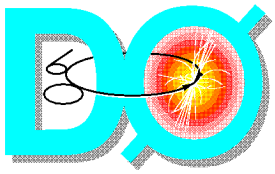


Bottom Quark Production at DØ

Kevin P. Davis
University of Arizona
DÆ Collaboration

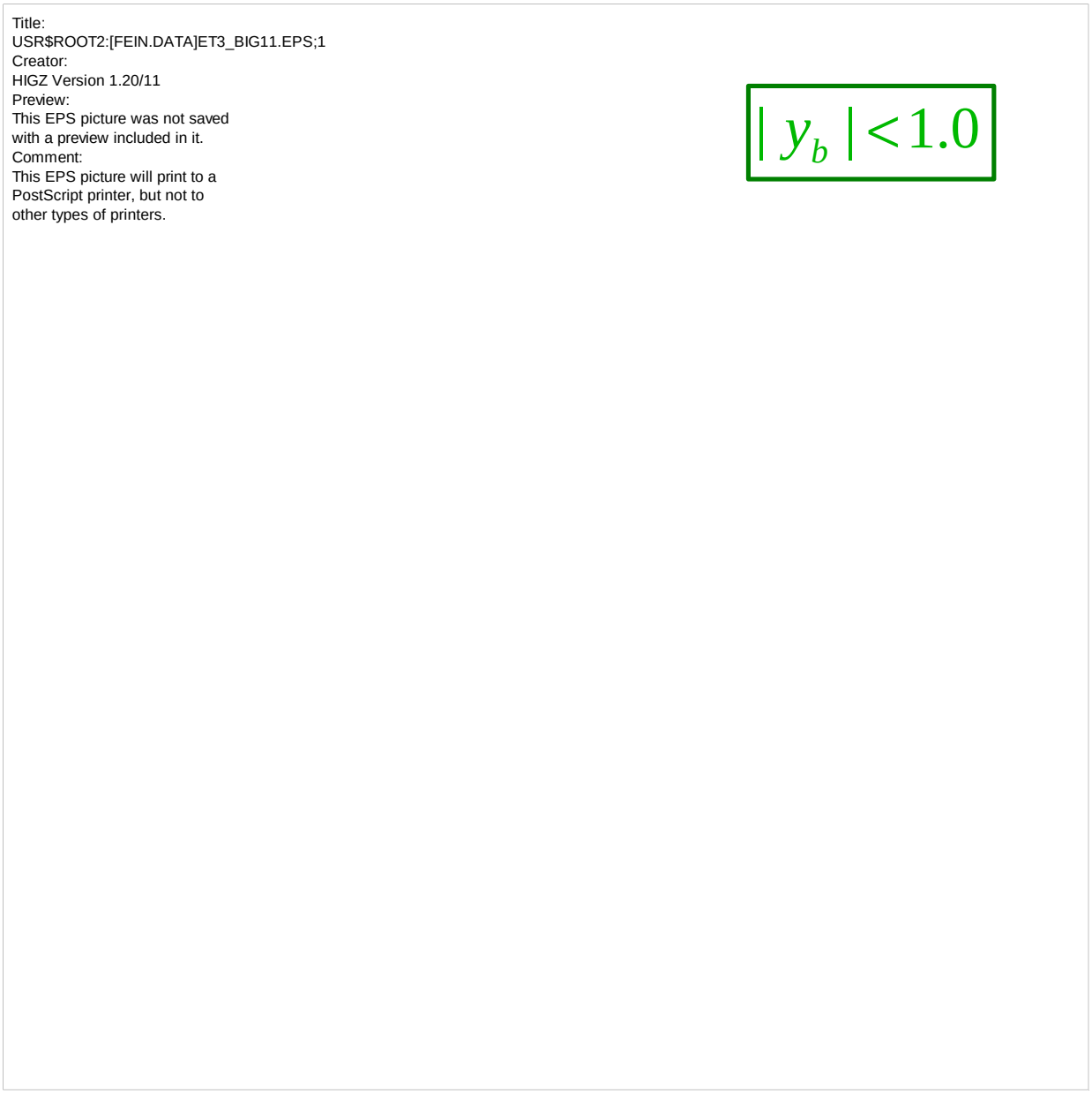
I. Open Bottom Production at 1.8 TeV
II. Run II B Production Prospects

$b\bar{b}$ Correlations at 1.8 TeV

NLO processes improve theoretical prediction of bottom quark production

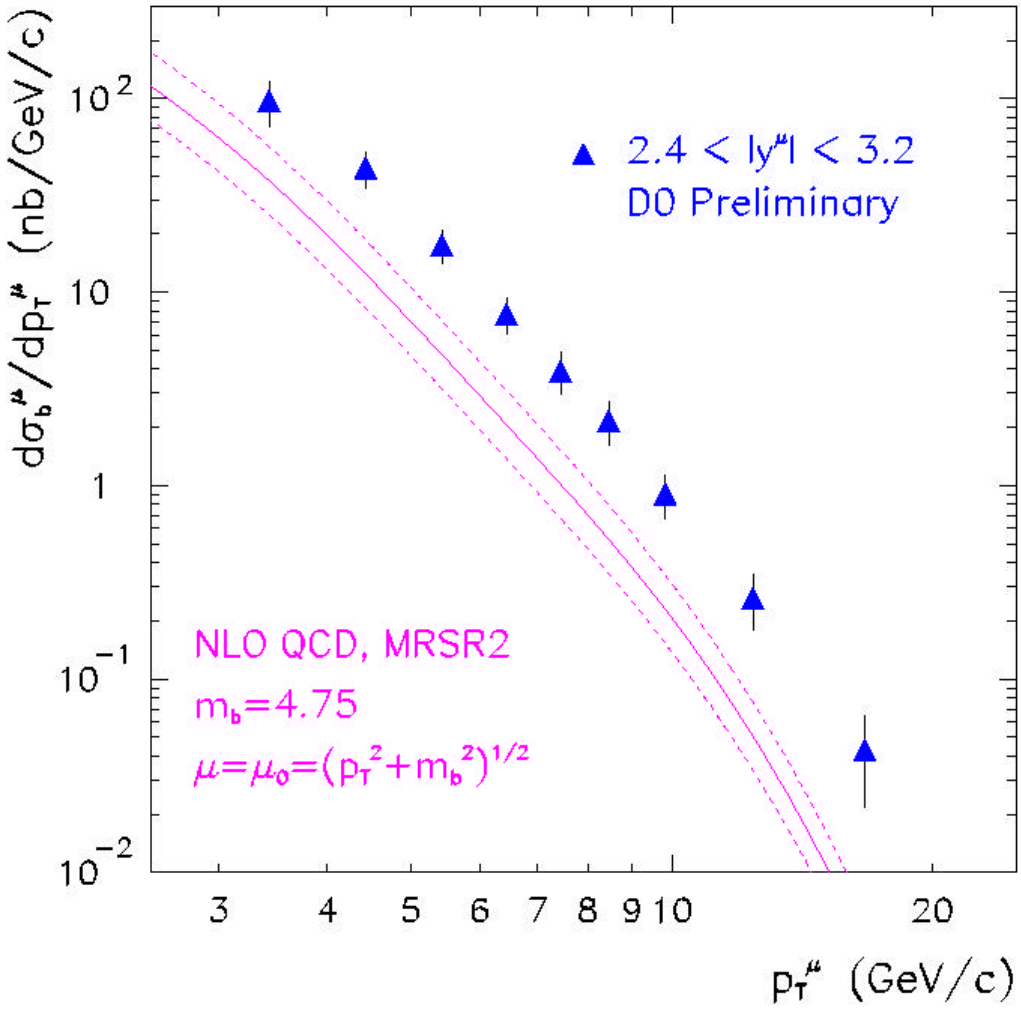
b-quark Cross Section at 1.8 TeV

- Central value of QCD calculation generated with MNR
- Theoretical uncertainty obtained by varying
  - $4.5\ \text{GeV}/c^2 < m_b < 5.0\ \text{GeV}/c^2$
  - $\mu_o / 2 < \mu < 2\mu_o \qquad \mu_o \equiv \sqrt{(m_b)^2 + (p_T^b)^2}$



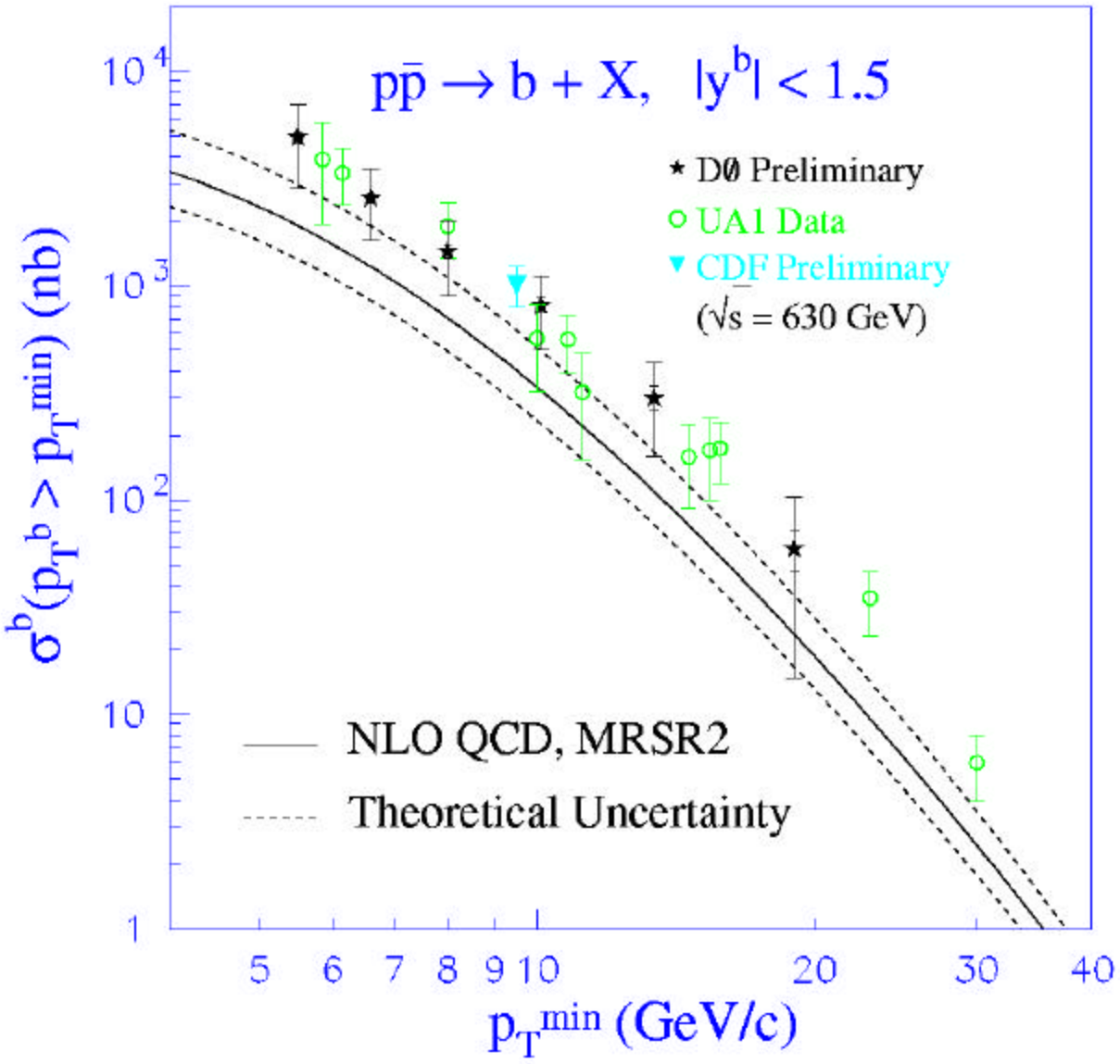
$$|y_b| < 1.0$$

Muon Cross Section at 1.8 TeV

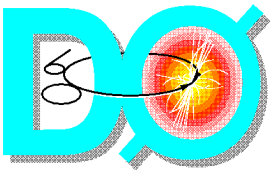


Muon cross section coming from b quarks is a factor of about 4 above NLO predictions for forward muons.

b-quark Cross Section at 630 GeV



Preliminary only - UA1 and D0 points on this plot are under review.



Why the Tevatron?

With dedicated B-factories like Belle and Babar, why do B physics at the Tevatron?

- Test and probe pQCD
- Plenty of b-quark pairs produced
- Above production threshold for all B species
- Unitarity triangle reach
- B_s mixing

Run II B Physics Goals

- Continue Run I program
  - QCD tests
  - spectroscopy and lifetimes Λ_b, B_c
- $|V_{td}/V_{ts}|$
  - B_S mixing $B_s \to K^* \gamma$
  - radiative decays
- CP violation and CKM angles
  - $\sin(2\beta)$ $B \to J/\psi + K_s$
  - $\sin(2\alpha)$ $B \to \pi^+ \pi^-$
  - possibly γ $B_s \to D_s^{\pm} K^{\mp}$
- non SM CP violation
  - $B_s \to J/\psi + \phi$
- Rare decays
  - $B \to \mu^+ \mu^-$, $B \to \mu^+ \mu^- X_s$

B Physics at the Tevatron

- $L_{inst} = 2 \times 10^{32}\ cm^{-2}s^{-1}$
- $\sigma_{inel} \sim 50$ mb
- $\sigma_{bb} / \sigma_{inel} \sim 10^{-3}$ (100 μb)
  - 10^{11} bb pairs produced per year
  - All species produced (B^0, B^+, B_S , B_C , *b*-baryons)
  - Trigger on leptons and displaced tracks
- Harsh environment
  - Large occupancies
  - Multiple interactions

$$BR(B \to l^+ n_l) = 10\%$$

$\Rightarrow 10^{10}\ b\bar{} \to l$ decays per year
$\Rightarrow 10^{9}\ b\bar{b} \to ll$ decays per year

Improved Statistics in Run II

In Run I - 35 K muon in jet events for a luminosity of 5 pb^{-1} from 100 pb^{-1} of data

In Run II - 5 fb^{-1} per year at $2x10^{32}$

Statistically less limited

Improves cross section reach, but just how far remains to be seen.

Estimated to be 250 GeV in B-jet E_T and 100 GeV in P_T^{min}

Improved Systematics

B fraction

DØ - 10% using P_t^{rel} fits

Improved stats, better fits

Momentum Resolutions (central B field) -

Run I - 20%

Run II - 4%

Jet Energy Scale - One of the largest systematic uncertainties (30% in the LNR),

Resolution improves

… but how much needs to be studied (don't forget - we're kids with a new toy)

The Sky-High Luminosity Pie

Increased luminosity introduces the following fun “challenges”

Multiple interactions become more of a problem - systematic effects?

Lepton trigger rate high (need sim.) -

Increased efficiency and coverage

B physics competes with other (worthwhile) physics topics for data samples - both imply prescales

Crossing angle for 132 ns bunch spacing

Displaced vertex trigger (right away?)

Hopeful Error Estimates

Errors here:

Removed statistical error

b-fraction - 10%

Unsmearing - 20% to 4%

Conclusions...

DØ has measured b-production at 630 and 1800 GeV

We'll do it all again at 2 TeV, and more

Systematic effects (lum, trigger, resolutions, JES) need to be studied (duh)

Also, the systematic effects of simply having more statistics (fit results, physics reach, etc.) need to be investigated.

February is ambitious!

Get to WORK!