W+jj status

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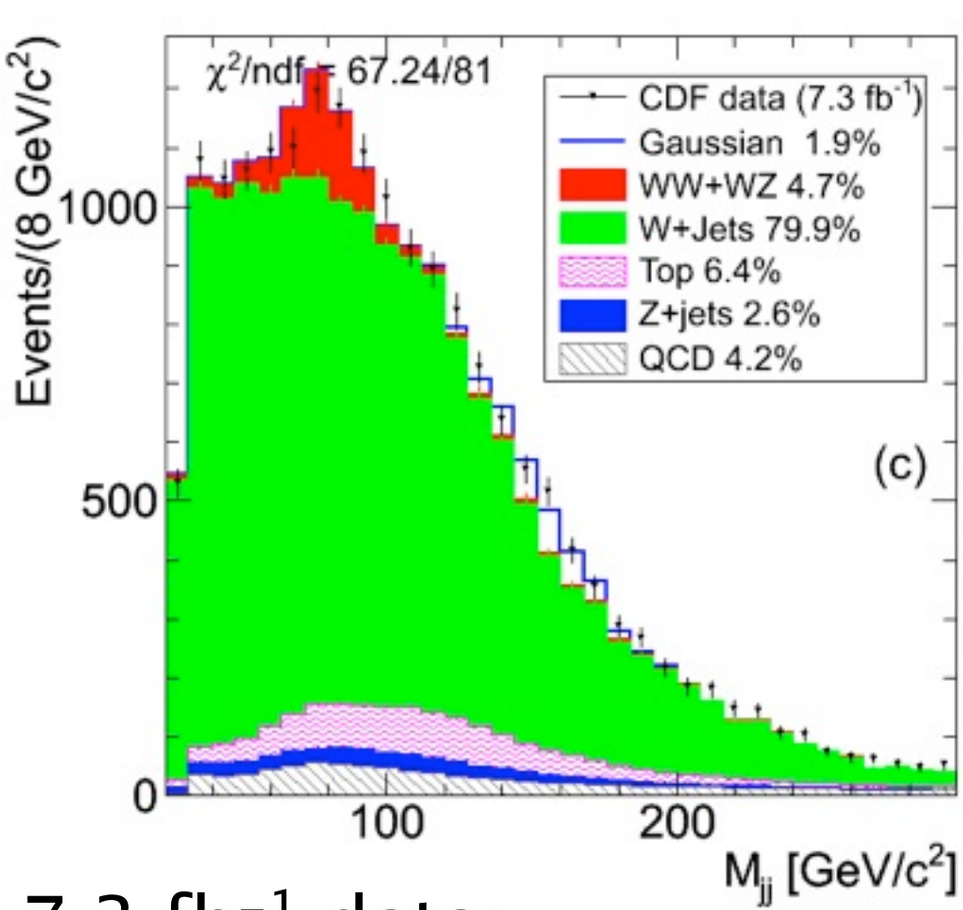
Fermilab

CTEQ meeting

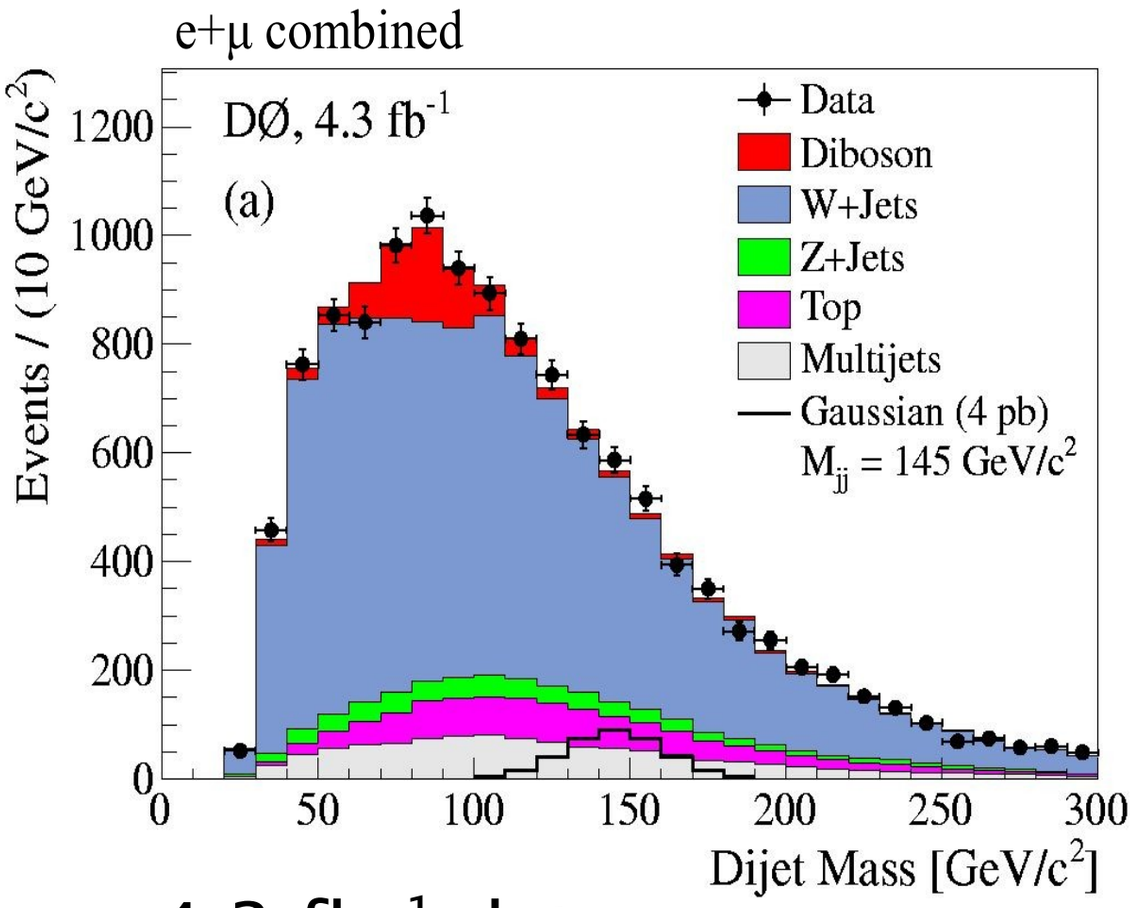
Nov. 17th, 2011

- central lepton (e/μ), $p_{Tl} > 20$ GeV, $|\eta_l| < 1.1$
- MET > 25 GeV,
- 2 jets $p_T > 30.0$ GeV, $|\eta_j| < 2.5$, $\Delta\eta_{jj} < 2.5$
- $p_{T,jj} > 40.0$ GeV
- look in dijet mass spectrum



7.3 fb^{-1} data:

4.1σ excess

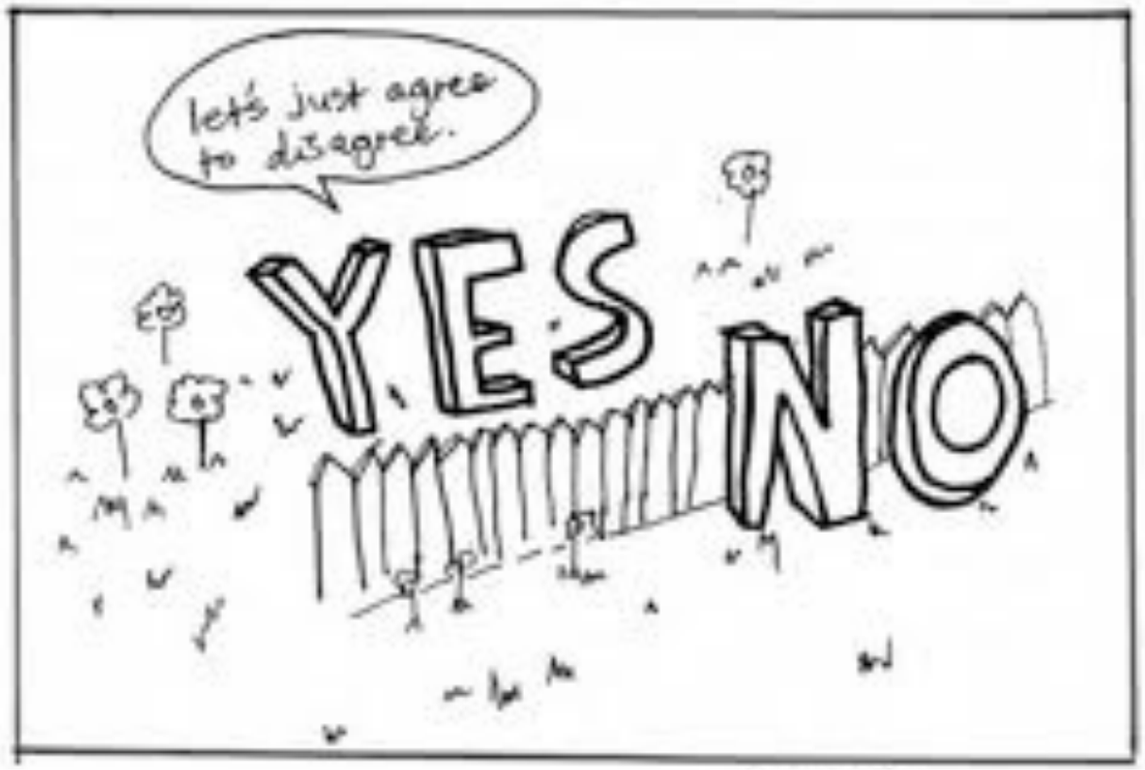


4.3 fb^{-1} data:

consistent with SM

what about this task force?

came.. saw... **agreed to disagree**



issue NOT settled

did get better estimates of how consistent/discrepant results are:

CDF: 3.0±0.7 pb

D0: $0.82^{+0.83}_{-0.82}$ pb

($0.42^{+0.76}_{-0.42}$ pb)

using H(bb)W, m_H = 150 GeV
acceptance*efficiency

& studied how MC choices/tunings effect results

first : quarks vs. gluons

lots of noise about mis-modeled gluon JES as an explanation

CDF response:

- vary $p_{T,2}/p_{T,1}$, changes gluon content (according to LO parton level)
- excess shape and location (M_{jj}) remains intact

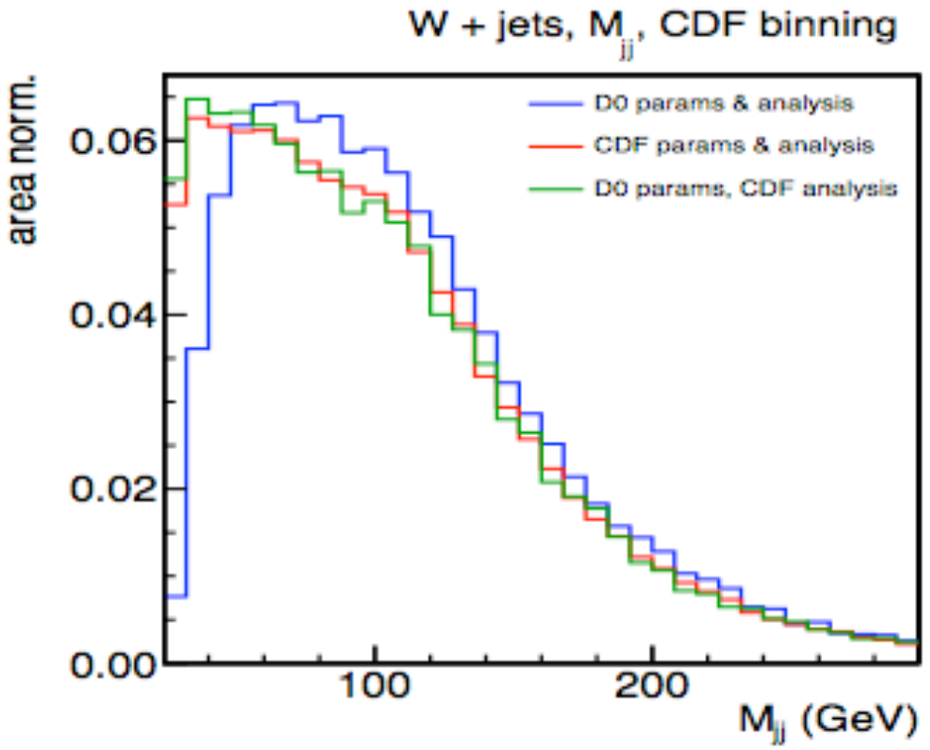
SEE: www-cdf.fnal.gov/physics/ewk/2011/wjj/7_3.html

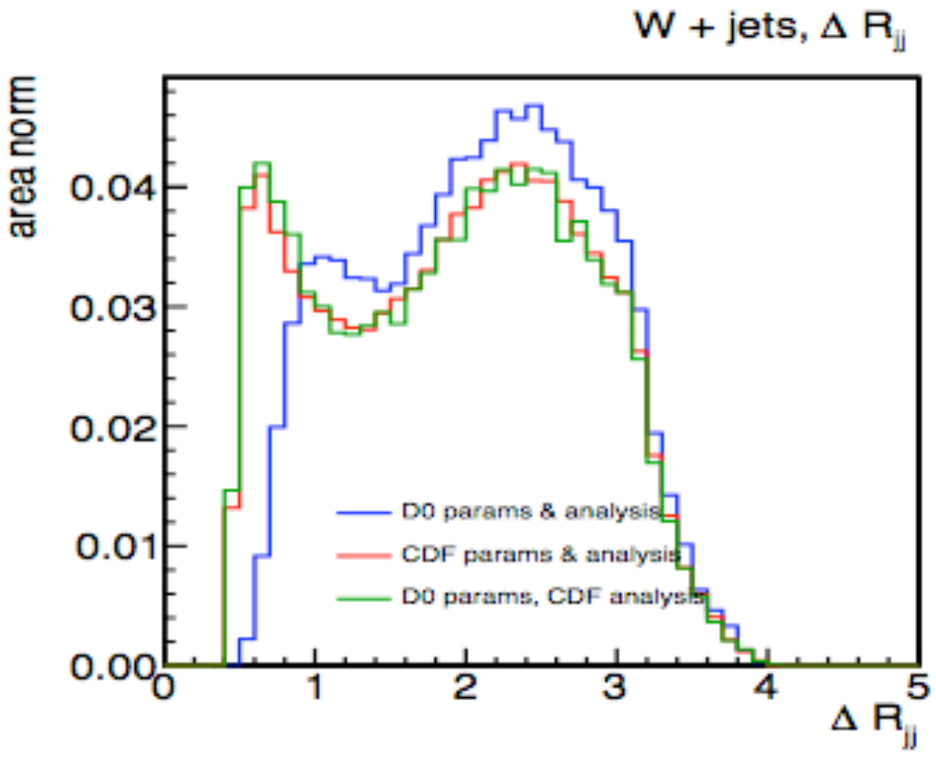
Issue is still being pursued by CDF (see CDF note 10601 (July '11))

but **NO** evidence so far that q/g qualitatively changes result

(despite many, many rumors)

MC studies and cross-checks





CDF/D0 have slightly different MC parameters

D0: p_{Tj} = 8 GeV

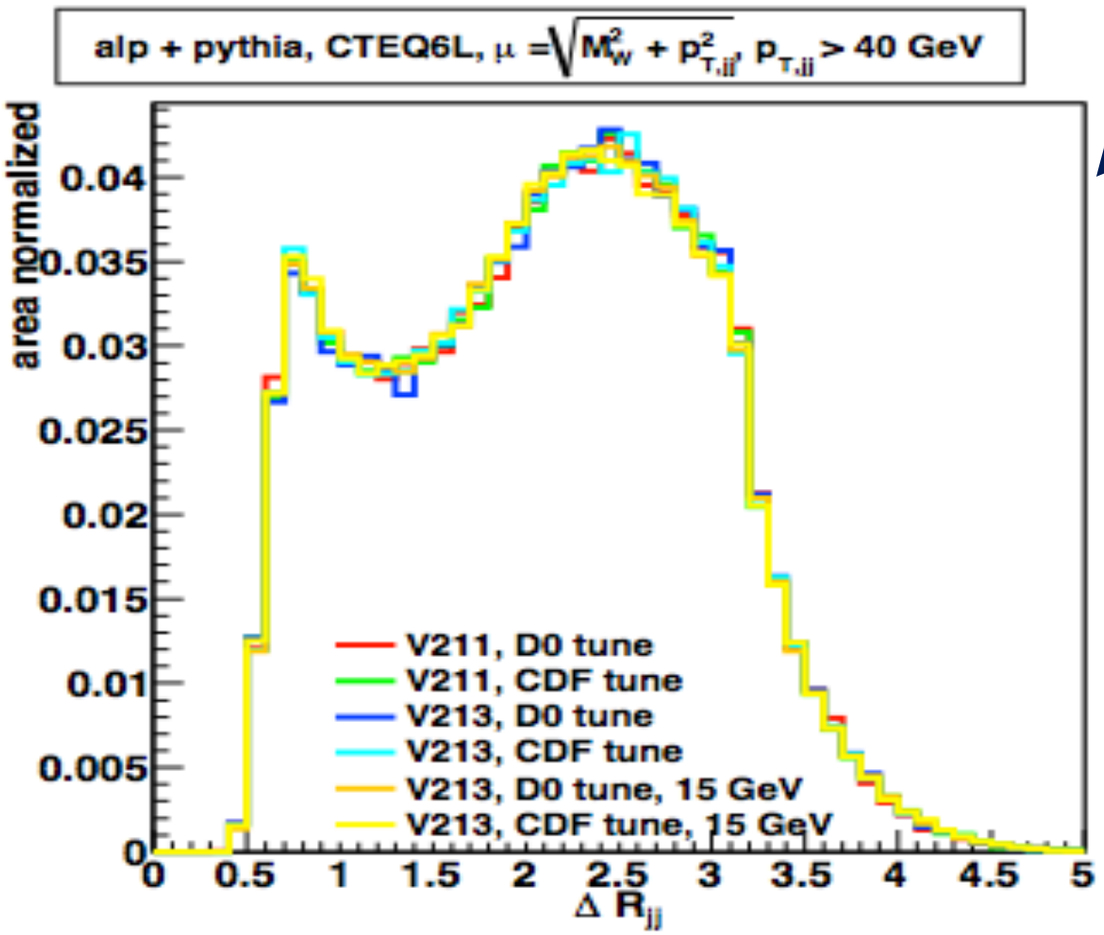
CDF: p_{Tj} = 15 GeV

both use ALPGEN+PYTHIA,
MLM matching,
matching p_T set to jet p_T

red vs. green: result of changing parton-level cuts, matching scale

blue vs. red: result of using R= 0.5 (D0) vs. R = 0.4 (CDF)

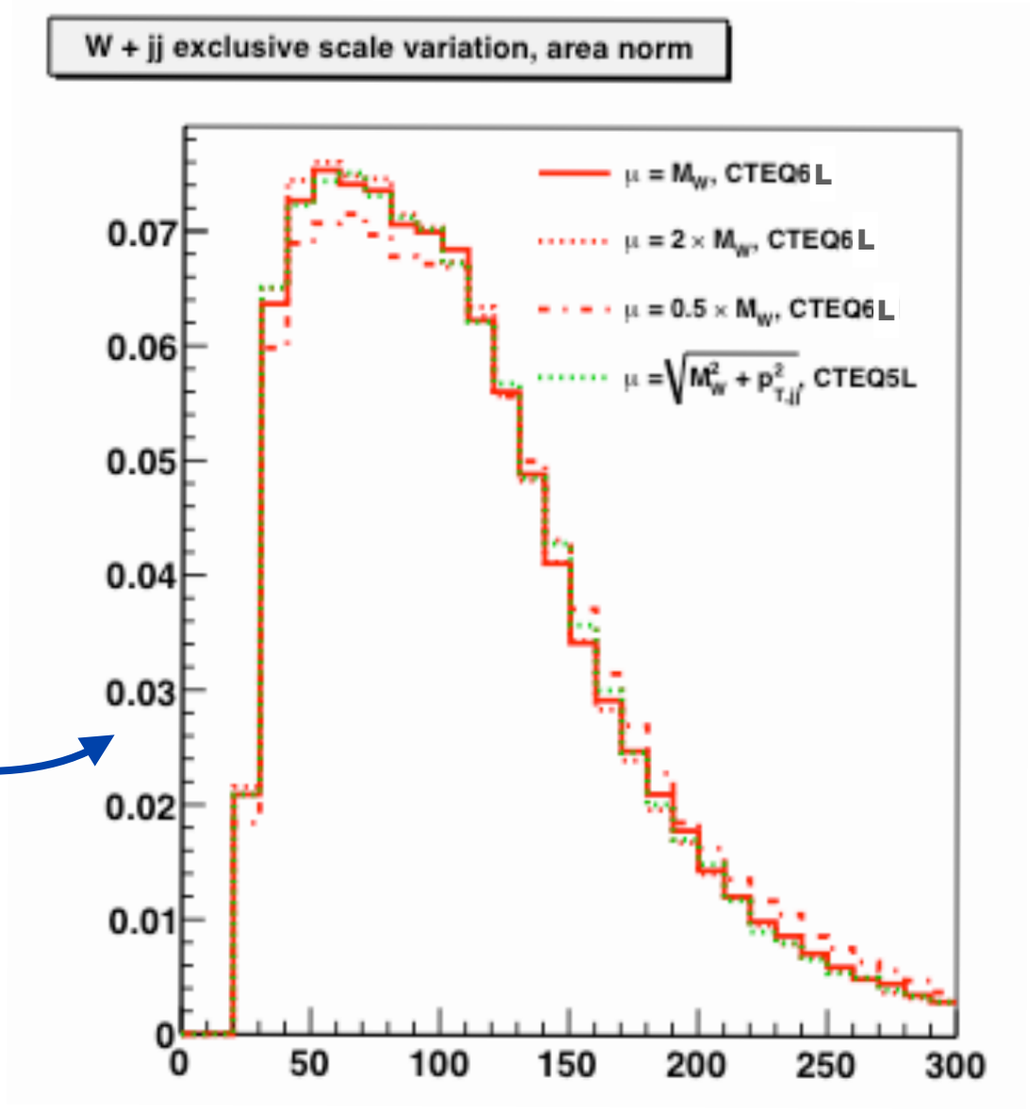
MC studies and cross-checks



different ALPGEN versions,
UE event tunes checked

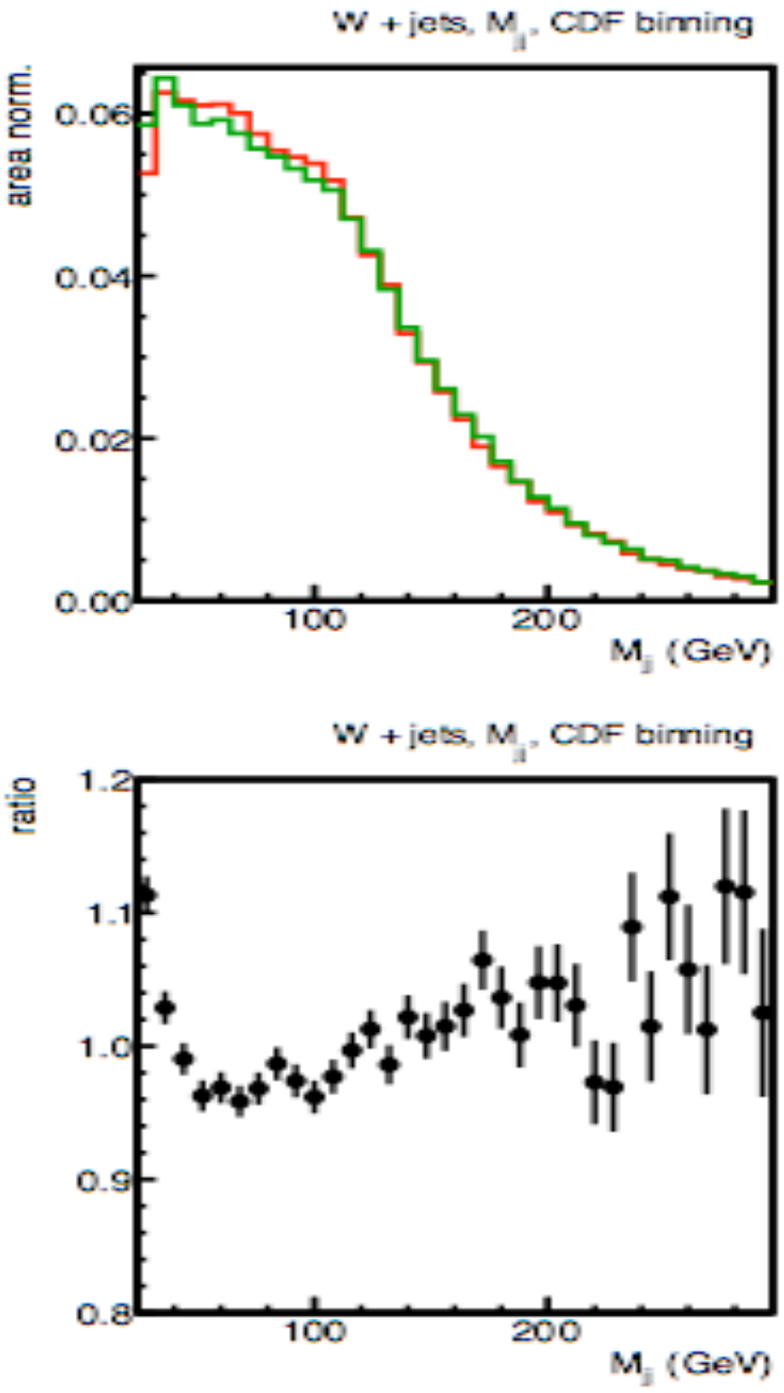
scale & pdf variations
investigated, very little effect
on shape

all with 'CDF cuts'



MC studies and cross-checks

for many more plots, see http://home.fnal.gov/~aomartin/jet%20composition/jet_compositon/jet_composition.html



shower dependence:

same ALPGEN events run through PYTHIA (red) and HERWIG (green)

analyzed with "CDF cuts"

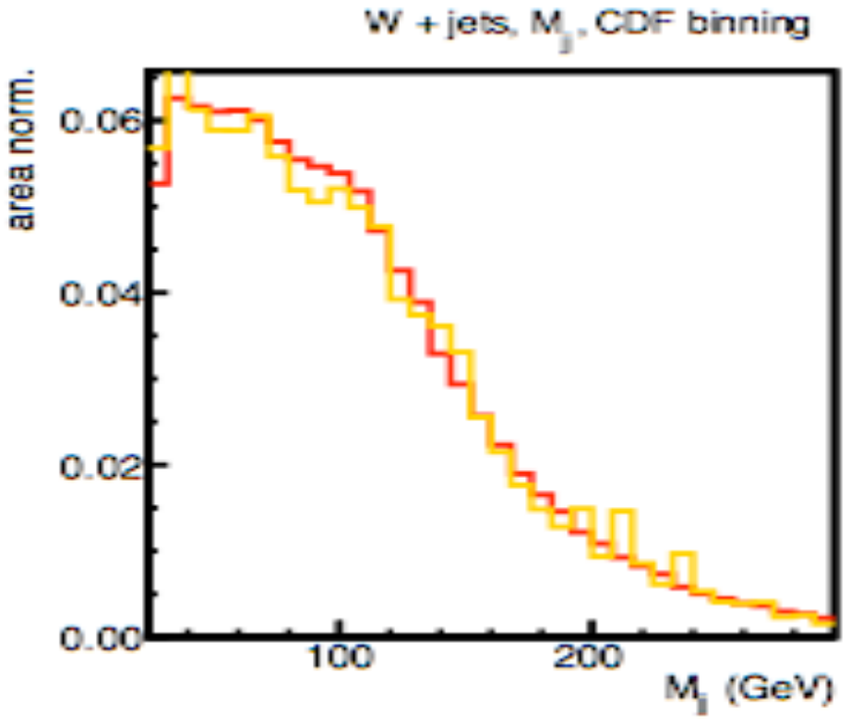
NLO studies:

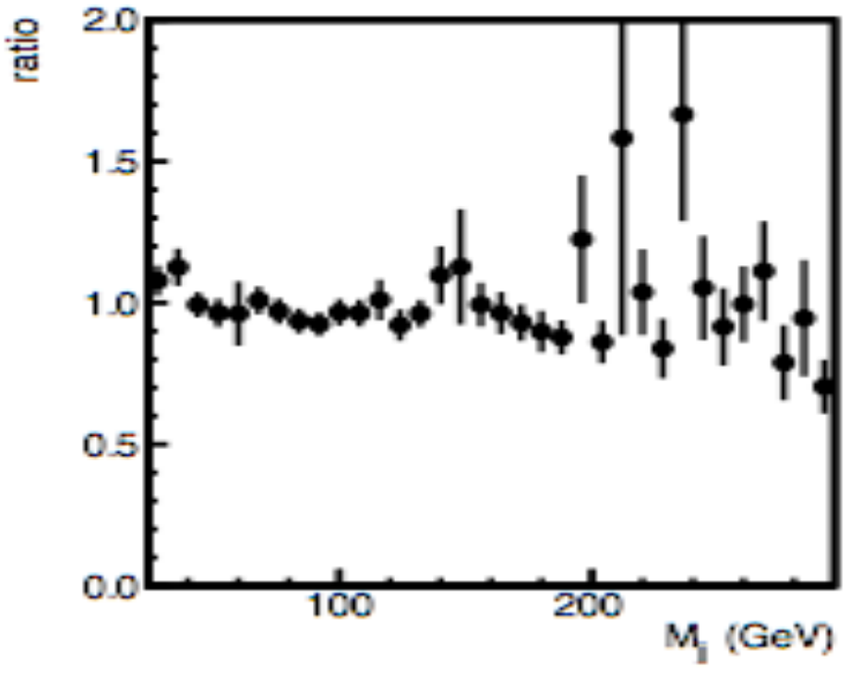
- shape of backgrounds, % consistent with CDF
- no surprising K factors (MCFM, CDF cuts)

(Campbell, AM, Williams 1105.4594)

recent NLO+PS study (Frederix et al 1110.5502) reaches similar conclusions

MC studies and cross-checks





ALPGEN + PYTHIA (red)

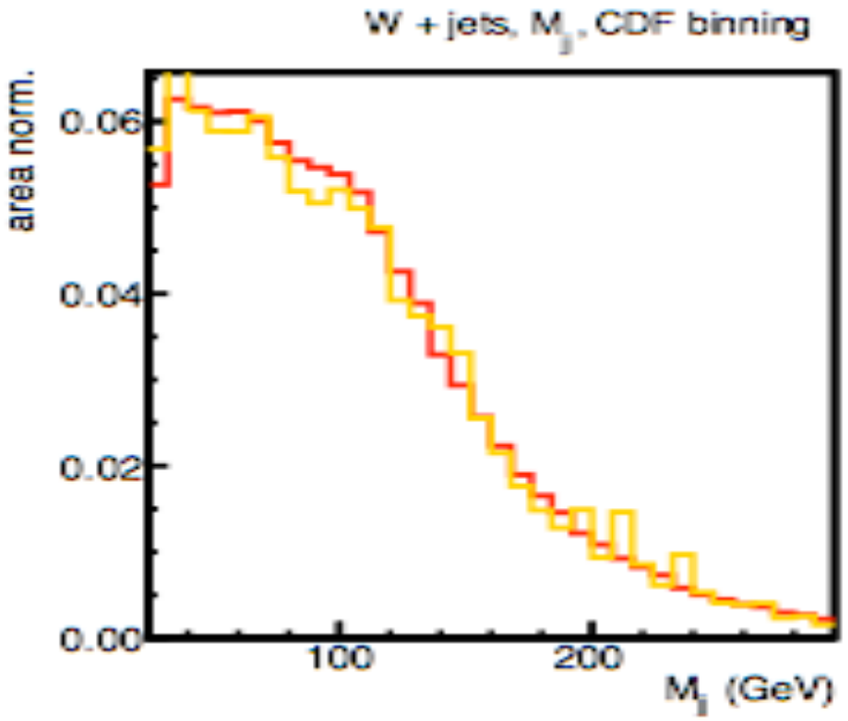
vs.

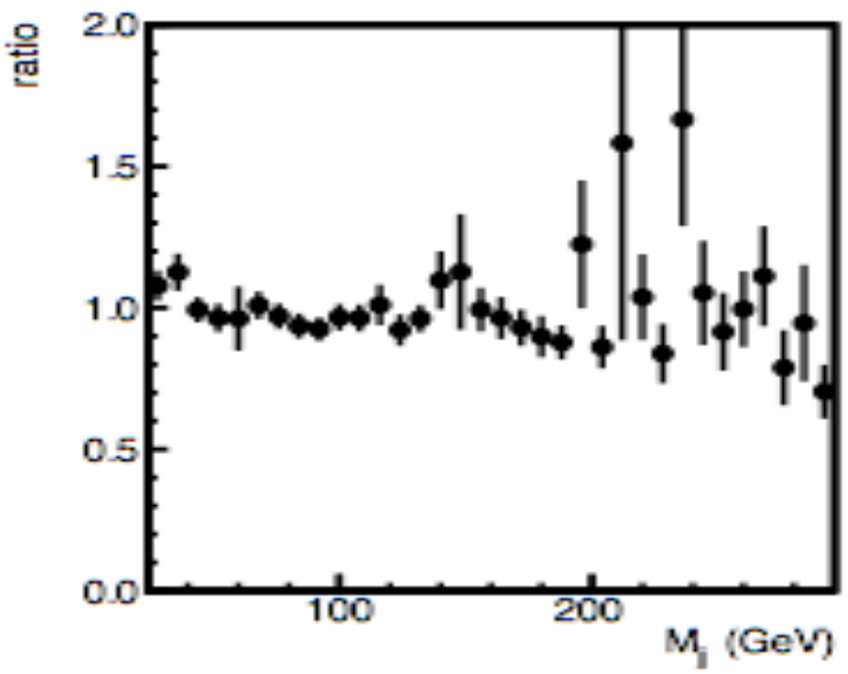
SHERPA (orange)

different ME/matching/pdfs/shower

analyzed with "CDF cuts"

MC studies and cross-checks





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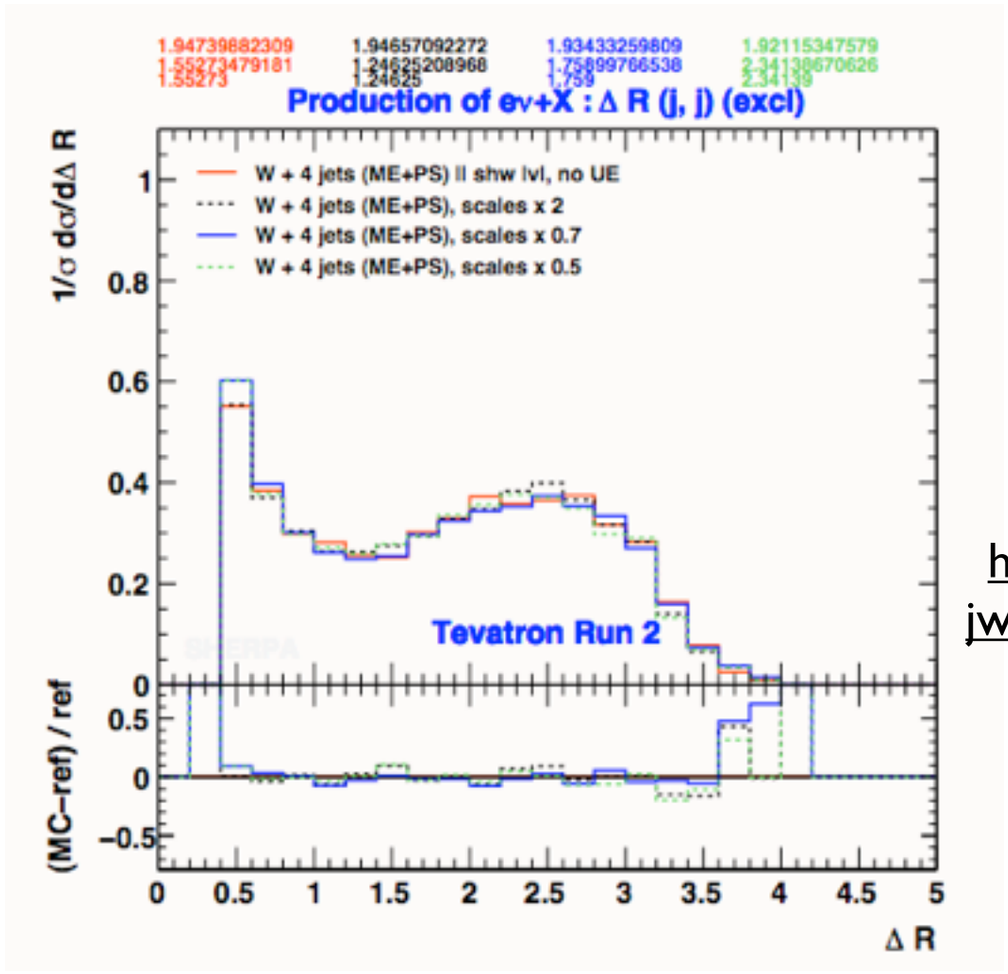
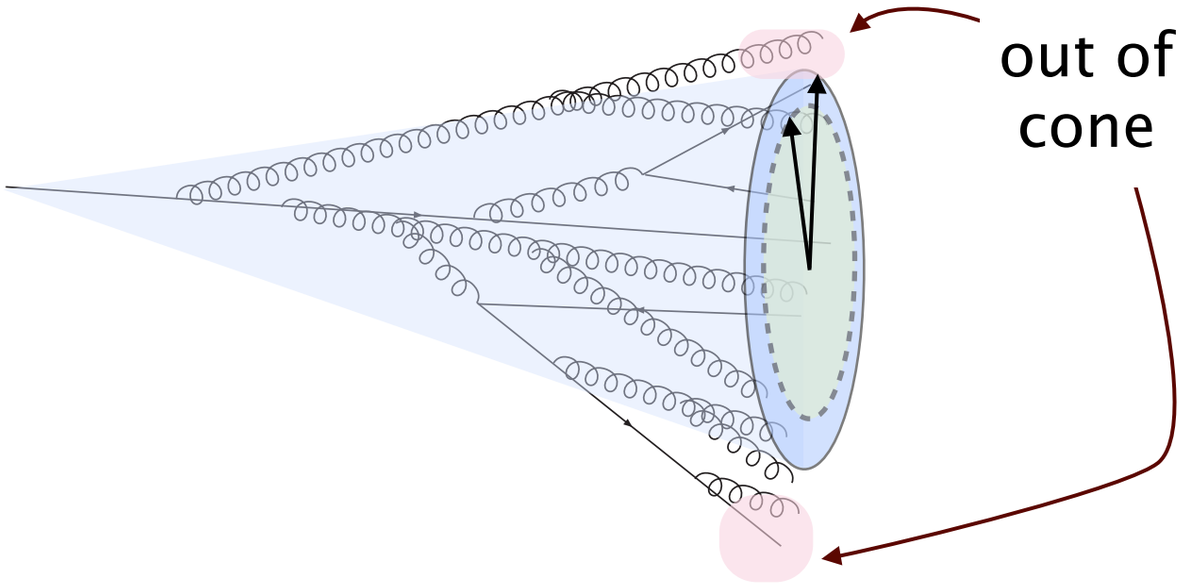


scale dependence also checked w/in SHERPA
(J. Winter, CERN)

http://jwinter.web.cern.ch/jwinter/Temp/Project/cdfwjj/

what could it be?

D0 adds in `out-of cone' radiation, CDF does not
(not clear they have the same definition of 'out-of-cone')



leads to slightly different
definition of jets

CDF excess is quite sensitive to p_T

jet p_T > 30.0 GeV : 3.2 σ
jet p_T > 20.0 GeV : 1.1 σ

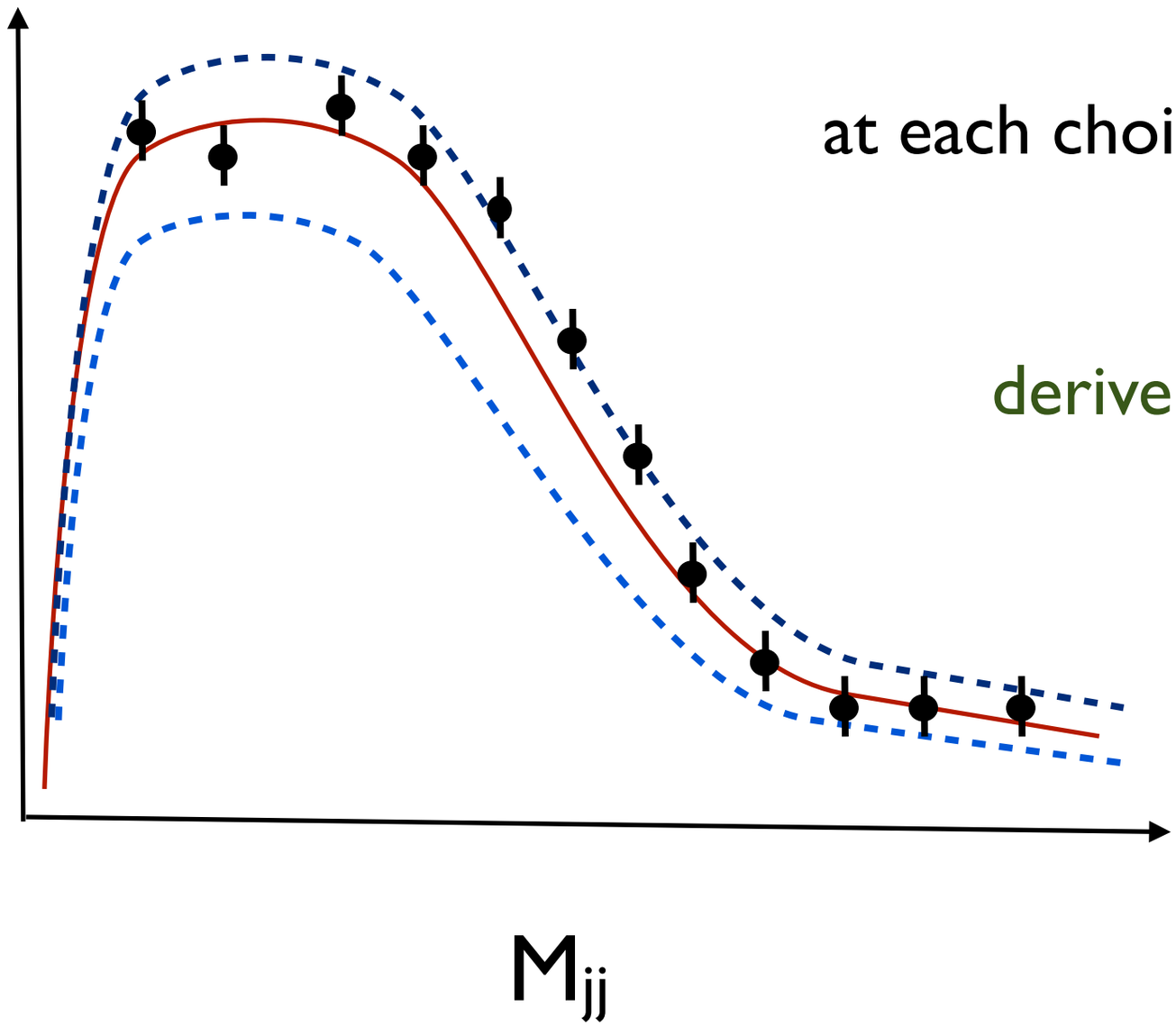
at 4.3 fb^{-1}

analysis with harder p_T cuts would **really** clear this up.
& could also lead to much higher S/B

treatment of systematics

CDF way:

vary systematics (Q^2, matching scale, pdf) in discrete steps (ex. $2Q^2$, Q^2, $0.5Q^2$)



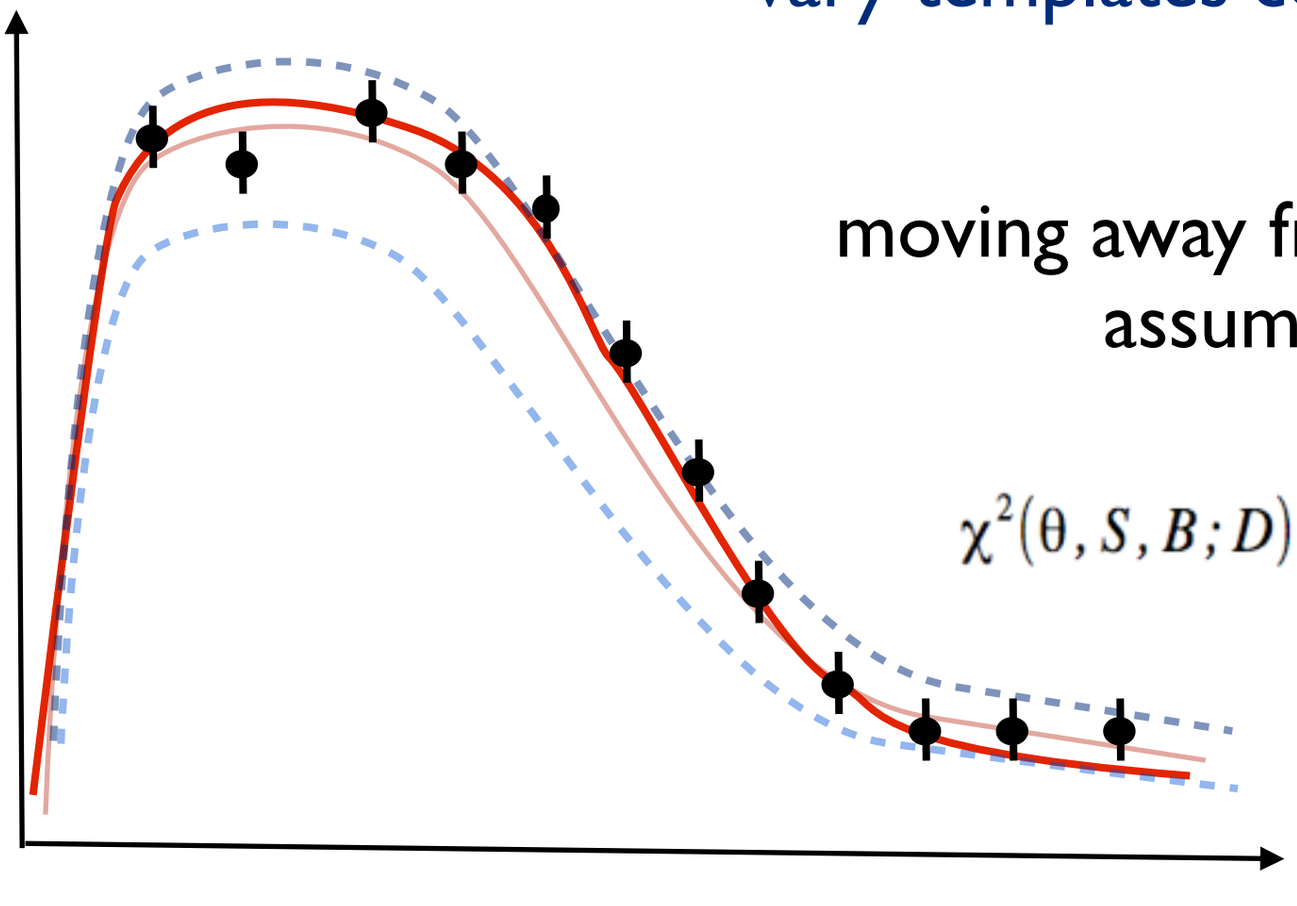
at each choice (all combinations), find p-value

derive significance from maximum p-value

treatment of systematics

D0 way:

vary templates continuously, fit to M_{jj}



moving away from central template adds to χ^2, assuming gaussian distribution

$$\chi^2(\theta, S, B; D) = 2\sum_{i=0}^{N_{bins}} (B_i + S_i - D_i) - D_i \ln\left(\frac{B_i + S_i}{D_i}\right) + \sum_{k=0}^{N_{syst}} \theta_k^2$$

In addition to systematics common to CDF, additional systematics used:

ΔR correction, $p_{T,W}$ correction

- definitions?
- derived 'from data' but not clear what data

treatment of systematics

Are the discrete systematic steps by CDF adequate?

- CDF analysis using D0 systematics approach (but not extra syst.)?

Are D0 assumptions about variation of systematics sensible?

- what are posterior fit values?
- fit without extra corrections?

If different treatment of systematics can cause such effects
--> we're in **deep** trouble

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Are the discrete systematic steps by CDF adequate?

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underway?

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Are the discrete systematic steps by CDF adequate?

- CDF analysis using D0 systematics approach (but not extra syst.)?

underway?

Are D0 assumptions about variation of systematics sensible?

- what are posterior fit values?
- fit without extra corrections?

never given

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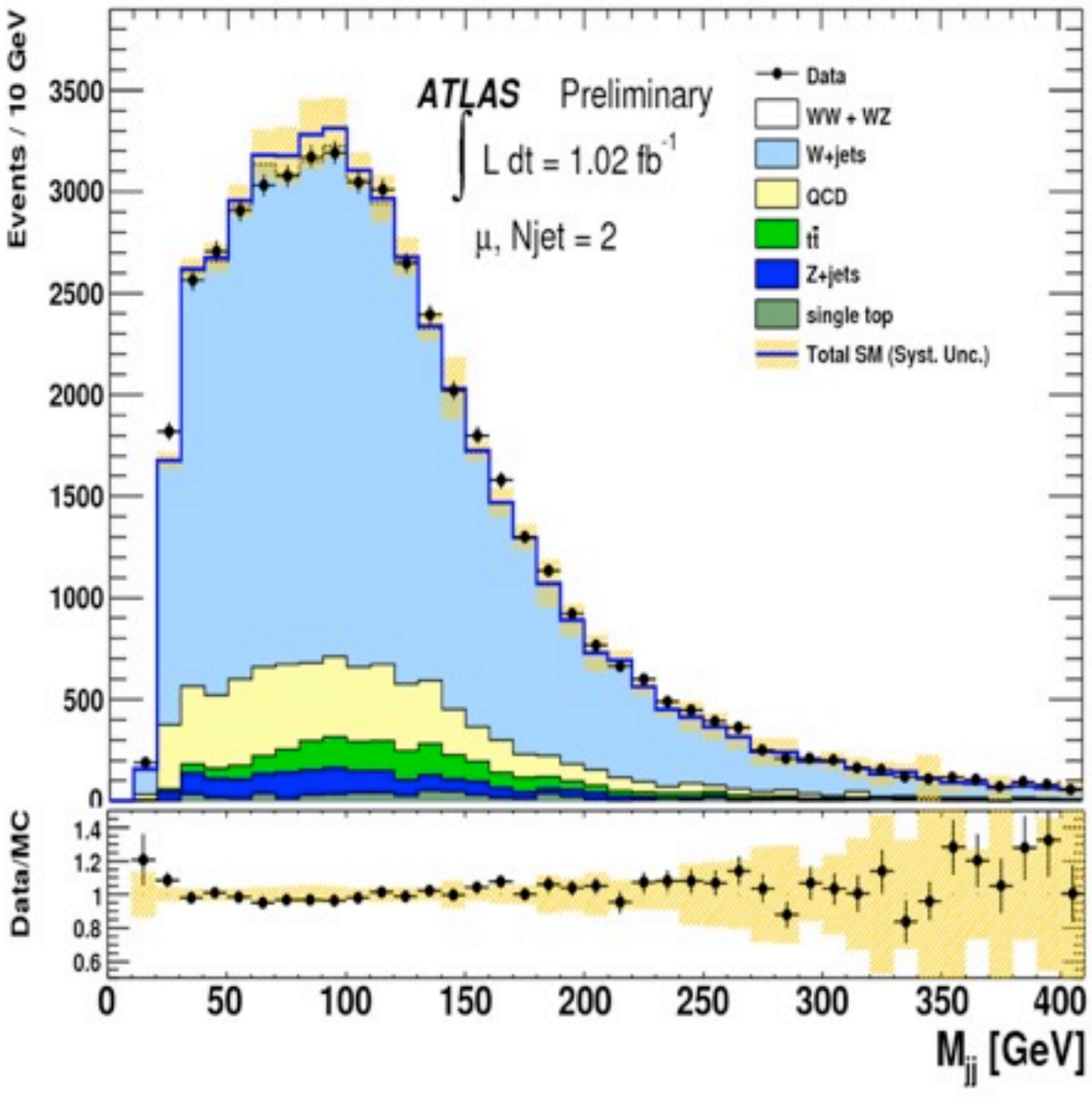
@ the LHC?

difficult to study at the LHC:

- W+jets increases by x10,
- qqbar induced processes only increase by ~ x4



ATLAS analysis (1 fb-1) sees no deviation from SM

rules out glue-induced or large coupling new physics

not yet sensitive to WW/WZ

estimate that ~5^{+} fb^{-1} needed for 3σ (stat) if qqbar induced NP. syst?

(Eichten, AM, Lane 1107.4075, Buckley et al 1107.5799)

Conclusions

discrepancy between CDF & D0 in Wjj remains unresolved

quark vs. gluon JES is being studied, but **no** evidence that varying it changes result

MC choices (generator, shower, pdf, matching) appear to have little effect in the region of interest

biggest difference is systematics ... NEEDS to be understood