



Breakdown of tagged CP events

DECAY MODE

T A G G I N G C A T E G O R Y	Tag	$J/\psi K_s^0 (\pi^+ \pi^-)$			$J/\psi K_s^0 (\pi^0 \pi^0)$			$\psi(2S)K_s^0$			Total		
		B^0	\bar{B}^0	Tot	B^0	\bar{B}^0	Tot	B^0	\bar{B}^0	Tot	B^0	\bar{B}^0	Tot
	$e + K$	2	0	2	0	0	0	1	0	1	3	0	3
$\mu + K$	1	0	1	0	1	1	2	0	2	3	1	4	
e	5	5	10	1	1	2	1	2	3	7	8	15	
μ	3	6	9	0	0	0	2	1	3	5	7	12	
Lepton	11	11	22	1	2	3	6	3	9	18	16	34	
Kaon	54	54	108	14	11	25	12	11	23	80	76	156	
NT1	10	12	22	1	1	2	2	2	4	13	15	28	
NT2	18	18	36	8	3	11	4	4	8	30	25	55	
Total tag	93	95	188	24	17	41	24	20	44	141	132	273	
No tag	76			20			13			109			
Tag ϵ (%)	71 ± 3			67 ± 6			77 ± 6			71 ± 2			



Breakdown (continued)

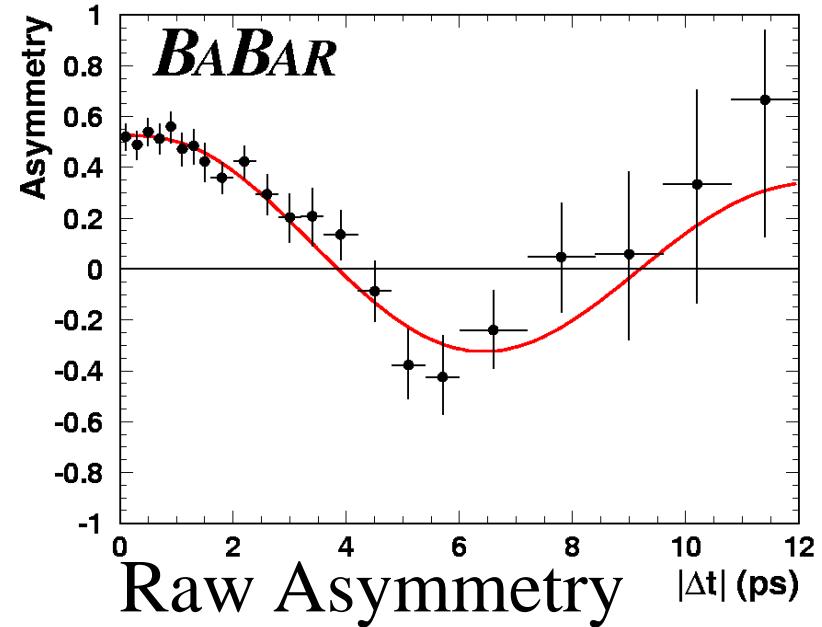
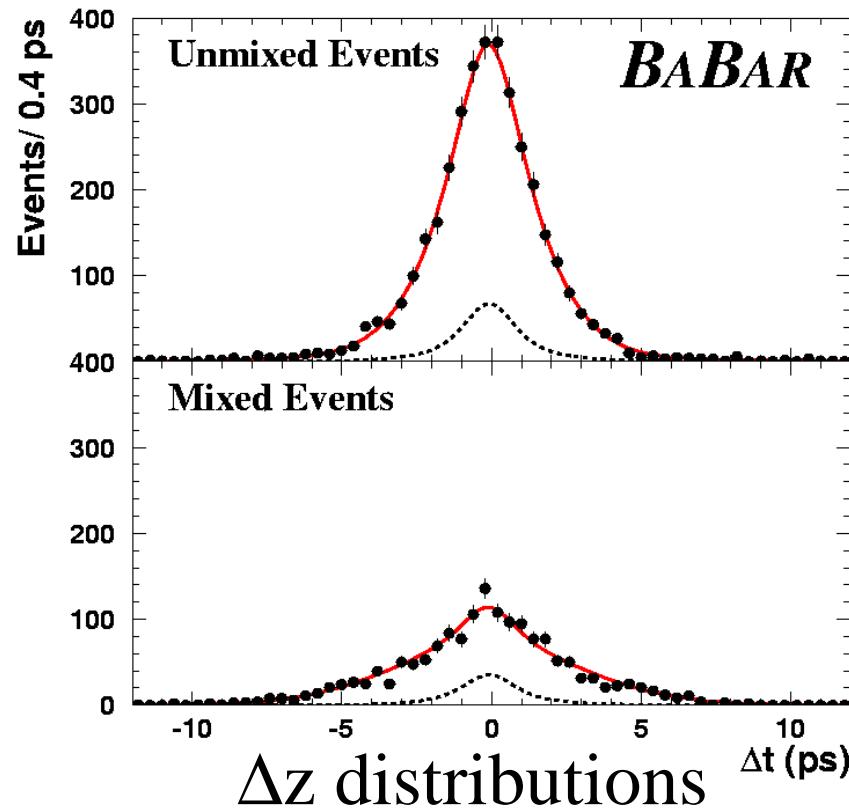
DECAY MODE

TAGGING CATEGORY	Tag	$CP = 1$ modes			$J/\psi K_L^0$			Total		
		B^0	\bar{B}^0	Tot	B^0	\bar{B}^0	Tot	B^0	\bar{B}^0	Tot
TAGGING	$e + K$	3	0	3	1	6	7	4	6	10
	$\mu + K$	3	1	4	3	5	8	6	6	12
	e	7	8	15	11	8	19	18	16	34
	μ	5	7	12	5	6	11	10	13	23
CATEGORY	Lepton	18	16	34	20	25	45	38	41	79
	Kaon	80	76	156	70	60	130	150	136	286
	NT1	13	15	28	16	6	22	29	21	50
	NT2	30	25	55	32	27	59	62	52	114
	Total tag	141	132	273	138	118	256	279	250	529
	No tag			109			130			239
	Tag ϵ (%)			71 ± 2			66 ± 2			69 ± 2



Δt distributions for self tagged B_{flav} modes by B^0/\bar{B}^0 tag

Cross checks with other physics, fit for Δm_d



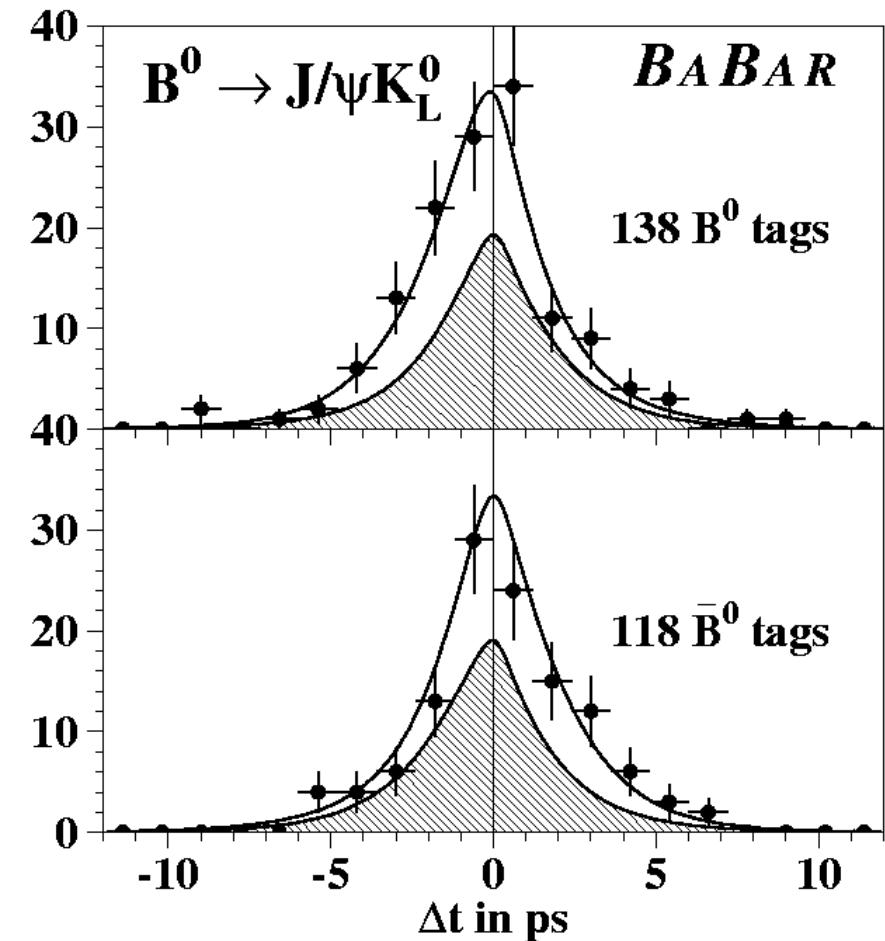
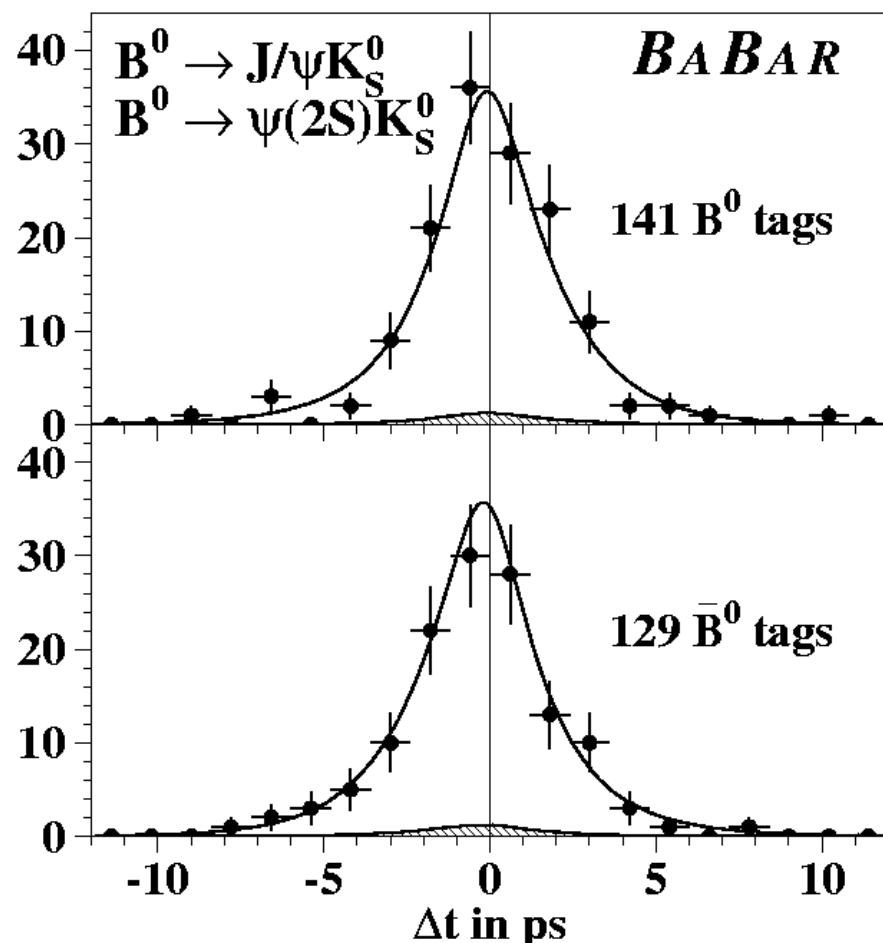
Preliminary mixing results
 $\Delta m_d = 0.519 \pm 0.020 \pm 0.016 \text{ ps}^{-1}$

$$A = \frac{N^{mix}(\Delta t) - N^{unmix}(\Delta t)}{N^{mix}(\Delta t) + N^{unmix}(\Delta t)}$$
$$\propto \cos(\Delta m_d \Delta t)$$



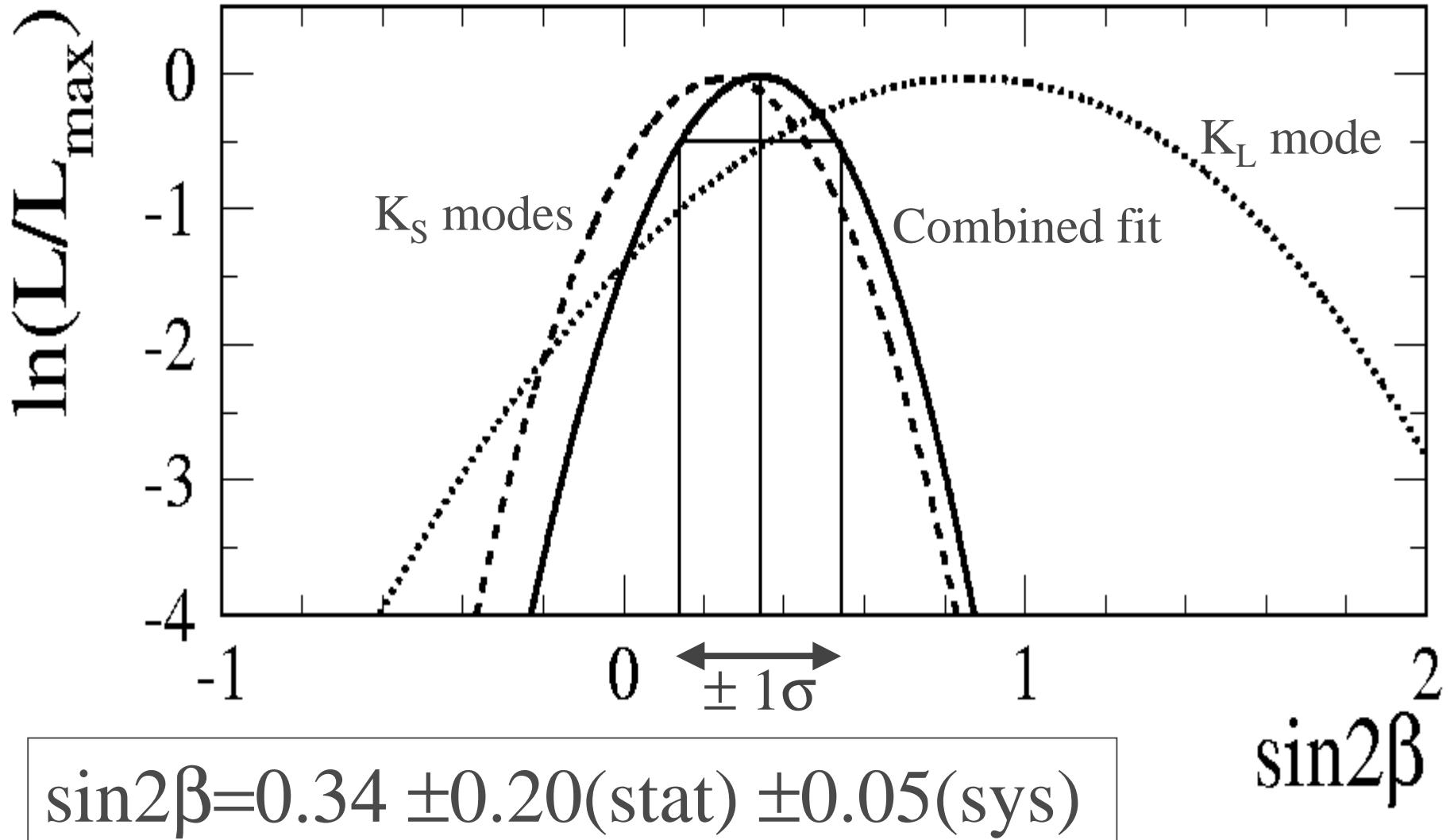
Δt distributions for B_{CP} Modes by B^0/\bar{B}^0 tag

separated K_S & K_L Modes which
have opposite CP \Rightarrow opposite shifts in Δt .



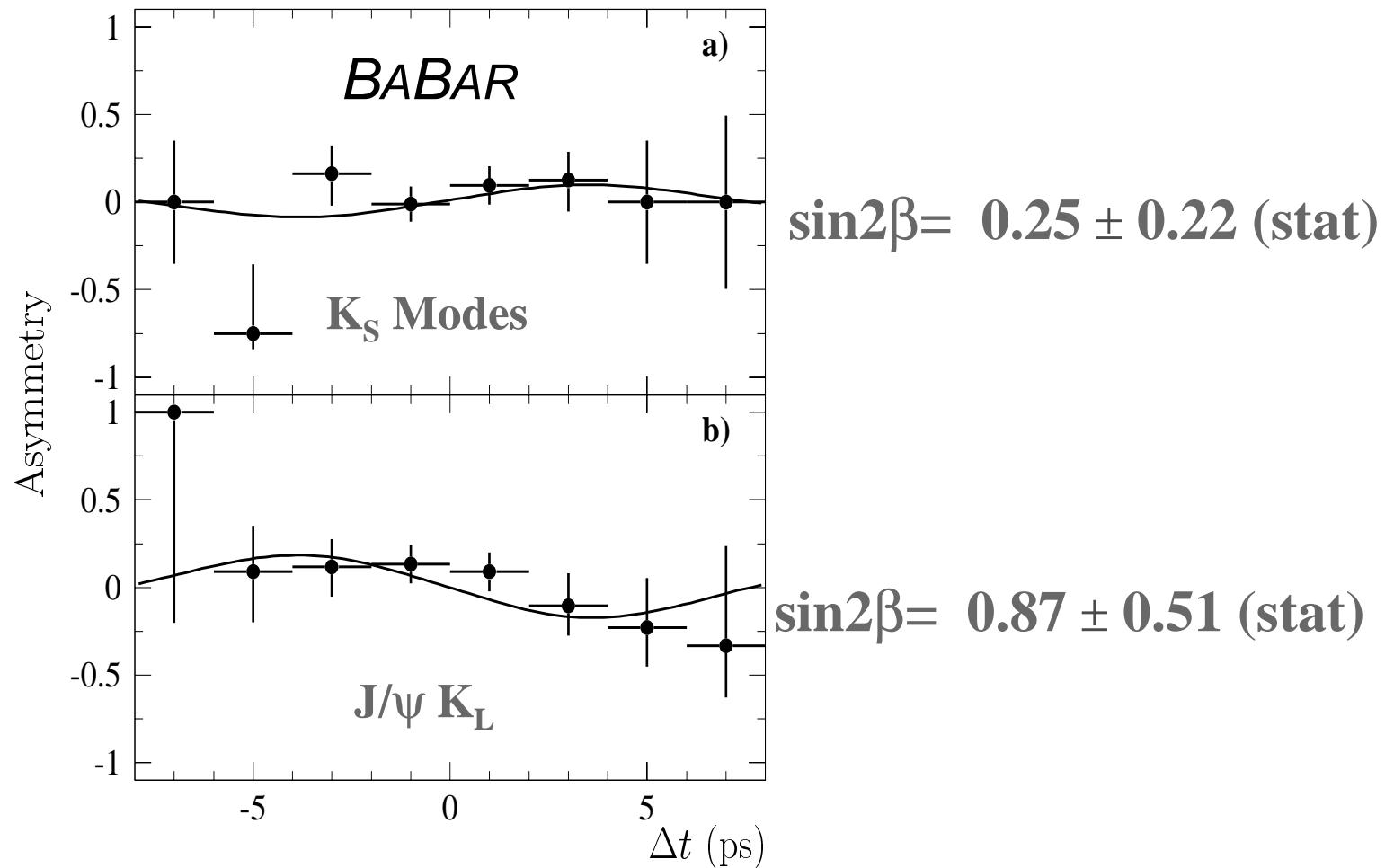


Loglikelihood of $\sin 2\beta$ measurements





A(Δt) vs Δt (Binomial Errors)



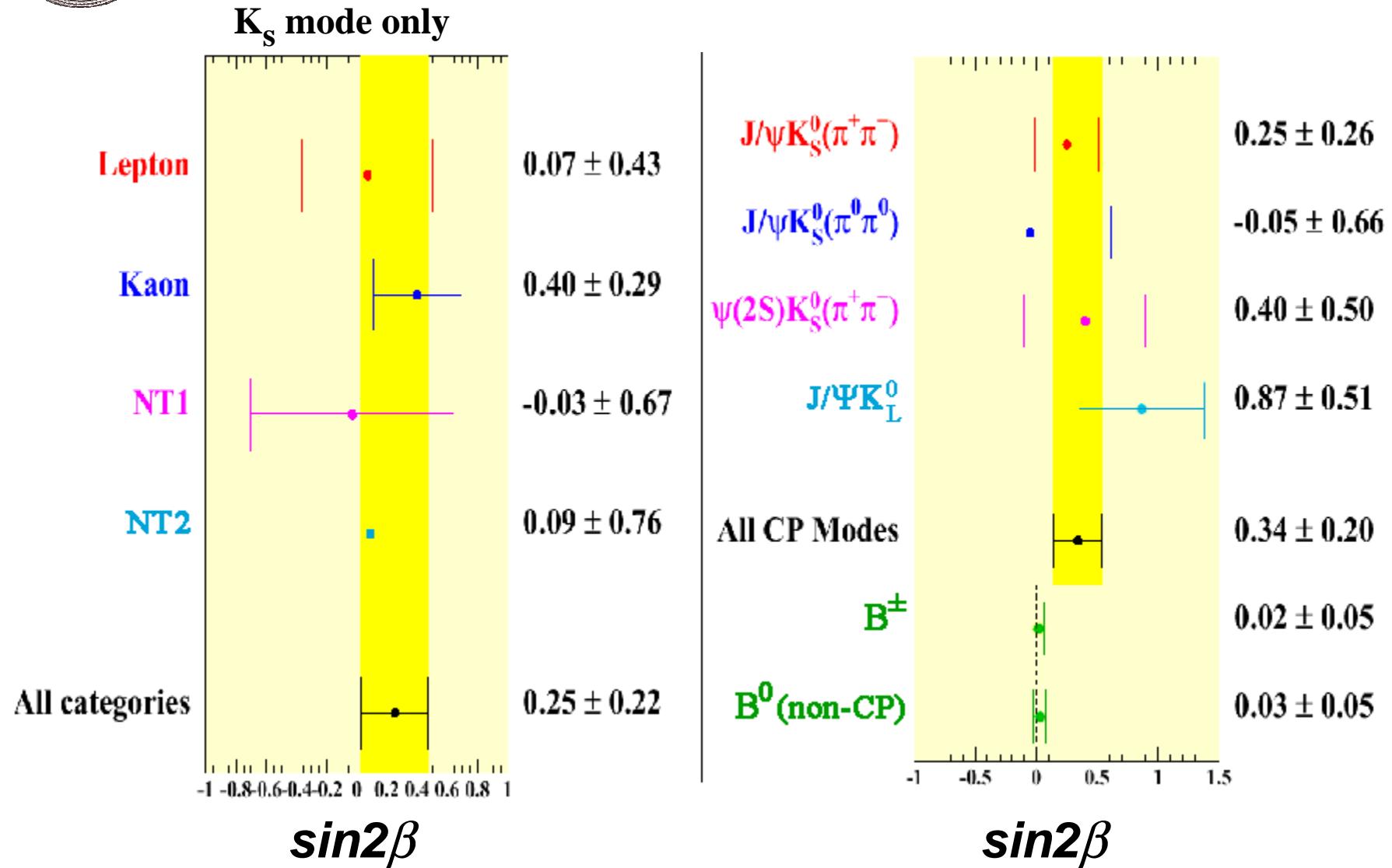


Systematic Effects

Systematic	$J/\psi K_S^0, \psi(2S)K_S^0$	$J/\psi K_L^0$	Full sample
Δt determination	0.04	0.04	0.04
$J/\psi K_S^0, \psi(2S)K_S^0$ back.	0.02	—	0.02
$J/\psi K_L^0$ back.	—	0.09	0.01
$J/\psi K_L^0$ Sig. fraction	—	0.10	0.01
τ_{B^0}	0.01	0.01	< 0.01
Δm_{B^0}	0.01	< 0.01	0.01
Other	0.01	0.01	0.01
Total	0.05	0.14	0.05



$\sin 2\beta$ for various parts of CP sample; crosschecks from B_{flav} and charged B' s

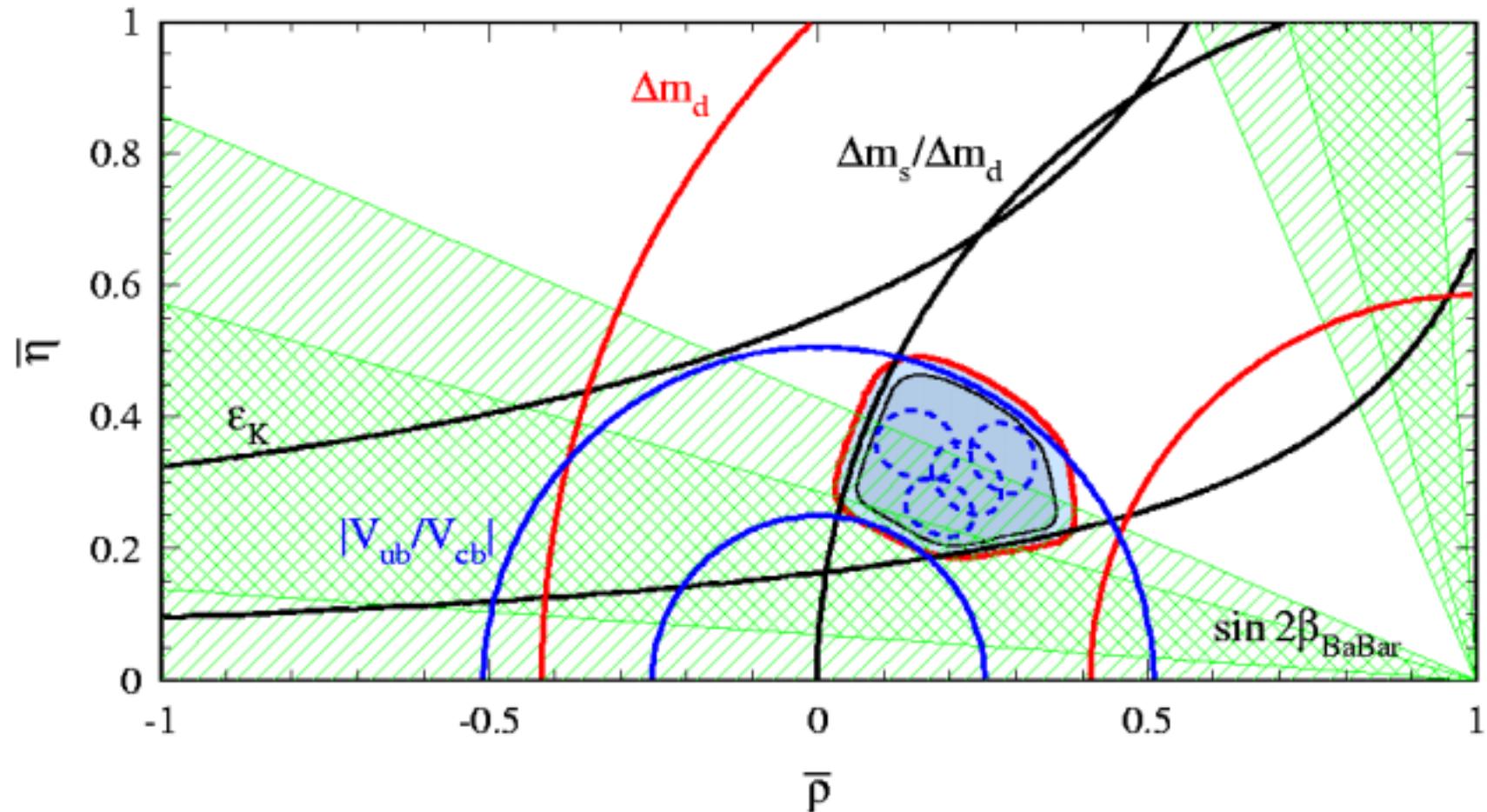


Measurement of CP -Violating Asymmetries in B^0 Decays to CP Eigenstates

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Constraints on Unitarity Triangle

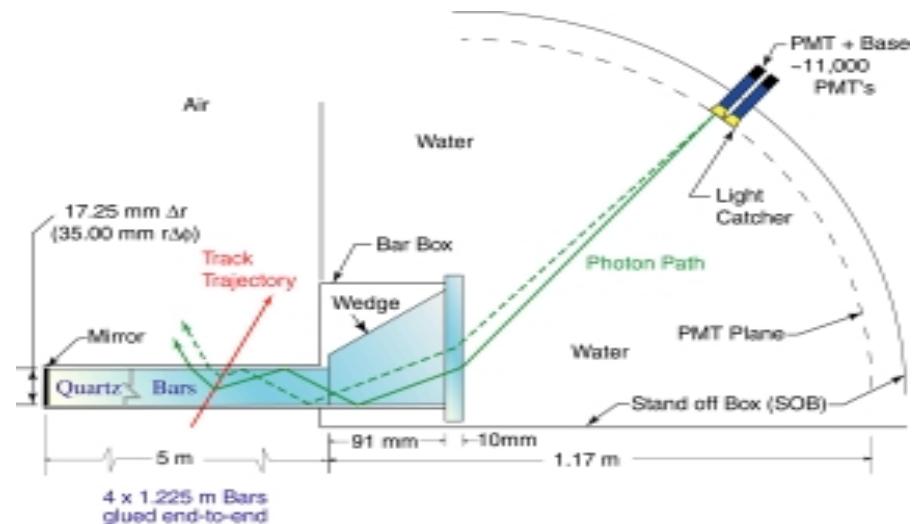
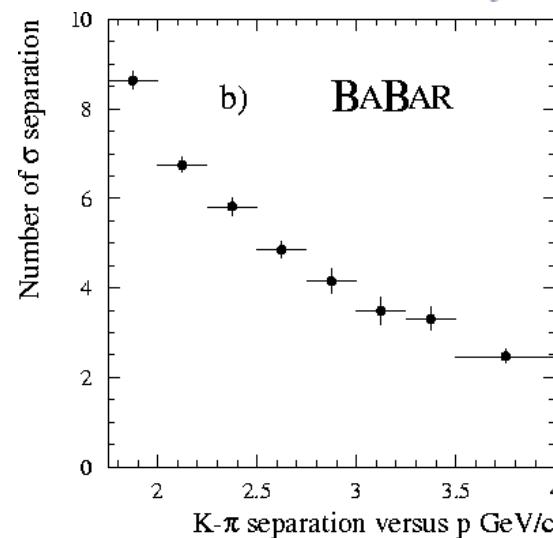
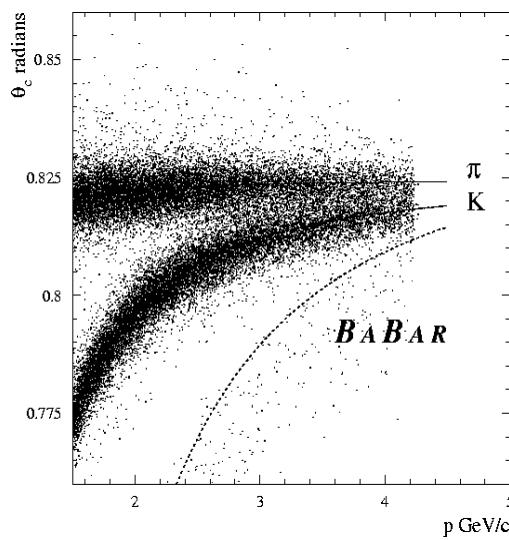


Allowed region (blue) is determined using theoretical inputs and fitting many experimental measurements



Particle identification

- **DIRC: Detector of Internally Reflected Cherenkov light.**
- **Good π^+ / K^+ separation up to high momentum.**



π^+ / K^+ separation with
kinematically identified
 $D^{*+} \rightarrow D^0 \pi^+ \rightarrow (K^- \pi^+) \pi^+$



$\pi^+\pi^- / K^+\pi^- / K^+K^-$: results

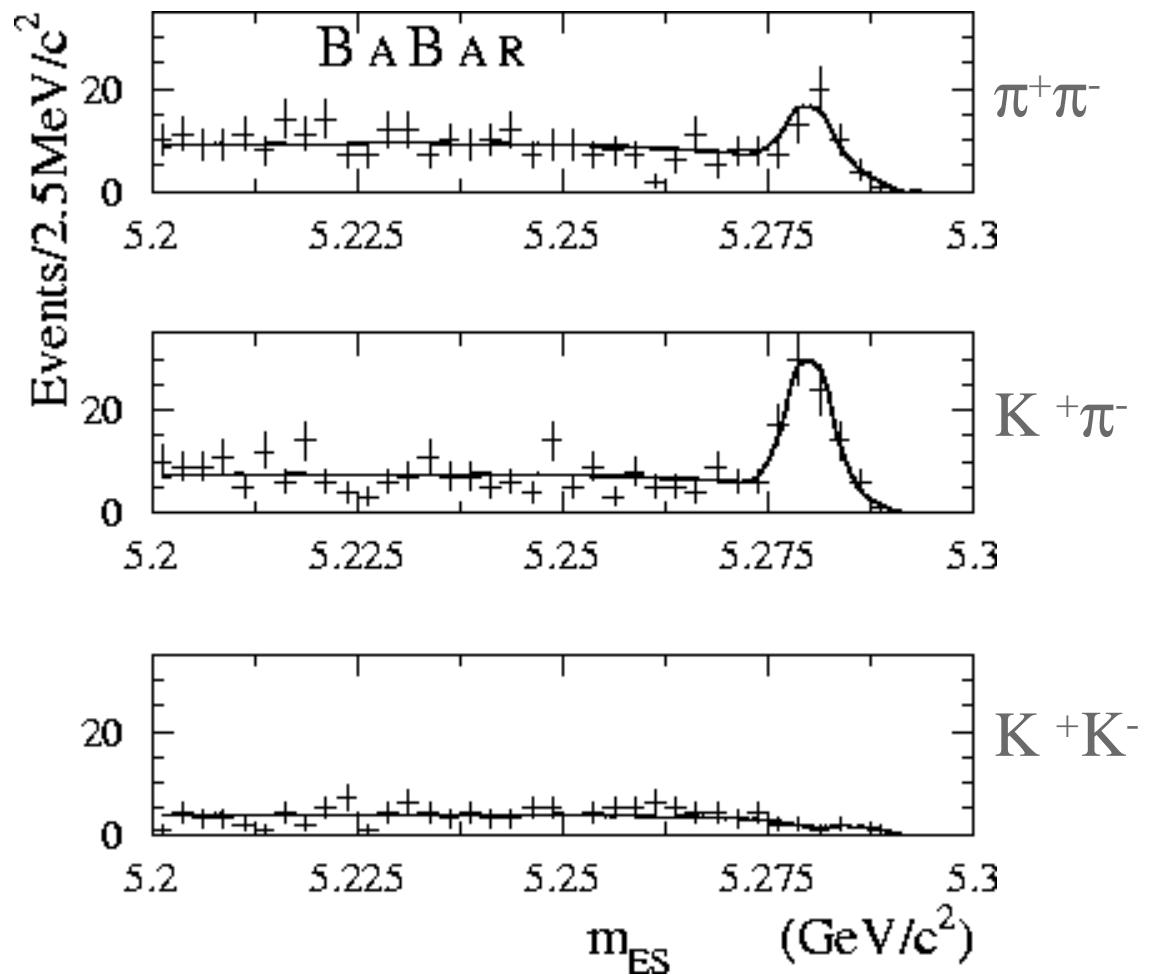
	N_{signal}	$\text{Br BABAR} (\times 10^6)$	$\text{Br CLEO} (\times 10^6)$
$\pi^+\pi^-$	41 ± 10	$4.1 \pm 1.0 \pm 0.7$	$4.3^{+1.6}_{-1.4} \pm 0.5$
$K^+\pi^-$	169 ± 17	$16.7 \pm 1.6^{+1.2}_{-1.7}$	$17.2^{+2.5}_{-2.4} \pm 1.2$
K^+K^-	$8.2^{+7.8}_{-6.4}$	< 2.5 (90% CL)	< 1.9 (90% CL)

$$\Gamma(B^0 \rightarrow \pi^+\pi^-) / \Gamma(B^0 \rightarrow K^+\pi^-) \approx 0.25$$



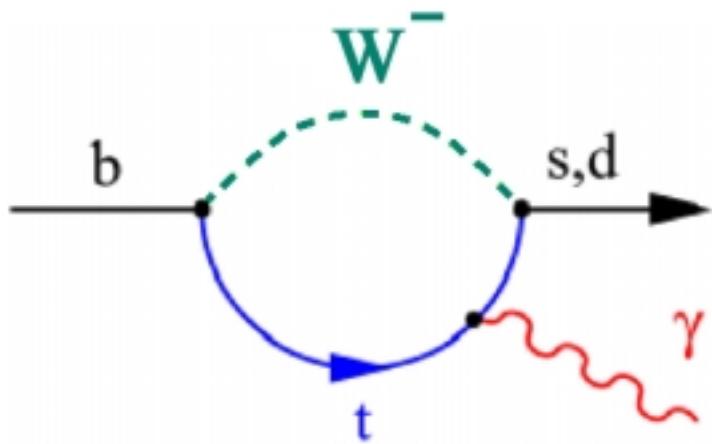
$\pi^+\pi^- / K^+\pi^- / K^+K^-$: event counting

- Event counting analysis performed as a cross-check
- Lower sensitivity
- Gives consistent results





Loop Decays (“Penguins”)



- Sensitive to top quark couplings
→ CKM matrix elements V_{td}, V_{ts}
- Sensitive to New Physics
(e.g. SUSY: $W^- \rightarrow H^-$)
→ No considerable CP asymmetry
in Standard Model but beyond

→ Low Energy Window to High Mass Physics