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Enhanced ψ ′ yield and ψ ′ / (J / ψ) yield ratio as a possible signature of QGP formation in high multiplicity p + p p+p collisions

Suppression in the yield of quarkonia (heavy quark-antiquark bound states) has been considered one of the important signatures of the formation of the thermalized deconfined partonic matter, also known as the Quark Gluon Plasma (QGP), in Relativistic Heavy Ion Collision Experiments (RHICE). Traditionally, the in-medium dissociation of quarkonium states has been presented by implicitly assuming an adiabatic approximation, which considers that the heavy quark Hamiltonian changes slowly over time owing to change in the medium. However, in high multiplicity smaller systems, such as in p+p collisions, the early development of transverse flow resulting from the finite transverse size of the locally thermalized medium may cause the quarkonium states to undergo a non-adiabatic evolution. It has been argued that in the presence of such a non-adiabatic evolu tion, the suppression of heavy quark-antiquark bound state yields may not reliably indicate QGP formation [1]. We propose that, rather than concentrating on the suppression of J/ψ yields, the enhancement in the yield ratio of ψ′ to J/ψ (i.e., ψ′/(J/ψ)), along with an increase in ψ′ yield, should be considered as a probe of QGP formation for small systems. Our findings, based on real istic modeling of the time evolution of small systems, suggest that the yield ratio ψ′/(J/ψ) and the yield of ψ′ increase as a function of hydrodynamization temperature incorporating the non-adiabatic transitions in high multiplicity p + p collisions.

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