Recent results from the B-Factories

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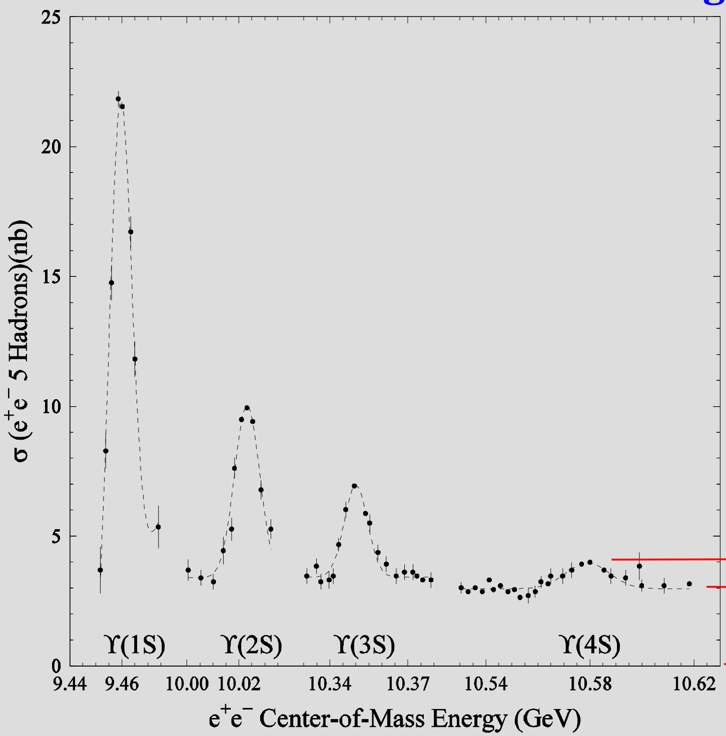
B-Factories

e^+e^- colliders at the Υ(4S) resonance

$e^+e^- \rightarrow$ hadrons cross section vs. energy (CLEO)



~1 nb

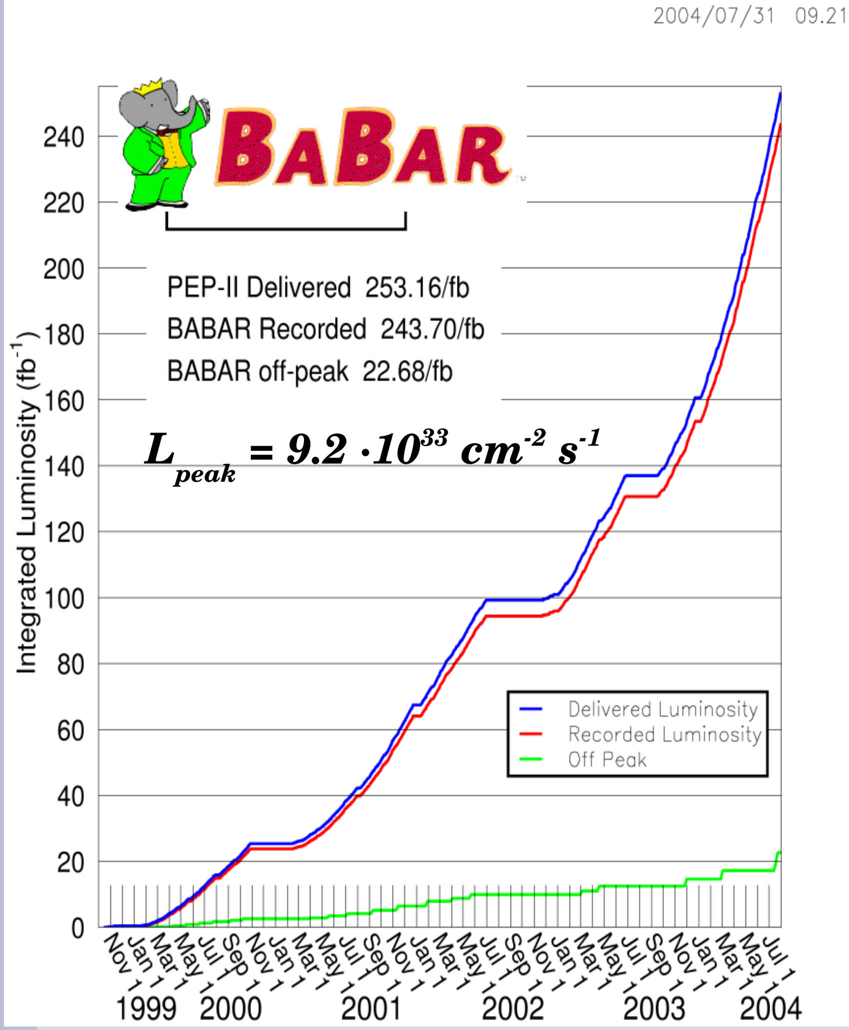
~3 nb

$$e^+e^- \rightarrow \Upsilon(4S) \xrightarrow{\approx 100\,\%} B\bar{B} \qquad (\sim 1\text{nb})$$

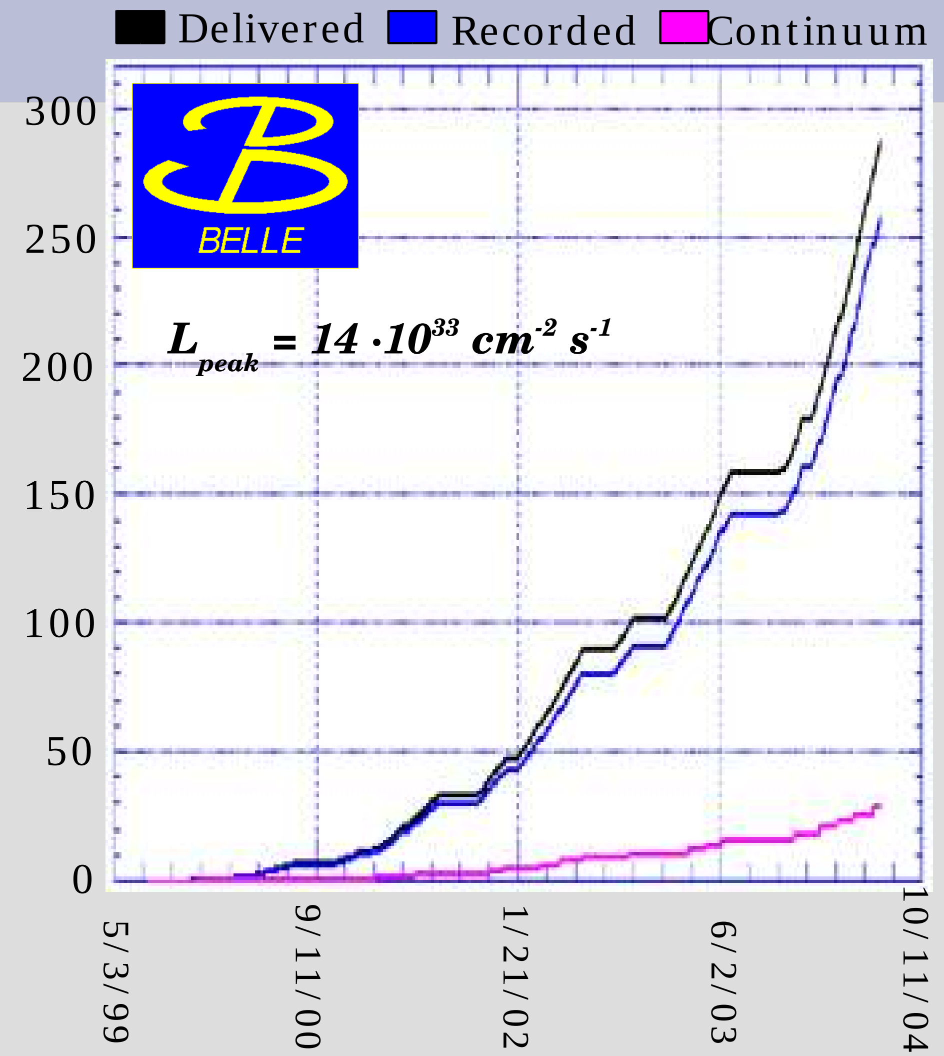
$$e^+e^- \rightarrow q\bar{q} : \text{main background} \quad (\sim 3\text{nb})$$

Data Samples (for this talk)

Luminosity 244 fb^{-1} + 286 fb^{-1} = 0.530 ab^{-1}!

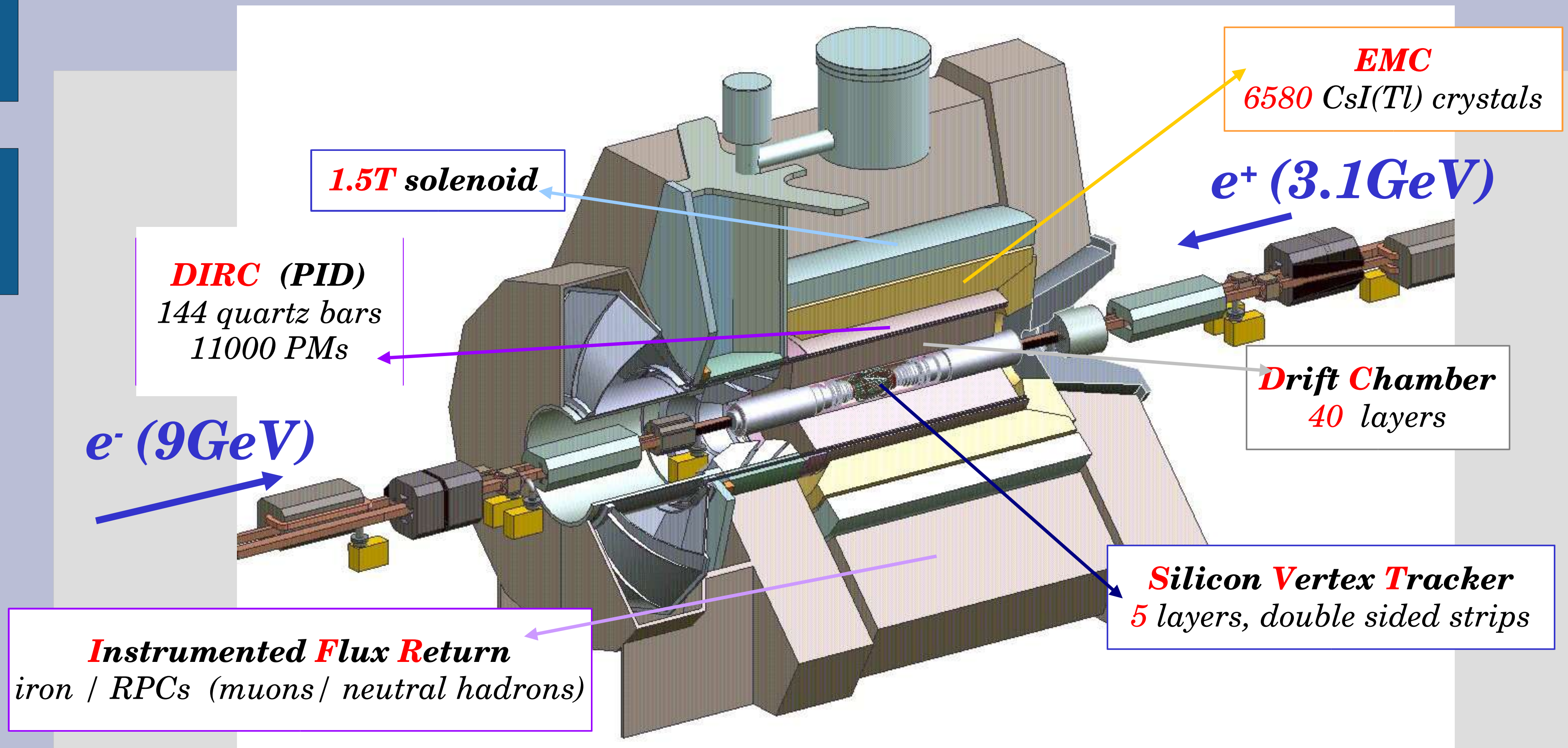


$L_{peak} = 9.2 \cdot 10^{33}\ cm^{-2}\ s^{-1}$



$L_{peak} = 14 \cdot 10^{33}\ cm^{-2}\ s^{-1}$

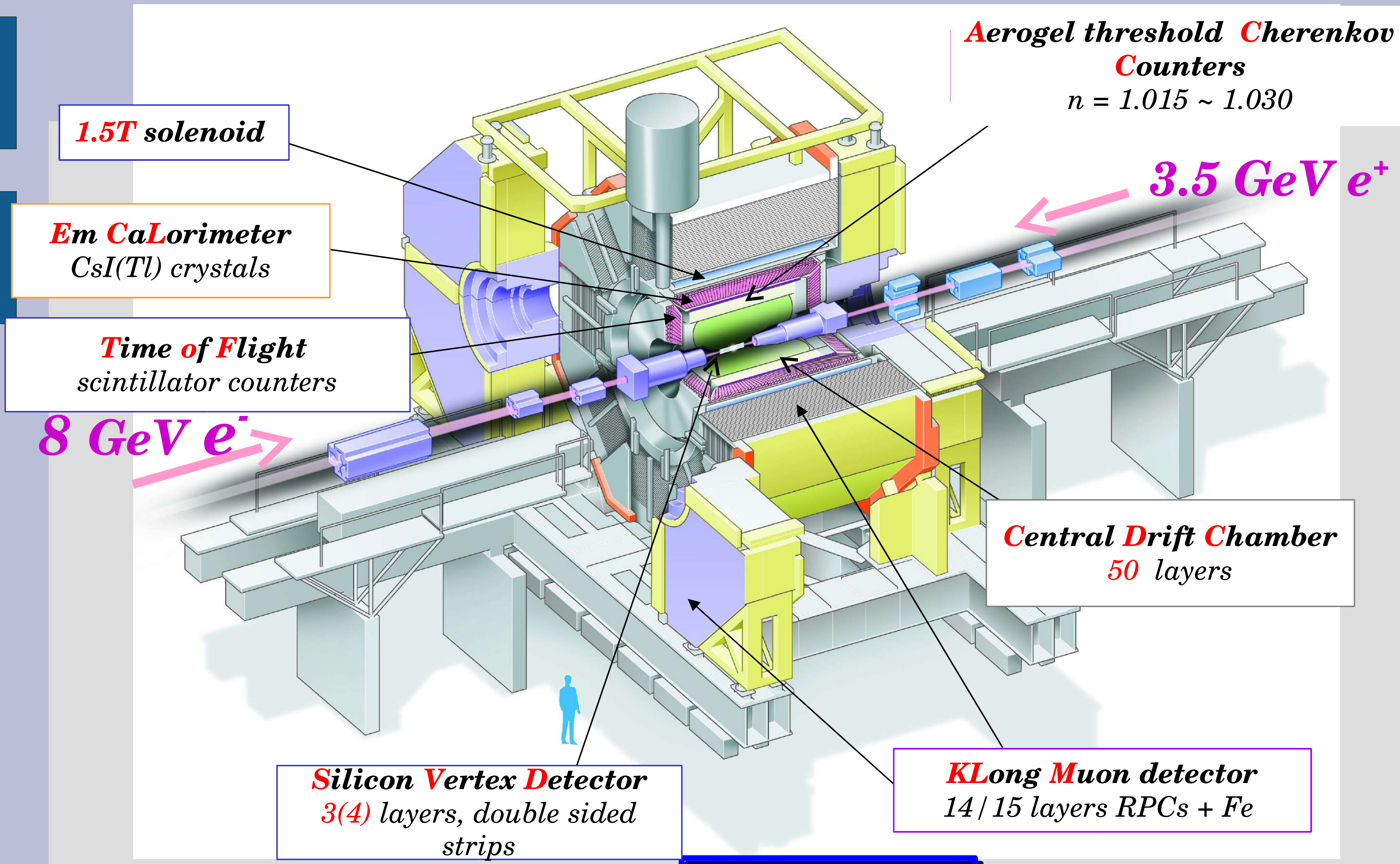
BaBar Detector



9 GeV e^- x 3.1 GeV e^+

$\beta\gamma_{\Upsilon(4S)} \sim 0.56$

Belle Detector



8 GeV e^- x 3.5 GeV e^+

$\beta\gamma_{\Upsilon(4S)} \sim 0.43$

Searches for non Standard Model effects in:

- ***Sin2β in penguin final states*** ($B \to \phi K_s$, $B \to f_0(980) K_s$, $B \to \eta' K_s$,...)

- ***Flavour Changing Neutral Currents*** ($b \to s\gamma$, $b \to sll$, $b \to d\gamma$)

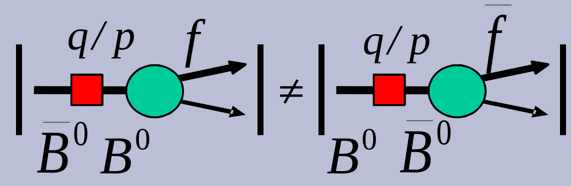
- ***Leptonic B decays*** ($B \to l\nu(\gamma)$, $B \to \nu\nu(\gamma)$, $B \to ll$)

- ***Tau decays***($\tau \to e\gamma$, $\tau \to \mu\gamma$, $\tau \to lll$, $\tau \to hll$,....)

All results are PRELIMINARY unless published in a journal

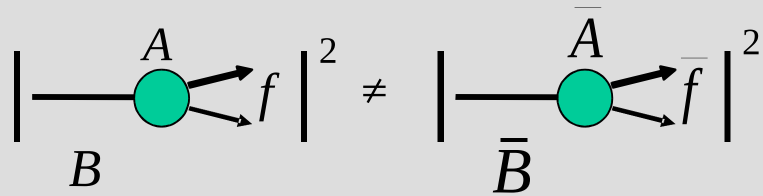
3 ways for CP violation

1. *CP violation in mixing*



First mechanism observed historically in kaon decays

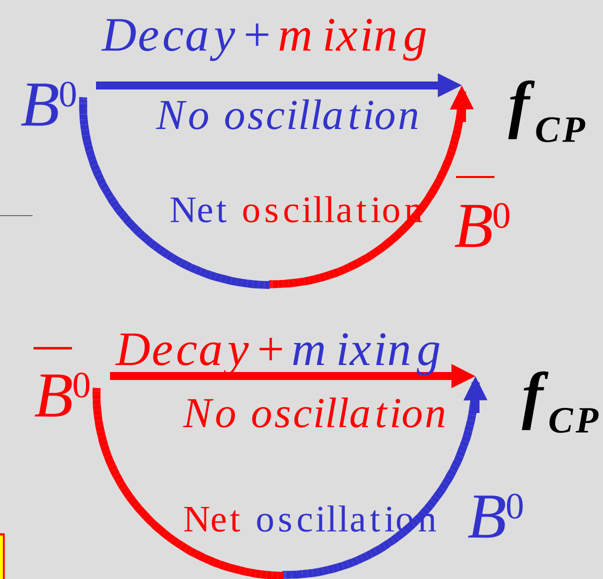
2. *Direct CP violation in the decay*



Occurs when $|A| \neq |\bar{A}|$ ***where A is the amplitude for B decays into a final state f and*** $\bar{A}$ ***is the amplitude of*** $\bar{B}$ ***decays into the CP conjugate state*** $\bar{f}$***.***

3. *Time dependent*

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

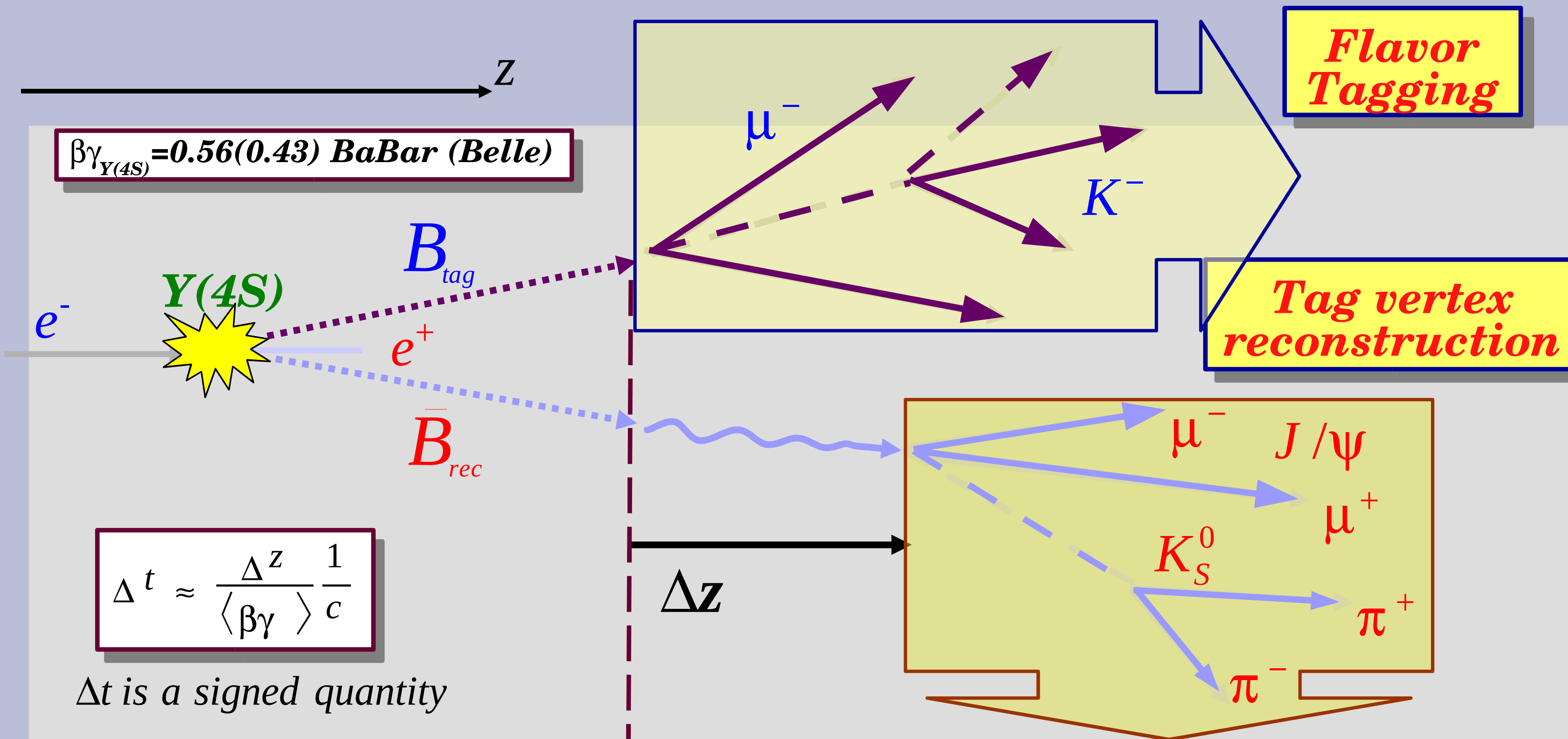


$$A_{f_{CP}} = -C_{f_{CP}}\cos(\Delta m t) + S_{f_{CP}}\sin(\Delta m t)$$

$S_{fCP} \sim \eta_{CP}\sin 2\beta$, $C_{fCP} \sim 0$ for $b\to c\bar{c}s$, $b\to s\bar{s}s$

BaBar conventions

Measuring time-dependent CP asymmetries



$$\Delta t \approx \frac{\Delta z}{\langle \beta\gamma \rangle} \frac{1}{c}$$

Δt is a signed quantity

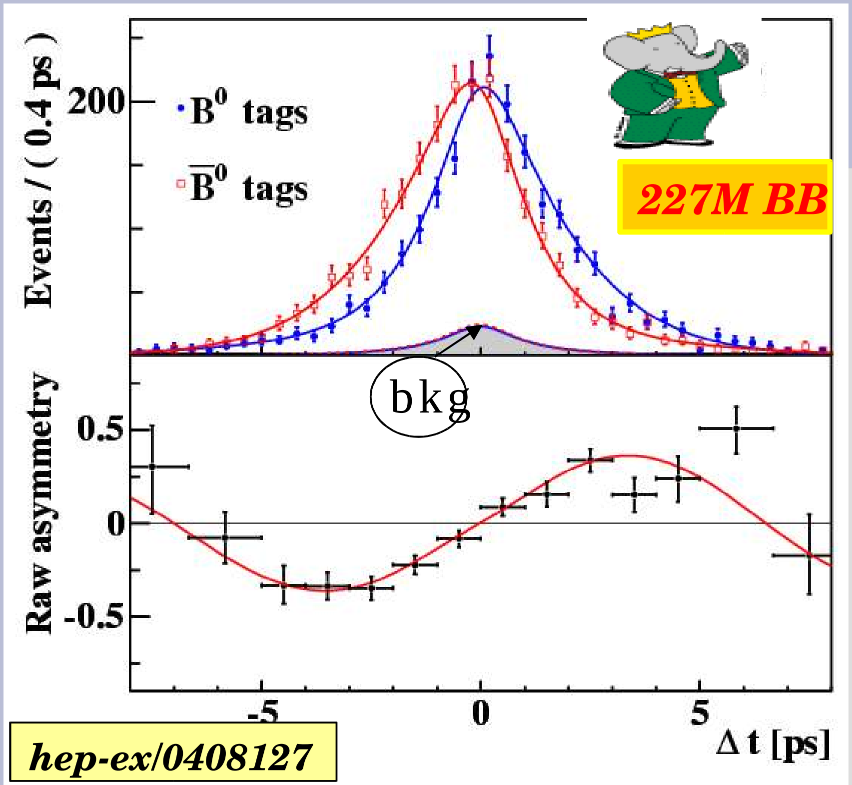
Exclusive B Meson and vertex reconstruction

BaBar:

$\sigma_{\Delta t}$ ~ **1 ps → 170 μm**

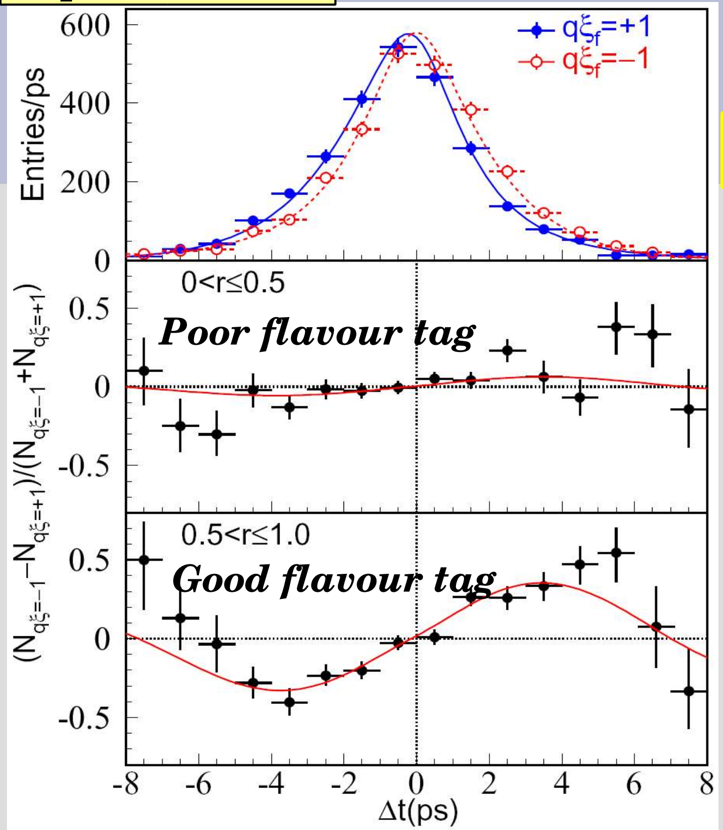
τ_B ~ **1.6 ps → 250 μm**

$\sin2\beta$ from charmonium ($b\to c\bar{c}s$) modes



$(c\bar{c})K^0_s$ (CP odd) modes

hep-ex/0408111



$(c\bar{c})K^0_s$ (CP odd) $+c\bar{c}\ K_L$ (CP even) modes

$Sin2\beta=0.722\pm0.040\pm0.023$

$|\lambda|=|\bar{A}/A|=0.950\pm0.031\pm0.013$

Limit on direct CPV

$Sin2\beta=0.728\pm0.056\pm0.023$

$|\lambda|=|\bar{A}/A|=1.007\pm0.041\pm0.033$

$\sin2\beta_{WA}=0.726\pm0.037$ (stat+syst) from HFAG

Do  and  yield the same $\sin 2\beta$?

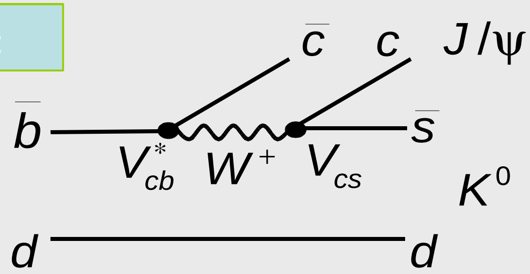
$b \to c\bar{c}s$ decays are tree and penguin diagrams, with equal dominant weak phases

$b \to s\bar{s}s$ decays are pure "internal" and "flavor-singlet" penguin diagrams

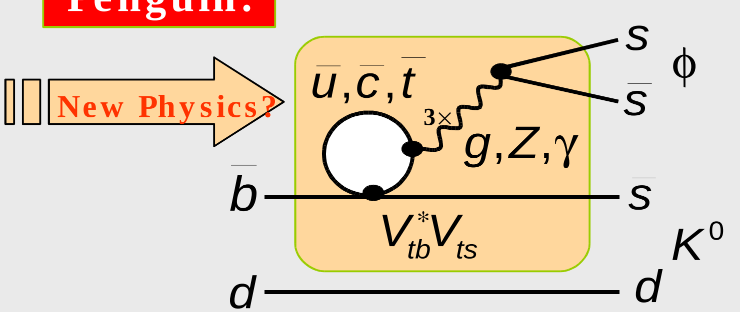
High virtual mass scales involved: believed to be sensitive to New Physics

Both decays dominated by single weak phase

Tree:



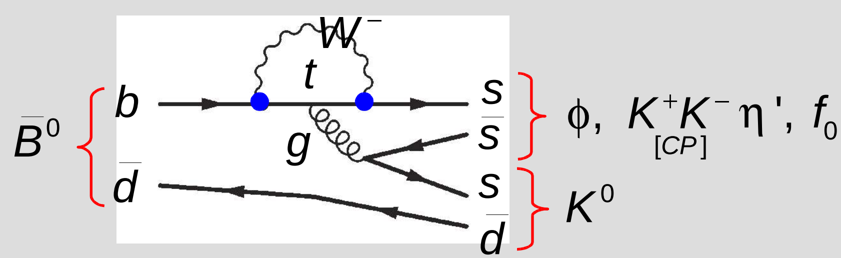
Penguin:



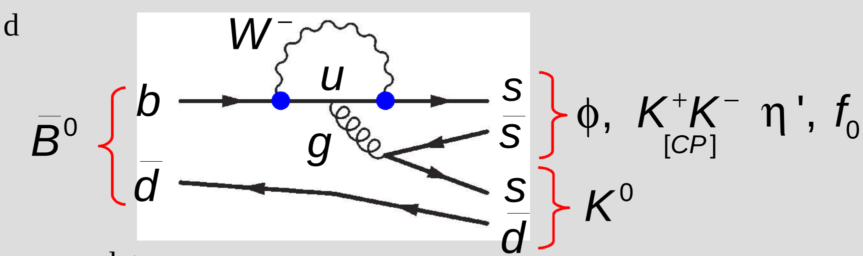
$\sin 2\beta$ [charmonium] $\stackrel{?}{=}$ $\sin 2\beta$ [s-penguin]

Diagram ranking:

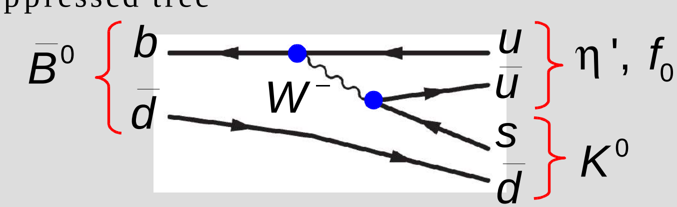
Dominant



Suppressed

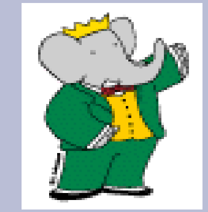


Color-suppressed tree

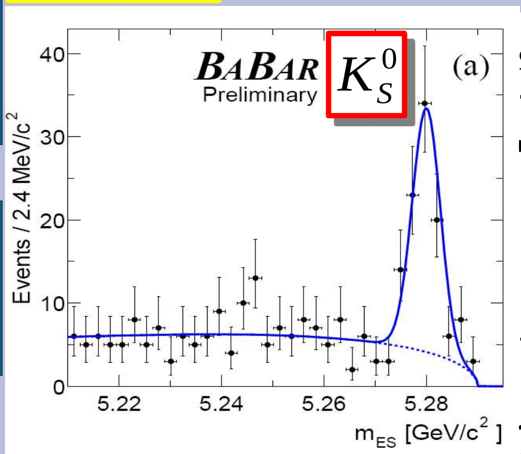


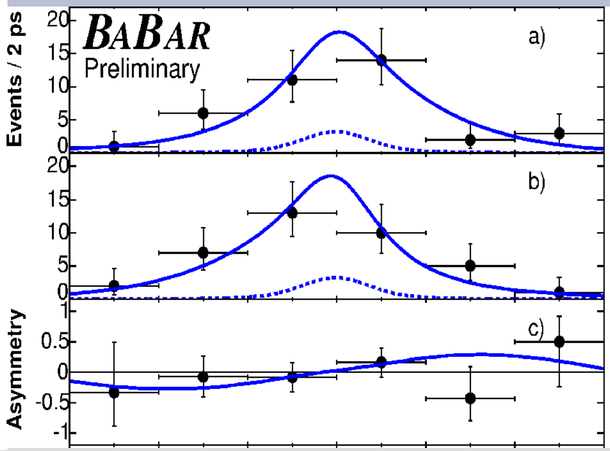
Modes with suppressed C-S tree diagram have smallest uncertainty (ϕK_S)

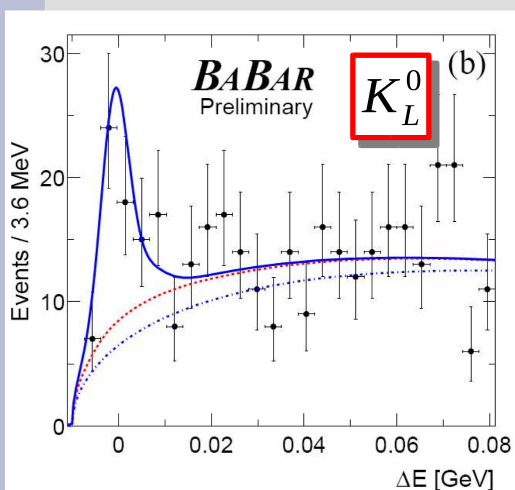
BaBar results for $B^0 \to \phi K^0$

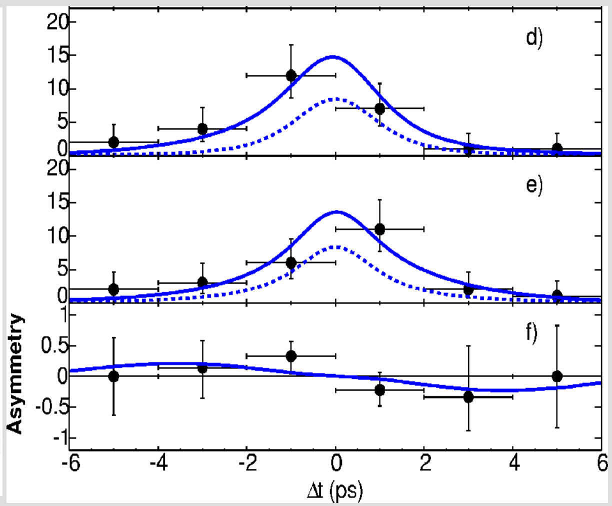


227M BB hep-ex/0408072









$\phi \to KK$

- Separation kaons pions
- Suppress qq events using neural network or Fisher
- Opposite η_{CP} for ϕK_s and ϕK_L

$B \to \phi K_s$: 114 ± 12 events

$S_{\phi Ks} = +0.29 \pm 0.31$ (stat.)

$C_{\phi Ks} = -0.07 \pm 0.27$ (stat.)

$B \to \phi K_L$: 98 ± 18 events

$S_{\phi KL} = +1.05 \pm 0.51$ (stat.)

$C_{\phi KL} = +0.31 \pm 0.49$ (stat.)

$S_{\phi K0} = +0.50 \pm 0.25^{+0.07}_{-0.04}$

$C_{\phi K0} = +0.00 \pm 0.23 \pm 0.05$

$\sin 2\beta$ (ccs) @ 0.9 σ

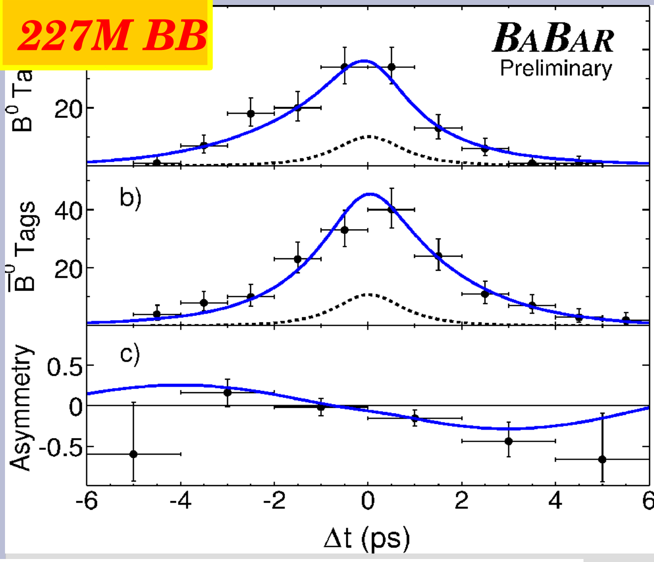
Typical B- reconstruction variables:

$m_{ES} = \sqrt{E^{*2}_{beam} - P^2_B}$

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

More BaBar results from b→sss penguins

227M BB



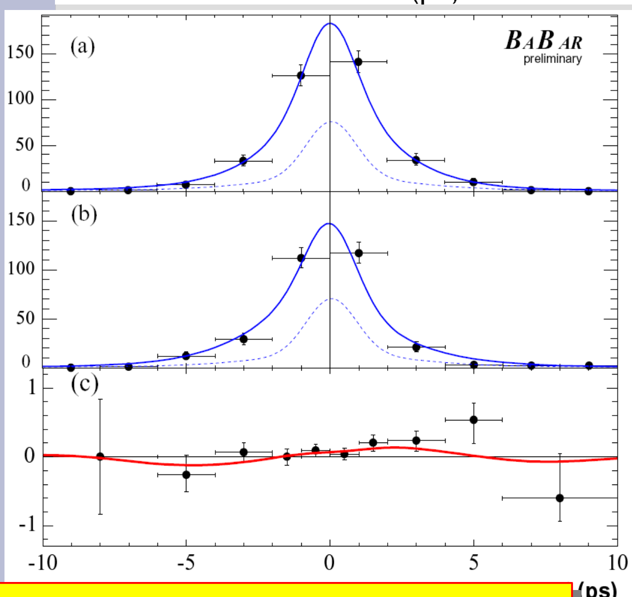
$B \to (K^+K^-)_{CP} K_S$

- Independent sample with (K^+K^-) mass outside φ region
- CP content can be determined experimentally with an angular moment analysis

S_{KKKs}=-0.42±0.17±0.04
C_{KKKs}=+0.10±0.14±0.06

Sin2β = 0.55±0.22±0.04±0.11
⇒sin2β (ccs) @ 0.7 σ

hep-ex/0408076



$B \to \eta' K_S$

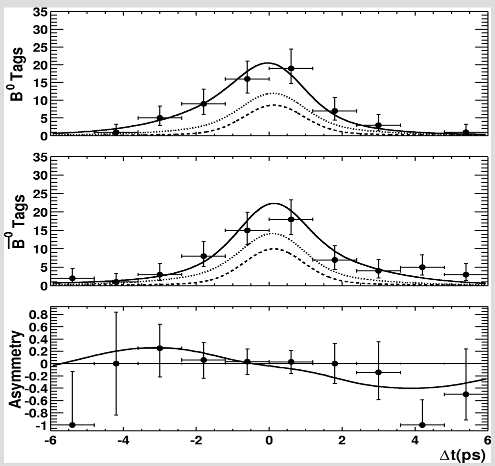
hep-ex/0408090

209M BB

$\eta' \to \rho\gamma, \eta\pi^+\pi^-$
$\eta \to \gamma\gamma, \pi^+\pi^-\pi^0$

$S_{\eta' Ks}$=+0.27±0.14±0.03
$C_{\eta' Ks}$=-0.21±0.10±0.03

sin2β (ccs) @ 3.0 σ



$B \to f_0(980) K_S$

$f_0(980) \to \pi^+\pi^-$

hep-ex/0408095

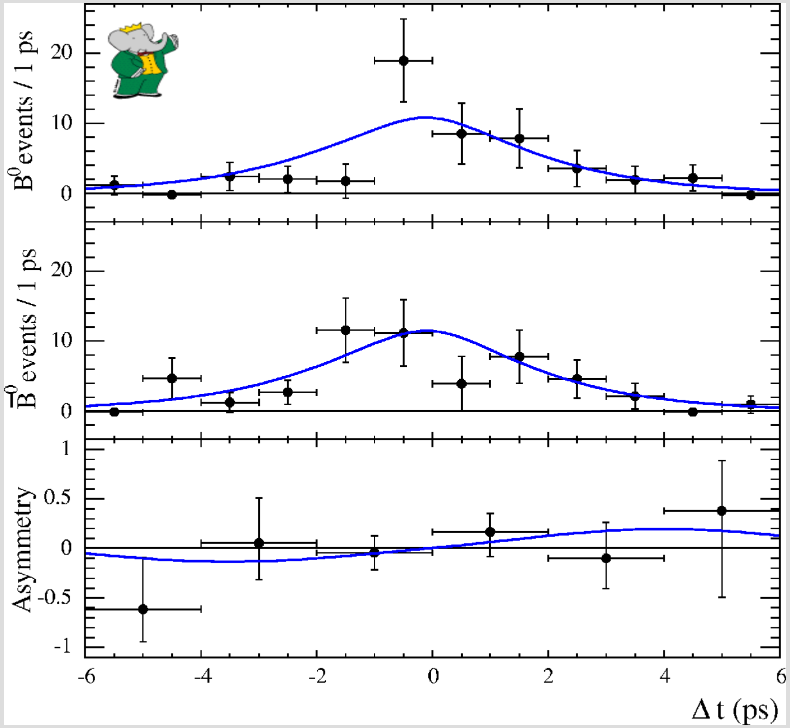
227M BB

S_{f0Ks}=$-0.95^{+0.32}_{-0.23}$±0.10
C_{f0Ks}=-0.24±0.31±0.15

sin2β (ccs) @ 0.6 σ

Still another penguin mode: $B^0 \to \pi^0 K_S$

- *Challenging mode because of the presence of the π^0*
- *New vertexing technique developed by BaBar in 2003 for this mode*



Background corrected signal-weights (Pivk-LeDiberder physics 0402083)

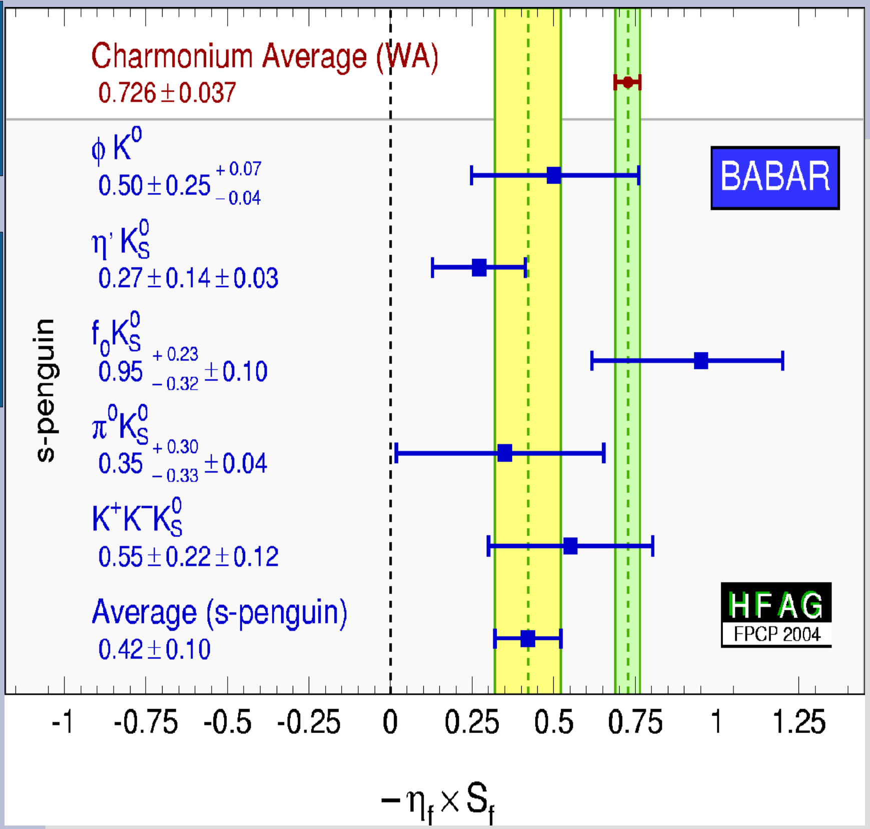
227M BB — *hep-ex/0408062*

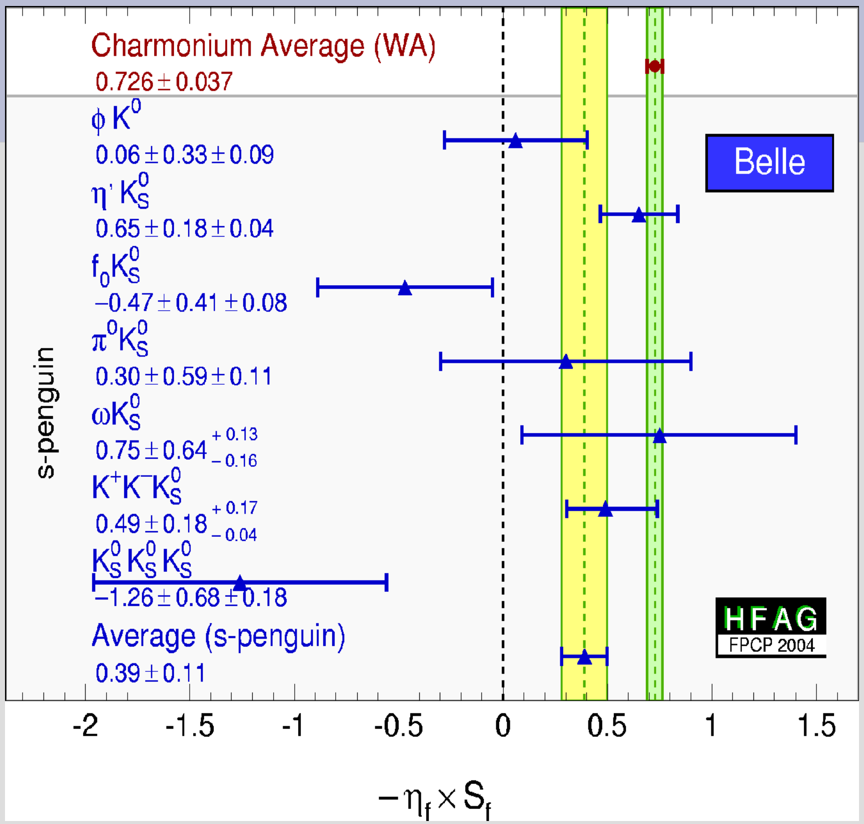
$$S_{\pi 0 Ks} = +0.35^{+0.30}_{-0.33} \pm 0.04$$
$$C_{\pi 0 Ks} = +0.06 \pm 0.18 \pm 0.06$$

274M BB — *hep-ex/0409049*

$$S_{\pi 0 Ks} = +0.30 \pm 0.59 \pm 0.11$$
$$C_{\pi 0 Ks} = -0.12 \pm 0.20 \pm 0.07$$

Results on sin2β from s-penguin modes



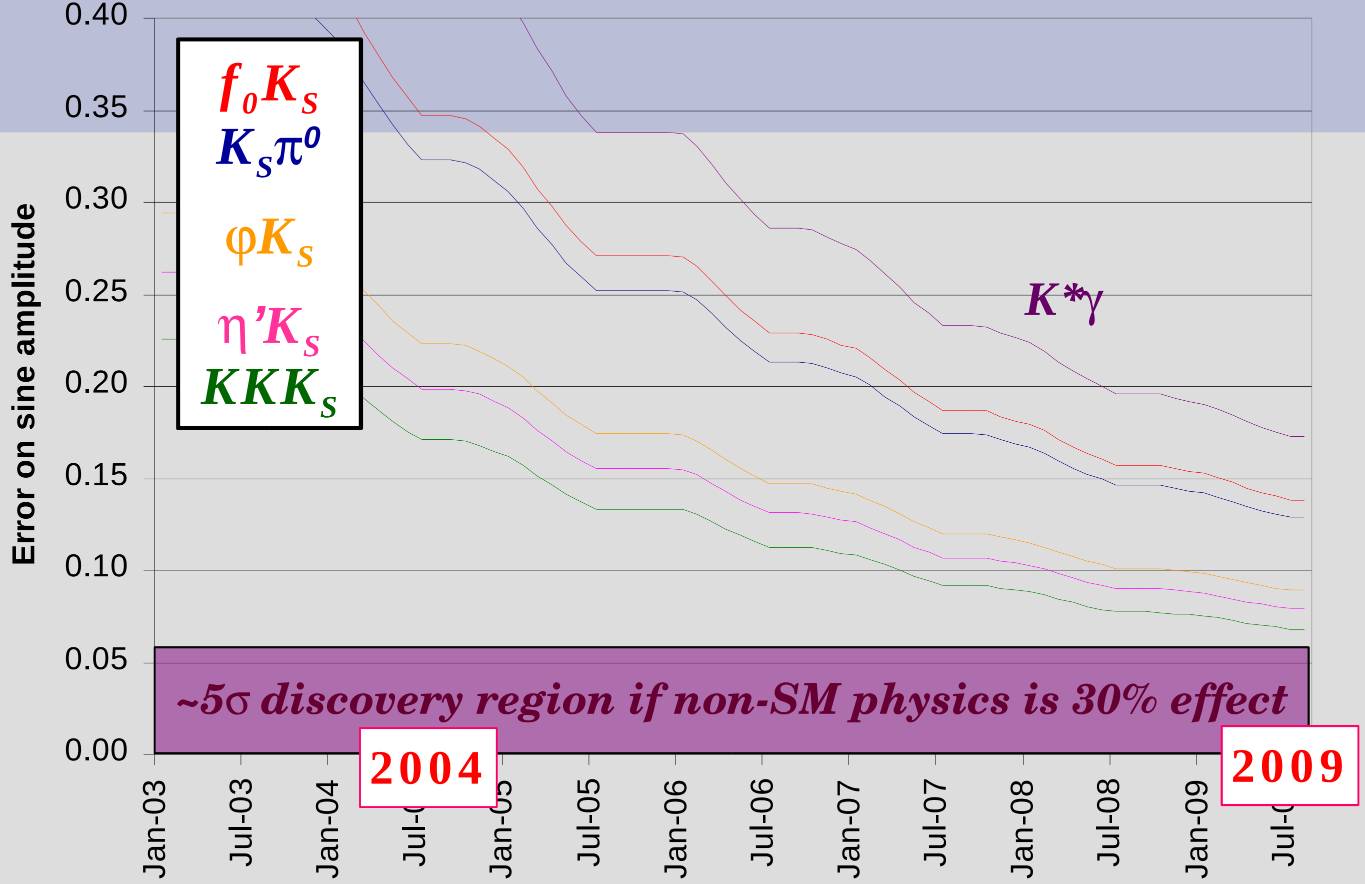


2.7σ from s-penguin to sin2β($c\bar{c}$)

2.4σ from s-penguin to sin2β($c\bar{c}$)

Note that: if NP contributes significantly to CPV in loop decays, we naturally expect it to be different among the modes ⇒ averaging only useful in case of SM

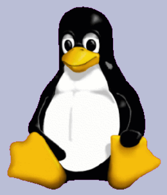
Projections for Penguin Modes

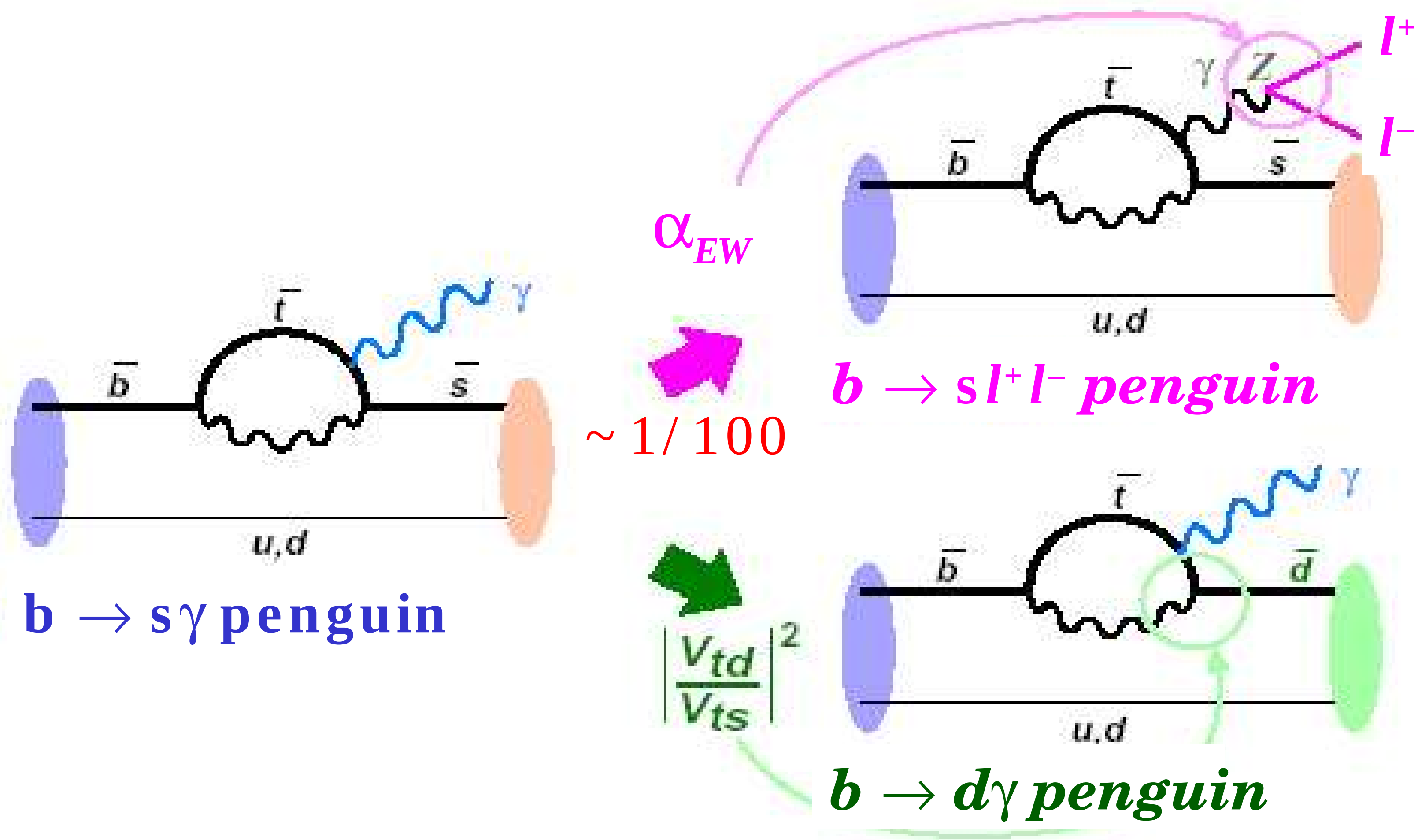


Luminosity expectations:

2006=500 fb^{-1}
2009=1.5 ab^{-1}

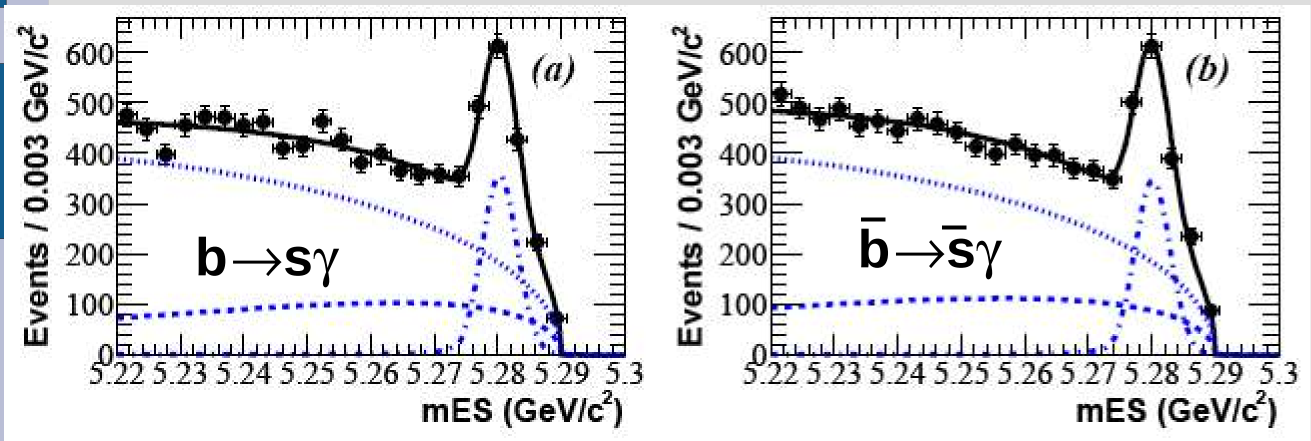
Projections are statistical errors only; but systematic errors at few percent level. BaBar projections only, but similar projections hold for Belle as well.

Radiative & EW  Loops



Direct CP Asymmetry: $b \to s\gamma$ and $B \to K^*\gamma$

- *BF($b \to s\gamma$) confirms SM predictions*
- *But direct CP asymmetry (< 1% in the SM) could receive ~10% NP contributions*
- *Either inclusive or exclusive decays could reveal new physics*
- *B or K charge tags the flavor of the b quark with ~1-2% asymmetry systematic*



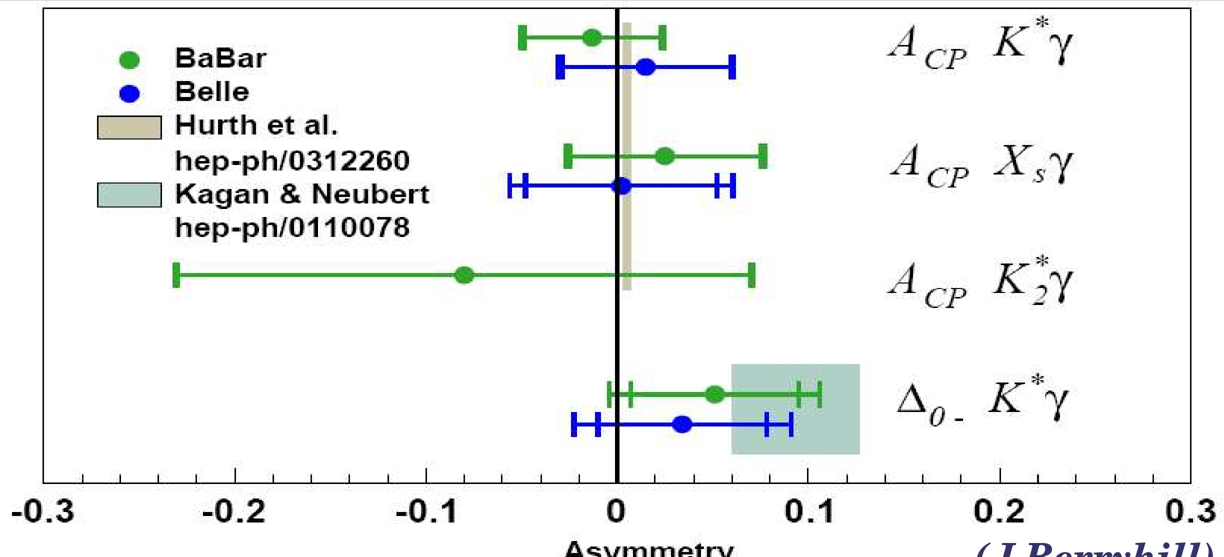
89M BB

PRL 93:021804(2004)

$A_{CP} = 0.025 \pm 0.050 \pm 0.015$

$$A_{CP} = \frac{\Gamma(b \to s\ ) - \Gamma(\overline{b} \to \overline{s}\ )}{\Gamma(b \to s\ ) + \Gamma(\overline{b} \to \overline{s}\ )}$$

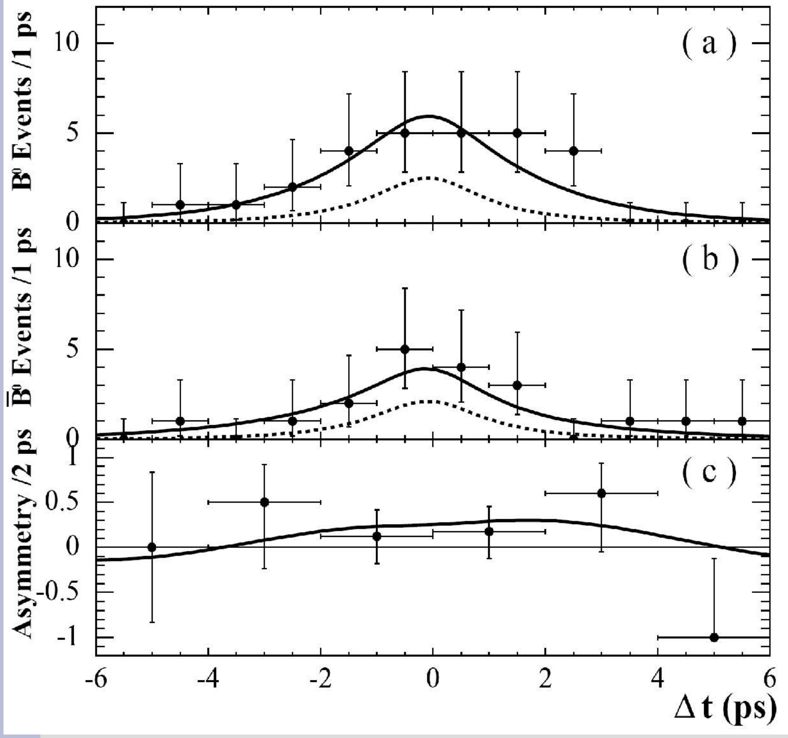
CP asymmetries consistent with SM at 5% level:



(J.Berryhill)

*Time Dependent CP asymmetry in B→K*γ*

- **Same technique as for Ksπ^0**
- ***In the SM, mixed decay to K*γ requires wrong photon helicity, thus***
- ***CPV is suppressed. In SM: C = -A_{CP} ≈ -1%   S ≈ 2(m_s/m_b)sin 2β ≈ 4%***



124M BB

hep-ex/0405082

K*γ signal = 105 ± 14 events

$S_{K^*\gamma}$=+0.25±0.63±0.14
$C_{K^*\gamma}$=-0.57±0.32±0.09

Consistent with SM
For C fixed to 0, S = 0.25 ± 0.65 ± 0.14

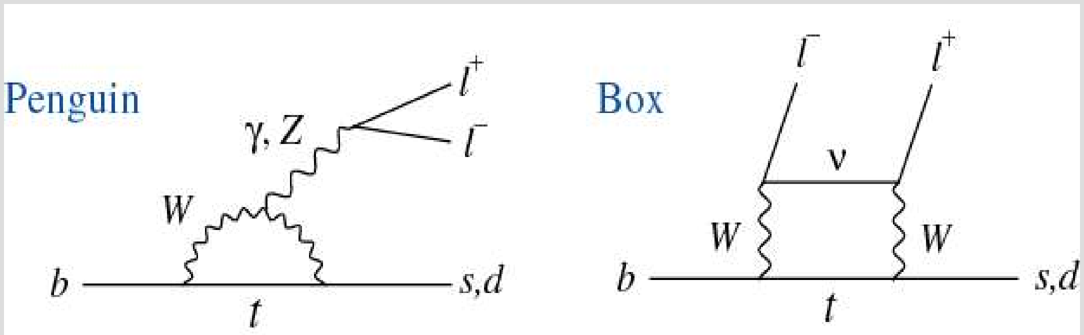
275M BB

Belle-Conf-0475

$S_{K^*\gamma}$=-0.58±0.46±0.11
$C_{K^*\gamma}$=-0.03±0.34±0.11

$b \to s l^+ l^-$

- *First observed in exclusive mode B→Kll by Belle*
- *Proceed through penguin, Z penguin and W box diagrams*

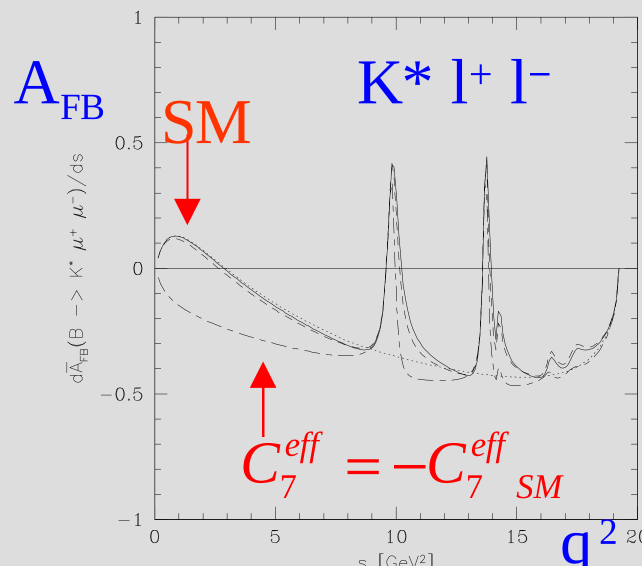


- *Sensitive to new physics*
- *Information on Wilson coefficient*

C_7, C_9, C_{10} can be obtained from square di-lepton momentum (q^2) distribution and forward-backward asymmetry $A_{FB}(q^2)$ of the two leptons.

- *BF(b→sll) is low compared with b→sγ,*

suppressed by additional α_{em} thus needs l arge statistics



Ali et al. Phys.Rev. D61 (2000) 074024

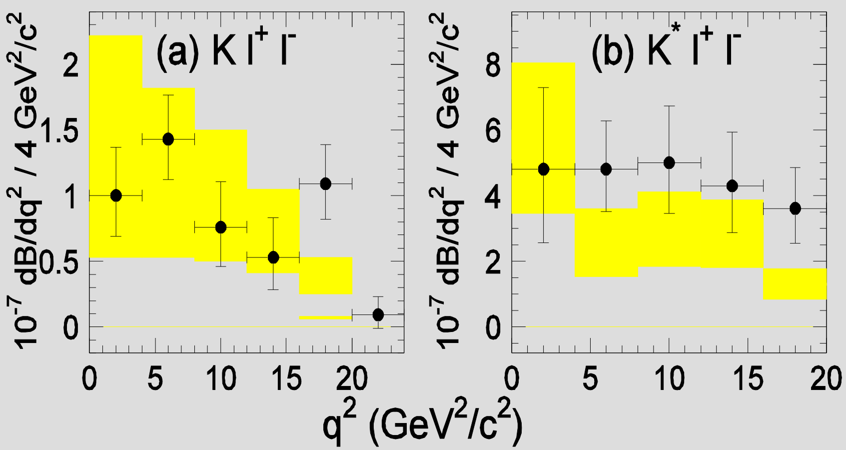
$B \to K^{(*)} l^+ l^-$

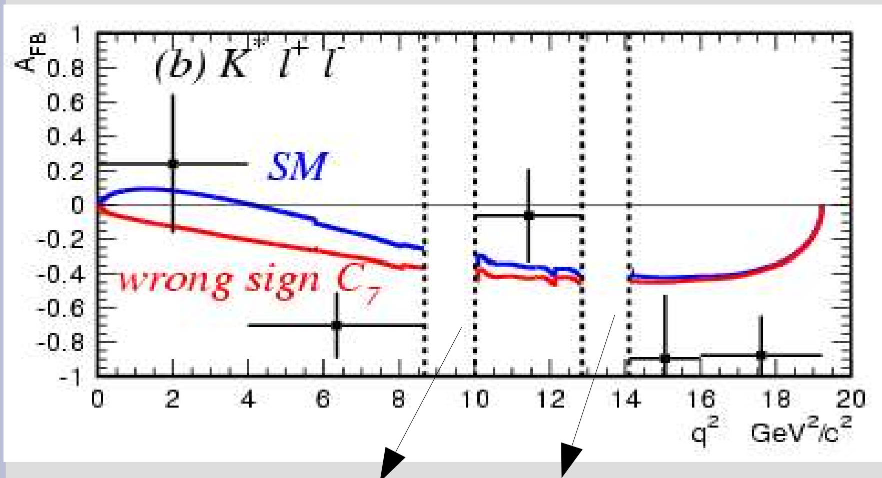
- *Apply tight particle identification criteria*
- $P_e > 0.5$ GeV, $P_\mu > 1$ GeV
- *Recover Bremsstrahlung photons for e^+e^- modes*
- *Peaking background from J/Ψ(Ψ')Xs and Xsππ*
- *Non peaking background from semileptonic decays and qq*

275M $B\bar{B}$

hep-ex/0410006

$$BF(Kl^+l^-) = (5.50^{+0.75}_{-0.70} + 0.27 + 0.02)10^{-7}$$
$$BF(K^*l^+l^-) = (16.5^{+2.3}_{-2.2} \pm 0.9 \pm 0.4)10^{-7}$$





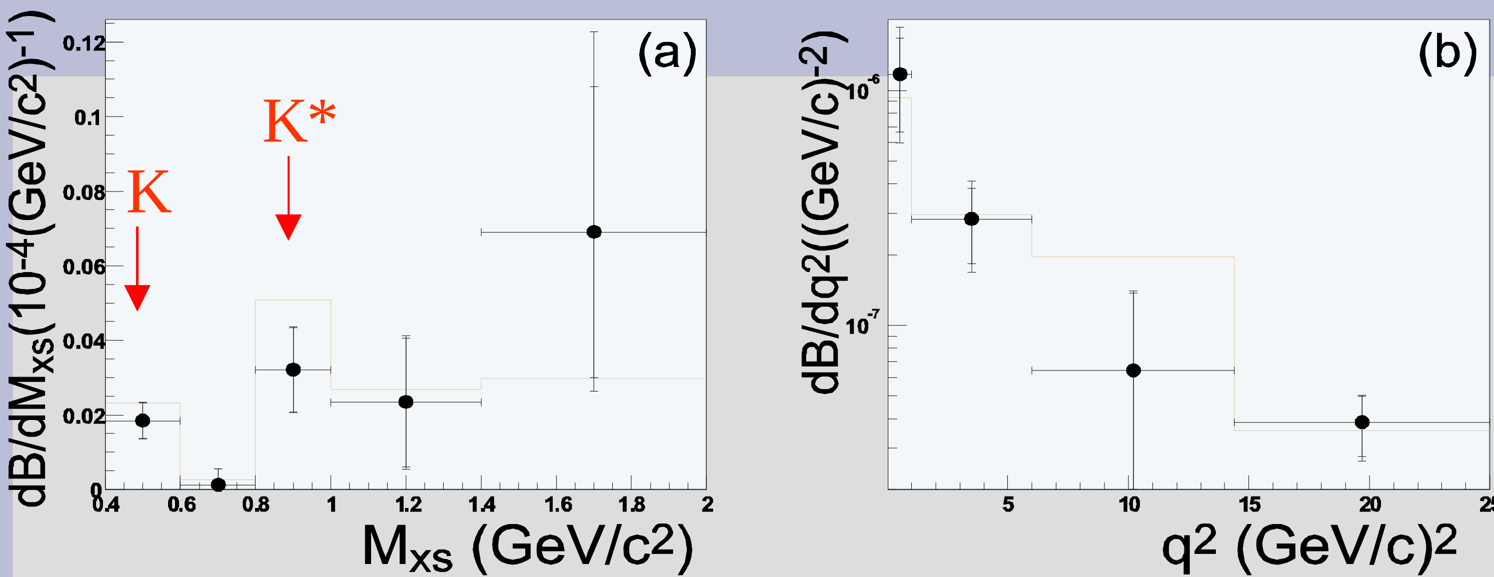
J/ψ veto *Ψ'veto*

$$A_{FB} = \frac{\Gamma(\theta_{Bl^+} < \pi/2) - \Gamma(\theta_{Bl^+} > \pi/2)}{\Gamma(\theta_{Bl^+} < \pi/2) + \Gamma(\theta_{Bl^+} > \pi/2)}$$

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

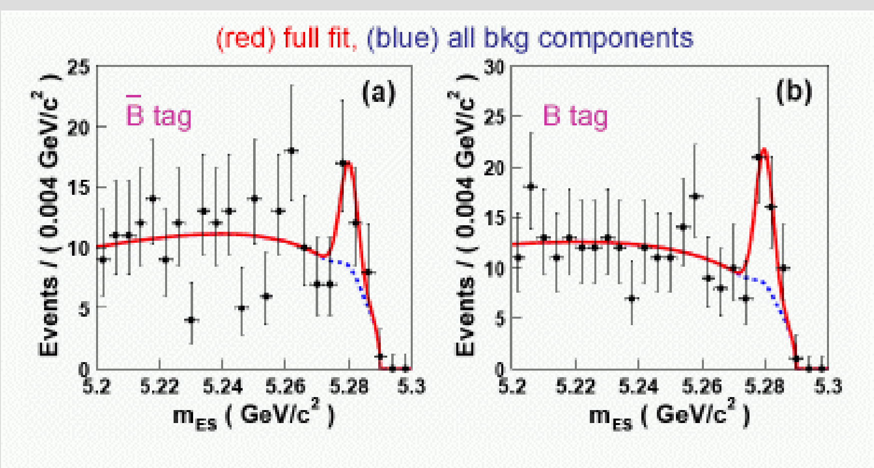
Look at sum of exclusive modes from s-quark fragmentation:

$K^{(*)}$ and up to 4 pions up (~50% of total final states)



152M BB

hep-ex/0408119



Direct CP Asymmetry

	$B \to X_s l^+l^-$
$N(\bar{B}) \pm$ (stat)	14.7 ± 6.5
$N(B) \pm$ (stat)	22.9 ± 7.4
$A_{CP} \pm$ (stat)	-0.22 ± 0.26

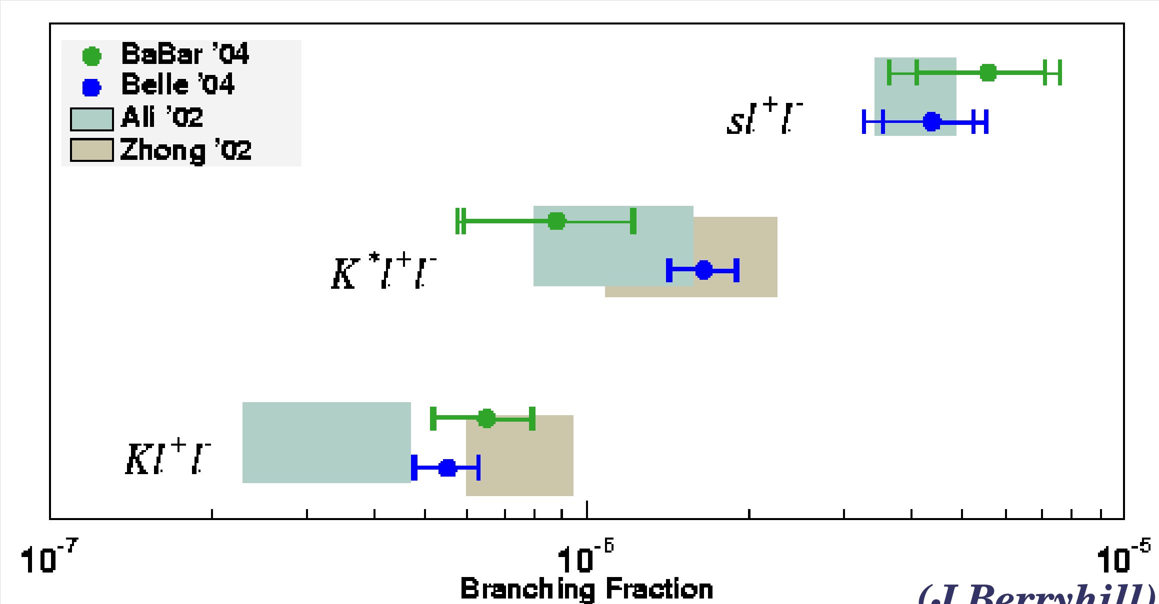
89M BB

hep-ex/0404006

$A_{CP}(Xsl^+l^-) = -0.22 \pm 0.26 \pm 0.02$

$b \to sll$ branching ratio summary

Good Agreement with SM



(J.Berryhill)

- ***BF(Kee)/BF(Kμμ) sensitive to neutral Higgs emission from internal loop in 2HDM with large tan β.***
- ***BF(K*ee)/BF(K*μμ) sensitive to size of photon pole***

$$\mathcal{R}_{K\ell\ell} = \frac{\mathcal{B}(B\to K\mu\mu)}{\mathcal{B}(B\to Kee)} = 1.38^{+0.39+0.06}_{-0.41-0.07} = 1.00$$

$$\mathcal{R}_{K^*\ell\ell} = \frac{\mathcal{B}(B\to K^*\mu\mu)}{\mathcal{B}(B\to K^*ee)} = 0.98^{+0.30}_{-0.31} \pm 0.08 \sim 0.75$$

in the SM.

$b \to d\gamma$: $B \to \rho(w)\gamma$

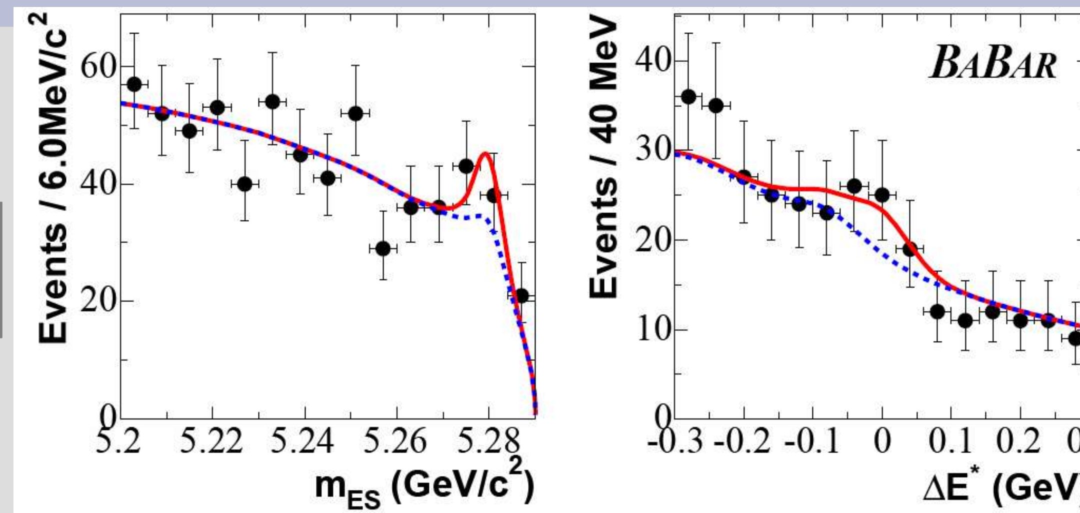
- *Important to reject $K^*\gamma$*
- *Particle identification is crucial*

$$\Gamma(B \to (\rho,\omega)\gamma) = \Gamma(B^+ \to \rho^+\gamma) = 2\Gamma(B^0 \to \rho^0\gamma) = 2\Gamma(B^0 \to \omega\gamma)$$

219M $B\bar{B}$

hep-ex/0408034

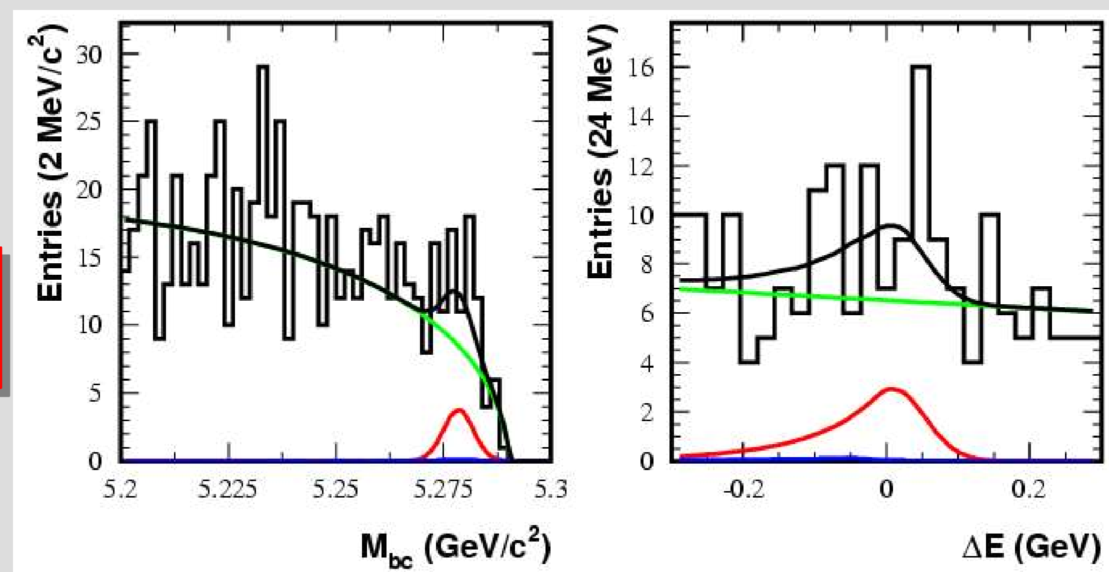
$BF(B \to (\rho,\omega)\gamma) = (0.72 \pm 0.27\,) x\ 10^{-6}$
[< 1.4 x 10^{-6} @90% CL]



275M $B\bar{B}$

hep-ex/0408137

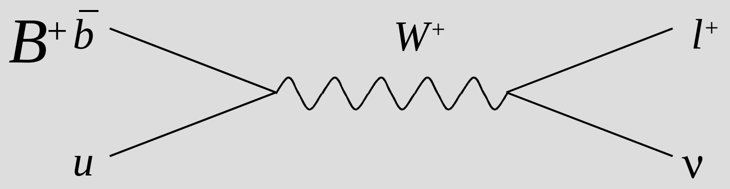
$BF(B \to (\rho,\omega)\gamma) = (0.6 \pm 0.3 \pm 0.1)\ x\ 10^{-6}$
[< 1.2 x 10^{-6} @90% CL]



Leptonic B decays to $\tau^+ \nu$, $l^+ l^-$, $\nu \bar{\nu}$

Leptonic decays of heavy-quark mesons provide a laboratory

- ***For testing straightfoward SM predictions:***

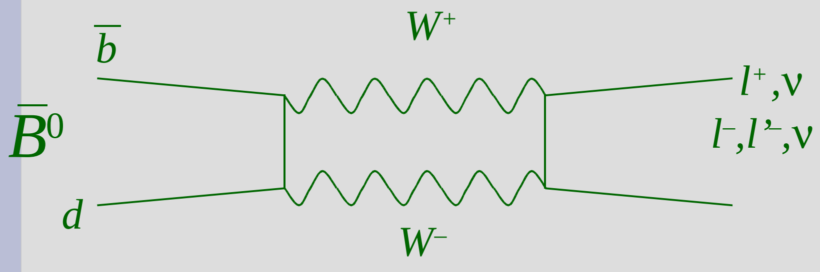


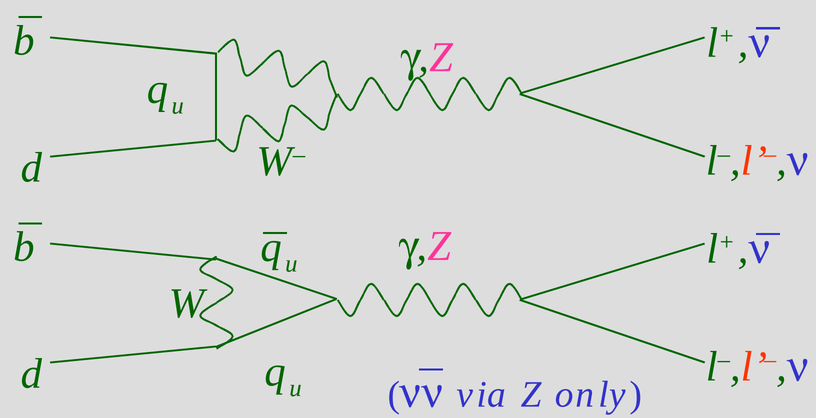
SM predictions:

BF($B^+ \rightarrow \tau^+ \nu_\tau$) ~ 10^{-5}

BF($B^+ \rightarrow \mu^+ \nu_\mu$) ~ 10^{-7}

- ***For searching for non-SM effects in highly suppressed processes. Some new-physics in loops (e.g., SUSY) can enhance these by orders of magnitude. Also LFV?***

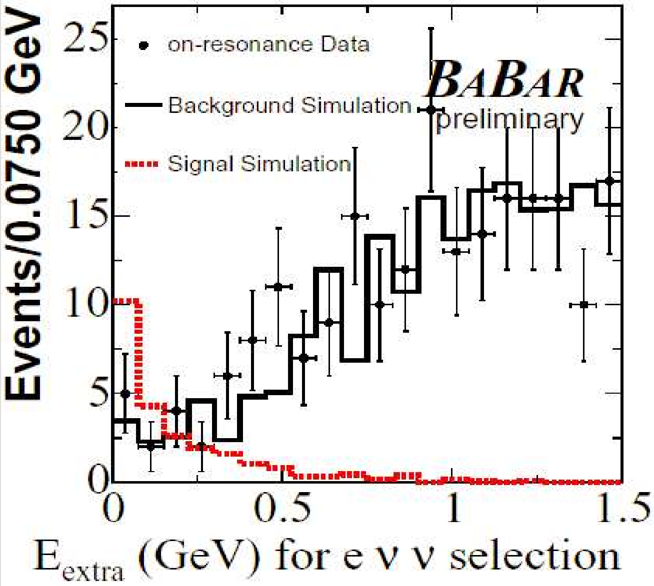




$B^+ \to \tau\nu$

- ***Reconstruction of*** $\tau \to \mu(e)\nu\nu, \pi\nu, \pi\pi^0\nu, \pi\pi\pi\nu$
- ***Large missing energy in the event due to the neutrinos***
- ***Tag the other B, B*** $\to D^{*0}l\nu$, $D^{(*0)}X$: ***strong suppression of combinatorial and continuum background, although low efficiency***

(Signal MC scaled to BF=10^{-3})



Discriminating variable: remaining neutral energy in the event after the signal and tag B are subtracted

hep-ex/0408091 ***hep-ex/0407038***

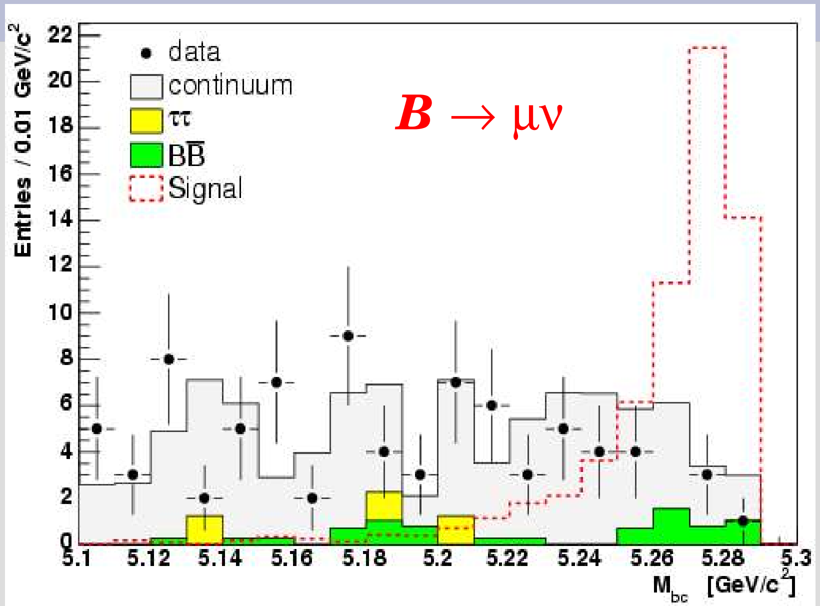
$\mathcal{B}(B^+ \to \tau^+ \nu_\tau) < 3.3\times10^{-4}$ (90%CL)

hep-ex/0408144

124M BB

$\mathcal{B}(B^+ \to \tau^+ \nu_\tau) < 2.9\times10^{-4}$ (90%CL)

$B^0 \to \mu\nu$, $l\ \nu\gamma$



$BF(B \to \mu\nu) < 2.0 \times 10^{-6}$ (90%CL)

$BF(B \to e\nu\gamma) < 2.2 \times 10^{-5}$ (90%CL)

$BF(B \to \mu\nu\gamma) < 2.3 \times 10^{-5}$ (90%CL)

- *Helicity suppression of $B \to \mu\nu$ with respect to $B \to \tau\nu$, smaller BF of ~225 times*
- *Observation with current dataset would be clear indication of NP*
- *Search extended to ratiative modes ($B \to l\nu\gamma$) for electrons and muons (where no helicity suppression does occur)*

- *Selection is based on electron and muon identification*
- *The other B is in the event is tagged*

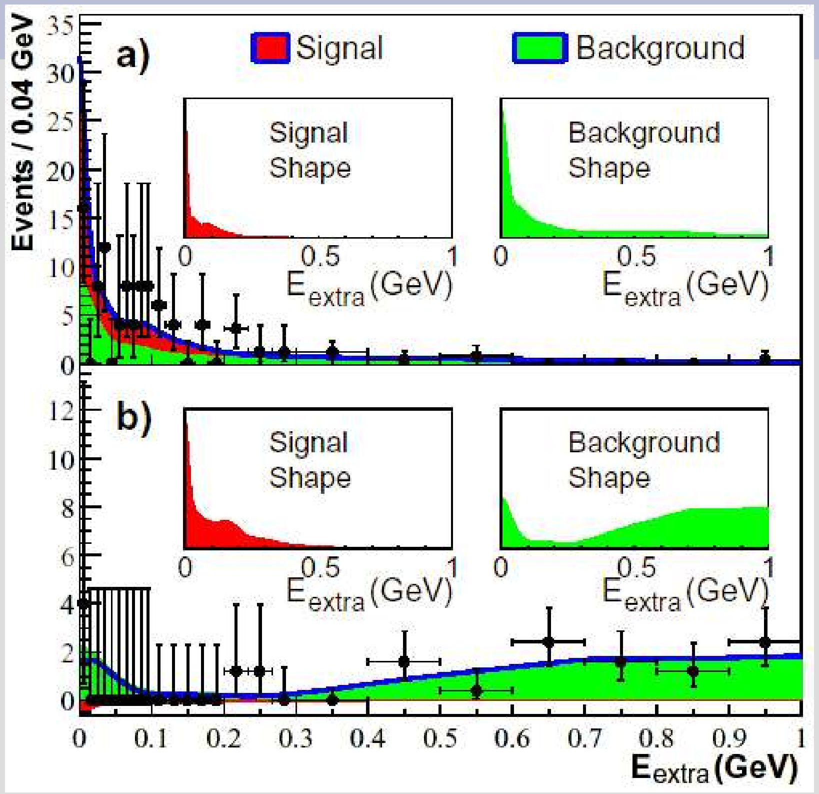
BELLE **152M BB**

hep-ex/0408132

$B^0 \to$ *invisible* ($\nu\,\bar{\nu}$), $\nu\,\bar{\nu}\,\gamma$

$\nu\,\bar{\nu}$

$\nu\,\nu\,\gamma$



- ***The Branching Fraction for*** $\nu\nu$ ***is well below the range of current observability***
- ***Higher (~10^{-9}) but still below the current range is the*** $B\to\nu\nu\gamma$

- ***Experimental signature: tag the other B in the event in*** $B\to D^{(*)}l\nu$
- ***Look at the remaining neutral energy in the event***

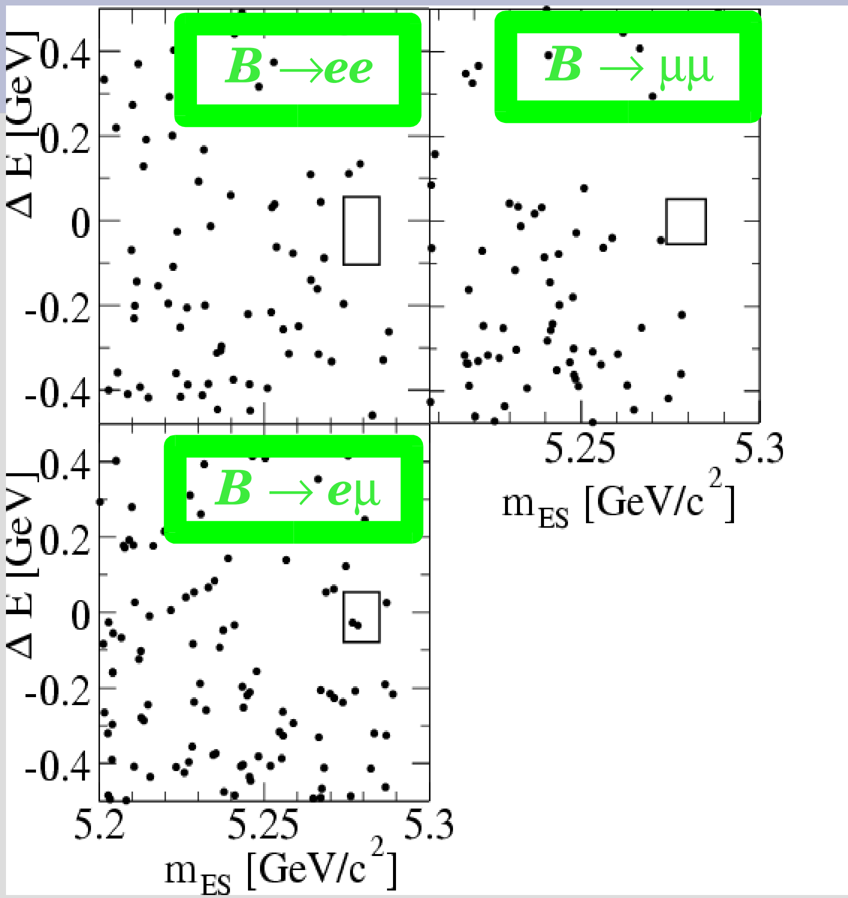
BF($B^0 \to$ invisible) < 22 × 10^{-5} (90%CL)

BF($B^0 \to \nu\,\nu\,\gamma$) < 4.7 × 10^{-5} (90%CL)

89M BB

hep-ex/0405071

$B^0 \to l^+ l^-$ (e^+e^-, $\mu^+\mu^-$, $e^+\mu^-$)



Highly suppressed processes in the SM

Experimental key features:

- *identification of two high energy lepton*
- *rejection of QED and qq backgrounds*

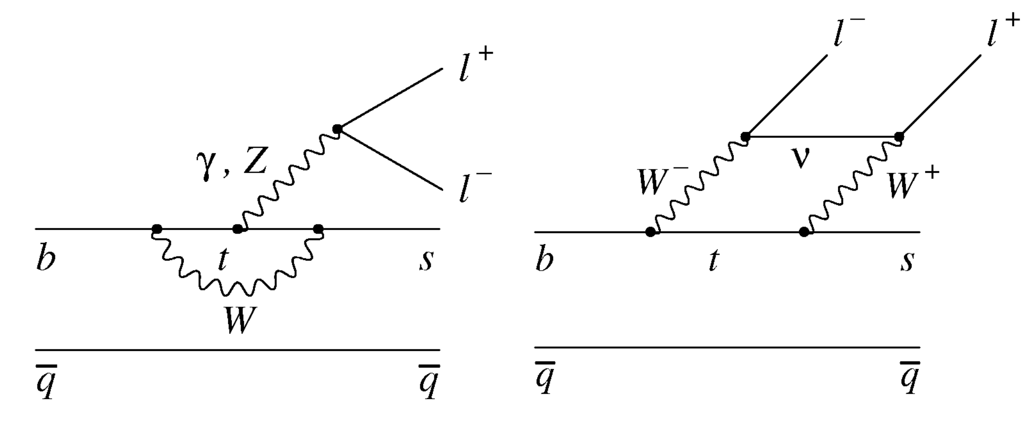
Improvements with respect to the previous limits:

- ***BF(B →ee) < 6.1 × 10^{-8} (90%CL)***
- ***BF(B → μμ) < 8.3 × 10^{-8} (90%CL)***
- ***BF(B → eμ) < 18 × 10^{-8} (90%CL)***

127M BB

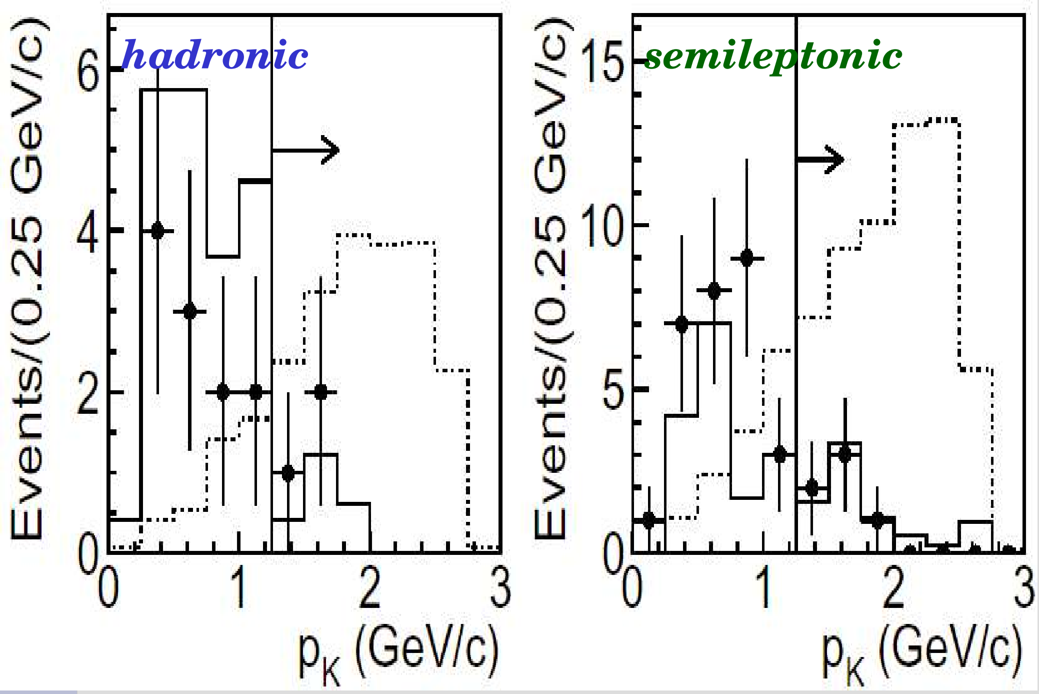
hep-ex/0408096

Leptonic B decays to K(π) $\nu\bar{\nu}$



- *The flavor-changing neutral current decays B→K/πνν occur in the Standard Model via one-loop radiative penguin and box diagrams*
- *SM expectation: $B(B^+ \rightarrow K^+\nu\nu) \sim 10^{-6}$, $B(B^+ \rightarrow \pi^+\nu\nu) \sim 10^{-7}$*
- *Their analysis is theoretically very clean; observation of these processes would be complementary to the observation of $B \rightarrow K^{(*)} l^+ l^-$*
- *These also present another opportunity for the observation of new-physics effects in the loops.*

$B^+ \to K/\pi^+ \nu \bar{\nu}$

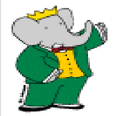


Points: data; solid: background MC; dashed: signal MC (arbitrary scale)

- *Large missing energy*
- *Tagged B in the event reconstructed in semileptonic or hadronic decays*
- *Combinatorial bakground from continuum events reduced using topological variables*
- $\pi\nu\nu$ *and* $K\nu\nu$ *have opposite particle identification criteria*

$BF(B^+ \to K^+\nu\nu) < 5.2\times10^{-5}$ *(90%CL)*

$BF(B^+ \to \pi^+\nu\nu) < 1.0\times10^{-4}$ *(90%CL)*



89M BB

hep-ex/0408086

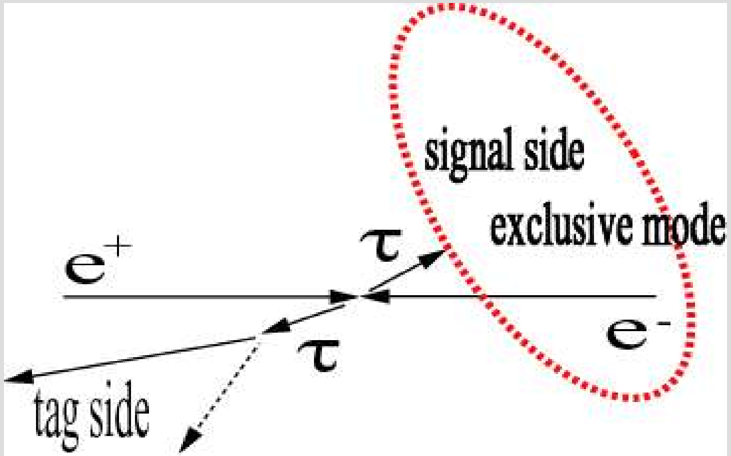
Search for lepton flavour violation in tau decays

__@ BaBar/Belle__: $\sigma\ (e^+e^- \rightarrow \tau\tau) = 0.9$ nb; $\sigma(e^+e^- \rightarrow BB) = 1.0$ nb at (4S)

Lepton (baryon) flavour violation not yet observed. It is supposed to be very small in the SM. It is indeed enhanced in many models beyond the SM

__Experimental Strategy:__

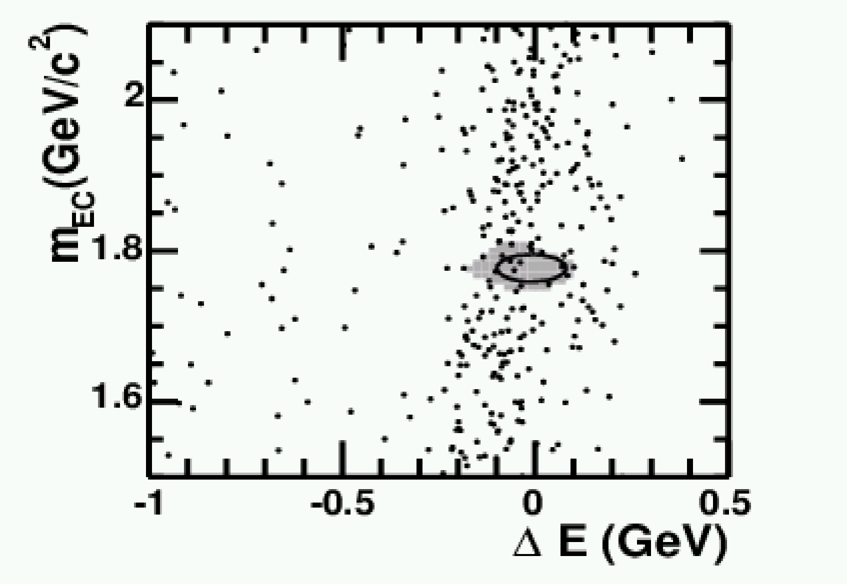
- ***Separation into 2-hemisphers***
  - ***signal-side***
  - **tag-side: 1or 3 prong (need high efficiency)**



- **Background from higher-order radiative Bhabha and μμ, qq, ττ with wrong particle identification**

Search for $\tau \to \mu(e)\gamma$

$\tau \to \mu\nu$



Dots = data, shaded region = MC signal

- ***Clean signature given by a μ and γ compatible with τ mass***
- ***The other τ decays in 1 or 3 charged particles***
- ***Background from ee→μμγ, ee→ττγ***
- ***Use neural Network***

BF (τ→μγ) < 0.9x10^{-7} 90%CL

Preliminary BaBar result @ TAU 04

$\tau \to e\nu$

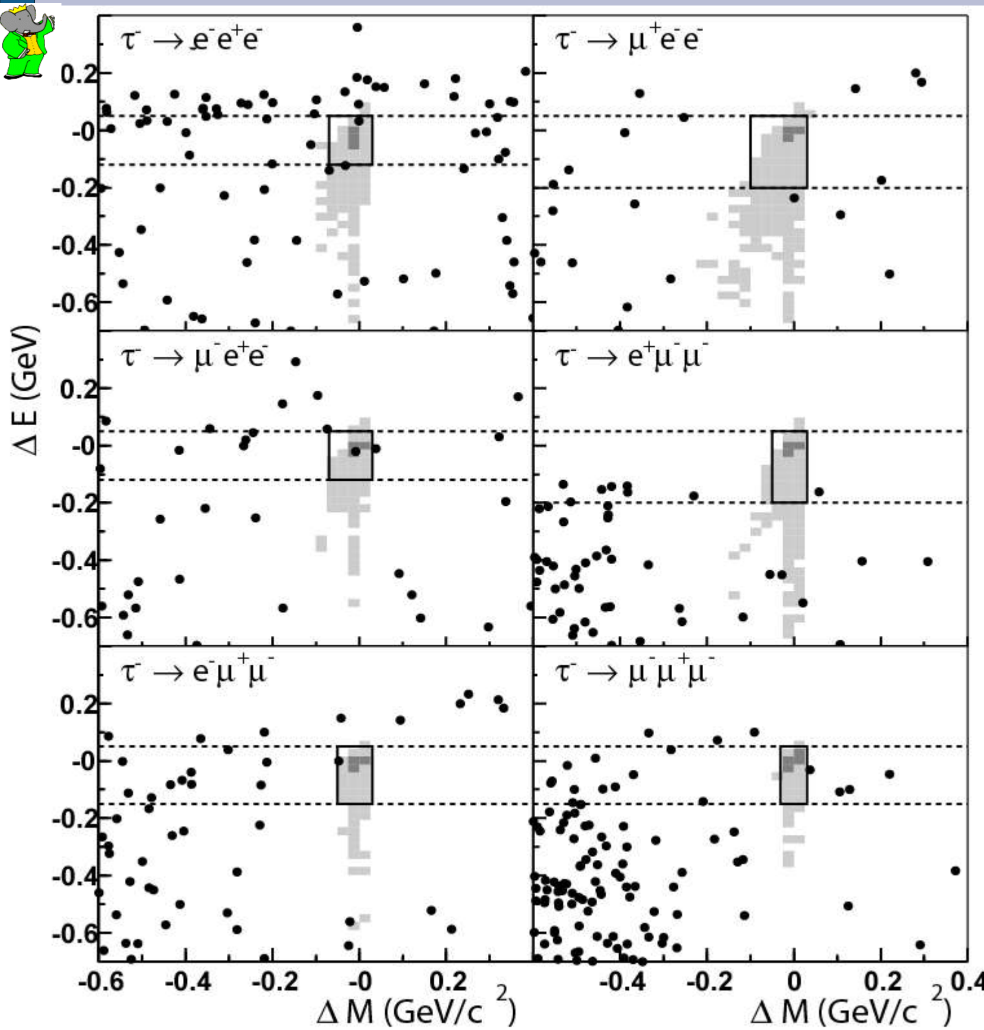
- ***Require e and γ consistent with τ mass***
- ***Main backgrounds ττγ and eeγ***

87.1/fb data

Belle-Conf.04069

BF (τ→eγ) < 3.8x10^{-7} 90%CL

Search for τ→lll,lhh (h=K,π)



All possible combinations consistent with charge conservation are considered

A total of 6 lll final states and 14 hhl final states are studied

The other tau has only a charged track

Main background from low multiplicity qq events, BhaBha, μμ, ττ.

BF limits are set ~2x10^{-7} per each final state

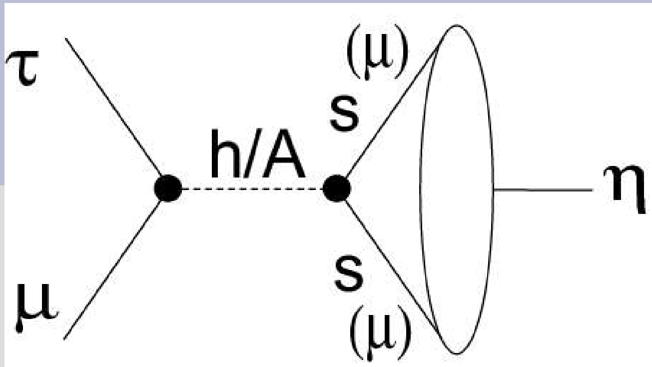
PRL 92:121801(2004)

hep-ex/0403039

hep-ex/0409036

Search for LFV τ *decays involving* π^0, η, η'

$\tau \to \mu\eta$ **provides a very stringent bound on Higgs mediated LFV decays**



Searches for $\tau \to l\eta$, $l\pi^0$, $l\eta'$(where $\eta' \to \pi\pi\eta$) are perfomed

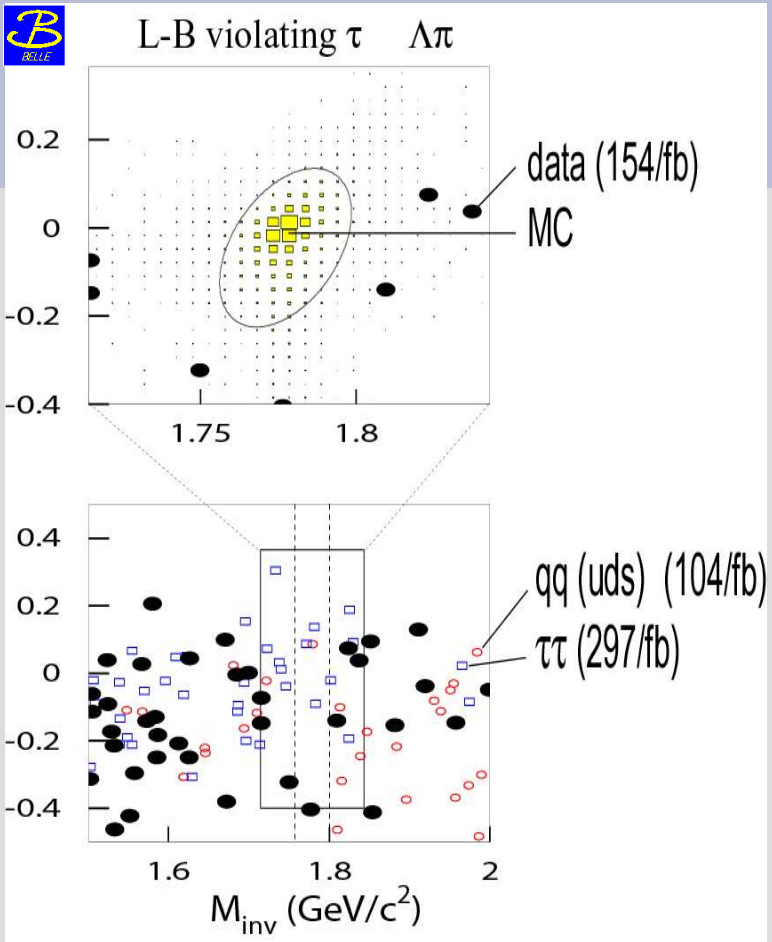
153.8/fb ***Belle-Conf-0432***

Mode	Subdecay mode	U.L. of $\mathcal{B}$ @ 90% C.L.
$\tau^- \to e^-\eta$	$\eta \to \gamma\gamma$	3.9×10^{-7}
	$\eta \to \pi^+\pi^-\pi^0$	5.6×10^{-7}
$\tau^- \to e^-\eta$	combined	2.3×10^{-7}
$\tau^- \to \mu^-\eta$	$\eta \to \gamma\gamma$	2.4×10^{-7}
	$\eta \to \pi^+\pi^-\pi^0$	5.4×10^{-7}
$\tau^- \to \mu^-\eta$	combined	1.3×10^{-7}
$\tau^- \to e^-\pi^0$	$\pi^0 \to \gamma\gamma$	1.9×10^{-7}
$\tau^- \to \mu^-\pi^0$	$\pi^0 \to \gamma\gamma$	4.3×10^{-7}
$\tau^- \to e^-\eta'$	$\eta' \to \pi^+\pi^-\eta$	10×10^{-7}
$\tau^- \to \mu^-\eta'$	$\eta' \to \pi^+\pi^-\eta$	4.1×10^{-7}

10-70 times tighter limit than before

First search

Search for Baryonic Decays of the tau



In some extentions of the SM, L and B numbers are separately violated but L-B is conserved

Search for tau decays violating L and B separately is perfomed

$Br(\tau^- \to \bar{\Lambda}\pi^-) < 1.3 \times 10^{-7}$ @ 90% C.L. ($B-L$ conserving)

$Br(\tau^- \to \Lambda\pi^-) < 0.70 \times 10^{-7}$ @ 90% C.L. ($B-L$ violating)

$Br(\tau \to p\gamma) < 3.0 \times 10^{-7}$ @ 90% C.L.

$Br(\tau \to p\pi^0) < 6.5 \times 10^{-7}$ @ 90% C.L.

153.8/fb
except pγ (86.7/fb)

Belle-Conf-0433

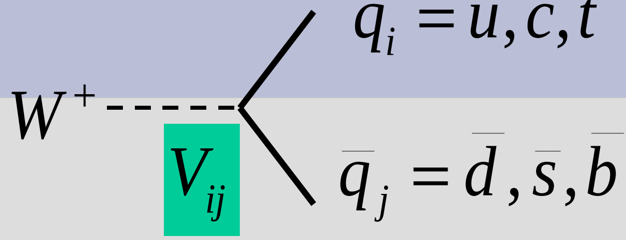
Conclusions and outlook

- *Good agreement between BaBar and Belle results on s-penguins, but both experiments still show discrepancies with charmonium! Puzzling difference.*
- *New results in the radiative penguin sector. Moving toward precision measurement in $b \to sll$.*
- *Probing B decays into leptonic final states.*
- *Looking for lepton and baryon flavor violating in tau decays*

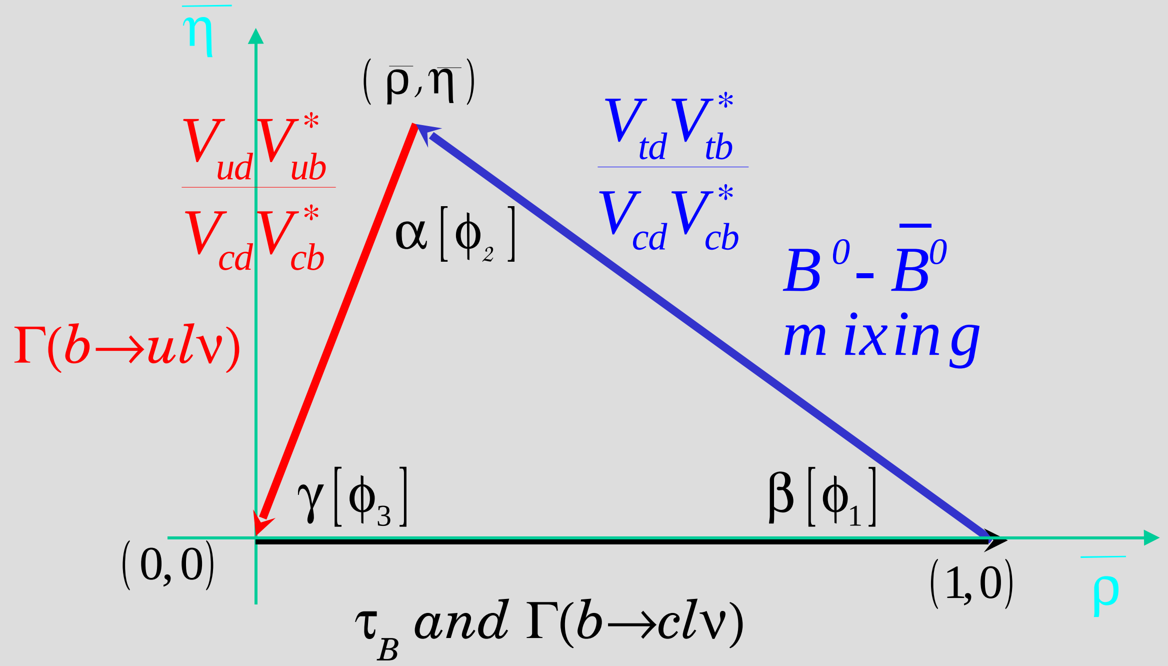
Looking forward to $0.5ab^{-1}$ per B-Factory by 2006!

Backup Slides

CKM and unitarity conditions



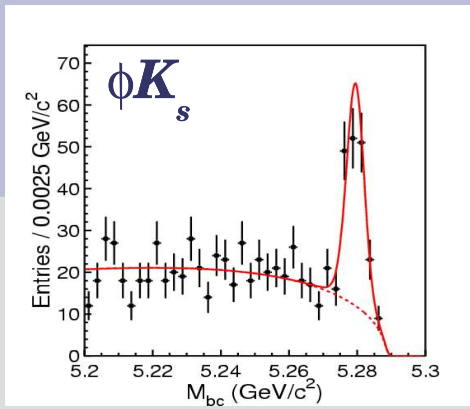
$$V = \begin{vmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{vmatrix}$$

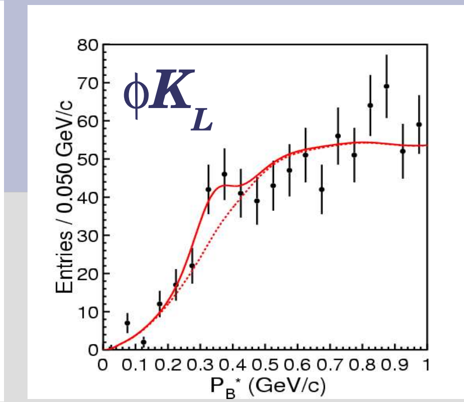


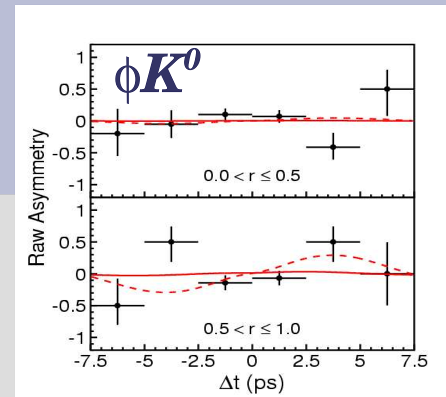
More Belle results from b→ss$\bar{s}$ penguins

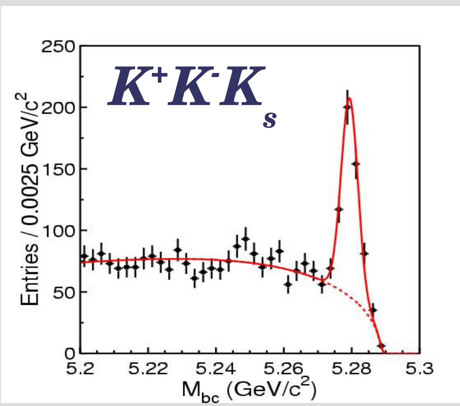
274M BB

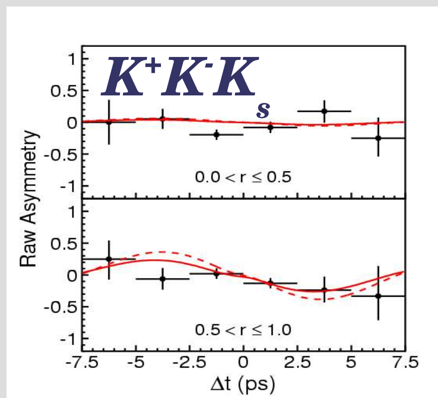
hep-ex/0409049

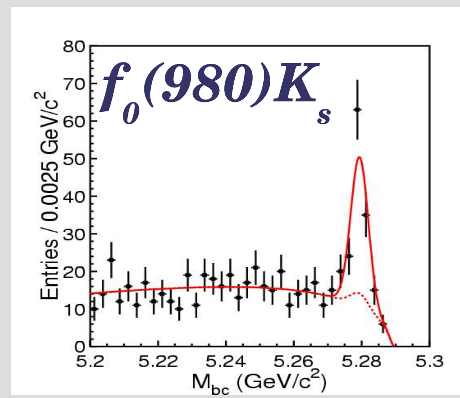


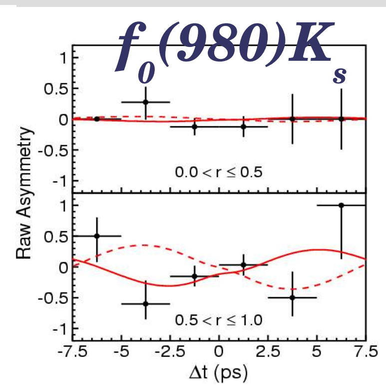


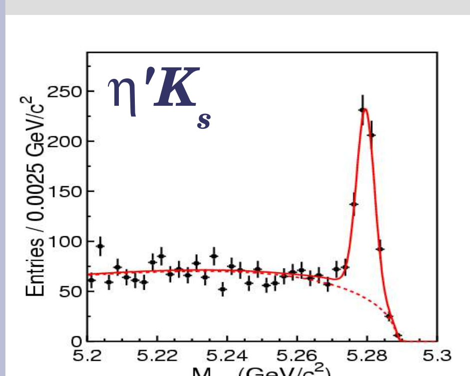


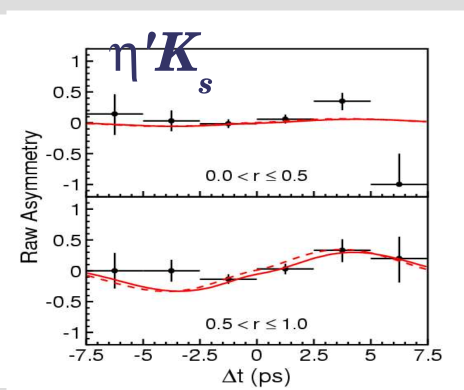


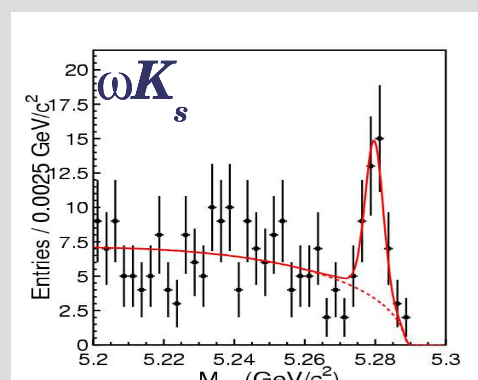


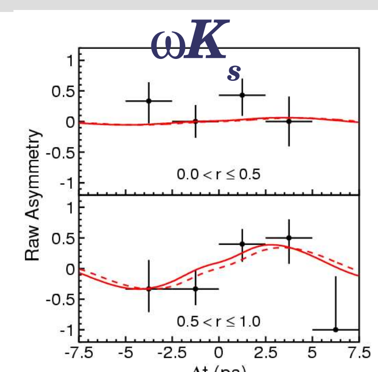












Also many more new results from the B-Factories not discussed here...

- New results on the angle α
- New constraints on γ
- New results on $|V_{cb}|$, $|V_{ub}|$
- ...but let me show you a highlight $\Rightarrow$

First observation of Direct CPV in B decays

$B^0 \to K^+ \pi^-$

BABAR — *hep-ex/0408057, accepted by PRL*

Signal (227M BB pairs): 1606 ± 51

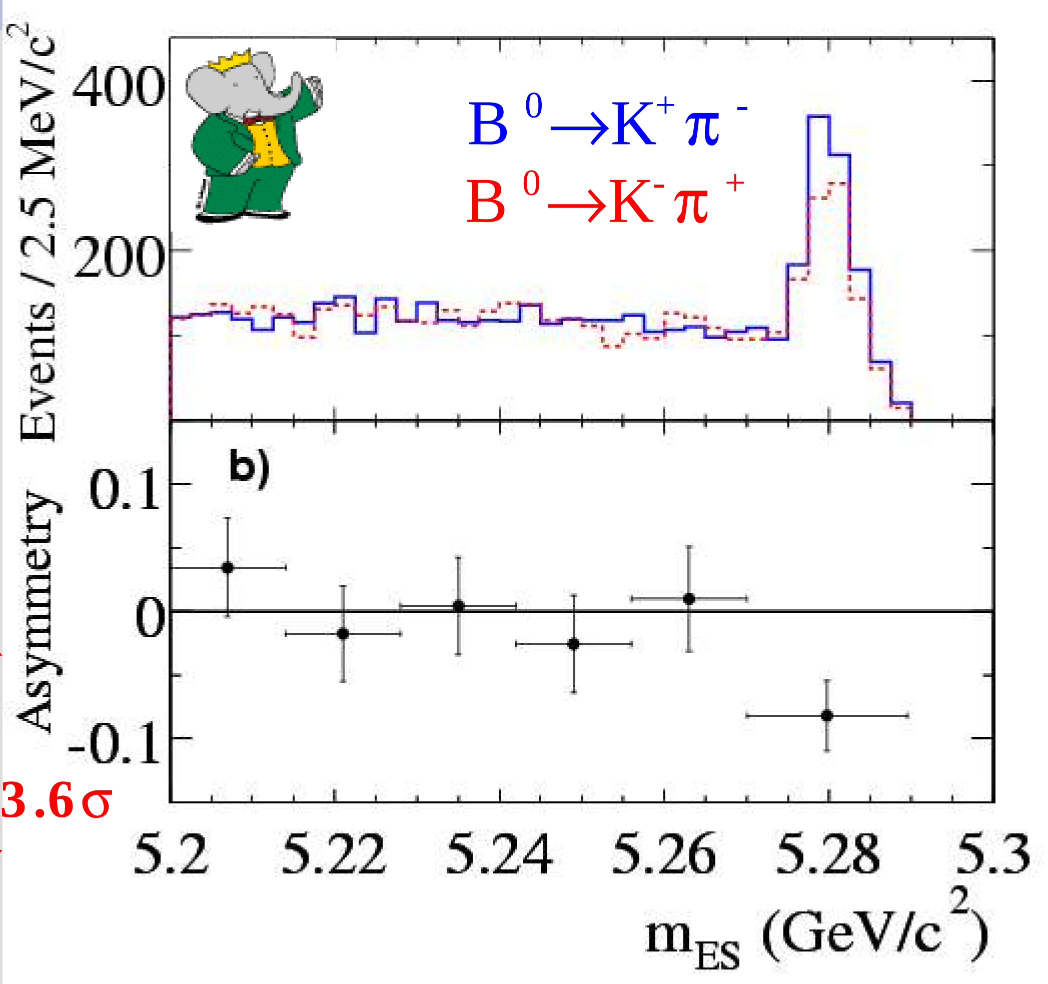
A_{CP} = -0.133 ± 0.030 ± 0.009 **4.2σ**

Belle — ***Confirmation at ICHEP04***

A_{CP} = -0.101 ± 0.025 ± 0.005 **3.9σ**

(274M BB pairs): 2140 ± 52

Average ***A_{CP} = -0.114 ± 0.020***



$B^+ \to K^+ \pi^0$

A_{CP} = 0.06 ± 0.06 ± 0.01 BaBar

A_{CP} = 0.04 ± 0.05 ± 0.02 Belle

3.6σ

Average ***A_{CP} = +0.049 ± 0.040***