

Constraints from the Pierre Auger Observatory on BSM scenarios generating UHE ν_τ , τ , and τ -like particles

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The Fluorescence Detector (FD) of the Pierre Auger Observatory provides a large exposure for the detection of ultra-high-energy (UHE) upward-going showers (UGS) as suggested by the “anomalous” events reported by ANITA. Recently, strong limits on UGS were obtained using 14 years of FD data, which are in tension with the observations made by ANITA-I and III. Later, ANITA-IV has reported new UGS candidates. Both of these observations motivate the exploration of beyond standard model (BSM) scenarios. In this work, we explore the parameter space to test three classes of BSM models. These unknown BSM particles can interact inside the Earth and produce ν_τ , τ , or τ -like particles which can further interact or decay. Some of their final products may escape the Earth and induce a UGS in the atmosphere. Due to the non-observation of the UGS by the FD, upper flux limits of these types of UHE BSM particles are obtained as a function of their possible cross-sections with matter. In addition, stronger constraints are achieved by combining the surface detector and FD data of the Pierre Auger Observatory.

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