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Studies of the structure of diffraction and of exclusive diffractive final states at HERA

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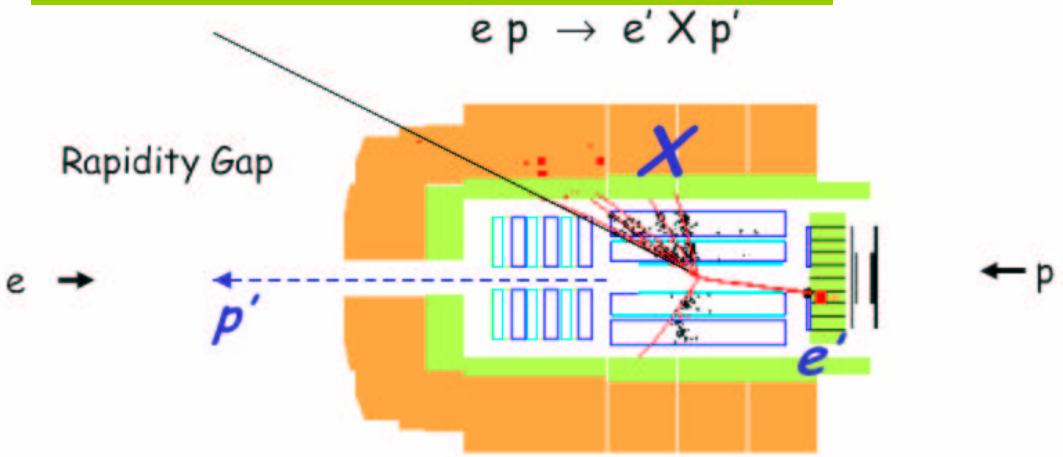
On behalf of H1 and ZEUS collaborations

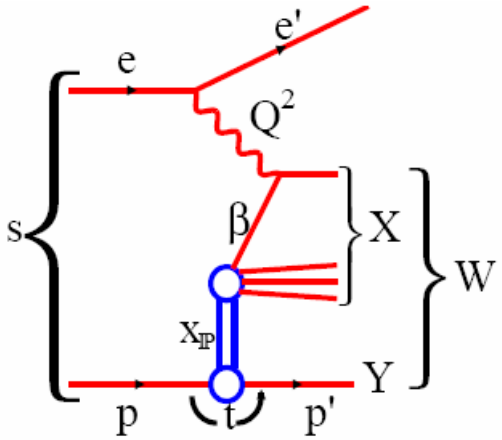
1. Inclusive diffraction and perturbative QCD
2. New measurements at high Q^2
3. From soft to hard diffraction : VM production
4. J/ψ and γ photoproduction at high t
5. Deeply Virtual Compton Scattering

Inclusive diffraction

Diffractive event in the H1 detector :



Kinematic variables :



x_{IP} fractional loss of the proton longitudinal momentum
M_X invariant mass of the diffractive final state
$\beta = x_{Bj}/x_{IP}$

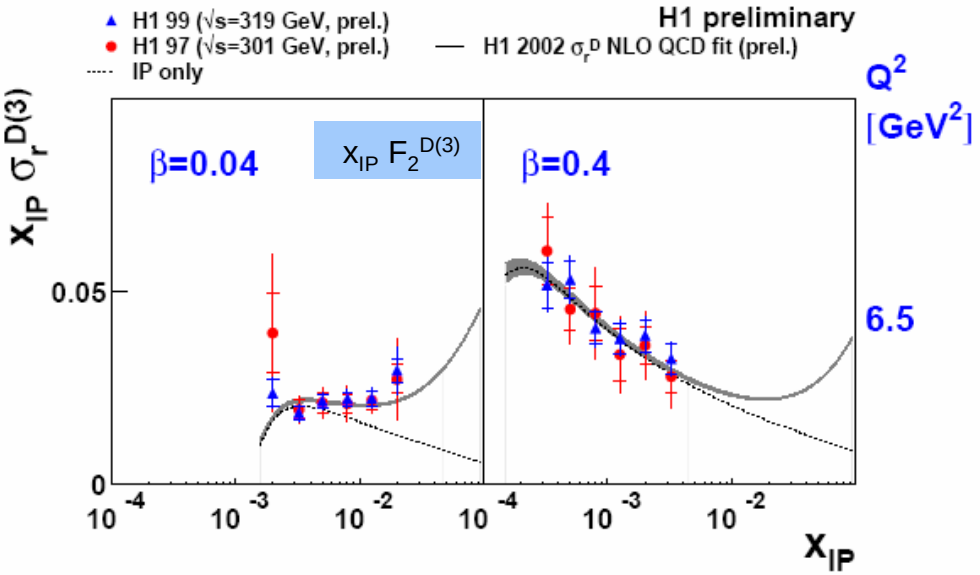
Diffractive cross section :

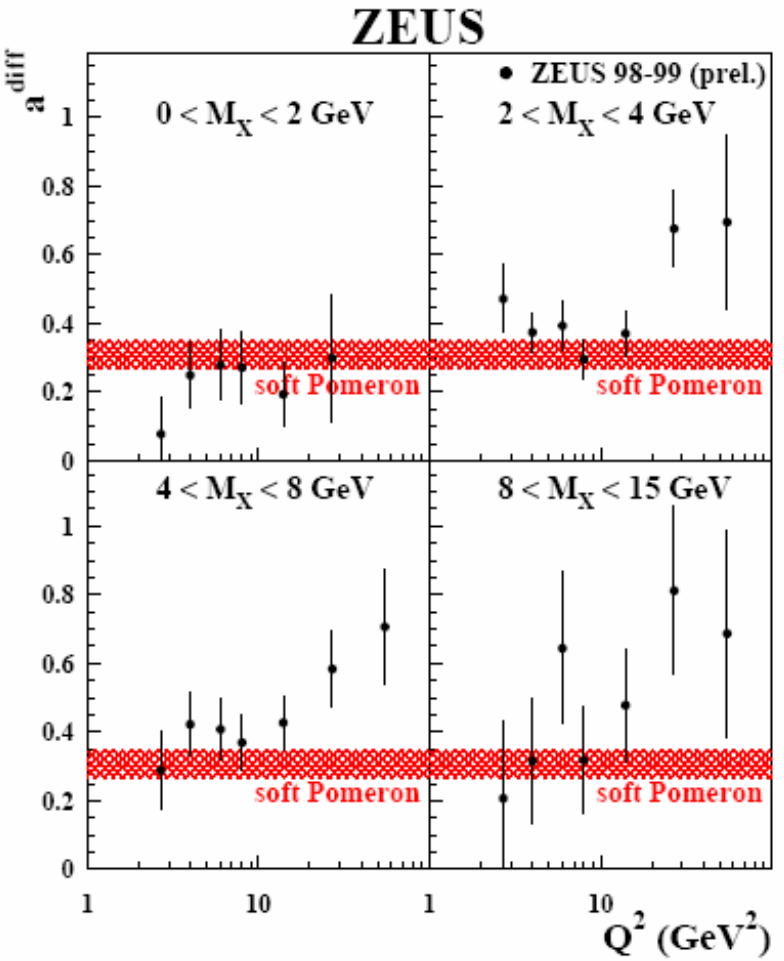
$$\frac{d\sigma^{ep\longrightarrow eXY}}{d\beta dQ^2 dx_{IP} dt} = \frac{4\pi\alpha^2}{\beta Q^4}\left(1 - y + \frac{y^2}{2}\right)\sigma_r^{D(4)}$$

with $\sigma_r^D \sim F_2^D$

F_2^D => diffractive parton densities

Perturbative QCD and hard diffraction





Good description of F_2^D by QCD fit
(based on DGLAP evolution of diffractive pdfs)

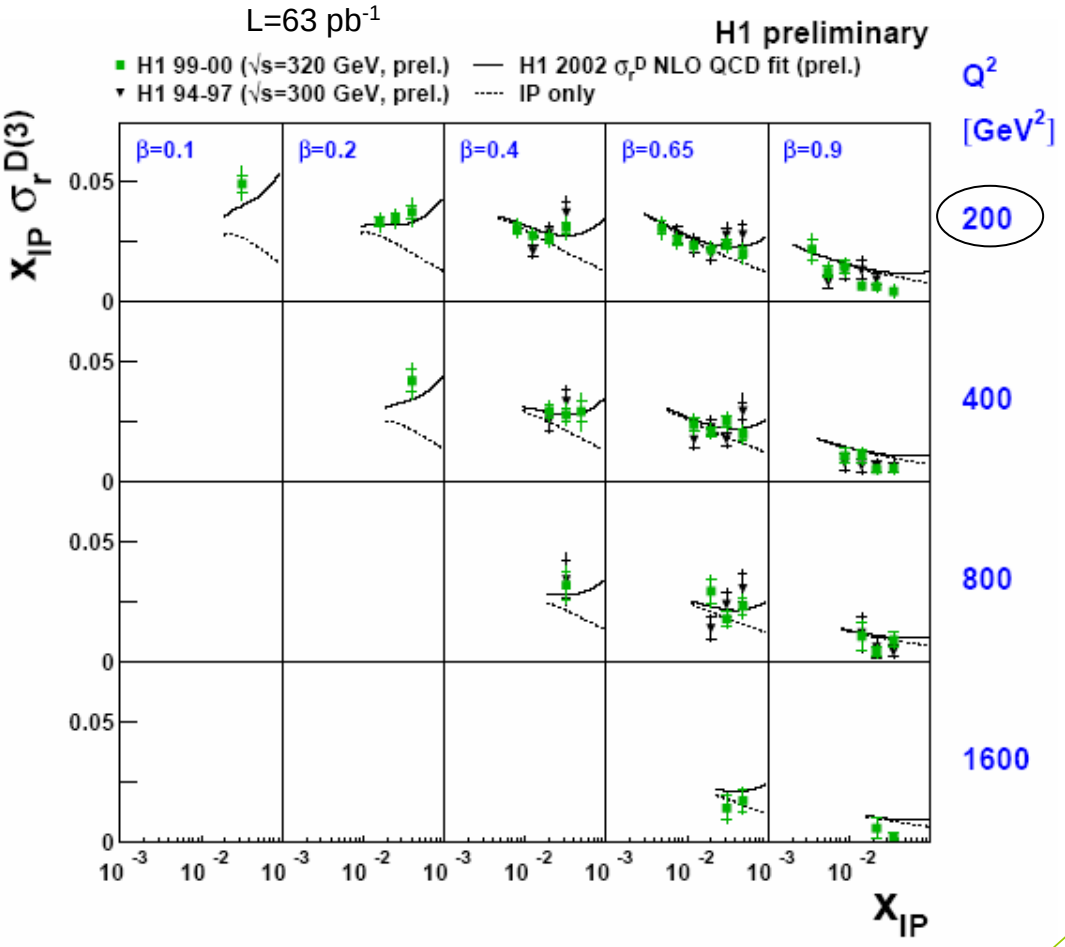
Same conclusions for ZEUS measurements :

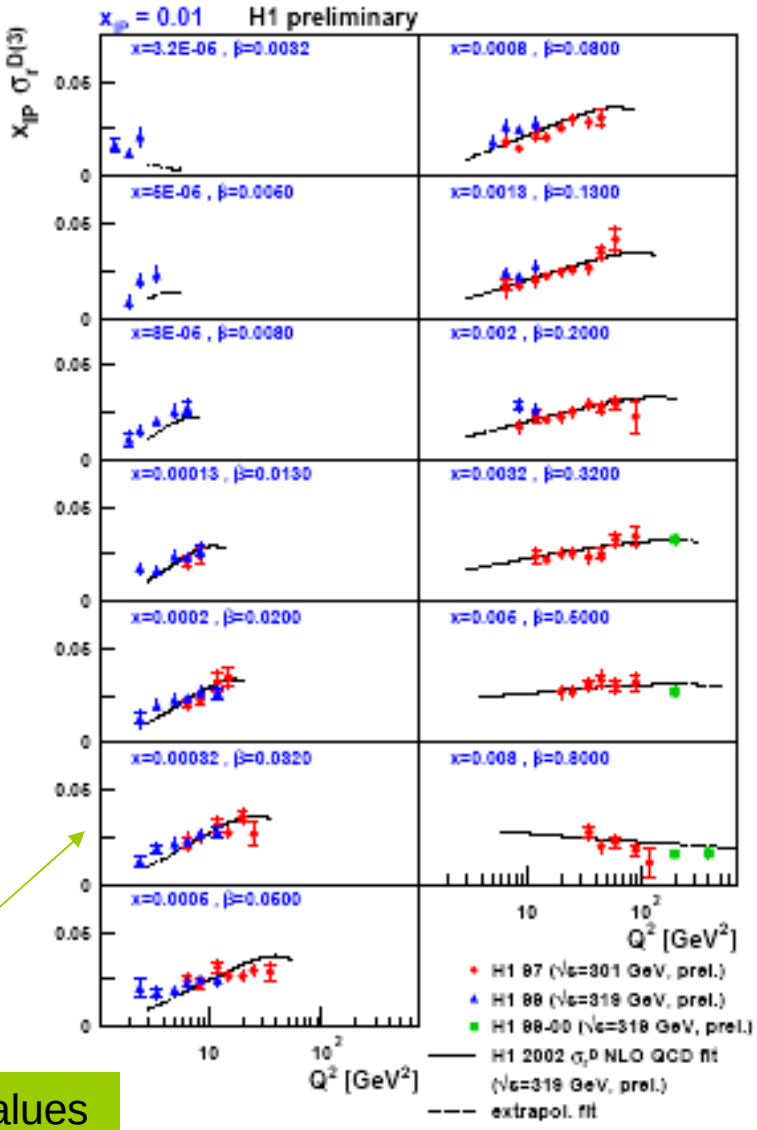
$d\sigma^{diff}/dM_X \sim W^{adiff}$ with $a^{diff} = 2.(2\alpha_{IP}-2)$

$M_X < 2$ GeV => soft pomeron
$M_X > 2$ GeV => transition from soft to hard process

=> large Q^2 + large M_X : perturbative regime

New measurements at high Q^2

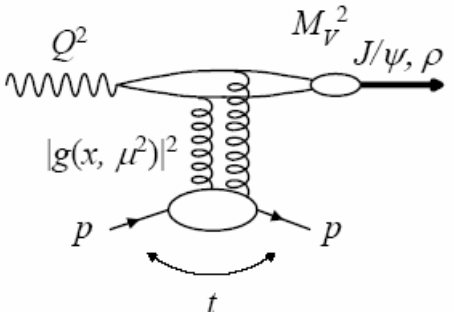


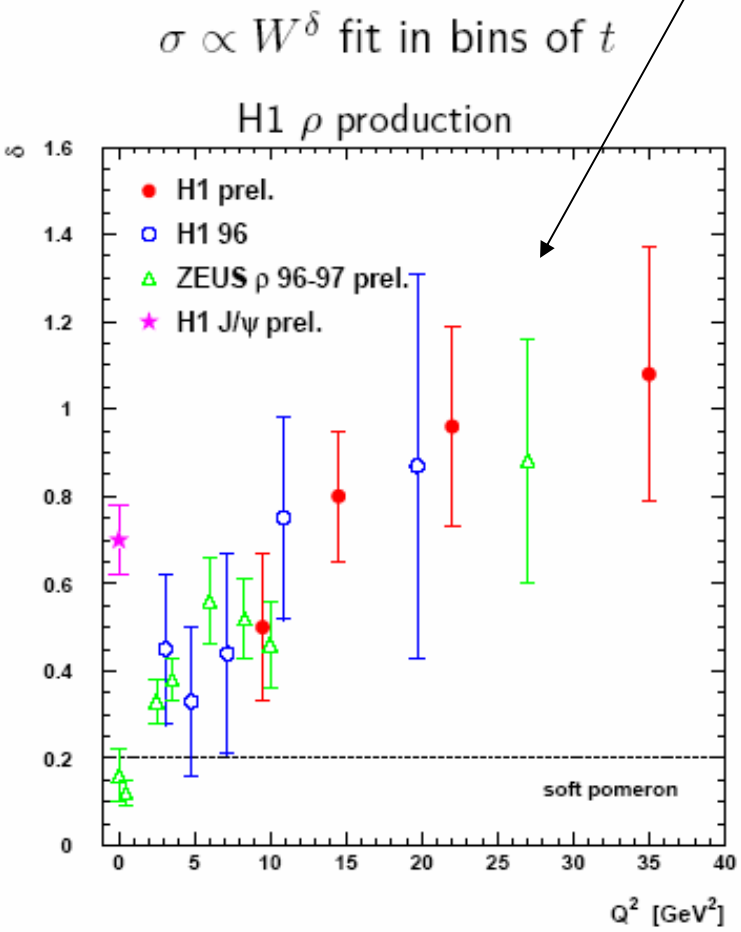


Positive scaling violations (at low x_{IP}=0.01) till high β values
=> hard pomeron is gluon dominated

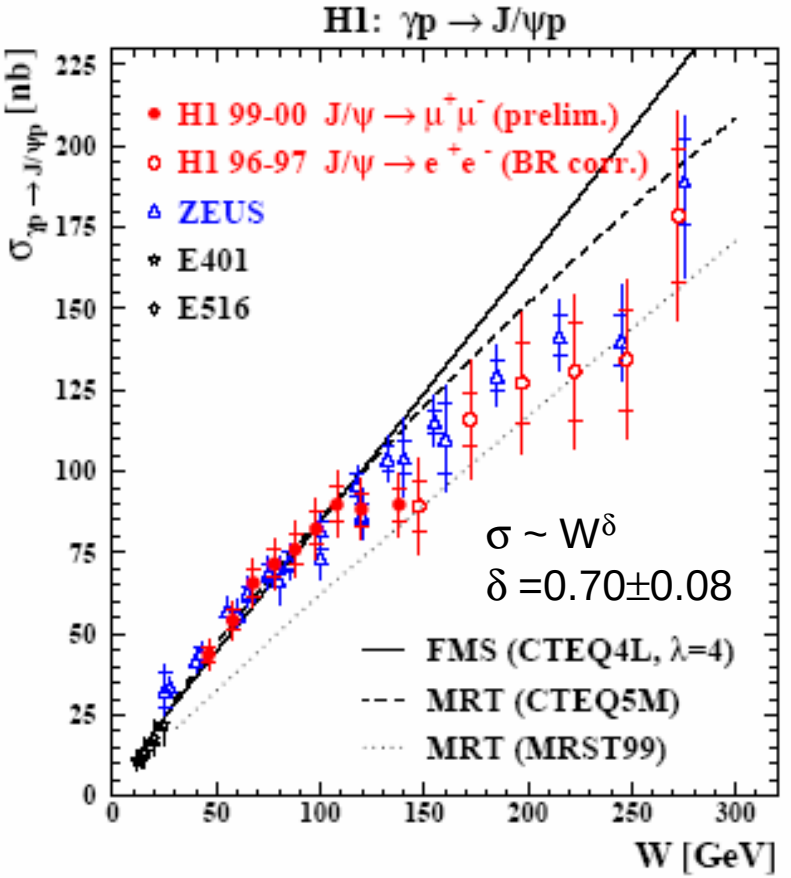
From soft to hard diffraction and VM production

In VM production, hard scale is given by Q^2,M_V^2 or t
In case of low mass VM => transition from soft to hard
(when Q^2 is increasing)





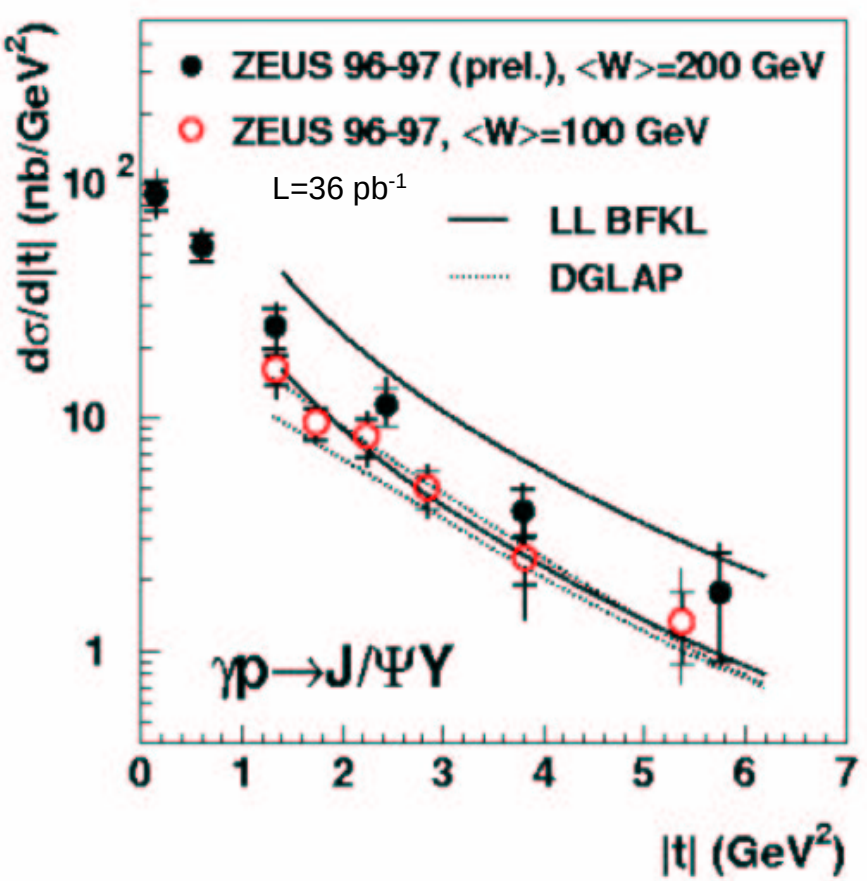
In photoproduction of J/ψ, the hard scale is given by $M_{J/\psi}$

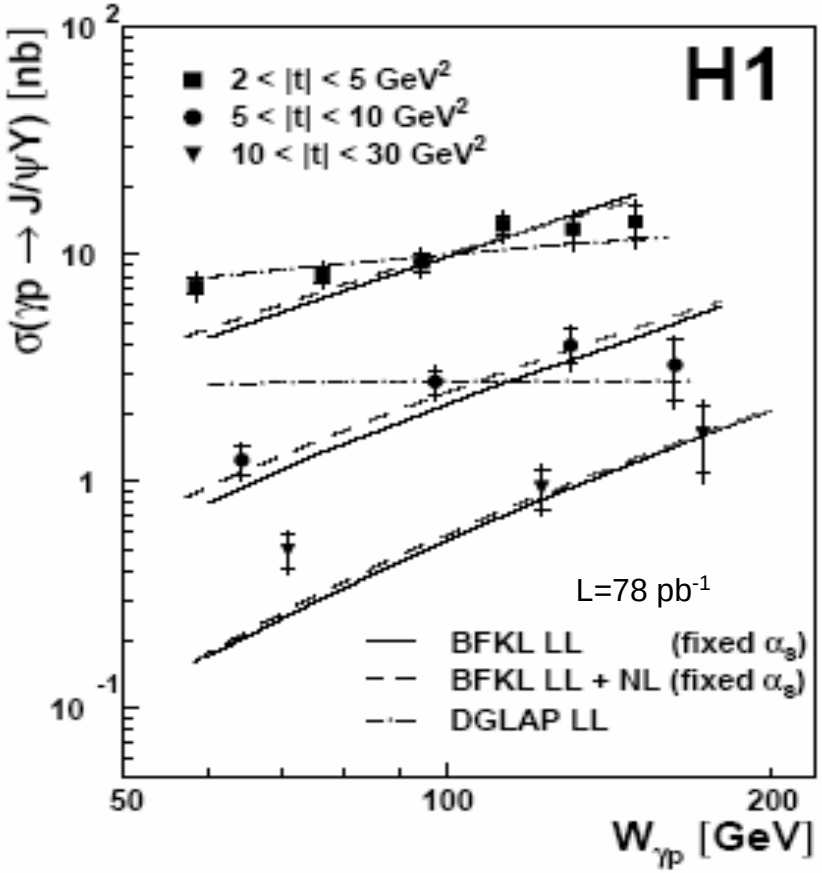


Diffractive J/ψ photoproduction at high t

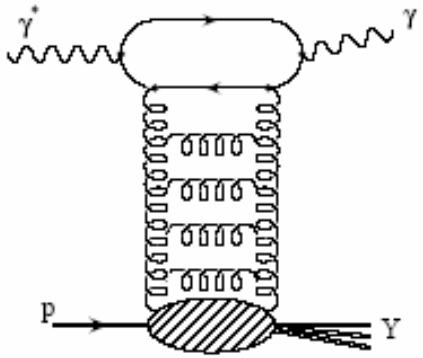
Cross-sections at high t => qualitatively well described by QCD calculations with an interesting sign of BFKL evolution

DGLAP → ~ no W dependance

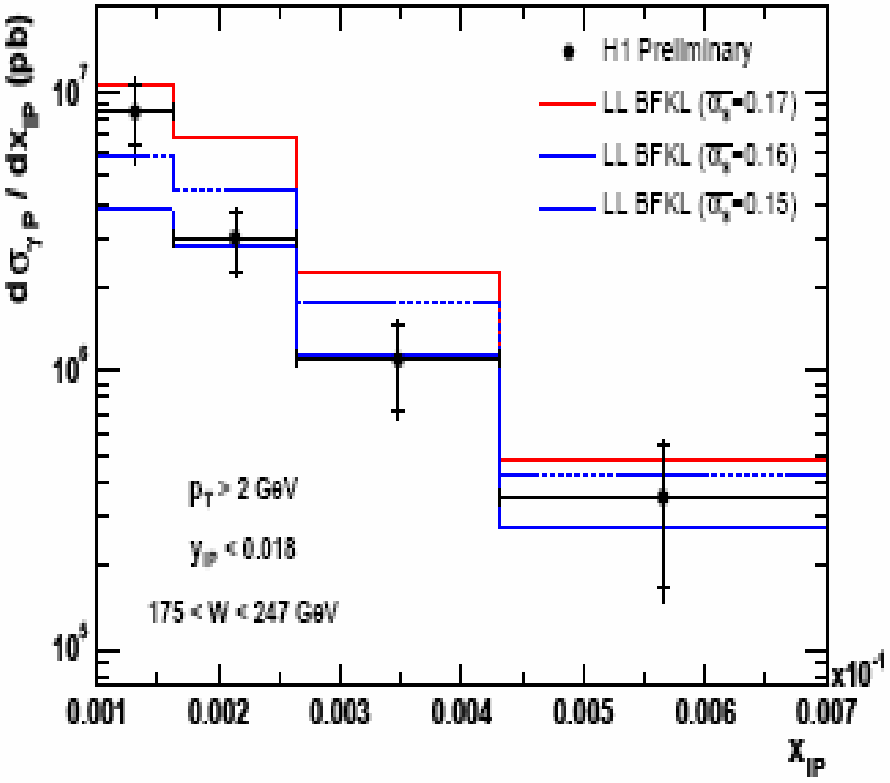


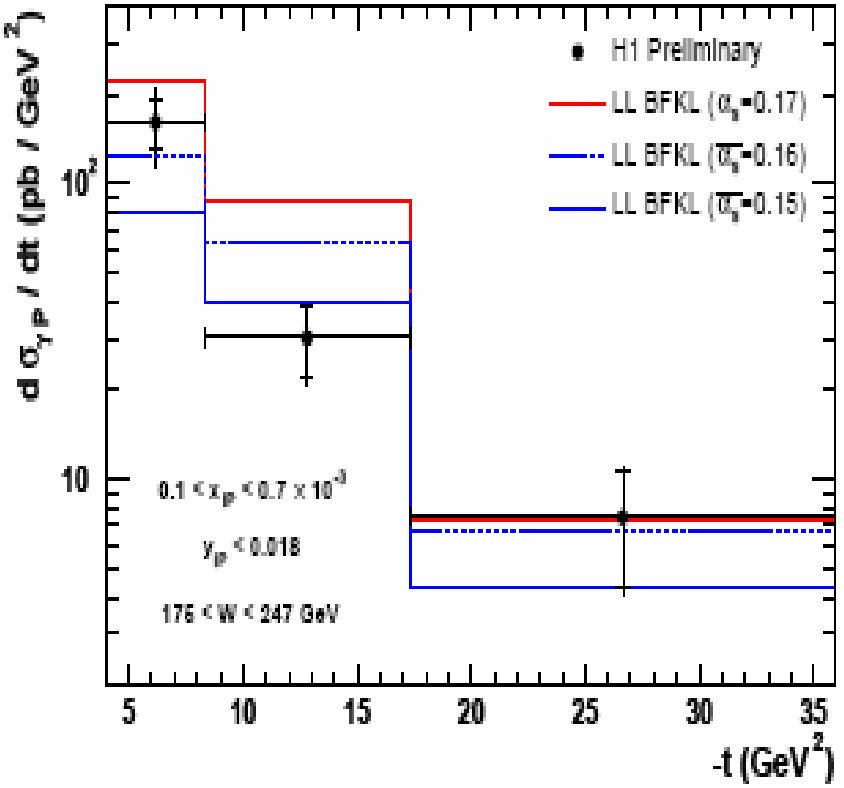


Diffractive γ photoproduction at high t

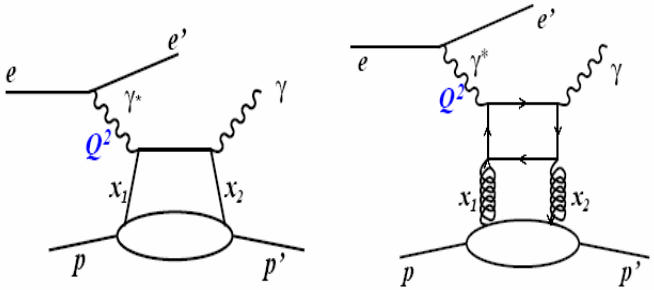


Similar conclusions :
cross-sections basically described by LL BFKL



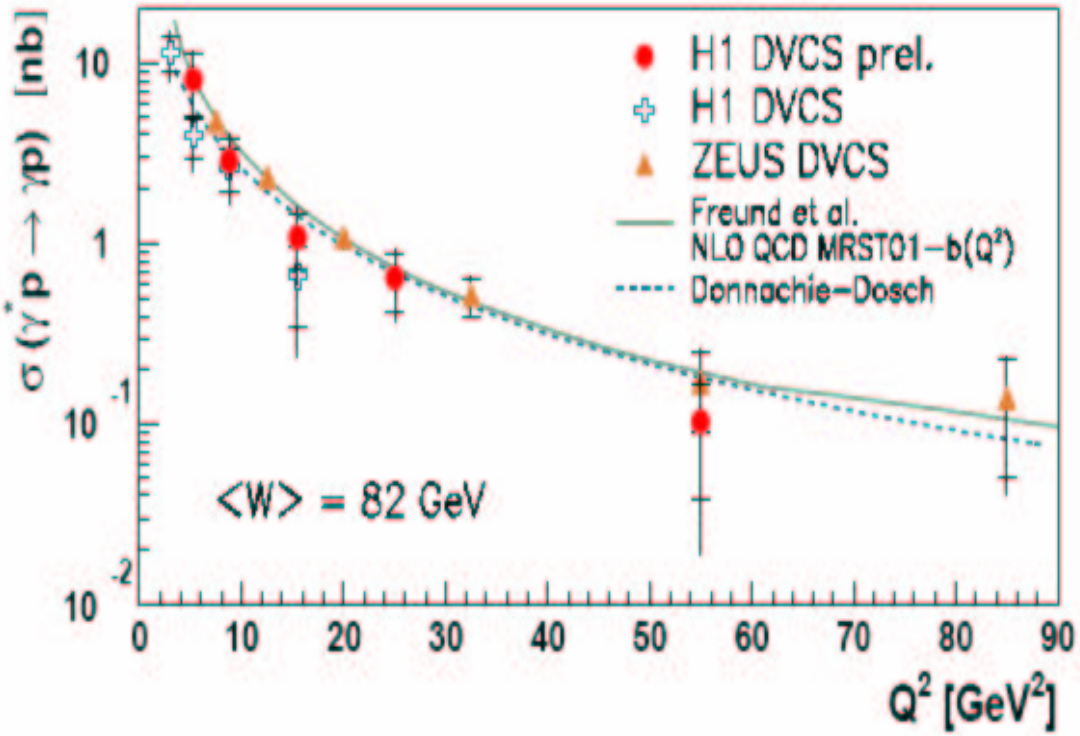


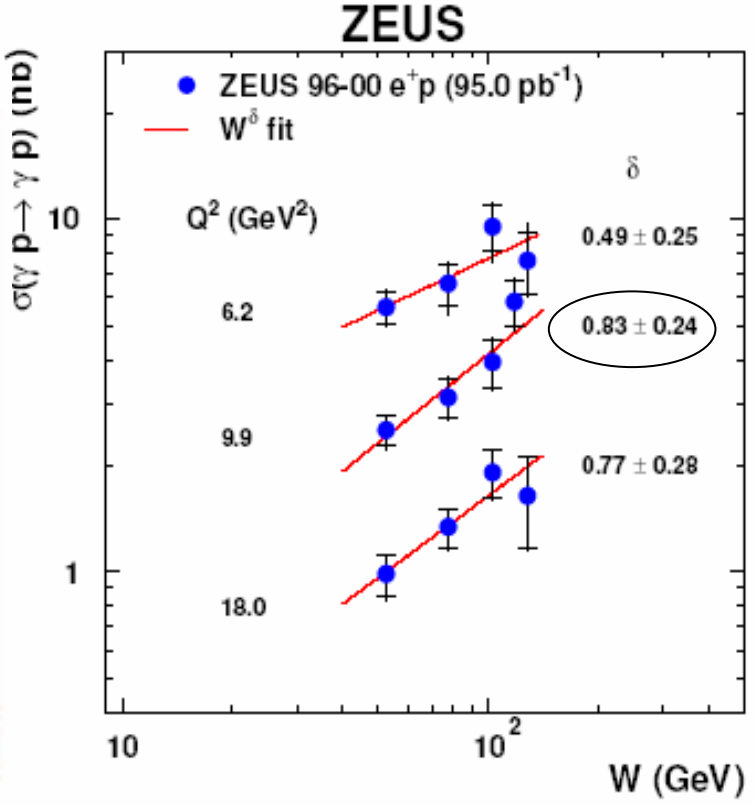
Deeply Virtual Compton Scattering



DVCS process : production of real γ.

New measurements in H1 and ZEUS well reproduced by QCD calculations based on Generalized Parton Distributions (GPDs)





Summary

Inclusive diffraction is well described by perturbative QCD at large Q^2 and large M_X leading to a hard W dependence

Extension of the QCD fit to new high Q^2 measurements of $F_2^{D(3)}$

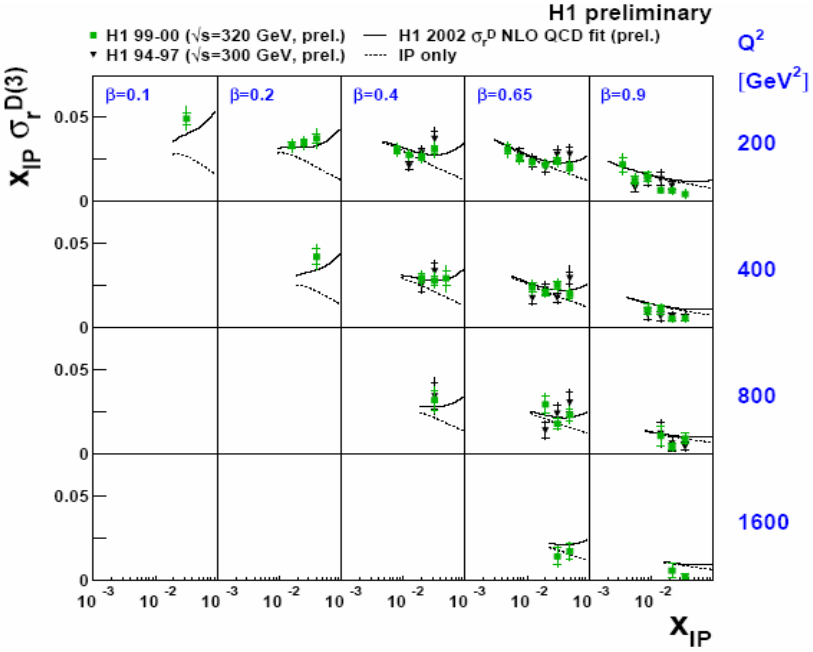
Generic process of diffraction is analysed with interest in VM production with the hard scale given by Q^2,M_V^2 or t => a hard W dependance is obtained

In addition, diffractive J/ψ and γ photoproduction at high t give a sign of BFKL evolution (to be studied further).

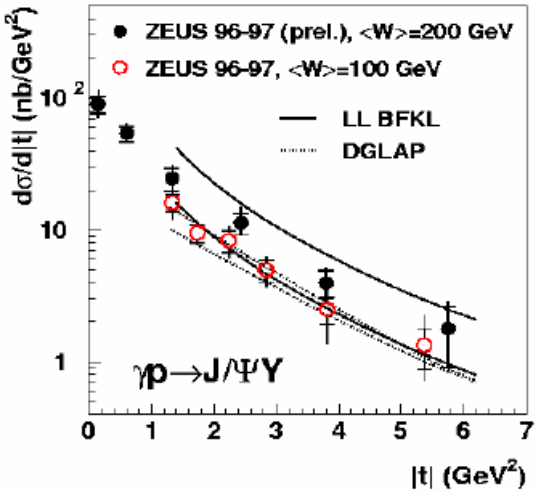
Finally HERA has measured DVCS cross-section => a hard W behaviour is observed and data are well described by a perturbative model based on GPDs

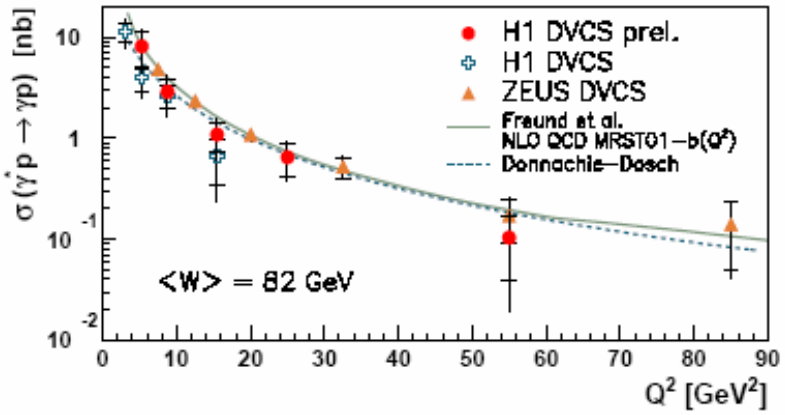
Studies of the structure of diffraction and of exclusive diffractive final states at HERA H1 and ZEUS collaborations

New measurements of the diffractive structure function at large Q^2
=> good agreement with QCD fit



VM production is a well adapted process to study the generic process of diffraction and transition from soft to hard regime. New measurements of diffractive photoproduction of J/ψ at large t => sign of BFKL evolution?





New measurements of the DVCS cross-section w.r.t. Q^2 and W. This is a golden process to access to GPDs via asymetries. Already, HERA measurements show a good agreement with a model based on GPDs evolved at NLO

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