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Fixed target charmonium production with proton and lead beams at LHC

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The possibility to study the production of J/ψ mesons in the fixed target experiments with proton and lead beams at LHC has been investigated. At SPS energies the normal nucleus suppression of J/ψ in proton-nucleus collisions and anomalous suppression in central lead-lead collisions was observed in NA50 experiment. The anomalous suppression for central indium-indium events at SPS was confirmed by NA60 experiment. PHENIX experiment at RHIC shows that the J/ψ suppression in Au-Au and Cu-Cu collisions at 200 GeV in nucleon-nucleon centre of mass system is of the same order as the suppression at SPS energies. There is no theoretical models now that could reproduce all the data. Future experiments at much higher energies at ALICE, LHC could produce the charmonium and bottomonium families and possible suppression pattern can be studied. However an energy interval between SPS, RHIC and LHC is very important to study the mechanism of quarkonium production and suppression, to investigate medium effects and conditions for Quark Gluon Plasma formation.

We suggest to plan at LHC fixed target experiment for charmonium production at the energy range between SPS and RHIC in p-A and A-A collisions with planning proton beam at T=7 TeV (sqr s = 114.6 GeV) and Pb beam at 2.75 TeV (sqr s = 71.8 GeV). This is unique possibility to clarify the mechanism of charmonium, J/ψ and ψ' production, to separate two possibilities: i): hard production and suppression in QGP and/or hadronic dissociation or ii): hard production and secondary statistical production with recombination, since the probability of recombination decreases with decreasing energy of collision in thermal model.

As it was already used for the experiment on a collider with a fixed target at HERA-B, the target in the form of thin ribbon could be placed around the main orbit of LHC. The life time of the beam is determined by the beam-beam and beam-gas interactions. Therefore after some time the particles will leave the main orbit and will interact with target ribbon. So for the fixed target experiment at LHC only halo of the beam will be used. Hence no deterioration of the main beam will be introduced. The experiments at different interaction points will not feel any presence of the fixed target.

The geometrical acceptances for the J/ψ production, luminosity and counting rate estimations for measurement at LHC with the fixed target are calculated and discussed.

Summary

The possibility to study the production of J/ψ mesons in the fixed target experiments with proton and lead beams at LHC has been investigated.

We suggest at LHC a fixed target experiment for charmonium production at the energy range between SPS and RHIC in p-A and A-A collisions with planning proton beam at T=7 TeV (sqr s = 114.6 GeV) and Pb beam at 2.75 TeV (sqr s = 71.8 GeV). This is unique possibility to clarify the mechanism of charmonium, J/ψ and ψ' production.

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