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Quarkonium production in heavy-ion collisions

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The production of quarkonium states in heavy-ion collisions plays a crucial role among the probes to investigate the formation of a plasma of quarks and gluons (QGP). In a hot and deconfined medium quarkonium production is expected to be significantly suppressed, due to color screening mechanism, with respect to the p-p yield scaled by the number of binary nucleon-nucleon collisions. Such a suppression was indeed observed first at SPS and then at RHIC experiments and it was found to be significantly larger than the one due to cold nuclear matter effects, as shadowing and absorption in nuclear matter. In spite of the different center of mass energy of the two accelerators, the observed suppression patterns present similar features. To explain this unexpected behaviour, other additional mechanisms as J/ψ production via (re)combination of charm and anti-charm quarks were proposed.

Now, after more than 25 years since the first quarkonium studies in heavy ion collisions, the Large Hadron Collider (LHC) provides a new wealth of data, opening a new energy regime for the study of quarkonium. At $\sqrt{s_{NN}}$ = 2.76 TeV, the charm quark density produced in the collisions is expected to increase dramatically with respect to SPS and RHIC and this may result in the enhancement of the probability to create J/ψ from combination of charm quarks in the QGP. This additional production mechanism may, at LHC, become dominant and, therefore, counteract, in certain kinematic regions, the J/ψ suppression in the QGP. High quality results from ALICE, ATLAS and CMS should allow to shed some light on these mechanisms.

Furthermore at LHC, other quarkonium states, as the Υ(1S), Υ(2S) and Υ(3S), which were barely accessible at lower energies, can be studied in details. Bottomonia states, being less affected by cold nuclear matter effects and regeneration, turn out to be golden probes providing information towards a comprehensive description of the quarkonia behaviour in the extremely hot medium.