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Quarkonium production in pp collisions with ALICE at the LHC

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Quarkonia are mesons formed of either a charm and anti-charm quark pair (J/ψ, $\psi(2S)$), or a beauty and anti-beauty quark pair (Υ(1S), (2S) and (3S)). In high-energy hadronic collisions such as those delivered by the LHC between 2010 and 2016, quarkonium production results from the hard scattering of two gluons in a process which occurs very early in the collision followed by the hadronization of the heavy quark pair in a bound state. In pp collisions, quarkonium measurements help characterize production mechanisms. These same measurements also provide a reference baseline for p-A and A-A measurements which in turn quantify cold and hot nuclear properties of the Quark-Gluon Plasma (QGP). While charmonia are produced rather abundantly in such collisions, interpreting the measurement of their inclusive production is complicated by the presence of a sizable non-prompt contribution from the decay of b-hadrons. Bottomonia on the other hand have much smaller production cross sections but no non-prompt contribution. Moreover, their heavier mass makes them more suitable for perturbative QCD calculations.

In this presentation we will report on forward rapidity ($2.5 < y < 4$) J/ψ and $\psi(2S)$ production measured in pp collisions at center of mass energies $\sqrt{s} = 5.02$ and 13 TeV, using data collected at the LHC in 2015. Together with similar measurements performed at $\sqrt{s} = 2.76$, 7 and 8 TeV, these results constitute a stringent test for models of charmonium production. In particular, they will be compared to NRQCD and FONLL calculations, which describe prompt and non-prompt charmonium production respectively. Results on forward-rapidity Υ production in pp collisions will also be discussed.
The availability at the LHC of the largest collision energy in pp collisions allows a significant advance in the measurement of J/ψ production as function of event multiplicity. The interesting relative increase of the J/ψ production rate in high multiplicity pp collisions observed with data at the LHC at s√=7 TeV and at RHIC at s√=200 GeV is studied now at unprecedented multiplicities for pp collisions. This will impose tight constrains on model calculations and improve the understanding on the origin of this enhancement. The newest measurement performed at mid-rapidity in pp collisions at s√ = 13 TeV in the dielectron decay channel, facilitated by triggering on high-multiplicity events, allows the comparison to J/ψ production in p-Pb collisions at similar multiplicities.
We will compare our newest measurements on the J/ψ yields as a function of event multiplicity in pp collisions at s√ = 13 and 5.02 TeV to those obtained in p-Pb collisions at sNN¯¯¯¯√ = 5.02 TeV at mid- and forward rapidity and at sNN¯¯¯¯√ = 8.16 TeV at forward rapidity.
The results will also be discussed in comparison to predictions from available theoretical models and to data at lower energies.

Experimental Collaboration

ALICE Collaboration

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