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One-to-One correspondence of soft and hard Pomeron with the CDP of the gluon density at low x

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In Figure 1 we compared the behavior of the gluon distribution with respect to the color dipole picture (CDP) asymptotic limit and the parametrization of the proton structure function for $1\ \mathrm{GeV}^2 \leq Q^2 \leq 100\ \mathrm{GeV}^2$

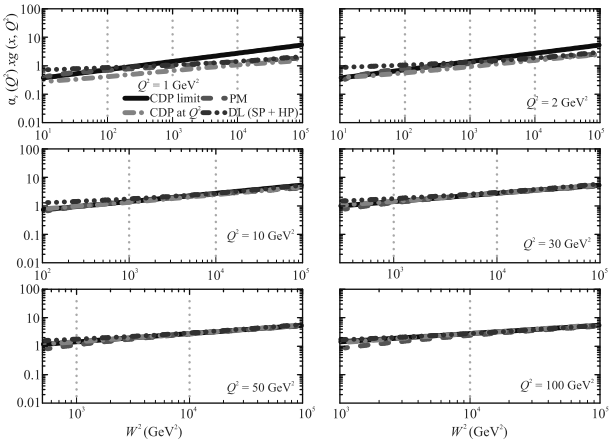

Fig. 1. (Color online) $\alpha_s(Q^2)xg(x,Q^2)$ as a function of W^2 for various values of Q^2 in the CDP asymptotic limit (solid curve), PM (dashed curve) and soft-hard Pomeron model (SP + HP) (dased-dot-dot curve)

in a wide range of W^2. In this figure we compared the results the Regge behavior with the parametrization model and the CDP predictions. The parametrization model is comparable with the Regge behavior at low and large Q^2 values and it is comparable with CDP at moderate and high Q^2 values. In this figure, the Regge behavior is defined into the soft and hard Pomeron behaviors. The behavior of the two-Pomeron approach converge towards the CDP and parametrization models at $Q^2 \gtrsim 10\ \mathrm{GeV}^2$. Consistency between results for moderate and large Q^2 values shows that two-Pomeron approach leads to the CDP asymptotic limit where it is free of Q^2 parameters. This indicates that the Regge model must have at least two parameters or more to match the models. In [1] two-Pomeron-plus-Reggeon approach fitted to the experimental data on the deep-inelastic lepton-nucleon scattering at low values of x and consistency with the CDP is introduced in [2–4]. In fact, we have shown that in order to converge the CDP results with the Regge theory, it is necessary to introduce the Regge theory with two-Pomeron approach. In conclusion, we have studied the effects of soft and hard Pomeron (SP, HP) in relation to the CDP and parametrization models (PM). We determined the gluon distribution function (multiplied by $\alpha_s(Q^2)$) from our representation of the photoabsorption cross section in the CDP and compared with the results of the parametrization of the proton structure function and the soft and hard Pomeron in the structure function of the proton. It turned out that the gluon function at order $\alpha_s(Q^2)$ is proportional to the proton structure function at a shifted scale $x \to \xi_L x$. The parametrization and CDP results have similar behavior at $10\ \mathrm{GeV}^2 \leq Q^2 \leq 100\ \mathrm{GeV}^2$. We have found that the Regge like behavior of the proton structure function with a SP and HP and also tensor-Pomeron (TP) approach improve the description of the gluon behavior at $10\ \mathrm{GeV}^2 \leq Q^2 \leq 100\ \mathrm{GeV}^2$. The SP and HP results confirm the predictions of the CDP and this is requiring consistency of the CDP and perturbative Quantum Chromodynamics (pQCD) for $Q^2 \gtrsim 10\ \mathrm{GeV}^2$.

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