σ(Z+b)/σ(Z+j)

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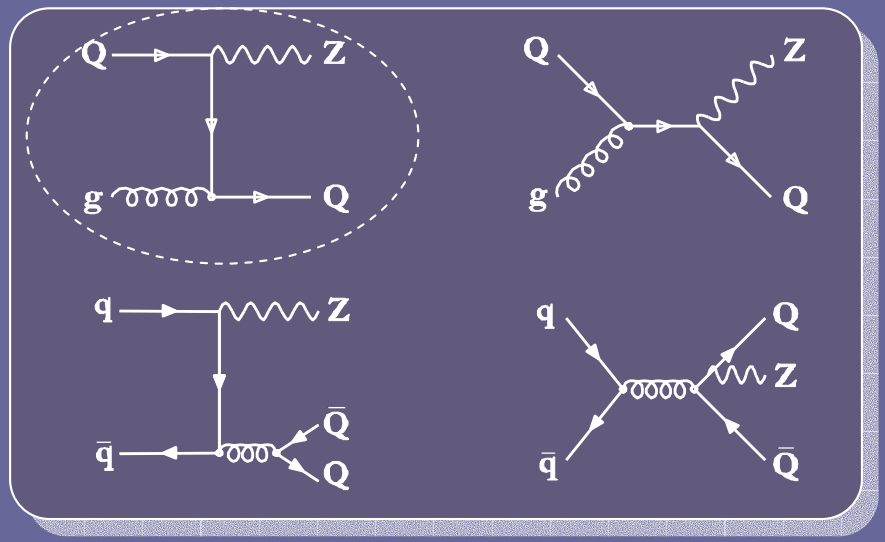
Z + single b-tag

- Z+b inclusive diagrams

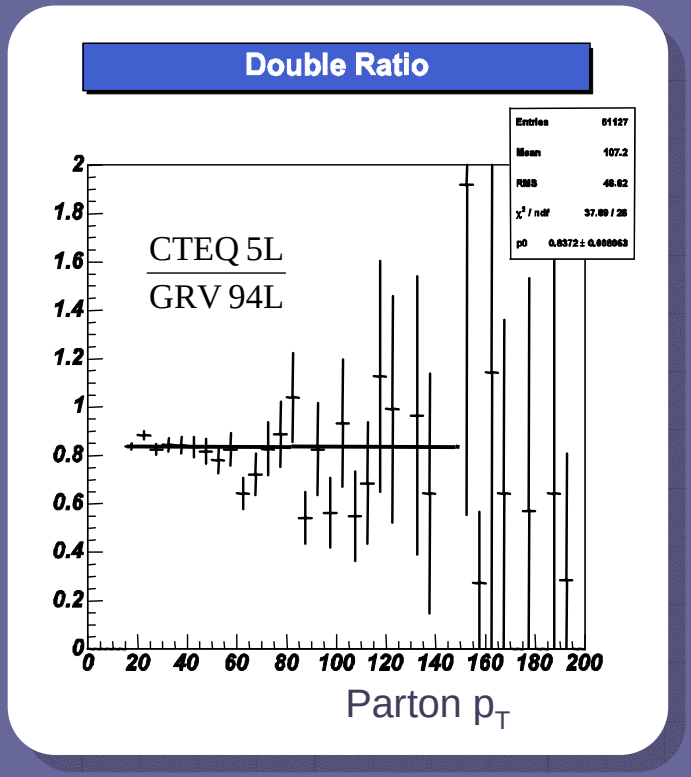


  - gg→Zbb is considered as NLO corrections to gb→Zb in the scheme of Campbell et al. PRD 69 (2004) 074021

- Background to Higgs search in ZH mode at the Tevatron
- Benchmark analysis for gb→hb
- Probe of b-quark parton density
  - Hb
  - Single top
  - Charged Higgs
  - bb-bar → H
- DØ has a preliminary result of $\sigma(Z+b)/\sigma(Z+j)$

Measurement of Z+b/Z+j

- Insensitive to detector effects to first order
  - Lepton trigger efficiencies
  - Jet energy scale
  - Reconstruction efficiencies of jets and leptons
  - Energy resolutions
- Sensitive to any differences of above between light and b-jets of the above
  - measurement is unbiased if experimental effects are identical between b and light jets
- Sensitive to PDF?
  - Double ratio of Z+b/Z+j using CTEQ5L to GRV94L

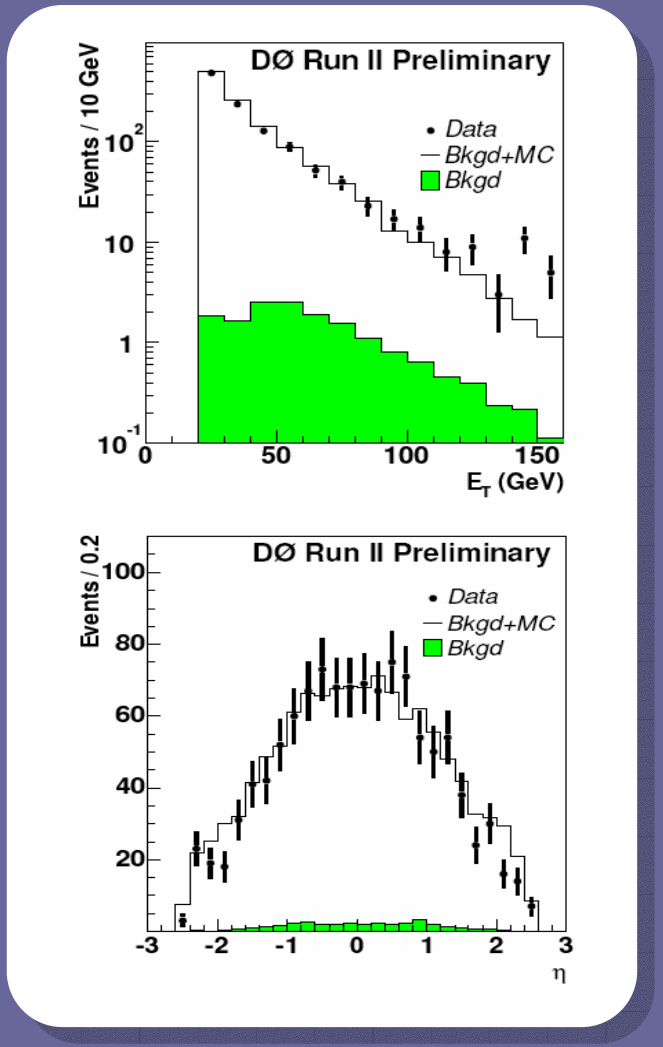


Analysis Flow

1. Select Z + jet events
   - Admixture of light (N_l), b (N_b) and c (N_c)
2. Apply b-tagging
   - Changes the mixture of light, c and b
   - Average B-tagging efficiency (ε_b) and light-jet mistag (ε_l) rate measured from the data
   - c-to-b tagging ratio measured from MC $\varepsilon_c/\varepsilon_b$ and assume ratio holds for the data
3. Solve 3 equations
   - $N_{Z+jets} = N_l + N_b + N_c$
   - $N_{Z+bjets} = \varepsilon_l N_l + \varepsilon_b N_b + \varepsilon_c N_c$
   - Assume from theory N_c/N_b

Z + jet

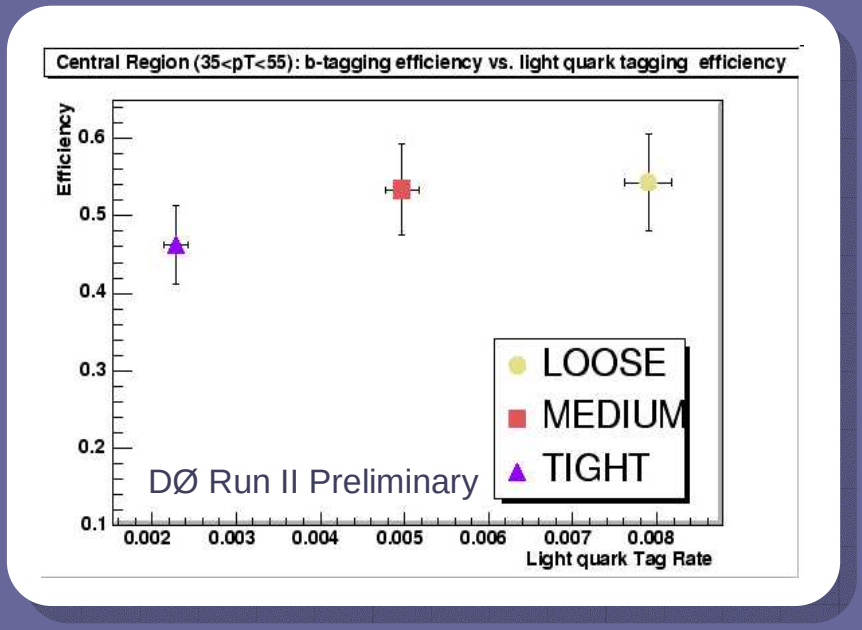
- Event Selection
  - 2 isolated high p_T leptons
    - ≥1 matching track required for dielectron channel
  - Z mass window
  - "taggable" jet E_T>20 GeV, $|\eta|$<2.5
  - ~2800 events both channels combined
- Background
  - Look at side band or use "matrix method"
  - e fakes – jets with high π^0 content with accidental matching track
  - μ – bb-bar with semileptonic decays



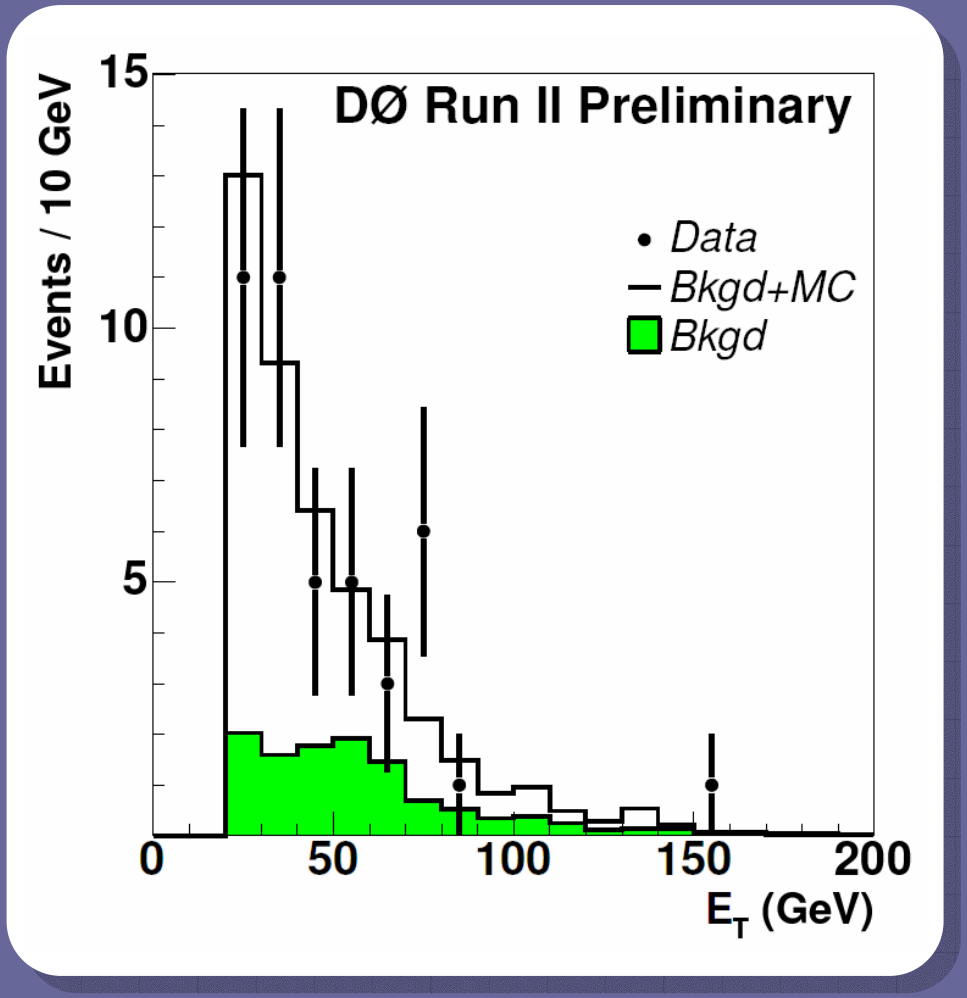
Z(μμ)+jets

Secondary Vertex b-tagging

- b-tagging should be a talk on its own
- D0 has a dedicated b-id group
  - Development of all b-tagging algorithms (tagging b-jets)
  - Rigorous measurement and critical evaluation of performance for several operating points and uncertainties
  - All efficiencies measured in data except charm using b-enriched and light flavor enriched samples
  - This gives us a uniform framework in working with various taggers
- Since b-id is continually evolving, the algorithms are run at analysis stage either in ROOT or in the framework
- All b-taggers give parametrization of tagging efficiencies and uncertainties
  - as function of jet p_T and η as a C++ code
  - performance for standard samples documented



Z+b-tag



- 42 events remain after b-tagging
- Background shown in the figure is the sum of
  - Instrumental background
  - light-jet mistag
- Composition is found by solving the set of equations

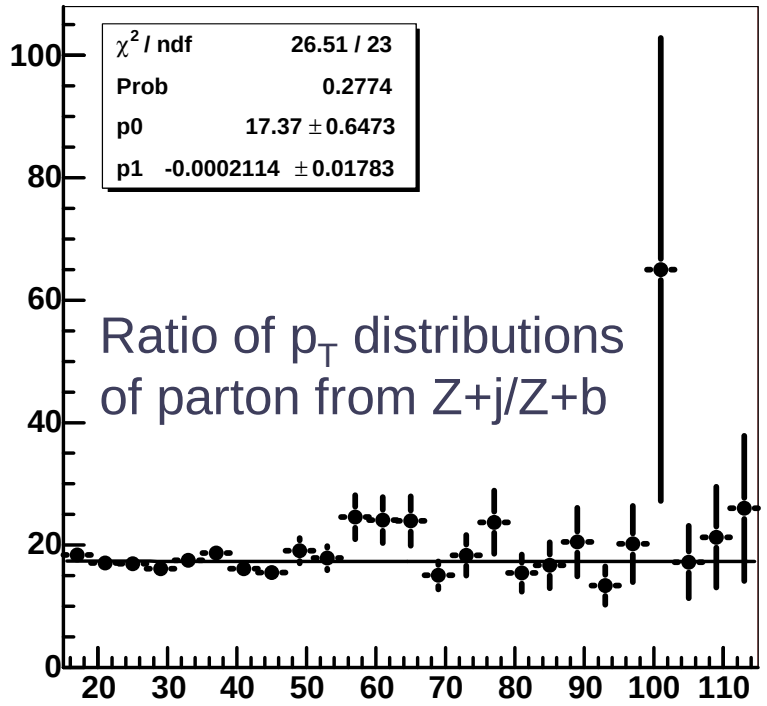
Z+b-tag

- Use the jet spectra from data
  - Assume it is the b-jet spectra before b-tagging
  - Comparison of jet spectra from Z+j and Z+b are very similar
- Average b-tagging and light-jet mistag rate is derived by convoluting the jet distribution with efficiency parametrization macro

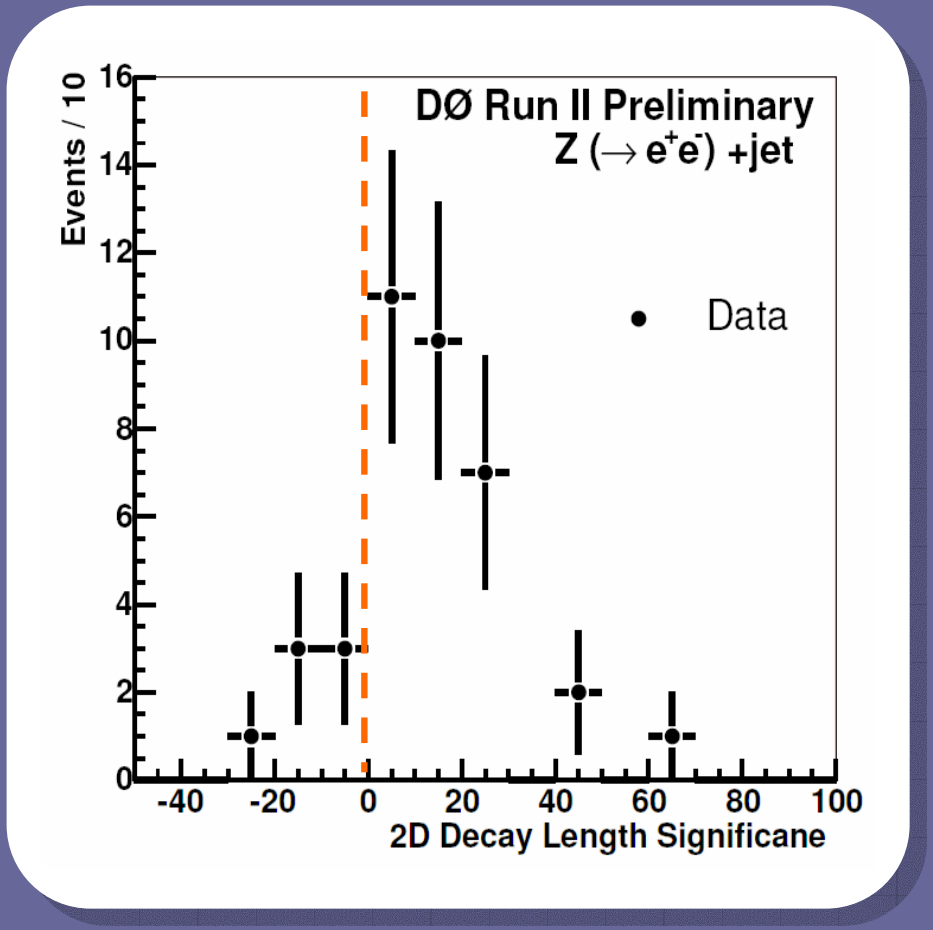
$$\bar{\varepsilon}_b = \int \varepsilon_b(p_T, \eta) \frac{d\sigma}{dp_T d\eta} \approx 34\%$$

$$\bar{\varepsilon}_l \approx 0.3\%$$

  - There are corrections to be made for going from per jet efficiency to per event efficiency



Result



- Measured ratio:

$$\frac{\sigma(Z+b)}{\sigma(Z+j)} = 0.024 \pm 0.005\,(stat)^{+0.005}_{-0.004}\,(syst)$$

  - Main sources of systematic uncertainty
    - b/c tagging efficiency
    - background estimation
  - NLO Theory: 0.018±0.004
- Cross checks
  - Z(ee) channel: Given N_b, N_c, N_l 10.3 events expected with Soft lepton tags and 12 observed
  - Z(μμ) channel: Correlation with impact parameter based tagger is different for b and c and light

Summary and Outlook

- A unique measurement of Z+b is being done at DØ
  - A probe to b-quark PDF
  - Result agrees with calculation that includes both Z+b and Z+bb
- $bg \rightarrow Zb$ or $q\bar{q} \rightarrow Zb\bar{b}$?
  - Look at double tagged events and then extrapolate contribution to single tag
  - What about 2 b's merged inside a jet?