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Proton-Oxygen collisions at the LHC for air shower research

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New measurements at the LHC are needed to resolve the Muon Puzzle in cosmic-ray induced air showers and to reduce the systematic uncertainties of air shower simulations overall. In particular, the very forward production of light hadrons has to be studied with LHCb and other forward detectors. The LHC has accelerated proton and lead beams so far (and a bit of Xenon). The hadronic interaction models used to simulate air showers are primarily tuned to p-p data, while the most common collision in an air shower is between a high energy hadron and a oxygen or nitrogen nucleus. The predictions for these interactions vary between models by 50 % in multiplicity. This variance needs to be reduced to 10 % and the fraction of energy which ends up in neutral pions need to be clarified. This can be achieved by studying proton-oxygen collisions at the LHC, which have been proposed for 2023. We review the science case for measuring proton-oxygen collisions and report on the status of the proposal.

Summary

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