

# A simulation study for one-pion exchange contribution on very forward neutron productions in ATLAS-LHCf common events

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To understand the mass-compositions of ultra-high energy cosmic rays, we need to validate hadronic interaction models using accelerator experiments.

Measurements of the one-pion exchange contributions at the Large Hadron Collider are important to validate high-energy pion-proton collisions and to reduce uncertainties in muon components of air shower simulations.

Differences between data and models in very forward neutron productions were reported by the LHCf experiment.

If these differences are caused by diffractive / Non-diffractive collisions

=> affects both  $\langle X_{\max} \rangle$  and  $\langle X_{\max}^{\mu} \rangle$

**One-pion exchange**

Which connects **high-energy pion-proton collisions**.

**Possibility of measurements of pion-proton collisions using this process.**

=> affects muon components in air shower



It is important to measure the one-pion exchange contribution separately in the experiment for validation of pion-proton collisions.

We have developed a method for separating one-pion exchange contribution on very forward neutron productions using ATLAS and LHCf detectors.

In LHC-Run3, we can separate the one-pion exchange contributions in event-by-event bias and measure cross-sections and multiplicity of the contribution.

And these results will constrain cross-sections and multiplicity for high-energy pion-proton collisions.