STAR Results on Transversity and TMD-Related Observables

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Constructing a three-dimensional understanding of the proton's structure has gained much interest. Theoretical frameworks, such as the transverse-momentum-dependent (TMD) framework, have been developed to describe the three-dimensional structure of the proton. In the TMD framework, the proton structure is described in terms of TMD parton distribution functions (PDFs) and fragmentation functions (FFs). Utilizing the transversely polarized proton beams accelerated and maintained by the Relativistic Heavy Ion Collider (RHIC), the Solenoidal Tracker At RHIC (STAR) experiment measures observables sensitive to transversity and TMD physics at $p+p$ center-of-mass energies of 200 and 510 GeV. The transverse single-spin asymmetries (A_N) of electromagnetic jets in the forward direction provide insights into the origin of the large inclusive hadron A_N observed at forward rapidity. The Sivers effect is probed using the shift in the opening angle of dijets and A_N measurements of $W^{\pm}$ and Z^0. The convolution of collinear transversity PDF and the Interference FF is investigated via the spin-dependent di-hadron correlators. The Collins effect describing the convolution of the collinear transveristy PDF and the Collins FF is measured via the azimuthal modulations of identified hadrons in jets. Measurements of $\Lambda(\bar{\Lambda})$ hyperon transverse spin transfer offer insights into the (anti-)strange quark transversity. This talk will discuss these recent STAR highlights and updates related to transversity and TMD physics and provide a brief overview of future STAR measurements.