Korean Belle Data Grid and Analysis of $B \to \phi\pi$ decays in Belle.

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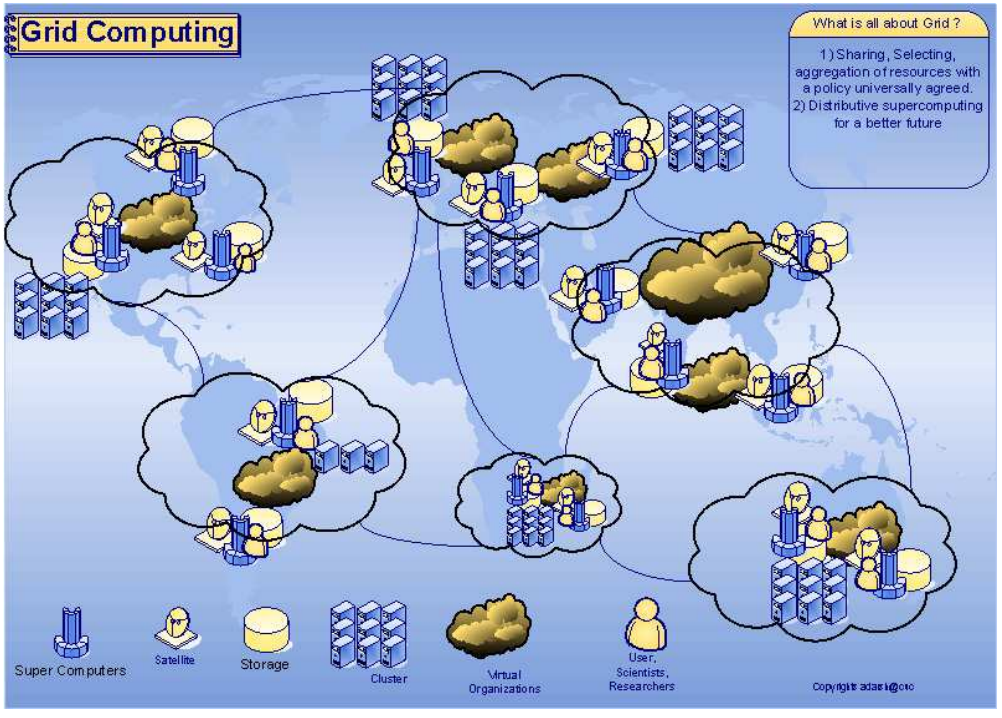
Invitation in KISTI, 2008.11.21

Outline

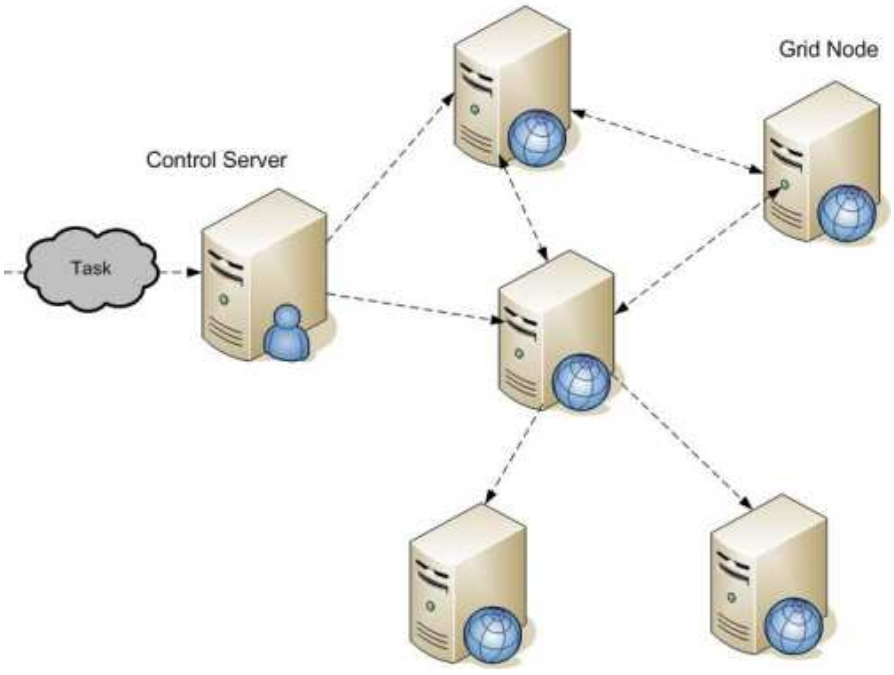
The problems

- Why We need to use the supercomputing in many fields?
  - The semiconductor Technology has the limitation.
    $\to$ We can't overcome the Relativity effect in semiconductor material.
  - The OS development is so slow.
    $\to$ From 32bit to 64bit, it take over 10 years. From 64bit to 128bit How long time..?? Can you confirm..??



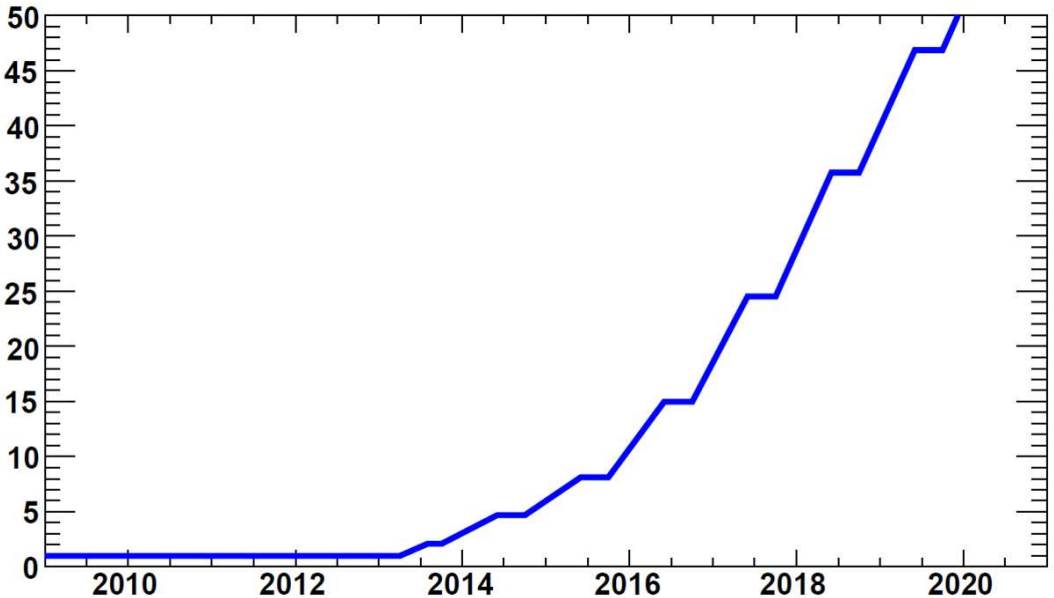
The problems

- Why We need to use the supercomputing in HEP?
  - The Hig Energy Physicists want to explore the beyond Standard Model(SM).
  - To explore the SM, The resources are not so bad.
    $\rightarrow$ The measurememts of branching fraction is larger than 10^{-6}
  - To explore the beyond SM, How order is it needed ?
    $\rightarrow$ The measurememts of branching fraction is less than 10^{-7}



The current status in Belle experiment.

- We have 656.725 $\pm$ 8.940 $\times 10^6$ events, 605fb^{-1}, to use for the B physics in Belle experiment.
  $\to$ What is the mean?
  - The data are stored in 144.72 Gbytes per $1fb^{-1}$.
  - At least, we need 95.04Tbytes for the analysis of B physics.
- Is this all ?
- Super Belle is $\times$ 50 than now!!!!

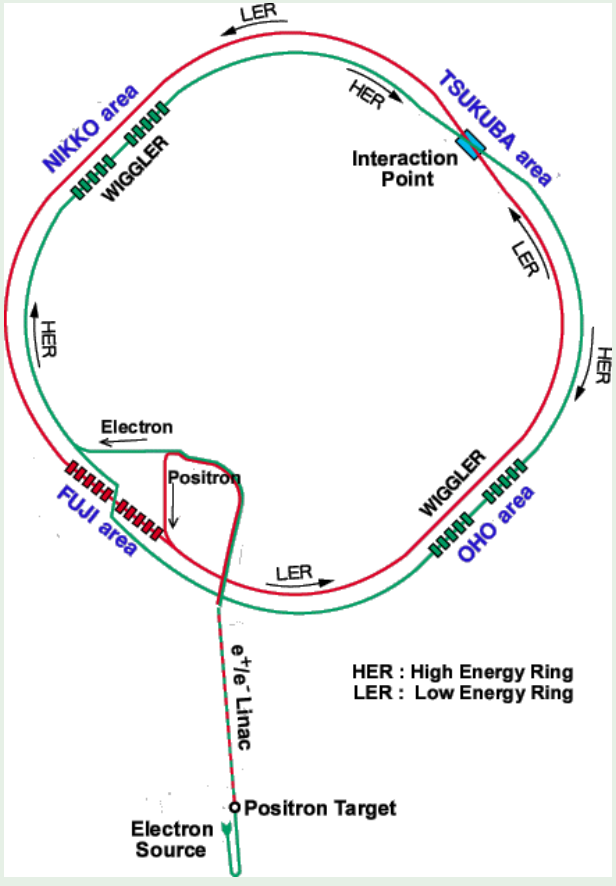


- The integral luminosity of Super Belle experiment.

Accelerator

- Beam:$e^+(3.5GeV)$, $e^-(8.0GeV)$
- The center of mass is 10.58GeV.
- Ring Circumference:3016.26m
- Detector location : TSUKUBA area.

Accelerator

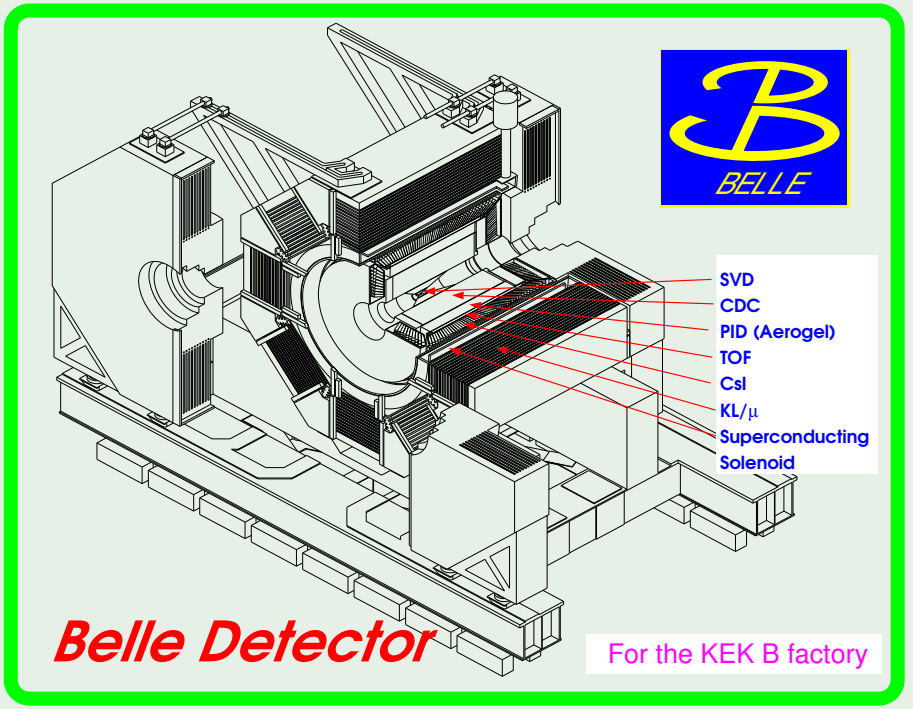


Arrangement of two rings

Detector

- SVD:
  vertex point
- CDC:
  momentum and dE/dx of charged particle
- ACC(PID):
  kaon and pion seperation($1.2 \sim 3.5 GeV/c$)
- TOF:
  kaon and pion seperation($0.6 \sim 1.2 GeV/c$)
- ECL:
  energy measurement
- KLM:
  measurement the direction of K_L and to identify muon

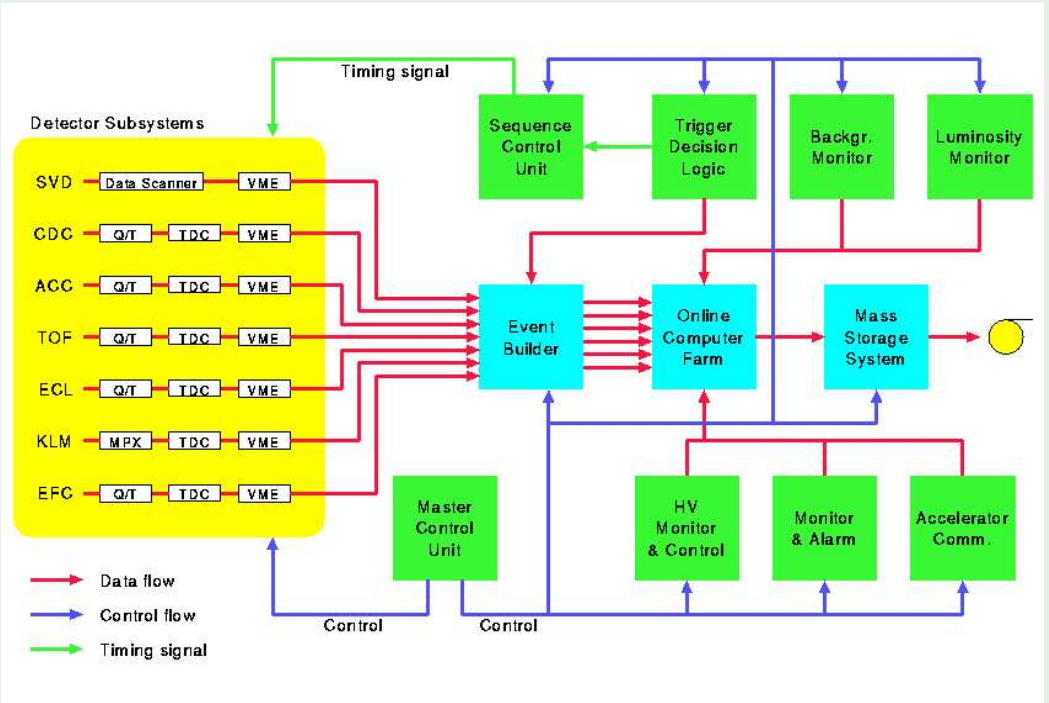
Detector



Belle DAQ system

- From detector, We get the informations of the final stats particle
- The useful data is made from DAQ system for analysis.

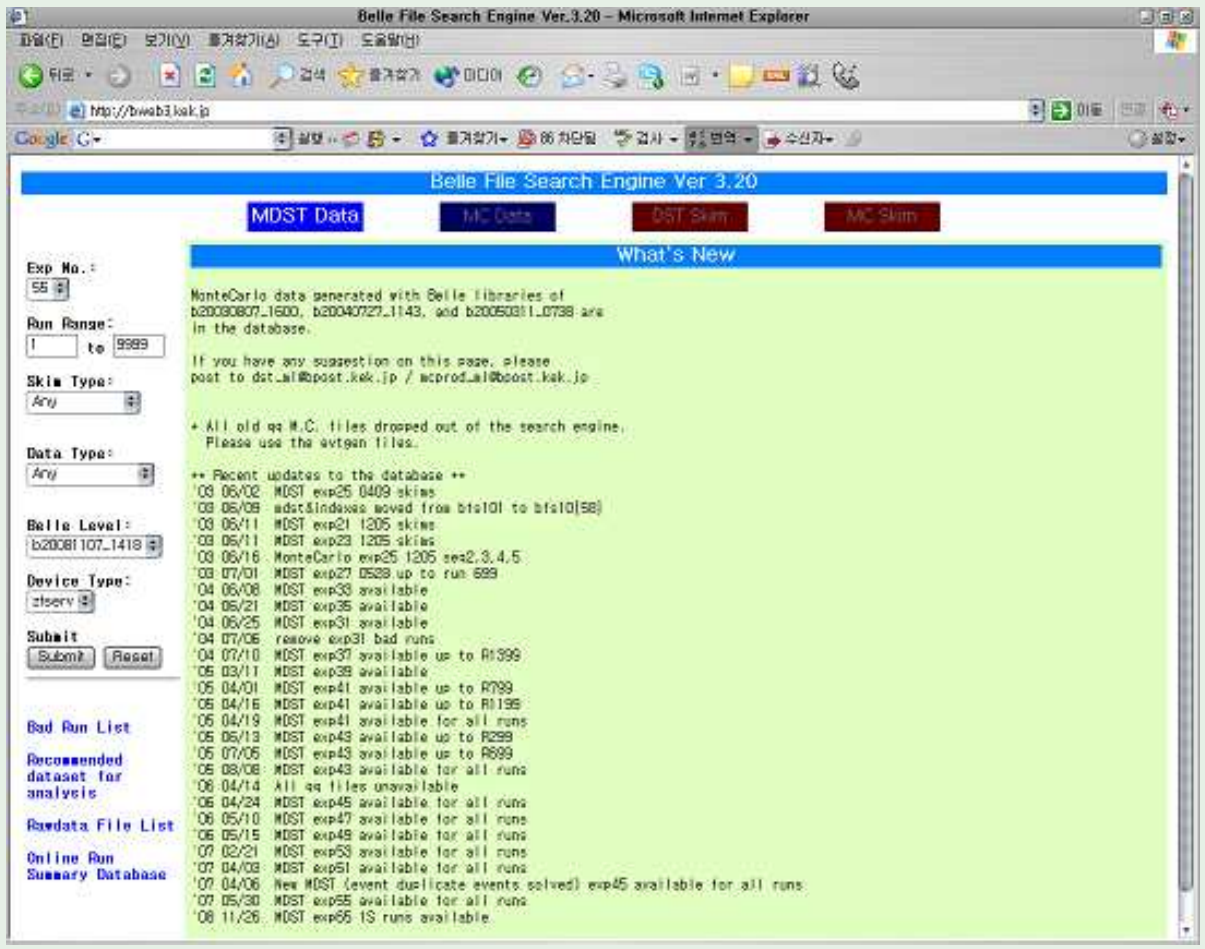
Belle DAQ system



Belle Data

- What kind of the data set do you want to get ?
- Find the data at here.

Belle Search Engine ver 3.20



Belle Data type for the anaysis

Data for B physics.

data	size
on-resonance	$605fb^{-1}$(95.04TB)
off-resonance	$68.2fb^{-1}$(5.5TB)
skim data	$605fb^{-1} \times 30$

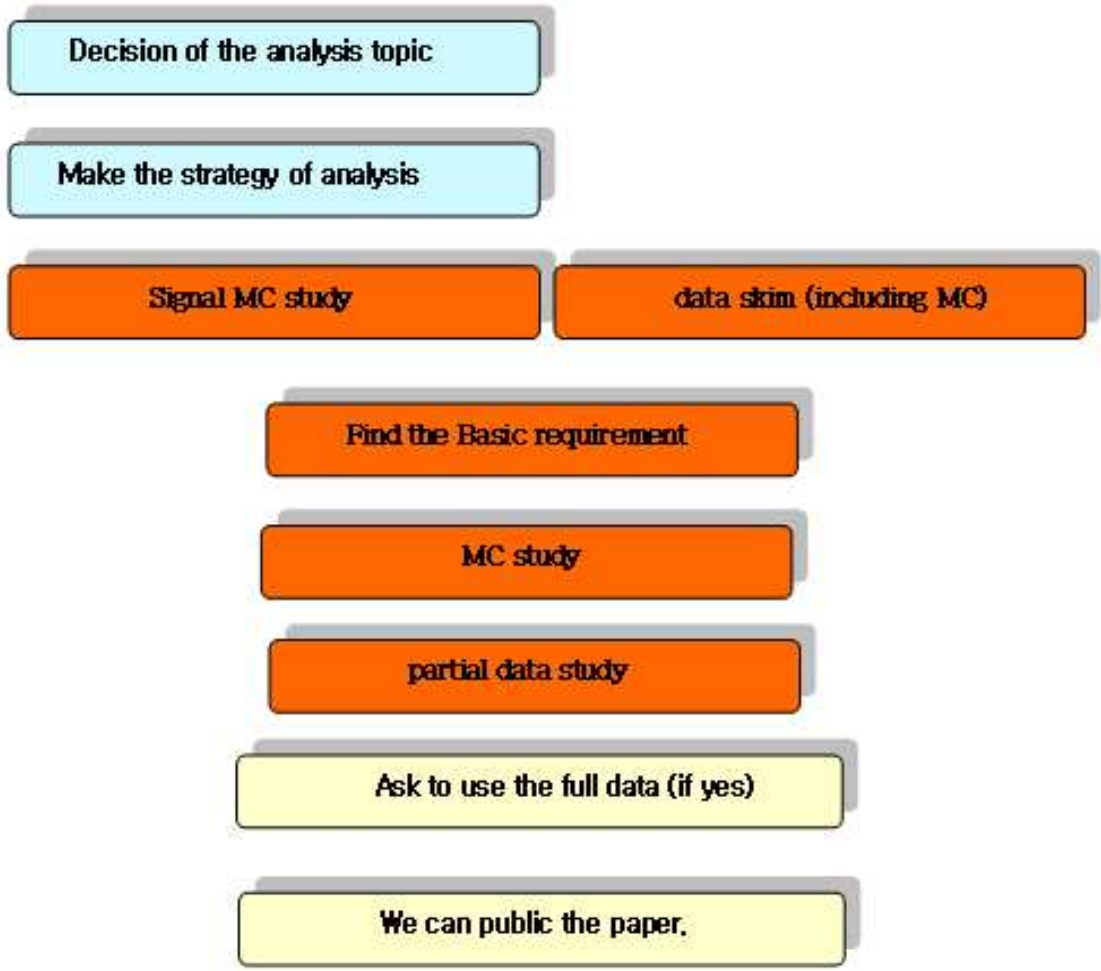
MC for B physics.

MC	size
uds of on-resonance	$605fb^{-1} \times 10/4$(396TB)
charm of on-resonance	$605fb^{-1} \times 10/4$(396TB)
mixed of on-resonance	$605fb^{-1} \times 10/4$(132TB)
charged of on-resonance	$605fb^{-1} \times 10/4$(132TB)
uds of off-resonance	$68.2fb^{-1} \times 10/4$(41.3TB)
charm of off-resonance	$68.2fb^{-1} \times 10/4$(41.3TB)
rare B MC	$25000fb^{-1}$

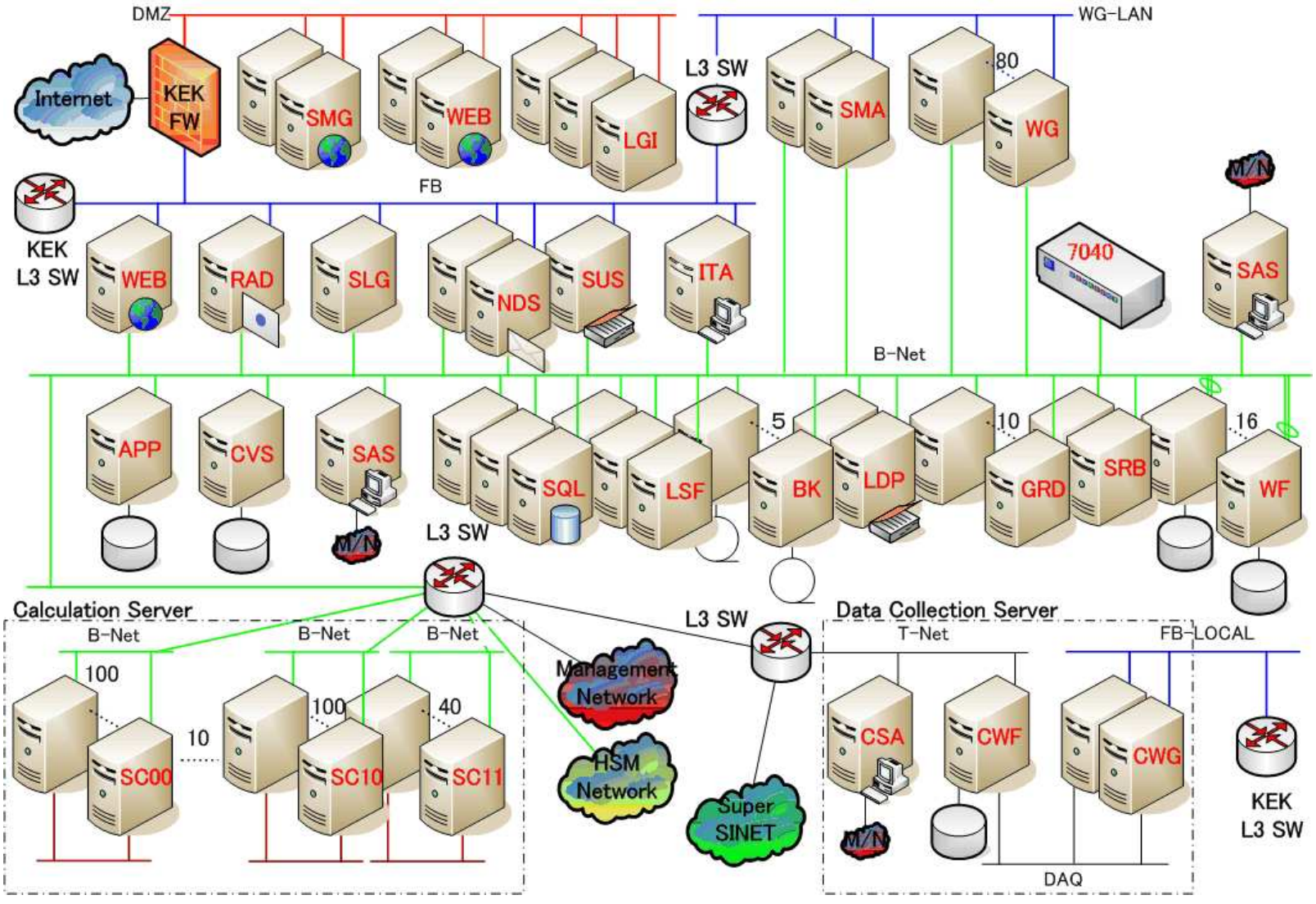
- Although the rare B MC and each topic skim data are small size, the others are not.
- At least, we need (1151.8 + α)Tbytes storage for B physics in Belle.

Analysis for B physics

- A user is assigned 300Gbytes storage for analysis.
- Do you have the sufficient storage ? $\rightarrow$ Not so bad.
- We need the computing power.

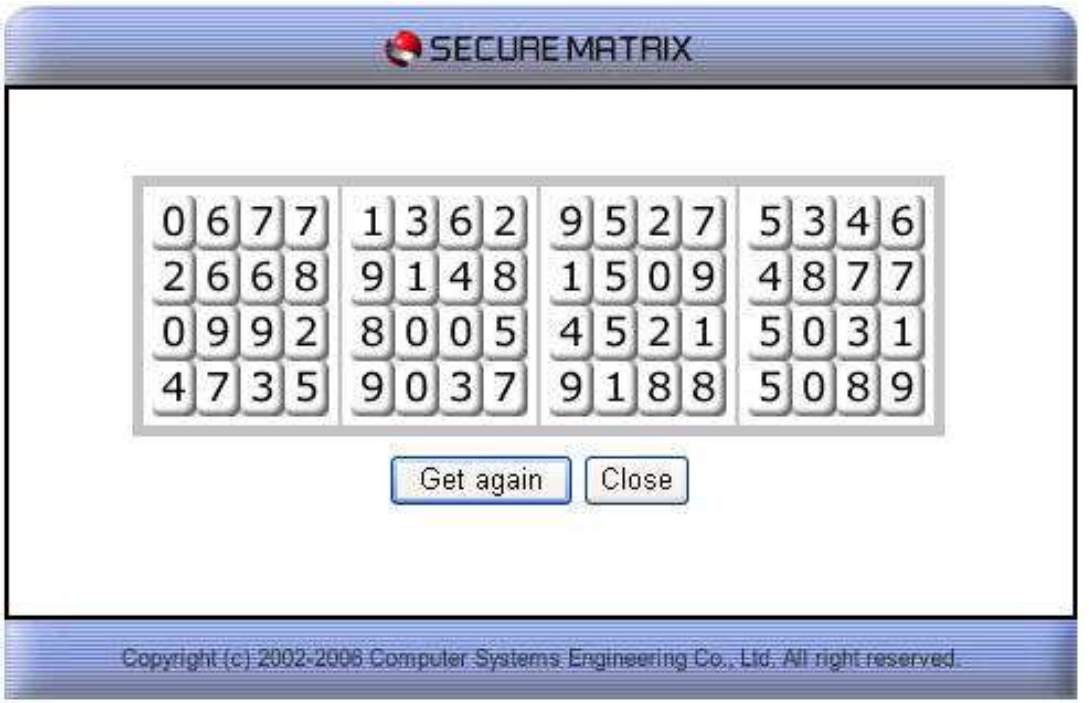


Computing power in Belle experiment



Computing power in Belle experiment

- How to use the B computer.
- We can get a account for analysis.
  - LGI: These are used when you login to the B-Factory computer system from Internet.
  - WG: These are used when you do interactive processing, like edit programs, compile programs, submit jobs.
  - SC:These are used for running batch jobs.



Computing power in Belle experiment

- For analysis and MC production →
  We should use the SC nodes, which are composed on 1140 node.
- batch job system : LSF
- A user is assigned with maximum 20 node.
- Almost people complain to be assigned with the limitation.
- All node was offered by DELL.

system configuration.

Type of Server	CPU	Num of CPUs	Amount of Memory	Type of Network	Num.
LGI	Xeon3.6GHz	2	1GB	GigabitEthernet	3
WG	Xeon3.6GHz	2	1GB	GigabitEthernet	80
SC	Xeon3.6GHz	2	1GB	GigabitEthernet	1140

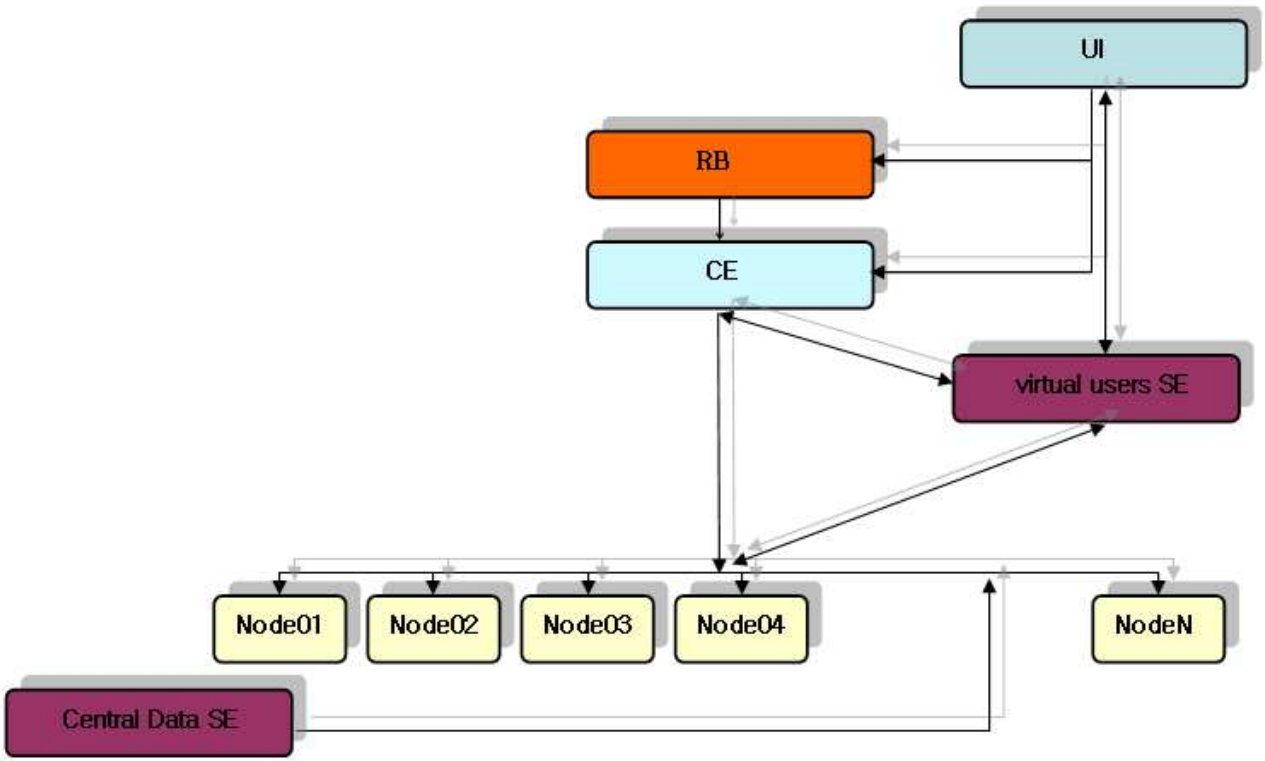
Computing power in Belle experiment

Data control for analysis

data type	size	Num. of events	time/events	Time	Result
Data skim	95.04TB	658×10^6	2min/10K	8.19 days	skim files
MC skim	1056.0TB	6580×10^6	2min/10K	91.00 days	skim files
Signal MC production	4.2GB		8hours/30K	3.3 days	mdst data
analysis run	58.08TB	658×10^6	2min/10K	5.01days	ntuple or root

- How much do the resources need to work in Super Belle ?
  $\to$ Super Belle data will be $\times$ 50 for all !!

The scheme of Korea Belle Data Grid



Schemer: JungHyun Kim(SKKU)

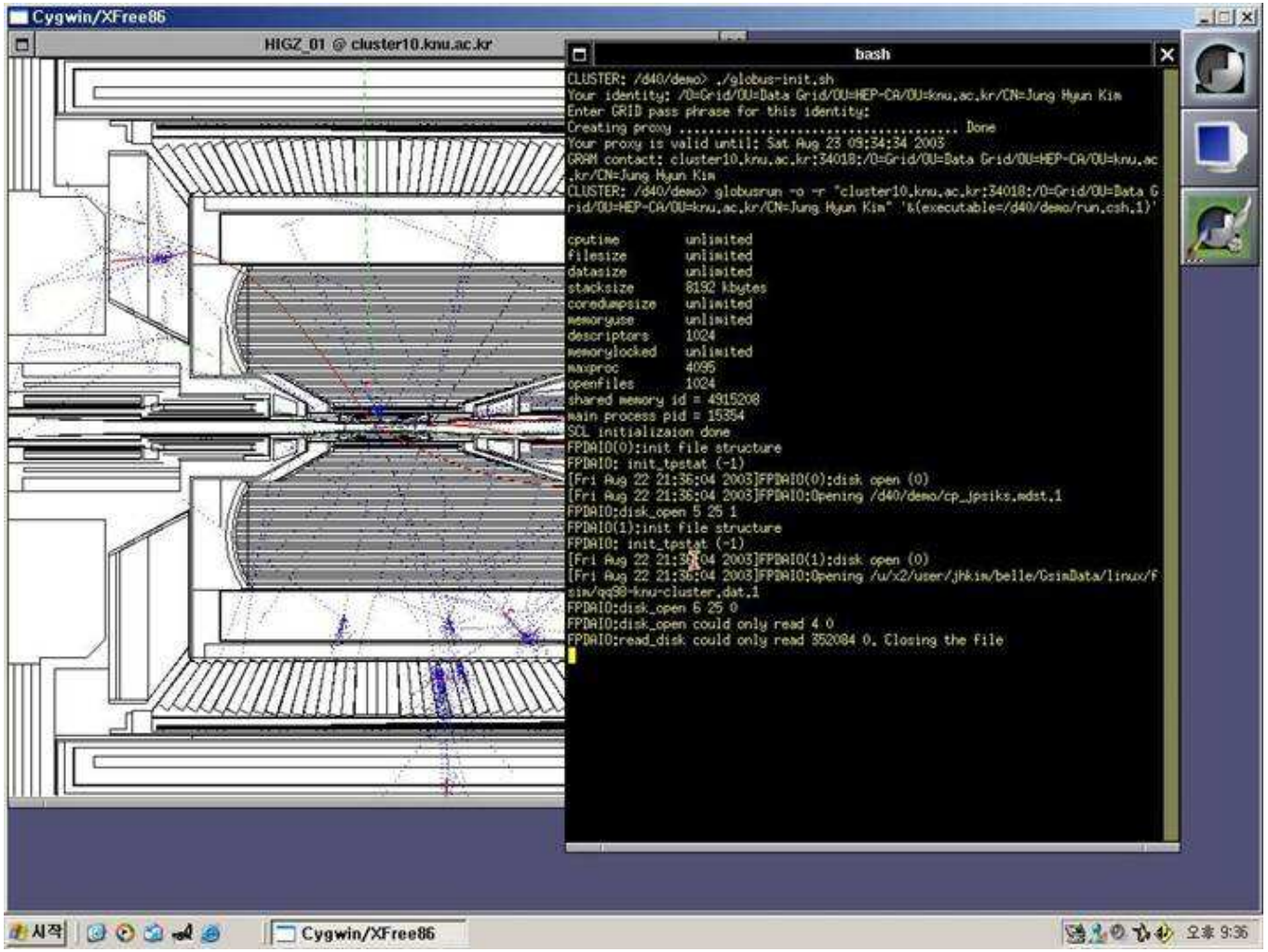
The work of Korea Belle Data Grid

component	purpose	site	development	CPU	OS	middleware	date(year.month)
UI	user interface	hepgrid.skku.ac.kr	O	intel 2.4GHz	linux	globus 2.4	2003.11
VU	virtual user	cluster76.knu.ac.kr	O	AMD 2.0GHz	linux	globus 2.4	2003. 8
CE	computing element	cluster76.knu.ac.kr	O	intel 2.4GHz	linux	globus 2.4	2002. 12
RB	resource broker		X			globus 2.4	
SE	storage element	hep.skku.ac.kr	X	intel 2.4GHz	linux		
Node	computing node	local IP(4)	O	intel 2.0(SMP)	linux		2002. 12
UI on website	portal and GUI	hepgrid.skku.ac.kr	O	intel 2.0(SMP)	linux	globus 2.4	2004. 1
CA on website	CA	hepgrid.skku.ac.kr	O	intel 2.4	linux	globus 2.4	2004. 1

- Development:
  - UI,VI,CE,Nodes(JungHyun Kim)
  - CA(gridca-1.1.1)(KISTI),modify(JungHyun Kim, SunMin Kim)
  - UI on website (JungHyun Kim, SunMin Kim)

The work of Korea Belle Data Grid

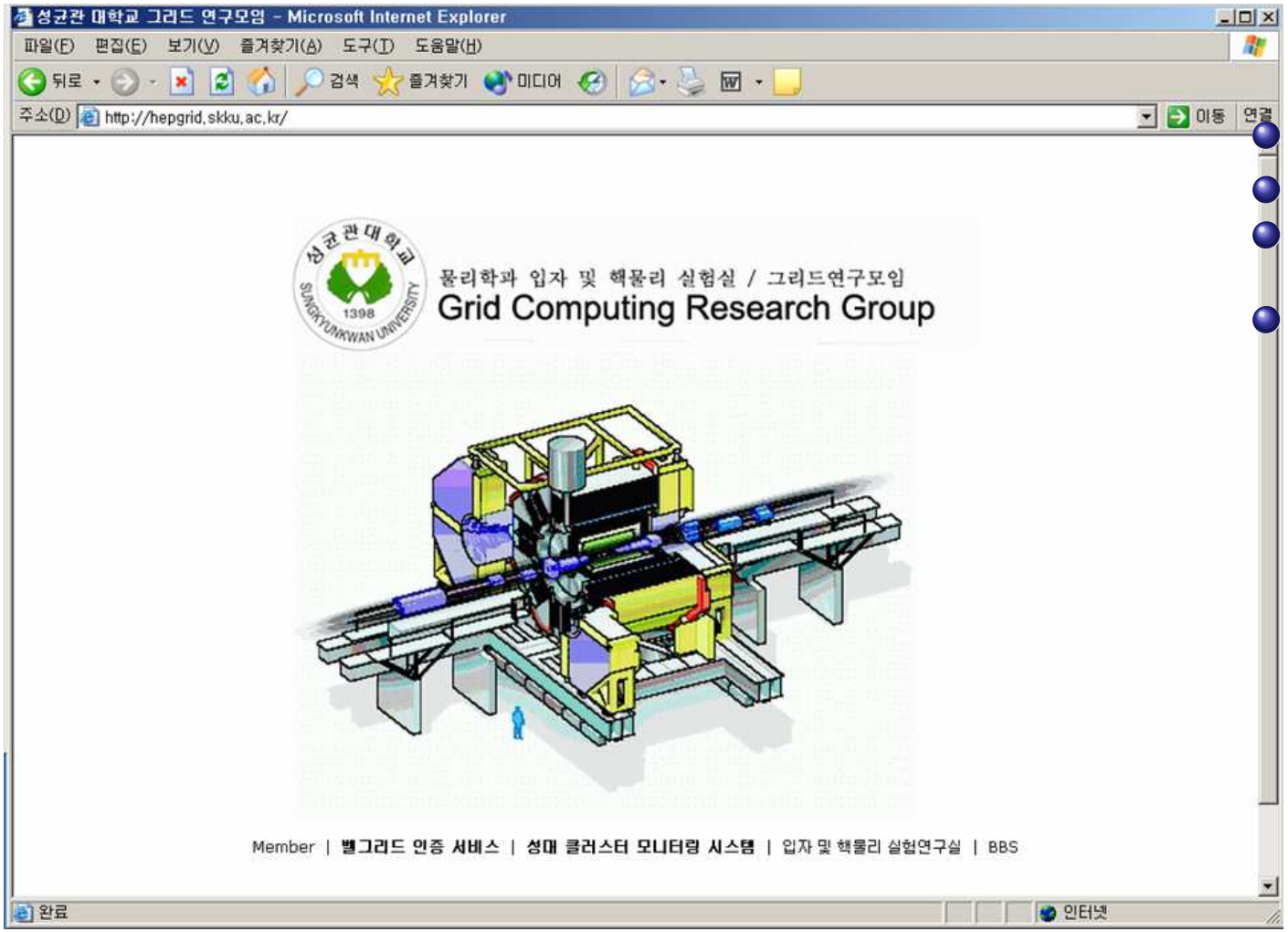
- Connection with Belle library and Globus tool kit.



- UI: hepgrid.skku.ac.kr
- CE: cluster10.knu.ac.kr
- Node: local IP
- SE: hep.skku.ac.kr
- OS : linux
- globus: globus-2.4
- belle lib: b20020424_ 1007
- development :JungHyun Kim

The work of Korea Belle Data Grid

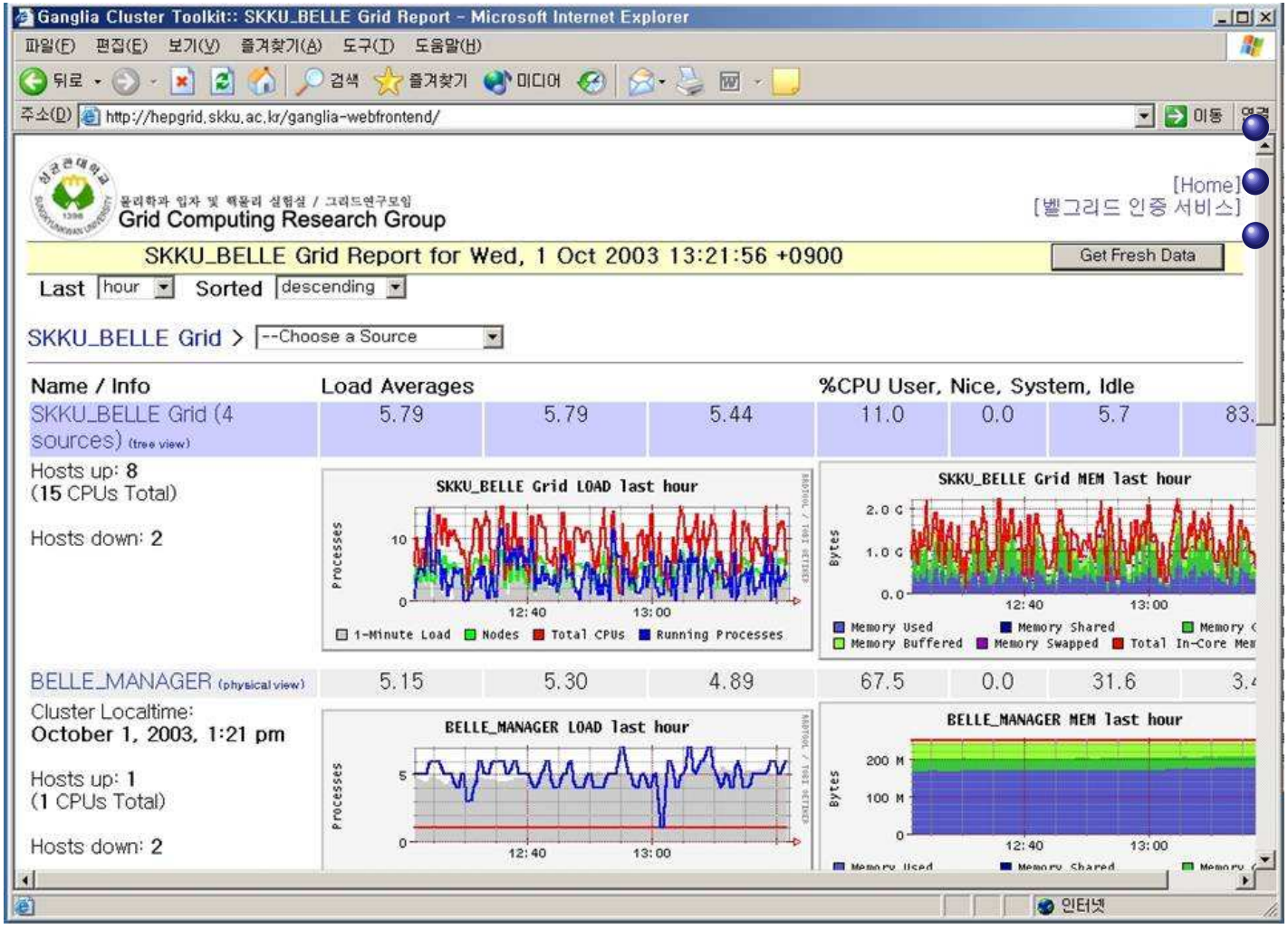
- Website of Korea Belle Data Grid



- UI: hepgrid.skku.ac.kr
- OS : linux
- globus: globus-2.4 item Design :JungHyun Kim
- development :JungHyun Kim, SunMin Kim

The work of Korea Belle Data Grid

- The monitor system of Korea Belle Data Grid



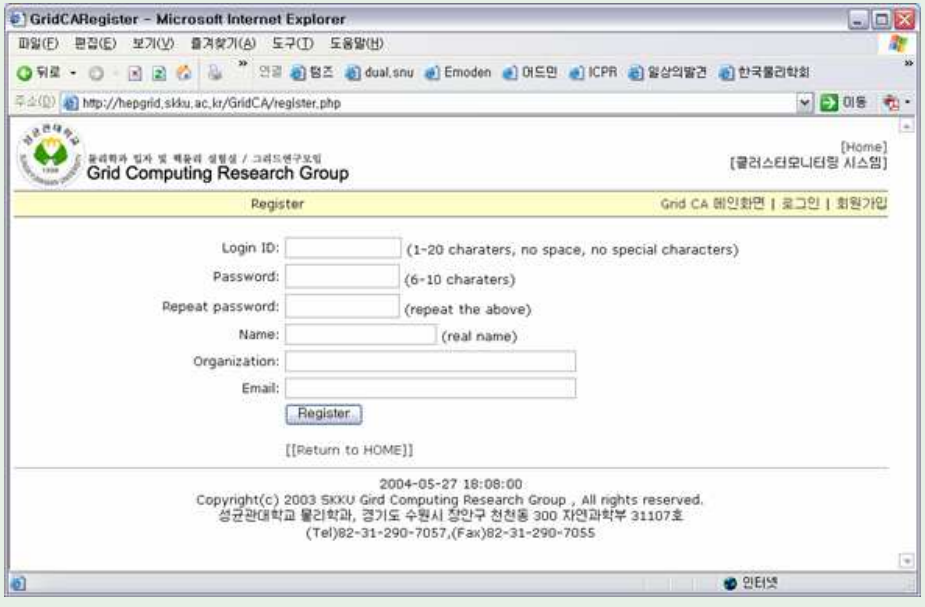
UI: hepgrid.skku.ac.kr

OS : linux item Design :JungHyun Kim

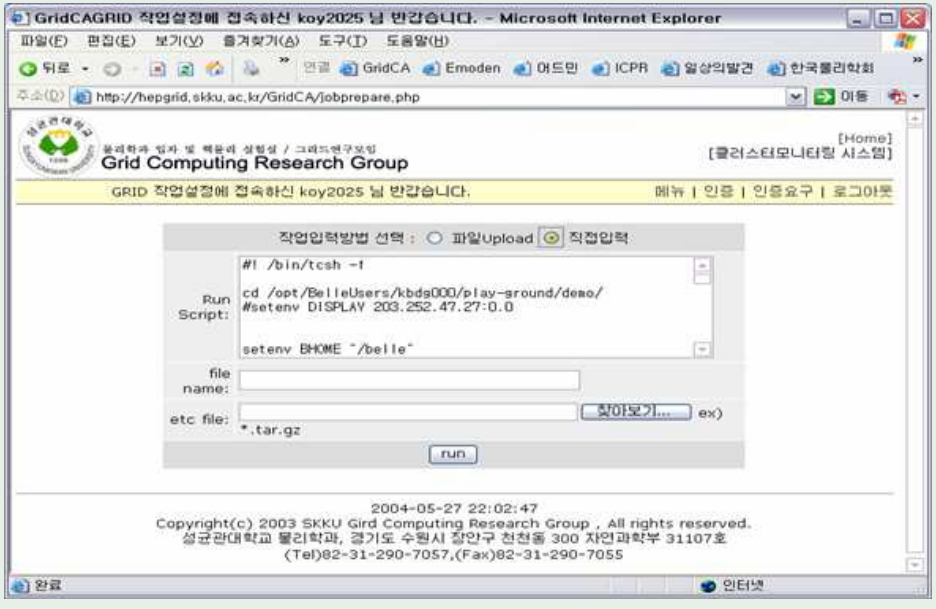
development :JungHyun Kim, SunMin Kim

The work of Korea Belle Data Grid

Certification Authority

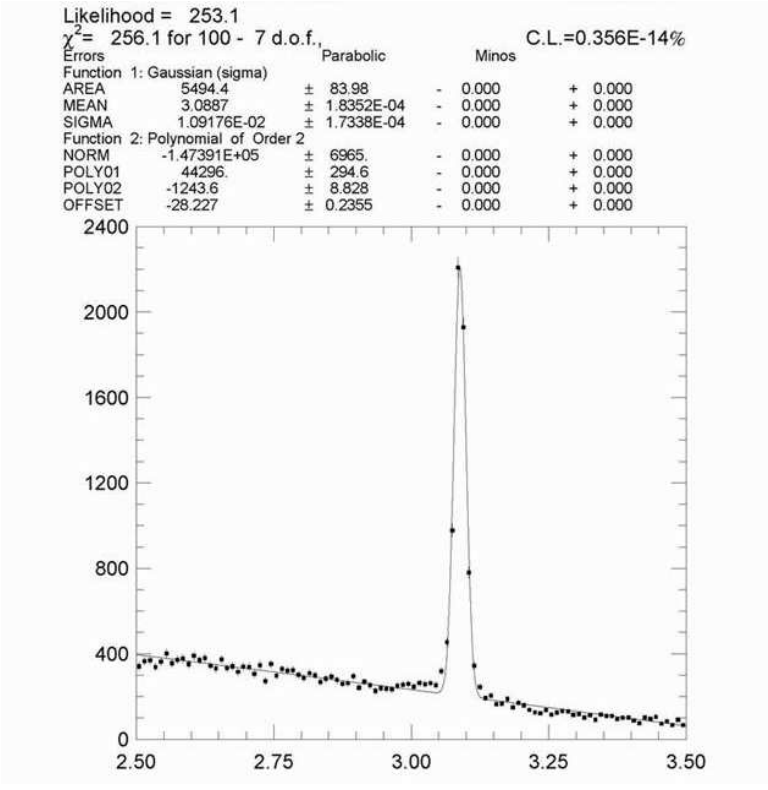


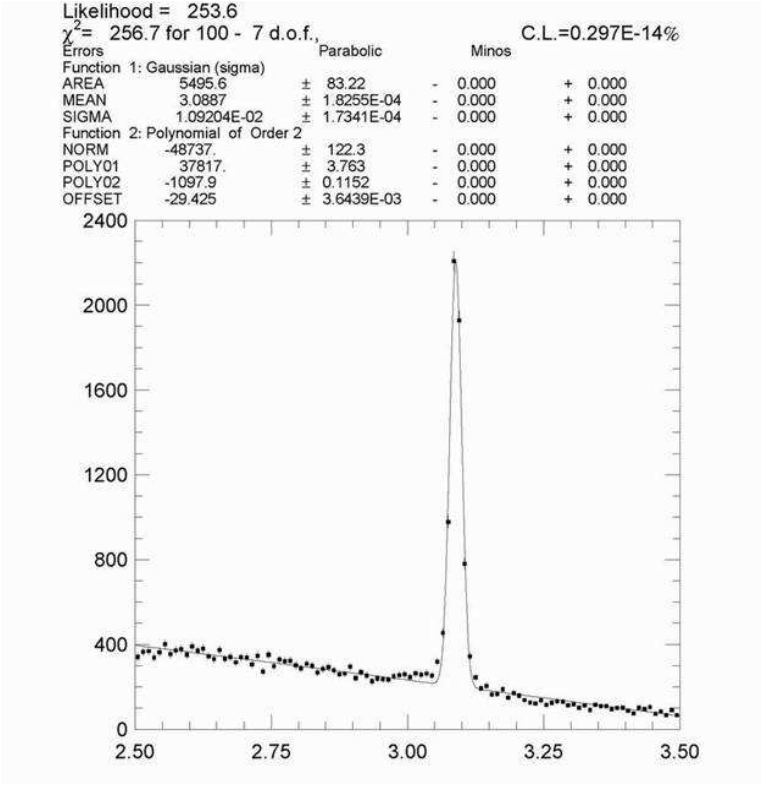
User Interface based on the Web.



- UI: hepgrid.skku.ac.kr
- OS : linux item Design :JungHyun Kim
- development :JungHyun Kim, SunMin Kim, KISTI(gridca-1.1.1)

The work of Korea Belle Data Grid





- The difference of the result is less than 1 event.
- The difference of CPU time is shown as the Table.

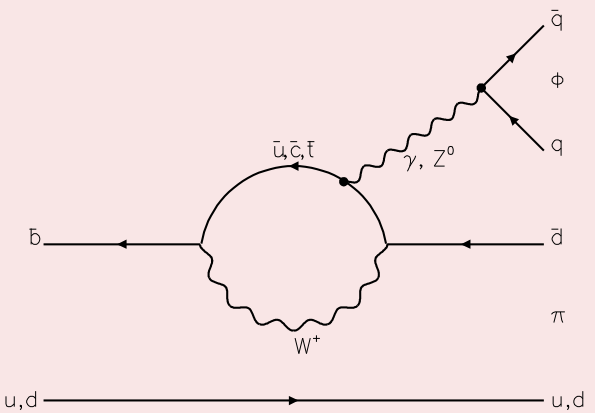
By SunMin Kim
M.S thesis.

	KISTI nodes(30 nodes)	Belle nodes(20 nodes)
relative CPU time	18 hours 21min 6 sec	53hours 46 min 47 sec

Introduction

- The measurements of $B \to \phi\pi$ decay rates is important...
  contribution beyond the Standard Model(SM)
- Strongly suppressed in the SM.
- The measurement of BABAR(2007) is $\lesssim 10^{-7}$
- The $B^0 \to \phi\pi^0$ decay is associated with measurements of time dependent CP asymmetry in $B^0 \to \phi K^0$.

Feynman Diagram



The Dataset and Skim Criteria

- The Dataset

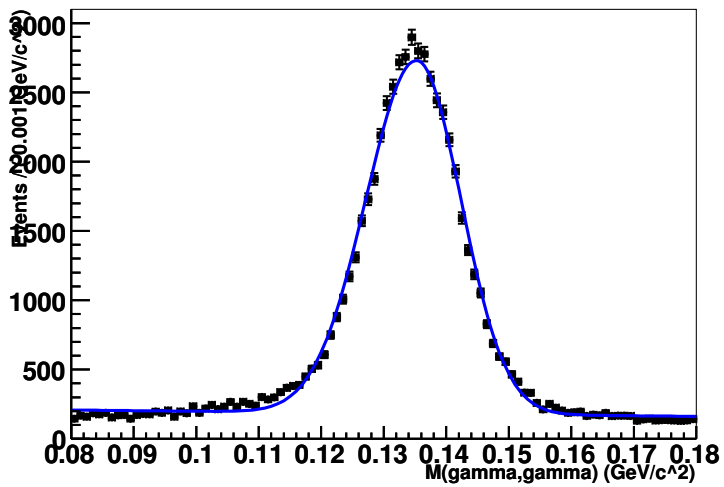
type	Luminosity
each decays signal MC	300K number of events based on exp51(420MB/30Kevent)
qq MC	$2480 fb^{-1}$(649.31TB)
$b \to c$ MC	$3501 fb^{-1}$(305.54TB)
$b \to u, d, s$ MC	$24850 fb^{-1}(unknown)$
data	$605 fb^{-1}$(95.04TB)

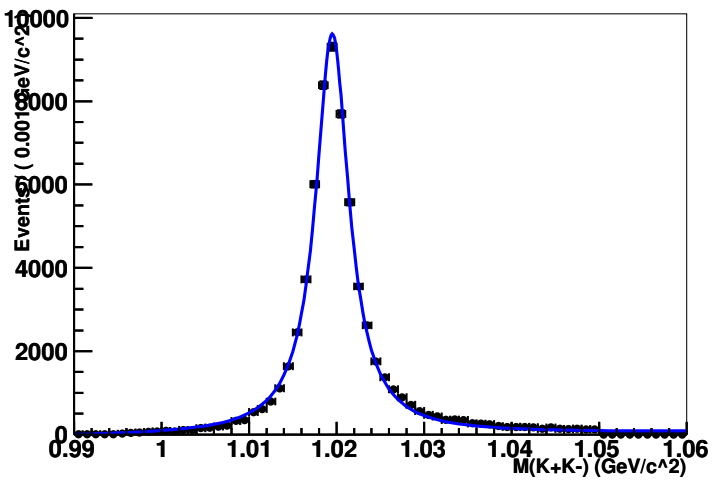
- Skim Criteria

Source	Requirement
Charged K Tracks	$\text{atc\_pidKpi}(3,1,5,3,2) > 0.1$
Charged π Tracks	$\text{atc\_pidKpi}(3,1,5,3,2) < 0.0$(not applyed)
π^0 invariant mass	$0.08GeV < M_{\gamma\gamma} < 0.18GeV$
ϕ invariant mass	$1.8GeV > M_{(K+K-)}$
ΔE and M_{bc}	$\lvert\Delta E\rvert < 0.42GeV$ and $M_{bc} > 5.19GeV$

Reconstruction

$M_{\gamma\gamma}$ and $M_{K^+K^-}$ mass distribution for neutral mode.

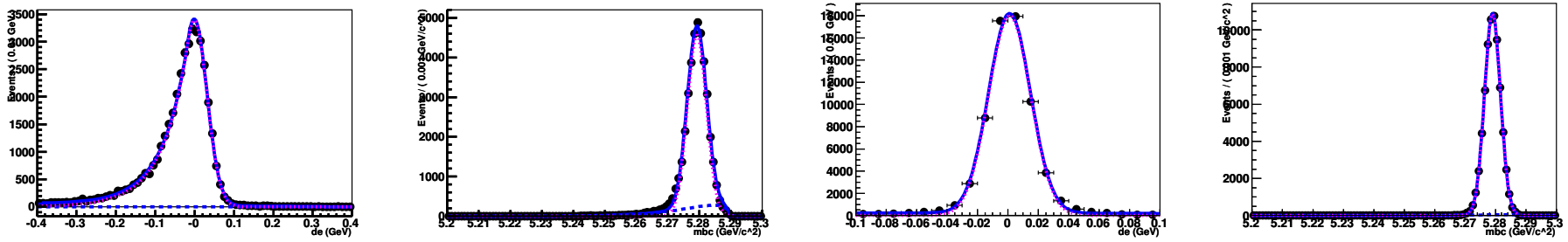




type	PDF	$\mu(GeV/c^2)$	width(GeV/c^2)	selection range(GeV/c^2)
π^0	bifurcated gauss + Cheby 1^{st}	0.1353	$^{-0.0081}_{+0.0071}$	$0.1153 < M_{\gamma\gamma} < 0.1528$
ϕ	Breit-Wigner + Cheby 1^{st}	1.020	0.005	$1.008 < M_{K^+K^-} < 1.031$
Photon				$> 0.2GeV$

Reconstruction

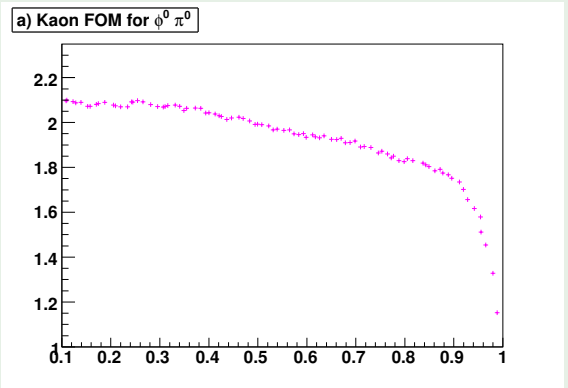
M_{bc} and ΔE distribution in $B \to \phi\pi$ decays(left side:neutral, right side: charged)

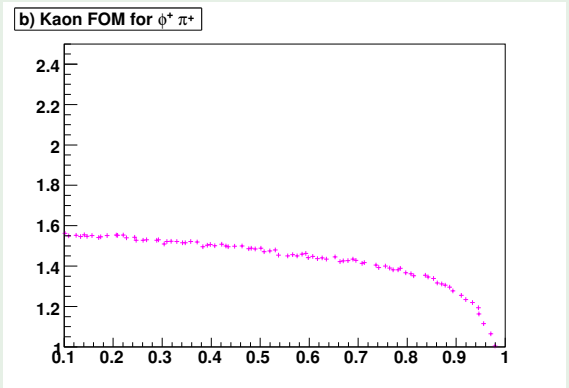


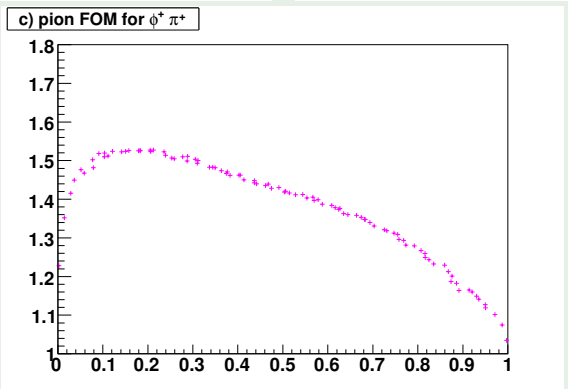
	$B^0 \to \phi\pi^0$	$B^+ \to \phi\pi^+$
ΔE PDF	Crystal Ball	Double Gaussian
M_{bc} PDF	Gaussian	Gaussian
ΔE window	$-0.4GeV < \Delta E < 0.4GeV$	$-0.1GeV < \Delta E < 0.1GeV$
M_{bc} window	$5.2GeV/c^2 < M_{bc} < 5.3GeV/c^2$	$5.2GeV/c^2 < M_{bc} < 5.3GeV/c^2$
ΔE Slice range	$-0.16GeV(5.0\sigma) < \Delta E < 0.10GeV(3.0\sigma)$	$-0.04GeV(3.0\sigma) < \Delta E < 0.040GeV(3.0\sigma)$
M_{bc} Slice range	$5.27GeV/c^2 < M_{bc} < 5.29GeV/c^2$	$5.27GeV/c^2 < M_{bc} < 5.29GeV/c^2$

Particle Identification(PID)

The F.O.Ms of $B \to \phi\pi$ decays







- Signal : $B \to \phi\pi$ decay
- Noise : qq and $b \to u, d, s$ background
- Corr. factor :discrepancy of MC vesus data for the continuum candidates
- Iteration with continuum suppression

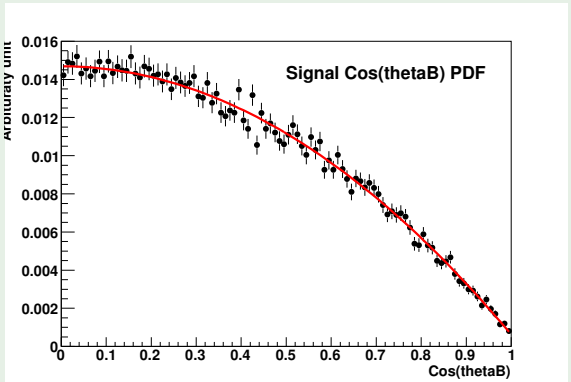
- The results

decay	Kaon ID	π ID
$B^0 \to \phi\pi^0$	> 0.3	
$B^+ \to \phi\pi^+$	> 0.3	< 0.2

$Cos(\theta_B^*)$ and $Cos(\theta_{Helicity})$

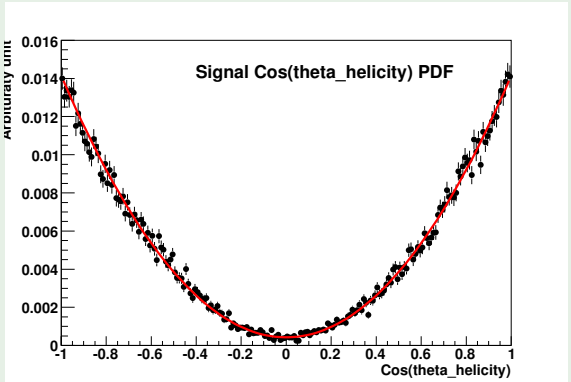
- $Cos(\theta_B^*)$
  - θ_B^* is defined as the angle of the B meson flight direction with respect to the beam axis.
  - The angular momentum conservation
  - Signal: spherical
  - Continuum: jet-like(flat)
  - $cos\theta_{B*} = P_0 - P_1 cos^2\theta_{B*}$

$cos\theta_{B*}$ distribution of $B^0 \to \phi\pi^0$ decay



- $Cos(\theta_{Helicity})$
  - θ_H is defined as the angle between K^+ direction and the B meson direction in the ϕ mass rest frame.
  - $cos\theta_H = P_0 - P_1 cos^2\theta_H$

$Cos(\theta_{Helicity})$ distribution of $B \to \phi\pi^0$ decay



ΔZ

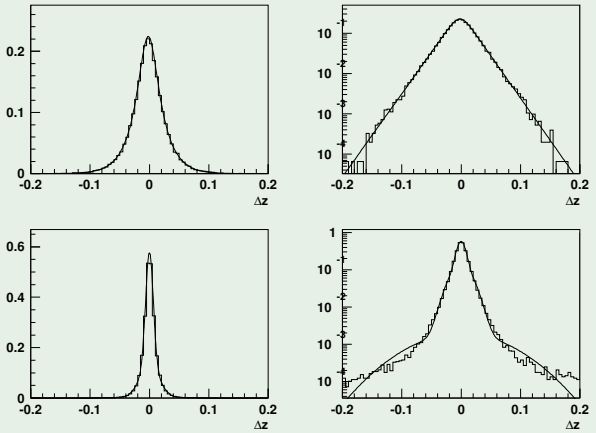
- assymetric life-time convolute with the gaussian in signal events

$$LF \otimes R = exp(-|x|/\tau) \otimes R = \int_{-\infty}^{-\infty} exp(-|x-\mu|/\tau) * exp[-0.5 * (\frac{x - M_{mean}}{\sigma})^2]d\mu \quad (1)$$

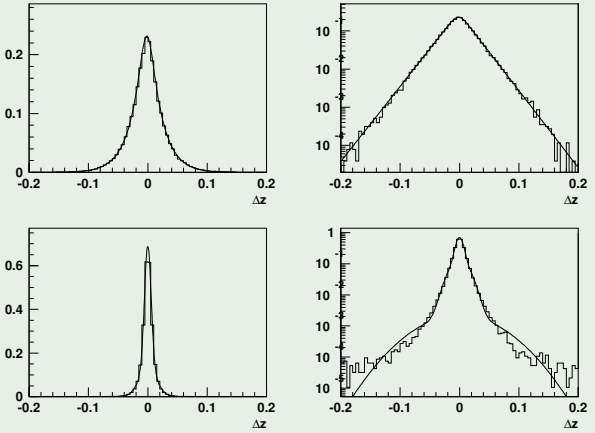
- δ function convolute with the gaussian in continuum events.

$$\delta \otimes R = R_1 + R_2 + R_3 \quad (2)$$

- ΔZ PDF of $B^0 \to \phi\pi^0$

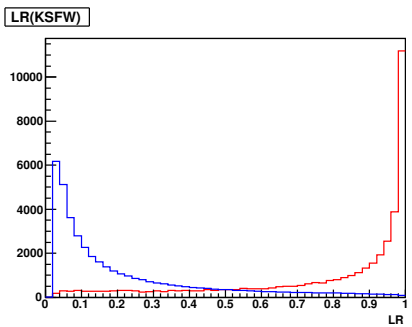


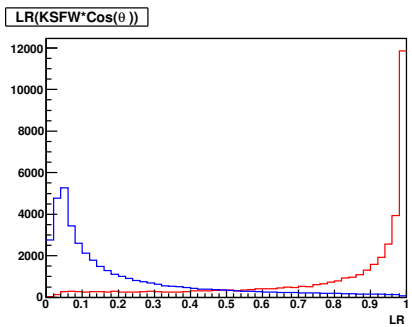
- ΔZ PDF of $B^+ \to \phi\pi^+$

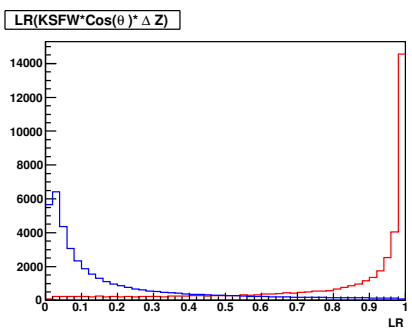


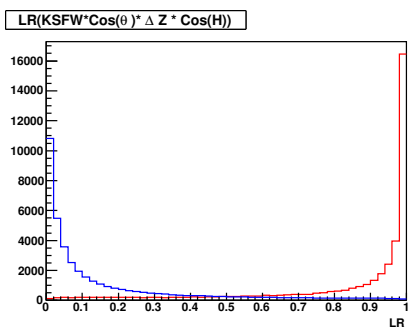
Likelihood Ratio(KSFW,$Cos(\theta_B^*)$,ΔZ,$Cos(\theta_H)$)

LR of $B^0 \to \phi\pi^0$

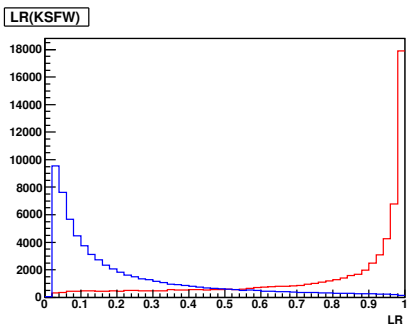


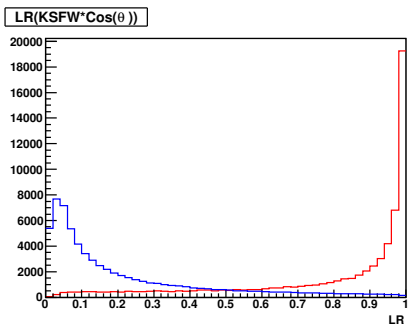


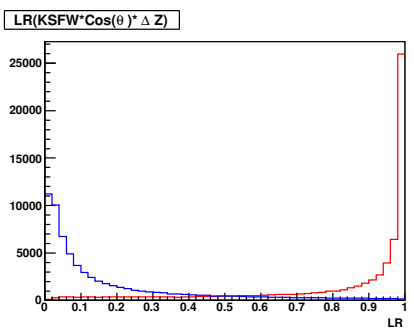


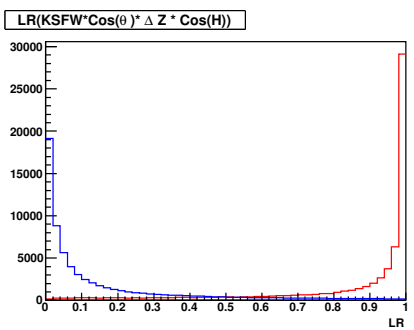


LR of $B^+ \to \phi\pi^+$





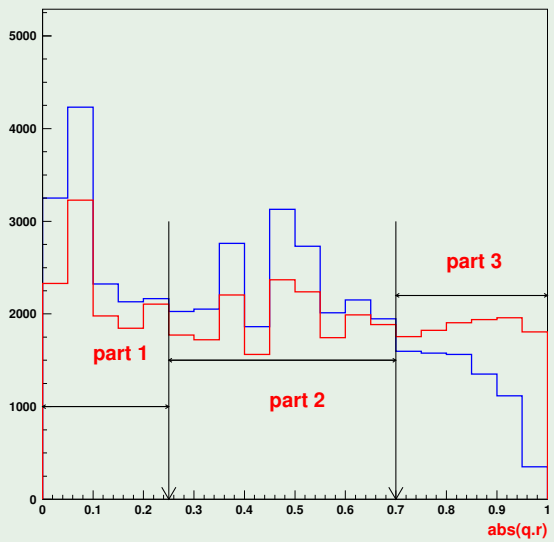




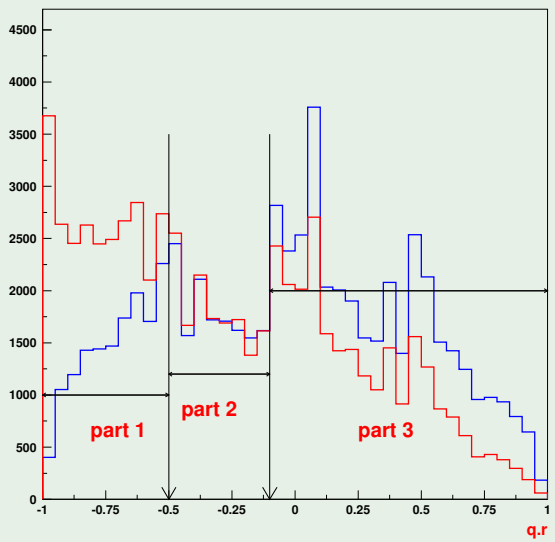
- The likelihood ratio is improved from gradually using the discriminants.

$q \bullet r$

$q \bullet r$ of $B^0 \to \phi\pi^0$



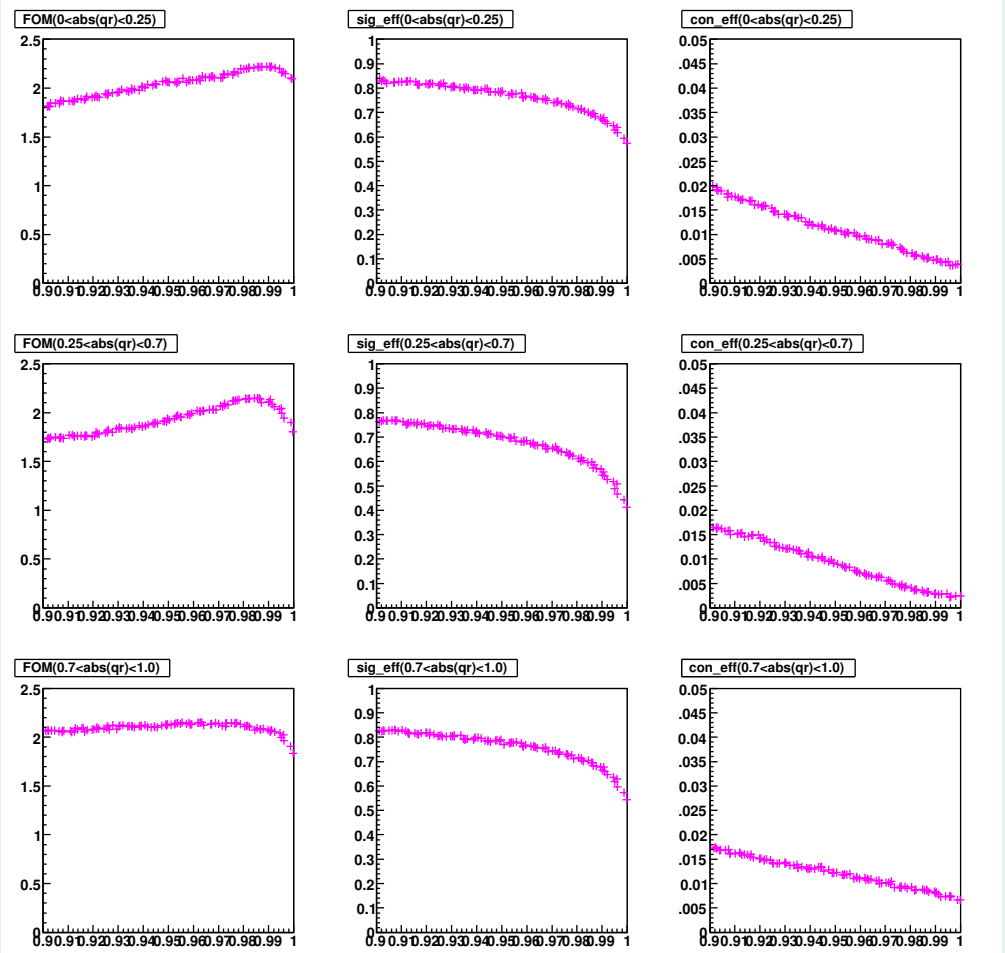
$q \bullet r$ of $B^+ \to \phi\pi^+$



- q($+1 = B^0$, $-1 = \overline{B^0}$)
- r (= 1-2w)($0 \to 1$: better tagging quality)
- part1: signal $<$ continuum, part2:signal $\sim$ continuum, part3: signal $>$ continuum

Figure of Merit(KSFW,$Cos(\theta_B^*)$,ΔZ,$Cos(\theta_H)$) dependent on $q \bullet r$

LR and FOM of $B^0 \to \phi\pi^0$ with $q \bullet r$

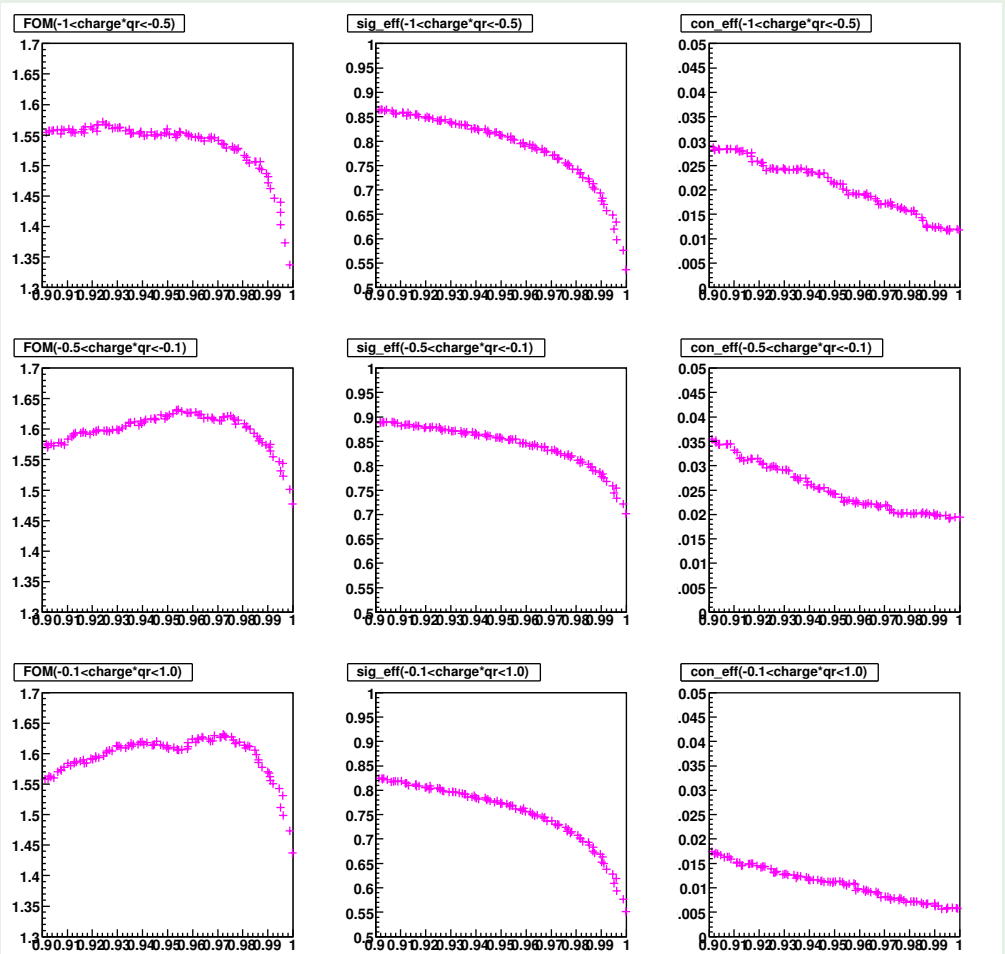


the requirement of the FOM with q.r

- correction factor = 2.37 by $M_{bc} < 5.27 GeV/c^2$ of side band data
- if $0 < |q \bullet r| < 0.25$, $LR = 0.99$
- if $0.25 < |q \bullet r| < 0.7$, $LR = 0.98$
- if $0.7 < |q \bullet r| < 1.0$, $LR = 0.96$

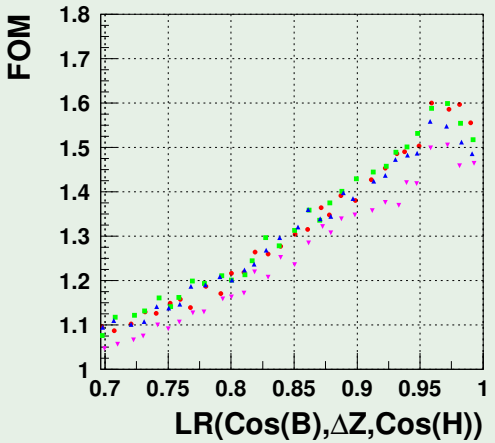
Figure of Merit(KSFW,$Cos(\theta_B^*)$,ΔZ,$Cos(\theta_H)$,$q \bullet r$) dependent on $q \bullet r$

LR and FOM of $B^+ \to \phi\pi^+$ with $q \bullet r$



the requirement of the FOM with q.r

- correction factor = 1.35 by $M_{bc} < 5.27 GeV/c^2$ of side band data
- if $-1.0 < q \bullet r < -0.5$, $LR = 0.93$
- if $-0.5 < q \bullet r < -0.1$, $LR = 0.96$
- if $-0.1 < q \bullet r < 1.0$, $LR = 0.97$

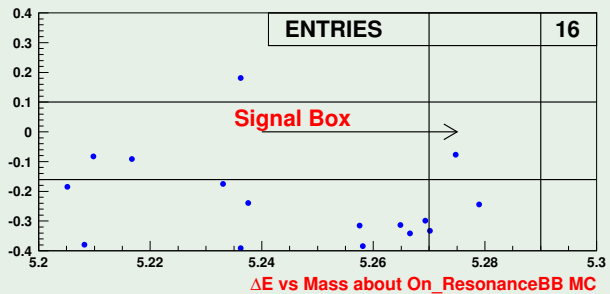


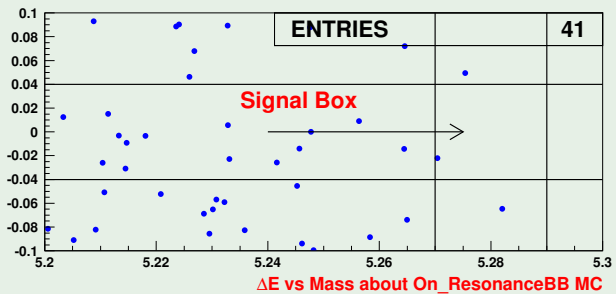
- $-2.5\Gamma < M_{K^+K^-} < 2.5\Gamma$

$b \to c$ background

	$B^0 \to \phi\pi^0$	$B^+ \to \phi\pi^+$
remained evt	16	41
Expectation($605 fb^{-1}$)	2.76	7.08

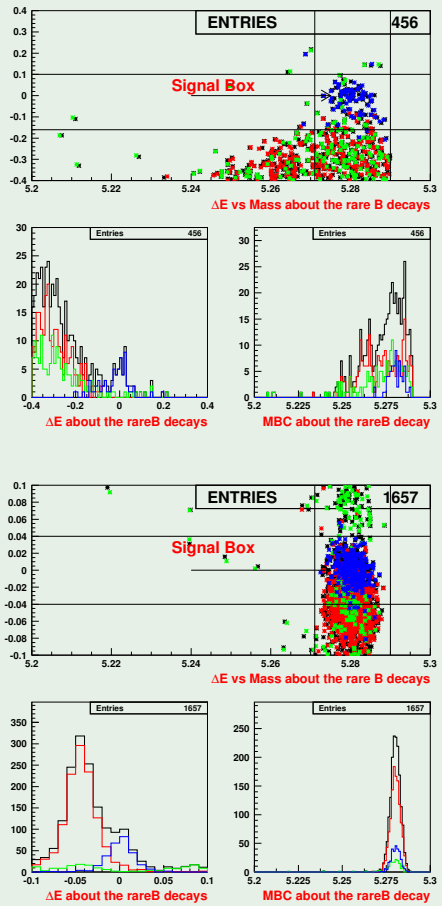
ΔE,M_{bc} distribution for $b \to c$ background(left:neutral, right:charged)





$b \to u, d, s$ background

ΔE,M_{bc} distribution for $b \to u, d, s$



- $b \to u, d, s$ background

Decay Mode	Br(10^{-6})	remained evt	Expectation($605fb^{-1}$)
$B^0 \to \phi\omega$	< 1.2	5	0.12
$B^0 \to \phi K_S$	$= 8.6$	202	4.91
$B^\pm \to \phi\rho^\pm$	$= 0.45$	27	0.66
$B^0 \to K^+K^-\pi^0$	< 19	28	0.68
$B^0 \to a_0{}^0\pi^0$		14	0.34
$B^0 \to f_0\pi^0$		22	0.54
other decays		158	3.84
$B^\pm \to \phi K^\pm$	$= 8.3$	1205	29.32
$B^\pm \to K^+K^-\pi^\pm$	< 6.3	7	0.17
$B^\pm \to a_0{}^0\pi^\pm$	< 5.8	273	6.64
$B^\pm \to f_0\pi^\pm$		4	0.10
other decays		168	4.08

PDF component

- The PDF components of $B^0 \to \phi\pi^0$ decay

Component	ΔE	M_{bc}
signal	Crystall Ball	Gaussian
continuum	Chebyshev polynomial 1^{st}	ARGUS background
$b \to c$	histogram to PDF	histogram to PDF
$b \to u, d, s$	histogram to PDF	histogram to PDF

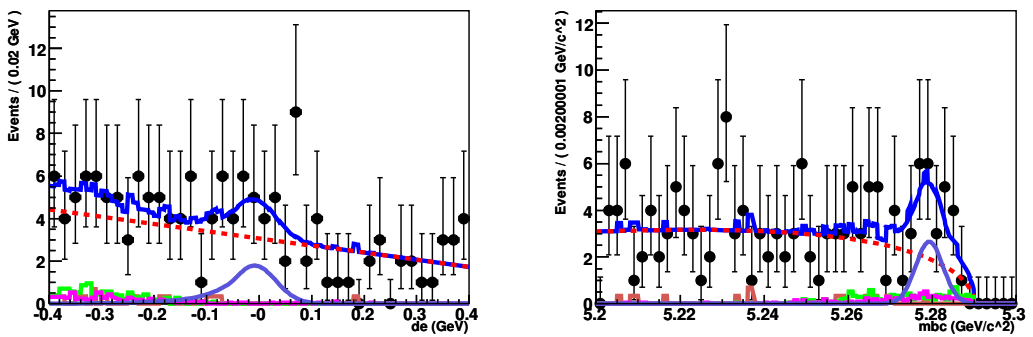
- The PDF components of $B^+ \to \phi\pi^+$ decay

Component	ΔE	M_{bc}
signal	double Gaussian	Gaussian
continuum	Chebyshev polynomial 1^{st}	ARGUS background
$b \to c$	histogram to PDF	histogram to PDF
$b \to u, d, s$(dominant)	double Gaussian	Gaussian
$b \to u, d, s$(the rest of backgound)	histogram to PDF	histogram to PDF

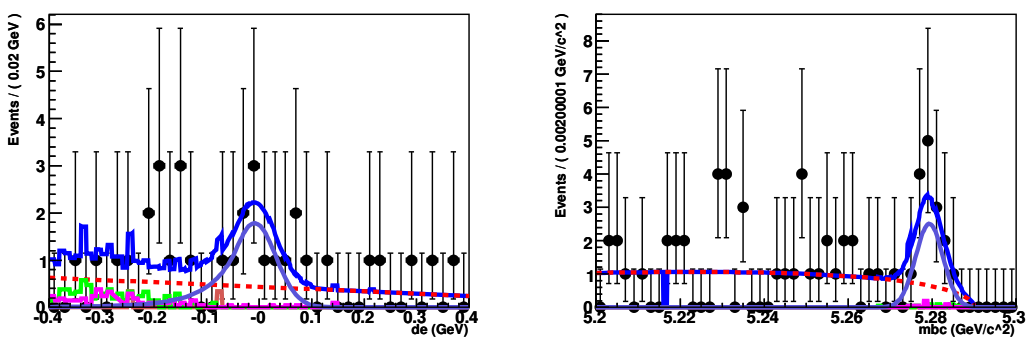
MC Fit of $B^0 \to \phi\pi^0$ decay

MC fit based on $605fb^{-1}$

- Entire Region



- Slice Region



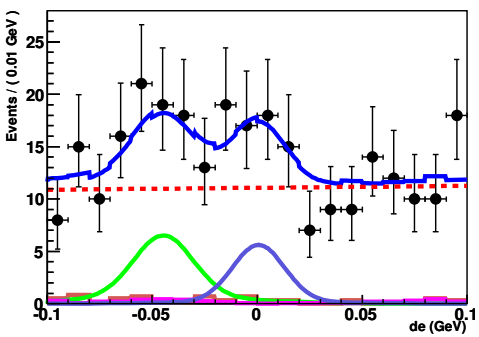
the fit result

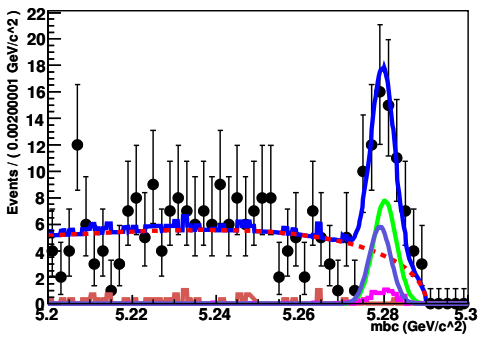
	expected(input)	fit result
ArgPar		-20.0 ± 11
dElin		-0.38 ± 0.15
$q\bar{q}$	75.08	70.5 ± 8.7
$b \to c$	2.76	fixed
dominant B	5.69	fixed
the rest B	3.84	fixed
nSig	8.45	11.1 ± 4.1

MC Fit of $B^- \to \phi\pi^-$ decay

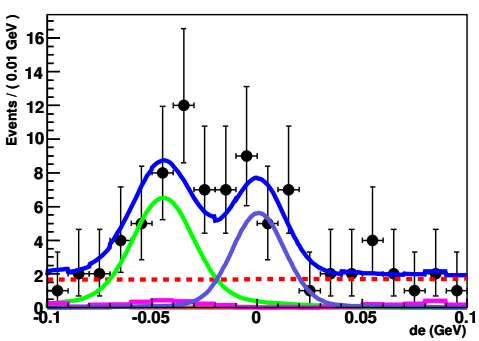
MC fit based on $605fb^-1$

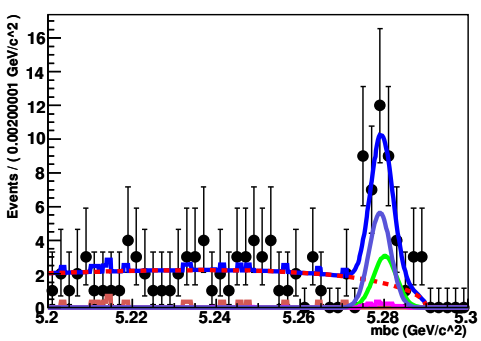
- Entire Region





- Slice Region



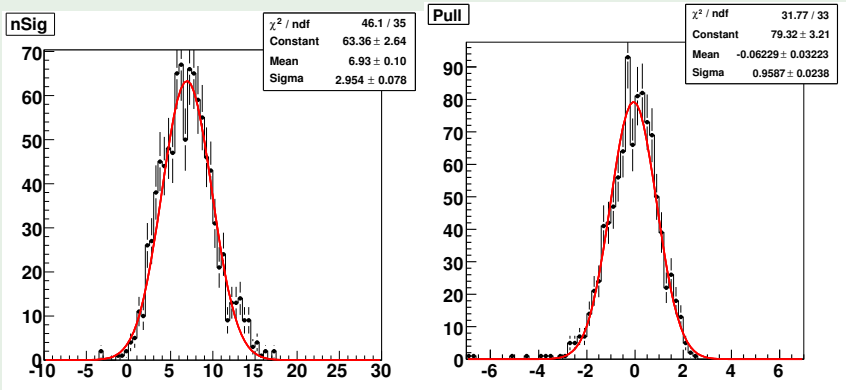


the fit result

parameters	expectation	fit result
ArgPar		-24.54 ± 8.3
dElin		0.02 ± 0.12
$q\bar{q}$	216.22	222 ± 16
$b \to c$	7.08	fixed
dominant B	29.32	26.9 ± 6.7
the rest B	4.06	fixed
nSig	14.34	18.8 ± 5.6

Toy MC

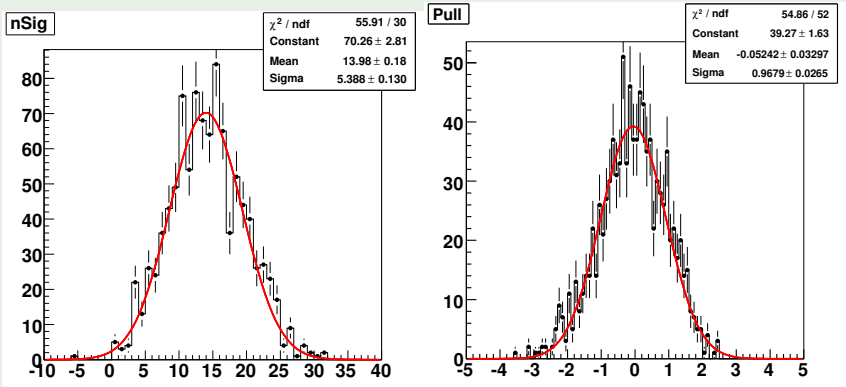
$B^0 \to \phi\pi^0$:1K samples, 94 candidates



- The result of $B^0 \to \phi\pi^0$

parameter	mean(μ)	sigma(σ)
nSig	6.93$\pm$0.10	2.954$\pm$0.078
pull	-0.06229$\pm$0.03223	0.9587$\pm$0.0238

$B^+ \to \phi\pi^+$:1K samples, 271 candidates

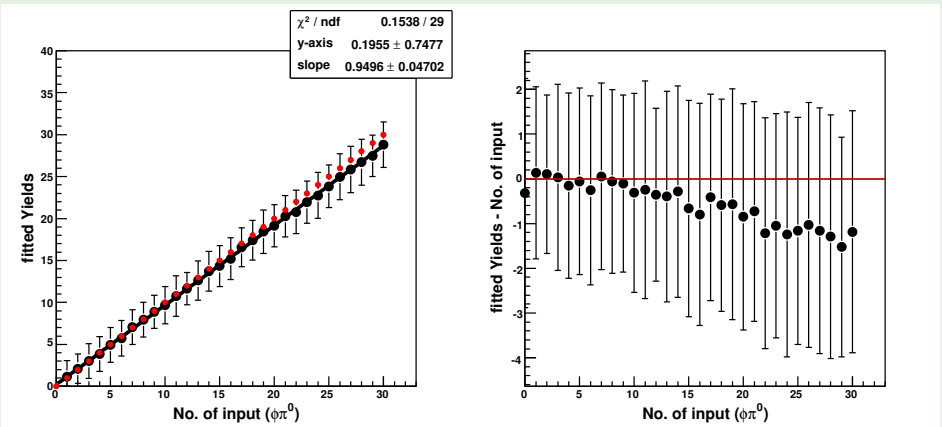


- The result of $B^+ \to \phi\pi^+$

parameter	mean(μ)	sigma(σ)
nSig	13.988$\pm$0.18	5.388$\pm$0.130
pull	-0.05242$\pm$0.03297	0.9679$\pm$0.0265

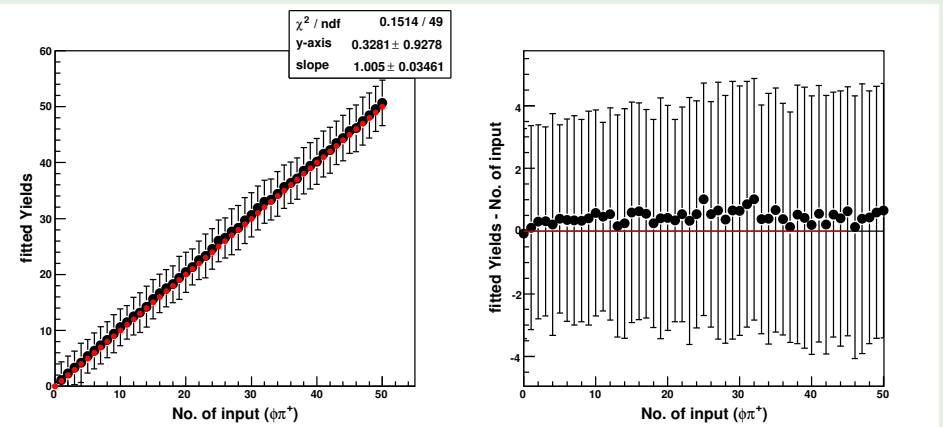
GSIM linearity test

$B^0 \to \phi\pi^0$



- 100 samples for each signal number of events
- $Y_{\phi\pi^0} = 0.950(Y'_{\phi\pi^0}) + 0.196$
- data point : mean, error : standard deviation

$B^+ \to \phi\pi^+$



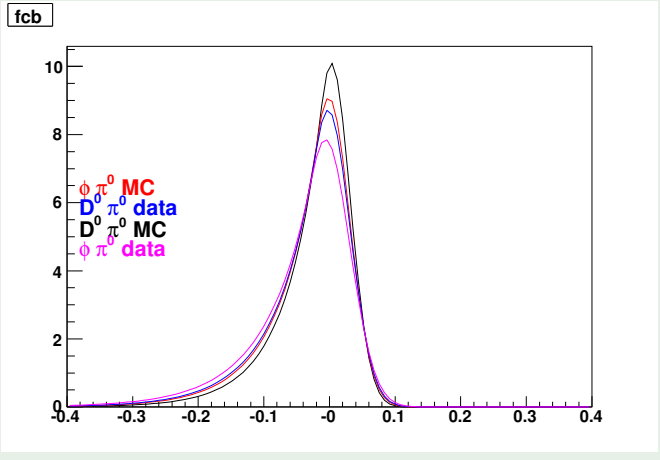
- 100 samples for each signal number of events
- $Y_{\phi\pi^+} = 1.005(Y'_{\phi\pi^+}) + 0.328$
- data point : mean, error : standard deviation

Calibration for $B^0 \to \phi\pi^0$

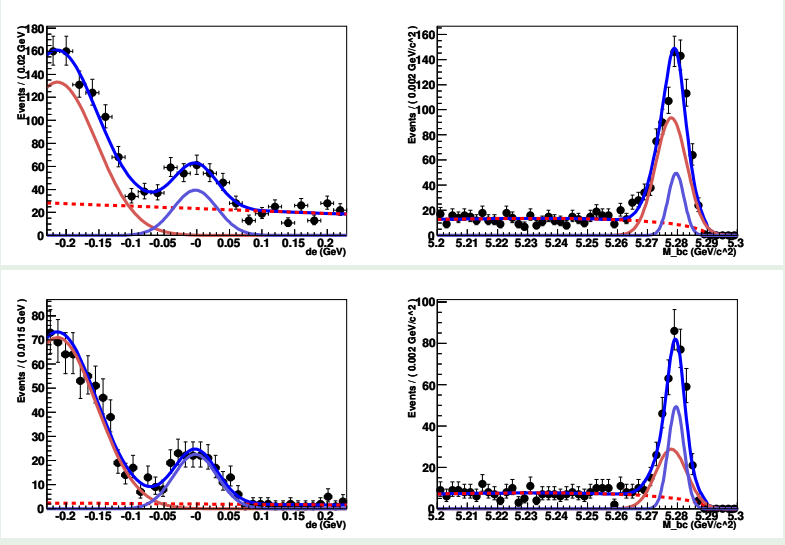
	$B^0 \to \phi\pi^0$ MC	$B^0 \to \overline{D^0}\pi^0$ MC	$B^0 \to \overline{D^0}\pi^0$ data	$B^0 \to \phi\pi^0$ data
μ	-0.001096	0.002881	-0.00218	-0.006157
σ	0.03215	0.02896	0.0335	0.03719

- control sample : $B^0 \to \overline{D^0}\pi^0$
- $\mu_{\phi\pi^0}{}^{data} = \mu_{\phi\pi^0}{}^{MC} + (\mu_{D\pi^0}{}^{data} - \mu_{D\pi^0}{}^{MC})$
- $\sigma_{\phi\pi^0}{}^{data} = \sigma_{\phi\pi^0}{}^{MC} \times (\sigma_{D\pi^0}{}^{data} / \sigma_{D\pi^0}{}^{MC})$

CB shape



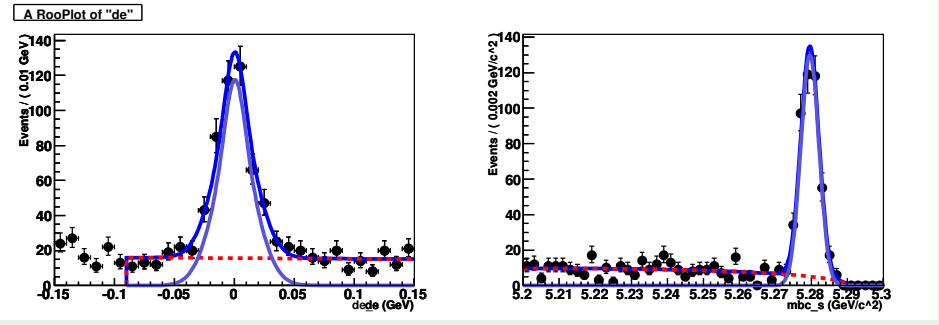
$B^0 \to \overline{D^0}\pi^0$ data fit



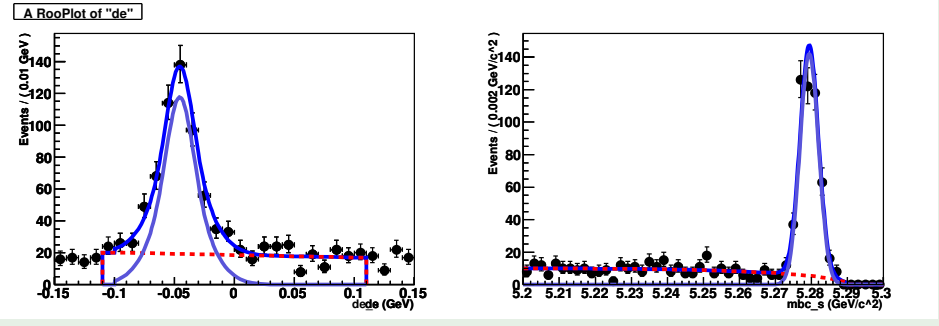
Calibrations for $B^+ \to \phi\pi^+$, $B^+ \to \phi K^+$ Background

$B^+ \to \phi K^+$ for data: prob$(K/\pi) > 0.6$

- $B^+ \to \phi\pi^+$ calibration



- $B^+ \to \phi K^+$ Background calibration



- $B^+ \to \phi\pi^+$ calibration

prob(K/pi)	0.6
σ_1	0.0173
σ_2	0.0076
μ	0.00049
frac	0.81

- $B^+ \to \phi K^+$ Background calibration

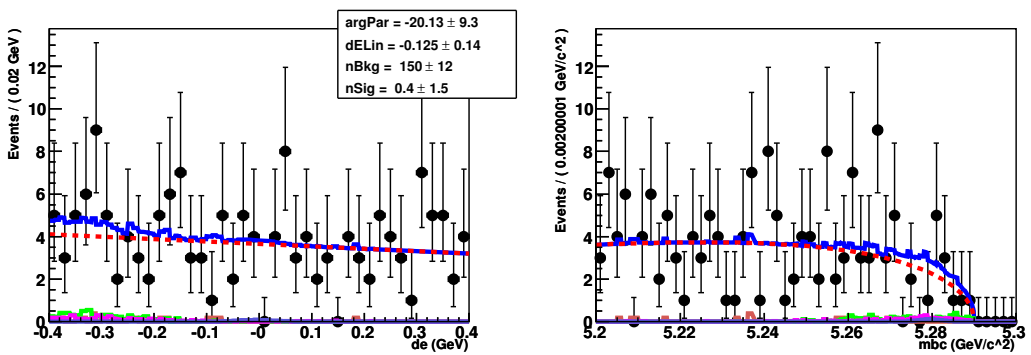
prob(K/pi)	0.6
σ_1	0.0102
σ_2	0.0209
μ	-0.04454
frac	0.37
nSig	268

- expectation : 19.77(357 fb^-1)

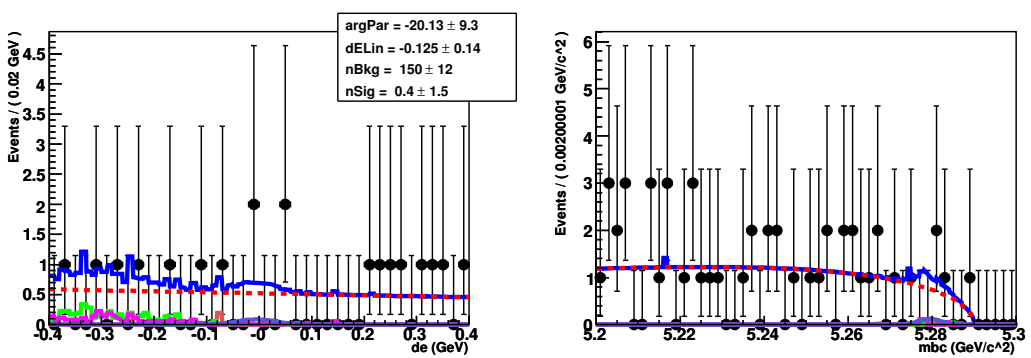
Data Fit of $B^0 \to \phi\pi^0$ decay: with $a^{00}\pi^0$ component

$357fb^{-1}$ data

- Entire Region



- Slice Region



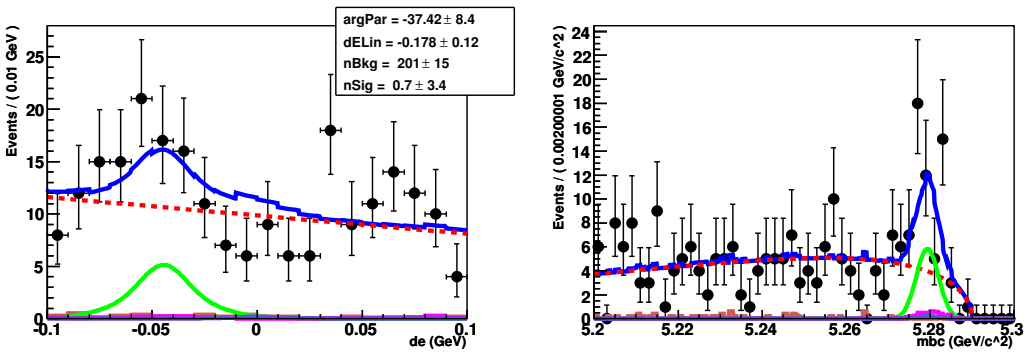
the fit result

	expected(input)	fit result
ArgPar		-20.13 ± 9.3
dElin		-0.125 ± 0.14
$q\bar{q}$	44.37	150 ± 12
$b \to c$	1.63	fixed
dominant B	3.36	fixed
peaking	0.44	fixed
the rest B	2.27	fixed
nSig	4.20	0.4 ± 1.5

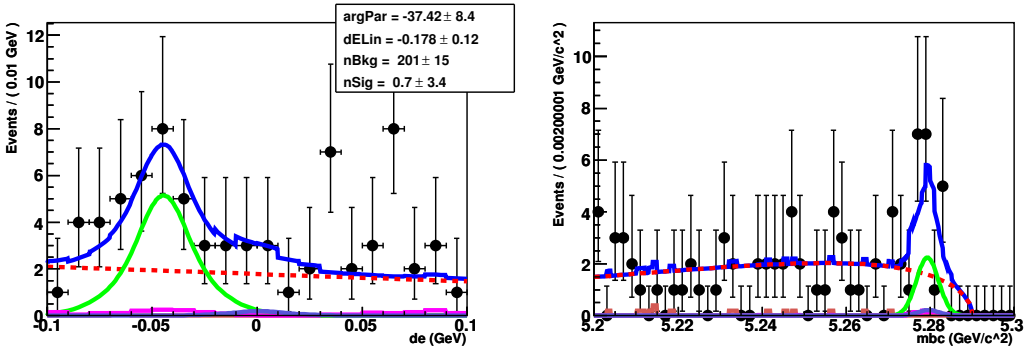
Data Fit of $B^+ \to \phi\pi^+$ decay : with $K^+K^-\pi^+$ component

$357fb^{-1}$ data

- Entire Region



- Slice Region



the fit result

parameters	expectation	fit result
ArgPar		-37.42 ± 8.4
dElin		-0.178 ± 0.12
$q\bar{q}$	127.78	201 ± 15
$b \to c$	4.18	fixed
dominant B	19.77	fixed
the rest B	2.40	fixed
peaking	3.21	fixed
nSig	8.42	0.7 ± 3.4

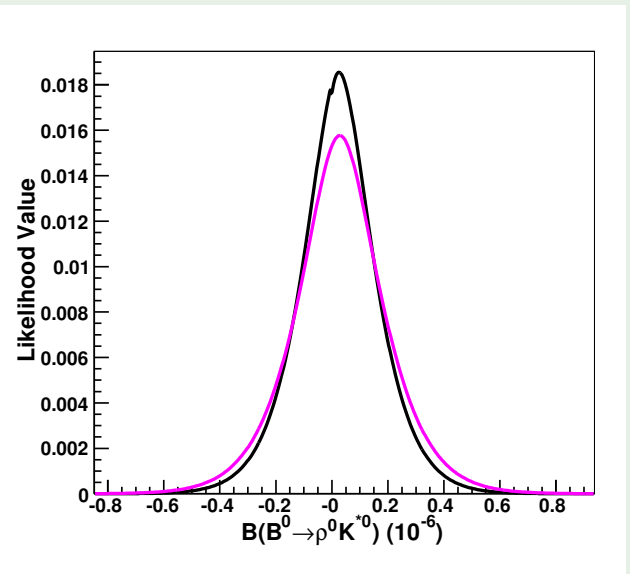
systematics of $B \to \phi\pi$ decays for $357fb^{-1}$

Type		$B^0 \to \phi\pi^0$		$B^+ \to \phi\pi^+$	
		$+\sigma$	$-\sigma$	$+\sigma$	$-\sigma$
M_{bc}	σ_A	0.07	-0.08	0.08	-0.07
ΔE	σ_A	0.13	-0.15	0.49	-0.67
ΔE range	σ_A	0.07	-0.0	-	-
$b \to qq$	σ_A	0.26	-0.26	0.89	-0.89
$b \to c, b \to u, d, s$ background	σ_A	0.02	-0.04	0.77	-0.89
The non resonance	σ_A	+0.21	-0.34	0.9	-2.88
The fitting bias	σ_A	0.20	-	0.33	-
MC acceptance	σ_M	+0.9%	-0.9%	+0.6%	-0.6%
PID	σ_M	+1.3%	-1.3%	+2.0%	-2.0%
Tracking	σ_M	+2.0%	-2.0%	+3.1%	-3.1%
π^0 detection efficiency	σ_M	+3.0%	-3.0%	-	-
MDLR efficiency	σ_M	+11.1%	-11.1%	+7.1%	-7.1%
$N_{B\bar{B}}$	σ_M	+1.2%	-1.2%	+1.2%	-1.2%

Upper Limit: $357 fb^{-}1$ data

$B^0 \to \phi\pi^0$

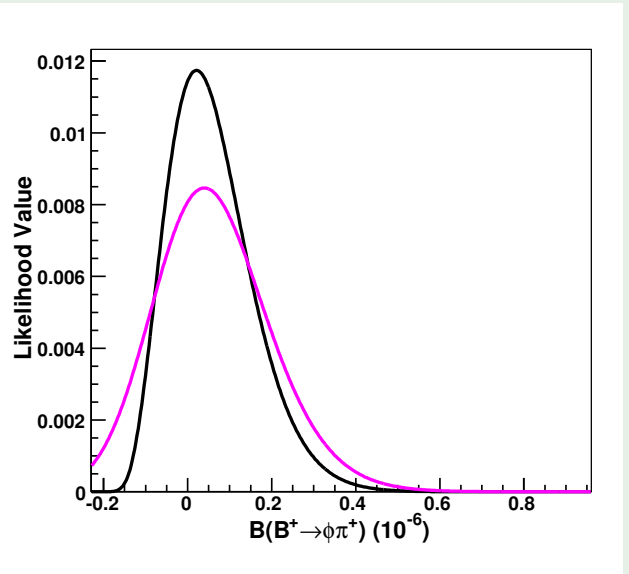
- Central mode : $B^0 \to {a_0}^0\pi^0$



- Upper Limit : $0.30 \times 10^{-}6$
- BF($B^0 \to \phi\pi^0$) : $(0.02^{+0.11}_{-0.07}(stat)^{+0.04}_{-0.03}(syst)) \times 10^{-6}$

$B^+ \to \phi\pi^+$

- Central mode : $B^+ \to K^+K^-\pi^+$



- Upper Limit : $0.27 \times 10^{-}6$
- BF($B^+ \to \phi\pi^+$) : $(0.02^{+0.11}_{-0.09}(stat)^{+0.06}_{-0.09}(syst)) \times 10^{-6}$

Plan

- $357 fb^{-1} \to$ Graduation thesis.
- $605 fb^{-1} \to$ Will be submitted to PRD.
- We find the interesting something. $B^+ \to K^+K^-\pi^+$ final stat has a peak in the side band in the viewpoint of $M(K^+K^-)$.
  $\to$ The peak has high probability of $B^+ \to {a_0}^0\pi^+$.
- We have the similar modes ,$B \to \phi\rho$.
  $\to$ Nobody study the modes.