TNG & the Gamma ray sky of Canary Islands: scientific and technical synergies

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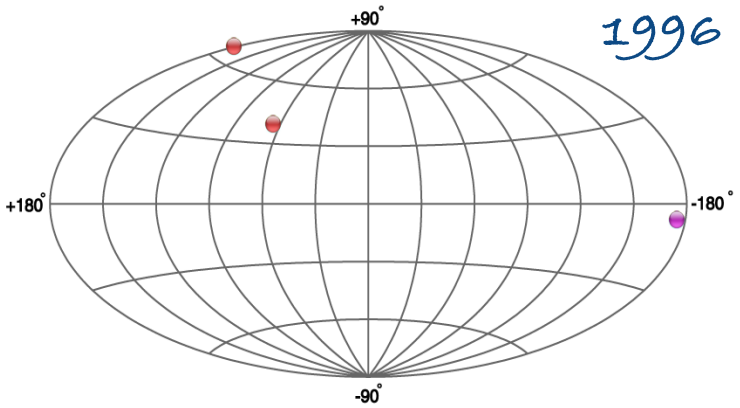
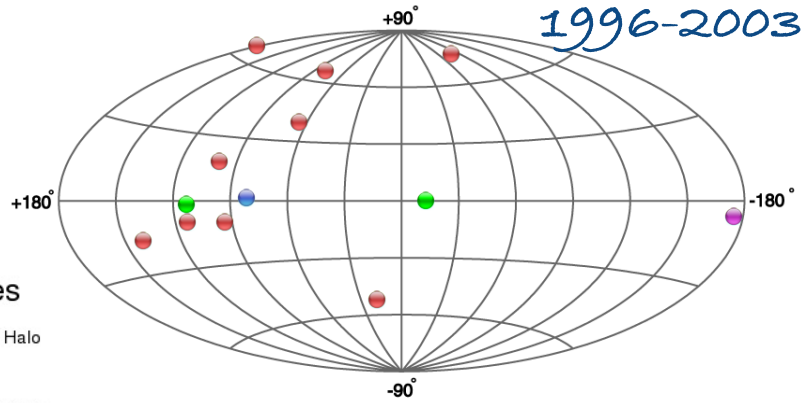
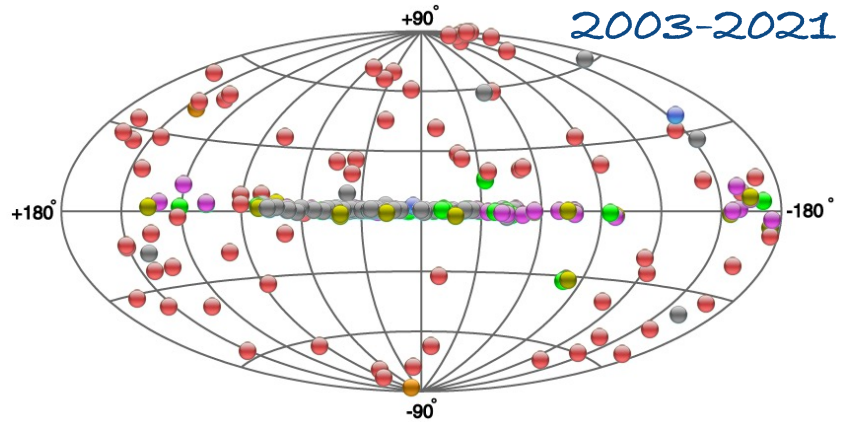
Outline

- INAF and the dawn of Gamma Ray Astronomy
- INAF under the Gamma Ray Sky of Canary Islands
- MAGIC & TNG
- From MAGIC to CTA
- TNG & CTA

INAF & the dawn of VHE gamma ray astronomy







Source Types

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

1989 Crab Nebula is the first TeV source observed.
1996 Extragalactic TeV sources: MKN 421 e MKN 501
2003 12 gamma ray sources observed
2006 INAF started joining MAGIC e CTA
2021 Over 250 new gamma ray sources observed: many new classes of gamma ray sources discovered.

INAF & Gamma Ray Sky of Canary Islands

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New Collaborators

- *The MAGIC Collaboration is still growing, we are moving towards the ~200 physicist collaboration*
- *Several groups are applying to become independent members in MAGIC (will be considered by the CB in tomorrow's session):*
  - *Diego Torres & his team (Spain)*
  - *INAF (Italy)*
  - *Elisa Bernardini & her team (Germany)*

(29-31) May 2007 MAGIC GENERAL MEETING, Sofia, Bulgaria

2007

New Collaborators

- *The MAGIC Collaboration is still growing, we are moving towards the ~200 physicist collaboration*
- *A consortium of 3 groups from Croatia (CROATEA, 6 people from U. Rieka, Ruder Boskovic Inst. in Zagreb and U. Split) joined MAGIC on last Wednesday's CB meeting*
- *The group from Granada (IAA, F. Prada) became full member in MAGIC ~2 months ago*
- *The groups from DESY (E. Bernardini), INAF (M. Salvati) and IEEC-CSIC (D. Torres) became full members 2 days ago*

24-25 April 2008 MAGIC GENERAL MEETING, Bad Aibling, Germany

2008

GRB Conference at La Palma

Participants:

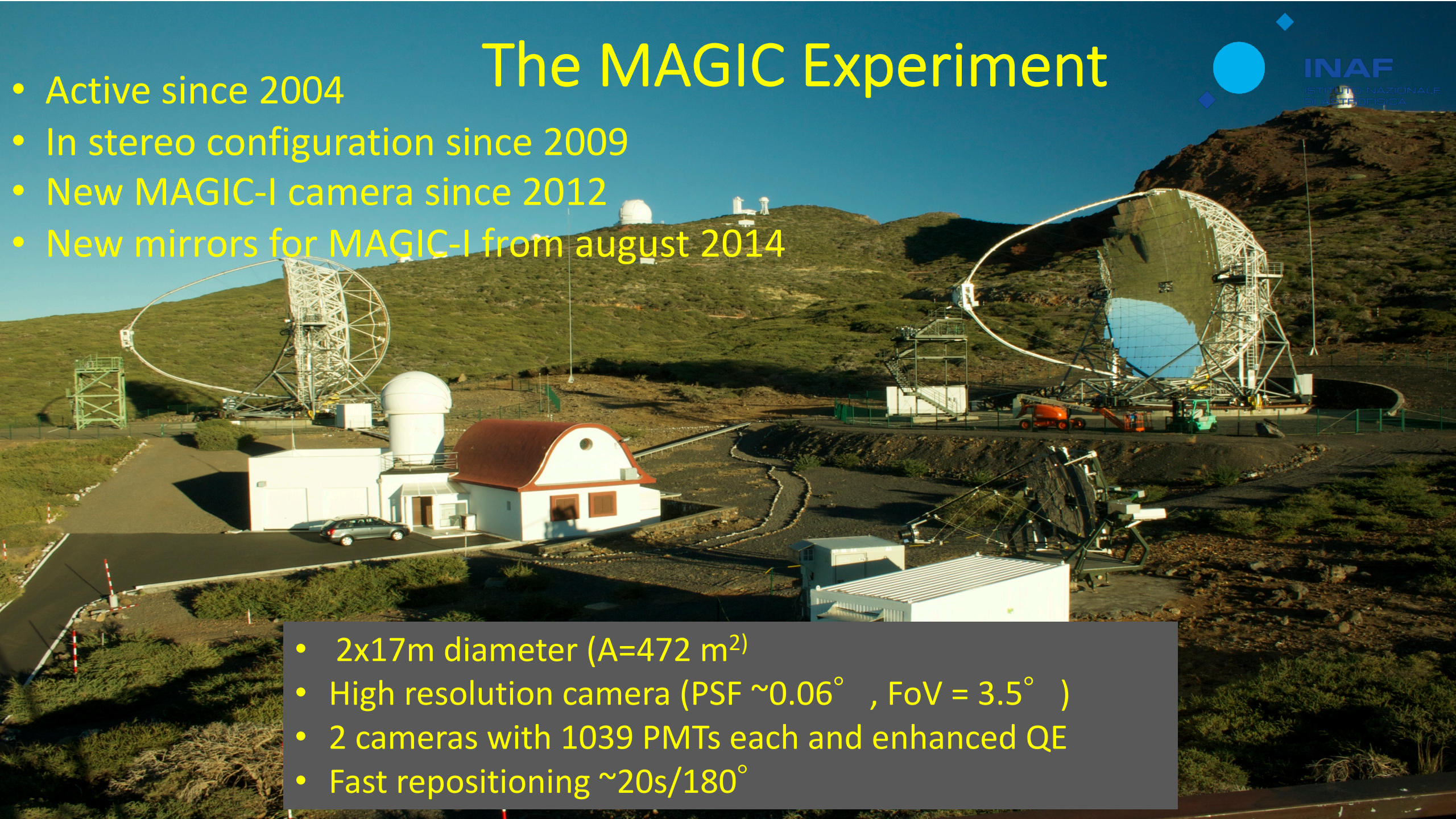
Angelo Antonelli		INAF, Rome, Italy
Antonino La Barbera		INAF, Palermo, Italy
Denis Bastieri		INFN, Padova, Italy
Alessandro Carosi		University of L'Aquila, Rome, Italy
Daniele Dormiento		INFN, Rome, Italy
Jens Dreyer		University Dortmund, Dortmund, Germany
Daniele Fargion		Universita di Roma "La Sapienza" & INFN, Rome, Italy
Alessandra Galli		Universita di Roma "La Sapienza", Rome, Italy
Markus Garczarczyk		Max Planck Institute, Munich, Germany
Markus Gaug		IAC, Tenerife, Spain
Nicola Galante		Max Planck Institute, Munich, Germany
Francesco Longo		INFN, Trieste, Italy
Pietro Oliva		INFN, Rome, Italy
Josefa Becerra		IAC, Tenerife, Spain
Luigi Piro		INAF, Rome, Italy
Valeria Scapin		INFN, Udine, Italy

Status Report GRB WG conveners

Markus Gaug (IAC), Stefano Covino (INAF)

The MAGIC Experiment

- Active since 2004
- In stereo configuration since 2009
- New MAGIC-I camera since 2012
- New mirrors for MAGIC-I from august 2014



- 2x17m diameter (A=472 $m^{2)}$
- High resolution camera (PSF ~0.06° , FoV = 3.5°)
- 2 cameras with 1039 PMTs each and enhanced QE
- Fast repositioning ~20s/180°

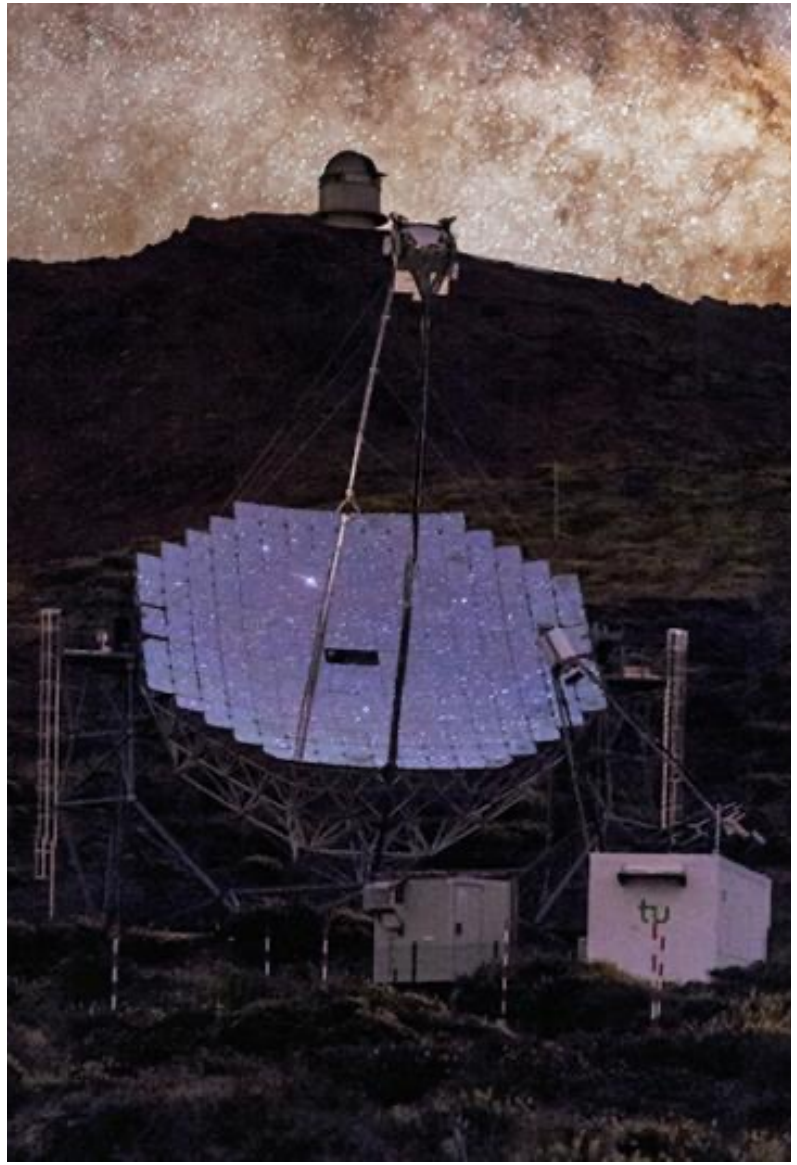
INAF & the VHE gamma ray astronomy: MAGIC

Official entrance June 2007 - Admittance to Full-membership April 2008.

INAF has contributed to MAGIC with:

- Mirrors for MAGIC 2 and new MAGIC 1
- Data Taking Shifts and data analysis
- Software development (e.g. fast repointing software)
- Science and MWL activities
- **Logistic support by TNG staff**
- Public Outreach activities
- Full members scientists + associate scientists

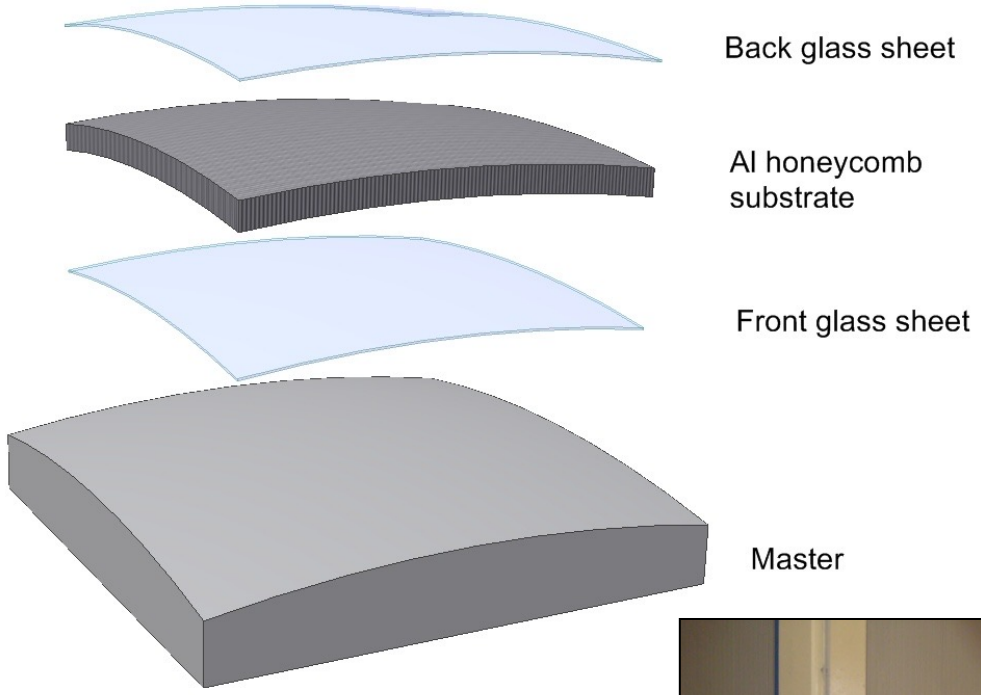
INAF's participation in MAGIC has been of fundamental importance for acquiring know-how on technologies, observational techniques as well as the scientific skills that have led INAF researchers to establish themselves in a leading role in this new branch of astronomy in 15 years.

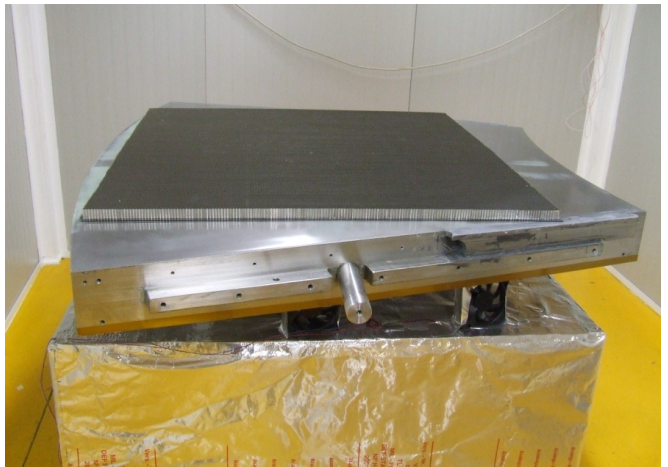


INAF & MAGIC Mirrors

The INAF and MediaLario recipe for IACT mirrors.

- Derived from a similar technique proposed by Oberto Citterio for the manufacturing of X-Ray optics, a thin glass sheet (1-2 mm) is elastically deformed to retain the shape imparted by a master with convex profile.
- A honeycomb structure is glued on the deformed glass sheet (under vacuum force) providing the needed rigidity.
- Then a second glass sheet is glued on the top in order to obtain a sandwich.
- After releasing the vacuum a reflecting coating (Aluminum) and a thin protective coating (Quartz) are released on the concave side.

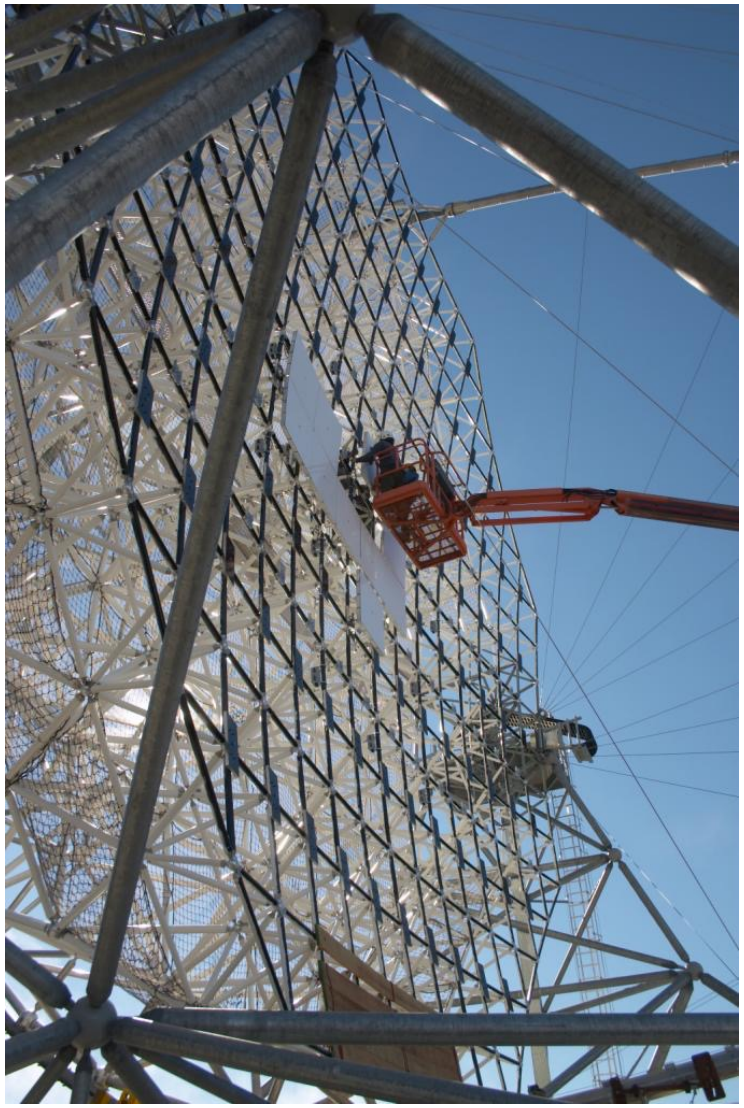




INAF & MAGIC Mirrors

In 2008 **104** panels + 10 spares 1 x 1 m^2 were successfully produced and installed on MAGIC 2. Funded in 2006 by a PRIN INAF. Crucial the role of FGG in the procurement and of TNG people in the installation.

In 2014 **200** panels were produced to substitute older mirrors in MAGIC 1. Again of fundamental importance the role of TNG personnel.



Installing MAGIC mirrors

People from Obs. of Padua/Cima Ekar and TNG have played a crucial role in mirrors installation and qualification.

Courtesy F. Dazzi

Installing MAGIC mirrors

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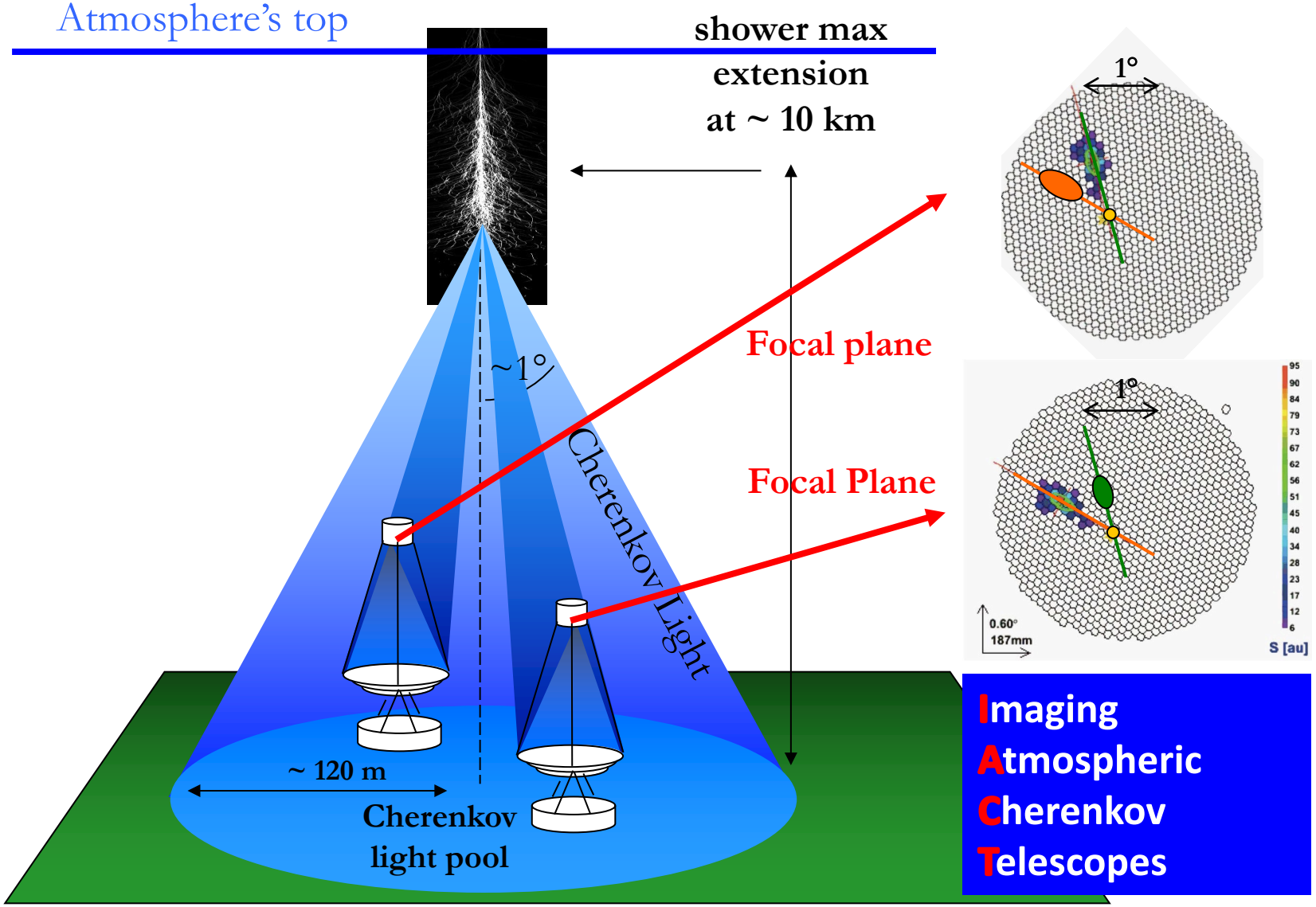
Courtesy F. Dazzi

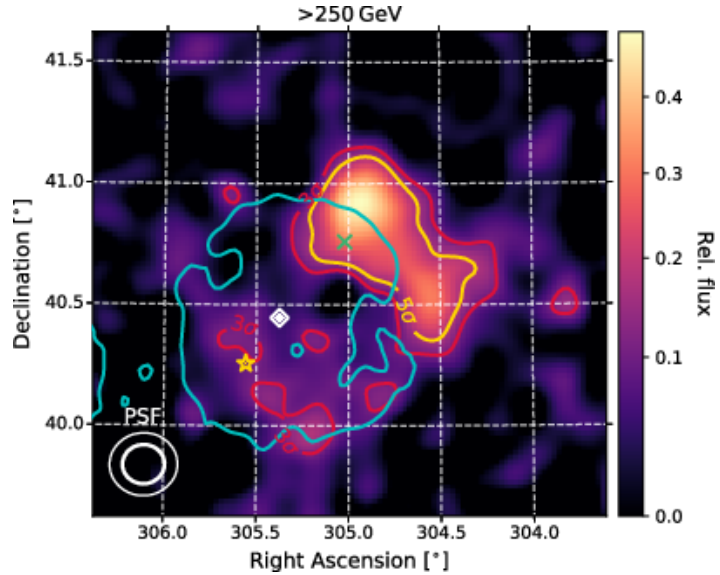
The Imaging Atmospheric Cherenkov Telescopes



Imaging Atmospheric Cherenkov Telescopes

The Cherenkov Telescope Technique

- Atmoshere as a calorimeter
- Large optics to maximize light collection (⌀ 4 - 24 m)
- fast and light structures
- High sensitivity cameras
- Very fast elettronics (~2-3 ns)
- Large computing capabilities for simulating and analysing events.



INAF & MAGIC science and operations

MAGIC has represented an important training center for INAF scientists with respect to IACT tecnique, data analysis, simulations and science. INAF scientist have given to MAGIC an important scientific expertise in particular on the multiwavelength approach to VHE targets.

TNG's role, as well as the role of other observing facilities accessible to Italian astronomical community, has been important for some observing programs of VHE sources mainly within MWL observing campaigns.

1. GRB and other transients follow up observations.
2. Blazar monitoring expecially with polarimeter and fast photometer
3. Multi-messanger astronomy: joint observations of neutrino sources and gravitational waves sources

Some instruments (e.g. SIFAP2 or PAOLO) are more suitable for synergic science.

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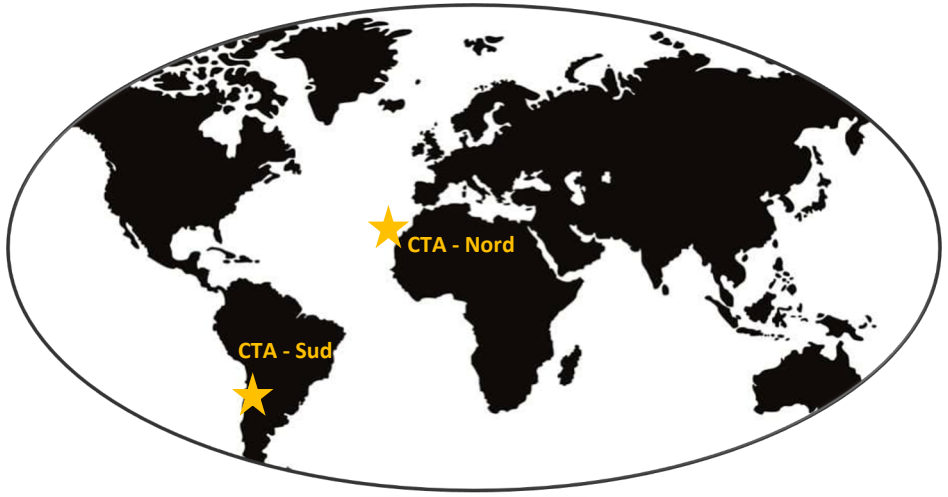
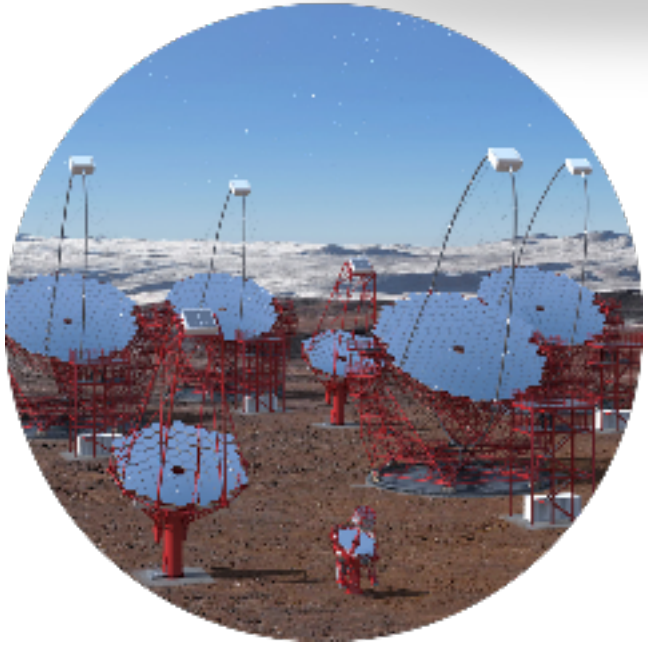
INAF & Gamma Sky of Canary Islands: from MAGIC to CTA

INAF & Gamma Sky of Canary Islands: CTA





cherenkov telescope array

A great observatory at the VHE based on two arrays observing both northern and southern sky.

- CTA-North located at ORM in La Palma
- CTA-South located in between of Cierro Paranal and Cierro Armazones in Chile

INAF & Gamma Sky of Canary Islands: CTA

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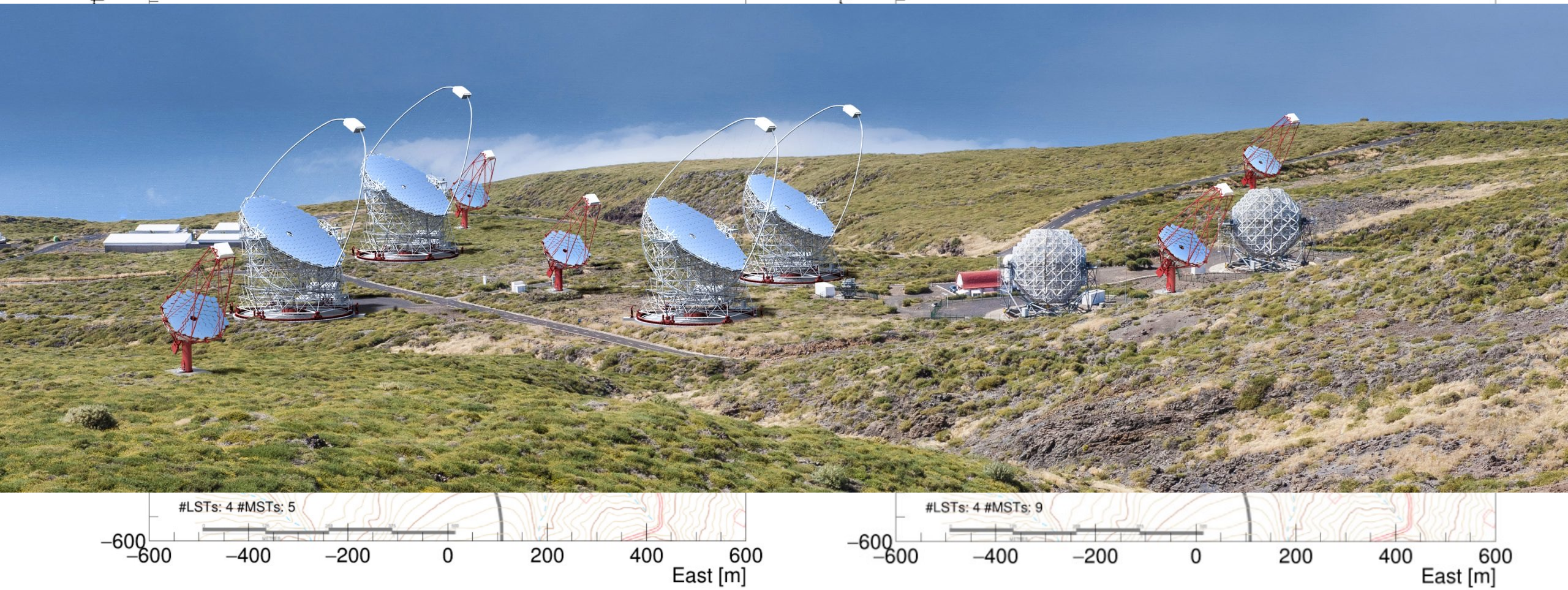

Alpha Configuration Layout: 4 LST + 5 MST

Beta Configuration Layout: 4 LST + 9 MST

From R. Zanin @ CTA GM 2021

INAF & Gamma Sky of Canary Islands: LST

The Large-Sized Telescopes (LSTs) are devoted to cover the low energy sensitivity of CTA between 20 and 200 GeV. With its mirror having 24 m diameter is the largest telescope in La Palma.

INAF has just (2020) joined the LST Collaboration and is supporting the project by providing:

1) Two technical figures: the Deputy Telescope Manager and an Operation Specialist who will spend most part of their time in LP
2) Data taking and analysis activities (expecially for joint MAGIC+LST observations)
3) Software development

Even if a major contribution from FGG was not possible, the TNG support will be very important as usual.

INAF Mirrors for CTA: Medium Size Telescopes

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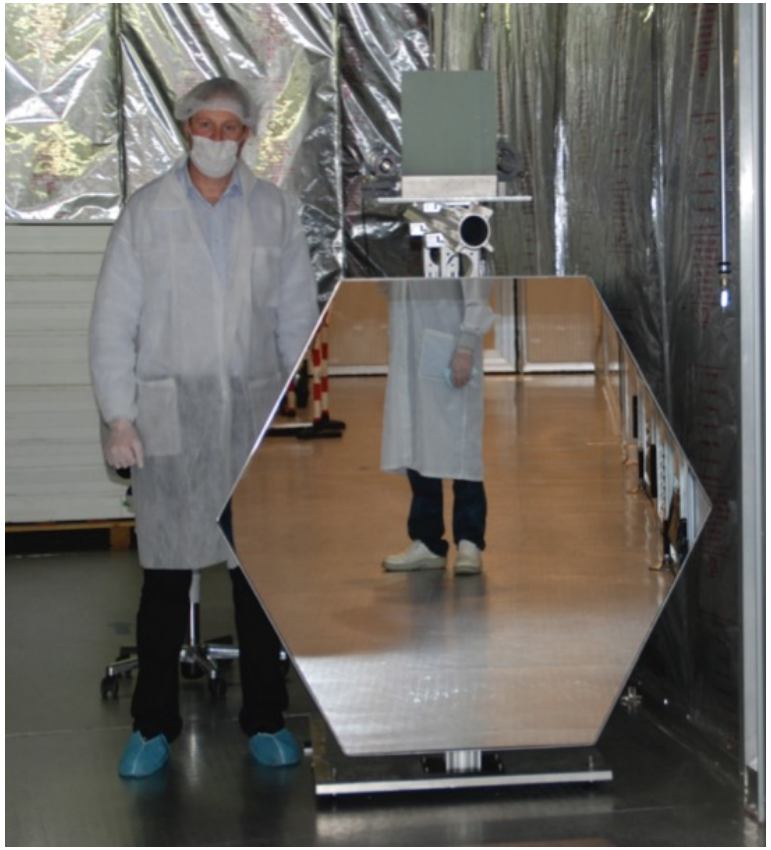
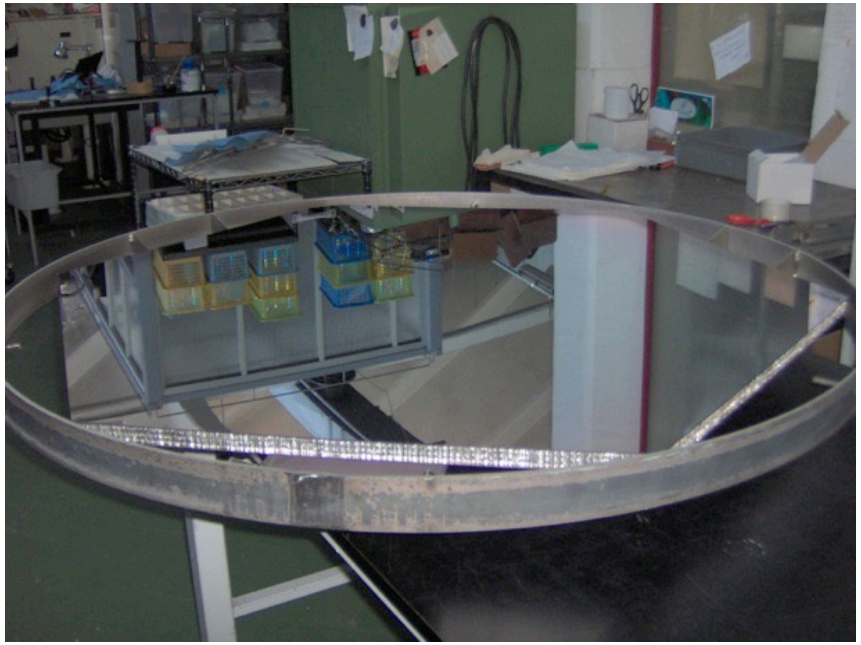
The INAF contribution to the Medium Size Telescopes (MST) is the entire reflecting surface of all the telescopes in La Palma. Mirrors produced with the INAF technology will be provided in the next years.
A first bunch of MST mirrors has been already produced and installed on the MST prototype in Berlin.





TNG & the Gamma Sky of Canary Islands

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Synergies and collaboration between TNG and Cherenkov Telescopes in Canary Islands (see also Giovanni Pareschi's talk on ASTRI) are very important for both technical and scientific sides.

The local support of valuable and very skilled technical people is of fundamental importance for the hardware realization and conduction.

Scientific synergies are fundamental as well. The multiwavelength approach is definitely important for exploiting the very high energy observations of many sources. The possibility of accessing an observational facility as TNG equipped with proper instruments and closeby the observatory can made an important difference in the competivity of our community.


Thank you TNG!
and thank you TNG people!