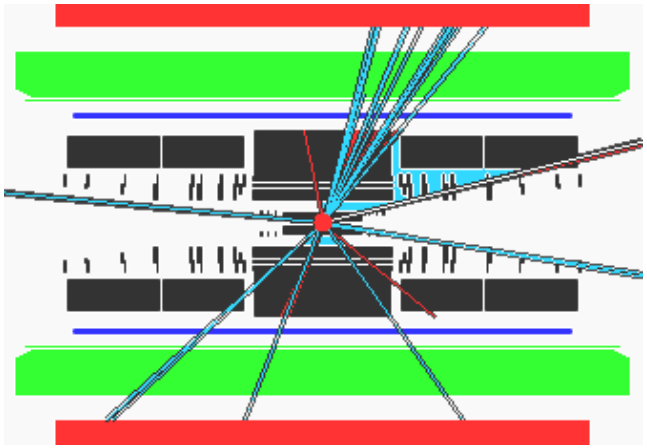
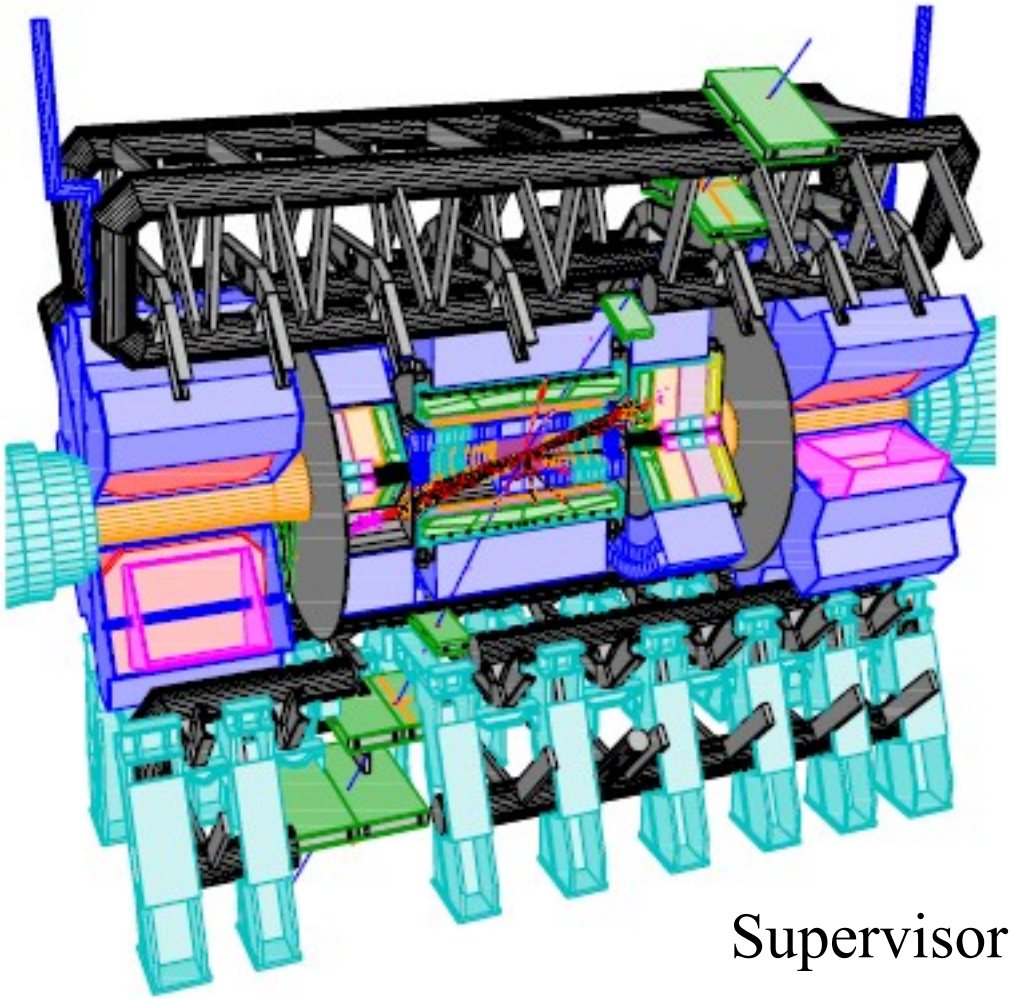
1st Year Summary Talk

Adam Davison
University College London
15/06/07



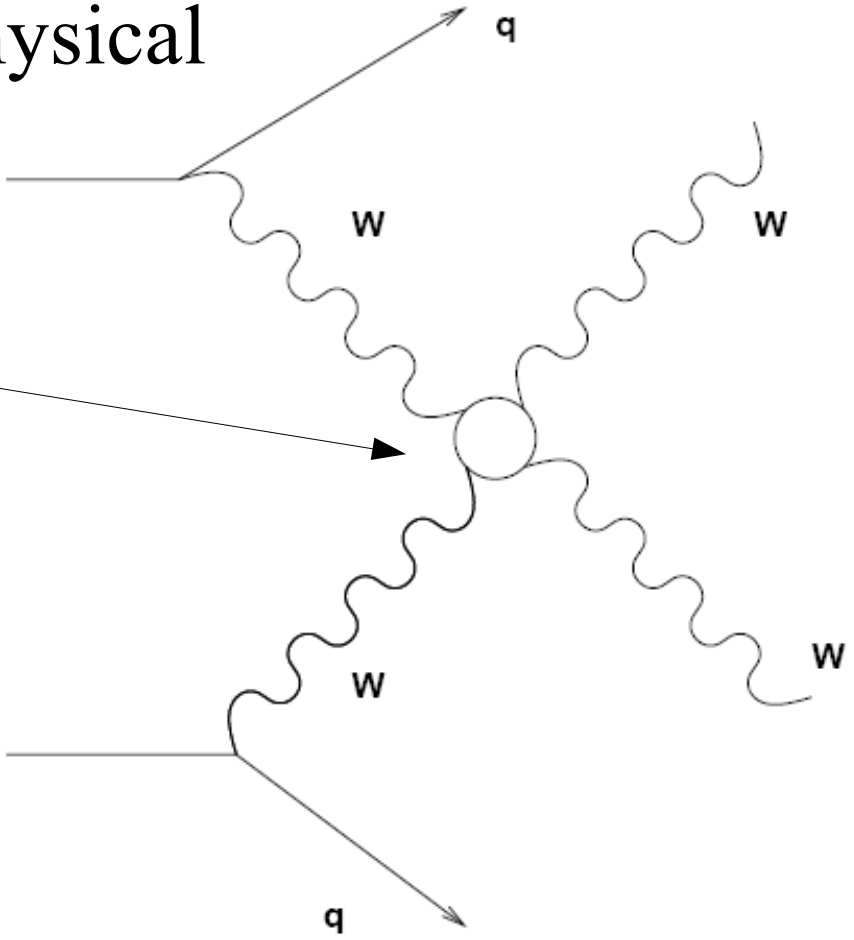
Working on ATLAS



Supervisor is J. Butterworth

Process is WW Scattering

- At TeV scale SM predictions for WW scattering cross-section are unphysical



Insert new particles here

WW Scattering at UCL is:
J. Butterworth, A. Davison
E. Ozcan, P. Sherwood,
(S. Stefanidis)

Analysis

- Study WW→lnqq (semi-leptonic) final state
- Biggest challenge is W+n jets background
- Specifically identifying W→qq vs QCD jets
  - Study highest p_t jet as W candidate
  - Make minimum p_t cut at 300GeV
  - Need to make more cuts but...
  - **Above 300GeV qq often boosted into a single jet!**

Kt Jets

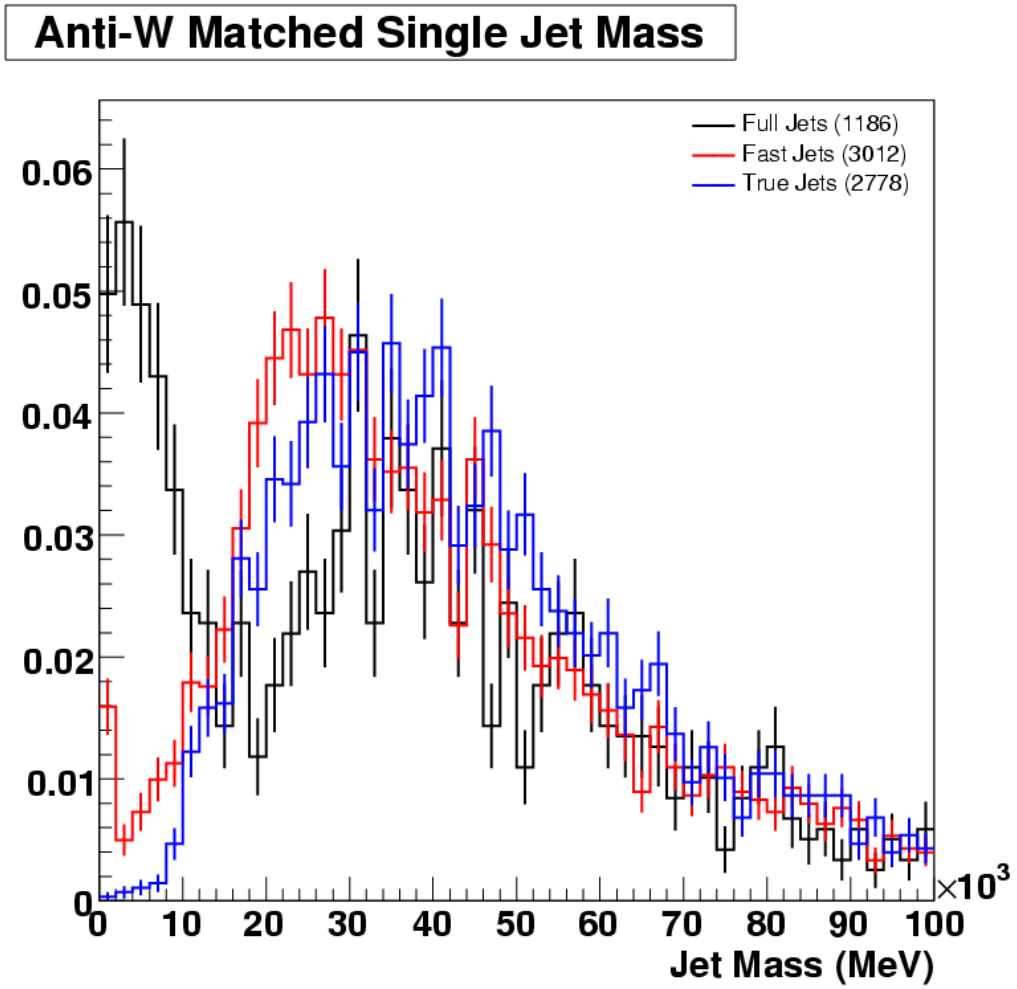
- Kt is a jet finding algorithm
- Merge constituents based on "distance" in phase space
- As long as merging (recombination) scheme is 4-vector addition, final jets have a "single jet mass"
- For jets containing all decay products of W,Z, expect mass to be $M_{W,Z}$

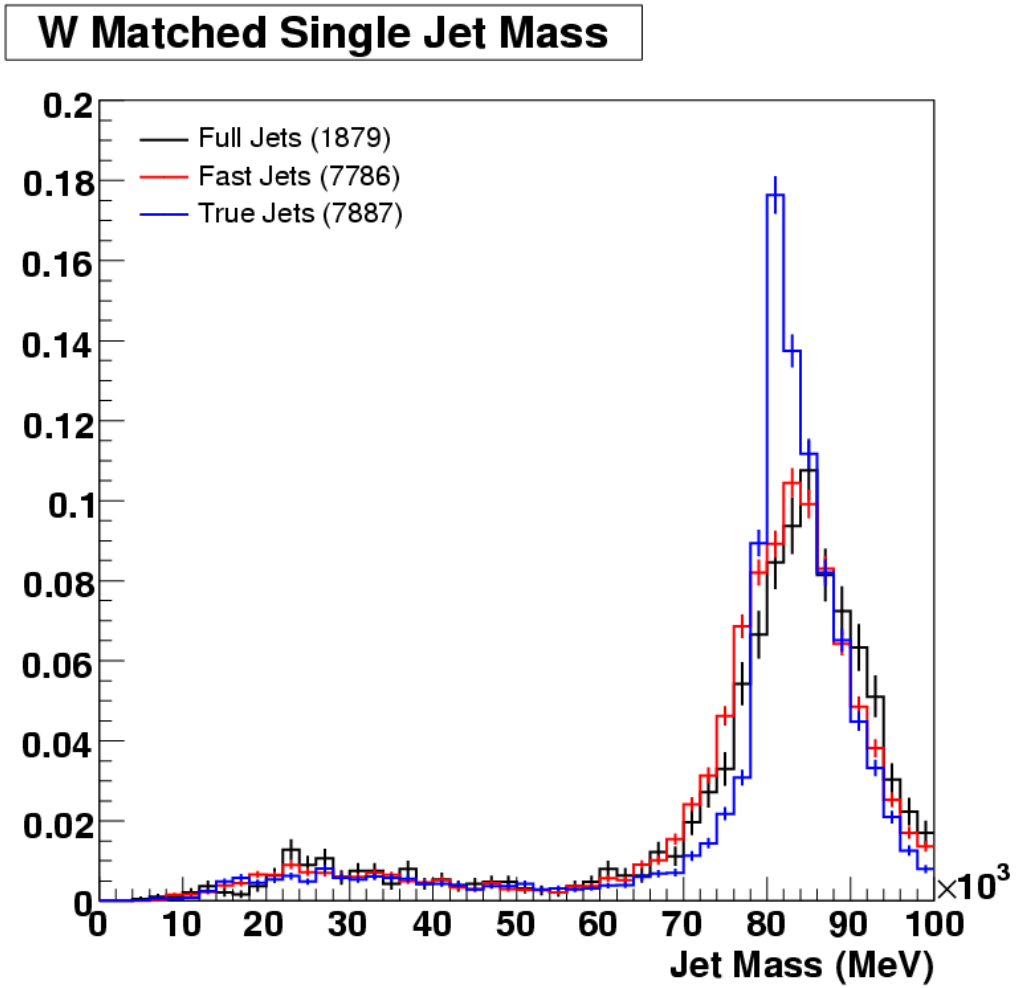
$$dist \approx min\left(E_a^2, E_b^2\right)\theta_{ab}^2$$

Single Jet Mass

- Need to check we understand detector effects
- Not previously explored in detail
- Evaluate discriminating power
- ATLAS has two different detector simulations
  - GEANT4 full simulation
  - Atlfast
- Compare the two and see if they look equivalent
- Done using WW signal sample

Single Jet Mass True/Fast/Full



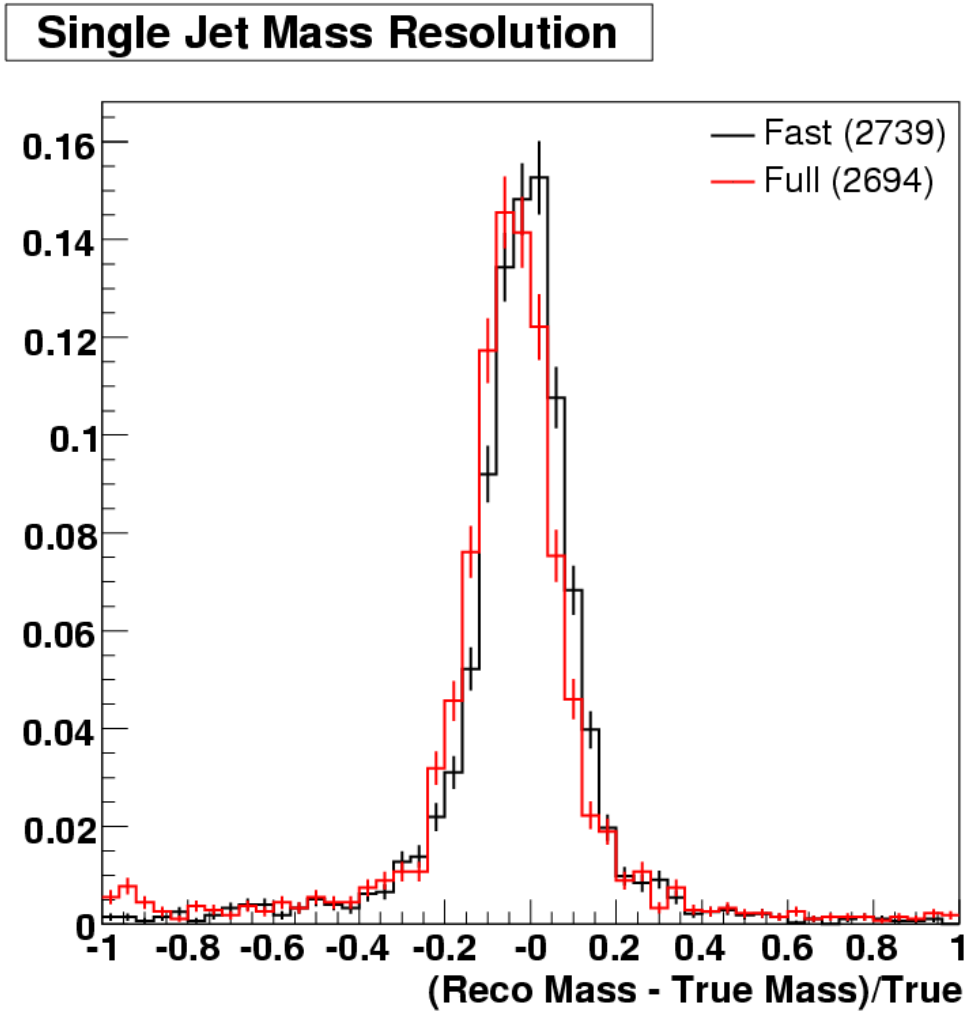


Matched to True W by dR < 0.2

Agreement generally good

Single Jet Mass Resolution

- Jets
  - All leading jets w/P_t > 300GeV
  - Matched by event number
- Again good agreement



Single Jet Mass Resolution

By Gaussian fit to resolution plots:

	σ
Fullsim	9.2% ± 0.2%
Atlfast	9.1% ± 0.2%

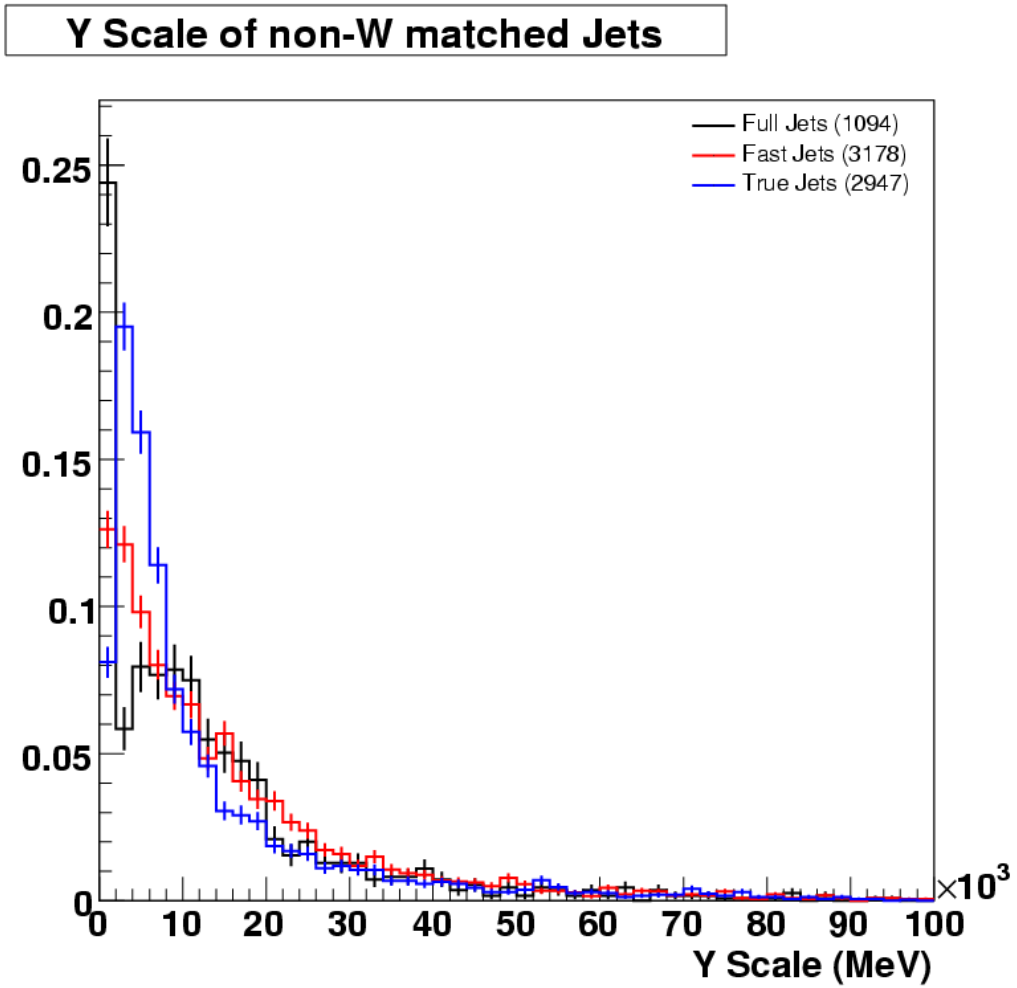
- Again (surprisingly?) good agreement given the large simplifications Atlfast makes

Y Values

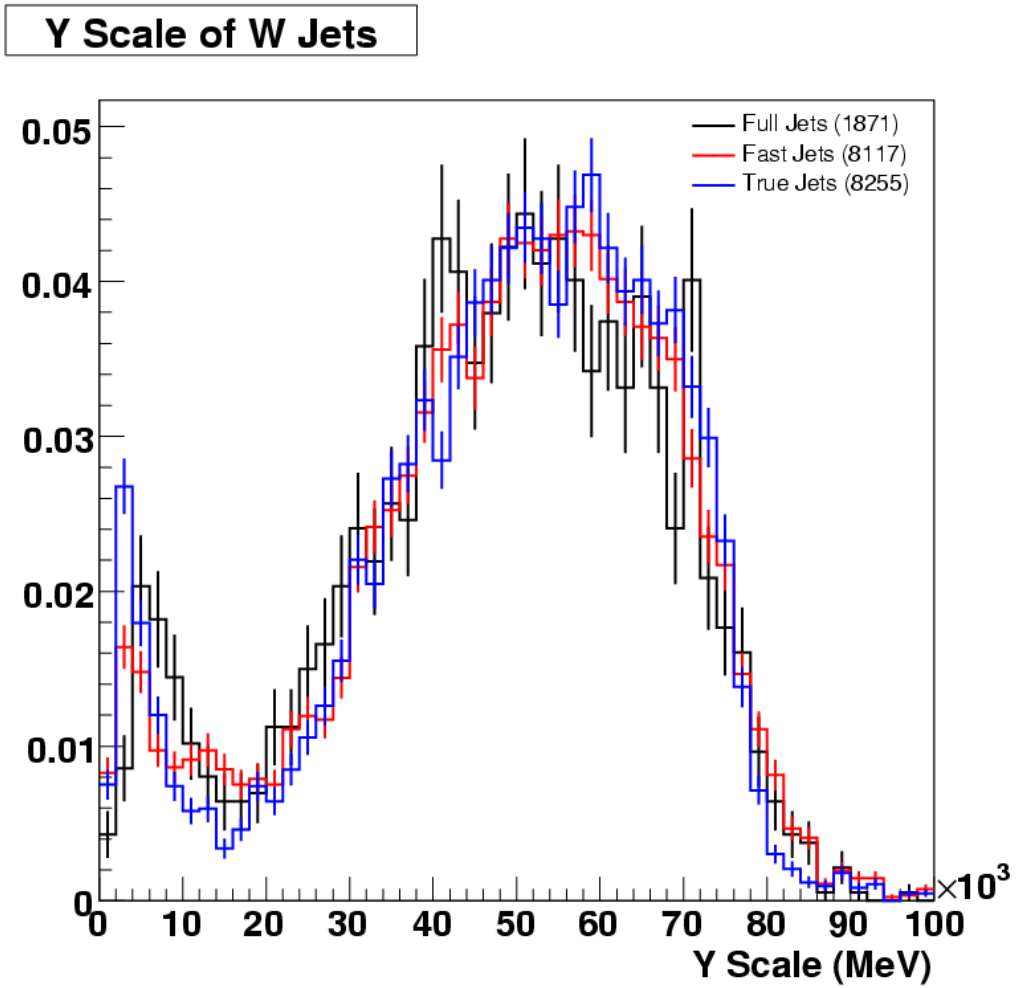
- Kt algorithm merges constituents a pair at a time
- Record "distance" between final pair of merged constituents
- Can also be converted to an energy scale
- Can be thought of as a resolution
- Low for light jets, related to $M_{W,Z}$ for VB jets
- Even less explored than single jet mass

$$p^2_{t\ jet}\, y_2 = min\left(E^2_a, E^2_b\right)\theta^2_{ab}$$

Y Scale Mass True/Fast/Full



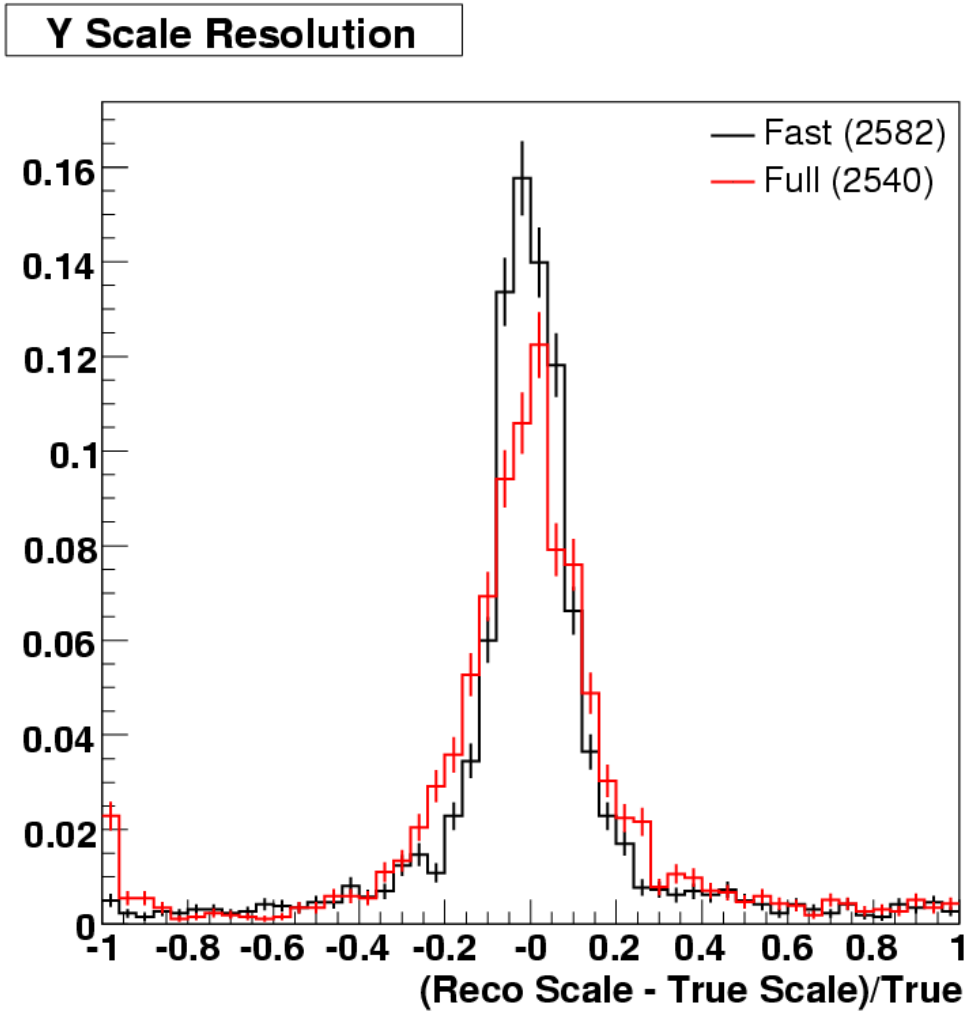
Matched to True W by dR < 0.2



Again agreement generally good

Y Scale Resolution

- Jets
  - All leading jets w/P_t > 300GeV
  - Matched by event number
- Full seems to have slightly worse resolution



Y Scale Resolution

By Gaussian fit to resolution plots:

	σ
Fullsim	12.3%± 0.3%
Atlfast	8.8% ± 0.2%

- Atlfast underestimates resolution
  - But not terribly badly

Atlfast Hadronic Cut Efficiencies

- Is a y scale cut worth bothering with?

Units are fb	**WW s1150**	**W+4jet**	**W+3jet**
Input	19.6	1530.0	164761.0
Pt 300GeV +Mass 60GeV	7.0	124.5	5004.4
Y Cut 40GeV	5.5	42.0	1855.8

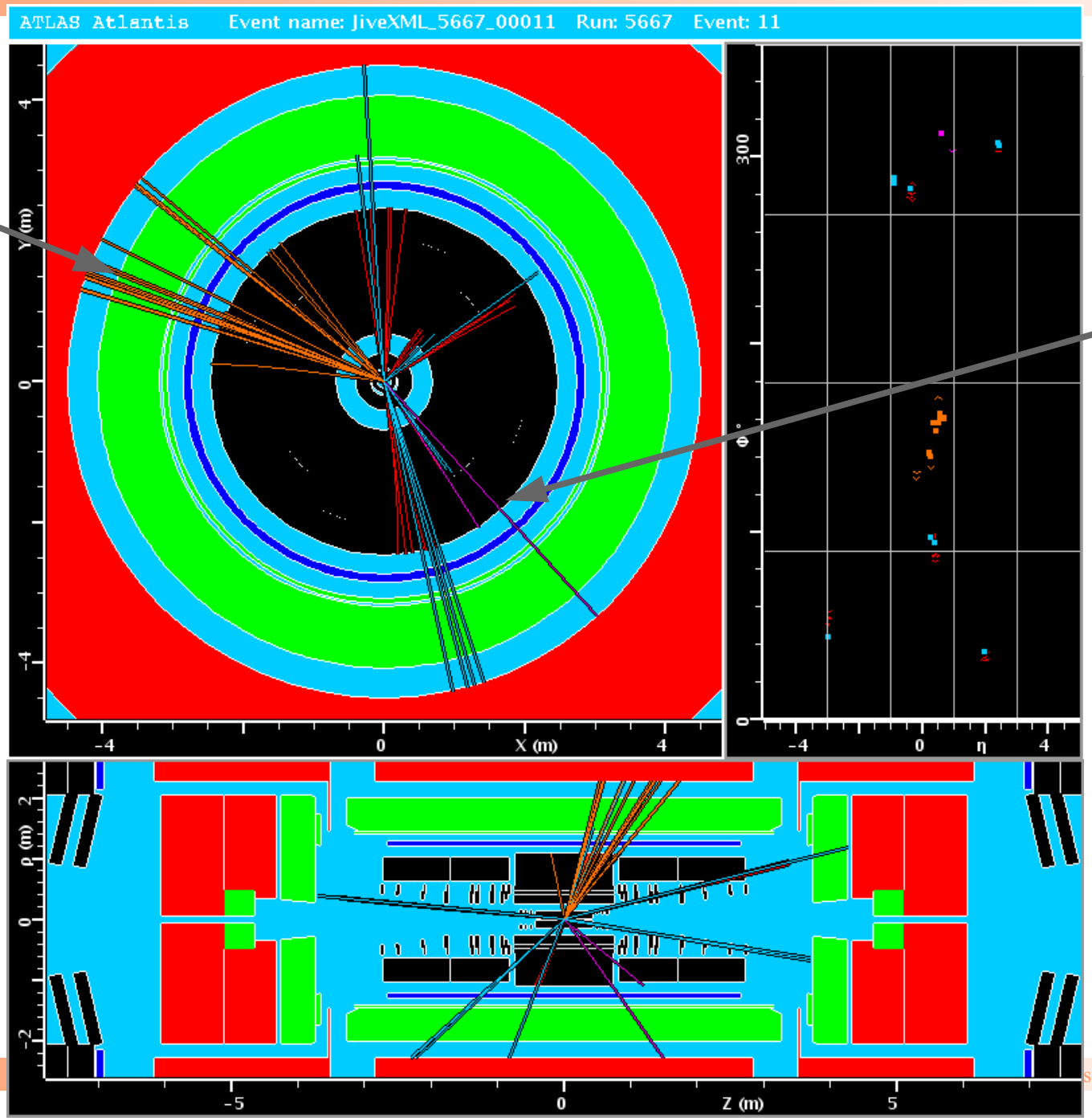
% Per Stage	**WW s1150**	**W+4jet**	**W+3jet**
Input	~	~	~
Pt 300GeV +Mass 60GeV	36.0	8.1	3.0
Y Cut 40GeV	78.7	33.7	37.1

- Even after mass cut, y cut rejects ~65% of W+jets bg with signal efficiency of ~80%

Implications of this Study

- Variables are well understood in signal region
- Agreement good between two simulations
- Resolution evaluated
- Work presented at ATLAS Trigger and Physics week 05/06/07

Atlantis


ATLAS Atlantis Event name: JiveXML_5667_00011 Run: 5667 Event: 11
Jet from W
e and nu
X (m)
Y (m)
η
Z (m)
ρ (m)

Atlantis

- Bug fixing
- Profiling/Optimisation
- Distributed event generation
- With Atlantis development team, gave part of an Atlantis tutorial aimed at new users at CERN

Other Things

- Atlfast and Pythia version comparisons
  - Already saw this at Christmas meeting
- Distributed analysis, running on the grid
- Plenty of work on our analysis code
- Contributed code to ATLAS jet reconstruction software

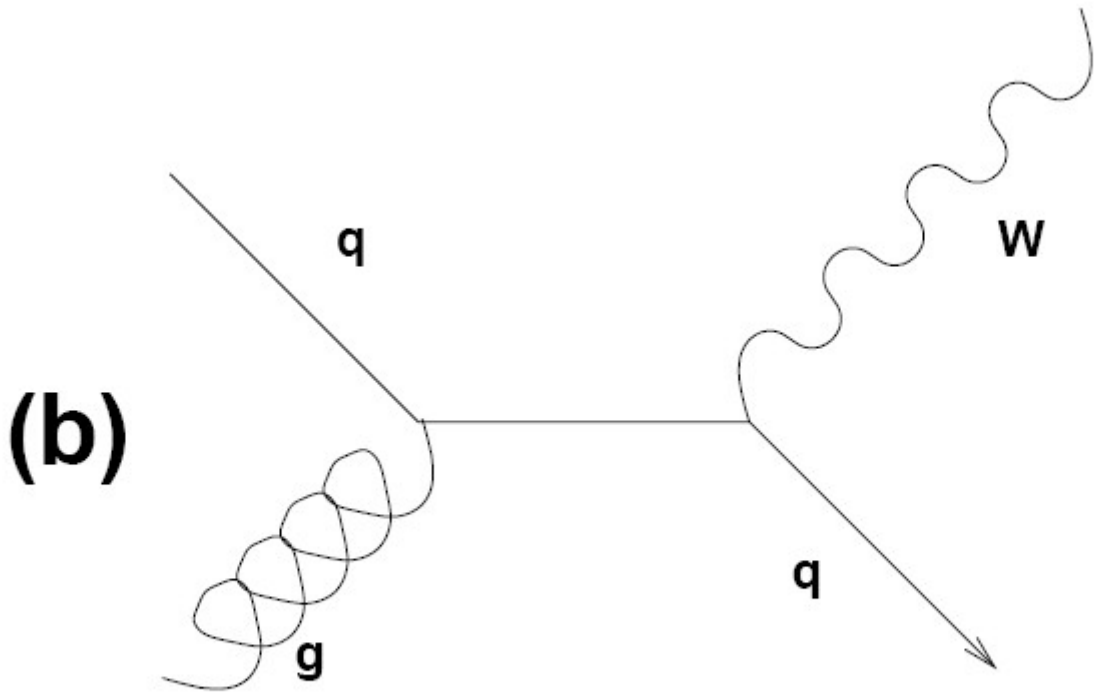
Conclusions

- Done some things
- Most significant is exploration of properties of single jet mass and y scales at ATLAS
- In the future
  - Continue to develop WW scattering analysis
  - Expand contribution to Atlantis

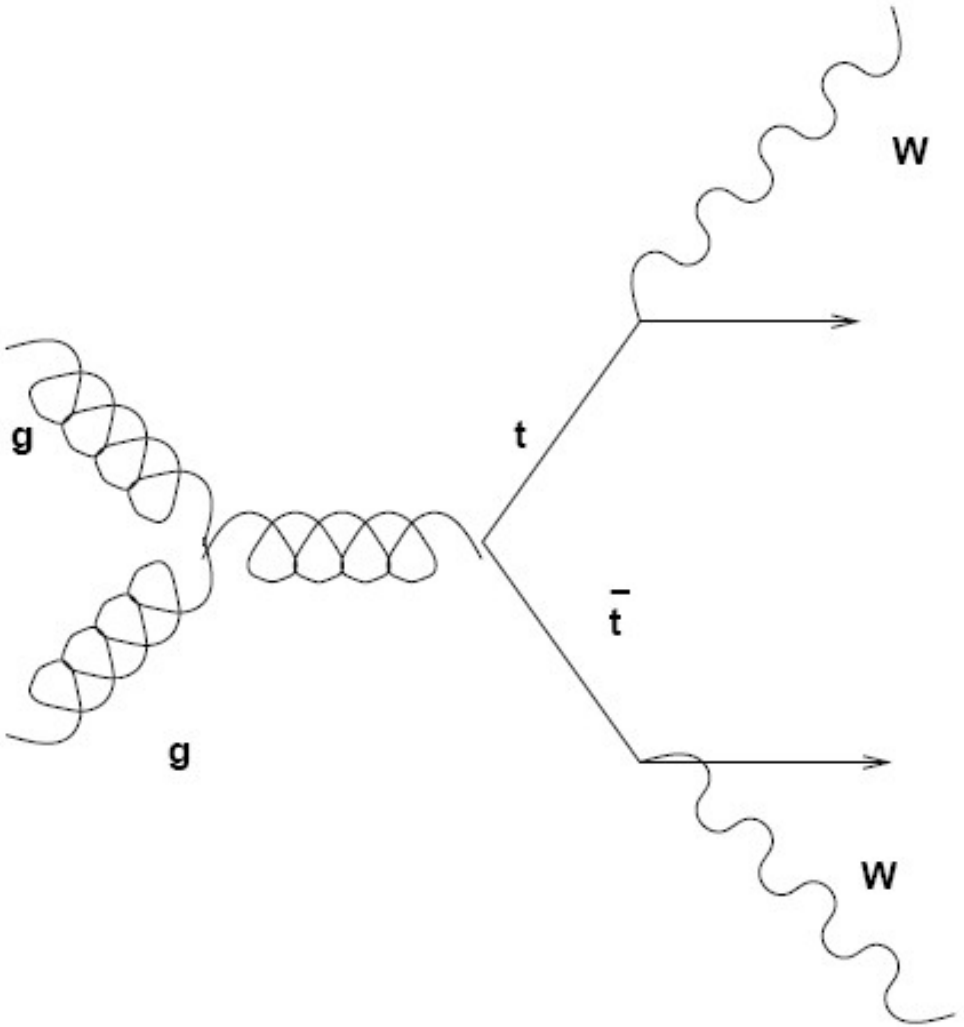
Questions?

Backup Slides...

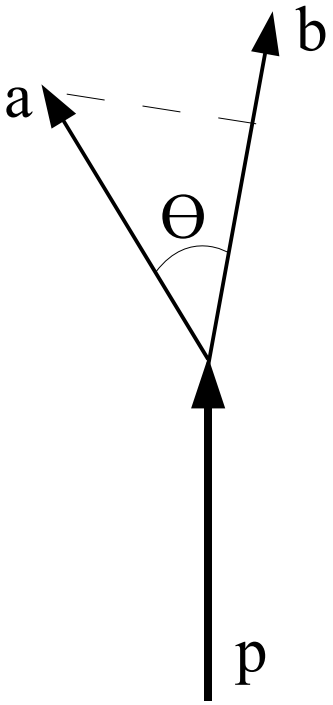
W+jets



ttbar

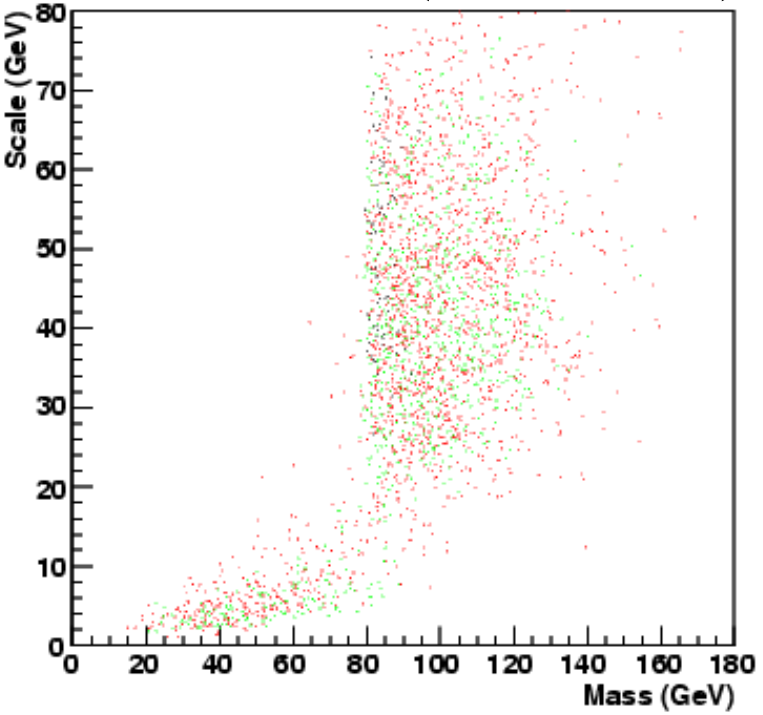


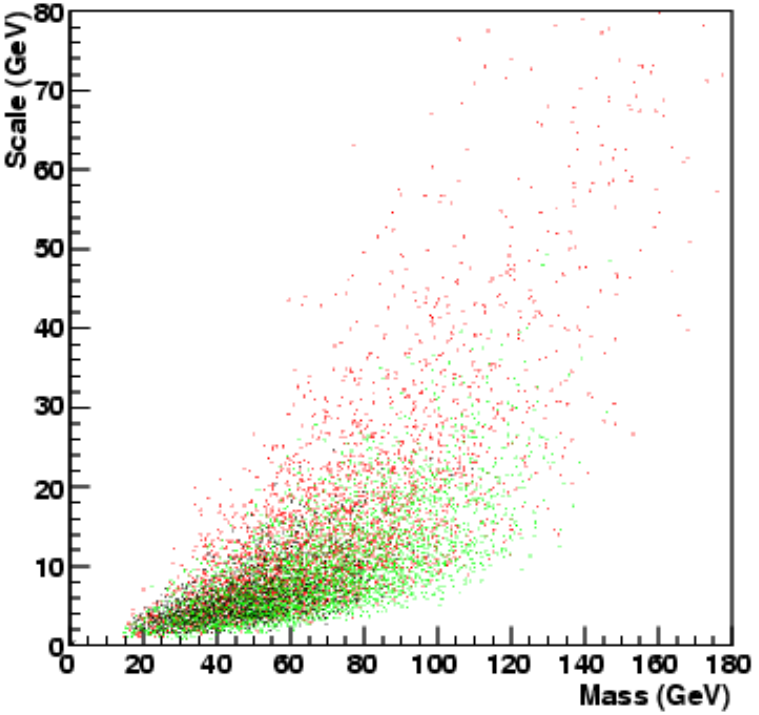
y2

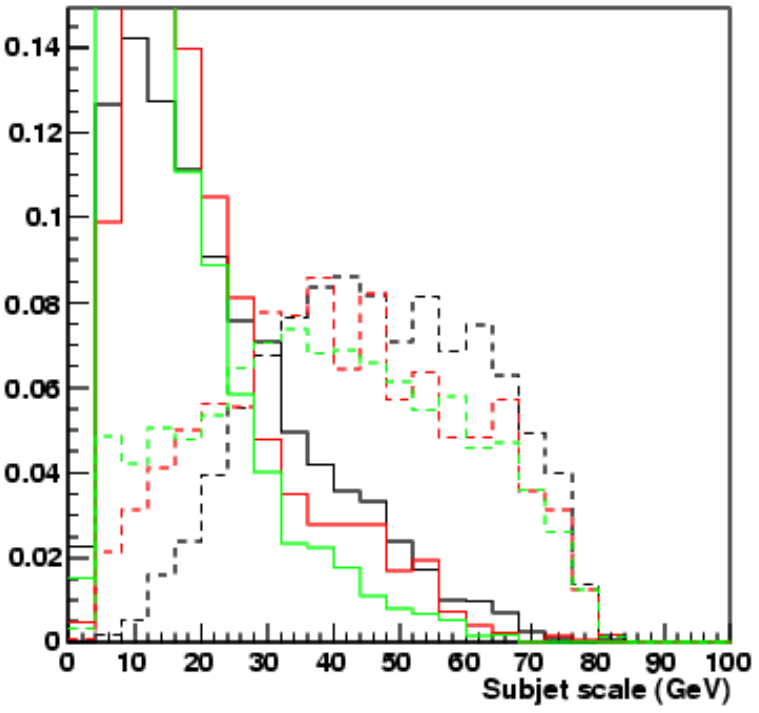


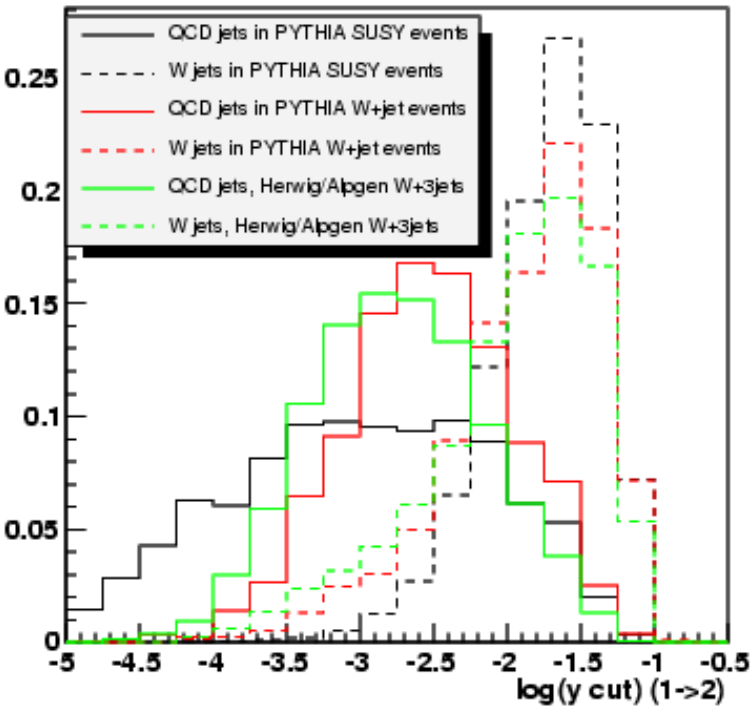
$$p^2_{t\,jet} y_2 = min(E^2_a, E^2_b)\theta^2_{ab}$$

J. Butterworth, J. Ellis, A. Raklev (JHEP 2007)

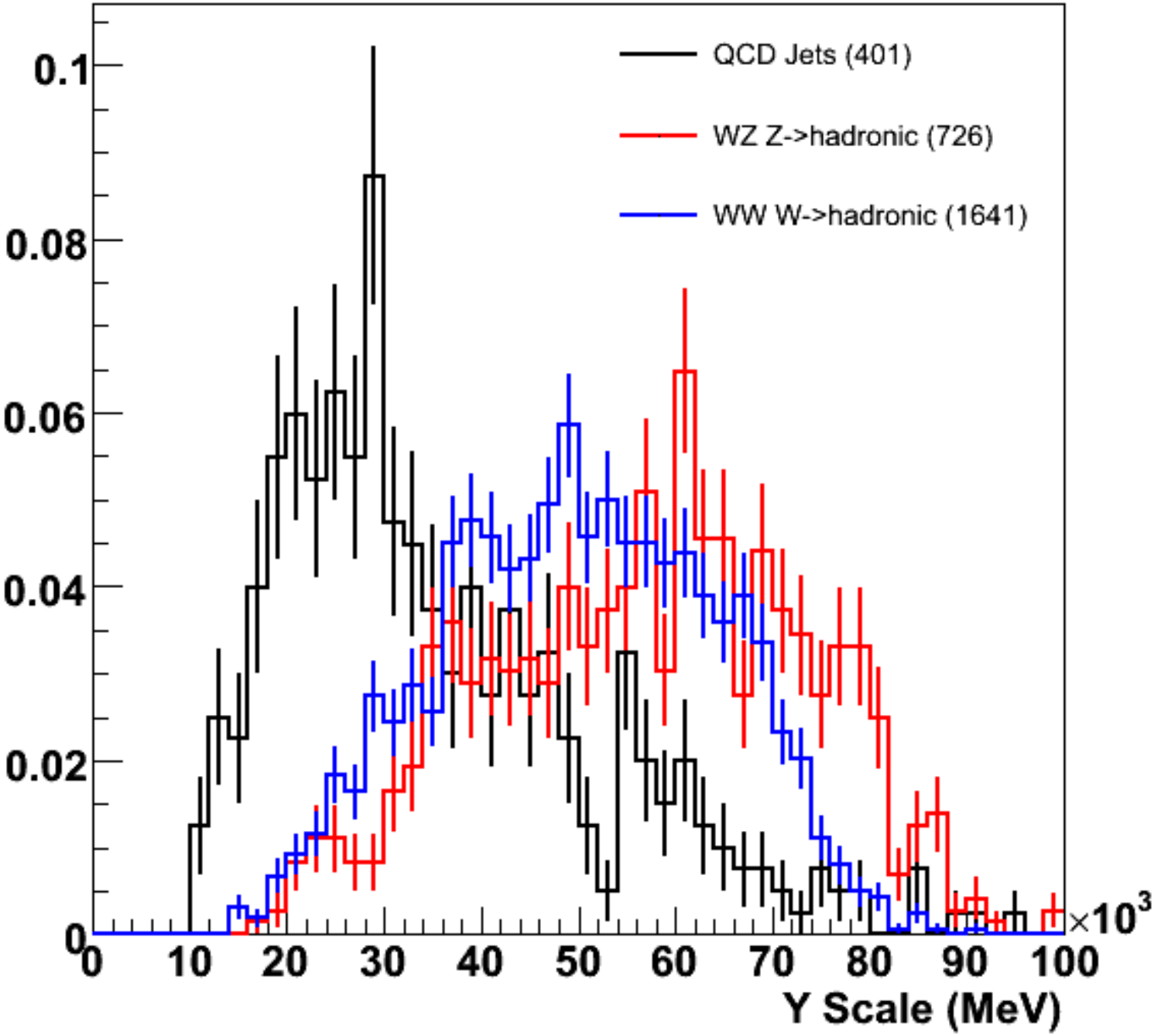








Y Scale of Jets w/ Mass Cut at 60GeV



The Sample

trig1_misal1_mc12.005667.PythiaWWFusionChLs1150jjln

WW scattering signal

Scalar Resonance at 1.15TeV

10k events in theory

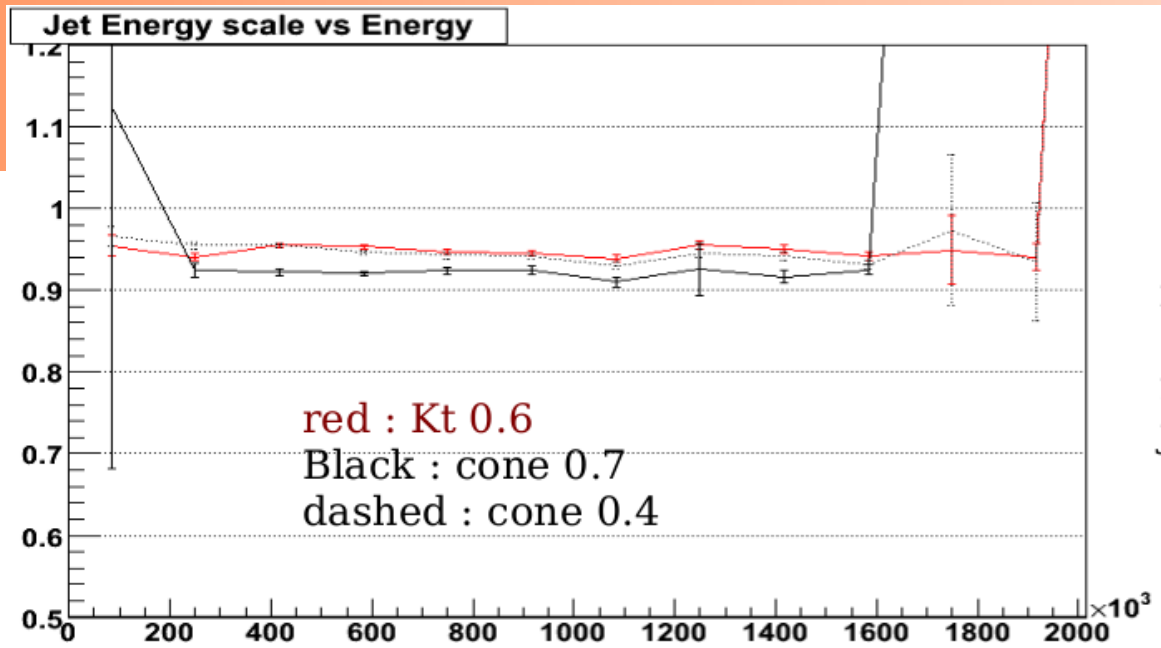
Got ~6.5k from the grid

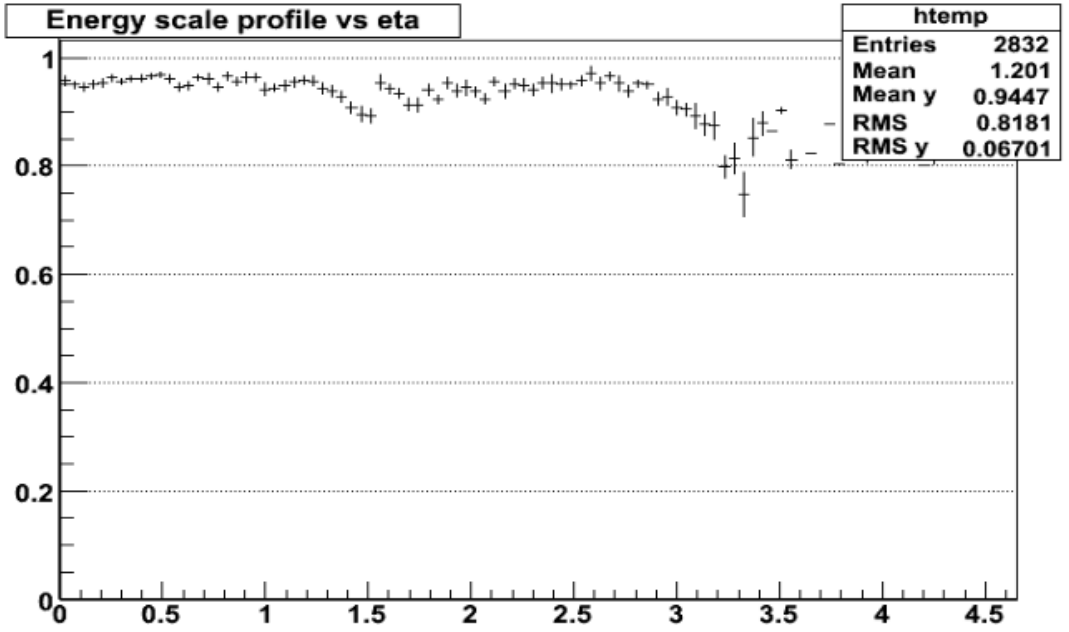
Details

- A few pertinent details
  - Comparing True/Fast/Full
  - Full is from CSC AODs, True/Fast done privately
  - Jet finder is Kt with R = 0.5
  - Atlfast is without FastShower
  - Re-running jet finder on AOD Topos for full
  - Aware of Topo calibration issues

Single Jet Mass Resolution

$\|\eta\|$	Events	Full σ	Fast σ
0.0-1.0	1923	8.6% ± 0.2%	8.5% ± 0.2%
1.0-2.0	735	8.6% ± 0.4%	8.9% ± 0.4%
2.0-5.0	100	11.7% ± 4.0%	9.9% ± 2.2%





Using recalculated jets:
from calibrated cluster :

necessary if we want to use jet moment

energy scale to low

How to re-calibrate ?

J. Idarraga