

## From Quark to $J/\psi$ : Probing the Strong Interaction Realm at RHIC-STAR

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### Abstract: From Quark to $J/\psi$ : Probing the Strong Interaction Realm at RHIC-STAR

Quantum Chromodynamics (QCD) serves as the foundational theory of the strong interaction, governing the behavior of quarks and gluons. The production of  $J/\psi$  mesons provides a unique opportunity to explore both perturbative and non-perturbative regimes of QCD, while also serving as a sensitive probe to study the properties of hot and dense quark-gluon plasma (QGP) created in relativistic heavy-ion collisions. In this talk, we present the latest experimental results from the RHIC-STAR collaboration on  $J/\psi$  production in proton-proton collisions, with a focus on the novel measurements of  $J/\psi$  energy correlators, which shed light on the underlying partonic dynamics. Furthermore, we discuss the role of  $J/\psi$  spin observables in heavy-ion collisions as a tool to investigate the in-medium effects and the properties of the QGP. These measurements provide critical insights into the evolution of the strongly interacting matter from initial quark-gluon interactions to the formation of hadronic states.

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