Particle density fluctuations and correlations in low energy Cosmic-Ray showers simulated with CORSIKA

Weronika Stanek[1] Jerzy Pryga[2] for the CREDO Collaboration

[1]Faculty of Physics and Applied Computer Science
AGH UST, Krakow, Poland

[2]Faculty of Physics, Astronomy and Applied Computer Science
Jagiellonian University, Krakow, Poland

37th ICRC, July 2021

Introduction

- **C**osmic **R**ay **E**xtremely **D**istributed **O**bservatory (**CREDO**) - a global collaboration which main aim is to search for Cosmic-Ray Ensembles (CRE) using all available data.
- CRE could be observed as some number of correlated air showers of relatively low energies spread over a large area.
- In this work we analysed low energy air showers (1 TeV - 4 000 TeV) simulated with CORSIKA.
- The main objective is to investigate the particle density fluctuations, for muons and EM particles (electrons, positrons and photons).

Basic energy dependences

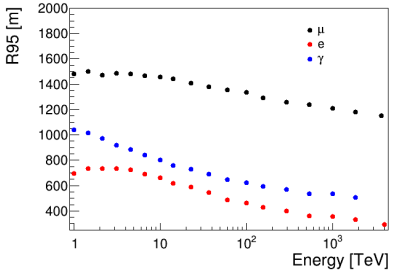

Figure: Average radius in which 95% of particles are included (denoted as $R95$).

First part includes calculation of radii in which a particular fraction of particles is included.

- It refers to particle density changes in different distances from the centre.
- Particles are not distributed evenly but are strongly grouped in the centre.

Two particles correlation in location

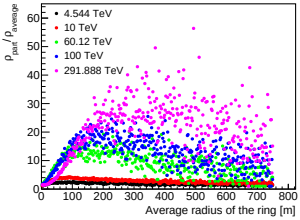

Figure: Ratio of density for EM particles.

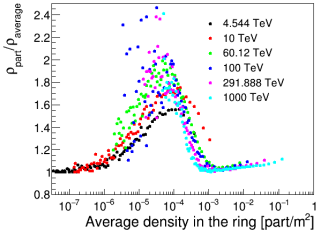

Figure: Ratio of density for muons.

- Each cascade was divided into rings with a specific width. The neighborhood of a particle is similar to the square $(R - r) \times (R - r)$ (R - outer radius of a ring, r - inner.)
- Clustering effect is easily noticeable for muons and very strong for EM particles.

Thank you for your attention!