Diffractive Charged Currents in ep
Probe of Pomeron Flavour Content

Related to tests from W+/W- asymmetry in pp diffraction

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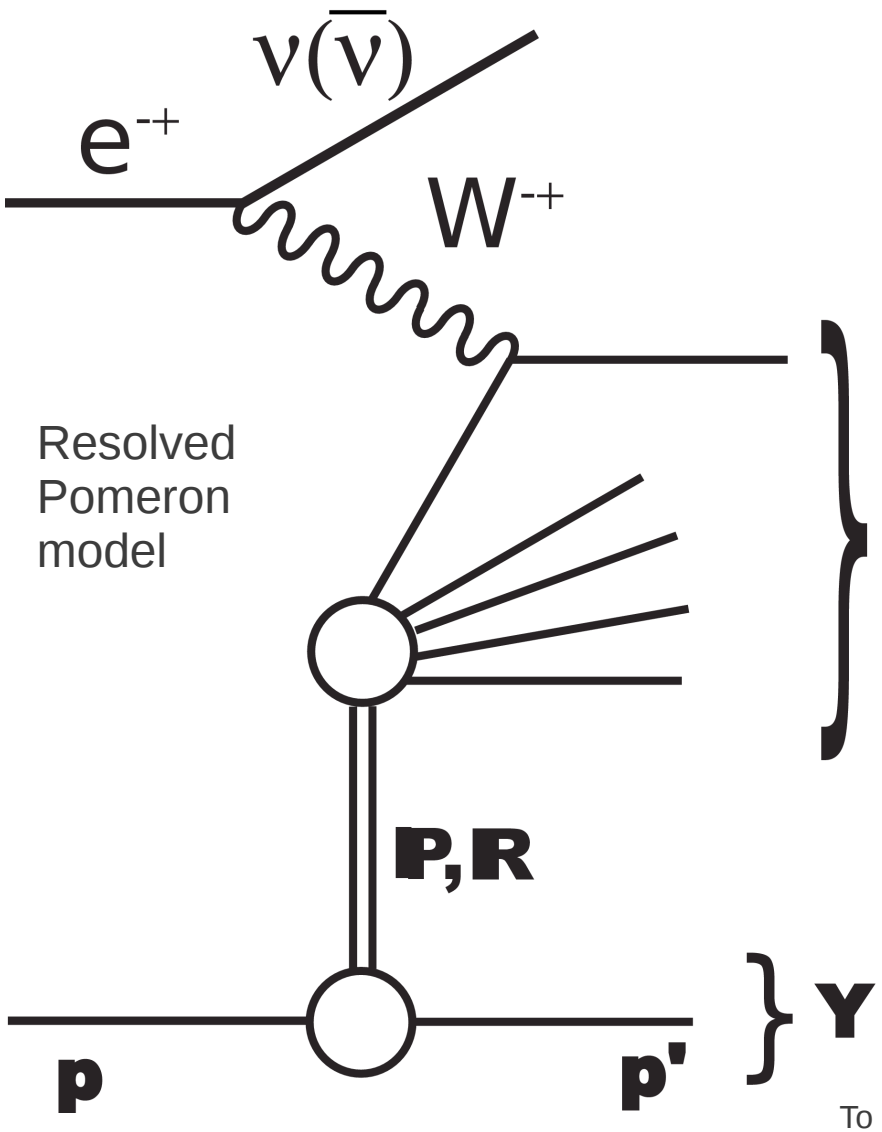
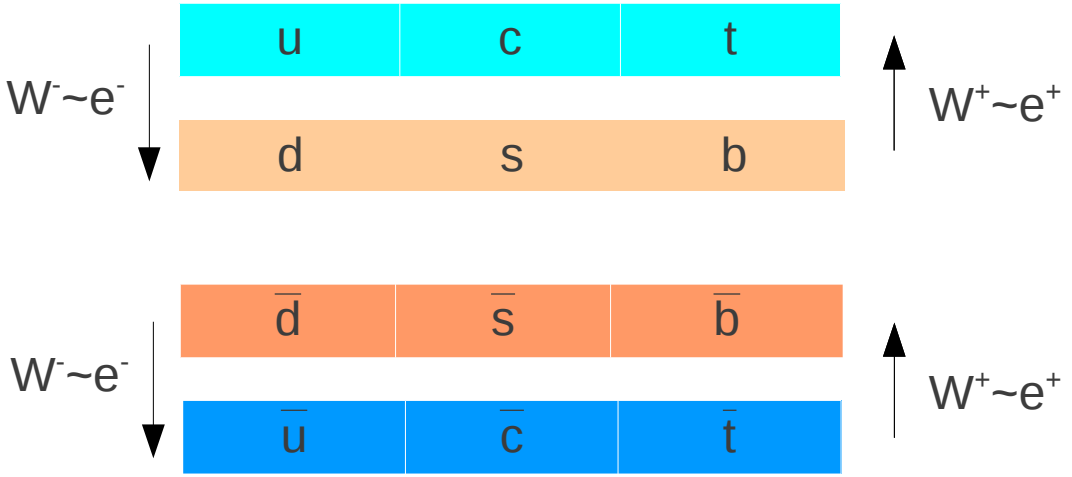
26.11. 2012 Krakow

Charged Currents as a Flavour Probe (Parton Model View)





Different shapes of W + (q / $\bar{q}$) interactions!

$$\frac{d\sigma}{dy}(e^- q) \propto 1$$

$$\frac{d\sigma}{dy}(e^- \bar{q}) \propto (1-y)^2$$

Suppressed in bwd region

$$\frac{d\sigma}{dxdy}(e^- p) \propto [(d+s)+(\bar{u}+\bar{c})(1-y)^2]$$

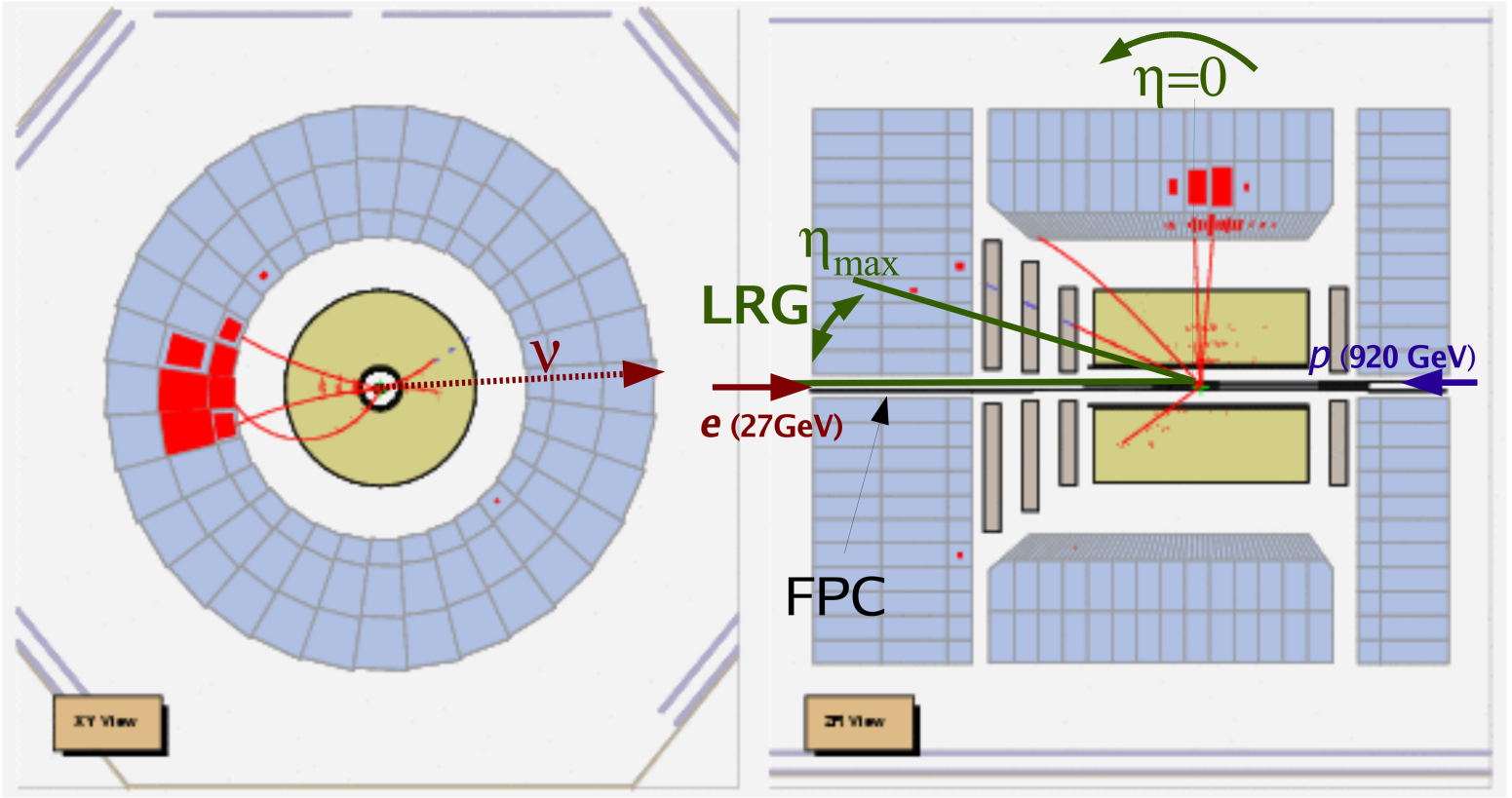
$$\frac{d\sigma}{dxdy}(e^+ p) \propto [(\bar{d}+\bar{s})+(u+c)(1-y)^2]$$

To extract these components, measurements with several beam energies needed (compare to F_L measurement)

CC Event Topology

- Missing Et due to outgoing neutrino
- Diffraction selection by LRG requirement of by leading proton tagging

ZEUS
event display



- All interesting kinematics calculable from momenta of X system

$$y=\frac{E^X-p_z^X}{2E_e} \qquad Q^2=\frac{(p_T^X)^2}{1-y} \qquad x_{IP}=\frac{Q^2+2E_e(E^X+p_z^X)}{4E_eE_p} \qquad \beta=\frac{Q^2}{x_{IP}ys}$$

Diffractive Factorization

QCD factorization formula (in CC γ->W^{+-}):

$$\mathrm{d}\sigma^{D}(\gamma p \to Xp) = \sum_{parton_i} f_i^{D}(\beta, Q^{2,} x_{IP}, t) * \mathrm{d}\hat{\sigma}^{\gamma i}(\beta, Q^2)$$

f_i^D DPDFs, obeys DGLAP evolution, process independent

x_{IP} Momentum fraction of the diffractive exchange

$\mathrm{d}\hat{\sigma}^{\gamma i}$ Process dependent partonic x-section, calculable within pQCD

β Fraction of exchange momentum entering hard subprocess

In addition to DGLAP evolution, Regge vertex factorization is assumed:

$$f_i^{D}(\beta, Q^{2,} x_{IP}, t) = f_{IP/p}(x_{IP}, t) \cdot f_i^{IP}(\beta, Q^2)$$

$\alpha(t) = \alpha_0 + \alpha' t$

$$f_{IP/p}(x_{IP}, t) = \frac{e^{Bt}}{x_{IP}^{2\alpha(t)-1}}$$

Pomeron flux factor
Parametrization inspired by „old“ Regge theory

Pomeron PDF
Obey DGLAP evolution

H1 2006 Fit B ansatz:

$$f_u^{IP} = f_d^{IP} = f_s^{IP} \qquad f_c^{IP} = 0$$
$$f_q^{IP} = f_{\bar{q}}^{IP}$$

Resolved Pomeron model with Fit B predicts zero e+/e- asymmetry in CC

Situation at HERA

- Measurement probably done only for HERA I 1999/2000 data (~ 61 pb^{-1})

H1

$$\sigma_{H1}^{CCdiff} = 0.39 \pm 0.12(stat) \pm 0.07(syst)\,\text{pb}$$

10 events

ZEUS

$$\sigma_{ZEUS}^{CCdiff} = 0.49 \pm 0.20(stat) \pm 0.13(syst)\,\text{pb}$$

6 events

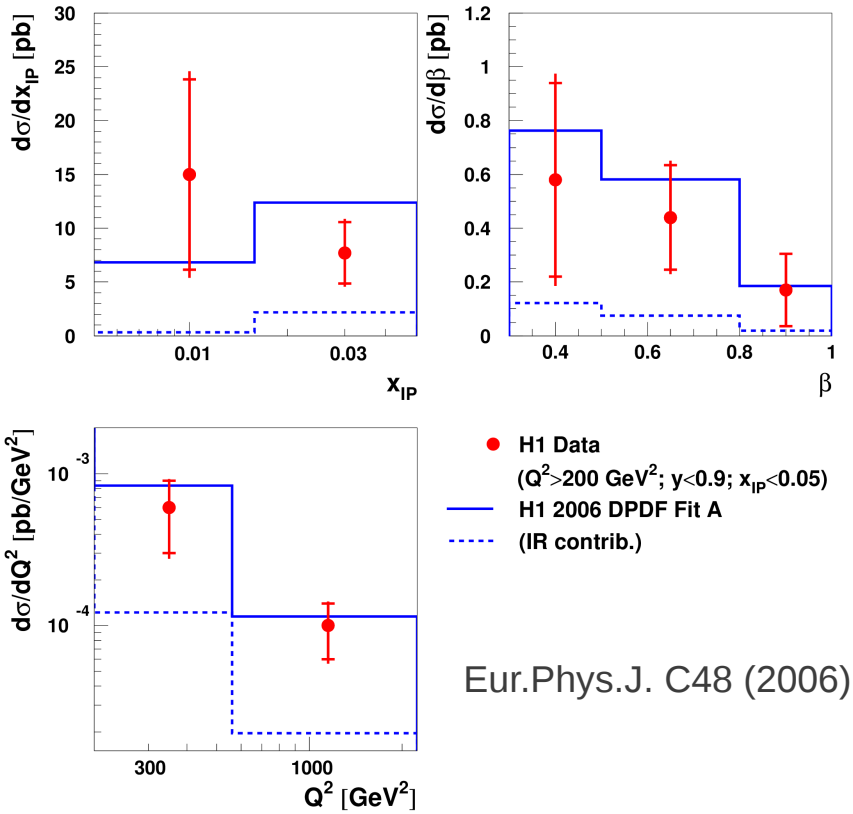
Around 2 % of CC x-section in both cases

Analysis cuts

$$Q^2 > 200\,\text{GeV}^2$$
$$y < 0.9$$
$$x_{IP} < 0.05$$

High Q2 cut to suppress background from diffractive photoproduction

e+/e- asymmetry not studied



Eur.Phys.J. C48 (2006) 715-748

Predictions for LHeC

Calculation performed by MC RAPGAP with H1 2006 Fit B

The same cuts as in HERA measurement

HERA
920+27.5
$\sigma_{H1}^{CCdiff}(\mathrm{MC}) = 0.4\,\mathrm{pb}$
25 events (60pb^{-1})

LHeC
7000+60
$\sigma_{LHeC}^{CCdiff}(\mathrm{MC}) = 10.4\,\mathrm{pb}$
~100,000 events (10 fb^{-1})

Events counts without losses due to detector acceptance

- Presence of Pomeron valence quark clearly visible form e+/e- asymmetry

$$\frac{d\sigma}{dxdy}(e^- p) \propto [(d+s)+(\bar{u})(1-y)^2]$$

$$\frac{d\sigma}{dxdy}(e^+ p) \propto [(\bar{d}+\bar{s})+(u)(1-y)^2]$$

$$\frac{d\sigma}{dxdy}(e^- p) - \frac{d\sigma}{dxdy}(e^+ p) \propto [(d-\bar{d}+s-\bar{s})-(u-\bar{u})(1-y)^2]$$

- Charged asymmetry from ~1% in DPDFs observable at LHeC

Predictions for LHeC Flavour Asymmetry

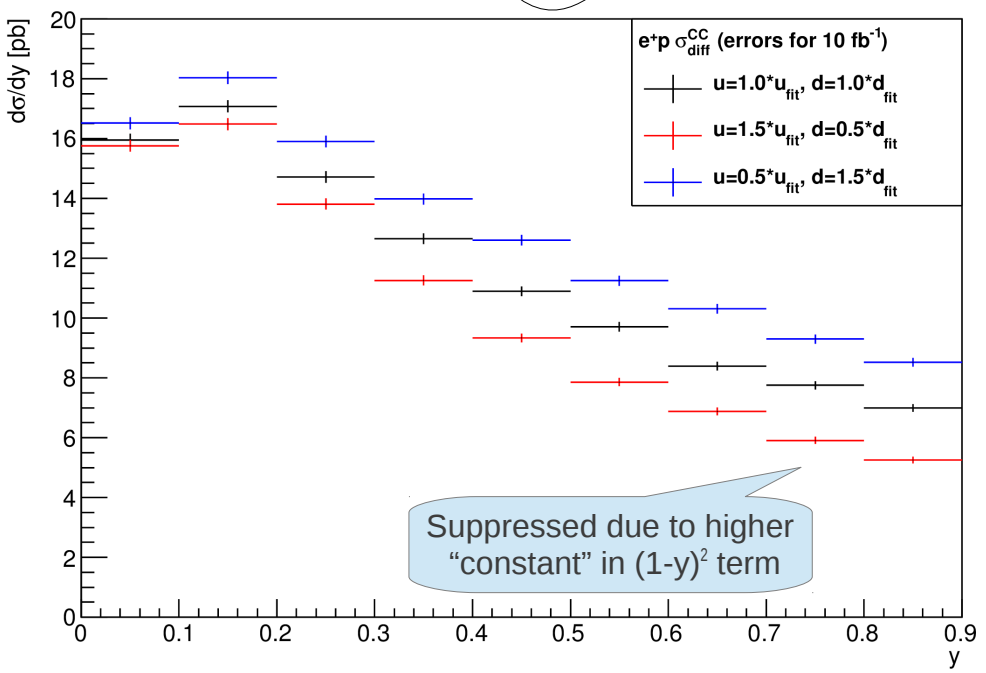
- From shape of y distribution one can distinguish between UP and DOWN quarks

$$\frac{d\sigma}{dxdy}(e^- p) \propto [2+(1-y)^2]q$$

Without variation

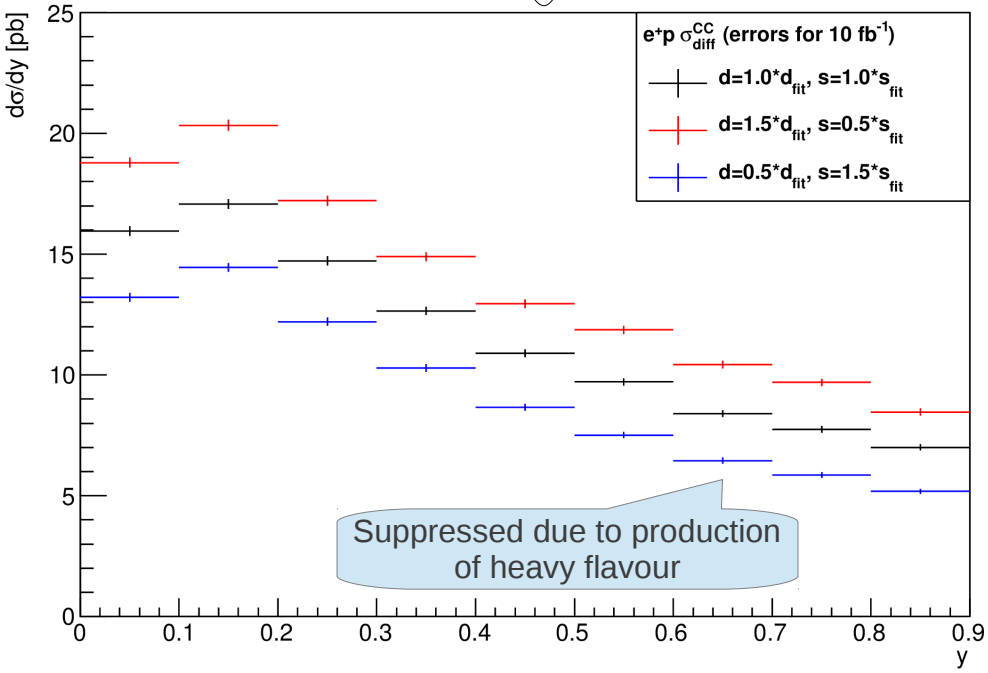
Variation of **u/d**

$$\frac{d\sigma}{dxdy}(e^- p) \propto [(d+s)+(\bar{u})(1-y)^2]$$



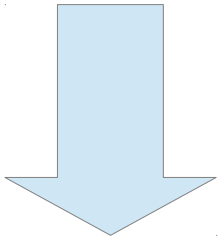
Variation of **d/s**

$$\frac{d\sigma}{dxdy}(e^- p) \propto [(d+s)+(\bar{u})(1-y)^2]$$



Conclusion

- Due to higher luminosity and larger cross section at LHeC energies enormous increase in statistics for diffractive CC
- e^+/e^- asymmetry indicates Pomeron valence quarks
- Pomeron u/d asymmetry observable in shape of y-distribution



LHeC collider opens new area of hard diffraction – CC
New chance to test diffractive factorization