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FoCal - a high-granularity electromagnetic calorimeter for forward direct photon measurements at LHC

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An important open question related to the low-x structure of hadrons is the postulated existence of gluon saturation. We propose the measurement of forward direct photons in proton-nucleus collisions at the LHC as a decisive probe of gluon saturation. Due to the harsh environment of such a measurement, existing detectors are not suitable. In particular an extremely high-granularity electromagnetic calorimeter is required, which we propose as a detector upgrade to the ALICE experiment covering $3.5 < \eta < 5.3$, the Forward Calorimeter (FoCal).

To facilitate the design of the upgrade and to perform generic RD necessary for such a novel calorimeter, a compact high-granularity electromagnetic calorimeter prototype has been built. The corresponding RD studies will be the focus of this presentation. The prototype is a Si/W sampling calorimeter using CMOS sensors of the MIMOSA type with a pixel pitch of 30 μm and binary readout with a total of 39 million pixels. We will report on performance studies of the prototype with test beams at DESY and CERN in a broad energy range. The results of the measurements demonstrate a very small Molière radius (11mm) and good linearity of the response. Unique results on the detailed lateral shower shape, which are crucial for the two-shower separation capabilities, will be presented. We will compare the measurements to GEANT-based MC simulations, which additionally include a modeling of charge diffusion. The studies demonstrate the feasibility of this high-granularity technology for use in the proposed detector upgrade. They also show the extremely high potential of this technology for future calorimeter development. Finally, we will briefly discuss the projected performance for measurements of the nuclear modification factor R_{pPb} for forward isolated photons at the LHC.

On behalf of collaboration:

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