TERA: eA Observables for new QCD phenomena

M.Strikman, PSU

Prime Objective - study QCD in the limit of high parton densities deep into the region where large screening effects and presence of nonlinear dynamics is expected and regime of interaction with nearly black target is possible.

Observables:

• *Scaling violation for the ratio*

$R_{2A}(x, Q^2) = \frac{2}{A} F_{2A}(x, Q^2)/F_{2D}(x, Q^2)$,

study of gluon shadowing via dijet production in $\gamma + A$ scattering.

Qualitative Expectation in nonlinear regime: slower increase of F_{2A} with increase of Q^2 for larger A.

$\Longrightarrow$ amplified version of the Caldwell plot for heavy nuclei, and decrease of $R_{2A}(x, Q^2)$ with increase of Q^2.

• *Measurement of the A-dependence of* σ_L.

More sensitive to the gluon channel and hence larger non-linear effects are expected.

- *Exclusive Diffraction*

Two simplest (theoretically) observables are ρ and J/ψ elastic production off nuclei. This does not require detection of in the nucleus direction since the peak is very narrow and one can use also information about lack of neutrons.

Expectation is that when $x \leq 10^{-3}$ one will reach regime of color opacity: The cross section will be strongly suppressed as compared with a naive color transparency expectation:

$$\sigma_A(t) \propto A^2 F_A^2(t) \sigma_N(t),$$

where $F_A(t)$ is the nucleus form factor.

Other way to address this question is to study the energy dependence of say J/ψ production for a given nucleus. The expectation is that in the screening regime the fast growth will turn to a nearly energy independent behavior. Study of this pattern as a function of Q^2 would provide a sensitive test of interplay of opacity and transparency.

Main practical questions are counting rate and acceptance.

Our estimates indicated that at HERA one would need 10 pb$^{-}1$ per nucleus.

- *Inclusive Diffraction*

This is direct test of the degree of blackness of interaction.

Expectation: probability of coherent diffraction for heavy nuclei is close to 50% and somewhat different for the gluon and quark channels. At TERA one can in principle study dynamics of nearly black interactions as a function of x, Q^2 and for different triggers.

- *Fluctuations of the central multiplicity*

Another useful observable is study of the fluctuations of multiplicity for central rapidities - expectation is that the fluctuations of multiplicity should increase with A and be of long range in rapidity. It appears that the current detectors will have good acceptance in this region.