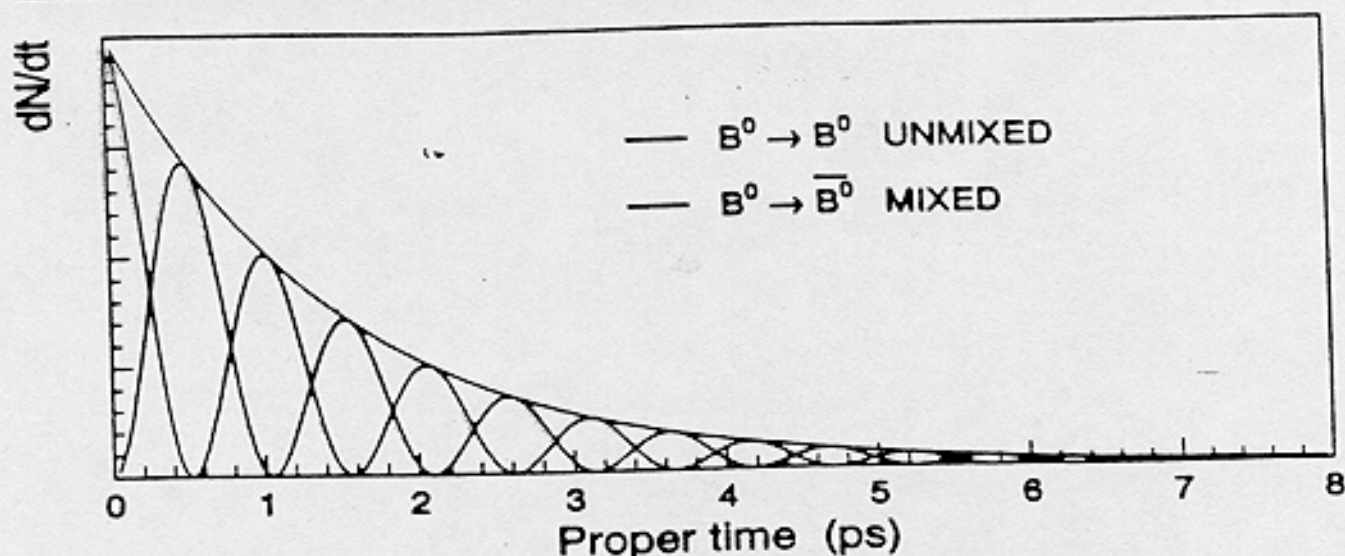


STEPHANE'S TALK

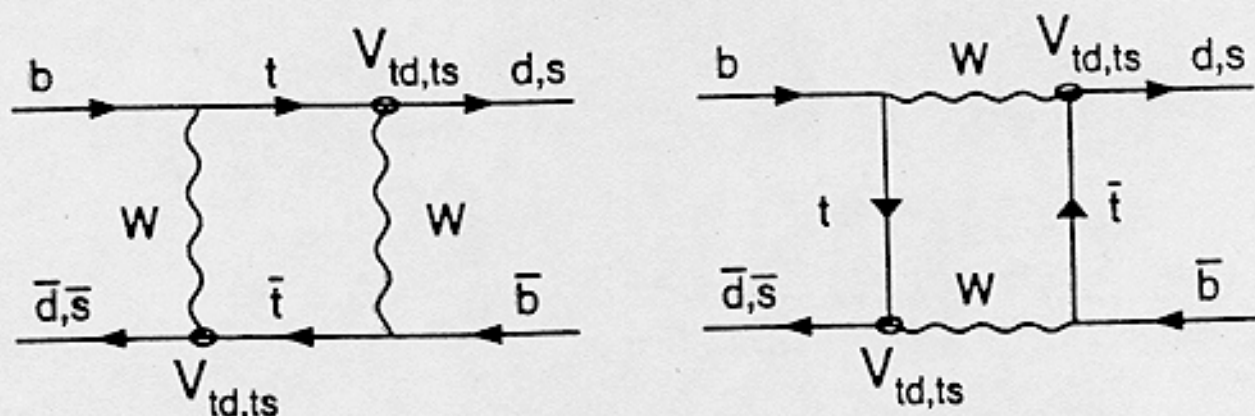
KIRKWOOD
6/22/00
JAJ

B^0_s MIXING

- B^0_s oscillates to $\bar{B}^0_s$ at frequency Δm_s



- Second order weak interaction in Standard Model



$\approx 20\%$ ERROR

$$\Delta m_d = \frac{G_F^2 m_b m_t^2 F}{6\pi^2} \left(\frac{m_t^2}{m_W^2} \right) B_{Bd} f_{Bd}^2 \eta_{QCD} |V_{tb}^* V_{td}|^2$$

- Measuring Δm_s and Δm_d allows the most accurate determination of $|V_{td}|$. Most uncertainties cancel in ratio

$\sim 5\%$ ERROR

$$\frac{\Delta m_s}{\Delta m_d} = \frac{\eta_{QCD} M_{Bs} (f_{Bs}^2 B_{Bs})}{\eta_{QCD} M_{Bd} (f_{Bd}^2 B_{Bd})} \cdot \left| \frac{V_{ts}}{V_{td}} \right|^2 = (1.15 \pm 0.05)^2 \cdot \left| \frac{V_{ts}}{V_{td}} \right|^2 \quad (|V_{ts}| = |V_{cb}|)$$

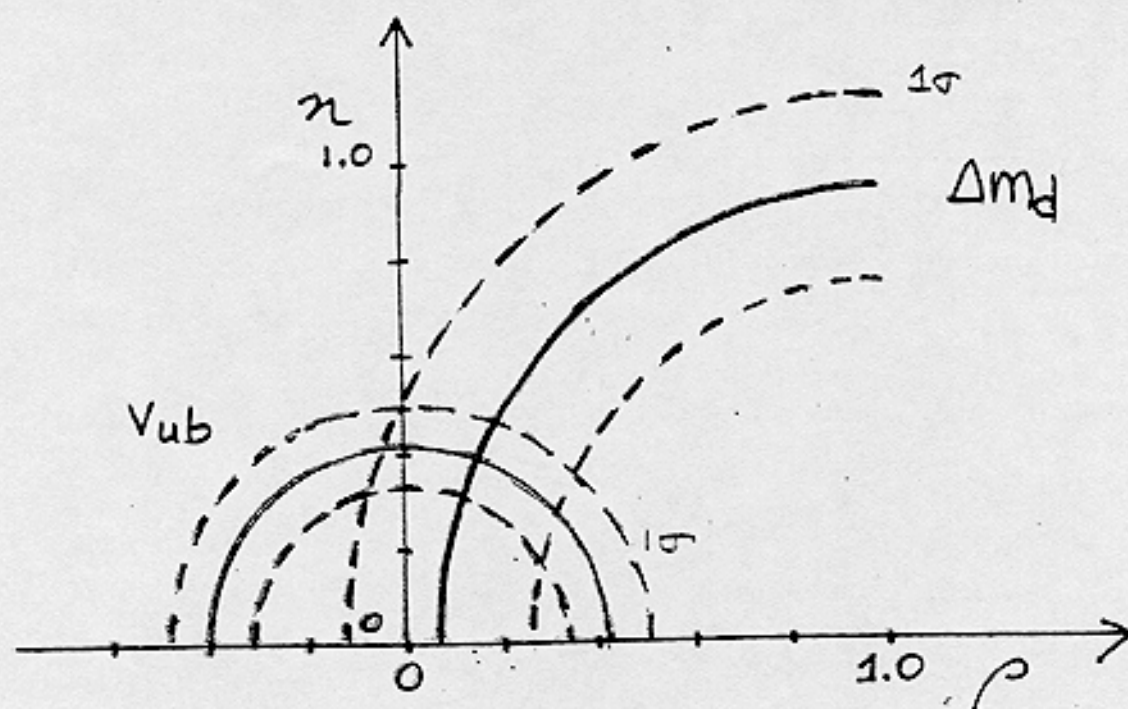
KOBAYASHI & MASKAWA EXPLAINED ~~CP~~ IN TERMS OF THE PHASE η OF THE QUARK MIXING MATRIX

$$\begin{pmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{pmatrix} = \begin{pmatrix} 1 - \lambda^2/2 & \lambda & A\lambda^3(\rho - i\eta) \\ -\lambda & 1 - \lambda^2/2 & A\lambda^2 \\ A\lambda^3(1 - \rho - i\eta) & -A\lambda^2 & 1 \end{pmatrix}$$

TO TEST THIS EXPLANATION:

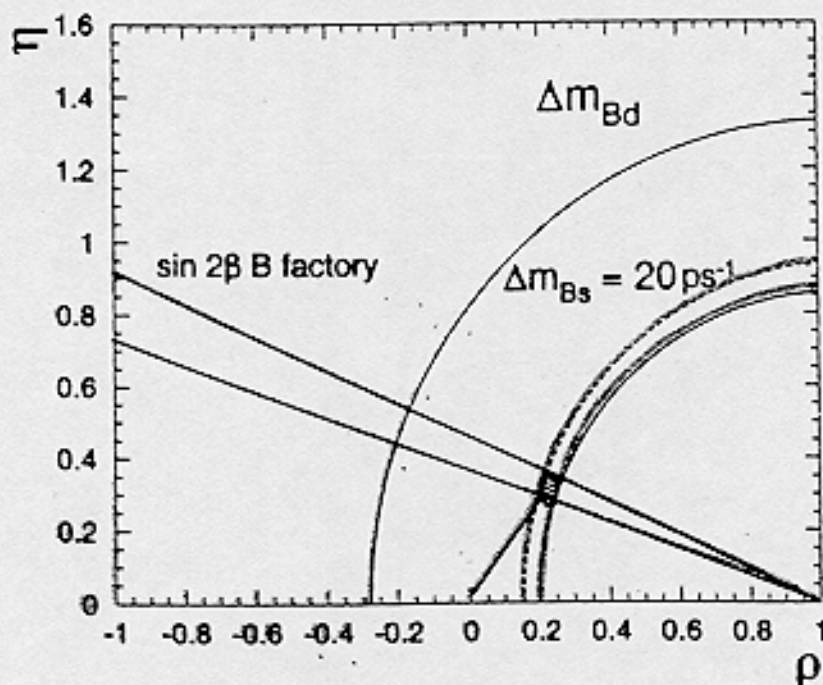
- DETERMINE ρ, η IN PROCESSES NOT INVOLVING ~~CP~~ (e.g. FIND $|V_{td}|$ AND $|V_{bu}|$)
- IS ρ, η CONSISTENT WITH ϵ_K AND $\sin 2\beta$?

THIS TEST IS NOT YET CONCLUSIVE



IMPORTANCE OF MEASURING Δm_s

1. CONFIRM KM'S EXPLANATION OF ~~CP~~.
2. DETERMINE $|V_{td}|$ INDEPENDENT OF NEW PHYSICS CONTRIBUTIONS
3. ASSUMING KM, PRECISELY DETERMINE ρ, η IN CONJUNCTION WITH $\sin 2\beta$ (MINIMAL THEORETICAL UNCERTAINTY)



Assuming $\sin 2\beta = 0.70 \pm 0.06$

EXPECTATIONS FOR Δm_s

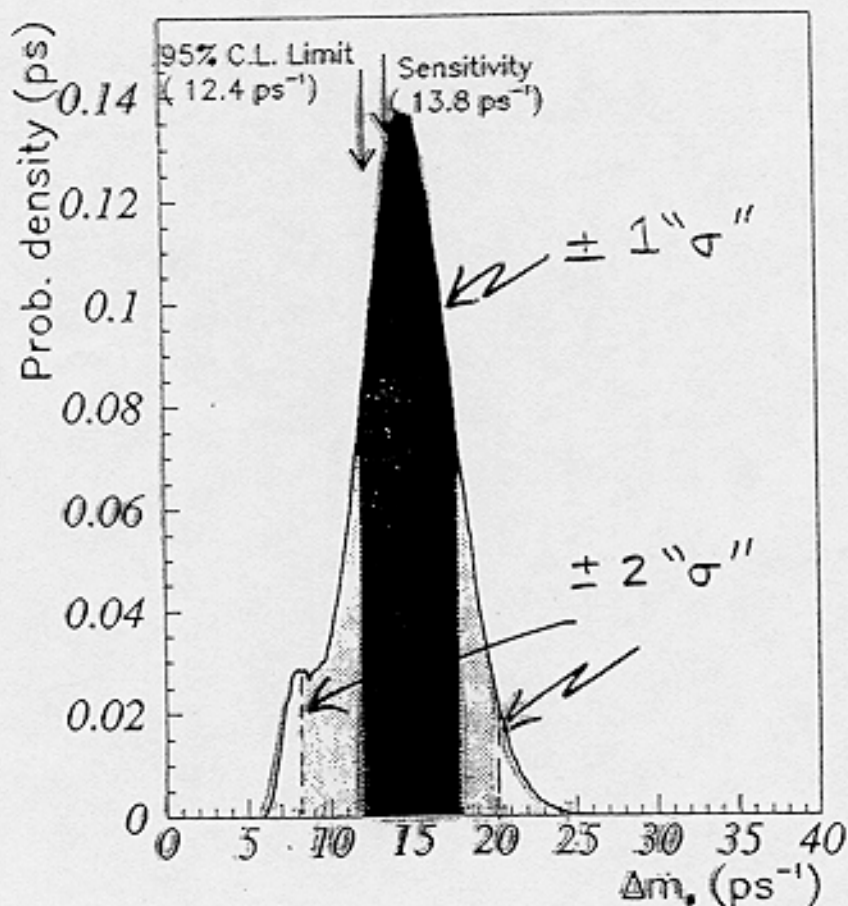
1) $\Delta m_d \Rightarrow |V_{td}| \Rightarrow \Delta m_s$

CURRENT THEORETICAL
UNCERTAINTY IN $|V_{td}|$ LEADS TO

$$\Delta m_s = 14.3^{+9.5}_{-2.9} \text{ ps}^{-1}$$

2) ASSUME KM EXPLANATION. USE

$$\epsilon_K, |V_{ub}|, \Delta m_d \Rightarrow \Delta m_s$$



EXPECTATIONS FOR Δm_s

$$3) \Delta \Gamma_s \Rightarrow \Delta m_s$$

2 MASS EIGENSTATES HAVE
DIFFERENT LIFETIMES

$$m_H = \bar{m} + \Delta m_s / 2 \quad \Gamma_H \quad CP \approx -$$

$$m_L = \bar{m} - \Delta m_s / 2 \quad \Gamma_L \quad CP \approx +$$

SINCE $B_s^0 \rightarrow c \bar{s} \bar{c} s \approx CP +$,

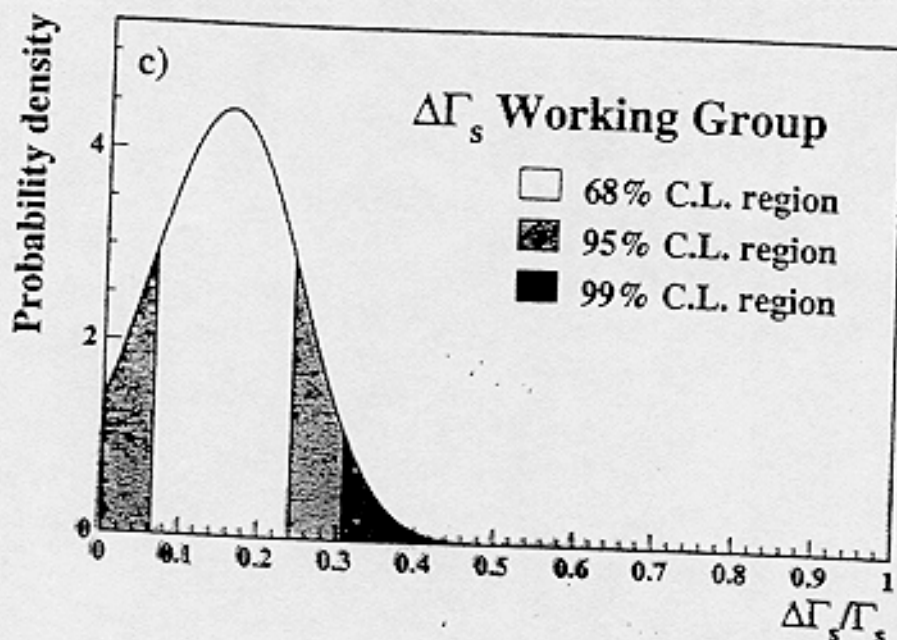
$$\Gamma_L > \Gamma_H$$

ROUGHLY

$$\frac{\Delta \Gamma_s}{\Delta m_s} \approx \frac{3}{2} \pi \frac{m_b^2}{m_t^2}$$

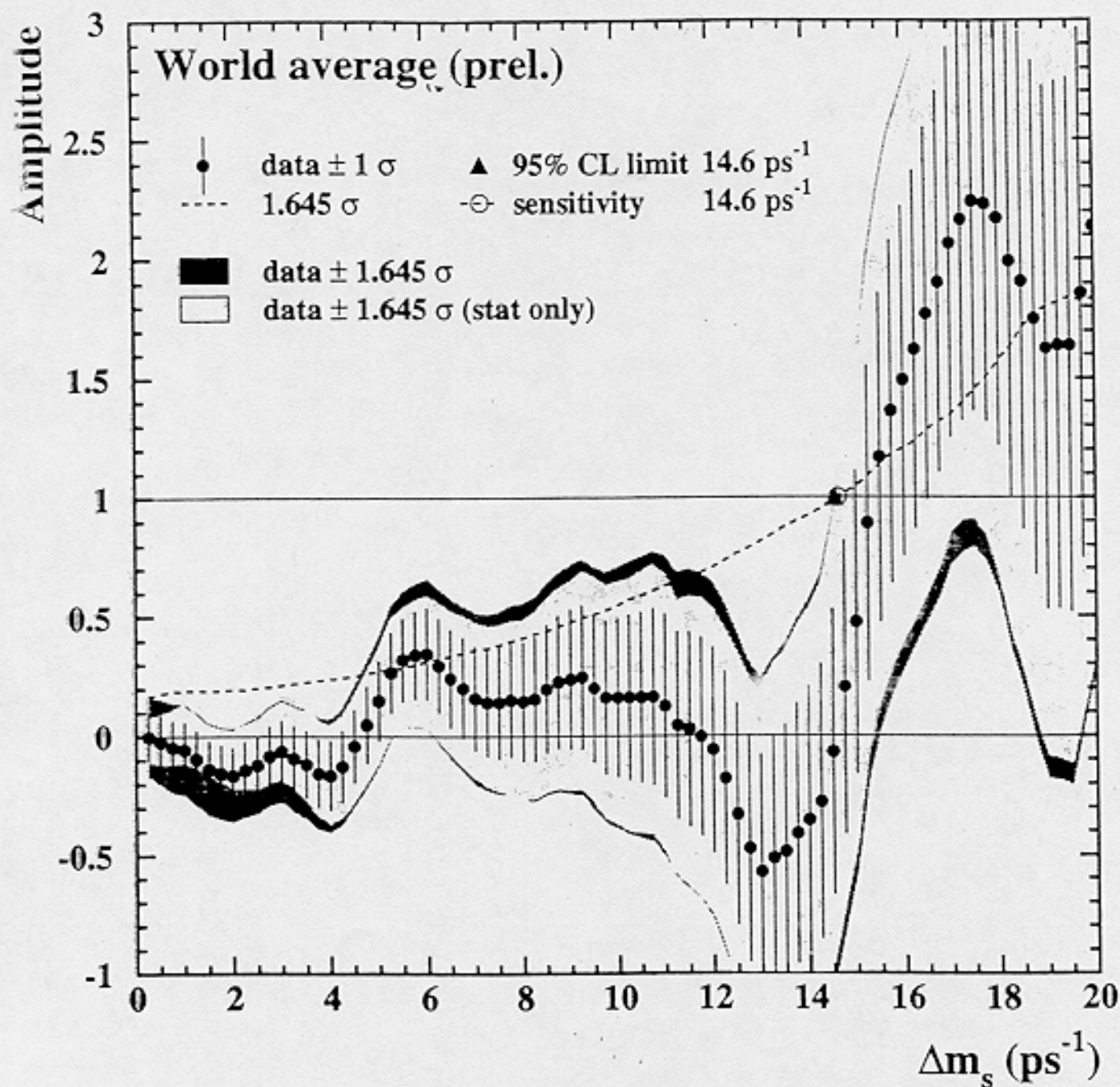
(LEP)

$$\frac{\Delta \Gamma_s}{\Gamma_s} = 0.16 \pm 0.08 \quad (\Delta m_s \sim 60 \pm 30 \text{ fs}^{-1})$$



NOT YET A SIGNIFICANT CONSTRAINT

PRESENT STATUS OF Δm_s MEASUREMENTS



• $\Delta m_s > 14.6 \text{ ps}^{-1}$ (95% CL)

• STRUCTURE AT $\Delta m_s \sim 17 \text{ ps}^{-1}$???

• INSUFFICIENT SENSITIVITY

• MUST IMPROVE SENSITIVITY

What's new since Aug.99?

Development of new or improved tools

- Vx-alone tracking (tracking group) TOSHI, AARON, LEON, MOHAN
improve charge reconstruction $\Rightarrow$ increase Bs and dipole tag purities
- Boost reconstruction (Dan Dong)
combine LAC-based and track-based algorithms
 $\Rightarrow$ improve resolution
- Initial state tag (Thomas Moore)
optimize for R16 & add new tags (ZVTOP3 dipole, same-side tags)
 $\Rightarrow$ improve tag purity
- Track selection (Dave Jackson, Tom Wright) JULIA
loosen quality cuts $\Rightarrow$ improve efficiency and dipole tag purity
- Kaon ID (Jodi Wittlin)
optimize for VXD3 (R16) & calibrate $\pi \rightarrow$ "K" misID and $K \rightarrow$ "K"
efficiency
- Kalman method vertexing package (Tracy Usher)
general package, can vertex resultant B and D vtx "tracks"
- RECON 17 FOR 96 DATA SU DONG, MOHAN

What's new since Aug.99?

Development of individual analyses

- Ds+tracks (Cheng-Ju Lin)
Ds selection with NN $\Rightarrow$ increased efficiency
Bs track selection and vertexing $\Rightarrow$ increased purity?
- Charge dipole (Julia Thom, Stéphane Willocq)
looser track selection $\Rightarrow$ slightly higher Bs and dipole purities
"D" vtx track used in B vertex fit $\Rightarrow$ decreased σ_L
- Lepton+D (Tracy Usher, Homer Neal)
Kalman vertexing
NN track selection $\Rightarrow$ increased efficiency and Bs purity
- Lepton+tracks (Thomas Moore)
incorporate ZVTOP3 information $\Rightarrow$ increased overall sensitivity?
- Lepton+kaon orphan analysis...

ANALYSIS OVERVIEW

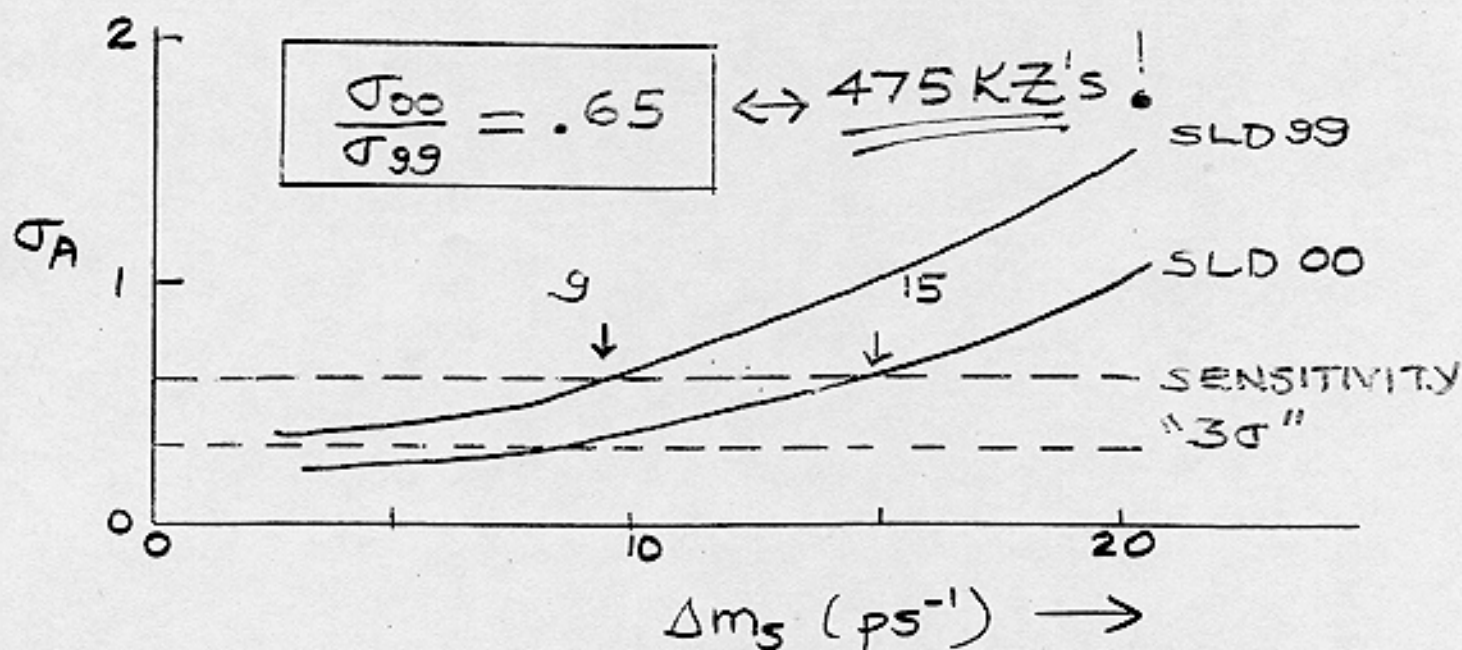
- ADDED $D_S + \text{TRACKS}$ ANALYSIS
- STILL NO μ -LEPTON + K ANALYSIS
- REMOVED OVERLAP EVENTS

"FOOD CHAIN"

$D_S + \text{TRACKS}$ μ -LEPTON + D μ -LEPTON + TRACKS

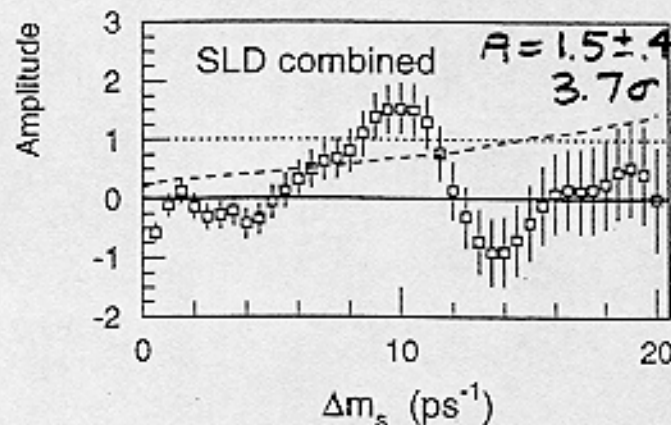
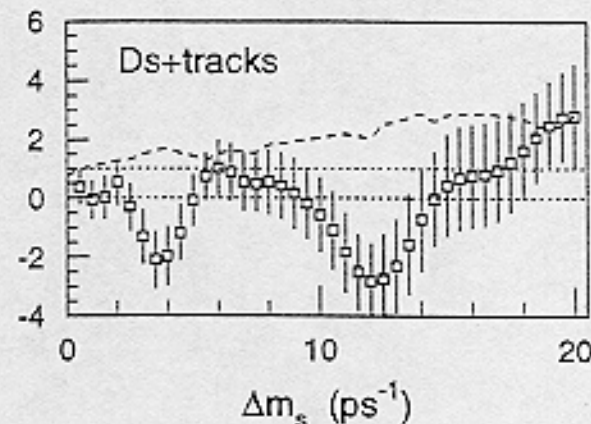
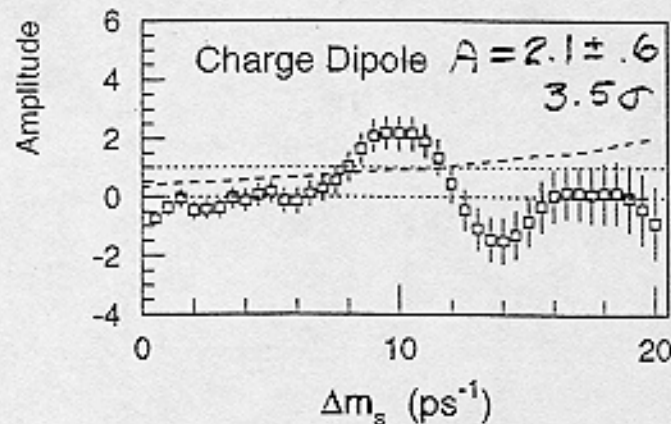
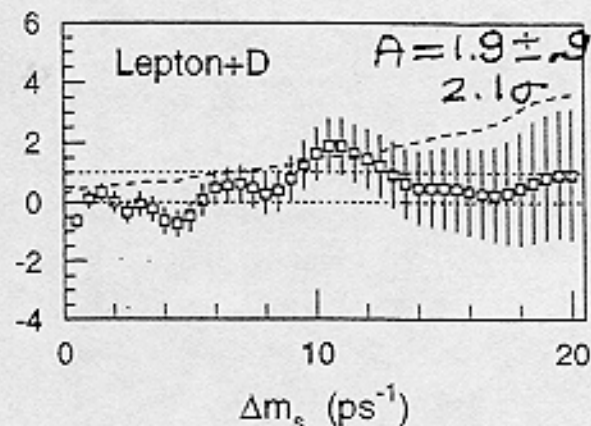
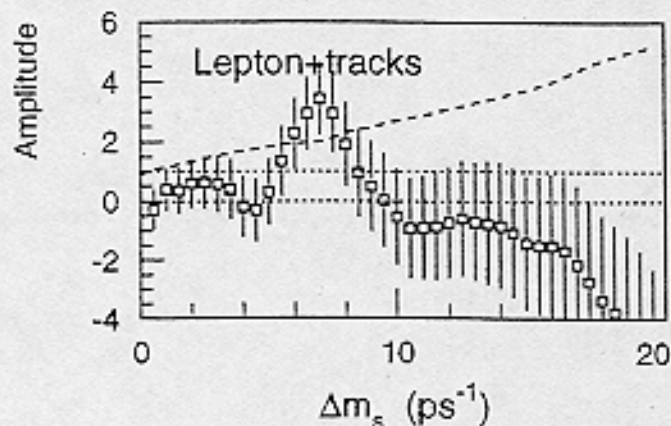
- ASSUME $f_{B_S} = 10.0\%$ (10.8% LAST YEAR)
- ASSUME $\tau_{B_S} = 1.46 \text{ ps}$ (1.57 ps LAST YEAR)
- NO '96 DATA YET. HOPEFULLY SOON.

ERRORS REDUCED SIGNIFICANTLY!

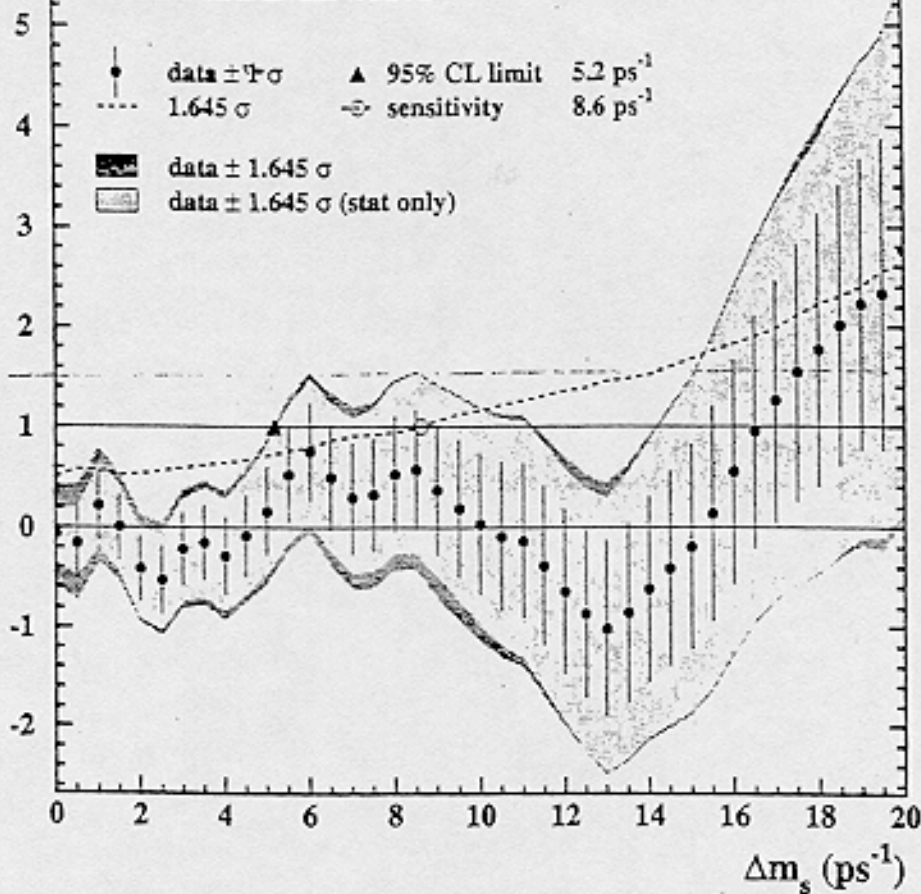
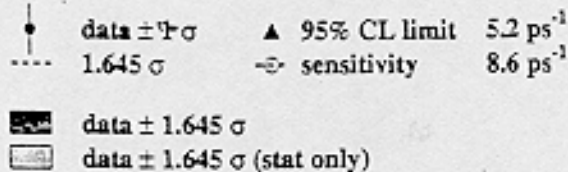


ANALYSIS OVERVIEW

		<u>#EVENTS</u>	<u>$S(p\bar{s}^{-1})$</u>	<u>$\sigma_A(10 p\bar{s}^{-1})$</u>	<u>$\sigma_A(15 p\bar{s}^{-1})$</u>
L+D	99	2 009	3.5	1.18	1.63
	00	3095	6.8	.85	1.30
L+Track	99	7 149	0.1	1.68	2.63
	00	1770	1.0	1.50	2.2
DIPOLE	99	7547	5.4	0.87	1.43
	00	7752	11.5	0.60	.90
Ds + Tracks	99	200	.5	1.9	2.4
	00	325	.7	1.3	1.6
Σ 99			8.6	.65	1.01
Σ 00			~15	.44	.64

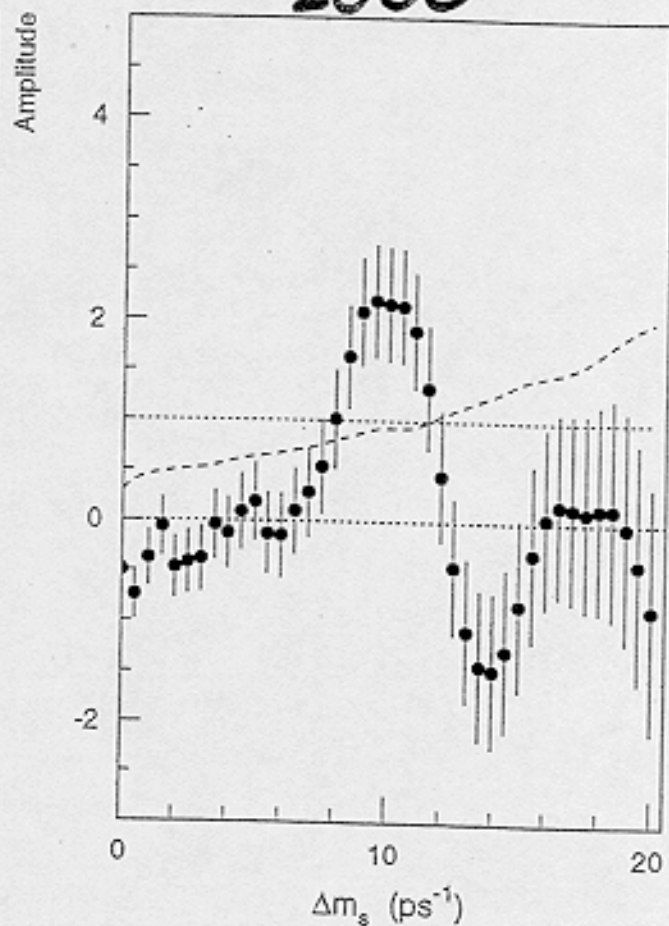
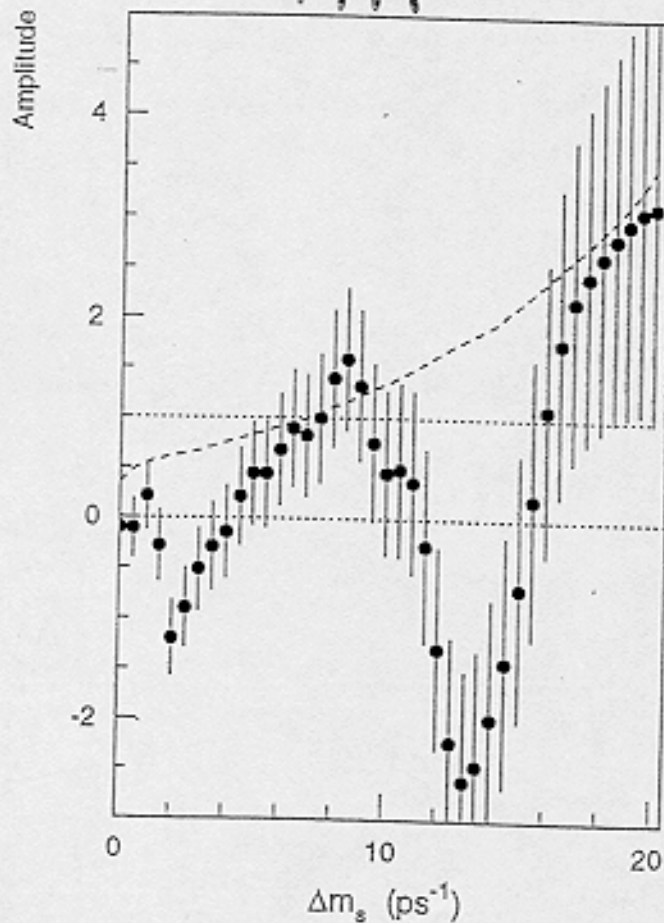


SLD PRELIMINARY

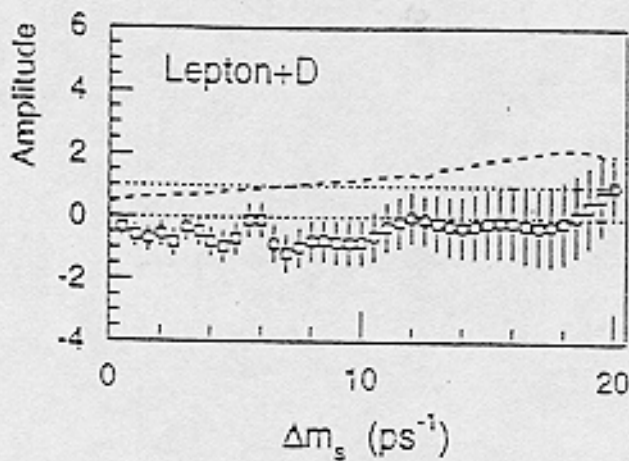


1999

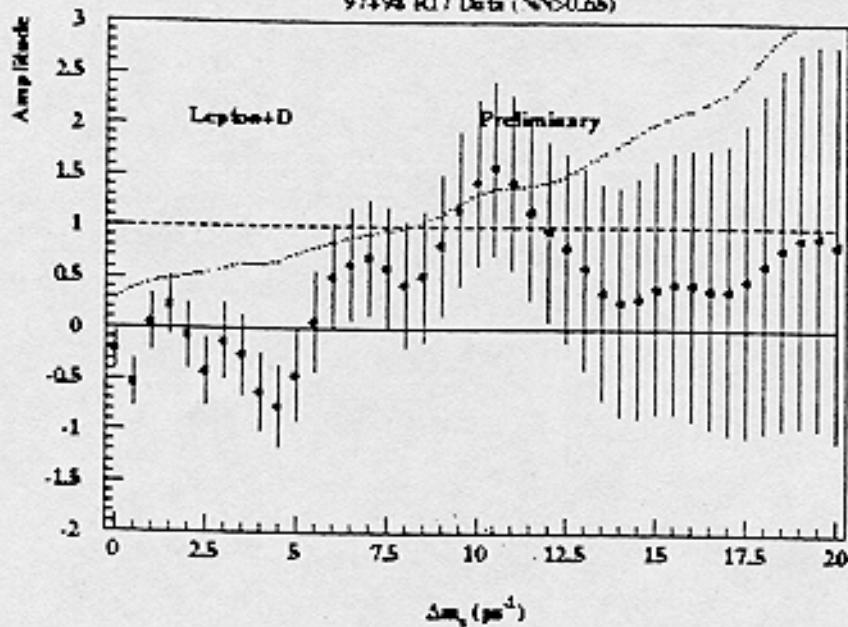
2000



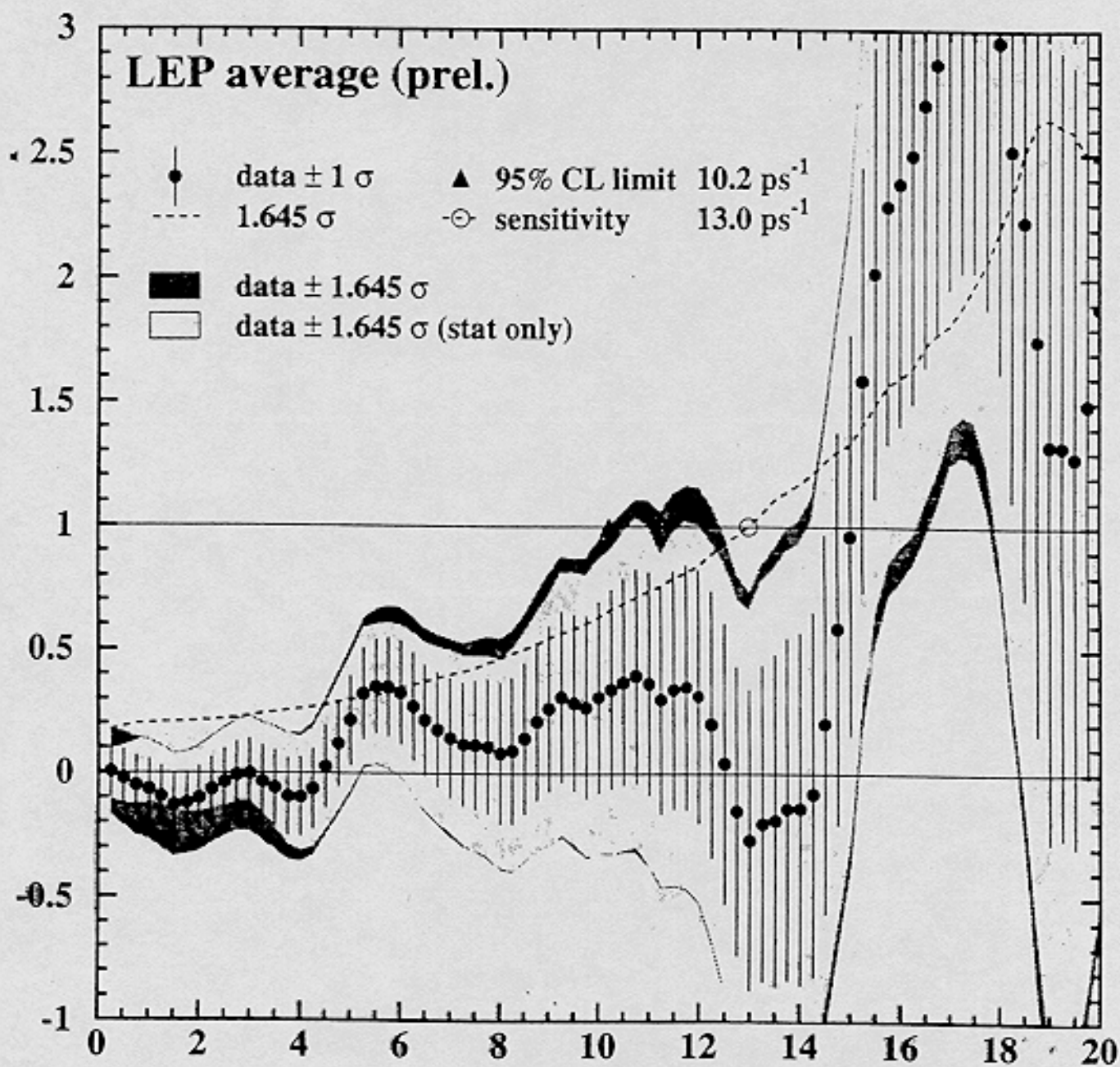
1999

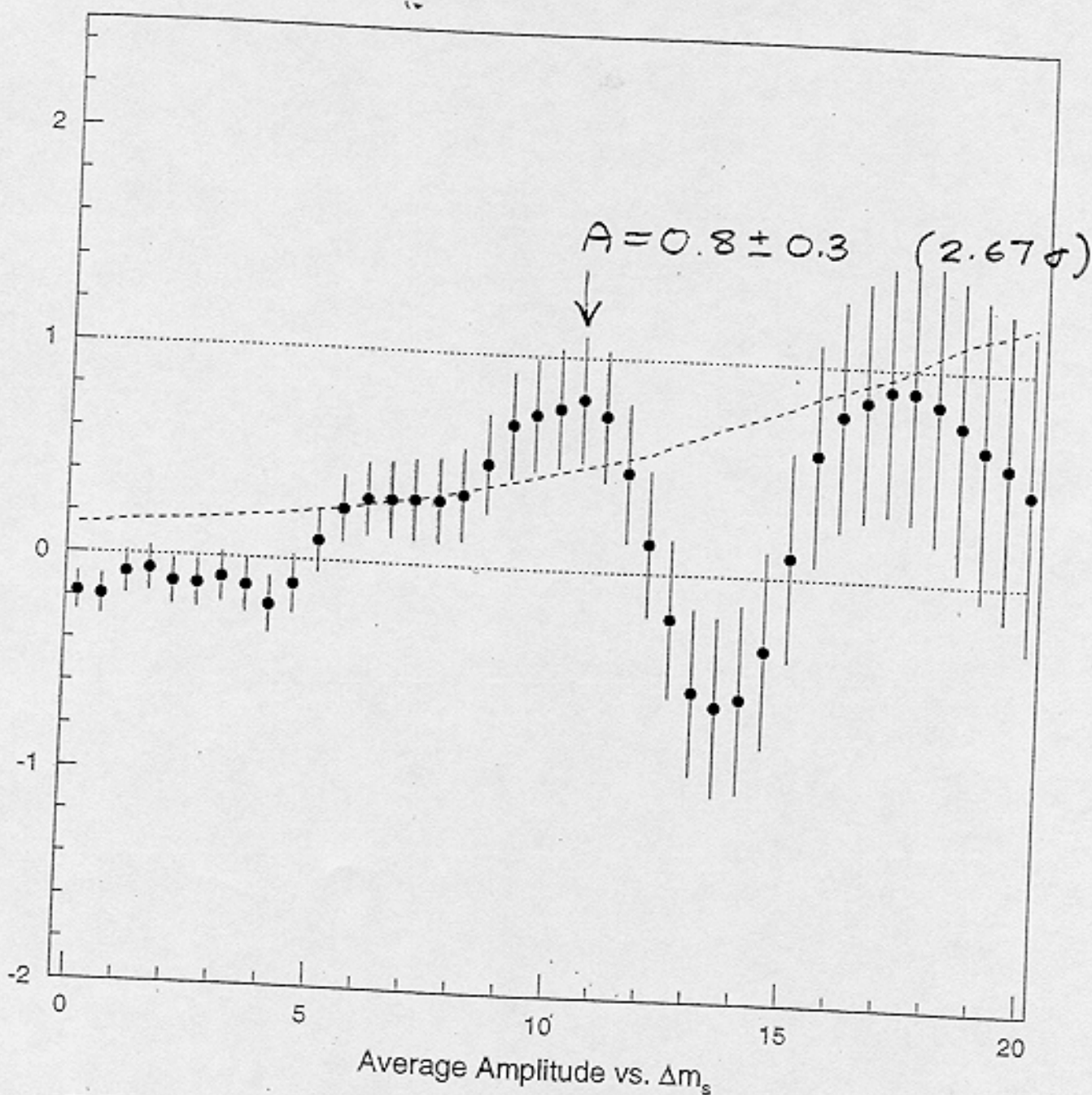


2000

97+98 R17 Data ($N_N > 0.65$)

Q: DOES LEP EXCLUDE $\Delta m_S = 10$?





LEP IS UPDATING MOST SIGNIFICANT ANALYSES

ALEPH ℓ

DELPHI $\ell + D_S$

DIPOLE (*NEW)

OPAL $\ell + D_S$

AN INTERESTING SUMMER!

ULTRA - PRELIMINARY CONCLUSIONS

- IMPROVEMENTS TO ANALYSES HAVE INCREASED THE COMBINED SIGNIFICANCE BY 50%
- SIGNIFICANT INDICATION OF A SIGNAL AT $\Delta m_s \approx 10 \text{ ps}^{-1}$
- **CAVEATS**
 - MANY CHECKS REMAIN TO BE DONE
 - FITTING FUNCTIONS NEED REFINEMENT
 - MUST ADD SYSTEMATIC ERRORS
 - WHAT IS SIGNIFICANCE OF SIGNAL?
- MIXING GROUP IS WORKING HARD IN PREPARATION FOR OSAKA.
- MORE TO COME

JULY 19 SLD WEEK

JULY 20 SLAC SEMINAR