SWGO: Status Update

Ulisses Barres de Almeida (CBPF)

On behalf of the SWGO Collaboration

Content

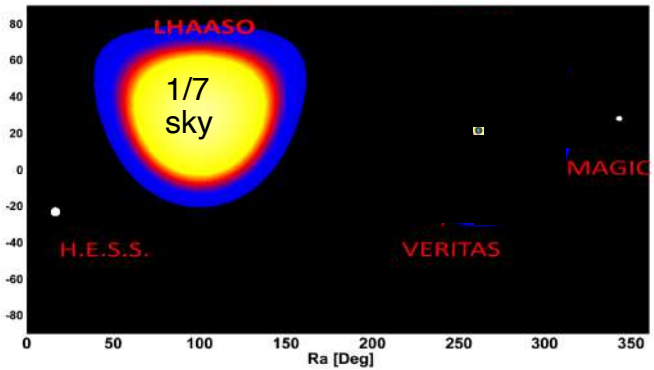
1. Introduction

2. SWGO R&D

3. Site Selection

Ground-based Gamma-ray Astronomy Network

Two techniques

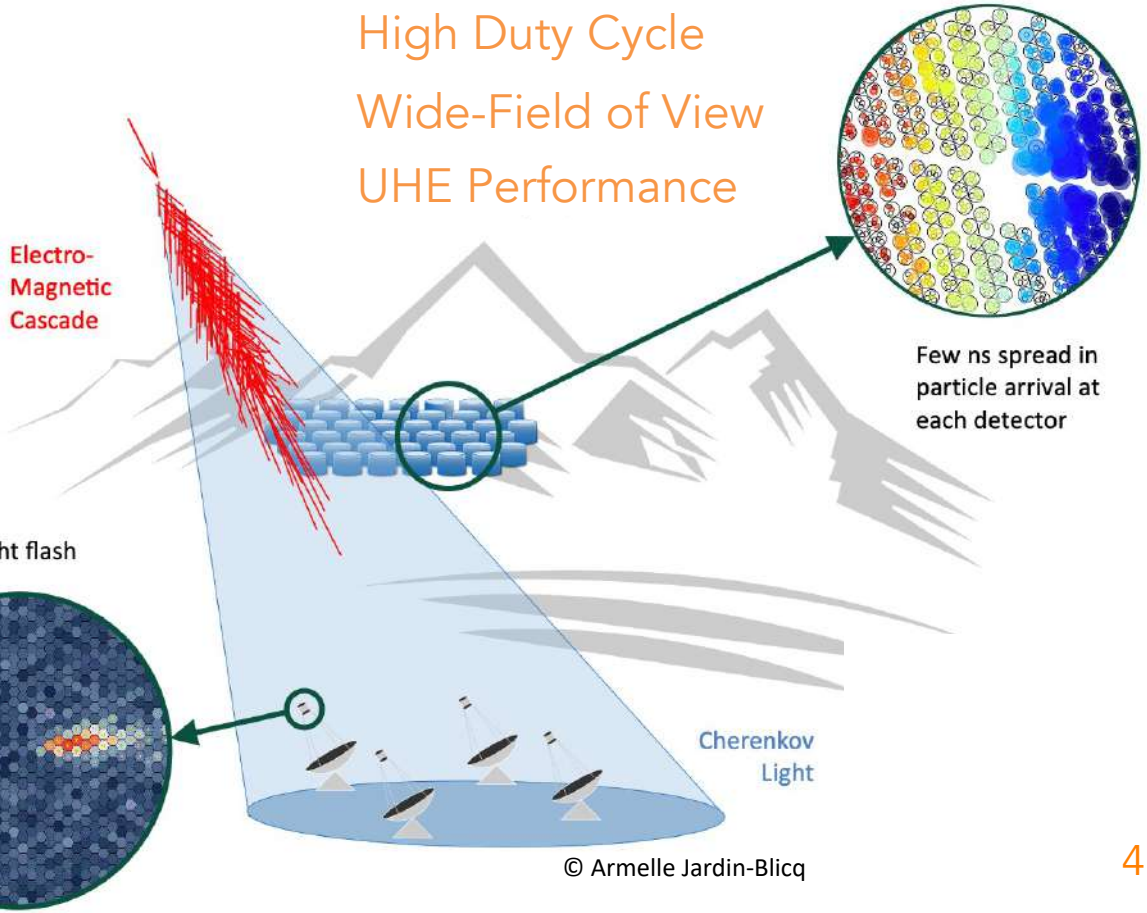


Air-shower particle arrays

High Duty Cycle

Wide-Field of View

UHE Performance



Air-Cherenkov Telescopes

Low Duty Cycle

Pointing instruments

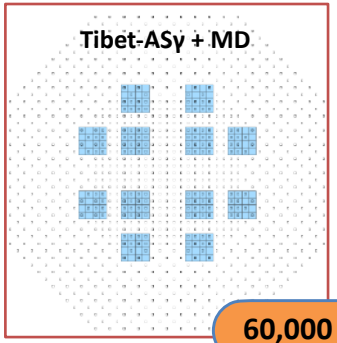
Precision Astronomy at VHE

© Armelle Jardin-Blicq

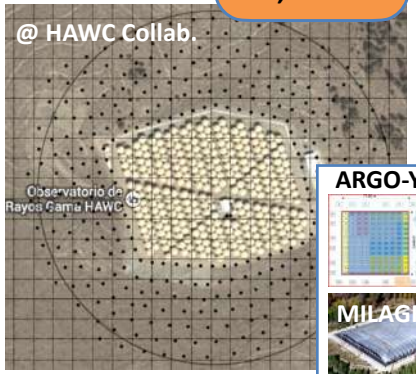
Larger and higher...

1.3 km

2010s



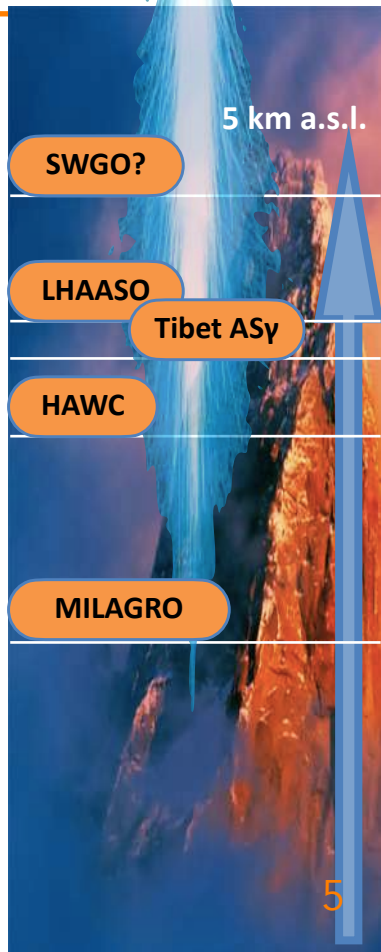
60,000 m²



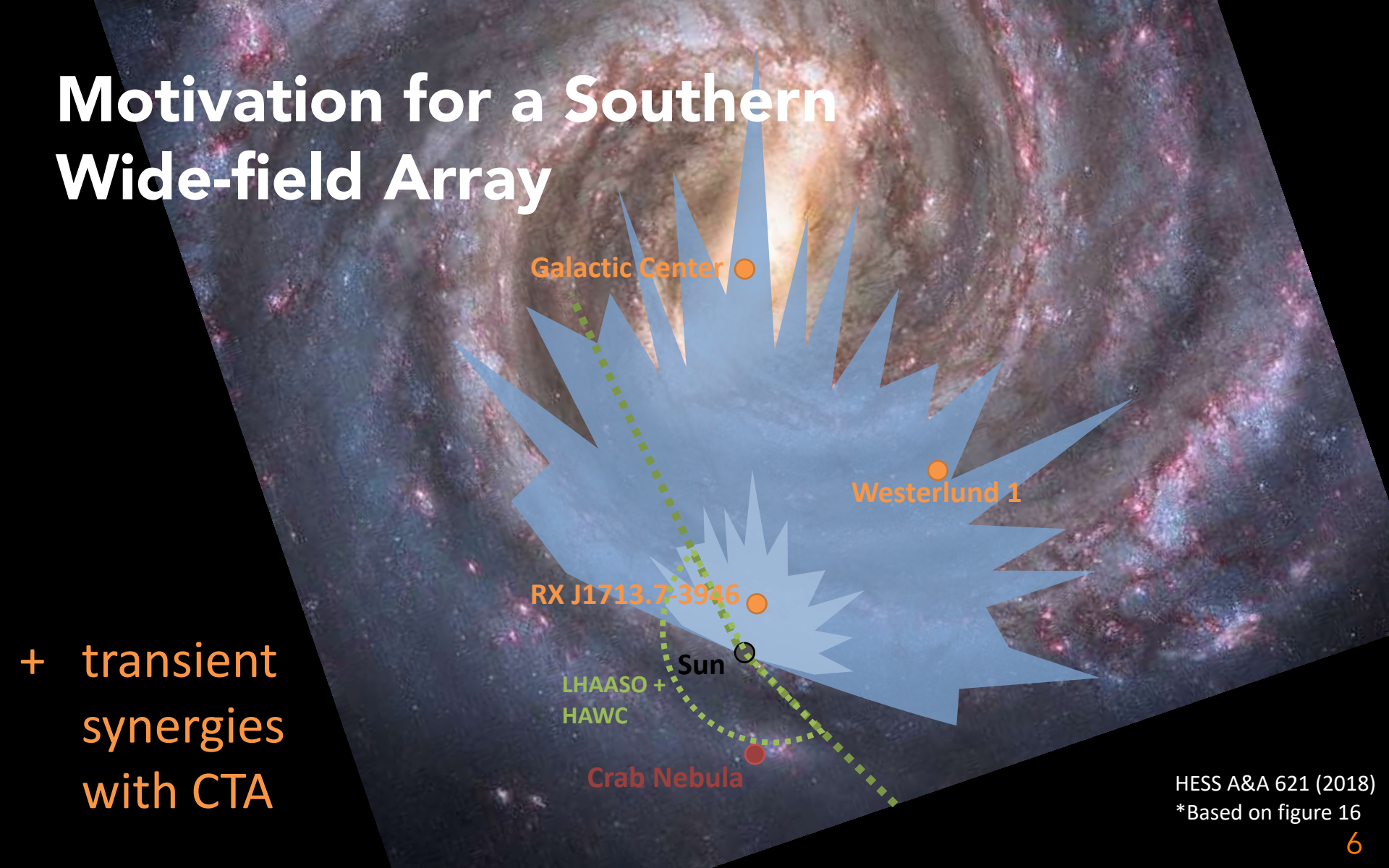
2000s

ARGO-YBJ

6,000 m²



Motivation for a Southern Wide-field Array



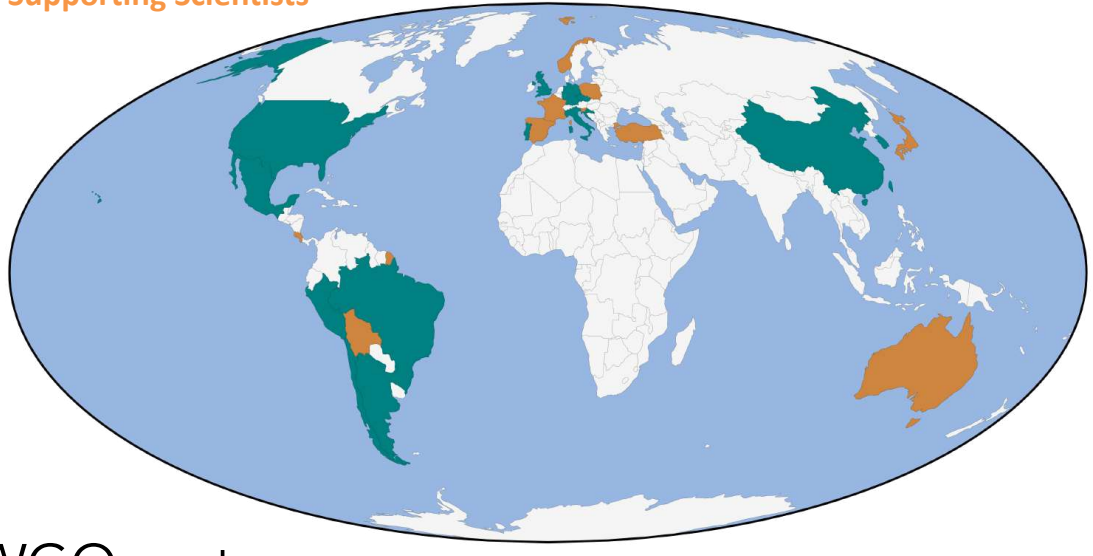
\+ transient synergies with CTA

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

SWGO Collaboration

Member Institutes

Supporting Scientists



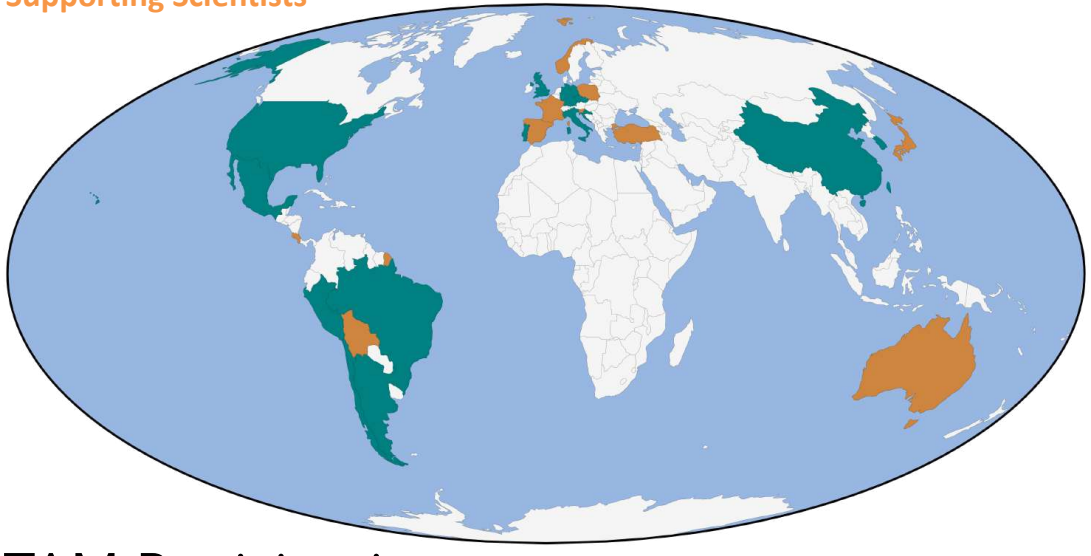
- SWGO partners
  - → 15 countries, over 90 institutes
  - → + supporting scientists

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

SWGO Collaboration LATAM

Member Institutes

Supporting Scientists



Spokespersons:

Jim Hinton (Germany)
Ulisses Barres (Brazil)
Petra Huentemeyer (USA)

Steering Committee LATAM:

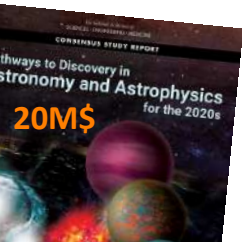
AR: Adrian Rovero (IAFE)
BR: Alberto Reis (CBPF)
→Elisabete Dal Pino (IAG)
CH: Claudio Dib (UTFSM)
MX: Ibrahim Torres (INOAE)
PR: Luis Otiniano (CONIDA)

- LATAM Participation
  - → 5 countries, about 40 institutes
  - → Nearly 100 scientists

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

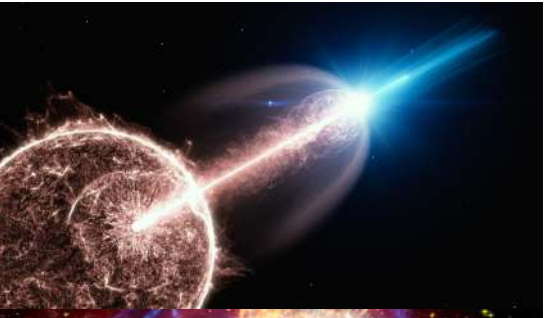
- R&D Phase
  - → Kick off meeting Oct 2019
  - → Expected completion 2025
    - ✓ Site and Design Choices made
  - → Then:
- Preparatory Phase
  - → Detailed construction planning
  - → **Engineering Array in 2026**
- (Full) Construction Phase
  - → From 2027

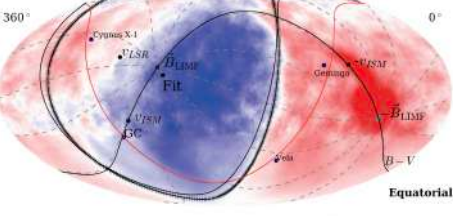


- Roadmaps
  - → US Decadal Review
  - → SNOWMASS, APPEC, Astronet

Science Drivers

White paper in planning

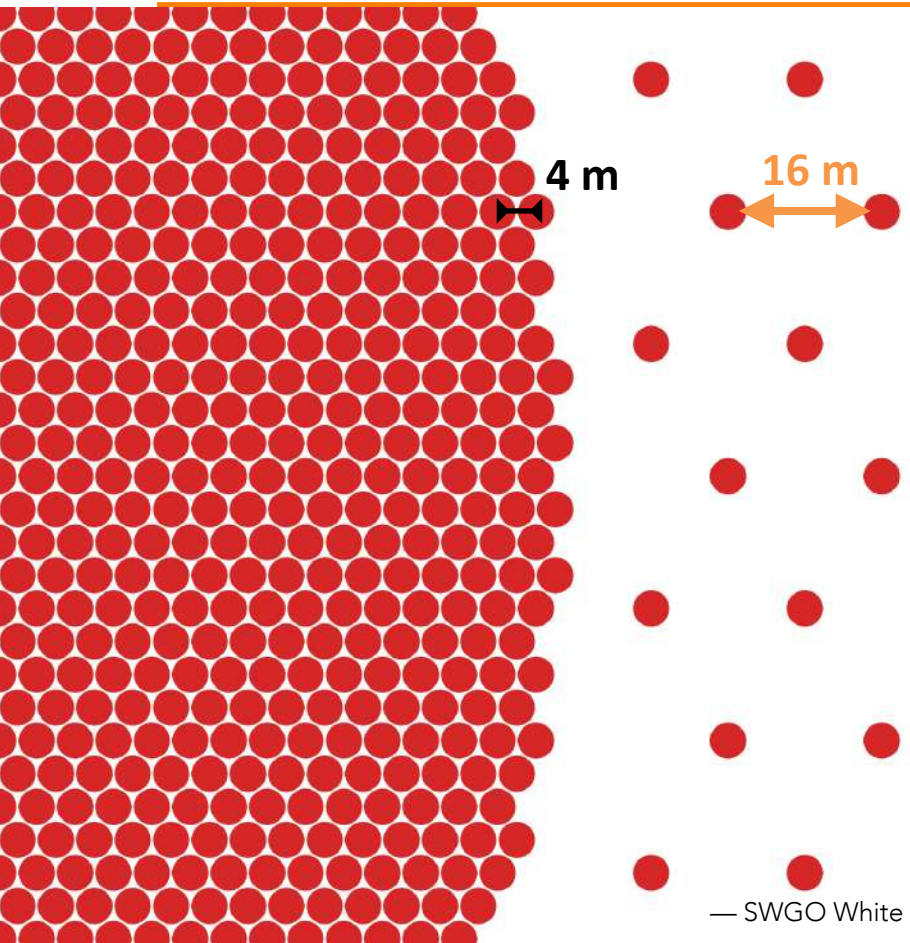




Science Case	Design Drivers
Transient Sources: Gamma-ray Bursts	Low-energy sensitivity & Site altitude[a]
Galactic Accelerators: PeVatron Sources	High-energy sensitivity & Energy resolution[b]
Galactic Accelerators: PWNe and TeV Halos	Extended source sensitivity & Angular resolution[c]
Diffuse Emission: 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

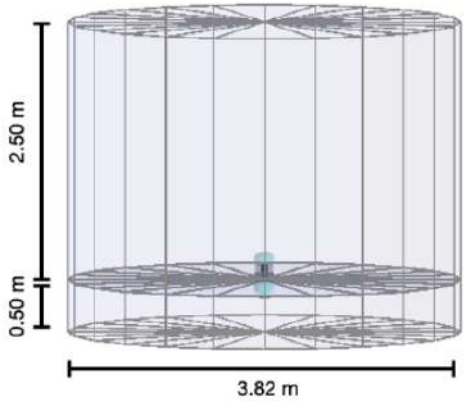


Core: Ø 320 m, FF = 80%
5,700 WCD units

Outer: Ø 600 m, FF = 5%
880 WCD units

Altitude: 4,700 m a.s.l.

✧ muon tagging

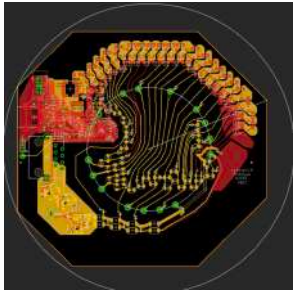


Exploring WCD technologies

Development of new concepts and approaches

PHOTOSENSORS

BLADDERS

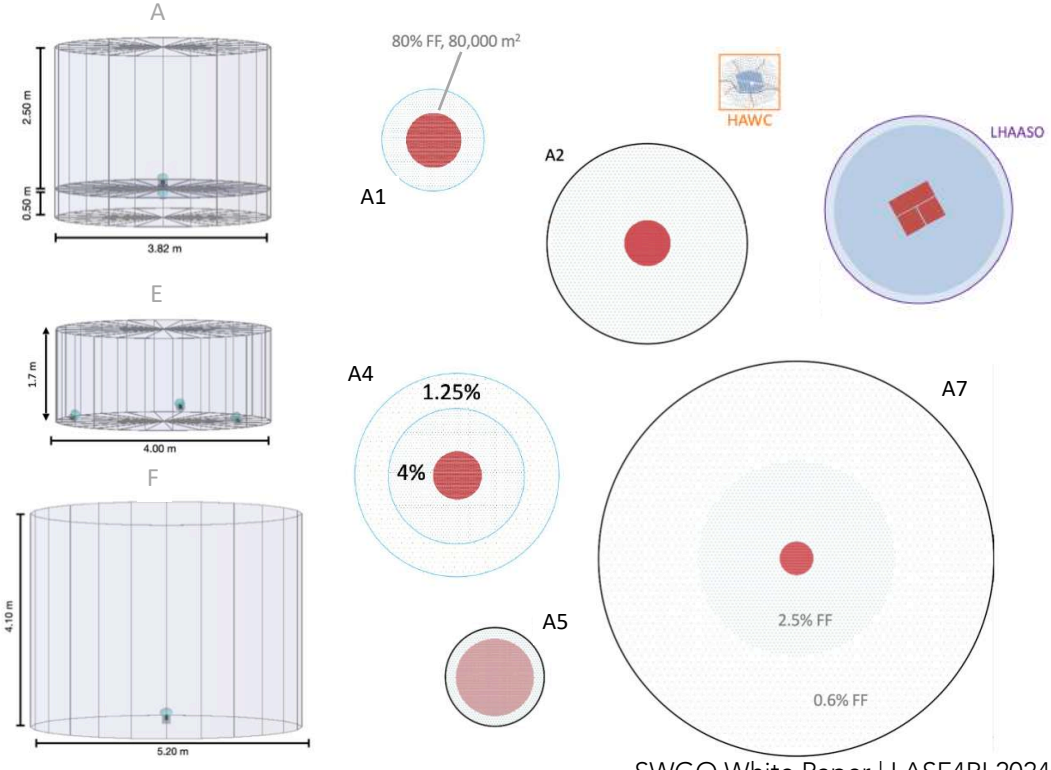


ELECTRONICS

WCD Unit

A next generation observatory

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

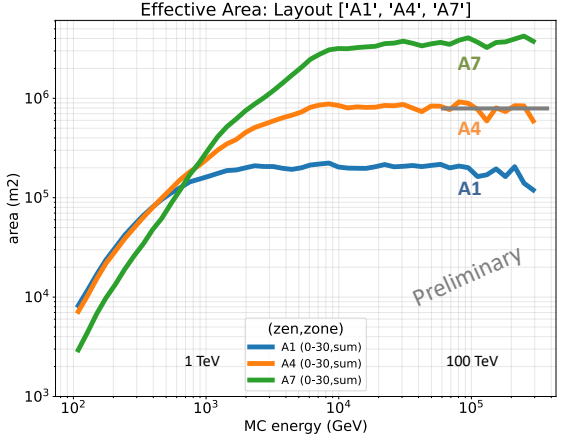


CORSIKA — Simulation of extensive air showers

AERIE — Detector simulation

SWGO-RECO — Shower reconstruction

PYSWGO — High-level reconstructions (IRFs)

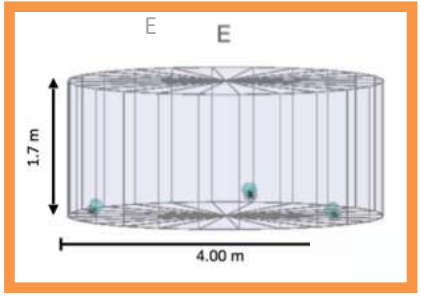


LHAASO approx

All layouts present in the SWGO simulation framework

Hardware Development in BR

OUTER (PeV) ARRAY

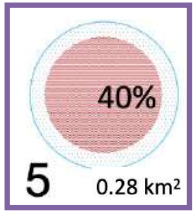


Rotoplastyc

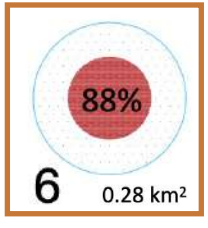
New patent on rotomolding technology with immediate applications to the agribusiness

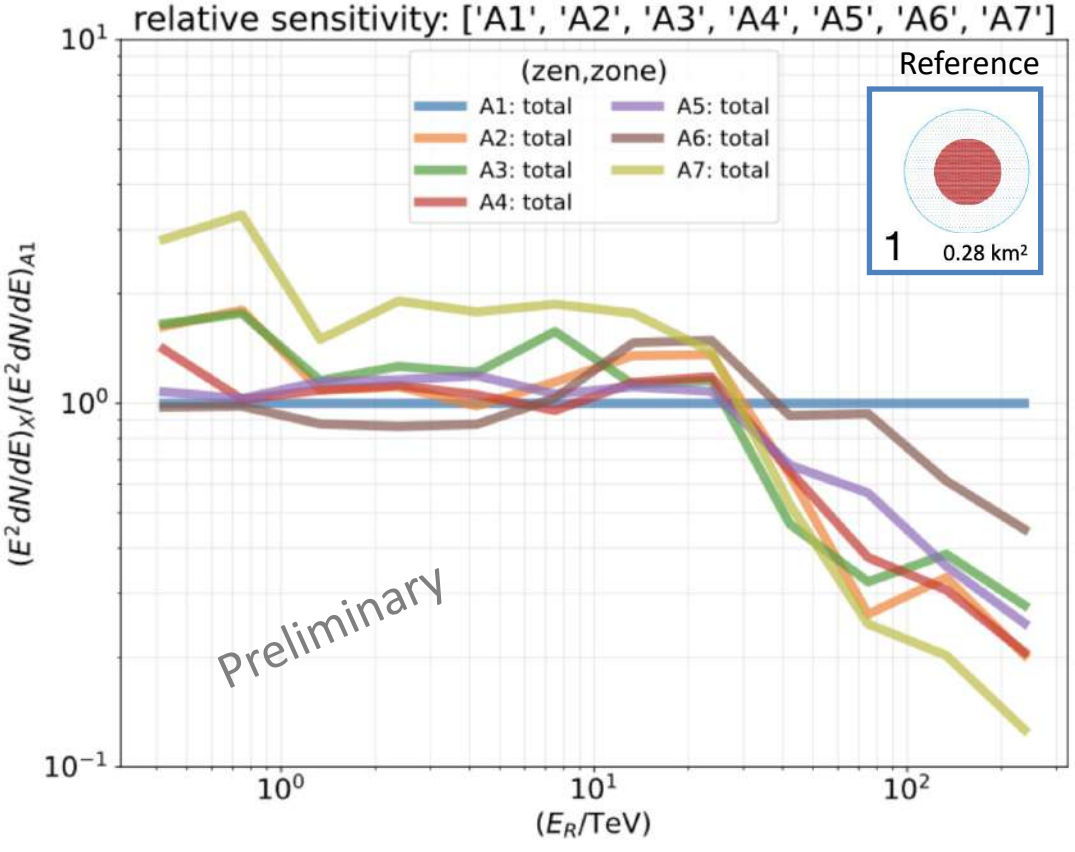
All layouts present in the SWGO simulation framework

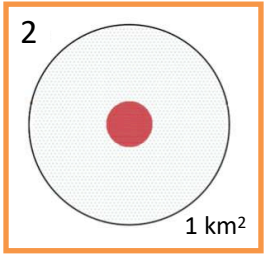
A next generation observatory



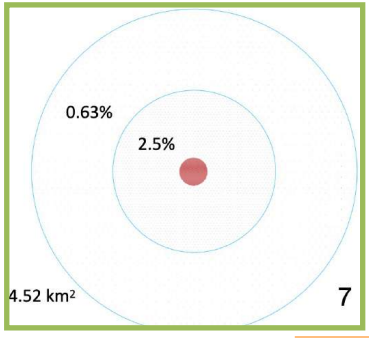
Exploring trade-off between core footprint and fill-factor.



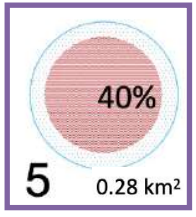




Exploring very large areas and low fill-factors



A next generation observatory



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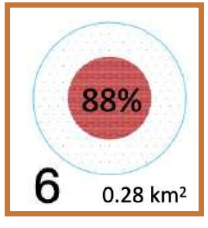

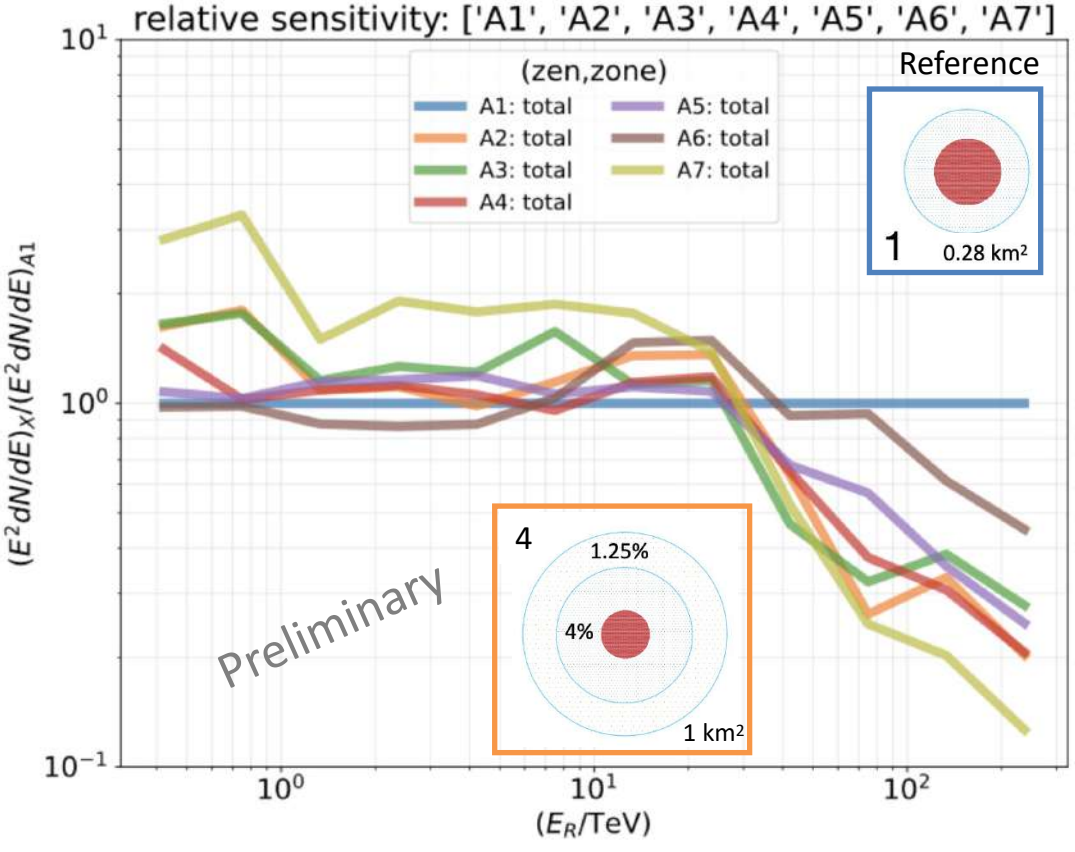

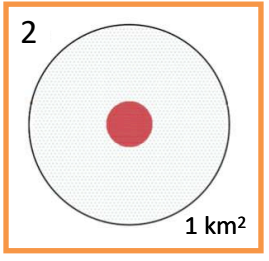

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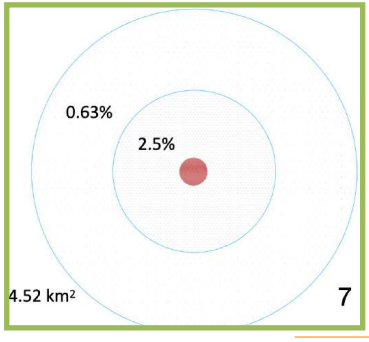
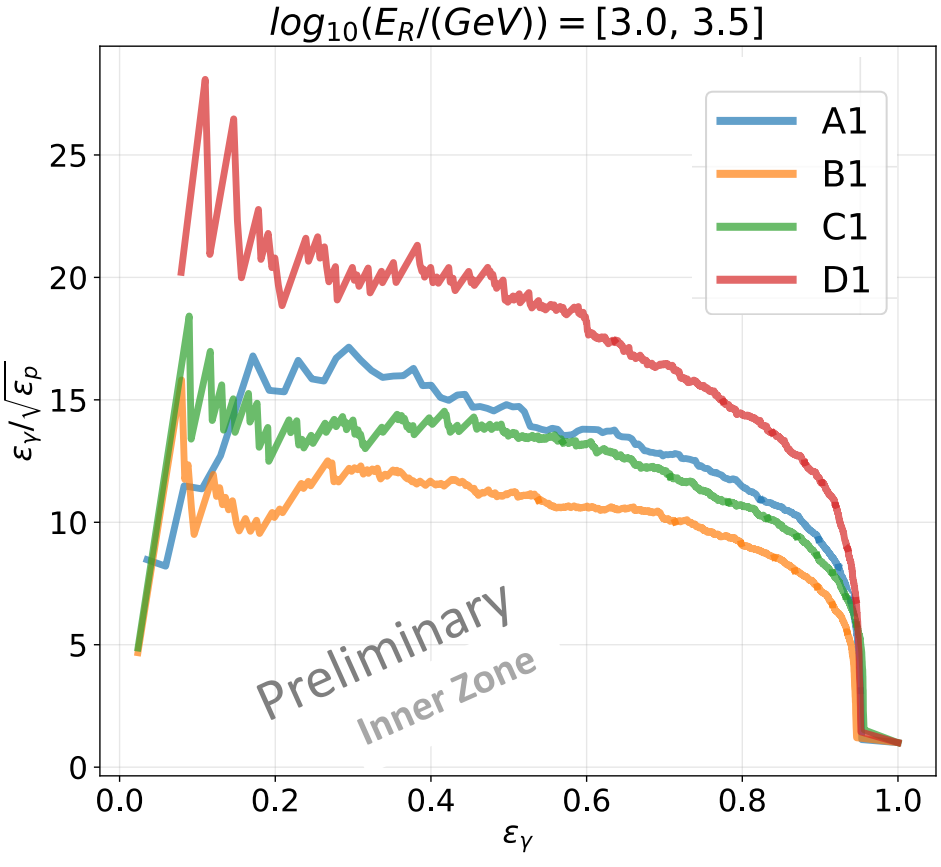


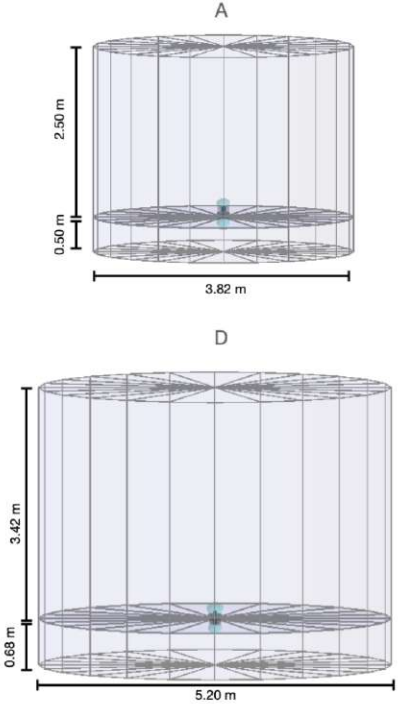
A next generation observatory



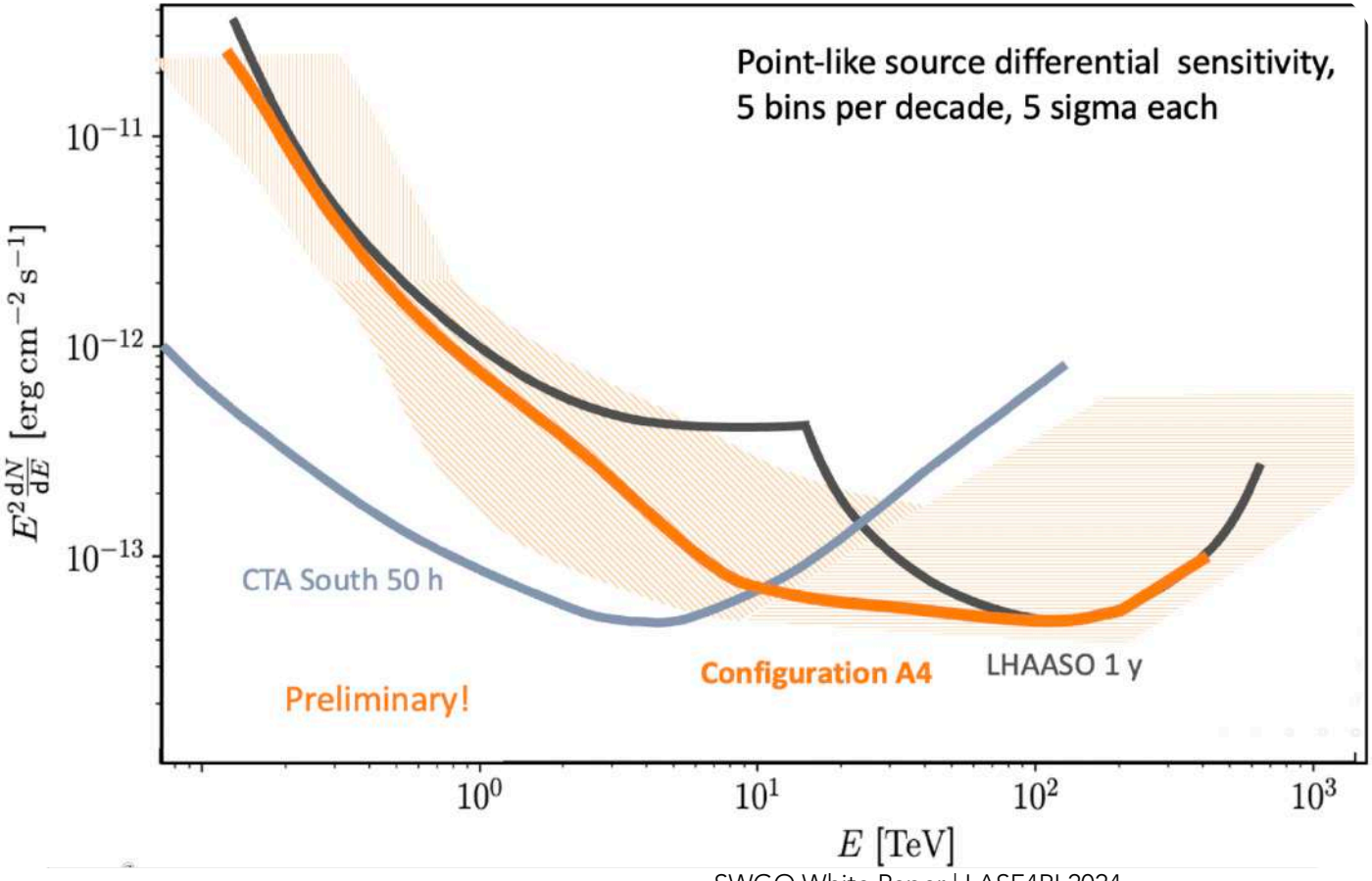
Double-layer WCD unit concept

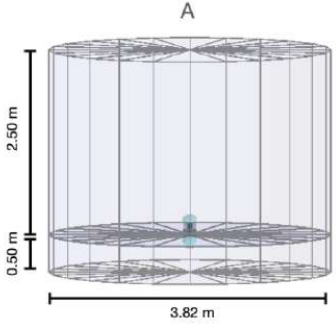
Cost-effective γ/hadron separation

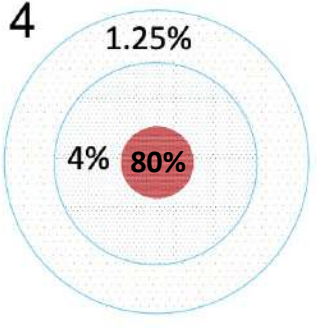
Large background rejection power > 1 TeV 400, with 50% gamma efficiency



Expected Sensitivity



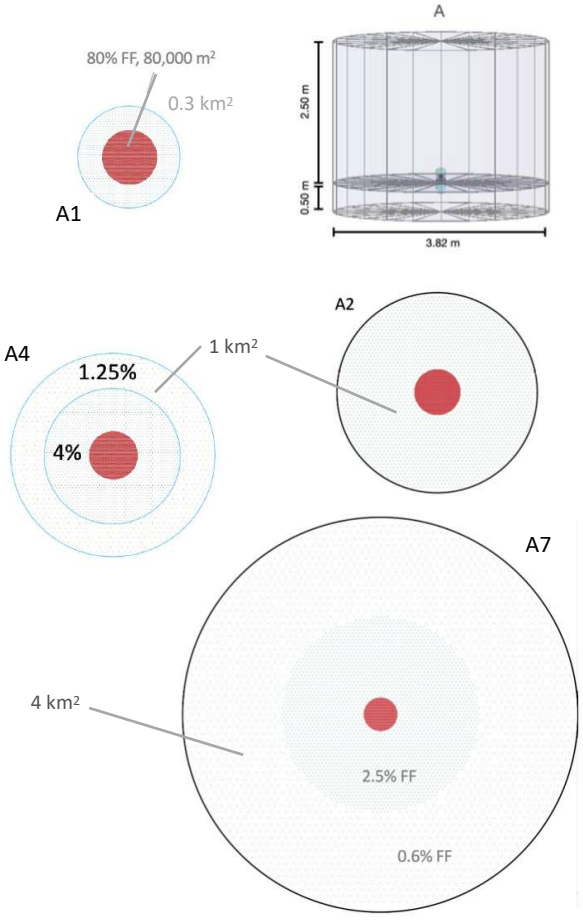


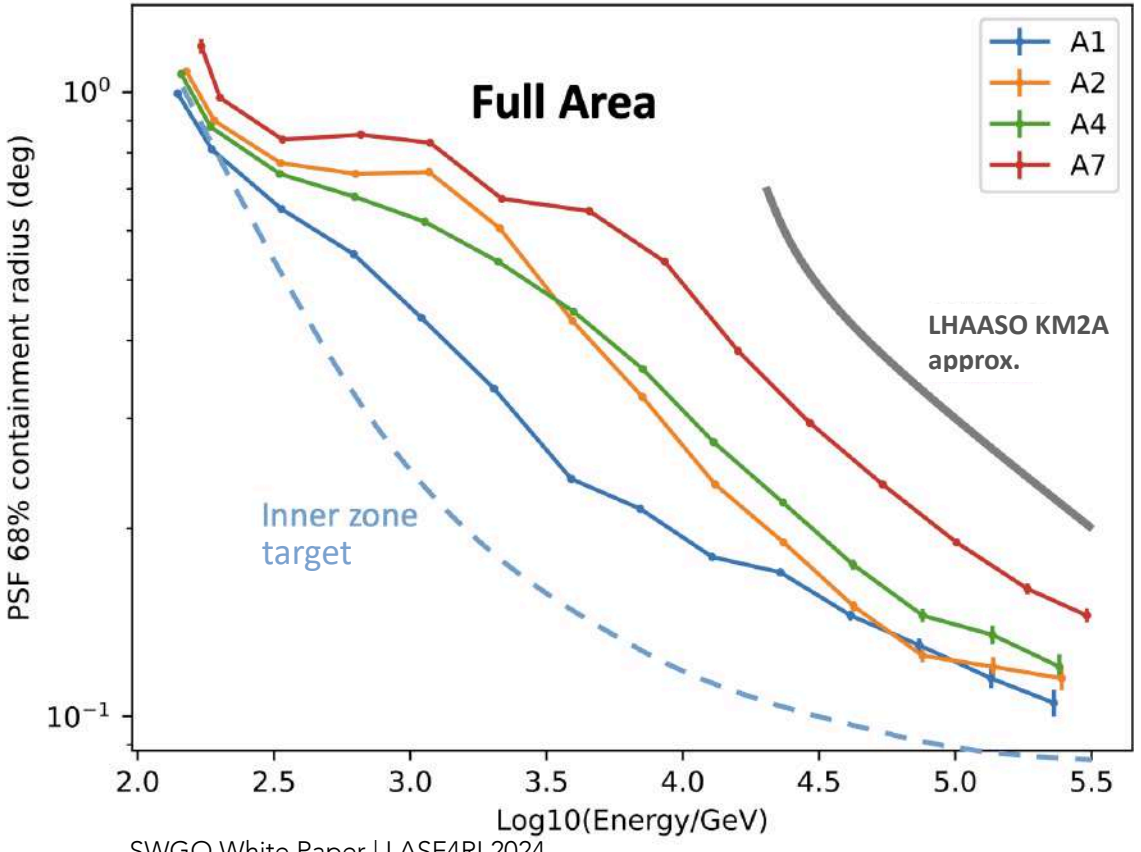


At 4,700 m a.s.l.

Target Angular Resolution

Unprecedented for wide-field instrument

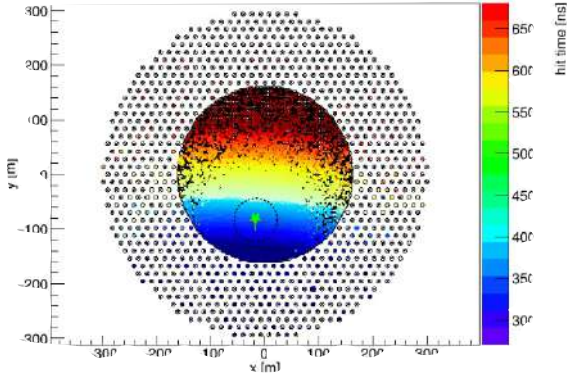


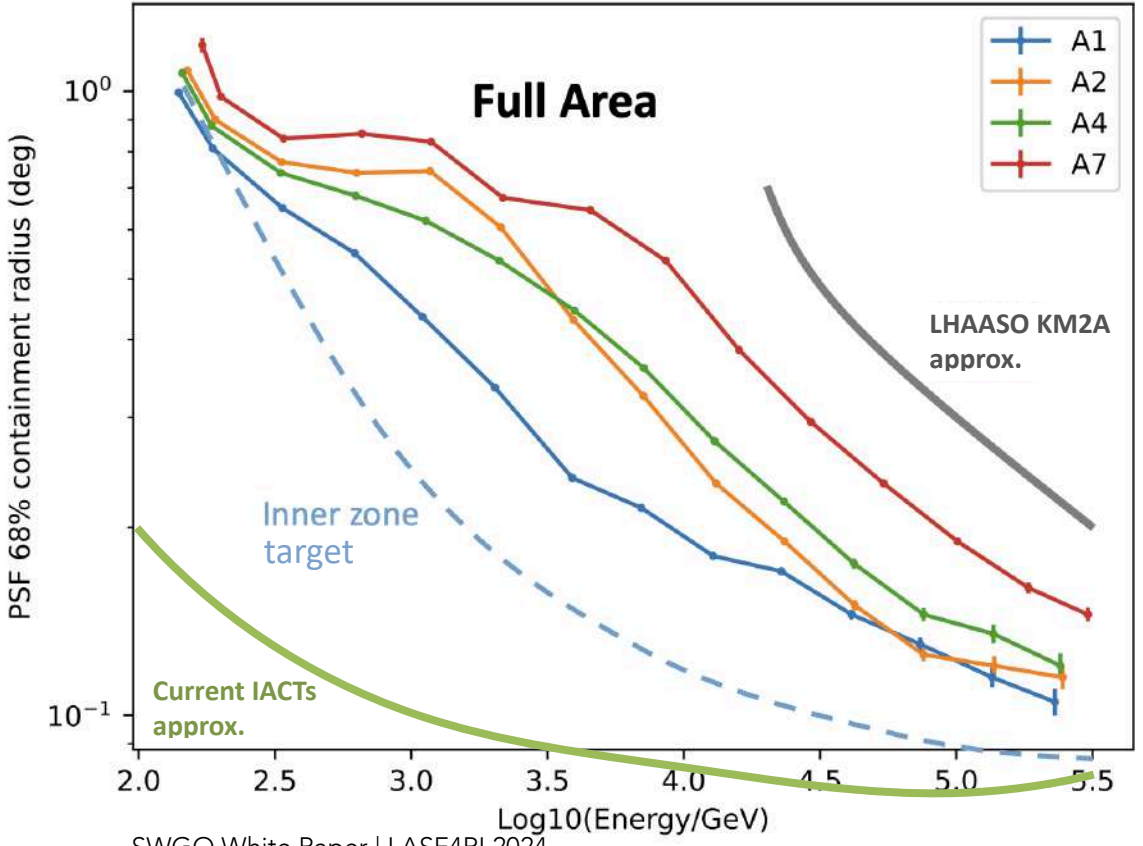


Target Angular Resolution

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

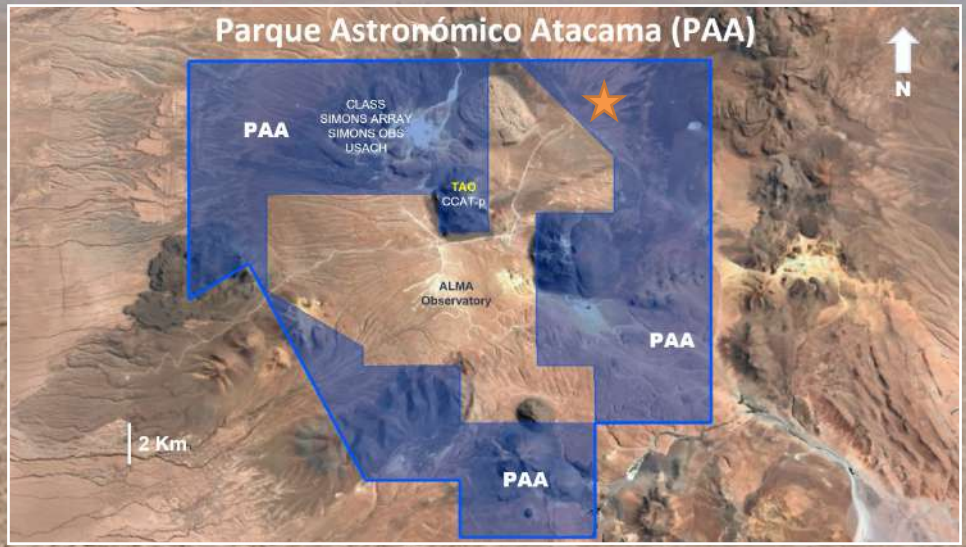
- All sites extremely flat with < 2% slope
- Shortlisting criteria included
  - → Science performance (array footprint + altitude)
  - → Site preparation and construction costs
  - → Construction and operations risks
  - → Environmental impact
  - → Social impact
- Engagement with local communities among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

Summary

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

- SWGO is an international project, with large Latin-American participation
  - → 1/3 of the Steering committee (5 countries)
  - → Almost 40 institutes, and nearly 100 members

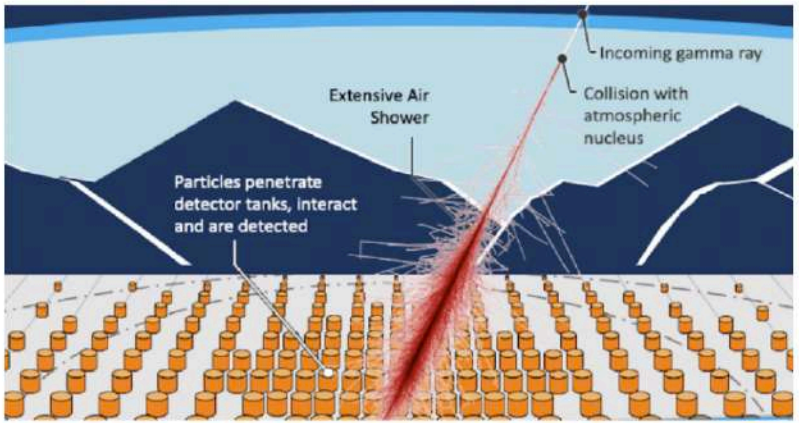
- SWGO will be the first large, wide-field gamma-ray observatory in the Southern Hemisphere
  - → Large opportunities for Regional Cooperation
  - → Many opportunities for synergies with CTAO and other Astroparticle Physics / Astrophysics Experiments

CLAF and MCTI High Level Seminar

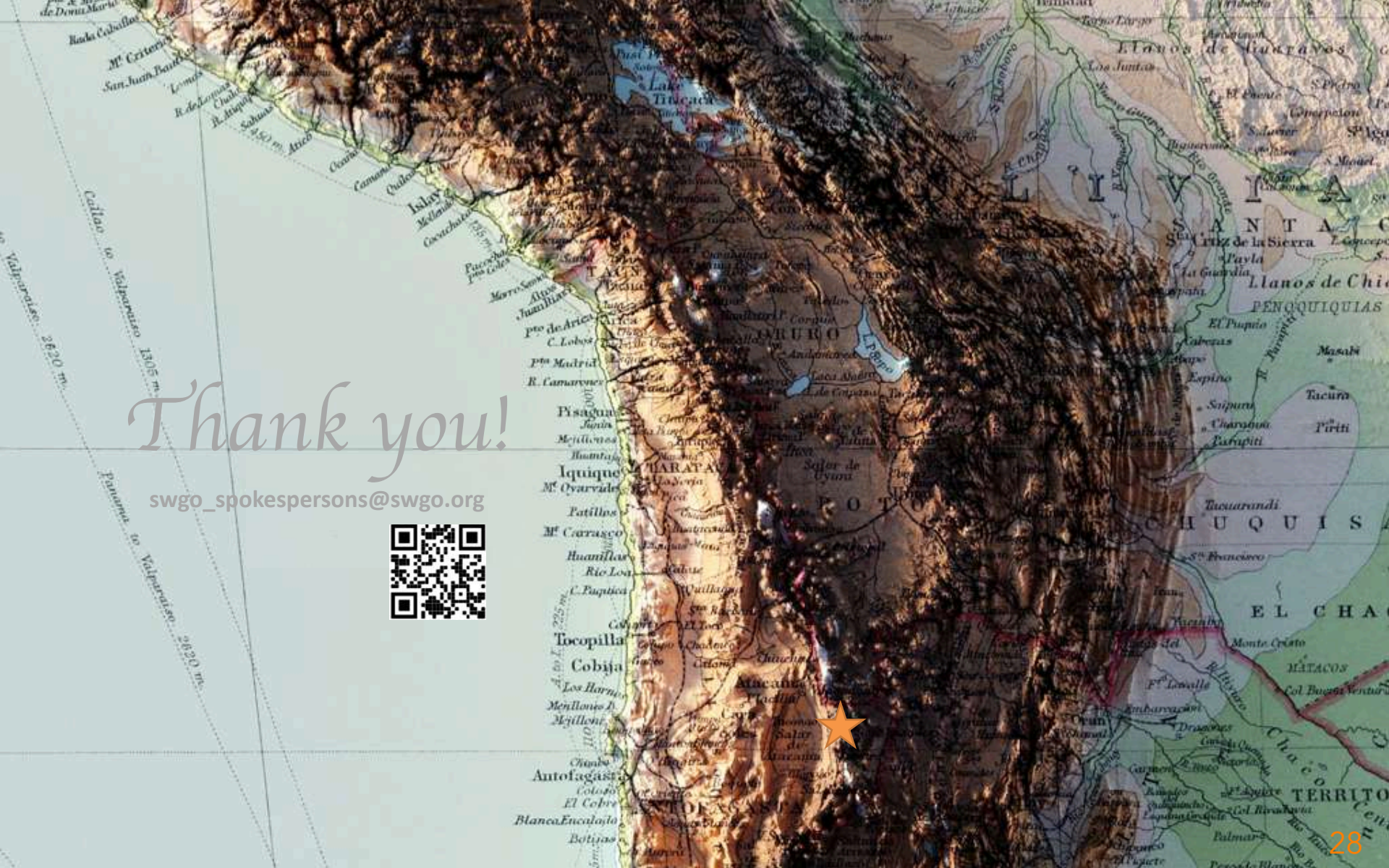
Opportunities for the Latin-American Participation and Cooperation in Astro-Particle Physics and the Project SWGO

20 April 2023
CBPF, Rio de Janeiro, Brazil

Seminar Programme



The CLAF Astroparticle Physics Unit is a recently instated branch of CLAF for the development of this frontier field of experimental physics in Latin America. It will bring together scientists from all CLAF member states to set the future course of regional cooperation in this rapidly developing research area, for the benefit of scientific development and integration in the region.


Thank you!
swgo_spokespersons@swgo.org