Physics Potential of BABAR with 1 ab^{-1}

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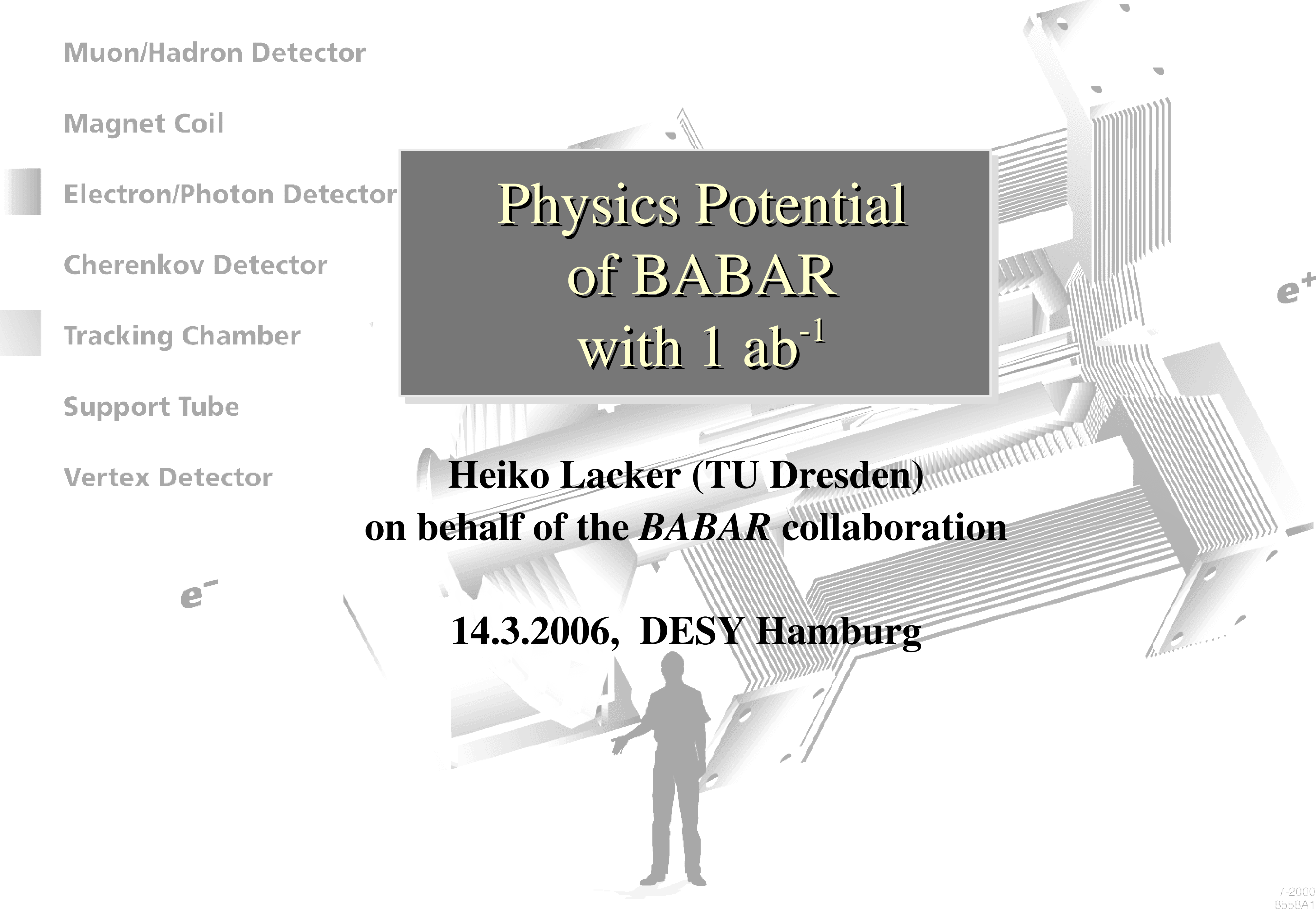
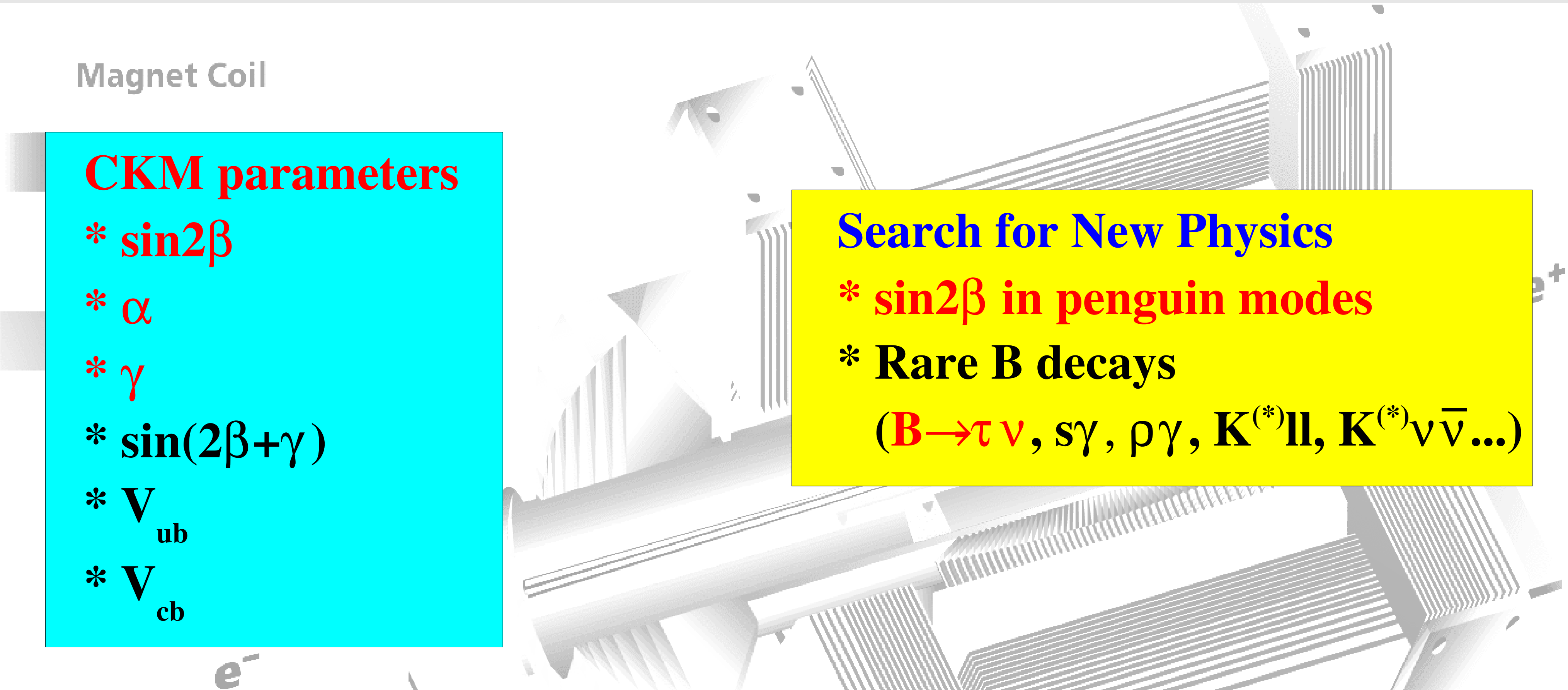
on behalf of the *BABAR* collaboration

14.3.2006, DESY Hamburg



Physics Programme of BABAR

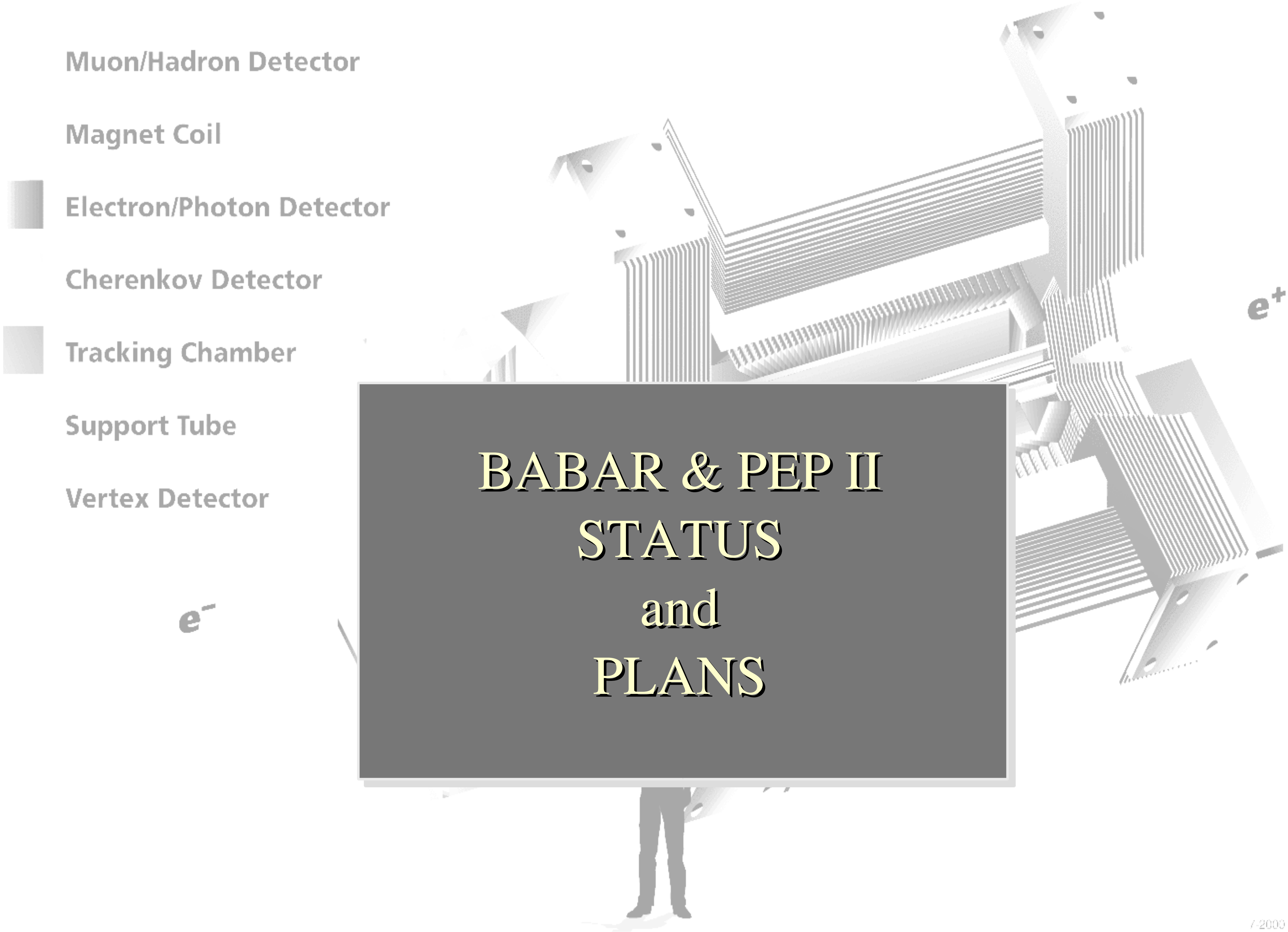


CKM parameters
* $\sin 2\beta$
* α
* γ
* $\sin(2\beta+\gamma)$
* V_{ub}
* V_{cb}

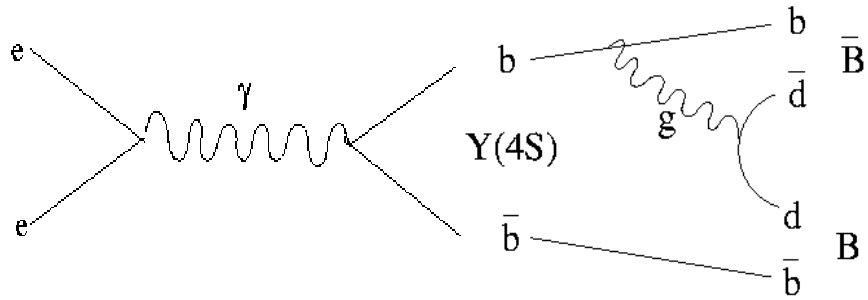
Search for New Physics
* $\sin 2\beta$ in penguin modes
* Rare B decays
  ($B\to\tau\nu$, $s\gamma$, $\rho\gamma$, $K^{(*)}ll$, $K^{(*)}\nu\bar{\nu}$...)

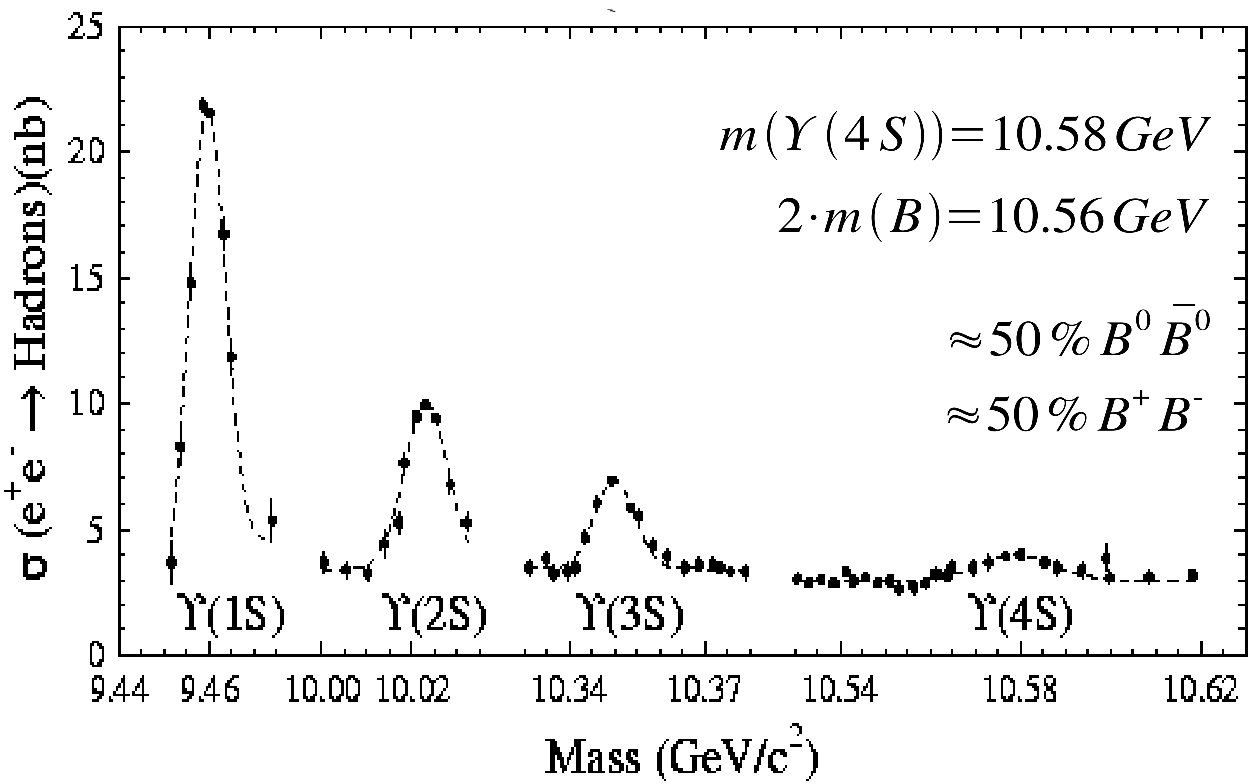
More than just a B-factory
* tau, charm, ISR, two photon physics
  => Rare τ ($\tau\to l\gamma$, ...) & charm ($D^0\to l^+l^-$, ...) decays; R, ...
* Spinoff:
  1. Many new unexpected states discovered (D_{SJ}, Y(4260), ...)
  2. Pentaquark searches in different environments

BABAR & PEP II STATUS and PLANS



An almost pure B-meson source: Υ(4S)



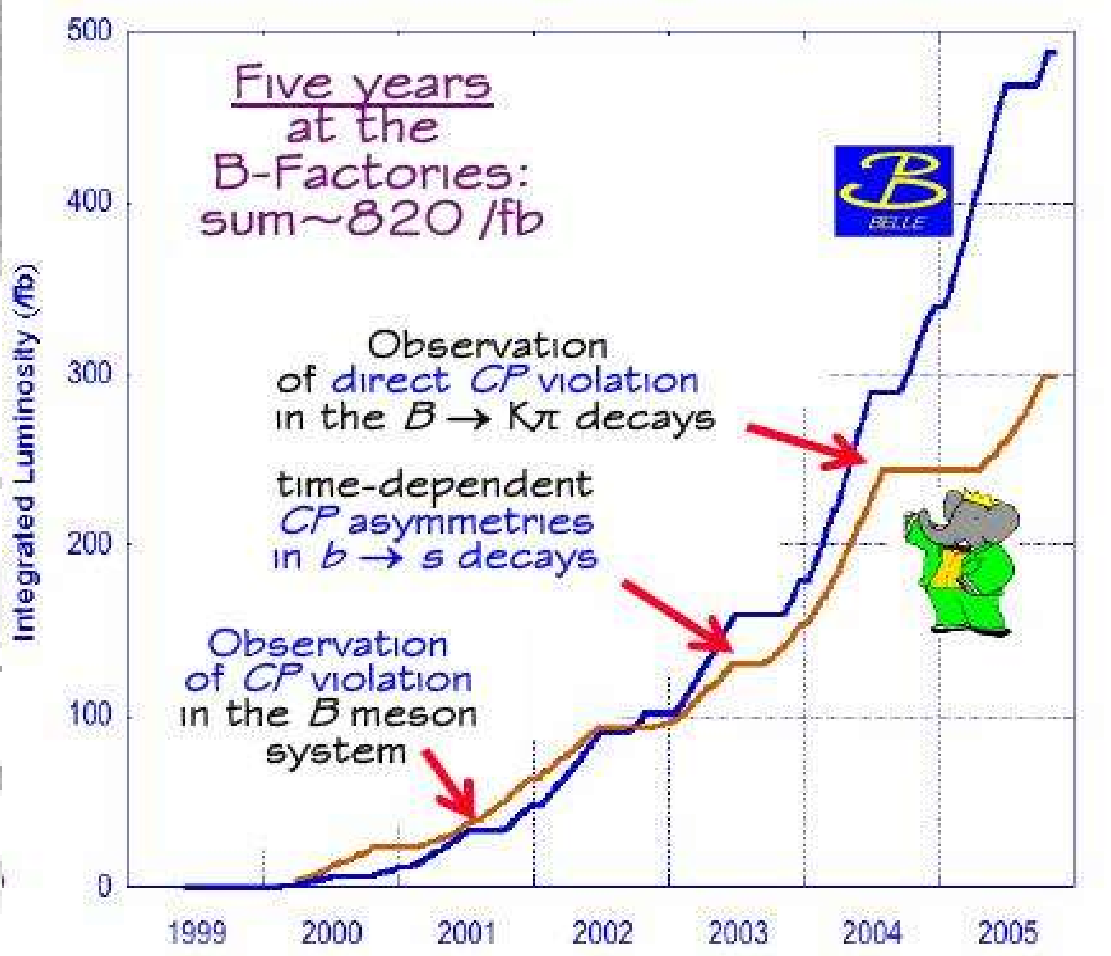


$e^+e^- \rightarrow$	σ (nb)
$b\,\bar{b}$	1.05
$u\,\bar{u}$	1.39
$d\,\bar{d}$	0.35
$s\,\bar{s}$	0.35
$c\,\bar{c}$	1.30
$\tau^+\tau^-$	0.94
$\mu^+\mu^-$	1.16
e^+e-	≈ 40

\+ S/B ~ 1/3.5 (Hadron Machines O(10^{-3}))

\- Small cross section => High luminosity needed and realized @ PEP-II/BABAR und KEKb/Belle

The B-Factories



PEP II Records

Peak luminosity	1.00×10^{34} cm^{-2}s^{-1} (3 × design!)
Best shift	247.2 pb^{-1}
Best day	710.5 pb^{-1}
Best 7 days	4.5 fb^{-1}
Best month	16.7 fb^{-1}
Best 30 days	17.0 fb^{-1}
BABAR logged	318.1 fb^{-1}

More data per day than ARGUS in total (80/90ies)

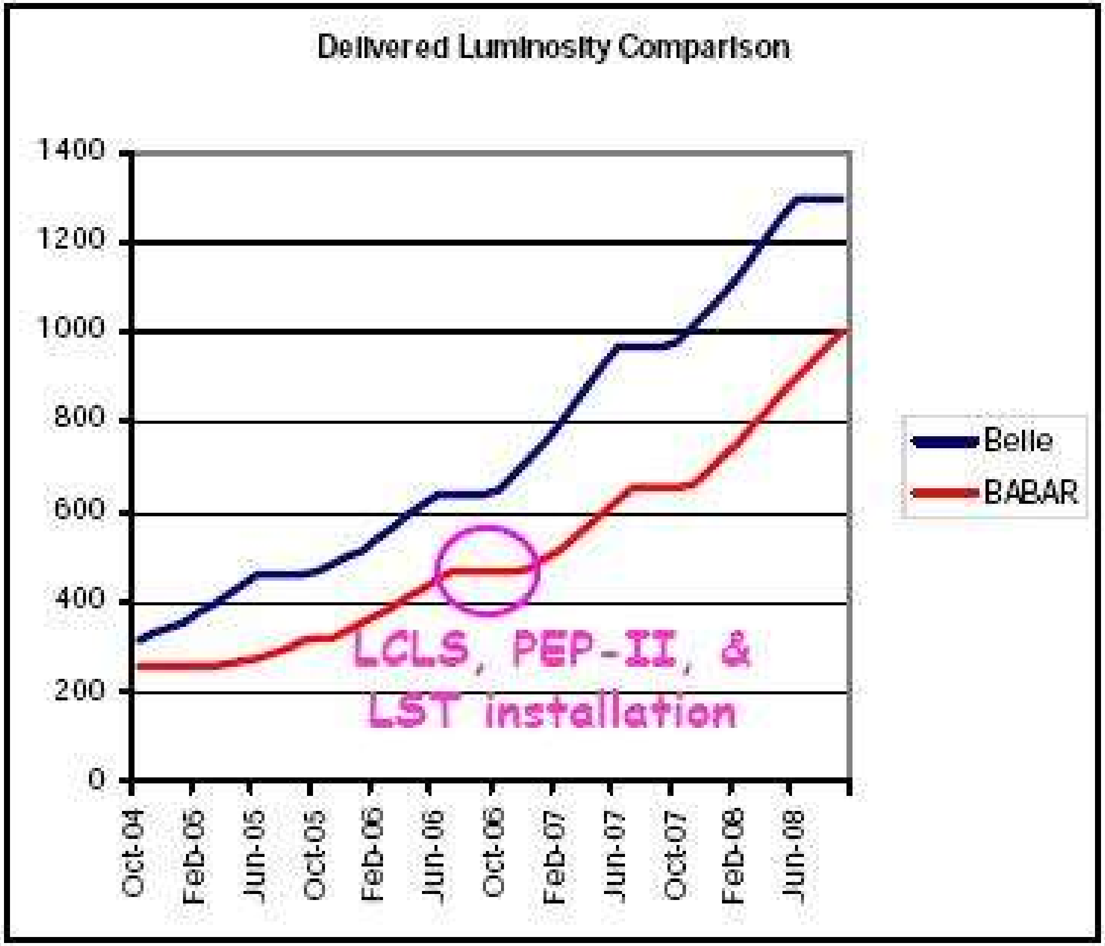
PEP II Plans

Goals:

* 1.2×10^{34} spring 2006 (3300 mA LER, 1700 mA HER)
* Improve peak lumi to 2×10^{34} by 2008

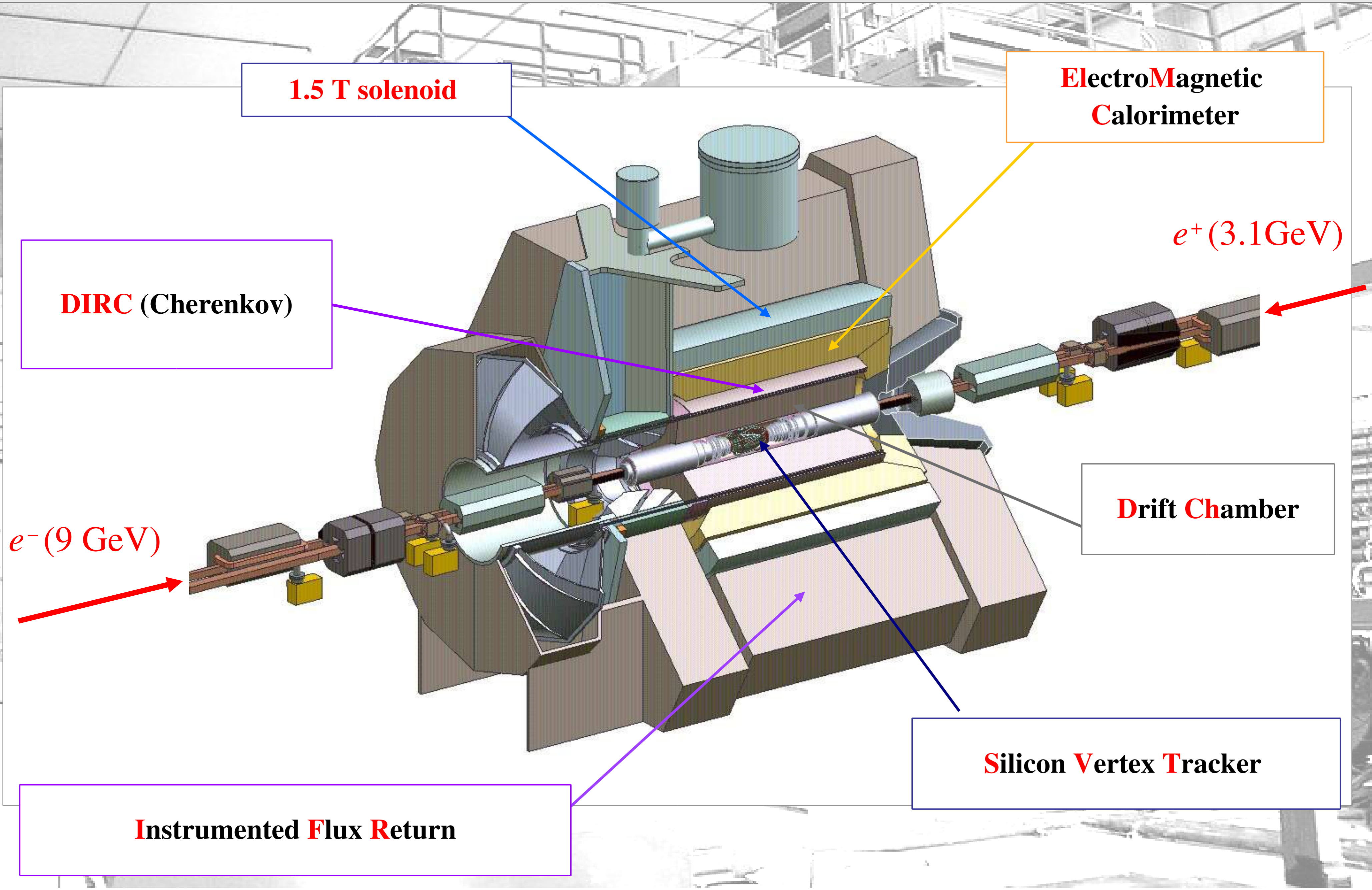
2006: Double data to 450 fb^{-1}

2008: Double again to 1000 fb^{-1}



BABAR Detector

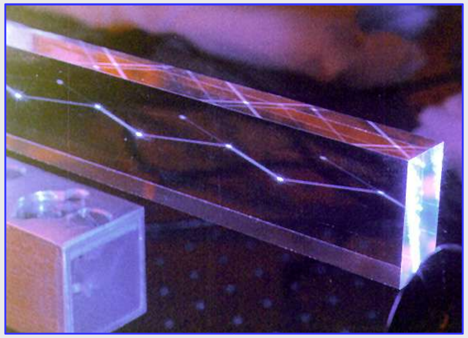
BABAR, NIM A479, 1 (2002)

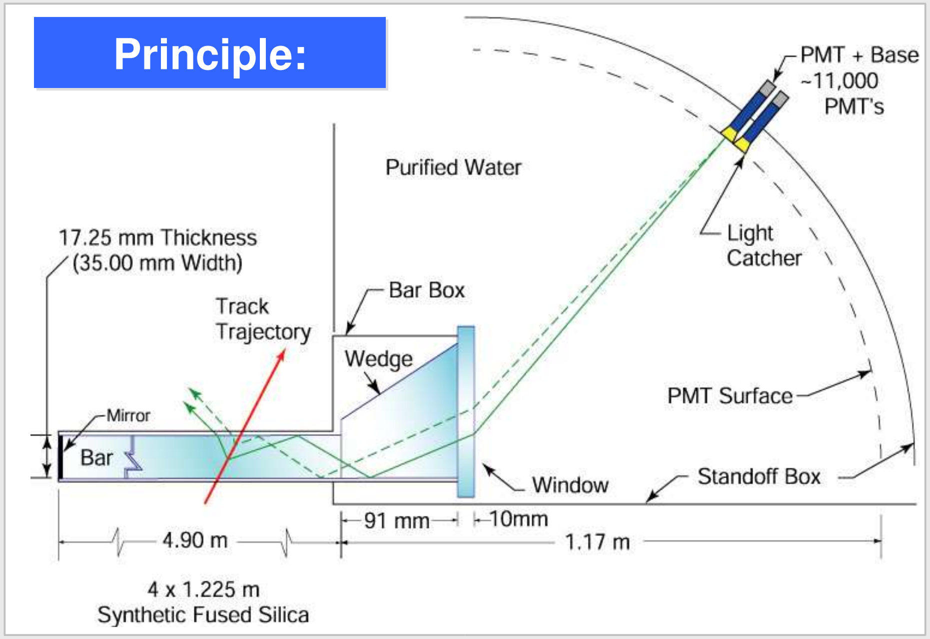


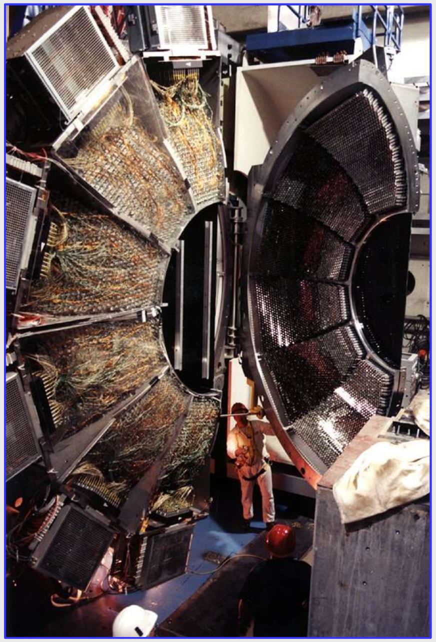
Innovative PID @ BABAR: DIRC

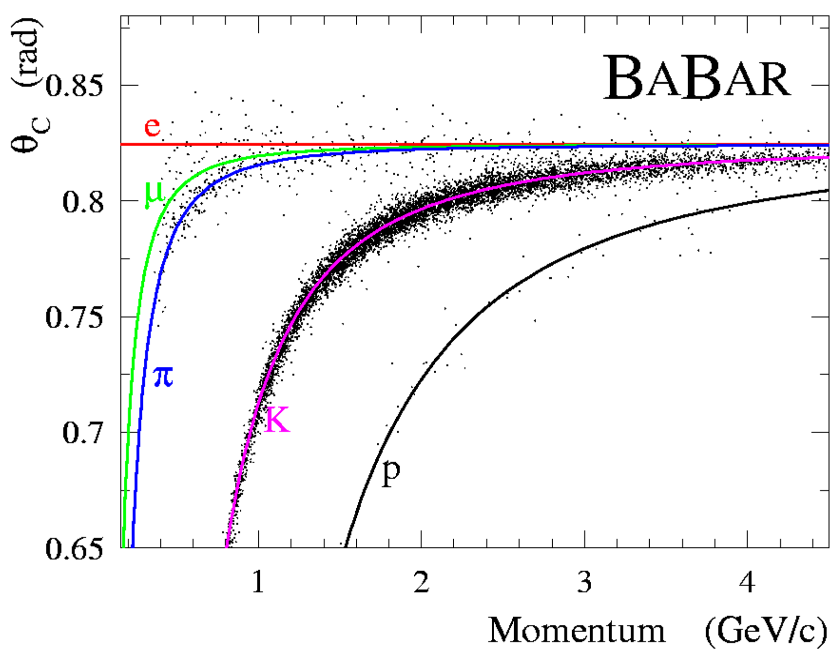
BABAR-DIRC, NIM A502, 67 (2003)

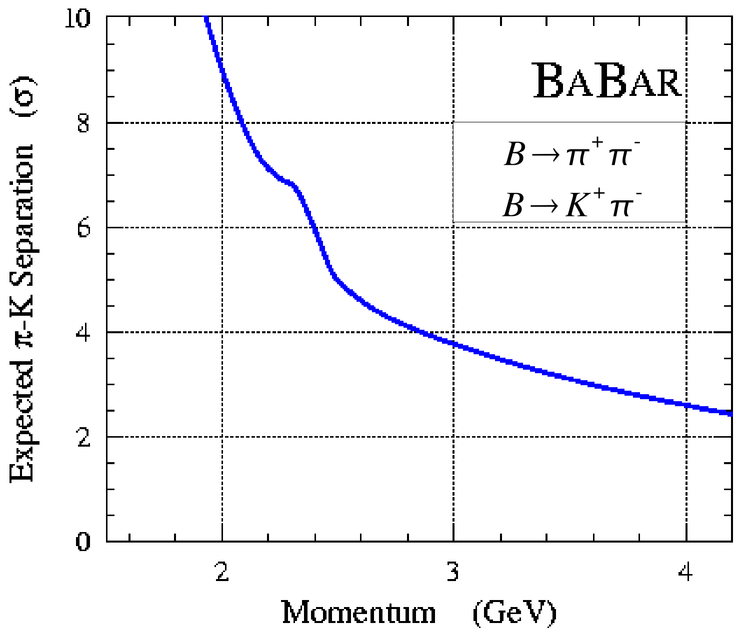
Detection of
Internally
Reflected
Čerenkov light

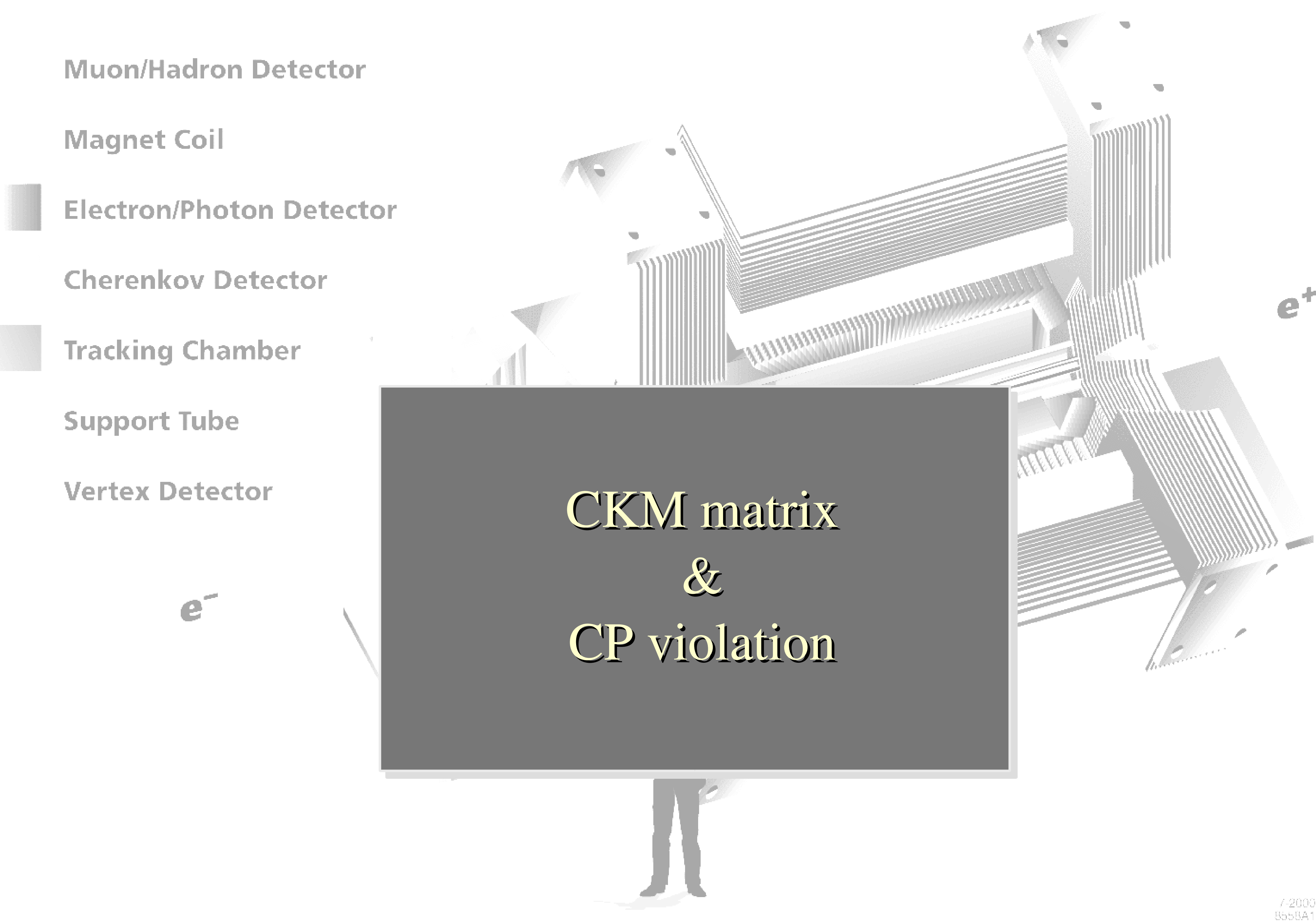












CKM matrix & CP violation

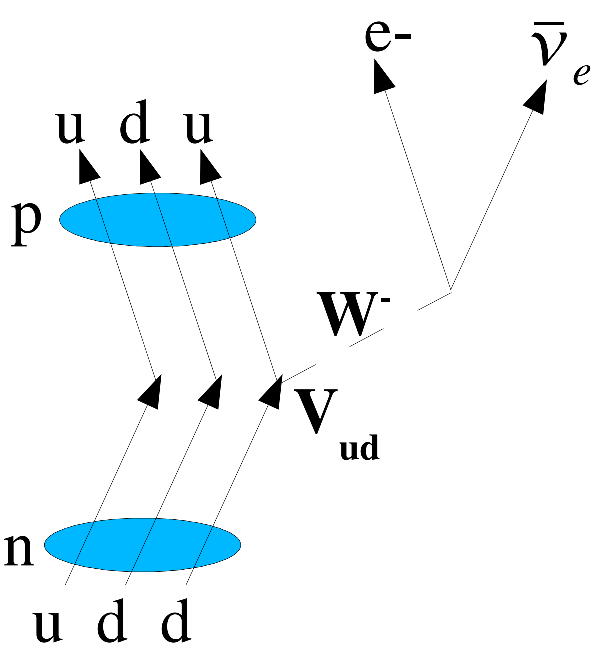
Origin of CKM-Matrix:

Mass versus Weak Interaction Eigenstates

$$L_{quark\ masses} = \bar{u}_L M_u u_R + \bar{d}_L M_d d_R + h.c.\,, \quad u \equiv \begin{pmatrix} u \\ c \\ t \end{pmatrix}, d \equiv \begin{pmatrix} d \\ s \\ b \end{pmatrix}$$

M_u, M_d complex 3x3-Matrices

DIAGONALISATION: $M_{u,diag} = U_L^+ M_u U_R \quad M_{d,diag} = D_L^+ M_d D_R$



Mass Eigenstates

$$\begin{pmatrix} d' \\ s' \\ b' \end{pmatrix} = U_L^+ D_L \cdot \begin{pmatrix} d \\ s \\ b \end{pmatrix}$$

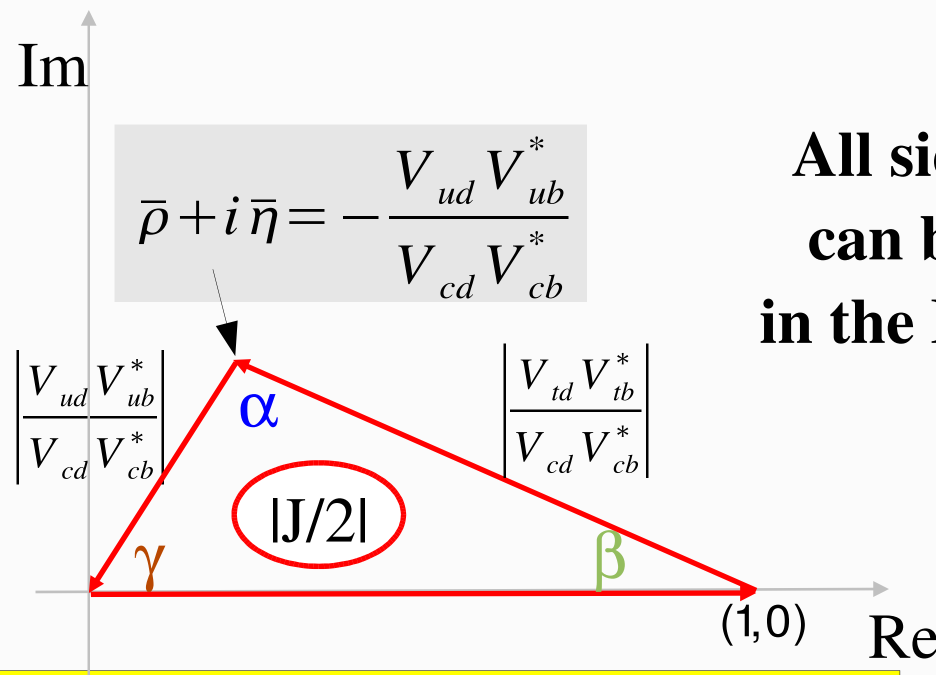
Eigenstates of weak interaction

$$V_{CKM} = \begin{pmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{pmatrix}$$

unitary

CP violation quantitatively: Unitarity Triangle

$$\frac{1}{V_{cd}V_{cb}^{*}}\left(V_{ud}V_{ub}^{*}+V_{cd}V_{cb}^{*}+V_{td}V_{tb}^{*}\right)=0$$



All sides & angles can be determined in the B-meson system!

J: Jarlskog parameter

All data compatible with CKM ?

Yes → **Precise determination of CKM parameters**

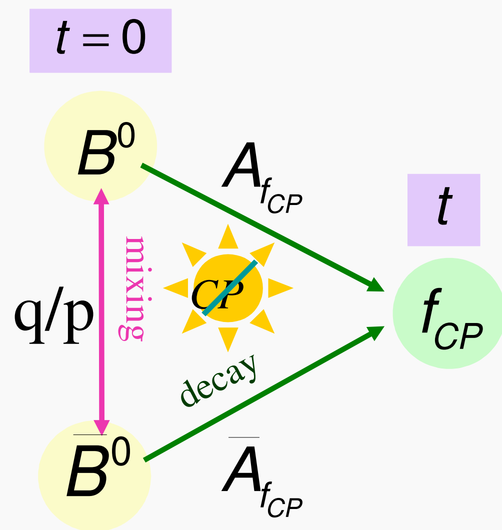
No → **New Physics beyond SM (Higgs sector, SUSY, ...)**

Veni, vidi, vici:
sin2β

Different manifestations of *CP* violation

$$i\frac{d}{dt}\begin{pmatrix} B^0 \\ \bar{B}^0 \end{pmatrix} = \left(M - \frac{i}{2}\Gamma\right)\begin{pmatrix} B^0 \\ \bar{B}^0 \end{pmatrix}$$

$$|B_L> \propto p|B^0> + q|\bar{B}^0>$$
$$|B_H> \propto p|B^0> - q|\bar{B}^0>$$
$$\Delta m_B \equiv M_H - M_L$$



$$\lambda_{f_{CP}} = \eta_{f_{CP}} \frac{q}{p} \frac{\bar{A}_{f_{CP}}}{A_{f_{CP}}}$$

***CP*-Eigenvalue**

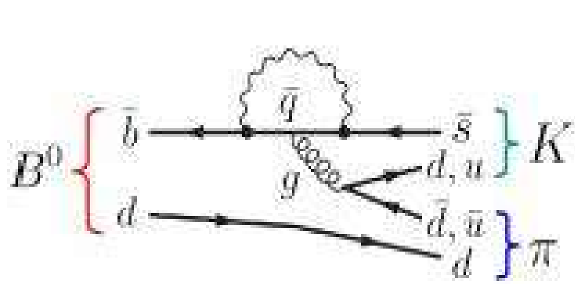
$$A_{CP}(t) = \frac{\Gamma(\bar{B}^0(t) \to f_{CP}) - \Gamma(B^0(t) \to f_{CP})}{\Gamma(\bar{B}^0(t) \to f_{CP}) + \Gamma(B^0(t) \to f_{CP})}$$

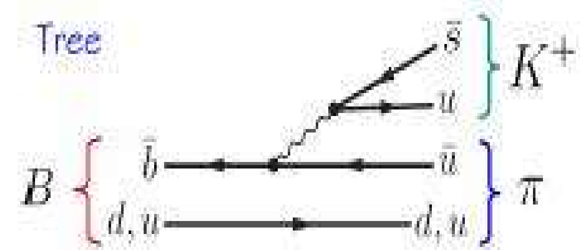
$$= \frac{2\,\mathrm{Im}\,\lambda}{1+|\lambda|^2}\sin(\Delta m_d t) - \frac{1-|\lambda|^2}{1+|\lambda|^2}\cos(\Delta m_d t)$$

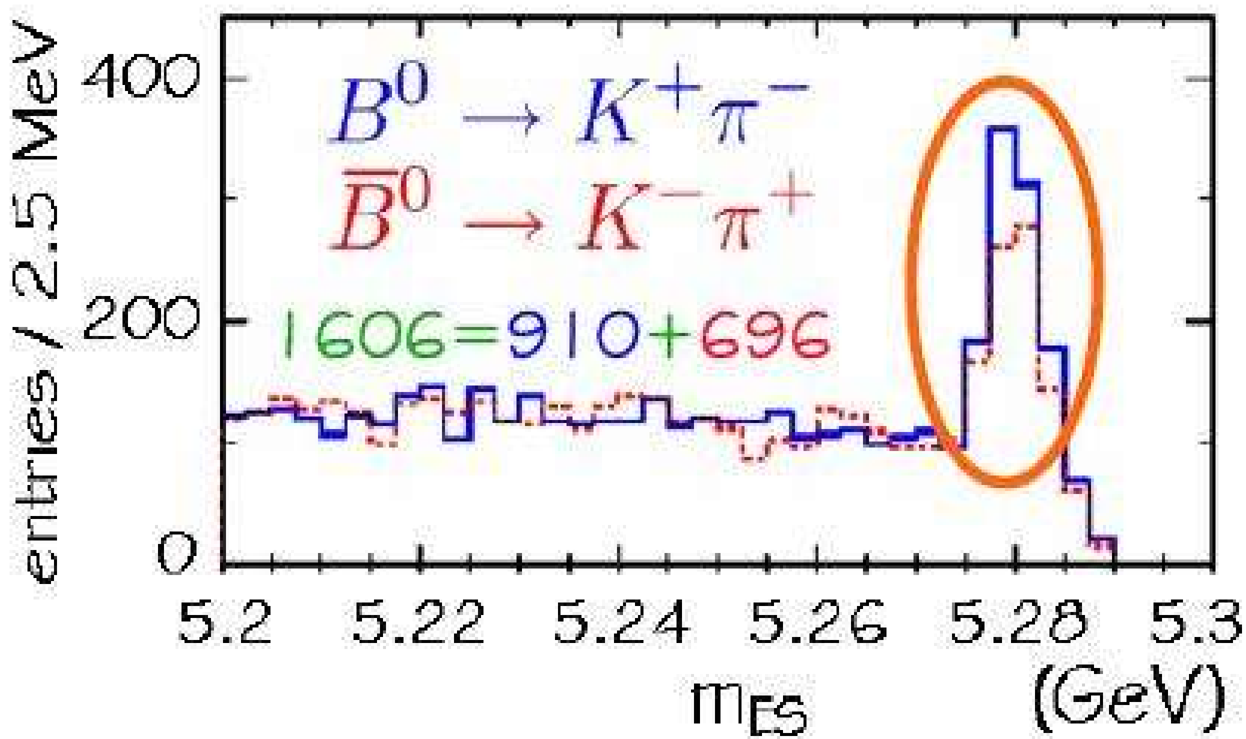
Oscillation frequency

- ***CP* violation in *Mixing*:** $|q/p| \neq 1$
- ***CP* violation in *Decay*:** $|\bar{A}_{f_{CP}}/A_{f_{CP}}| \neq 1$
- ***CP* violation in *Interference between decay with and without Mixing*:** $\mathrm{Im}\,\lambda_{f_{CP}} \neq 0$

CP violation in decay in the B system





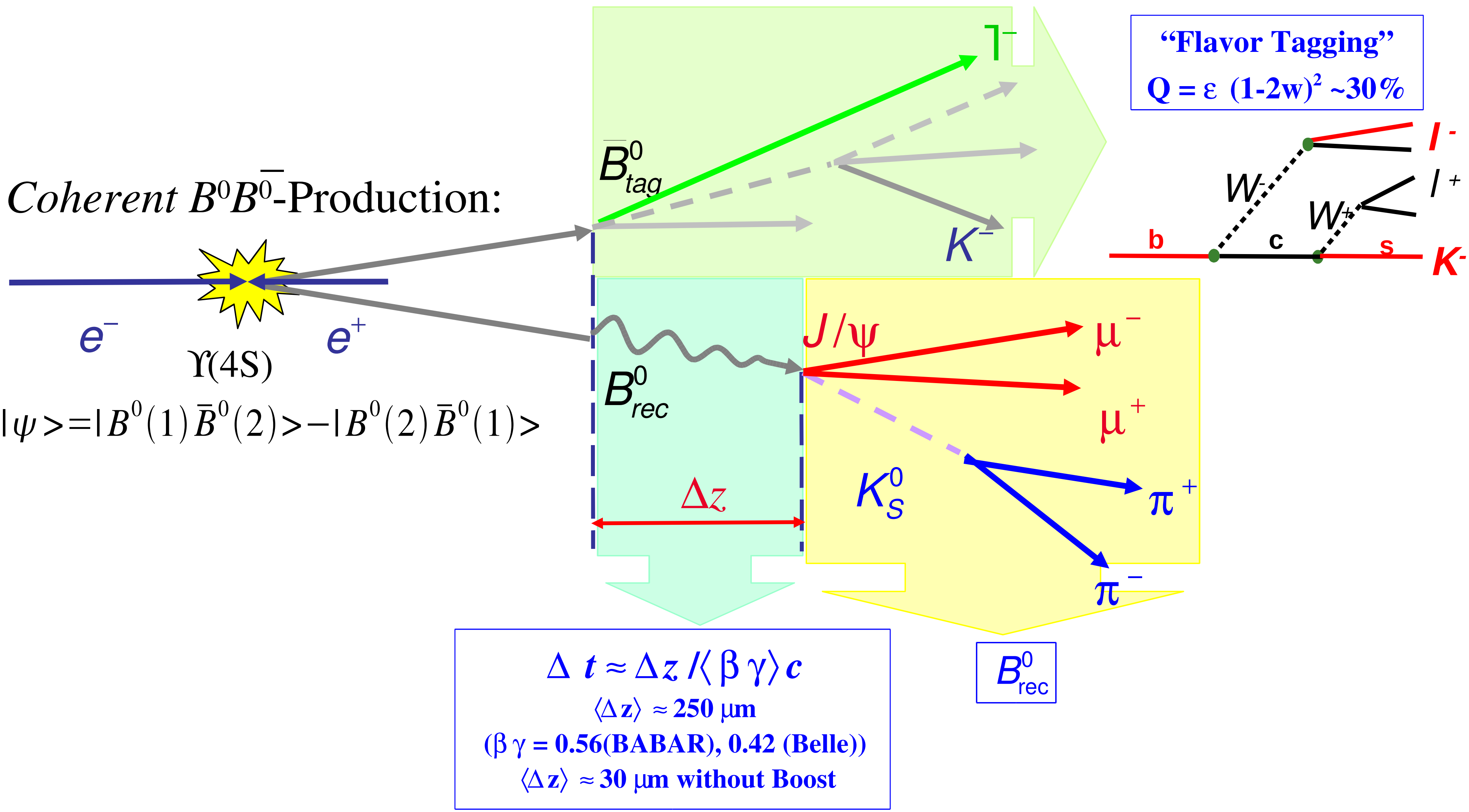


$$m_{ES} = \sqrt{E_{beam}^{*2} - \vec{p}_B^{\,2}}$$

$$\mathcal{A}_{K\pi} = -0.133 \pm 0.030 \pm 0.009$$

(a 4.2 sigma effect)

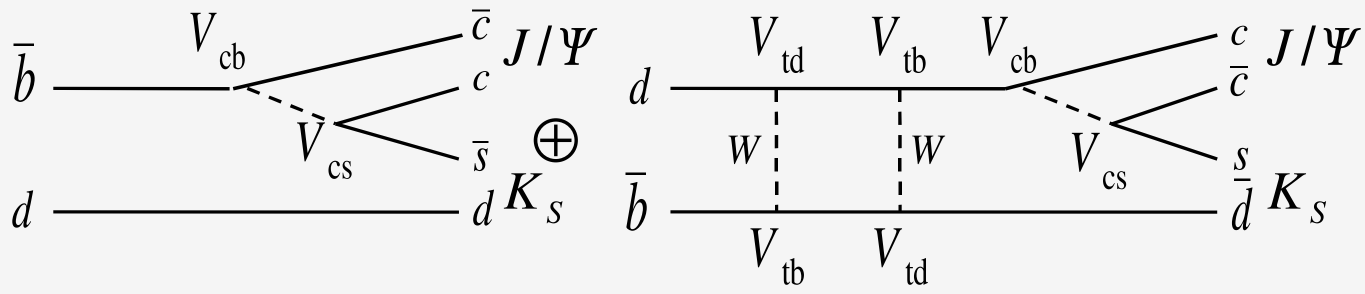
Time-dependent CP violation: Experimental Technique



$B^0_{rec} = B^0_{flav}$ **(Flavor eigenstate)** → **Oscillation, life time, ...**

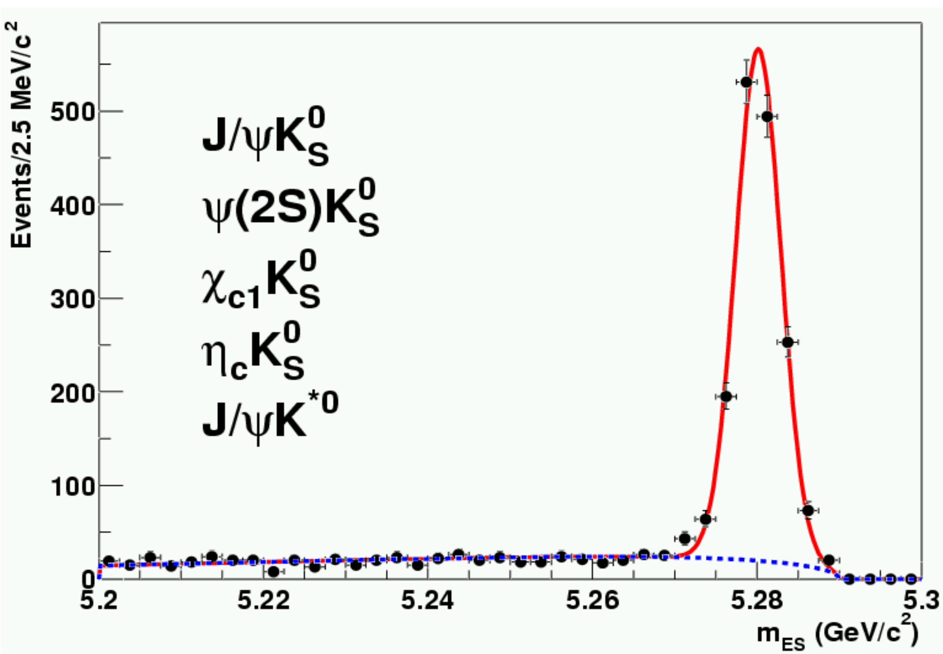
$B^0_{rec} = B^0_{CP}$ **(*CP* eigenstate)** → ***CP* asymmetries**

Nature distinguishes Matter from Antimatter



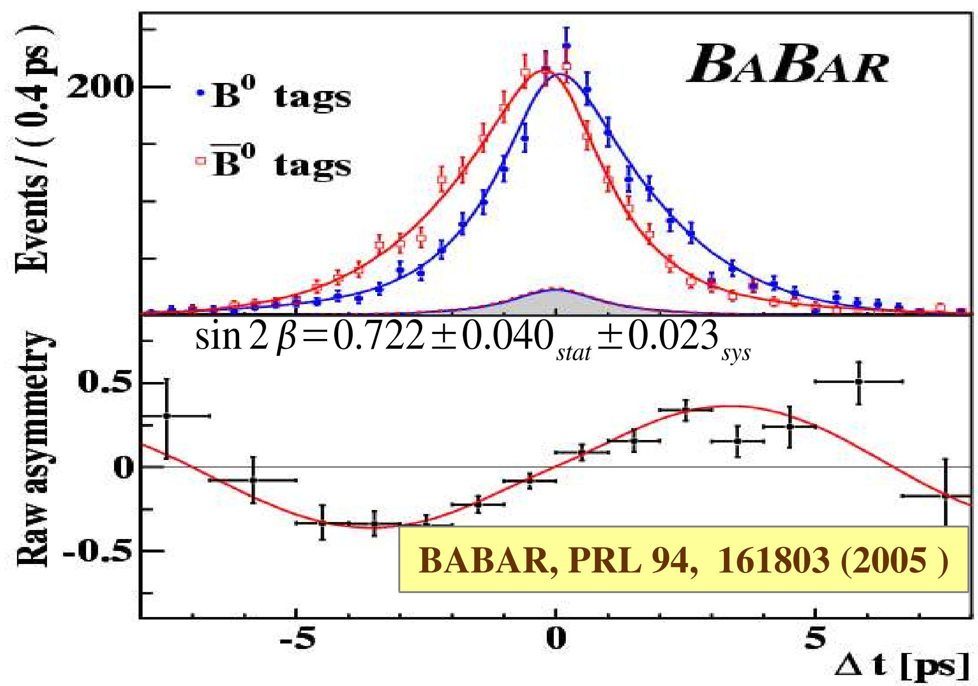
$$\left(\frac{q}{p}\right)_B \frac{\bar{A}}{A} = e^{-2 \cdot i \beta}$$

A clean measurement:



Expected CP asymmetry:

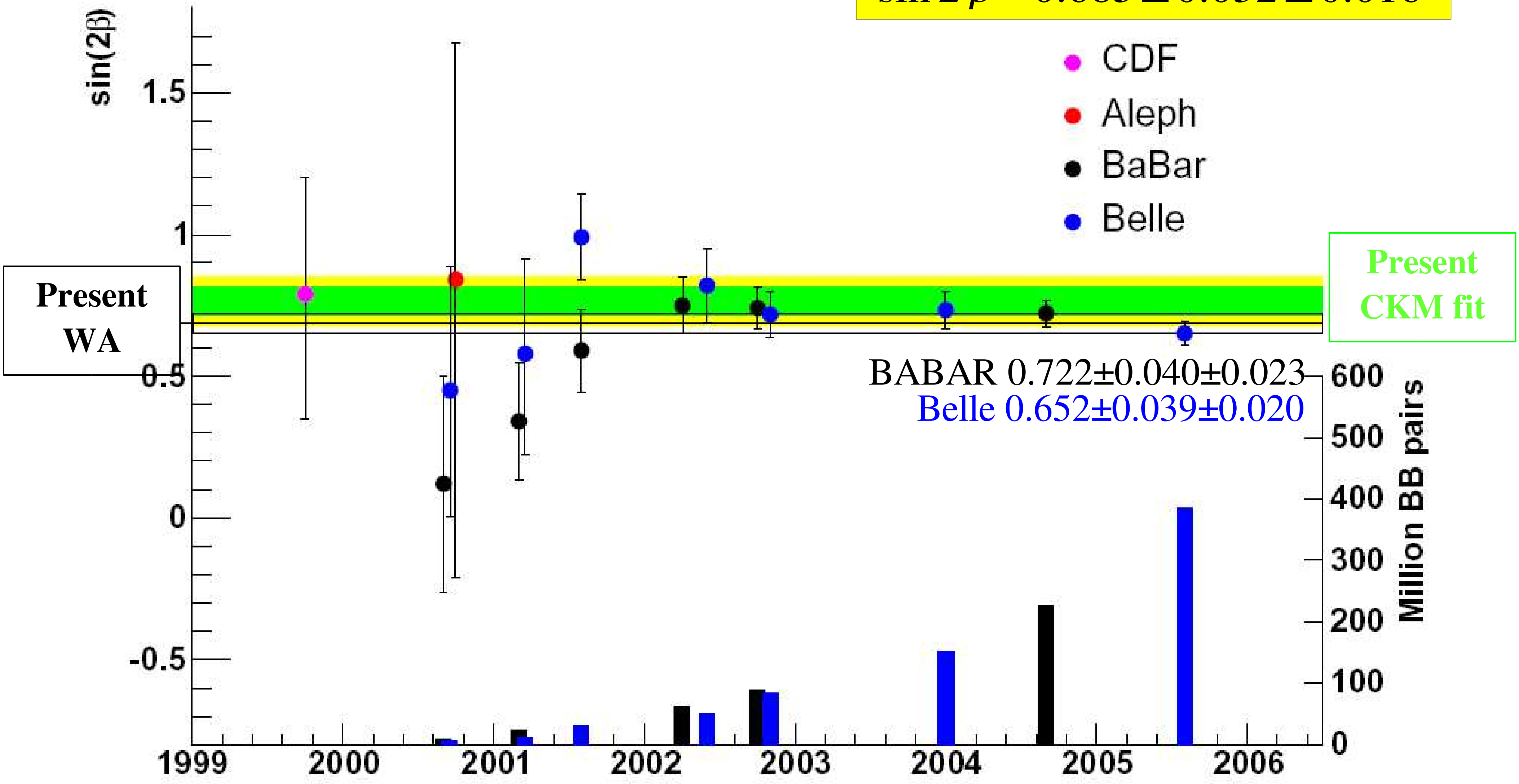
$$A_{CP}(t) = \sin(2\beta) \cdot \sin(\Delta m_d \Delta t)$$



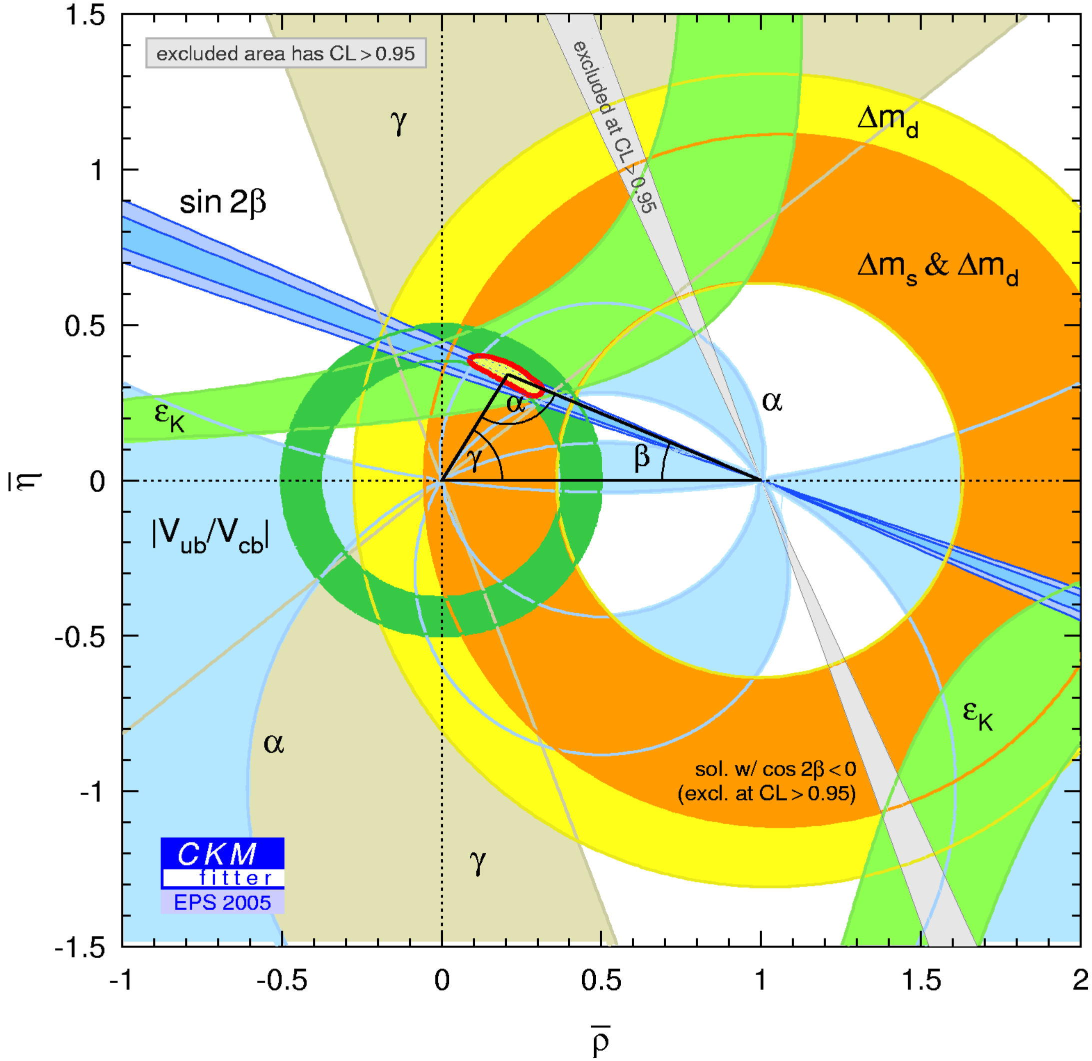
Evolution of sin2β measurements

World average

$\sin 2\beta = 0.685 \pm 0.032 \pm 0.016$



CP violation & CKM matrix 2006: a new era



CKM mechanism plays a dominant role

CP violation in SM (CKMfitter):

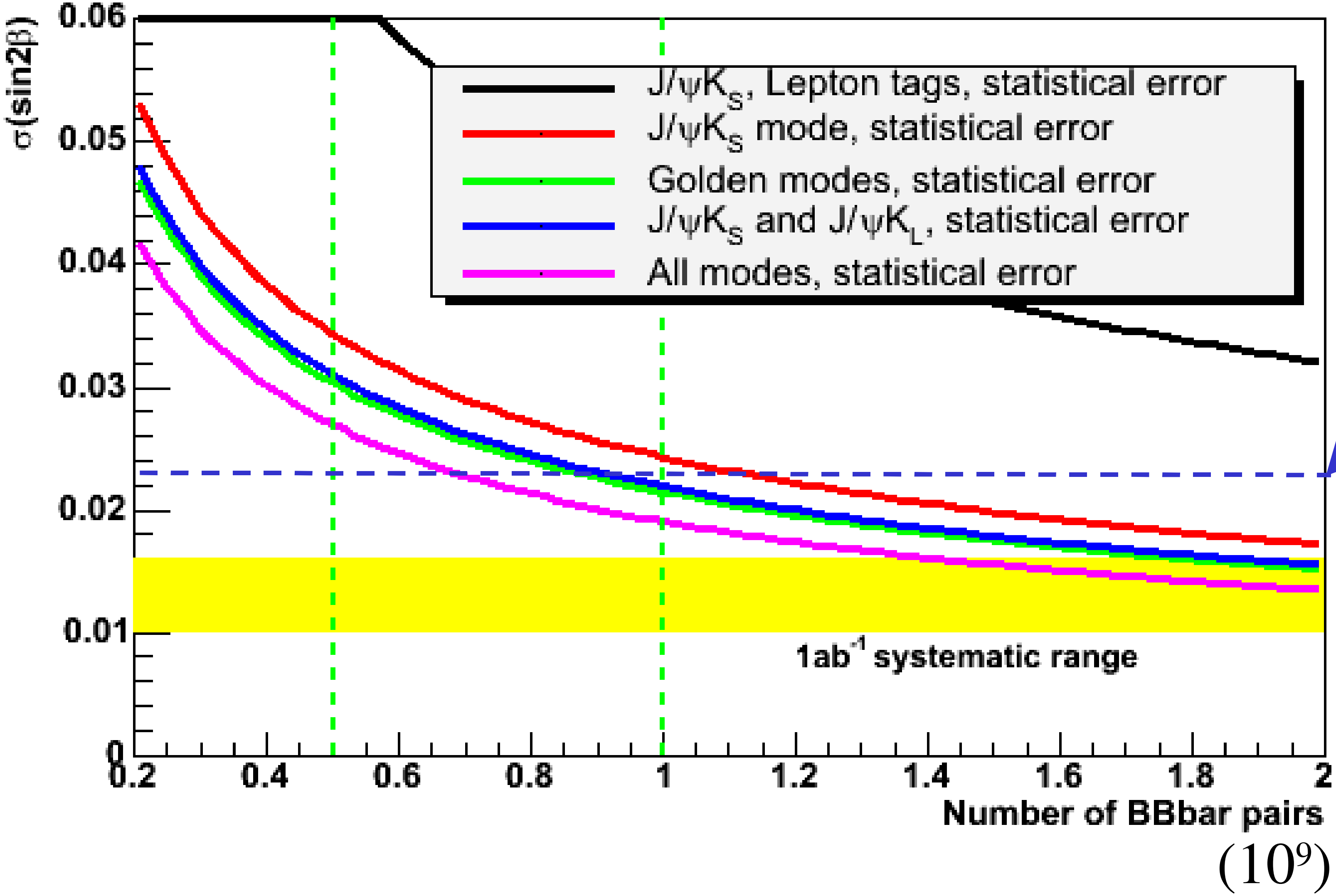
$$J = (3.11^{+0.48}_{-0.57}) \cdot 10^{-5} \ @95\%CL$$

CP violation too small → **to explain baryon asymmetry in universe by means of SM** ← **Higgs mass too large**

=> Indirect hint for NP... but where?

NP in quark flavor sector ? → Era of precision measurements started
Measure all flavor transitions as precisely as possible

sin2β uncertainties vs. integrated luminosity

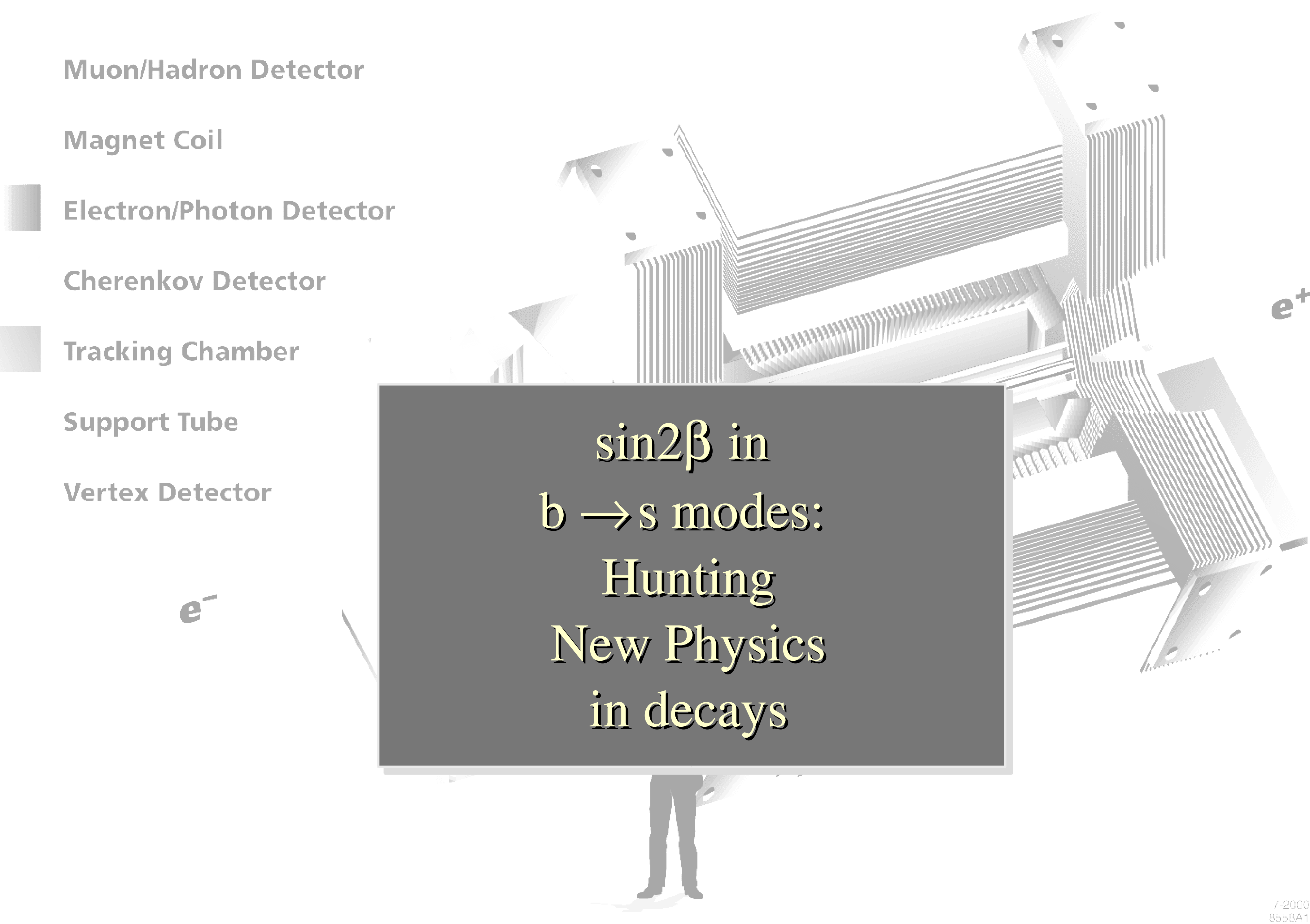


Current systematic uncertainty

Estimated systematic error range @ 1 ab^{-1}

At 1 ab^{-1}, sin2β uncertainty can be improved by nearly a factor of 2.

sin2β in
b → s modes:
Hunting
New Physics
in decays

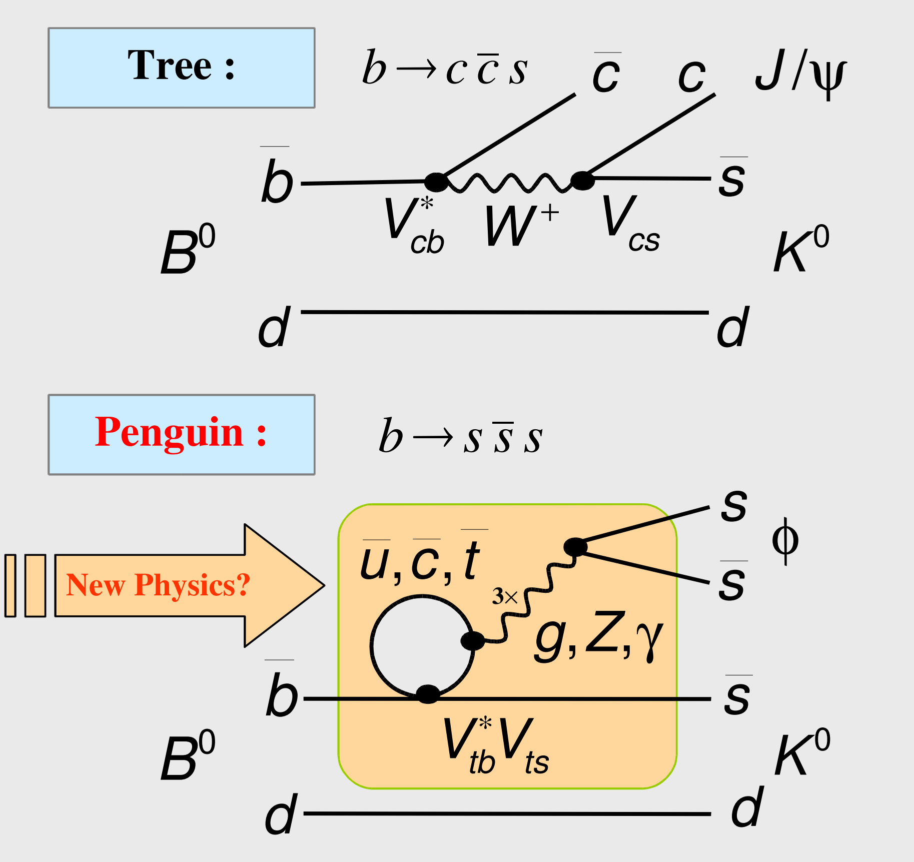


Confronting Loop Decays with Tree Dominance

- $b \to c\bar{c}s$: **tree and penguin diagrams with equal dominant weak phases**
- $b \to s\bar{s}s$: **pure "internal" and "flavor-singlet" penguin diagrams**

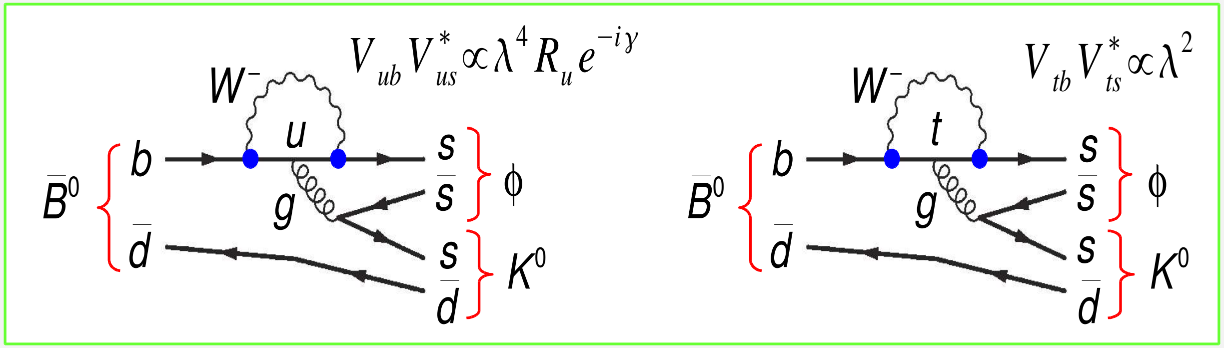
➡ **High virtual mass scales involved: sensitive to New Physics**

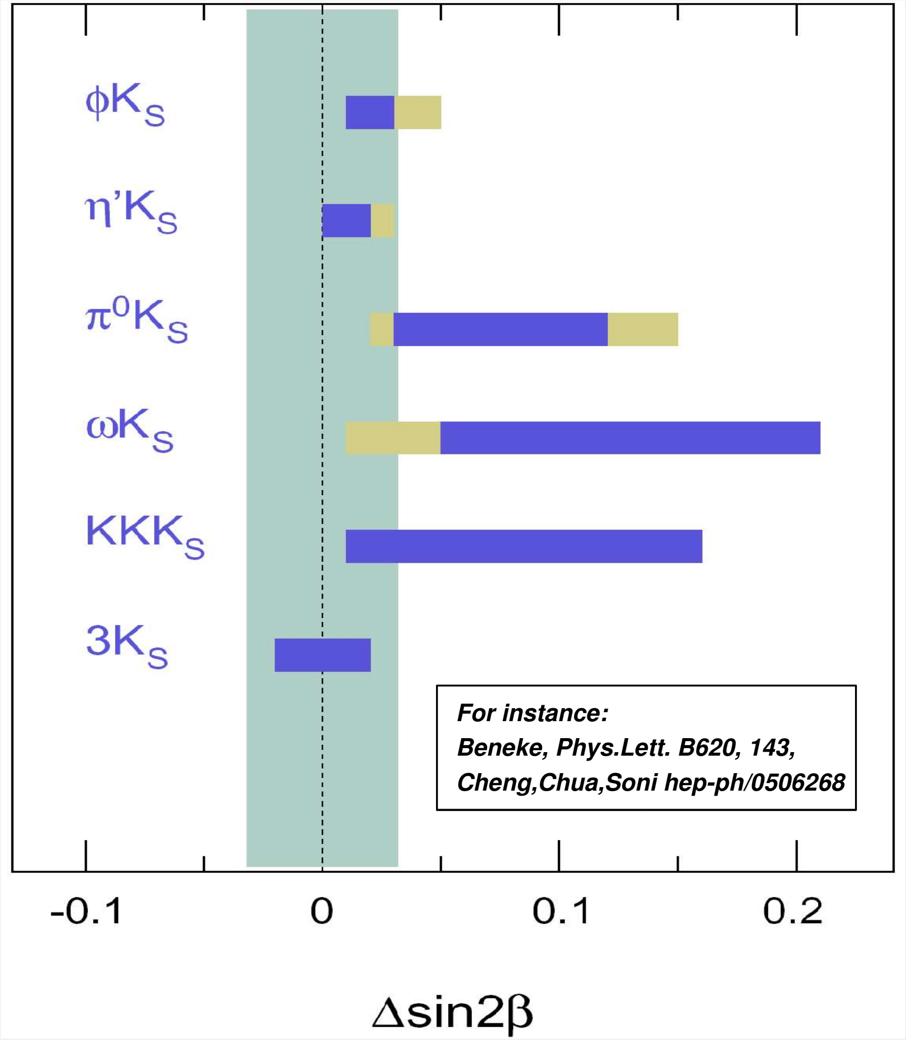
Both decays dominated by one single weak phase



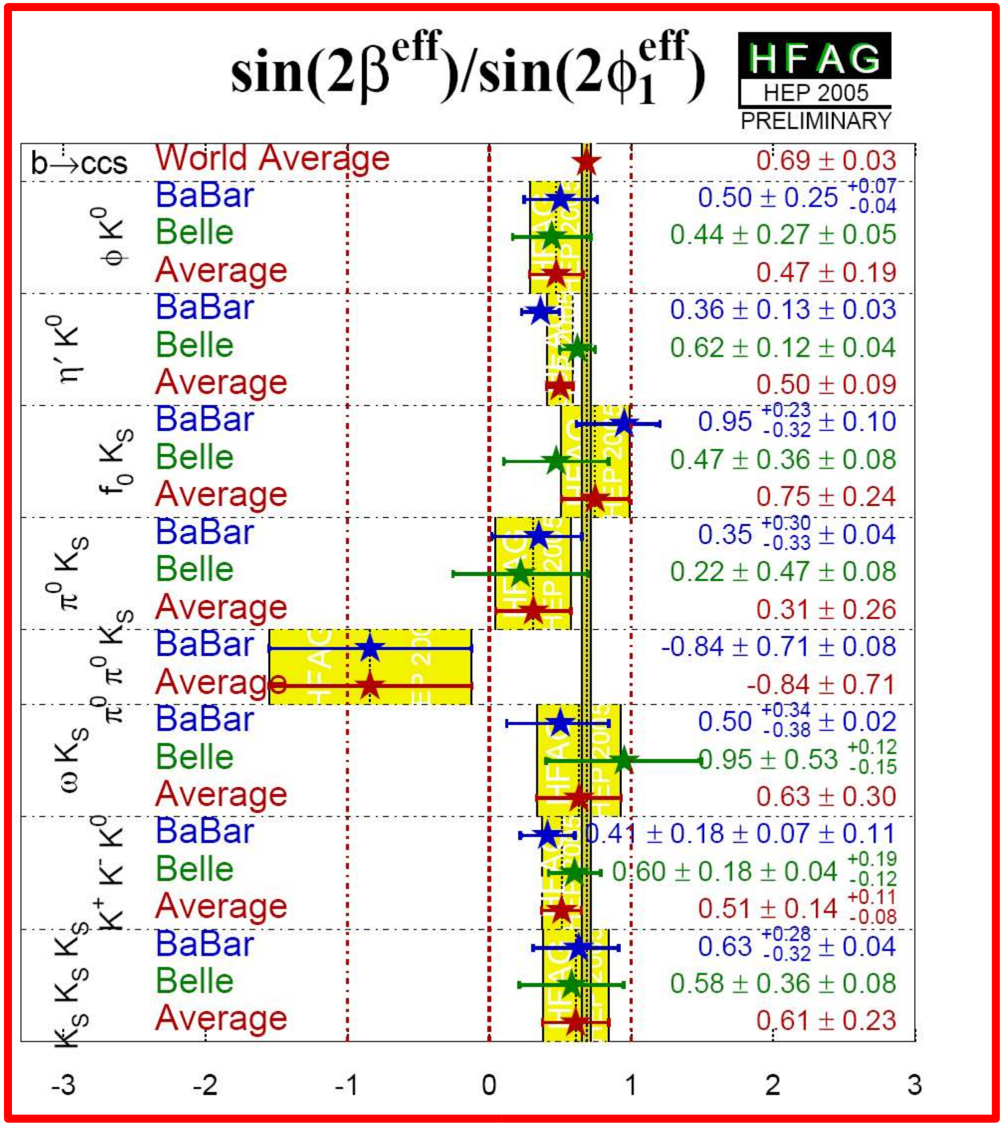
Standard model	New Physics
$S_{J/\psi K_S} = S_{\phi K_S} = \sin 2\beta$	$S_{J/\psi K_S} \neq S_{\phi K_S}$
$C_{J/\psi K_S} \sim C_{\phi K_S} \sim 0$	$C_{J/\psi K_S} \neq C_{\phi K_S}$

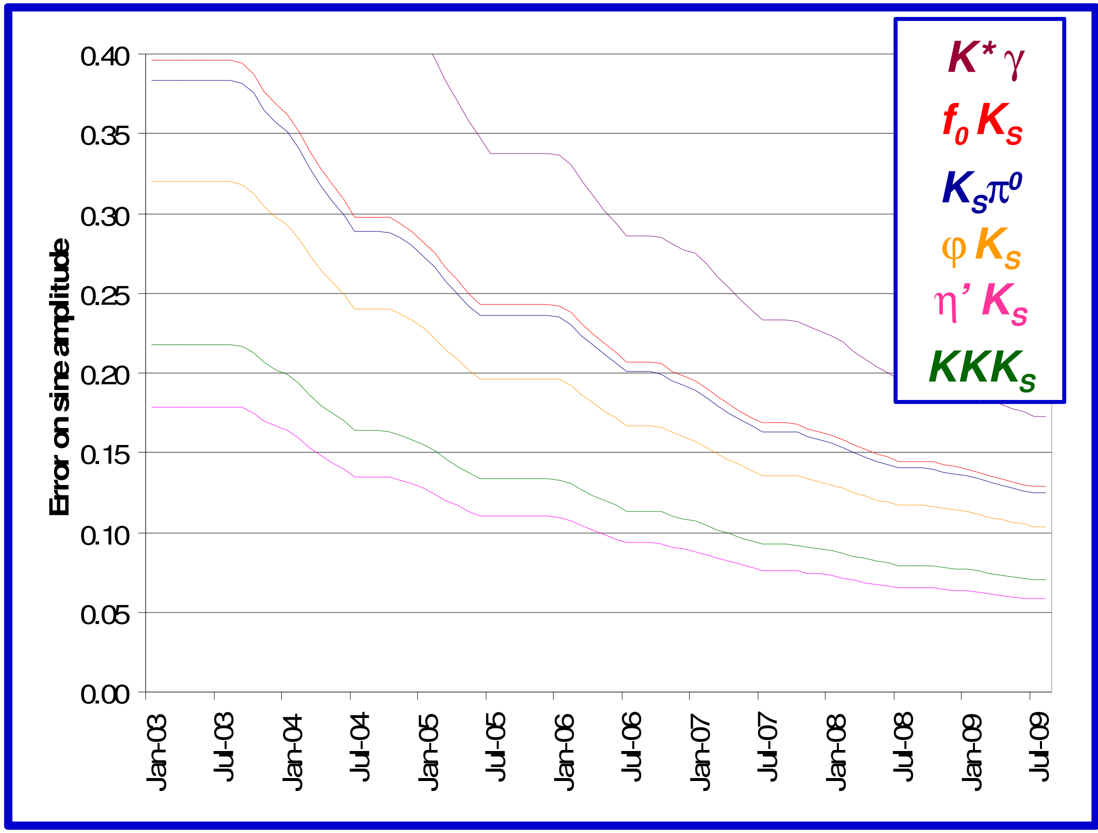
Clean and less clean penguin modes





Experimental situation and outlook





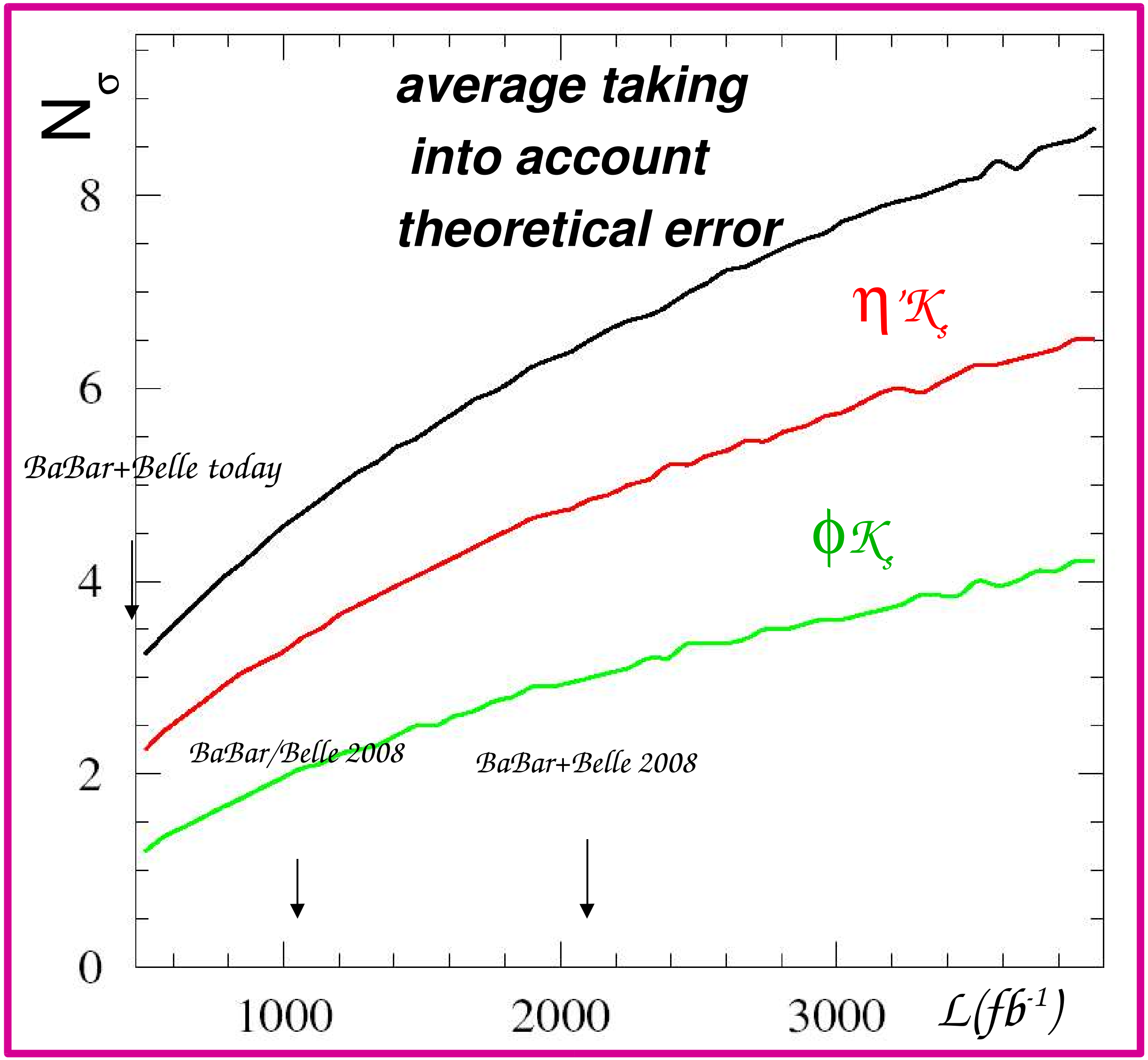
Averaging all penguin modes misleading:

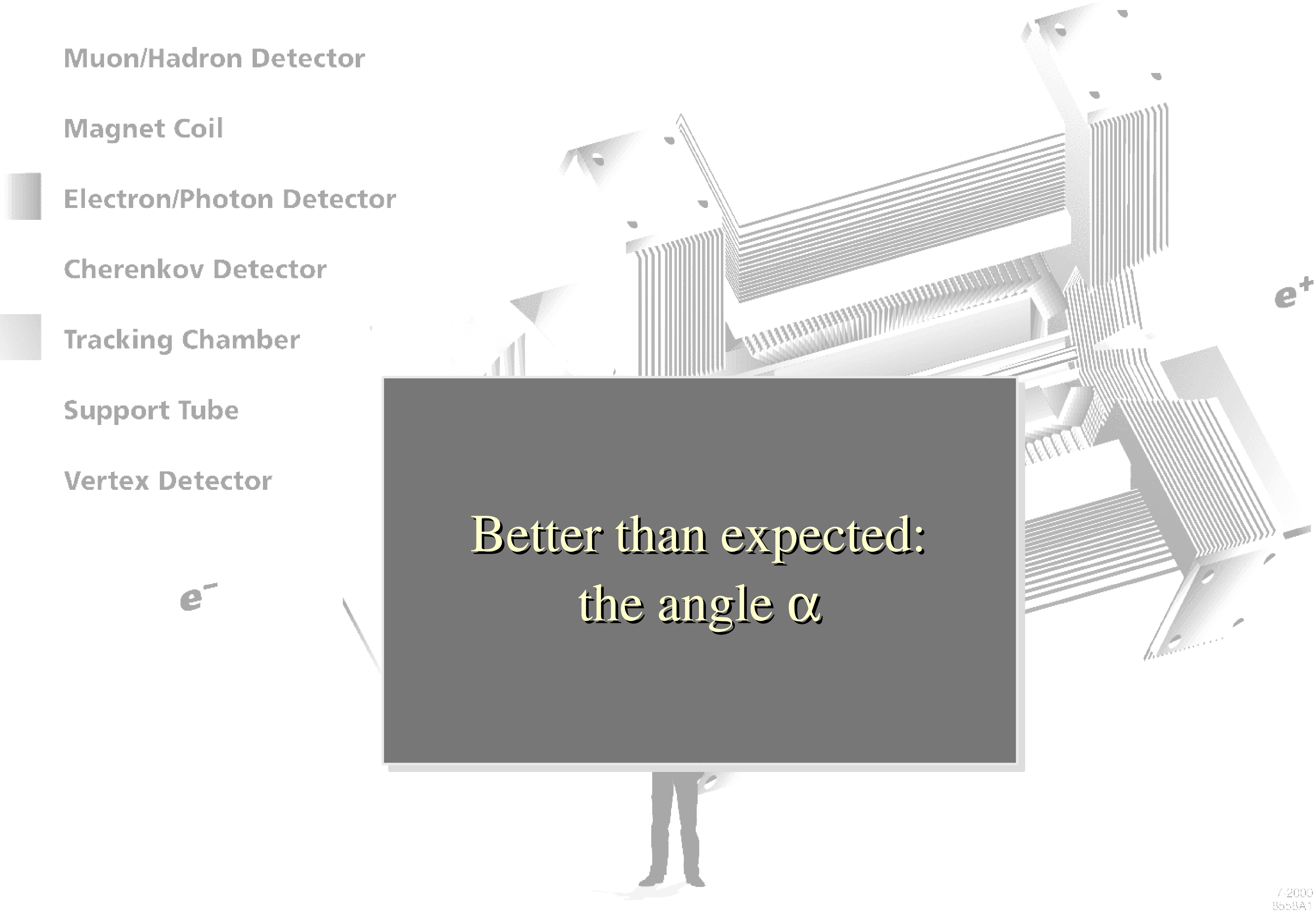
1. SM uncertainties different

2. NP effects likely to be different

Deviation from Standard Model

Assume that current values stay the same and compare with theoretical expectation



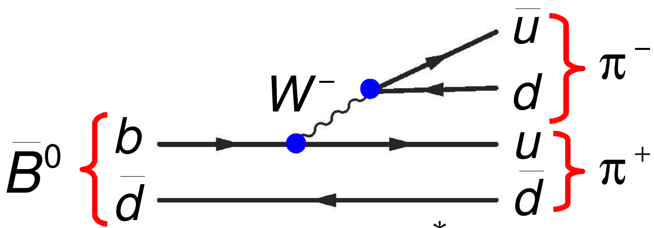


Better than expected:
the angle α

"Charmless" $b \to u$ Decays

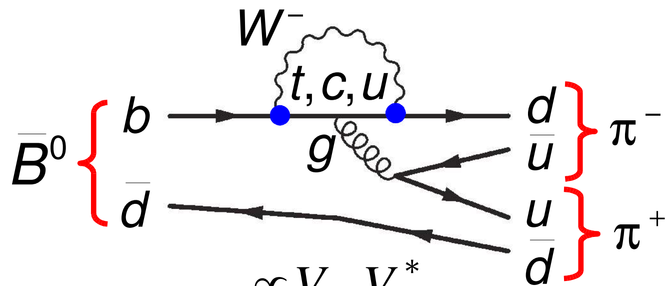
$b \to u \bar{u} d$

Tree : dominant | **Penguin : competitive ?**



$\propto V_{ub} V_{ud}^*$

$\propto \lambda^3$



$\propto V_{tb} V_{td}^*$

$\propto \lambda^3$

Principal modes :

$B^0/\bar{B}^0 \to \pi^+ \pi^-$

$B^0/\bar{B}^0 \to \rho^\pm \pi^\mp$

$B^0/\bar{B}^0 \to \rho^+ \rho^-$

Not a *CP* eigenstate

★ **If penguin is negligible**

$$\lambda_{h^+h^-} = \eta_{h^+h^-} \frac{V_{tb}^* V_{td}}{V_{tb} V_{td}^*} \frac{V_{ub} V_{ud}^*}{V_{ub}^* V_{ud}} = \eta_{h^+h^-} e^{2 \cdot i \alpha}$$

$$\Rightarrow \quad C_{h^+h^-} = \frac{1 - |\lambda_{h^+h^-}|^2}{1 - |\lambda_{h^+h^-}|^2} = 0$$

★ **Time-dependent *CP* observable**

ideal scenario

$$A_{\pi^+\pi^-}(t) = \sin(2\alpha) \sin(\Delta m_d t)$$

However: Penguin contribution not negligible!

$|\lambda| \neq 1 \quad \Rightarrow \quad C_{\pi\pi} \neq 0$

$\mathrm{Im}(\lambda) \neq \sin(2\alpha) \Rightarrow S_{\pi\pi} \sim \sin(2\alpha_{eff})$

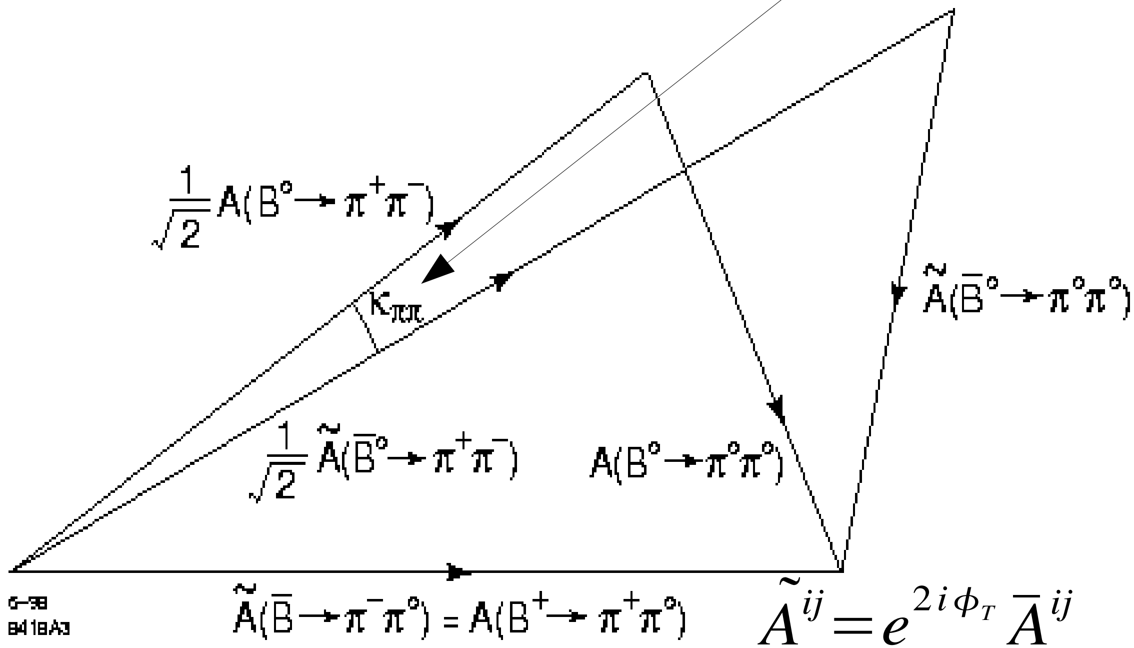
$\Rightarrow \quad |P_{\pi\pi}/T_{\pi\pi}|,\ \delta = \arg(P_{\pi\pi}/T_{\pi\pi}) \quad ?$

Isospin Analysis for $B \to \pi\pi, \rho\rho$

SU(2) analyses : **Gronau-London**, PRL 65, 3381 (1990), **Lipkin *et al.***, PRD 44, 1454 (1991), a.o.

$$A^{+0} = \frac{1}{\sqrt{2}} A^{+-} + A^{00} \quad \xleftrightarrow{\text{CP conjugation}} \quad \bar{A}^{-0} = \frac{1}{\sqrt{2}} \bar{A}^{+-} + \bar{A}^{00}$$

$$2\alpha_{eff} = 2\alpha + \kappa_{\pi\pi}$$



$$\tilde{A}^{ij} = e^{2i\phi_T} \bar{A}^{ij}$$

$$\cos(2\alpha - 2\alpha_{eff}) \geq \frac{1 - 2B^{00}/B^{+0}}{\sqrt{1 - C_{\pi\pi}^2}}$$

Grossman-Quinn 98; Charles 99; Gronau-London-Sinha-Sinha 01

$BR(\pi^+\pi^-) = (5.0 \pm 0.4) \cdot 10^{-6}$

$BR(\pi^\pm\pi^0) = (5.5 \pm 0.6) \cdot 10^{-6}$

$BR(\pi^0\pi^0) = (1.45 \pm 0.3) \cdot 10^{-6}$

Bound is weak.

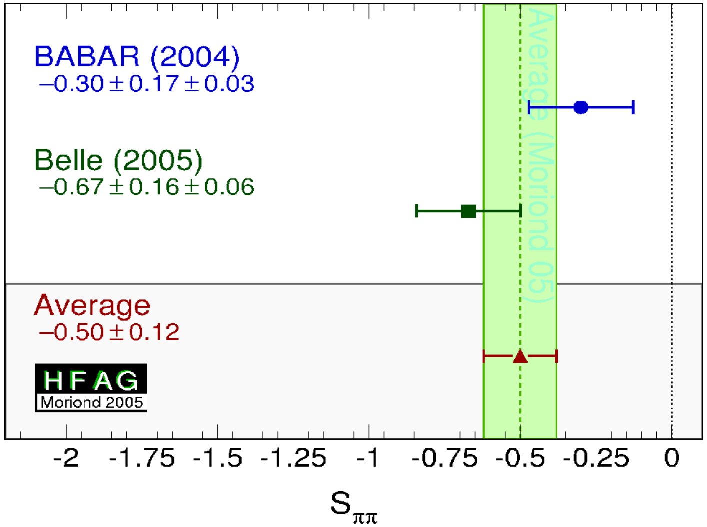
Full SU(2) analysis needed

$C(\pi^0\pi^0) = 0.28 \pm 0.40$

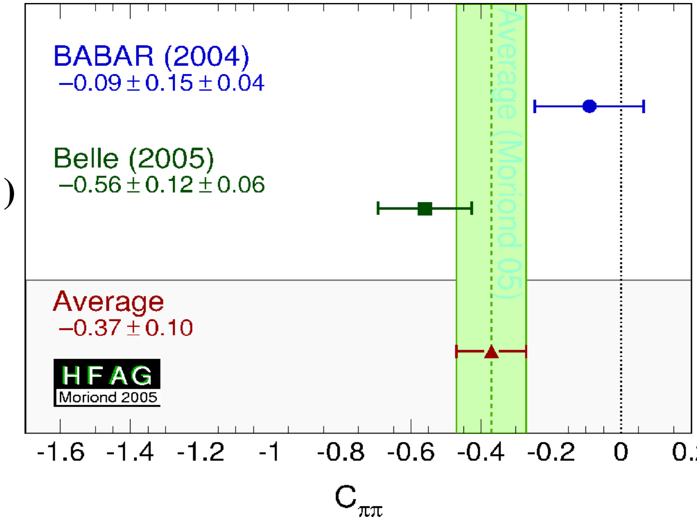
α can be extracted up to

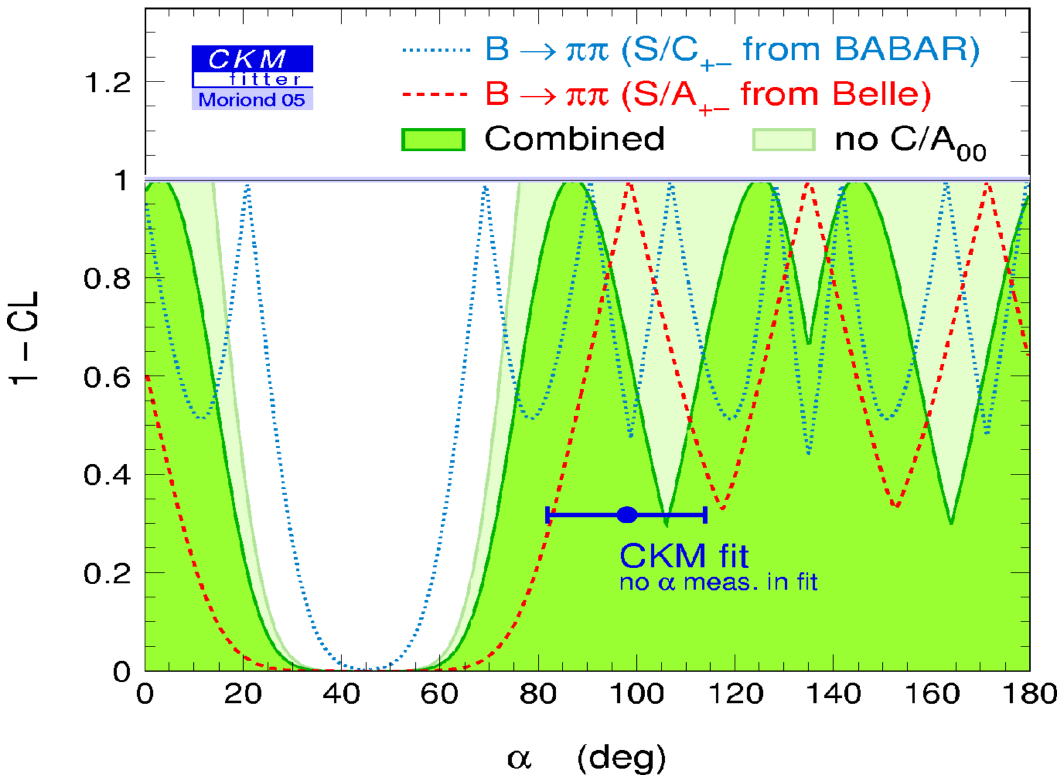
8-fold ambiguity within $[0,\pi]$

Results for $B^0 \to \pi^+ \pi^-$

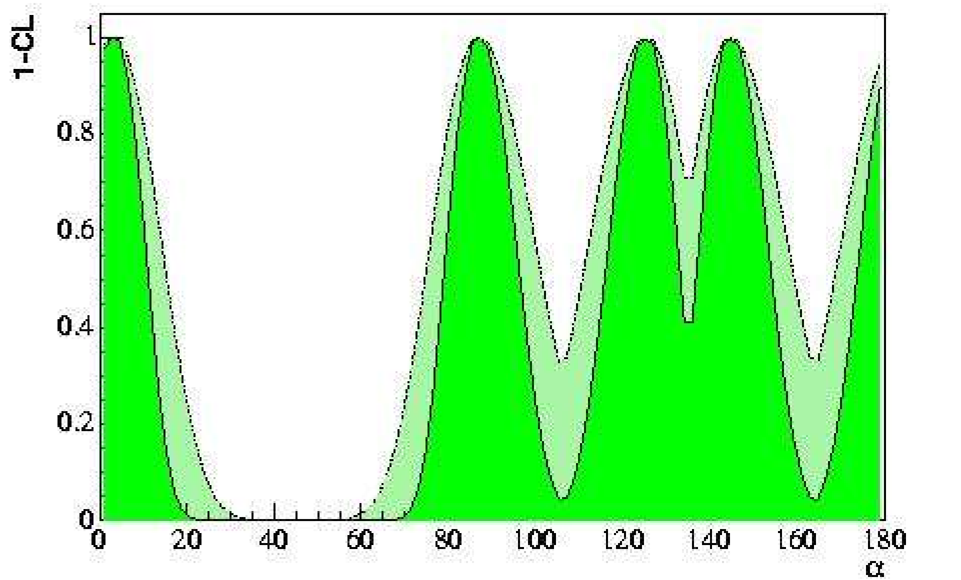


Agreement : $\chi^2 = 7.9$
(CL = 0.019 ⇒ 2.3 σ)





Constraint with same central values: 2 ab^{-1}



=> Precise extraction of α difficult

=> Size & error of *BR*($\pi^0\pi^0$) & *C*($\pi^0\pi^0$) important

A "surprise" : $B^0 \to \rho^+ \rho^-$

★ **BF's for $B \to \rho\rho$ (WA):** $B^{+-} = (26.2\,^{+3.6}_{-3.7}) \times 10^{-6}$, $B^{+0} = (26.4\,^{+6.1}_{-6.4}) \times 10^{-6}$, $B^{00} < 1.1 \times 10^{-6}$ @ 90% CL

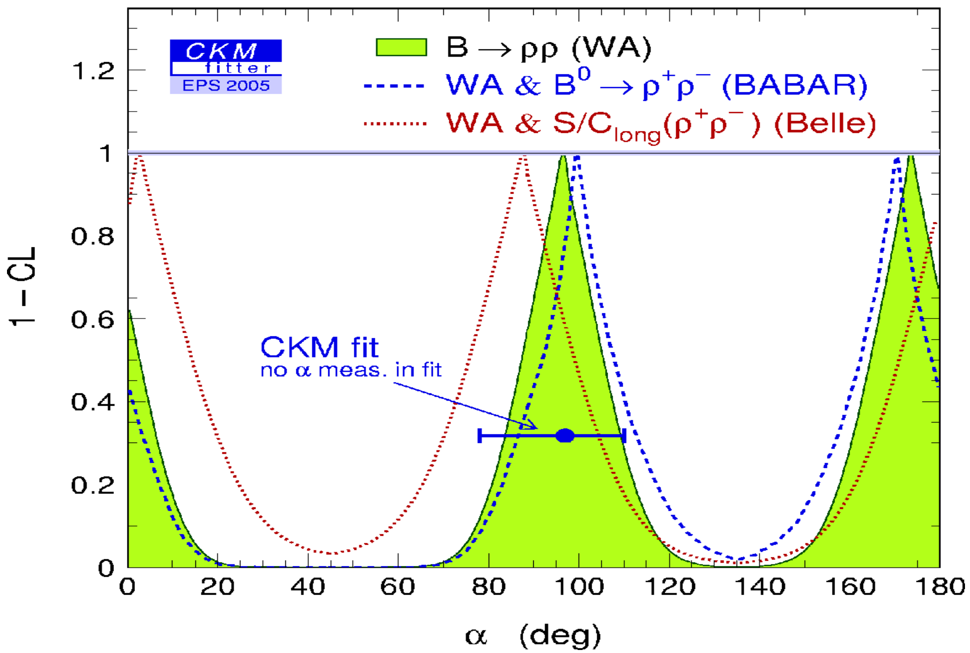
★ **$B \to VV$ can have $L_{VV} = 0, 1, 2$**

$CP(L_{VV}=0,2) = +1$ & $CP(L_{VV}=1) = -1$

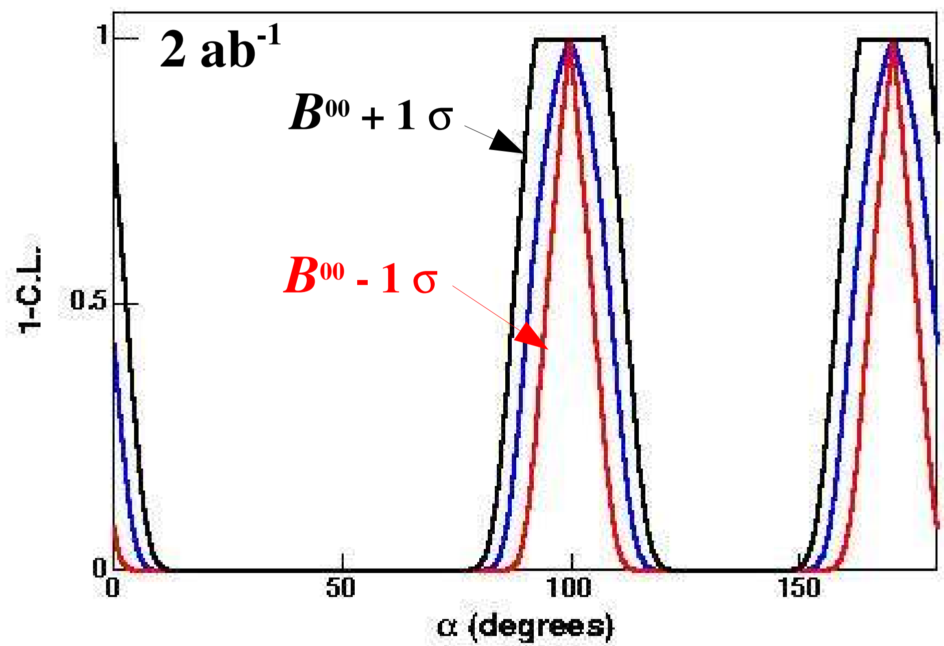
$$f_L(\rho^+\rho^0) = 0.97\,^{+0.07}_{-0.05},\ f_L(\rho^+\rho^-) = 0.971\,^{+0.031}_{-0.030}$$

=> almost no *CP* dilution

	BABAR (232 M)		Belle (275 M)
$S_{\rho\rho}$	$-0.33 \pm 0.24^{+0.08}_{-0.14}$	$S_{\rho\rho}$	$0.09 \pm 0.42 \pm 0.08$
$C_{\rho\rho}$	$-0.03 \pm 0.18 \pm 0.09$	$C_{\rho\rho}$	$0.00 \pm 0.30^{+0.10}_{-0.09}$



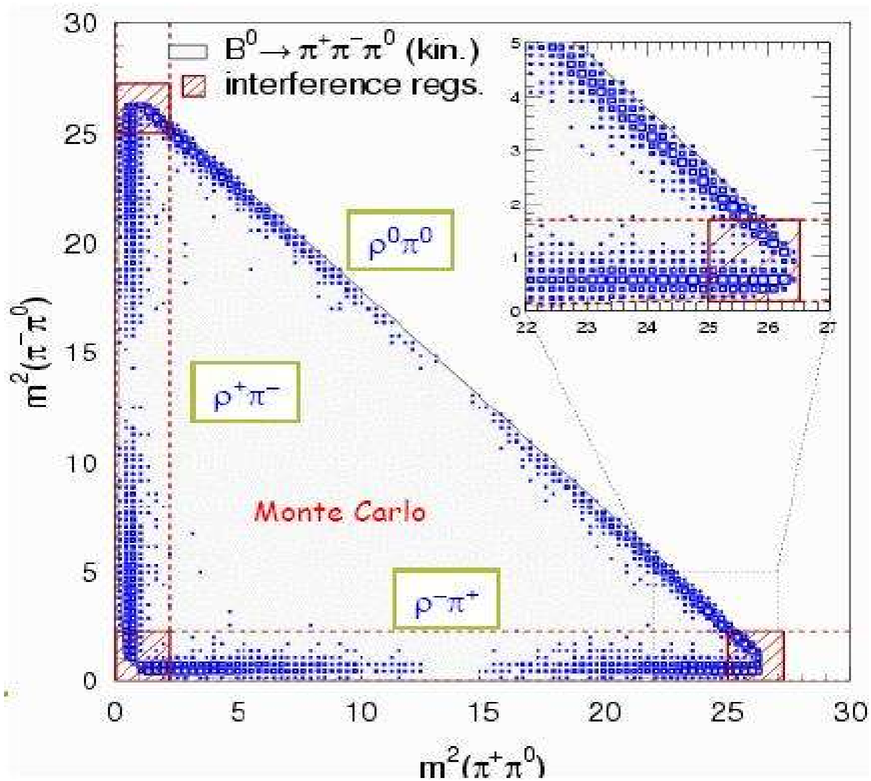
$$|\alpha - \alpha_{eff}| < 15^\circ \text{ @ } 90\%\ CL$$



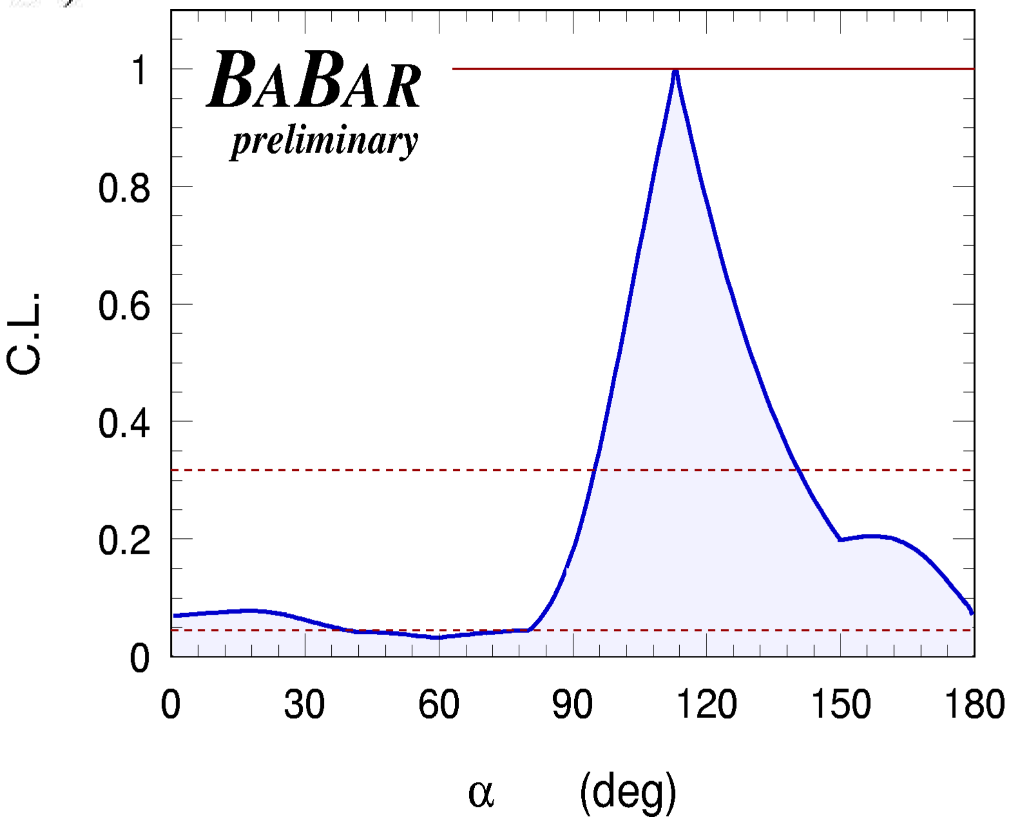
The third way to α: Time-dependent Dalitz plot analysis $B^0 \rightarrow \pi^0 \pi^+ \pi^-$

Snyder & Quinn, PRD 48, 2139 (1993)

$$A(B^0 \rightarrow \pi^+\pi^-\pi^0) = f_+ A(\rho^+\pi^-) + f_- A(\rho^-\pi^+) + f_0 A(\rho^0\pi^0)$$
$$\overline{A}(\overline{B}^0 \rightarrow \pi^+\pi^-\pi^0) = f_+ \overline{A}(\rho^+\pi^-) + f_- \overline{A}(\rho^-\pi^+) + f_0 \overline{A}(\rho^0\pi^0)$$



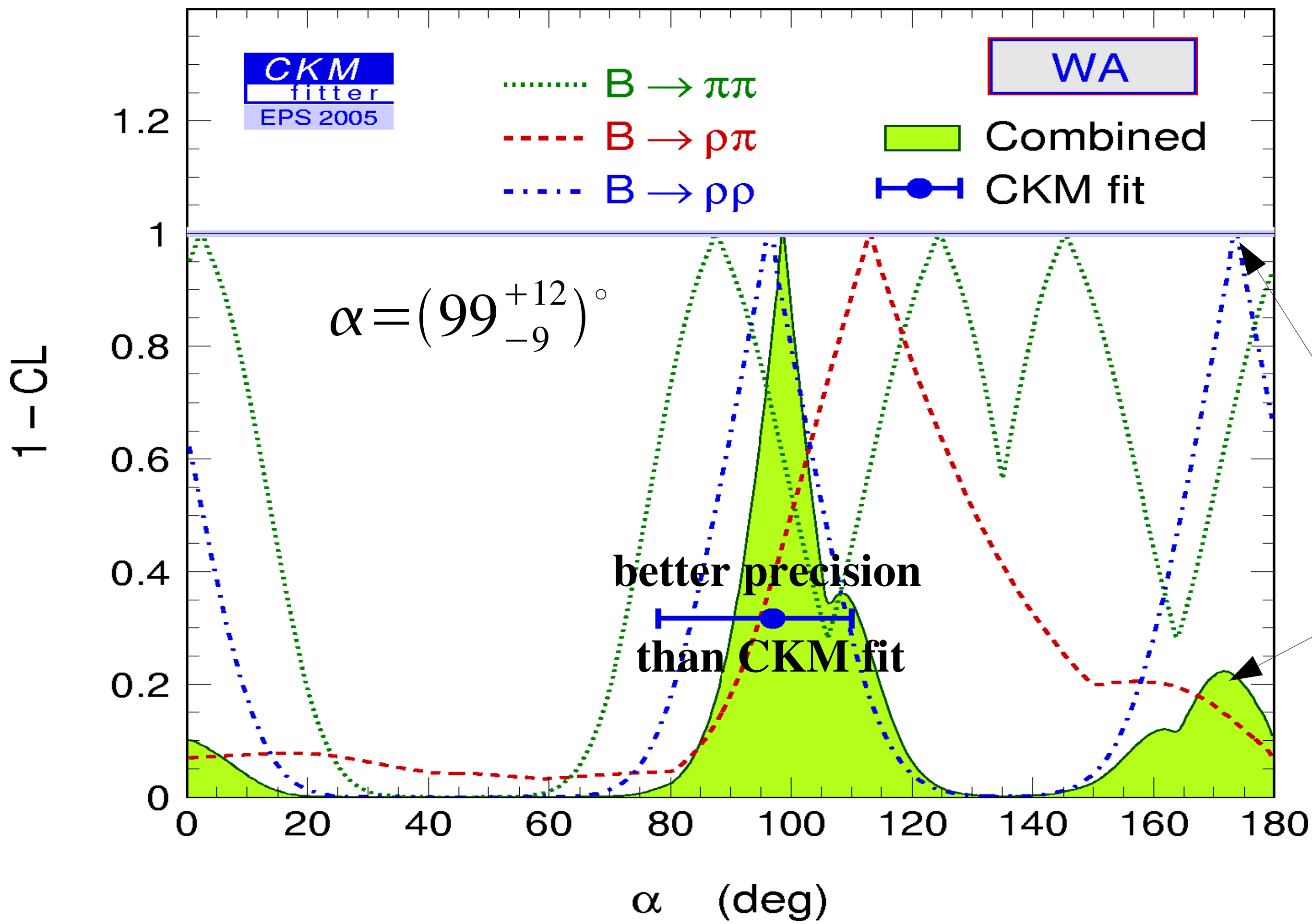
Assume ρ dominance and use phase information across Dalitz plane to extract α



Extraction of α without ambiguity!

Combination of $\pi\pi$, $\pi\pi\pi$, $\rho\rho$

Combining the three analyses (dominated by $\rho\rho$ and $\pi\pi\pi$) :



mirror solution ($\rho\rho$)

disfavored

(due to constraint

from $\pi\pi\pi$)

B→ππ: Needs large statistics

B→ρρ: Currently best constraint; Size of B^{00}/B^{+0}?

B→πππ: Will become more and more important

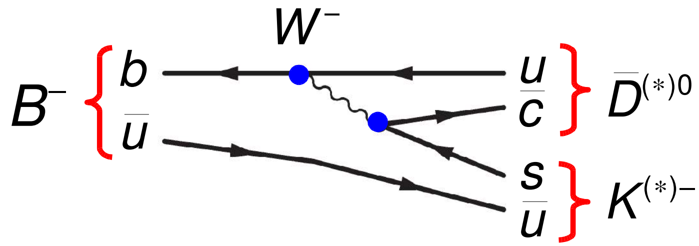
The opportunity one should not miss:

γ

The Measurement of γ: Methods

- **Measurement of γ through *CP* violation in decay:** $b \to c\bar{u}s, u\bar{c}s$

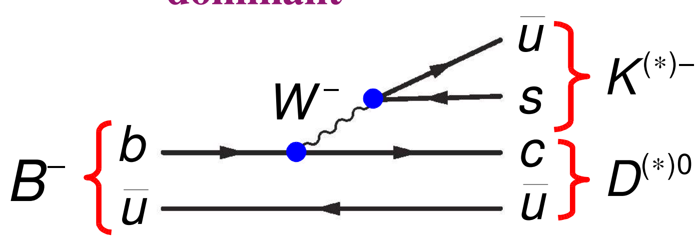
color-suppressed



$\propto V_{ub} V^*_{cs}$

$$r_B = \frac{\text{color-suppressed}}{\text{dominant}} \approx 0.1 - 0.3$$

dominant



$\propto V_{cb} V^*_{us}$

relative CKM phase : γ	relative strong phase : δ

- **Several variants :**

  - ***D^0* decays into *CP* eigenstate** « GLW »
  - ***D^0* decays to $K^-\pi^+$ (favored) and $K^+\pi^-$ (suppressed)** « ADS »
  - ***D^0* decays to $K_S\pi^+\pi^-$ (interference in Dalitz plot)** « GGSZ »

Gronau-London, PL B253, 483 (1991); Gronau-Wyler, PL B265, 172 (1991)

Atwood-Dunietz-Soni, PRL 78, 3257 (1997)

Giri-Grossman-Soffer-Zupan, PRD 68, 054018 (2003)

The "GGSZ" Dalitz Analysis

GGSZ : $B^- \to D^0(\to K_S \pi^+ \pi^-)\, K^-$: Interference between amplitudes in Dalitz plot

$$A_-(m_-^2, m_+^2) = |A(B^- \to D^0 K^-)|\,(f_{-+} + r_B e^{i(\delta-\gamma)} f_{+-})$$

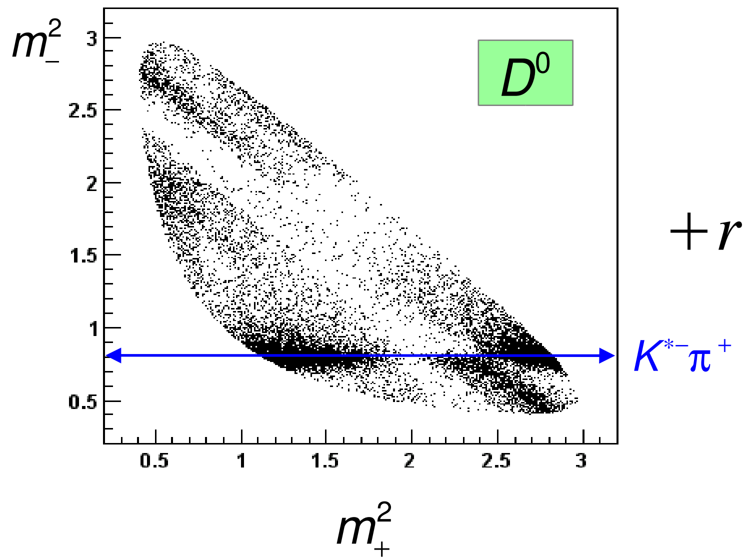
CP ↕

$$A_+(m_+^2, m_-^2) = |A(B^+ \to \bar{D}^0 K^+)|\,(f_{+-} + r_B e^{i(\delta+\gamma)} f_{-+})$$

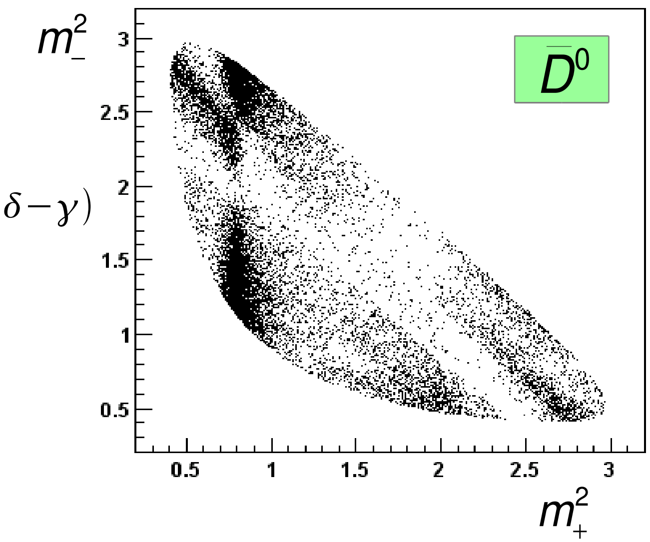
Sum of amplitudes contributing to $D^0 \to K_S \pi^+ \pi^-$

$$f_{+-} = f(m_+^2, m_-^2)$$
$$m_\pm = m(K_S^0 \pi^\pm)$$

$|A_-|^2 = |A(B^- \to D^0 K^-)|^2 \Big|$



$+ r_B e^{i(\delta-\gamma)}$

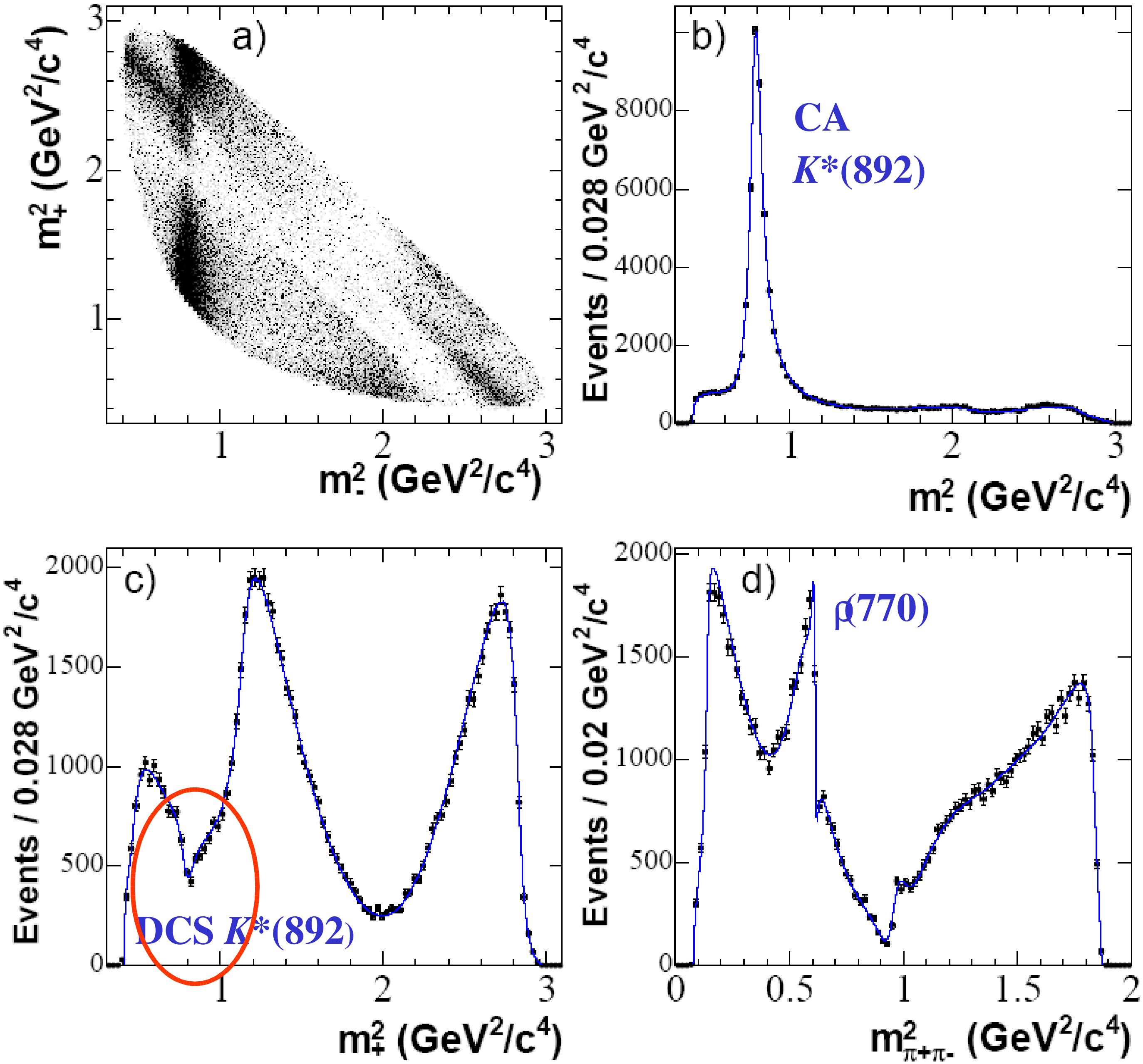


$\Big|^2$

Simultaneous measurement of r_B, δ and γ

The "GGSZ" Dalitz Analysis: Dalitz plane model

BABAR PRL 95(2005) 121802



Continuum data

$D^{*+} \to D^0 \pi^+$ (91.5 fb^{-1})

N_{evts} = 82 K

Purity: 97%

Issue: contribution of broad, s-wave resonances

Orig. method: 2 BWs

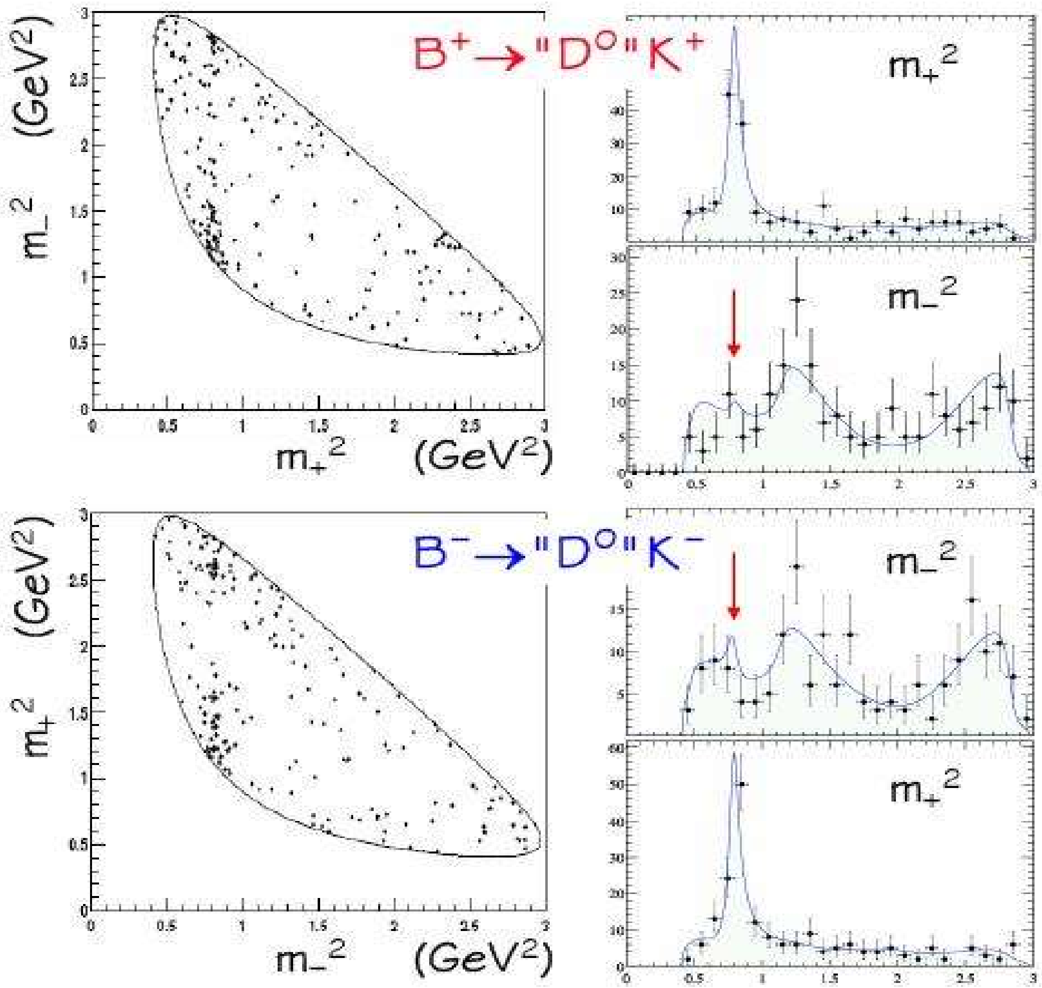
New: K-matrix

Anisovich & Saratev

Eur. Phys. J A16, 229 (2003)

χ^2/dof≈3824/3022=1.27

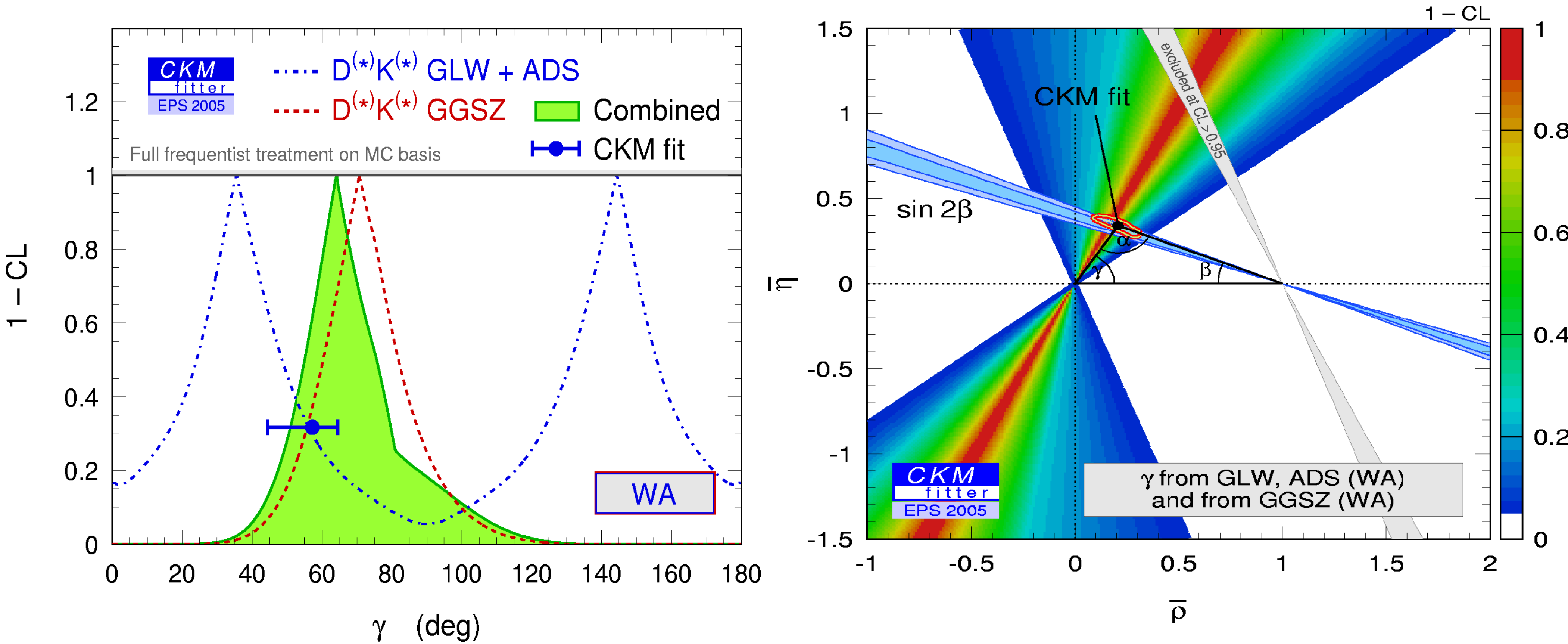
“GGSZ”: Constraint on γ



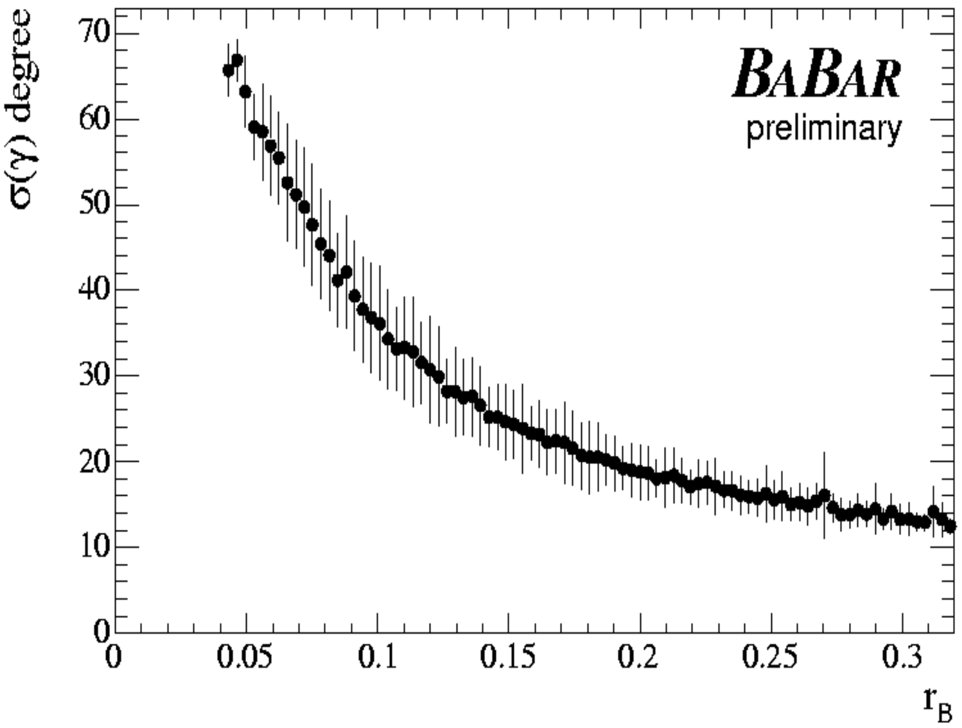
BABAR (227 M)	$\gamma = 70^\circ \pm 31^\circ_{stat} \pm 11^\circ_{sys} \pm 13^\circ_{model}$	$r_B < 0.28, r_B^* < 0.35$	(95% CL)
Belle (274 M)	$\gamma = 68^\circ {}^{+14}_{-15} \pm 13^\circ_{sys} \pm 11^\circ_{model}$	$r_B = 0.24 \pm 0.09, r_B^* < 0.39$	(90% CL)

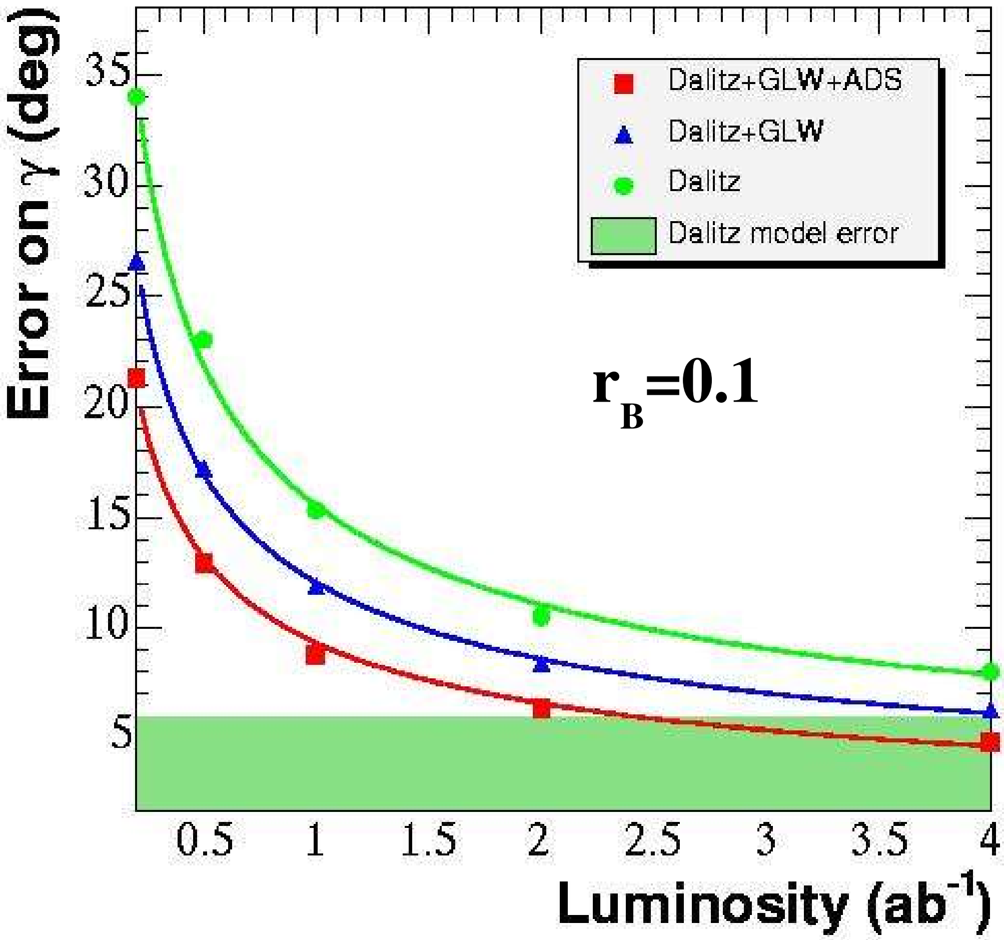
Results for γ

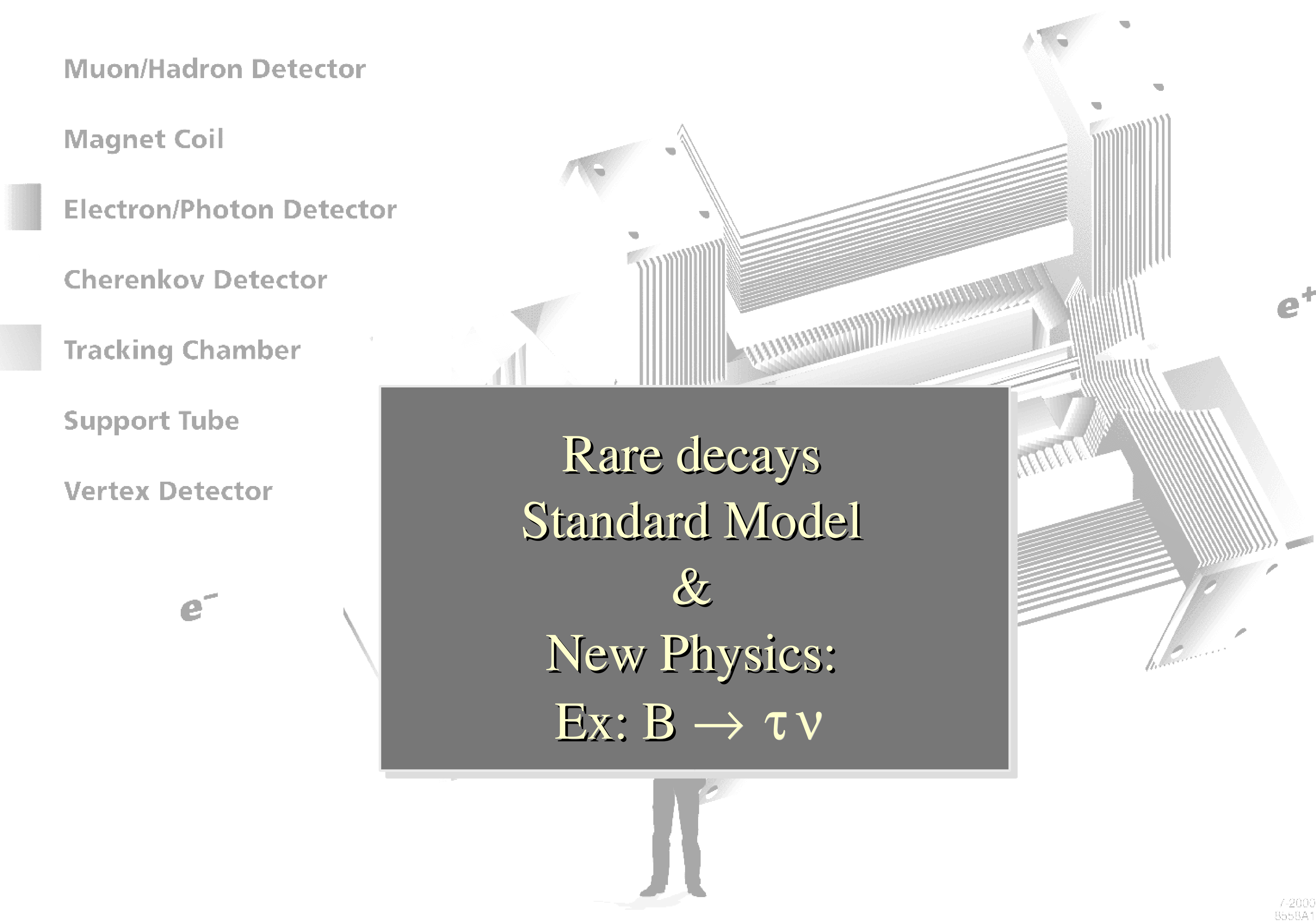
$$\gamma_{meas} = \left(63^{+15}_{-12}\right)^{\circ} \qquad \gamma_{CKM} = \left(57^{+7}_{-13}\right)^{\circ}$$



Sensitivity to γ:
Strong dependence on r_B







Rare decays

Standard Model

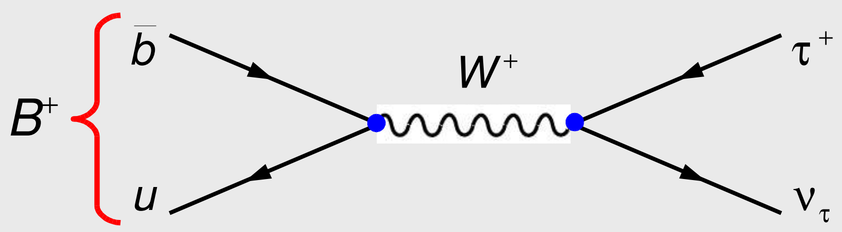
&

New Physics:

Ex: $B \to \tau\nu$

$B \to \tau\nu$

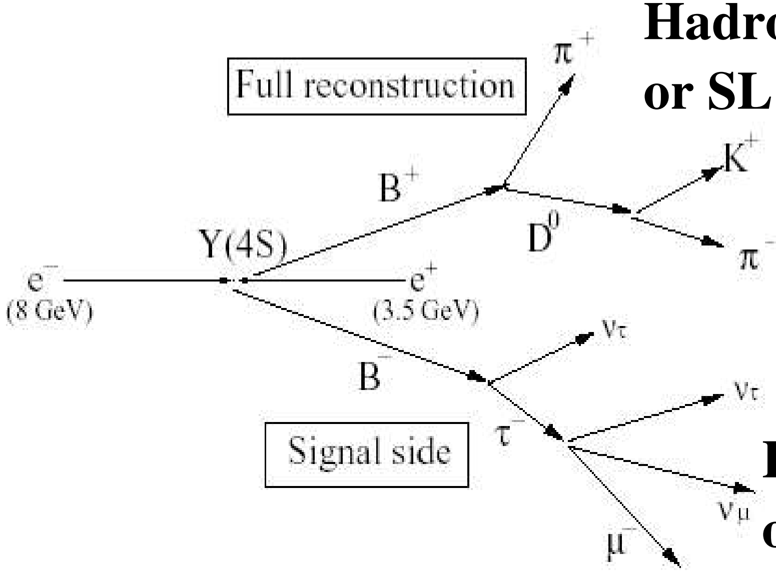
- Helicity-suppressed annihilation decay sensitive to $(f_B * |V_{ub}|)^2$
- Powerful <u>together</u> with Δm_d : removes f_B (Lattice QCD) dependence
- Sensitive, *e.g.*, to charged Higgs replacing the W-propagator



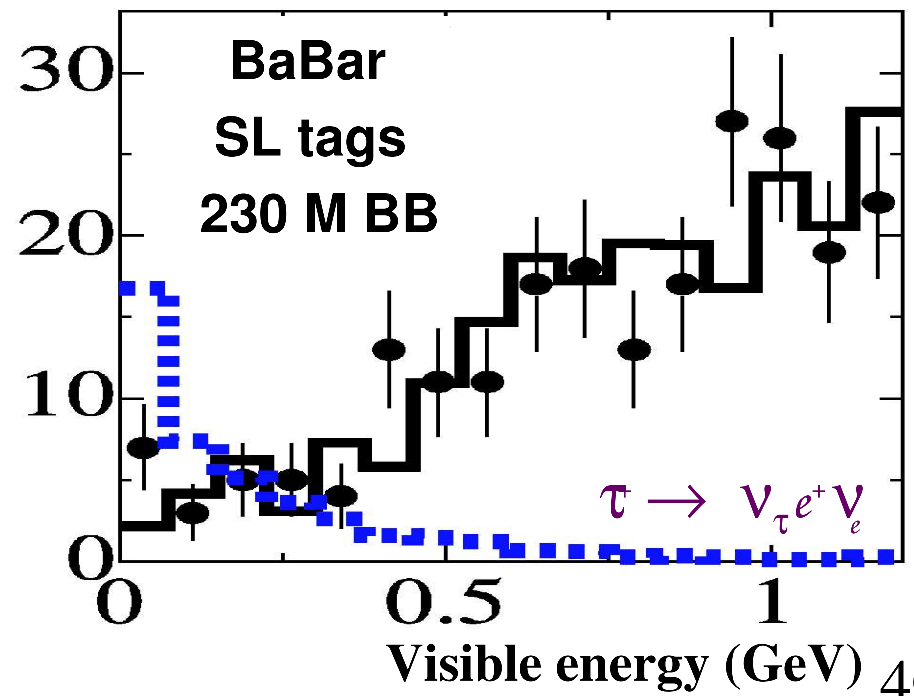
$$\mathcal{B}(B^- \to \ell^- \bar{\nu}) = \frac{G_F^2 m_B m_\ell^2}{8\pi}\left(1 - \frac{m_\ell^2}{m_B^2}\right)^2 f_B^2 |V_{ub}|^2 \tau_B$$

<u>**Experimental techniques:**</u>

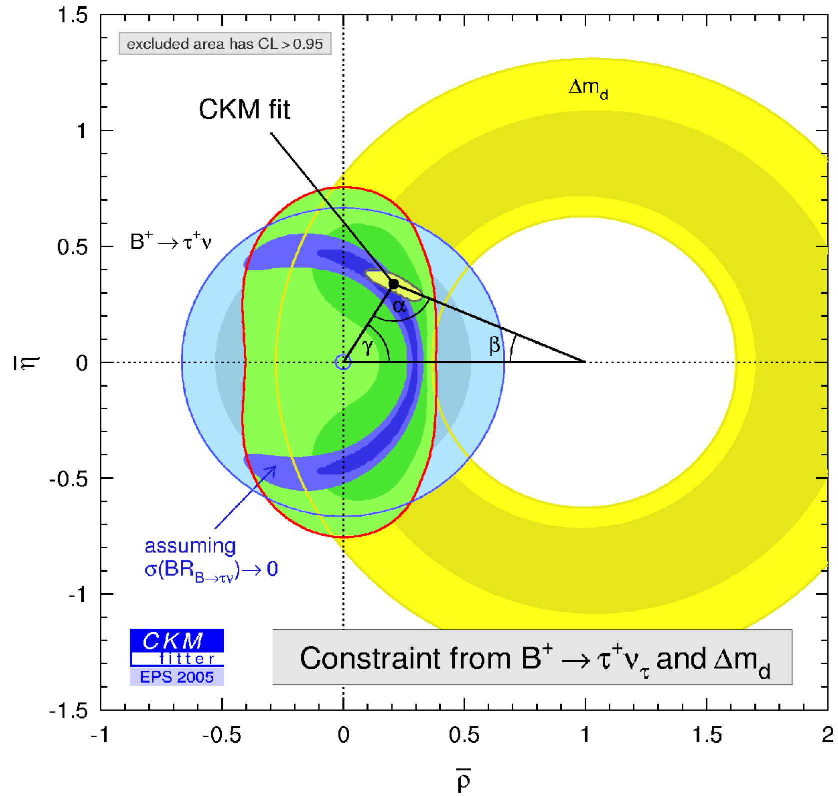
Hadronic or SL tags



Hadronic or leptonic τ-decays



$B \to \tau\nu$



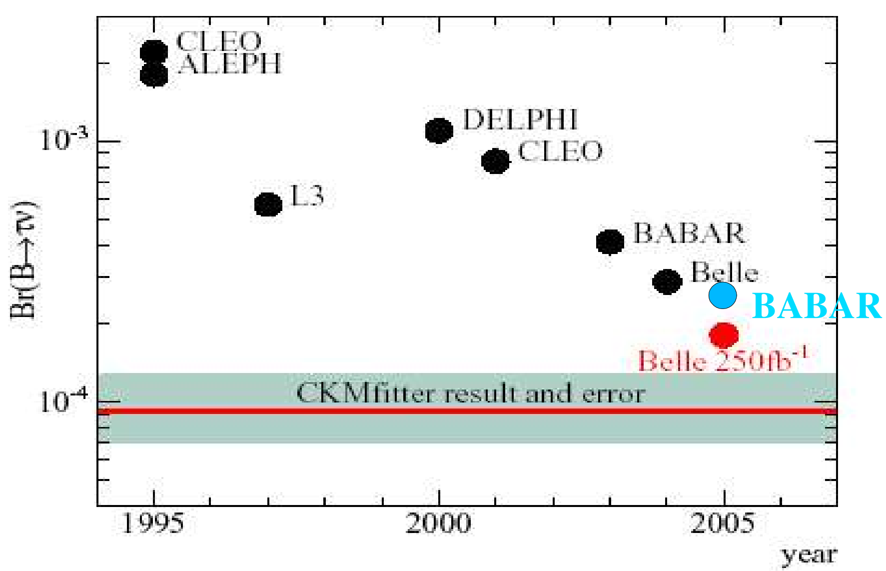
BABAR: $BF(B^+ \to \tau^+ \nu_\tau) < 2.6\ 10^{-4}$ @ 90 % C.L.

Belle: $BF(B^+ \to \tau^+ \nu_\tau) < 1.8\ 10^{-4}$ @ 90 % C.L.

Prediction from global CKM fit:

$$BF(B^+ \to \tau^+ \nu_\tau) = (8.2^{+1.7}_{-1.3})\ 10^{-5}$$

$$({}^{+5.0}_{-2.2}\ @\ 95\%\ C.L.)$$



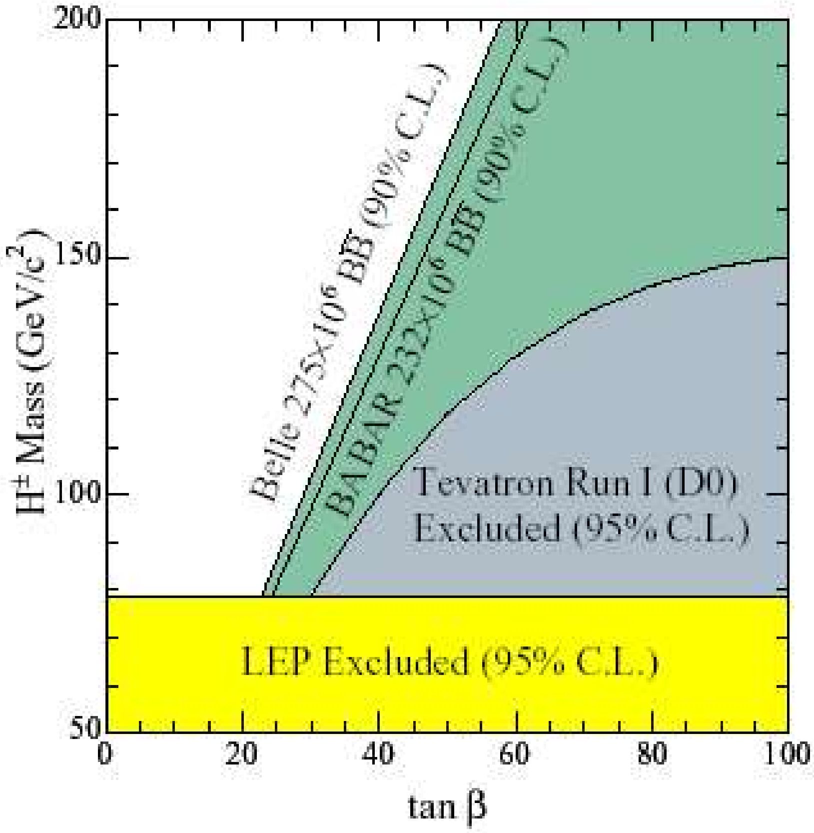
New Physics: B → τν

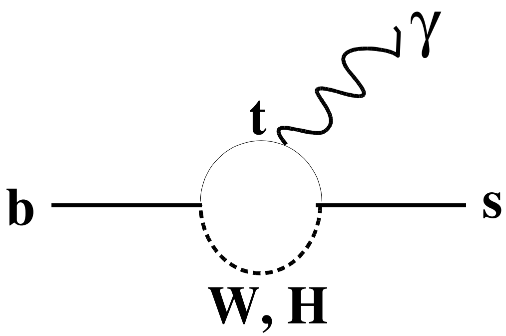
$$\mathcal{B}(B \to \tau\nu) = \mathcal{B}(B \to \tau\nu)_{\rm SM} \times r_H,$$

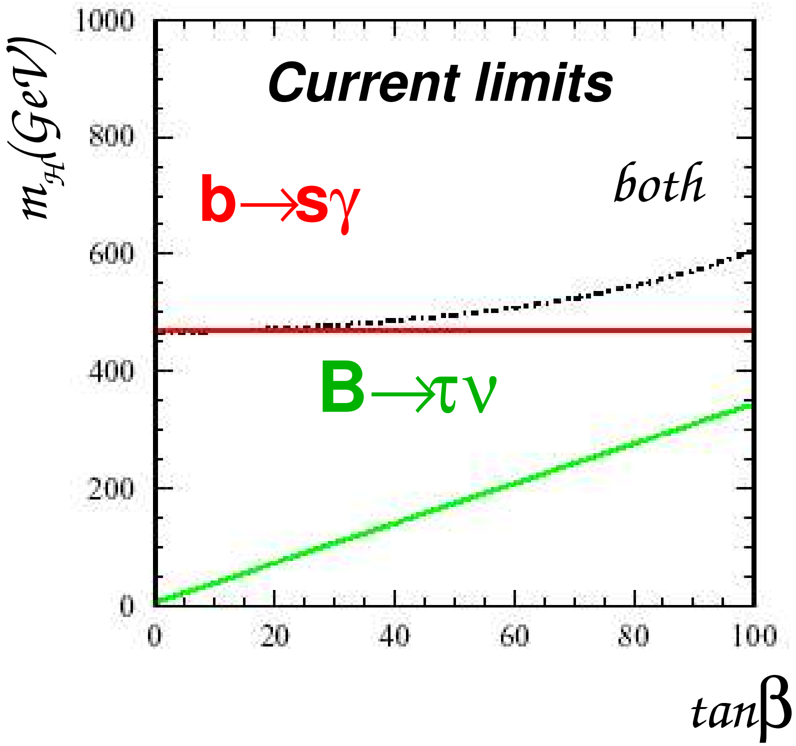
$$r_H = \left(1 - \frac{m_B^2}{m_H^2}\tan^2\beta\right)^2$$

Phys. Rev. D **48**, 2342 (1993)

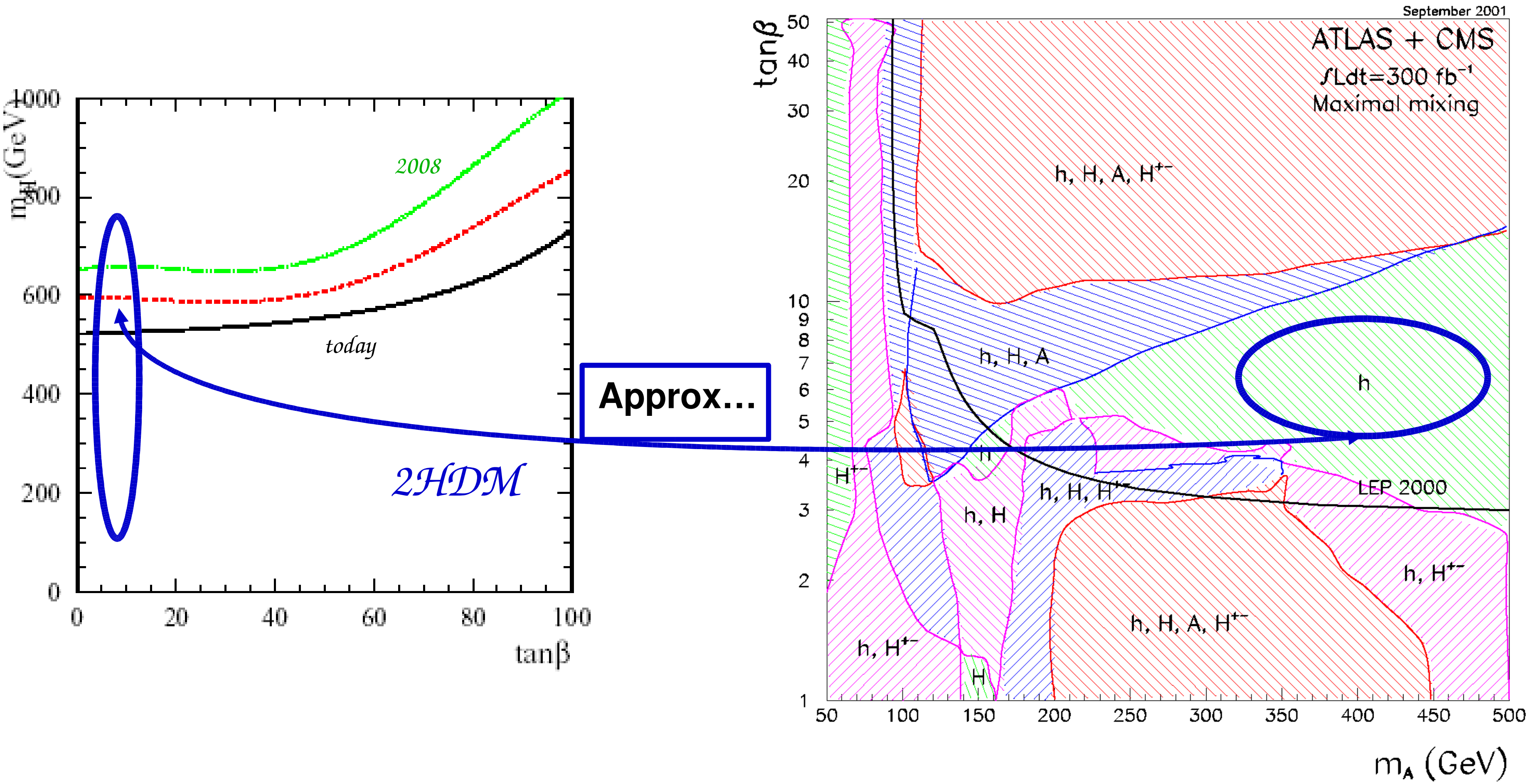
2HDM
Gambino, Misiak Nucl. Phys. B611 338
Hou Phys.Rev.D48:2342-2344,1993







Projections and LHC: B → τν & b → sγ



Uncertain regions could be clarified by B-Factories

- **depends on all other SUSY parameters …**

Conclusions

* **PEP II/BABAR very successful: Luminosity, detector (e.g. DIRC)**

* **BABAR physics programme until 2008: rich & competitive**
  Many analyses will be performed with 4 x current statistics

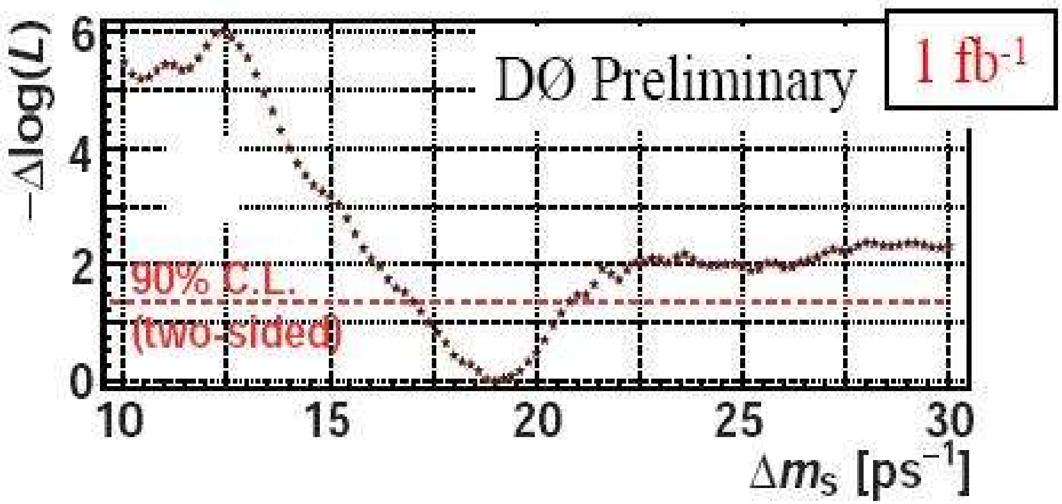
* **Large luminosity => analyses on recoil of fully reconstructed B decays**

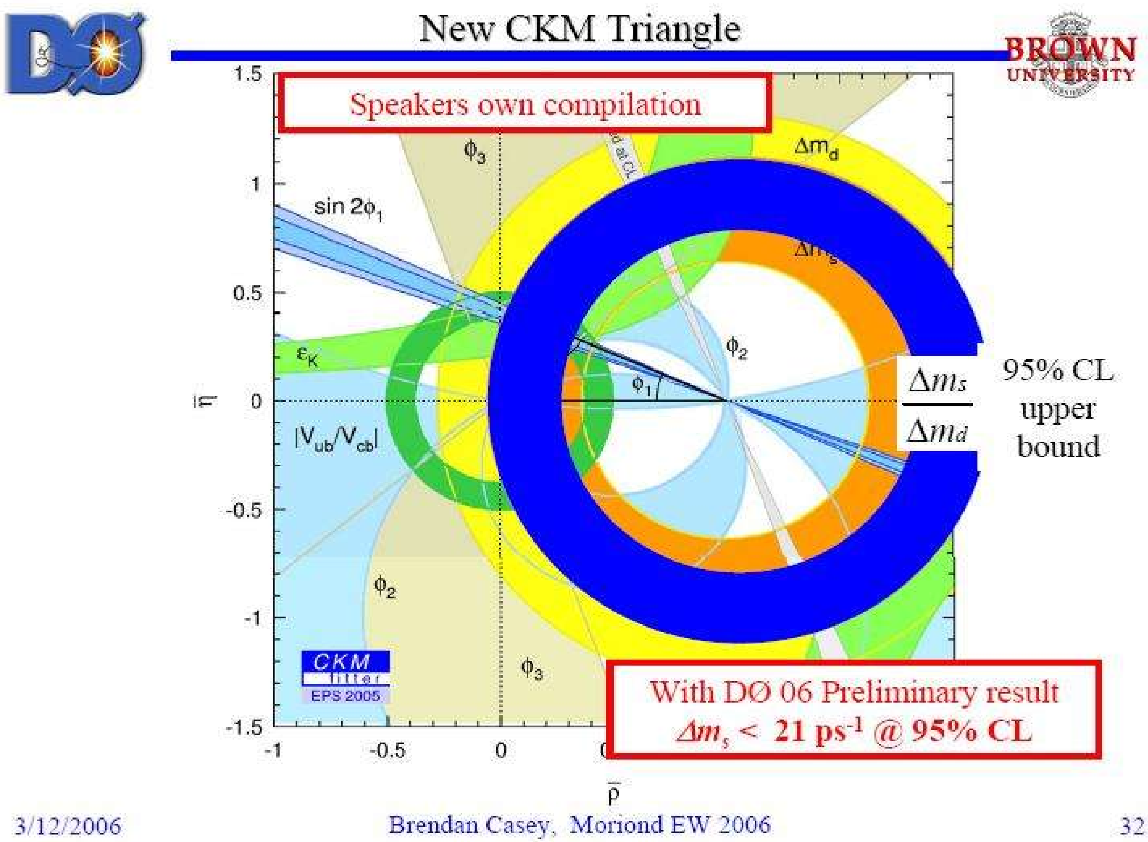
* **Precision on CKM parameters will be significantly improved:**
  $\sigma(\sin 2\beta) \approx 0.02$, $\sigma(\alpha) \approx 8°$, $\sigma(\gamma) \approx 10°$

* **Interesting opportunities to look for NP:**
  $\sin 2\beta$ in penguin modes: $\sigma(\phi K_s) \approx 0.08$, $\sigma(\eta' K_s) \approx 0.07$
  Rare B decays: e.g. $B \to \tau\nu$ **(SM: expect evidence by 2008)**

* **More than just a B-factory!**

Most recent news from flavour physics



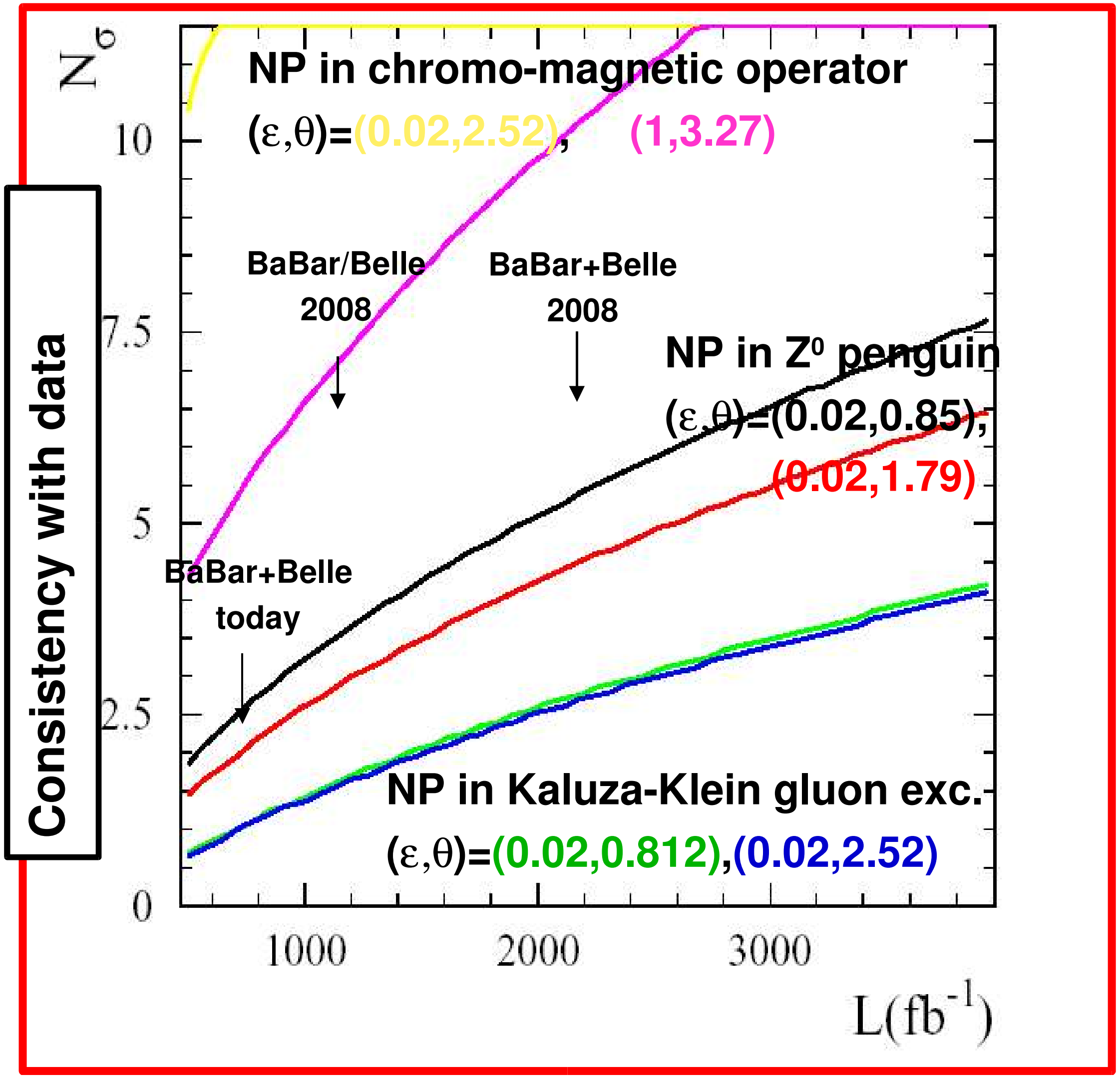


Discriminating between models

Buchalla, Hiller, Nir, Raz (hep-ph/0503151): differences among the values of S in several modes would discriminate between models.

Wilson coefficients:

$$C_{NP}=C_{SM}(1+\varepsilon e^{i\theta})$$



The "GLW" Analysis

- **GLW : measure branching fraction of $B^- \to D^0_{(CP)} K^-$**
  $D^0_{CP+} \to K^-K^+$, $D^0_{CP-} \to K_S\pi^0$, ...

- **Observables sensitive to γ:**

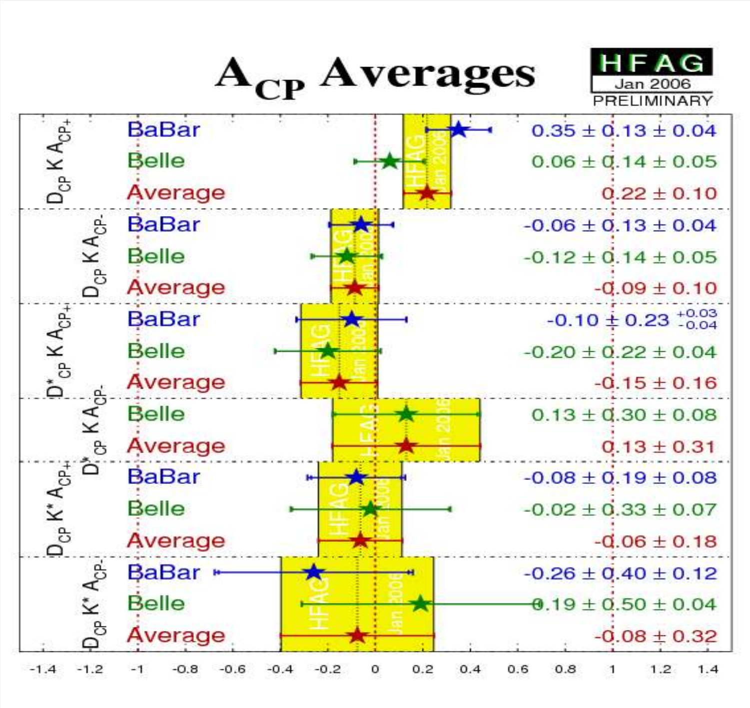
$$R_{CP\pm} \propto \Gamma(B^- \to D^0_{CP\pm} K^-) + \Gamma(B^+ \to D^0_{CP\pm} K^+) \propto 1 + r_B^2 \pm 2 r_B \cos\gamma \cos\delta_B$$

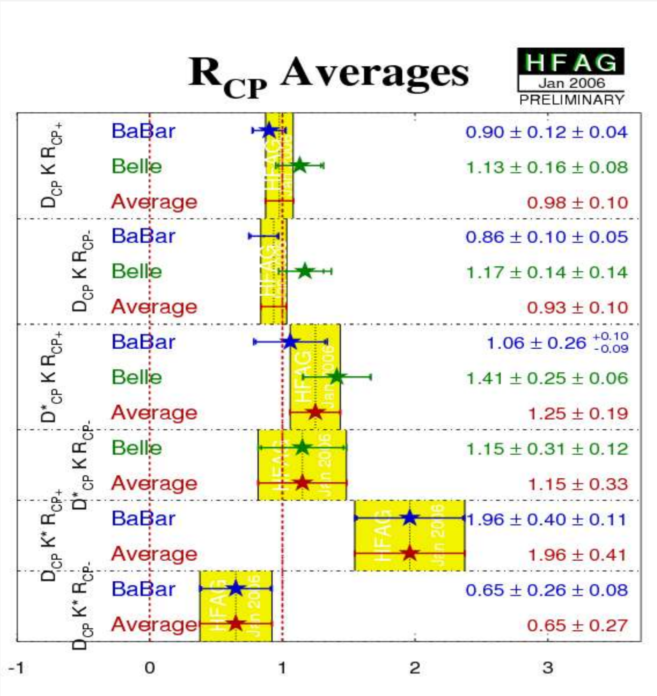
$$A_{CP\pm} \propto \Gamma(B^- \to D^0_{CP\pm} K^-) - \Gamma(B^+ \to D^0_{CP\pm} K^+) \propto \pm 2 r_B \sin\gamma \sin\delta_B / R_{CP\pm}$$

$r_B = |A(b \to u\bar{c}s)/A(b \to c\bar{u}s)|$ ~ 0.1 - 0.3 ??

δ_B: strong phase difference

- **Problem: interference of amplitudes with very different sizes**





The “ADS“ Analysis

ADS : disfavor favored amplitude and favor disfavored amplitude

$$B^- \to D^0(\to K^+\pi^-)K^- \quad \leftrightarrow \quad B^- \to \bar{D}^0(\to K^+\pi^-)K^-$$

2 × Cabibbo-suppressed

$$r_D = |A(c \to d\bar{u}s)/A(c \to s\bar{u}d)|$$

= 0.060 ± 0.003

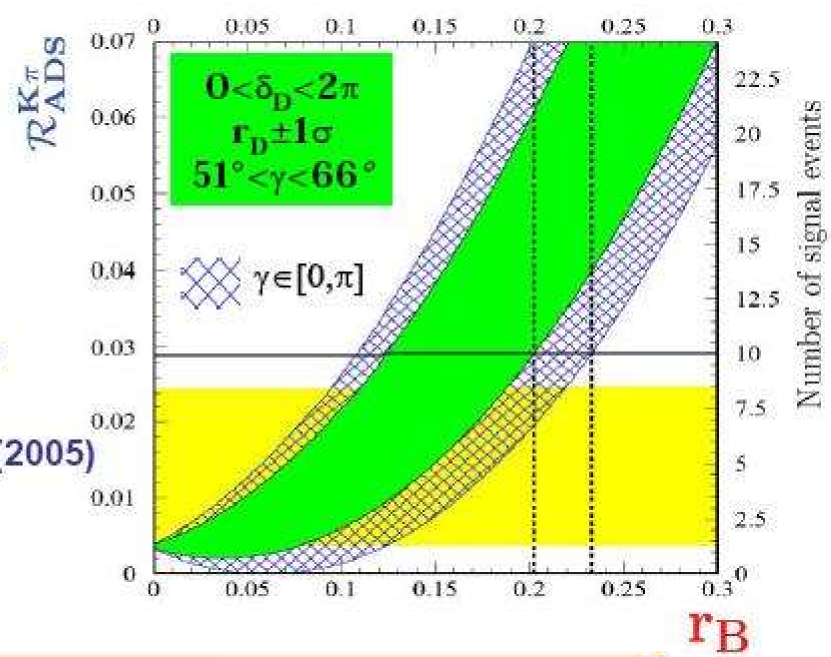
$$R_{ADS} \propto r_D^2 + r_B^2 + 2 r_B r_D \cos\gamma \cos(\delta_B + \delta_D)$$
$$A_{ADS} \propto 2 r_B r_D \sin\gamma \sin(\delta_B + \delta_D)/R_{ADS}$$

strong phase in decay of *D*

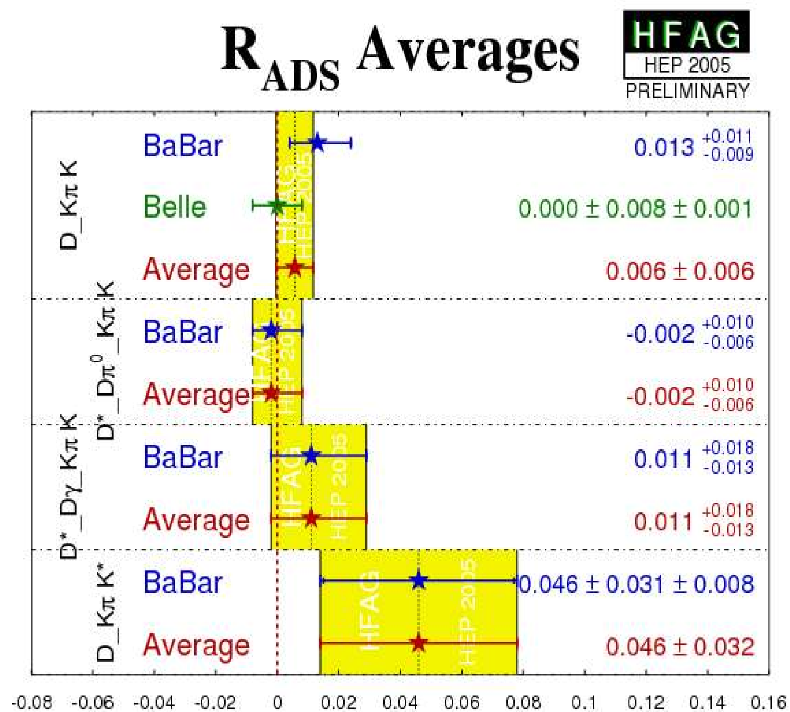
232×10^6 B pairs

hep-ex/0504047

PRD 72, 71104 (2005)

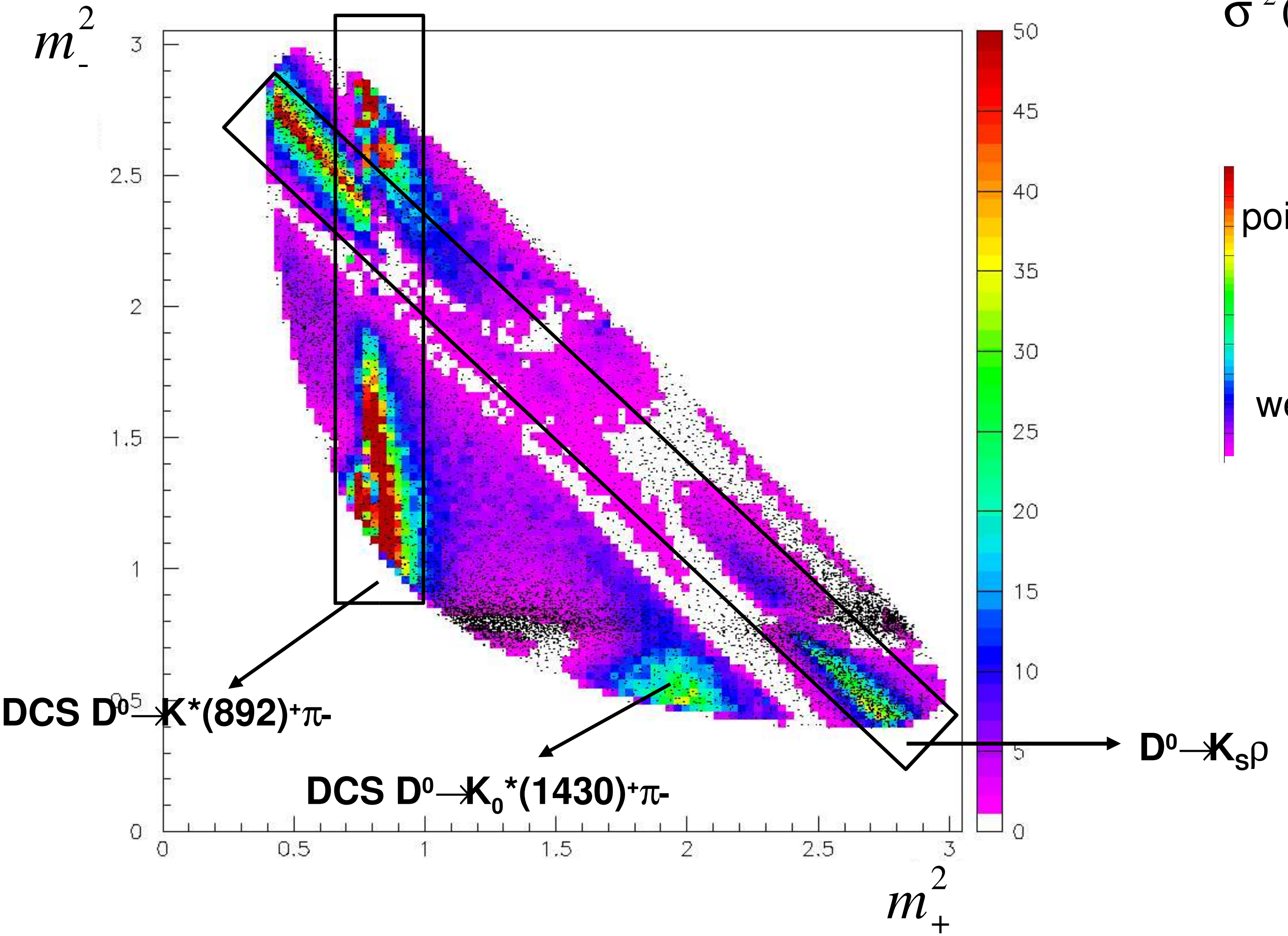


D(*)K: r_B<0.23 and r_B^{*2} <0.16² @ 90%CL



The "GGSZ" Dalitz Analysis: sensitivity to γ

Sensitivity varies strongly over Dalitz plane



$$\sigma^2(\gamma) \sim \frac{1}{\frac{d^2 \ln(L)}{d\gamma^2}}$$

points : weight = 1

$$\text{weight} = \frac{d^2 \ln(L)}{d\gamma^2}$$

r_B = 0.12

γ = 70°

δ = 180°