



Contribution ID: 94

Type: Oral presentation

## Charmonium production in Pb–Pb collisions with ALICE

Thursday, 7 April 2022 14:40 (20 minutes)

Charmonium production is a direct probe of deconfinement in heavy-ion collisions. For  $J/\psi$ , a bound state of  $c\bar{c}$  quarks, its (re-)generation within the QGP or at the phase boundary, is found to be the dominant production mechanism at low transverse momentum ( $p_T$ ) and in central Pb–Pb collisions at the LHC energies. The relative production of the  $\psi(2S)$  excited state with respect to the  $J/\psi$  is one possible discriminator between the two different regeneration scenarios. In addition, the non-prompt component of  $J/\psi$  production from b-hadron decays allows one to access the interaction of b-hadrons with the QGP down to low transverse momentum. In this talk, we present for the first time new results on the  $\psi(2S)$ -to- $J/\psi$  double ratio in Pb–Pb collisions at  $\sqrt{s_{NN}} = 5.02$  TeV with respect to a new pp reference with improved precision, thanks to a new Run 2 data sample with an increase of the statistics collected by a factor 10. The combined Run 2 data set of ALICE allows the extraction of a significant  $\psi(2S)$  signal in central Pb–Pb collisions at forward rapidity down to 0 transverse momentum. The  $\psi(2S)$  nuclear modification factor  $R_{AA}$  as a function of  $p_T$  and centrality will also be shown, as well as the inclusive  $J/\psi$   $R_{AA}$  at forward rapidity. At midrapidity, the inclusive, prompt and non-prompt  $J/\psi$   $R_{AA}$  as a function of centrality and  $p_T$  will be presented, based on the full Run 2 statistics. The extraction of the non-prompt  $J/\psi$  fraction extends down to very low  $p_T$  and its precision is improved significantly compared to the previous publications. Additionally, the measurements of inclusive, prompt and non-prompt  $J/\psi$  in p–Pb collisions will be discussed in view of the interpretation of the Pb–Pb data. All the results will be compared with model calculations.

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**Session Classification:** Parallel Session T11: Heavy flavors, quarkonia, and strangeness production

**Track Classification:** Heavy flavors, quarkonia, and strangeness production