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Prompt atmospheric leptons and the potential role of intrinsic charm

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The all-sky very-high energy (10^4 - 10^6 GeV) atmospheric muon flux, most recently measured by IceCube, shows a spectral hardening in the higher energy range, indicating a prompt component. Since the atmospheric muon neutrino flux at high energy, also measured by IceCube, is dominated by the astrophysical flux, only upper bounds on the prompt atmospheric muon neutrino flux contribution are currently available. We provide a new evaluation of the prompt atmospheric muon flux including for the first time an intrinsic charm component to the colliding nucleons. This increases forward production of $\bar{D}^0$, D^- and Λ_c which decay into final states that can contain muons and muon neutrinos. We show how the increase in the prompt muon flux due to intrinsic charm has an associated increase in the prompt muon neutrino flux. We implement the models of Brodsky-Hoyer-Peterson-Sakai and the Regge ansatz for intrinsic charm in MCEq, used for the calculation of the lepton fluxes. The challenges of obtaining predictions that are simultaneously consistent with IceCube's high energy atmospheric muon flux measurements and their upper bound on the prompt muon neutrino flux are discussed and the discrepancies are quantified.

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