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Implications of hadronic interactions in the Cosmic Ray and Neutrino Physics

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A comprehensive study of the heavy quark production in ultra high energy cosmic ray interactions in the atmosphere is presented considering that the primary cosmic ray can be either a photon, neutrino or a proton. We show that the contribution of heavy quarks for cosmic ray interactions is in general non-negligible and can be dominant depending of the process considered. Moreover, we present a detailed mapping of the dominant kinematical domains contributing to the prompt atmospheric neutrino flux at high neutrino energies by studying its sensitivity to the cuts on several kinematical variables crucial for charm production in cosmic ray scattering in the atmosphere. We demonstrate that the production of neutrinos with energies larger than $E_\nu > 10^7$ GeV is particularly sensitive to the center-of-mass energies larger than the ones at the LHC and to the longitudinal momentum fractions in the projectile $10^{-8} < x < 10^{-5}$, which are not currently under theoretical control. Our results indicate that the precision data on the prompt atmospheric neutrino flux can efficiently constrain the mechanism of heavy quark production and underlying QCD dynamics in kinematical ranges beyond the reach of the current collider measurements.

Summary

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