XV Latin American Symposium on High Energy Physics
SILAFAE 2024

Status of the Southern Wide-field Gamma-ray Observatory (SWGO)

José Bazo
jbazo@pucp.edu.pe
Pontificia Universidad Católica del Perú
on behalf of he SWGO Collaboration

Nov, 5th, CINVESTAV, CDMX

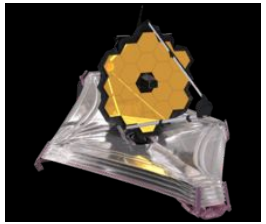
Contents

- Overview
- Science case
- SWGO experiment
- Detector design
- Site
- Expected performance
- Timeline

EM spectrum observation

VLA, radio

Webb, IR



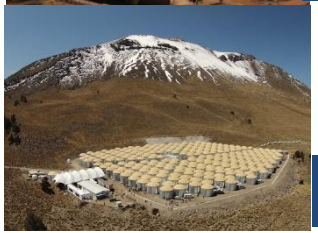
HST, visible

Chandra, X-rays Fermi, gamma

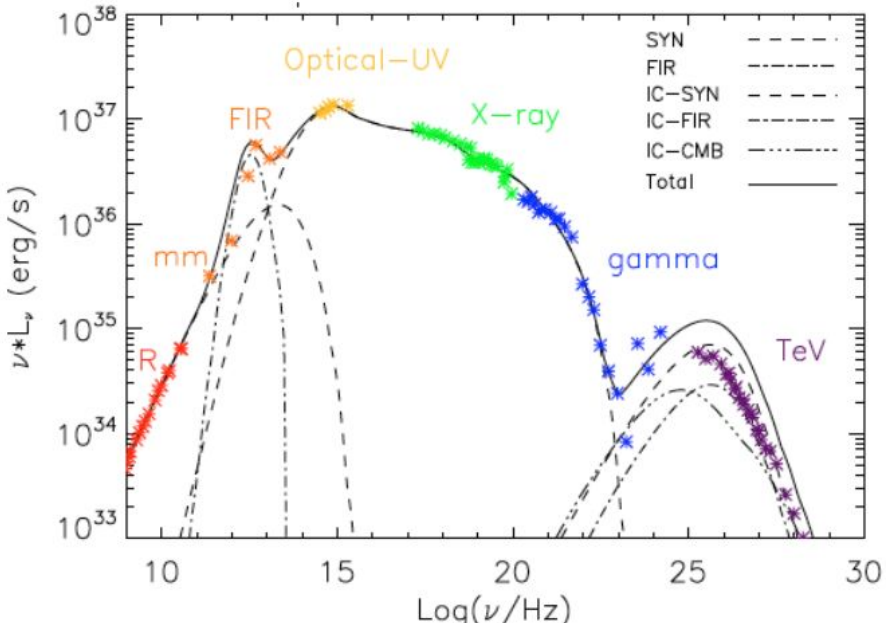
TeV

MAGIC-2

HESS-2

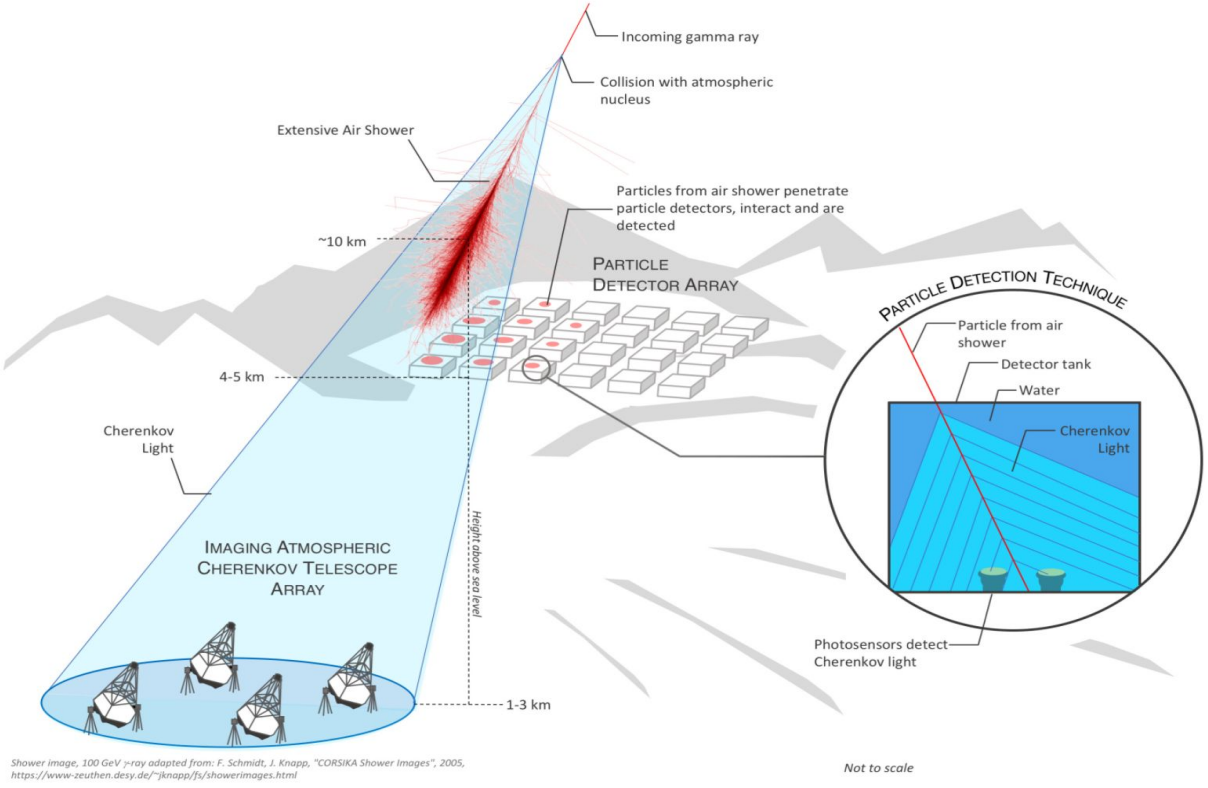


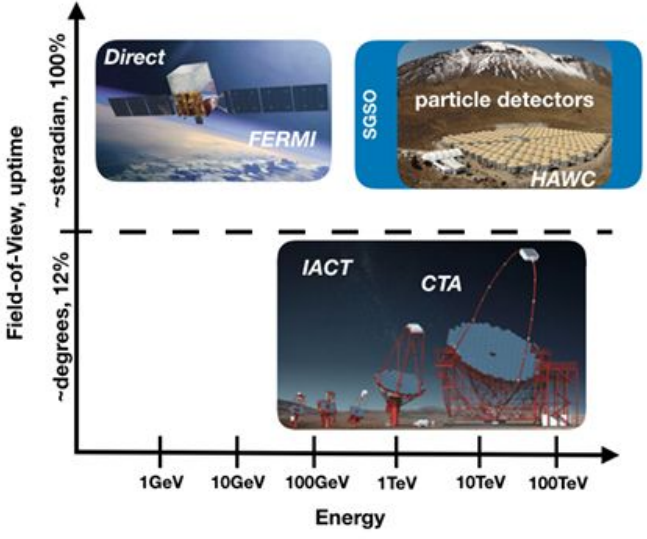
HAWC



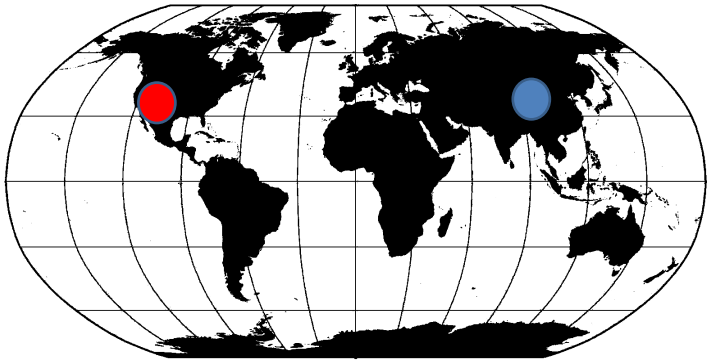
Crab Nebula

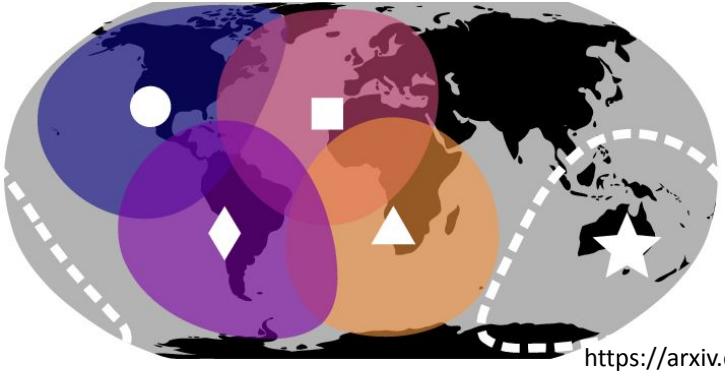
Detection techniques





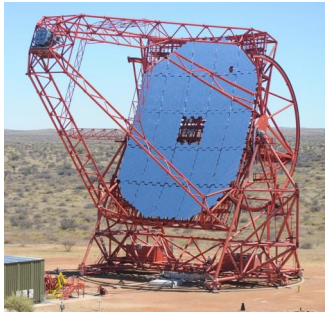
TeV Astronomy





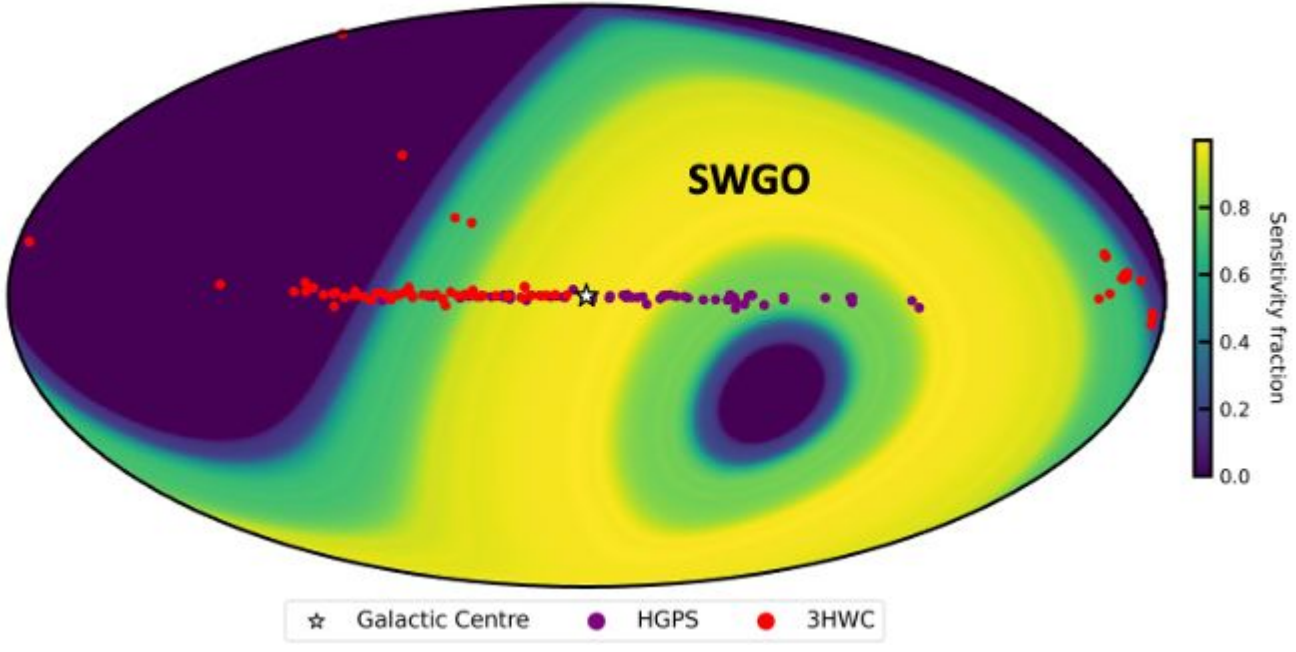
https://arxiv.org/abs/2206.07945

Water Cherenkov Detectors



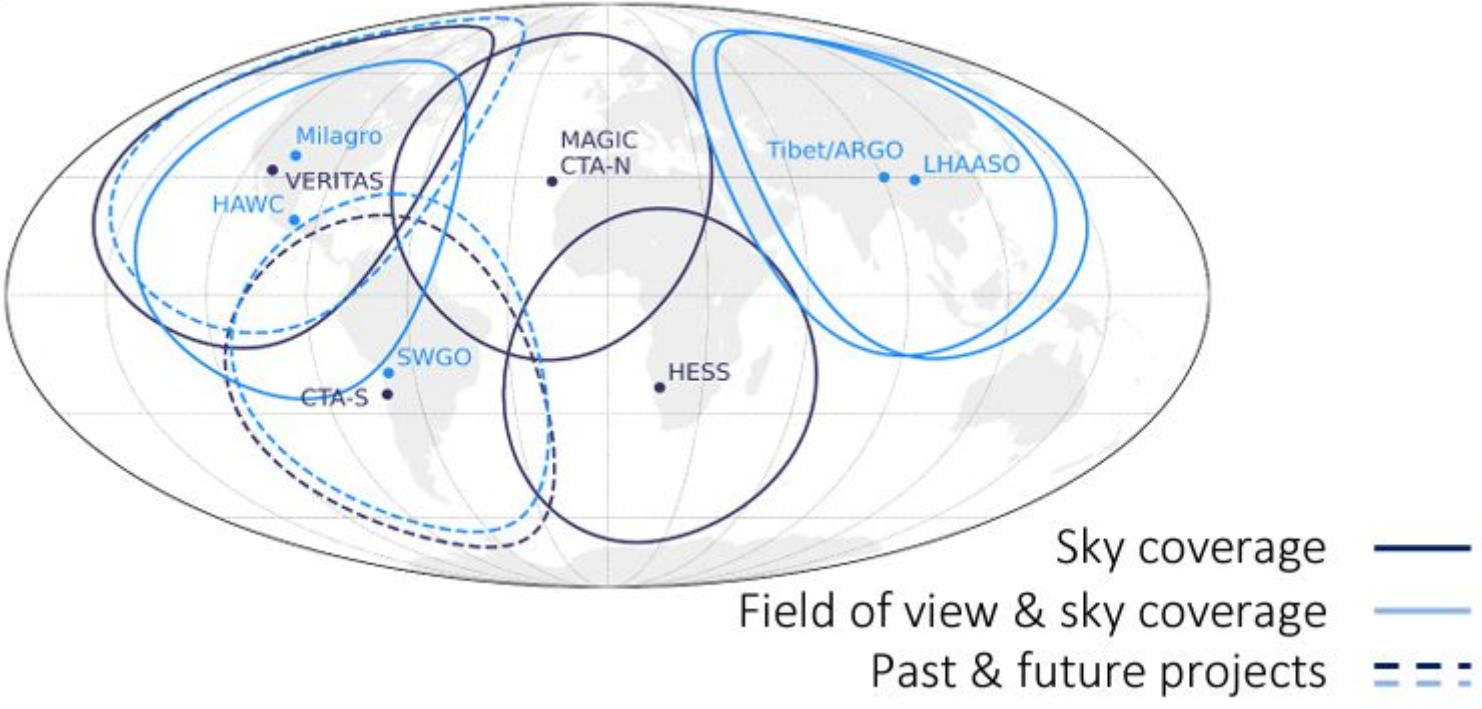
Imaging Atmospheric Cherenkov Telescopes

Sky coverage



doi:10.1088/1742-6596/2429/1/012022

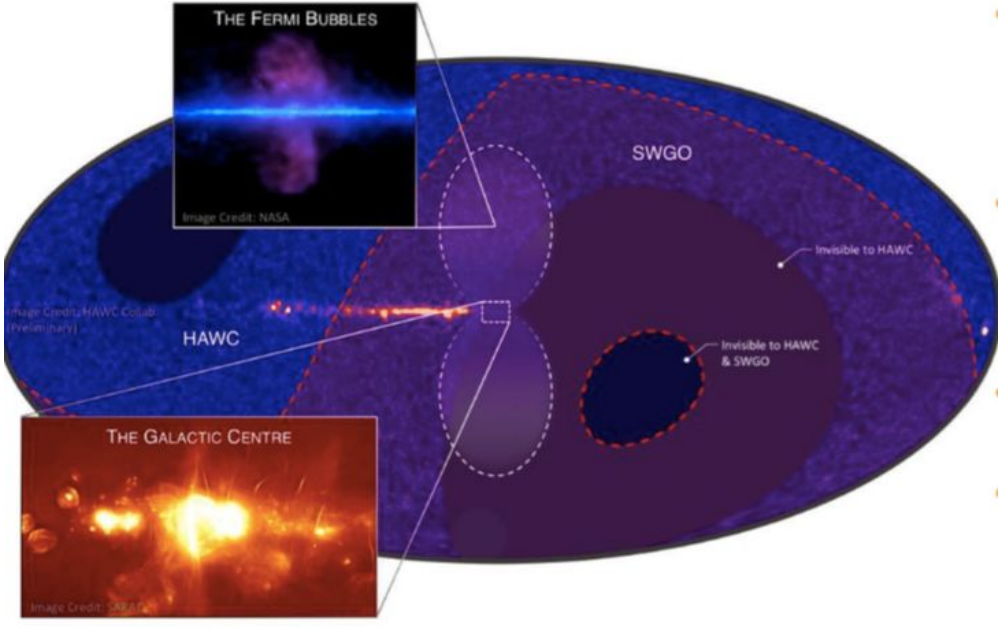
Sky coverage



Science Case

Science Case for a Wide Field-of-View Very-High-Energy Gamma-Ray Observatory in the Southern Hemisphere

arXiv:1902.08429v1

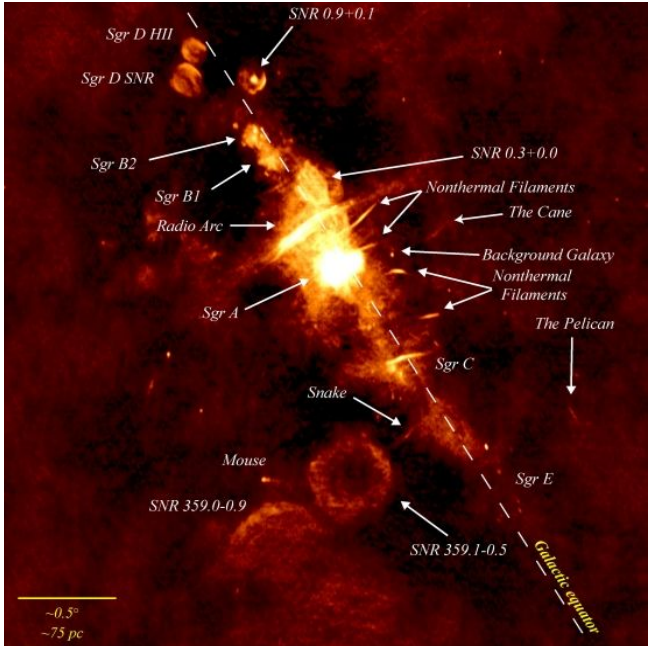


Science Case

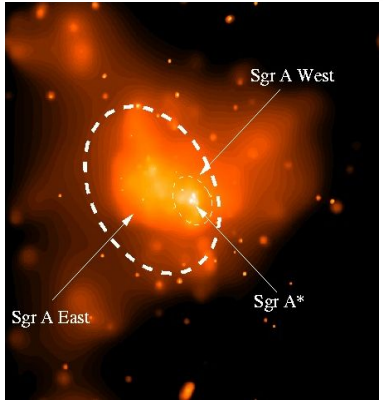
- Galactic and extragalactic sources (Pevatrons, PWN, GR halos, Fermi bubbles, galactic center, SNR, AGNs)
- Transient sources (GRBs)
- Fundamental Physics (dark matter candidates, LIV)
- Cosmic Rays (anisotropies, spectrum & composition up to knee)

Galactic center

Radio image

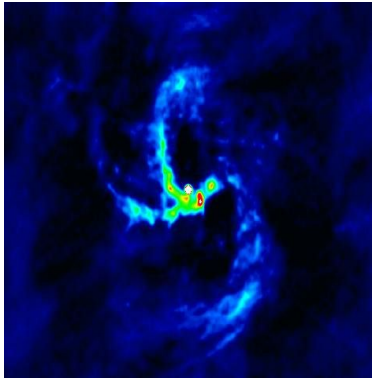


Kassim et al. Naval Research Lab



X-ray image

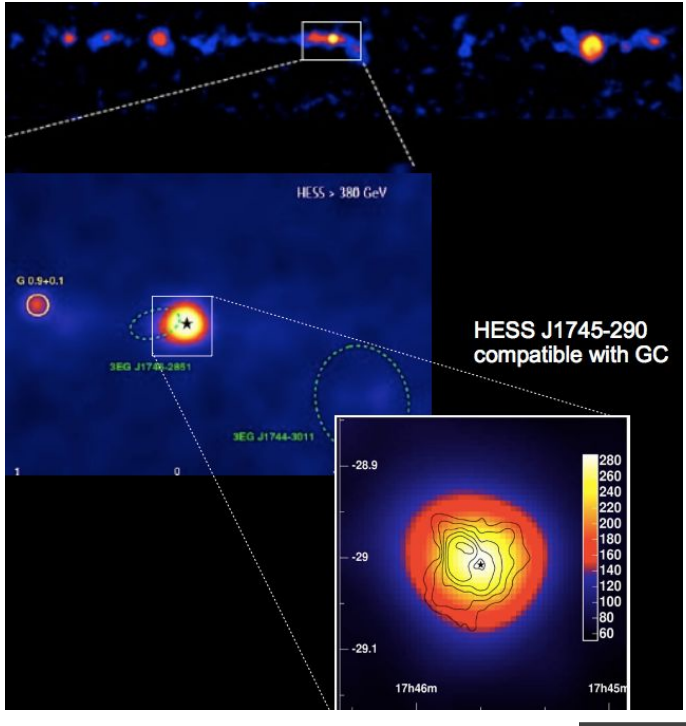
NASA Chandra X-Ray Observatory and Penn State U



Radio image of Sgr A West

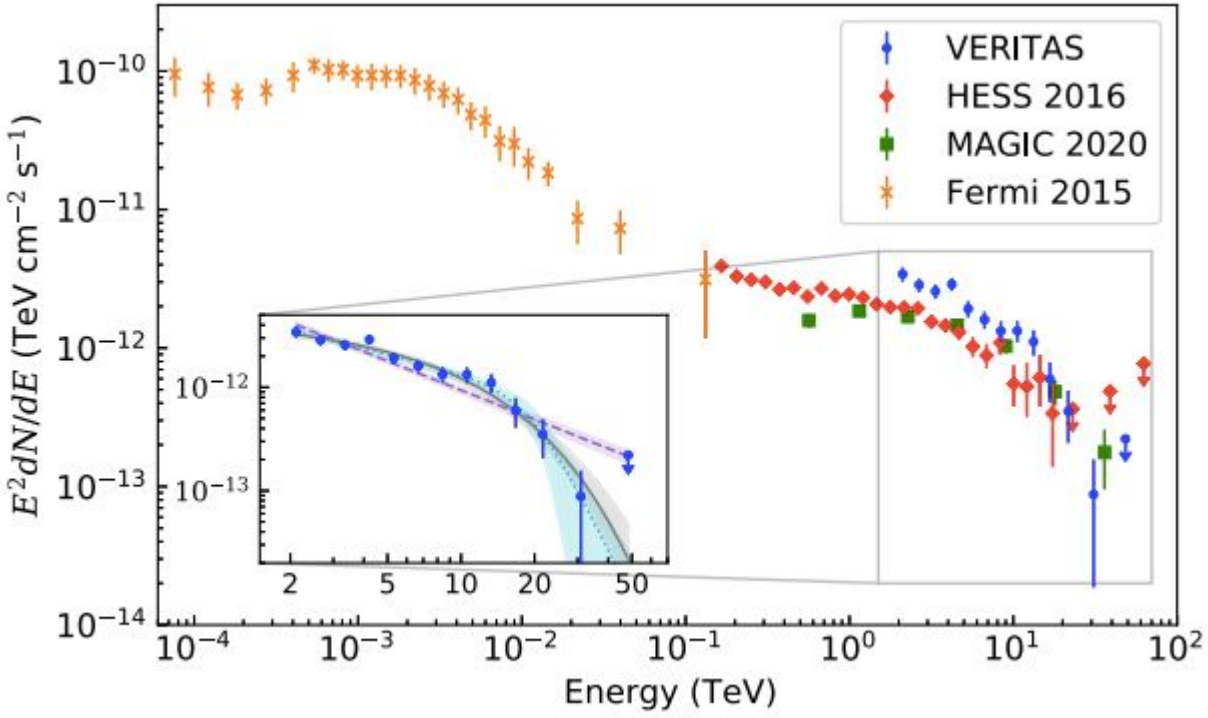
Roberts et al. NRAO / AUI ./ NSF -VLA

Gamma-rays



Lemiere, HESS

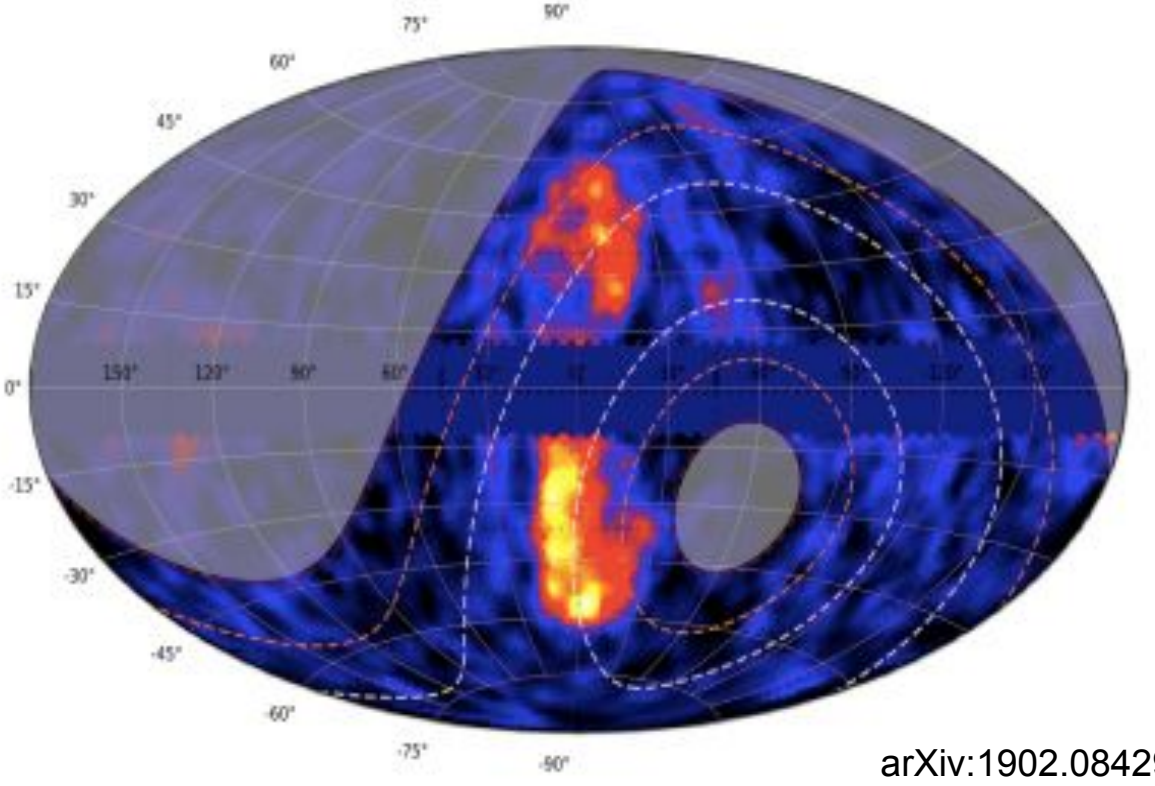
Galactic center



DOI 10.3847/1538-4357/abf926

Fermi bubbles

Diffuse emission

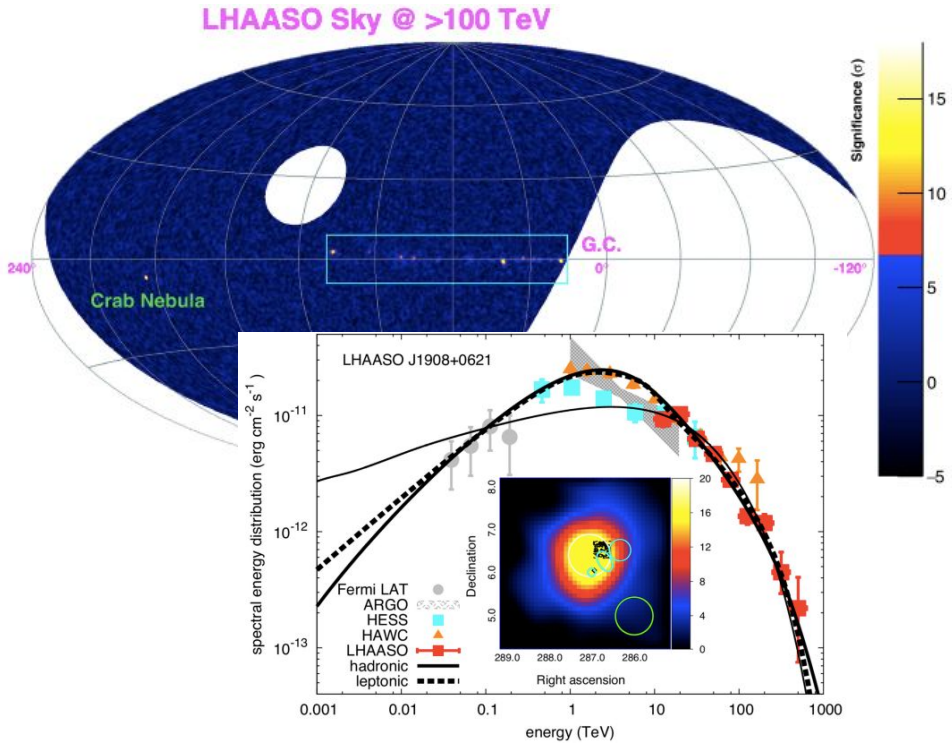


arXiv:1902.08429

LHAASO results

Galactic accelerators: PeVatrons

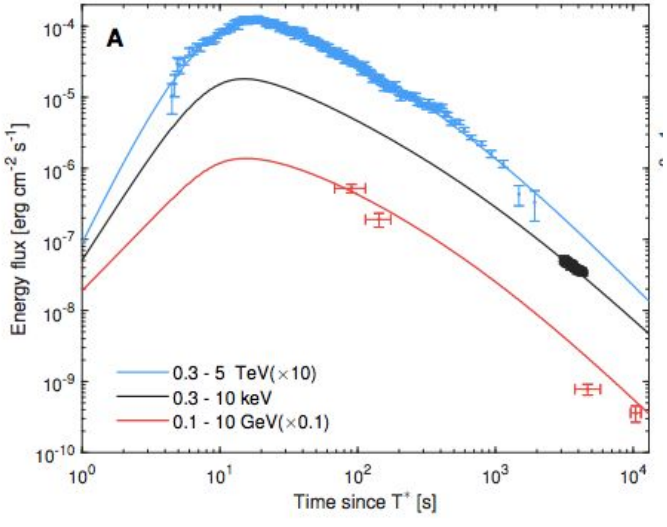
12 γ-ray galactic sources, up to 1.4 PeV



doi.org/10.1038/s41586-021-03498-z

Transiente sources: GRB 221009A

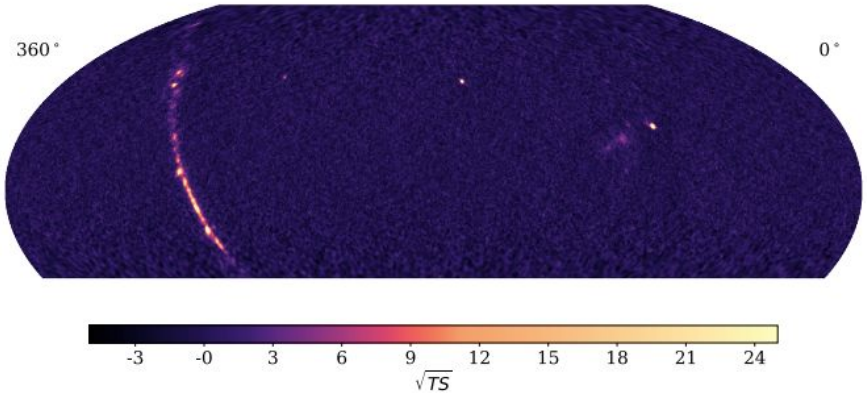
First detection of photons > 10 TeV from GRBs



doi/10.1126/science.adg9328

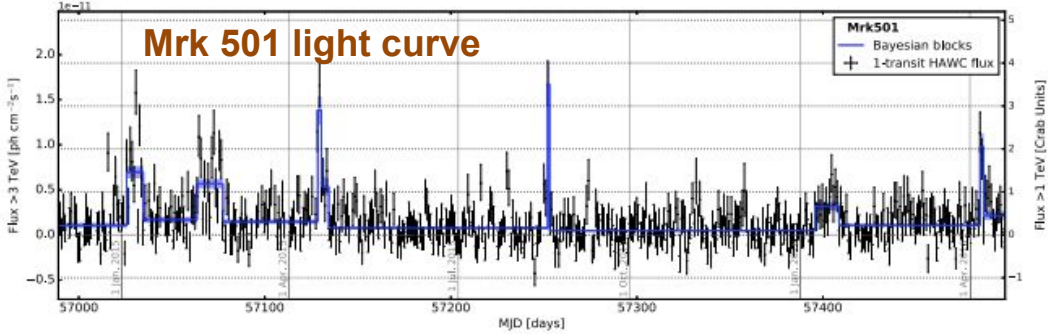
HAWC results

3HWC - All-sky significance map



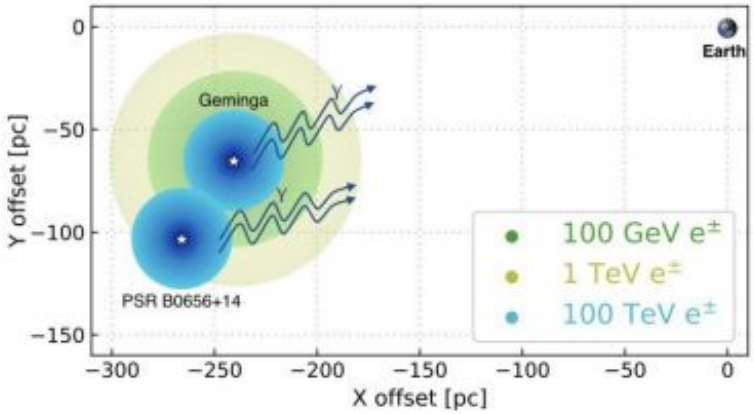
2020 ApJ 905 76

Mrk 501 light curve

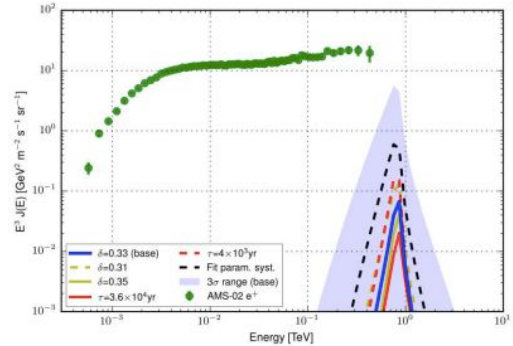


Albert et al. ApJ 841:100 (2017)

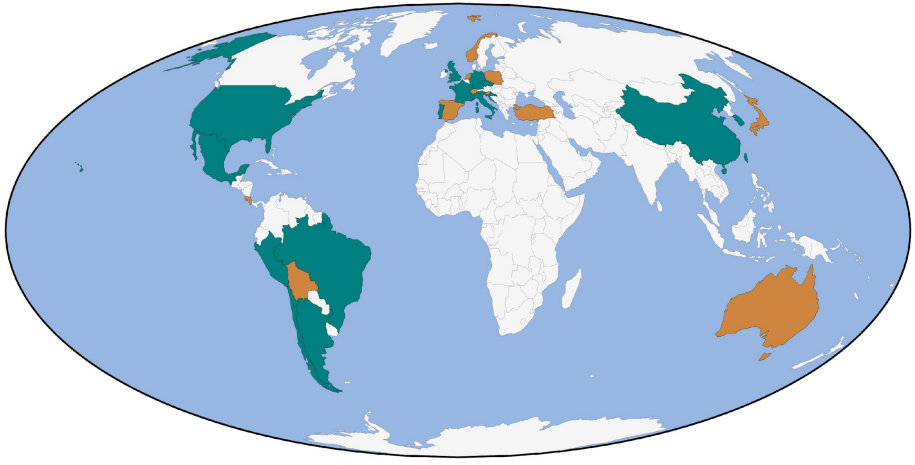
Extended gamma-ray sources around pulsars constrain the origin of the positron flux at Earth



DOI:10.1126/science.aan4880



SWGO Collaboration
since 2019

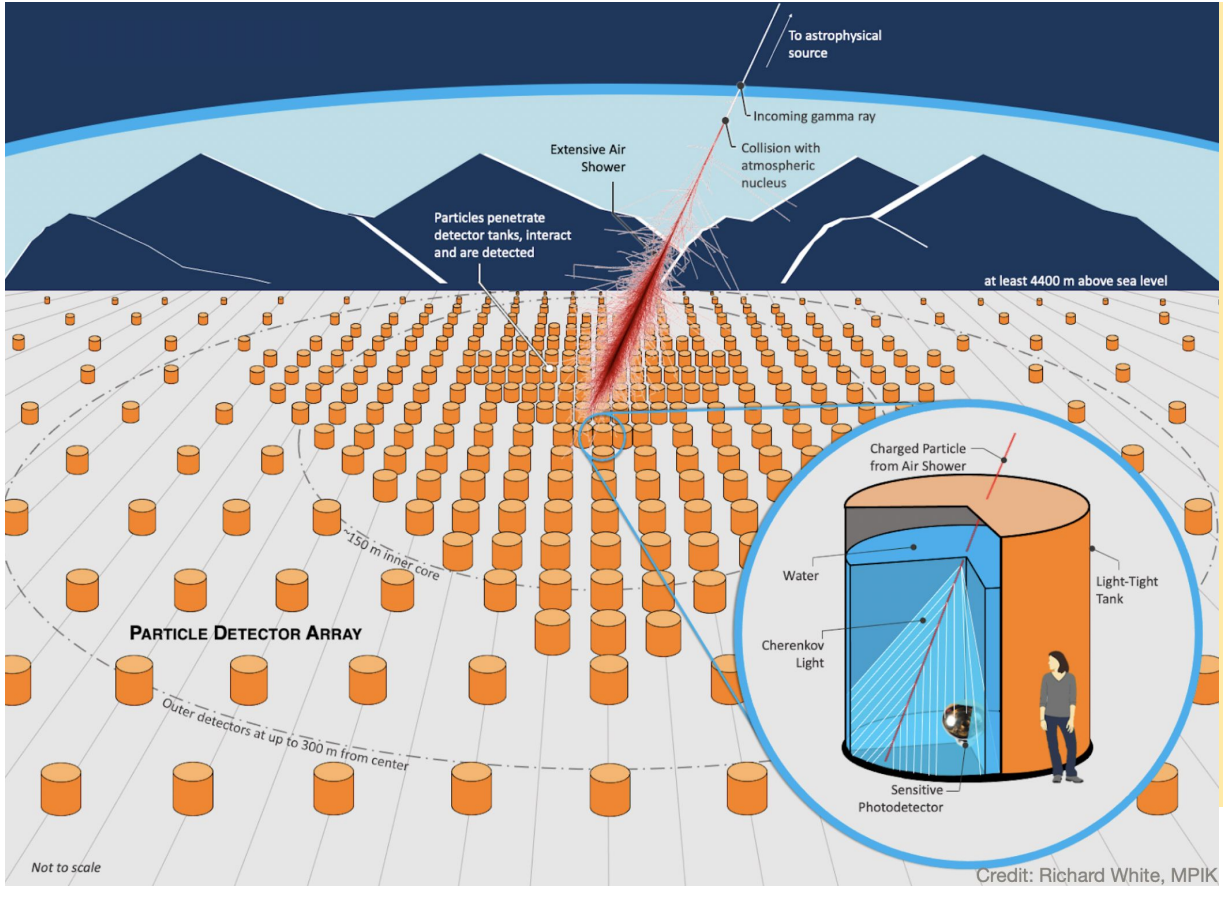


- 286 scientists
- 100 research institutions
- 14 countries

Spokesperson:
Jim Hinton (Germany)

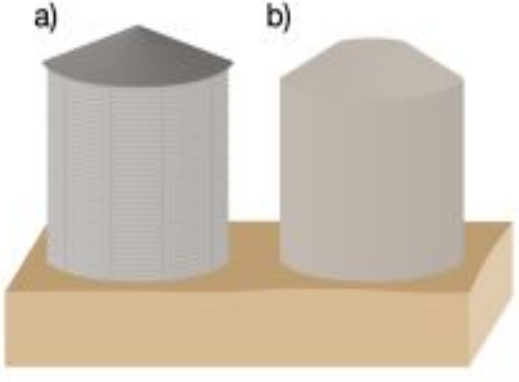
Vice-spokespersons:
Petra Huentemeyer (USA)
Ulisses Barres (Brazil)

SWGO experiment conce

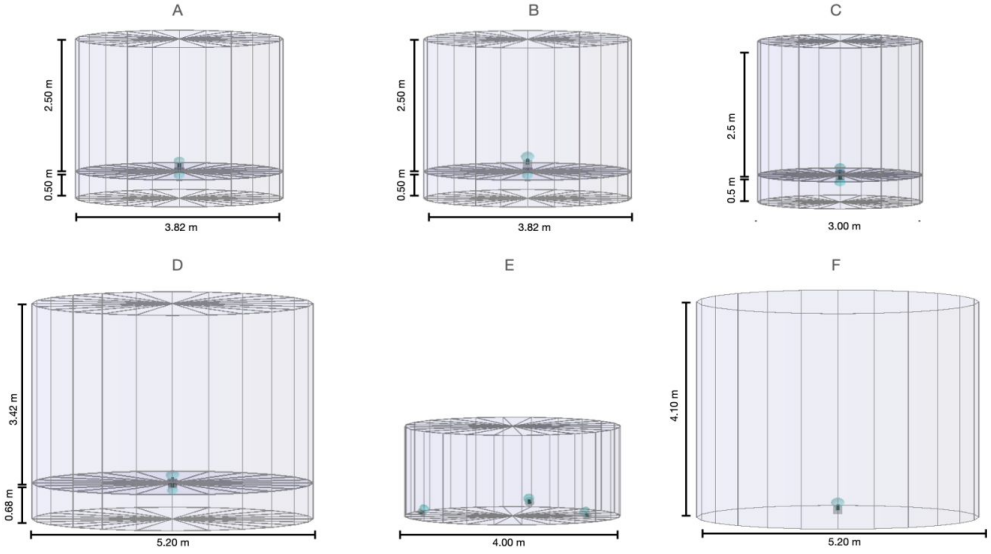


- **Ground-level** particle detection
- **~100% duty cycle**
- ~sr wide field of view
- In: Atacama Astronomical Park, Chile
- Altitude: 4770 m.
- Energy: 100s GeV - ~PeV
- Water Cherenkov detector units.

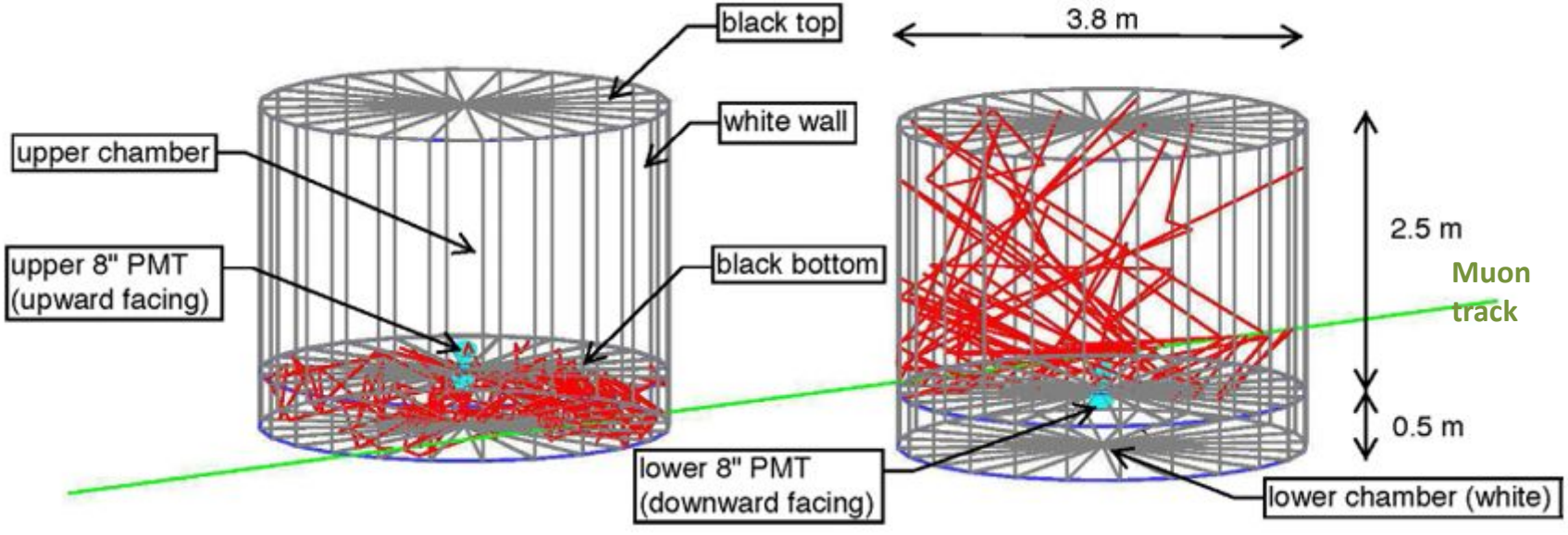
WCD designs



arXiv:2111.13158

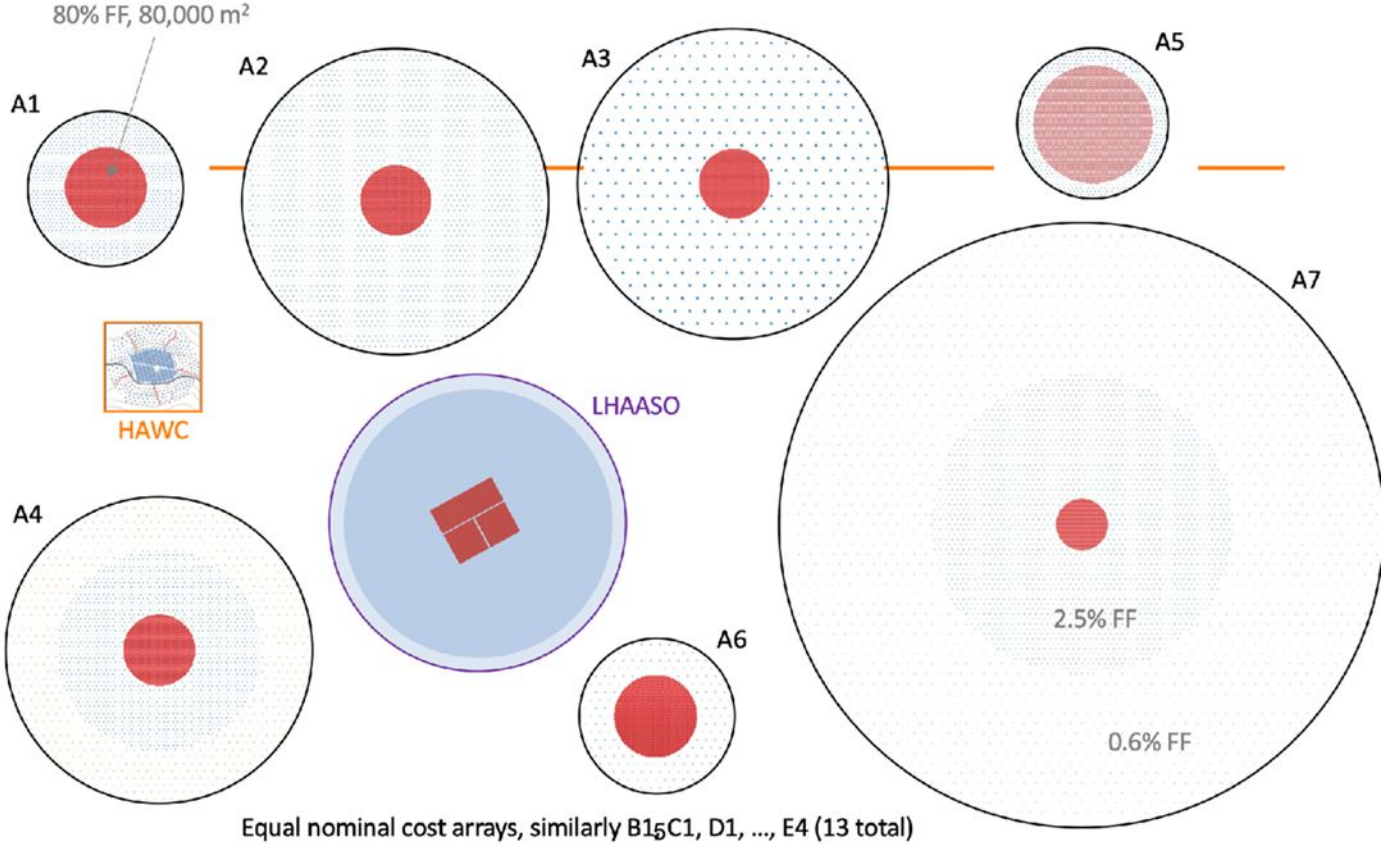


Double-layered WCD

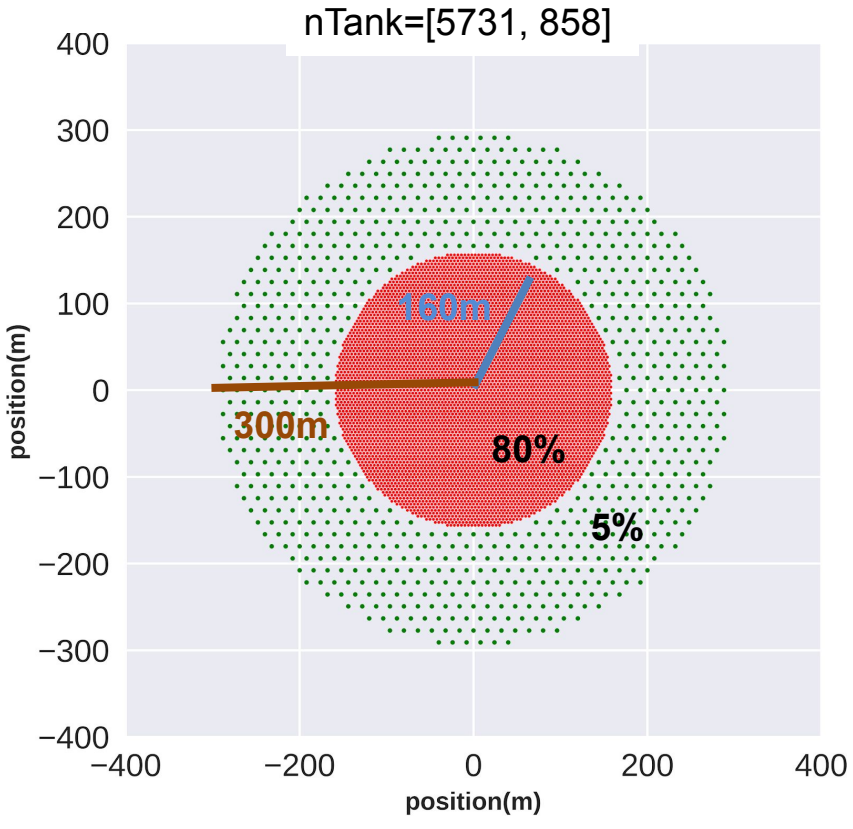


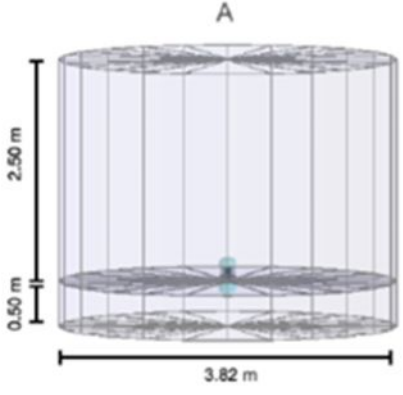
NIMA 1050 (2023) 168138

Candidate configurations



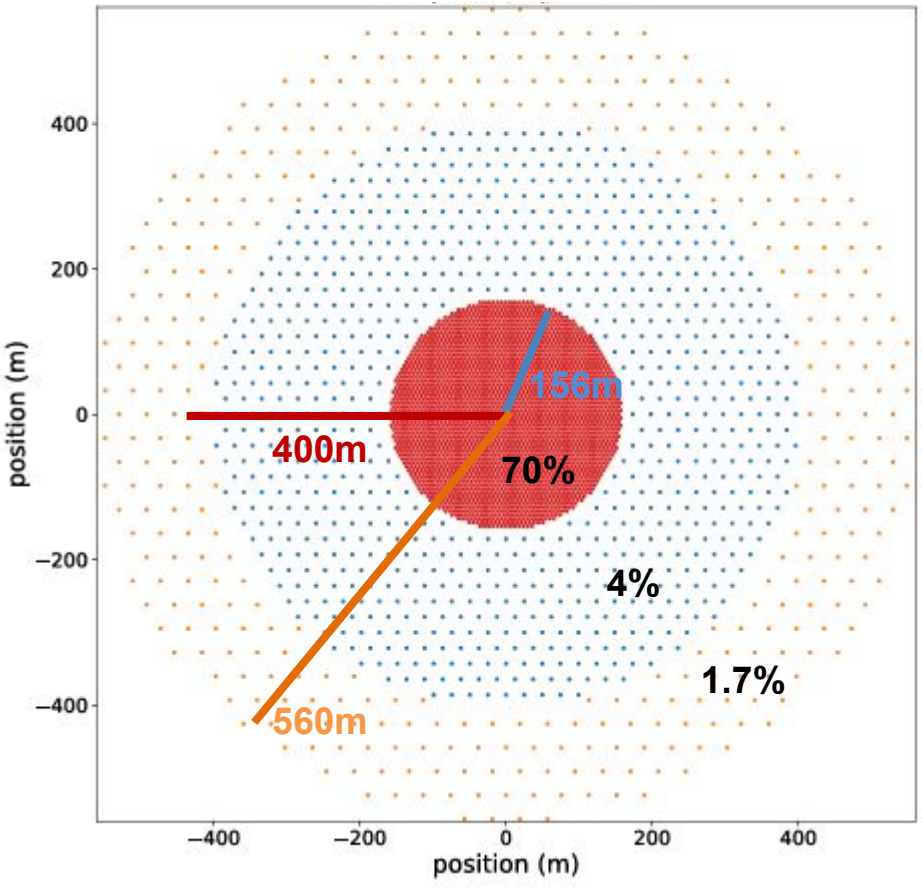
Reference design (A1)

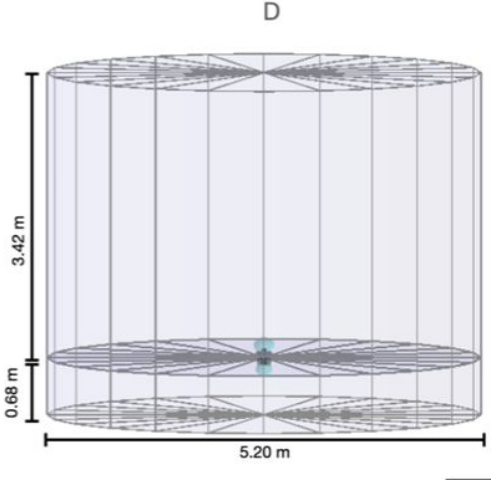




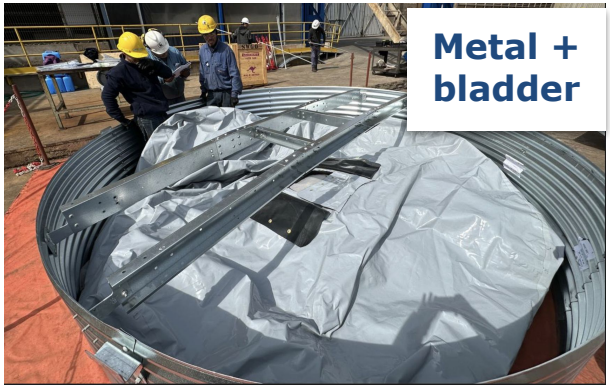
New Baseline Layout (D8)

nTanks = [2587,792,384]

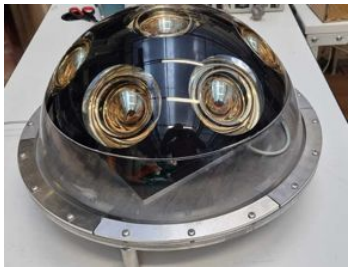




Assembling WCDs

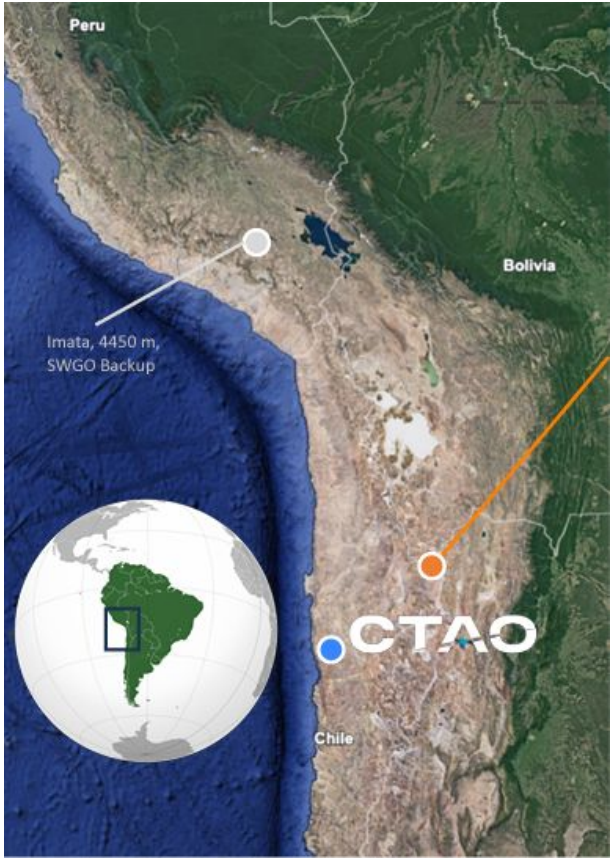


Metal + bladder



Rotomolded

Site: Atacama Astro Park



SWGO primary site:
Pampa La Bola @ AAP (Atacama Astronomical Park)

PLB+ at 4770 m a.s.l.
Latitude: 22.94° S

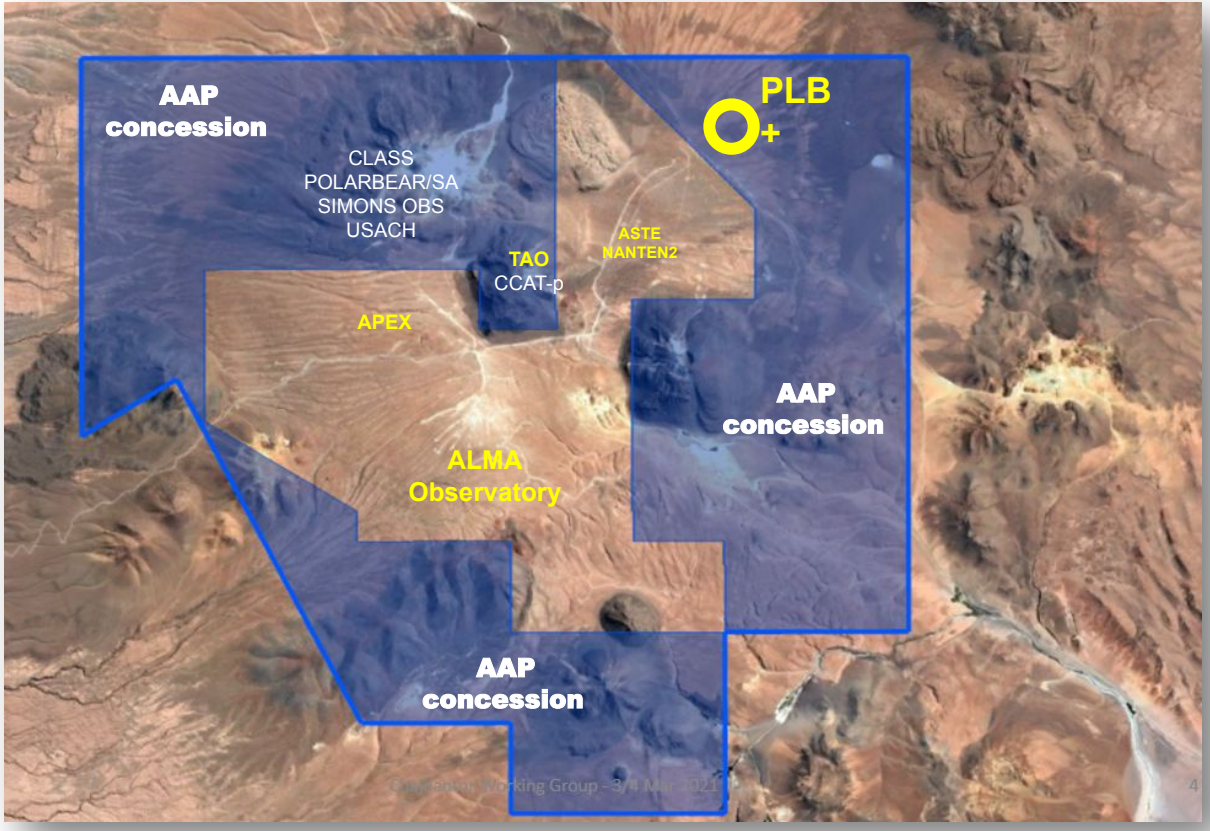
Getting to SWGO Site

Antofagasta:
~ 350 km
- main port

Calama:
~ 140 km
- nearest airport

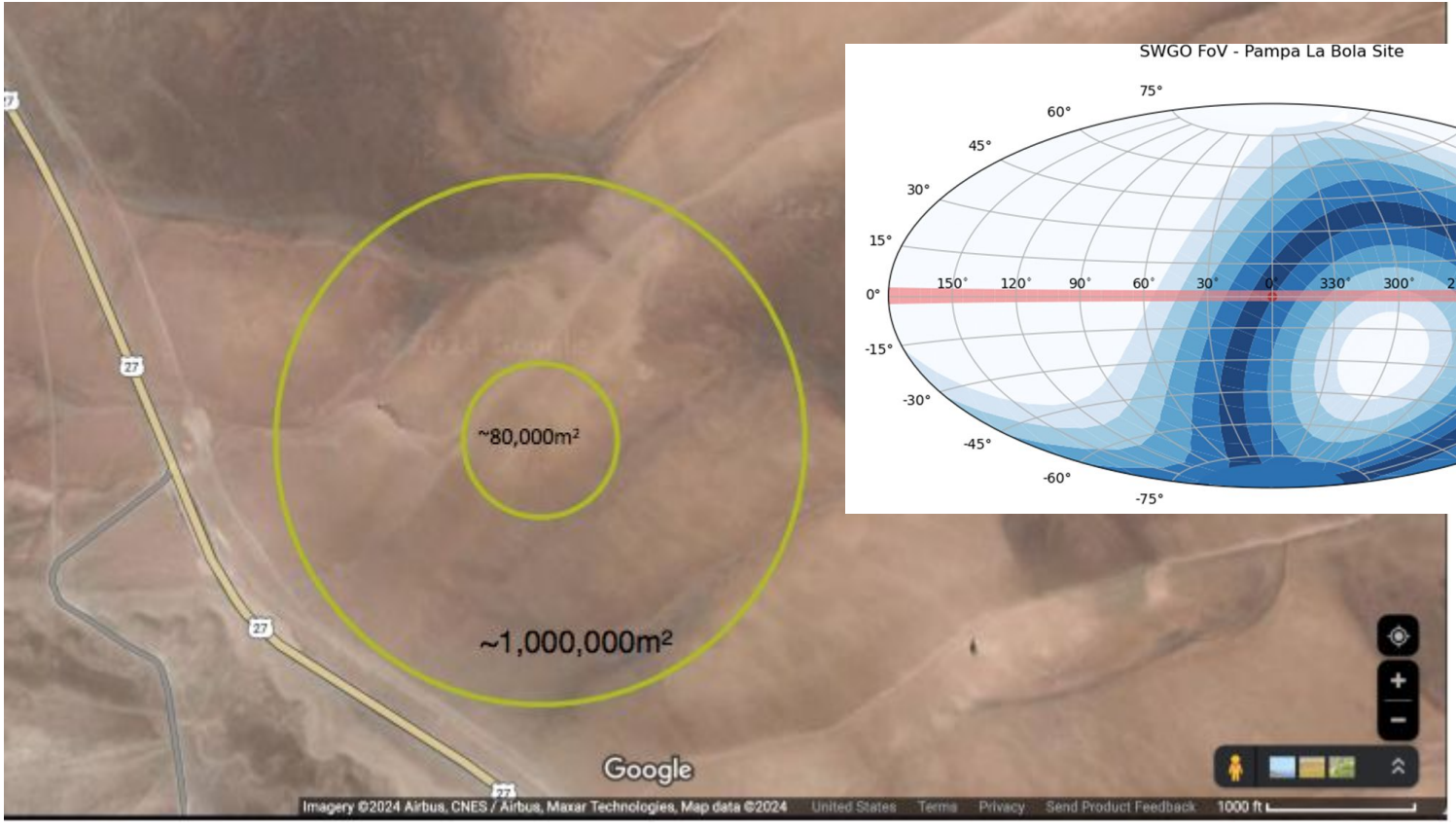
San Pedro de Atacama:
~ 50 km
- nearest town

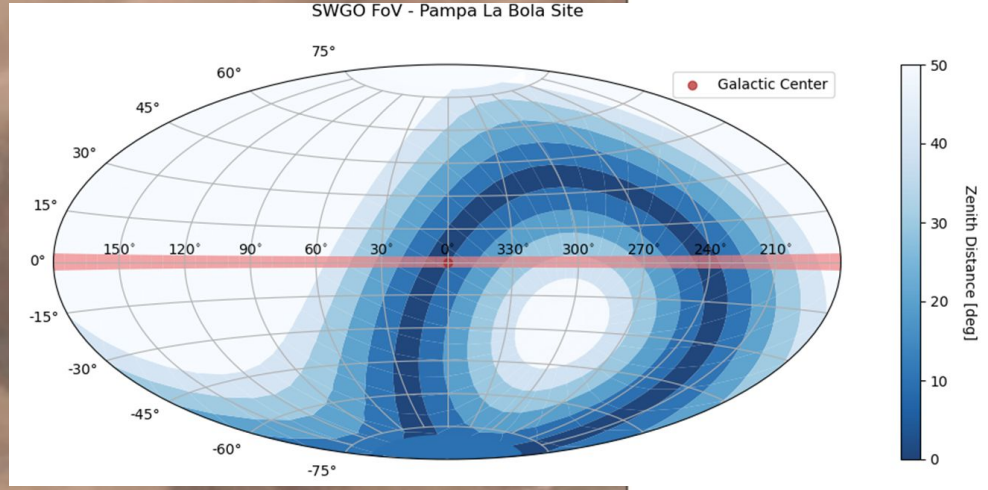
Site: Atacama Astro Park



AAP concession 360 Km2

Site: Atacama Astro Park





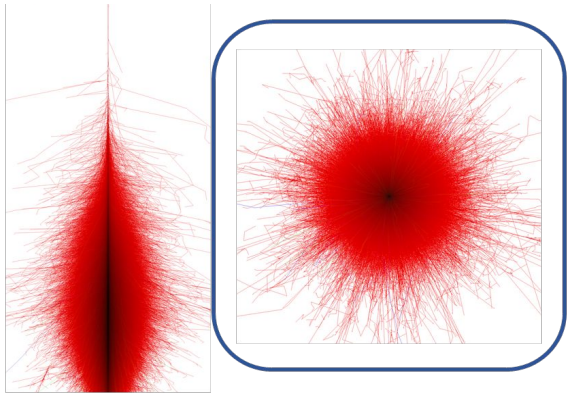
Simulation Performance

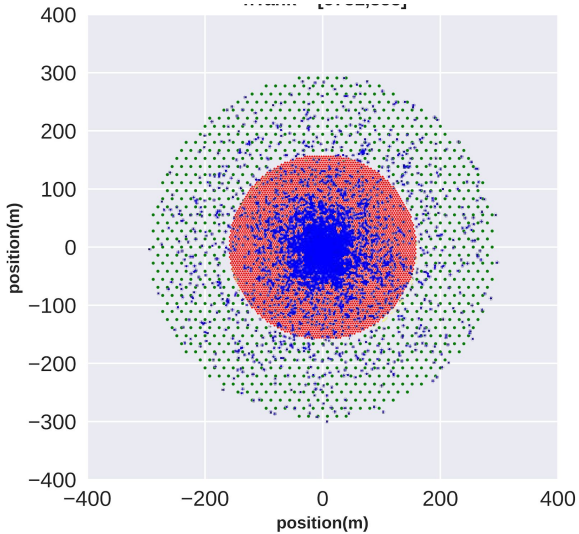
Looking for an instrument response function (IRF)

CORSIKA

COsmic Ray SImulations for KAscade

AERIE/ GEANT4 A SIMULATION TOOLKIT

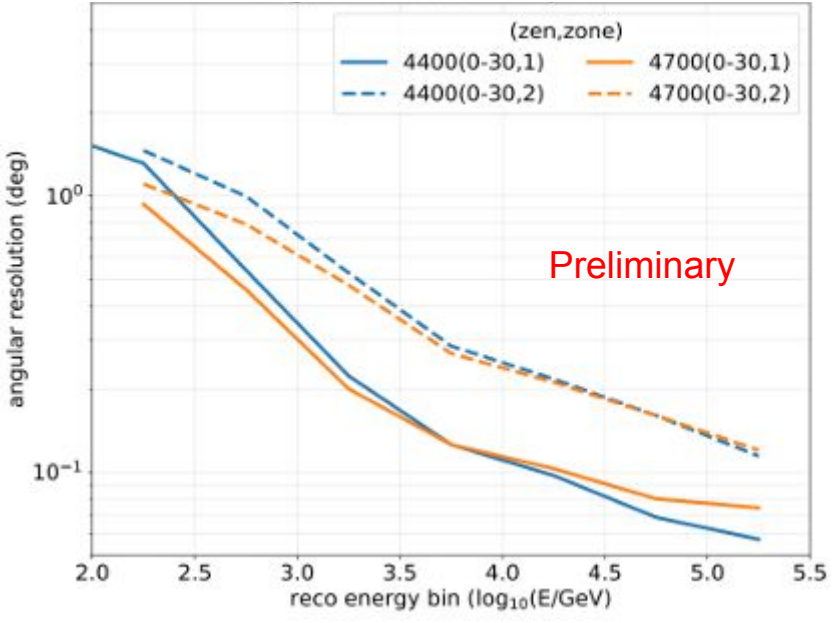




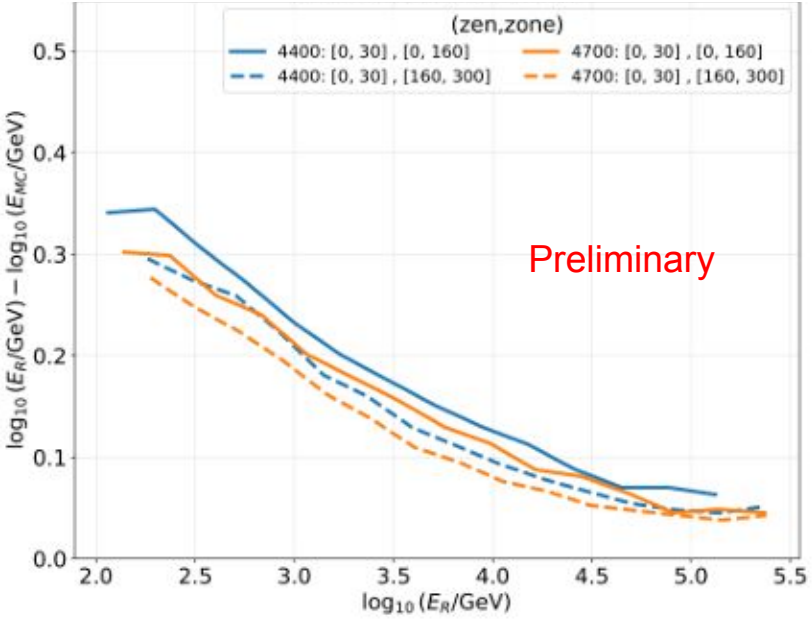
100 TeV photon

Reconstruction (A1)

Angular resolution

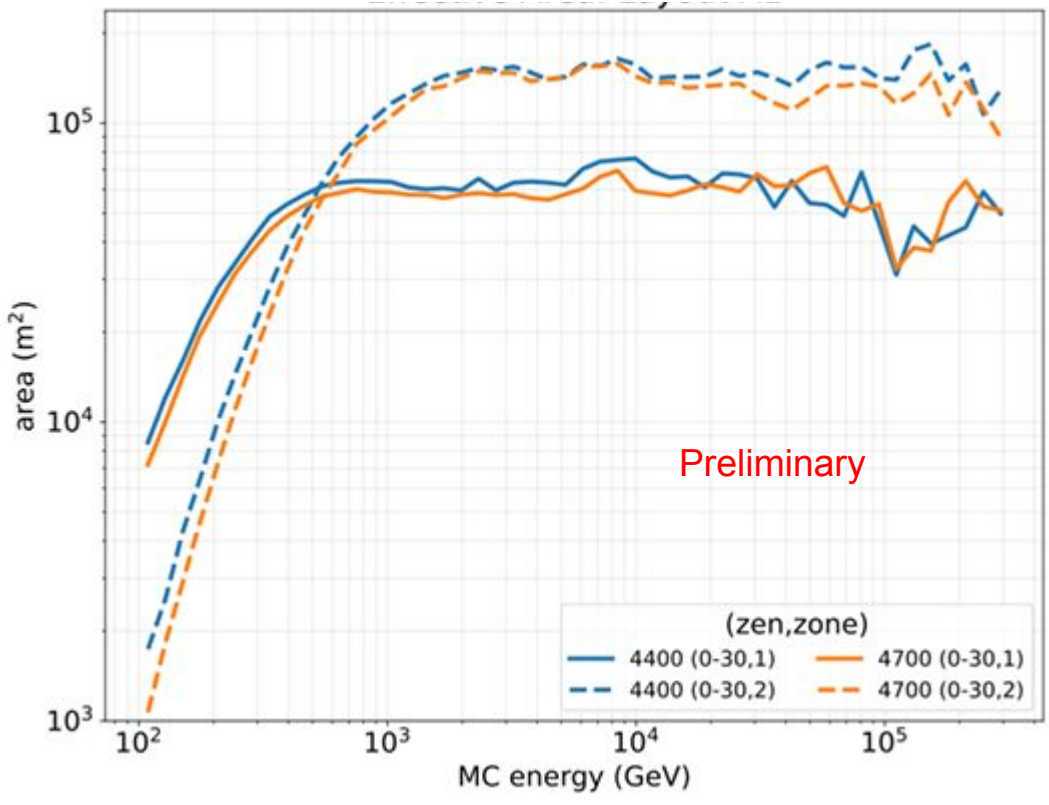


Energy resolution

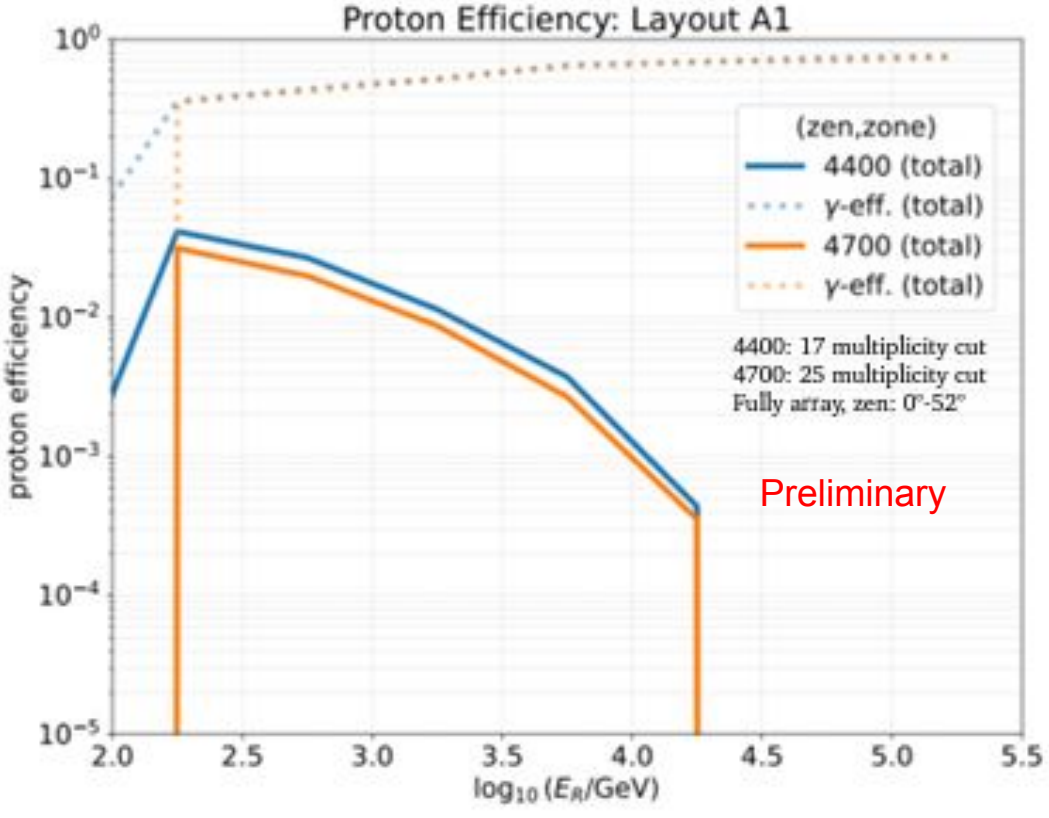


RMS of $(\log_{10}(E_{\mathrm{reco}}/\mathrm{GeV}) - \log_{10}(E_{\mathrm{true}}/\mathrm{GeV}))$

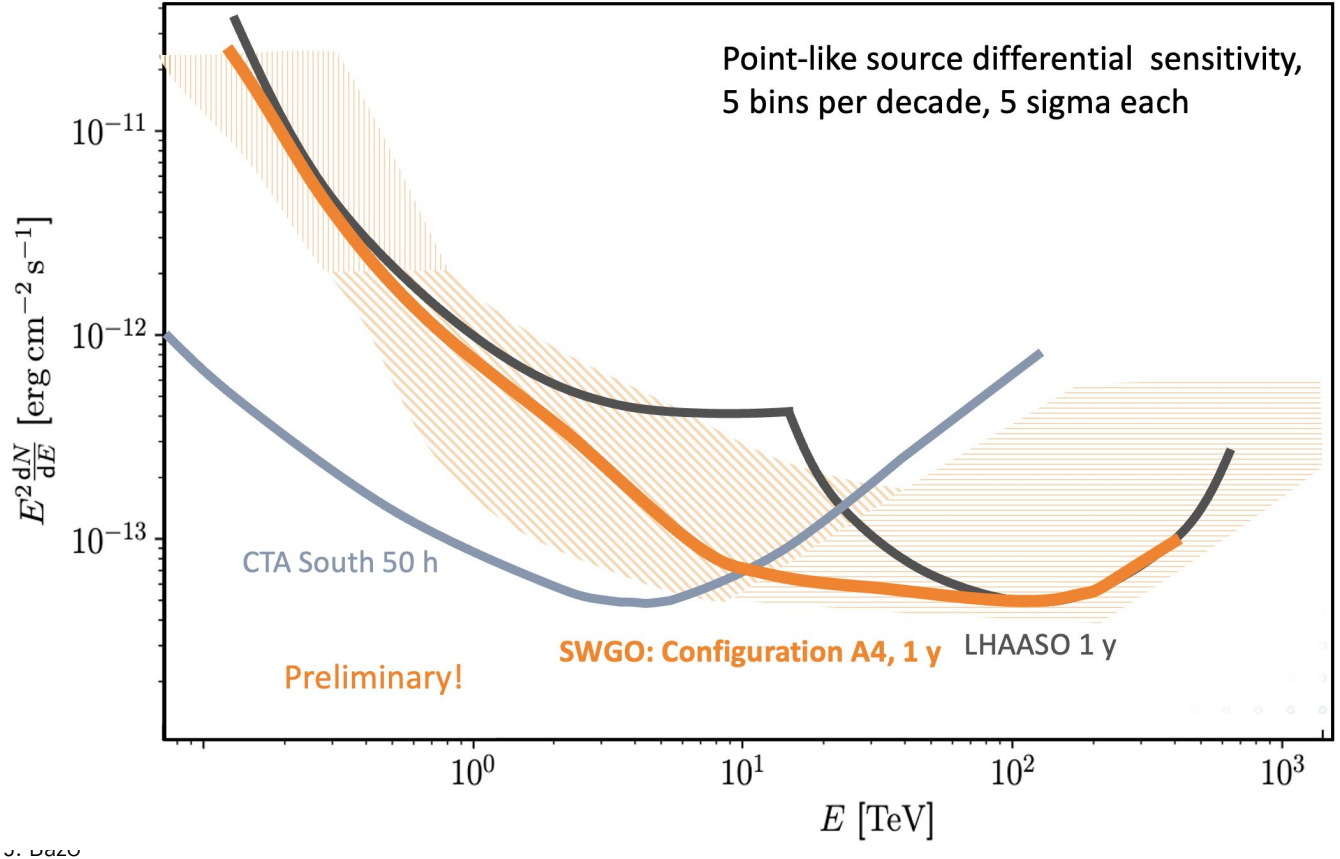
Effective Area (A1)



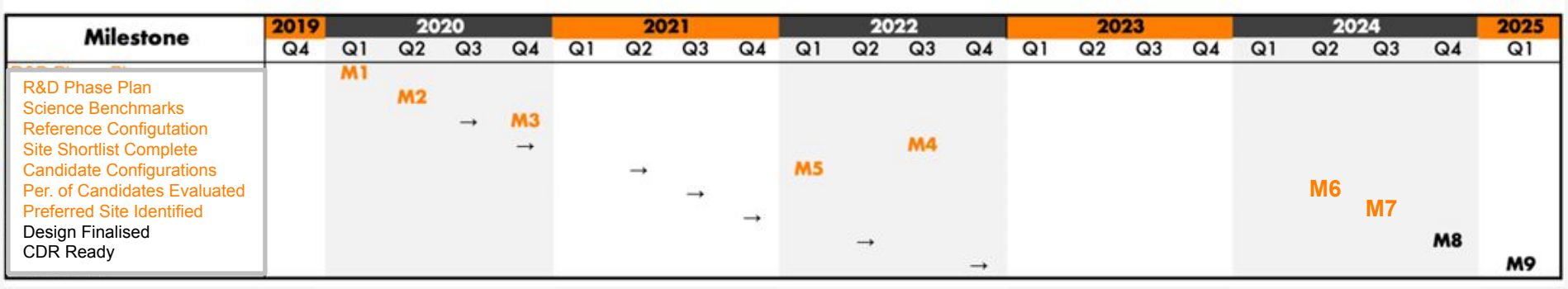
Efficiency (A1)



Point Source Sensitivity



R&D Timeline Milestones

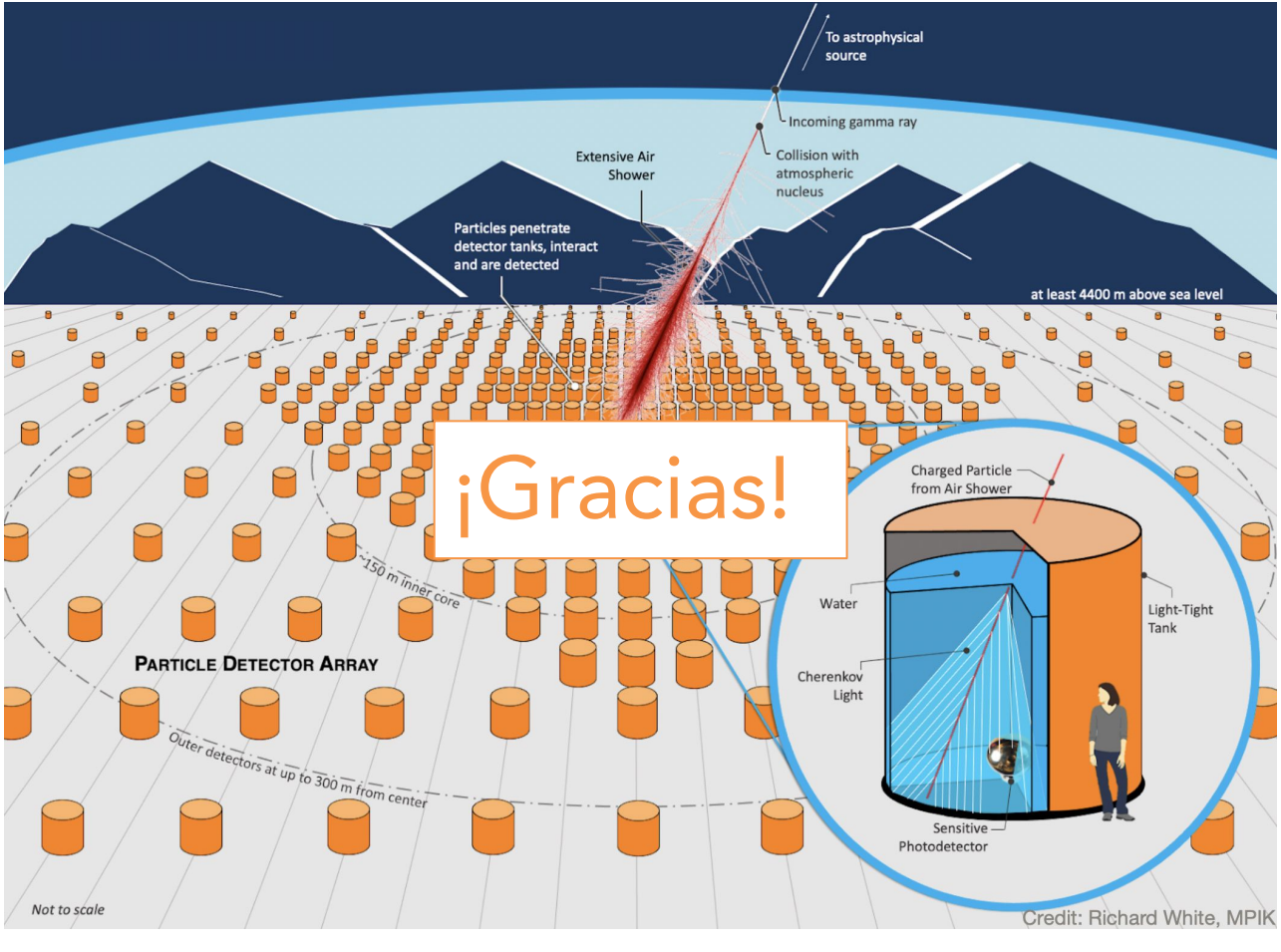


Take home messages

- Need for a high duty cycle TeV gamma detector in Southern hemisphere
- Observations of GC, Fermi bubbles, PeVatrons, GRBs, extended sources
- Atacama AstroPark in Chile as chosen site
- SWGO reference configuration based on WCD tanks with graded array with denser inner part.
- Expect to start construction in 2026 and gamma-ray observations before the end of the decade.

SWGO
The Southern Wide-field Gamma-ray Observatory

PUCP



¡Gracias!