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cos(2□) and sin(2□-□s) azimuthal spin asymmetries in the pion induced Drell-Yan process

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The Drell-Yan process, involving the annihilation of a quark and an antiquark into a lepton-antilepton pair, provides valuable insights into the structure and dynamics of hadrons. In this study, we focus on the investigation of azimuthal angular asymmetries, specifically the cos(2ϕ) and sin(2ϕ-ϕs) asymmetries, which probe the spin and transverse momentum-dependent properties of the initial-state hadrons. The cos(2ϕ) asymmetry arises from the convolution of two Boer-Mulders functions in an unpolarized π-p Drell-Yan process. It reflects the polarization of the initial-state quarks and antiquarks, providing information on the distribution of quark spins inside the hadrons. Similarly, the sin(2ϕ-ϕs) asymmetry (with ϕs , the azimuthal angle of target transverse spin) can be obtained through the convolution of the Boer-Mulders function of the pion and the transversity distribution of the proton. By analyzing the sin(2ϕ-ϕs) asymmetry, one can extract valuable information about the transverse spin structure of the nucleons and study the role of spin-orbit correlations. We discuss the theoretical framework and formalism employed for the calculation of these asymmetries, taking into account the pion parton distribution functions from the light-front holographic QCD and proton parton distribution functions from light-front quark-diquark model, and we show the comparison with the COMPASS (2017) and other theoretical studies.

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