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Nuclear PDF, Small x Physics Results at RHIC

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The proton gluon distribution function increases rapidly with decreasing momentum fraction x at fixed Q^2, but cannot increase indefinitely as x decreases. Gluon saturation is expected at a low x value when gluon recombination balances gluon splitting. The nuclear (with atomic mass number A) gluon distribution is approximately $A^{1/3}$ larger than the nucleon gluon distribution function at the same x. Understanding the kinematics of gluons in the low x region will provide insights into the nuclear matter origin and improves the knowledge of Quantum Chromodyanmics (QCD) in the non-perturbative region. The Relativistic Heavy Ion Collider (RHIC) can probe gluons with x between 0.001 and 0.02 inside the gold nuclei via forward di-jet or di-hadron measurements. Both STAR and PHENIX experiments have carried out a series of measurements to study the nuclear gluon distribution functions (nPDFs) and observed clear nuclear modification of the gluon PDF in the low x region. Recent studies of forward inclusive hadron, di-hadron, di-jet and heavy flavor measurements in 200 GeV d+Au, p+Au, p+Al and ^{3}He+Au collisions and 500/510 GeV p+p collisions have extended the kinematic region of the probed proton/nuclear gluon distribution function. We will present selected results from RHIC in this talk. Prospects of future measurements from detector upgrades at PHENIX, sPHENIX and Electron Ion Collider (EIC) will be presented as well.

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