

Isolated photon cross section in pp collisions at $\sqrt{s} = 8$ TeV with the ALICE at LHC

Sinjini Chandra (for the ALICE Collaboration)*

Experimental High Energy Physics and Applications Group,

Variable Energy Cyclotron Centre, Kolkata - 700064,

India and Homi Bhabha National Institute,

Training School Complex, Anushaktinagar, Mumbai - 400094, India

Introduction

In ultra-relativistic hadronic collisions, direct photons are those photons that are directly produced in elementary processes and act as a valuable tool to test perturbative Quantum Chromodynamics (pQCD) predictions. Since these photons are produced directly from parton-parton hard scatterings, they can be used to constrain the parton distribution functions (PDFs). In leading order pQCD, direct photons are mainly produced via $2 \rightarrow 2$ processes, namely quark-gluon Compton scattering and quark-antiquark annihilation. These photons together with the fragmentation or bremsstrahlung photons are referred to as the prompt photons [1]. Photons from the $2 \rightarrow 2$ processes 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 π^0 and η mesons. A selection called "isolation criterion", which is based on a threshold on the contributions of transverse energy/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 has been performed using the Electromagnetic Calorimeter (EMCal) [3], whereas charged particles were reconstructed with the ALICE central tracking detectors, a combination of the Inner Tracking System (ITS) [4] and the Time Projection Chamber (TPC) [5] in the midrapidity region. The Minimum Bias (MB) interaction trigger is based on the response of the V0 detector [6]. 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 σ_{long}^2 is a parameter based on the shape of the electromagnetic shower in the EMCal [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 η - φ plane with a fixed radius, $R = \sqrt{(\Delta\eta)^2 + (\Delta\varphi)^2}$, summing the transverse momenta of all the charged-particles inside the isolation cone ($\Sigma p_{\text{T}}^{\text{track}}$) and limiting it to a threshold value ($p_{\text{T}}^{\text{iso, ch}}$). 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 $\Sigma p_{\text{T}}^{\text{track}}$ value before applying the isolation threshold. In this analysis, a threshold of $p_{\text{T}}^{\text{iso, ch}} < 1.5$ GeV/c with $R = 0.4$ has been set to extract the isolated-photon candidates.

*Electronic address: s.chandra@vecc.gov.in

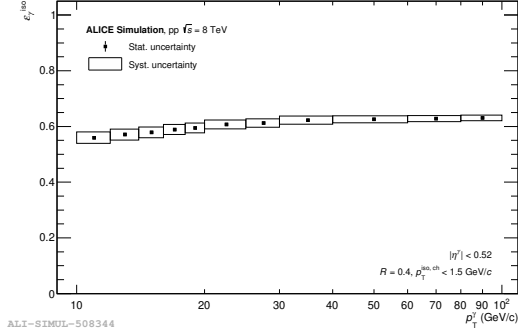


FIG. 1: Isolated photon efficiency in pp collisions at $\sqrt{s} = 8$ TeV.

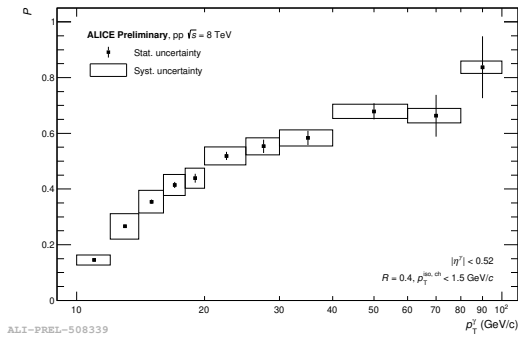


FIG. 2: Isolated photon purity in pp collisions at $\sqrt{s} = 8$ TeV.

Results and Discussions

Figures 1 and 2 show the isolated photon efficiency and purity, respectively, as a function of the isolated photon transverse momentum (p_T^γ) for pp collisions at $\sqrt{s} = 8$ TeV. The measurement covers a range of $|\eta| < 0.52$ and $10 < p_T^\gamma$ (GeV/c) < 100 . The isolated photon cross section is shown in Fig. 3. The measurement is compared to two different Next-to-Leading Order (NLO) pQCD calculations as shown in the top panel of the figure. The isolated photon cross section in data and model predictions using JETPHOX 1.3.1.4 [7] are in agreement within uncertainties as evident from the lower panel of the figure where the data/model ratio is shown. In all the figures, the data is represented with black

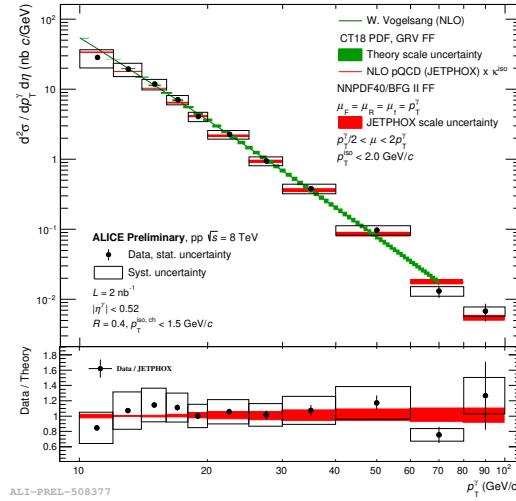


FIG. 3: Isolated photon cross section in pp collisions at $\sqrt{s} = 8$ TeV and comparison with NLO calculations.

solid points, the statistical errors with error bars and systematic errors with open boxes. The NLO scale uncertainties are shown with coloured (red and green) bands. The ALICE results extend the LHC measurements to low p_T which will in-turn aid measurements at low Bjorken x , since $x \approx x_T = 2p_T/\sqrt{s}$.

References

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