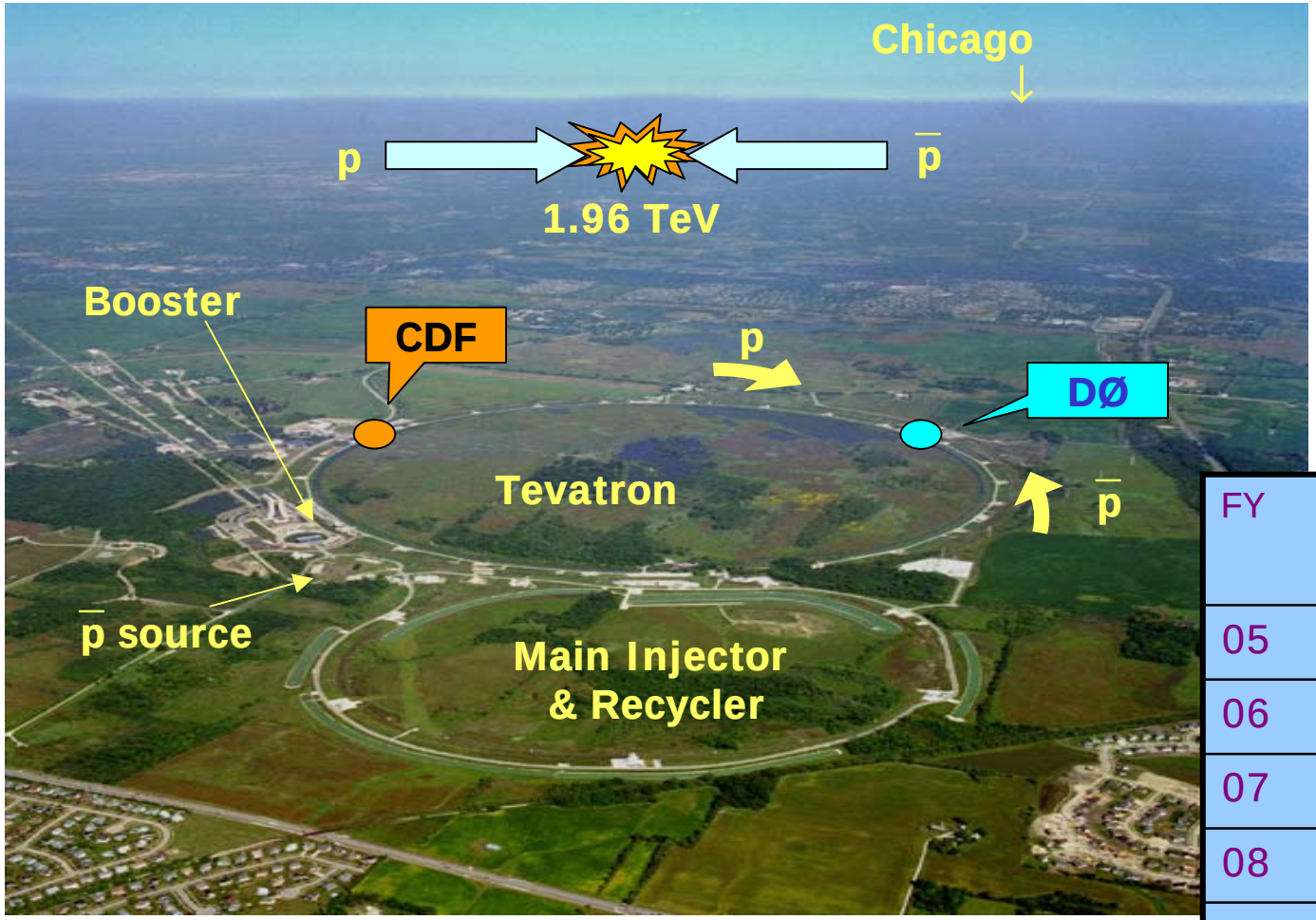
b-production cross-section at the TeVatron

Eric Kajfasz, CPPM/D0
for the CDF and D0 collaborations

The TeVatron

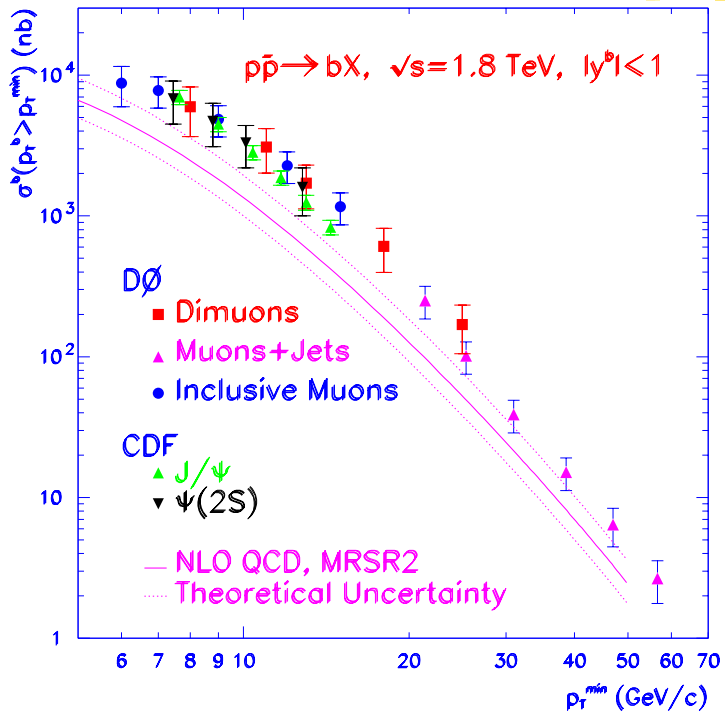


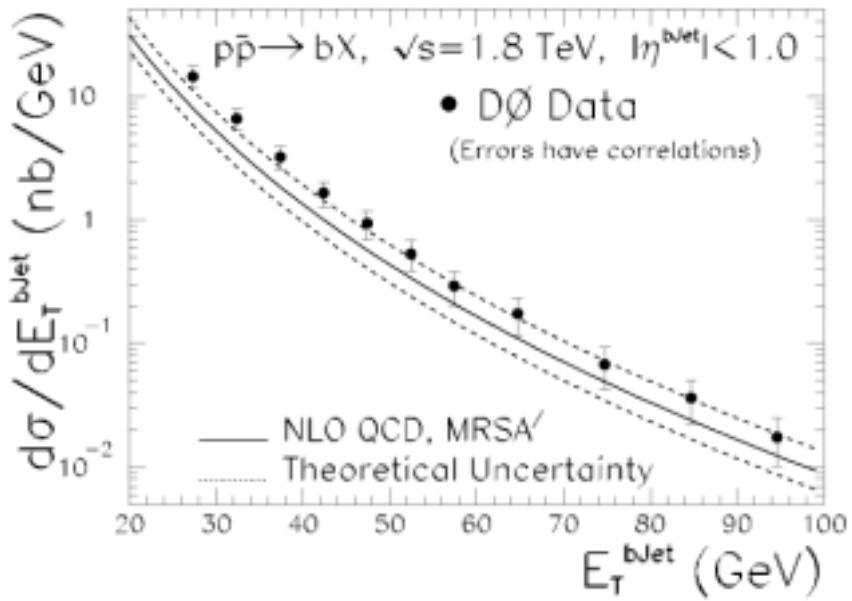
Run 1:
0.1 fb^{-1}

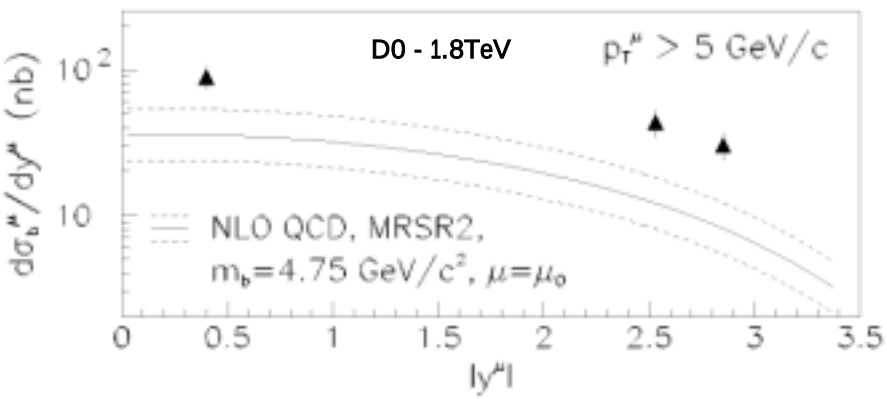
Run 2:

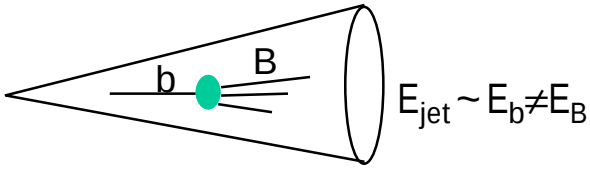
FY	base (fb^{-1})	stretch (fb^{-1})
05	1.7	2.5
06	3.2	5.0
07	shutdown	shutdown
08	4.7	8
09	6.5	11

b-jet production: Run I results





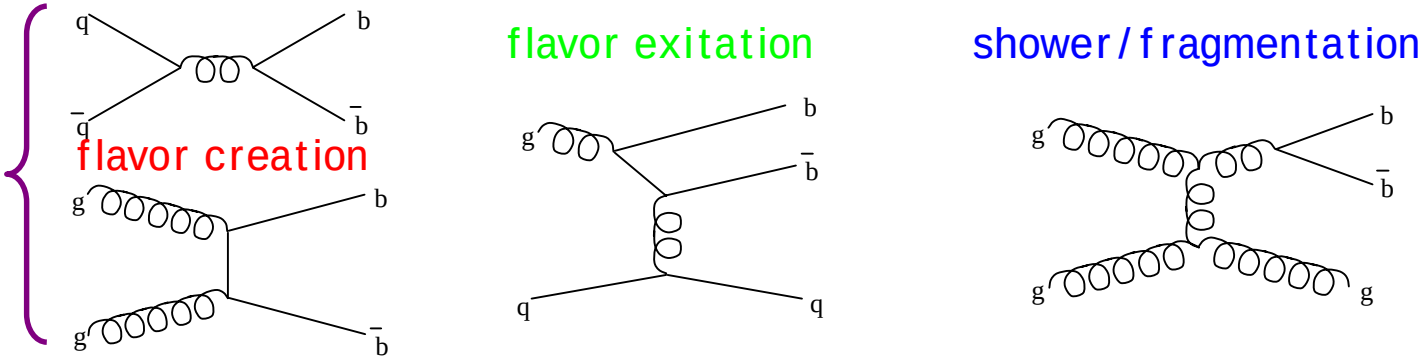


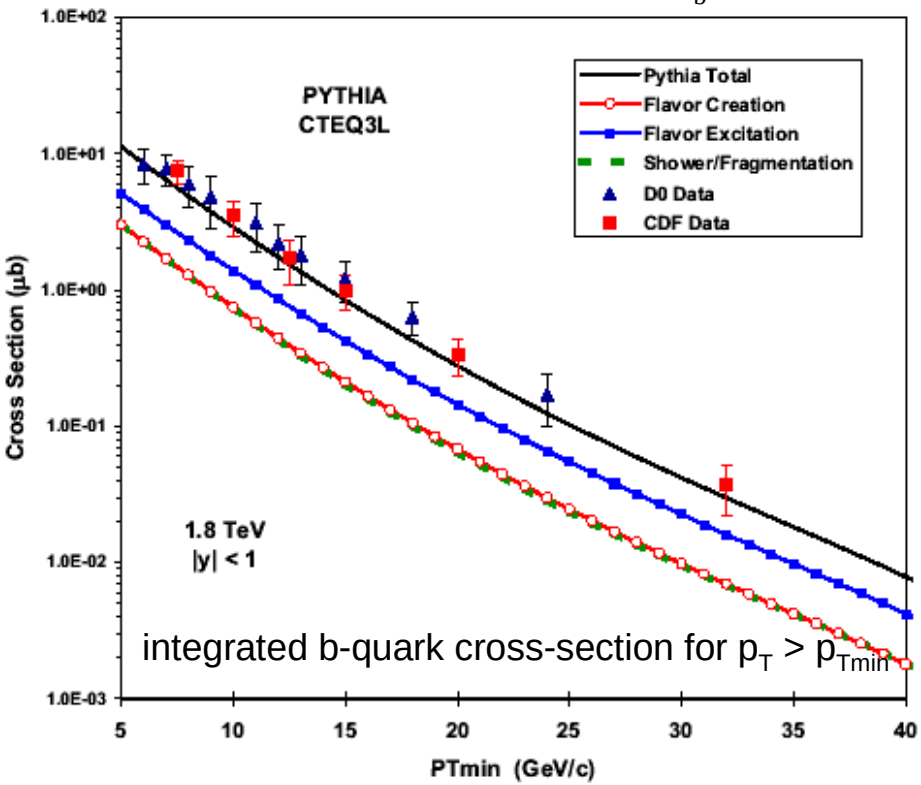


b-jet production: phenomenology

R.D. Field - hep-ph/0201112

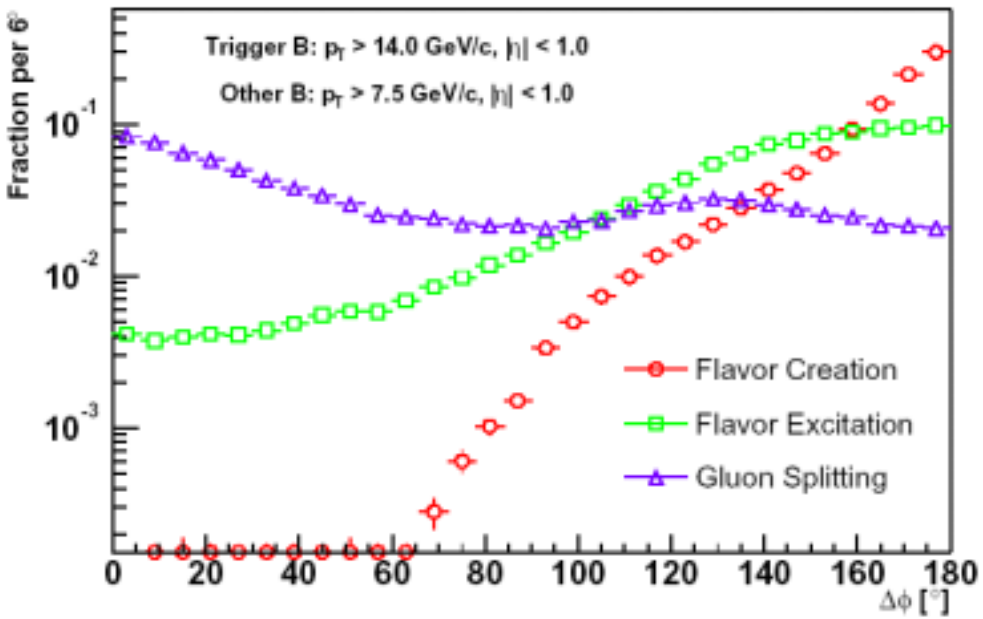
sources





integrated b-quark cross-section for $p_T > p_{Tmin}$

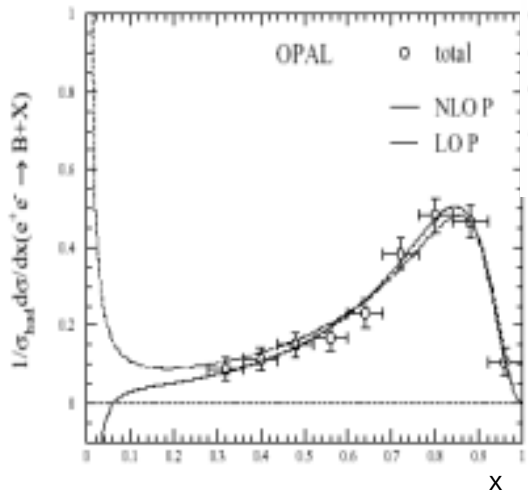
Pythia 6.2 (CTEQ5L) - normalized $\Delta\phi$ correlations

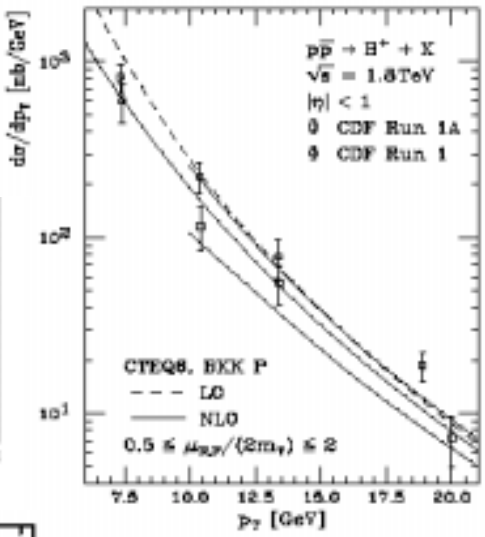


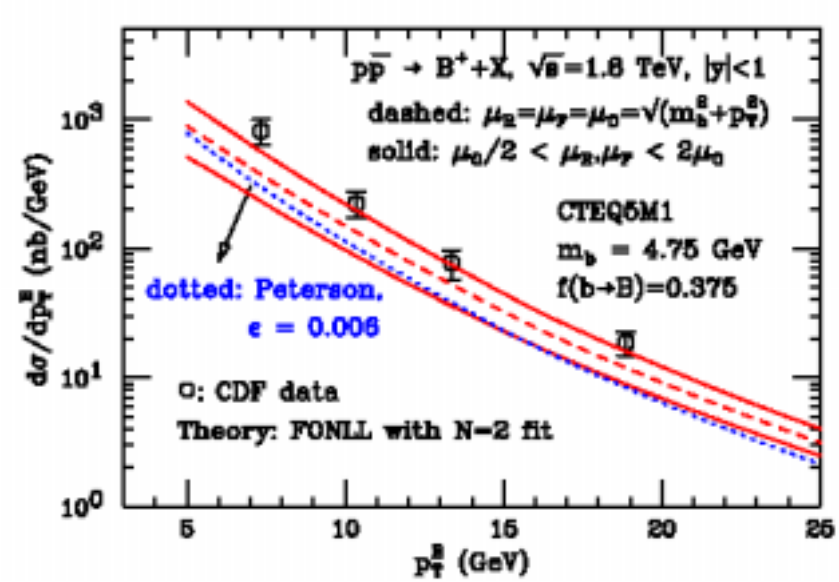
b-jet production: phenomenology

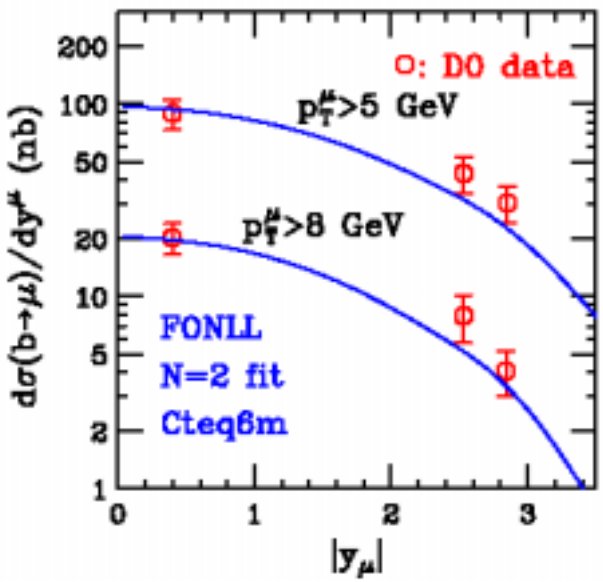
Binnewies, Kniehl, Kramer - hep-ph/9802231
Kniehl - hep-ph/0211008

Re-determine LO and NLO B-meson Fragmentation Functions using data collected at LEP1





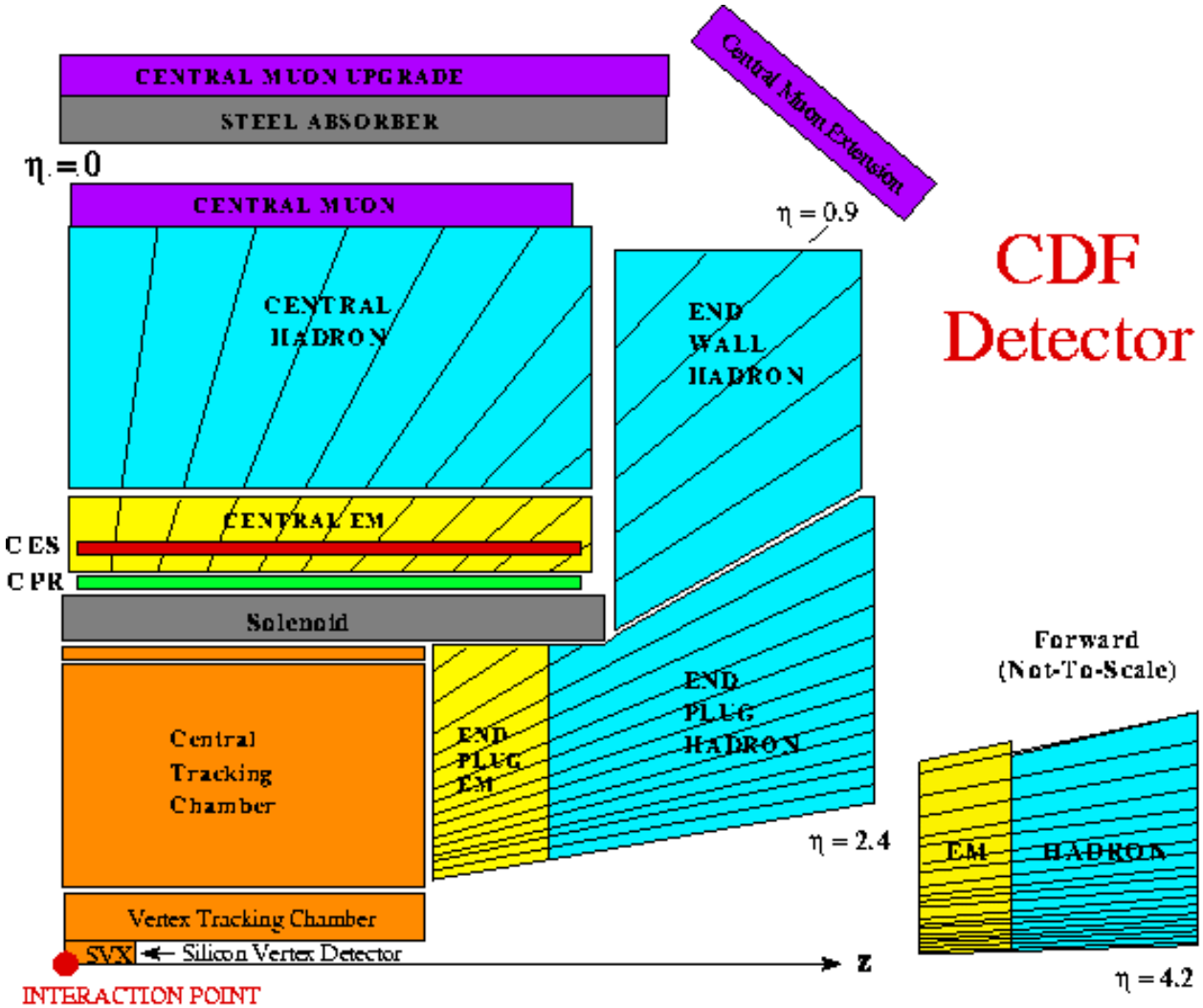




Cacciari, Nason - hep-ph/0204025
Nason - hep-ph/0301003

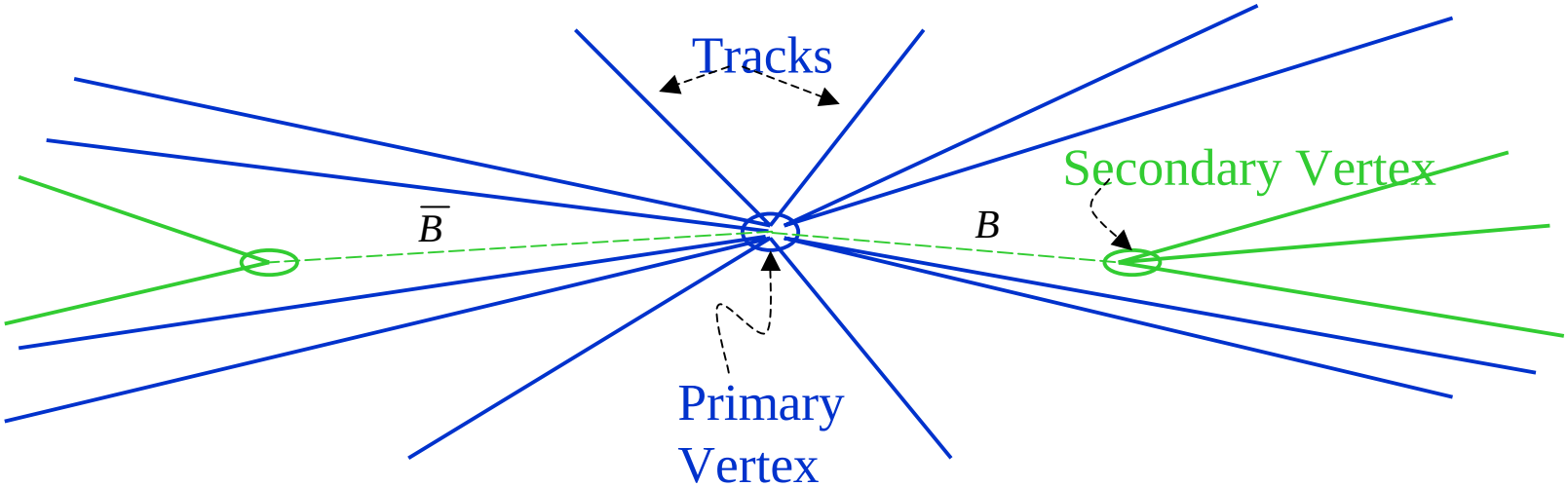
retuned FF and NLL resummations (FONLL)

Run I: CDF detector



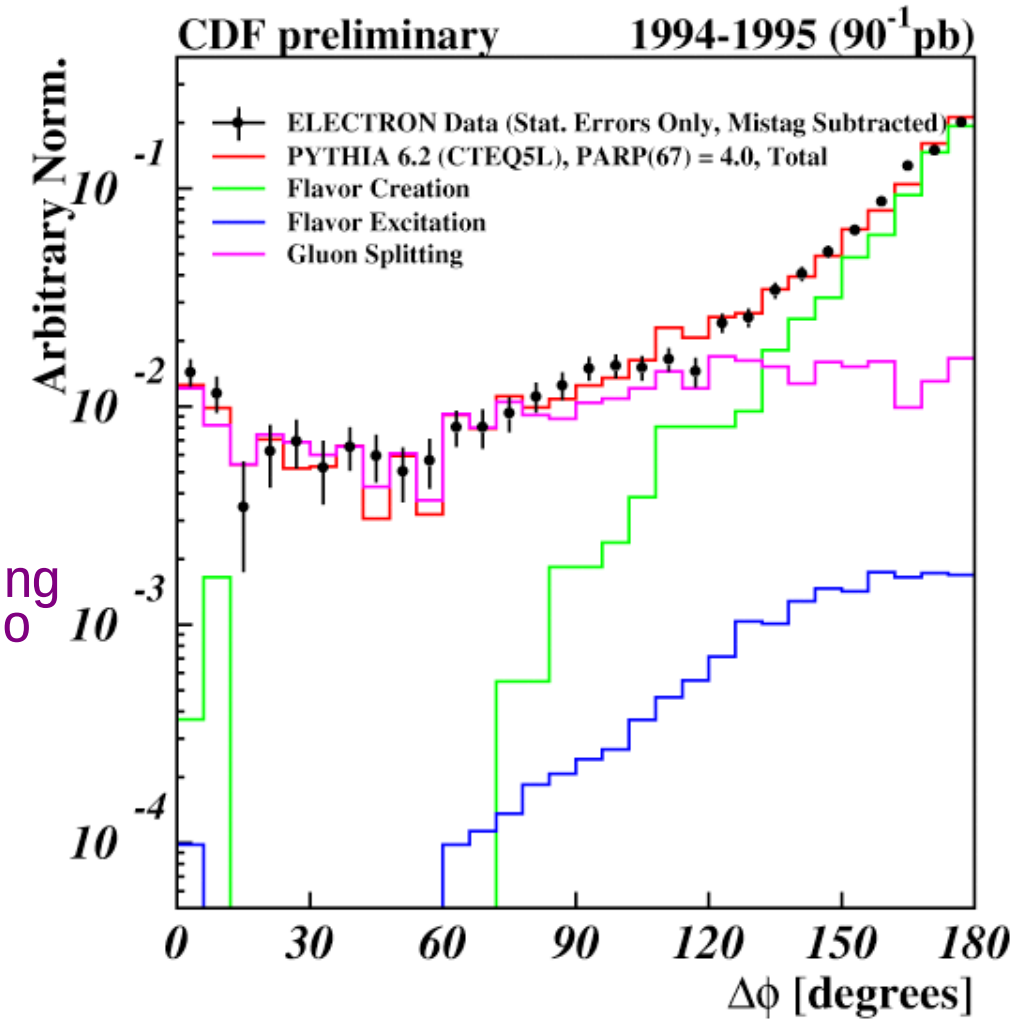
Run I: Secondary Vertex Correlations

- Uses 90 pb^{-1} sample taken by CDF in 1994-1995 run (Run IB)
- Enrich *b* content of data by requiring an electron or muon trigger
- Use tracking information to reconstruct decay vertices of both *B* hadrons
- Compare correlations of these reconstructed vertices to PYTHIA and HERWIG predictions
- Use Monte Carlo to convert raw secondary vertex correlations to *B* hadron correlations



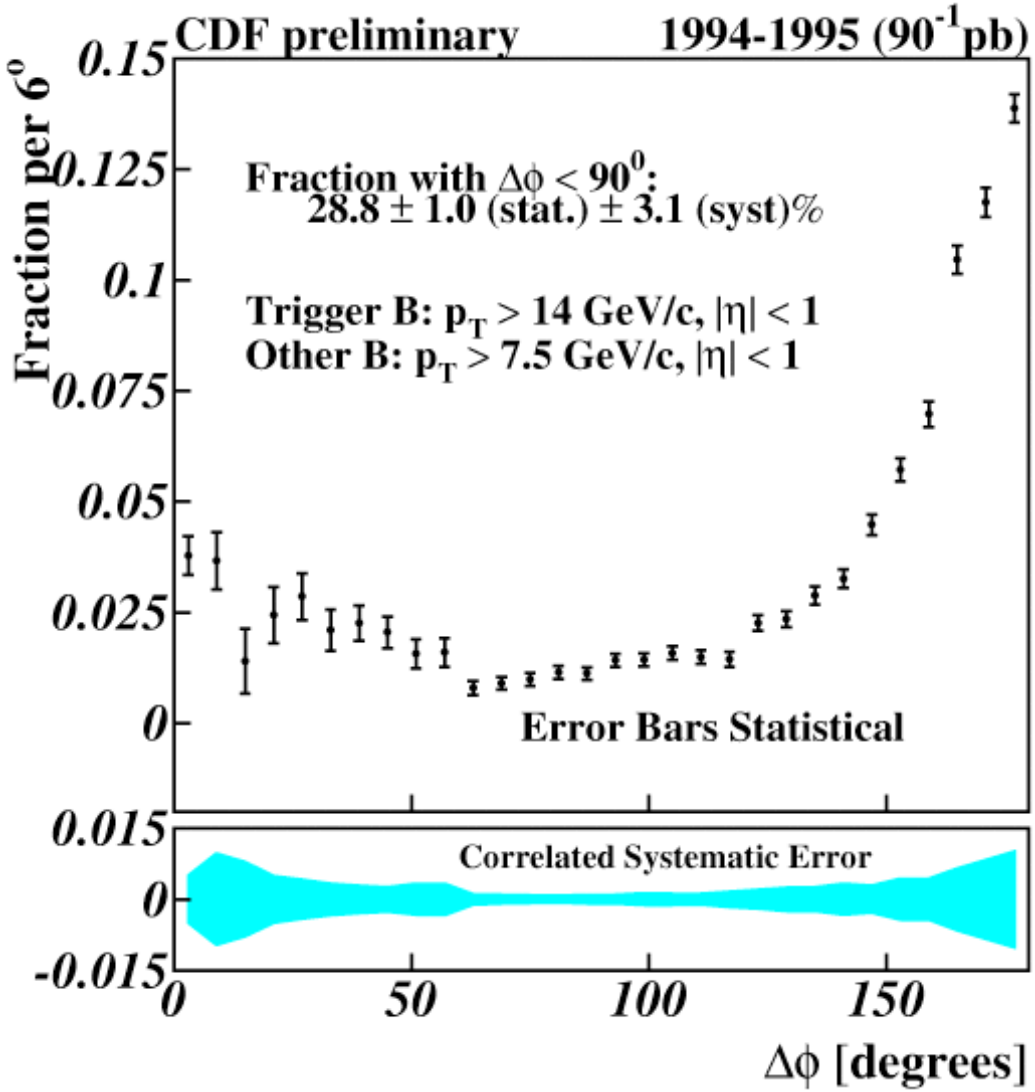
Run I: Secondary Vertex Correlations

- $\Delta\phi$ = opening angle between momentum vectors of secondary vertices in the transverse plane
- Detector effects are simulated in Monte Carlo
- Relative contribution from flavor creation, flavor excitation, and gluon splitting varied to give best match to data
- Similar distributions for muons

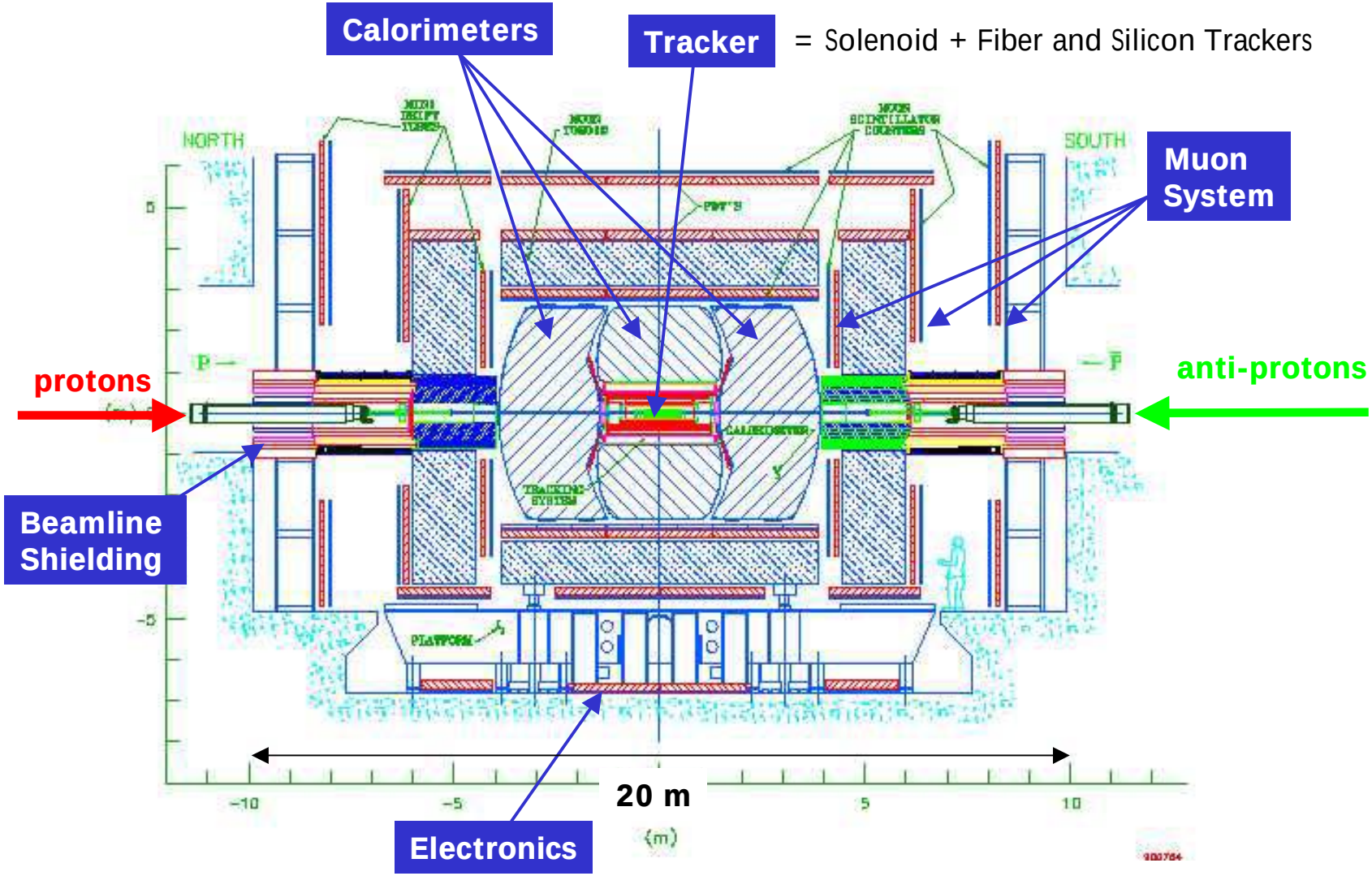


Run I: Measured *B*-Hadron Correlations

- $\Delta\phi$ = opening angle between measured *B* directions in transverse plane
- Detector effects unfolded from data using PYTHIA Monte Carlo
- Error bars show statistical errors
- 17,000 e+μ events



Run II D0 detector



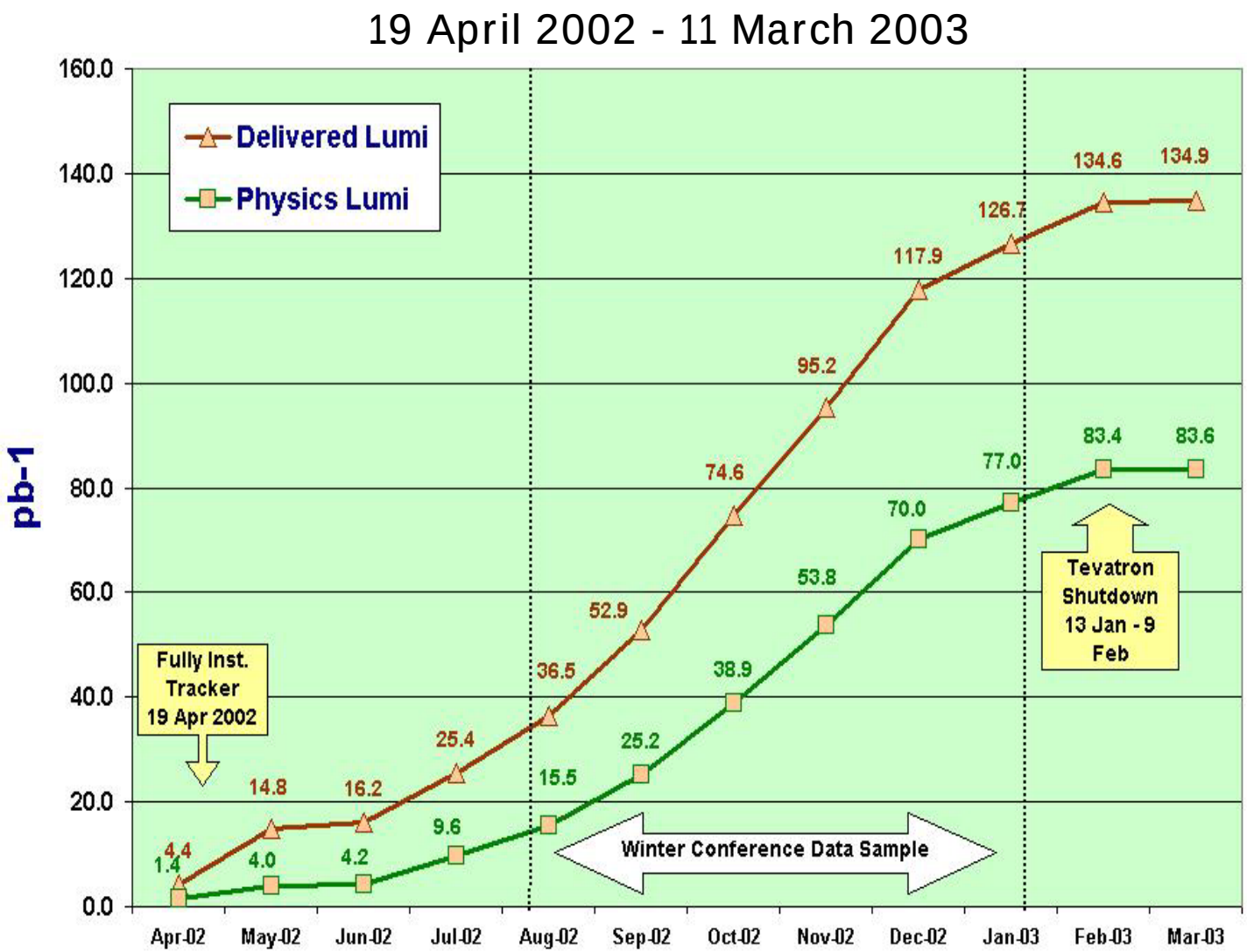
D0 Integrated Luminosity

Current trigger rates:

L1 rate 1KHz
L2 rate 0.6 KHz
L3 rate 50 Hz

February data taking efficiency:

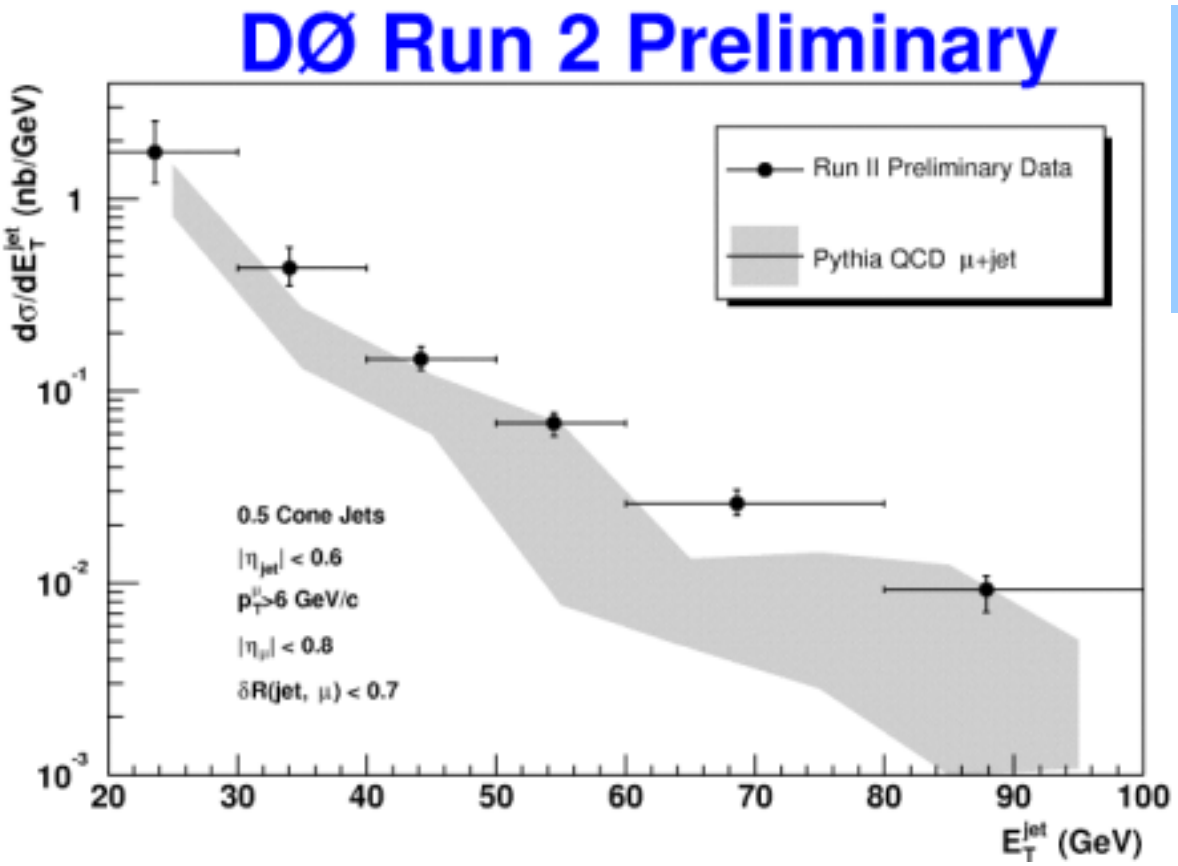
~90% per run
~85% overall



RunII b-jet cross-section

- Strategy:
  - use 3.4 pb^{-1} of data (1.96 TeV - 02/28/02-05/10/02)
  - Measure μ+jet cross section
  - Extract b-content using P_T^{Rel}
- Data selection and kinematic cuts:
  - jet: 0.5 cone
  - μ: track measured in muon system only
  - $|\eta^{jet}| < 0.6$
  - $|E_T^{jet}| > 20$ GeV
  - $|\eta^{\mu}| < 0.8$
  - $p_T^{\mu} > 6$ GeV/c
  - $\Delta R(jet,\mu) < 0.7$

RunII: μ+jet cross-section



Jet reco efficiency:
100% for E > 20 GeV

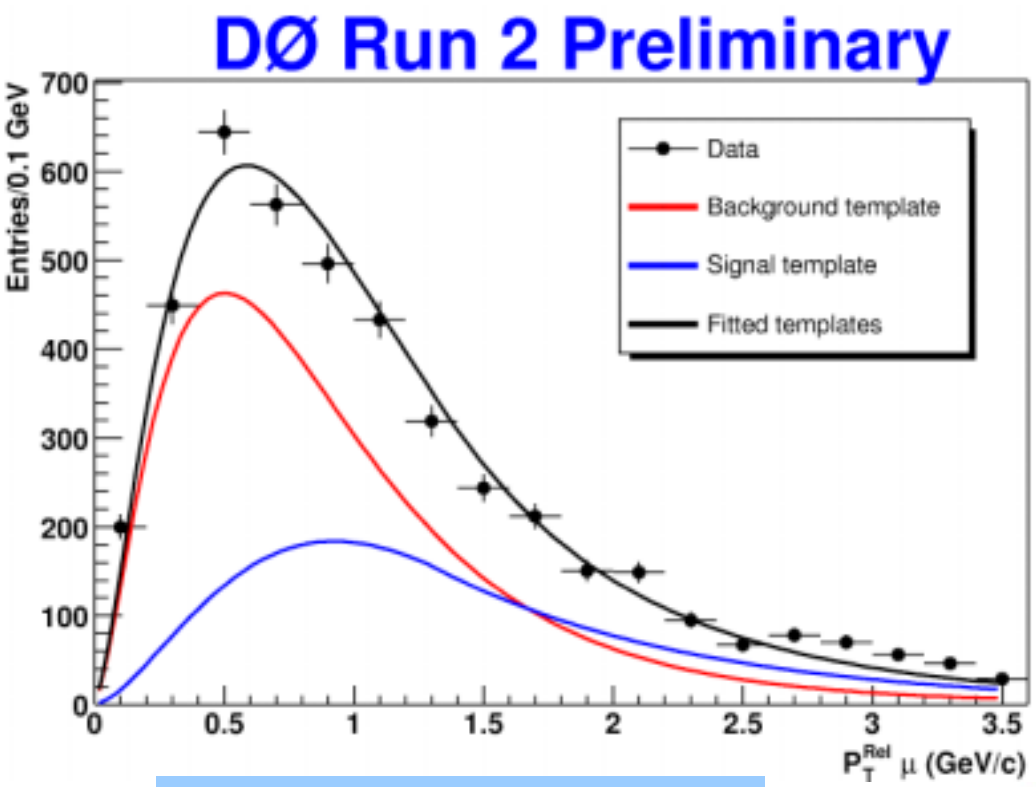
μ reco efficiency:
43.7 ± 0.8(stat) ± 2.2(syst) %

Jet resolution:
dijet p_T imbalance

μ momentum resolution:
from central tracks

RunII: b-tagging

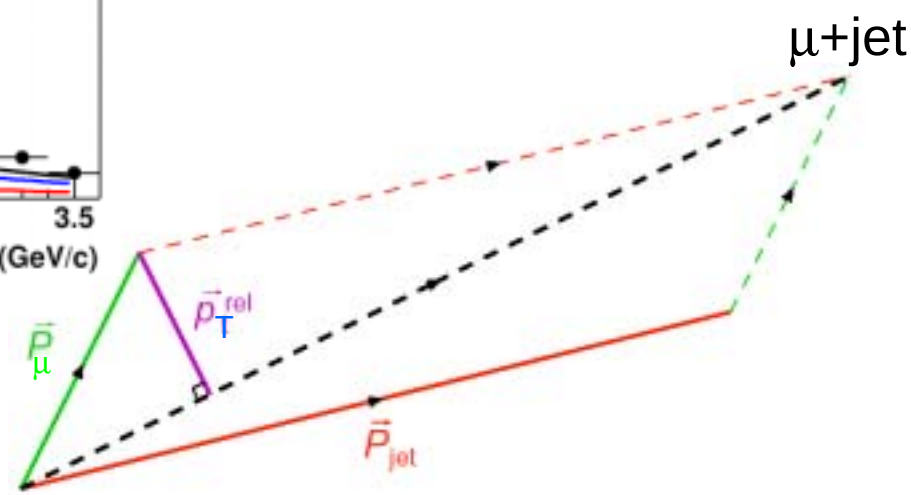
P_T^{Rel} for jets with 20 GeV < E_T < 25 GeV



signal template:
from b -> μ Monte-Carlo

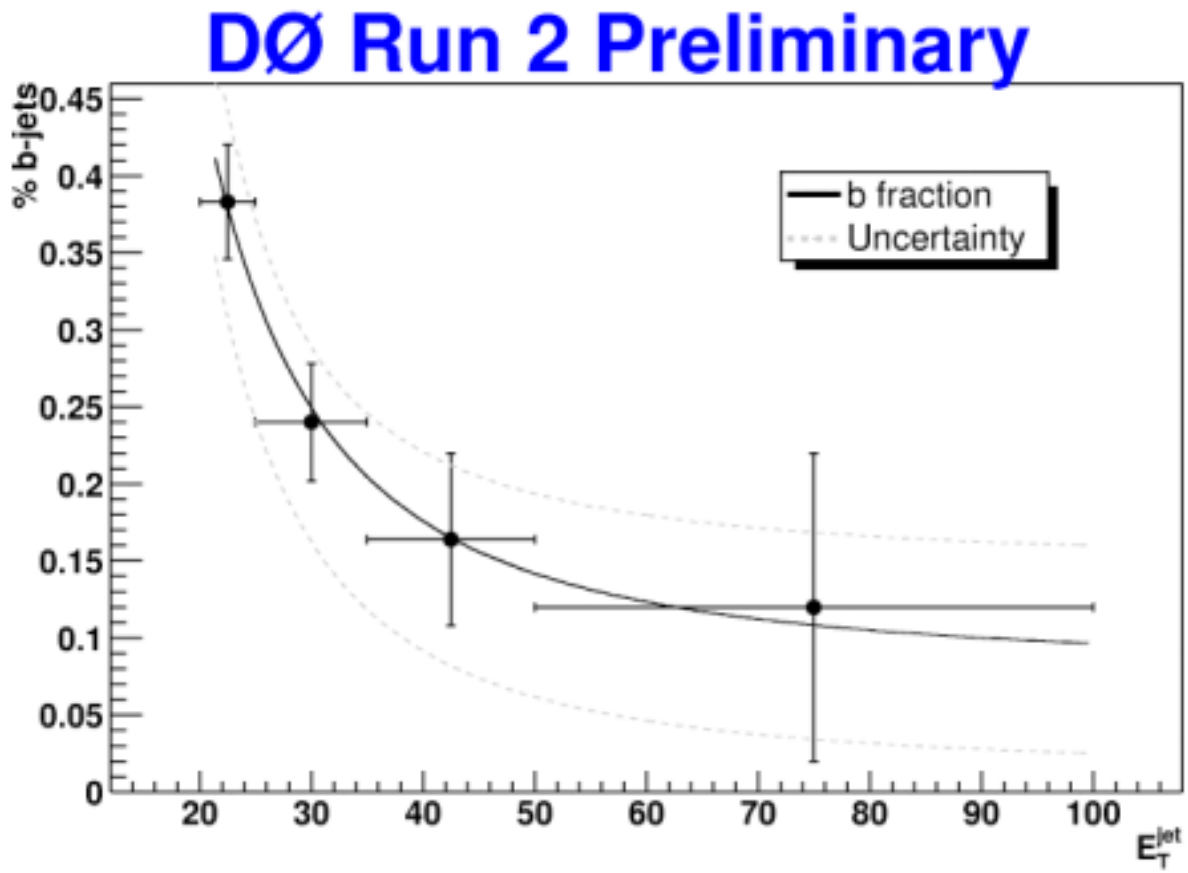
background template:
from 1.5 million QCD events

Fit P_T^{Rel} templates in jet E_T bins



RunII: b-jet fraction

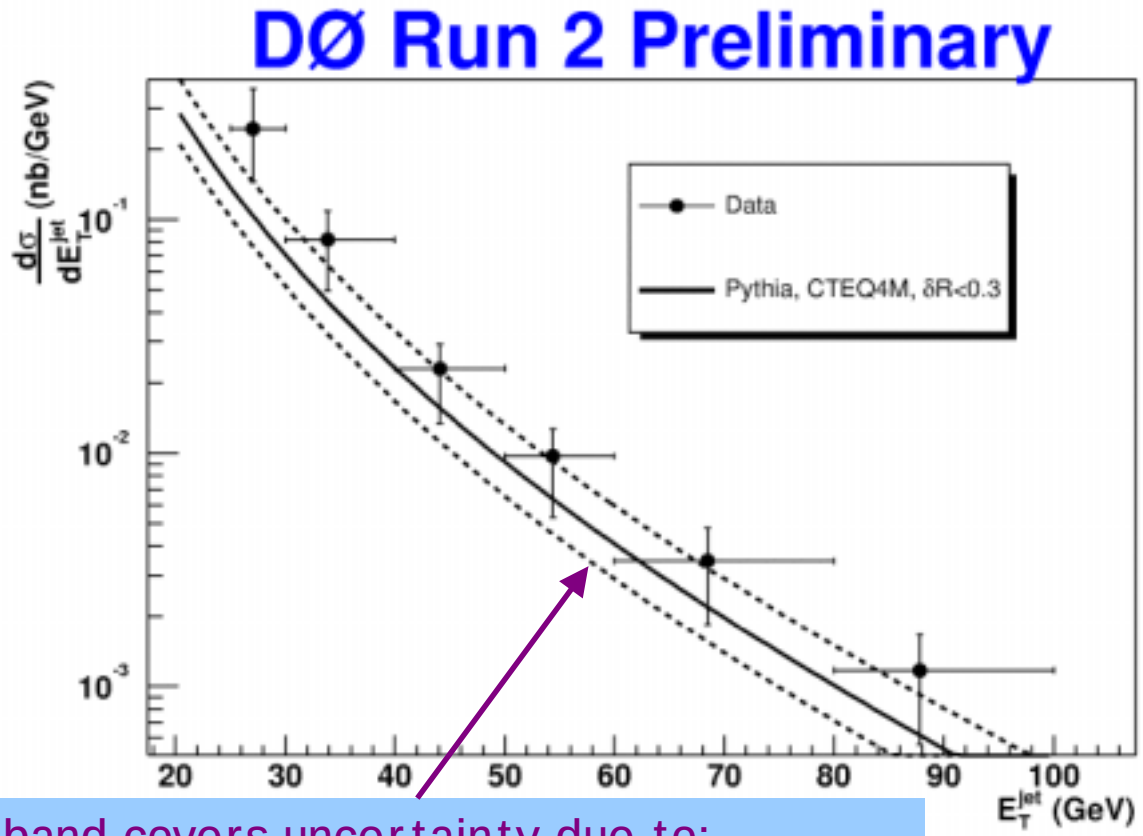
b-jet fraction as a function of jet E_T



# of bins constrained by statistical limitations of background templates

fitted with functional form: $a + b/E_T^{jet}$

RunII: b-jet cross-section



- ansatz function used to unfold the calorimeter resolution
- dominant error from jet energy scale
- consistent with Run I

band covers uncertainty due to:

- b-quark mass
- renormalization/factorization scales
- pdf's
- fragmentation functions

Conclusions

- better phenomenological understanding of heavy flavor production (sources, retuned FF, NLL resummations ...) tend to make the shape and normalization of calculated distributions closer to their measured ones
- b-bbar correlation distributions indicate that at the TeVatron all three sources of b-quarks are important.
- We are just beginning to reap the fruits of RunII data. New results will follow soon ...