

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

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6 **Abstract**

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