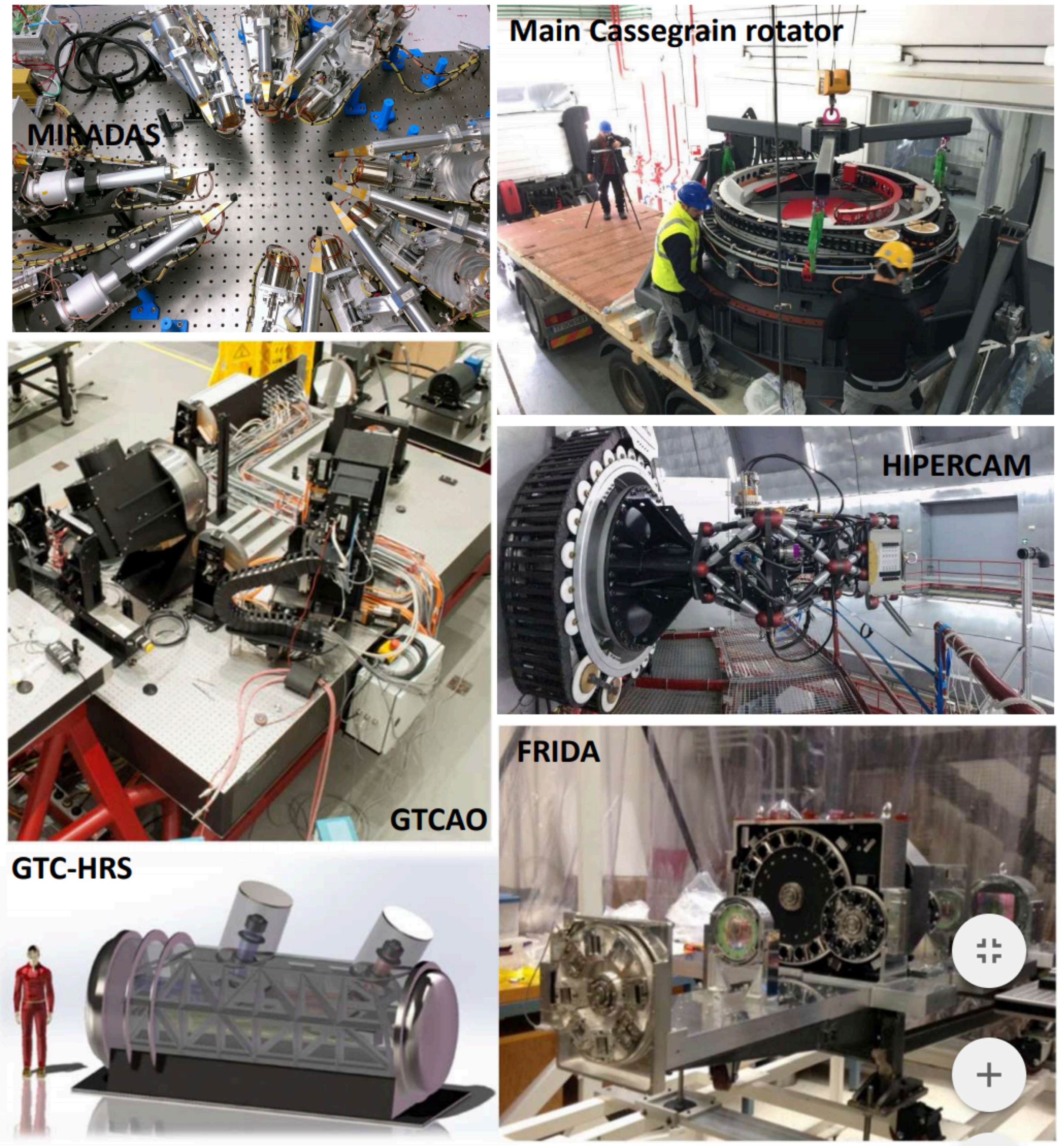
STARTING WITH THE ARCHIVE AND THE GTC INSTRUMENTATIONS PLANS

GTC instrumental plan (2020-2025)

- **OSIRIS** will be moved to Main Cassegrain focal station in 2021, due to the arrival of GTCAO system. A new detector will be incorporated by the end of 2021, and a new module (MAAT) to be used in OSIRIS is currently under discussion.
- **HORuS** will be in operation while OSIRIS is available at Nasmyth-B focal station.
- **Canaricam** will be decommissioned once remaining GT is completed (before the end of 2020).
- **MIRADAS** will be installed and commissioned on March 2021. If longer delays are produced, **HIPERCAM** will be temporarily mounted again at Folded Cass E. In any case, HIPERCAM will be back in a permanent focal station by 2022.
- **GTCAO** is steadly progressing. It's expected at the telescope on early 2021 (NGS). **FRIDA** will be available on late 2021-early 2022.
- **GTC-HRS**, developed by NAOC-NIAOT, has passed successfully its CDR on June 2019, and the instrument will be completed by 2025 (it will be operated at Coudé focal station).



A. Cabrera-Lavers

Number of refereed papers using GTC data:	460
Number of refereed papers with science-ready data in the GTC archive:	136
Number of science-ready data files in the GTC archive:	11 311

J. Manuel Alacid & E. Solano

NEW INSTRUMENTS FOR GTC

The MAAT basic parameters

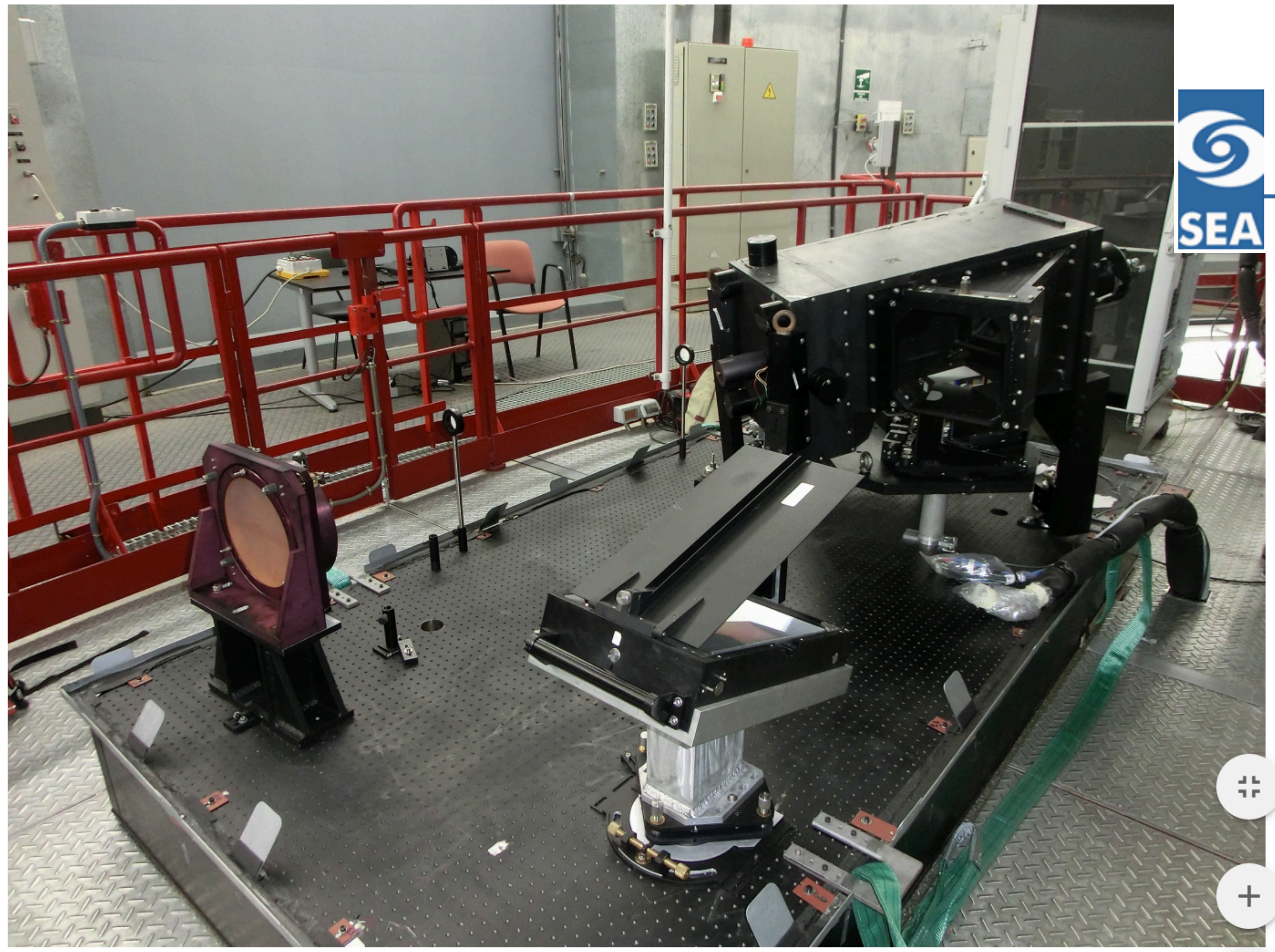
Parameter	Value	Notes
Spectrograph	OSIRIS	Install at GTC Cassegrain focus
Module	Integral Field Unit	
Field-of-View	14.20″ × 10.00″	IFU sky area is 142 arcsec^2 (141 arcsec^2 without vignetting)
Field aspect ratio	1.42	The footprint can be rotated to match the target shape or multiple objects
Slicer width	0.303″	
Spatial sampling	0.303″ × 0.127″	0.303″ × 0.254″ with 1 × 2 CCD binning
Wavelength range	360 to 1000 nm	
Spectral resolution	600 to 4100	Enhanced 1.6 times resolution power w.r.t. a 0.6″ long-slit
Detector	4k × 4k (15 μm pixel)	New Teledyne-e2v CCD231-84 deep-depleted astro multi-2
CCD plate scale	0.127″ per pixel	

Sky	Telescope	Instrument	Spectral range	Resolution	Field of View	Spatial sampling	IFU
Southern	VLT	MUSE	480–930 nm	1770–3590	59.9″ × 60.0″	0.2″ × 0.2″	mirror slicer
Northern	Keck	KCWI	350–560 nm	3000–4000	8.25″ × 20.0″	0.34″ × 0.147″	mirror slicer
N & S	Gemini	GMOS-IFU	360–940 nm	600–4400	5.0″ × 7.0″	0.2″	lenslet/fibers
Northern	GTC	MAAT	360–1000 nm	600–4100	10.0″ × 14.20″	0.303″ × 0.127″	mirror slicer

XIV.0 Reunión Científica 13-15 julio 2020

MAAT by F. Prada et al.

Horus, by C. Allende Prieto



Resolving power
25,000

Spectral coverage
377-691 nm

1 hour exposure
S/N **50,30,20**
V 14, 15,16

XIV.0 Reunión Científica 13-15 julio 2020

DATA TREATMENT

R. Infante-Sainz, M. Akhlagi &R. Baena Gallé

Results

Maneage is introduced as a customizable template that will:

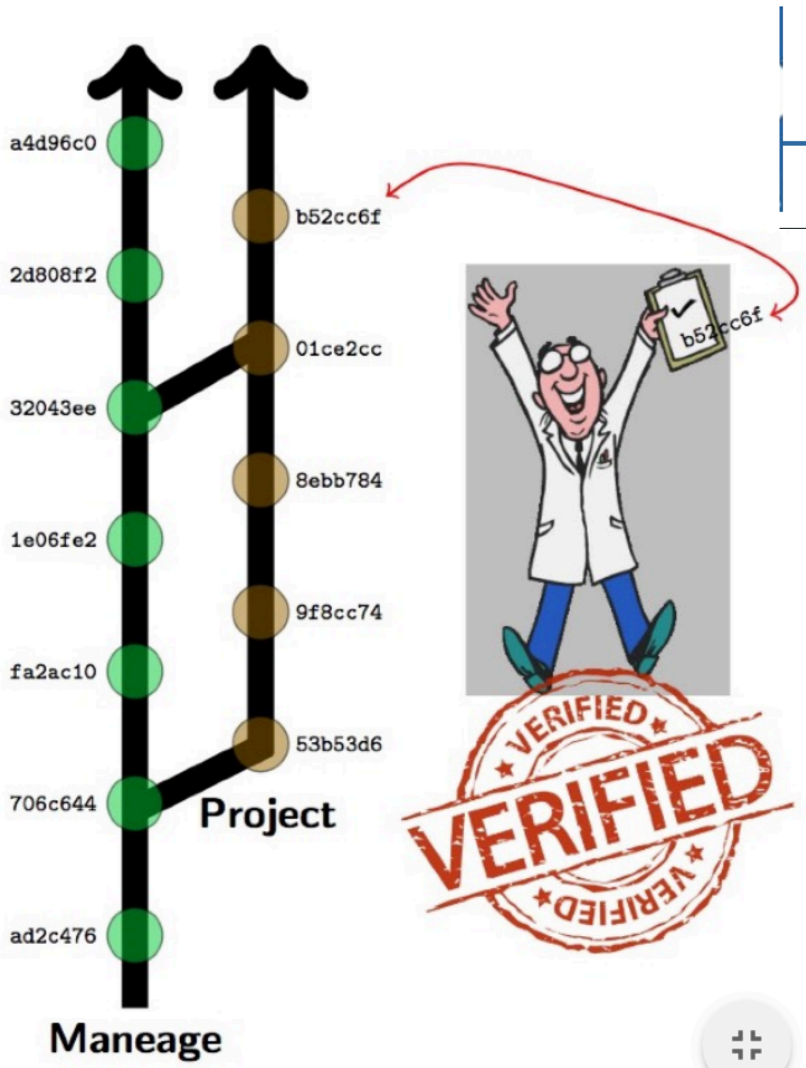
Automatically downloads software source and data

Builds the software in a closed environment

Run software on data to obtain research results

Use LaTeX to generate the paper

The whole project is under version control (Git)




```
$ git clone http://git.maneage.org/project.git
$ ./project configure
$ ./project make
```

HORIZON 2020

Manage was awarded with a RDA Adoption grant (EU Horizon 2020)

Onsite Data Reduction at La Palma

A, Baquero et

The analysis running on site, produces low and high level analysis products

R0 to DL1
- Low level calibration (pedestal subtraction, etc)
- High level calibration (ADC -> photoelectrons conversion)
- Image cleaning
- Image parameters (Hillas Parameters)

15 GB/min — 1/5 reduction

DL1 to DL2
- Apply **Random Forest** trained to DL1 data
  - Arrival direction
  - Energy estimation
  - Gamma/hadron separation

3 GB/min — 1/100 reduction

DL2 to DL3
- Gamma/hadron separation cuts (gammaness cut)
- Signal extraction cuts (theta2 cut)

0.03 GB/min

LSTOSA

IT Cluster on La Palma

55 computational nodes
x 32 cores
1760 total cores
264 GB RAM memory each

LSTOSA is the software package based on **lstchain** and **ctapipe** th... performs the first steps of LST analysis providing low-level analysis products and spotting potential issues that may affect the data

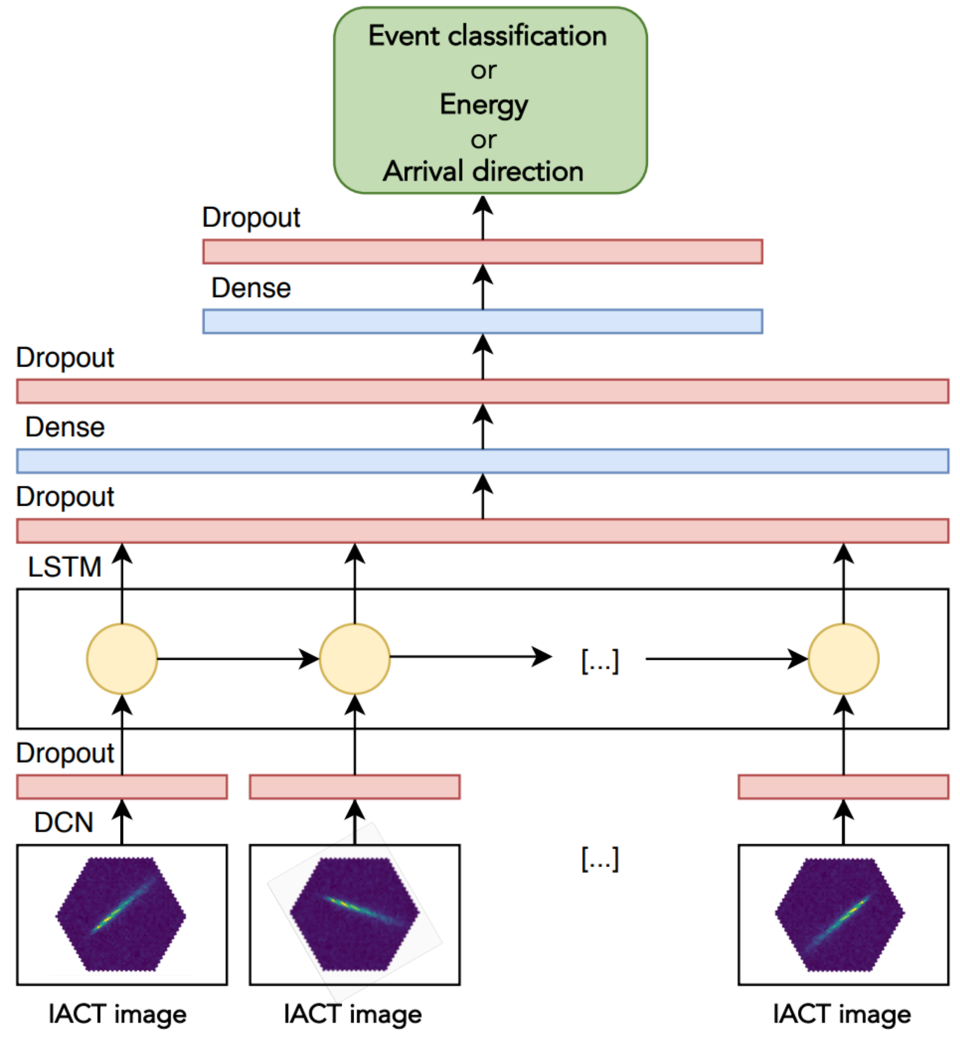
Deep learning for IACT event reconstruction: CTLearn

IPARCOS ESCAPE

CTLearn

Core developers
DN, Tjark Miener (IPARCOS-UCM)
Ari Brill, Qi Feng (Columbia)
Bryan Kim (UCLA, now at Stanford)

- High-level Python package for using deep learning for IACT event reconstruction
- Configuration-file-based workflow and installation with conda drive reproducible training and prediction
- Supports any TensorFlow model that obeys a generic signature
- Open source on GitHub:
  https://github.com/ctlearn-project/ctlearn
  https://pos.sissa.it/358/752
  DOI 10.5281/zenodo.3345947



D. Nieto, T. Miener & A.

CUBESATS & THE FUTURE

A.E. Peláez

1. Context: "New Space" and the CubeSat standard

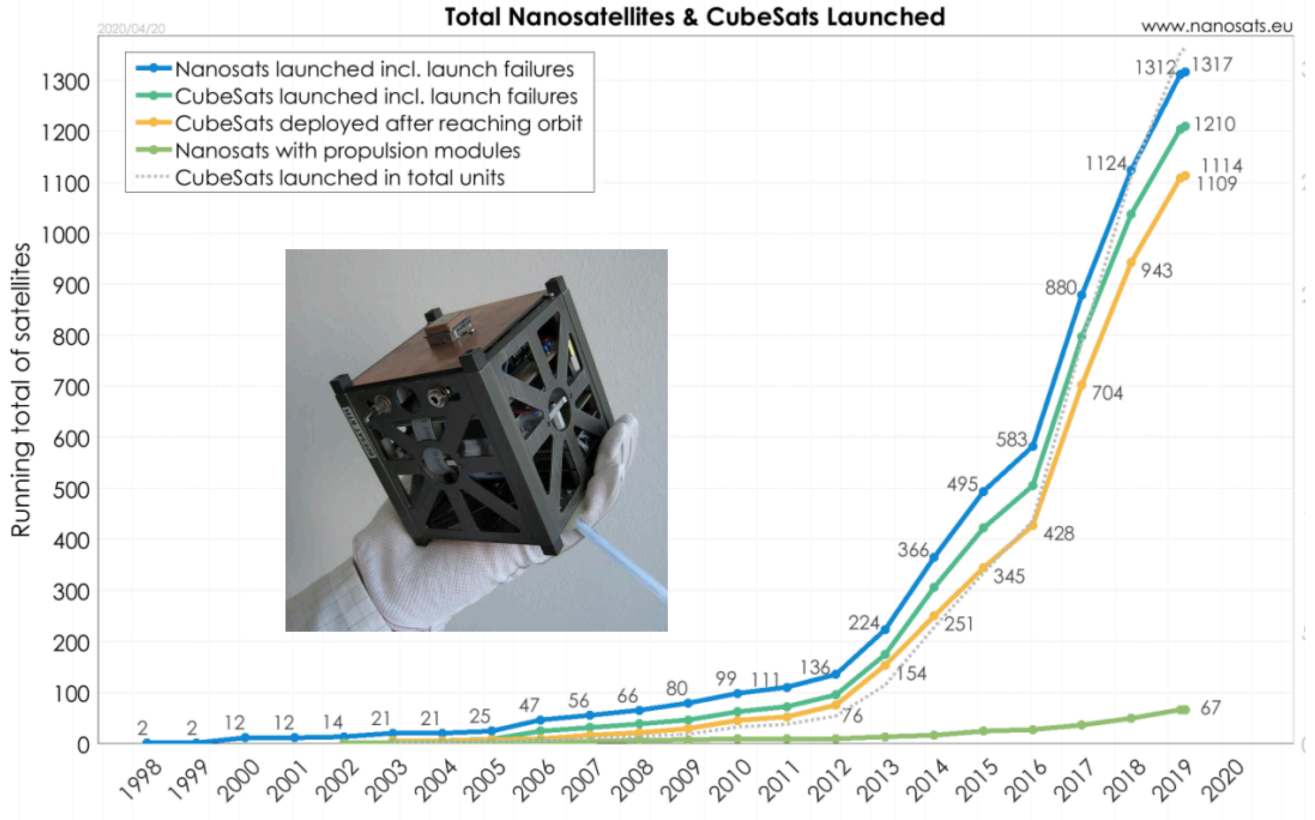
IACTEC Space

Gobierno de Canarias

GOBIERNO DE ESPAÑA · MINISTERIO DE CIENCIA E INNOVACIÓN · UNIÓN EUROPEA

CubeSats are standardized Smallsats in modular 10x10x10 cm units (1U, 3U, 6U, 12U…)

- low cost (1 ESA M-class mission ≈ 10 x 12U CubeSats), short built times, COTS components available
- frequent launch opportunities as secondary payloads
- over 1700 Smallsats (1300 CubeSats) launched! (Starlink… ☹)



… could CubeSats be "astronomers friends"?

- observing during periods and at λ's inaccesible from ground (low energy gamma, X-rays, UV, IR, radio gaps)
- low cost → small collaborations → no telescope time allocation
- CubeSat constellations → flexibility and high FoV to respond to transient events (GRBs, supernovae, GW counterparts)
- calibrators for ground observatories; auxiliary missions / subsystem demonstrators for larger missions

… but with some technological challenges to face

- high resolution only achievable with complex deployable systems
- pointing stability
- propulsion and communications in deep space missions
- achieve high-performance following the small SWaP-C concept

-Creating and maintaing a catalogue of man-made space objects
-Conjuction prediction and risk analysis
-Re-entry prediction
-Fragmetation detection
-Special mission support
-Characterising sub-catalogue objects

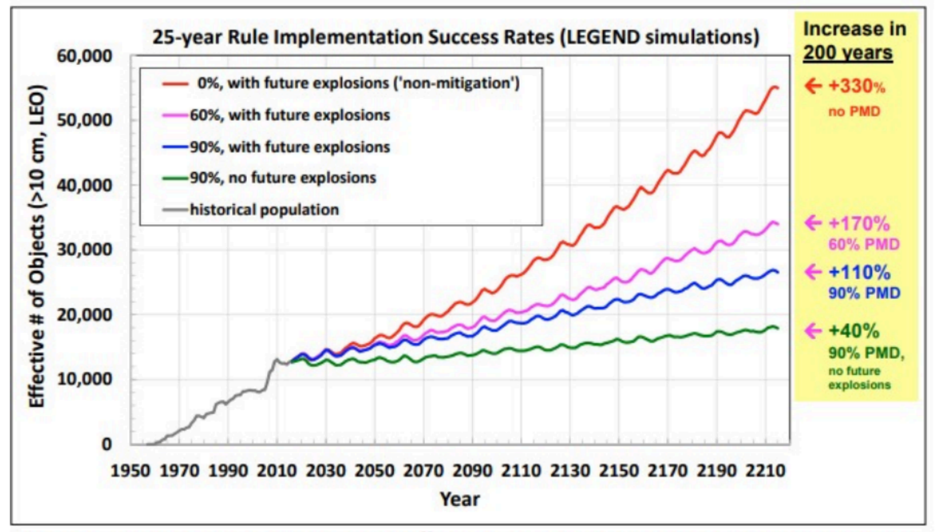


Figure 4. Future population projections based on different 25-year rule compliance levels and accidental explosions. Projection results are based on averages of 100 Monte Carlo simulations each.

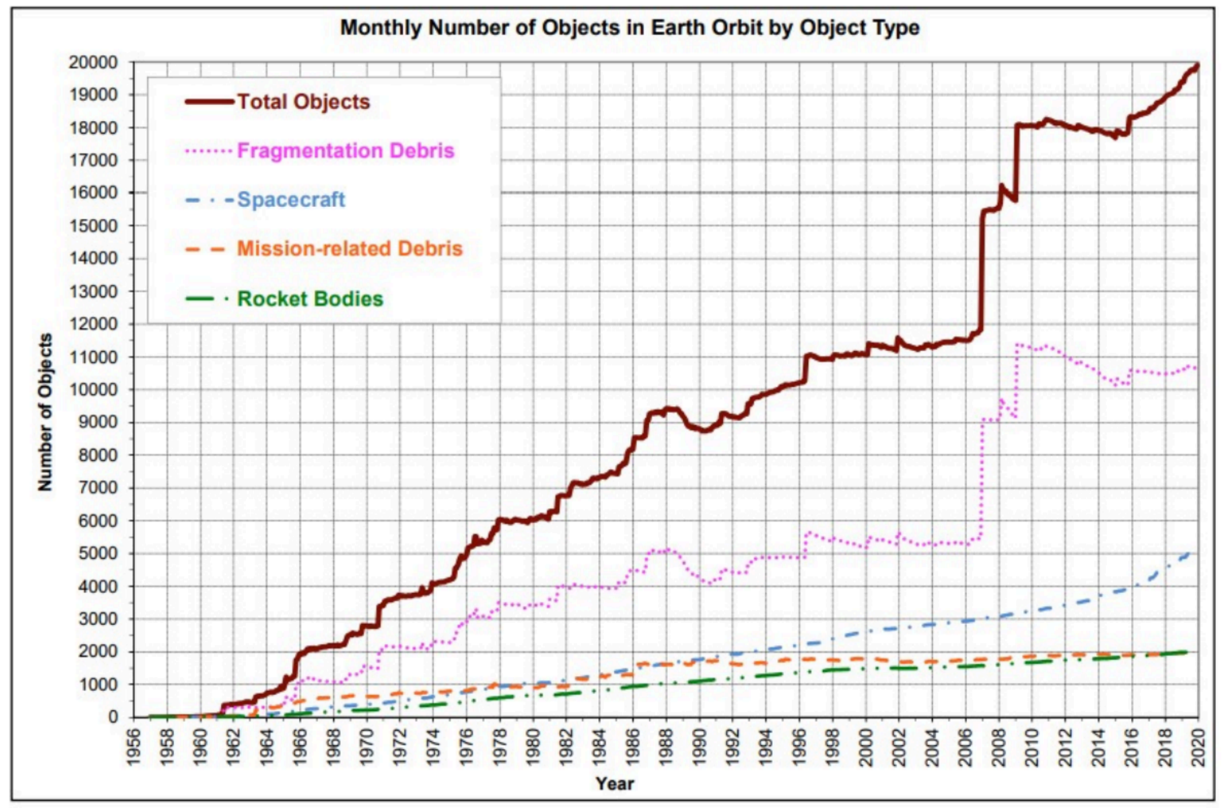


Figure 1. Monthly Number of Cataloged Objects in Earth Orbit by Object Type. This chart displays a summary of all objects in Earth orbit officially cataloged by the U.S. Space Surveillance Network. "Fragmentation debris" includes satellite breakup debris and anomalous event debris, while "mission-related debris" includes all objects dispensed, separated, or released as part of the planned mission.

Source: NASA Orbital Debris Quarterly News issue 24i1

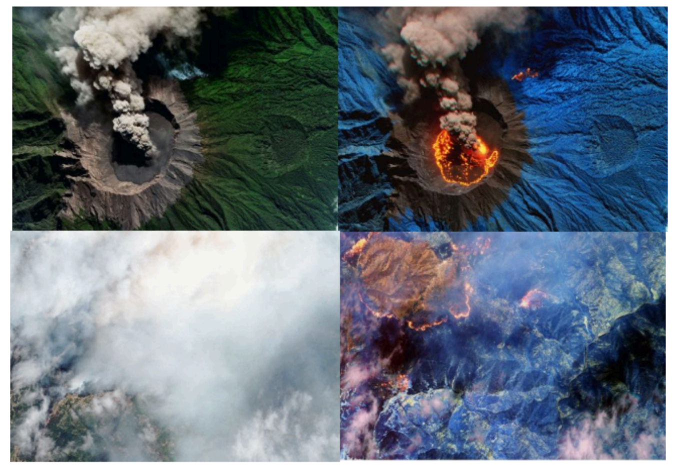
O. Zamora, M. Rodriguez Alarcón & M. Koll Pistani

IACTEC Space

3. Results II

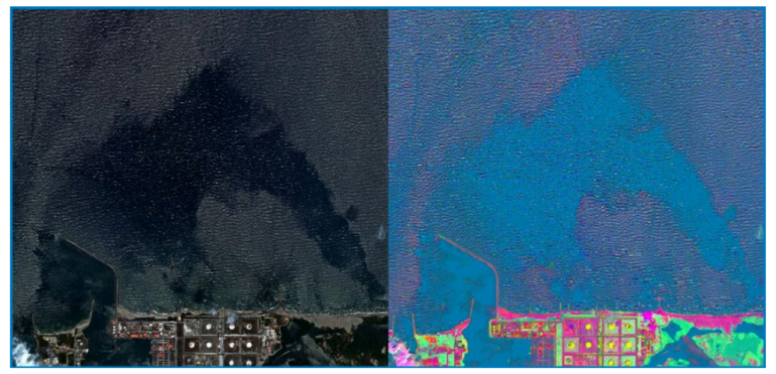
Imaging in SWIR

Wildfire detection and monitoring



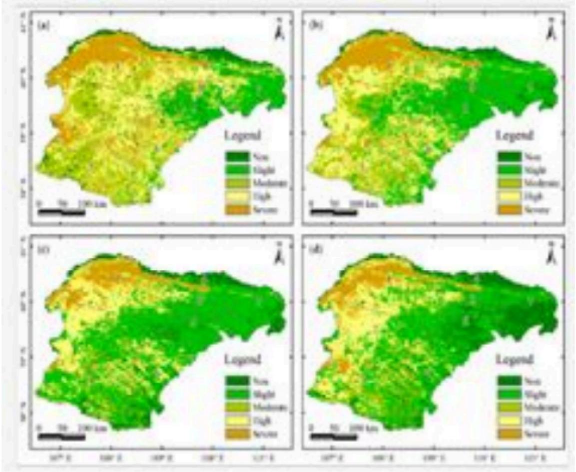
Visible (1) SWIR

Oil spills monitoring



Visible (1) SWIR

Desertification analysis



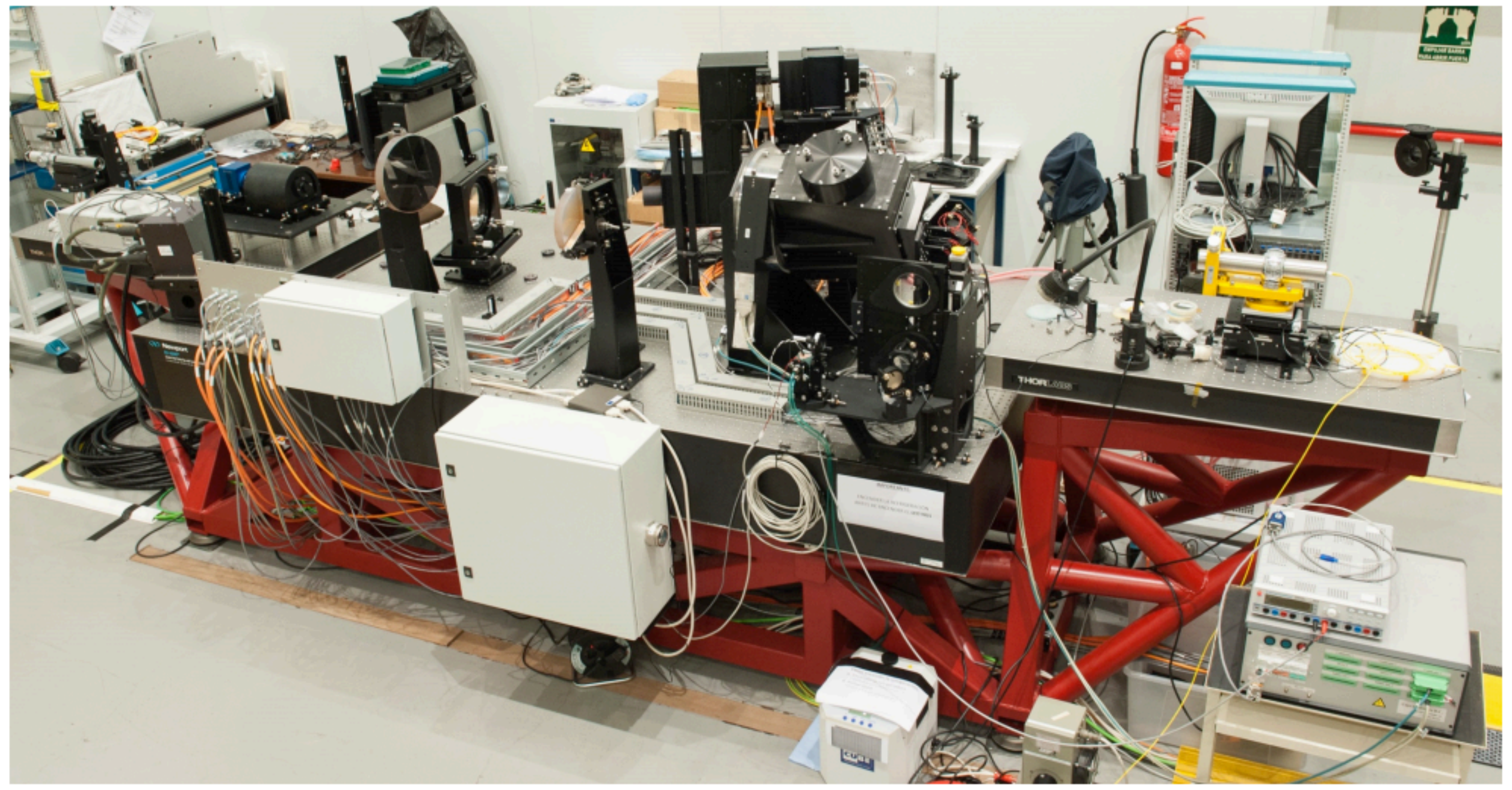
(2)

I. Bustamante

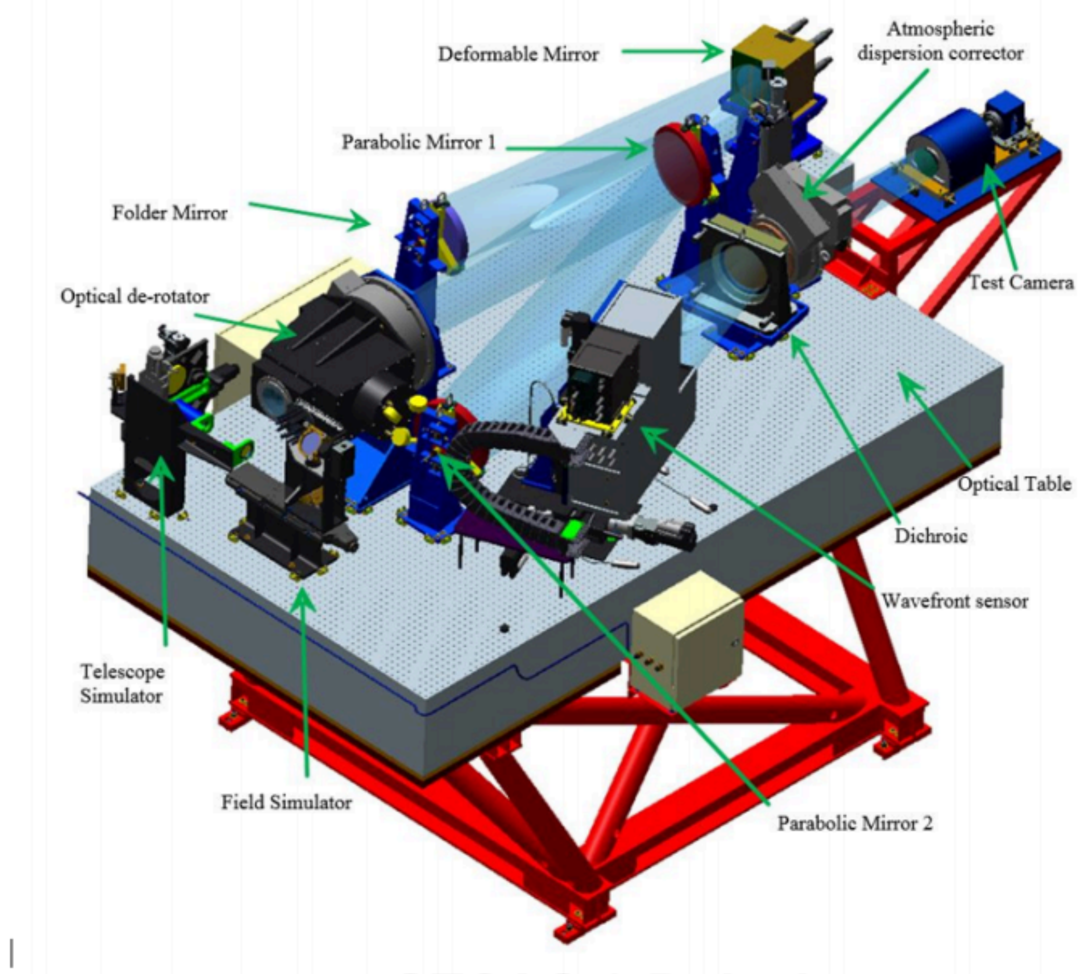
V. BEJAR ET AL. & THE LASER GUIDE STAR

GTCAO update

- All the subsystems already tested at the lab
- Testing the GTCAO performances including Non-Common Path Aberrations (NCPAs)
- Design a mechanism in the Calibration System to focus the input fiber to TestCam and FRIDA
- Develop the SW of the TestCam, mechanisms in the GTC Control System
- Built of the final GTCAO structure



GTCAO at AIV lab



GTCAO 3-D design

GTCAO LGSF

GTCAO and LGS schedule

MILESTONE	DATE
GTCAO AIV completed in lab – Acceptance tests	Spring 2021 (TBC with GRANTECAN)
GTCAO AIV in GTC	Summer 2021 (TBC with GRANTECAN)
Laser system final acceptance at IAC	July 2020
Detailed Design LGS	CDR Spring 2021
Laser Launch Telescope acceptance at IAC	September 2021
LGS Subsystems integration in laboratory	2022
LGS AIV in laboratory completed – ready for acceptance tests	End 2022
LGS AIV en GTC	Summer 2023

I. JIMÉNEZ & MAGIC

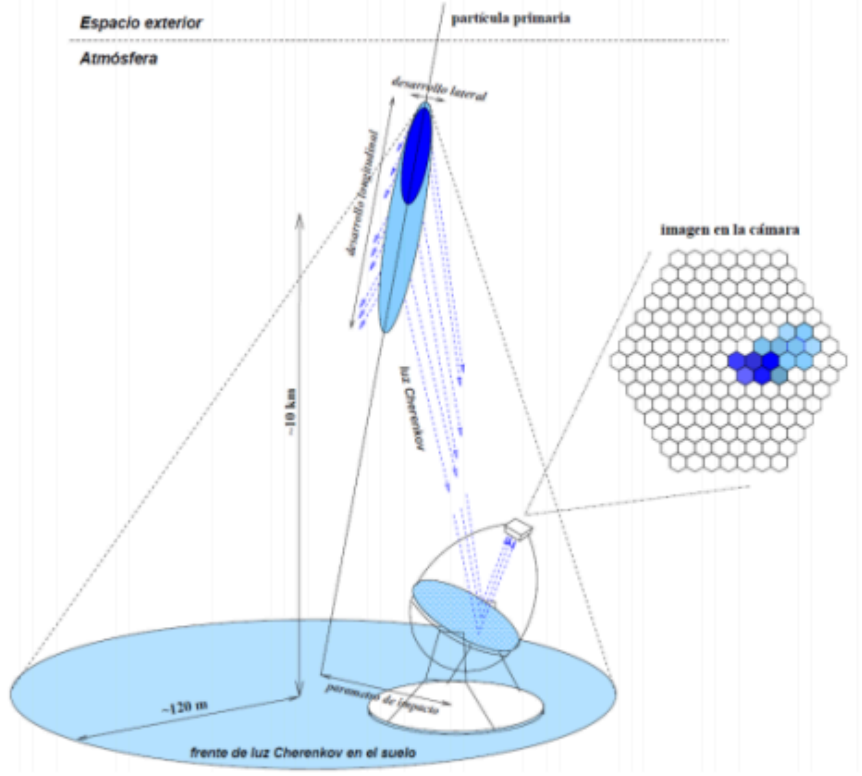
Context of the research

What is MAGIC?

- 'Major Atmospheric Gamma Imaging Cherenkov Telescopes'
- System of two Imaging Atmospheric Cherenkov Telescopes in Roque de los Muchachos (La Palma, Spain) sensitive to gamma rays above 50 GeV
- Diameter of each reflector: 17m

How does it work?

- Charged particles interact with our atmosphere, producing a series of cascades or 'atmospheric showers'
- Some of these particles move faster than light in that medium, producing a very short flash (nanoseconds) of blue light
- This effect is known as 'Cherenkov radiation'



What is the Intensity interferometry technique?

- For the right telescope separation both starlight amplitude and intensity are correlated
- Conventional "phase/amplitude interferometry" looks for correlation in amplitude while we are measuring correlation in intensity
- The correlation of the starlight intensity fluctuations allows us to measure the spatial coherence or visibility $|V_{1,2}|^2$
- Measuring $|V_{1,2}|^2$ over a sufficient range of baselines allows us to construct an image of the source
- Most stars have angular diameters of less than 1 miliarcsecond (m.a.s.) and resolving them requires baselines of hundreds of meters at optical wavelengths