

# Southern Wide-Field Gamma-ray Observatory

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## **Gamma-ray Astronomy**



Shower image, 100 GeV >-ray adapted from: F. Schmidt, J. Knapp, "CORSIKA Shower Images", 2005, https://www-zeuthen.desy.de/~jknapp/fs/showerimages.html

## **Observational Panorama**

#### Ocherenkov Atmospheric Telescopes

- → 20% duty-cycle
- → Pointing (few degrees FoV)
- → Energy threshold down to 10s GeV
- $\rightarrow$  Good energy and angular resolution





HESS





#### Particle Detector Arrays

- → 100% duty-cycle
- → Wide-field of View (~ steradian)
- $\rightarrow$  Energy range 100s GeV up to 100s TeV
- → Long exposure and accurate background determination



#### Broadband panorama of high-energy Astrophysics

Point source sensitivity for X- and gamma-ray instruments



New facilities (CTA, LHAASO) will drive an order of magnitude increase in sensitivity for ground-based gamma-ray astronomy in the next decade, reaching beyond the 100 TeV energy range.

The Low-energy frontier remains to be open for wide-field 10 10 10 10 10 10 10 10 10 10 10 10

## The Core Concept for the Observatory

o High-altitude particle detector above 4.4 km a.s.l

- Latitude range between 15 and 30 degrees South
- Wide energy range reaching down to 100 GeV and 100+ TeV
- High fill-factor core (2x HAWC) for significantly better > 10x sensitivity, plus large low-density outer array
- ◎ Goal for R&D study conclusion in 2022

### **Candidate Sites**



Country	Elevation	Location:
Peru	4900	Laguna Sibinacocha
Peru	4450	Imata lake
Peru	4450	Imata
Peru	4140	Sumbay
Argentina	4800	Cerro Vecar
Argentina	4450	Alto Tocomar
Chile	4700	ALMA Pampa La Bola
Chile	4400	AAP Pajonales
Bolivia	4700	ALPACA area



### A wide-field observatory in the South



#### Science Case: https://arxiv.org/abs/ 1902.08429

### A wide-field observatory in the South



SWGO will complement the view of the Galactic source population towards the highest energies and will greatly expand our reach for disclosing the full Galactic population of high-energy accelerators.



### An observatory for gamma-ray transients



SWGO will provide the necessary complement to observation of the Southern Hemisphere transient sky, filling-up a missing niche in the global network of multimessenger astronomy. It will also work as a powerful trigger for transient observations, specially for GRBS, with peak performance at the short < 1 ks timescale.



Timescale

## An observatory for gamma-ray transients



## The SWGO Concept

#### **Detector array**

Large array for low-energy events Compact core with large instrumented area



• 'Strawman' - reference detector layout EPJ-C. H. Schoorlemmer, J.A. Hinton, R. Lopez-Coto, (2019) Potentially more sensitive than CTA over several years integration time provided good background suppression is achieved.



**Annual Exposure** 

12

# The SWGO Concept

#### **Detector units**

Bladder with

white inside

Volume divider (allowing water flow)

optional/movable walkway Hatch

Concrete

dividers

HAWC-style Vs 2

# Multiple detector options to be investigated

- oCore unit is a water-Cherenkov Detector
  - Options being investigated based on tanks (HAWC-like), ponds (Milagro-like) and lake-base (test pool under construction at MPIK-Heidelberg)
- Simulations currently ongoing to constrain all aspects of the detectors

#### • Design strongly dependent on site choice

- Water access, construction costs, infrastructure feasibility, compatibility with scientific driven main design goals...
- Strong muon detection capability
  - Large potential for gamma/hadron separation above 1 TeV and consequently backgroundfree conditions driving high sensitivity at the highest 100+ TeV range,
- Muon-tagging in all units?
  - Double layer WCD unities
  - Time-intensity tagging of single through-going particles

PoS (ICRC2019) 720





### **Conclusion and thanks!**



#### Countries in SWGO Institutes

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

#### Supporting scientists

Australia, Chile, France, Japan, Slovenia, Spain

\*also supporting scientists

# Backups

#### **The Collaboration**

#### Southern Wide-Field Gamma-ray Observatory

- + higher altitude (4400+ m asl) and larger area
- + more efficient detector units + muon tagging capability

improved sensitivity and lower E threshold

**Established in July 2019** 3 year R&D Programme

www.swgo.org

Member institutes signed the Sol.

Any interested individual can become a supporting scientist.