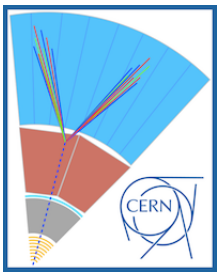

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Atmospheric axion-like particles at Super-Kamiokande

Friday 4 November 2022 14:00 (20 minutes)

We consider a muonphilic axion-like-particle (ALP), denoted as a, lighter than twice the muon mass. ALPs of this mass range dominantly decay into a pair of photons, induced by a triangular muon loop. Such light muonphilic ALPs are naturally long-lived. At the atmosphere, the ALPs are copiously produced from charged-meson decays in air showers, such as $\pi^{\pm} \to \mu^{\pm}\nu a$, via the ALP-muon coupling $g_{a\mu\mu}$. After propagating tens of kilometers, the ALPs decay with $a \to \gamma\gamma$ inside large-volume Cherenkov detectors near the Earth's surface, such as Super-Kamiokande (SK). We find the present SK observation constrains on muonphilic ALPs of mass range [1 MeV, 30 MeV] and ALP-muon coupling $[10^{-3}, 10^{2}]$, assuming the proper decay length $c\tau_a$ in $[10^{-3}$ km, 10^{6} km] either dependent on or independent of $g_{a\mu\mu}$. We conclude that atmospheric searches of such exotic states can be complementary to collider and beam-dump experiments as well as astrophysical probes.

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