Backgrounds to ttbar and Heavy Flavor Production Mechanisms

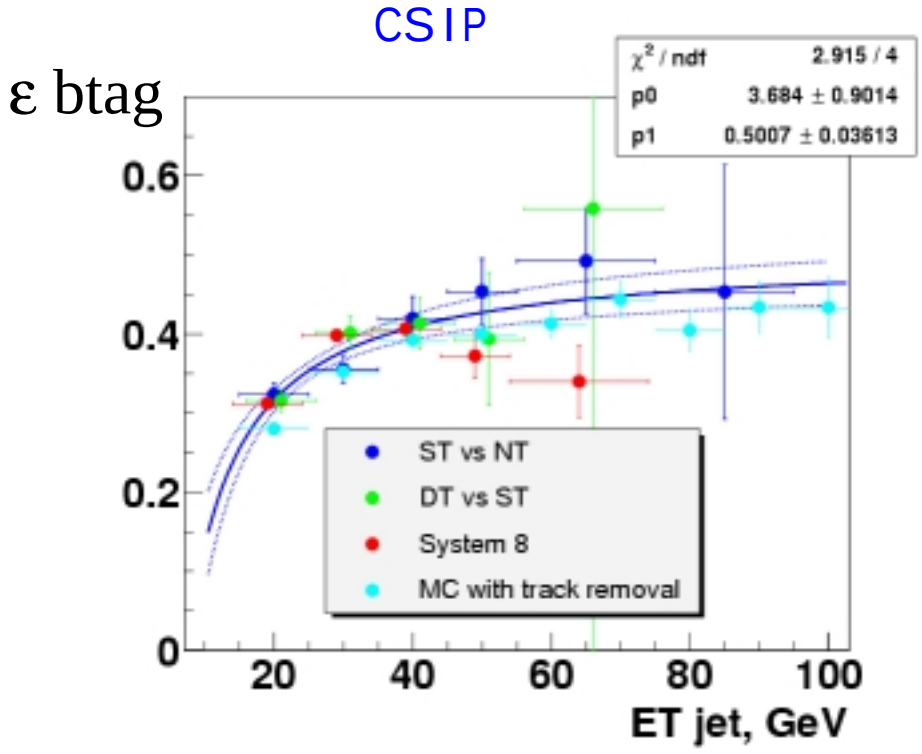
Regina Demina
August 8, 2003

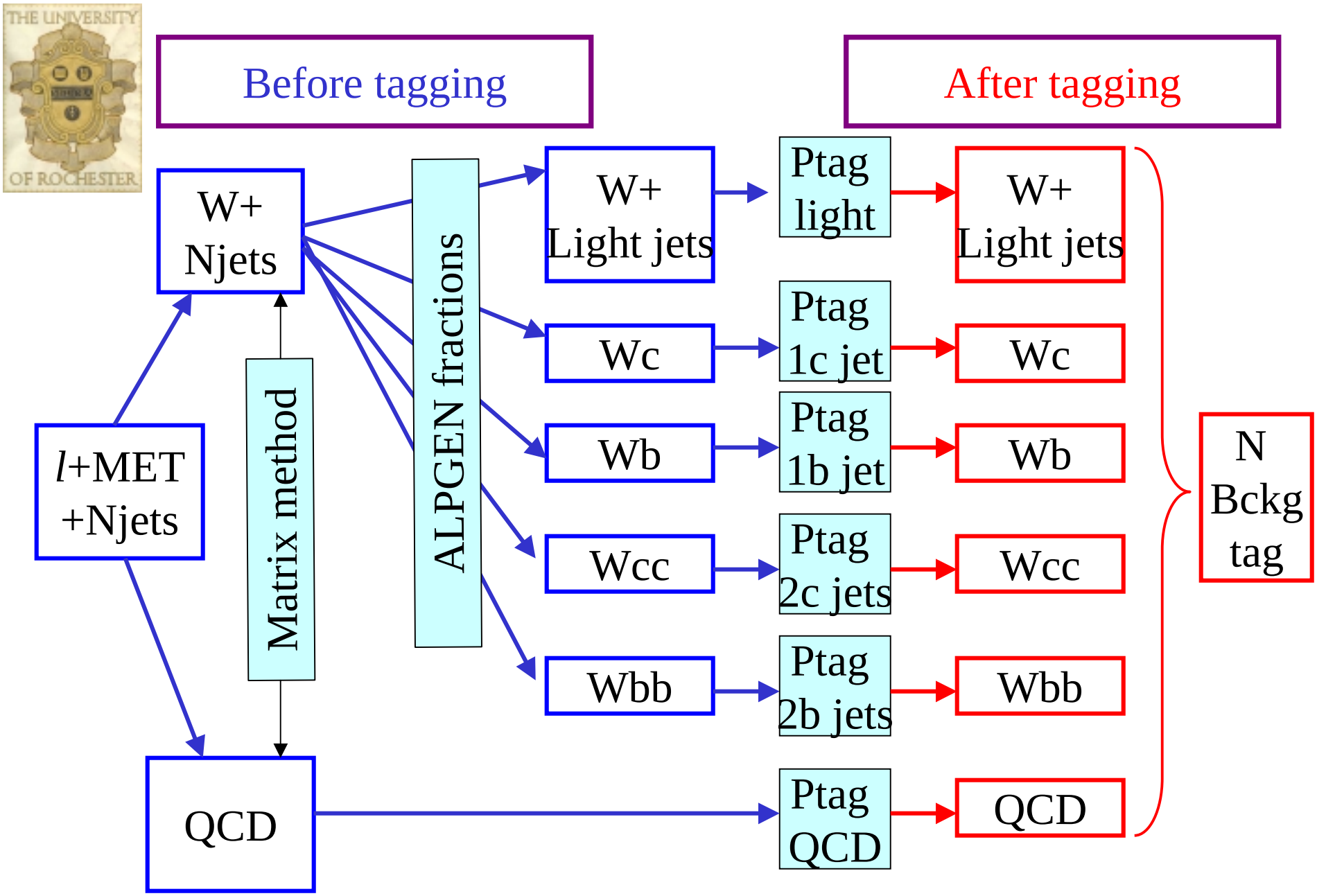
Outline

- Status of top production x-section using b-tagging
- Backgrounds to ttbar
- Heavy flavor production mechanisms and review of run 1 results
- Possible course of action

Ttbar production

- T→W b
- Two b-jets in the final state, b-tag at least one ~45%
- Top signal is extracted as an access over the expected in background in W+>=3 jets

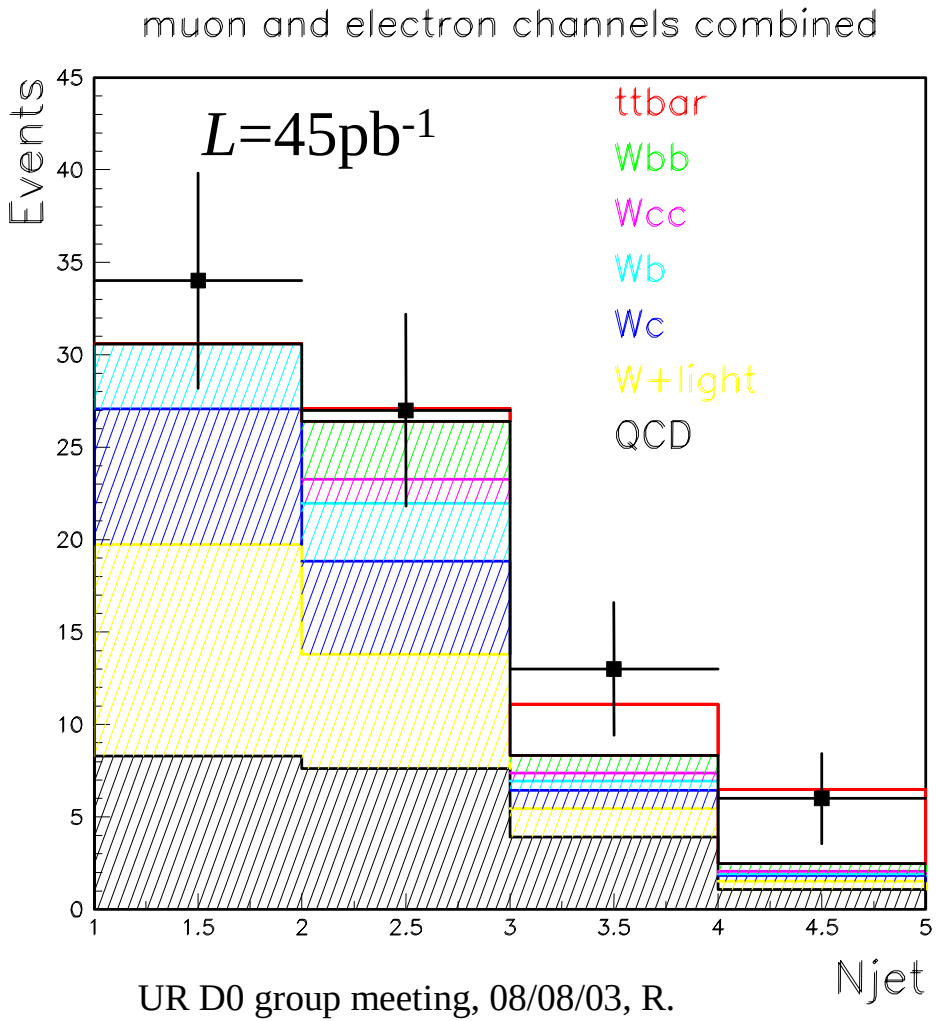




ALPGEN fractions were not verified on data yet.

Ttbar production cross section

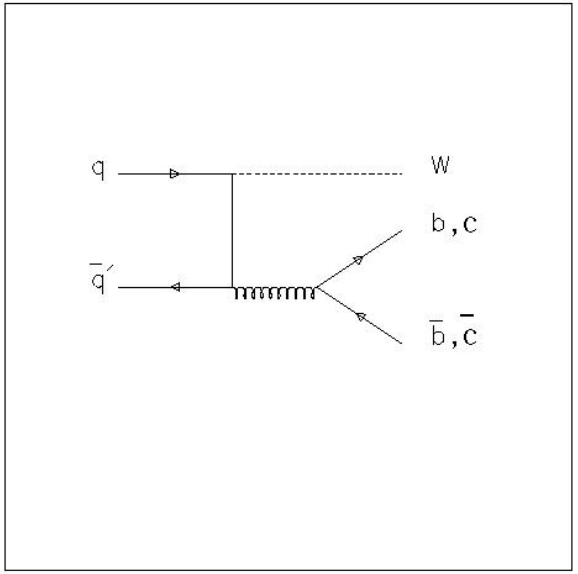
$$\sigma = 7.4^{+4.4}_{-3.6}(\text{stat})^{+2.1}_{-1.8}(\text{sys}) \pm 0.7(\text{lum})\ \text{pb}$$



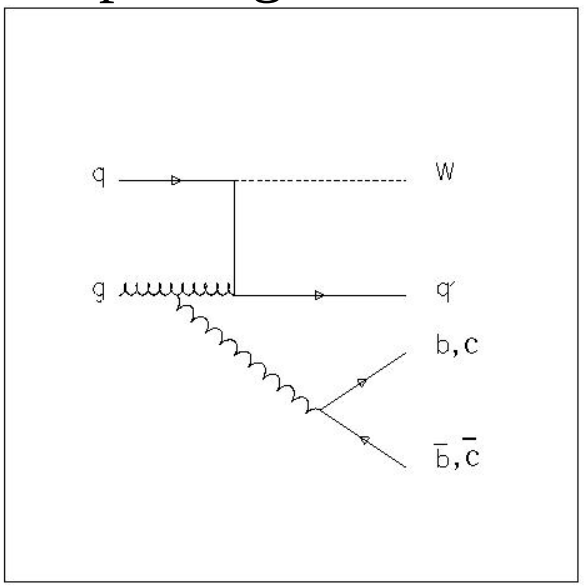
- *Allow 3 or more jets in lepton+jets channel, but apply b-tagging*
- First time in DØ use lifetime based b-tagging!

SM W(Z)+heavy flavor production.

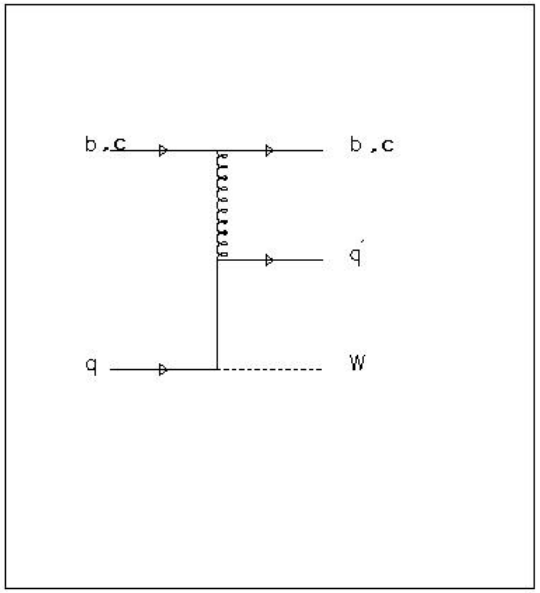
Final state gluon splitting

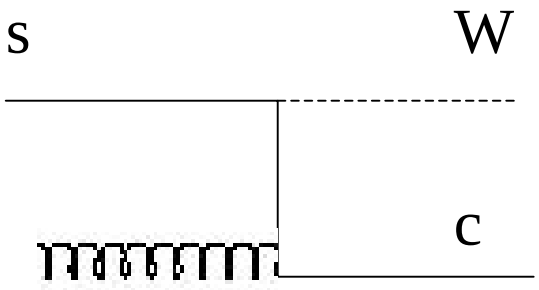


Initial state gluon splitting



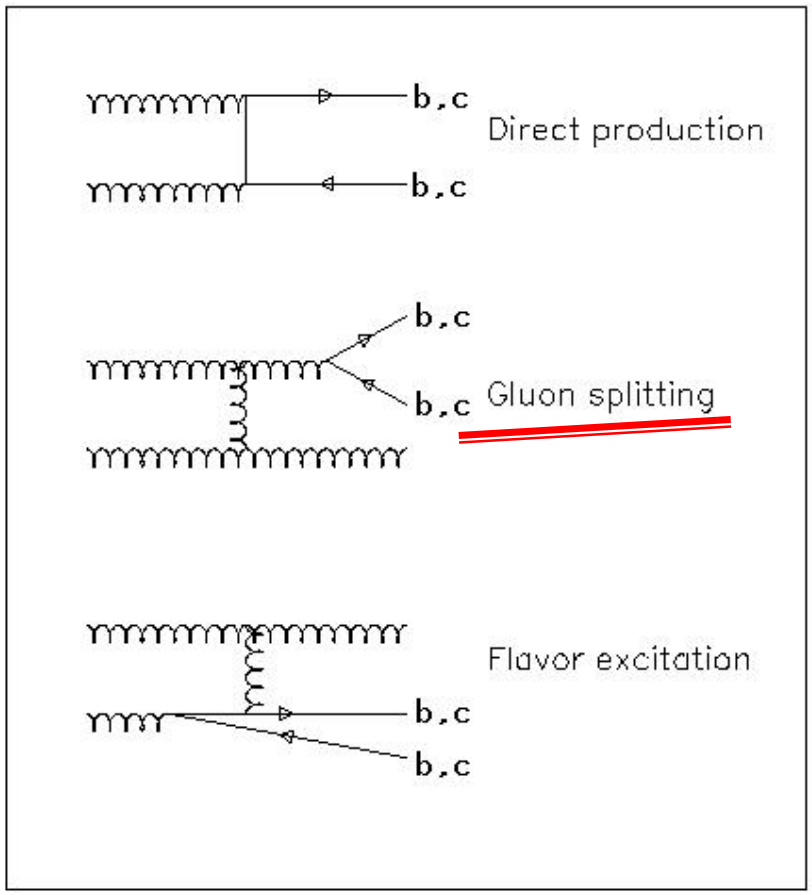
Flavor excitation.





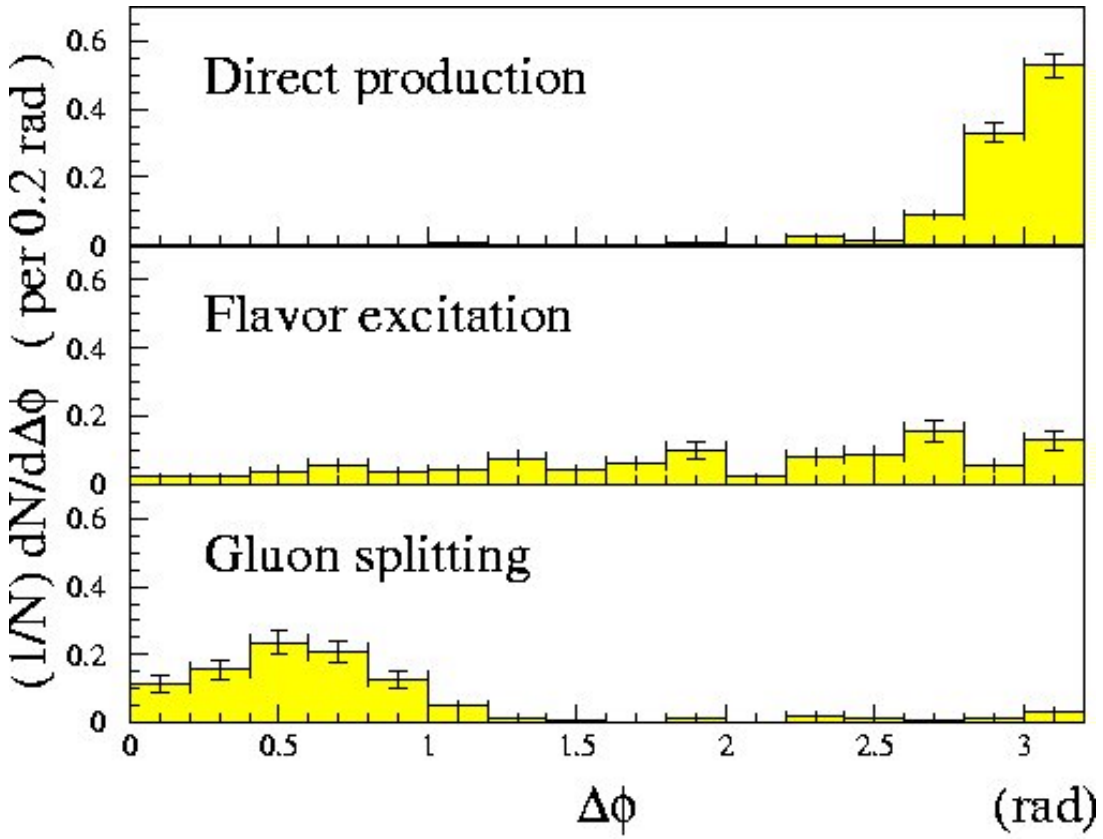
sg→Wc- uncertainty dominated by s-quark pdf's constrained by NuTeV/CCFR data: sn→lc (same diagram w/o g, but twisted. 13-15%

QCD Heavy flavor production mechanisms



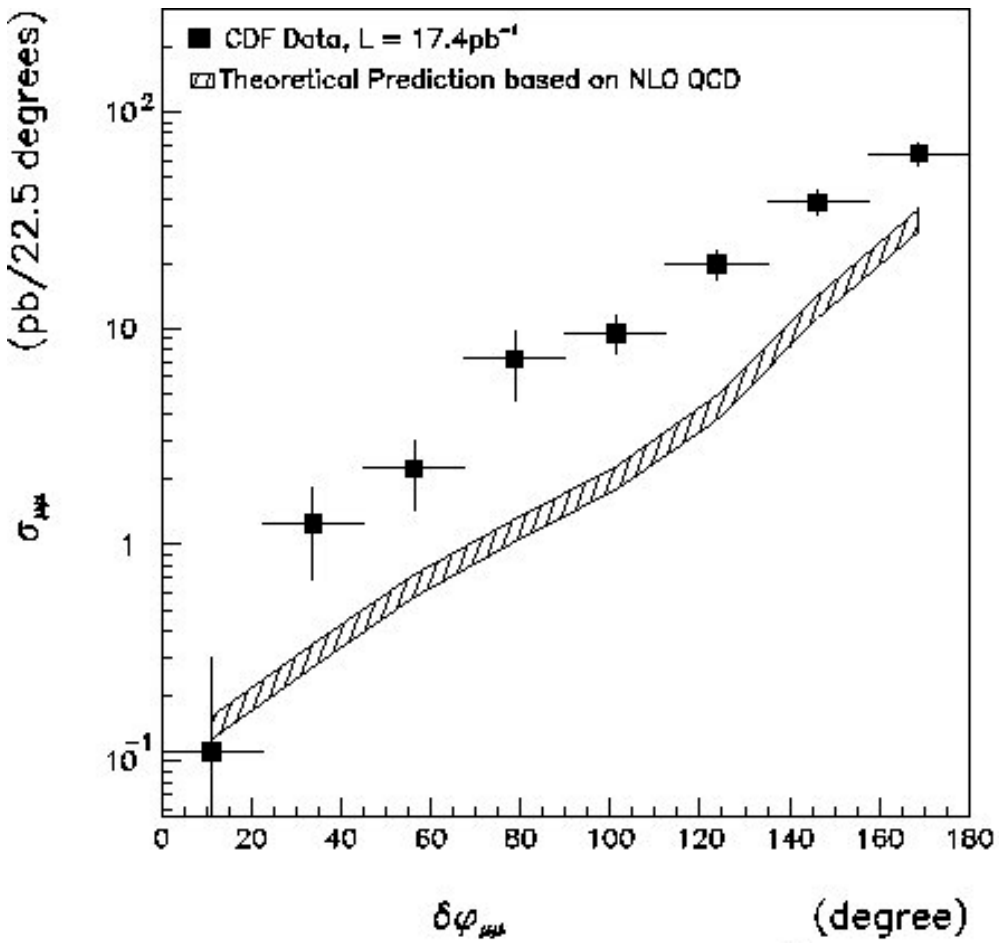
- Use high statistics QCD samples to calibrated MC prediction for gluon splitting component on data.
- Tag jets using different methods – lifetime or lepton.
- $\Delta\phi$ or ΔR are typically used to distinguish different mechanisms of h.f. production.

Correlations between h.f. jets.



Use $\Delta\phi$ between tagged jets to determine the fraction of gluon splitting component after tagging.

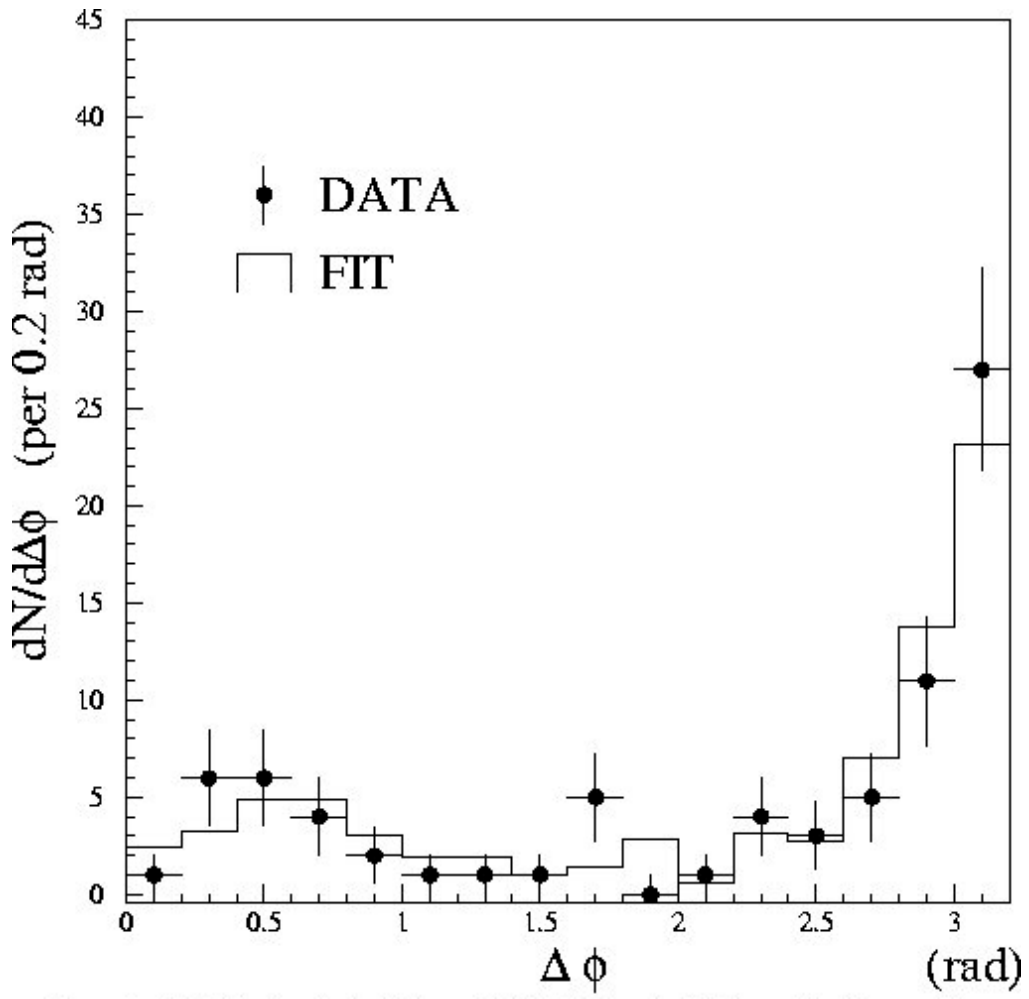
Studies of the QCD h.f. production.



Tag both b-jets by muons.
2 muons Pt>3 GeV/c
Use 2D impact parameter fitting to determine b fraction.

$\Delta\phi(\mu-\mu)$, compared to MNR Prediction.
Published Phys. Rev. D55,2546(1997)

Studies of the QCD h.f. production.



Both jets taged by lifetime.
$\Delta\phi$ (JETVTX tags) compared to PYTHIA Prediction.

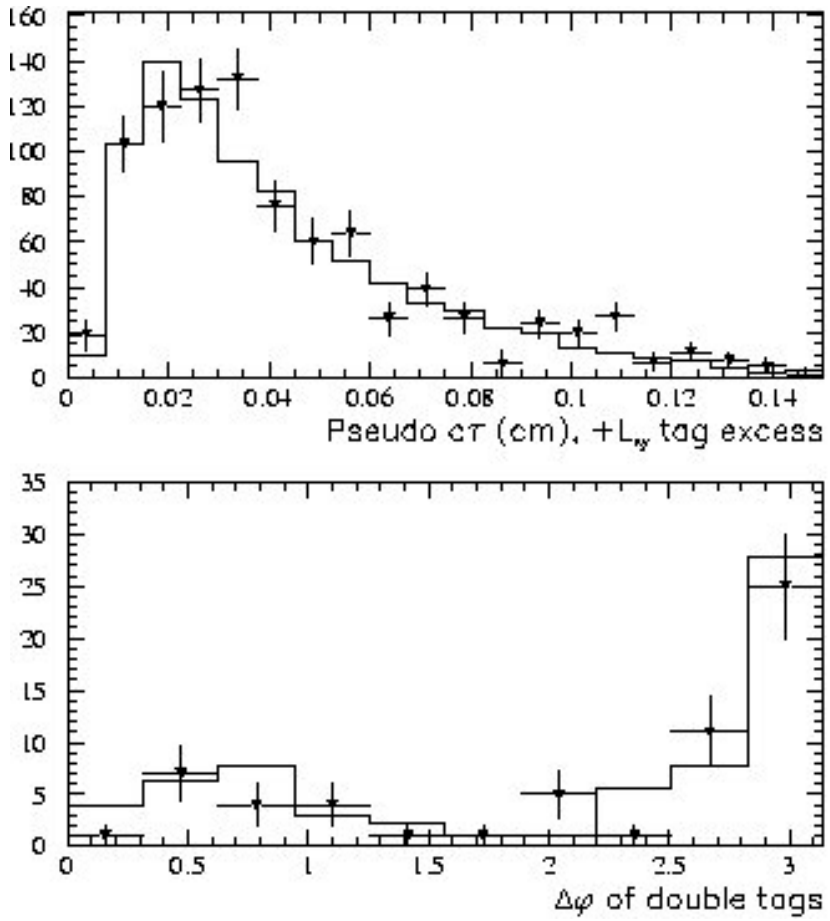
$$\frac{data}{MC}:$$

$$F_{direct} = 1.07 \pm 0.2(stat);$$

$$F_{flavex.} = 0.85 \pm 0.55(stat);$$

$$F_{gsplit} = 0.96 \pm 0.32(stat).$$

Studies of the QCD h.f. production.



Later incarnation of tagging
Use cτ to distinguish b from c
Δϕ SECVTX tags, compared to HERWIG Prediction.

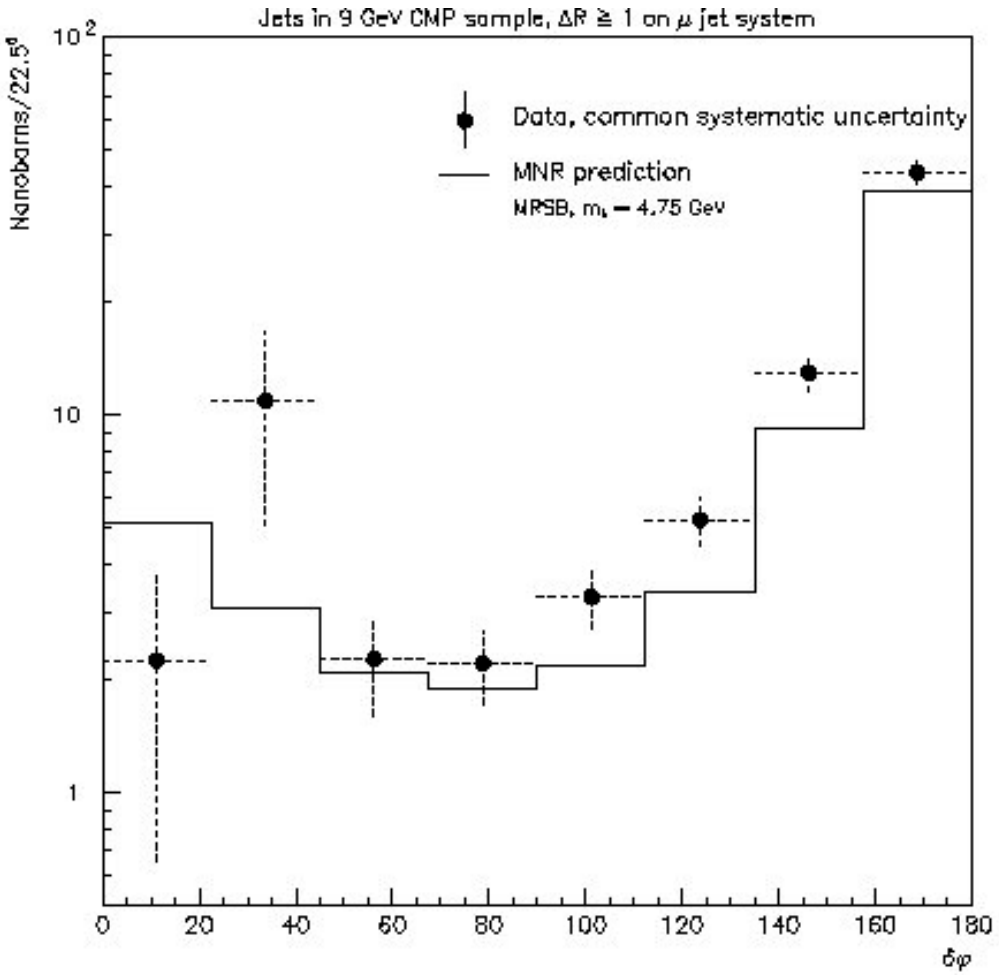
$$\frac{data}{MC}:$$

$$F_{direct} = 0.82 \pm 0.19(stat);$$

$$F_{flavex.} = 1.36 \pm 0.42(stat);$$

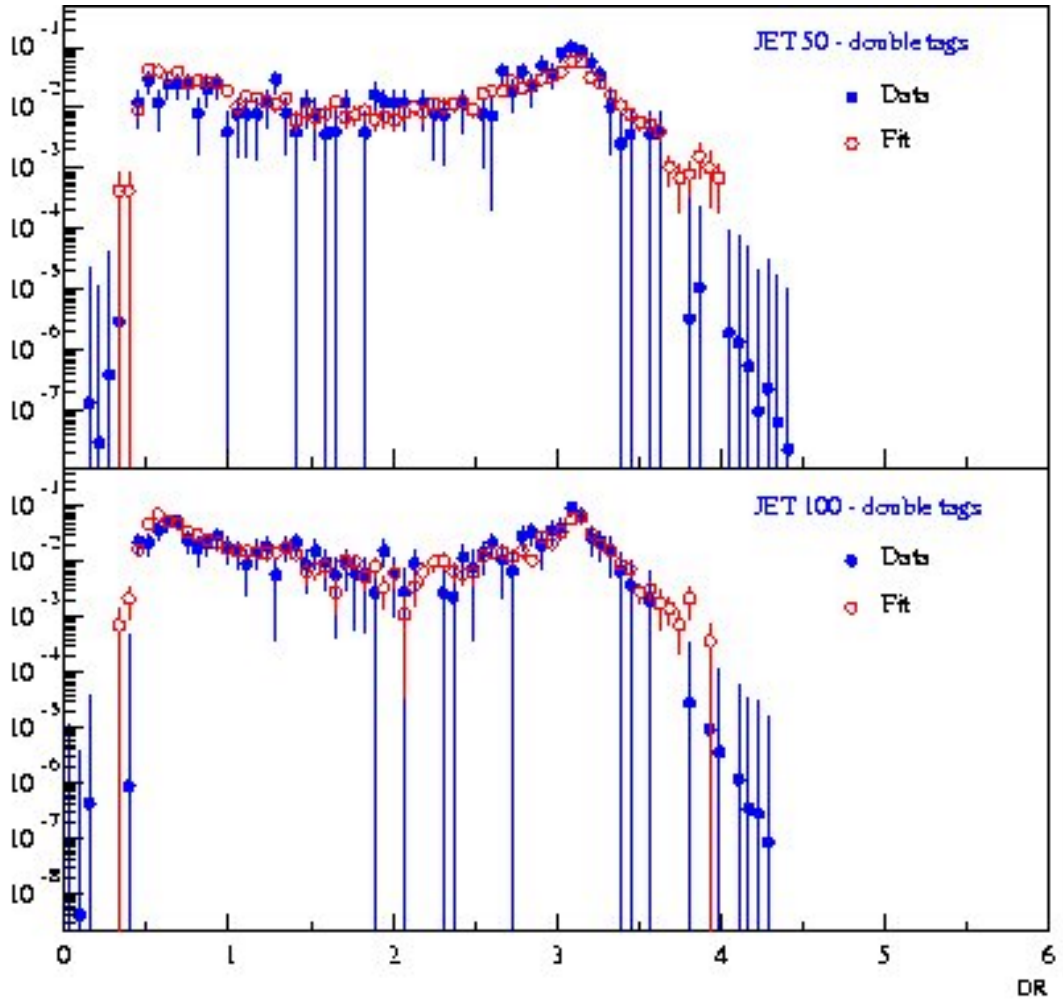
$$F_{gsplit} = 0.95 \pm 0.25(stat) \pm 0.16(sys).$$

Studies of the QCD h.f. production.



Δϕ(μ–JETPROB tag) compared to MNR Prediction.
Published
Phys. Rev. D53,1051(1996)
Pt(μ)>9 GeV/c,
Use impact parameter fitting to determine b fraction (40%) in muon jet, and JETPROB shape fitting on the away jet.

Studies of the QCD h.f. production.



From top x-section paper.
ΔR SECVTX tags, compared to HERWIG Prediction.

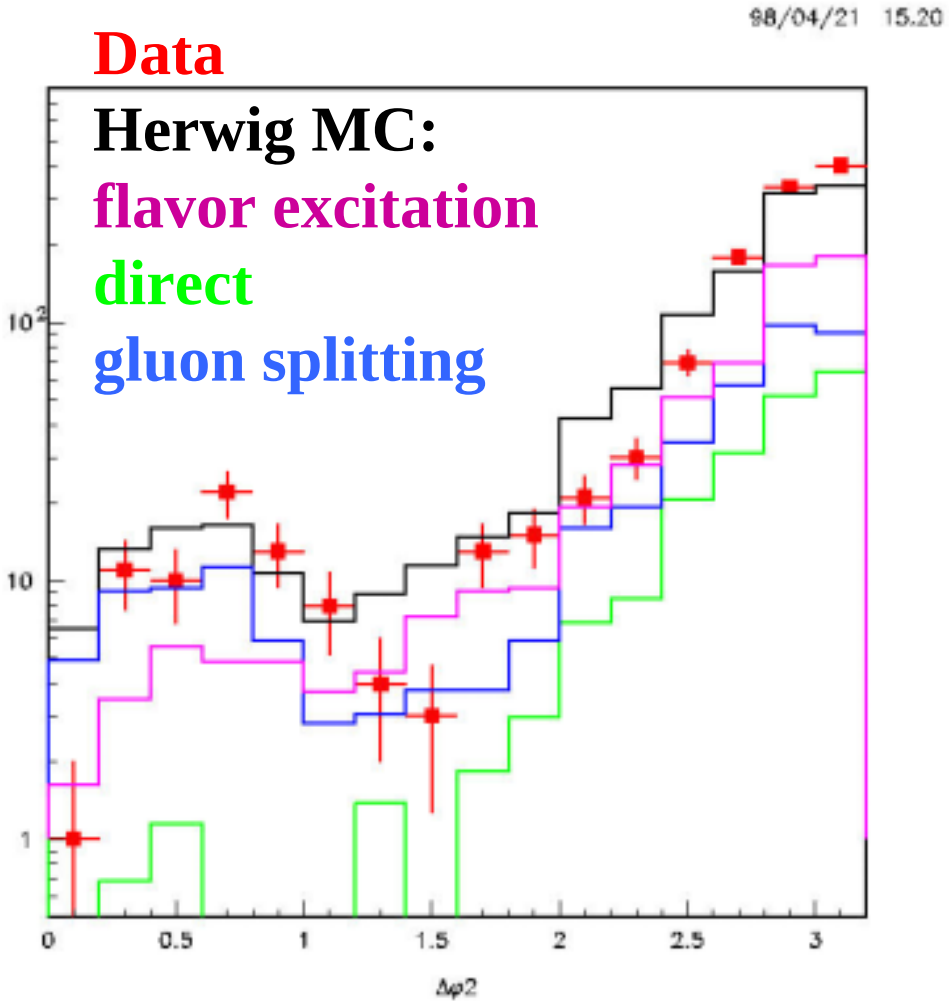
$$\frac{data}{MC}:$$

$$F_{direct} = 0.47 \pm 0.22(stat);$$

$$F_{flavex.} = 1.37 \pm 0.41(stat);$$

$$F_{gsplit} = 1.40 \pm 0.19(stat).$$

Studies of the QCD h.f. production.



Δϕ(D*-JETPROB), compared to HERWIG Prediction.

Select

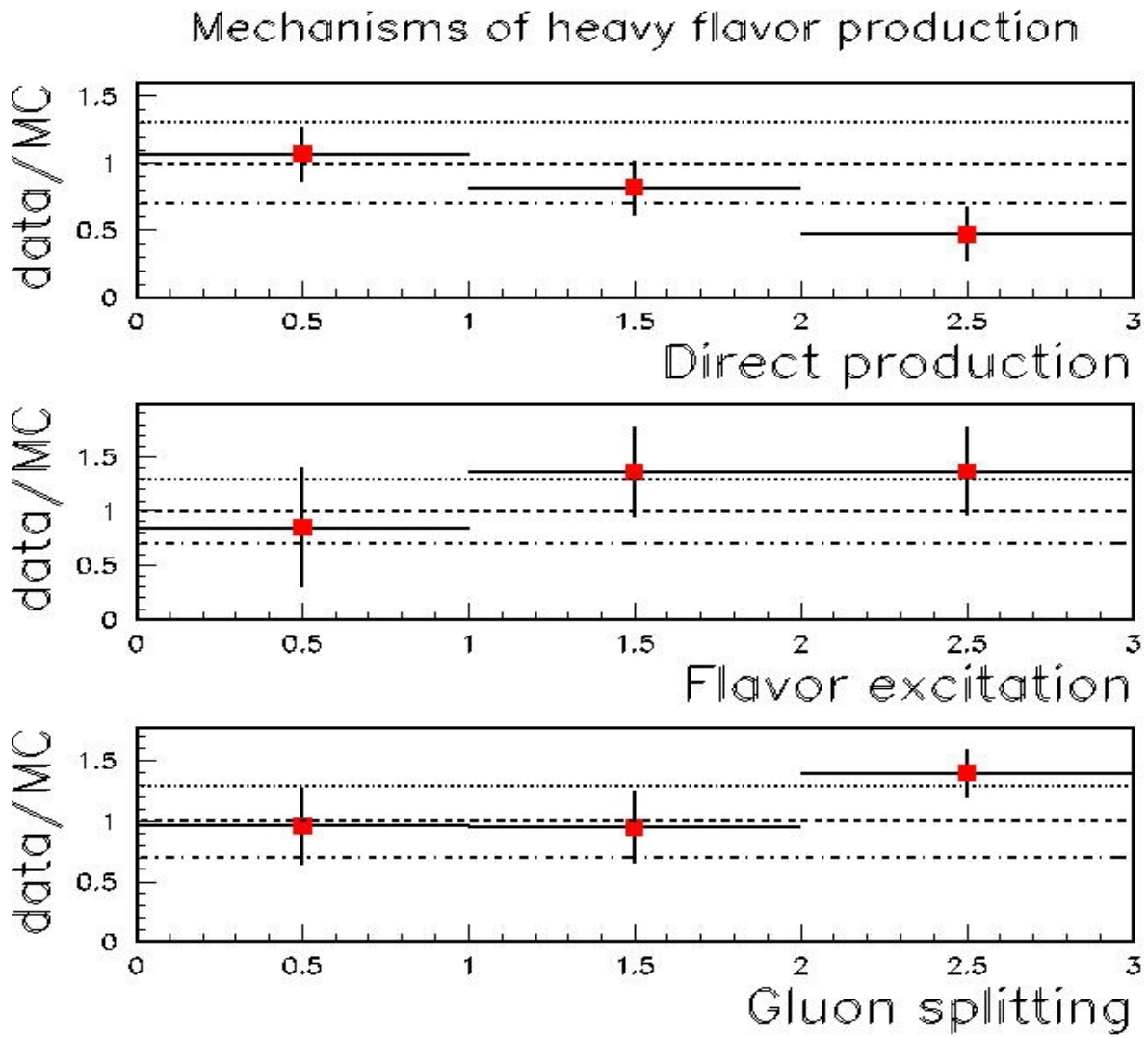
D*->D0π, D0->μKν.

Pt(μ)>9GeV/c,

away jet: JetProb<10%.

Sample 90% charm: probe g→cc splitting

Studies of the QCD h.f. production. Summary.



We don't know it better than 30-40%, but now we have more data, better tagging tools.

Rick Field's studies

- A more though study was initiated by R. Field
- Looked at the flavor correlation between jets:
- If one jet is definitely a heavy flavor what is the other one
- CDF note 5558

Open questions

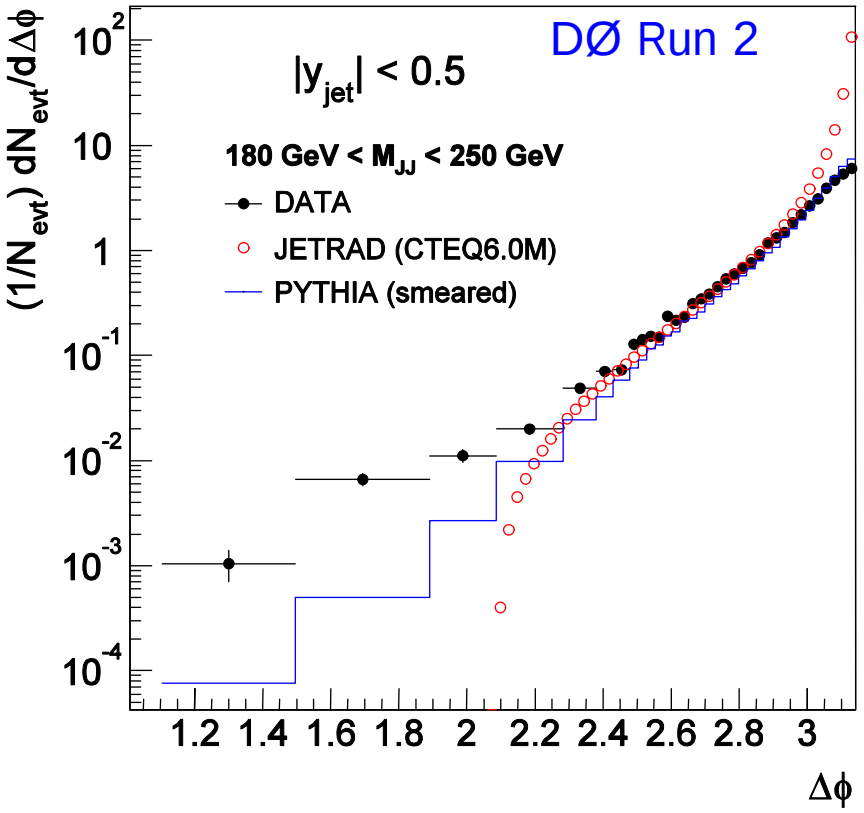
- Basically all of them
- Overall rate
- Need better precision in fractions
- APPGEN fraction need to be verified on data
- B/c separation

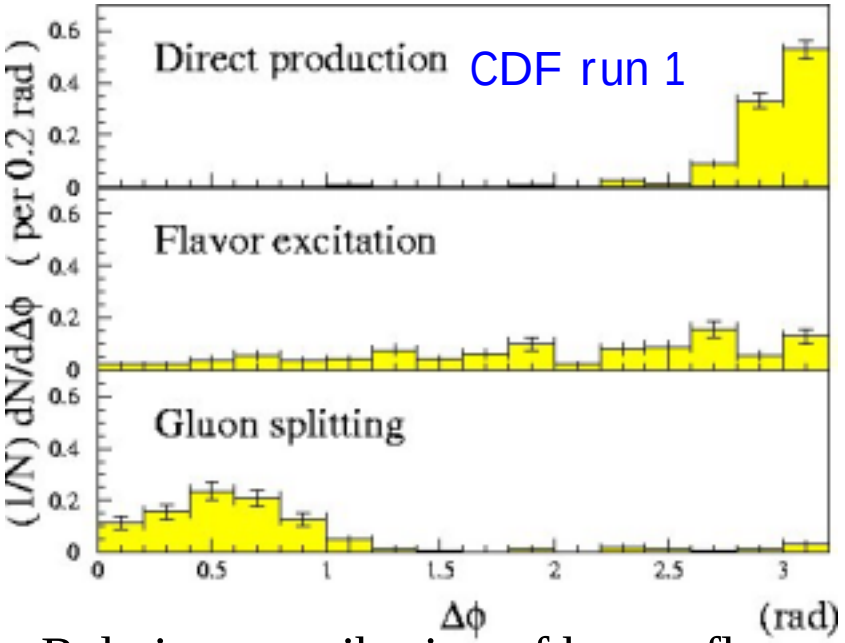
Possible course of action

- ALPGEN fractions verification
  - Use dijet data+tagging (CSIP – ready, certified, very simple)
  - Need dijet ALPGEN MC
  - Use mu+jets data – higher b-fraction, two independent taggers (mu+lifetime)
  - Use reconstructed D-states (Burdin, Borisov, Nomerotski)

Jet production

- $\Delta\phi$ – sensitive to different production mechanisms, especially when jets are tagged as heavy flavor





Relative contribution of heavy flavor production mechanisms is know to an unacceptable >30% accuracy.
W+g(→bb,cc)- main background to top and Higgs production.

Jet production cross section

- One of the first run 2 physics results
- Dijet mass – new physics probe