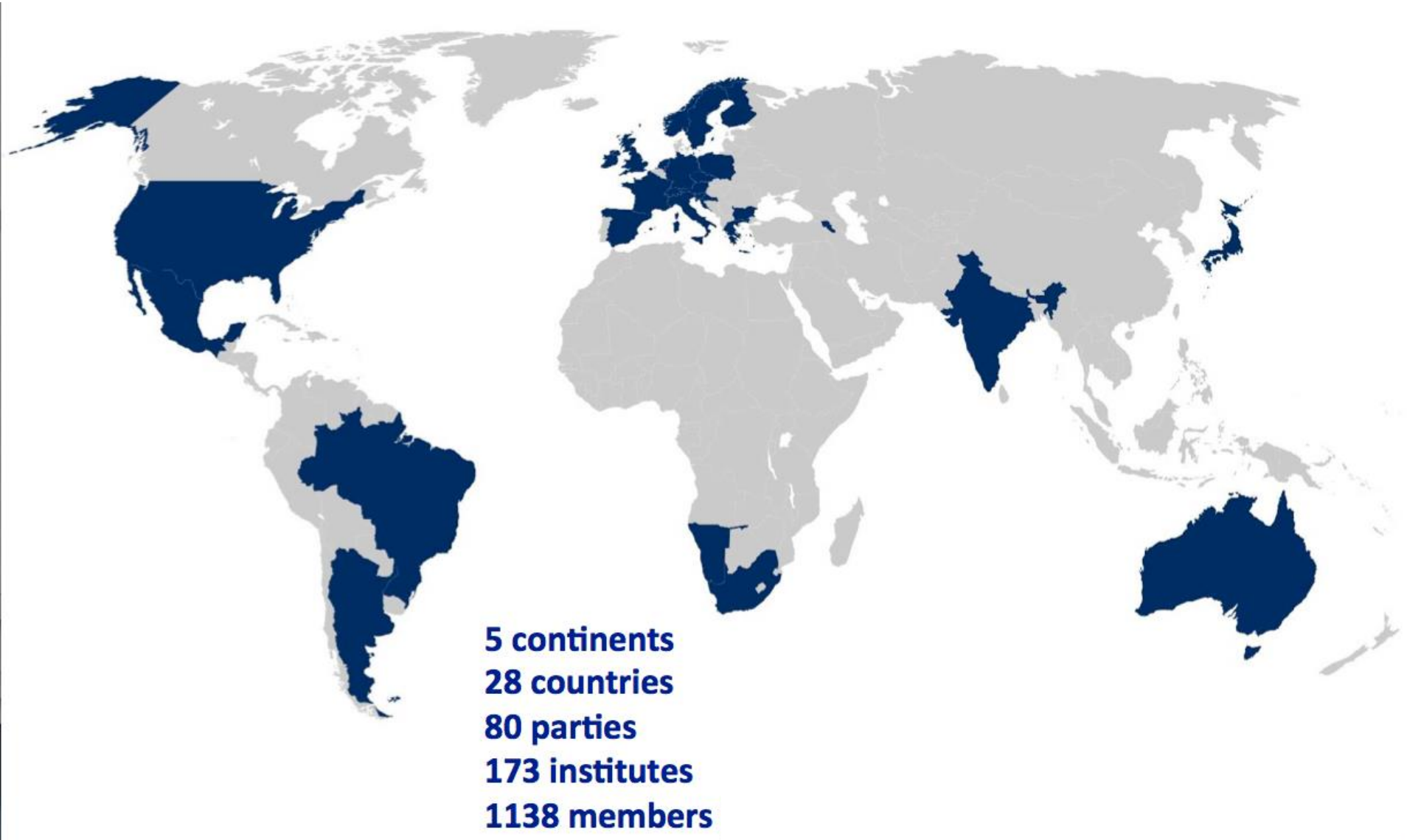
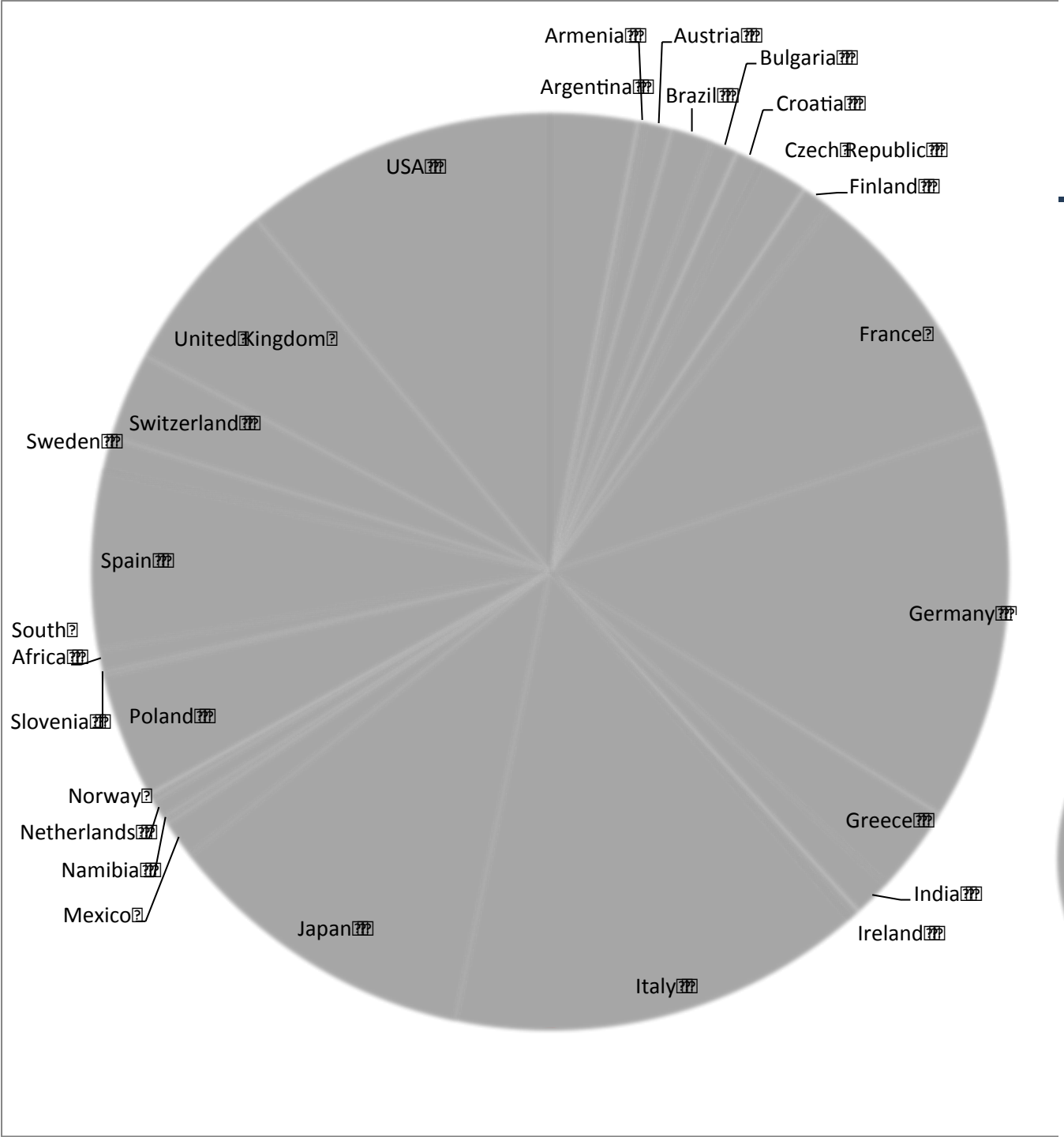
Patrizia Caraveo

using slides stolen (with permission) from W. Hofmann

STATUS OF CTA

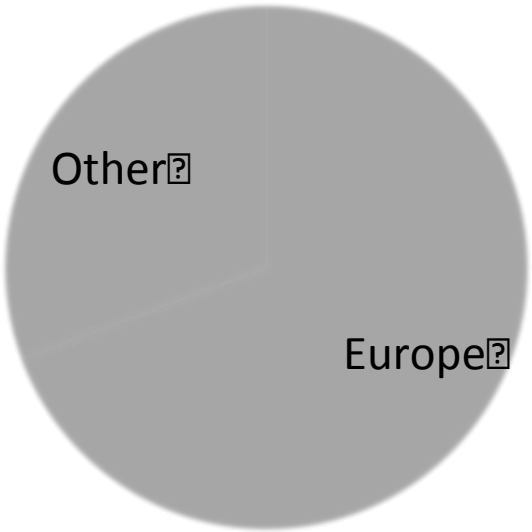
CTA CONSORTIUM





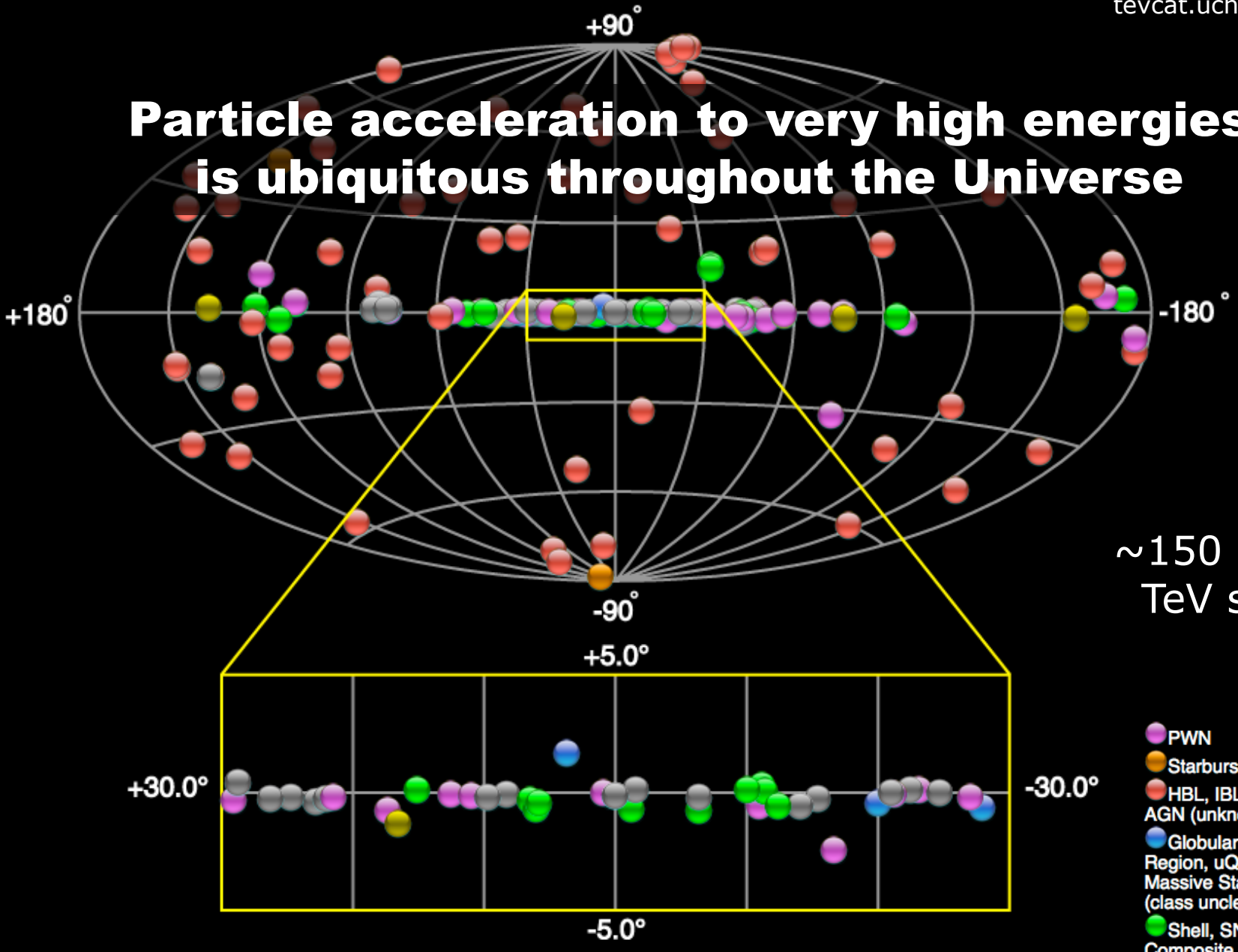
cta
cherenkov telescope array

CTA scientists



tevcat.uchicago.edu/

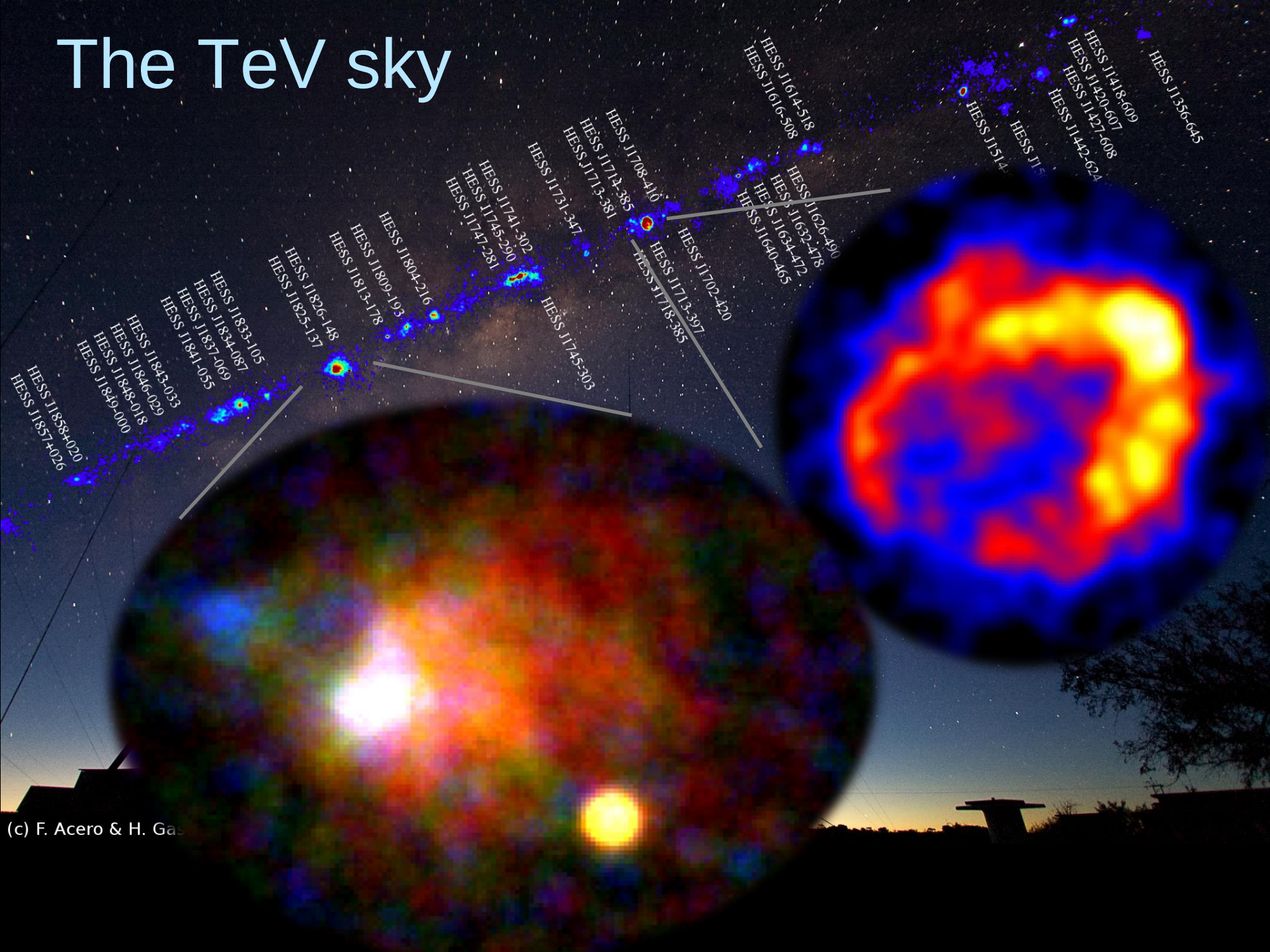
Particle acceleration to very high energies is ubiquitous throughout the Universe

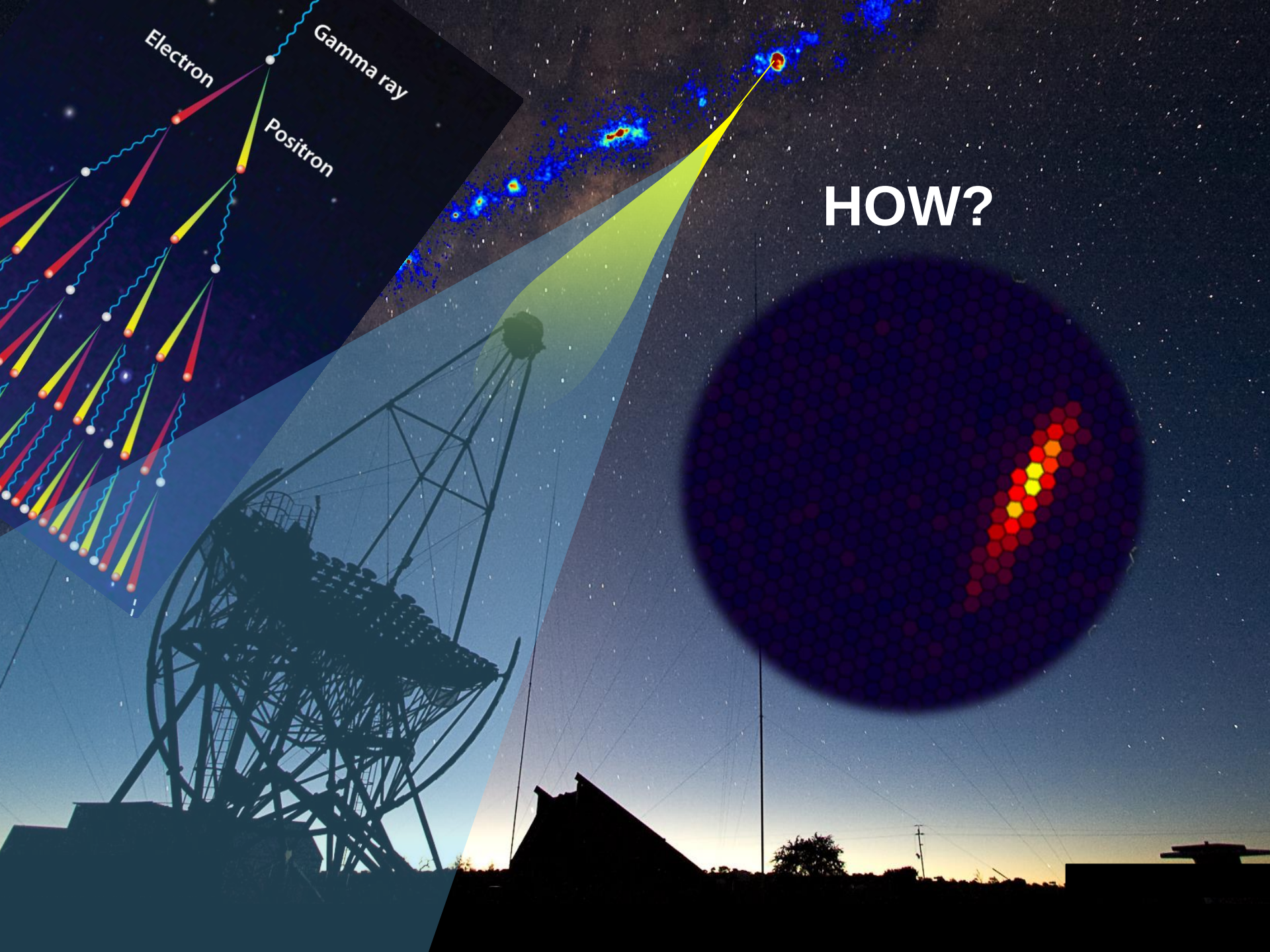


~150 known TeV sources

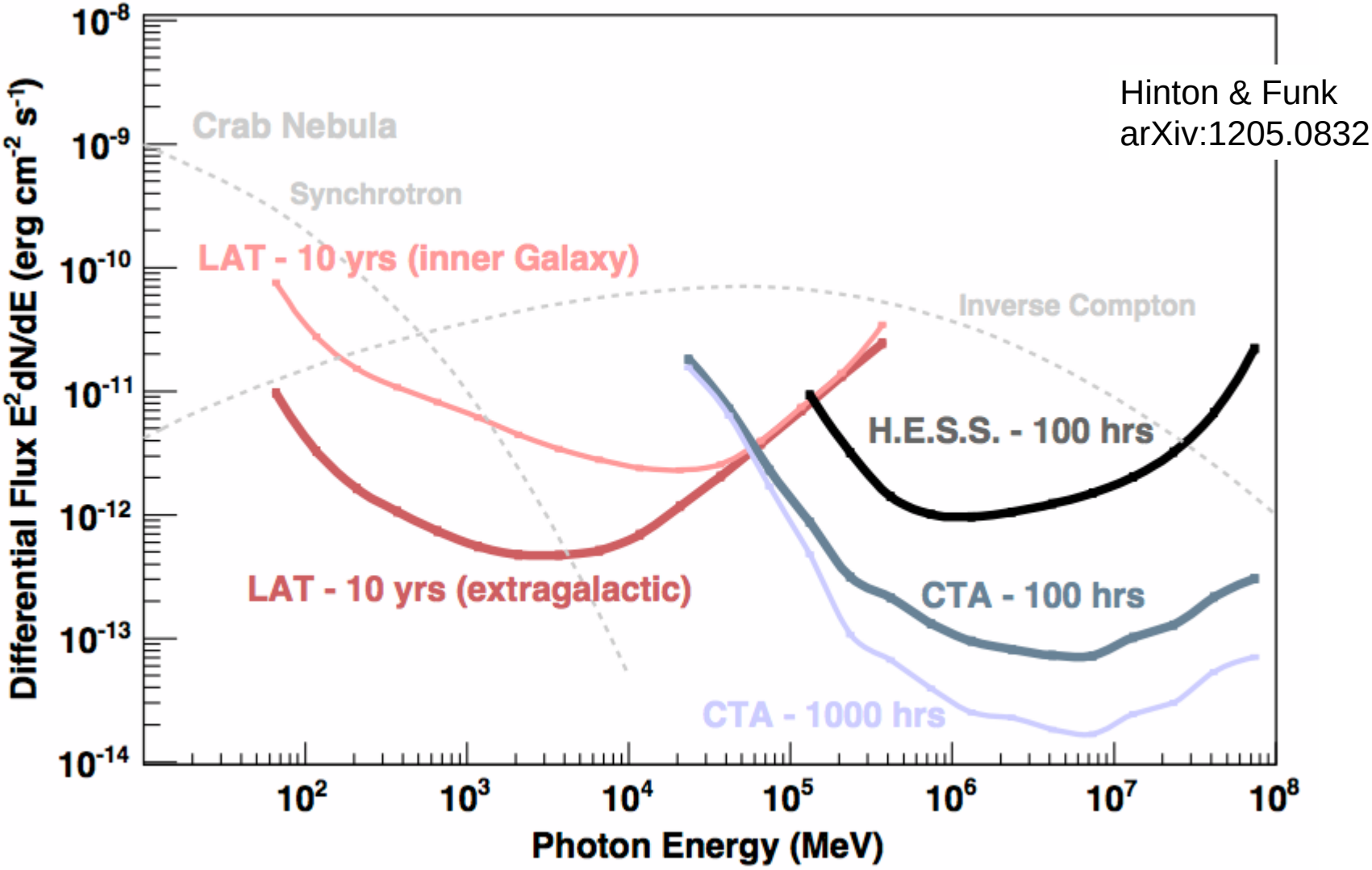
PWN
Starburst
HBL, IBL, FRI, FSRQ, LBL, AGN (unknown type)
Globular Cluster, Star Forming Region, uQuasar, Cat. Var., Massive Star Cluster, BIN, BL Lac (class unclear), WR
Shell, SNR/Molec. Cloud, Composite SNR
DARK, UNID, Other
Binary, XRB, PSR, Gamma BIN

The TeV sky


HESS J1356-645
HESS J1418-609
HESS J1420-607
HESS J1427-608
HESS J1442-624
HESS J1514
HESS J1614-518
HESS J1616-508
HESS J1626-490
HESS J1632-478
HESS J1634-472
HESS J1640-465
HESS J1708-410
HESS J1714-385
HESS J1713-381
HESS J1731-347
HESS J1741-302
HESS J1745-290
HESS J1747-281
HESS J1745-303
HESS J1804-216
HESS J1809-193
HESS J1813-178
HESS J1825-137
HESS J1826-148
HESS J1833-105
HESS J1834-087
HESS J1837-069
HESS J1841-055
HESS J1843-033
HESS J1846-029
HESS J1848-018
HESS J1849-000
HESS J1858+020
HESS J1857+026
HESS J1702-420
HESS J1713-397
HESS J1718-385
(c) F. Acero & H. Ga


Electron
Gamma ray
Positron
HOW?

DIFFERENTIAL FLUX SENSITIVITY



Hinton & Funk
arXiv:1205.0832

REQUIREMENTS & DRIVERS

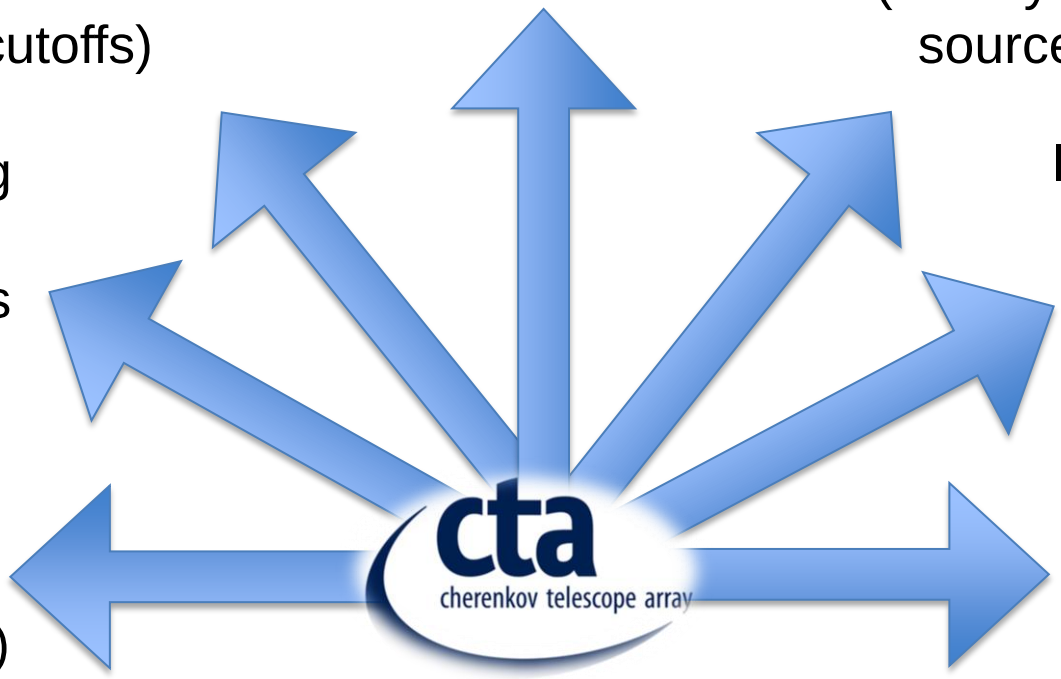
10 x Sensitivity
and collection area
(nearly every topic)

Good energy
resolution of ~10%
(lines, cutoffs)

Large field of view of 8^{o}
(surveys, extended
sources, flares)

Rapid slewing
(20 s)
to catch flares

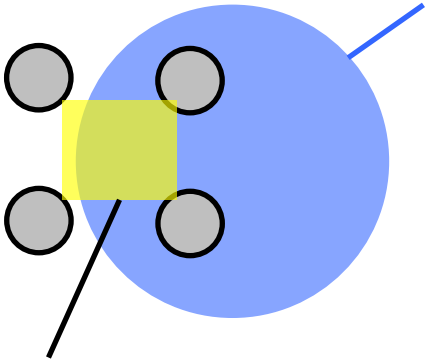
Improved angular
resolution of
few arcmin
(source
morphology)



Energy coverage
down to 20 GeV
(AGN, cosmology)

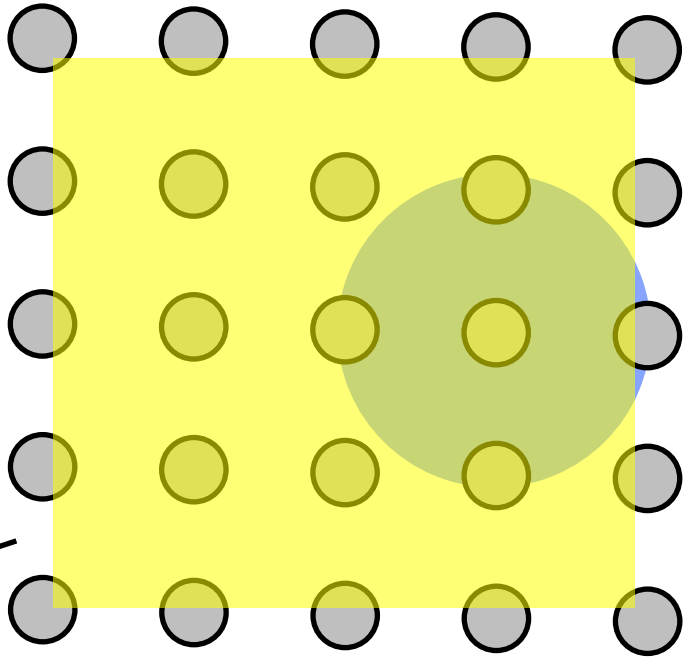
Energy coverage
up to 300 TeV
(Pevatrons)

FROM CURRENT ARRAYS TO CTA



light pool radius
R ≈100-150 m
≈ typical telescope spacing

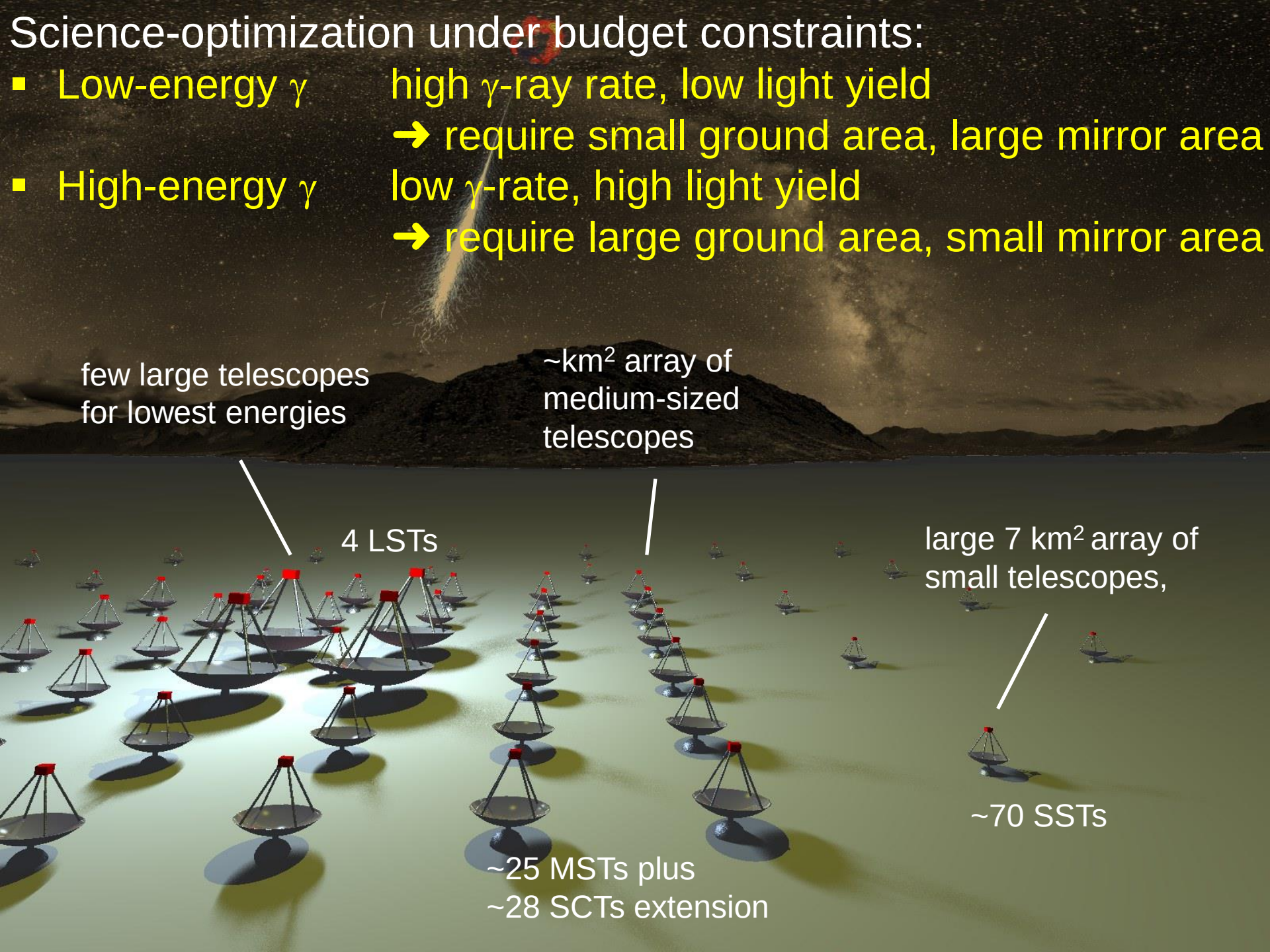
Sweet spot for
best triggering
and reconstruction:
most showers miss it!



large detection area
more images per shower
lower trigger threshold

Science-optimization under budget constraints:

- Low-energy γ — high γ-ray rate, low light yield
  ➜ require small ground area, large mirror area
- High-energy γ — low γ-rate, high light yield
  ➜ require large ground area, small mirror area



SOUTHERN AND NORTHERN SITES

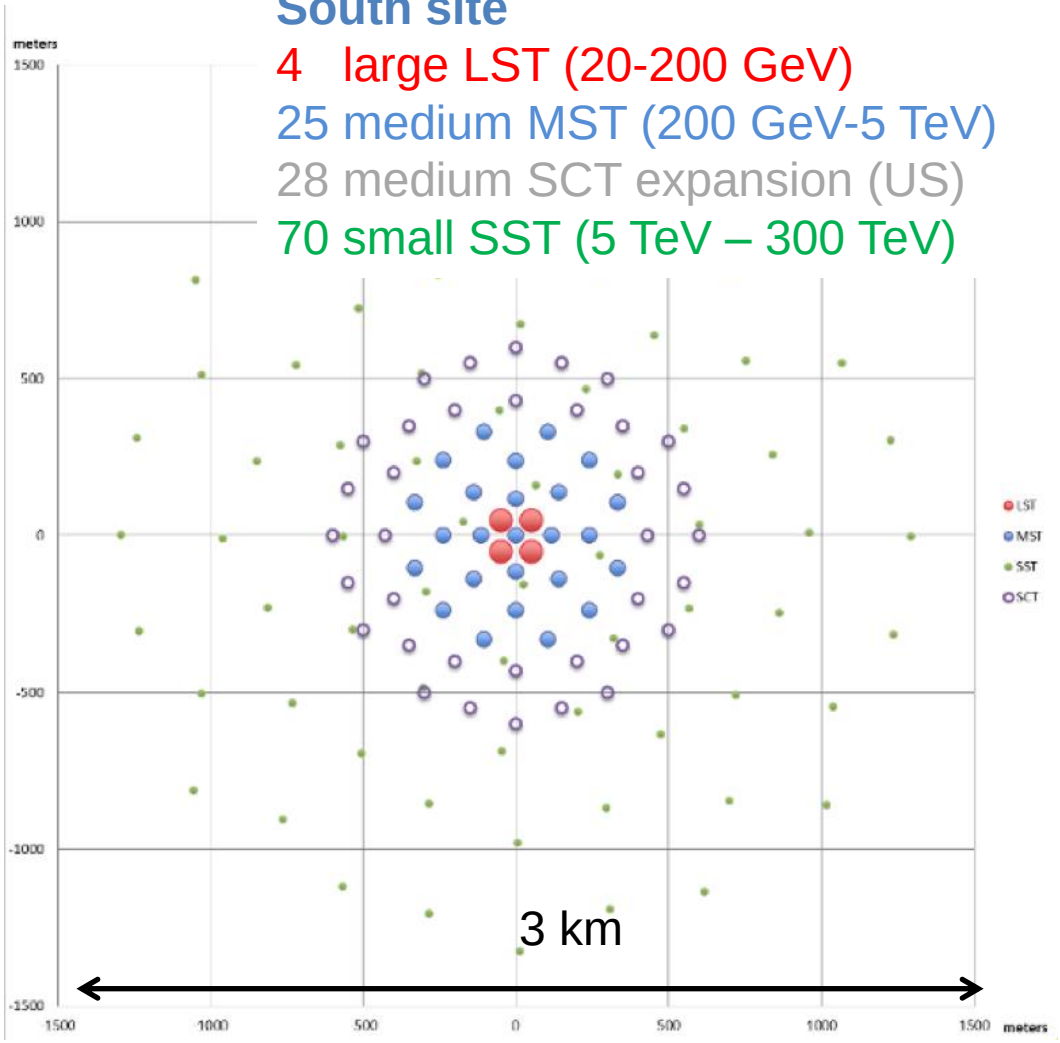
South site

4 large LST (20-200 GeV)

25 medium MST (200 GeV-5 TeV)

28 medium SCT expansion (US)

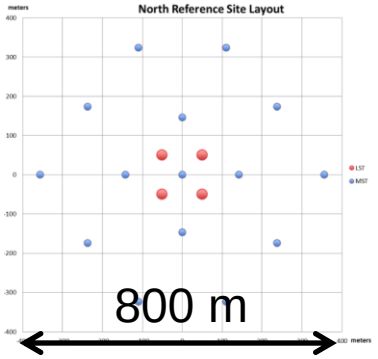
70 small SST (5 TeV – 300 TeV)



North site

4 large LST

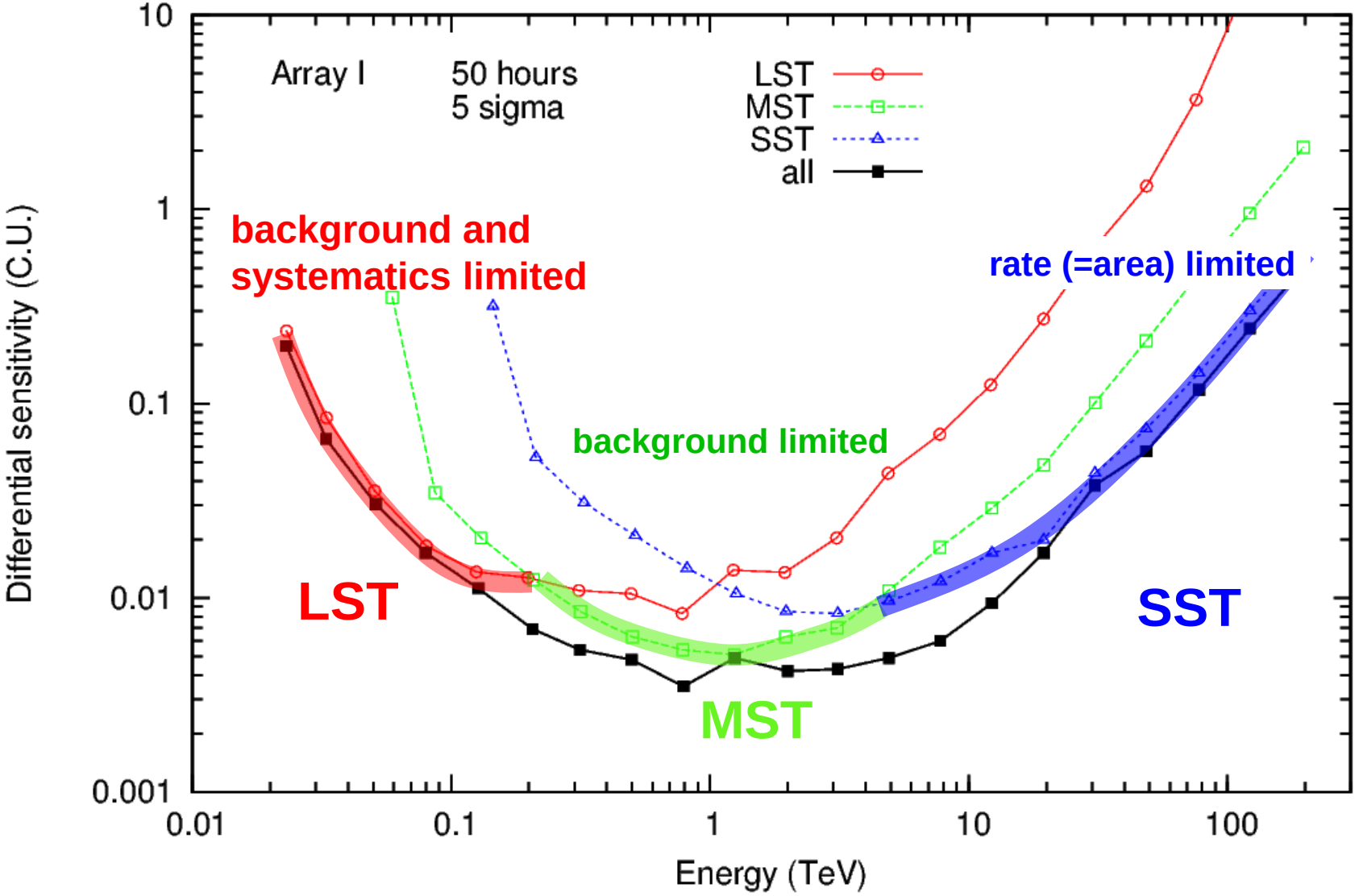
15 medium MST



~2/3 of all current sources in Southern sky

SENSITIVITY (IN UNITS OF CRAB FLUX)

FOR DETECTION IN EACH 0.2-DECADE ENERGY BAND



cta
cherenkov telescope array

Theme 1: Cosmic Particle Acceleration

- How and where are particles accelerated?
- How do they propagate?
- What is their impact on the environment?

Theme 2: Probing Extreme Environments

- Processes close to neutron stars and black holes?
- Processes in relativistic jets, winds and explosions?
- Exploring cosmic voids

Theme 3: Physics Frontiers – beyond the SM

- What is the nature of Dark Matter? How is it distributed?
- Is the speed of light a constant for high energy photons?
- Do axion-like particles exist?

CTA SCHEDULING

Monitoring
4 telescopes

PeV Deep Field
using SSTs

GeV observations
using LSTs

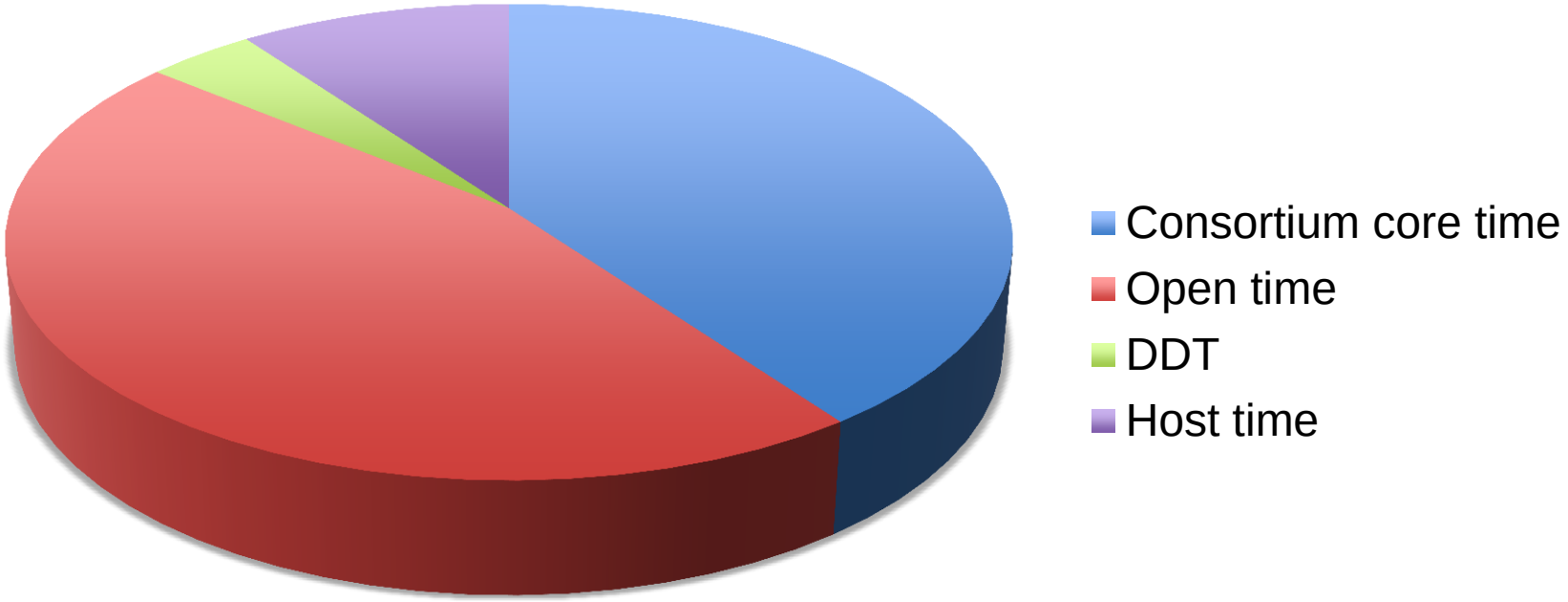
TeV
survey
using
MSTs

Large zenith angle
observations from
other hemisphere

Monitoring
1 telescope

- CTA North and South through single portal, AO, identical tools
- Queue mode scheduler taking into account actual sky conditions, sub-arrays & conditions requested in proposal, priorities, TOOs

SHARING OF OBSERVATION TIME

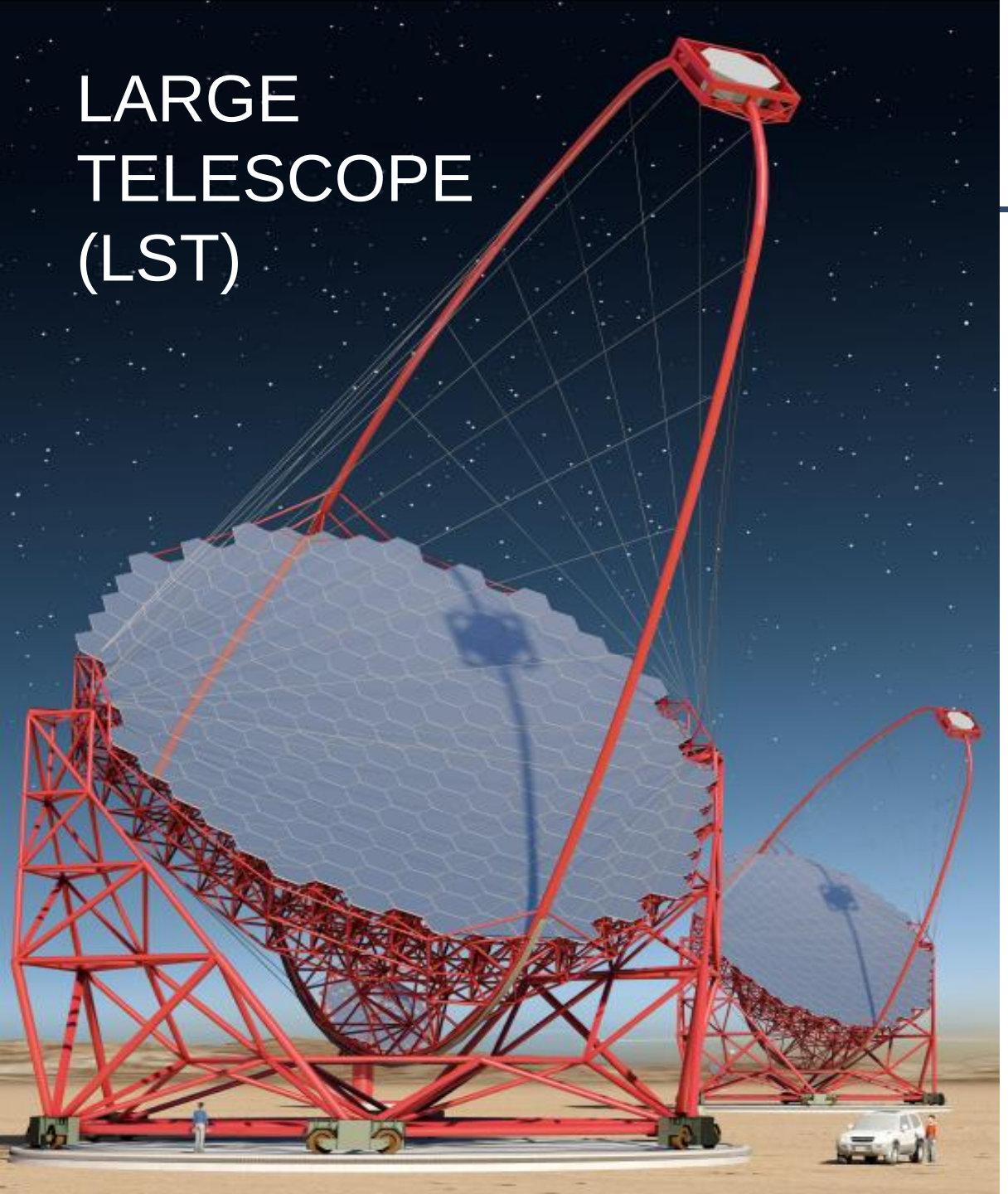


Example; sharing will be time dependent

- Open time: open to participating countries (?)
- Archival data: fully open, 1yr proprietary time (?)

CTA TELESCOPES

LARGE TELESCOPE (LST)



cherenkov telescope array

23 m diameter
389 m^2 dish area
28 m focal length
1.5 m mirror facets

4.5^o field of view
0.1^o pixels
Camera ø over 2 m

Carbon-fibre structure
for 20 s positioning

Active mirror control

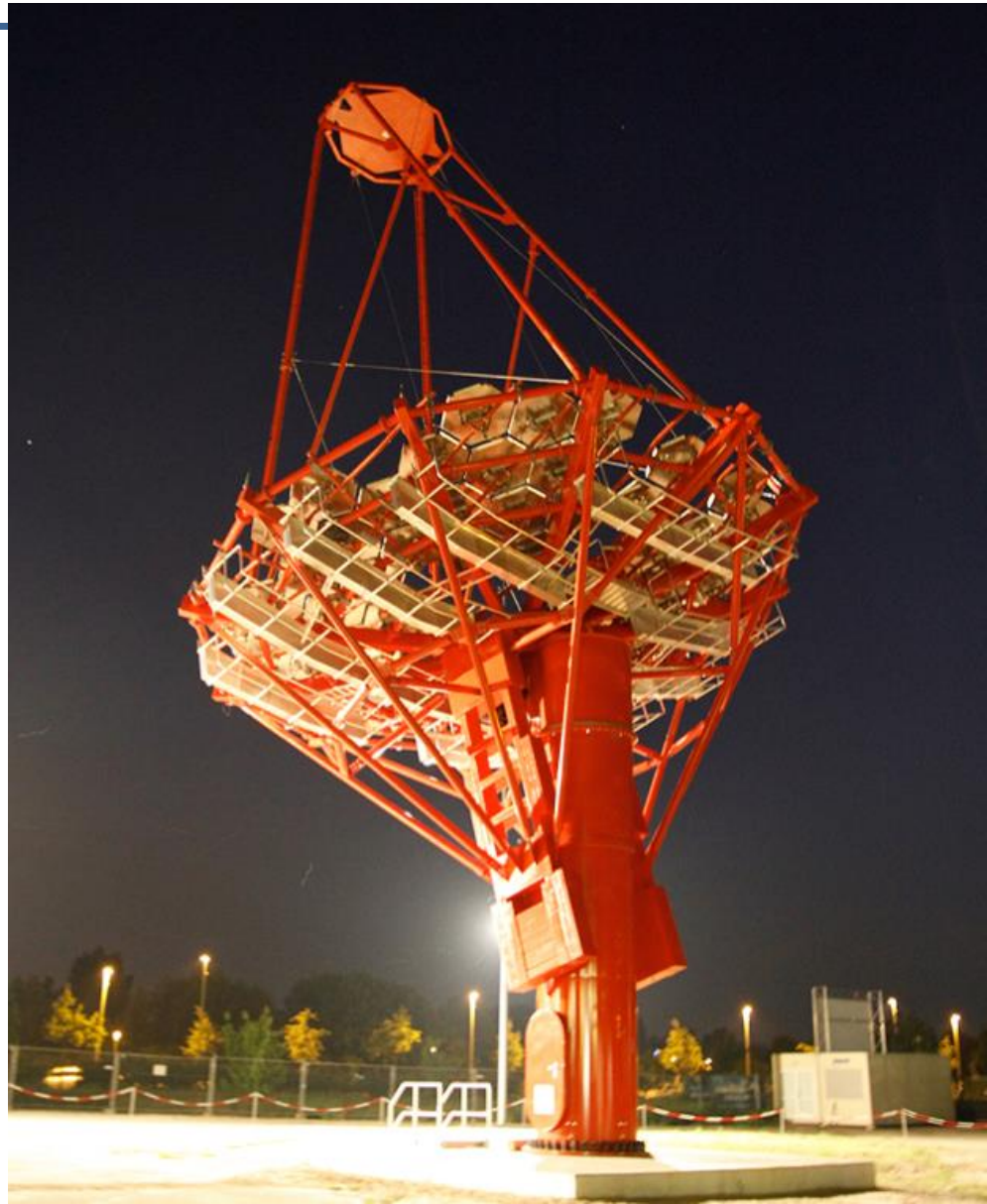
4 LSTs on South site
4 LSTs on North site
Prototype = 1st telescope

MEDIUM-SIZED 12 M TELESCOPE
OPTIMIZED FOR THE 100 GEV TO ~10 TEV RANGE

100 m^2 dish area
16 m focal length
1.2 m mirror facets

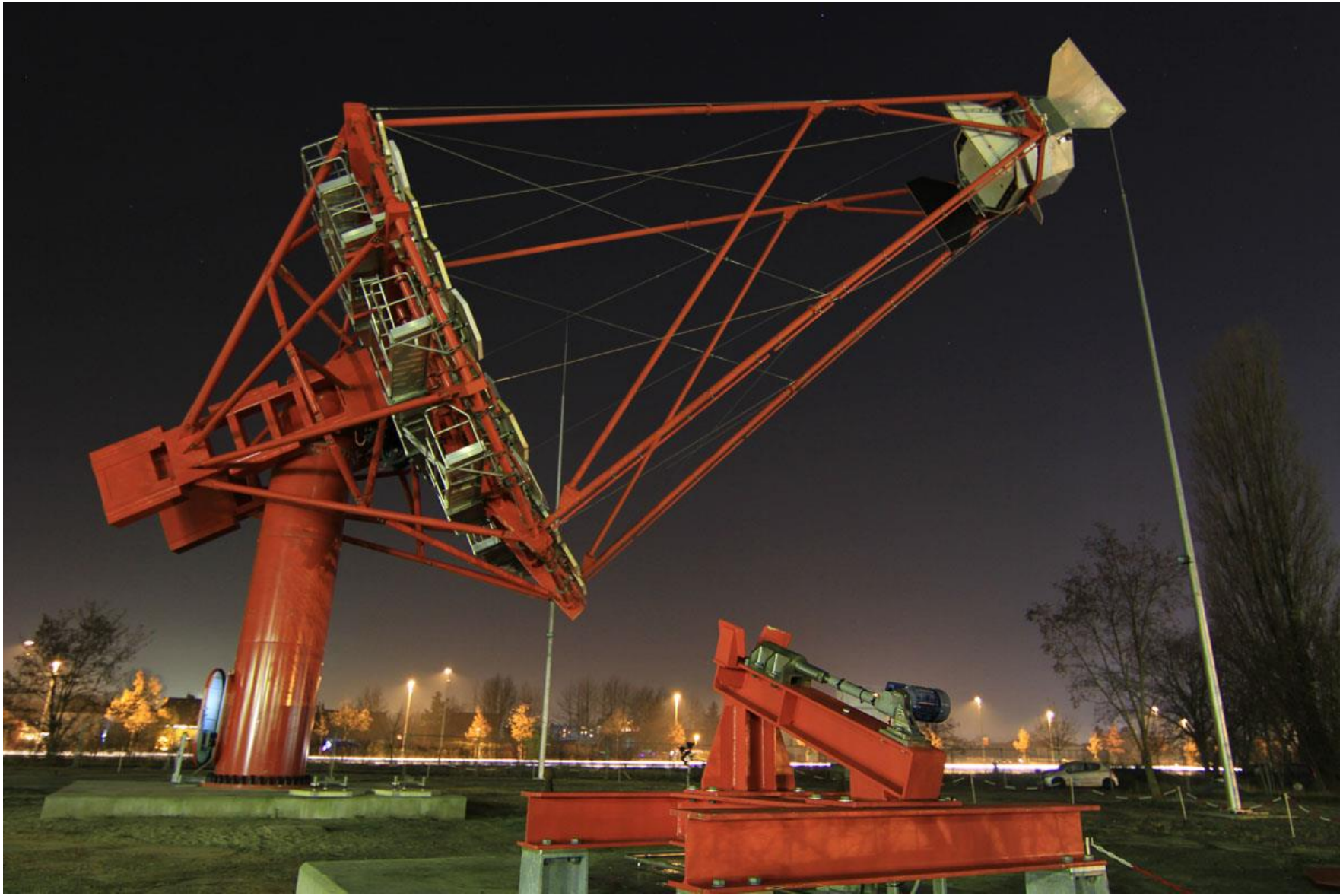
8^o field of view
~2000 x 0.18^o pixels

25 MSTs on South site
15 MSTs on North site



Berlin
MST prototype
operational

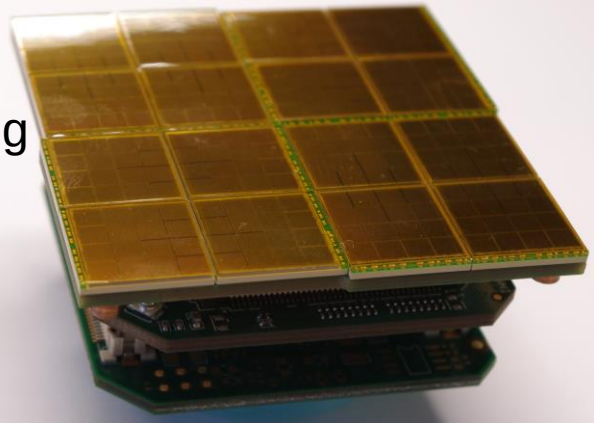
MST PROTOTYPE



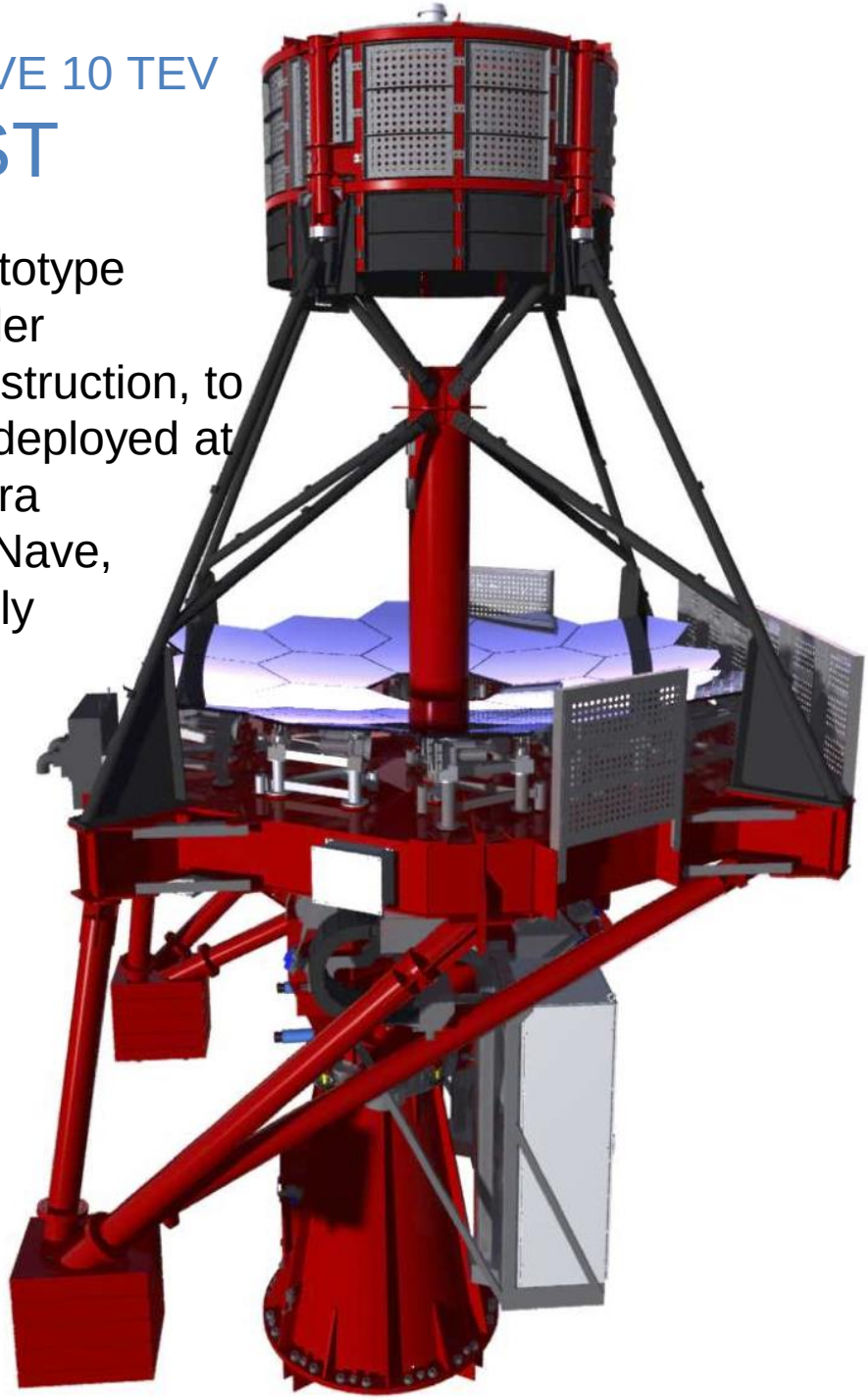
SST - OPTIMIZED FOR THE RANGE ABOVE 10 TEV

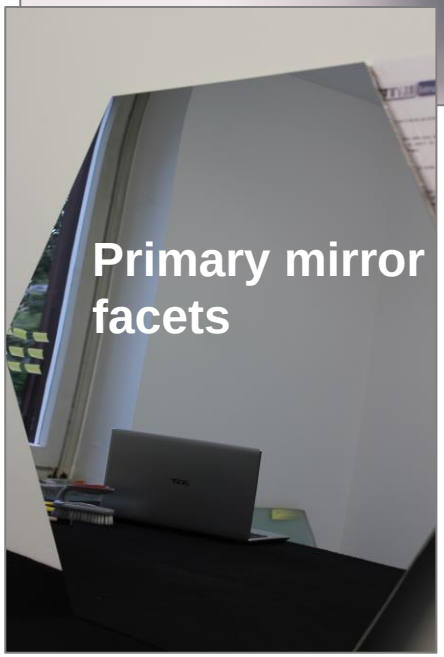
ASTRI DUAL MIRROR SST

ASTRI
Si camera
module using
S&H ASIC
(CITIROC)

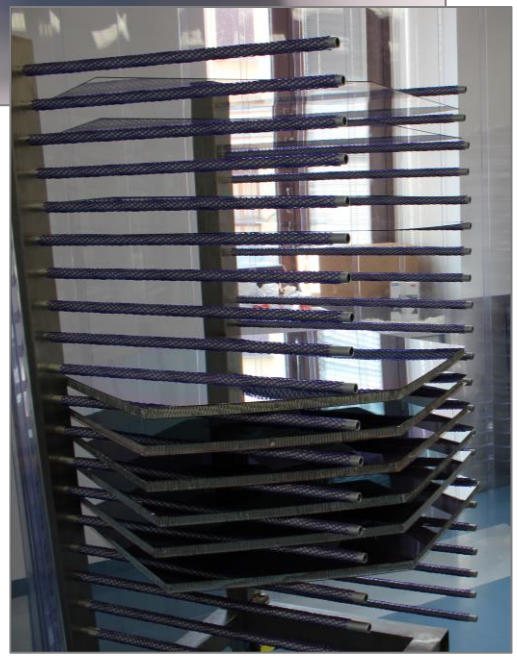


Prototype
under
construction, to
be deployed at
Serra
La Nave,
Sicily





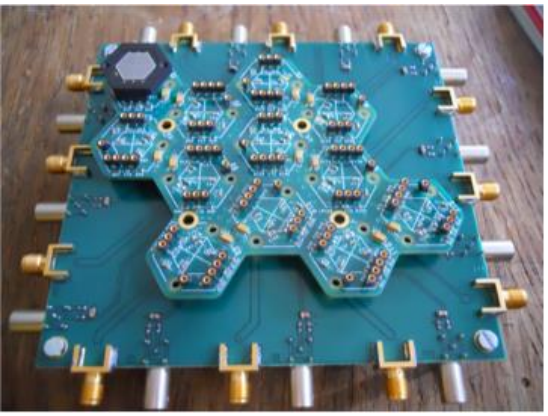
Primary mirror facets

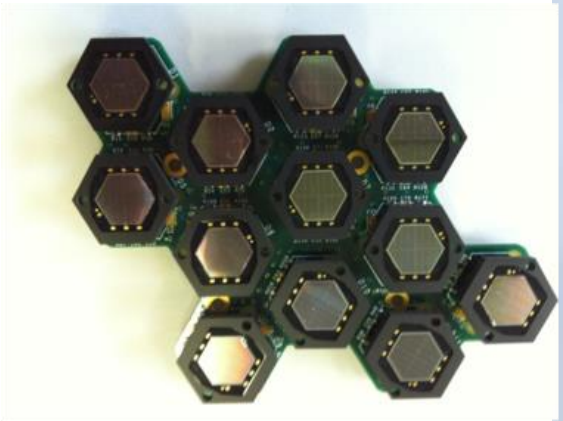


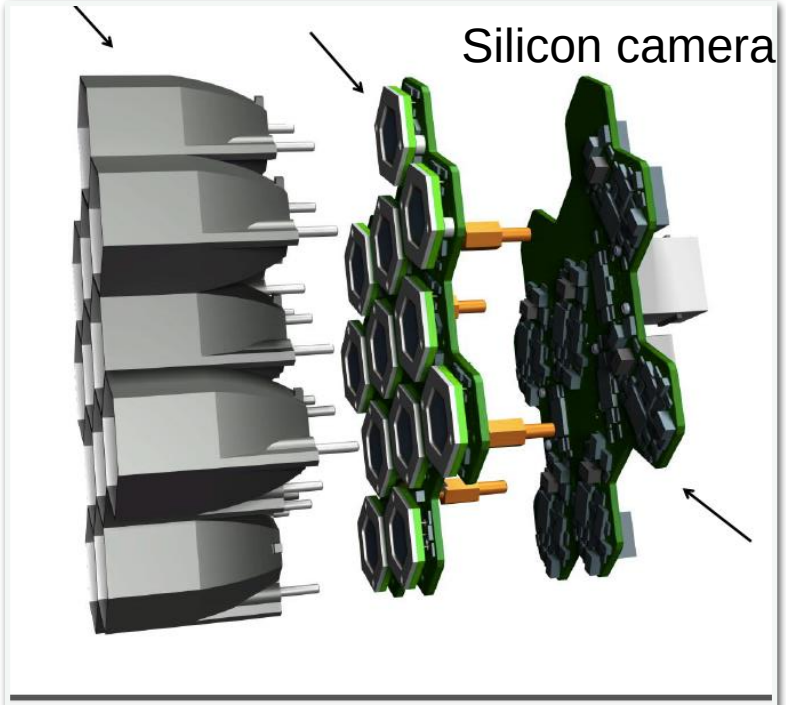
GATE DUAL MIRROR SST

Prototype under construction at Paris, ASTRI/GATE merge towards common design in progress

SINGLE-MIRROR PROTOTYPE SST







IMPLEMENTATION

Prototypes

- MST @ Berlin
- SST-1M @ Cracow, SST-2M @ Sicily, Paris

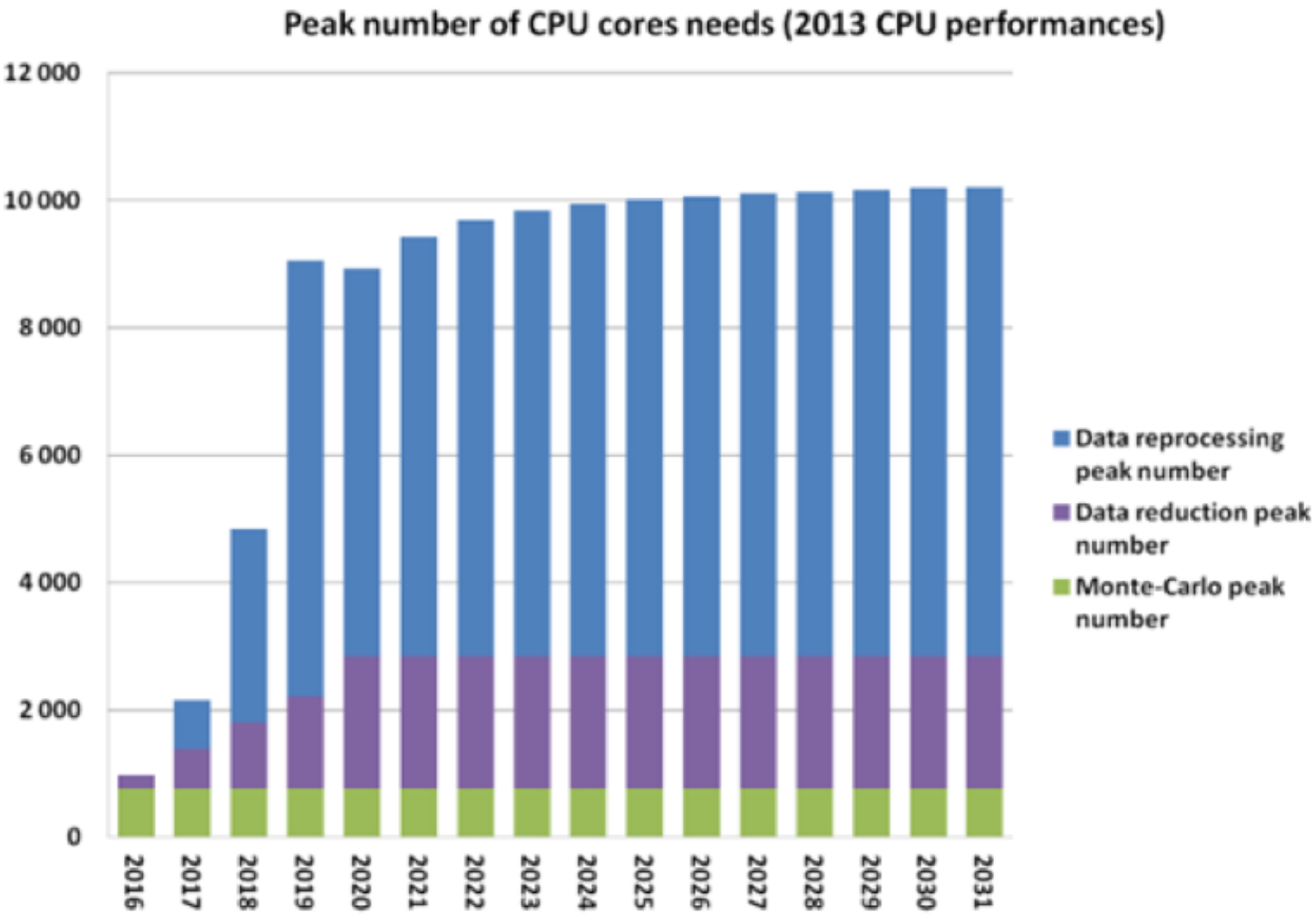
Pre-production telescopes:

- to verify mass production and deployment
- “Mini-arrays” at final sites, used in final arrays
- 1 LST
- ~3 MSTs
- ~5 SST-1M
- ~5 SST-2M

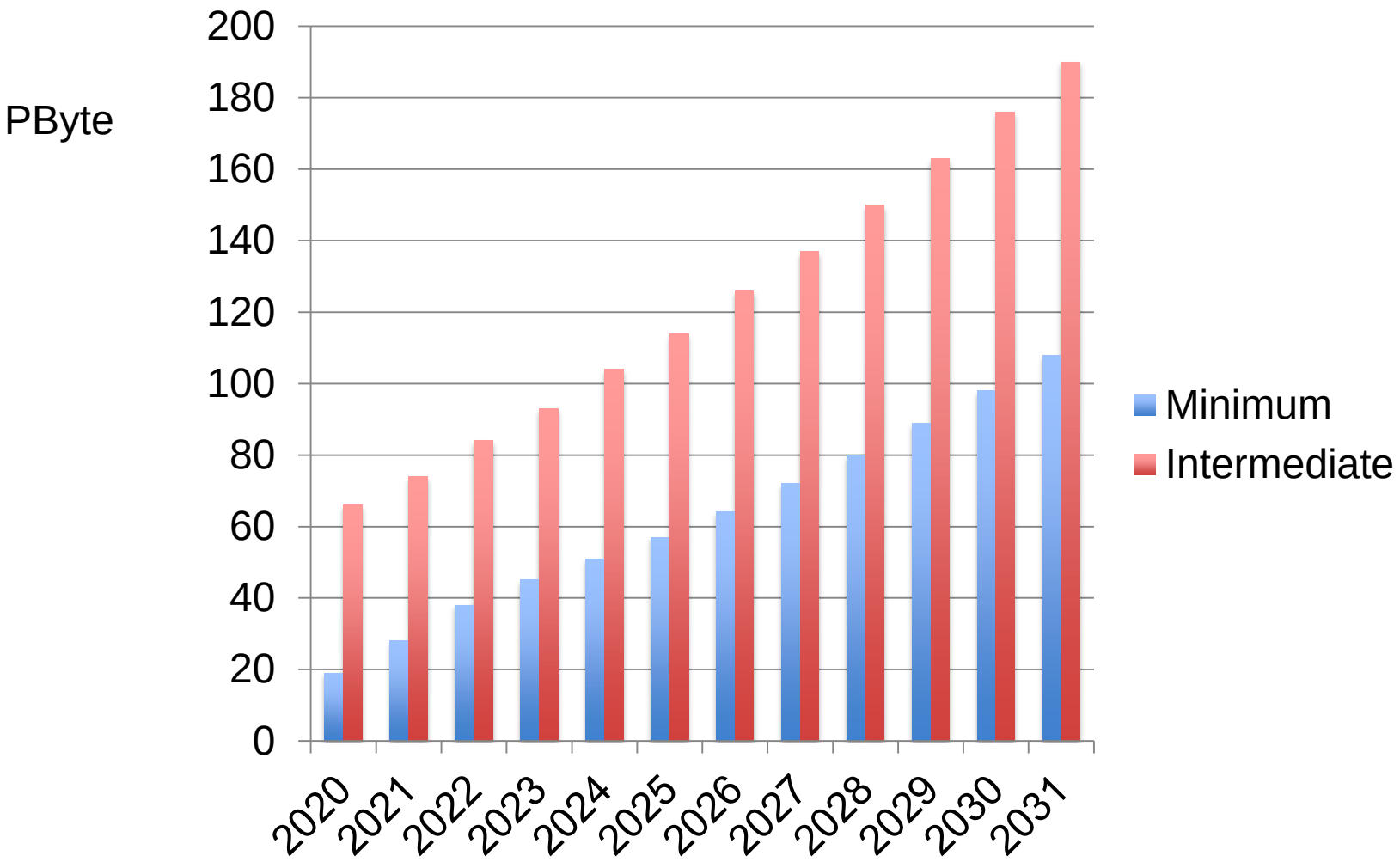
Mass production and deployment

CHALLENGE: HANDLING CTA DATA

PROCESSING NEEDS

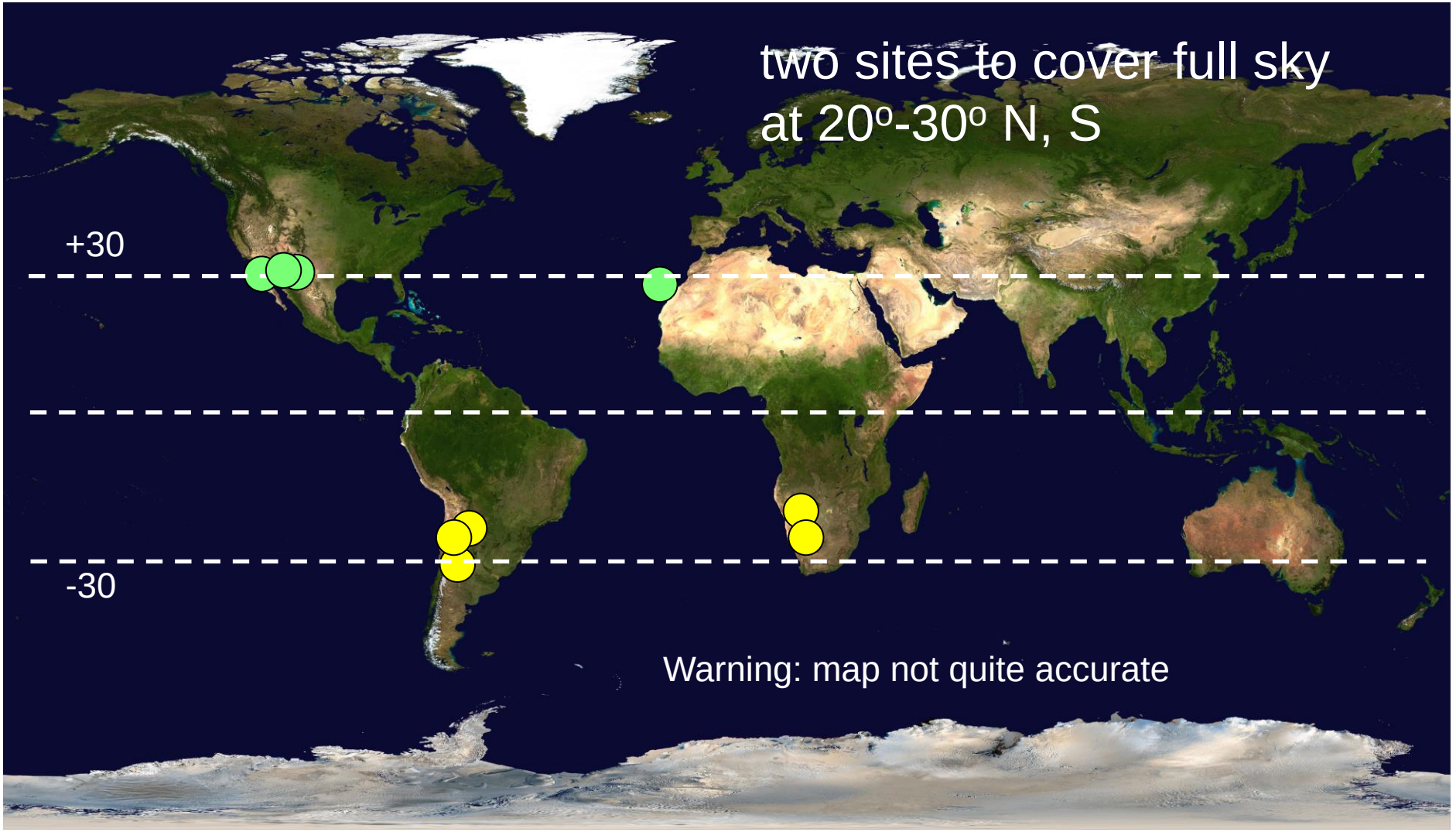


STORAGE CAPACITY

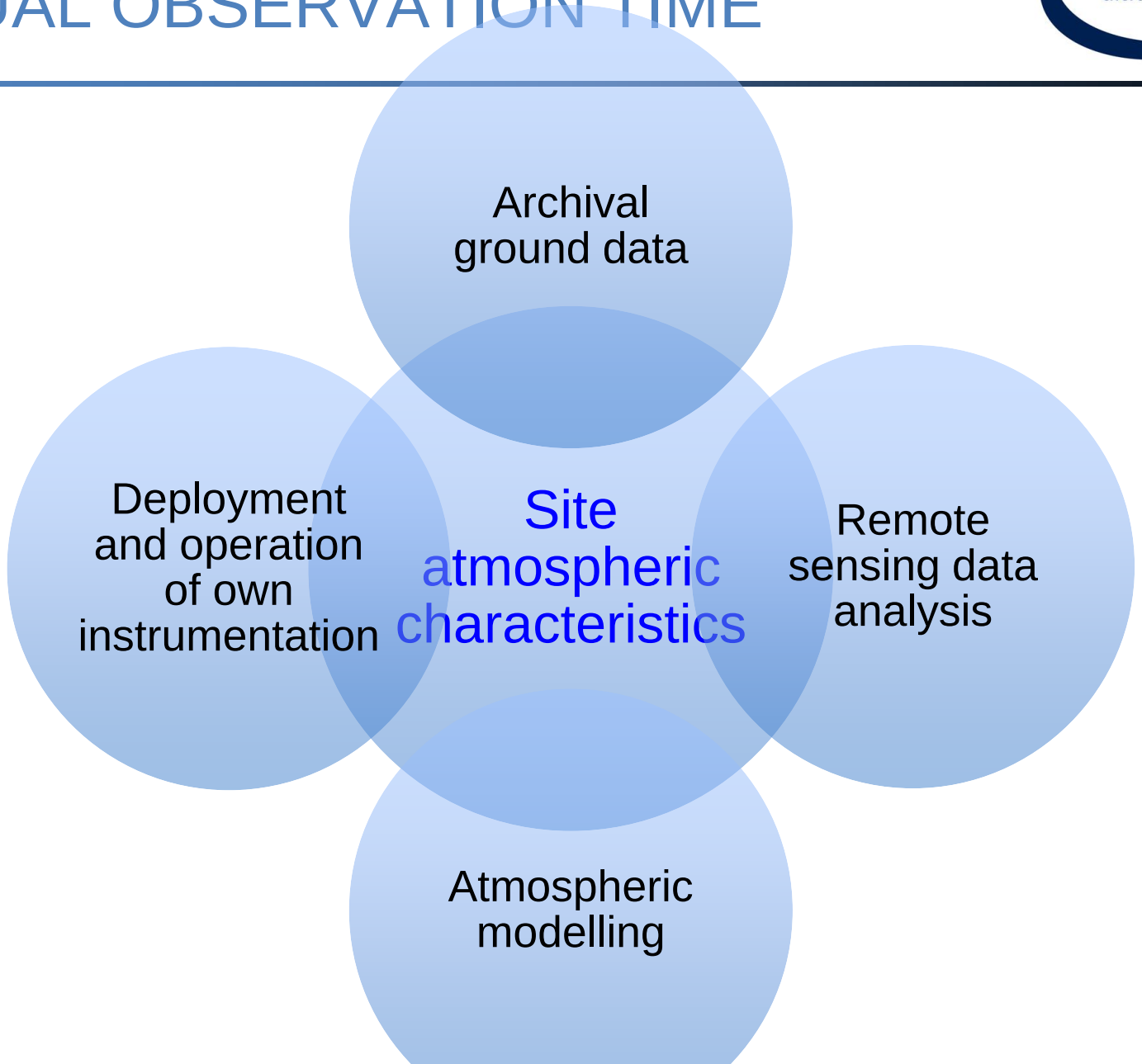


CTA SITE SELECTION

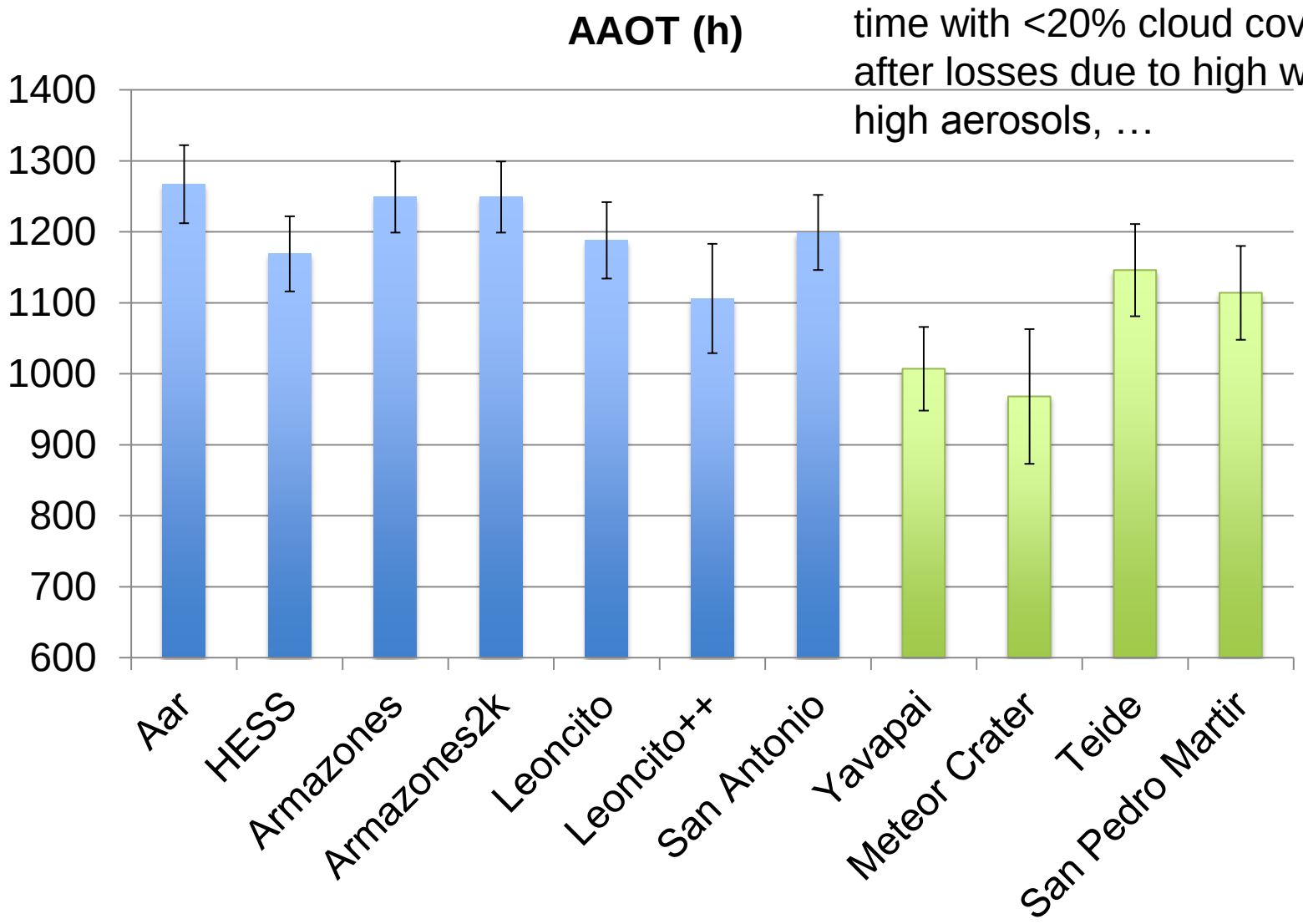
SITE SELECTION



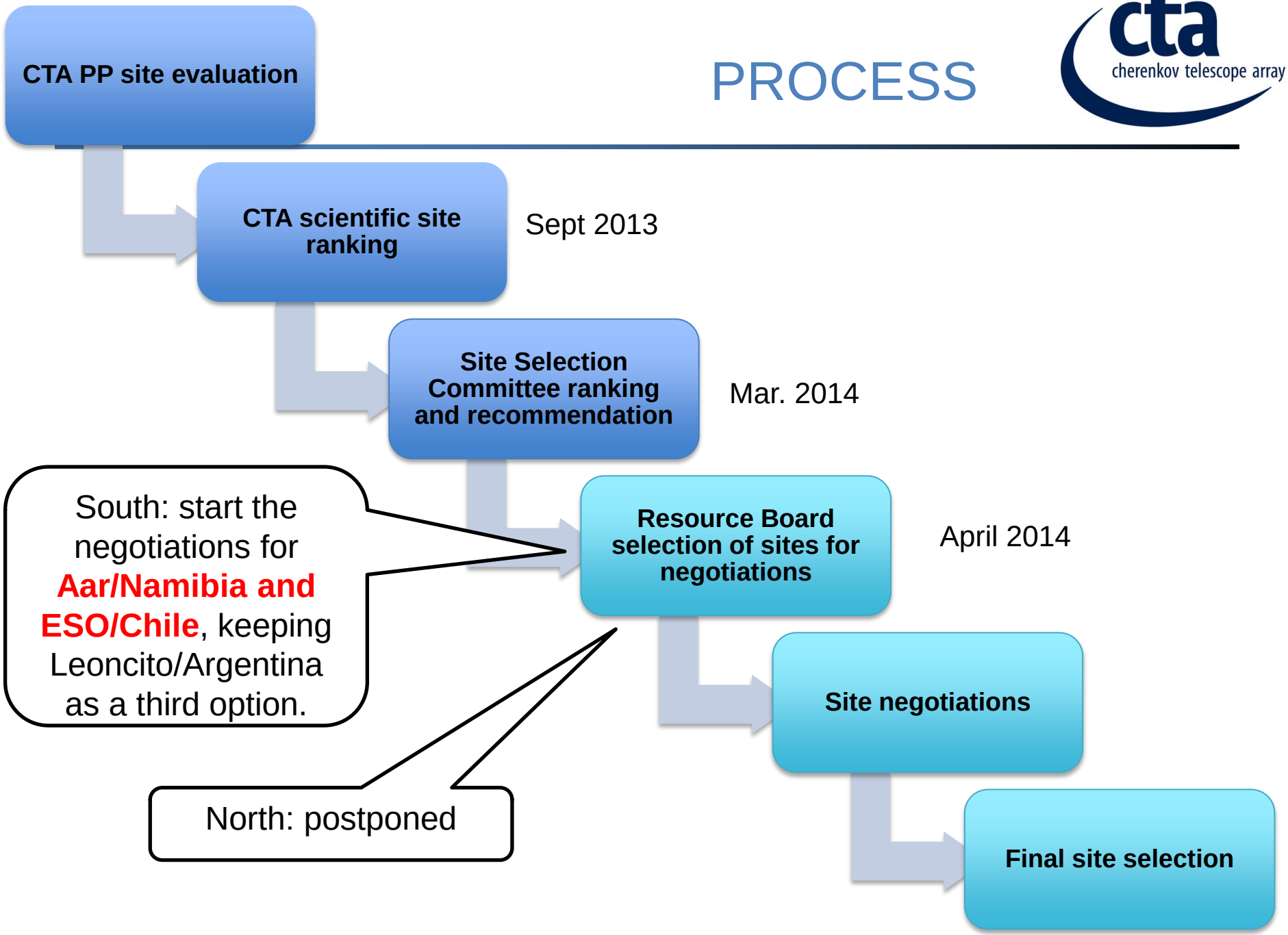
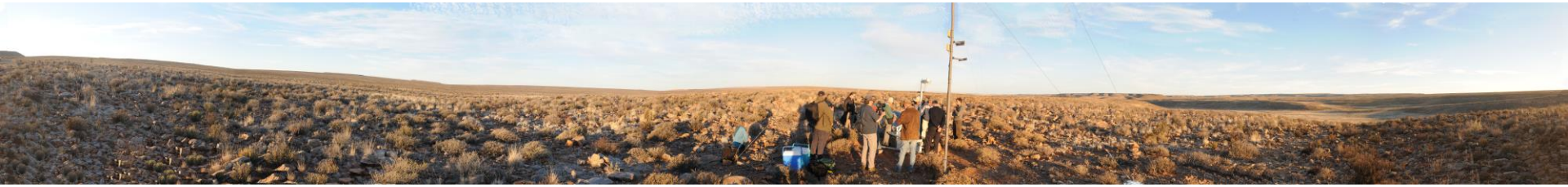
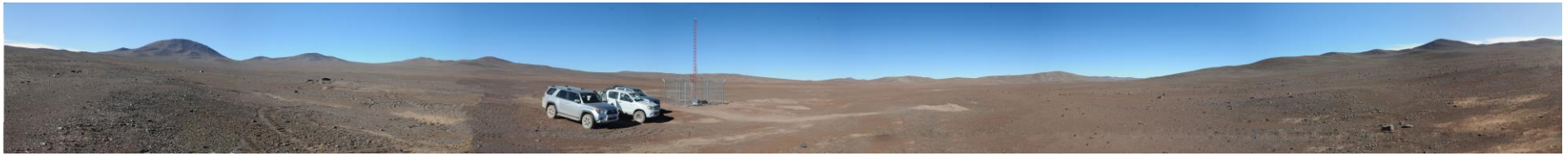
IMPORTANT CRITERION: ANNUAL OBSERVATION TIME



AVERAGE ANNUAL OBSERVATION TIME



PROCESS


CTA PP site evaluation
CTA scientific site ranking
Sept 2013
Site Selection Committee ranking and recommendation
Mar. 2014
South: start the negotiations for Aar/Namibia and ESO/Chile, keeping Leoncito/Argentina as a third option.
Resource Board selection of sites for negotiations
April 2014
North: postponed
Site negotiations
Final site selection