SWGO
The Southern Wide-field
Gamma-ray Observatory

The Southern Wide-Field Gamma-ray Observatory

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CBPF

SWGO
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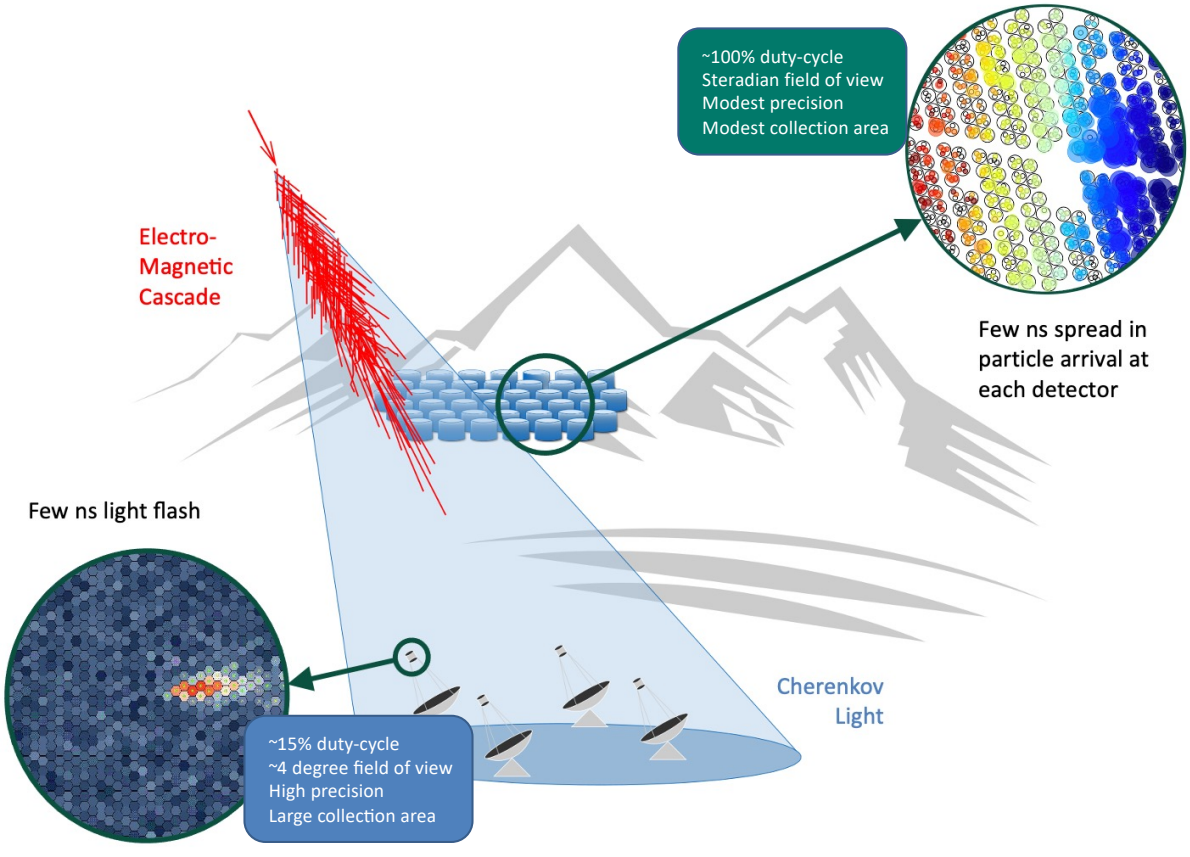
Ground-based gamma-ray astronomy



Global Landscape

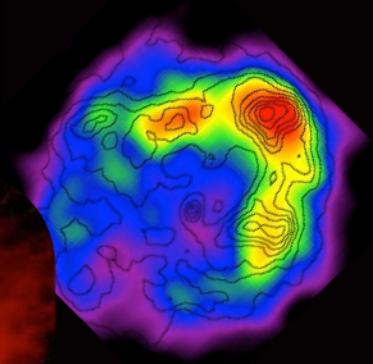
- Astonishing variety of TeV* emitters
  - Within the Milky Way
    - Supernova remnants
    - Bombarded molecular clouds
    - Stellar binaries - colliding wind & X-ray
    - Massive stellar clusters
    - Pulsars and pulsar wind nebulae
    - Supermassive black hole Sgr A*
  - Extragalactic
    - Starburst galaxies
    - MW satellites
    - Radio galaxies
    - Flat-spectrum radio quasars
    - ‘BL Lac’ objects
    - Gamma-ray bursts
- Acceleration to TeV energies is common, gamma-rays are an effective probe
  - Strongly complementary to sync. measurements

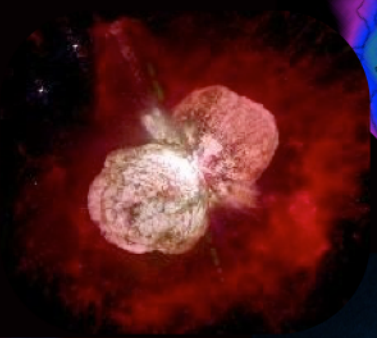
*0.05-50 TeV

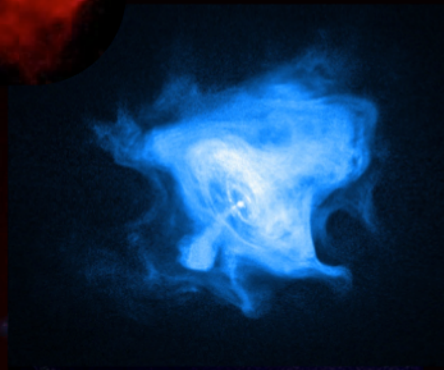
240 VH ESources

Background: Fermi-LAT

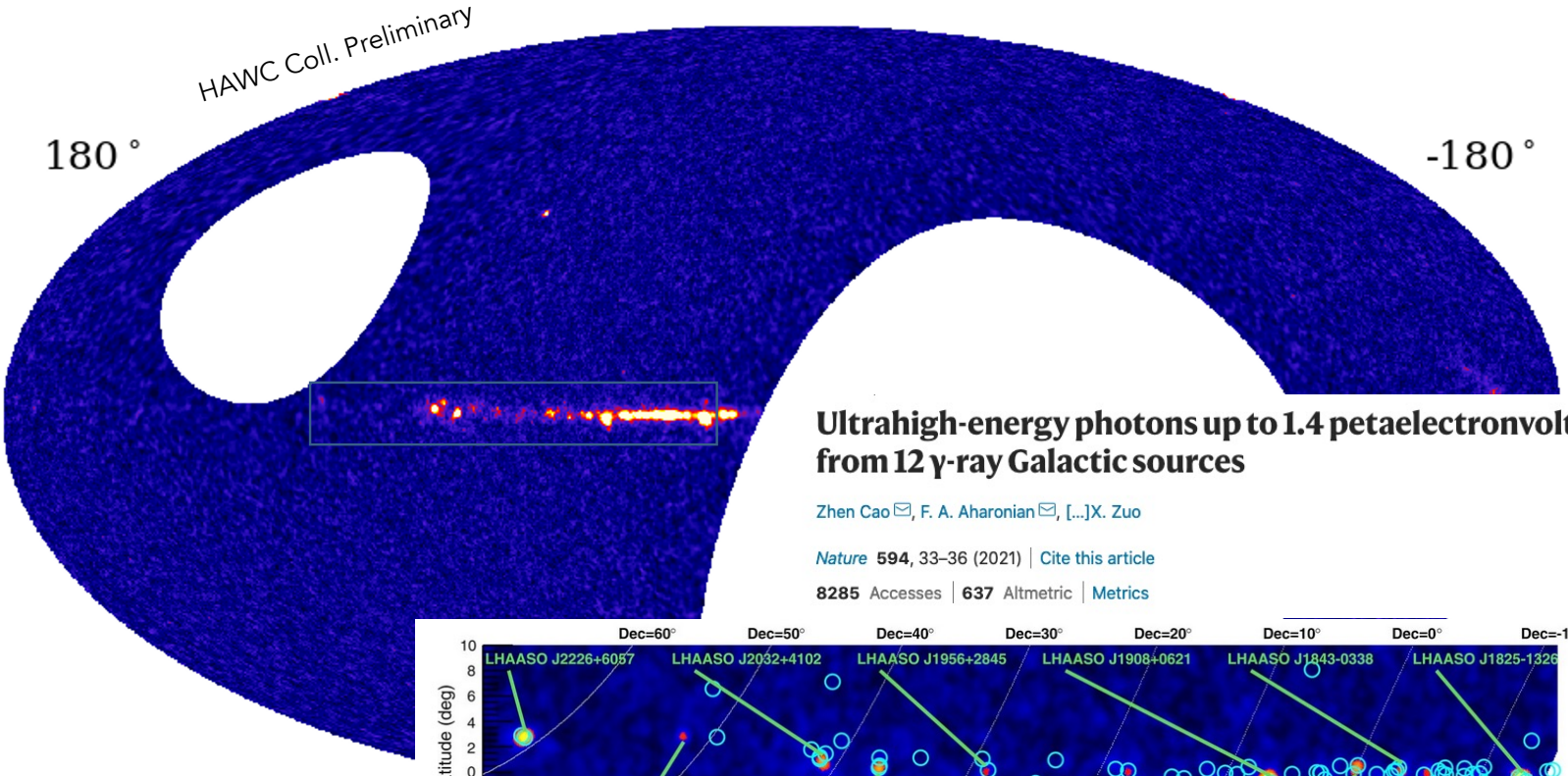
gamma-sky.net







The new PeVatron Window

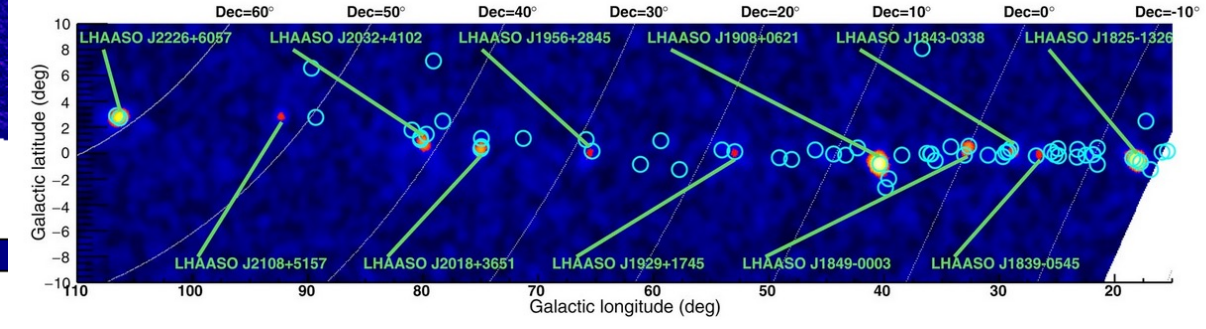


Ultrahigh-energy photons up to 1.4 petaelectronvolts from 12 γ-ray Galactic sources

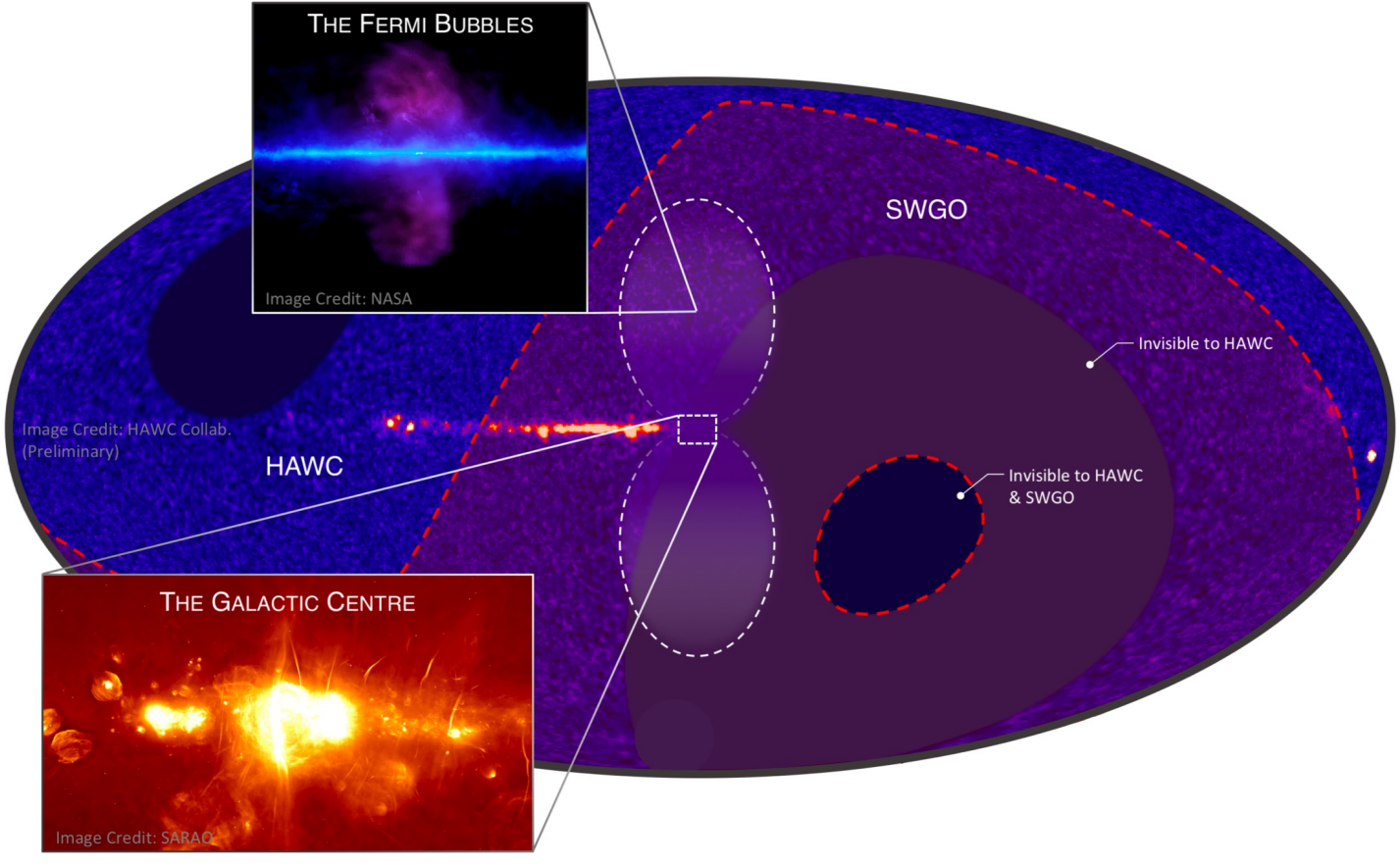
Zhen Cao, F. A. Aharonian, [...]X. Zuo

Nature **594**, 33–36 (2021) | Cite this article

8285 Accesses | **637** Altmetric | Metrics

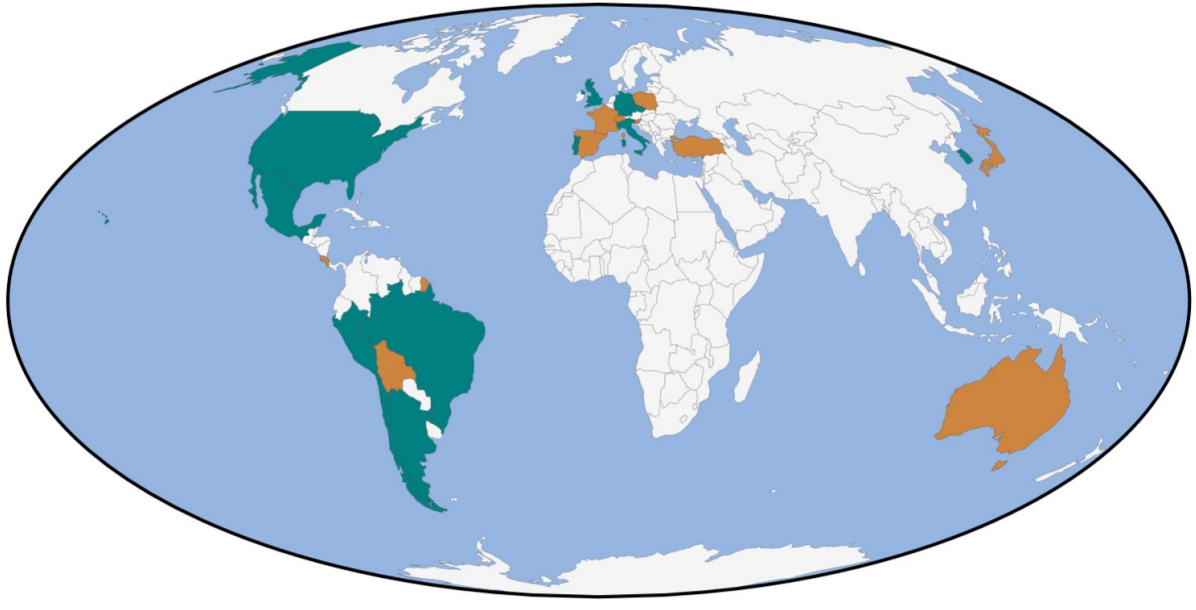


SWGO's global niche



The SWGO Collaboration

Collaboration



Countries in SWGO

Institutes

Argentina*, Brazil, Chile, Czech Republic, Germany*, Italy, Mexico, Peru, Portugal, South Korea, United Kingdom, United States*

Supporting scientists

Australia, Bolivia, Costa Rica, France, Japan, Poland, Slovenia, Spain, Switzerland, Turkey

**also supporting scientists*

- 47 institutes in12 countries
  - → + supporting scientists

→ Formed 2019
3-year R&D phase
Design SWGO & choose Site

The SWGO Collaboration

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

- Spokespersons
  swgo_spokespersons@swgo.org
  - → Jim Hinton (Germany), Petra Huentemeyer (USA), Ulisses Barres (Brazil)

Science

Gwenael Giacinti & Francesco Longo

Analysis & Simulations

Ruben Conceição, Harm Schoorlemmer & Andy Smith

Detector

Felix Werner & Lukas Nellen

Site

Marcos Santander & Arthur Moraes

Outreach & Comms

Elisa Prandini & Ana Pichel

The Science Case for SWGO

- Detection of short-timescale phenomena
  - Low-energy threshold for detection of short-timescale (< 1hr) transient events down to 100 GeV
- Search for PeVatrons
  - Improved sensitivity up to a few 100s TeV to search for PeV Galactic particle accelerators.
- PWNe and Gamma-ray Halos
  - Unique potential for accessing the high-energy end of the Galactic Population.
- Dark Matter and Diffuse Emission
  - Unique access to the Galactic Center and Halo at the high-energy end of the spectrum.
- Cosmic-rays
  - Unique complement to LHAASO for anisotropy studies, with capability to reach low-angular scale.
  - Good muon tagging implies good mass resolution for composition studies up to the knee.

Design Implications

- Decreasing of the low-energy threshold to c. 100 GeV, at ~10^{-11} erg/cm^2.s (5-year)
  - Combination of Improved design and background rejection, plus high-altitude site > 4.5 km a.s.l.
- Large array (> 200.000 m^2) to achieve good sensitivity > 100 TeV
  - Aim is to push sensitivity <10^{-13} erg/cm^2.s in the range 100-300 TeV.
- Muon counting capability
  - For cosmic-ray studies and background subtraction.
- Improved angular (0.2 deg) and energy resolutions (<30%) above 10 TeV.

The SWGO Concept

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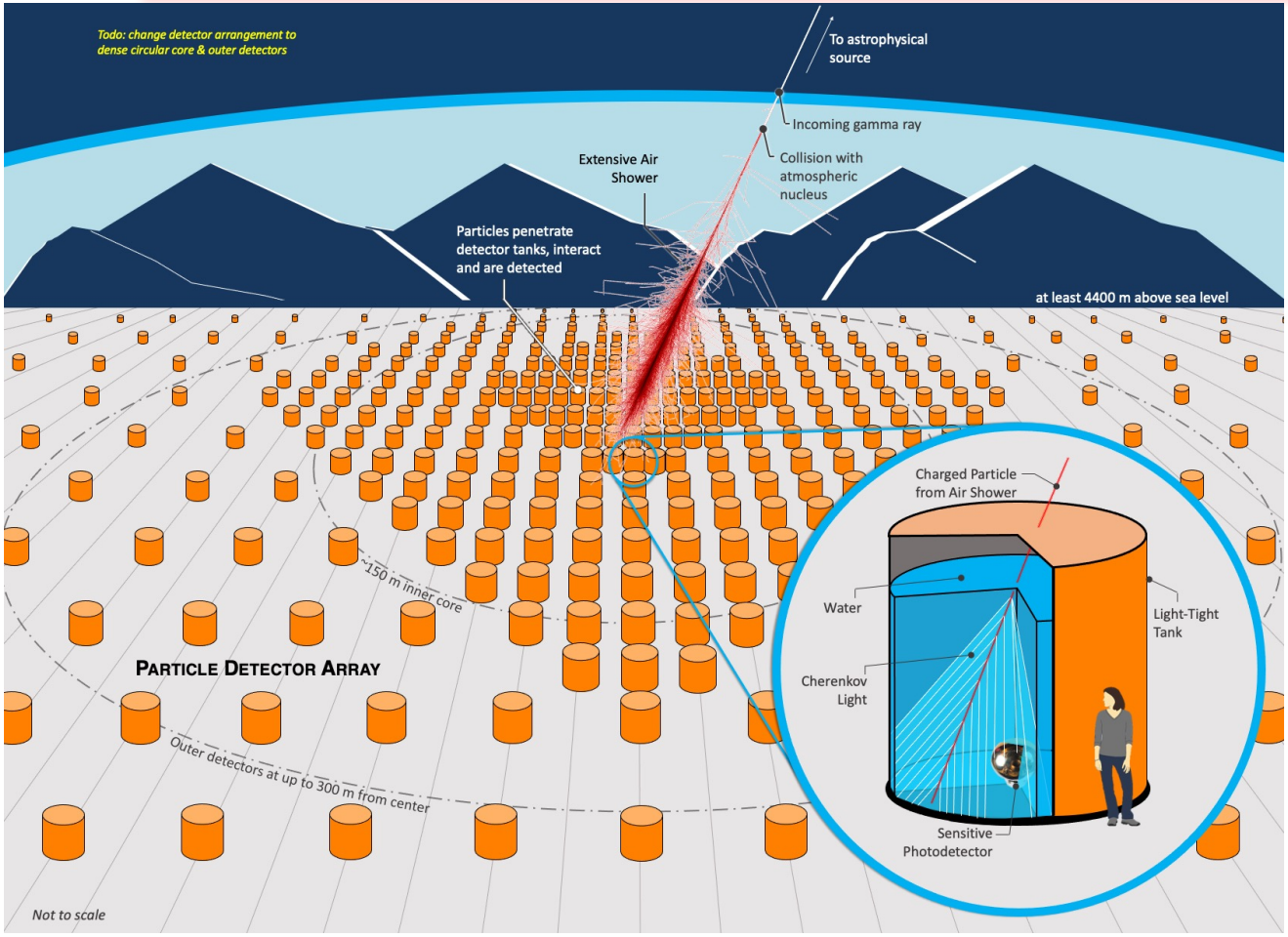
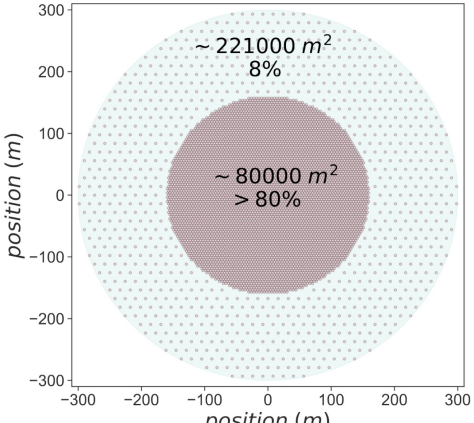


- Reference Configuration
  - → Dense Core
  - → Extended and sparse outer array
  - → Detector units with muon-ID capability



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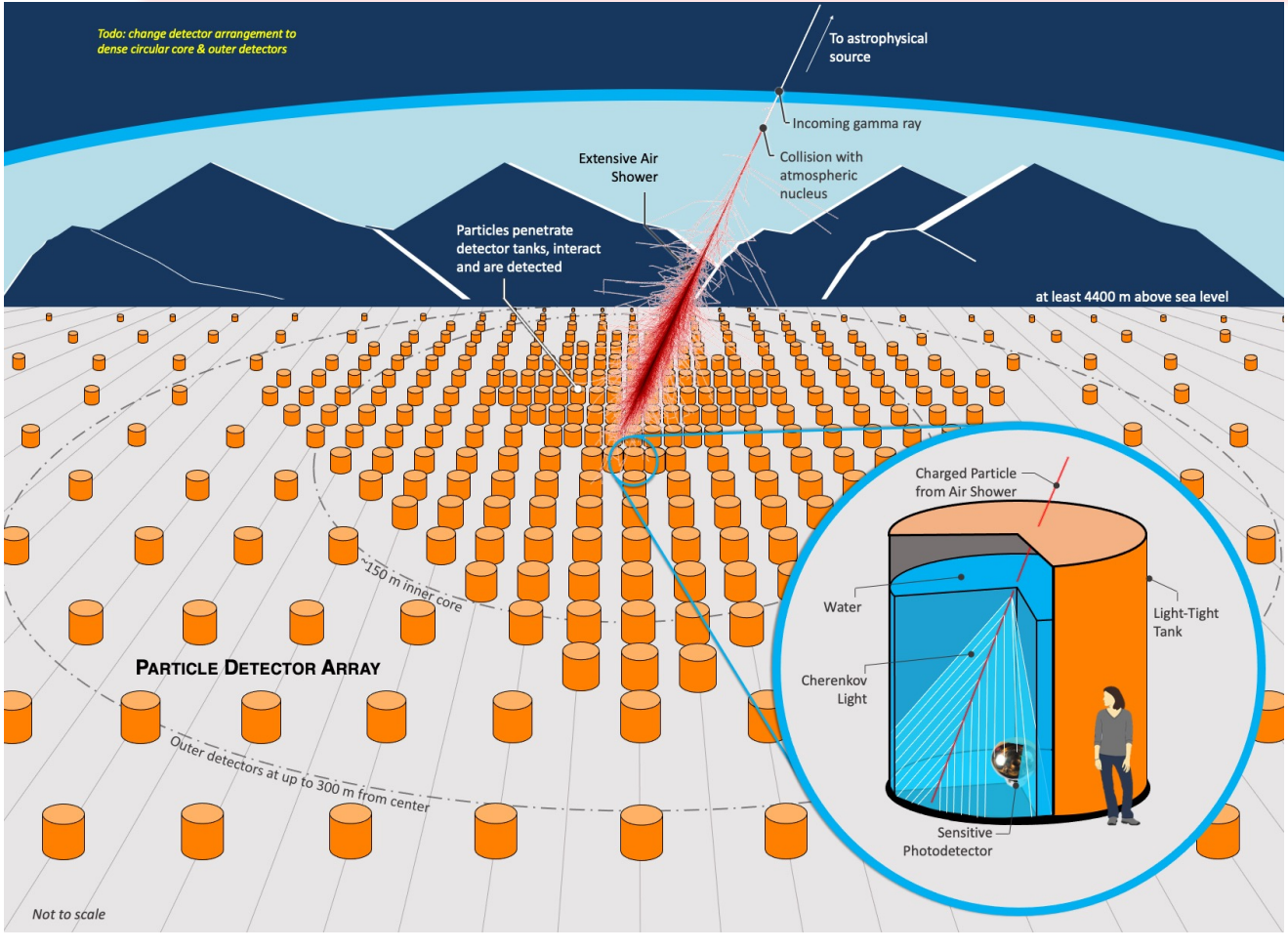

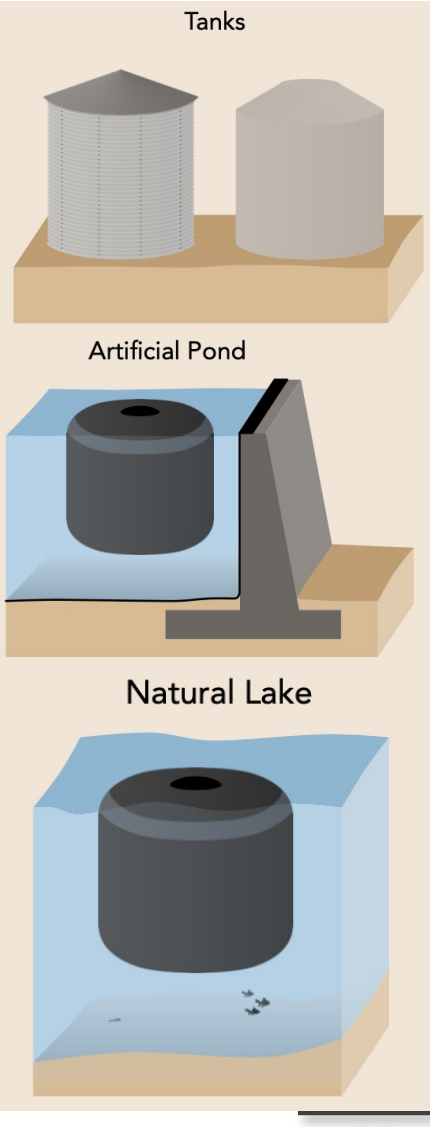

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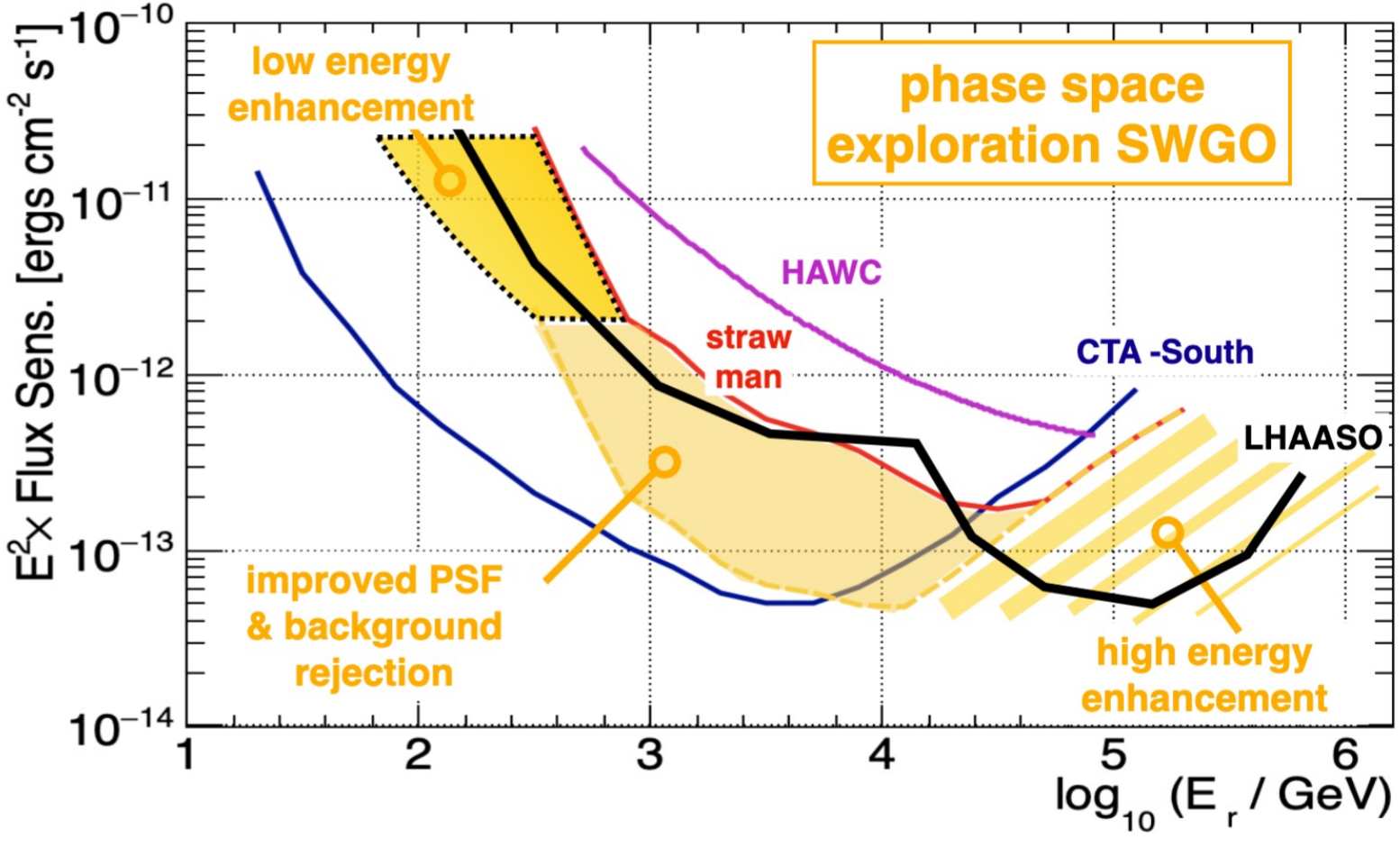
The SWGO Design Exploration



The SWGO Design Exploration

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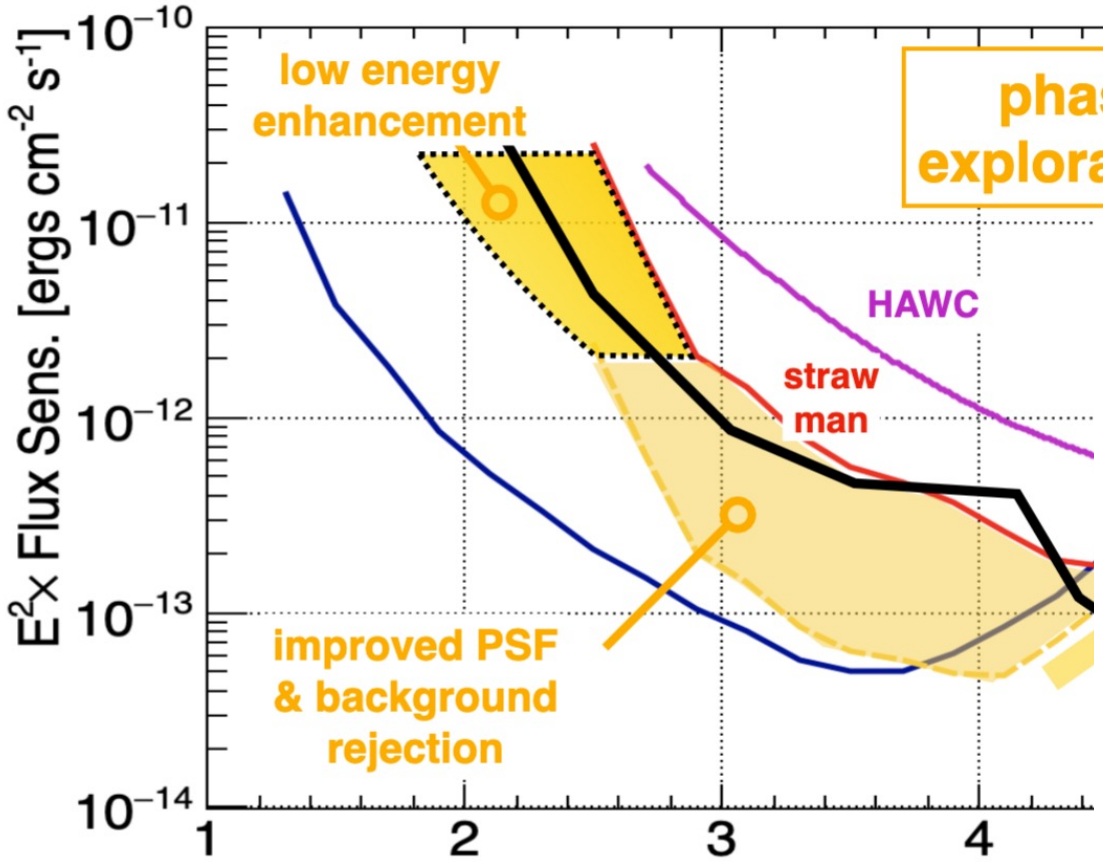
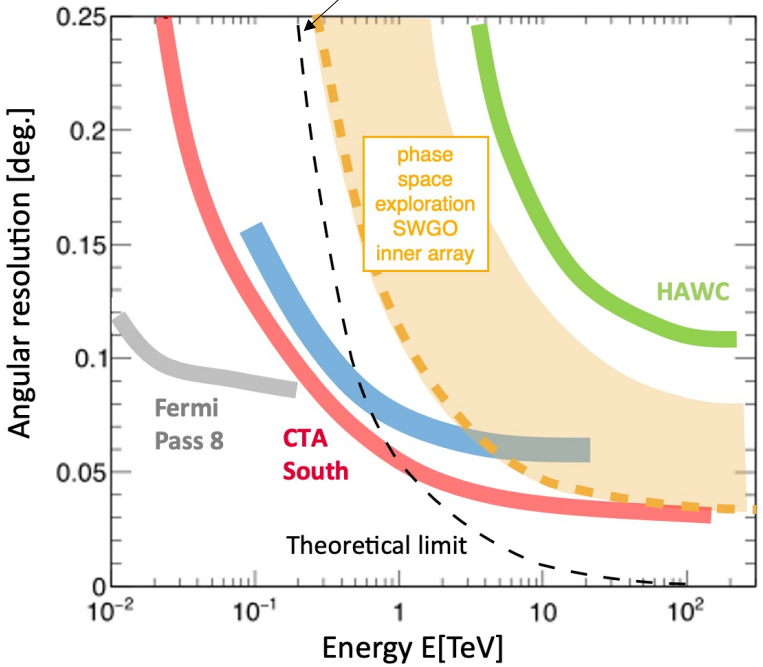


Unprecedented Resolution

Hofmann (2020) Astroparticle Physics 123, 102479



SWGO Site Candidates

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lat. 15 S

lat. 23 S

- Alto Tocomar (Argentina)
- Cerro Vecar (Argentina)
- Chacaltaya (Bolivia)
- AAP Pajonal (Chile)
- AAP Pampa La Bola (Chile)
- Lake Sibinacocha (Peru)
- Imata (Peru)
- Sumbay (Peru)
- Peru National Observatory
- Yanque (Peru)

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Conclusions

- A southern hemisphere VHE-UHE wide-field gamma-ray observatory is a natural next step in the field
  - → Unique view of the Galaxy and the GC
  - → Strong synergies with LHAASO, CTA, and neutrino instruments
- Strong science case
  - → From 100 GeV (transients, MM) to PeV (cosmic-rays)
- The R&D phase is underway
  - → Choice of site and detector technologies in 2023
- A key astro-particle experiment in Latin America
  - → Strong participation and leadership from Brazil

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Thank you for listening!

First Collaboration Meeting

at the Padova Astronomical Observatory, Italy, on October 30th–31st 2019

www.swgo.org

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