Applications of Smu/Sem showers universality for mass composition and hadronic interactions studies

Abstract content

We present the first results of the application of the recently found universality of behavior of muon (Smu) to electromagnetic signal (Sem) ratio with respect to the vertical depth of showers maximum \(X_{\text{max}}\) for mass composition and hadronic interaction studies. Making use of the fact that for zenith angles >45 deg. the dependence of Smu/Sem on \(X_{\text{max}}\) is very similar for QGSJET\textsuperscript{II} and EPOS\textsuperscript{I.99} we show that this provides the possibility to estimate muon shower content in almost interaction model independent way. To evaluate the excess of signal in the data in respect to Monte-Carlo predictions we propose to use mass independence of the electromagnetic signal. Using the simulations with EPOS\textsuperscript{I.99} as ‘real data’ we show that one can determine the absolute scaling factor between these ‘data’ and the interaction model under test (QGSJET\textsuperscript{II} in our case). Applying this scaling factor to the total and muon signals of QGSJET\textsuperscript{II} one can make accurate conclusions on the primary mass of samples prepared with EPOS\textsuperscript{I.99}. The present study is performed on proton, helium, oxygen and iron showers, generated with CORSIKA in the energy range \(\log(E/eV)=18.5-20.0\) and uniformly distributed in \(\cos^2(\theta)\) for QGSJET\textsuperscript{II}/Fluka and EPOS\textsuperscript{I.99}/Fluka interaction models.

Summary

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