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The link between the highest-energy cosmic rays and particle physics at the LHC

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The study of ultra-high-energy cosmic rays (UHECR), i.e. nuclei exceeding energies of 10^{18} eV, and the extensive air showers they induce is closely intertwined with particle physics studied in experiments at accelerators, especially hadronic interactions. On the one hand, precise models of hadronic interactions, well constrained by accelerator data, are an invaluable ingredient to predict air shower observables for a given primary particle and, in return, to infer properties of the primary particle from measurements of these observables. On the other hand, UHECR-air interactions happen at centre-of-mass energies up to 400 TeV and allow probing particle physics far beyond the reach of the LHC.
In my talk I will review recent progress and remaining open problems of the field. In particular, I will focus on the so-called "muon puzzle", a ⊠ 40 % discrepancy between data and simulations w.r.t. the number of muons in UHECR air showers. I will outline how this is related to modelling of particle production in phase-space so-far poorly constrained by accelarator data, collective effects known in heavy-ion physics thay may play a role also in small systems, and how the upcoming oxygen run of the LHC may help to solve the mystery.

Is this abstract from experiment?

No

Name of experiment and experimental site

N/A

Is the speaker for that presentation defined?

Yes

Details

N/A

Internet talk

No

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