High Energy Physics - Phenomenology

# Propagation in the atmosphere of ultrahigh-energy charmed hadrons

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Charmed mesons may be produced when a primary cosmic ray or the leading hadron in an air shower collide with an atmospheric nucleon. At energies \ge 10^8 GeV their decay length becomes larger than 10 km, which implies that they tend to interact in the air instead of decaying. We study the collisions of long-lived charmed hadrons in the atmosphere. We show that (\Lambda_c,D)-proton diffractive processes and partonic collisions of any q^2 where the charm quark is an spectator have lower inelasticity than (p,\pi)-proton collisions. In particular, we find that a D meson deposits in each interaction just around 55% of the energy deposited by a pion. On the other hand, collisions involving the valence c quark (its annihilation with a sea cbar quark in the target or c-quark exchange in the t channel) may deposit most of D meson energy, but their frequency is low (below 0.1% of inelastic interactions). As a consequence, very energetic charmed hadrons may keep a significant fraction of their initial energy after several hadronic interactions, reaching much deeper in the atmosphere than pions or protons of similar energy.

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