

Progress with the Double B-quark Fragmentation Function

SLD Collaboration Meeting 2000

by

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Talk Outline

- Motivation
- Analysis Milestones
- Selection Criteria
- Current Best Double-B energy plot
- Summary
- Future Timetable

Motivation of the Double B Hadron Fragmentation Function

- What is it?

The correlated leading B hadron energy:

$$1/\sigma \cdot d^2\sigma/dx_B dx_{\bar{B}}$$

- Dan measured the single inclusive B hadron energy
- Perhaps the only current experiment that can
->Another World's First
- Tests of Theory
There are many single B-hadron predictions that ought to be adaptable to the double B case; the correlation between hemispheres needs be calculated.
- We can test against various functional forms
- Catch up with, and prompt further theoretical work

The paper: *Z.Phys.C53:149-156,1992*
 written by *Burrows, Del Duca, Hoyer*
 explicitly predicts the energy correlations between
 the B hadrons

- In general, $b\bar{b}$ events described by 3 independent variables:
 $X_b = E_b/E_{\text{beam}}$,
 $X_{\bar{b}}$,
 $\Psi = \text{angle between the two}$
- The probability density $P(X_b, X_{\bar{b}}; \Psi)$ is calculable in pQCD
- If fragmentation is scale invariant, then the double moments of $P(X_b, X_{\bar{b}})$ are related to the single B hadron moments, $P(X_b)$:

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

$$D_{kl} = \int x_b^k x_{\bar{b}}^l P(x_b, x_{\bar{b}}; \Psi) dx_b dx_{\bar{b}}$$

$$M_k = \int x_b^k P(x_b) dx_b$$

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

Of course, X_b is unmeasurable, but I am able to use X_B by virtue of Dan's analysis:

- The single moment : $M_k = A^{NP}_k P^k_{QCD}$
- The double moment: $D_{kl} = A^{NP}_k A^{NP}_l P^{kl}_{QCD}$

The non-perturbative effects are explicitly measured in the single inclusive analysis, thereby leading to an *absolute prediction* for the double B hadron energy correlations

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

- progressive decrease with increasing k,l
- small mass dependence

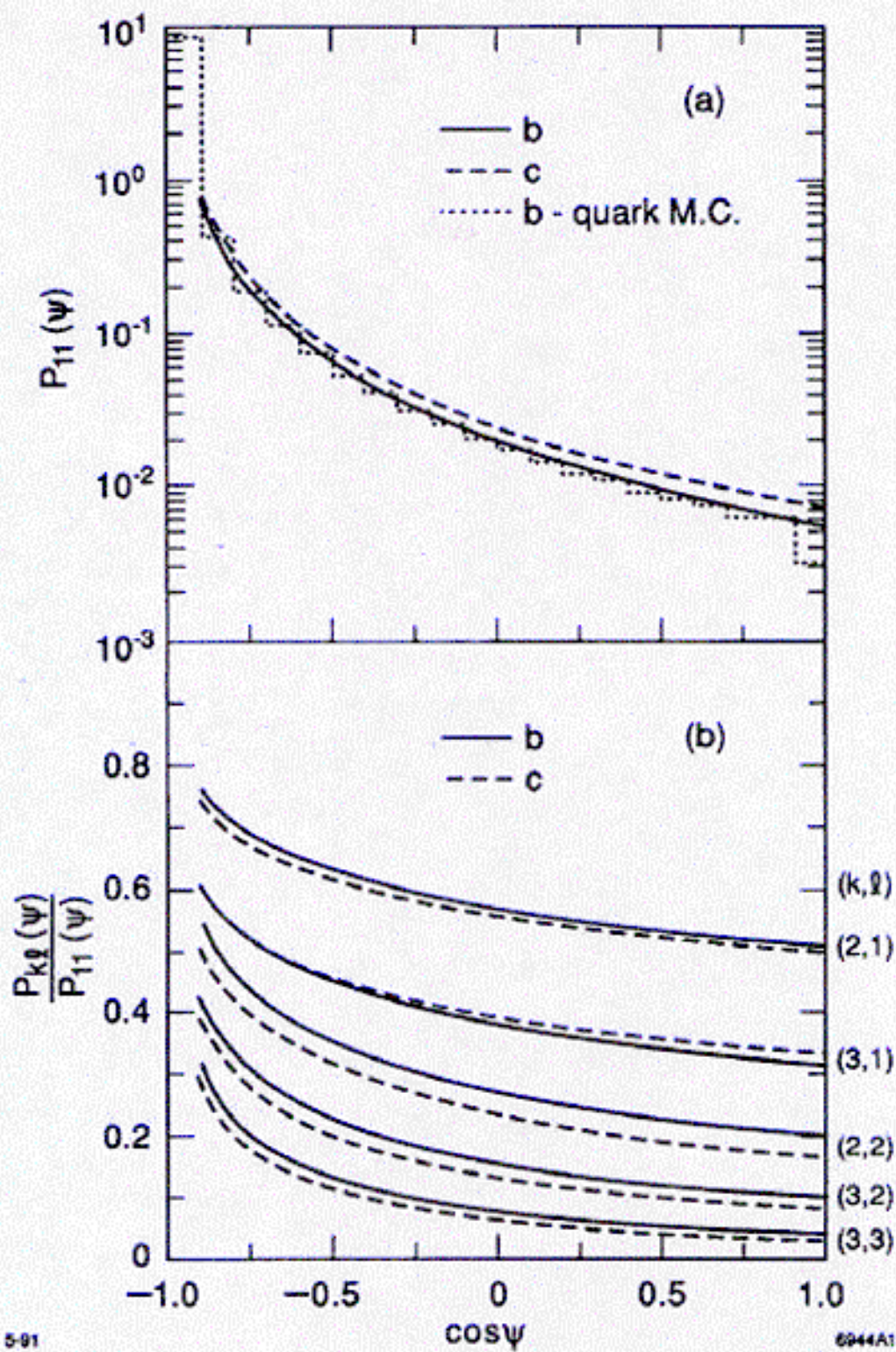


Figure 1

Further Relevance of the Double-B Analysis

- B-fragmentation is among the largest systematics in heavy flavor analysis
- Correlation not varied: Don't know how
- Potentially large systematic in the measurement of R_b

$$N_b = 2N(R_b \epsilon_b + R_c \epsilon_c + R_s \epsilon_s + \dots)$$

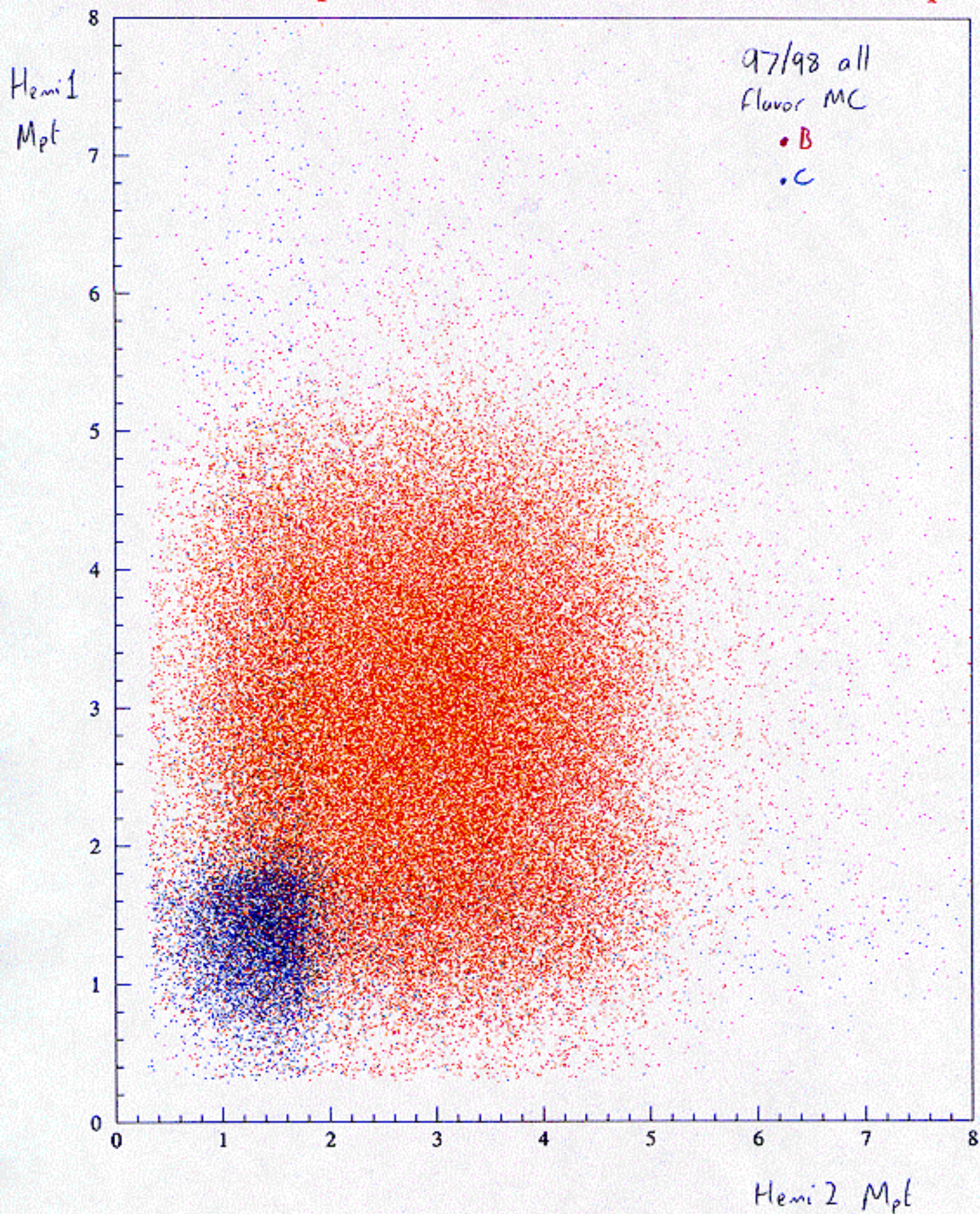
$$N_{bb} = N(R_b \epsilon_b^2 \lambda_b + \dots)$$

The Double-B analysis will resolve the problem

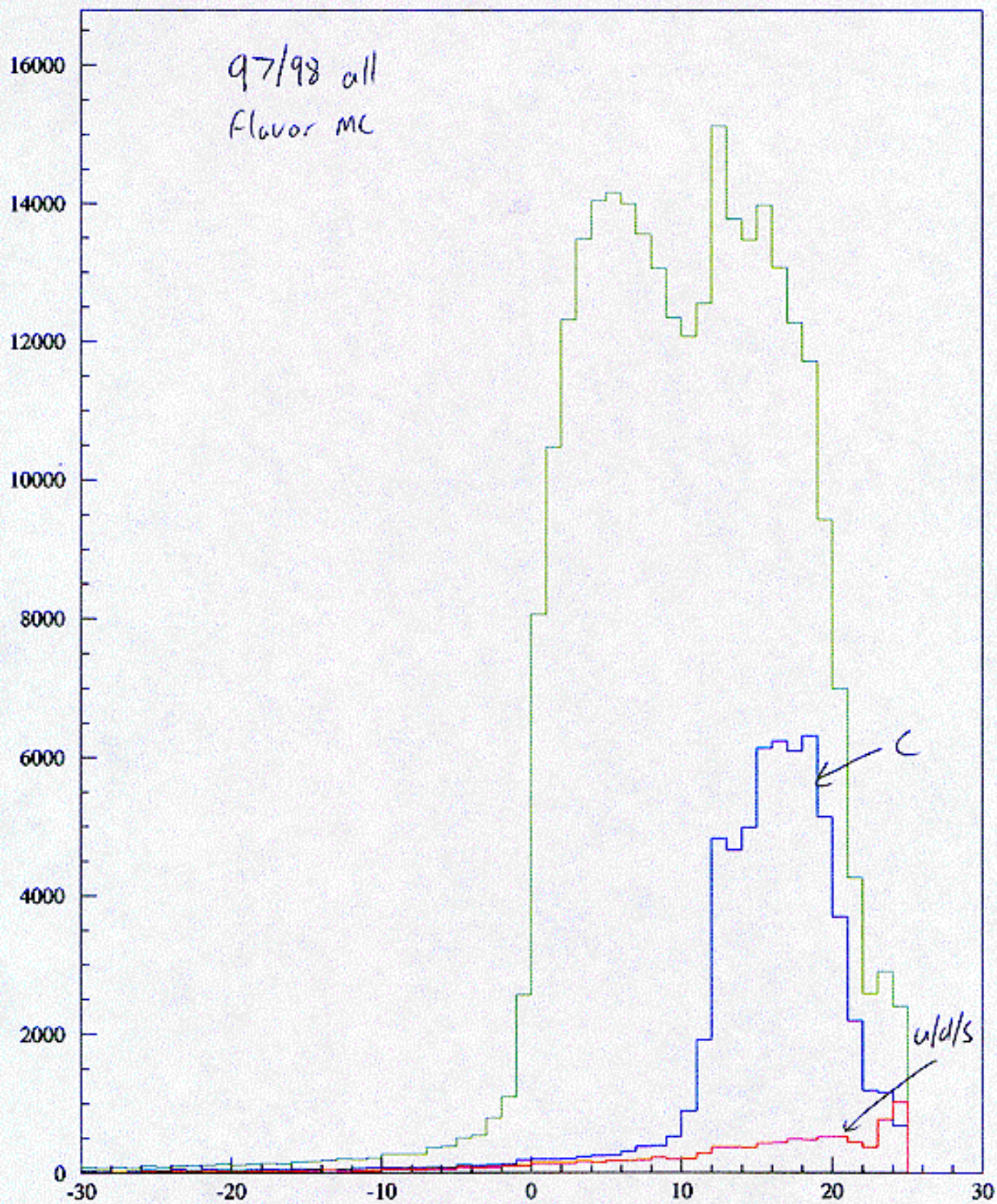
Milestones

- Reproduce single inclusive B energy distribution, using the full data set and compare with Dan.
- Selection of event with a measurable B and \bar{B}
- Obtain the raw double-B energy distribution
- Compare with:
 - > correlations inferred from single B analysis
 - > ad hoc functional forms
 - > prediction of the explicit correlations between the B's

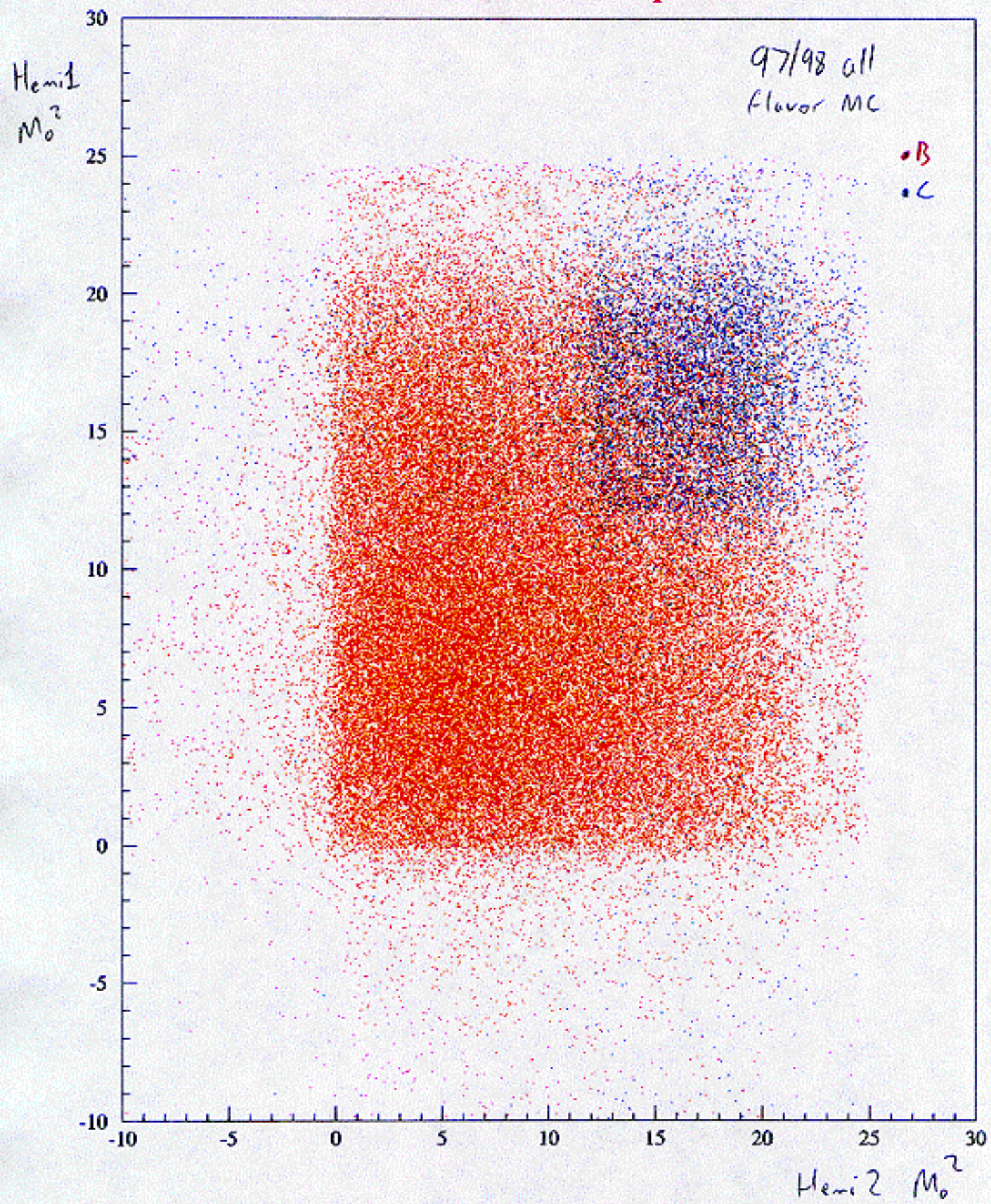
Distribution of Mpt where a VTX is found in each Hemisphere



M0 Squared Dist. for all VTX found by ZVTOP



Distribution of M0 Squared



Selection Details

- The cuts used for the single B analysis gave a final selection efficiency of 4%. $(4\%)^2 = 0.16\%$ for the $B\bar{B}$ selection!
- Standard point of reference are the Mpt plots, and cuts imposed on this variable.
- **NO CUT ON MPT** -> 90 % percent pure
-> 50 % efficient

150481 $b\bar{b}$ passed hadronic selection

ZVTOP finds 83548 events with a vtx in each hemi

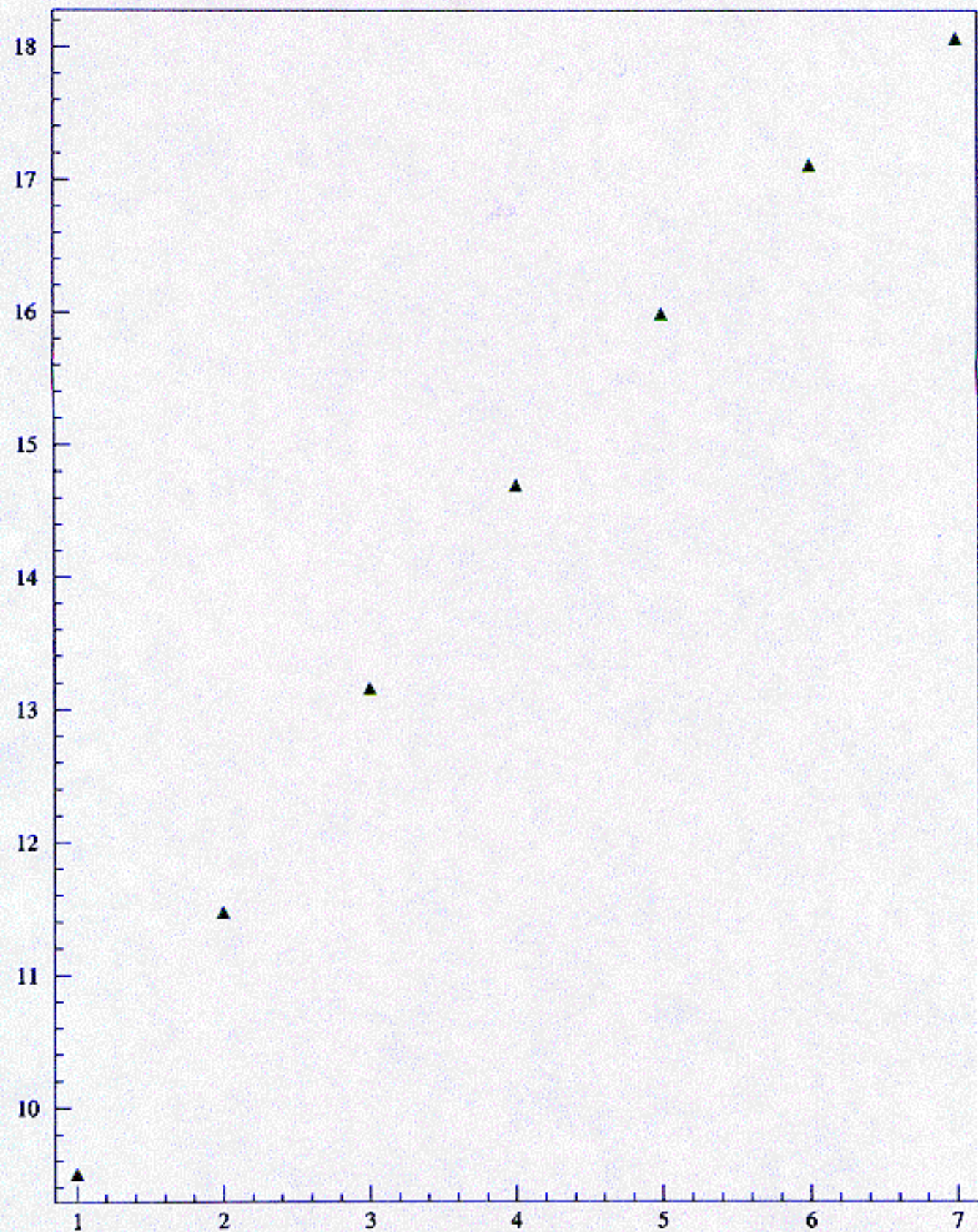
75205 $b\bar{b}$

8253 $c\bar{c}$

90 u/d/s

- Not yet tried to implement the neural net selection
- M_0^2 cut **crucial** for resolution but **destroys** efficiency

Resolution verses Cumulative M0 Bins

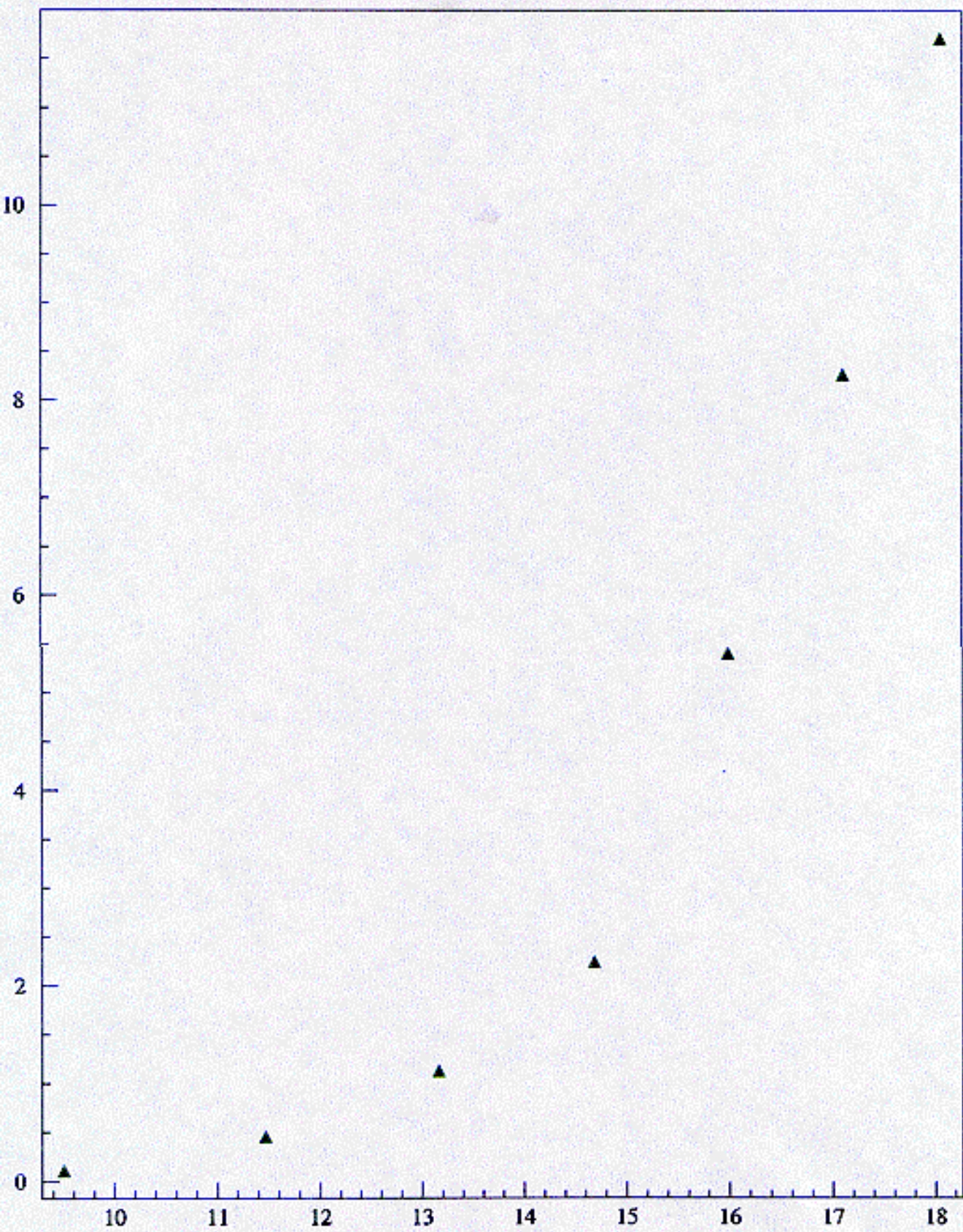


Resolution

$-1 < m_0 < X$	Tot. $B\bar{B}$ Found	Non $B\bar{B}$ Background	$B\bar{B}$ sel. Efficiency	Rel. Energy Residual %
1	170	0	0.113	9.67
2	691	0	0.459	11.52
3	1701	0	1.130	13.23
4	3372	0	2.241	14.75
5	5703	4	5.403	16.04
6	8720	5	8.262	17.15
7	12356	9	11.705	18.11
8	16443	12	15.577	19.02
9	20816	16	19.719	19.81
10	25406	26	24.061	20.46

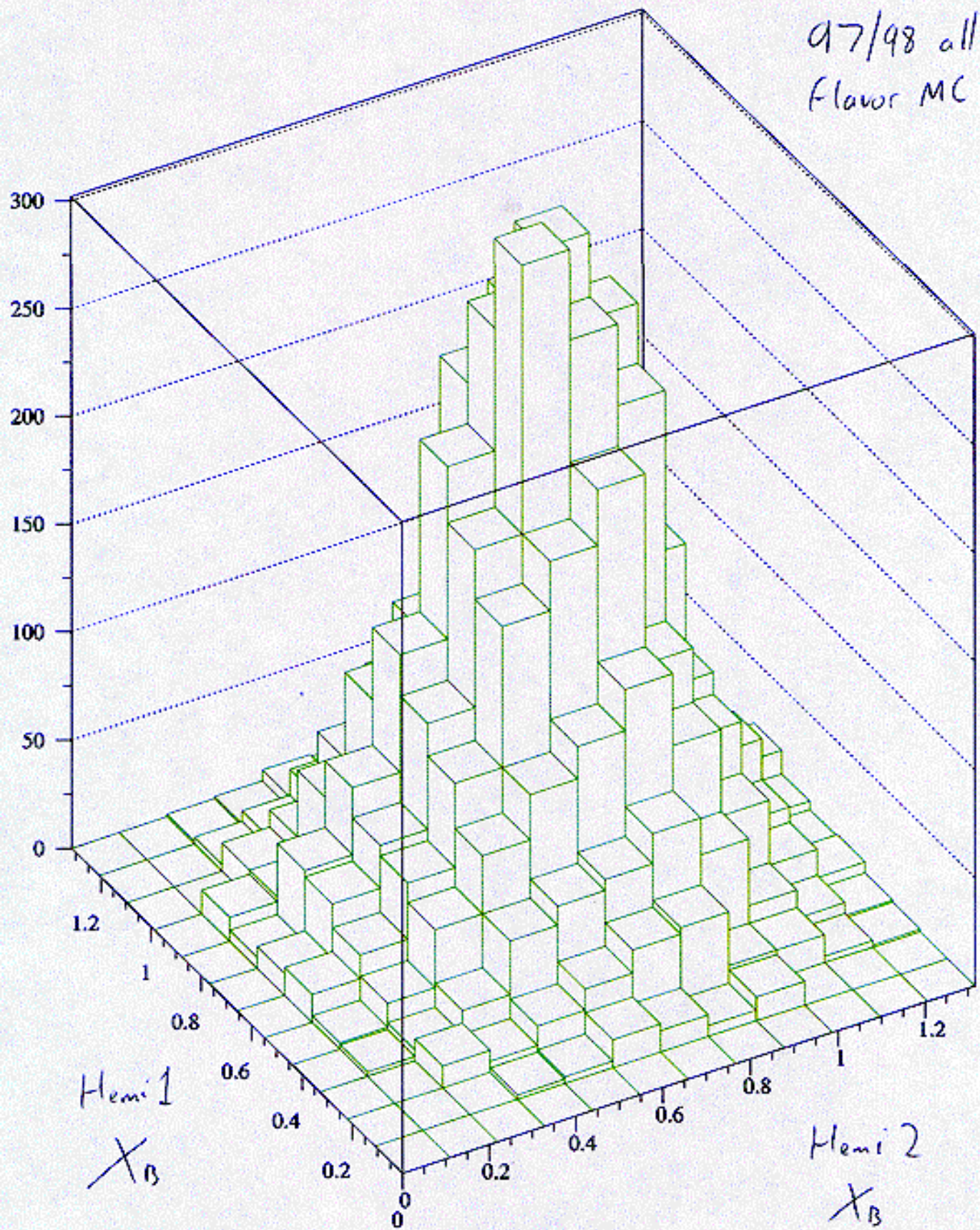
*I am not trading off efficiency-vs-purity, but rather
efficiency-vs-resolution*

Efficiency versus Energy Resolution



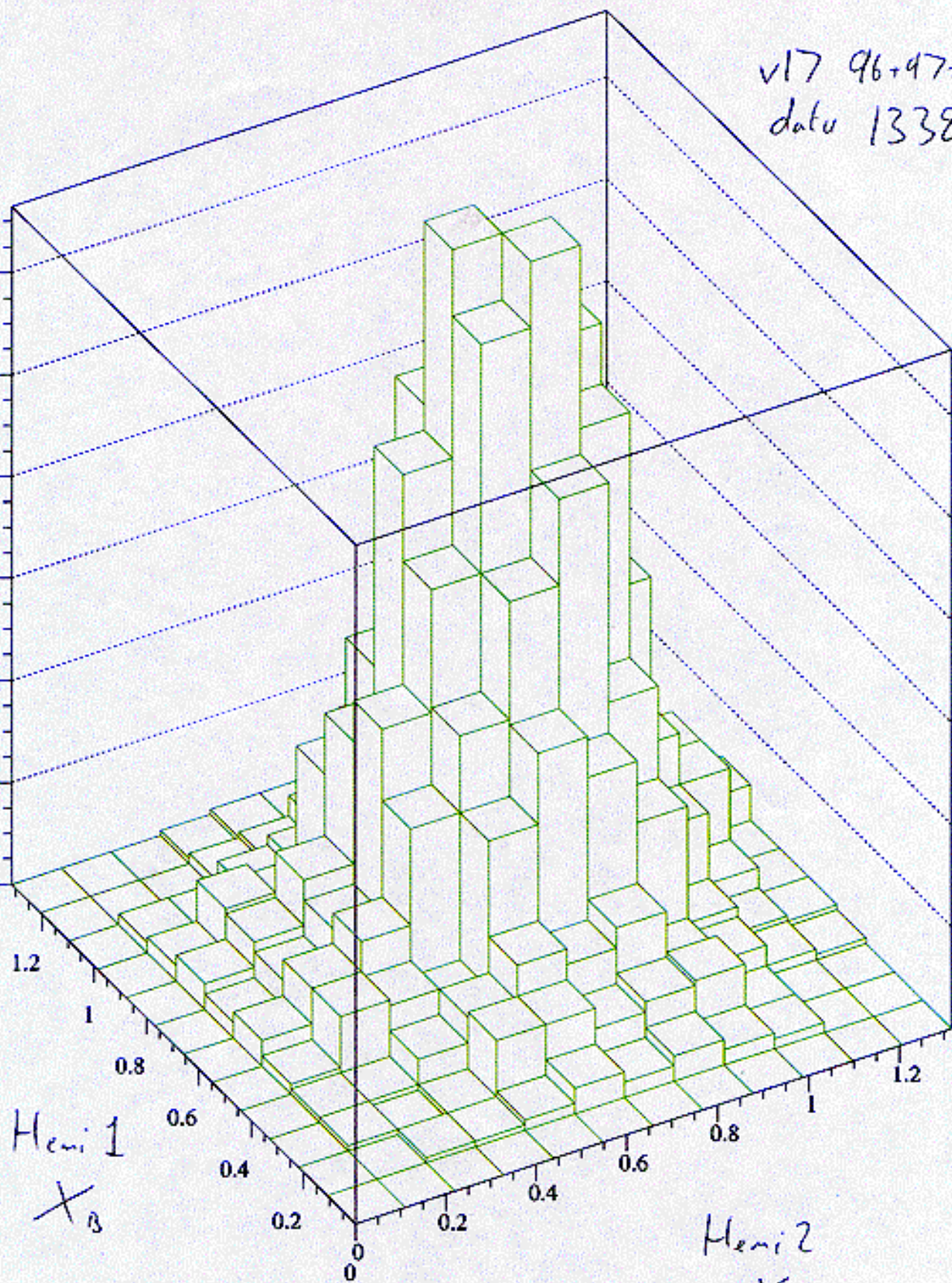
Distribution of the Scaled B Hadron Energies

97/98 all
Flavor MC



Distribution of the Scaled B Hadron Energies

v17 96+97+98
data 1338 events



Summary

- Repeated Dan's single inclusive analysis: **we agree**
- Taken a first look at reconstructing $B\bar{B}$ events
 - > tighter cuts yield 76 events in the data
 - > looser cuts yield 1338 event
 - > A **factor 18 increase** in data
 - > degraded resolution by a factor 1.5
- Detailed exploration of the parameter space
 - > try to recover the resolution

Planned Timetable

There will not be a result for the summer or winter conferences

I will present the results of the updated 1D analysis at DPF in August

Preliminary result of the 2D analysis ready for Moriond

Final result and any corresponding publication should be signed and sealed by Fall 2001