

Measurement of the b jet cross section for events with a Z boson

Paul Thompson (Birmingham), Andrew Mehta (Liverpool)

- Introduction
- Method
- b fraction determination
- Summary

Why make this measurement?

- **QCD.**

Can help constrain b density in proton. Also important test of b production in QCD. At present not all data agree with NLO. Has very small scale dependence c.f. other b processes.

- **Higgs search.**

SM Higgs may be found in associated production, $Zh, h \rightarrow b\bar{b}$. This process is the overwhelming background. MSSM Higgs $pp \rightarrow b\bar{b}h$ is very sensitive to b density. $Z + b$ probes b density at similar scales.

- **Exotics.**

An excess in this channel at high masses could indicate $q^* \rightarrow bZ$. Others ...

QCD production diagrams

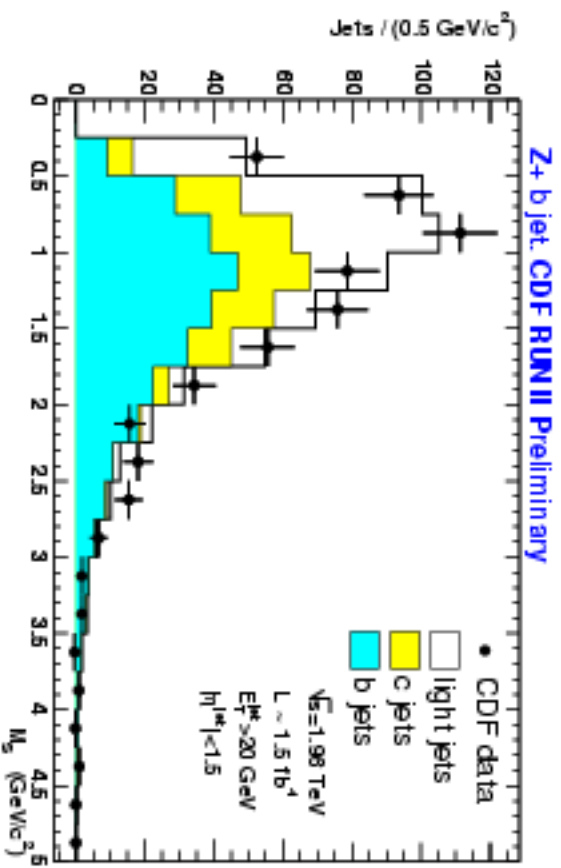


First 2 probe heavy quark component of proton.

Error on Theory

Scale dependence is small ($\approx \pm 10\%$)

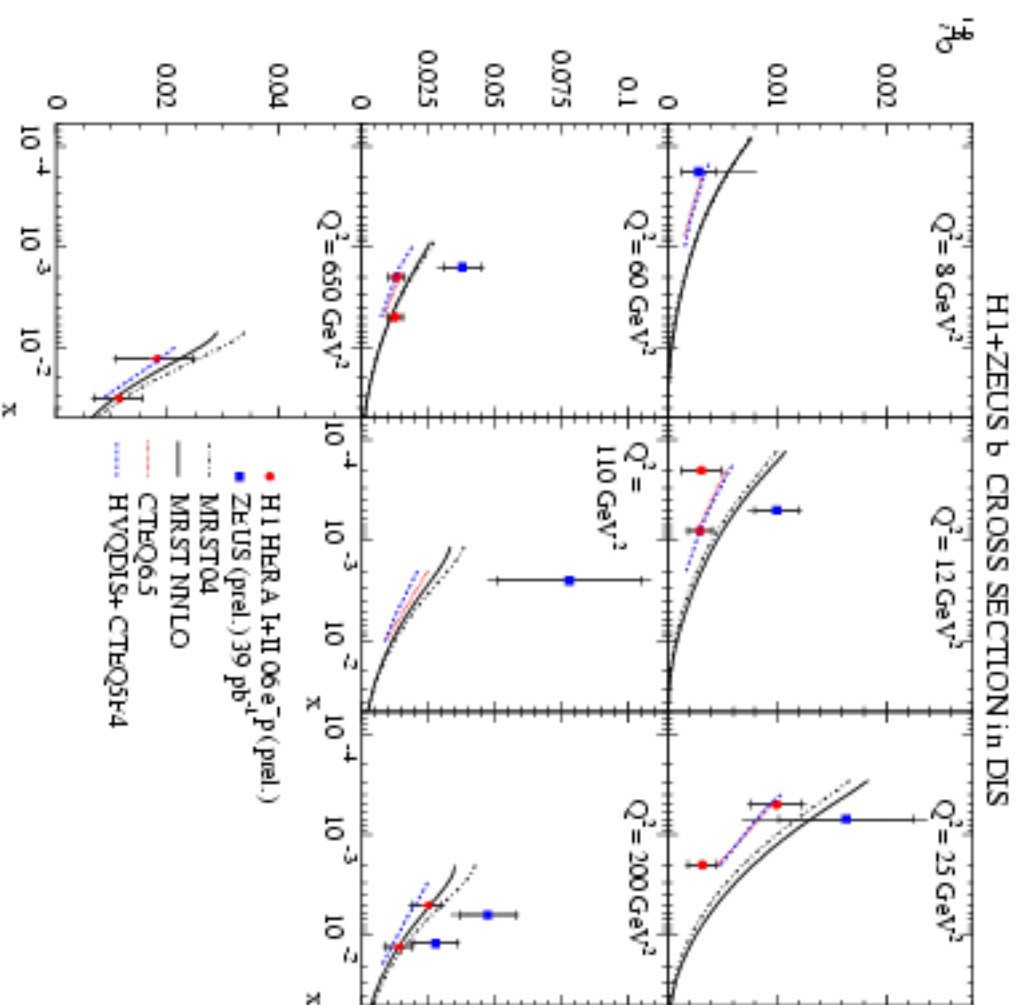
Results from CDF



	CDF Run II Preliminary Data	PYTHIA	MCFM NLO	MCFM NLO +ue +had
$\sigma(Z^0 + b\text{jet})$	$0.94 \pm 0.15 \pm 0.15$ pb	0.84	0.51	0.56

- A little above NLO (2σ , no error assigned for u.e. or hadronisation).

F_2^{bb} data from HERA

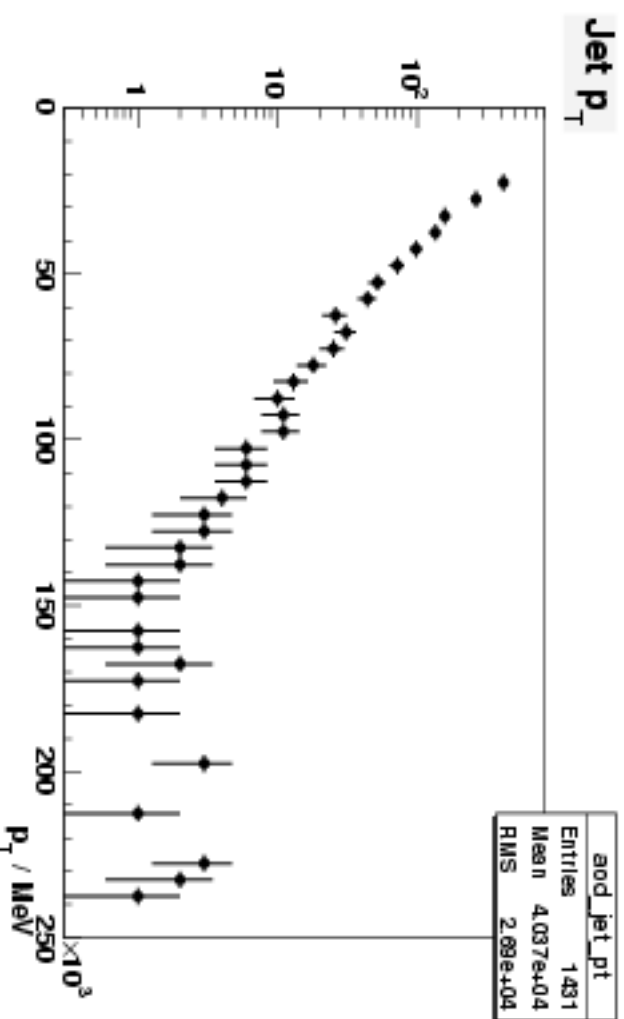
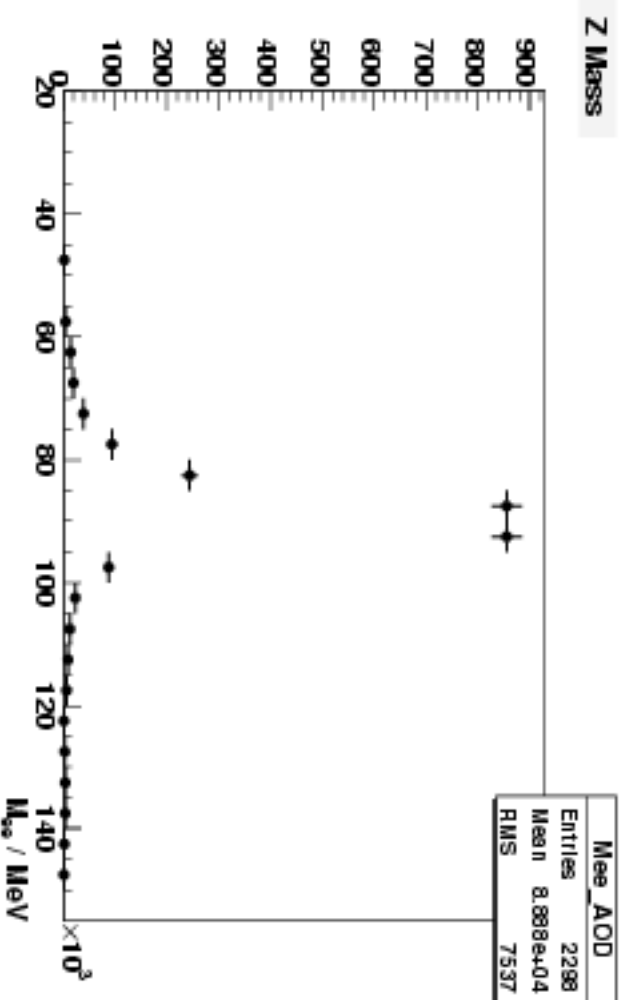


CTEQ below MRST by up to $\times 2$ at low Q^2 but similar at higher scales. Data roughly in agreement but errors large at present

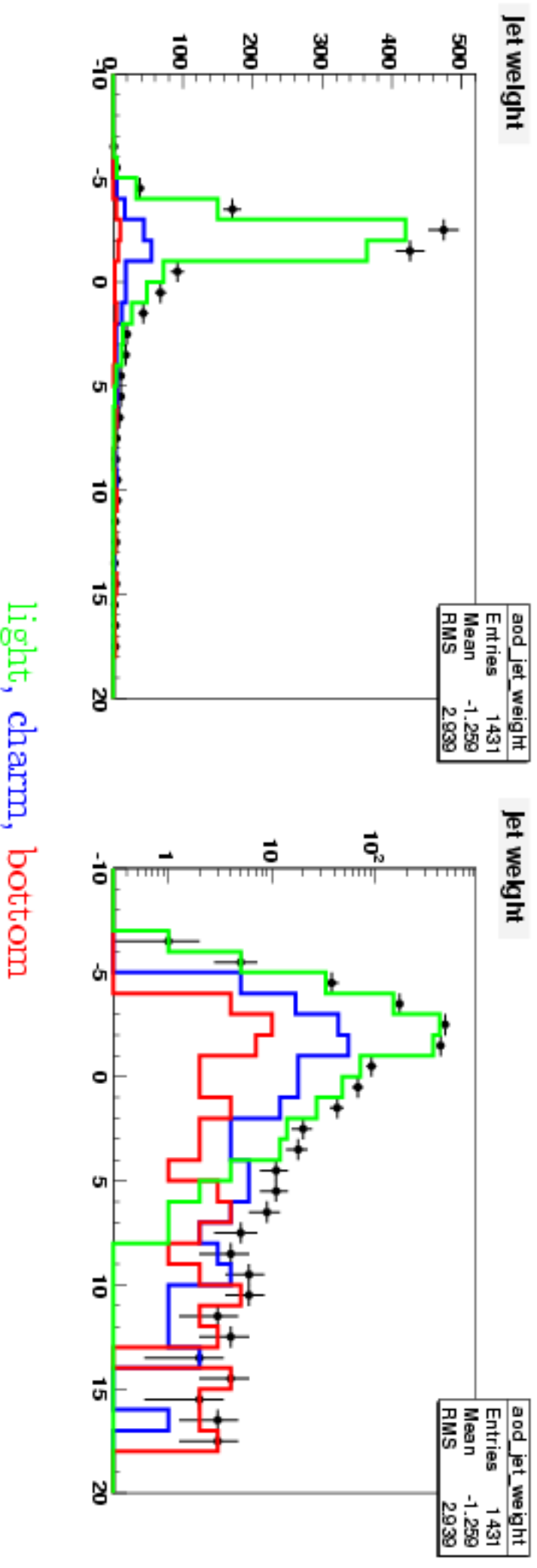
Experimental Method

- Reconstruct $Z \rightarrow e^+e^-$ with standard HighPtView electron selection.
- Use inclusive Z file: `trigl_misal1_csc11_V1.005144.PythiaZee.recon.AOD.v12000601`
- Look for jets in the event (`topocone1.0` with $\delta R(\text{elec}) > 0.4$)
- Using cone jets 0.7
- Use the standard b tag likelihood output (`SV+ImpactPar`)
- Fit the spectrum with light, c and b templates to work out b fraction of jets
- Correct to the hadron level b -jet cross section for Z events with $E_T > 20$ GeV and $|\eta| < 2$.

Z mass and jet P_T



b tag likelihood



Distributions for light, *c* and *b* have different shapes so may be separated with a fit and the fraction of *b* jets determined.

Should be able to do this measurement with low luminosities of just a few thousand *Z* events. More crucially is how long *b* tagging variables take to understand.

May be easier with first data to use mass at secondary vertex (a la CDF), track DCA or significance (a la H1) rather than a likelihood.

Summary

- b jet measurements are an important test of QCD and needed for backgrounds in searches
- $Z + b$ jet offers a relatively simple measurement with low theory errors.
- Could be done with early data if b tagging is understood.