ATLAS UK SM

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

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- 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.

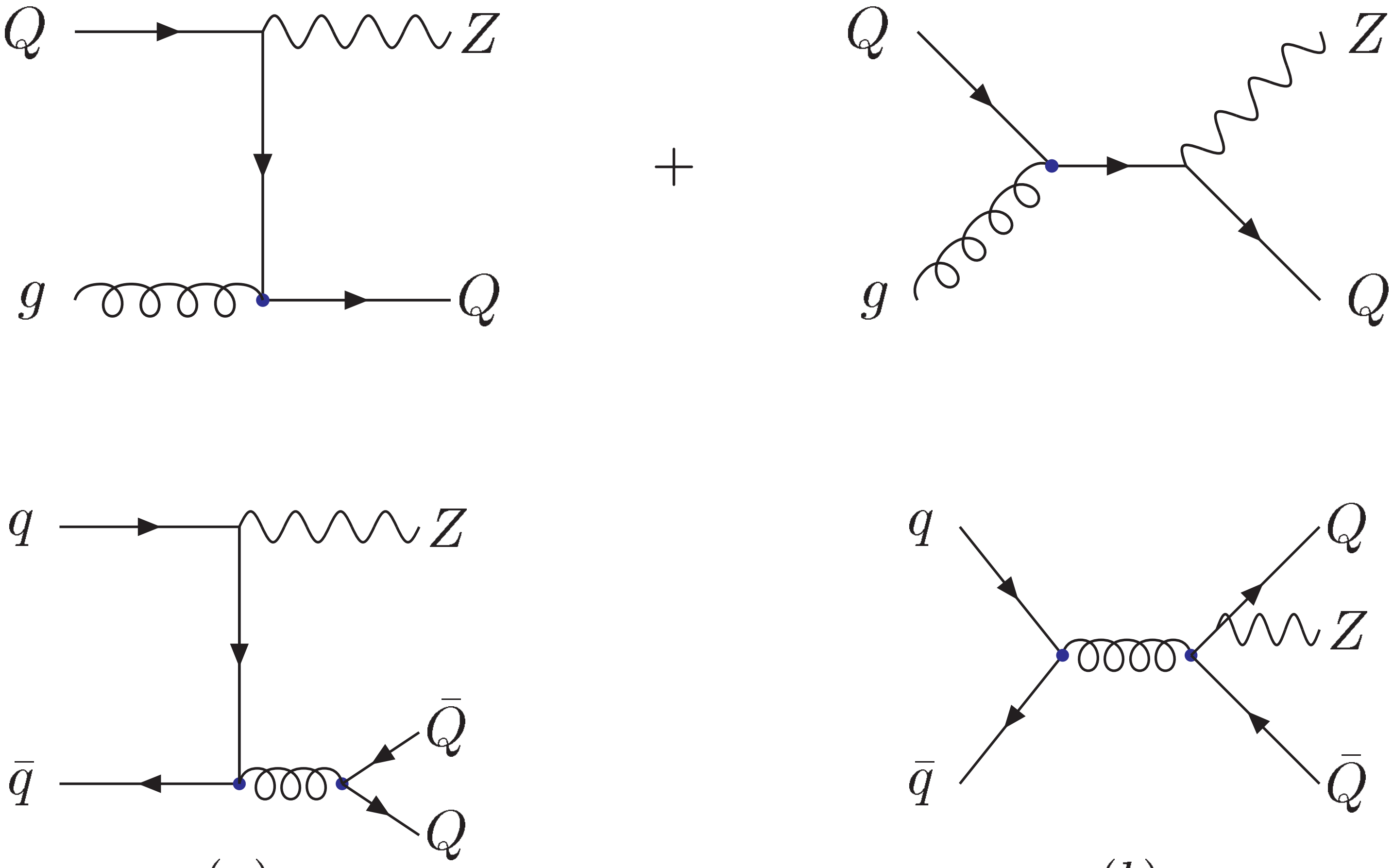
- Higgs search.

SM Higgs may be found in associated production, Zh, $h \to b\bar{b}$. This process is the overwhelming background. MSSM Higgs $pp \to b\bar{b}h$ 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 $q^* \to bZ$. Others ...

QCD production diagrams



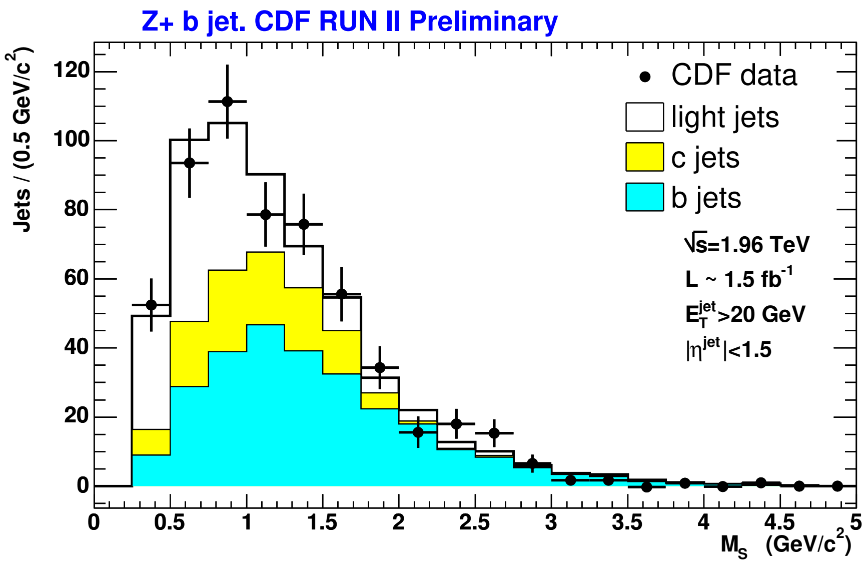
(a) (b)

First 2 probe heavy quark component of proton.

Error on Theory

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

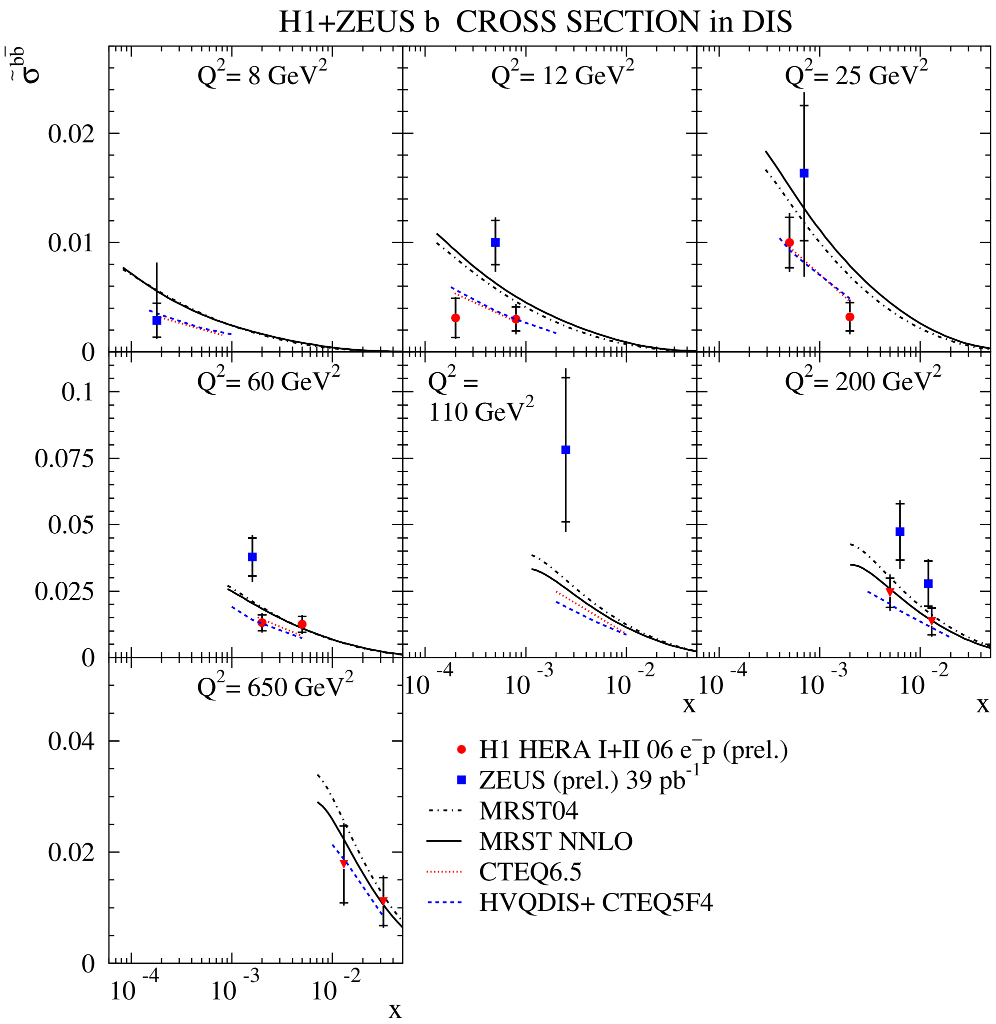
Results from CDF



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

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

$F_2^{b\bar{b}}$ data from HERA

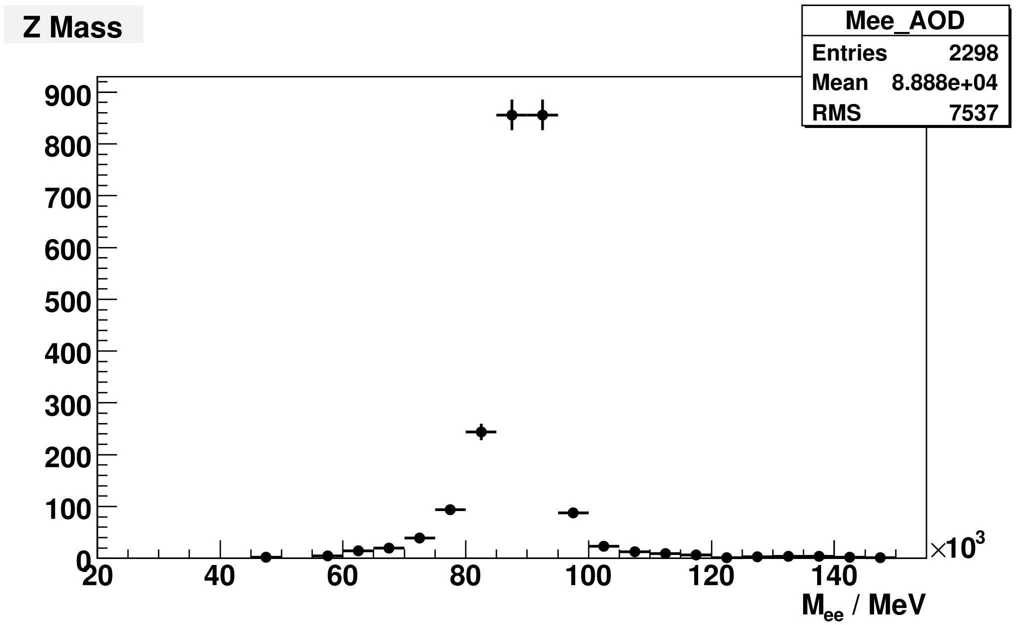


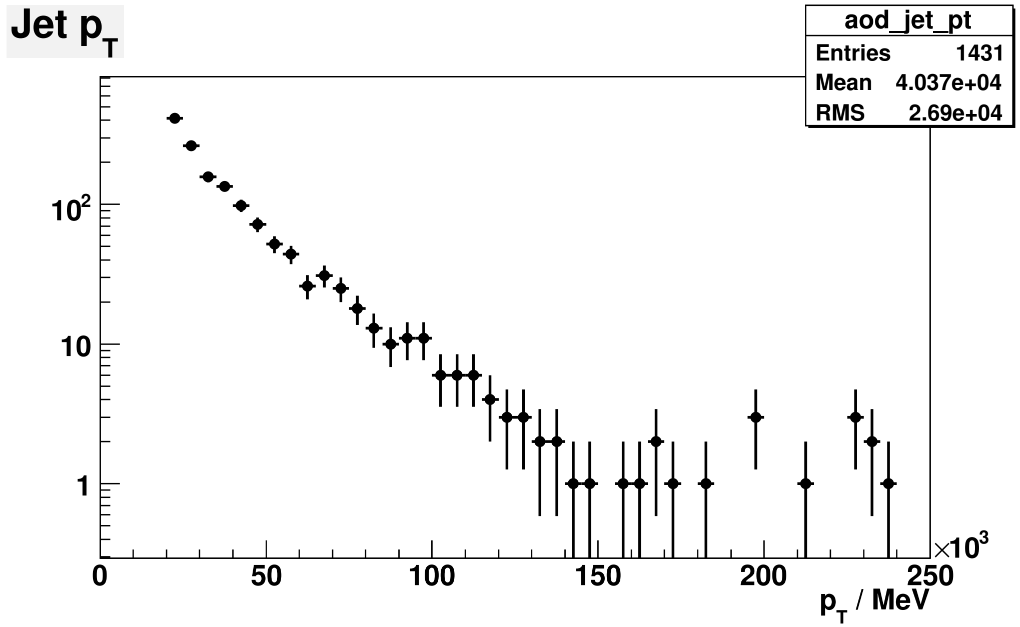
CTEQ below MRST by up to $\times 2$ at low Q^2 but similar at higher scales. Data roughly in agreement but errors large at present

Experimental Method

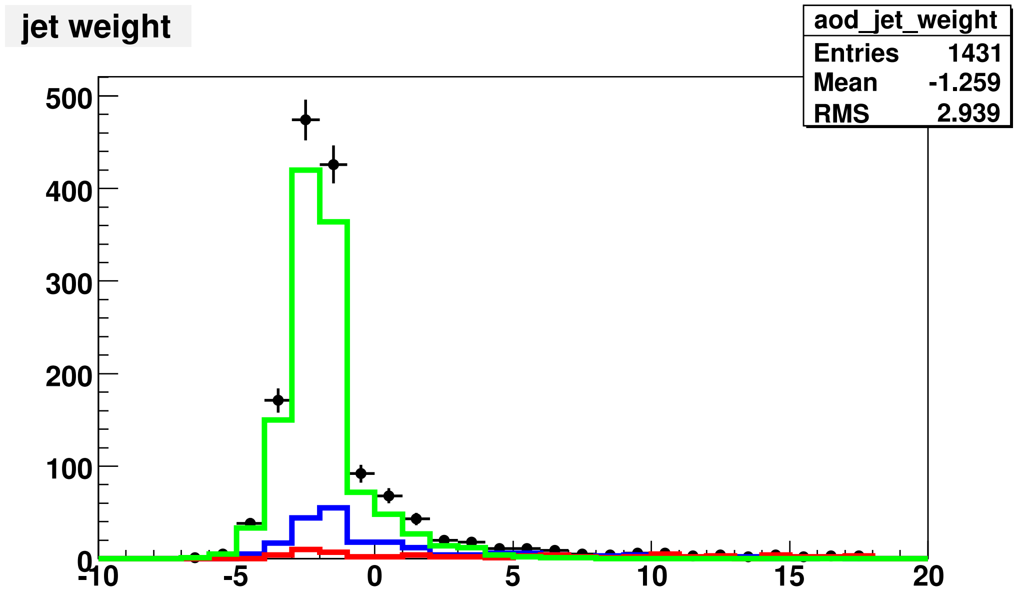
- Reconstruct $Z \to e^+e^-$ with standard HighPtView electron selection.
- Use inclusive Z file: trig1_misal1_csc11_V1.005144.PythiaZee.recon.AOD.v12000601
- Look for jets in the event (topocone1.0 with $\delta R(\mathrm{elec}) > 0.4$)
- Using cone jets 0.7
- Use the standard b tag likelihood ouput (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 $|\eta| < 2$.

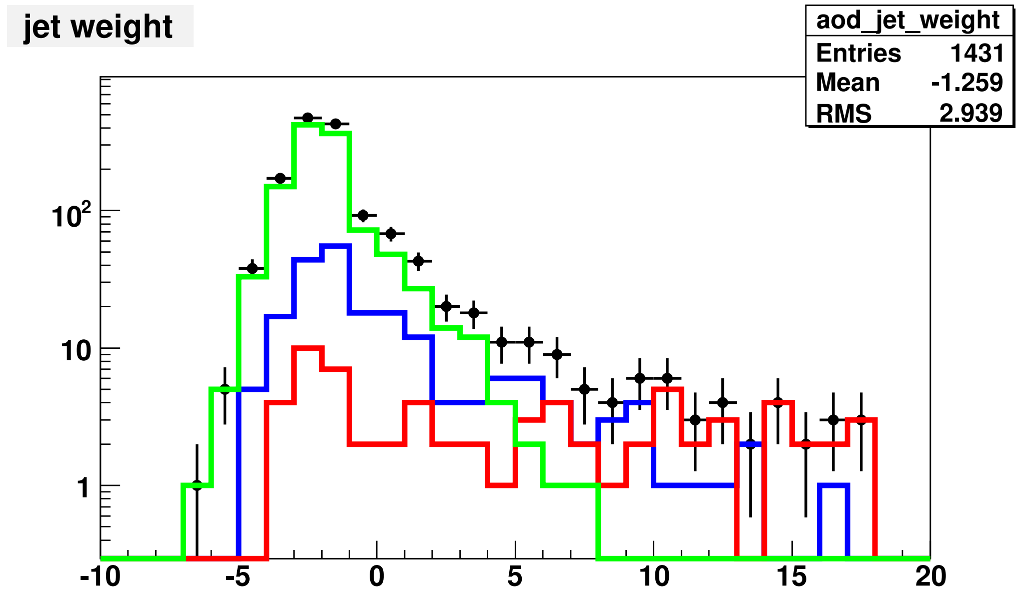
Z mass and jet P_T





b tag likelihood





light, charm, bottom

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.