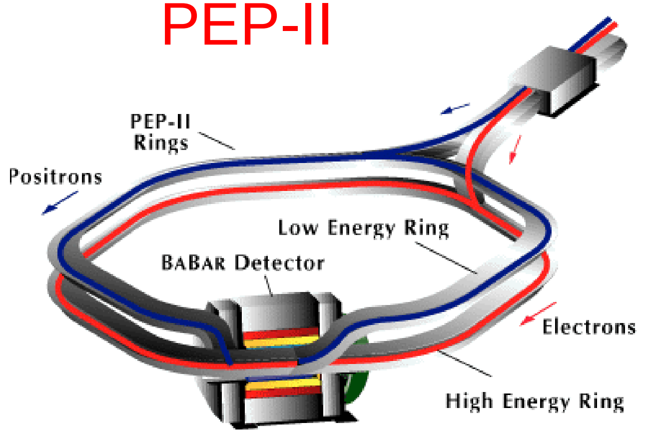
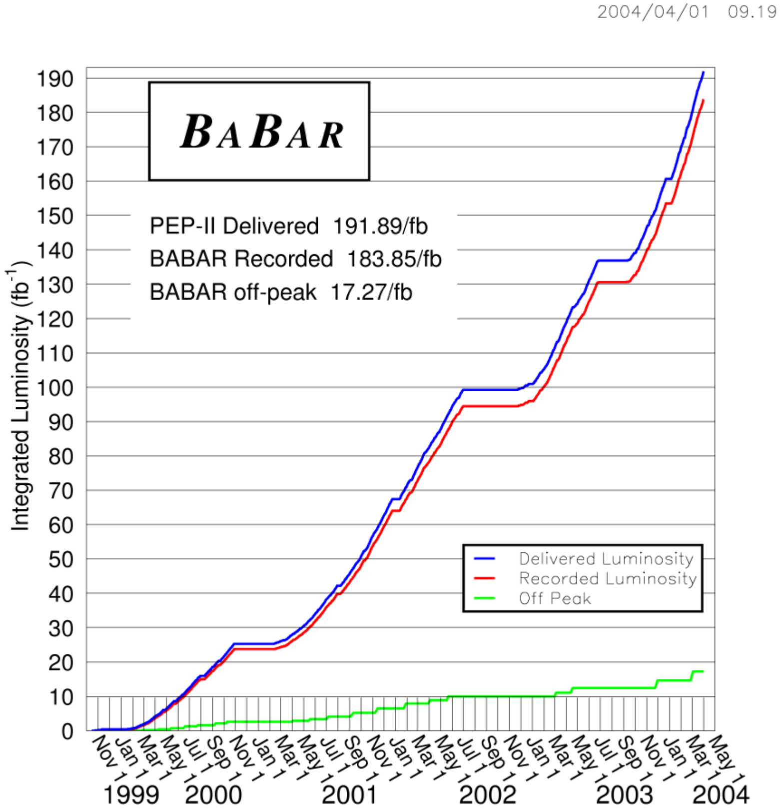
Recent Results of BaBar

- UT angles α, γ, β
- Measurements sensitive to New Physics
- $|V_{cb}|$
- New particles and rare decays

PEP II



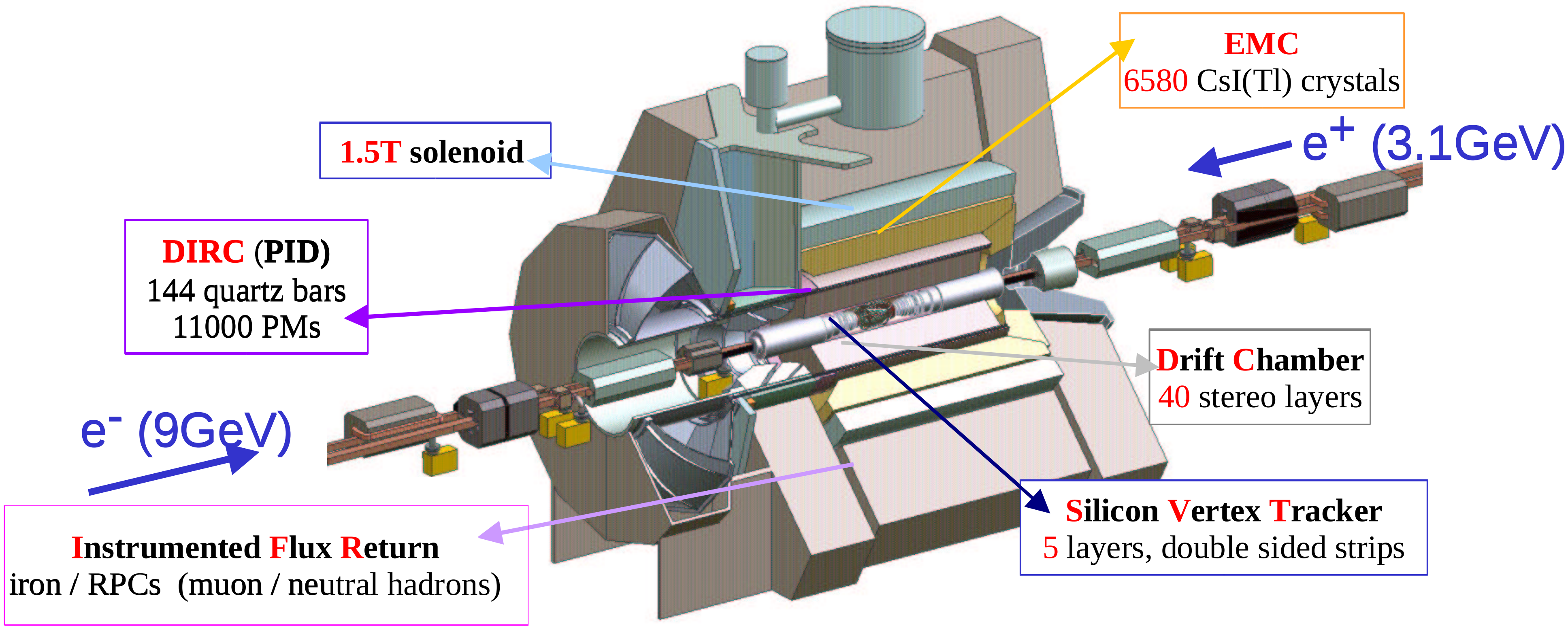


9 GeV $e^- \times$ 3.1 GeV e^+

Υ(4S) boost $\beta\gamma = 0.55$

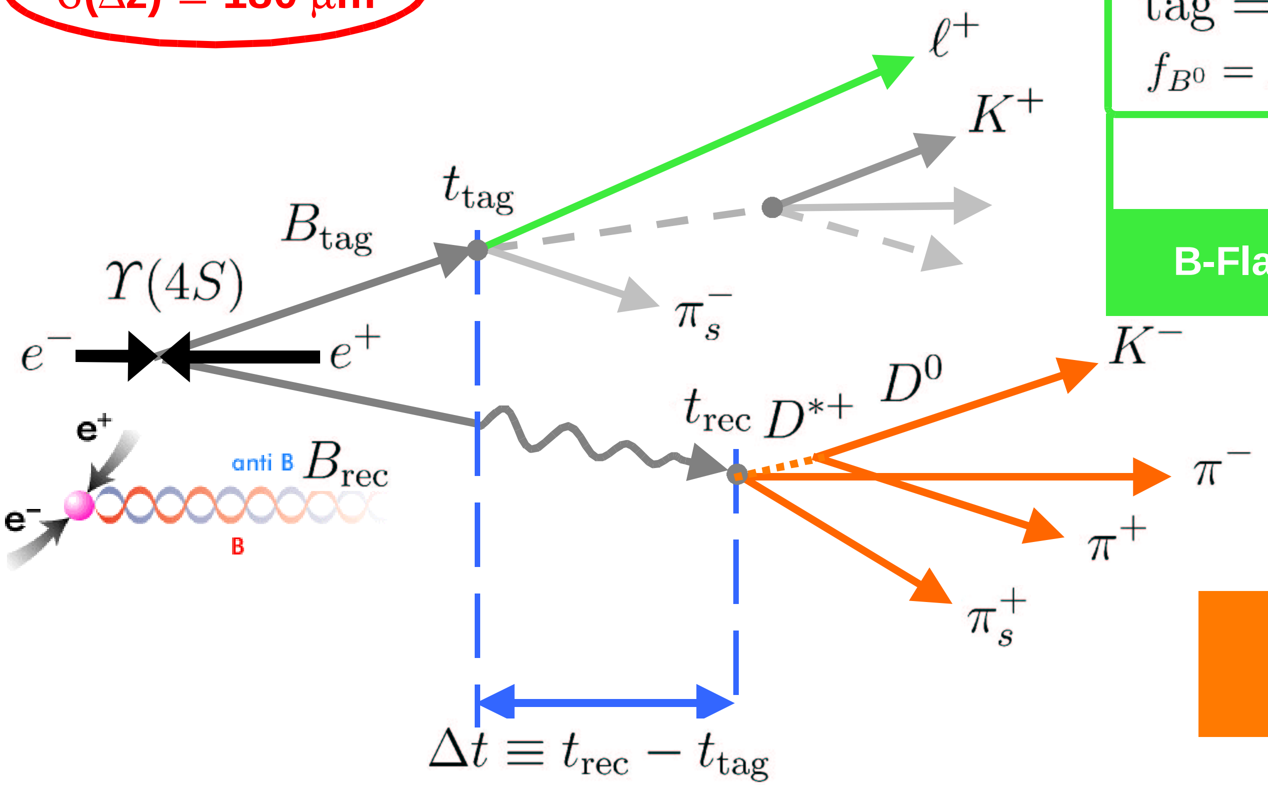
	$L_{peak}(10^{33})$	$L_{int} fb^{-1}$
2004	12.5	260
2005	18.2	395
2006	23	580
2007	30	880

BaBar


EMC
6580 CsI(Tl) crystals
1.5T solenoid
e+ (3.1GeV)
DIRC (PID)
144 quartz bars
11000 PMs
Drift Chamber
40 stereo layers
e- (9GeV)
Silicon Vertex Tracker
5 layers, double sided strips
Instrumented Flux Return
iron / RPCs (muon / neutral hadrons)

Coherent Time Evolution at the Υ(4S)

σ(Δz) ≅ 180 μm



$$\text{tag} = B^0,\ \overline{B}^0$$
$$f_{B^0} = X\ell^+\nu,\ XK^+,\ X\pi_s^-, \ldots$$

B-Flavor Tagging

Exclusive B Meson Reconstruction

$$\Delta t \approx \Delta z / c \langle \beta\gamma \rangle_{\Upsilon(4S)}$$
$$\langle |\Delta z| \rangle_{B\bar{B}} \approx 260\ \mu\text{m}$$
$$\langle |\Delta t| \rangle_{B\bar{B}} \approx 1.5\ \text{ps}^{-1}$$

Vertexing & Time Difference Determination

$$\text{rec} = \text{flav},\ \overline{\text{flav}},\ CP$$
$$f_{\text{flav}} = D^{*-}\pi^+, \ldots$$
$$f_{CP} = J/\psi\, K_S^0,\ J/\psi\, K_L^0, \ldots$$

B decay into CP eigenstates

CPV in mixing-decay interference → S ; **direct CPV** → C

$$dN \propto \exp(-|\Delta t|/\tau_B)\ \left(1 \pm D\,(S \sin(\Delta m \Delta t) - C \cos(\Delta m \Delta t))\right) \otimes R$$

$$S = \frac{2\,\Im\,\lambda}{1 + |\lambda|^2} \qquad C = \frac{1 - |\lambda|^2}{1 + |\lambda|^2}$$

D = mistag dilution **R = time resolution**

$$\lambda = \eta_{cp}\,\frac{q}{p}\,\frac{\overline{A}}{A}$$

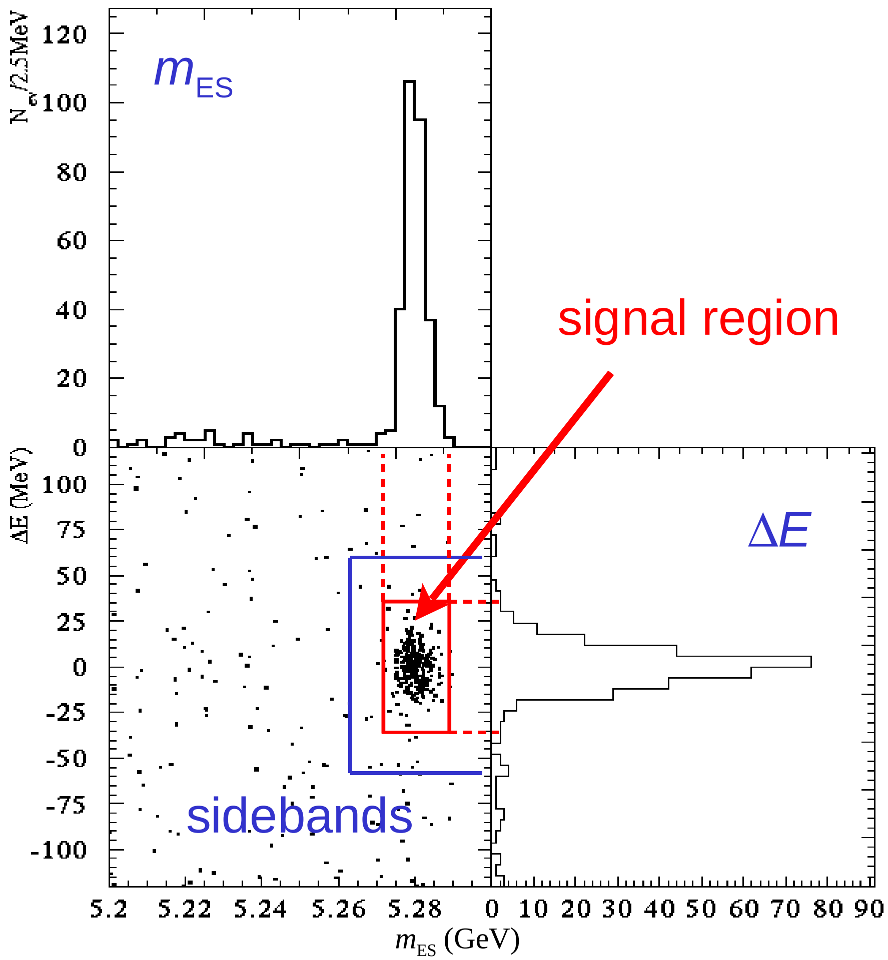
Amplitude ratio $B^0 \to f_{cp} / \overline{B^0} \to f_{cp}$ → $\frac{\overline{A}}{A}$

CP eigenvalue → η_{cp}

B mixing → $\frac{q}{p}$: $|B_\pm\rangle = p|B^0\rangle \pm q|\overline{B^0}\rangle$

$$\frac{q}{p} = \frac{V^*_{tb} V_{td}}{V_{tb} V^*_{td}} = e^{2i\phi}$$

B meson reconstruction at the Υ(4S)



$\Delta E = E^*_B - \sqrt{s}/2$

$m_{ES} = \sqrt{(s/4 - p^{*2}_B)}$

$\sigma(m_{ES}) \approx$ 2.5 MeV

$\sigma(\Delta E) \approx$ 15 - 30 MeV

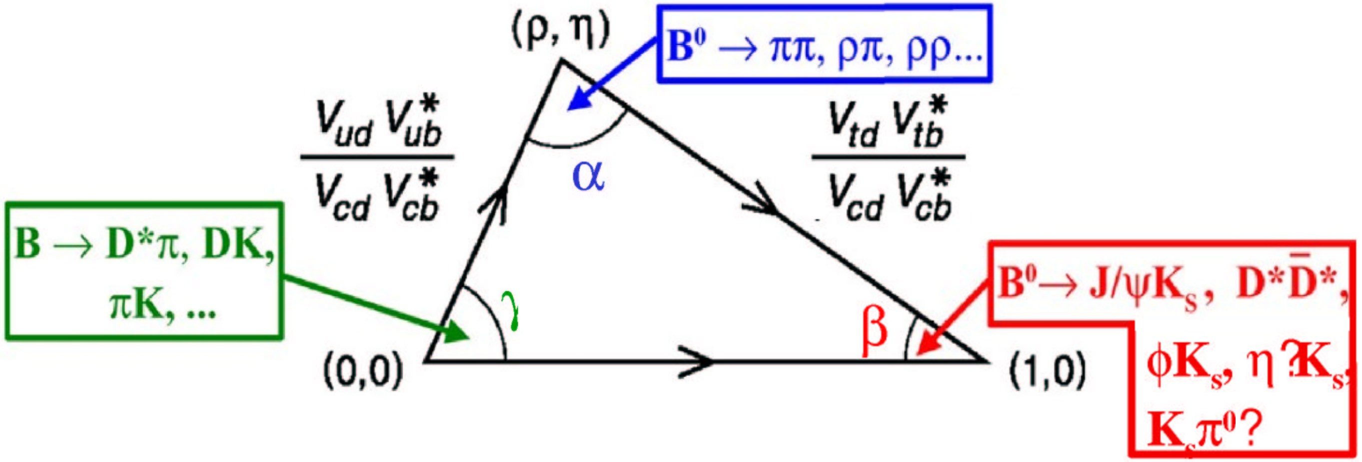
$\Delta E = 0$
$m_{ES} = m_B$

B decays

Angles of the Unitarity Triangle

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

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

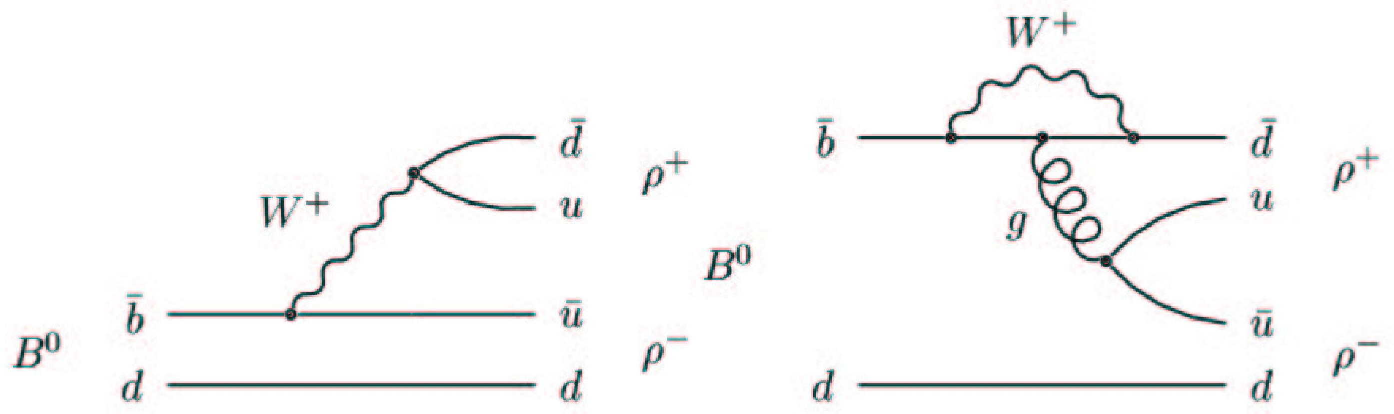


$B^0 \to \rho^+\rho^-$ ·····▶ α

$B^- \to D^0 [K^+\pi^-] K^-$ ·····▶ γ

$B^- \to J/\psi K^{*0}$ ·····▶ β

$B^0 \rightarrow \pi^+\pi^-$ $(\rho^+\rho^-)$



Tree　　　　Penguin

Penguin contributions introduce additional phases
extra weak and strong phases + |P/T| modify α :

$$\sin 2\alpha \rightarrow \sin 2\alpha_{eff}$$

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

Penguin contributions for $B^0 \rightarrow \pi^+\pi^-$ are large

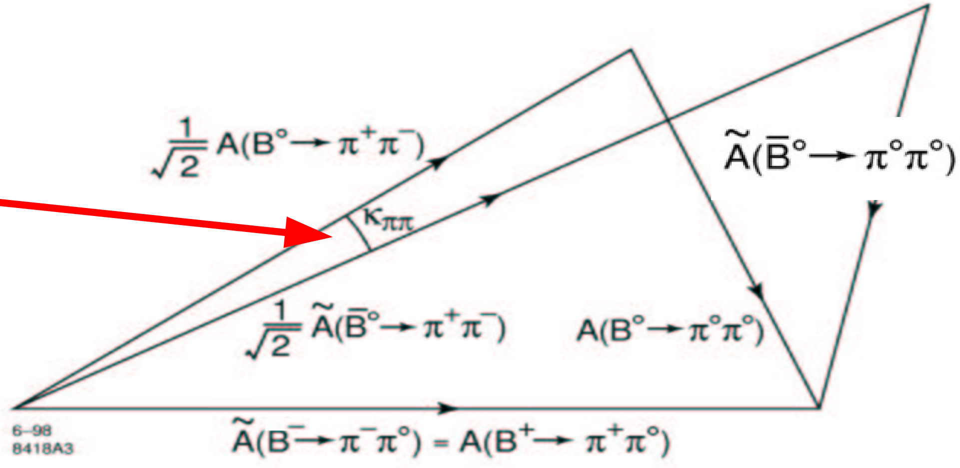
$B^0 \rightarrow \pi^+\pi^-$

To relate α to α_{eff}

Assuming SU(2)

- Isospin analysis

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

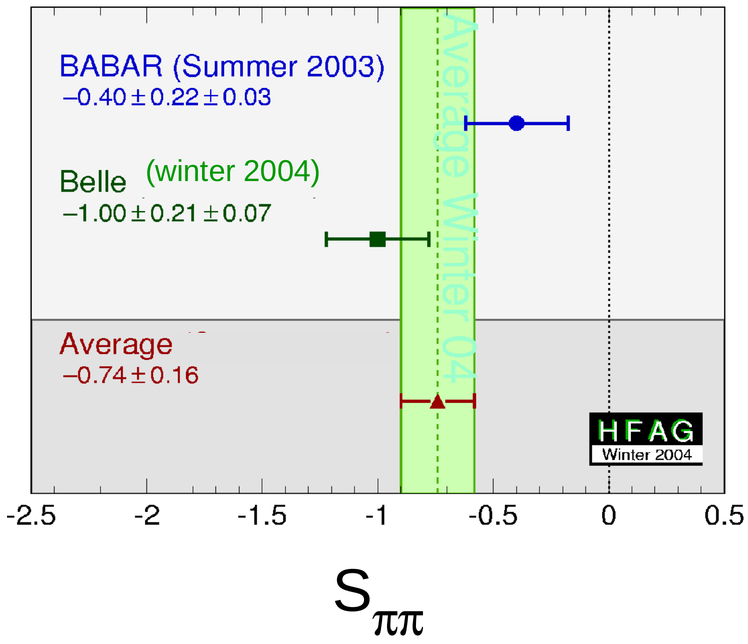


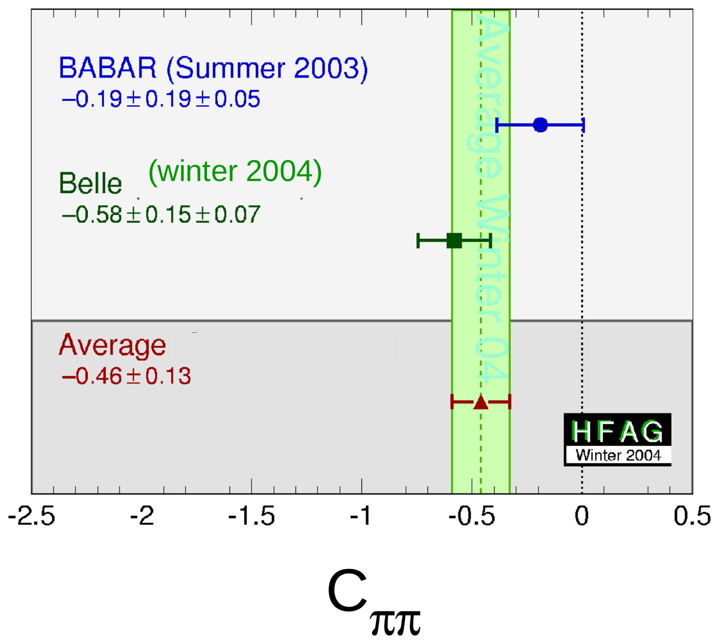
Need flavour tagged rates for
$\pi^+\pi^-$, $\pi^\pm\pi^0$, $\pi^0\pi^0$

- Grossmann-Quinn bound:

$$\sin^2(\alpha_{eff} - \alpha) \leq \frac{Br(B^0 \rightarrow \pi^0\pi^0)}{Br(B^\pm \rightarrow \pi^\pm\pi^0)}$$

Status of $B^0 \to \pi^+\pi^-$





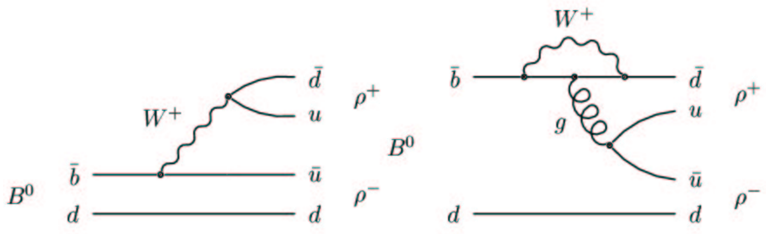
$Br(B^0 \to \pi^0\pi^0) = (2.1 \pm 0.6 \pm 0.3) \times 10^{-6}$ BaBar PRL 91, 241801 (2003)

- $Br\,(B^0 \to \pi^0\pi^0)\,/\,Br\,(B^\pm \to \pi^\pm\pi^0)$, GC bound: $|\alpha_{eff} - \alpha| < 47^o$
- Statistics too low to perform isospin analysis

$B^0 \to \rho^+ \rho^-$

- Same scenario, tree diagram + penguin contributions

➔ asymmetry sensitive to sin $2\alpha_{eff}$



- P → VV decay: 3 helicity states.
  From angular analysis: longitudinal polarization is dominant
  $f_L = 0.99 \pm 0.03\,^{+0.04}_{-0.02}$

➔ CP–even final state

- Branching fraction relatively high
  $Br(B^0 \to \rho^+\rho^-) = (30 \pm 4 \pm 5) \times 10^{-6}$ [$Br(B^0 \to \pi\pi) \sim 5 \times 10^{-6}$] submitted to PRL

- Penguin contamination expected to be small (can be bound experimentally)

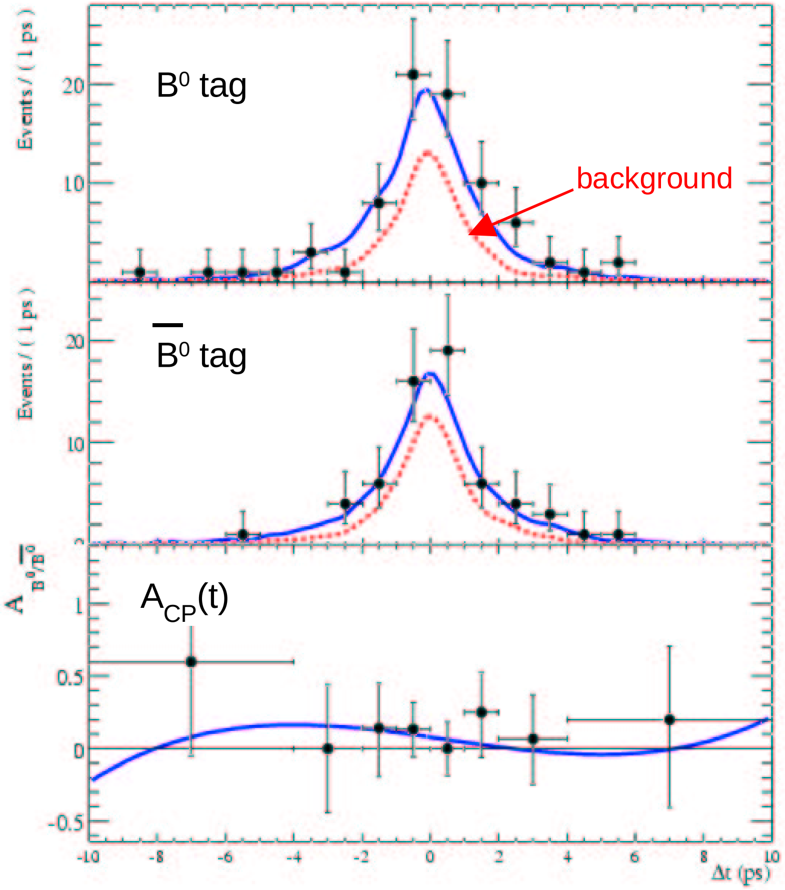
$B^0 \rightarrow \rho^+\rho^-$ - time dependent CP asymmetry

Maximum Likelihood fit on m_{ES}, ΔE, NN(evt. shape), Δt, $M(\rho)$, ρ helicity angles

with 114×10^6 BB pairs:

- $S_{long} = -0.19 \pm 0.33 \pm 0.11$
- $C_{long} = -0.23 \pm 0.24 \pm 0.14$

preliminary



$B^0 \to \rho^+\rho^-$

Assuming SU(2)

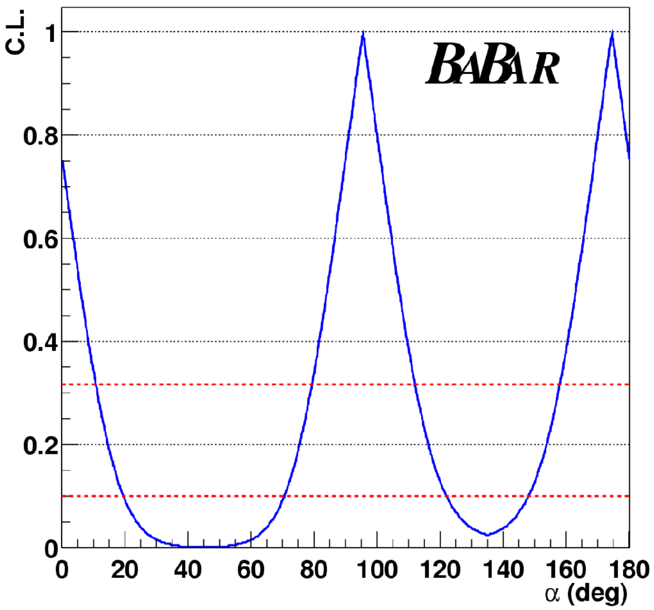
Limit on the penguins via the Grossmann-Quinn bound:

$$Br(B^+ \to \rho^+\rho^0) = (22.5\ ^{+5.7}_{-5.4} \pm 4.9) \times 10^{-6}$$

$$Br(B^0 \to \rho^0\rho^0) = 0.6\ ^{+0.7}_{-0.6} \pm 0.1) \times 10^{-6}$$

$$\sin^2(\alpha_{\mathbf{eff}} - \alpha) \leq \frac{f_L(B^0 \to \rho^0\rho^0)\, Br\,(B^0 \to \rho^0\rho^0)}{f_L(B^\pm \to \rho^\pm\rho^0)\, Br\,(B^\pm \to \rho^\pm\rho^0)}$$

$|\alpha_{\mathbf{eff}} - \alpha| < 13^{o}$ (68 % C.L.)

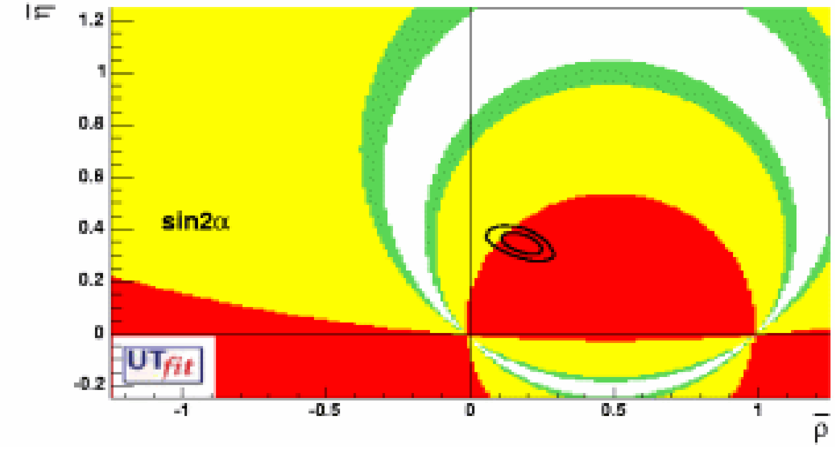


Isospin analysis

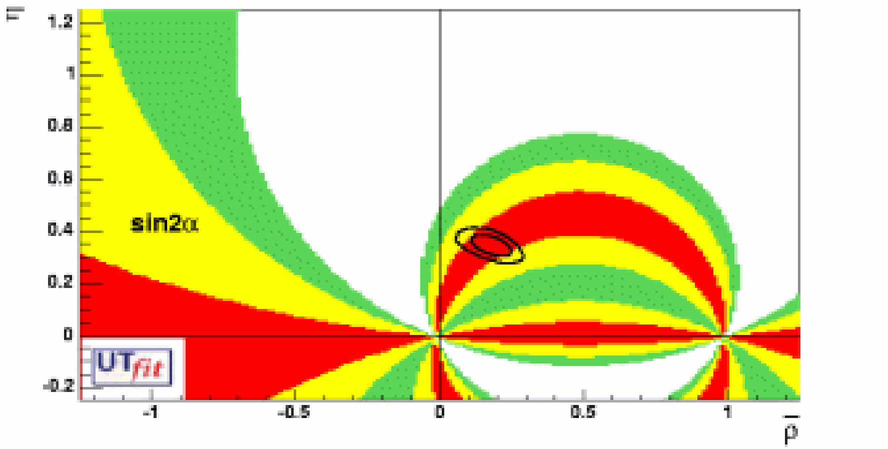
$\alpha = 95^{o} \pm 10^{o}\ ^{+4^o}_{-3^o} \pm 13^{o}$ (penguin)

$B^0 \rightarrow \pi^+\pi^-$, $\rho^+\rho^-$

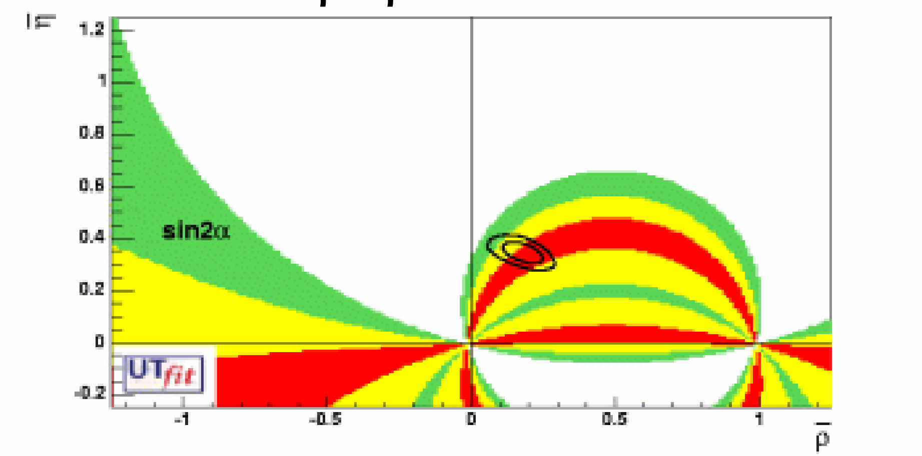
$\pi^+\pi^-$



$\rho^+\rho^-$



$\pi^+\pi^- + \rho^+\rho^-$

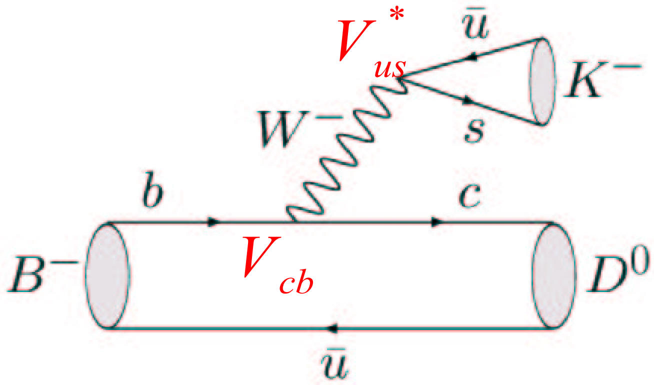


α starts to constraint the UT vertex

BaBar only

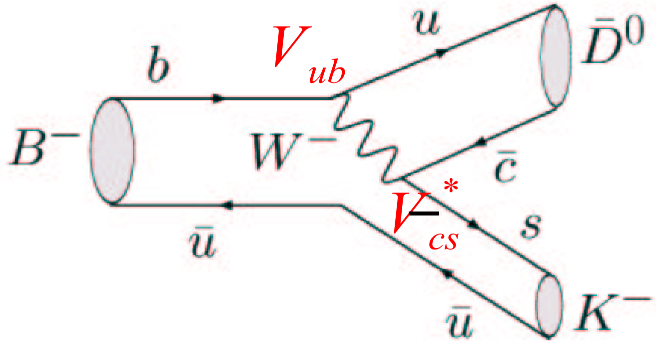
$B \rightarrow DK$

γ is the phase between the amplitudes of $b \rightarrow u$ and $b \rightarrow c$



colour suppressed

r ~ 0.1 · ÷ 0.2



Exploits the interference between $B^- \rightarrow D^0 K^-$ and $B^- \rightarrow \bar{D}^0 K^-$ when $D^0/\bar{D}^0$ decay to a common final state f

Theoretically clean extraction of γ but generally with discrete ambiguities
The number of ambiguities depends on the D final state **f**

$B^- \to [K^+\pi^-]_D K^-$

Atwood-Duniets-Sony (ADS): equalize the interference amplitudes

favoured	suppressed
$B^- \to D^0 K^-$	$D^0 \to K^+\pi^-$
suppressed	**favoured**
$B^- \to \overline{D}^0 K^-$	$\overline{D}^0 \to K^+\pi^-$

$$R_{ADS} = \frac{Br([K^+\pi^-]K^-) + Br([K^-\pi^+]K^+)}{Br([K^-\pi^+]K^-) + Br([K^+\pi^-]K^+)} = r_d^2 + r_b^2 + 2 r_b r_d \cos\delta \cos\gamma$$

$$A_{ADS} = \frac{Br([K^+\pi^-]K^-) - Br([K^-\pi^+]K^+)}{Br([K^+\pi^-]K^-) + Br([K^-\pi^+]K^+)} = 2 r_b r_d \sin\delta \sin\gamma / R_{ADS}$$

unknowns

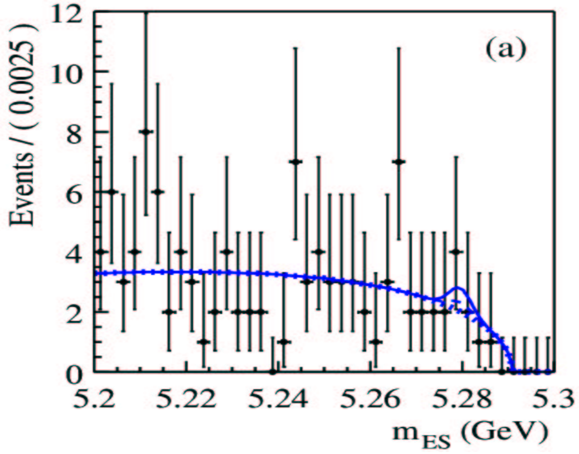
$$r_d = \frac{|A(D^0 \to K^+\pi^-)|}{|A(D^0 \to K^-\pi^+)|} = 0.060 \pm 0.003 \qquad r_b = \frac{|A(B^- \to \overline{D}^0 K^-)|}{|A(B^- \to D^0 K^-)|}$$

δ = strong phase diff.
$A(B^- \to \overline{D}^0 K^-)$ and $A(B^- \to D^0 K^-)$

γ

$B^- \to [K^+\pi^-]_D K^-$

$N([K^\pm\pi^\mp]K^\mp) = 1 \pm 3$



A_{ADS} not measured

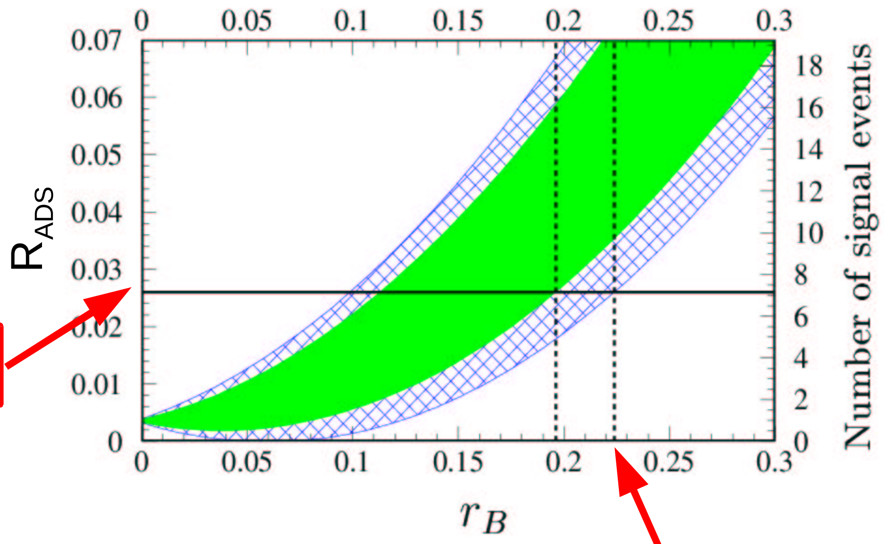
Limit on R_{ADS}:

$R_{ADS} < 0.026$ (90% C.L.)

First experimental limit on r_b:

$r_b < 0.22$ (90% C.L.)

$R_{ADS} = 0.026$



$r_b = 0.22$

hep-ex/0402024 Sub. to PRL

Perspectives for γ

Many decay modes give information on γ :

- $B \rightarrow D^{(*)}K^{(*)}$, $D^0 \rightarrow$ CP eigenstate
- $B \rightarrow D^{(*)}K^{(*)}$, $D^0 \rightarrow$ Double Cabibbo Suppressed (previous slides)

Provide a theoretically clean measurement of γ, but require very large B samples

- $B^0 \rightarrow D^*\pi$ (time dependent analysis, measures $\sin(2\beta+\gamma)$)

Also requires large statistics, theoretical interpretation not as clean

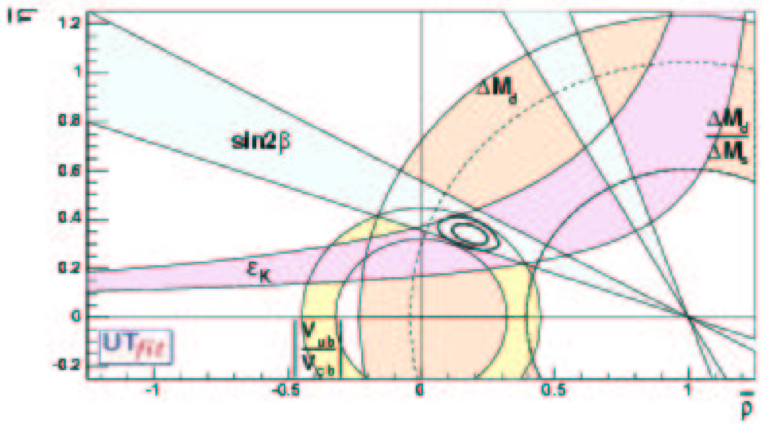
- $B \rightarrow D^{(*)}K^{(*)}$, $D^0 \rightarrow$ 3-body

Dalitz analysis to evaluate strong interaction contribution, requires less statistics. Next summer, with $\sim$ 200 fb-1, could provide γ with an error of $15^o \div 20^o$

Status for β

CP violation in B decays has been observed, sin2β is

sin2β = 0.741 ± 0.067 ± 0.034 (89M BB)

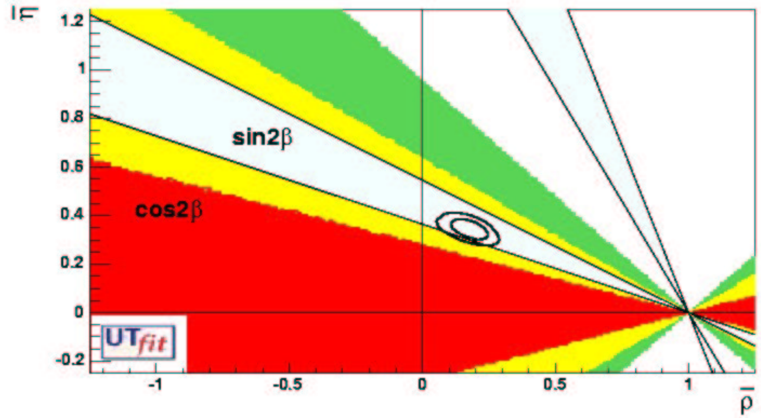


theory error on sin2β with J/ΨK⁰s <1%
still room for improvement with larger data samples

New time-dependent asymmetry measurement with $B^0 \rightarrow J/\psi\ K^{*0}(K_s\pi^0)$

P→ VV: angular analysis required

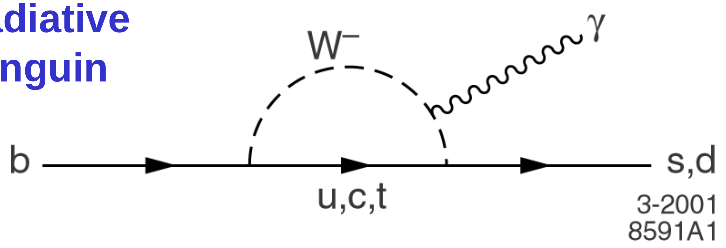
cos 2β < 0 (89% C.L.)   preliminary



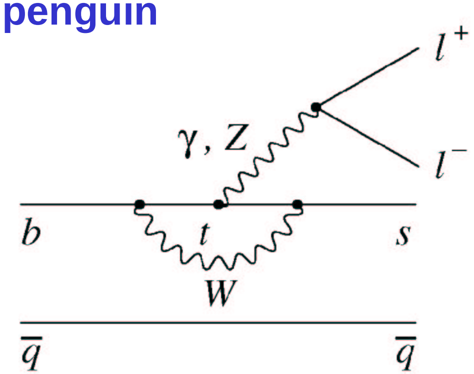
Other B decays are sensitive to sin2β: $K^0{}_s\phi$, $K^0{}_s\pi^0$, ... mostly useful to search for NP

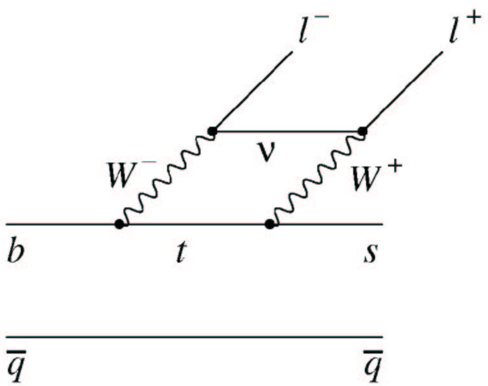
Search for NP

Radiative penguin



EW penguin





Sensitive to NP in $\sin 2\beta_{eff}$

- $B^0 \to \phi K_s$
- $B^0 \to K^+K^-K_s$
- $B^0 \to f_0K_s$
- $B^0 \to K_s\pi^0$
- $B^0 \to K^{*0} (\to K_s\pi)\,\gamma$

radiative decays

- $B \to \gamma X_s$
- $B \to \gamma K^*$
- $B^0 \to l^+l^- X_s$

$B^0 \to \phi K_s$

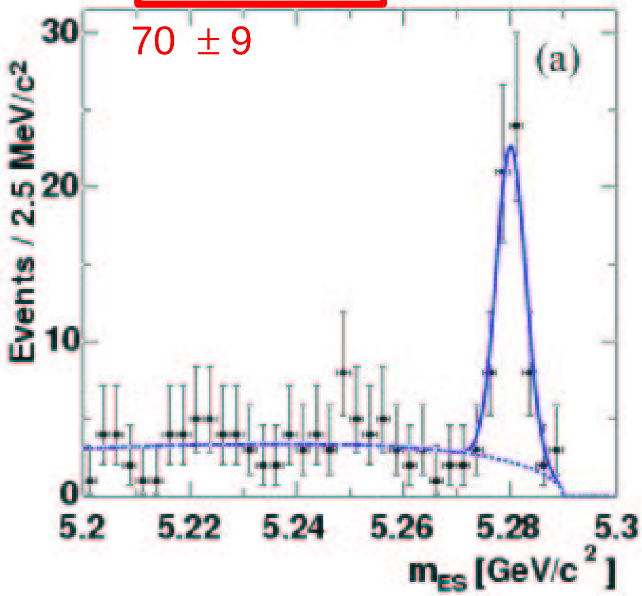
Decay dominated by pure $b \to sss$ gluonic penguins

$A_{CP}(t) = S \sin(\Delta m \Delta t) - C \cos(\Delta m \Delta t)$

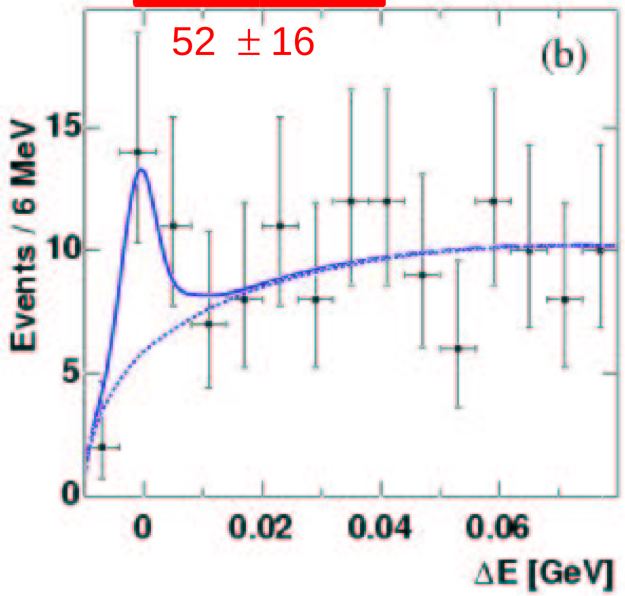
In the SM: $C = 0$, $S = -\eta_f \sin(2\beta)$ $\eta_f = -1\ (+1)$ for ϕK_S (ϕK_L)

search for NP ⇒ comparison of CP-violating observables with SM expectation

ϕK_S



ϕK_L



$\phi \to K^+K^-$

$B^0 \to \phi K_S$

Combined $B^0 \to \phi K_S$ $B^0 \to \phi K_L$ result:

$S = 0.47 \pm 0.34 \,^{+0.08}_{-0.06}$

$C = 0.01 \pm 0.33 \pm 0.10$

In the SM: $S = \sin(2\beta) = 0.74$, $C=0$

results compatible at the 1σ level

N.B. Belle finds

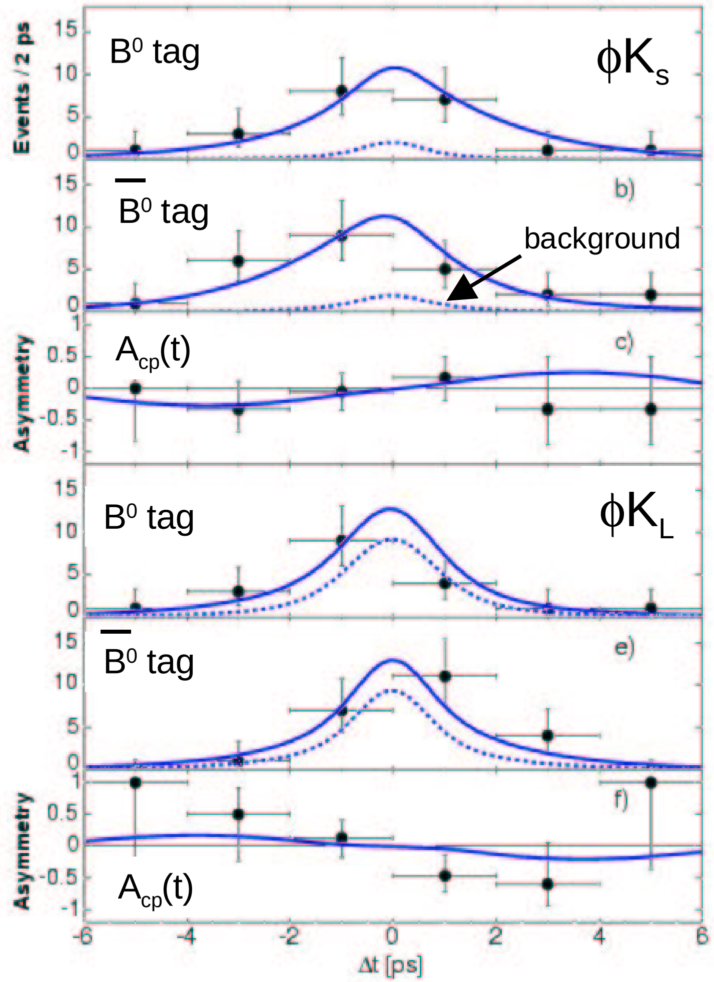
$S = -0.96 \pm 0.50 \,^{+0.09}_{-0.11}$

$C = 0.15 \pm 0.29 \pm 0.07$

3.5σ from the SM

2.5σ from BaBar

hep-ex/0403026



$B^0 \rightarrow K^+K^-K_s$

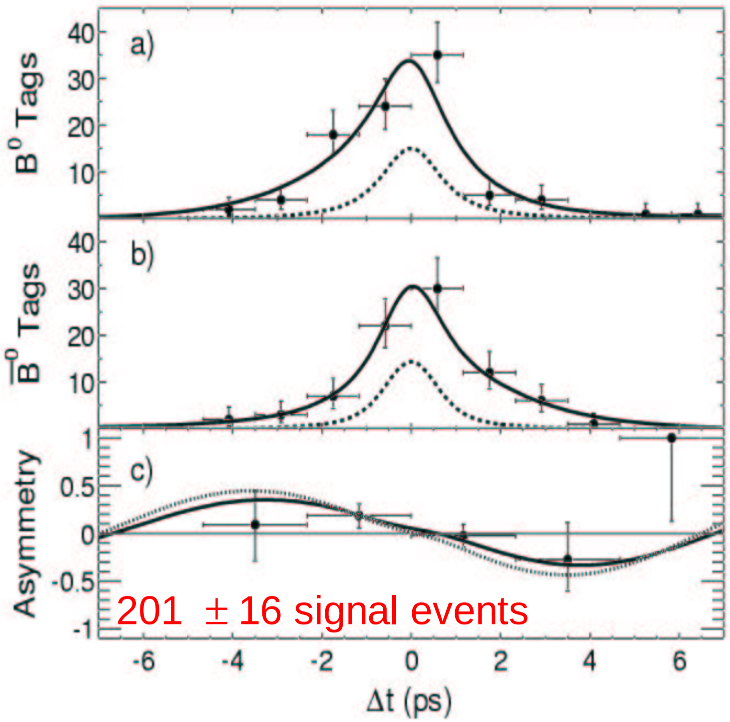
Decay dominated by pure $b \rightarrow s\bar{s}s$ gluonic penguins

veto on ϕ

determine CP-even fraction from: helicity angle of K^+K^- + isospin relations

$f_{CP\text{-}EVEN} = 0.98 \pm 0.15 \pm 0.04$

Moriond EW 04



$S = -0.56 \pm 0.25 \pm 0.04 + 0 - 0.17$

$C = 0.10 \pm 0.19 \pm 0.09$

consistent with SM:

$S = -\sin(2\beta)$

$C = 0$

$B^0 \to f_0(980)\,K_s$

Decay dominated by pure $b \to s\bar{s}s$ gluonic penguins (b $\to u\bar{u}s$ suppressed)

reconstruct $f_0 \to \pi\pi$

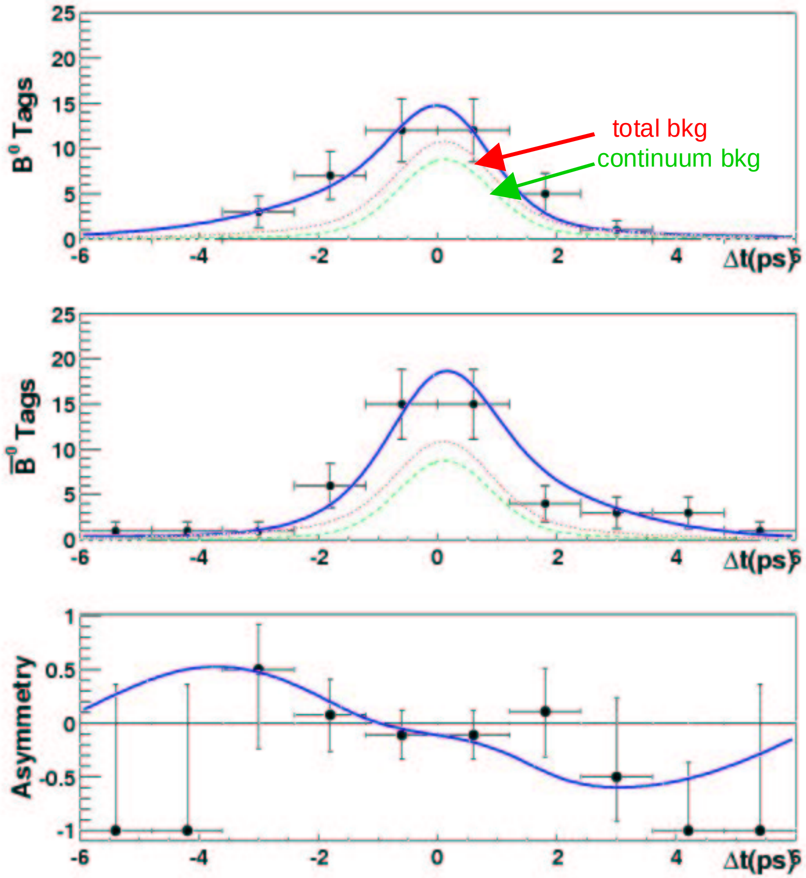
Fit m_{ES}, ΔE, NN(evt. shape), $M(\pi\pi)$

$S = -1.62\,^{+0.56}_{-0.51} \pm 0.10$

$C = 0.27 \pm 0.36 \pm 0.12$

f_0 is scalar, f_0K_s is CP-even

SM expectation : $S \simeq -\sin(2\beta)$



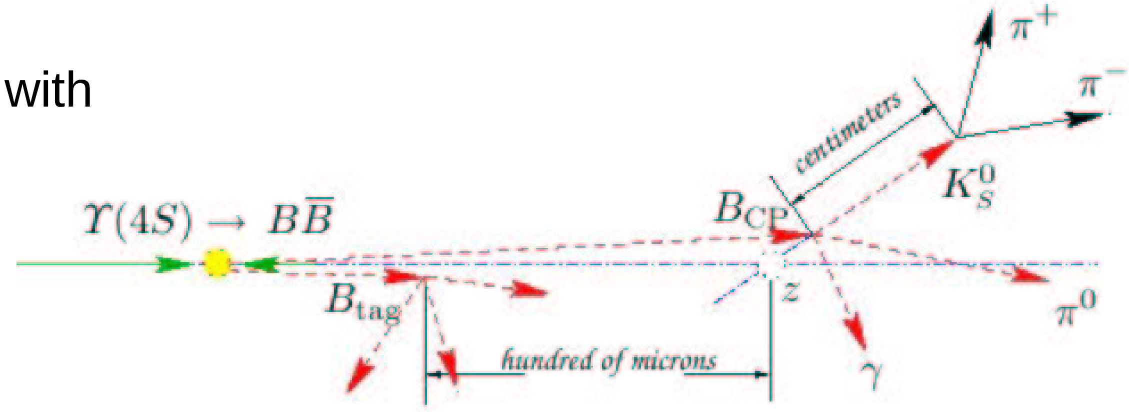
94 ± 14 ± 6 signal events

Moriond EW 04

$B^0 \to K_s\pi^0$

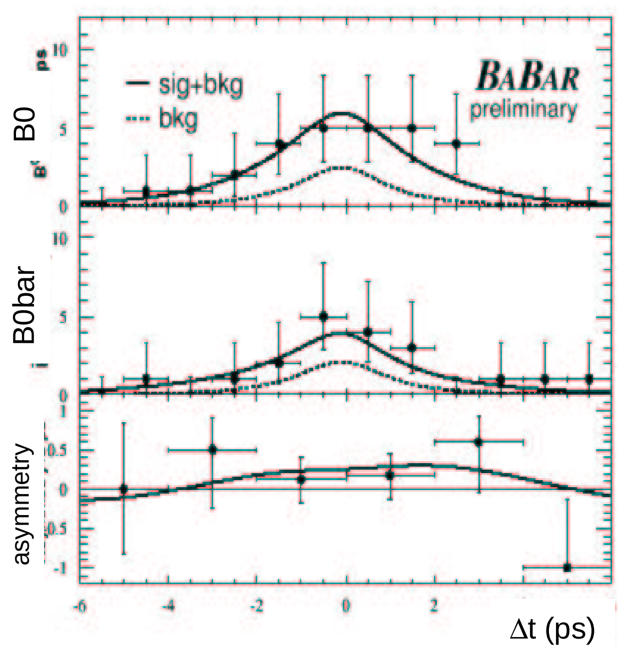
B decay position determined with
beam constrained vertexing

Method validated with $J/\psi\ K_s$



Decay dominated by $b \to s\bar{q}q$ penguins

SM expectation : $S \simeq \sin(2\beta)$

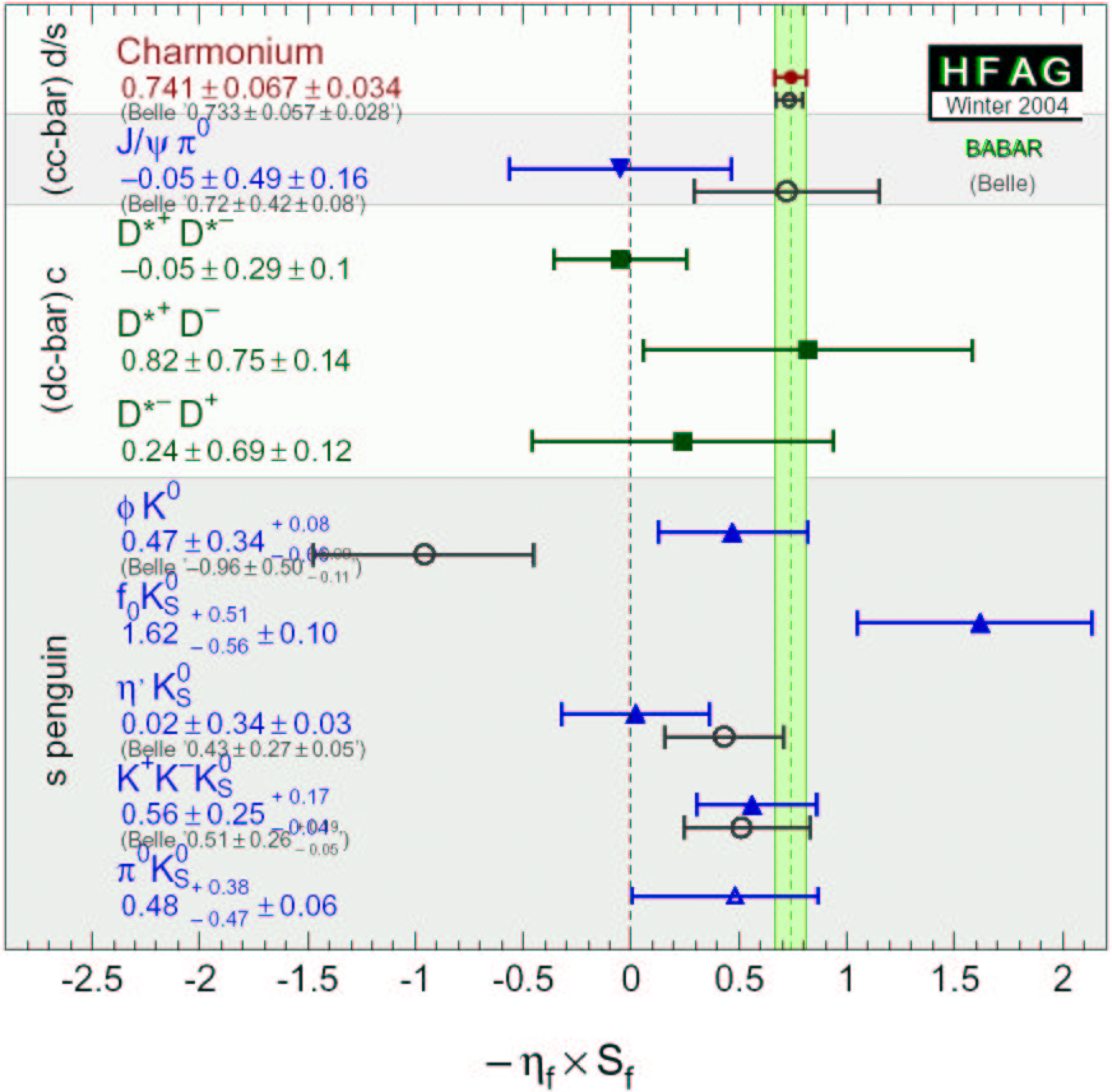


$S = 0.48\ ^{+0.38}_{-0.47} \pm 0.06$

$C = 0.40\ ^{+0.27}_{-0.28} \pm 0.09$

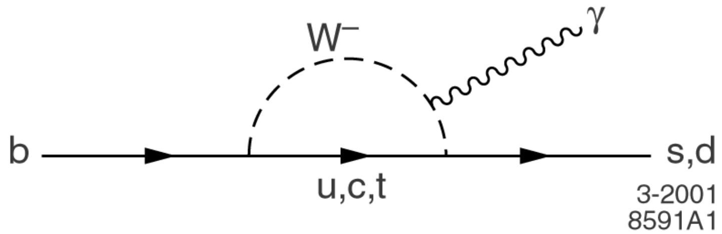
Moriond EW 04

$-\eta_f \times S_f$

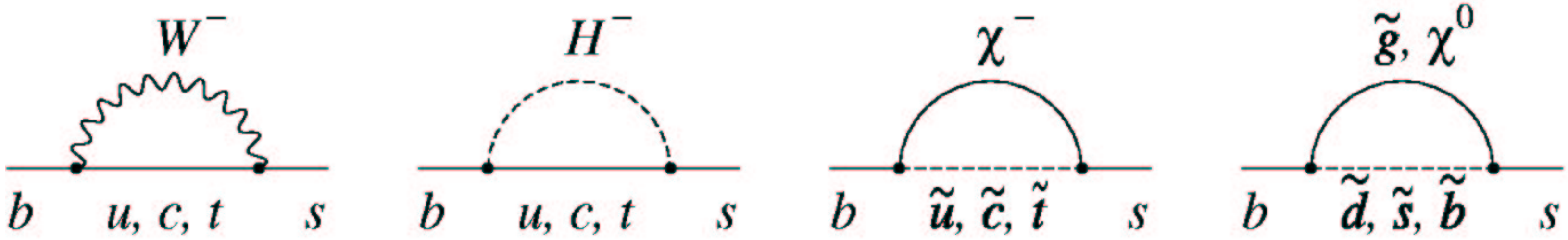


Radiative decays

In the SM flavour changing neutral currents are forbidden at the tree level



Additional contributions may come from exotic (super- symmetric) particles and modify the SM predictions



measurements of BR and CP (isospin) asymmetry

↔

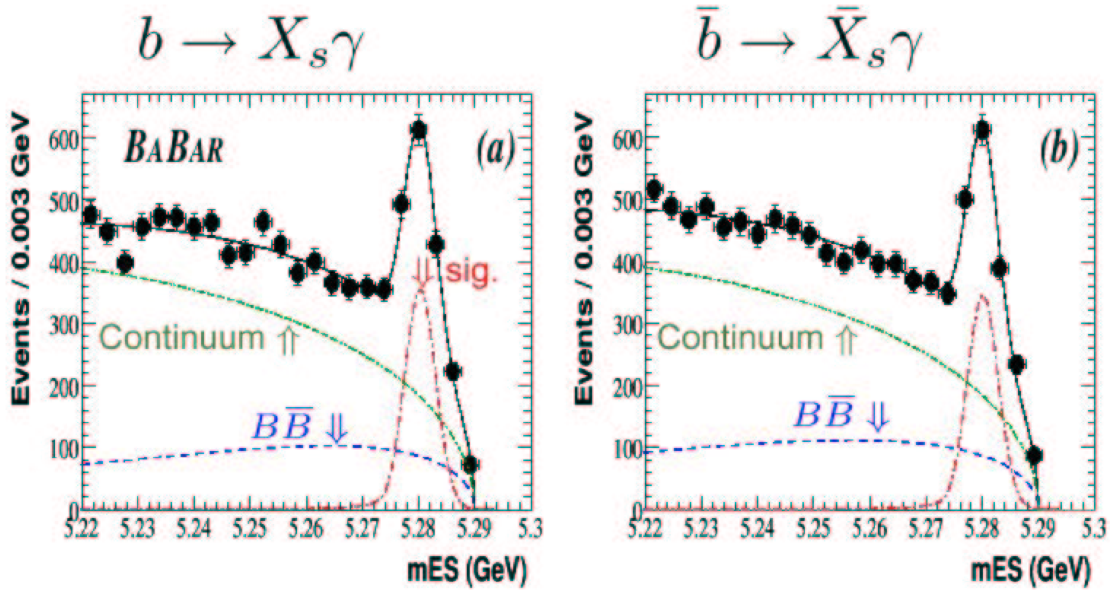
SM theoretical predictions

$B \to X_s \gamma$

- X_s reconstructed in 12 exclusive self-tagging channels : $K + n\,\pi$ (n<4, at most 2 π^0)
- 0.6 GeV < m (X_s) < 2.3 GeV   (48% of the total rate)

Signal and background are extracted with a fit to m_{ES}

89M BB



787 ± 54 signal events   769 ± 54 signal events

Hep-ex/0403035

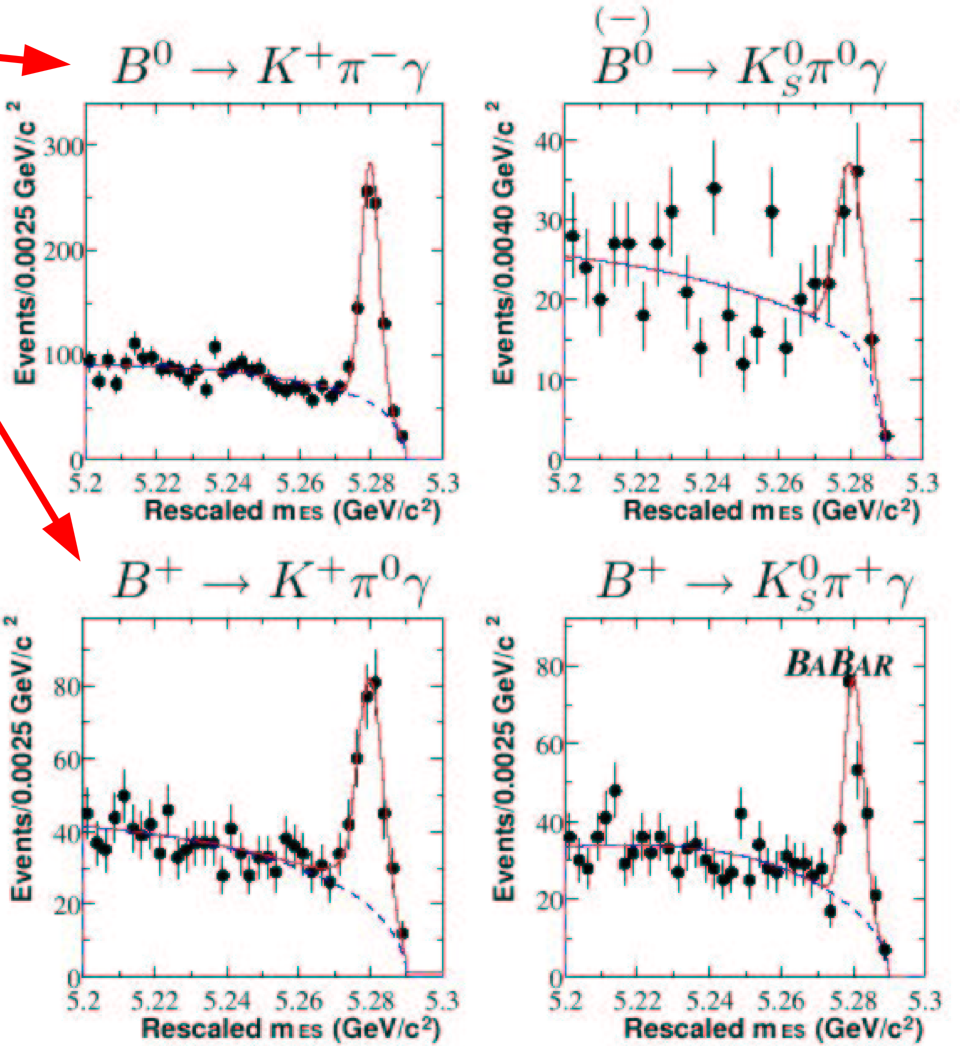
$A_{CP} = (2.5 \pm 5.0 \pm 1.5)$ %

SM: $A_{CP} = (0.44\,^{+0.24}_{-0.14})$ %

$B \to K^* \gamma$

- $B^0 \to \gamma K^{*0}$ ($K^{*0} \to K^+\pi^-$, $K_s\pi^0$)
- $B^+ \to \gamma K^{*+}$ ($K^{*0} \to K^+\pi^0$, $K_s\pi^+$)
- Fit m_{ES}, ΔE

Measure CP and isospin asymmetries



SM:

A_{CP} = < 1%

Δ_{0-} = + 5 ÷10 %

Measured:

A_{CP} = (-1.5 ± 3.6 ± 1.0) %

Δ_{0-} = (+5.1 ± 4.4 ± 2.3 ± 2.4 ($R^{+/-}$)) %

$B^0 \to K^{*0}\gamma\,(K^{*0} \to K_s\pi^0)$

- Final state accessible to both B^0 and $\bar{B}^0$

Vertexing like in $K_s\pi^0$ – Measurement of CP asymmetry in the interference between decay and mixing: $A_{CP}(t) = S\sin(\Delta m\, t) - C\cos(\Delta m\, t)$

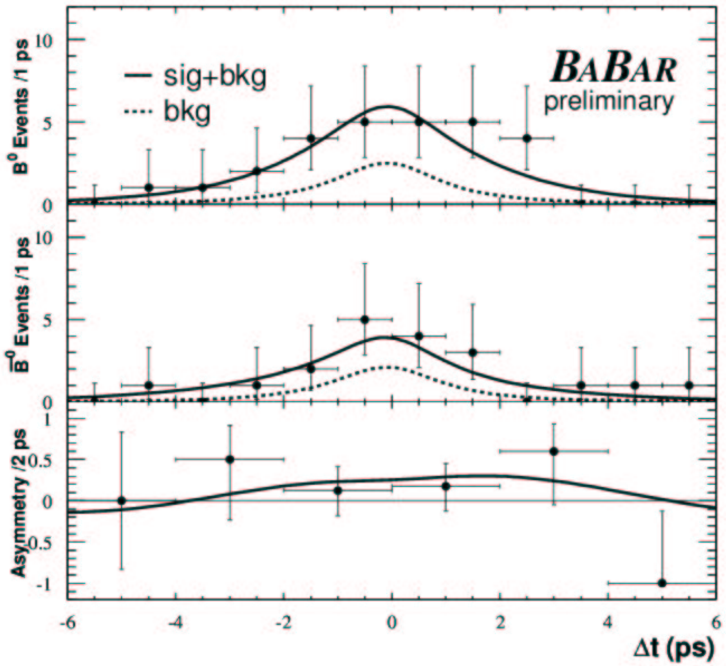
- In the limit of massless s quark, the final state γ is completely polarized with opposite helicities for B and $\bar{B}$. Helicity suppression can change if NP.

SM: $S = 2\,(m_s / m_b)\sin 2\beta \sim 4\ \%$

$|C| < 1\ \%$

Measured: $S = 0.25 \pm 0.63 \pm 0.14$

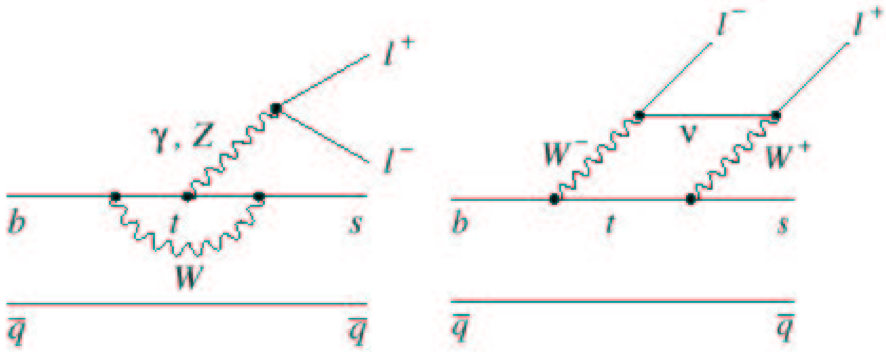
$C = -0.56 \pm 0.32 \pm 0.09$



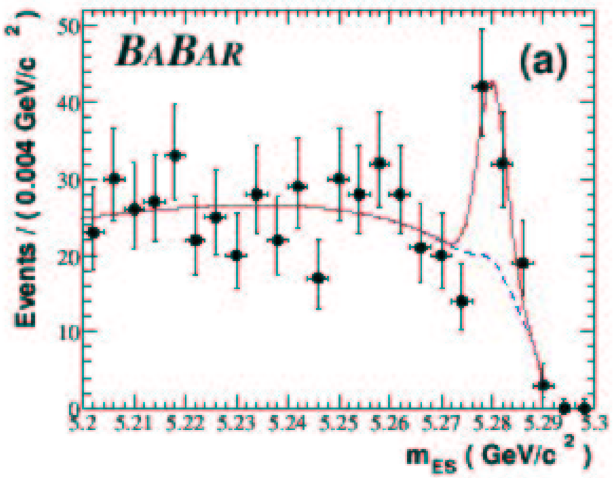
$B^0 \to l^+l^- X_s$

Process allowed via EW penguins and W-box diagrams

NP in these loops would contribute at the SM order



SM: $Br\,(B \to l^+l^- X_s) = (4.2 \pm 0.7) \times 10^{-6}$ ← $m(l^+l^-) > 0.2\ \mathrm{GeV}/c^2$



X_s = K + n π (n<2, at most 1 π^0)

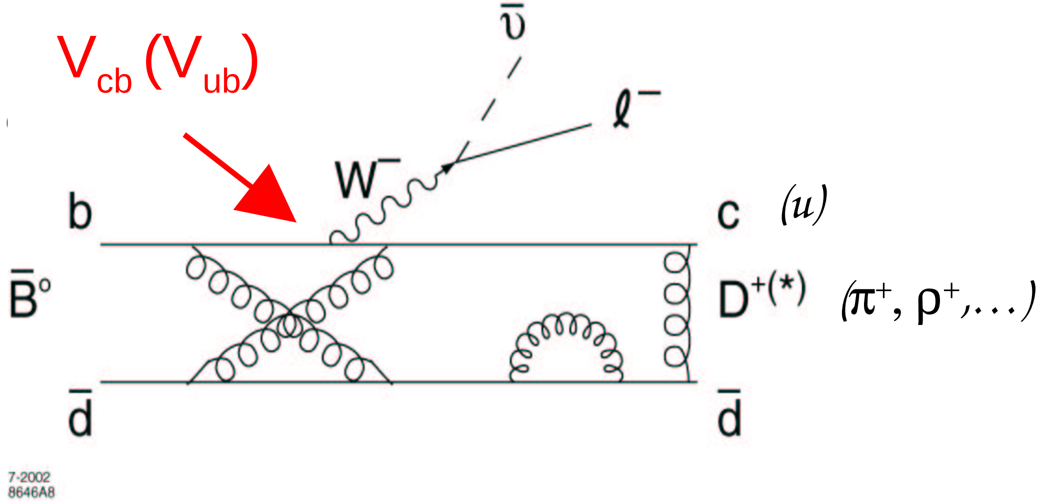
Measured:

$Br\,(B \to l^+l^- X_s) = (5.6 \pm 1.5 \pm 0.6 \pm 1.1) \times 10^{-6}$

submitted to PRL

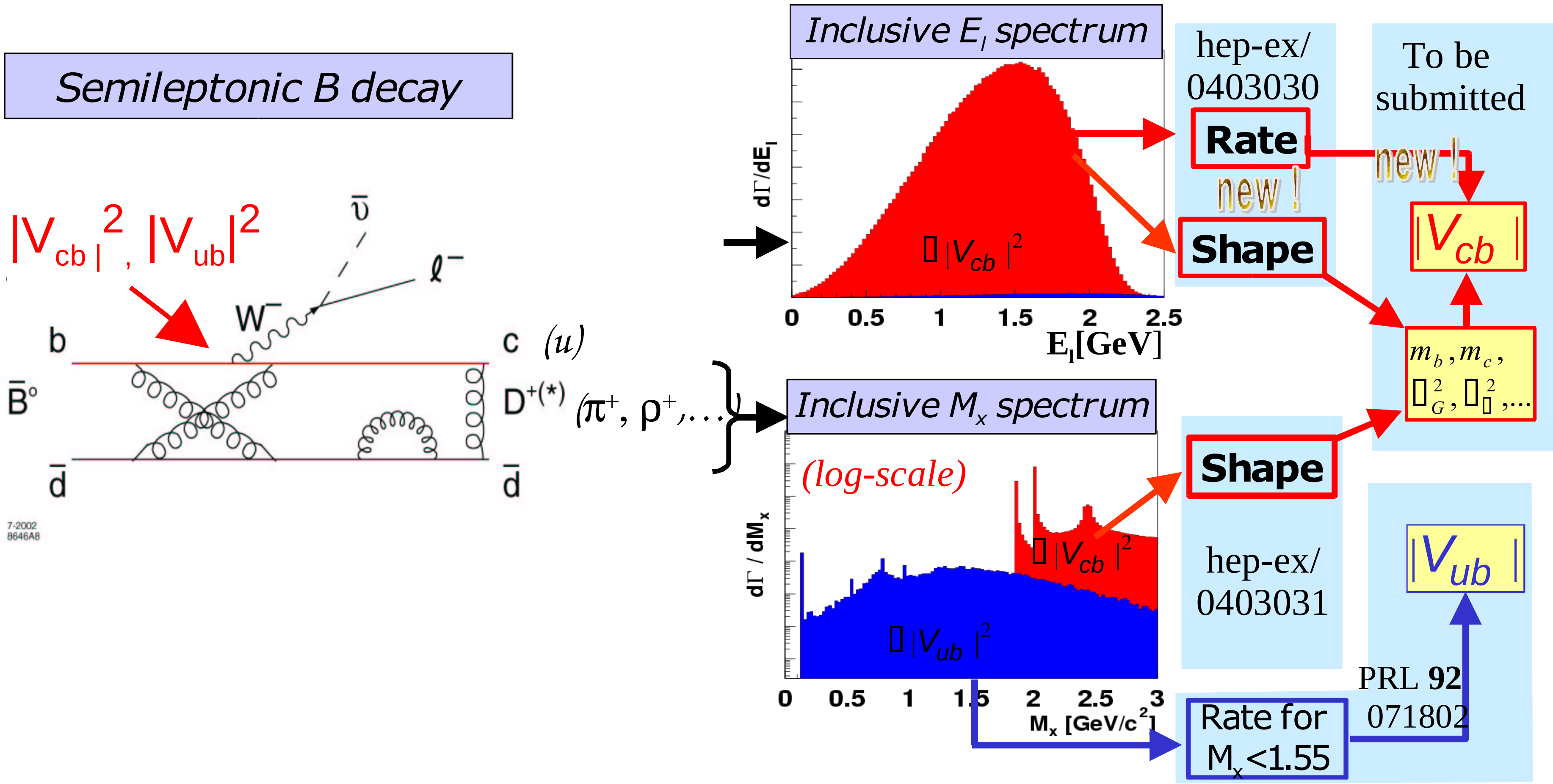
$|V_{cb}|$ from inclusive $b \to c\, l\, \nu$ decays

- $B \to X_c\, l\ \nu$



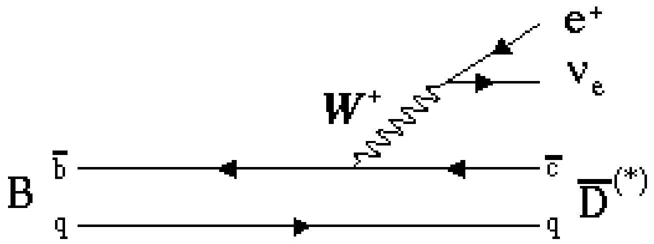
See also seminar by Bob Kowalewski, 30 April 2004
http://particle.phys.uvic.ca/kowalews/babar/Rome-Frascati-seminar.pdf

The big picture



$|V_{cb}|$

Semileptonic B decays provide best method for determination of $|V_{cb}|$ and $|V_{ub}|$



Transition matrix element factorizes:

- Leptonic current ($W \rightarrow l\ \nu$) (easy)
- Hadronic current ($b \rightarrow W\ c$) (QCD, hadronic uncertainties)

Theoretical framework: Heavy Quark Expansions relate Br($B \rightarrow X_c\ l\ \nu$) to $|V_{cb}|$

Relation contains heavy quark masses $m_b(\mu)$, $m_c(\mu)$ and 4 non-perturbative parameters – large uncertainties

Br, $|V_{cb}|$ and the 6 parameters determined from a fit to the moments of the hadronic-mass and electron-energy distributions

- $B \to X_c e \nu$ decays → electron-energy moments

  - High energy electron p* > 1.4 GeV/c
  - Oppositely charged signal electron
  - Veto back-to-back electrons and J/ψ

take into account backgrounds, electron efficiency, mixing, Bremsstrahlung ...
contribution from $B \to X_u e \nu$; correction for QED radiative effects ...
corrections due to finite histogram binning and boost ....

Extract 0^{th} – 3^{th} moments vs $E_{e,cut}$

$|V_{cb}|$

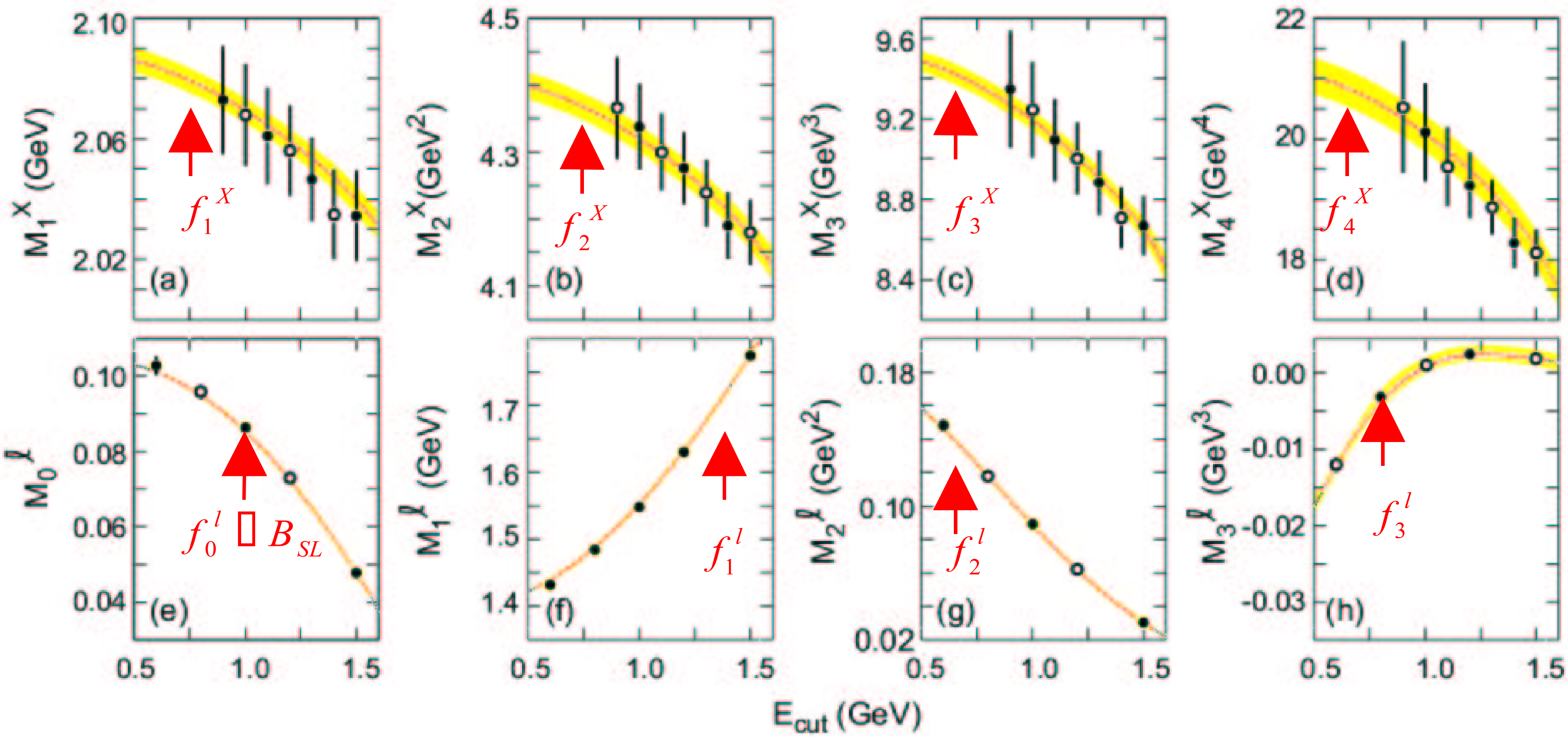
- $B \to X\, l\, \nu$ decays ➡ hadronic-mass moments
  - Fully recostructed hadronic B decay
  - Semileptonic decay of other B
  - M_X from kinematic fit: $p_\nu^2 = 0$, 4-momentum conservation, mB

Extract $\langle M_x^k \rangle$, k=1..4

Main uncertainties are non $b \to c\, l\nu$ background, simulation of track and neutral reconstruction, modeling of QED radiation, B-reco sideband subtraction

Combined Fit to E_l and M_X Moments

hep-ex/0403031 sub. to PRD



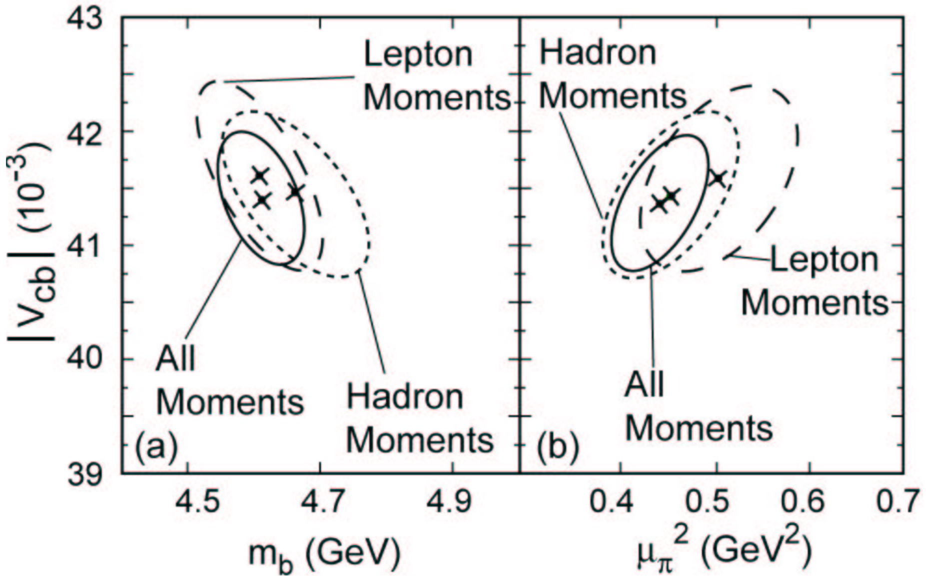
$\chi^2 = 15.0 \quad (N_{dof} = 20)$

$|V_{cb}|$ - Cross check of fit results

E_l moments calculated up to $\alpha_s^2\beta_0$

M_X moments up to α_s (*higher order small wrt experimental error*)

Separate fit to E_l and M_X agree well



Overall power of E_l and M_X is comparable

M_X higher sensitivity but higher exp. uncertainty

E_l less sensitivity but higher precision

Separate fits applying constraints derived from m_{B^*} - m_B and QCD sum rules

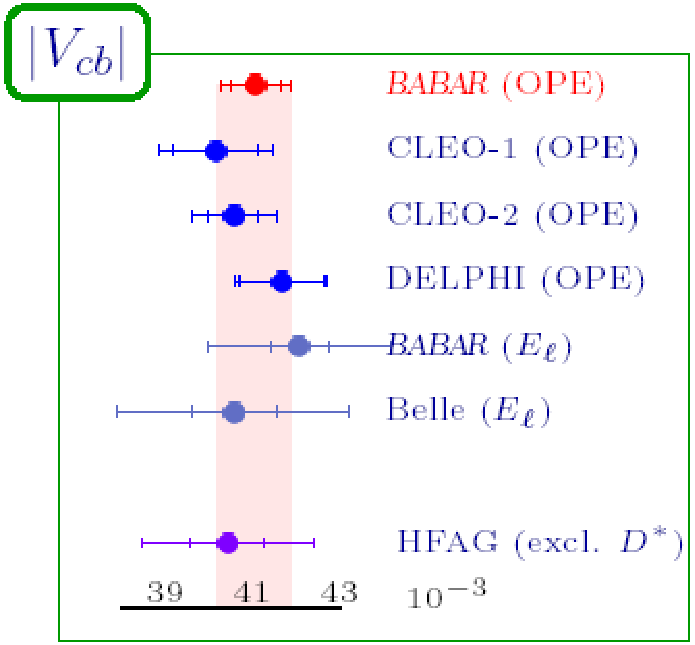
$|V_{cb}|$ – OPE preliminary fit results

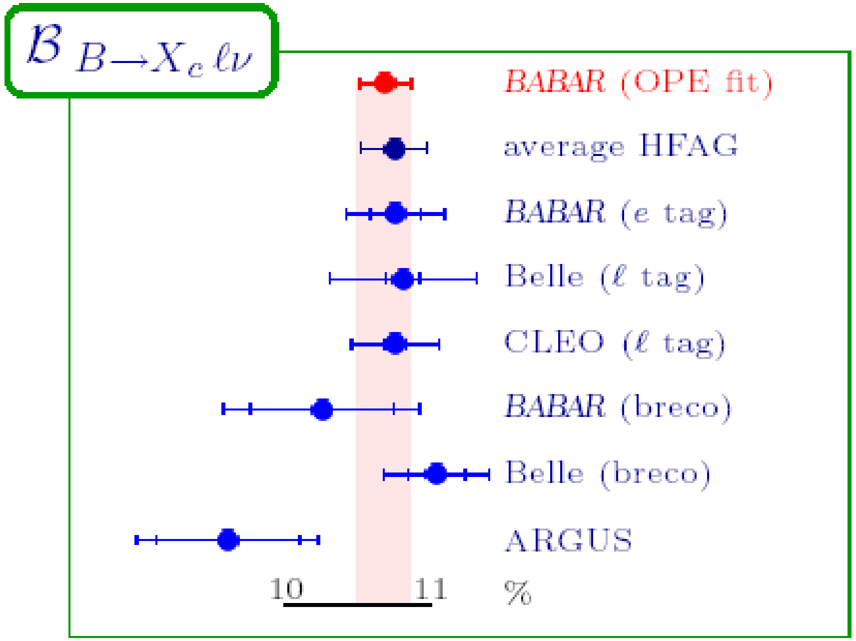
$|V_{cb}|$ = $(41.4 \pm 0.4_{exp} \pm 0.4_{HQE} \pm 0.6_{th}) \times 10^{-3}$

$Br(B \to X_c l \nu)$ = $(10.61 \pm 0.16_{exp} \pm 0.06_{HQE})$ %

m_b (1 GeV) = $(4.61 \pm 0.05_{exp} \pm 0.04_{HQE} \pm 0.02_{th})$

m_b (1 GeV) - m_c (1 GeV) = $(3.44 \pm 0.03_{exp} \pm 0.02_{HQE} \pm 0.01_{th})$





Different OPE schemes used

$|V_{cb}|$ – Comparison of inclusive and exclusive determinations

HFAG average from D* l ν

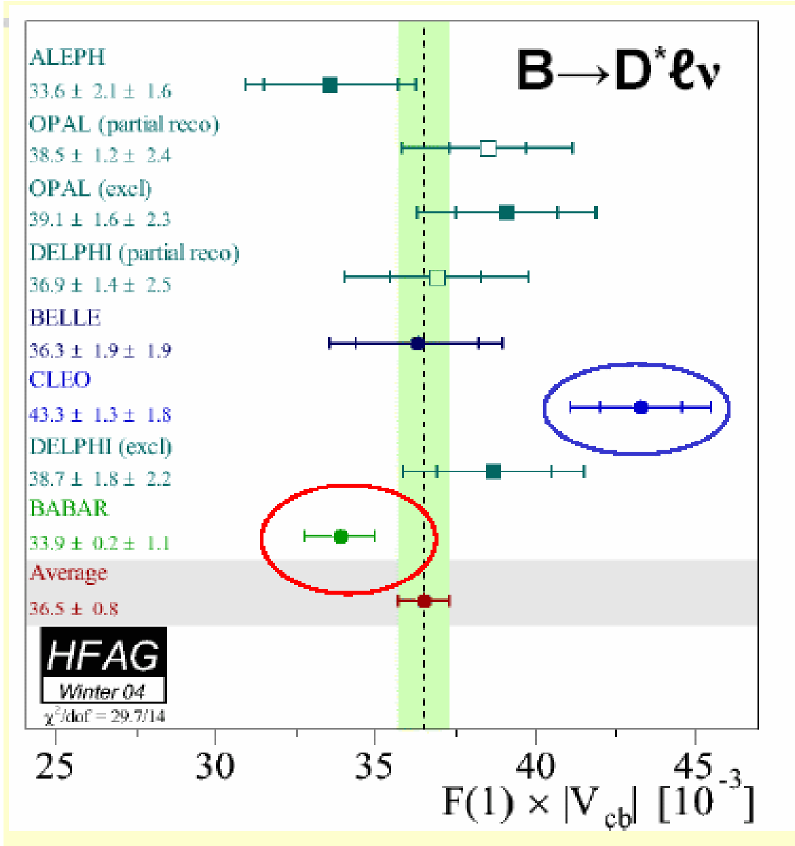
$|V_{cb}| = (40.1 \pm 0.9_{exp} \pm 1.8_{th}) \times 10^{-3}$

BaBar preliminary D* l ν

$|V_{cb}| = (37.1 \pm 1.5_{exp} \pm 1.6_{th}) \times 10^{-3}$

BaBar preliminary HQE fit to semileptonic moments

$|V_{cb}| = (41.4 \pm 0.4_{exp} \pm 0.4_{HQE} \pm 0.6_{th}) \times 10^{-3}$



F(1) = 0.92 ± 0.03

New particles and rare decays

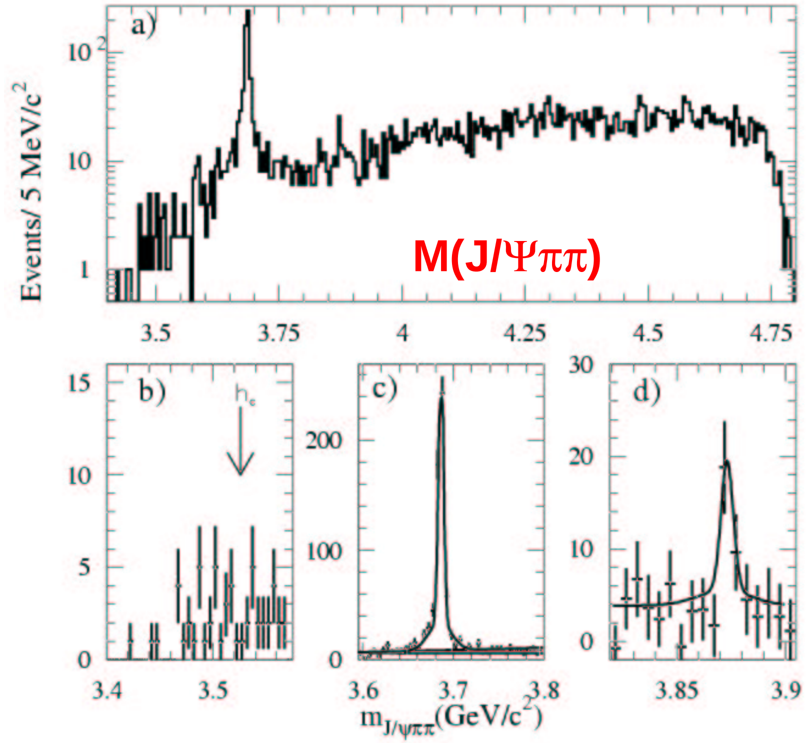
- $B \to J/\psi K \pi\pi$
- $B \to X(3872) K^-$
- $B \to D_{sJ} D^*$
- $B \to$ charmless isoscalar pairs
- $B \to \eta K, \eta \rho, \eta \pi^0, \omega \pi^0$
- $B \to a_0 (K^0, K, \pi)$

$B \to J/\psi\ K\ \pi\pi$

$Br(B^- \to J/\psi\ K^-\pi^+\pi^-) =$

$(11.6\ \pm 0.7 \pm 0.9) \times 10^{-4}$

Moriond EW 04



h_c $\Psi(2S)$ $X(3872)$

Confirmed the observation of $X(3872) \to J/\psi\ \pi^+\pi^-$ by Belle and CDF

$m_X = 3873.4\ \pm 1.4$ MeV/c^2

$Br(B \to X(3872)K^-) \times Br(X \to J/\psi\ \pi^+\pi^-) =$

$(1.28 \pm 0.41)\ \times 10^{-5}$

$Br(B \to h_c\ K^-) \times Br\ (h_c \to J/\psi\ \pi^+\pi^-) < 3.4 \times 10^{-6}$

$Br(B^- \to J/\psi\ D^0\pi^-) < 5.2\ \times 10^{-5}$

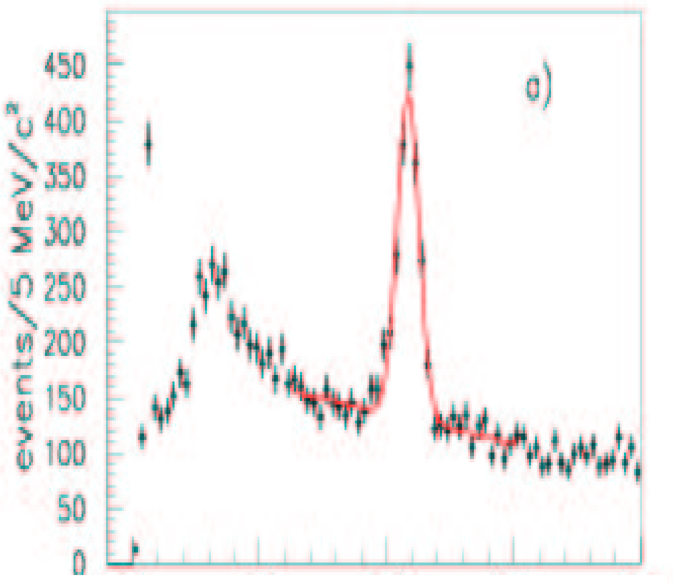
In 2003 BaBar discovered a new narrow $D_s^+\pi^0$ resonance near 2.32 GeV/c² and observed a second new $D_s^{*+}\pi^0$ resonance near 2.46 GeV/c².

$D^*_{sJ}(2317)^+$ observed in $\rightarrow D_s^+\pi^0$ $m = 2317.3 \pm 0.4 \pm 0.8$ MeV/c²

$D_{sJ}(2458)^+$ observed in $\rightarrow D^{*+}_s\pi^0$

$\rightarrow D_s^+\pi^+\pi^-$

$D_s^+\gamma$ $m = 2458.0 \pm 1.0 \pm 1.0$ MeV/c²



most likely spin-parity assignement are:

$J^P(D^*_{sJ}(2317)^+) = 0^+$

$J^P(D_{sJ}(2458)^+) = 1^+$

$B \to D_{sJ} D^{(*)}$

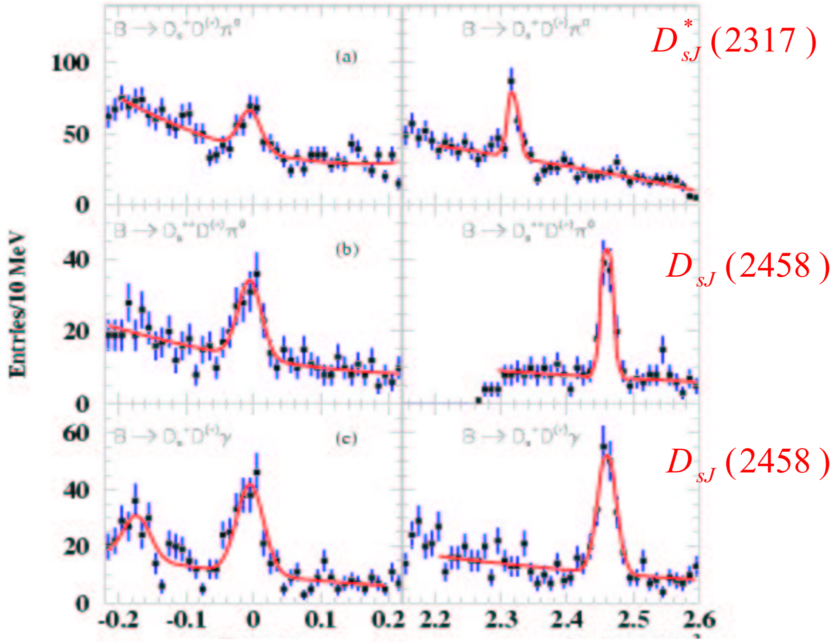
Production analyzed both in neutral and in charged B decays, with

$D^*_{sJ}(2317)^+ \to D_s^+ \pi^0$

$D_{sJ}(2458)^+ \to D^{*+}_s \pi^0$

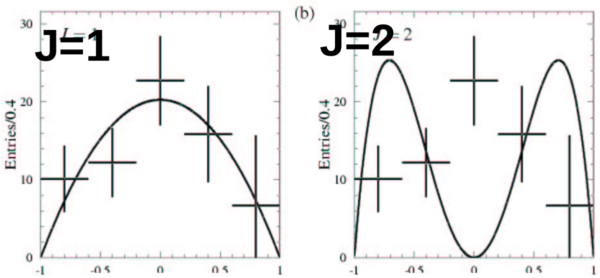
$\to D_s^+ \gamma$

Moriond EW 04



ΔE (GeV) m(D_{sJ}) (GeV/c²)

Preliminary



$\cos\theta_h$ $\cos\theta_h$

θ_h=angle between D_s and B momentum in D_{sJ} rest frame

Angular analysis of $D_{sJ}(2458) \to D_s\gamma$

χ^2 fit of $\cos\theta_h$ favours J=1 wrt J=2

(J=0 ruled out by P and angular momentum conservation)

B $\rightarrow$ charmless isoscalar pairs

hep-ex/0403046 sub. to PRL

Mode	S(σ)	$\mathcal{B}(10^{-6})$	UL (10^{-6})	UL (10^{-6}) CLEO
$\eta\eta$	0.0	$-0.9^{+1.6}_{-1.4} \pm 0.7$	< 2.8	< 18
$\eta\eta'$	0.3	$0.6^{+2.1}_{-1.7} \pm 1.1$	< 4.6	< 27
$\eta'\eta'$	0.4	$1.7^{+4.8}_{-3.7} \pm 0.6$	< 10	< 47
$\eta\omega$	4.3	$4.0^{+1.3}_{-1.2} \pm 0.4$	< 6.2	< 12
$\eta'\omega$	0.0	$-0.2^{+1.3}_{-0.9} \pm 0.4$	< 2.8	< 60
$\eta\phi$	0.0	$-1.4^{+0.7}_{-0.4} \pm 0.2$	< 1.0	< 9
$\eta'\phi$	0.8	$1.5^{+1.8}_{-1.5} \pm 0.4$	< 4.5	< 31
$\phi\phi$	0.3	$0.3^{+0.7}_{-0.4} \pm 0.1$	< 1.5	< 12

$B \to \eta K, \eta \rho, \eta \pi^0, \omega \pi^0$

hep-ex/0403025 sub to PRD

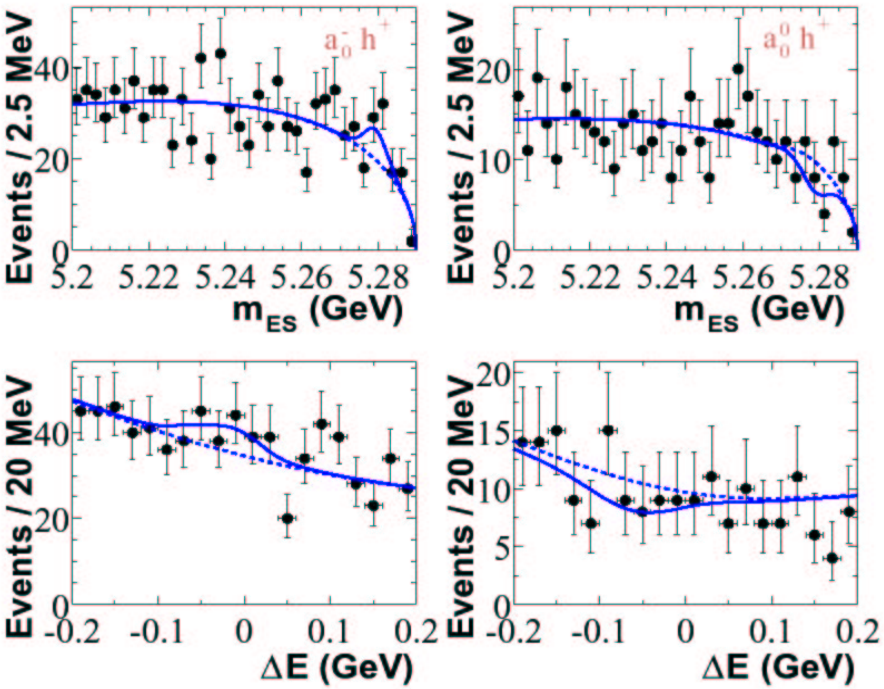
Mode	$\mathcal{S}(\sigma)$	$\mathcal{B}(10^{-6})$	UL (10^{-6})	$\mathcal{A}_{ch}$
$B^+ \to \eta' K^+$	>10	76.9 ± 3.5		0.037 ± 0.045
$B^0 \to \eta' K^0$	>10	60.6 ± 5.6		
$B^+ \to \eta \pi^+$	7.9	$5.3 \pm 1.0 \pm 0.3$		$-0.44 \pm 0.18 \pm 0.01$
$B^+ \to \eta K^+$	6.1	$3.4 \pm 0.8 \pm 0.2$		$-0.52 \pm 0.24 \pm 0.01$
$B^0 \to \eta K^0$	3.3	$2.9 \pm 1.0 \pm 0.2$	<5.2	
$B^+ \to \eta' \pi^+$	3.4	$2.7 \pm 1.2 \pm 0.3$	<4.5	
$B^+ \to \eta K^{*+}$	9	$25.6 \pm 4.0 \pm 2.4$		$+0.13 \pm 0.14 \pm 0.02$
$B^0 \to \eta K^{*0}$	11	$18.6 \pm 2.3 \pm 1.2$		$+0.02 \pm 0.11 \pm 0.02$
$B^+ \to \eta \rho^+$	3.5	$9.2 \pm 3.4 \pm 1.0$	<14	
$B^0 \to \eta \rho^0$	–	$-1.1^{+0.7}_{-0.9} \pm 0.4$	<1.5	
$B^0 \to \eta \pi^0$	0.8	$0.7^{+1.1}_{-0.9} \pm 0.3$	<2.5	
$B^+ \to \eta' K^{*+}$	1.9	$6.3^{+4.6}_{-3.6} \pm 1.8$	<14	
$B^0 \to \eta' K^{*0}$	2.1	$4.1^{+2.1}_{-1.8} \pm 1.2$	<7.6	
$B^+ \to \eta' \rho^+$	2.6	$12.9^{+6.2}_{-5.5} \pm 2.0$	<22	
$B^0 \to \eta' \rho^0$	0.5	$0.8^{+1.7}_{-1.2} \pm 0.9$	<4.3	
$B^0 \to \eta' \pi^0$	0.7	$1.0^{+1.4}_{-1.0} \pm 0.8$	<3.7	
$B^0 \to \omega \pi^0$	–	$-0.6^{+0.7}_{-0.5} \pm 0.2$	<1.2	
$B^0 \to \phi \pi^0$	0.7	$0.2^{+0.4}_{-0.3} \pm 0.1$	<1.0	

PRL 91, 161801 2003

PRL 92, 061801 2004

New

B → scalar a_0 mesons



UML fits; $a_0 \to \eta\pi$, $\eta \to \gamma\gamma, 3\pi$

No evidence of signal

No confirmation of previous 3.7σ $B^0 \to a_0(980)^- \pi^+$

Preliminary

Mode	$\mathcal{S}(\sigma)$	$\mathcal{B}(10^{-6})$	UL (10^{-6})
$B^0 \to a_0^- \pi^+$	2.0	$2.8^{+1.5}_{-1.3} \pm 0.7$	< 5.1
$B^0 \to a_0^- K^+$	0.4	$0.4^{+1.0}_{-0.8} \pm 0.2$	< 2.1
$B^- \to a_0^- K^0$	0.6	$-1.5^{+2.4}_{-1.8} \pm 0.8$	< 3.9
$B^+ \to a_0^0 \pi^+$	1.9	$3.6^{+2.1}_{-1.9} \pm 0.8$	< 6.7
$B^+ \to a_0^0 K^+$	0.0	$-3.7^{+1.6}_{-1.3} \pm 0.5$	< 1.8
$B^0 \to a_0^0 K^0$	1.0	$2.8^{+3.1}_{-2.4} \pm 1.1$	< 7.8

In conclusion

No hint for NP yet – nothing beyond the SM observed in BaBar

Belle finds $B^0 \to \phi K_S$ at 3.5σ from the SM but also at 2.5σ from BaBar

And Belle – BaBar discrepancy in $B^0 \to \pi^+\pi^-$ is now down to 2.2σ

ϕK_S like $\pi^+\pi^-$?

Summer 2004: with > 200 fb^{-1} BaBar will update

- $B \to \pi^+\pi^-$
- $B \to \phi K_S$
- $B \to K_s\pi^0$

	$L_{peak}(10^{33})$	$L_{int} fb^{-1}$
2004	12.5	260
2005	18.2	395
2006	23	580
2007	30	880