Will it make the boat go faster?

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Roberta.Zanin@cta-observatory.org
18.04.2024 - 2nd CTAO science symposium


Credits to G. Tagliaferri


Credits to DESY


cta
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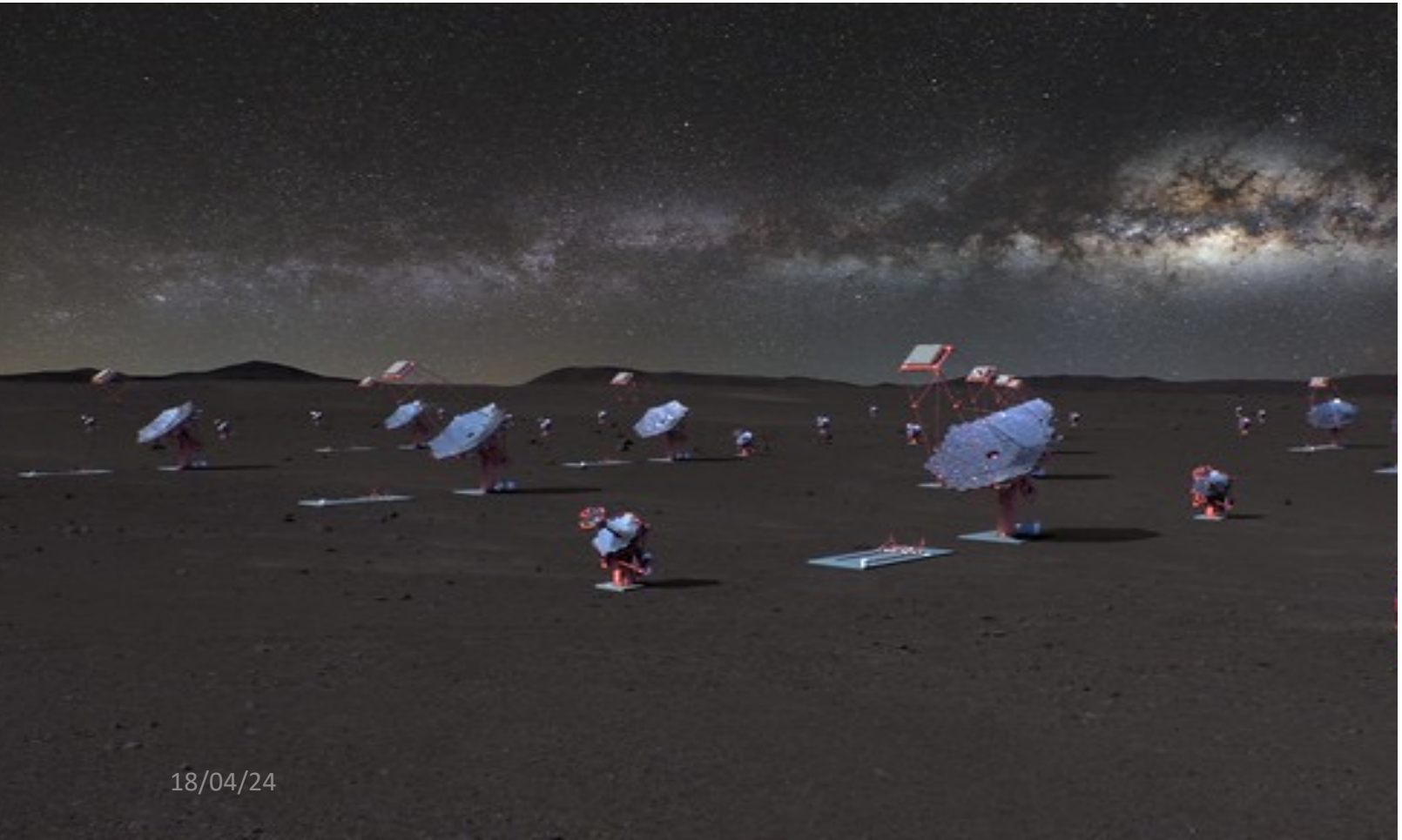
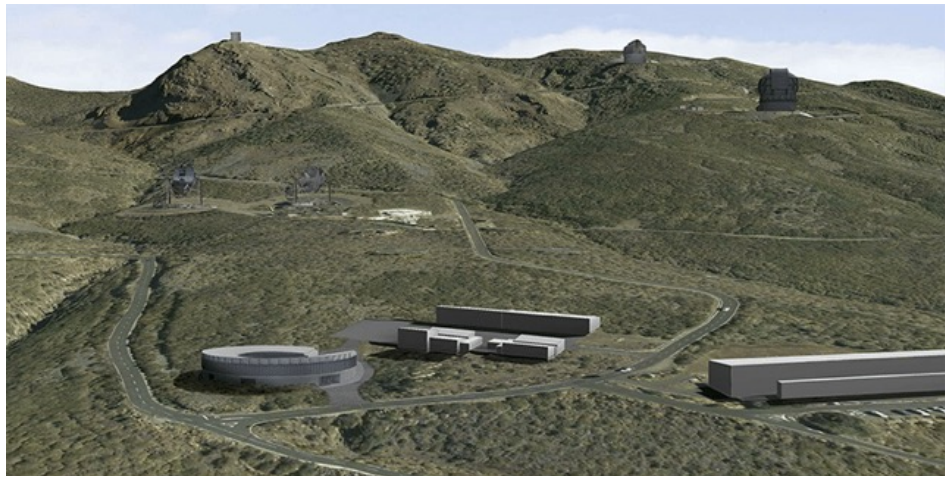
cta

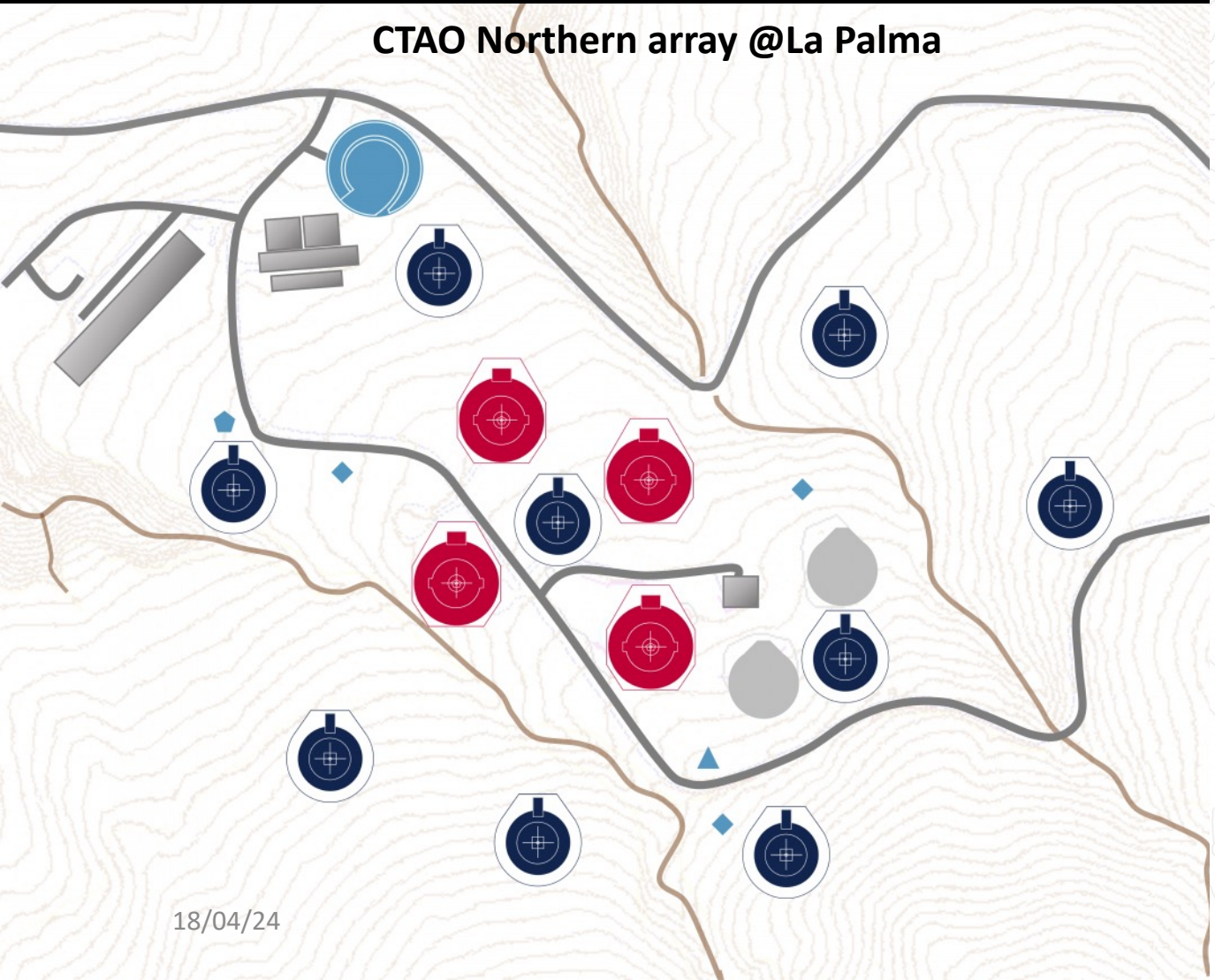




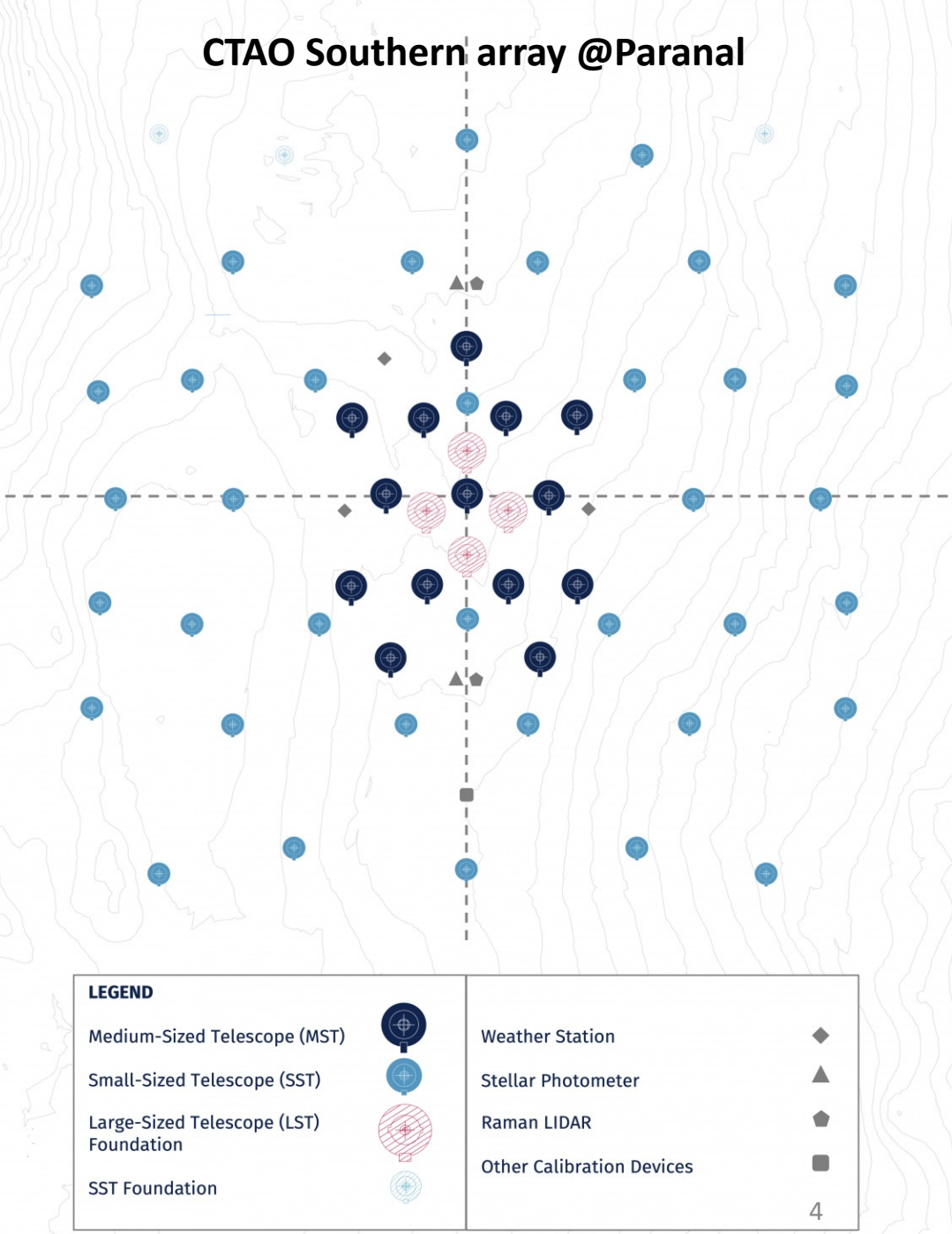
CTAO: two array sites, one unique observatory

[Alpha configuration]

CTAO Northern array @La Palma



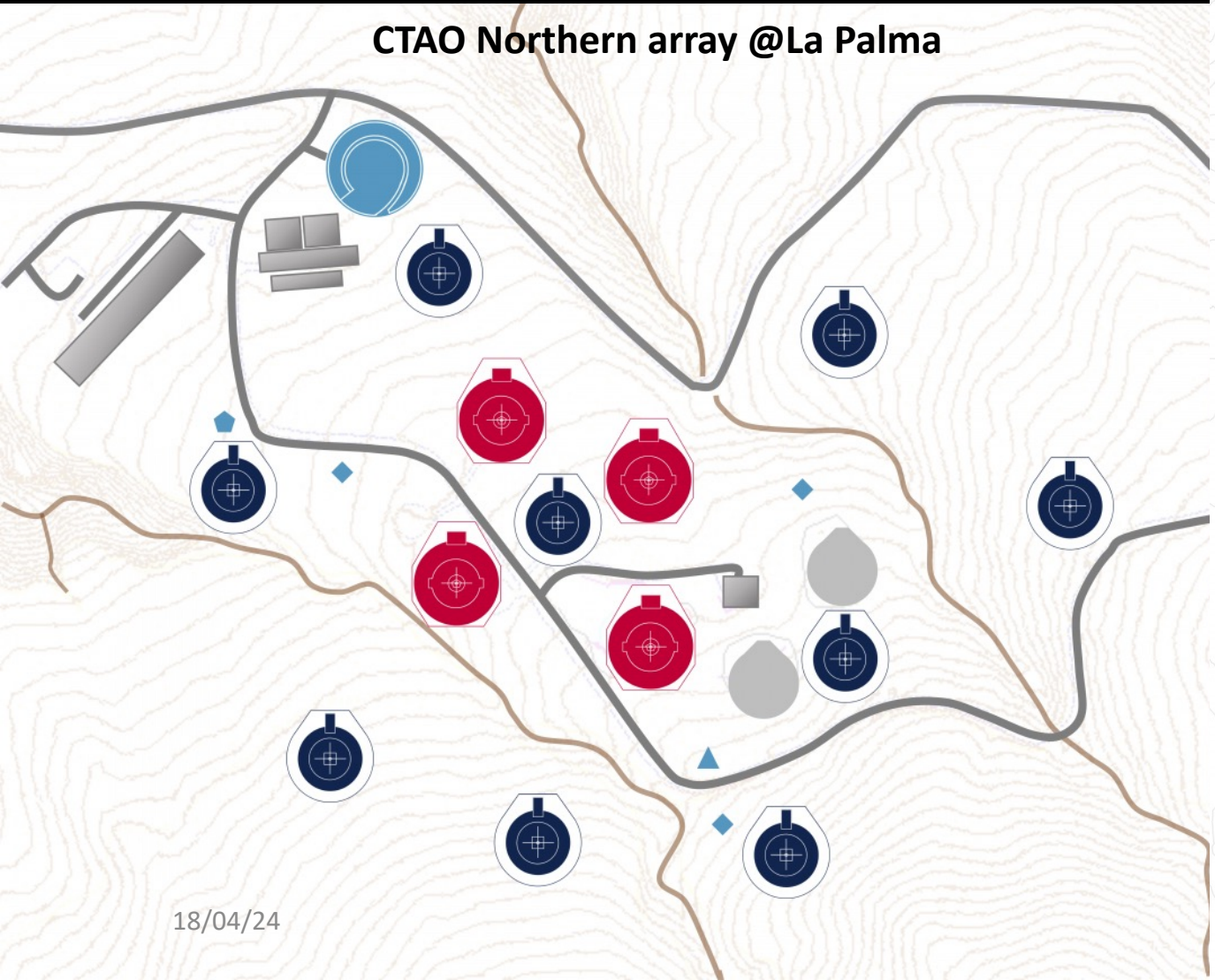
CTAO Southern array @Paranal



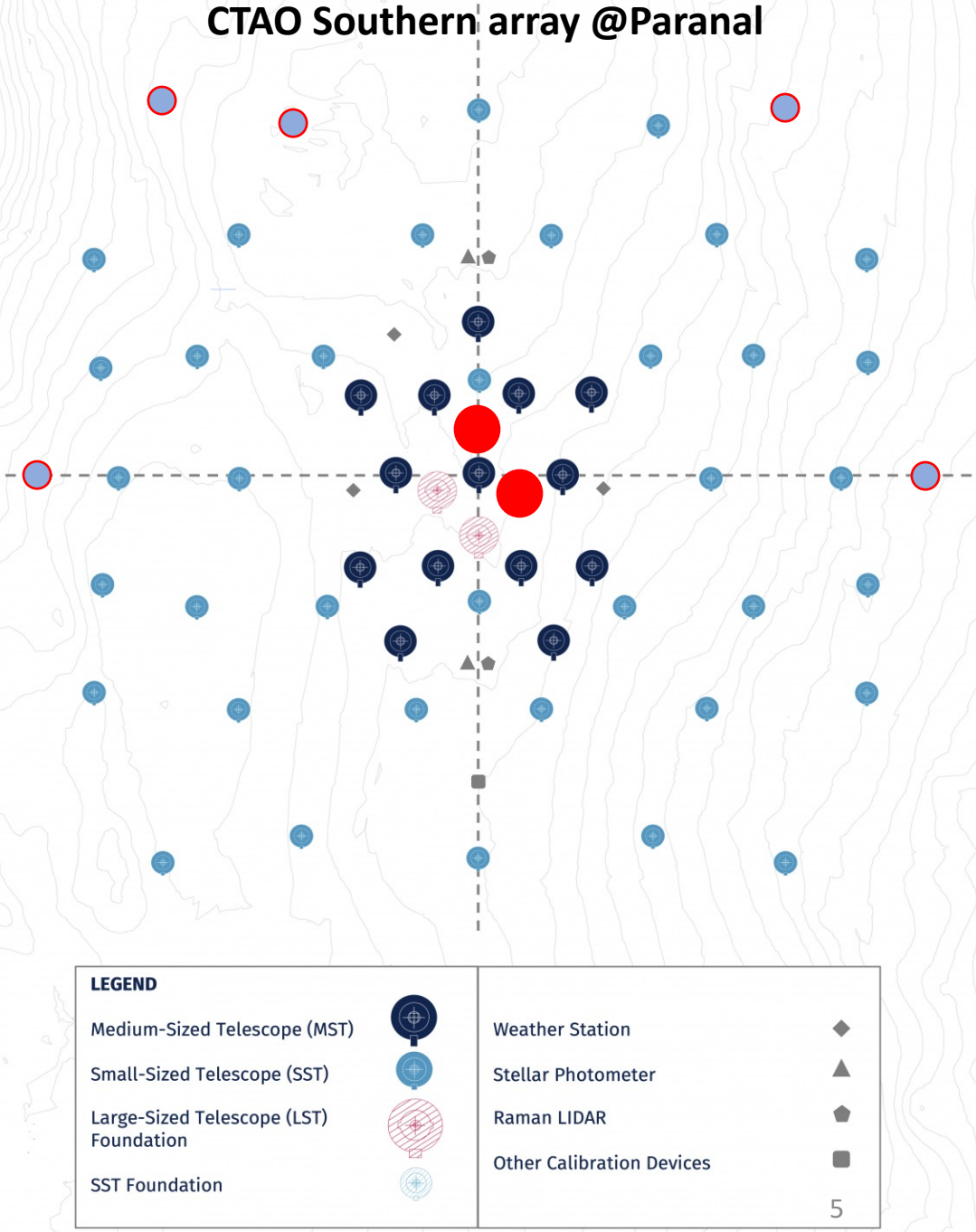
CTAO: two array sites, one unique observatory

[Alpha configuration + 2 LSTS + 5 SSTs?]

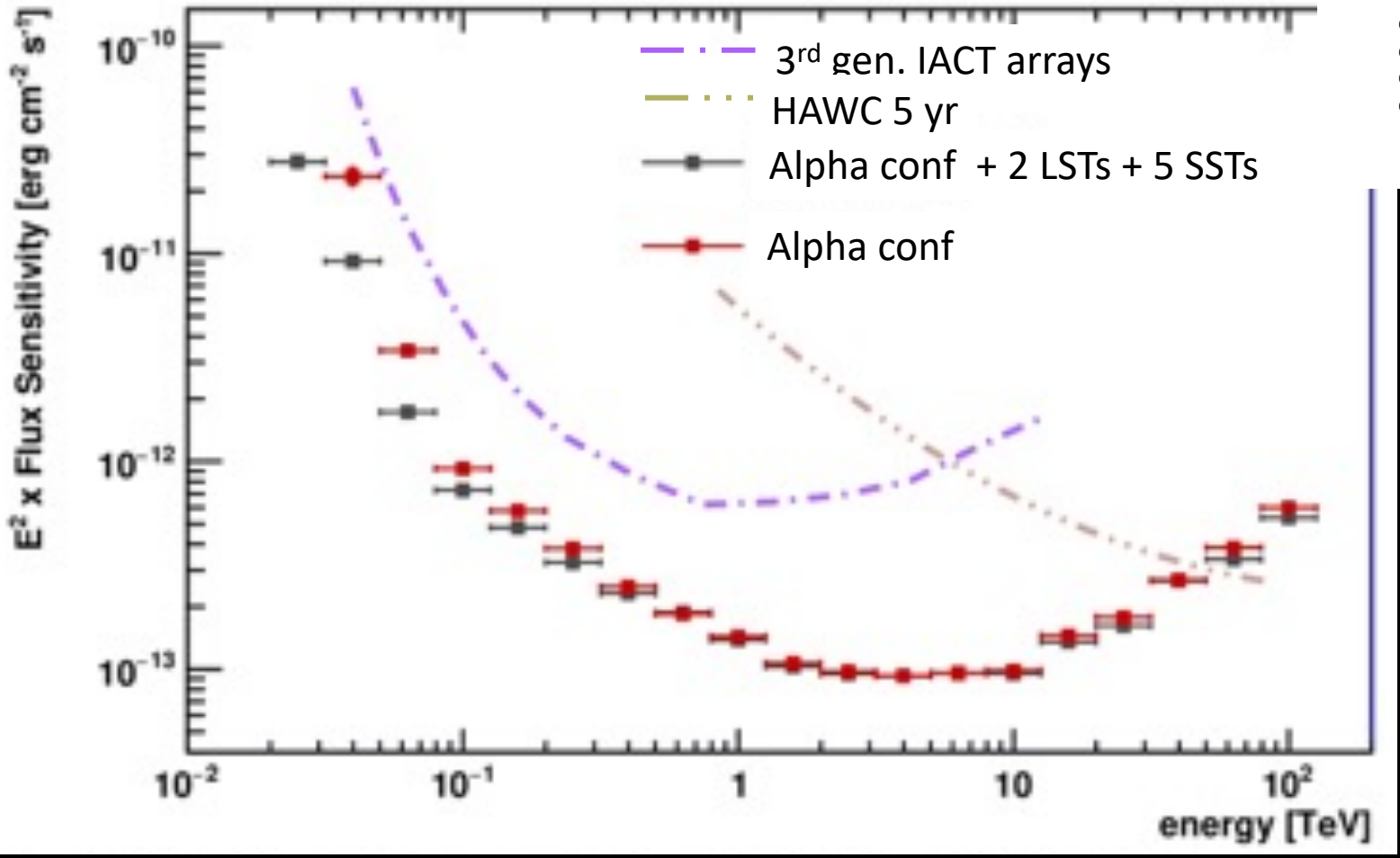
CTAO Northern array @La Palma

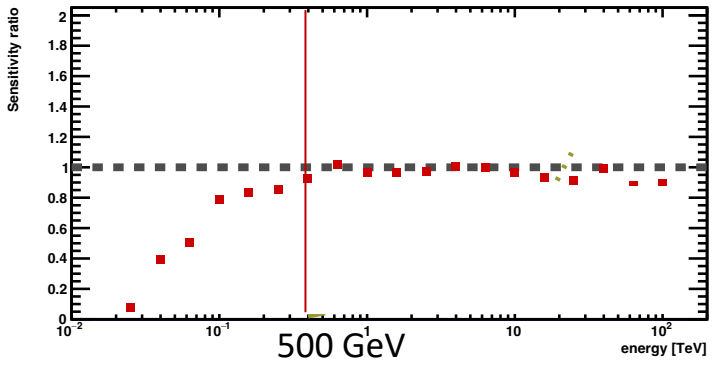


CTAO Southern array @Paranal



Improved Alpha Configuration

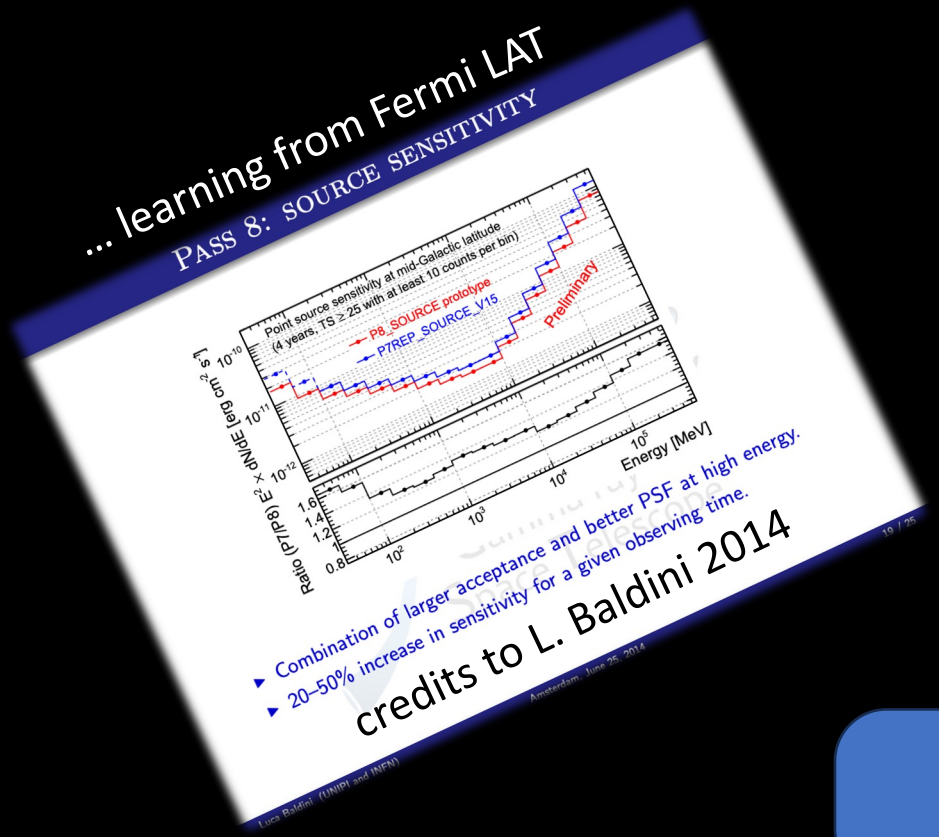


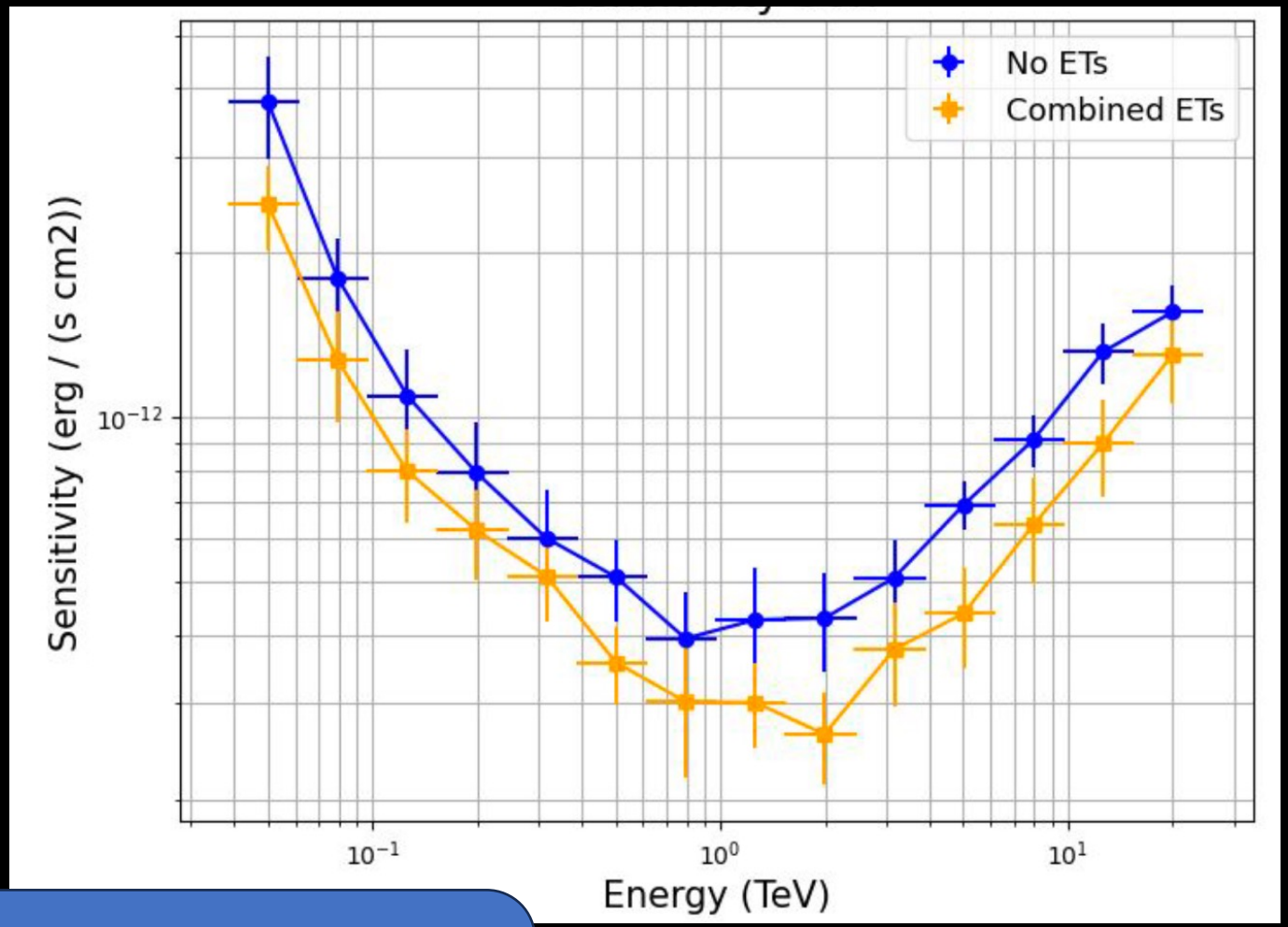


+ 20% improvement in angular resolution to 500 GeV

Improving performance of Alpha Configuration

... introducing the concept of event types





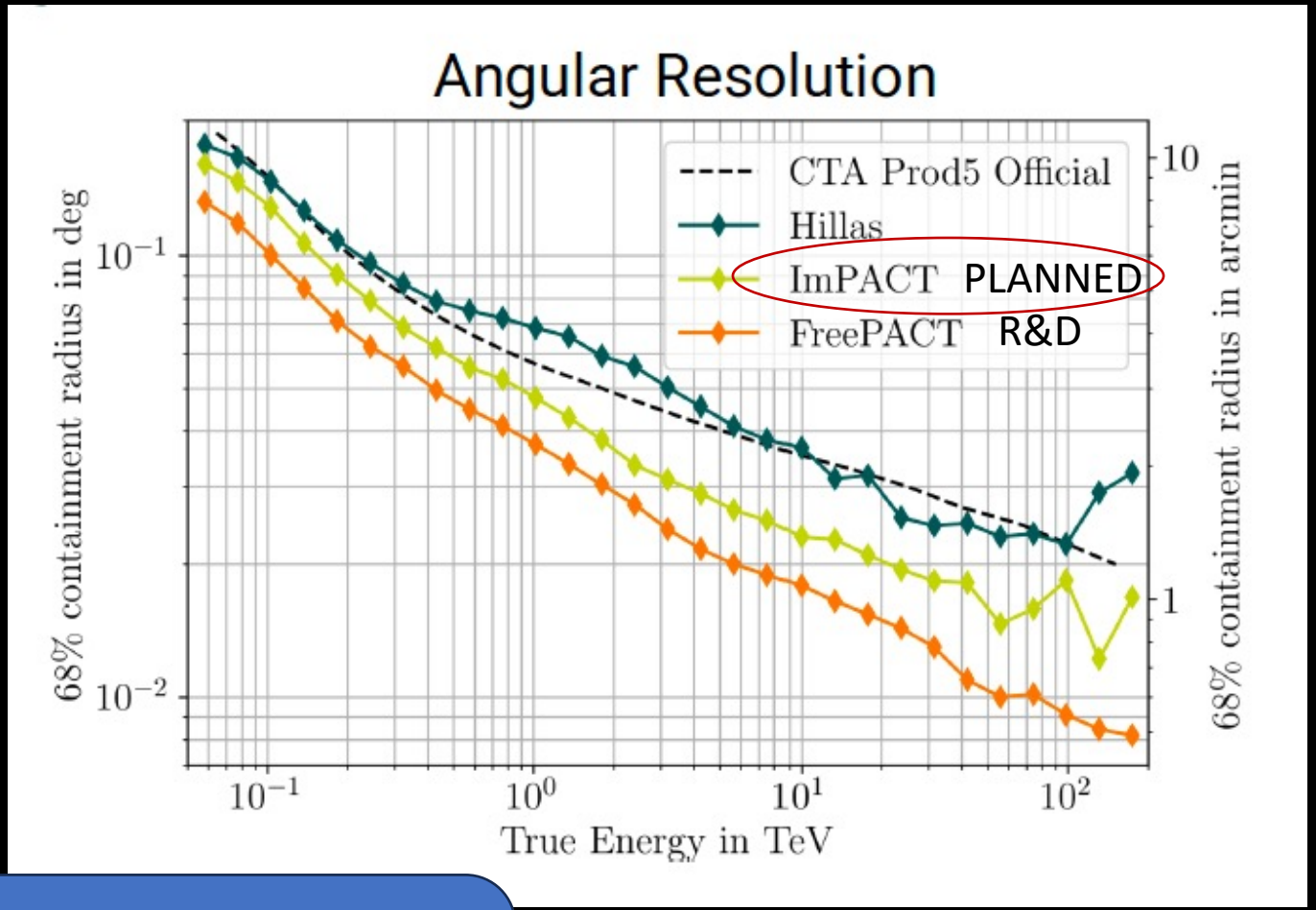
POSTER ID-073
J.Bernete-Medrano et al

Improving performance of Alpha Configuration

There is more room

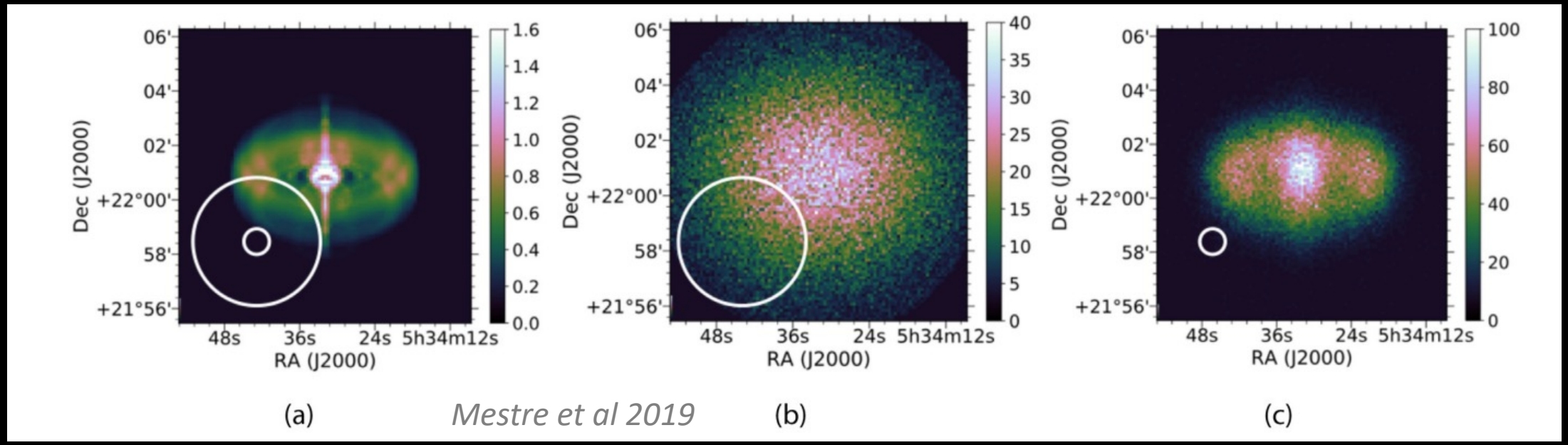
... using a hybrid likelihood, machine-learning algorithm

What does this imply for science?



POSTER ID-037
G. Schwefer et al

Improving performance of Alpha Configuration



Mestre et al 2019

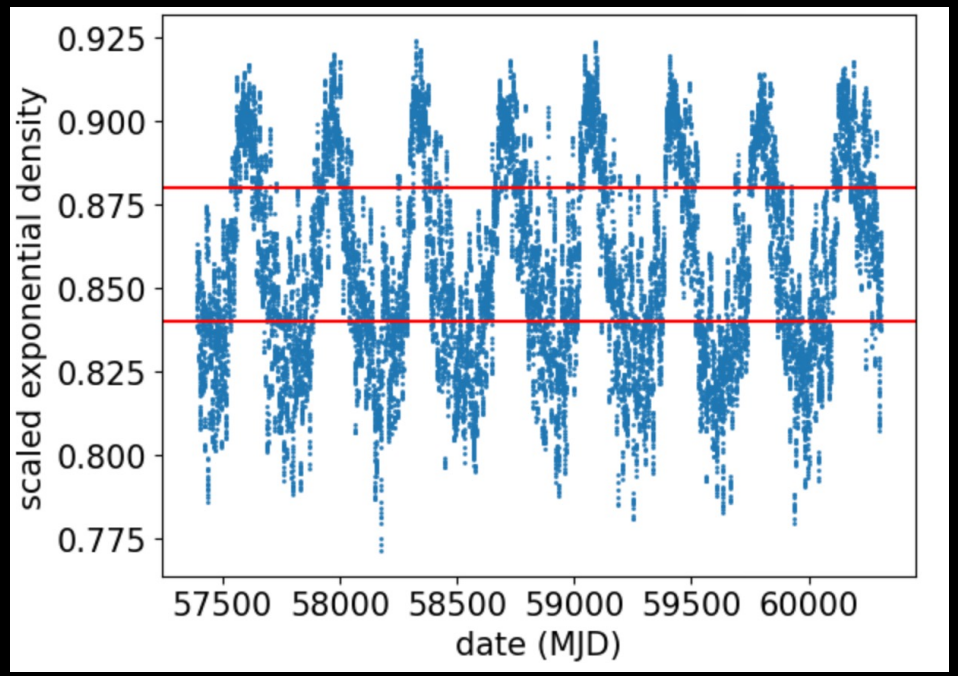
0,04º as requirent

factor 4 better angular resolution

Keeping systematic uncertainties under control

- ongoing detailed studies to be able to account for variations of molecular profiles, absorbing molecules, aerosols, and clouds in the simulations

AN EXAMPLE

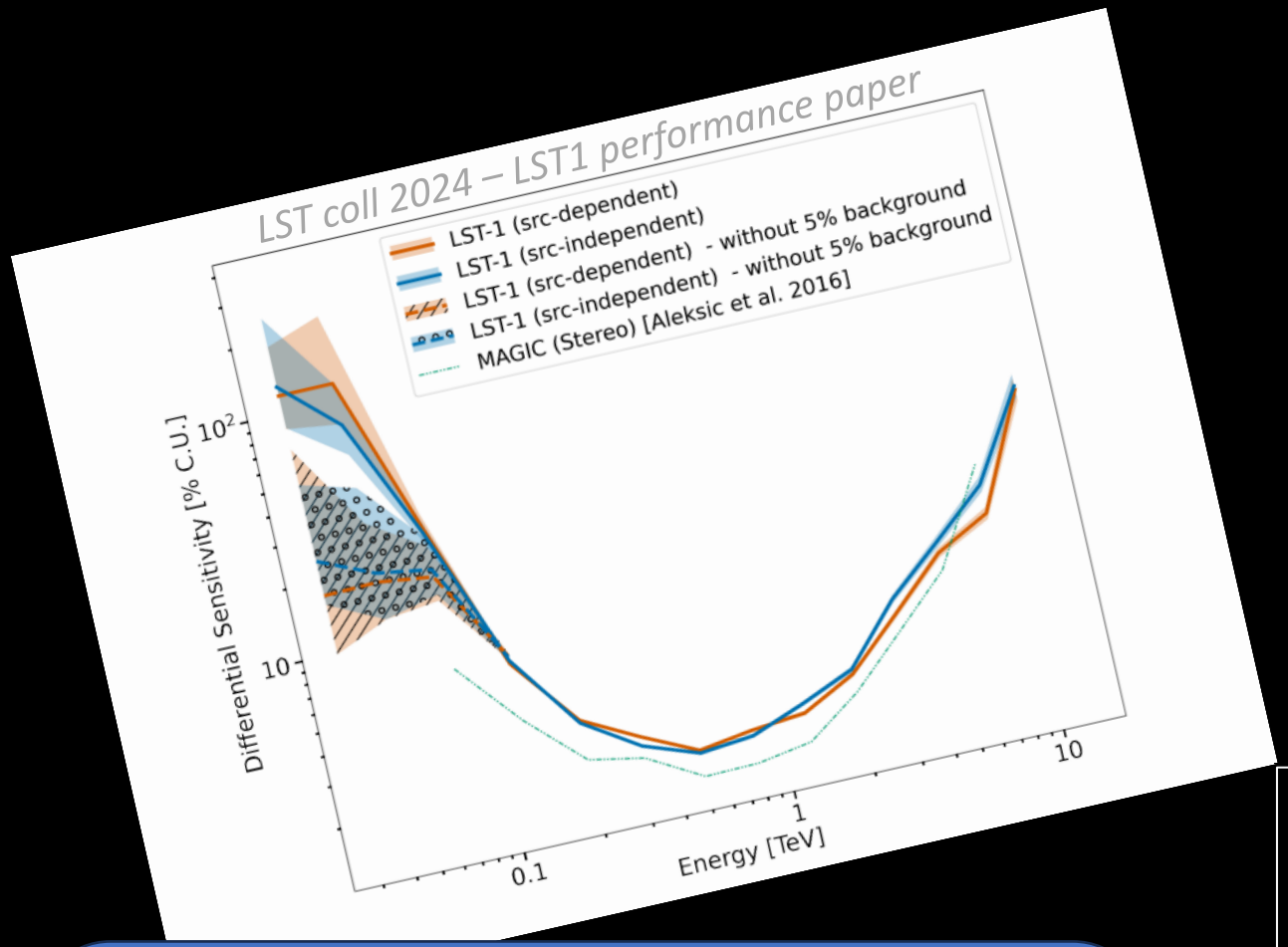


Credits to G. Voutsinas

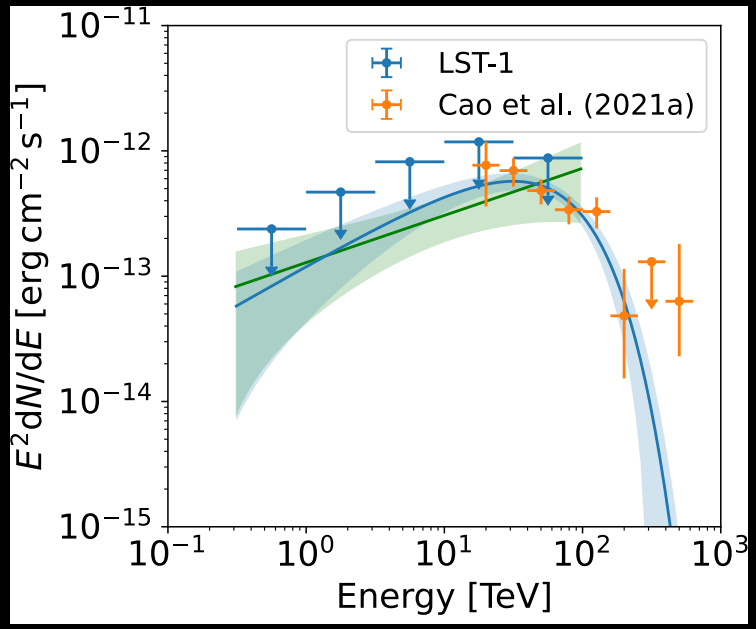
- Discrepancy between the real molecular density profile and the simulated can be maintained within <2% systematic uncertainty if we simulate three reference molecular density profiles to account for its seasonal variations
- To compute the accuracy and precision of the ECMWF info we are organizing radio sonde campaigns
  --> partecipating in the ESO atmospheric characterization campaign

POSTER ID-075
G. Voutsinas et al

The prototype telescope LST-1 is already taking data



The PeVatron candidate LHAASO J2108+5157 seen by LST-1



First detection of VHE gamma-ray emission from FSRQ OP 313 with LST-1

ATel #16381; *Juan Cortina (CIEMAT) for the CTAO LST collaboration*
on ***15 Dec 2023; 14:31 UT***
Credential Certification: Juan Cortina (Juan.Cortina@ciemat.es)

Subjects: Gamma Ray, >GeV, TeV, VHE, Request for Observations, AGN, Blazar, Quasar

POSTER ID-028 Pulsars with LST1 Brunelli et al.
POSTER ID-002 Axions with LST1 Batkovic et al.
POSTER ID-029 LIV with LST1 Plard et al.
TALKS by D. Green, D. Morcuende & M.S. Carrasco

The plan towards the first CTAO data: intermediate array configuration

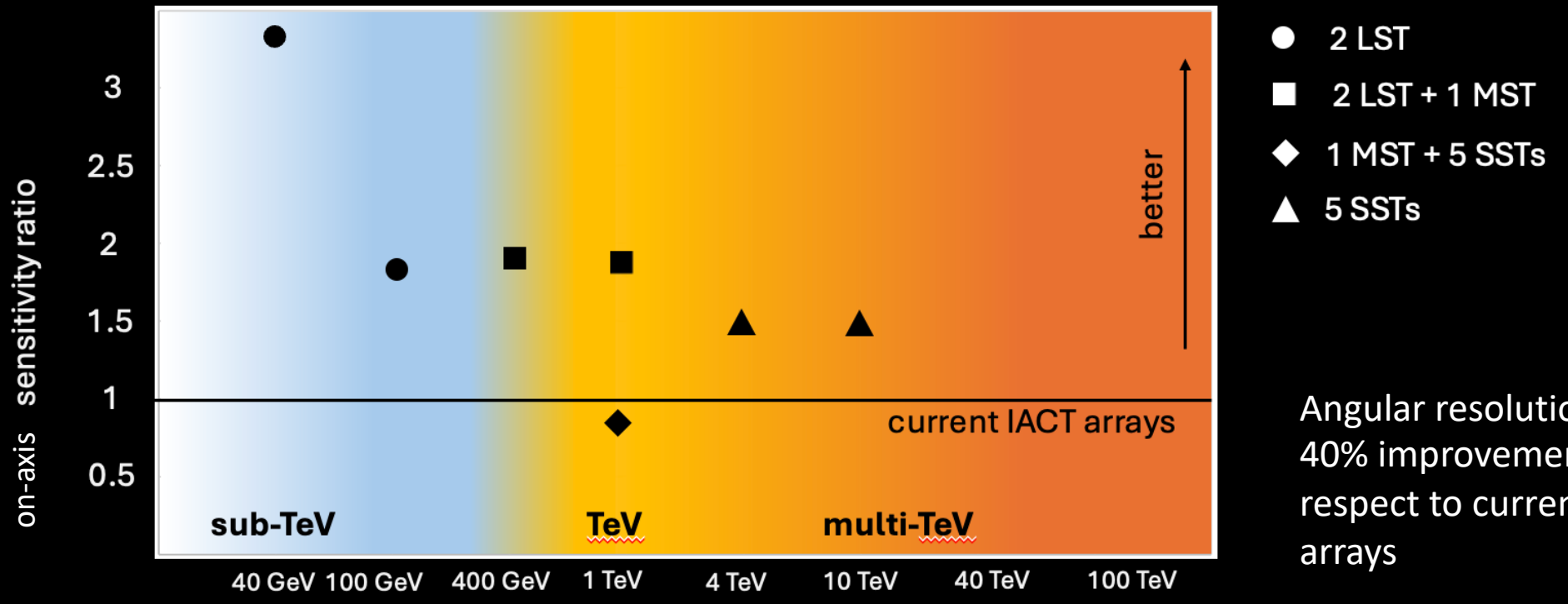
CONCEPT

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

When will the scientific impact begin?

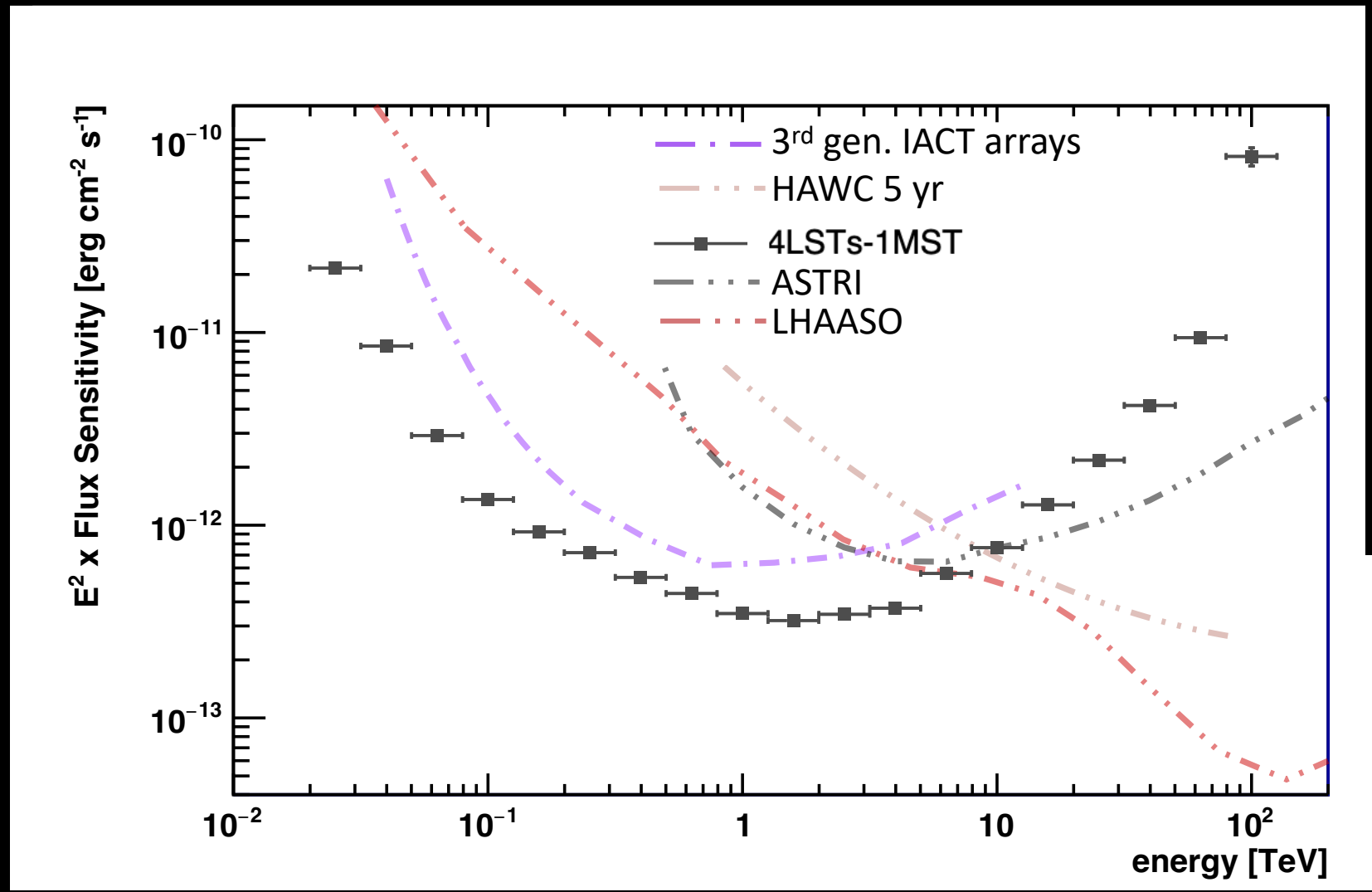


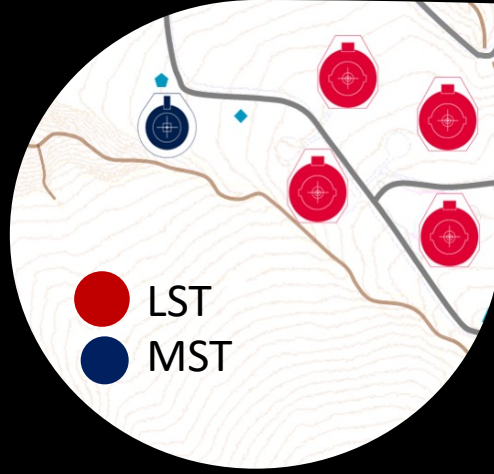
Angular resolution up to 40% improvement with respect to current IACT arrays

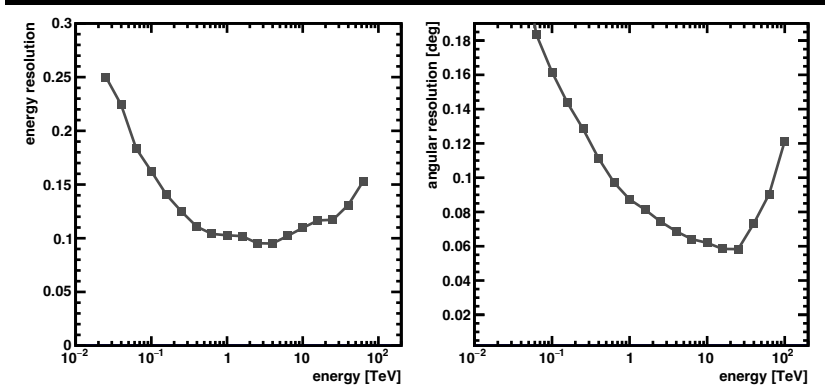
To get first high impact results we shall focus on science cases needing sensitivity more than angular resolution

in 2027

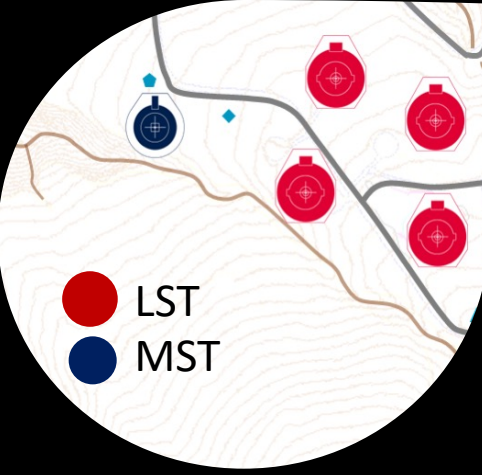
@CTAO-North

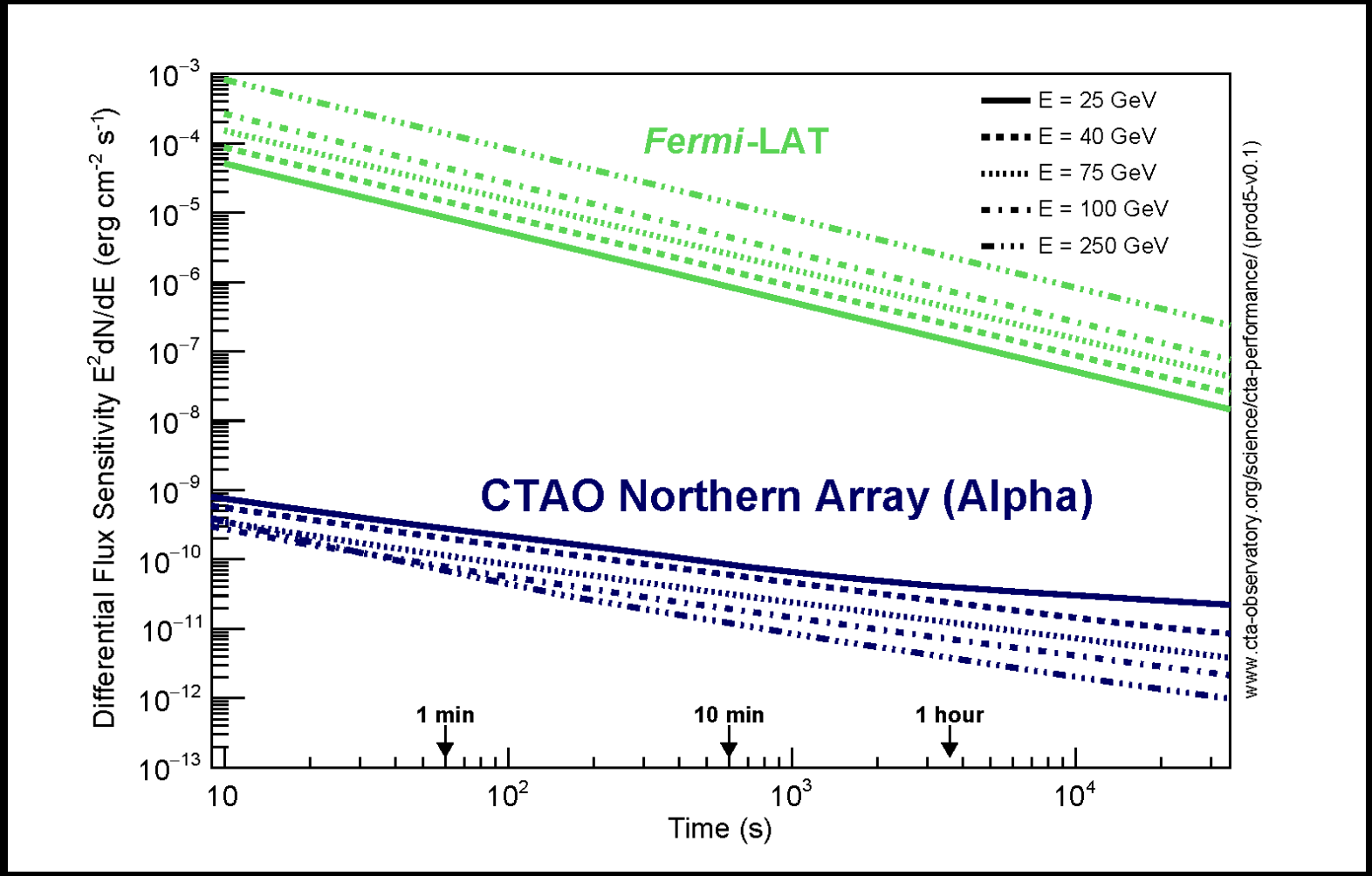

3rd gen. IACT arrays
HAWC 5 yr
4LSTs-1MST
ASTRI
LHAASO
E² x Flux Sensitivity [erg cm⁻² s⁻¹]
energy [TeV]


LST
MST


energy resolution
energy [TeV]
angular resolution [deg]
energy [TeV]

@CTAO-North

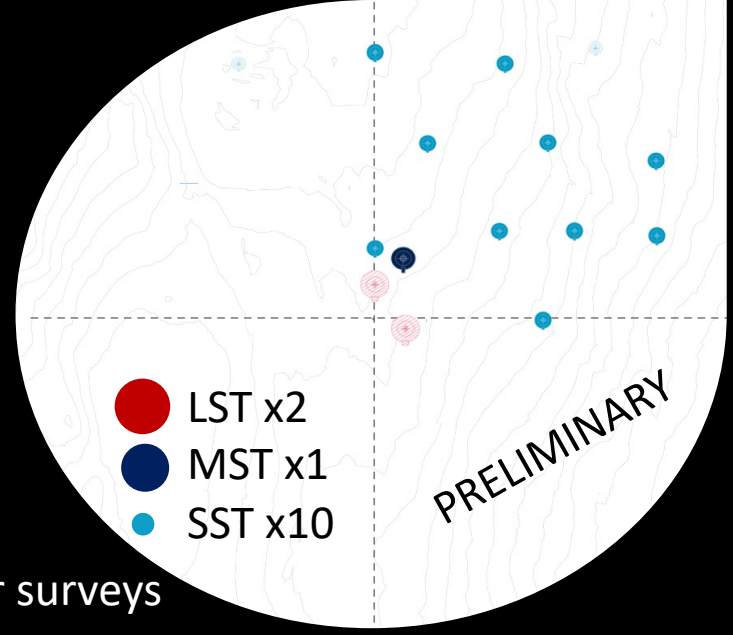

LST
MST


Differential Flux Sensitivity E²dN/dE (erg cm⁻² s⁻¹)
Time (s)
Fermi-LAT
CTAO Northern Array (Alpha)
E = 25 GeV
E = 40 GeV
E = 75 GeV
E = 100 GeV
E = 250 GeV
1 min
10 min
1 hour
www.cta-observatory.org/science/cta-performance/ (prod5-v0.1)

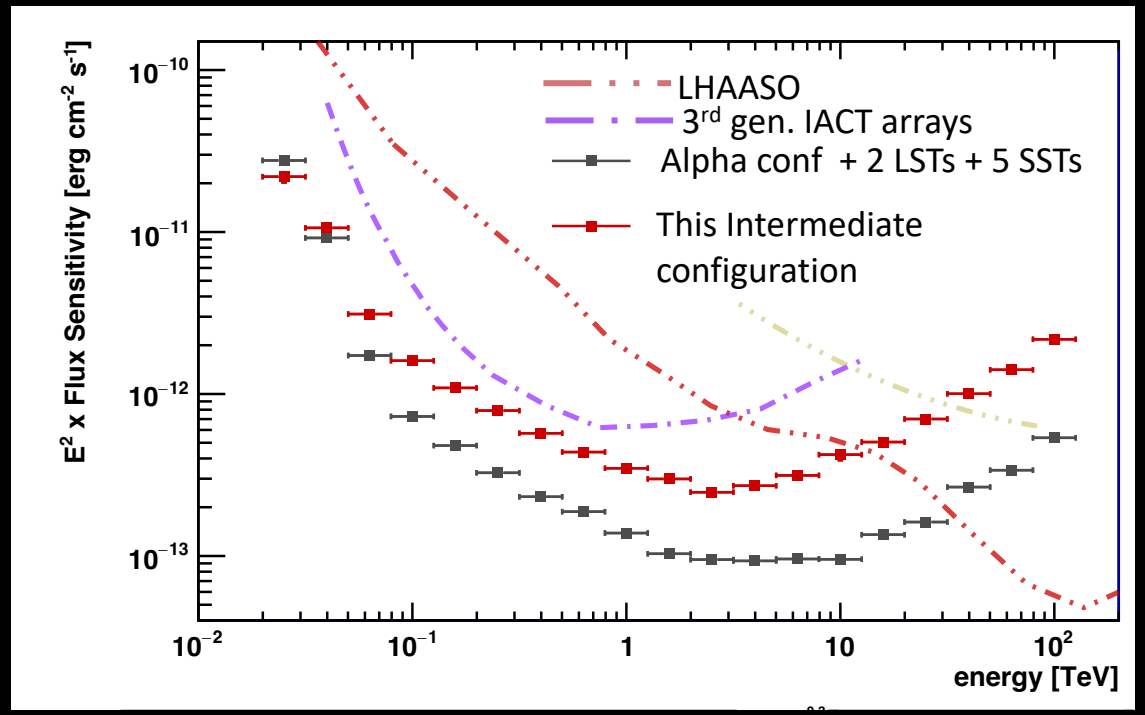
@CTAO-South

@10 TeV

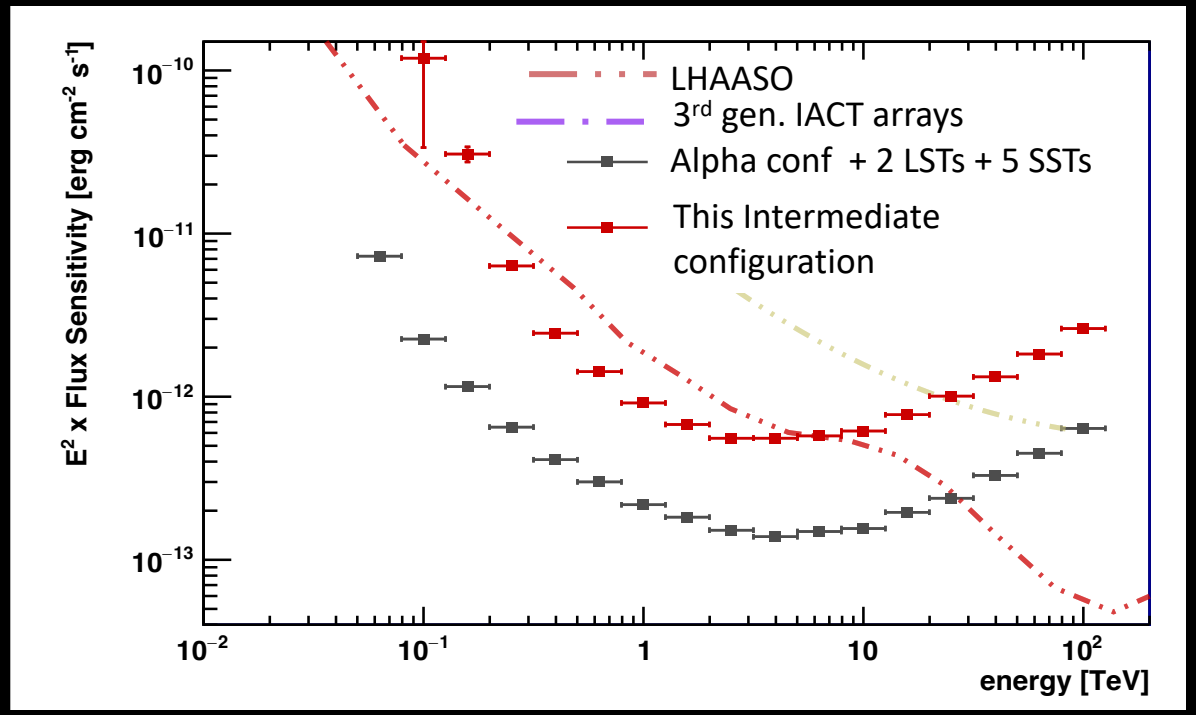
- as good as LHAASO
- 80% better than ASTRI



on-axis @ 3º



off-xis @ 3º → critical for surveys



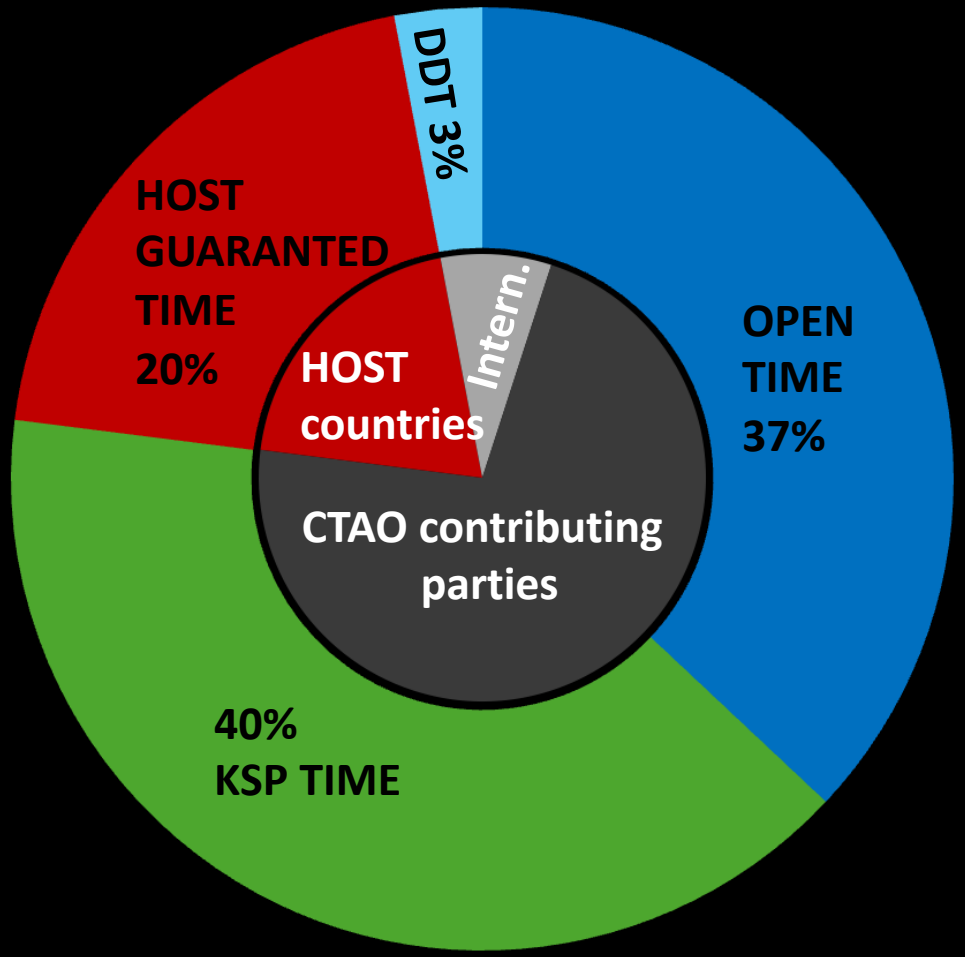
Access to CTAO data

- not yet decided the access during construction
  - an incentive for in-kind contributors
  - broad-community will be kept involved

- during the array deployment, integration & commissioning will have the priority

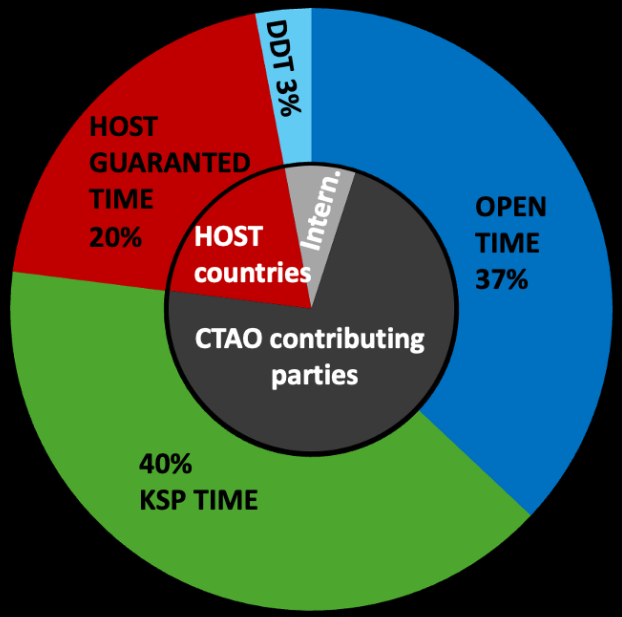
Access to CTAO data

In operation phase access is regulated by he already approved access policy

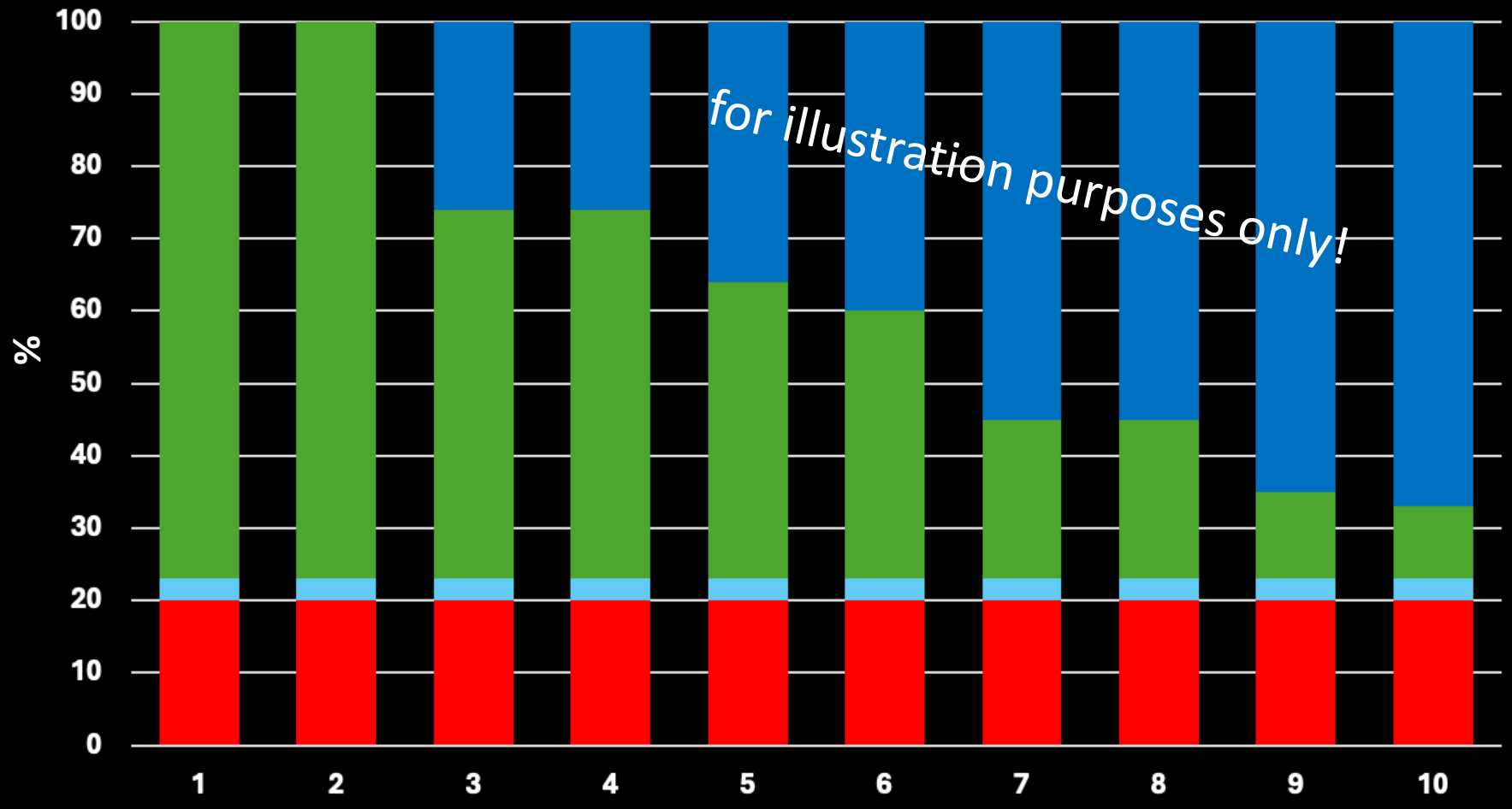


integrated over 10 yr

Access to CTAO data in operations phase



integrated over 10 yr



Key Science Projects

- Guaranteed time observations as reward for contribution to the construction project provided that all contributing parties pull their time creating a science collaboration
- KSP principles: science-driven & community wide on key science cases promising major breakthrough
- KSP deliverable: legacy data sets and legacy data products, among which gamma-ray catalogues, which are produced in a coherent fashion
- Large & Long Proposals, requesting >100 hr and involving several observing period
- there are science cases focusing on the sub-TeV range that could be started before the full array deployment is completed without science losses

Bridging with other communities

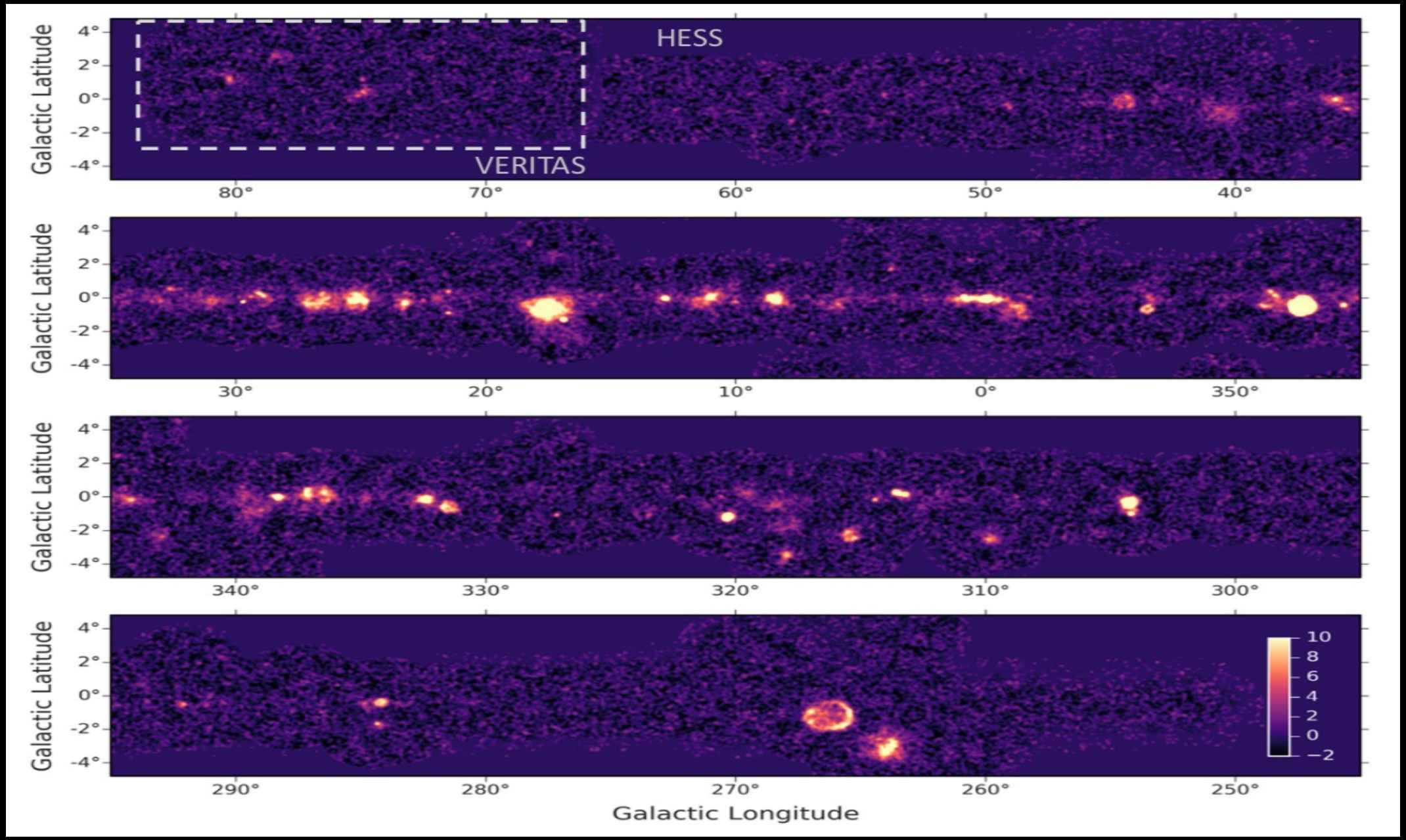
- workshops on specific science and science operations topics to discuss synergies

- to make a non-gamma-ray astronomer familiar with both the scientific capabilities and the data analysis we are organizing science data challenges

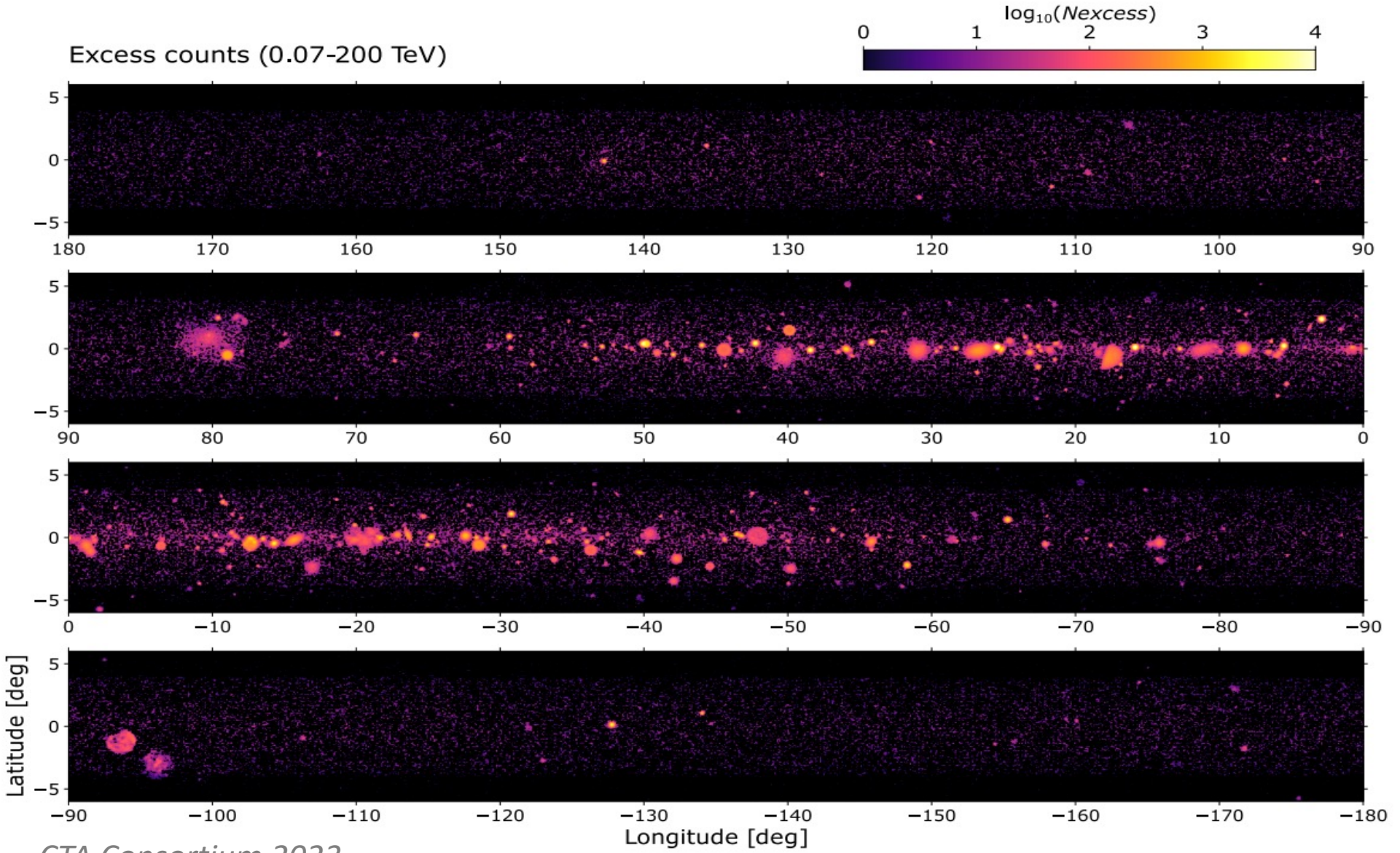
  - end of 2025 release of the first open SDC (7 years of data)

  - this afternoon release of 1 year of data for internal community as PoC

All credits to the SDC technical task force and a huge thanks to the collaboration of the CTAO Consortium & gammapy team



Prandini, Park, Parsons in Advances in very-high energy astrophyiscs

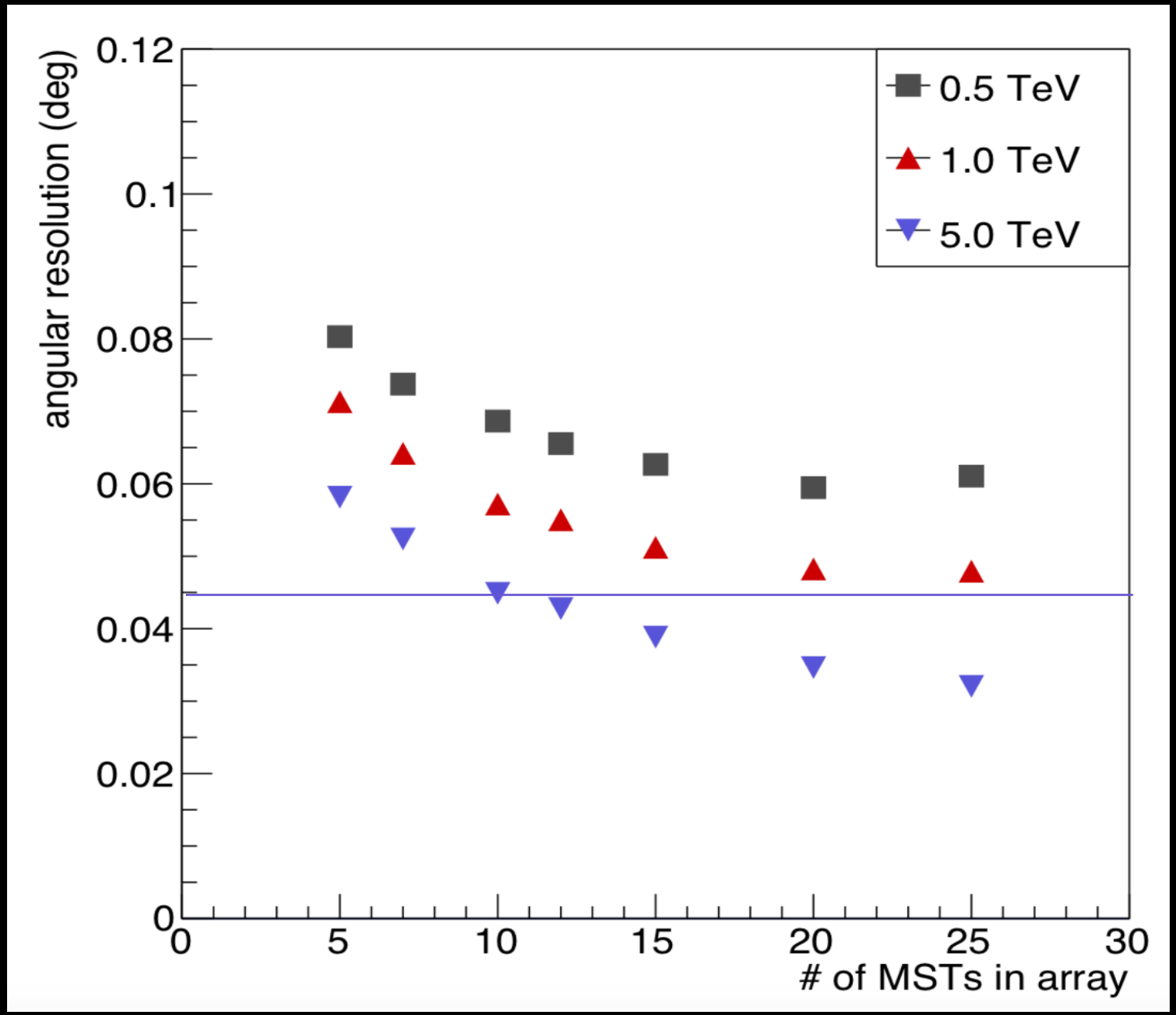


CTA Consortium 2023

~ 500 sources detected

Thank you

Credits to Otger Ballester


angular resolution (deg)
0.12
0.1
0.08
0.06
0.04
0.02
0
0
5
10
15
20
25
30
# of MSTs in array
0.5 TeV
1.0 TeV
5.0 TeV