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2 Measurement of transverse single-spin asymmetries of  $\pi^0$  and  
3 electromagnetic jets at forward rapidity in 200 and 500 GeV  
4 transversely polarized proton-proton collisions at STAR

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6 **Abstract**

7 We present recent results of transverse single-spin asymmetries (TSSAs) for neutral pions  
8 using the Forward Meson Spectrometer at STAR in proton-proton collisions at center of mass  
9 energies of 200 and 500 GeV. The results from the two energies show that the pion TSSA  
10 increases continuously with Feynman- $x$ . Comparisons with previous measurements show  
11 that the pion TSSA is mostly independent of collision energy from 20 GeV to 510 GeV. It is  
12 observed that isolated pions with no other particles nearby tend to have larger TSSA than  
13 the non-isolated ones which may suggest novel mechanisms for generating the TSSA. In order  
14 to separate the contributions of initial and final state effects, we also measure the TSSA for  
15 the electromagnetic jets and the Collins asymmetry through the TSSA of neutral pions inside  
16 the electromagnetic jets. The jet TSSA, sensitive to the initial state effect, follows a similar  
17 Feynman- $x$  dependence as the neutral pions, but with a significantly smaller amplitude.  
18 The Collins asymmetry, related to the final state effect, is consistent with zero and shows  
19 evidence of a  $j_T$  dependence, which is the pion transverse momentum with respect to the jet  
20 axis. These results provide rich information towards understanding the physics mechanism  
21 of TSSA in hadron collisions.