

GEF

OBSERVATORY

Results from the Pierre Auger Observatory

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Hybrid Observatory







What could be the origin of the before on the ground. For data, we reconstruct the of the detector stations. The average relative resolution





simulations the uncertainty was estimated by the spreading a sample of simulated showers, where each shower is reconstructed multiple times, each time changing only the

interaction models for proton (red) and iron (blue) showers The gray band represents the expectations from the measured VACUUM

> Muon fluctuations driven by first interactions 15^{2002-6} 17

L'enagnetic field [3]. Einstein the section of 11% [5] drops validation of the whole analysis method Letter on samples of simples of simples of simple states and samples of simples of simpl iron showers. tematic uncertainty over directering

Because of the alm the systematic uncertaint souther chergy tacate to for [25] practic absolute energy scale o ELEISE THE LEADORS A THORSE STRATEGY the relative fluctuation absolute scale of R reason. 'I are summ average relative num is $\langle R_{\mu} \rangle (10^{1} \text{ eV} \text{ Properties units for }$ These age relative number of muons at 10¹ $0.02(\text{stat}) \stackrel{+0.03}{=} (\text{syst}).$ the values previously reported **R5**, **N**(1) TABLE I relative fluctonations aro central value is $\sigma/\langle R_{\mu}\rangle$ CODDALSTATING Source of uncertainty Source of uncertainty *E* absolute scale SI **INUONS** *E* resolution E'ABBERTE (schentributions to the sestematic EAUMONE HUGTOR LOOPS OF OF (by 18. Ranhsolutereale R_{μ}^{on} entrational matrix R_{μ}^{o} R_{μ}^{o measured otal systematics R_{...} resolution 9 Sharekantion 26 (2R The state wave the sure wave the state of the state of the sure wave the sure of the state of the sure per-bialkali photoc fuctuations and shortighterent in the second of a PMT. The names of the different contractions in the different contraction is when the second of the second s) and *m* fluctuate. ppfgnmovdeletof newergeneration of PMTs with a \$70 per aligned at the start of the

Territal 29.5 1% at 3,5 nm enteres n tax at north on the card SubGrisco Natural Providence in the number of muons of vertical 29.5 1% at 3,5 nm enteres n tax at north of the card SubGrisco Natural Providence in the number of muons of the second subscription of the

netharter and the children ere lectrons.



 $O_A \vdash \Box = \Gamma \vdash Z \vdash Tharge scale and multipolar anisotropie of the Pie¹²$

ole components in the equatorial



the probability to get a larger amplitude of r_1^{α} from



vas $1.4 imes 10^{-9}$ (ApJ 2020) and 2.6 $imes 10^{-8}$ (Science 2017)

Corresponds to 6.6σ

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No clear trend in



AugerPrime



Components of AugerPrime

- 3.8 m² scintillator panels (SSD)
- New electronics (40 MHz -> 120 MHz)
- Small PMT (dynamic range WCD)
- Radio antennas for inclined showers
- Underground muon counters
 - (750 m array, 433 m array)
- Enhanced duty cycle of fluorescence tel.

(Giovanni Marsella) (Ana Botti) (Gabriella Cataldi) (Tomas Fodran) (Felix Schlüter) (Gaia Silli)

Signal/VEI 500 - 005



Upgrade of the Observatory – Auge

Physics motivation











