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Some thoughts about the muon puzzle

Data from cosmic ray experiments hint at a significant, yet unexplained, discrepancy between the observed muon content in air showers and that predicted by state-of-the-art interaction models, suggesting a need for refinements in our understanding of elementary particle physics. This discrepancy is now widely known as the "muon puzzle." Muons trace the development of the hadronic cascade; thus, the only explanations of the muon puzzle which have been explored rely primarily upon modifying the fraction of energy which is transferred from hadronic collisions into the electromagnetic sub-shower. This can be accomplished either by reducing π^0 production (with associated strangeness enhancement), or by suppressing π^0 decay (through Lorentz invariance violation). The recent analysis of FASER data has returned only null results for a possible increase of strange-particle yields relative to pions. This provides strong motivation to explore alternative schemes. In this communication I will discuss general ideas which guide the construction of beyond Standard Model physics models that could uncover the elusive origin of the muon puzzle.

Collaboration(s)

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