# Recent results on quarkonium production in Pb–Pb collisions in Run 3 with ALICE

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## Introduction

The main goal of ultra-relativistic heavy-ion collisions is to study the quark-gluon plasma (QGP), a state of matter where quarks and gluons are deconfined. Normal nuclear matter (quarks and gluons are confined in hadrons) at the extreme energy densities and temperatures undergoes a transition into a QGP. Relativistic Heavy Ion Collider (RHIC) and Large Hadron Collider (LHC) explore the high temperature and low baryon chemical potential ($\mu_{\rm B}$) region of the phase diagram. In this context, quarkonium production plays a special role and it is used as a probe for the QGP formation. Quarkonium states are expected to be dissociated in a QGP medium by color screening [1] or dissociation [2]. The regeneration mechanism, described dynamically within the QGP [3] or by thermal weights at the phase boundary [4], is an important ingredient for describing the J/$\psi$ production at LHC energies [5].

The ALICE Collaboration has studied J/$\psi$ and $\psi$(2S) production at forward rapidity (2.5 $< y <$ 4) in the $\mu^+\mu^-$ decay channel in Pb–Pb collisions at $\sqrt{s_{\rm NN}} = 5.36$ TeV using Run 3 data. The analysis was carried out by using the new computing scheme for Run 3 which replaces the traditionally separate online and offline frameworks by a unified one, which is called O$^2$. Inclusive charmonium measurements have been carried out down to zero $p_{\rm T}$ in forward rapidity regions. In this contribution, inclusive J/$\psi$ and $\psi$(2S) production will be discussed.

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## Results

The J/$\psi$ and $\psi$(2S) raw yields were determined from the invariant mass distribution of unlike-sign (US) dimuons using two methods. In the first one, the US dimuon invariant mass distributions were fitted with the sum of a signal and a background functions. In the second approach, the background, estimated using an event-mixing technique and normalised using the like-sign dimuon distributions [5–7], was subtracted and the resulting spectra were fitted with the sum of a signal function and a small residual background component. The smaller plot in Figure 1 shows the invariant mass spectrum of J/$\psi$ along with the mixed-event background. The larger plot in Figure 1 represents the invariant mass and corresponding fits to J/$\psi$ and $\psi$(2S) based on the invariant mass spectrum shown in the smaller plot, after subtracting the mixed-event background.

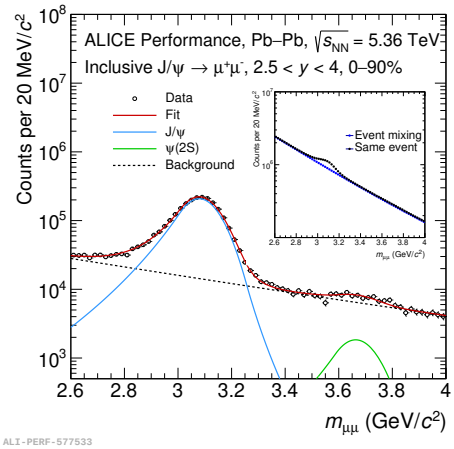


FIG. 1: Small plot: Invariant mass spectrum of J/$\psi$ along with the mixed-event background. Large plot: Fit to the invariant mass spectrum of J/$\psi$ and $\psi$(2S) after mixed-event background subtraction.

## Summary and outlook

The inclusive production of charmonia ($J/\psi$ and $\psi(2S)$) is measured at forward rapidity in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.36$ TeV from Run 3 data using $O^2$ framework. The $J/\psi$ and $\psi(2S)$ signals are clearly visible from centralilty (0-90%), $p_T$ and rapidity integrated invariant mass spectrum after the mixed-event background subtraction. The Muon Forward Tracker (MFT) which was installed during the LHC Long Shutdown 2 and participated in Run 3 data taking will substantially improve the performance of the Muon Spectrometer and open the path to new measurements not accessible previously in Run 1 and Run 2. These include the separation of open charm/beauty and the measurement of $J/\psi$ from b-hadron decays. Separation of prompt and non-prompt $J/\psi$ and $\psi(2S)$ using MFT is ongoing. Stay tuned for new measurements of prompt and non-prompt $J/\psi$ and $\psi(2S)$ production at forward rapidity.

## Acknowledgments

B. Paul is very grateful for the financial support by the Science and Engineering Research Board (SERB) of India.

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