Annabelle Chuinard - 02/21/2014

LHC Working Group on Forward Physics and Diffraction

Diffractive W Analysis Plans

Who am I???

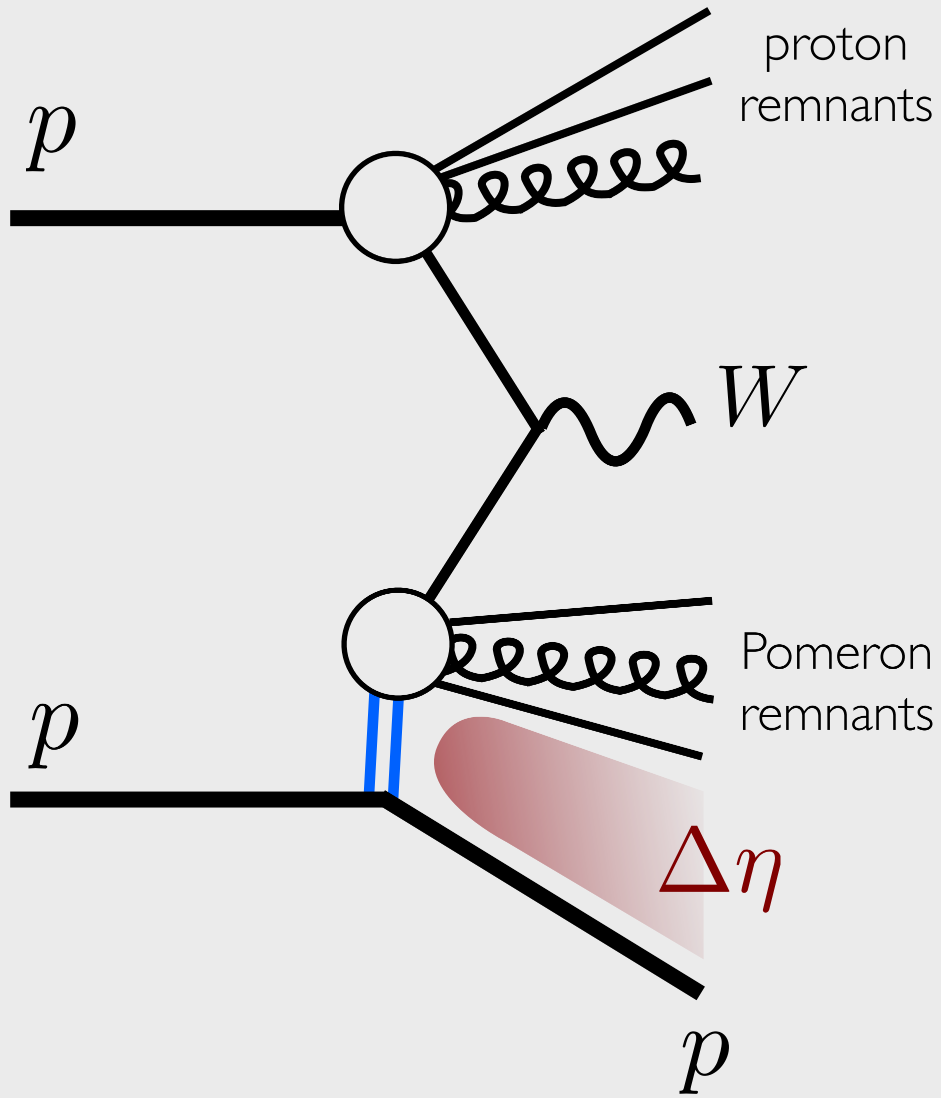
- An(n)abel(le) Chuinard, PhD from McGill University, Montréal
- Previously working in LHCb for my Masters in CH

  CP violation and Charge Asymmetry in $B^{\pm} \to \eta' K^{\pm}$

  Selection optimization for $X(3872) \to J/\psi\pi\pi$
- As joined ATLAS 1 year ago. Now wants to contribute in the Forward Physics group for my thesis!

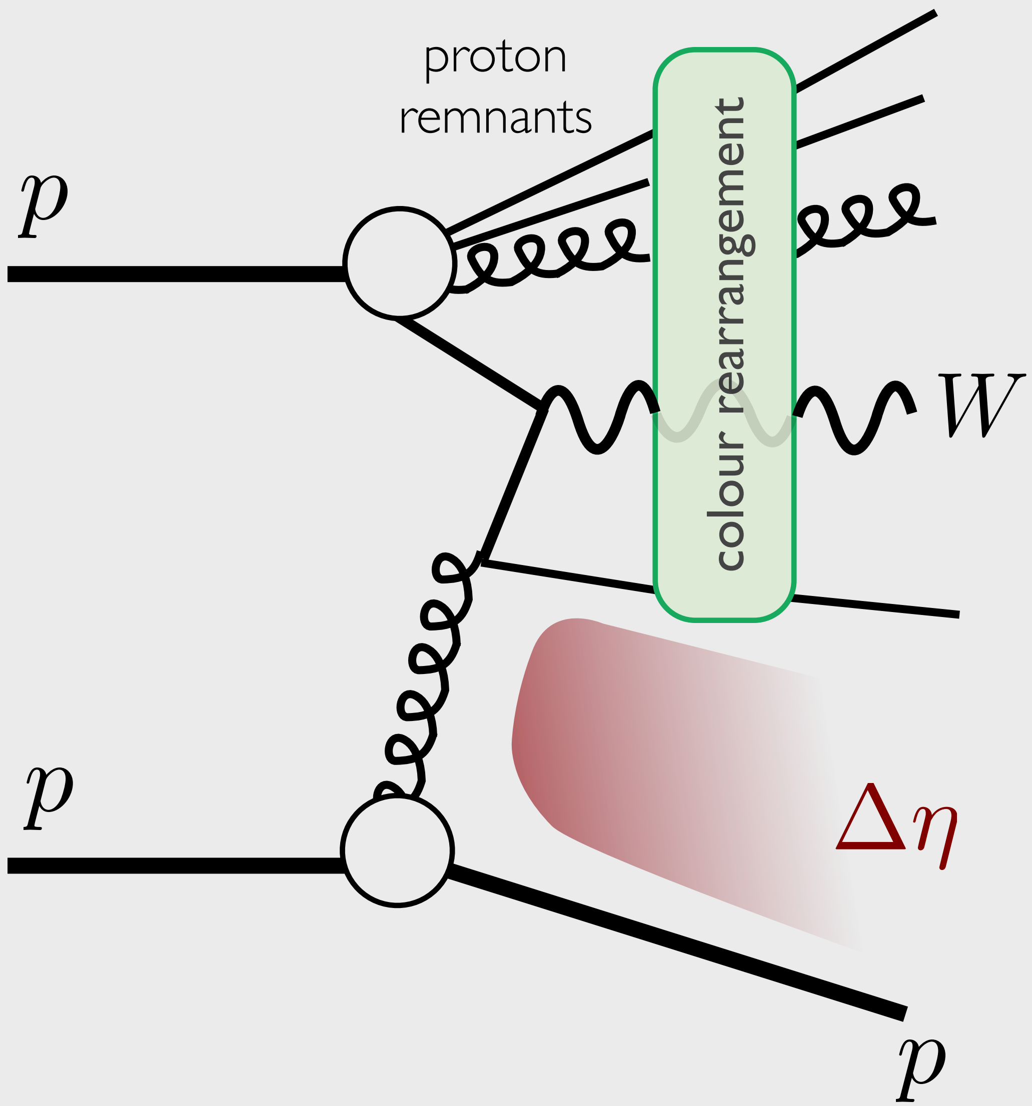
SINGLE DIFFRACTIVE **W** PRODUCTION

Single Pomeron Exchange



Interacting quarks
coming from Pomeron

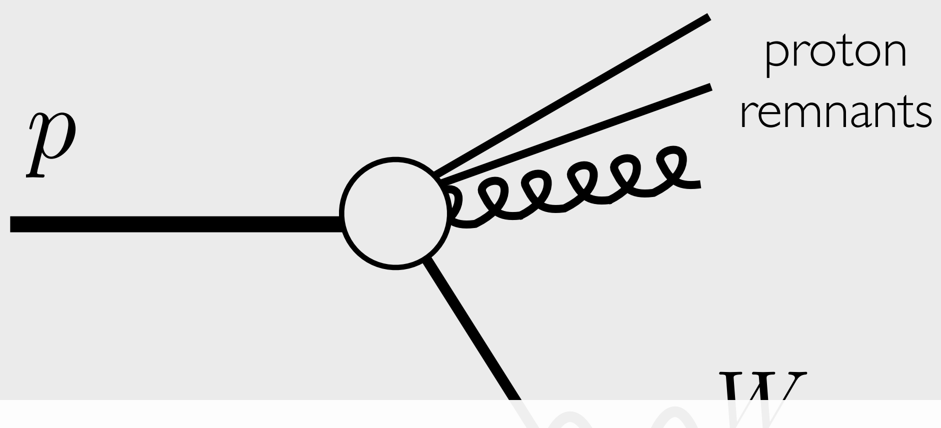
Soft Colour Interaction?

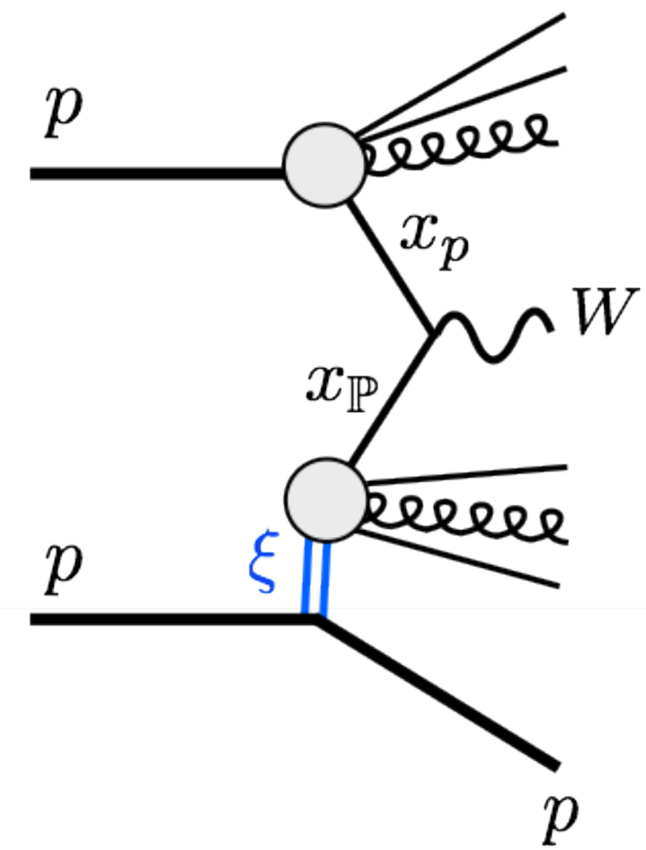


Interacting quarks
coming from **proton**

SINGLE DIFFRACTIVE **W** PRODUCTION

Single Pomeron Exchange





Rapidity Gap Survival Probability

Diffractive Pomeron PDF

Non Diffractive Proton PDF

$$d\sigma = S^2 \cdot \underbrace{\Phi_{\mathbb{P}}(\xi, t) \cdot f_{\mathbb{P}}(x_{\mathbb{P}}/\xi, \mu^2)} \cdot f_{\mathrm{PDF}}(x_p, \mu^2) \cdot d\sigma_{\mathrm{hard}}(x_{\mathbb{P}}, x_p, \mu^2)$$

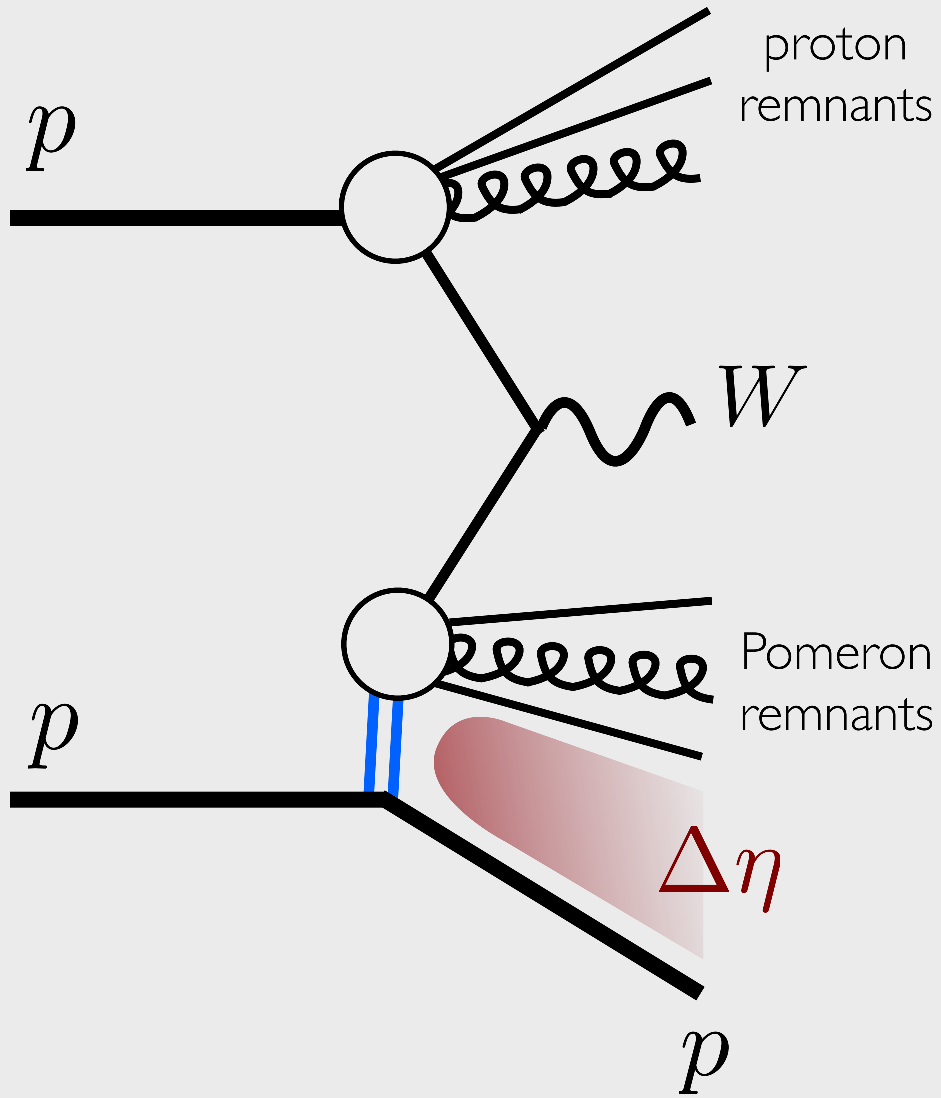
Pomeron flux

Pomeron PDF

Cross-section for parton-parton hard interaction

SINGLE DIFFRACTIVE **W** PRODUCTION

Single Pomeron Exchange



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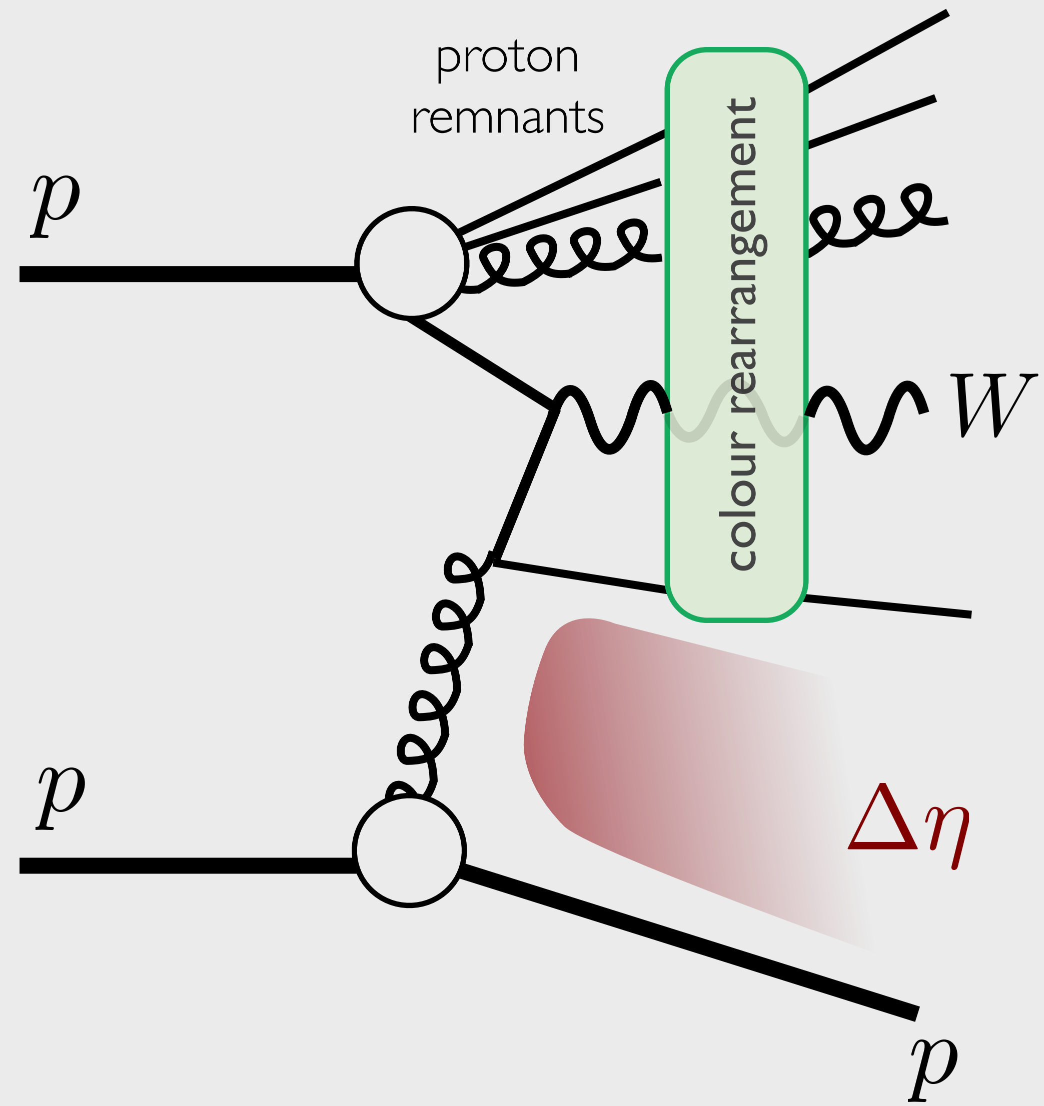
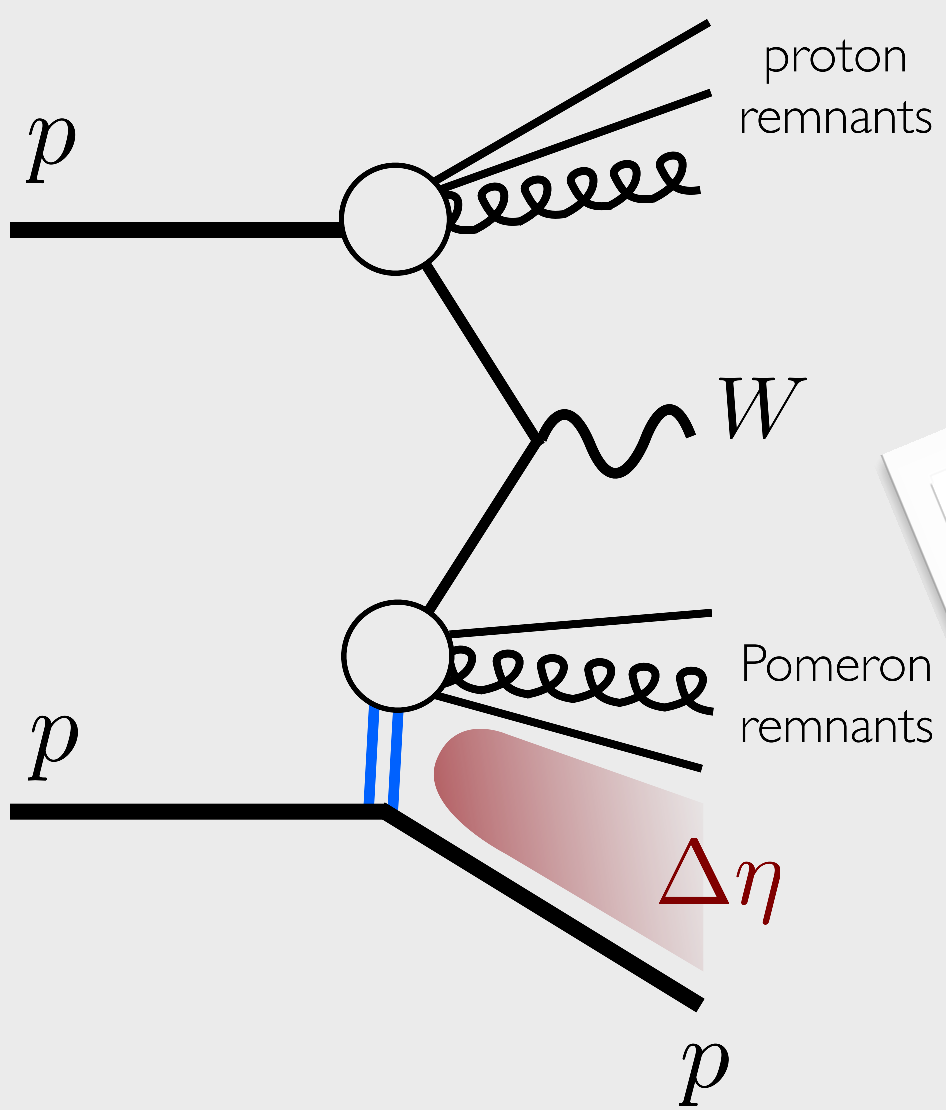


Interacting quarks
coming from **proton**

SINGLE DIFFRACTIVE **W** PRODUCTION

ATLAS EXPERIMENT

Single Pomeron Exchange



Interacting quarks coming from **Pomeron**

Soft Colour Interaction?

UPPSALA UNIVERSITET

W Charge Asymmetry to test the Pomeron Model

ATLAS EXPERIMENT

$$\mathcal{A} = \frac{N^+ - N^-}{N^+ + N^-}$$

Systematic errors cancel out

N^+: number of W^+ (related to the differential cross-section of prod. of W^+)

N^-: ....

$$\frac{d\sigma_{W^+}}{dy d\xi} \propto (u(x_p) + \bar{d}(x_p)) \cdot f_{\mathbb{P}}(x_{\mathbb{P}}/\xi)$$

$$\frac{d\sigma_{W^-}}{dy d\xi} \propto (d(x_p) + \bar{u}(x_p)) \cdot f_{\mathbb{P}}(x_{\mathbb{P}}/\xi)$$

if Single Pomeron Exchange...

Probe the flavour content of the Pomeron.

$$\text{If} \left.\begin{array}{l} u^D = \bar{u}^D \\ d^D = \bar{d}^D \\ s^D = \bar{s}^D \end{array}\right\} \mathcal{A} = 0$$

Other scenarios (compatible with HERA):

$$\left.\begin{array}{l} u^D/d^D = 2 \\ u^D/d^D = 0.5 \end{array}\right\} \mathcal{A} \neq 0$$

if Soft Colour Interaction...

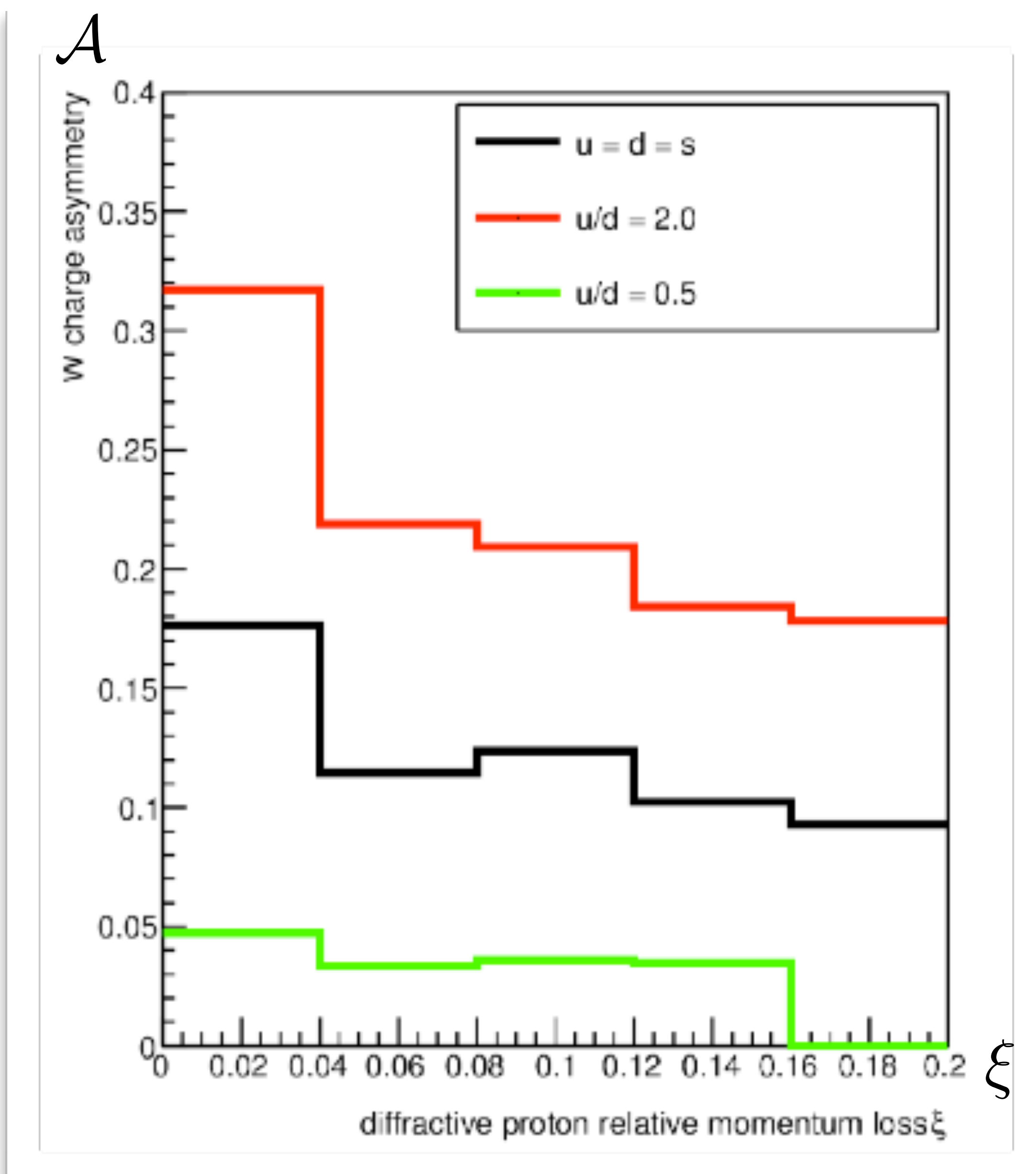
Diffractive structure happens after hard W production.

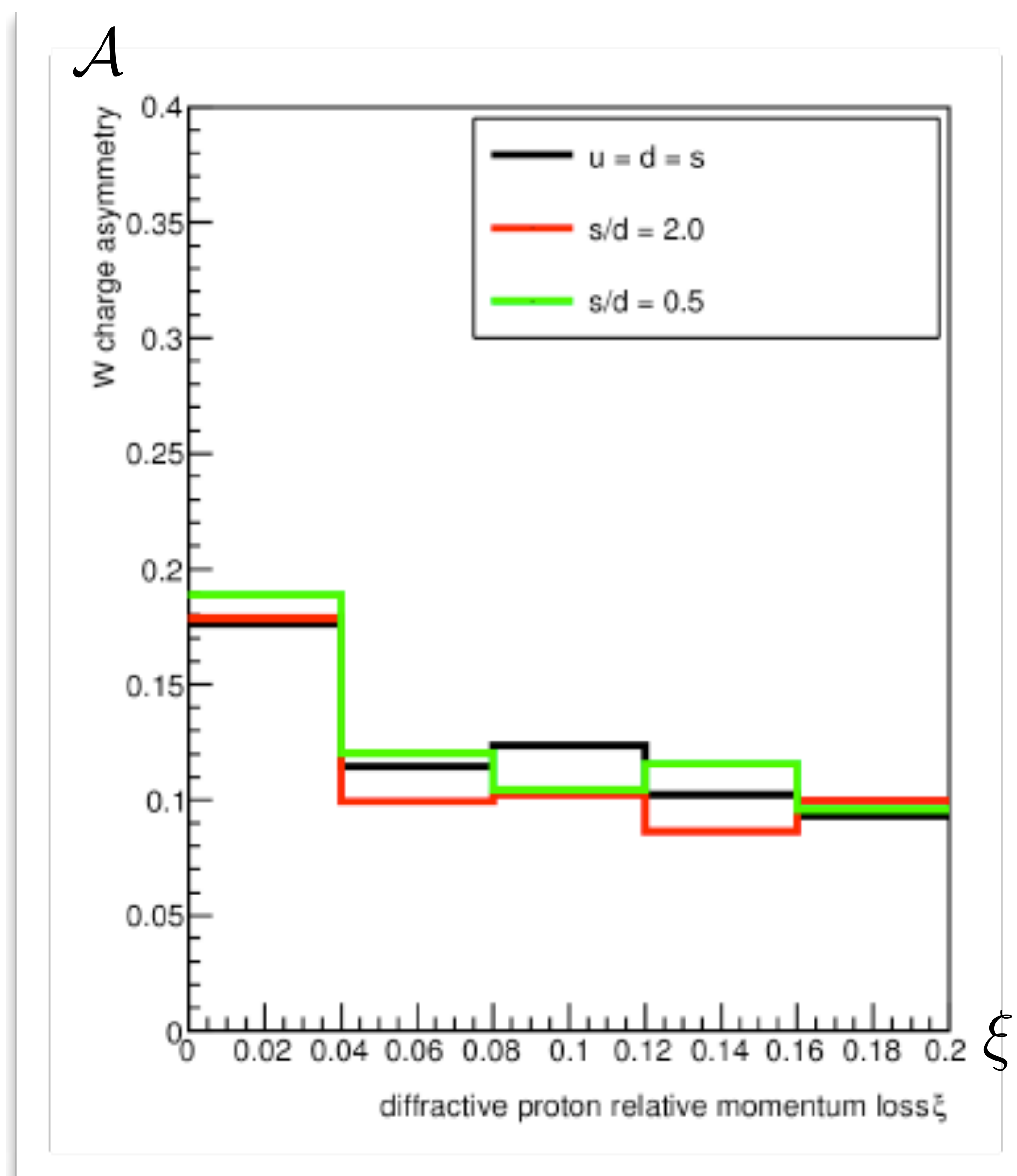
➡ Should get the same value as for non-diffractive processes

$$\mathcal{A} \neq 0 \qquad \mathcal{A} \approx \mathcal{A}_{ND}$$

W Charge Asymmetry to test the Pomeron Model

Sensitivity to Pomeron DPDFS to be tested with FPMC:





Rafal Staszewski, from Talk: *Single Diffractive W production* 13/07/18

Challenges and perspectives

Experimentaly...

- Rapidity Gap measurement (statistical fluctuations in ND events)
- Pile-up: need to be handled
- QCD background from ND (polluting minimum bias observed in calorimeters)
  - ➡ Need good vertex reconstruction
  - ➡ Careful selection
  - ➡ Need proton tagging and tof (AFP)

On the theory side...

- No universal model for Pomeron
  - ➡ Need to understand Pomeron parton densities