# OUTLOOK

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***Superb workshop***

***LNF November 11-12, 2005***

# OUTLINE

- Physics case
  - » M.Ciuchini BSM with 50 ab-1
  - » T.Iijima the SuperKEKB motivation
- Machine & WG1
  - » Y.Funakoshi on SuperKEKB
- Detector & WG2
  - »

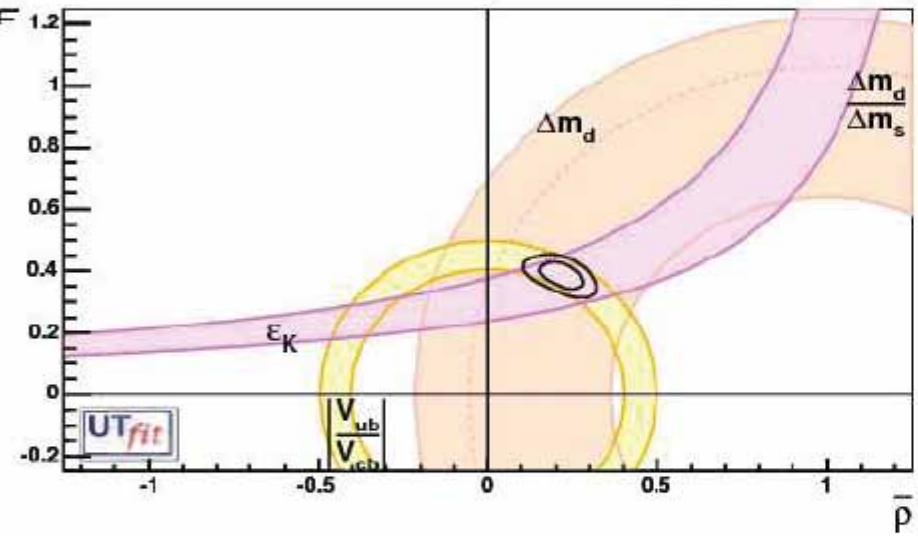
# 2005: A new story begins

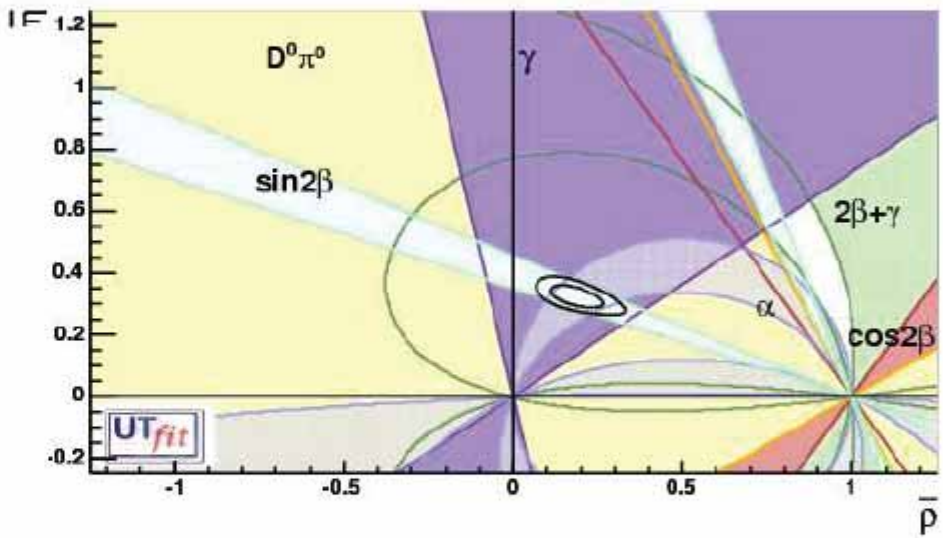
No angles:

$|V_{ub}/V_{cb}|$, $\Delta m_d$, $\Delta M_s$, $\varepsilon_K$

Angles only:

sin2β, cos2β, sin2α, γ




**the parameter determination era ends**

**the precision test/new physics era begins**

redundant constraints on the triangle and **test of new physics**

# Conclusions

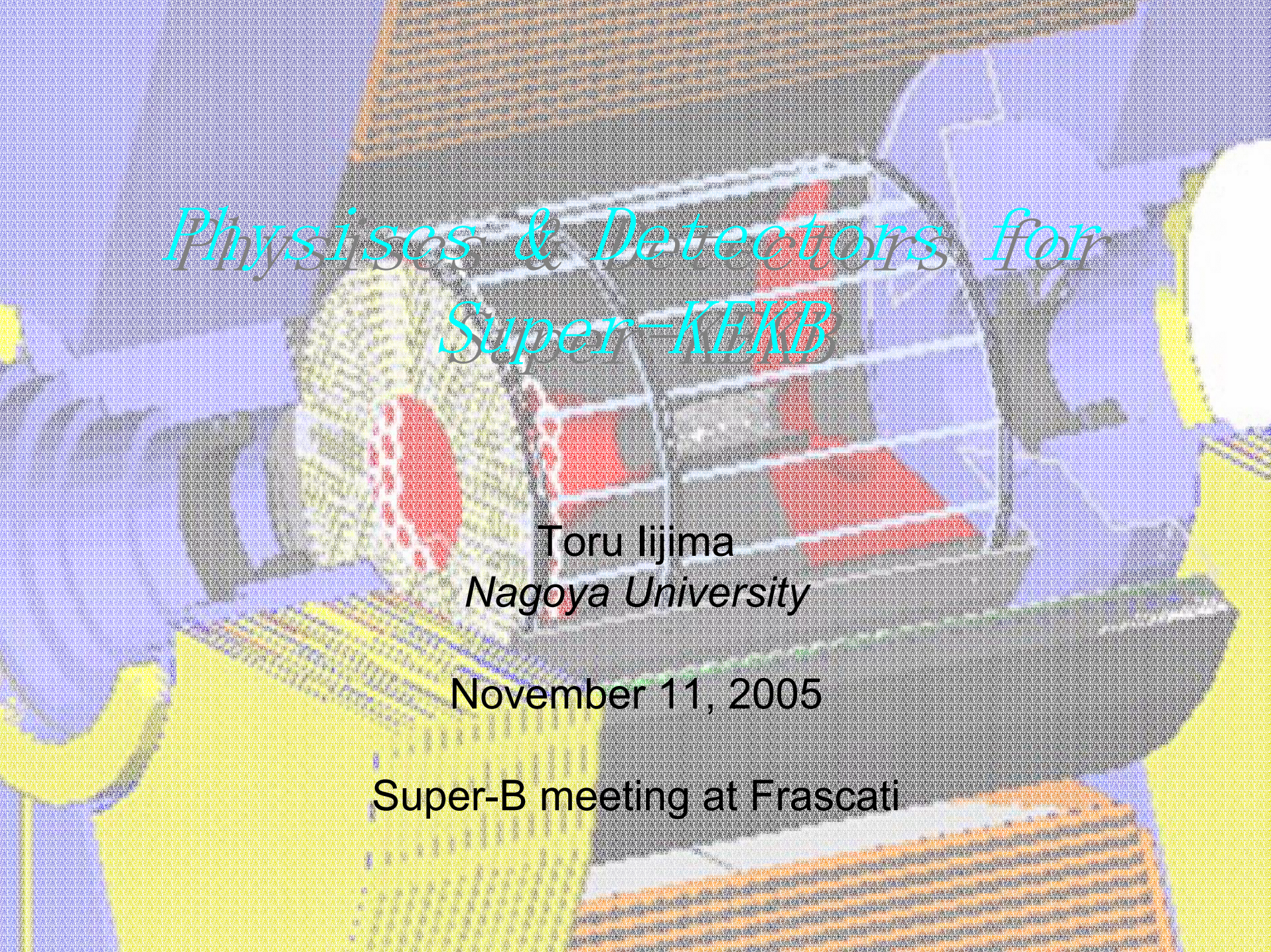
The precision test/new physics era of B physics just began. It requires high statistics and a careful assessment of the uncertainties to be successful

Flavour physics probes the structure of NP models. A high-precision test program is like a NP genome project

Present results point to either no new physics in $\Delta F=2$ $b/s \to d$ transitions or models with (N)MFV. O(1) NP effects are still possible, yet MFV NP is better studied through correlations among different B (and K) decays

Ample room for visible NP in $b \to s$ transitions: motivations from theory, more precise data needed

Interplay between quark and lepton FV in SUSY-GUTs



# Physisics & Detectors for Super-KEKB

Toru Iijima
*Nagoya University*

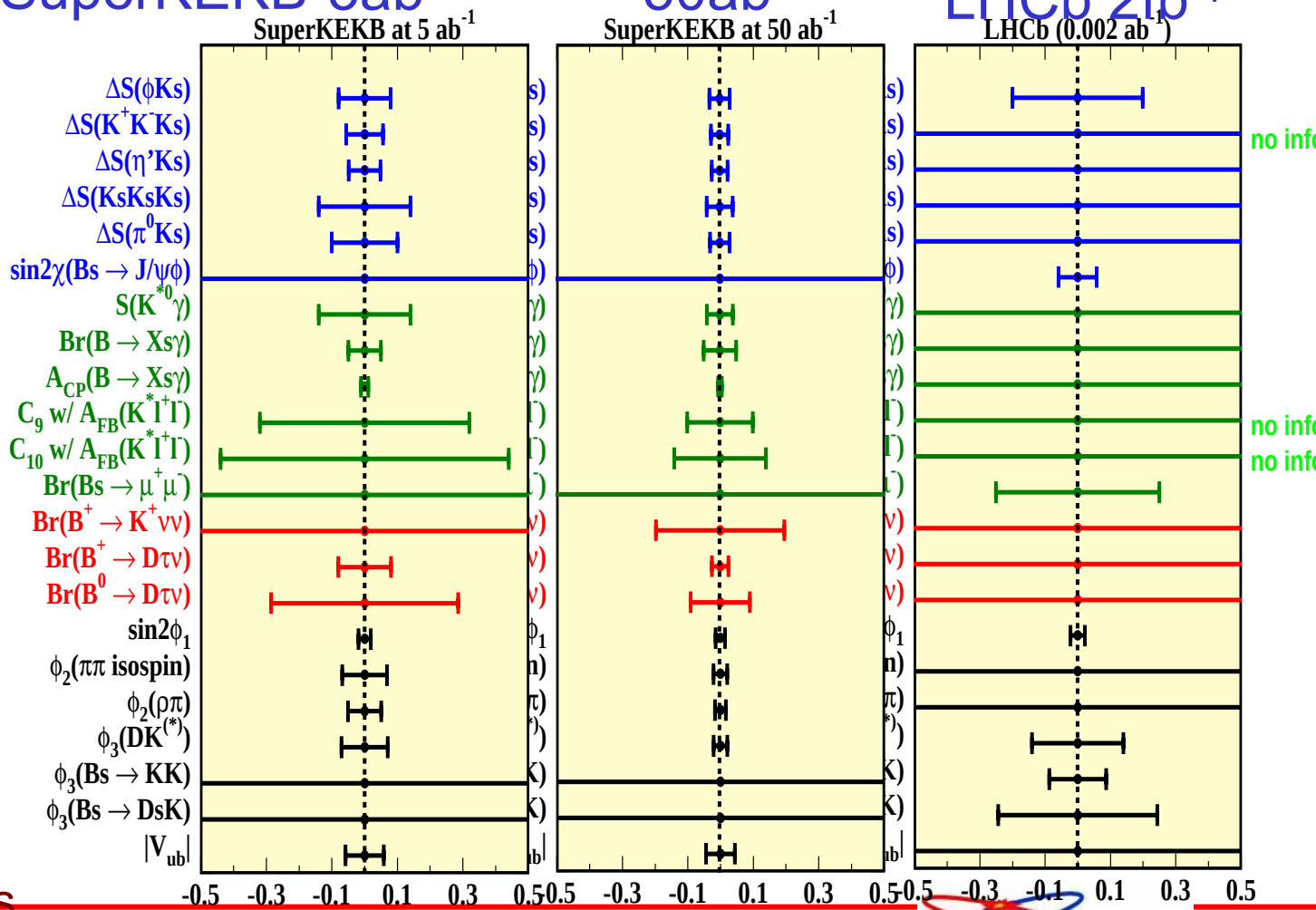
November 11, 2005

Super-B meeting at Frascati

# Physics Reach at Super-KEKB

| | | SuperKEKB (5 ab$^{-1}$) | (50 ab$^{-1}$) |
|---|---|---|---|
| CPV ($b \to s$) | $\sin 2\beta$ | 0.079 | 0.031 |
| | $\cos 2\beta$ | 0.056 | 0.026 |
| | $\alpha$ | 0.049 | 0.024 |
| | $S(K^{*0}\gamma)$ | 0.14 | 0.04 |
| | $A_{CP}(b \to s\gamma)$ | 0.10 | 0.03 |
| | $A_{CP}(b \to s\eta' K)$ | × | × |
| FCNC | $S(K^{*0}\gamma)$ | 0.14 | 0.04 |
| | $A_{CP}(b \to s\gamma)$ | 5% | 5% |
| | $A_{CP}(b \to (s+d)\gamma)$ | 0.011 | $5\times10^{-3}$ |
| | $A_{FB}(B \to K^{*}\ell^{+}\ell^{-})$ zero-crossing | 32% | 10% |
| | $A_{FB}(B \to K^{*}\ell^{+}\ell^{-})$ zero-crossing | 44% | 14% |
| | $A_{FB}(b \to s\ell^{+}\ell^{-})$ zero-crossing | × | × |
| w/ $\nu$ | $B \to K^{+}\nu\bar{\nu}$ | | 5.1$\sigma$ |
| | $B \to D\tau\nu$ | 8% | 2.5% |
| | $B \to D^{*}\tau\nu$ | 3.5$\sigma$ | 9% |
| CKM | $\sin 2\beta$ | 0.019 | 0.014 |
| | $\phi_2$ | 3.9° | 1.2° |
| | $\phi_2$ | 2.9° | 0.9° |
| | $\phi_3$ | 4° | 1.2° |
| | $B \to DK$, $D \to$ CP eigenstates | × | × |
| | $B \to DK$, $D \to$ Dalitz | × | × |
| | $\|V_{ub}\|$ | 5.8% | 4.4% |

SuperKEKB 5ab$^{-1}$ 50ab$^{-1}$ LHCb 2fb$^{-1}$




and rich $\tau$ physics



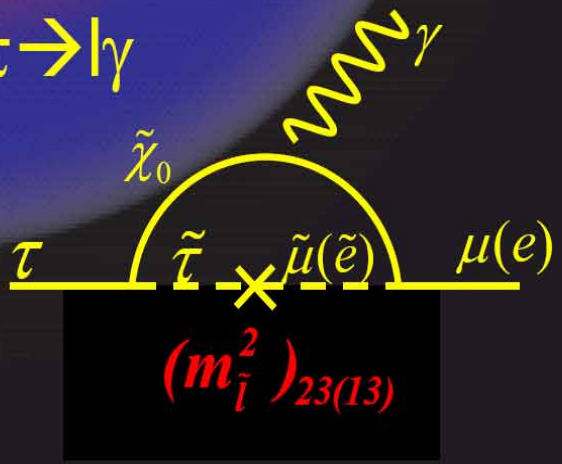
Superb

# LFV Search at Super-B

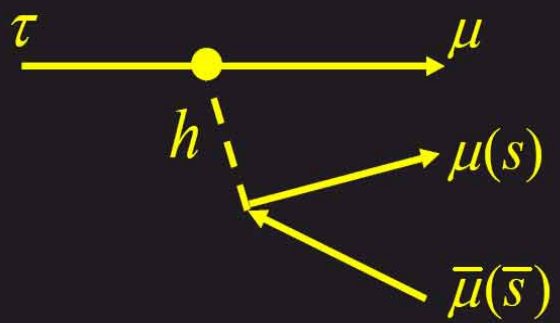
LFV in neutrino sector ⇒LFV in charged leptons ?

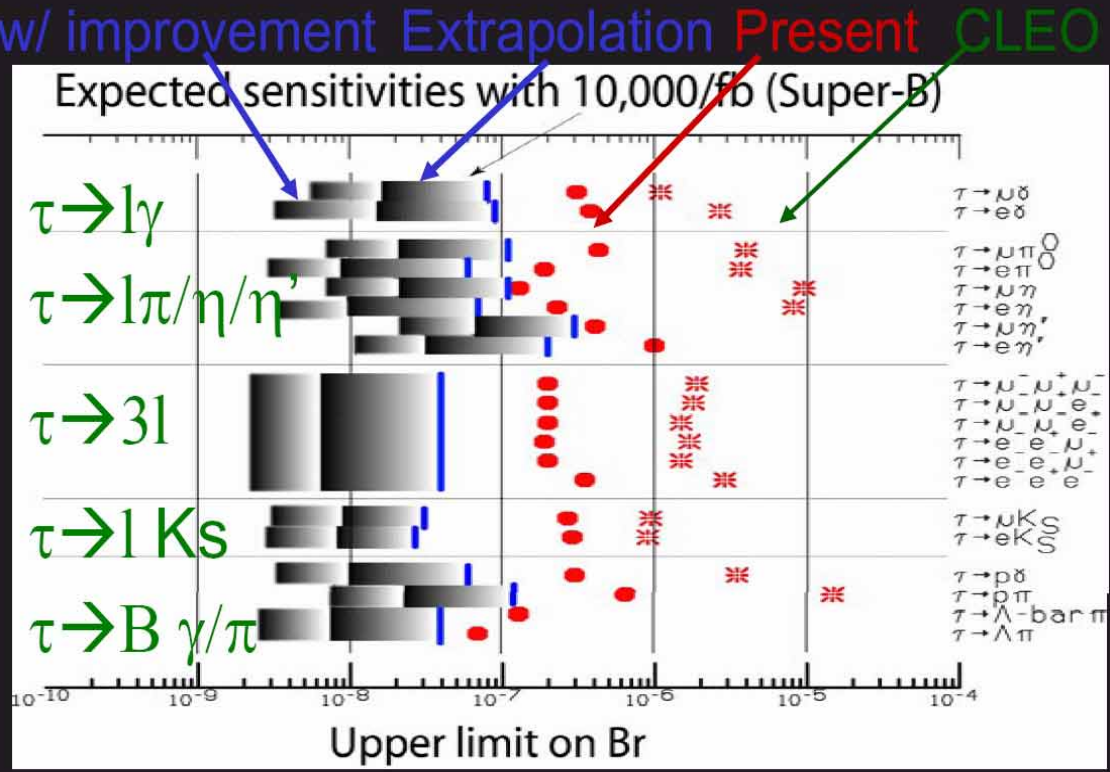
Search for "SM Zero"

$\tau \rightarrow l\gamma$




$\tau \rightarrow 3l$, $l\eta$




Search region enters into $O(10^{-8} \rightarrow 10^{-9})$

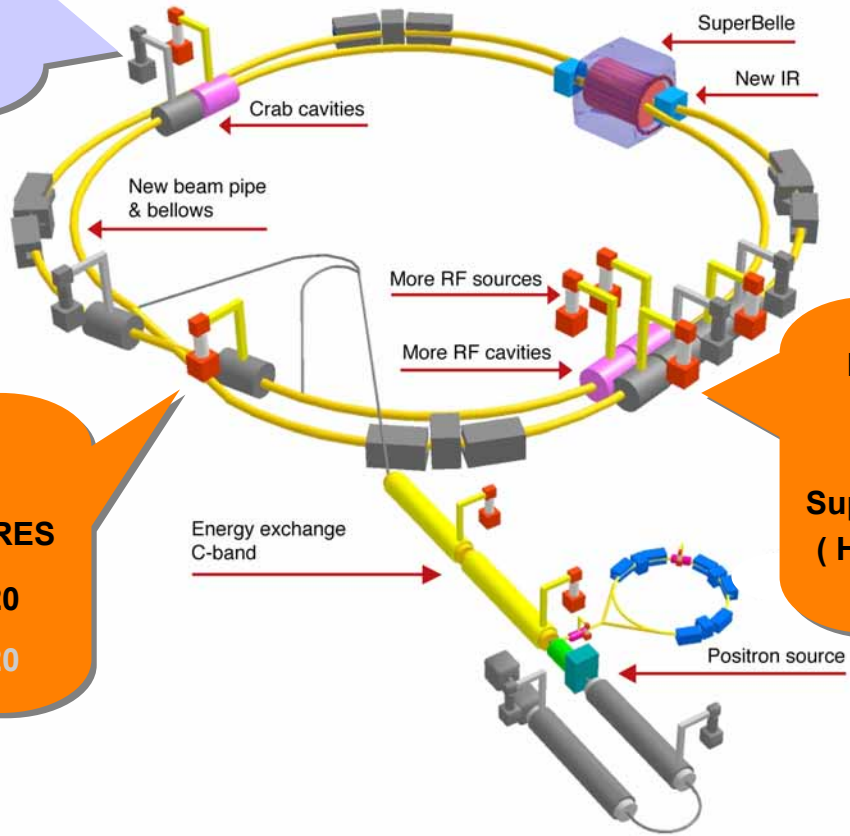
# SuperKEKB Requires More RF Sources and More RF Cavities

* 1MW CW Klystron (509 MHz)

1klystron:2 NC cavity -> 1klystron:1 NC cavity
KEKB -> SuperKEKB

**Nikko**
**SC RF section (HER)**

| | #Kly.* | #SCC |
|---|---|---|
| SuperKEKB | 12 | 12 |
| KEKB | 8 | 8 |

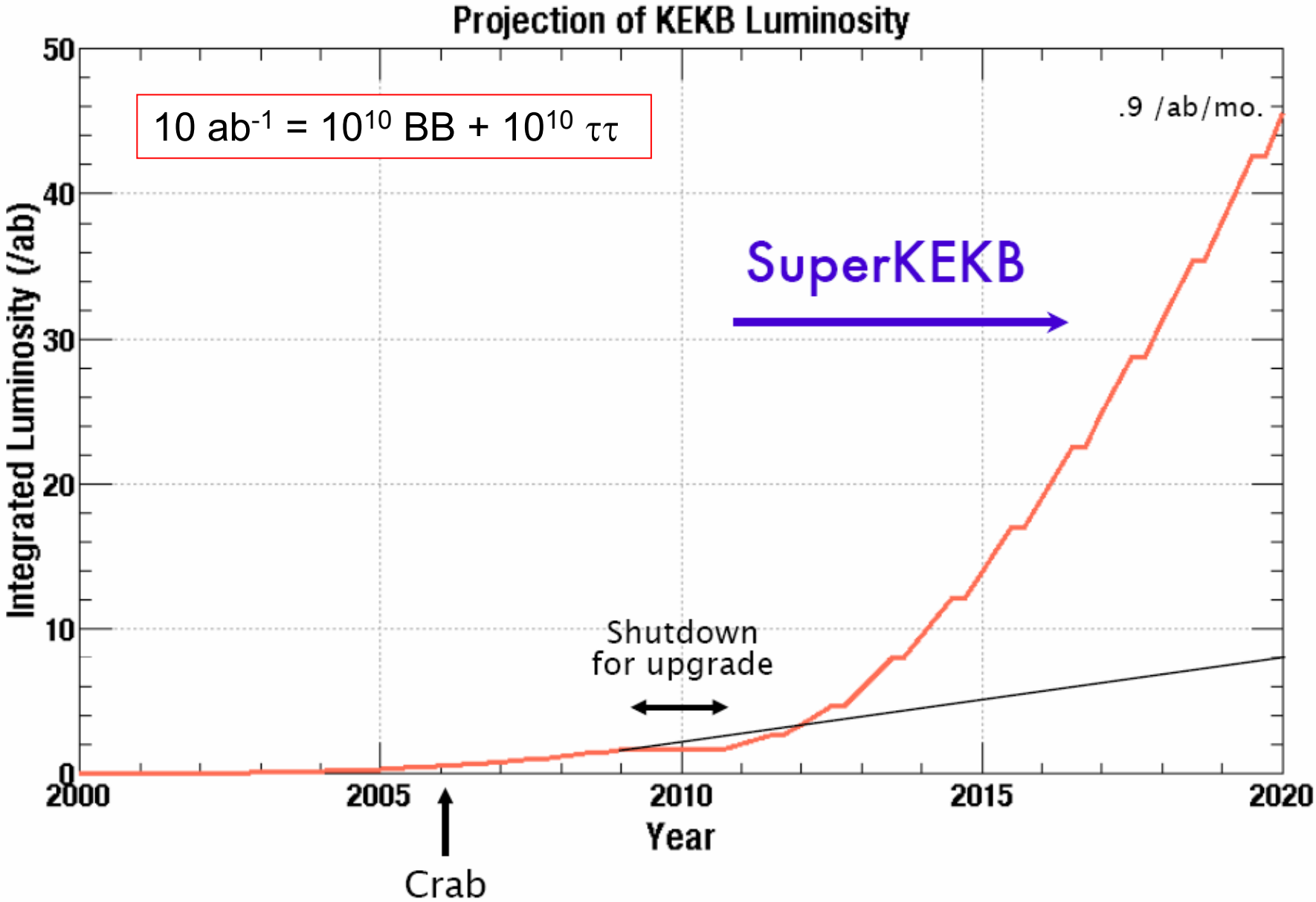



**Fuji**
**NC RF section (LER)**

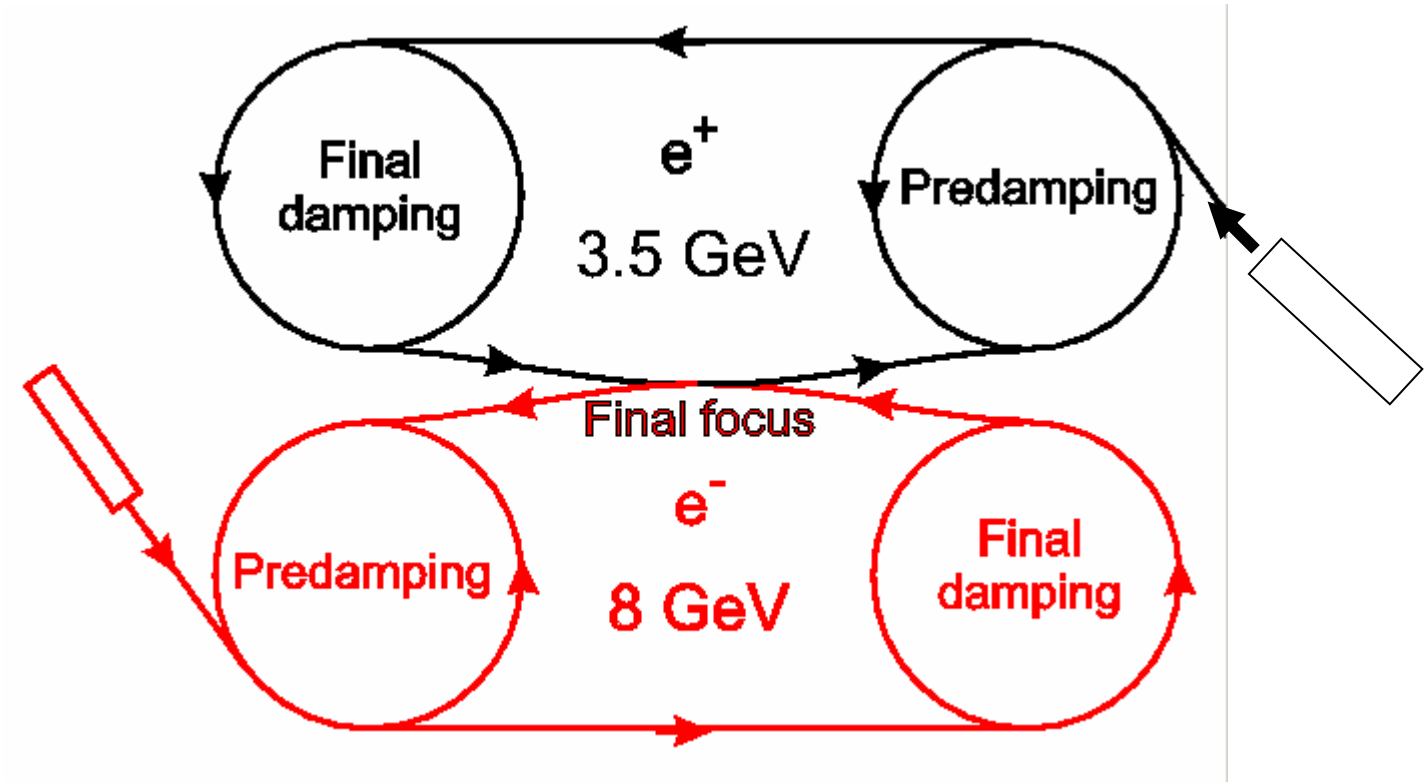
| | #Kly. | #ARES |
|---|---|---|
| SuperKEKB | 20 | 20 |
| KEKB | 10 | 20 |

**Oho**
**NC RF section (HER&LER)**

| | #Kly. | #ARES |
|---|---|---|
| SuperKEKB | 24 | 24 |
| ( HER/LER | 8 / 16 | 8 / 16 ) |
| KEKB | 6 | 12 |


Projection of KEKB Luminosity
10 ab-1 = 1010 BB + 1010 ττ
.9 /ab/mo.
SuperKEKB
Shutdown
for upgrade
Integrated Luminosity (/ab)
Year
Crab
0
10
20
30
40
50
2000
2005
2010
2015
2020

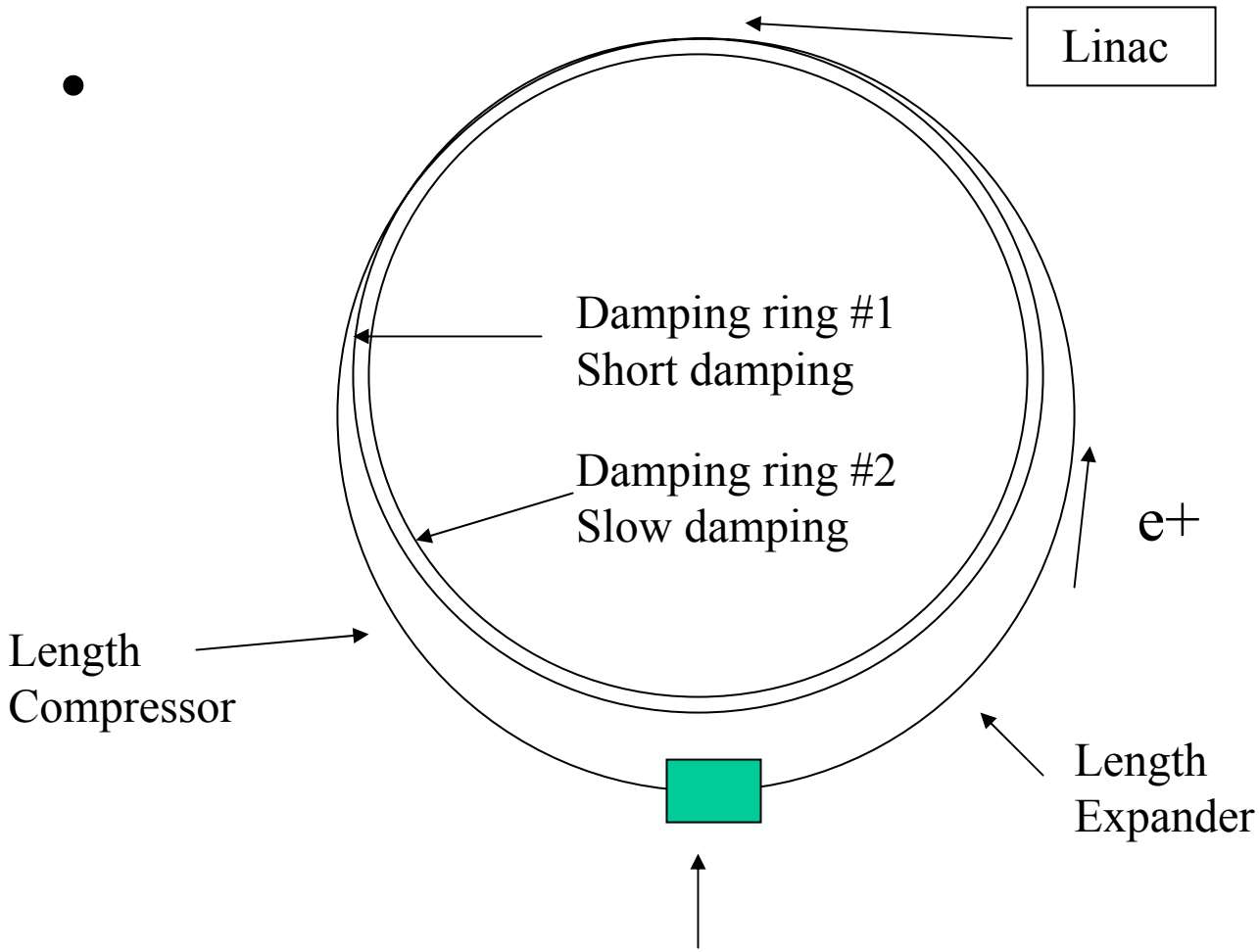
# Reference Design of a SBF



# A lot of activity and progress in WG1

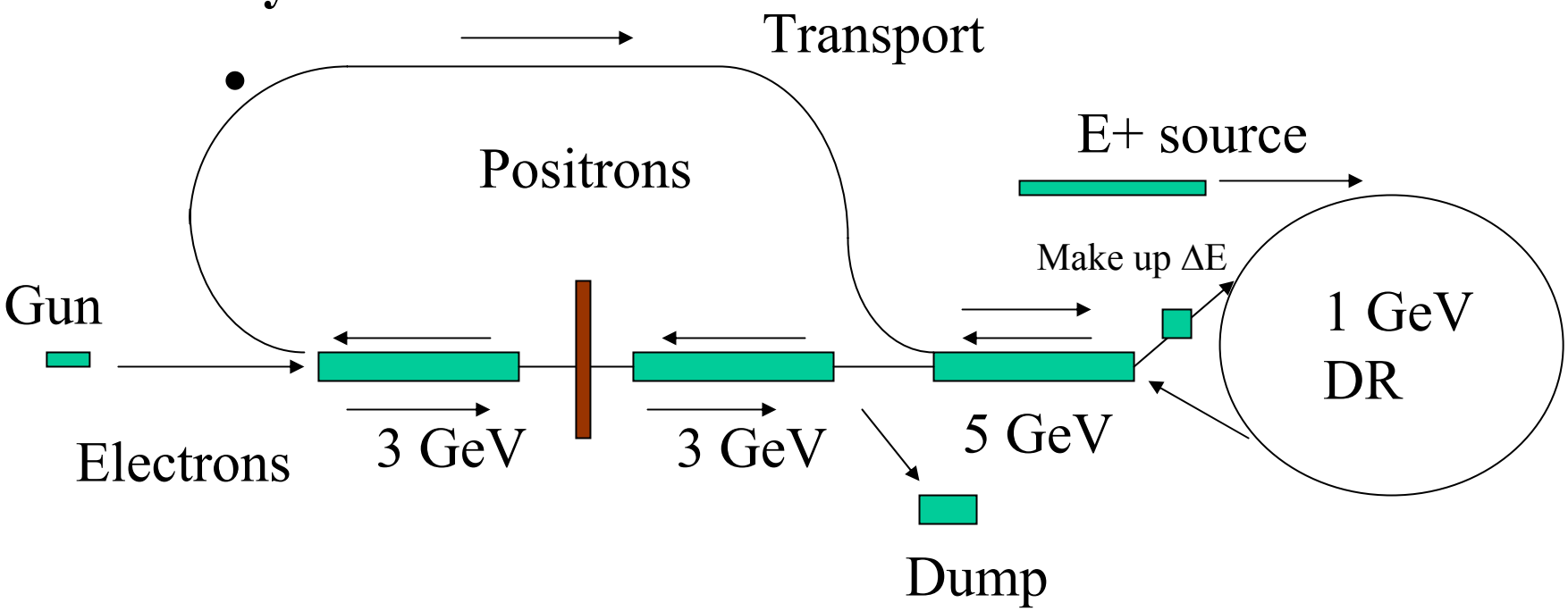
There was an important evolution of the original Pantaleo idea with the contribution of all the experts.

# Overview schematic (One beam)



# New SBF Layout with SC Linacs

**Luminosity 1-2 $10^{36}$**




**New possible scheme. Asymmetry is an open parameter. Wall power linear with the DR energy is an issue.**

# What from now!

Simulations of the propose strawman design needed to optimize

Luminosity/(Wall power ) ratio.

Evaluation of Bkgd inside the detector O(10) or O($10^2$) les then in the original Super PEPII

Choice of the machine asymmetry (7+4 GeV)

Better definition of the synergy with ILC activities.

Preliminary definition of the machine R&D needed.

# Tracking Options

**S.Playfer**

1. Minicell drift chamber with slow gas
   He:DME (70:30) or He:$CO_2$:i$C_4H_{10}$ (80:10:10)
   *Drift distance up to 2cm, drift velocity 0.5-2cm/$\mu$s*
   Spatial resolution <100$\mu$m achieved in test chambers

2. Jet chamber with He:i$C_4H_{10}$ (80:20) or He:$CO_2$:i$C_4H_{10}$
   *Drift distance up to 10cm, drift velocity* $\approx$*2cm/$\mu$s*
   Minimizes regions of poor resolution at edges of cells

3. Time Projection Chamber (TPC) as considered for ILC
   *GEM or MicroMega detectors coupling to readout pads*
   $r/\phi$ resolution $\approx$100$\mu$m, $z$ resolution a few 100$\mu$m (diffusion)
   Maximum drift distance $\approx$1m means drift time $> 7\mu$s
   *but can determine $t_0$ from apparent $z$ vertex position of tracks*

**S.Playfer**

# Particle Identification

We only need a "not-so-fast" RICH or DIRC

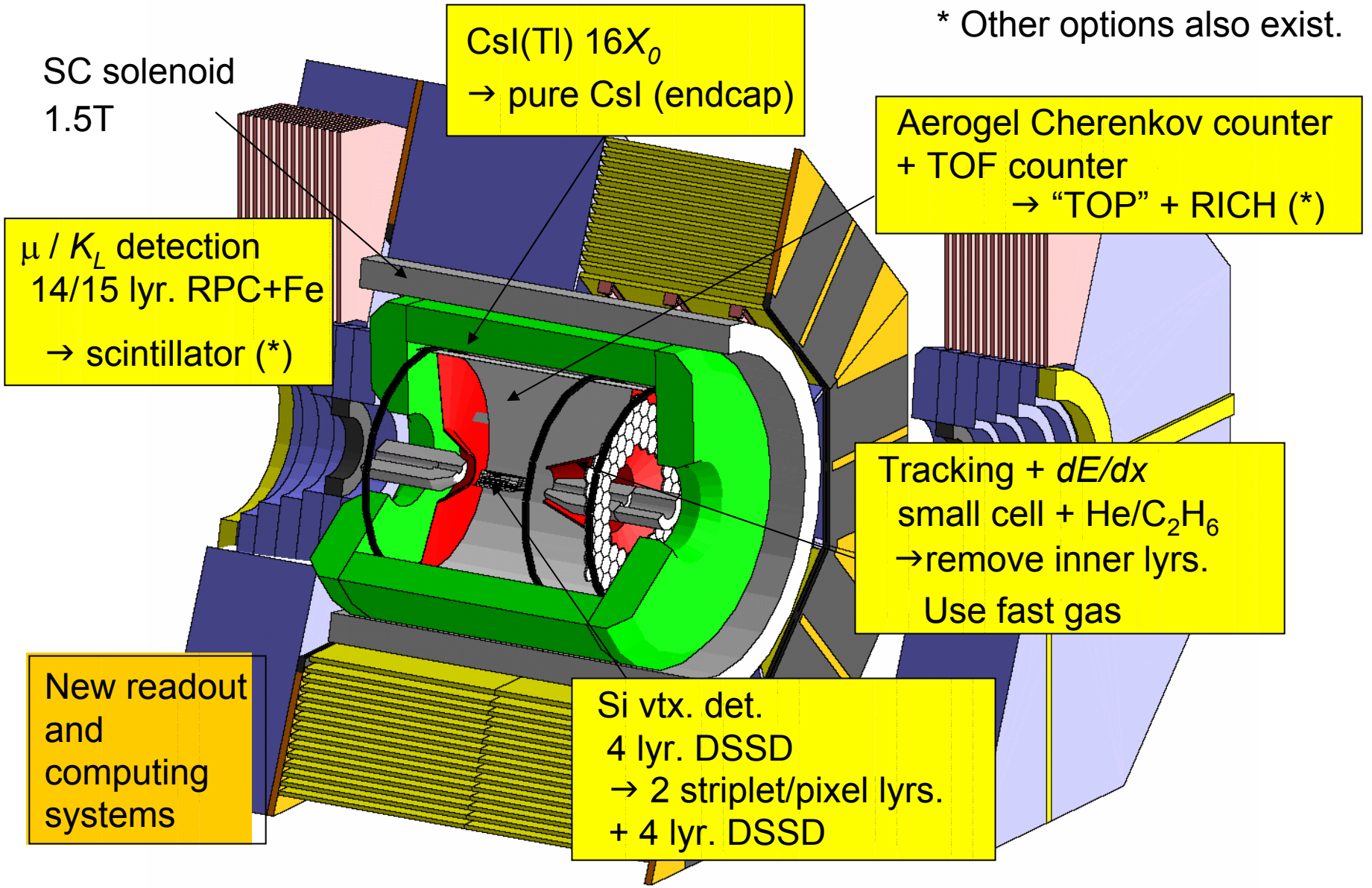
*Can the available time of 7μs be used to improve the precision of the Cherenkov angle measurement?*

Where do we put the DIRC/RICH readout?

*The lower energy asymmetry means there will need to be a backward calorimeter*

I assume there are no significant issues with muon detection

# Super-Belle


SC solenoid
1.5T
CsI(Tl) 16$X_0$
→ pure CsI (endcap)
* Other options also exist.
Aerogel Cherenkov counter
+ TOF counter
→ "TOP" + RICH (*)
μ / $K_L$ detection
14/15 lyr. RPC+Fe
→ scintillator (*)
Tracking + *dE/dx*
small cell + He/$C_2H_6$
→remove inner lyrs.
Use fast gas
New readout
and
computing
systems
Si vtx. det.
4 lyr. DSSD
→ 2 striplet/pixel lyrs.
+ 4 lyr. DSSD

# Detector

If machine could have low Bkg then designing the detector wouldn't be terrible

It could be based on the present Babar or Belle with an improved vertex (beam pipe down to 10mm?)

PID improved

and with a reduced asymmetry (7+4 GeV ?) a more hermetic detector is feasible then

A NEW EMC ENDCAPS also needed.

# Conclusion

What we learned :

MACHINE parameters is the issue.

We need a common effort of machine experts, most of them involved in ILC project.

DETECTOR appears feasible and reasonably obtainable from a joint effort of Babar and Belle communities.

Another workshop will be needed before we are ready for a final report.

We must consider a possible date in February or early march 2006.

IN FRASCATI we hope.

THANKS TO THE DIRECTOR OF THE

LNF

FOR THE KIND HOSPITALITY