Measurement of the Cross-Section for the Production of a W Boson in Association with *b*-jets in *pp* Collisions at √*s* = 7 TeV with the ATLAS Detector

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Phenomena
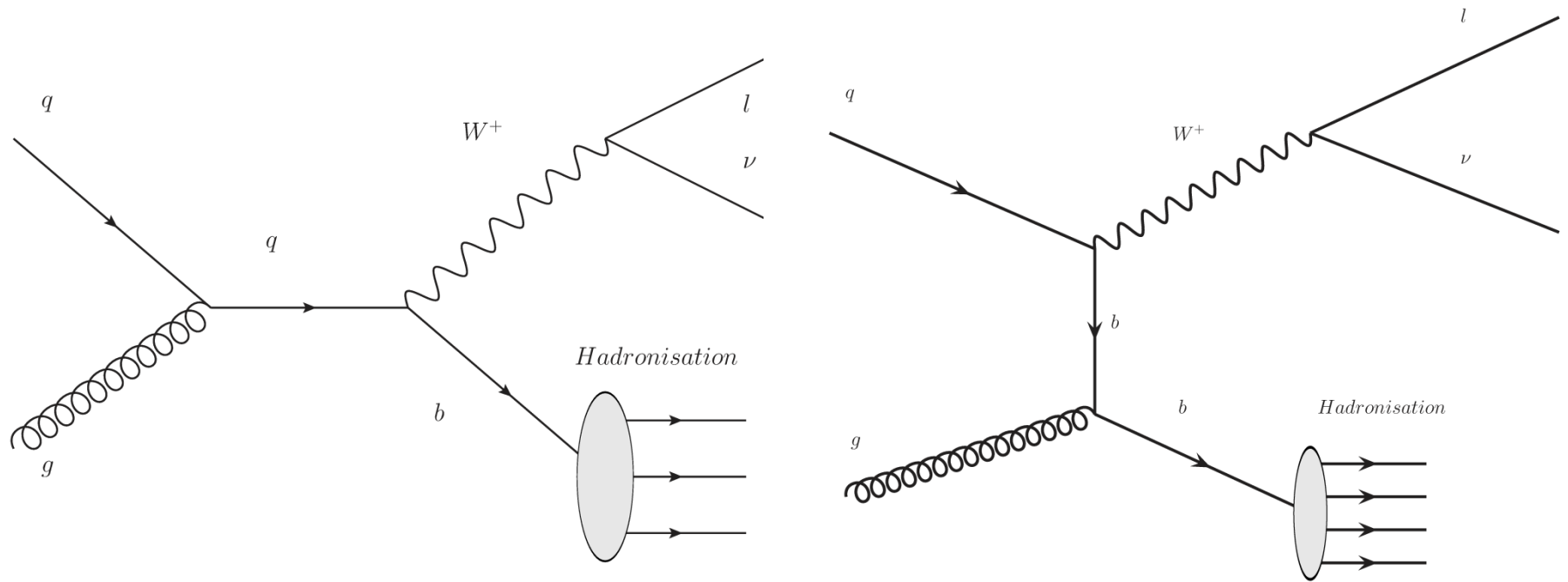
NOT from top production

Motivation
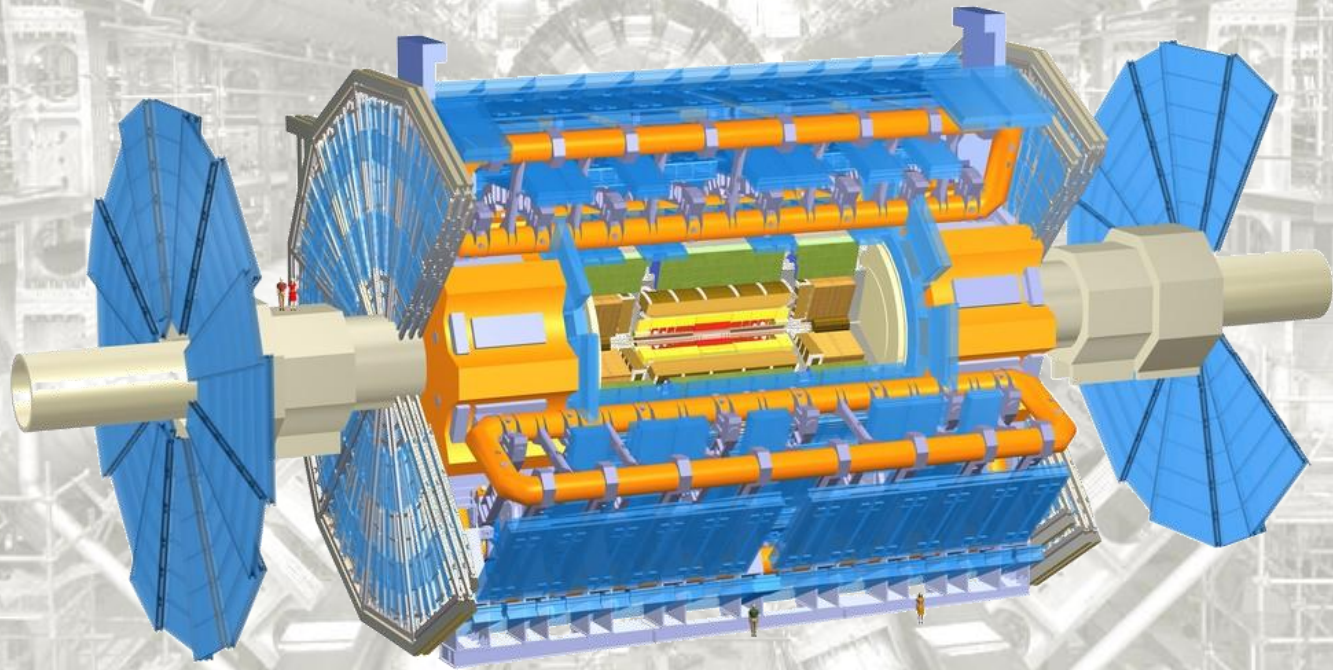
- Test of QCD
- Identify background to:
  - Higgs boson production
  - Production of single and pair of top quark
  - New physics!
- Previous measurement revealed a larger cross-section than expected

How?

Using ATLAS...

Isolating W + b Events

- 1 or 2 jets only
  - Excluding leptonic jets
  - Only one *b*-jet
- Single lepton
  - Momentum threshold: $p_T > 20$ GeV
- Missing energy

Reconstruction

- W reconstructed from:
  - Lepton transverse momentum
  - Transverse missing energy
- b reconstructed with efficiency 35 ± 6-13%
- Other jets (light and c) can be reconstructed
  - 0.3% of light-jets misreconstructred
  - 8% of c-jets misreconstructed

Background

- c- and light-flavour- jets
- Top quark pair
- Single top
- Multi-jets (and other EW processes)
- Z+jets
- Di-bosons
- W→ τν

Background Summary

	$W \to \mu\nu$, 1-jet		$W \to \mu\nu$, 2-jet	
	Pred.	Fit result	Pred.	Fit result
$W+b$	25	28 ± 13	26	62 ± 18
$W+c$	108	170 ± 20	45	54 ± 19
$W+$light	38	21.2 ± 9.9	20	21 ± 10
Multi-jets	8	-	10	-
$t\bar{t}$	11	-	44	-
Single top	17	-	23	-
Other backgrounds	3.9	-	2.5	-
Total Predicted	212	-	170	-
Data	261	-	217	-

	$W \to e\nu$, 1-jet		$W \to e\nu$, 2-jet	
	Pred.	Fit result	Pred.	Fit result
$W+b$	18	33 ± 12	19	38 ± 14
$W+c$	84	105 ± 18	36	24 ± 15
$W+$light	30	22 ± 10	17	14.4 ± 7.7
Multi-jets	10	-	5.8	-
$t\bar{t}$	8.1	-	33	-
Single top	14	-	18	-
Other backgrounds	1.9	-	2.1	-
Total Predicted	167	-	131	-
Data	194	-	136	-

Systematic Uncertainties

- *b*-tagging efficiency
- m_{SV} (mass-of-secondary-vertex) templates :
c- and b-jets
- Top pair : lack of statistics
- Signal modelling : parton shower
- Multi-jet: lack of statistics
- Z+ jets + di-boson : integrated luminosity

Uncertainty Summary

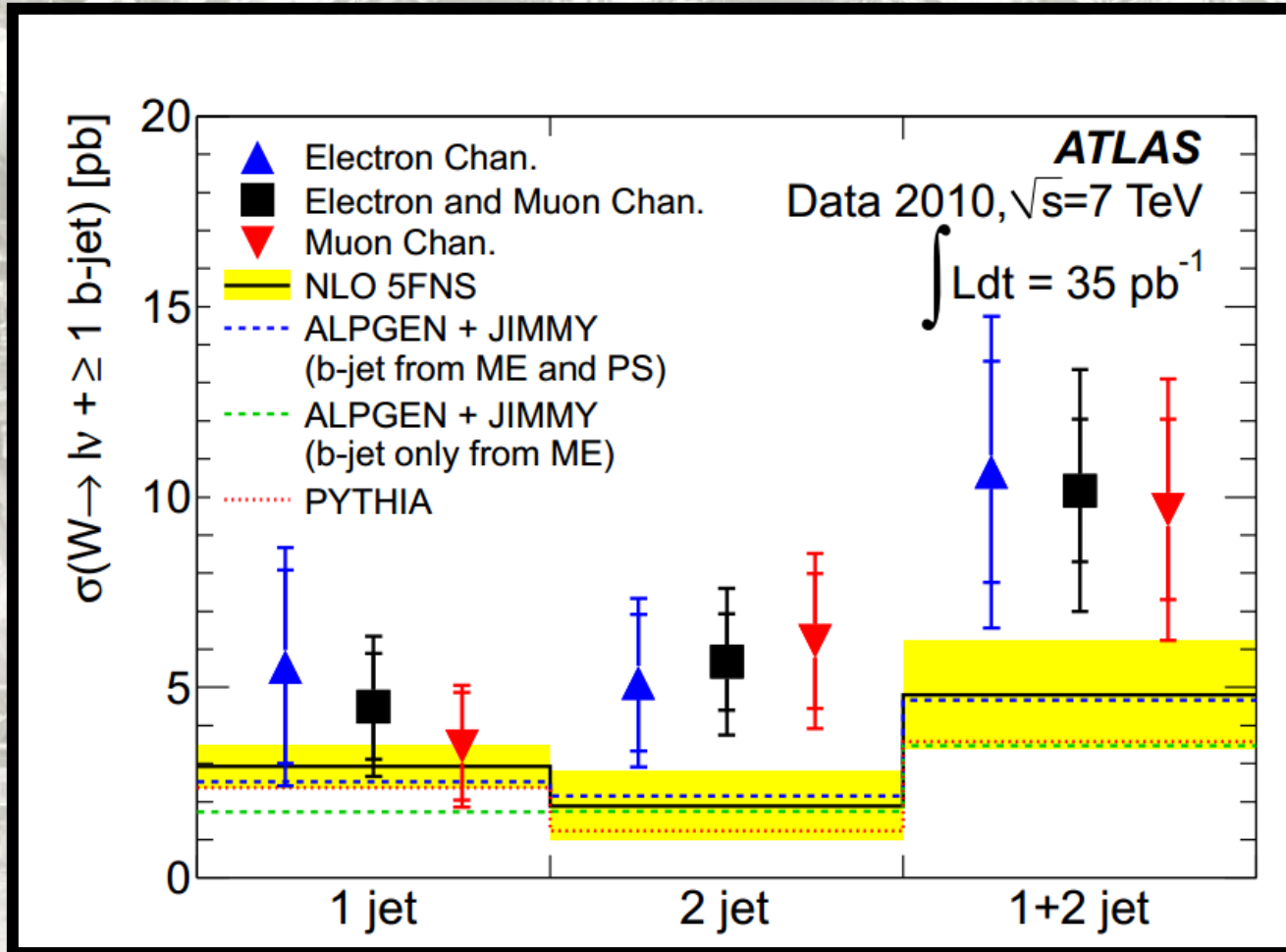|	1 jet			2 jet			1+2 jet		
Fiducial cross section [pb]	μ	e	μ & e	μ	e	μ & e	μ	e	μ & e
Measured cross section	3.5	5.5	4.5	6.2	5.1	5.7	9.7	10.7	10.2
Statistical uncertainty	1.6	2.1	1.3	1.8	1.9	1.3	2.4	2.8	1.9
Systematic uncertainty	1.1	1.7	1.3	1.5	1.5	1.4	2.4	3.0	2.6
Breakdown of systematic uncertainty [%]									
b-tag efficiency	15	14	14	10	10	10	11	12	12
Template shapes	16	13	12	10	12	10	11	11	10
$t\bar{t}$	9	6	7	12	16	13	11	11	11
Single top	10	6	8	4	6	5	7	6	6
Signal modeling	9	8	9	10	10	10	9	9	9
Multi-jets	7	18	11	4	8	4	5	13	7
Jet uncertainties	9	6	7	7	10	8	7	7	7
Lepton uncertainties	3	5	3	2	5	3	2	5	3
$E_{\mathrm{T}}^{\mathrm{miss}}$	1	1	1	2	2	1	1	1	1
Luminosity	5	5	5	4	5	5	5	5	5
Multiple interactions	5	4	5	3	3	3	3	4	3

Results

Experimental Results

- W + b jet cross section found to be 10.2 pb

- ± 1.9 statistical

- ± 2.6 systematic

- Higher than predicted

- However, still within 1.5 σ

Theoretical Predictions

- According to F. Caola, the calculated cross section is 4.8 pb

- $^{+1.2}_{-0.7}$ (scale) $^{+0.3}$ (PDF)

$^{+0.3}_{-0.2}$ (m_b) $\pm$ 0.3 (non-pert.)

- ALPGEN results : 4.7 pb

- $\pm$ 0.1 statistical

Conclusion

Questions ?

I FOUND THE HUGS BISON

Meanwhile at CERN ...