Measurement of the cross section and the single transverse spin asymmetry of forward neutrons from p-p collisions at RHIC-PHENIX.

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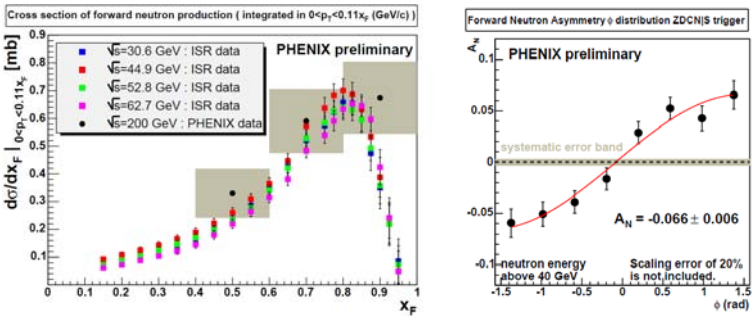
Forward neutron production from p-p collisions has been studied and provided intriguing results. In the ISR experiment on pp-collisions at $\sqrt{s}$=30.6 to 62.7 GeV, the Feynman-x dependence of their neutron cross sections have a quite different shape in the very forward region (p_T~0) and their cross sections scaled well with Feynman-x. One possible explanation of these interesting results is given by the one-pion exchange model.

The Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL) has been operated with polarized proton beams colliding mainly at $\sqrt{s}$=200 GeV. In RUN2 (2001-2002), an unexpected large single transverse spin asymmetry A_N for forward neutrons was discovered at the 12 o'clock interaction point experiment. The measured asymmetry may also be explained by pion exchange, which has a spin flip interaction component. The forward neutron asymmetry can access the spin-dependent terms of neutron production directly and can be a new tool to understand the production mechanism of forward neutrons.

Through 2003-2006, the PHENIX experiment has measured forward neutrons by the Zero-Degree Calorimeter (ZDC) with a position-sensitive Shower-Max Detector (SMD), which covers ±2.8 mrad of the forward and backward directions. The PHENIX experiment has accumulated data at $\sqrt{s}$=62.4, 200, and 410 GeV so far. In the left figure, the neutron cross section at $\sqrt{s}$=200 GeV is plotted along with ISR results, showing that Feynman-x scaling works quite well in this high energy region. In the right picture, a clear forward neutron asymmetry is seen and its ϕ-dependence is fitted by a sine curve.

In this talk, the physics implications will be discussed which arise from the measurement of the neutron cross sections and asymmetries by the PHENIX experiment.



The cross section (left) and the single transverse spin asymmetry (right) of forward neutron production in p-p collision at $\sqrt{s}$=200 GeV.