



MAGIC
Major Atmospheric
Gamma-Ray Imaging
Cherenkov Telescopes

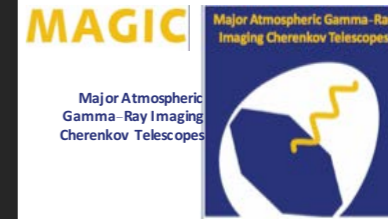
Major Atmospheric Gamma-Ray
Imaging Cherenkov Telescopes

cta
cherenkov telescope array



Consiglio di Sezione:
preventivi 2019, 9 luglio 2018

Mosè Mariotti
INFN Sezione Di Padova



Sommario

MAGIC status

- Attività 2018
- Attività 2019

CTA status (in particolare LST)

- Attività 2018
- Attività 2019

Richieste finanziarie ed ai servizi di Sezione

Padova CTA/MAGIC group (2018- 2019)

Magic = 9 firme, CTA = 14 firme Tot_FTE = 9 + 2 grant post doc già assegnati

Mose' Mariotti
group leader



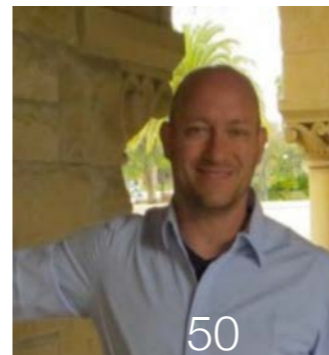
Alessandro de Angelis INFN dir. of research



Michele Doro
RTDB



Eugenio Bottacini
RTDB



Elisa Prandini
Ass. Senior



Riccardo Rando
Ricercatore conf.



Manuela Mallamaci
postdoc



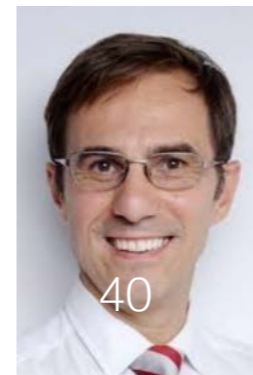
Ruben Lopez
postdoc INFN stranieri



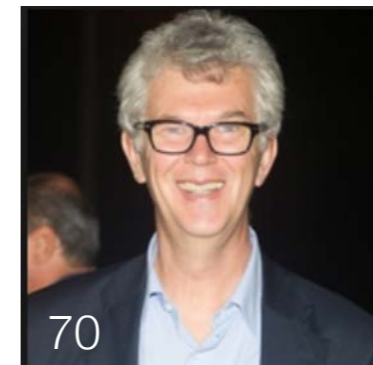
Simona Paiano
Assegno Astro



Denis Bastieri
Prof. Associato



Giovanni Busetto
Prof. Ordinario



Giampiero Naletto
Prof. Associato



2 Post Docs
"Bernardini e Doro"



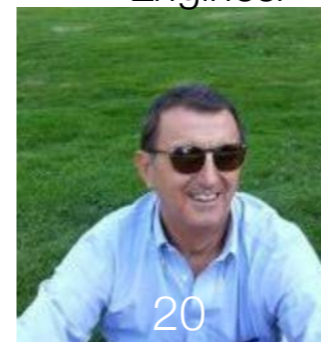
Luca Foffano
PhD student



Elisa bernardini
PA



Adriano Pepato
Engineer



Sandro Ventura
Ricercatore INFN



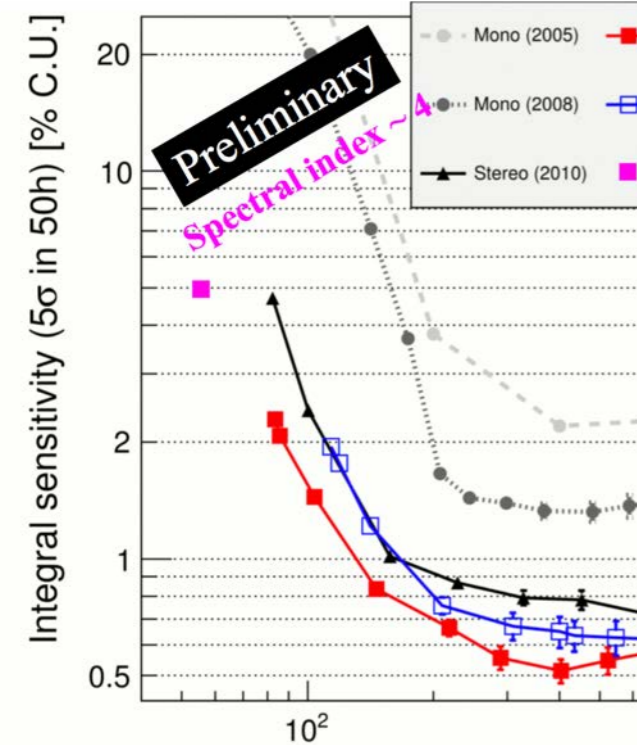
Daniele Corti
Electronic Engineer



Technical supporters

MAGIC is alive!

Buon 15-esimo
compleanno!



- From 1-telescope to 2-telescope
- Novel SUM-TRIGGER concept
- 30 GeV

4-fold improvement in sensitivity
→ ~10-fold improvement



PhD Thesis

- o Cornelia Schultz "Development of a new trigger system for MAGIC-2, 2013;
- o Francesco Dazzi "A new trigger system for MAGIC-2, 2013;
- o Elisa Prandini "TeV observations with MAGIC-2, 2013;
- o Saverio Lombardi "Development of a new trigger system for MAGIC-2, 2013;
- o Michele Doro "Novel Reflector for MAGIC-2, 2013;
- o Villi Scalzotto "Development of a new trigger system for MAGIC-2, 2013;

Master Thesis

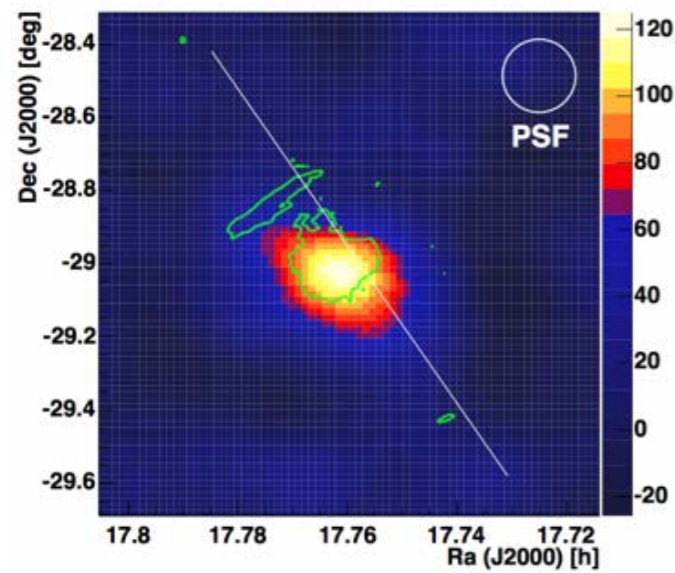
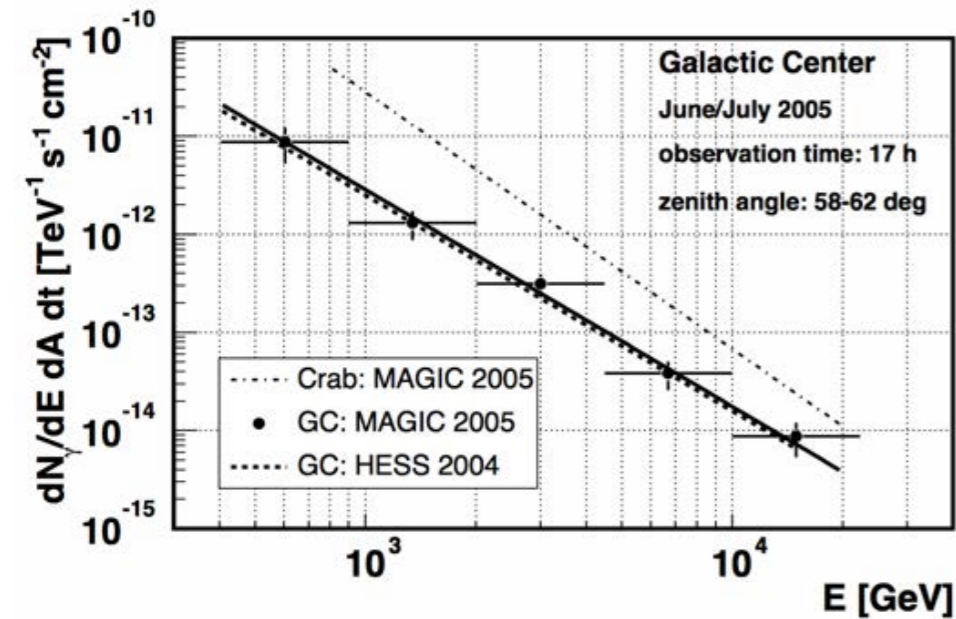
- o Giampietro Gumiero "Analysis of the MAGIC-2 data, 2013;
- o Simona Paiano "Ricerche sperimentali sul sistema di trigger di MAGIC-2, 2013;
- o Alessandro Venturini, "Indagini sul sistema di trigger di MAGIC-2, 2013;
- o Fabio Zandanel "Dark Matter search with MAGIC-2, 2013;
- o Saverio Lombardi "Studio di un nuovo sistema di trigger per MAGIC-2, 2013;
- o Valeria Scapin "Osservazioni di MAGIC-2, 2013;
- o Roberta Zanin "Osservazioni di MAGIC-2, 2013;
- o Elisa Prandini "Osservazioni di MAGIC-2, 2013;
- o Diego Tesaro "Informazioni sul sistema di trigger di MAGIC-2, 2013;
- o Michele Doro "The Commissioning of MAGIC-2, 2013;
- o Giorgia Rossato "Studio di un nuovo sistema di trigger per MAGIC-2, 2013;
- o Villi Scalzotto "Il principio di funzionamento di MAGIC-2, 2013;
- o Nicola Galante "Il telescopio MAGIC-2, 2013;
- o Nadia Tonello "Misure ottiche di MAGIC-2, 2013;
- o Francesco Dazzi "Realizzazione di un nuovo sistema di trigger per MAGIC-2, 2013;

Diploma Thesis

- o Stefano Protti, "Calcolo della sensibilità di MAGIC-2, 2013;
- o Alice Borghese "Stima della sensibilità di MAGIC-2, 2013;
- o Stefano Vecchio "Studio di un nuovo sistema di trigger per MAGIC-2, 2013;
- o Francesco Valentino "Studio di un nuovo sistema di trigger per MAGIC-2, 2013;
- o Marco Drago "Studi sulla sensibilità di MAGIC-2, 2013;
- o Alessandra Abano "Studio di un nuovo sistema di trigger per MAGIC-2, 2013;

Salto di Quailità

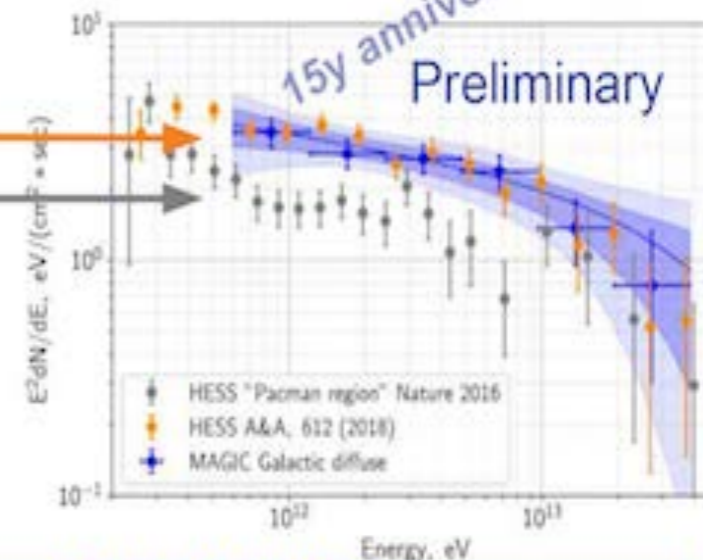
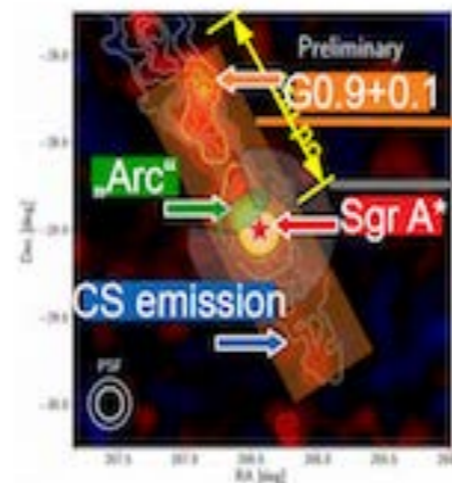
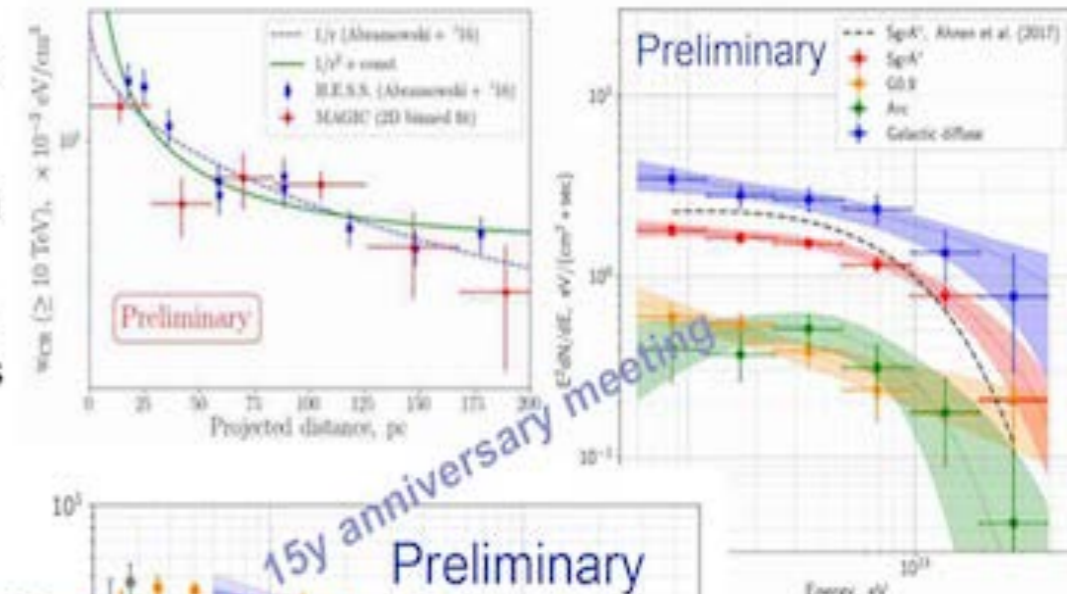
2018



2006

Galactic Center (diffuse emission)

- Complicated region containing point-sources and ext./diffuse emission
- By now collected 100 h (until 2017) and aiming for 50 h +
- Working on paper on 100 h
- Testing Pevatron hypothesis (cut-off?, profile)



Christian Fruck,
Ievgen Vovk,
Yuki Iwamura,
Marcel Strzys

Salto di Qualità

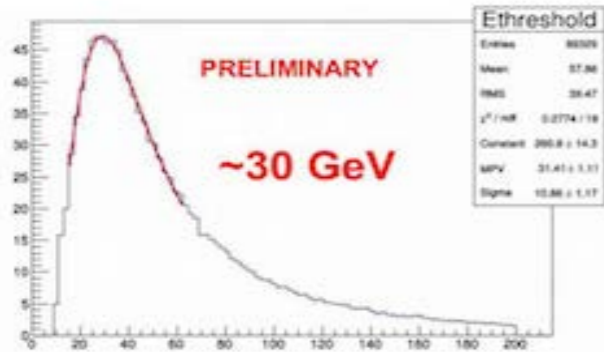
Sum Trigger performance

- Energy threshold now ~30 GeV
- Crab Nebula SED starting at 33 GeV



J. R. Garcia,
G. Ceribella,
M. Lopez,
T. Saito,
T. Schweizer

15y anniversary meeting



C. Fruck et al. Report from the Gal. PWG La Palma, Tue. 26.06.2018

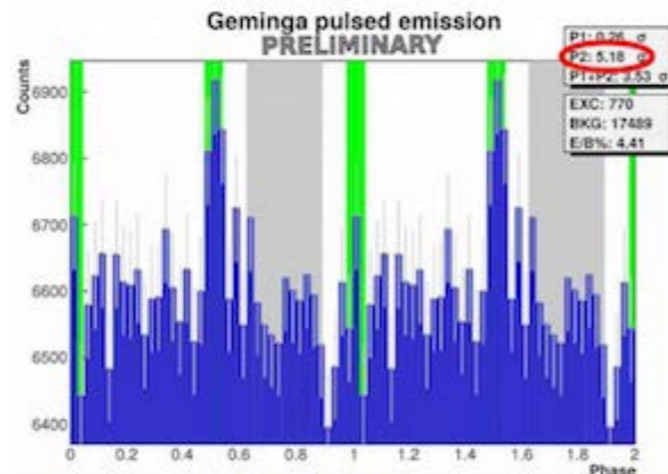
Geminga

- Third pulsar detected in VHE
- Possible due to application of MAGIC Sum Trigger
- Threshold for index -3: ~35 GeV
- Data from C12 and C13
- 5 sigma det. Form 30 h in C12
- Problems with C13 data set



J. R. Garcia,
G. Ceribella,
M. Lopez,
T. Saito,
T. Schweizer

15y anniversary meeting



C. Fruck et al. Report from the Gal. PWG La Palma, Tue. 26.06.2018 12

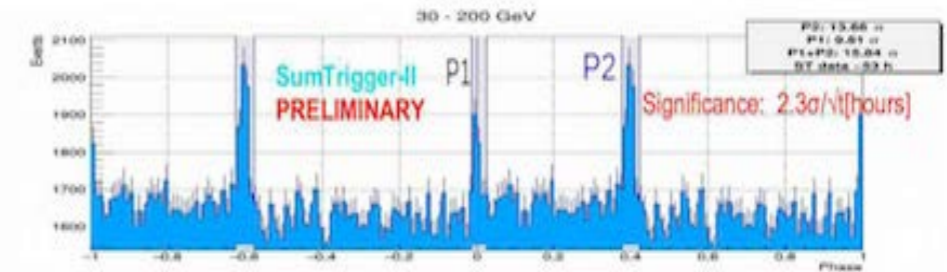
Crab Pulsar

- Substantial improvement in sign./sqrt(t) compared to standard trigger

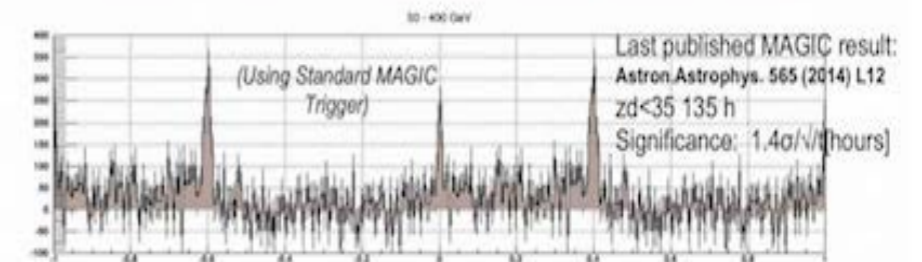


J. R. Garcia,
G. Ceribella,
M. Lopez,
T. Saito,
T. Schweizer

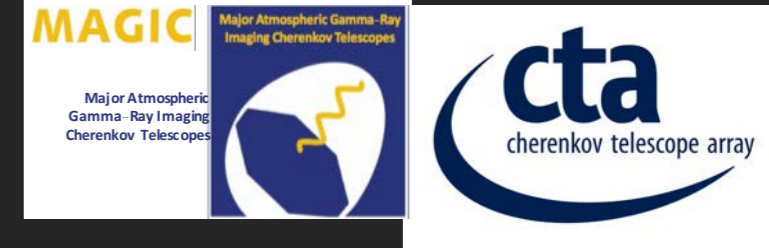
15y anniversary meeting



Fruck et al. Report from the Gal. PWG La Palma, Tue. 26.06.2018 14



Scienza a Padova



Fundamental Physics

Dark Matter and Fundamental Physics with the Cherenkov Telescope Array

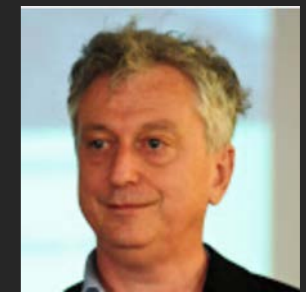
CTA Consortium Collaboration (M. Doro (Barcelona, Autonoma U.) *et al.*). Aug 2012. 31 pp.
Published in *Astropart.Phys.* **43** (2013) 189-214

A decade of dark matter searches with ground-based Cherenkov telescopes

Michele Doro (Padua U. & INFN, Padua & Barcelona, Autonoma U.). Apr 20, 2014.
Published in *Nucl.Instrum.Meth.* **A742** (2014) 99-106

Searches for Dark Matter signatures in the Segue 1 dwarf spheroidal galaxy with the MAGIC-I telescope

MAGIC Collaboration (S. Paiano *et al.*). Oct 2011.
e-Print: [arXiv:1110.6775](https://arxiv.org/abs/1110.6775) [astro-ph.HE] | [PDF](#)



... and others, including several thesis works

AGN and cosmology

Constraining blazars distances with combined GeV and TeV data

E. Prandini, M. Mariotti, F. Tavecchio. Nov 2011.
e-Print: [arXiv:1111.0913](https://arxiv.org/abs/1111.0913) [astro-ph.HE] | [PDF](#)

Estimating the redshift of PKS 0447-439 through its GeV-TeV emission

Elisa Prandini, Giacomo Bonnoli, Fabrizio Tavecchio. Oct 2011. 5 pp.
Published in *Astron.Astrophys.* **543** (2012) A111

TeV observations of blazars and constraints on their redshifts: a detailed study of PG 1553+113 and PKS 1424+240 with MAGIC

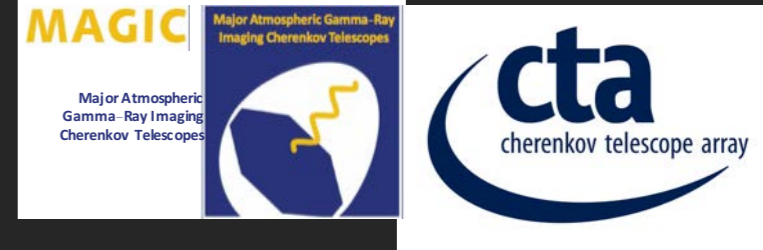
Elisa Prandini (Padua U.). 2011.



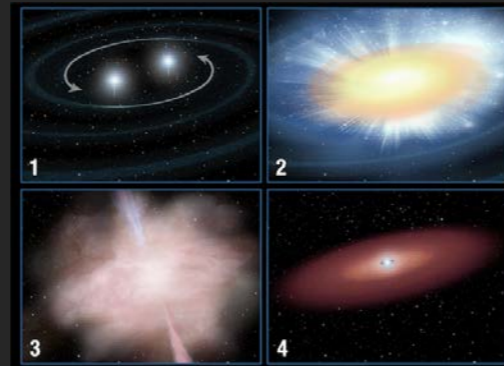
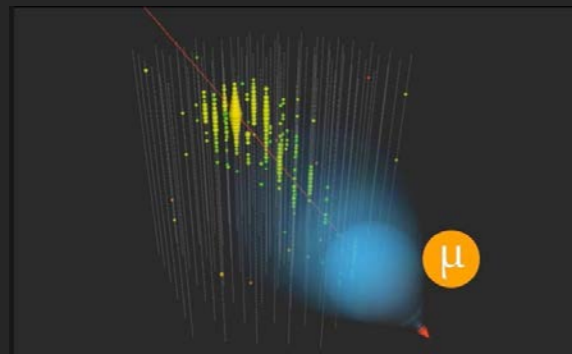
CONVENOR

... and others, including several thesis works

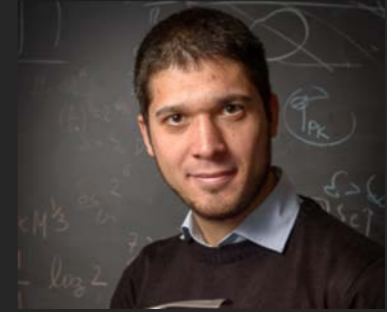
Scienza a Padova



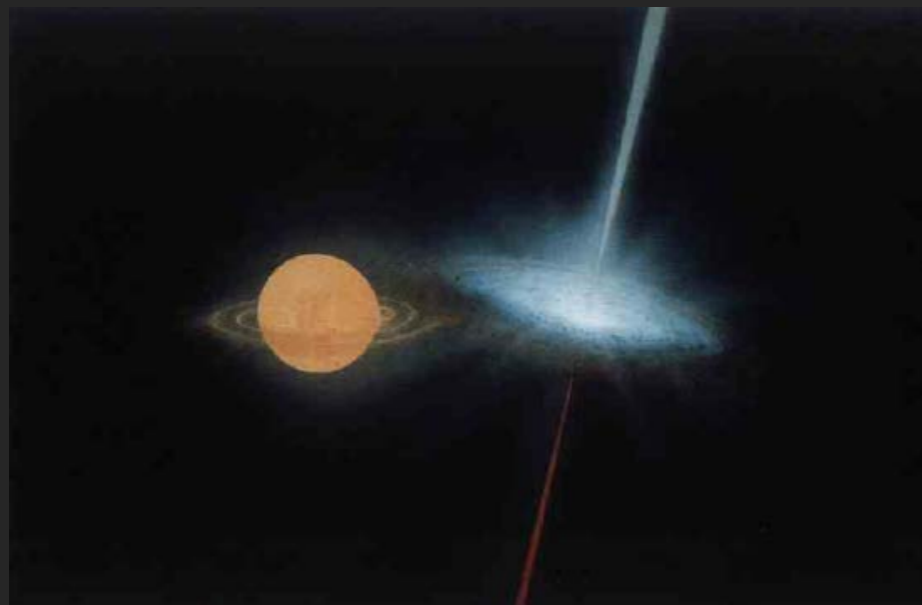
Transients:
neutrino, GRB, GW



Neutrino
PI



Galactic



NEW
CONVENOR

Follow up of the neutrino event

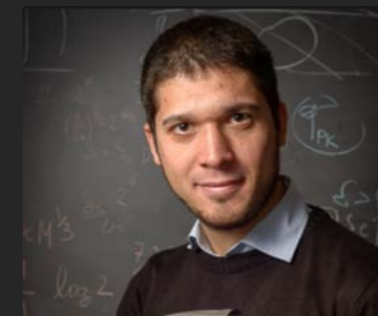
La nascita della “multi messenger” Astronomy



Analysis supervisor



PI



main analyzer

[[Previous](#) | [Next](#) | [ADS](#)]

First-time detection of VHE gamma rays by MAGIC from a direction consistent with the recent EHE neutrino event IceCube-170922A

ATel #10817; *Razmik Mirzoyan for the MAGIC Collaboration*
on 4 Oct 2017; 17:17 UT
Credential Certification: Razmik Mirzoyan (Razmik.Mirzoyan@mpp.mpg.de)

Subjects: Optical, Gamma Ray, >GeV, TeV, VHE, UHE, Neutrinos, AGN, Blazar

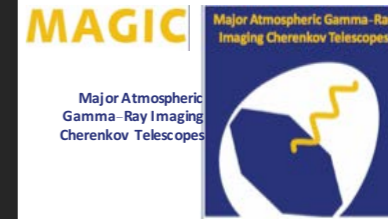
Referred to by ATel #: [10830](#), [10833](#), [10838](#), [10840](#), [10844](#), [10845](#), [10942](#)

[Tweet](#) [Recommend 448](#)

After the IceCube neutrino event EHE 170922A detected on 22/09/2017 (GCN circular #21916), Fermi-LAT measured enhanced gamma-ray emission from the blazar TXS 0506+056 (05 09 25.96370, +05 41 35.3279 (J2000), [Lani et al., Astron. J., 139, 1695-1712 (2010)]), located 6 arcmin from the EHE 170922A estimated direction (ATel #10791). MAGIC observed this source under good weather conditions and a 5 sigma detection above 100 GeV was achieved after 12 h of observations from September 28th till October 3rd. This is the first time that VHE gamma rays are measured from a direction consistent with a detected neutrino event. Several follow up observations from other observatories have been reported in ATels: #10773, #10787, #10791, #10792, #10794, #10799, #10801, GCN: #21941, #21930, #21924, #21923, #21917, #21916. The MAGIC contact persons for these observations are R. Mirzoyan (Razmik.Mirzoyan@mpp.mpg.de) E. Bernardini (elisa.bernardini@desy.de), K.Satalecka (konstancja.satalecka@desy.de). MAGIC is a system of two 17m-diameter Imaging Atmospheric Cherenkov Telescopes located at the Observatory Roque de los Muchachos on the Canary island La Palma, Spain, and designed to perform gamma-ray astronomy in the energy range from 50 GeV to greater than 50 TeV.

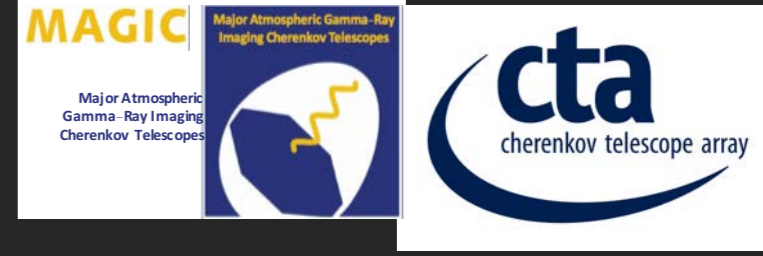
Press release for the official announcement in a Science paper in preparation.
Under embargo until July 12

Conferenza stampa in streaming (Washington 11 luglio 11:00 ET) :



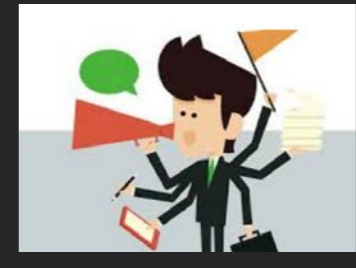
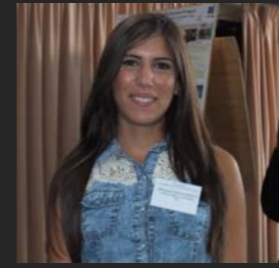
Attività 2019 MAGIC

Attività 2019



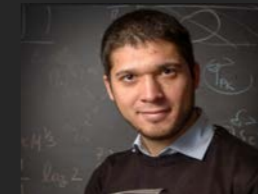
Presenza Dati

- 2+1 turni di presa dati

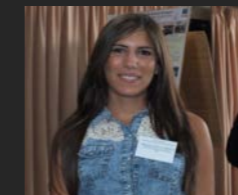
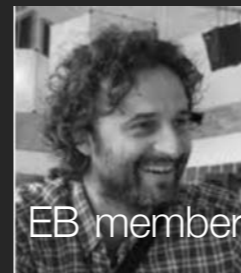


Analisi dati partecipazione ai Gruppi scientifici

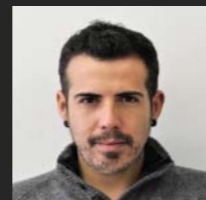
- AGN Physics working group



- Astroparticle and fundamental



- Galactic



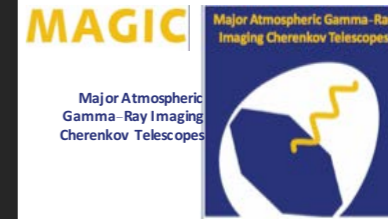
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Manutenzione telescopio

Specchi

Elettronica





Attività 2018 LST



cherenkov
telescope
array



Istituto Nazionale di Fisica Nucleare

STATUS AND SCHEDULE OF THE CSS TENSIONING CABLES

A. PEPATO, M. ROMANATO

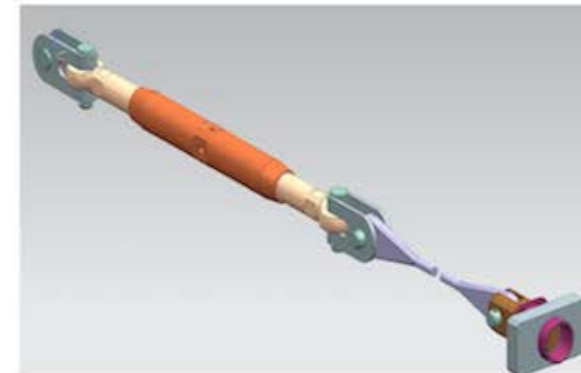


• Status of the metallic components production.

- A first batch of the metallic components of the CF rope, to be integrated in the Arch structure has been delivered to La Palma and integrated at LORIMA.
- The remaining parts (DUPLEX Mat.) have been completed at FF premises in Sri Lanka and delivered to La Palma



Metallic components of the CF rope.



SOUTHERN SPARS INTERNATIONAL (PVT) LTD
 DEPT Lot 11, Phase 1
 Waligama, Maldives
 Sri Lanka
 Tel: 96 11240573
 Fax: 96 11240575

COMMERCIAL INVOICE Invoice Number: INV-00000001

Customer: Eduardo Contreras, eduardo@infm.com, Contact: Palle, Loredana	Customer Agent (only valid): Contact: Palle, Loredana	Date:	05/05/2018
Name: Instituto de Astrofísica de Canarias	Agencia Costanera	POB:	REYKJAVIK
Address: C/PO-400000000, Observatorio del Roque de los Muchachos	SI-17000, 36-140	Shipping Terms:	GAP
City/Country: P.O. Box 30, 38750, Izaña, La Palma, Islas Canarias	38750, Santa Cruz de La Palma	Payment Terms:	Net 60
Country: Spain	La Palma, Canary Islands	Customer #:	000000
Phone: 000000000000000	Spain	Method of Ship:	SEA
Fax: 000000000000000		Currency:	EUR

THE PRODUCTS LISTED ON THIS INVOICE ORIGINATED IN SRI LANKA

Quantity	Description	Unit	List Price	Total
120	Carbon Fiber Ropes & Accessories	PCS	117.50	14100.00
				14100.00
				0.00
				0.00
				14100.00

Some components of the CF rope had to be machined at INFN PD Mechanical Workshop:

- all pins have been delivered to LAPP and should be already in La Palma;
- The CTA04 series are under completion @INFN PD MW and will be delivered to La Palma on W22

07/05/18



LST Engineering Meeting



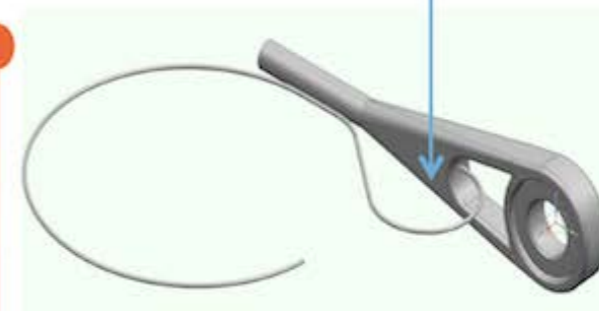
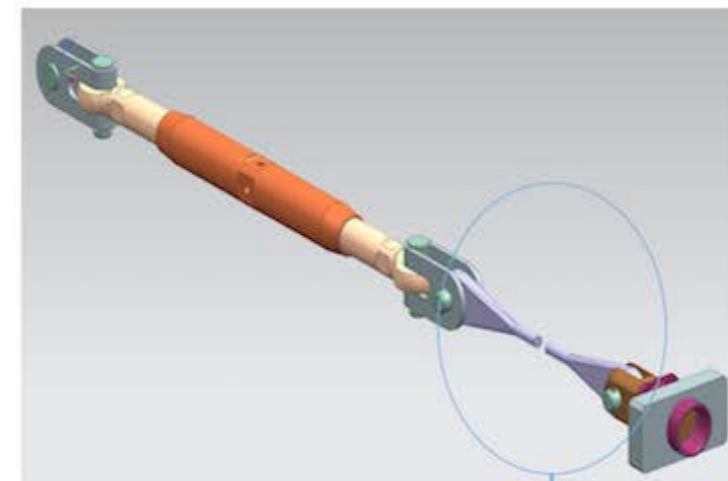
3

Status of the Carbon Fibre Cables production.

- Seventeen of about 26 cables have been completed and certified @FF premises in SL
- There was a problem on the quality of some of the optical fiber sensors so FF had to wait for a new supply.
- The remaining 9 cables under under completion and certification.
- The proposed delivery schedule is reported below.
- A detailed report on production and testing has been distributed.



Carbon Fibre Cables production.

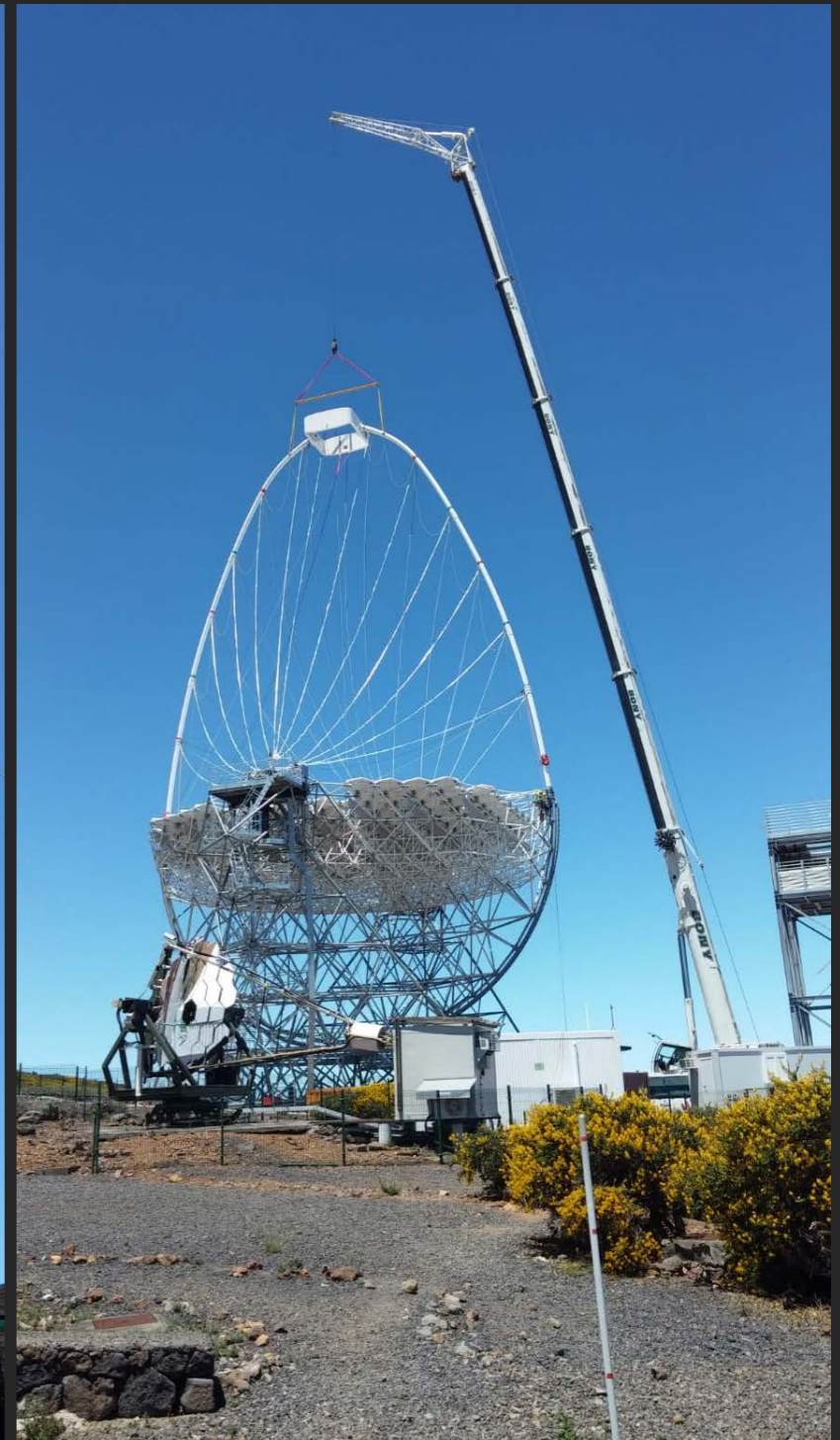
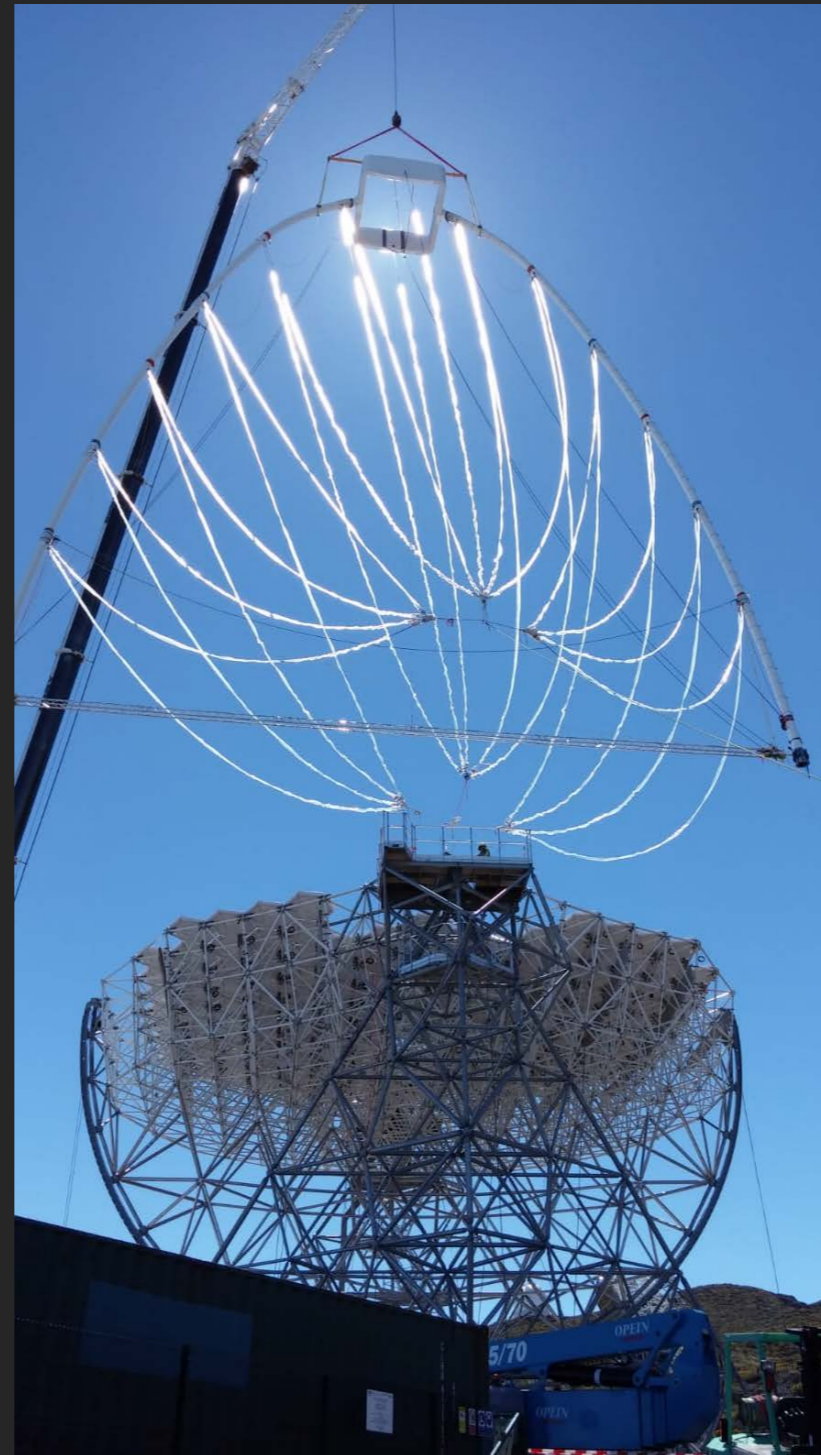


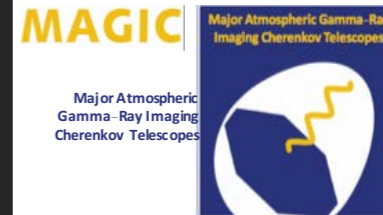
Endrope with optical fibre routing.

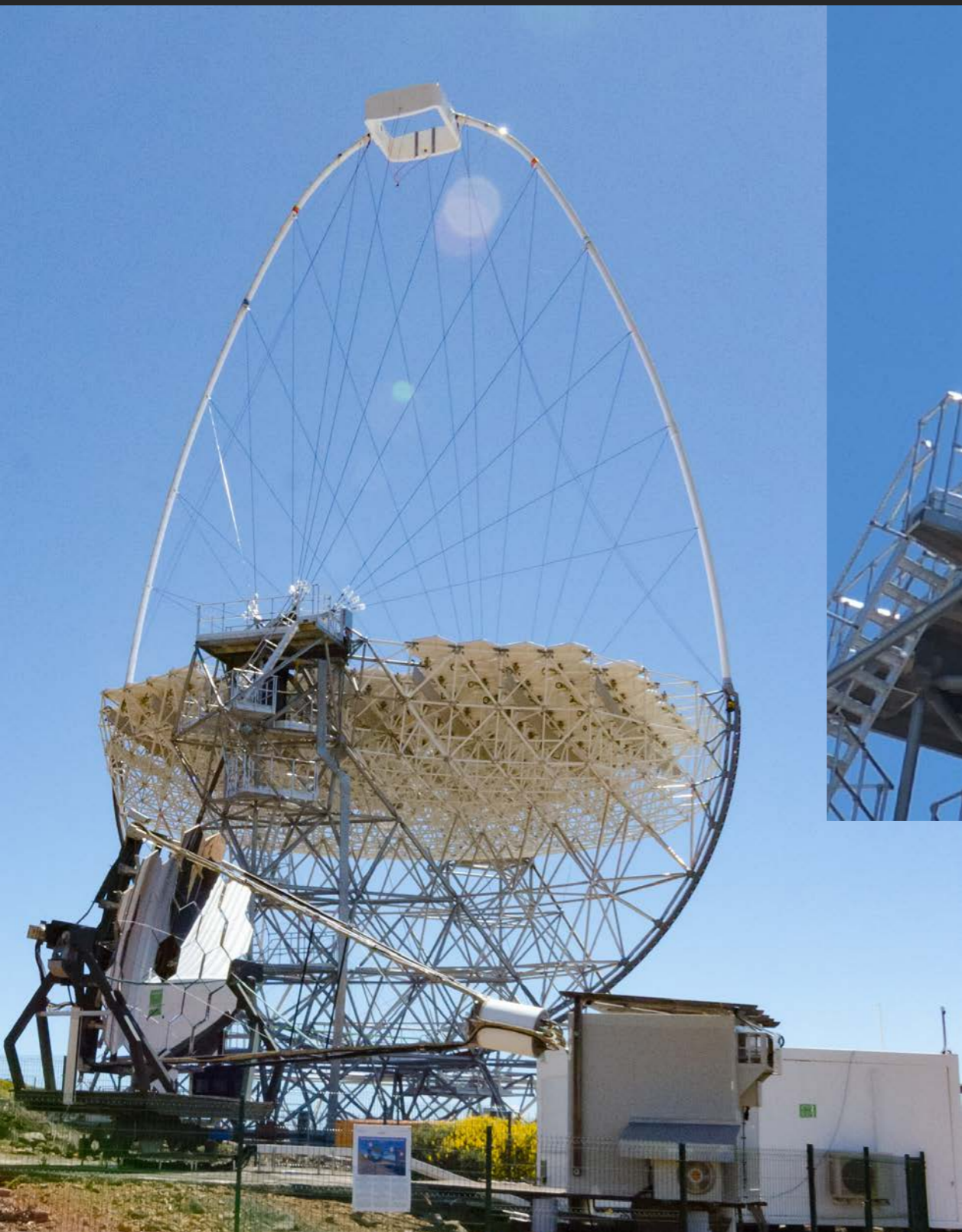
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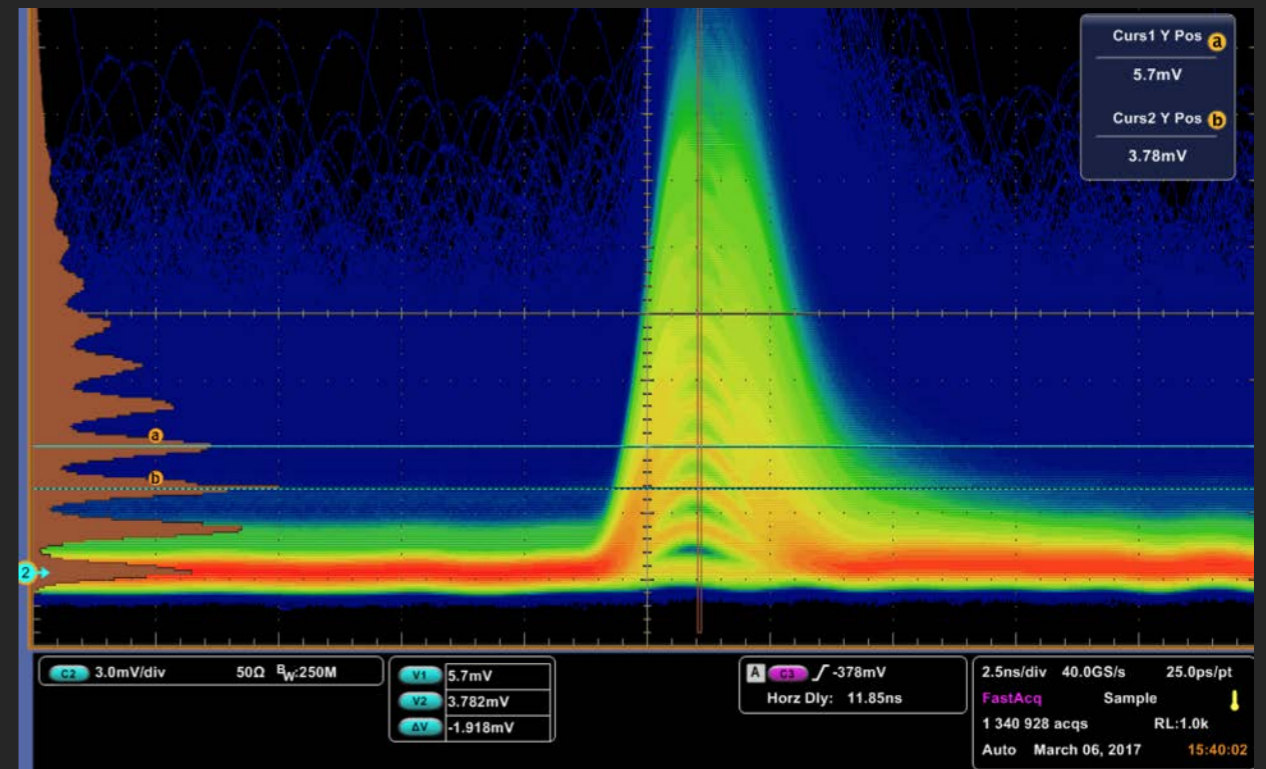
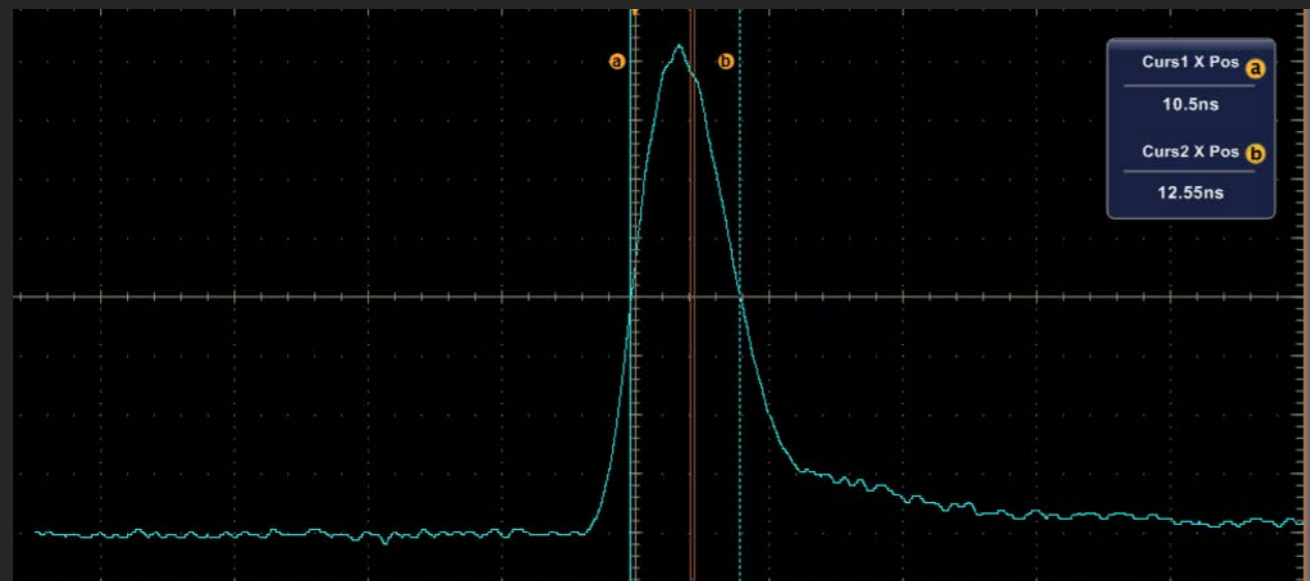
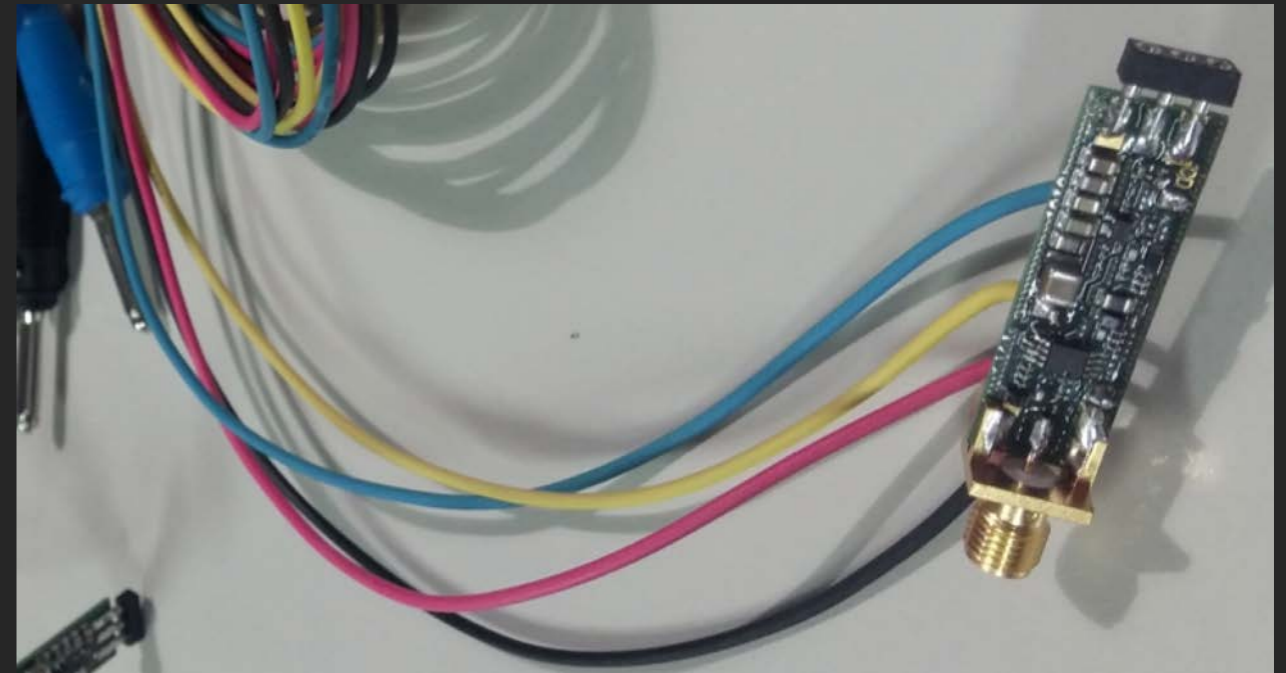
Cluster a SiPm per LST



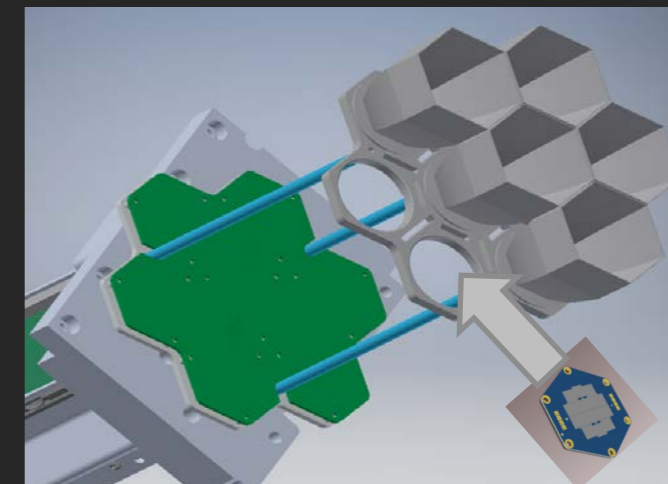
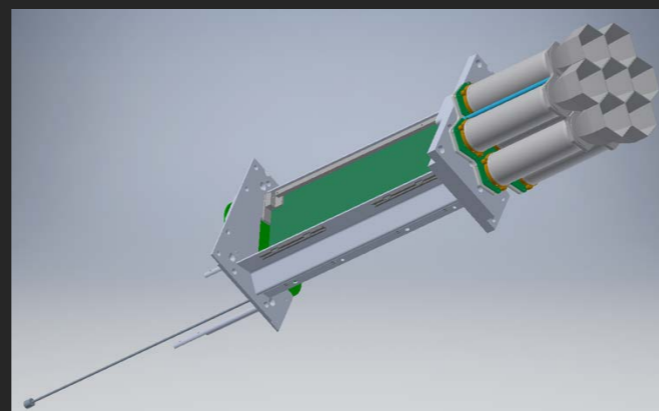
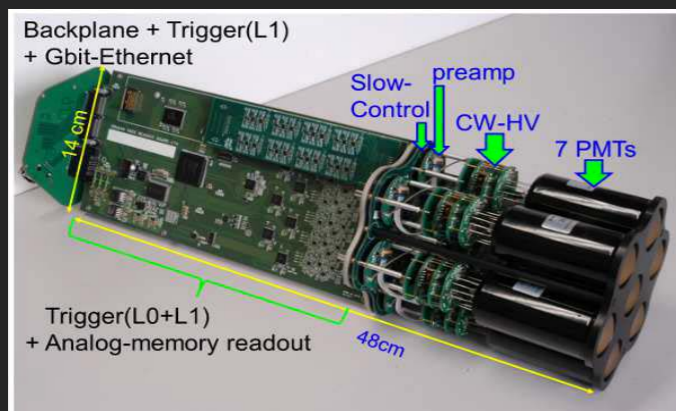
Progettato prodotto e realizzato un amplificatore per SiPm con prestazioni da record:

FWHM = 2ns

Conservando un ottimo rapporto segnale rumore



Cluster a SiPm per LST



Design of a SiPM-based cluster for the Large Size Telescope camera of CTA

Manuela Mallamaci^{1*}, Daniele Corti¹, Luigi Lessio², Mosè Mariotti^{1,3}, Riccardo Rando^{1,3}, Bagdat Baibussinov¹, Giovanni Busetto³, Alessandro De Angelis^{1,2,4,5}, Federico Di Pierro⁶, Michele Doro^{1,3}, Elisa Prandini³, Piero Vallania^{6,7}, Carlo Francesco Vigorito^{6,8}

¹ INFN Padova, ² INAF Padova, ³ Università di Padova, ⁴ Università di Udine, ⁵ IST and LIP Lisbon, ⁶ INFN Torino, ⁷ INAF OATo Torino, ⁸ Università di Torino
[*manuela.mallamaci@pd.infn.it](mailto:manuela.mallamaci@pd.infn.it)

A Silicon Photomultiplier (SiPM)-based photodetector will be built to be possibly used in the Large Size Telescope (LST) camera of the Cherenkov Telescope Array (CTA). It has been designed to match the size of the standard Photomultiplier Tube (PMT) cluster unit and to be compatible with mechanics, electronics and focal plane optics of the first LST camera. Here, we describe the overall SiPM cluster design along with the main differences with respect to the currently used PMT cluster unit. The fast electronics of the SiPM pixel and its layout are also presented. In order to derive the best working condition for the final unit, we measured the SiPM performances in terms of gain, photodetection efficiency and cross-talk. A pixel, a unit of 14 SiPMs, has been built. We will discuss also some preliminary results regarding this device and we will highlight the future steps of this project.

Cluster a SiPm per LST

SiPM characterization

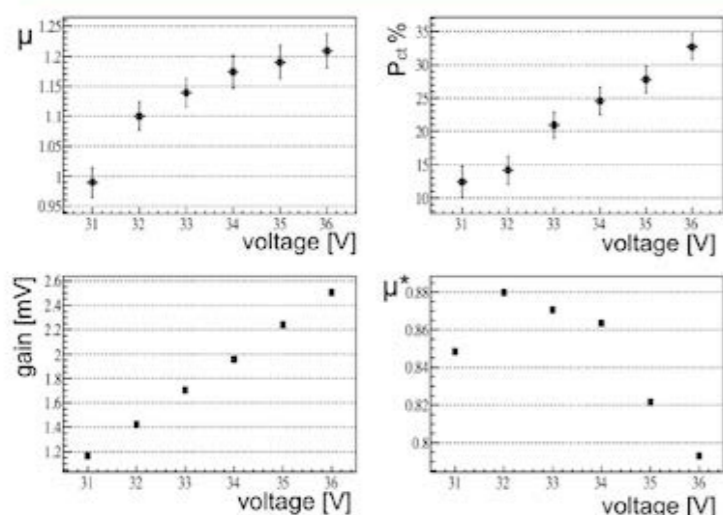


Fig. 7: Results on FBK NUV HD3_2 SiPM (single photo-sensor), obtained for $\lambda=376$ nm

From the distribution of peak voltages, we evaluated:

- the number of collected photoelectrons (indicated as μ),
- the cross-talk probability (P_{ct}),
- the gain
- the signal-to-noise ratio (S/N). The latter is in particular reported as $\mu^* = (S/N)^2$.

Maximum μ^* at 32 V, where $P_{ct}=14.2\pm 2.1(\text{stat})\%$.

We repeated the same tests exploiting a second laser (Picoquant PLS 8-2-519) with $\lambda=499$ nm. The signal-to-noise ratio is maximum between 32 and 34 V. At 33 V, $P_{ct}=18.4\pm 2.3(\text{stat})\%$.

The excess noise factor [5] due to stochastic noise of secondary events is $ENF = 1 + P_{ct}$. Its value is between ~ 1.14 and 1.18 for the tested sensors at their optimal working point.

Tested the SiPM performances. Model: 6×6 mm² FBK NUV HD3_2

- Photon detection efficiency: 60% at 350 nm and 30% at 500 nm.
- Single photo-sensor connected to an amplifier powered by a voltage of -3.3 V and 3.3 V.
- Laser source (Picoquant PLS8-2-592) at $\lambda=376$ nm

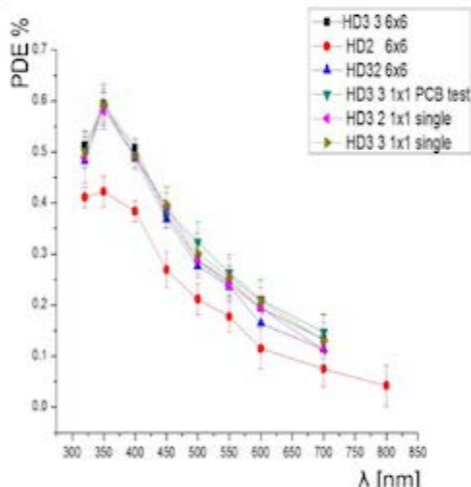


Fig. 8: PDE measured for different version of FBK NUV SiPMs.

Blue triangles are the measurements for the version used in this work (from private comm. with Dr. Lucia Consiglio - INFN Napoli)

SiPM pixel characterization and future studies

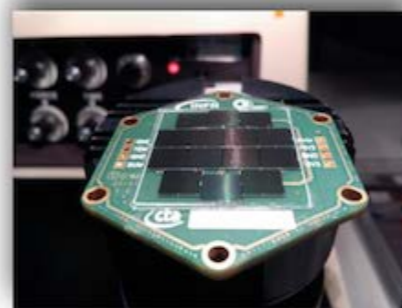


Fig. 9: View of one of the pixels built for this project.

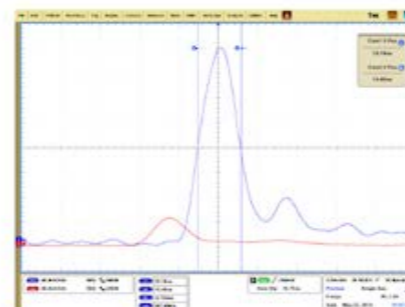


Fig. 10: Pixel (blue line) and single SiPM (red line) signals from the oscilloscope.

This project of a SiPM cluster is based on the production of 7 pixels of SiPMs. Following the design here described, we built and characterized two sensors with 14 6×6 mm² SiPMs of the model described above.

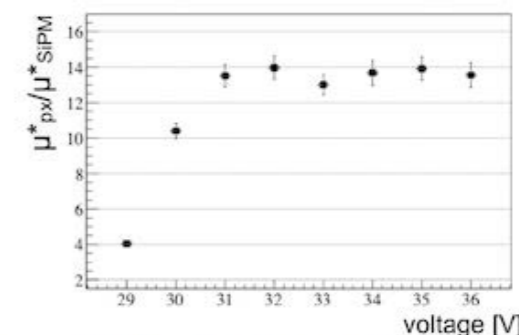
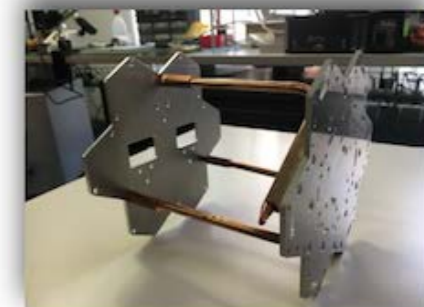


Fig. 10: Ratio of μ^* between the pixel and a single SiPM used as reference

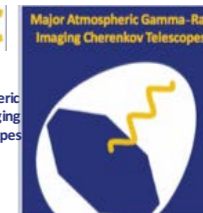
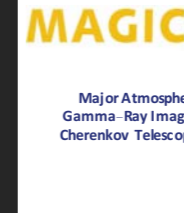
The pixel behaves as a sum of 14 objects, within the errors and preserves the peak width of the single SiPMs, being the FWHM less than 2.7 ns.

The electronic noise is 0.78 mV and the dynamical range is around 1000 (defined as the ratio A^*/σ_e , with A^* amplitude of the signal before saturation and σ_e , electronic noise).

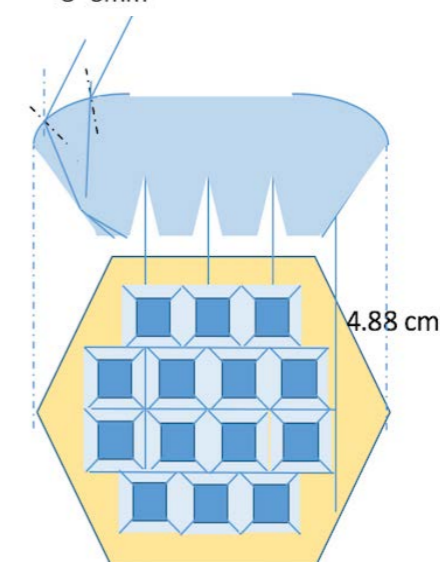
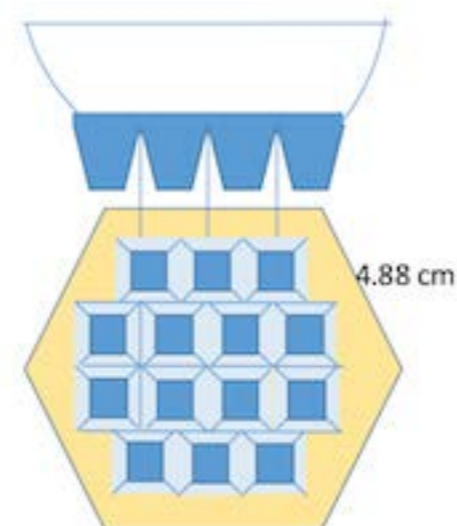
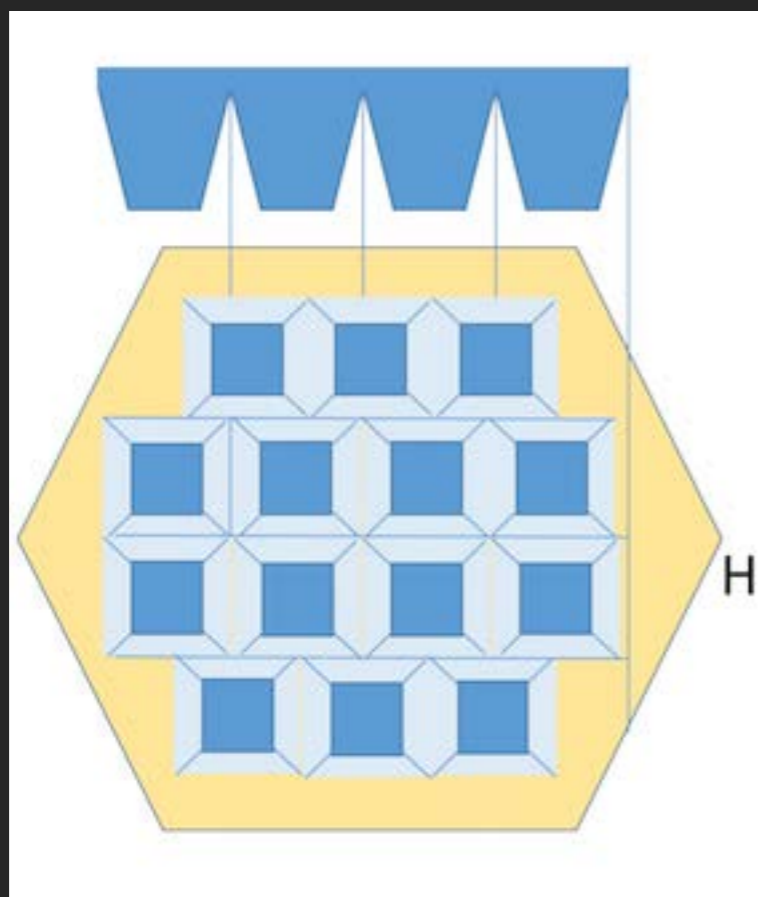
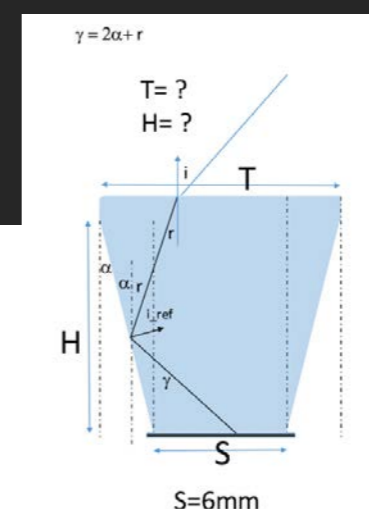


One of the next steps for this project is to design an optical system. We will also test how to drive the heat from the power control board to the cooling plate, which is 15 cm below. For this purpose a set of heat pipes will be applied and tested.

Cluster a SiPm per LST



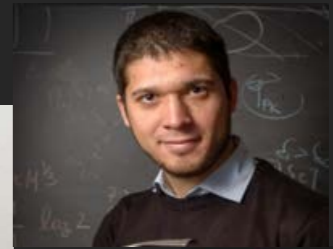
Studio ottica di paino focale:
confronto con guide di luce a riflessione o
interamente dielettriche



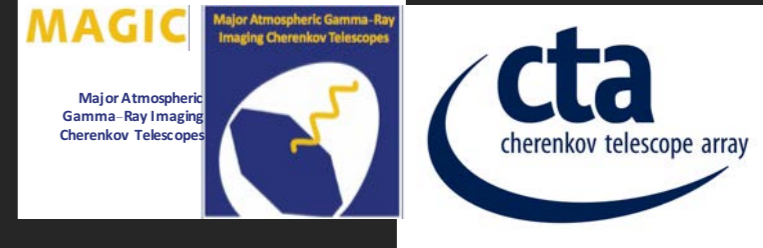
Attività previste 2019

Costruzione/operazione LST1

- Software di analisi,
- Turni di commissioning presa dati + prima scienza
- Monitoraggio tensione su cavi
- Attività di supporto in sito



Attività previste 2019



Realizzazione 3 Prototipi cluster SiPm per LST

- Test nuovo pixel
- Integrazione del cluster con DRAGON
- Test termici
- Ottica di piano focale
- Confronto nuovo cluster SiPm con tradizionale



Contributo per LST2-4

- Impostazione gara funi per LST2-4
- Meccanica carrelli?



CTA- PD: anagrafica



Ricercatori						
	Nome	Età	Contratto	Qualifica	Aff.	%
1	Bastieri Denis		Associato	Prof. Associato	CSN II	40
2	Bernardini Elisa				CSN II	50
3	Bottacini Eugenio Alessio		Associato	Ricercatore Tempo Determinato Tipo B	CSN II	50
4	Busetto Giovanni		Associato	Prof. Ordinario	CSN II	70
5	De Angelis Alessandro		Associato	Prof. Ordinario	CSN II	50
6	Doro Michele		Associato	Ricercatore	CSN II	100
7	Foffano Luca		Associato	Dottorando	CSN II	100
8	Lopez Coto Ruben		Dipendente	Borse post doc stranieri	CSN II	100
9	Mallamaci Manuela		Dipendente	Assegno di Ricerca	CSN II	70
10	Mariotti Mose'		Associato	Prof. Associato	CSN II	70
11	Paiano Simona		Associato	Assegnista	CSN II	100
12	Prandini Elisa		Associato	Assegnista	CSN II	100
Numero Totale Ricercatori					12	FTE: 9.0

Tecnologi						
	Nome	Età	Contratto	Qualifica	Aff.	%
1	Naletto Giampiero		Associato	Prof. Associato	CSN II	30
Numero Totale Tecnologi					1	FTE: 0.3

Tecnici						
	Nome	Età	Contratto	Qualifica	Aff.	%
Numero Totale Tecnici					0	FTE: 0.0

Richieste finanziarie 2019



Capitolo	Descrizione	Parziali		Totale	
		Richiesta	SJ	Richieste	SJ
MISSIONI	1. meeting MAGIC+CB	5.00		66.00	0.00
	2. working group	6.00			
	3. Turni MAGIC 3	11.00			
	4. 2 turni tecnici manutenzione MAGIC/CTA (supporto tecnico)	5.00			
	5. turni di commissioning LST (prime prese dati)	7.00			
	6. meeting coll. Internazionale CTA	15.00			
	7. conferenze	8.00			
	8. meeting collab. Italiana	9.00			
MISSIONI					
CONSUMO	1. Ottica cluster LST	5.00		14.00	0.00
	2. Manutenzione meccanica	3.00			
	3. produzione schede per sensori ed amplificatori prototipo cluster SiPm	6.00			
CONSUMO					
ALTRI_CONS					
TRASPORTI	1. Attrezzature sul sito LST	2.00		2.00	0.00
APPARATI	1. Contratto per nuove funi secondo telescopio LST2	150.00		170.00	0.00
	2. sistema elettronico di lettura e monitoraggio tensioni sulle funi	20.00			

Richieste ai servizi di sezione

RICHIESTE Servizi di Sezione CTA 2018

LE 3 mU

- Sviluppo e produzione schede per interfaccia per cluster SiPm 3,0 mese/uomo

Bellato 5 mU

- Nuova versione PCB sensori SiPm LST (sviluppo produzione e test) 2.0 mese/uomo
- Montaggio dei pixel nel cluster LST e test funzionali del sistema 2,0 mese/uomo
- Montaggio e test del cluster (2 viaggi a Tenerife/ La Palma) 1.0 mese/uomo

Ventura

- Manutenzione sistema lettura stress funi 1.0 mese/uomo

OM 2.5 mU

- Supporto per realizzazione meccanica dei cluster SiPm LST 1.0 mese/uomo
- Supporto manutenzione specchi 1.5 mese/uomo

UT 5 mU

- Supporto per progettazione ottica cluster LST 2.0 mese/uomo
- Supporto tecnico messa a punto meccanica del telescopio 1.0 mese/uomo