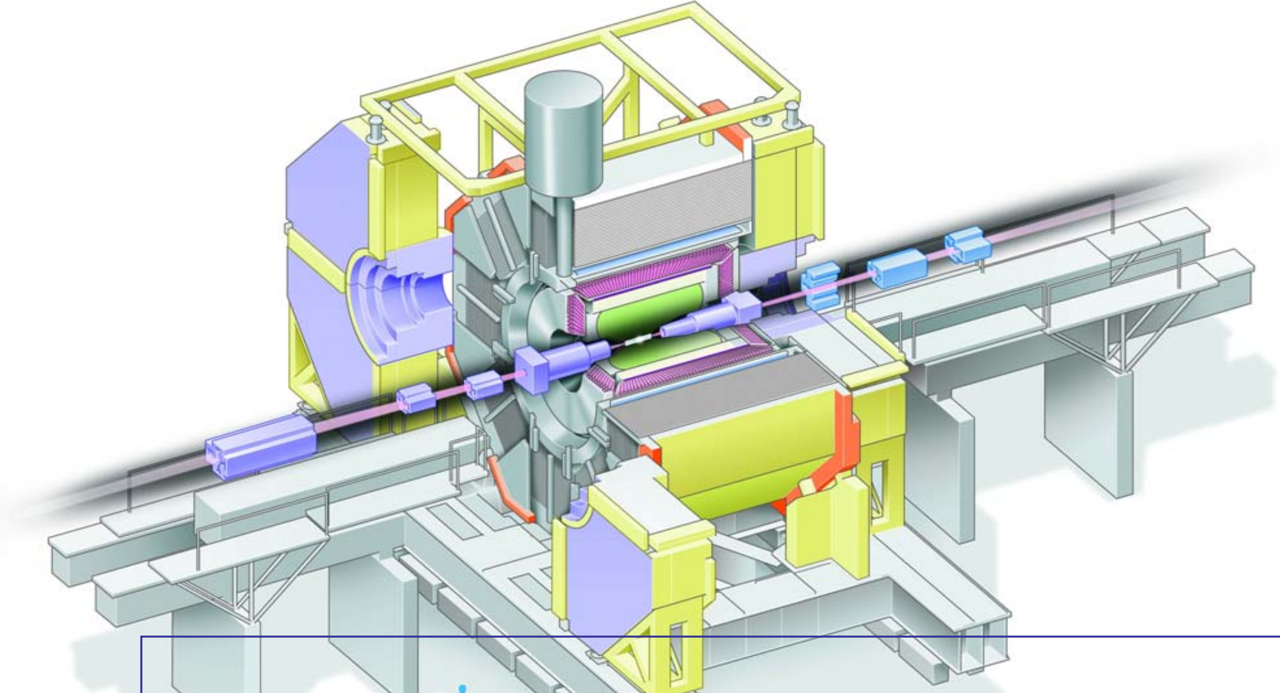


Results of $B \to \omega h$ and $B \to \phi\phi K$ at Belle

Minori WATANABE, Niigata univ

(For the Belle collaboration)

1st Nov 2006

DPF/JPS meeting

Introduction

$B \to \omega h$ ($h = K^\pm, K^0, \pi^\pm, \pi^0$) Update 350fb^{-1}

New B.F. $B^0 \to \omega K^0$ (U.L → B.F.)

Update B.F. $B^\pm \to \omega K^\pm$, $B \to \omega\pi$, A_{CP}

$B \to \phi\phi K$ Update 414fb^{-1}

New B.F. $B^0 \to \phi\phi K^0$, A_{CP}

Update B.F. $B^\pm \to \phi\phi K^\pm$

We add more data and add mode.

Previous results(78fb^{-1})

$$Br(B^\pm \to \omega K^\pm) = (6.5^{+1.3}_{-1.2} \pm 0.6)\times 10^{-6} \quad A_{CP} = (-0.06^{+0.21}_{-0.18} \pm 0.01)$$

$$Br(B^\pm \to \omega \pi^\pm) = (5.7^{+1.4}_{-1.3} \pm 0.6)\times 10^{-6} \quad A_{CP} = (-0.5^{+0.23}_{-0.20} \pm 0.02)$$

← Large?

$$Br(B^0 \to \omega K^0) < 7.6\times 10^{-6}$$

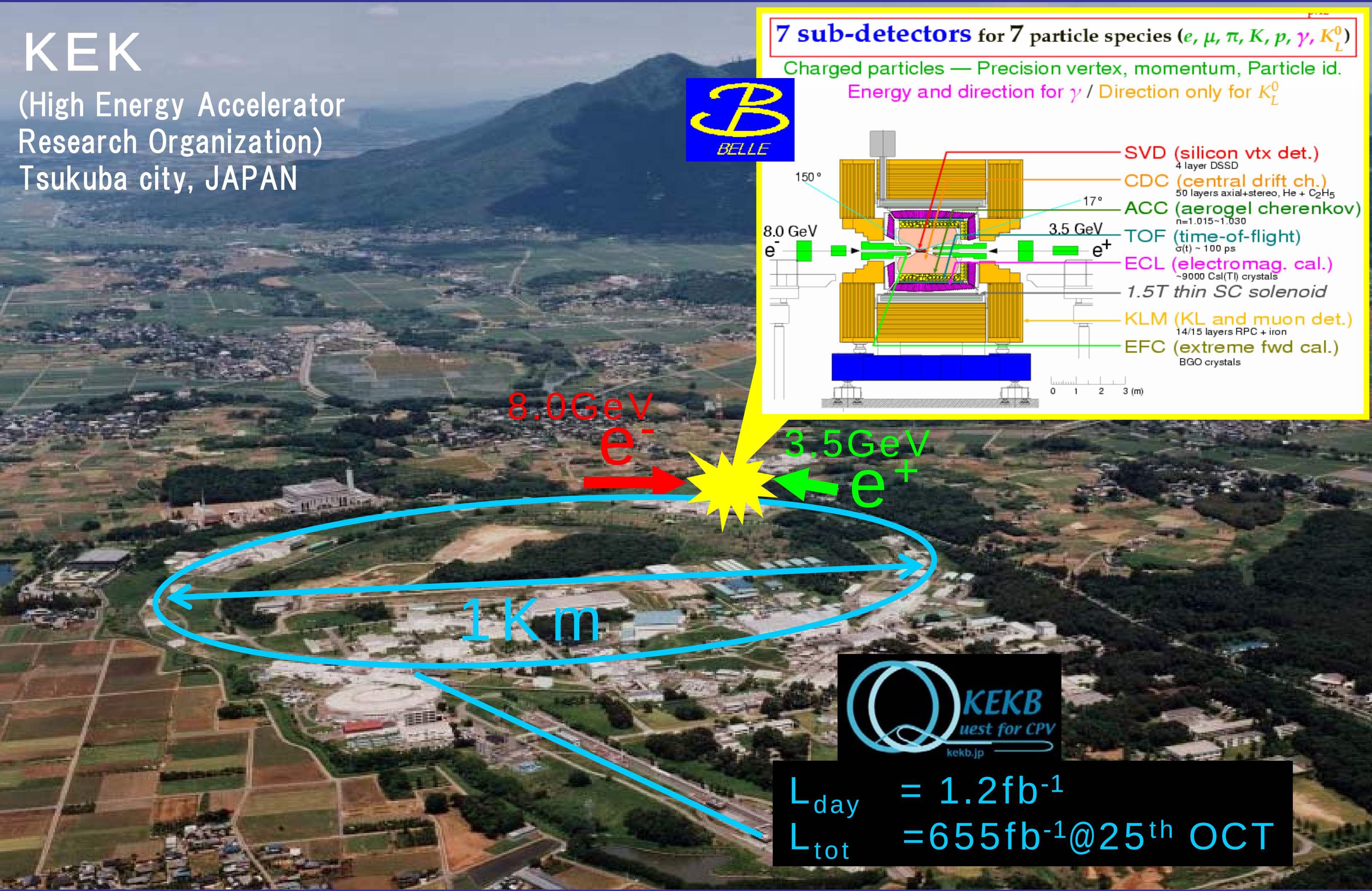
$$Br(B^0 \to \omega \pi^0) < 1.9\times 10^{-6}$$

[Phys.Rev.D70, 012001(2004)]

$$Br(B^\pm \to \phi\phi K^\pm) = (2.6^{+1.1}_{-0.9} \pm 0.3)\times 10^{-6}$$

[Phys. Rev. Lett. 91, 241802 (2003)]

KEKB & Belle Detector

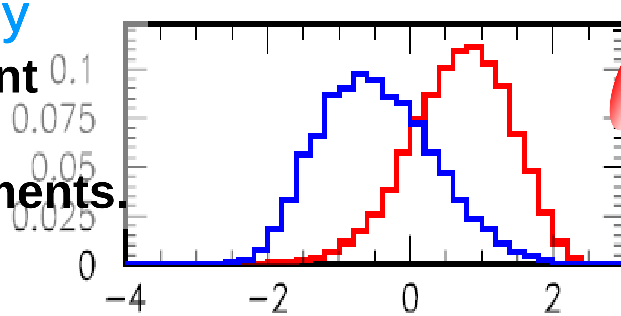


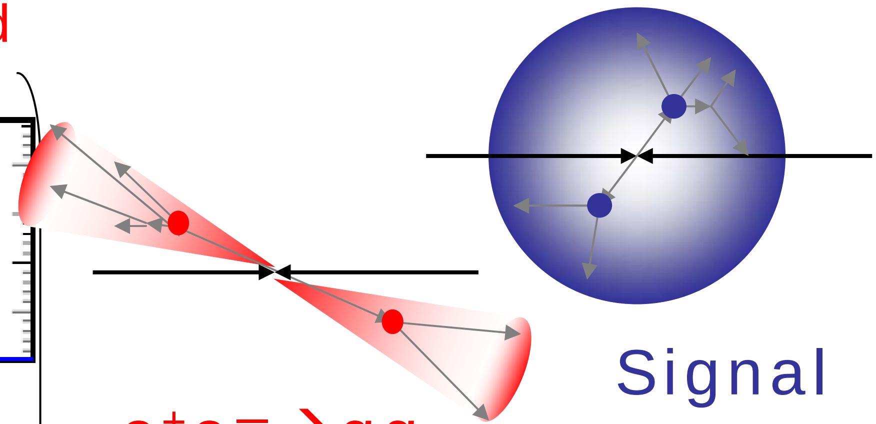
Continuum suppression with Event topology

$e^+e^- \to qq$: dominant background

Event topology

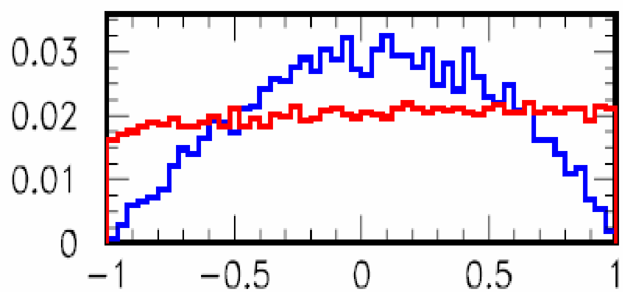
Fisher discriminant from modified Fox-Wolfram moments.





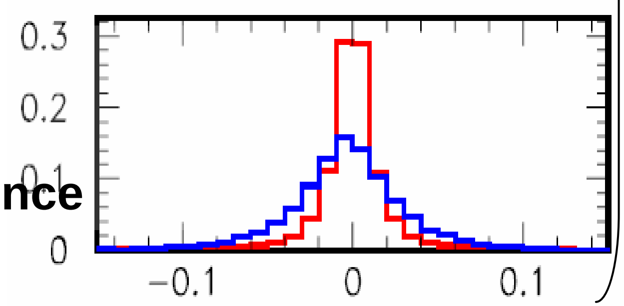
Spin parity conservation

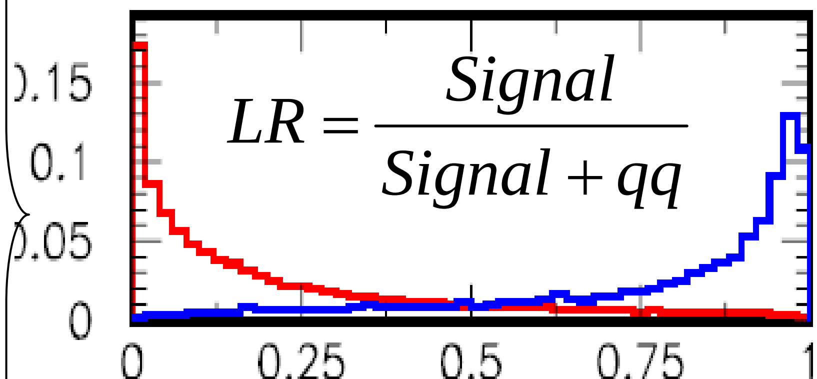
B flight direction, $\cos\theta_B$



Decay time difference

Decay time difference





$$LR = \frac{Signal}{Signal + qq}$$

+

B flavor tagging information

Tag quality parameter

B→ωh

hep-ex/0508052
submitted PRD

Introduction of $B \to \omega h$

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

QCD Factorization (QCDF)
$\to$ B.F. ≒ $10^{-5} \sim 10^{-6}$

Perturbative QCD (PQCD):

$$\to \begin{cases} Br(B^\pm \to \omega K^\pm) = 3.22 \times 10^{-6} \\ Br(B^0 \to \omega K^0) = 2.07 \times 10^{-6} \end{cases}$$

There are theoretical expections.

Nucl.Phys. B675, 333(2003)

Phys.Lett.B 525, 56(2002)

Phys.Rev.D72, 013006(2005)

Eur.Phys.J.C23, 275(2002)

Previous results @ $78fb^{-1}$

$$\begin{cases} Br(B^\pm \to \omega K^\pm) = (6.5^{+1.3}_{-1.2} \pm 0.6) \times 10^{-6} \\ Br(B^\pm \to \omega \pi^\pm) = (5.7^{+1.4}_{-1.3} \pm 0.6) \times 10^{-6} \\ Br(B^0 \to \omega K^0) < 7.6 \times 10^{-6} \\ Br(B^0 \to \omega \pi^0) < 1.9 \times 10^{-6} \end{cases}$$

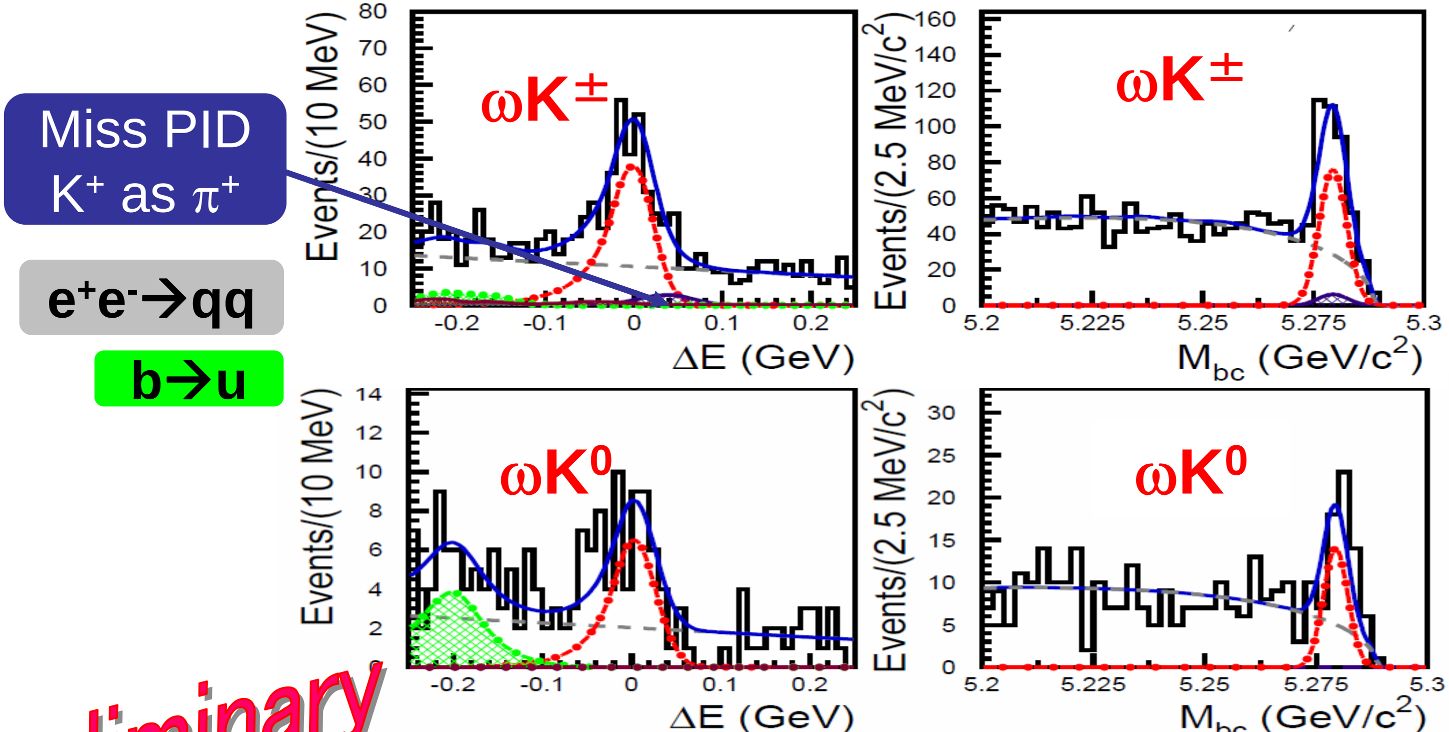
Just upper limit

Update with $350fb^{-1}$

[Phys.Rev.D70, 012001(2004)]

$B \to \omega K$ B.F.($350 fb^{-1}$)

- $B \to \omega K \to (\pi^+ \pi^- \pi^0)K$
- Unbinned maximum Likelihood 2D fit (ΔE, M_{bc})

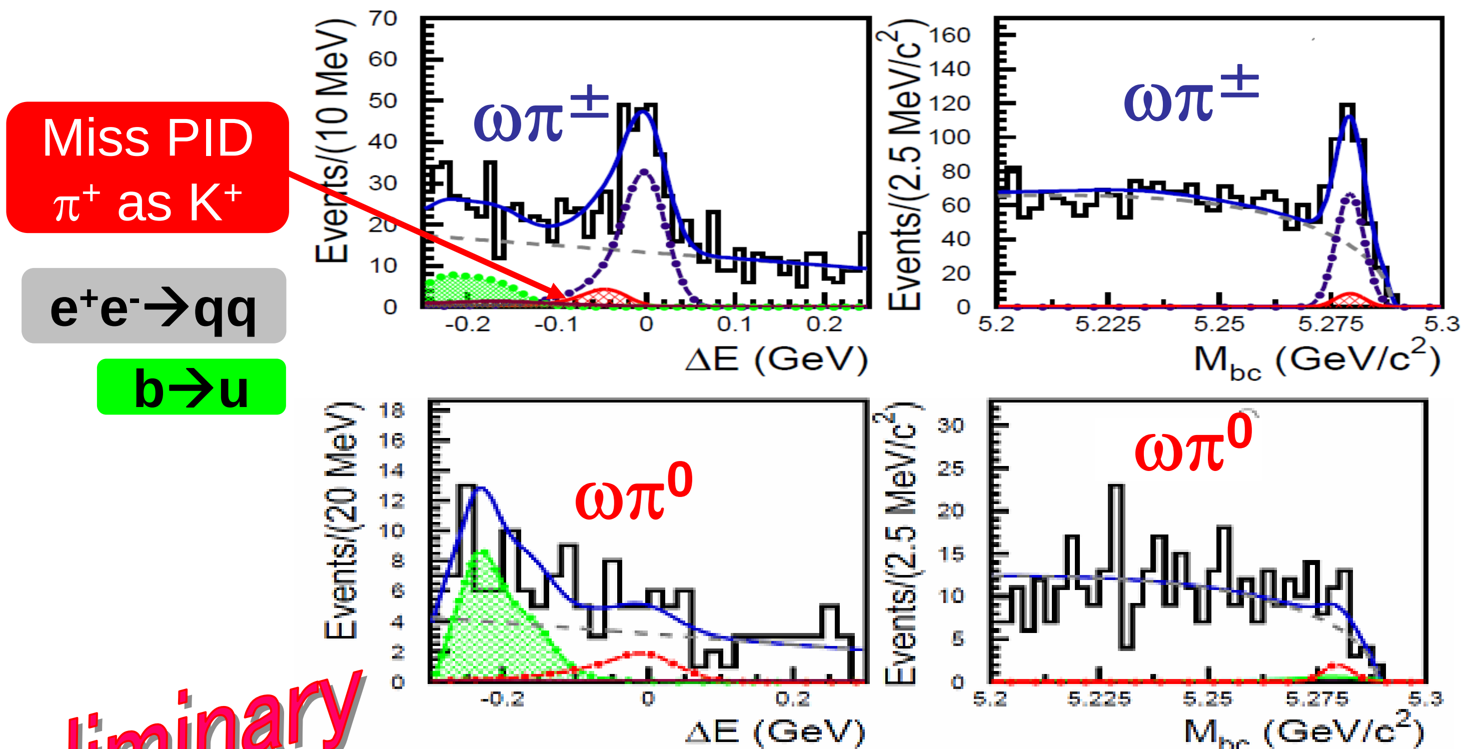


Preliminary

Mode	Yield	B.F.($\times 10^{-6}$)	Sig.
$\omega K^\pm$	$259.5^{+20.4}_{-19.4}$	$8.1 \pm 0.6 \pm 0.5$	19.5σ
ωK^0	$41.5^{+8.0}_{-7.0}$	$4.4^{+0.8}_{-0.7} \pm 0.3$	9.3σ

$B \to \omega\pi$ B.F.($350 fb^{-1}$)

- $B \to \omega\pi \to (\pi^+\pi^-\pi^0)\pi$
- Unbinned maximum likelihood 2D fit (ΔE, M_{bc})



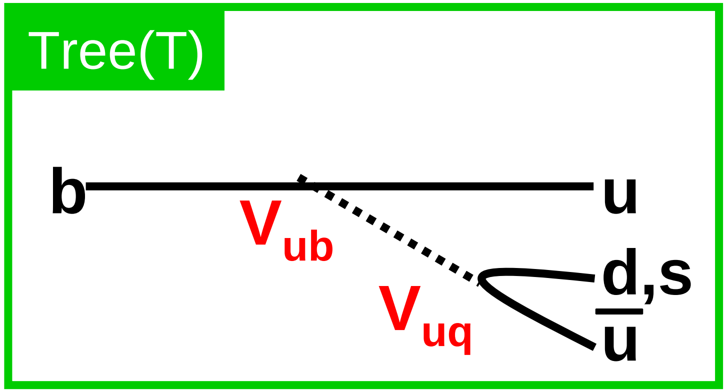
Preliminary

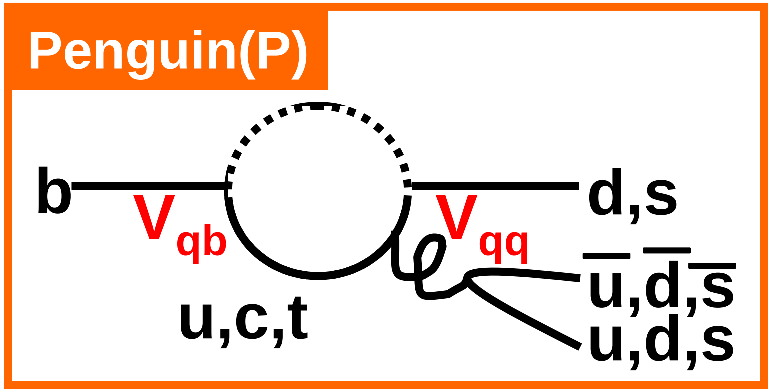
Mode	Yield	B.F.($\times 10^{-6}$)	Sig.
$\omega\pi^+$	$224.8^{+20.3}_{-19.3}$	$7.0 \pm 0.6 \pm 0.5$	17.1σ
$\omega\pi^0$	$5.9^{+4.8}_{-4.1}$	$< 0.9 (U.L.)$	1.5σ

Still upper limit

A_{CP} of $B \rightarrow \omega h$

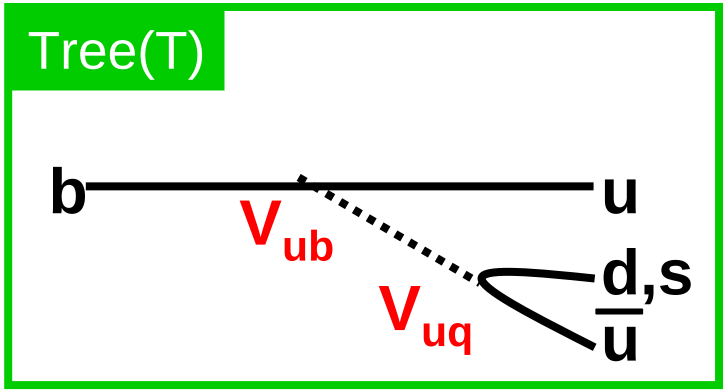
Generally A_{CP} is small in SM

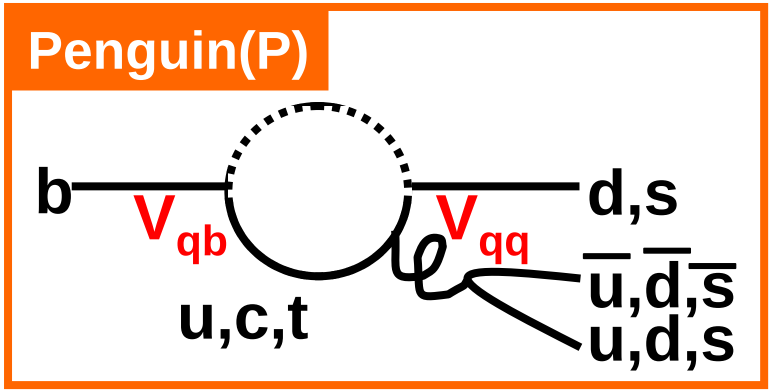


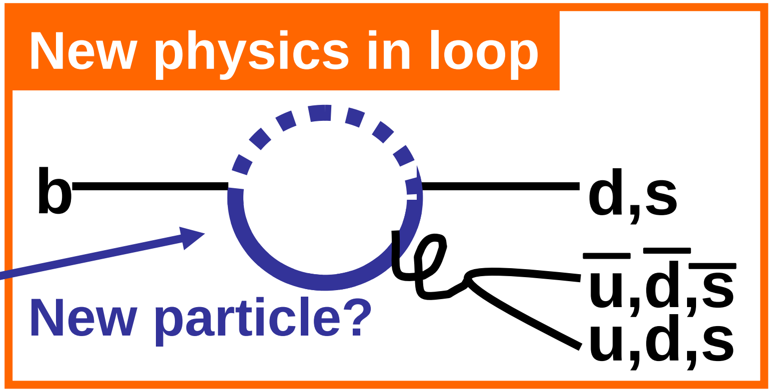


A_{CP} of B→ωh

Generally A_{CP} is small in SM→ sensitive to New Physics.

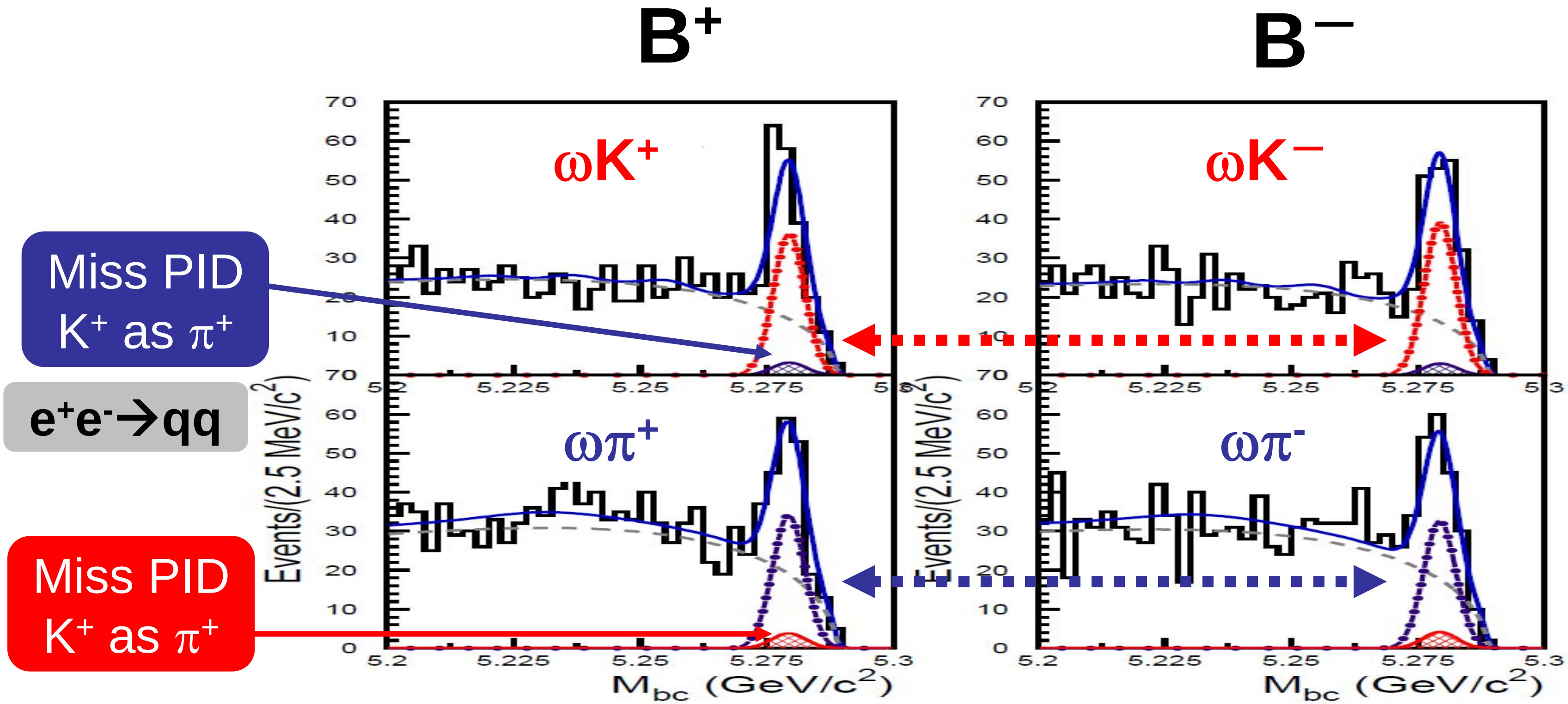






If NP in loop,
A_{CP} can be deviated
from zero.

A_{CP} of $B \to \omega h$ (350fb^{-1})



Preliminary

Mode	A_{CP}
$B^{\pm} \to \omega K^{\pm}$	$0.05 \pm 0.08 \pm 0.01$
$B^{\pm} \to \omega \pi^{\pm}$	$-0.02 \pm 0.09 \pm 0.02$

$$A_{CP} = \frac{\Gamma(\bar{B} \to \bar{f}) - \Gamma(B \to f)}{\Gamma(\bar{B} \to \bar{f}) + \Gamma(B \to f)}$$

Each A_{CP} is consistent with zero.

Summary of B→ωh

@386 M $B\bar{B}$

We update the result for charged modes.

$$\begin{cases} Br(B^{\pm} \to \omega K^{\pm}) = (8.2 \pm 0.6 \pm 0.5) \times 10^{-6}, & A_{CP} = (0.05^{+0.08}_{-0.07} \pm 0.01) \\ Br(B^{\pm} \to \omega \pi^{\pm}) = (7.0 \pm 0.6 \pm 0.5) \times 10^{-6}, & A_{CP} = (-0.02 \pm 0.09 \pm 0.01) \end{cases}$$

We succeed to measure B.F.

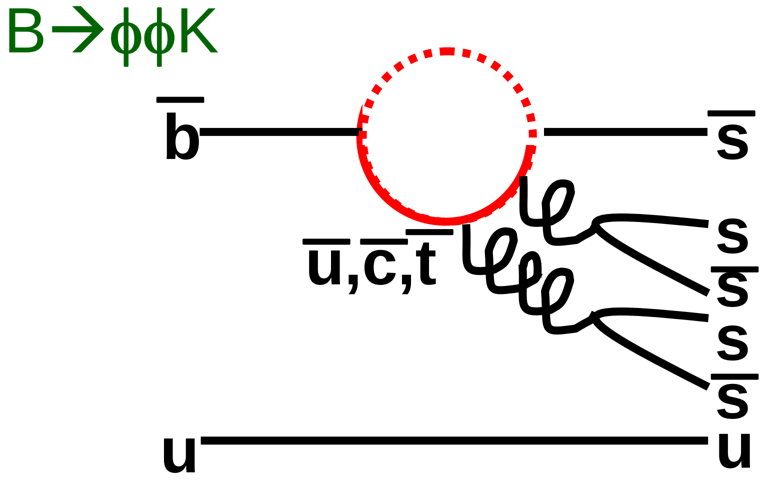
$$Br(B^{0} \to \omega K^{0}) = (4.4^{+0.8}_{-0.7} \pm 0.3) \times 10^{-6}$$

We need more data for this mode.

$$Br(B^{0} \to \omega \pi^{0}) < 0.9 \times 10^{-6} (90\% C.L.)$$

$B \to \phi\phi K$

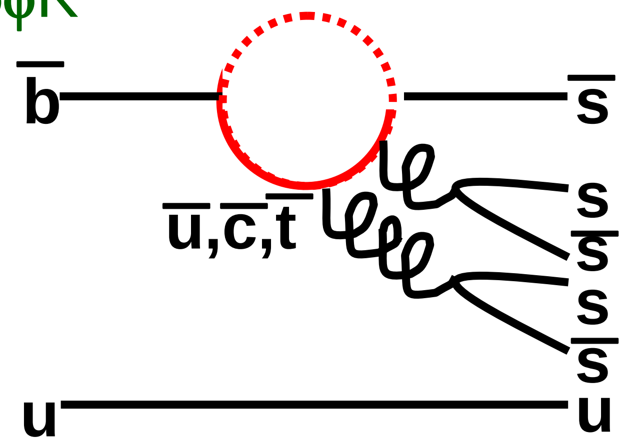
Introduction of B→ϕϕK



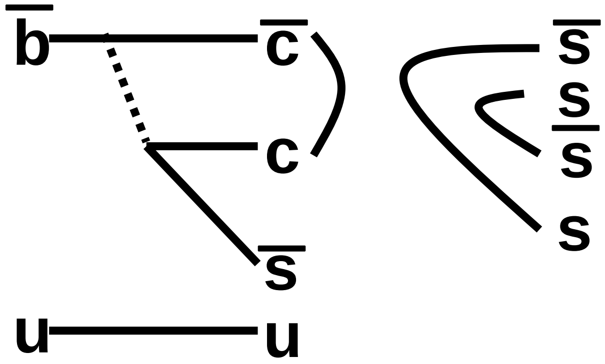
- The first study about b→$s\bar{s}s\bar{s}s$ decay

Introduction of B→φφK

B→φφK



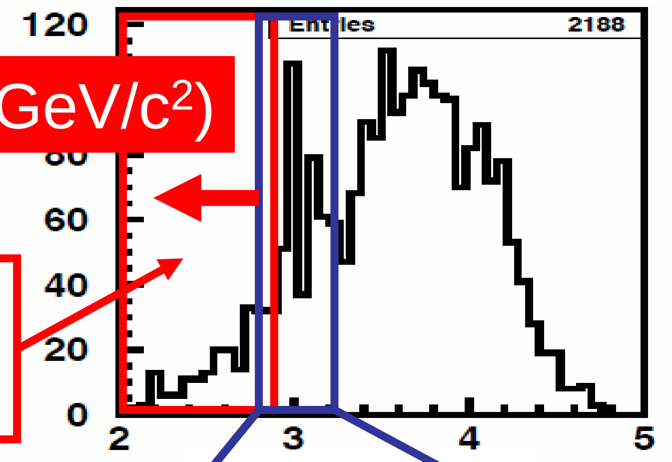
B→η_c(→φφ)K



- The first study about $b \to s\bar{s}s\bar{s}s$ decay
- The same final states through charmonium (η_c) decays

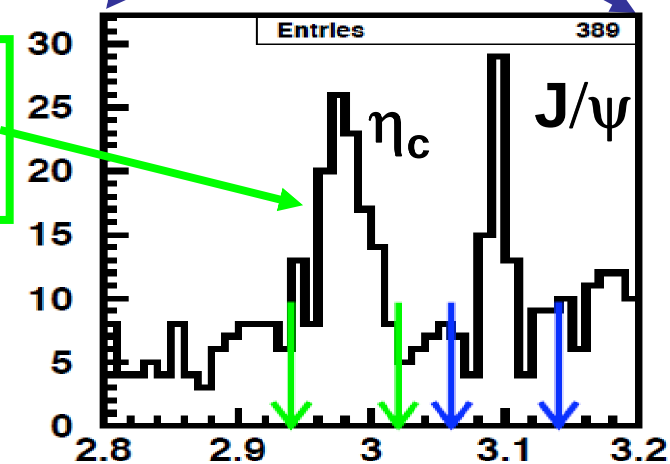
M_{4K} spectrum

M_{4K}<2.85(GeV/c^2)



1.Charmless deacay contributed region:
B→ϕϕK →(KK)(KK)K

2.Charmonium decay contributed region:
B→η_c(→ϕϕ) K →(KK)(KK)K

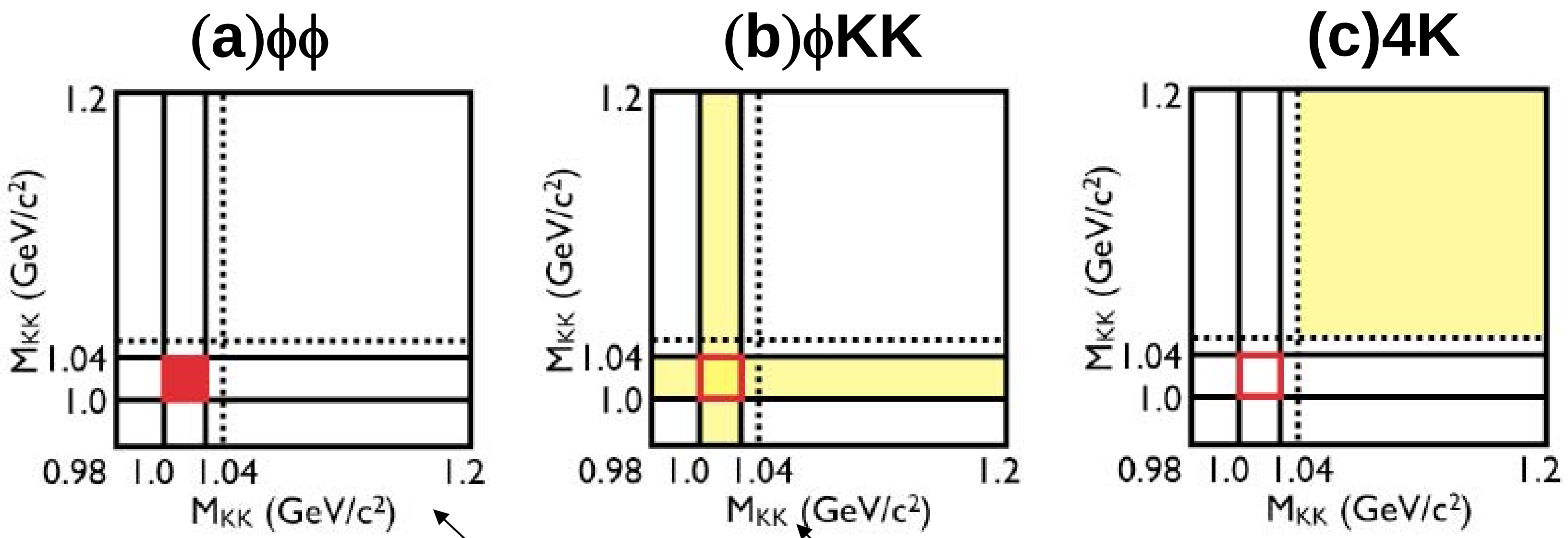


We perform analysis for each region.

1.Background from non-resonant B→ϕ(KK)K/5K

- Non-resonant components:

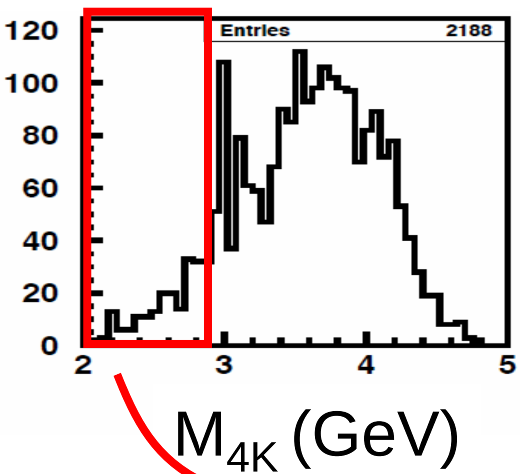
  B→ϕ(KK)K and 5K are subtracted from signal yield.

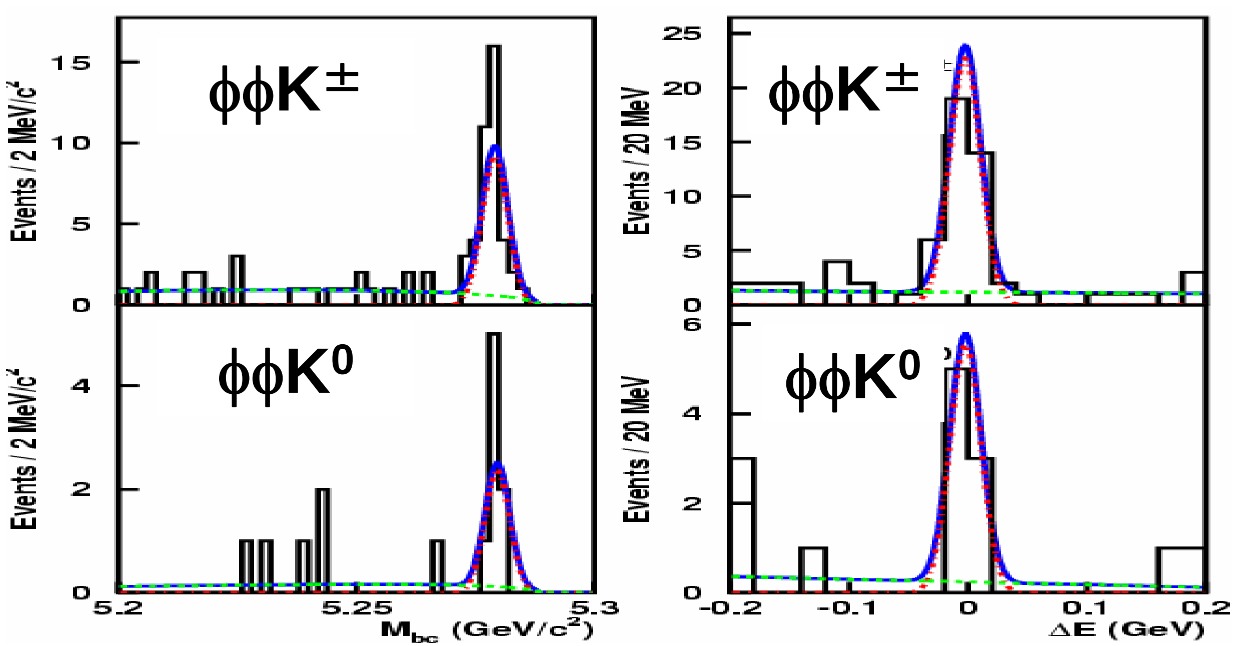


Mode	case (a)	case (b)	case (c)
$B^{\pm} \to K^{\pm}(K^+K^-)(K^+K^-)$	$40.98^{+7.00}_{-6.32}$	$4.37^{+0.81}_{-0.72}$	$1.31^{+0.40}_{-0.35}$
$B^0 \to K^0(K^+K^-)(K^+K^-)$	$7.76^{+3.17}_{-2.51}$	$0.73^{+0.33}_{-0.25}$	$0.22^{+0.17}_{-0.12}$

1.Charmless B→ϕϕK B.F.(441fb^{-1})

- Signal region: M_{4K} < 2.85 MeV/c^2
- Unbinned maximum likelihood 2D fit (M_{bc},ΔE)

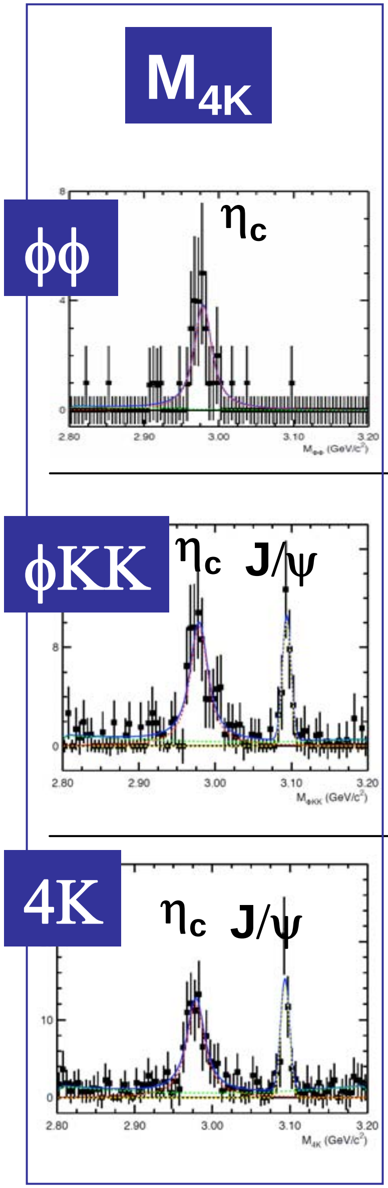




Preliminary

Mode	Yield	B.F.(x10^{-6})	Sig.
ϕϕK±	$34.2^{+6.37}_{-5.77}$	$3.18^{+0.6}_{-0.52} \pm 0.27$	9.5σ
ϕϕK0	$7.27^{+3.04}_{-2.44}$	$2.31^{+1.00}_{-0.74} \pm 0.24$	4.7σ

2. Charmoinum B→$\phi\phi$K B.F.(441fb^{-1})

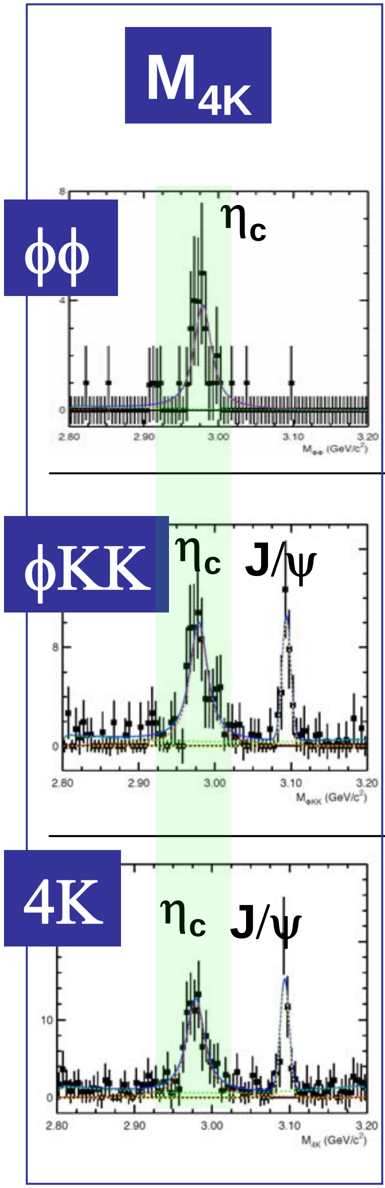


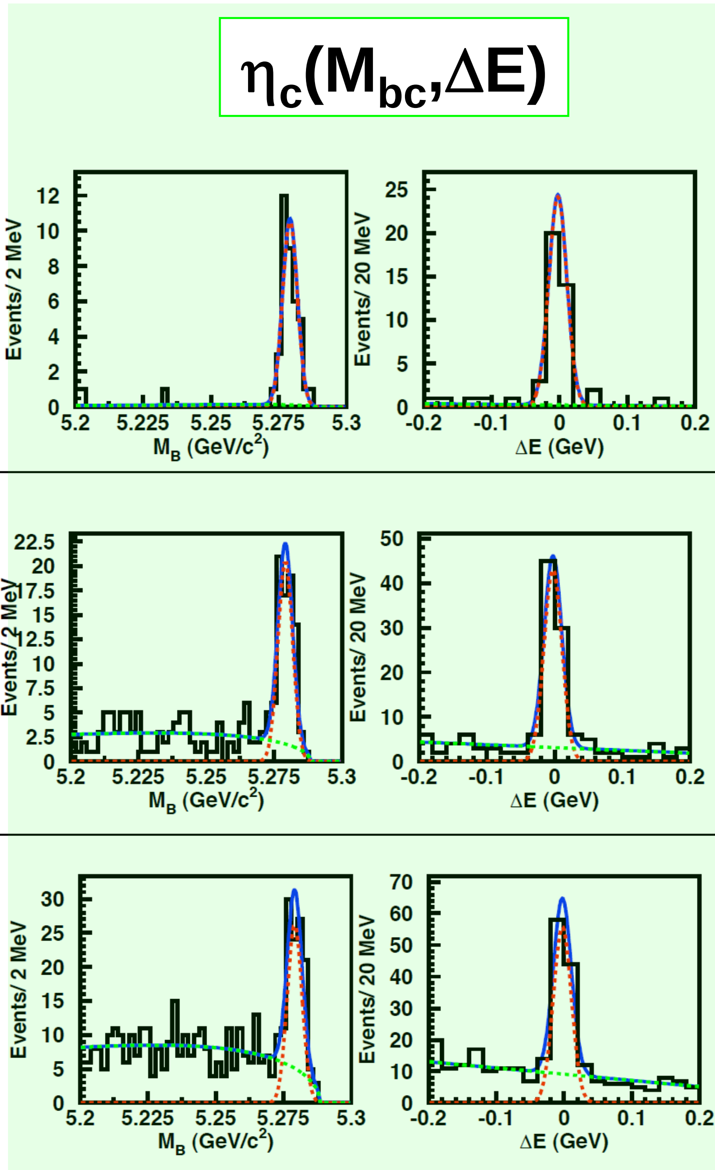
Select charmonium signal candidates in M_{4K} spectrum.

⬇

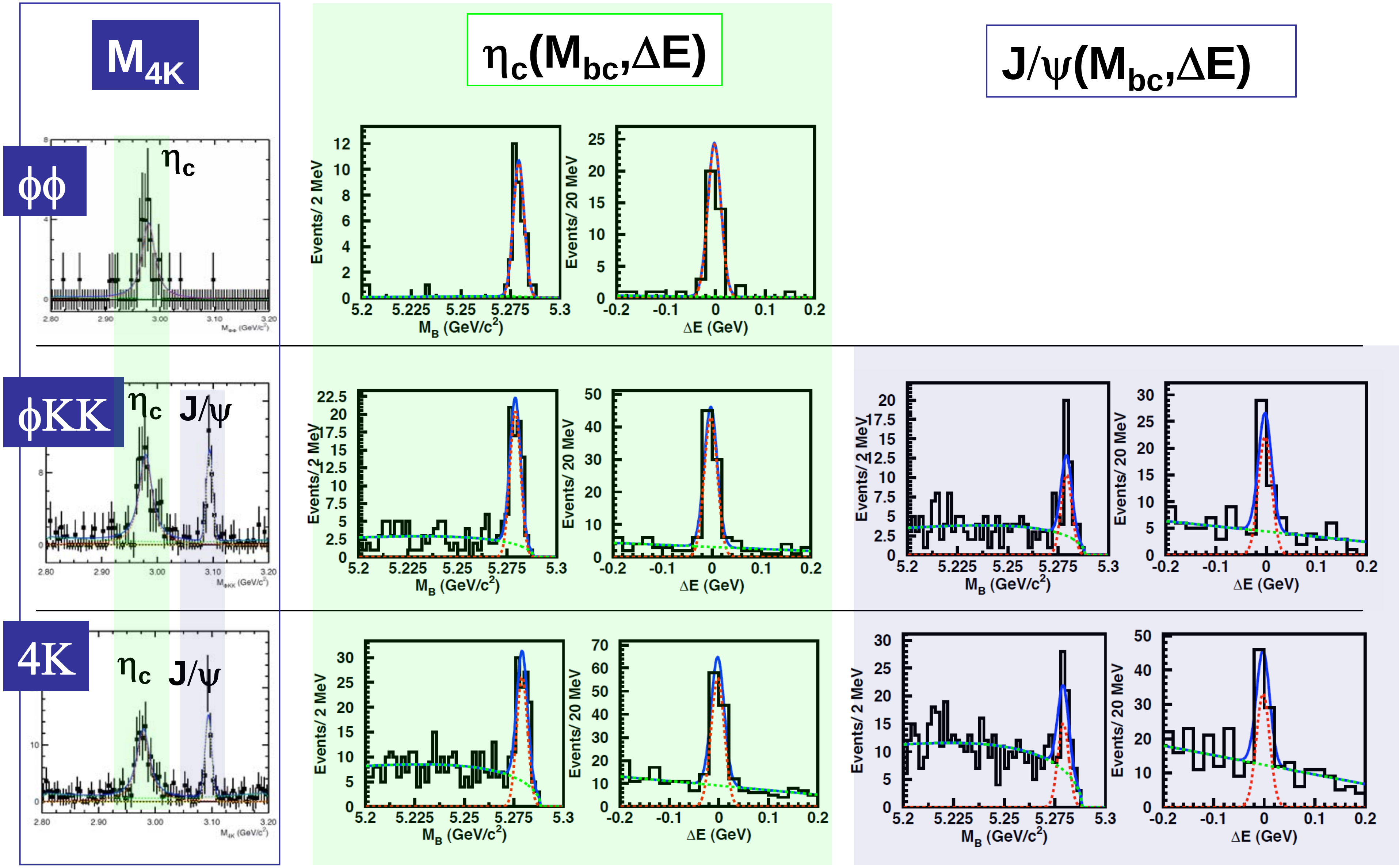
Reconstruct B meson from charmonium and kaon.

2. Charmonium B→$\phi\phi K$ B.F.(441fb^{-1})





2. Charmoinum B→ϕϕK B.F.(441fb^{-1})

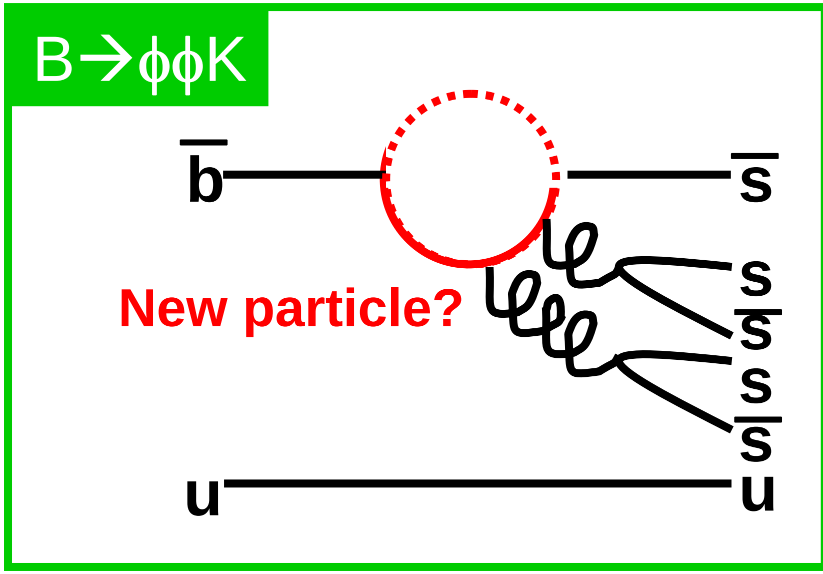


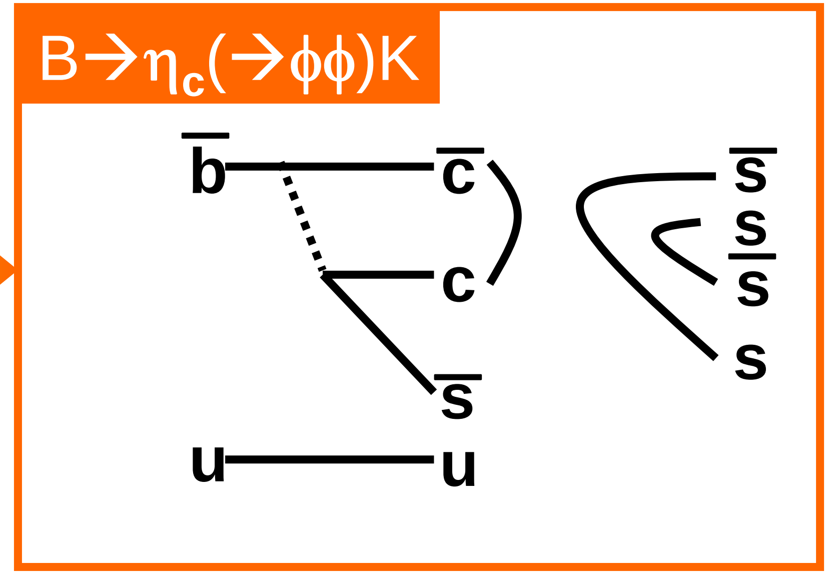
2. Charmonium $B \to \phi\phi K$ B.F.($441 fb^{-1}$)

Preliminary

Mode	Yield	Efficiency (%)	$\mathcal{B}(\times 10^{-6})$
$B^{\pm} \to \eta_c K^{\pm}, \eta_c \to \phi\phi$	$29.75^{+6.80}_{-5.49}$	2.72 ± 0.01	$2.44^{+0.56}_{-0.45} \pm 0.19$
$B^{\pm} \to \eta_c K^{\pm}, \eta_c \to \phi K^+ K^-$	$76.76^{+13.55}_{-12.44}$	4.85 ± 0.02	$3.54^{+0.62}_{-0.57} \pm 0.29$
$B^{\pm} \to \eta_c K^{\pm}, \eta_c \to 2(K^+ K^-)$	$104.60^{+20.20}_{-17.25}$	9.93 ± 0.05	$2.35^{+0.45}_{-0.39} \pm 0.19$
$B^{\pm} \to J/\psi K^{\pm}, J/\psi \to \phi K^+ K^-$	$25.55^{+7.02}_{-5.96}$	4.67 ± 0.02	$1.22^{+0.34}_{-0.29} \pm 0.11$
$B^{\pm} \to J/\psi K^{\pm}, J/\psi \to 2(K^+ K^-)$	$40.97^{+7.26}_{-6.59}$	9.41 ± 0.05	$0.97^{+0.17}_{-0.16} \pm 0.09$

B → φφK as a probe for new physics





Interference between two decay diagram

- **SM**: No weak phase difference ➔A_{CP}∼0
- **non-SM**: New physics can create large CP phase difference
  ➔A_{CP} ∼ 0.4 at most

[M.Hazumi,Phys. Lett. B583. 285. (2004)]

A_{CP} B→ ϕϕK and B→η_c(→ϕϕ) K interference

Preliminary

$$A_{CP} = \frac{\Gamma(\bar{B} \to \bar{f}) - \Gamma(B \to f)}{\Gamma(\bar{B} \to \bar{f}) + \Gamma(B \to f)}$$

$$= (0.01^{+0.19}_{-0.16} \pm 0.02)$$

- A_{CP} is consistent with zero

Summary

Preliminary

Update of B→ωh B.F. and A_{CP} (with 350fb^{-1} data)

hep-ex/0508052
Submitted PRD

$$\begin{cases} Br(B^\pm \to \omega K^\pm) = (8.2 \pm 0.6 \pm 0.5)\times 10^{-6} & , A_{CP} = (0.05^{+0.08}_{-0.07} \pm 0.01) \\ Br(B^\pm \to \omega \pi^\pm) = (7.0 \pm 0.6 \pm 0.5)\times 10^{-6} & , A_{CP} = (-0.02 \pm 0.09 \pm 0.01) \end{cases}$$

$$\begin{cases} Br(B^0 \to \omega K^0) = (4.4^{+0.8}_{-0.7} \pm 0.3)\times 10^{-6} \\ Br(B^0 \to \omega \pi^0) < 0.9\times 10^{-6} (90\% C.L.) \end{cases}$$

Update of B→φφK B.F. and A_{CP} (with 414fb^{-1} data)

Non-resonant components are taken in account.

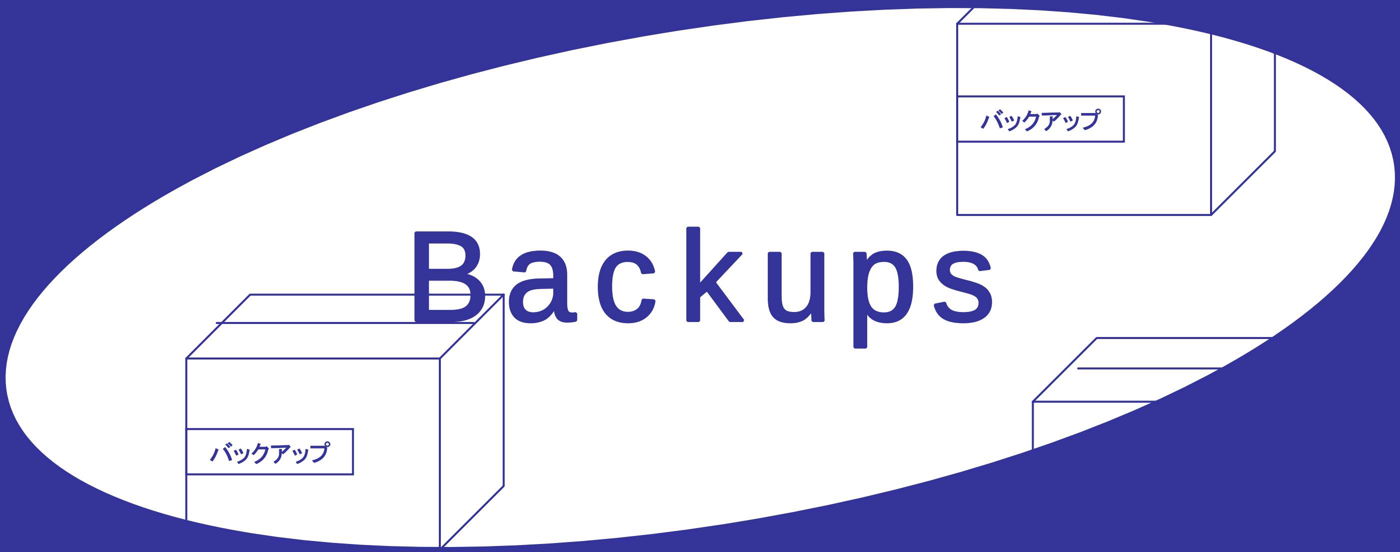
$$\begin{cases} Br(B^\pm \to \phi\phi K^\pm) = (3.18^{+0.60}_{-0.52} \pm 0.27)\times 10^{-6} \\ Br(B^0 \to \phi\phi K^0) = (2.31^{+1.00}_{-0.74} \pm 0.24)\times 10^{-6} \end{cases}$$

←first observation

B→φφK mode can be one of probe beyond SM.

$$A_{CP}(B^+ \to \eta_c(\to \phi\phi)K^+) = (0.01^{+0.19}_{-0.16} \pm 0.02)$$

Backups



Update results for B→φφK (441fb⁻¹)

1.Charmless B.F:

B→φφK →(KK)(KK)K

M_{4K}<2.85(GeV/c)

2.The related charmoniums B.Fs:

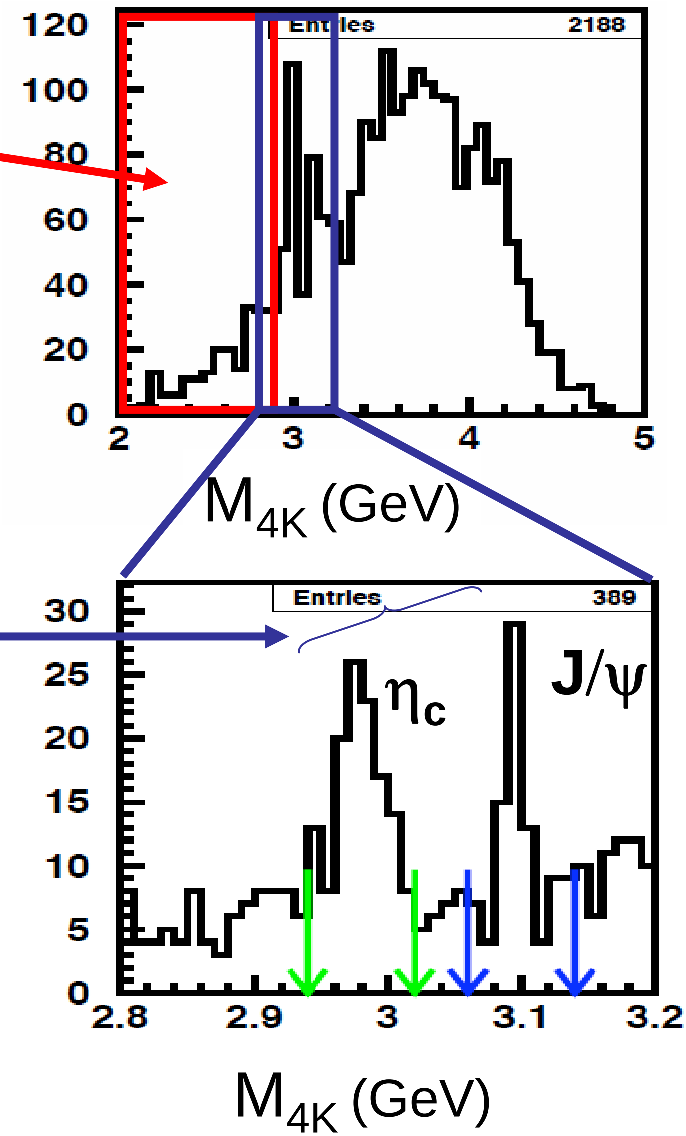
B→η_c(→φφ) K →(KK)(KK)K

In addition,

Non-resonant for η_c and J/ψ:

- B→η_cK→(φKK)K
- B→η_cK→(KKKK)K

- B→J/ψK→(φKK)K
- B→J/ψK→(KKKK)K



B reconstruction

1.Daughter particle Reconstruction

- $\pi^{\pm}$, $K^{\pm}$: tracking, particle ID (Aerogel Cherenkov+TOF+dE/dx)
- $K^0_s \rightarrow \pi^+\pi^-$: displaced vertex
- $\pi^0 \rightarrow \gamma\gamma$: CsI calorimeter

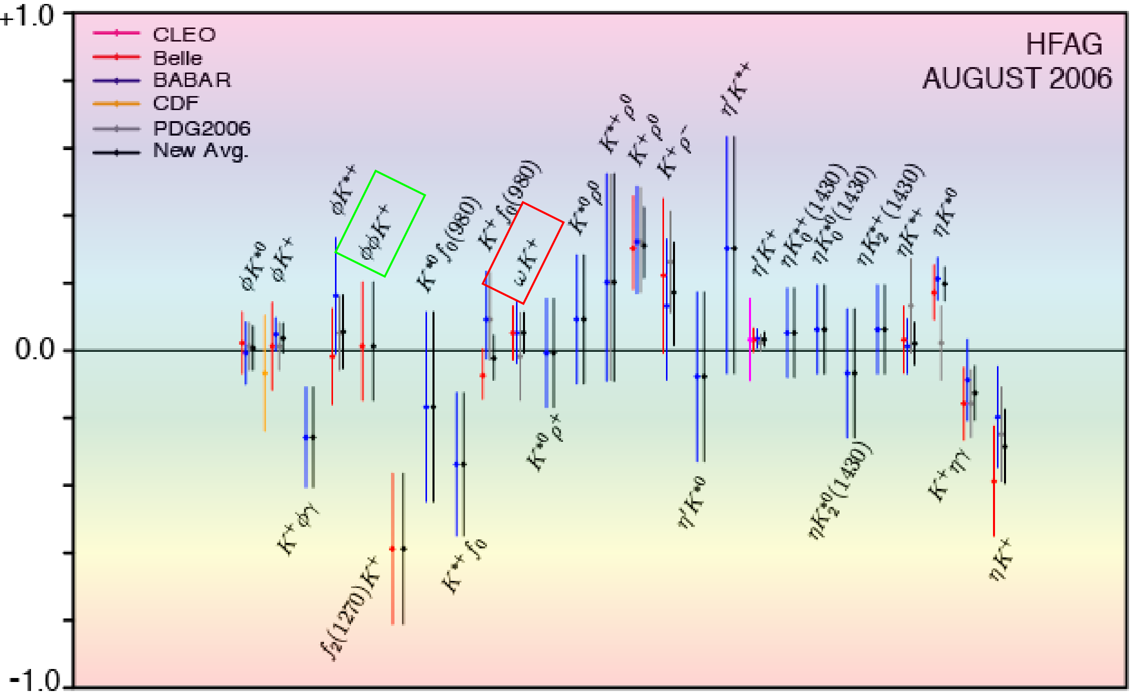
2. B Reconstruction

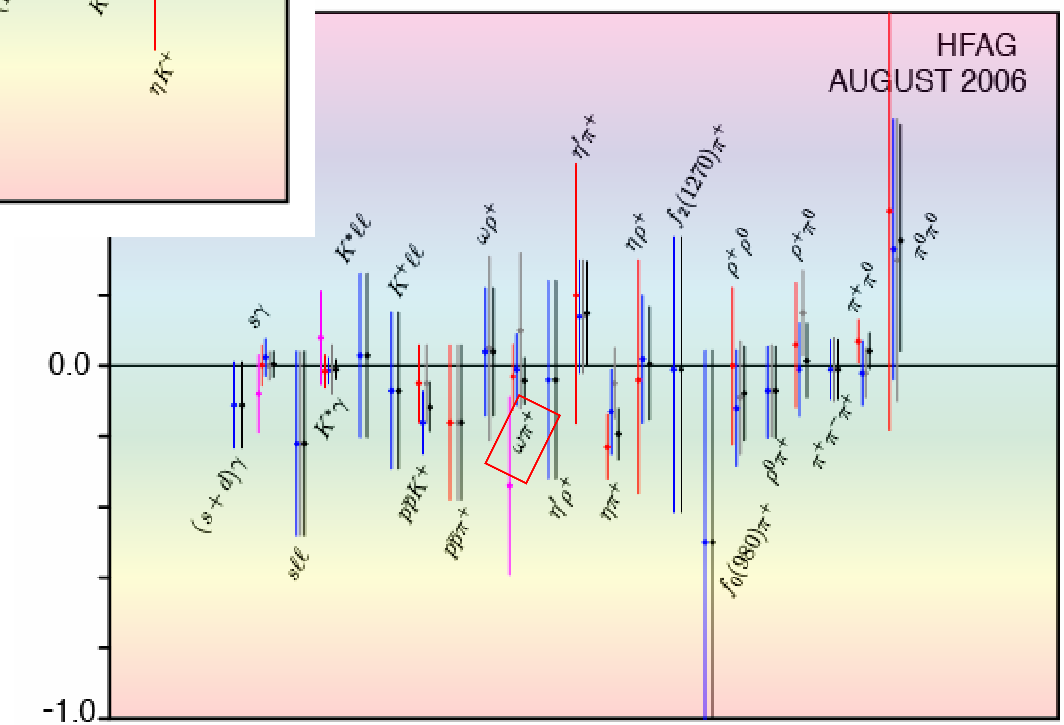
Two Independent kinematical variables

$$M_{bc} = \sqrt{E_{beam}^2 - \left|\vec{P}_{recon}\right|^2}$$

$$\Delta E = E_{recon} - E_{beam}$$

A_{CP} , HFAG


+1.0
0.0
-1.0
CLEO
Belle
BABAR
CDF
PDG2006
New Avg.
HFAG
AUGUST 2006

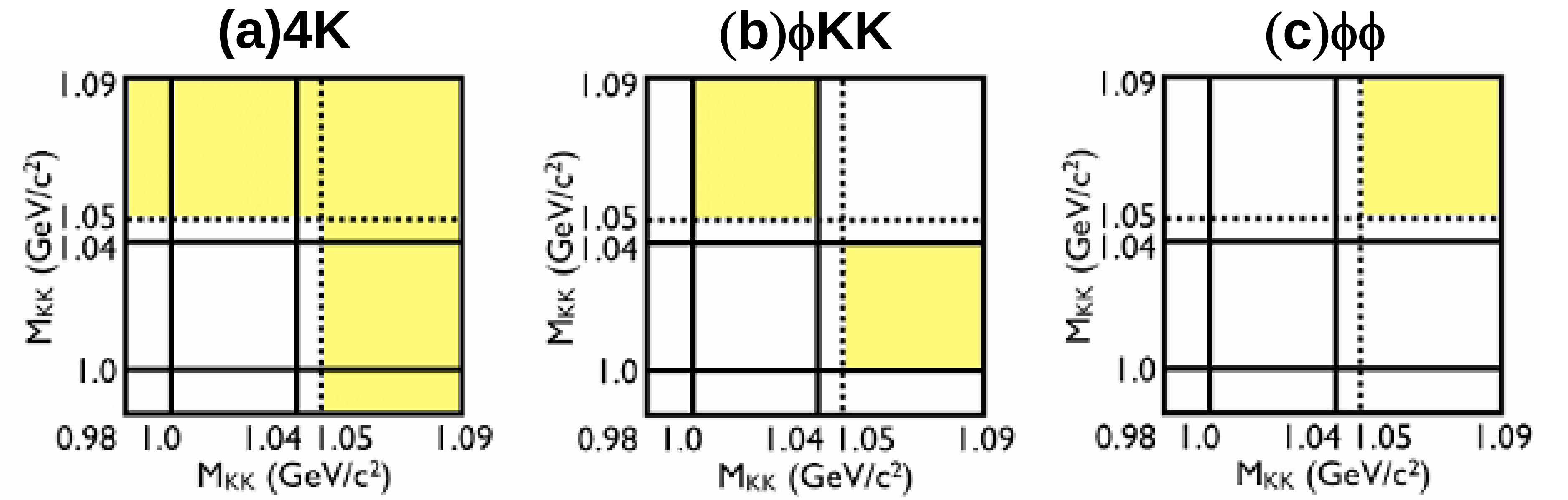

0.0
-1.0
HFAG
AUGUST 2006

HFAG.B.F

Mode	PDG2006 Avg.	BABAR	Belle	CLEO	CDF	New Avg.
$\phi\phi K^0$ §	New	$4.1^{+1.7}_{-1.4} \pm 0.5$	$2.3^{+1.0}_{-0.7} \pm 0.2$			$2.8^{+0.9}_{-0.7}$
ωK^+	5.1 ± 0.7	$6.1 \pm 0.6 \pm 0.4$	$8.1 \pm 0.6 \pm 0.5$	$3.2^{+2.4}_{-1.9} \pm 0.8$		6.9 ± 0.5
$\omega\pi^+$	5.9 ± 1.0	$6.1 \pm 0.7 \pm 0.4$	$7.0 \pm 0.6 \pm 0.5$	$11.3^{+3.3}_{-2.9} \pm 1.4$		6.7 ± 0.6
ωK^0	$5.5^{+1.2}_{-1.0}$	$6.2 \pm 1.0 \pm 0.4$	$3.9 \pm 0.7 \pm 0.4$	$10.0^{+5.4}_{-4.2} \pm 1.4$		4.8 ± 0.6
$\omega\pi^0$	< 1.2	< 1.2	< 1.5	< 5.5		< 1.2

$B \to \eta_c(\to \phi\phi)K$, Purifying signals

- Non-resonant components:
  $B \to \eta_c(KK)K$, 5K or $B \to J/\psi(KK)K$, 5K
  are subtracted from signal yield.



	η_c mass region	J/ψ mass region
(a)	$13.56^{+4.34}_{-3.67}$	$4.74^{+3.00}_{-2.29}$
(b)	$2.96^{+2.08}_{-1.42}$	-
(c)	$7.15^{+3.20}_{-2.52}$	$1.29^{+1.93}_{-1.15}$

B→ϕϕK (441fb-1), Systematic errors

Table 8: Summary table of systematic errors of $B \to \phi\phi K$ analysis.

Mode	Tracking	PID	$\mathcal{LR}$ cut	Fitting	K_S^0	ϵ_{eff}	$N_{B\bar{B}}$	Total
$B^\pm \to \phi\phi K^\pm$								
SVD I	5%	5%	2.7%	0.3%	-	1.6%	0.8%	7.8%
SVD II	5%	5%	2.7%	0.3%	-	1.4%	1.5%	7.8%
$B^0 \to \phi\phi K^0$								
SVD I	4%	4%	2.7%	0.2%	4.9%	2.1%	0.8%	8.3%
SVD II	4%	4%	2.8%	0.1%	4.9%	1.9%	1.5%	8.3%

Summary of B→ωh

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Phys.Lett.B 525, 56(2002)

Eur.Phys.J.C23, 275(2002)

Mode	Feynman diagram			
	T_u	C_u	P_s	P_d
$B \to \omega K^+$	○	○	○	-
$B \to \omega K^0$	-	-	○	-
$B \to \omega \pi^+$	○	○	-	○
$B \to \omega \pi^0$	-	○	-	○

- **T_u**: b→u Tree color allowed
- **C_u**: b→u Tree color suppressed
- **P_s**: b→s Penguin
- **P_d**: b→d Penguin

$B \to \omega \pi^+$, **$B \to \omega K^+$** → QCD Factorization (QCDF)→B.F. ≒10^{-5}～10^{-6}

$B \to \omega K^+$, **$B \to \omega K^0$** → Perturbative QCD (PQCD):

$$\to \begin{cases} Br(B^\pm \to \omega K^\pm) = 3.22 \times 10^{-6} \\ Br(B^0 \to \omega K^0) = 2.07 \times 10^{-6} \end{cases}$$

$B \to \omega \pi^0$ No T_u and P_s → small B.F.

And small A_{CP} between B^+ and B^-.

Summary of B→ωh

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Mode	Feynman diagram			
	T_u	C_u	P_s	P_d
B→ωK⁺	○	○	○	-
$B\to\omega K^0$	-	-	○	-
$B\to\omega\pi^+$	○	○	-	○
$B\to\omega\pi^0$	-	○	-	○

- **T_u**: b→u Tree color allowed
- **C_u**: b→u Tree color suppressed
- **P_s**: b→s Penguin
- **P_d**: b→d Penguin

$B\to\omega\pi^+$ $(7.0\pm0.6\pm0.5)\times10^{-6}$

$B\to\omega K^+$ $(8.2\pm0.6\pm0.5)\times10^{-6}$

$B\to\omega K^0$ $(4.4^{+0.8}_{-0.7}\pm0.3)\times10^{-6}$

QCD Factorization (QCDF) (for $B\to\omega\pi^+$, $B\to\omega K^+$)

→B.F. ≒10^{-5}～10^{-6}

Perturbative QCD (PQCD): (for $B\to\omega K^+$, $B\to\omega K^0$)

$$\rightarrow \begin{cases} Br(B^\pm \to \omega K^\pm) = 3.22\times10^{-6} \\ Br(B^0 \to \omega K^0) = 2.07\times10^{-6} \end{cases}$$

$B\to\omega\pi^0$ $< 0.9\times10^{-6}(90\% C.L.)$ } No T_u and P_s → small B.F.

And small A_{CP} between B^+ and B^-.

B→ωh /Summary

TABLE XVII: Signal yields(N_s), efficiencies(ϵ), efficiencies with secondary decay branching fractions and PID efficiencies ($\epsilon_{sig} \times \epsilon_{PID} \times \mathcal{B}_s$), fitting significance($\Sigma$), branching fractions($\mathcal{B}_r$), the 90% confidence level upper limits (UL) on the branching fractions for $\omega\pi^0$, and $\mathcal{A}_{CP}$.

Mode	N_s	$\epsilon_{svd1}(\%)$	$\epsilon_{PID}(\%)$	$\epsilon_{svd2}(\%)$	$\epsilon_{PID}(\%)$	Σ	$\mathcal{B}_r$ $(\times 10^{-6})$	UL$(\times 10^{-6})$	$\mathcal{A}_{CP}$
$\omega K^\pm$	$259.5^{+20.4}_{-19.4}$	10.2 ± 0.15	8.7 ± 0.13	10.0 ± 0.15	8.0 ± 0.12	19.5σ	$8.1 \pm 0.6 \pm 0.5$	–	$0.05^{+0.08}_{-0.07} \pm 0.01$
$\omega\pi^\pm$	$224.8^{+20.3}_{-19.3}$	11.1 ± 0.15	9.1 ± 0.12	10.4 ± 0.15	8.0 ± 0.12	17.1σ	$7.0 \pm 0.6 \pm 0.5$	–	$-0.02 \pm 0.09 \pm 0.01$
ωK^0	$41.5^{+8.0}_{-7.0}$	3.0 ± 0.08	2.7 ± 0.07	3.1 ± 0.08	2.4 ± 0.06	9.3σ	$4.4^{+0.8}_{-0.7} \pm 0.3$	–	–
$\omega\pi^0$	$5.9^{+4.8}_{-4.1}$	5.3 ± 0.11	4.6 ± 0.09	4.1 ± 0.1	3.3 ± 0.08	1.5σ	–	< 0.9	–

B→ωh /B.F. Summary

TABLE I: Summary of branching fraction results for B decays to ω mesons from CLEO [12], previous Belle measurements [6] [13], BaBar [14] [8] and the present analysis. The results for all fits are given as well as a 90 % confidence level upper limit if the measured yields are not judged to be significant. The signal yields and efficiencies (ϵ) are also given.

Expt.	# $B\bar{B}$ ($\times 10^6$)	Fit $\mathcal{B}$ ($\times 10^{-6}$)	UL $\mathcal{B}$ ($\times 10^{-6}$)	signif. (σ)	single yields	ϵ (%)
$B^+ \to \omega K^\pm$						
CLEO	10	$3.2^{+2.4}_{-1.9} \pm 0.8$	7.9	2.1	$7.9^{+6.0}_{-4.7}$	26.0
Belle	32	$9.2^{+2.6}_{-2.3} \pm 1.0$	–	6.0	$18.9^{+5.4}_{-4.7}$	6.0
Belle	80	$6.5^{+1.3}_{-1.2} \pm 0.6$	–	7.8	$44.6^{+9.1}_{-8.3}$	8.1
BABAR	89	$5.0 \pm 1.0 \pm 0.4$	–	8.9	87.0 ± 15	18.0
This result	386	$8.2 \pm 0.6 \pm 0.5$	–	19.5	$259.5^{+20.4}_{-19.4}$	8.3 ± 0.2
$B^+ \to \omega \pi^\pm$						
CLEO	10	$11.3^{+3.3}_{-2.9} \pm 0.8$	–	6.2	$28.5^{+8.2}_{-7.3}$	6.2
Belle	32	$4.2^{+2.0}_{-1.8} \pm 0.5$	8.1	3.3	$10.4^{+4.7}_{-4.3}$	7.7
Belle	80	$5.7^{+1.4}_{-1.3} \pm 0.6$	–	6.0	$42.1^{+10.1}_{-9.3}$	8.7
BABAR	89	$5.4 \pm 1.0 \pm 0.5$	–	8.4	101 ± 18	19.0
This result	386	$7.0 \pm 0.6 \pm 0.5$	–	17.1	$224.8^{+20.3}_{-19.3}$	8.4 ± 0.2
$B^0 \to \omega K^0_S$						
CLEO	10	$10.0^{+5.4}_{-4.2} \pm 1.4$	21.0	3.9	$7.0^{+3.0}_{-2.9}$	7.4
Belle	32	–	–	–	–	–
Belle	80	$4.0^{+1.9}_{-1.6} \pm 0.5$	7.6	3.3	$11.1^{+5.2}_{-4.4}$	3.3
BABAR	232	$5.9 \pm 1.0 \pm 0.4$	–	8.6	96.0 ± 14	6.5
This result	386	$4.4^{+0.8}_{-0.7} \pm 0.3$	–	9.3	$41.5^{+8.0}_{-7.0}$	2.5 ± 0.1
$B^0 \to \omega \pi^0$						
CLEO	10	–	–	–	–	–
Belle	32	–	–	–	–	–
Belle	80	–	1.9	–	$0.0^{+2.1}_{-0.0}$	–
BABAR	89	$-0.6^{+0.7}_{-0.5} \pm 0.2$	1.2	–	-9.0 ± 8.0	6.5
This result	386	$0.5^{+0.4}_{-0.3} \pm 0.1$	0.9	1.5	$5.9^{+4.8}_{-4.1}$	3.8 ± 0.1

01

B→ωh ,systematic errors

TABLE XVIII: Summary table of the total systematic errors combined Set I with Set II for the $B^{\pm}/B^0 \to \omega h^{\pm}/\omega h^0$ decays.

Mode	PDF_fitting	detection bias	$\omega K^{\pm} \leftrightarrow \omega\pi^{\pm}$	reconstruction	Sum
$\Delta B_r(\omega K^{\pm})$	$^{+0.16}_{-0.03}$	–	$^{+0.04}_{-0.03}$	± 0.51	$^{+0.54}_{-0.51}$
$\Delta B_r(\omega \pi^{\pm})$	$^{+0.14}_{-0.04}$	–	$^{+0.01}_{-0.03}$	± 0.43	$^{+0.45}_{-0.43}$
$\Delta B_r(\omega K^0_S)$	$^{+0.06}_{-0.03}$	–	–	± 0.29	$^{+0.30}_{-0.29}$
$\Delta B_r(\omega \pi^0)$	± 0.03	–	–	± 0.04	± 0.05
$\Delta A_{cp}(\omega K^{\pm})$	$^{+0.005}_{+0.003}$	-0.005	$^{+0.001}_{+0.0003}$	–	$^{+0.006}_{-0.005}$
$\Delta A_{cp}(\omega \pi^{\pm})$	$^{+0.01}_{+0.006}$	-0.002	± 0.004	–	$^{+0.012}_{-0.005}$