The Southern Wide-field Gamma-ray Observatory

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Galactic Science with the Southern Wide-field Gamma-ray Observatory

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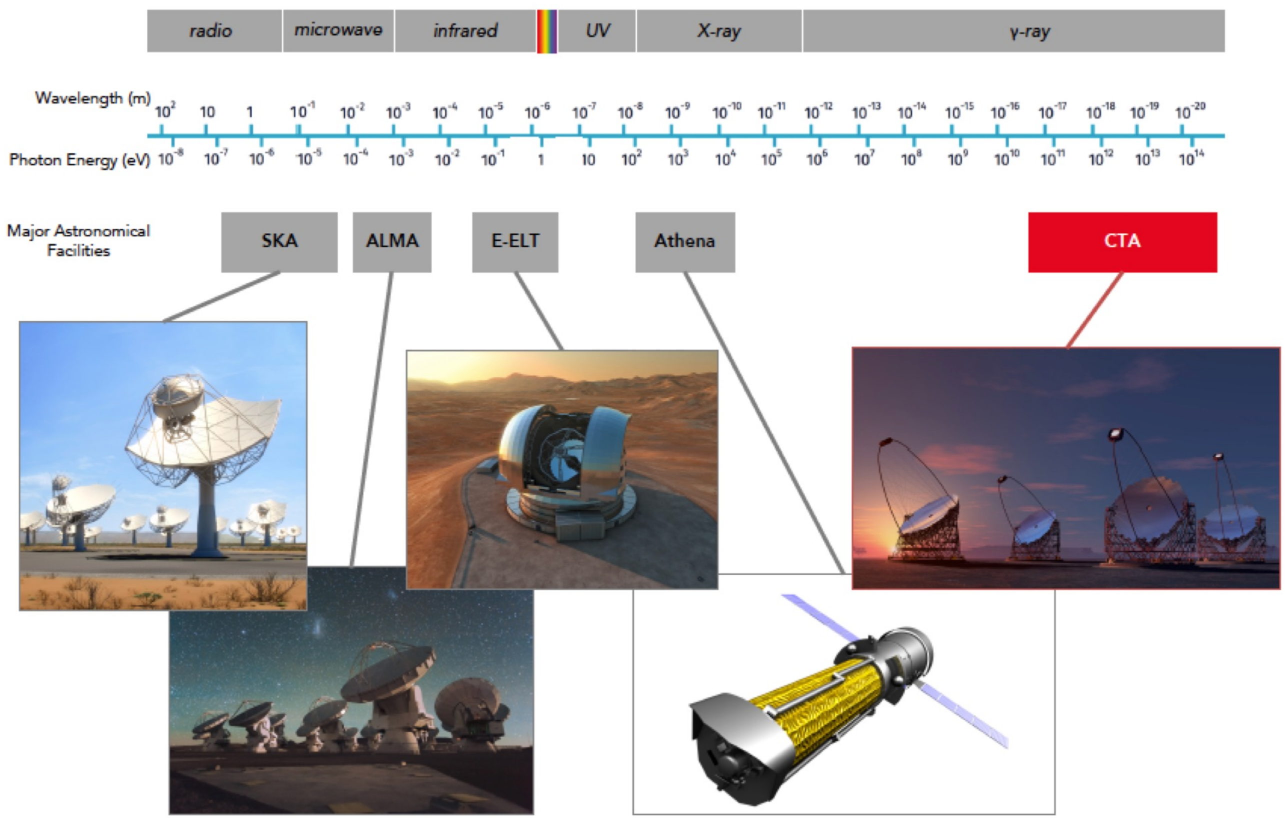
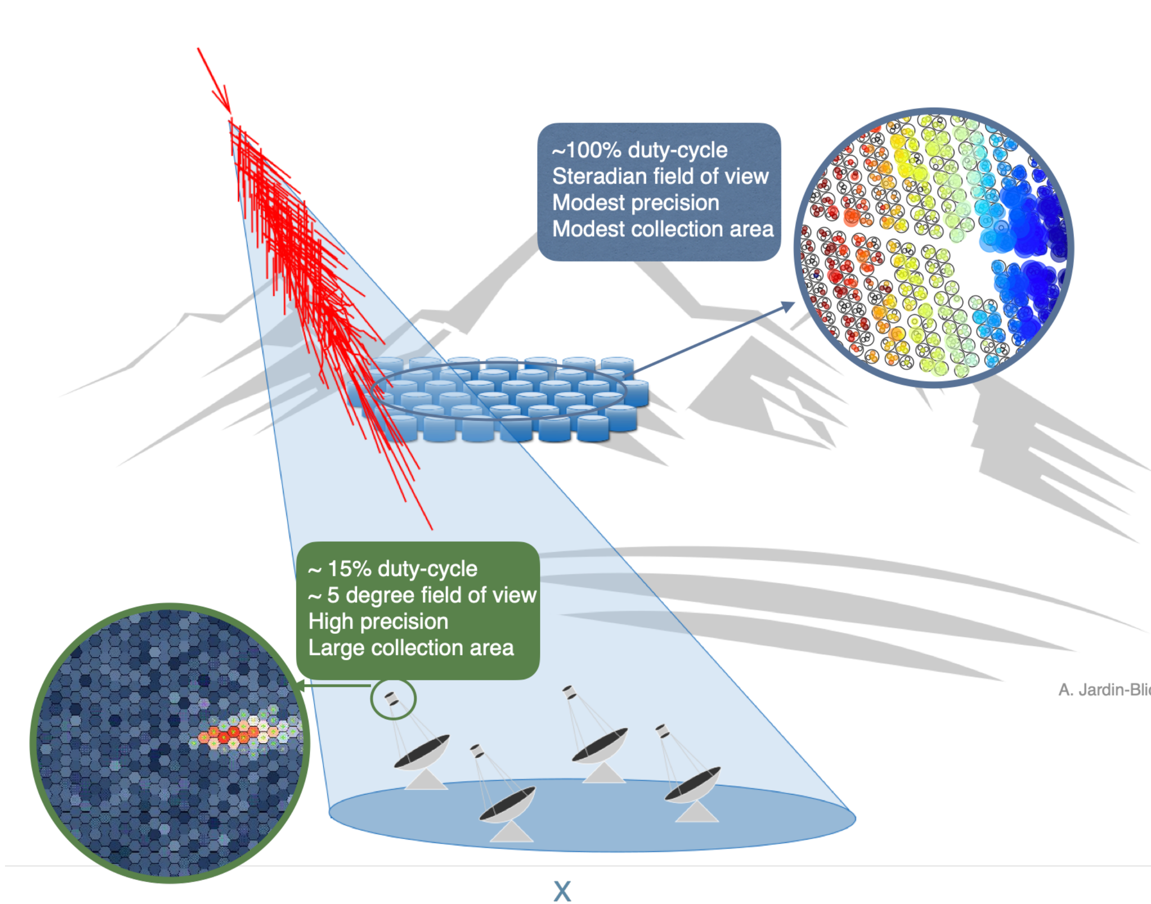
SWGO
The Southern Wide-field Gamma-ray Observatory

The EM spectrum



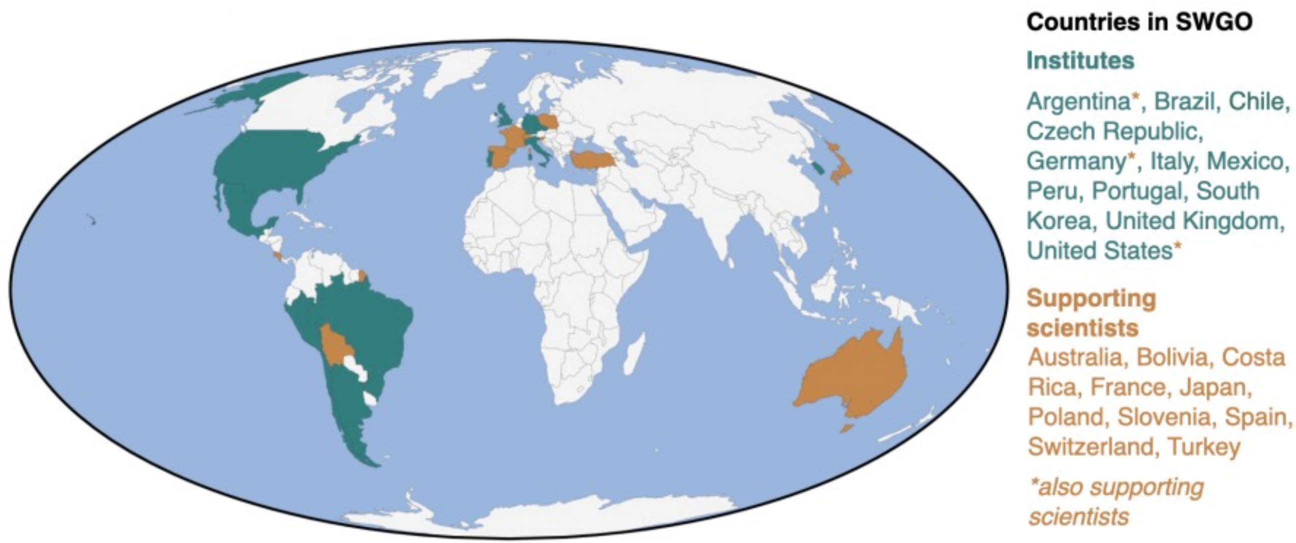
VHE gamma rays: different techniques



SWGO

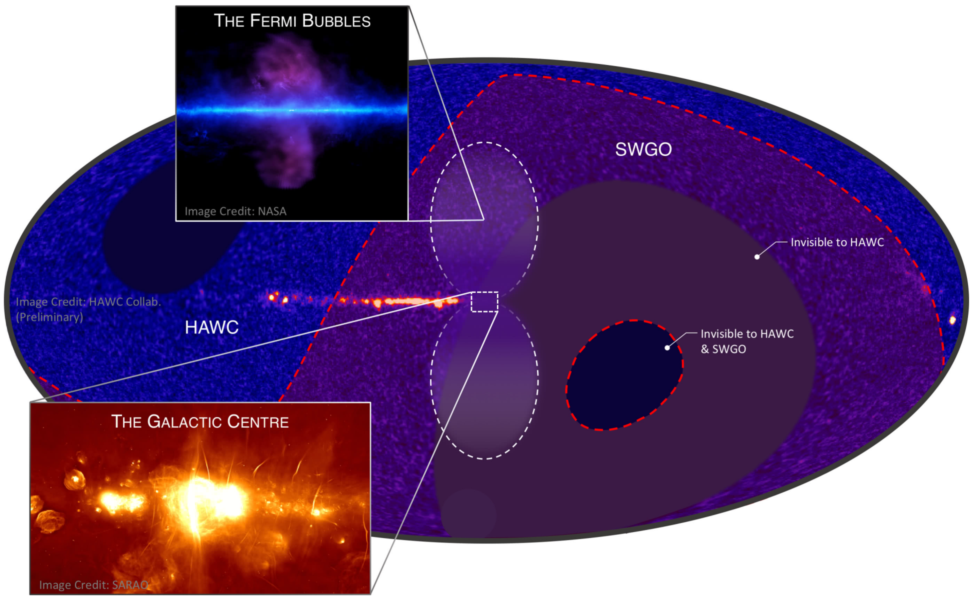
Southern Wide-field Gamma-ray Observatory

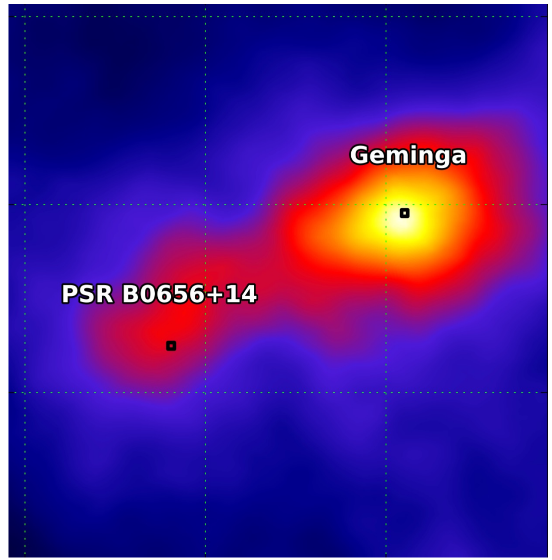
- In comparison to previous detectors (HAWC) -> Higher altitude, larger area, higher efficiency detection units, larger fill factor.
  => lower threshold and better sensitivity.
- Collaboration established in July 2019 to develop the design/plan.
- First collaboration meeting October 2019.
- 3 year programme, 12 countries signed up + supporting scientists.



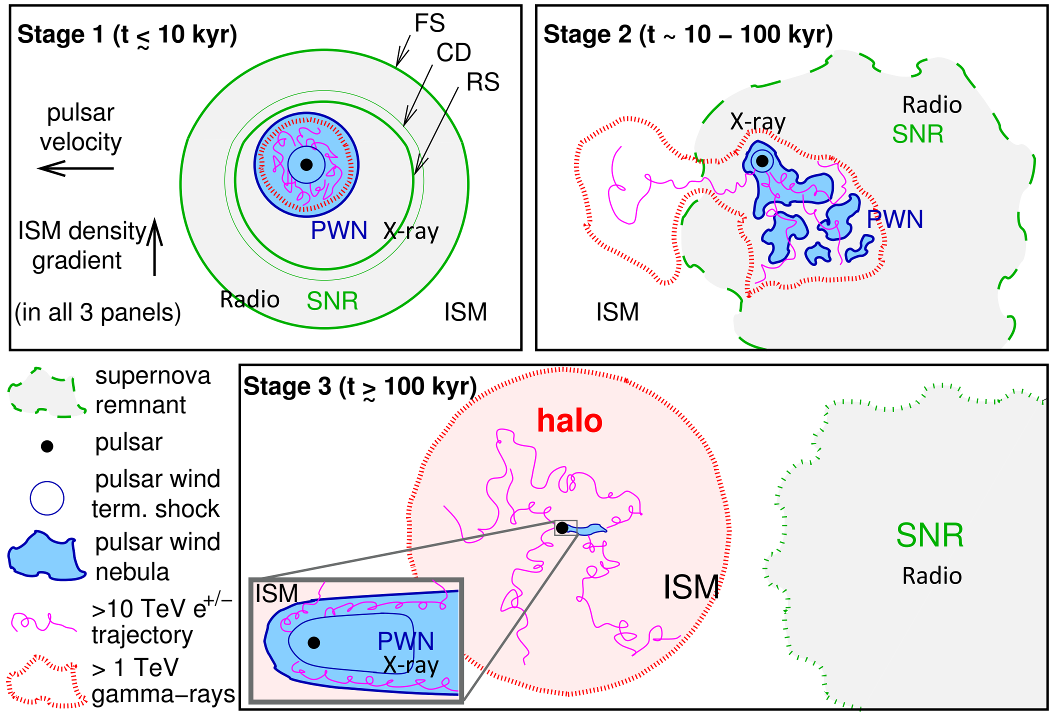
Galactic Science

- Several Science cases within the Galaxy for which SWGO can add a significant contribution





Pulsar Wind Nebulae and Halos

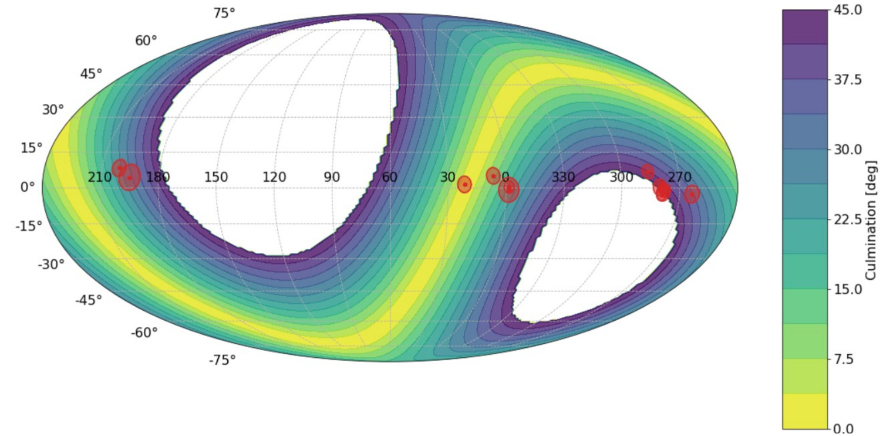


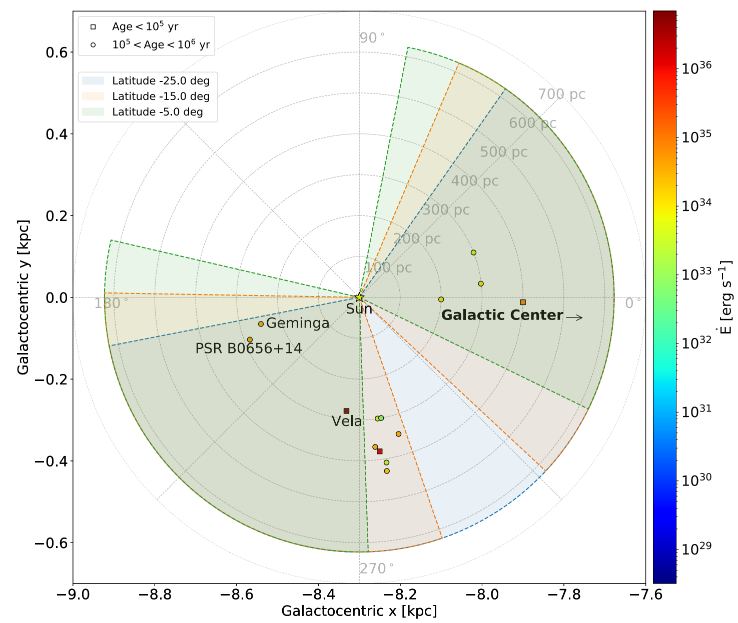
Giacinti et al, A&A 636 (2020) A113

- Halos are a distinct phase in the evolution of Pulsar Wind Nebulae
  - → Regions in which electrons and positrons generated in the pulsar magnetosphere propagate freely into the Interstellar Medium
- They can reach large sizes

Halos: Status

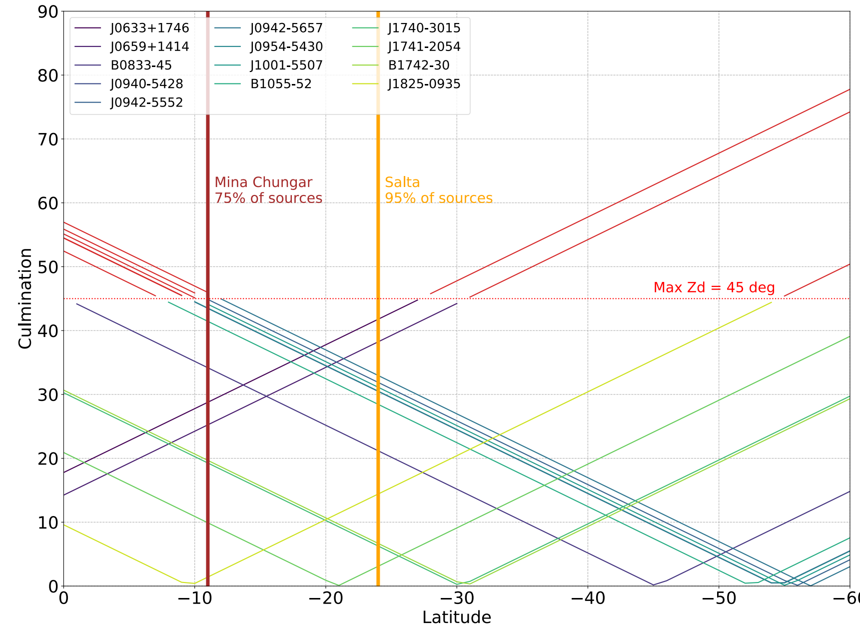
- Halos mainly studied by wide-field instruments due to their extension -> far away ones are less bright.
- SWGO can:
  - → Characterize nearby ones through morphological measurements
  - → Observe and detect further away ones -> need to have a good angular resolution to avoid source confusion.





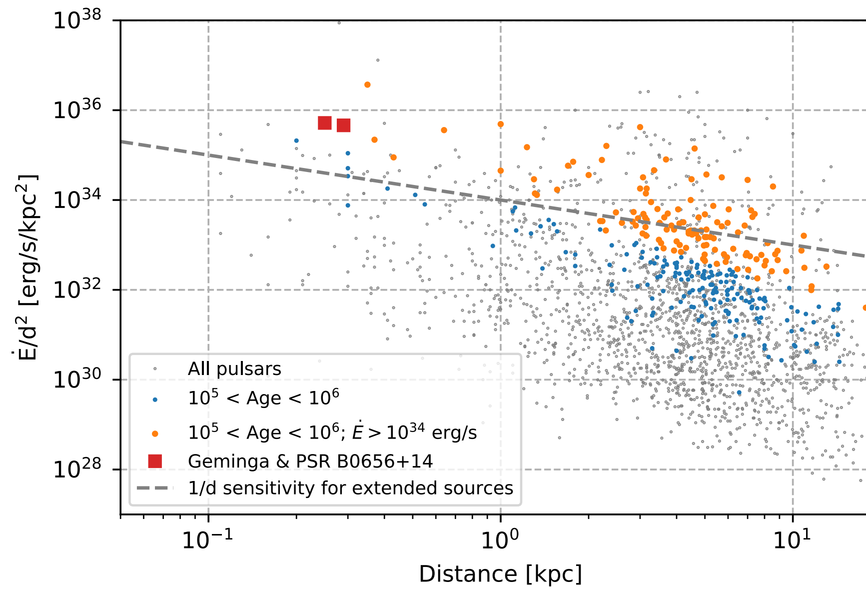
Halos: Observability

- We took all nearby (<500 pc) pulsars likely to produce a TeV halo
- Some TeV halo candidates out of the reach for low latitudes.
- On the other hand, high latitud sites imply short exposures for two sure TeV halos (Geminga and PSR J0659).



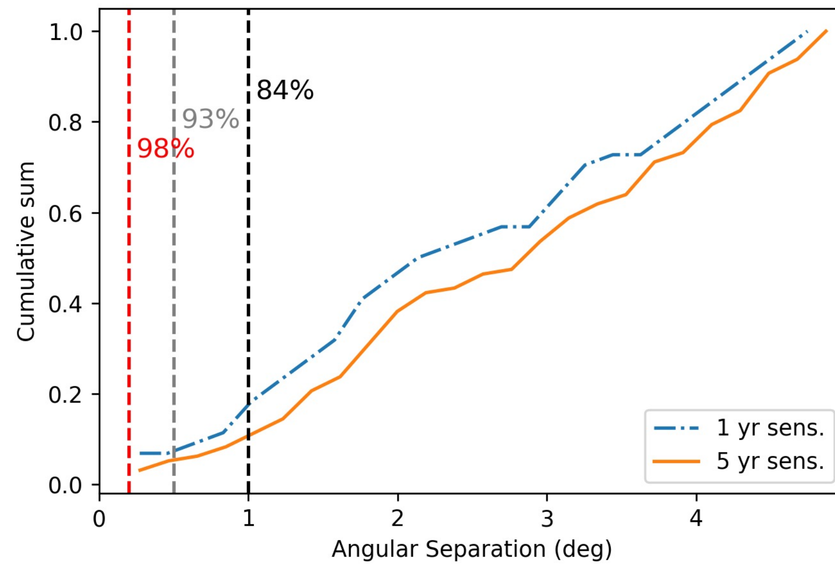
Halos: Sensitivity to known pulsars

- Sensitivity shown uses SWGO straw-man IRFs
- Also interested on further sources to complete these studies.
- The grey-dashed line shoulc become flat when we hit the angular resolution of SWGO

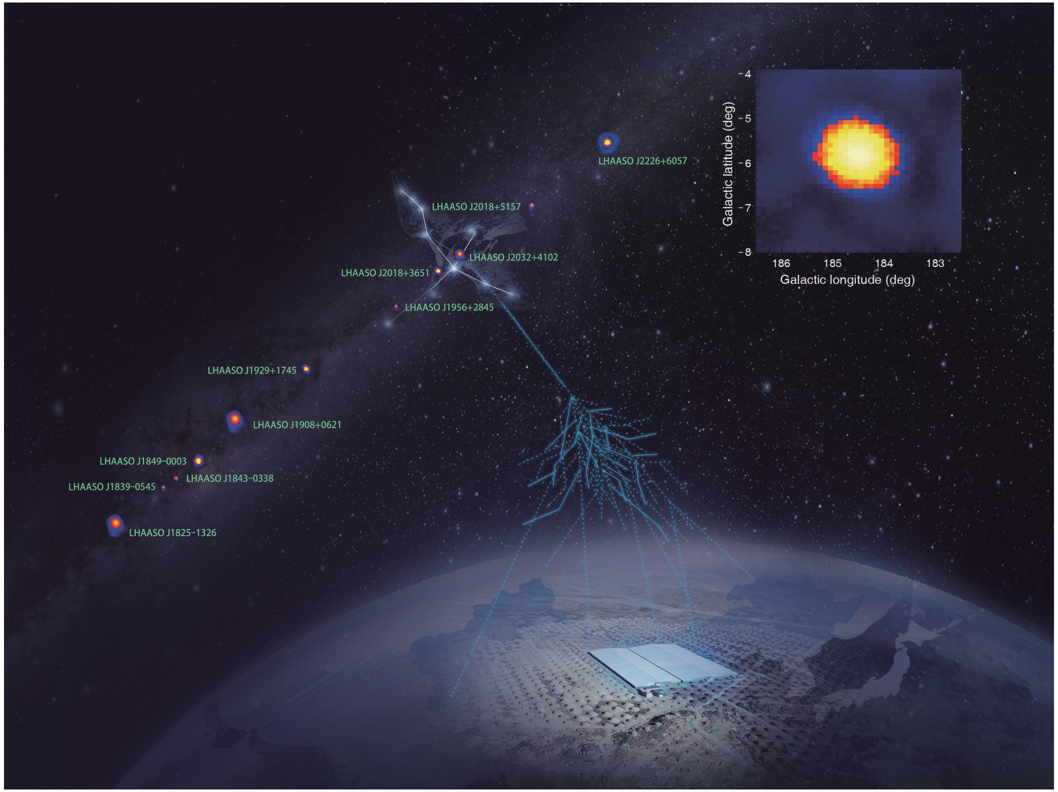


Halos: SWGO Requirements

- Requirements: Angular resolution
  - 0.5 deg to resolve 93% of the sources
  - 0.2 deg to resolve 98% of the sources
  - Including all simulated/predicted halos and HGPS sources



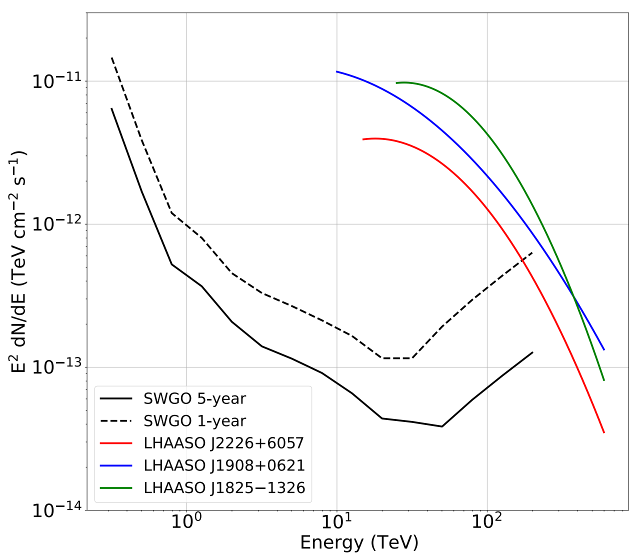
PeVatrons

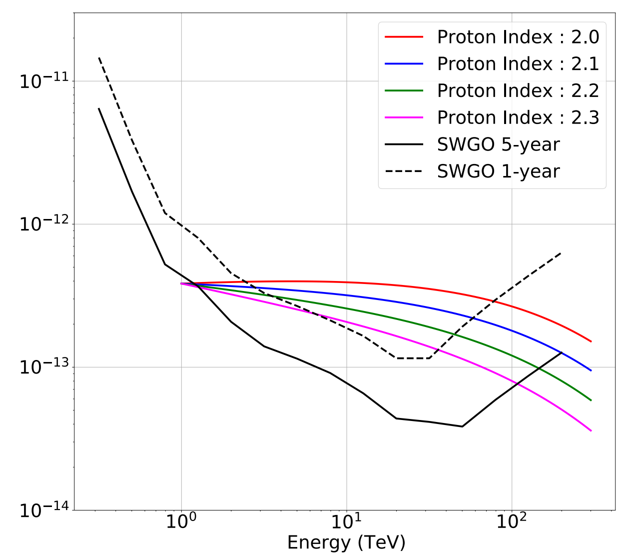


LHAASO J2226+6057
LHAASO J2018+5157
LHAASO J2032+4102
LHAASO J2018+3651
LHAASO J1956+2845
LHAASO J1929+1745
LHAASO J1908+0621
LHAASO J1849−0003
LHAASO J1843−0338
LHAASO J1839−0545
LHAASO J1825−1326
Galactic latitude (deg)
−4
−5
−6
−7
−8
186
185
184
183
Galactic longitude (deg)

Prospects for PeVatrons

- PeVatron detection can be done by spectral investigation.
  - → Understand which spectral cutoff energies can be detected with SWGO.
  - → Estimate number of PeVatron sources that can be detected / identified with SWGO when final IRFs are available.





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Galactic Diffuse γ-ray Emission and Fermi Bubbles

Diffuse emission and Fermi Bubbles

- Diffuse emission from the Galactic Plane should extend up to PeV energies.
  - Wide-field instruments are optimal for the detection of very extended emission.
  - SWGO guarantees a detection of the extended spectrum up to multi-TeV energies

- The Fermi Bubbles are bubble-like structures seen in radio and gamma rays.
  - Their detectability will depend on the extension of their spectrum to TeV energies.

Conclusions

- Very promising Galactic Science with SWGO:
  - Progress in TeV halos studies: several new sources apart from the already known ones are expected
  - Number of accessible PeVatrons depends on the final layout selected
  - Diffuse Galactic gamma-ray emission and Fermi Bubbles under study
  - For more info, please refer to the published proceeding (https://arxiv.org/pdf/2109.03521.pdf)