

Exclusive diffraction at HERA

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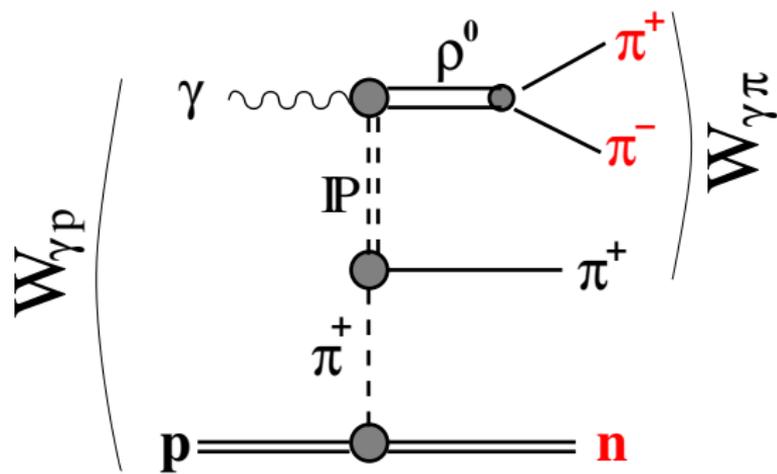


New analyses from H1 and ZEUS experiments

- H1: Exclusive photoproduction of ρ^0 with forward neutron at HERA
- H1: Elastic and proton-dissociative photoproduction of J/ψ mesons at HERA
- ZEUS: Measurement of the cross section ratio $\sigma_{\psi(2S)}/\sigma_{J/\psi}$ in deep inelastic scattering (DIS) at HERA
- ZEUS: Exclusive dijet production in diffractive DIS at HERA

Exclusive photoproduction of ρ^0 with forward neutron at HERA

Exclusive photoproduction of ρ with forward neutron

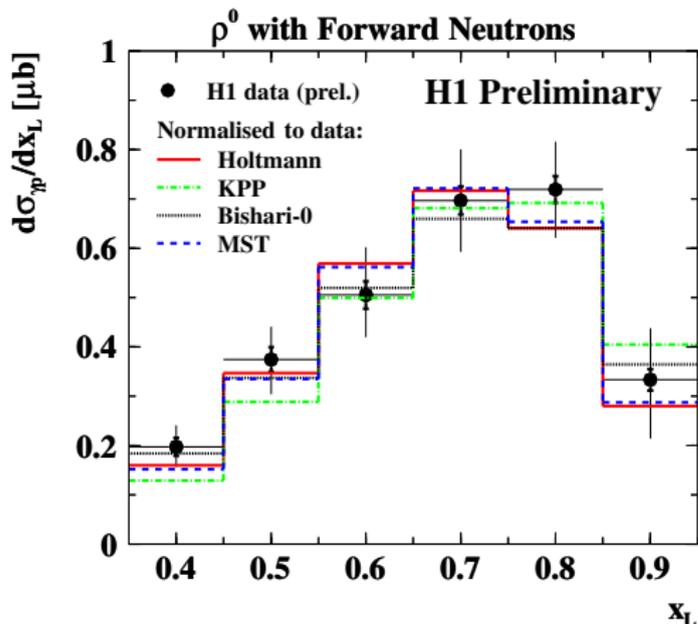


H1 experiment

- data 2006-2007
 1.16 pb^{-1}
- measured: three pions and the neutron for $x_L > 0.35$
- mean $W_{\gamma \pi}$: 22 GeV (soft regime)

- the photon from the electron beam scatters elastically on the pion emitted from the proton producing a ρ^0
- Theoretical model: exchange of two Regge trajectories in a double-peripheral scattering process

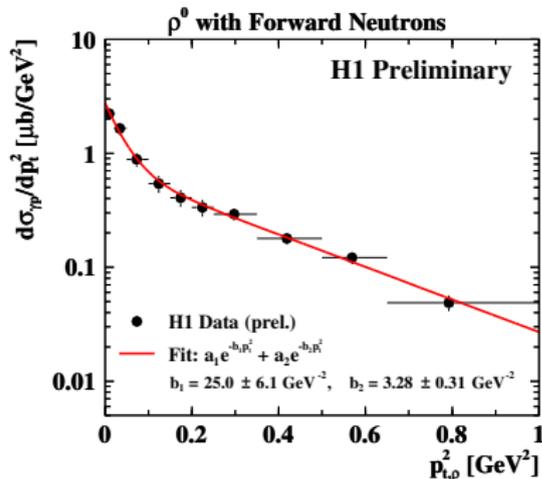
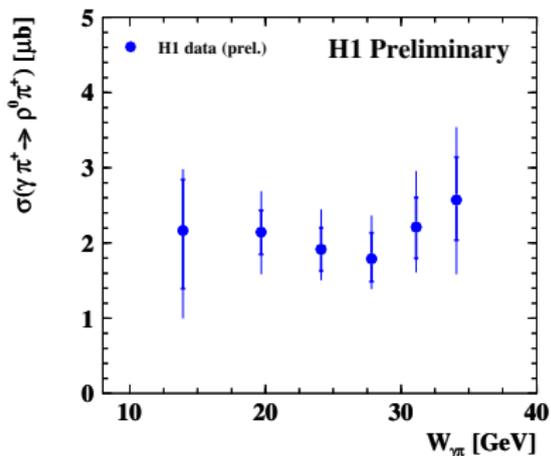
Exclusive photoproduction of ρ with forward neutron



$$d\sigma_{\gamma p}/dx_L$$

- shape well described by model predictions
- models differ in calculating the pion flux

Exclusive photoproduction of ρ with forward neutron



$\sigma(\gamma\pi^+ \rightarrow \rho^0\pi^+) \text{ vs. } W_{\gamma\pi}$

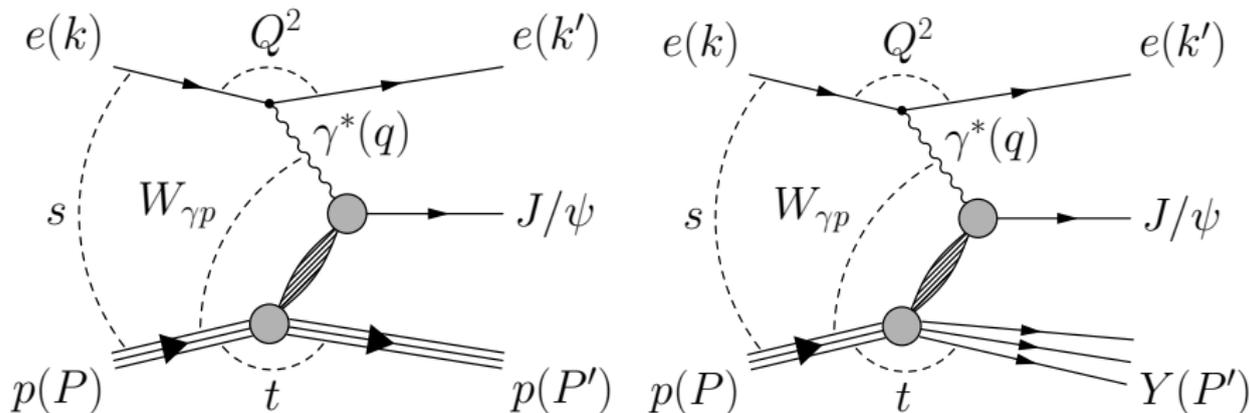
- $\sigma_{\gamma\pi}^{el} / \sigma_{\gamma p}^{el} = 0.21 \pm 0.06$
at $W = 22 \text{ GeV}$

π and IP exchange

- two slopes as predicted for a double-peripheral process

Elastic and proton-dissociative photoproduction of J/ψ

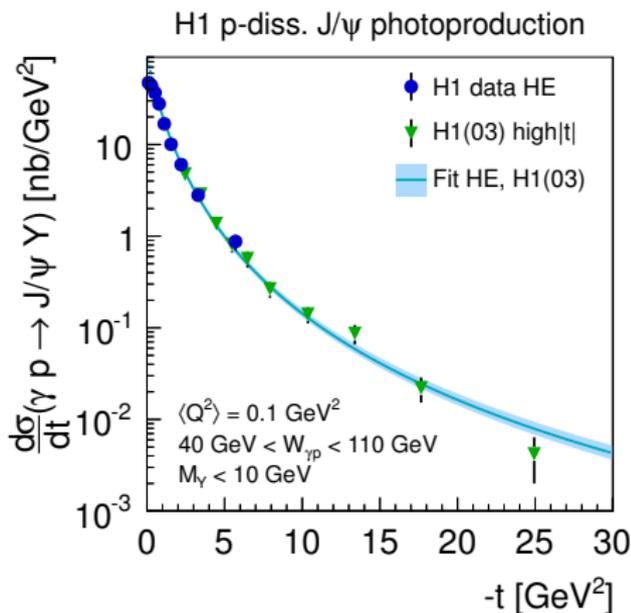
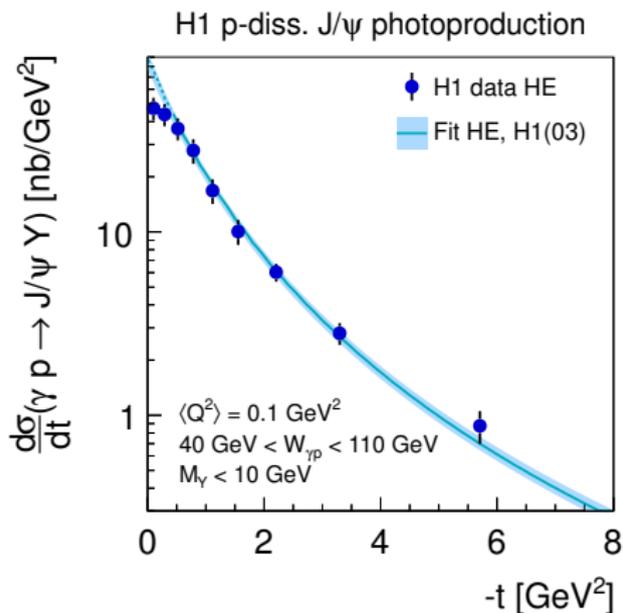
Elastic and proton-dissociative photoproduction of J/ψ



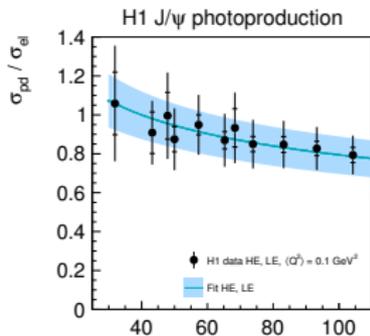
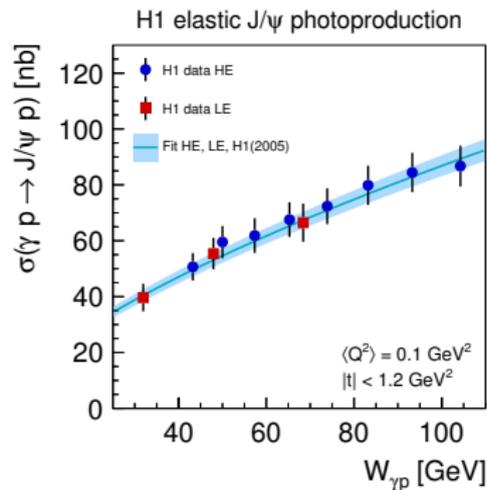
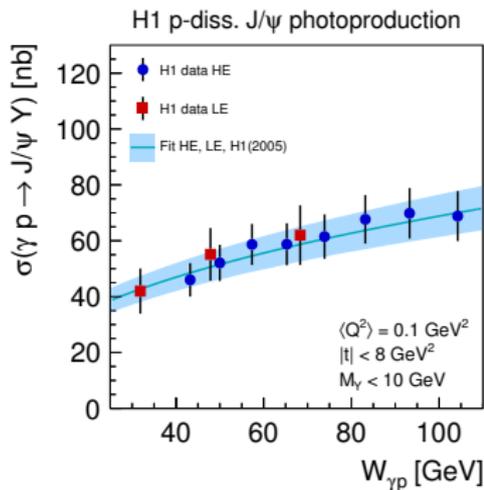
H1 experiment:

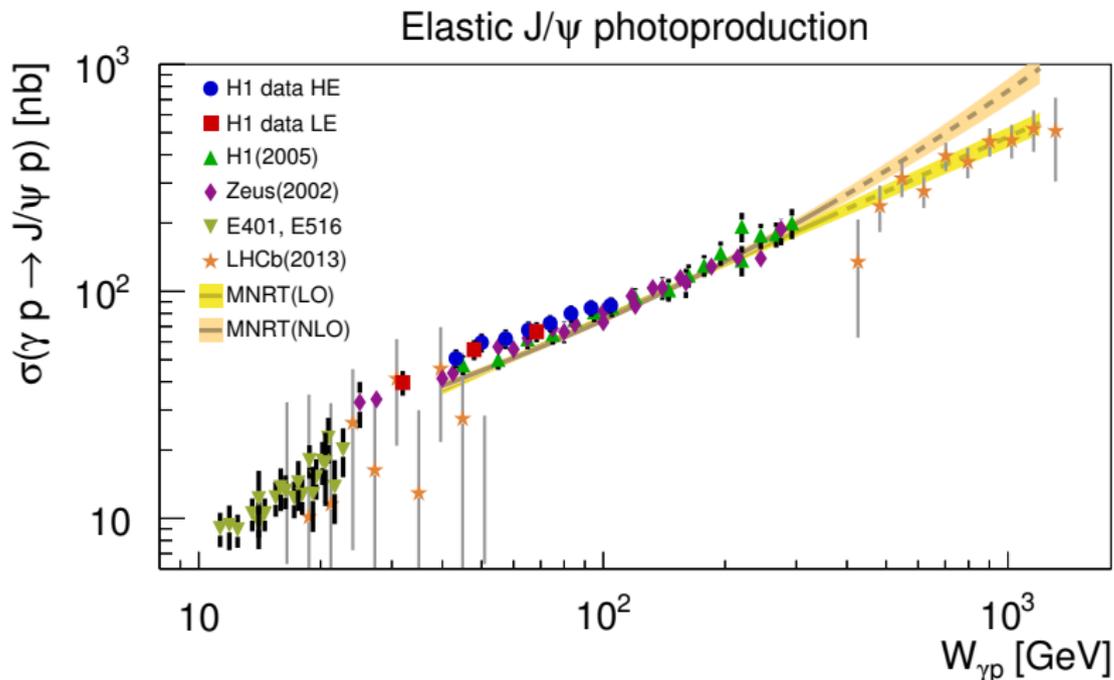
- measured: J/ψ via e^+e^- and $\mu^+\mu^-$ decays and hadrons from proton-dissociation
- three subdetectors in forward direction were used to measure fragments of the proton-dissociative system down to small four-momentum transfer squared, t
- two ep energies: $\sqrt{s} = 318$ GeV and $\sqrt{s} = 225$ GeV

Elastic and proton-dissociative photoproduction of J/ψ



Elastic and proton-dissociative photoproduction of J/ψ

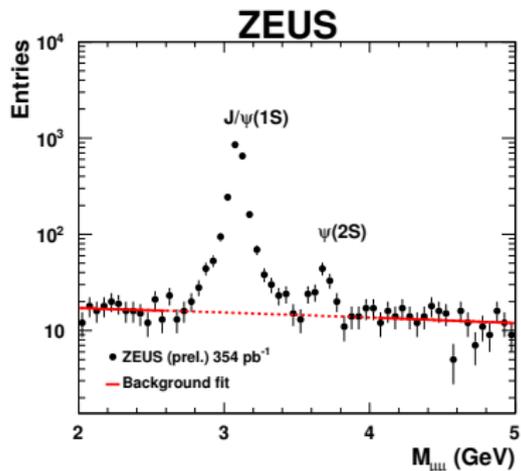




- QCD predictions are based on two-gluon exchange, obtained by fits to previous data from H1 and ZEUS

$\sigma_{\Psi(2S)}/\sigma_{J/\Psi}$ in DIS at HERA

$\sigma_{\Psi(2S)}/\sigma_{J/\Psi}$ in DIS at HERA



ZEUS experiment

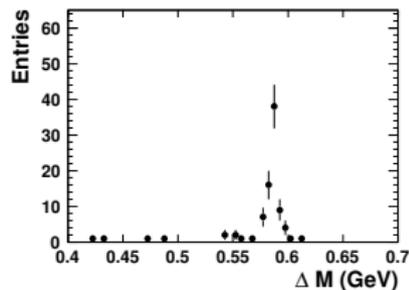
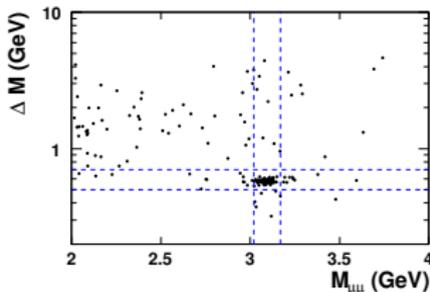
- 354 pb⁻¹
- $5 < Q^2 < 70$ GeV²
- $30 < W < 210$ GeV

measured particles:

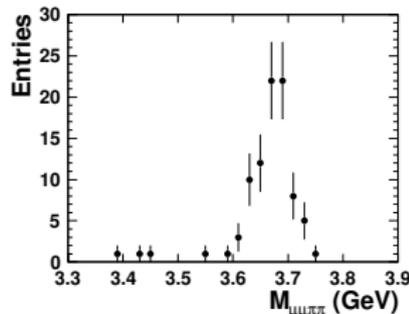
- $ep \rightarrow e\mu^+\mu^-$, $e\mu^+\mu^-\pi^+\pi^-$
- signals of $J/\Psi(1S)$ and $\Psi(2S)$

$\sigma_{\Psi(2S)}/\sigma_{J/\Psi}$ in DIS at HERA

ZEUS



• ZEUS (prel.) 354 pb^{-1}

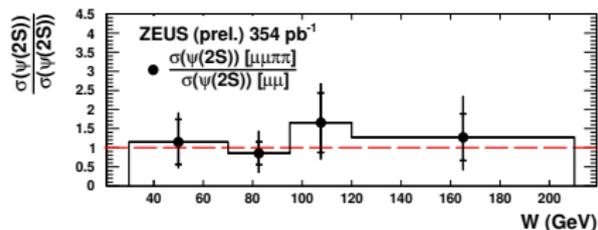
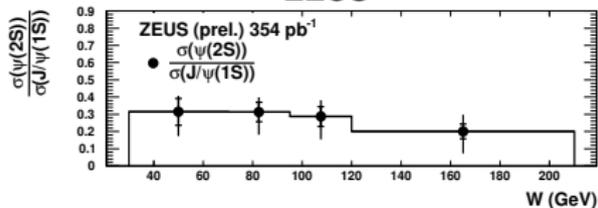


$$\Psi(2S) \rightarrow J/\Psi \pi^+ \pi^-$$

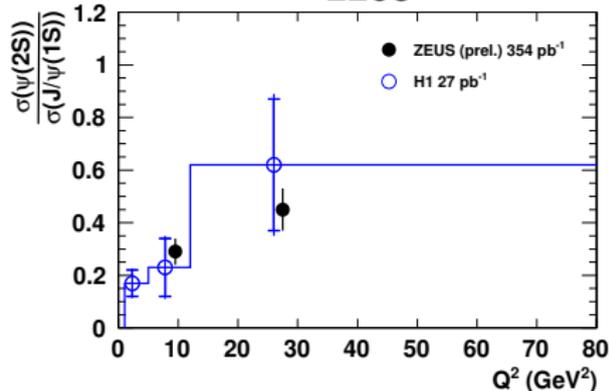
$$\bullet \Delta M = M(\mu\mu\pi\pi) - M(\mu\mu)$$

$\sigma_{\Psi(2S)}/\sigma_{J/\Psi}$ in DIS at HERA

ZEUS



ZEUS

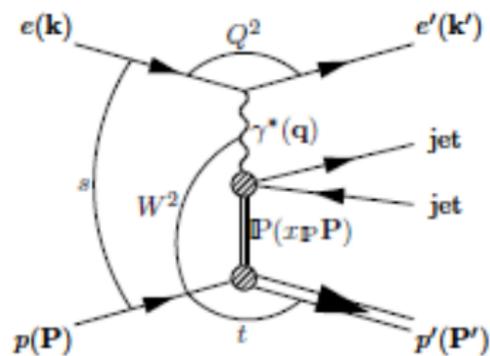


combined $\Psi(2S)$ decays ($5 < Q^2 < 70 \text{ GeV}^2$; $30 < W < 70 \text{ GeV}$):

- $\bullet \sigma(\Psi(2S))/\sigma(J/\Psi(1S)) = 0.28 \pm 0.03^{+0.02}_{-0.01}$

Exclusive dijet production in diffractive DIS

Exclusive dijet production in diffractive DIS



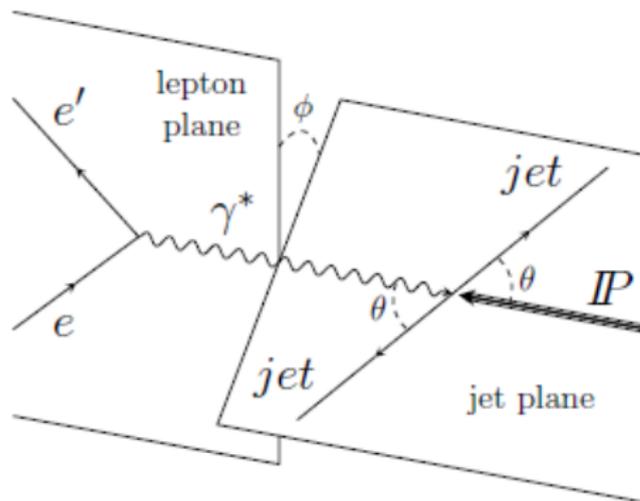
ZEUS experiment

- data 2003-2007
372 pb⁻¹
- $Q^2 > 25 \text{ GeV}^2$
- $90 < W < 250 \text{ GeV}$

Aim: comparison to model predictions

- Resolved Pomeron model (G. Ingelman and P. Schlein et al.)
- Two-gluon exchange model (J. Bartels and H. Jung et al.)
- models predict different shape for dijet azimuthal angular distribution

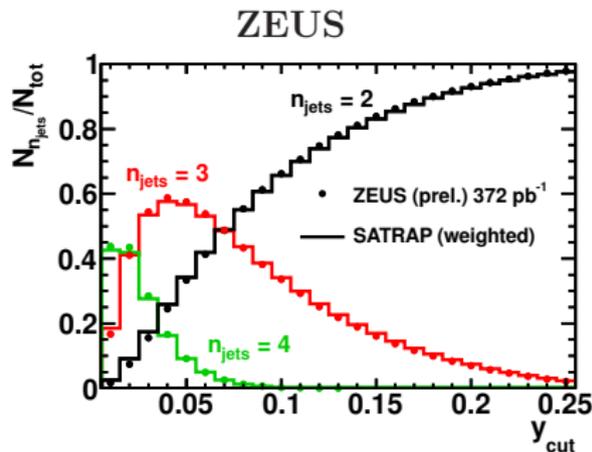
Exclusive dijet production in diffractive DIS



definition of the dijet azimuthal angle Φ

- angle between two planes spanned in the γ^* -pomeron system

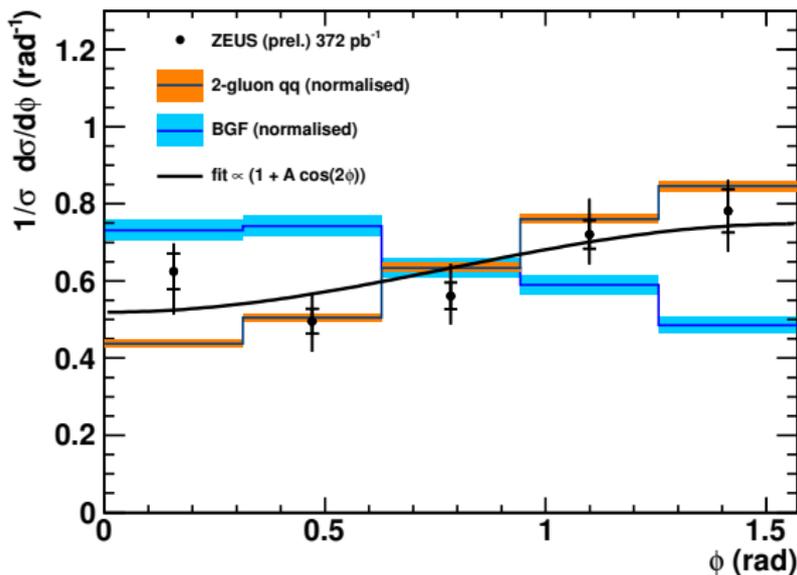
Exclusive dijet production in diffractive DIS



dijet events

- Jets by k_T cluster algorithm; cut on resolution parameter: $y_{\text{cut}} = 0.15$
- $p_T^{\text{jet}} > 2 \text{ GeV}$ selects hard jets
- $\eta^{\text{jet}} < 2$ select diffractive events with rapidity gap
- $0.5 < \beta = x/x_{IP} < 0.7$ selects events with exchange of large proton longitudinal momentum

ZEUS



dijet azimuthal angular distribution ($0.5 < \beta < 0.7$)

- The fitted shape favours the two-gluon exchange model prediction
- The Resolved Pomeron model (BGF) does not describe this data

- Photoproduction of exclusive ρ^0 associated with leading neutron, measured by H1, was used to extract the elastic cross section $\sigma(\gamma\pi^+ \rightarrow \rho^0\pi^+)$ for the first time at HERA
- Elastic and proton-dissociative cross sections of J/ψ photoproduction were measured for all t by H1. W dependence is described by QCD predictions based on colourless two-gluon exchange
- The cross section ratio $\sigma_{\psi(2S)}/\sigma_{J/\psi}$ was measured by ZEUS with improved precision
- Exclusive dijet production at DIS, measured by ZEUS, agrees with a model prediction based on a colourless two-gluon exchange