Lepton-D Analysis

March 2000

Status Report

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- Overview of analysis

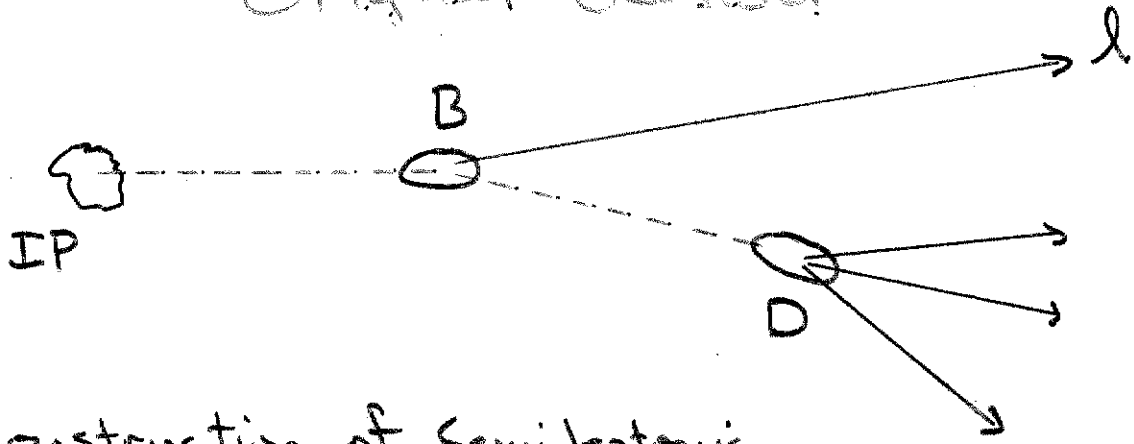
- Reconstruction efficiency improvements
  - Using ZVTOP3 (correctly…)
  - Neural Net decay selection

- Charge purity improvements
  - Track attachment algorithm
  - VX Alone vectors

- Future plans

Lepton - D Analysis

Original Version



Reconstruction of Semileptonic B Decays:

→ Select hemispheres with high p_T leptons (wrt jet or thrust axis)

→ Select candidate D from ZXFIND 2 prong vtxs

→ Attempt to attach tracks to D

→ Intersect resultant D vector with lepton to form B vertex

→ Attempt to attach slow pion to B vertex

→ Selection cuts applied to improve B purity

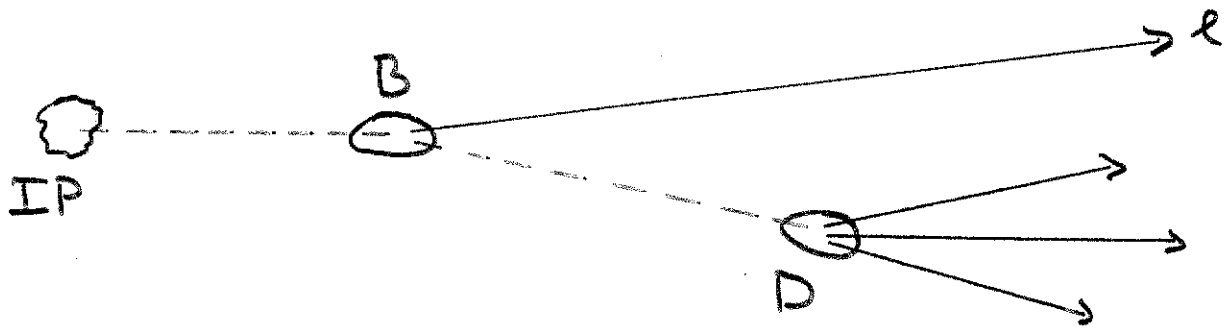
Problems:

→ Low efficiency for reconstruction
- Lepton cuts (selection & p_T)
- Vertexing

→ Efficiency drops rapidly near IP
- ZXFIND requires separation from IP

Lepton - D Analysis

Version II : '95-'96 + '99.



→ Used a "special" version of ZVTOP where lepton candidates were not used in search for candidate vertex

1) Require hemispheres to have a candidate lepton and a ZVTOP secondary vertex

2) Attempt to attach tracks to secondary vertex
   → use L/D algorithm

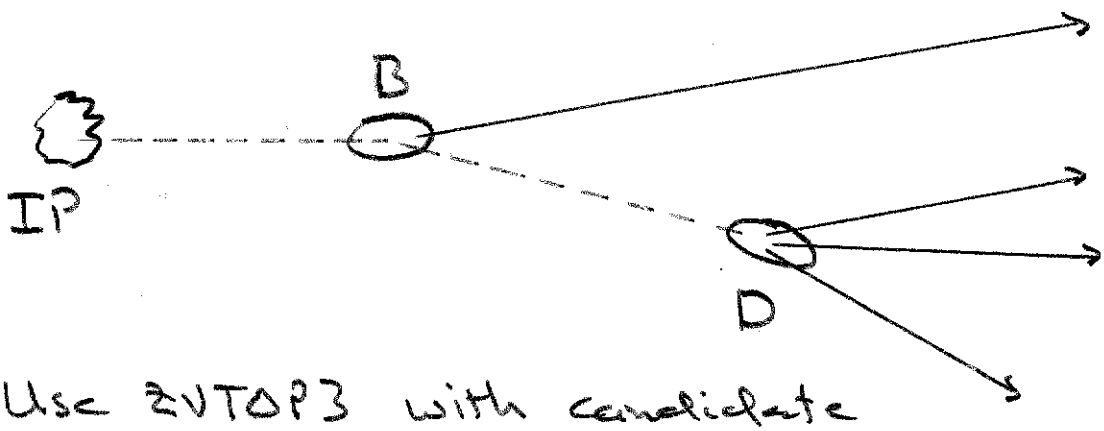
3) Resultant D vector intersected with lepton to form B vertex

4) Attempt to attach slow pion to B vertex

→ Good efficiency, especially near IP
→ Can efficiency be better?
→ No B Decay Length error estimate
→ Possible to get better charge purity?

Lepton-D Analysis

Latest Version



→ Use ZVTOP3 with candidate lepton removed from consideration

→ Use Kalman Filter to fit resultant D track with lepton to form B vertex

→ Track selection cuts severely loosened

→ Track attachment algorithm changed

→ Slow pion attachment studied

⇒ Attempting to maximize reconstruction efficiency before final selection cuts

Lepton-D Analysis
ZVTOP3

- Follow Dave Jackson's suggestion and loosen "quality" track cuts
  - No track chi-square cut
  - 2 or more VXD3 hits

- Use ZVTOP3 to find candidate seed vertices
  - Lepton track held out of vertex finding
  - run algo = 2 mode (ghost track mode)

- Use L/D to attach tracks to seed vertex (candidate D)

- Fit candidate D with Kalman Filter
  - Get resultant D track

- Fit resultant D track with Lepton to get B vertex
  - Get decay length uncertaintity automatically
  - Can smear angular errors of B track to account for incompletely reconstructed D

Attempt to attach slow pion candidate to B vertex

Problem:

Ghost track mode frequently returns one prong seed vertices and code was throwing those away…

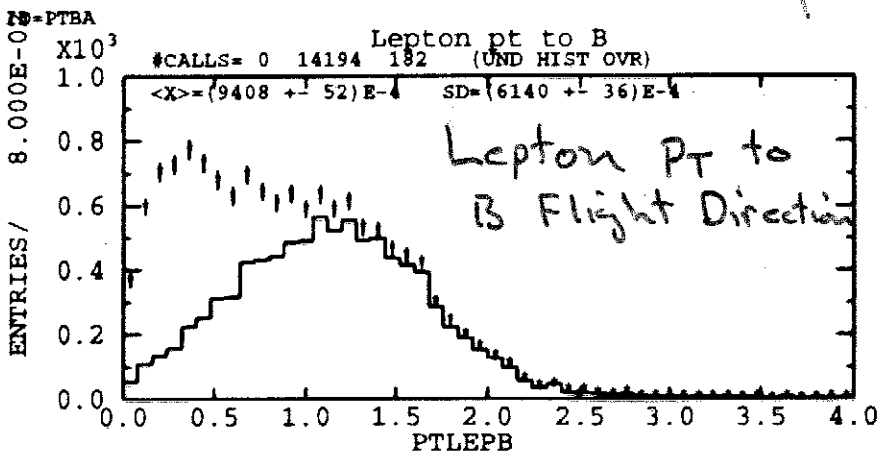
Efficiency improved:

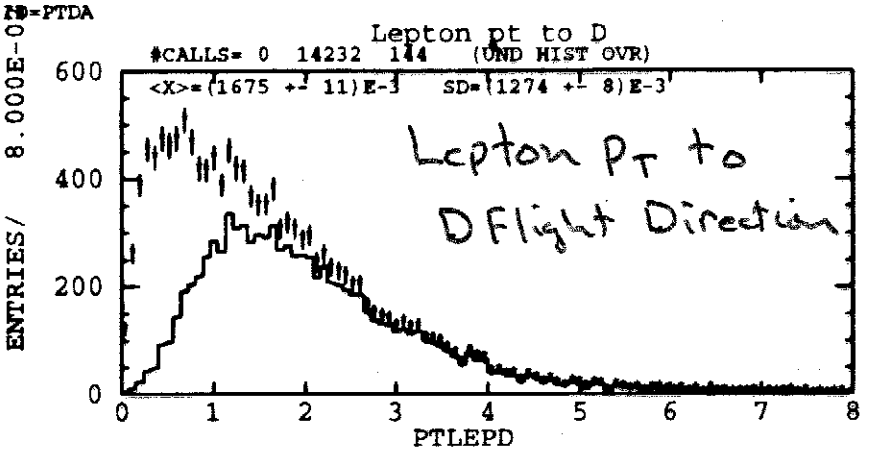
ZVTOP3 returns seed vertex in 58% of semileptonic B decays
Lepton-D reconstructs 57% of semileptonic B decays
Of which 34% pass combined vertex chi-square cut

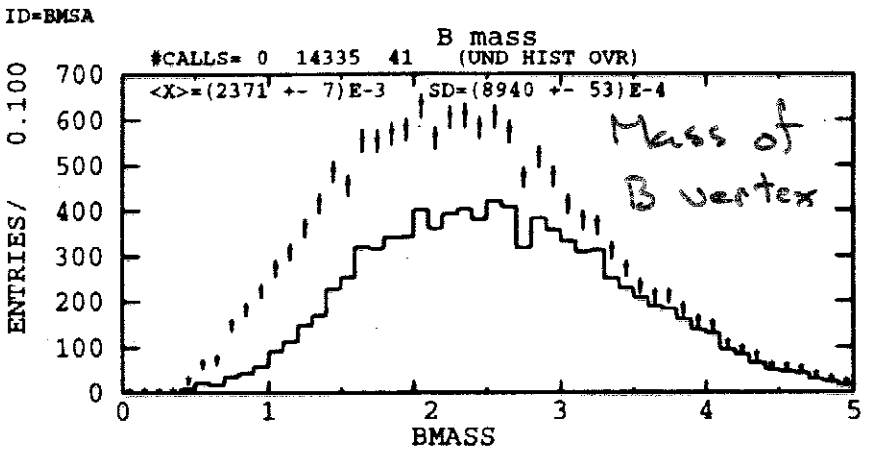
Lepton - D Analysis

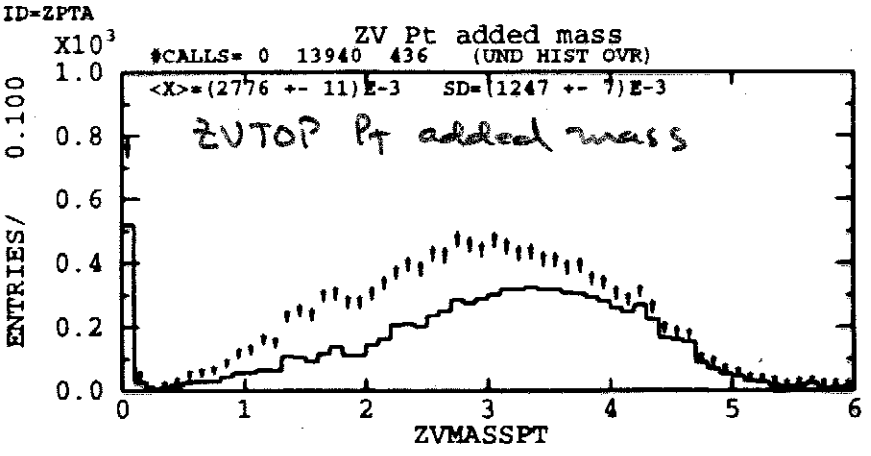
R17 MC. B Decays

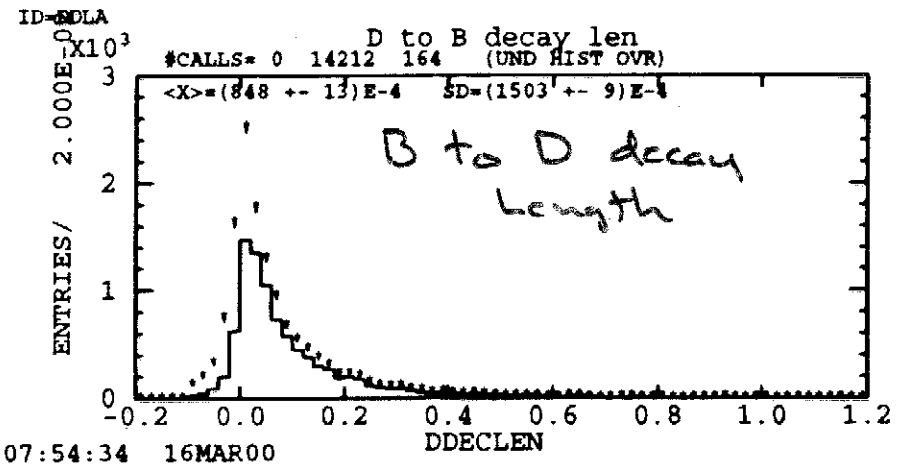
Decay Selection









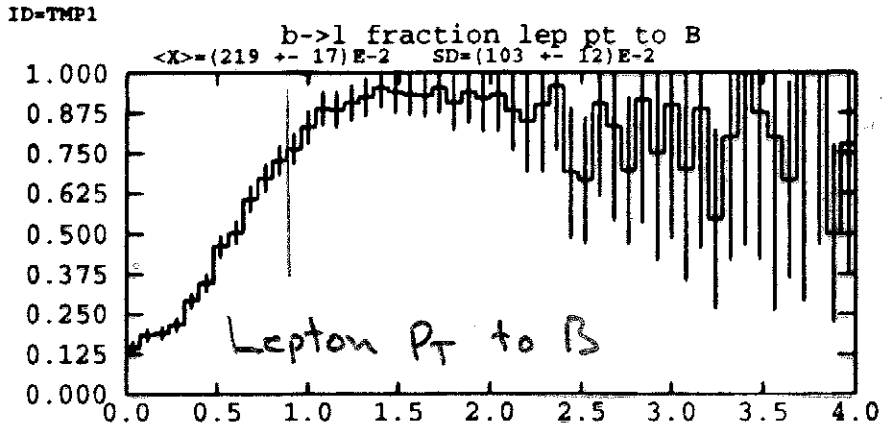


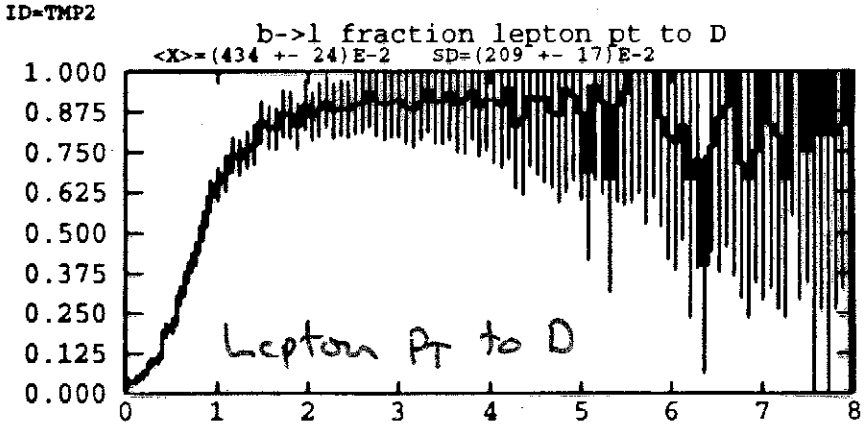
All Reconstructed B decays

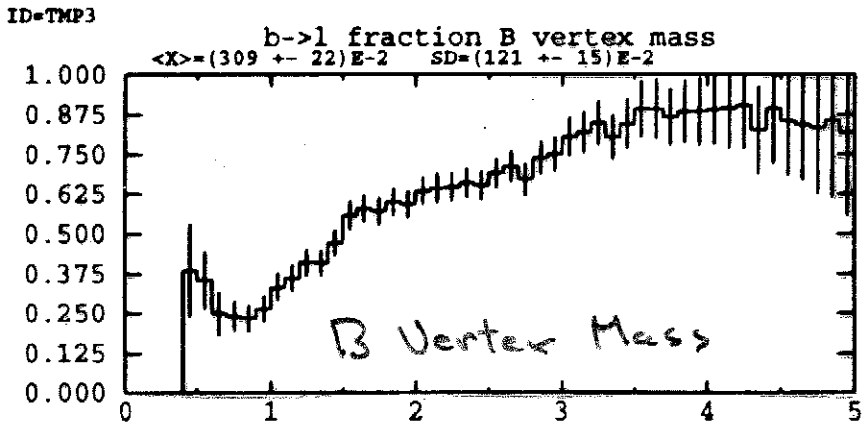
True b→l decays

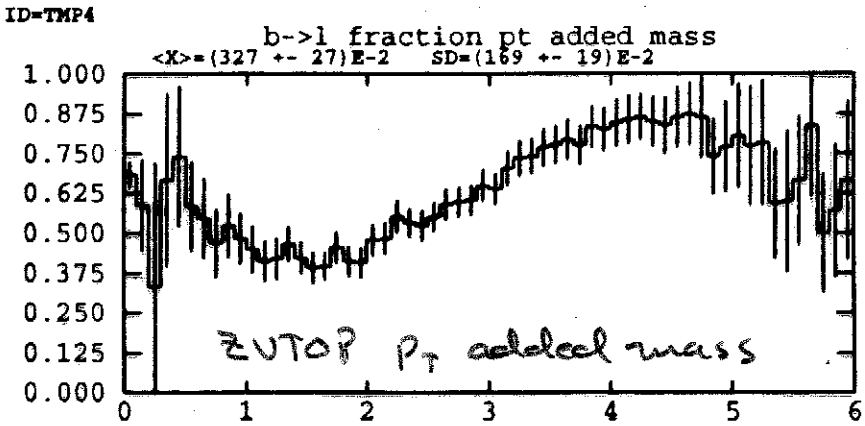
Lepton - D Analysis

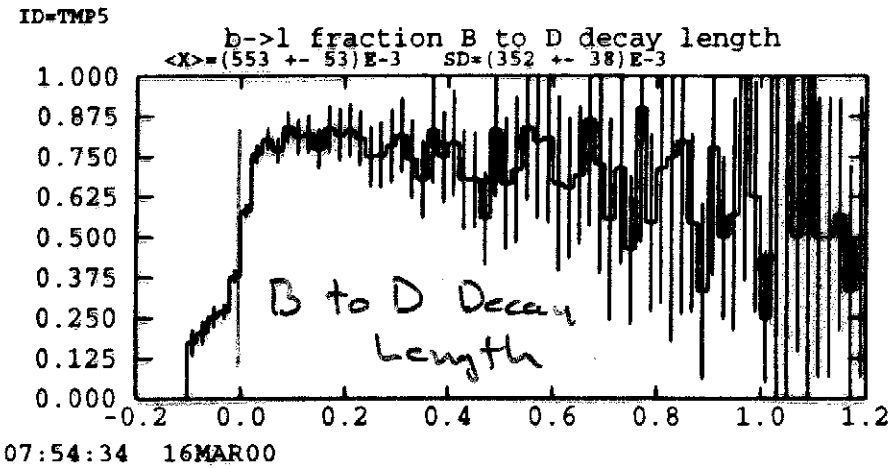
RIT MC. B Decays











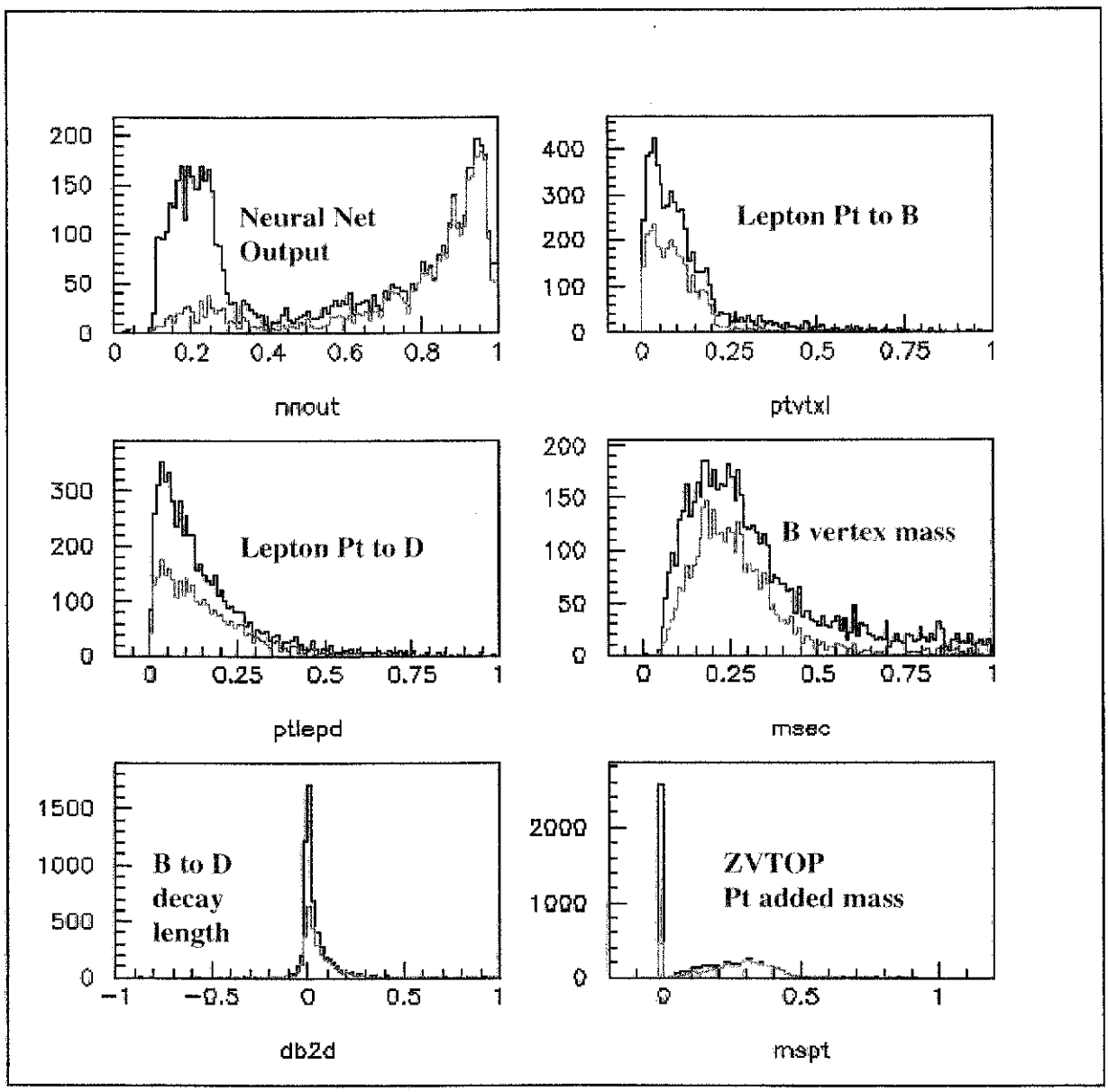
- All plots represent the fraction of true b→l decays vs. various quantities
- Use these to get b→l probability Then combine?

⇒ Use Neural Net

Neural Net Decay Selection

Homer Neal

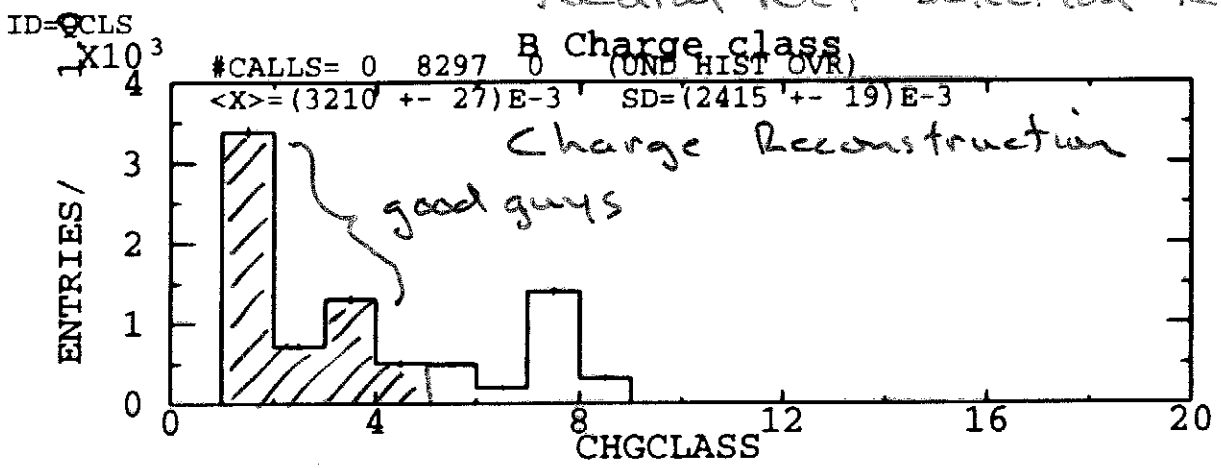
- Uses JETNET package
- Five Inputs, 10 hidden layers
- Trained on mixed MC sample - using '96 version of Lepton D analysis



Lepton-D Analysis

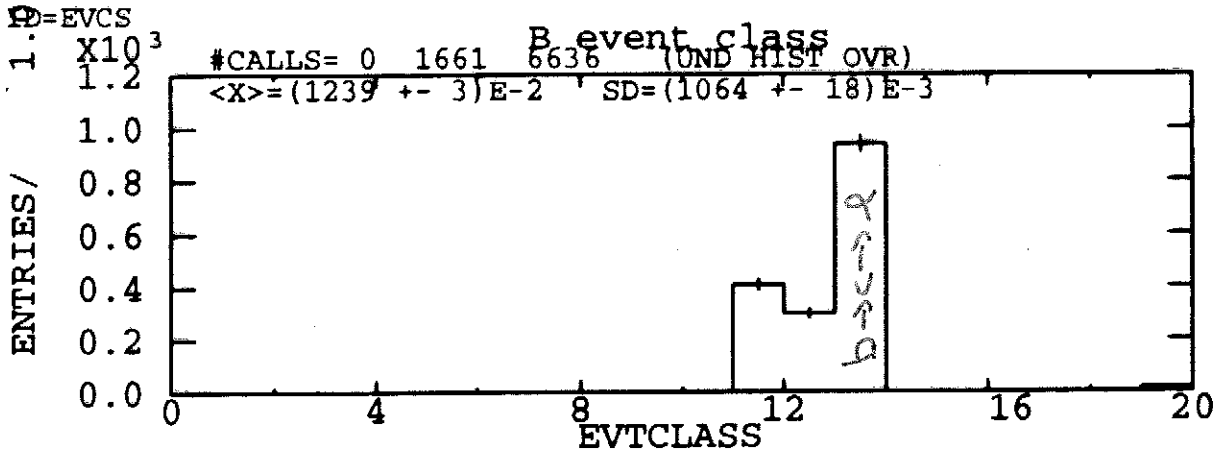
R1+bb Monte Carlo

Neural Net Selection Results

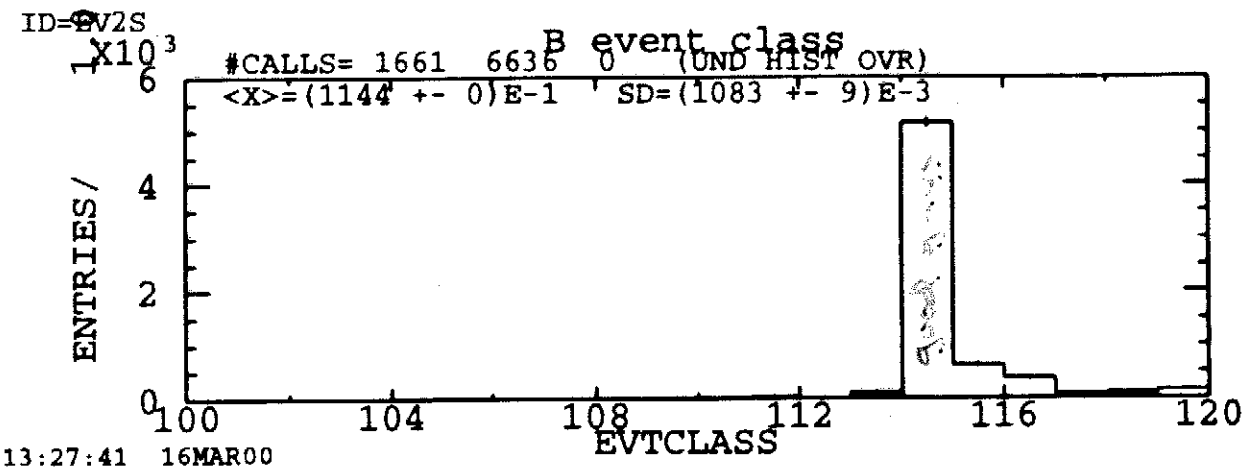


⇒ Pass 58% of Decays

Correct charge
71%



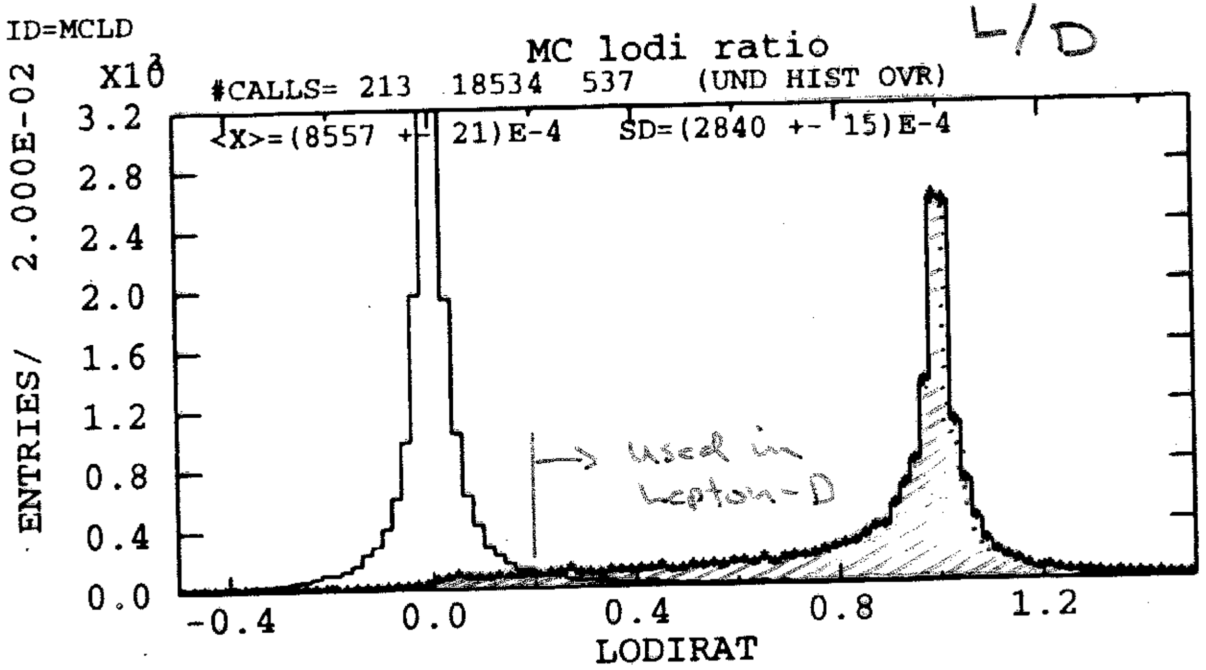
b→c→ℓ fraction
11%



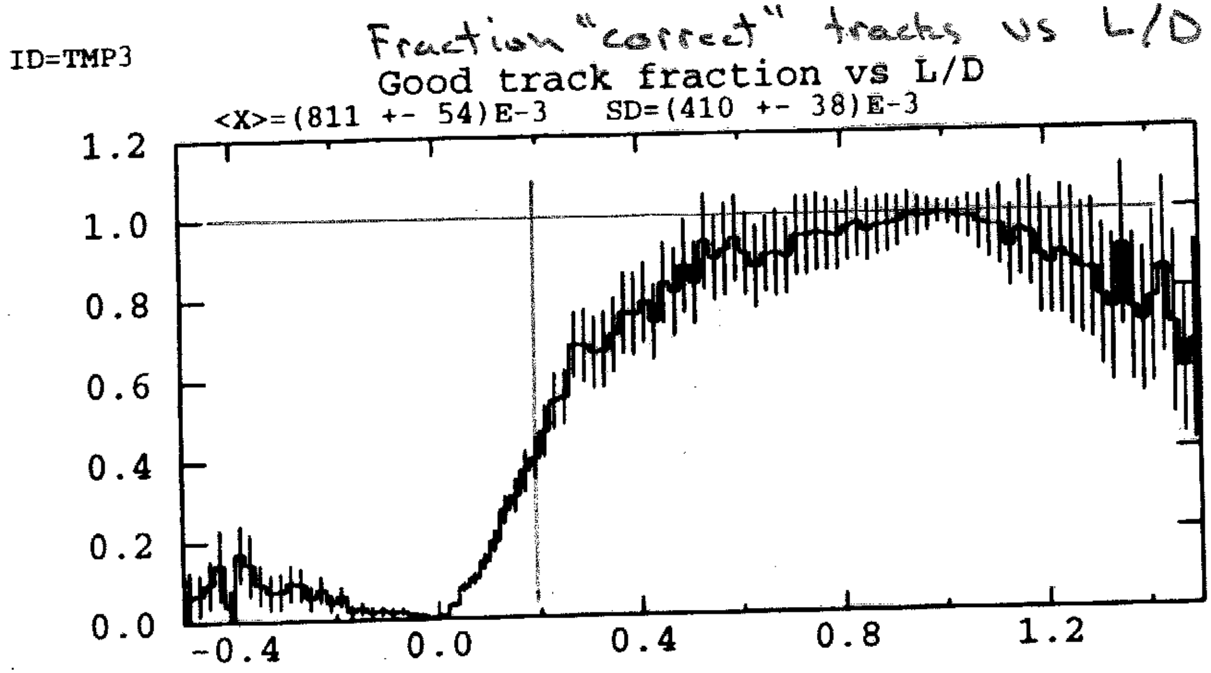
Fully reconstructed Semileptonic B decays:
62%

→ Still needs some work but is very promising

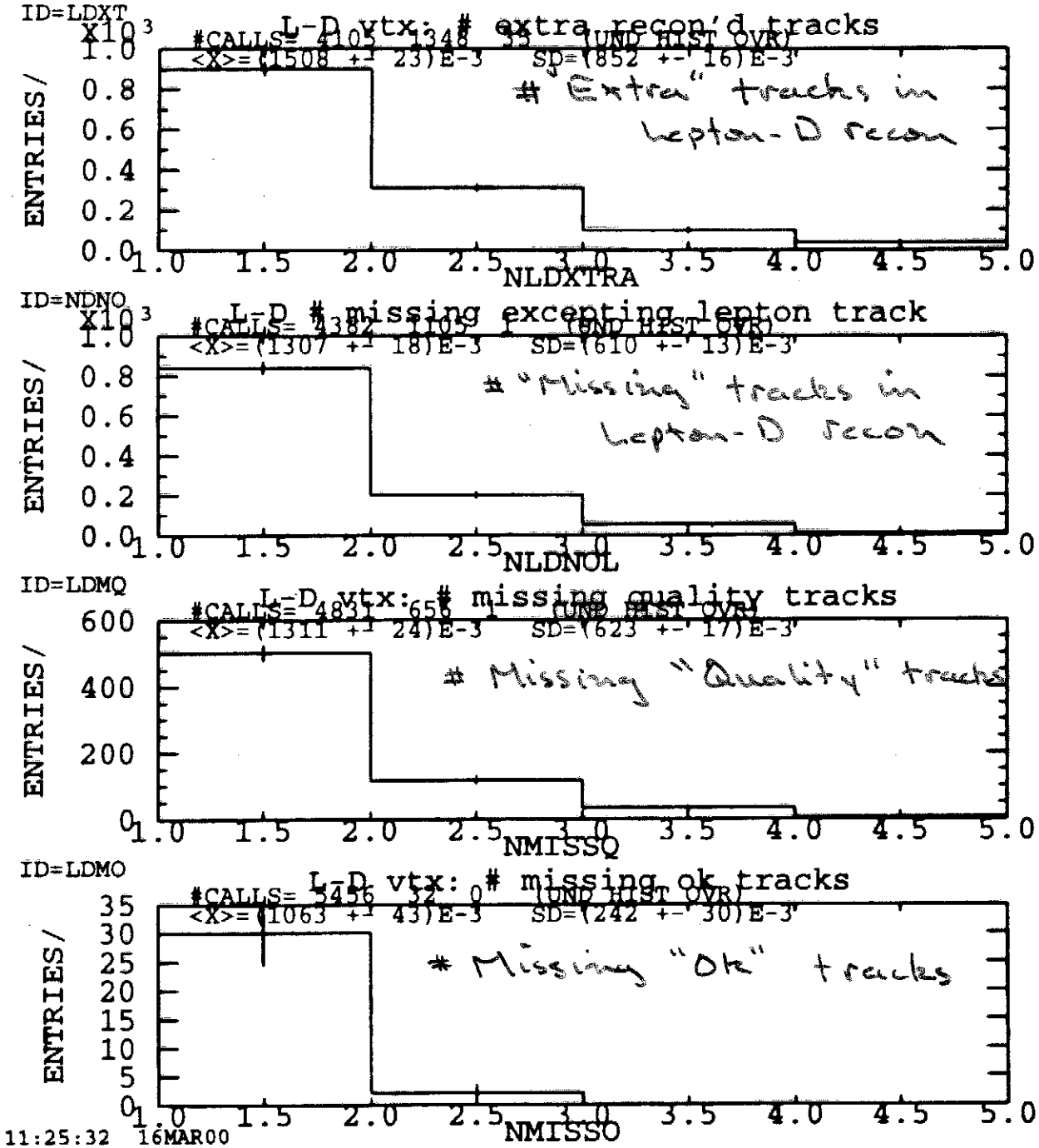
Lepton-D Analysis: L/D Track Attachment



Current L/D cut is L/D > .2



Lepton-D Analysis: Track attachment



~25% of recon'd decays have at least one extra track

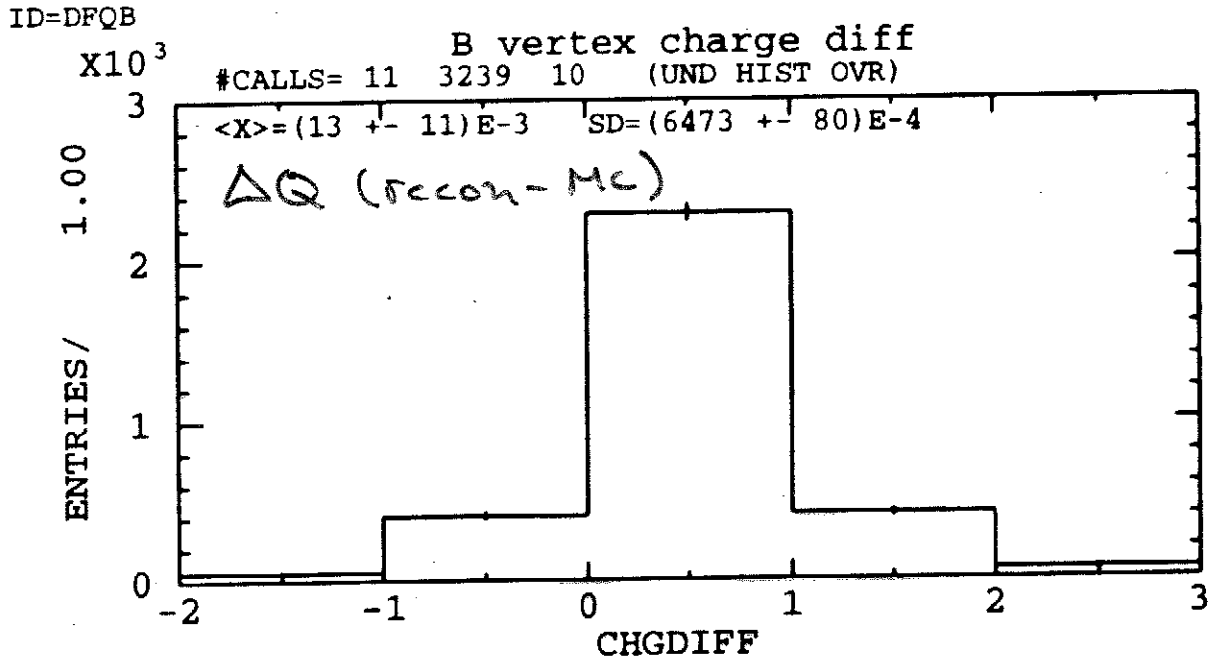
~20% of recon'd decays are missing at least one track

~12% of recon'd decays are missing a "quality" track

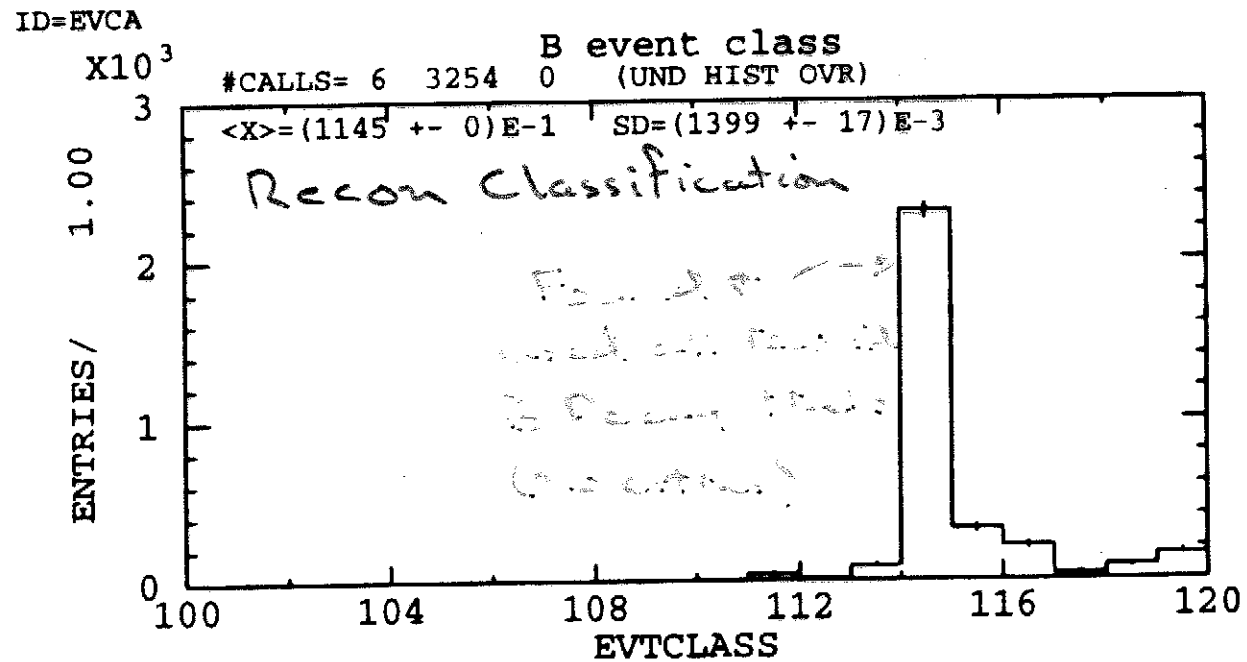
~6% of recon'd decays are missing an "ok" track

Lepton-D Analysis

R.I.P. $b\bar{b}$ MC



Correct Charge Reconstructed in 70.5% of decays



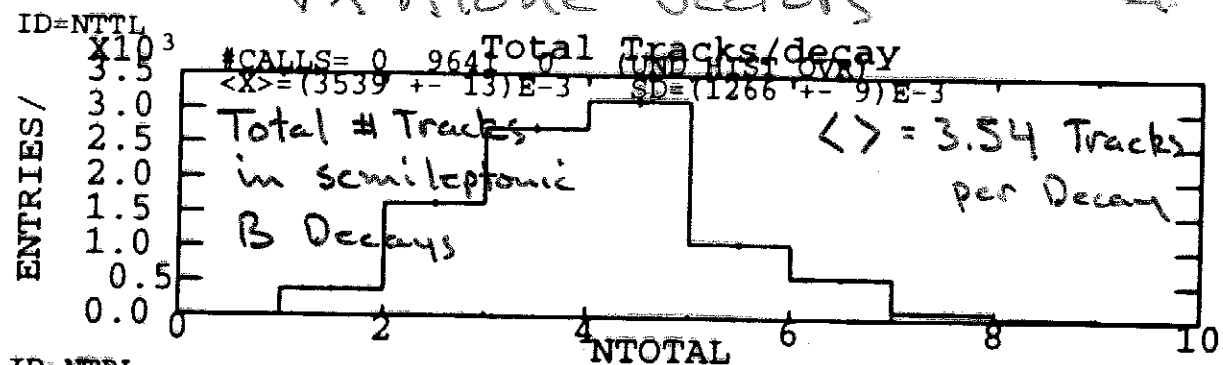
All tracks found and used in 70.7% of decays

→ Should still be able to do a little better...

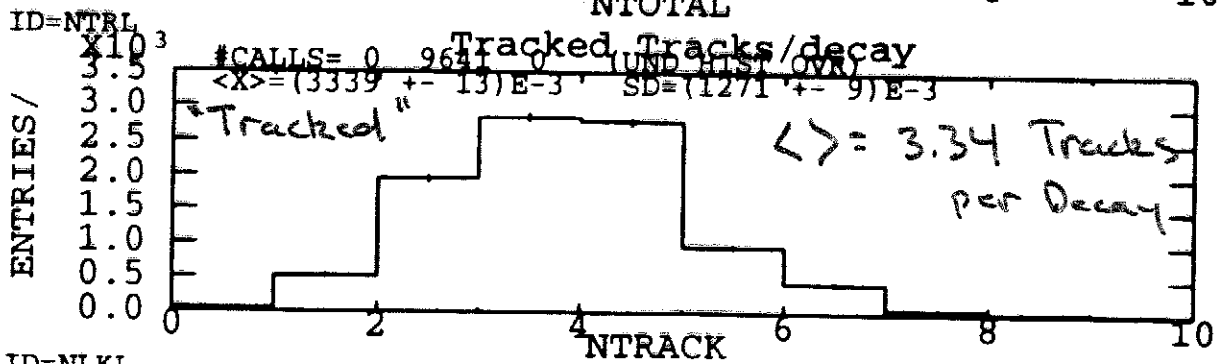
Lepton-D Analysis

VX Alone Vectors

→ Semileptonic B decays

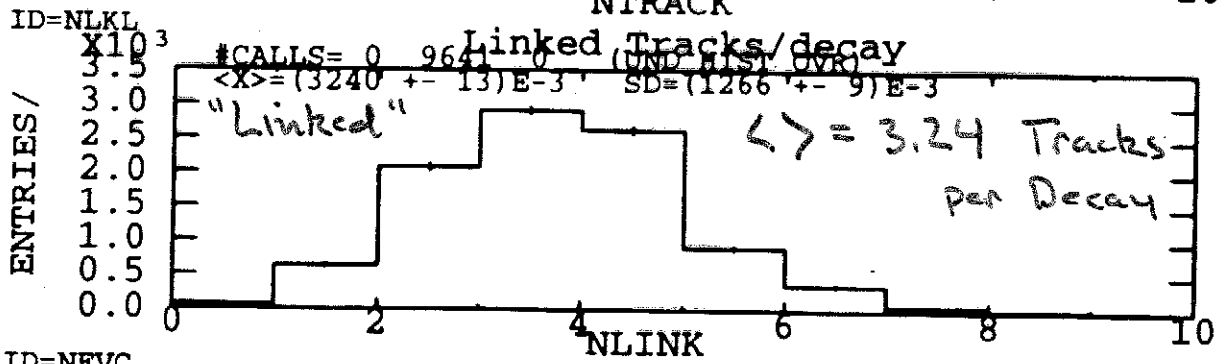


9641 Decays



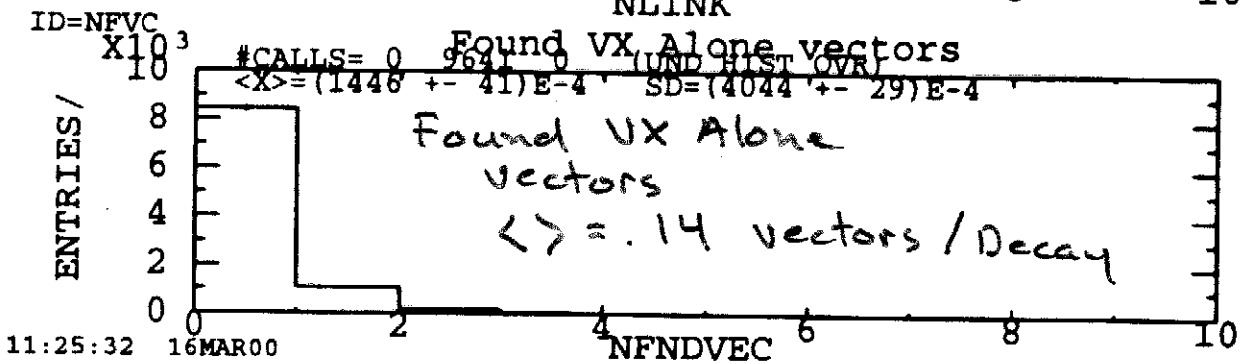
7948 Decays with all tracks "tracked"

→ 82.4%



7320 Decays with all tracks "linked"

→ 75.9%



2321 Decays without linked track

1219 Decays with VX Alone vector

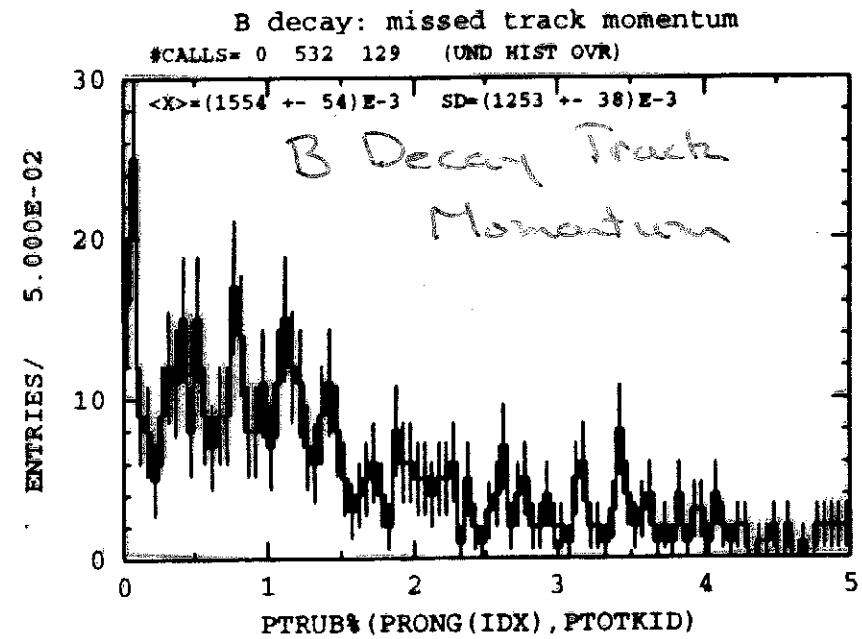
→ 52.5%

→ ~ Half decays with no linked track have VX alone vector

Lepton-D Analysis

Missing Tracks

ID=BTPM



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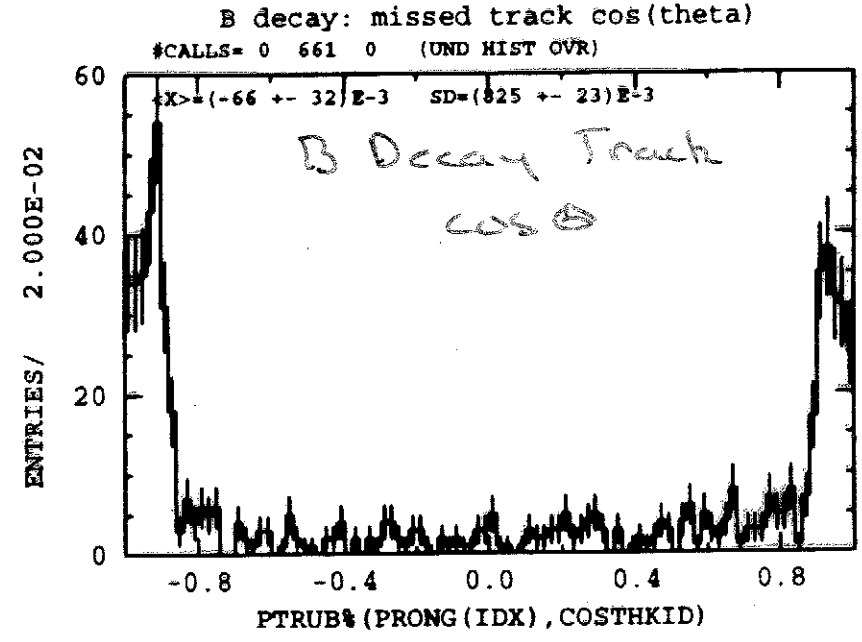

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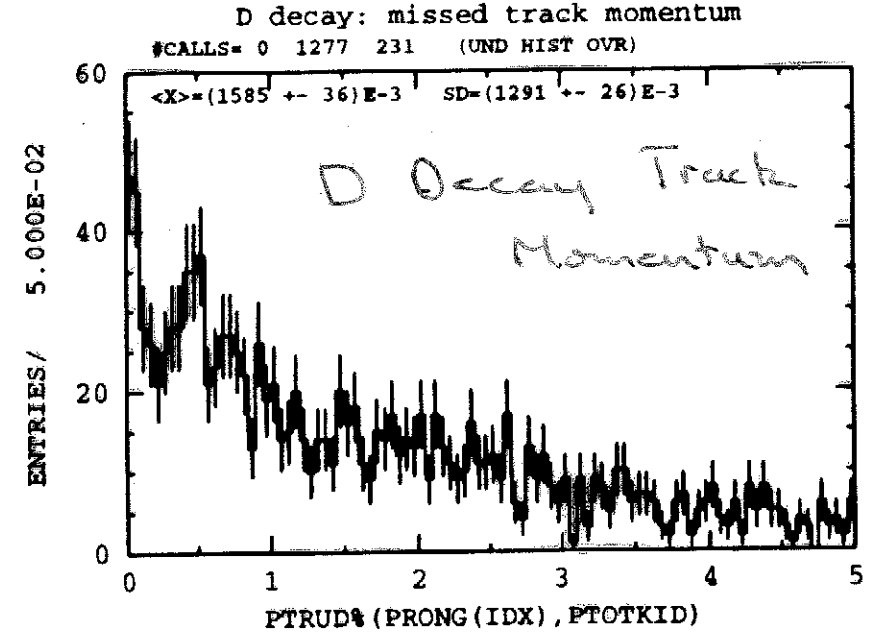

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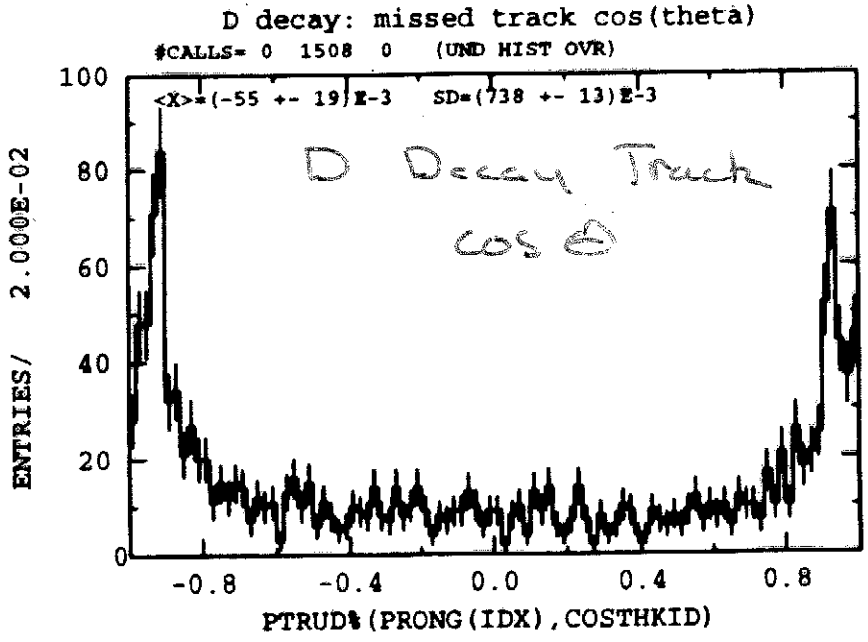

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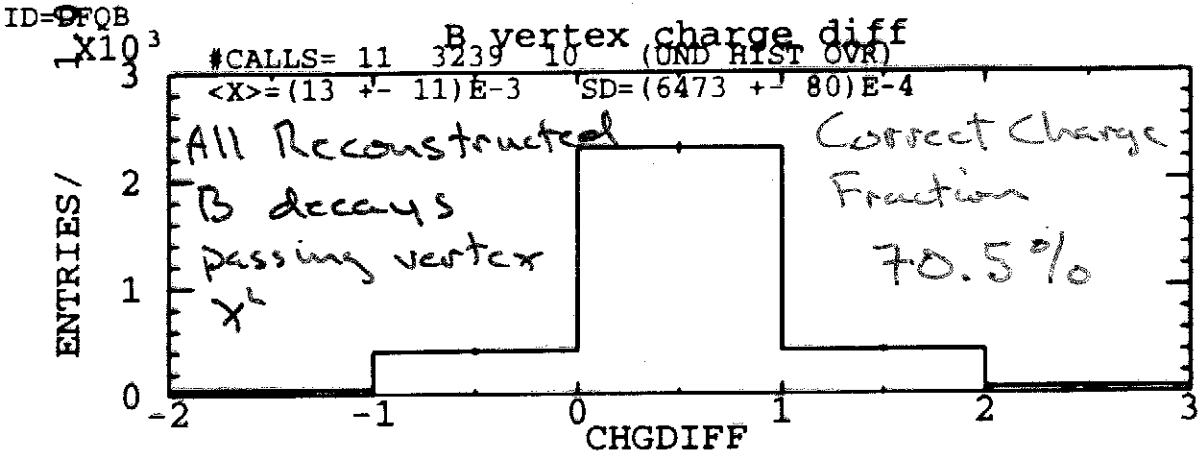
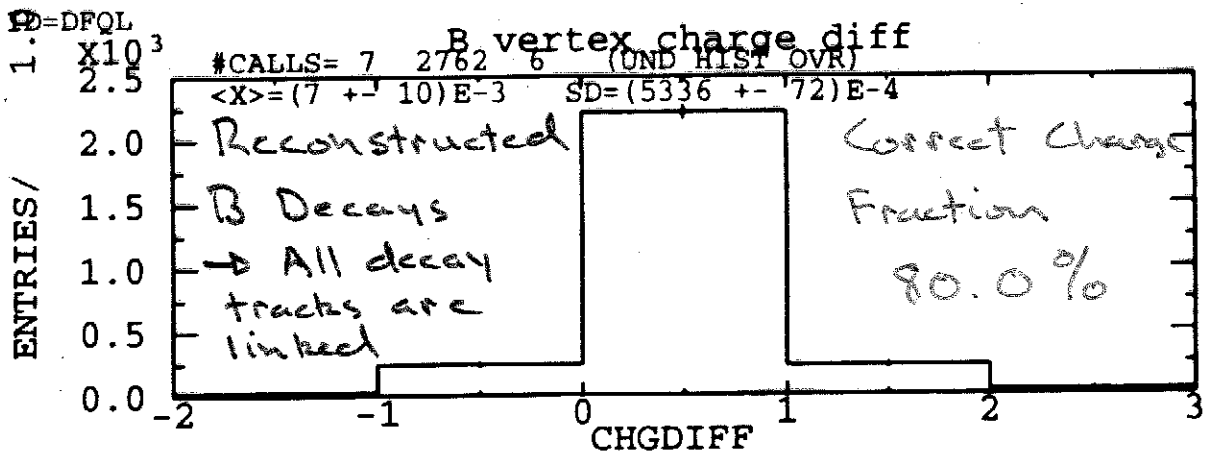
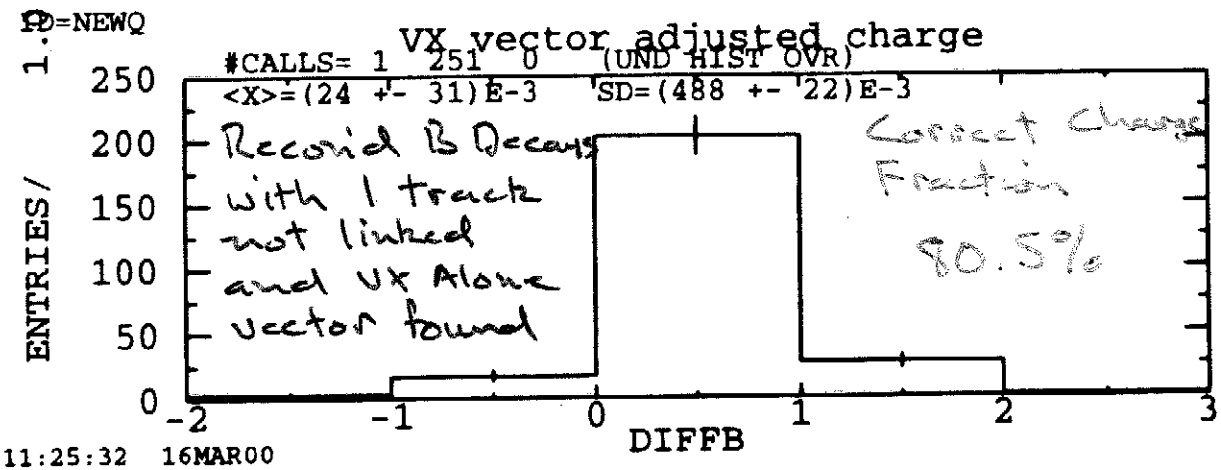
→ Most Missing tracks at high cos θ

Lepton-D Analysis

→ Semileptonic B Decays







→ Still lots to do here

Assumes you find the correct vector with 100% efficiency

→ Best you could hope for

Lepton-D Analysis
Immediate Plans

- Finalize the track attachment cuts
  - See if number of extra tracks can be reduced

- Get new version of sampe to Homer for more work with Neural Net decay selection

- Work on incorporating VX Alone vectors into reconstruction

- Begin processing of Monte Carlo and Data by mid-April