Study of J/Ψ and single-muon production in pp collisions at √s =2.76 TeV with ALICE

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Introduction

ALICE experiment has been dedicated to study heavy-ion physics at the Large hadron Collider (LHC). LHC can generate sufficient high energy density with respect to RHIC and Tevatron, which will enable to explore the properties of hot and dense deconfined matter in a thermalized medium, commonly referred to as Quark-Gluon-Plasma (QGP) and this strongly interacting new state of matter under extreme conditions has been predicted by Quantum Chromodynamics (QCD). The properties of the medium can be studied using the unique probe quarkonium states (J/Ψ, Ψ′ and Y, Y′ and Y″). The invariant mass resolution is of the order of 70 MeV and 100 MeV for the quarkonia J/Ψ and Y respectively.

In ALICE, the quarkonium states are reconstructed down to $p_T = 0$ through their e^+e^- decay channel in central barrel ($|y| \leq 0.9$) and $\mu^+\mu^-$ decay channel in the muon spectrometer ($2.5 \leq y \leq 4.0$). The inclusive J/Ψ production cross section as a function of the centre of mass energy, transverse momentum (p_T), rapidity (y) and of charged particle multiplicity have been comprehensively studied. Besides this, a polarization analysis has been done and performance results of J/Ψ from B mesons decay have been obtained already.

Measurement of inclusive J/Ψ production cross section in proton-proton collisions at √s = 7 and 2.76 TeV has been performed [Figs. 1 and 2]. Inclusive J/Ψ production was studied in Pb-Pb collisions at √s = 2.76 TeV for both decay channels and Fig. 3 shows the invariant mass distribution after mixed-event background subtraction in the most centrality class (0-10%). The dependence of charged particle multiplicity of the inclusive J/Ψ yield in p-p collisions at √s = 7 TeV has been performed [Fig. 4].

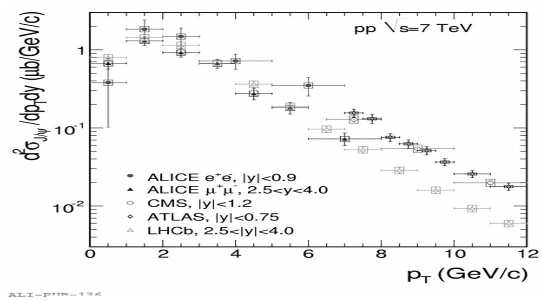

Fig. 1 $d^2\sigma_{J/\Psi}/dydp_T$ compared with other LHC experiments obtained in same rapidity range

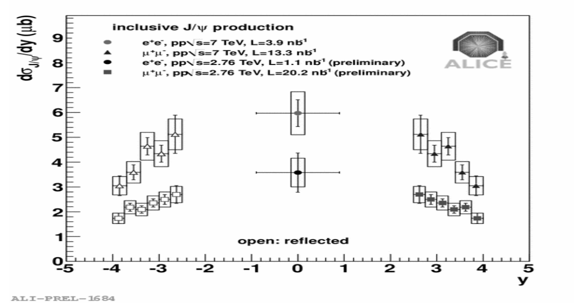

Fig. 2 Inclusive *J/Ψ* rapidity differential cross-section in p-p collisions at 7 and 2.76 TeV

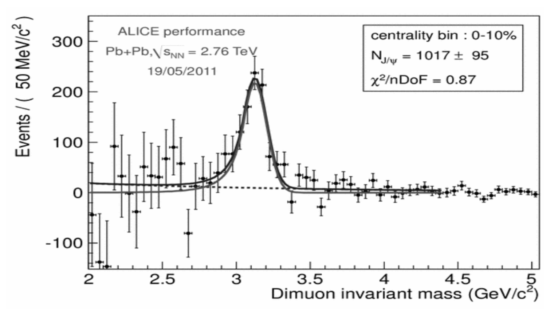

Fig. 3 Invariant mass distribution for opposite-sign muon pairs in Pb-Pb collisions at 2.76 TeV

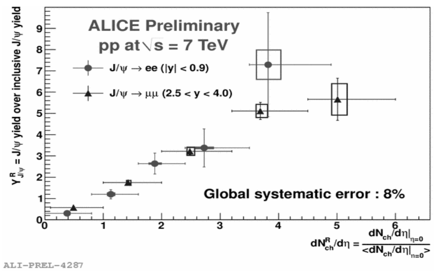

Fig. 4 The J/ Ψ yield divided by the number of events in each multiplicity bin normalized with the total minimum bias yield divided by the number of minimum bias events.

In March 2011, LHC provided p-p collisions at √s = 2.76 TeV, the same energy as for Pb-Pb collisions. The analysis of this data will provide essential reference data to measure nuclear modification factor (R_{AA}) of J/Ψ production in Pb-Pb collisions.

In this report, we are presenting an analysis of p-p data at the centre of mass energy 2.76 TeV.

The physics motivation of this study is to investigate J/Ψ → $\mu^+ \mu^-$ and single-μ analysis in the ALICE muon spectrometer as a function of the charged particle density measured via the multiplicity, defined as number of tracklets in the ALICE Silicon Pixel Detector (SPD) in p-p collisions. This study has been done at √s = 7 TeV [1] already.

ALICE Detector

The ALICE experiment consists of two main parts: central barrel and muon spectrometer.

For this analysis, the relevant data came from the following detectors: the central barrel detectors Inner Tracking System (ITS), Time Projection Chamber (TPC); muon spectrometer and forward detector VZERO.

The ITS consists of six layers and the innermost layer comprises of two SPD of radii 3.9 and 7.6 cm respectively surrounding the central beam pipe. The ITS was used to precise track reconstruction and vertex identification close to interaction point and track particles down to p_T of about 100 MeV/c covering pseudo rapidity $|\eta| \leq 0.9$. The pixel layers of SPD are used to measure the charged particle multiplicity. The muon spectrometer detects muons with a momentum larger than 4 GeV/c. The VZERO detector scintillator hodoscopes are placed on either side of the interaction region (A and C) and used for trigger requirement. The details of ALICE detector has been described in [2].

Data Collection &Triggers

The data has been taken from the period of March, 2011 and performed with the reconstruction pass2 filter. The list of 18 runs has been analyzed. All the events selected passed the Physics Selection conditions and two Triggers were analyzed: CINT1B (Minimum Bias events) and CMUS1B (Single Muon events).

The CINT1B trigger is defined as a hit in the SPD or in either one of the VZERO detectors i.e. V0A or V0C. The CMUS1B (Single Muon) defines as at least one signal in the trigger chambers of muon spectrometer is required to be coincidence with CINT1B.

Analysis

The analysis of the data has been performed using GRID facility and AliRoot platform.

The multiplicity is being studied taking care of full acceptance of the SPD on each event and the position of the vertex along the beam line $|z| < 10$ cm is to be required. The real charged particle density $dN_{ch}/d\eta$ would be corresponding multiplicity corrected by the ratio N_{gen}/N_{det} and divided by the η range. N_{gen}/N_{det} can be obtained using simulations of the SPD, giving the number of generated charged particles versus number of reconstructed tracklets in the same acceptance.

The official ALICE performance plots for J/Ψ → $\mu^+\mu^-$ as function of Multiplicity in p-p collision at 2.76 TeV are in progress.

References

[1] M. Lenhardt et al., ALICE Internal Notes, 2010.

[2] K. Aamodt et al., (ALICE Collaboration), J. Instrum 3, S08002, 2008.