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Transverse analyzing power measurement in the high energy forward $p^{\uparrow}p$ and $p^{\uparrow}A$ scattering at RHIC hydrogen jet target polarimeter

The Polarized Hydrogen Gas Jet Target Polarimeter (HJET) at the Relativistic Heavy-Ion Collider (RHIC) is utilized to accurately measure the vertical polarization of proton beams with low systematic uncertainties of approximately $\sigma_P^{\text{syst}}/P \leq 0.5\%$. These measurements are conducted in the CNI region, $0.0013 < |t| < 0.017$ GeV^2. By measuring the elastic single $A_{\text{N}}(t)$ and double $A_{\text{NN}}(t)$ spin analyzing powers for 100 and 255 GeV proton beams, the contributions from hadronic spin-flip amplitudes were isolated. A Regge fit was performed, revealing a non-zero Pomeron spin-flip component. Preliminary results for inelastic $p^{\uparrow}p$ and elastic $p^{\uparrow}A$ (for d, O, Al, Ru, Zr, and Au nuclei) analyzing powers were also obtained. However, the completion of these studies requires the development of a theoretical parametrization for the corresponding analyzing powers. The successful implementation of HJET at RHIC has prompted its potential use for proton beam polarimetry with a desired accuracy of 1\% at the upcoming Electron-Ion Collider (EIC). The feasibility of using HJET for ^{3}He (h) beam polarimetry at EIC will also be discussed. To accurately measure the helion beam polarization using HJET, knowledge of the hadronic spin-flip amplitudes for the $p^{\uparrow}h$ and $h^{\uparrow}p$ is essential. These amplitudes can be derived with sufficient precision from the proton-proton hadronic spin-flip amplitude determined at HJET. Another potential concern for ^{3}He polarization measurement is the possibility of helion breakup in hp scattering. An estimate of the breakup effect indicates that while it can introduce corrections of up to 4\% to the spin-flip interference terms, these effects cancel out and have negligible impact on the calculating the ^{3}He beam polarization (which depends on the effective $A_{\text{N}}^{ph}(t)/A_{\text{N}}^{hp}(t)$ analyzing power ratio).

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