XXVII International Workshop on Deep Inelastic Scattering and Related Subjects

Contribution ID: **265** Type: **Parallel Session Talk**

Gradient corrections to the classical McLerran-Venugopalan model

Tuesday 9 April 2019 09:50 (20 minutes)

In the Color Glass Condensate framework the profile of the target is modelled by the saturation scale, $Q_s(\vec{b})$. In the literature it is commonly assumed that the length scale of the fluctuations of the saturation scale, $l_{fluc.}$, is large. One implication of this approximation is that the gluon dipole cannot couple to gradients of the saturation scale. Using the McLerran-Venugopalan (MV) model in the classical limit we find that there are two different ratios of relevance to the suppression of gradient corrections, the ratio of the length scale of the fluctuations to the quantum cutoff, $\frac{1}{l_{fluc.}\Lambda_{QCD}}$, and to the size of the gluon dipole, $\frac{r_{dip.}}{l_{fluc.}}$. In large system where $\frac{1}{l_{fluc.}\Lambda_{QCD}} \ll 1$ the quantum scale successfully cuts off all the gradient corrections. In small systems or systems with large gradients, $\frac{1}{l_{fluc.}\Lambda_{QCD}} \sim 1$, the gradient expansion is controlled by the size of the gluon dipole, $\frac{r_{dip.}}{l_{fluc.}}$. We find that when $\frac{r_{dip.}}{l_{fluc.}} \ll 1$ all but the second harmonic (quadrupole moment) are suppressed. This means that there is no justification for ignoring coupling to the gradients of the saturation scale. We finish by calculating the leading order gradient contribution to the classical McLerran-Venugopalan model for a gaussian distribution.

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Session Classification: WG2: Small-x and Diffraction

Track Classification: WG2: Low-x and Diffraction