Regge in exclusive electro-production (e.g. DVCS, meson production)

Adam Szczepaniak
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- Adam Szczepaniak, J.T. Londergan, Phys.Lett. B643,17 (2006)

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- Why ?

- there exist "regge motivated" parametrizations of gpd's, but are they properly "motivated"

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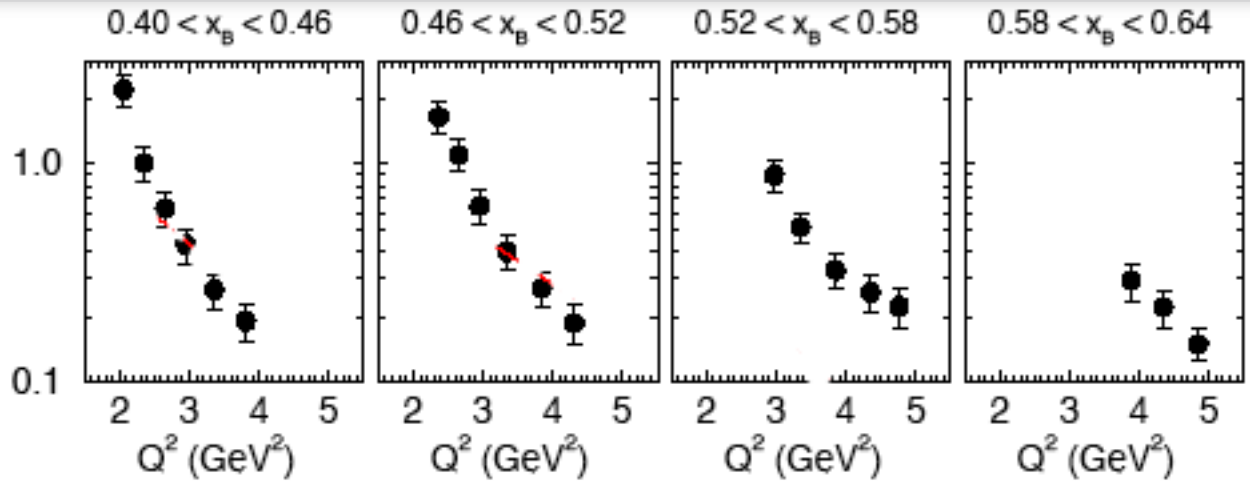

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scaling (collinear factorization)

$$n = 3$$

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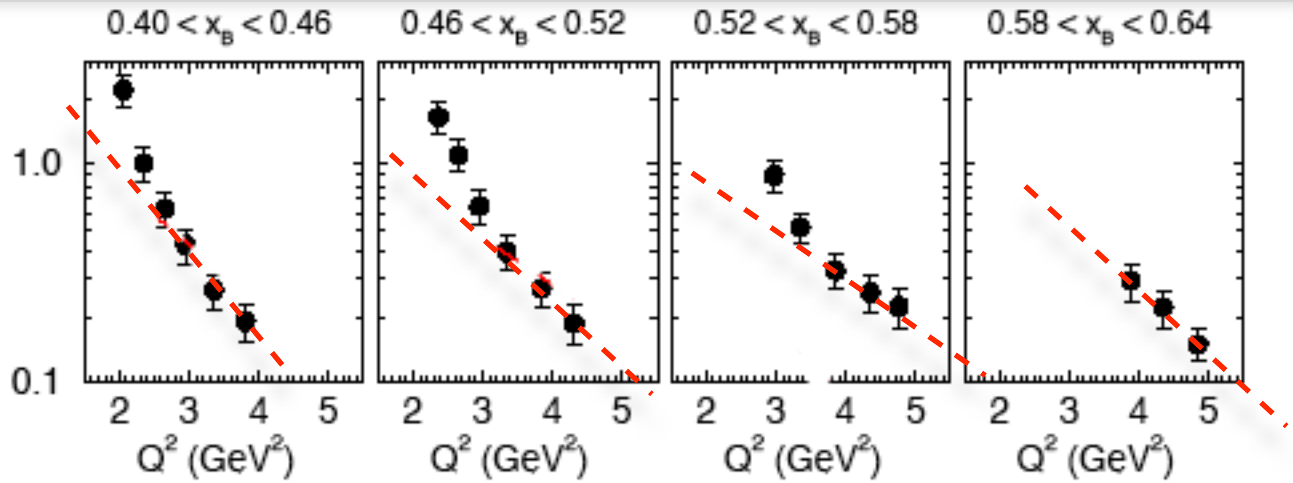

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$n \sim 1.7$

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3.7 E00-110

Deeply Virtual Compton Scattering at 6 GeV

C.E. Hyde-Wright, P.-Y. Bertin, R. Ransome and F. Sabatié, spokespersons,
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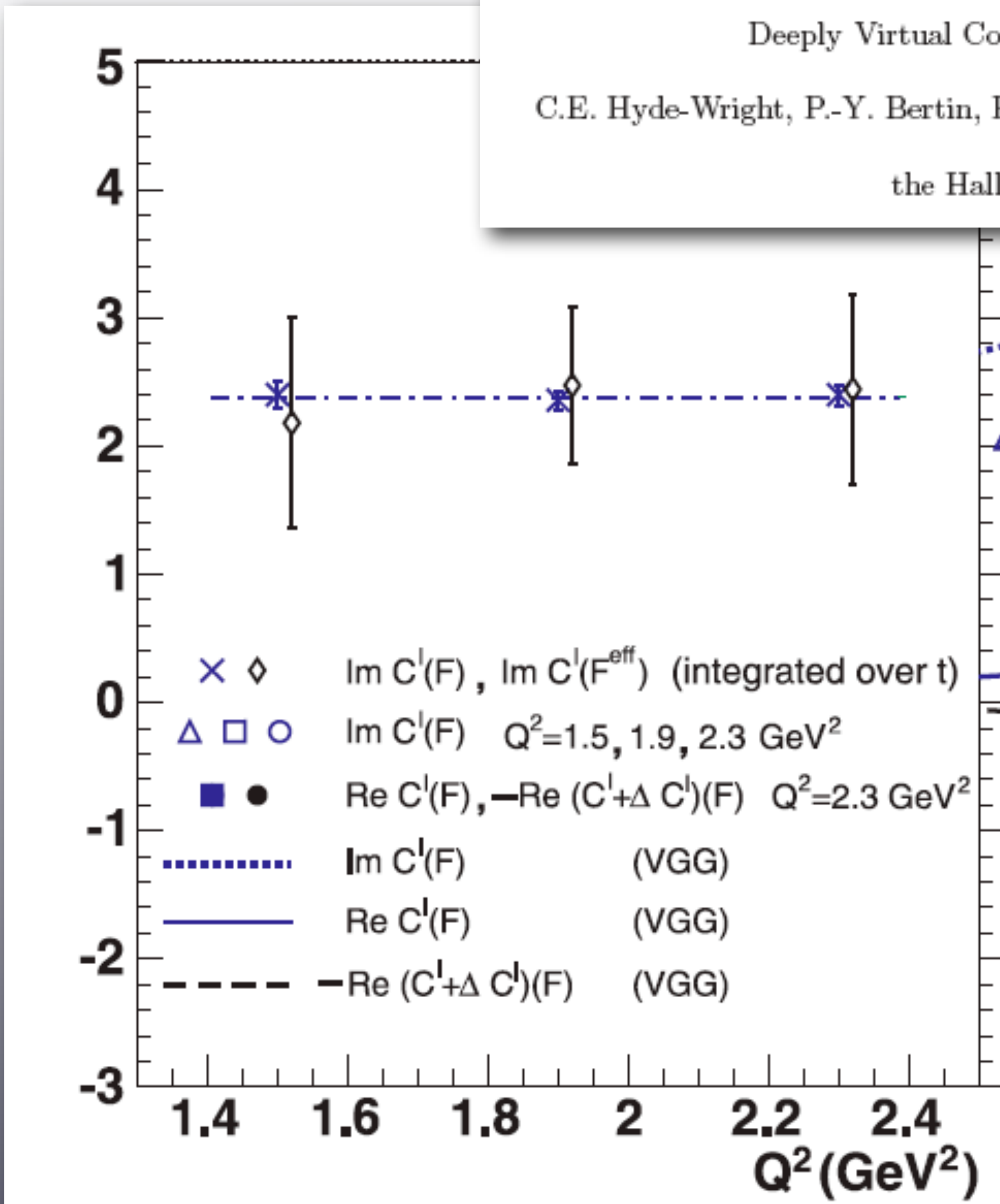

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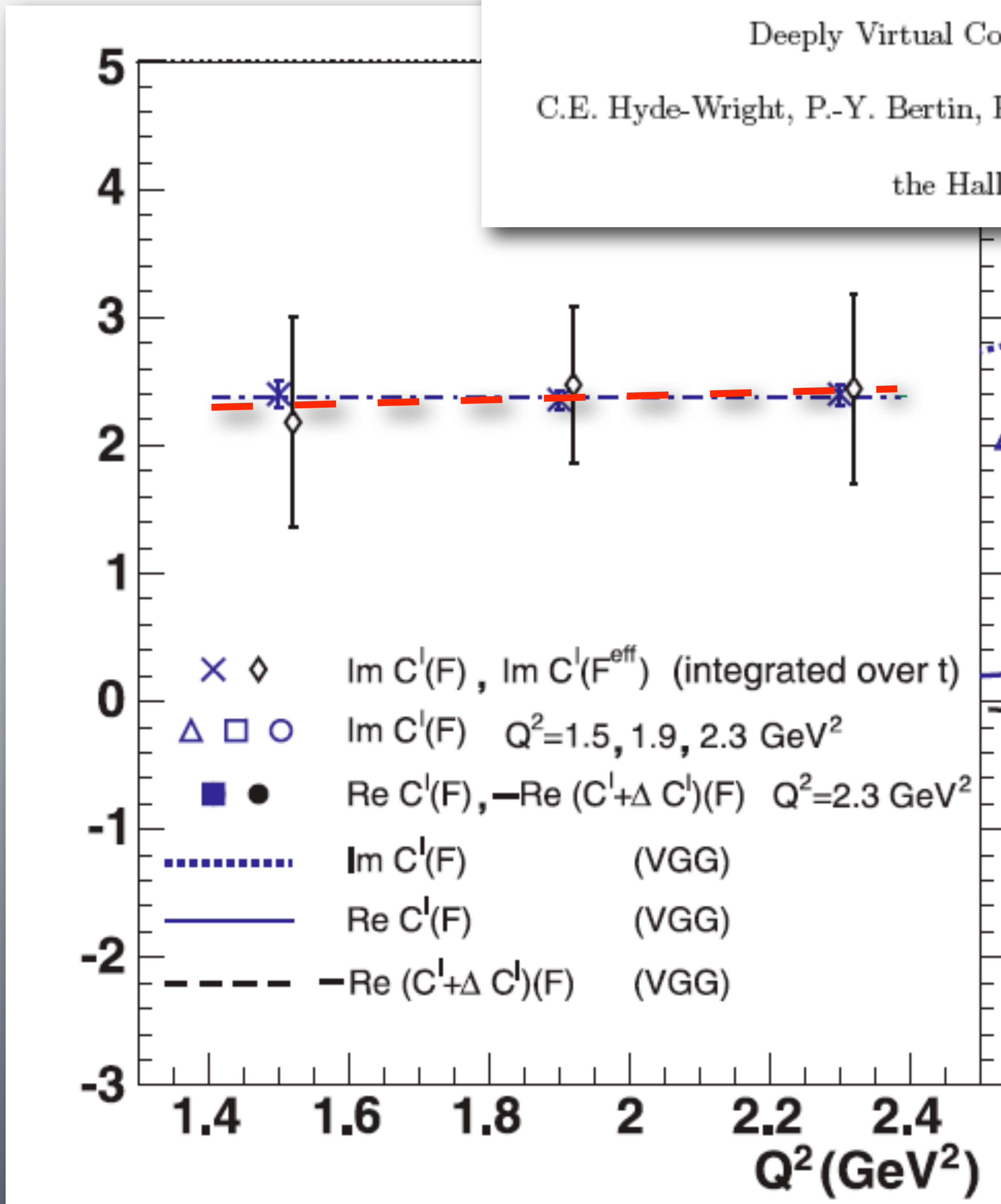


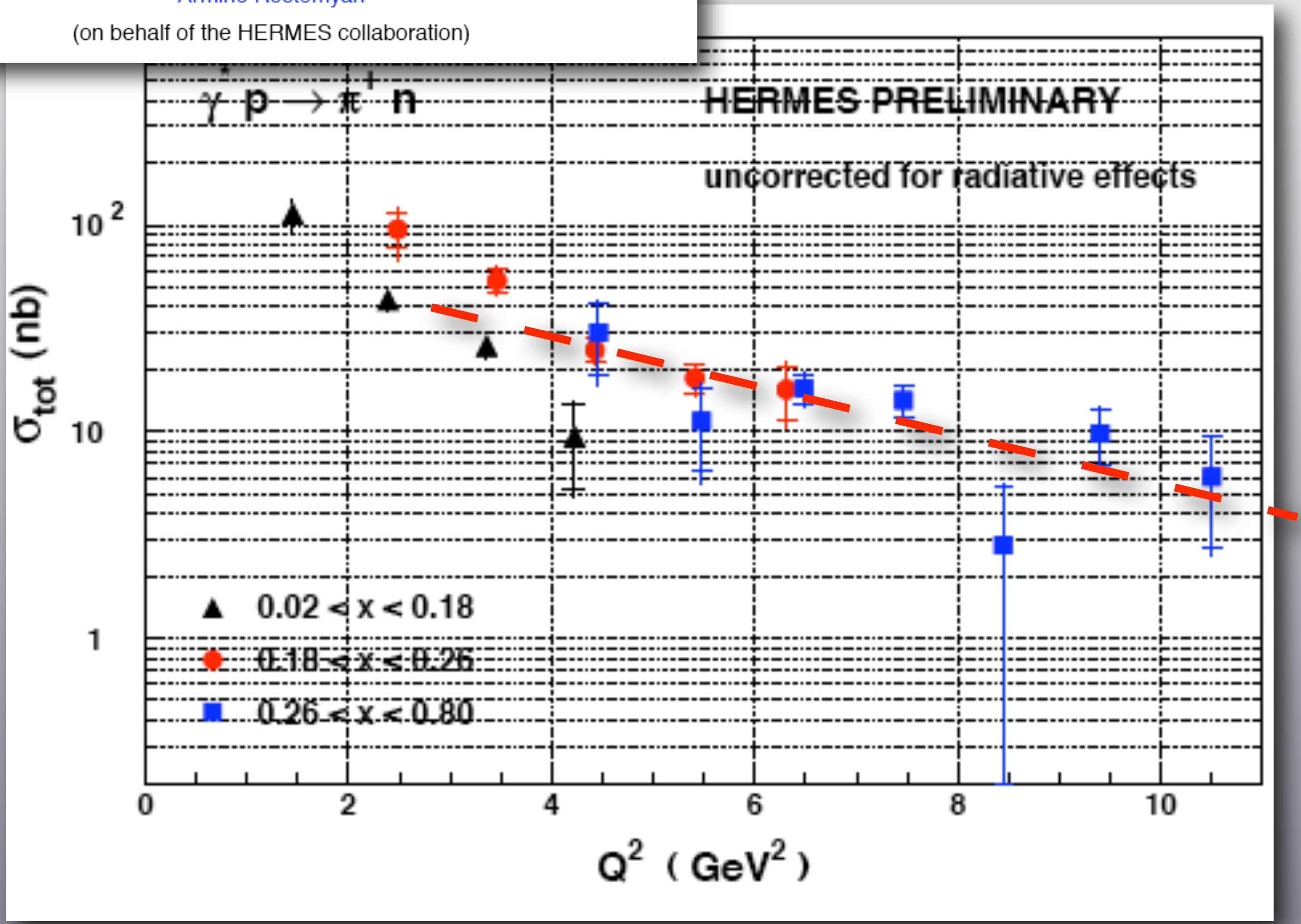
$$\propto \left(Q^2\right)^{\alpha}$$

$$\alpha = 0.25$$

Exclusive Meson Production at HERMES

Jefferson Lab, VA, USA, May 2007

Armine Rostomyan
(on behalf of the HERMES collaboration)



$$\sigma_{x=fixed} \sim \left(\frac{1}{Q^2}\right)^n \quad n = 3 \quad \dashrightarrow \quad n = 1.6$$

- regge parametrizations motivated by what DIS structure functions

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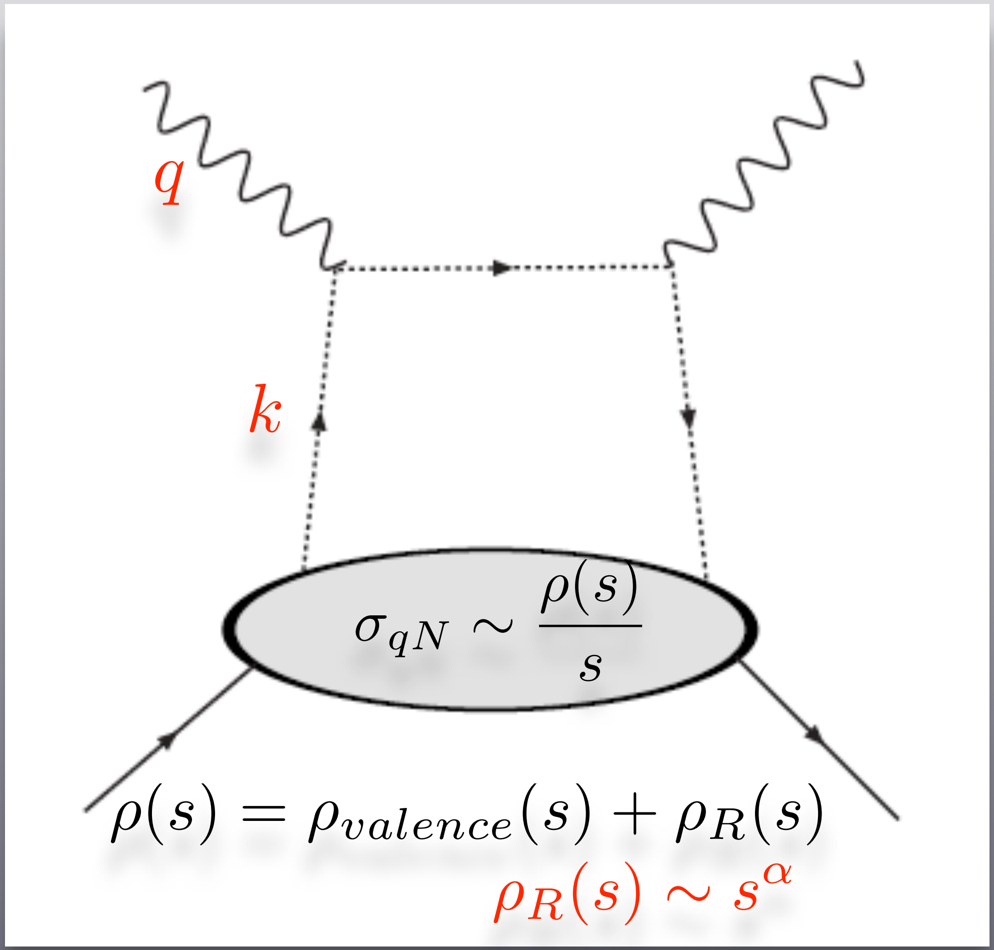
- large masses are "problematic" so put regge at the level of parton-nucleon amplitude and see what happens to the handbag diagram

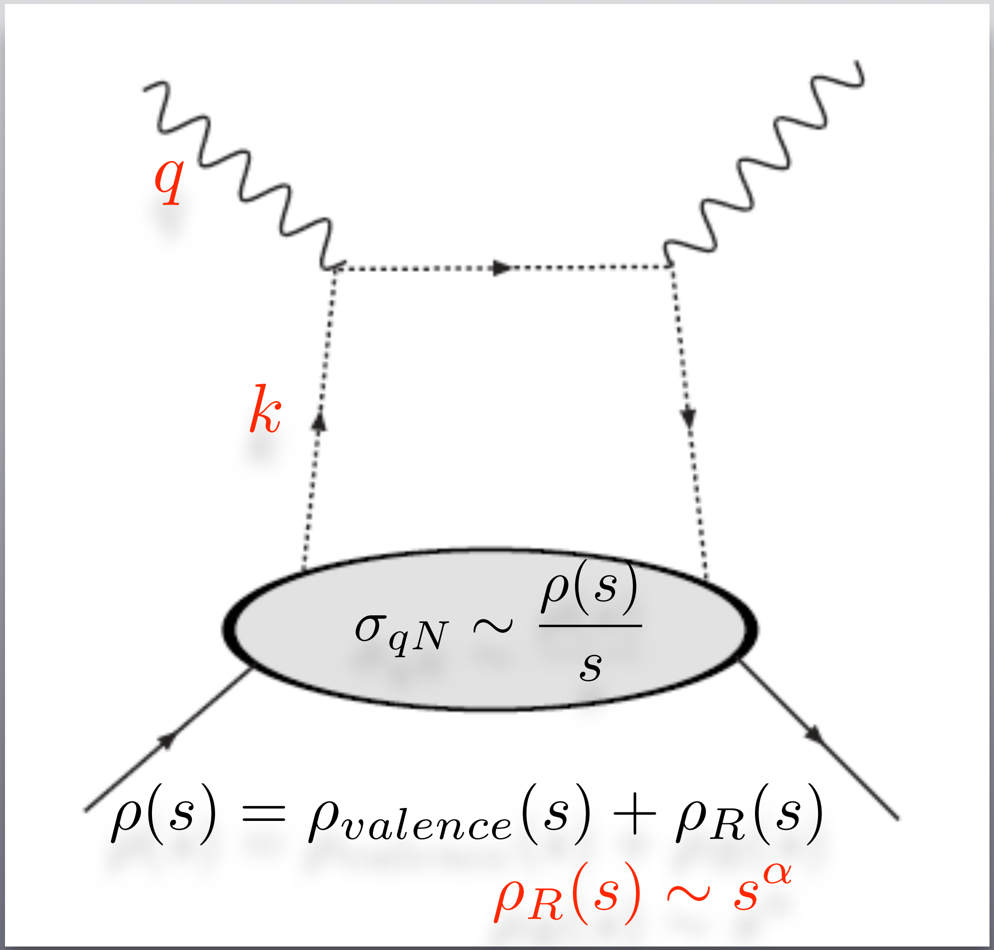


q
k
$\sigma_{qN} \sim \frac{\rho(s)}{s}$
$\rho(s) = \rho_{valence}(s) + \rho_R(s)$
$\rho_R(s) \sim s^{\alpha}$

DIS:

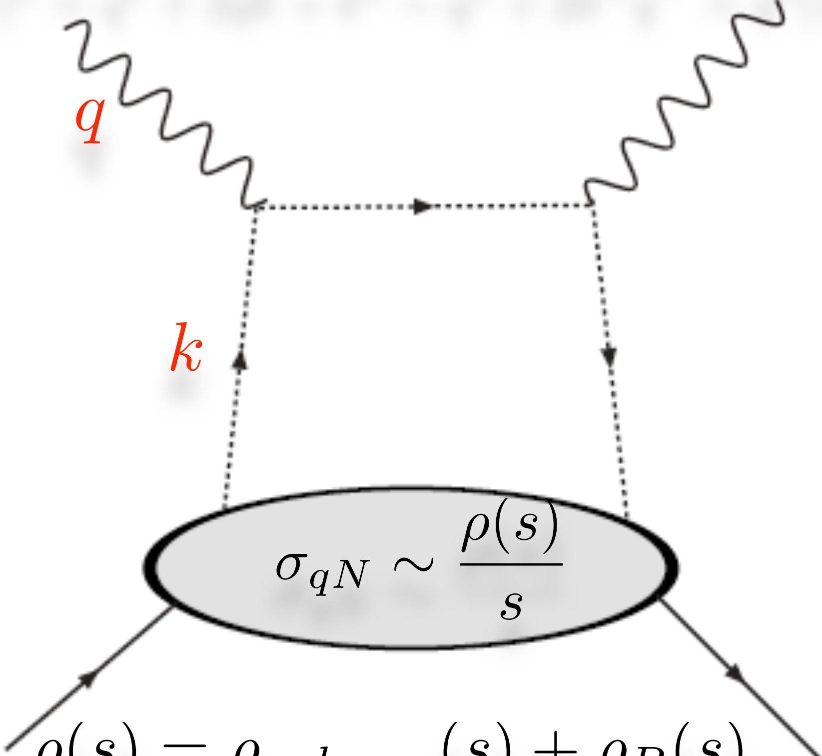
S.J.Brodsky, F.Close, J.F.Gunion,
Phys. Rev. 8 , 3678 (1973)

$$f(x_{BJ}) = f_v(x_{BJ}) + \sum_{0<\alpha<1} x_{BJ}^{-\alpha}$$



one can start from collinear factorization and get the same result

$$(q+k)^2 = q^2 + 2qk + k^2 \sim q^2 + 2k^+q^- = q^2(1 - x/x_B)$$



$$\rho(s) = \rho_{valence}(s) + \rho_R(s)$$

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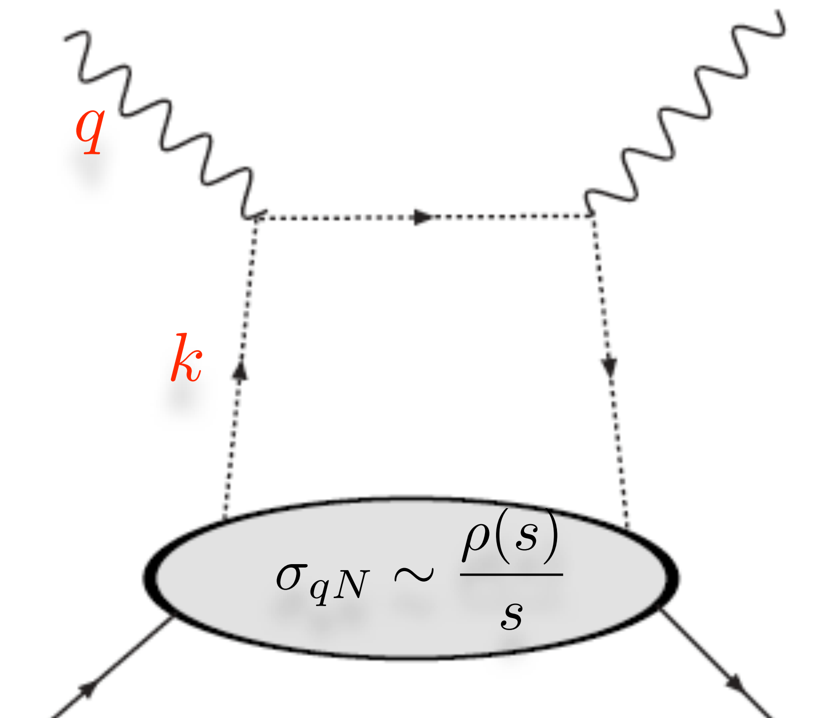

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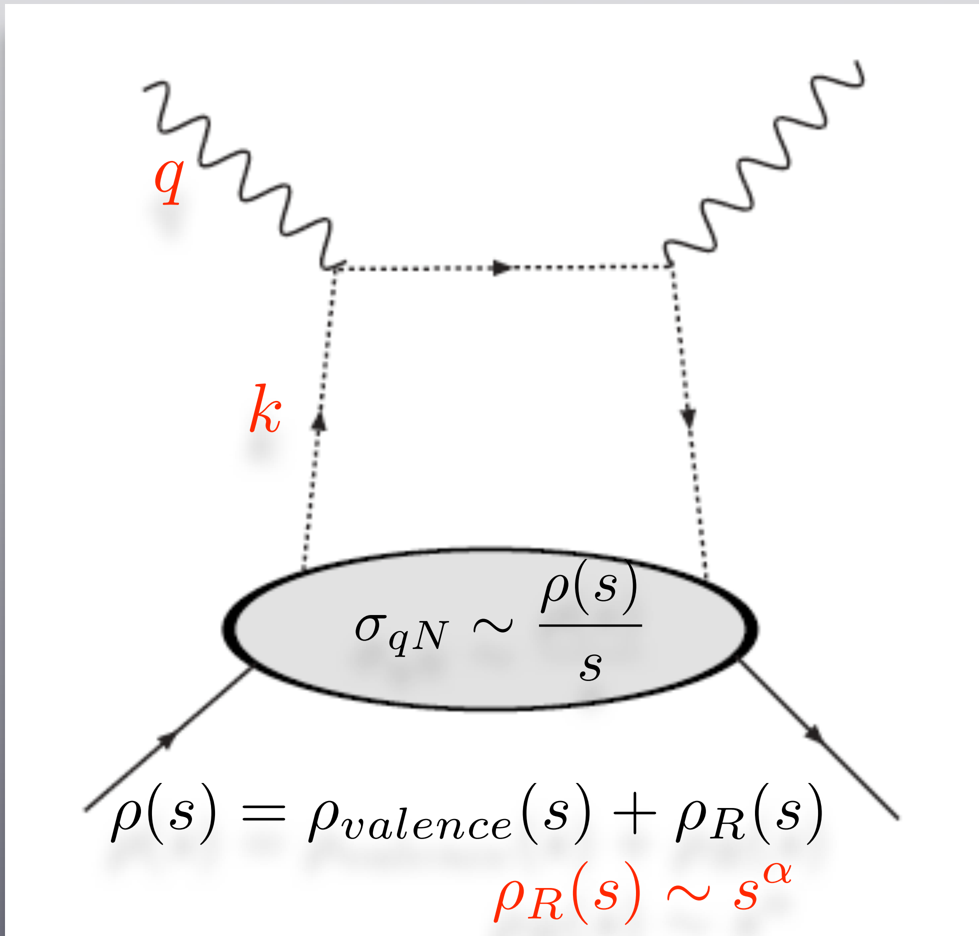

DVCS:

$$f\left(\frac{\nu}{Q^2}\right) \to f\left(\frac{\nu}{\Lambda^2}\right)$$

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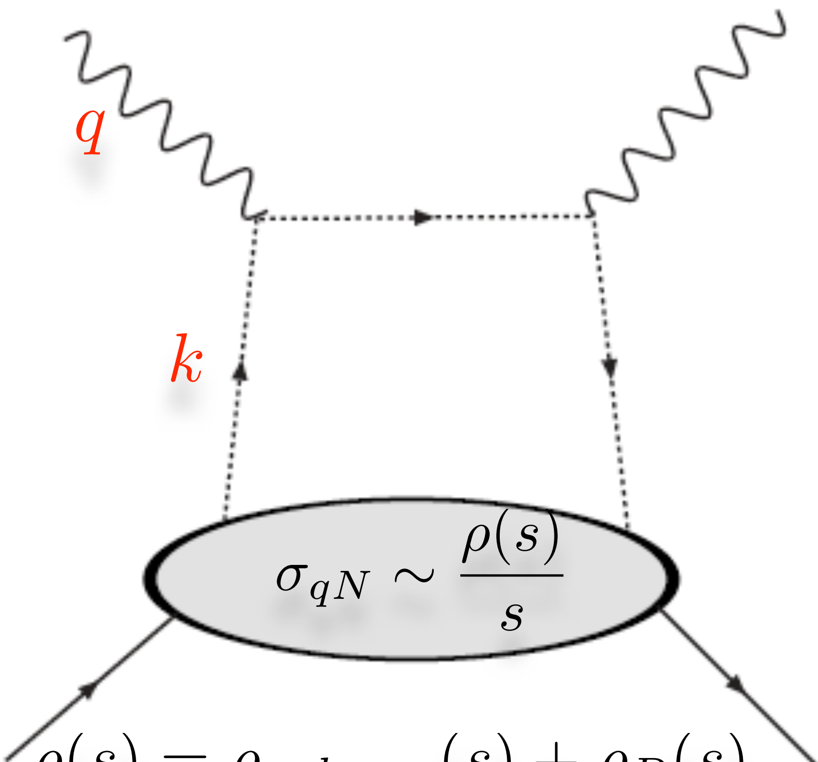

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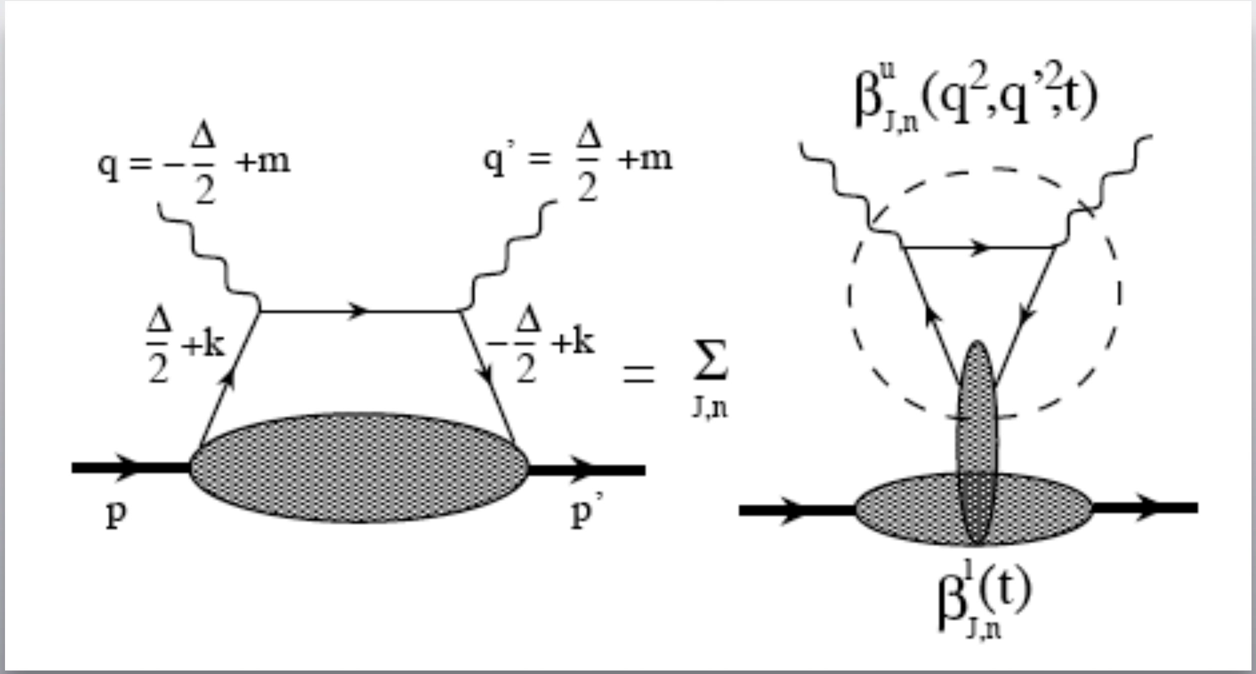
singular contribution to collinear factorization from subtraction terms

$$T_{parton N \to parton N}(s) = \int dm^2 \frac{\rho_R(m^2)}{s - m^2} - \int dm^2 \frac{\rho_R(m^2)}{-m^2}$$

what about t-channel description ?

Adam Szczepaniak, J.T. Londergan, Phys.Lett. B643,17 (2006)

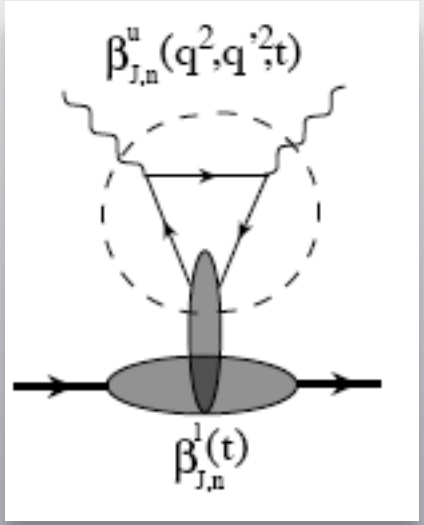


$$\int d^4 z e^{-ikz} \langle p' | T\left[\phi^\dagger\left(\frac{z}{2}\right)\phi\left(-\frac{z}{2}\right)\right]|p\rangle = \frac{\beta^u_{Jn}(t)}{t - M^2_{Jn}} \Phi_{Jn}(p-p',k)$$

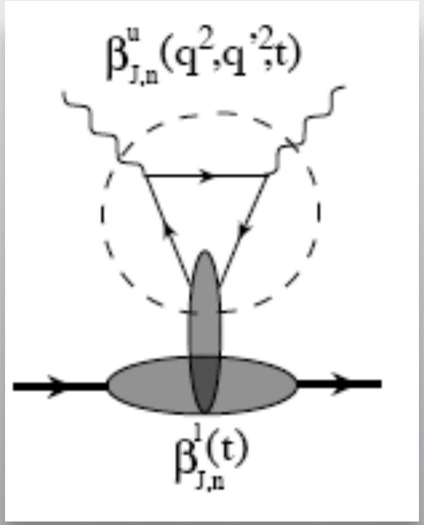
$$\sum_{\lambda=-J}^{J} \left[k^{\nu_1}\cdots k^{\nu_J}\epsilon^\lambda_{\nu_1\cdots\nu_J}(p'-p)\right]^* \left[\frac{(p'+p)^{\mu_1}}{2}\cdots\frac{(p'+p)^{\mu_J}}{2}\epsilon^\lambda_{\mu_1\cdots\mu_J}(p'-p)\right]$$

$$a(J,t) \sim \frac{\beta(t)}{J-\alpha(t)} \left(\frac{1}{Q^2}\right)^J \left(\frac{Q^2}{x}\right)^J$$

DIS



$$A(s,t) \sim \sum_J a(J,t) \sim \left(\frac{1}{x}\right)^{\alpha(0)}$$



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DVCS

$$A(s,t) \sim \sum_J a(J,t) \sim \left(\frac{Q^2}{x}\right)^{\alpha(t)}$$

Leading Regge exchange dominates not only at small-x but for all-x

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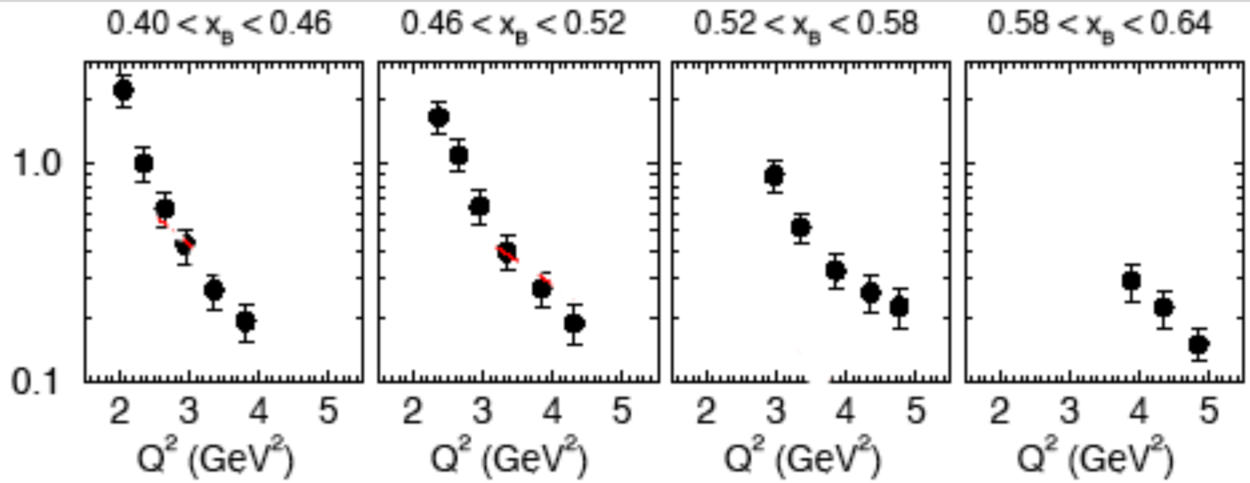

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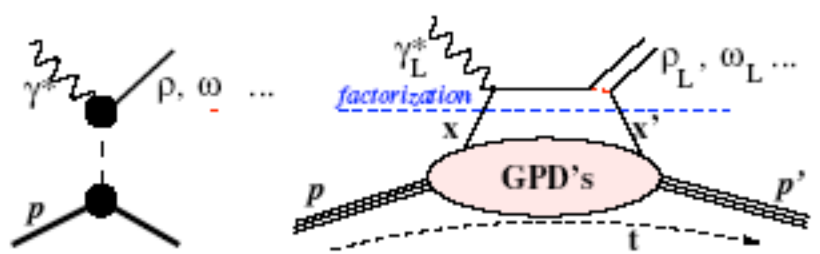

Fig. 1. Schematic representations of the t-channel exchange (left) and of the handbag diagram (right) for exclusive vector meson electroproduction.

$$\sigma_{x=fixed} \sim \frac{|A_{\gamma^* \to V}|^2}{Q^4} \sim \frac{1}{Q^6}$$

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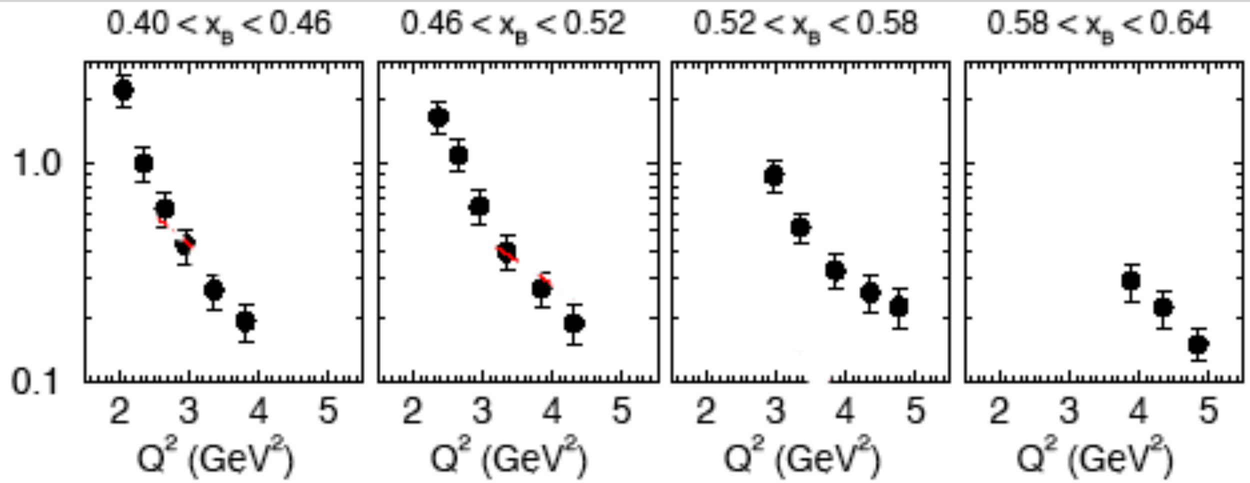

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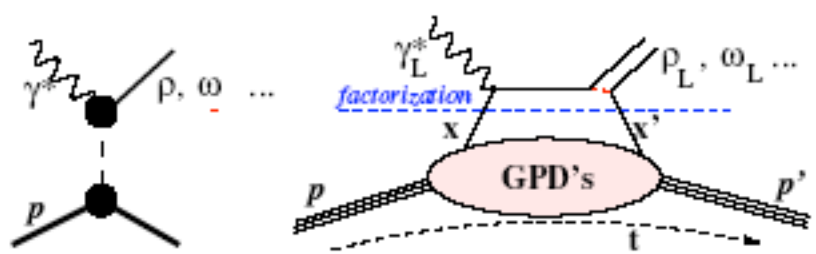

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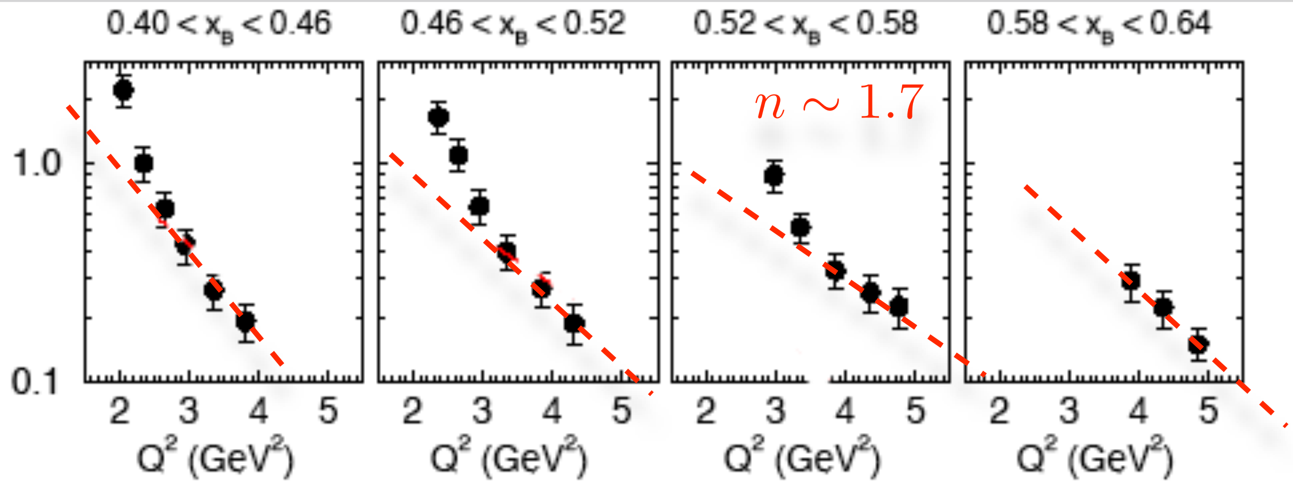

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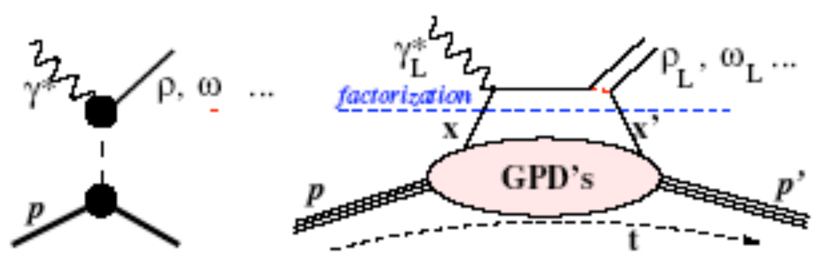

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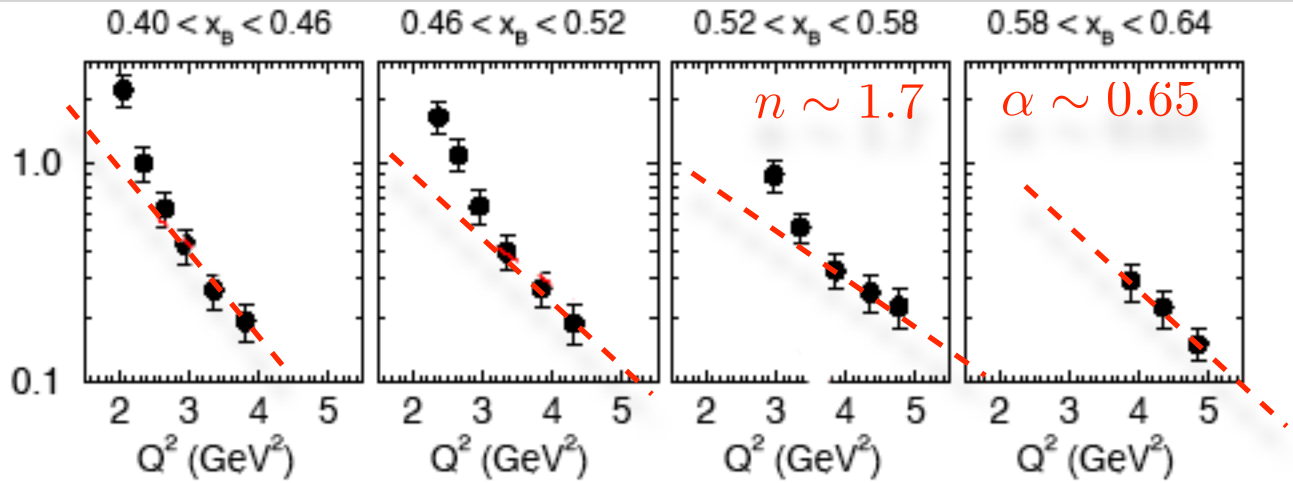

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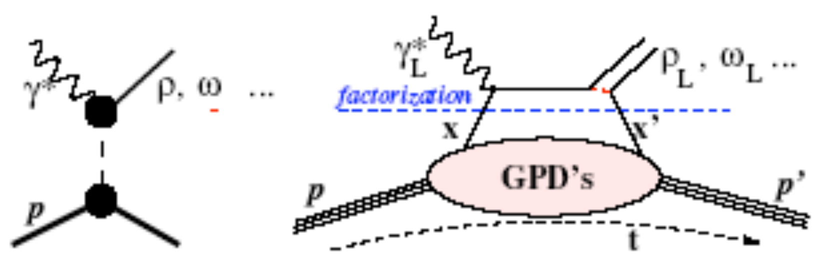

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$$n = 3 \;\; \to 3 - 2\alpha(t)$$

Summary:

- in DIS regge dominates only when $x_{BJ} << 1$
- in DVCS leading regge dominates even in the valence region