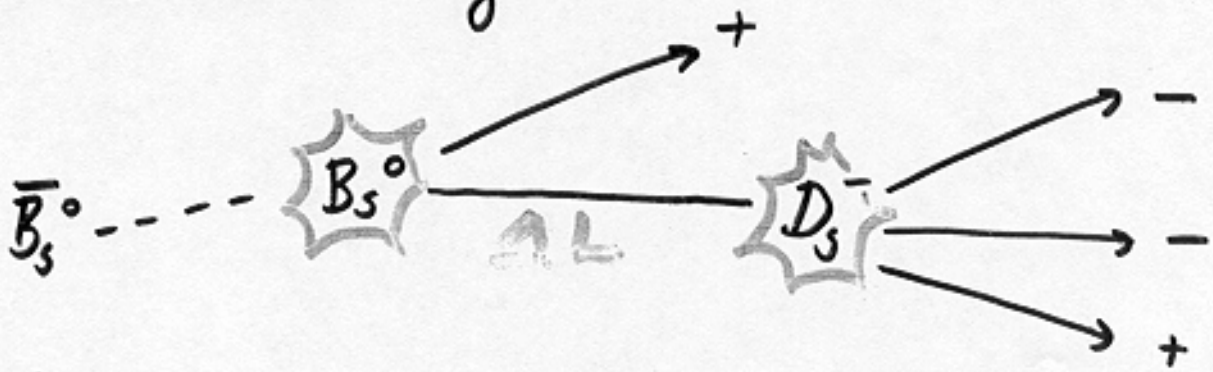
J. Thom, S. Willocq

6/22/00

B_s mixing with 2 vertex dipole

Final state tag:



if $\Delta L \cdot \text{SIGN}(Q_D - Q_B)$

$= \ominus \rightarrow$ right tag (b)

$= \oplus \rightarrow$ wrong tag ($\bar{b}$)

2 reconstructed topological vertices

$Q^{tot} \stackrel{!}{=} 0 \qquad (B_s)$

$Q_B \neq Q_D$

What's new since last round?

a) new (relaxed) track selection

standard: quality trk cuts

relaxed: qual. cuts + trks w/ $p_T > 0.2$ GeV, ≥ 3 VXD hits

f_{B_s}: 17.4% → 17.9%

$(1-2\eta)$: 0.58 → 0.61

$S = \sqrt{N} f_{B_s} (1-2\eta)$ 6% improvement

b) Dan's new boost reconstruction

~10% better tail resolution

c) better decaylength-error estimates σ_L

Tracy's "fake D track"

$$\frac{L_{rec} - L_{MC}}{\sigma_L} \approx 1$$

d) vx-alone tracks added

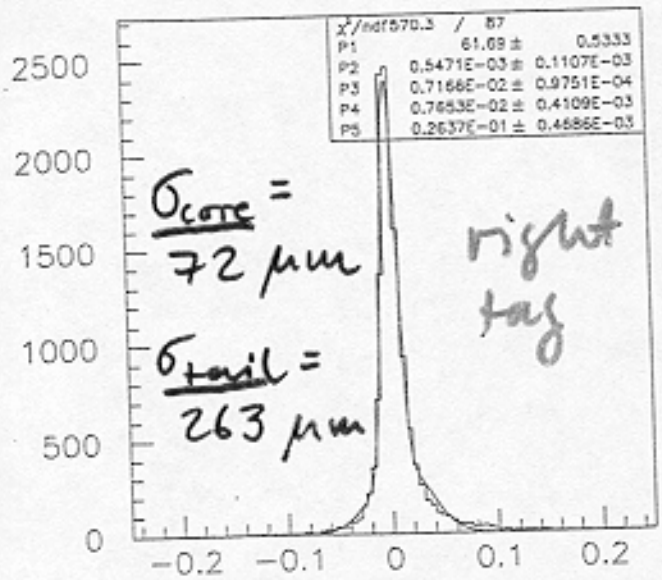
better charge reconstruction

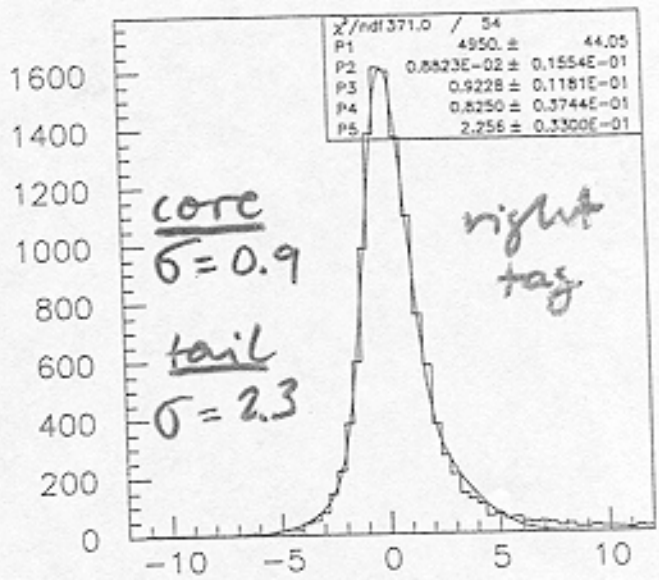
~5% improvement in sensitivity

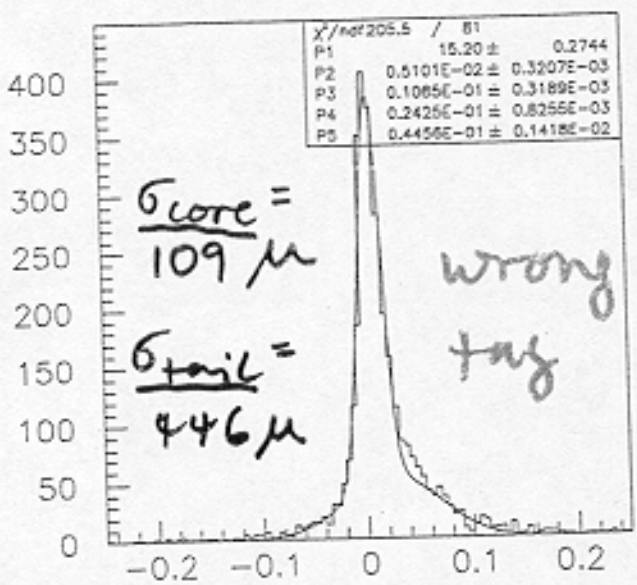
b) Improvement in decaylength estimate

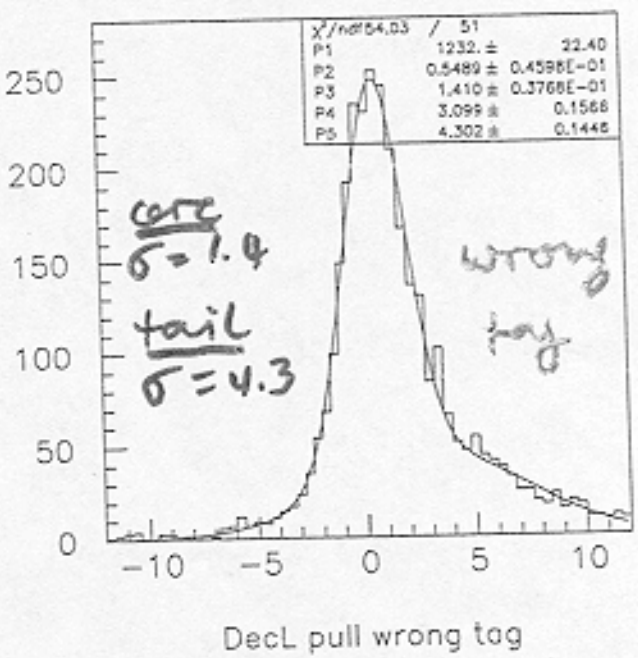
$L_{rec} - L_{true}$

$\frac{L_{rec} - L_{true}}{\sigma_L}$ ← decaylength error









fit "fake D track" with B vertex

introduce angular uncertainty

⇒ better estimate of σ_L

Use of vx-alone tracks:

a) qual trks → ZVTOP3 → B, D vertex

b) vx-alone trks → L/D attch. to B, D

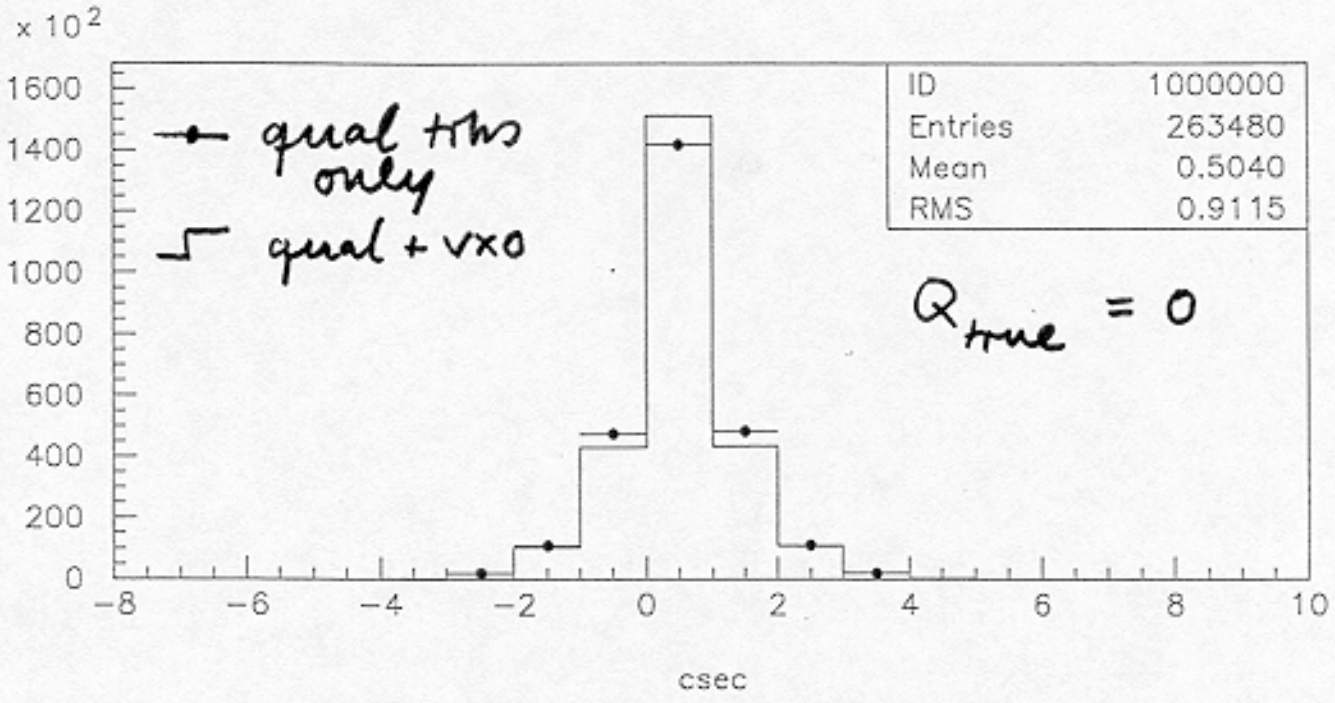
use vx-alone info for

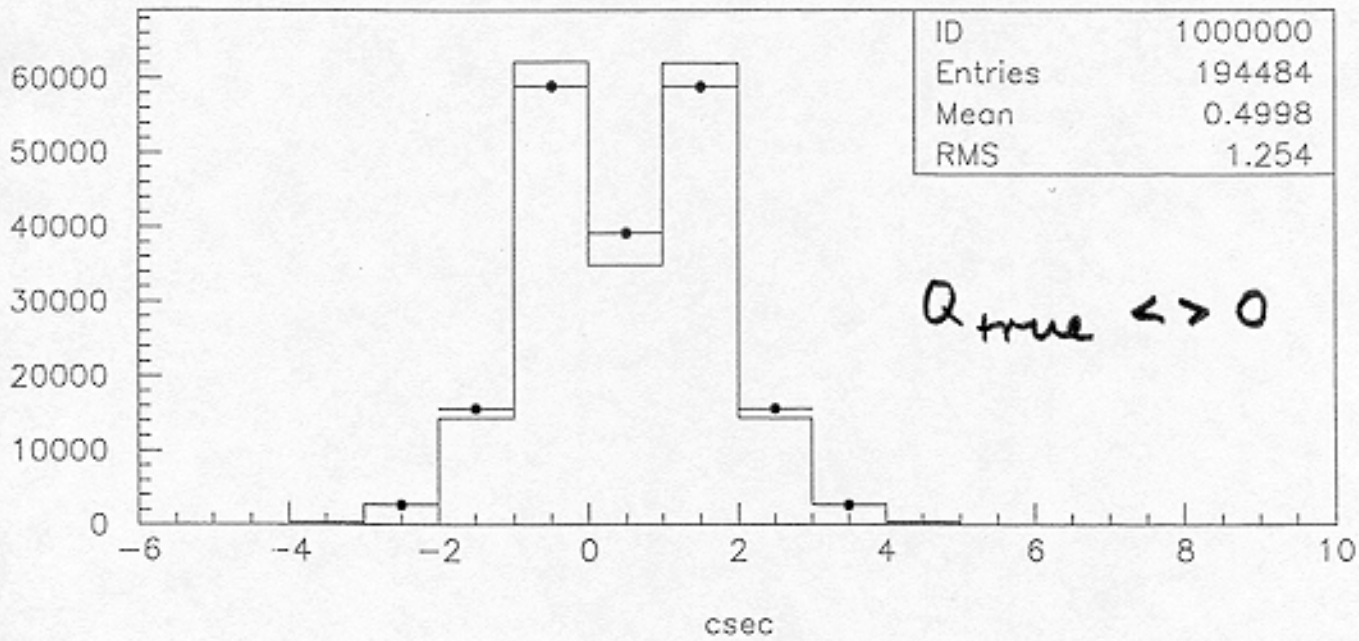
total charge determination

& Q_B, Q_D determination only:

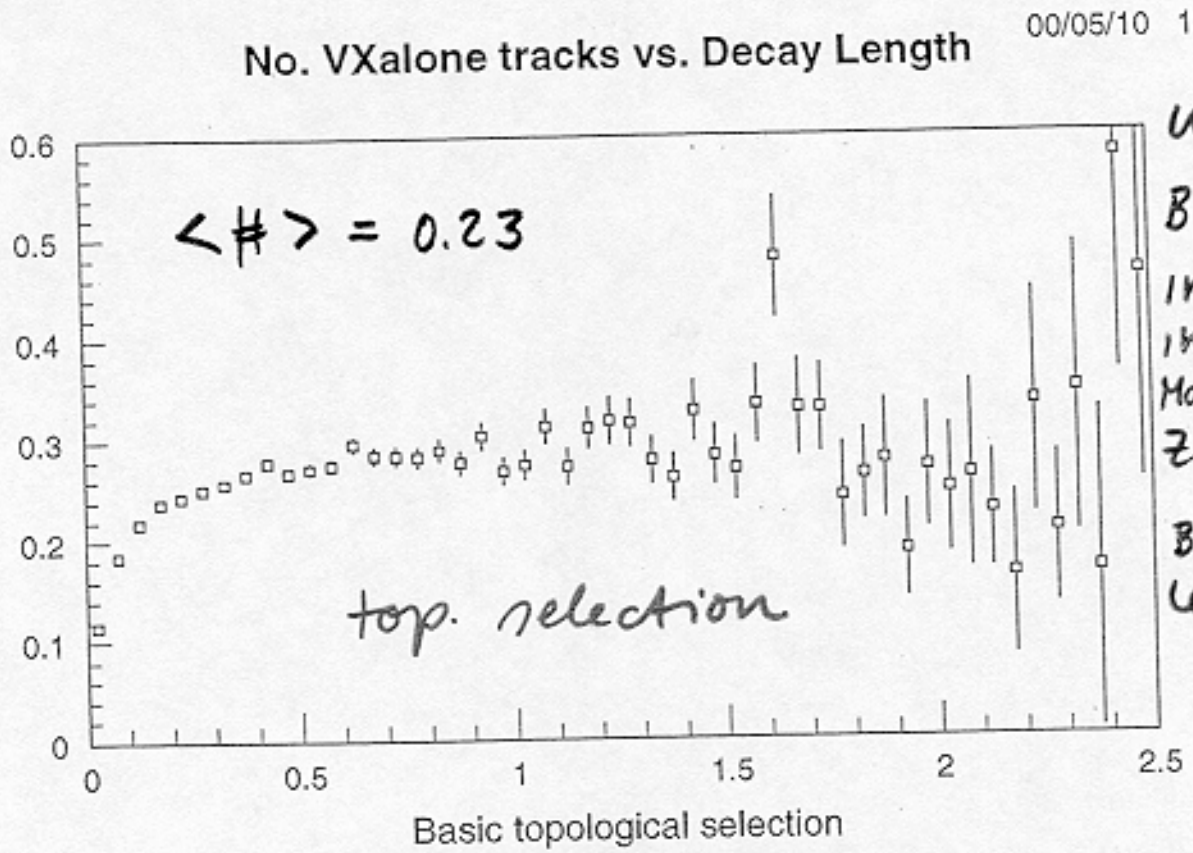
Dipole select. cut	VX alone	qual trks
$Q^{tot} = 0$	✓	✓
$Q_B \neq Q_D$	✓	✓
$\Delta L_{BD} > 250\,\mu$	–	✓
$M_D < 2$	–	✓
boost < 10 GeV	–	✓
p_T (VX alone) < 4 GeV	✓	–

bb MC basic top. selection

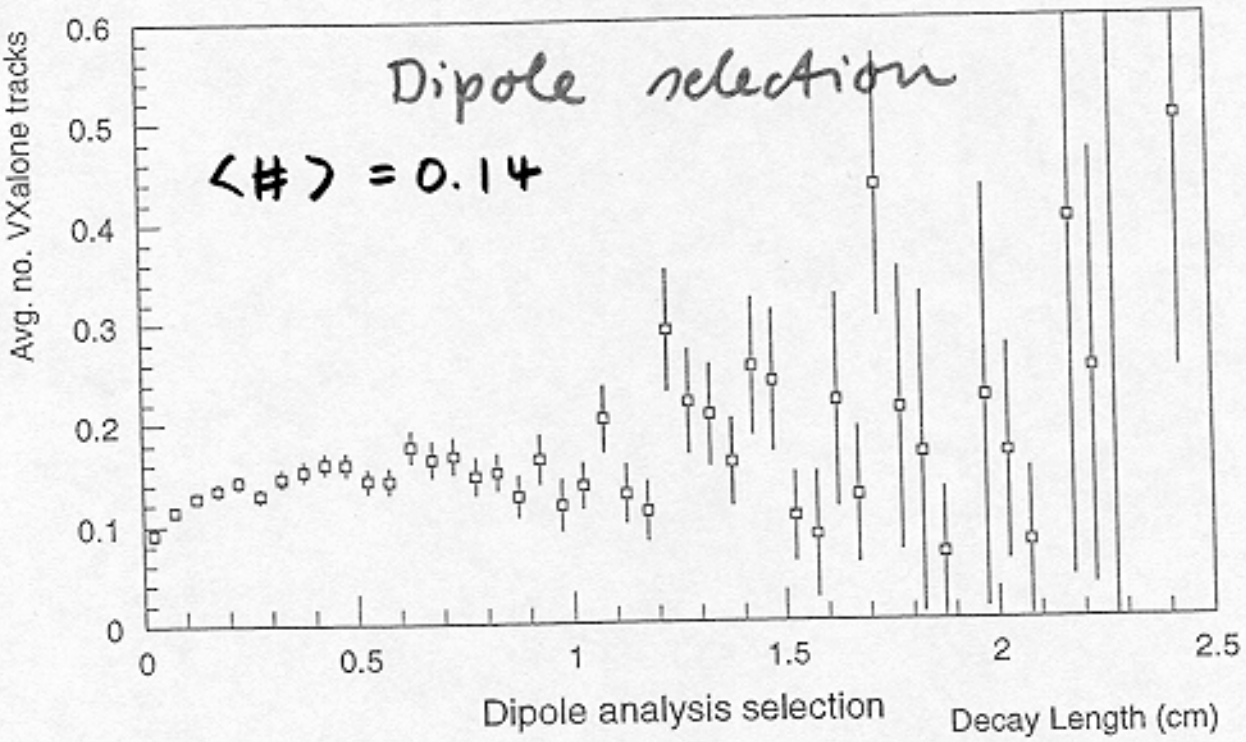




new cuts:



using:
BBGTVXOP.
impLow = -1
impHigh = 1
MaxChi2 = 8
Z_Cut = 1.5
BBVCVXOP.
LodimMin = 0.025



Why does #VXO drop with Dipole selection?

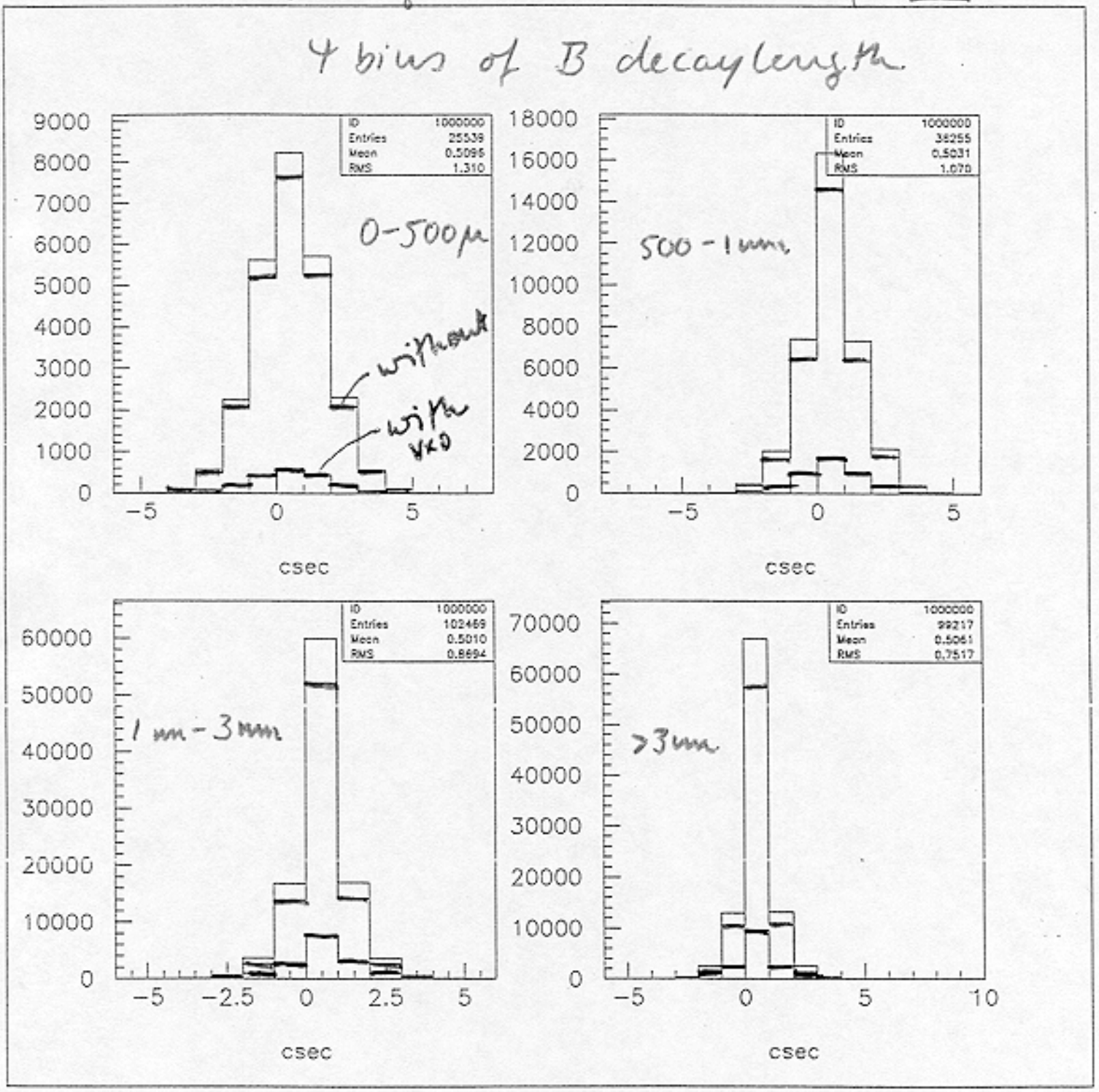
$Q^{tot} = 0$

MC → 60% neut

VXD's at small decaylength

Charge reconstruction of true neutrals

4 bins of B decaylength

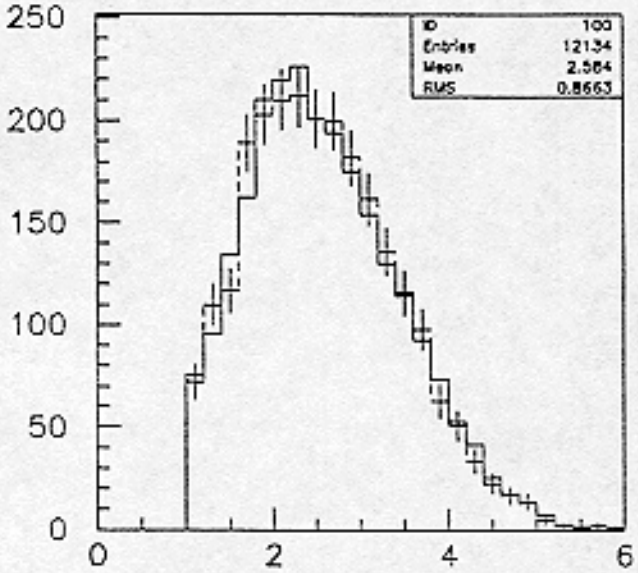


⌐ events with VXD's

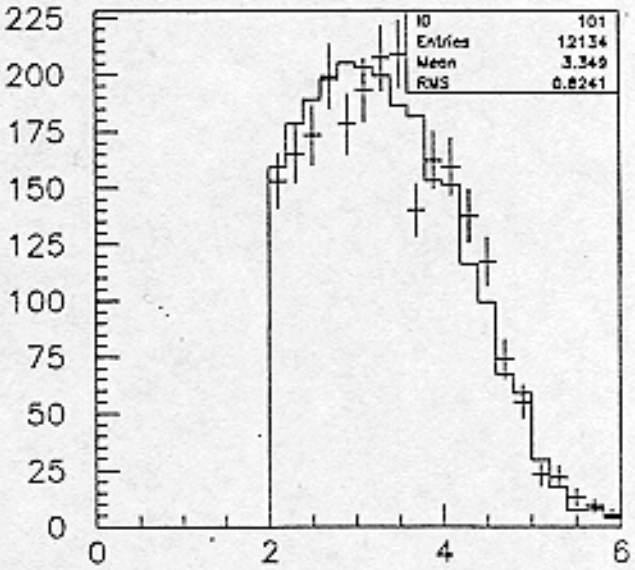
⌐ no VXD's attached

+ 97 Data R17

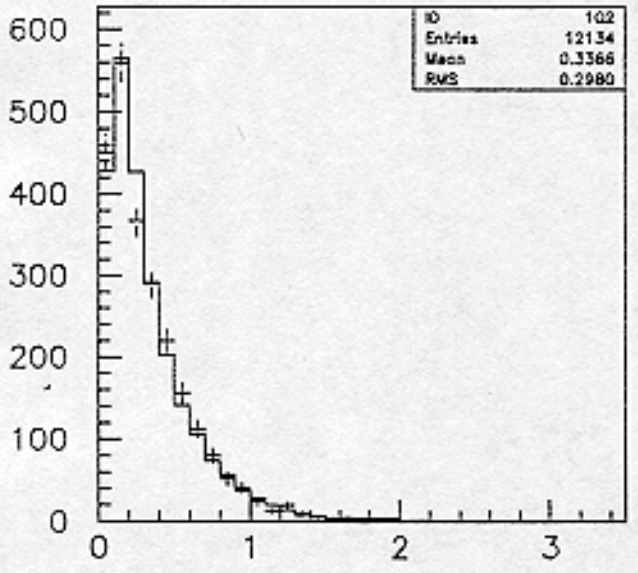
$\int$ 97 $q\bar{q}$ MC



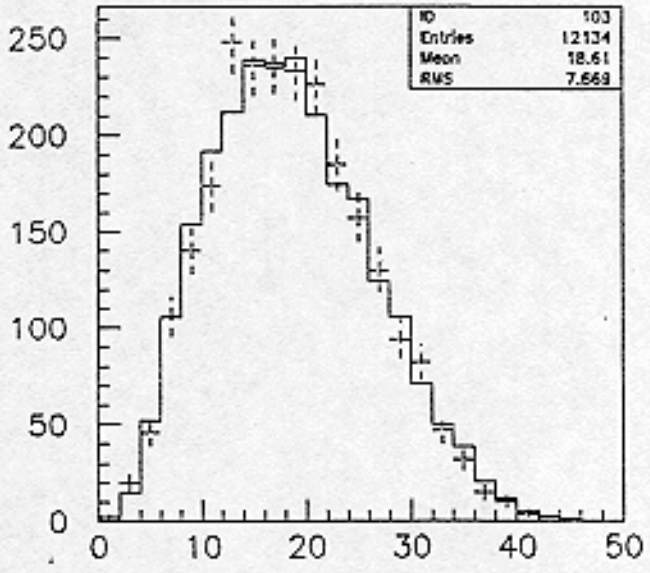
Vtx Raw Mass (GeV)



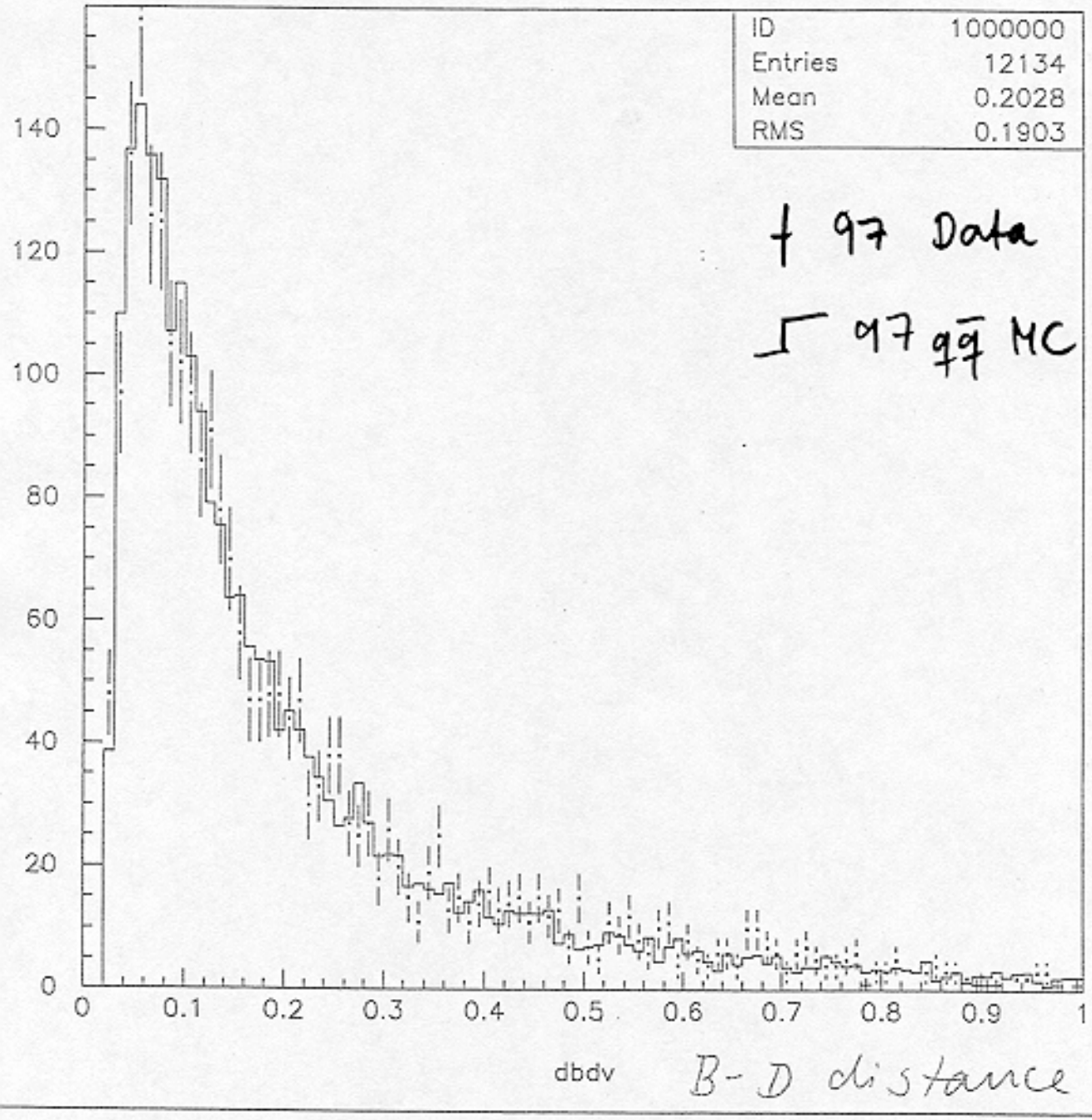
Vtx Pt−Mass (GeV)



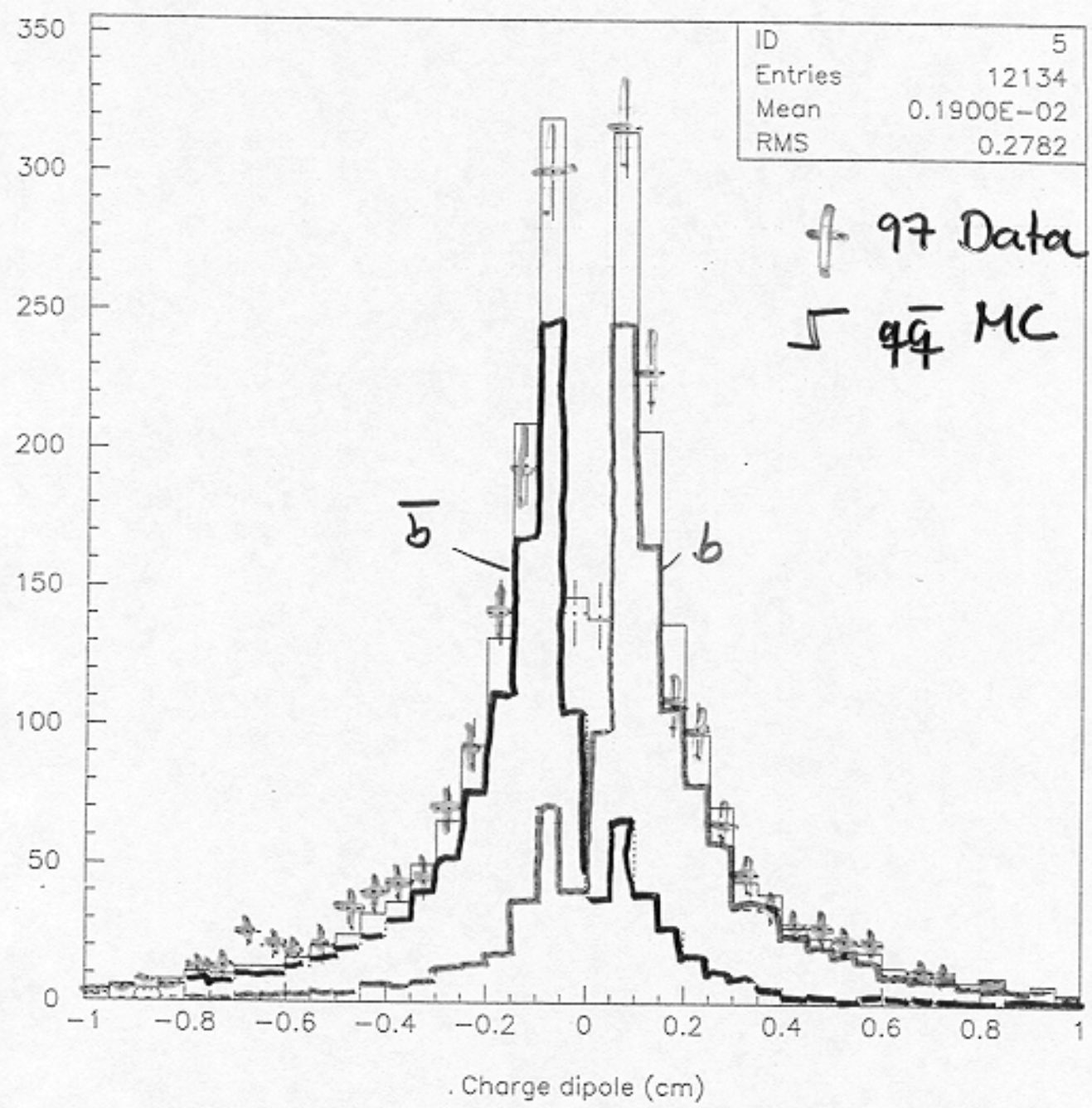
Decay Length (cm)



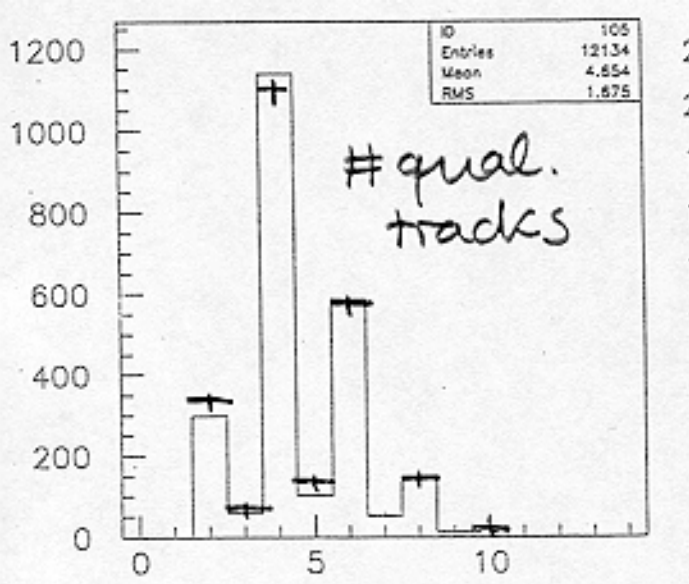
Total momentum (GeV/c)

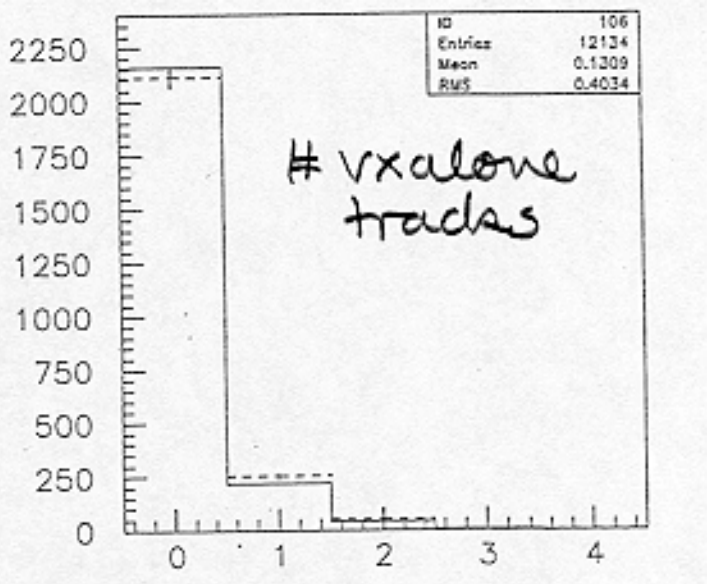

ID 1000000
Entries 12134
Mean 0.2028
RMS 0.1903
140
120
100
80
60
40
20
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
dbdv
f 97 Data
⌜ 97 $q\bar{q}$ MC
B - D distance

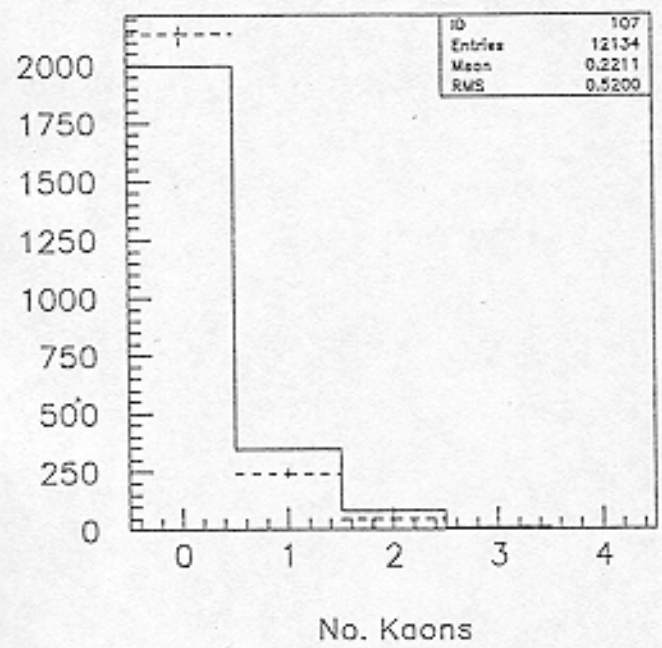
B D- distance

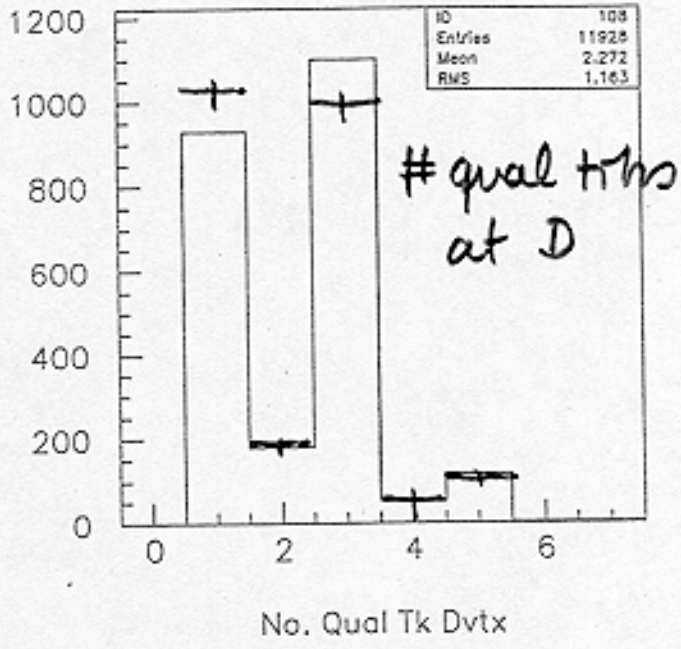

ID 5
Entries 12134
Mean 0.1900E-02
RMS 0.2782
97 Data
$q\bar{q}$ MC
$\bar{b}$
b
350
300
250
200
150
100
50
0
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1
. Charge dipole (cm)

$$\Delta L * (Q_D - Q_B)$$


ID 105
Entries 12134
Mean 4.654
RMS 1.675
qual. tracks
No. Qual Tk

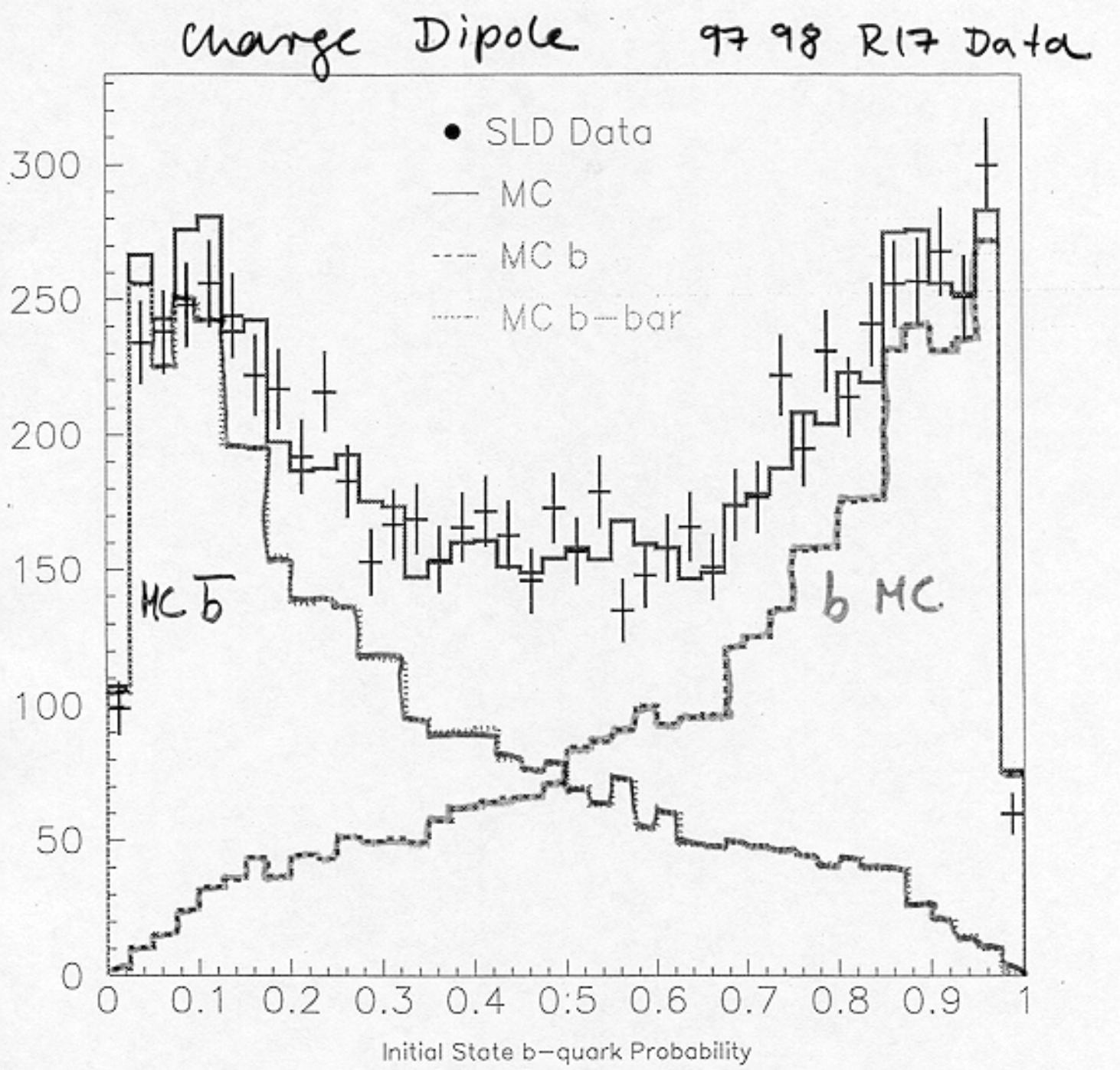

ID 106
Entries 12134
Mean 0.1309
RMS 0.4034
vxalone tracks
No. OK Tk = # vxo tk


ID 107
Entries 12134
Mean 0.2211
RMS 0.5200
No. Kaons


ID 108
Entries 11926
Mean 2.272
RMS 1.163
qual trks at D
No. Qual Tk Dvtx

+ Data

⌐ MC

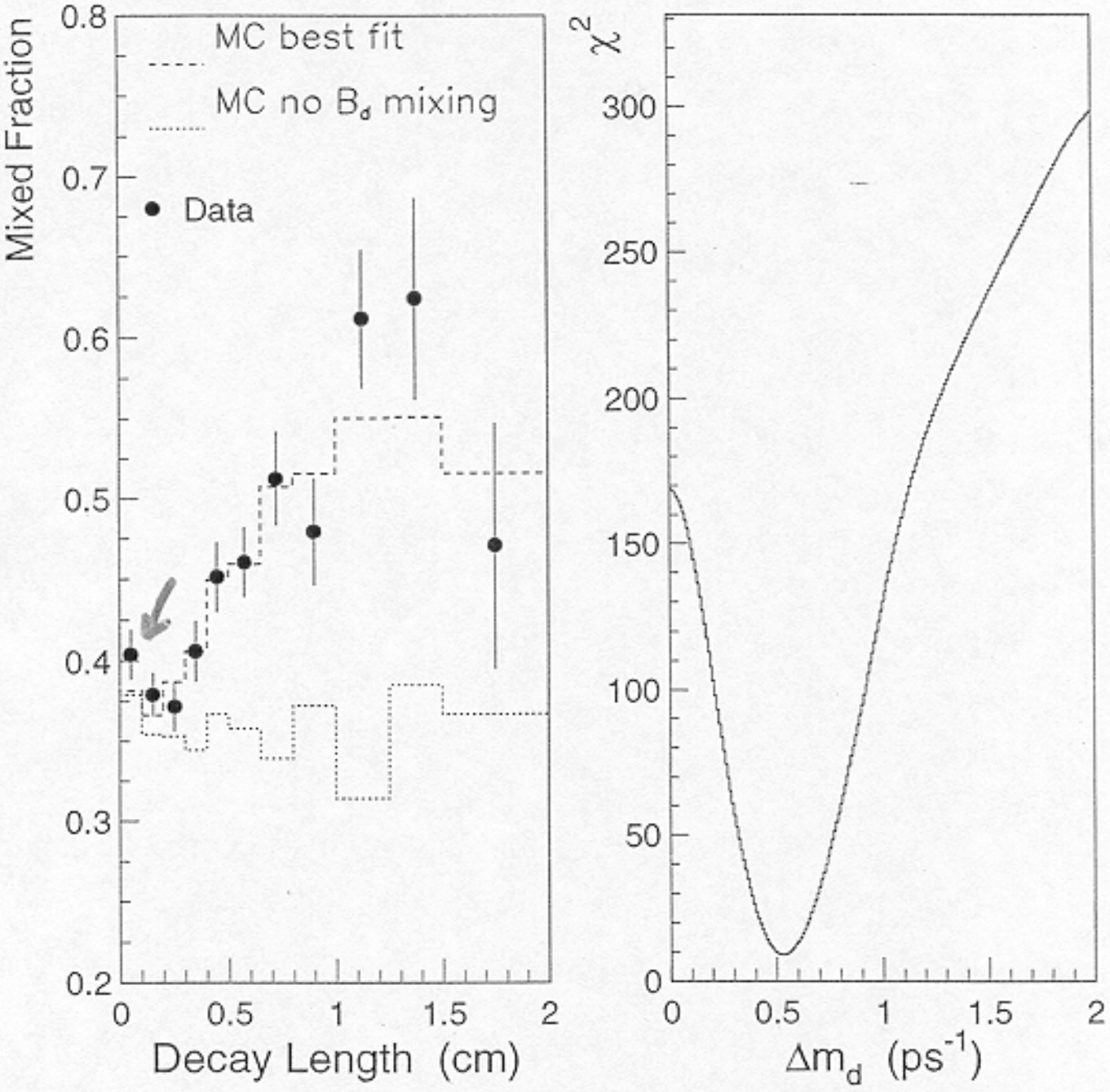


Average right tag fraction = 77.6%

more MC - Data agreement tests:

B_d mixing

2000/06/19 09.19



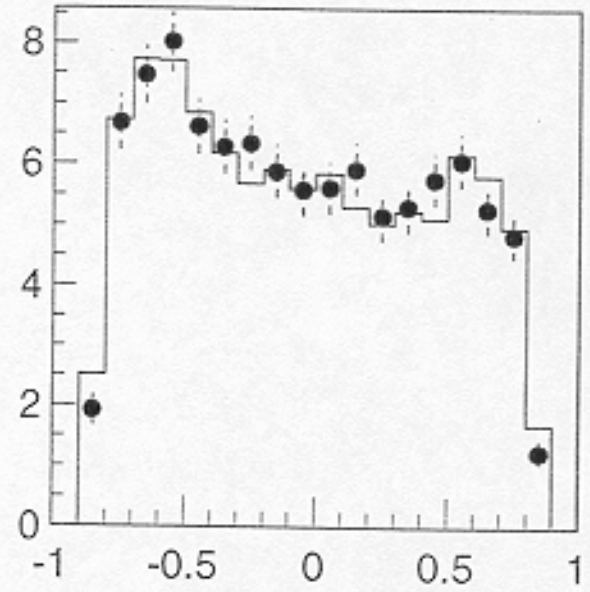
$\Delta m_d = 0.5311 \pm 0.0333$

(overlap events removed)

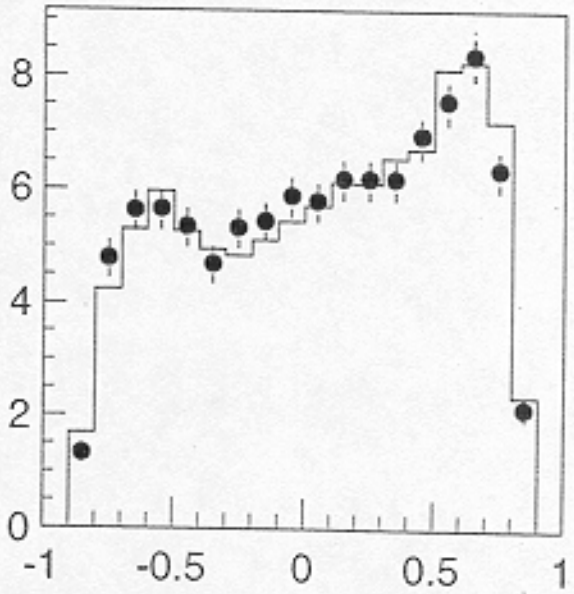
Forward - Backward Asymmetry

$Q^{tot} = 0$

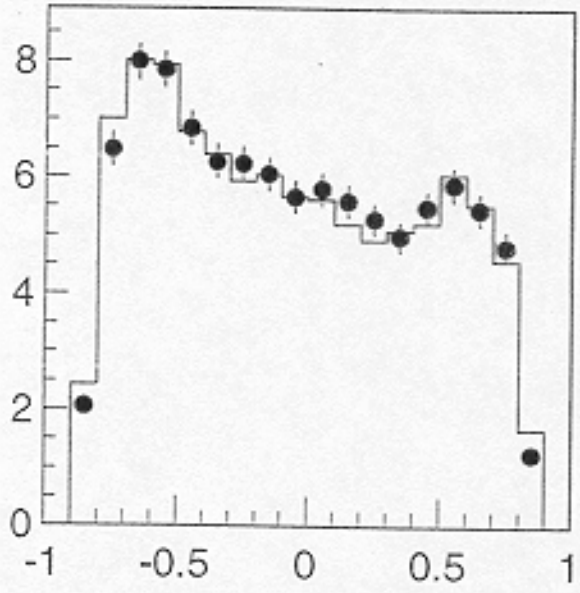
2000/06/19 · 09.21



MC signed cos theta Right



MC signed cos theta Left

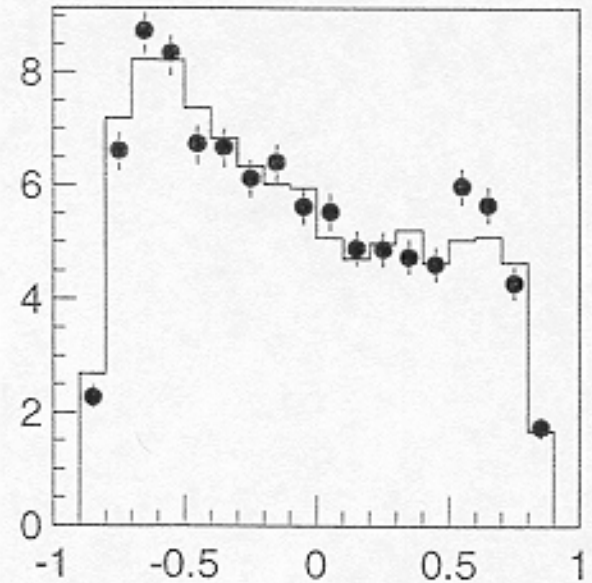


MC signed cos theta

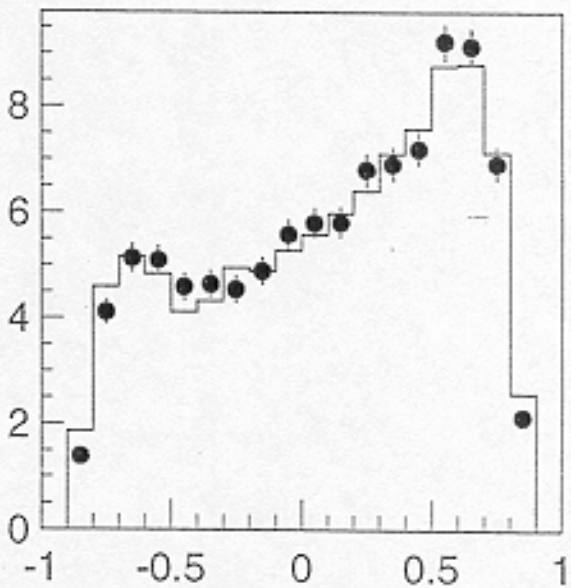
Forward - Backward Asymmetry

$Q^{tot} = \pm 1$

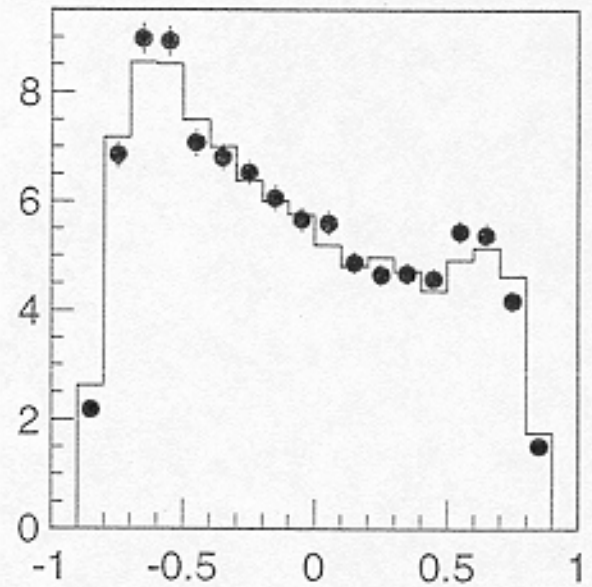
2000/06/19 10.01



MC signed cos theta Right

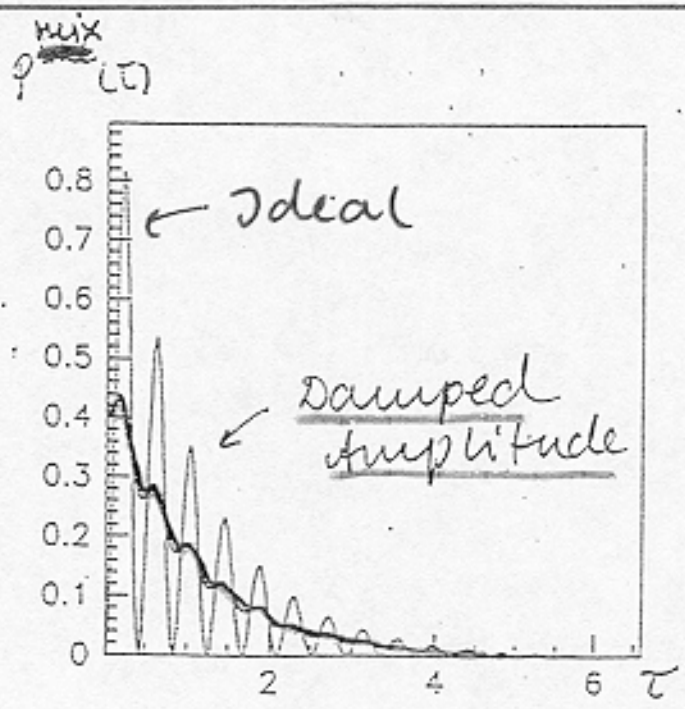


MC signed cos theta Left



MC signed cos theta

Damping of oscillation signal



$$P^{exp}_{mix} = \frac{e^{-t/\tau}}{2\tau} f_{B_s} \left\{ (1 - D e^{-\frac{\Delta m_s^2 \sigma_t^2}{2}} \cos \Delta m_s t) \right\}$$

f_{B_s} → high B_s fraction

D → small mistag rate

$e^{-\frac{\Delta m_s^2 \sigma_t^2}{2}}$ → $\sigma_t^2 = \sqrt{\left(\frac{\sigma_L}{\beta\gamma c}\right)^2 + \left(\frac{\sigma_{\beta\gamma}}{\beta\gamma}\right)^2}$

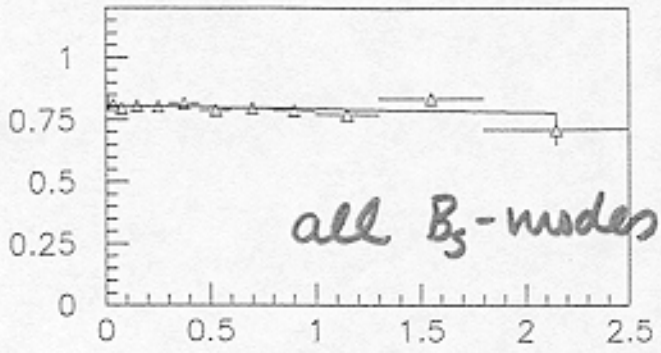
→ good decaylength resolution

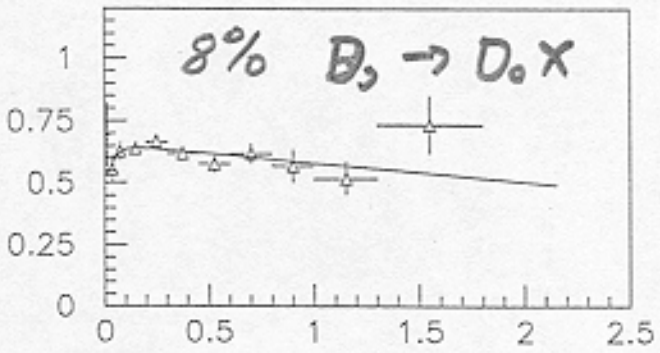
→ good boost resolution

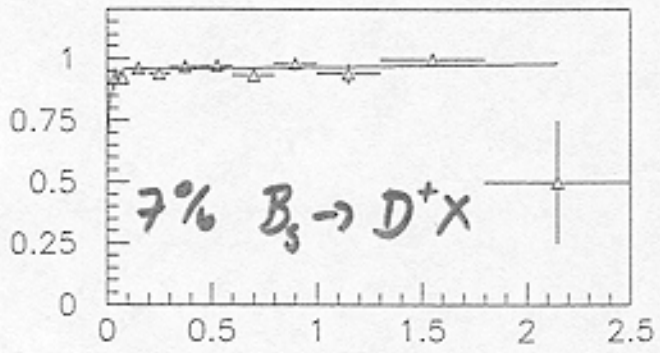
$$\mathcal{L} = \prod_i^{events} \left(P^i_{mix} + P^i_{unmix} \right)$$

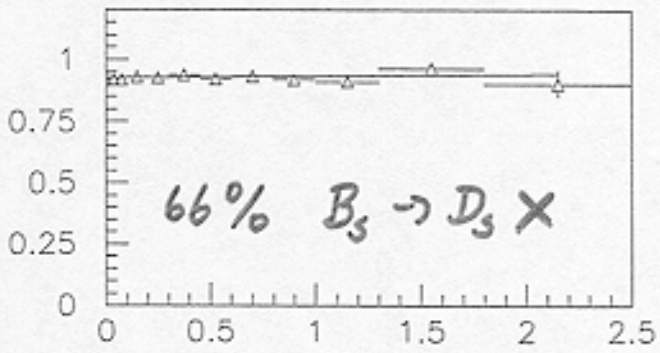
Parametrizations (2 Examples)

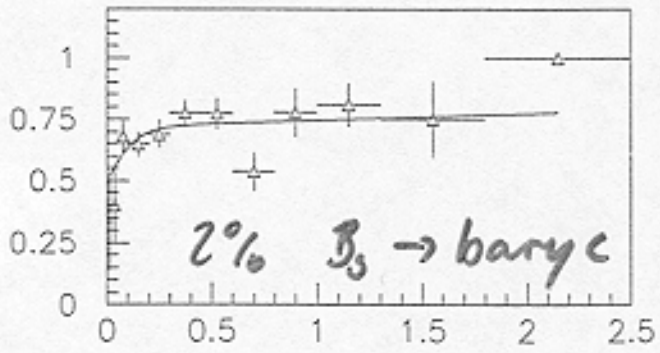
a) dipole tag "purity" as fct. of B dec. length

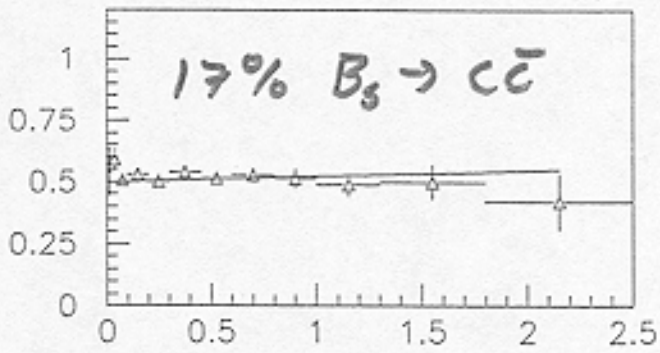








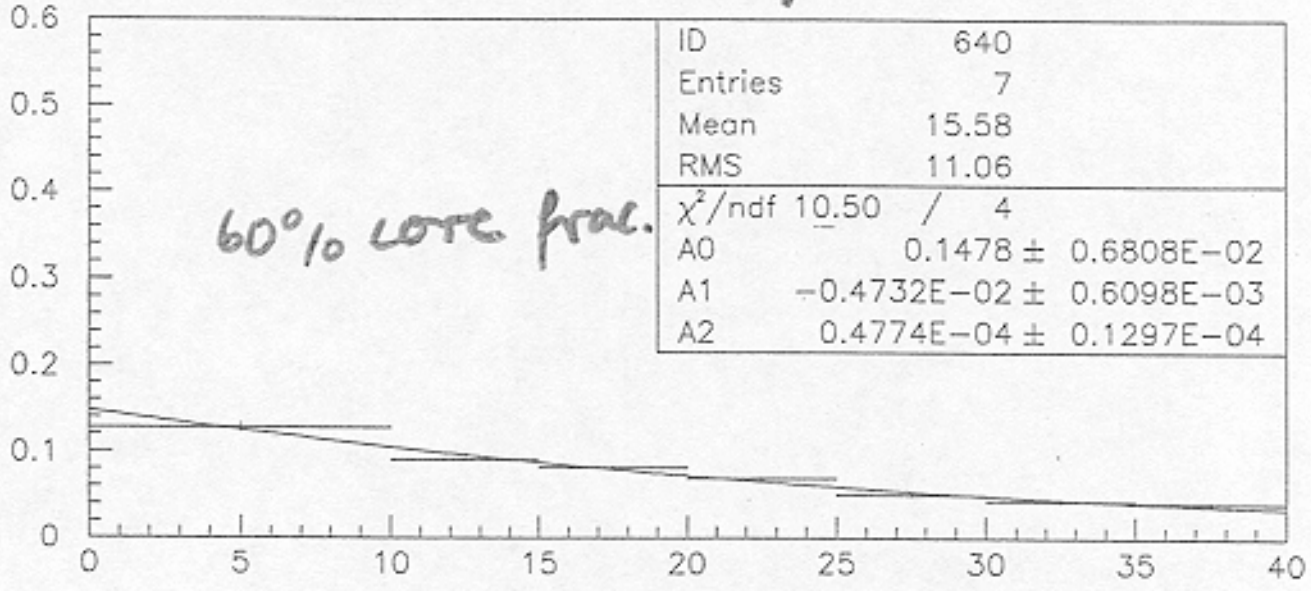


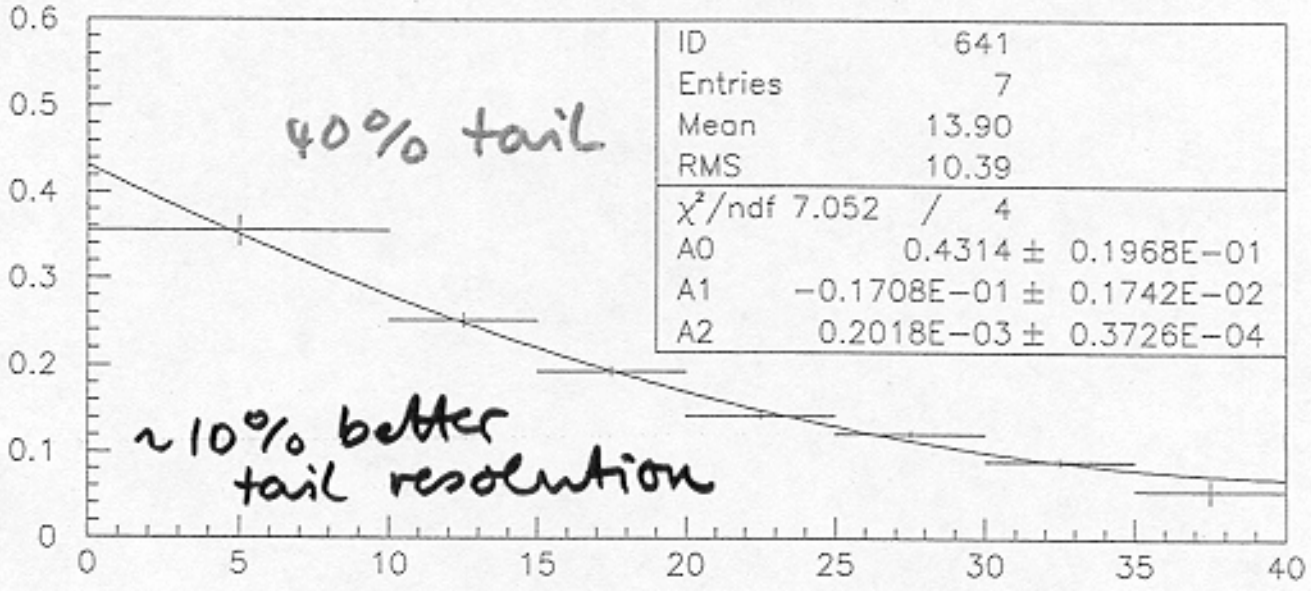


(overlap events have been removed)

b) relative boost residuals as fct. of Energy

B_s only

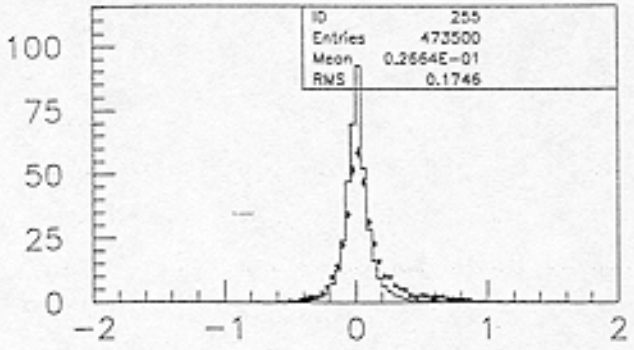




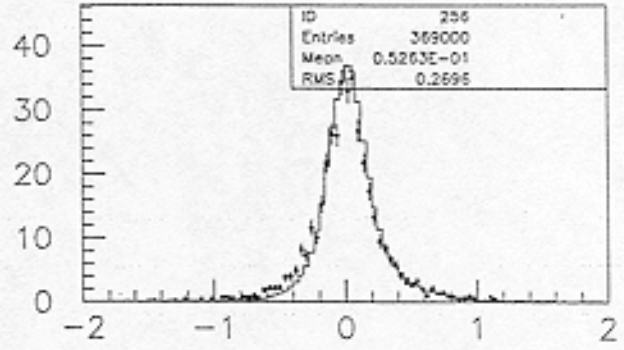
Dan's new boost combination

Crosschecks : Parametrizations OK ?

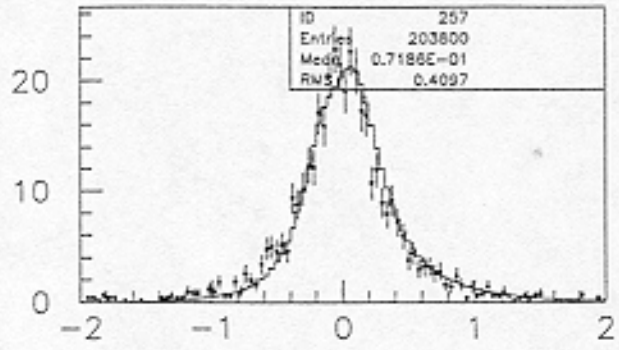
$\sqsubset$: $\sigma_t = \sqrt{\left(\frac{\sigma_L}{\gamma\beta c}\right)^2 + \left(t\frac{\sigma_{xy}}{\gamma\beta}\right)^2}$ + MC



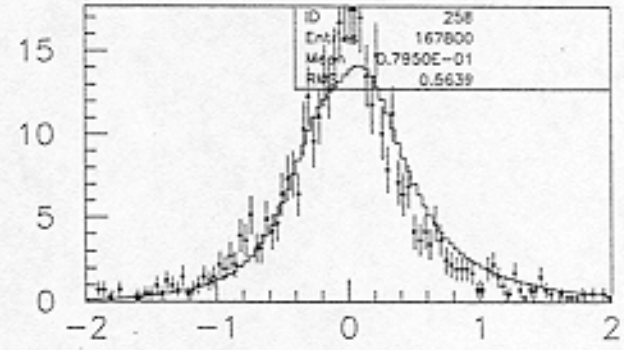
proper time 0–1 (ps)



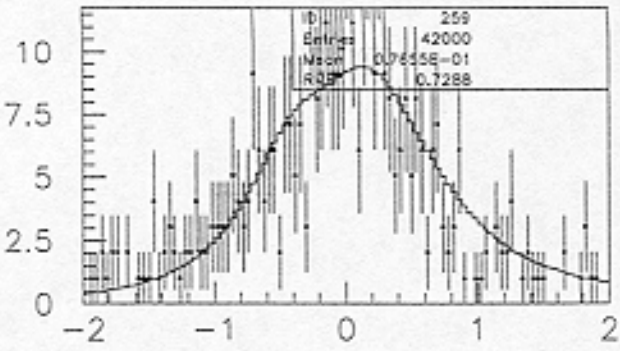
proper time 1–2 (ps)



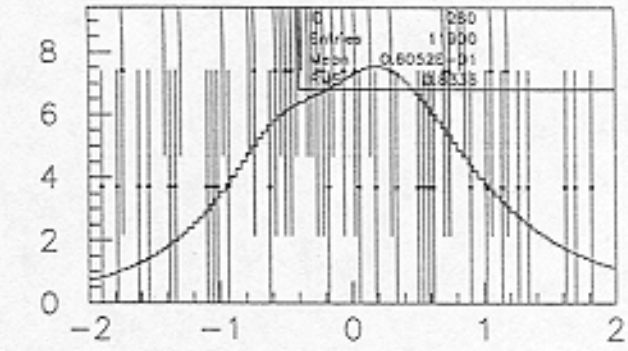
proper time 2–3 (ps)



proper time 3–5 (ps)

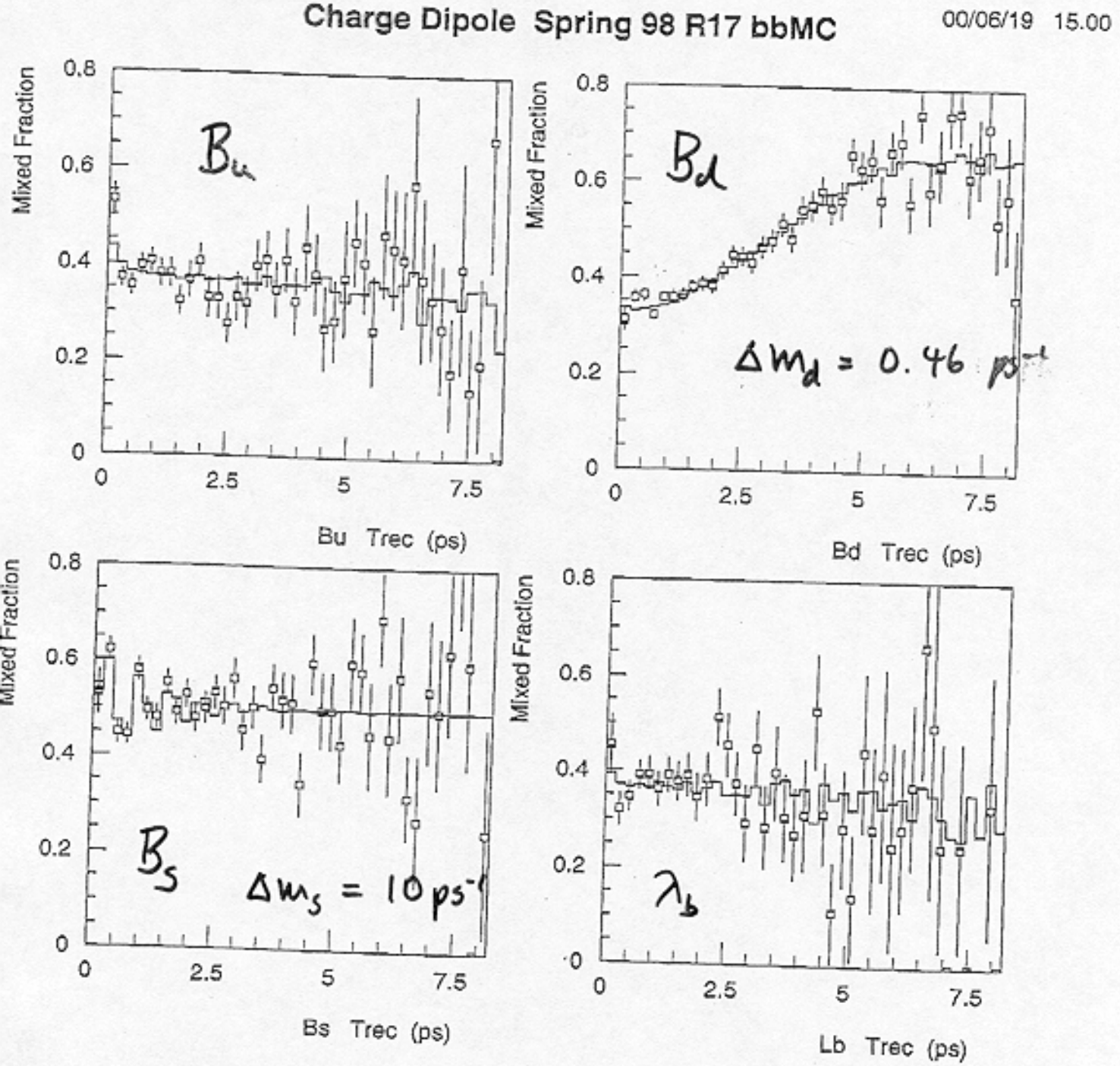


proper time 5–7 (ps)



proper time 7 (ps)

$b\bar{b}$ R17 M



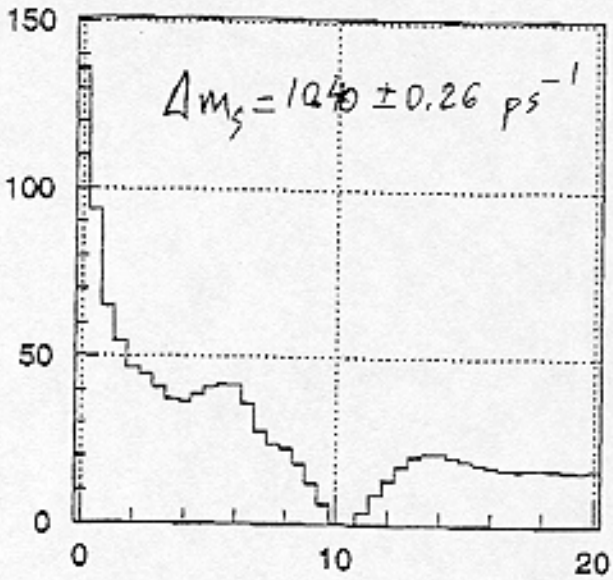
- Likelihood function (5)

+ MC

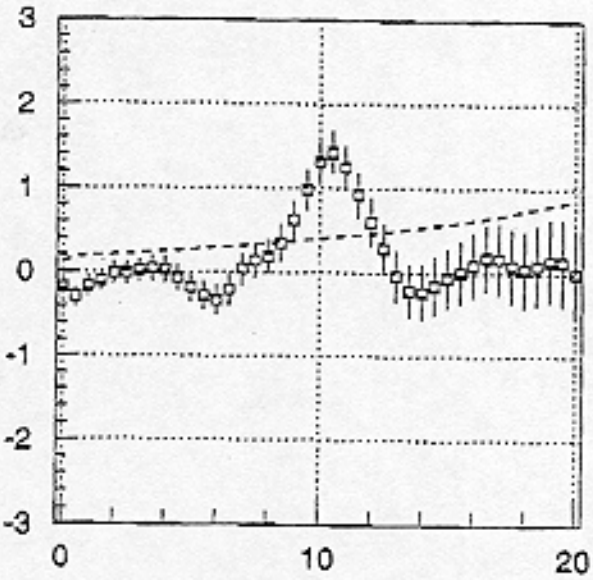
65 R17 MC

Charge Dipole Spring 98 R17 bbMC

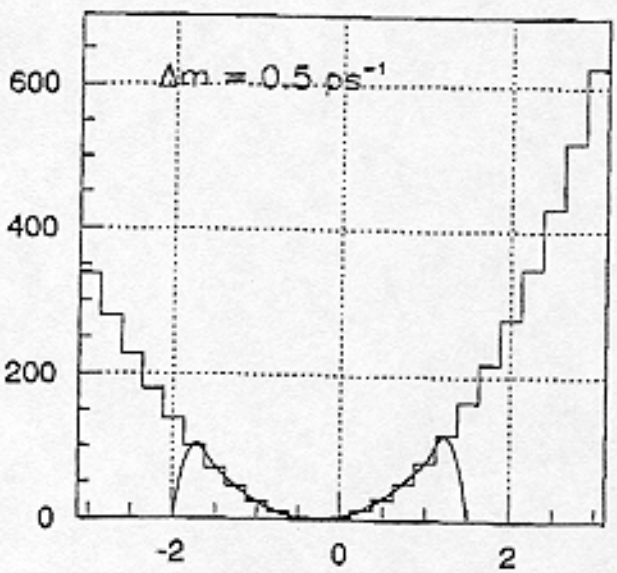
00/06/19 14.57



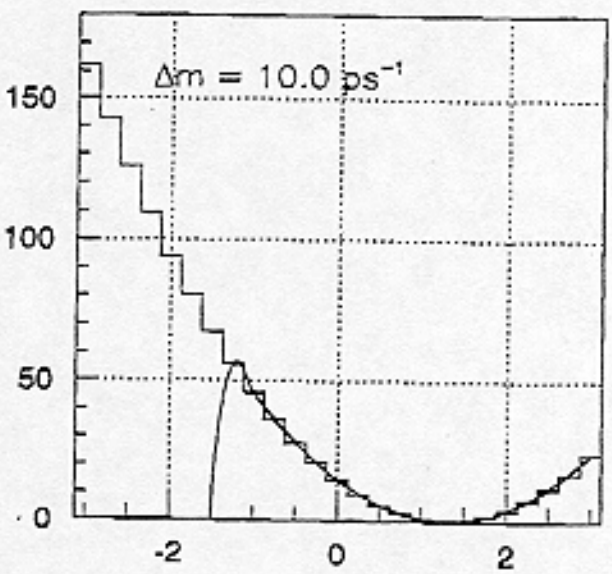
-Log Lik vs. delta m



Amplitude vs. delta m



-Log Lik vs. amplitude

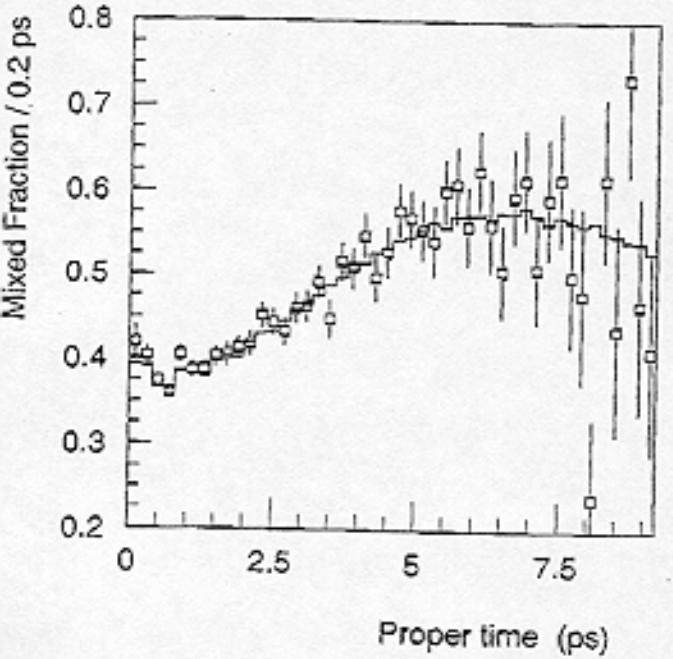


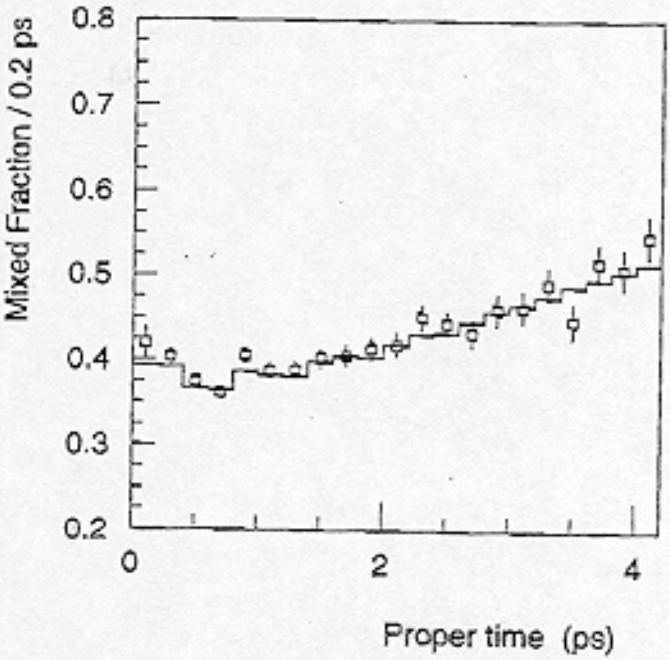
-Log Lik vs. amplitude

bb MC

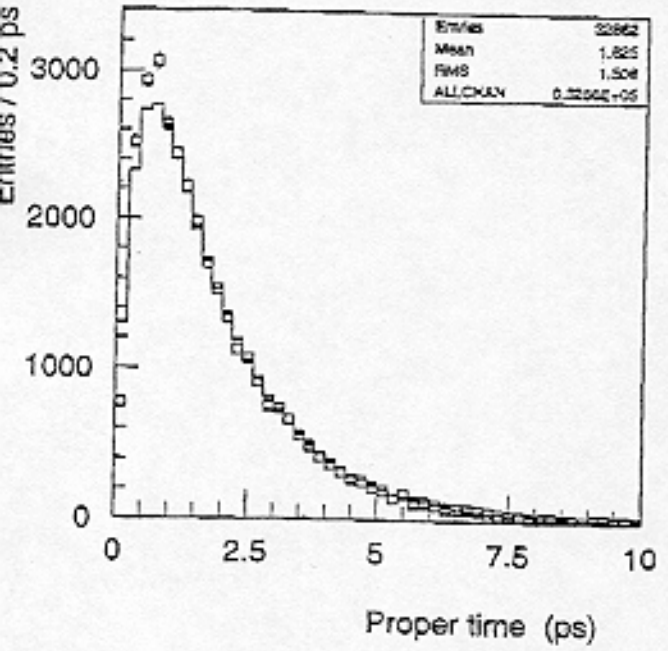
Charge Dipole Spring 98 R17 bbMC

00/06/19 15.02



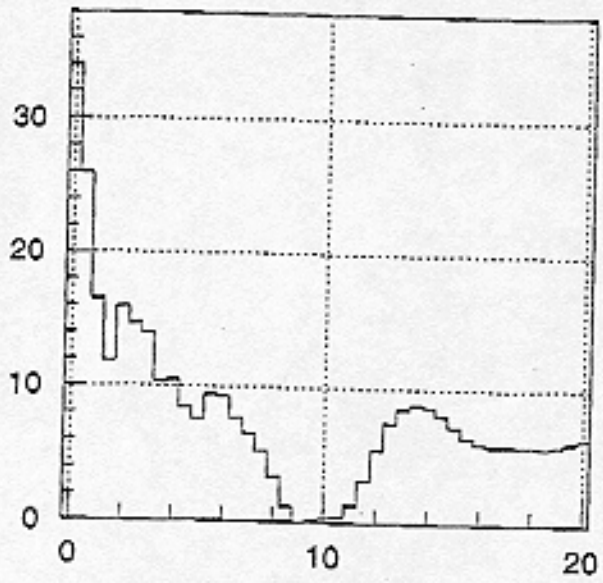


all B types

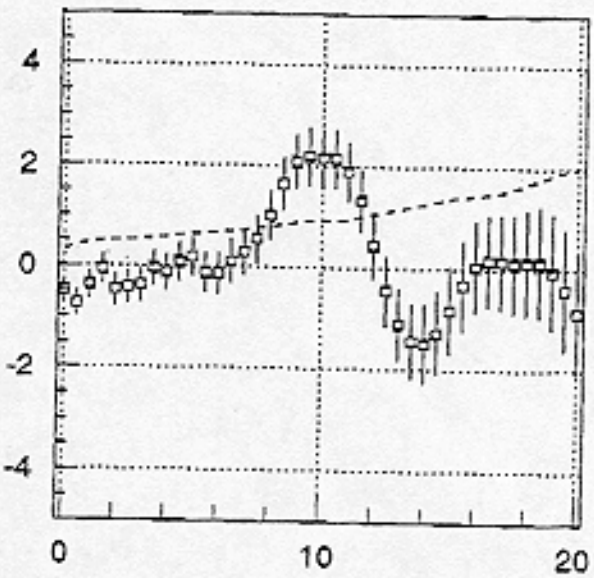


R17 Data

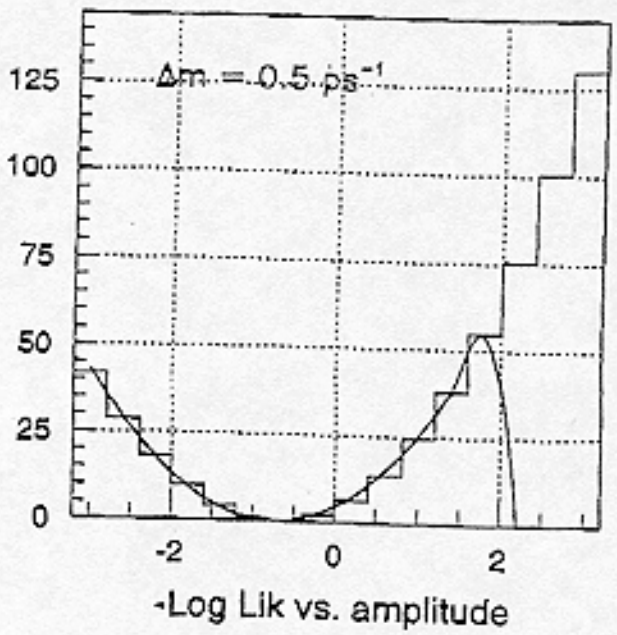
Charge Dipole 97-98 R17 Data 00/06/19 15.05



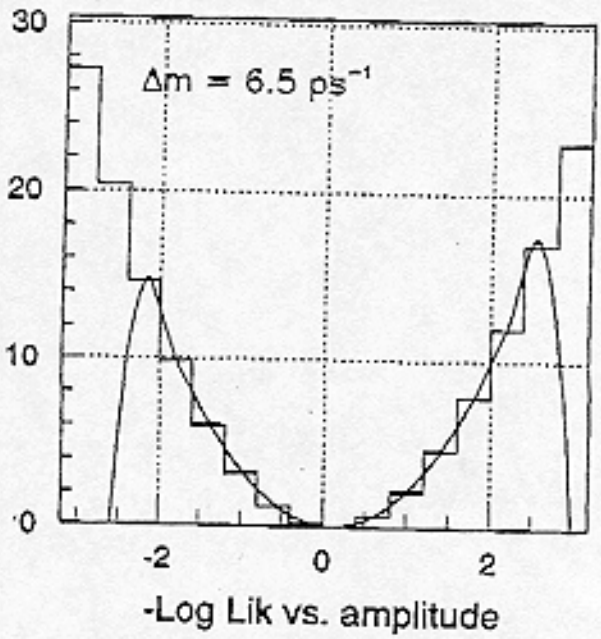
-Log Lik vs. delta m



Amplitude vs. delta m



-Log Lik vs. amplitude



-Log Lik vs. amplitude

95% CL sensitivity at $\Delta m_s \simeq 11.5\ ps^{-1}$

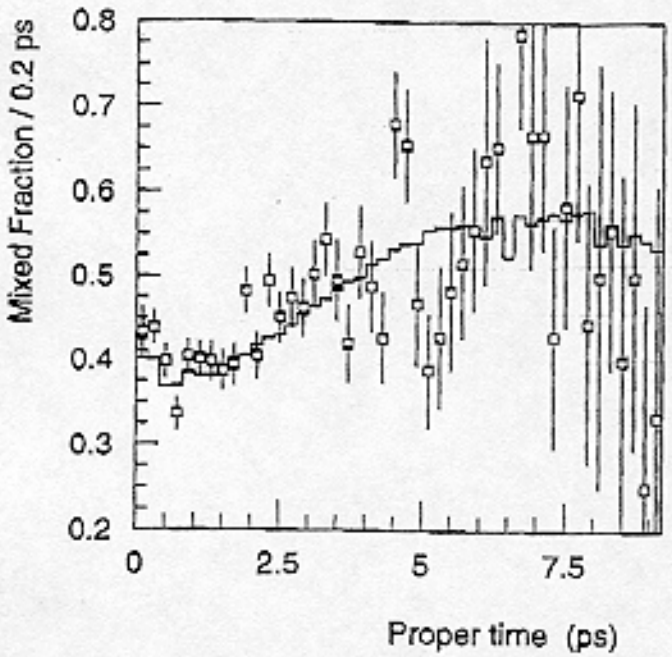
(7)

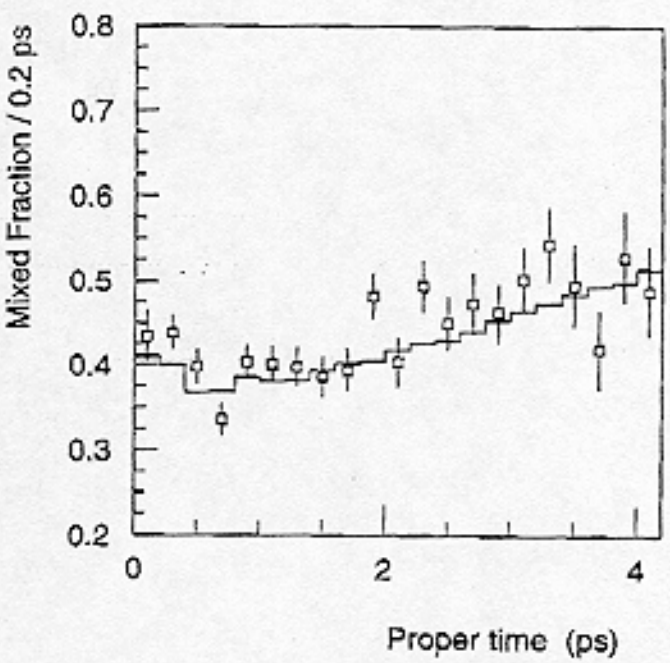
→ M_{P_T} dependence of decay mode fractions turned on

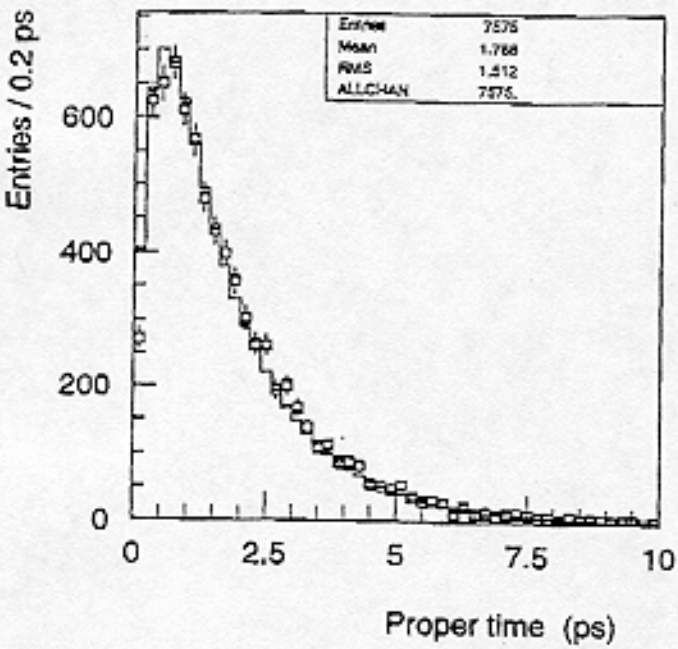
97-98 R17 Data

Charge Dipole 97-98 R17 Data

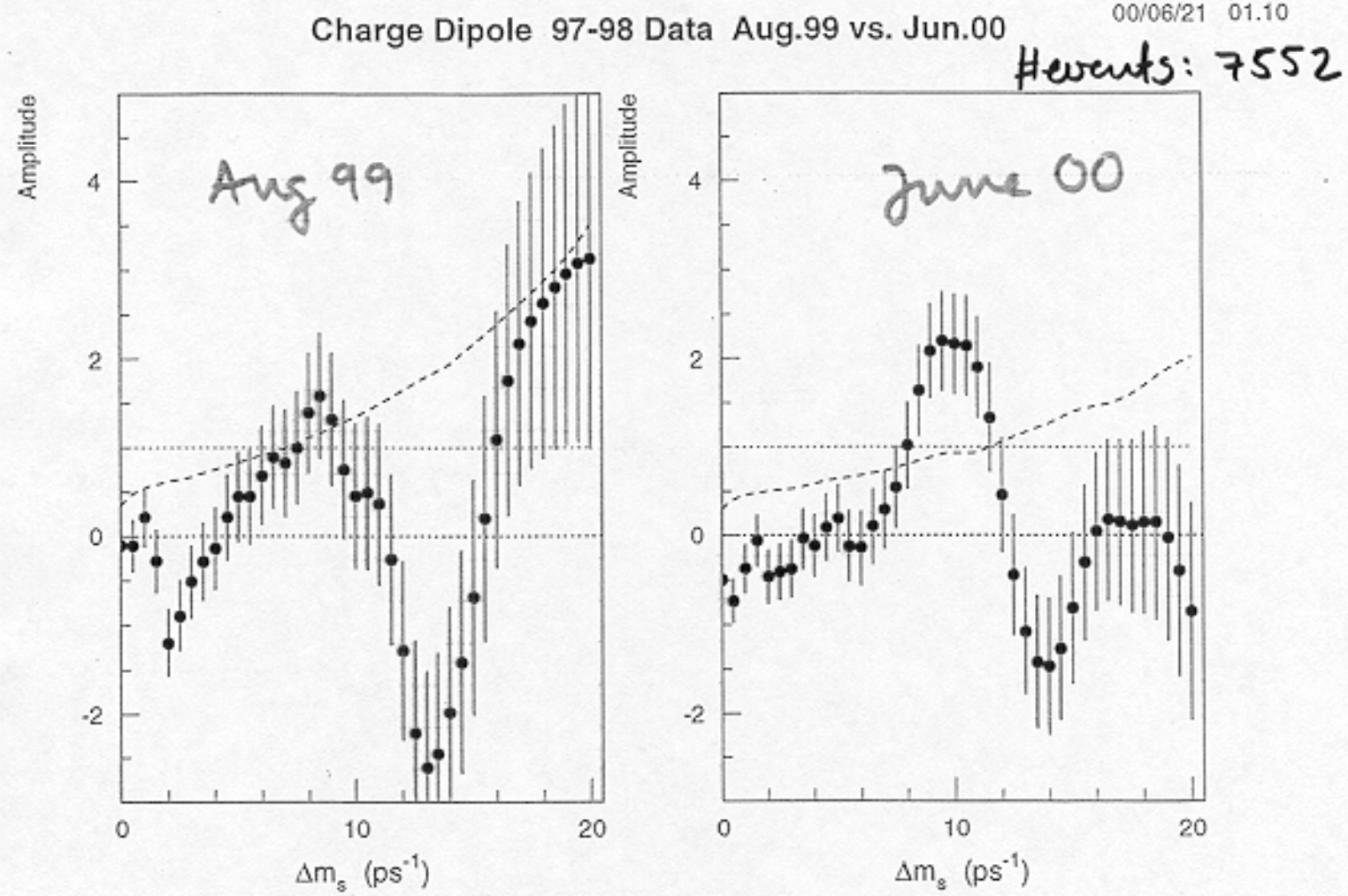
00/06/19 15.05







Amplitude Fits with 97 98 Data



95% CL sensitivity:

at $\Delta m_s \simeq 7$ ps^{-1} $\Delta m_s \simeq 11.5$ ps^{-1}

Aug 99 Jun 00

Summary:

- 5 - 10% improvements in

  σ_L, $\sigma_{\gamma\beta}$

- better charge reconstr. (vx-alone thrs)
  → 5% better B_s - fraction

- higher purity with relaxed cuts

⇒ dipole sensitivity @ $\Delta m_s = 11.5\ ps^{-1}$

Plan: systematics
(til Osaka) more cross-checks
some unfinished parametrizations
96 Data