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Exploring System-Size and Energy Dependence of J/ψ production with the STAR experiment

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The suppression of quarkonium production in heavy-ion collisions has long been recognized as a key signature of QGP formation, reflecting the medium's temperature and color-screening properties. However, interpreting the observed nuclear modification factor (R_{AA}) remains challenging due to the interplay between hot-medium effects (dissociation and regeneration) and cold nuclear matter effects. Systematic measurements across different collision systems and energies are therefore essential to disentangle these contributions and deepen our understanding of QGP properties.

In this talk, we present new measurements of the J/ψ R_{AA} as a function of centrality and transverse momentum in O+O collisions at $\sqrt{s_{\rm NN}} = 200$ GeV, together with preliminary results from Au+Au collisions at $\sqrt{s_{\rm NN}}$ = 14.6–27 GeV collected during the RHIC BES-II program. The O+O data probe a unique regime in system size, bridging small (p+p, p+Au) and large (Au+Au, U+U) collisions, and are directly comparable to results from intermediate-size systems such as Cu+Cu and isobar (Ru+Ru, Zr+Zr) collisions. These measurements provide crucial insight into the onset of QGP formation and the nuclear properties across system size and energy. We further discuss the energy dependence of J/ψ R_{AA} from RHIC to LHC energies and compare the results with theoretical model calculations.

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