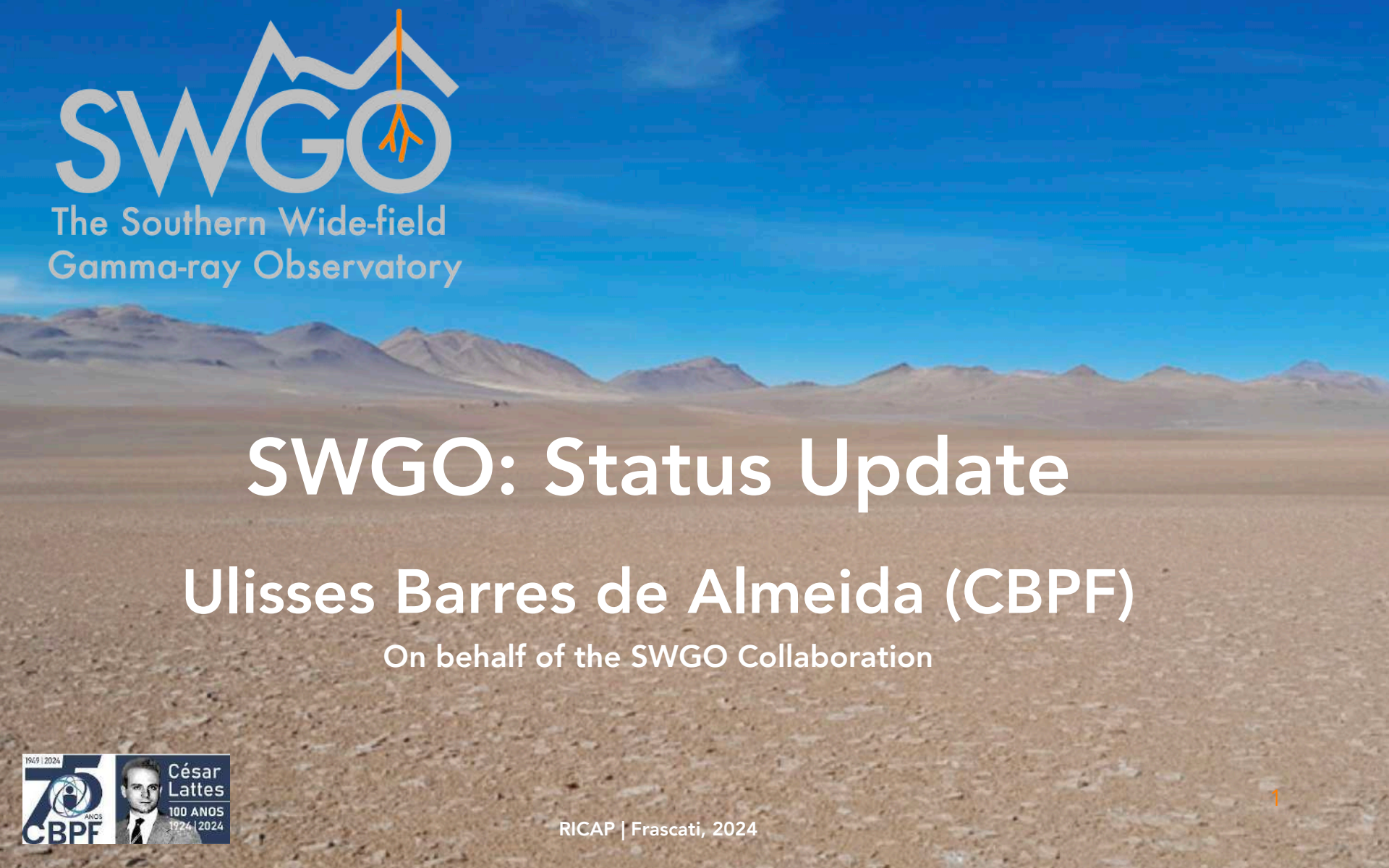


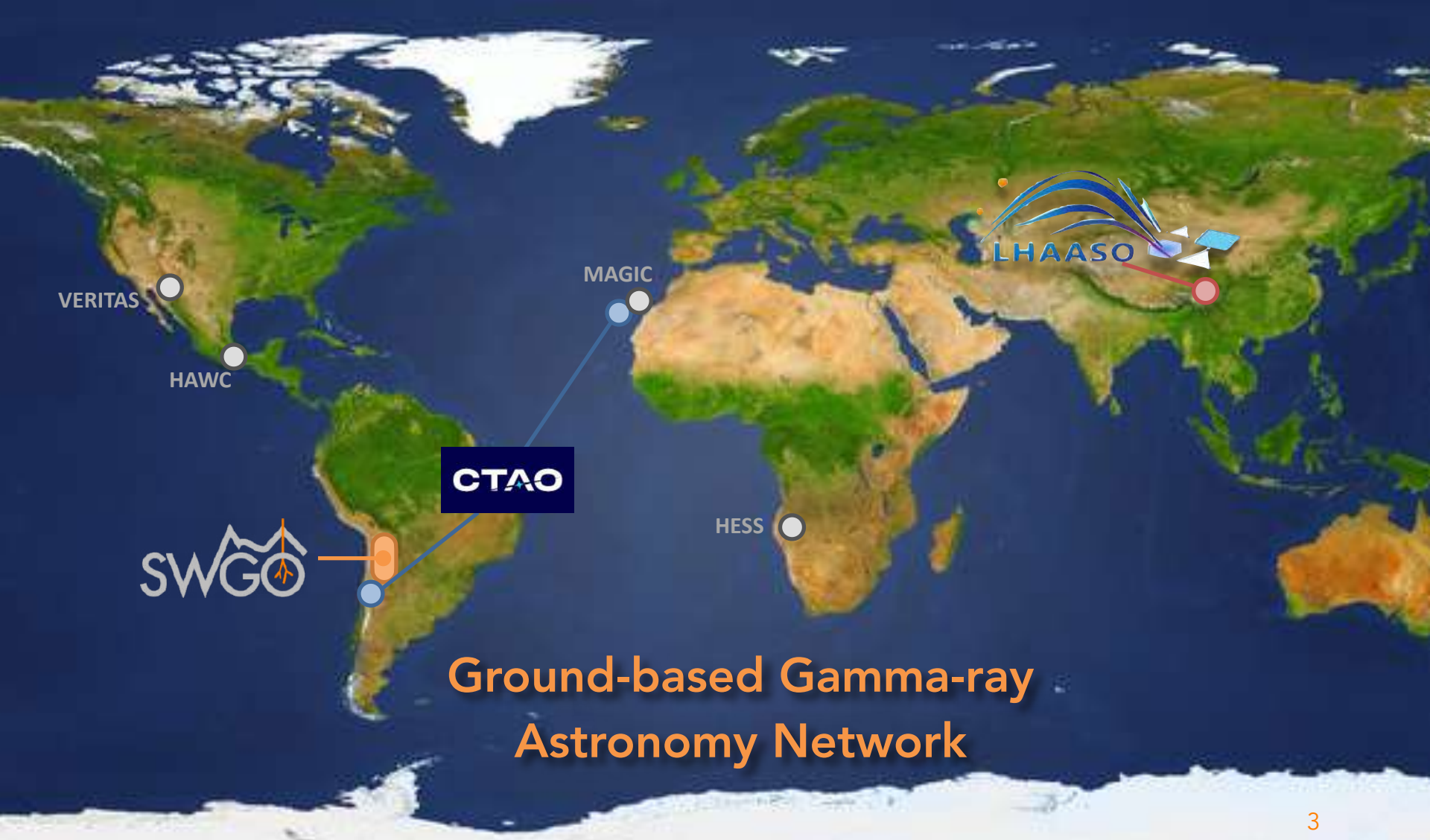
SWGO: Status Update

Ulisses Barres de Almeida (CBPF)

On behalf of the SWGO Collaboration

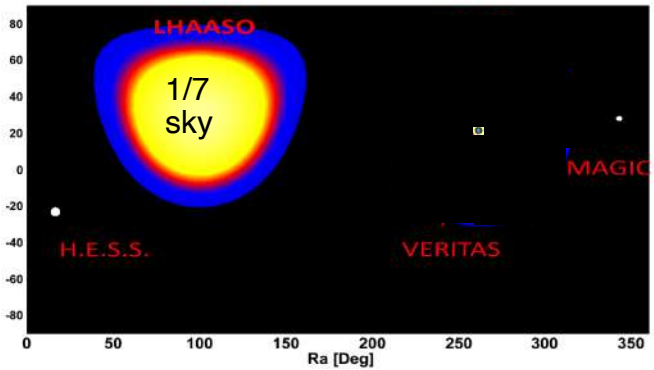
Content

1. Introduction
2. SWGO R&D
3. Site Selection



Ground-based Gamma-ray Astronomy Network

Two techniques

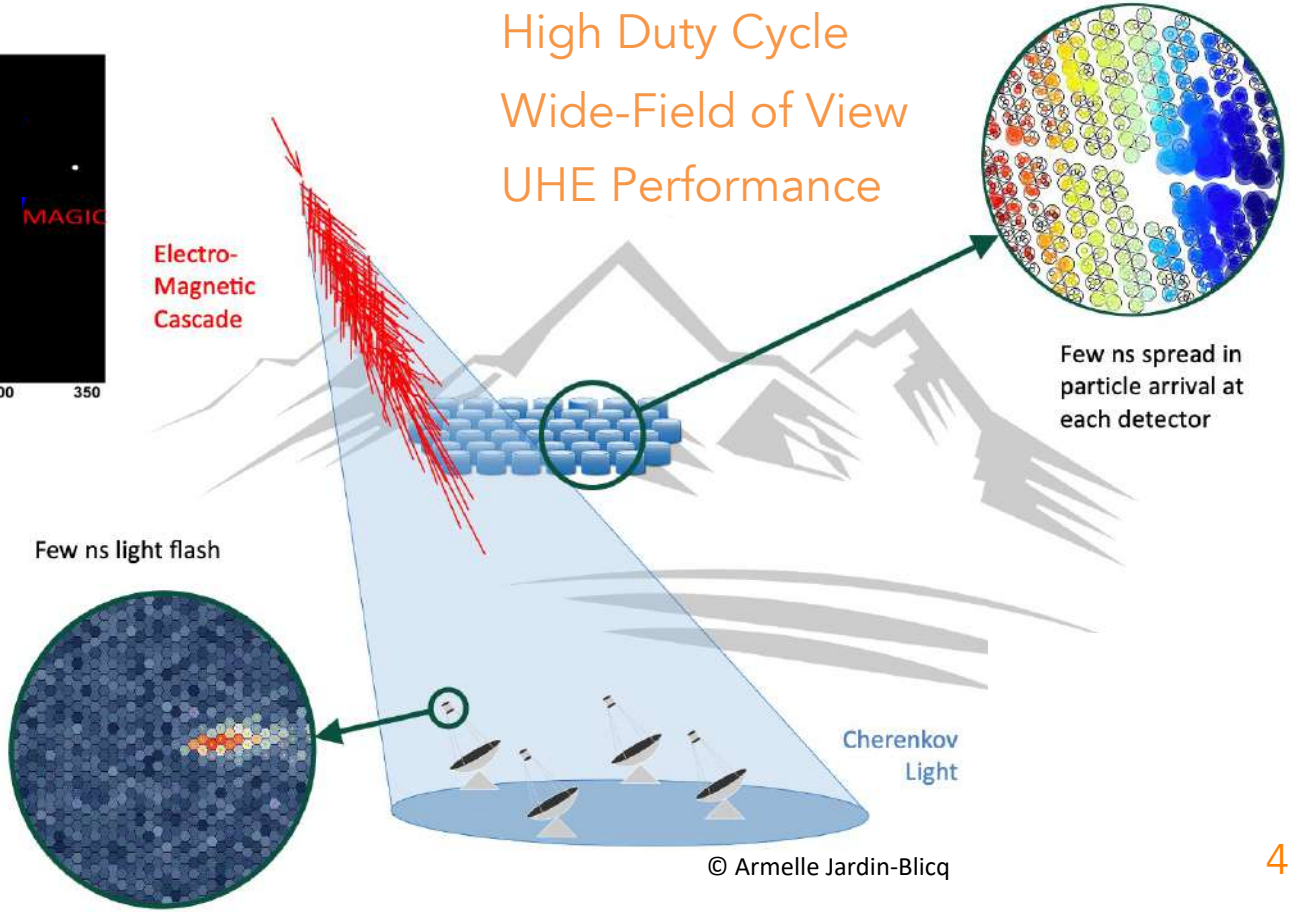


Air-shower particle arrays

High Duty Cycle

Wide-Field of View

UHE Performance



Air-Cherenkov Telescopes

Low Duty Cycle

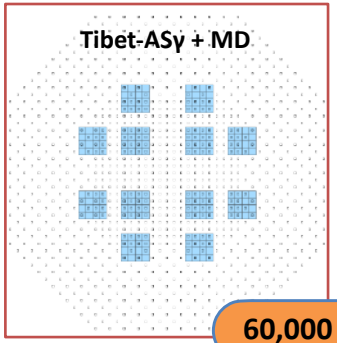
Pointing instruments

Precision Astronomy

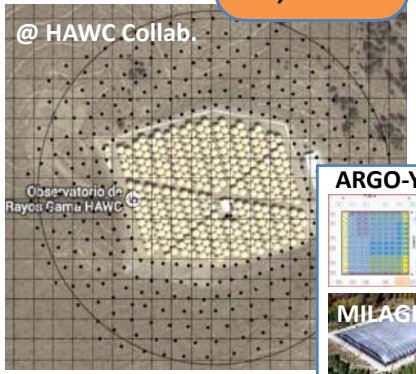
Larger and higher...

1.3 km

2010s



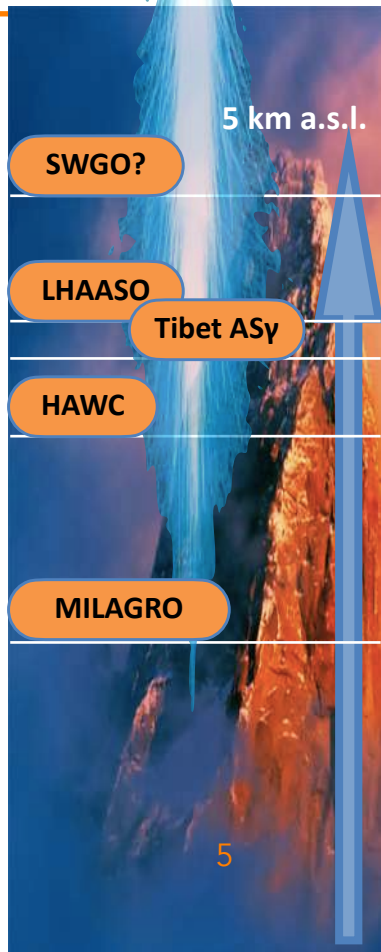
60,000 m²



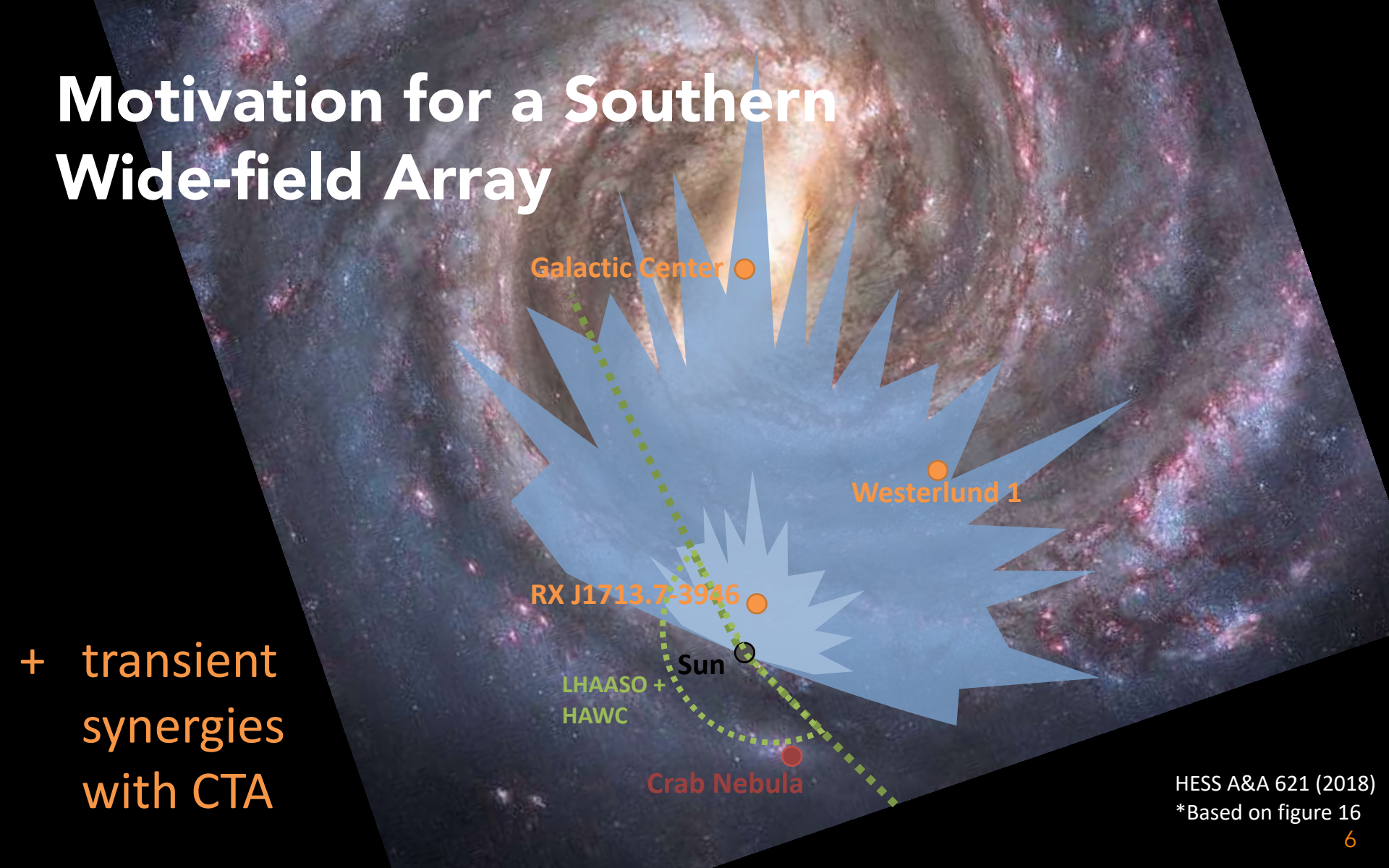
2000s

ARGO-YBJ

6,000 m²



Motivation for a Southern Wide-field Array



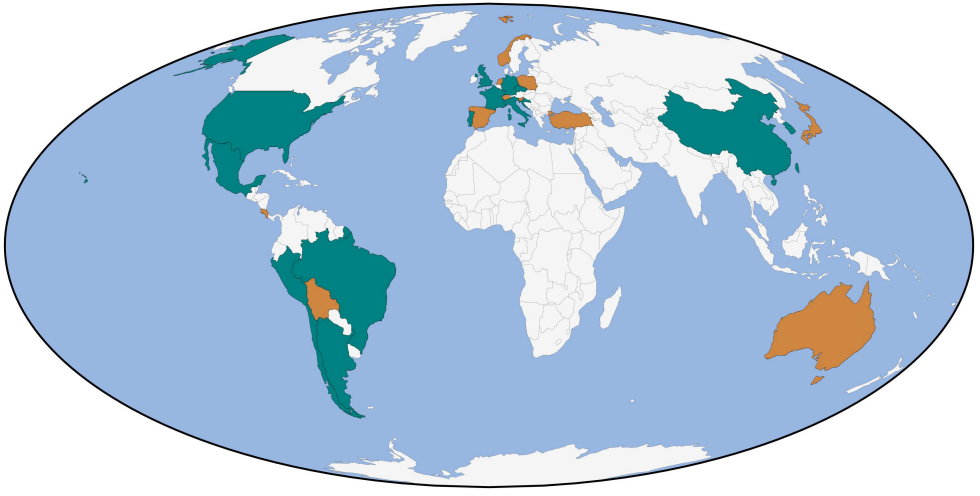
\+ transient synergies with CTA

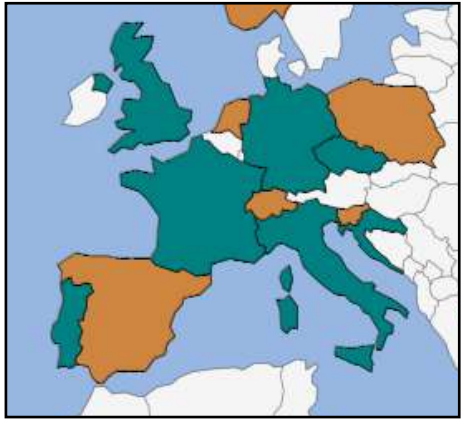
HESS A&A 621 (2018)
*Based on figure 16

SWGO Collaboration

Member Institutes

Supporting Scientists





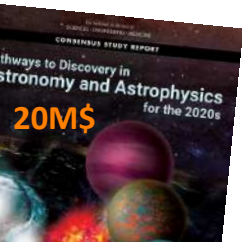
- SWGO partners
  - → 15 countries, over 90 institutes
  - → + supporting scientists

Argentina
Brazil
Chile
China
Croatia
Czech Republic
France
Germany
Italy
Mexico
Peru
Portugal
South Korea
United Kingdom
United States

Project Status

		SWGO R&D Phase Milestones
2019 ✓	M1	R&D Phase Plan Established
✓	M2	Science Benchmarks Defined
2020 ✓	M3	Reference Configuration & Options Defined
✓	M4	Site Shortlist Complete
2022 ✓	M5	Candidate Configurations Defined
✓	M6	Performance of Candidate Configurations Evaluated
2024 ✓	M7	Preferred Site Identified
→	M8	Design Finalised
	M9	Construction & Operation Proposal Complete

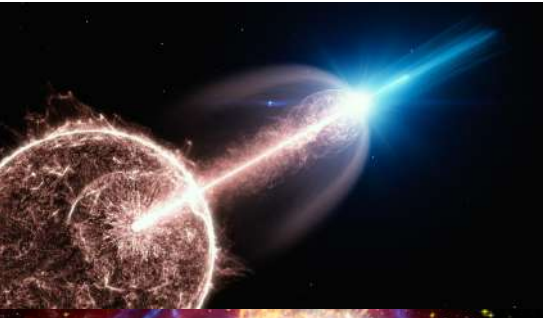
- R&D Phase
  - → Kick off meeting Oct 2019
  - → Expected completion 2025
    - ✓ Site and Design Choices made
  - → Then:
- Preparatory Phase
  - → Detailed construction planning
  - → **Engineering Array in 2026**
- (Full) Construction Phase
  - → From 2027

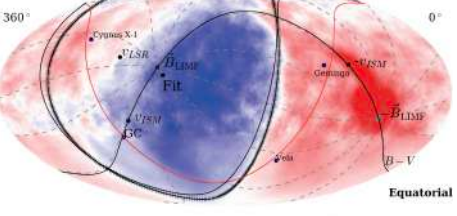


- Roadmaps
  - → US Decadal Review
  - → SNOWMASS, APPEC, Astronet

Science Drivers

White paper in planning

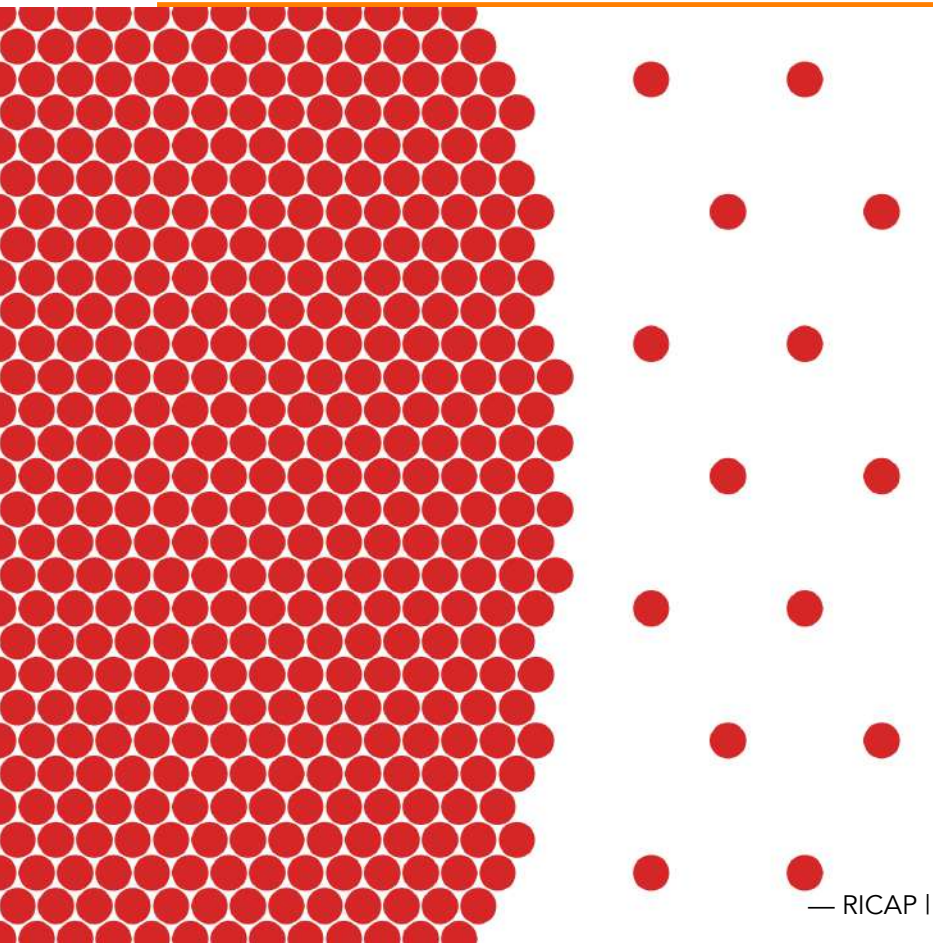




Science Case	Design Drivers
Transient Sources: Gamma-ray Bursts	Low-energy sensitivity & Site altitude[a]
Galactic Accelerators: PeVatron Sources	High-energy sensitivity & Energy resolution[b]
Galactic Accelerators: PWNe and TeV Halos	Extended source sensitivity & Angular resolution[c]
Diffuse Emission: Fermi Bubbles	Background rejection
Fundamental Physics: Dark Matter from Galactic Halo	Mid-range energy sensitivity Site latitude[d]
Cosmic-rays: Mass-resolved dipole/multipole anisotropy	Muon counting capability[e]

Science tools compatible with gammapy

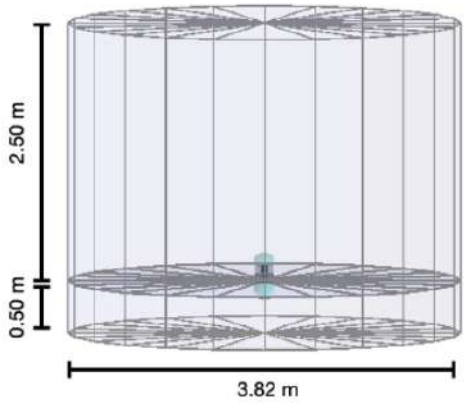
The reference detector concept



Layout: Core + Outer Array

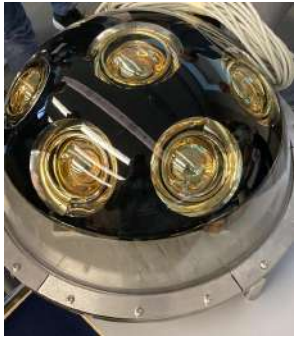
Altitude: > 4,400 m a.s.l.

✧ muon tagging



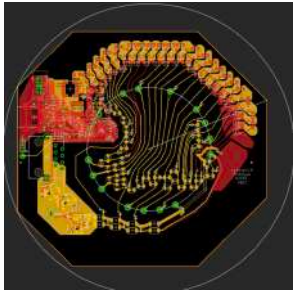
Exploring WCD technologies

Development of new concepts and approaches



PHOTOSENSORS

BLADDERS & LAKES

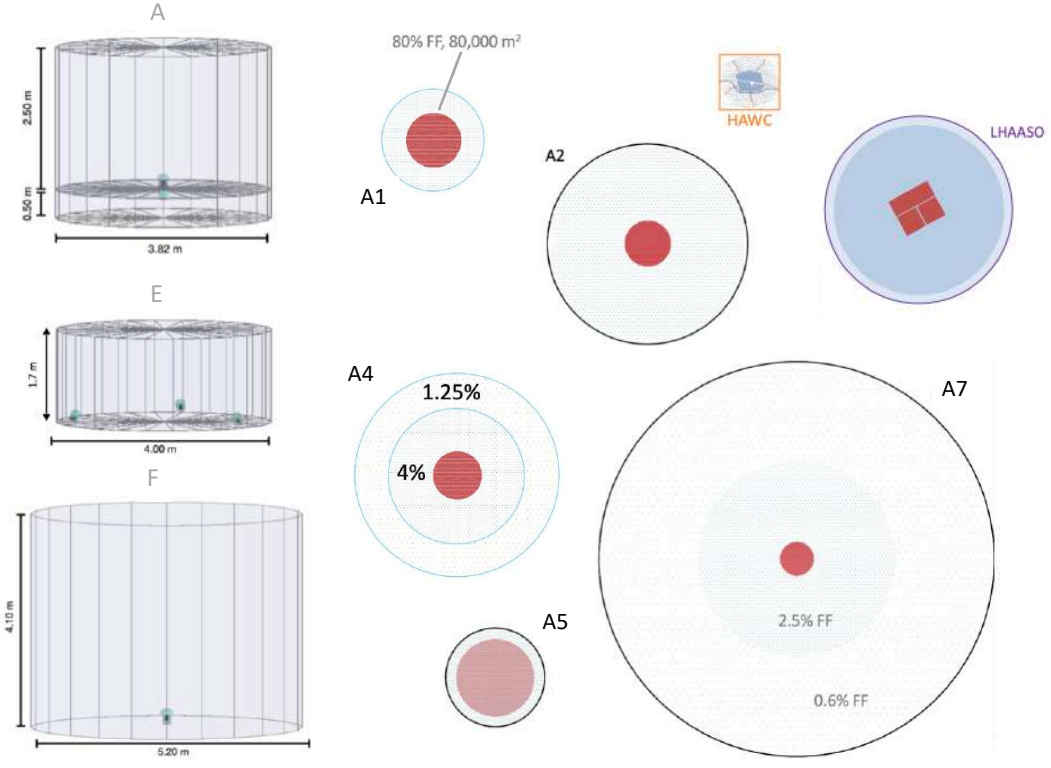


ELECTRONICS

WCD Unit

A next generation observatory

Comprehensive **simulations of 13 configurations** completed; several **reconstruction** and **γ/hadron** separation passes.



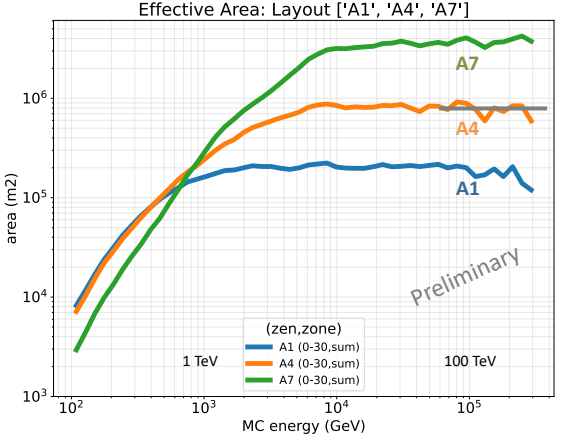
All layouts present in the SWGO simulation framework

CORSIKA — Simulation of extensive air showers

AERIE — Detector simulation

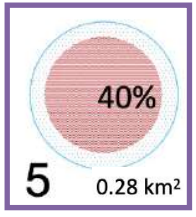
SWGO-RECO — Shower reconstruction

PYSWGO — High-level reconstructions (IRFs)

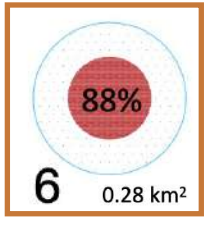


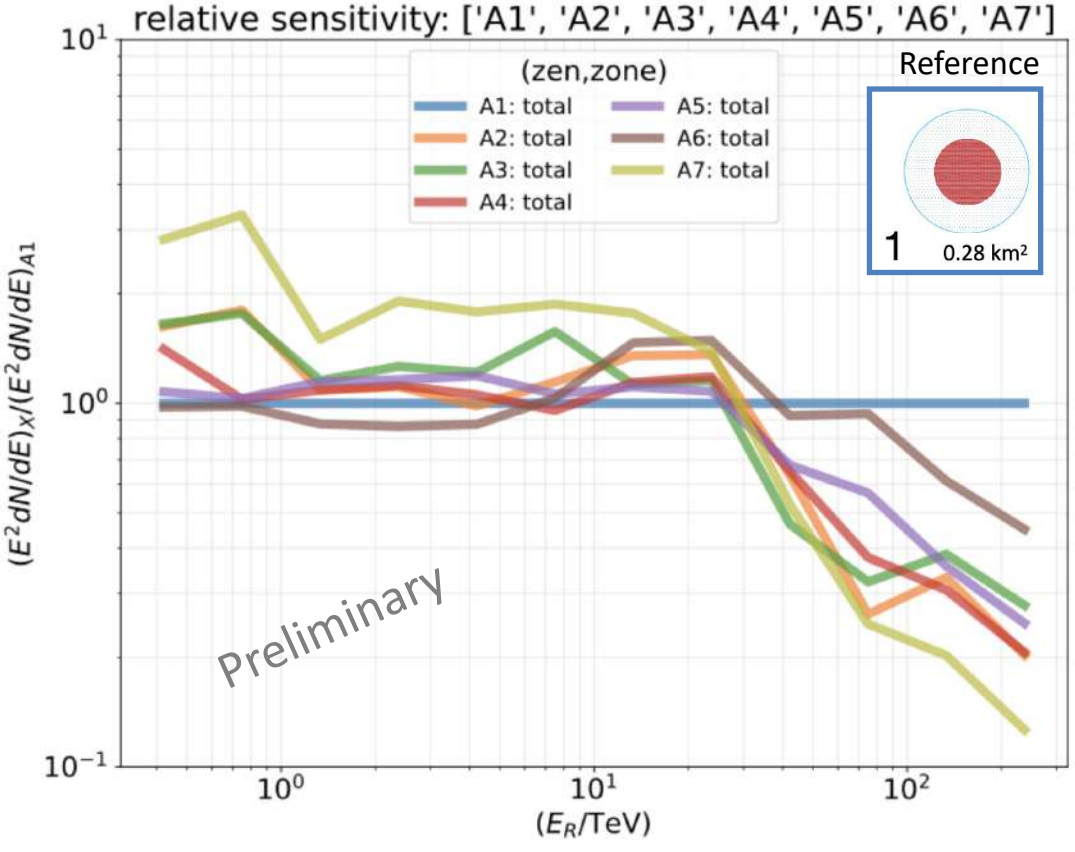
LHAASO approx

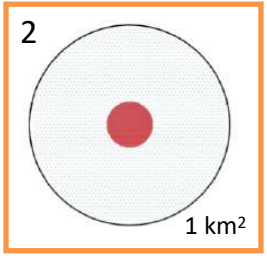
A next generation observatory



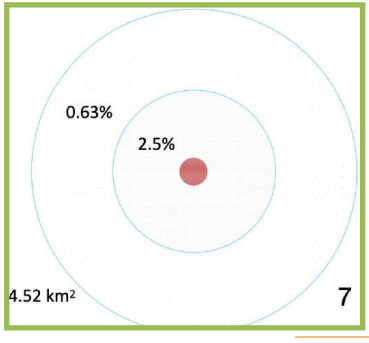
Exploring trade-off between core footprint and fill-factor.



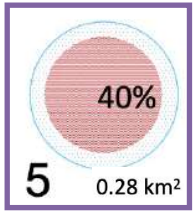




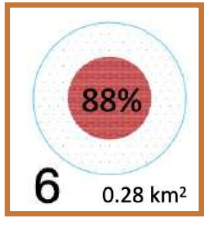
Exploring very large areas and low fill-factors

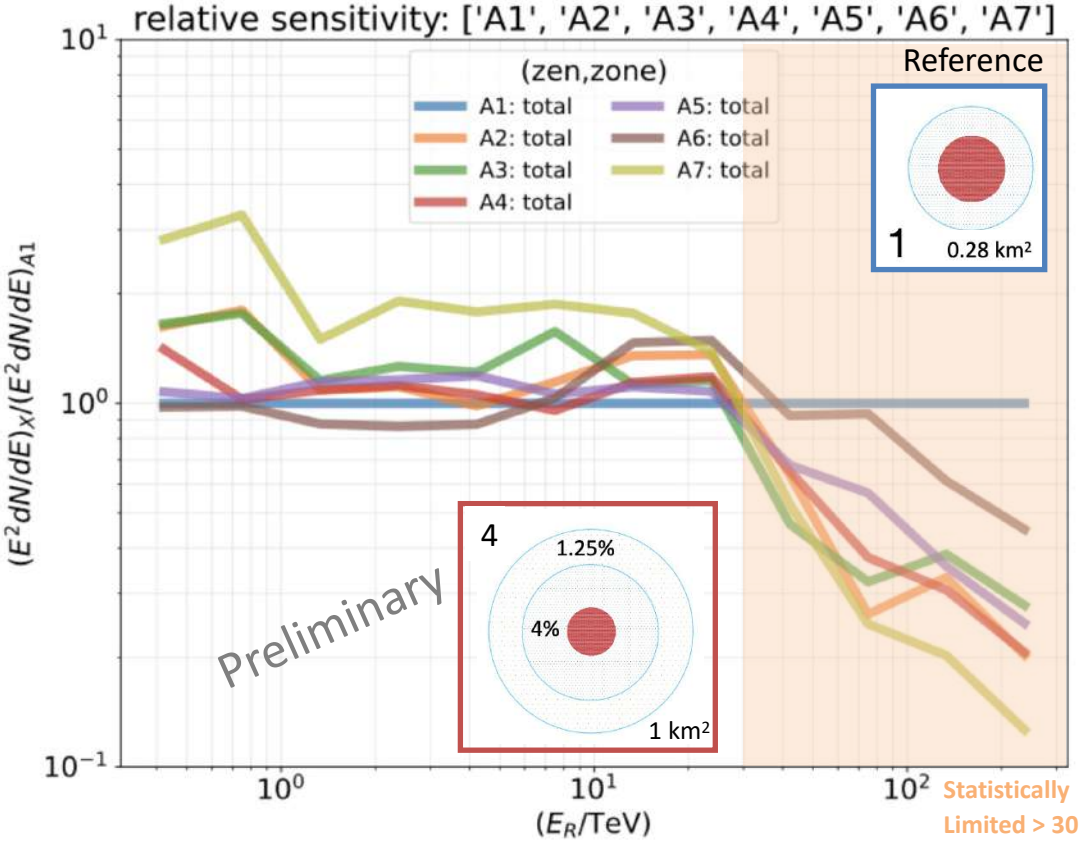


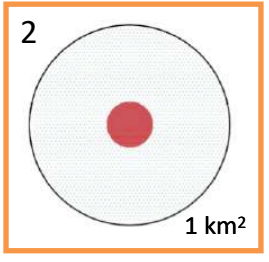
A next generation observatory



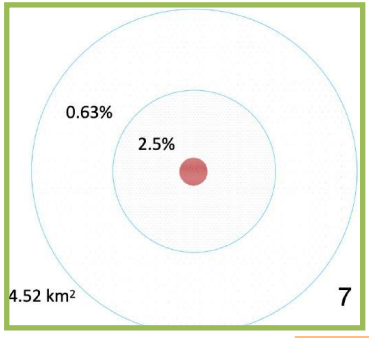
Exploring trade-off between core footprint and fill-factor.





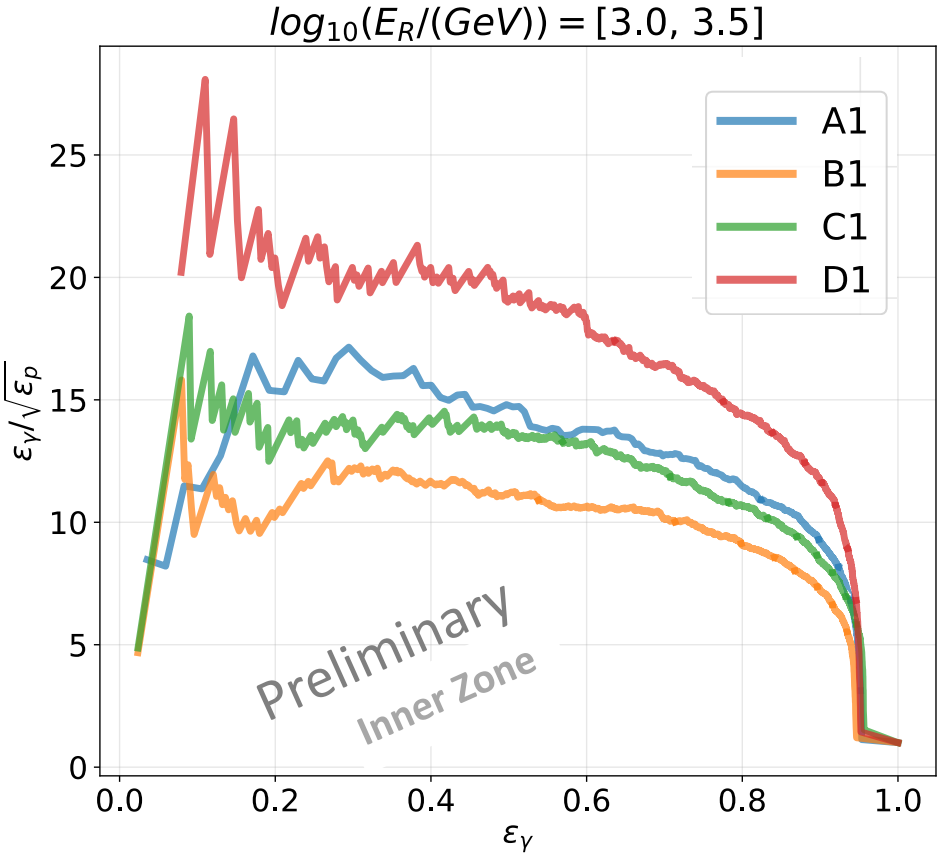


Exploring very large areas and low fill-factors



Statistically Limited > 30 TeV

A next generation observatory

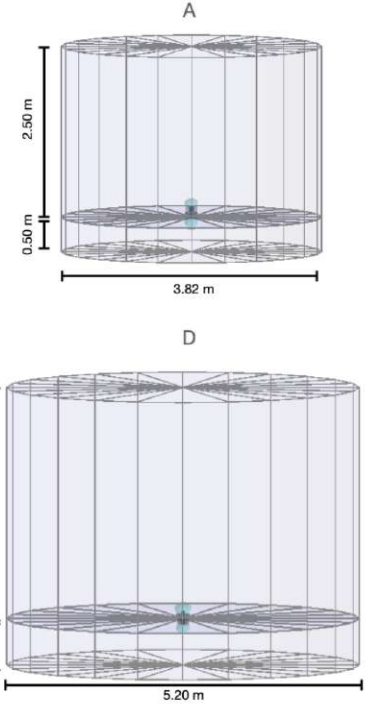


Double-layer WCD unit concept

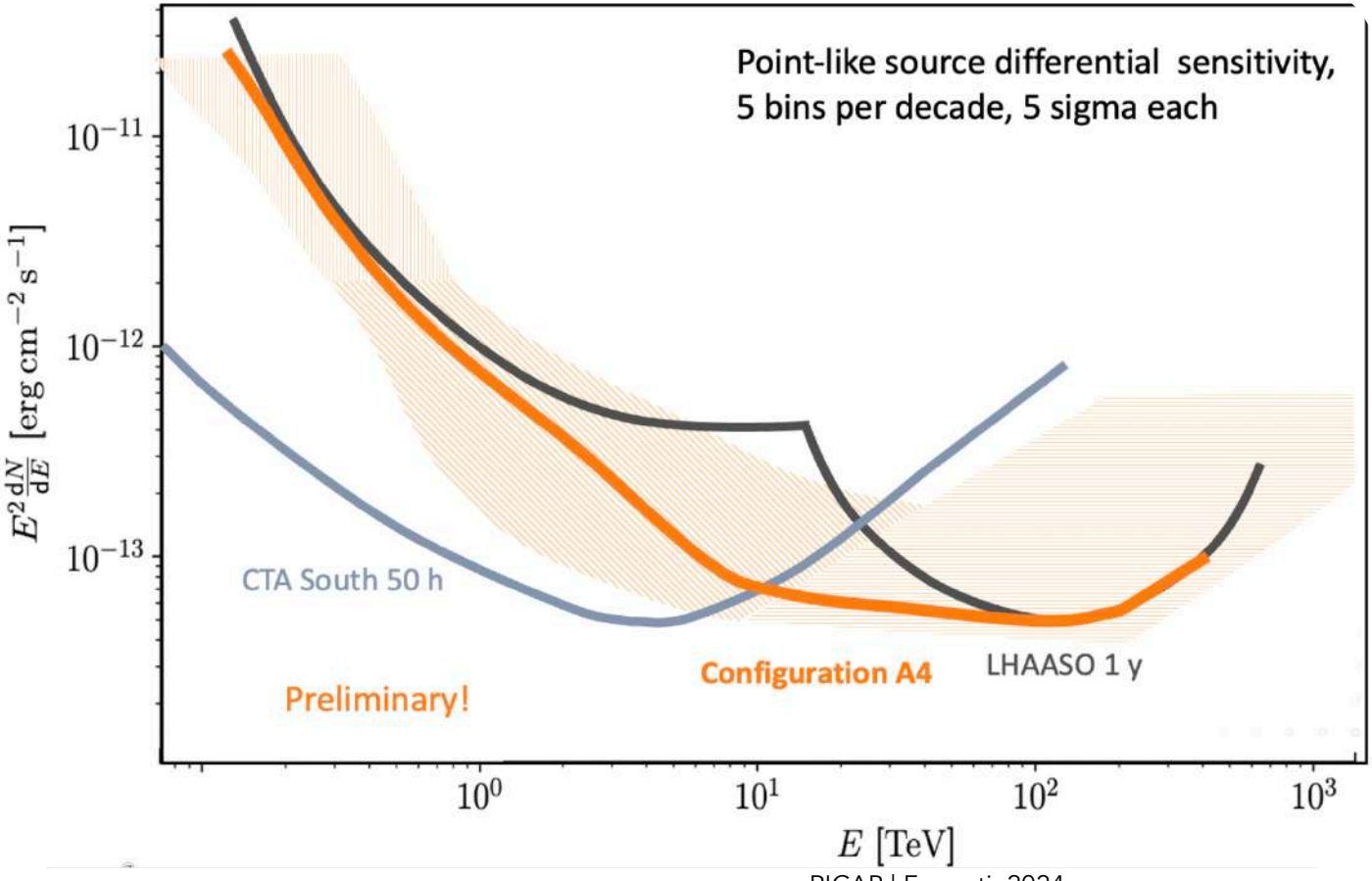
Cost-effective γ/hadron separation

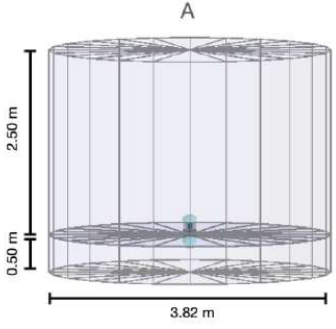
Large background rejection power > 1 TeV

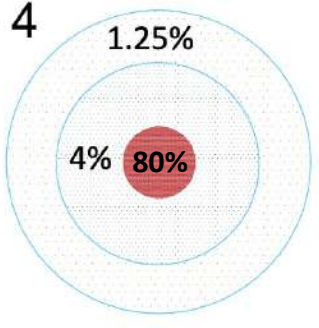
> 400, with 50% gamma efficiency



Expected Sensitivity



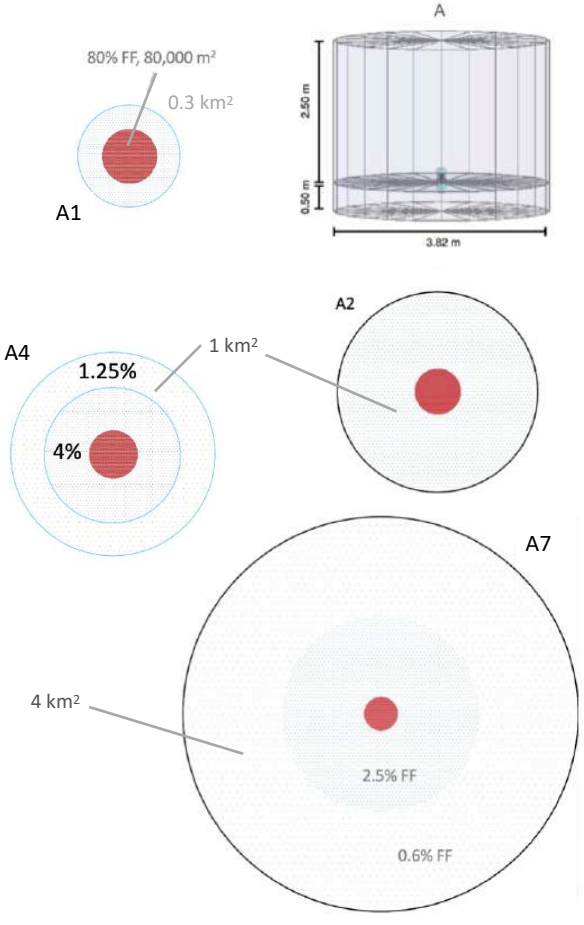


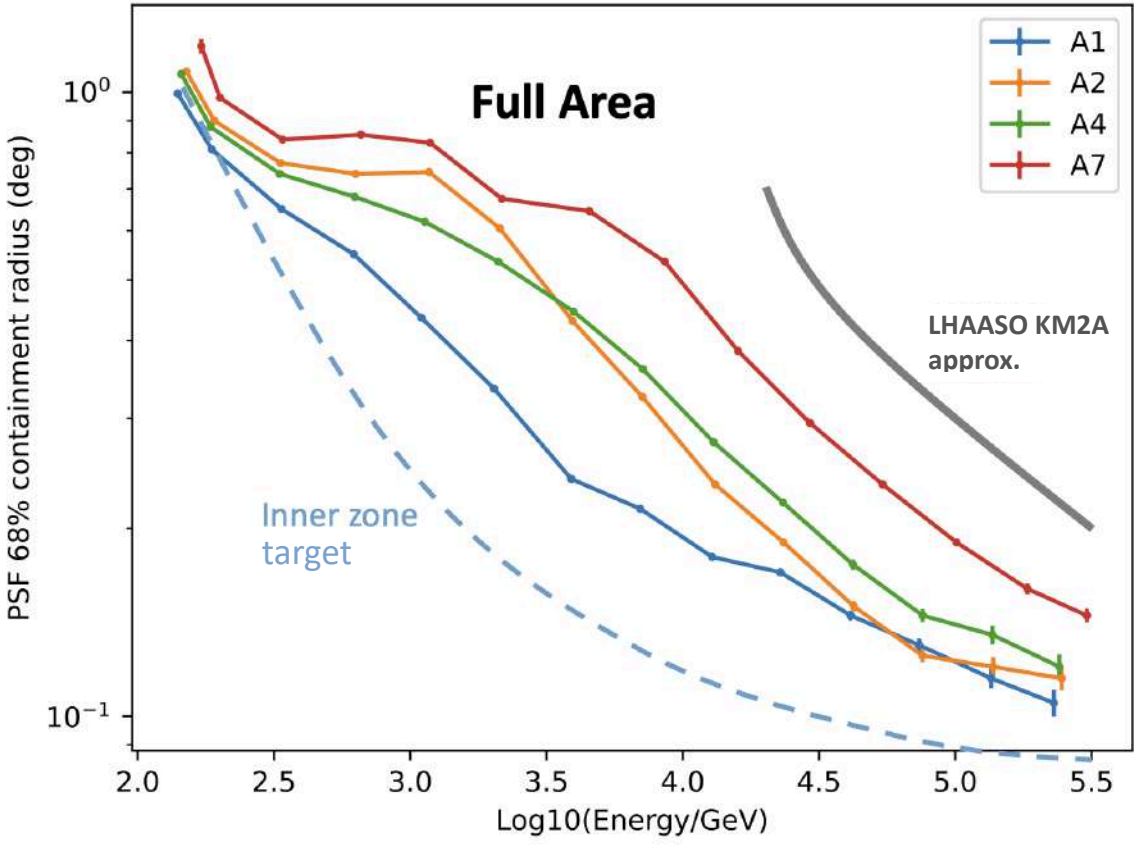


At 4,700 m a.s.l.

Target Angular Resolution

Unprecedented for wide-field instrument

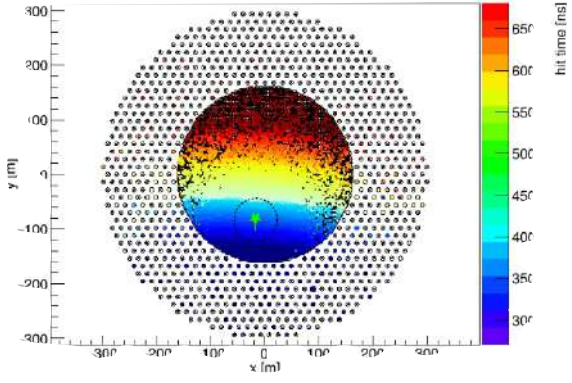


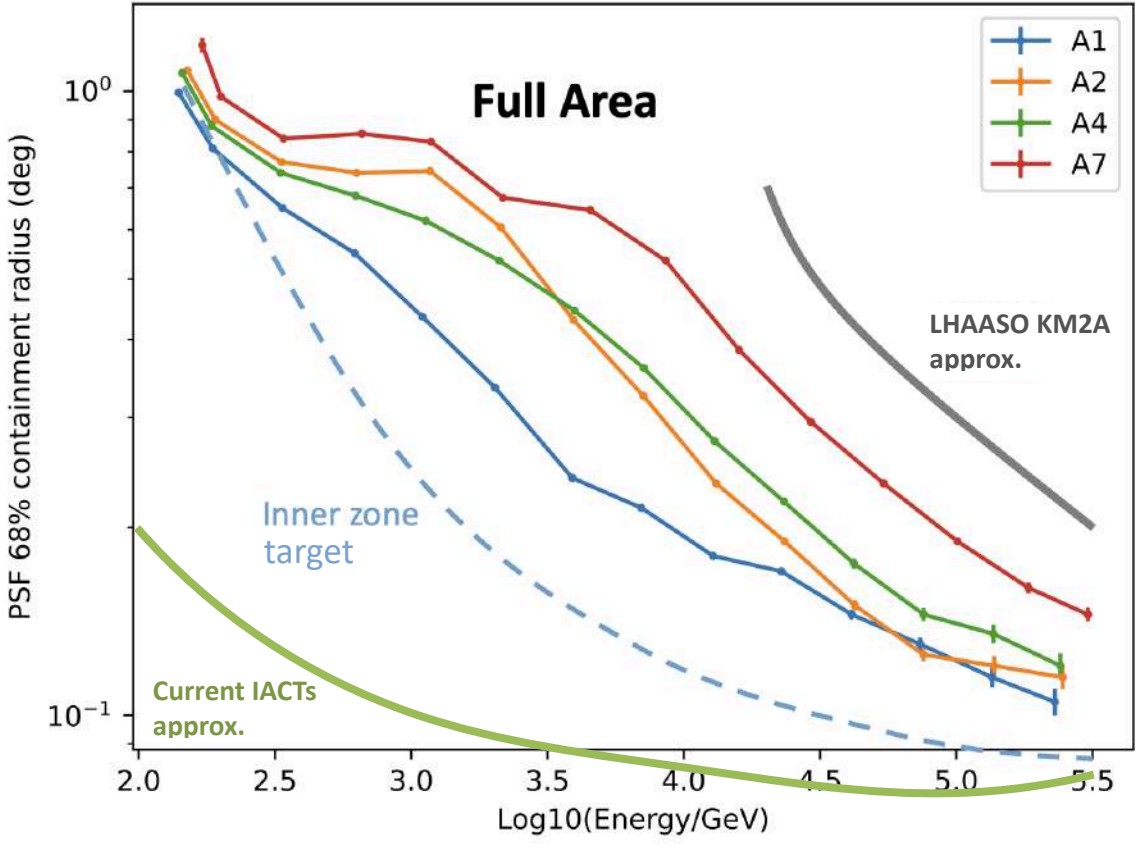


Target Angular Resolution

Unprecedented for wide-field instrument

Angular reconstruction methods still being refined





Site Search

- Candidate Sites in Argentina, Chile and Peru
  - → Latitudes between 14° and 24° South
  - → Elevations between 4,400 and 4,850 m a.s.l.
- Minimum available area 1 km^2
- Solution for water provision / availability
- Site visits took place in Oct-Nov 2022
  - → At the first available opportunity after the COVID-19 Pandemic

Shortlisted Sites

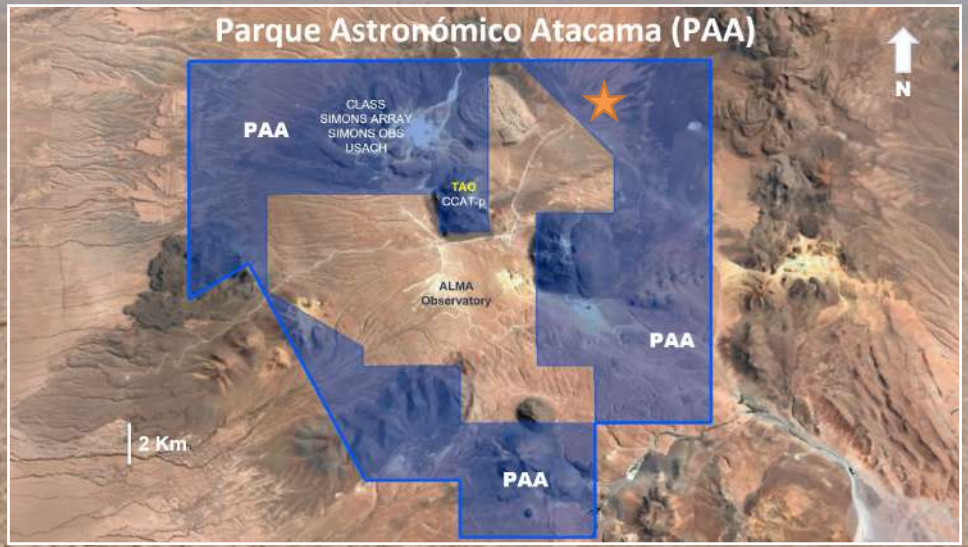
- All sites extremely flat with < 2% slope
- Shortlisting criteria included
  - → Science performance (array footprint + altitude)
  - → Site preparation and construction costs
  - → Construction and operations risks
  - → Environmental impact
  - → Social impact
- Engagement with local communities among priority factors in evaluation

Site Selection

- Preferred and back-up site announced on 12th August
- Pampa La Bola, Atacama Astronomical Park (Chile)

Site Selection

- Preferred and back-up site announced on 12th August
- Pampa La Bola, Atacama Astronomical Park (Chile)
  - Vast plateau at 4,770 m a.s.l.
  - 23° South, 68° West
  - Available area superior to 1 km^2
  - At the international road Chile-Argentina
    - ✓ Few km from ALMA
    - ✓ 40 min from San Pedro de Atacama
    - ✓ 2 hours from Calama (airport)



Site Selection

- Pampa La Bola, Atacama Astronomical Park (Chile)

Towards Construction

Construction phase aimed to start 2026

- SWGO collaboration will place a NSF request to fund the first SWGO-A stage.
  - → SWGO-A will work as a seed of SWGO and is expected to have superior performance to HAWC
  - → Current timeline foresees construction to start in 2026

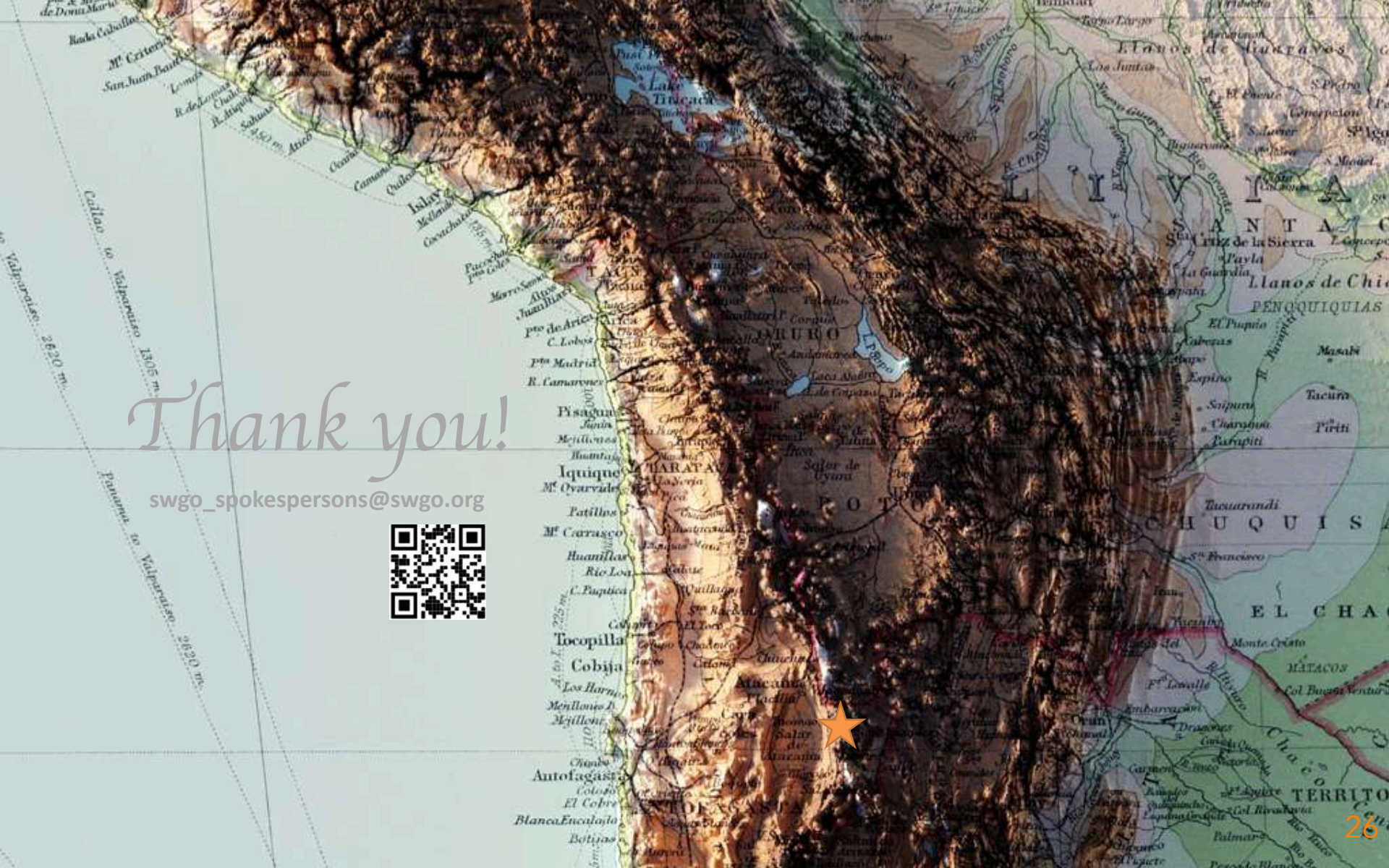
- The SWGO Collaboration is looking for additional funding opportunities to complement SWGO-A
  - → In addition to double layer tanks, a shallow rotomolded tank is being explored as a solution for the outer array, profiting from R&D developments in Brazil/CBPF
  - → Multi-PMT modules developed in Italy/INFN are a potential photosensor solution for instrumenting such tanks.

Summary

- SWGO is approaching the conclusion of its R&D Phase, and has recently announced the observatory site.

- SWGO will be an international, multi-agency project
  - → Steering committee composed of 15 associated countries
  - → Spokesteam reflects the strong participation of Europe, North and South America

- SWGO will be the first km^2-scale wide-field gamma-ray observatory in the Southern Hemisphere
  - → Open a new survey window in astronomy with unprecedented sensitivity
  - → Large opportunities for synergies with neighboring CTAO, including transients


Thank you!
swgo_spokespersons@swgo.org

A lake-based array?

- SWGO will be built in the Atacama Astronomical Park, in Chile.
  - The scope of the 1 km^2-scale array is from few hundred GeV to the PeV scale
  - Timeline expectations are for construction to start in 2027

- The SWGO Collaboration will continue to explore a multi-km2 array as a possible future extension **enhancing UHE capabilities**
  - In addition to the main site, a lake-based multi-km2 array extension is considered as a possible solution based on performance-cost considerations
  - Developments are in the R&D stage and timeline is beyond the current scope of the main array preparation / construction.