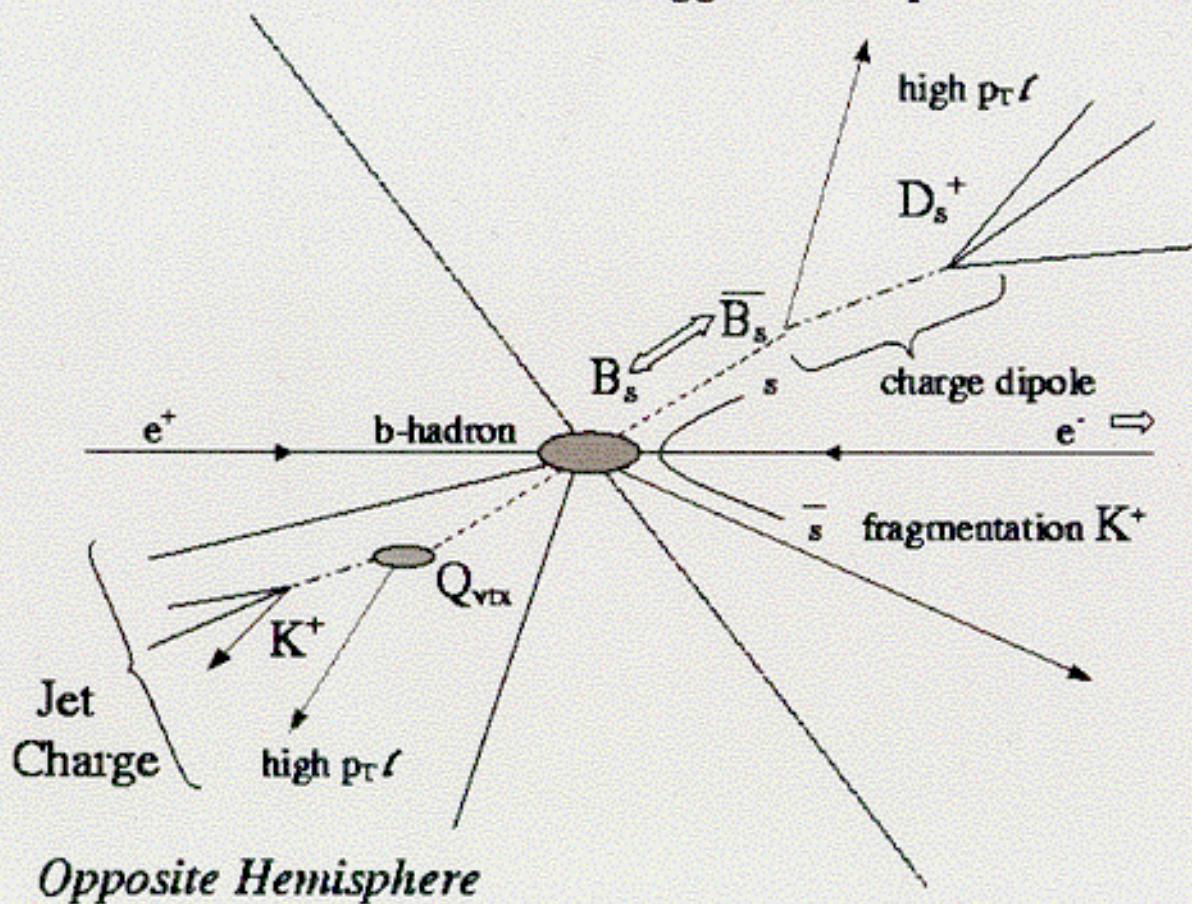


B_s Mixing Initial State Tag & Lepton+Tracks

Thomas Moore
Kirkwood Collaboration Meeting
June 22, 2000

Initial/Final State Tagging

Tagged Hemisphere



Initial State Tags

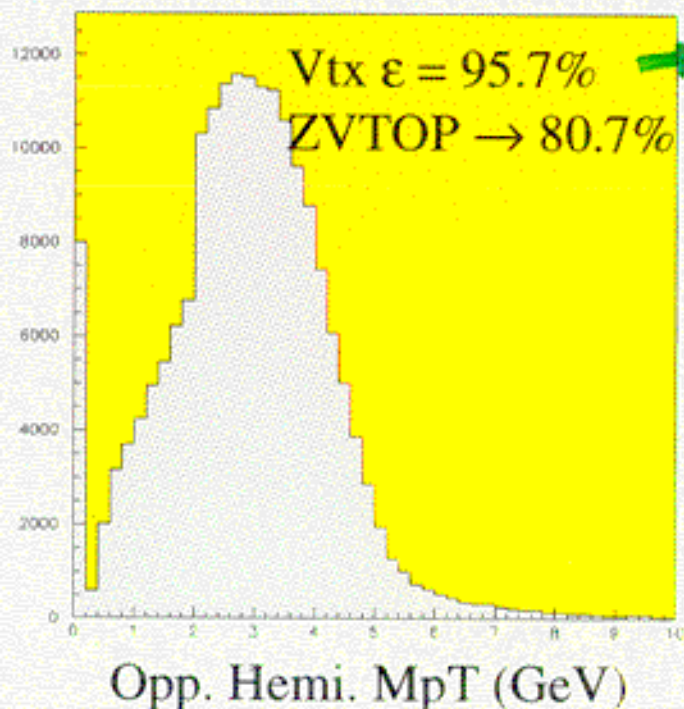
- Polarization
- Jet Charge
- Vertex Charge
- Lepton Charge
- Kaon Charge
- Charge Dipole

Current Status

- Polarization
- Jet Charge

Core components of
I.S. tag. No recent
modifications.

Pol+JetQ $\pi = 74.6\%$

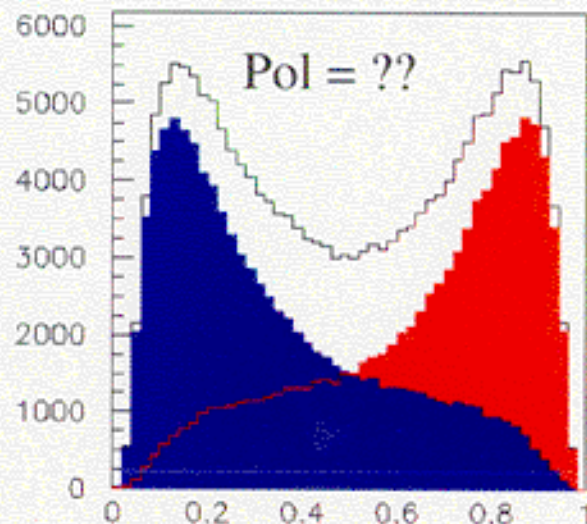


92 % in
Dipole Mode

- Lepton
- Kaon
- $V_{tx}Q$
- Charge Dipole

All updated with
ZV_{TOP}3
 $\Rightarrow$ higher
efficiency

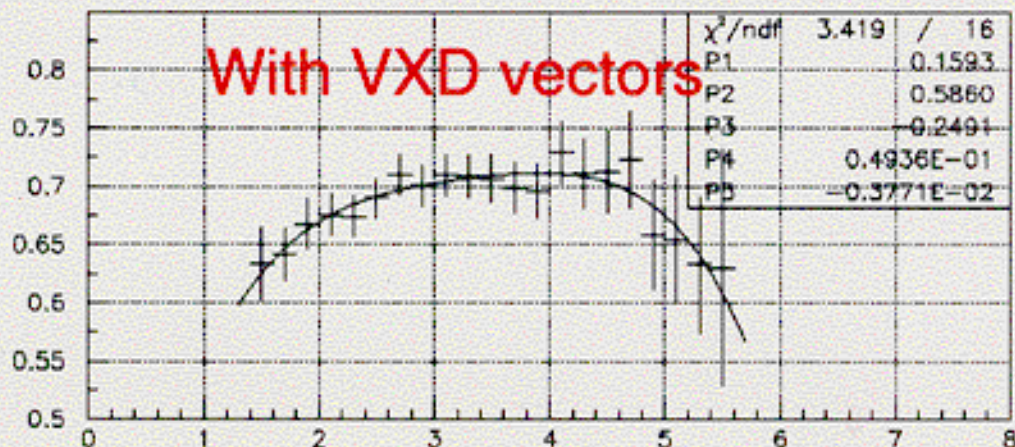
(bb tag: MpT > 2.0 GeV in either hemi.)



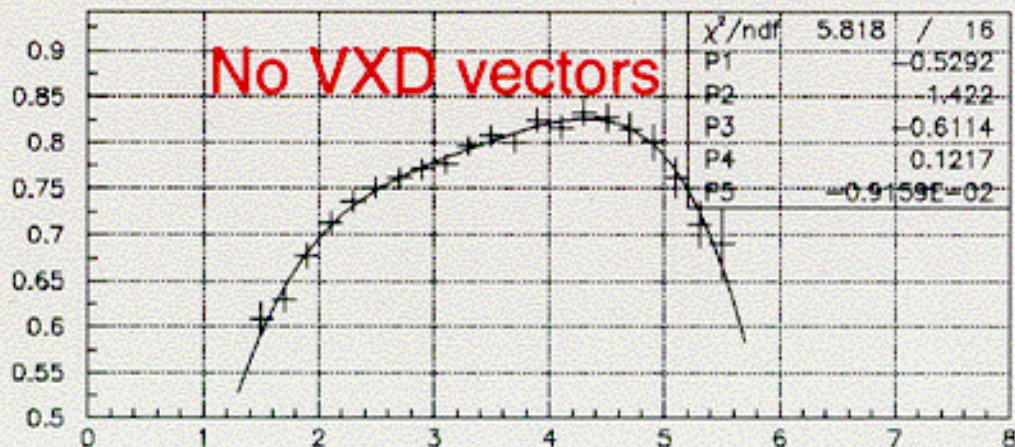
Vertex Charge

- ZVTOP3 vertex in Opposite Hemi.
- Attach secondary tracks by L/D.
- Try to attach VXD vectors
- Require $VtxQ \neq 0$.
- Parametrize charge purity versus p_T added mass.

$$\epsilon = 46.0\%$$
$$\langle \pi \rangle = 75.4\%$$



M_{PT}



M_{PT}

SLD

Charge Dipole

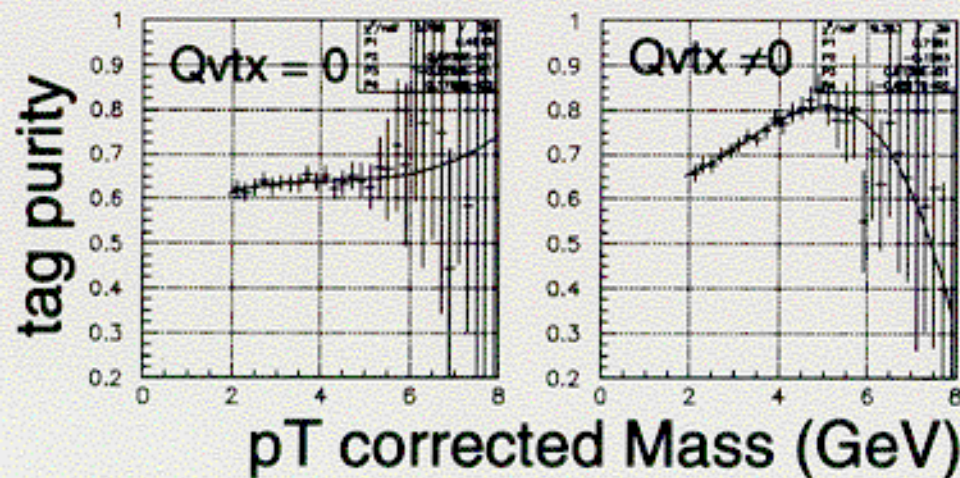
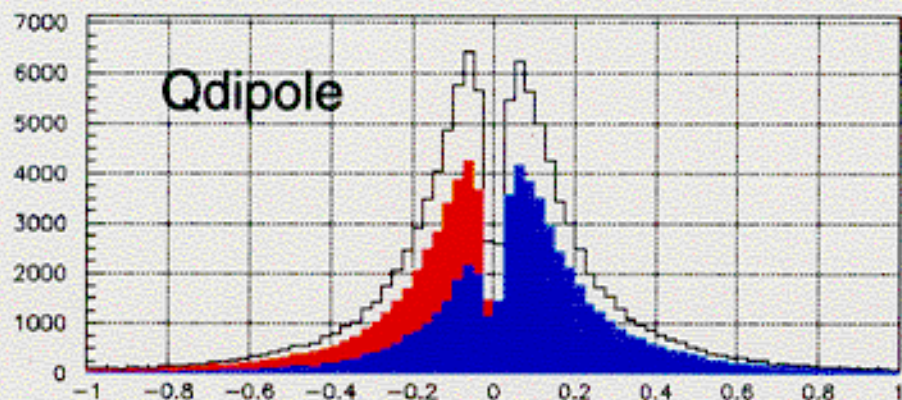
Locate ZVTOP3 “B” and “D” vertices in the Opposite Hemisphere.

Require:

- $M_{pT} > 2.0$ GeV
- $\Delta Q = (Q_B - Q_D) \neq 0$
- B/D vertex separation
 $250 \mu\text{m} < \text{BDdist} < 1.0 \text{ cm}$

$$\text{Qdipole} \equiv \Delta Q \times \text{BDdist}$$

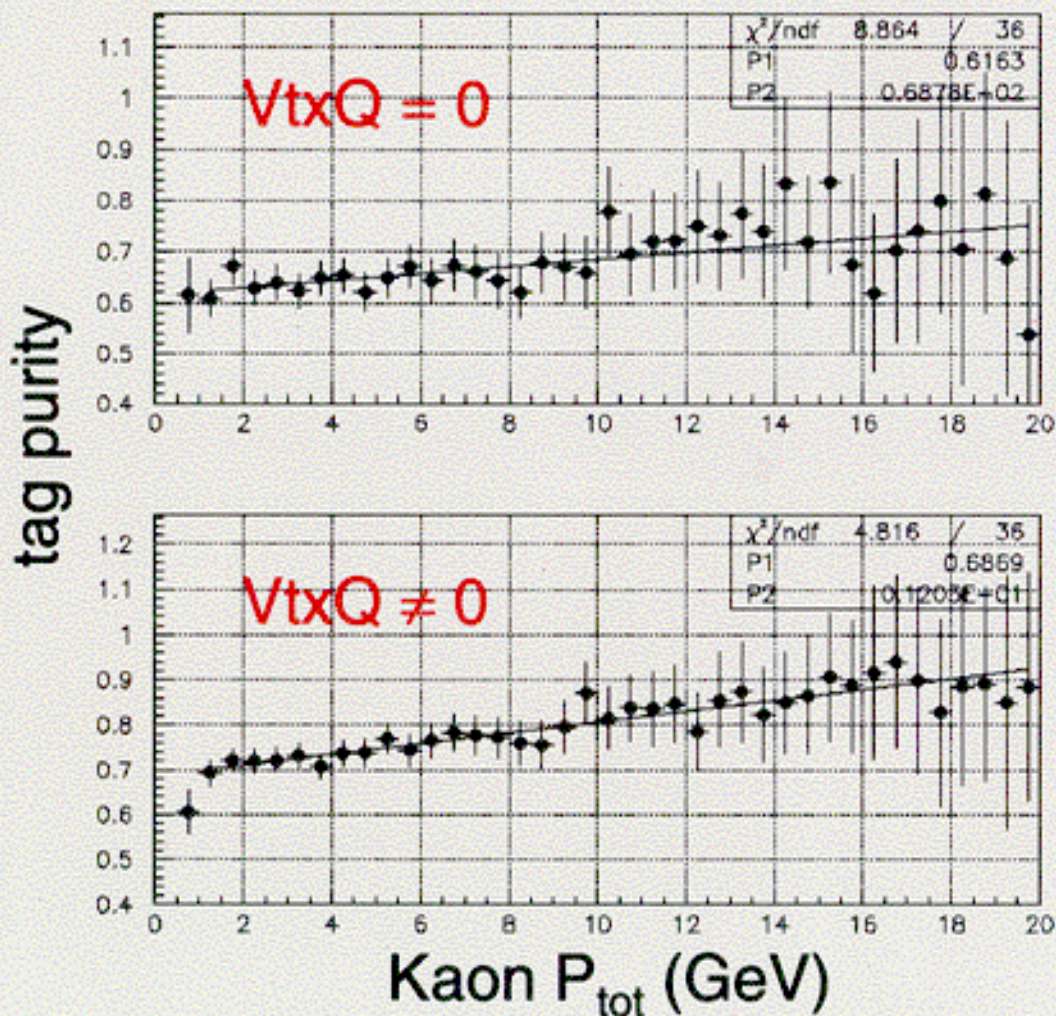
$$\varepsilon = 21.4\%$$
$$\langle \pi \rangle = 69.7\%$$



Decay Kaons

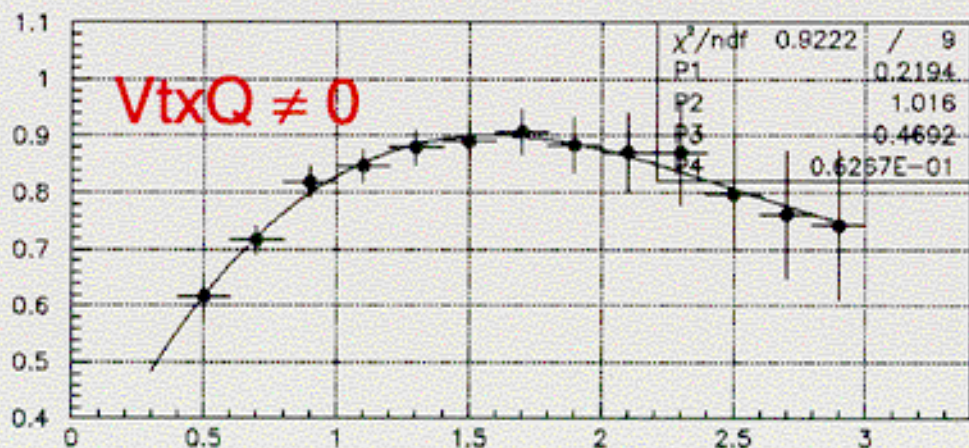
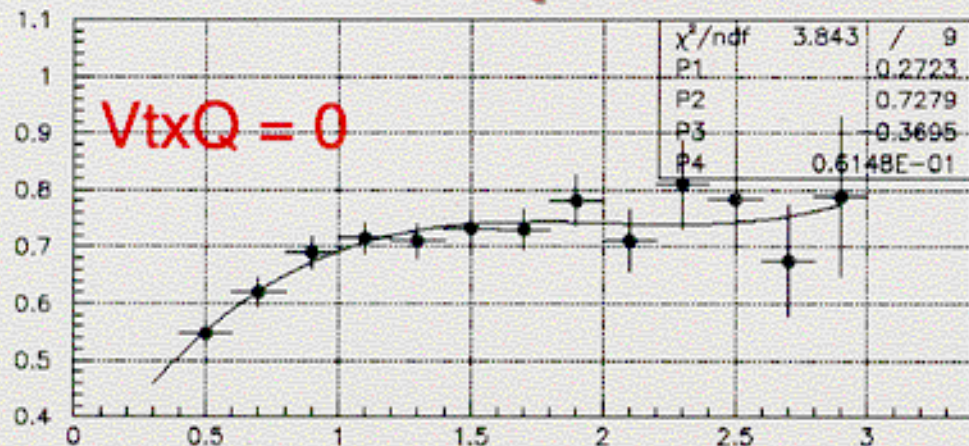
- Select Kaon tracks using CRID info.
- Kaon tracks in ZVTOP3 “B” or “D” vertices.
- Use ΣQ_K if more than 1 Kaon.
- Parametrize vs largest Kaon momentum.

$$\epsilon = 18.0\%$$
$$\langle \pi \rangle = 72.8\%$$



Lepton Charge

Tag purity



lepton p_T (GeV)

- Lepton NN eid > 0.96 or $W_{giveMu} = 1.$ (WK+CRID)
- Lepton attached to ZVTOP3 "B" vertex.
- $0.4 < p_T < 3.0$ GeV
- parametrize tag purity versus p_T for $V_{tx}Q = 0$ and $V_{tx}Q \neq 0$.

$$\epsilon = 12.3\%$$

$$\langle \pi \rangle = 72.3\%$$

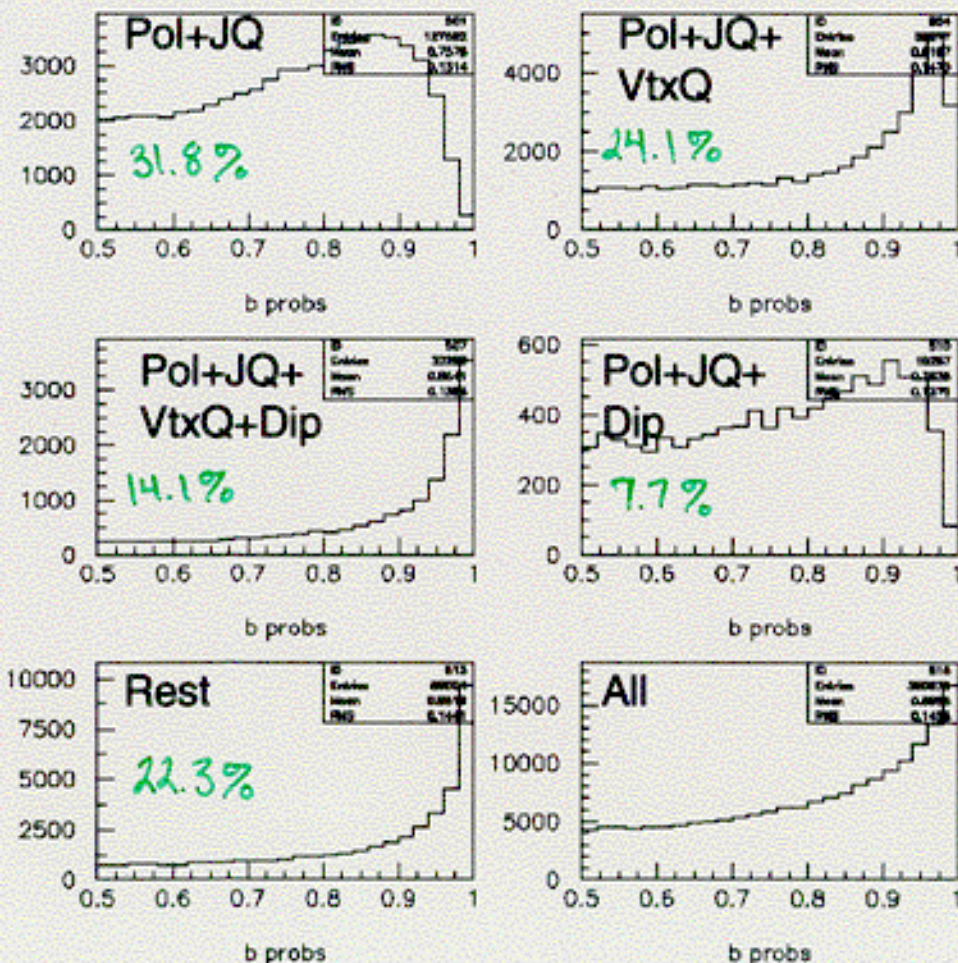
b Quark Probabilities

Combine tags as if they were uncorrelated

$$P_b = \frac{P_1 \cdot P_2 \cdot P_3 \dots}{P_1 \cdot P_2 \dots + (1 - P_1) \cdot (1 - P_2) \dots}$$

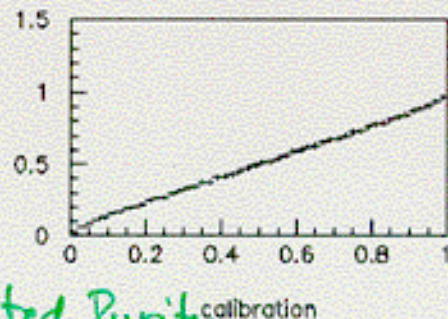
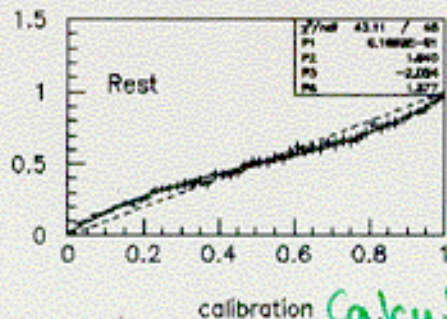
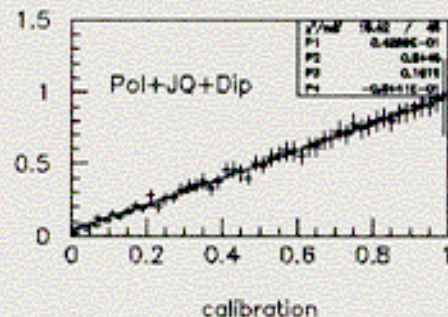
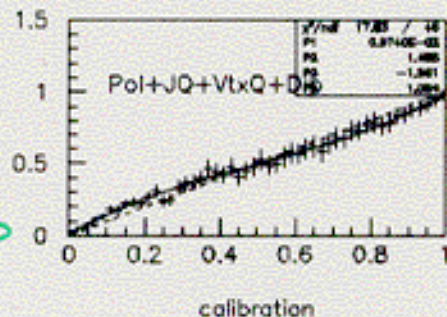
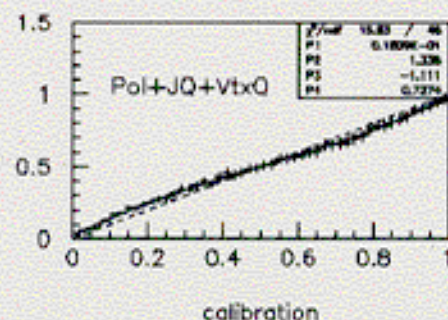
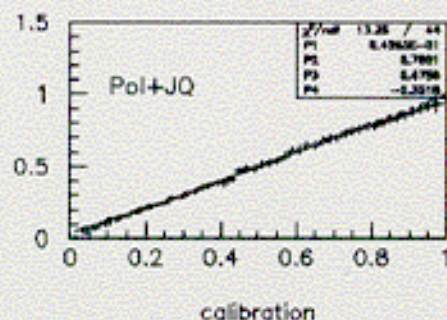
Correct Tag Fractions

- Pol+JQ = 75.7%
- Pol+JQ+VQ = 81.7%
- Pol+JQ+VQ+Dip = 86.4%
- Pol+JQ+Dip = 76.4%
- Rest = 85.2%
- All = 80.1%



Tag Purity Corrections

MC b quark Fraction



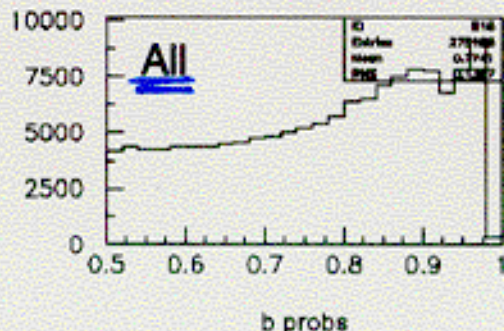
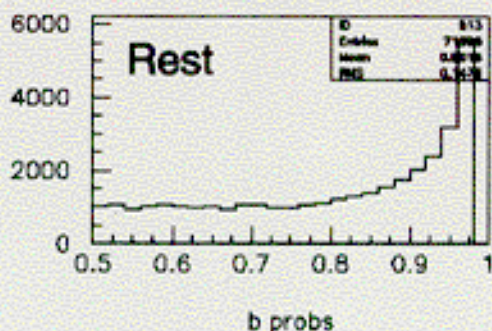
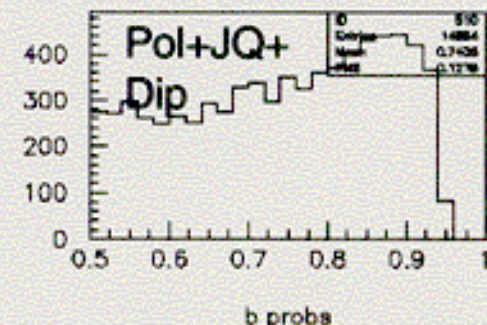
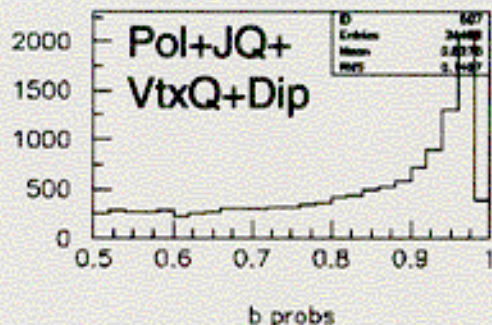
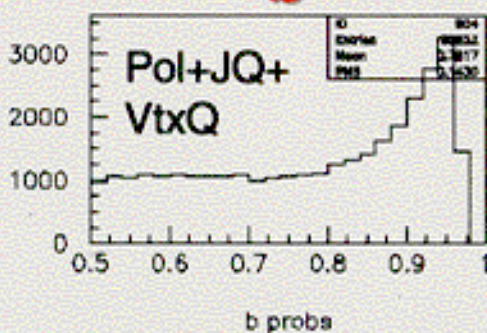
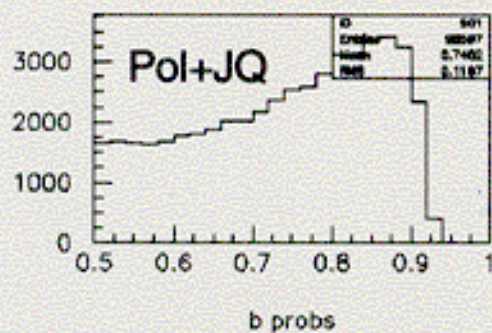
The events are now divided into 5 categories and a correction is calculated for each. The categories with more tags present receive the largest corrections.

Calculated Purity

Corrected P_b Distributions

Correct Tag Fractions

- Pol+JQ = 74.0%
- Pol+JQ+VQ = 78.2%
- Pol+JQ+VQ+Dip = 82.8%
- Pol+JQ+Dip = 74.4%
- Rest = 80.2%
- All = 77.4%



Lepton+Tracks Status

Current Cuts:

- Lepton p_T to Jet Axis > 0.8 GeV/c.
- ZVTOP3 $M_{pT} > 2.0$ GeV in either hemisphere.
- VtxQ (including VXD vectors) = 0

⇒ 3276 events in the 97-98 R17 data.

Lepton correct tag = 84%

B_s fraction = 17%

bb fraction = 96.4%

Analysis has been reparametrized with 97-98 bb and qq MC.

VXD Vectors

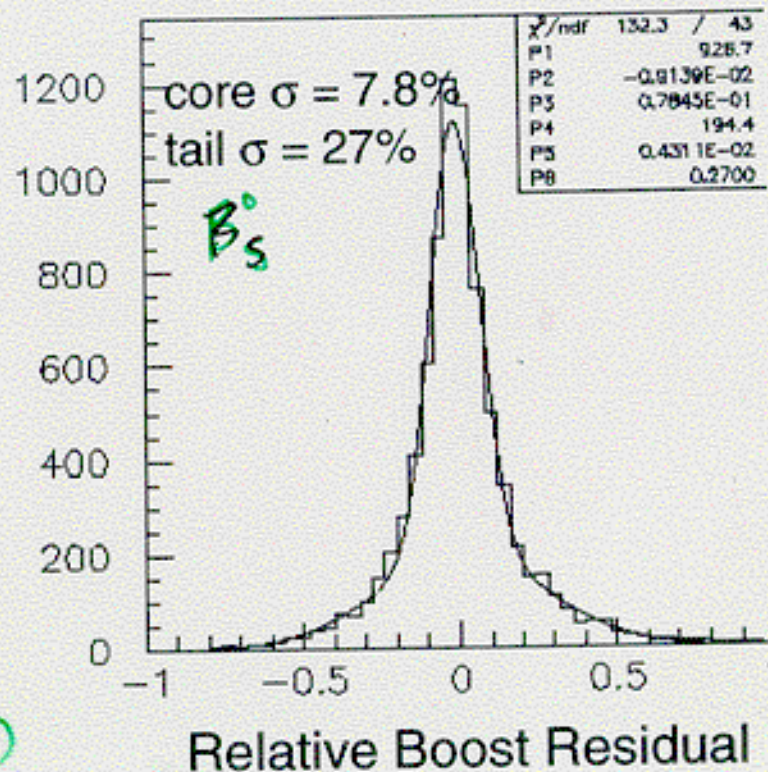
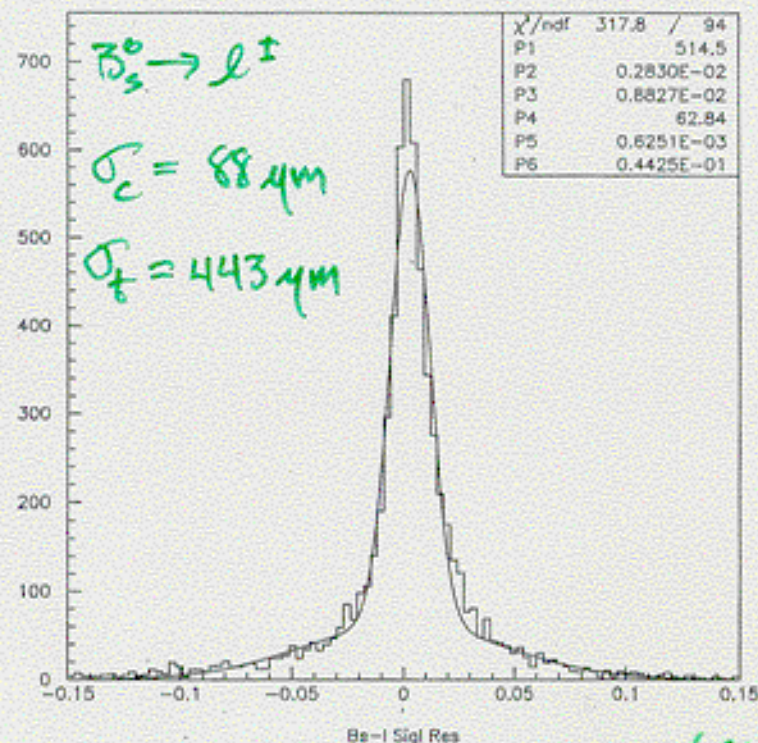
VXD vectors have been included in the analysis :

- Call BBGTVXO to add VXD vectors to ZXTRKS.
- Call BBVLINK try to re-link vectors to CDC tracks.
- Use new BLATTVXO routine to attach vectors to existing secondary vertex. If attached, the vertex is used as an additional point to improve charge determination.

^{9.6}
Xx% of B vertices have at least one VXD vector attached
The efficiency to tag neutral vertices increases by xx%
Bs fraction in neutral sample increases xx%
^{2.9}
^{0.5}

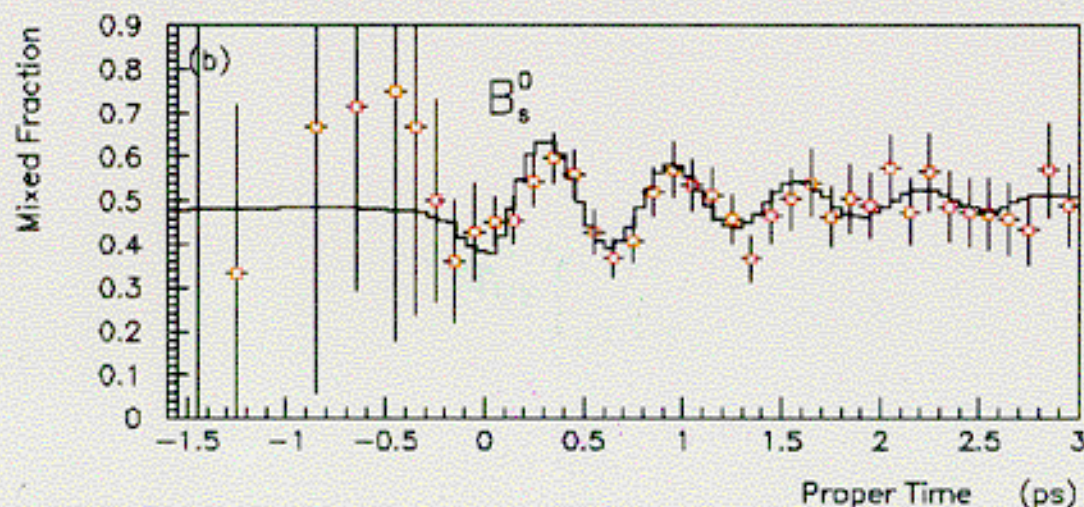
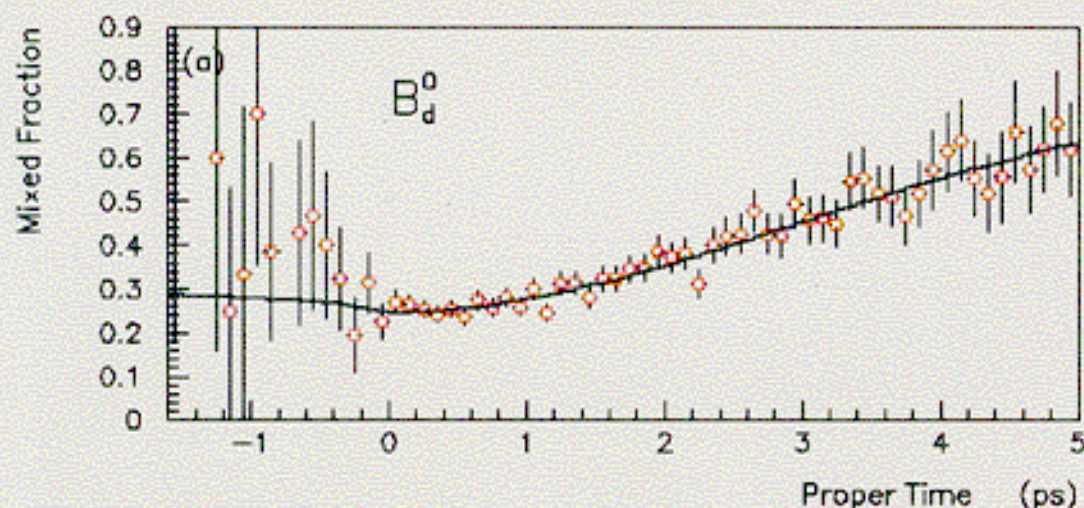
- VXD vectors are used for charge information only.
- If vector is relinked to CDC track, track may be added to boost.

Proper Time Resolution



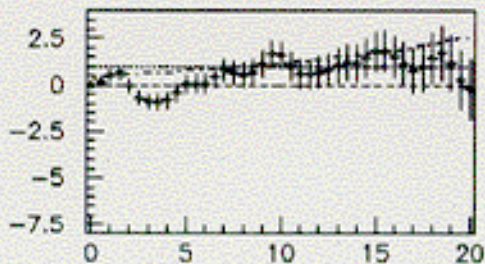
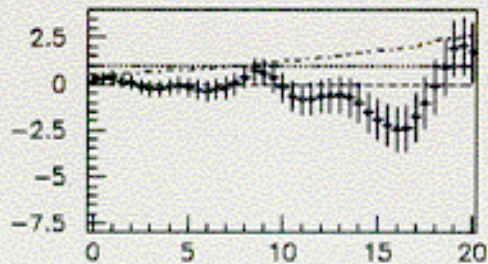
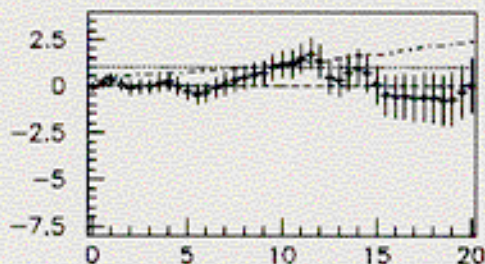
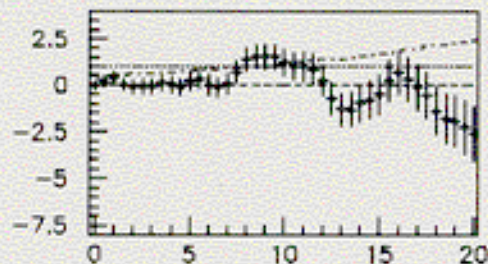
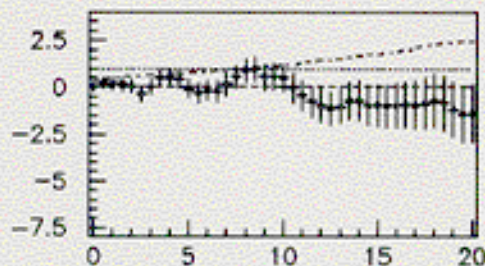
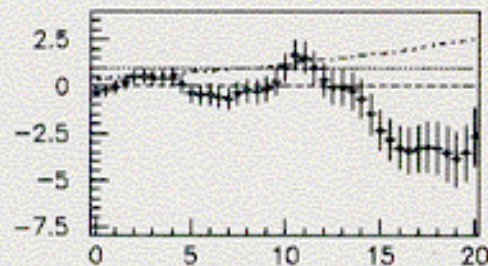
- Proper time Resolution is estimated event-by-event based on σ_{vtx} and E_B^+

MC vs Likelihood Calculations



$$\Delta m_d = 0.48 \text{ ps}^{-1}$$
$$\Delta m_s = 10.0 \text{ ps}^{-1}$$

MC Amplitude Fits

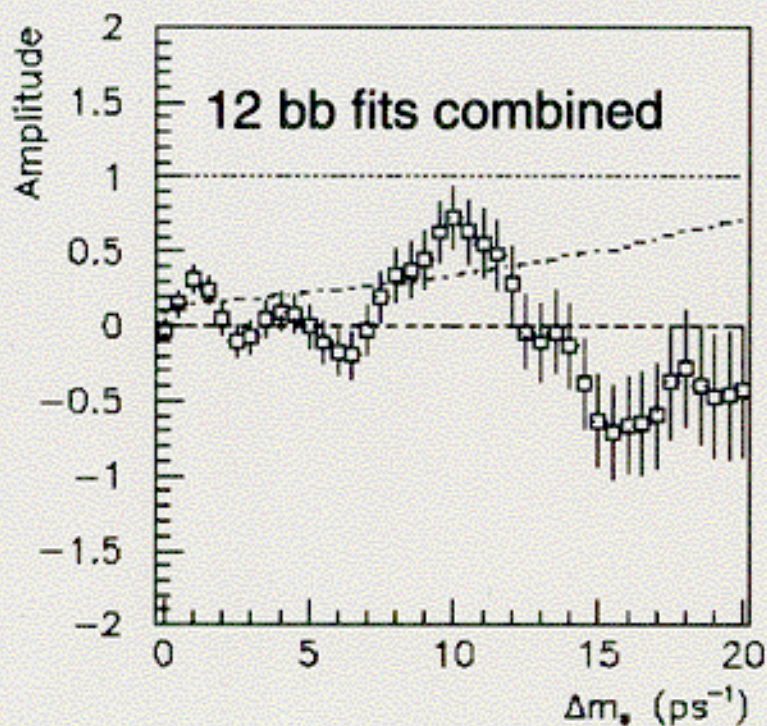


Δm_s (ps⁻¹)

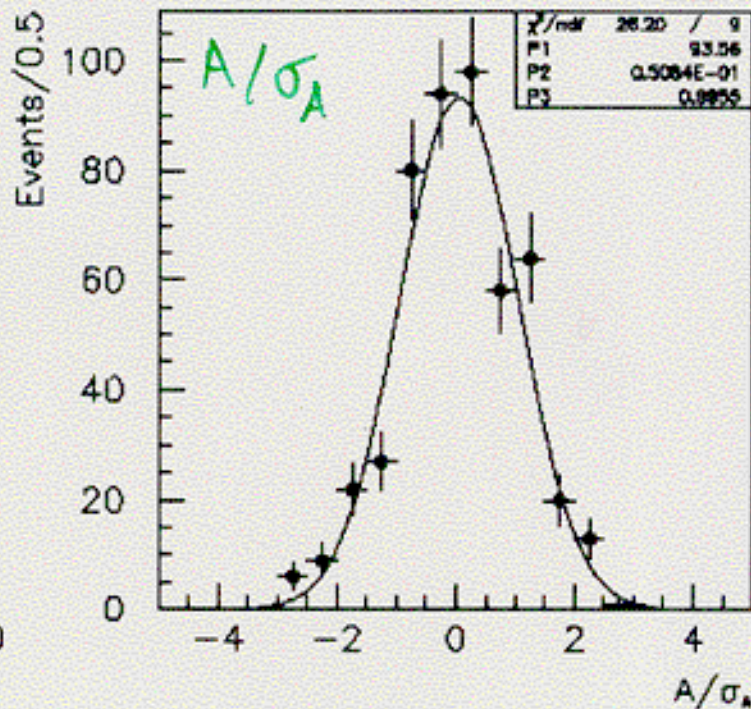
97-98 bb MC divided into 12 ~ data sized samples. 6 examples shown here.

$$\text{MC } \Delta m_s = 10.0 \text{ ps}^{-1}$$

MC Amplitude Fit



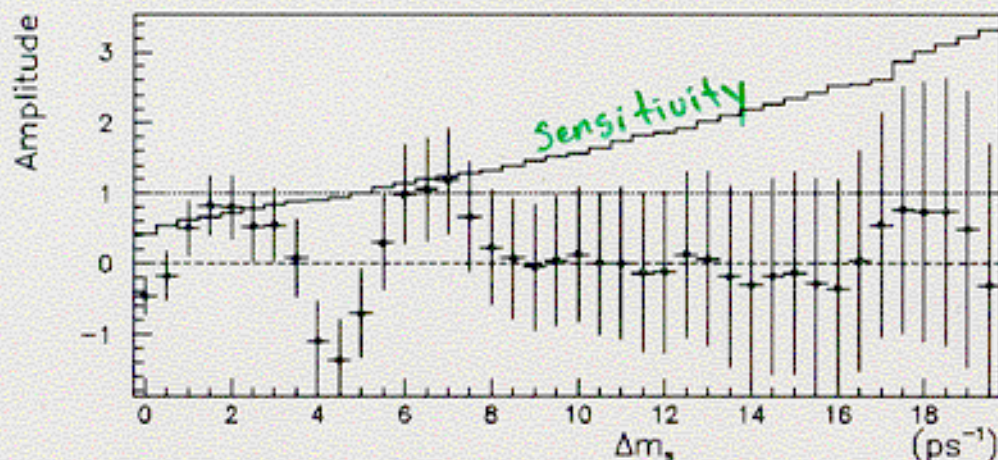
MC $\Delta m_s = 10.0 \text{ ps}^{-1}$



$\sigma = 0.996$

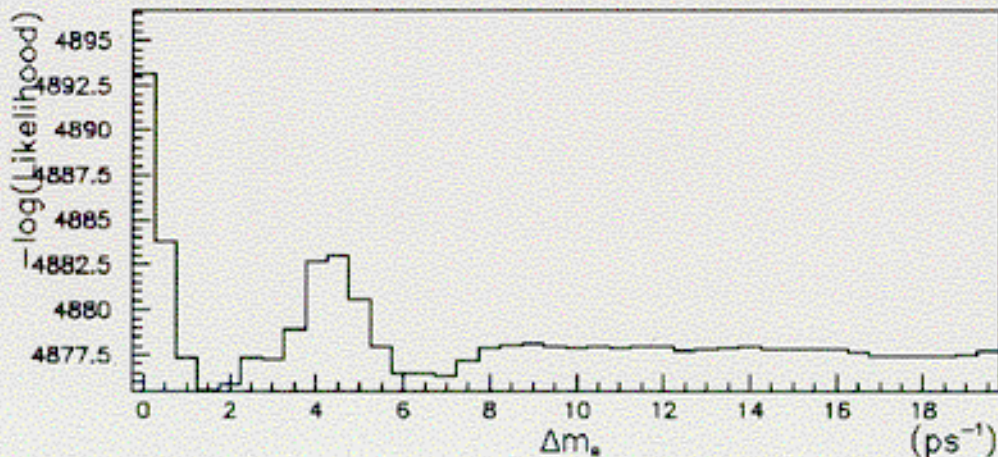
mean = 0.051

Data Amplitude Fit



97-98 R17 Data
 $\Rightarrow$ 3276 events
($V_{txQ} = 0$)

Sensitivity $\approx 5.0 \text{ ps}^{-1}$
(statistical only)



★ B_s prod frac = 10.8%
(10.0%)

★ $\tau(B_s) = 1.54 \text{ ps}$
(1.46 ps)

Analysis Overlaps

Lepton+Tracks is now required to remove events from

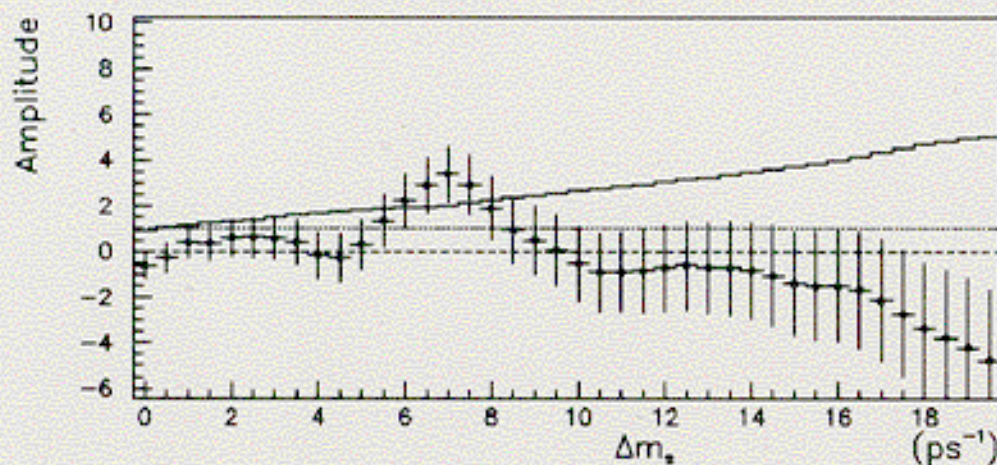
- Exclusive $D_s \rightarrow$ 17 events
 - Lepton+D $\rightarrow$ 1219 events
 - Dipole $\rightarrow$ 270 events
- } total = **46%** of Lepton+Tracks

There are other effects as well:

- B_s fraction drops from 16.9% to 14.4%
- B_s correct tag drops from 86.4% to 72.7%
($B_s \rightarrow c \rightarrow \ell$ fraction increases)
- overlap tends to be at longer proper time
- effect on proper time resolution is not yet determined

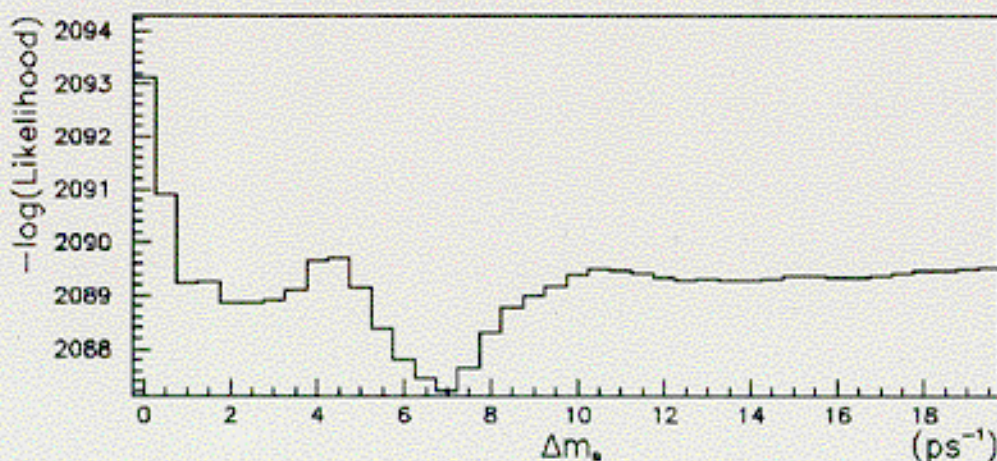
Data Amplitude Fit

Overlap Removed



97-98 R17 Data
⇒ 1770 events

Statistical errors
only.



*Including charged
vertices may improve
sensitivity.*

To Do List

- Evaluate affects of overlap removal on proper time Resolution
- update for latest $f_{B_s^0}$ and $\mathcal{Z}_{B_s^0}$ measurements
- Measure B_d^0 mixing in the data
- Data/MC comparisons and checks
- Re-evaluate Systematics
- Possibly include charged vertices
- 96 Data