

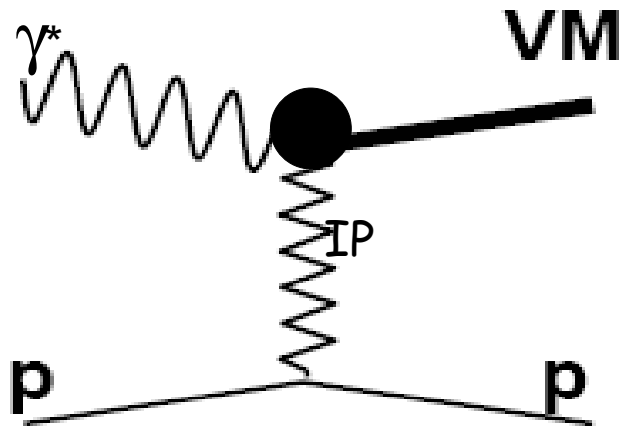
Exclusive ρ^0 electroproduction

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**on behalf of
the ZEUS collaboration**

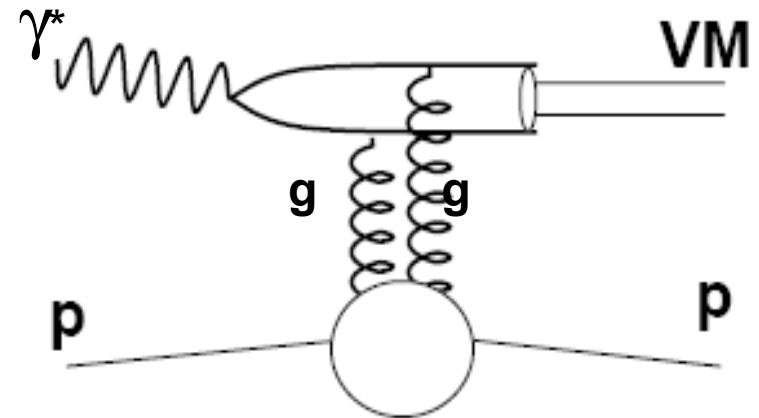
DIS 08, 9th April 2008

Motivation



'soft'

Expect: $\sigma(W) \propto W^\delta$
 $\frac{d\sigma}{dt} \propto e^{-b|t|}$



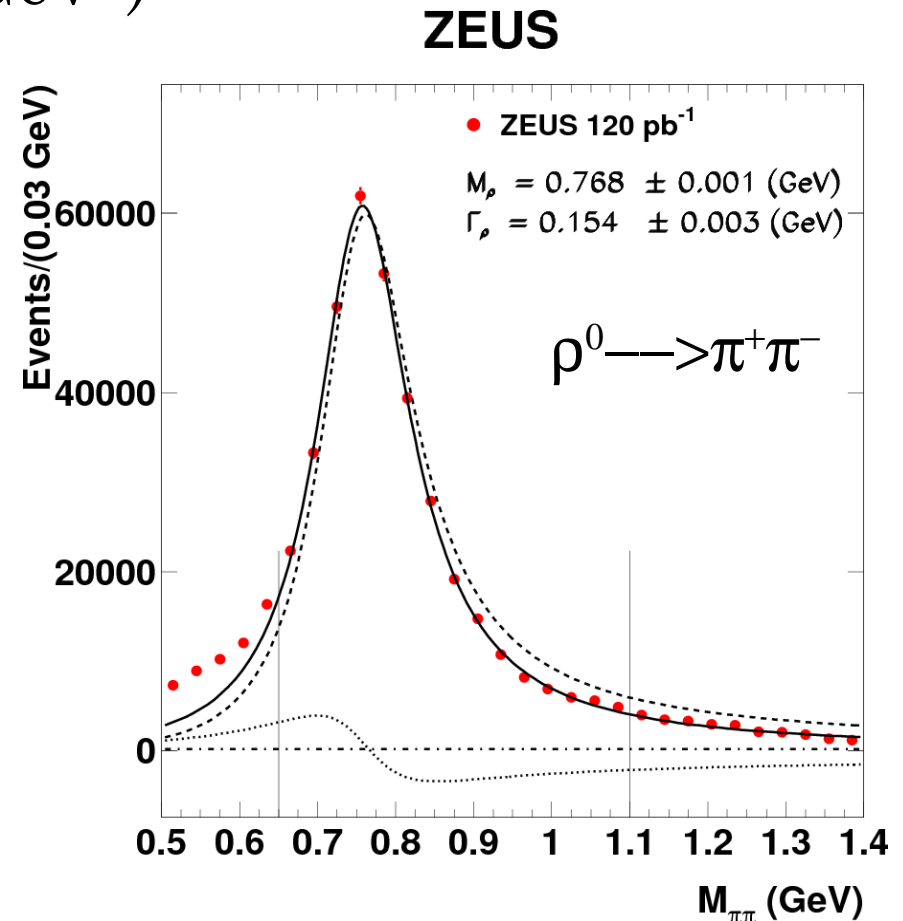
'hard'

- Expect δ to increase from ~ 0.2 ('soft Pomeron') to ~ 0.8 (from $|xg(x, Q^2)|^2$)
- Expect b to decrease from soft ($\sim 10 \text{ GeV}^{-2}$) to hard ($\sim 4 - 5 \text{ GeV}^{-2}$)

$$\gamma^* p \rightarrow \rho^0 p$$

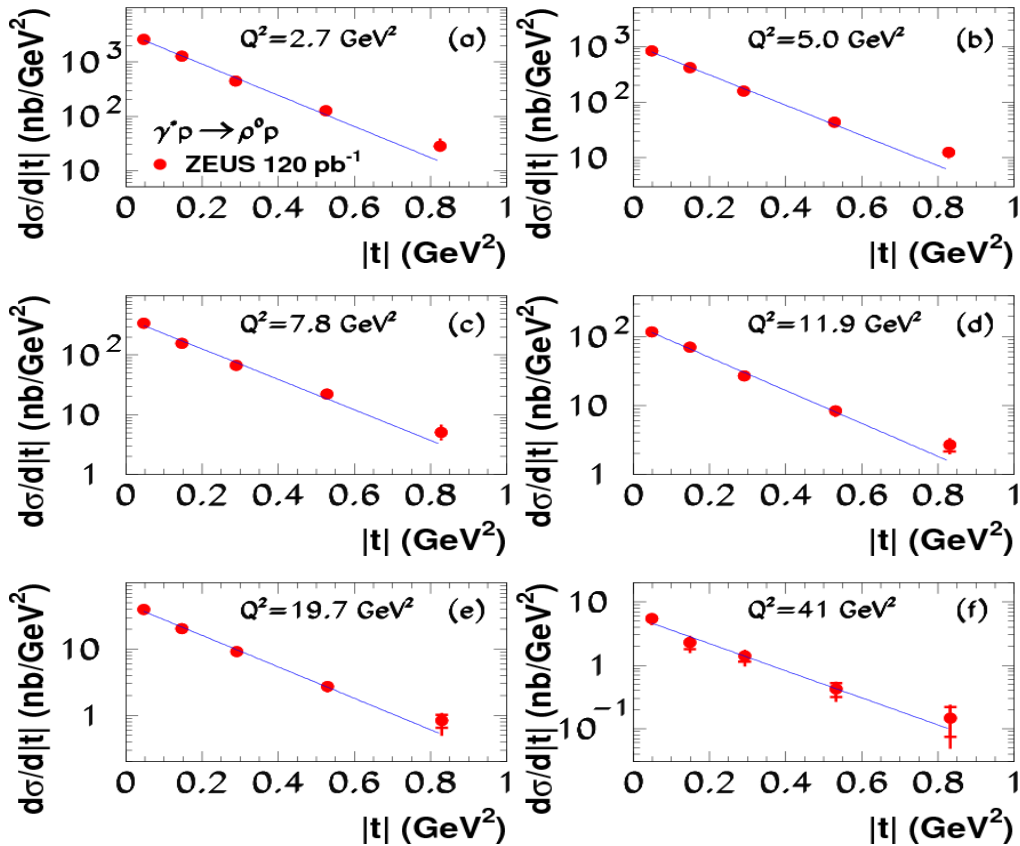
Data collected during 1996-2000, $\mathcal{L}=120 \text{ pb}^{-1}$

- Electroproduction ($2 < Q^2 < 160 \text{ GeV}^2$)
- $|t| < 1 \text{ GeV}^2$
- Proton undetected
- $32 < W < 160 \text{ GeV}$
- $0.65 < M(\pi\pi) < 1.1 \text{ GeV}$
- Proton dissociation subtracted:
 $19 \pm 2(\text{stat.}) \pm 3(\text{sys})\%$

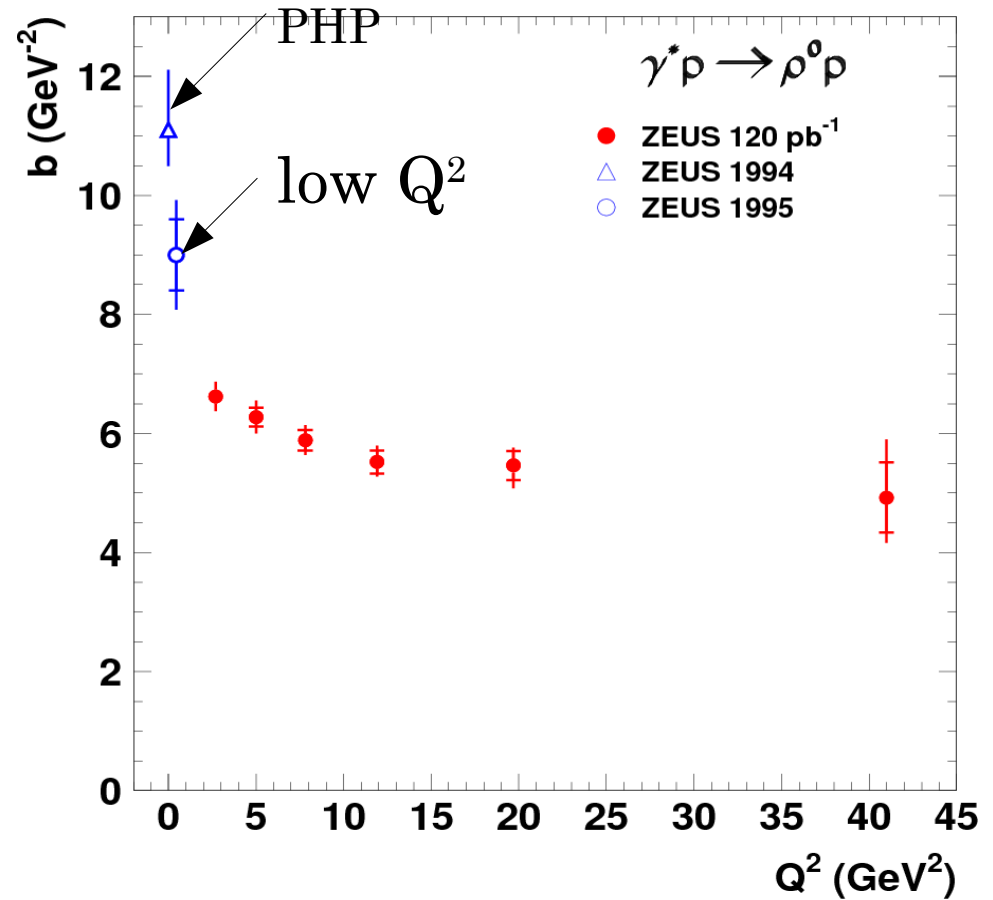


The slope b

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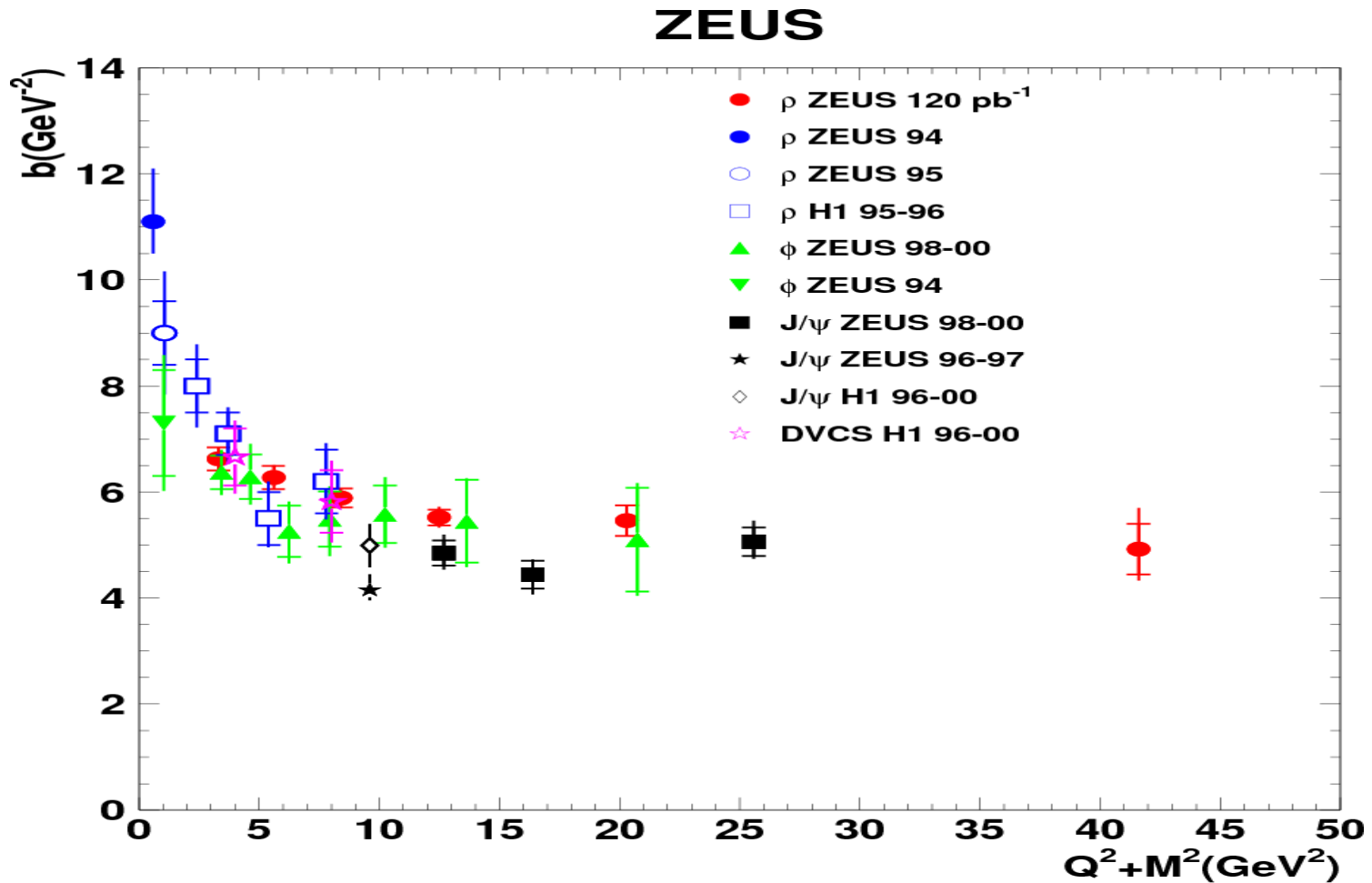
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$$d\sigma/d|t| \sim e^{-b|t|}$$

The slope b decreases with increasing Q^2

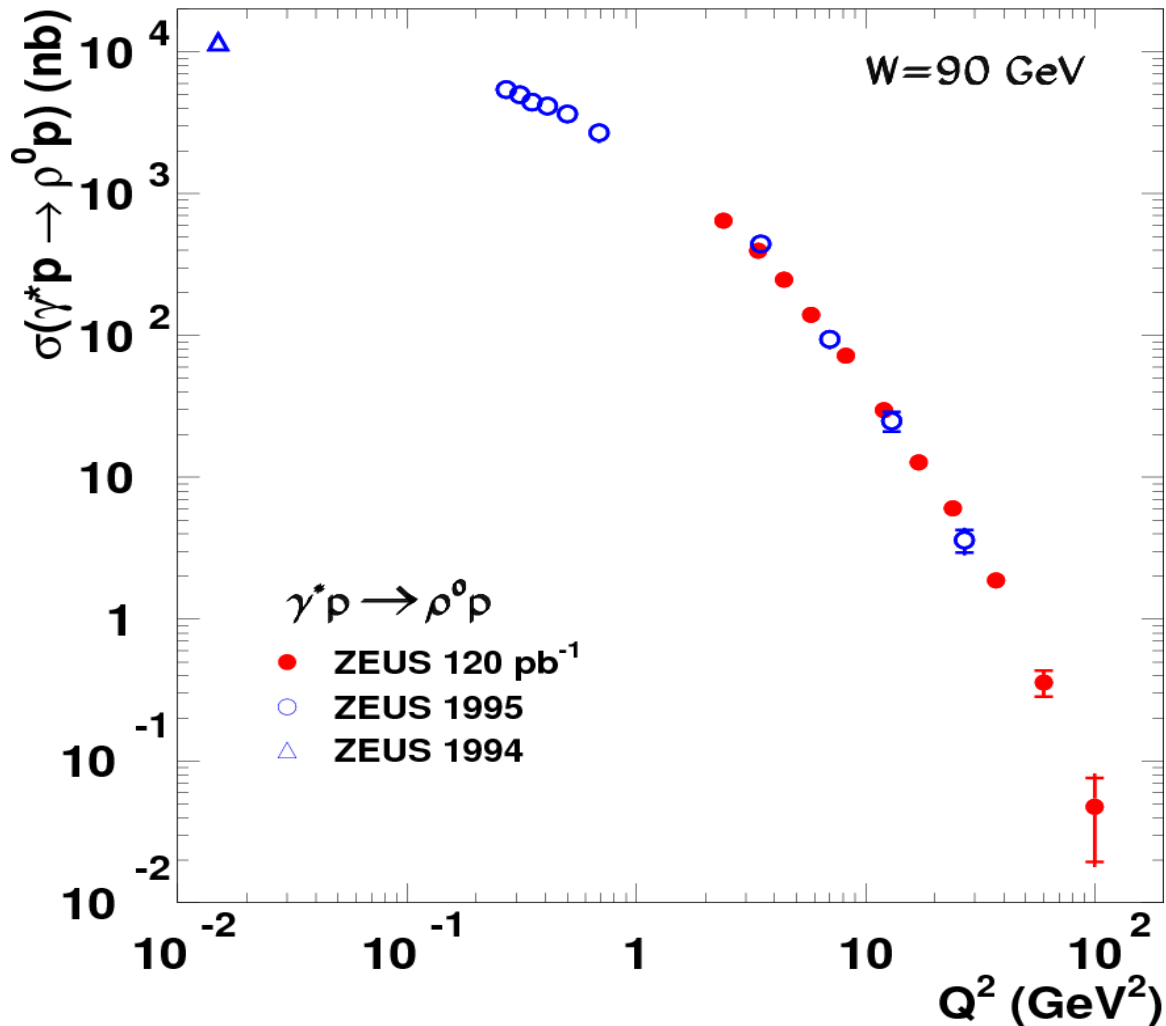
Comparison to other VM: $b(M^2+Q^2)$



The slope b decreasing with increasing scale, to asymptotic value 5 GeV^{-2}

Cross section as a function of Q^2

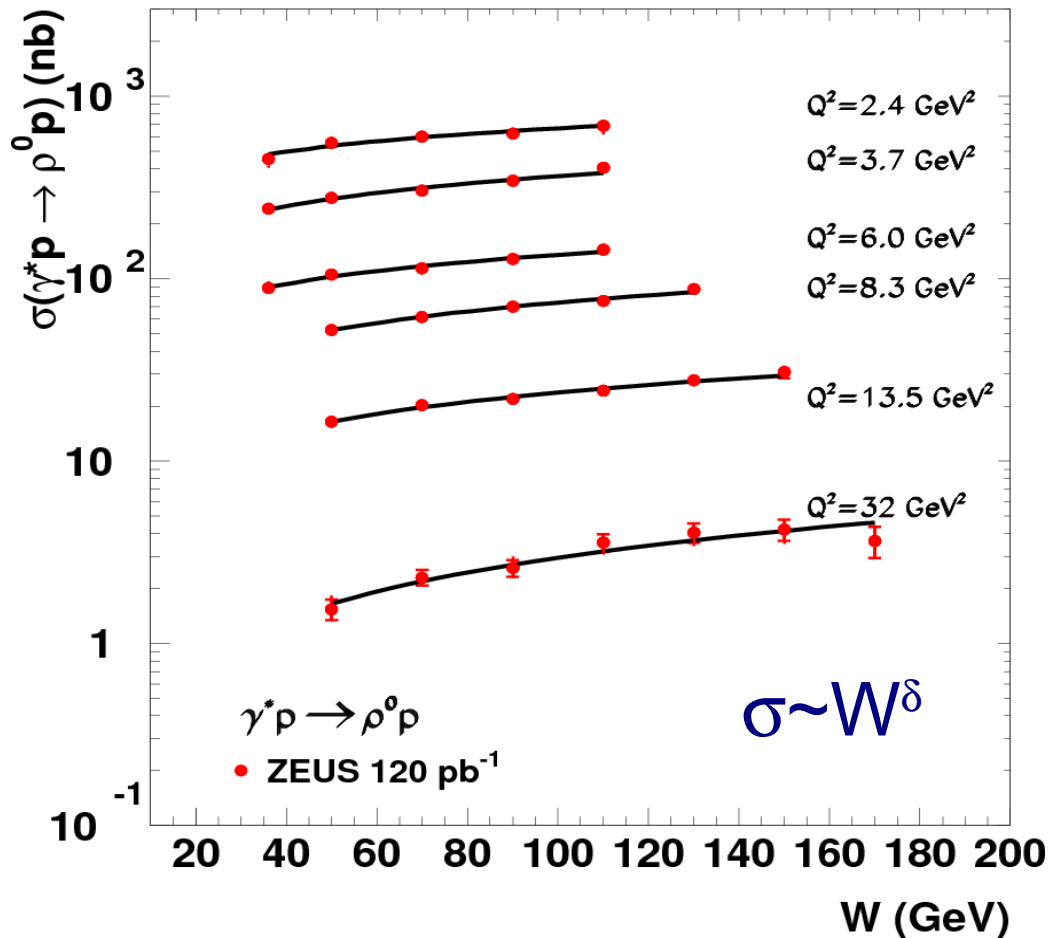
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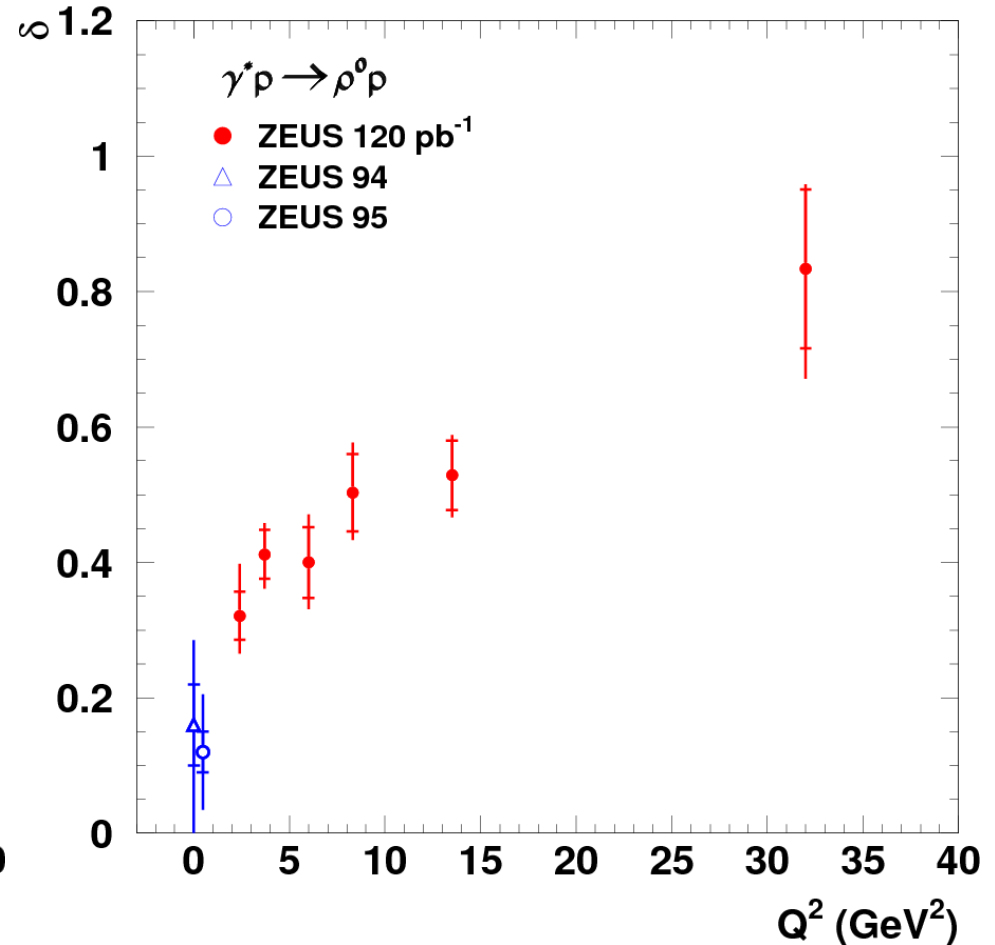
The cross section decreases steeply with increasing Q^2

Cross section as a function of W

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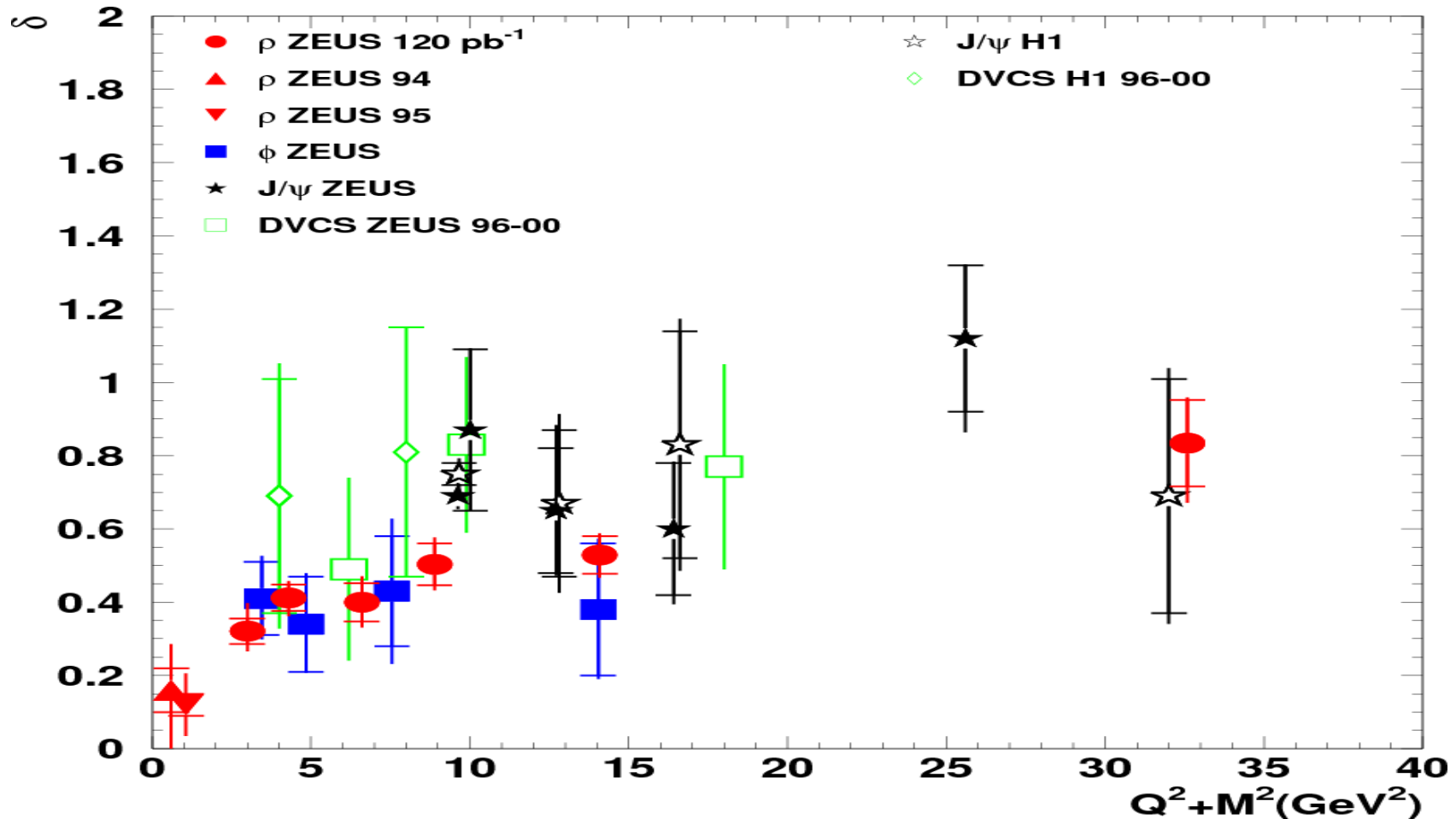
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δ increases with increasing Q^2

Comparison to other VM: $\delta (M^2+Q^2)$

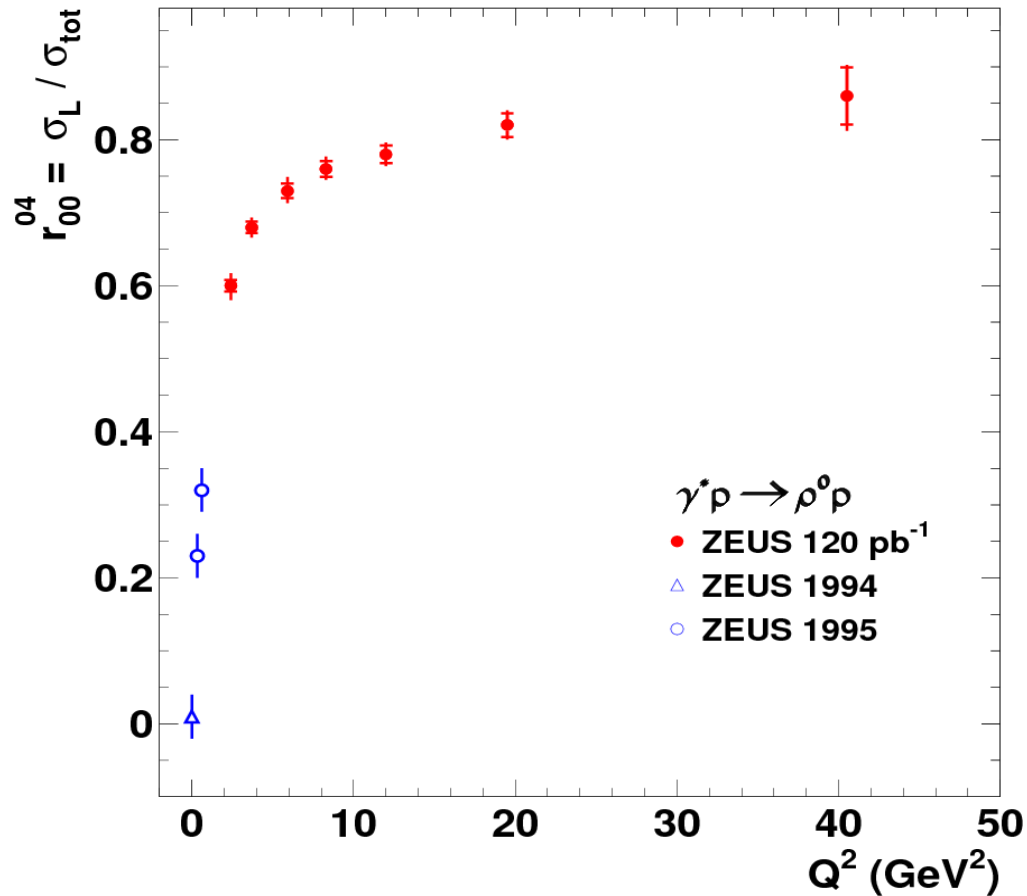
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The value of δ increases with the scale

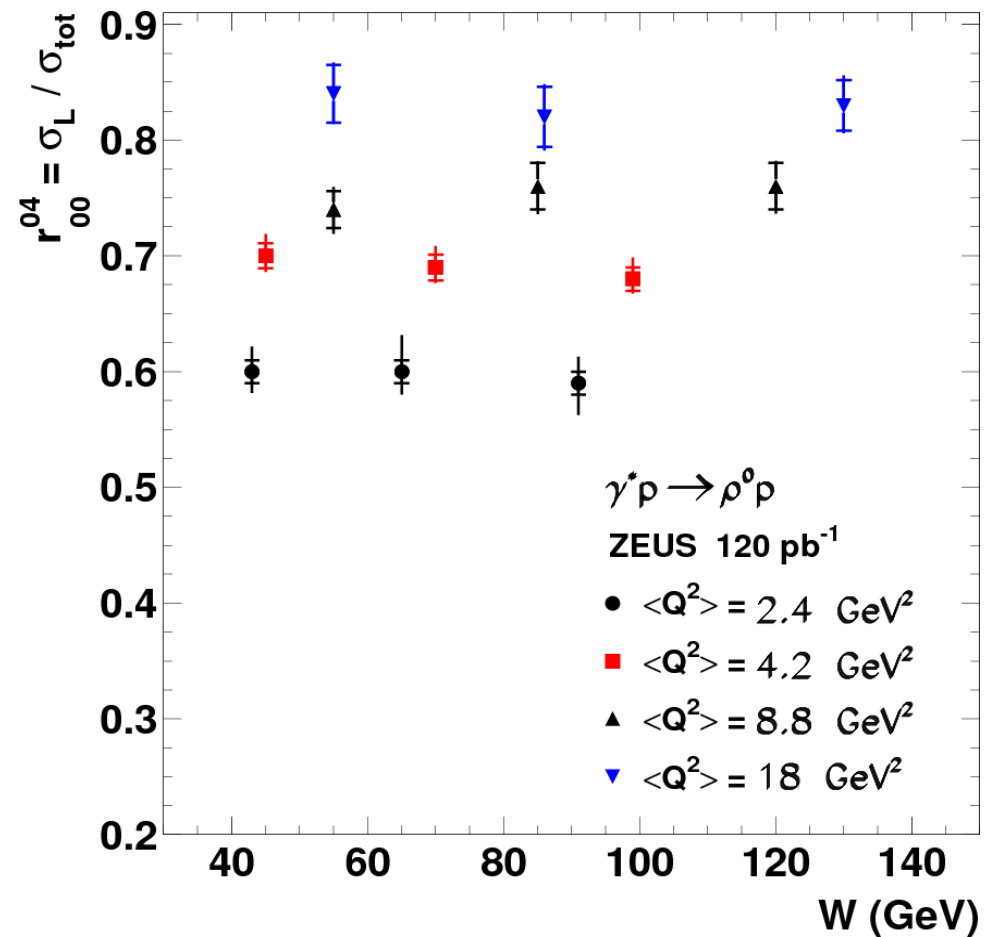
$\sigma_L/\sigma_{\text{tot}}$ dependence

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$\sigma_L/\sigma_{\text{tot}}$ asymptotic with Q^2

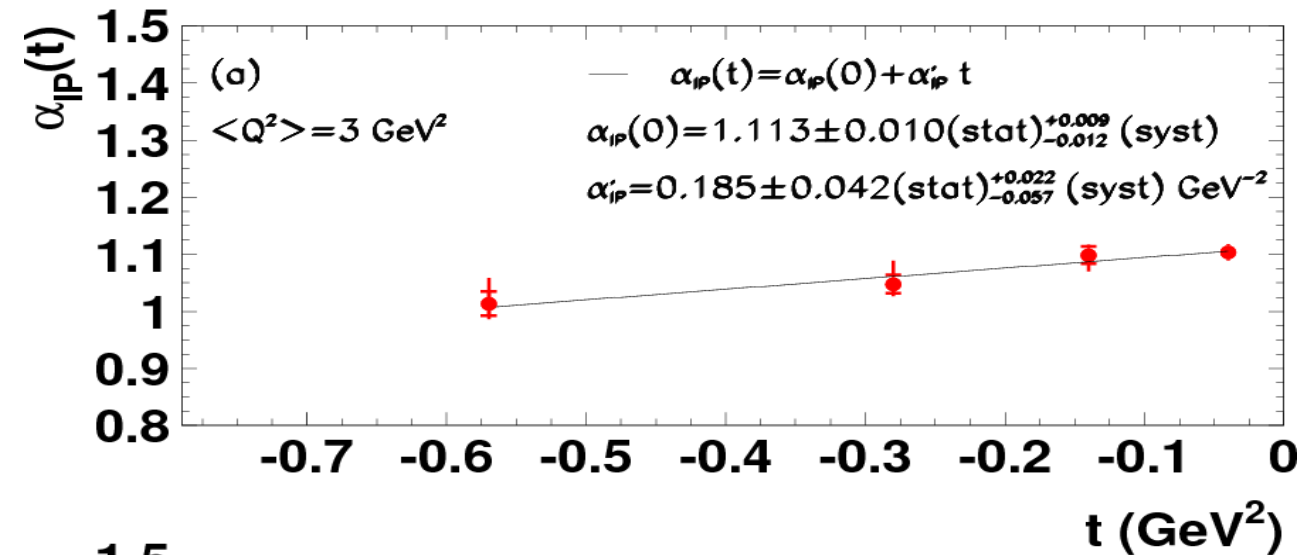
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$\sigma_L/\sigma_{\text{tot}}$ independent of W

The Pomeron trajectory

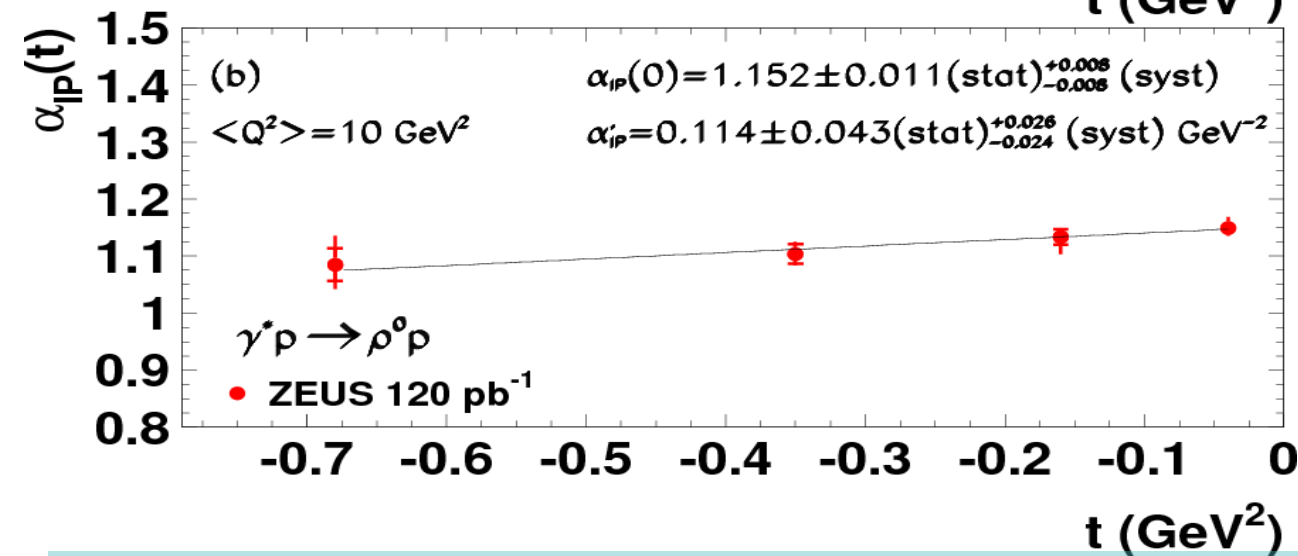
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$$d\sigma/dt(W) \sim W^{4\alpha_{\text{IP}}(t)-4}$$

with effective trajectory:

$$\alpha_{\text{IP}}(t) = \alpha_{\text{IP}}(0) + \alpha'_{\text{IP}}(t) \cdot |t|$$



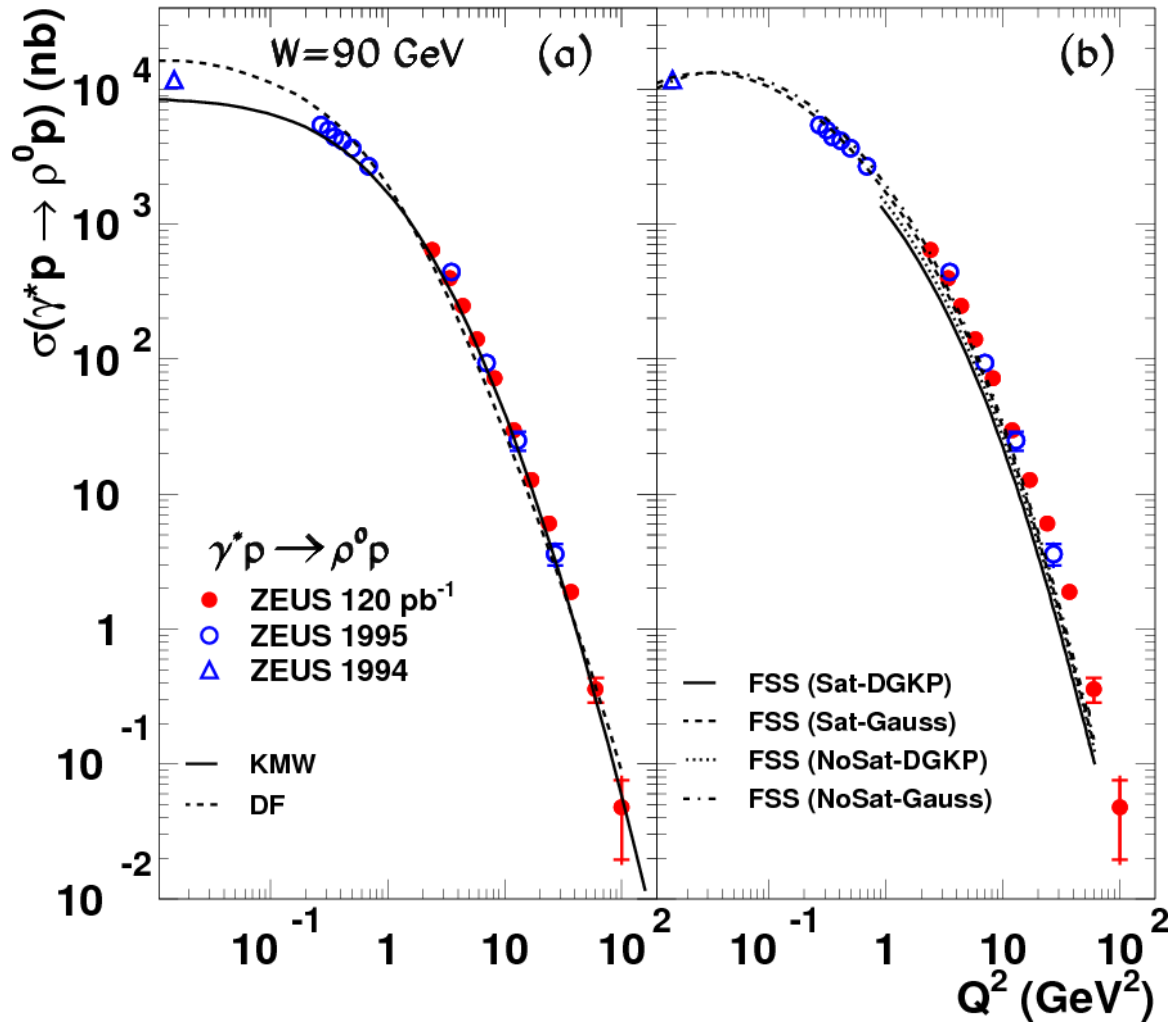
The effective Pomeron trajectory has a larger intercept and smaller slope than those extracted from soft interactions.

Comparison to theory

- **Martin-Ryskin-Teubner (MRT)** – two gluon exchange as the dominant mechanism for the dipole-proton interaction
- **Kowalski-Motyka-Watt (KMW)** – add impact parameter dependence, Q^2 evolution – DGLAP
- **Dosch-Ferreira (DF)** – dipole cross section calculated using Wilson loops. Use soft and hard Pomeron for an effective evolution
- **Forshaw-Sandapen-Shaw (FSS)** – exchange of a soft and hard Pomeron, with and without Saturation and use the DGKP and Gaussian ρ^0 wave-functions

Q^2 dependence

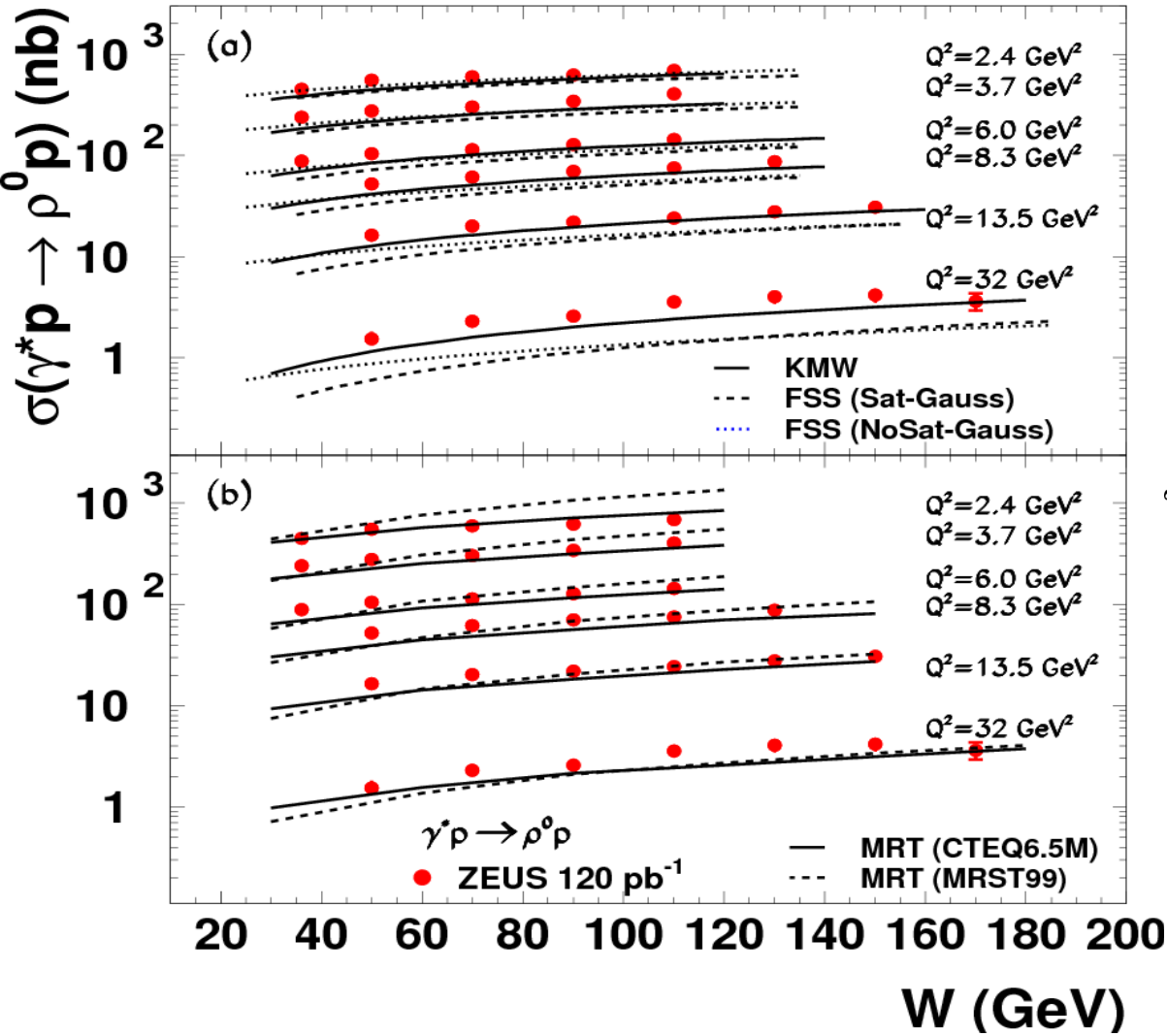
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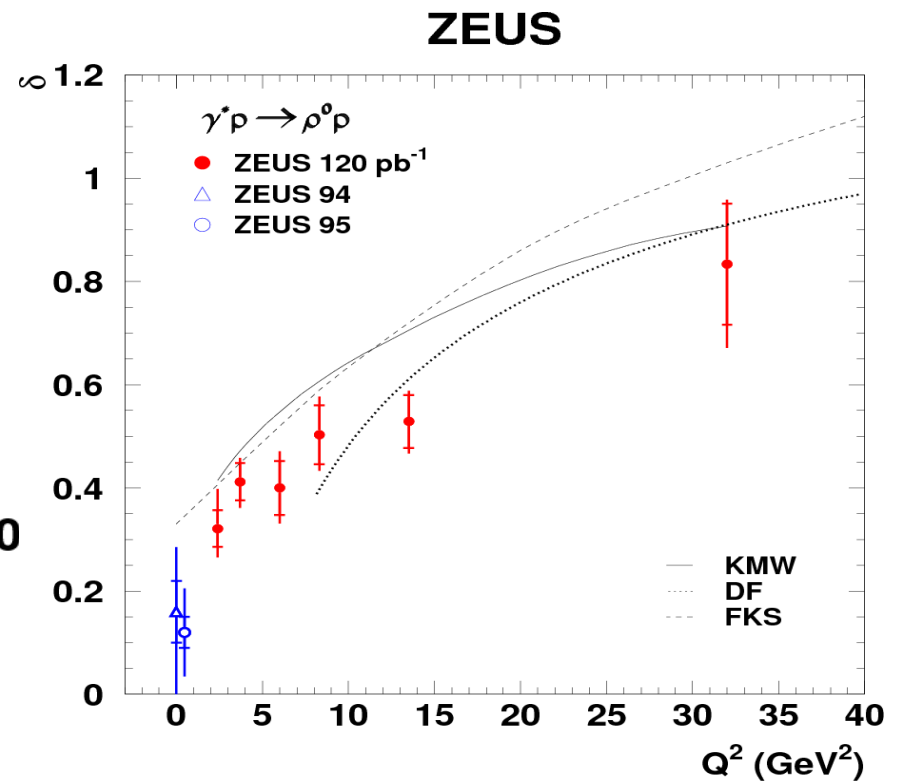
- **FSS** model with the three dimensional Gaussian ρ^0 wave function describes the low- Q^2 data very well
- **KMW** & **DF** describe the $Q^2 > 1 \text{ GeV}^2$ region well

W dependence

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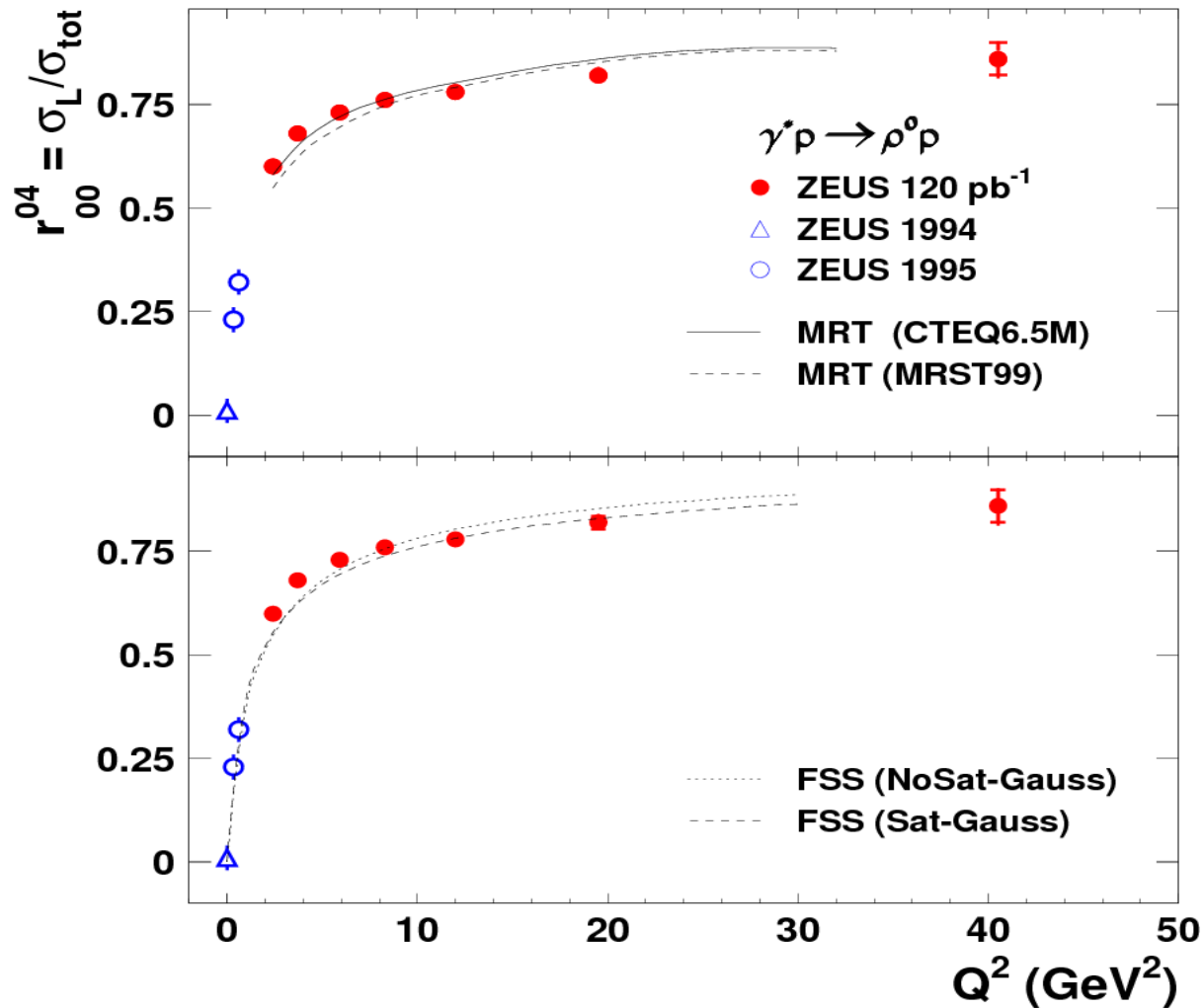


The models: **MRT** (CTEQ6.5M) and **KMW** - the closest to the data in shape and magnitude



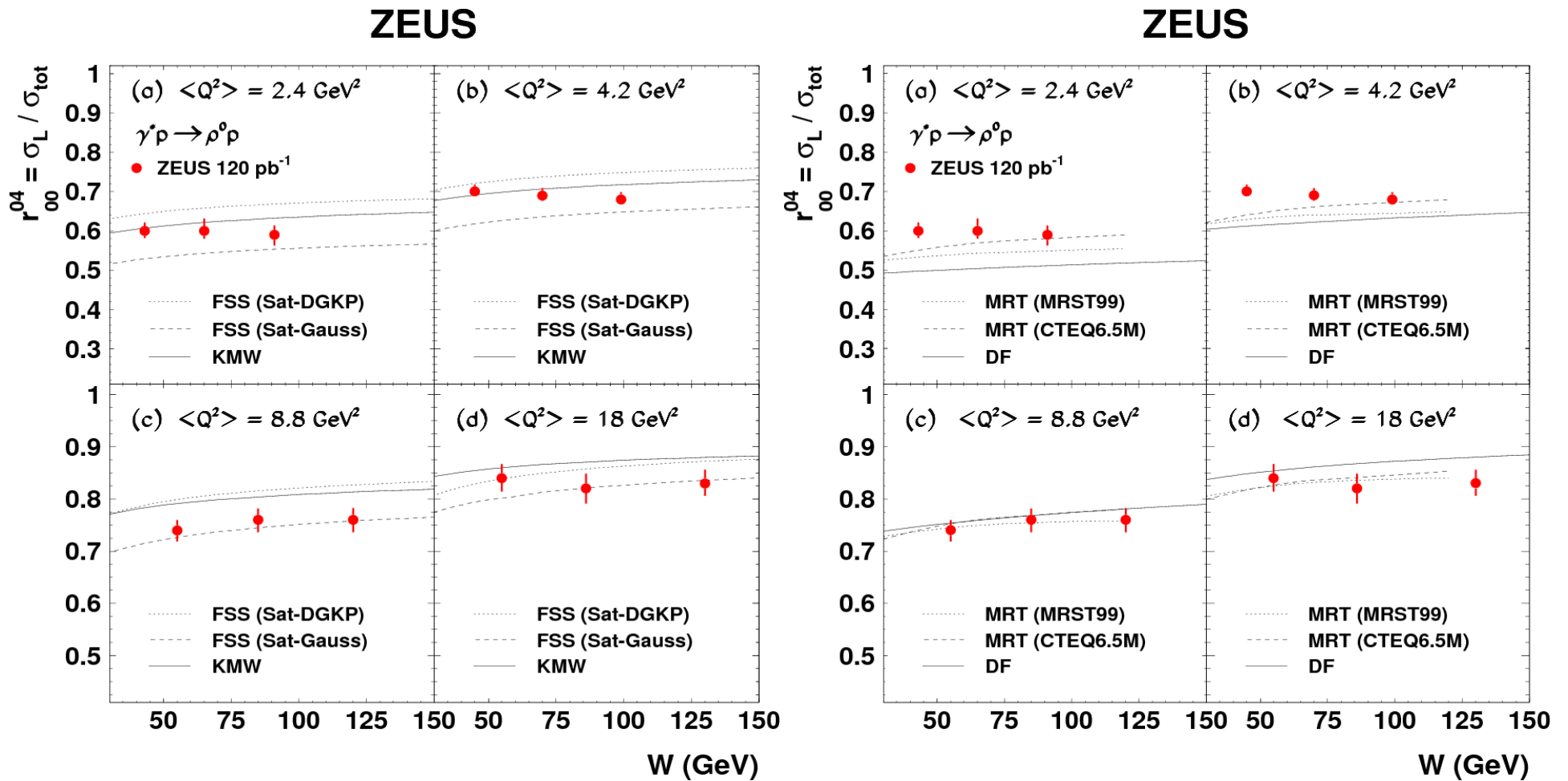
The ratio $\sigma_L/\sigma_{\text{tot}}$ as a function of Q^2

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Only the **MRT** (CTEQ6.5M gluon) describes data in the range $Q^2 > 4\text{GeV}^2$

The ratio $\sigma_L/\sigma_{\text{tot}}$ as a function of W



All the models exhibit a mild dependence of $\sigma_L/\sigma_{\text{tot}}$

but

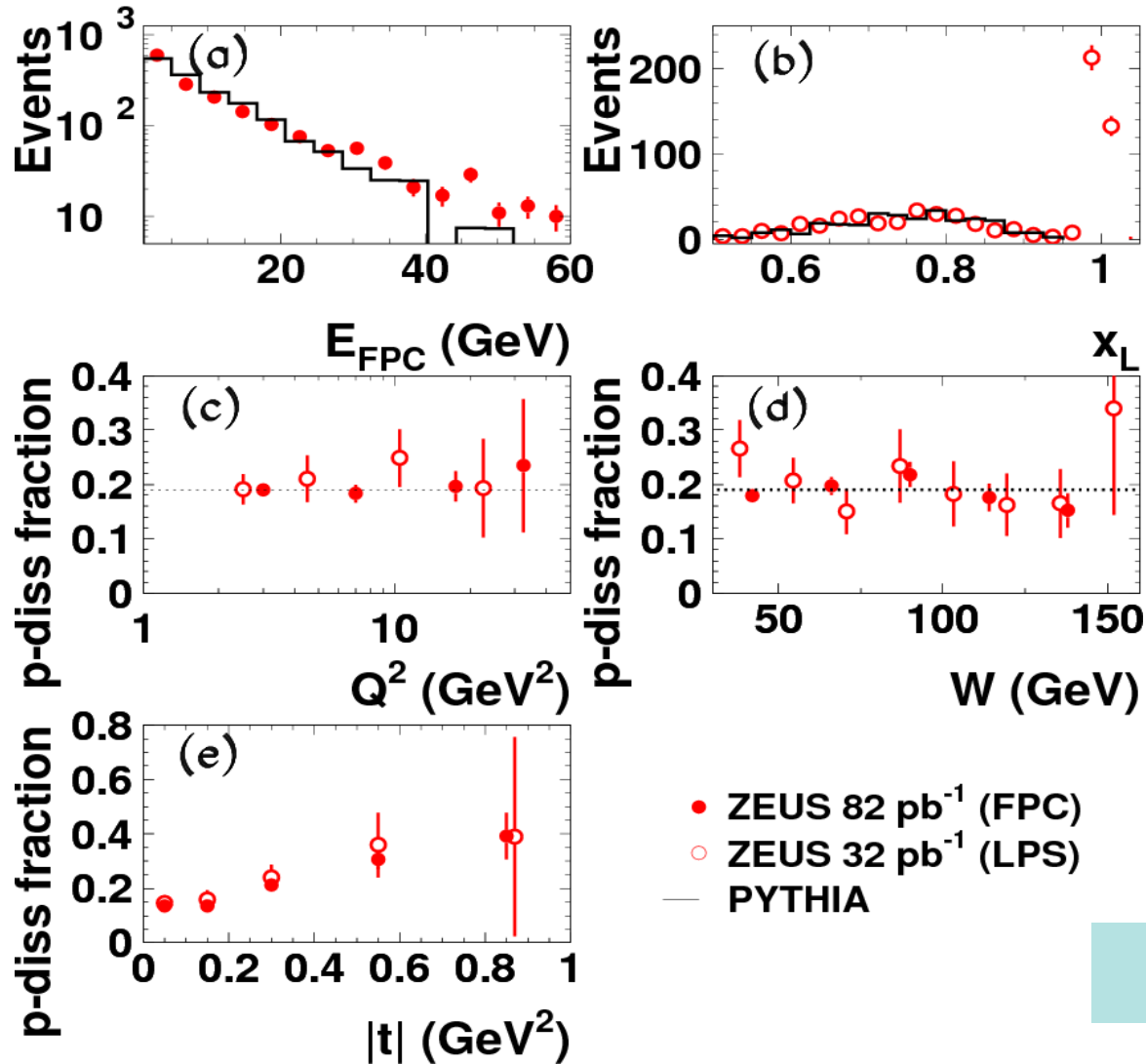
none of them reproduces the magnitude of $\sigma_L/\sigma_{\text{tot}}$ in all the Q^2 bins 15

Conclusions

- $\sigma(\gamma^*p \rightarrow \rho p)$ is steeply falling with Q^2 .
- The cross section rises with W and its logarithmic derivative in W increases with increasing Q^2 .
- The exponential slope of the t distribution decreases with Q^2 and levels off at about $b = 5 \text{ GeV}^{-2}$.
- $\sigma_L/\sigma_{\text{tot}}$ is independent of W for all Q^2 values.
- The effective Pomeron trajectory has a larger intercept and smaller slope than those extracted from soft interactions.
- All these features are compatible with expectations of perturbative QCD.
- None of the available models is able to reproduce all the features of the data.

Proton dissociation

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ppdis: $19 \pm 2(\text{st}) \pm 3(\text{sys})\%$