CTAO
Cherenkov Telescope Array Observatory

Gamma-ray astronomy in Italy

June 3, 2025

Roberta Zanin (CTAO Project Scientist)
Roberta.Zanin@cta-observatory.org

Bologna 1959

Among the first experiment in the world for the detection of gamma rays

SEARCH FOR $gamma$ RADIATION FROM THE CYGNUS A RADIOSOURCE

JOURNAL ARTICLE · 01 September 1960 · Nuovo Cimento (Italy) Divided into Nuovo Cimento A and Nuovo Cimento B

OSTI ID: 4155738

Braccesi, A; Ceccarelli, M; Salandin, G

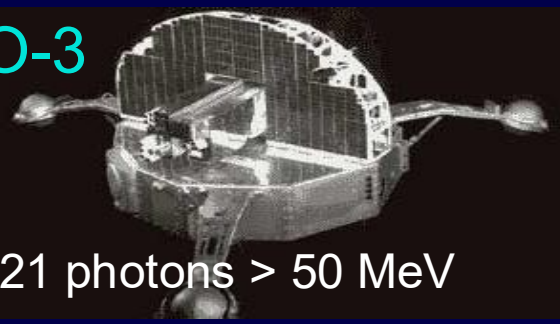
An experiment is described for detecting energetic gamma radiation from a peculiar celestial object (Cygnus A) interpreted as a collision between a galaxy of matter and one of anti-matter. The experiment was negative and settled as upper limit for the gamma flux a value of about 5 x 10/sup -3/ quanta/ cm/ sup 2//sec, which is about two orders of magnitude smaller than estimated by Morrison under the assumption previously mentioned. (auth)

Credits to G. Vettolani

Soft gamma rays

in the 70's the first gamma-ray satellites

OSO-3



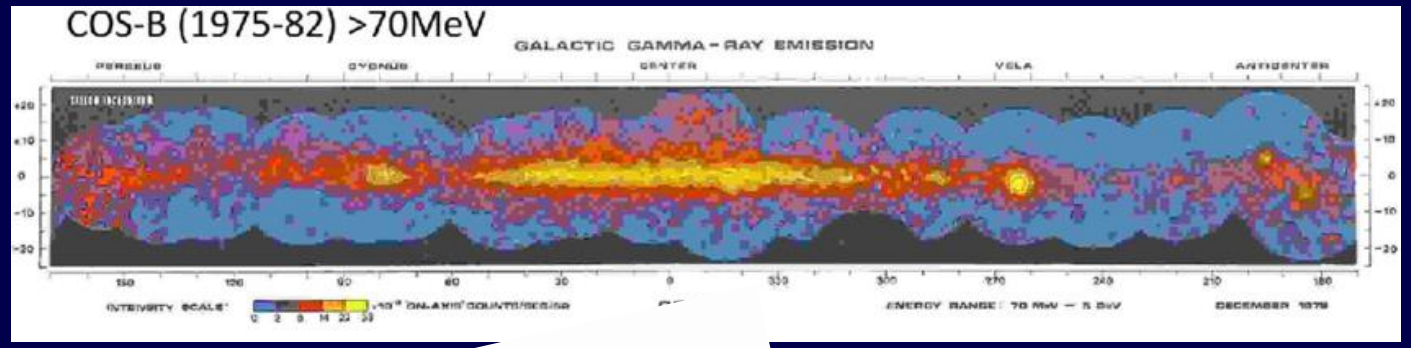
first 621 photons > 50 MeV

SAS-2

30 – 200 MeV

COS-B: 30 MeV – 5 GeV

Crab and Vela pulsars, Geminga

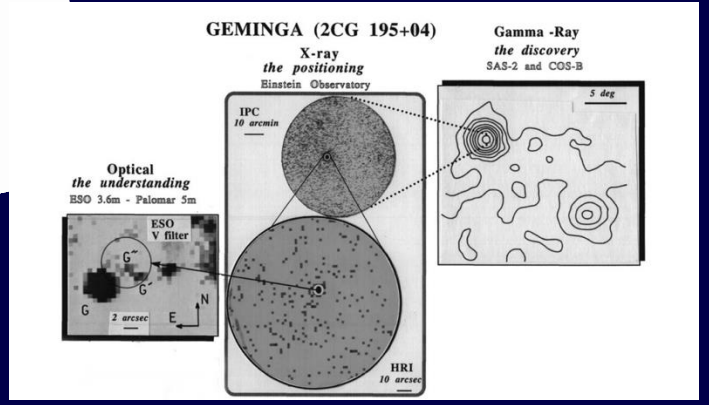



Scientific Correspondence | Published: 28 May 1992

Geminga: new period, old γ-rays

G. F. Bignami & P. A. Caraveo

Nature **357**, 287 (1992) | Cite this article



Caraveo 2022

Soft gamma rays

Beppo SAX

Integral

in the 2000's

Letter to the Editor

INTEGRAL discovery of persistent hard X-ray emission from the Soft Gamma-ray Repeater SGR 1806–20 *

S. Mereghetti[1], D. Götz[1], I. F. Mi

Received: 26 November 2004 | A

A&A 411, L427–L432 (2003)
DOI: 10.1051/0004-6361:20031369

Astronomy & Astrophysics

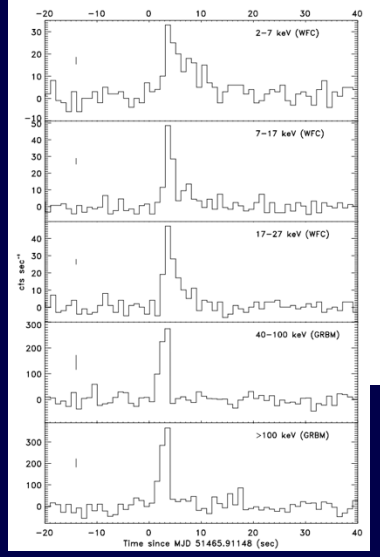
INTEGRAL discovery of a bright highly obscured galactic X-ray binary source IGR J16318–4848

Mon. Not. R. Astron. So

R. Walter[1,2], J. Rodriguez[3,1], L. Foschini[4], J. de Plaa[5], S. Corbel[3,6], T. J.-L. Courvoisier[1,2], P. R. den Hartog[5], F. Lebrun[3], A. N. Parmar[7], J. A. Tomsick[8], and P. Ubertini[9]

The fraction of Compton-thick sources in an *INTEGRAL* complete AGN sample

A. Malizia,[1★] J. B. Stephen,[1] L. Bassani,[1] A. J. Bird,[2] F. Panessa[3] and P. Ubertini[3]
[1]*IASF/INAF, via Gobetti 101, I-40129 Bologna, Italy*
[2]*School of Physics and Astronomy, University of Southampton, Southampton SO17 1BJ*
[3]*IASF/INAF, via del Fosso del Cavaliere 100, I-00133 Roma, Italy*



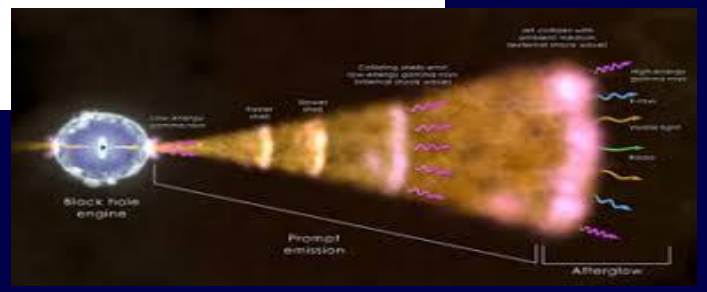
In't Zand + 2000

Letter | Published: 19 June 1997

Discovery of an X-ray afterglow associated with the γ-ray burst of 28 February 1997

E. Costa, F. Frontera, J. Heise, M. Feroci, J. in 't Zand, F. Fiore, M. N. Cinti, D. Dal Fiume, L. Nicastro, M. Orlandini, E. Palazzi, M. Rapisarda#, G. Zavattini, R. Jager, A. Parmar, A. Owens, S. Molendi, G. Cusumano, M. C. Maccarone, S. Giarrusso, A. Coletta, L. A. Antonelli, P. Giommi, J. M. Muller, ... R. C. Butler + Show authors

Nature **387**, 783–785 (1997) | Cite this article



High energy gamma rays

Agile satellite [23 April 2007 – 2025]

A purely Italian satellite - ASI

Fermi satellite [June 11, 2008 -]

Significant Italian contribution by ASI, INFN and INAF (tracker, readout electronics…)

High energy gamma rays

Gamma-Ray Flares from the Crab Nebula

A. A. ABDO, M. ACKERMANN, M. AJELLO, A. ALLAFORT, L. BALDINI, J. BALLET, G. BARBIELLINI, D. BASTIERI, K. BECHTOL, [...], AND M. ZIEGLER +158 authors Authors Info & Affiliations

SCIENCE · 6 Jan 2010 · Vol 331, Issue 6018 · pp. 739-742 · DOI: 10.1126/science.1199705

Discovery of Powerful Gamma-Ray Flares from the Crab Nebula

M. TAVANI, A. BULGARELLI, V. VITTORINI, A. PELLIZZONI, E. STRIANI, P. CARAVEO, M. C. WEISSKOPF, A. TENNANT, G. PUCELLA, [...], AND G. F. BIGNAMI +58 authors

Authors Info & Affiliations

SCIENCE · 6 Jan 2011 · Vol 331, Issue 6018 · pp. 736-739 · DOI: 10.1126/science.1200083

Letter | Published: 22 November 2009

Extreme particle acceleration in the microquasar Cygnus X-3

M. Tavani, A. [illegible]

N. A. Nizhelskij, [illegible]

M. Trifoglio, F. Gi[illegible]

Salotti + Show

Nature 462, 62[illegible]

Modulated High-Energy Gamma-Ray Emission from the Microquasar Cygnus X-3

THE FERMI LAT COLLABORATION, A. A. ABDO, M. ACKERMANN, M. AJELLO, M. AXELSSON, L. BALDINI, J. BALLET, G. BARBIELLINI, D. BASTIERI, [...], AND M. ZIEGLER

+167 authors Authors Info & Affiliations

SCIENCE · 26 Nov 2009 · Vol 326, Issue 5959 · pp. 1[illegible]

LETTERS · FREE ARTICLE

NEUTRAL PION EMISSION FROM ACCELERATED PROTONS IN THE SUPERNOVA REMNANT W44

A. Giuliani, M. Cardillo, M. Tavani, Y. Fukui, S. Yoshiike, K. Torii, G. Dubner, G. Castelletti, G. Barbiellini, A. Bulgarelli ▾ Show full author list

Published 2011 November 11 • © 2011. The American Astronomical Society. All rights reserved.

The Astrophysical Journal Letters, Volume 742, Number 2

Citation A. Giuliani *et al* 2011 *ApJL* **742** L30

DOI 10.[illegible]

Detection of the Characteristic Pion-Decay Signature in Supernova Remnants

M. ACKERMANN, M. AJELLO, A. ALLAFORT, L. BALDINI, J. BALLET, G. BARBIELLINI, M. G. BARING, D. BASTIERI, K. BECHTOL, [...], AND S. ZIMMER +159 authors

Info & Affiliations

DOI: 10.1126/science.1231160

AGILE Gamma-Ray Detection of the Exceptional GRB 221009A

Marco Tavani, Giovanni Piano, Andrea Bulgarelli, Luca Foffano, Alessandro Ursi, Francesco Verrecchia, Carlotta Pittori, Claudio Casentini, Andrea Giuliani, Francesco Longo

▾ Show full author list

Published 2023 October 17 • © 2023. The Author(s). Published by the American Astronomical Society.

The Astrophysical Journal Letters, Volume 956, Number 1

Focus on the Ultra-luminous Gamma-Ray Burst GRB 221009A

Citation Marco Tavani *et al* 2023 *ApJL* **956** L23

DOI 10.3847/2041-8213/acfaff

ANNUAL REVIEW OF ASTRONOMY AND ASTROPHYSICS Volume 52, 2014

Review Article

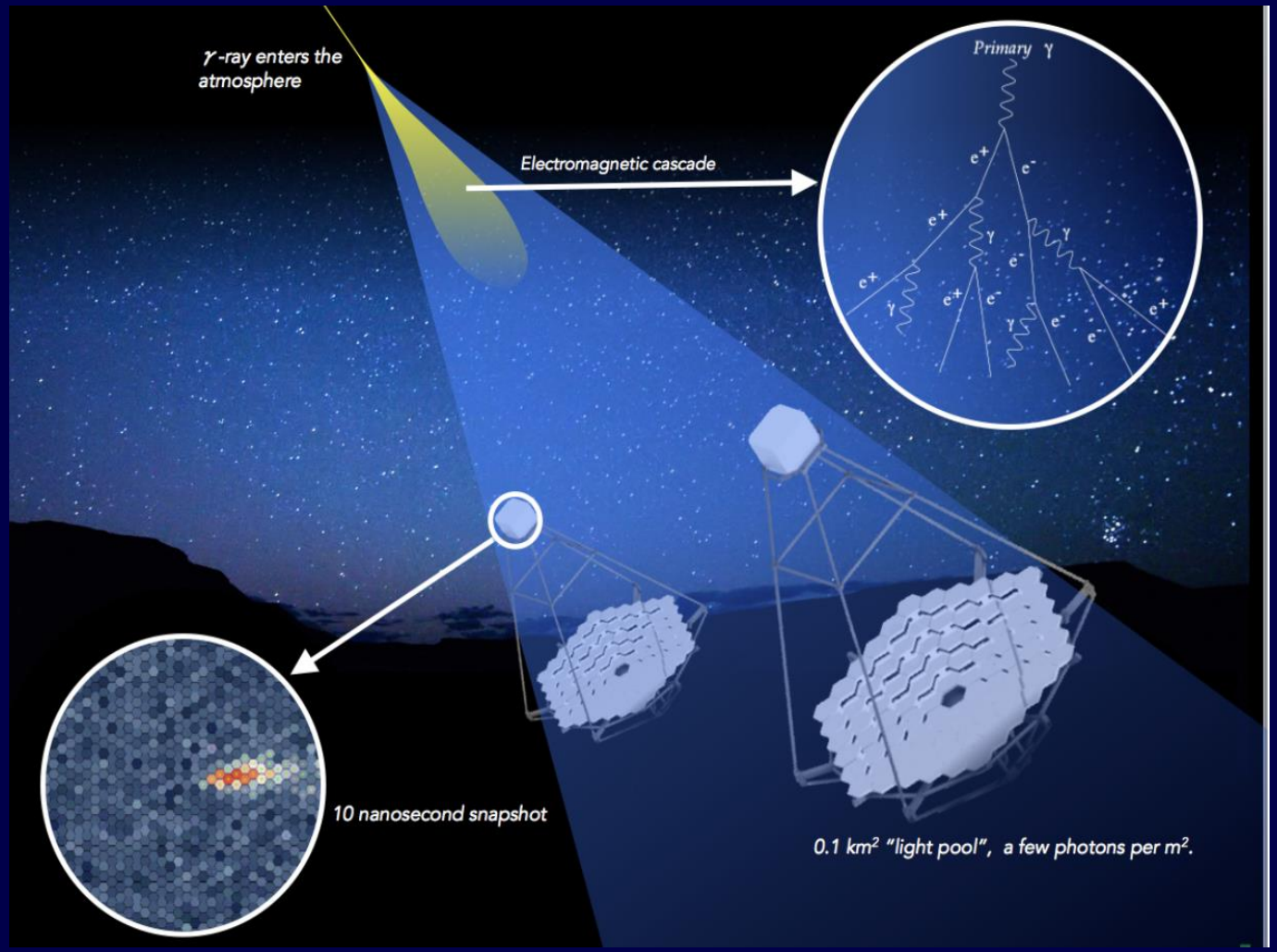
Gamma-Ray Pulsar Revolution

Patrizia A. Caraveo[1]

View Affiliations

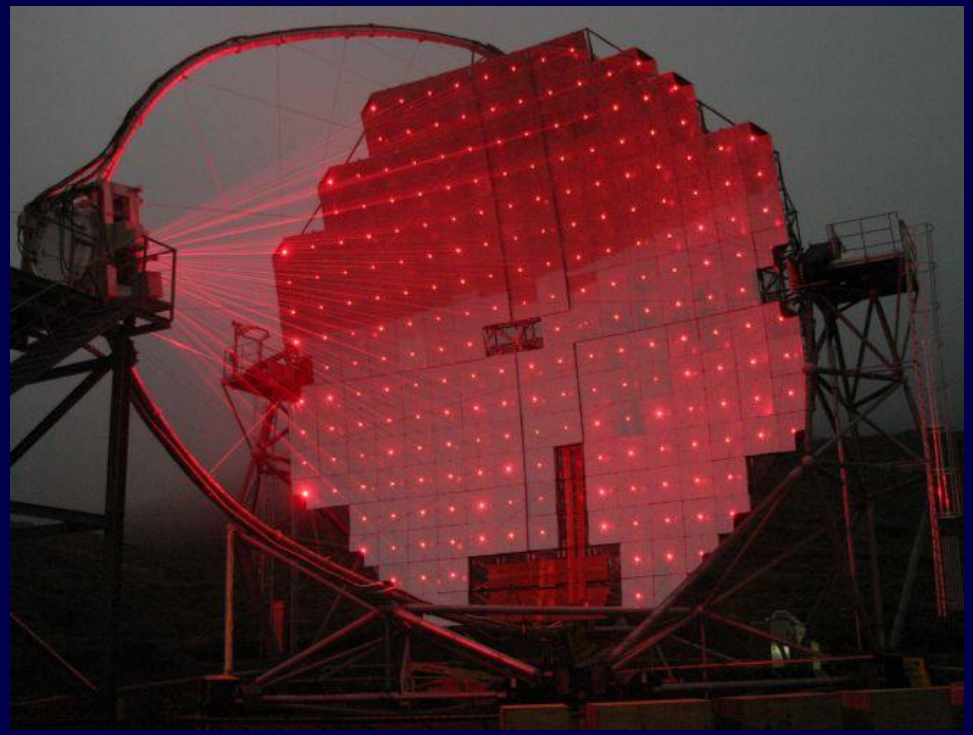
Vol. 52:211-250 (Volume publication date August 2014) | https://doi.org/10.1146/annurev-astro-081913-035948

Very-high energy gamma rays



Very-high energy gamma rays

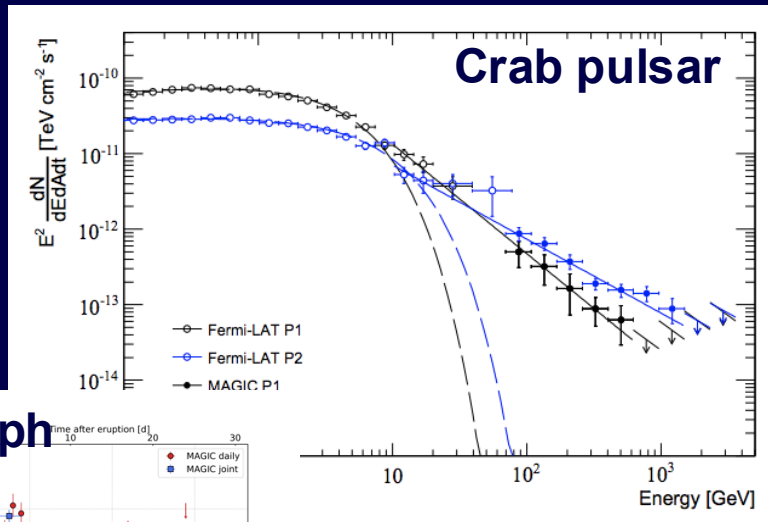
The MAGIC telescopes

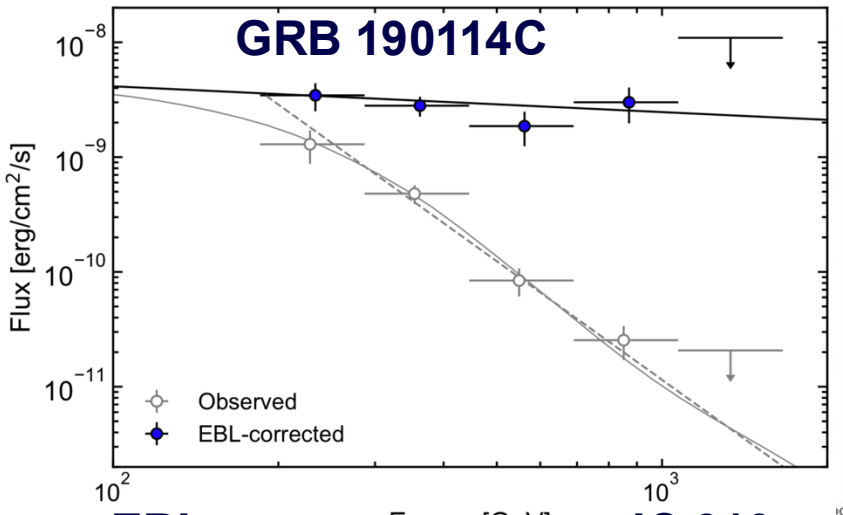


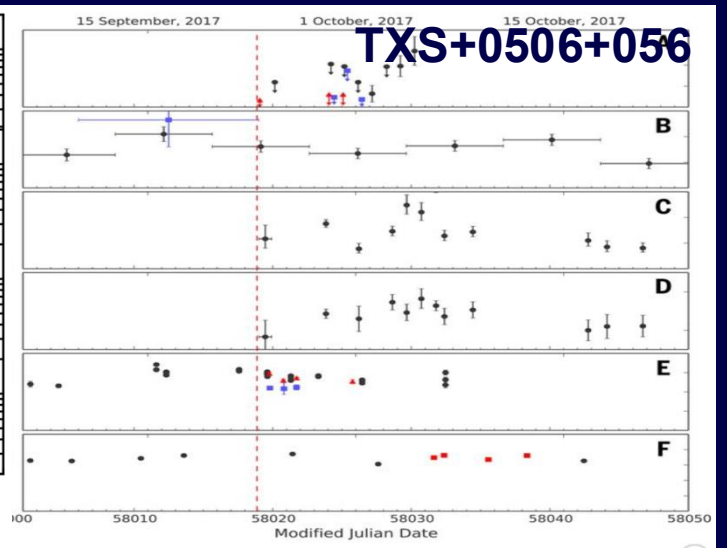
INFN joined the MAGIC collaboration since the beginning
INAF joined in 2008 contributing to the mirrors of the second telescope

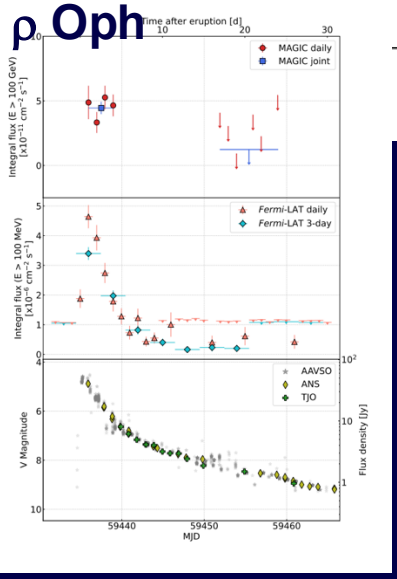
Very-high energy gamma rays

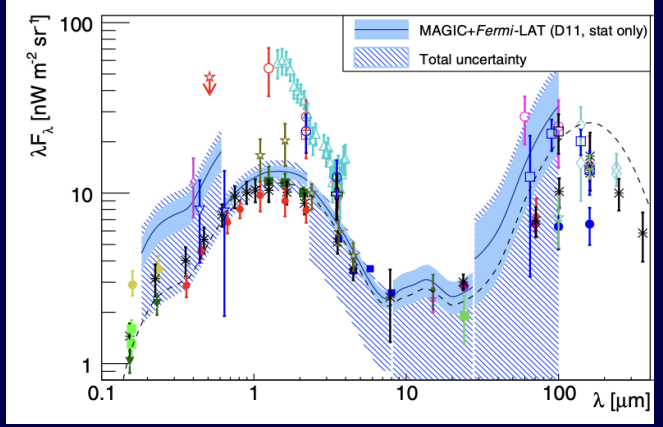
The MAGIC telescopes

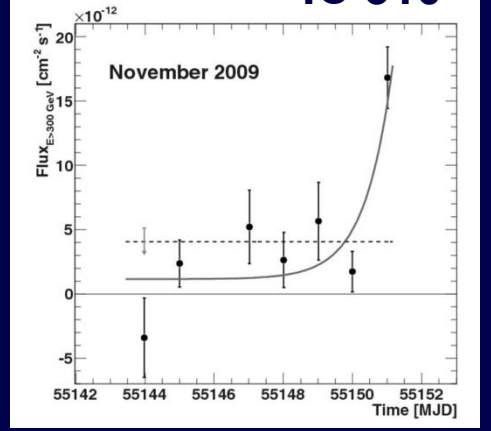




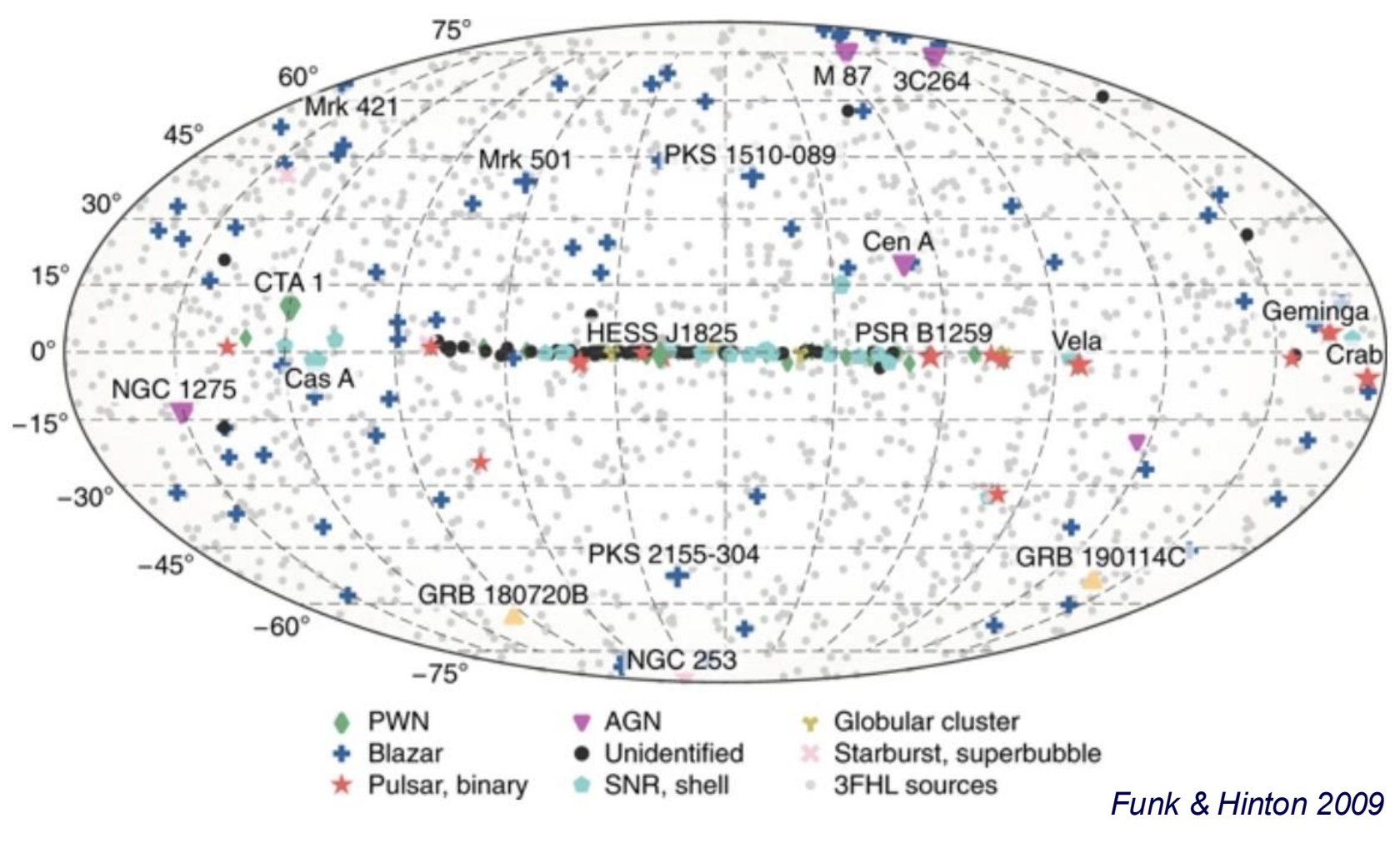






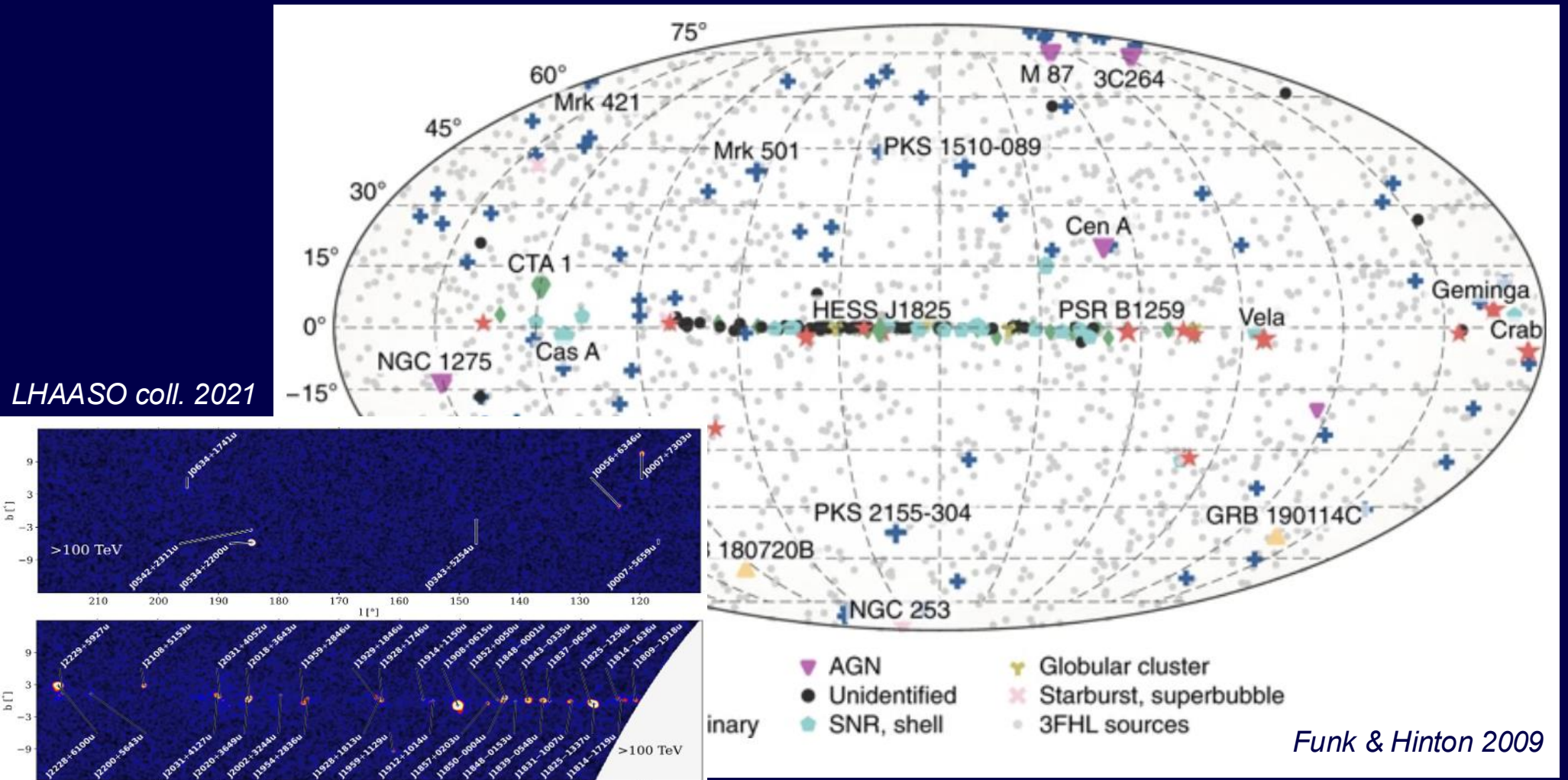


Very-high energy gamma rays



Funk & Hinton 2009

Very-high energy gamma rays



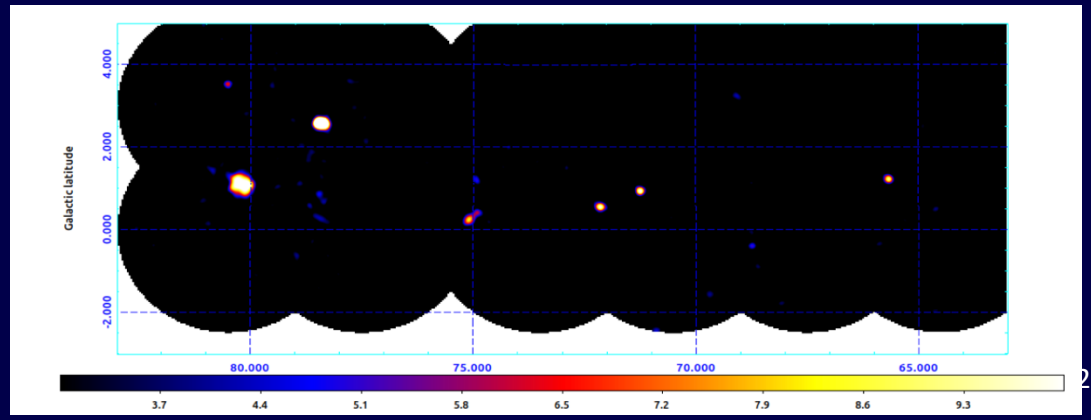
LHAASO coll. 2021

Very-high energy gamma rays

ASTRI Mini-Array

Start data taking this year with 3 telescopes, full array expected by 2027

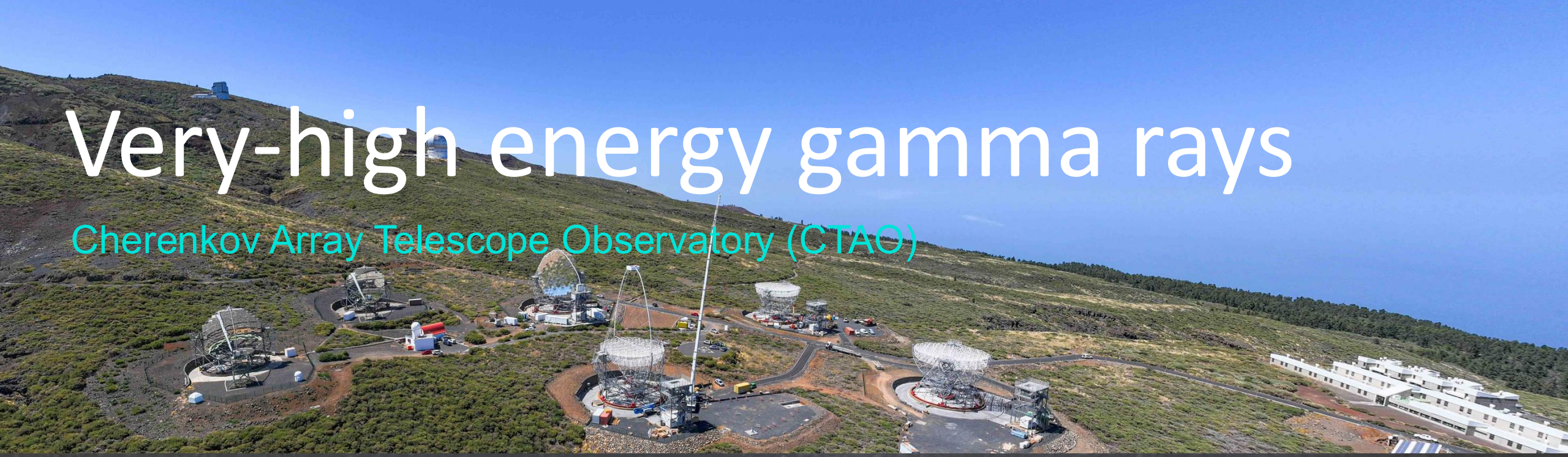
Scudieri + 2023

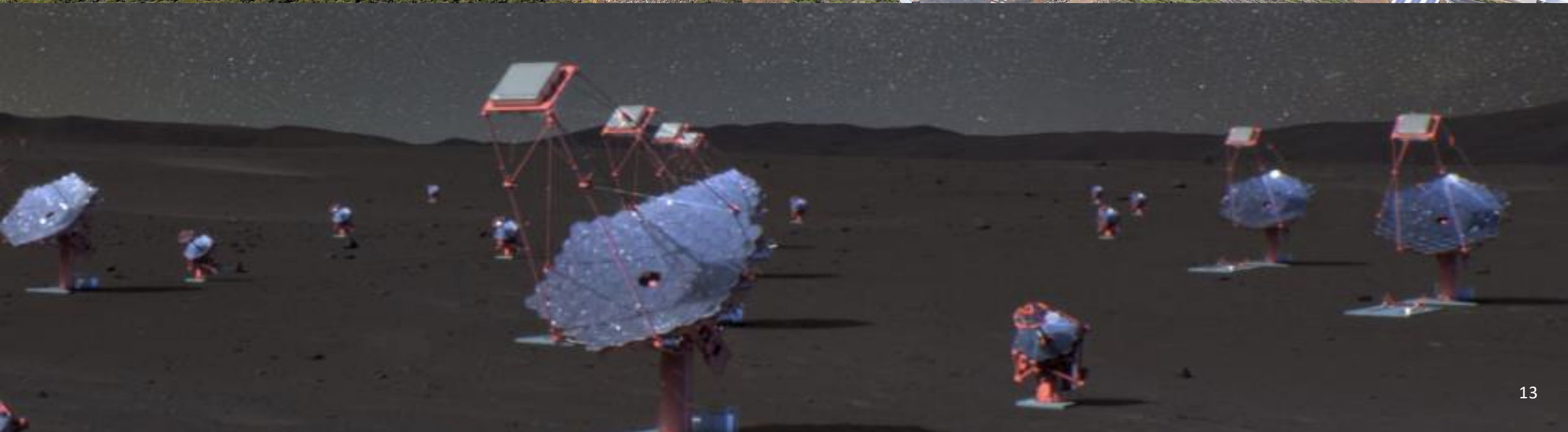


Giuliani + 2023

Very-high energy gamma rays

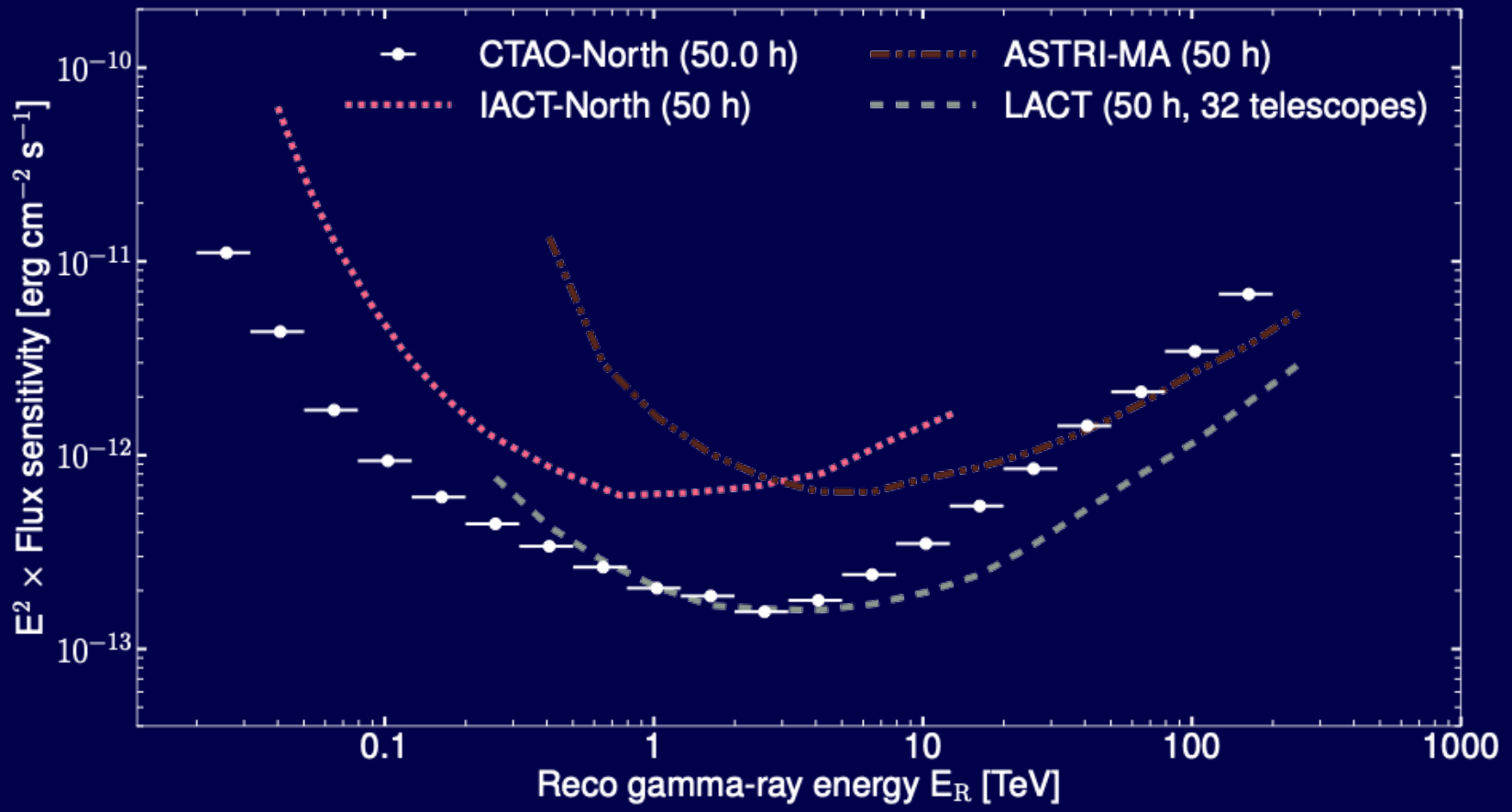
Cherenkov Array Telescope Observatory (CTAO)





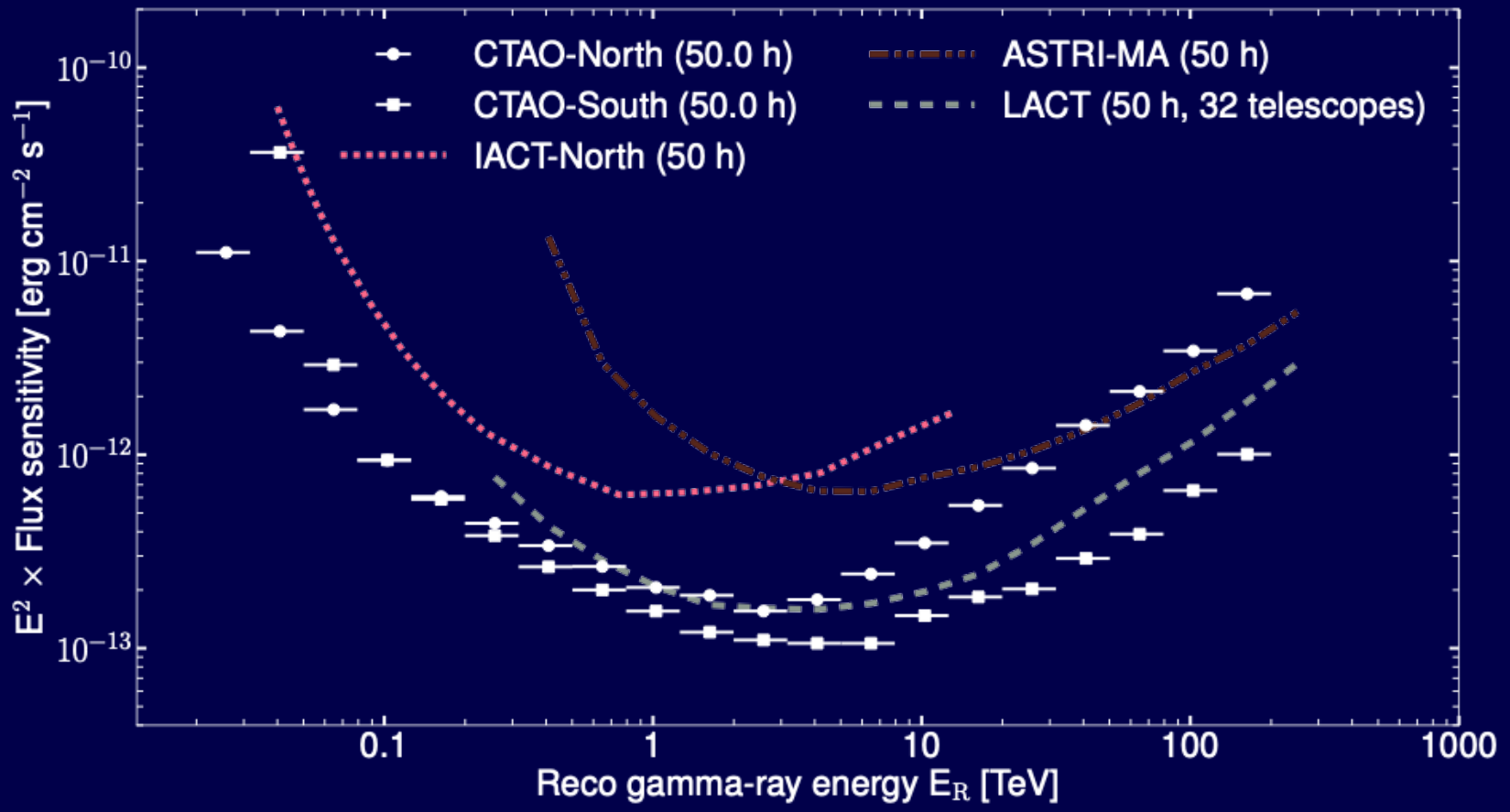
Very-high energy gamma rays

Cherenkov Array Telescope Observatory (CTAO)



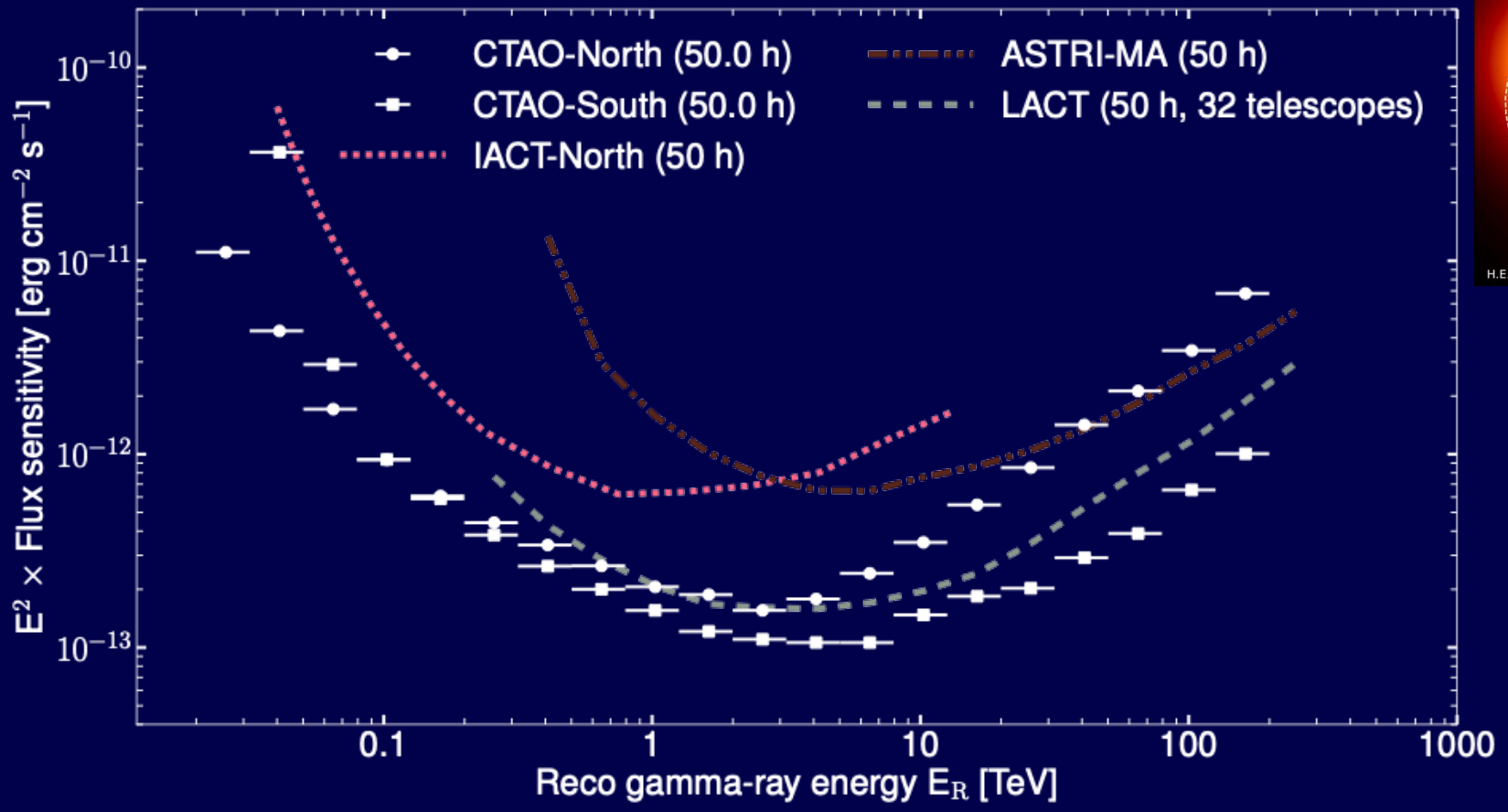
Very-high energy gamma rays

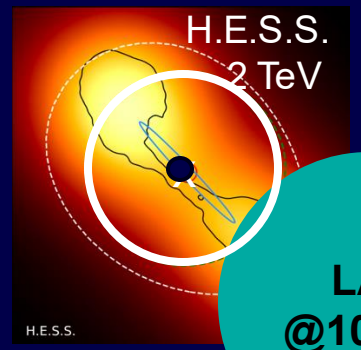
Cherenkov Array Telescope Observatory (CTAO)

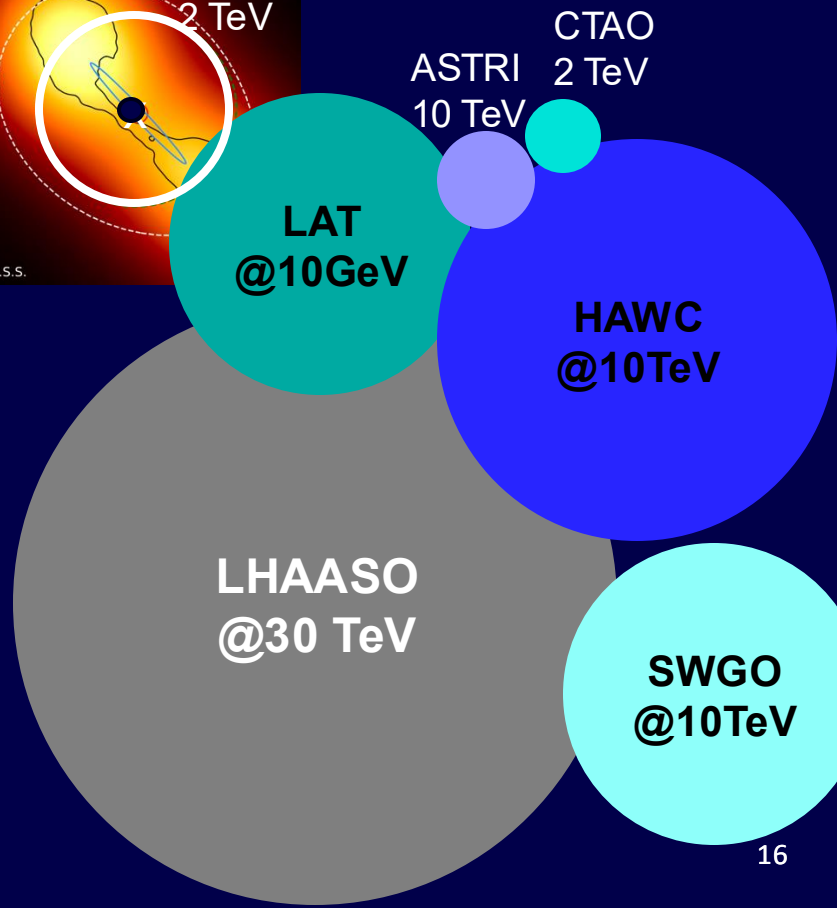


Very-high energy gamma rays

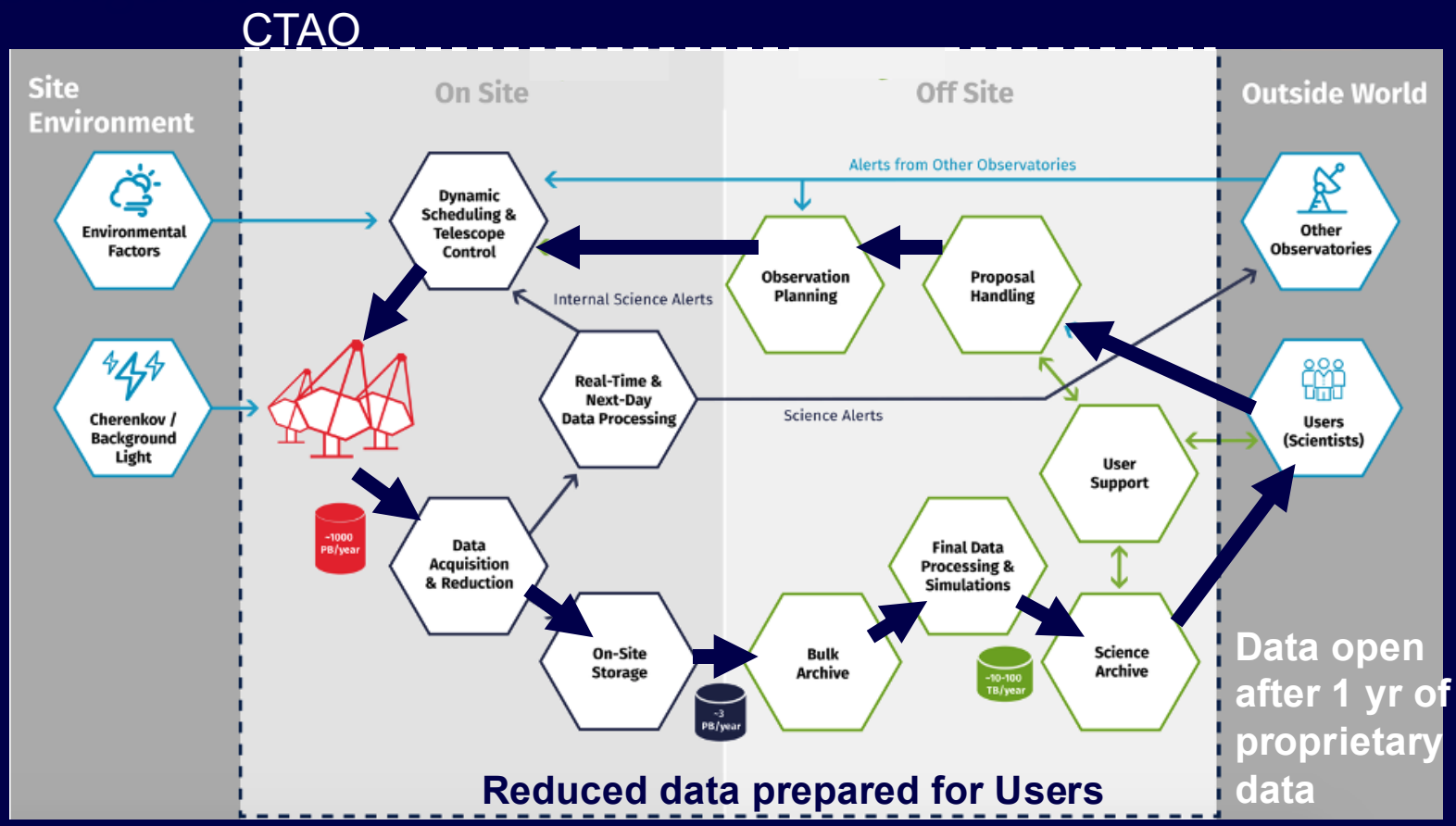
Cherenkov Array Telescope Observatory (CTAO)



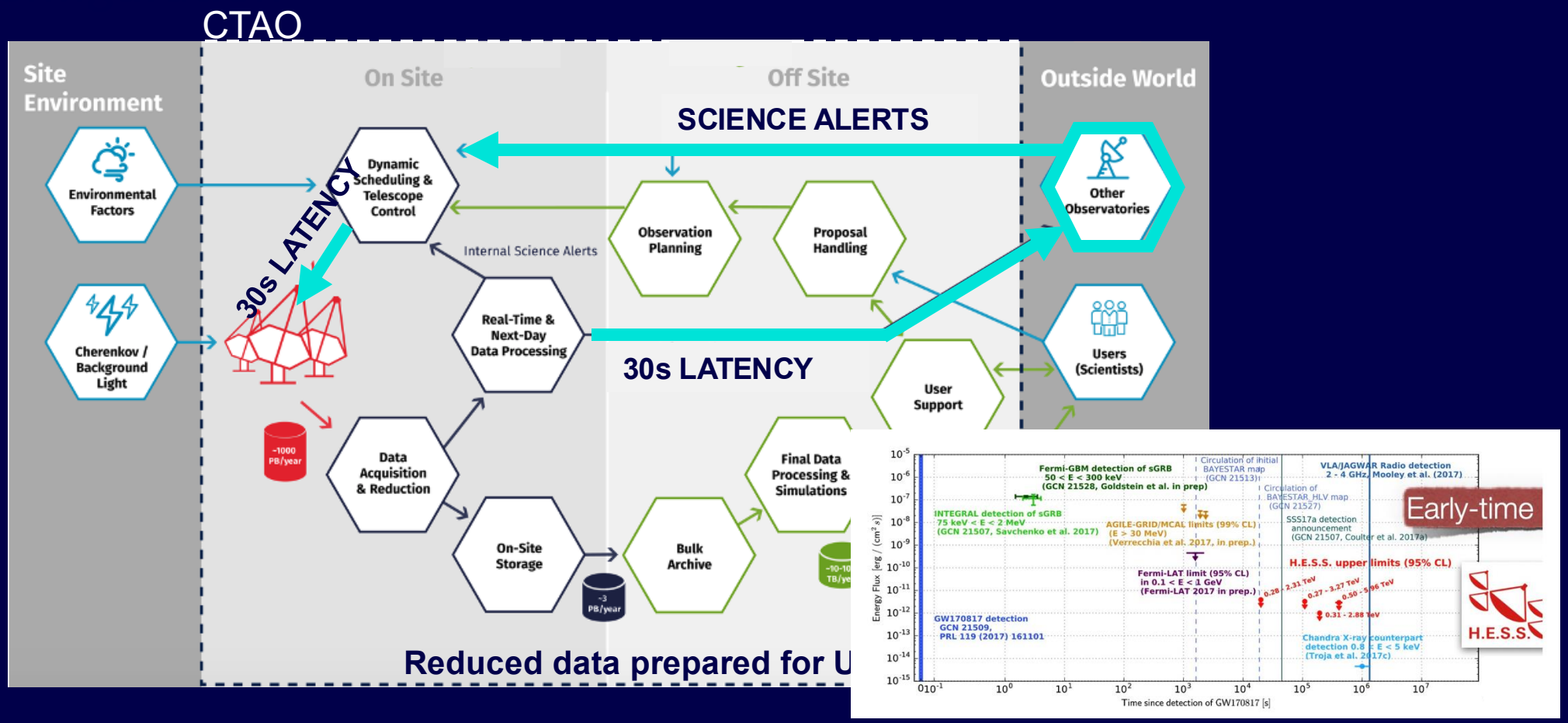




A proposal-driven observatory



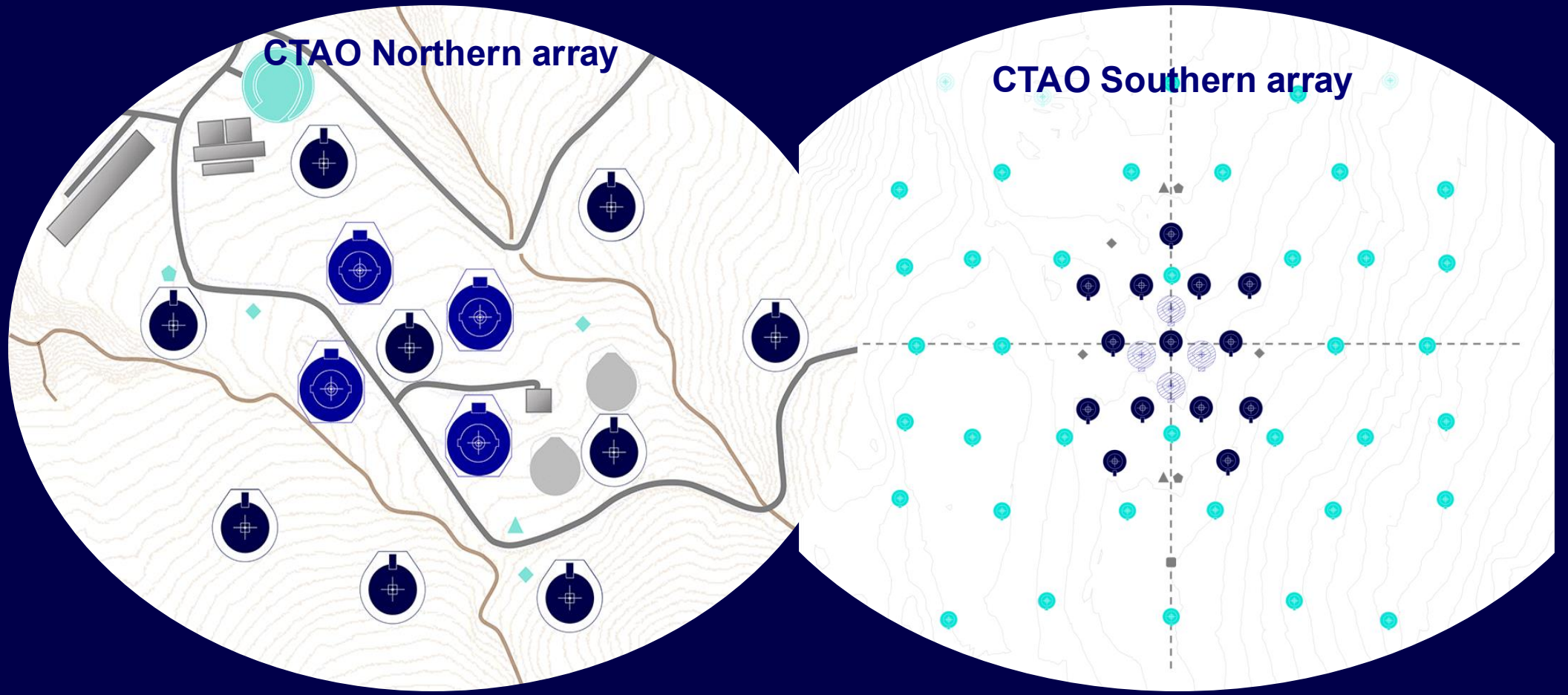
A proposal-driven observatory



CTAO arrays

Alpha Configuration

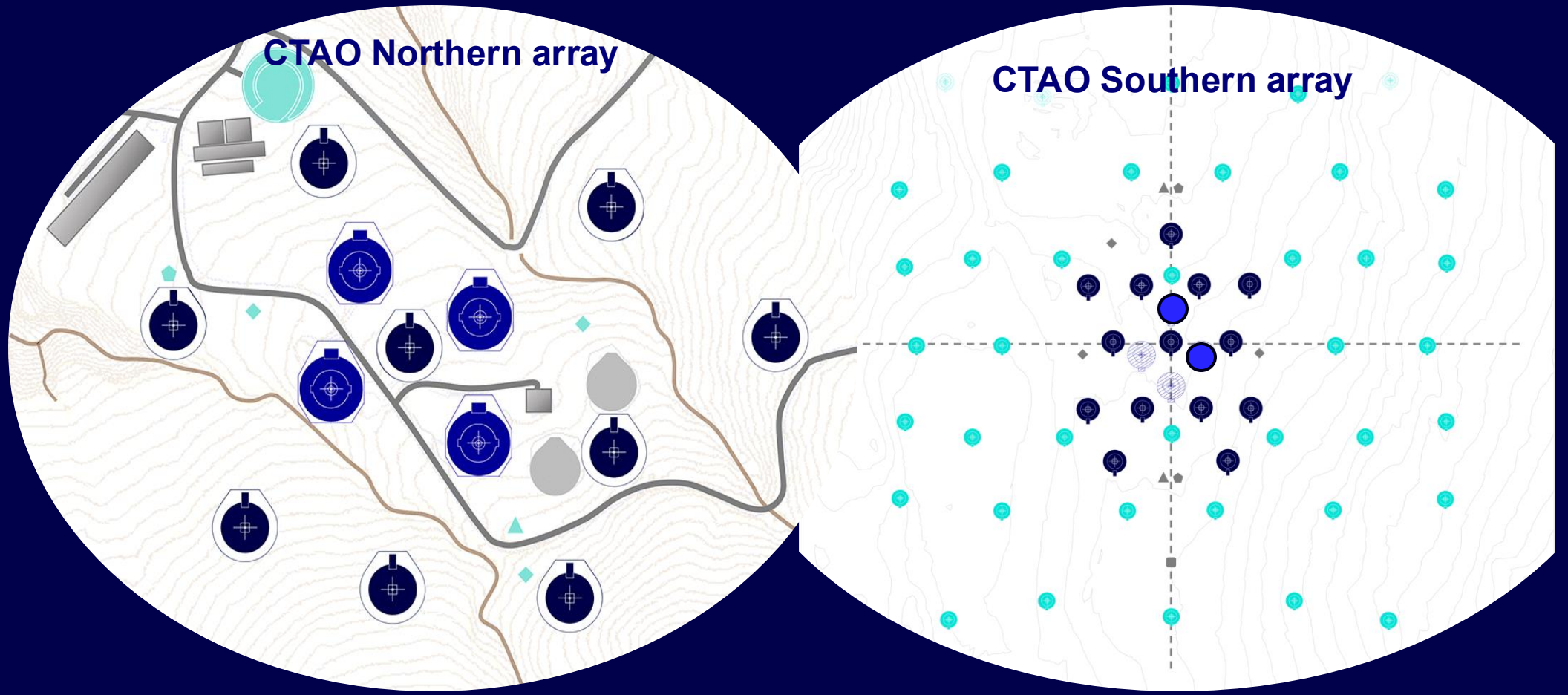
E = [20 GeV – 300 TeV]
γ-ray FoV ~6∘
energy resolution ~ 10%
angular resolution ~ 0.02 ∘



CTAO arrays

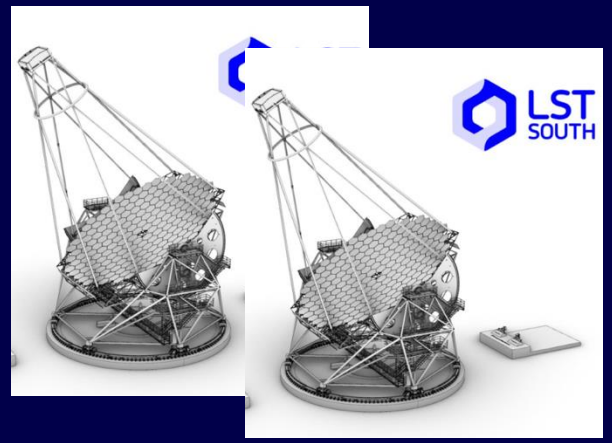
Alpha Configuration + (2 LST @ CTAO-South)

E = [20 GeV – 300 TeV]
γ-ray FoV ~6◦
energy resolution ~ 10%
angular resolution ~ 0.02 ◦

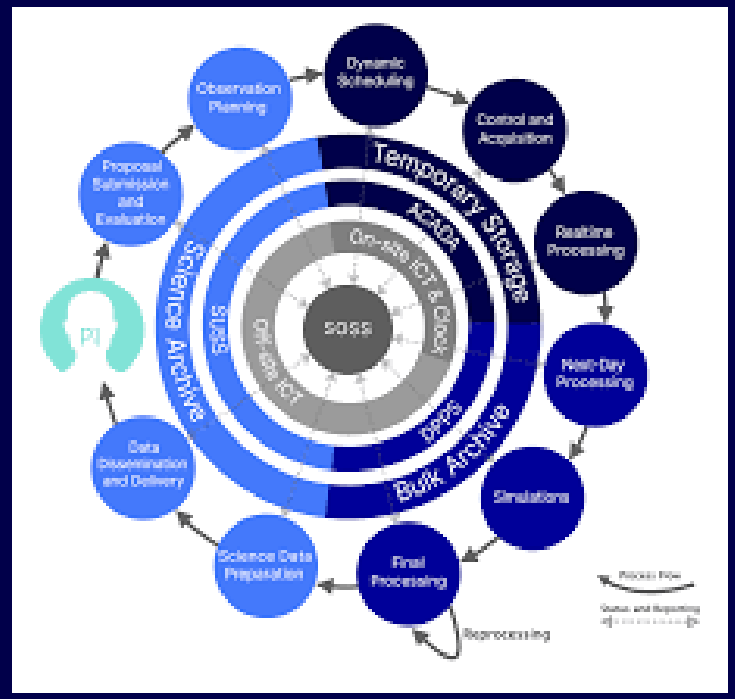


Very-high energy gamma rays

Cherenkov Array Telescope Observatory (CTAO)



funded by CTA+ (PNRR)

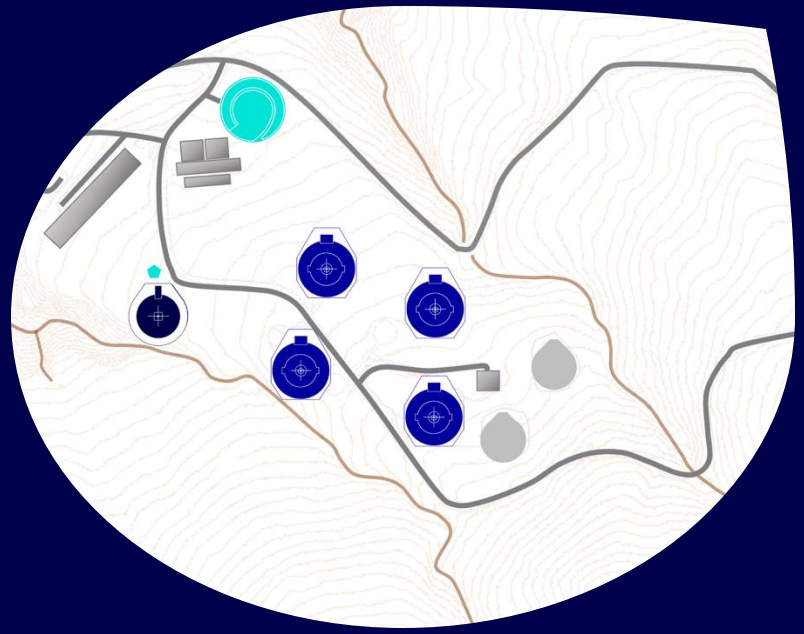


Software development

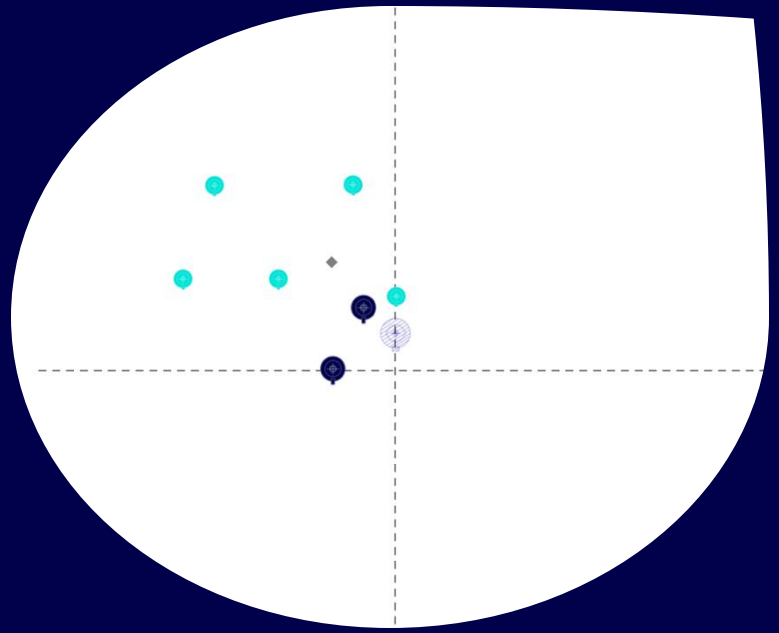
1st intermediate configuration

In two years from now

CTAO Northern array



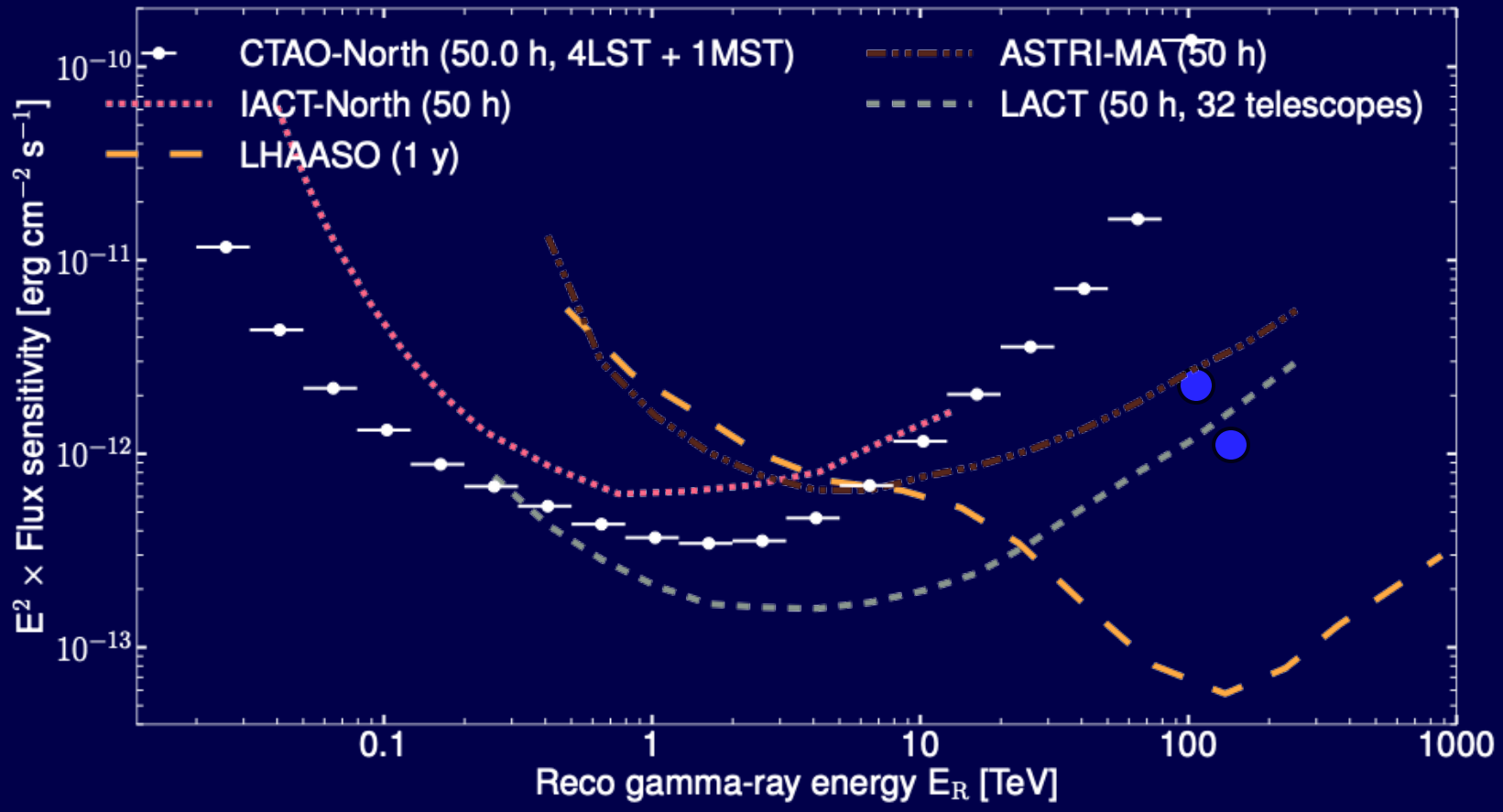
CTAO Southern array



Optimal capabilities for the transient science cases already from the 1st intermediate configuration

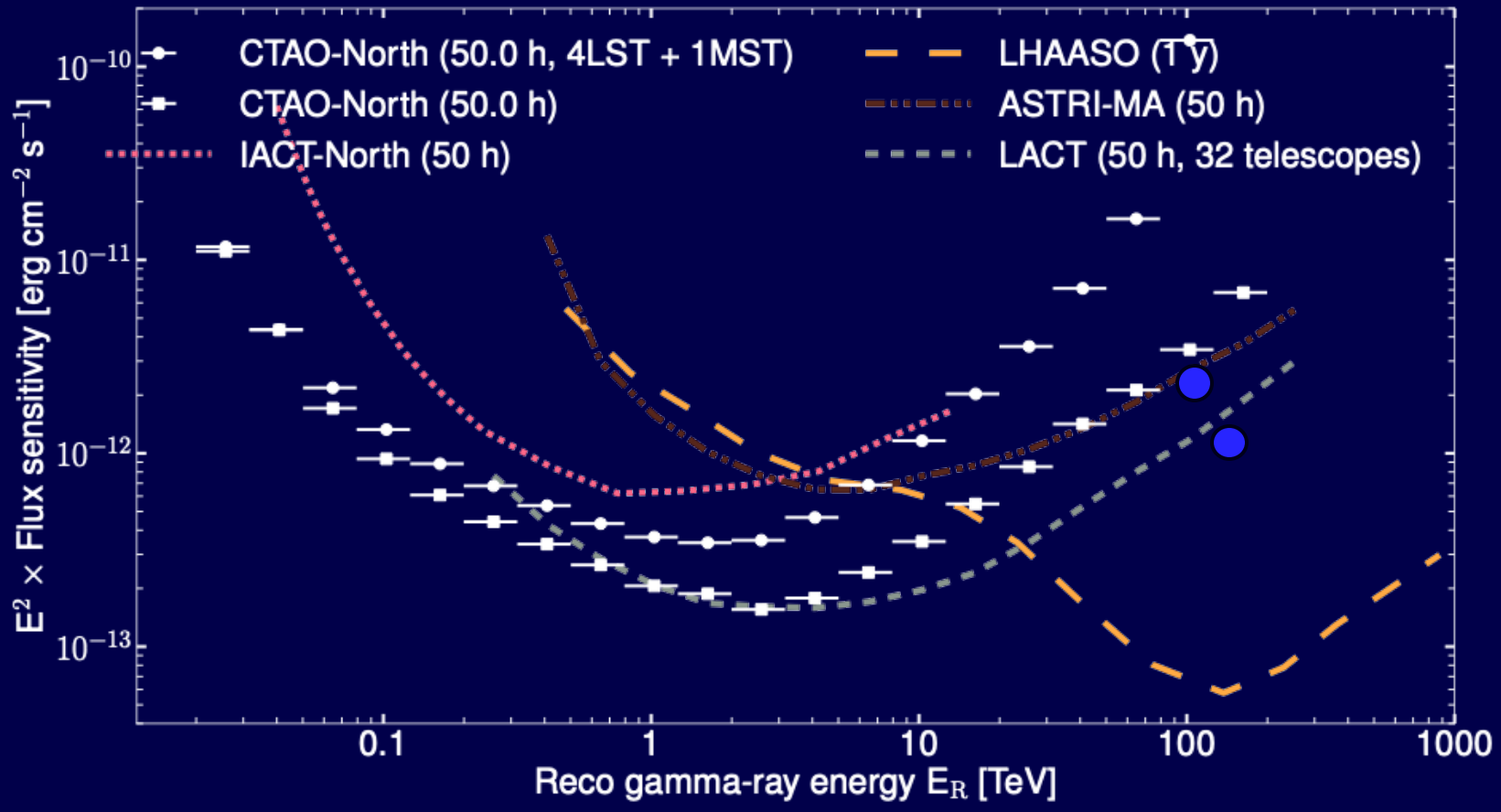
1st intermediate configuration

Northern hemisphere



1st intermediate configuration

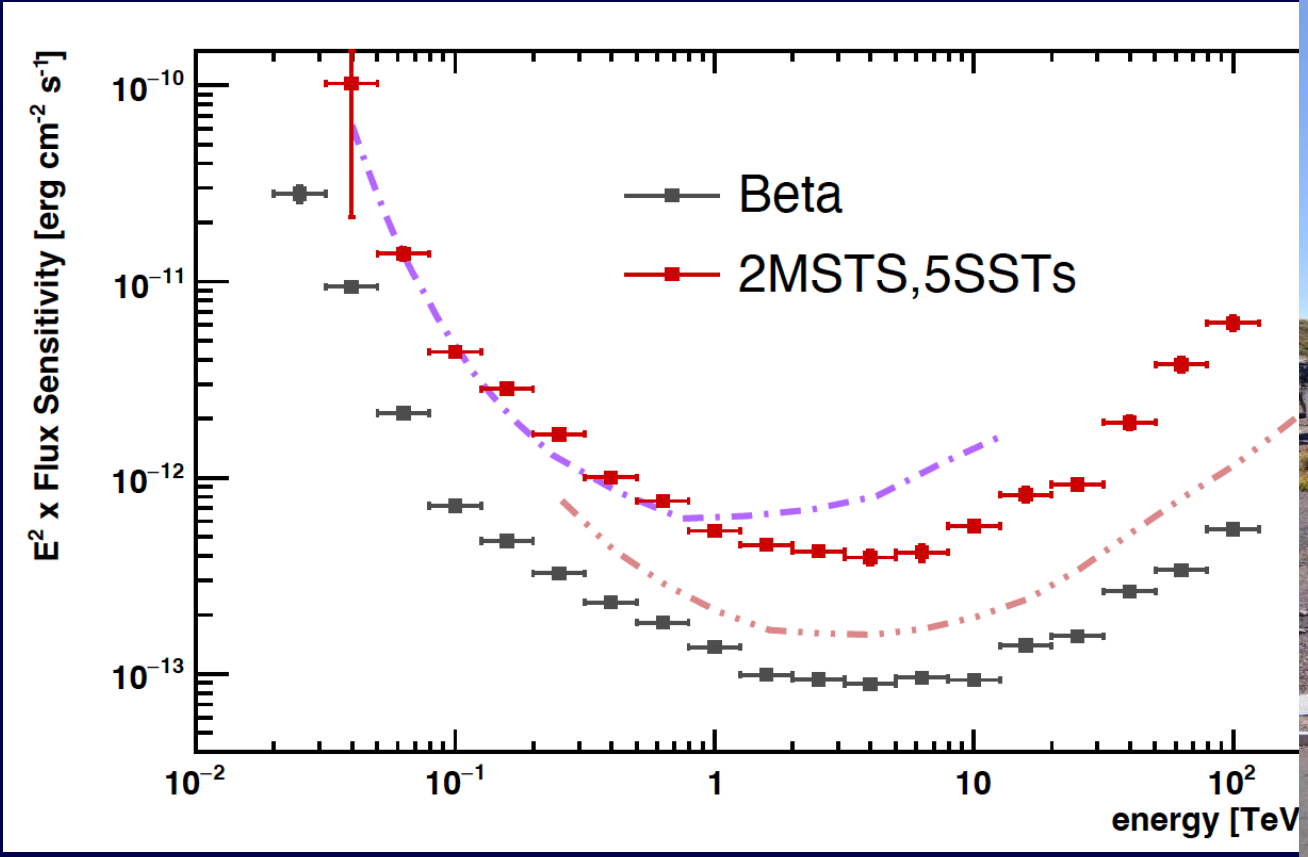
Northern hemisphere



1st intermediate configuratio

CTAO PUBLIC SCIENCE DATA CHALLENGE

Southern hemisphere



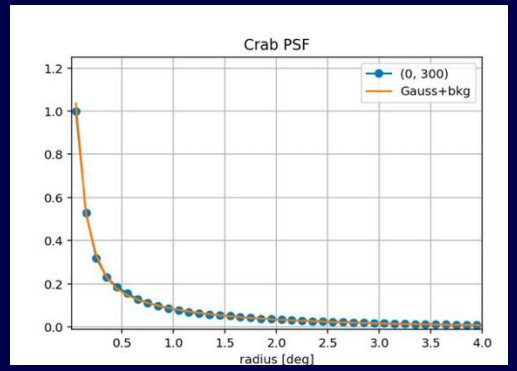
Getting ready

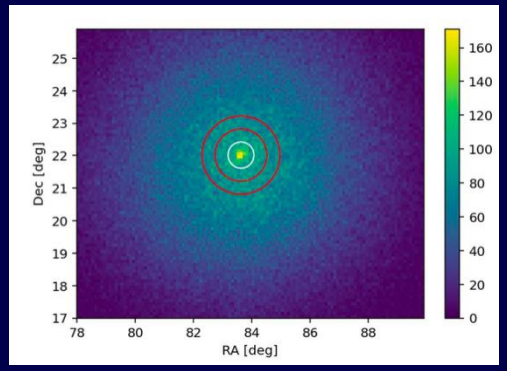
Join the VHE Italian network!

CTAO PUBLIC SCIENCE DATA CHALLENGE

VHEgam Monthly Newsletter

ASTRI science verification.
Credits to A.Giuliani and the ASTRI team





Bright future ahead

Key players in the time domain astronomy at the highest energies with array of IACTs at TeV energies and soft gamma-ray satellites for fast transient detections

Strong scientific expertise built on decades of leadership in the field

CTAO
Cherenkov Telescope Array Observatory

Thank you