Axion Like Particles with HAWC.

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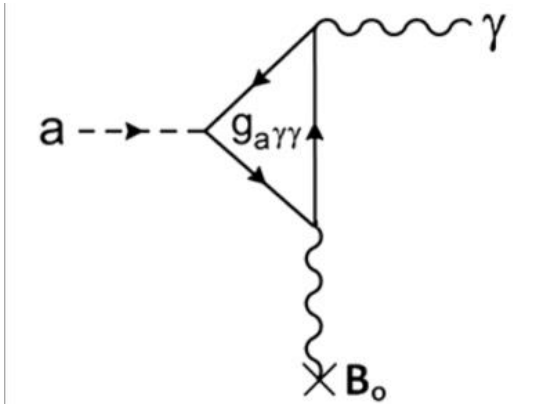
ALPs:Coupling

Due to this coupling it is possible ALPs-Photons conversions



The Conversion probability depends, mainly, on 3 factors : **Distance, Magnetic Field, Energy**

Increasing Magnetic Field

The searches for these particles by enhancing the magnetic field are conducted using haloscopes that amplify magnetic fields. An example of such is the CAST experiment (CERN Axion Solar Telescope).

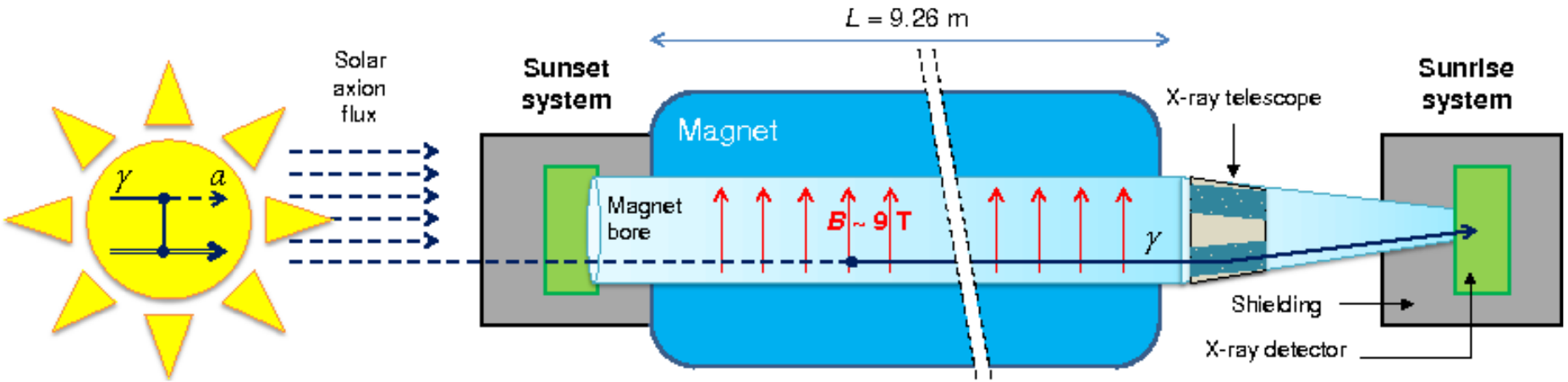


Figure: Ilustration

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Astrophysical Sources

Astrophysical sources represent excellent targets for the study of these particles.

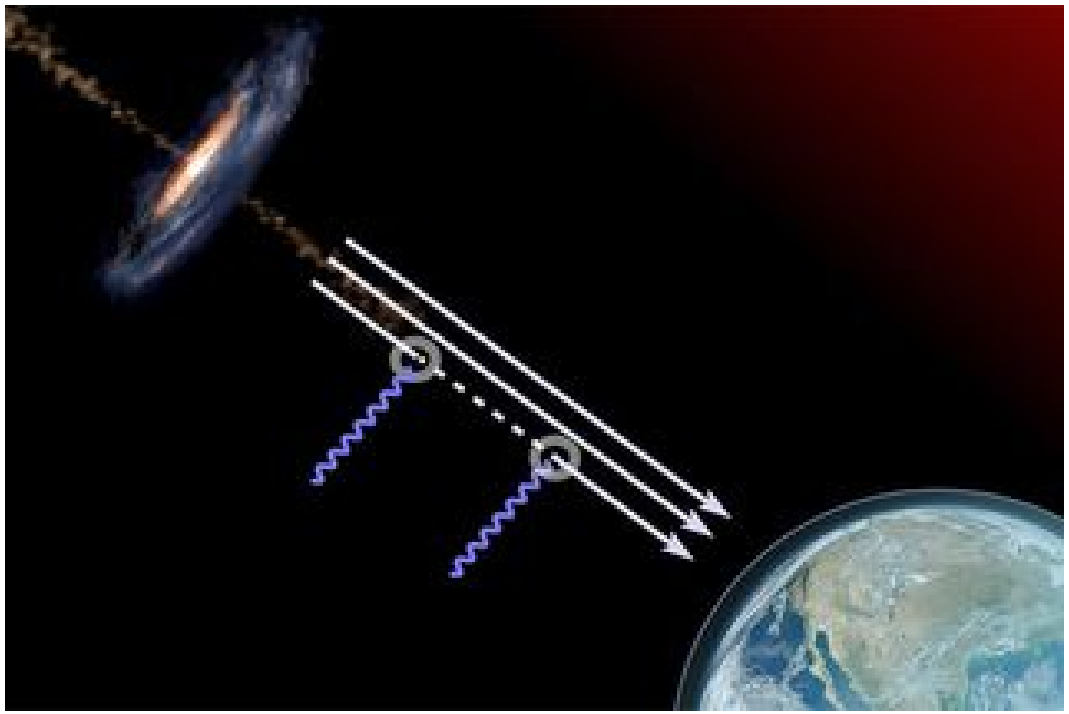

Figure: Ilustration

Extragalactic Sources: AGNs

Utilizing extragalactic sources ensures an increase in the distance term, thereby enhancing the probability of conversion. The best targes are AGNs with high energies (GeV-TeV emission)
Why? Because **EBL**

Extragalactic Sources: AGNs

The effect of the EBL is the attenuation of high-energy photon flux due to pair creation. However, if photons oscillate into axions, they could avoid this attenuation, resulting in an excess of photons that we could detect.

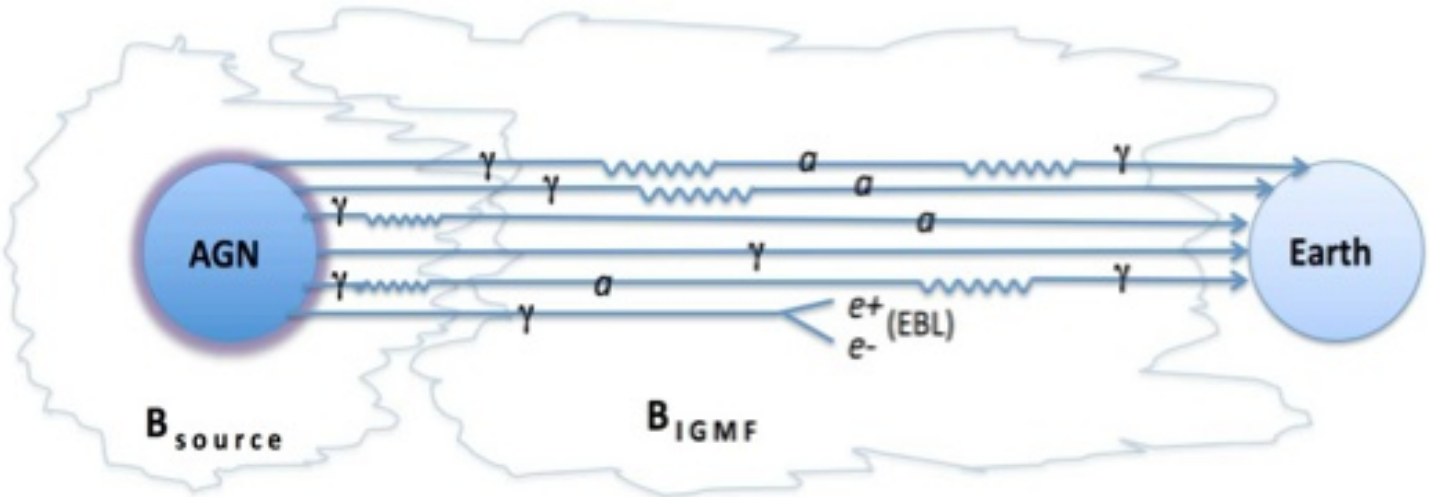

Figure: Ilustration

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Galactic Sources

Studying galactic sources has advantages, e.g., no EBL. Different magnetic field models are also not necessary, only 1.
However....

$$\frac{d\phi}{dE_\gamma} = \left(1 - P_{\gamma\to a}\right) \left.\frac{d\phi}{dE_\gamma}\right|_{\text{source}}, \tag{1}$$

with

$$P_{\gamma\to a}(E_\gamma) = \left(1 + \frac{E_c^2}{E_\gamma^2}\right)^{-1} \sin^2\left(\frac{g_{a\gamma} B_T L}{2}\sqrt{1 + \frac{E_c^2}{E_\gamma^2}}\right), \tag{2}$$

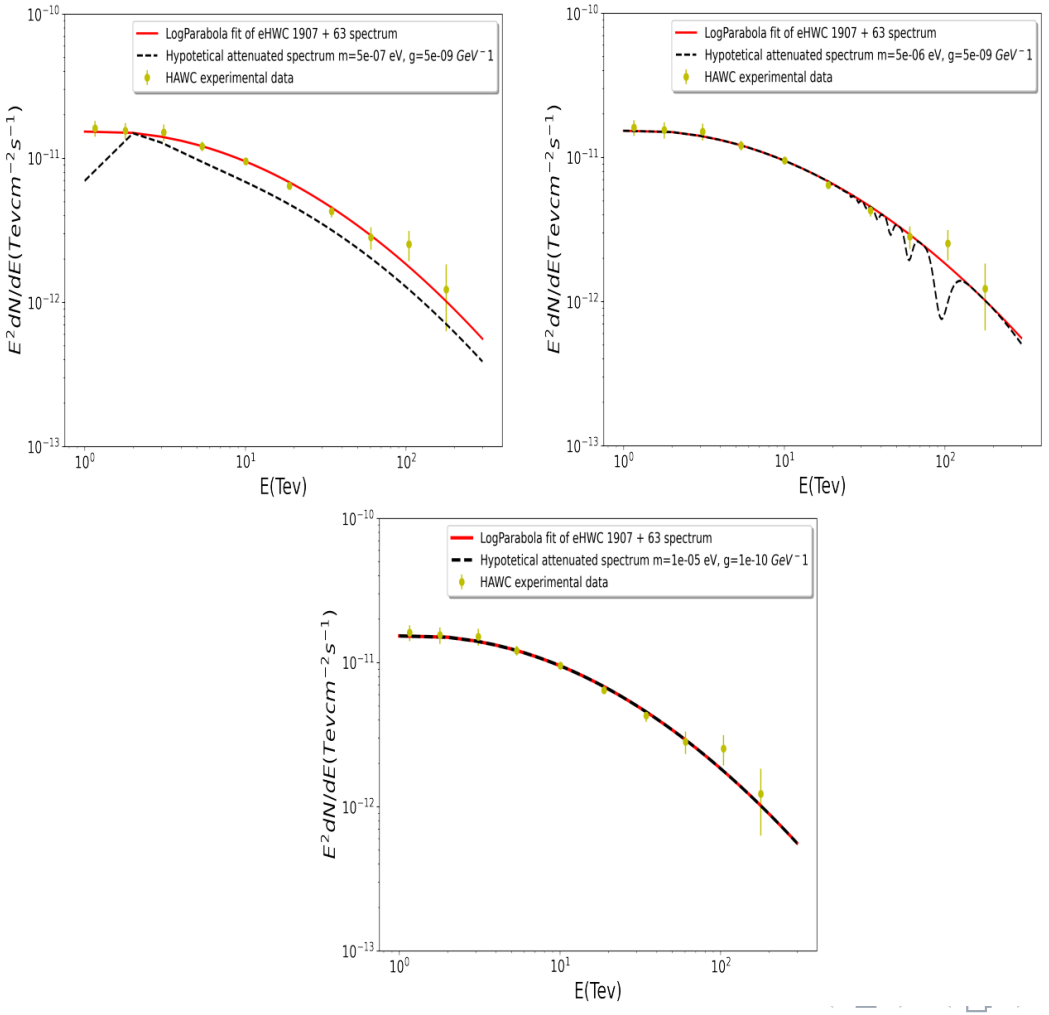
HAWC Obervatory

High Altitude Water Cherenkov Observatory
Energy range: 100 GeV- 250 TeV

Figure: Ilustration

Galactic source

Hypothetical J1908 modified spectrum



Exclusion Region with HAWC

We obtained an aexclusion region using HAWC.