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## **Hadronic interactions and air showers : the need of Oxygen beam with LHCf**

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In detailed air shower simulations, the uncertainty in the prediction of shower observable for different primary particles and energies is currently dominated by differences between hadronic interaction models. With the general results of the first run of the LHC, the difference between post-LHC model predictions has been reduced at the same level than experimental uncertainties of cosmic ray experiments for  $X_{\max}$  measurements, but a deficit in muon production in simulation remains. At the same time new type of air shower observable, like the muon production depth, has been measured adding new constraints on hadronic models. Currently no model is able to reproduce consistently all mass composition measurement possible within the Pierre Auger Observatory for instance. In parallel, only few new measurements at LHC are providing new tests of the models which could help understanding the remaining differences between observed and simulated air showers. LHCf is the only LHC experiment testing the model used for such simulations in the relevant phase space and in combination with central trigger. The measurements in Run 1 and 2, already showed deficiency in the models. Results of LHCf with Oxygen beam which will include the nuclear effects missing in p-p collisions, as originally planed in Run 3, would be crucial to get enough information to solve the problems observed in a proper way and early enough that it can still be applied in the analysis of the current largest cosmic ray experiments.

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