First Measurement of the *CP*-Violating Asymmetries with *BaBar*

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DPF 2000
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- **Overview**
- **PEP-II and *BaBar***
- **Measurement of CP-violating asymmetries at in B decays at $\Upsilon(4S)$ resonance**
  - ∗ **Reconstructing CP sample**
  - ∗ **Flavor tagging**
  - ∗ **Δt and its resolution**
  - ∗ **Mistag fractions**
  - ∗ **Determining CP asymmetries**
- **Conclusions and Outlook**

CKM Matrix and the Unitarity Triangle

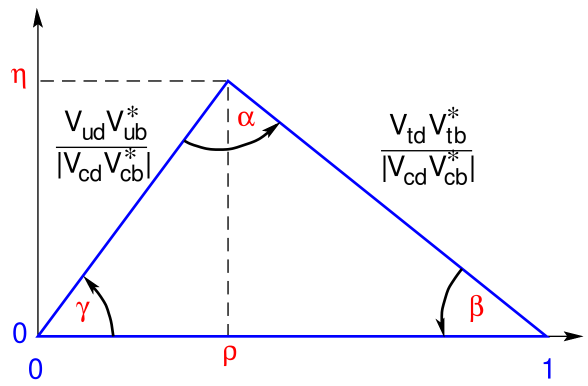
- **In the Standard Model, the CP violation occurs due to a single non-vanishing phase in the CKM matrix**

$$V = \begin{pmatrix} 1-\frac{\lambda^2}{2} & \lambda & A\lambda^3(\rho - i\eta) \\ -\lambda & 1-\frac{\lambda^2}{2} & A\lambda^2 \\ A\lambda^3(1-\rho-i\eta) & -A\lambda^2 & 1 \end{pmatrix} + \mathcal{O}(\lambda^4).$$

$\rightarrow$ CP **observables are closely related in the Standard Model**

- **CKM matrix is unitary, e.g**

$$V_{ud}V_{ub}^* + V_{cd}V_{cb}^* + V_{td}V_{tb}^* = 0$$



$\Rightarrow$ CP**-violation has never been observed outside the $K^0 - \bar{K}^0$ system**

$\Rightarrow$ $B^0 - \bar{B}^0$ **system provides the cleanest environment for measuring CKM parameters**

Testing the Standard Model

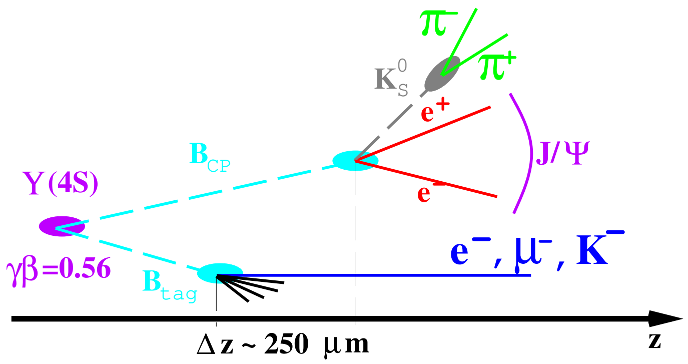
- **Constraining the parameters of the Unitarity Triangle allows one to test a rigorous prediction of the Standard Model**
- CP**-violating asymmetries are determined by angles α, β, and γ**
  - CP **asymmetry in** $B^0 \to J/\Psi K^0_S$ **mode measures** $\sin 2\beta$
  - CP **asymmetry in** $B^0 \to \pi\pi$, $B^0 \to \rho\pi$ **modes measures** $\sin 2\alpha$.
  - **Angle γ, being the hardest to determine experimentally, can be determined from decays of B_s meson, $B^\pm \to DK^\pm$ decays, or $B_d \to D^*\pi$ decays**
- **The sides of the Unitarity Triangle are determined from non-CP measurements**
  - $|V_{cb}|$ **and** $|V_{ub}|$ **: semileptonic B decays**
  - $|V_{td}V^*_{tb}|$ **: measurement of the mixing parameter x_d**

$\Rightarrow$ **All these measurements will be performed by BaBar**

- **Standard Model tests**
  - **Consistency of the Unitarity Triangle**
  - **Consistency between related observables, e.g. $B^0 \to J/\Psi K^0_S$ vs $B^0 \to J/\Psi K^0_L$ and $B^0 \to D^{*+}D^{*-}$.**

  $\rightarrow$ **Rich phenomenology of the B sector allows one to probe a wide variety of theories beyond the Standard Model.**

Ingredients of the measurement

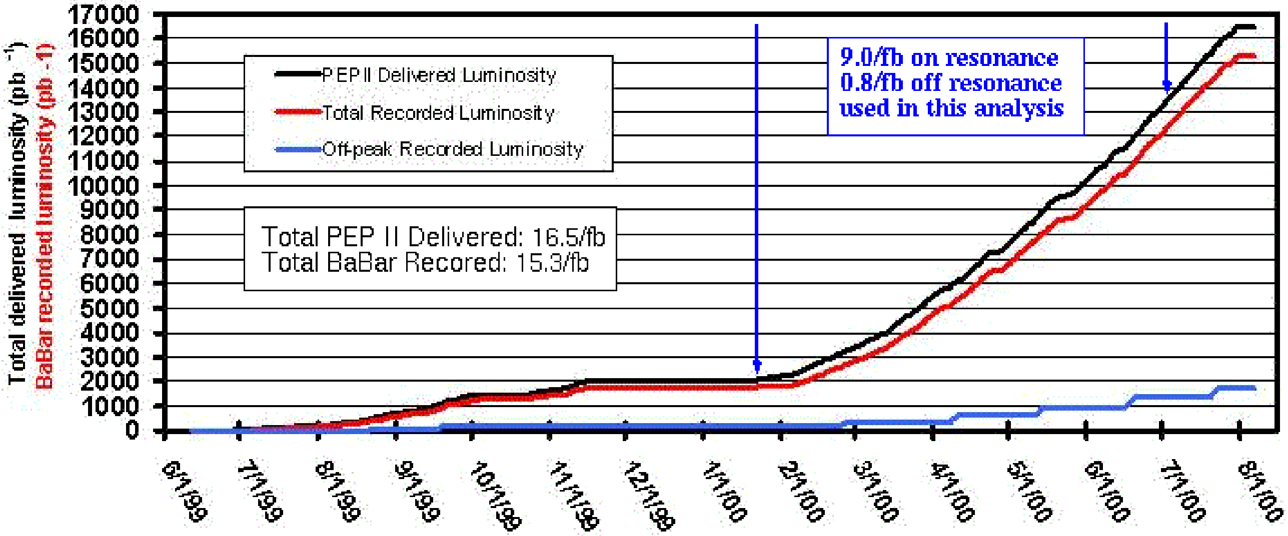


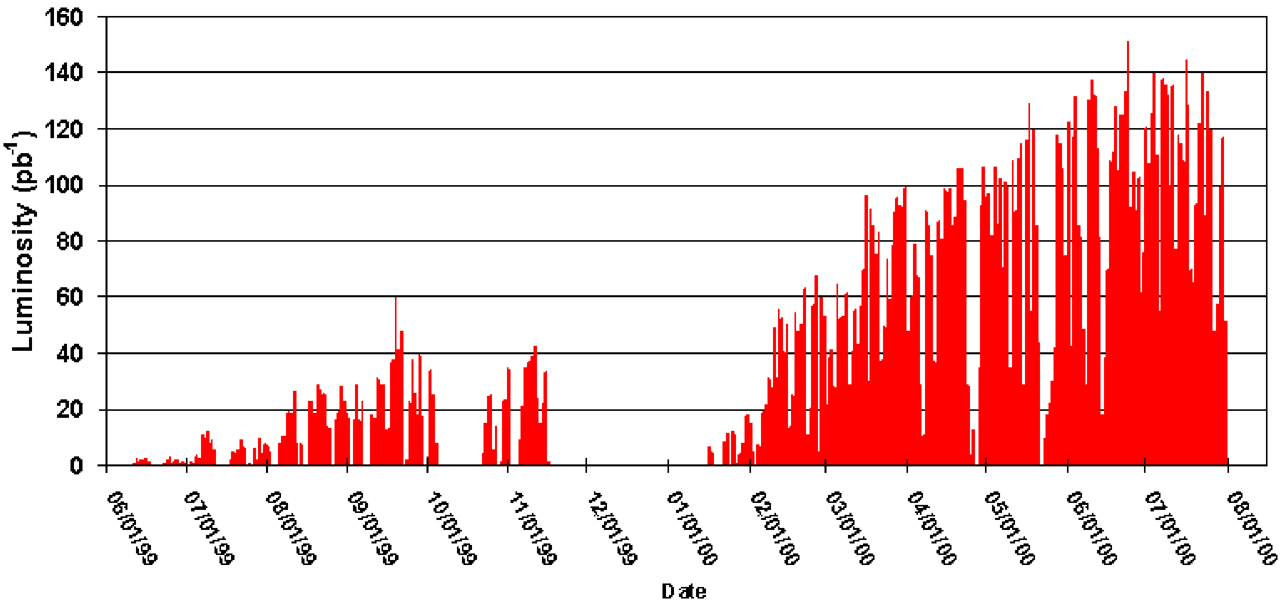
- **Copious production of neutral B mesons in a clean environment**
  - $\rightarrow$ **High-luminosity B Factory at $\Upsilon(4S)$ resonance**
- **High reconstruction efficiency for B_{CP}**
  - $\rightarrow$ **Hermetic detector**
  - $\rightarrow$ **Efficient tracking and calorimetry**
  - $\rightarrow$ **Efficient reconstruction of B daughters**
- **Flavor tagging**
  - $\rightarrow$ **Good particle identification**
  - $\rightarrow$ **Understanding of systematic effects, *e.g.* charge asymmetries**
- **Measurement of time-dependent asymmetries**
  - $\rightarrow$ **Asymmetric B Factory**
  - $\rightarrow$ **Excellent vertex resolution**

PEP-II and *BABAR*

- **Asymmetric collisions at the $\Upsilon(4S)$ resonance**
  - $E_{\rm CM} = 10.580$ **GeV**
  - **Design** $\mathcal{L} = 3.0 \cdot 10^{33}\,{\rm cm}^{-2}{\rm s}^{-1}$
  - → **Achieved peak luminosity of** $2.3 \cdot 10^{33}\,{\rm cm}^{-2}{\rm s}^{-1}$
  - **First collisions in Spring 1998, steady luminosity improvements since**
  - ⇒ **Exceeded design value for integrated daily luminosity (135 pb^{-1}/day).**
- **First collisions in *BABAR* on May 26, 1999**
  - **Efficient operation (reached** $> 95\%$ **logging efficiency)**
  - **Data are reconstructed with 1 day latency**
- **Integrated luminosity from May 1999 to August 2000**
  - **PEP-II delivered: 16.5 fb^{-1}**
  - ***BABAR* recorded: 15.3 fb^{-1}**
  - → **For** $\sin 2\beta$ **analysis we use 9.8 fb^{-1} collected between January and July 2000**

PEP-II Performance



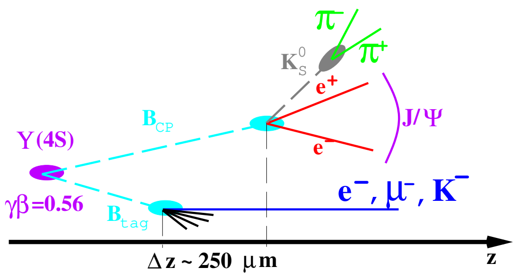


BABAR Presentations at DPF

1. $B^0 - \bar{B}^0$ **Oscillations**
   Shahram Rahatlou: Bottom Quark, Aug 9, 1:30 pm
2. B **lifetimes**
   Chih-Hsiang Cheng: Bottom Quark, Aug 9, 1:30 pm
3. **Inclusive** B^0 **decays**
   Mike Kelsey: Bottom Quark, Aug 9, 4:00 pm
4. **Charmonium** B **decays**
   Gregory Dubois-Felsmann: Bottom Quark, Aug 11, 1:30 pm
5. **Partially-reconstructed** B^0 **decays**
   Ben Brau: Bottom Quark, Aug 9, 4:00 pm
6. $B \to K^* \gamma$
   Hirohisa Tanaka: Bottom Quark, Aug 12, 8:30 am
7. $B \to K^{(*)} l^+ l^-$
   Natalia Kuznetsova: Bottom Quark, Aug 12, 8:30 am
8. **Charmless** B **decays**
   Jim Olsen: Bottom Quark, Aug 12, 11:00 am
9. **This talk**
   CKM Session, Aug 10, 1:30 pm
10. **SVT Radiation Protection**
    Tim Meyer: New Detector Technologies, Aug. 9, 4:00 pm
11. *BABAR* **CsI Calorimeter**
    Matt Weaver: New Detector Technologies, Aug. 11, 1:30 pm
12. *BABAR* **Trigger and DAQ**
    Rainer Bartoldus: New Detector Technologies, Aug. 12, 8:30 am

$\Rightarrow$ **Conference papers at** `http://www.slac.stanford.edu/BFROOT`

Overview of the Analysis



- **Select candidate events by reconstructing B decays into a CP *eigenstate* $B^0 \to J/\Psi K_S^0$, $B^0 \to \Psi(2S) K_S^0$**
  - $B^0 \to J/\Psi K_S^0,\ K_S^0 \to \pi^+\pi-$
  - $B^0 \to J/\Psi K_S^0,\ K_S^0 \to \pi^0\pi0$
  - $B^0 \to \Psi(2S) K_S^0,\ K_S^0 \to \pi^+\pi-$
- **Identify flavor of the other *(tagging)* B using leptons from semileptonic decays and kaons from $b \to c \to s$ transitions.**
- **For each type of the tag (tagging category), measure *mistag fraction* w_i and determine *dilutions* $\mathcal{D}_i = 1 - 2w_i$**
  - **Use fully reconstructed hadronic decays $B^0 \to D^{(*)-}X$ ($X \equiv \pi, \rho, a_1$) and semileptonic decays $B^0 \to D^{*-}l^+\nu$**
- **Reconstruct decay vertices of B_{CP} and $B_{\rm tag}$, measure $\Delta z = z_{CP} - z_{\rm tag}$ and *signed time difference* between decays $\Delta t = \Delta z/\langle\beta\gamma\rangle$.**
- **Determine *resolution function* $\mathcal{R}(\Delta t)$**

Overview of the Analysis (cont.)

- **Construct a CP-violating observable**

$$\mathcal{A}_{CP}(\Delta t) = \frac{\mathcal{F}_+(\Delta t) - \mathcal{F}_-(\Delta t)}{\mathcal{F}_+(\Delta t) + \mathcal{F}_-(\Delta t)} \sim \mathcal{D} \sin 2\beta \times \sin \Delta m_d \, \Delta t$$

where

$$\mathcal{F}_\pm(\Delta t; \Gamma, \Delta m_d, \mathcal{D} \sin 2\beta, \hat{a}) = \frac{1}{4}\Gamma \mathrm{e}^{-\Gamma|\Delta t|} \left[1 \pm \mathcal{D} \sin 2\beta \times \sin \Delta m_d \Delta t\right] \otimes \mathcal{R}(\Delta t; \hat{a})$$

and $\hat{a}$ represents parameters of the resolution function.

Likelihood Fit

- In practice, the value of $\sin 2\beta$ is determined from an unbinned maximum likelihood fit

⇒ Most of the parameters of likelihood function are determined from the data

  - ∗ Mass resolutions
  - ∗ Time resolutions
  - ∗ Tagging efficiencies and mistag fractions

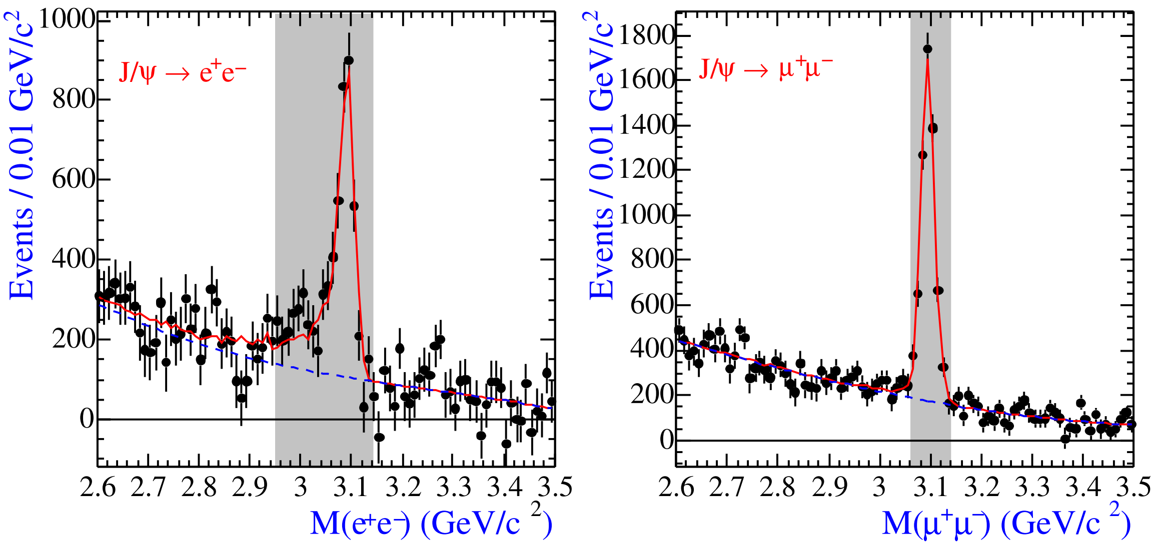
- Maximum likelihood fitting procedure was extensively tested
  - ∗ "Toy" experiments: full detector response not simulated, but events smeared according to resolutions found in data
  - ∗ Multiple experiments with low statistics samples to test for possible biases
  - ∗ Test effects of backgrouds, Δz biases, etc.
- Full Monte Carlo studies with high-statistics signal samples

⇒ Use data control samples to perform "null asymmetry" tests

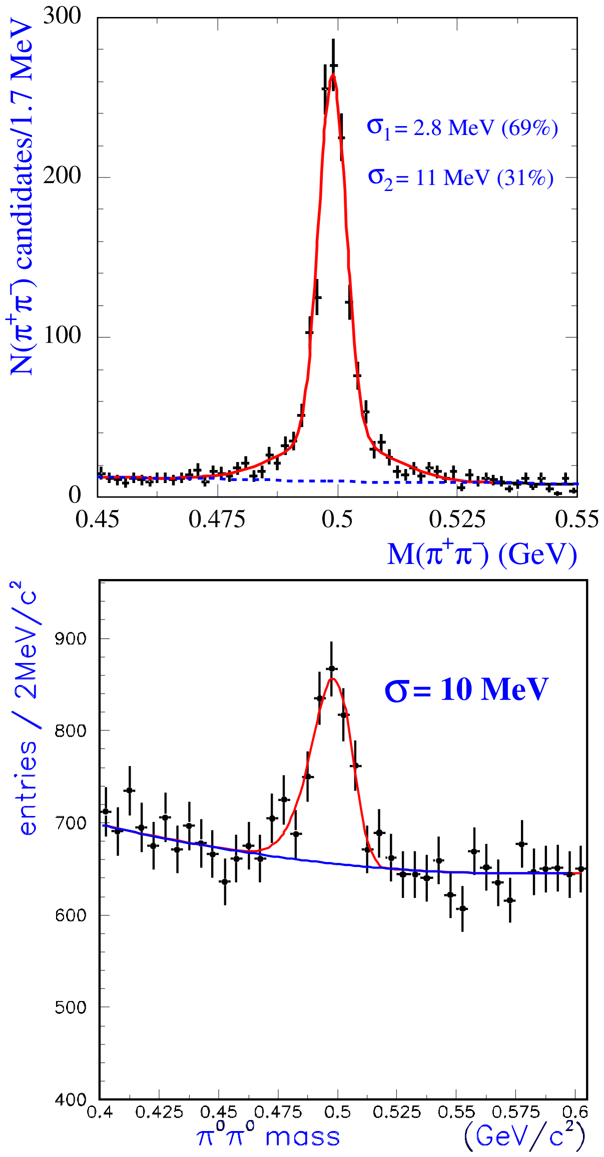
Reconstruction of the Charmonium states

- $J/\Psi, \Psi(2S) \rightarrow e^+e^-$ **and** $J/\Psi, \Psi(2S) \rightarrow \mu^+\mu^-$
  - **Electron ID using EMC and drift chamber** dE/dx
  - **Muon ID using EMC and IFR**
  - **Bremsstrahlung recovery if both electrons are positively identified**
- $\Psi(2S) \rightarrow J/\Psi\pi^+\pi^-$
  - $J/\Psi \rightarrow e^+e^-, \mu^+\mu^-$ **as above**
  - **30 MeV window for** $M(J/\Psi\pi^+\pi^-) - M(J/\Psi)$

$\rightarrow$ **Gregory Dubois-Felsmann: Bottom Quark Session, Aug 11, 1:30 pm**



K^0_S reconstruction



The B_{CP} Sample

- **Reconstruct B_{CP} by combining mass-constrained J/Ψ ($\Psi(2S)$) and K_S^0 candidates**
  - **Select candidates in a box of m_{SE} and ΔE variabes**

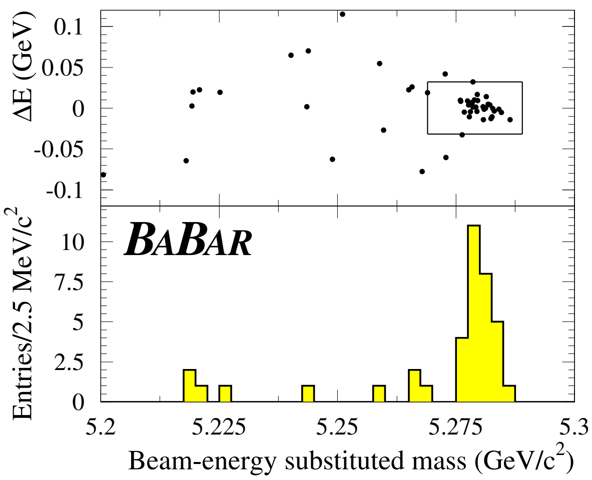
$$m_{SE} = \sqrt{E^{*2}_{\text{beam}} - p^{*2}_B}$$

and

$$\Delta E = E^*_B - E^*_{\text{beam}}$$

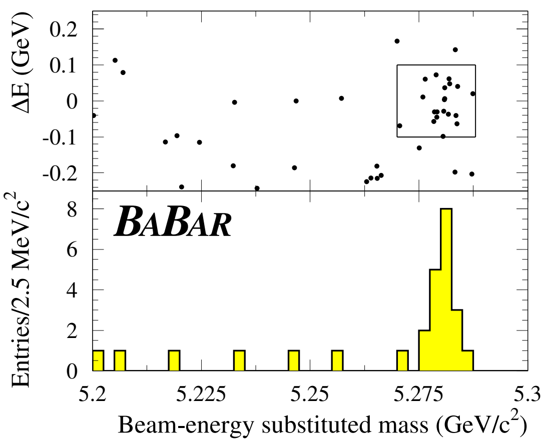
⇒ **168 reconstructed candidates**

- $B^0 \to J/\Psi K_S^0\,(K_S^0 \to \pi^+\pi^-)$: 124 ± 12 **events, purity** 96%

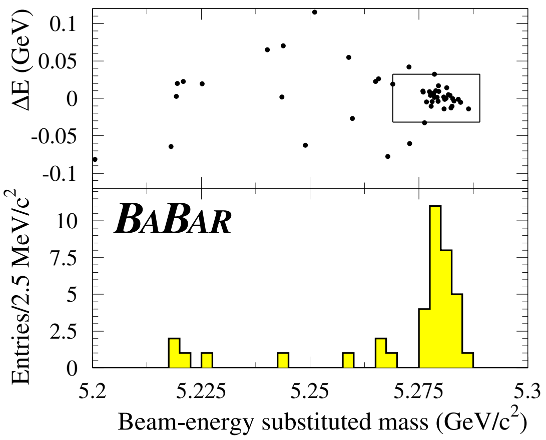


The B_{CP} Sample (cont.)

- $B^0 \to J/\Psi K_S^0\,(K_S^0 \to \pi^0\pi^0)$: 18 ± 4 **events, purity** 91%



- $B^0 \to \Psi(2S) K_S^0$: 27 ± 6 **events, purity** 93%



Flavor Tagging

→ **Identify the flavor of the recoiling B_{tag} at the time of its decay through its inclusive decays**

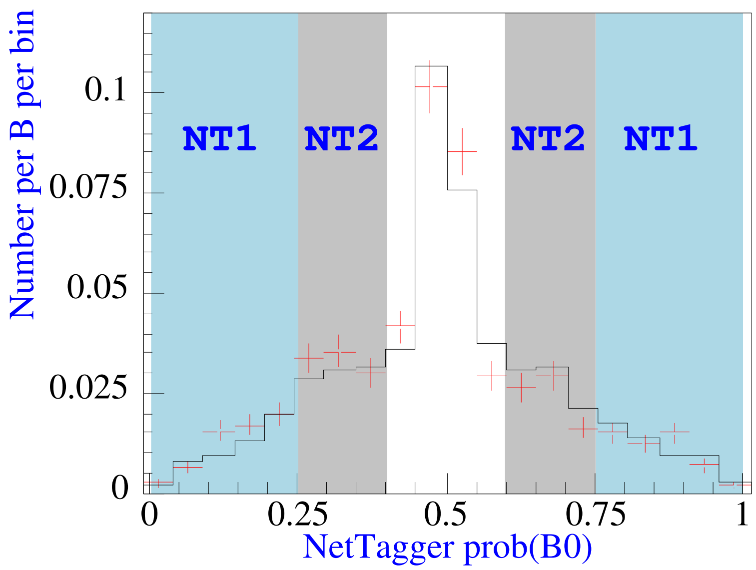
- **Charge of a direct lepton (e or μ) from $B^0 \to X l^+ \nu$ decay**
- **Charge of a secondary lepton (e or μ) from charm decays**
- **Charge of a kaon from $b \to c \to s$ transition**
- **Charge of a slow pion from $B^0 \to D^{*-} X$, $D^{*-} \to \bar{D}^0 \pi^-$ decay**
- **"Jet Charge" – momentum-weighted sum of track charges**

→ **Use a combination of simple cut-based tags and a multivariate (neural network) algorithm**

Flavor Tagging (cont.)

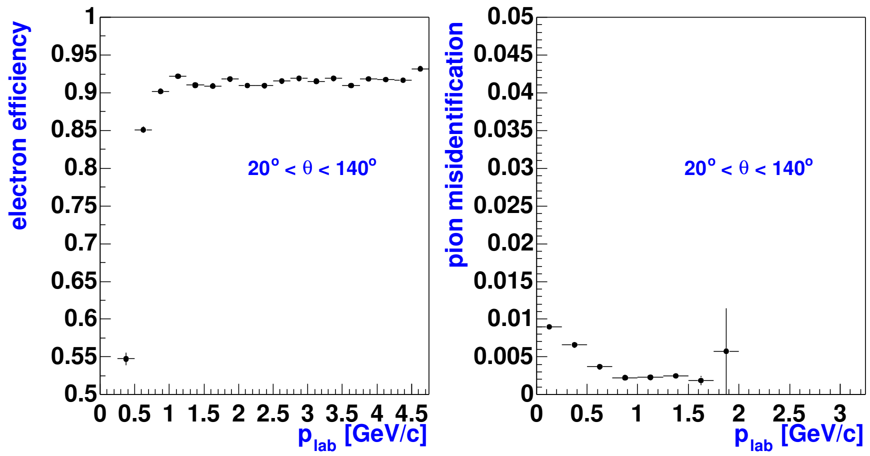
→ **5 tagging categories (in the order of importance)**

1. `Electron` **category: charge of the highest-momentum electron with** $p^* > 1.1\ \mathrm{GeV}$ **unless conflicts with** `Kaon` **category**
2. `Muon` **category: charge of the highest-momentum muon with** $p^* > 1.1\ \mathrm{GeV}$ **unless conflicts with** `Kaon` **category**
3. `Kaon` **category: total charge of all kaons in the event**
4. `NT1` **category: neural network tag with** $0.25 < |\mathrm{prob}(B^0) - 0.5|$
5. `NT2` **category: neural network tag with** $0.1 < |\mathrm{prob}(B^0) - 0.5| < 0.25$

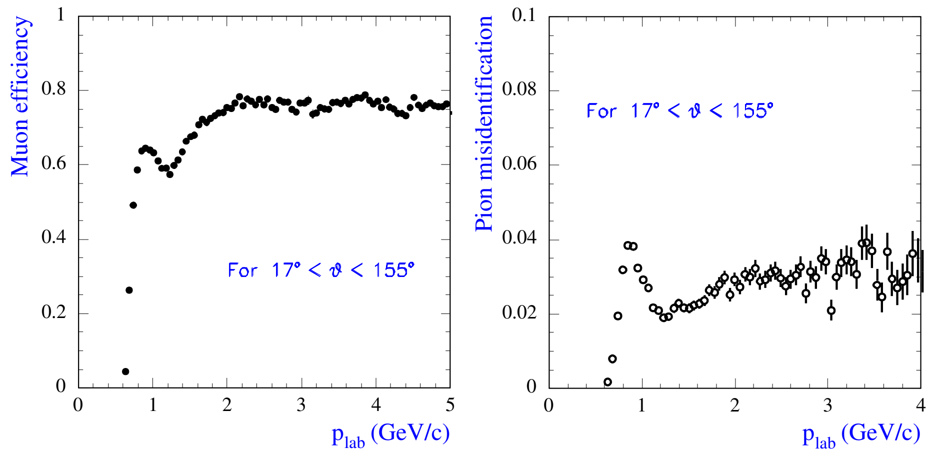


Particle Identification

- **Electrons: combined information from EMC, DCH, and DIRC**

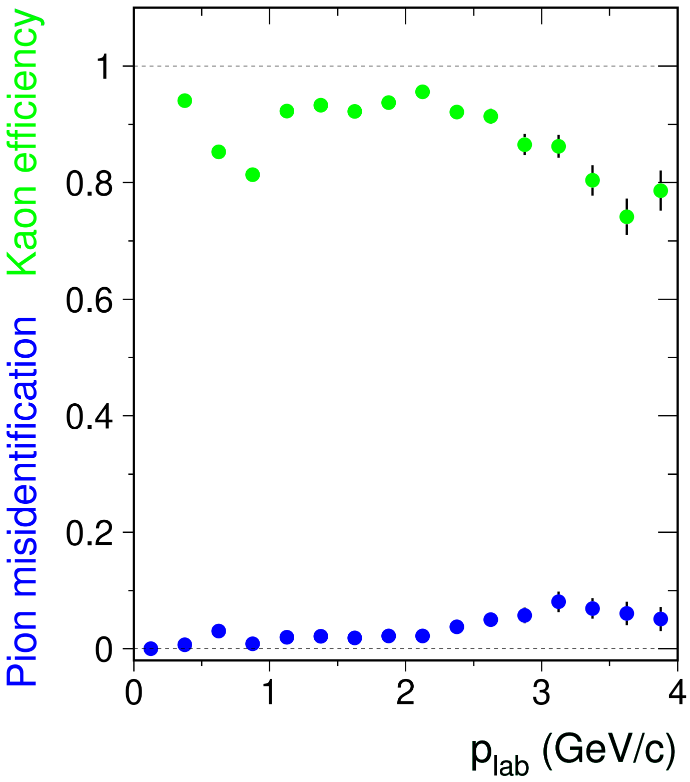


- **Muons: combined information from IFR and EMC**



Particle Identification (cont.)

- **Kaons: combined SVT and DCH dE/dx and Cherenkov angle and number of photons from the DIRC**



Proper Time Difference

- CP side: geometric and kinematic fit with mass constraints for the intermediate resonances
  - $\sigma(z_{CP}) = 45..65\ \mu\mathrm{m}$ depending on the decay mode
- Tag side
  - Fit the remaining tracks
  - Combined kinematic and geometric fit using B_{CP} momentum vector and IP position and errors
  - Replace tracks that form a long-lived V0 (e.g. K^0_S) with trajectory and error matrix of the V0
  - Iterative fit removing the worst track with $\chi^2 > 6$ at each step

$\rightarrow$ Minimize bias due to charm decays

$\rightarrow$ $\sigma(z_{\mathrm{tag}}) \approx 125\ \mu\mathrm{m}$ and bias $\delta z_{\mathrm{tag}} \approx 25\ \mu\mathrm{m}$

Δt resolution

- **Dominated by the tag side, and hence identical for all decay modes**
- **Well-described by a double Gaussian function**

$$\mathcal{R}(\Delta t; \hat{a}) = \sum_{i=1}^{2} \frac{f_i}{\sigma_i \sqrt{2\pi}} \exp\left(-(\Delta t - \delta_i)^2 / 2{\sigma_i}^2\right)$$

with $f_1 \approx 70\%,\ \sigma_1 \approx 0.6$ ps,$\sigma_2 \approx 1.8$ ps, $\delta_1 \approx -0.2$ ps

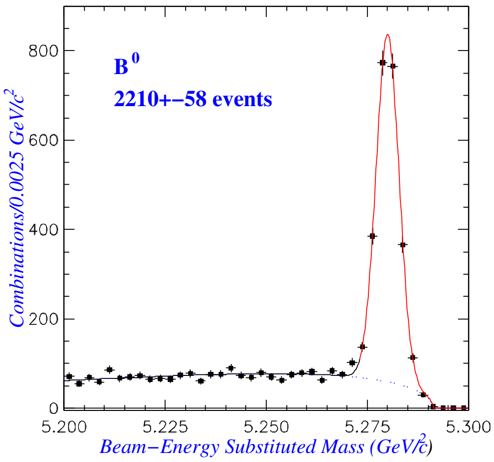
- **We also add a third Gaussian with a fixed width** $\sigma_w = 8$ ps **to account for a small fraction of misreconstructed events. The fraction** $f_w \approx 1\%$
- **For likelihood fits, we use event-by-event error** $\sigma_{\rm fit}(\Delta t)$ **and introduce scale factors** $\mathcal{S}_1 = \sigma_1/\sigma_{\rm fit},\ \mathcal{S}_2 = \sigma_2/\sigma_{\rm fit}$
- **Fit to the sample of hadronic** B **decays**

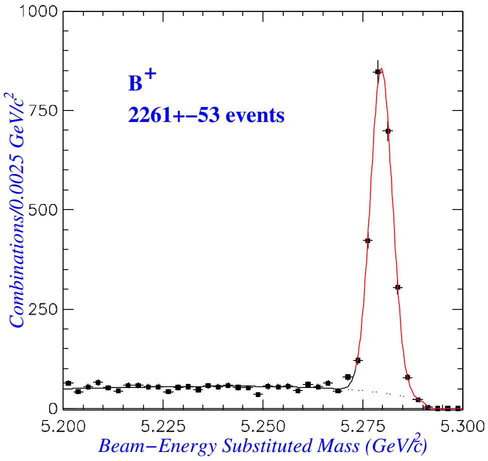
Parameter		Value	
δ_1	(ps)	-0.20 ± 0.06	**from fit**
$\mathcal{S}_1$		1.33 ± 0.14	**from fit**
f_w	(%)	1.6 ± 0.6	**from fit**
f_1	(%)	75	**fixed**
δ_2	(ps)	0	**fixed**
$\mathcal{S}_2$		2.1	**fixed**

B^0 and B^+ lifetimes

→ **Tests understanding of resolution function**

- **Hadronic decays of B^0 and B^+ into open charm and charmonium states**
- B^0 **sample:** 2210 ± 58 **events, 86% purity**
- B^+ **sample:** 2261 ± 53 **events, 89% purity**

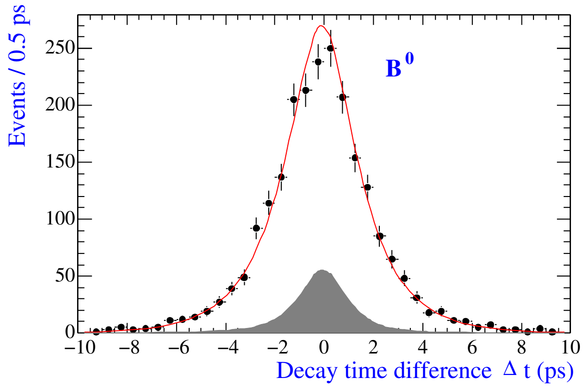




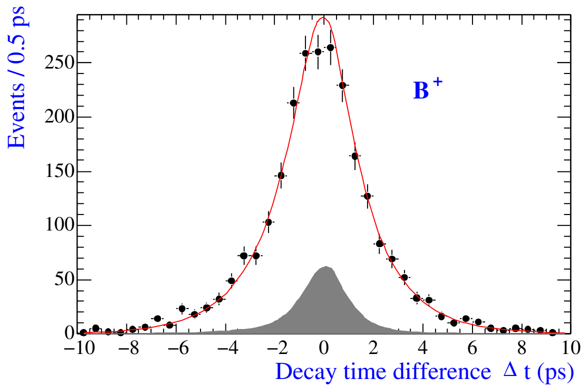
→ **Chih-Hsiang Cheng: Bottom Quark Session, Aug 9, 1:30 pm**

B^0 and B^+ lifetimes (PRELIMINARY)

- $\tau_{B^0} = 1.506 \pm 0.052\ (\mathrm{stat}) \pm 0.029\ (\mathrm{syst})$ ps
  PDG: 1.548 ± 0.032 ps



- $\tau_{B^+} = 1.602 \pm 0.049\ (\mathrm{stat}) \pm 0.035\ (\mathrm{syst})$ ps
  PDG: 1.653 ± 0.028 ps



- $\tau_{B^+}/\tau_{B^0} = 1.065 \pm 0.044\ (\mathrm{stat}) \pm 0.021\ (\mathrm{syst})$
  PDG: 1.062 ± 0.029

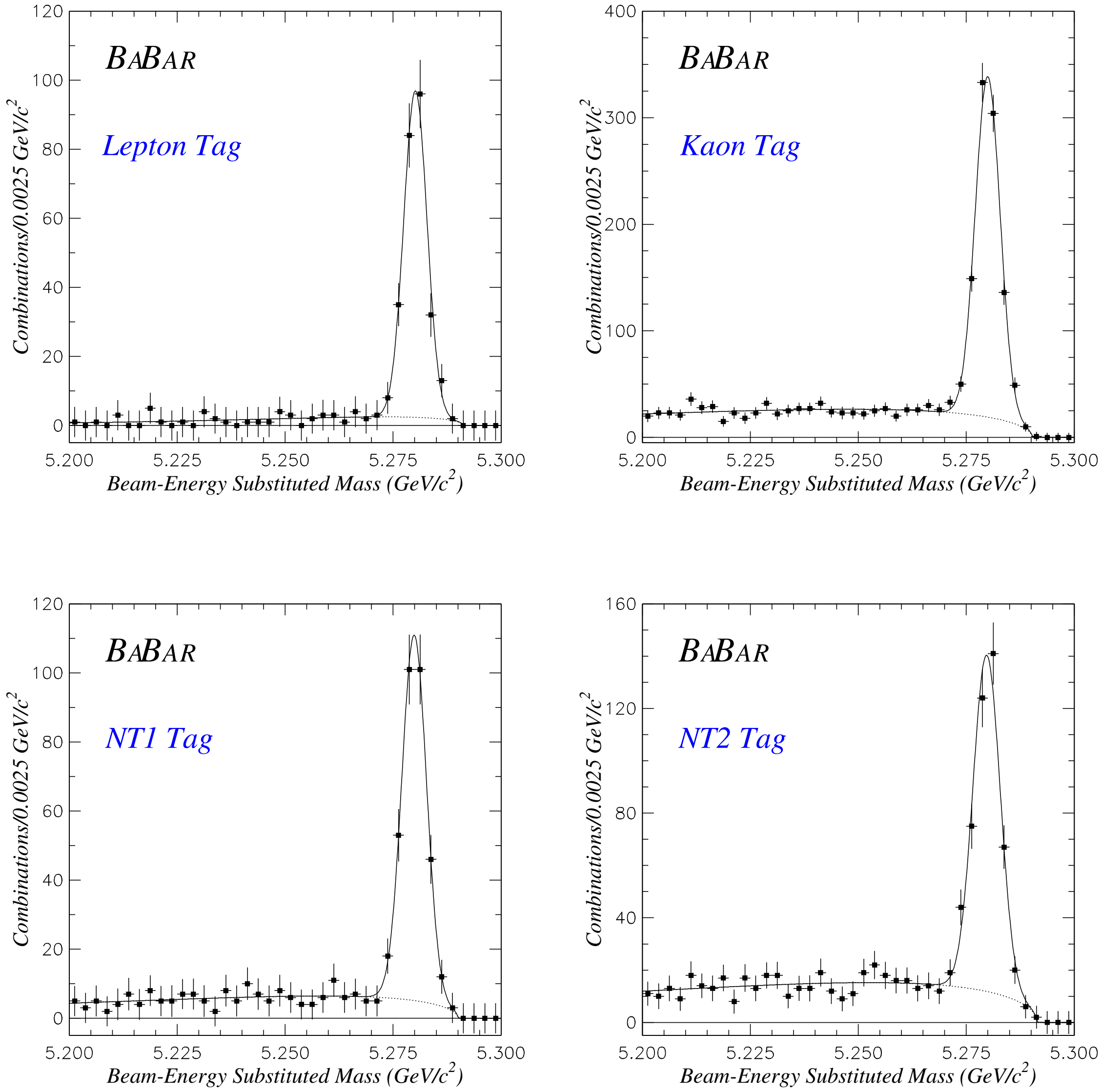
Mistag fractions and Δm_d

- **Directly measure mistag fractions w_i and Δm_d using fully reconstructed B decays into flavor eigenstates**
  - 2577 ± 59 **hadronic** B^0 **decays**
  - 7517 ± 104 $B^0 \to D^* l\nu$ **decays**
  - **Purity** $80 - 90\%$
- **Tag the recoiling B candidate to determine its flavor at decay time and determine the rate of *mixed* and *unmixed* events**
- **Period of time-dependent asymmetry determines Δt and amplitude yields dilutions $\mathcal{D}$**

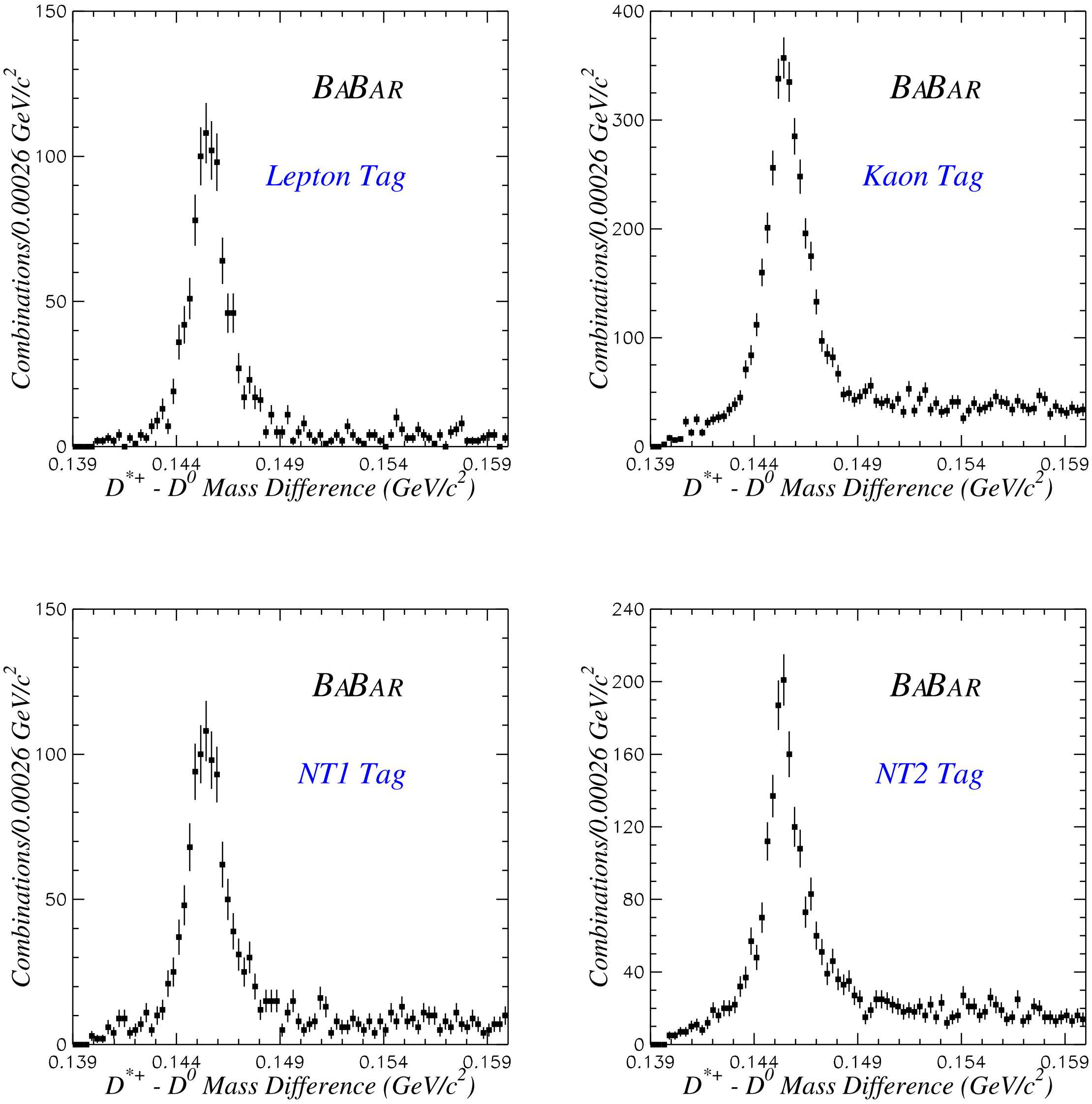
$$a(\Delta t) = \frac{\mathcal{F}_{\text{unmix}} - \mathcal{F}_{\text{mix}}}{\mathcal{F}_{\text{unmix}} + \mathcal{F}_{\text{mix}}} \sim \mathcal{D} \cos \Delta m_d \Delta t$$

$\rightarrow$ **Shahram Rahatlou: Bottom Quark Session, Aug 9, 1:30 pm**

Hadronic Sample

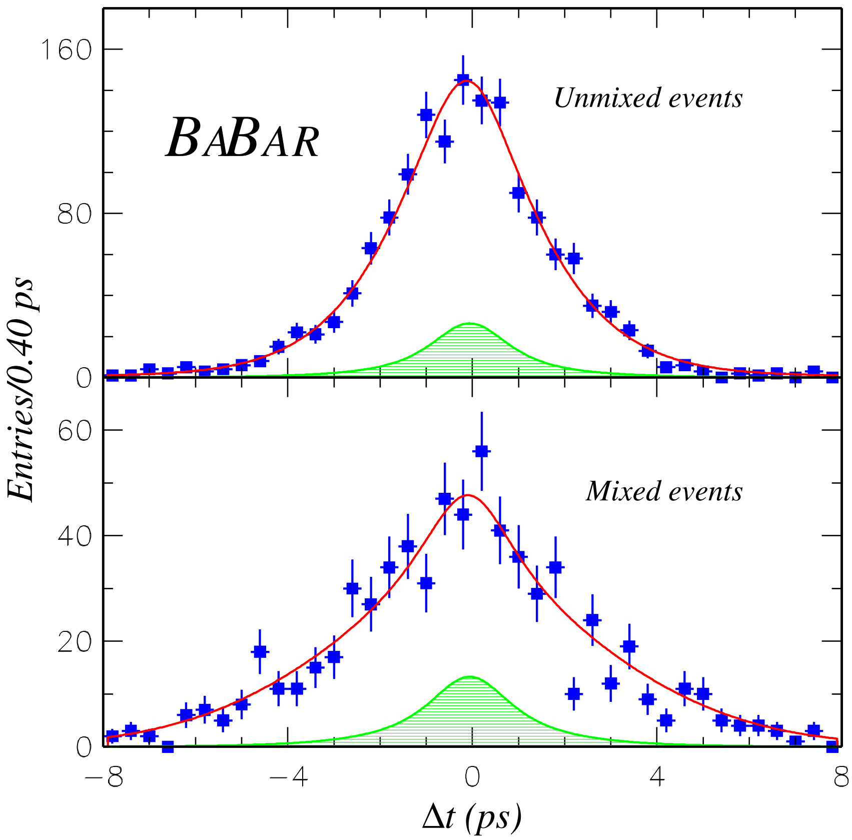


Semileptonic Sample



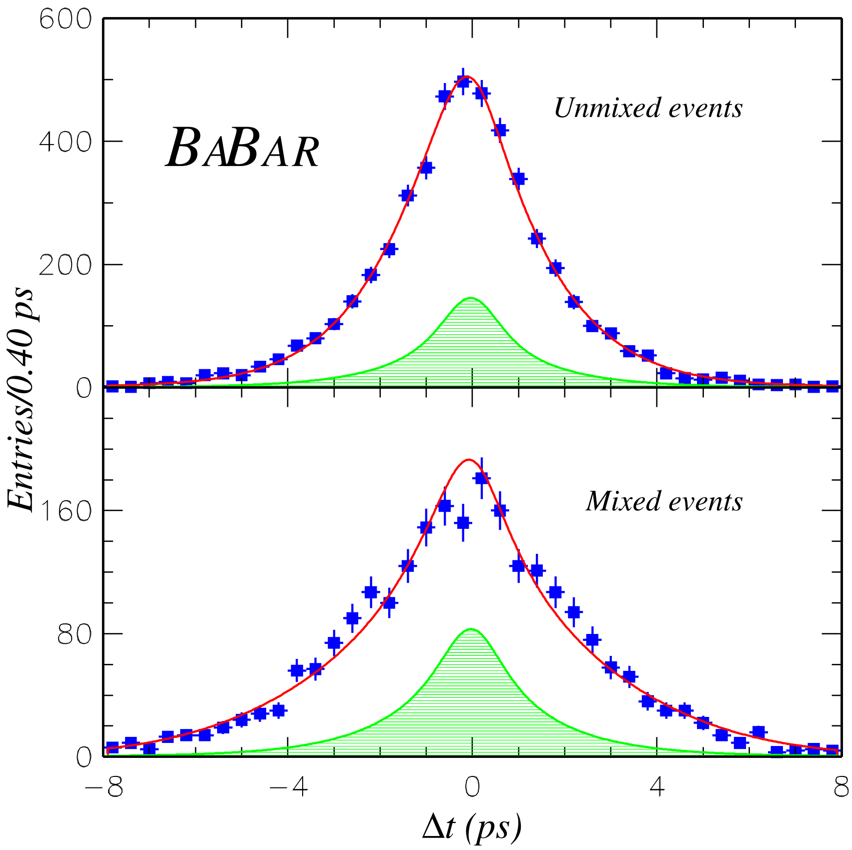
Measurement of Δm_d: Hadronic Sample

- **Unbinned likelihood fit**



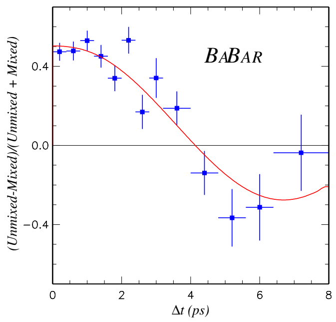
Measurement of Δm_d: Semileptonic Sample

- **Unbinned likelihood fit**

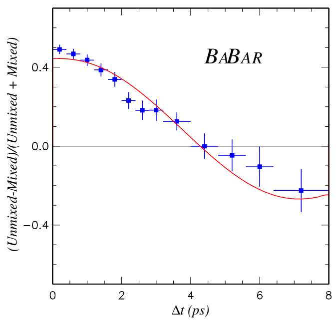


Measurement of Δm_d (PRELIMINARY)

- **Hadronic:**
  $\Delta m_d = 0.516 \pm 0.031\,(\text{stat}) \pm 0.018\,(\text{syst})\,\hbar\,\text{ps}^{-1}$

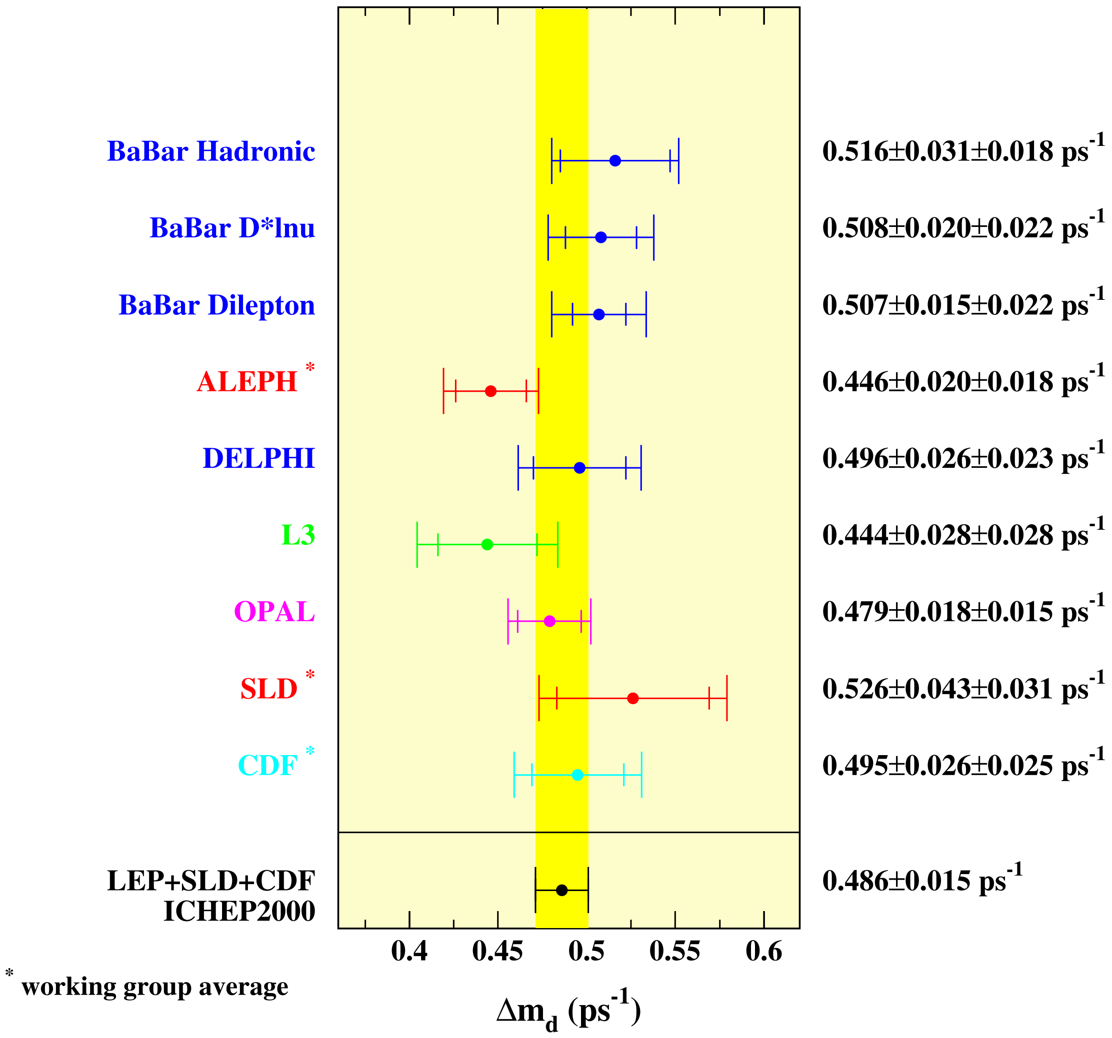


- **Semileptonic:**
  $\Delta m_d = 0.508 \pm 0.020\,(\text{stat}) \pm 0.022\,(\text{syst})\,\hbar\,\text{ps}^{-1}$



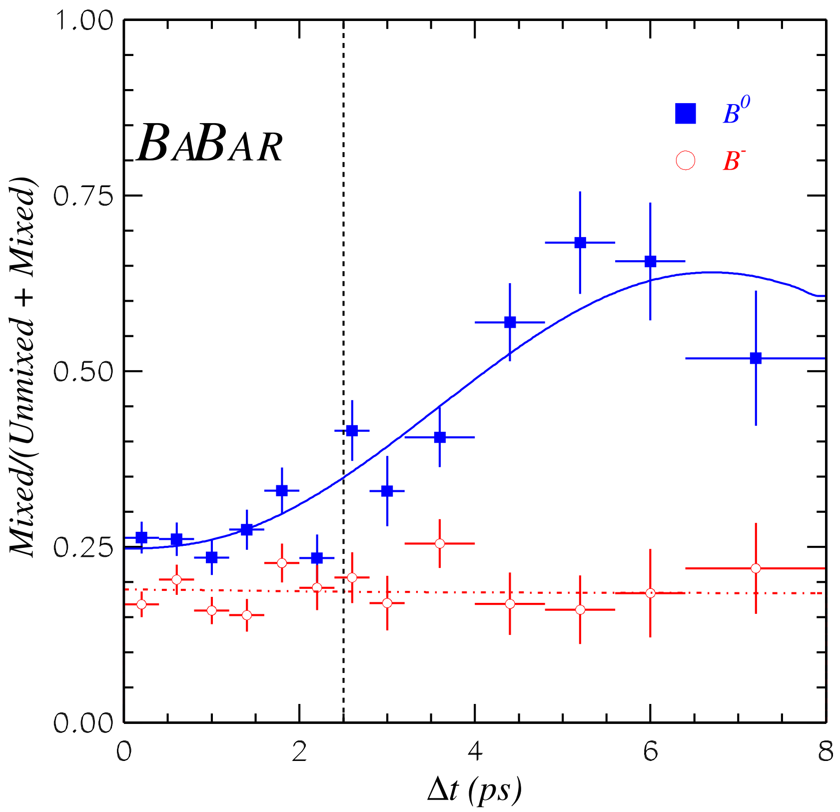
- **Combined:**
  $\Delta m_d = 0.512 \pm 0.017\,(\text{stat}) \pm 0.022\,(\text{syst})\,\hbar\,\textbf{ps}^{-1}$
  ICHEP2000: $\Delta m_d = 0.486 \pm 0.015\,\hbar\,\textbf{ps}^{-1}$

Measurement of Δm_d (PRELIMINARY)



Measurement of Mistag Fractions

- **Results of unbinned maximum likelihood fit**
  - **Use time-integrated measurement as cross check**



Mistag Fractions

Tag Category	Mistag, w	
	Likelihood	Single-Bin
Lepton	$0.096 \pm 0.017 \pm 0.013$	$0.102 \pm 0.016 \pm 0.015$
Kaon	$0.197 \pm 0.013 \pm 0.011$	$0.187 \pm 0.012 \pm 0.015$
NT1	$0.167 \pm 0.022 \pm 0.020$	$0.176 \pm 0.020 \pm 0.024$
NT2	$0.331 \pm 0.021 \pm 0.021$	$0.345 \pm 0.020 \pm 0.023$

$\Rightarrow$ **Effective tagging efficiency** $Q = \epsilon_{\mathrm{tag}}(1-2w)^2 = 0.28$

$\sin 2\beta$: Blind Analysis

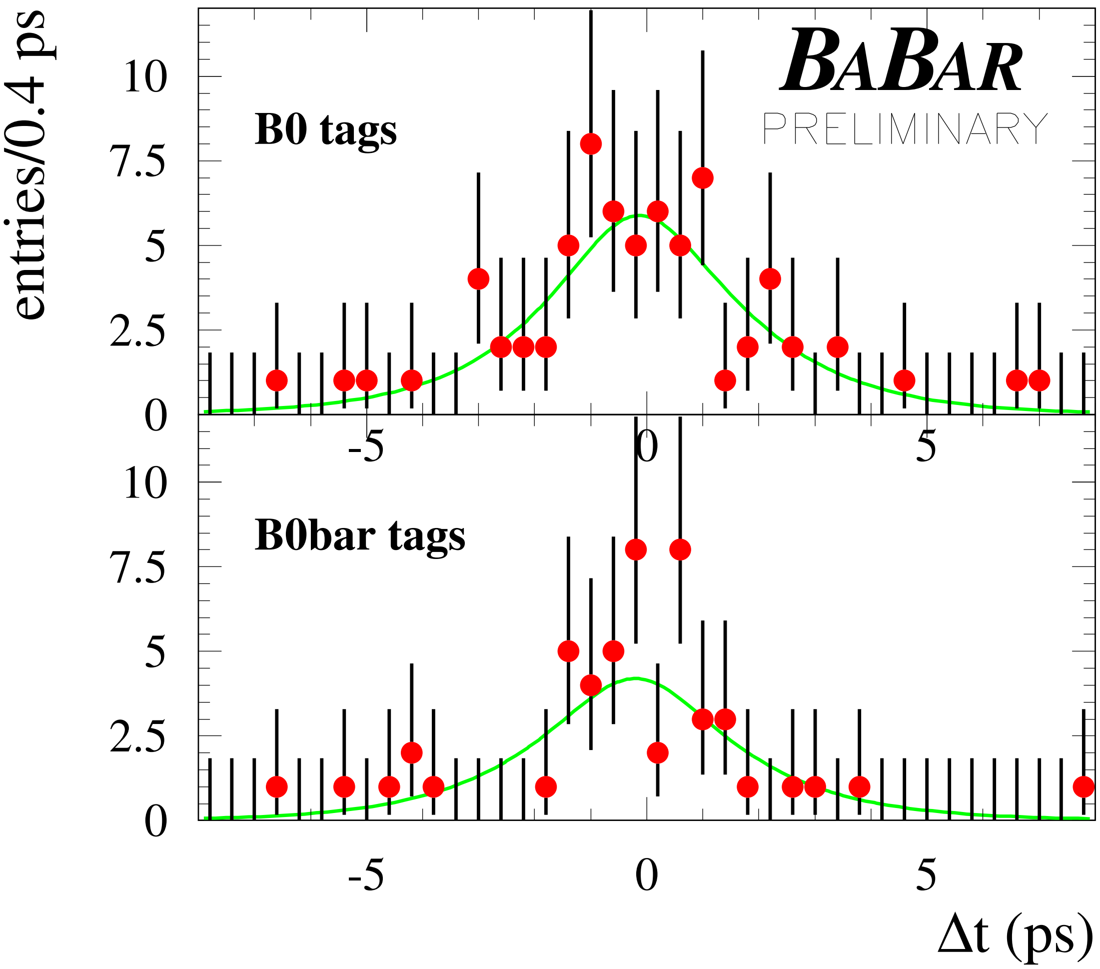
- **The $\sin 2\beta$ analysis was done blind to eliminate analyst's bias**
  - ∗ **The fitted value of $\sin 2\beta$ was hidden by randomly flipping its sign and adding an arbitrary offset**
  - ∗ **The apparent CP asymmetry in the Δt distribution was hidden by multiplying Δt by the sign of the tag and adding an arbitrary offset**
  - $\Rightarrow$ **The fits operated on true values**
  - $\Rightarrow$ **The uncertainty on $\sin 2\beta$ remained correct after blinding, while the value was arbitrary**
- **The blind analysis allows systematic studies of most aspects of the analysis (e.g. event selection, tagging, vertexing, etc.) without danger of a bias**

$\rightarrow$ **The result was unblinded on July 17**

Extracting sin 2β

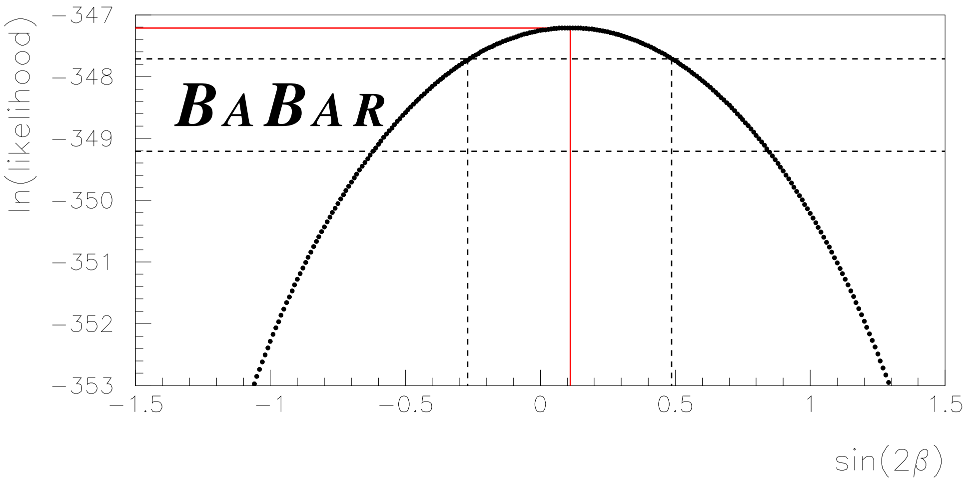
⇒ **Reconstruct 120 tagged events**

- **The Δt distributions of tagged B^0 and $\bar{B}^0$ events analyzed with an unbinned maximum likelihood method**



Extracting $\sin 2\beta$ (PRELIMINARY)

- **Log likelihood function**

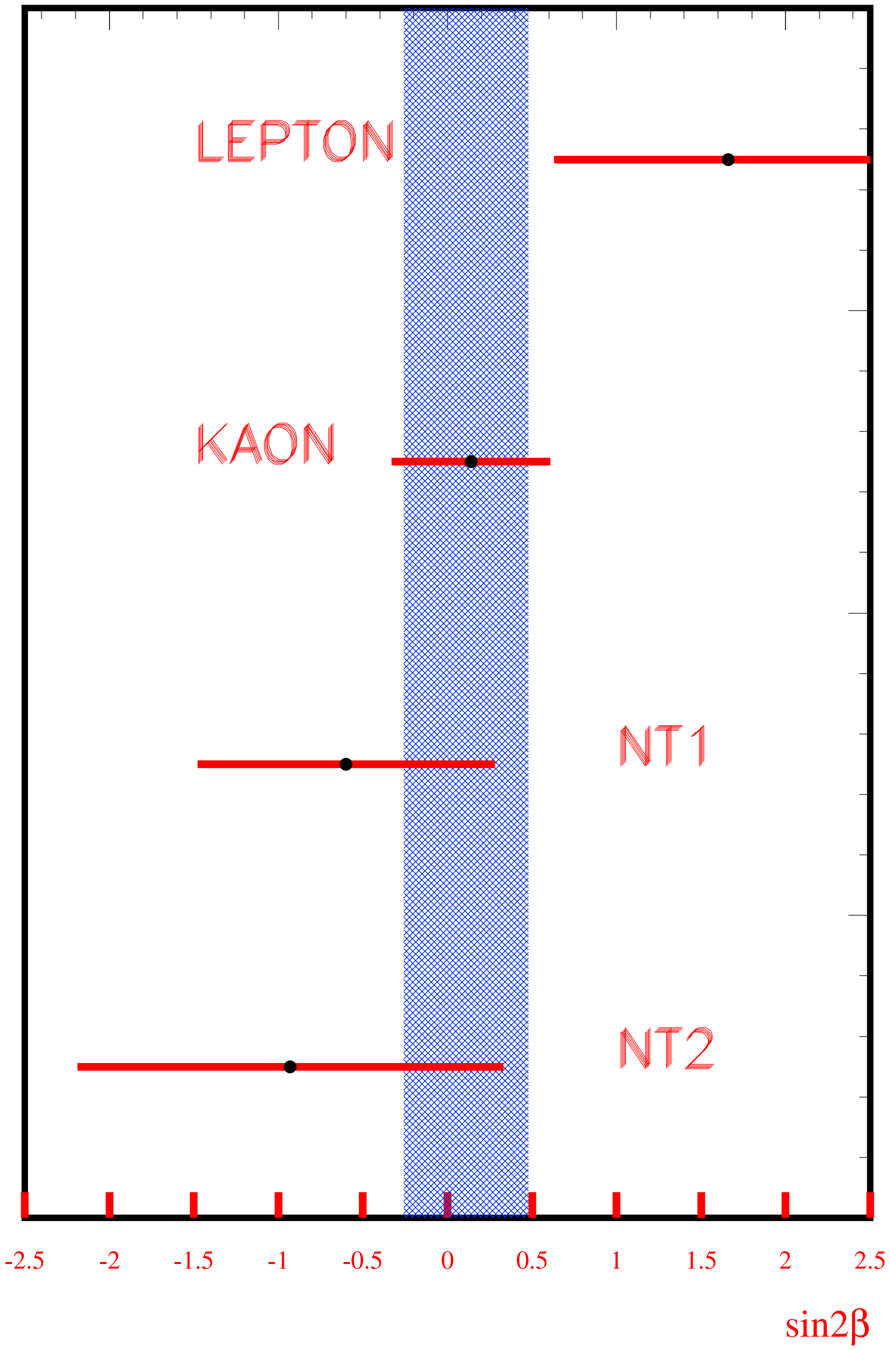


⇒ **Result of the fit**

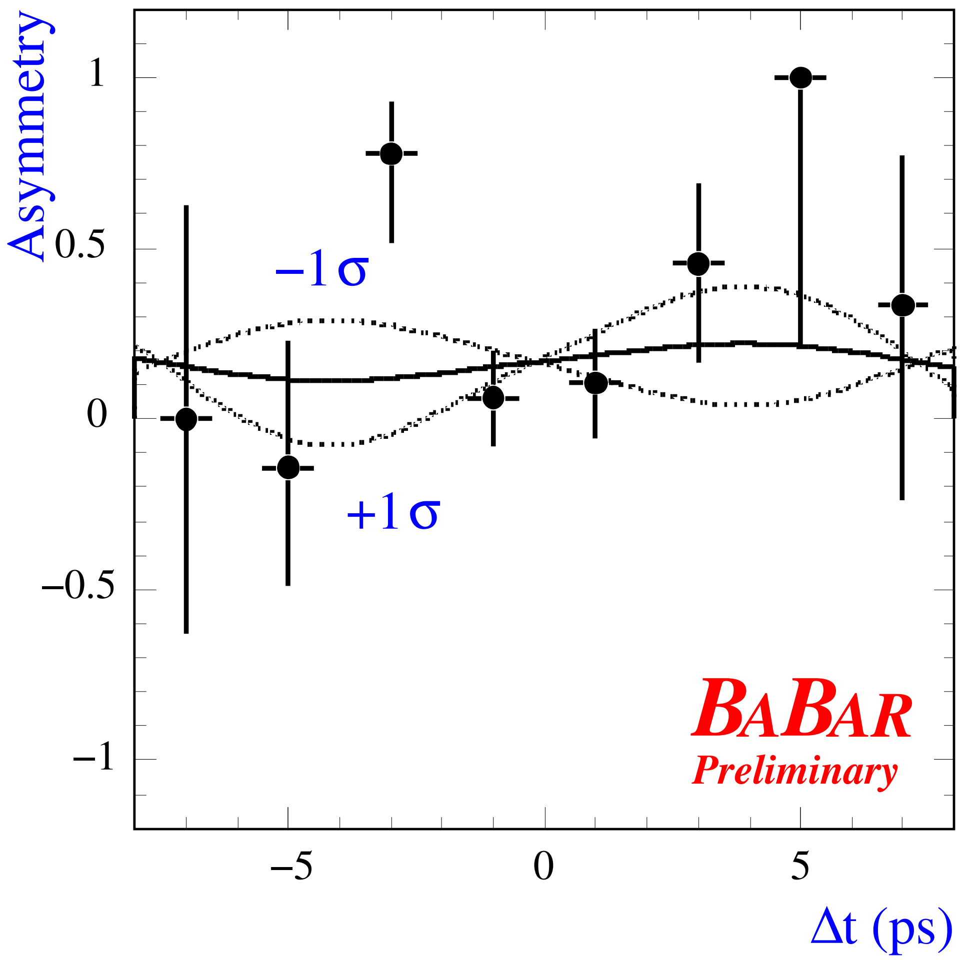
$\sin 2\beta = 0.12 \pm 0.37\,(\mathrm{stat}) \;\; \pm 0.09\,(\mathrm{syst})$

Sample	$\sin 2\beta$
***CP* sample**	$\mathbf{0.12 \pm 0.37}$
$J/\Psi K_S^0\;(K_S^0 \to \pi^+\pi^-)$ **events**	-0.10 ± 0.42
other *CP* events	0.87 ± 0.81
`Lepton`	1.6 ± 1.0
`Kaon`	0.14 ± 0.47
`NT1`	-0.59 ± 0.87
`NT2`	-0.96 ± 1.30

Extracting sin 2β (PRELIMINARY)



Graphical Representation



- **Probability to obtain likelihood lower than the fitted value is 20%**
- **χ^2 for the binned asymmetry and the likelihood fit is 9.2 for 7 degrees of freedom**

Graphical Representation

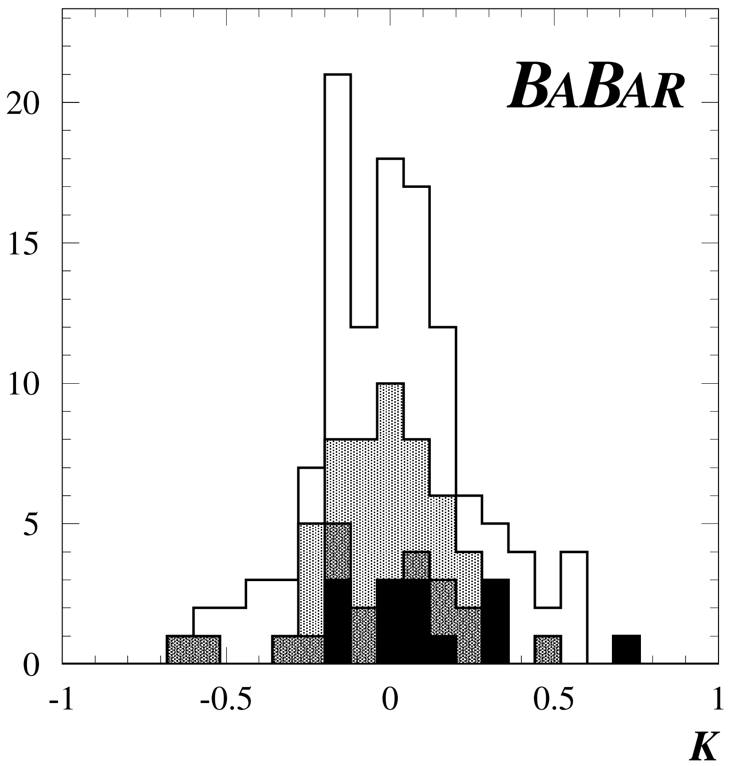
- **KIN variable $\mathcal{K}$**

$$\mathcal{K} = \left(\frac{\varepsilon_{\rm tag}}{\sin 2\beta}\right) \times (\mathcal{F}_+ - \mathcal{F}_-)\,/\,(\mathcal{F}_+ + \mathcal{F}_-) \approx \varepsilon_{\rm tag}\mathcal{D}\sin\Delta m_d \Delta t$$

where $\varepsilon_{tag} = +1(-1)$ for a $B^0(\bar{B}^0)$ tag

- **$\mathcal{K}$ is a simple measure of $\sin 2\beta$:**

$$\sin 2\beta = \langle\, \mathcal{K}\,\rangle / \left\langle\, \mathcal{K}^2 \,\right\rangle \pm \sqrt{[\,1 - \sin^2 2\beta \,\langle\, \mathcal{K}^4\,\rangle / \langle\, \mathcal{K}^2\,\rangle\,]\,/\,[\,N_{CP}\,\langle\, \mathcal{K}^2\,\rangle]}$$



Tests of null CP asymmetry

Sample	**Apparent CP asymmetry**
Hadronic B^+ decays	0.03 ± 0.07
Hadronic B^0 decays	-0.01 ± 0.08
$J/\Psi K^+$	0.13 ± 0.14
$J/\Psi K^{*0}$ $(K^{*0} \to K^+\pi^-)$	0.49 ± 0.26

Statistical Error

- **Use "toy" Monte Carlo with realistic resolutions to determine the distribution of 1σ statistical errors for a large number of experiments of 120 events**
  - **Distribution of errors is centered around** $\langle\sigma(\sin 2\beta)\rangle = 0.32$
  - **RMS of the distribution is** 0.03
  - **Probability to obtain a statistical error larger than** 0.37 **is** **5%**

Systematics

Source of uncertainty	Uncertainty on $\sin 2\beta$
τ_{B^0}	0.002
Δm_d	0.015
Δz resolution for CP sample	0.019
Time-resolution bias for CP sample	0.047
Measurement of mistag fractions	0.053
Different mistag fractions for CP and non-CP samples	0.050
Different mistag fractions for B^0 and $\bar{B}^0$	0.005
Background in CP sample	0.015
Total systematic error	**0.091**

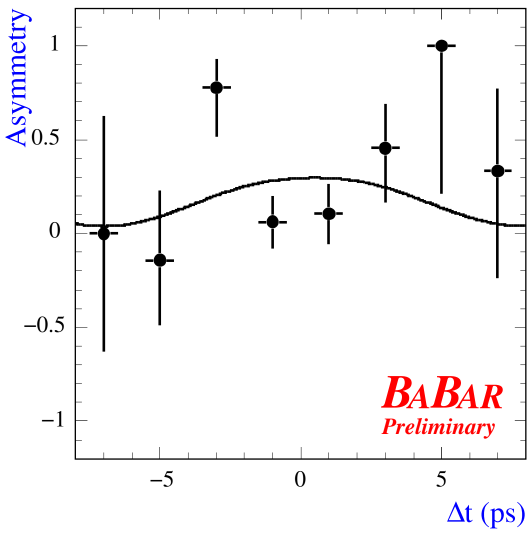
Fit for Indirect *CP* Violation

- **Allow a cos term in the time-dependent asymmetry**

$$\mathcal{A}_{CP}(\Delta t) = \frac{\mathcal{D}\sin 2\beta \sin \Delta m_d \Delta t + \left(1 - |\lambda_{CP}|^2\right)\cos \Delta m_d \Delta t}{1 + |\lambda_{CP}|^2}$$

$\rightarrow$ $\sin 2\beta = 0.12 \pm 0.37$

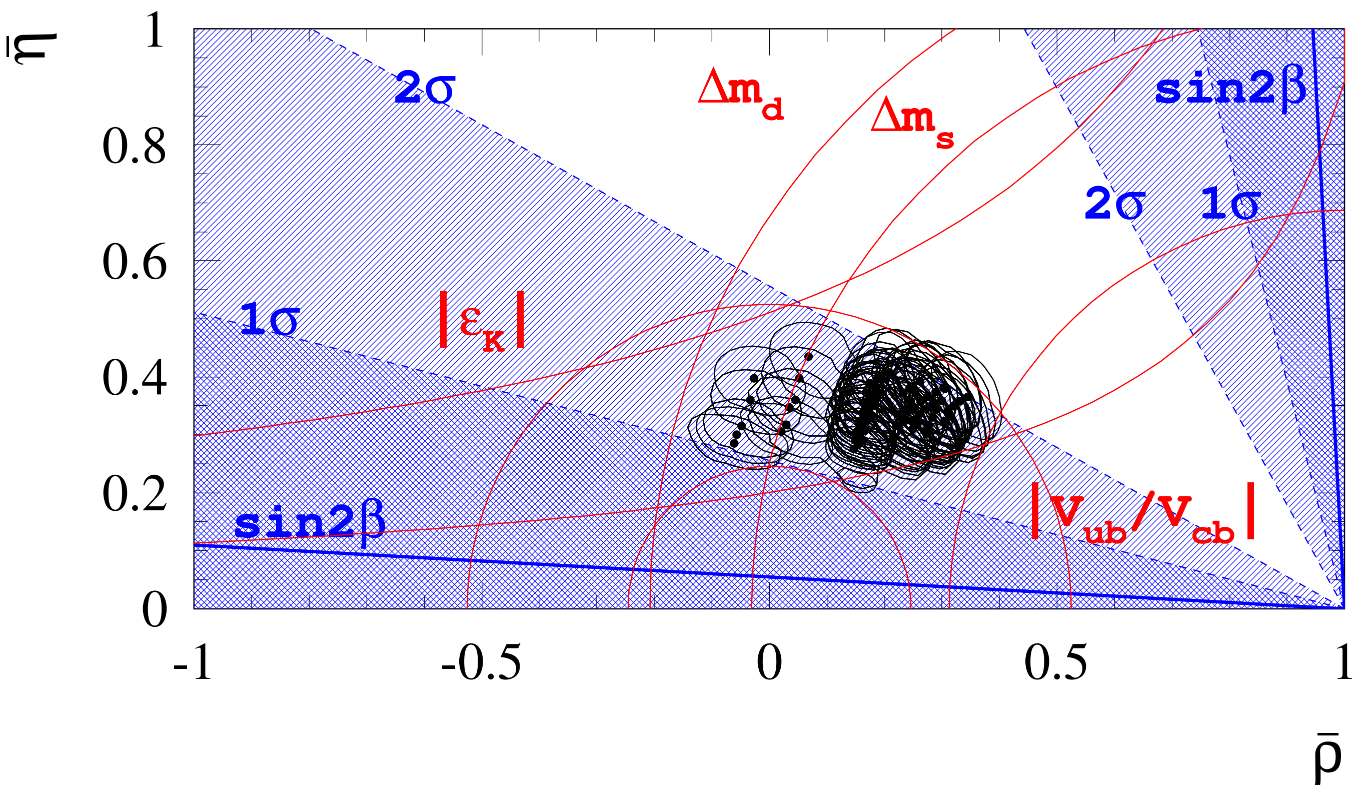
$\rightarrow$ $\frac{1-|\lambda_{CP}|^2}{1+|\lambda_{CP}|^2} = 0.26 \pm 0.19$



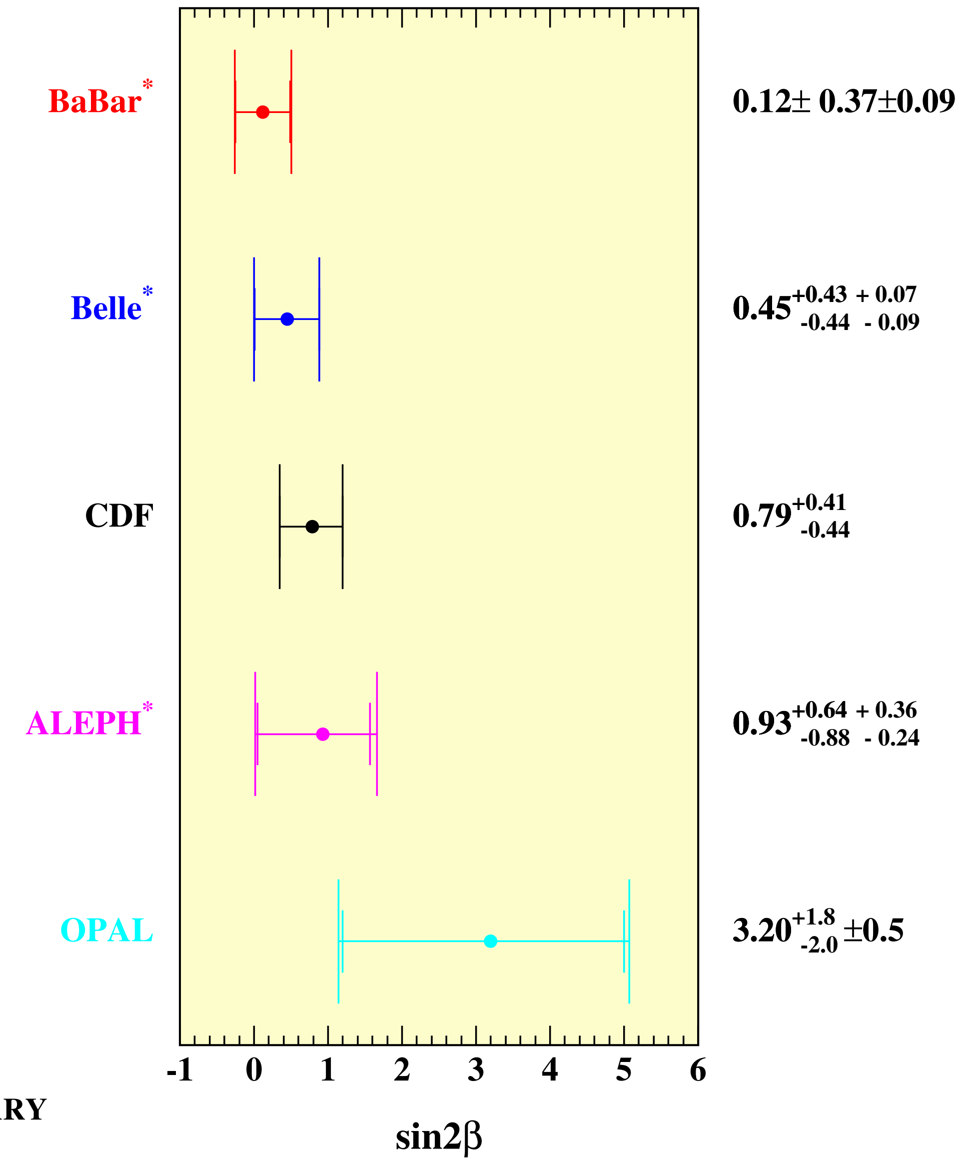
Constraints on Unitarity Triangle

- The ellipses represent the allowed range of $(\bar{\rho}, \bar{\eta}$ parameters based on the present measurements and typical ranges of the model-dependent theoretical parameters

→ $\sin 2\beta$ values NOT included in the fits



World Data on $\sin 2\beta$



* PRELIMINARY

Conclusions and Outlook

- **Very productive first year**
  - $*$ **PEP-II delivered more than 16 fb^{-1}**
  - $*$ ***BABAR* recored over 15 fb^{-1}**
  - $*$ **Detector and computing keeping up with the data**
  - $\Rightarrow$ **Many analysis efforts underway**
- **With $\approx$ $9\ \mathrm{fb}^{-1}$ of data on $\Upsilon(4S)$, we reconstructed 120 tagged decays of B^0 and $\bar{B}^0$ into CP eigenstates $J/\Psi K_S^0$ and $\Psi(2S)K_S^0$**
  - $\Rightarrow$ **Measure**

    $\sin 2\beta = 0.12 \pm 0.37\ (\mathrm{stat})\ \pm 0.09\ (\mathrm{syst})$
- **PEP-II will run through October, with the goal of integrating $25\ \mathrm{fb}^{-1}$**
  - $*$ **Interesting measurement of $\sin 2\beta$ in the charmonium states by the end of the year**
  - $*$ **Many more exciting opportunities**