

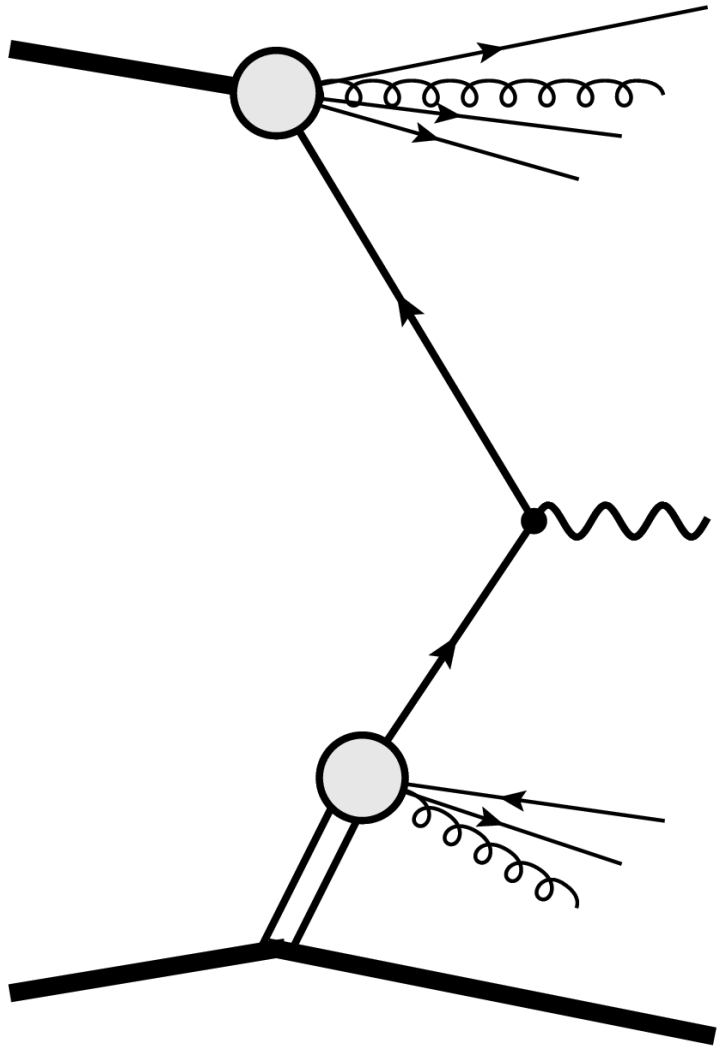
# Diffraction W Production at the LHC

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(IFJ PAN Cracow)*

*28 February 2012*



# Single Diffractive Production



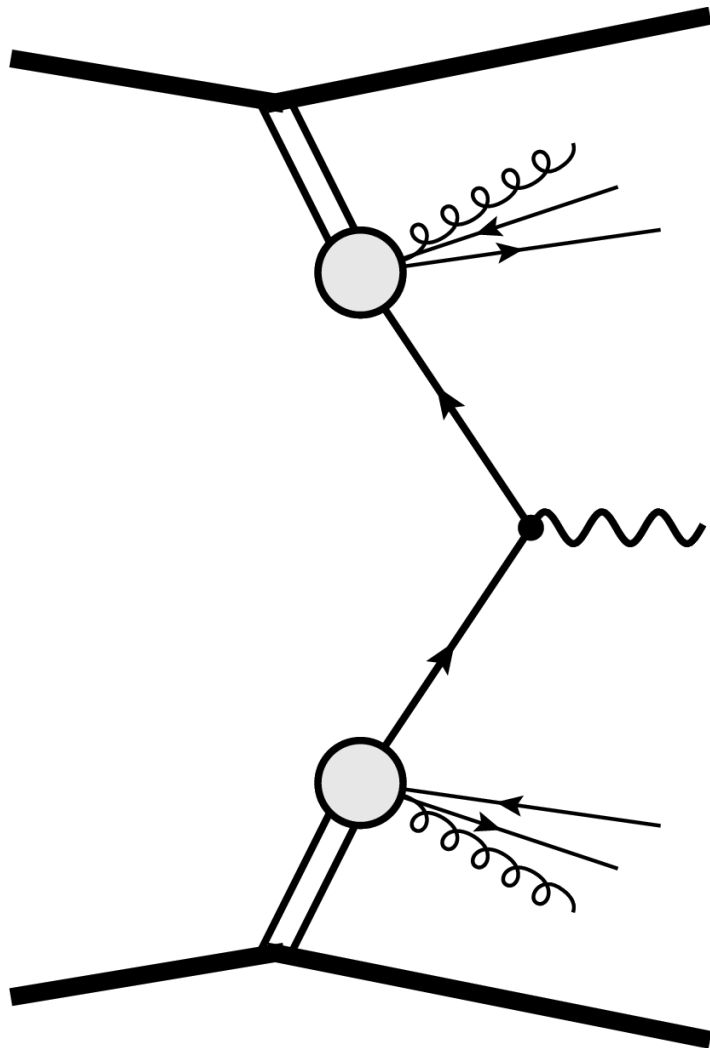
Single Diffractive Production

Measurement of Rapidity Gap Survival Probability for SD processes

Sensitive to quark PDFs of the Pomeron

Measurement possible with Rapidity Gaps and/or AFP detectors

# Central Diffractive Production



Double Pomeron Exchange

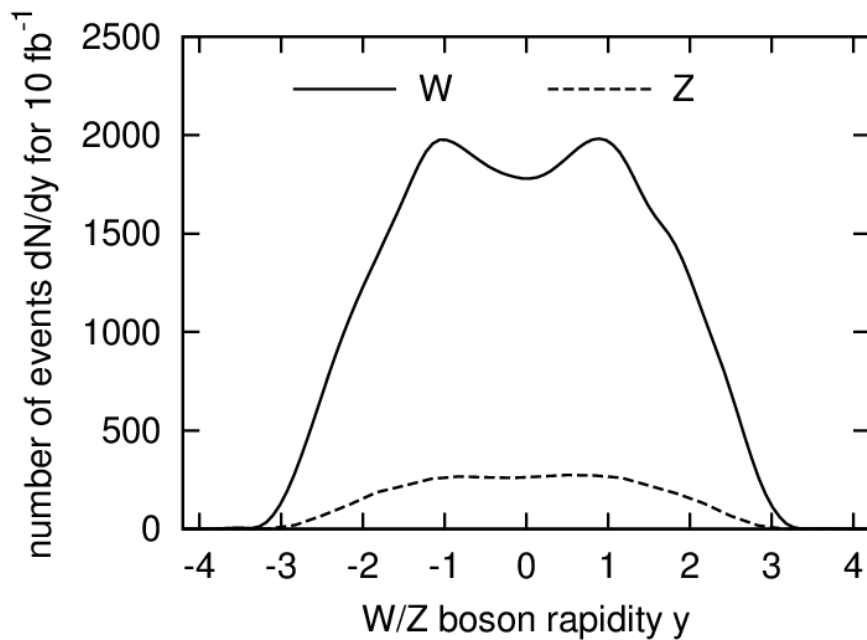
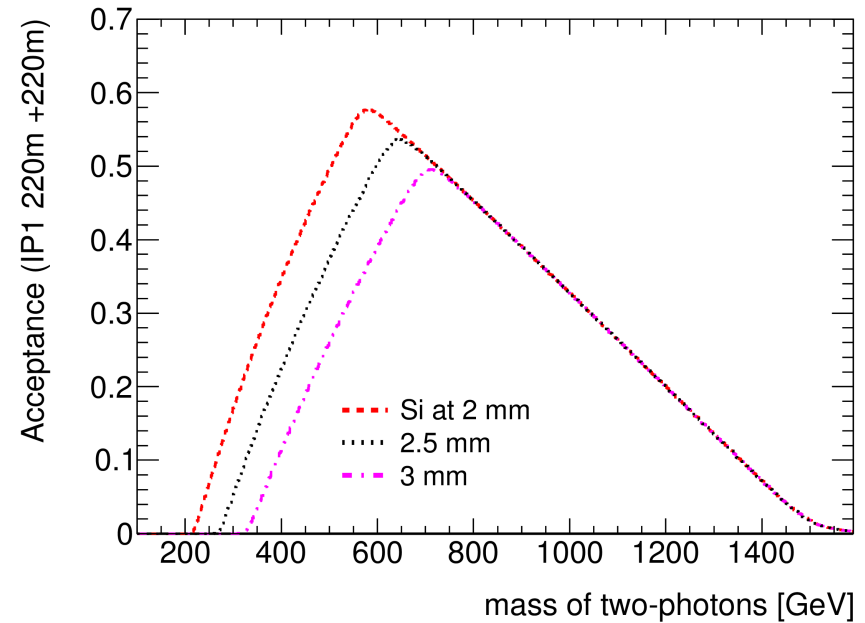
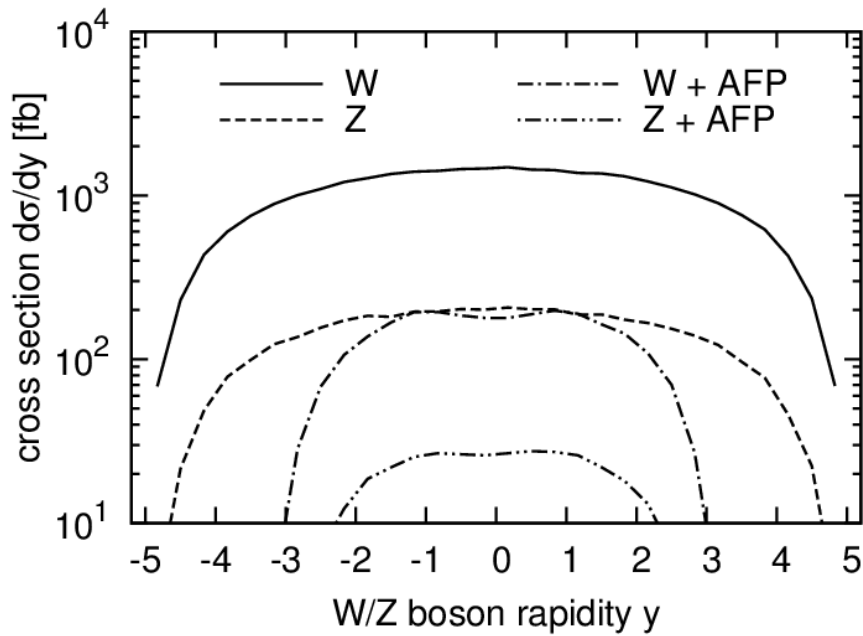
Measurement of Rapidity Gap Survival Probability for DPE processes

Probing diffractive mechanism

Flavour composition of the Pomeron

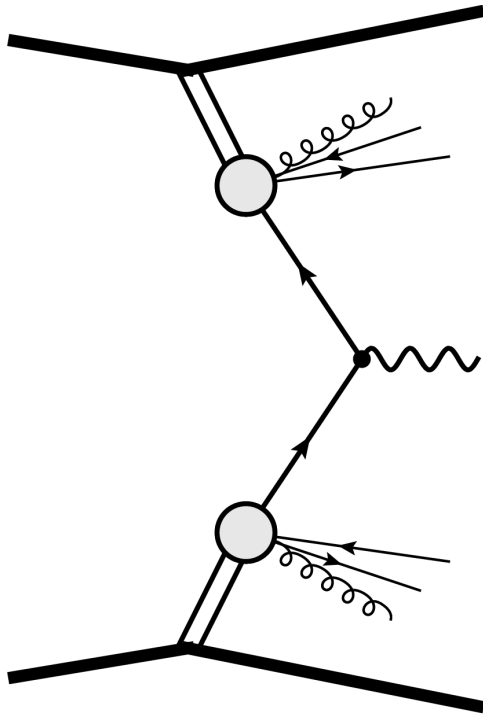
Measurement with AFP

# DPE W/Z Cross Sections



- For W decaying into lepton
- Considerable number of events produced

# Diffractive Mechanism

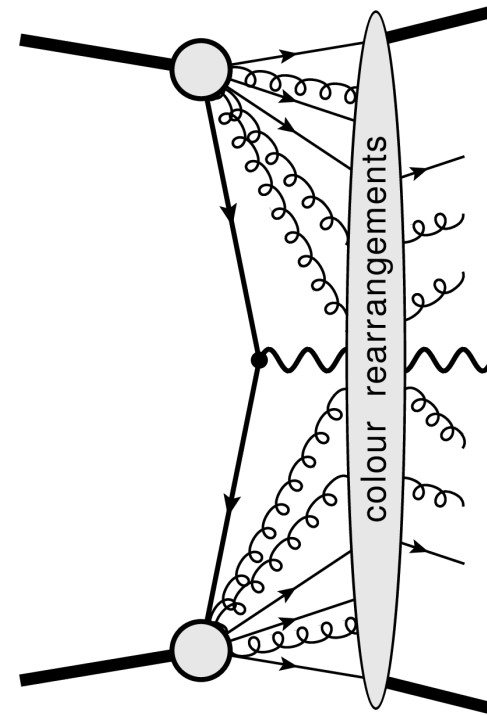


Double Pomeron Exchange

Quarks from Pomeron

Charge and flavour symmetry:

$$u=d=s=\bar{u}=\bar{d}=\bar{s}$$



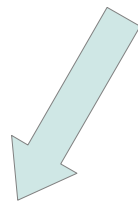
Soft Colour Interactions

Quarks from protons

Diffractive signature due to color rearrangements

# W Charge Asymmetry

$$A = \frac{N_+ - N_-}{N_+ + N_-}$$



## Double Pomeron Exchange

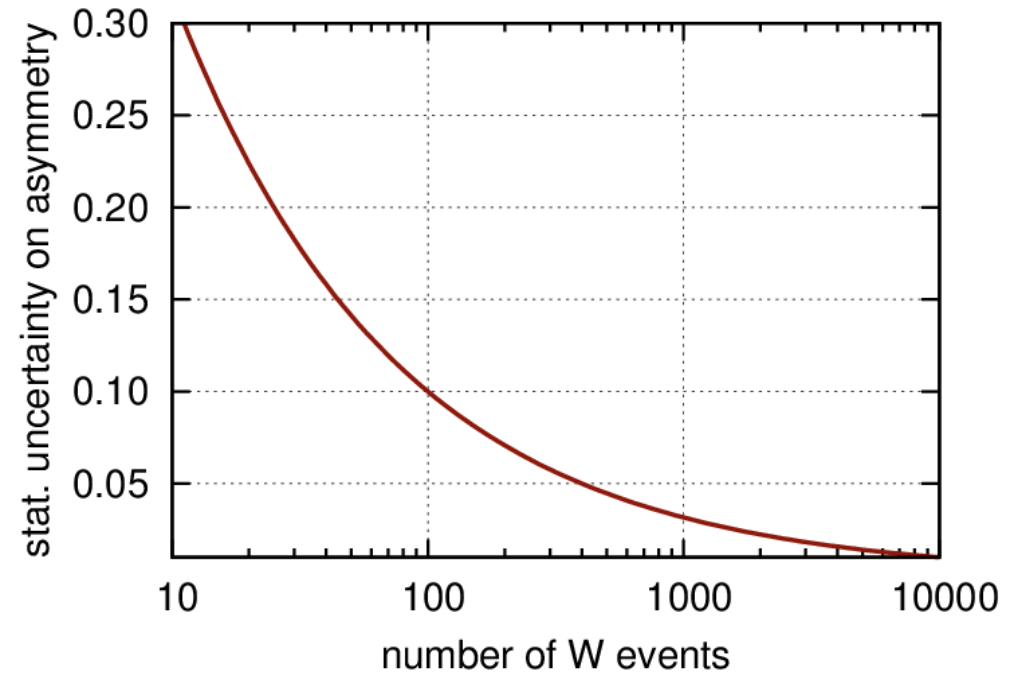
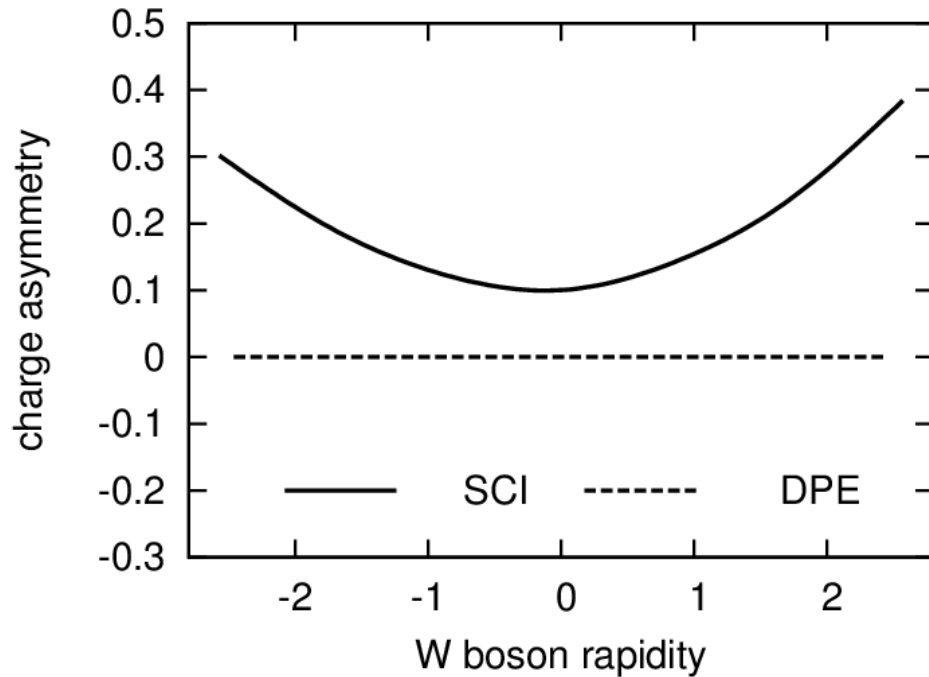
- **A = 0**
- Even without  $u=d=s$  assumption  
( $u=\bar{u}$ ,  $d=\bar{d}$ ,  $s=\bar{s}$  is enough)

## Soft Color Interactions

- **A = 0.14**
- Like in non-diffractive production
- Might depend on the implementation

**Many systematic effects cancel when measuring asymmetry!**

# W Charge Asymmetry



- Total asymmetry:  $A=0$  (DPE),  $A=0.14$  (SCI)
- $\sim 1000$  events to distinguish DPE from SCI

# Flavour Symmetry of the Pomeron

Natural assumption  
for Pomeron model:  
 $u(x, Q^2) = d(x, Q^2) = s(x, Q^2)$

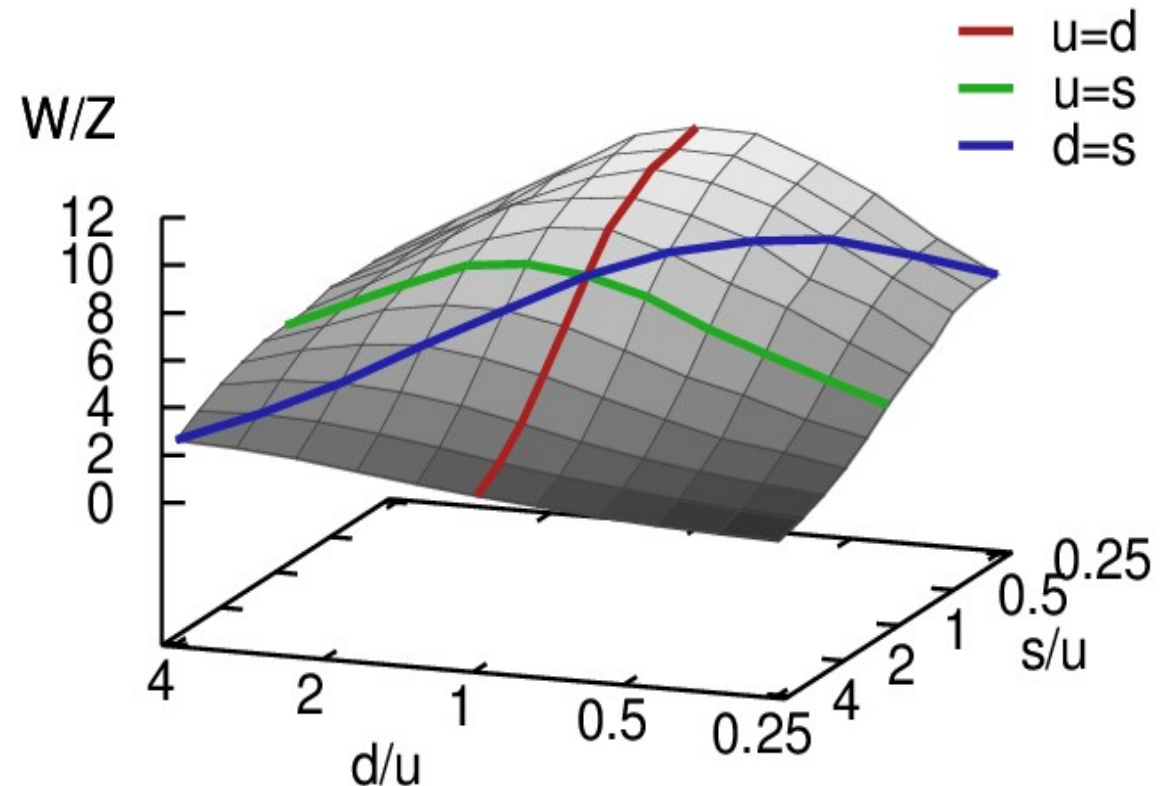
Never tested  
experimentally

HERA measurements  
constrain  $u+d+s$

DPE W and Z at the LHC:

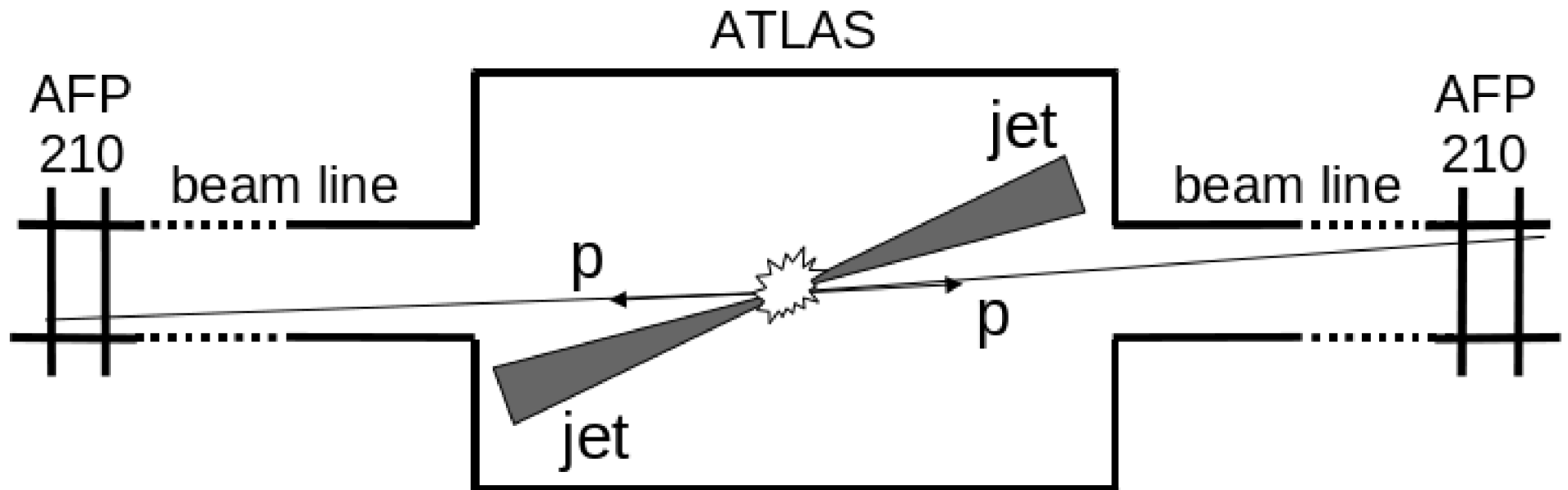
- $W/Z$  cross section ratio is sensitive
- Many systematic effects cancel

K. Golec-Biernat, C. Royon, L. Schoeffel, R.S.  
Phys. Rev. D84 (2011) 114006



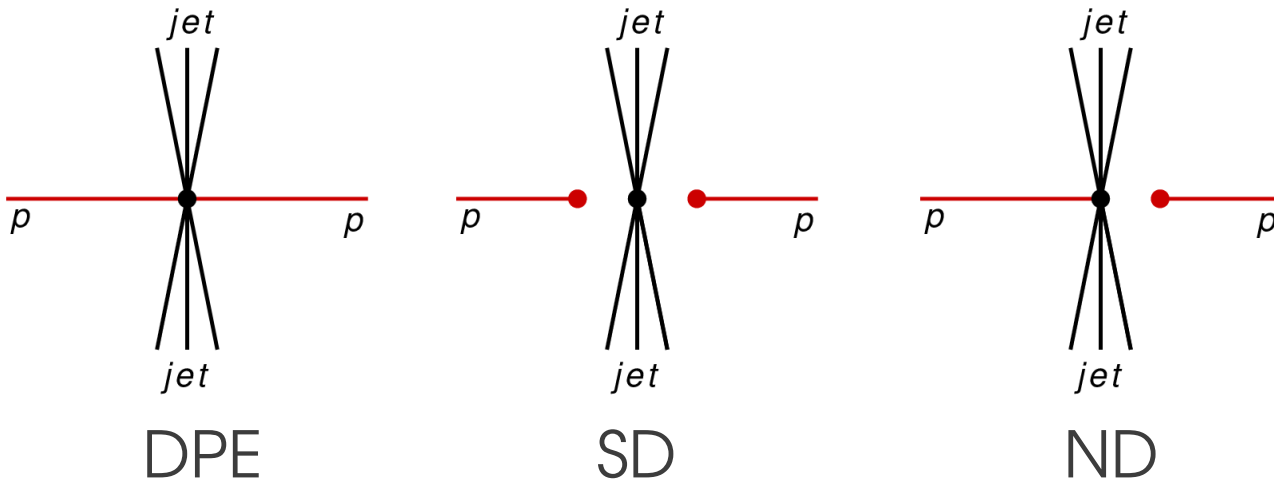


# CD – Measurement Principle

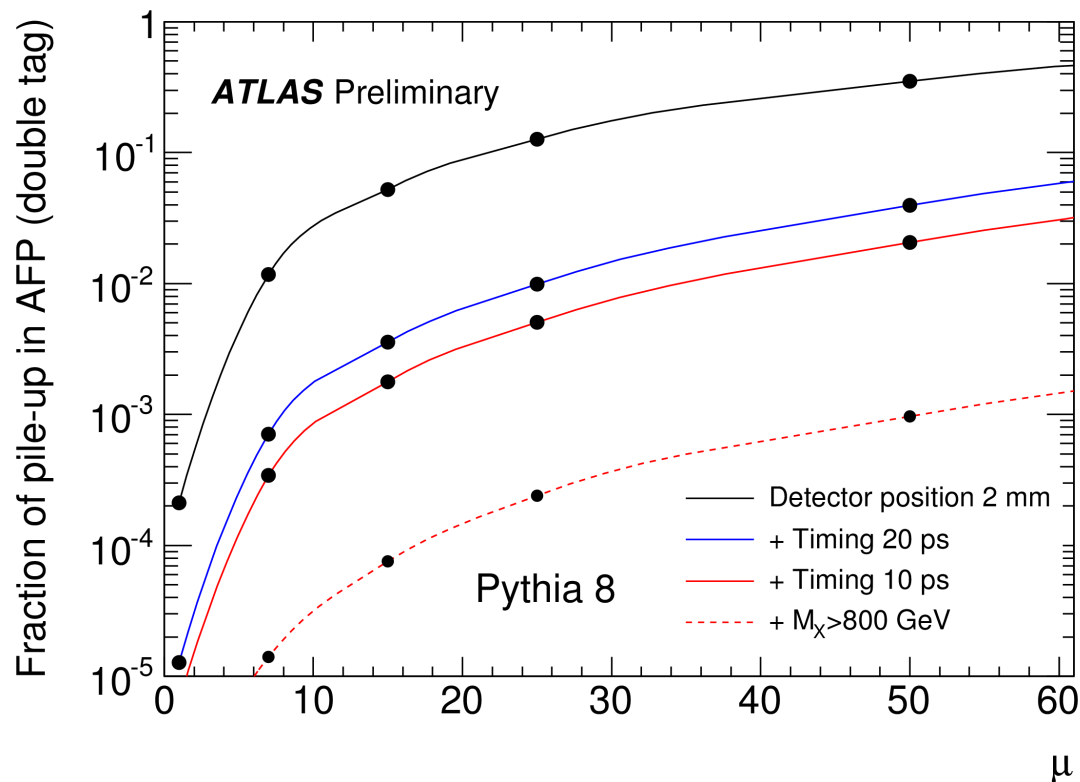


- Lepton + MET in central detector
- Protons tagged in AFP detectors
- Proton arrival time measured at each station and checked if compatible with vertex position

# Experimental Background



Non-diffractive and Single Diffractive can look like DPE due to protons from pile-up



- The smaller pile-up the better
- Time measurement helps to reduce the background

# SD – Experimental Challenges

- Rapidity Gap measurement
- Only tracking detectors can observe gaps in pile-up environment, but limited  $\eta$  range
- Gap in calorimeter spoiled by additional min. bias. interactions
- Large gap can emerge as fluctuation in non-diffractive
- Only particles above some  $p_T$  threshold can be seen
- *See talk by Vlasta on Thursday*
- Better measurement with AFP

# Summary

- Both Single Diffractive and Central Diffractive (DPE) production of  $W$  boson can be measured at the LHC
- Asymmetry in Central Diffractive  $W$  boson production can probe diffractive mechanism
- Additional Central Diffractive  $Z$  can probe flavour composition of the Pomeron
- Measurements are not easy – background from non-diffractive production
- AFP detectors are needed