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Diffractive Vector Meson Production

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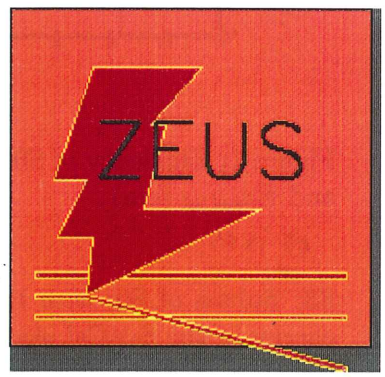
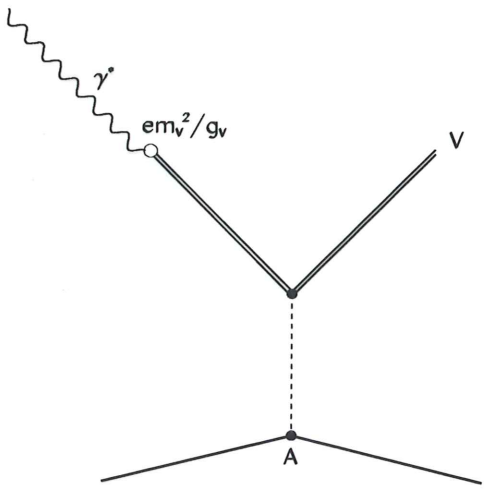
For the H1 and ZEUS collaborations



Outline

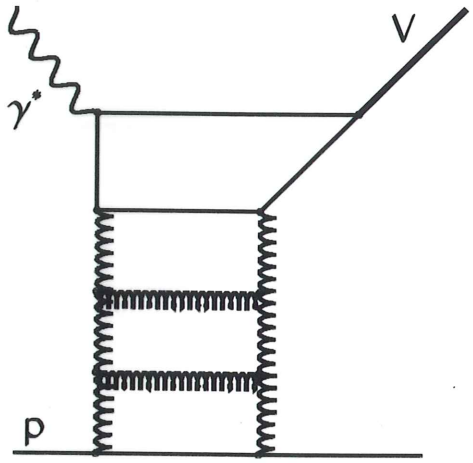
- Introduction: phenomenology, perturbative scales
- Helicity studies in ρ electroproduction
- Helicity studies in ρ photoproduction at high $|t|$
- Energy dependence in electroproduction $(\rho, \phi, J/\psi)$
- Υ photoproduction
- Summary

Soft Diffractive VM Production



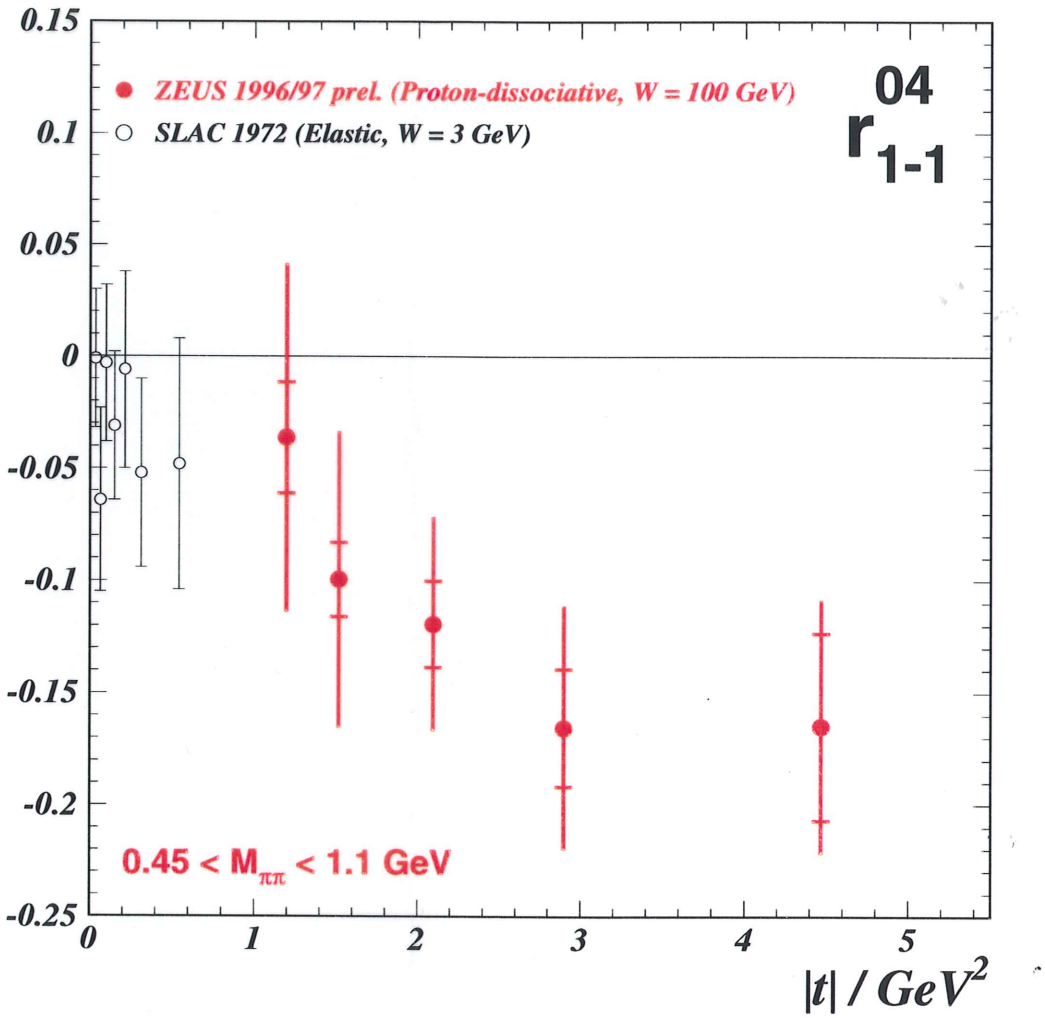
- Vector-meson dominance model (VDM)
- Soft pomeron exchange
- Slow rise of cross section with energy W, related to total γp cross section
- Forward peak $\sigma \sim e^{-b|t|}$ "shrinks" with increasing W
- s-Channel helicity conservation (SCHC) and natural parity exchange (NPE)

Diffractive VM Production in pQCD



- Need hard scale – Q^2, $|t|$, M_V^2
- Rapid rise of cross section with W, related to rise in gluon density at small x
- No shrinkage

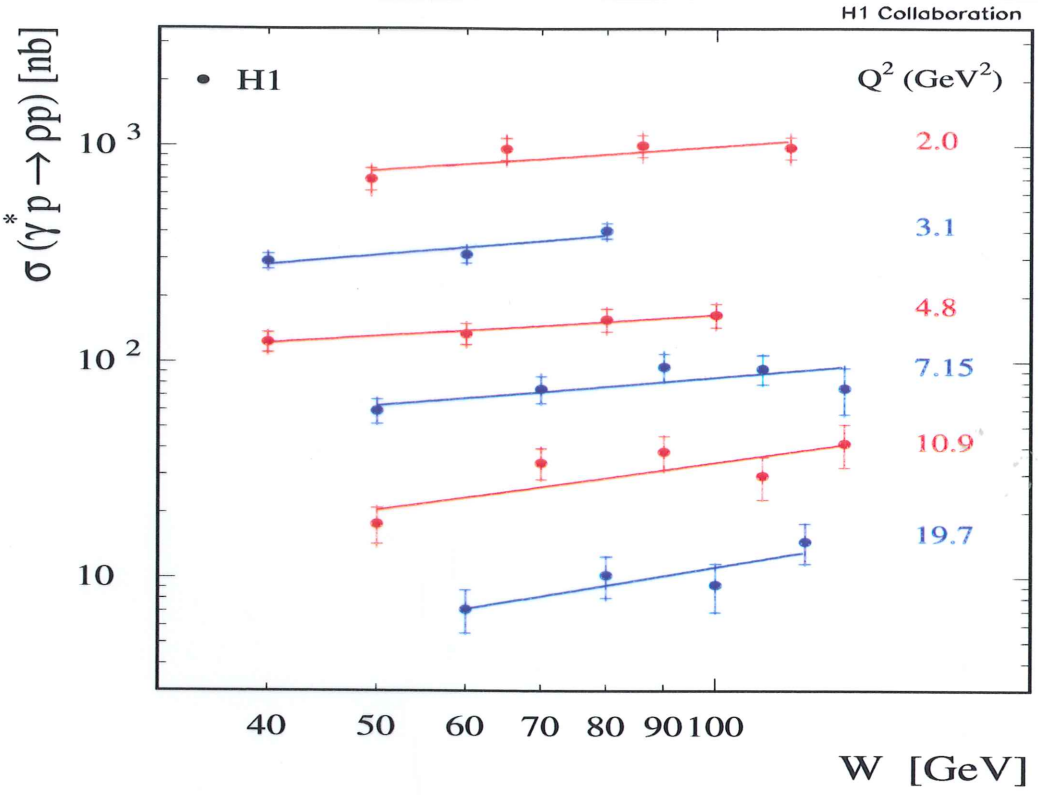
Helicity in High-$|t|$ ρ Photoproduction

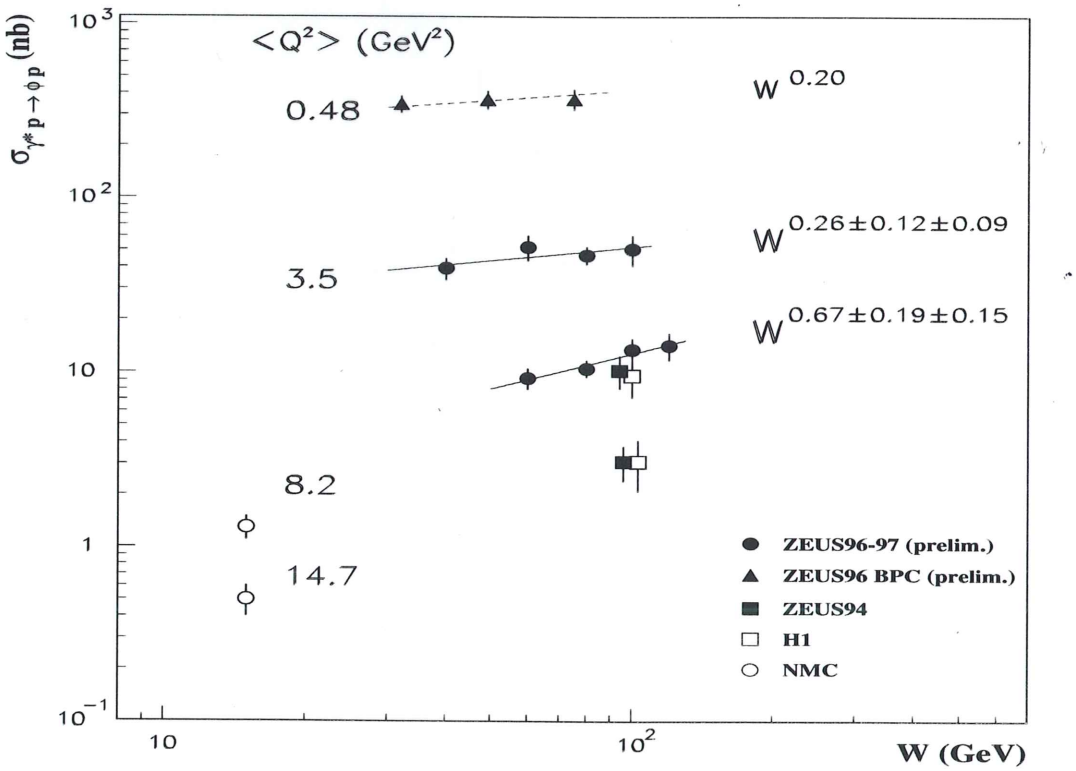


$$r_{1-1}^{04} \simeq \frac{\mathrm{Re}(T_{11}T_{1-1}^{*})}{T_{01}^{2}+T_{11}^{2}+T_{1-1}^{2}}$$

- Sensitive to helicity flip of transverse photon
- Double-flip contribution increases with $|t|$

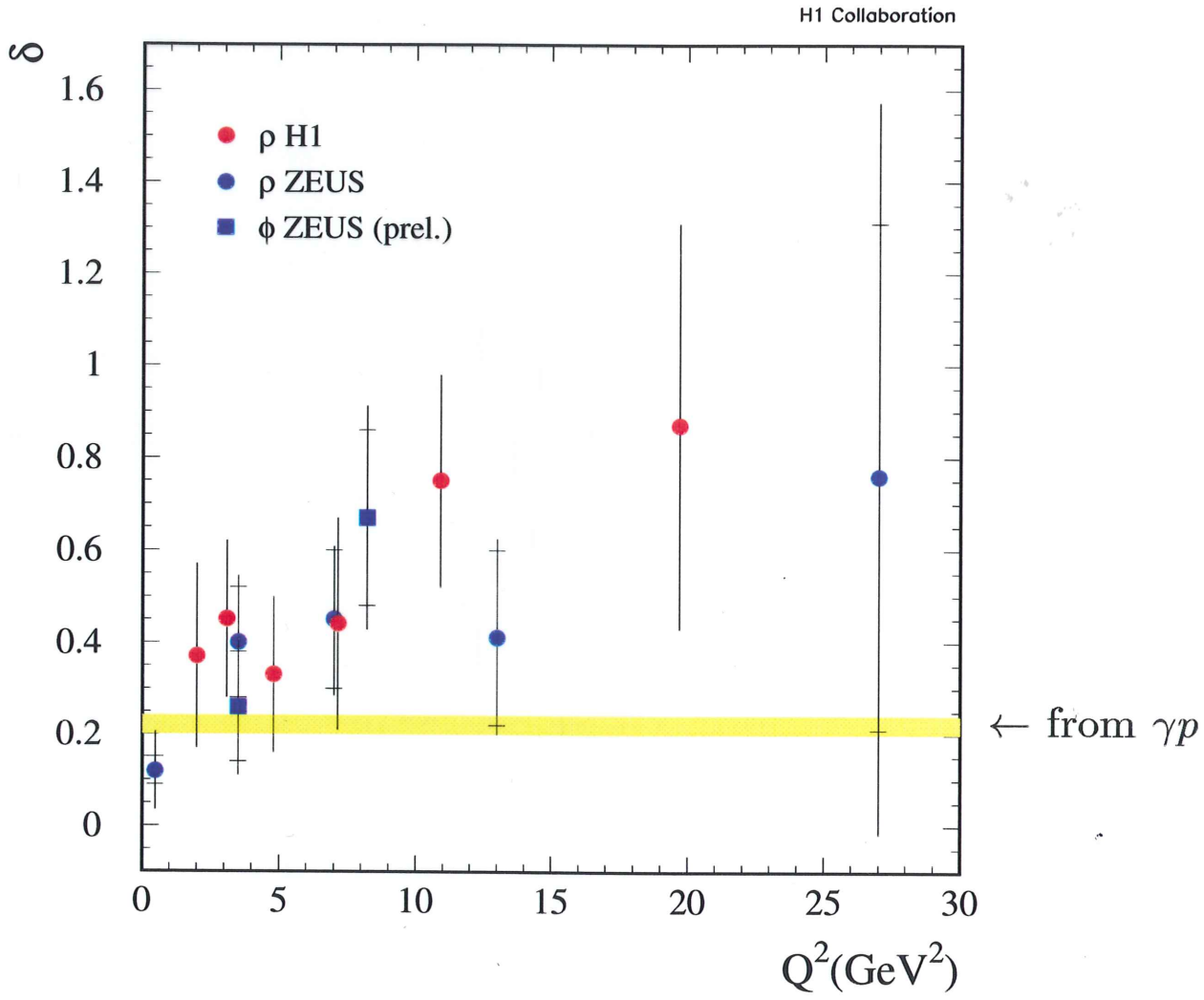
Energy Dependence in Light VM Electroproduction





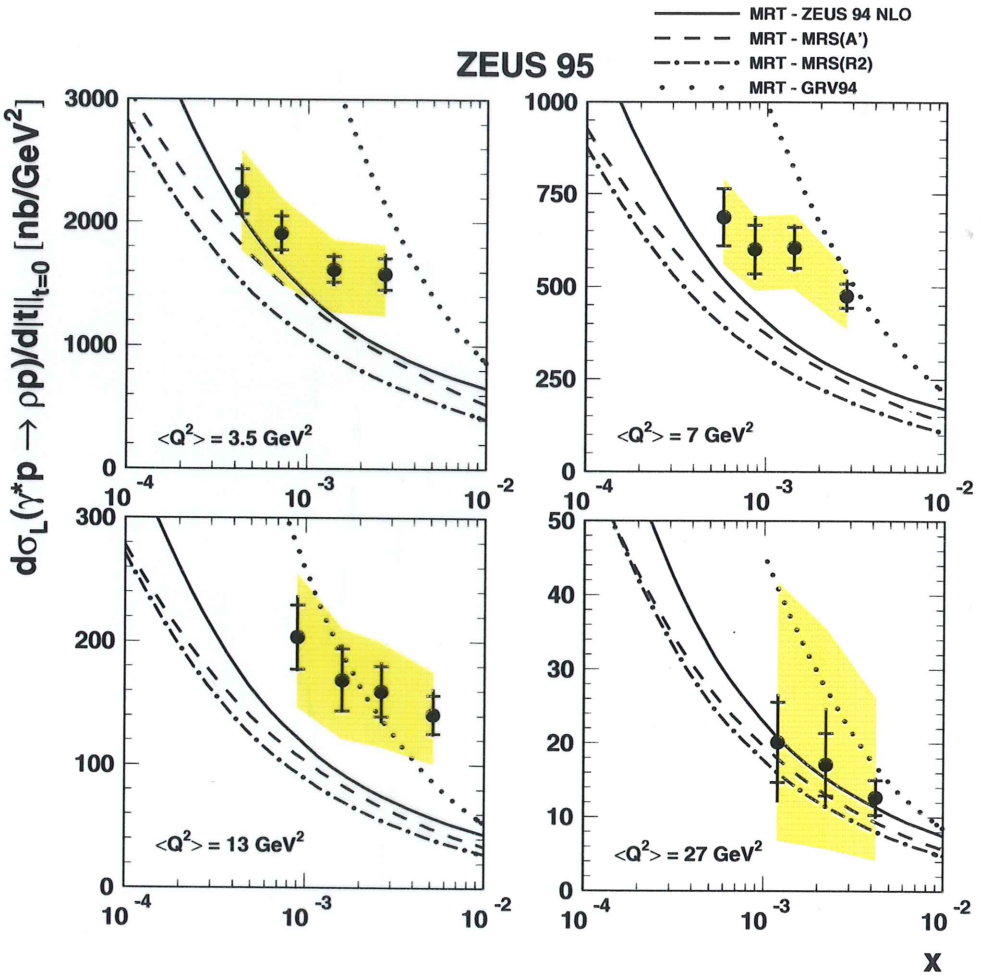
- Does W dependence become steeper as scale Q^2 is increased?
- Parameterize dependence as $W \propto W^{\delta}$.

Energy Dependence in Light VM Electroproduction



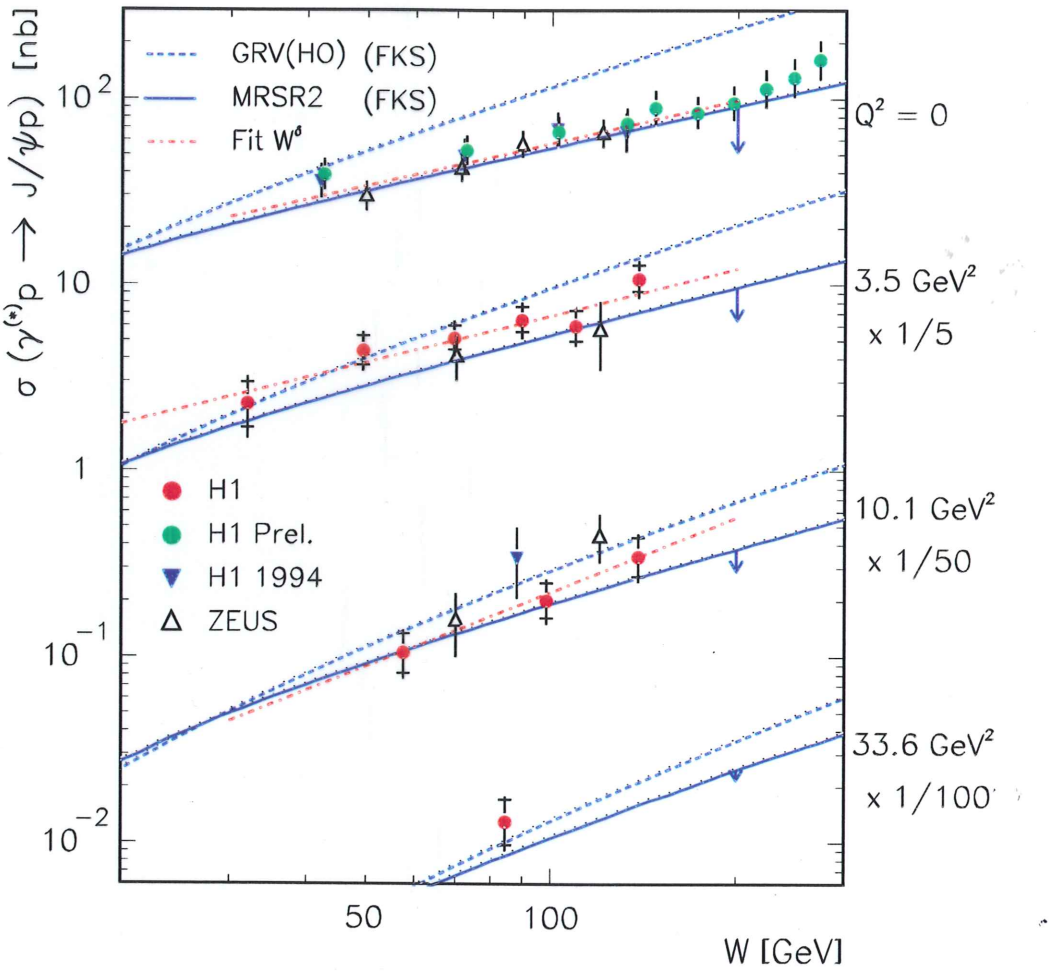
- Plot W-slope δ vs Q^2.
- Evidence for slope increasing with Q^2.

Gluon Density In ρ Electroproduction



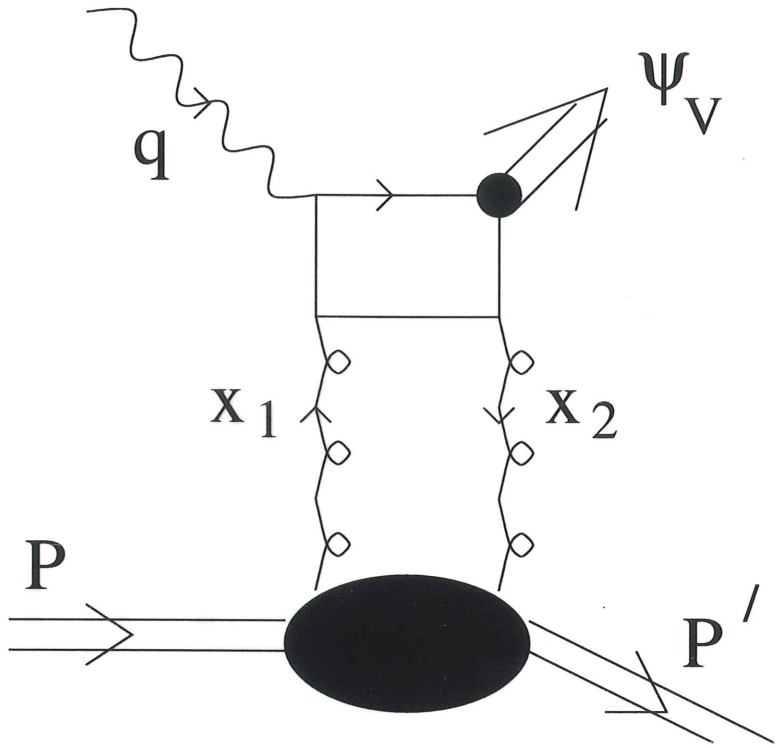
- pQCD calculation (Martin-Ryskin-Teubner): forward longitudinal cross section sensitive to choice of parton distributions
- Sensitive to rise in gluon density at low x (high W).

Energy Dependence in J/ψ Electroproduction



- Steep W dependence already seen in photoproduction.
- Slope at higher Q^2 compatible with that in photoproduction.
- Sensitive to gluon density.
- Also sensitive to charm mass ($\downarrow$ shows effect of change 1.4 to 1.5 GeV).

Off-Diagonal Parton Distributions



- Calculations by:
  - Frankfurt, McDermott, Strikman: hep–ph/9812316
  - Martin, Ryskin, Teubner: hep–ph/9901420
- Off-diagonal gluon distribution $x'g(x,x')$
- $x \simeq M_V^2/W^2, x' \ll x$
- Important effect for large $M_V \rightarrow$ large scale, large x

Summary

- VDM + soft pomeron works well when no hard scale is present.
- Small violation of SCHC at higher Q^2, described by pQCD model.
- Longitudinal/transverse cross-section ratio rises with Q^2, but not linearly.
- Double-flip contribution in ρ photoproduction increases with $|t|$.
- Evidence for steeper energy dependence at higher Q^2 in light VM photoproduction.
- Energy dependence of J/ψ production and ρ electroproduction sensitive to gluon density in proton.
- Υ cross section requires contribution from off-diagonal gluon distribution.