



cherenkov
telescope
array

Thesis Day

Roberta Zanin on behalf of the CTA Bologna group (Stefano Marchesi, Paolo da Vela, Eleonora Torresi, Paola Grandi, Massimo Cappi, Cristian Vignali...)
February 5, 2024

What is CTAO?

have you ever consider to ask for a thesis on CTAO?



3 motivations to carefully listen to this talk and consider CTA as beginning of your scientific career

1. Astronomy

many of the main open questions in physics are related to astronomy

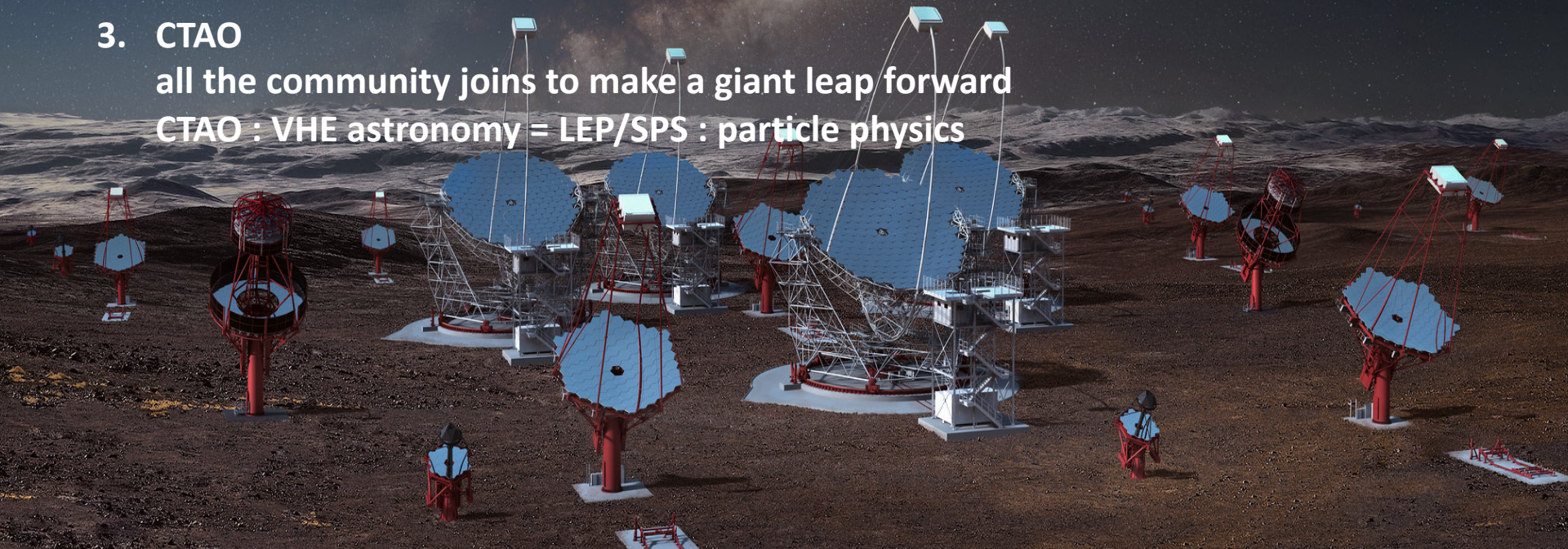
2. Very-high-energy gamma-ray astronomy

→ astroparticle: the Universe is our particle factory and the Earth's atmosphere as calorimeter

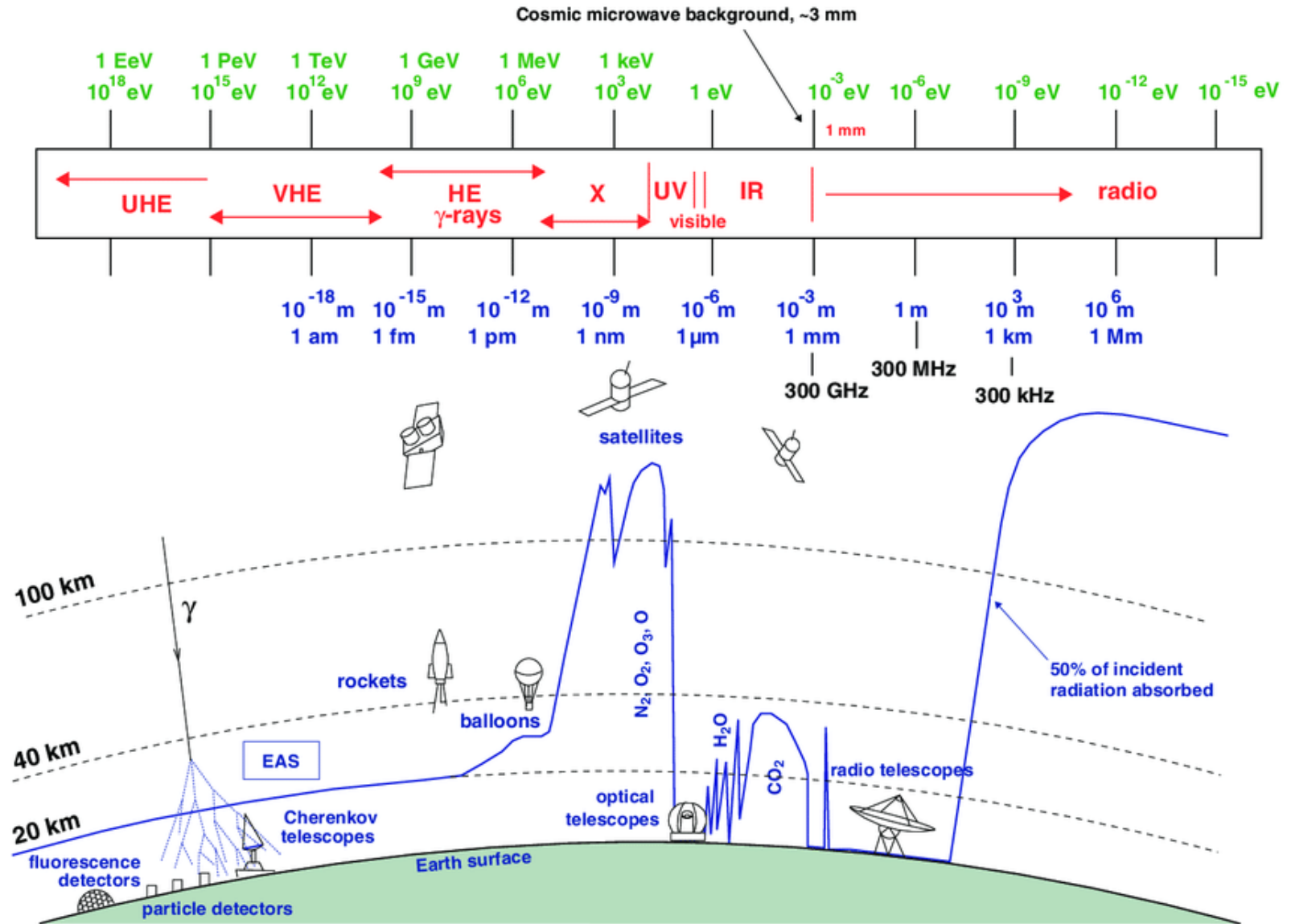
3. CTAO

all the community joins to make a giant leap forward

CTAO : VHE astronomy = LEP/SPS : particle physics



Very-high-energy astronomy



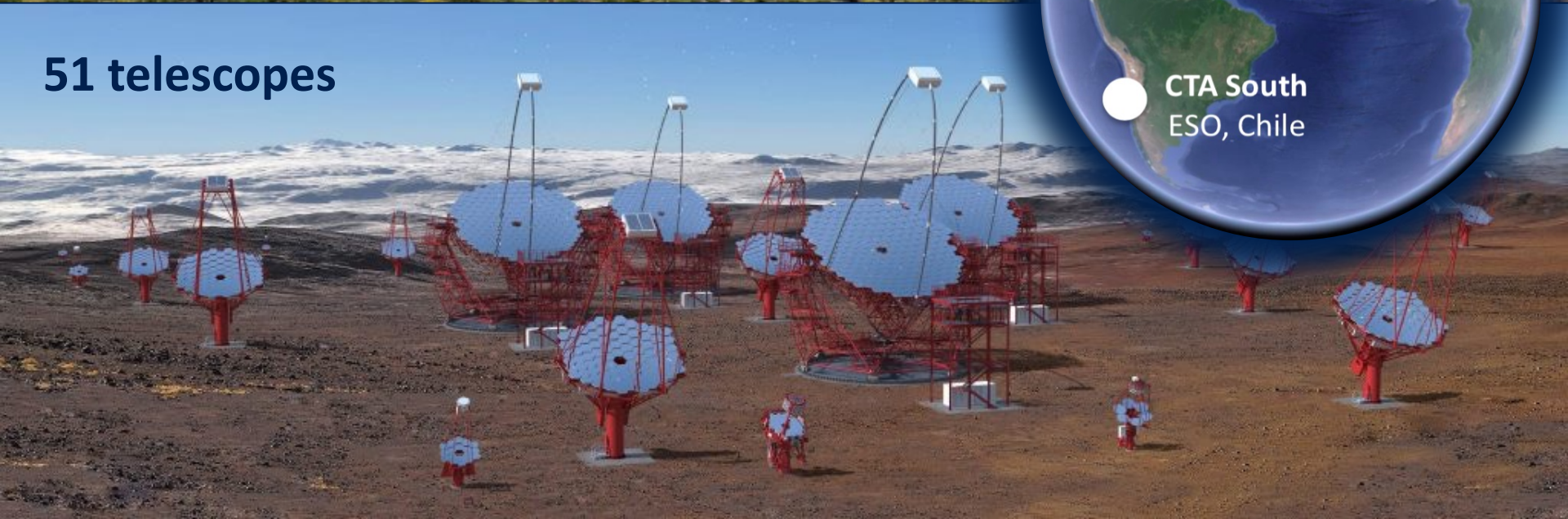
CTAO



13 telescopes

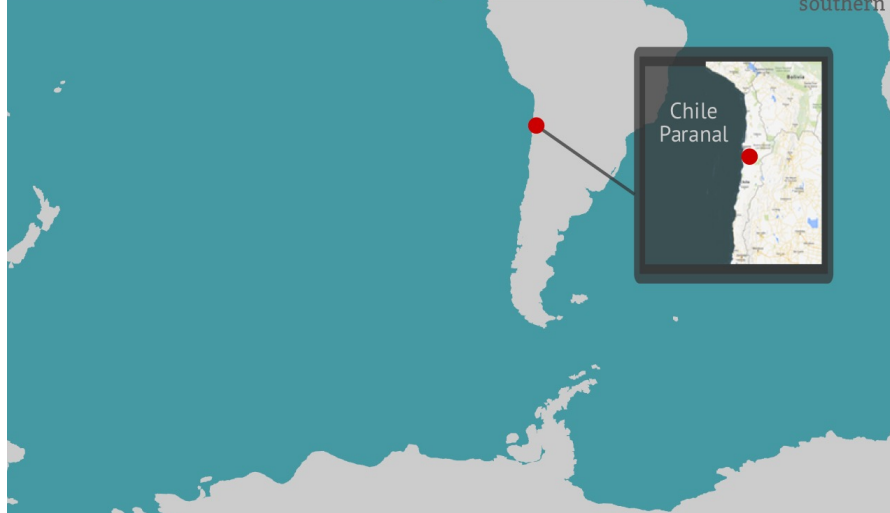


51 telescopes

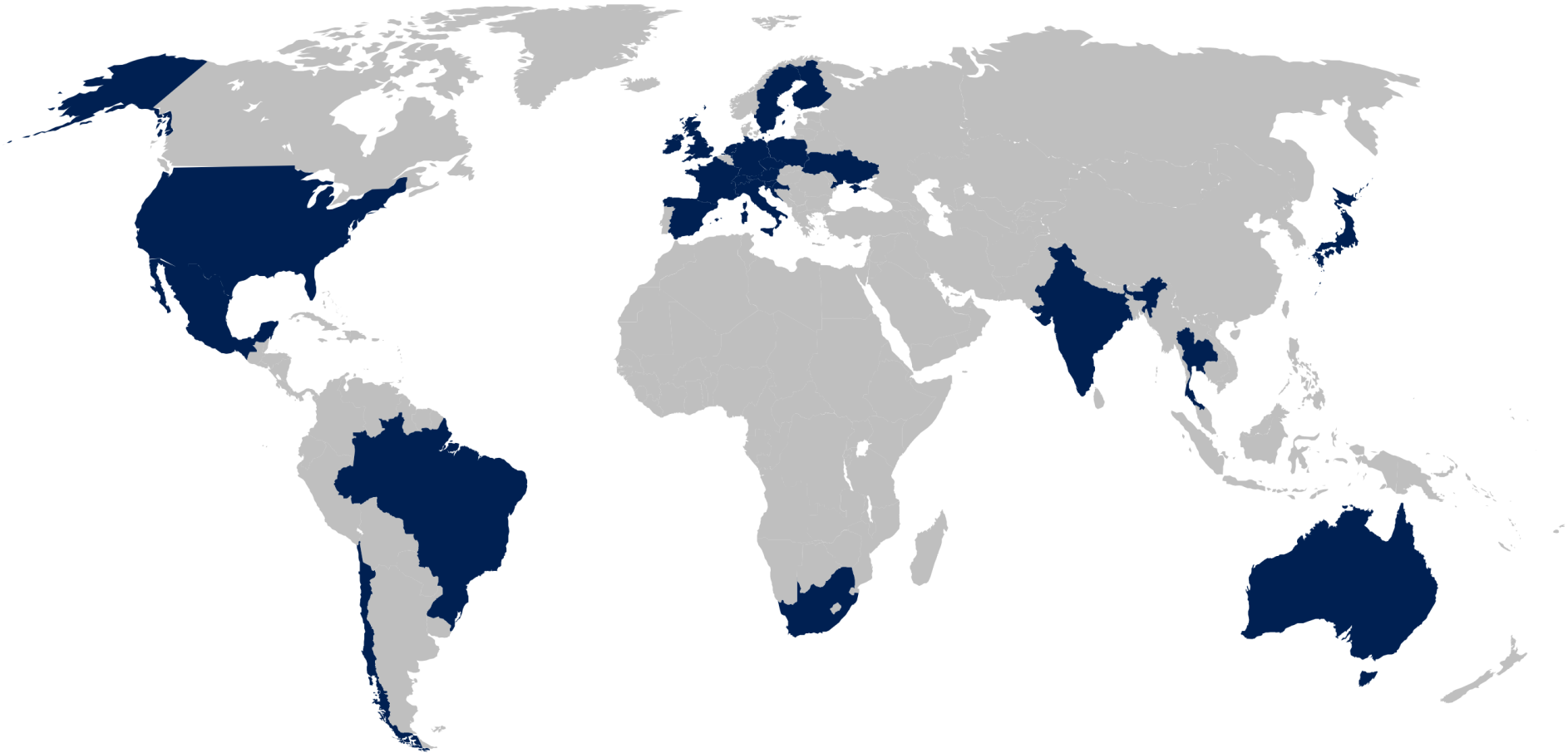




northern hemisphere
southern hemisphere



CTAO headquarters



world-wide community: many interesting possibility to set up exchange programs with several countries, especially within Europe.

A transversal group

- **CTAO HQs** where the entire project is managed: construction, operations and science organization
R. Zanin
- **DIFA** extragalactic high-energy experts
Prof. M. Brusa, S. Marchesi, Prof. C. Vignali
- **OAS** software developers, extragalactic and galactic high-energy experts
A. Bulgarelli, M. Cappi, A. Comastri, P. da Vela, V. Fioretti, P. Grandi, E. Torresi, V. Sguera + 5 Ph.D. students: E. Bronzini, G. Brunelli, C. Nanci, G. Panebianco, A.

Perfect timing to join



First telescope already taking data

→ hands on real data



Perfect timing to join



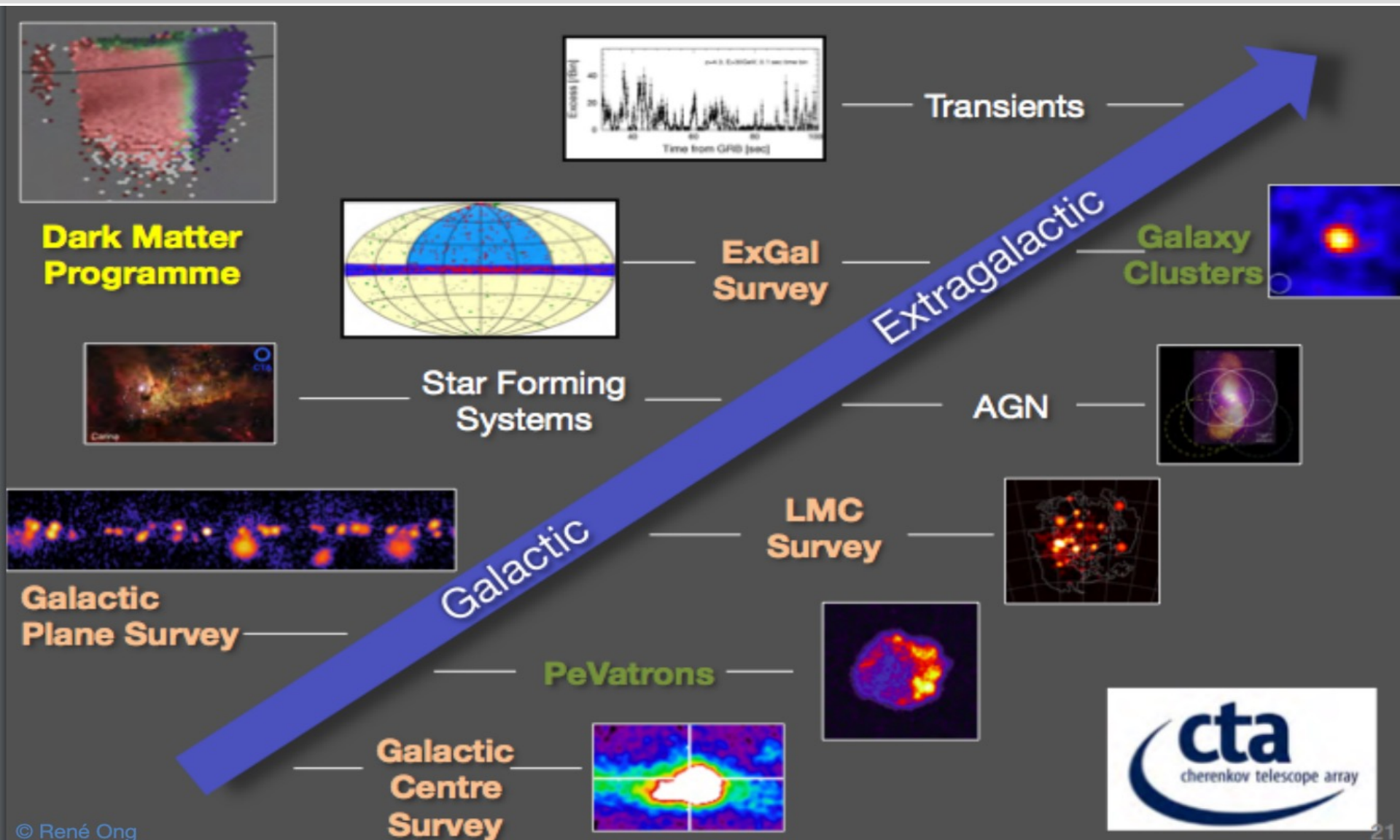
First telescope already taking data

→ hands on real data

tens of other telescope
will take the first data
in the coming years



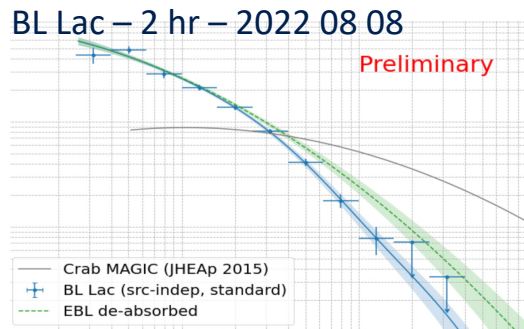
CTAO science



First scientific results of LST1



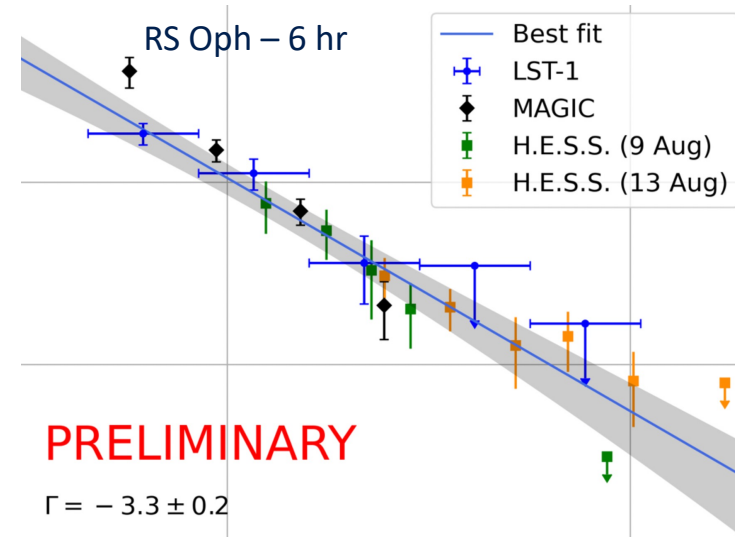
- analysis and results interpretation of VHE-emitting blazars detected by LST-1



- Search for VHE emission from Galactic transients and/or gamma-ray binaries in the LST-1 data

The candidate will become member of the LST collaboration and as such will have access to the LST1 data learning:

- to analyze VHE gamma-ray data both low- and high-level analysis
- to interpret the results addressing specific questions of the considered science case
- to insert the obtained results in a multi-wavelength context
- to present the results to the collaboration



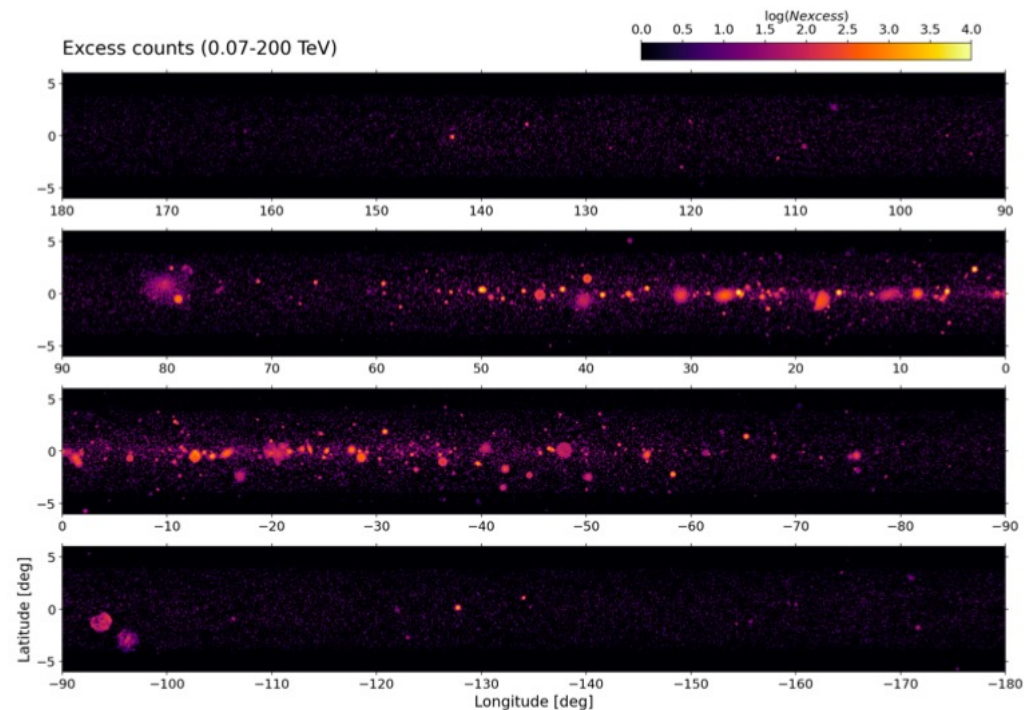
CTAO Science data challenge



- use the GRB templates used to simulate GRB events to study CTAO capability of detecting GRBs as a function of different physical and observational parameters, with a clear focus during the construction phase
- CTAO capabilities in spatial-dependent spectroscopy using simulated data of extended source like the Cygnus Cocoon

The candidate will learn:

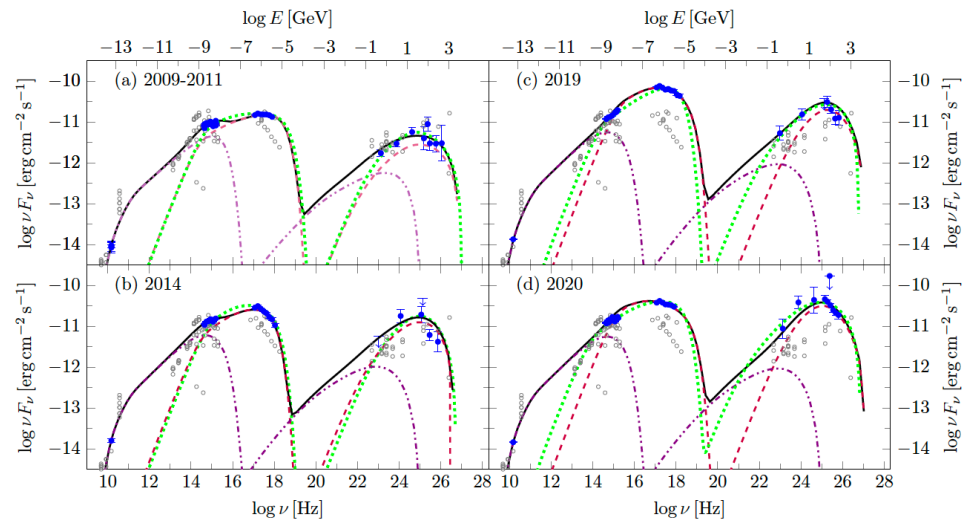
- *to simulate VHE gamma-ray data preparing the physical model and convolving it with the instrument response*
- *to analyze VHE gamma-ray data with gammapy*
- *to interpret the obtain results and understand the capability that CTAO will have in exploiting the two science cases*
- *to present the results to the CTA scientific collaboration*





Towards a public archive of extragalactic sources studied by MAGIC

- During the years, MAGIC Cherenkov telescope has studied a significant number of extragalactic sources in the most extreme energy range.
- However, as of today, no public archive for both TeV and multiwavelength products exists for MAGIC: currently, only a page with fits files is available (<http://vobs.magic.pic.es/fits/>)
- Other collaborations: VERITAS has archive publicly accessible on HEASARC.
- H.E.S.S.: built an online repository containing fits file and list of information in each paper.



MAGIC collaboration (2023)



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DI ASTROFISICA

Thesis project: contribute to make the archive OpenAccess compliant, use it for population studies

- Two-step project: first part would be working on putting available files (SEDs, light curves) in a common format that can be used by everyone, as well as generating publicly accessible Jupyter codes for plotting and data analysis
- The files will also be made accessible by public tools for the multi-wavelength analysis of blazars, such as the Open Universe VOU-Blazars one (<https://sites.google.com/view/ou4blazars>), the SSDC-ASI TeGeVcat (<https://www.ssdc.asi.it/tgevcats/>), Firmamento (https://firmamento.hosting.nyu.edu/data_access), MMDC (<https://mmdc.am/>)...
- These tools allow one to produce spectral energy distributions of a source of interest (which can be a known blazar as well as a new candidate target), and model them to get information on the SED properties (synchrotron peak location, variability...)
- Firmamento already includes information on CTA expected sensitivity as well: powerful tool to make predictions for CTA (both on single sources and on surveys).
- Other projects (TeV luminosity function, IR-variability vs synchrotron peak) are available.
- Thesis in collaboration with Università di Padova (Prof. Michele Doro; Dott.ssa Elisa Prandini)

Thank you!

