High-mass WW Scattering Status

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(standing in for Adam Davison)

Artemis 1st Annual Meeting

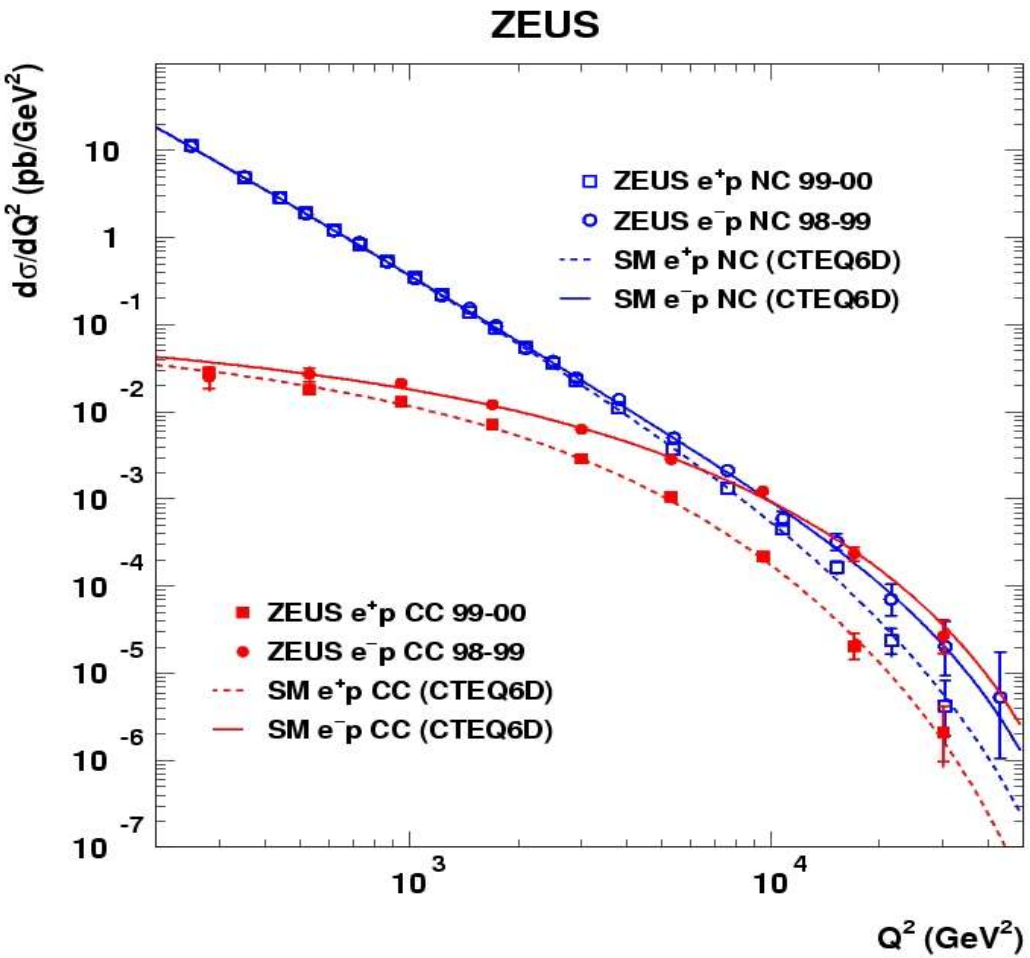
Chalkidiki, Thessaloniki, 28th Sept 2007

Outline

- Physics Reminder
- Hadronic W reconstruction
- Forward jets
- Trigger studies
- Plans

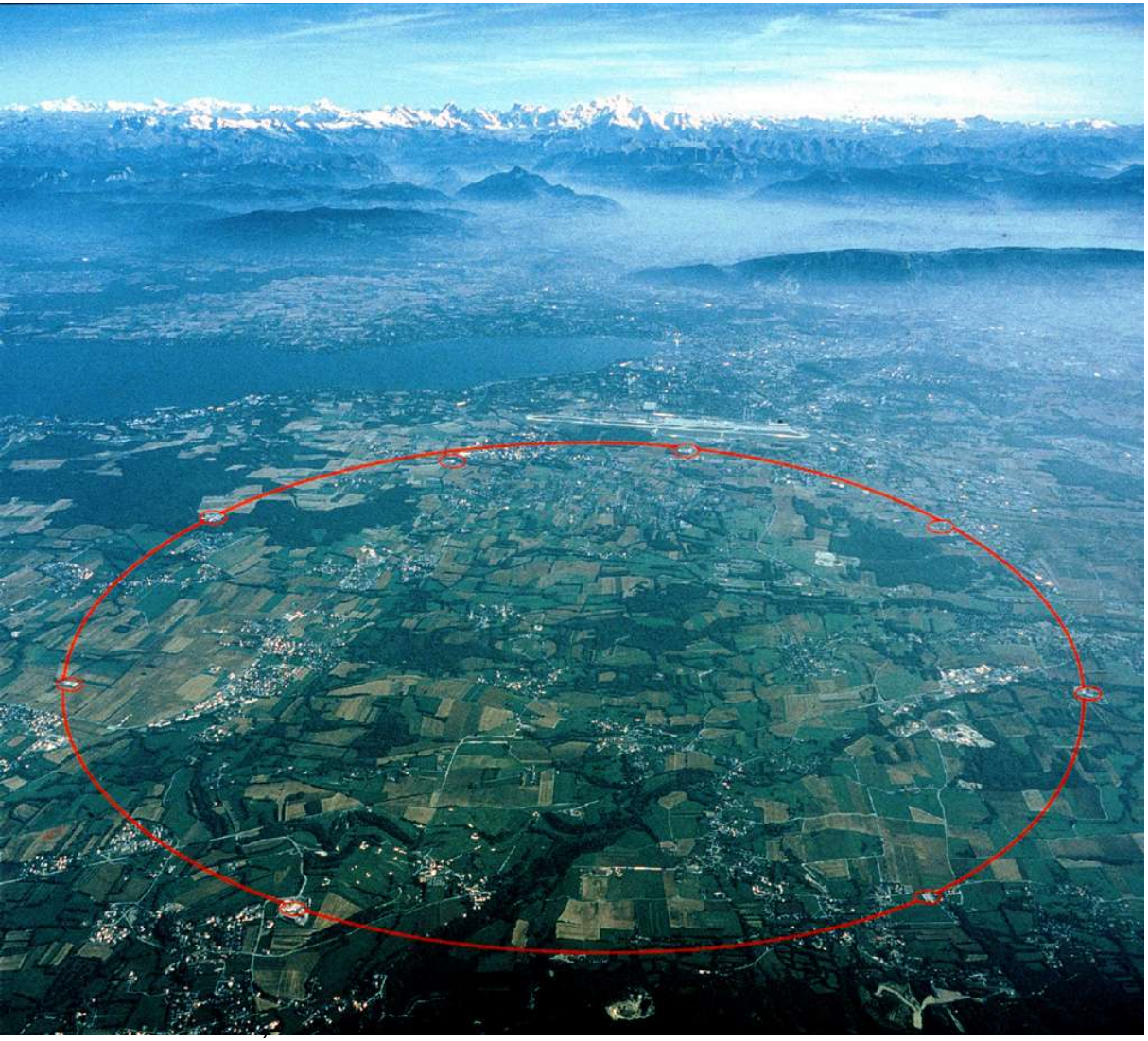
UCL/Artemis: *JMB, AD, Erkcan Ozcan, Peter Sherwood*
Others: *Montreal, Glasgow, IHEP, Dresden, Wisconsin...*

Physics Reminder



- Electroweak symmetry breaking
  - W, Z have a high mass
  - Virtual W and Z are rarer at low energies than virtual photon
  - This is the reason the weak force is weak..
- Electroweak "unification" at high energies

Physics Reminder



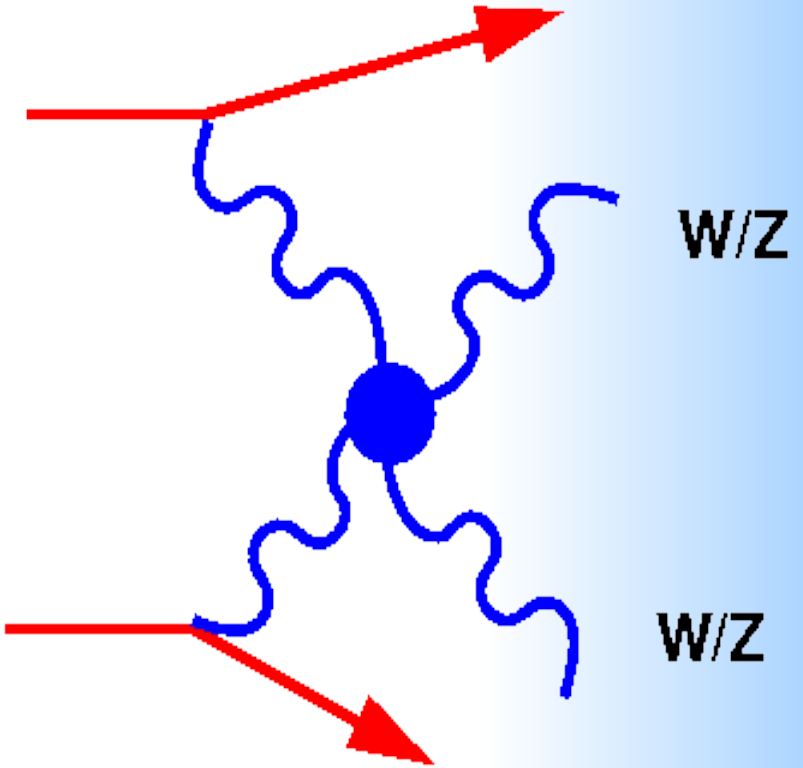
- Why are the W and Z so heavy when the photon is light?
- To find out, need an experiment with (more than) enough energy to study the region above unification.
- i.e. LHC

Physics Reminder

- In gauge theories, we are not at liberty to just invent stuff.
  - Standard Model hangs together very beautifully.
  - Adding arbitrary mass breaks the symmetries which make the SM work at all (non-renormalisable)
  - In the standard model, the Higgs mechanism gives the mass in a way which works.
- If there's no Higgs, expect problems somwhere
  - should be seen first in WW scattering -->

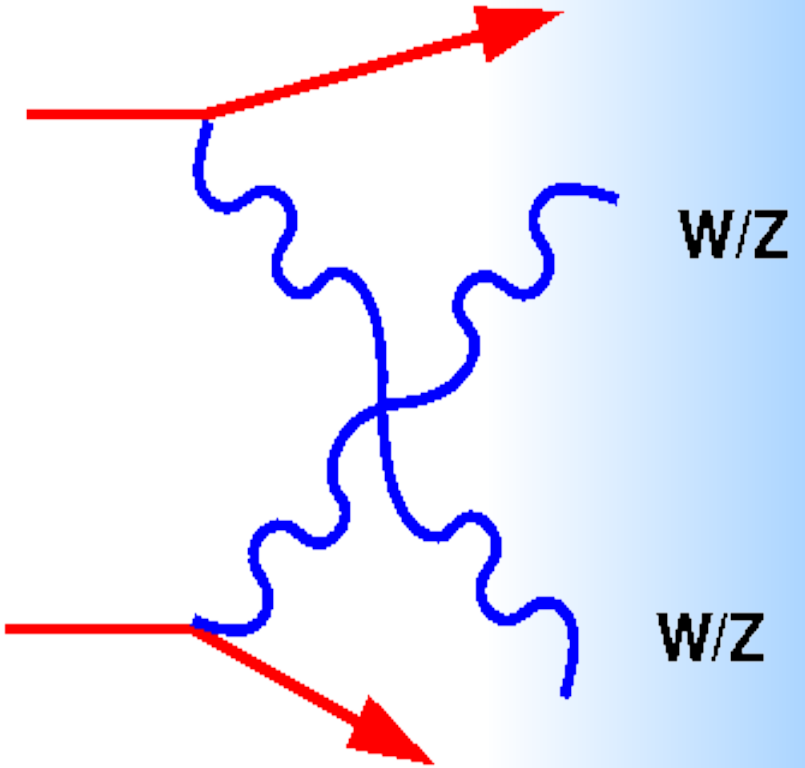
Vector Boson Scattering

- W radiated from a quark in each proton.
  - Scatter off each other.
- Standard Model prediction for the stuff in the blue circle:



Vector Boson Scattering

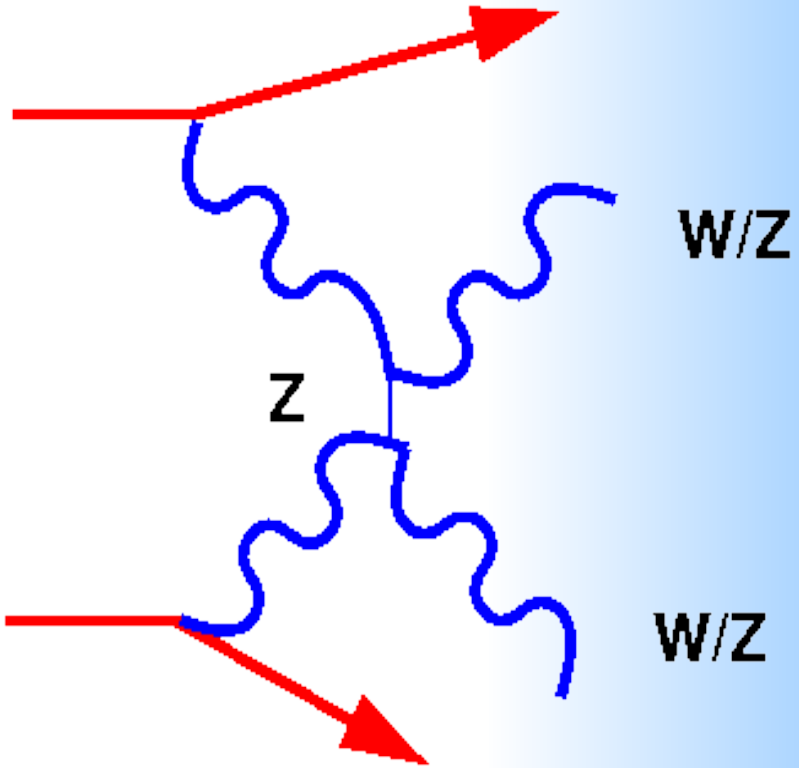
- W radiated from a quark in each proton.
  - Scatter off each other.
- Standard Model prediction for the stuff in the blue circle
  - quartic WWWW coupling



Vector Boson Scattering

W and Z inside the proton

- W radiated from a quark in each proton.
  - Scatter off each other.
- Standard Model prediction for the stuff in the blue circle
  - quartic WWWW coupling
  - ZWW coupling



Vector Boson Scattering

- W radiated from a quark in each proton.
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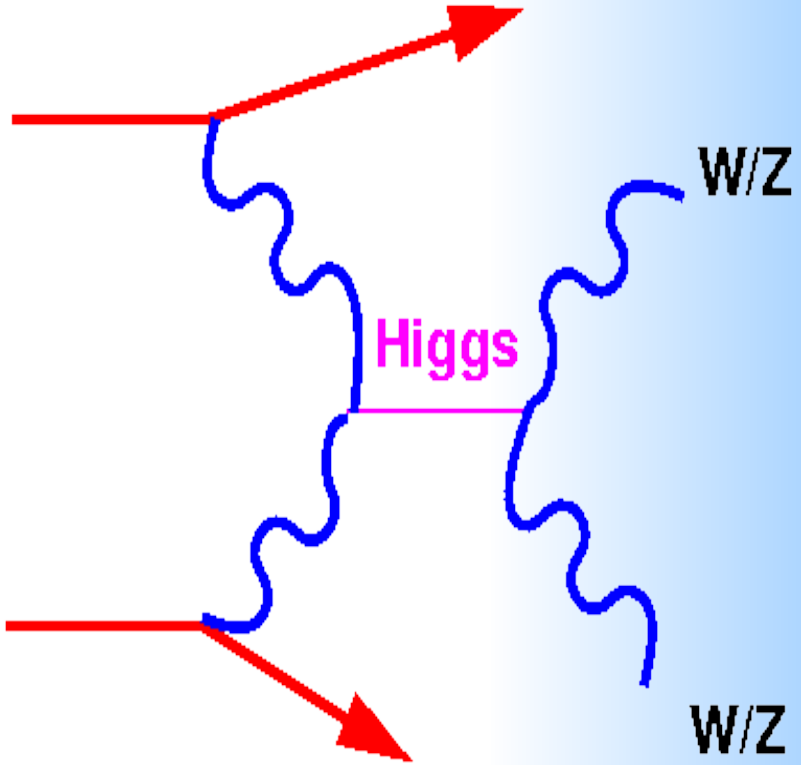
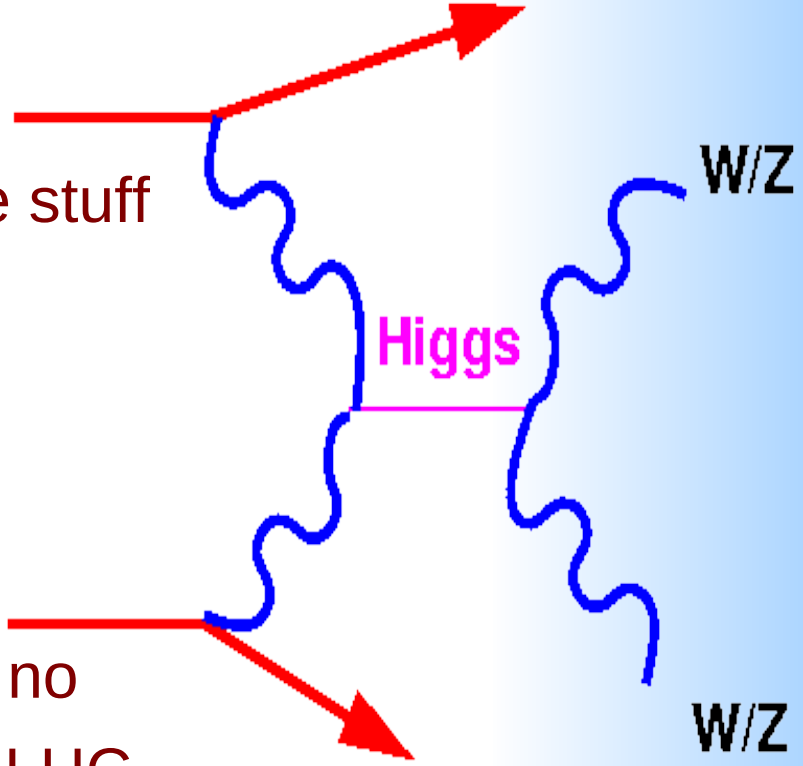
  - quartic WWWW coupling
  - ZWW coupling
  - WW Higgs coupling



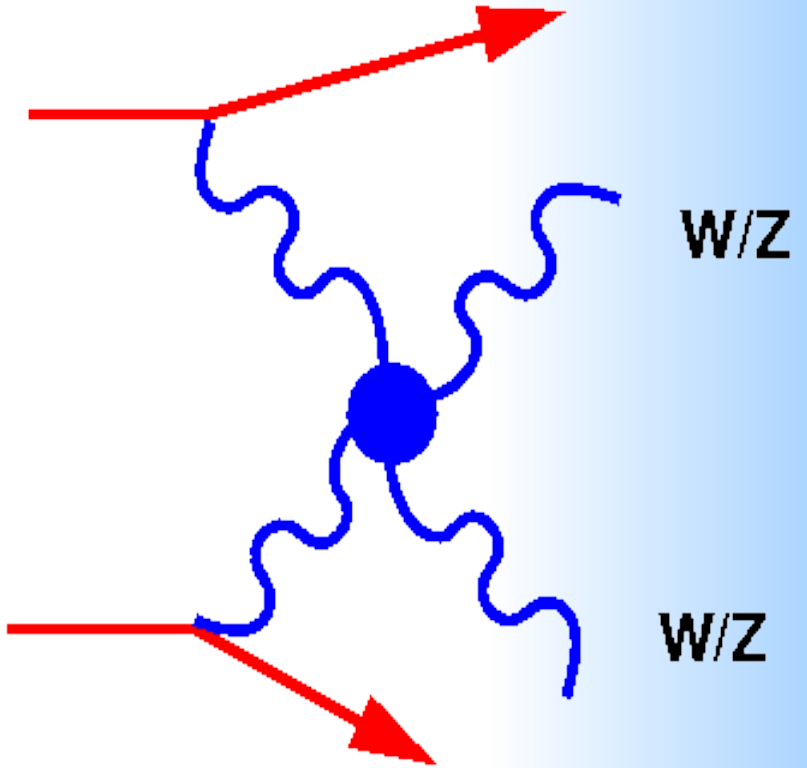
Vector Boson Scattering

- W radiated from a quark in each proton.
  - Scatter off each other.
- Standard Model prediction for the stuff in the blue circle
  - quartic WWWW coupling
  - ZWW coupling
  - WW Higgs coupling
- Without Higgs diagrams, there is no SM Prediction for this process at LHC

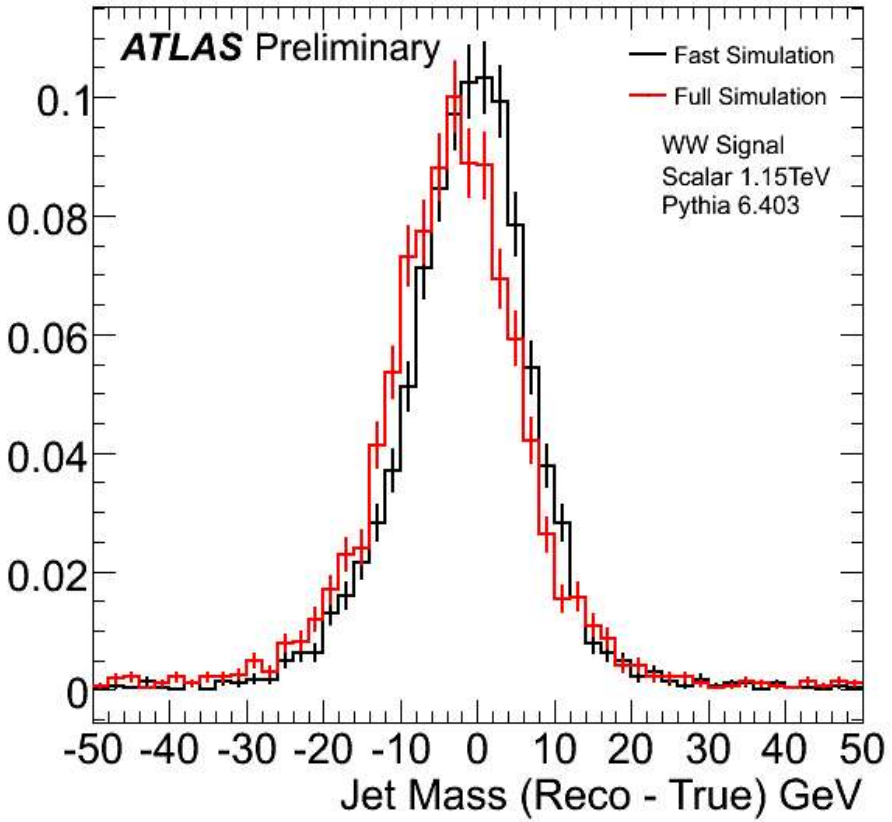


Key Signatures

- Semileptonic channel;
  - reduce background
  - only one neutrino
- Very high pT hadronic W
- Forward “tag” jets
- Suppression of QCD radiation
  - (not yet studied in detail)

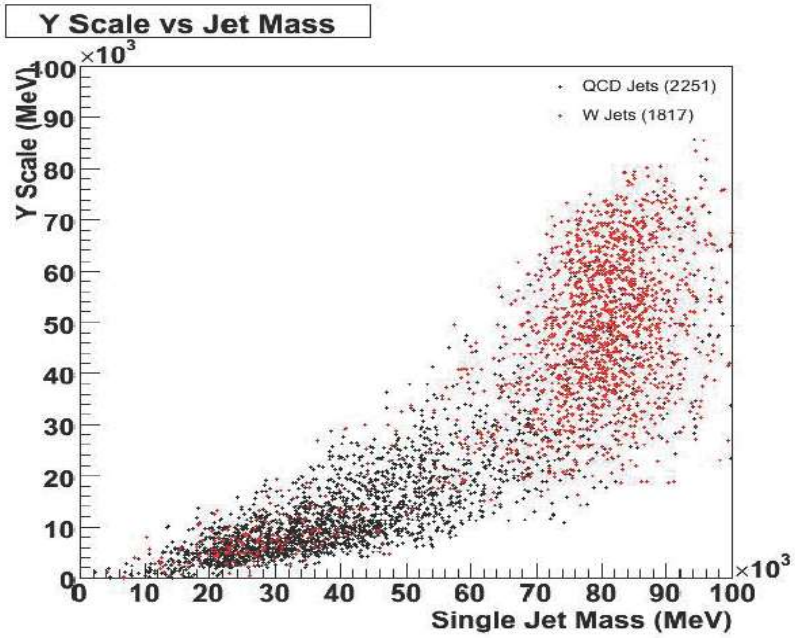


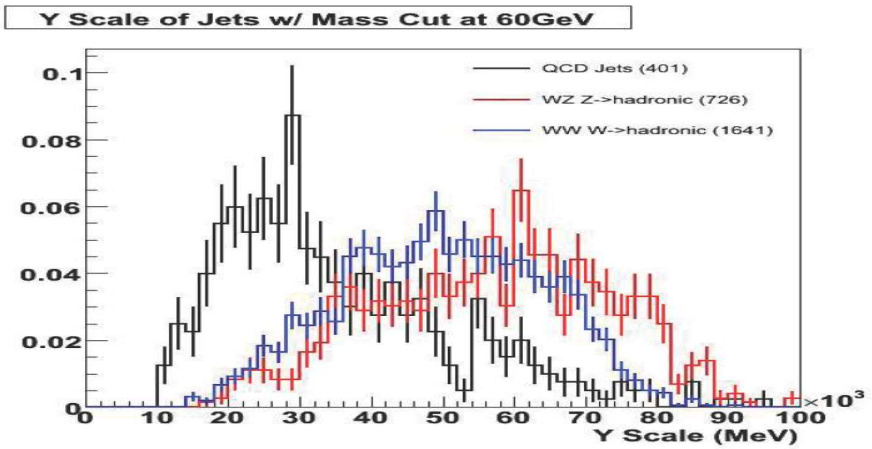
Hadronic W



- Highly boosted W
  - 2 quarks merged in single jet
- Measure single jet mass

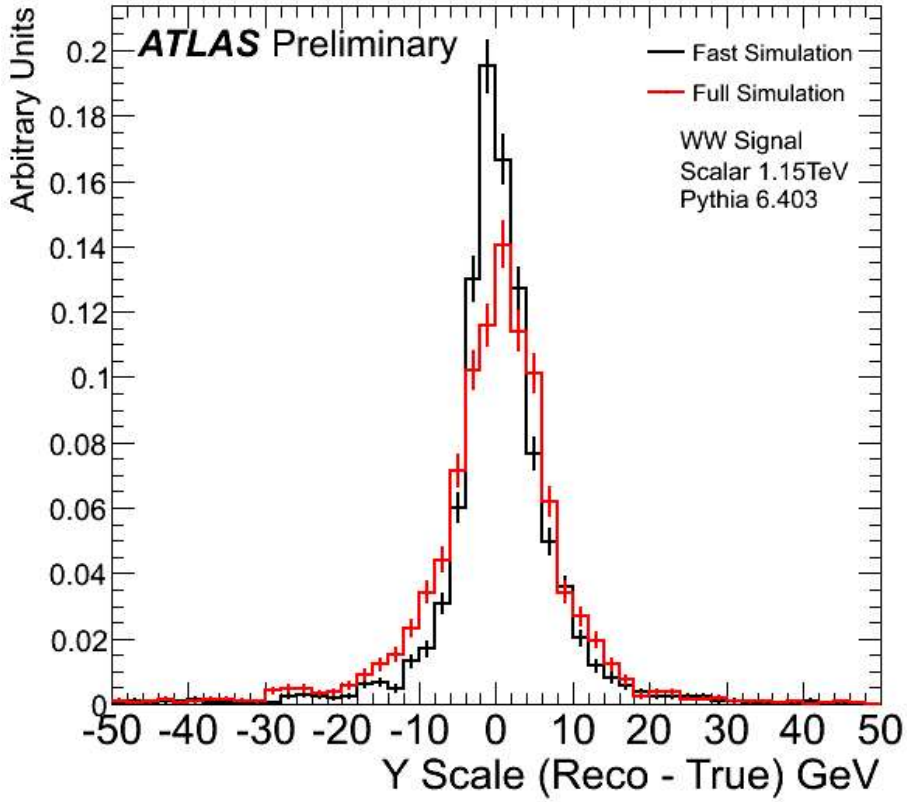
Hadronic W





- Highly boosted W
  - 2 quarks merged in single jet
- Measure single jet mass
- Measure the scale at which the jet splits into two (yscale)
  - ysplitter tool, now in jetrec.
- Scale for QCD is << E_T
  - (leading logs again)
- Scale for W is ~M_W

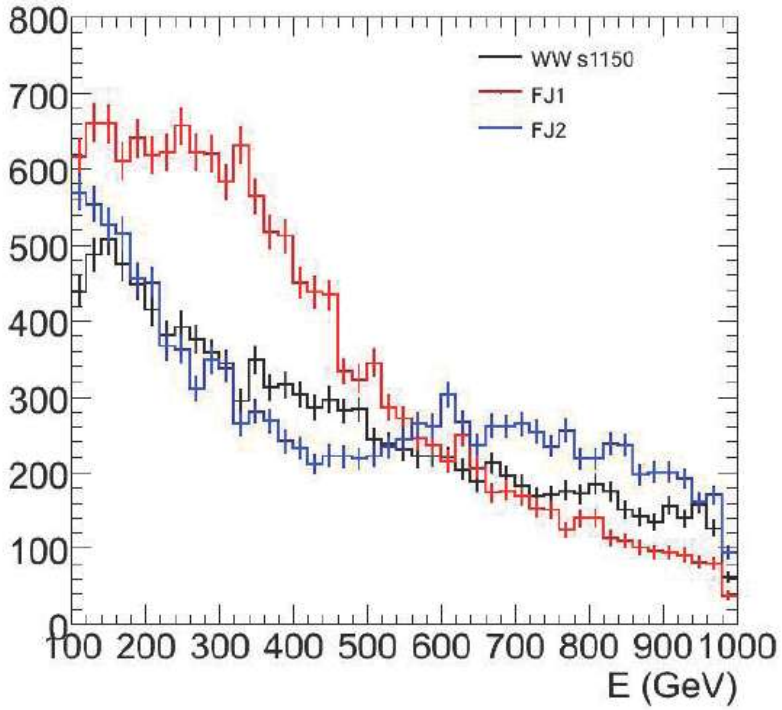
Hadronic W



- y scale can be measured with reasonable resolution
- Atlfast not doing too bad a job.

Forward Jets

- Typical tag jet definition in WW is
  - $2.5 < |\eta| < 4.5$
  - $E > 300\text{GeV}$
  - $P_T > 20\text{GeV}$



Resolutions for different jet options

WW (5667)	E σ	E mean
TowerK6	6.6% ± 0.1%	-4.1% ± 0.1%
TopoK6	6.7% ± 0.1%	-3.7% ± 0.1%
TowerK4	7.1% ± 0.1%	-4.6% ± 0.1%
TopoK4	8.0% ± 0.1%	-4.1% ± 0.1%

Trigger Studies

- Active participation in trigger menu discussions
  - (EO, John Idarraga)
- Generally easy enough to trigger on these events
  - care with the jet triggers: is the VB one or two jets?
  - lepton isolation criteria currently damaging performance
- Work ongoing...

Plans

- Only recently got all the samples we need
- ExoticPhysView
  - “private” branch, shared within group
  - PS, AD working on merging this into rel 13.
- First runs (Montreal) through full analysis
  - need to do this for all channels, all samples, and reevaluate efficiencies etc
- Detailed review November exotics meeting
- Finish note by end of year.