Exclusive ρ^0 electroproduction

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on behalf of
the ZEUS collaboration

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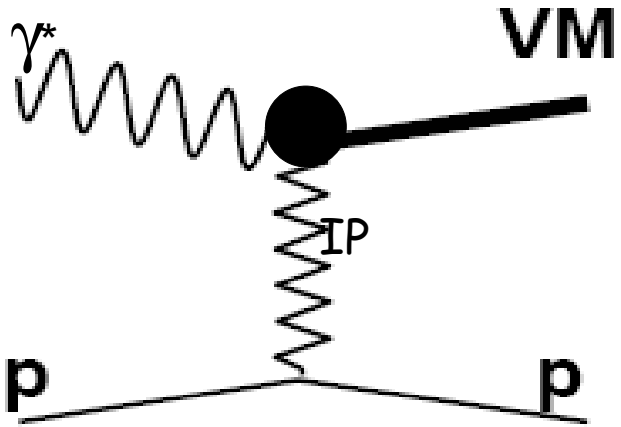
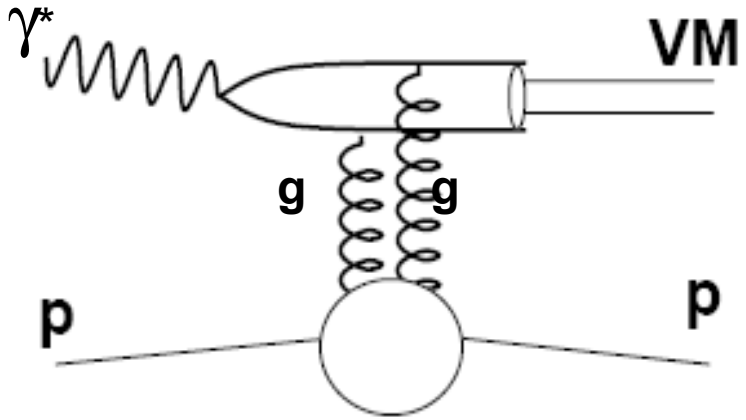
Motivation



'soft'



'hard'

$\sigma(W) \propto W^{\delta}$

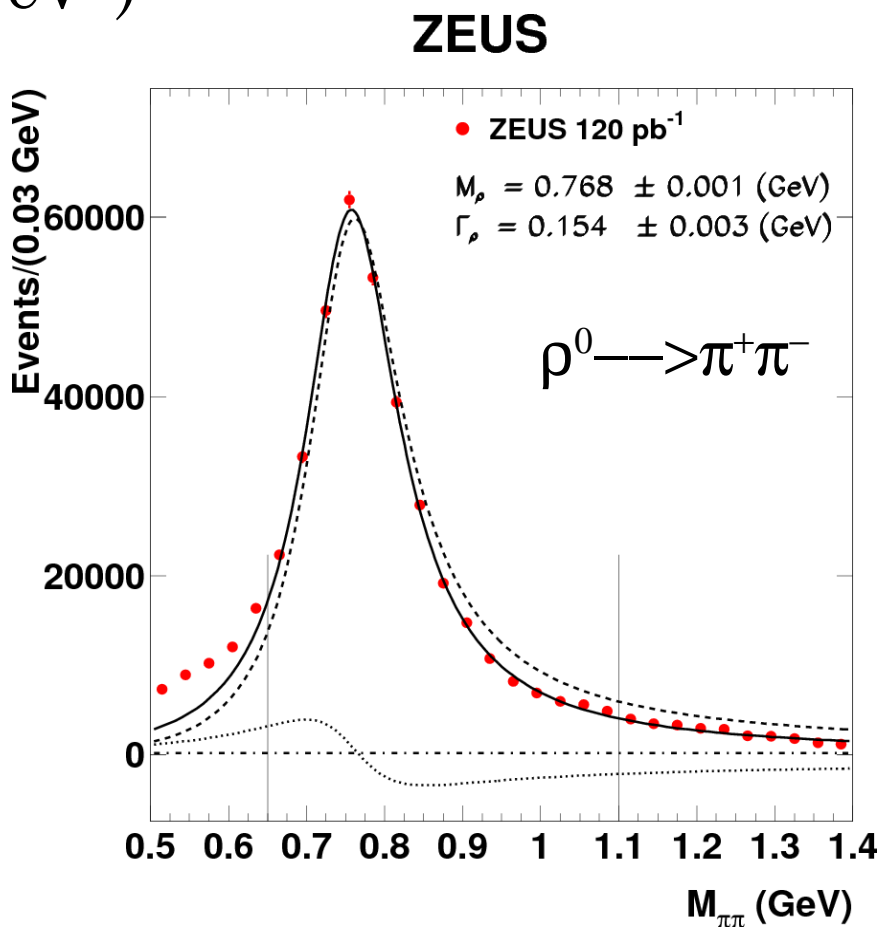
Expect: $\frac{d\sigma}{dt} \propto e^{-b|t|}$

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

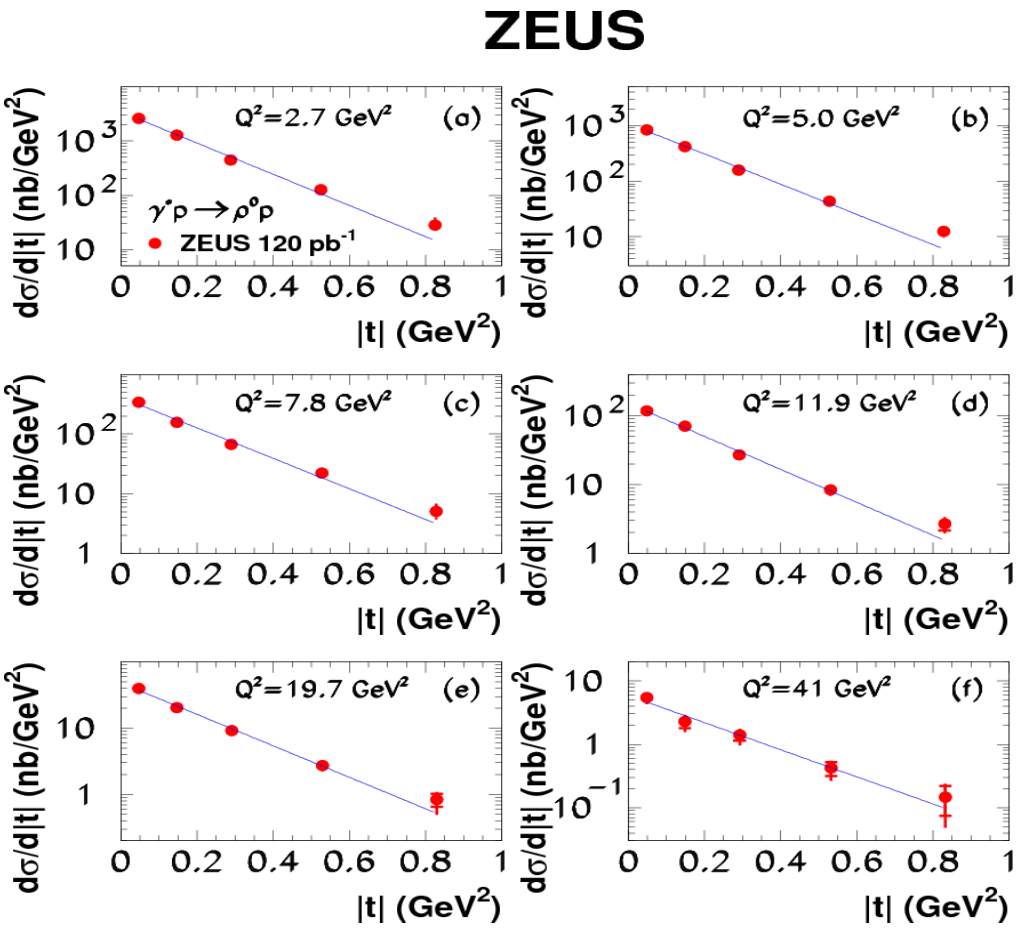
$\gamma^* p \rightarrow \rho^0 p$

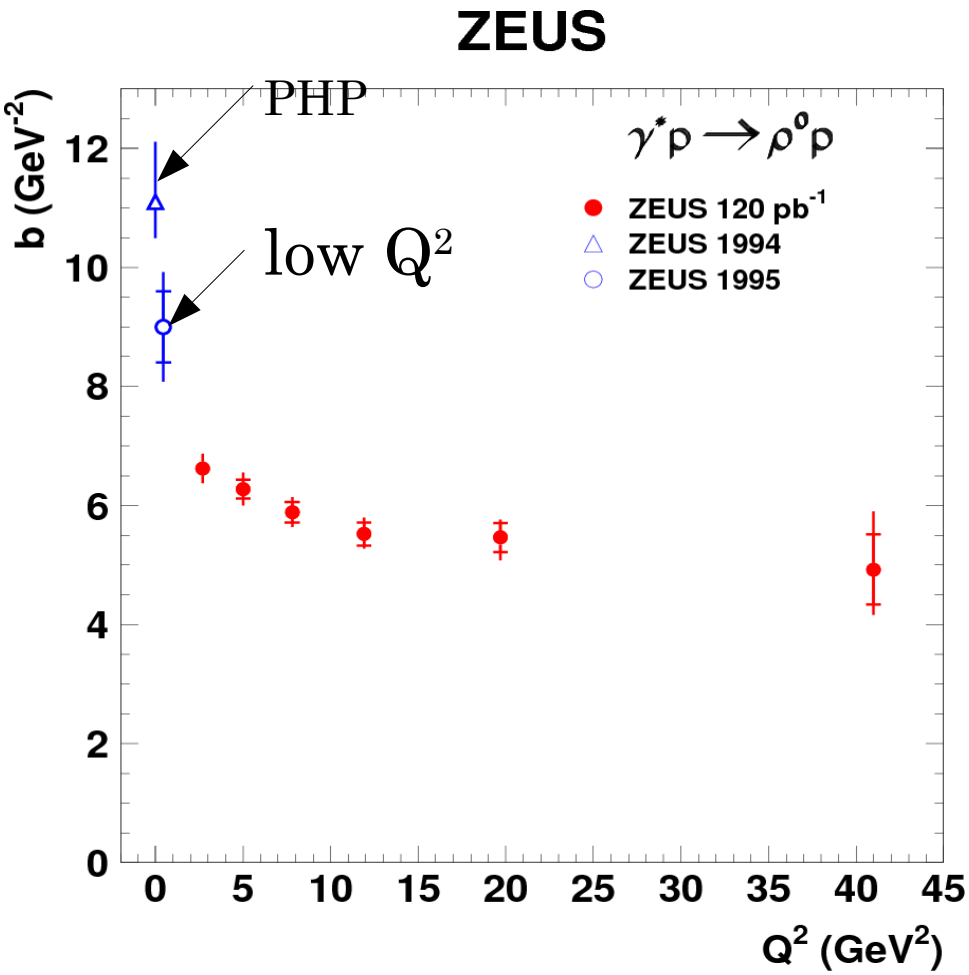
Data collected during 1996-2000, $\mathcal{L}$=120 pb^{-1}

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



The slope b

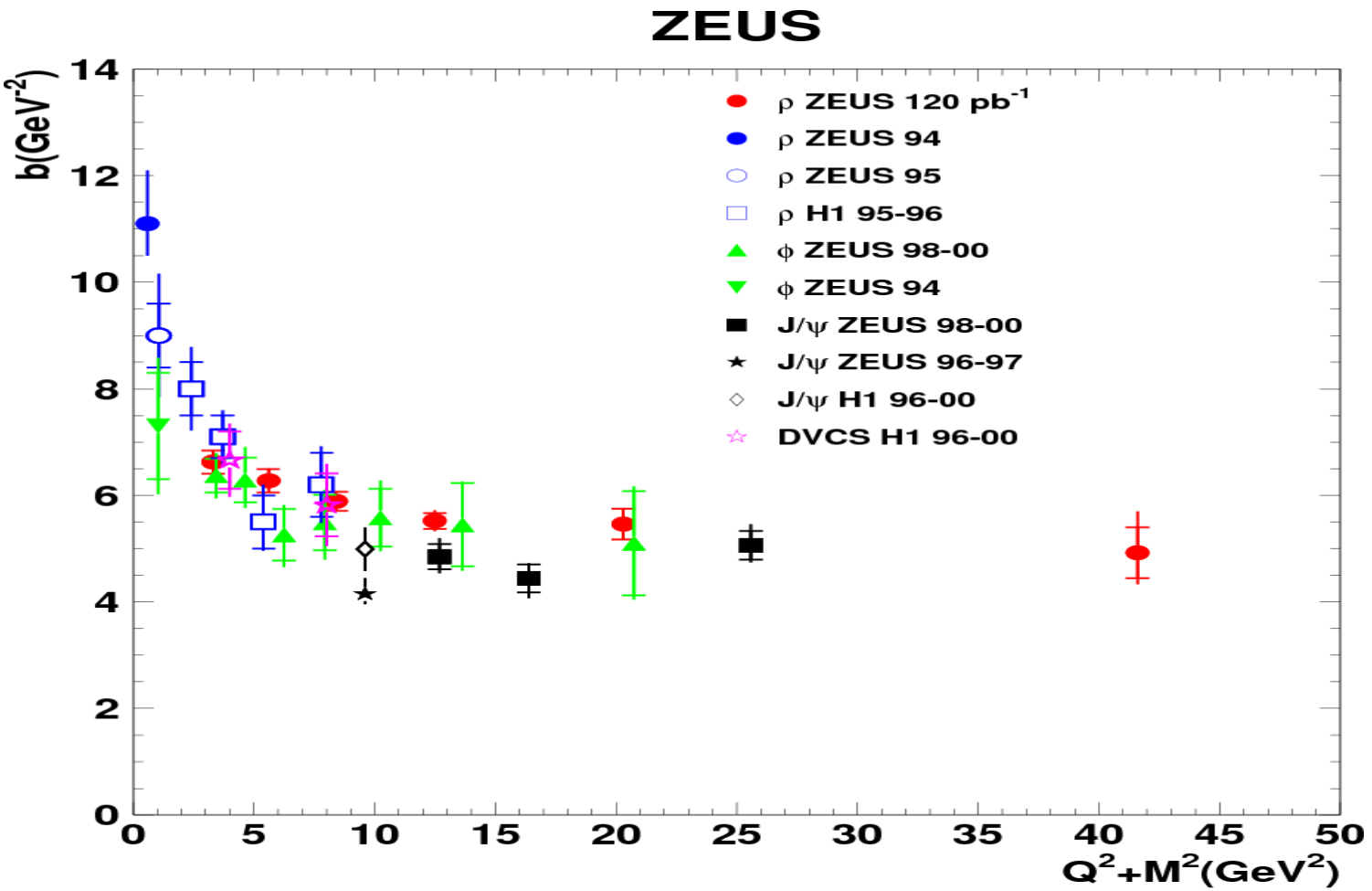




$d\sigma/d|t| \sim e^{-b|t|}$

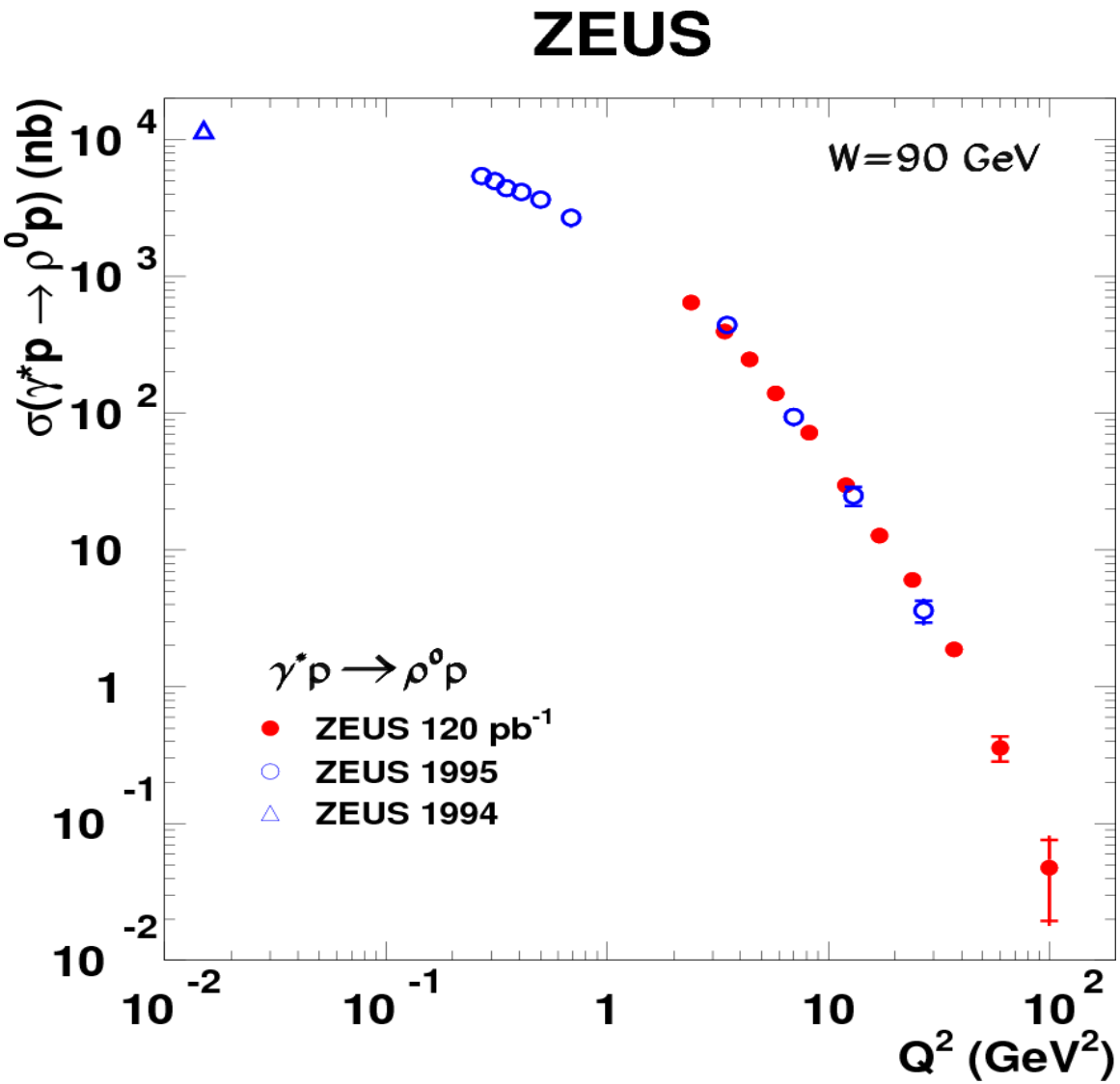
The slope b decreases with increasing Q^2

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



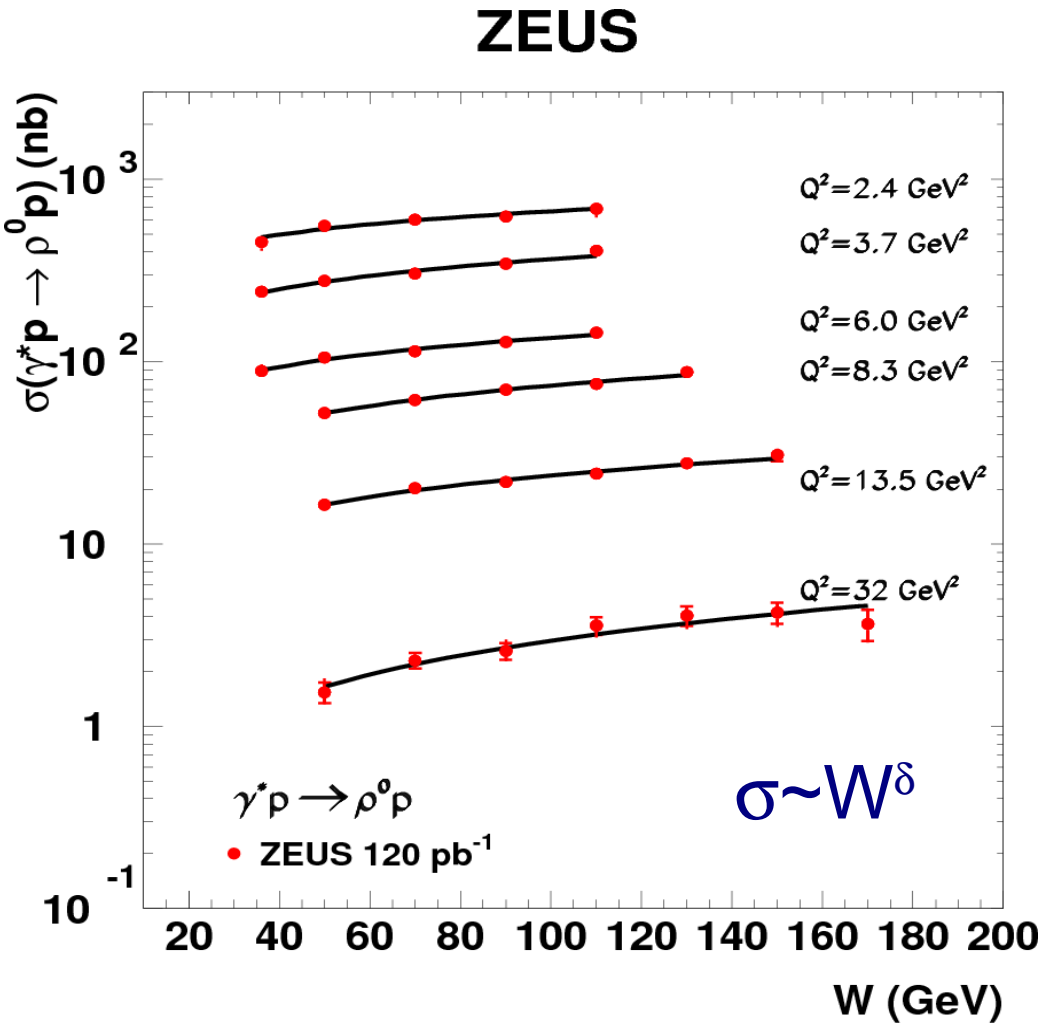
The slope b decreasing with increasing scale, to asymptotic value 5 GeV^{-2}

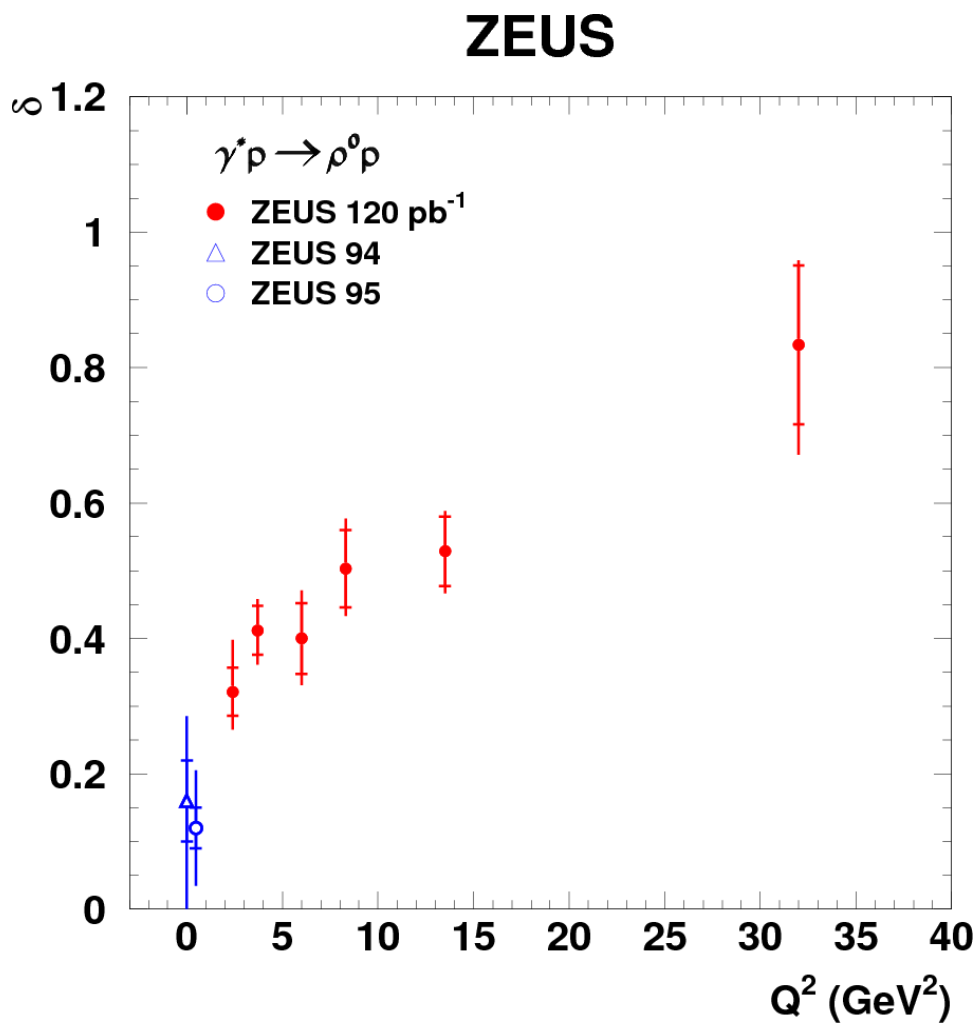
Cross section as a function of Q^2



The cross section decreases steeply with increasing Q^2

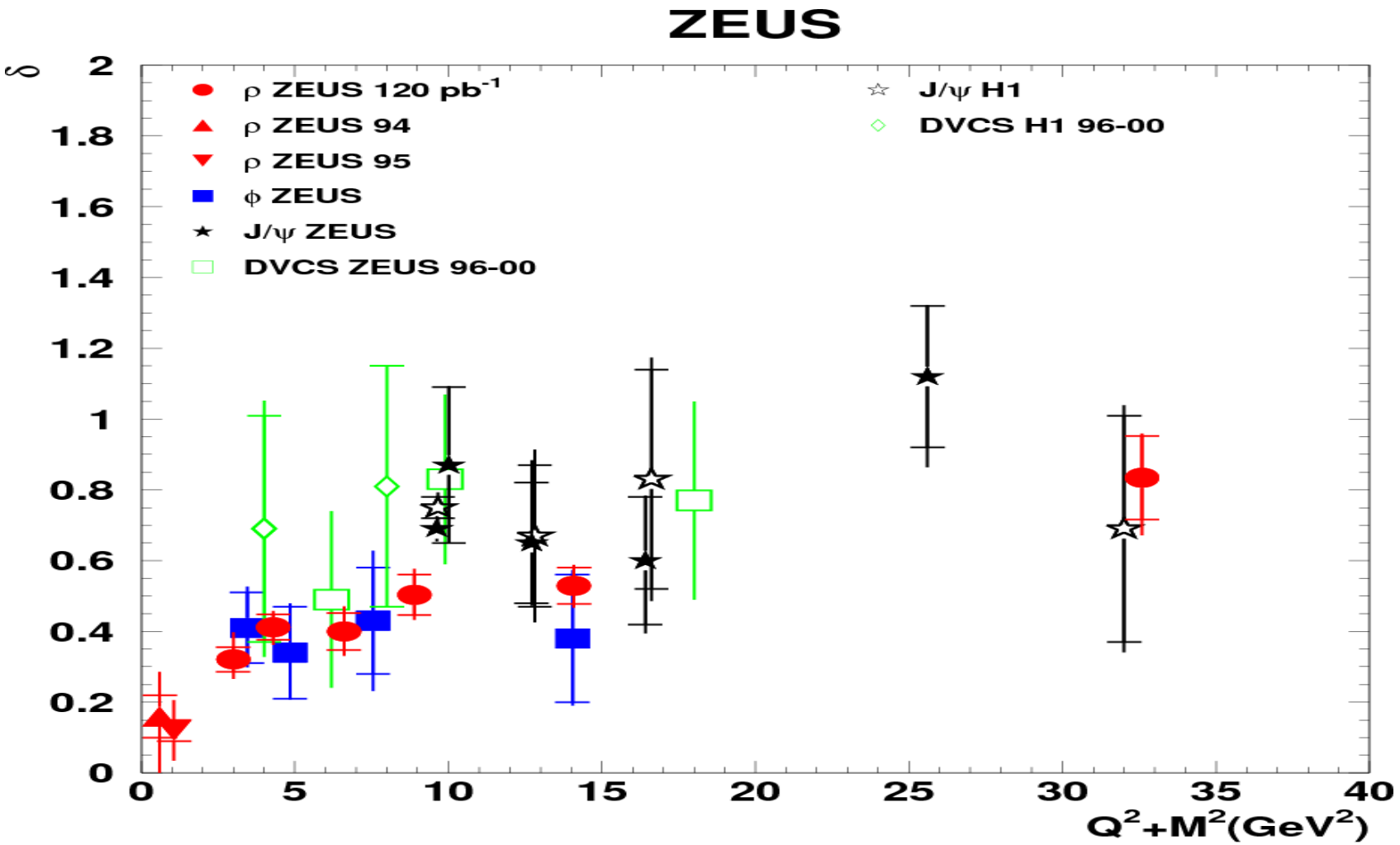
Cross section as a function of W





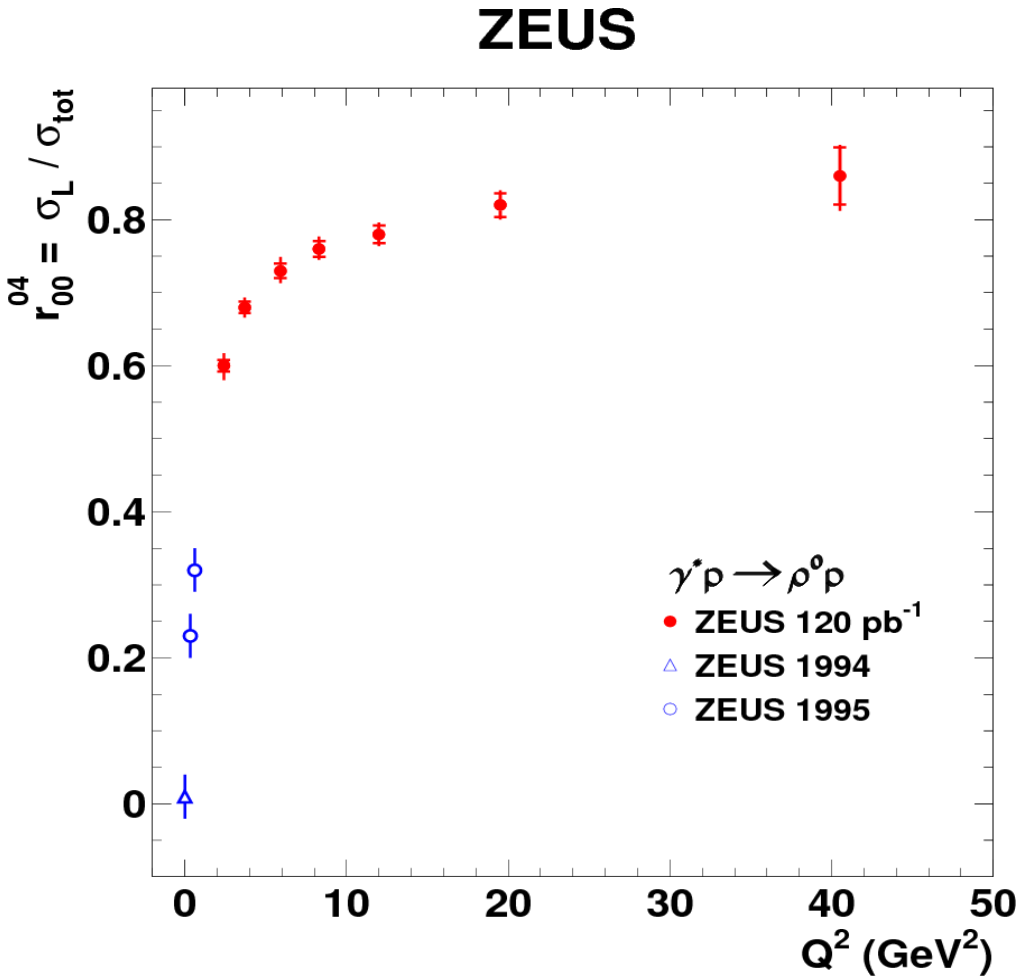
δ increases with increasing Q^2

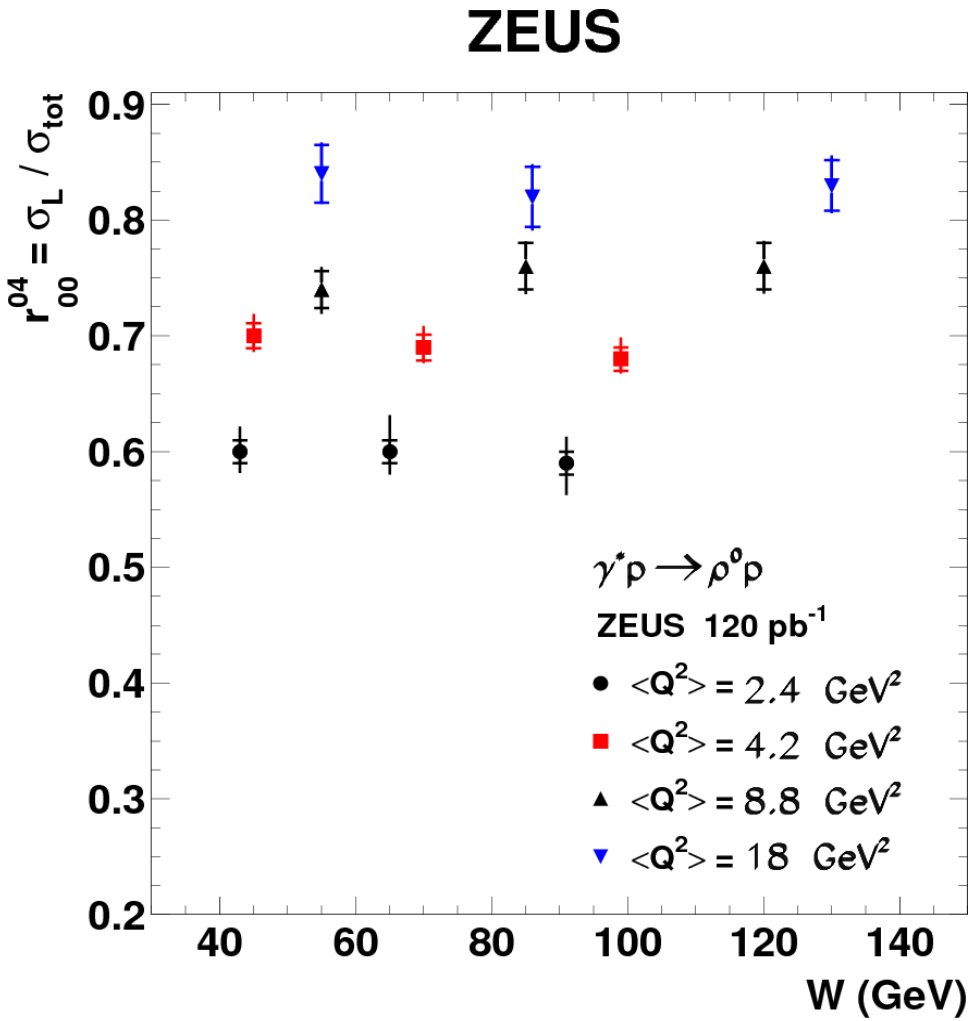
Comparison to other VM: δ (M^2+Q^2)



The value of δ increases with the scale

σ_L/σ_{tot} dependence

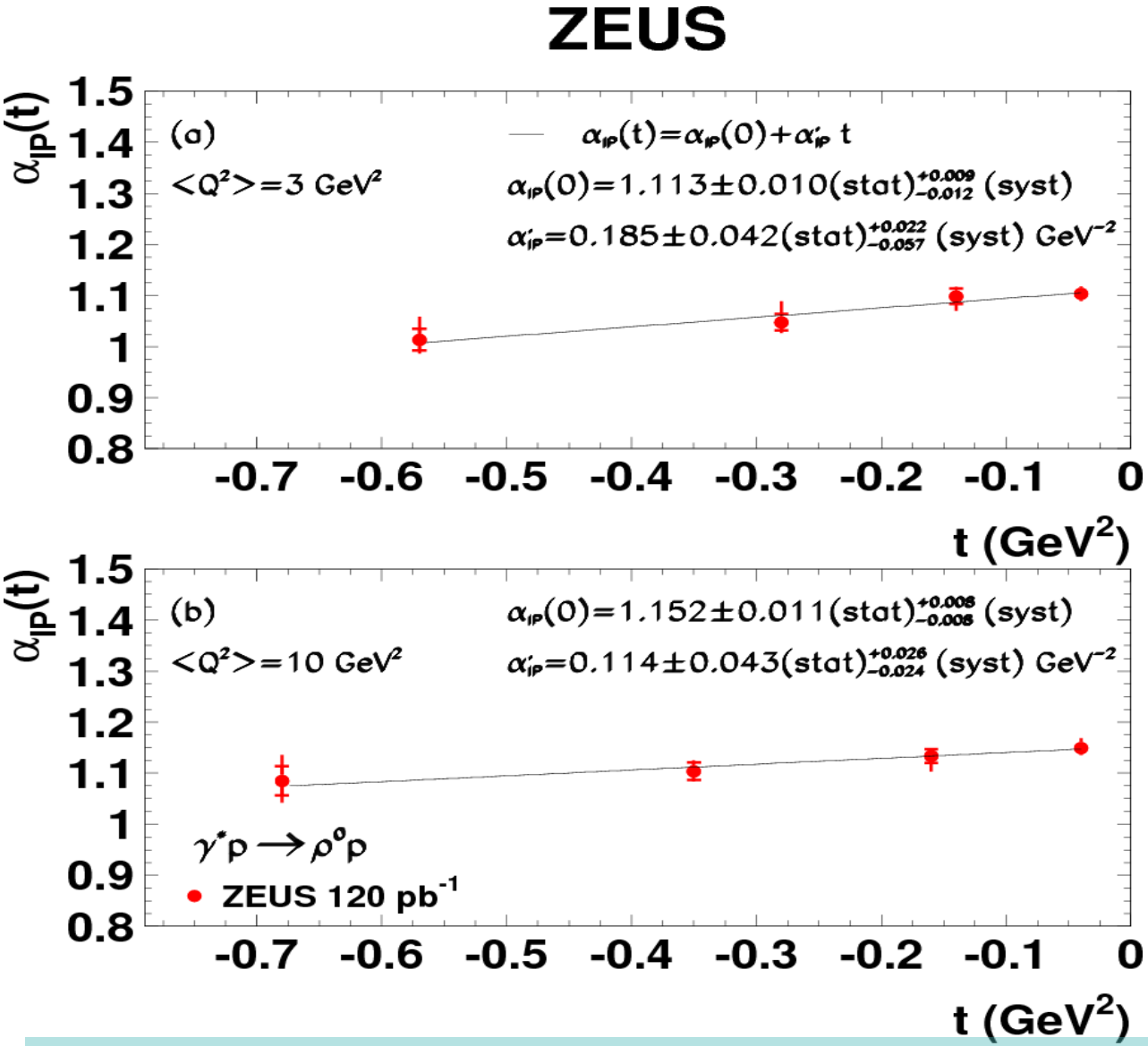




σ_L/σ_{tot} asymptotic with Q^2

σ_L/σ_{tot} independent of W

The Pomeron trajectory



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

with effective trajectory:

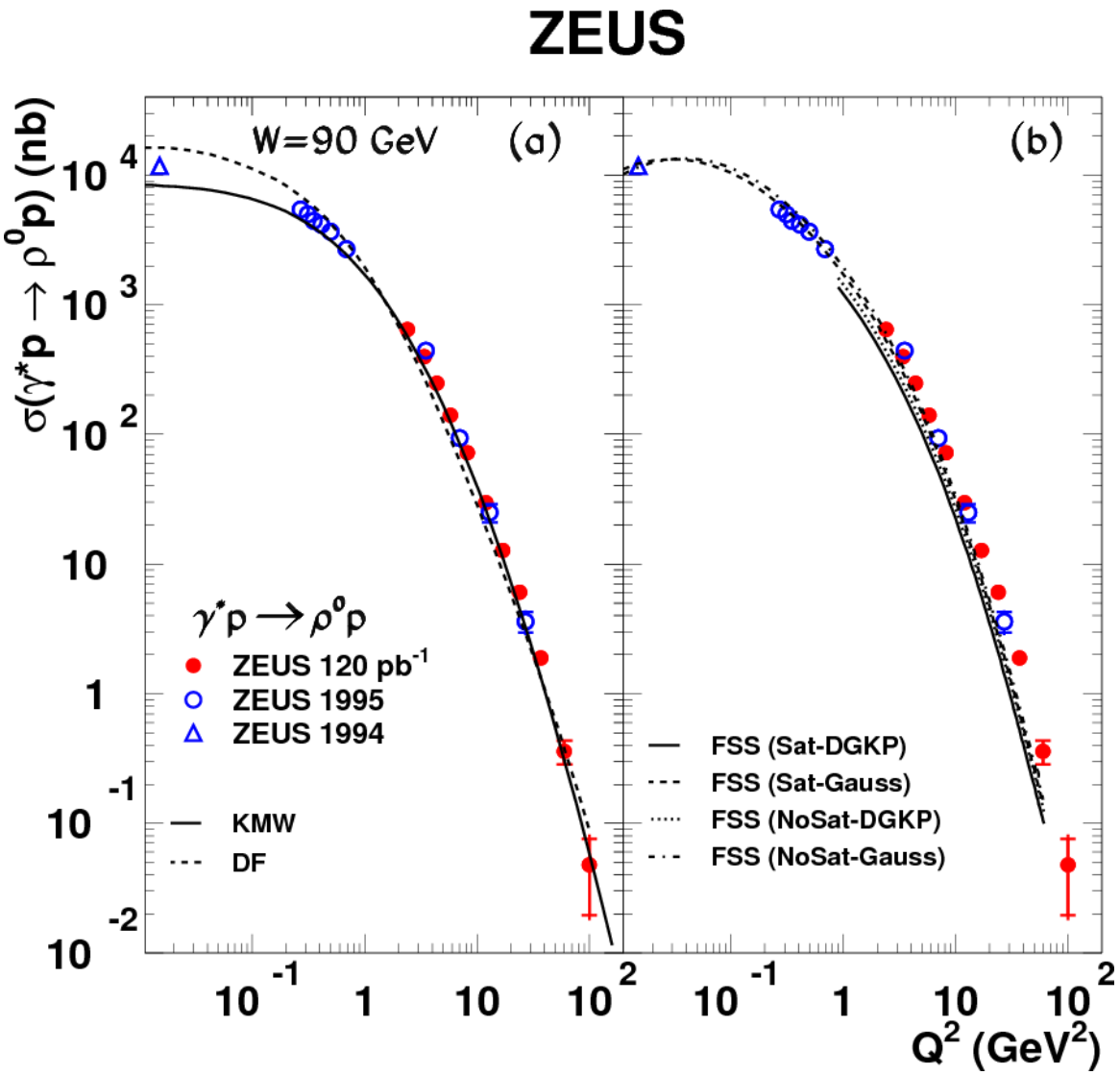
$\alpha_{IP}(t) = \alpha_{IP}(0)+\alpha_{IP}'(t) \cdot |t|$

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

Comparison to theory

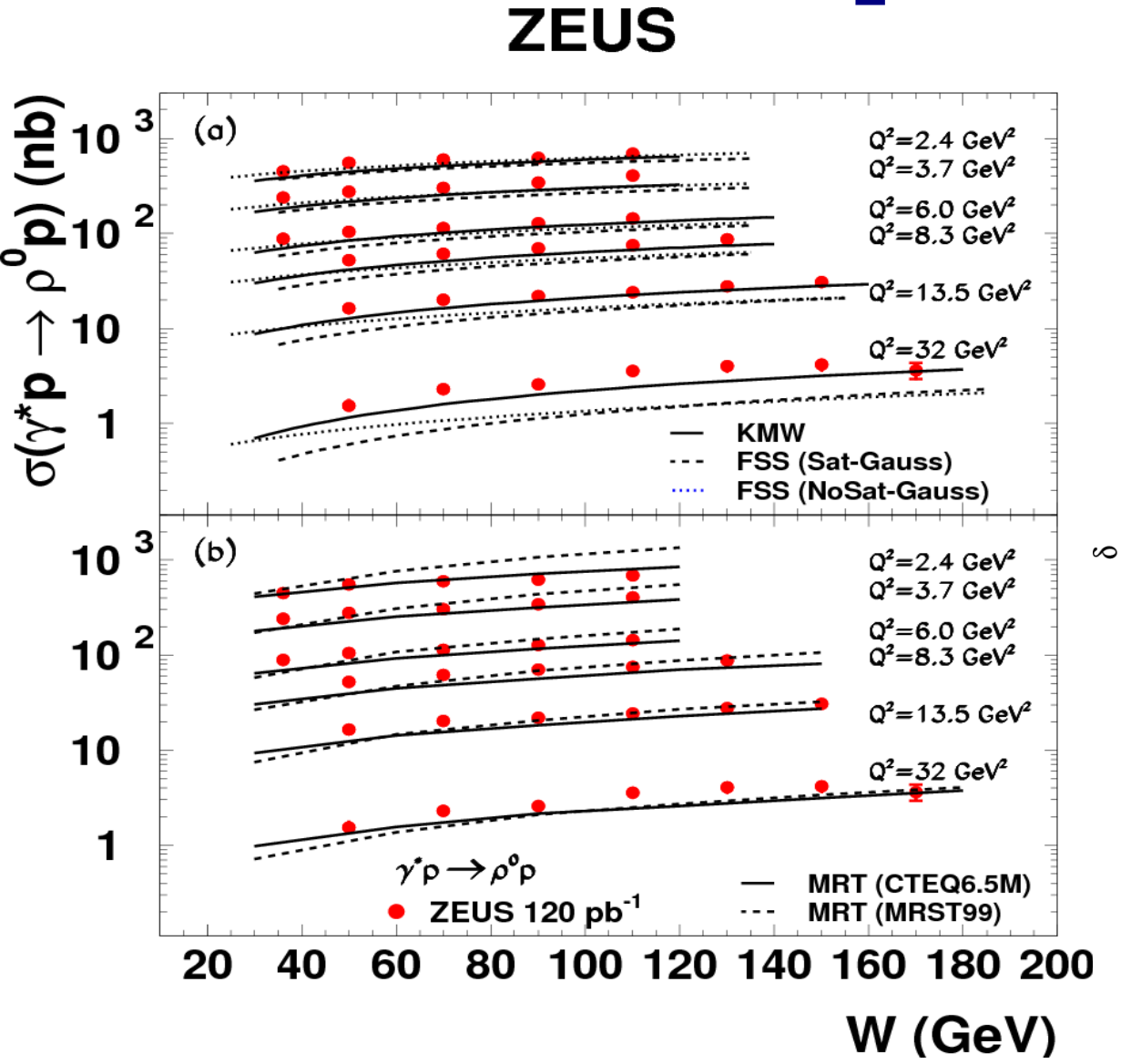
- Martin-Ryskin-Teubner (MRT) – two gluon exchange as the dominant mechanism for the dipole-proton interaction
- Kowalski-Motyka-Watt (KMW) – add impact parameter dependence, Q^2 evolution – DGLAP
- Dosch-Ferreira (DF) – dipole cross section calculated using Wilson loops. Use soft and hard Pomeron for 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

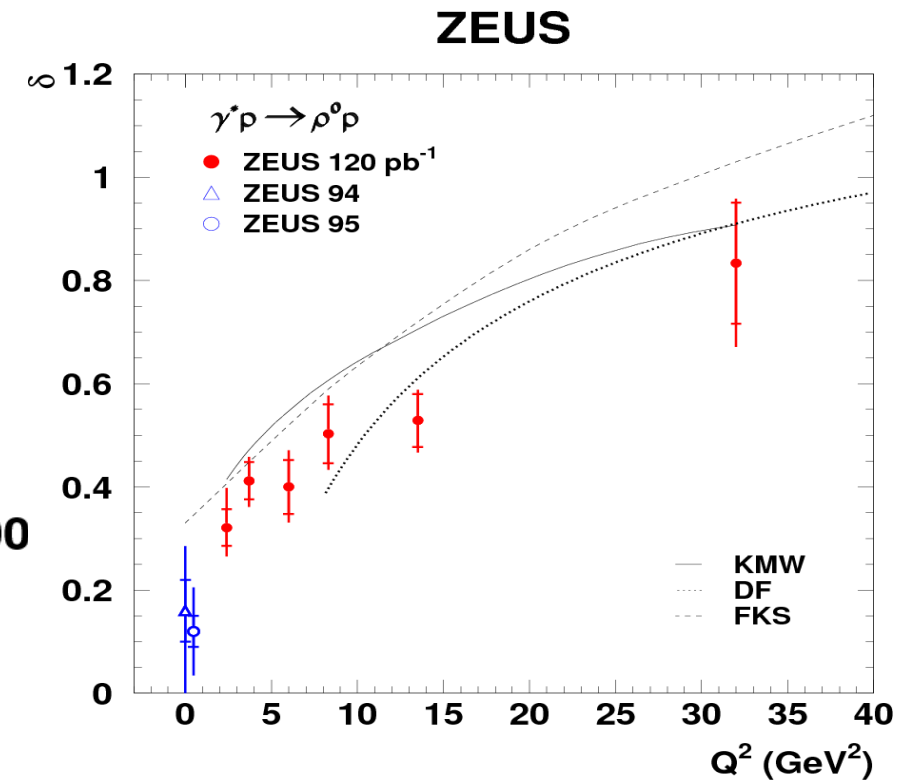


- FSS model with the three dimensional Gaussian ρ^0 wave function describes the low-Q^2 data very well
- KMW & DF describe the Q^2>1GeV^2 region well

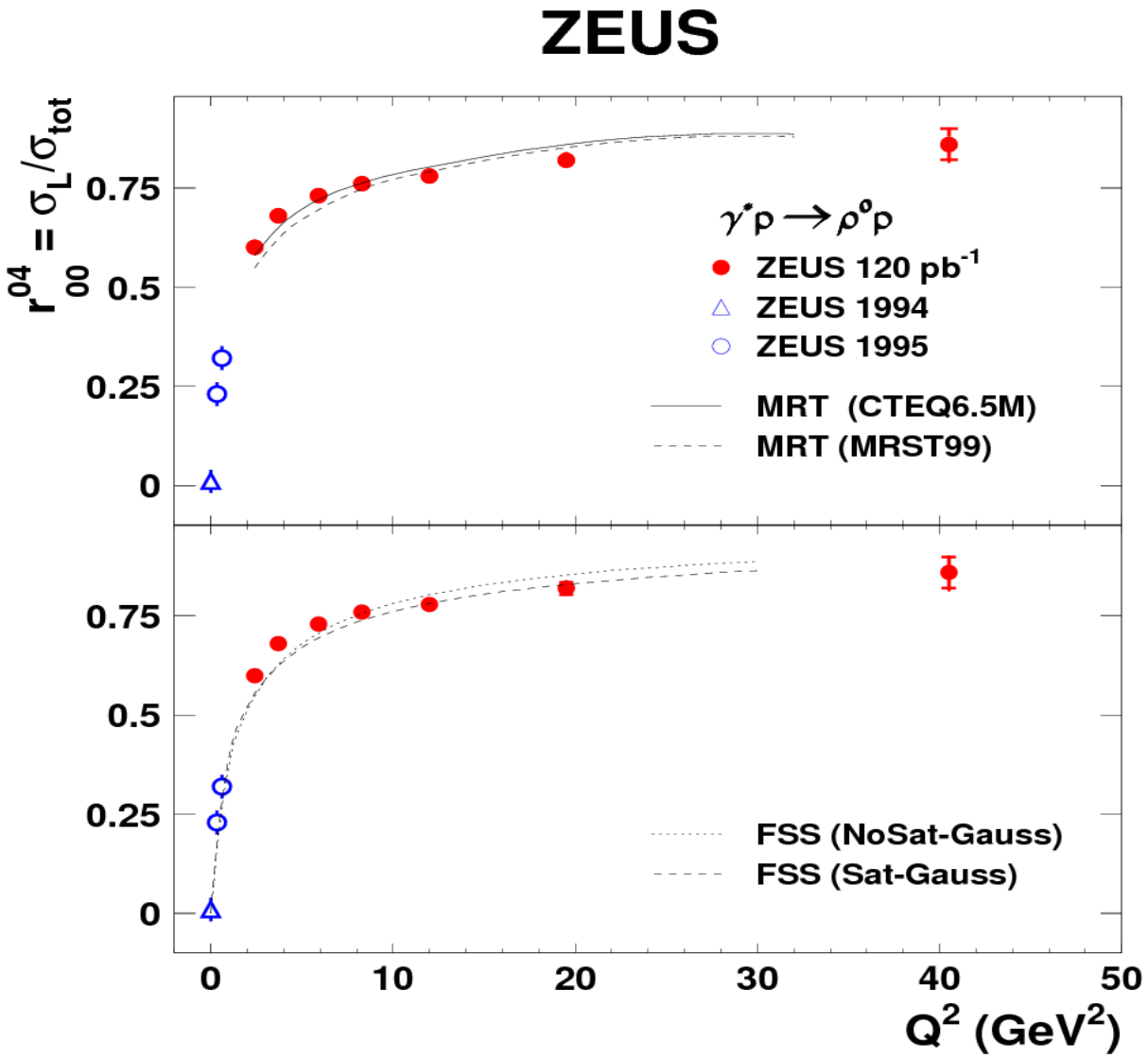
W dependence



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

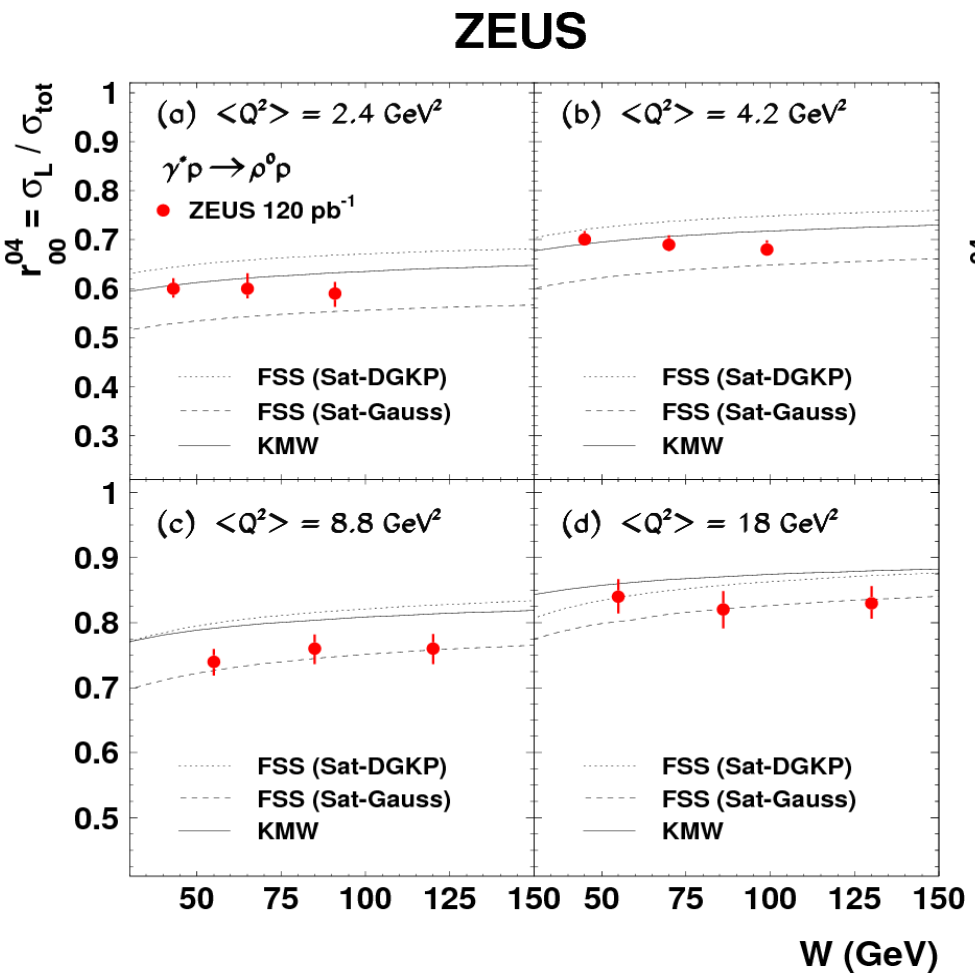


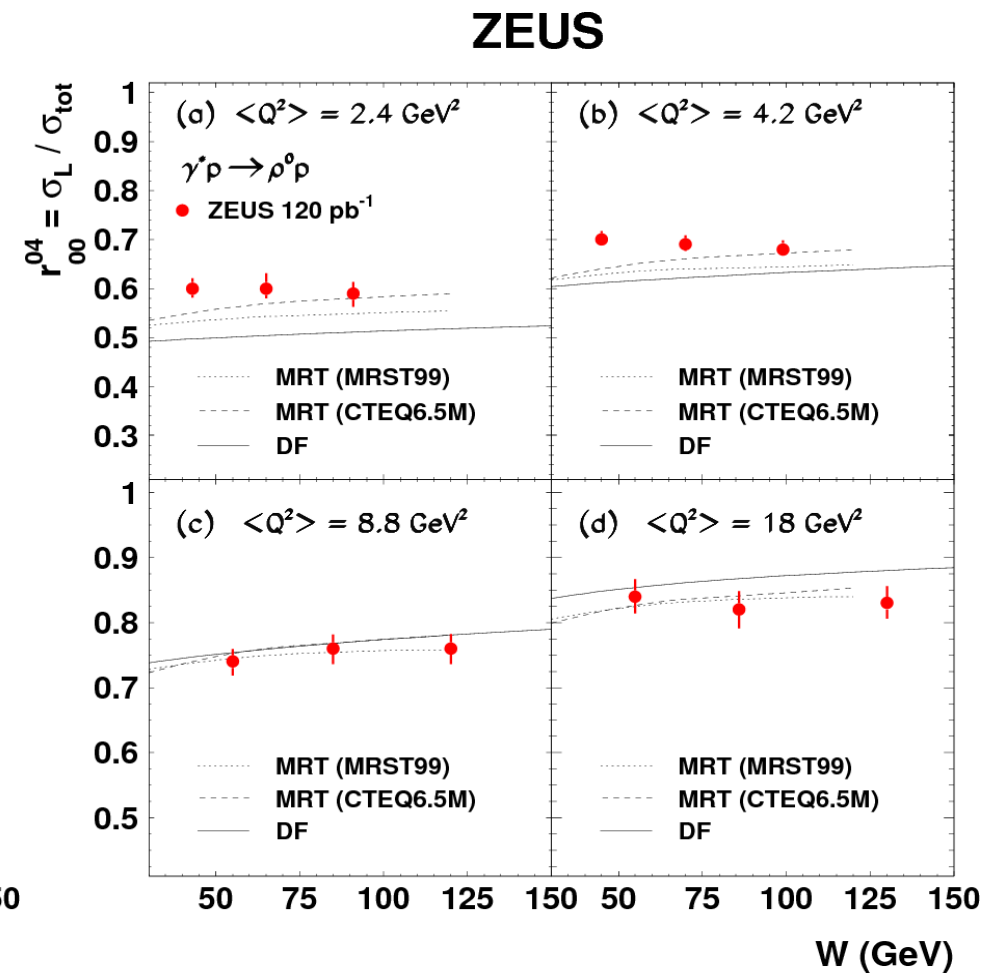
The ratio σ_L/σ_{tot} as a function of Q^2



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

The ratio σ_L/σ_{tot} as a function of W





All the models exhibit a mild dependence of σ_L/σ_{tot}

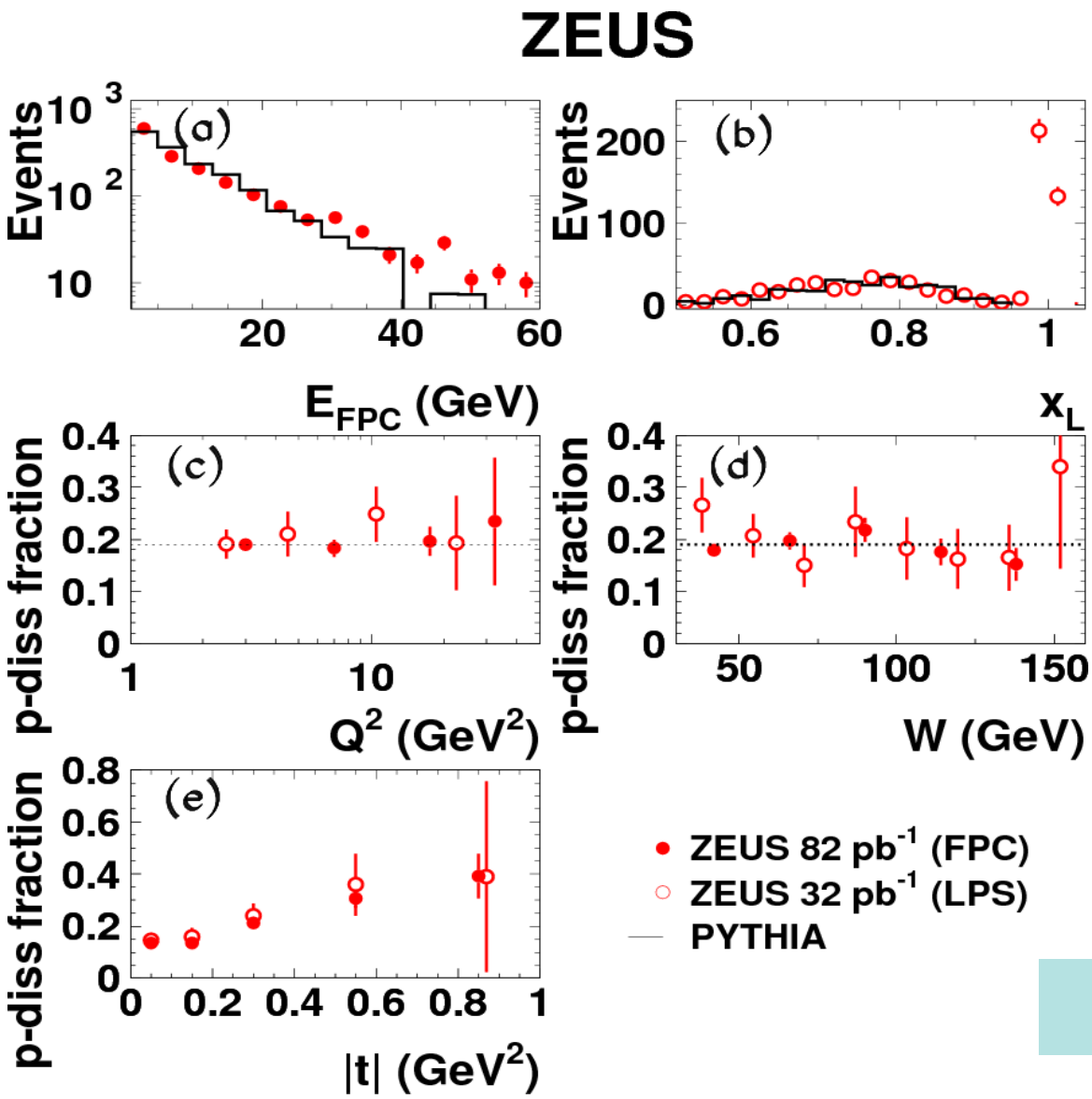
but

none of them reproduces the magnitude of σ_L/σ_{tot} in all the Q^2 bins

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 $b = 5\ GeV^{-2}$.
- σ_L/σ_{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 this 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



ppdis:19±2(st)±3(sys)%