Science Benchmarks for SWGO

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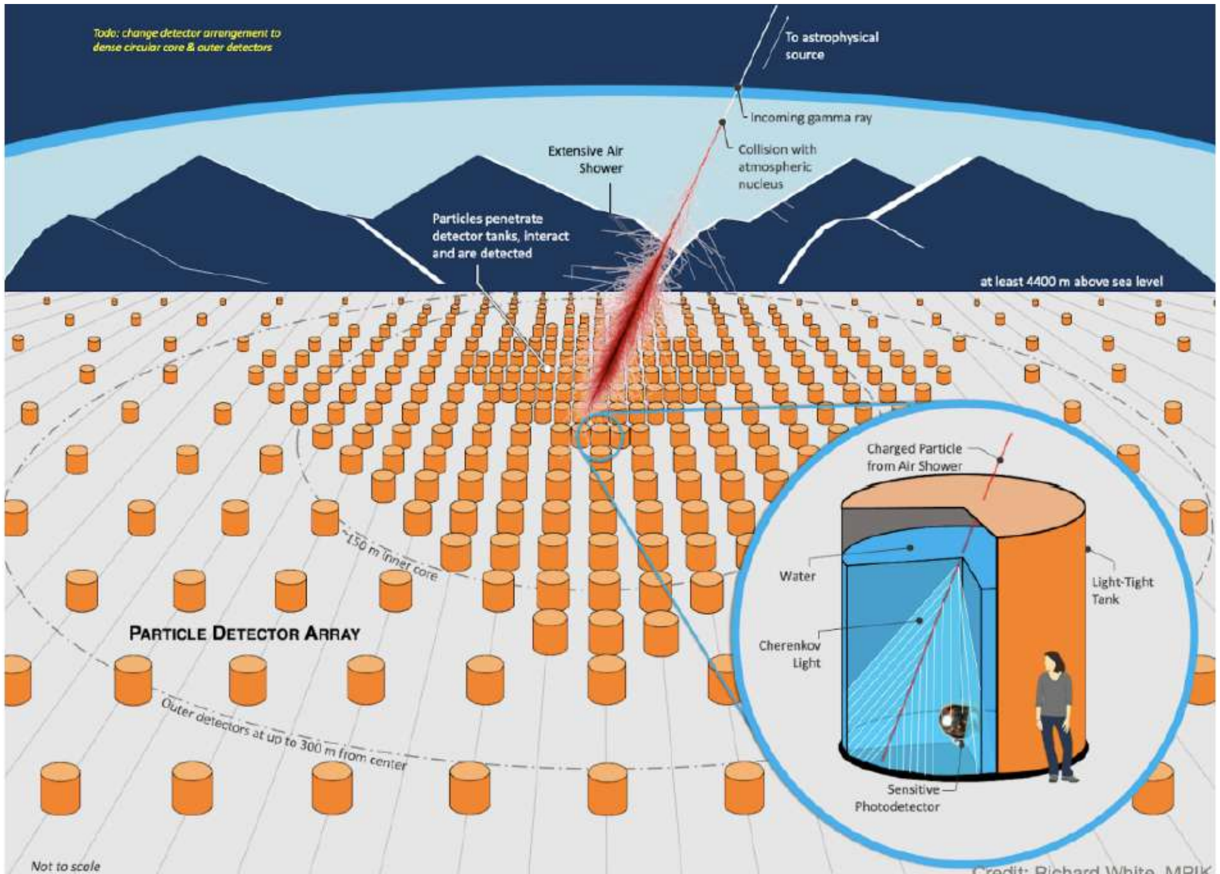
The SWGO Concept



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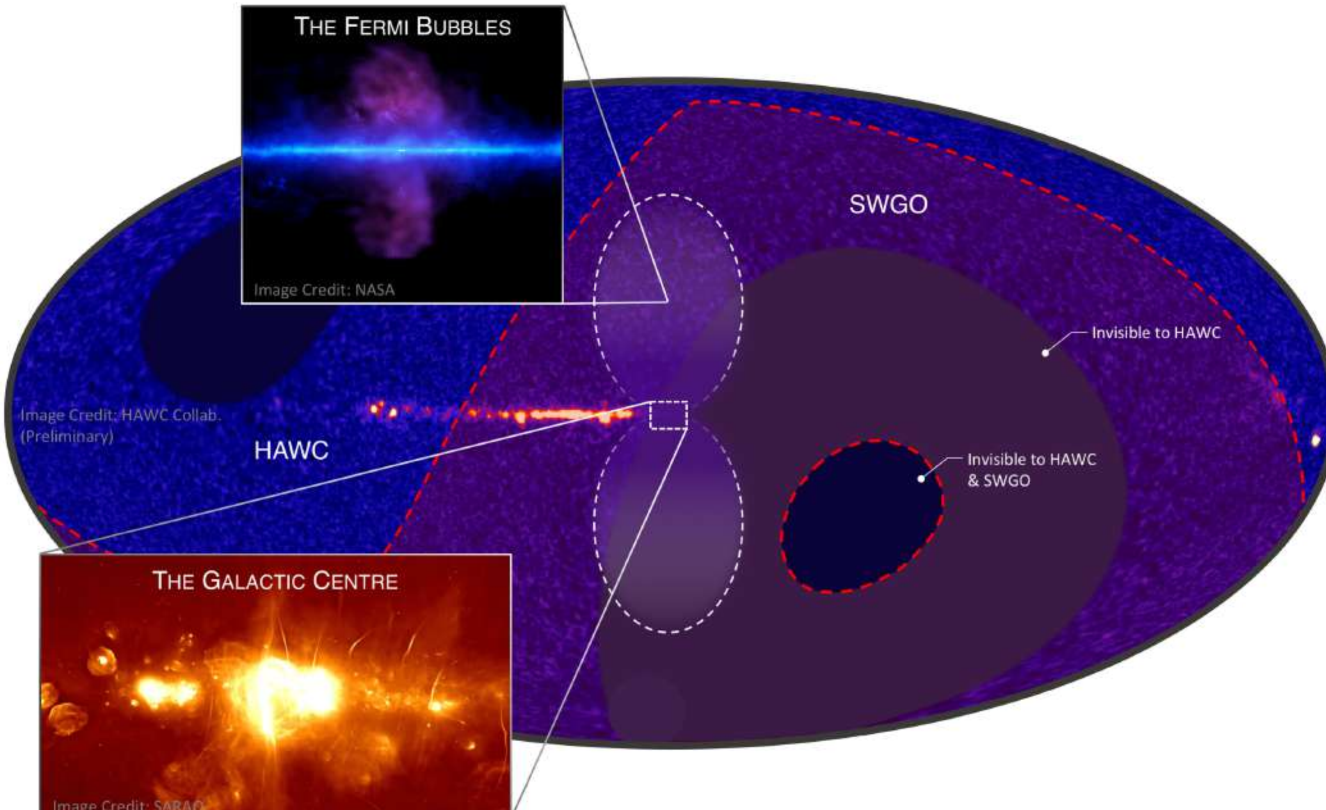
- Extended energy range
  - From c. 100 GeV to the PeV scale
- Design Elements
  - water Cherenkov detector (WCD) units
  - Large (80,000 m^2) high-fill factor core
  - Low-fill factor outrigger covering at least an area of 200,000 m^2
- Site
  - Deployed at high-altitude in the Andes
  - Above 4,4 km a.s.l.

The SWGO Science Case



- PeVatrons and Galactic Accelerators
  - Poses a requirement of ~30% on the energy resolution for identification of spectral features above 100 GeV
- Gamma-ray Bursts and transients
  - Exploits the wide-FoV and continuous duty cycle to work as a monitoring instrument complementary to CTA
- Dark Matter searches
  - constrain the entire WIMP mass range, up to 100 TeV at the GC
- Cosmic-ray studies
  - Capability to detect single muons crucial for mass-resolved studies up to PeVs

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

Science Benchmarks for SWGO

Science Case	**Design Drivers**	**Benchmark Description**
Transient Sources: Gamma-ray Bursts	Low-energy sensitivity & Site altitude[a]	Min. time for 5σ detection: F(100 GeV) = 10^{-8} erg/cm^2.s, PWL index = -2., F(t) $\propto t^{-1.2}$
Galactic Accelerators: PeVatron Sources	High-energy sensitivity & Energy resolution[b]	Maximum exp-cutoff energy detectable 95% CL in 5 years for: F(1TeV) = 5 mCrab, index = -2.3
Galactic Accelerators: PWNe and TeV Halos	Extended source sensitivity & Angular resolution[c]	Max. angular extension detected at 5σ in 5-yr integration for: F(>1TeV) = 5×10^{-13} TeV/cm^{-2}.s
Diffuse Emission: Fermi Bubbles	Background rejection	Minimum diffuse cosmic-ray residual background level. Threshold: < 10^{-4} level at 1 TeV.
Fundamental Physics: Dark Matter from GC Halo	Mid-range energy sensitivity Site latitude[d]	Max. energy for $b\bar{b}$ thermal relic cross-section limit at 95% CL in 5-years, for Einasto profile.
Cosmic-rays: Mass-resolved dipole / multipole anisotropy	Muon counting capability[e]	Max. dipole energy at 10^{-3} level; Log-mass resolution at 1 PeV – goal is A={1, 4, 14, 56}; Maximum multipole scale > 0.1 PeV

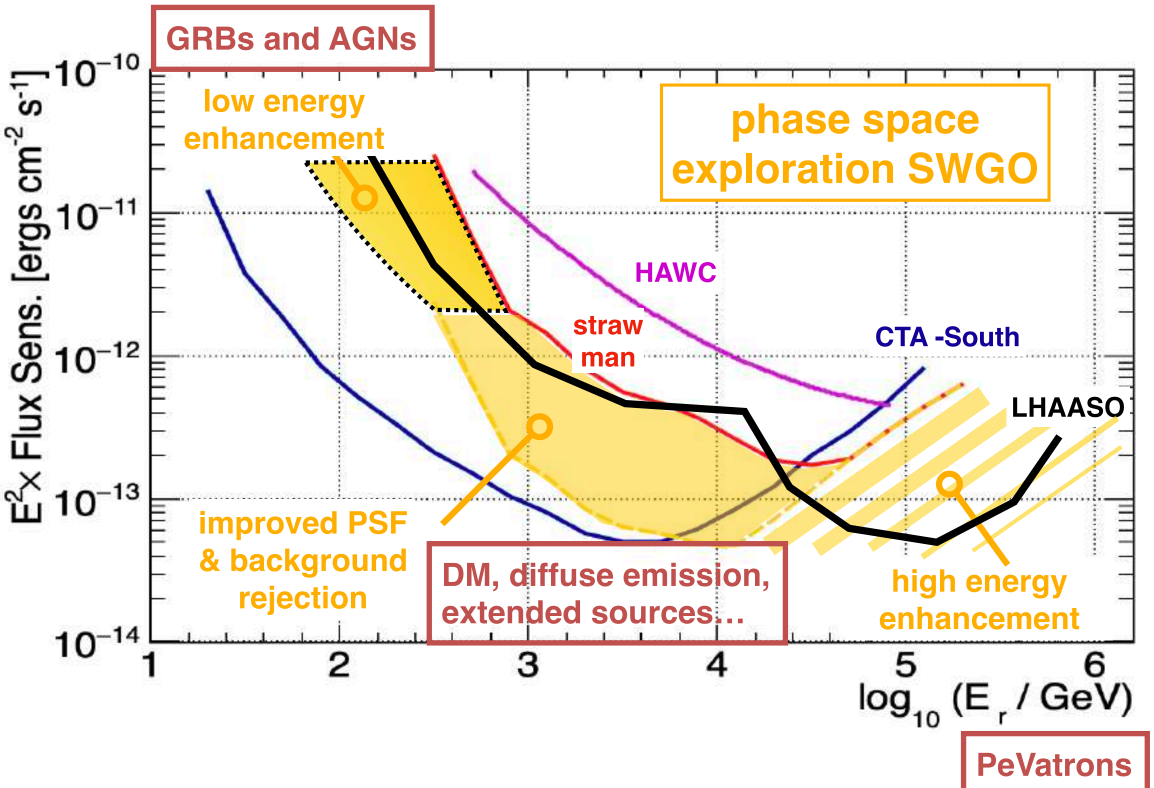
Table 1: SWGO Science Benchmarks. [a]Site altitude to be greater than 4.4 km above sea level. [b]Energy resolution < $O(30\%)$ throughout core energy range 1-100 TeV. [c]Angular resolution ~ 0.15° throughout core energy range 1-100 TeV. [d]Site latitude not constraining among candidates under consideration. [e]WCD units with muon identification capability for γ/hadron discrimnation.

The set of **core science cases** has been defined to guide the R&D studies and to benchmark the final observatory design among different options and trade-offs.

The **benchmarks** reflect a minimum set of science goals that encompass the full set of performance requirements for the Observatory.

The **quantitative benchmarks** will be used to compare and select a set of candidate configurations for the array, currently under study.

Design Implications



- The SWGO reference configuration
  - A **dense core array** with excellent gamma/hadron separation for low energy detection < 300 GeV, with circa 5x the effective area of HAWC.
  - An **extended sparse array** with peak sensitivity between 50 and 100 TeV to approach LHAASO's performance at the PeV range
  - **Muon tagging capability** at individual WCD units for cosmic-ray studies and improve background rejection
  - **Improved** angular (~0.15°) and energy (~30%) resolution in the core 1-100 TeV range

SWGO
The Southern Wide-field Gamma-ray Observatory

Thank you!

First Collaboration Meeting

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

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The **SWGO Collaboration** involves more than **100 scientists** from **12 countries.**