

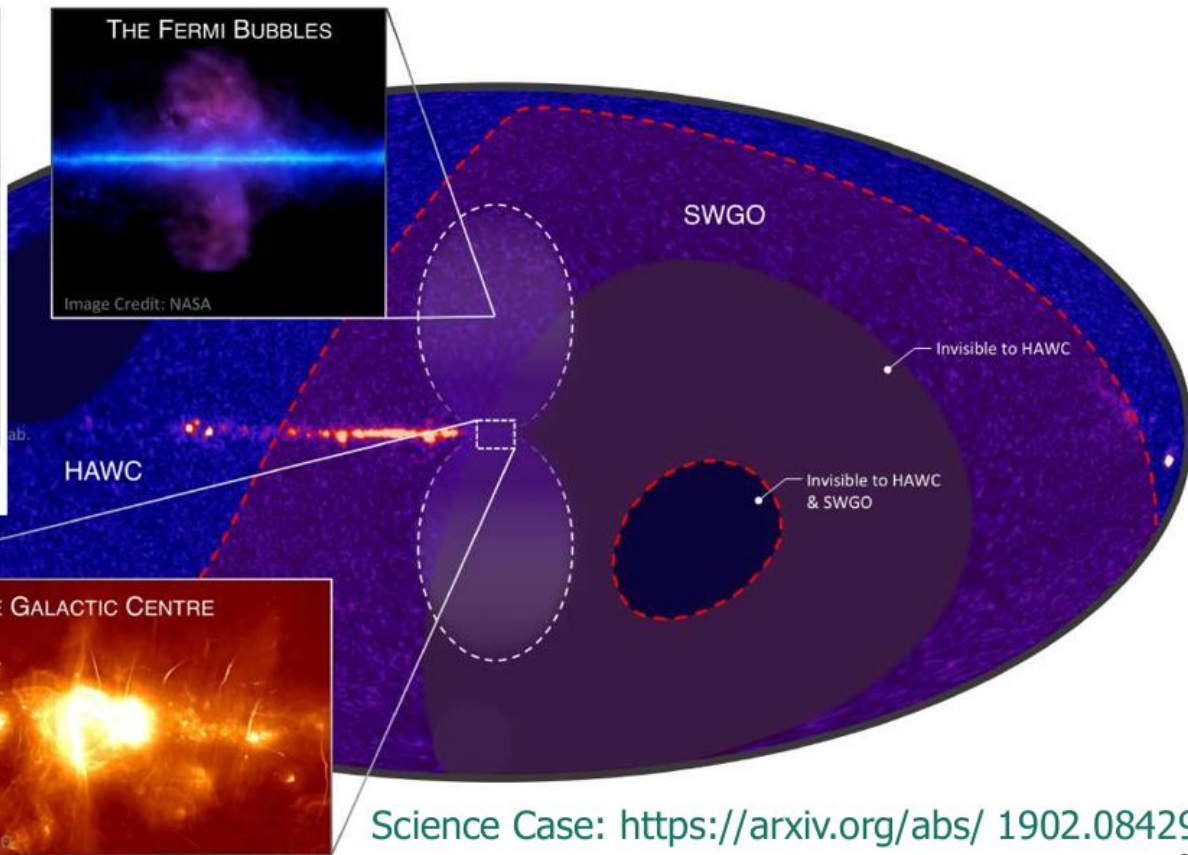
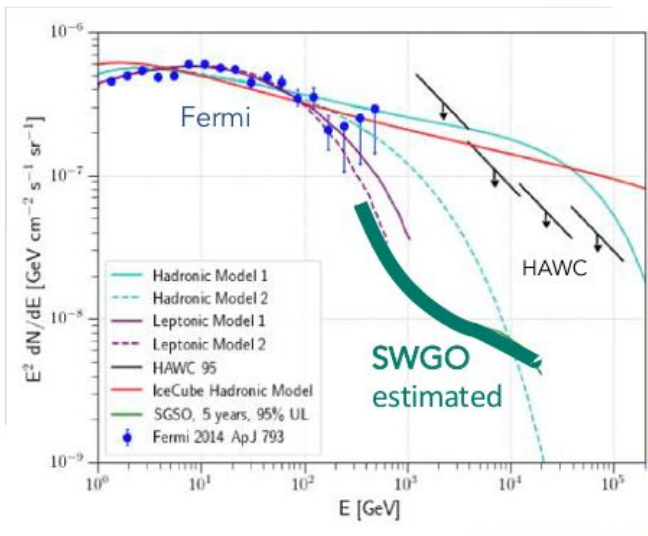
***The Southern Wide-field Gamma-ray Observatory "SWG0"  
Timeline and Synergies with CTA  
April 2023***

Jose Bellido  
The University of Adelaide

CTA-OZ meeting #1, 2023  
April 13, 2023, Adelaide



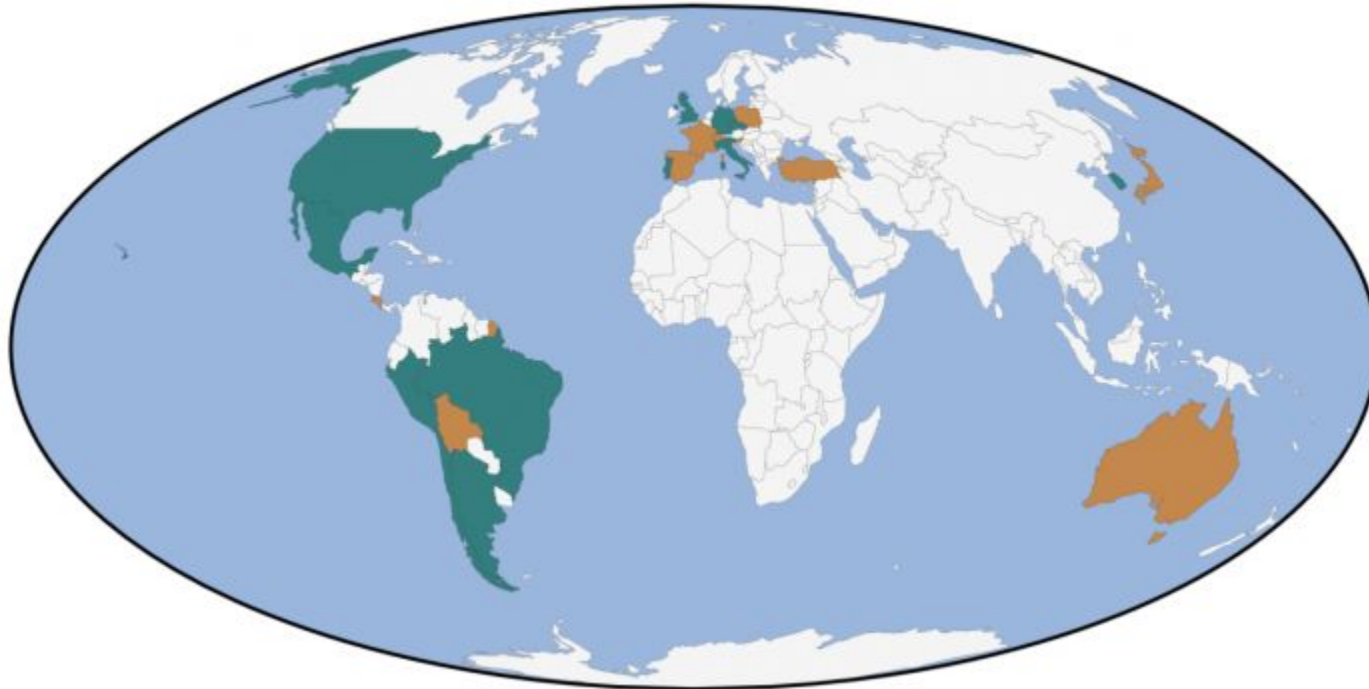
# A wide-field observatory in the South is ideal to map Southern Sky in the TeV and sub TeV energy range



Crucial access to the Galactic Plane and the Galactic Center, and a complementary view of the sky with HAWC and LHAASO for cosmic-rays and diffuse emission studies.

Science Case: <https://arxiv.org/abs/1902.08429>

# “The Southern Wide-field Gamma-ray Observatory” Collaboration



## Countries in SWGO

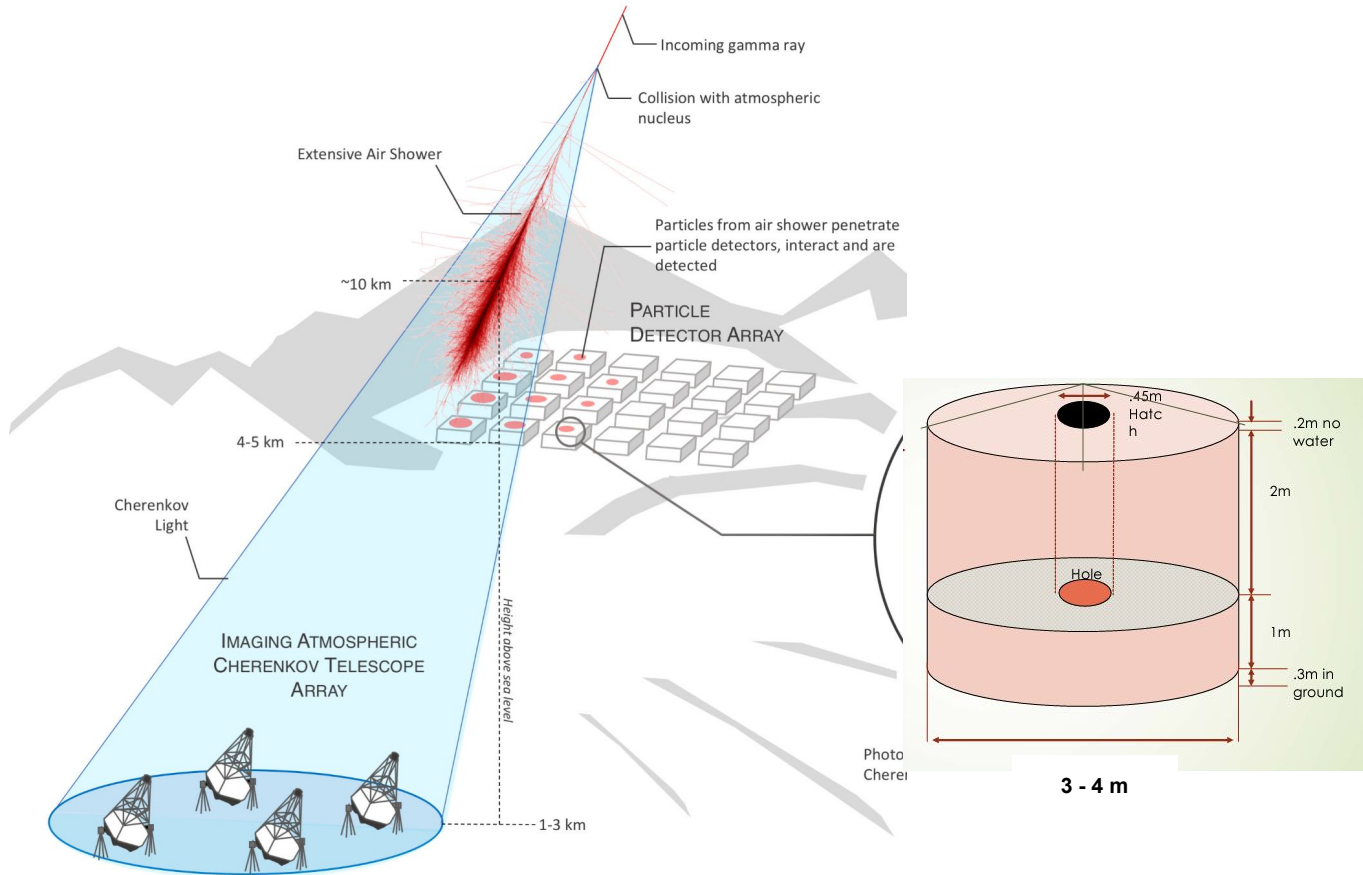
### Institutes

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*



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

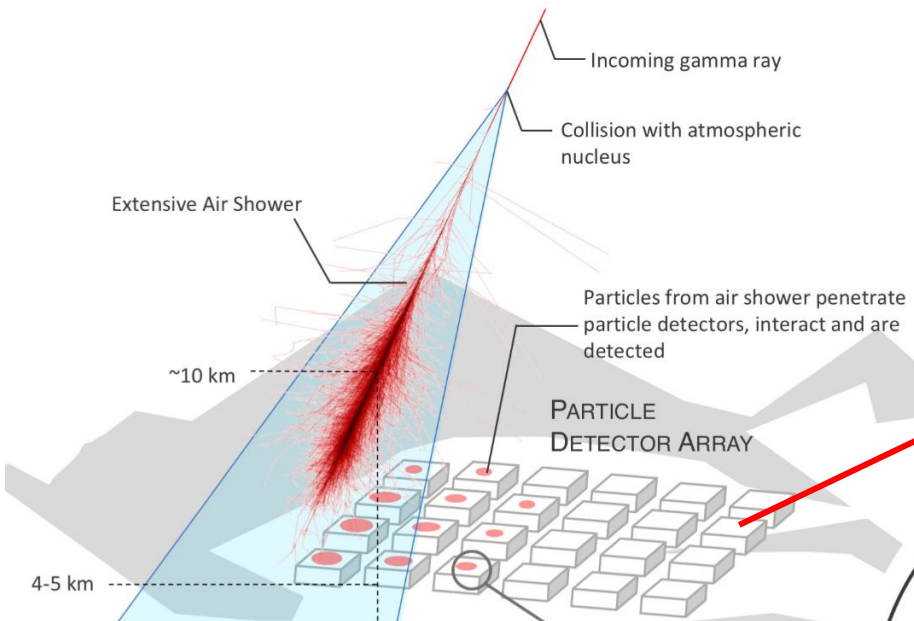
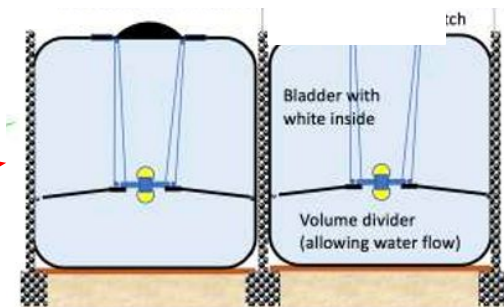
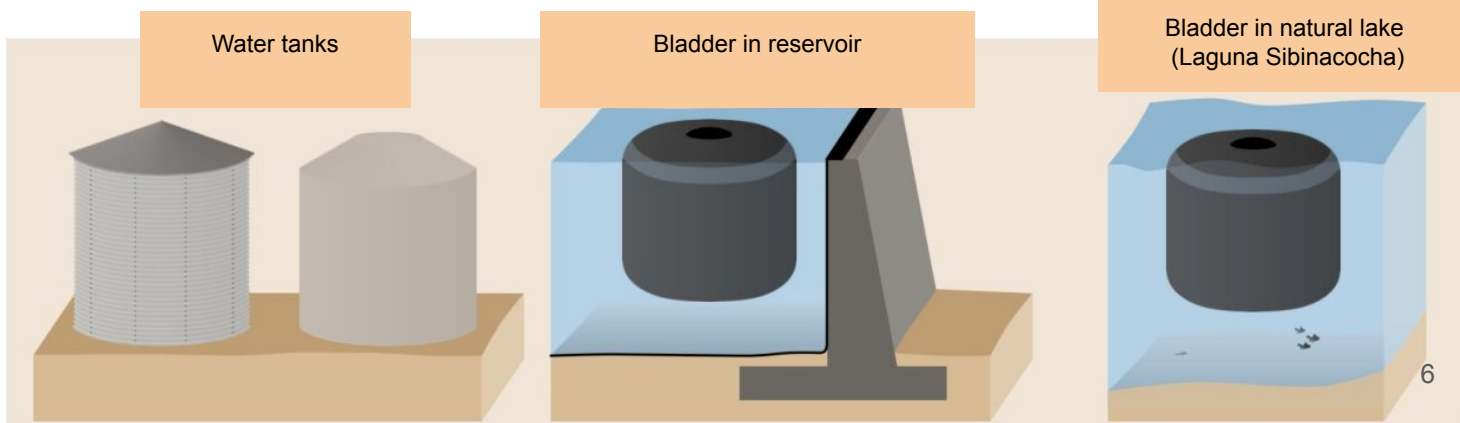


Diagram of the inside of the detector



Three detector concepts under study





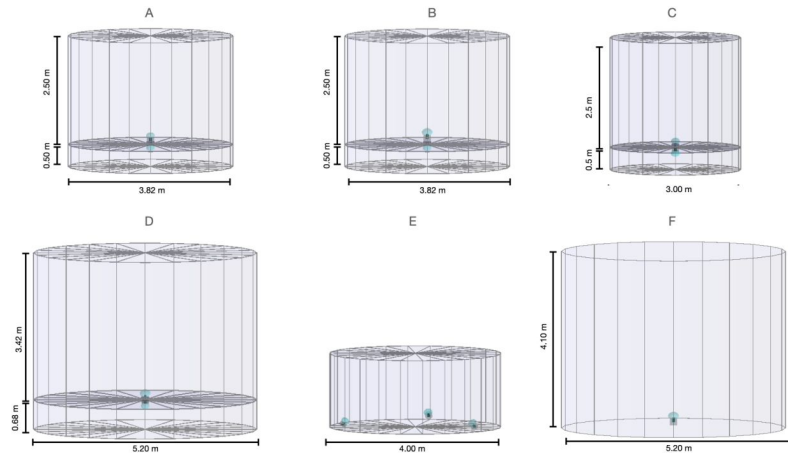
# M5.1 - Candidate Configuration Description

## 6 Candidate tank designs from 3 types -

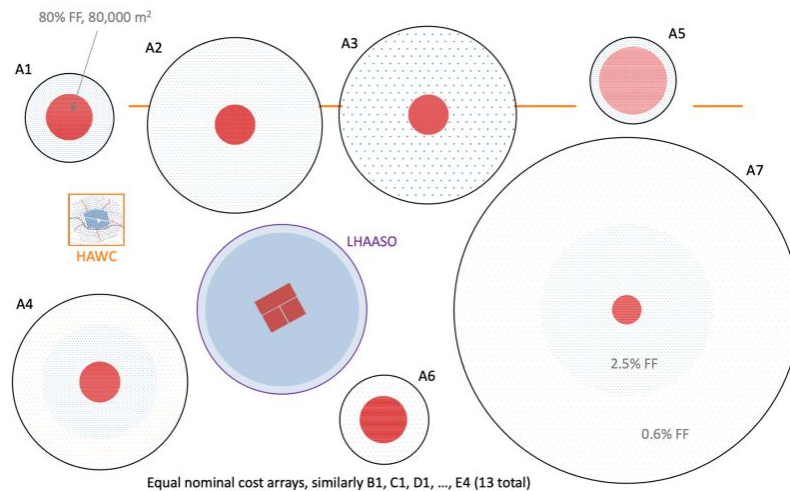
- **Dual layer** (A,B,C,D) - Dual layer (top - air show, bottom - muon)
- **Mercedes** (E) - novel multi-PMT single shallow layer design.
- **Single deep layer** (F) - HAWC/LHAASO-like
- Equal cost designs - Based on commercially available tanks and PMTs

## Simulated 7 detector layouts

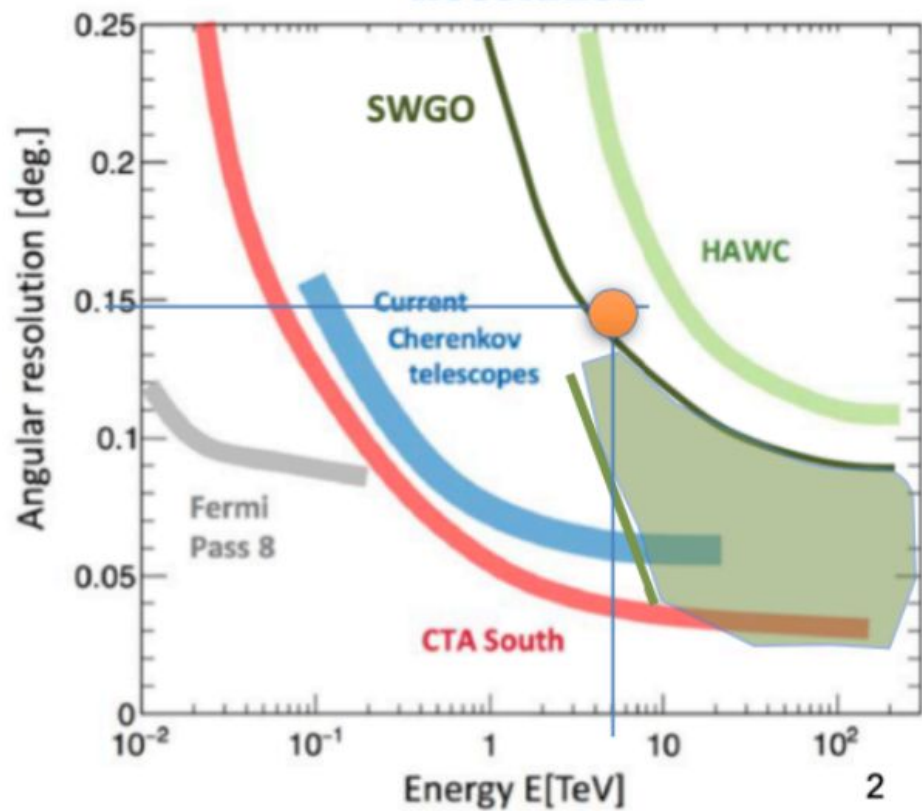
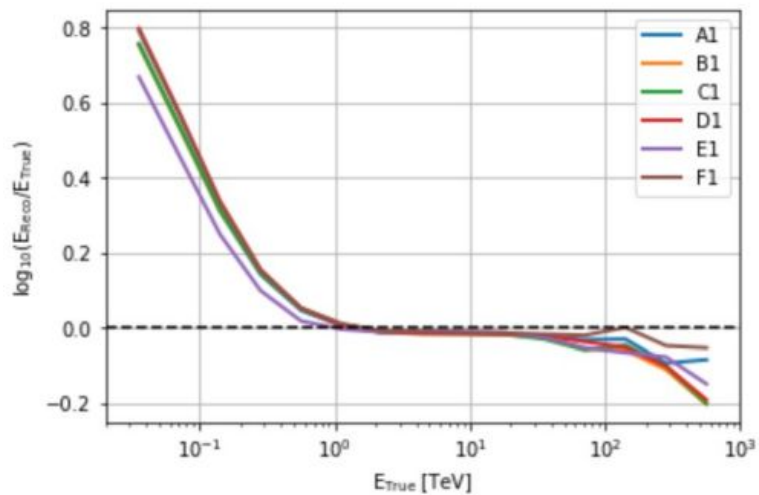
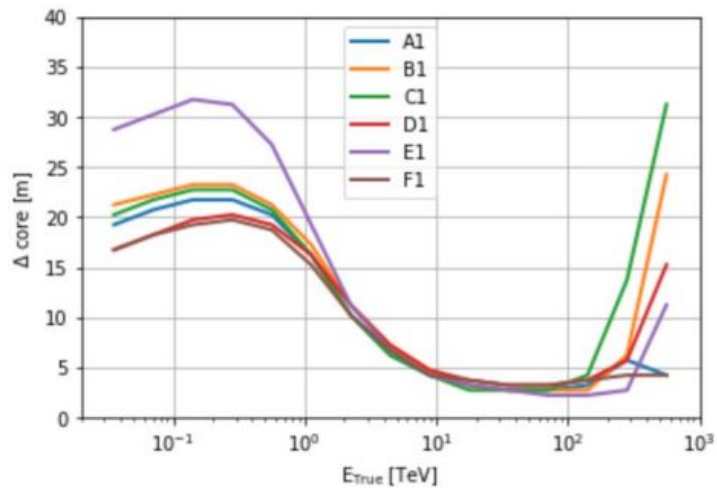
- Evaluate sensitivity vs energy differences
- ABCDF are simulated with white cylinders, but black bottom, E - all white inside
- Can extract black-walled sims by rejecting photons based on number of bounces



		Layout						
		1	2	3	4	5	6	7
Tank Type	A	x	x	x	x	x	x	x
	B	x						
	C	x						
	D	x						
	E	x			x			
	F	x						





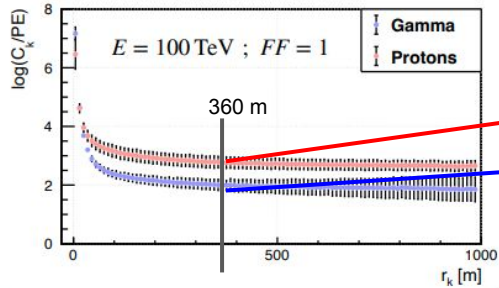
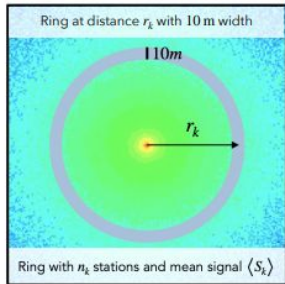


# Gamma/Hadron discrimination

## Exploring the shower azimuthal asymmetries

R. Conceição, L. Gibilisco, M. Pimenta, B. Tomé, arXiv:2204.12337

$$C_k = \frac{2}{n_k(n_k - 1)} \frac{1}{\langle S_k \rangle} \sum_{i=1}^{n_k-1} \sum_{j=i+1}^{n_k} (S_{ik} - S_{jk})^2$$

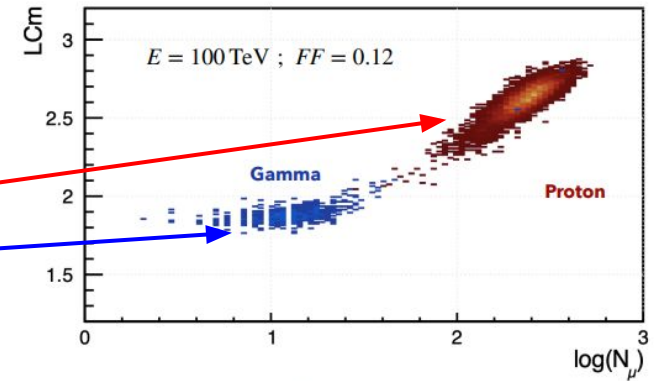


Ruben Conceição

3

## $LCm$ vs $N_\mu$

(Total signal at ground : e.m. + muons + hadrons)



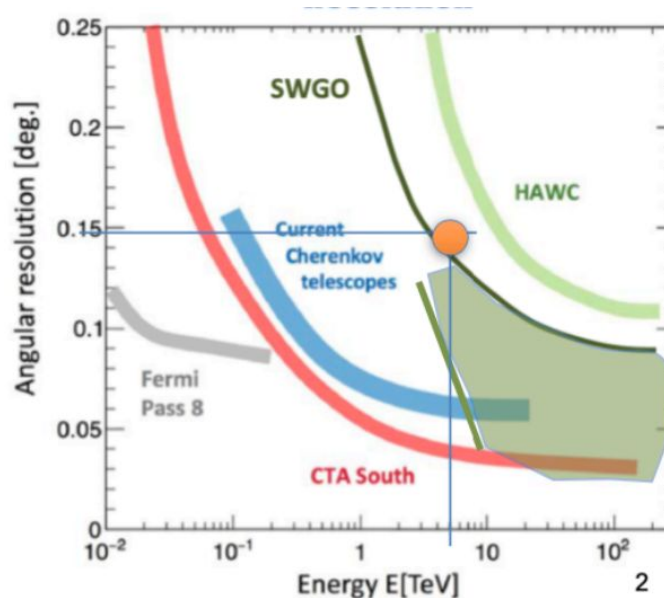
Ruben Conceição

HAWC achieves up to about 99.97% hadron rejection for large showers (looking at the smoothness of the Lateral Distribution).

## Synergies with CTA

SWGO being an array of particle detectors, it has a 100% duty cycle and has a very large field of view. It can see almost the entire sky above it. However, its effective area gets smaller for inclined showers.

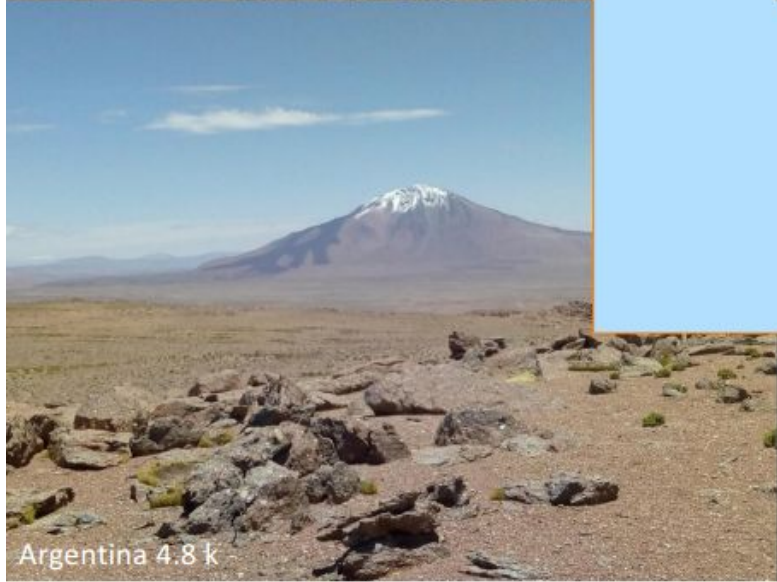
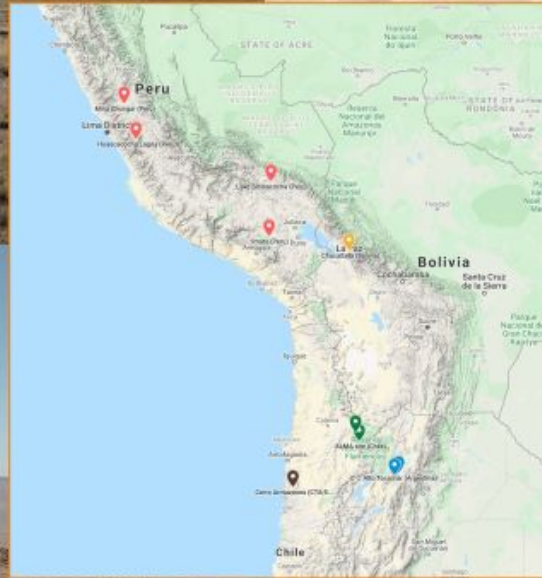
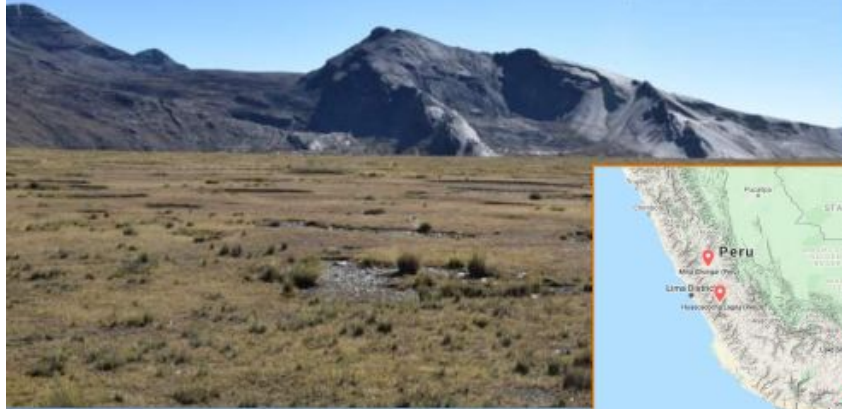
SWGO, is an ideal Survey instrument at an energy range overlapping with CTA. Furthermore, CTA and SWGO are relative close, both being located in South America. Therefore, a SWGO trigger alert could be followed up up almost immediately with CTA telescopes. CTA telescopes have better angular resolution:



Bolivia 4.7k

# Candidate Sites

Chile 4.8 k

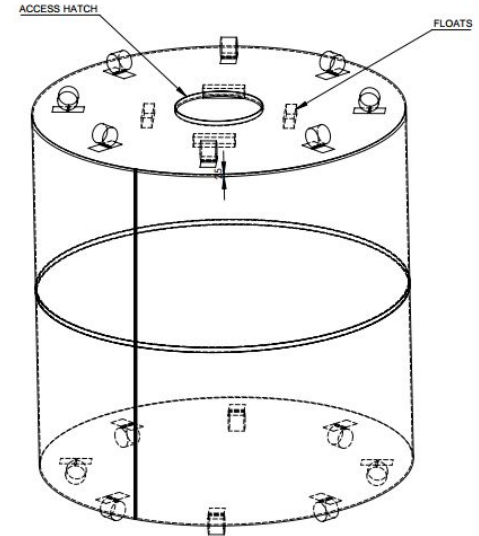
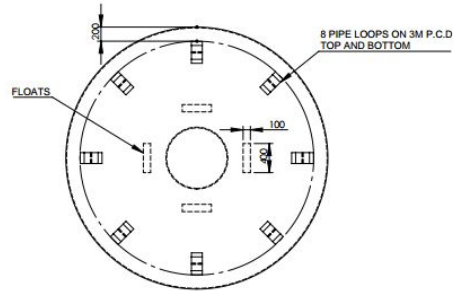
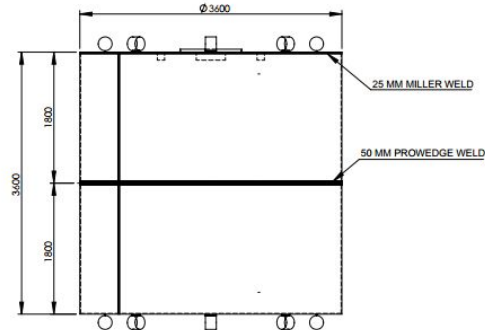


Argentina 4.8 k



Peru 4.9 k

# Characteristics of the bladders that will be deployed at Sibinacocha lake



**AQUAMATE**  
 16 Drury Terrace  
 Tonsley SA 5042  
 P. +61 (0)8 8277 5777  
 aquamate.com.au  
 info@aquamate.com.au

GENERAL TOLERANCES  
 <100 ±0.1mm  
 100 - 500 ±0.5mm  
 500 - 1000 ±1.0mm  
 >1000 ±2.0mm  
 ANGULAR ±10°  
 ALL DIMENSIONS IN mm  
 UNLESS OTHERWISE STATED

	INIT.	DATE	DESCRIPTION
DRAWN BY	KALP	22/05/22	
CHECKED	DD	22/05/22	
APPROVED			
ISSUED			

**BLADDER ASSEMBLY**

SCALE	SHEET	WEIGHT	PROJ. No.	DWG No.
SEE ABOVE	SHEET 1	NA	NA	

## Two Aquamate bladder materials will be tested in Sibinacocha



ENVIRO LINER 6020



GEOFLEX-20

# HAWC Gamma-ray Observatory (Mexico)



The  
prototype  
detectors are  
nearly ready  
to go to  
Perú.

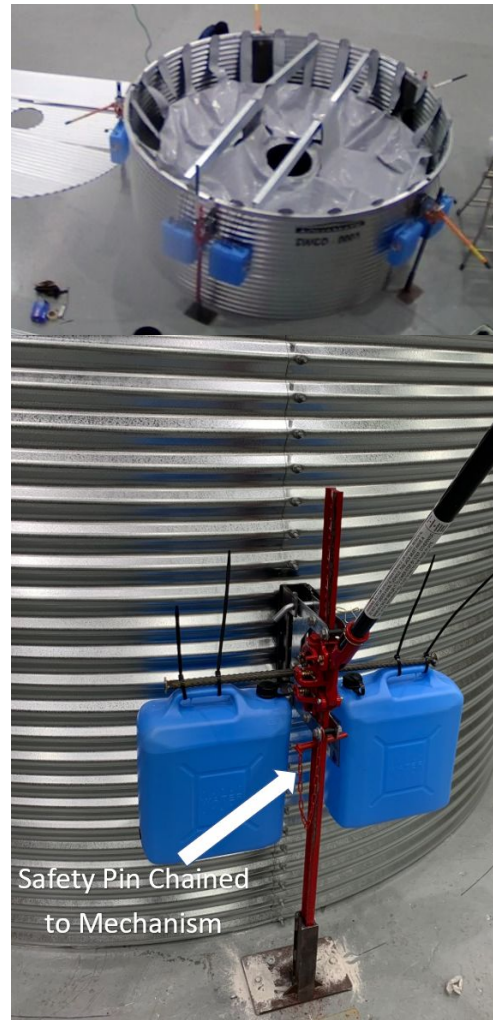


Aquamate tanks are delivered in compact cases and are simple to assemble  
(Pictures from Michael Schneider, US)





**5 high jacks were custom  
made in order to mount  
the tanks**



## Tank and Geomembrane crated and ready for shipping from Australia to Peru

Very easy to transport  
Price scales with volume  
(US\$6500 shipped to Perú  
Volume: 3.6 high, 3.6 diameter)



# Crates arrived to the University of Arequipa in January 2023



# SWGGO Visit to Perú October 2022



AGENCIA  
ESPACIAL  
DEL PERU  
C O N T I D A



Yanque  
Site  
5000 masl

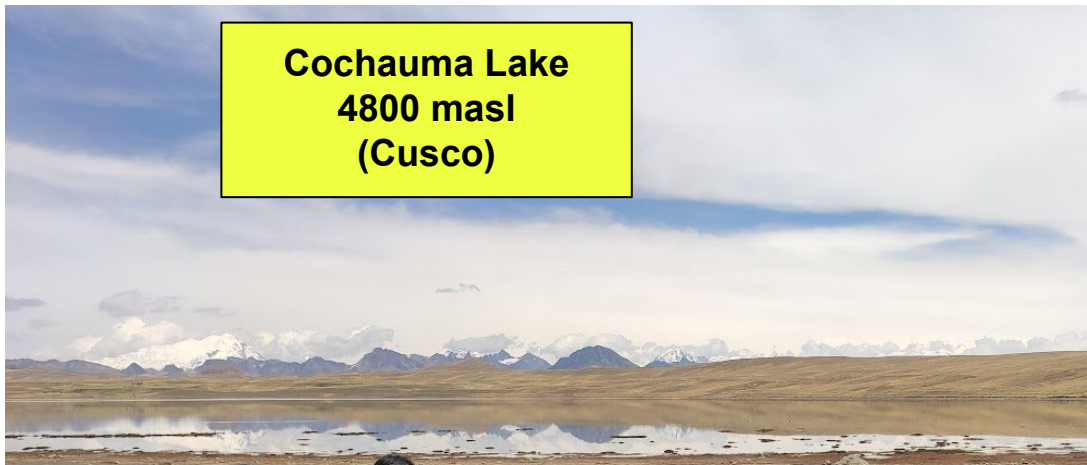




Imata  
Site  
4500 masl



**Cochauma Lake  
4800 masl  
(Cusco)**



SHOT ON MI 9T PRO  
AI TRIPLE CAMERA

**Cochachaca Lake, 4800 masl**



SHOT ON MI 9T PRO



SHOT ON MI 9T PRO  
AI TRIPLE CAMERA

## Sibinacocha Lake, 4900masl, Cusco



**Meeting with community that lives next to Sibinacocha lake**

