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Model study on bottomonia modification in small collision systems

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Quarkonia have been long considered as key features in heavy ion collision to study the properties of the quark-gluon plasma. One of the key signatures is the sequential yield suppression for different quarkonium states in nucleus-nucleus (A+A) collisions compared to p+p collisions following the ordering of their binding energies. Moreover, sequential yield modification has also been observed in small collision systems such p+Au and p+Pb collisions. Theoretical models consider dissociation and regeneration effects to describe these experimental results, whereas the additional suppression of excited states in small systems is considered to be beyond initial-state effects which is premature to claim for any hot medium effect. To quantitatively test and disentangle such hot medium effects, a model study is performed in various small collision systems such as p+p, p+Pb, p+O, and O+O collisions for $\Upsilon(nS)$ production. In this model, we incorporate a theoretical calculation of hot in-medium effects for $\Upsilon(nS)$ states into a Monte Carlo simulation to more realistically probe the medium produced in heavy ion collisions with event-by-event initial collision geometry and hydrodynamical evolution. The theory calculation considers gluo-dissociation and inelastic parton scattering for dissociation and their inverse reaction for regeneration and reasonably describes the modification of $\Upsilon(1S)$ in Pb+Pb collisions. In this work (Phys. Rev. C 107, 054905 (2023)), we quantify the nuclear modification factor of $\Upsilon(nS)$ as a function of charged particle multiplicity ($dN_{ch}/d\eta$) and transverse momentum. We also calculate the elliptic flow of $\Upsilon(nS)$ in small collision systems. The results are compared with existing experimental results and discussed in terms of prospects for the upcoming LHC oxygen ion run.

Category

Theory

Collaboration (if applicable)

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