

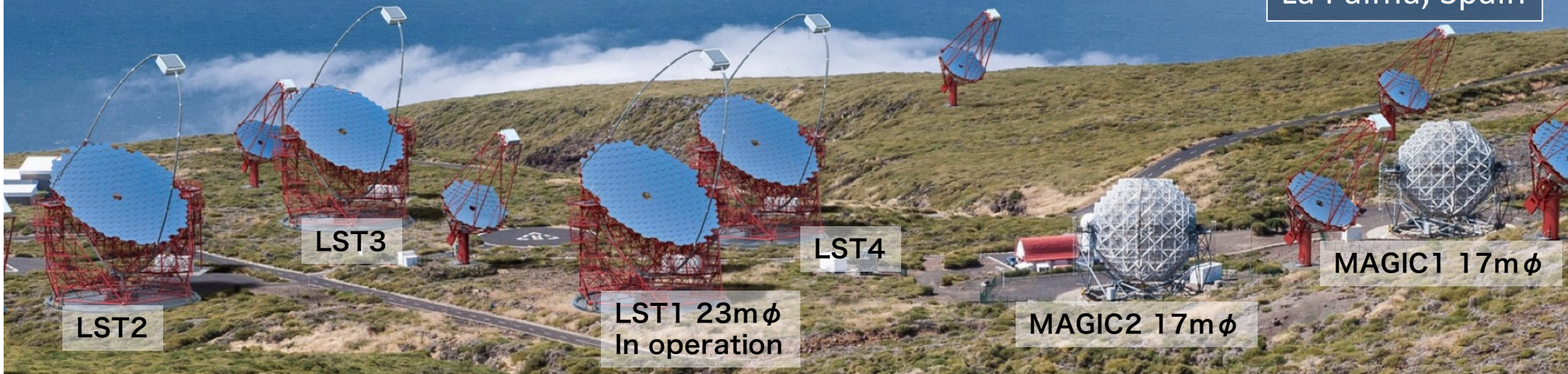
MAGIC and CTA Projects

Finance and promotion of the projects

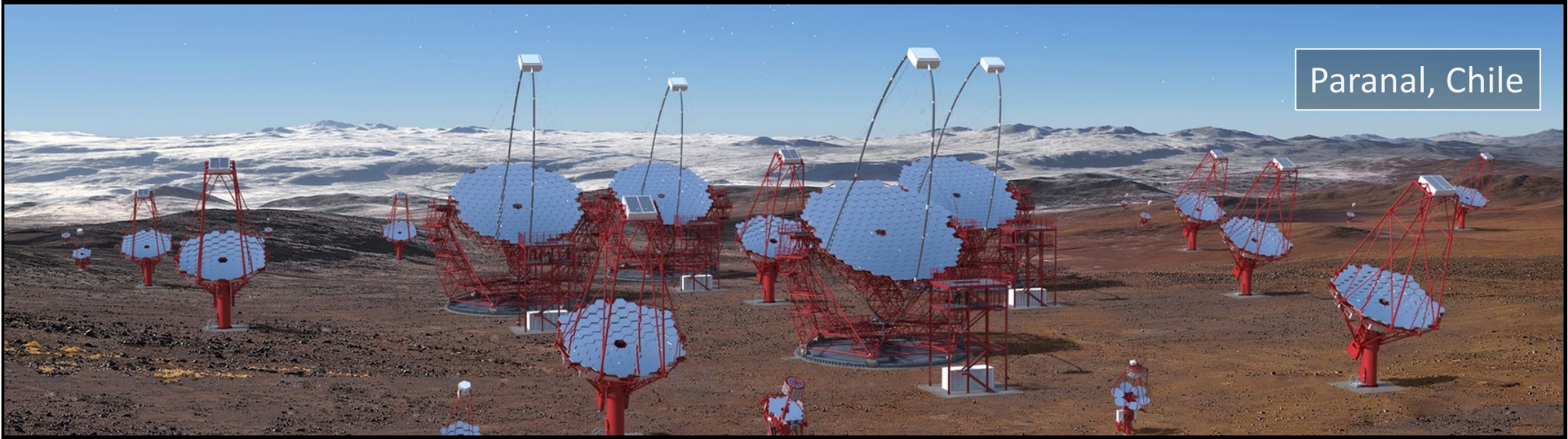
Masahiro Teshima

4 LSTs will be fully operation in 2025

La Palma, Spain

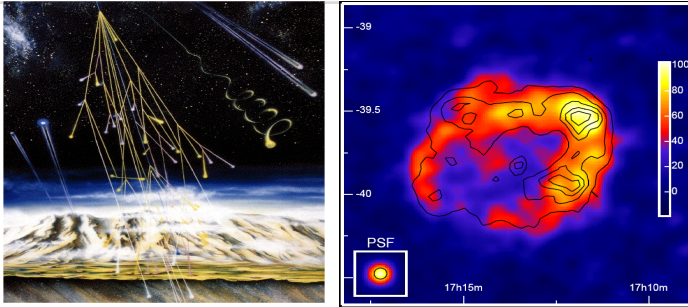


Paranal, Chile



Science of CTA is very wide

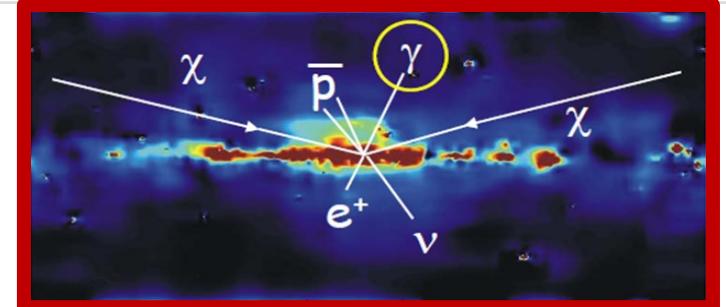
SNRs, PWNe, AGNs, GRBs, Dark Matter



Cosmic Ray Origin

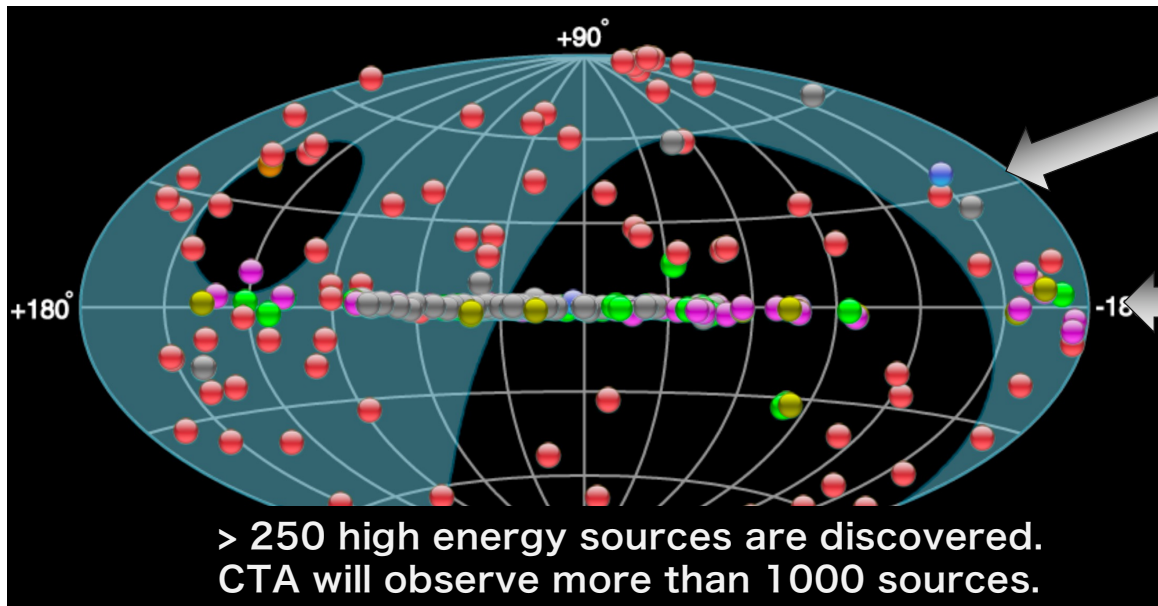


Super Massive
Black Holes



Dark Matter Search (Discovery)

- Origin of Cosmic Rays (Big accelerators)
- Black Hole and S.M.B.H.
- Dark Matter Search



Extragalactic Sources

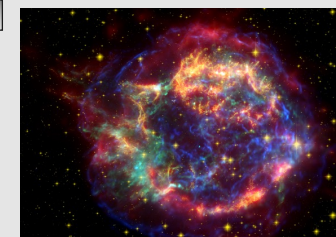


Active Galactic Nuclei

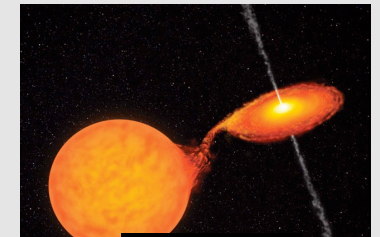


Gamma Ray Bursts

Galactic Sources



Super Nova Remnants

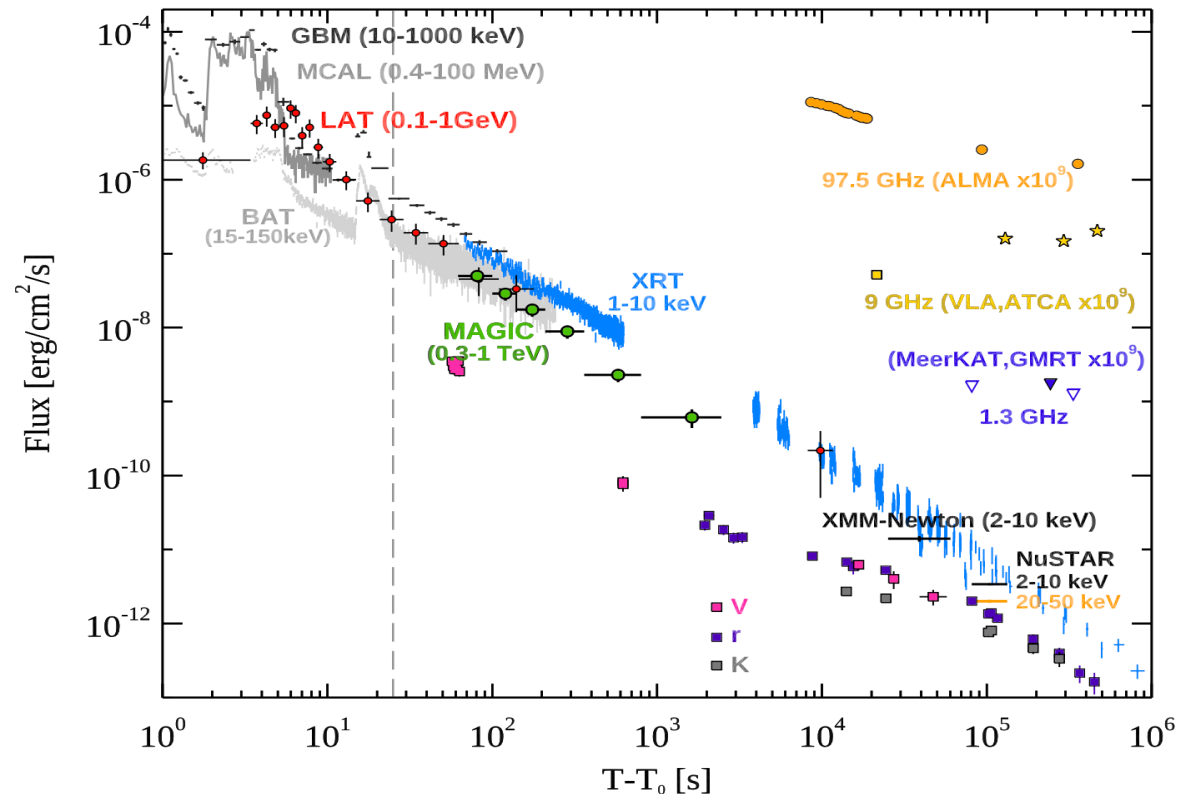
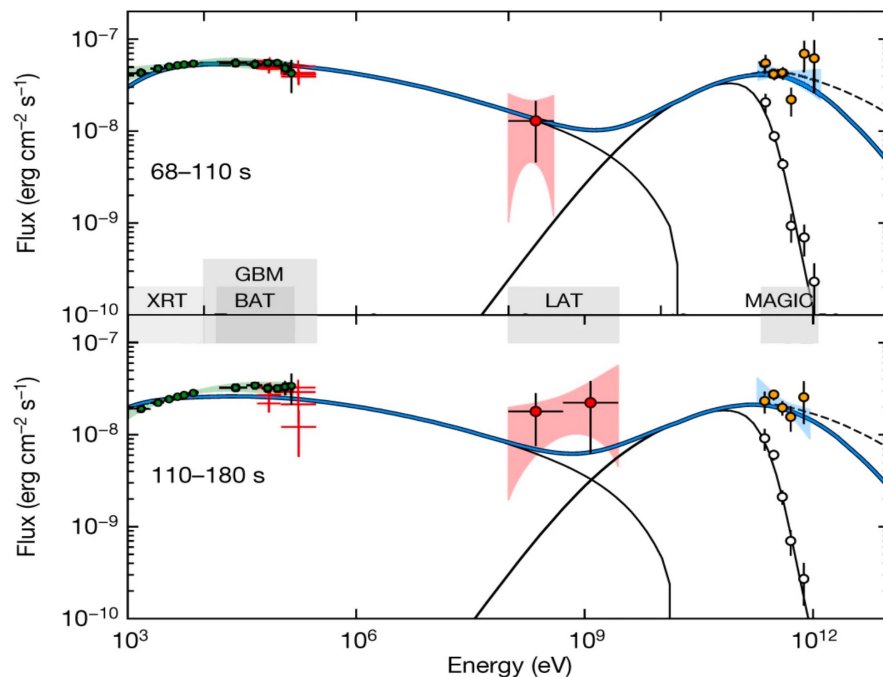
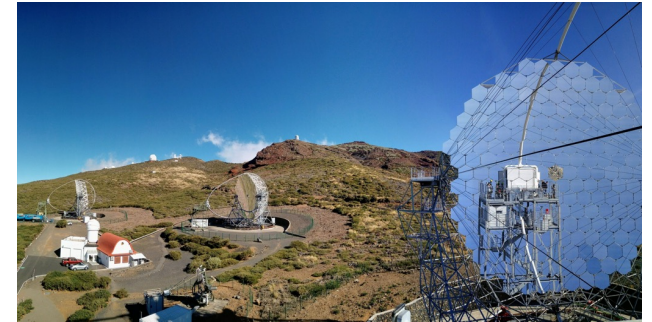
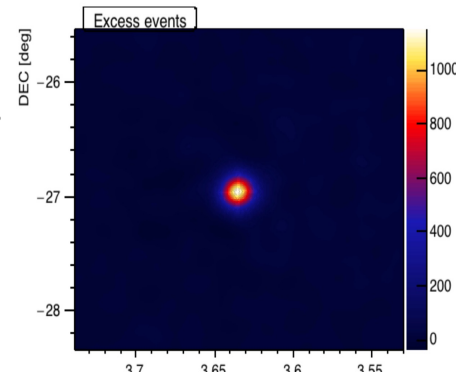


Binaries

MAGIC Highlight, Gamma Ray Burst GRB190114C (z=0.42)

Historical achievement

- ❑ First Detection of the GRB from ground.
- ❑ ~100 Crab flux in the first minutes.
- ❑ TeV bump has a similar energetics with KeV-GeV bump





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telescope
array

Historical remarks on the MAGIC and CTA Projects

- [1997 HESS and MAGIC proposals are discussed in ICRC Durban, South Africa](#)
- 2003 M.T. join in MAGIC (MPI-Phys)
- [2004 HESS Inauguration](#)
- [2004 MAGIC-I Inauguration](#)
- 2006 M.T. Spokesperson of MAGIC
- 2006 Construction of MAGIC-II started
- 2006 The first CTA Meeting at Harnack haus organized by Werner Hofmann & MT
- 2007 CTA got a strong recommendation from ASPERA and ASTRONET
- 2008 CTA on **ESFRI** (European Science Forum for Research Infrastructure) roadmap
- [2009 MAGIC-II Inauguration](#)
- 2010 CTA Consortium founded
- 2010 CTA-LST Collaboration organized by M.T.
- 2010 M.T. Cross Appointment ICRR and MPP
- [2012 MAGIC-II upgrade](#)
- [2012 HESS-II Inauguration](#)
- [2018 CTA-LST1 Inauguration](#)
- 2018 CTA, Landmark in the **ESFRI** roadmap
- 2022 CTA-LST2-4 construction started
- 2023 CTA **ERIC** (EU Research Infrastructure Consortium) will be established



MAGIC-II Stereo System
17m diameter Cherenkov Telescopes

Finance for MAGIC

- Scheme
 - Write a Letter of Intent or Proposal and start the discussion
 - Prepare core money (1/10 of full budget) and start R&D
 - Build collaboration and organization
 - Apply for grants and increase finance
 - Prepare MoU with participating institutes and assign responsibilities
 - Start the project
- Similar to Japanese mid-size experiments
- Use all kinds of resources from collaborating institutions.
 - Examples at MPI
 - Startup fund of M.T. (1.8MEur)
 - Internal budget of Max-Planck-Institute for Physics (0.5-1 MEur/yr) for several years
 - Central Fund from MPG Large Equipment (2 MEur)



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MAGIC Project (15MEur)

M1 Finance 2000-2002
MPI, INFN, Spain, institutions

MPG Big Instruments (Grant)

M1+M2 Finance
M.T. Startup fund

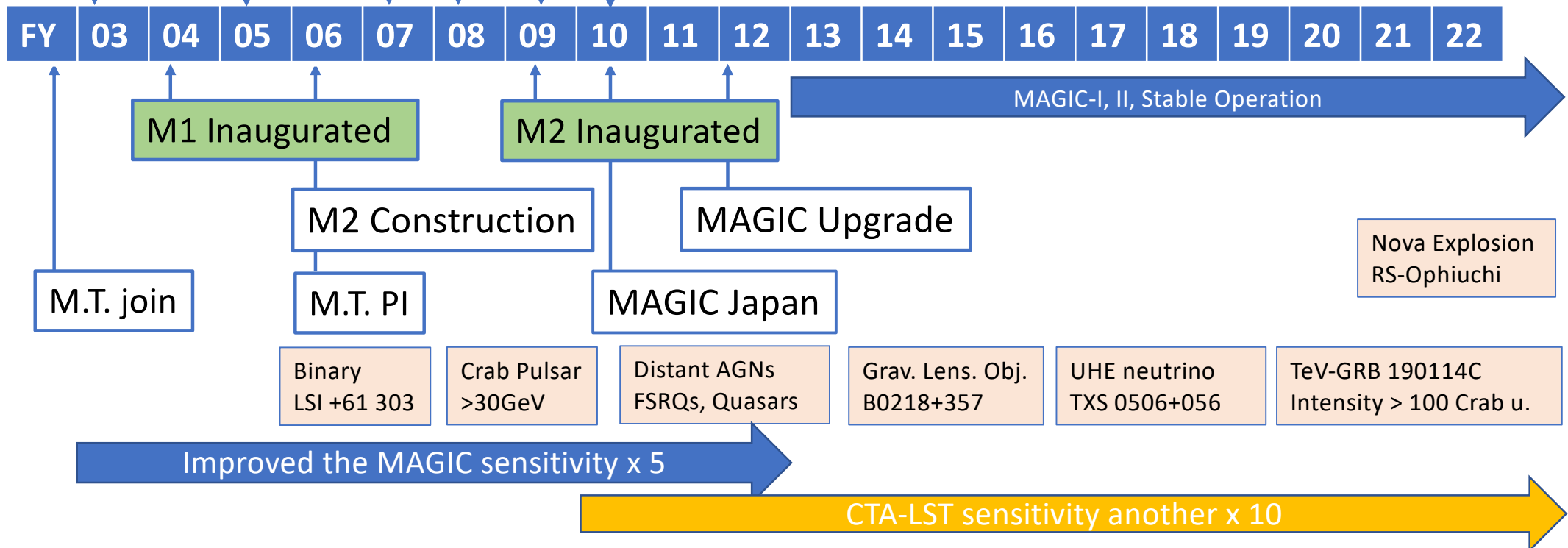
MPI Internal budget
INFN C-2 budget

Construction/upgrade budget 15MEur

MPI	Telescope Structure, Camera
INFN/INAF	Mirrors, Read Out Electronics
Spanish Inst.	Infrastructures, Camera
Other countries	

Operation 1 MEur / yr

Shifters (four scientists/mo.)
Running costs (Maintenance, Electricity,
Telescope managers)





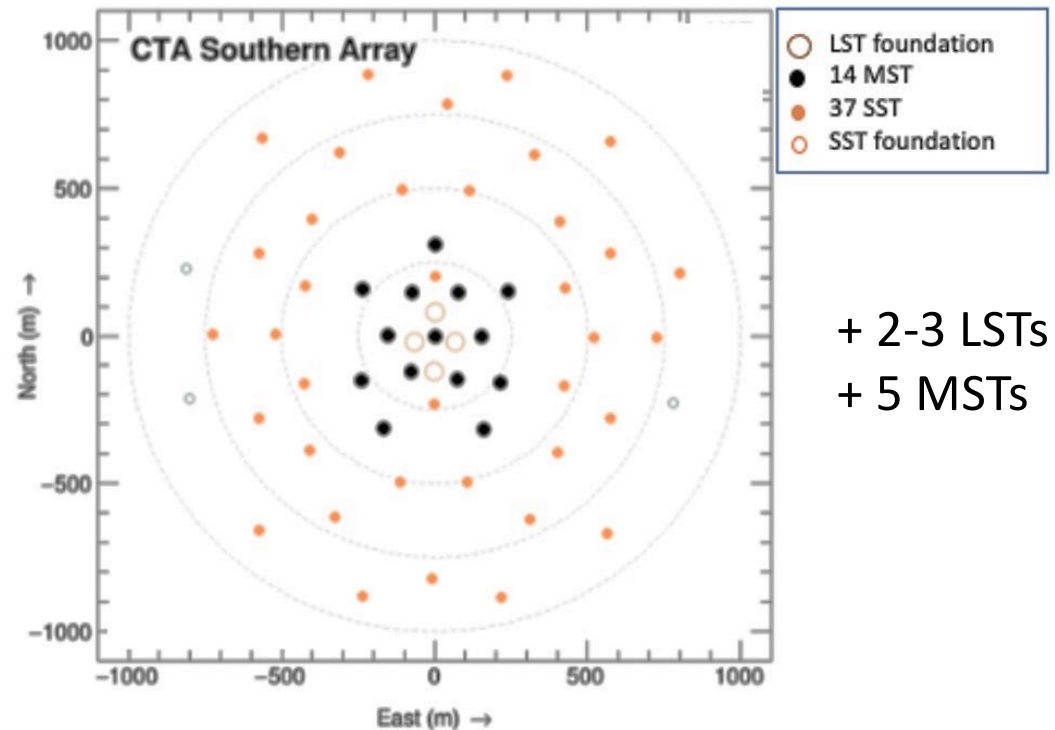
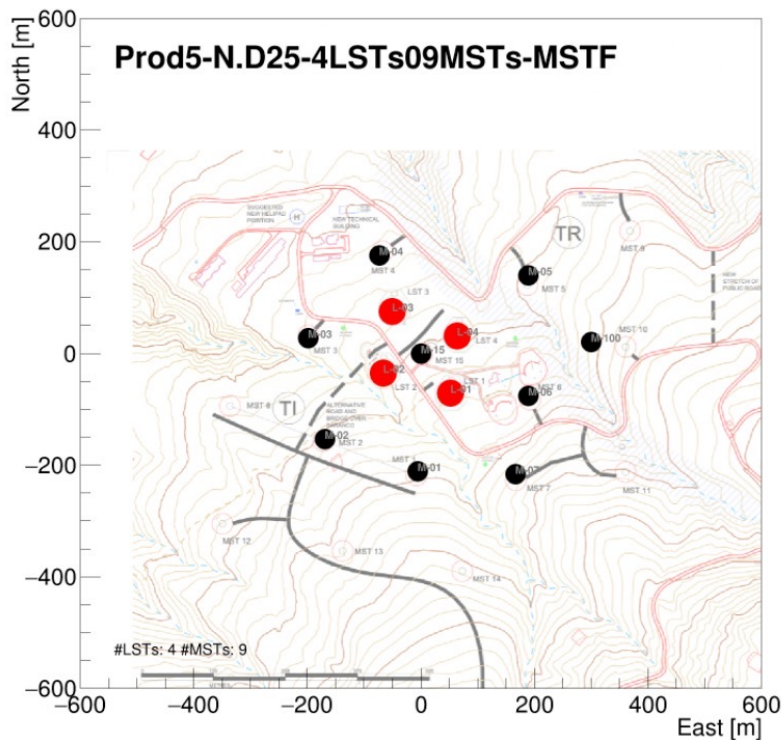
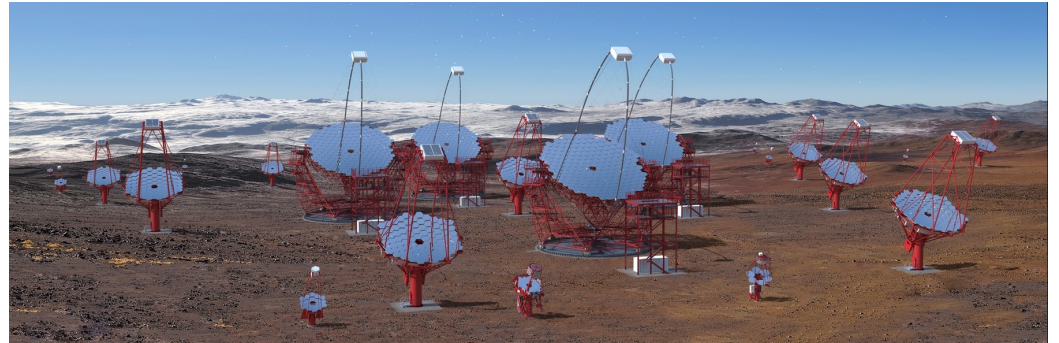
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We are now constructing CTAO in Spain La Palma and Chile Paranal

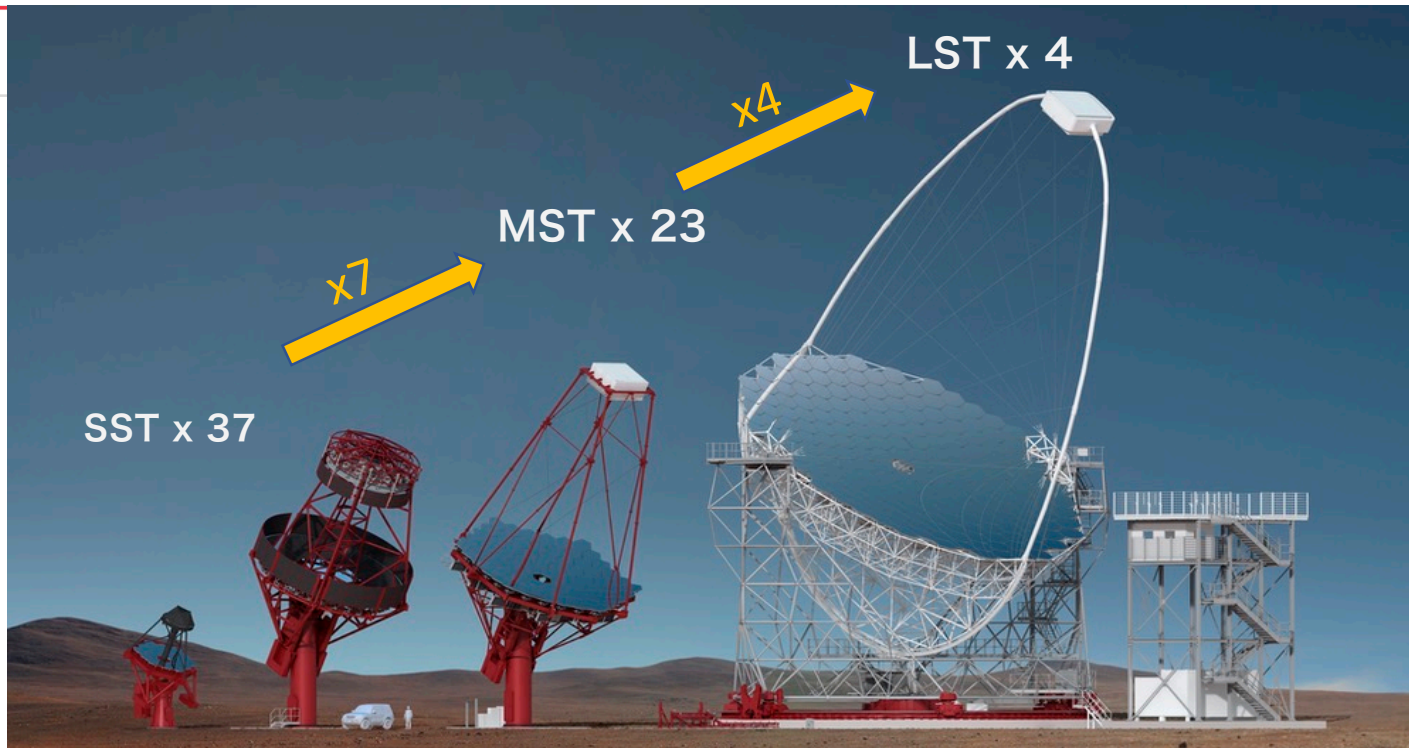
Roque de los Muchachos Observatory
La Palma, Spain



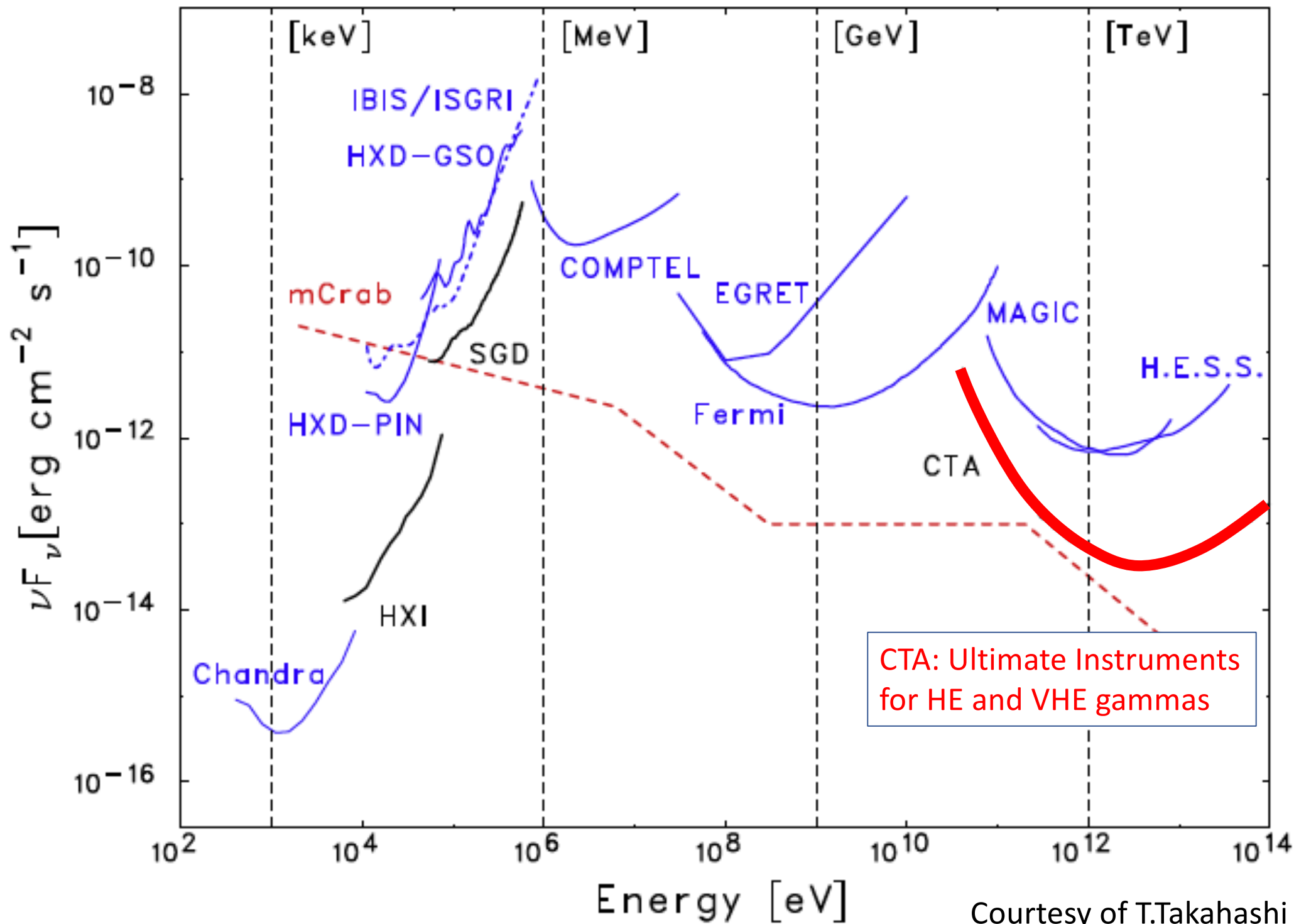
Paranal, Chile



Telescope Design



Telescope Types	SST	MST	LST
Optics	Schwarzschild-Couder	Davies-Cotton	Parabolic (Isochronous)
FoV and Camera	10.5 deg SiPM	7.5 deg PMT	4.3 deg PMT
Mirror Diameter	4.3m	11.5m	23m
Energy Range	3 TeV - 200 TeV	100GeV - 10TeV	20GeV – 2000GeV
Science Targets	Galactic Sources PeVatron (UHE CR)	Galactic Sources Nearby AGNs ($z < 0.5$) Dark Matter	Transient Sources AGNs($z < 2$), GRBs($z < 4$) Dark Matter



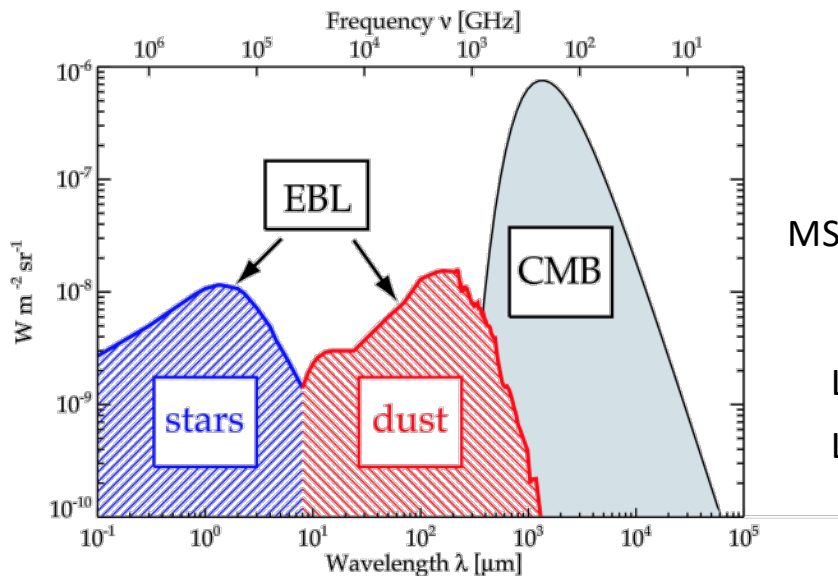
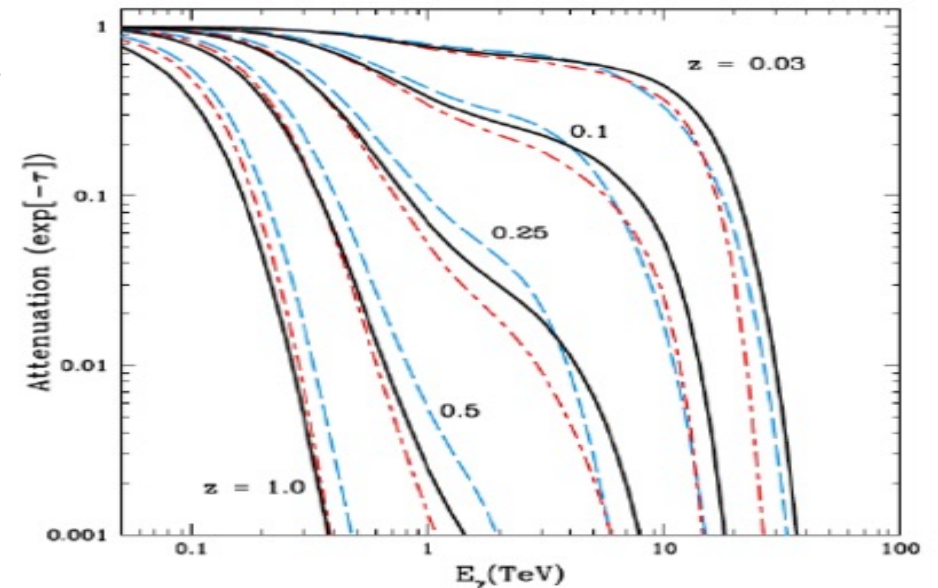
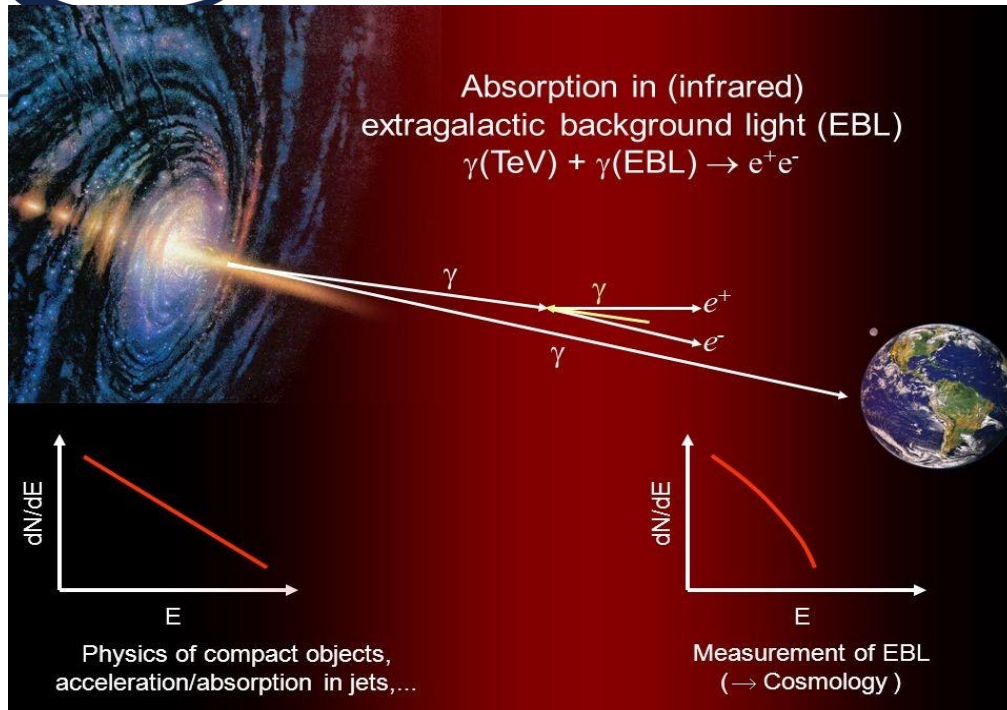
Courtesy of T.Takahashi



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Gamma Ray Horizon

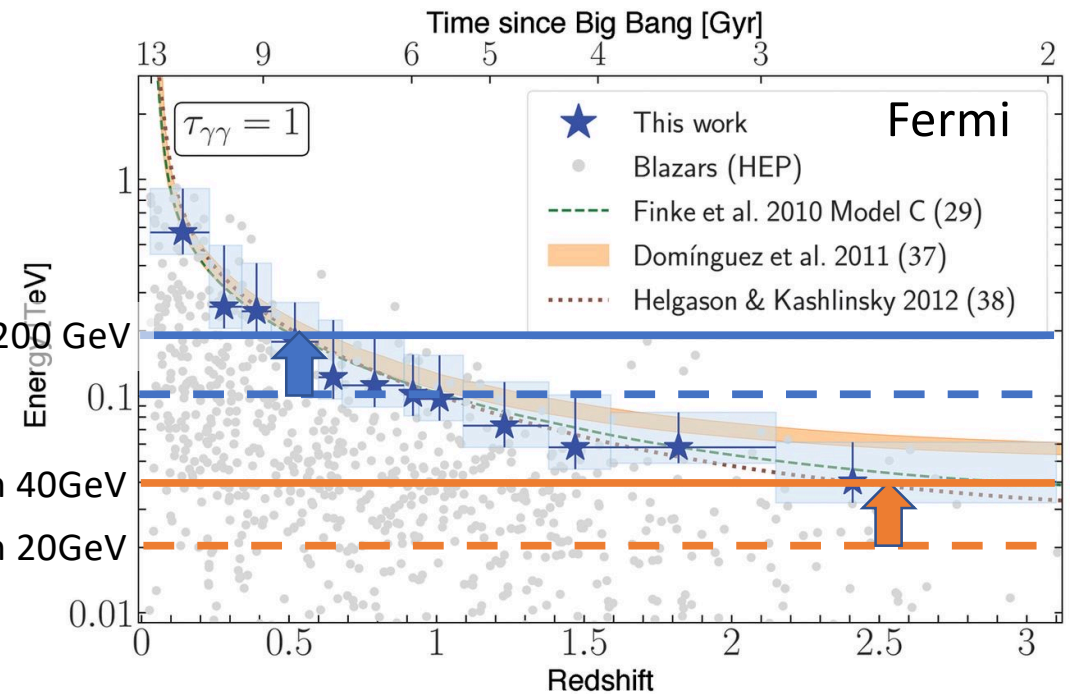
20GeV Low Threshold Energy $\rightarrow z \sim 4$



MST@45° Eth 200 GeV

LST@45° Eth 40GeV

LST@25° Eth 20GeV



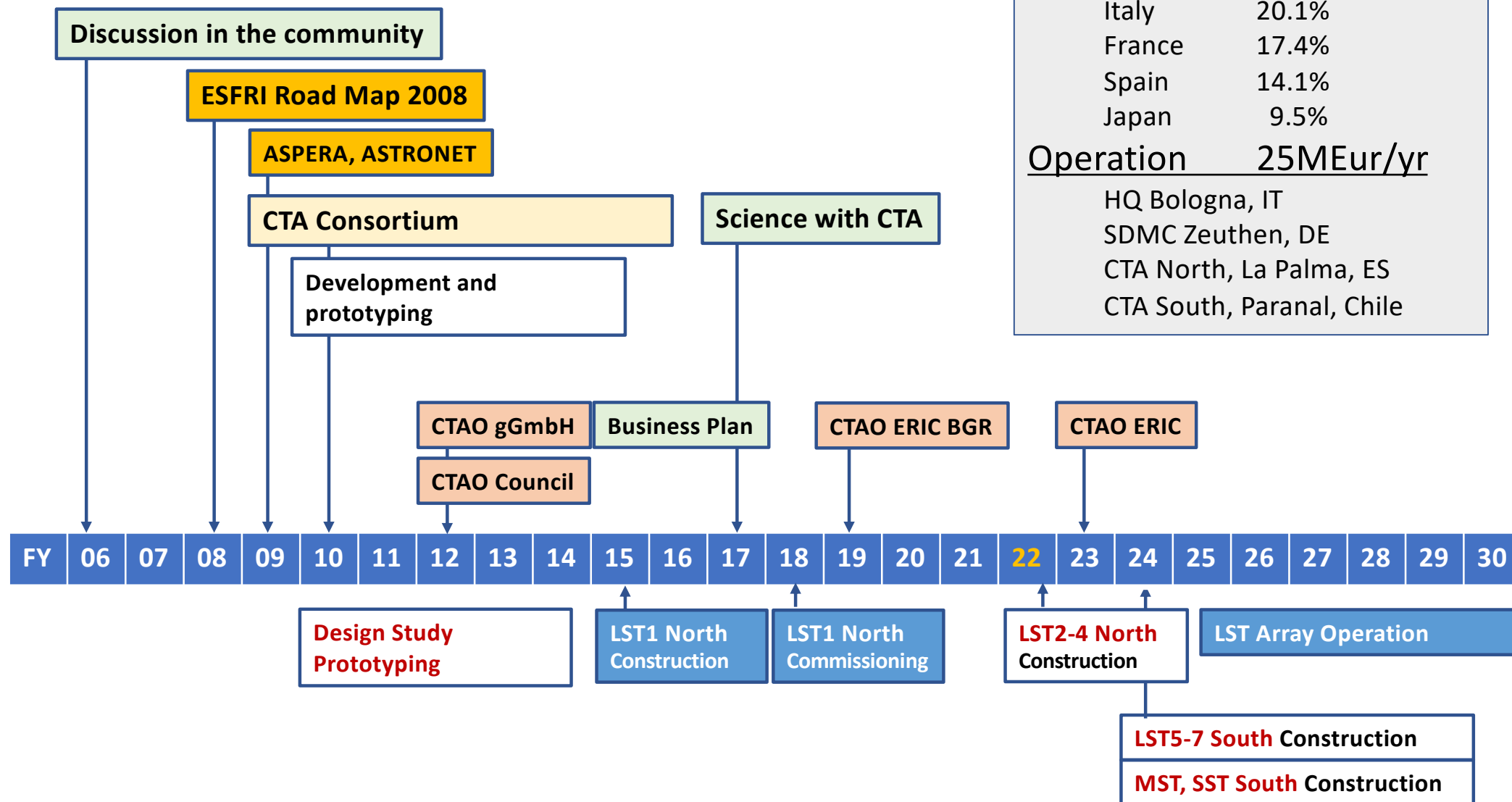
History of the CTA Project

- 2006 The first meeting was organized at MPG Harnackhaus in Berlin by W.H. and M.T. (100MEur Project)
- 2008 CTA listed as an emerging project in the ESFRI road map 2008
- 2009 CTA got a strong recommendation from the EU community network, ASPERA, ASTRONET
- 2010 CTA Consortium formed (250MEur Project)
 - 30 member countries, including Japan
- 2012 CTAO gGmbH (Legal Entity) founded
 - 12 member countries, including Japan
- 2012 CTAO Council formed (Negotiations with funding agencies)
- 2015 CTAO Business plan (CTAO Council lead) (400MEur Project)
- LST1 Construction started
- 2017 Science with CTA (CTAC lead)
- 2017 CTAO Council decided to move the final form of CTAO ERIC (EU Research Infrastructure Consortium, EU Legal Entity) (600MEur Project including Infra.)
- 2019 CTAO ERIC BGR (Board of Governmental Representatives) (400MEur Project descoping the array configuration)
 - 11 member countries, Including Japan as a strategic partner
 - Compiled CTAO ERIC Statutes
 - Submit the Second Step CTAO ERIC Statutes to the EU office in June 2022
- 2023 CTAO ERIC will be founded



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History and plan of the CTA Project



Comparison of CTAO ERIC & MAGIC

Project	MAGIC	CTAO ERIC
Budget Size	15MEur + 1MEur/yr	400MEur + 25MEur/yr
Participating Units	Institutes	Countries (12)
Collaborators (Japanese)	200 Scientists (42)	1500 Scientists (120)
Organizational Body	MAGIC Collaboration	CTAO ERIC (EU Legal Entity)
Highest level committee	MAGIC collaboration board	CTAO ERIC Council/BGR (Governmental Rep.)
External committee		STAC, Resource Board
Managements	Spokesperson (Part-Time) CB chair (Part-Time)	Director General (Full time) Project Manager (Full time) Project Scientist (Full time)
Rules, Finance, Management	MoU	Statutes
Support from EU, Community	CERN RE17, ASPERA	ESFRI, ASPERA, ASTRONET
Time for preparation of the project	4-5 yrs	15-20 yrs
Financial responsibility/contribution	GDP/capita*scientists	GDP/country (like NATO)

CTAC → CTA gGmbH → CTAO ERIC

- CTAC is the Organization for Scientists
 - Usual Experimental Organization
- CTAO gGmbH is German Legal Entity
 - A central organization, Legal Entity in Germany
 - CTAO Council (Highest level committee with governmental representatives)
 - Employees: Managing Director, PM, Scientists, and engineers (30)
 - Operation budget 2.6MEur/yr, salaries, travel cost
 - Function: Political/Financial negotiation, Reviews, CDR, Outreach
- CTAO ERIC is European Legal Entity
 - European Organization
 - CTAO ERIC BGR (Board of Governmental Representatives)
 - HQ Bologna Italy, SDMC Zeuthen Germany, CTA-N La Palma, Spain, CTA-S Paranal, Chile
 - Employees: Director General, Scientists, Engineers, and Technicians (~200)
 - Operation budget 20 MEur/yr, Tax exemptions for all services
 - Operation and maintenance of telescopes,

- Two cases are discussed,
 - MAGIC (M-Size, 15+20MEur, 5 + 20 yr – two generations) and
 - CTA (L-Size, 400+600MEur, 20 + 30 yr – three-four generations)
- In the case of CTA, we have introduced the EU framework ERIC (European Research Infrastructure Consortium) to get strong support from governments and countries.
- We could launch the 1BEur project with the bottom-up process, but it is very long.
 - Non-EU countries join the CTAO ERIC, Japan as the strategic partner and Australia as an observer.



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Multi-messenger and Multi-wavelength Astrophysics

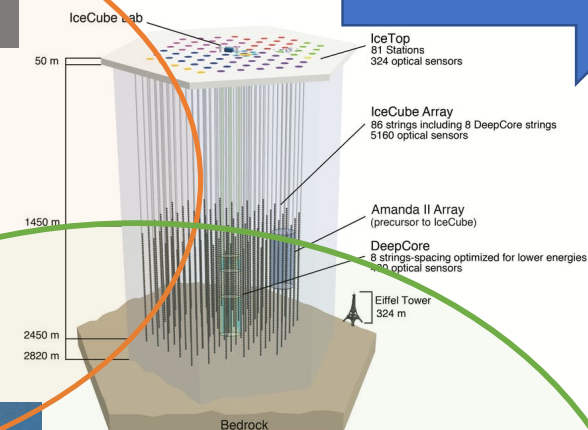
Wave
AstroPhysics



ASTRO-PARTICLE PHYSICS
Cosmic Ray Physics
High Energy Astrophysics



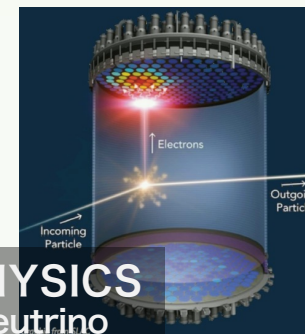
Particle Physics



ASTRO-PHYSICS
Gamma Ray Bursts, Black holes,
Neutron Stars, Space and Time



PARTICLE PHYSICS
Dark Matter, Neutrino
Energy Frontier





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