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Testing hadronic interactions with the Pierre Auger Observatory

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The most energetic particles in the universe - ultra-high energy cosmic rays –interact with the atmosphere creating air showers whose characteristics are sensitive to the primary mass composition and hadronic interaction properties. Currently, these showers are our only window to test the properties of collisions at energies beyond the reach of human-made accelerators.

The Pierre Auger Observatory provides the largest data sample of cosmic ray events with energy above 10^{18} eV. Being a hybrid detector, it allows us to independently measure two different shower components: the profile of the electromagnetic particles crossing the atmosphere, and a sample of all particles that reach the ground, from which we can retrieve the muon number and the muon production depth profile.

It will be shown that none of the hadronic interaction models used for simulations of extensive air showers, which were updated after the LHC data, is able to consistently describe all these measured shower observables.

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