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Quarkonia Yield Modification in Ultra-relativistic p-p Collisions Questioning the baseline for heavy-ion Collisions: A Quark Gluon Plasma Saga

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The strongly interacting quarks and gluons plasma (QGP) phase is a must to exhibit the collective behavior. Experimental observations from heavy-ion collisions at the Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC) revealed such collective phenomena. Additionally, intriguing features like strangeness enhancement further support the existence of QGP in these collisions. The p+p collision system has traditionally served as a baseline for heavy-ion collisions due to its lower particle number density. However, the possibility of QGP-like behavior in small systems cannot be entirely dismissed, especially at high collision energies. Recent investigations at LHC energies have even detected collective behavior and strangeness enhancement in p+p collisions. In this context, we focus on charmonia yield modification as a probe for QGP-like effects in p+p collisions at center-of-mass energies 5.02, 7, and 13 TeV. We employ second-order viscous hydrodynamics to the Unified Model of Quarkonia Suppression (UMQS) to interpret experimental data related to normalized charmonium yield with respect to the normalized charged-particle multiplicity. The UMQS model incorporates QGP effects such as color screening, collisional damping, gluonic dissociation, and regeneration, all of which influence the net quarkonia yield in ultrarelativistic collisions. Additionally, we also observe the influence of medium anisotropy on the above-mentioned QGP effects. This investigation sheds light on the intriguing interplay between QGP-like phenomena and small collision systems, offering valuable insights into the fundamental properties of the strong force under extreme conditions.

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