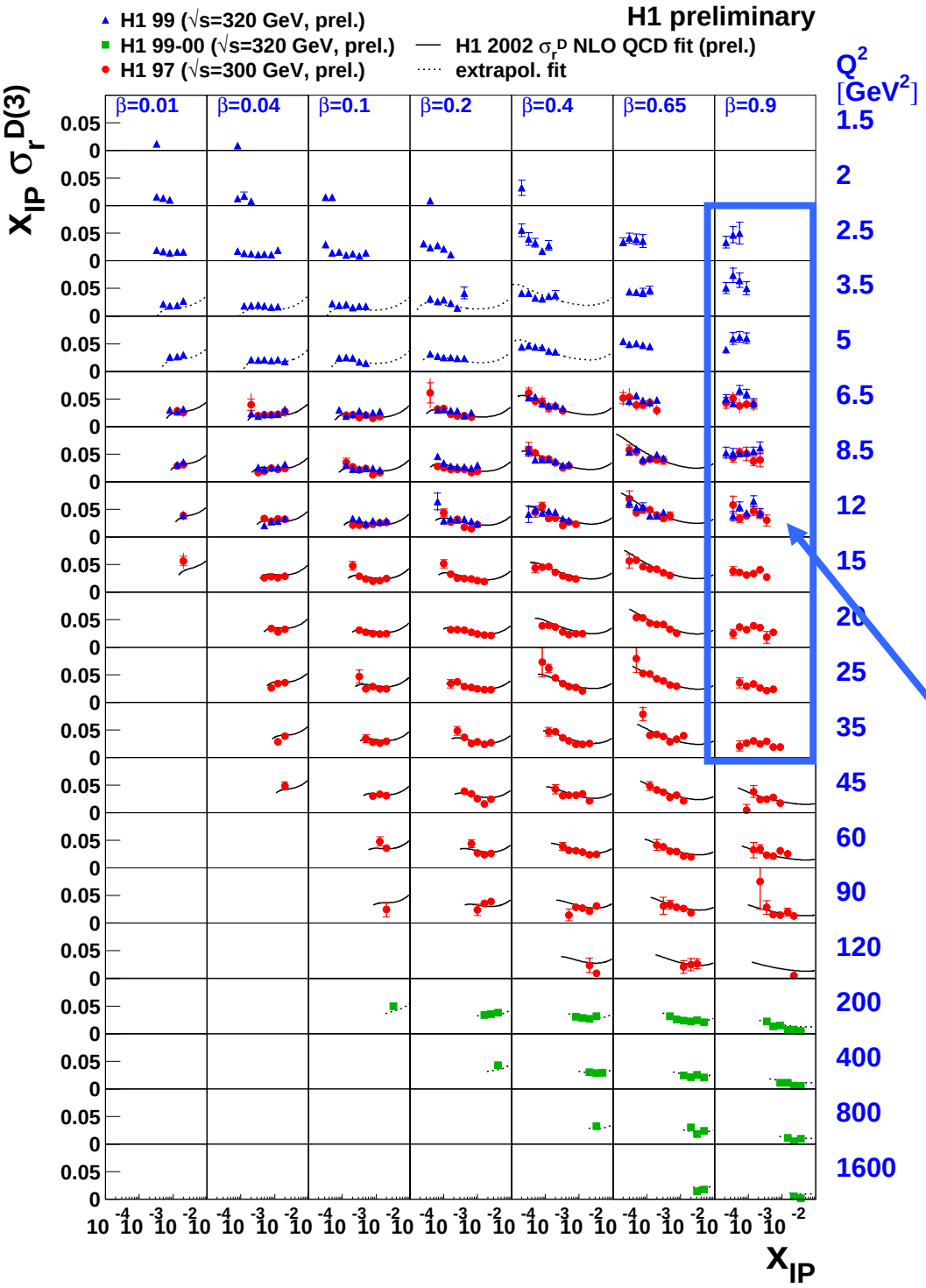
Perspectives for diffraction at H1

- F_2^D LRG measurements at medium and high Q^2
- F_2^D FPS measurements
- F_L^D measurements (low E_p running)
- Diffractive CC cross sections
- Factorization tests in hadron final states
  - D* in DIS and photo-production
  - di-jets and 3-jets in DIS and photo-production
- Leading neutron production



F_2^D measurements

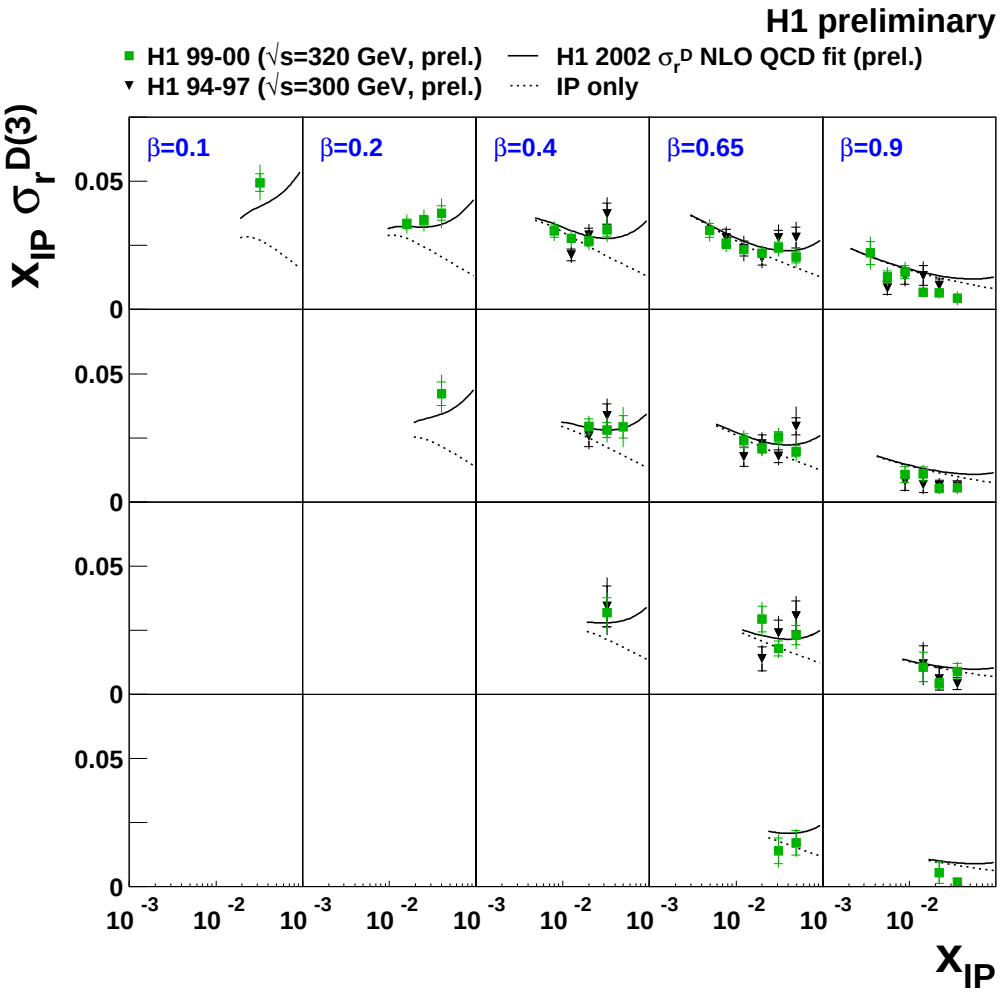
Data at Low, Medium and High Q^2:

- Statistical errors ~ 10-15%
  ➔ 3-5% at medium Q^2 for HERA-2
- FwDet syst, p-diss uncertainty ~ 9%
  ➔ diminished by VFPS at HERA-2
- CenDet sys, model dependence ~9%
  ➔ could be reduced down to 5%

Need more statistics and better model at high β to constrain high twist contribution

Data well described by H1 NLO QCD Fit to medium Q^2 data ➔ diffractive PDF's

F_2^D measurement at High Q^2



Q^2 [GeV^2]

200

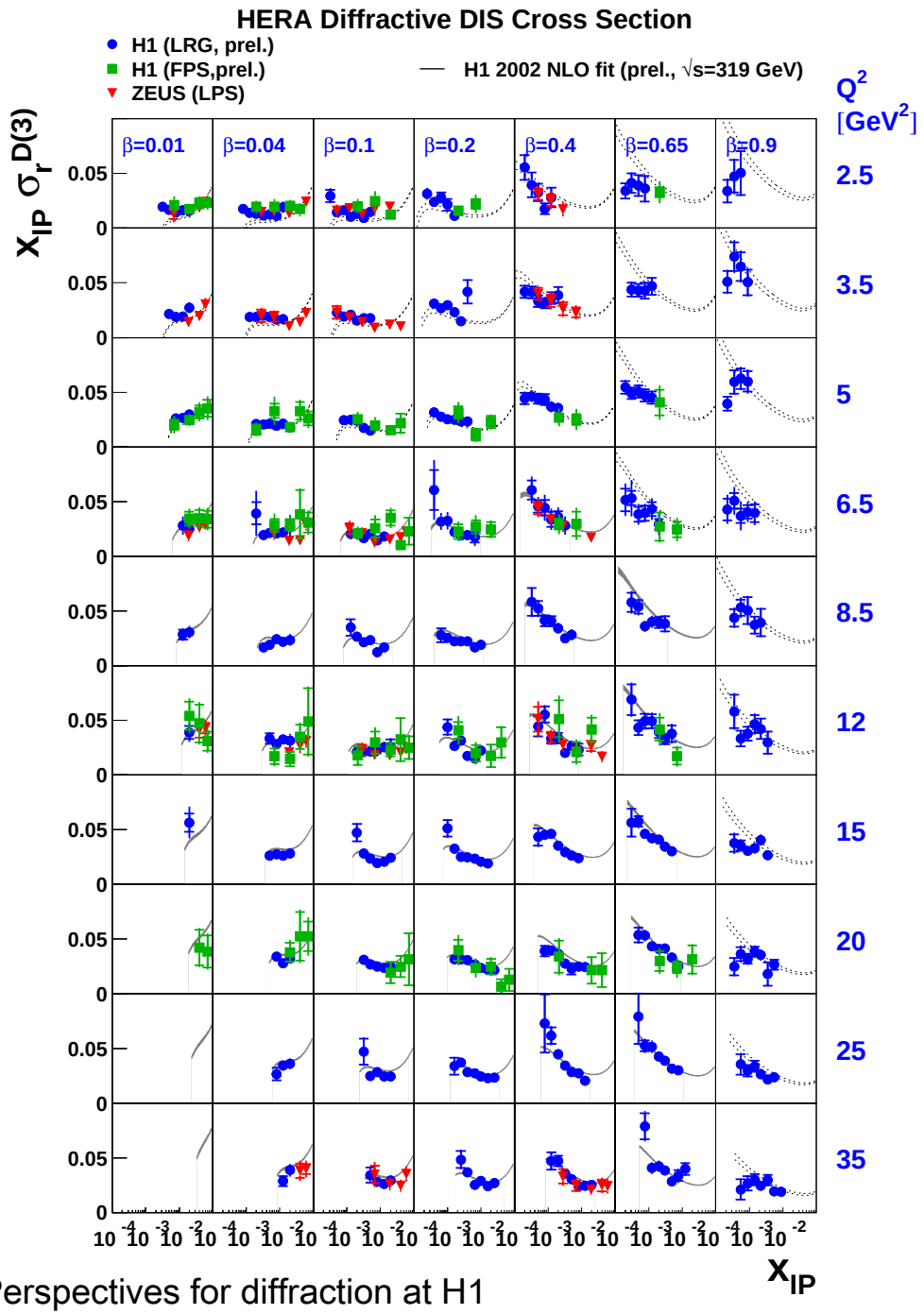
400

800

1600

- HERA-I Data at High Q^2, $\mathscr{L}$ = 65 pb^{-1}
- Prediction of NLO Fit based on Medium Q^2 data ➔ good agreement
- 10 times more statistics expected at HERA-2
  ➔ Data will constrain fit at high Q^2

FPS proton vs Large Rapidity Gap



- Large rapidity gap selection: M_Y<1.6 GeV and |t|<1 GeV^2
- FPS proton selection: $M_Y = m_p$ extrapolated to |t|<1 GeV^2

➔Good agreement between two methods and two experiments

- LRG/FPS ratio

➔ p-dissociation contribution

- FPS measurements:

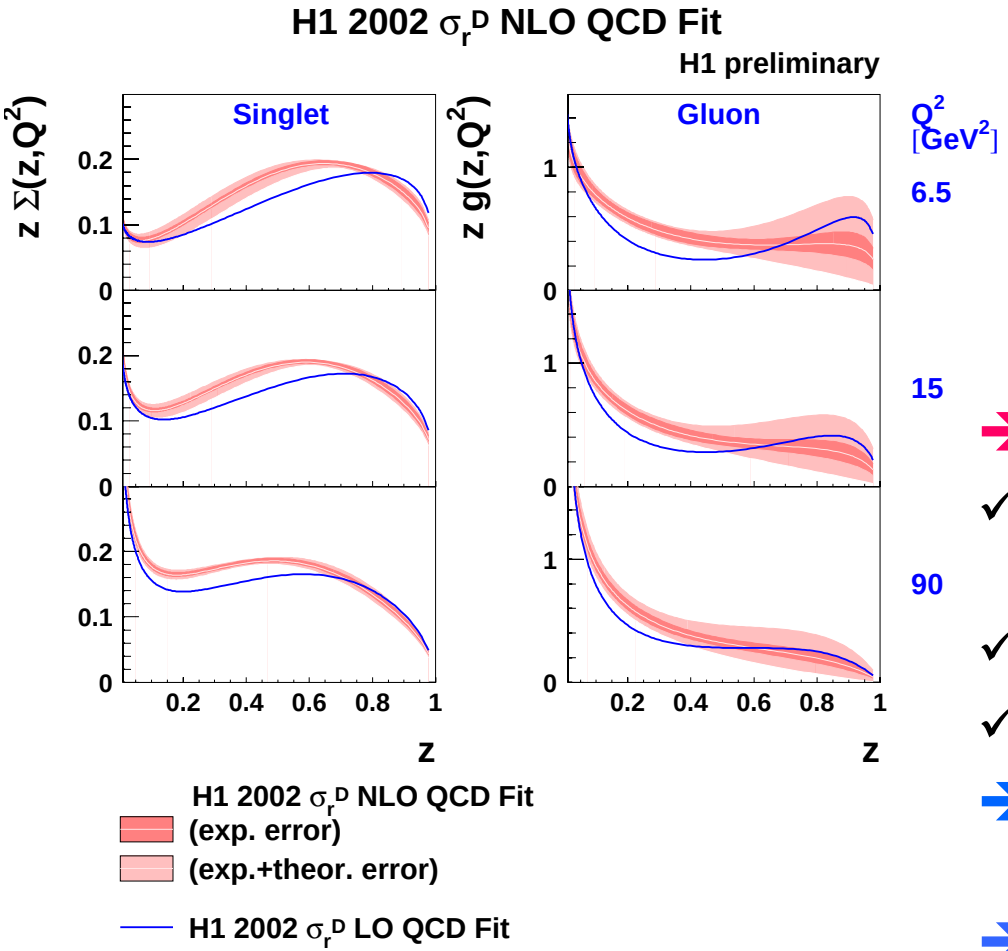
➔ constrain IR at high x_{IP}

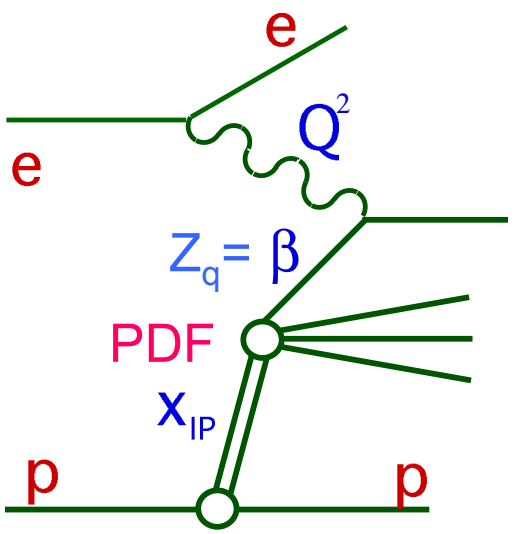
➔ t-dependence at fixed x_{IP},β,Q^2

➔energy flow as function of rapidity

HERA-2 ➔ VFPS

NLO DGLAP Fit → PDF





➔ Diffractive PDFs:

✓ Precise measurement of quark singlet distribution

✓ Gluon distribution dominated ➔ 75±15%

✓ Large gluon uncertainty at high *z*

➔need precision measurement and better model at high β

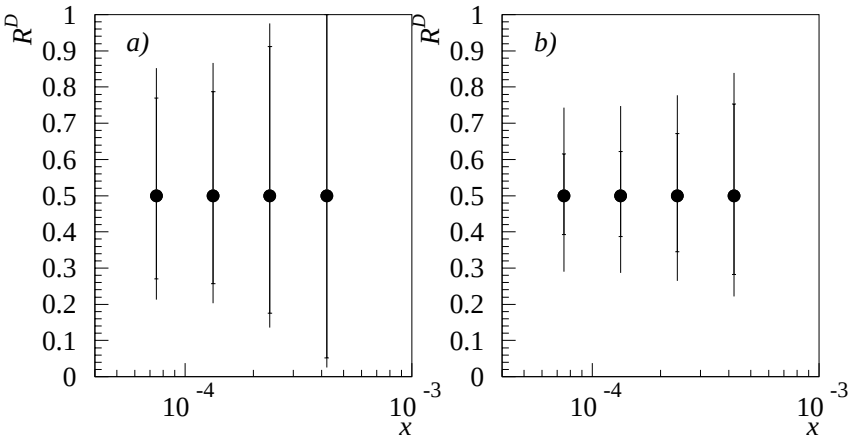
➔fit at fixed x_{IP}, more statistics needed, data are limited in (β, Q^2)

➔FPS/VFPS: constrain IR contribution, t-dependence for fixed x_{IP}

➔Can be applied to test QCD factorization in *ep* final states (charm, di-jets)

Reduced E_p and F_L^D measurement

$R_D = \sigma_L/\sigma_T = F_L^D/(F_2^D - F_L^D)$ ratio of longitudinal to transverse diffractive cross section



10 pb^{-1}, 500 GeV 50 pb^{-1}, 500 GeV

50 pb^{-1}, 820 GeV 250 pb^{-1}, 820 GeV

- Vary s to get $\sigma(\beta, Q^2, x_{IP})$ at different y

➔Statistical and systematic errors comparable with 50 pb^{-1} at E_p=500 GeV, R_D measured to 40%

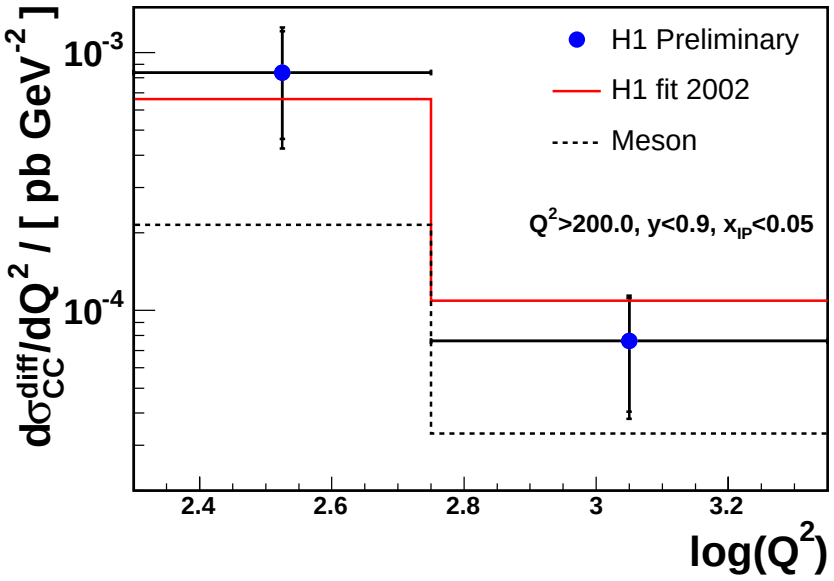
Another approach:

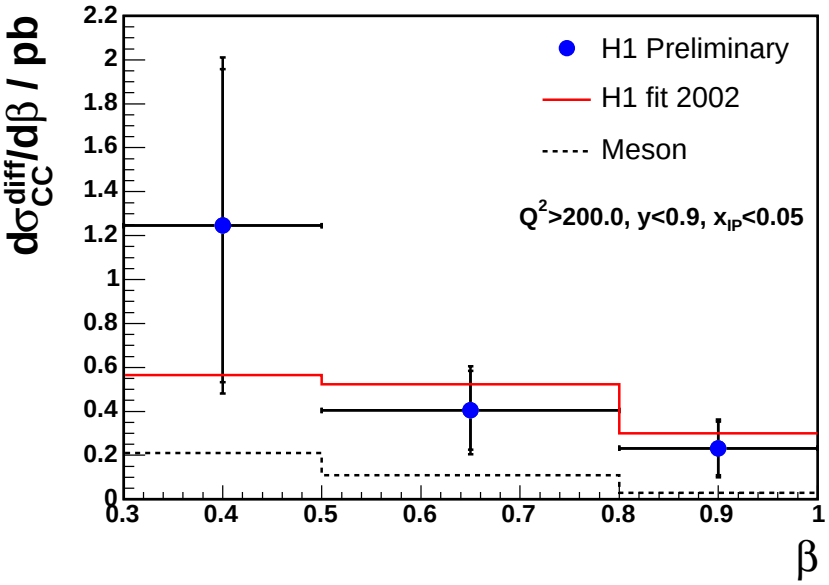
➔ Interference between transverse and longitudinal photon induced processes leads to modulation in $\cos \Phi_{ep}$

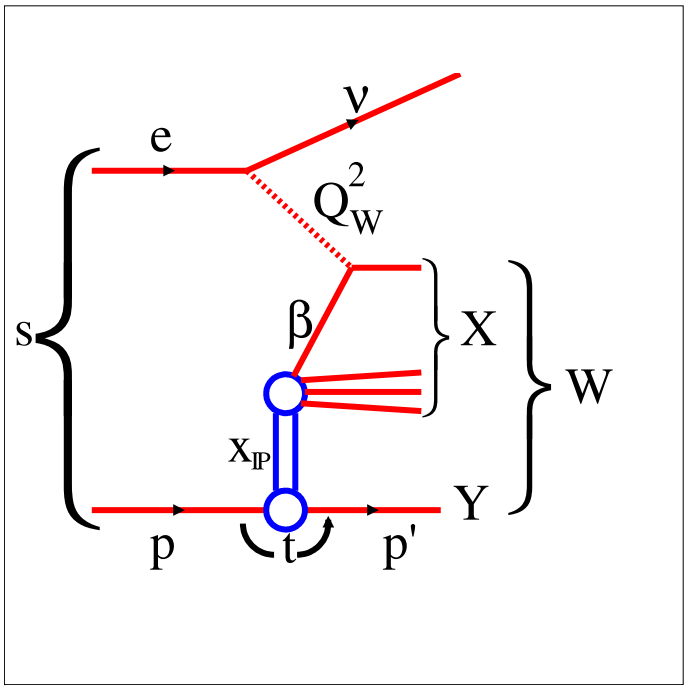
➔ Predicted ~20% for β>0.8

➔VFPS expect to measure $\cos \Phi_{ep}$ in 15 bins (see VFPS talk)

Differential CC cross sections

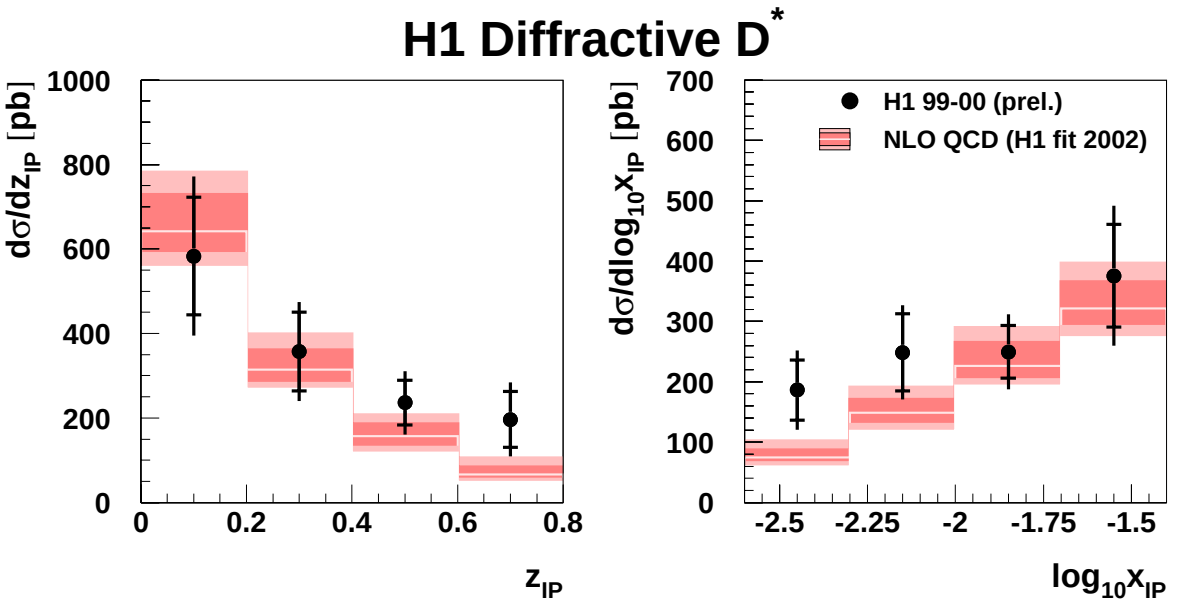


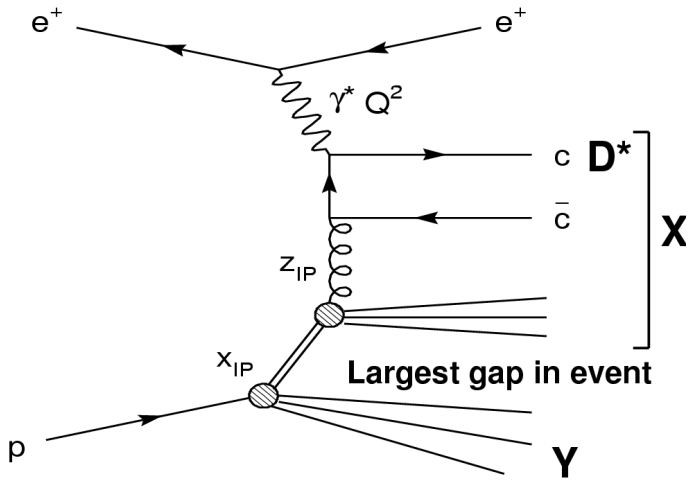


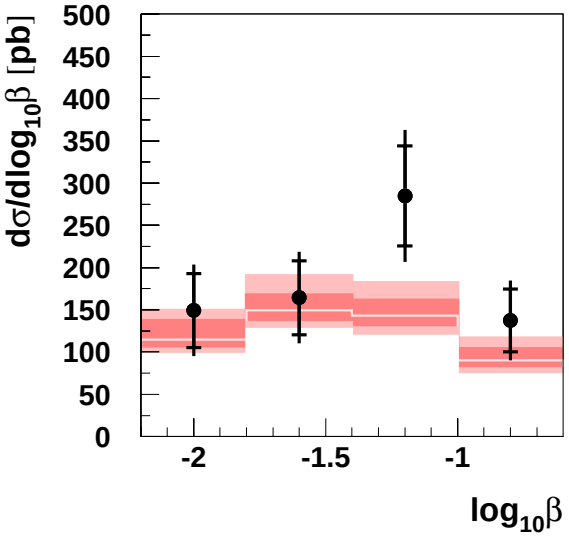


- First measurement of differential LRG CC cross sections
- HERA-I data: 14 events
- RAPGAP with diffractive PDFs from H1 QCD Fit describes LRG CC cross sections
  - ➔10 times more statistics expected at HERA-2
  - ➔test diffractive PDFs in weak interactions

Diffractive D* in DIS





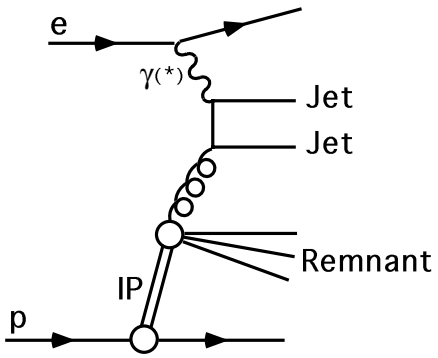


- H1 99-00 statistics in DIS / γp: 140 / 80 events
  ➔ Direct sensitivity to gluon PDF
  ➔DIS data are in agreement with NLO predictions (PDFs from H1 QCD fit)
  ➔No factorization breaking in DIS
  ➔What about photo-production?

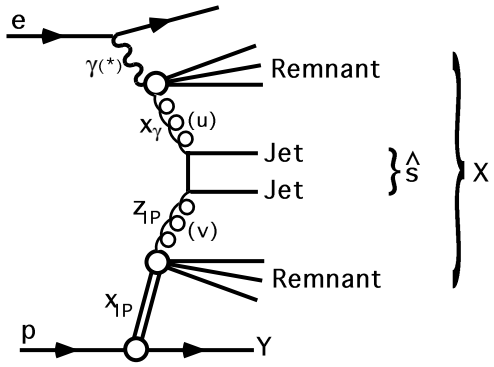
- 10 times more statistics expected at HERA-2
  ➔New FTT trigger with higher efficiency
  ➔p-dissociation constrained by VFPS
- possible $F_2^{D,cc}(\beta, Q^2, x_{IP})$ measurement

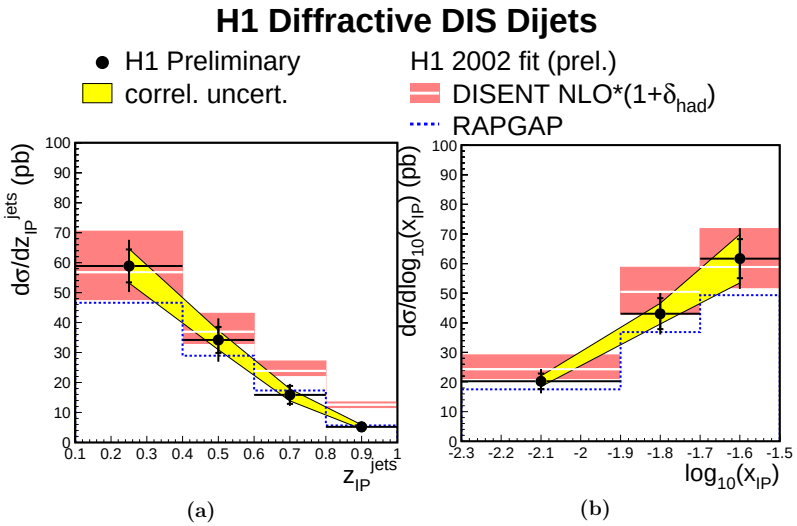
Diffractive di-jets in DIS and PhP

DIS and direct γp



Resolved γp





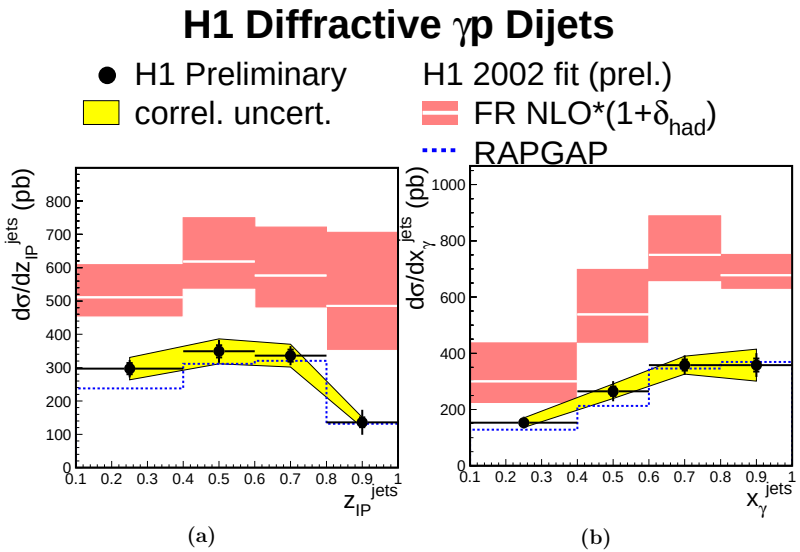
- NLO predictions based on H1 PDFs describe di-jets in DIS

➔no factorization breaking in DIS

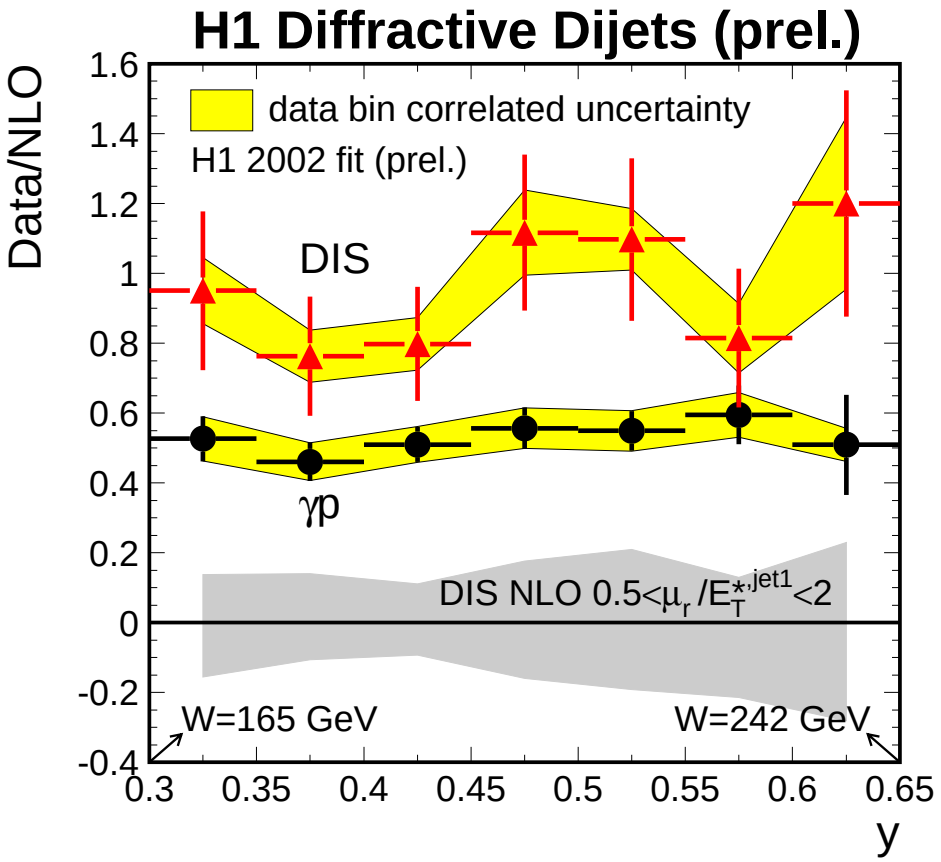
- Data are factor 0.5 below NLO prediction for resolved and direct photo-production

➔factorization breaking in γp

- Same suppression factor for direct and resolved PhP?



Diffractive di-jets in DIS and PhP



- expected 3 times more statistics for H1 99-00 data
- 10 times more statistics at HERA-2

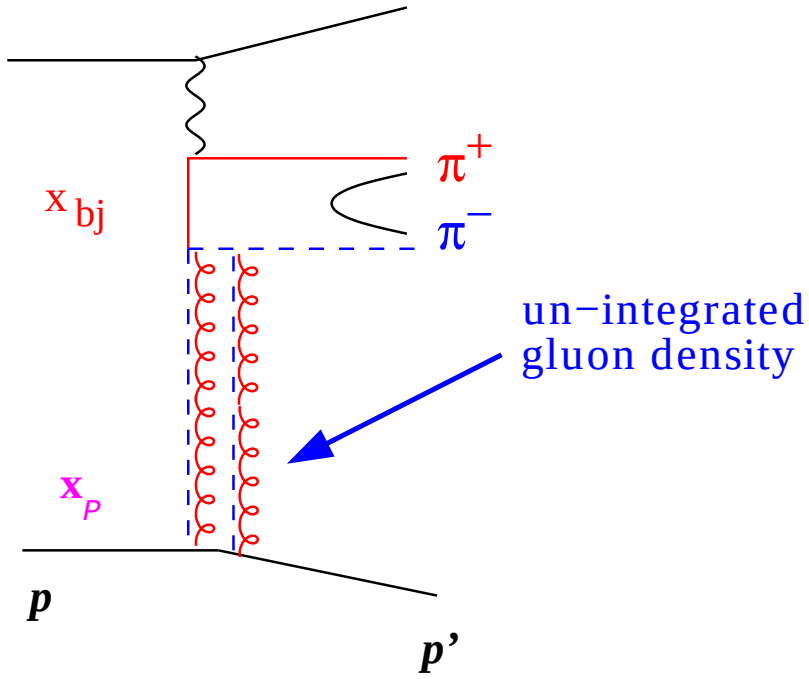
➔new H1 Jet trigger applied for diffraction

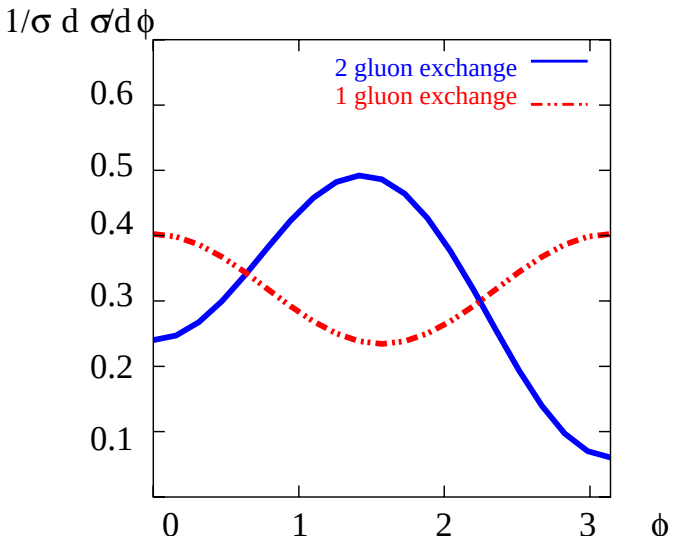
- need smaller model uncertainties
- include di-jet DIS into QCD fit to constrain gluon?

➔ need data in (z_{IP}, Q^2, x_{IP}) bins

- HERA-2: expected amount of 3-jet events sufficient for factorization tests

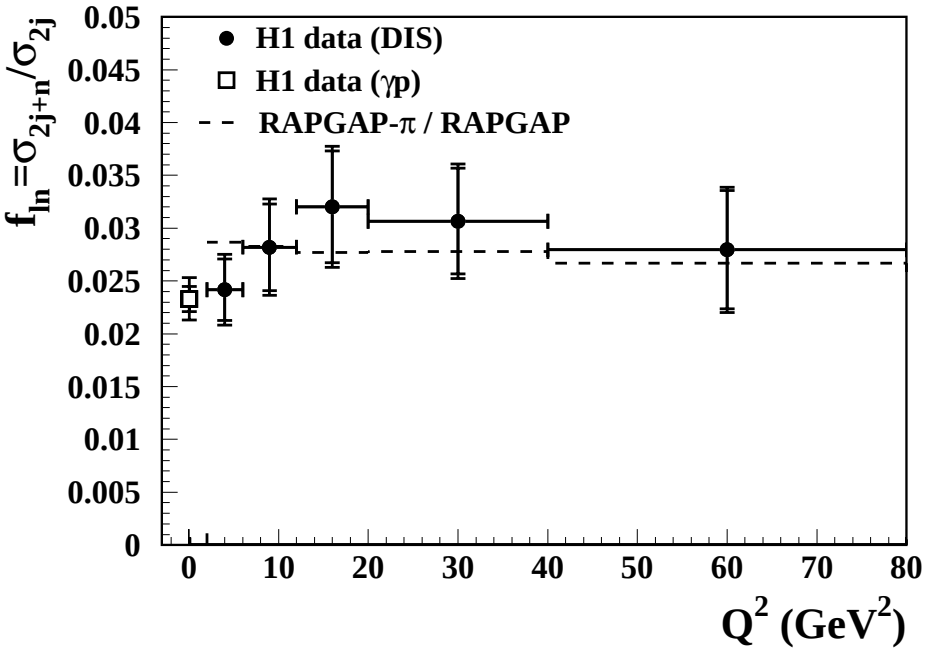
Exclusive production of $\pi^+\pi^-$ (or jets)

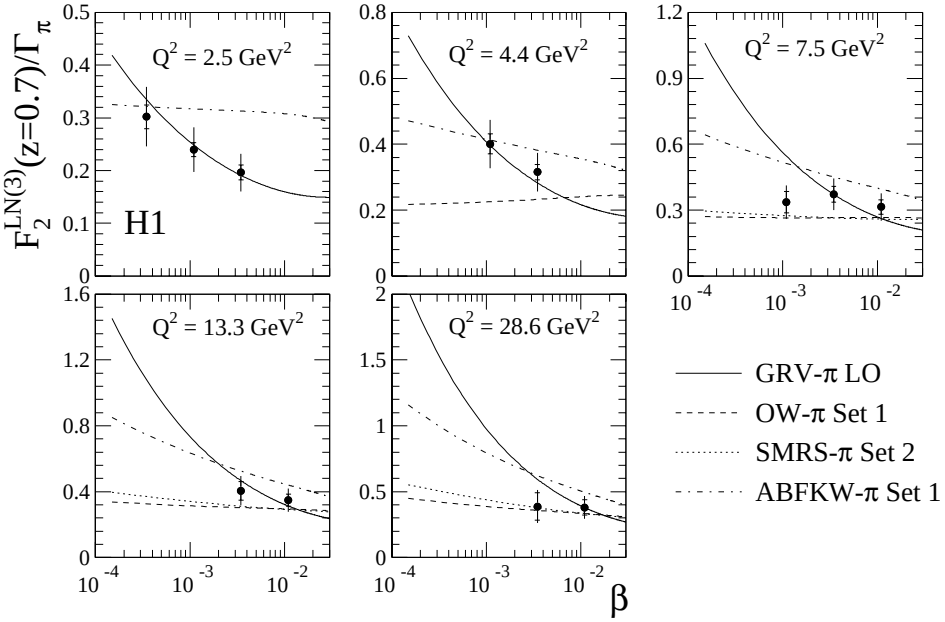




- Azimuthal correlation between exclusive $\pi^+\pi^-$ (jets) and lepton scattering planes distinguish between BGF and 2-gluon exchange
- HERA-2: 4σ level effect for 10% correlation in 7 Φ bins based on 250 pb^{-1}
- direct test of 2-gluon model
- study transition between low $P_T(\pi^+\pi^-)$ and high P_T (jets)

di-jets and F_2^{LN} with leading neutron





- Leading Neutron di-jet DIS and PhP data are in agreement with NLO calculations

➔No factorization breaking within the errors

HERA-2: new forward neutron calorimeter with better energy resolution

- 10 times more statistics at HERA-2
- precision is limited by FNC acceptance systematic
- measurement of F_2^{LN} and high Q^2
- measurement of F_2^{π} as $F_2^{LN}/\Gamma(\pi)$ at high β, comparison with fixed target data

Summary

- F_2^D LRG measurements at medium and high Q^2
  - ➔ extraction of PDFs from NLO QCD fit
- F_2^D FPS measurements
  - ➔ constrain p-dissociation in LRG
  - ➔ t-dependence, energy flow in diffraction
- F_L^D measurements are dependent on low E_p running
- Diffractive CC measurements need HERA-2 luminosity
- More precise factorization tests in hadron final states:
  - D* in DIS and photo-production
  - multi-jets in DIS and photo-production
  - di-jets with leading neutron