Contribution ID: **133** Type: **Parallel Session Presentation**

Transverse Single Spin Asymmetry of Forward Neutrons at PHENIX

Thursday, 21 October 2021 09:34 (18 minutes)

Very forward neutron production cross sections in proton proton collisions are well described by a one pion exchange (OPE) mechanism. However, the simple OPE model alone was not able to explain the large transverse single spin asymmetry (A_N) that was discovered at RHIC in polarized proton proton collisions. An interference between the spin-flip pion exchange and non-flip a_1-Reggeon exchange could create asymmetries, and such a model reasonably describes the measurements.
More interestingly, recent PHENIX measurements in p+A collisions at 200 GeV show surprisingly strong nuclear dependence of A_N, resulting from the interplay of different neutron production mechanisms. To understand the mechanisms in detail explicit transverse momentum p_T and longitudinal momentum fraction x_F dependent analyses are performed. In addition, correlation analysis with other detector activity provides additional information on how different interactions contribute to the asymmetry.
For a large phase space coverage in x_F and p_T it is also essential to make the measurements over a wide range of center of mass energy of collisions. PHENIX has taken polarized proton proton collision data at $\sqrt{s}$ = 62, 200, 500 and 510 GeV.
At PHENIX the Zero degree calorimeter (ZDC) is used for neutron detection in conjunction with the Beam Beam Counter (BBC) for tagging various event topologies. We will show results for explicit p_T and x_F dependence of A_N at $\sqrt{s}$ = 200 GeV in $p\uparrow+p$, $p\uparrow+Al$ and $p\uparrow+Au$ collisions. We will also show the current status of the center of mass energy dependence analysis for $p\uparrow+p$ collisions.

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Session Classification: Transverse Momentum Structure (TMD)

Track Classification: Parallel Sessions: Transverse momentum structure (TMD)