Contribution ID: **58** Type: **not specified**

Bounds on axion-like particles from the diffuse supernova flux

Tuesday 22 September 2020 17:50 (13 minutes)

The cumulative emission of Axion-Like Particles (ALPs) from all past core-collapse supernovae (SNe) would lead to a diffuse flux with energies $\mathcal{O}(50)$ MeV. We use this to constrain ALPs featuring couplings to photons and to nucleons. ALPs coupled only to photons are produced in the SN core via the Primakoff process,and then converted into gamma rays in the Galactic magnetic field. We set a bound on the ALP-photon coupling using recent measurements of the diffuse gamma-ray flux observed by the Fermi-LAT telescope. However, if ALPs couple also with nucleons, their production rate in SN can be considerably enhanced due to the ALPs nucleon-nucleon bremsstrahlung process. If ALPs are heavier than keV, the decay into photons becomes significant, leading again to a diffuse gamma-ray flux. Allowing for a (maximal) coupling to nucleons, the limit improves to the level of $10^{-19}\mathrm{GeV}^{-1}$
for $m_a \sim 20\mathrm{MeV}$, which represents the strongest constraint to date.

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Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics