Low *x* Meeting

Sinaia, Romania

# Extension of Geometric Scaling to Large *x*

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- ►Motivation
- ►Large *x* behavior
- ►$Q^2$ dependence
- ►A simple model of $\sigma_{\gamma p}$

(work in collaboration with M. Mondragón: hep-ph/0506038)

# Motivation

**Goal:** Separate the large and small *x* degrees of freedom

**Propose to write:**

$$\sigma_{\gamma^* p} = WS$$

**Where**

***W***: Carries the information on small *x* dynamics

***S***: Describes the large *x* behavior

# Requirements for *W* and *S*

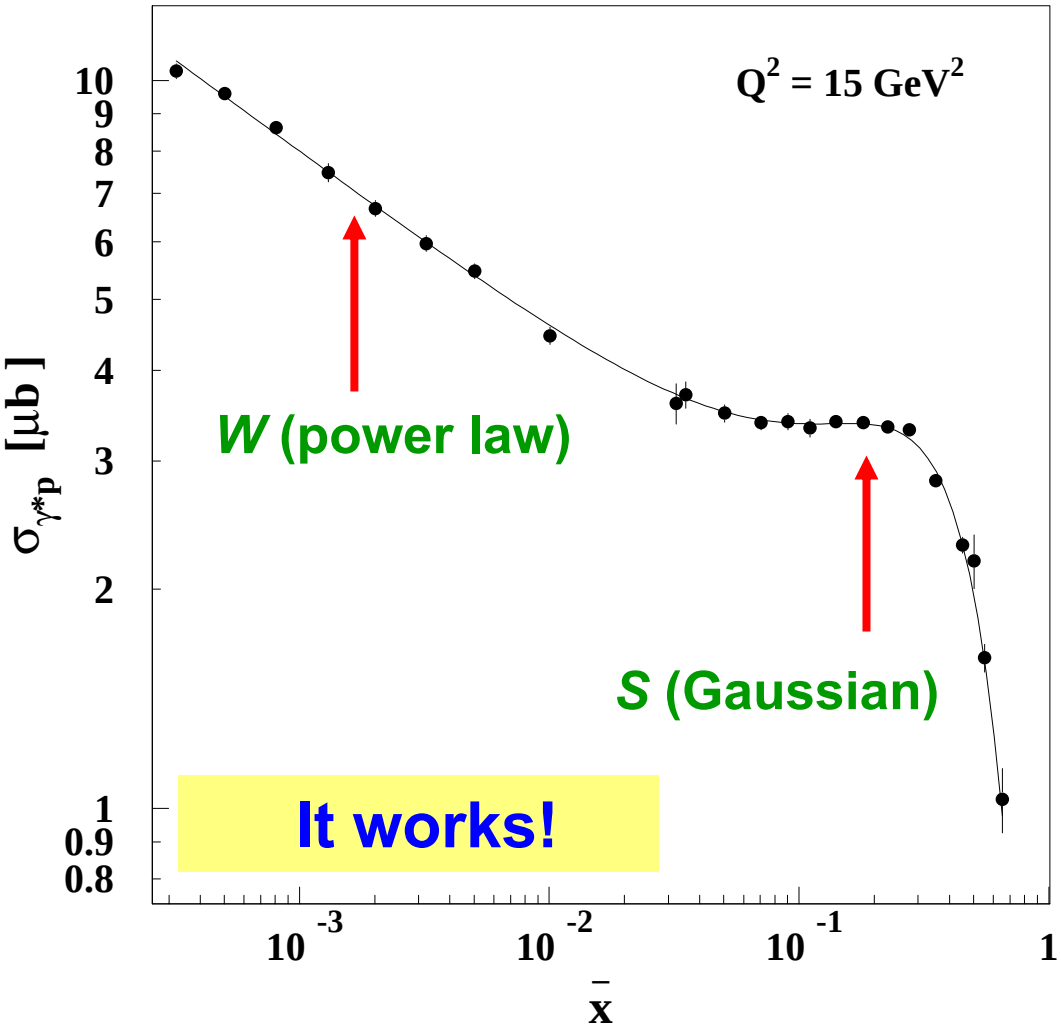
***W*: Power law at small *x* and fixed $Q^2$ as expected from theory (BFKL) and found in data (HERA)**

$$W = Nx^{-\lambda}$$

***S*: Has to be approximately constant at small *x* to preserve behavior of *W* and describe large *x* data**

$$S = Gaussian$$

# Testing the proposal




**Use fixed target and HERA data at a given $Q^2$ to test the proposal $\sigma_{\gamma^* p} = WS$**

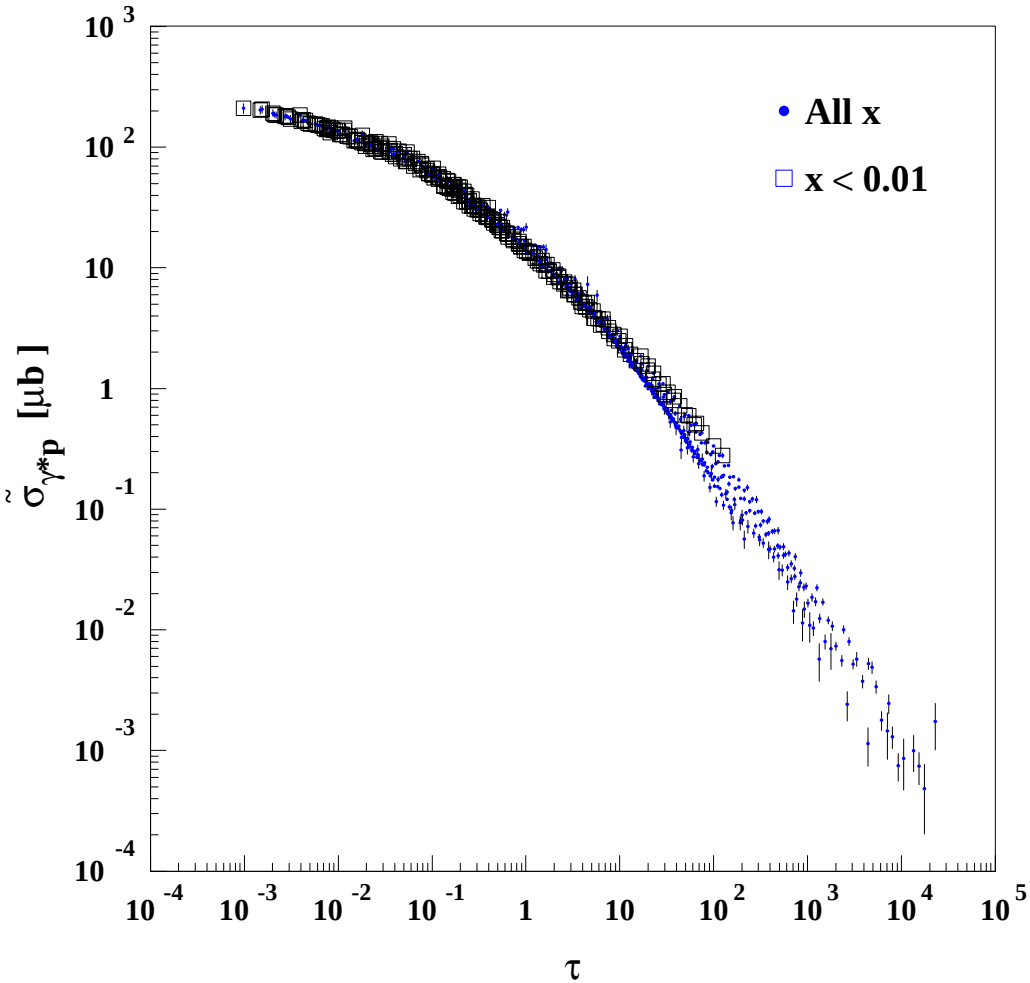
**Surprise:**

***S* do not depend on $Q^2$**

$$S(x) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{(x-x_0)^2}{2\sigma^2}\right)$$

**$x_0 = 0.27$ $\sigma^2 = 0.07$**

# Geometric Scaling of reduced cross section W(*x*,Q²)



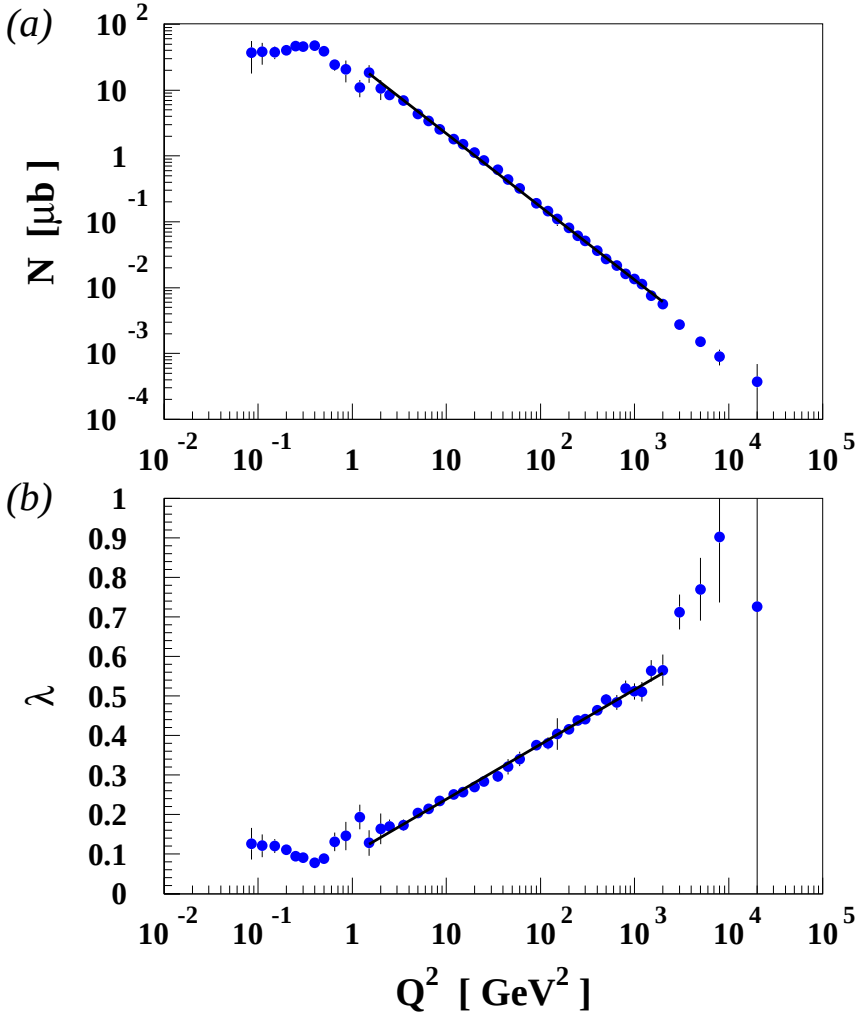

Small *x* behavior is a power law

→ define a reduced cross section to isolate the power law also at large *x:*

$$\tilde{\sigma}_{\gamma^* p}(x,Q^2) \equiv W(x,Q^2) = \frac{\sigma_{\gamma^* p}}{S(x)}$$

There is geometric scaling behavior for the reduced cross section at all values of *x* and Q²

# $Q^2$ dependence of $W(x,Q^2)$




$$W(x,Q^2) = N(Q^2)x^{-\lambda(Q^2)}$$

**There are two regimes for N and λ:**

- **Constant for $Q^2$ below ≈ 1 $GeV^2$**
- **Above this value**

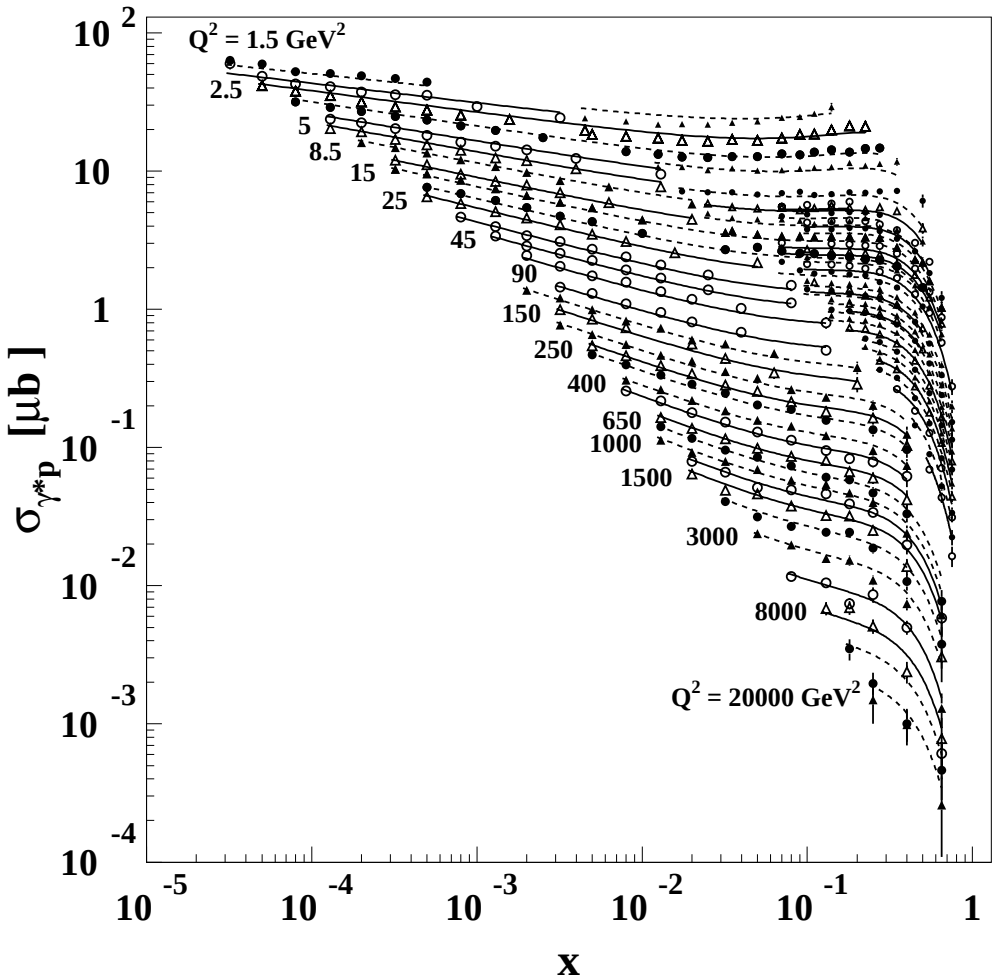
**N is a power law**

**λ dependes logarithmically on $Q^2$**

$$N(Q^2) = bQ^{2\beta},$$
$$\lambda = a + \alpha \log(Q^2)$$

**b = 28 μb, β = -1.1, a = 0.1, α = 0.06**

# A simple description of the total γ*p cross section



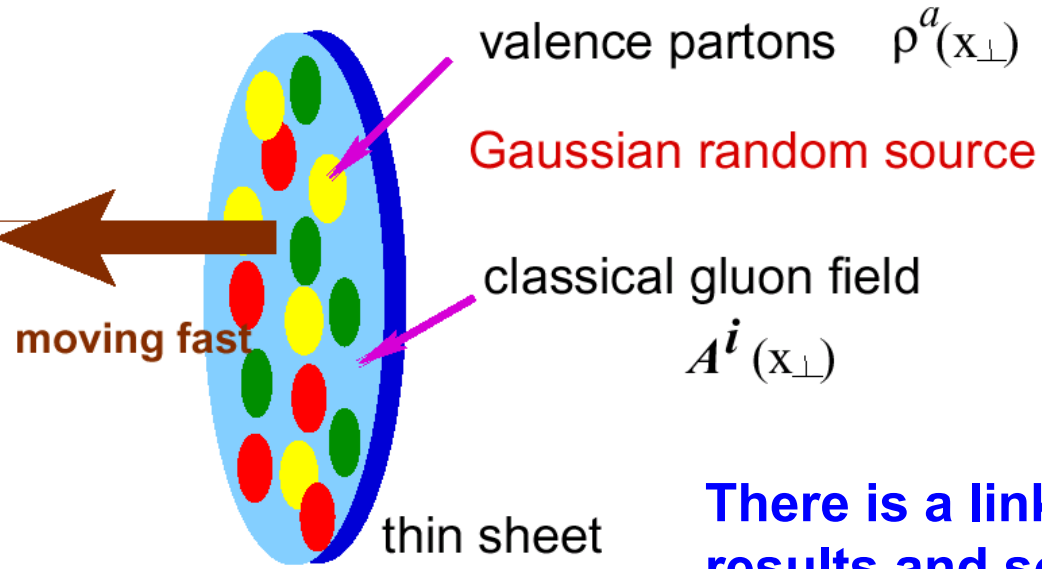

The possibility to describe N and λ analytically permits to have a simple six parameter descripton of the total γ*p cross section for all data above $Q^2 \approx 1.5$ GeV$^2$

Using the fits to N, λ and *S* one obtains

$X^2$/dof = 0.96 (622 data points)

# A link to CGC ideas

CGC separates a static color source at large *x* from the wee partons, produced by the source, at small *x*




*S* resembles the color source:

- ► Sits at large *x* (valence-like)
- ► It is a Gaussian
- ► It is 'static' in the sense of
  - a) it is constant at small *x*
  - b) it is independent of $Q^2$

*W* embodies the power law behavior expected from wee partons

There is a link between the phenomenological results and solid theoretical ideas

# Summary and conclusions

- It is possible to write

  $\sigma_{\gamma^* p} = W(x,Q^2)S(x)$

  where

  $W$ is a power law

  $S$ is a Gaussian distribution

- This separation is reminiscent of CGC ideas

- The reduced cross section $W(x,Q2)$ exhibits geometric scaling in the complete kinematic plane

- This procedure yields a simple six-parameter description of the total γ*p cross section for all data with $Q^2 > 1.5$ GeV$^2$

All details in hep-ph/0506038