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# Computation of atmospheric neutrinos production

Atmospheric neutrinos are produced by the interactions of cosmic rays with Earth's atmosphere which create unstable secondary particles that decay producing neutrinos. Due to have a wide energy spectrum of some hundreds of MeV until order of TeV, these neutrinos are good objects to test new theories and to study neutrino oscillation where there is a change of neutrino flavor state to another. In addition, atmospheric neutrinos constitute both the background and calibration of high energy neutrino telescopes and the search for rare processes, which motivates us to study how is its production and evolution in the atmosphere. In this way, we want to determinate the basic reactions of atmospheric neutrino creation by weak interactions and the processes of absorption and scattering of charged particles, such as pions and muons, produced by the interactions of protons (main constituents of cosmic rays) with the atmosphere. For this, we will proceed to solve cascade equations that relate source and sink terms of the particle flux to obtain its evolution up to the earth surface, including the dependence of atmospheric density and the different arrival directions for incident protons. We started with analytical calculation to understand the physics of the cascade development and the dependence on the free mean path, the decay length and particle energy loss observing how this parameters are modified for each particle that compose the cascade.

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