Issues in verification of ALPGEN heavy flavor production

Regina Demina

University of Rochester

with

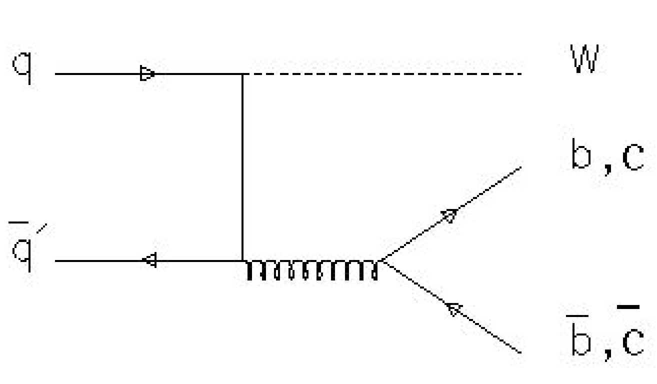
M. Begel, T.Ferbel, M. Zielinski

Outline

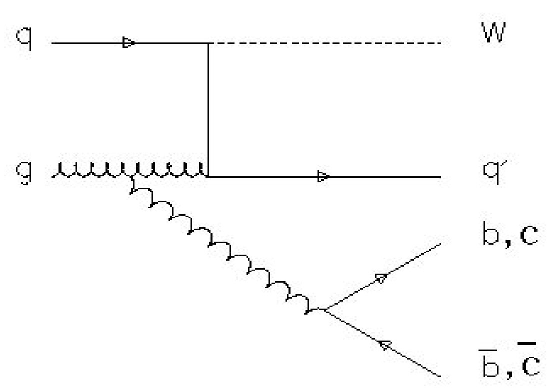
- Mechanisms of heavy flavor production
  - In association with W-boson
  - In multijets
- Run 1 approach to MC verification
  - Problems
- Fractions of heavy flavor and Angular correlations
- Summary: What can and what cannot be measured

SM W+heavy flavor production.

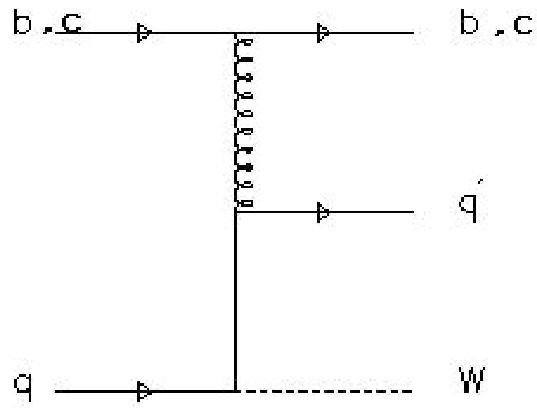
Final state gluon splitting



Initial state gluon splitting

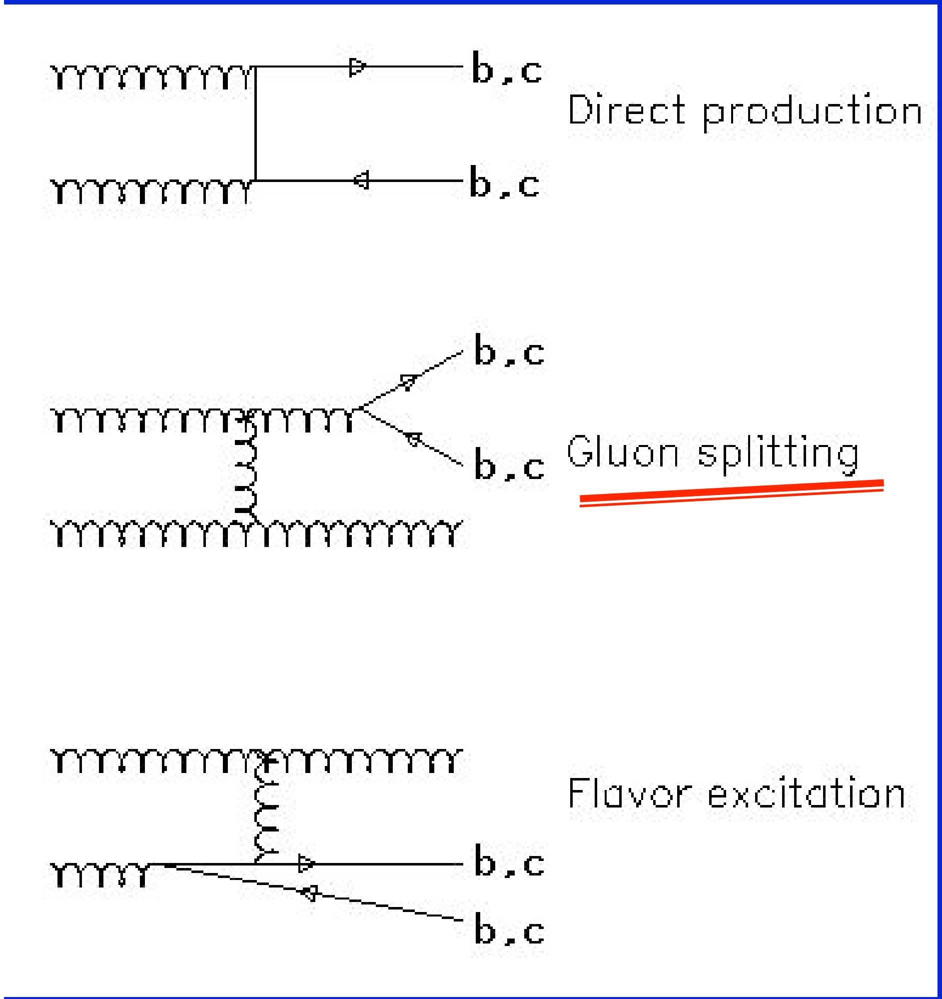


Flavor excitation.



These processes can only be separated at the ME level. For x-section calculation, interference must be accounted for.

Heavy flavor production in multijets



•Run 1 approach:

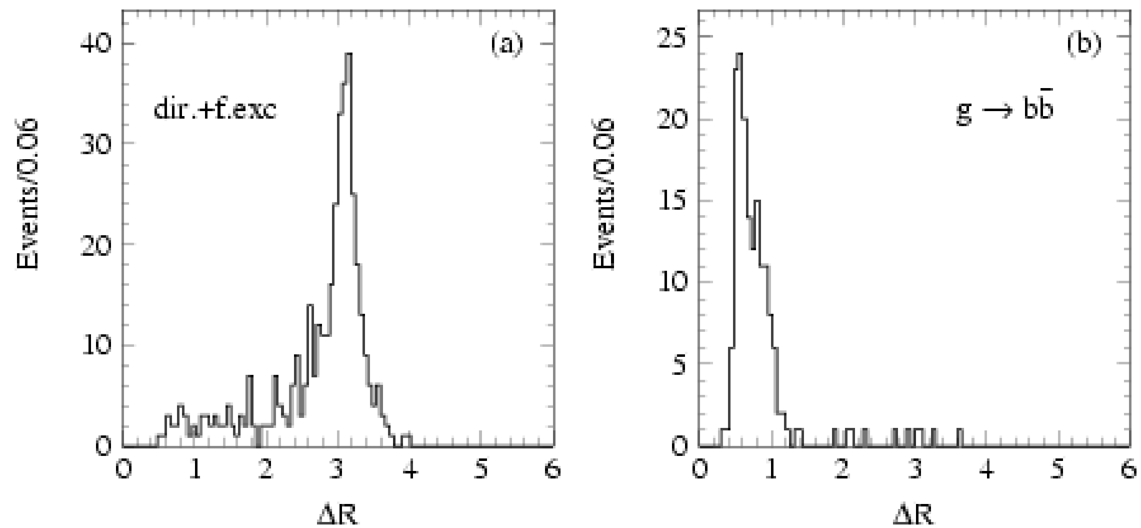
•Use high statistics QCD samples to calibrated MC prediction for gluon splitting component on data.

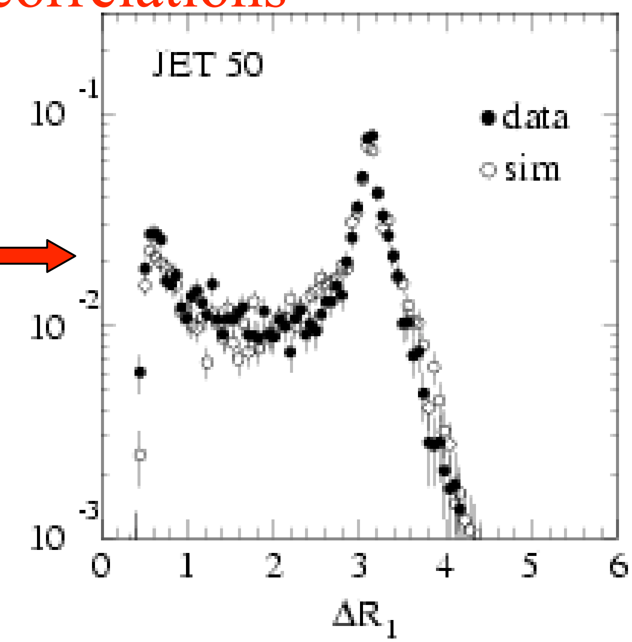
•Tag jets using different methods – lifetime or lepton.

• $\Delta\phi$ or ΔR are typically used to distinguish different mechanisms of h.f. production.

CDF Run 1 tt x-section

Herwig (parton shower) prediction for angular correlations





Process	Cross section weight
b direct production+flavor excitation	1.09 ± 0.15
$g \to b\bar{b}$	1.40 ± 0.19
b Total	1.22 ± 0.12

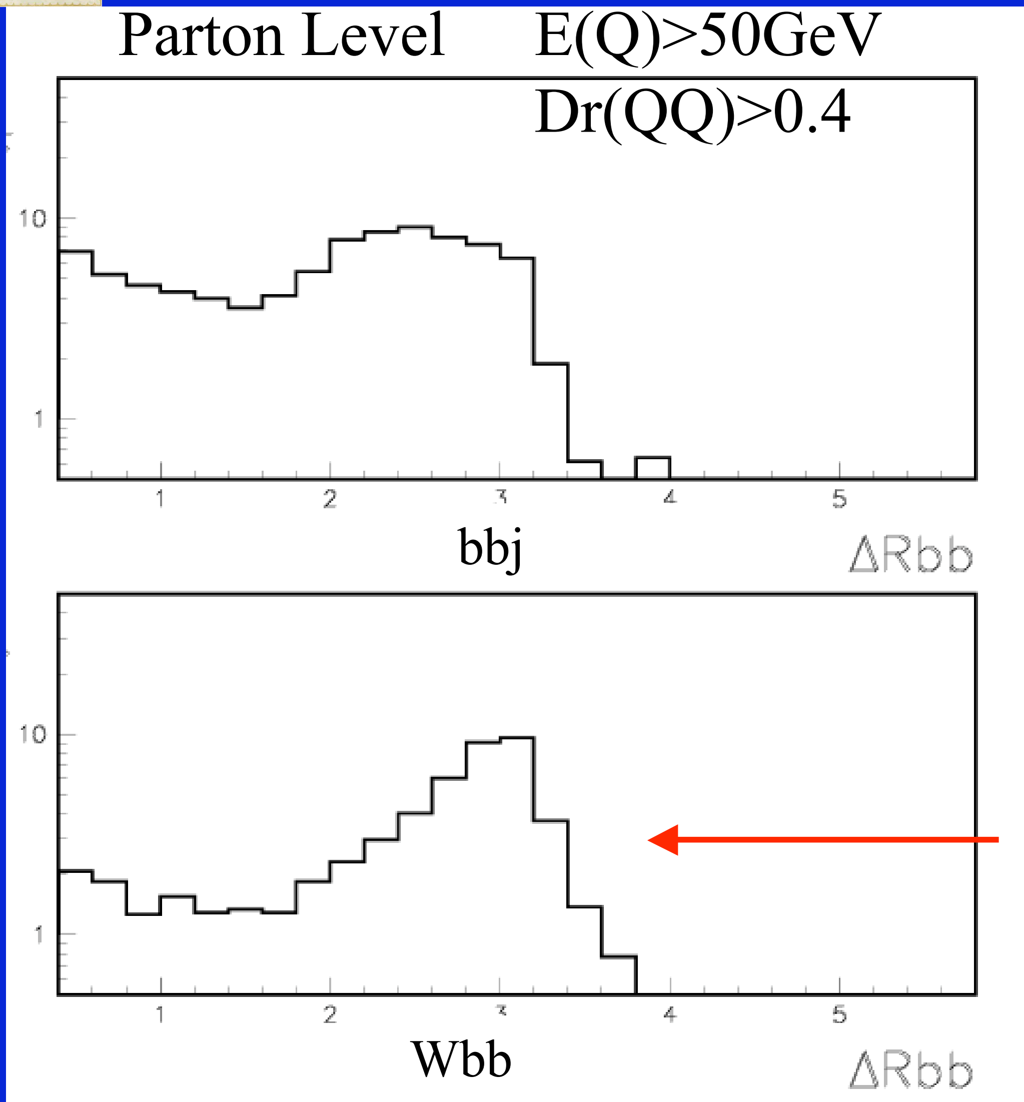
Wbb scaled up by this factor → 1.40 ± 0.19

T. Affolder et al., The CDF Collaboration, Phys. Rev. D64, 032002 (2001).

Problems with this approach

- Assume in Wbb (bb) comes
  - predominantly from g→bb production
  - shower evolution
- Neglect interference terms in multijet production
- Use parton shower approximation in multijet production
- Combine LO with NLO
  - bb with bbj
- **Advantage**
  - Tunable parameter – f(g→bb)

ALPGEN: bbj and Wbb



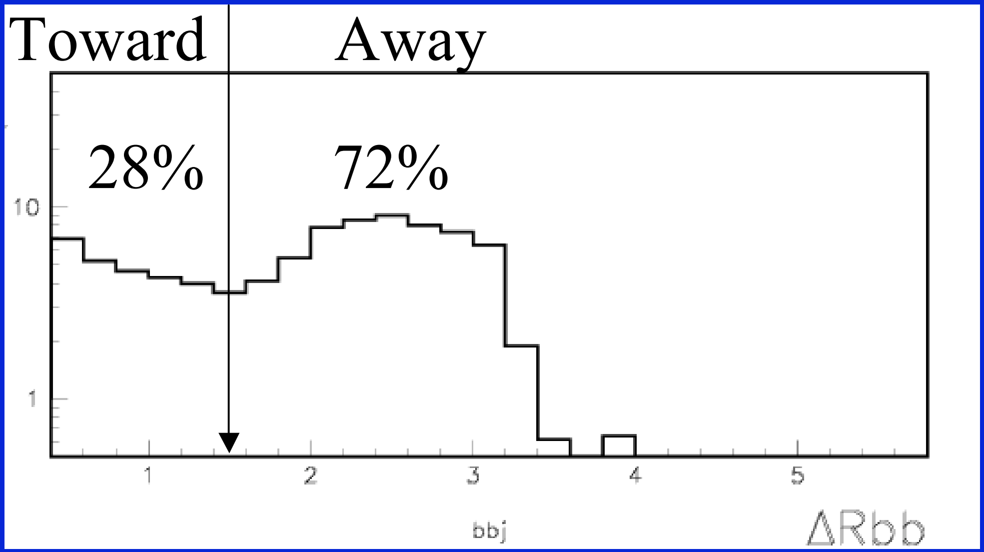
- ME level calculation
- Deals with exclusive final states
  - bbj, Wbb, not
  - bb+>=0j
- No artificial separation between production mechanisms
- ME g→bb does not look like parton shower g→bb

ALPGEN verification

- Still work under the assumption that by comparing data and MC in multijets we verify WQQ production
- But no tunable parameter (cannot separate g→bb)
  - Difficult to quantify the level of agreement
- Need to work with exclusive final states, e.g. bbj
  - Loss in statistics
  - How to relate observed 3j to 3 partons

bbj observables

- Fraction of bbj in jjj
- Compare distribution in Dr(bb), or
- Ratio of away/toward jet (R. Field's terminology):
  - DR(bb)<1.5 – toward jet
  - DR(bb)>1.5 – away jet



DØ Statistics

- b-tagging ε~40%, double tagging ~16%
- Wbb:
  - Wbb/Wjj = 1.17%
  - #observed events(Wjj)=~2300/100 pb^{-1} =>4 double tagged events/100pb^{-1}
- bbj:
  - bbj/jjj=1.41%
  - #observed events(jjj)=1 million/100pb^{-1} (in trigger JT65) => ~2000 double tagged events/100pb^{-1}

Summary: What can and what cannot be measured

- ME level Monte Carlo
  - Correct handling of parton multiplicity
  - Interference included
  - ME instead of parton shower (very different angular correlation)
  - No obvious tunable parameter in the model (too predictive) => no f(g→bb)
- Use 3jet final state to compare data and MC
  - bbj/jjj ratio
  - Toward/away ratio
  - Problem: parton vs jet counting