

MODELING OF EXTENSIVE AIR SHOWERS IN PYTHIA 8.3 WITH MODIFIED HADRONIC INTERACTION CHARACTERISTICS

One of the most relevant difficulties in the ultra-high energy cosmic ray (UHECR) physics is the so-called “muon puzzle”. It refers to the observed excess of muons in extensive air showers (EAS) induced by UHECR compared to the results of simulations. It is assumed that one possible solution of the “muon puzzle” could be the modification of hadronic interaction models. Some studies suggest an idea of the excess of ρ^0 -mesons compared to ρ^\pm -mesons. Other possible solutions may include an increased yield of baryons or strange particles in hadronic interactions. However, performing numerical calculations using standard EAS simulation tools within the framework of the abovementioned modifications is a serious challenge.

In this study, the methods for modeling muon and hadronic components of the EAS induced by UHECR are investigated using the PYTHIA 8.3 event generator which allows modification of hadronic interaction parameters. In particular, the influence of hadronization parameters, such as the probability of s-quark production relative to u- and d-quarks and the probability of vector meson production relative to pseudoscalar mesons, on the EAS characteristics is studied.

It is found that the increase in the strange particle yield leads to a noticeable increase in the number of muons in the EAS. In addition, the simulations, including partial replacement of π -mesons by heavier mesons, also indicate an increase in the number of muons in the EAS and a shift in the muon component energy spectrum. These results may support the hypothesis that changing of the hadronization parameters may play a role in solving the “muon puzzle”.

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Session Classification: Poster Session

Track Classification: Cosmic rays (nuclei, gammas, neutrinos) of very high energies (> 100 TeV)