Cross Section for b-Jet Production

DØ Collaboration
(Preliminary)

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for the

Fermilab B Physics Workshop
February 24-26, 2000 WG-4

- introduction
- data selection
- inclusive spectrum
- b component
- tagging acceptance
- results

Introduction

S. Frixione, M. Mangano, ***Nucl.Phys. B483, 321 (1997)***

- NLO production of jets containing heavy quarks
- Loosely; 'MNR'(1992) + Snowmass Jet-Cone

  at partonic level, $d\sigma = d\sigma^{(open)} + d\Delta$ (clustering)

- **b-Jets are jets carrying b-flavor**

- **A new DØ look into b-production,**
  complementary to open b-quark studies

- **Jets are directly observable**
  - ✓ Less model dependence in connecting observation with theory
  - ✓ Access to differential cross sections

- **Jet counting (muon tagged jets);**
  - ✓ theory counts jets with b ($\overline{b}$-integrated)
  - ✓ DØ counts tagging muons (in jets)

$$\frac{\mu^+ + \mu^-}{2\ \text{B.R.}} = \frac{b + \overline{b}}{2}$$

Data Sample

Run-1B (5.2±0.3) pb^{-1} muon & jet trigger
L1: muon P_T > 4GeV Jet Tower > 3GeV

Offline Selection

Jets	Muons
E_T > 25 GeV	**P_T > 6 GeV**
$\|\eta\|$ < 0.6	**$\|\eta\|$ < 0.8**
$\Delta R = 0.7$	**$\Delta R < 0.7$**

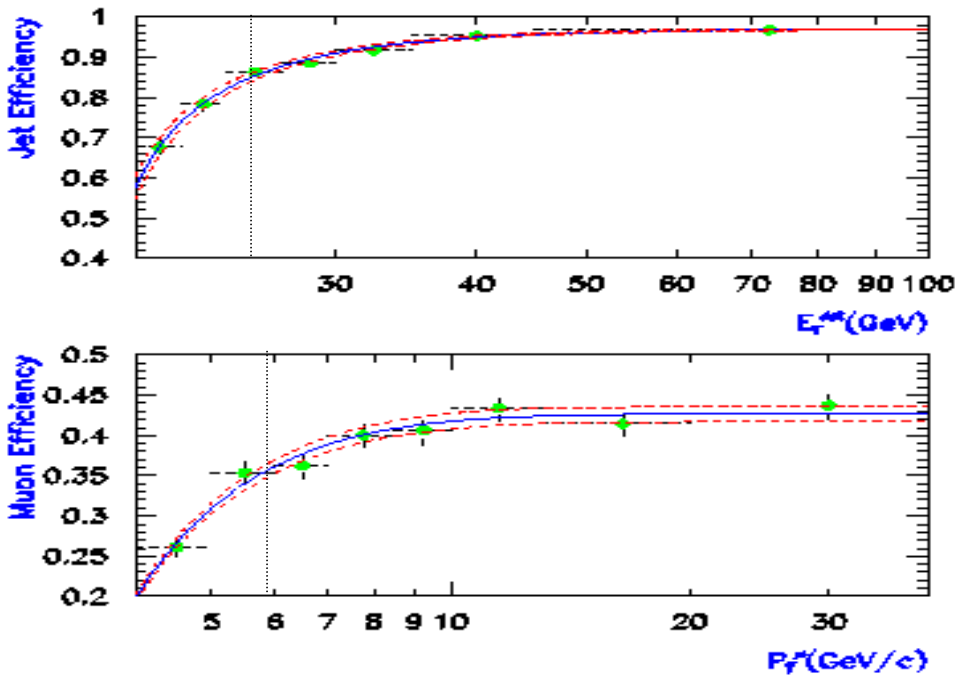
- P_T^{μ}>6GeV b's emerge from light bckgnd
- muon exclusion ($\varphi = \pm 20°$) around M.R.
- "out of time" muon contamination < 1%
- 30K events

Detection Efficiencies

	Jet	Muon
Trigger	E_T (85 - 100%)	P_T (50 - 60%)*
Reco	100%	P_T (90 - 95%)
Offline	(97±1)%	(83±3)%

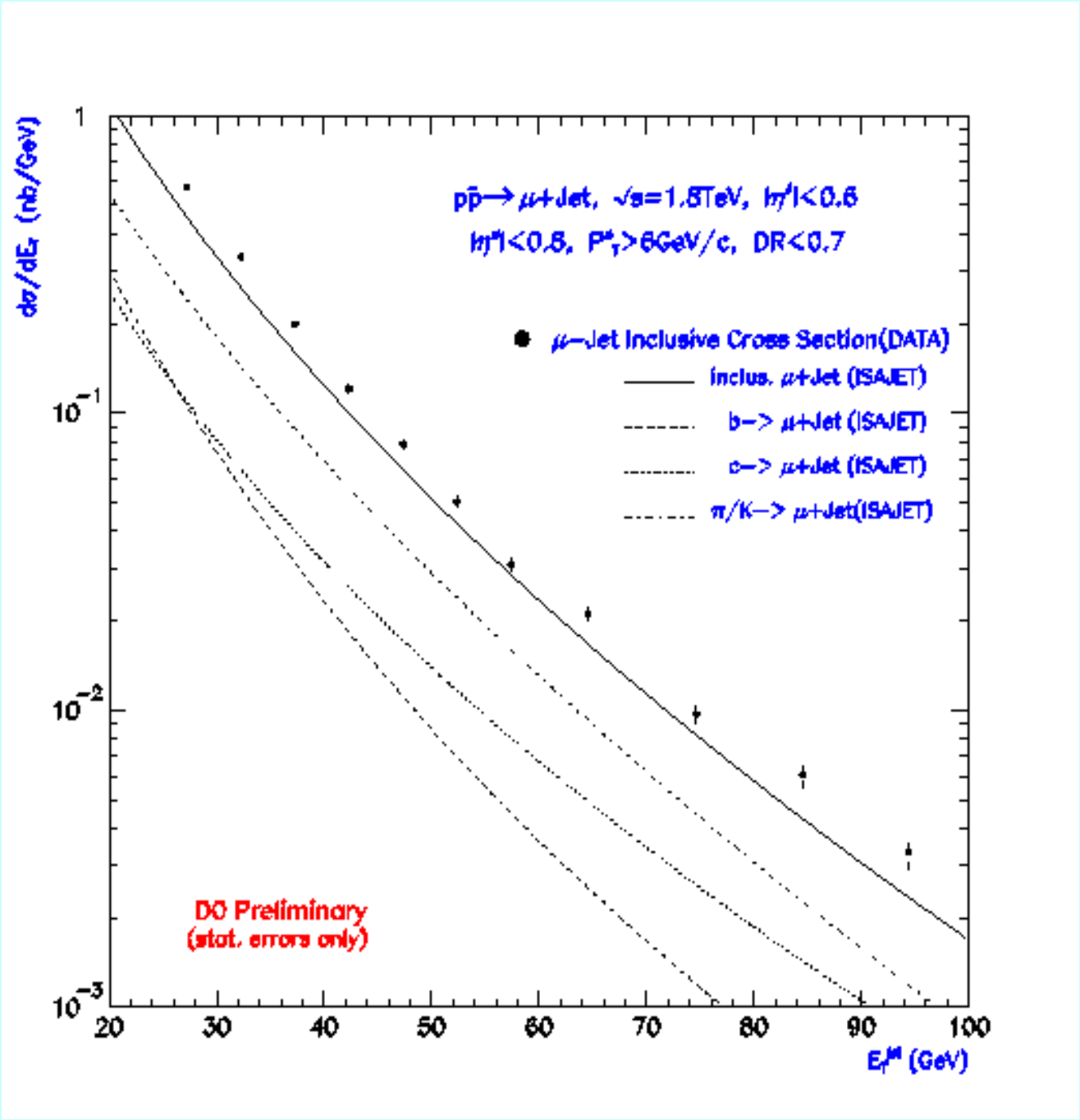
(*) Includes geom. acceptance

Combined



Inclusive Spectrum

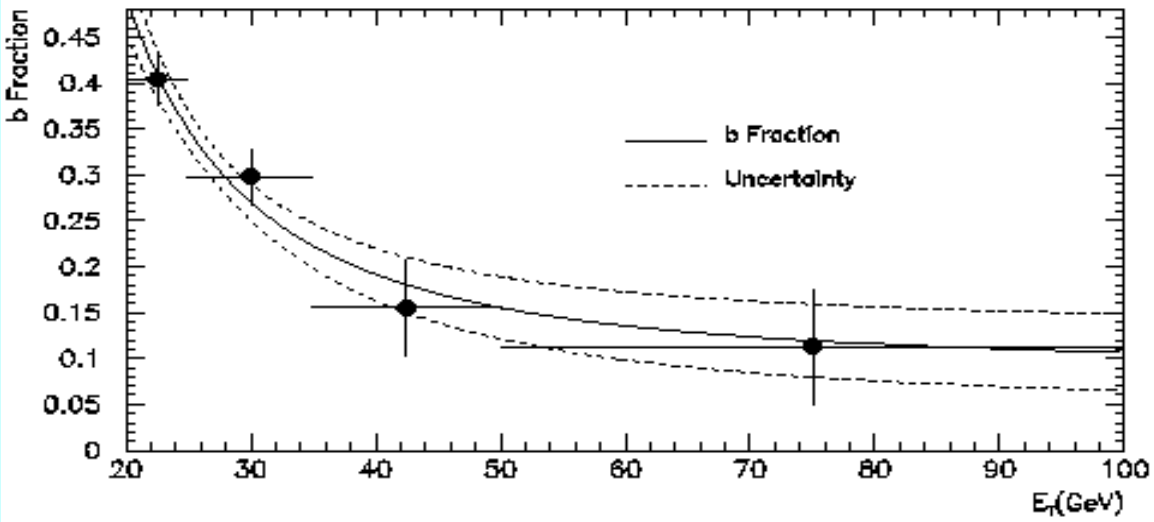
Muon-Tagged Jets

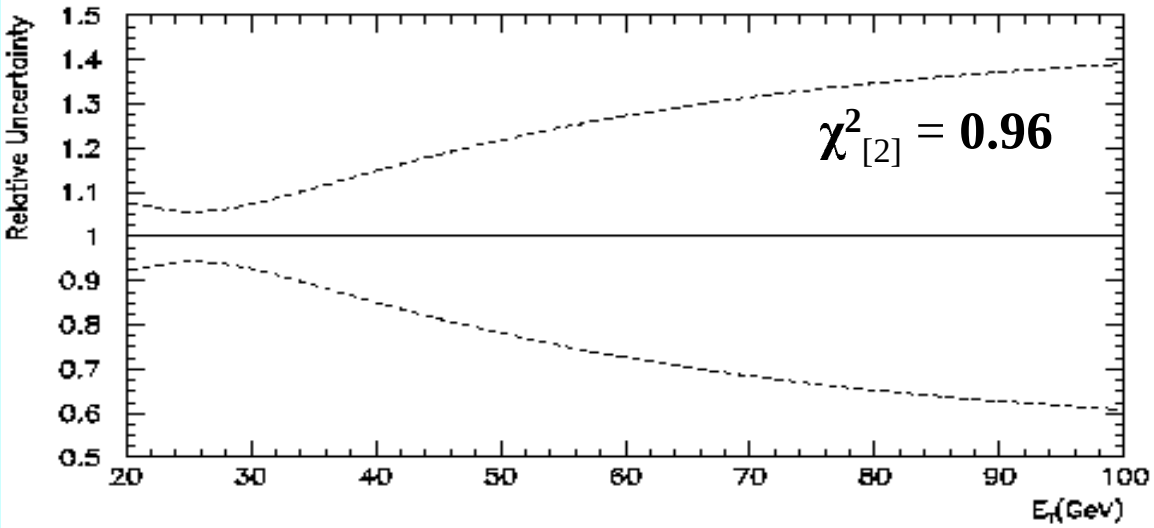


Extraction of the b Component

- P_T^{Rel} templates from Isajet (b and non-b)
- Fits to data using Cernlib's "**HMCMLL**"
- Individual b-fraction measurements at four separate E_T ranges; 20-25-35-50-100 GeV
- Closure tests with Monte Carlo samples
- Model dependence tests
- P_T^{Rel} discrimination power limits b-Jet sample to $E_T < 100$GeV
- This is the dominant source of uncertainty

b -Component





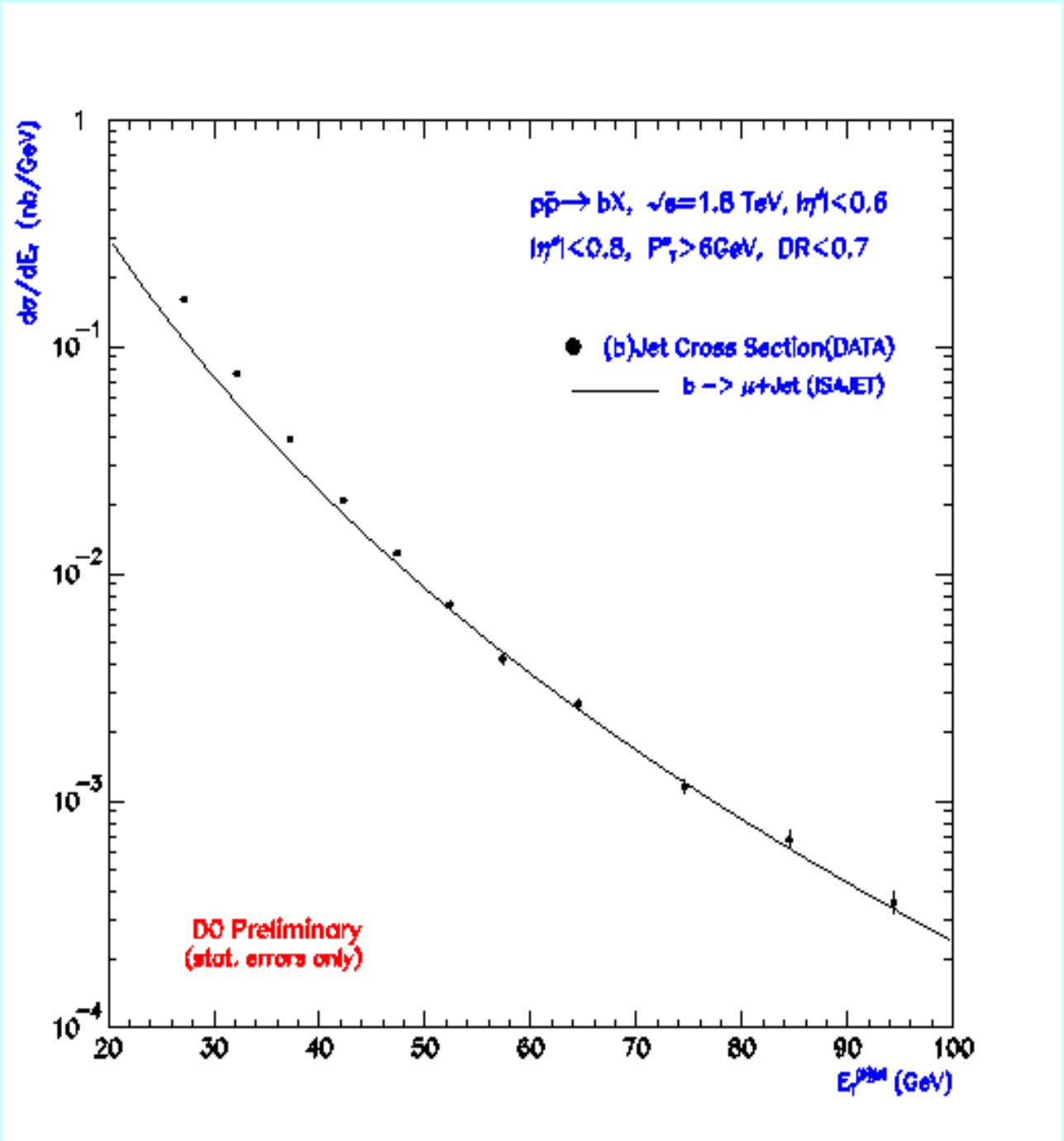
Covariance Matrix

2.65	1.35	0.48	-0.01
	1.45	1.52	1.56
		2.22	2.67
			3.39

x E-3

b-Jets Spectrum

b-Tagged Jets



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Tagging Acceptance Corrections

Corrections due to;

- **Muon η-range , p_T-threshold**
- **Muon-Jet association; ΔR<0.7**
- **Unseen Jet-E_T; (μ + ν)**
- **B. R. b → μ**
- **Jet η-range**

Correct observed spectrum with Monte Carlo ratio;

$$A(E_T)^{-1} = \frac{MC(b\rightarrow\mu)\ \text{parton jets},\ |\eta|<1}{MC(b\rightarrow\mu)\ \text{analysis image}}$$

Correction Uncertainties

- **Correction factor does not depend on MC production rates**
- **Fragmentation is the most relevant issue (fully correlated)**
- **Lepton E_T correction sensitivity is minimized by kinematics constraints over fragmentation**

Isajet 7.37 with CLEO decay modes

Frag (Peterson) ε = 0.006 ± 0.003

Error = (+8% ; –9%) E_T independent

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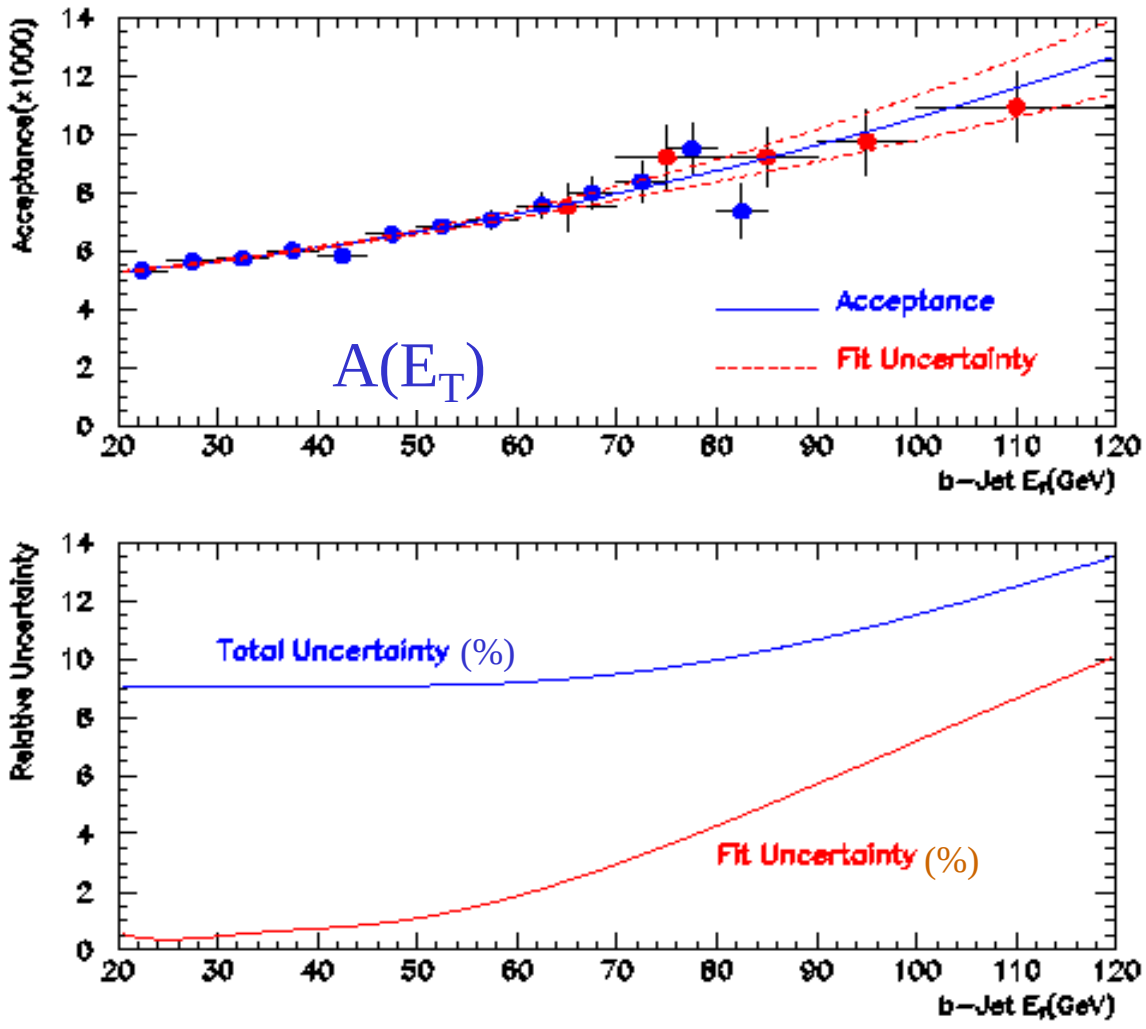
Tagging Acceptance Corrections



Avoided use of event weights

- *lower P_T^b generation threshold*
- *higher P_T^b generation threshold*

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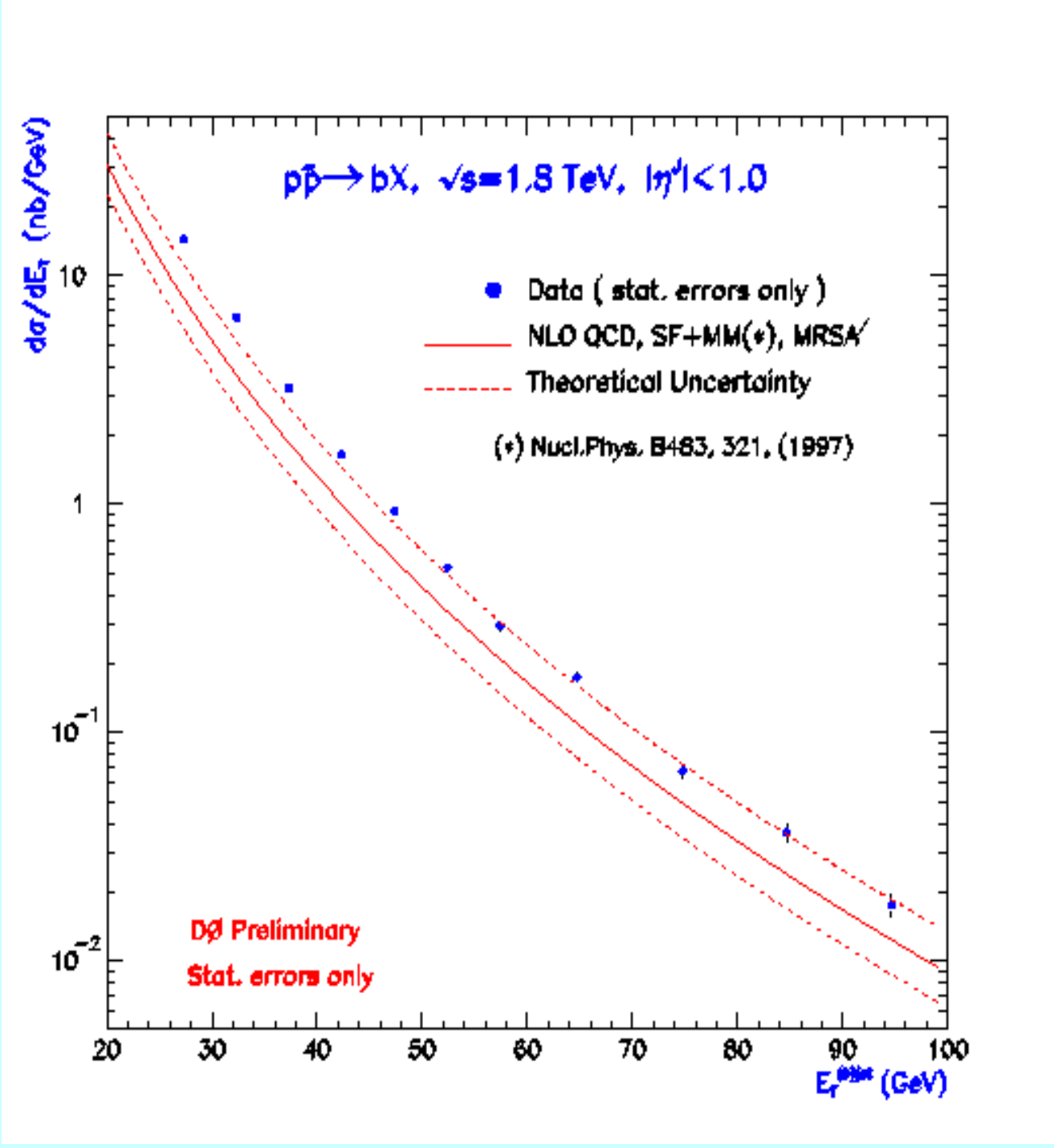
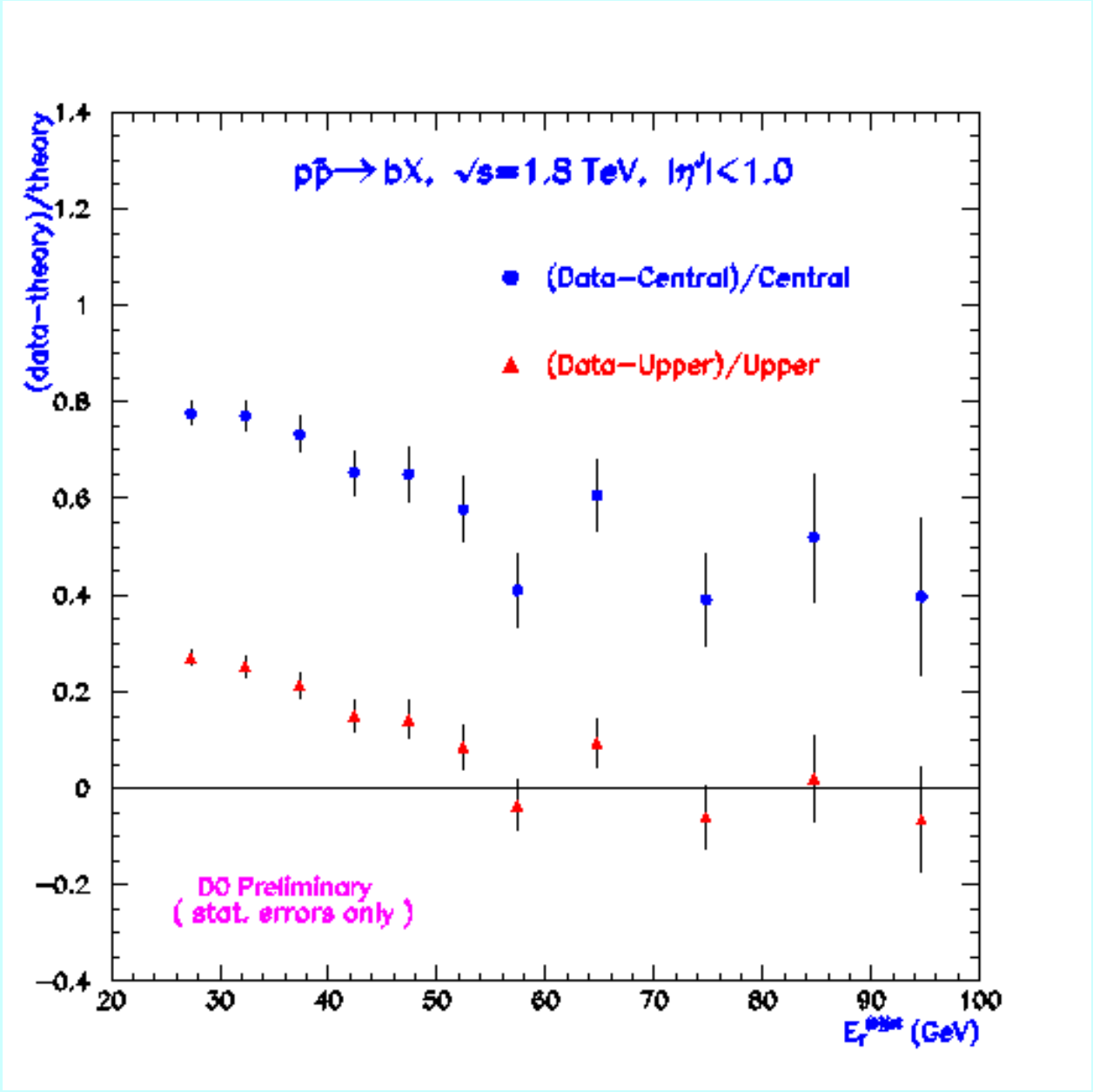
b-Jets Cross Section



(*) $2\,\mu_O \ldots \mu_O/2$, $\mu_O = (E_T^2 + M_b^2)^{1/2}$

(Data-Theory) / Theory



Systematic errors and their correlations confer 80% C.L. to theory higher edge

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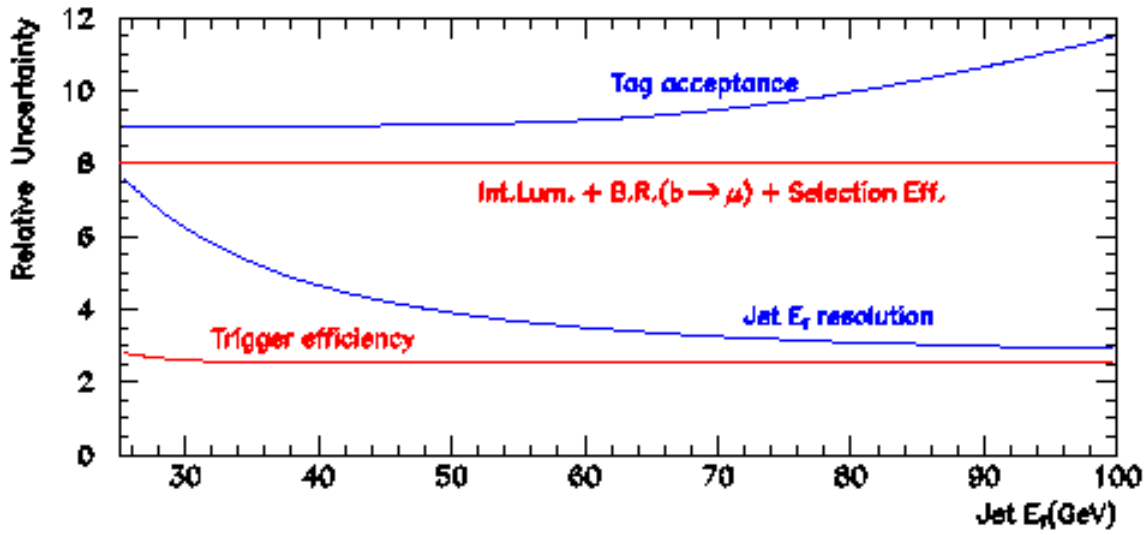
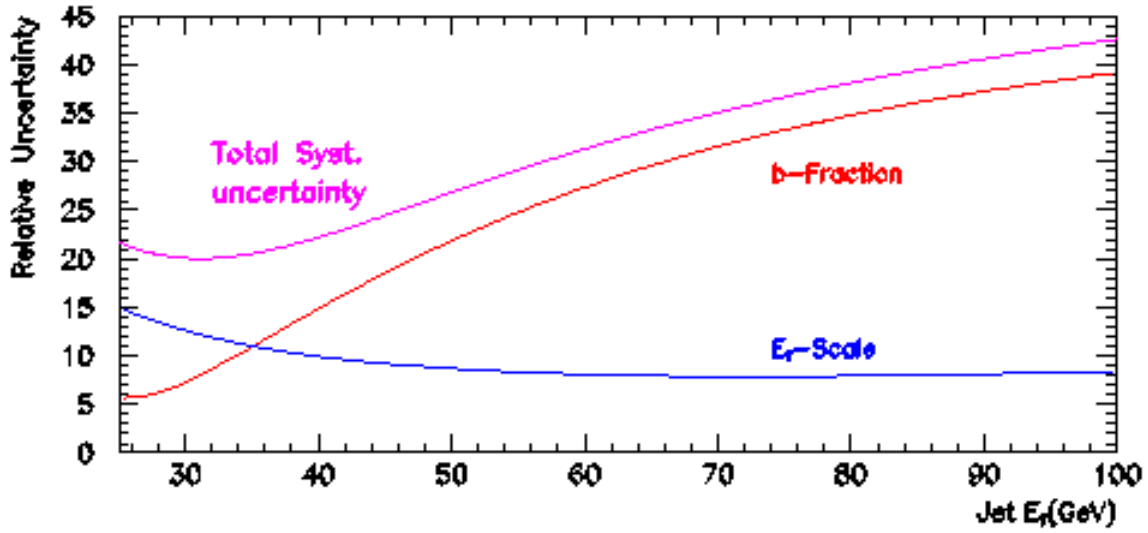
Systematic Uncertainties Summary





(relative , percentual)

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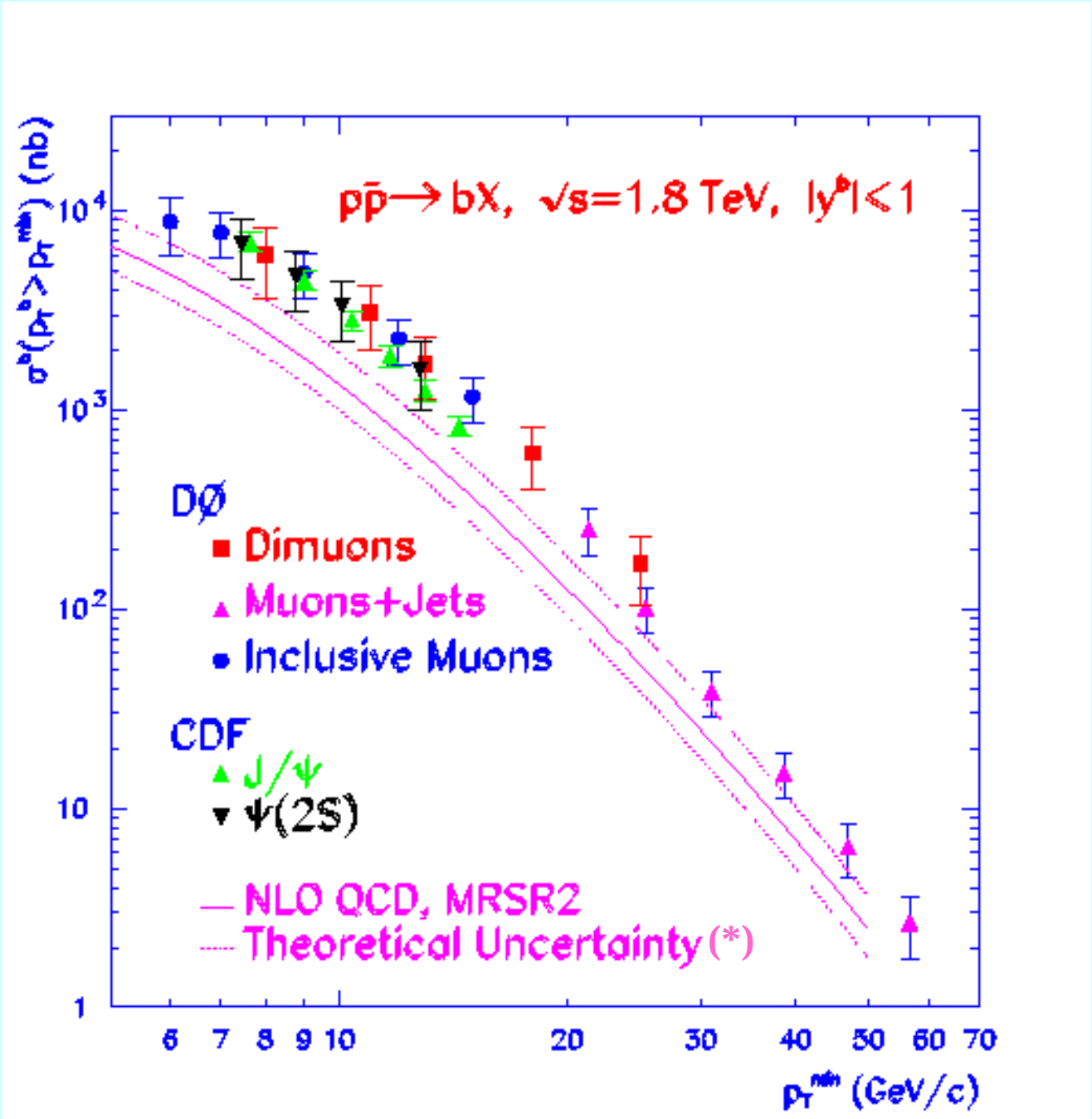
b-Quark Integrated Cross Section



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