CTA

Giovanni Marsella

On behalf of CTA group

Dipartimento di Fisica e Chimica

Università degli studi di Palermo e INFN sez. Catania

CTA Consortium

Science Data Management Center: DESY Zeuthen (Germany)

Headquarters: Bologna (Italy)

Leadership:
Spokesperson: Werner Hofmann
Co-Spokesperson: Rene Ong

Chair, CTA Consortium Board: Jürgen Knödlseder
Consortium Science Coordinator: Emma de Oña Wilhelmi
Consortium Deputy Science Coordinator: Jamie Holder
Chair, SAPO: Vitor de Souza
Vice-Chair, SAPO: Igor Oya

Aug2018

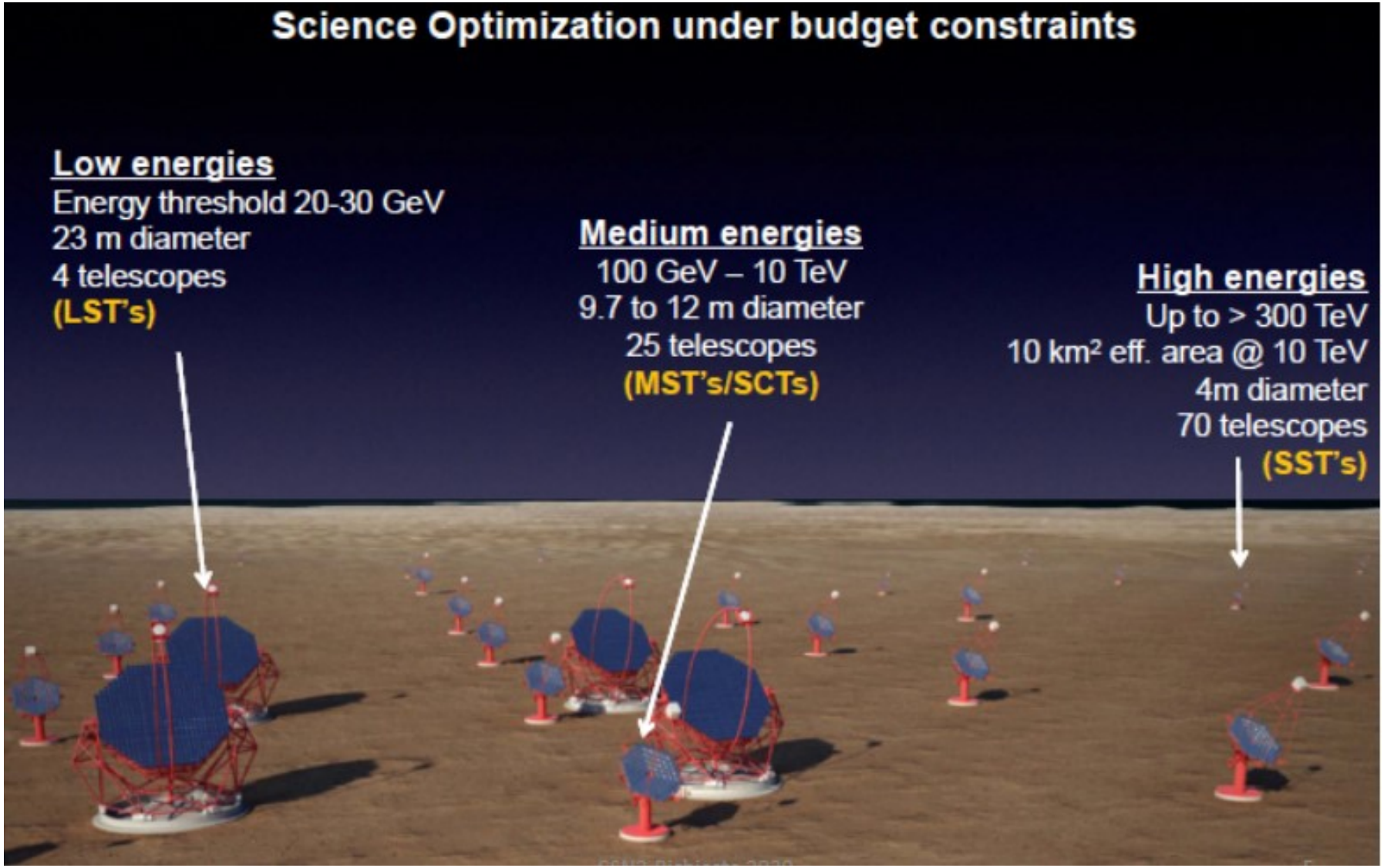
31 countries
93 parties
200 institutes
1500 scientists

North Site: La Palma (Spain, IAC)

South Site: Paranal (Chile, negotiations with ESO signed on Dec 2018)

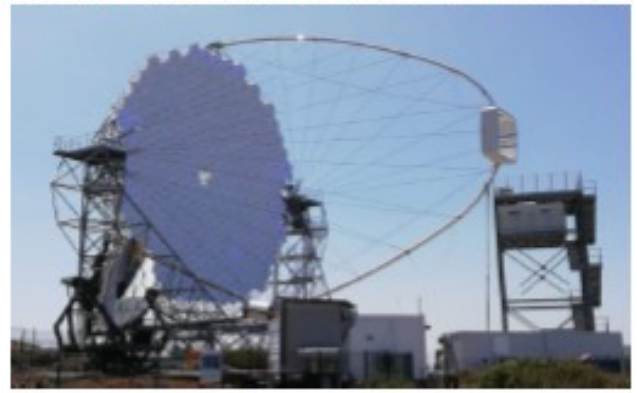
2

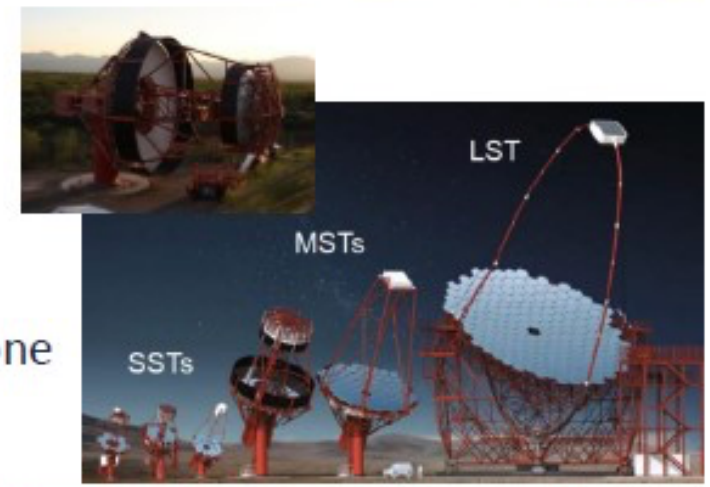
CTA Design


Science Optimization under budget constraints
Low energies
Energy threshold 20-30 GeV
23 m diameter
4 telescopes
(LST's)
Medium energies
100 GeV – 10 TeV
9.7 to 12 m diameter
25 telescopes
(MST's/SCTs)
High energies
Up to > 300 TeV
10 km² eff. area @ 10 TeV
4m diameter
70 telescopes
(SST's)

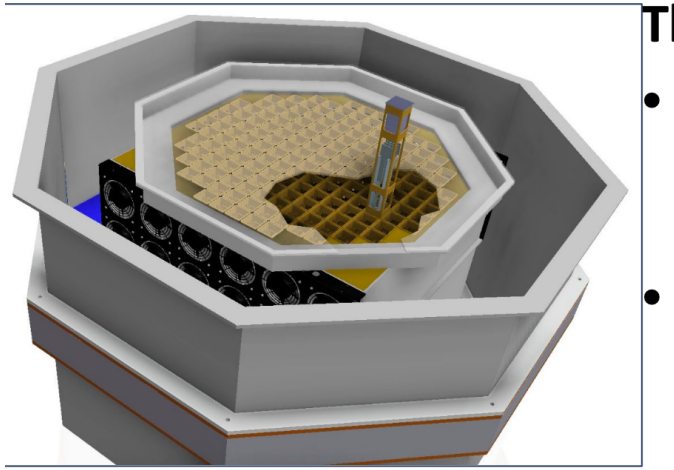
Attivita` INFN all'interno di CTA

- LST
  - Commissioning del primo prototipo, istallato sul sito di CTA-North @La Palma
  - Attivita` per i futuri telescopi
- SCT
  - Disegno MST con camera a SiPM e ottica Schwarzschild-Couder
  - Commissioning del prototipo di un prototipo istallato presso FLWO in Arizona
- Altre attivita`
  - Monitoraggio atmosferico con il LIDAR ARCADE
  - Sistemi di sincronizzazione e trigger inter-telescopio
  - Simulazioni, sviluppo software di ricostruzione e analisi dati, studio performance...



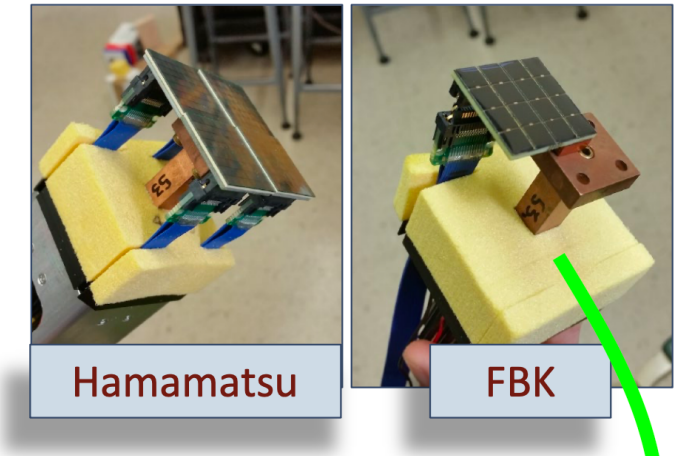


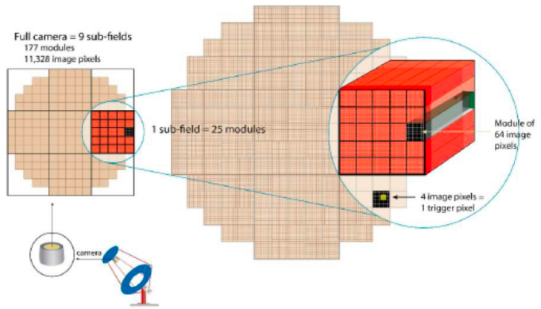
pSCT camera

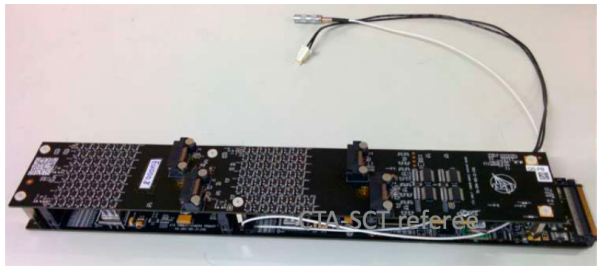


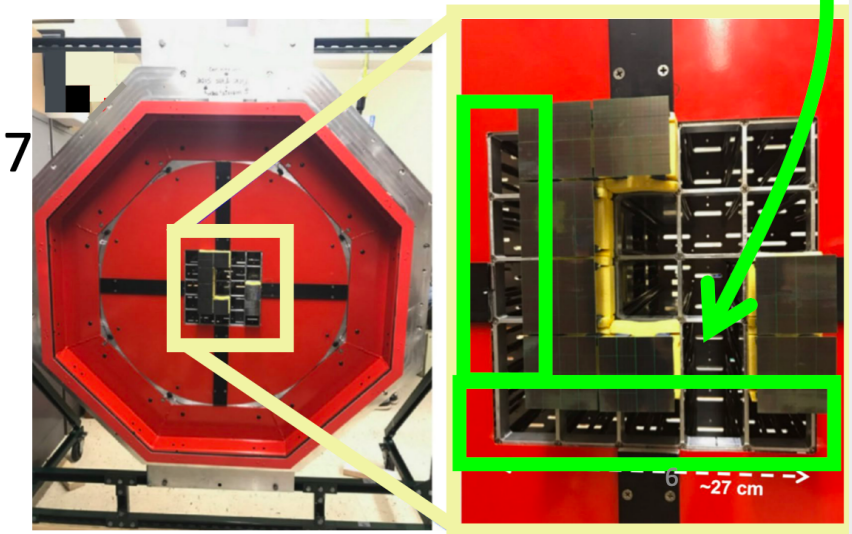
The pSCT Camera

- Module area: 54x54 mm^2, divided into 4 matrices composed by 16 SiPMs with an area of 6 x 6 mm^2
- 16 modules equipped with Hamamatsu MPPC S12642-0404PA-50(X)
- 9 modules equipped with FBK HD-3 SiPMs
- Readout directly behind the focal plane with TARGET 7 (1 GSa/s, 10 bits effective)









01/09/2020

CTA+

- Progetto presentato per **€ 89.243.506,60**
- Approvato per **€ 71.477.540,83**

	Work Packages	Indirect costs	Infrastructure	Instrumentation	Personnel	Training	Open Access	Totale
1240	**Camera and Raw Processing**	**€ 934.075,98**	**€ 357.070,40**	**€ 11.199.337,01**	**€ 728.942,60**	**€ 210.000,00**		**€ 13.429.425,99**
	UNISI	€ 15.483,39	€ 0,00	€ 0,00	€ 151.191,30	€ 140.000,00		€ 306.674,69
	POLIBA	€ 120.483,39	€ 0,00	€ 1.379.516,61	€ 151.191,30	€ 70.000,00		€ 1.721.191,30
	INFN-BA	€ 378.000,00	€ 0,00	€ 5.022.000,00	€ 0,00	€ 0,00		€ 5.400.000,00
	INFN-PI	€ 335.179,60	€ 0,00	€ 4.239.820,40	€ 213.280,00	€ 0,00		€ 4.788.280,00
	INFN-CT	€ 42.929,60	€ 357.070,40	€ 0,00	€ 213.280,00	€ 0,00		€ 613.280,00
	INFN-PI	€ 42.000,00	€ 0,00	€ 558.000,00	€ 0,00	€ 0,00		€ 600.000,00

Costruzione di 2 LST, 5 SST per il sito Sud (Cile) e un WP di R&D

CTA+ WP R&D

1500	**R&D (CTA Technologies Enhancement)**	**€ 365.672,89**	**€ 0,00**	**€ 4.184.327,11**	**€ 1.002.591,30**	**€ 140.000,00**		**€ 5.692.591,30**
1510	**Coordination Office**	**€ 16.433,08**	**€ 0,00**	**€ 83.566,92**	**€ 151.191,30**	**€ 0,00**		**€ 251.191,30**
	UniPA	€ 16.433,08	€ 0,00	€ 83.566,92	€ 151.191,30	€ 0,00		€251.191,30
1520	***Water Cherenkov + RPC***	**€ 124.368,41**	**€ 0,00**	**€ 1.425.631,59**	**€ 454.080,00**	**€ 0,00**		**€ 2.004.080,00**
	INFN-RM2	€ 46.678,88	€ 0,00	€ 553.321,12	€ 113.520,00	€ 0,00		€713.520,00
	IAPS ROMA	€ 10.500,00	€ 0,00	€ 139.500,00	€ 113.520,00	€ 0,00		€263.520,00
	INFN-TO	€ 23.781,68	€ 0,00	€ 226.218,32	€ 113.520,00	€ 0,00		€363.520,00
	INFN-NA	€ 26.610,47	€ 0,00	€ 323.389,53	€ 56.760,00	€ 0,00		€406.760,00
	INFN-PD	€ 16.797,38	€ 0,00	€ 183.202,62	€ 56.760,00	€ 0,00		€256.760,00
1530	***SiPM R&D***	**€ 126.491,96**	**€ 0,00**	**€ 1.623.508,04**	**€ 113.520,00**	**€ 70.000,00**		**€ 1.933.520,00**
	INFN-BA	€ 76.118,13		€ 973.881,87	€ 113.520,00	€ 0,00		€1.163.520,00
	INFN-TO	€ 3.271,03		€ 46.728,97	€ 0,00	€ 0,00		€50.000,00
	INFN-PD	€ 6.542,06		€ 93.457,94	€ 0,00	€ 0,00		€100.000,00
	INFN-NA	€ 9.813,08		€ 140.186,92	€ 0,00	€ 0,00		€150.000,00
	UNIBA	€ 14.392,52		€ 135.607,48	€ 0,00	€ 70.000,00		€220.000,00
	UNIPA	€ 16.355,14		€ 233.644,86	€ 0,00	€ 0,00		€250.000,00

CTA+ WP Science

	Work Packages	Indirect costs	Infrastructure	Instrumentation	Personnel	Training	Open Access	Totale
1600	**Science**	**€ 242.785,90**	**€ 175.000,00**	**€ 284.000,00**	**€ 679.830,00**	**€ 894.554,22**	**€ 18.000,00**	**€ 2.294.170,12**
1610	**Science**	€ 76.665,98	€ 0,00	€ 0,00	€ 529.674,00	€ 565.554,22		€ 1.171.894,20
	INAF-OAS Bologna	€ 12.068,62			€ 113.520,00	€ 58.888,89		€ 184.477,51
	INAF-OACagliari	€ 2.722,22			€ 0,00	€ 38.888,89		€ 41.611,11
	INAF-OA Brera	€ 7.946,40			€ 113.520,00			€ 121.466,40
	INAF-OACt	€ 2.722,22			€ 0,00	€ 38.888,89		€ 41.611,11
	INAF-OAArcetri	€ 4.083,31			€ 0,00	€ 58.333,00		€ 62.416,31
	INAF-OARoma	€ 5.444,44				€ 77.777,78		€ 83.222,22
	IASF-Milano	€ 4.083,31				€ 58.333,00		€ 62.416,31
	INFN-PD	€ 7.946,40			€ 113.520,00			€ 121.466,40
	UNISI	€ 4.083,31				€ 58.333,00		€ 62.416,31
	POLIBA	€ 5.444,44				€ 77.777,78		€ 83.222,22
	UNIPA	€ 4.083,31				€ 58.333,00		€ 62.416,31
	INFN-NA	€ 7.946,40			€ 113.520,00			€ 121.466,40
	DIFA	€ 8.091,58			€ 75.594,00	€ 40.000,00		€ 123.685,58
1620	**Outreach & Communication**	**€ 52.319,92**	**€ 25.000,00**	**€ 184.000,00**	**€ 150.156,00**	**€ 329.000,00**	**€ 18.000,00**	**€ 758.475,92**
	INAF-OAS Bologna	€ 8.733,20		€ 7.000,00	€ 99.760,00		€ 18.000,00	€ 133.493,20
	INAF-OA Brera	€ 3.850,00		€ 5.000,00		€ 50.000,00		€ 58.850,00
	INAF-OACt	€ 3.500,00				€ 50.000,00		€ 53.500,00
	INAF-OAPalermo	€ 4.900,00		€ 70.000,00				€ 74.900,00
	IASF-Palermo	€ 2.520,00				€ 36.000,00		€ 38.520,00
	INFN-PD	€ 1.750,00				€ 25.000,00		€ 26.750,00
	INFN-NA	€ 11.289,00		€ 77.000,00		€ 43.000,00		€ 131.289,00
	DIFA	€ 15.777,72	€ 25.000,00	€ 25.000,00	€ 50.396,00	€ 125.000,00		€ 241.173,72

Anagrafica 2024

None	contratto	Qualifica	percentuale
Buscemi Mario	Associato	Ricercatore a Tempo Determinato di tipo B	40
Cicciari Maria Gloria	Associato	Dottoranda	100
Leonora Emanuele	Dipendente	Tecnologo	20
Lopresti Domenico	Associato	Prof. Associato	40
Mallamaci Manuela	Associato	Rtd_A PNRR	10
Manicò Giulio	Associato	Ricercatore Universitario	40
Marsella Giovanni	Associato	Prof. Ordinario	40
Piattelli Paolo	Dipendente	Primo Ricercatore	20
Pumo Maria Letizia	Associato	Ricercatore a Tempo Determinato di tipo B	40
Randazzo Nunzio	Dipendente	Dirigente Tecnologo	20
Tripodo Giovanni	Associato	Dottorando	100
		Tot FTE	4,70
Servizio Elettronica			
?	Dipendente	Responsabile	10%
altro			1 mese uomo
Servizio Rivelatori			
?			20%
			1 m/u
1 Tecnologo PNRR			
1 Tecnico PNRR			

Richieste 2024

Descrizione	Richieste (Keuro)	SJ	Assegnate	Totale (Keuro)
Missioni	20			20
Consumi	10			10
Inventariabile	30			30
Totale	60			60

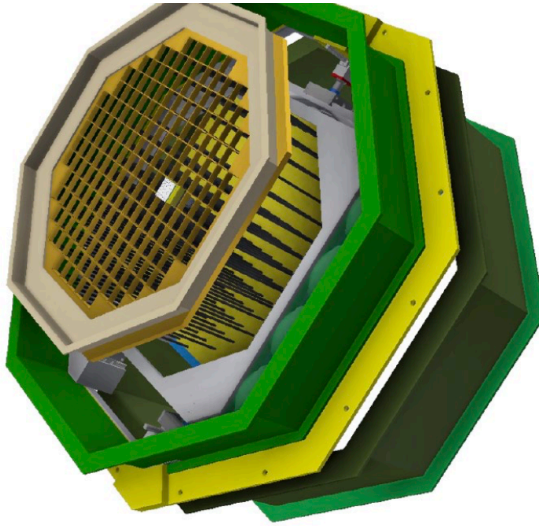
- Missioni: Turni presa dati (La Palma e Arizona), Conferenze e meeting di collaborazione
- Consumi: materiale per laboratorio
- Inventariabile: Sistema per fare in automatico le curve IV dei SiPM (picommaetro)

- Bakup

Articoli e presentazioni a conferenze

- Poster at Pisa Meeting 2022: «Quality control tests on the new front-end electronics for the Schwarzschild-Couder Telescope»
- Technical article: «High Density Near Ultraviolet Silicon Photomultipliers: characterization of photosensors for Cherenkov light detection» Submitted to NIMA
- SCT Coll.: «Assembly and performance of SiPM arrays for the prototype SCT proposed for CTA» Submitted to NIMA
- SCT Coll.: «Technical and scientific performance of the prototype Schwarzschild-Couder Telescope for CTA», Proceedings of SPIE - The International Society for Optical EngineeringVolume 118202021 Article number 118200°
- SCT Coll.: «Design and performance of the prototype Schwarzschild-Couder telescope camera», Journal of Astronomical Telescopes, Instruments, and SystemsOpen AccessVolume 8, Issue 11 January 2022 Article number 014007

Focal plane upgrade



INFN is in charge for the focal plane upgrade:

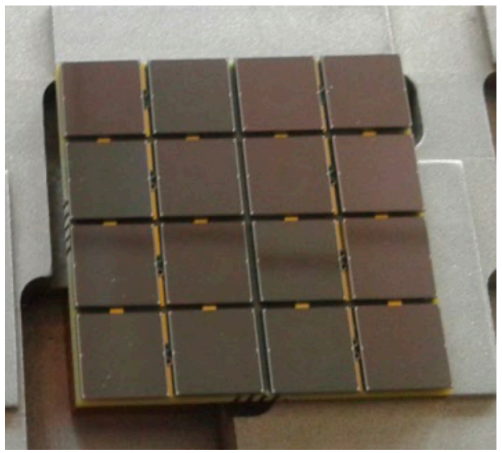
- 9 backplanes, 177 modules, 11328 pixels
- Upgrade of sensors with FBK SiPMs to be produced by Lfoundry
- SMART ASIC for signal preamp
  - Designed @ INFN-Bari by F. Licciulli : SMART

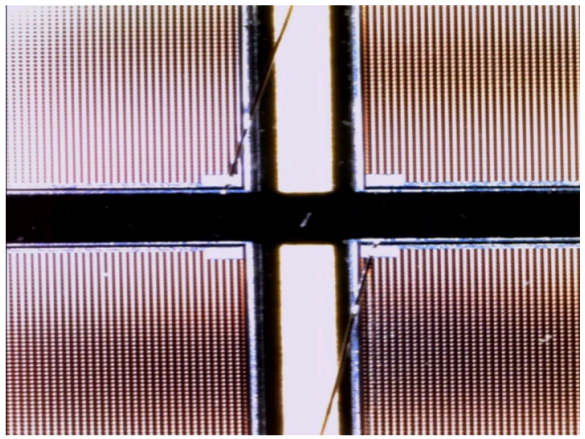
  "SiPM Multichannel Asic for high Resolution Cherenkov Telescopes"
- New FEE modules for signal digitization
  - TARGET7 replaced with TC+T5TEA
  - Designed @ INFN-Pisa + U.Leicester + U.Erlangen

FBK NUV-HD3 SiPMs

- SiPM modules have been assembled in 4x4 matrices with wire bond, no coating applied
- First 9 modules installed
- Matrices ready to assemble further 25 modules – tests ongoing (delayed due to Covid-19)

- Technology transfer FBK-Lfoundry for mass production
  - TSV technology will be employed
- Process ongoing





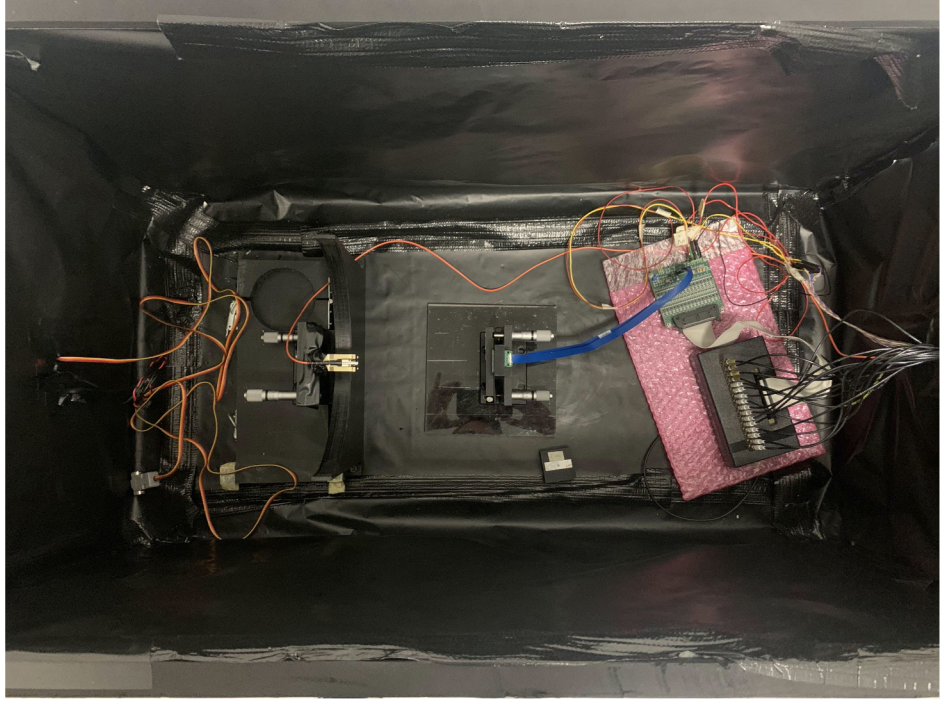
Ongoing activities in Catania

- Experimental setup
  - Optical bench
  - Front-end electronics
  - Data Acquisition
- Measurements
  - Break-down voltage
  - Dark Count Rate
  - Gain
- Data Analysis

New CTA-Lab in CT

Setup

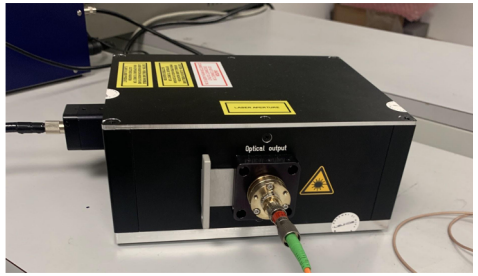
Dark box 45 x 90 cm
Samba - Leukos laser: wavelength 350 nm - 2400 nm, pulsed, fixed amplitude
Bebop - Leukos monochromator: 350-850 nm, $\Delta\lambda$ = 5 nm - 100 nm
Programmable Power supply Agilent 6626A , 4 channels
SiPM NUV-HD3 FBK 4x4 (40 µm, 6x6 mm^2)
Custom **amplifier** board 16 channels
Digitizer CAEN DT5742B - 16 channels, 5 GSa/s
Labview-based **DAQ**



Dark Box

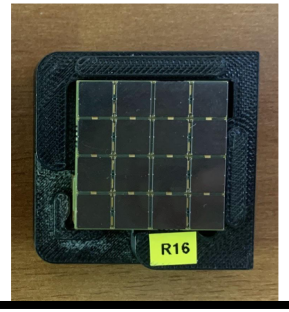
Laser

Monochromator

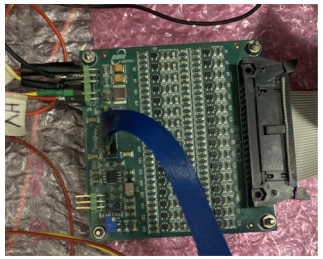


Diffuser

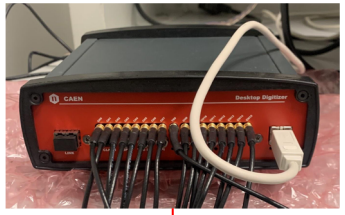
SiPM Matrix



Amplifier board

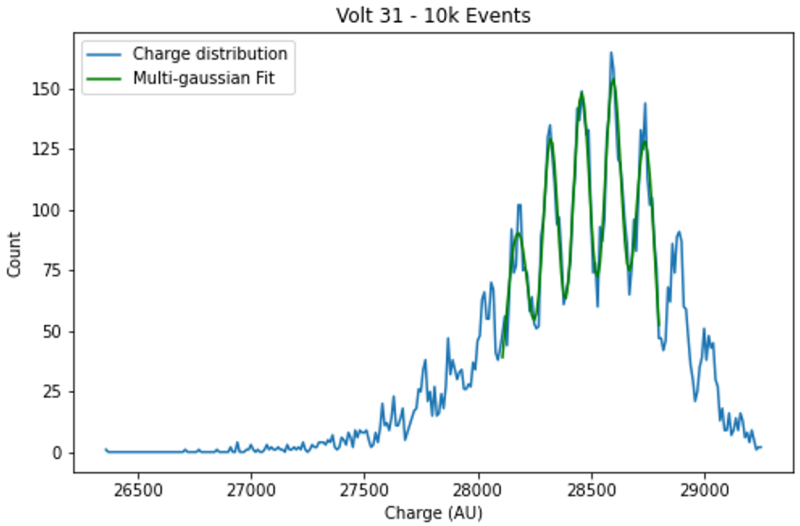


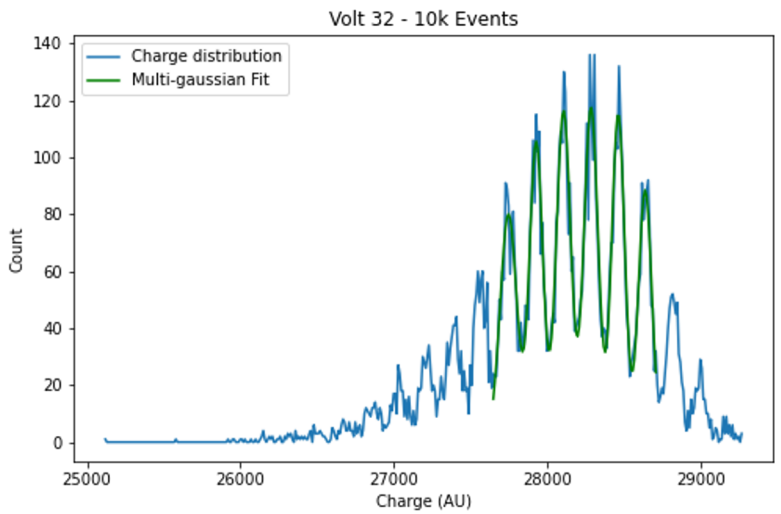
Digitizer

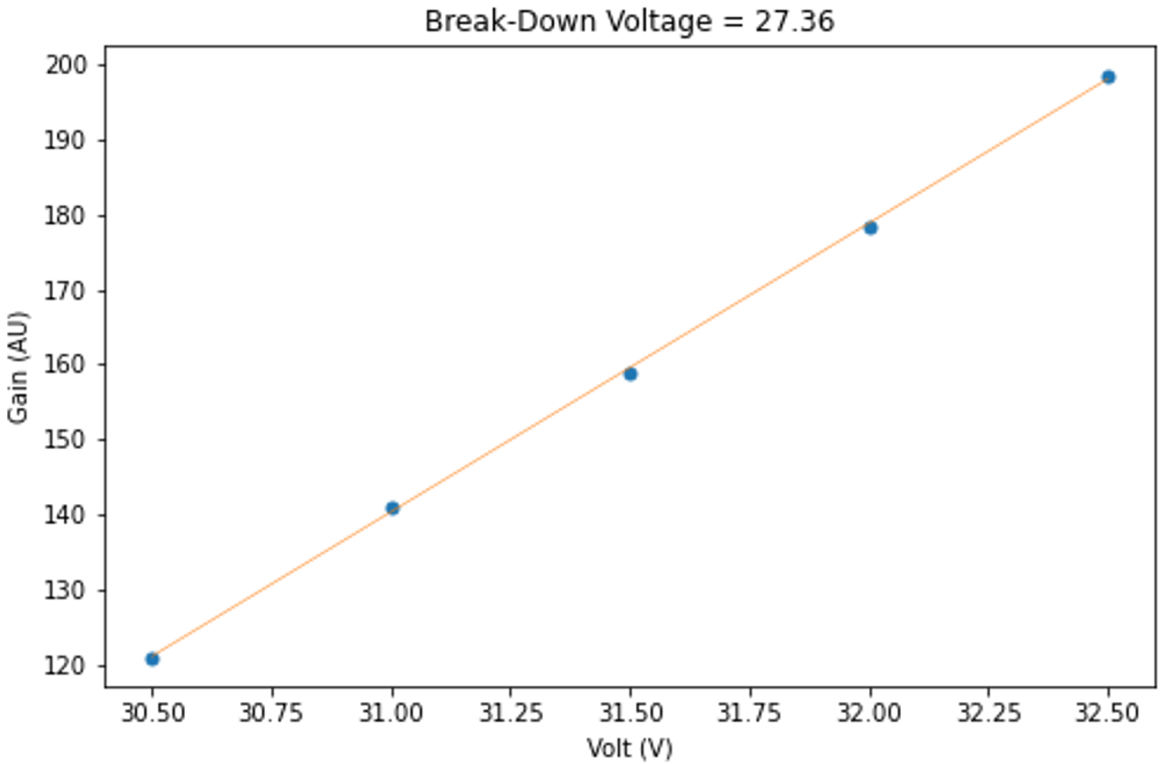


trigger

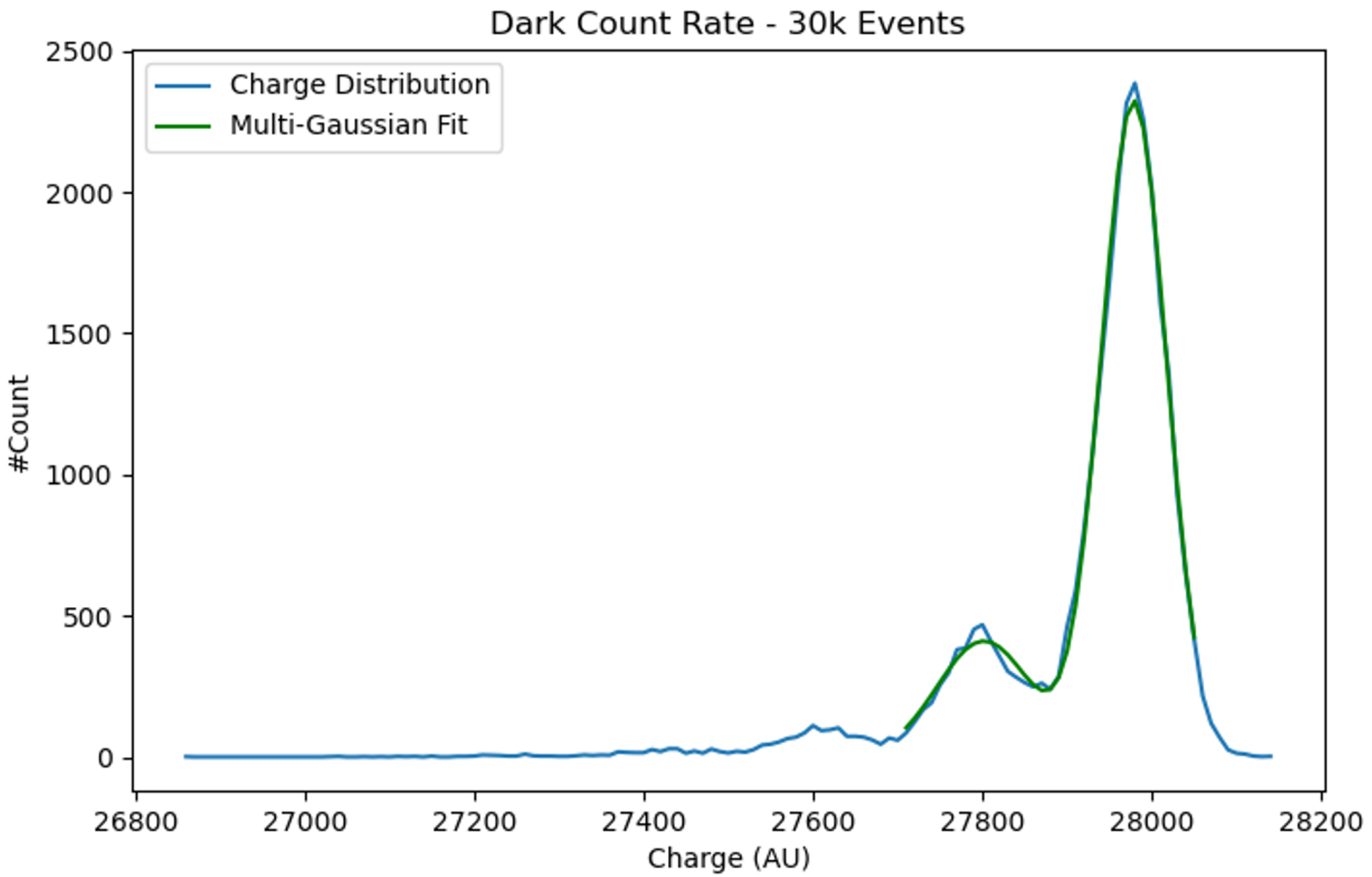
Gain vs HV (with HV 30.5 - 32.5 V step 0.5 V)







Dark

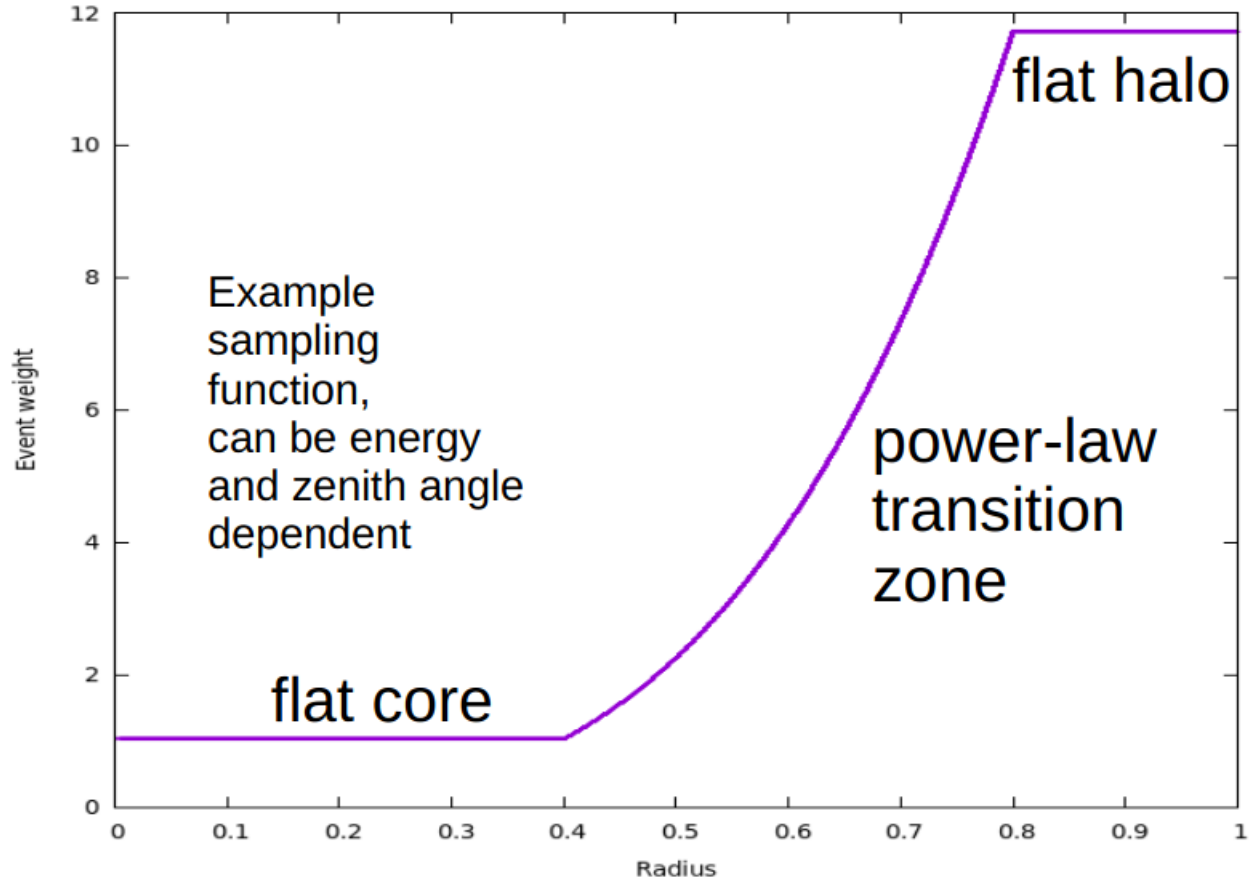

Dark Count Rate - 30k Events
Charge Distribution
Multi-Gaussian Fit
#Count
2500
2000
1500
1000
500
0
26800
27000
27200
27400
27600
27800
28000
28200
Charge (AU)

Contribution on MC task

G. Manicò

- Using importance sampling in Monte Carlo simulations we can reduce the variance.
  - Some random values in a simulation have more impact than others on the parameter being estimated.
  - Emphasizing these values by sampling more frequently we can obtain variance reduction.
- Hence, the basic methodology in importance sampling is to choose a distribution which "encourages" the important values.

IS in Corsika/IACT



(From K. Bernlohr's talk: «Importance sampling etc. in Corsika/IACT simulations», CTA ASWG telecon, 2021-02-03)