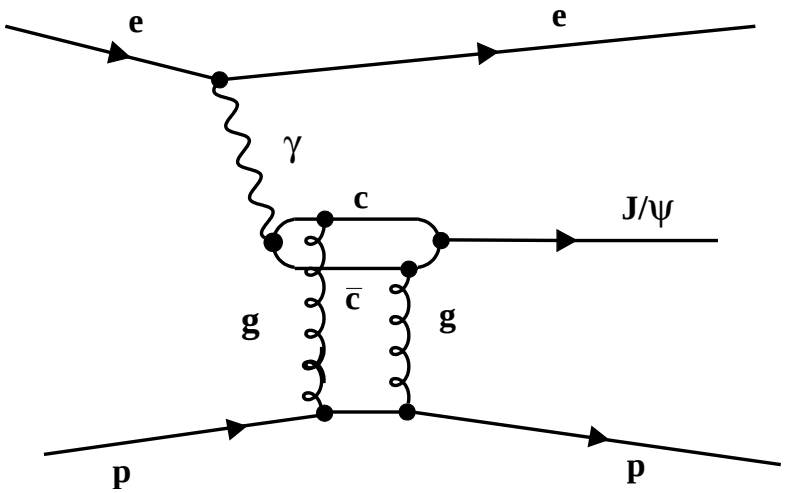
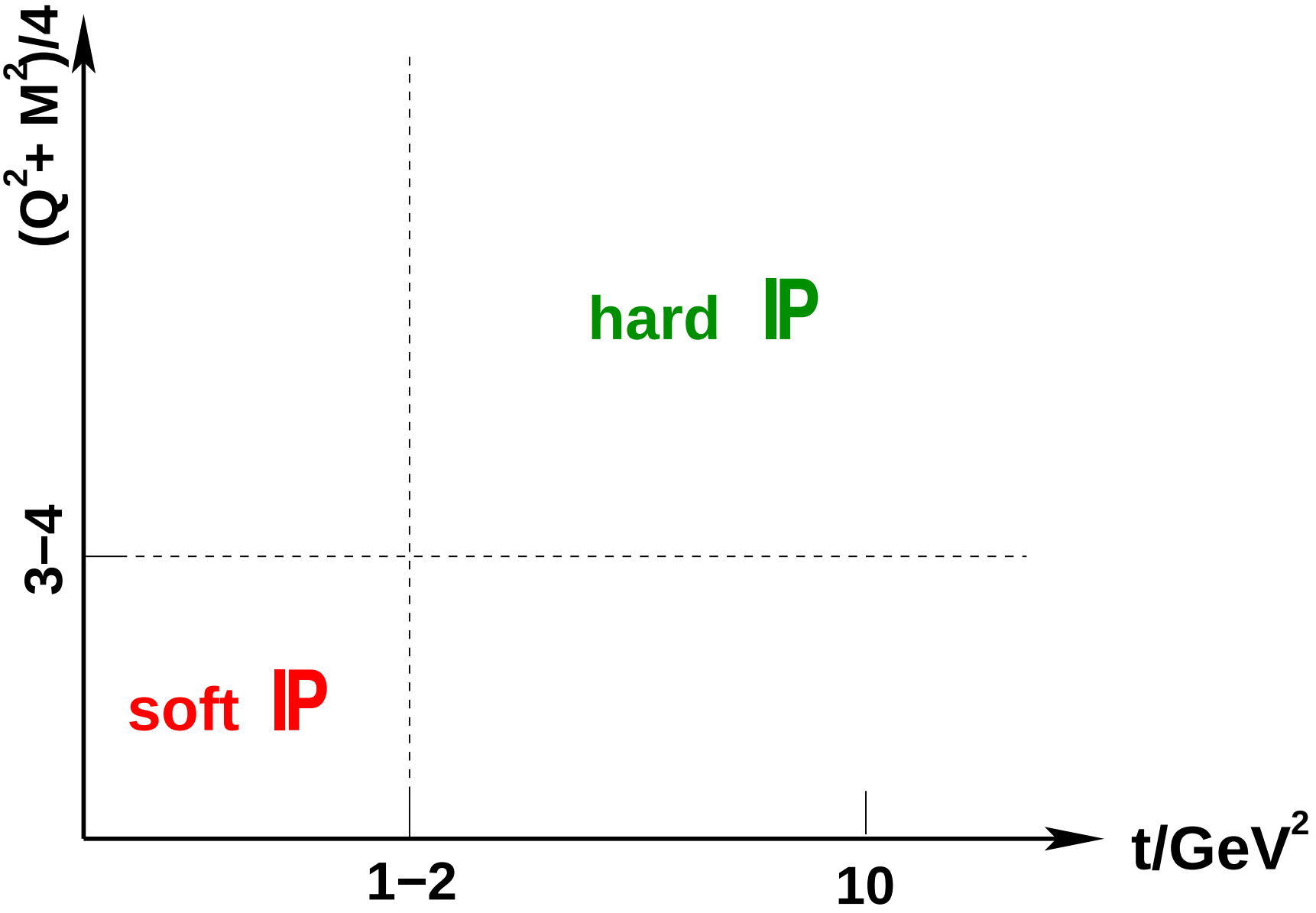
Vector Mesons and DVCS



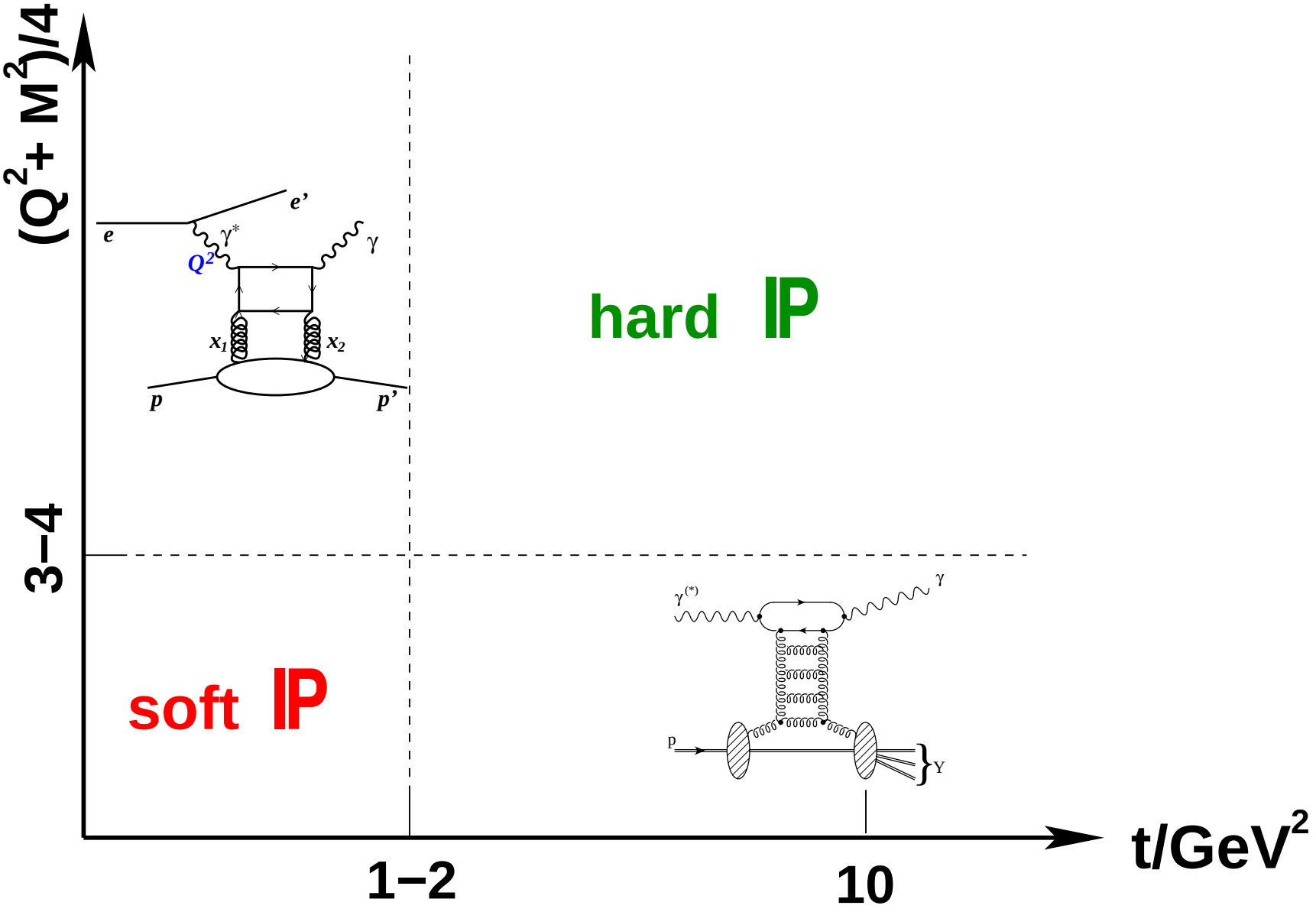
1. Relevant scales? Soft/hard $I\!P$
2. Real γ: DVCS and high t photons. Everything done?
3. Gluons from VM data – where and how to use them?

(4. Absorptive effects in VM PHP?)

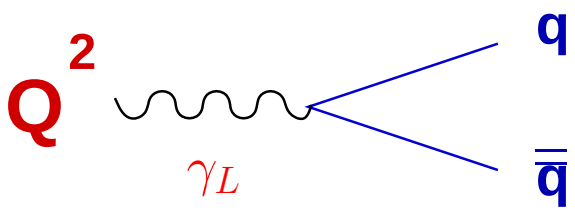
Relevant scales?

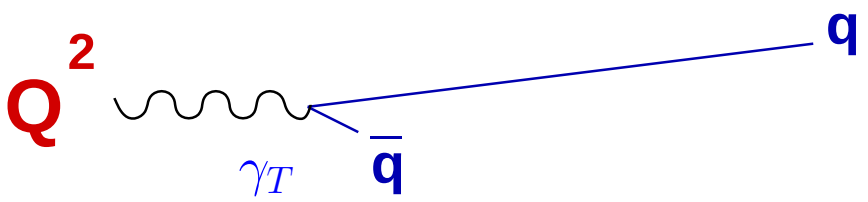


Relevant scales?



Interplay of soft and hard contributions





γ_L $(z \simeq 0.5)$: $\langle r_t^2 \rangle \simeq (z(1-z)Q^2 + m_q^2)^{-1} \simeq 1/[(Q/2)^2 + m_q^2]$

γ_T $(z \simeq 0; 1)$: $\langle r_t^2 \rangle \simeq (z(1-z)Q^2 + m_q^2)^{-1} \simeq 1/m_q^2$

Small dipole

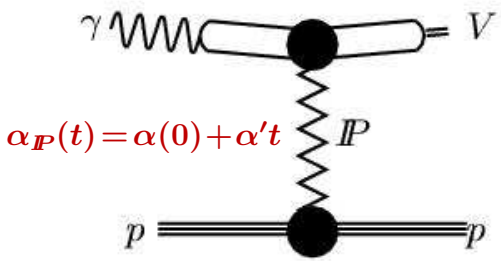
Large dipole

TABLE I: Interplay between the probabilities of hard and soft fluctuations in a highly virtual photon and the cross section of interaction of these fluctuations.

	$\lvert C_\alpha \rvert^2$	σ_α	$\sigma_{tot} = \sum_{\alpha=soft}^{hard} \lvert C_\alpha \rvert^2 \sigma_\alpha$	$\sigma_{sd} = \sum_{\alpha=soft}^{hard} \lvert C_\alpha \rvert^2 \sigma_\alpha^2$
Hard	~ 1	$\sim \frac{1}{Q^2}$	$\sim \frac{1}{Q^2}$	$\sim \frac{1}{Q^4}$
Soft	$\sim \frac{m_q^2}{Q^2}$	$\sim \frac{1}{m_q^2}$	$\sim \frac{1}{Q^2}$	$\sim \frac{1}{m_q^2 Q^2}$

Vector Mesons at HERA

soft $\mathbb{P}$omeron exchange



$\sigma \propto W_{\gamma p}^{4(\alpha_{I\!P}-1)}$

Hard scales: Q^2, M_V, t

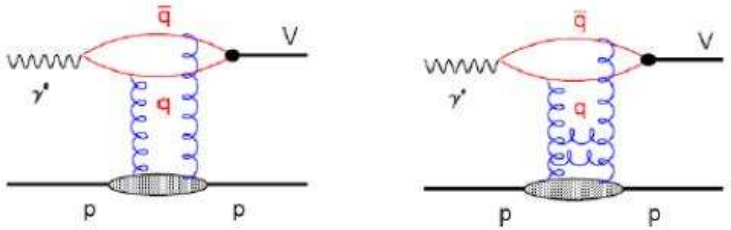
Predictions

$\alpha_{I\!P}(0) \simeq 1.08 \,/\, 1.20$

$\alpha'_{I\!P} \simeq 0.25 \,/\, 0.0$

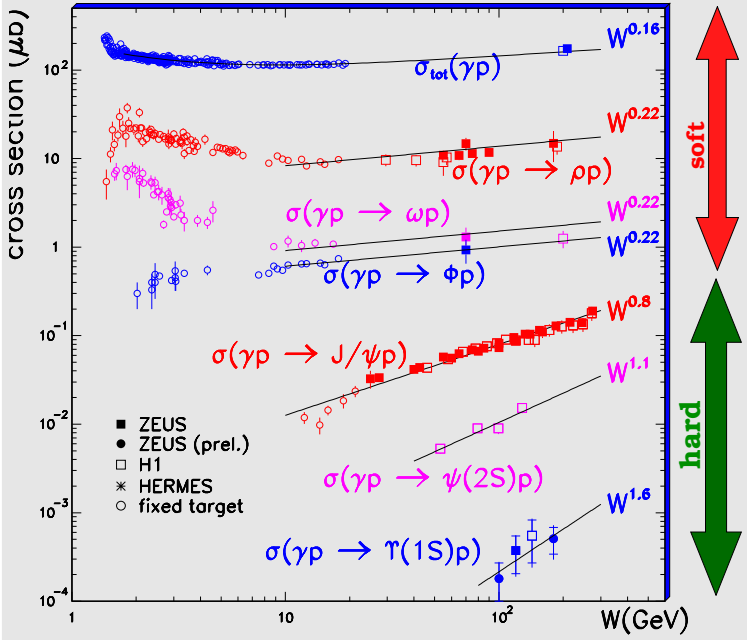
Universal scale $\mu^2 = (Q^2+M_V^2)/4$

hard $\mathbb{P}$omeron diagrams

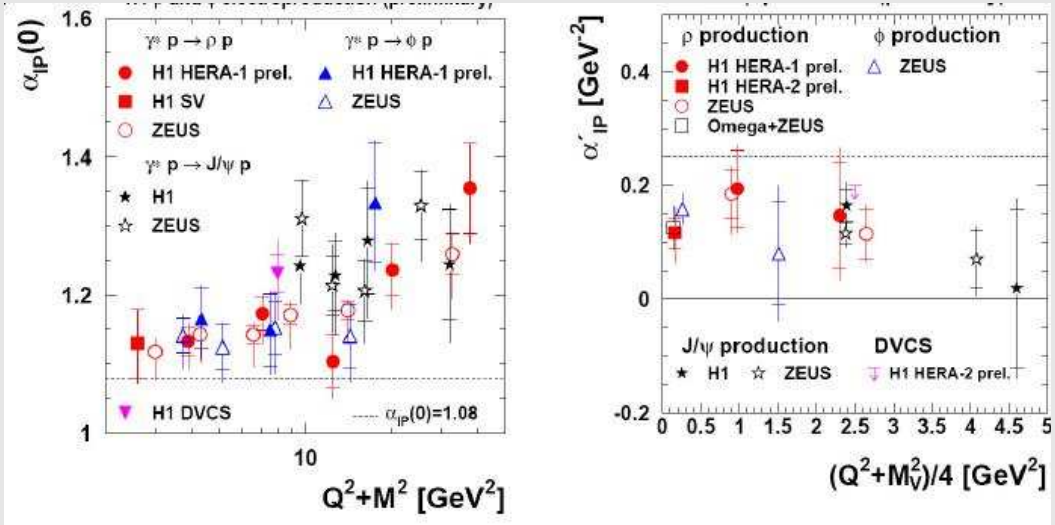


$\sigma \propto [xg(x,Q^2)]^2$

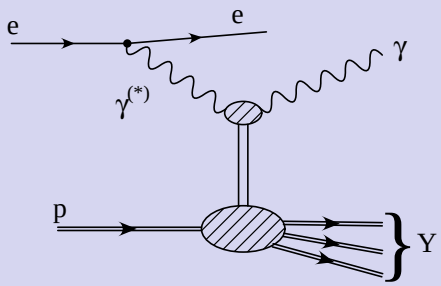
Exclusive VM production at HERA – a nice tool to study 'soft' vs 'hard' Pomeron regimes

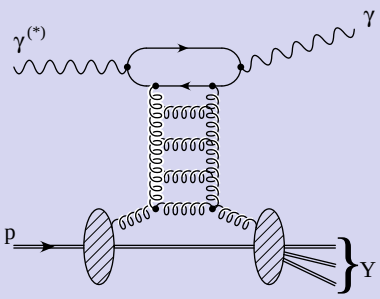


⇒ transition from soft to hard regime at $\mu^2 \simeq 4 \div 5$ GeV^2

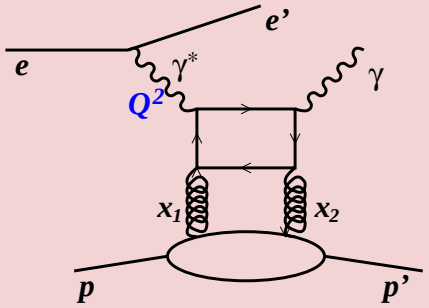


Diffractive scattering of γ at large $|t|$ and DVCS



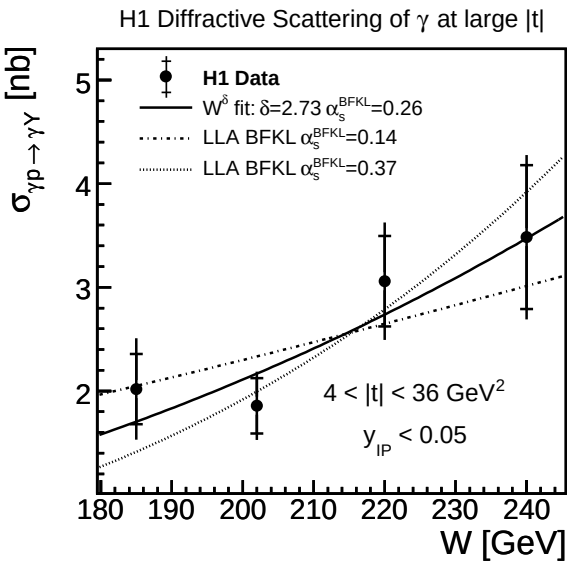


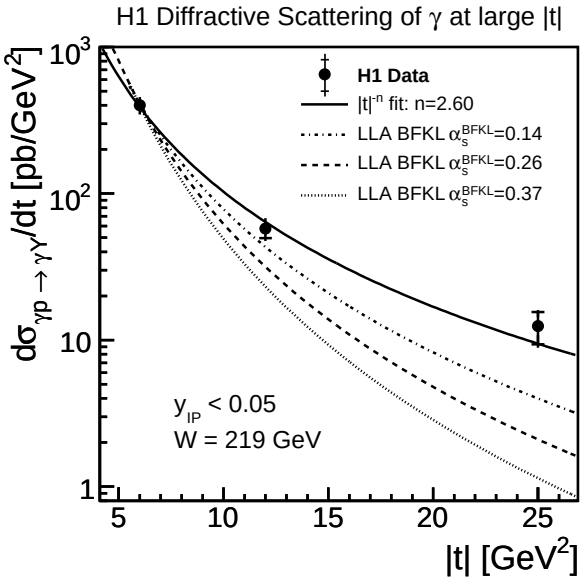
PHP ($Q^2 < 0.01$ GeV^2)



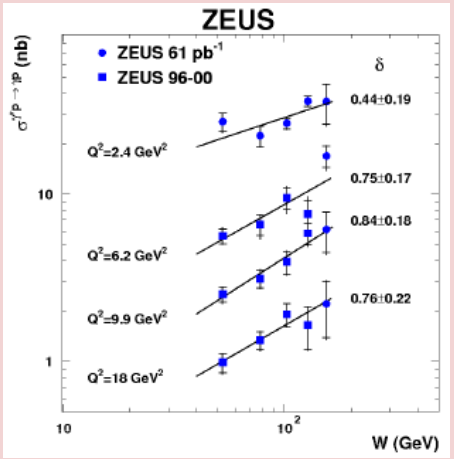
DIS ($Q^2 > 2$ GeV^2)

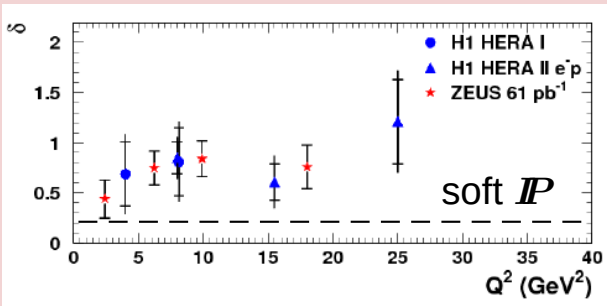
$$\sigma(W) \propto W^{4\omega_0} \qquad \omega_0 = 4N_c \frac{\alpha_s^{BFKL}}{\pi} \ln 2 \qquad \frac{d\sigma}{dt} \propto |t|^{-n}$$



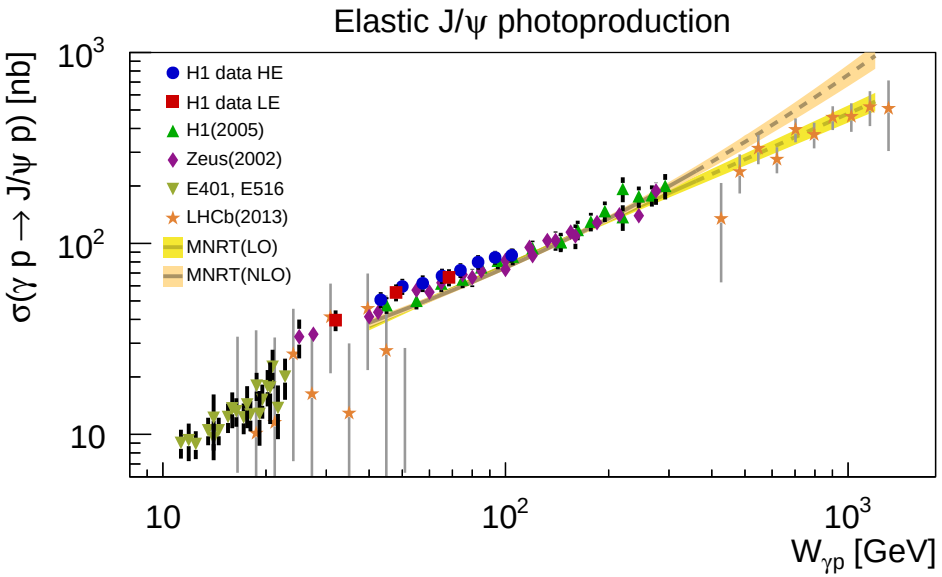


Hard Pomeron at work

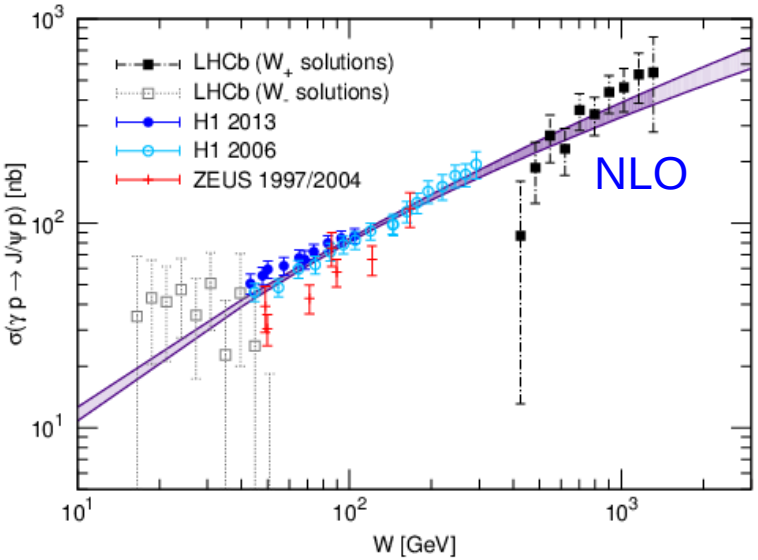


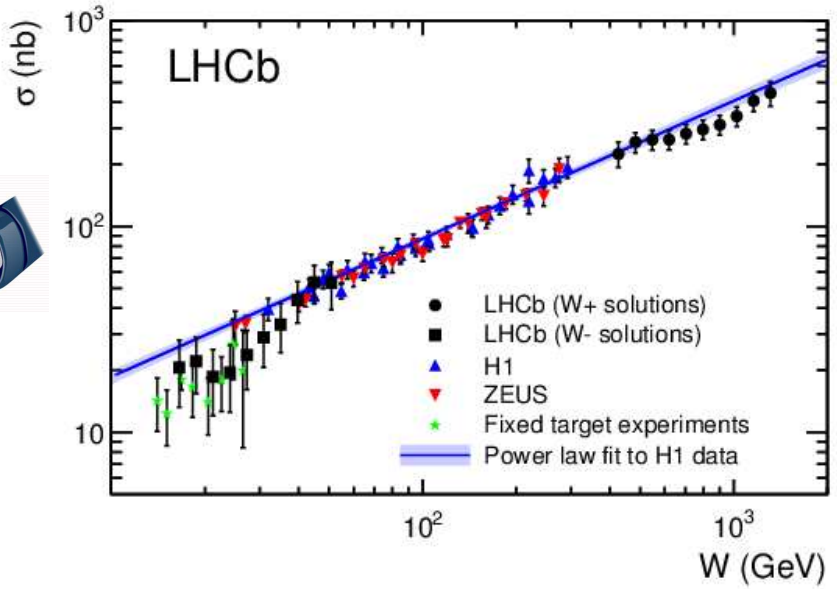


Exclusive Photoproduction of J/ψ Mesons



- Extrapolating HERA fit describes LHCb
- Low x gluon, based on old HERA data (A. Martin et al, 2008). NLO too steep
- New QCD analysis (A.Martin et al, 2013) skewed $g(x, x', k_T)$, abs.corr. for LHC
- New LHCb data ($\mathbf{930 pb^{-1}}$) [arXiv:1401.3288]





Absorptive factors, K_{abs}, in different PHP reactions