

# Measurement of isolated prompt photon production in pp and p–Pb collisions in ALICE

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## Introduction

In relativistic hadronic collisions, prompt photons with high transverse momenta ( $p_T$ ) are produced directly from the hard scattering of two partons [1]. At the lowest order in pQCD calculations, prompt photons are produced via (i) the 2→2 processes, namely quark–gluon Compton scattering and quark–antiquark annihilation; and (ii) the collinear fragmentation of a final-state parton into a photon. Prompt photons from (i) are known as ‘direct’; whereas those from (ii) are called ‘fragmentation’. Measured prompt photon production cross sections provide a direct test of pQCD, and constrain the proton and nuclear parton distribution functions (PDFs). Since photons are electromagnetic probes, they are unaffected by the strongly interacting nuclear medium. This makes them a ‘clean’ source for discriminating initial and final state contributions to the yield modifications observed in nuclear (p–A and A–A) collisions with respect to pp collisions.

Prompt photons provide clear constraints of the underlying parton kinematics, but making a clean separation between the different types of prompt photons is difficult. Additionally, measurements of direct photons are complicated due to the presence of a large photon background from hadron decays, especially from  $\pi^0$  and  $\eta$  mesons. A selection called “isolation criterion”, which is based on a threshold in the contributions of transverse momentum from particles inside a cone around the candidate photon, is applied to suppress the decay and fragmentation photons. This has led to

the prescription of “isolated photons” as reported in Ref. [2].

## Analysis Details

Photon reconstruction was performed using the Electromagnetic Calorimeter (EMCal) [3] and the Dijet Calorimeter (DCal) [4], whereas charged particles were reconstructed with the ALICE central tracking detectors, a combination of the Inner Tracking System (ITS) [5] and the Time Projection Chamber (TPC) [6] in the mid-rapidity region. Since photons are neutral particles, first a veto is applied to reject the clusters originating from charged particles. Then a selection of  $0.1 < \sigma_{\text{long}}^2 < 0.3$  has been applied, where  $\sigma_{\text{long}}^2$  is a parameter based on the shape of electromagnetic showers in the calorimeters [2]. This is done to reject the elongated clusters from neutral meson decays. Finally, the isolation criterion has been used to reduce the contamination from fragmentation and decay photons. Such a criterion is implemented by defining a cone centered around the photon direction in the  $\eta$ – $\varphi$  plane with a fixed radius,  $R = \sqrt{(\Delta\eta)^2 + (\Delta\varphi)^2}$ , summing the transverse momenta of all charged-particles inside the isolation cone ( $\Sigma p_T^{\text{track}}$ ) and limiting it to a threshold value ( $p_T^{\text{iso, ch}}$ ). The Underlying Event (UE) has been estimated using the charged-particle  $p_T$  contributions in cones which lie perpendicular to the selected clusters and has been subtracted from the  $\Sigma p_T^{\text{track}}$  value before applying the isolation threshold. In this analysis, a threshold of  $p_T^{\text{iso, ch}} < 1.5$  GeV/ $c$  with  $R = 0.4$  has been set to extract the isolated-photon candidates.

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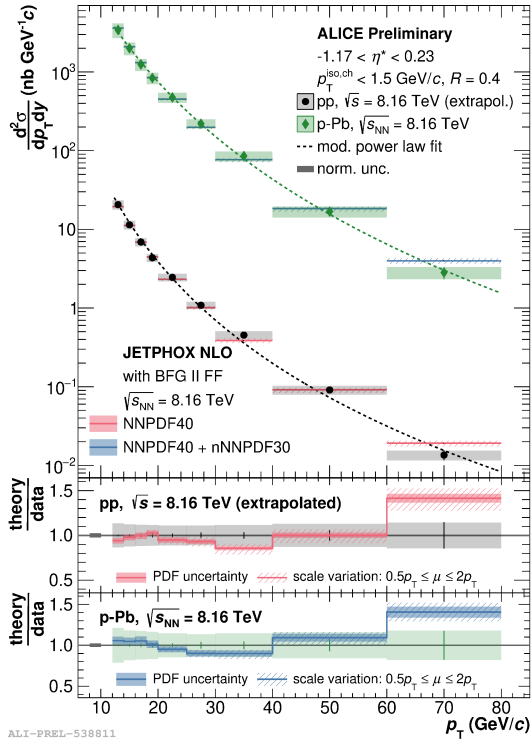


FIG. 1: Isolated prompt photon cross section in pp and p-Pb collisions at  $\sqrt{s_{NN}} = 8.16$  TeV.

## Results and Discussions

Figure 1 shows the isolated prompt photon production cross section in pp and p-Pb collisions at  $\sqrt{s_{NN}} = 8.16$  TeV. The pp measurement has been extrapolated from  $\sqrt{s} = 8$  TeV using the JETPHOX program at NLO [7]. The nuclear modification factor  $R_{pA}$  of isolated prompt photon production in p-Pb collisions at  $\sqrt{s_{NN}} = 8.16$  TeV is shown in Fig. 2. The measurements have been compared to NLO pQCD calculations using JETPHOX. In all the figures, the data is represented with

solid points, the statistical errors with error bars and systematic errors with open boxes. The PDF uncertainties are indicated by solid filled bands. The ALICE results extend the LHC measurements to low  $p_T$  which will in turn aid measurements at low Bjorken  $x$ , since  $x \approx x_T = 2p_T/\sqrt{s}$ .

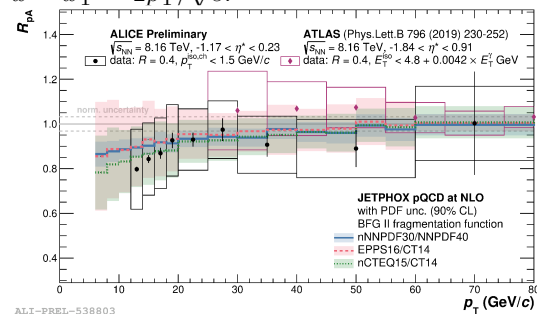


FIG. 2: Nuclear modification factor  $R_{pA}$  of isolated prompt photon production in p-Pb collisions at  $\sqrt{s_{NN}} = 8.16$  TeV.

Details of the analysis methods and recent ALICE results from pp and p-Pb collisions will be discussed in the conference.

## References

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