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Study of spin structure of the nucleon using a lepton-ion collider

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Construction of a high intensity, high energy polarized lepton beam facility to collide with the polarized proton beams of the existing Relativistic Heavy Ion Collider (RHIC), will allow polarized deep inelastic scattering off protons up to center of mass energies of ~ 100 GeV. The physics potential of such a facility have been studied in various workshops over the years, and will be summarized in this talk. We show that several important and unique measurements in spin physics could only be possible using this facility, eRHIC. They include the spin structure function $g_1(x, Q^2)$ of the proton at low x , precision measurement of the polarized gluon distribution through multiple processes such as scaling violations, di-jet production over a large x range, heavy quark and anti-quark flavor distributions using measurement of parity violating spin structure functions $g_5(x, Q^2)$, parton distributions of the polarized photons and many more. Bjorken spin sum rule, one of the the most fundamental spin sum rules in QCD could also be addressed with unprecedented precision with eRHIC if the polarized $^3\text{He}^{++}$ could be accelerated and stored in the RHIC. As such eRHIC promises extremely significant leaps in our understanding of the nucleon spin structure and of QCD, complementary and often beyond what is possible with RHIC spin and the present fixed target polarized DIS experiments at CERN, DESY and Jlab.