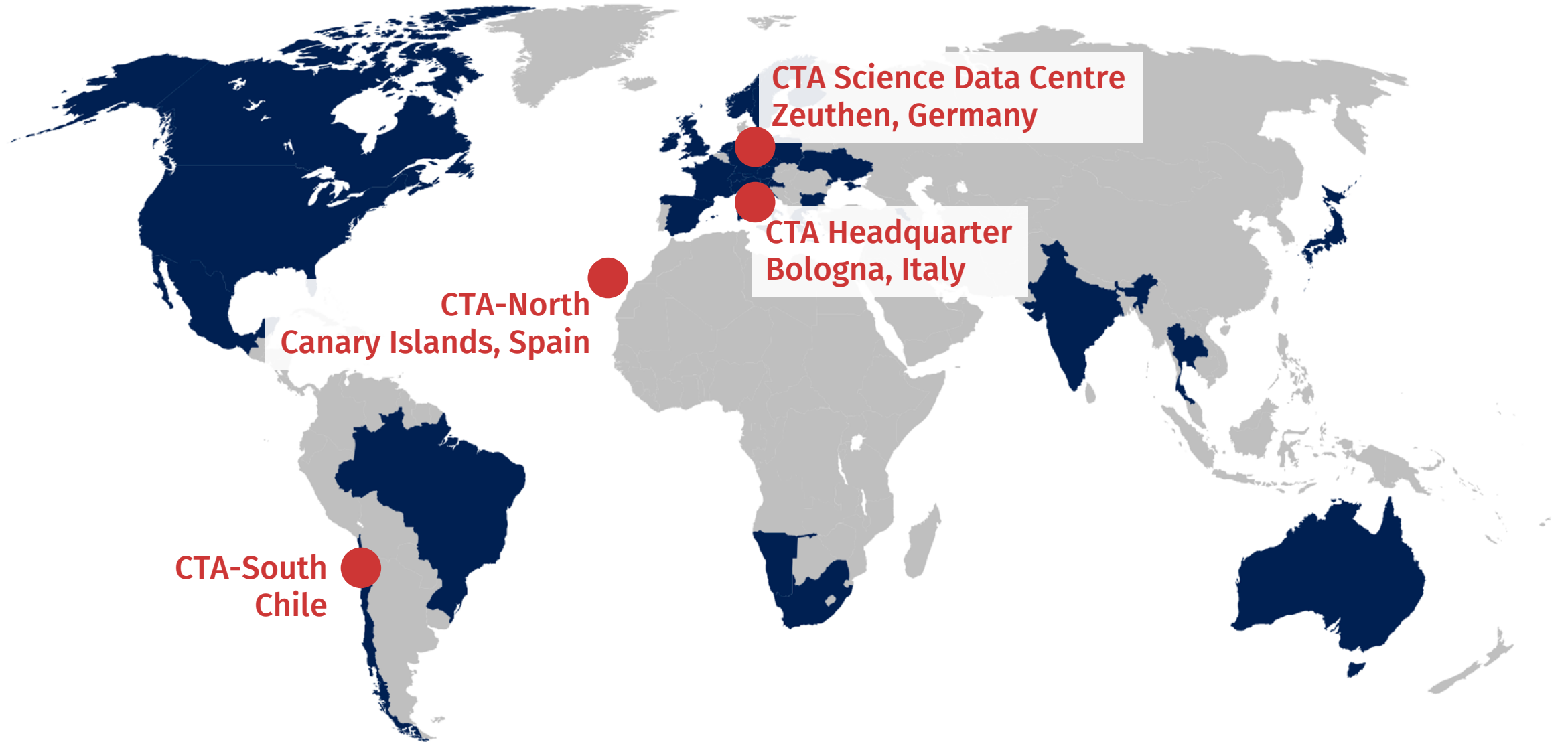
CTA Observatory (CTAO): Open, proposal-driven observatory



Data & Information Management



CTA Sites



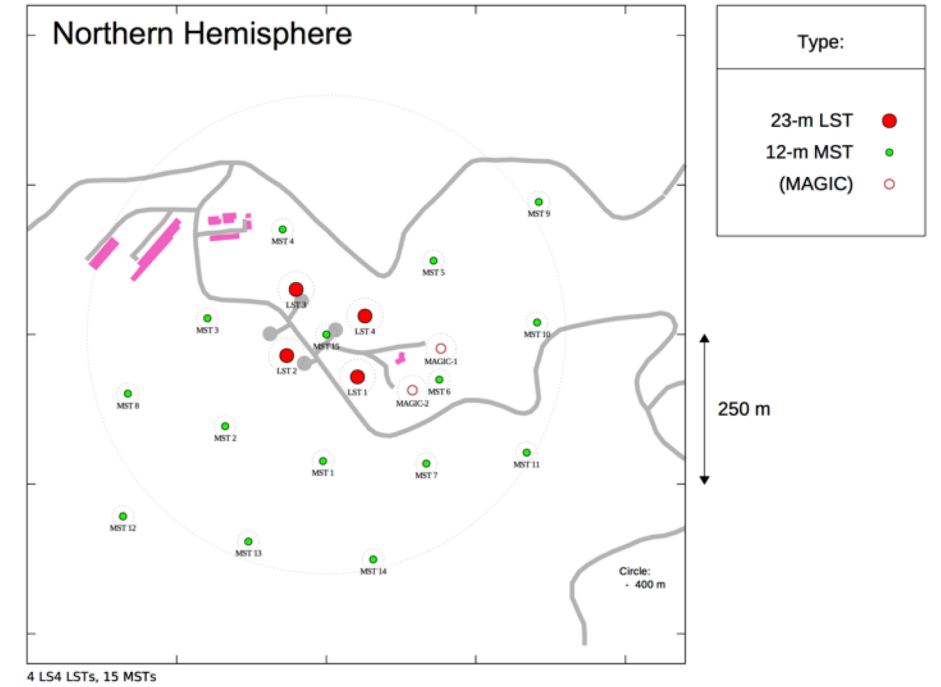
Northern Site

Observatorio del Roque de los Muchachos La Palma, Spain

- Selected: July 2015
- Agreement signed: Sept. 2016

Array Layout

- 4 Large-Sized Telescopes
- 15 Medium-Sized Telescopes



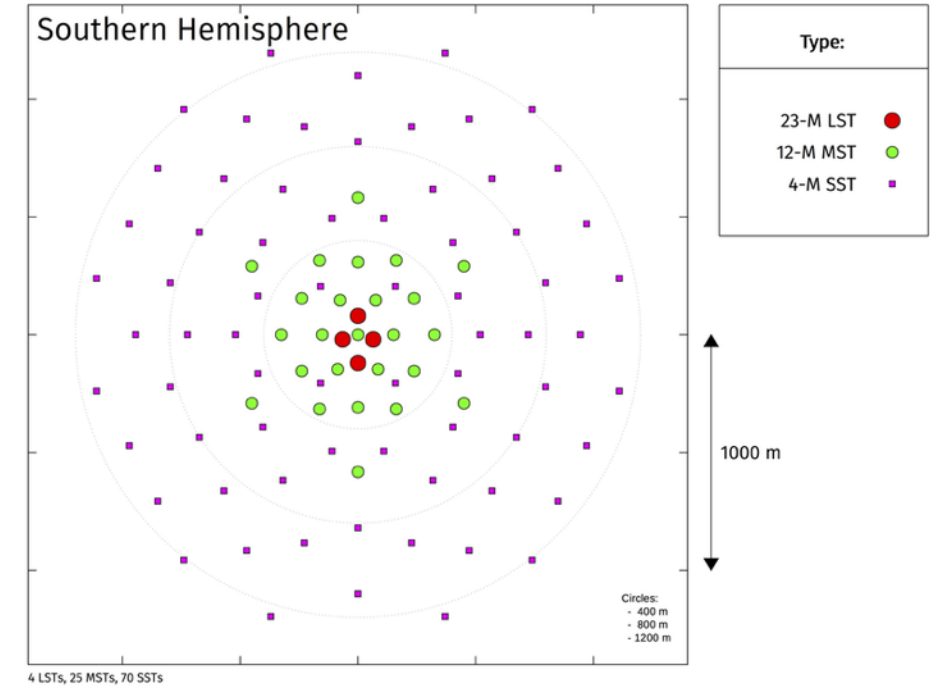
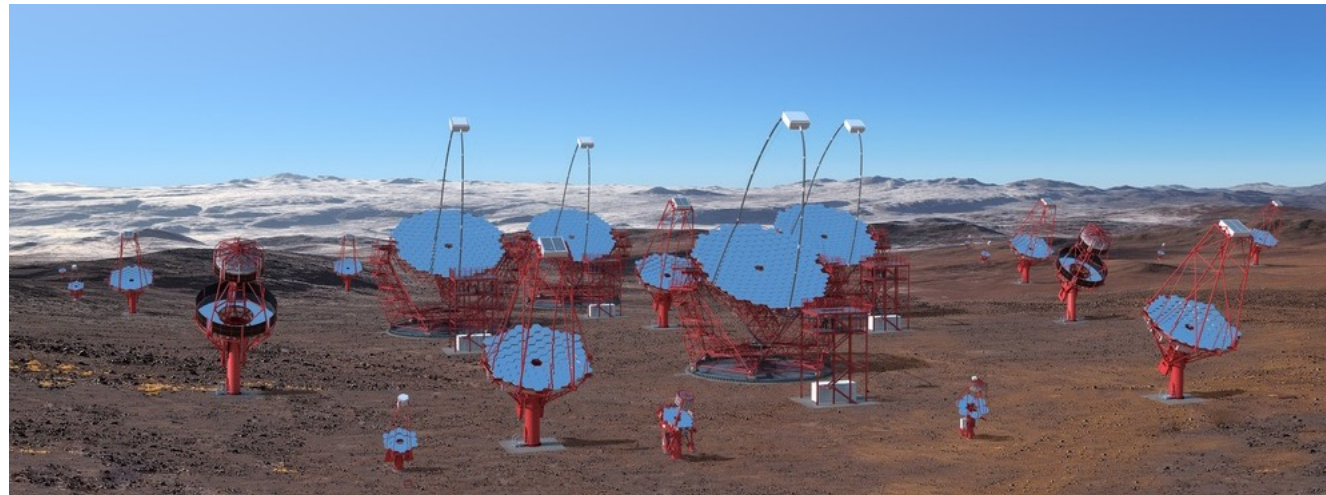
Southern Site

European Southern Observatory (ESO) Paranal, Chile

- Selected: July 2015
- Agreement signed: Dec. 2018

Array Layout

- 4 Large-Sized Telescopes
- 25 Medium-Sized Telescopes
- 70 Small-Sized Telescopes



Telescope Types



Large-Sized Telescopes

Prototype on La Palma

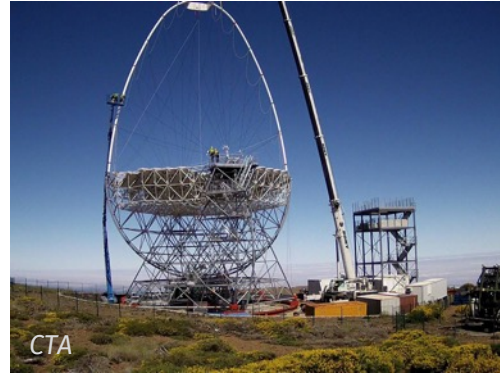
January 2017: Completion of foundation



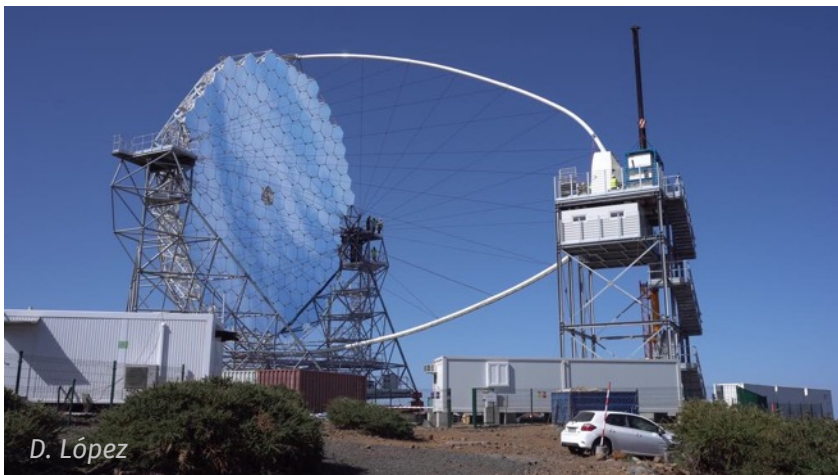
April 2018: Mirror installation



June 2018:
Installation of camera support structure



September 2018: Installation of camera & end of construction

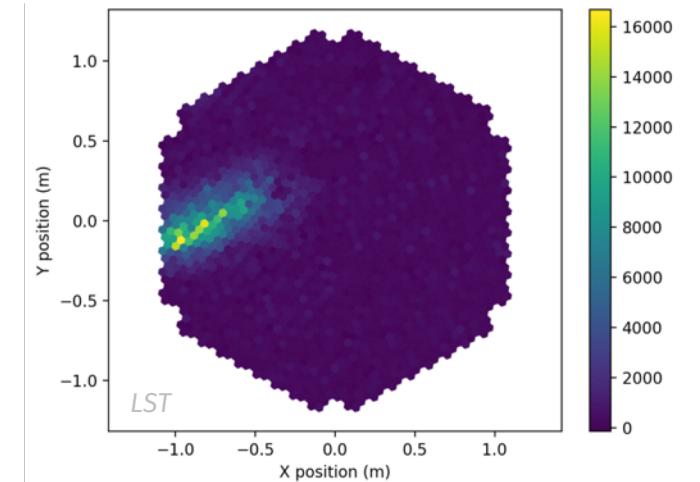


October 2018: LST-I inauguration



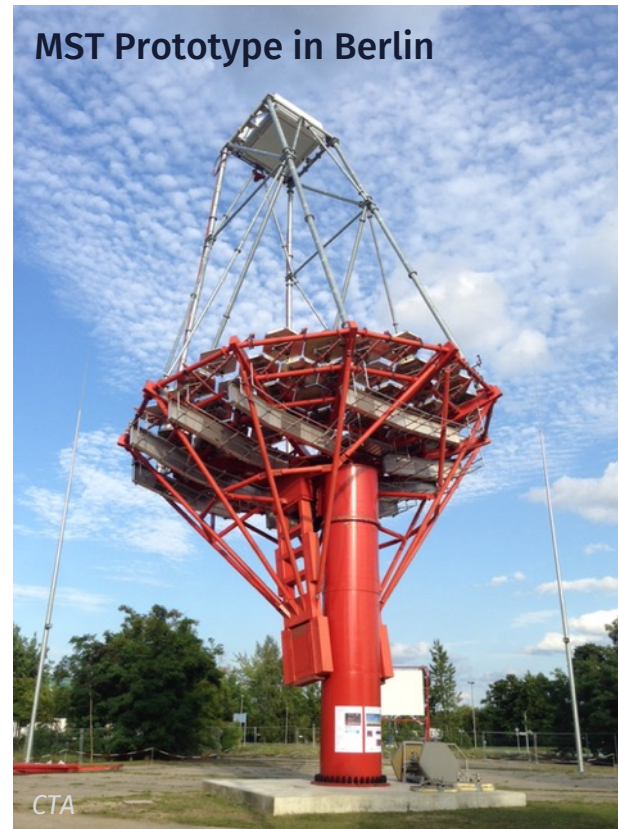
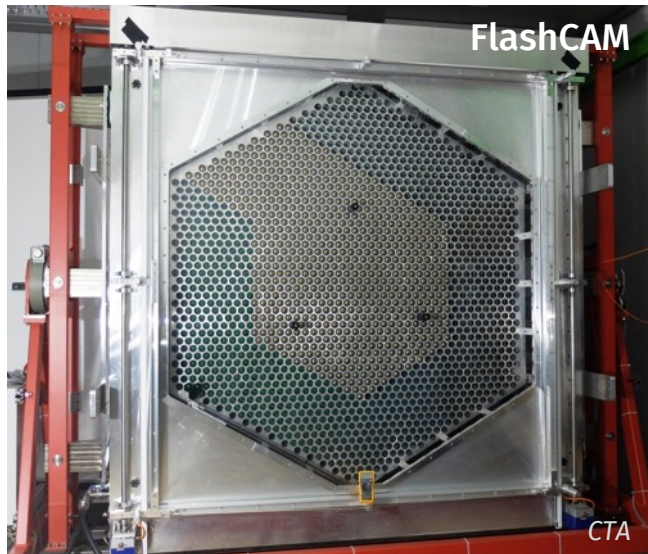
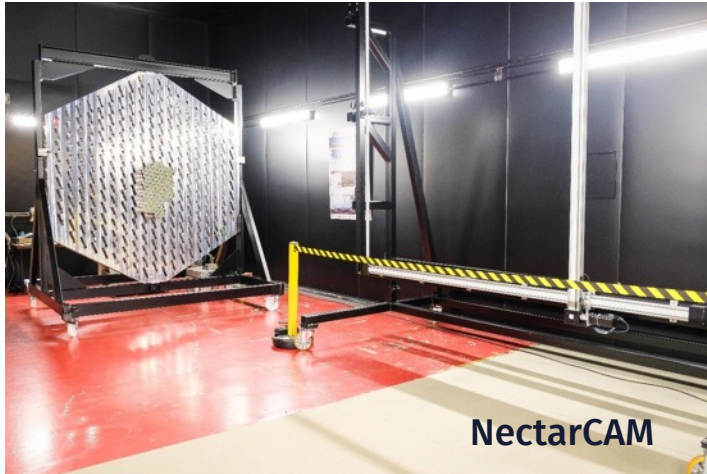
- Low-energy range: 20 GeV – 3 TeV
- Mirror of 23 m diameter
- Camera with 1855 pixels (PMT)
- Weight of 100 t
- Re-positioning within 20 s

December 2018: First light



Medium-Sized Telescopes

- Medium-energy range: 80 GeV – 50 TeV
- Effective mirror area: 88m² (MST) / 41m² (SCT)
- Camera pixels: ~2000 PMTs (MST) / ~11000 SiPMs (SCT)
- Field of View: 7.5° - 7.7°



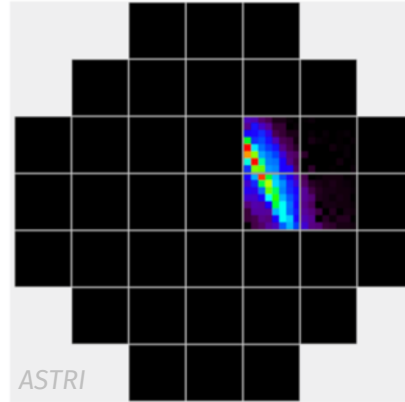
Small-Sized Telescopes

- High-energy range: 1 TeV – 300 TeV
- Effective mirror area: 7.5 – 8.9 m²
- Camera pixels: 1296 – 2368 SiPMs
- Field of View: 8.3° - 10.5°

SST-2M ASTRI Prototype in Sicily



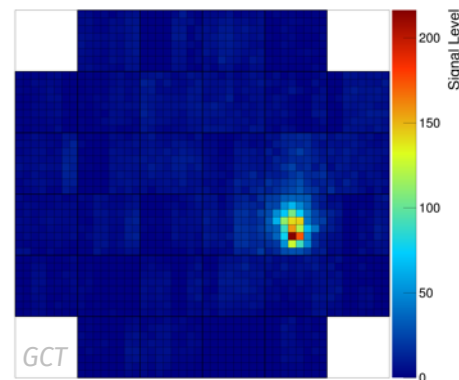
May 2017: First light



SST-2M GCT Prototype in Paris



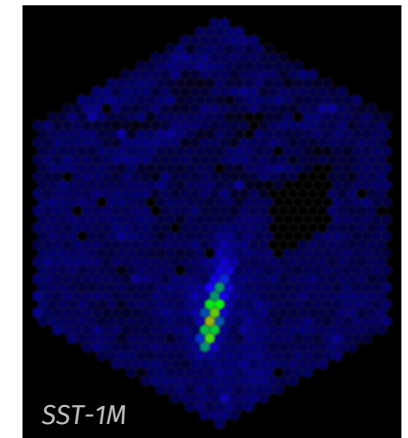
November 2015: First light



SST-1M Prototype in Krakow



August 2017: First light



Status

- All prototypes running and achieved first light
- All site agreements signed

- European Research Infrastructure Consortium (ERIC) in preparation
- Inter-governmental agreement for construction and operation of observatory in preparation

- Australia:
 - CTAC member: Access to key science projects & low-level data
 - CTAO member: Vote on governance policies

Next Steps

