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Probing Dense Gluonic Matter in Nuclei at High Energies

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High energy collisions involving nuclei provide a unique opportunity to study QCD in the strong-field limit. At high energies the Lorentz contraction of the nucleus results in the longitudinal overlap of low-momentum gluons producing a strong, coherent gluon field with large occupation numbers, characteristic of classical fields. In the context of parton distribution functions, the large gluon density in the contracted nucleus is expected to make non-linear recombination effects in the evolution of the gluon distribution, $g(x, Q^2)$, at low x dominant below some resolution scale, $Q^2 < Q_s^2$. This "satuation" of the low-x parton distributions is a direct consequence of unitarity in the strong-field limit of QCD. Results from HERA suggest that saturation is already seen in deep-inelastic scattering on the proton, and extrapolations of the extracted saturation scale, Q_s to large nuclei suggest that saturation may play an important role at RHIC in the production of forward jets in deuteron-Au collisions and in limiting the multiplicity of produced particles in Au+Au collisions. I will present the results of such measurements from RHIC and will discuss future measurements at RHIC, the LHC and a future electron-ion collider that will provide new insight on the strong-field limit of QCD.