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Forward photon measurements with ALICE at the LHC as a probe for low-x gluons

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The low-x gluon density in the proton and, in particular, in nuclei is only very poorly constrained, while a better understanding of the low-x structure is crucial for measurements at the LHC and also for the planning of experiments at future hadron colliders. In addition, deviations from linear QCD evolution are expected to appear at low x, potentially leading to gluon saturation and a universal state of hadronic matter, the color-glass condensate. However, these effects have not been unambiguously proven to date. Fortunately, data from the LHC can be used directly to provide better constraints of the PDFs. In this context, a Forward Calorimeter (FoCal) is proposed as an addition to the ALICE experiment, to be installed in Long Shutdown 3 (2024-2026). The main goal of the FoCal proposal is to measure forward (3.5 < y < 5) direct photons in pp and p–Pb collisions to obtain experimental constraints on proton and nuclear PDFs in a new region of low x (10^{-5}—10^{-6}). Based on the current knowledge from DIS experiments and first results from LHC, we will discuss the physics case for this proposed detector. While open charm measurements do provide important constraints, a photon measurement would provide additional unique information due to the cleanness of the dominant physics processes. In addition it provides measurements of neutral mesons, two-particle correlations, and jets in pp, p–Pb and (partially) in Pb–Pb. The direct photon measurement requires a new electromagnetic calorimeter with extremely high granularity. We will also present the corresponding innovative design principle of a high-resolution SiW sandwich calorimeter and results from the ongoing R&D program with test beams.

Summary

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