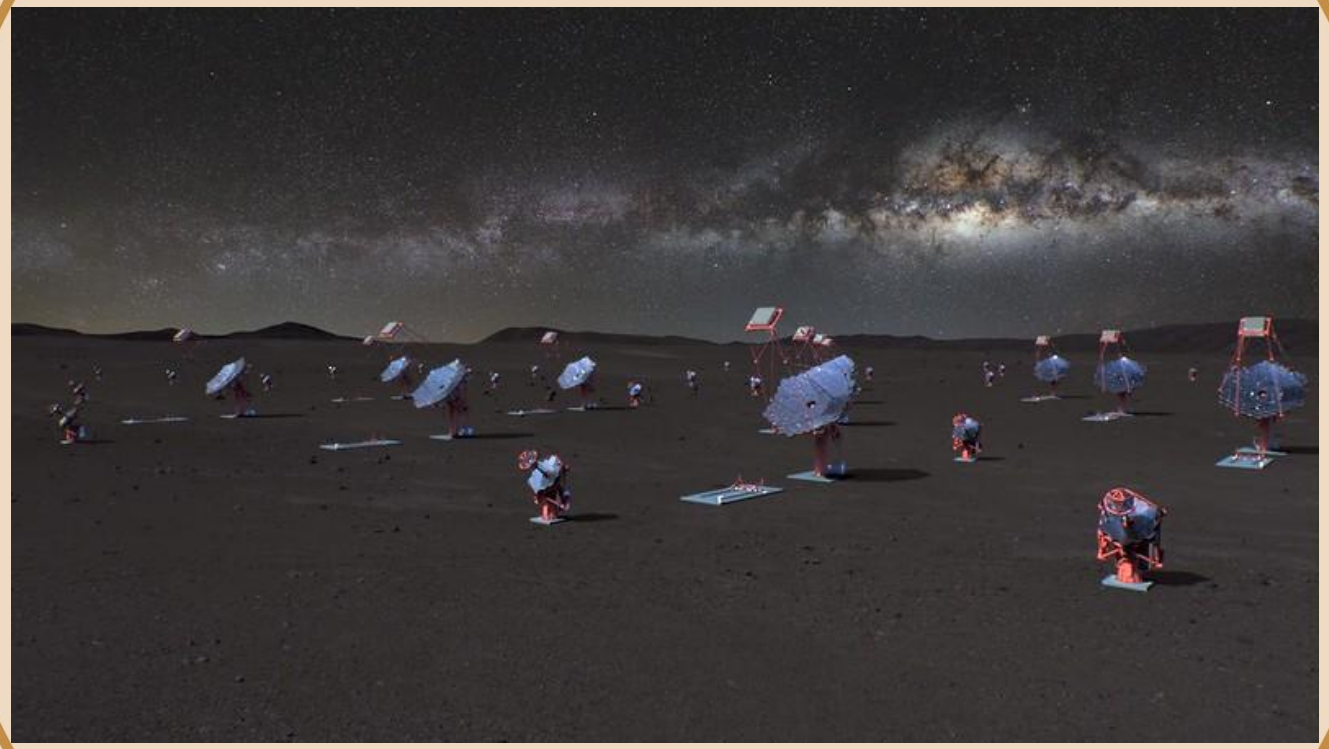
Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA
INAF ISTITUTO NAZIONALE DI ASTROFISICA

The CTAO: status and perspectives



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Advances in Modeling High-Energy Astrophysical Sources, Sexten, Italy
30 June - 4 July 2025

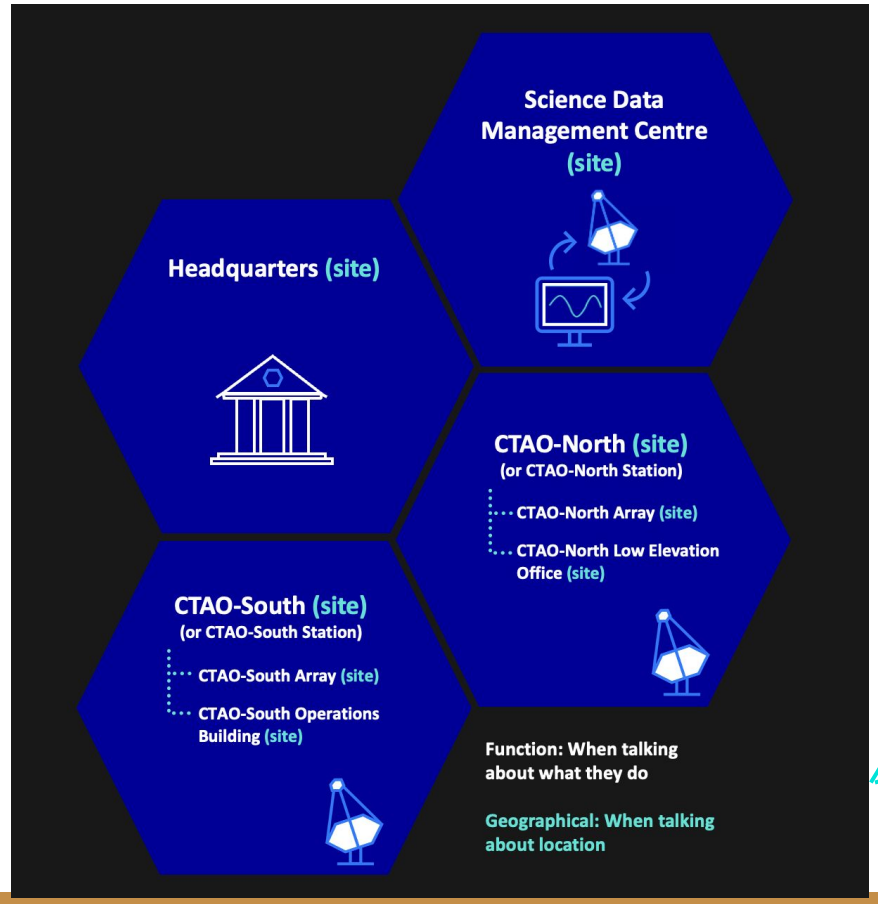
Progetto PNRR CTA+
Proposta IR0000012
CUP: C53C22000430006

Missione 4 ● **Istruzione e Ricerca**
Componente 2 Dalla ricerca all'impresa
Linea di investimento 3.1

Outline

- **CTAO : an astronomical observatory**
- **IACT: the present and the future**
- **Early science with CTAO**
- **Conclusions**

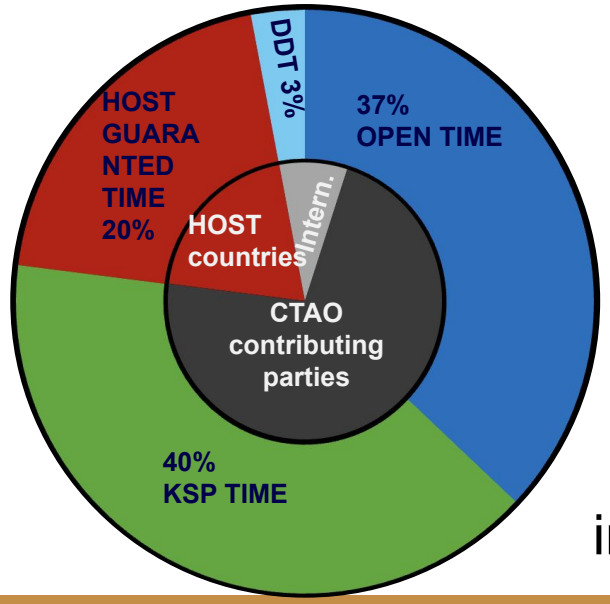
CTAO : a distributed facility



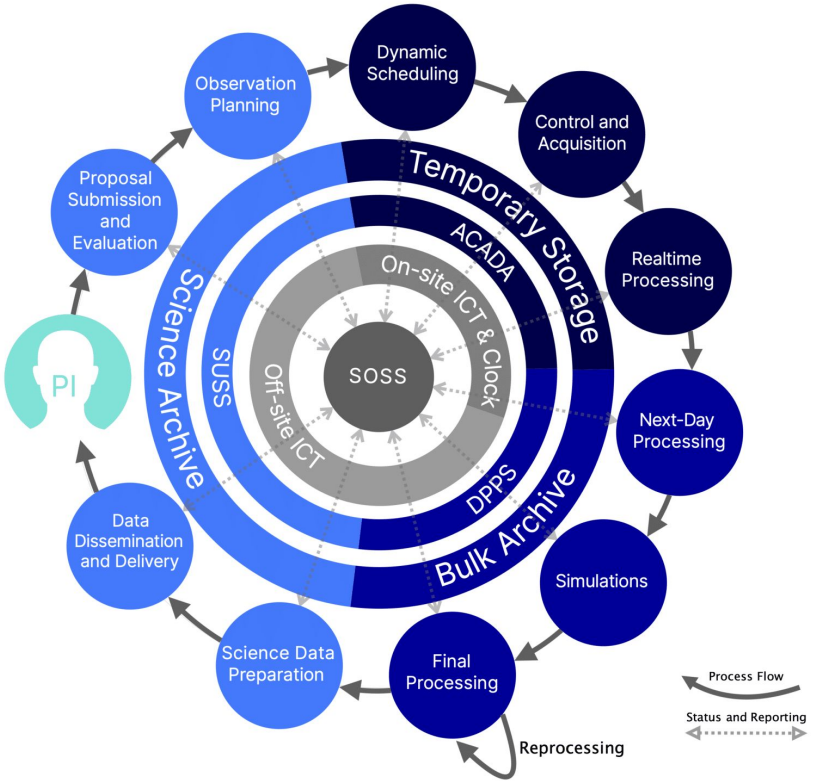
An Astronomical observatory

An open proposal-driven observatory

- Proposals will be evaluated only on their scientific merit
- Data with a proprietary period of 1 yr after that fully open



integrated over 10 yr



Today

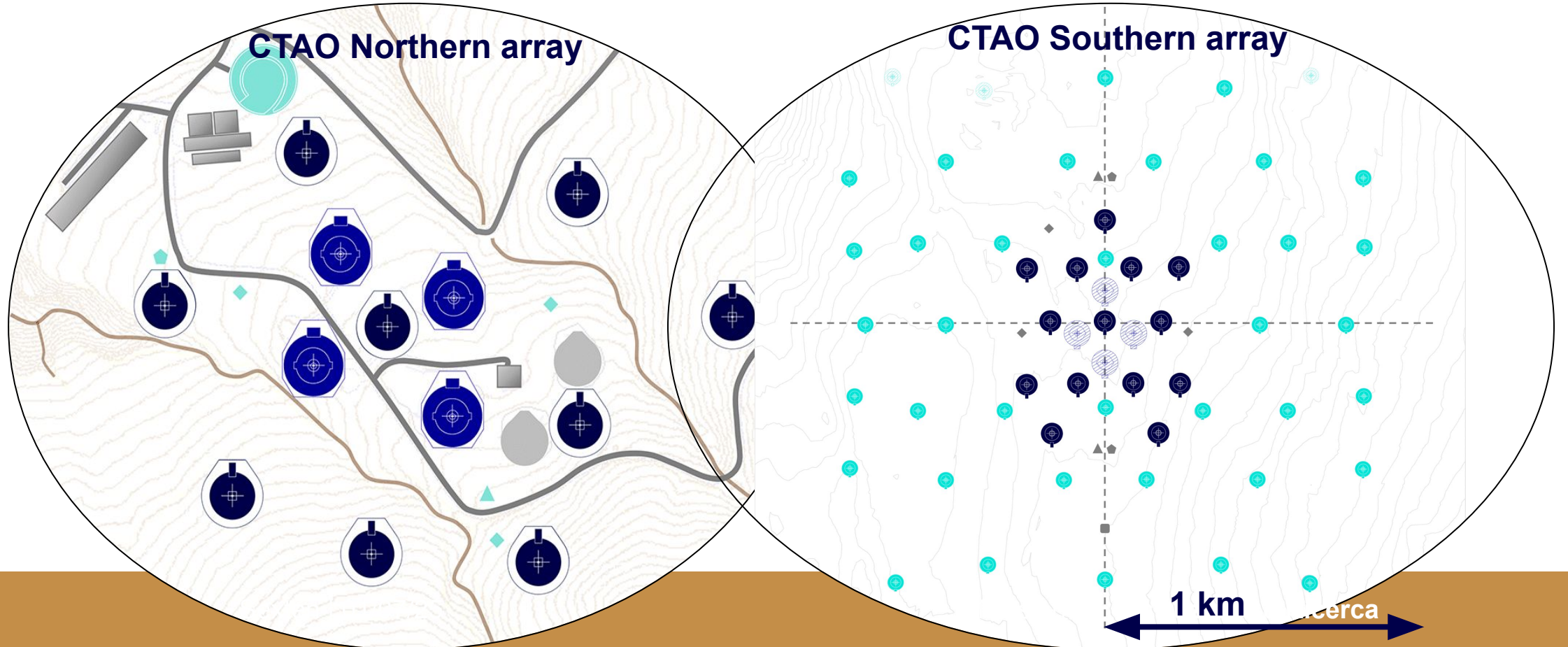
The second generation of IACTs (since 2004)

Today

The second generation of IACTs & of particle array detectors (since 2012)

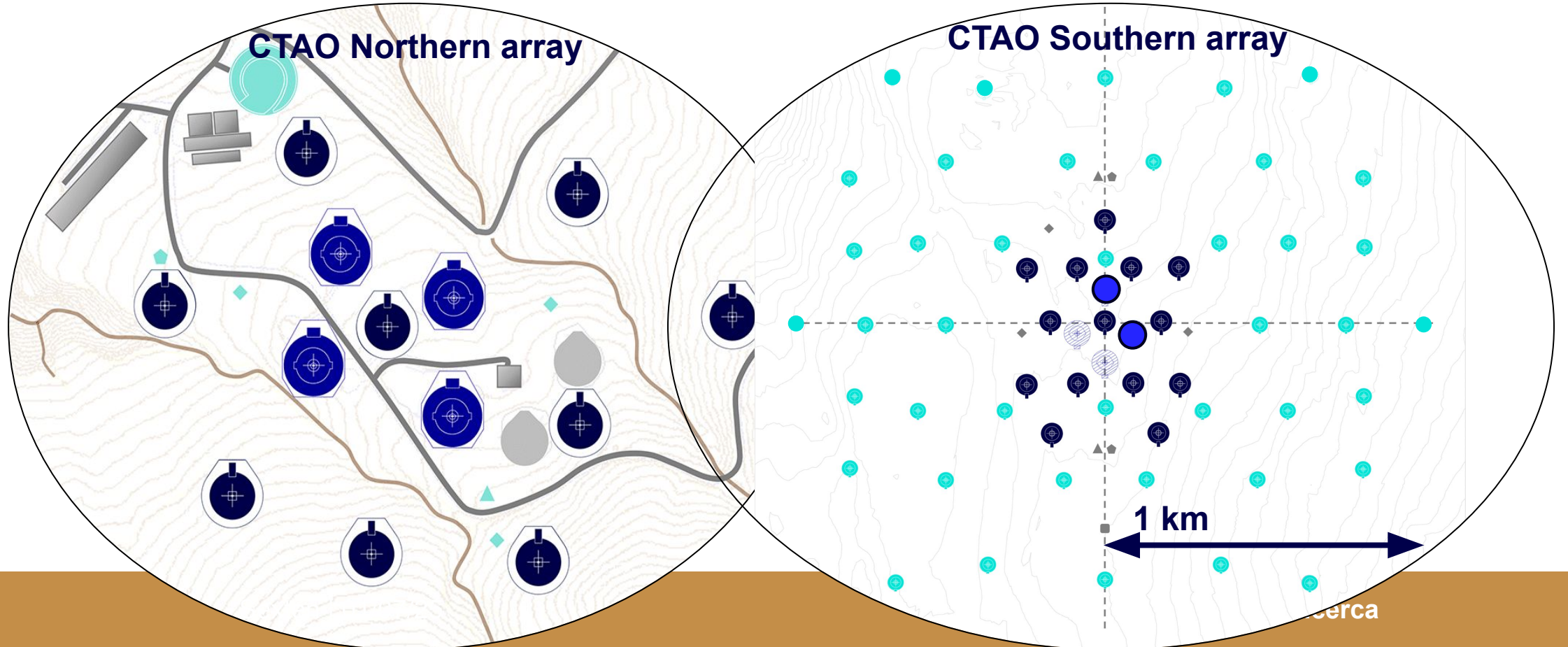
Two observation stations, one unique observatory

Alpha configuration

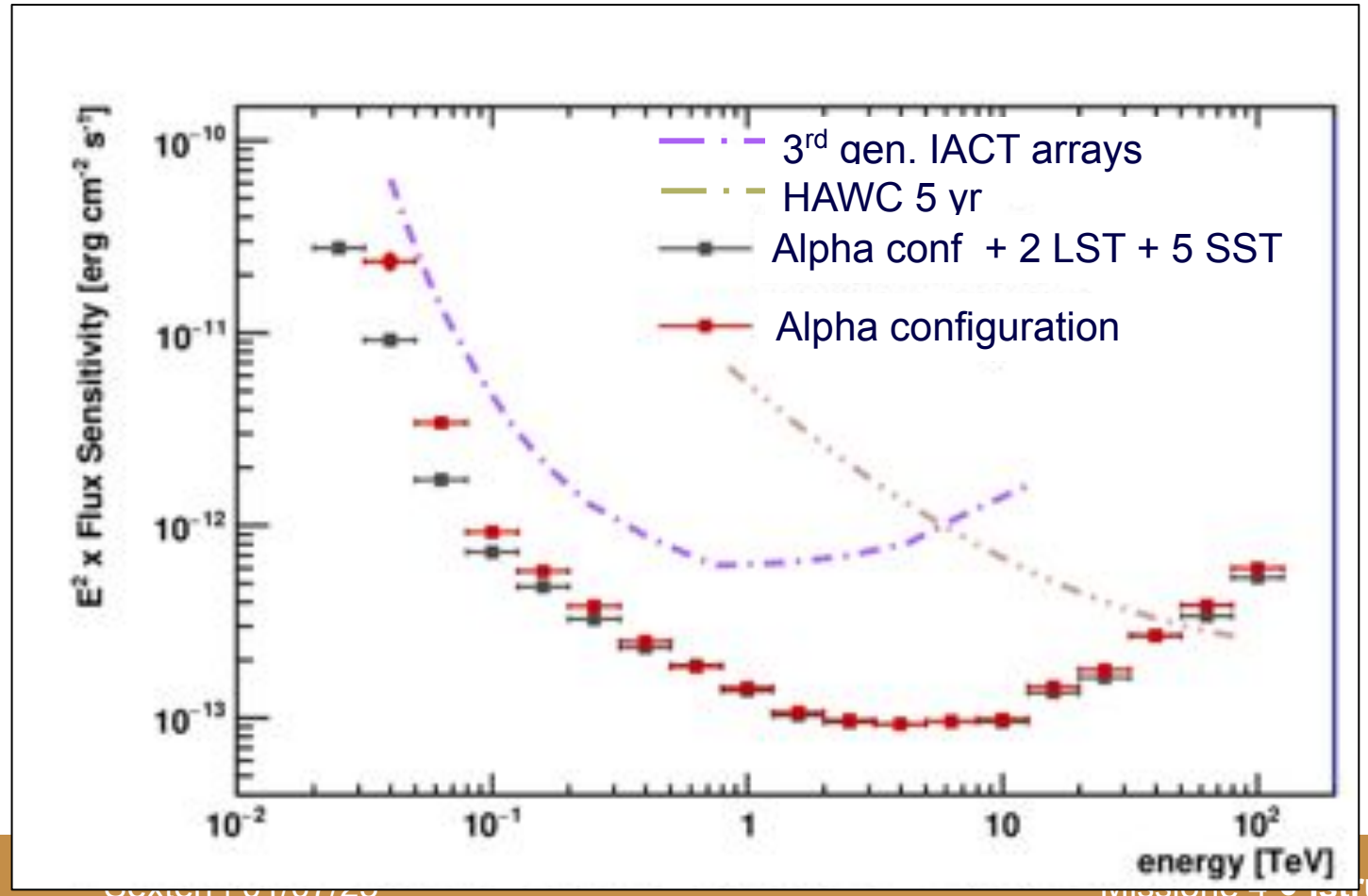


Two observation stations, one unique observatory

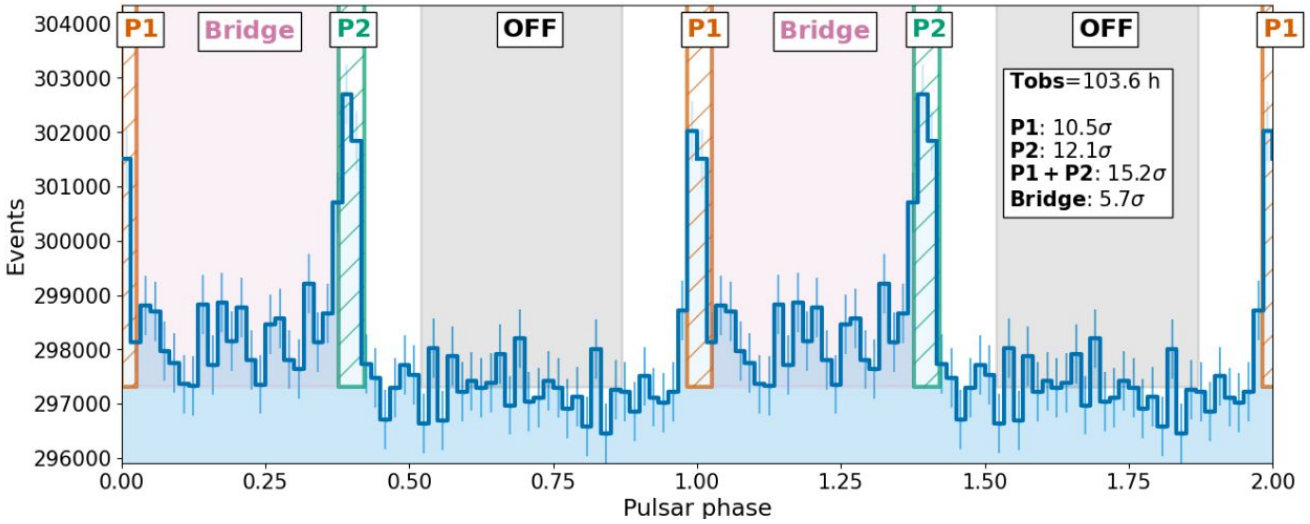
Alpha configuration



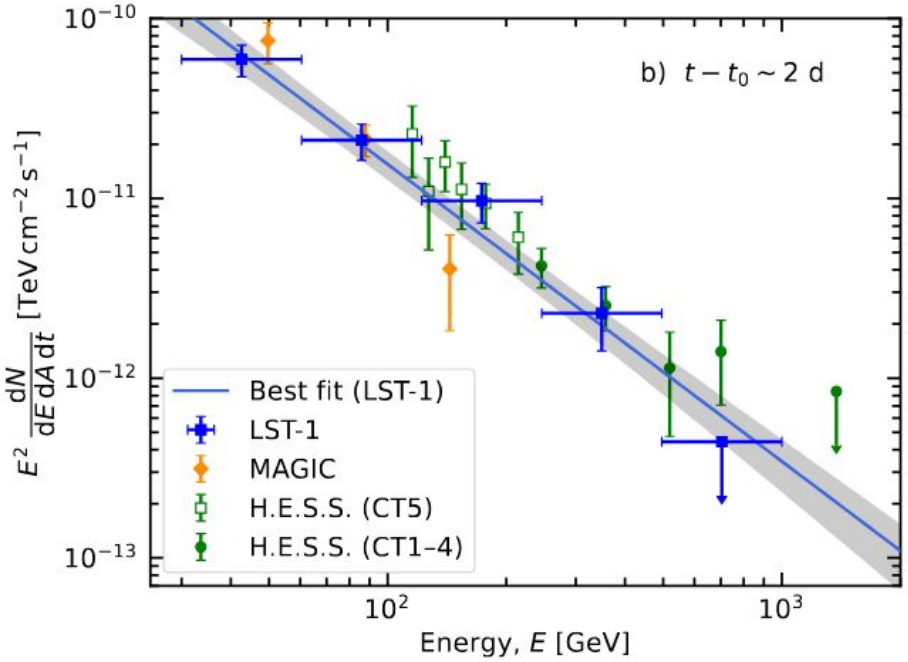
Improved Alpha configuration



Improved Alpha configuration



LST coll., 2024: Phaseogram of the Crab pulsar



LST coll., 2025: VHE detection of the nova RS Oph with LST1

Towards the first CTAO data

Intermediate array configurations

CONCEPT

Intermediate array configurations: incremental array configurations that become progressively operative

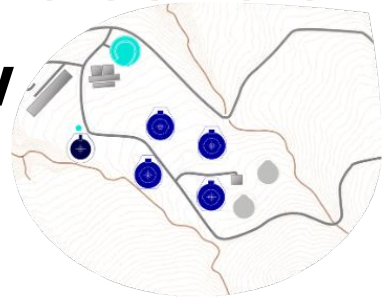
- array elements fully integrated with the intermediate releases of the software packages
- array elements include telescopes but also calibration devices and atmospheric characterization instruments

MID-PERIOD PLAN (3 yr long) BASED ON THE CONSTRUCTION SCHEDULE
built accounting for the inputs of the in-kind contribution teams

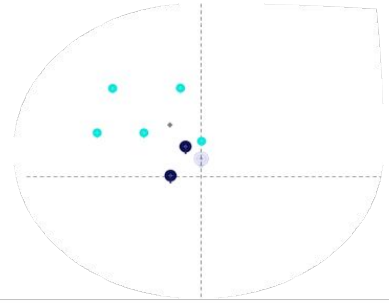
First intermediate configuration

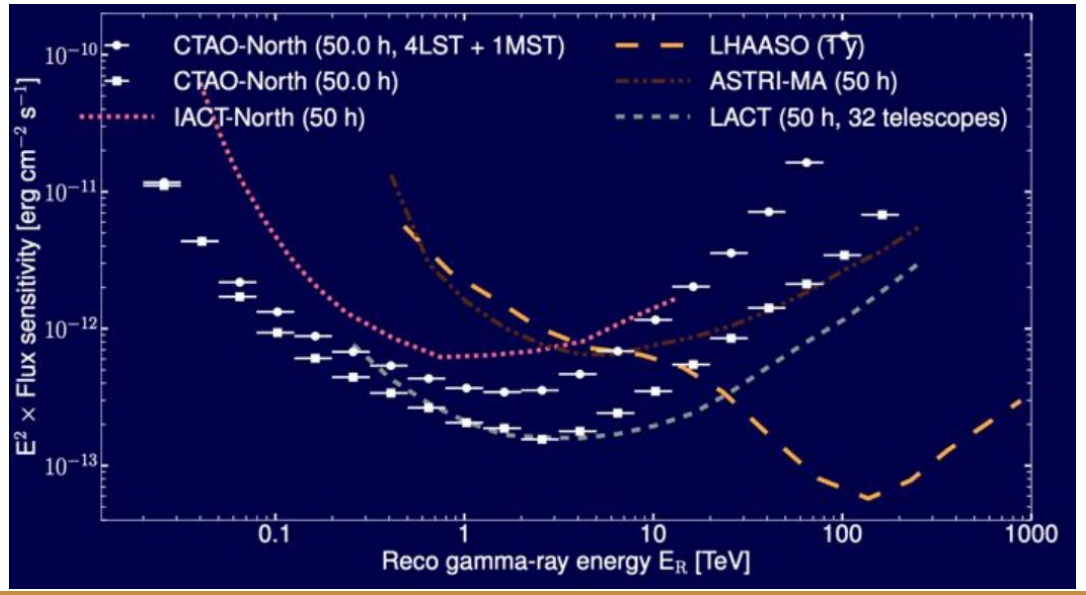
in 2 - 2.5 yr from now

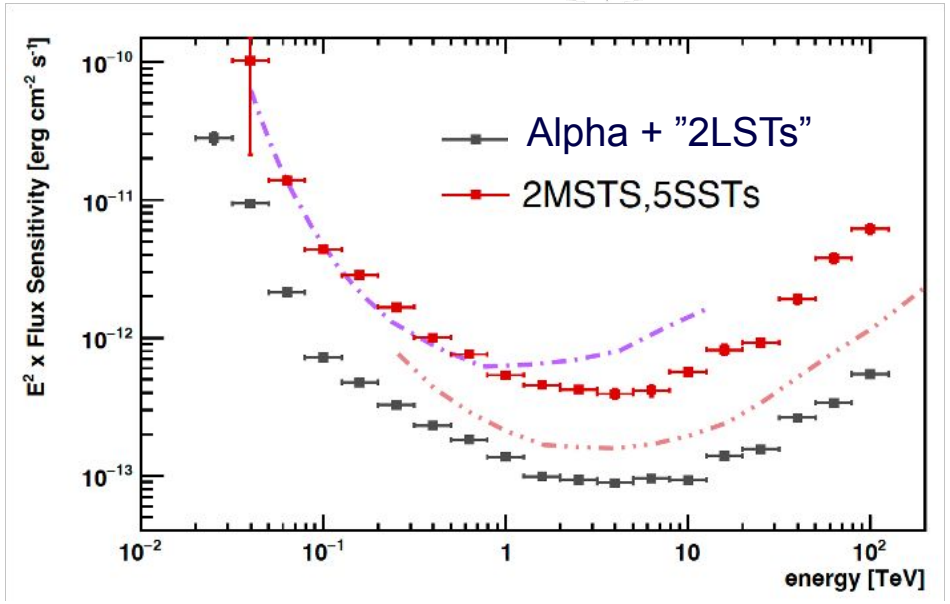
CTAO - North



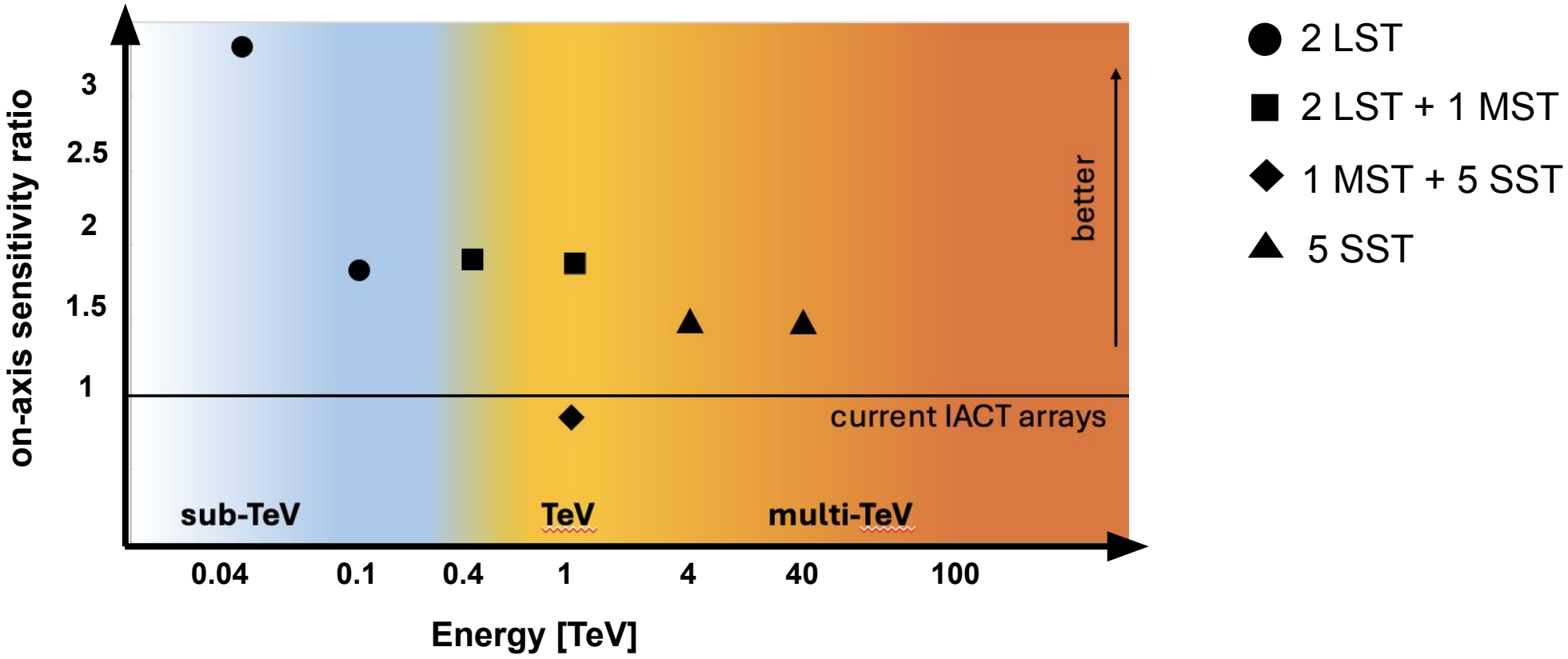
CTAO - South





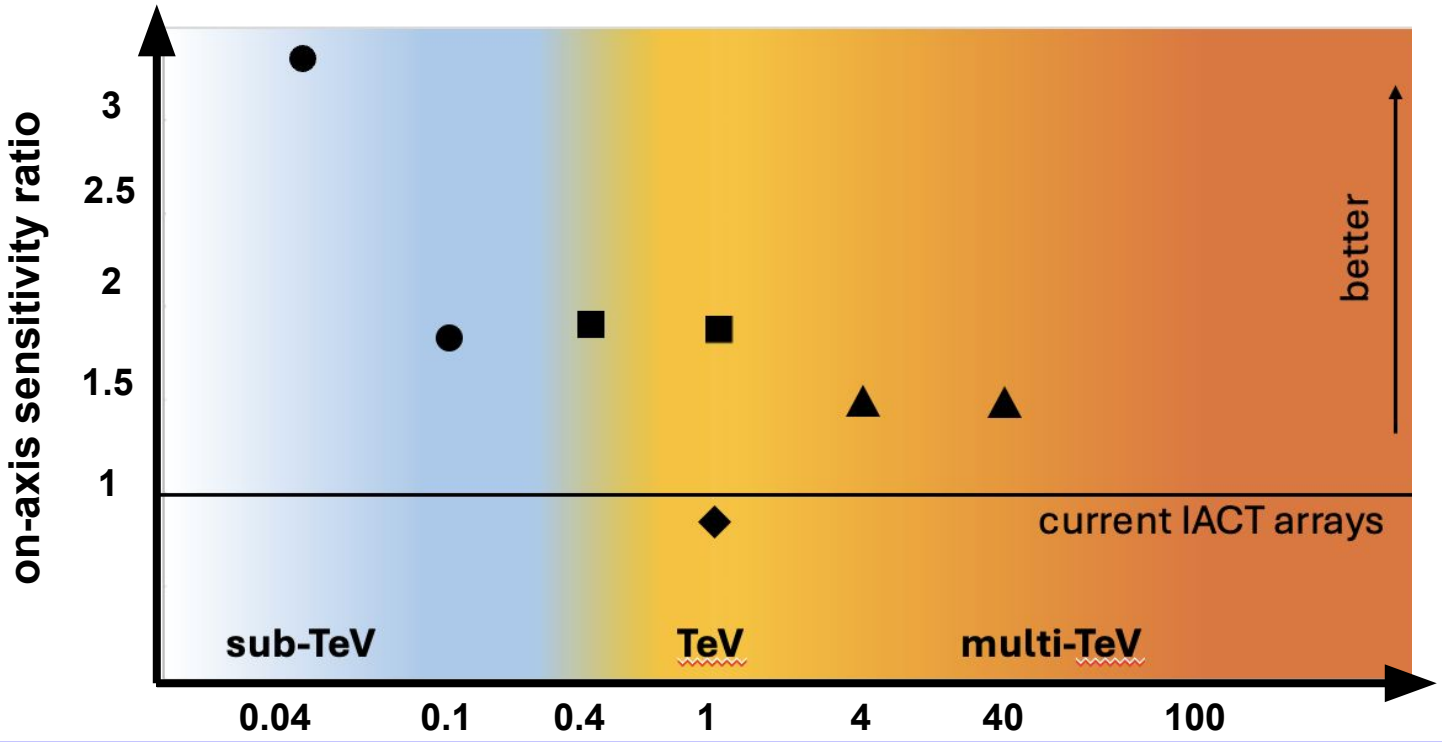


When will the scientific impact begin?



- 2 LST
- 2 LST + 1 MST
- 1 MST + 5 SST
- 5 SST

When will the scientific impact begin?



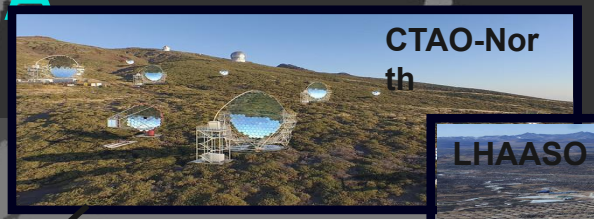
- 2 LST
- 2 LST + 1 MST
- 1 MST + 5 SST
- 5 SST

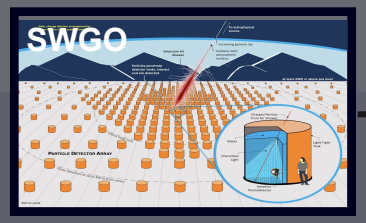
Angular resolution up to 40% improvement with respect to current IACT arrays

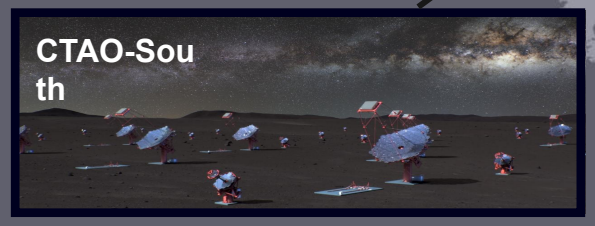
To get first high impact results we shall focus on science cases needing sensitivity more than angular resolution

A bright upcoming future

ASTRI - CTAO – SWGO - ALPACA

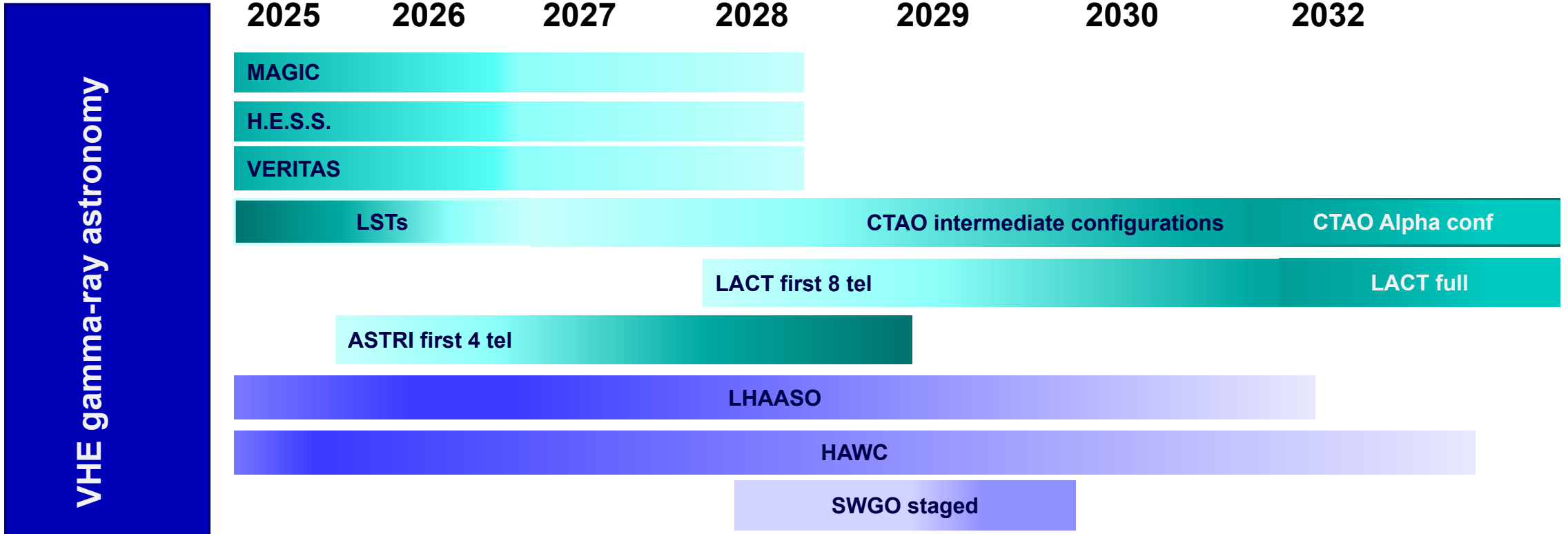






Galactic equator

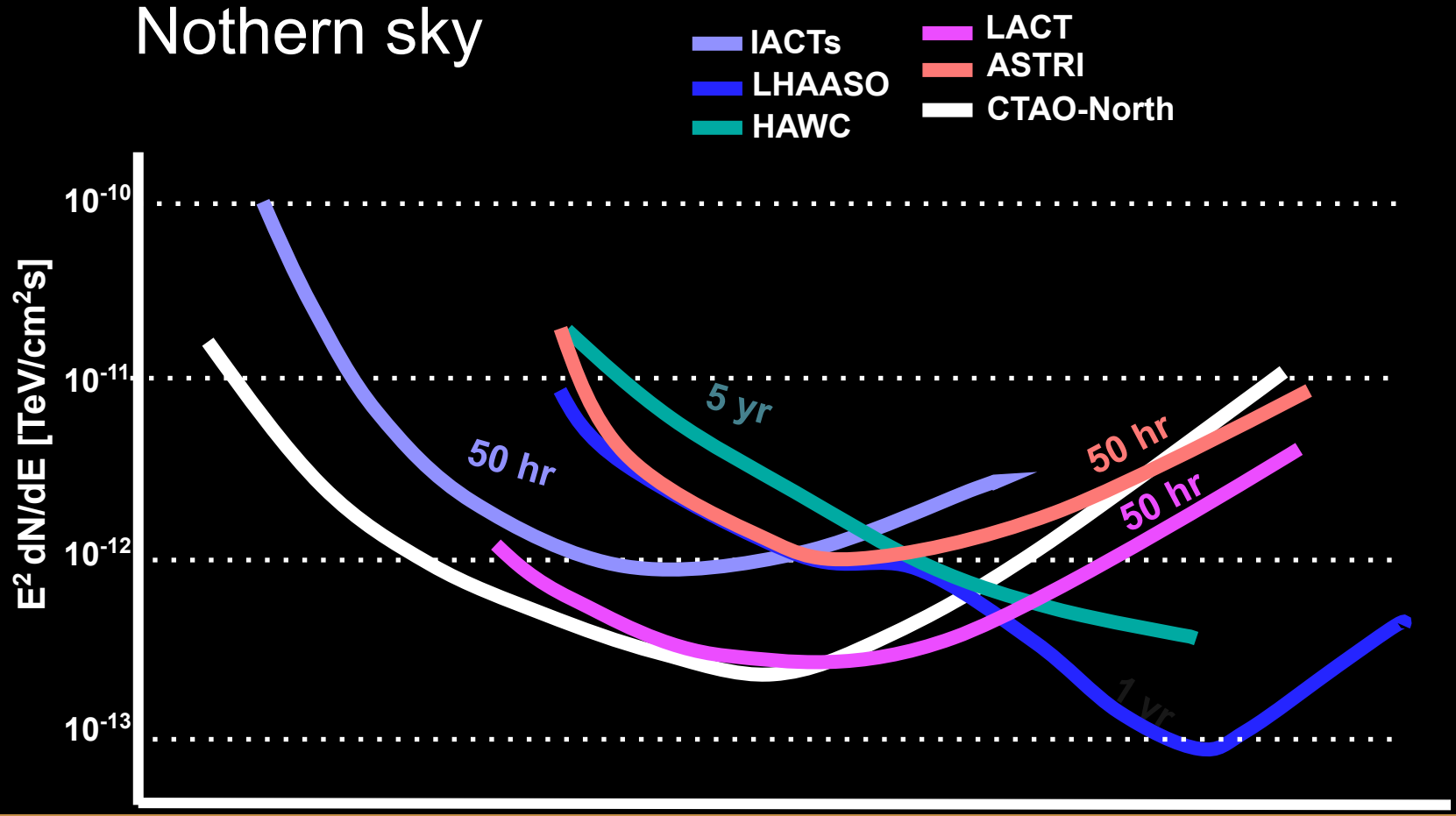
Status of the VHE astronomy



The end dates of the facilities are just indicative: the fate of these instrument is currently under discussion

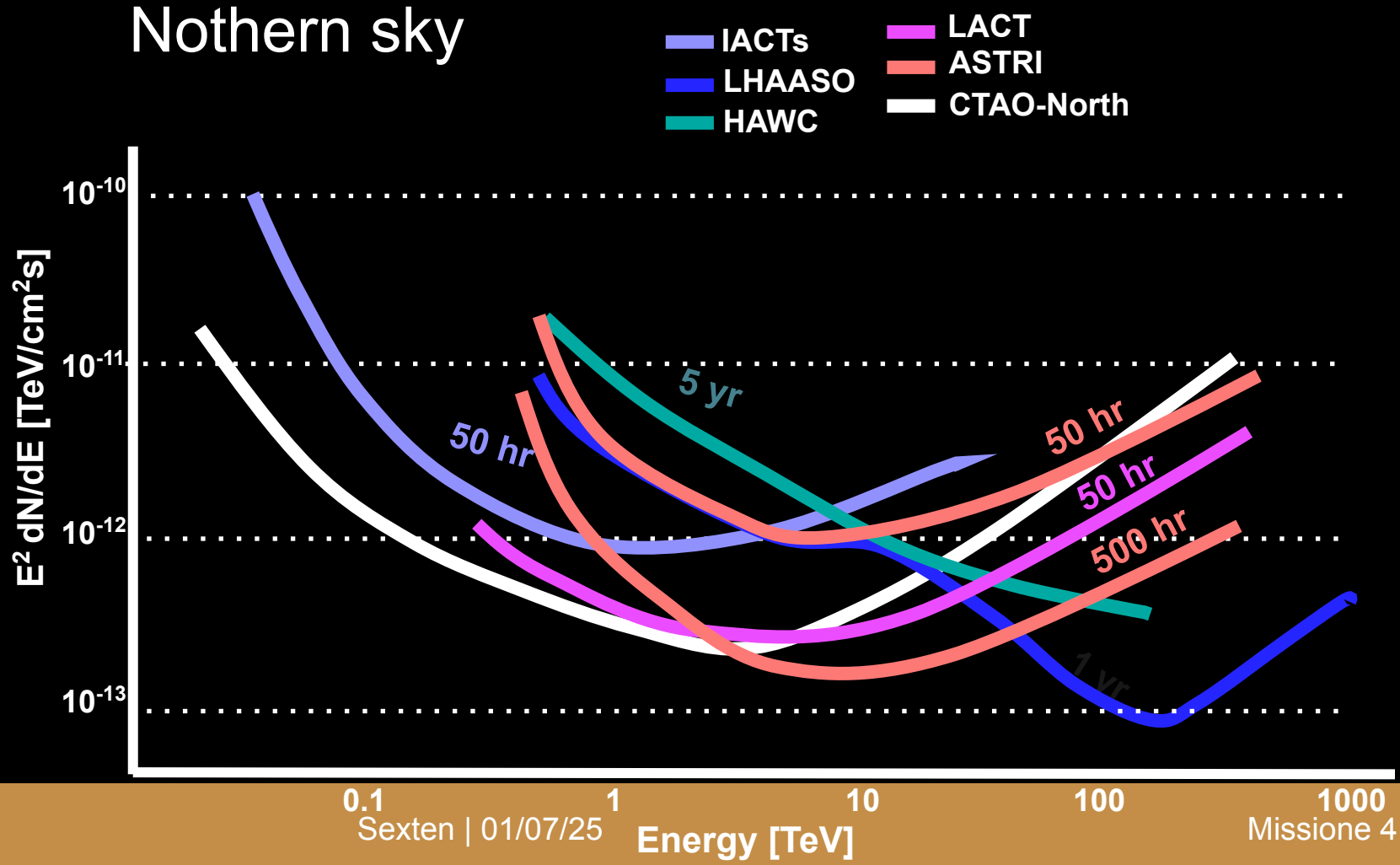
Steady source performance

Nothern sky



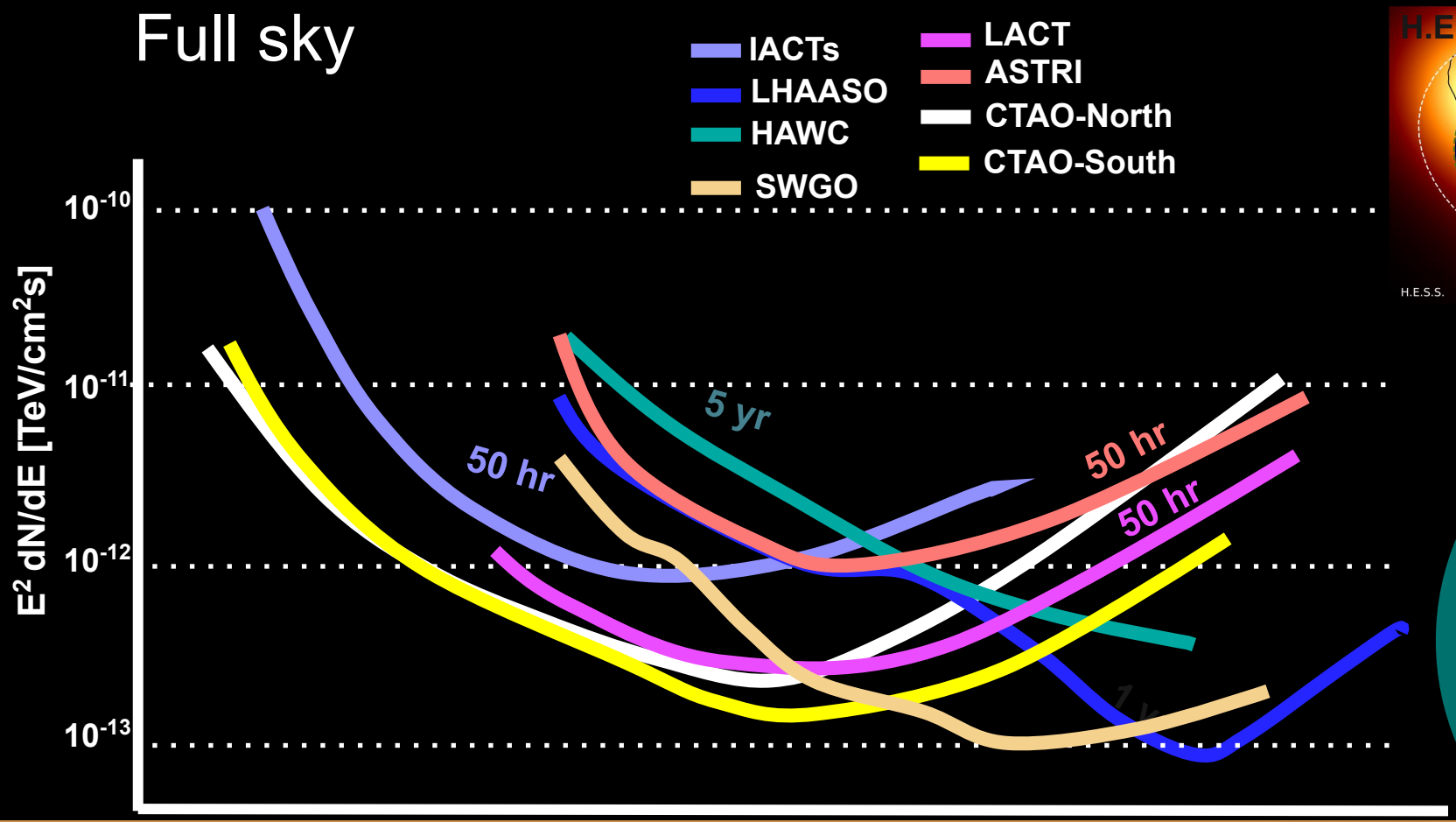
Steady source performance

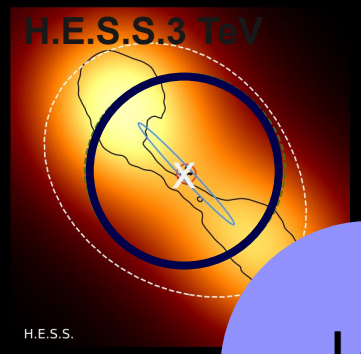
Nothern sky



Steady source performance

Full sky





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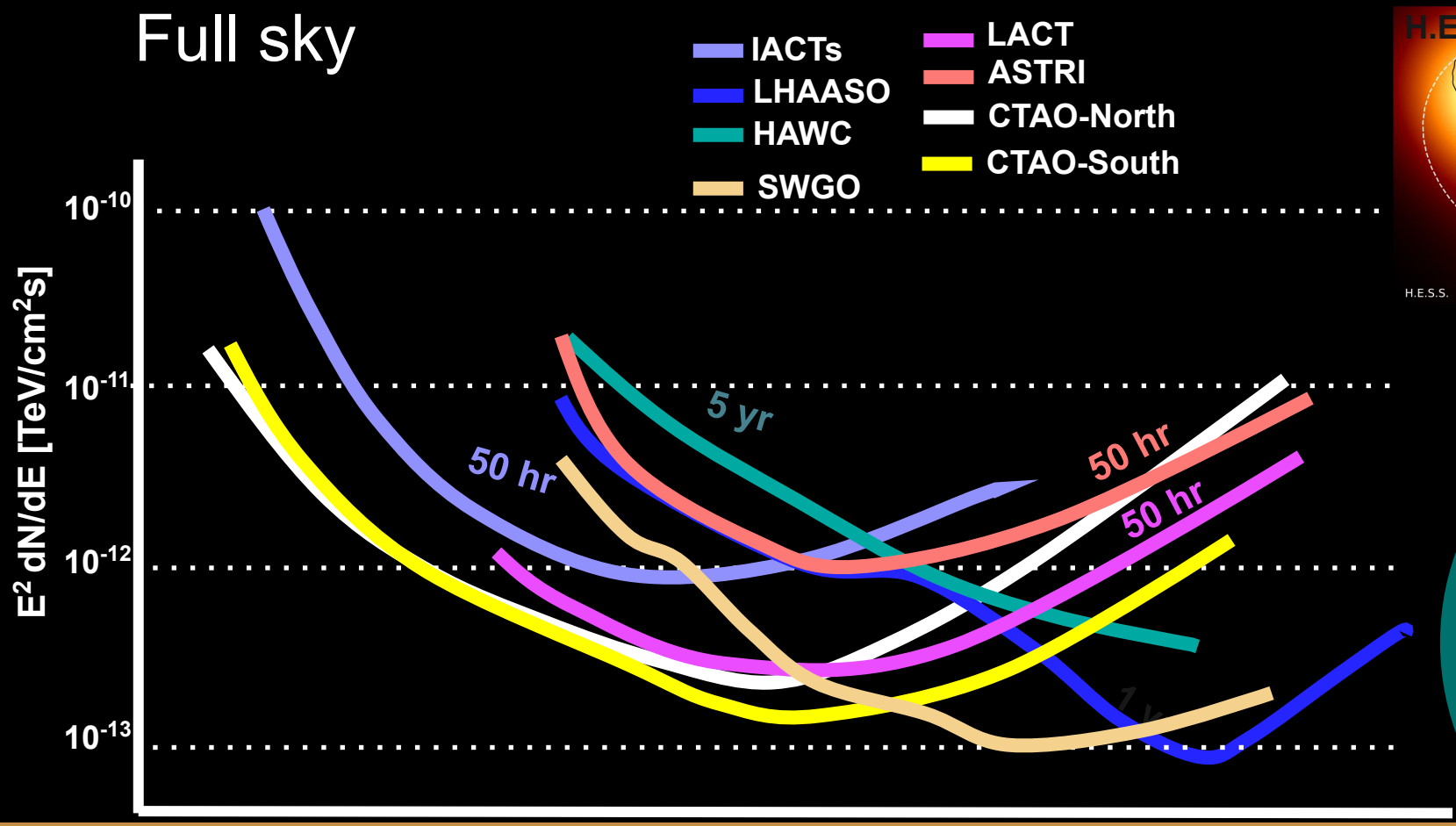
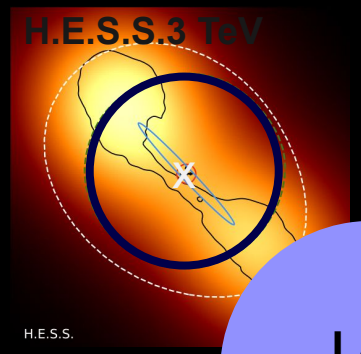
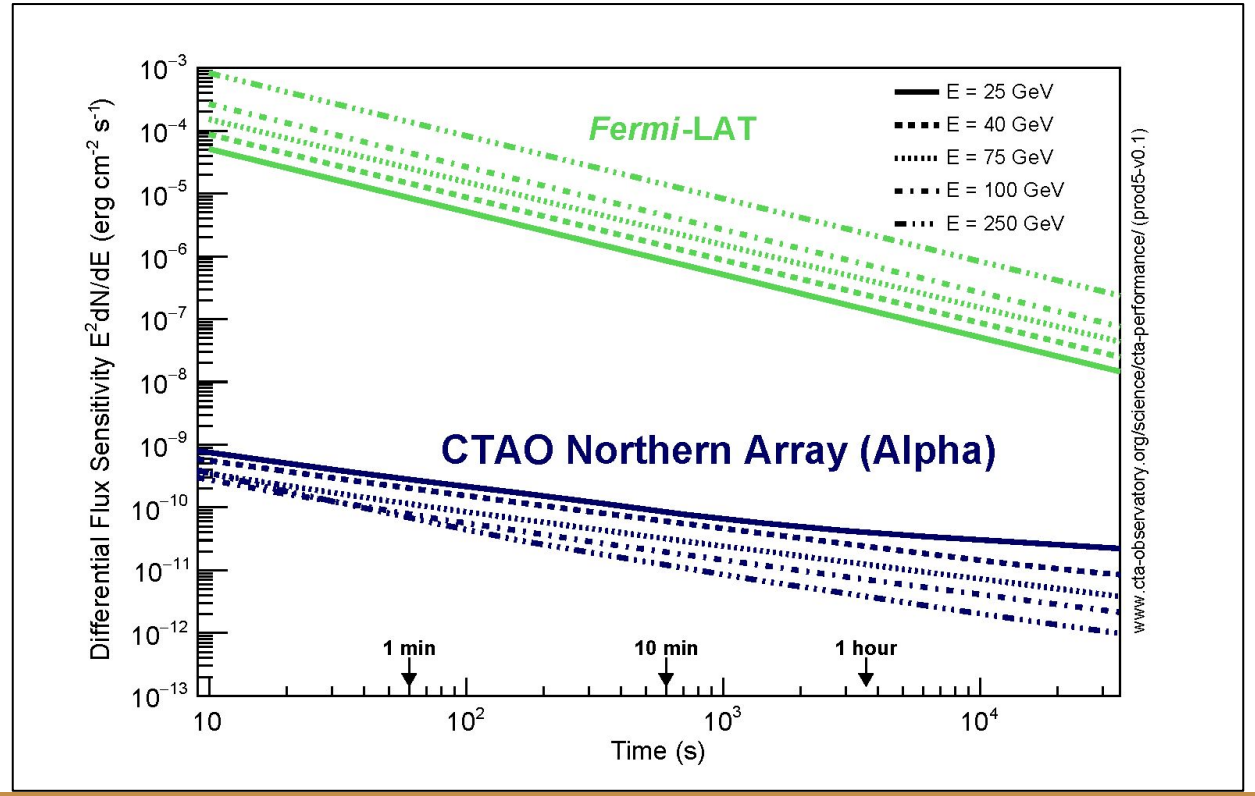




Source localization of the order of 15-30 arcsec!

Variable-flux-phenomea sensitivity

alias short-term observation sensitivity



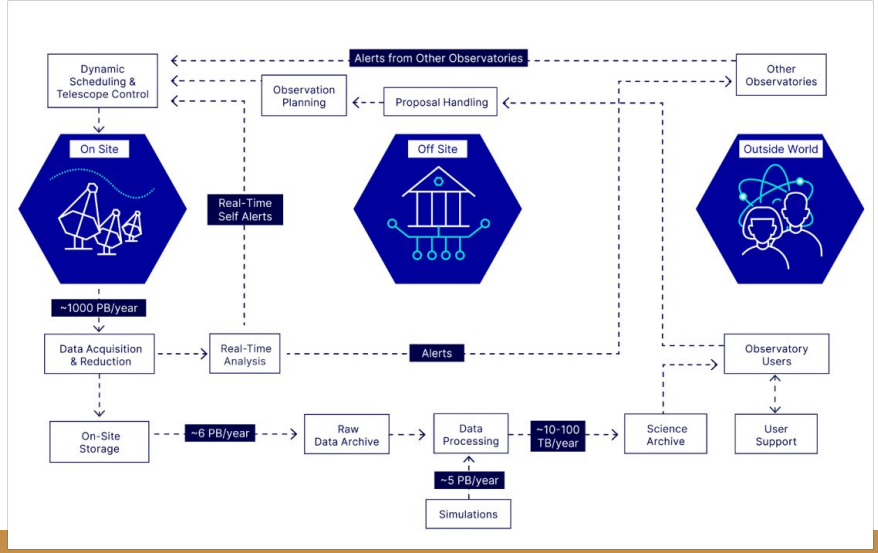
Transient Synergies

- **Arrays of IACTs are optimal instruments for the study of transient/variable phenomena** (especially at low-energies)
  …. **however they require observational triggers**

- **Particle array detectors are good triggering instruments** for nearby sources or super strong phenomena thank to their large FoV (serendipitous discoveries) and 100% duty cycle

To guarantee the maximum exploitation of the CTAO follow-up capabilities

- CTAO telescopes (LSTs) can repointing any point in the sky in less than 20”
- CTAO telescope can process the received alert in less than 50”



Construction has started

Conclusions

- **The future of the VHE gamma ray astronomy in the next decade is very bright**
- **CTAO first data is at reach within the next 3 years with performance capabilities that are already a factor 2 better than the existing facilities**
- **Transient phenomena can be explored at maximum capabilities already in 3 years from now**
- **We can start exploring the highest energies also in the Southern sky thanks to the first intermediate configuration**