Measurement of high-p_{T} neutral mesons with a high-energy photon trigger at ALICE

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ALICE, one of the experiments at the Large Hadron Collider (LHC) at CERN, is aimed at studying heavy-ion collisions and the properties of a deconfined state of matter, the quark-gluon plasma (QGP)[1]. High-p_{T} particle production is a powerful tool for characterizing the QGP because the interaction of its fast partons depends on the QGP transport properties. The hadron yields in heavy-ion collisions can be quantified by the nuclear modification factor (R_{AA}), which is the ratio of the particle yield in heavy-ion collisions normalized by the number of inelastic nucleon–nucleon collisions to the yield in pp collisions. Previous experiments have shown that R_{AA} at high p_{T} is significantly smaller than 1, which can be explained by the energy loss of fast partons traversing in QGP.

The ALICE experiment has a high-resolution and high-granularity electromagnetic calorimeter called PHOS[1]. One of the main achievable physics goals by PHOS is the study of the energy loss through the measurement of high-p_{T} neutral mesons (π^0 and η). Three PHOS modules are installed in the ALICE experiment, which covers azimuthal angles in the range $260° < \phi < 320°$ and pseudorapidity $|\eta| < 0.125$. PHOS provides a photon trigger (PHOS trigger) by requiring the measured energy to be above a threshold. The threshold was set to be 2 and 4 GeV in pp collisions at $\sqrt{s} = 8$ TeV and 7 GeV in p-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV. By using the PHOS trigger, high-p_{T} neutral mesons can be efficiently measured in the ALICE experiment. This paper discribes the analysis status of neutral-pion production measured with the PHOS trigger and minimum-bias (MB) trigger data in pp collisions.

In this analysis, $0.3nb^{-1}$ MB-trigger data and $70nb^{-1}$ PHOS-triggered data in pp collisions at $\sqrt{s} = 8$ TeV are used. The PHOS-trigger efficiency as a function of measured photon energy is evaluated with real MB-trigger data. By using this efficiency, the efficiency for a parent particle is estimated through a simulation. For instance, neutral-pion trigger efficiency in pp collisions at $\sqrt{s} = 8$ TeV is shown in Fig. 1.

The rejection factor of the PHOS trigger for the MB-trigger data, R, was determined with real data in this analysis. R corresponds to the number of MB-trigger events inspected while one PHOS trigger is issued. It is 150 for 2-GeV threshold in pp at 8 TeV, 4800 for 4-GeV threshold in pp at 8 TeV, and 6500 for 7-GeV threshold in p-Pb at 5.02 TeV.

Fig. 2 shows the invariant raw yield of neutral pions measured with the MB trigger (open circles) and that with the PHOS trigger (closed circles) in pp collisions at $\sqrt{s} = 8$ TeV. Only the statistical errors are shown in Fig. 2. Up to 40 GeV/c, neutral pions can be measured with PHOS trigger. No other experiments have successfully measured neutral pions up to 40 GeV/c. At the low-p_{T} region, MB- and PHOS-trigger results are consistent with each other within statiscical errors.

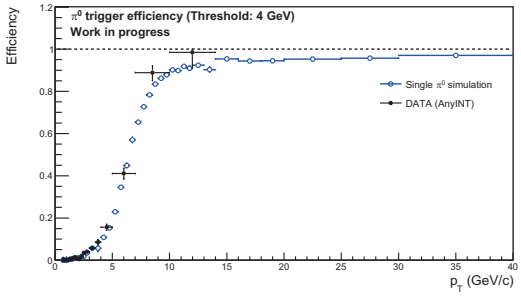

Fig. 1. Neutral-pion trigger efficiency.

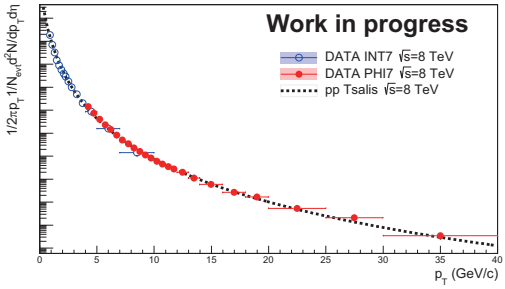

Fig. 2. Invariant raw yield of neutral pions in pp collisions at 8 TeV.

In summary, we began investigating PHOS-triggered data and attempting to extract the invariant yield of neutral mesons for the PHOS-triggered data. The final result of the invariant yield up to 40 GeV/c in pp collisions is expected to be obtained shortly. Furthermore, $1.6nb^{-1}$ PHOS-triggered data are recorded in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV. Neutral pions above 40 GeV/c can be measured with this data set. The analysis of PHOS-trigger data will extend our understanding of high-p_{T} particle production beyond the previounsly published result[2] of MB-tigger data. In Pb-Pb collisions, neutral pions near 40 GeV/c can be measured with data taken in 2011. By analyzing this data set, the extraction of R_{AA} for single particles up to 40 GeV/c will be possible, which is one of the future plans of our data analysis.

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References
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2) The ALICE colaboration, Phys.Lett.B 717 (2012), pp. 162 - 172.