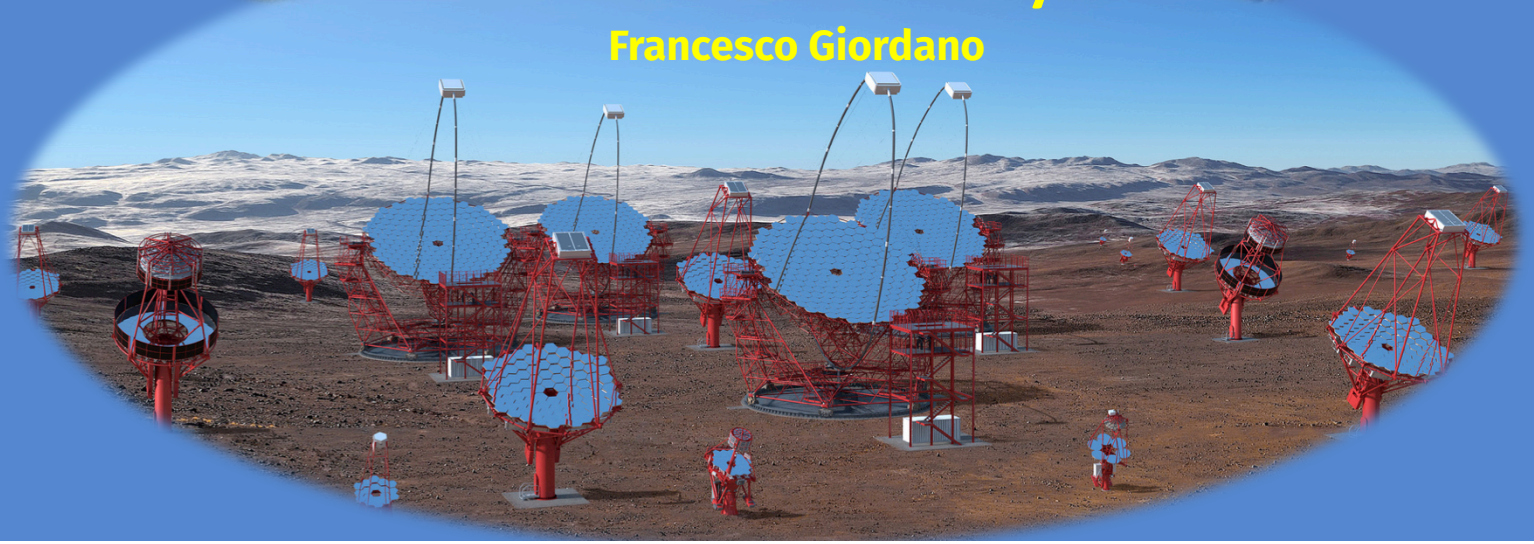
From Science to Society: a fruitful Path

Francesco Giordano



PNRR: overview

Three key objectives

1. To tackle the economic and social damage of the pandemic crisis
2. Contribute to addressing the structural weaknesses of the Italian economy
3. Accelerate the digital and green transition

For a country

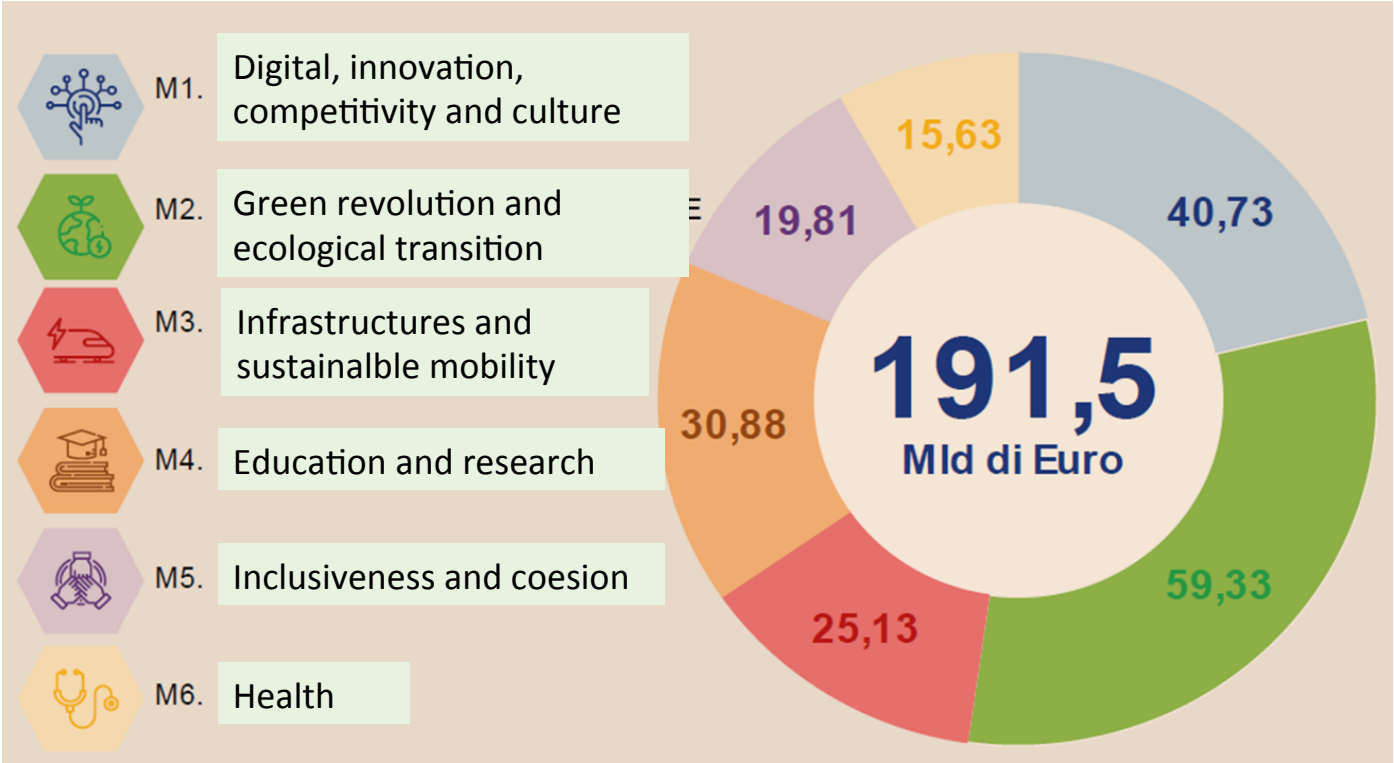
- **Innovative and digital**
- **Open to young people and gender balance**
- **Environmental friendly**
- Territorially cohesive

Instruments

PNRR

16 components,
6 Missions

Received from and reflect to the italian strategic pillar



MISSION 4 – EDUCATION AND RESEARCH

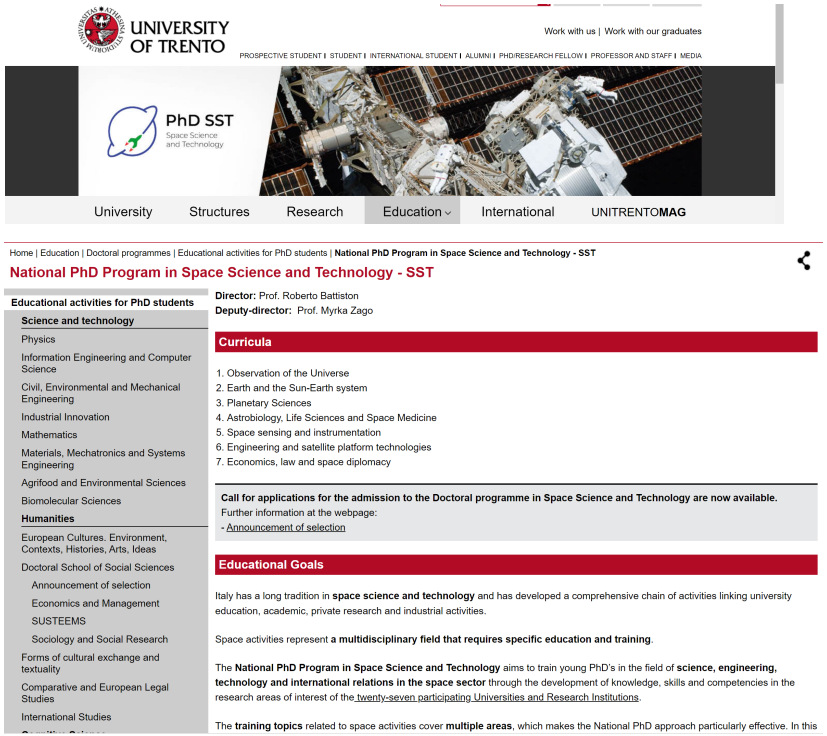
31,90 MLD €

- **COMPONENT 1: EMPOWERING services dedicated to education from kidergarden to universities (19,44 mld)**

- **COMPONENT 2: from research to industries (11,44 mld)**

L'ASResources (1/3)

Investiments	Mln€
1.6 from school to univ.	250
1.7 scolarship for enrollment to univ.	500
3.4 advanced teaching	500
4.1 more phds	432
1.1 fund for PNR (Programma Nazionale della Ricerca (PNR) and PRIN e Progetti di Ricerca di Rilevante Interesse Nazionale	1.800



L'ASSEGNAZIONE DELLE RISORSE AL MUR

Investiments	IMPORTO Mln€
1.2 Italian ERC (for young researcher)	600
1.3 Extended Partnership	1.610
1.4 Nazional Reserach center (Campioni Nazionali)	1.600
1.5 ecosystems	1.300
3.1 Infrastructures	1.580
3.3 Industrial phds	600

DM 351
DM 352

PE

- 1 • Artificial intelligence
- 2 • Future scenario on energy
- 3 • Natural and antropic risks for environment
- 4 • Quantum tech.
- 5 • Humanistic culture and patrimony for innovation in creativity
- 6 • Diagnosys and terapy in precision medicine
- 7 • Cybersecurity,
- 8 • Ageing
- 9 • Sustainibility
- 10 • Food tech
- 11 • Made-in-Italy circular economy
- 12 • Neuroscience e neuropharmacologia
- 13 • Emerging infective desease
- 14 • Telecomunications for future

15 Space activites

CN
•Simulations, HPC
•Tech for Agricolture (Agritech)
•Gene Therapy and RNA tech.
•Sustainable mobility
•Bio-diversity

cherenkov telescope array

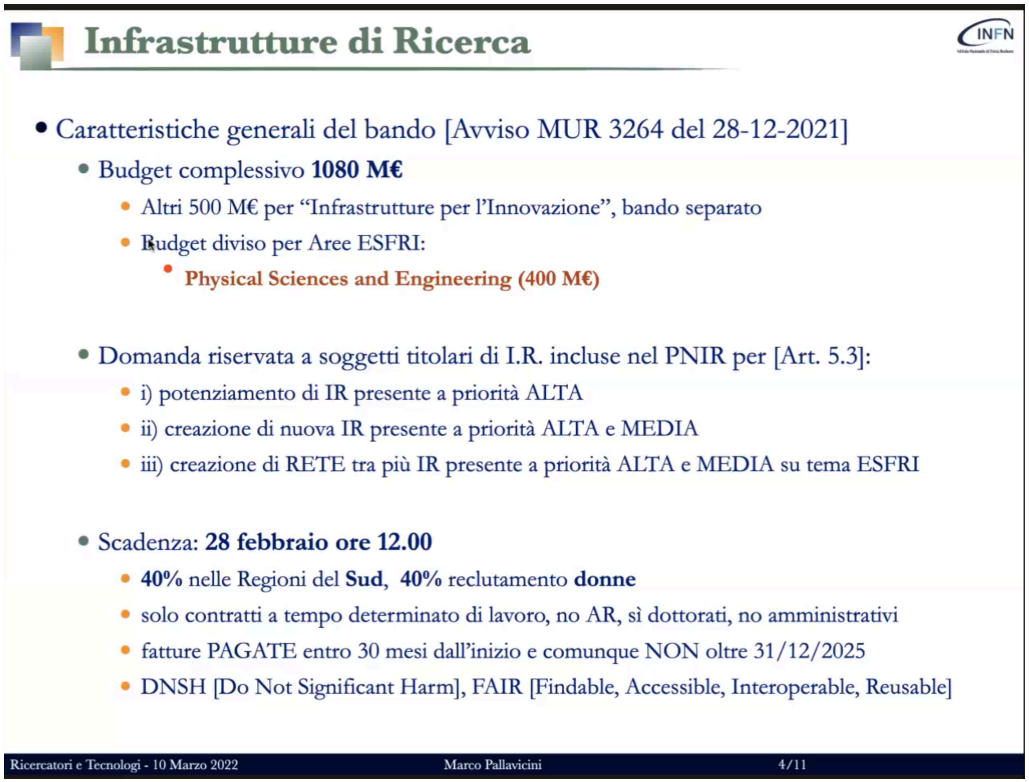
CTA+

PNRR/INFRA project for CTA-S enhancement

PNRR call

- Call for **ESFRI** (PNIR 2021-27)
- **High priority IR: CTA(INAF), ET(INFN), KM3-NET(INFN)**
- Total budget (Physycal Science&Engineering) 400M€/1080€ (line 3.1.1),
- 15M€/proposal (VAT incl.),
- target 20 proposals
- 40% for South of Italy
- Gender Parity (recruitment (t.d.) and Phd)

- **30 months**
  - ➢ **Bills < 2025**



CTA+

CTA alpha config.:

CTA-N: 4 LST + 9 MST

CTA-S: 0 LST + 14MST +37 SST

North site close to optimal situation

South Site in a reduced config.

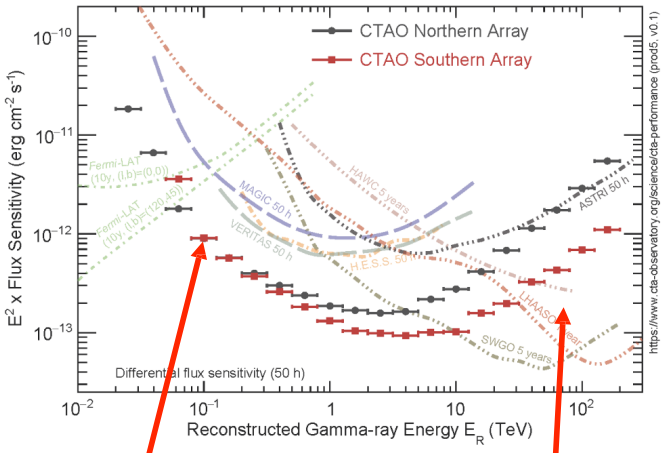
PNRR proposal:

- Improve South Site (2 LSTs, 7 SSTs) plus other facilities (optical and radio telescopes)
- R&Ds on technologies close to CTA

More than 400 pages

Idea

- INAF is leading a proposal (~80 M€) to enhance the ESFRI/ERIC CTA infrastructure at both low (<1 TeV) and high (>100s TeV) energies, and provide it with state-of-the-art ground-based multi-frequency telescopes for the follow- up of multimessenger transient sources (such as GRBs, GWs, Neutrinos, etc.) which are Core Science for CTA.

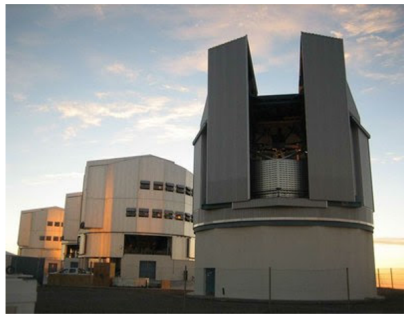


Increase (significantly) sensitivity here

…and here

TNG (North)

VST (South)



…and multi-ni follow-ups

WBS

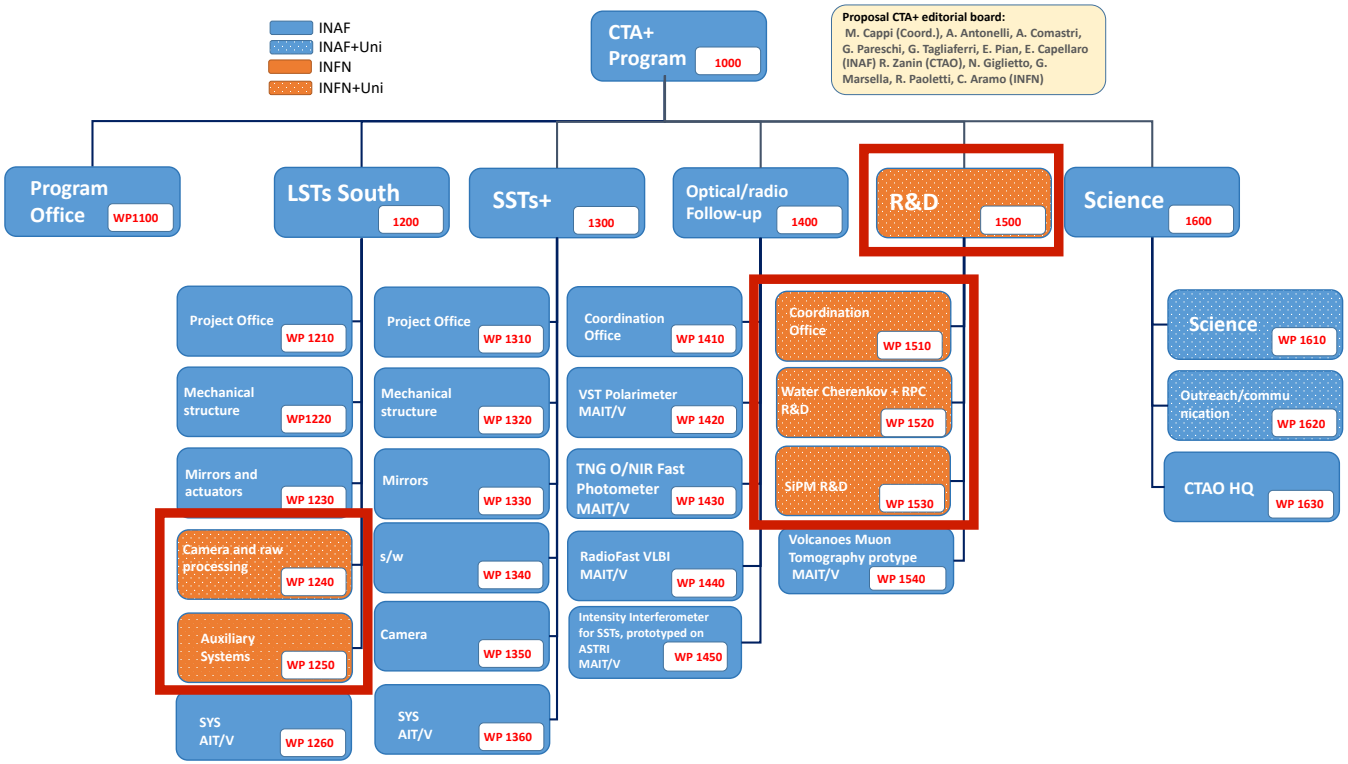
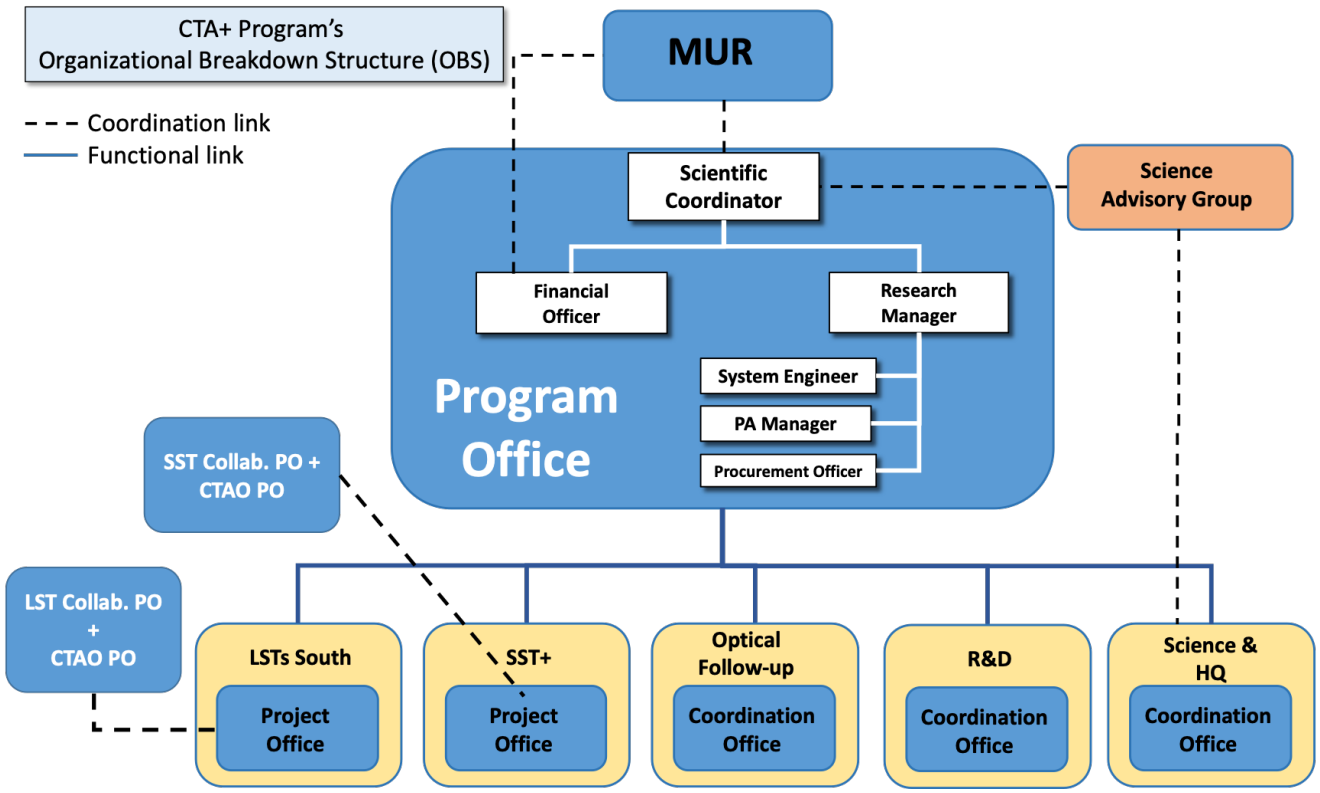


Fig. A - Work Breakdown Structure of CTA+ Program

OBS



Organization Breakdown Structure of CTA+ Program

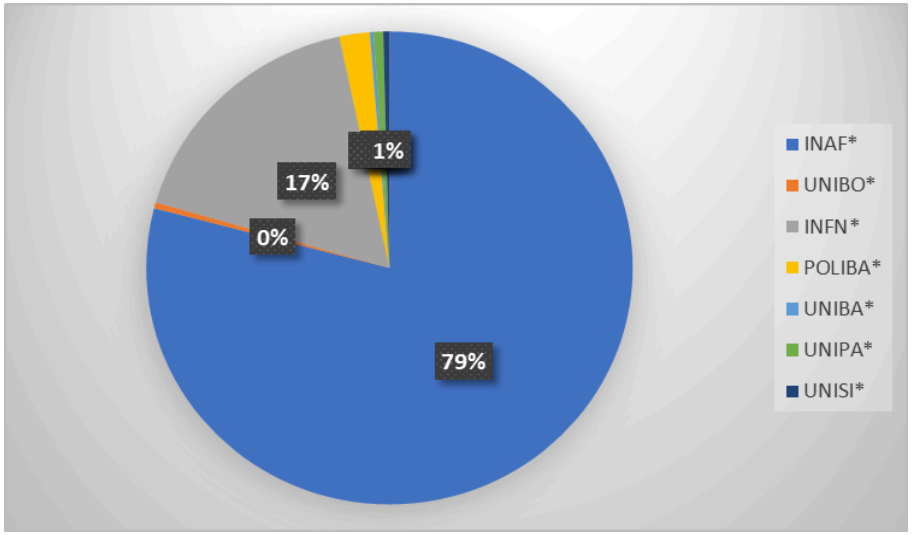
Costs and WPs

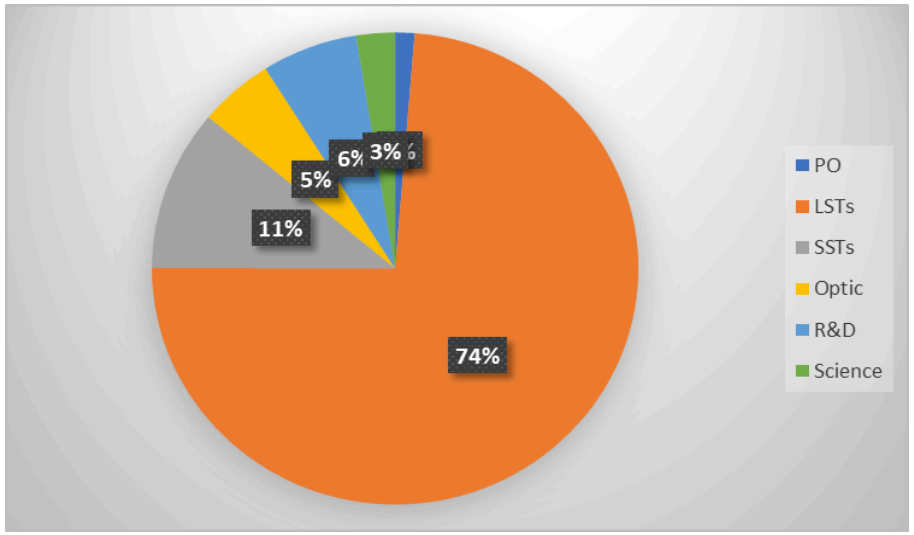
WP#	Work Packages	Indirect costs	Infrastructure	Instrumentation	Personnel	Training	Total
1100	Program Office	€ 383.800,00	€ 0,00	€ 0,00	€ 662.200,00	€ 94.600,00	€ 1.140.600,00
1200	LSTs South	€ 60.239.000,00	€ 400.000,00	€ 100.000,00	€ 2.372.582,60	€ 210.000,00	€ 65.661.582,60
1300	SSTs+	€ 7.785.403,00	€ 1.271.568,00	€ 195.000,00	€ 555.775,00	€ 0,00	€ 9.807.746,00
1400	Optical/radio follow-ups	€ 215.000,00	€ 110.000,00	€ 3.328.200,00	€ 681.120,00	€ 70.000,00	€4.404.320,00
1500	R&D (CTA Technologies Enhancement)	€ 3.000.000,00	€ 0,00	€ 1.400.000,00	€ 889.071,30	€ 140.000,00	€ 5.429.071,30
1600	Science	€ 619.700,00	€ 175.000,00	€ 77.000,00	€ 705.031,30	€ 829.000,00	€ 2.405.731,30
	Totale	€ 72.027.903,00	€ 1.846.568,00	€ 1.772.000,00	€ 5.184.660,20	€ 1.273.600,00	€ 88.849.051,20

CTA+ Budget (before cut)

Budget Totale						
54.1a Personnel	54.2b Instr, Eq & SW	54.3c Access	54.4d Infrastructure	54.5e Indirect	54.6f Training	Total Cost (€)
€ 6.469.654,90	€ 71.347.100,92	€ 36.000,00	€ 4.150.019,40	€ 6.261.052,07	€ 1.738.154,23	€ 89.243.505,60

Sud	€ 53.350.832,75
Nord	€ 35.892.672,85
Total Budget	€ 89.243.505,60
Sud/Totale	59,78%





The ASTRI Mini-Array Project

Mini-Array

EIE GROUP

Design and implementation of the telescope's & cameras electro-mechanical structures

VVO CONSTRUCCIONES P. S.A.

Implementation of the site infrastructure @Tenerife

CAEN GROUP COMPANY

Design and implementation of cameras

HAMAMATSU
PHOTON IS OUR BUSINESS

Production of the SiPM sensors

weeroc

ASIC design and production

Media Lario

Production of the primary mirrors reflecting panels

ZAOT
THIN FILM COATINGS

cilas arianeGROUP

Coating of the secondary mirrors via magnetron sputtering

ARCON
Premium Italian Telescopes

Polishing of the secondary mirrors surfaces

FLABEG
ADDED VALUE IN GLASS

Production of the secondary mirrors via thermal slumping

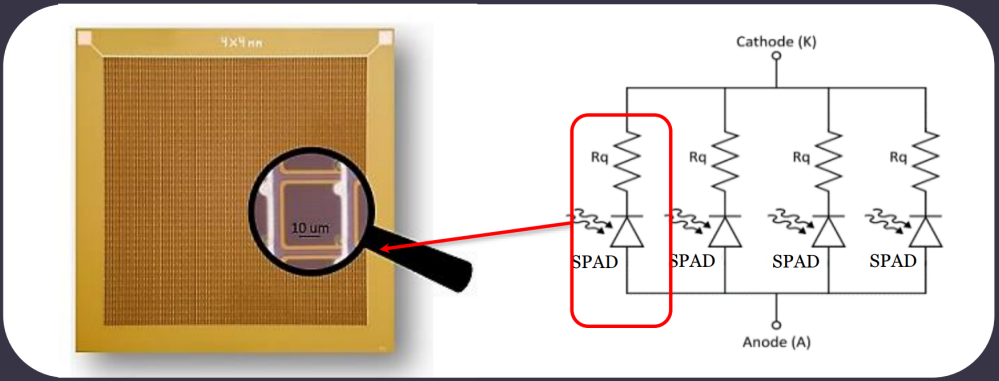
AC3E

Control sw based on the Alma Common Software

Credit: Giorgia Sironi

The detectors: Silicon Photomultipliers

SiPMs: array of reverse-biased Single Photon avalanche Diodes (**SPADs**) connected in parallel



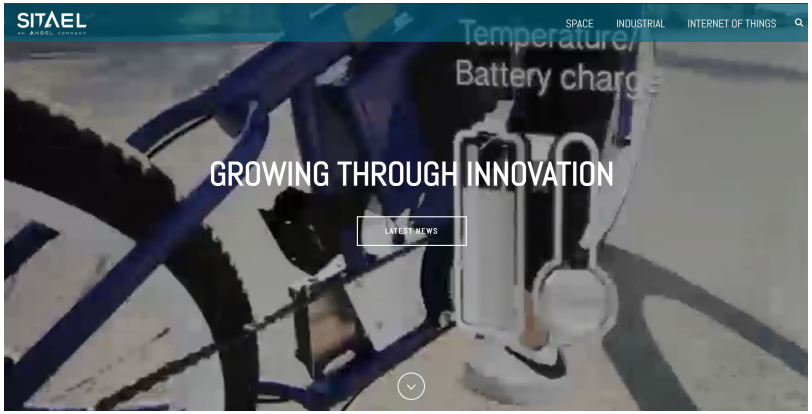
SiPM size:
from 1x1 mm^2 to 10x10 mm^2

SPAD size:
from 5 µm to 40 µm (typical)

http://advansid.com/resources/the-silicon-photmultiplier

FEEM Production

- Tender for the production of ~200 FEE modules for ~500k€
- Only one company applied: SITAEL SPA
- First part of the tender: production of 5 prototypes FEEMs
  - Prototypes delivered in mid May 2022
  - Tests of FEEM prototypes ongoing
- Full production to be started after prototypes validation
- FEEMs will be produced and delivered in batches of 75 modules
- Quality control test on each module to be performed
- Modules will be shipped to FLWO, Arizona (USA)



Keep home messages:

- Continue dialogue with private sector
- Intercept more calls for fondamental research and technology transfer
- Shorten the distance (academia and private sectors, north and south, gender gap)
- Open your mind to inter and multidisciplany approach to research and to life