The ASTRI Mini-Array at the Teide Observatory

Giovanni Pareschi & Salvo Scuderi

for the ASTRI Project

Telescopio Nazionale Galileo: 25 years of Astronomy in La Palma, 20 October 2021

(No mirrors, no party!)

Name given by Nanni Bignami

ASTRI: Astrophysics with Italian Replicating Technology Mirrors

Mini-Array

ASTRI-Horn Prototype

INAF-led Project funded by Italian Ministry of Research

End-to-end prototype installed and operational on Mount Etna volcano (Sicily, Italy)

First detection of a gamma-ray source (Crab Nebula) above 5σ **with a dual-mirror, Schwarzschild-Couder Chrenkov telescope** (Lombardi et al., 2020)

Array of 9 ASTRI telescopes

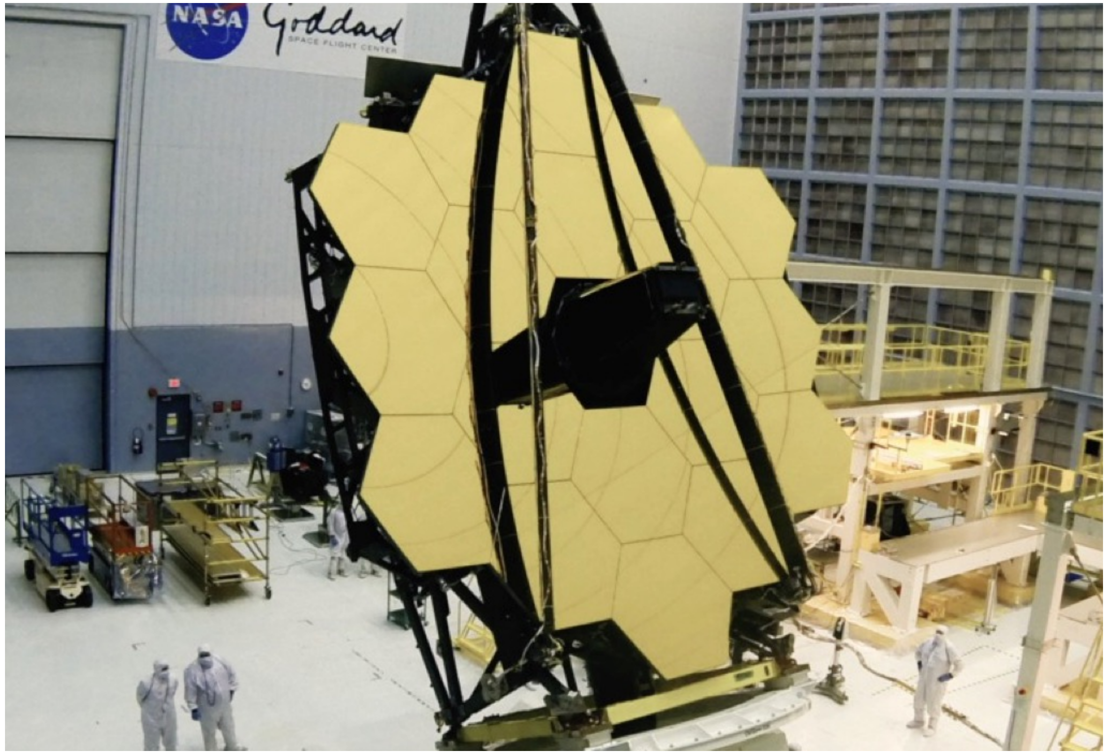
INAF-led Project with international partners: Univ. of Sao Paulo/FPESP (Brazil), North-West Univ. (S. Africa), IAC (Spain), FGG, ASI/SSDC, Univ. of Padova, Perugia and INFN

Being deployed at the *Observatorio del Teide* (Spain) in collaboration with IAC and FGG-INAF.

First 4 years → *Core Science*, following 4 → *Observatory Science*. **Science operation → 2024**

Segmented reflecting surface

Mini-Array



Credits: NASA

JWST, reflecting surface cost:
➔ **a few of Meuros/m²**

ASTRI, reflecting surface cost: ➔ **2 KEuros/m²**
(see Canestrari et al., SPIE, 2014)

The ASTRI-Horn Prototype

Mini-Array

ASTRI-Horn Timeline

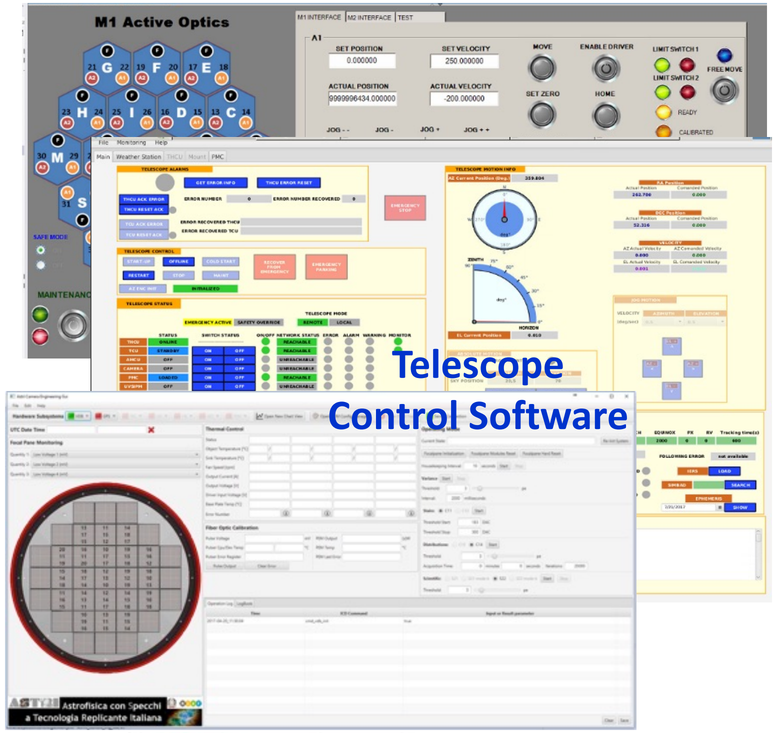
- **September 2014**: Inauguration of the prototype @ INAF-Catania mountain station in Serra La Nave placed at 1725 meters on the Etna volcano (Sicily)
- **October 2016**: Validation of the Schwarzschild-Couder concept
- **May 2017**: First Cherenkov light with the ASTRI camera
- **November 2018**: Dedication of ASTRI prototype telescope to Guido Horn D'Arturo a precursor of the technique of segmented astronomical mirrors
- **December 2018**: Detection of Crab Nebula
- **September 2019**: Telescope stopped for maintenance/refurbishment

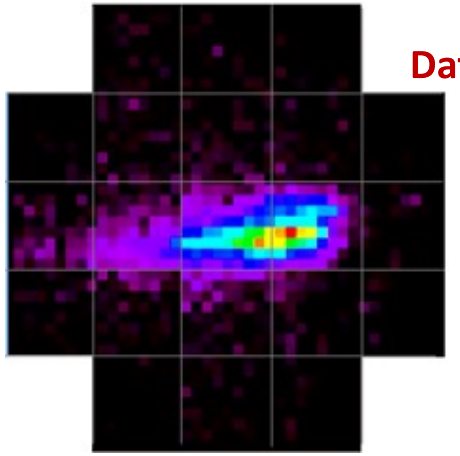
COVID-19

- **October 2021**: Telescope is resuming the
- operations

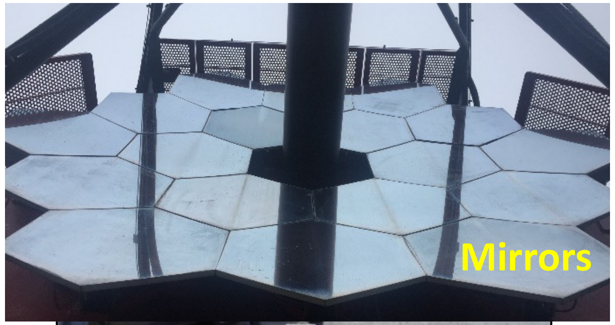
ASTRI-Horn end to end approach

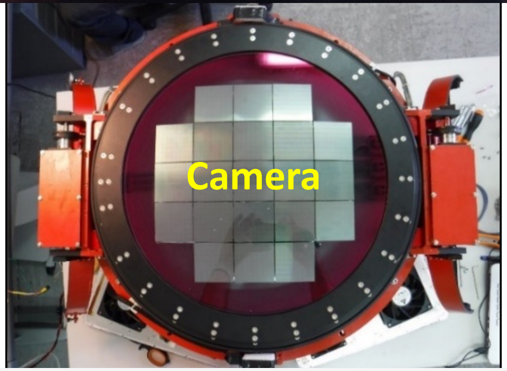
The end-to-end approach includes the telescope, internal and external calibration systems, control acquisition hardware and software, data reduction and analysis software, and the data archiving system

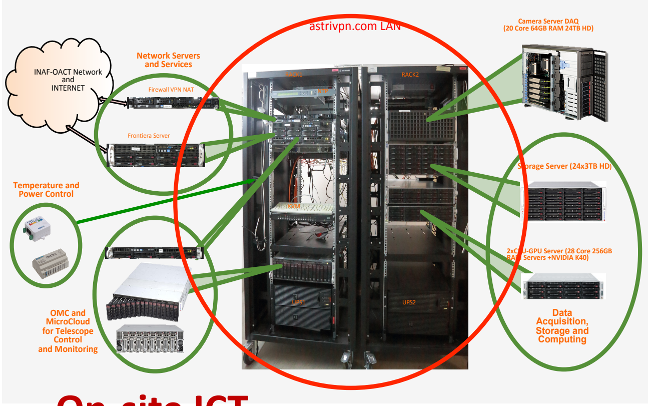




Data Analysis &
Archiving



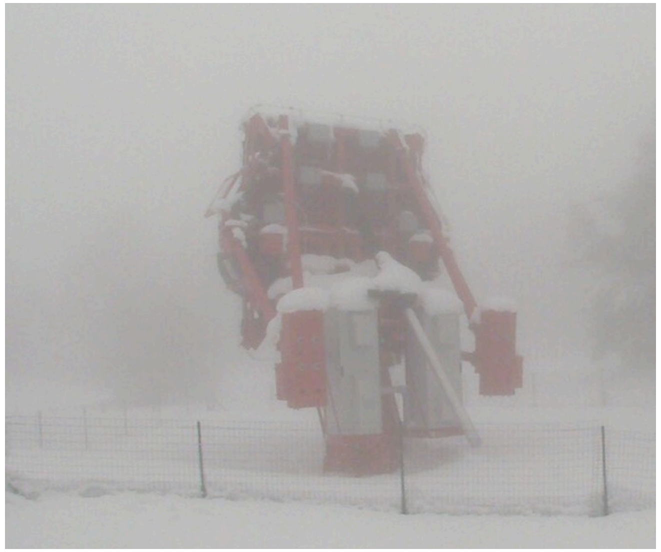


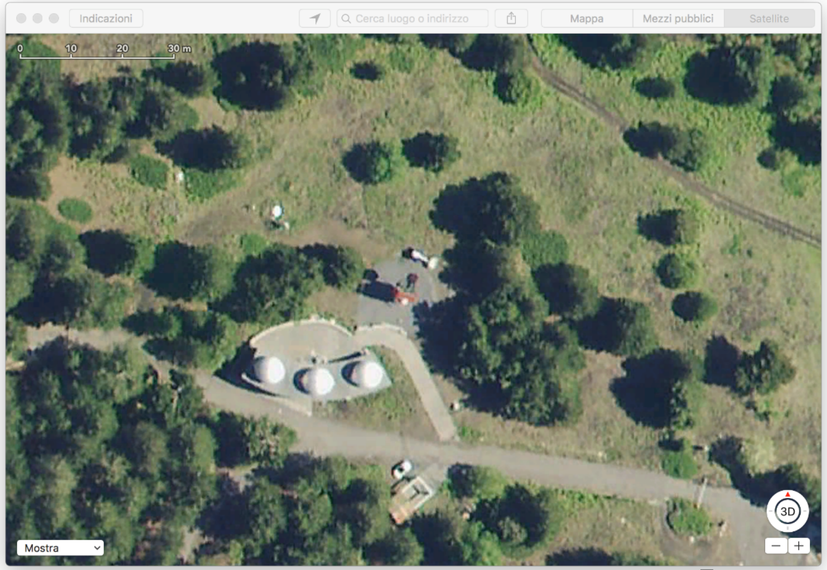


On-site ICT

ASTRI -Horn & the environment

The prototype is placed at 1725 meters on the Etna volcano @ INAF-Catania mountain station in Serra La Nave





The Schwarzschild Aplanatic Telescope

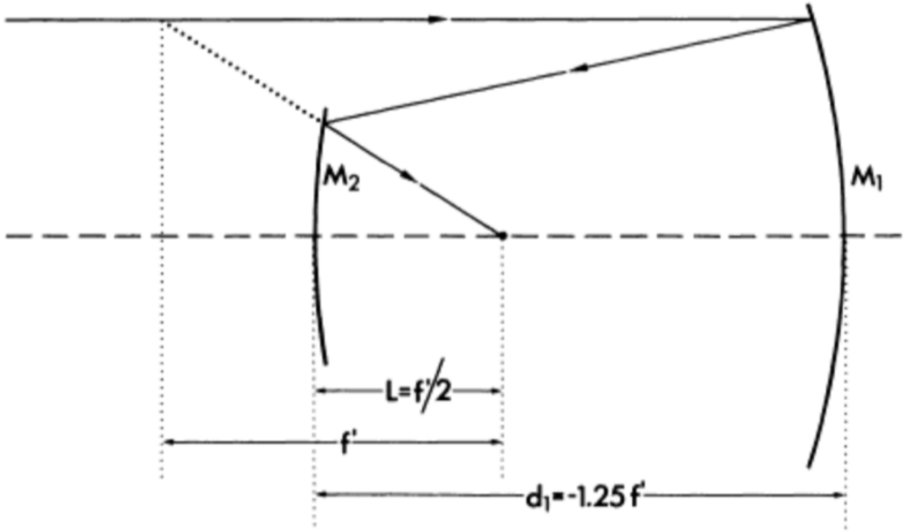
1905: Karl Schwarzschild solved the Seidel 's equations for **spherical** aberration and **coma** finding a relation between parameters capable to make a telescope **aplanatic**. *(Couder 1926 ➔ also correction of **astigmatism** with curved focal plane)*

Vladimir Vassiliev, UCLA

"For any geometry, 2 aspheric mirrors allow the correction of SI and SII to give an aplanatic telescope"

Schwarzschild telescope

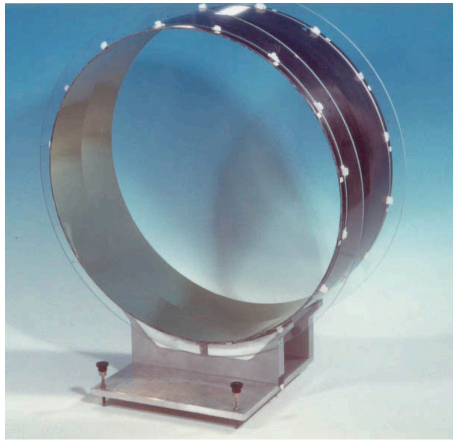
KS: f/3.0
b_{S1}= -13.5 (Hyperbola)
b_{S2}= 1.963 (Spheroid)
FoV:2.8 deg
RMS_{edge}~12"



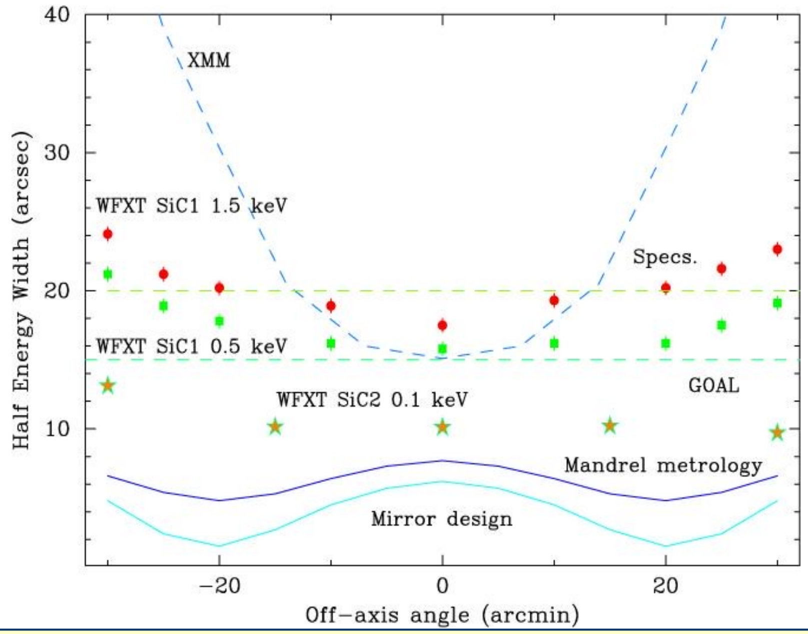
Technological challenge: Aspherical Optics manufacturing + large secondary mirror

The WFXT prototypes in SiC by epoxy replication

Polynomial mirrors developed in Italy for the WFXT mission by O. Citterio (1998-2001,- design by Paolo Conconi after the idea by R. Giacconi & R. Burg)



Citterio, Ghigo et al. , 1999

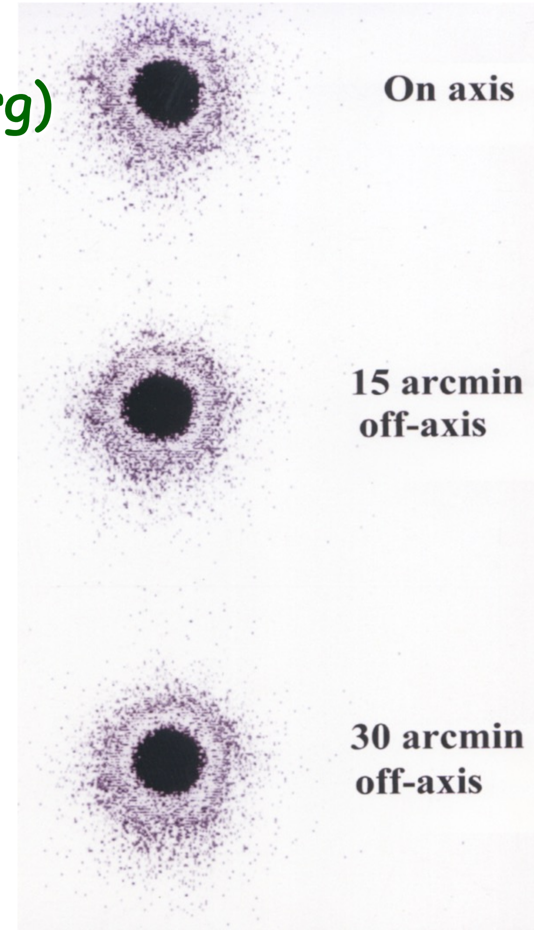


WFXT (epoxy replication on SiC) – Ø = 60 cm

Height = 20 cm

F. L. = 300 cm

HEW = 10 arcsec @ 0.1 keV



Ref:. O. Citterio, et al., ", *SPIE Proc.*, 3766, 198 (1999)
Ghigo et al., *SPIE Proc.*, 3766, 209 (1999)

The ASTRI-Horn results

Mini-Array

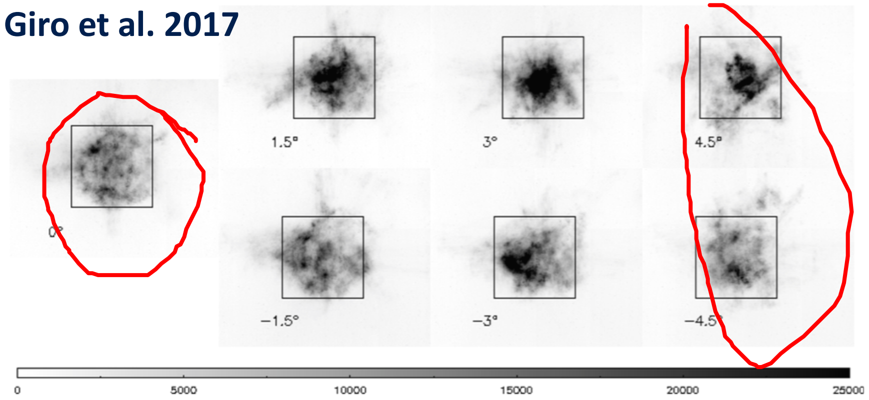
A&A 608, A86 (2017)
DOI: 10.1051/0004-6361/201731602

Astronomy & Astrophysics

First optical validation of a Schwarzschild Couder telescope: the ASTRI SST-2M Cherenkov telescope

E. Giro[1,2], R. Canestrari[2], G. Sironi[2], E. Antolini[3], P. Conconi[2], C. E. Fermino[4], C. Gargano[5], G. Rodeghiero[1,6], F. Russo[7], S. Scuderi[8], G. Tosti[3], V. Vassiliev[9], and G. Pareschi[2]

Giro et al. 2017

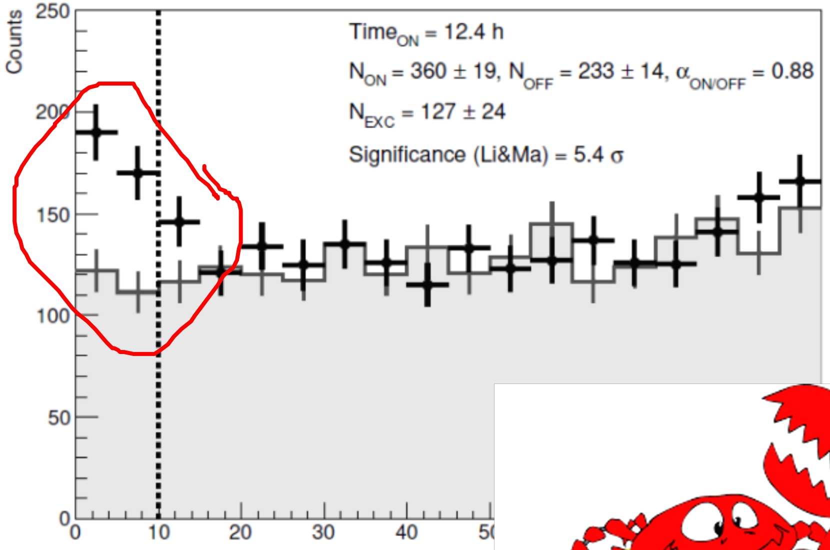


A&A 634, A22 (2020)
https://doi.org/10.1051/0004-6361/201936791

Astronomy & Astrophysics

First detection of the Crab Nebula at TeV energies with a Cherenkov telescope in a dual-mirror Schwarzschild-Couder configuration: the ASTRI-Horn telescope

S. Lombardi[1,2,★], O. Catalano[3,★], S. Scuderi[4,★], L. A. Antonelli[1,2], G. Pareschi[5], E. Antolini[6], L. Arrabito[7], G. Bellassai[8], K. Bernlöhr[9], C. Bigongiari[1], B. Biondo[3], G. Bonanno[8], G. Bonnoli[5], G. M. Böttcher[10], J. Bregeon[11], P. Bruno[8], R. Canestrari[3], M. Capalbi[3], P. Caraveo[4], P. Conconi[5], V. Conforti[12], G. Contino[3], G. Cusumano[3], E. M. de Gouveia Dal Pino[13], A. Distefano[4], G. Farisato[14], C. Fermino[13], M. Fiorini[4], A. Frigo[14], S. Gallozzi[1], C. Gargano[3], S. Garozzo[8], F. Gianotti[12], S. Giarrusso[3], R. Gimenes[13], E. Giro[14], A. Grillo[8], D. Impiombato[3], S. Incorvaia[4], N. La Palombara[4], V. La Parola[3], G. La Rosa[3], G. Leto[8], F. Lucarelli[1,2], M. C. Maccarone[3], D. Marano[8], E. Martinetti[8], A. Micciché[8], R. Millul[5], T. Mineo[3], G. Nicotra[15], G. Occhipinti[8], I. Pagano[8], M. Perri[1,2], G. Romeo[8], F. Russo[3], F. Russo[12], B. Sacco[3], P. Sangiorgi[3], F. G. Saturni[1], A. Segreto[3], G. Sironi[5], G. Sottile[3], A. Stamerra[1], L. Stringhetti[4], G. Tagliaferri[5], M. Tavani[16], V. Testa[1], M. C. Timpanaro[8], G. Toso[4], G. Tosti[17], M. Trifoglio[12], G. Umana[8], S. Vercellone[5], R. Zanmar Sanchez[8], C. Arcaro[14], A. Bulgarelli[12], M. Cardillo[16], E. Cascone[18], A. Costa[8], A. D'Aì[3], F. D'Ammando[12], M. Del Santo[3], V. Fioretti[12], A. Lamastra[1], S. Mereghetti[4], F. Pintore[4], G. Rodeghiero[14], P. Romano[5], J. Schwarz[5], E. Sciacca[8], F. R. Vitello[8], and A. Wolter[5]



Lombardi et al. 2020

The mini-array @Teide

ASTRI: a new pathfinder of the arrays of Cherenkov telescopes

On June 12nd 2019, in La Laguna (Tenerife, Spain) Prof. Nichi D'Amico, President of the Italian National Institute for Astrophysics (INAF), and Prof. Rafael Rebolo Lopez, Director of the Instituto de Astrofisica de Canaries, signed a Record of Understanding to enter a detailed negotiation on a technical and programmatic basis aimed to install and operate the ASTRI Mini-Array at the Observatorio del Teide

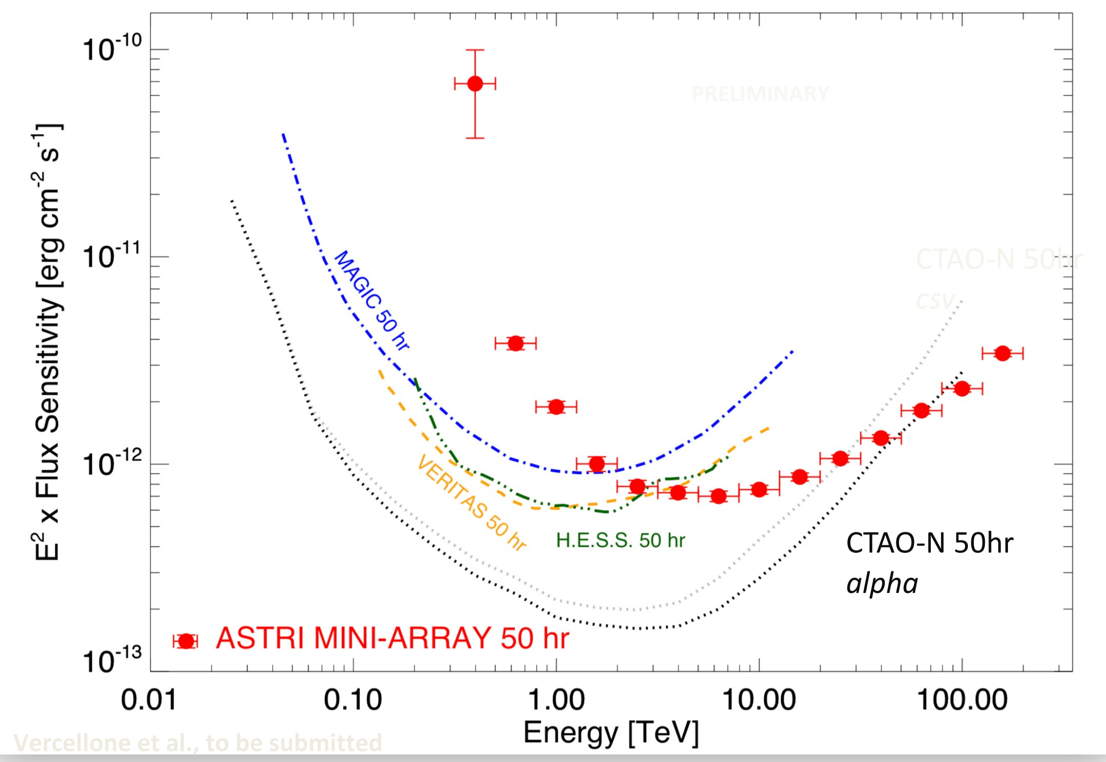
INAF and IAC Representatives on the Teide Observatory site

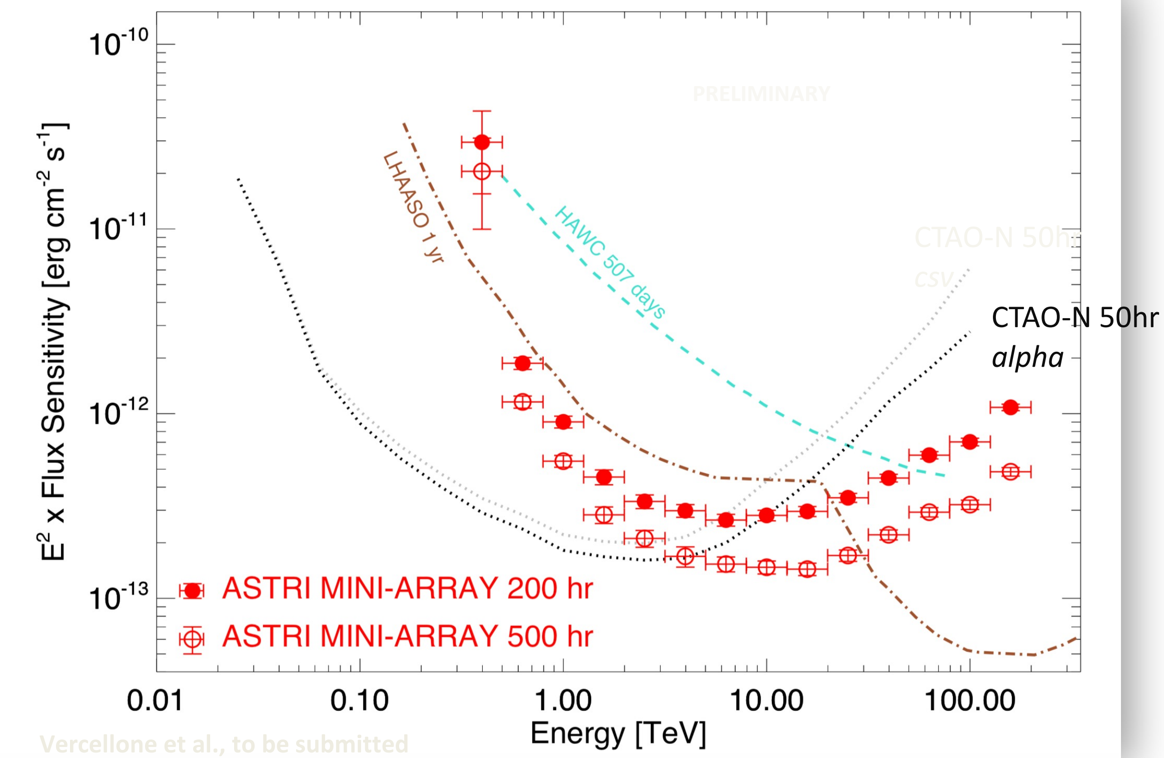
The ASTRI Mini-Array – Performance

See also Talk by S. Lombardi

- We extend the **differential sensitivity up to several tens of TeV and beyond**

- Investigate possible spectral features at VHE, such as the presence of **spectral cut-offs** or the detection of emission at several tens of TeV expected from **Galactic PeVatrons**





The ASTRI Mini-Array – Performance

ASTRI Mini-Array

PRELIMINARY

	ASTRI Mini-Array	MAGIC	VERITAS	H.E.S.S.	HAWC	LHAASO
Location	28° 18′ 04″ N	28° 45′ 22″ N	31° 40′ 30″ N	23° 16′ 18″ S	18° 59′ 41″ N	29° 21′ 31″ N
	16° 30′ 38″ W	17° 53′ 30″ W	110° 57′ 7.8″ W	16° 30′ 00″ E	97° 18′ 27″ W	100° 08′ 15″ E
Altitude [m]	2,390	2,396	1,268	1,800	4,100	4,410
FoV	~ 10°	~ 3.5°	~ 3.5°	~ 5°	2 sr	2 sr
Angular Res.	0.05° (30 TeV)	0.07° (1 TeV)	0.07° (1 TeV)	0.06° (1 TeV)	0.15°[(a)] (10 TeV)	(0.24–0.32)°[(b)] (100 TeV)
Energy Res.	12% (10 TeV)	16% (1 TeV)	17% (1 TeV)	15% (1 TeV)	30% (10 TeV)	(13–36)% (100 TeV)[(b)]
Energy Range	(0.3-200) TeV	(0.05-20) TeV	(0.08-30) TeV	(0.02-30) TeV[(c)]	(0.1-100) TeV	(0.1-1,000) TeV

Sensitivity: better than current IACTs (E ≳ 3 TeV)

Extended spectrum and cut-off constraints

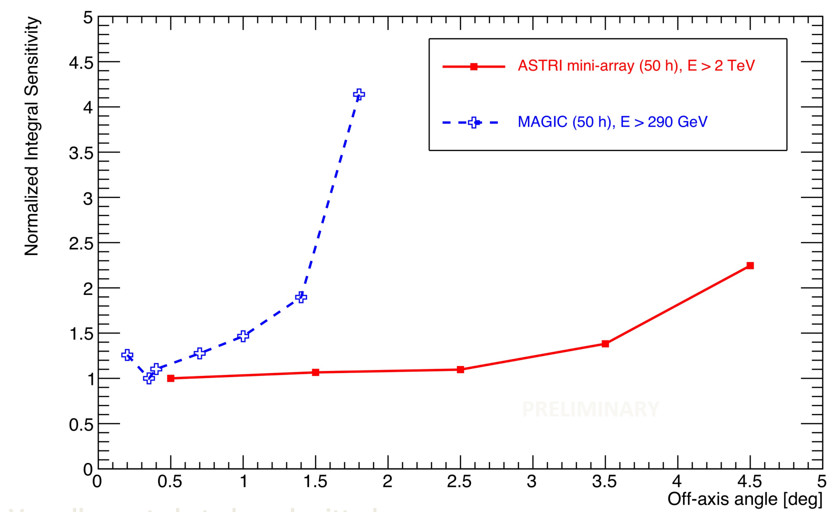
Energy/Angular resolution: ~10% / ~0.05° (E =10 TeV)

Identify and characterize extended sources morphology

10° field of view with homogeneous off-axis performance

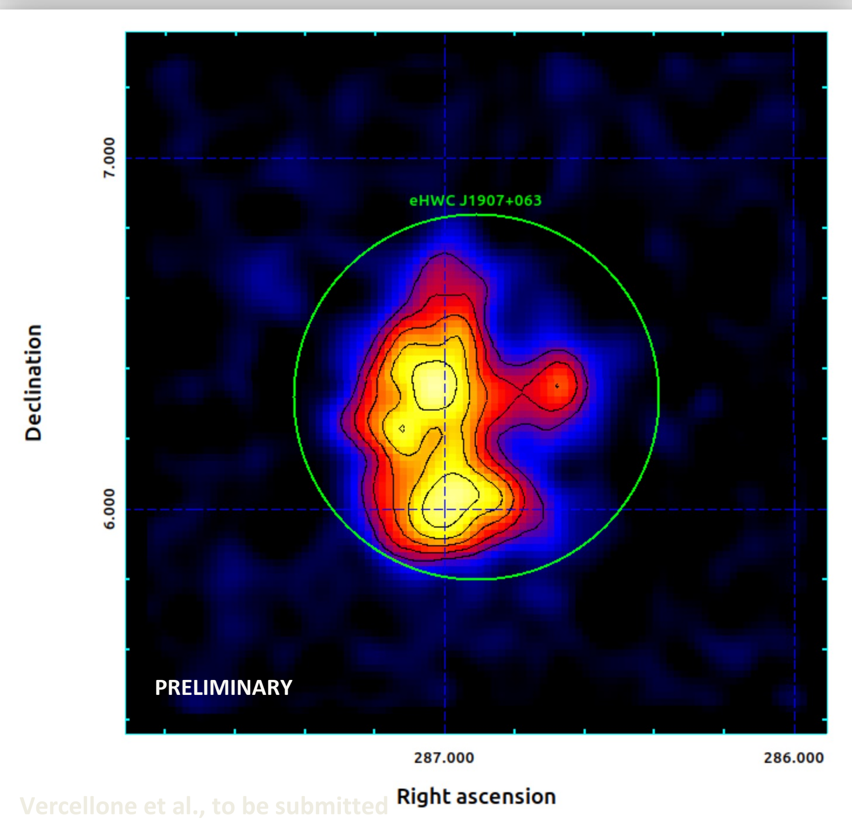
Multi-target fields, surveys, and extended sources

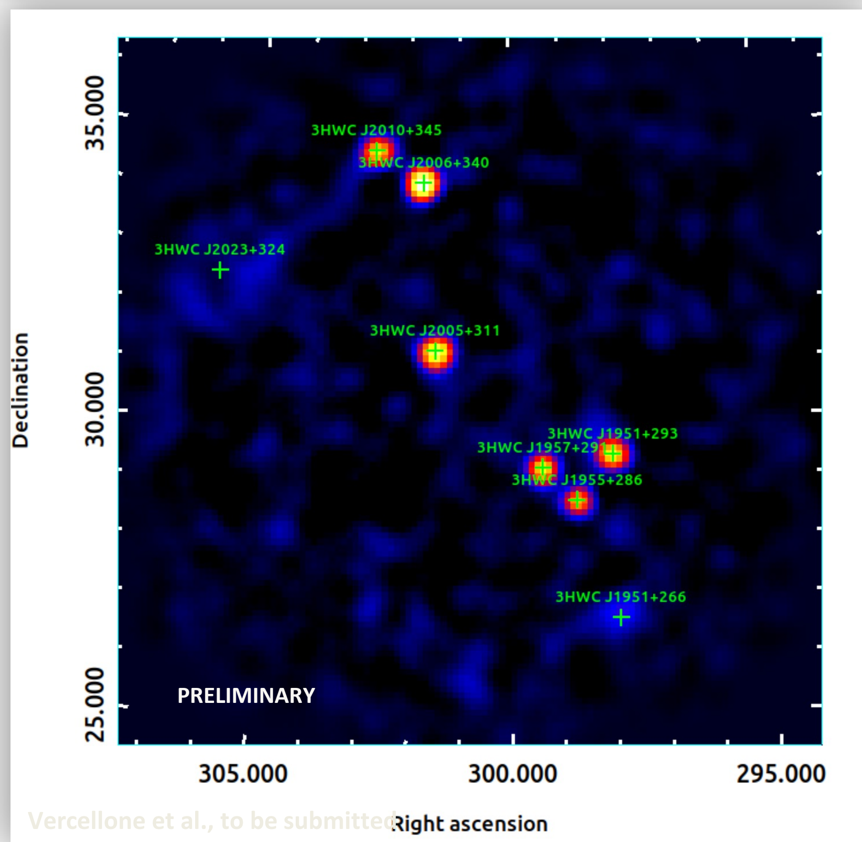
Enhanced chance for serendipitous discoveries



Vercellone et al., to be submitted

Angular resolution and large field of view





ASTRI Mini-Array **200 hr simulation (up to E~200 TeV)** of the region **of the Galactic source 2HWC J1908+063**. The light green circle marks the $\sim 0.52°$ HAWC error-box for $E > 56$ TeV

ASTRI Mini-Array **200 hr simulation of the Cygnus Region**. Green crosses mark the positions of the 3HWC sources in a 10° × 10° field of view

The Pillars' concept

First four years specific science topics → robust answers to a few **well-determined open questions**

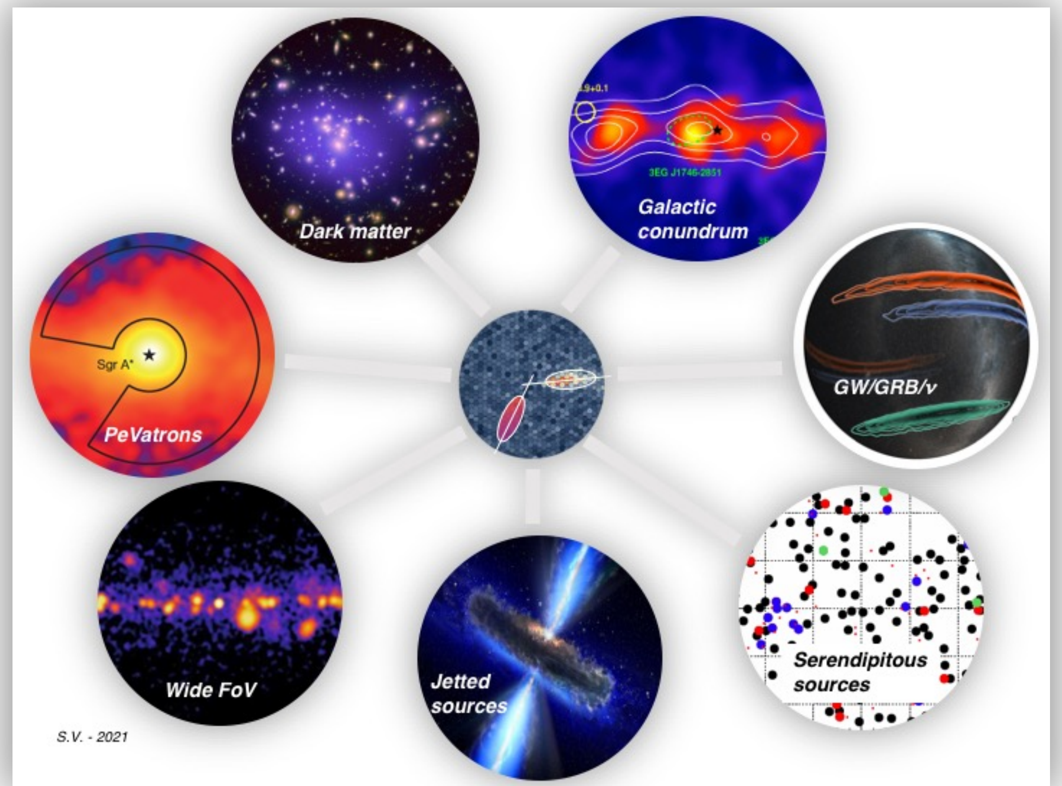
10° field of view →simultaneously **investigate more than one source** during the same pointing

Pillar 1 – The origin of cosmic rays

- The quest for PeVatrons
- Particle escape and propagation
- High energy emission from Pulsar Wind Nebulae
- Ultra High Energy Cosmic Rays from Starburst Galaxies

Pillar 2 – Cosmology and Fundamental Physics

- TeV observations and constraints on the IR EBL
- Probing intergalactic magnetic fields
- Blazars as probes for hadron beams
- Tests on the existence of axion-like particles
- Lorentz Invariance violation studies
- Indirect dark matter searches



The LHAASO PeVatrons

Cao et al., 2021, Nature

LHAASO Source	Possible Origin	Type	Distance (kpc)	Age (kyr)^a	L_s (erg/s)^b	Potential TeV Counterpart^c
LHAASO J0534+2202	PSR J0534+2200	PSR	2.0	1.26	4.5×10^{38}	Crab, Crab Nebula
LHAASO J1825-1326	PSR J1826-1334	PSR	3.1 ± 0.2^d	21.4	2.8×10^{36}	HESS J1825-137, HESS J1826-130,
	PSR J1826-1256	PSR	1.6	14.4	3.6×10^{36}	2HWC J1825-134
LHAASO J1839-0545	PSR J1837-0604	PSR	4.8	33.8	2.0×10^{36}	2HWC J1837-065, HESS J1837-069,
	PSR J1838-0537	PSR	1.3^e	4.9	6.0×10^{36}	HESS J1841-055
LHAASO J1843-0338	SNR G28.6-0.1	SNR	9.6 ± 0.3^f	$< 2^f$	—	HESS J1843-033, HESS J1844-030, 2HWC J1844-032
LHAASO J1849-0003	PSR J1849-0001	PSR	7^g	43.1	9.8×10^{36}	HESS J1849-000, 2HWC J1849+001
	W43	YMC	5.5^h	—	—	
LHAASO J1908+0621	SNR G40.5-0.5	SNR	3.4^i	$\sim 10 - 20^j$	—	MGRO J1908+06, HESS J1908+063,
	PSR 1907+0602	PSR	2.4	19.5	2.8×10^{36}	ARGO J1907+0627, VER J1907+062,
	PSR 1907+0631	PSR	3.4	11.3	5.3×10^{35}	2HWC 1908+063
LHAASO J1929+1745	PSR J1928+1746	PSR	4.6	82.6	1.6×10^{36}	2HWC J1928+177, 2HWC J1930+188,
	PSR J1930+1852	PSR	6.2	2.9	1.2×10^{37}	HESS J1930+188, VER J1930+188
	SNR G54.1+0.3	SNR	$6.3^{+0.8}_{-0.7}\,^d$	$1.8 - 3.3^k$	—	
LHAASO J1956+2845	PSR J1958+2846	PSR	2.0	21.7	3.4×10^{35}	2HWC J1955+285
	SNR G66.0-0.0	SNR	2.3 ± 0.2^d	—	—	
LHAASO J2018+3651	PSR J2021+3651	PSR	$1.8^{+1.7}_{-1.4}\,^l$	17.2	3.4×10^{36}	MGRO J2019+37, VER J2019+368,
	Sh 2-104	H II/YMC	$3.3 \pm 0.3^m/4.0 \pm 0.5^n$	—	—	VER J2016+371
LHAASO J2032+4102	Cygnus OB2	YMC	1.40 ± 0.08^o	—	—	TeV J2032+4130, ARGO J2031+4157,
	PSR 2032+4127	PSR	1.40 ± 0.08^o	201	1.5×10^{35}	MGRO J2031+41, 2HWC J2031+415,
	SNR G79.8+1.2	SNR candidate	—	—	—	VER J2032+414
LHAASO J2108+5157	—	—	—	—	—	—
LHAASO J2226+6057	SNR G106.3+2.7	SNR	0.8^p	$\sim 10^p$	—	VER J2227+608, Boomerang Nebula
	PSR J2229+6114	PSR	0.8^p	$\sim 10^p$	2.2×10^{37}	

Discovery of **12 sources emitting at several hundreds of TeV**, up to 1.4 PeV

Crab apart, the majority of remaining sources represent **diffuse γ-ray structures with angular extensions up to 1°**, and all of them are located along the Galactic plane

The **actual sources** responsible for the ultra high-energy γ-rays **have not yet been firmly localized and identified** (except for the Crab Nebula), leaving open the origin of these extreme accelerators

The **ASTRI Mini-Array** will investigate these and future PeVatron sources providing important **information on their identification and morphology**

The Galactic Center – a challenge in a challenge

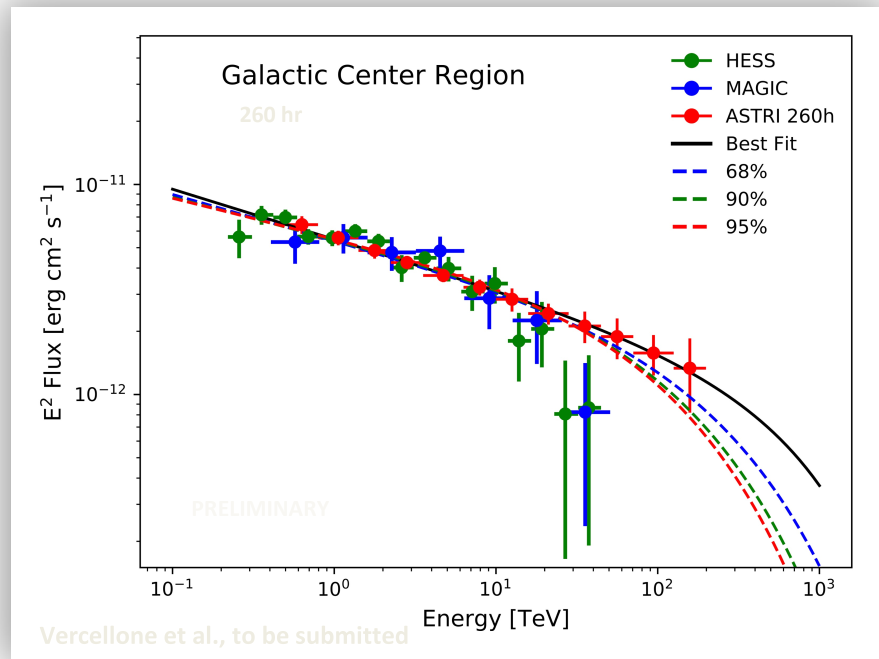
It is a complex region harbouring several potential sources of particle acceleration

It can be observed by the ASTRI Mini-Array only at high zenith angles

Current IACTs detected **non-variable emission with no significant cut-off up to a few tens of TeV**

ASTRI Mini-Array assets

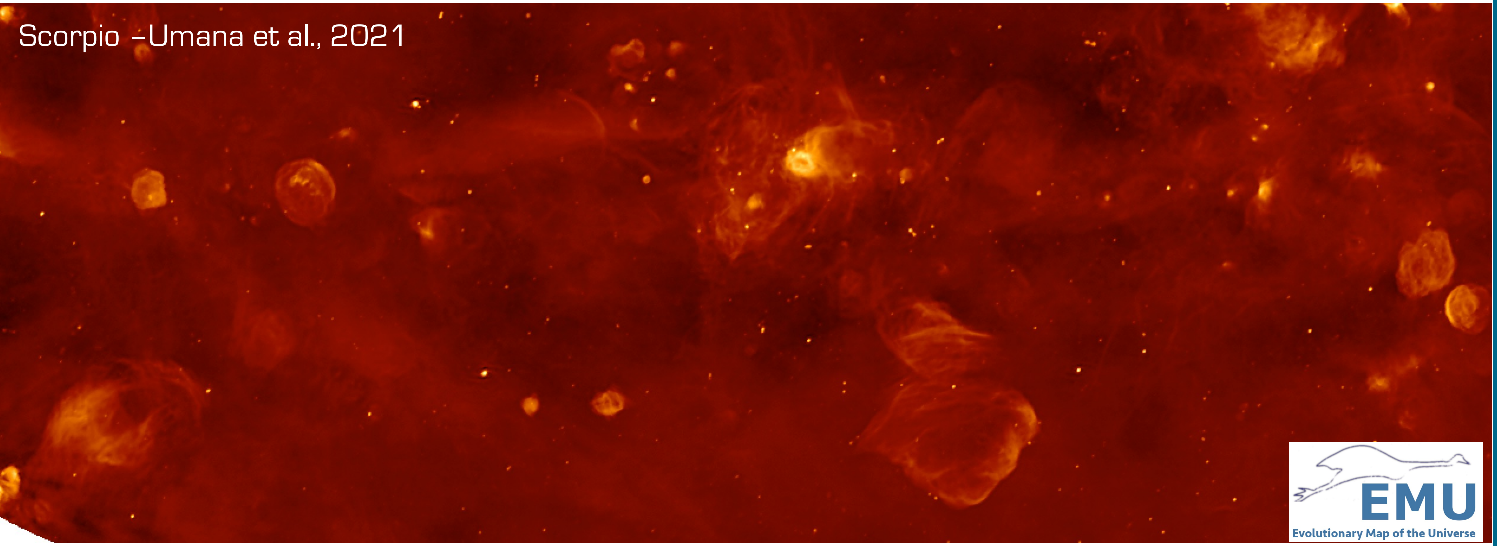
- **the large FoV** will allow us to map the **whole GC region in a single observation**
- **the excellent angular resolution** could help to **identify any HE source** among several candidates



Spatial and spectral characterization of the inner Galactic Ridge emission → (HESS Collab., 2018)

HESS, MAGIC and ASTRI spectra fitted with a proton population with a best fit cut-off at 120 PeV

Exclude a cut-off in proton pop. below 3.5 PeV, 2.0 PeV, and 1.7 PeV at 68%, 90%, and 95% C.L.



ASKAP

36 antenne (12 m)
Max baseline: 6 km
Risoluzione angolare= 10 arcs
Frequency coverage:
0.7- 1.8 GHz
Bandpass: 300 MHz
Sensitivity: 25 µJy/hr @ 1.4 GHz
FOV (PAF)= 30 deg^2

Large surveys, ToO, DDT
EMU: copertura Piano Galattico
Dati disponibili tra 2 anni

Dati di Piano Galattico con i precursori SKA:

ASKAP: copertura Piano Galattico (EMU)

MeerKAT: copertura Piano Galattico MGPS

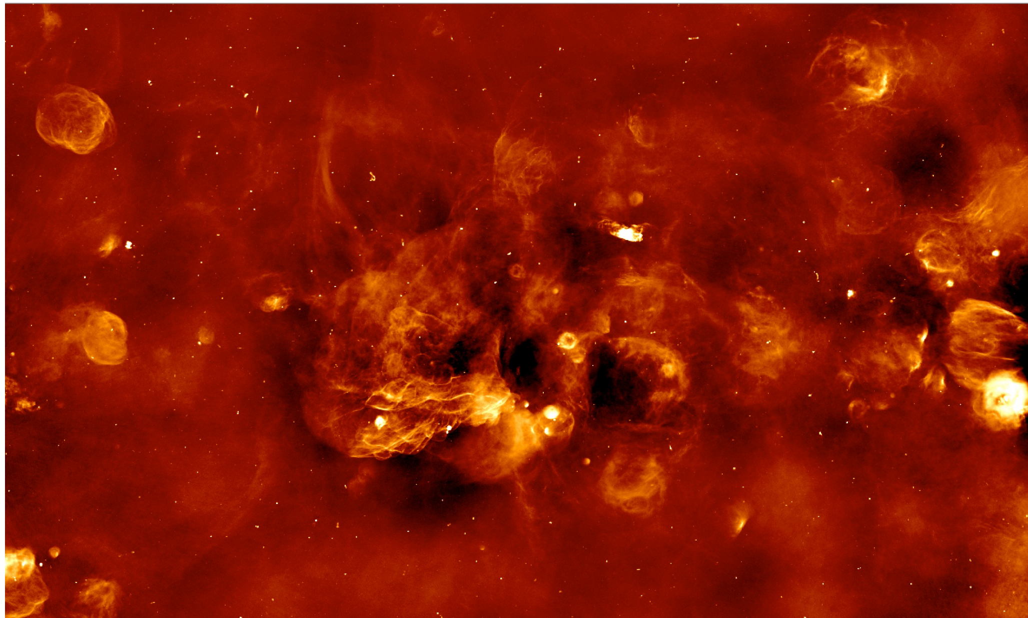
CREDTS: Grazia Umana

MeerKAT

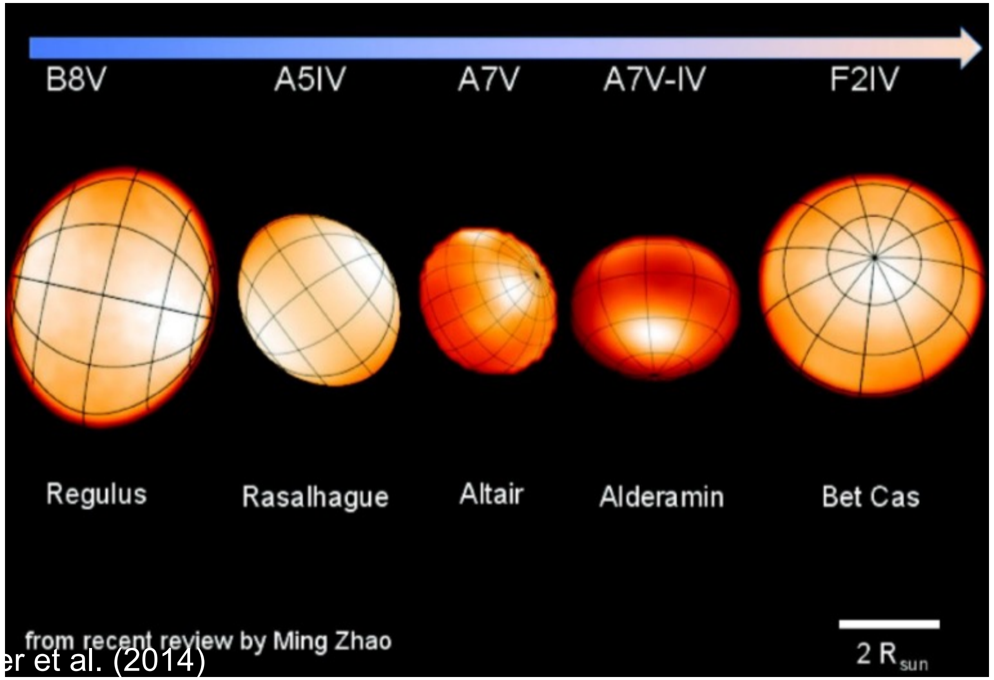
64 antenne (13.5m)
Max baseline: 8 km
Risoluzione angolare=10 arcs
Frequency coverage:0.6- 1.75GHz
Bandpass: 750 MHz
Sensitivity: 4-5 µJy/hr @ 1.4 GHz

Large surveys, 1 call/yr, ToO, DDT

MGPS: release dati, Q1 2022



Stellar Intensity Interferometry with the ASTRI Mini-Array: Imaging (aperture synthesis) with unprecedented angular resolution



The more baselines used, the more model independent an image will be (CHARA has 6 telescopes, ASTRI MA has 9 telescopes)

CHARA/MIRC IR (H band) synthetized images of eps Aur (A9I)
Long partial eclipse of the star eps Aur produced by an absorber with a disc-like geometry

ASTRI SI³ can image many A/B-type stars in visible light, extending the sample collected with CHARA in the IR CREDITS: L. Zampieri

ASTRI SI³ can observe systems of this type with unprecedented angular resolution → 50 microarcsec!

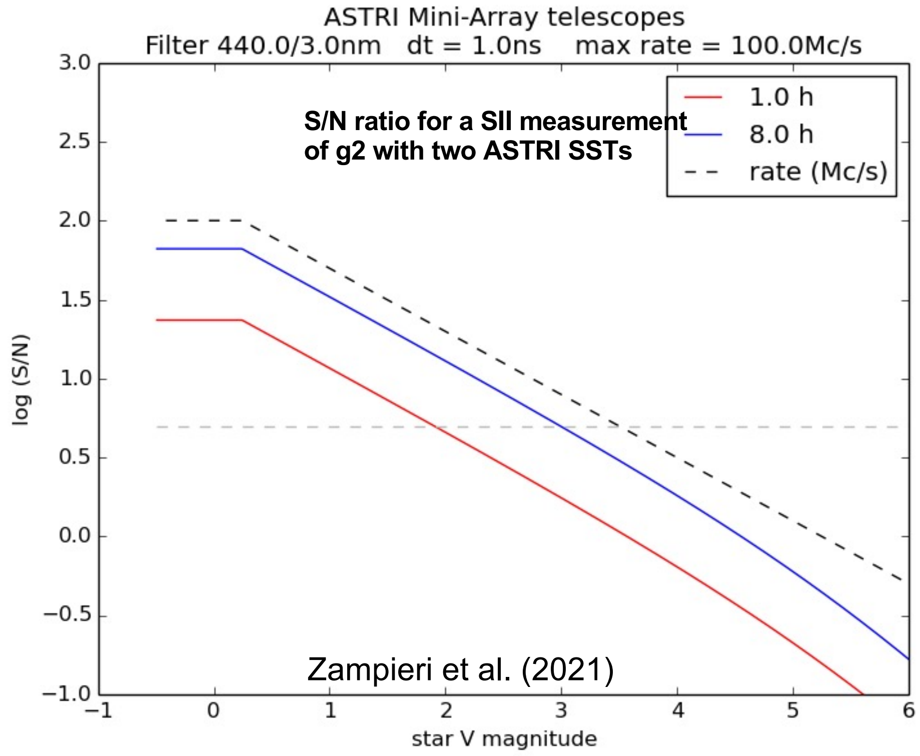
Stellar Intensity Interferometry with the ASTRI Mini-Array

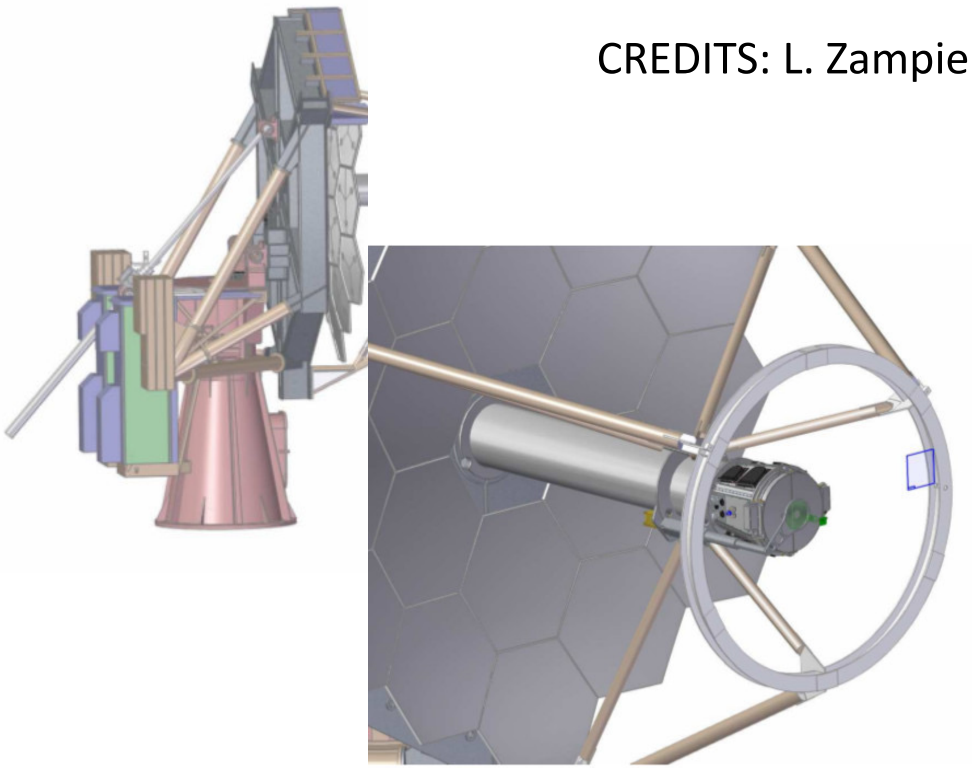
ASTRI Stellar Intensity Interferometry Instrument

The ASTRI Stellar Intensity Interferometry Instrument (SI^3) is conceived to *measure the 2nd order discrete degree of spatial and temporal coherence (g2) of a star*

To this end, accurate measurements (**~1 ns**) of single photon arrival times in a narrow optical wavelength range (**~5 nm**) are needed

Photon counting approach, performing the correlation off-line

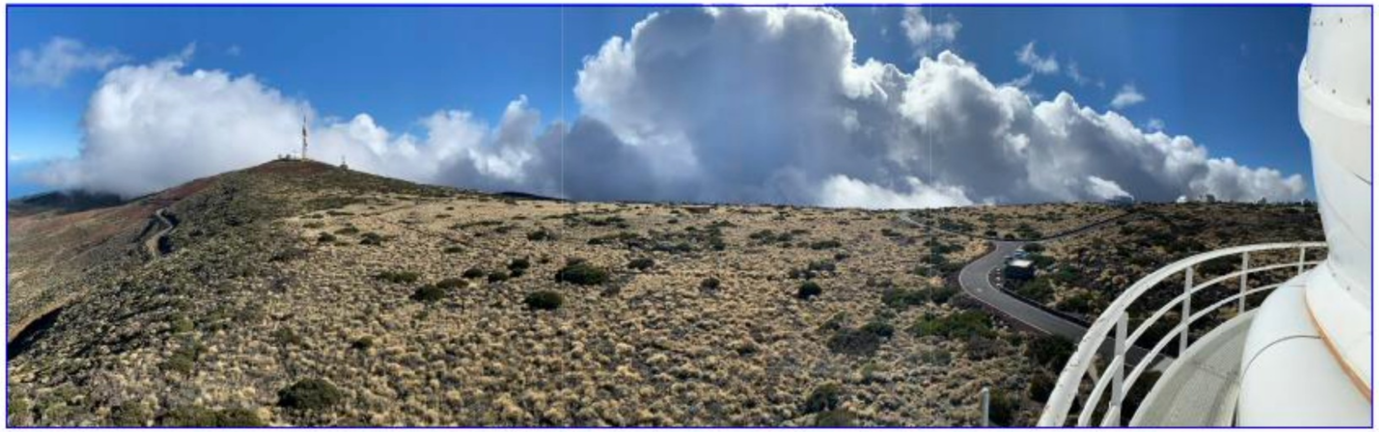




CREDITS: L. Zampieri

Stars with magnitude V < 3 are observable with the ASTRI SSTs in < 24 hours with a S/N > 5

ASTRI Mini-Array @ Teide Observatory



VISTAS DE LA ZONA ASTRIS, DESDE LA TERRAZA DEL THEMIS (5ª PLANTA)

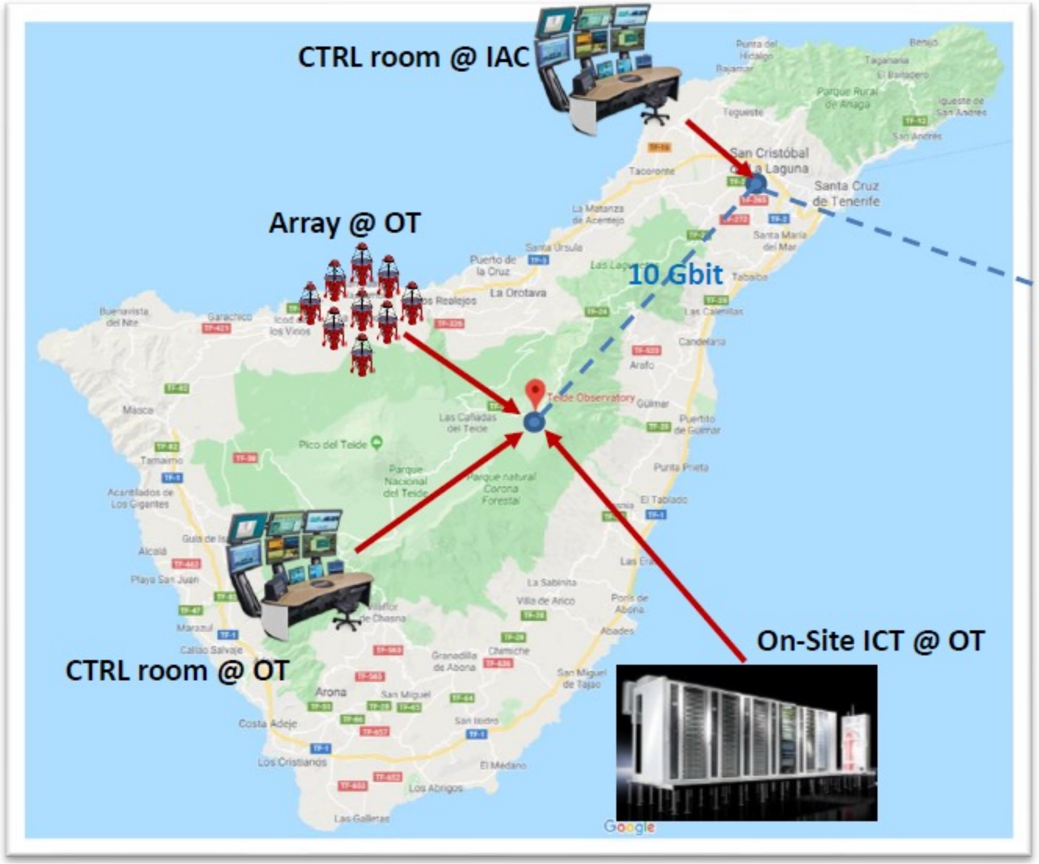
The ASTRI Mini-Array Architecture

The ASTRI Mini-Array in Tenerife

- Telescope Array & auxiliaries (Observatorio del Teide - OT)
- Local Control Room @ THEMIS building (OT)
- On site Data Centre @ IAC Teide Residencia (OT)
- Array operation center @IAC in La Laguna

The ASTRI Mini-Array in Italy

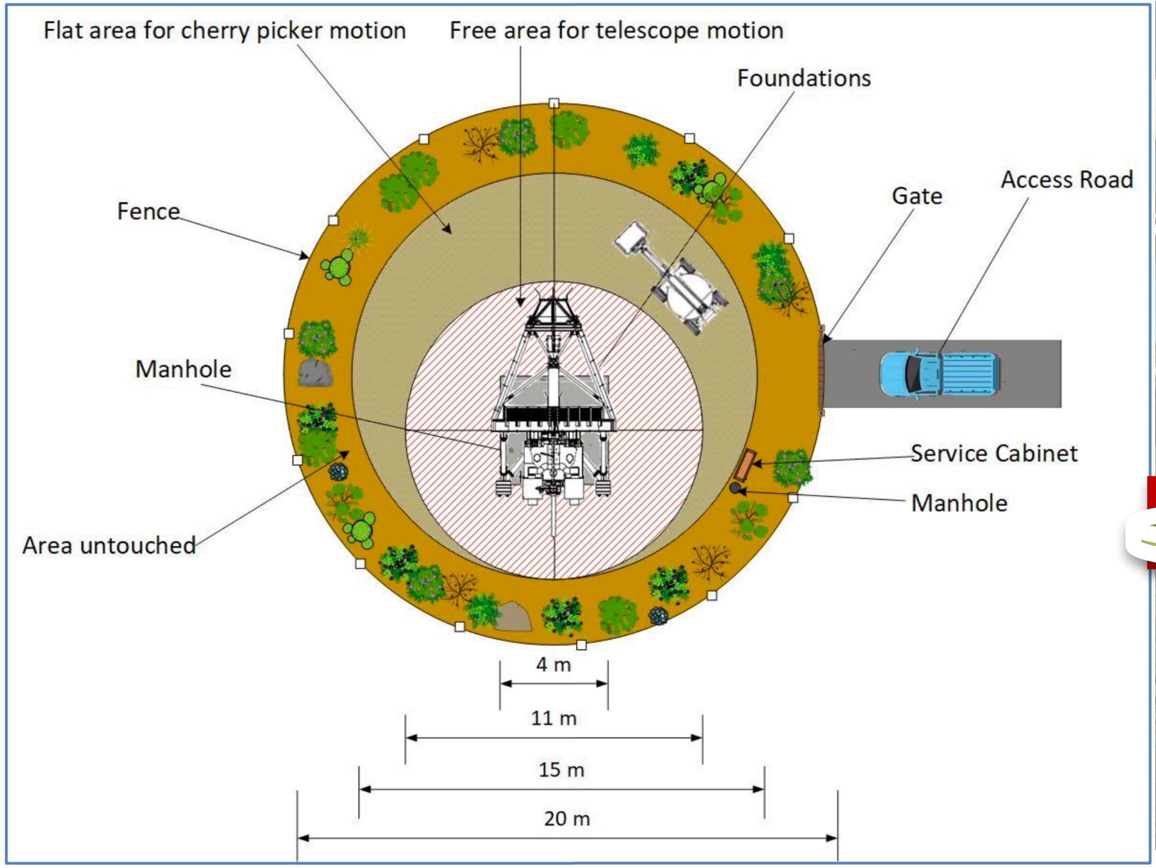
- Data Centre in Rome
- Remote Array operation centers

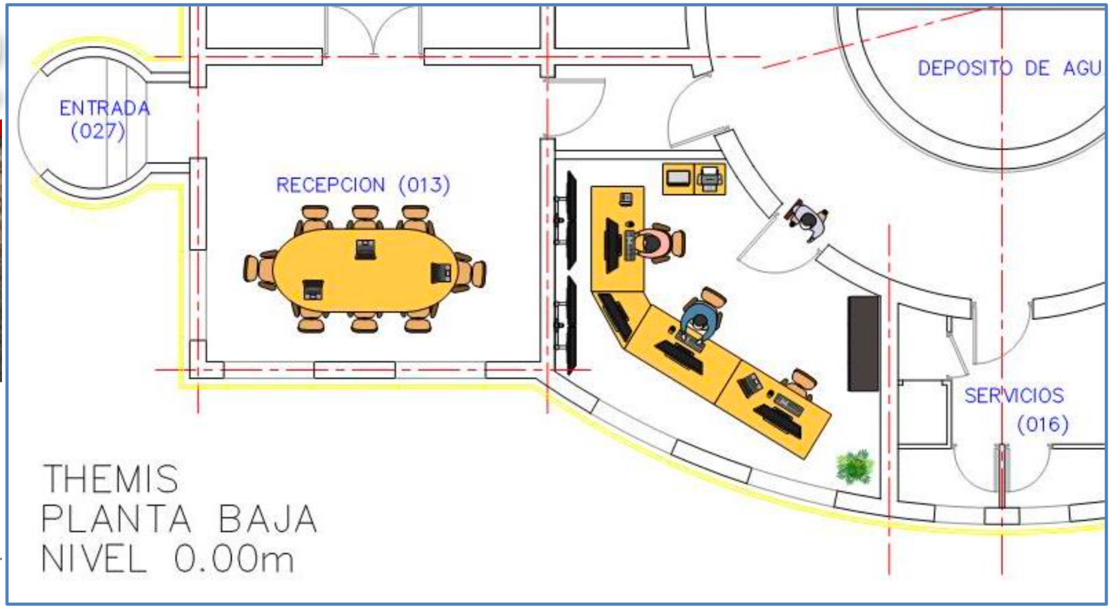


10 Gbit

ASTRI Mini-Array @ Teide Observatory

View from ASTRI-7

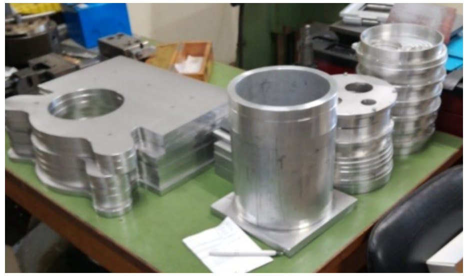




Status of production: Telescope

- 1st structure ready for factory tests in September → ship end of October
- 2nd and 3rd structures ready for shipping end of February
- EIE Group Srl responsible for production of three structures
- 6 to go → Tender to be issued in August

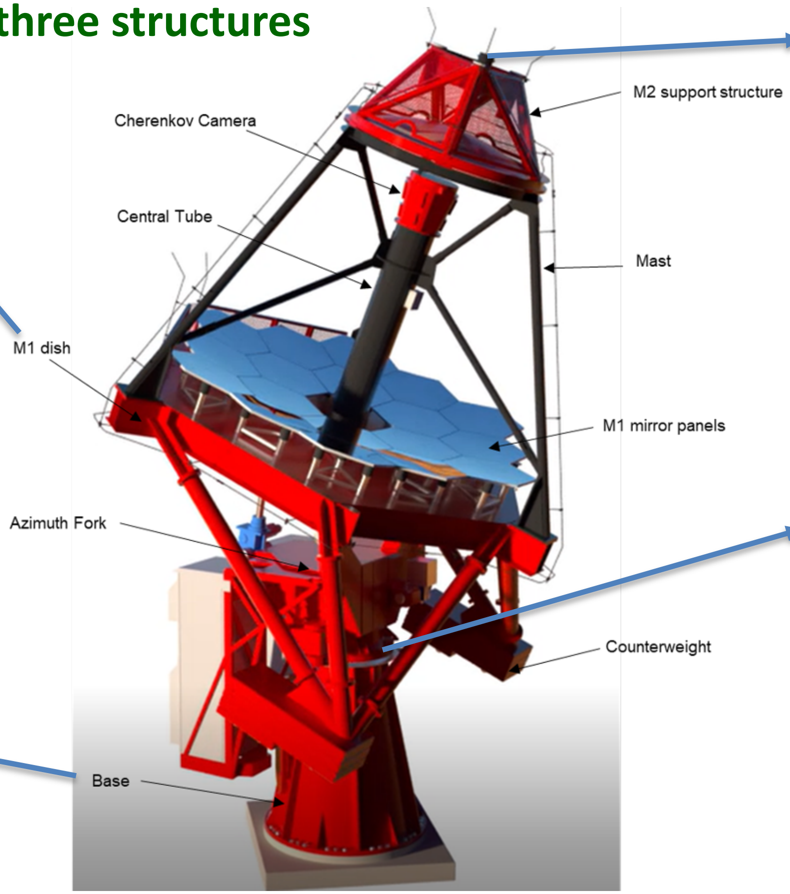
Pointing Monitoring Camera



Azimuth Bearings

M1 Dish

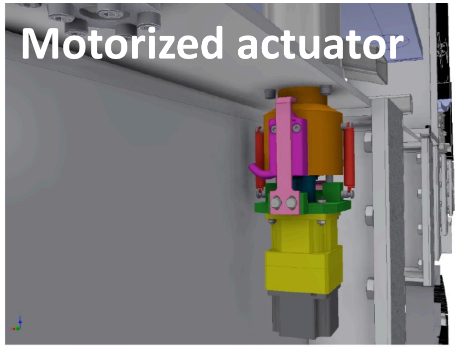
Base

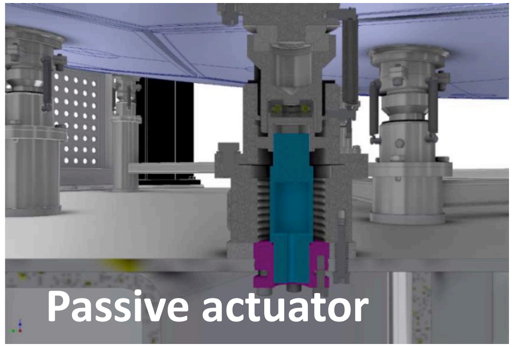


Status of production: AMC system

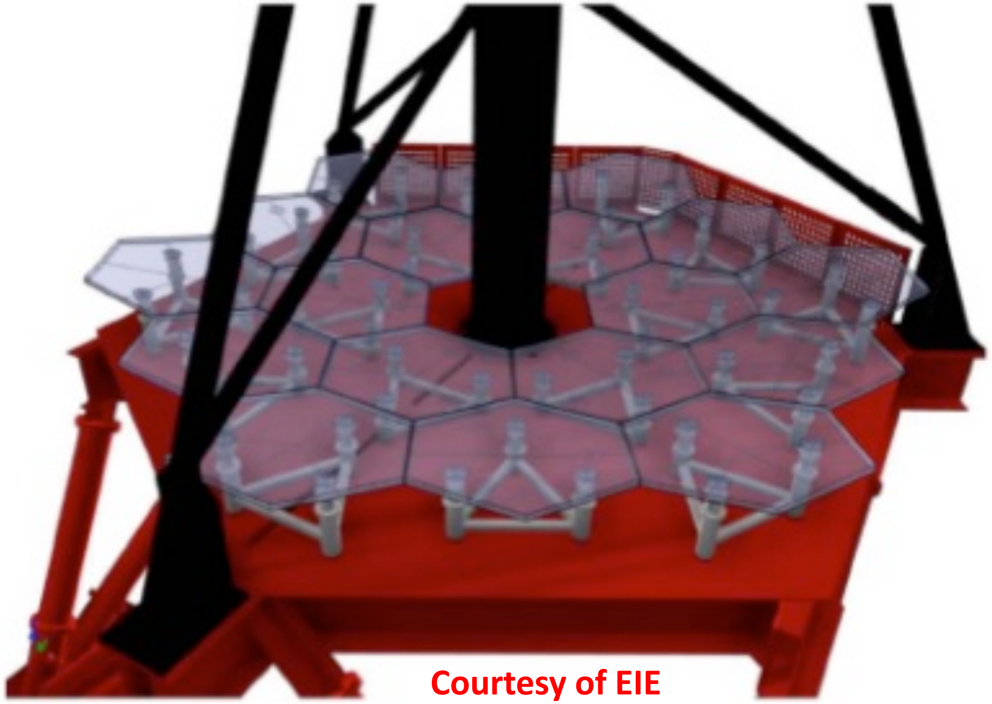
ASTRI Mini-Array

- Each mirror mounted on a triangle with three preloaded passive actuators with locking device.
- Triangles layout with radial symmetry (only three types: one for type of mirror)
- To align mirrors on each triangle 3 motorized actuators can be mounted (54 total for the entire mirror)
- Tip, Tilt, Piston





Courtesy of EIE



Courtesy of EIE

- Actuator stroke range: ±5 mm
- Actuator stroke accuracy: 0.1 mm
- Mirror inclination range: 1.5 degrees
- Mirror inclination accuracy: 30 arcsec
- Removable actuators completely independent

Status of production: mirrors & camera

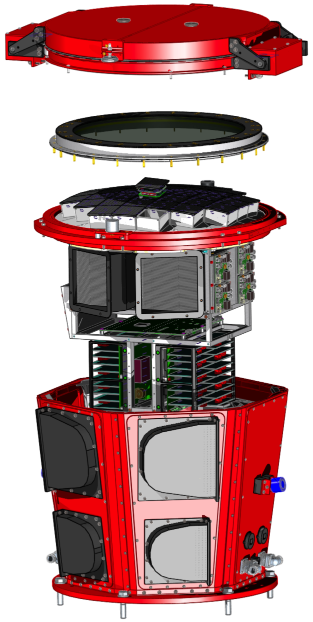
Mirrors Production

M1 mirrors (Media Lario Srl)

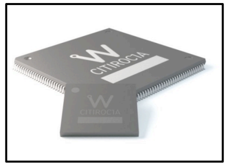
- Segments of primary mirrors ready
- First batch delivered for integration on the telescope

M2 mirrors (Flabeg GmbH, ZAOT, Media Lario)

- 2 mirrors delivered for telescope integration
- 7 mirrors under recoating process



CITIROC-1A



SiPM matrices

Camera production

New ASICs CITIROC-1A (Weeroc) → Delivered

New SiPM detectors (Hamamatsu photonics)

- Qualification batch (37 matrices) delivered and accepted
- First production batch (200 matrices) in September 2021
- Second & final batch March 2022

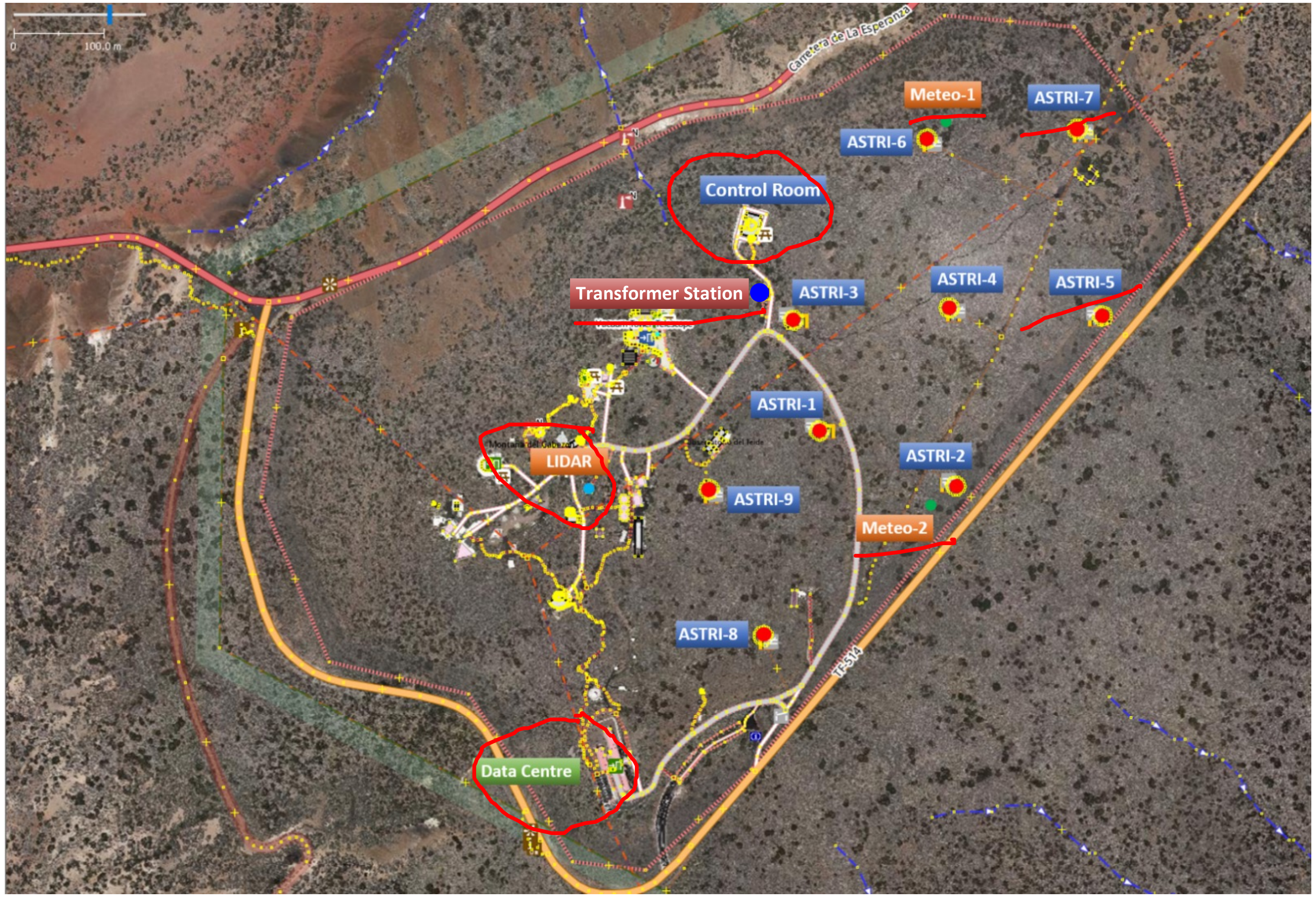
Cherenkov Cameras (CAEN/EIE)

- KOM for production activities 13th of July
- First camera at the site end of summer 2022

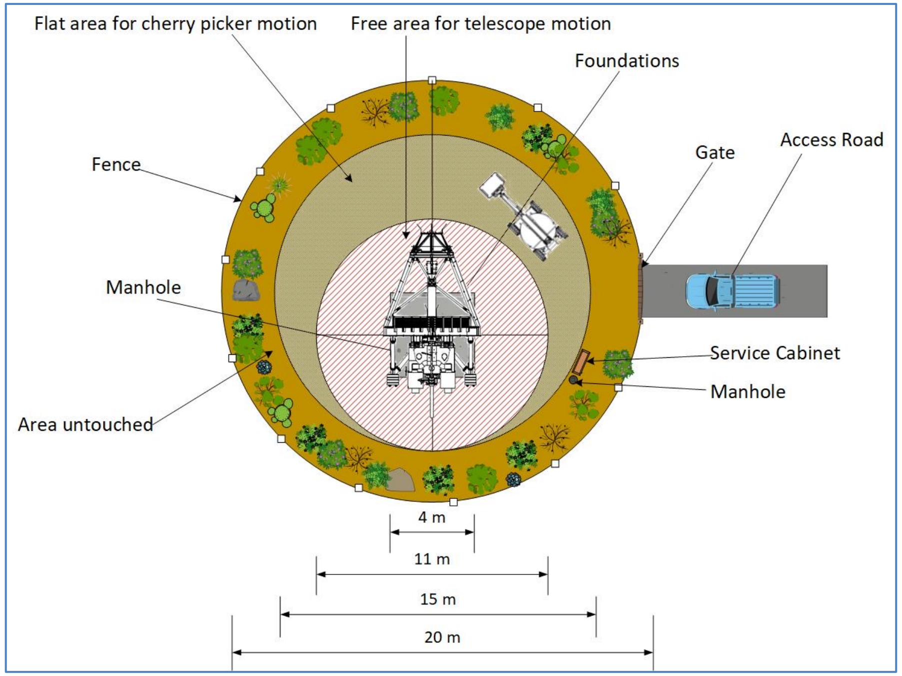
Site Implementation

ASTRI Mini-Array

- **9 telescopes** each placed in a dedicated area.
- **A control room** hosted at Themis observatory building.
- **A data centre** hosted at the OT Residencia building.
- **A LIDAR** placed in a dedicated dome
- **Two meteorological towers**
- **Access roads** to telescopes.
- **Trenches, cable ducts, cable pits** for power, data, timing and safety and security networks including electrical cables and optical fibres.
- **Medium to low voltage transformer station**
- **UPS and diesel generator** for power backup placed close to transformer station.
- **Illuminator**: a device to calibrate the telescopes no permanently mounted at the site.



Site Implementation



- Geotechnical survey completed
- Access roads completed
- Location data centre defined
- Location of Local control room defined
- Overall design of the site completed
- Approval by local authorities obtained

- Tender for construction in Aug 2021
- Construction started in October 2021!

Contract issued by the Fundacion Galileo Galilei

Infrastructure – Works formally started on October 4th, 2021

ASTRI Mini-Array

ACTA DE REPLANTEO Y COMIENZO DE OBRA

Tipo de obra: Infraestructuras para los telescopios Astri Mini-Array

Emplazamiento: Observatorio del Teide. Izaña. Tenerife

Nº de licencia de obra: Decreto 2021-2752 (Excmo. Ayuntamiento de Güímar)

Redactor del Proyecto: Juan José Saavedra Gallo

En Observatorio del Teide, Izaña (Tenerife), a 4 de octubre de 2021

REUNIDOS

D. Ennio Poretti, con NIE Y6058191M, gerente y representante de la Fundación Galileo Galilei-INAF, Fundación Canaria (CIF ES G-38783312) como promotor

D. David Aguilar Casanova, con DNI 78608264Z, gerente y representante de VVO Construcciones y Proyectos SA (CIF: A-35091057) como empresa constructora

D. Juan José Saavedra Gallo, con DNI 42.933.155K, como director de obra y coordinador de seguridad y salud

MANIFIESTAN

1.- Que todos los agentes que lo firman, disponen del proyecto de ejecución redactado para la construcción de la obra y en base a la cual se ha otorgado la licencia municipal de obra.

2.- Que habiendo procedido el constructor al replanteo de la obra proyectada, el director de la obra a la comprobación de dicho replanteo y a su verificación con relación a la documentación incluida en el proyecto, no aprecian ningún impedimento que impida el comienzo y desarrollo de la obra.

3.- Que el plan de seguridad y salud en el trabajo ha sido aprobado por el coordinador de seguridad y salud durante la ejecución de la obra.

4.- Que el constructor declara encontrarse en condiciones de iniciar los trabajos contratados.

5.- Que todos los agentes acuerdan el comienzo de la obra con fecha **4 de octubre de 2021**.

Y para que conste y sirva como justificante del inicio de la obra en los términos establecidos en la Ley de Ordenación de la Edificación, todos ellos firman de común acuerdo el presente acta, por triplicado ejemplar, en el lugar y fecha indicados.

El promotor

Ennio Poretti
Firmato digitalmente da Ennio Poretti
Data: 2021.10.04 16:31:30 +02'00'

Ennio Poretti

El constructor

AGUILAR CASANOVA DAVID - 78608264Z
Firmado digitalmente por AGUILAR CASANOVA DAVID - 78608264Z

David Aguilar Casanova

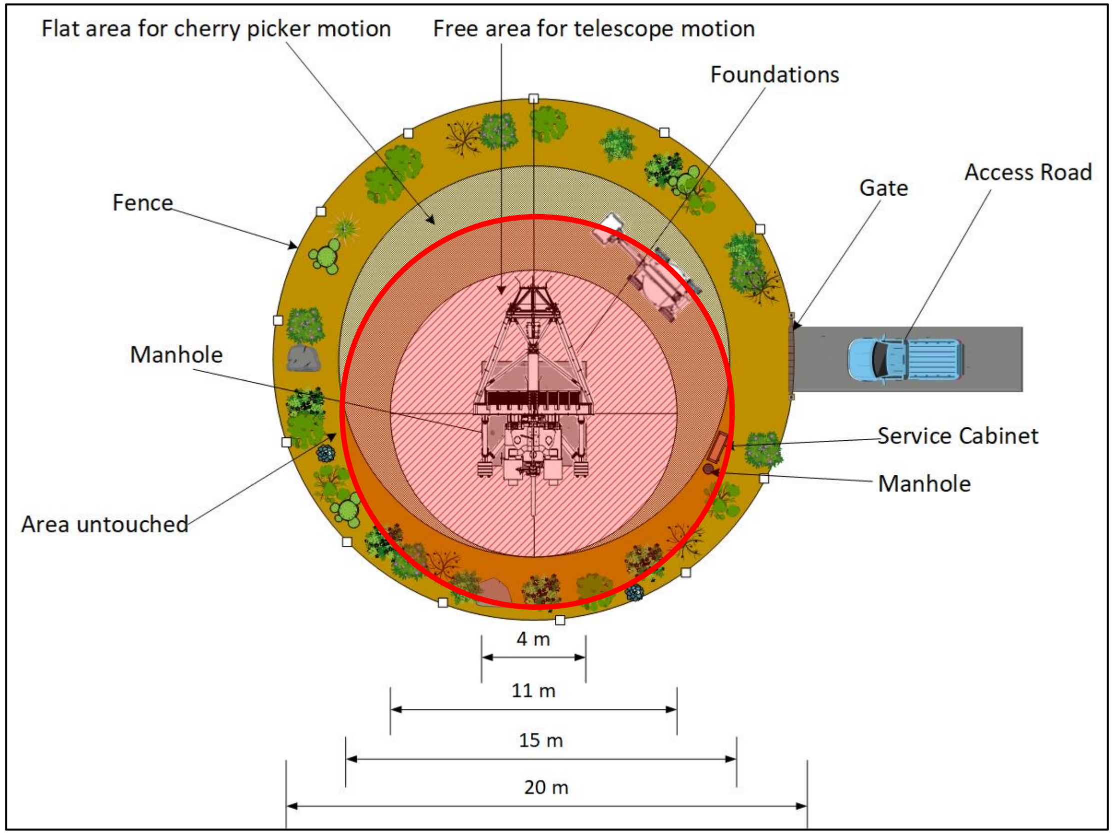
El director de obra y coordinador de seguridad y salud

SAAVEDRA GALLO JUAN JOSE - 42933155K
Firmado digitalmente por SAAVEDRA GALLO JUAN JOSE - 42933155K

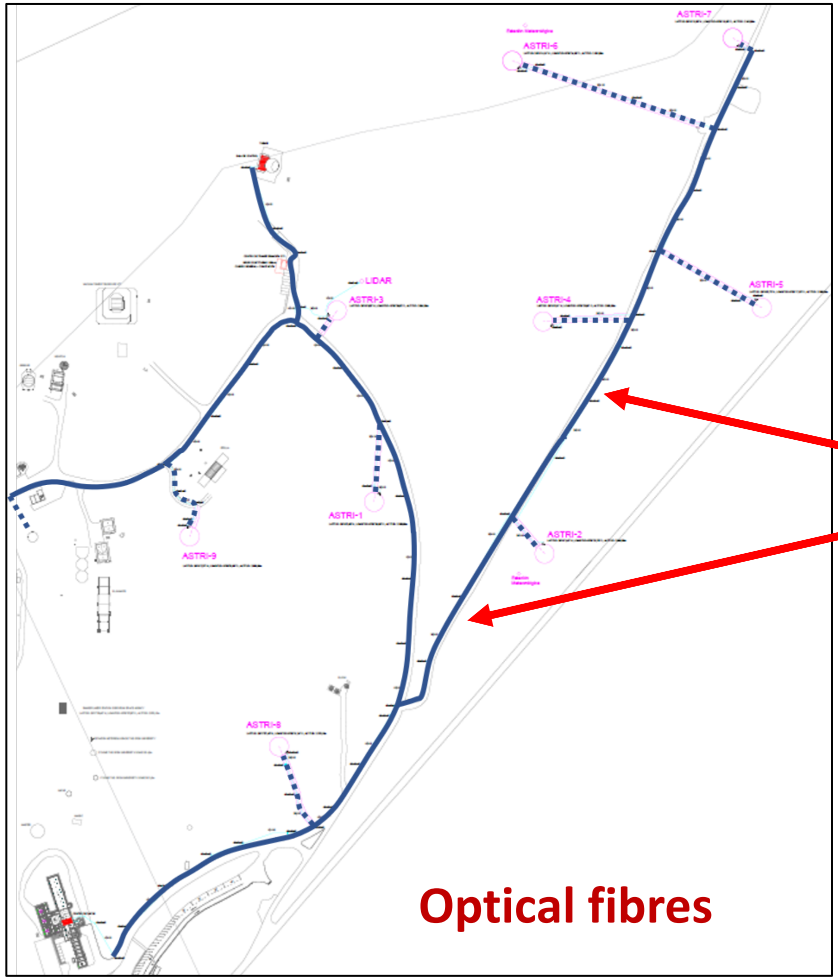
Juan José Saavedra Gallo


INAF
ISTITUTO NAZIONALE DI ASTROFISICA
Fundación Galileo Galilei - INAF
Fundación Canaria
PROYECTO
INFRAESTRUCTURAS PARA LOS TELESCOPIOS ASTRI MINI ARRAY
Director de Obra y CSS: Juan José Saavedra Gallo
Empresa Constructora: VVO Construcciones y P., S.A.
VVO CONSTRUCCIONES, P., S.A.
Plazo de Ejecucción: 9 meses
Excmo. Ayuntamiento de Güimar
LICENCIA DE OBRA MAYOR (Decreto 2021-2752)
EJECUCIÓN DEL PROYECTO
"INFRAESTRUCTURAS PARA LOS TELESCOPIOS ASTRI MINI ARRAY"
EN EL OBSERVATORIO DEL TEIDE
FECHA: 23/07/2021
CADUCIDAD: 23/07/2023
Servicio Administrativo de Gestión del Medio Natural y Seguridad
Informe Órgano Gestor del Espacio Natural Protegido
Nº Sigma : 2020 - 01942
17 de Noviembre de 2020

WP5000 – Foundations ongoing works



Trenches


ASTRI-7
ASTRI-6
LIDAR
ASTRI-3
ASTRI-4
ASTRI-5
ASTRI-1
ASTRI-9
ASTRI-2
ASTRI-8
Optical fibres


Retama

Excavation for foundation ASTRI#1

ASTRI Mini-Array

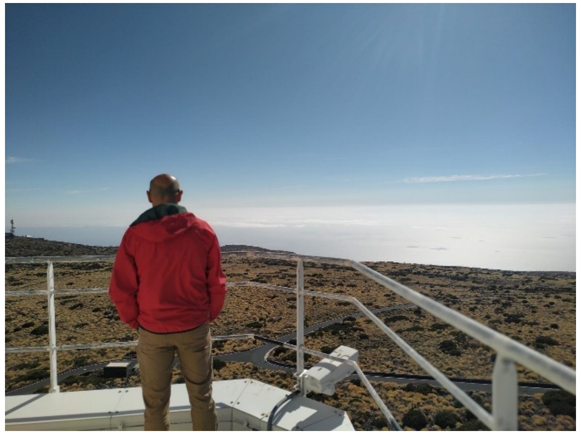
THEMIS – October 4, 2021

ASTRI Mini-Array

WP10300 – Illuminator

Better if

- **Wi-Fi connected**
- **Battery powered**



Next Actions

- The first telescope is being integrated in Italy at EIE GROUP (Venezia) and it will be shipped to Tenerife by the Christmas 2021 and the installed in Jan/Feb 2022

- Other 2 telescopes to implemented (Inauguration event will be organized in September 2022)

Grazie Fundacion Galileo Galilei e ragazzi del TNG per il supporto!