

# Diffractive Jets at H1

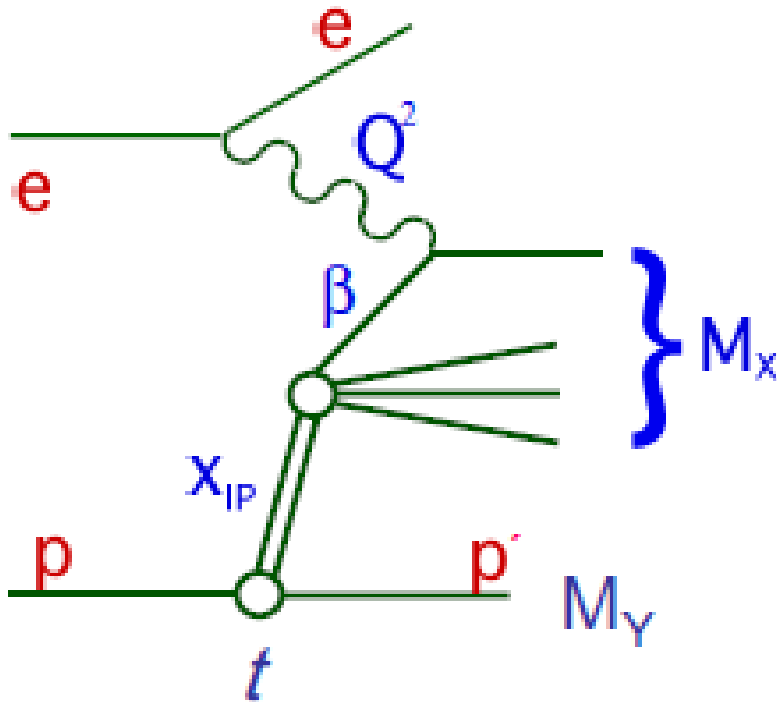


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Charles University in Prague  
On behalf of the  
H1 Collaboration



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DIS 2010, Firenze

# Diffraction measurements



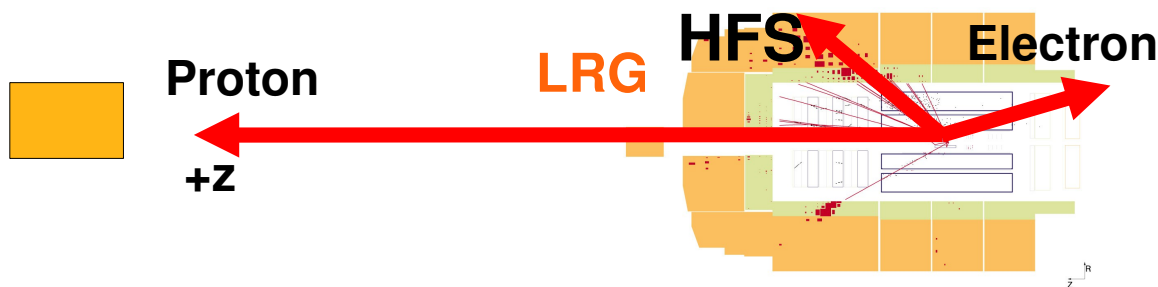
## Experimental techniques:

### LRG method

- + high statistics
- proton dissociative background
- not possible to measure the hadronic final state in the forward direction

### Proton Tagging

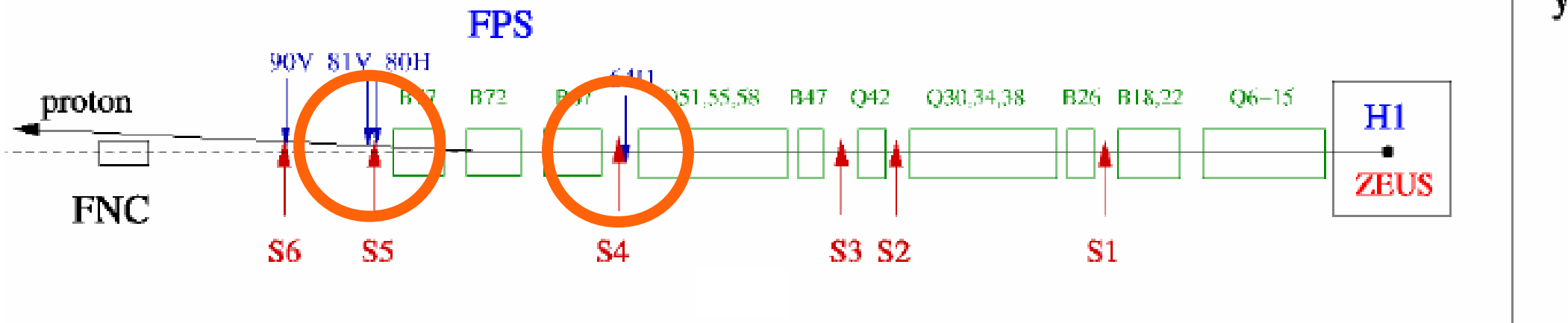
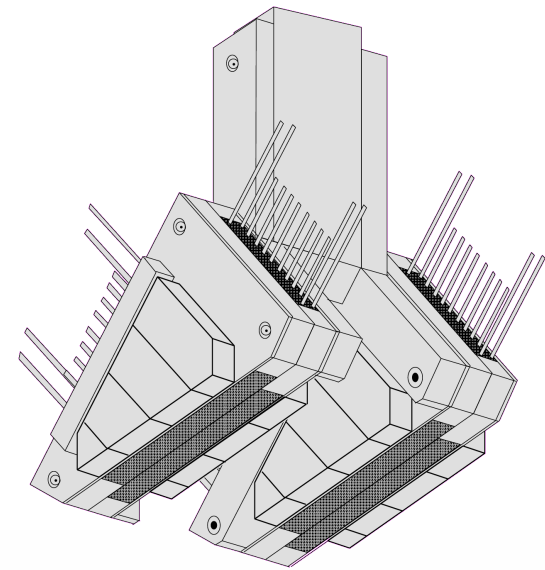
- + direct and accurate measurement of diffractive variables
- + free of proton dissociation background
- small acceptance  $\rightarrow$  low statistics



# FPS at H1



- Forward Proton Spectrometer:
  - 61m and 80m stations, each station able to measure x and y position twice, 2 station allow to measure the angle of the scattered proton
  - Scintillating fibres with PMT
  - Acceptance:
    - Proton Energy: 820 to 920 GeV
    - Proton  $P_x$ : -0.63 to -0.27 GeV
    - Proton  $P_y$ : - 0.8 to 0.8 GeV
    - $x_{IP} = 1 - E_{p'}/E_p$  up to 0.1



# Kinematical variables in diffractive DIS



$$Q^2 = (k - k')^2, y = pq / pk$$

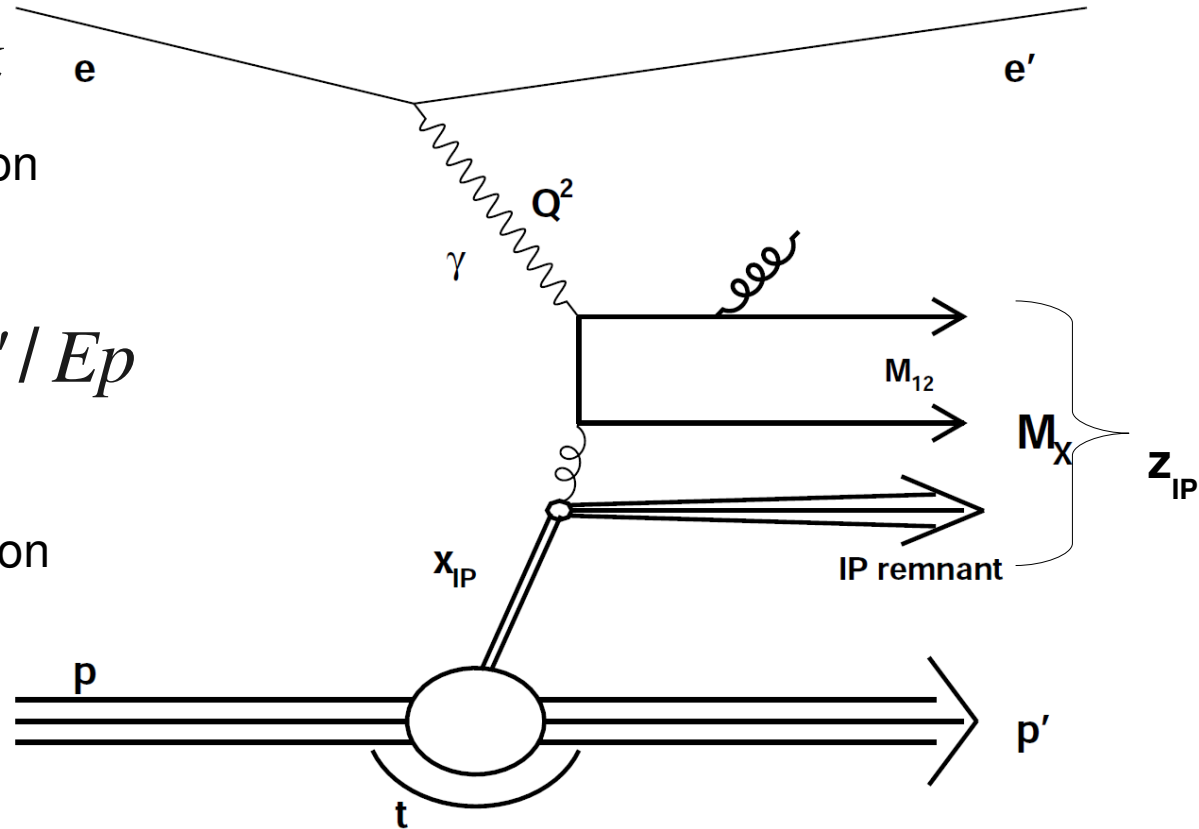
Reconstructed from scattered electron and hadronic final state

$$t = (p - p')^2, x_{IP} = 1 - Ep' / Ep$$

Reconstructed from direct measurement of the scattered proton

$$z_{IP} = (Q^2 + M_{12}^2) / (x_{IP} y s)$$

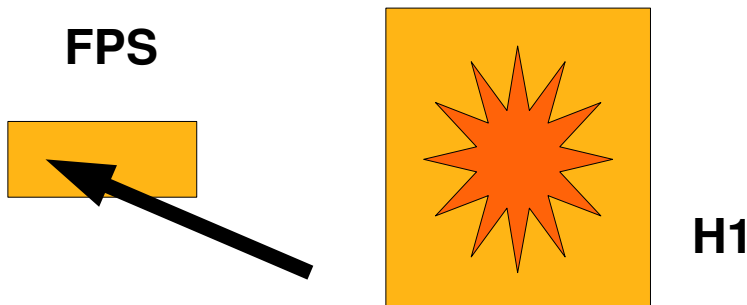
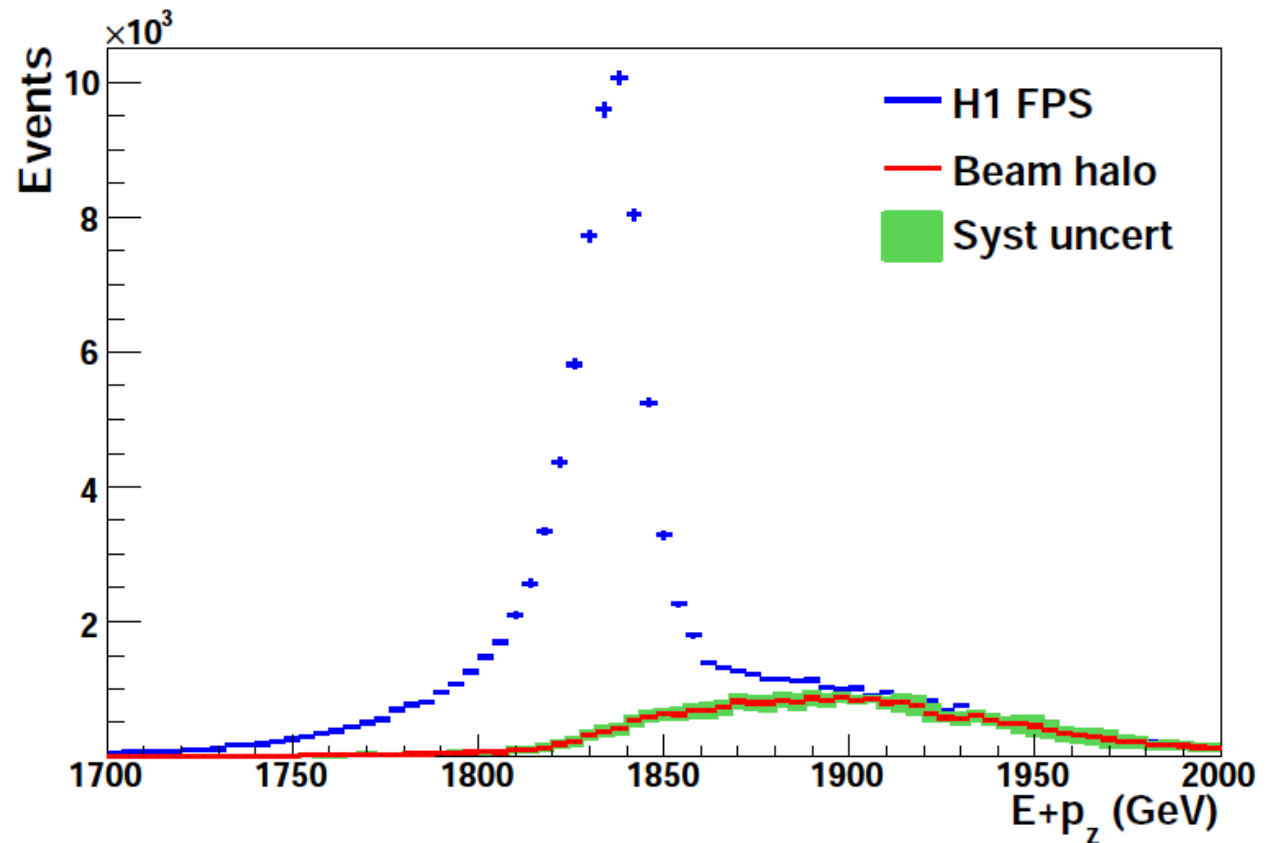
Fraction of mass of the hadronic final state that is contained in the dijet system



# Selection



- Data collected during whole HERA-II period with  $L_{\text{int}} = 156 \text{ pb}^{-1}$
- Tagged proton selection requires a good understanding of background in FPS due to coincidence of beam halo protons and event in the central detector



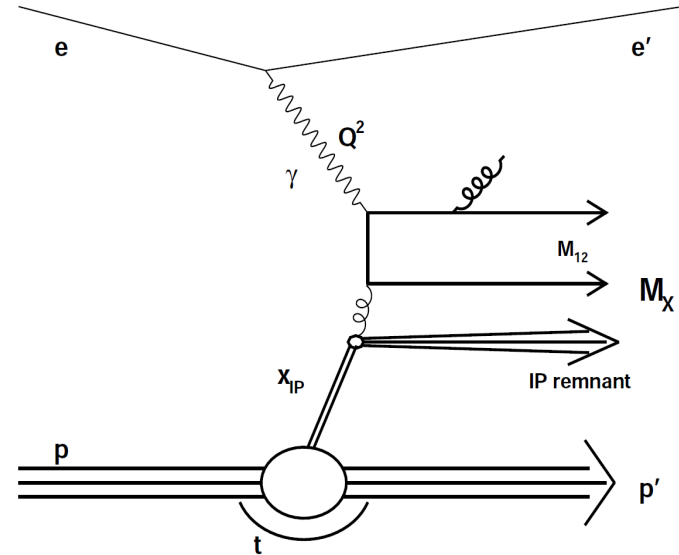
# Selection



- Central dijet selection:
  - Kt Algorithm applied in the hadronic centre-of-mass system
  - Selected: 450 events

$$0.05 < y < 0.7$$
$$4 < Q^2 < 110 \text{ GeV}^2$$
$$x_{\text{IP}} < 0.1$$

$$p_{T1}^* > 5 \text{ GeV}$$
$$p_{T2}^* > 4 \text{ GeV}$$
$$-1 < \eta < 2.5$$



# Cross section measurement



**NLOJET++ using  
H1 2006 DPDF Fit B**

- IP and IR contribution
- scale  $\mu = Q^2 + p_{T1}^{*2}$
- Hadronization uncertainties ~8%

**Detector**

- RapGap and NLO corrected by 1.23 due to **proton dissociation background missing** in FPS analysis

RapGap with DPDF  
2006 Fit B

**Stable hadrons**

**Data  
RapGap  
NLO**

# Comparison to previous analysis



- Diffractive DIS dijet analysis with LRG (JHEP 0710:042)
- Published data scaled by 1.23 (proton dissociation background)

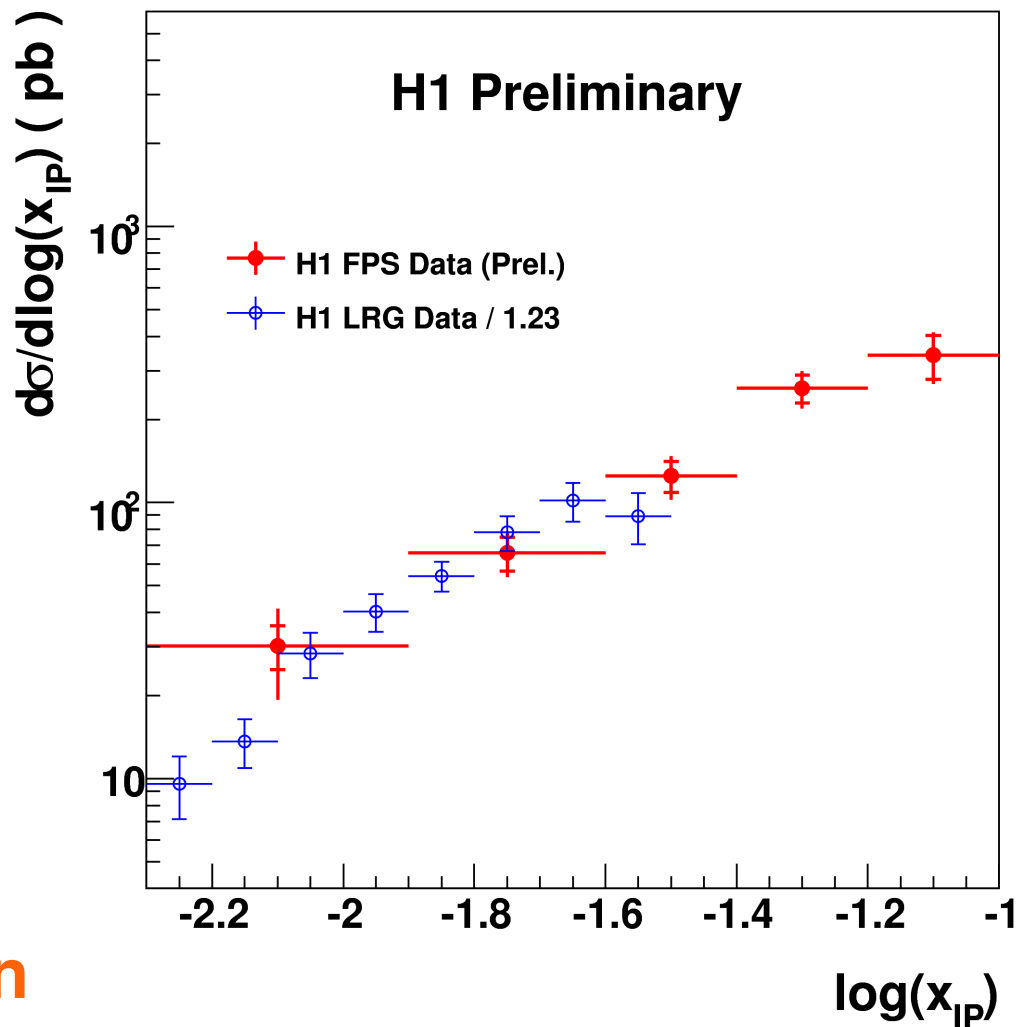
$$4 < Q^2 < 80 \text{ GeV}^2$$

$$0.1 < y < 0.7$$

$$p_{T1}^* > 5.5 \text{ GeV}$$

$$p_{T2}^* > 4 \text{ GeV}$$

- **Very good consistency**
- **Phase space extension in  $x_{IP}$  by factor of 3**





# $x_{IP}$ dependence



- Total uncorrelated error  $\sim 13\%$
- Total normalisation uncertainty approximately 5% (not presented)
- $R = \text{Theory}/\text{Data}$
- NLO error:
  - Scale variations  $2\mu, \mu/2 \oplus$  hadronization uncertainties

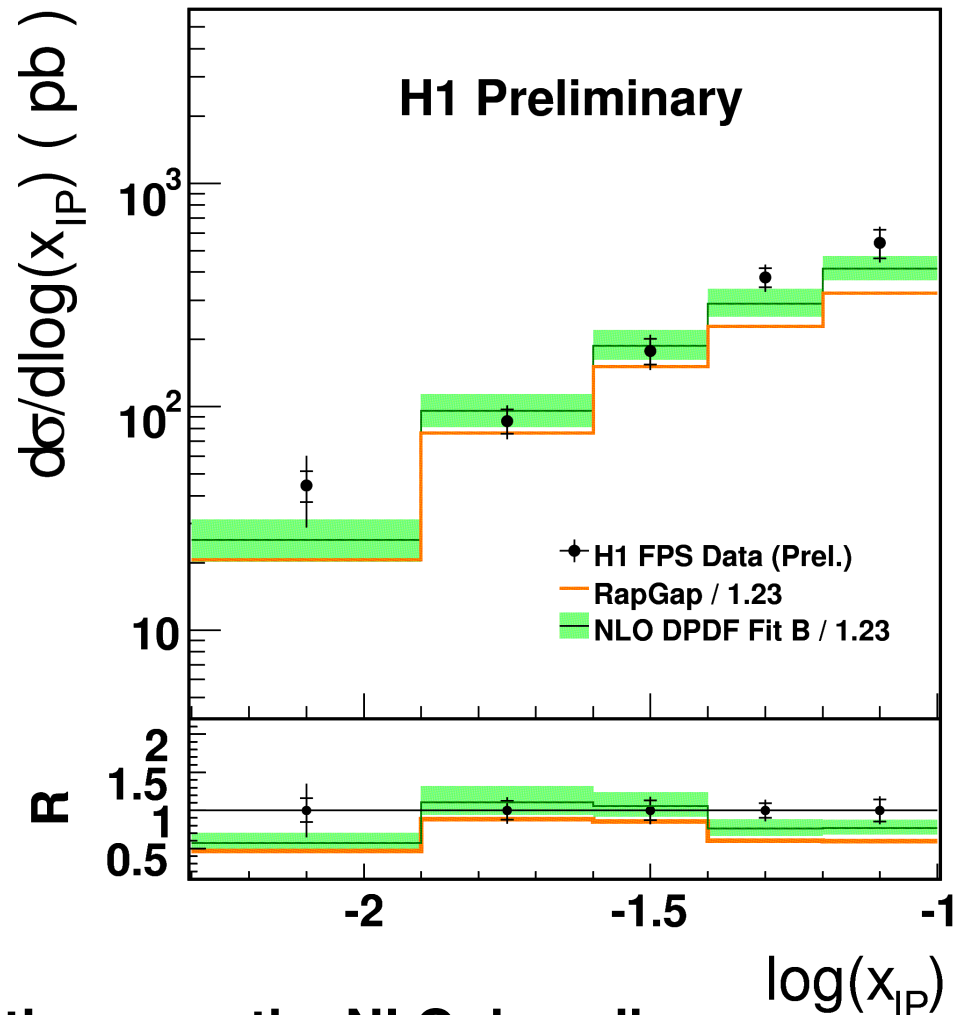
$$4 < Q^2 < 110 \text{ GeV}^2$$

$$0.05 < y < 0.7$$

$$x_{IP} < 0.1$$

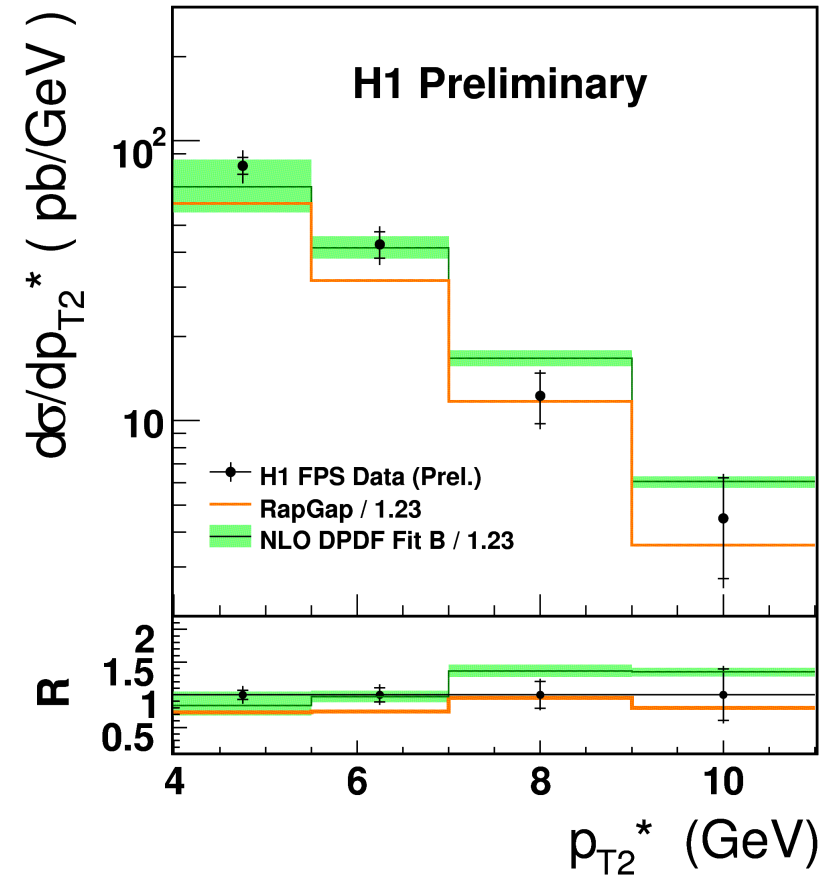
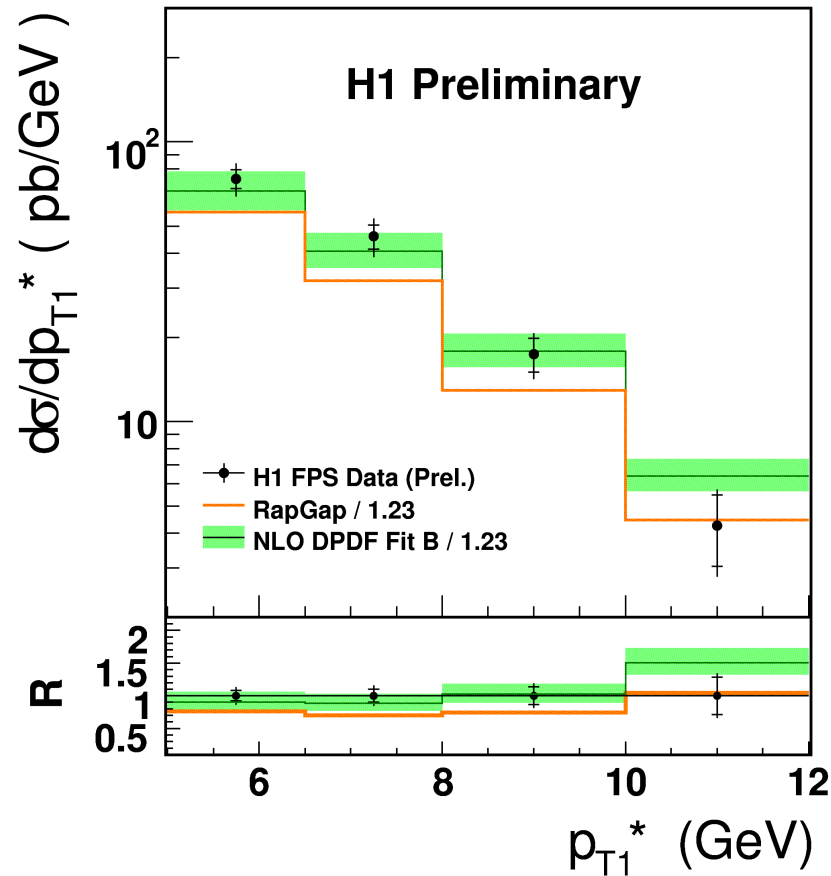
$$p_{T1}^* > 5 \text{ GeV}$$

$$p_{T2}^* > 4 \text{ GeV}$$



- Within the error, the NLO describes the data well
- RapGap describes the shape but it's off in normalisation

# Jet Transverse Momenta

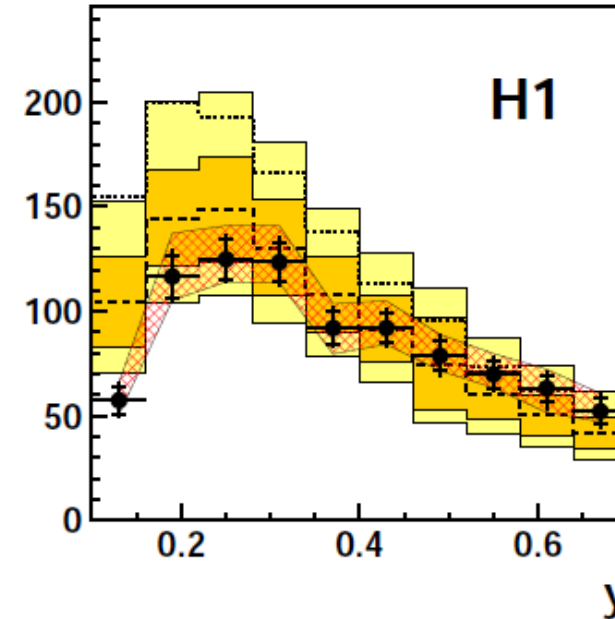
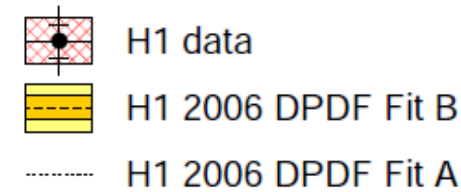
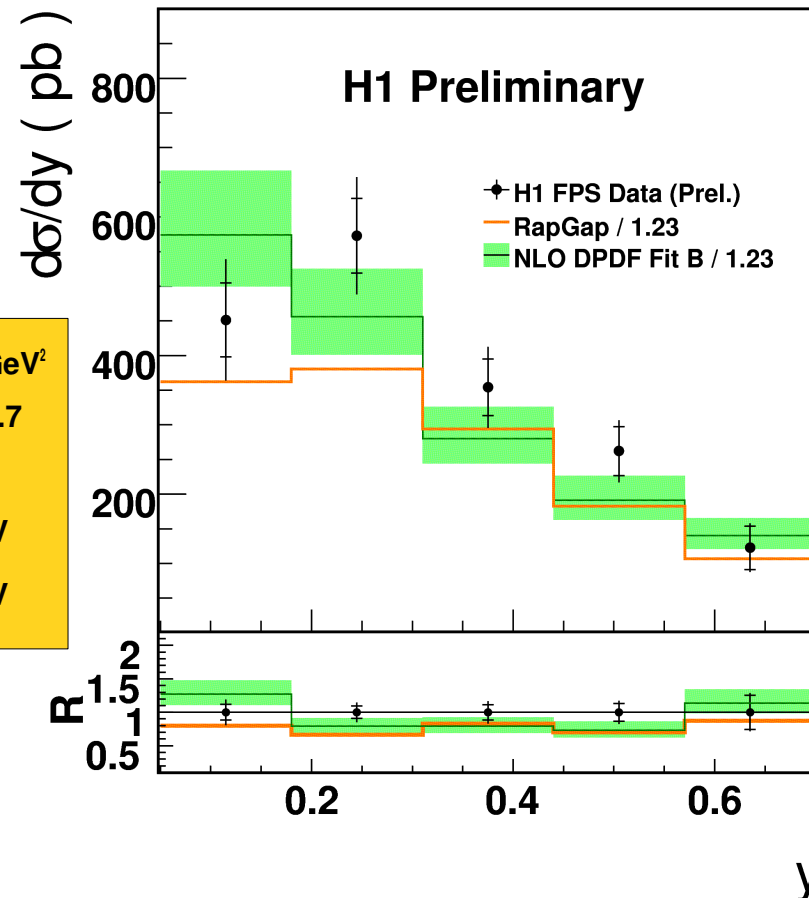


- Transverse momenta of the leading and next-to-leading jet are well described by the NLO predictions
- RapGap off in normalisation

# y dependence



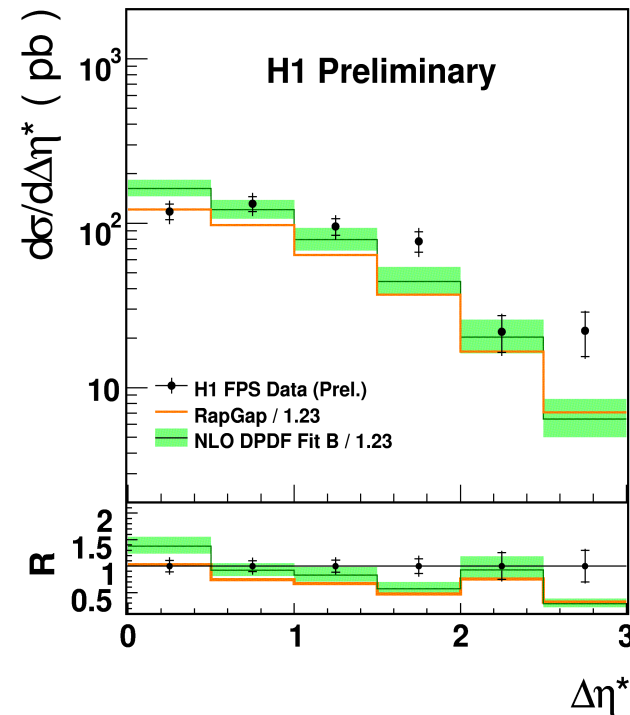
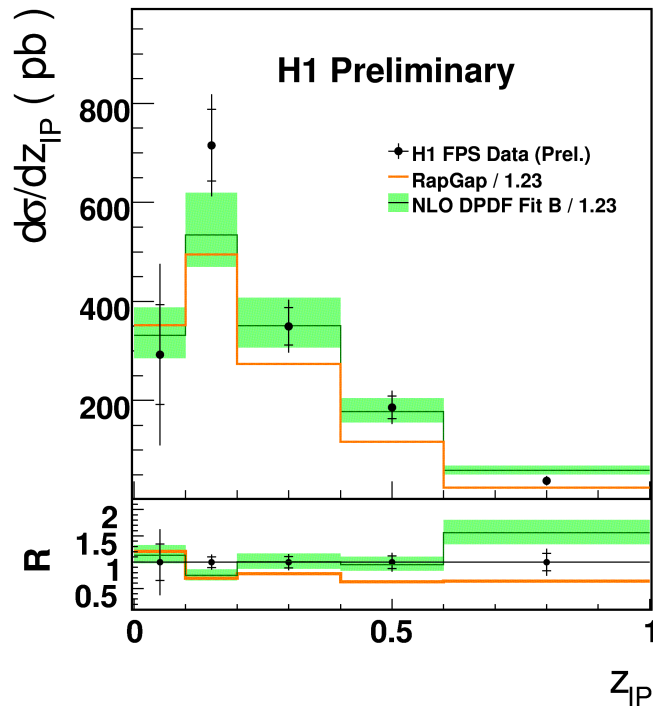
JHEP  
0710:042



$4 < Q^2 < 80 \text{ GeV}^2$   
 $0.1 < y < 0.7$   
 $X_p < 0.03$   
 $p_{T1}^* > 5.5 \text{ GeV}$   
 $p_{T2}^* > 4 \text{ GeV}$

- NLO gives a good description of the data within the errors
- Deviations at low  $y$  expected due to the absence of soft pomeron remnant in the NLO prediction
- RapGap agrees in shape better but is off in normalisation

# $z_{\text{IP}}$ and $\Delta\eta^*$



- NLO roughly agrees with the data within the errors
- Deviations expected due to the absence of soft pomeron remnant in the NLO
- Highest bin in  $\Delta\eta^*$  shows a significant deviation, extension to the topology of 1 central and 1 forward jet may be interesting

# summary



- Central jets with FPS measured
- HERA II period 20x higher statistics → first tagged proton dijet measurement in ep ever
- Consistency with previous analyses proven after subtraction of proton dissociation background
- DPDFs tested in new kinematical region up to  $x_p < 0.1$
- Within errors NLO describes the data, RapGap is off in normalisation