A Complementary Approach to DIS at low-x

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Starting Point

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(successfully describes many hadronic processes)

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Discrete Regge trajectories (Pomeron) expected to dominate structure functions at sufficiently low-x

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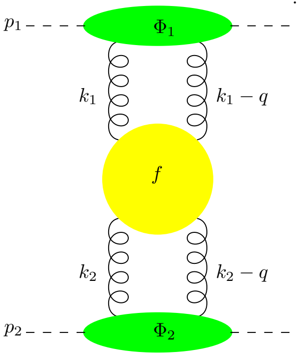
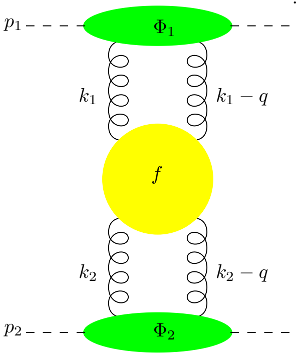
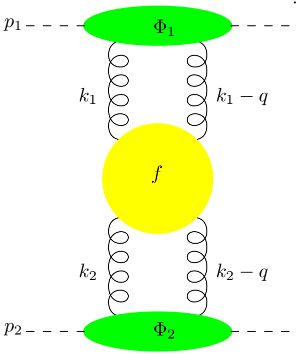
Purely perturbative NLO BFKL equation including effects of running coupling leads to a Regge cut - continuum spectrum of trajectories.


p_1
Φ_1
k_1
$k_1 - q$
f
k_2
$k_2 - q$
p_2
Φ_2



$$\mathcal{K} \bullet \phi(k) = \omega \phi(k)$$



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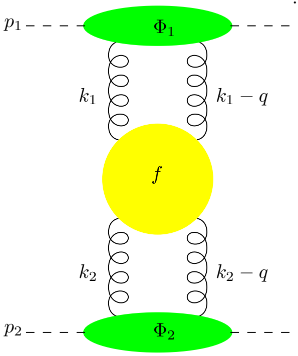
Coupling runs with k



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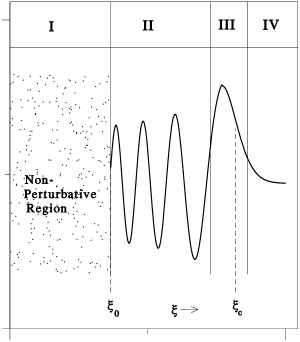
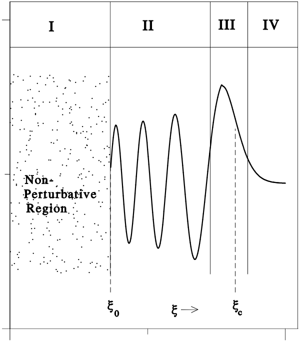
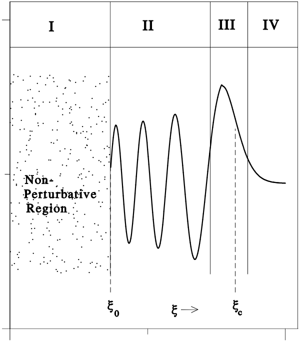
Coupling runs with k
Assume that at some low-$k = k_0$, IR (non-perturbative) features of QCD fix the phase, η of eigenfunctions.
(Lipatov '86)


I
II
III
IV
Non-
Perturbative
Region
ξ_0
$\xi \longrightarrow$
ξ_c



Only discrete values of ω respect the IR boundary phase AND transition at $\xi = \xi_c$ $\quad (\xi = \ln(k))$



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Leads to a discrete spectrum of Regge poles

$$\sum_i f_{\omega_i}(k^2) s^{\omega_i}$$

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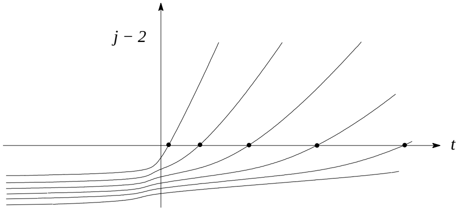

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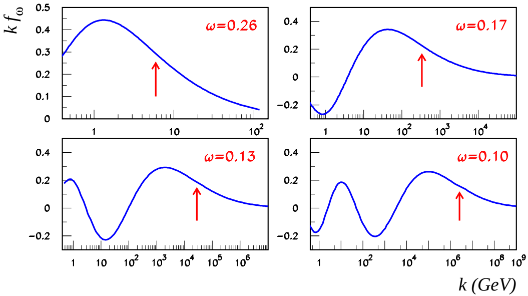

Leads to an un-integrated gluon density:

$$g(x,k) = \sum_i f_{\omega_i}(k) x^{-\omega_i} \int dk' f^*_{\omega_i}(k') \Phi_p(k')$$

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$$g(x,k) = \sum_i f_{\omega_i}(k) x^{-\omega_i}$$

For $x < 10^{-2}$ it is sufficient to use only first three terms in this series.

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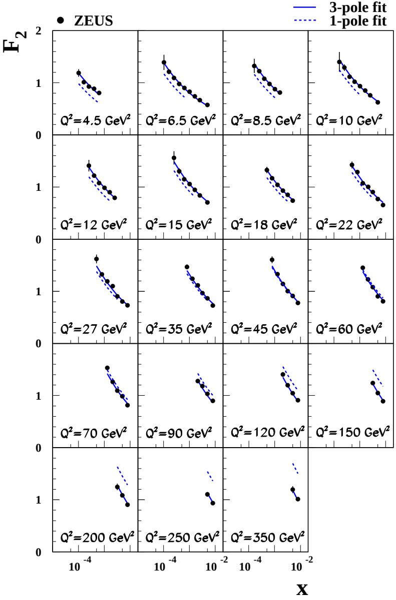
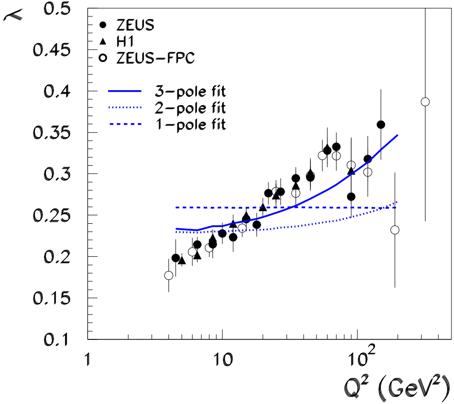
Nevertheless we are able to fit HERA data for $x < 10^{-2}$



ZEUS
3-pole fit
1-pole fit
F2
x
Q²=4.5 GeV²
Q²=6.5 GeV²
Q²=8.5 GeV²
Q²=10 GeV²
Q²=12 GeV²
Q²=15 GeV²
Q²=18 GeV²
Q²=22 GeV²
Q²=27 GeV²
Q²=35 GeV²
Q²=45 GeV²
Q²=60 GeV²
Q²=70 GeV²
Q²=90 GeV²
Q²=120 GeV²
Q²=150 GeV²
Q²=200 GeV²
Q²=250 GeV²
Q²=350 GeV²

$$F_2(x,Q^2) \sim \left(\frac{1}{x}\right)^{\lambda(Q^2)}$$



Uncertainties in Gluon distribution at low-x

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Lowest value of x:

$$x \sim \frac{p_T^{min}}{\sqrt{s}} > 10^{-2}$$

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Large uncertainties in low-x gluon distribution, although consistent with a given parametrization at some input Q_0^2

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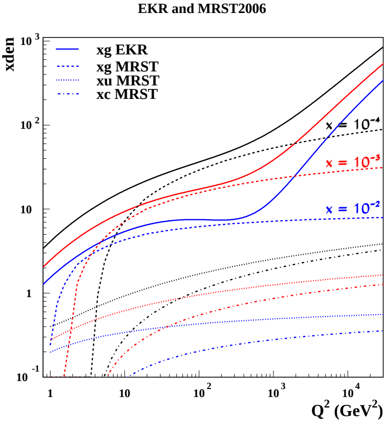

Preliminary: (Factorization scheme to be sorted out)

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LHC is expected to probe low-x gluon distribution directly, and should distinguish between these two approaches.