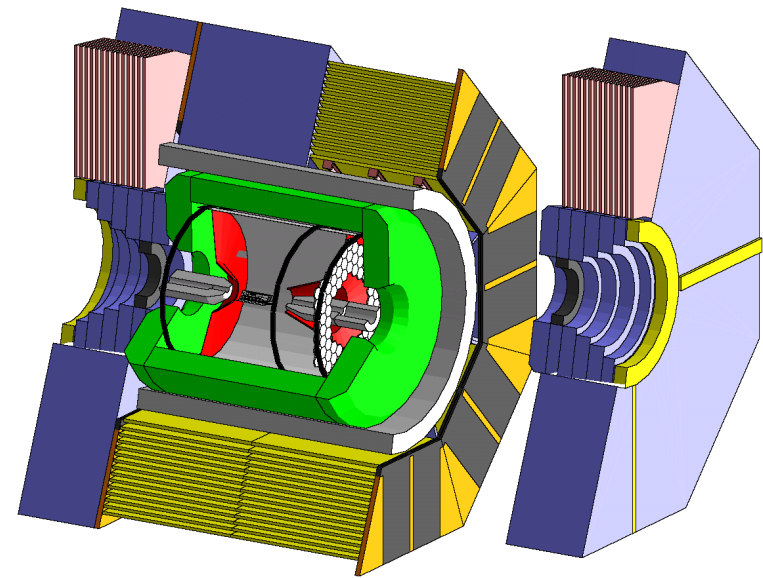
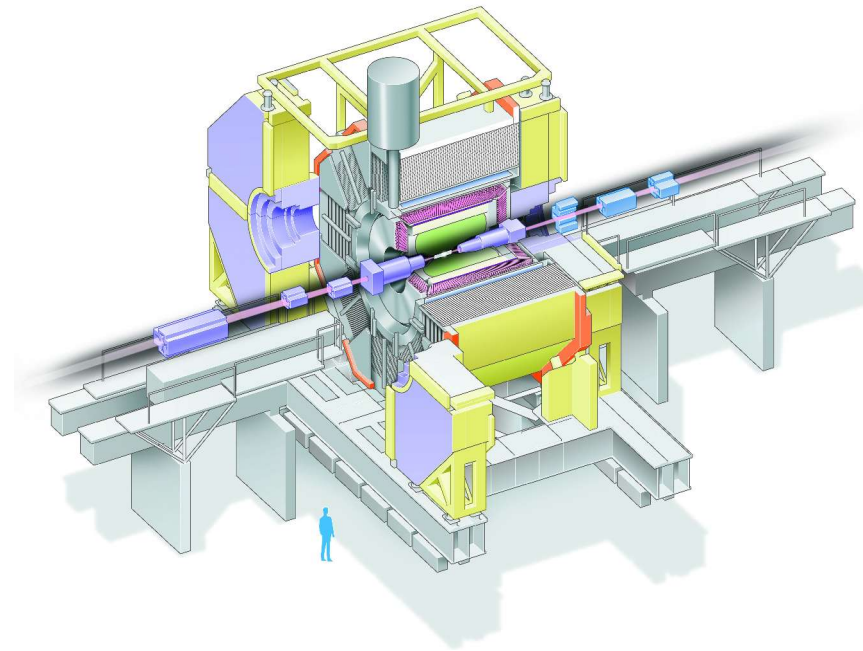


G4superb tracking and vertexing...

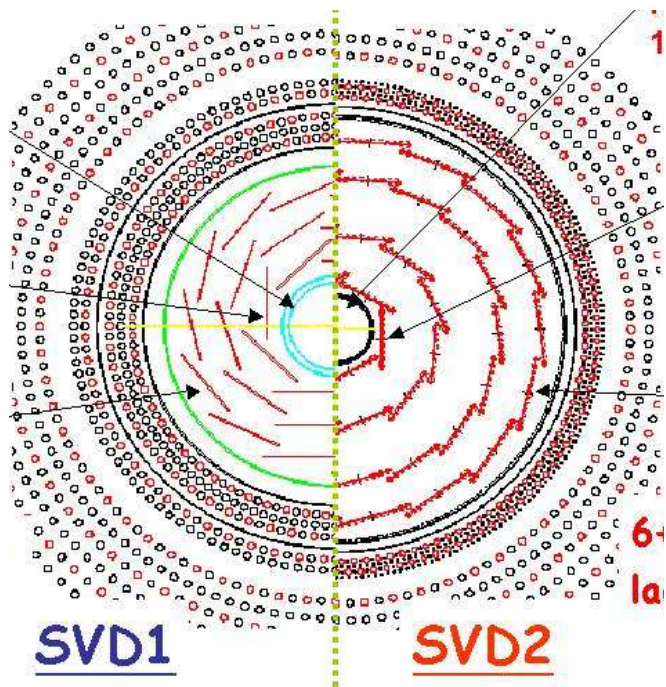
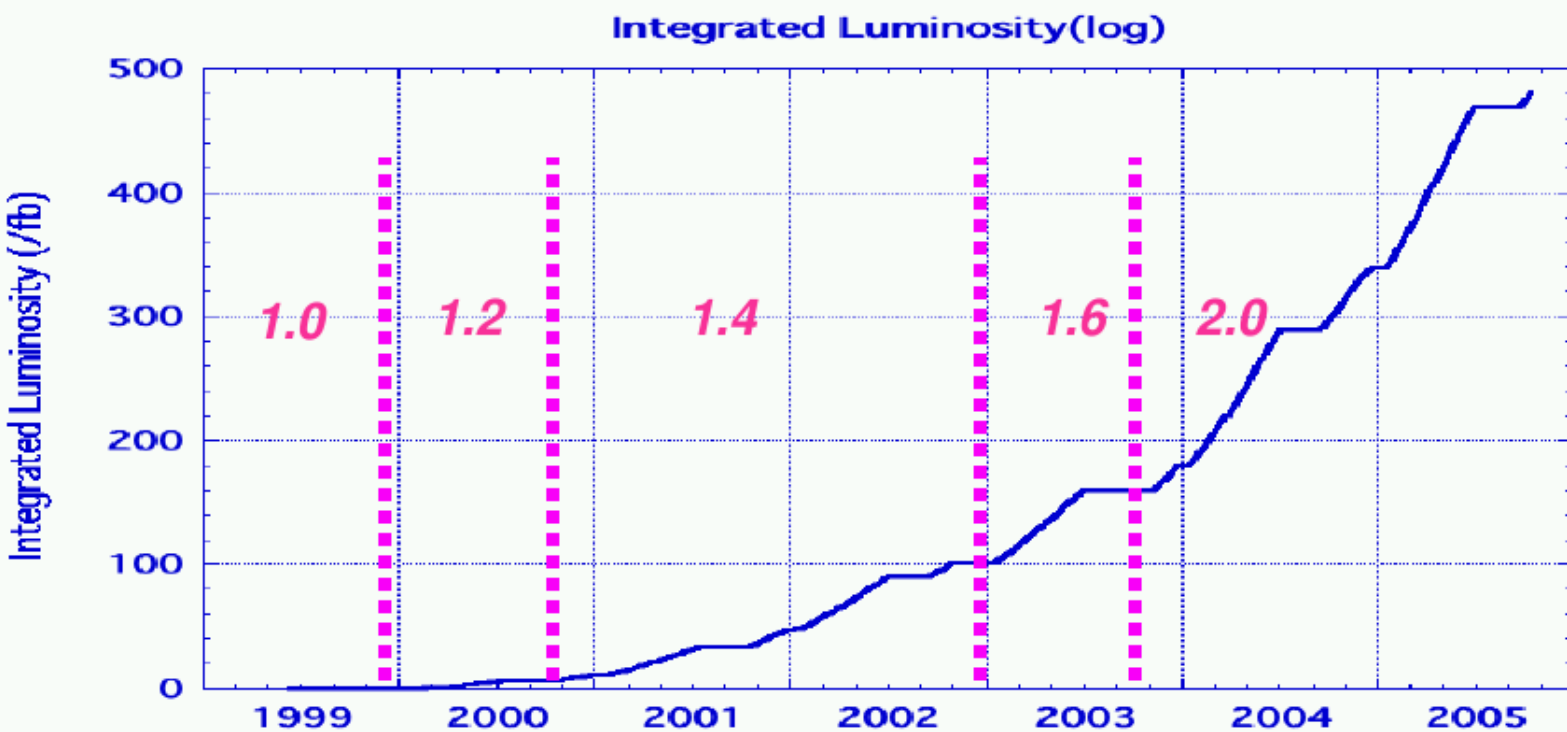
K.Trabelsi

Open meeting for proto-collaboration
March 20th, 2008

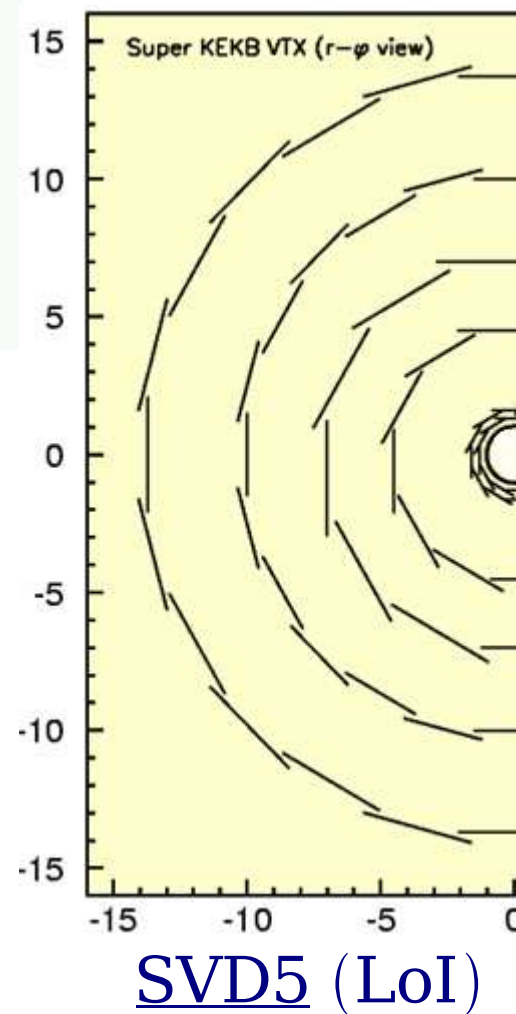


work done with A.Kibayashi, N.Katayama, T.Hara, H.Ozaki, Y.Iwasaki...

History of SVD(s)

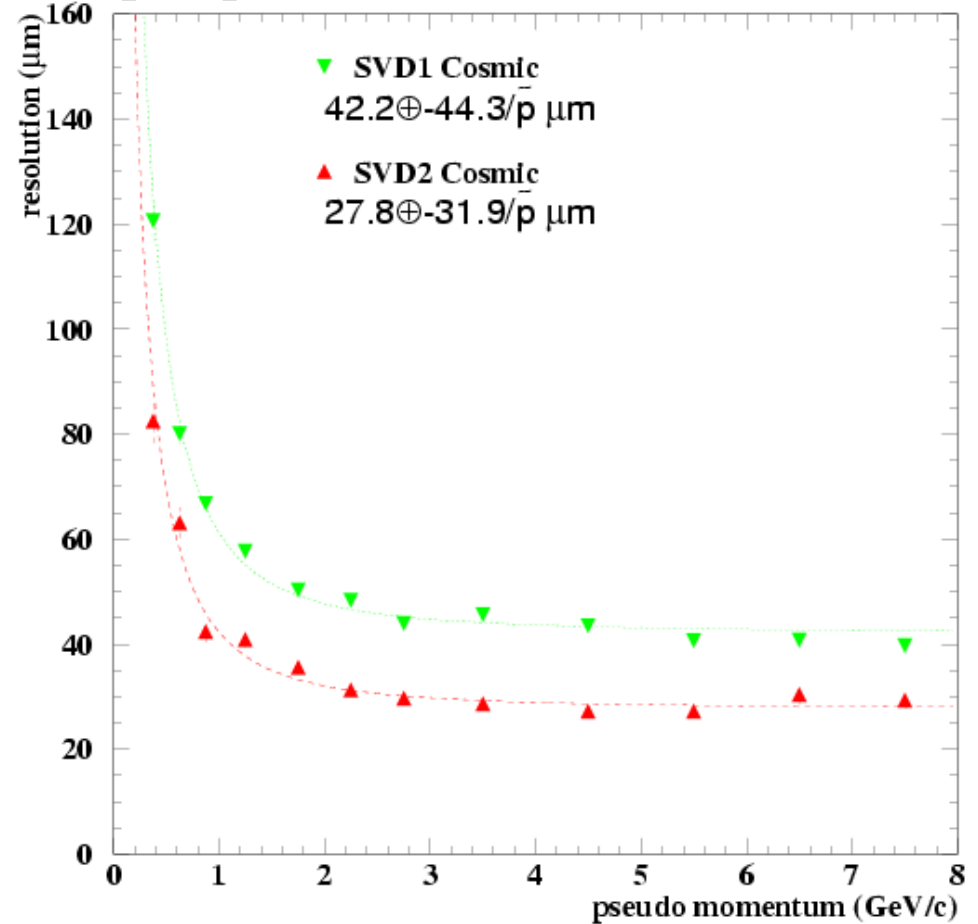
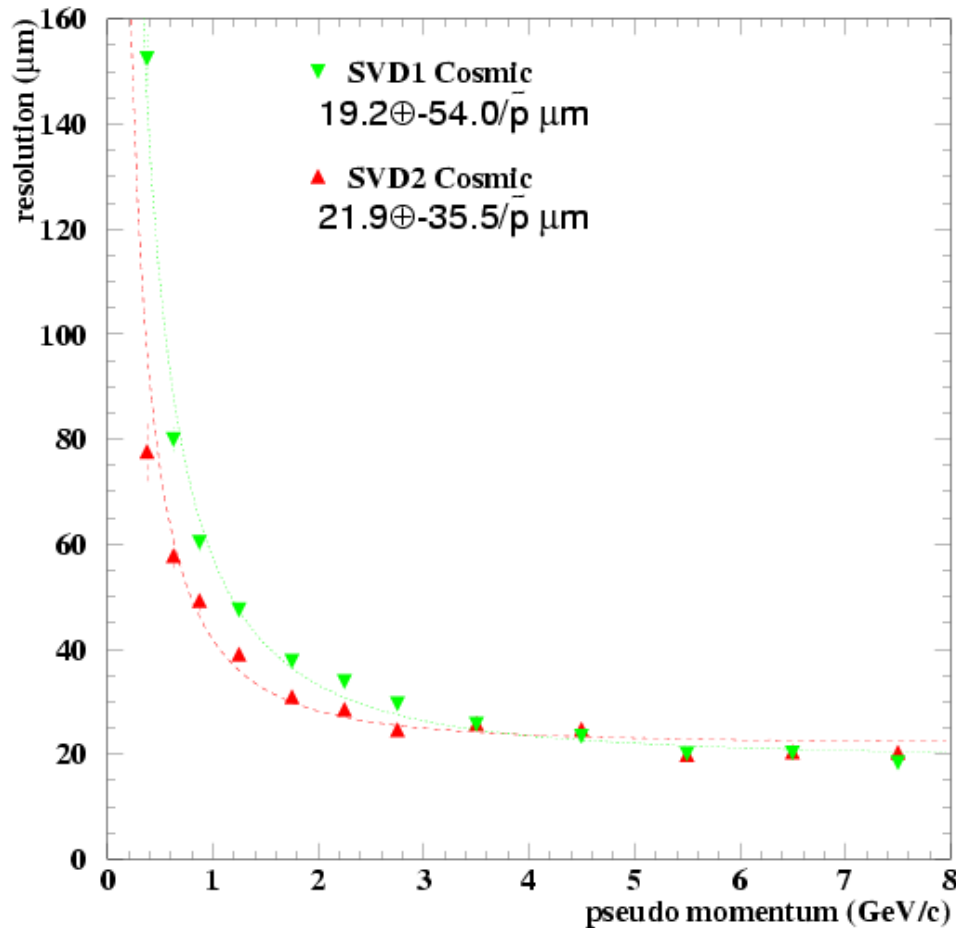


.....
SVD3mod (sBelle)



Impact parameter resolutions for SVD1/2

$$\tilde{p} = p\beta\sin\theta^f, \quad f=3/2(r-\phi), \quad 5/2(z)$$



$\sigma_{ip} = a \oplus b/P_t$	$a(\mu\text{m})$	$b(\mu\text{m GeV})$
LEP	25	70
SLD	8	33
LHC	12	70
RHICII	14	12
ILC	5	10

→ Belle SVD2

where will be Super Belle ?

until now...

T.Kawasaki
(Atami, 08)

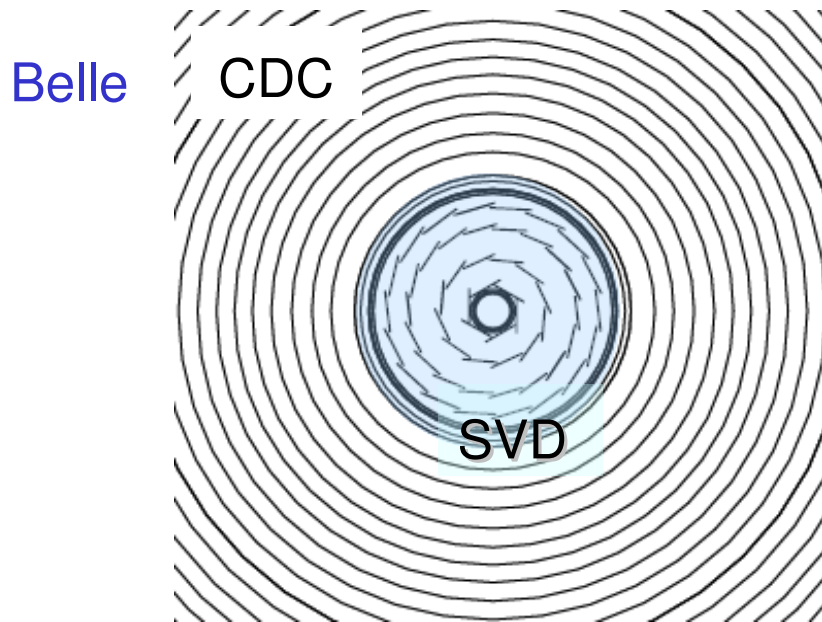
Study of detector configuration

SVD

L1-L4 @ $r = 2.0, 4.35, 7.0, 8.8$ cm

CDC

$r = 8.8 \sim 86.3$ cm

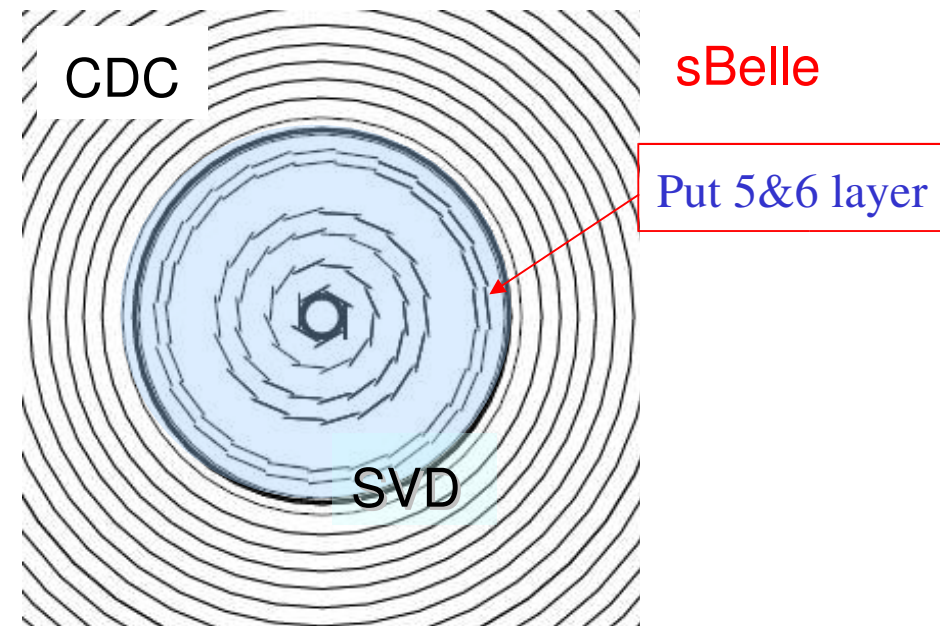


SVD

Add L5&L6 @ $r = (13), 14$ cm

CDC

$r = 16.0 \sim 112.0$ cm

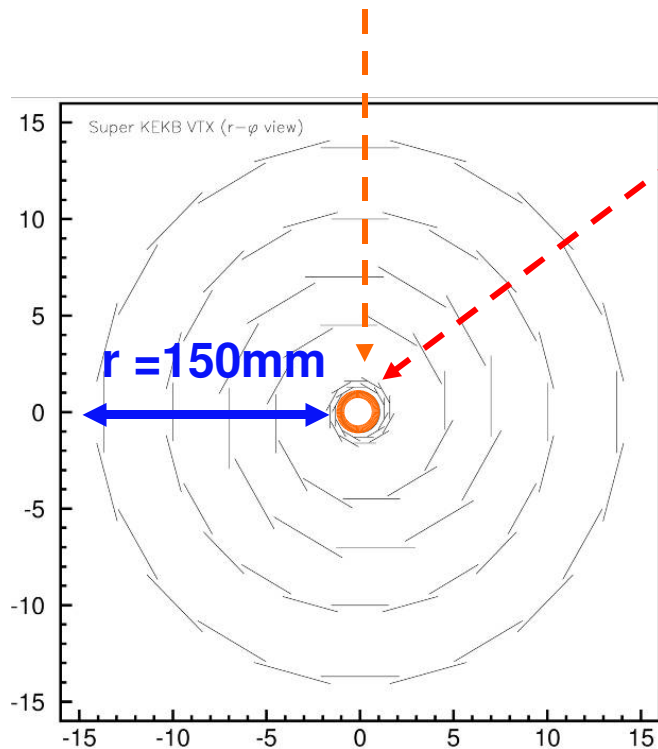


Evaluate new detector configuration
with TRACKER calculation & GEANT3
full simulation

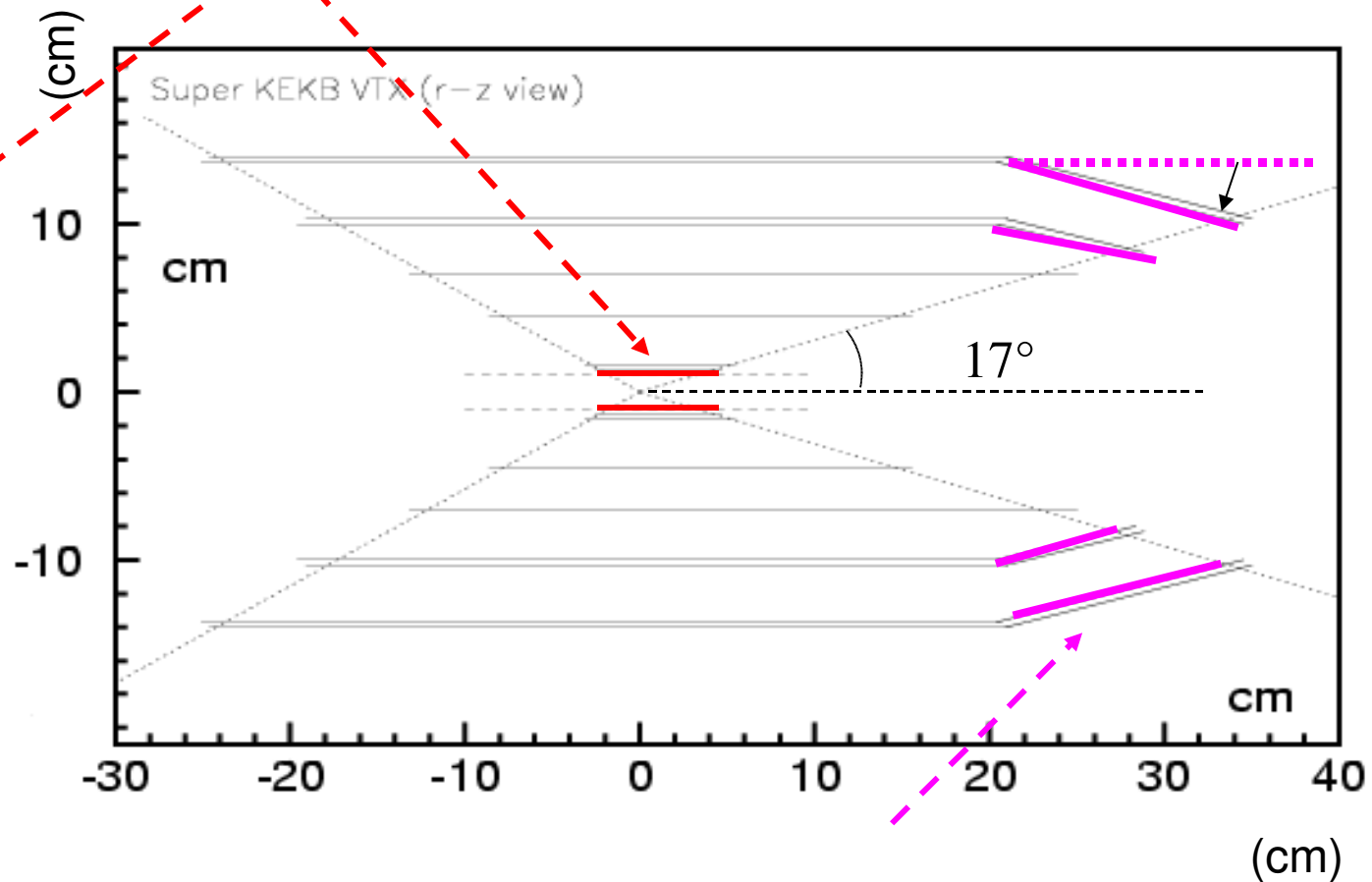
Modify the current Belle simulator
Use L4 ladder structure as L5&6 layer
No sensor at forward region

Super Belle Vertex Tracker (LoI '04)

Aim 1cm radius beam pipe



Two thin pixel layers

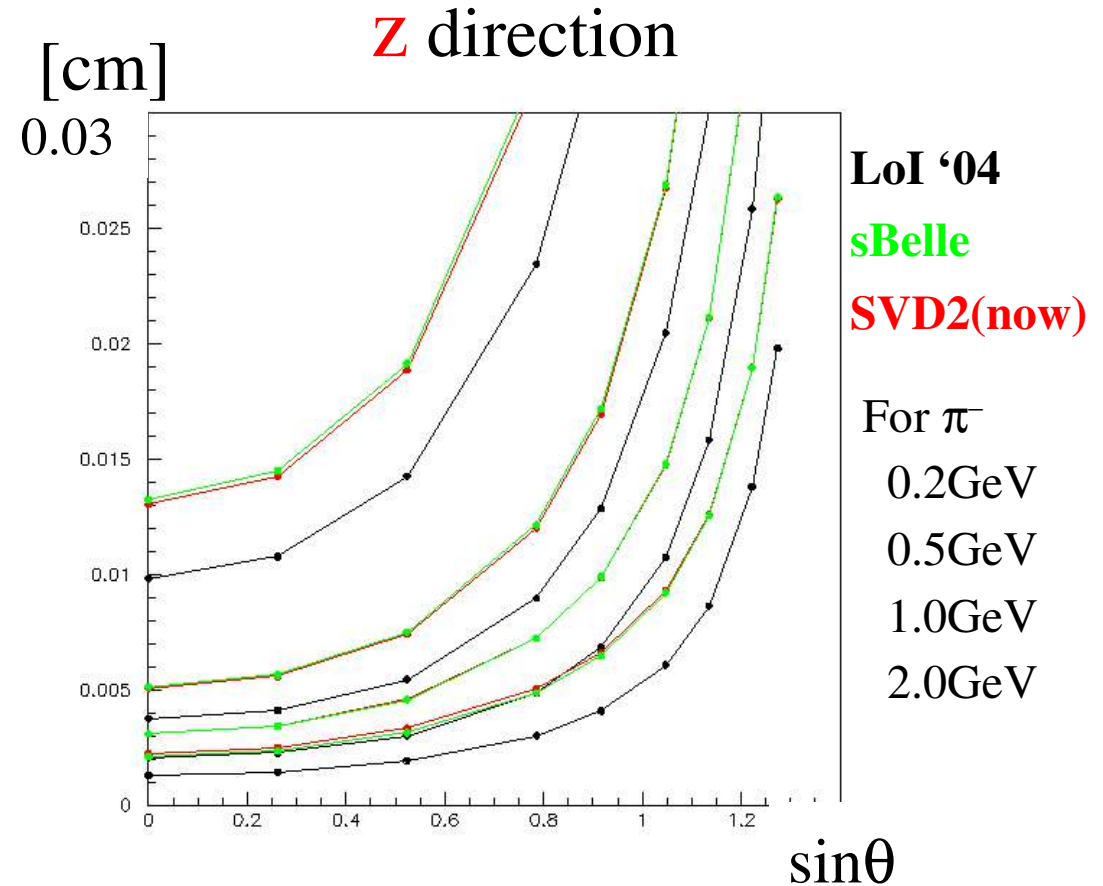
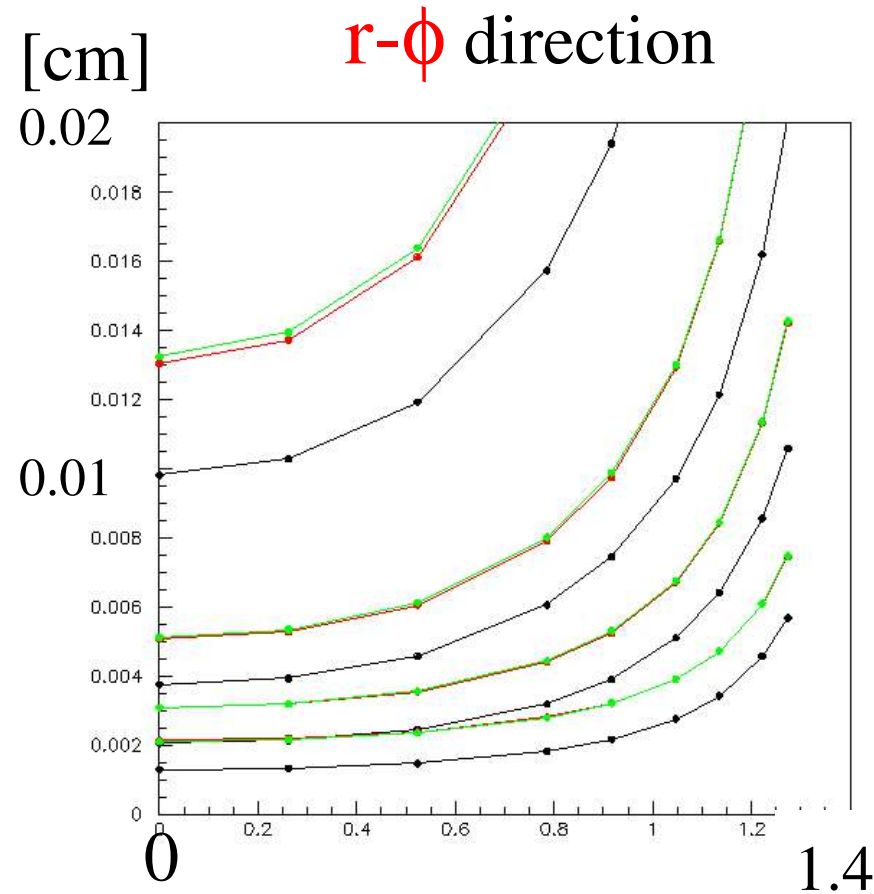


- 6 sensor layers to make low momentum tracking
- Slanted layer to keep acceptance , optimize incident angle and save detector size

Impact Parameter resolution

T.Kawasaki
(Atami, 08)

Calculated by TRACKERR



Beampipe radius is important
Competitive performance as the current SVD

Occupancy effects.

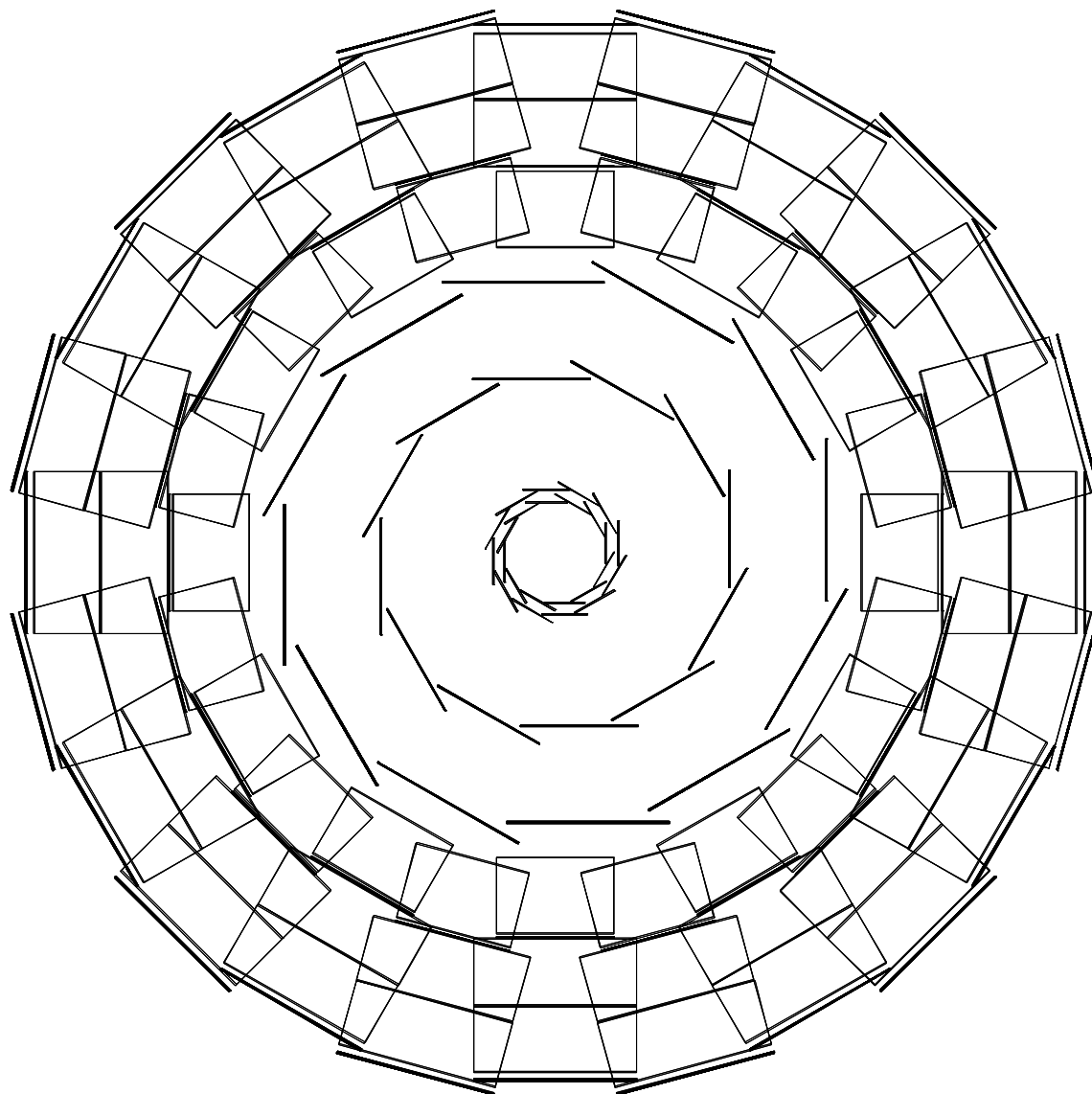
Degradation of intrinsic resolution
is included.

Efficiency loss is NOT included

Summary of SVD in the current G4 simulation

(see also previous talk, A.Kibayashi)

(a.k.a SVD 5)



layer 6

$r = 13.7\text{ cm}/14.0\text{ cm}$
($55\ \mu\text{m}$, $145\ \mu\text{m}$)

layer 5

$r = 10.0\text{ cm}/10.3\text{ cm}$
($55\ \mu\text{m}$, $152\ \mu\text{m}$)

layer 4

$r = 7.0\text{ cm}$
($55\ \mu\text{m}$, $145\ \mu\text{m}$)

layer 3

$r = 4.5\text{ cm}$
($55\ \mu\text{m}$, $152\ \mu\text{m}$)

layer 2

$r = 1.6\text{ cm}$
($78\ \mu\text{m}$, $55\ \mu\text{m}$)

layer 1

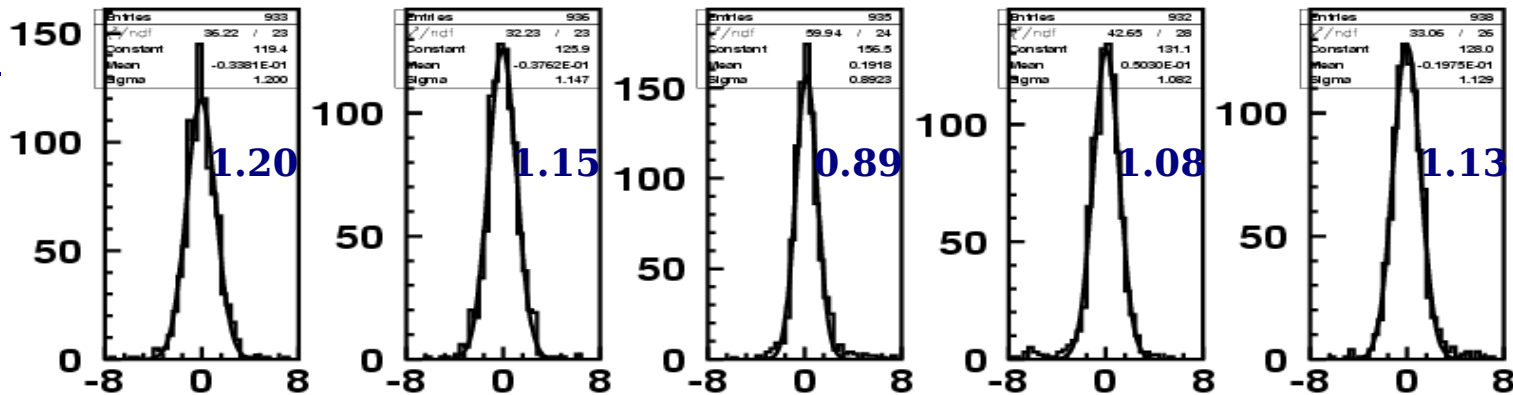
$r = 1.3\text{ cm}$
($66\ \mu\text{m}$, $69\ \mu\text{m}$)

Belle SVD clustering and (SVD+CDC) tracking software updated !

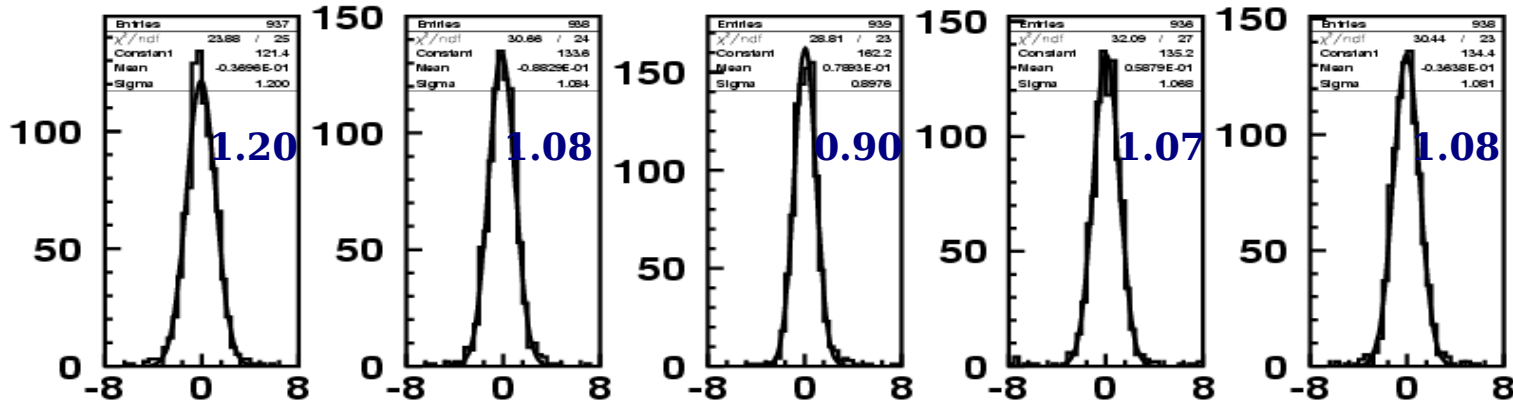
Geometry , material and hits resolution implemented...

$$\text{pull} = \frac{(a_{\text{true}} - a_{\text{rec}})}{\sigma_a}$$

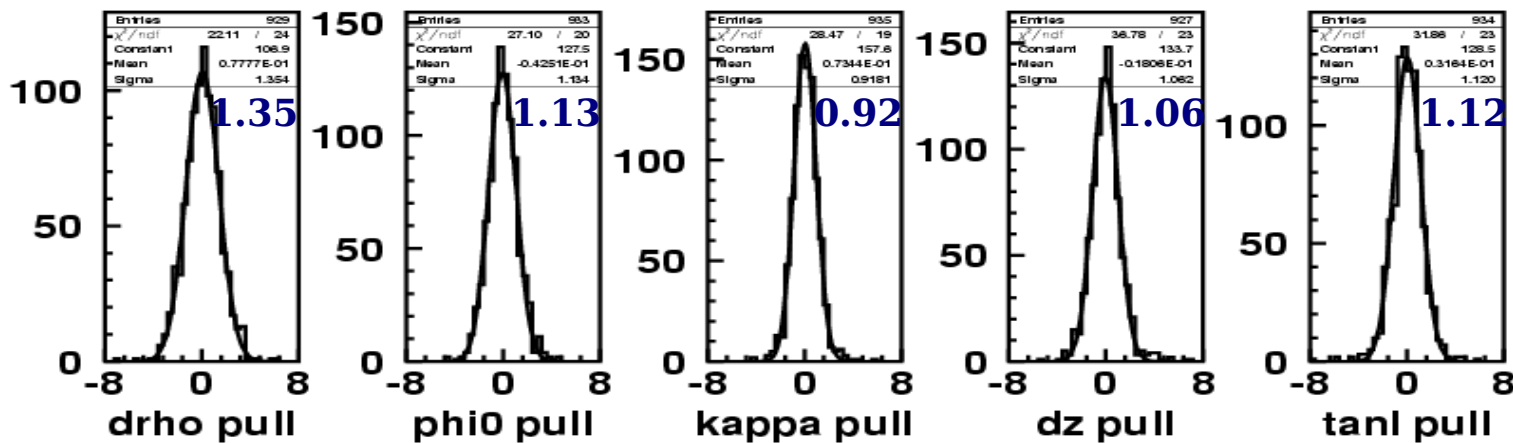
$p = 0.5 \text{ GeV}/c$



$p = 1.0 \text{ GeV}/c$

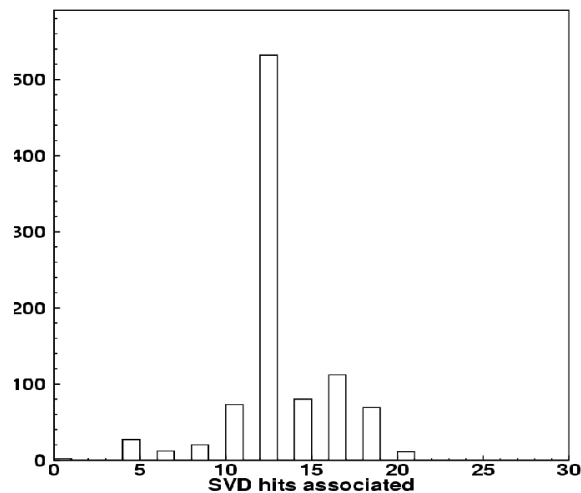


$p = 2.0 \text{ GeV}/c$



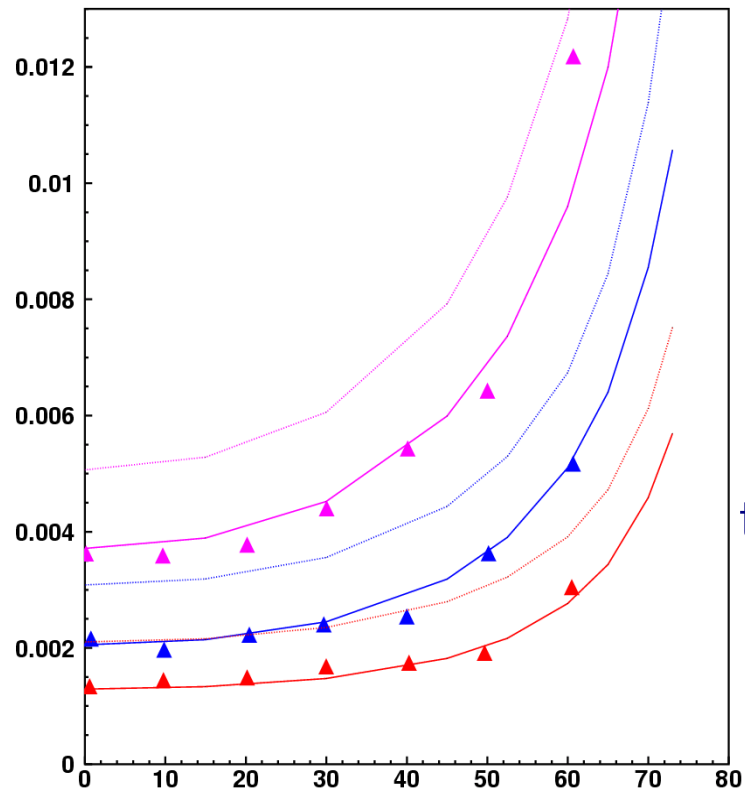
... \pm properly in simulation and reconstruction

and ...
(the latest version)



SVD hits associated ~ 12
 $\sim 1-r\phi$ and $1-z$ per layer

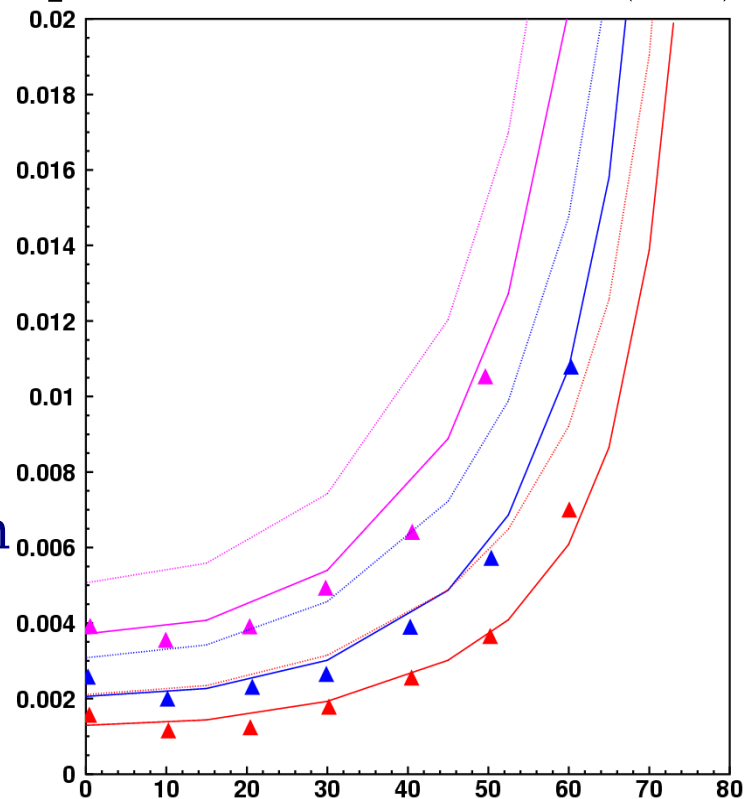
imp. parameter resol in $r-\phi$ (cm)



$p = 0.5$ GeV
 $p = 1$ GeV
 $p = 2$ GeV

lines: TRACKER
dotted lines: SVD2
full lines: SVD5
triangles: G4 version

imp. parameter resol in z (cm)



\rightarrow a first GEANT step...

The main goals of this software

- prepare tracks for the PID detectors...
- impact parameter resolutions...
(but not final goal, trackerr can do it)
- estimation of the advantage of the slanted version
- real goals :
 - tag side z resol improvement (charm vertex etc...)
 - continuum suppression
 - low momentum tracking (and not that low...)
 - 6/5/4 layers ?
 - ...

**→ motivate/justify the design of SVD/IR...
...as soon as possible**

Do we need a pixel upgrade?

Hitoshi Yamamoto
The University of Hawaii

Belle general meeting, March 24, 1999.

A proposal for systematic simulation study for
vertexing upgrade.

+ A status report on pixel technology

♠: items needing MC study

Example: Can we find $B^- \rightarrow K^{*0}K^-$
if Br is 1/20 of $\rho^0\pi^-$? ♠

CLEO 2.5: $\rho^0\pi^-$ S/N $\sim 20/20$ @ 5 fb^{-1}

Assume factor of 4 reduction in bkg by a loose
particle ID cut.

$$\begin{aligned} &\rightarrow K^{*0}K^- \text{ S/N} \sim 1/5 \text{ @ } 5 \text{ fb}^{-1} \\ &\rightarrow K^{*0}K^- \text{ S/N} \sim 10/50 \text{ @ } 50 \text{ fb}^{-1} \end{aligned}$$

Significance = $10/\sqrt{50} = 1.4\sigma$: **Not a signal.**

With $\sigma_{\Delta z^-} > 1/2$ and 1% tail,

Significance $\rightarrow 1.4 \times 5.2 = 7.3\sigma$: **Clear signal.**

$K^{*0}K^-$ is an important mode to understand FSI,
annihilation diagram, and $b \rightarrow d$ penguin.


There are many important modes at this Br level:
 D^+K_S , D^0K^+ , $K^*\eta'$... Many of them play critical
roles in direct CP studies. ♠

Factor of 2 improvement in $\sigma\Delta z$ resolution can be achieved by (rough calculation)

- R_{beampipe} 2cm \rightarrow 1cm.
- 1/2 reduction of material (Si, support, beampipe).
- Keeping the same $\sigma_{\text{measurement}}$.

In general,

- σ_{measure} counts for high- P tracks ($P > 2$ GeV).
- Material reduction is important.
- R_{beampipe} reduction is essential.

Full MC study needed. 

just a reminder...

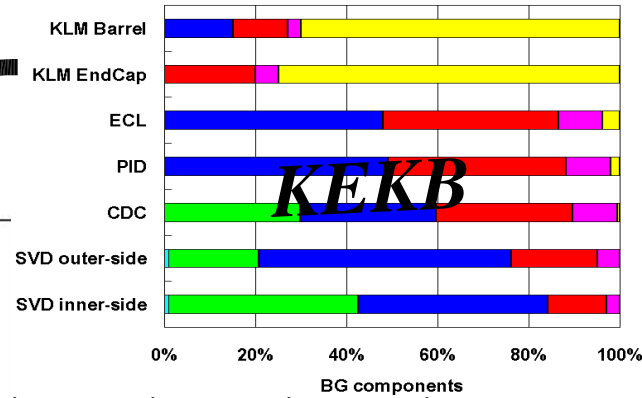
Not simulation !
just extrapolation

Background Estimation

2005
Hawaii
Tajima

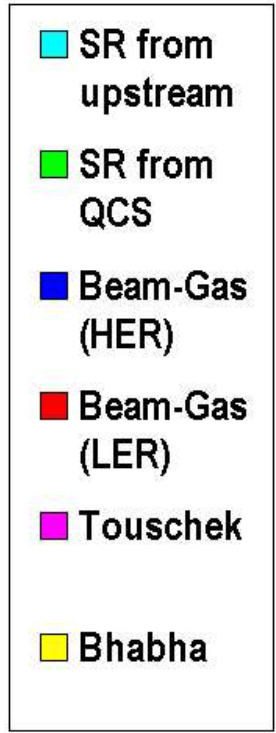
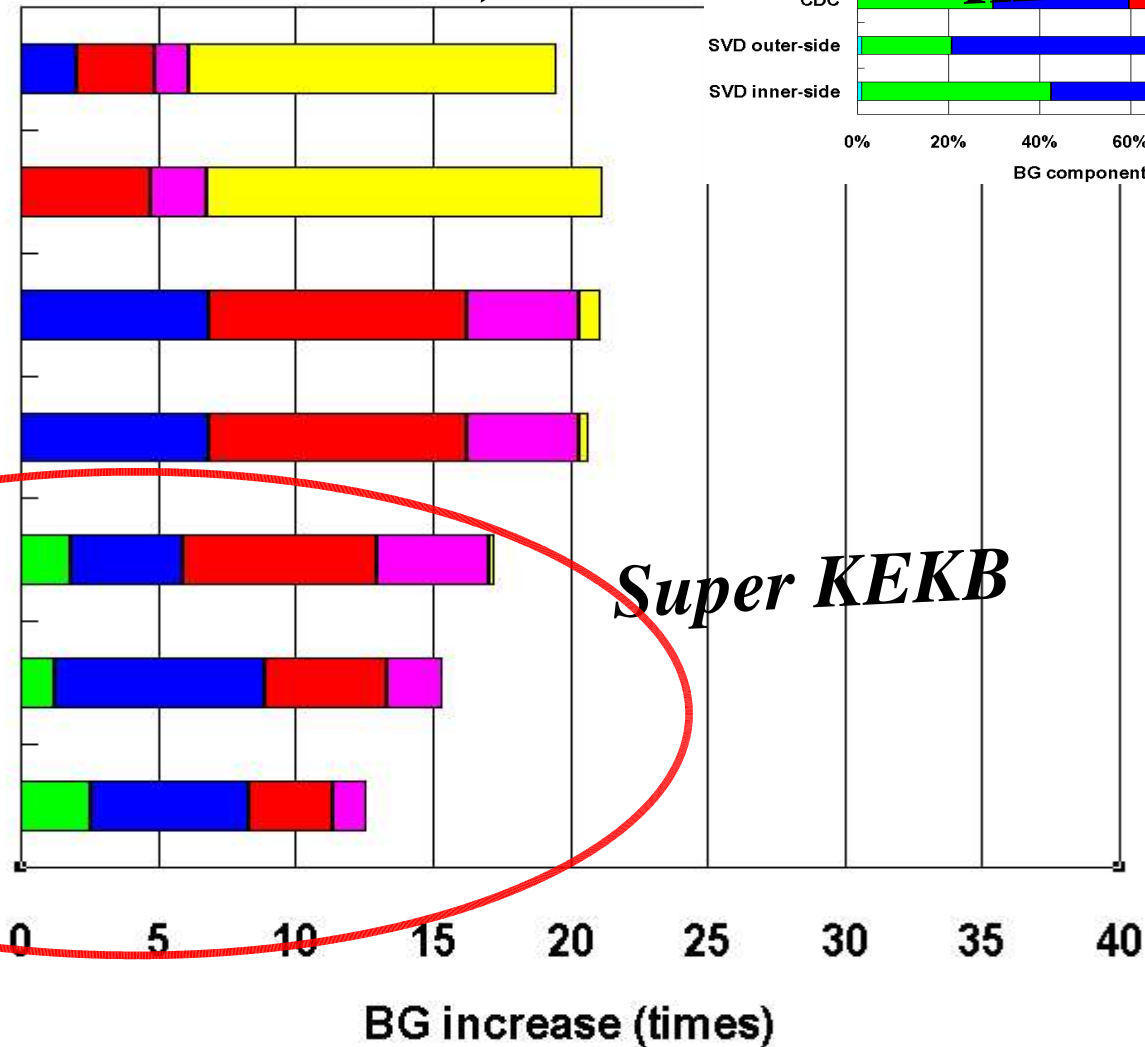
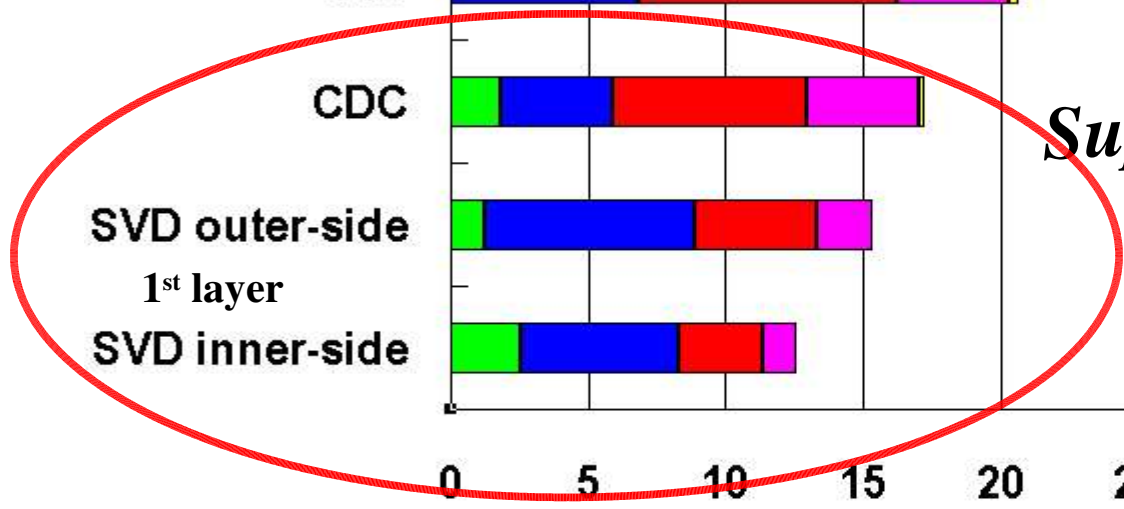
Average Vacuum 5×10^{-7} Pa

Average Vacuum 1.3×10^{-7} Pa

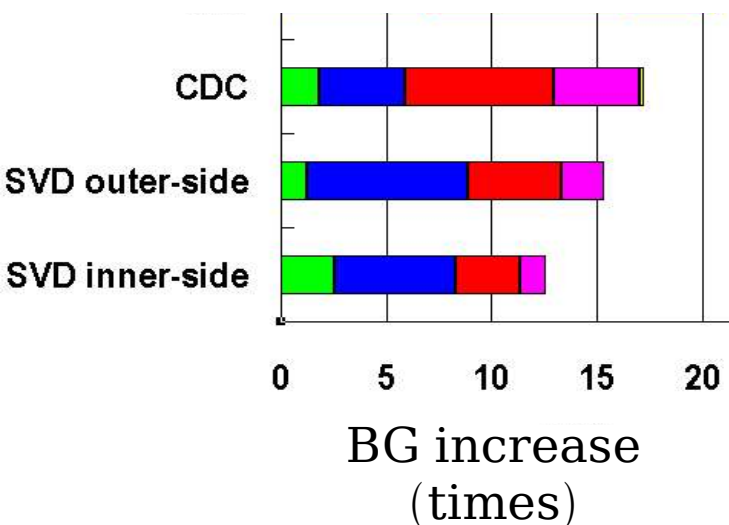


KEKB

Super KEKB



Background extrapolation



Beam Gas scattering origin

- HER/LER currents : 1.2/1.6 A \rightarrow 4.1/9.4 A
- $\times 4$ worse vacuum : $1 \sim 1.5 \times 10^{-7}$ Pa $\rightarrow 5 \times 10^{-7}$ Pa

$\times 13.6$ (HER), $\times 23.6$ (LER)

Touschek origin

- currently 10% of the total BG
- shorter bunch length, higher bunch current ($\times 1.5$), many # bunch ($\times 3.9$)

$\times 23.5 \sim 41$

SR origin

- reduced (1/5) due to improved IR chamber design

"...we assume $\times 20$ BG @ 2×10^{35} ..." , but you are also assuming...

- same optics for KEK-B (QCS magnets located same place)
- same interaction region (same inner radius for SVD, same masks...)

\rightarrow need to do the simulation and redesign the IR region for any change of the beampipe radius...

Summary

- G4 simulation is getting closer and closer to a realistic SVD5
(continuous efforts of the G4 group !)
- reconstruction has been patched *
(*mended, usually clumsily by covering a hole with a patch)
- now can start to perform optimization / tests on this full
G4 simulation
(many benchmarks: charm tagging, continuum suppression, standalone tracker...)
- soon need to rethink / rewrite the tracking
CDC is not anymore the center of tracking...
- need some background simulation...

SVT upgrade Strategy

T.Kawasaki
(Atami, 08)

- T=0 option (2012) for $L = \sim 10^{35}$
 - Keep beampipe radius of 1.5cm same as current one
 - Current SVD configuration + 2 outer layers = 6layers
 - Improve Ks efficiency. Replace CDC inner layers
 - Similar design DSSD can be used
 - Fast Shaping(~ 50 ns) + Timeslice on FE chip

SVD4.0
sBelle

→ modify current G3/reconstruction codes

- Further upgrade for $L > 10^{35}$
 - Smaller beampipe radius ($r = 1$ cm or less)
 - Innermost (thin) Pixel layers
 - Improve impact parameter resolution

SVD5.0
superBelle

→ new G4/reconstruction codes