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6/9/2000

B Decay Charm Counting via Topological Vertexing

Strategy

Do a 4 parameter fit to ~~the~~ ~~a~~ some data histogram

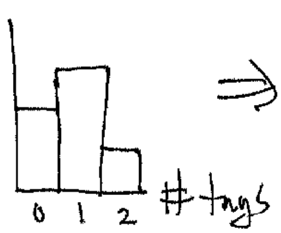
$$F_i = a_0 M_{0_i} + a_1 M_{1_i} + a_2 M_{2_i} + a_b M_{b_i}$$

where the M_i's are characteristic shape histograms derived from the Monte Carlo for the

$b \to \phi c$, $1c$, $2c$, and background components respectively

In principle, we can extract $(N_{bins} - 1)$ pieces of information.

This is similar to the R_b measurement

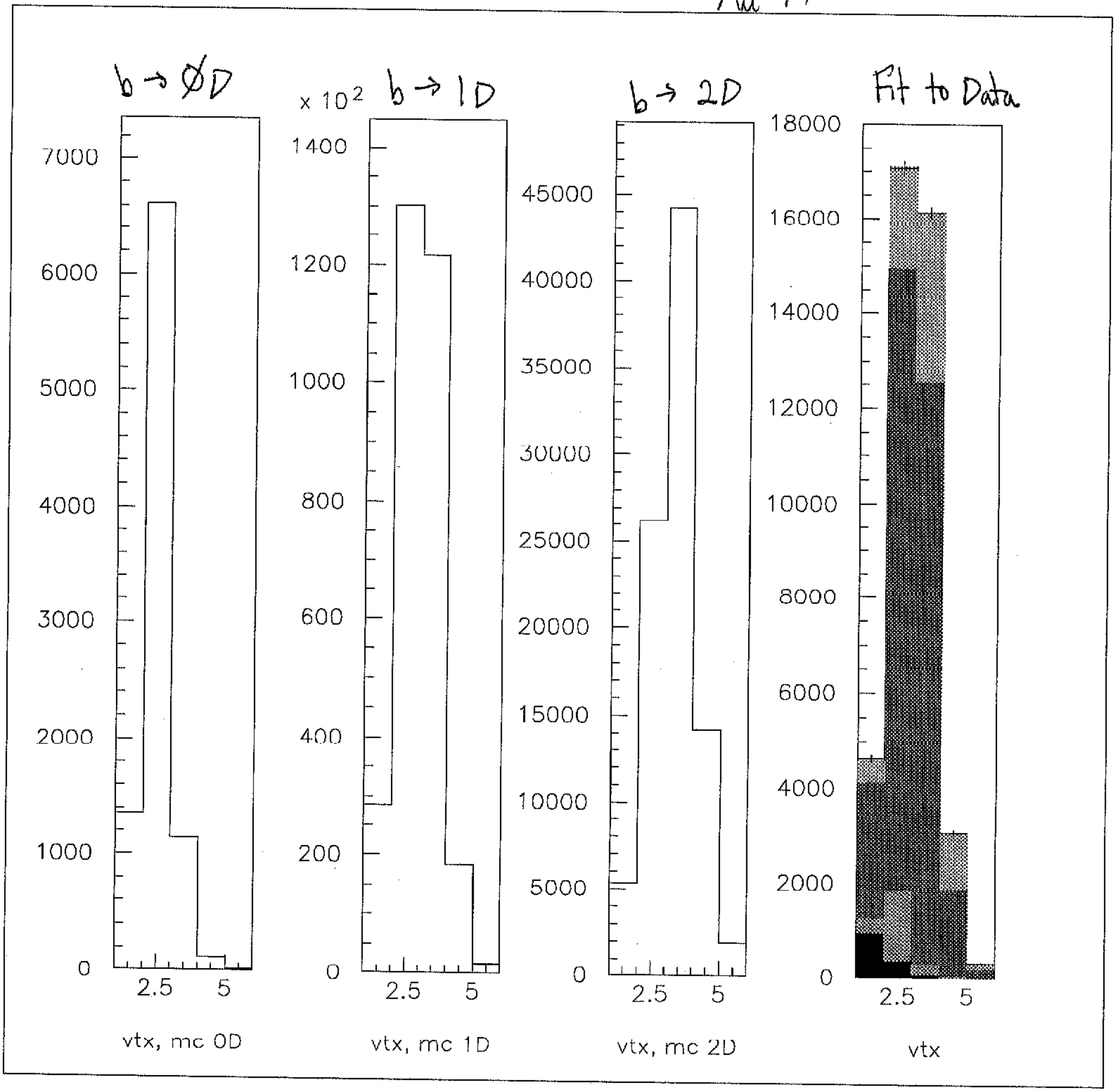


$\Rightarrow$ Assume MC purity π and fit for R_b, ε.

Alternatively, assume MC ε and fit for R_b, π.

12/8/99 ③

Vtx = 1 + # sec vtx   All 97-98 Data
All 97-98 MC



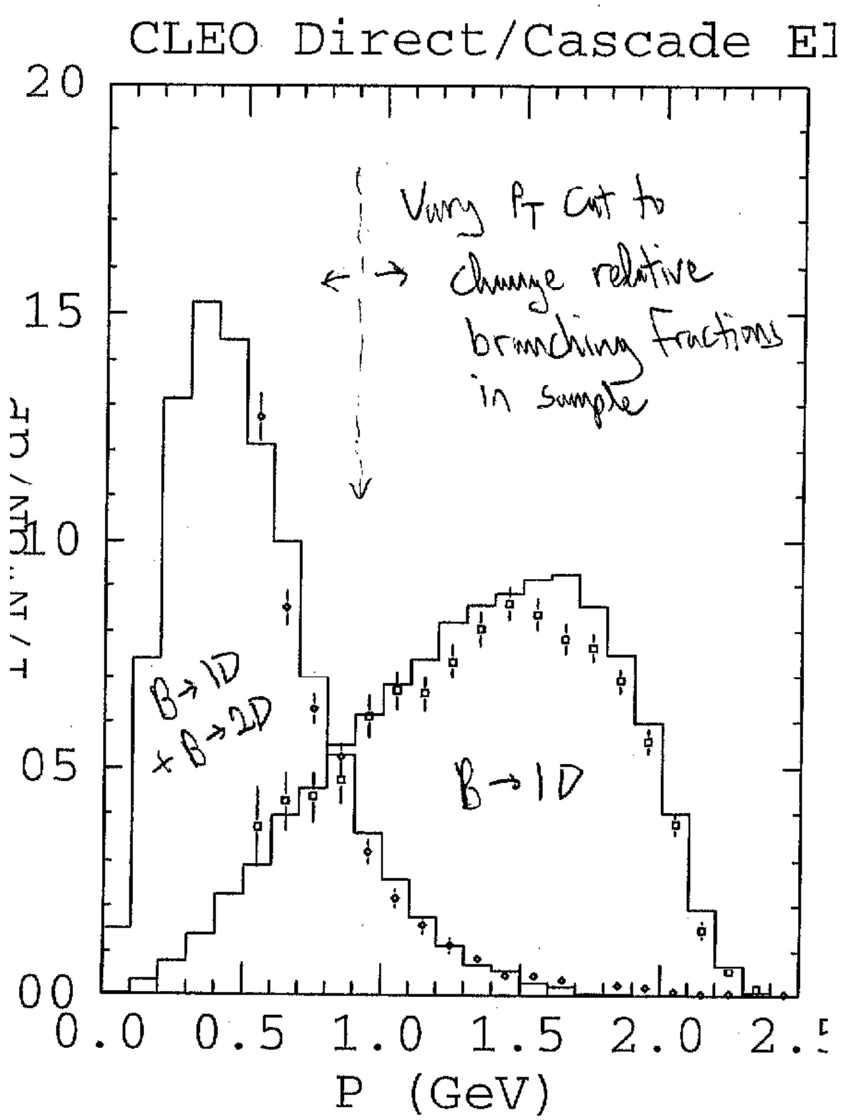
5 bin fit: MC BkGd = 0.034

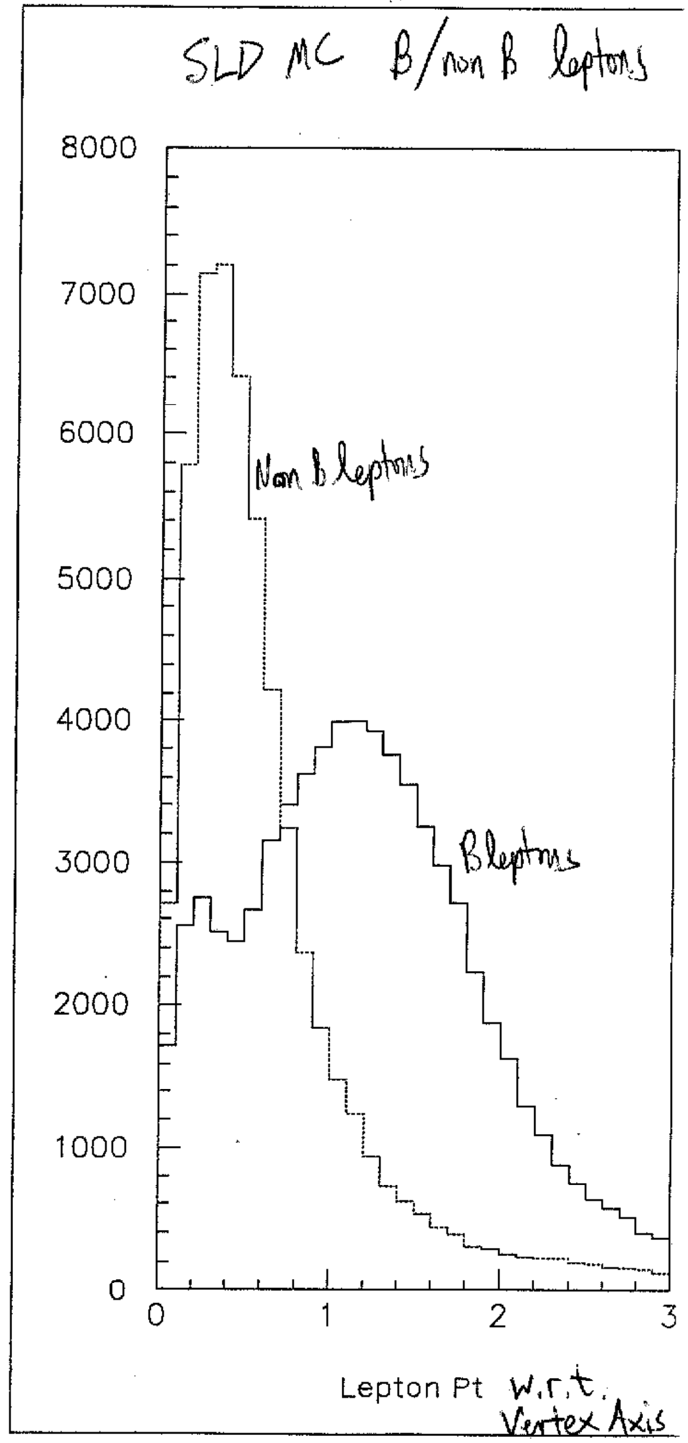
A = 0.0525 ± 0.0116

B = 0.7587 ± 0.0265

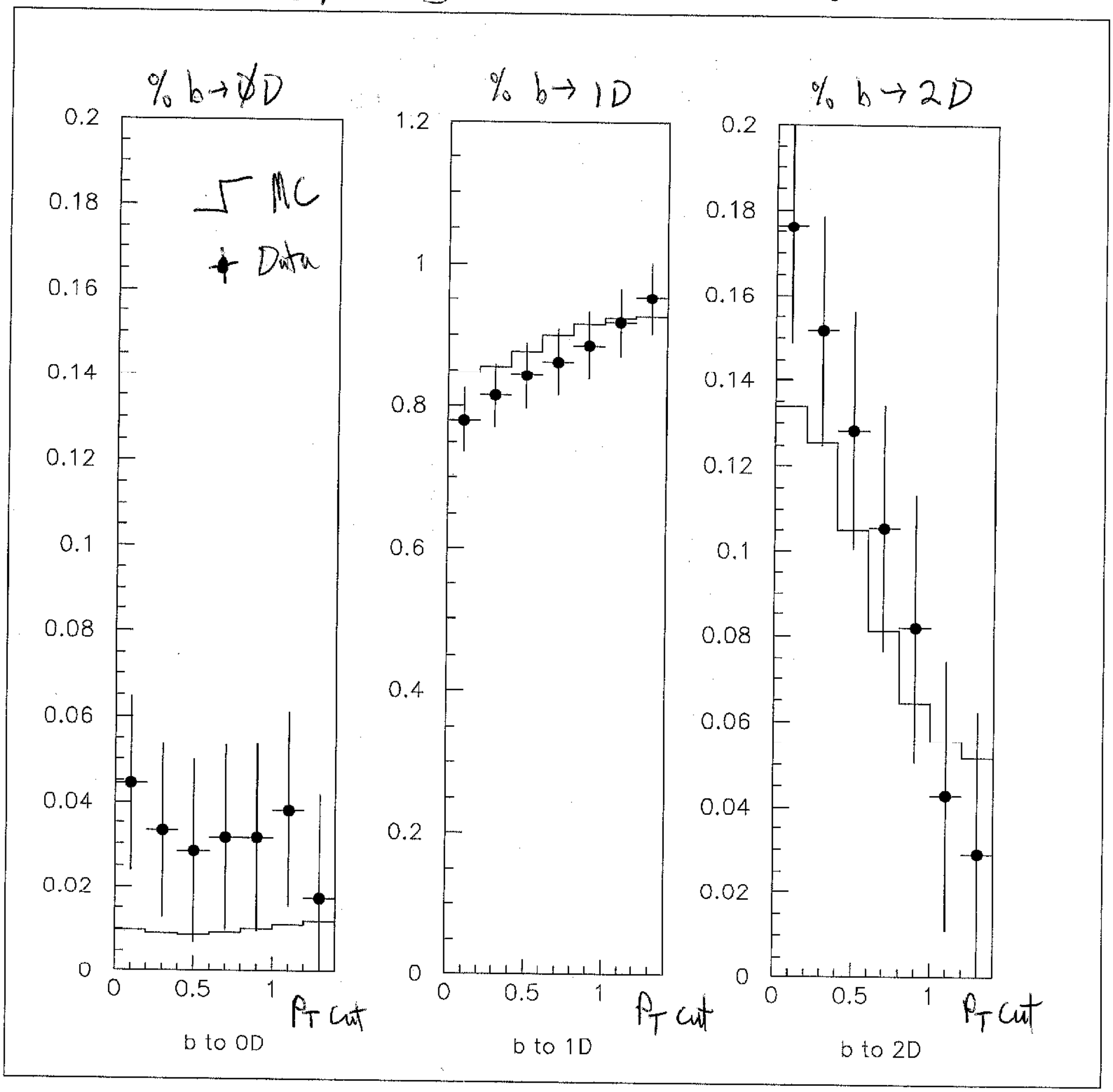
C = 0.1884 ± 0.0164

$\chi^2 = 1.04 / 1$ d.o.f.


CLEO Direct/Cascade El
Vary P_T Cut to change relative branching fractions in sample
B→1D + B→2D
B→1D
P (GeV)


SLD MC B/non B leptons
Non B leptons
B leptons
Lepton Pt w.r.t. Vertex Axis

Measuring Adjusted Branching Fractions with Varying High-P_T lepton Cut



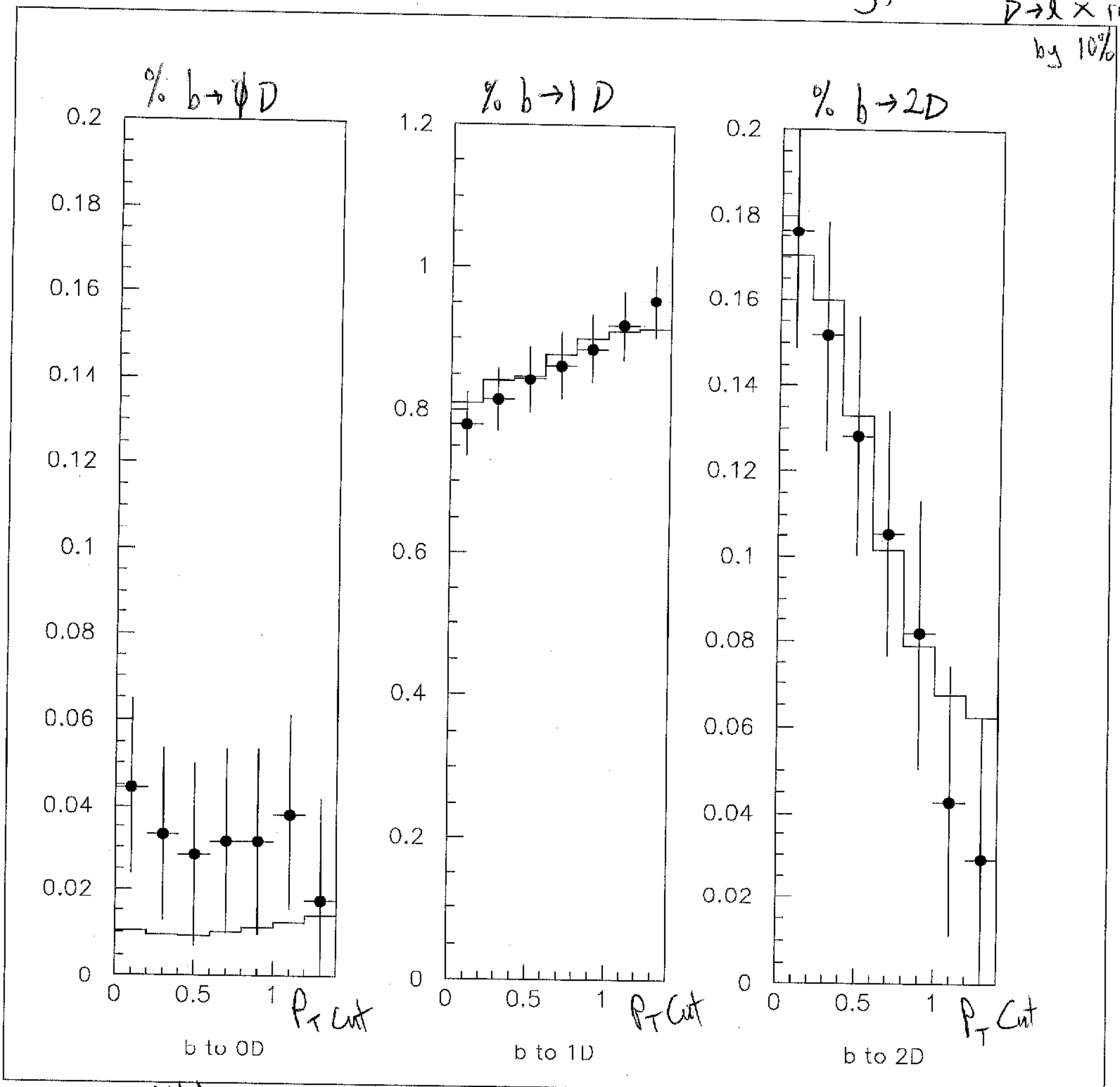
Using MC fractions:

bkgd	0.034
b→ØD	0.022
b→1D	0.772
b→2D	0.172

≈ default MC

12/7/99 ⑥

Twiddle MC Branching fractions to get slopes right (Alternatively, twiddle $B \to \ell X$, $D \to \ell X$ rates by 10%)

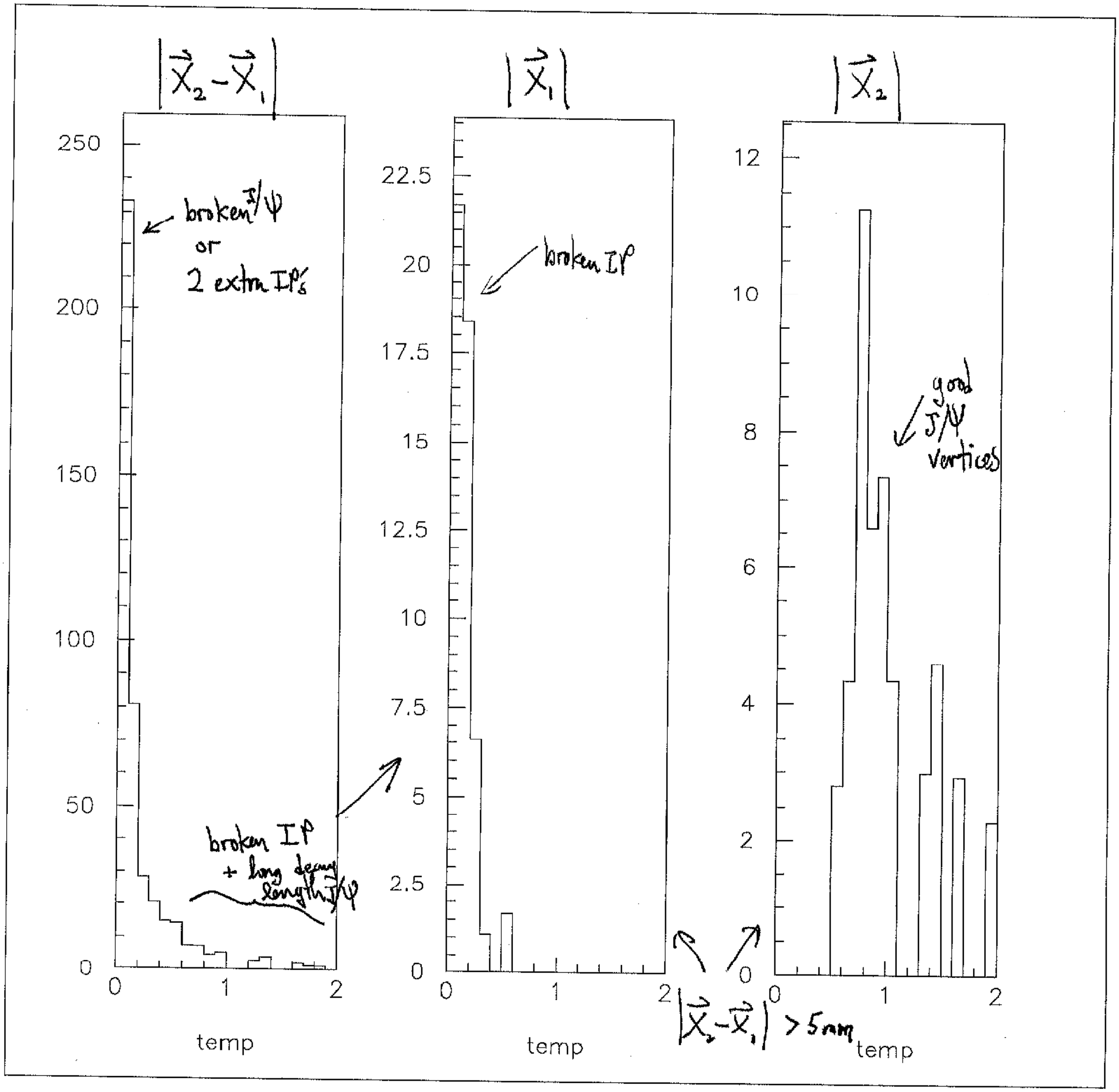


Using weighted MC Fractions

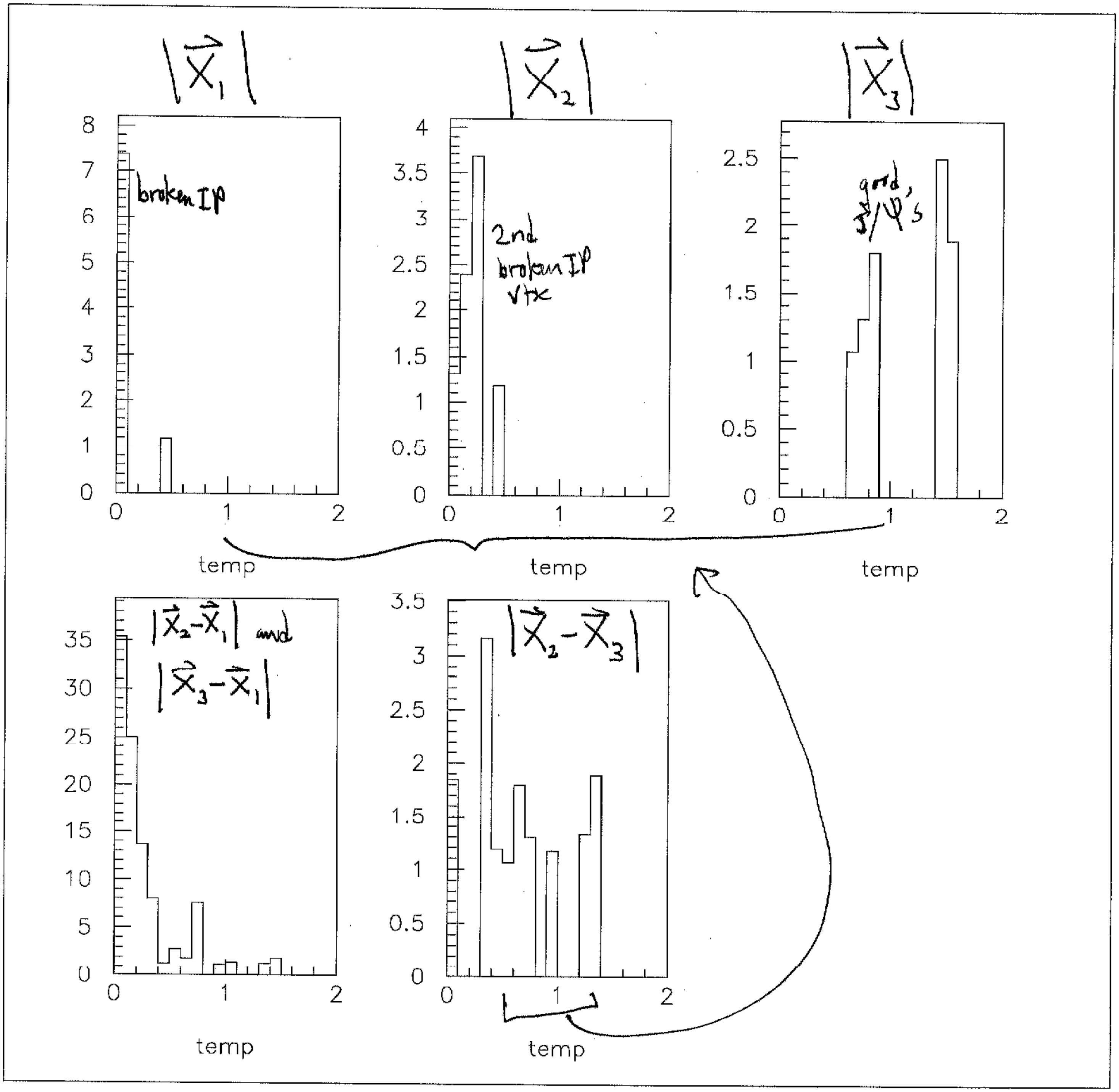
Bkgd	0.034
$b \to \phi D$	0.022
$b \to 1D$	0.742
$b \to 2D$	0.202

} ≈0.030 change still consistent with measured values

Charmonium → 2 sec. vtx



Charmonium → 3 sec. vtxs

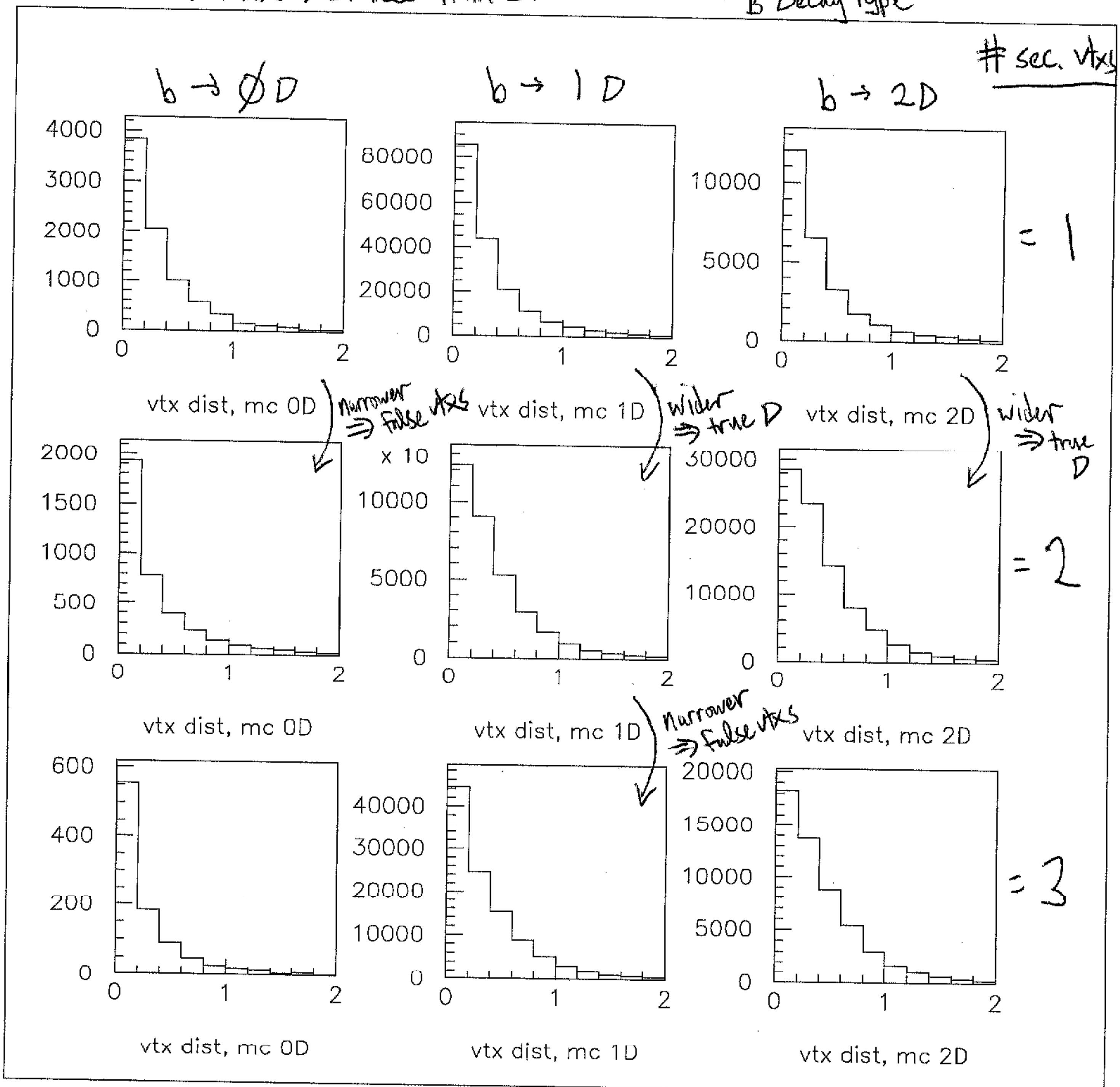


⟹ Extra vertices are consistent with 'broken vtx' hypothesis. Presumeably this is caused by tails of Impact Param. dist. and IP jitter.

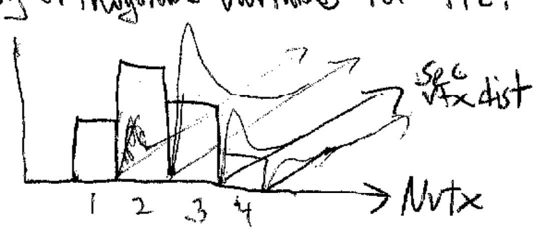
Total # Sec Vtxs

B Decay Type

Sec. Vertex Distances from IP



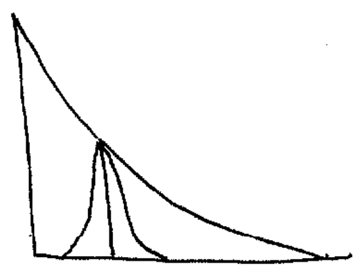
Get roughly orthogonal variable for fit.



Why histogram this way?

Poor control of the track resolution and the estimated error causes vertices to be accidentally broken up.

→ Assume a Gaussian broadening of the decay length distribution



Unbroadened $b \to \emptyset D$ events will stay in the $N_{SV} = 1$ histogram while the broadened distribution will spill over into the $N_{SV} = 2, 3$ histograms.

And similarly for $b \to 1D$, $2D$.

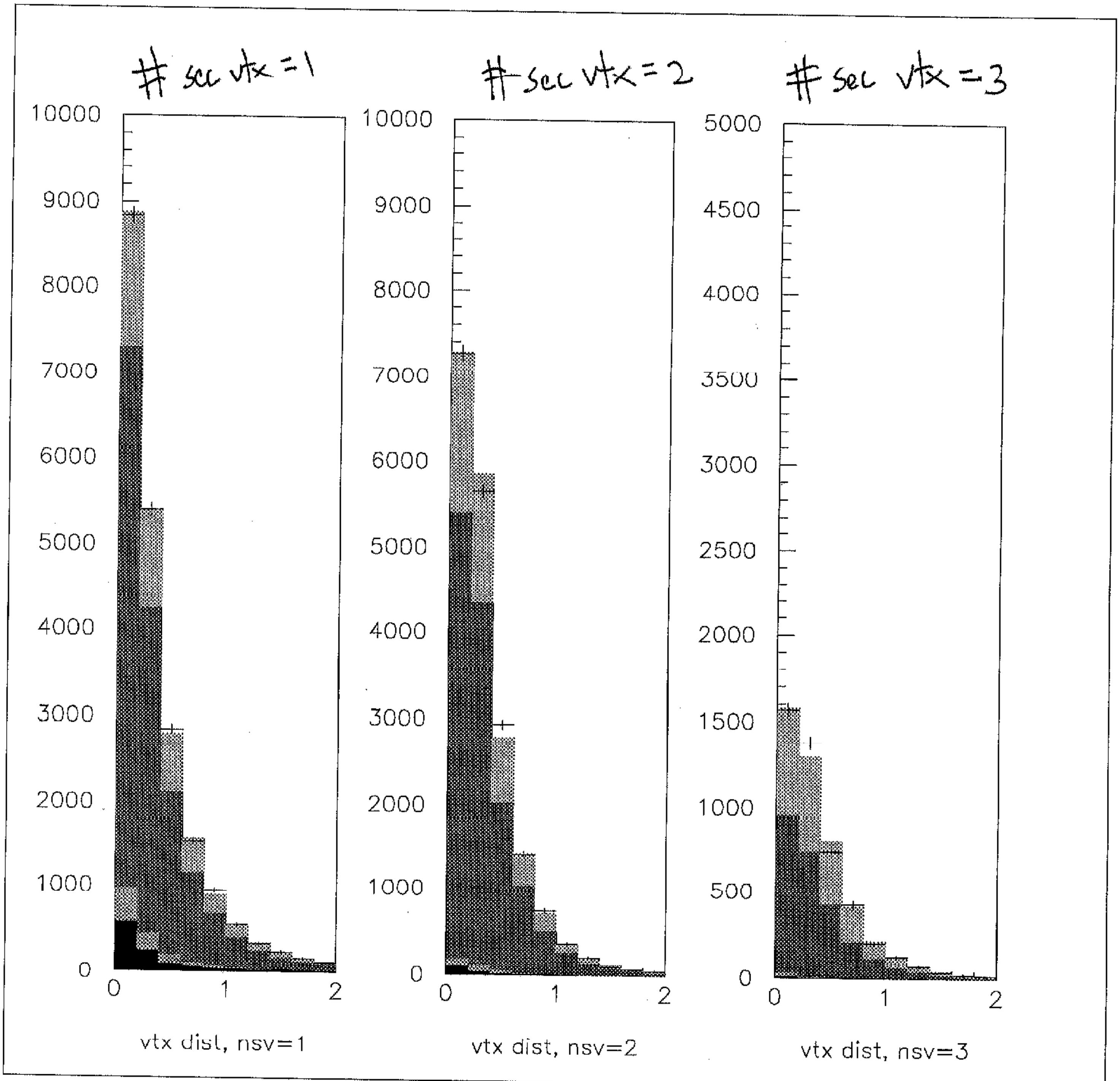
⇒ These histograms contain info about:

B, D boosts, lifetimes, track resolution

in addition to the charm yield.

4 parm

Fit to Data radial decay length dists. + # sec vtx = 0 bin

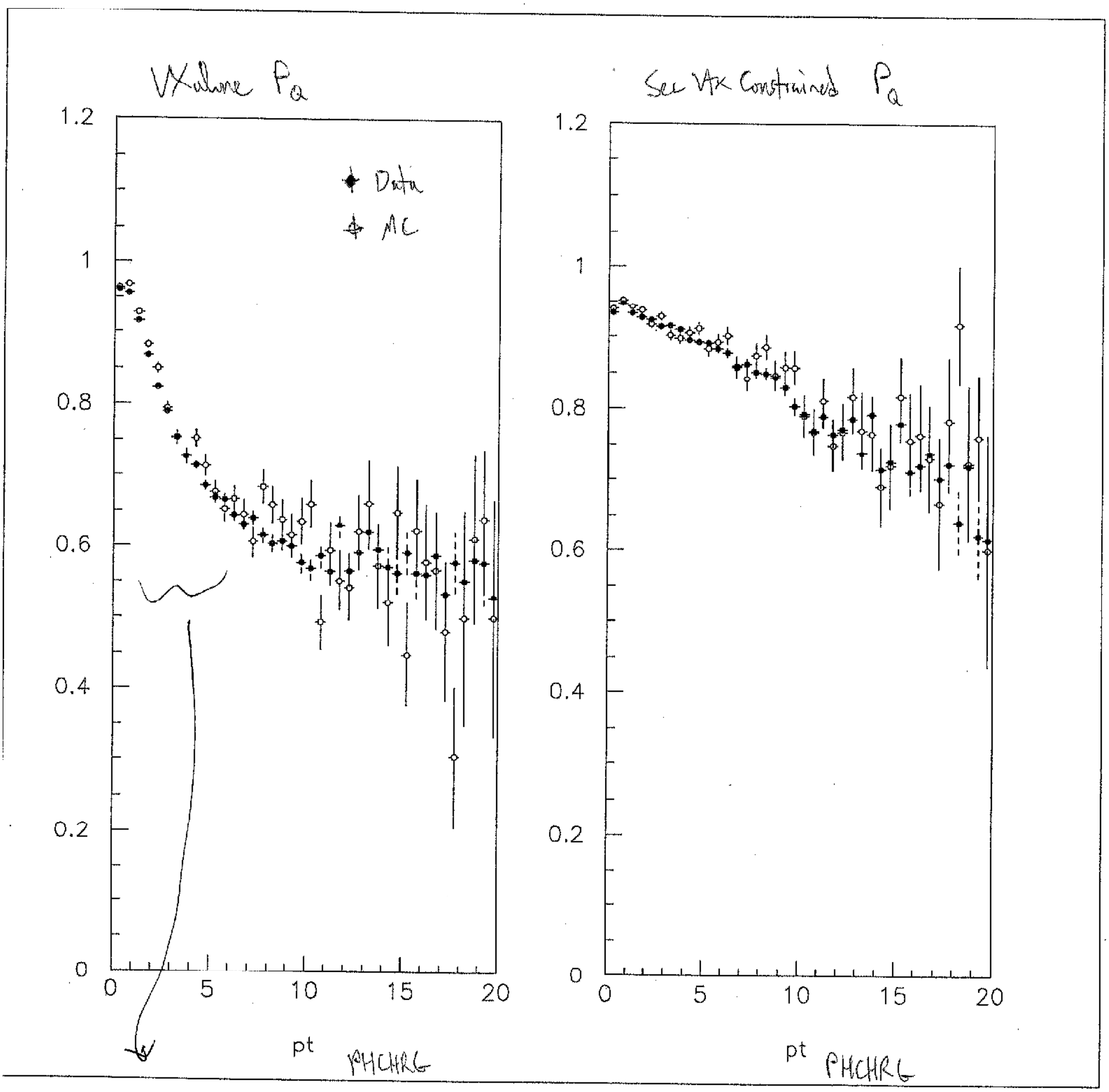


	all 97-8 data	only events without vertexed VXOVs
bkgd frac:	0.061 ± 0.004	0.071 ± 0.005
b→ ØD	0.026 ± 0.013	0.033 ± 0.015
1D	0.753 ± 0.021	0.731 ± 0.026
2D	0.221 ± 0.013	0.235 ± 0.016

$\chi^2 = 1.6$ (27 dof)

$\chi^2 = 1.6$

Fixed VXDV Charge Purity vs P_T using Prev. linked trks



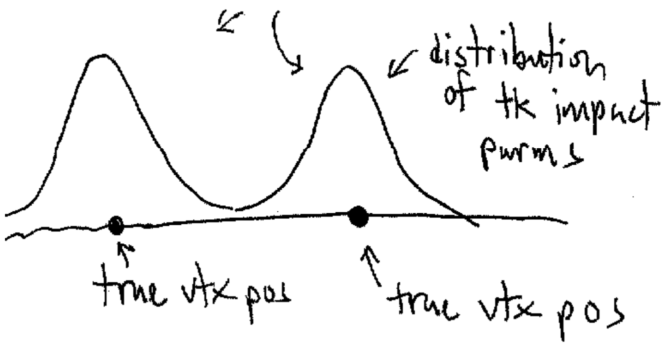
$\Rightarrow$ δ cluster resolution $\lesssim$ 0.5 mm

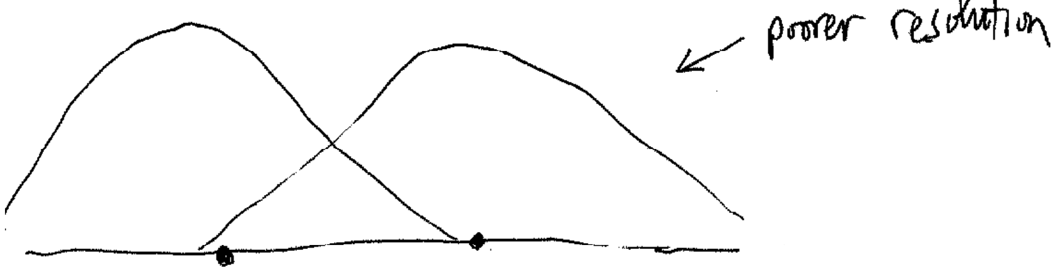
Is the resolution too good in the MC?

Impact Param. Resolution

Resolution and Tk. errors are 2 separate issues.

i.e. estimated resolution





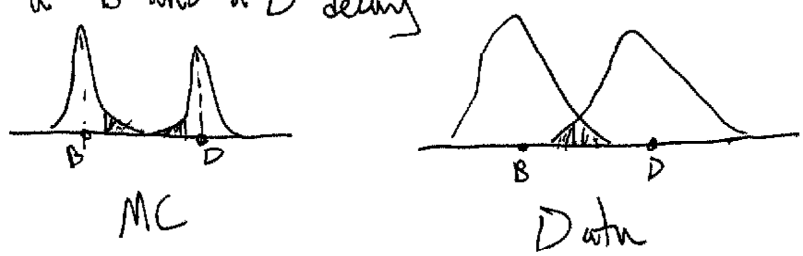
Adjusting tk errors will help model the resolution better, but resolution tuning can only really be done at the MC generator level. (Or, if we are lucky and MC res is better than data res, smear the tk params and reswim!)

Quick solution

Vertices are formed using the criterion $Prob(\chi^2; \#d.o.f.)$

where $\chi^2 \sim \left(\frac{X_{meas} - X_{true}}{\sigma}\right)^2$

If we have a B and a D decay



Then we can use $\sigma_{MC} \to \sigma_{MC\,eff}$ to tune the fraction of seperated vertices.

$\chi^2_{MC} \to \chi^2_{MC,\,eff}$, $Prob_{MC} \to Prob_{MC,\,eff}$.

$\Rightarrow$ Use different probability cuts on data and MC.

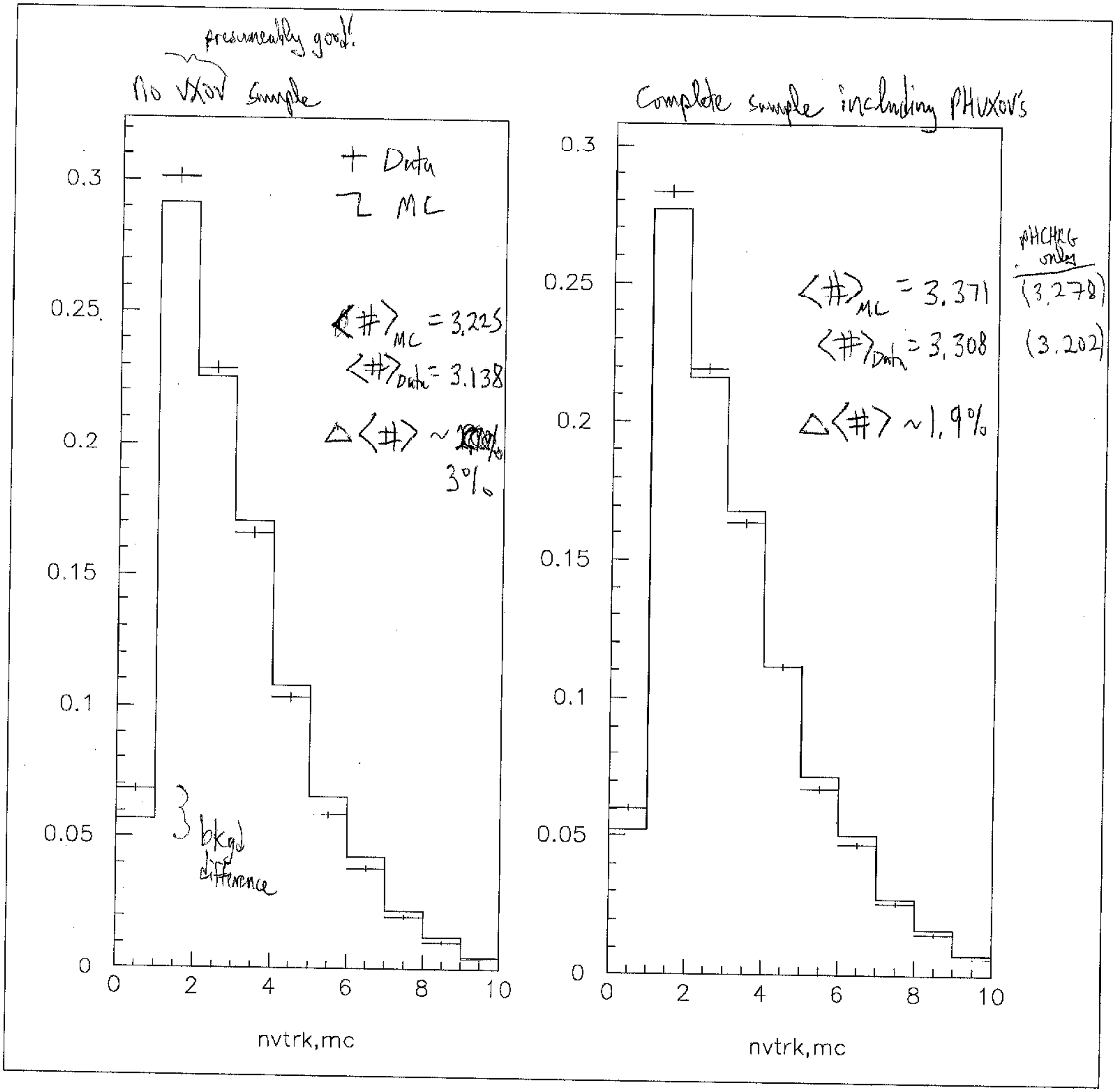
(An easy way to do this is to call ZVTOP3 several times in each tagged hemi. and request # vrts = 1, 2, 3, 4, 5, each time storing the value of the smallest vtx probability. Then, at the ntuple stage, set your pcut and loop through the vtx array until you get a satisfactory collection.)

Jun 09, 00 9:16

```
ipres=0.05
pcutd,mc=0.01

 CHISQUARE = 0.1554E+01
 VOUT(1) = 0.0231149
 VOUT(2) = 0.734369
 VOUT(3) = 0.24195
 VOUT(4) = 0.0736518
 VOUTE(1) = 0.0156819
 VOUTE(2) = 0.0267471
 VOUTE(3) = 0.0167053
 VOUTE(4) = 0.00564953

pcutd,mc=0.005

 CHISQUARE = 0.1513E+01
 VOUT(1) = 0.025126
 VOUT(2) = 0.743149
 VOUT(3) = 0.231043
 VOUT(4) = 0.0718556
 VOUTE(1) = 0.015641
 VOUTE(2) = 0.0268081
 VOUTE(3) = 0.0166471
 VOUTE(4) = 0.00558117

pcutd,mc=0.02

 CHISQUARE = 0.1553E+01
 VOUT(1) = 0.0103017
 VOUT(2) = 0.755139
 VOUT(3) = 0.234297
 VOUT(4) = 0.0746305
 VOUTE(1) = 0.0162161
 VOUTE(2) = 0.0269708
 VOUTE(3) = 0.0166419
 VOUTE(4) = 0.00570963
```

	Fit χ^2	Measured
$\chi^2_{DCut} = 4$ $\chi^2_{MCcut} = 4.0$	1.127	0.024 0.779 0.197 0.022
$\chi^2_{mccut} = 4.049$	1.106	0.772 0.206
$\chi^2_{mccut} = 4.05$	1.100	0.022 ± 0.012 0.772 ± 0.022 0.206 ± 0.012
$\chi^2_{mcut} = 4.051$	1.104	0.022 0.772 0.206
$\chi^2_{Dcut} = 3$ χ^2_{mccut}		
3.045	1.683	0.021 0.755 0.223
3.046	1.680	0.021 ± 0.012 0.755 ± 0.021 0.223 ± 0.012
3.047	1.682	0.022 0.754 0.224
3.0	1.719	0.023 ± 0.012 0.767 ± 0.021 0.209 ± 0.012

sec. vtxed Tks in hemisphere



⇒ Data has lower mult. than MC.

⇒ Tk ε corr should be $\lesssim 0.1$ vtxed tk/hemi rather than .5 tk/evt

Track Attachment