The One and Two Dimensional B-Quark Fragmentation Function

Thesis Motivation / Inaugural Talk

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Talk Outline

- Status of the 1D fragmentation analysis
- Motivation for the 2D analysis
- Improvements to the 1D case using Recon Version 17
- Quick look at the 2D distribution
- Future Plans

Status of the 1D Analysis

Dan’s thesis work was recently published in PRL.
Phys.Rev.Lett.84:4300-4304,2000

Preliminary ALEPH result has the edge by 5%
- keen to beat down our errors

Dan and I have begun working together in order to acheive this.

Optimise the old analysis for v17
Changes in procedure
- Add Su Dong’s Kill Kal
- Tom’s neural net
- Adjust cuts accordingly

The new improved result will be ready to be present at the summer conferences.

The 2D Fragmentation Function

Logical Continuation of Dan’s work

Challenging analysis - low statistics

Only current experiment that can
- Worlds First

Tests of Theory
- There are many 1D predictions which ought to be adaptable to the 2D case; the correlation between hemispheres may be calculated.
- Similar to the 1D case, we can do model tests of various MC simulations.
- Catch up with, and prompt futher theoretical work

The paper: *Z.Phys.C53:149-156,1992*
written by *Burrows, Del Duca, Hoyer*

is of particular interest because it explicitly predicts the correlations between the b and $\bar{b}$ hadrons

In general, $b\bar{b}$ events descibed by 3 indepenant variables:

$X_b=E_b/E_{beam}$,

$X_{\bar{b}}$,

Ψ=angle between the two

The probability density,$P(X_b,X_{\bar{b}};\Psi)$ is calculable in pQCD

Non-perterbitive effects factorise out; X_b -> X_B

If fragmentation is scale invariant, then the double moments of $P(X_b,X_{\bar{b}})$ are related to the 1D moments, $P(X_b)$, by moments of $P(X_b,X_{\bar{b}};\Psi)$

$$D_{kl}=M_k M_l P_{kl}$$

$D_{kl}= \ x_B{}^k x_{\bar{B}}{}^l P(X_B,X_{\bar{B}};\Psi)dx_B dx_{\bar{B}}$

$M_{kl} = \ \ x^k P(X)dx$

$P_{kl}(\Psi)= \ X_b{}^{k-1} X_{\bar{b}}{}^{l-1} P(X_b,X_{\bar{b}};\Psi)\ dx_b dx_{\bar{b}}$

The plots show the expected behavior of the double moments P_{kl}

- progressive decrease with increasing k,l
- a small mass dependance
- JETSET truth works well for k,l > 2, but is offset by a constant 10% for P_{11}
- Higher order corrections expected of the order 10%

Influence of the 2D Analysis

- B-frag among largest systematic in heavy flavor analysis
- Correlation not varied: Don't know how
- Potentially large systematic in the measurement of Rb

$$N_b = 2N(R_b\,\varepsilon_b + R_c\varepsilon_c + R_s\varepsilon_s + ...)$$

$$N_{bb} = N(R_b\varepsilon_b{}^2\lambda_b + ...)$$

The 2D analysis will resolve the problem

Improving the 1D Analysis

Starting to explore the items mentioned earlier

The Most Simple case:
keep same code with the same cuts and see what you get by switching from v15 to v17

- Note that 6 events are missing from v17and
  1 event v15

After cutting on Mpt>2

- v17 selects 14787 hemispheres
- v15 selects 14377
- 12957 are common to both

Final Selection

- v17 selects 1311 b decay vertices
- v15 selects 1301 b decay vertices
- Only 962 are common to both
-

v15 Purity = 99.3% Efficiency = 4.1%
v17 Purity = 98.9% Efficiency = 4.1%

The raw energy distribution is of a similar quality

- slightly better coverage at low E
- sharper high E edge.

2D Analysis

Improve efficiency for the final b selection requiring a good b in each hemisphere

- Could relax the cuts quite substantially. The 1D analysis has a background of only 0.7%.
- Looser cuts leads to better efficiency
- The double tag regains some of the purity

Optimised cuts for the 2D Analysis

Show some assembled parts at Kirkwood, and present the polished product at Moriond 2001