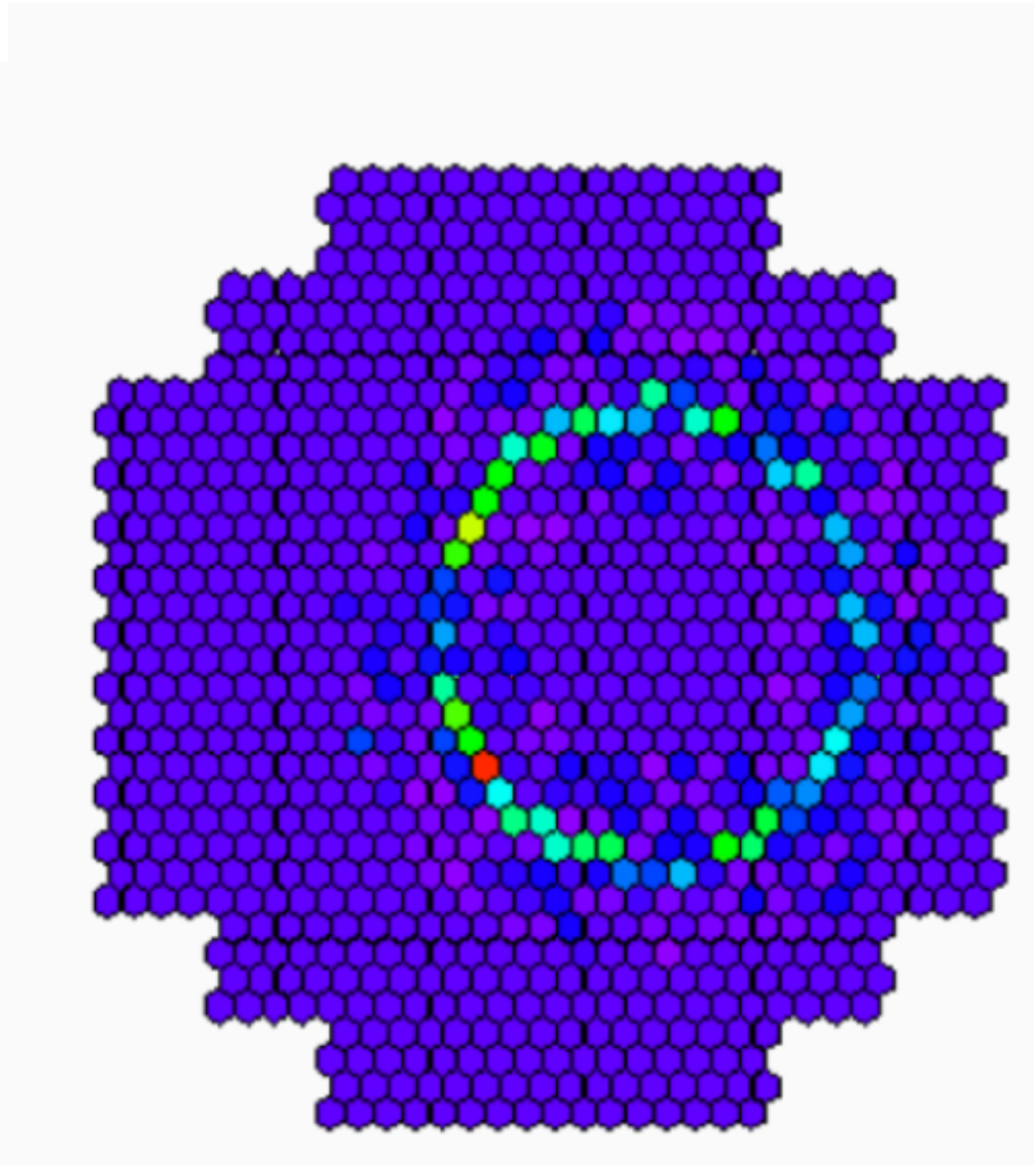
Muon LDF measurement with IACTs

R D Parsons, A M W Mitchell, H Dembinski

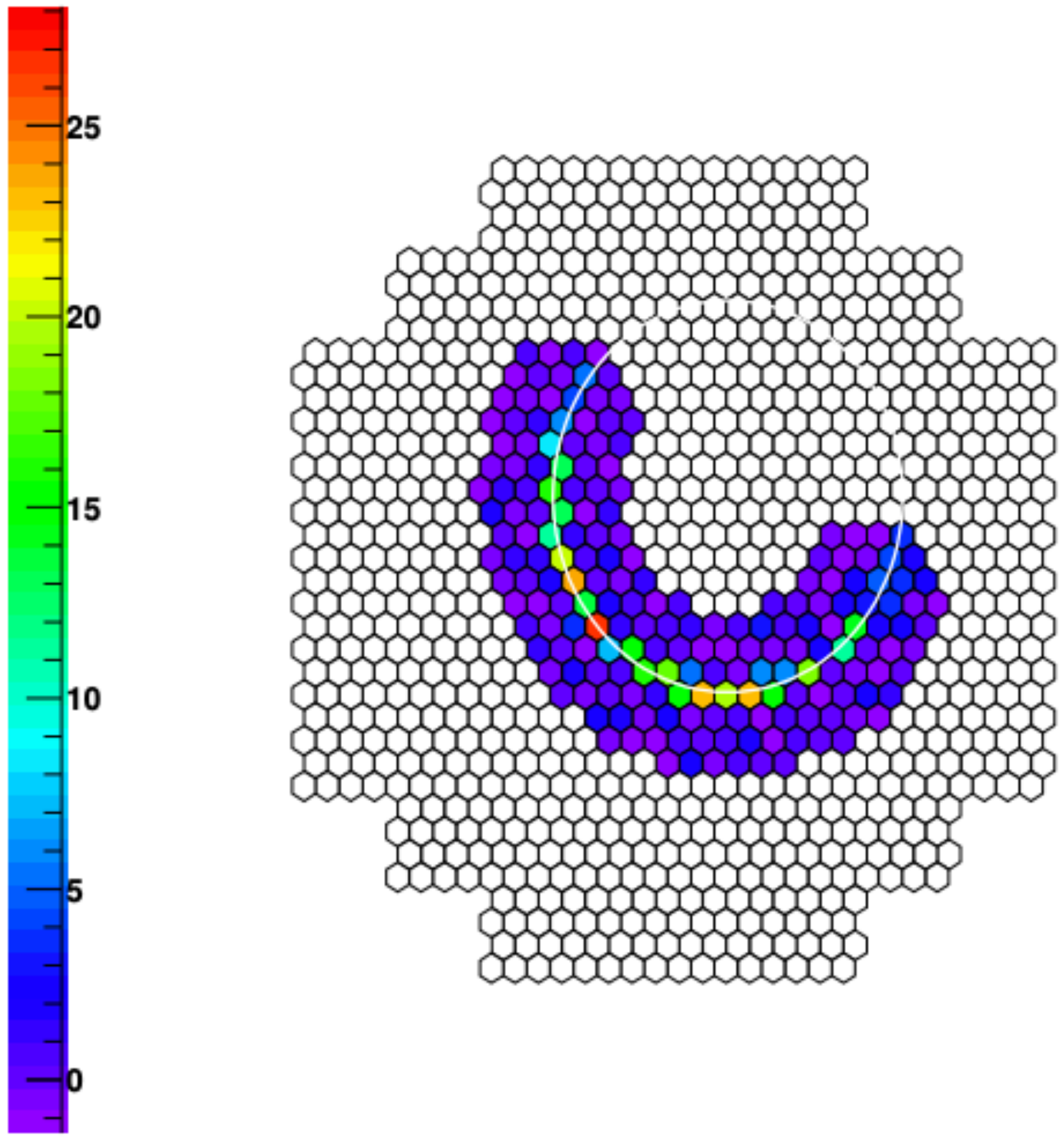
Measuring Muons with Cherenkov Telescopes



Images of single muons (when a muon passes through the dish of the telescope) represent a significant fraction of the images seen by IACT arrays

Due to the geometry of the emission these appear as a ring with a radius of the Cherenkov angle at sea level (about 1.2 deg)

The large mirror area and observation time of HESS mean we have a substantial dataset of cosmic ray muons we could use to constrain our hadronic interaction models



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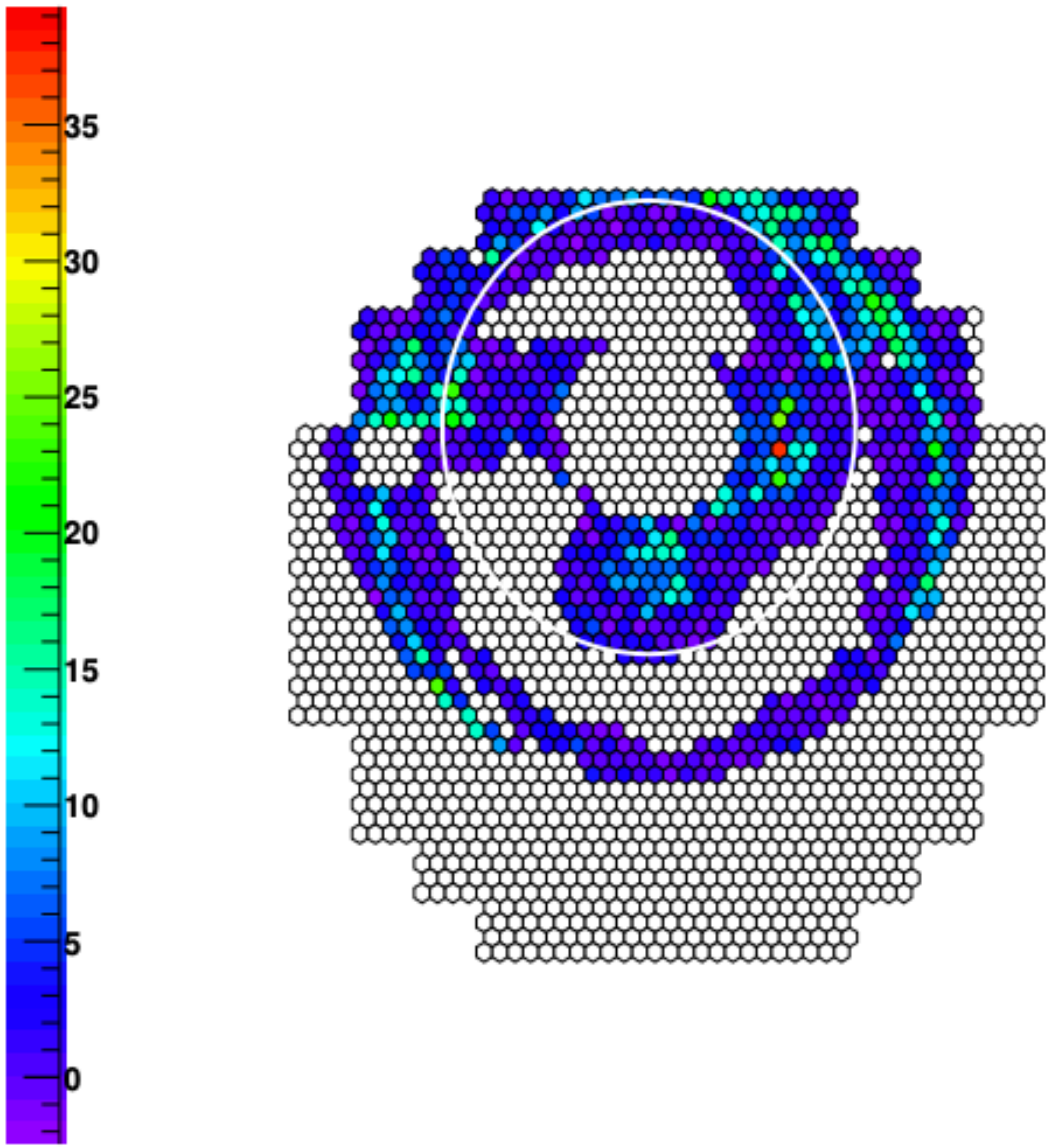

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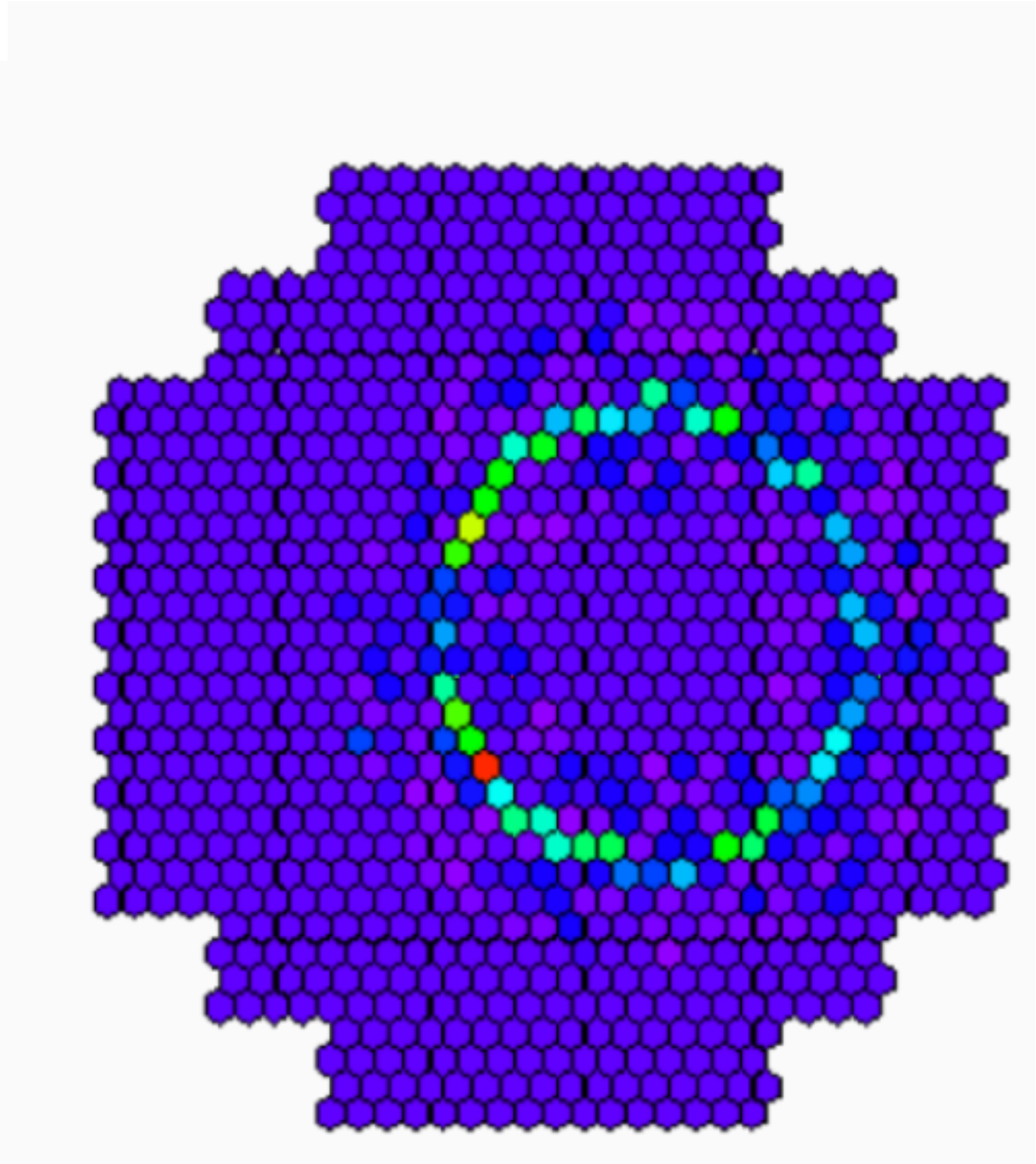

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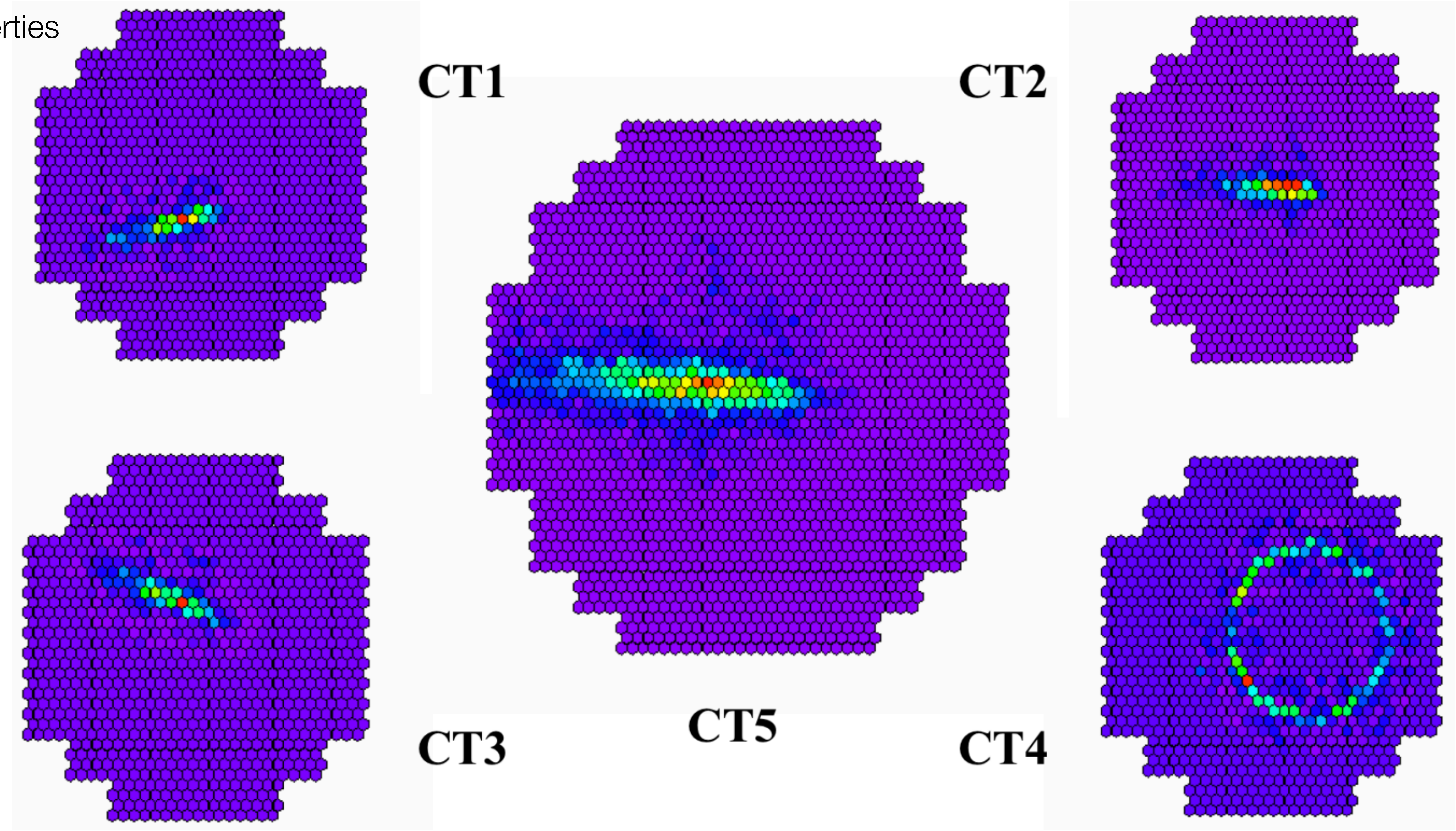
However, many events come from lower energy (1-100 GeV) showers where perhaps only one muon is produced

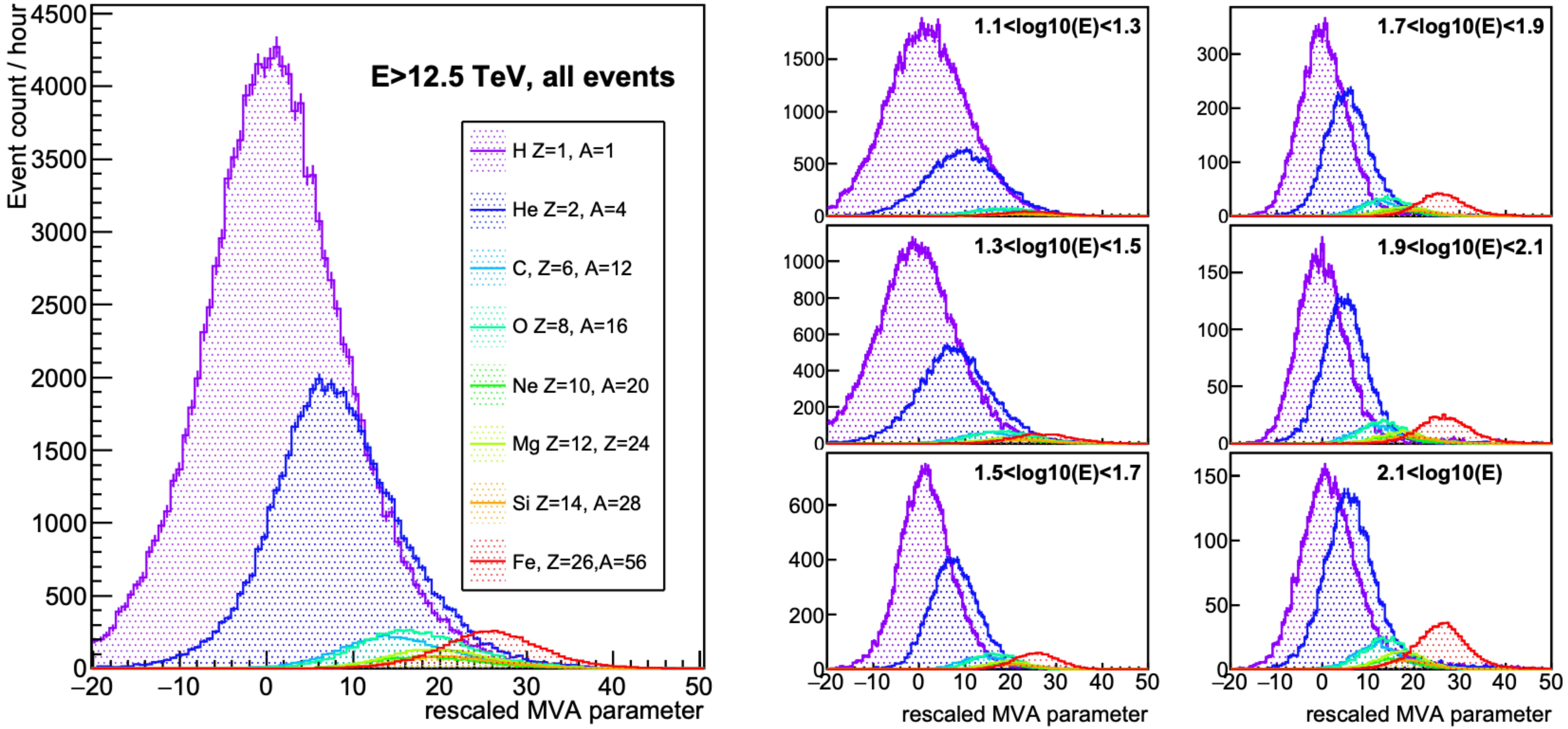
We also need to know the primary particle species (p -> Fe showers are very different)

Need to be able to determine the properties of the parent air shower

Shape and brightness of the images can determine the properties of the primary



Traditional Hillas parameter based event classification allows us to select light vs heavy nuclei, especially at 100 TeV

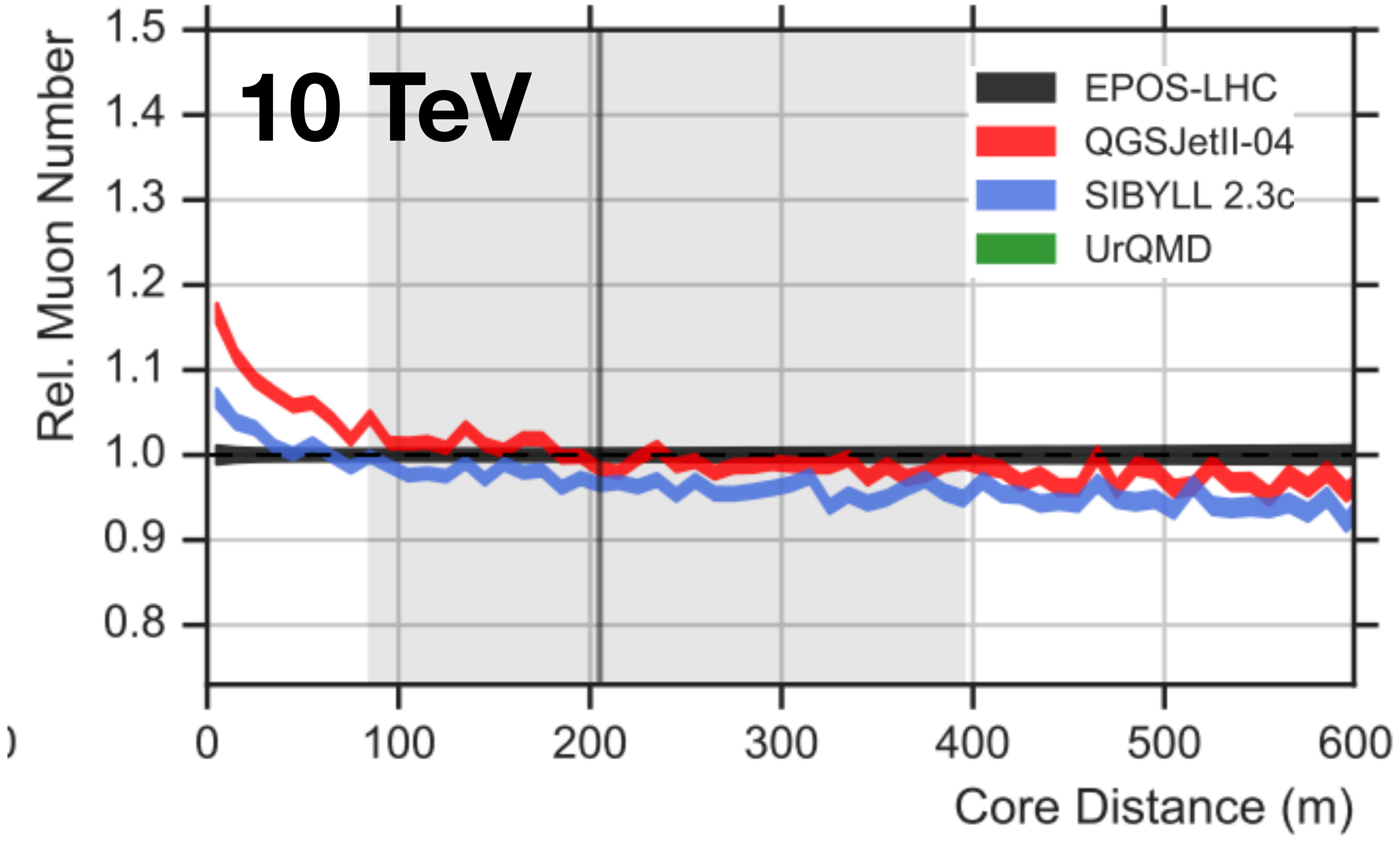


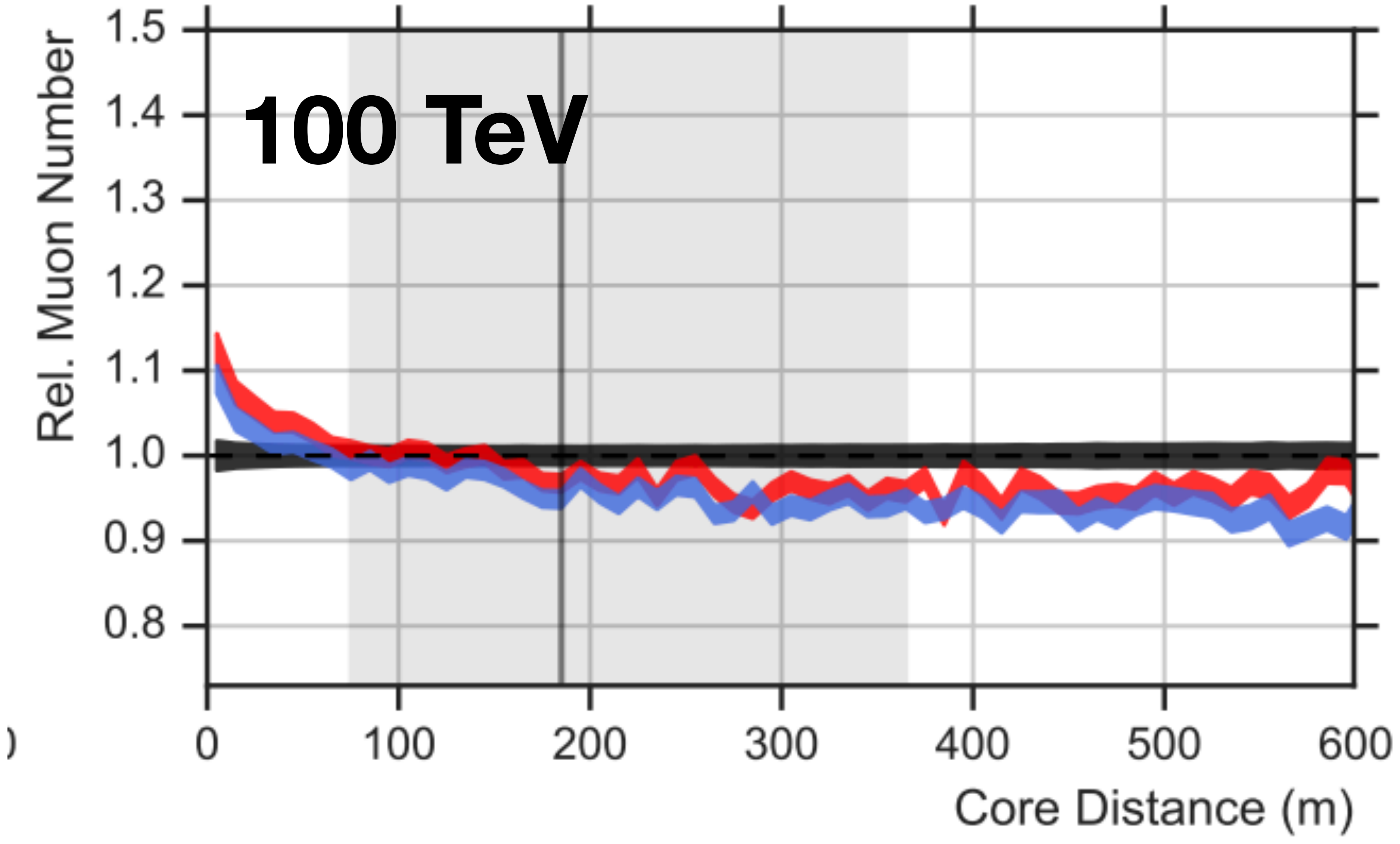
Expected model differences

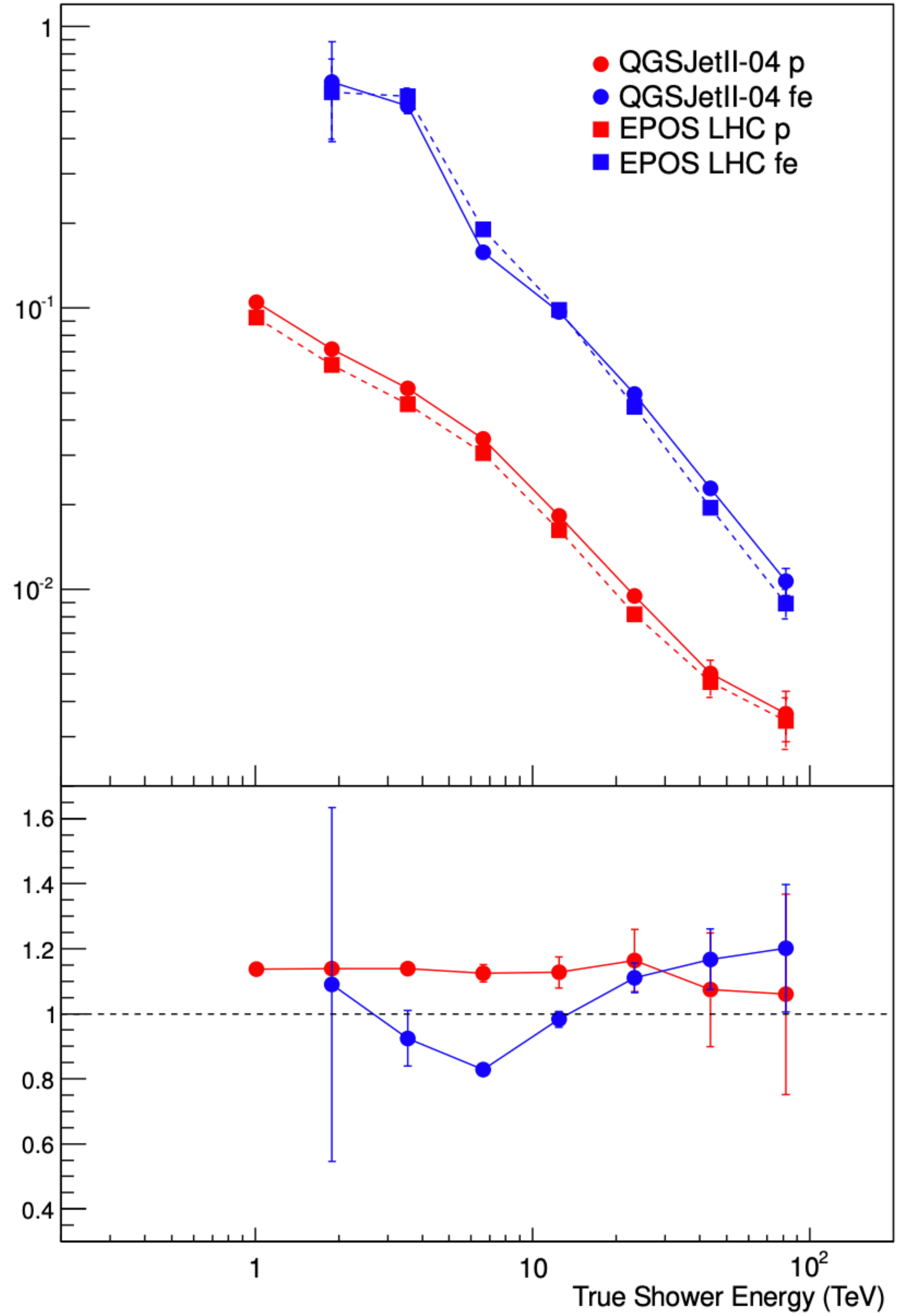
No real tuning data is available for the muon LDF is the 1-100 TeV range

Differences of about 20% are expected between the models

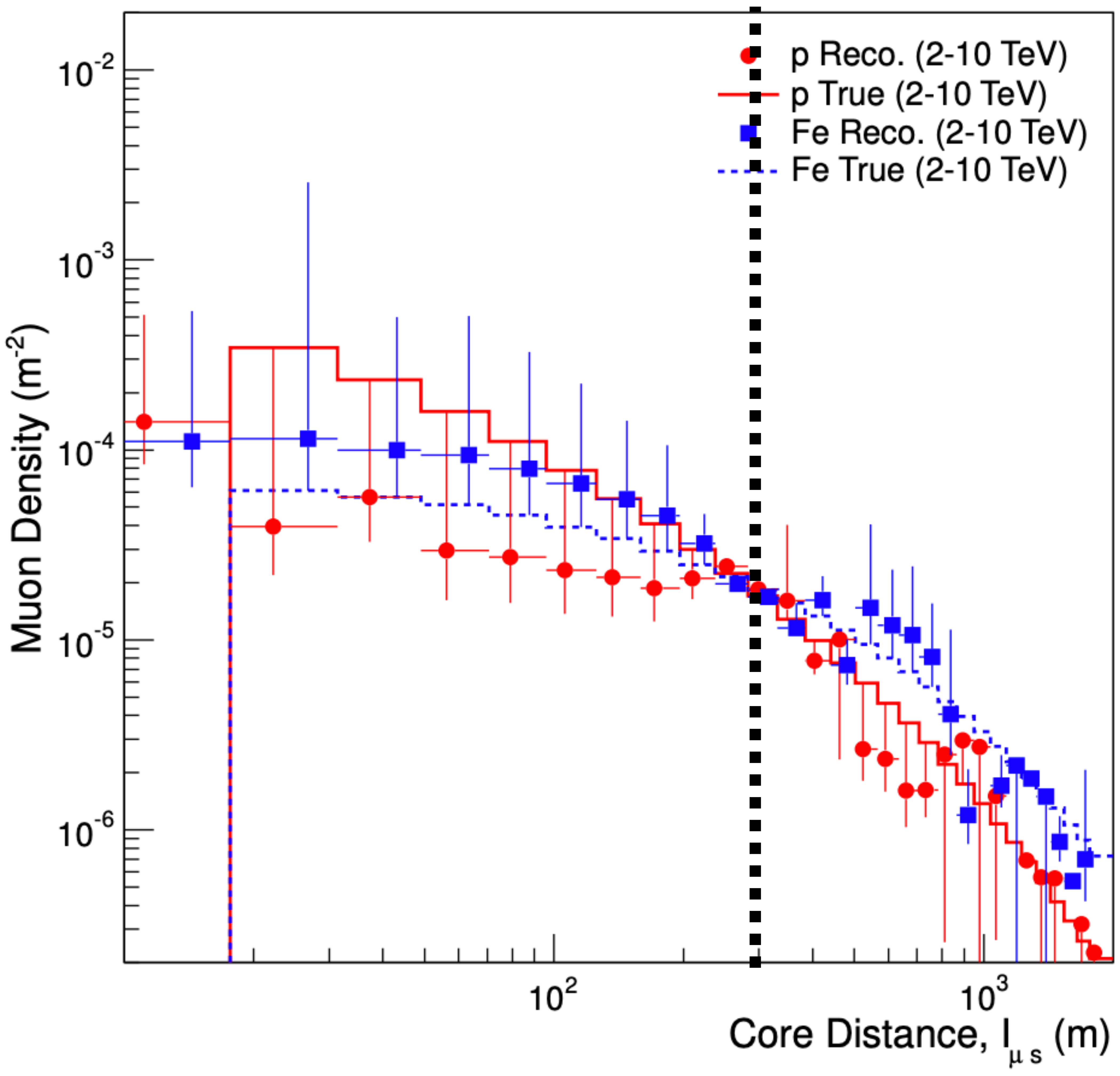
From studies these differences seem to occur from the production of the most energetic muons early in the shower development

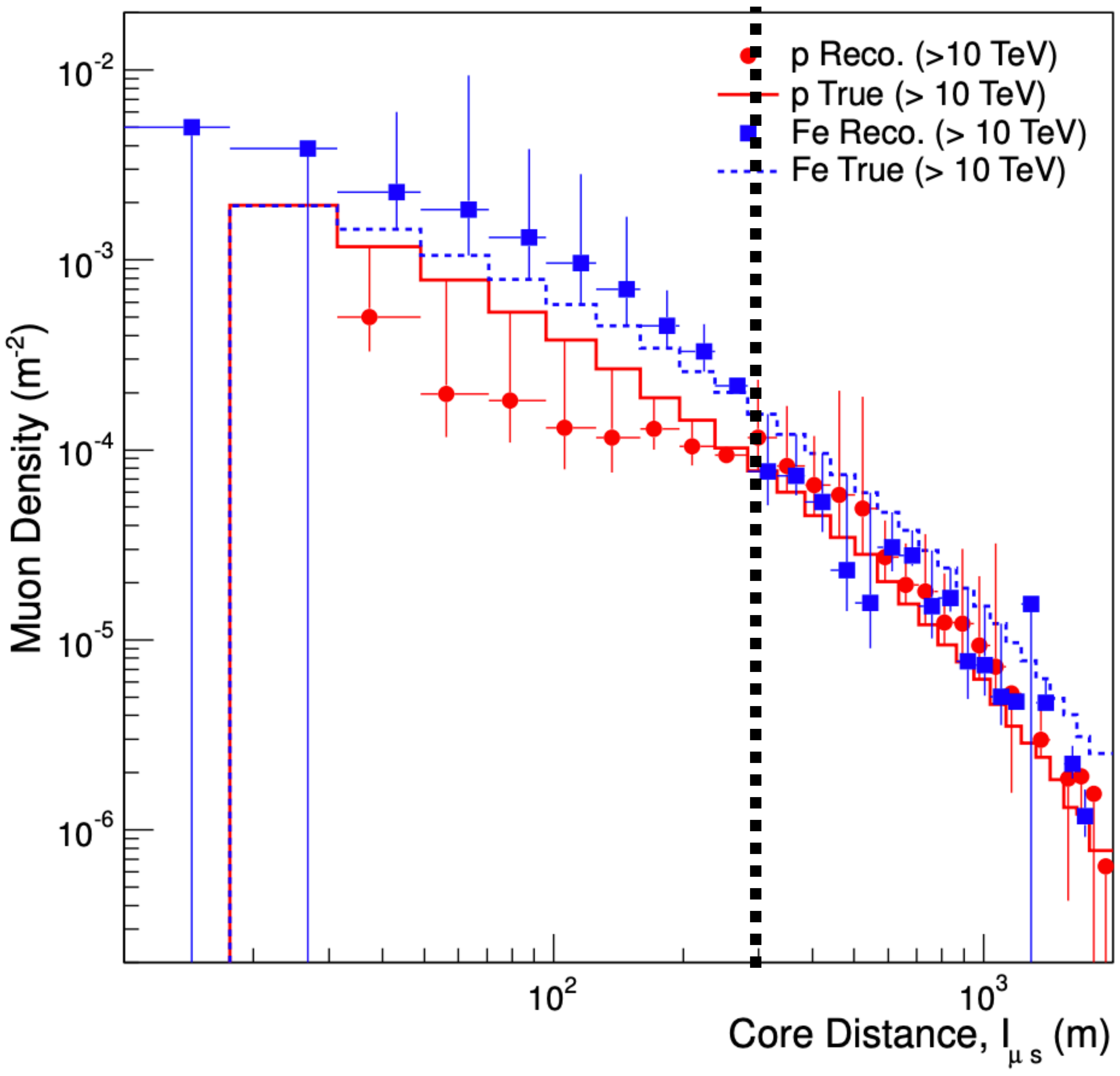






Performance on Simulations





Summary

Muons images are a common sight in IACT measurements

The combination of these images with images taken of the parent aid shower should allow is to make a measurement of the rate of muon production and the lateral distribution at group level

Differences in model predictions seem to directly relate to the production of energetic pions early in the shower development

Application of this method to the extensive HESS dataset (now >15 years of data) will allow us to produce a constraint on model behaviours where none is currently available

Combination with LHC measurements should allow the tuning of models in the 1-100 TeV range most important for IACTs