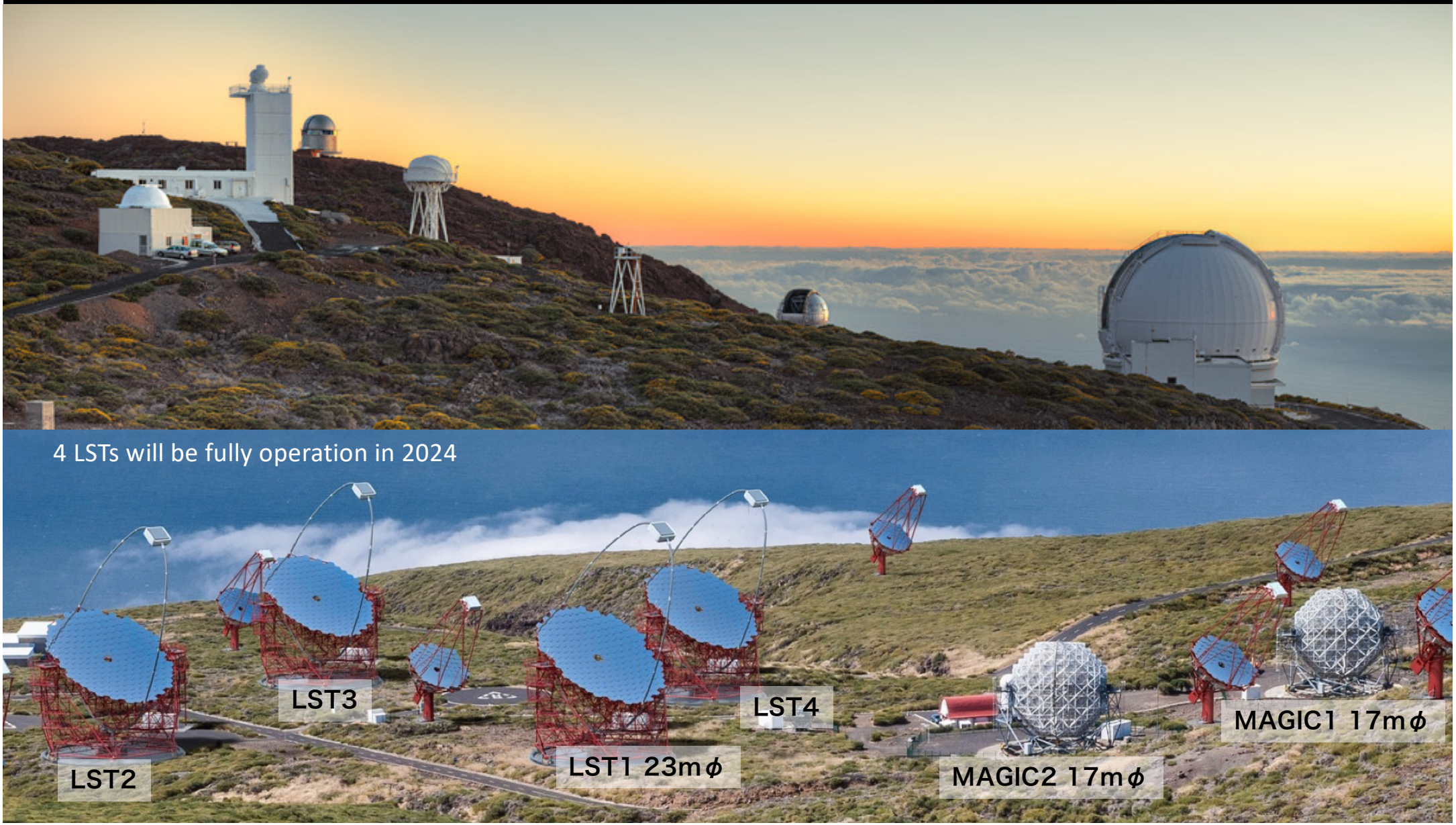
CTA Project

Masahiro Teshima for the CTA-Japan



CTA／MAGIC共同利用プロジェクト

プロジェクト	研究代表者	研究費	旅費	計
CTA 計画	手嶋政廣	700	1140	1840
CTA Japan 物理研究	井岡邦仁	0	240	240
CTA 大口径望遠鏡の焦点面検出器開発	山本常夏	200	600	800
CTA 大口径望遠鏡初号機カメラのコミッショニング	窪　秀利	0	713	713
CTA 大口径望遠鏡初号機の設置建設と初期運用	D. Mazin	0	600	600
CTA 北データセンターの構築・初期運用	D. Hadasch	0	380	380
CTA 小口径望遠鏡用カメラの開発	田島宏康	333	95	428
CTA モンテカルロシミュレーション	大石理子	0	190	190
活動銀河核における超高エネルギーガンマ線放射	西嶋恭司	0	600	600
MAGIC望遠鏡を用いた高エネルギーガンマ線天文学	窪秀利	0	475	475
CTA 大口径望遠鏡のためのSiPMモジュール開発	齋藤隆之	0	600	600
Development of the CTA/LST Telescope CS co	I. Vovk	0	600	600
CTA 大口径望遠鏡 反射鏡調整制御の運用	野田浩司	500	0	500
CTA 大口径望遠鏡のデータ解析手法の確立と初期観測	武石隆治	0	600	600
合計		**1733**	**6833**	**8566**

CTA Japan Members (121名)

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北里大学 医療衛生学部,	村石 浩 *
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高エネルギー加速器研究機構,	郡 和範 *, 田中 真伸
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(宇宙線研究所共同研究員,)	Daniela Hadasch, Daniel Mazin, Giovanni Ceribella, Moritz Hütten, Marcel Strzys, Ievgen Vovk, 石尾 一馬, 稲田 知大, 加賀谷 美佳, 佐野 栄俊, 林 克洋, 林 航平, 廣島 渚, 広谷 幸一, 藤田 裕, 村瀬 孔大, K. S. Cheng, Xiaohong Cui, Timur Dzhatdoev, David C. Y. Hui, Emil Khalikov, Albert K. H. Kong, Pratik Majumdar, Ellis R. Owen, Jumpei Takata, Thomas P. H. Tam, Wenwu Tian
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東北大学 大学院理学研究科,	當真 賢二 *
徳島大学 大学院理工学研究部,	折戸 玲子 *
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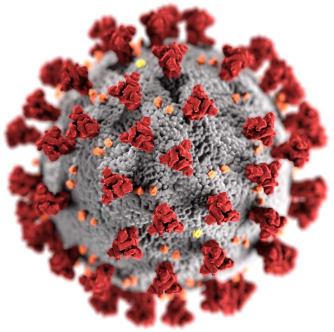
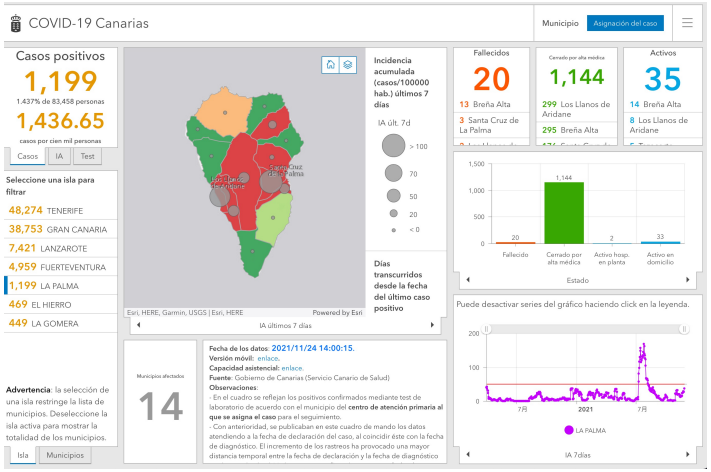
広島大学 宇宙科学センター,	水野 恒史 *
宮崎大学 工学部,	森 浩二 *
山形大学 理学部 物理学科,	郡司 修一 *, 坂本 貫太, 門叶 冬樹, 中森 健之
山梨学院大学 学習・教育開発センター,	内藤 統也 *, 原 敏
理化学研究所,	井上 進, 長瀧 重博 *, 榊 直人, 澤田 真理, Maxim Barkov, Gilles Ferrand, Haoning He, Donald Warren
立教大学理学部,	内山 泰伸 *, 林田 将明
早稲田大学理工学術院,	片岡 淳 *

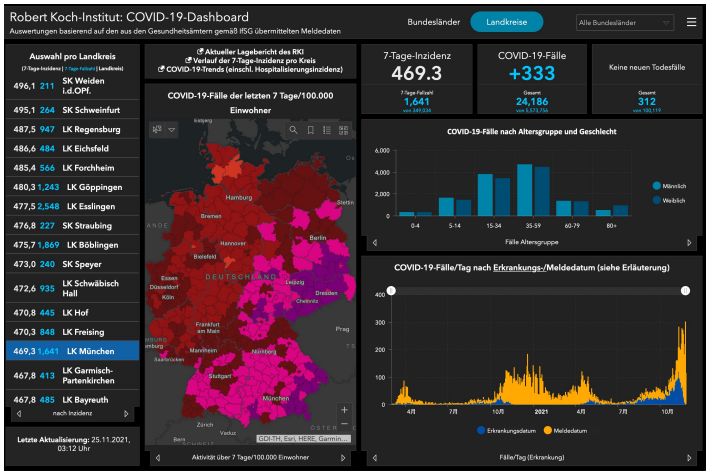
Last two years we suffered very much from Nature

Our status: Oh, my God!!

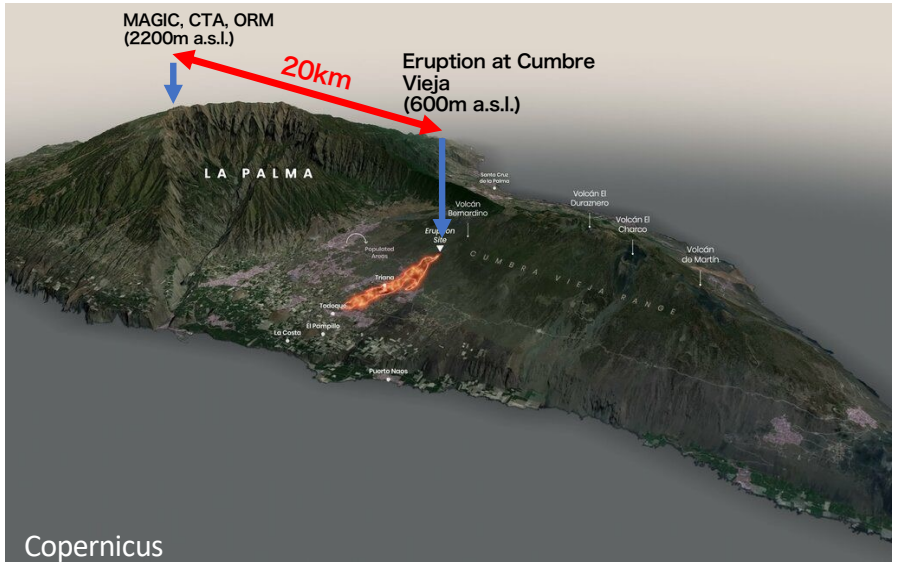
- Covid-19







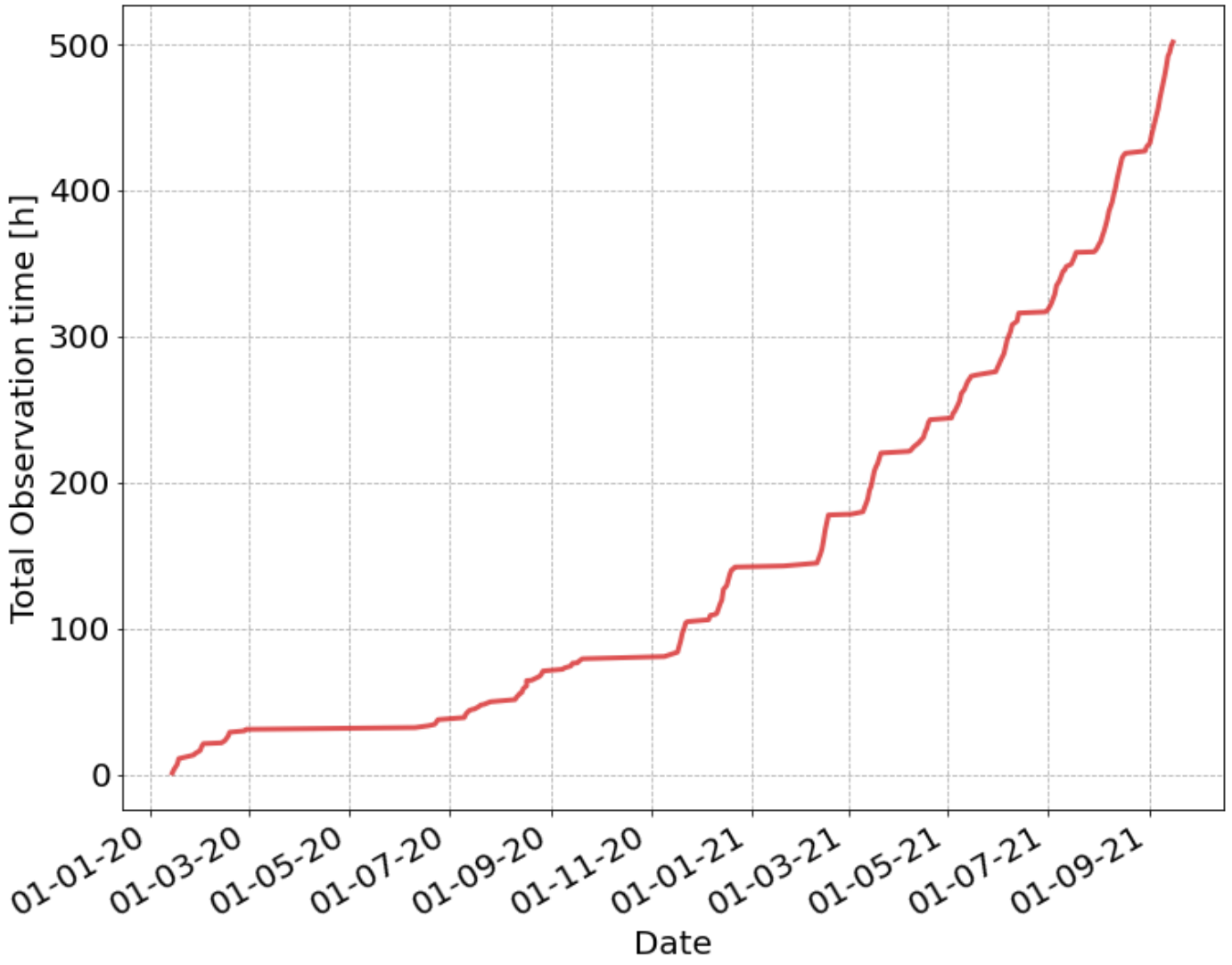
- Volcano Eruption (19.Sep-14.Dec)



Erupciones históricas en La Palma			
#	Erupción	Año	Días erupción
1	nombre?	2021	85?
2	Teneguía	1971	24
3	San Juan	1949	47
4	Charco	1712	56
5	San Antonio	1667/1678	66
6	Tigalate	1646	82
7	Tehuya	1585	84
8	Tacande	1430/1440	?

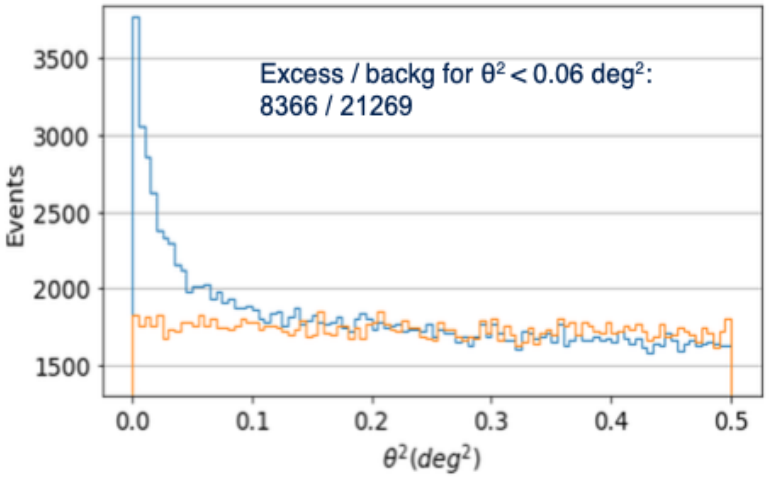
We are very sorry for the local people who evacuated from their living places and lost heir properties. Fortunately the ORM is located 20km from the volcano, so far there is no damage to MAGIC and CTA LST.

LST1 commissioning
500hrs of Scientific Observation

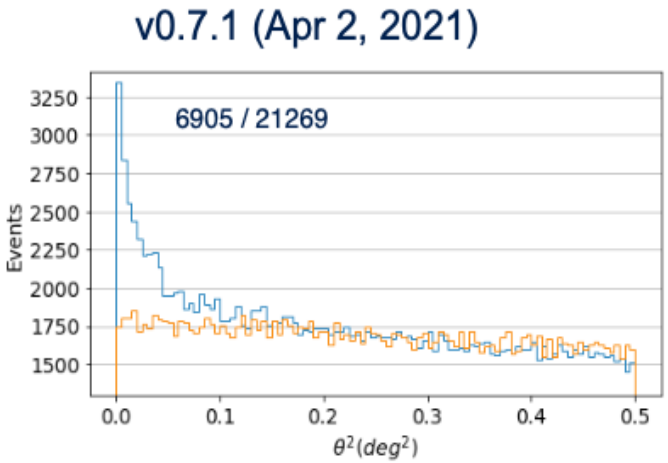


Evolution of the lstchain (standard source-independent) analysis, test on Crab Nebula

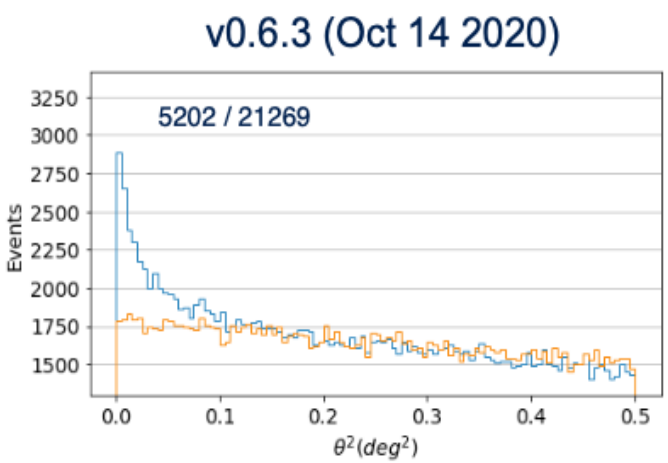
current status (~ next release v0.8.0)



v0.7.1 (Apr 2, 2021)



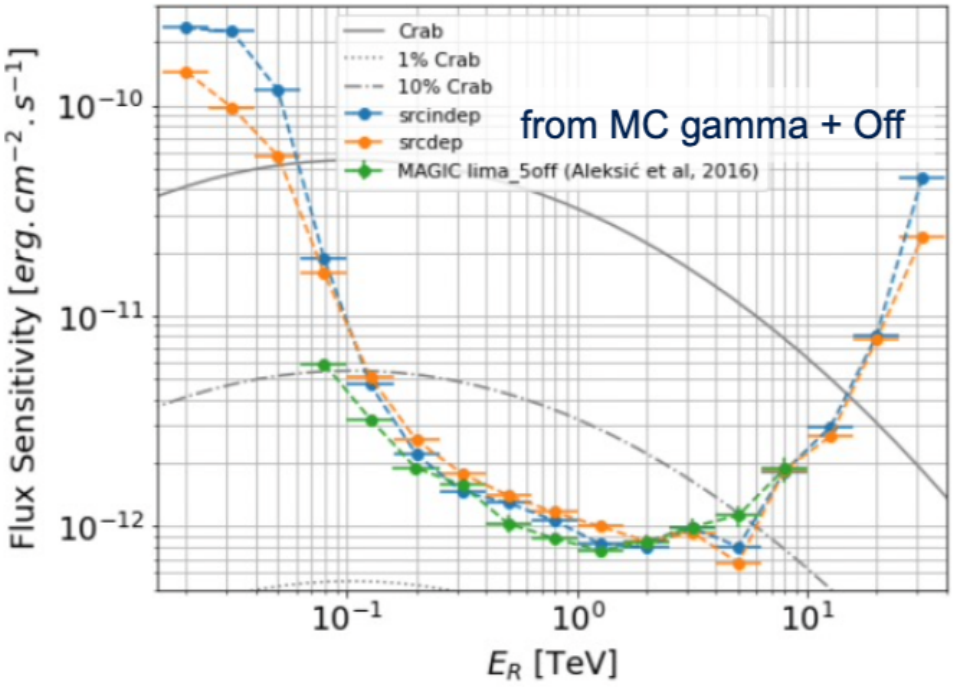
v0.6.3 (Oct 14 2020)



- 2020 Nov 20, Crab (t_{eff} = 3.5 h), ZD<30 deg, source-independent analysis, no intensity cut, gammaness ≳ 0.5 (adjusted for same background rate in all analyses)
- Current lstchain (with all improvements inclusing disp_norm): 1.6 × larger excess (w.r.t. v0.6) for the same background level

Source-dependent Analysis

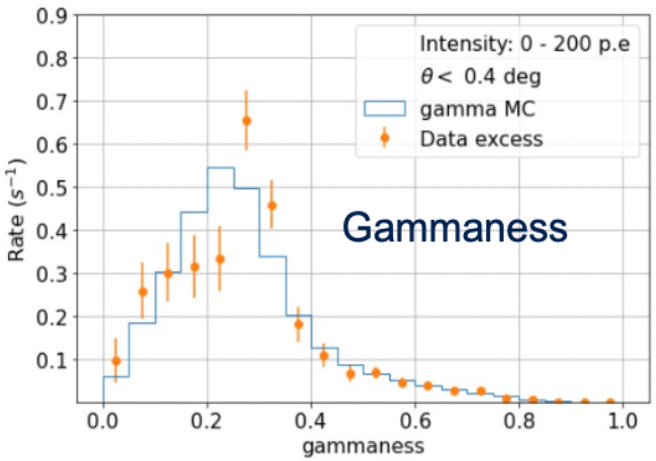
- A further improvement in performance can be achieved, for point-like sources, with the "source-dependent analysis"
- The known position of the source can be used in the reconstruction to get a better handle on the impact parameter
- Improvement in sensitivity and energy resolution below 80 GeV

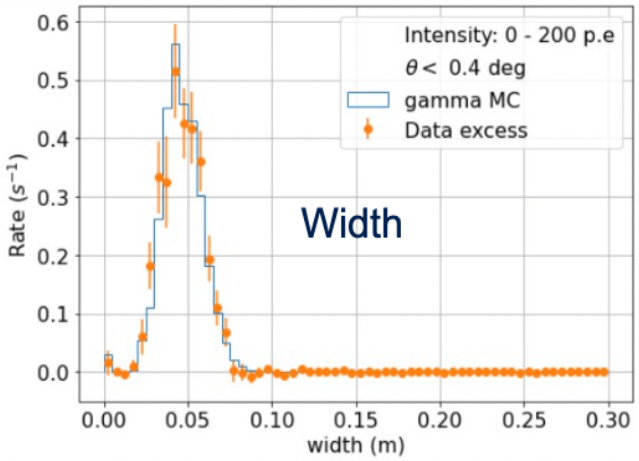


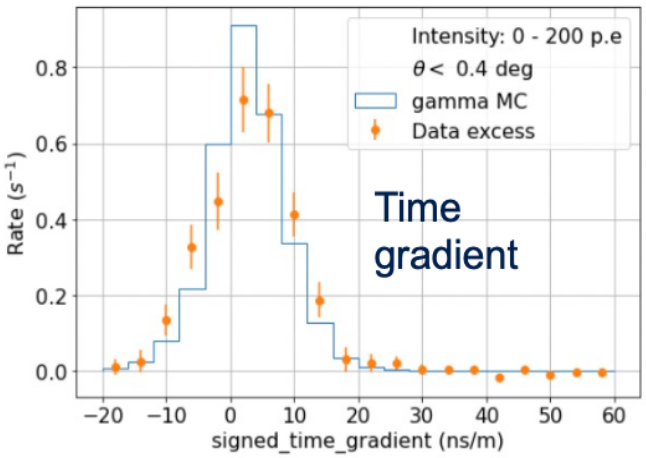
Test with stronger source at low-Energy (BL Lac)

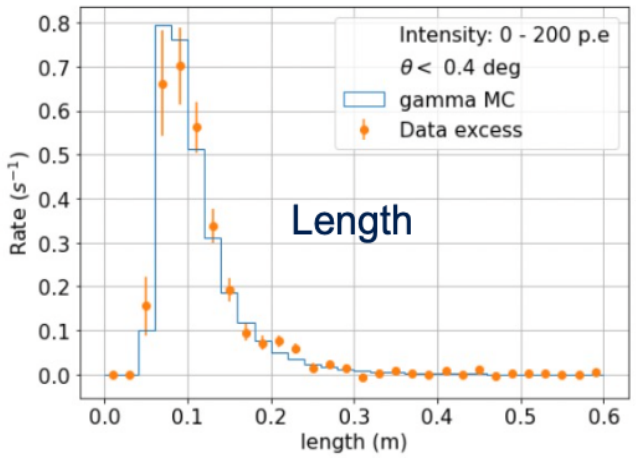
- If the problem is the low S/B ratio + background systematics, using a stronger source would help
- BL Lac Aug'21 flare, teff = 1.8 h, 2-3 times higher S/B in the low intensity bin
- Data is taken on a lower-NSB field, and 6 months apart from Crab's
- Very good width agreement, gammaness also better (note that still S/B is just 2-3% in this intensity range!)

Intensity < 200 pe



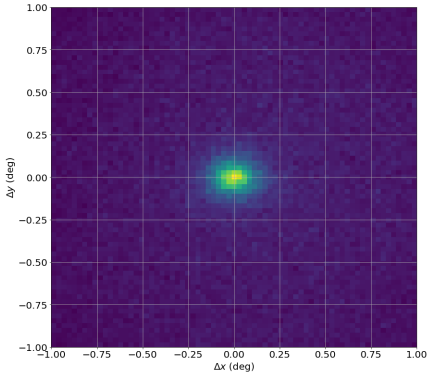




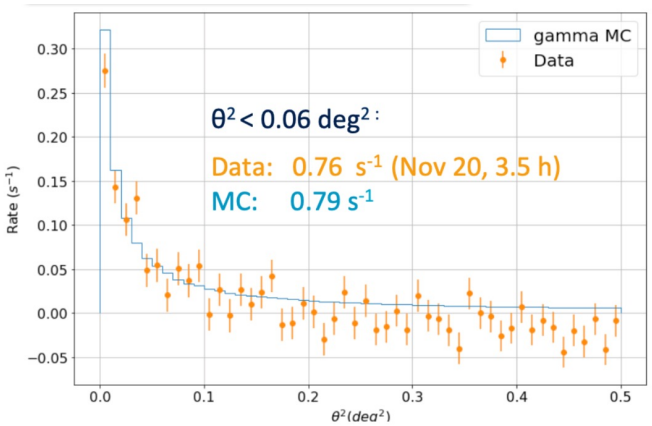


Crab Nebula and Pulsar

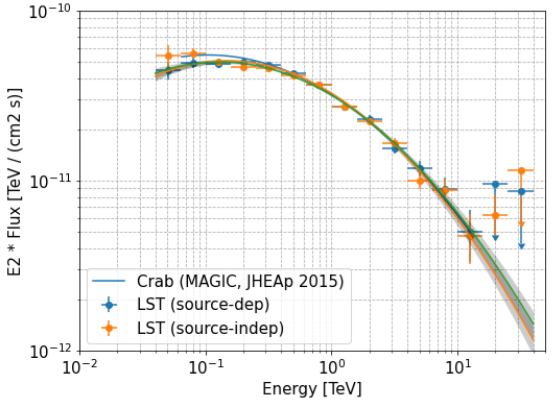
- Crab Nebula
- Crab Pulsar
- LST-MAGIC Joint Observations

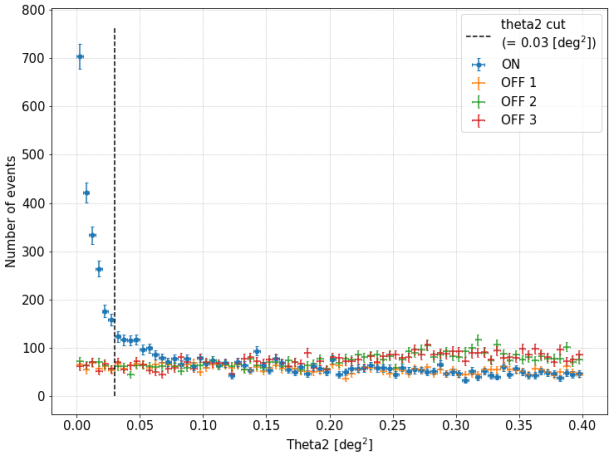


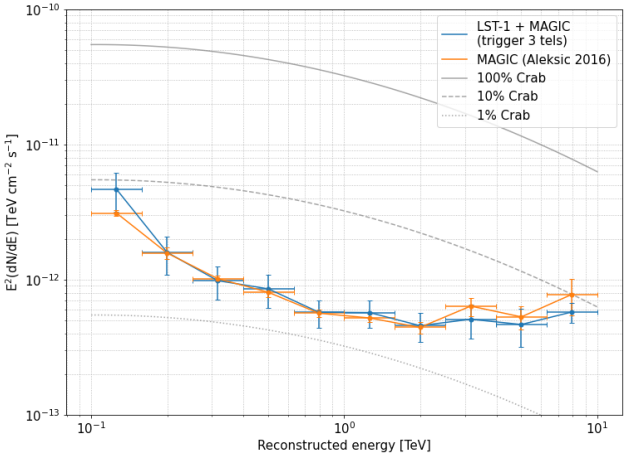
Crab theta2 by Abelardo



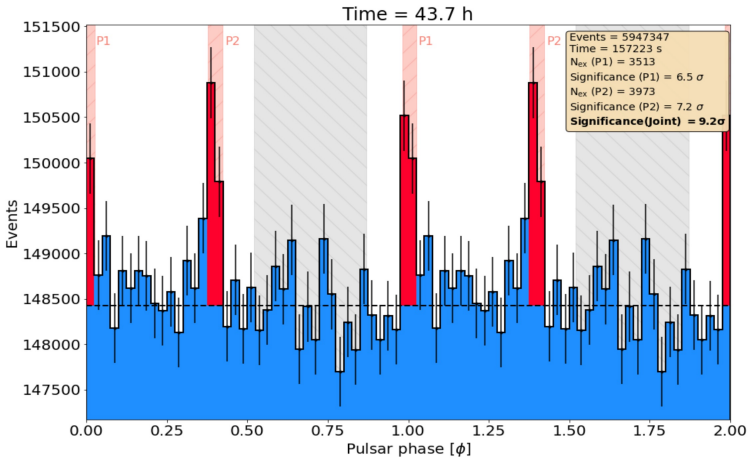
Crab Nebula by **Seiya Nozaki**







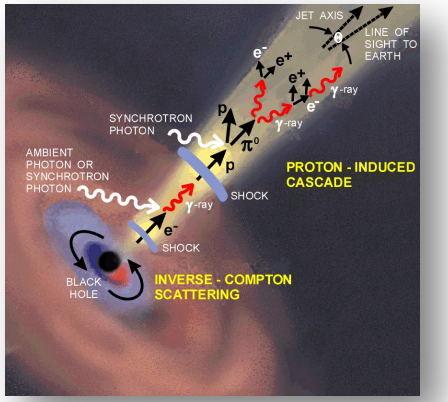
Crab LST-MAGIC joint analysis by **Yoshiki Ohotani**

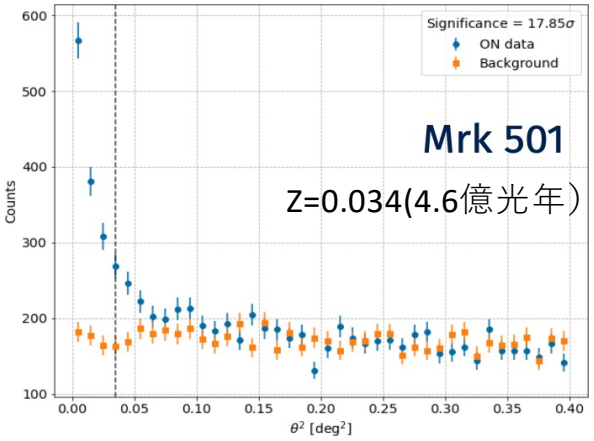


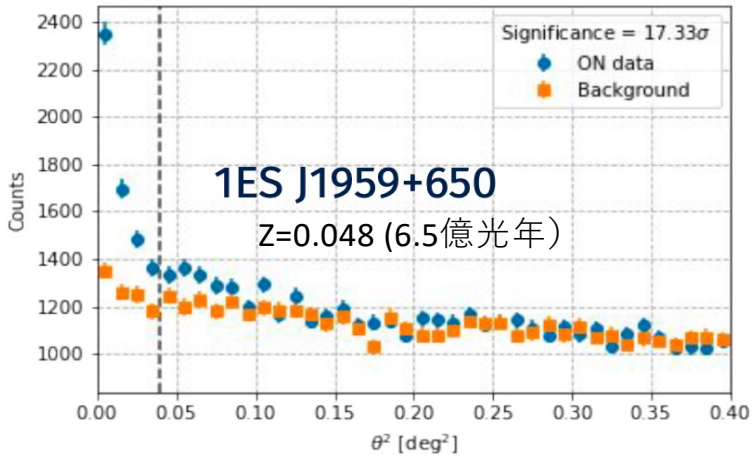
Crab Pulsar by Ruben

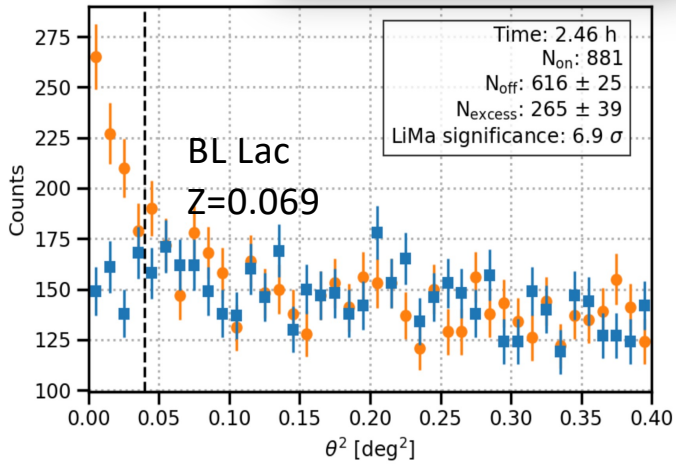
LST1 による活動銀河核の観測 2020-2021Q1

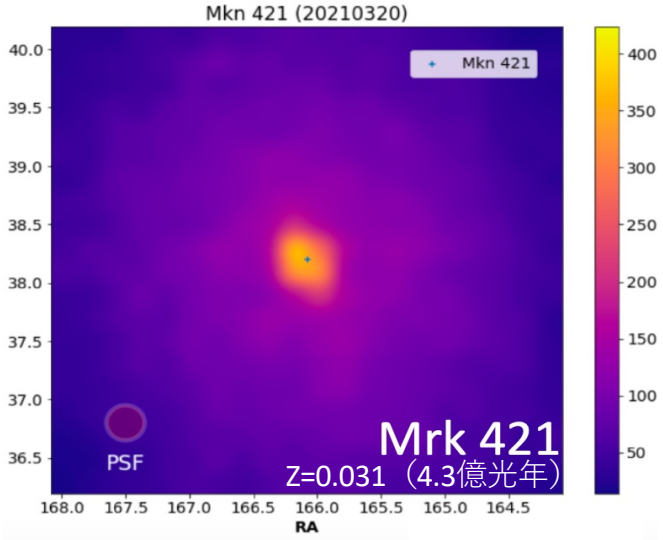
- 近傍の活動銀河核 Mrk501, Mrk421, 1ES 1959+650
- 遠方の活動銀河 1ES0647+250(New), PG1553+113
- LSTによる観測を数億光年から 50億光年へ拡張
- 活動銀河核、ガンマ線バーストの観測を 120億光年まで拡張観測を目指す（宇宙年齢137億光年）

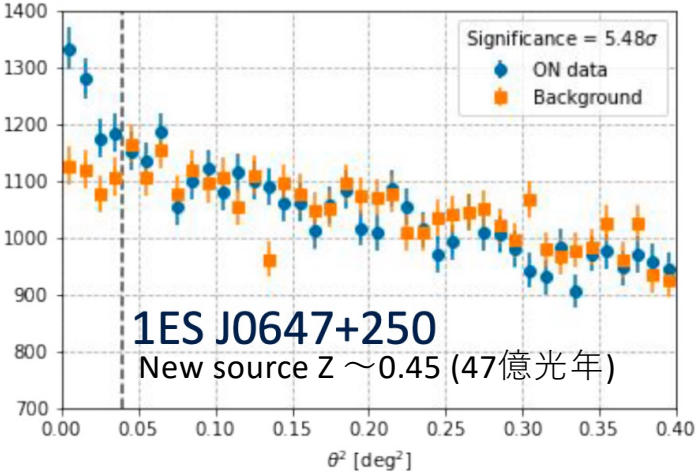


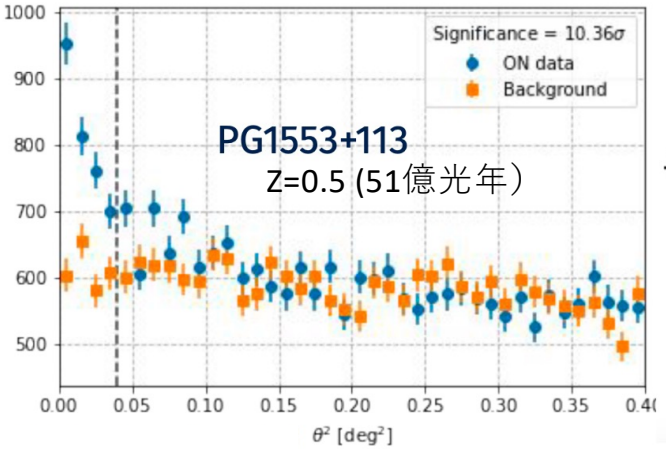






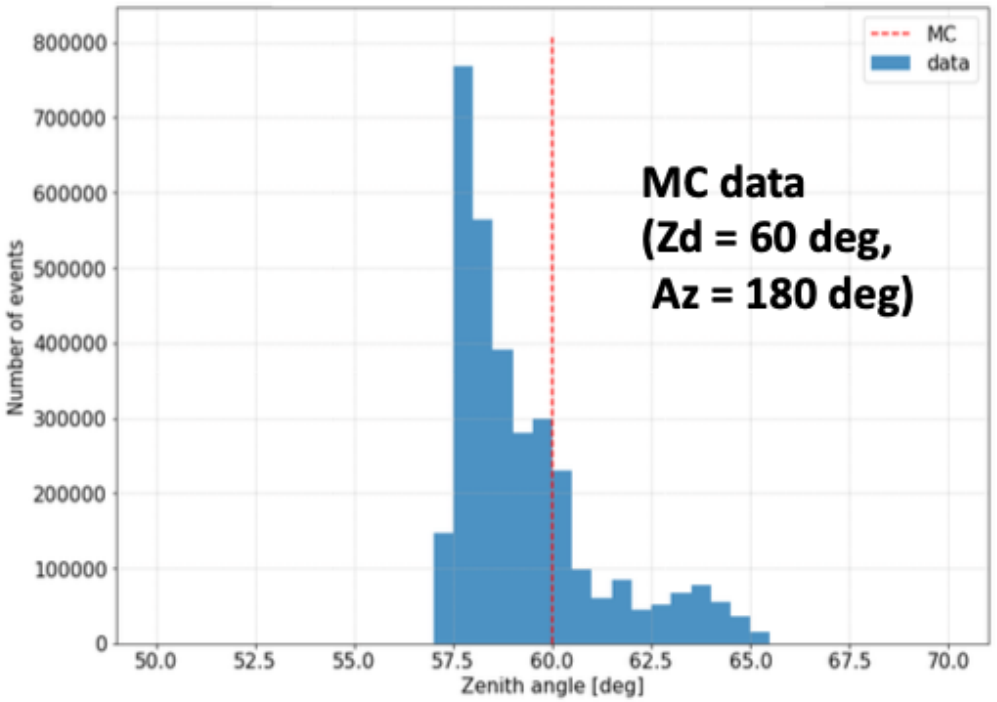


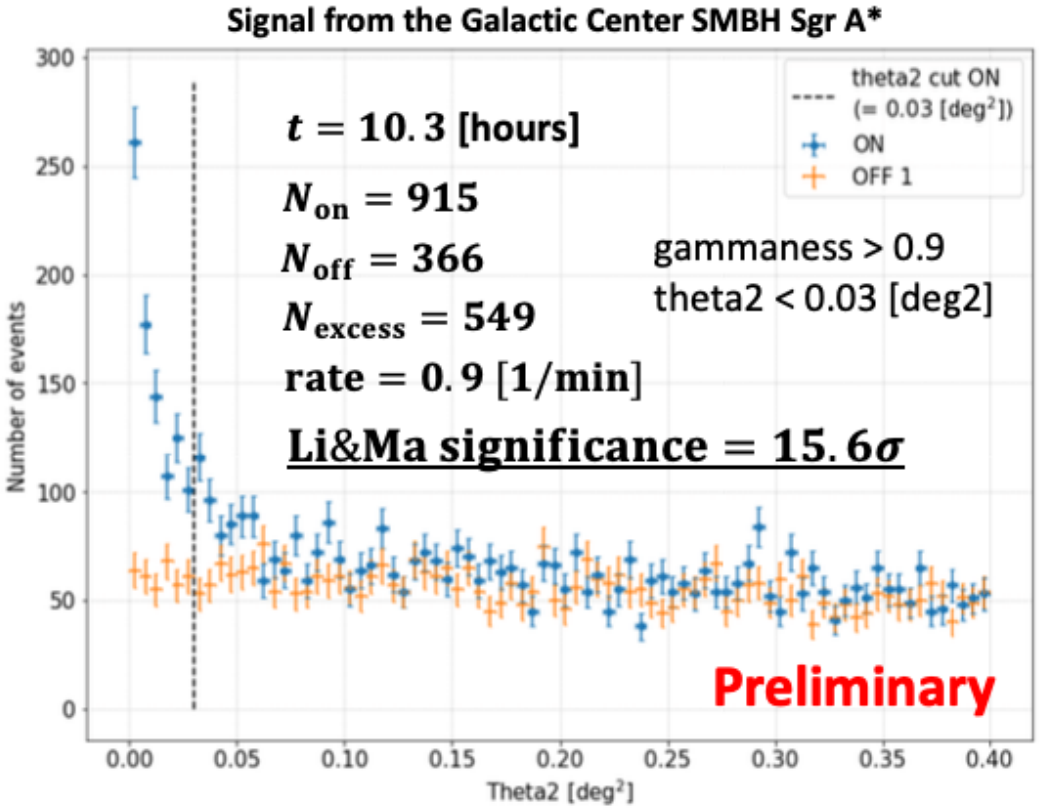




Galactic Center
with MAGIC+LST1 stereo by Yoshiki Ohtani

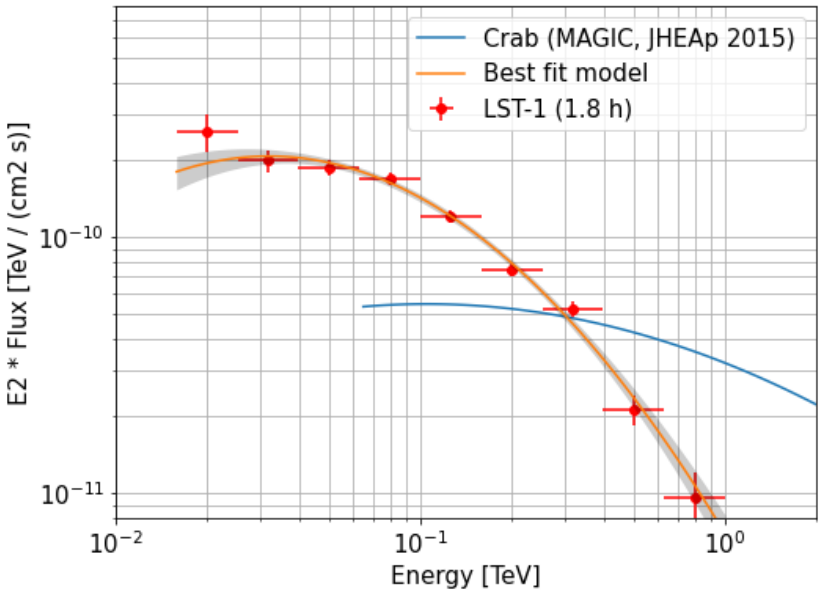
- The joint observations were performed not only the Crab Nebula, **but also other interesting sources such as Galactic Center**
- The Galactic Center is not only scientifically interesting region, containing SMBH SgrA*, SNRs, DM, etc., but also a stable source in VHE region, which could be used for calibration
- The application of the combined analysis pipeline to the data shows that **the Galactic Center has been clearly detected with 15.6σ in 10.3 hours observation time**

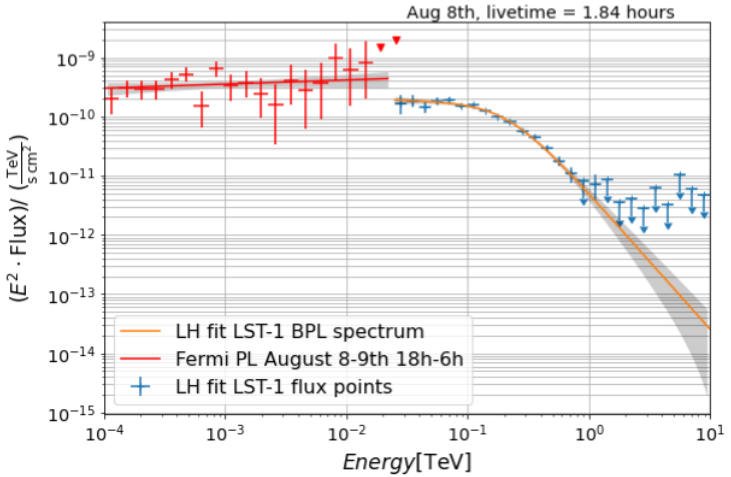




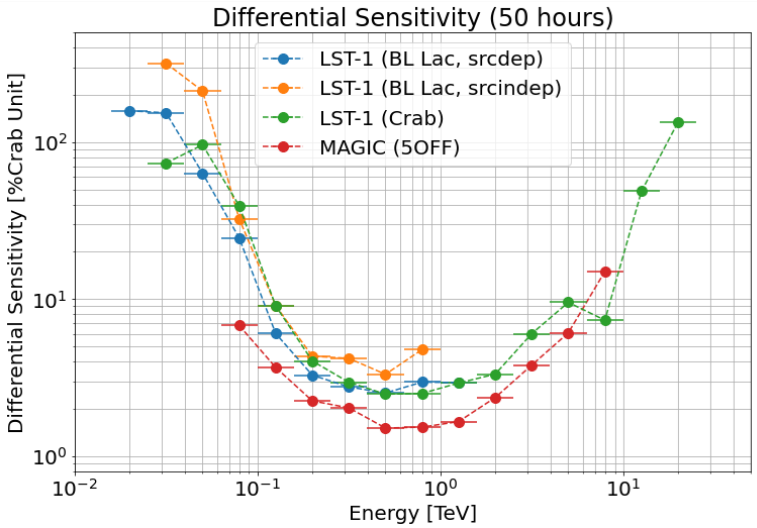
BL Lac Flare observed with LST1 by Seiya Nozaki

SED measured down to 20GeV

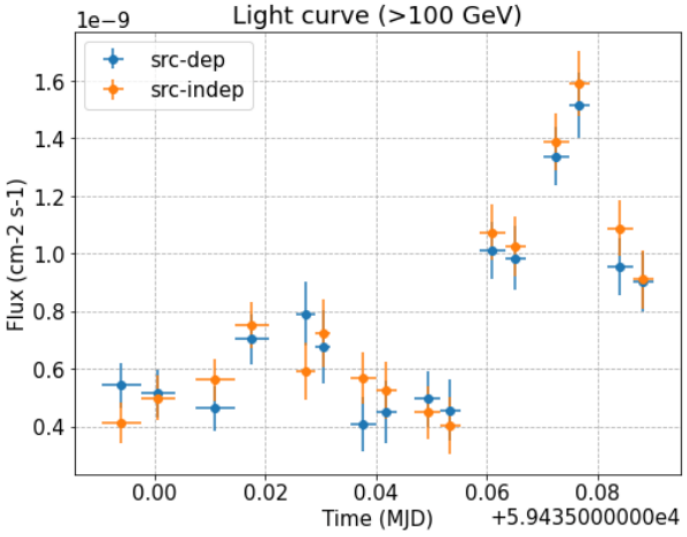




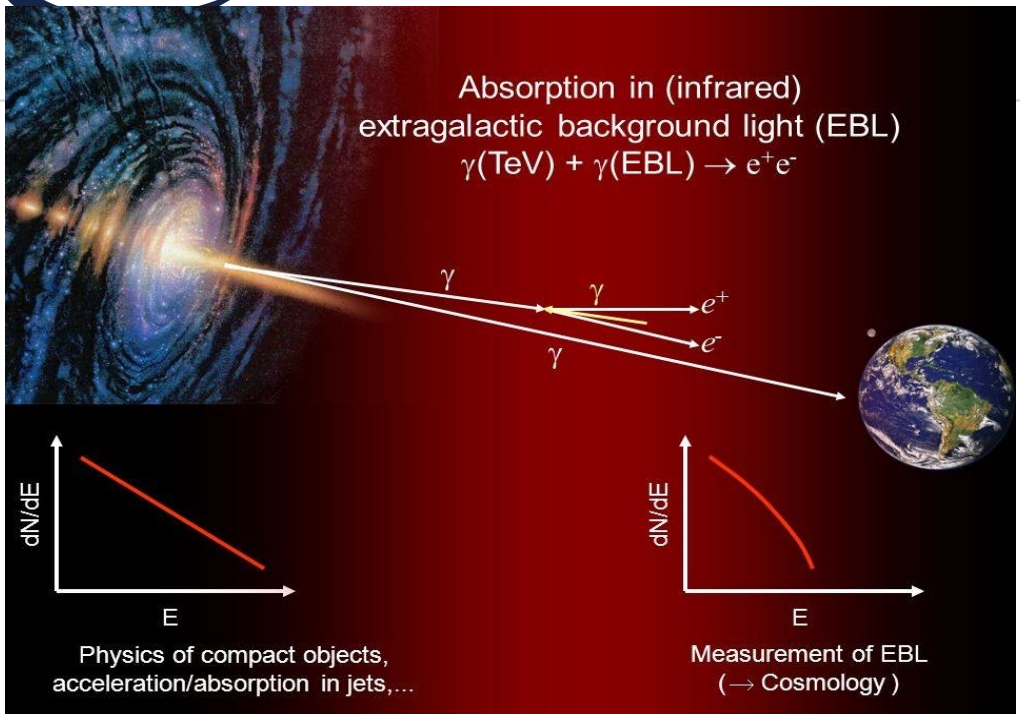
LH Analysis by Gabriel

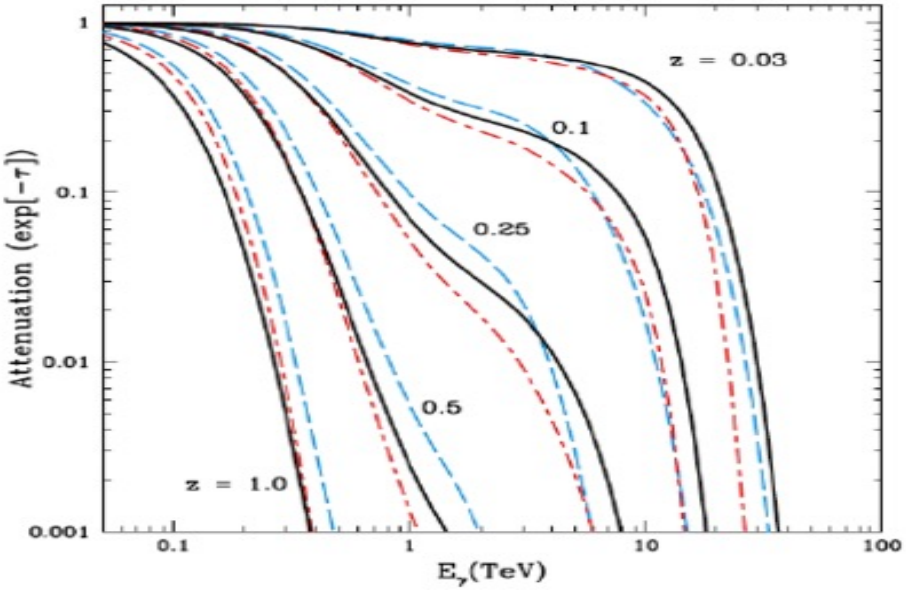


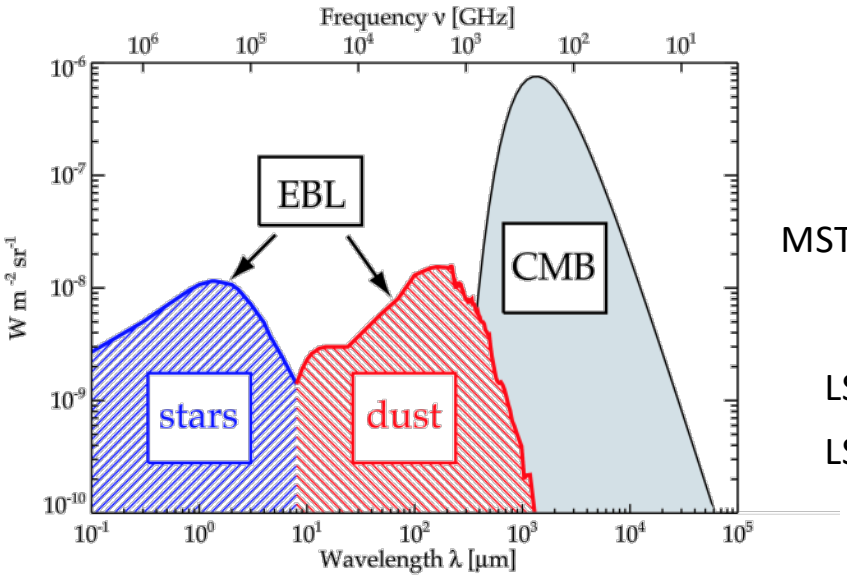
Intranight Variability



Gamma Ray Horizon



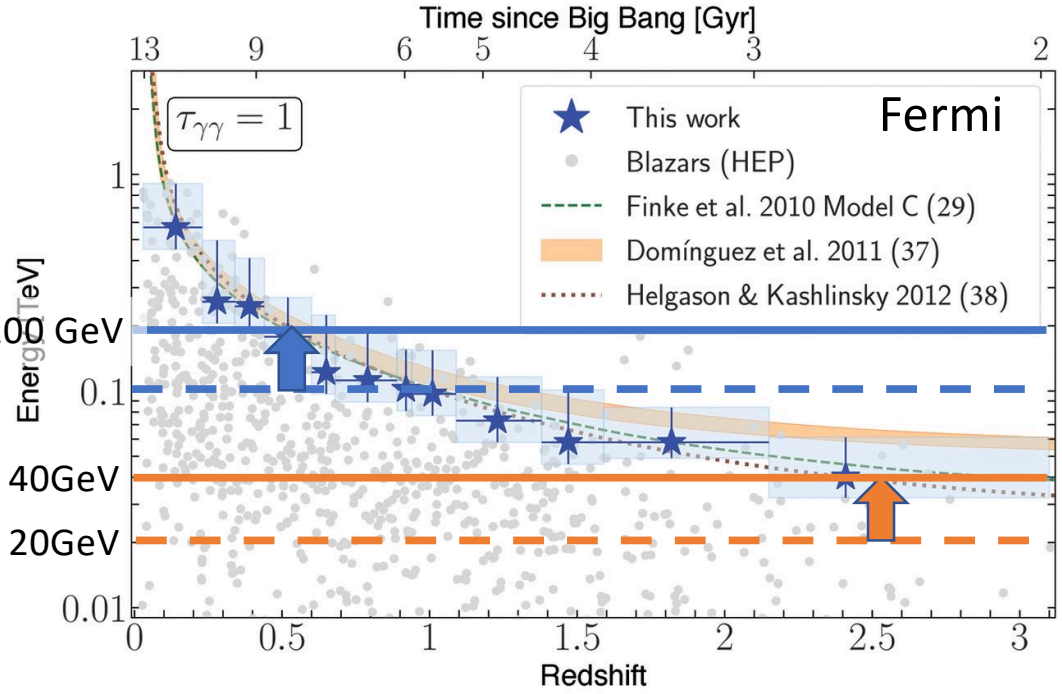




MST@45° Eth 200 GeV

LST@45° Eth 40GeV

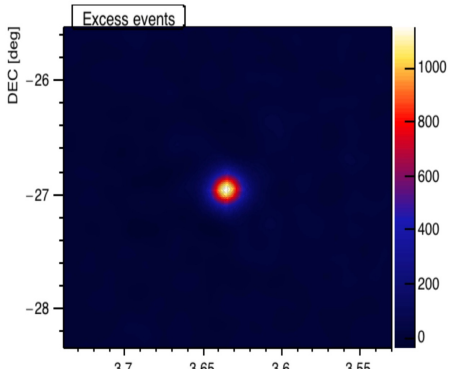
LST@25° Eth 20GeV

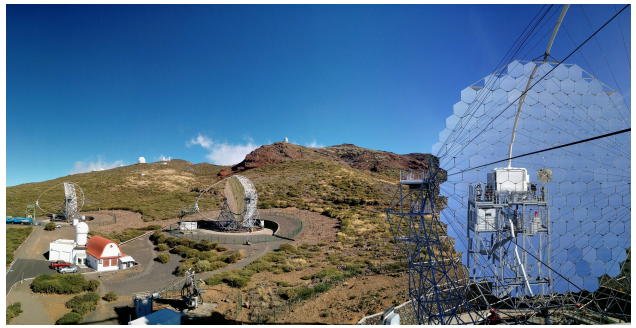


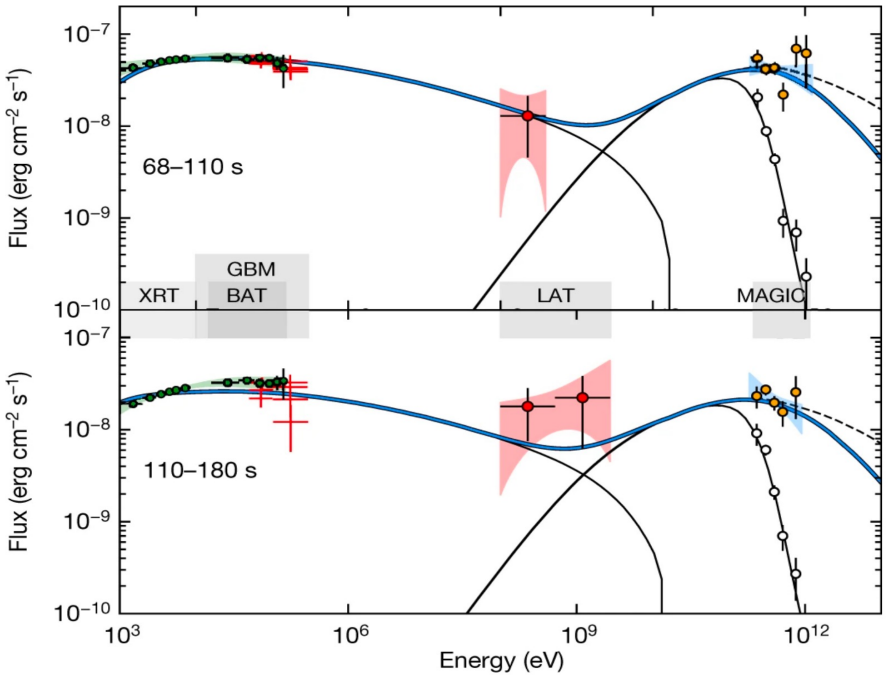
MAGIC Highlight, Gamma Ray Burst GRB190114C

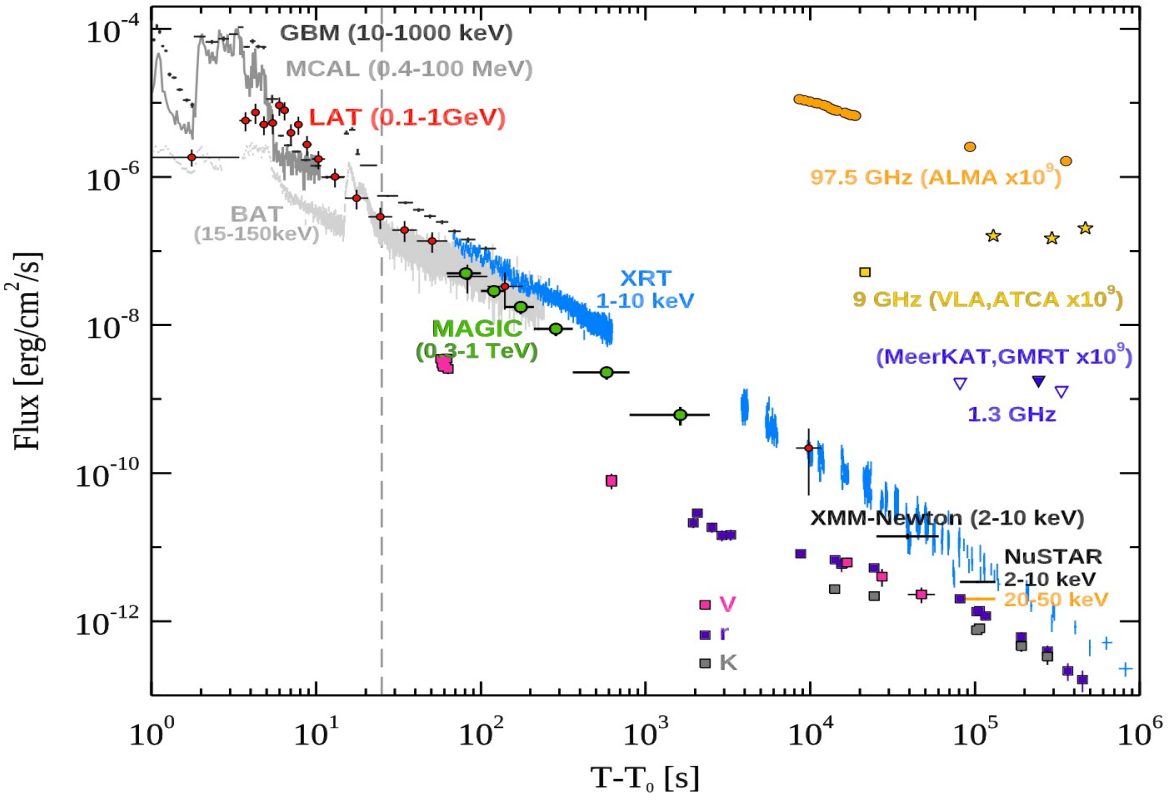
Historical achievement

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





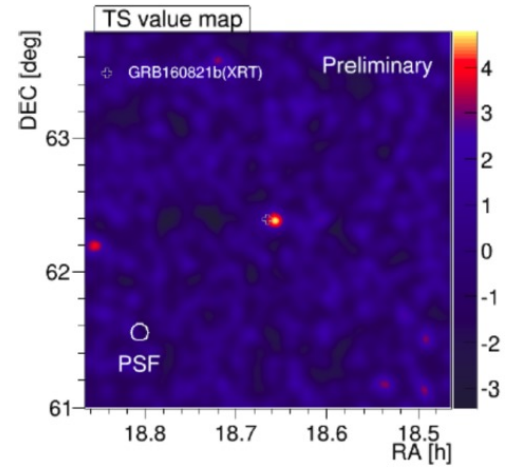


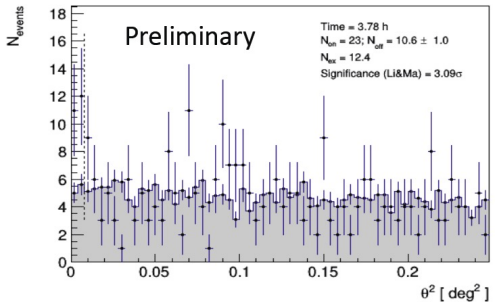


MAGIC Highlights
Other GRB observations with MAGIC

GRB 160821B

Short GRB under moon
E > 600GeV
Z = 0.162
3.1 σ (PostTrial)
Published in APJ 2021

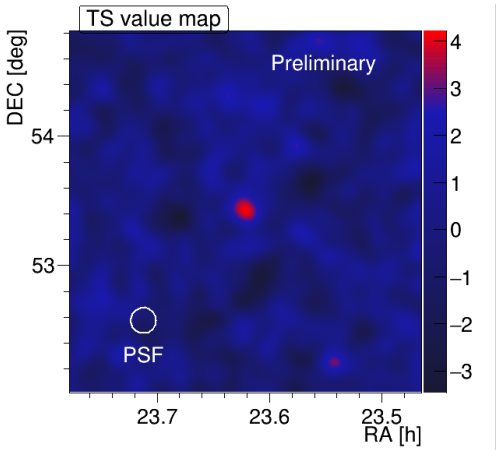


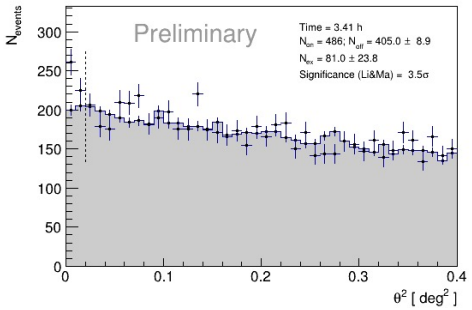


GRB 201015A

Long GRB in Dark

Z = 0.426
3.5 σ (PostTrial)
Published, ICRC 2021_797
Y. Suda et al.

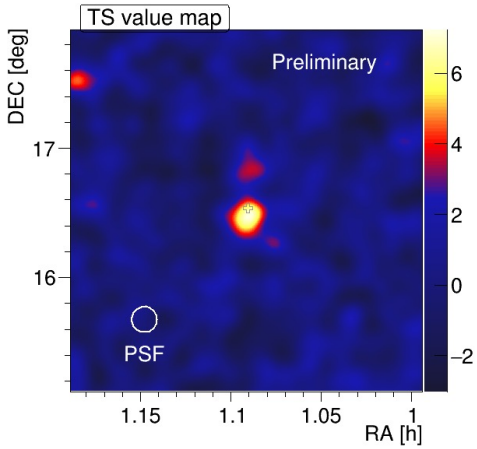


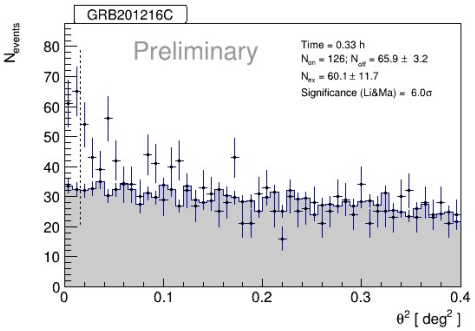


GRB 201216C

Long GRB in Dark

Z = 1.10
6σ (PostTrial)
Published, ICRC 2021_788
S. Fukami et al.



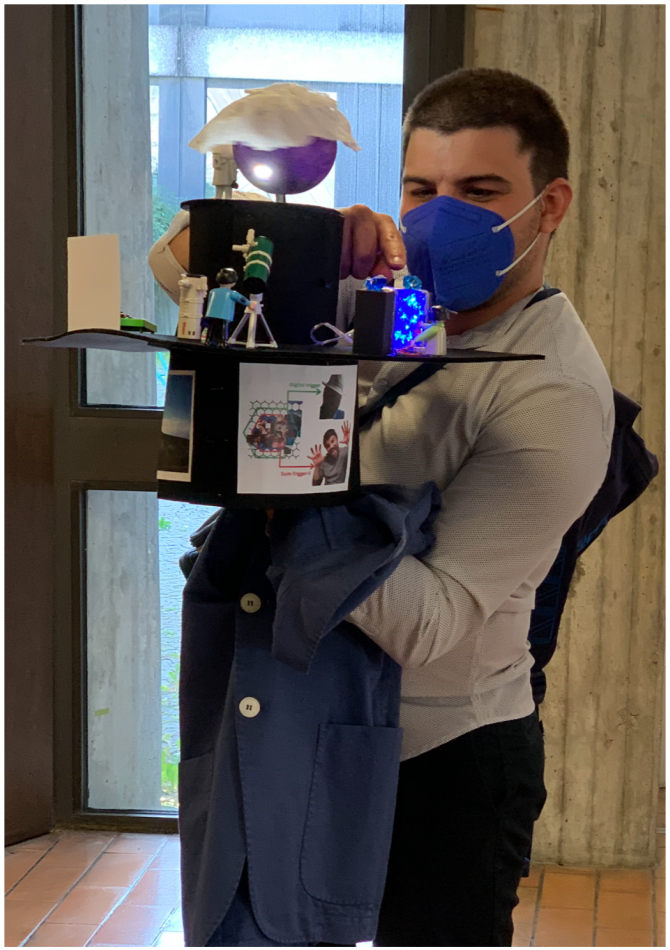


MAGIC Highlight:
Discovery of Geminga Pulsar at VHE

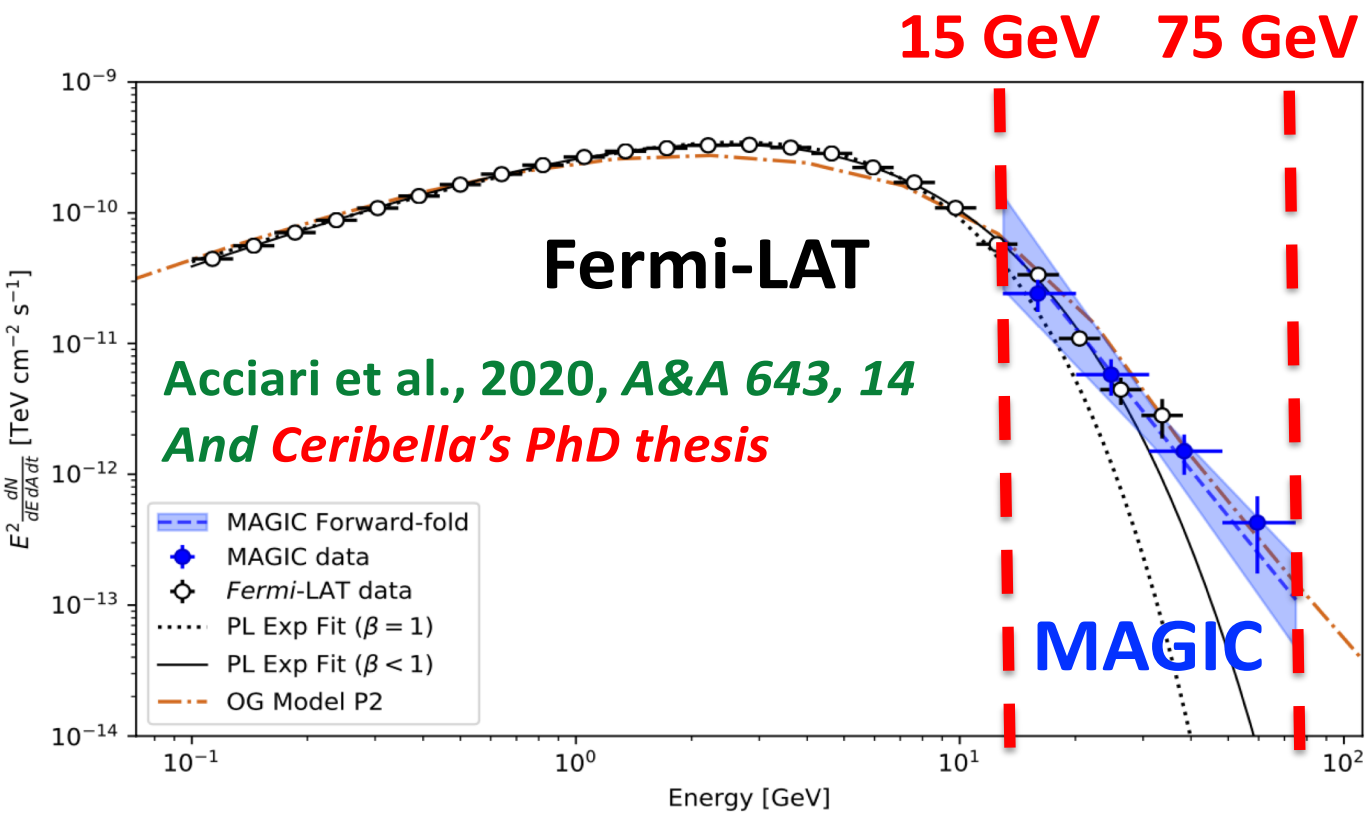
Sum-Trigger performance paper

F. Dazzi, T. Schweizer, **G. Ceribella**, *et al,*
IEEE Transactions on Nuclear Science, vol. 68, no. 7, pp. 1473-1486, July 2021, doi: 10.1109/TNS.2021.3079262
And Ceribella's PhD thesis

Giovanni Ceribella
PhD thesis defense (Sep14, 2021)



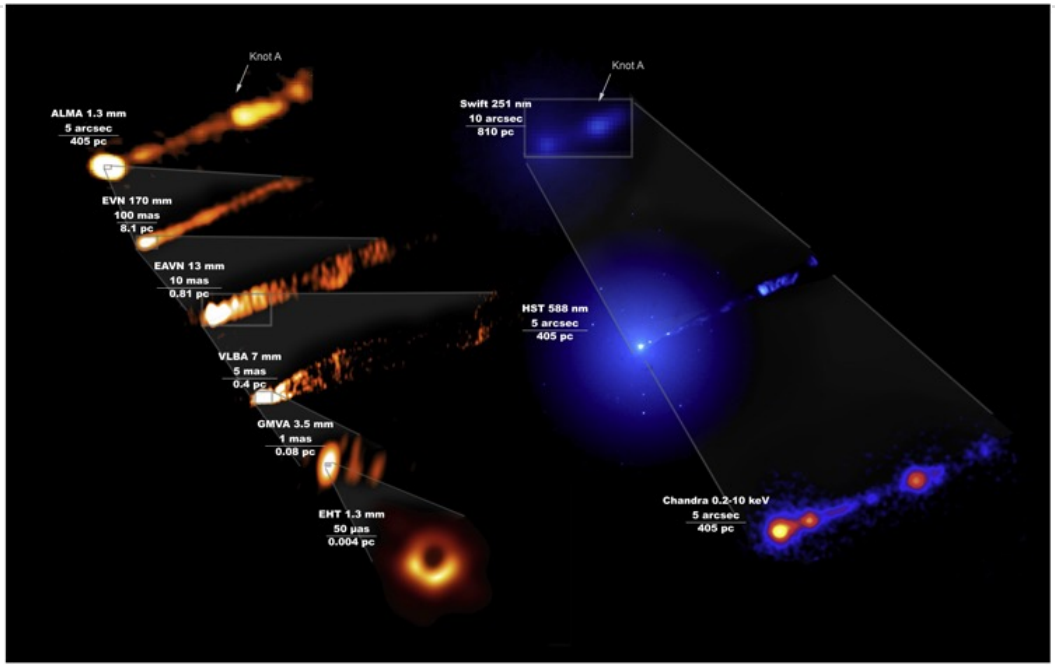
Discovery of Geminga pulsar at VHE

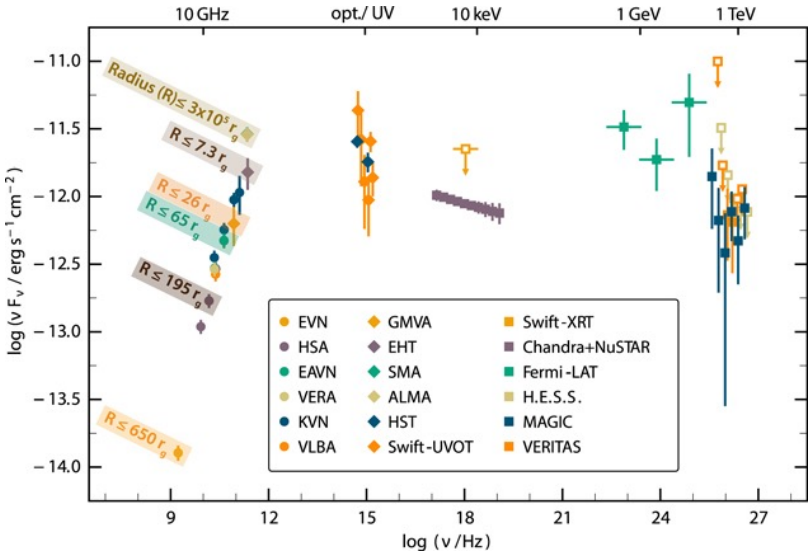


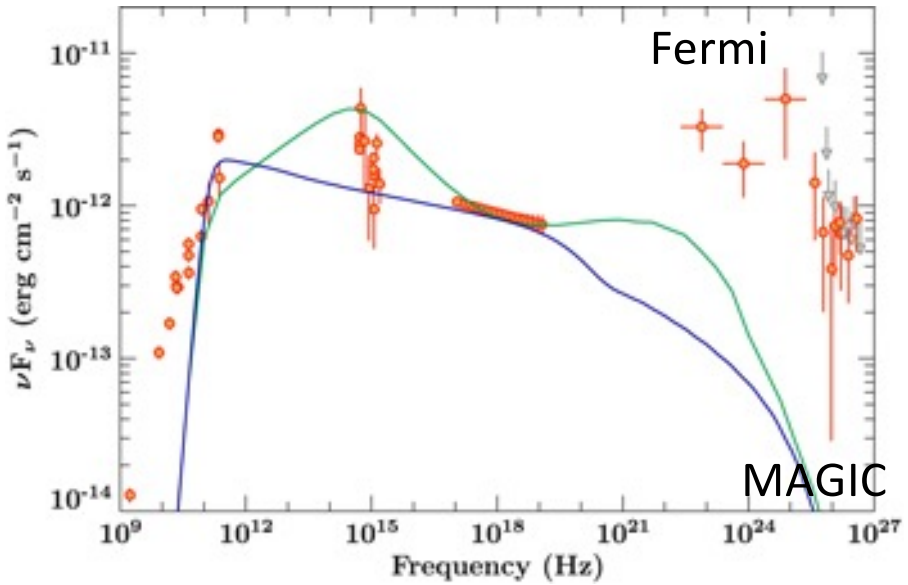
On October 1st, he was already working in Tokyo

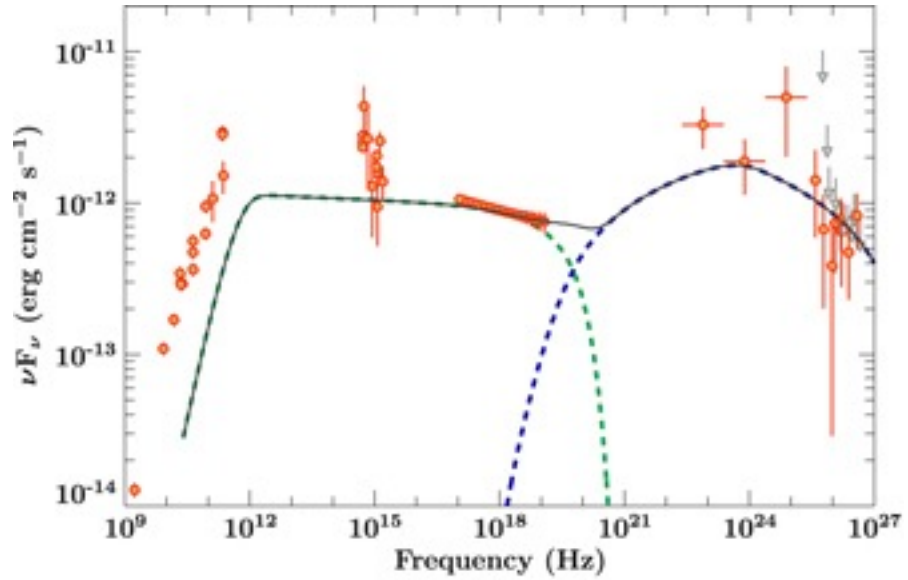
MWL Observation of M87

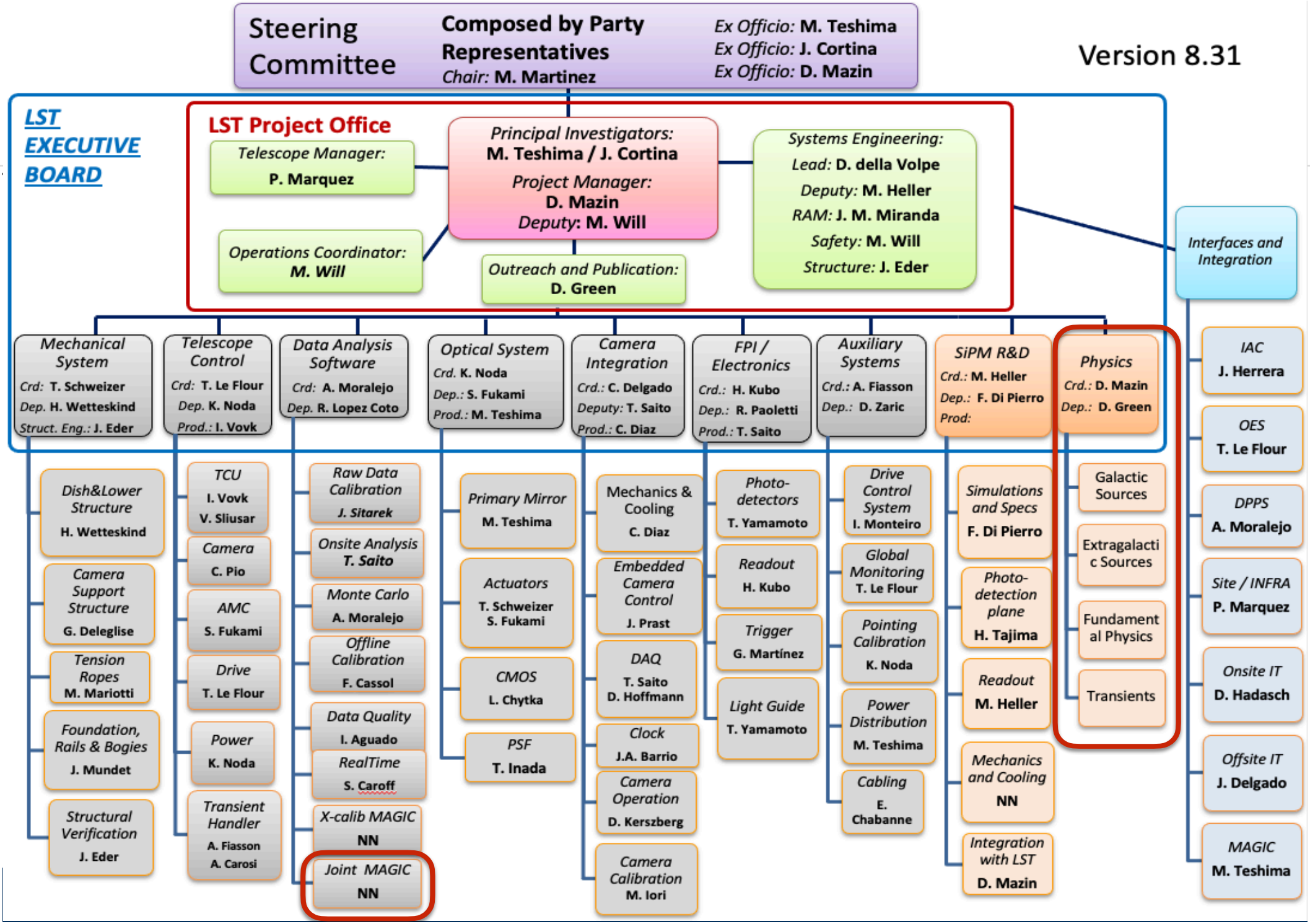
EHT collaboration, K.Asano, D.Mazin et al.

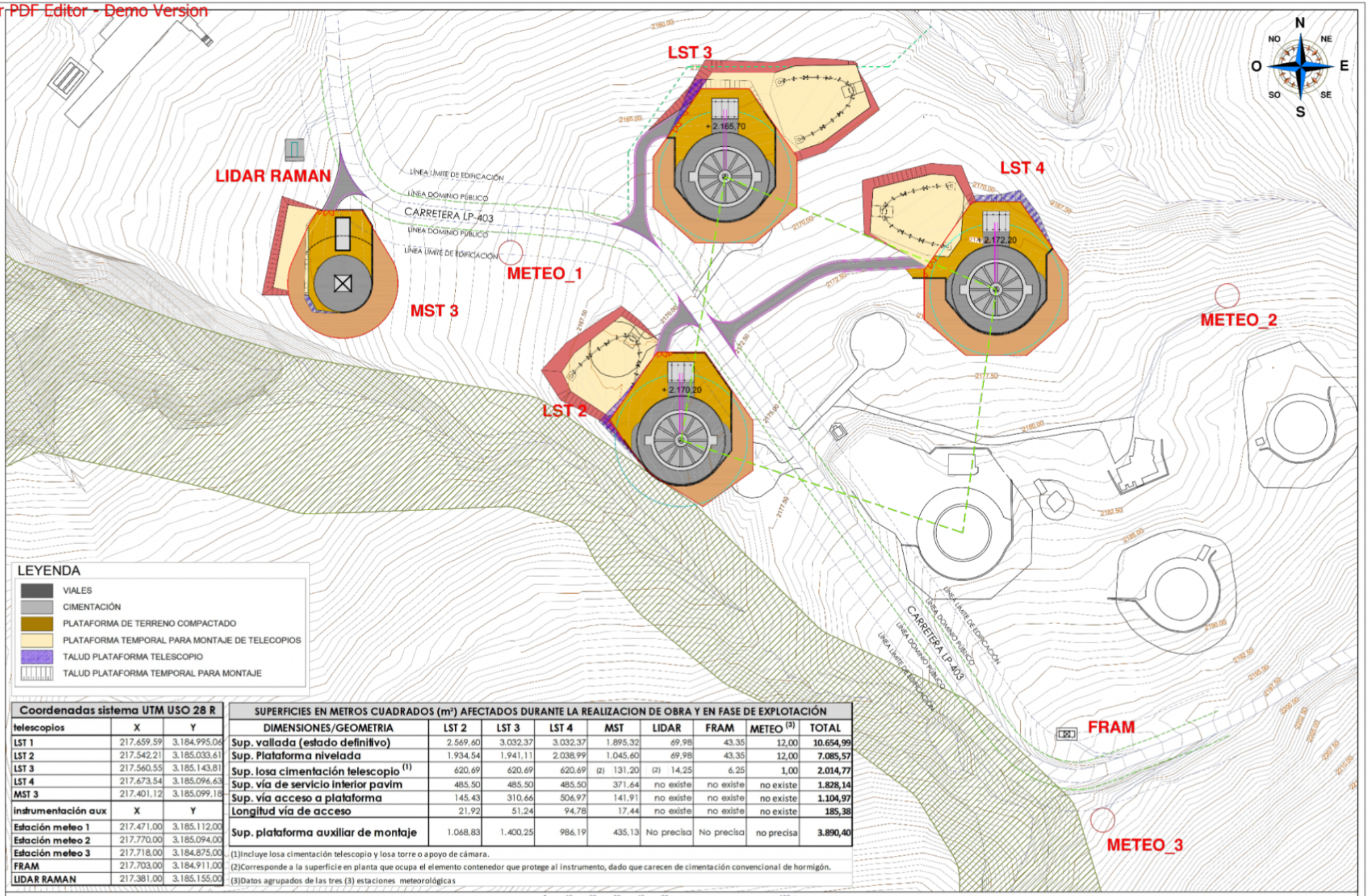









Steering Committee
Composed by Party Representatives
Chair: M. Martinez
Ex Officio: M. Teshima
Ex Officio: J. Cortina
Ex Officio: D. Mazin
Version 8.31
LST EXECUTIVE BOARD
LST Project Office
Telescope Manager: P. Marquez
Principal Investigators: M. Teshima / J. Cortina
Project Manager: D. Mazin
Deputy: M. Will
Operations Coordinator: M. Will
Outreach and Publication: D. Green
Systems Engineering:
Lead: D. della Volpe
Deputy: M. Heller
RAM: J. M. Miranda
Safety: M. Will
Structure: J. Eder
Interfaces and Integration
Mechanical System
Crd: T. Schweizer
Dep. H. Wetteskind
Struct. Eng.: J. Eder
Telescope Control
Crd: T. Le Flour
Dep. K. Noda
Prod.: I. Vovk
Data Analysis Software
Crd: A. Moralejo
Dep. R. Lopez Coto
Optical System
Crd. K. Noda
Dep.: S. Fukami
Prod.: M. Teshima
Camera Integration
Crd.: C. Delgado
Deputy: T. Saito
Prod.: C. Diaz
FPI / Electronics
Crd.: H. Kubo
Dep.: R. Paoletti
Prod.: T. Saito
Auxiliary Systems
Crd.: A. Fiasson
Dep.: D. Zaric
SiPM R&D
Crd.: M. Heller
Dep.: F. Di Pierro
Prod:
Physics
Crd.: D. Mazin
Dep.: D. Green
IAC
J. Herrera
OES
T. Le Flour
DPPS
A. Moralejo
Site / INFRA
P. Marquez
Onsite IT
D. Hadasch
Offsite IT
J. Delgado
MAGIC
M. Teshima
Dish&Lower Structure
H. Wetteskind
Camera Support Structure
G. Deleglise
Tension Ropes
M. Mariotti
Foundation, Rails & Bogies
J. Mundet
Structural Verification
J. Eder
TCU
I. Vovk
V. Sliusar
Camera
C. Pio
AMC
S. Fukami
Drive
T. Le Flour
Power
K. Noda
Transient Handler
A. Fiasson
A. Carosi
Raw Data Calibration
J. Sitarek
Onsite Analysis
T. Saito
Monte Carlo
A. Moralejo
Offline Calibration
F. Cassol
Data Quality
I. Aguado
RealTime
S. Caroff
X-calib MAGIC
NN
Joint MAGIC
NN
Primary Mirror
M. Teshima
Actuators
T. Schweizer
S. Fukami
CMOS
L. Chytka
PSF
T. Inada
Mechanics & Cooling
C. Diaz
Embedded Camera Control
J. Prast
DAQ
T. Saito
D. Hoffmann
Clock
J.A. Barrio
Camera Operation
D. Kerszberg
Camera Calibration
M. Iori
Photo-detectors
T. Yamamoto
Readout
H. Kubo
Trigger
G. Martínez
Light Guide
T. Yamamoto
Drive Control System
I. Monteiro
Global Monitoring
T. Le Flour
Pointing Calibration
K. Noda
Power Distribution
M. Teshima
Cabling
E. Chabanne
Simulations and Specs
F. Di Pierro
Photo-detection plane
H. Tajima
Readout
M. Heller
Mechanics and Cooling
NN
Integration with LST
D. Mazin
Galactic Sources
Extragalactic Sources
Fundamental Physics
Transients



Coordenadas sistema UTM USO 28 R		
telescopios	X	Y
LST 1	217.659,59	3.184.995,06
LST 2	217.542,21	3.185.033,61
LST 3	217.560,55	3.185.143,81
LST 4	217.673,54	3.185.096,63
MST 3	217.401,12	3.185.099,18
instrumentación aux	X	Y
Estación meteo 1	217.471,00	3.185.112,00
Estación meteo 2	217.770,00	3.185.094,00
Estación meteo 3	217.718,00	3.184.875,00
FRAM	217.703,00	3.184.911,00
LIDAR RAMAN	217.381,00	3.185.155,00

SUPERFICIES EN METROS CUADRADOS (m²) AFECTADOS DURANTE LA REALIZACION DE OBRA Y EN FASE DE EXPLOTACIÓN								
DIMENSIONES/GEOMETRIA	LST 2	LST 3	LST 4	MST	LIDAR	FRAM	METEO (3)	TOTAL
Sup. vallada (estado definitivo)	2.569,60	3.032,37	3.032,37	1.895,32	69,98	43,35	12,00	**10.654,99**
Sup. Plataforma nivelada	1.934,54	1.941,11	2.038,99	1.045,60	69,98	43,35	12,00	**7.085,57**
Sup. losa cimentación telescopio (1)	620,69	620,69	620,69	(2) 131,20	(2) 14,25	6,25	1,00	**2.014,77**
Sup. vía de servicio interior pavim	485,50	485,50	485,50	371,64	no existe	no existe	no existe	**1.828,14**
Sup. vía acceso a plataforma	145,43	310,66	506,97	141,91	no existe	no existe	no existe	**1.104,97**
Longitud vía de acceso	21,92	51,24	94,78	17,44	no existe	no existe	no existe	**185,38**
Sup. plataforma auxiliar de montaje	1.068,83	1.400,25	986,19	435,13	No precisa	No precisa	no precisa	**3.890,40**

(1)Incluye losa cimentación telescopio y losa torre o apoyo de cámara.
(2)Corresponde a la superficie en planta que ocupa el elemento contenedor que protege al instrumento, dado que carecen de cimentación convencional de hormigón.
(3)Datos agrupados de las tres (3) estaciones meteorológicas

PLANTA EMPLAZAMIENTO DE TELESCOPIOS E INSTALACIONES AUXILIARES SOBRE CARTOGRAFÍA ESCALA 1:1000

0 10 20 30 40 50 100 m

PROYECTO:
PROYECTO EJECUCIÓN
PROYECTOS DE LOS TELESCOPIOS LST-2, LST-3, LST-4 Y MST-03 E INSTRUMENTACIÓN AUXILIAR DEL CHERENKOV TELESCOPE ARRAY

Unión Europea
Fondo Europeo de desarrollo Regional "Una manera de hacer Europa"
El presente contrato está financiado con cargo al proyecto de "Los cuatro Large Size Telescopes (LST) del CTA-Norte en el ORM" de referencia ESFRI-2017-IAC-12 del Ministerio de Ciencia, Innovación y Universidades, co-financiado en un 85% con fondos Europeos de Desarrollo Regional (FEDER) del Programa Operativo de Crecimiento Inteligente 2014-2020. El mencionado proyecto está co-financiado por el Gobierno de Canarias, a través de la Consejería de Economía, Industria, Comercio y Conocimiento.
Gobierno de Canarias
Consejería de Economía, Industria, Comercio y Conocimiento
GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

AUTOR DEL PROYECTO: **UTE-LST**

PLANO: **PLANTA EMPLAZAMIENTO DE TELESCOPIOS E INSTALACIONES AUXILIARES SOBRE CARTOGRAFÍA**

FASE	VERSIÓN	ESCALA:	FECHA:
P	1	1/1000	ABRIL 2021
R			PLANO Nº:
A		CODIGO:	5
C			

Large Size Telescope

Mirrors: JP
Interface plates: JP, DE, BR
Actuators: JP, CH
CMOS: JP

Tension cables: IT

Camera Support Structure: FR

calibration: IT, HR, IN, DE

Camera electronics: JP, IT, ES
Camera mechanics: ES
Camera safety: FR

Telescope structure: DE

Rail: DE

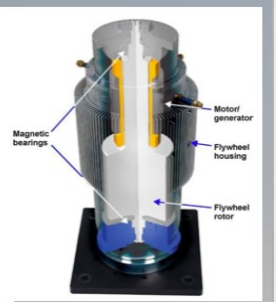
Camera Access Tower: DE, ES

Bogies: ES

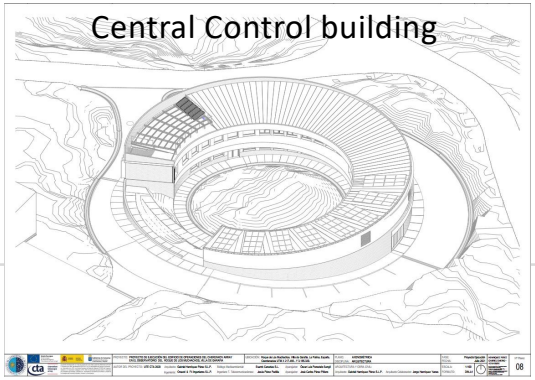
Foundation: ES

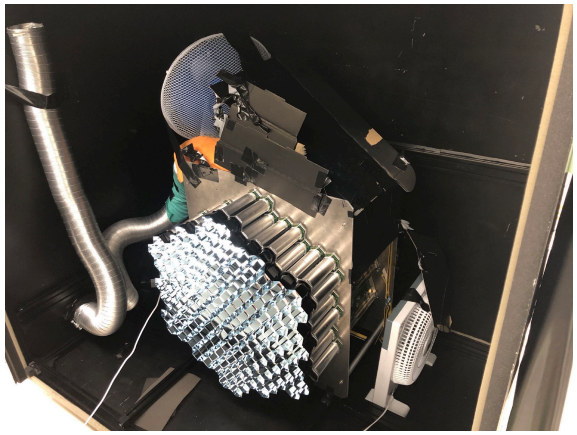
Drive and main el. cabinet: FR

FlyWheels (2x300kW) energy storage and UPS: JP

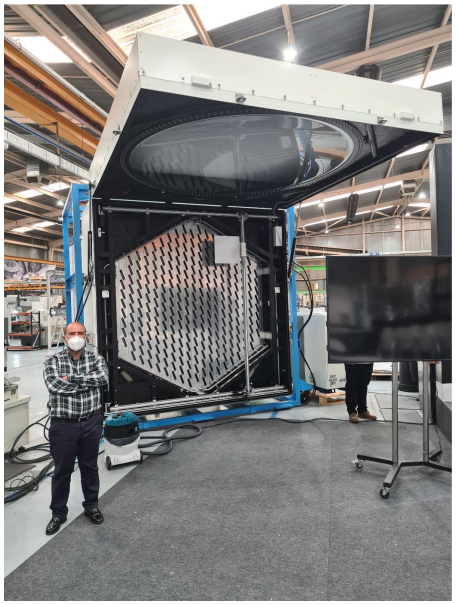


LST2-4

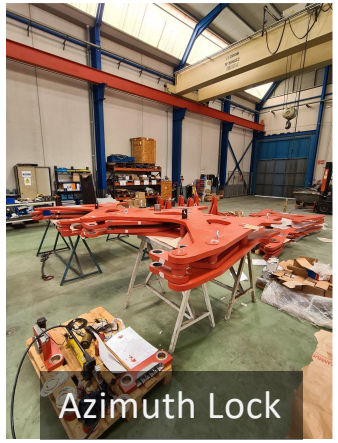


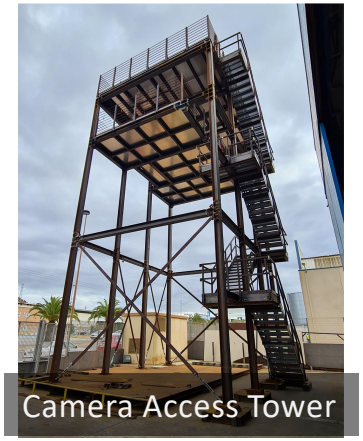


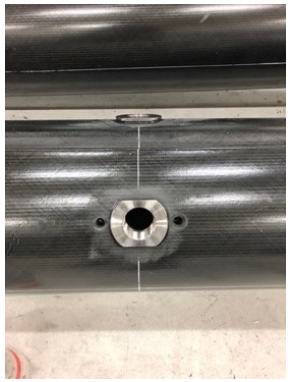
QC of PMT clusters
at IAC Tenerife, T.Saito et al.

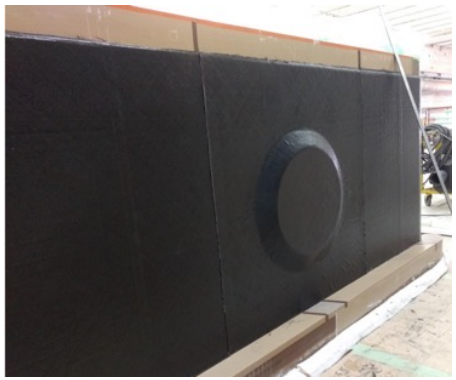


Camera production
at Arquimea, Madrid

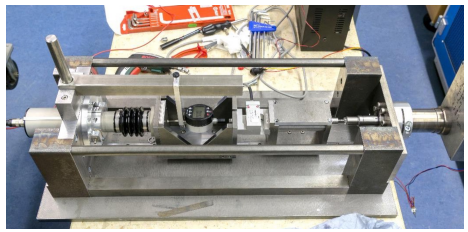




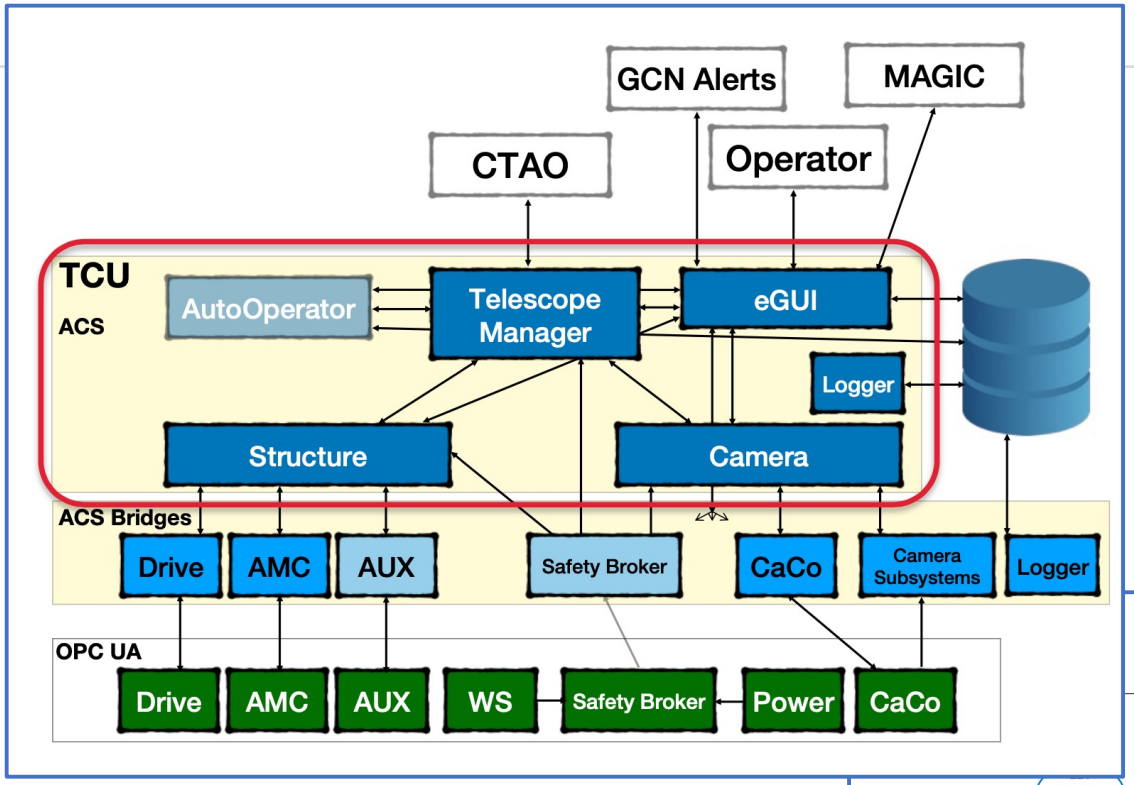




Camera Supporting Structure
at Annecy France

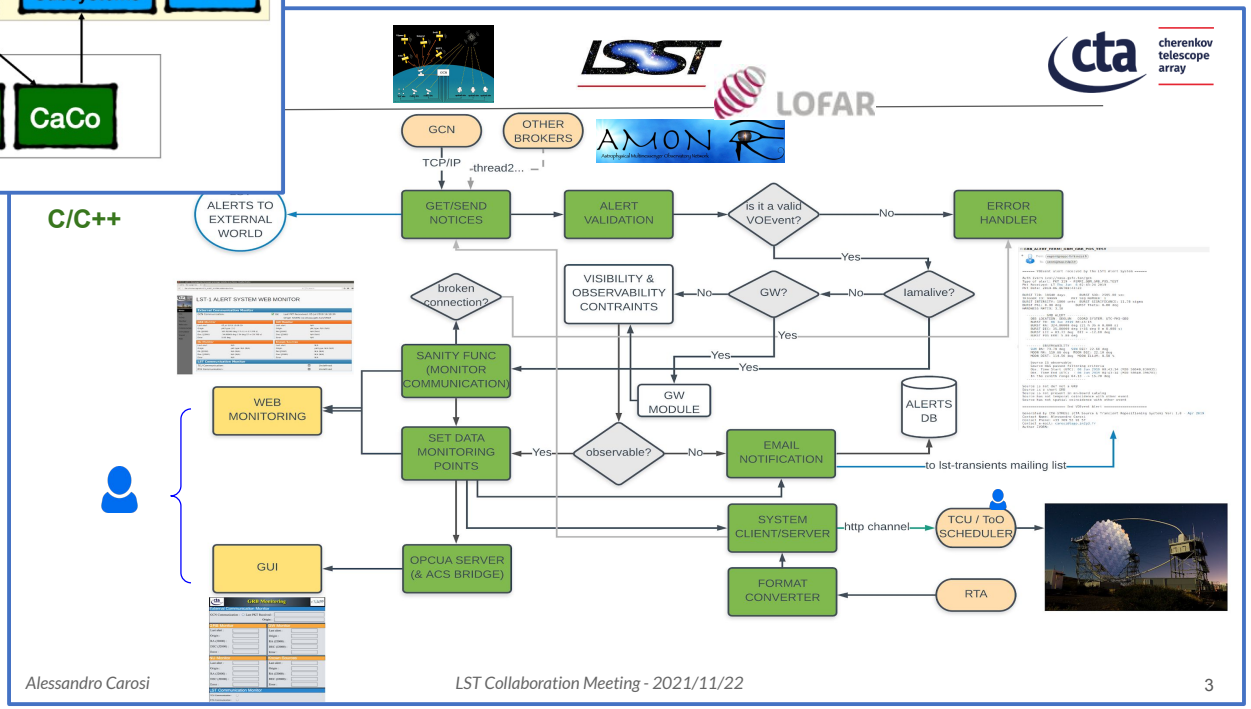


Telescope Control



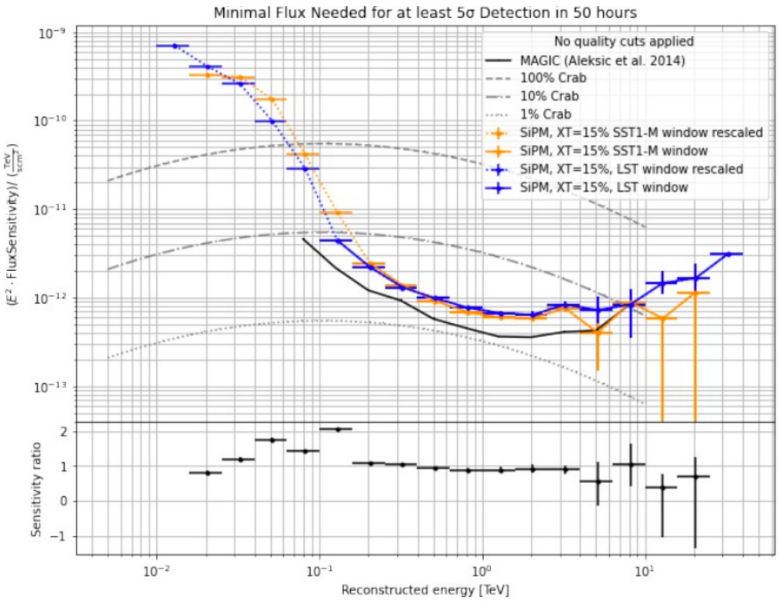
TCU (I.Vovk et al)

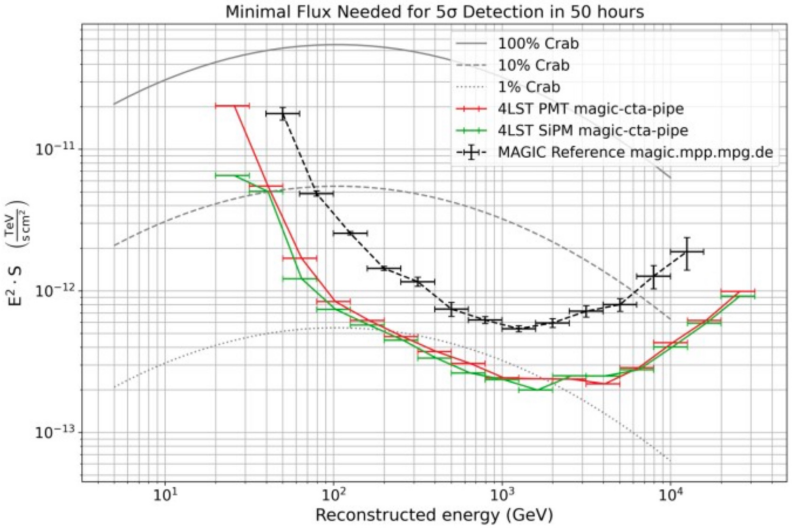
Transient Handler by Alessandro

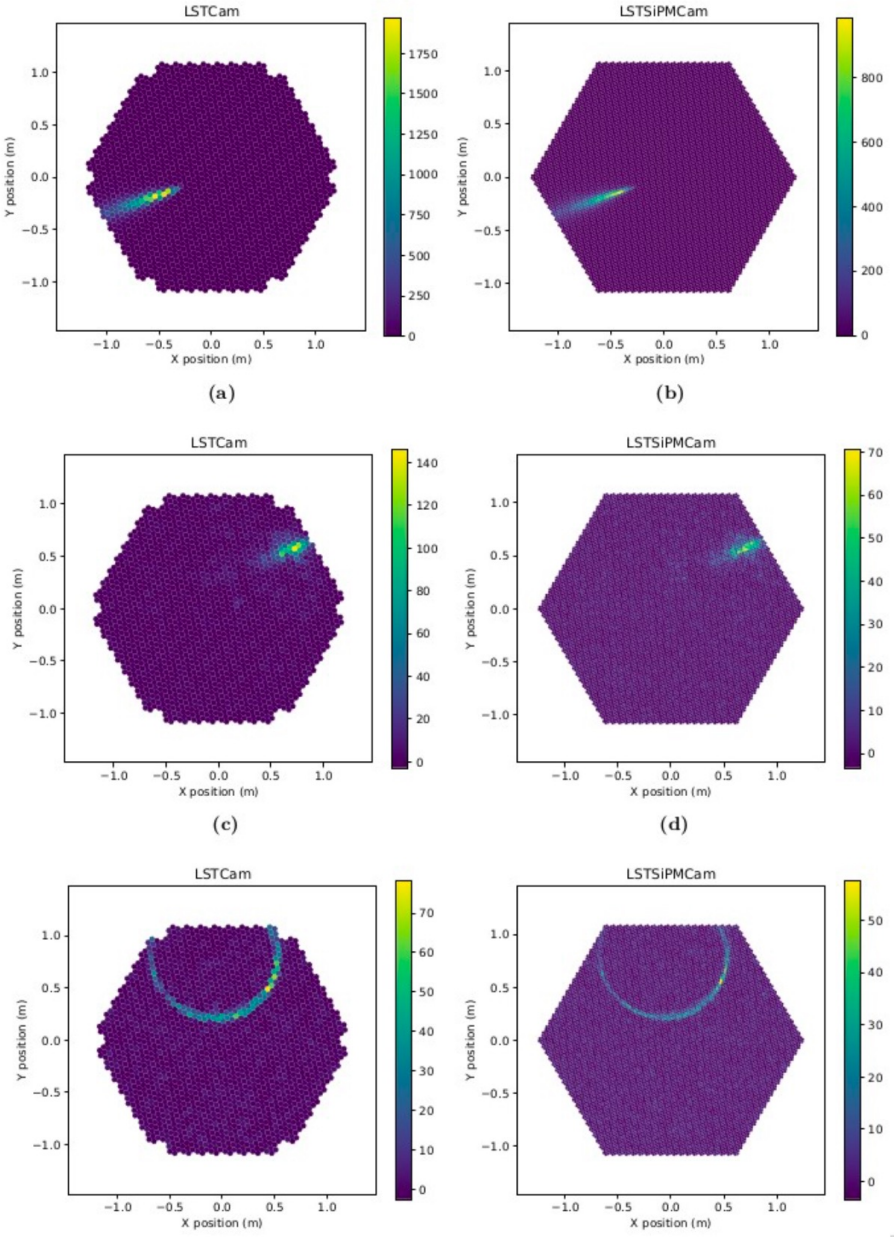


Development of SiPM camera, EU-Call INFRA-TECH

Federico's talk







CTA and LST Timeline

- 2016-2018 LST1 was constructed
- 2018-2021 LST1 in commissioning phase
- 2022-2024 LST2-4 will be constructed, and we need to take care operation and maintenance of LSTs
  LST1 can be defined in Science-Engineering Phase after commissioning
- 2022 CTAO ERIC will be founded
- 2026-2027 The final Acceptance of LST1-LST4 and IKC process
- 2023-2025 LST5-8 construction?

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Organization	CTAO gGmbH (Heidelberg)										
			CTAO ERIC (European Research Infrastructure Consortium)								
Alpha Config	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
LST North	Comissioning and Operation of LST1					Operation as 4 LST Array				Observatory Operation	
	CDR		Deployment of LST2-4								
MST North	Design and Finance		INFRA	Construction of 9MSTs							
CTA South	Array config, Finance and CDR		INFRA		Construction and Deplyment of 14 MSTs						
					Construction and Deployment of 37 SSTs						
Extension	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
LST South		Finance / CDR		Construction of 4 LSTs ???			Operation ???				

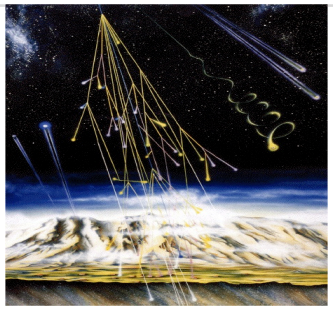
Next 3 - 4 years

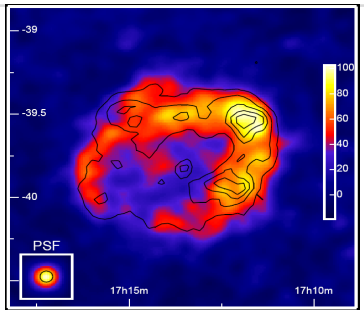
- Soon we will become very busy
  - 2022-2025 Construction of LST2-4
  - 2022-2025 Science and Engineering run with LST1
  - 2022-2025 Steps of acceptance process of LST1
  - 2022-2026 INFRA-TECH, R&D for LST south, prototyping and funding
  - 2023-2025 Construction of the LST5-8 ???

- After 3-4 years
  - 2025-2026 Commissioning of the four LST Array
  - 2026-2027 Acceptance and IKC process of the four LST Array

Science of CTA is very wide

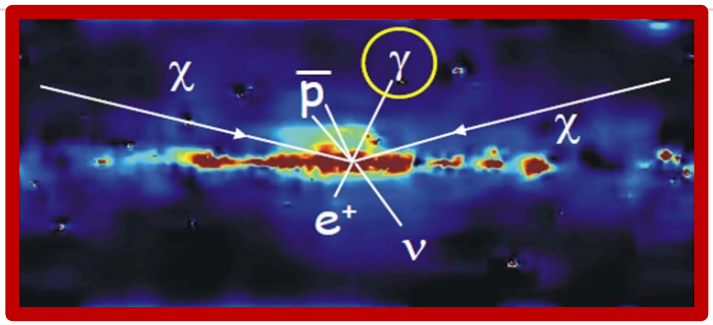
CTA-LST will cover S.M.B.H., Dark Matter, AGNs, GRBs





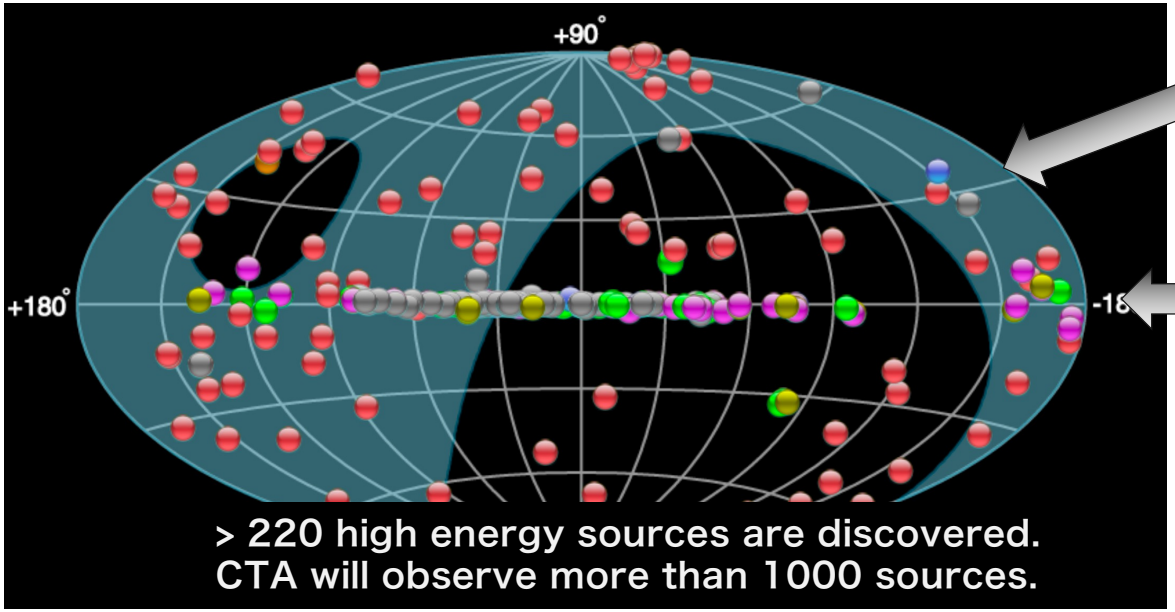
Cosmic Ray Origin

Super Massive Black Holes



Dark Matter Search (Discovery)

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

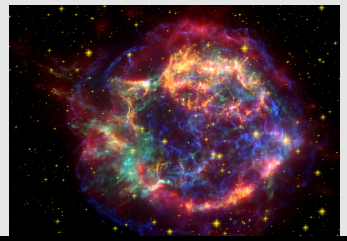


Extragalactic Sources

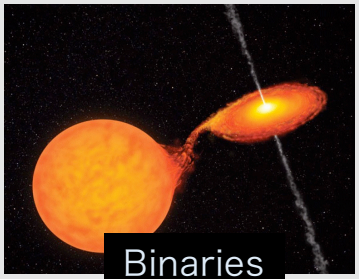
Active Galactic Nuclei

Gamma Ray Bursts

Galactic Sources



Super Nova Remnants



Binaries

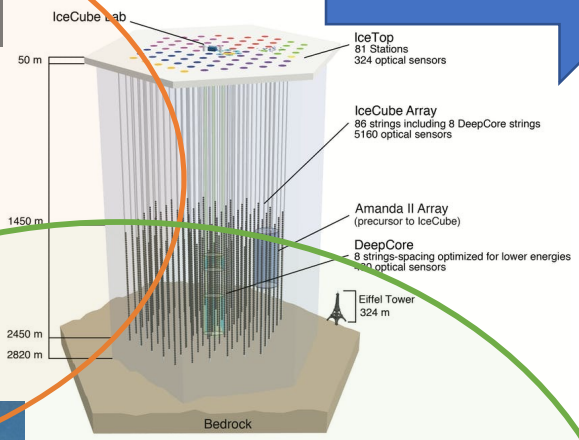
Multi-messenger and Multi-wavelength Astrophysics

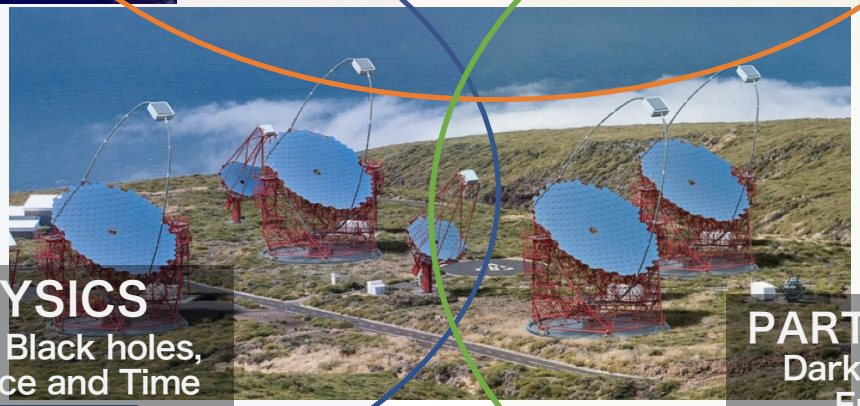
cherenkov telescope array

Wave AstroPhysics

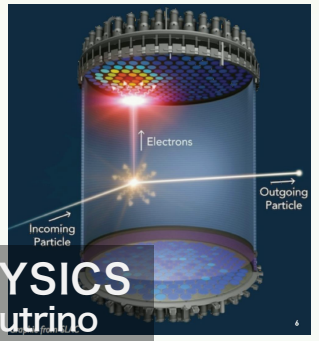
Particle Physics

ASTRO-PARTICLE PHYSICS
Cosmic Ray Physics
High Energy Astrophysics





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



PARTICLE PHYSICS
Dark Matter, Neutrino
Energy Frontier

Summary

- LST1 commissioning ➔ Science and Engineering operation
- LST1 Mono Sensitivity is close to MAGIC in factor two
- LST1+MAGIC joint observation shows high quality data.
  - In 2022 (Cycle-17), we expect 500hrs of joint observation
- 20GeV Threshold Energy is confirmed in BL Lac flare observation
- 10 sources are detected with LST1
- Now we are recovering from the volcano eruption
- LST2-4 construction is ready
  - Construction License from the local government acquired in December 2021
  - Tendering of the Civil work is on-going.
- LST5-8 construction is on Discussion

- **引き続き支援をよろしくお願いします。**

cherenkov telescope array

Thank you very much


cta
cherenkov
telescope
array