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Transverse Single-Spin Asymmetries for π^0 and Electromagnetic Jets at Forward Rapidities in $p^{\uparrow}$+p Collisions at Center-of-Mass Energies of 200 GeV and 500 GeV at STAR

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There have been numerous attempts, both experimentally and theoretically, to understand the origin of the unexpectedly large transverse single-spin asymmetries (A_N) for inclusive hadron production at forward rapidity in $p^{\uparrow}$+p collisions that persist from low to high center-of-mass energies. Two proposed potential sources are the twist-3 contributions in the collinear factorization and the transverse-momentum-dependent contributions from either the initial-state quark and gluon Sivers functions or the final-state Collins fragmentation function. To investigate the underlying physics leading to this large A_N, we study π^0 A_N with different topologies – isolated and non-isolated, and A_N for electromagnetic jets (EM-jets) of different substructures using Forward Meson Spectrometer (FMS) detector at STAR. Jet A_N is sensitive to the initial state effect and can provide access to Sivers functions. To investigate final-state effects, we measure the Collins asymmetry of π^0 inside EM-jets. We present the most recent results for these asymmetries from $p^{\uparrow}$+p collisions at 200 GeV and 500 GeV. We also present new preliminary results of A_N for EM-jets in FMS and Endcap Electromagnetic Calorimeter (EEMC) using $p^{\uparrow}$+p collisions at 200 GeV where we explore the dependences of A_N on photon multiplicity inside the jet, jet transverse momentum, and jet energy. These results provide rich information towards understanding the physics mechanism of large A_N in hadron collisions.

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