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Exploring the Quark Transversity and the Collins Fragmentation Functions using Polarized pp Collisions at STAR

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Understanding the internal spin structure of the nucleon still remains a challenge in strong interaction physics. Transversity, which describes the transverse spin structure of quarks in a transversely polarized proton, is still poorly constrained by experimental data. Since it is chiral-odd, it can only be accessed through channels that couple to other chiral-odd distributions, like the Collins fragmentation functions (so-called Collins effect) or the interference fragmentation functions.
Recently, a detailed calculation using the soft-collinear effective theory found that the Collins effect in pp collisions involves a mixture of collinear and transverse momentum dependent (TMD) factorization. The Collins effect provides a direct probe to the Collins fragmentation function and enables testing of its evolution, universality and factorization breaking in the transverse momentum dependent formalism.
In 2018, STAR published the first measurements of Collins asymmetries for charged pions in jets in polarized pp collisions at $\sqrt{s}$ = 500 GeV based on data taken during 2011. These measurements probe Q^2 scales one to two orders of magnitude larger than similar measurements in semi-inclusive deep-inelastic scattering (SIDIS) and the results are consistent with predictions based on global analyses of e^+e^- and SIDIS data.
In 2012 and 2015, STAR collected $\sim$14 pb^{-1} and $\sim$48 pb^{-1} of transversely polarized pp data at $\sqrt{s}$ = 200 GeV, respectively. These datasets provide the most precise measurement of the Collins effect in 200 GeV pp collisions to date, especially at the quark momentum fractions $0.1 \leq x \leq 0.4$. Preliminary results for Collins asymmetries of identified pions, kaons, and protons in jets in pp collisions at $\sqrt{s}$ = 200 GeV and comparisons to theory predictions will be presented.

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