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High granularity digital Si-W electromagnetic calorimeter for forward direct photon measurements at LHC

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It is widely expected that the non-linear growth of parton densities at low x predicted from linear QCD evolution will lead to gluon saturation. As a decisive probe of gluon saturation, the measurement of forward (3.5 < y < 5) direct photons in a new region of low x (10^{-5} ~ 10^{-6}) in proton-nucleus collisions at the LHC is proposed. An extremely high-granularity electromagnetic calorimeter is proposed as a detector upgrade to the ALICE experiment. This Forward Calorimeter (FoCal), is required to discriminate direct photons from decay photons with very small opening angle from neutral pions.

To facilitate the design of the upgrade and to perform generic R&D necessary for such a novel calorimeter, a compact digital Si/W sampling electromagnetic calorimeter prototype using Monolithic Active Pixel Sensors(MAPS) with a granularity of 30 × 30 μm and 28 X_0 has been built and tested with beams. The test beam results have shown the good energy linearity and very small Moliere radius (~ 11 mm). We will discuss new results of the R&D with electromagnetic showers, in particular a position resolution of better than 30 μm. This precise position determination and the detailed knowledge of the electromagnetic shower shape obtained will provide the crucial capability for two photon separation down to a few mm. The results also show the successful proof of principle of particle counting calorimetry technology for future calorimeter development.

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