Probing J/ψ production mechanisms in proton–proton collisions at SPD/NICA energies

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The Spin Physics Detector (SPD) at NICA offers a unique opportunity to investigate heavy quarkonium production in proton–proton collisions at a center-of-mass energy of $\sqrt{s} = 27$ GeV, an energy regime bridging the gap between fixed-target and collider experiments. In this study, we focus on J/ψ production as a promising channel to explore gluon-dominated processes and access the underlying partonic dynamics. The work aims to identify the most sensitive probes and kinematic observables to isolate the dominant production mechanisms at SPD energies. Particular attention is given to leading-order contributions, with a comparative investigation of potential higher-twist effects within both collinear and, where applicable, TMD frameworks. Simulations are performed using the PEGASUS event generator with modern TMDPDFs, and differential distributions such as $d\sigma/dp_T$ and $d\sigma/dy$ are analyzed. These studies are expected to shed light on the relative importance of color-singlet and color-octet channels and guide future measurements at SPD. This study

will help to determine the best experimental observables for shaping spin-dependent particle production mechanisms.