Status of SuperKEKB and Belle-II

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ECFA Plenary Meeting, CERN, Nov 25-26, 2010

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Contents

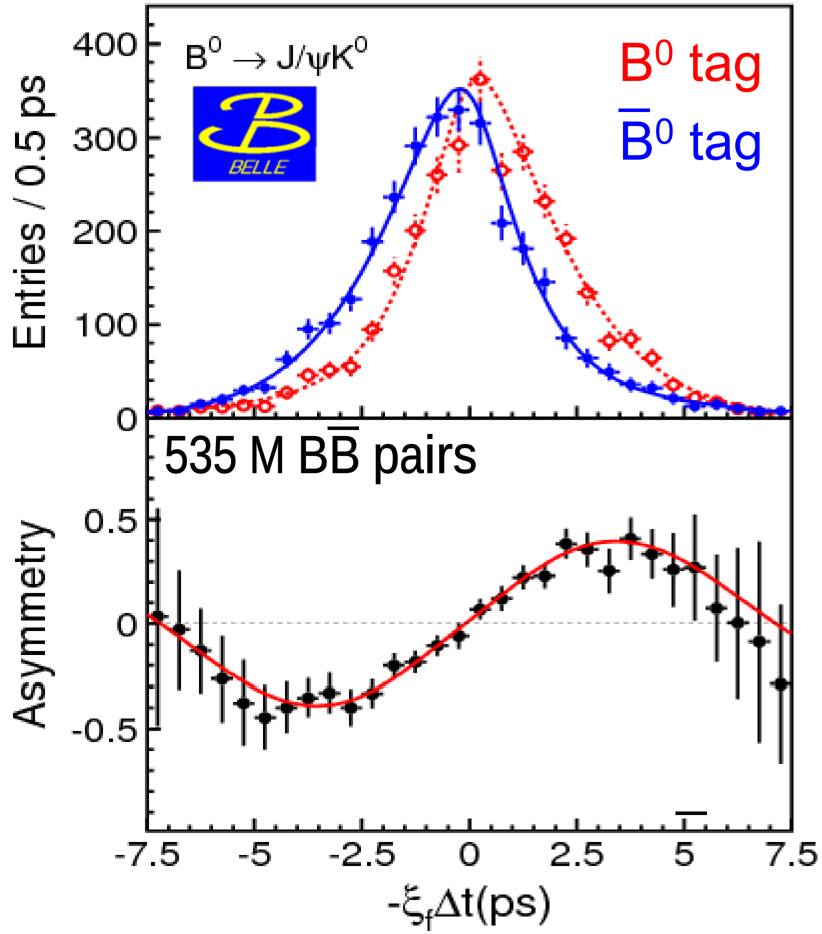
- Physics case for a Super B factory
- SuperKEKB/Belle-II@KEK
- Accellerator
- Detector
- Status and prospects of the project

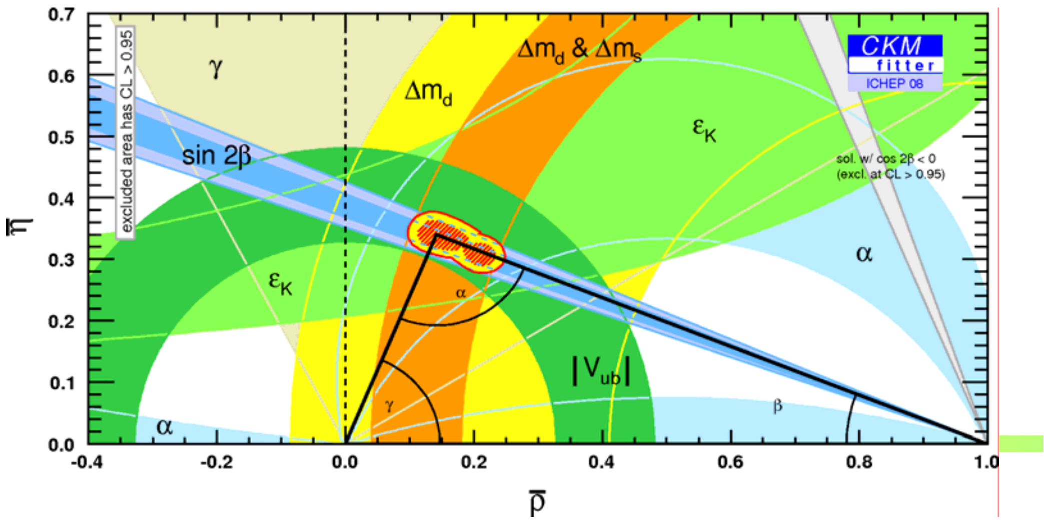
B factories: CP violation in the B system

CP violation in B system: from the discovery (2001) to a precision measurement (2006)

$\sin 2\phi_1 / \sin 2\beta$ from $b \rightarrow ccs$

World average 2008:
$\sin 2\phi_1 = 0.681 \pm 0.025$



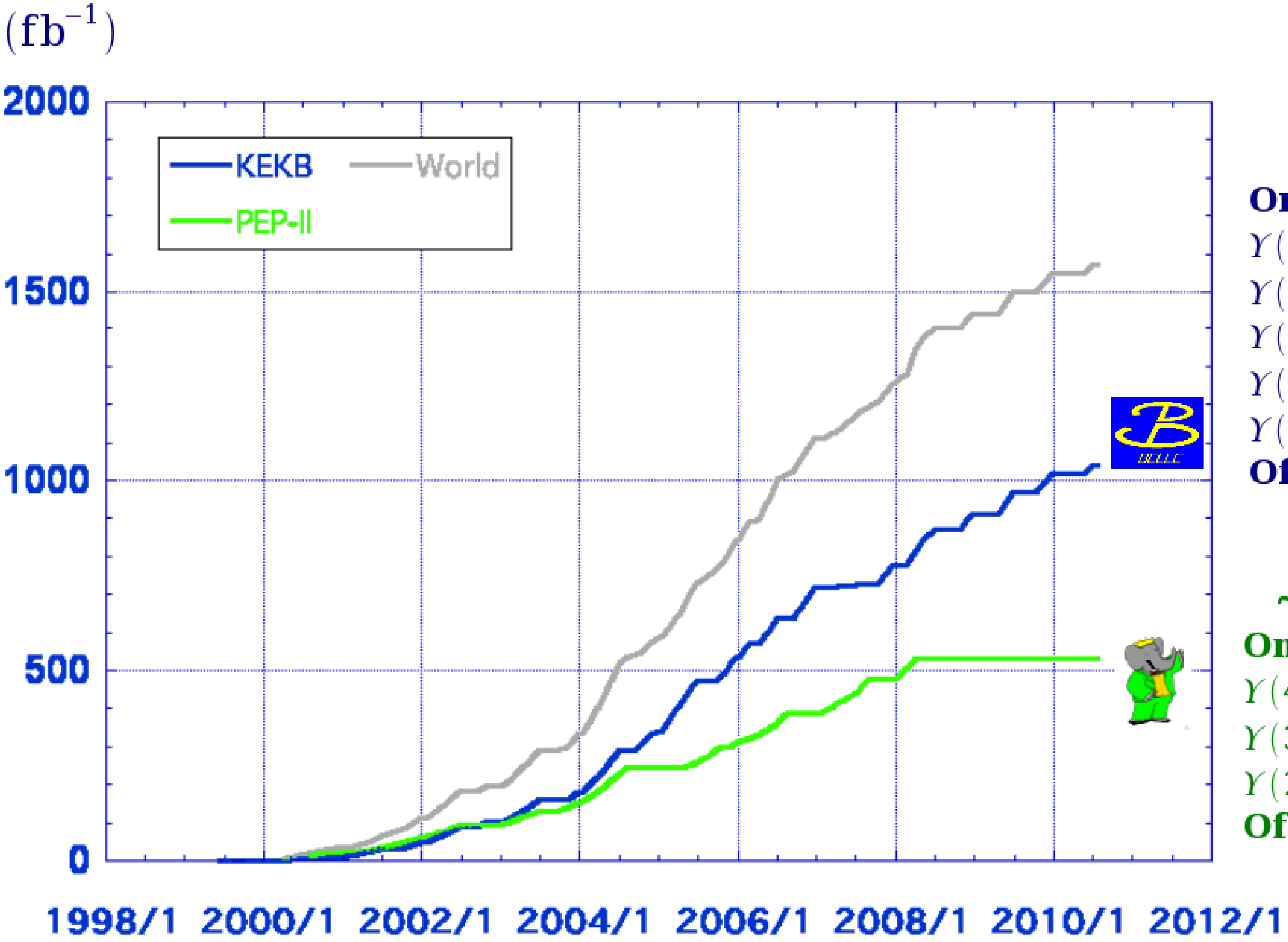


Constraints from measurements of angles and sides of the unitarity triangle → Remarkable agreement

B factories: a success story

- Measurements of CKM matrix elements and angles of the unitarity triangle
- Observation of direct CP violation in B decays
- Measurements of rare decay modes (e.g., $B \to \tau\nu$, $D\tau\nu$)
- $b \to s$ transitions: probe for new sources of CPV and constraints from the $b \to s\gamma$ branching fraction
- Forward-backward asymmetry (A_{FB}) in $b \to s l^+ l^-$ has become a powerfull tool to search for physics beyond SM.
- Observation of D mixing
- Searches for rare τ decays
- Observation of new hadrons

Luminosity at B factories



$> 1\ ab^{-1}$

On resonance:

$\Upsilon(5S)$: 121 fb^{-1}

$\Upsilon(4S)$: 711 fb^{-1}

$\Upsilon(3S)$: 3 fb^{-1}

$\Upsilon(2S)$: 24 fb^{-1}

$\Upsilon(1S)$: 6 fb^{-1}

Off reson./scan:

~ 100 fb^{-1}

~ 550 fb^{-1}

On resonance:

$\Upsilon(4S)$: 433 fb^{-1}

$\Upsilon(3S)$: 30 fb^{-1}

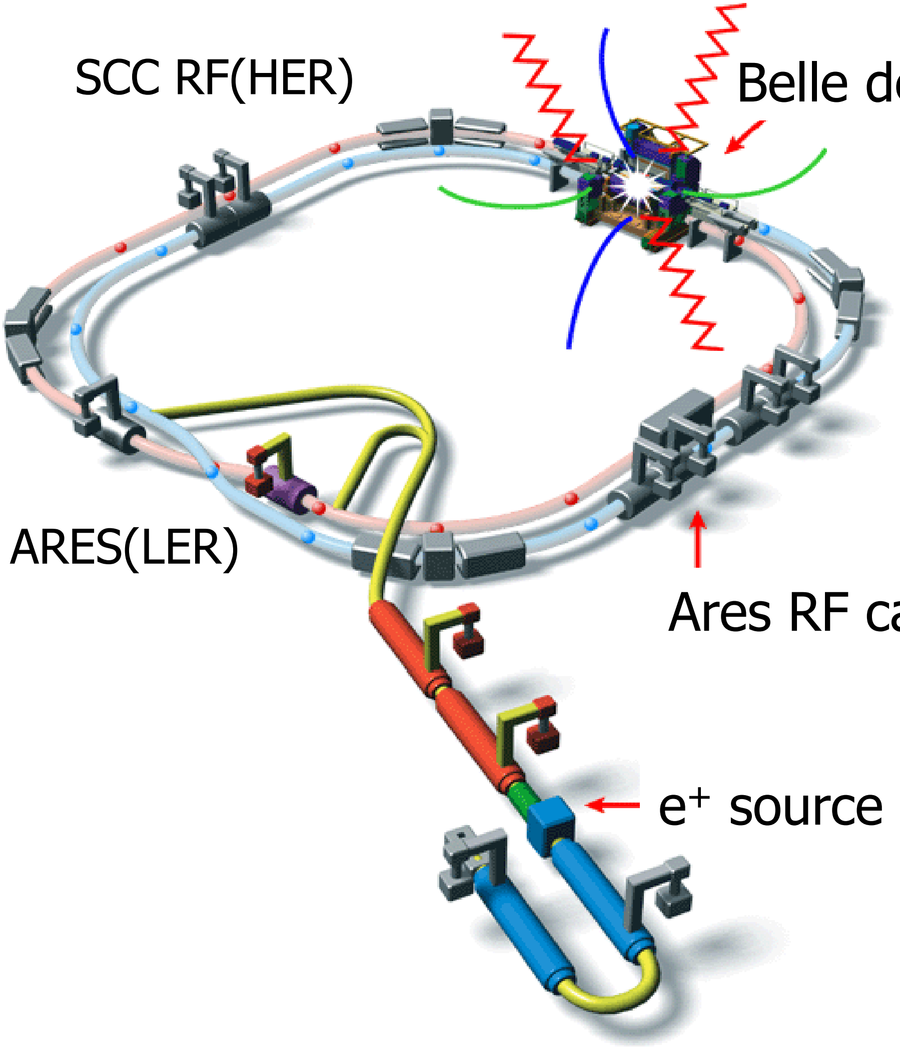
$\Upsilon(2S)$: 14 fb^{-1}

Off resonance:

~ 54 fb^{-1}

Fantastic performance much beyond design values!

The KEKB Collider & Belle Detector



- e^- (8 GeV) on e^+(3.5 GeV)
  - $\sqrt{s} \approx m_{\Upsilon(4S)}$
  - Lorentz boost: $\beta\gamma$=0.425
- 22 mrad crossing angle
- Operating since 1999

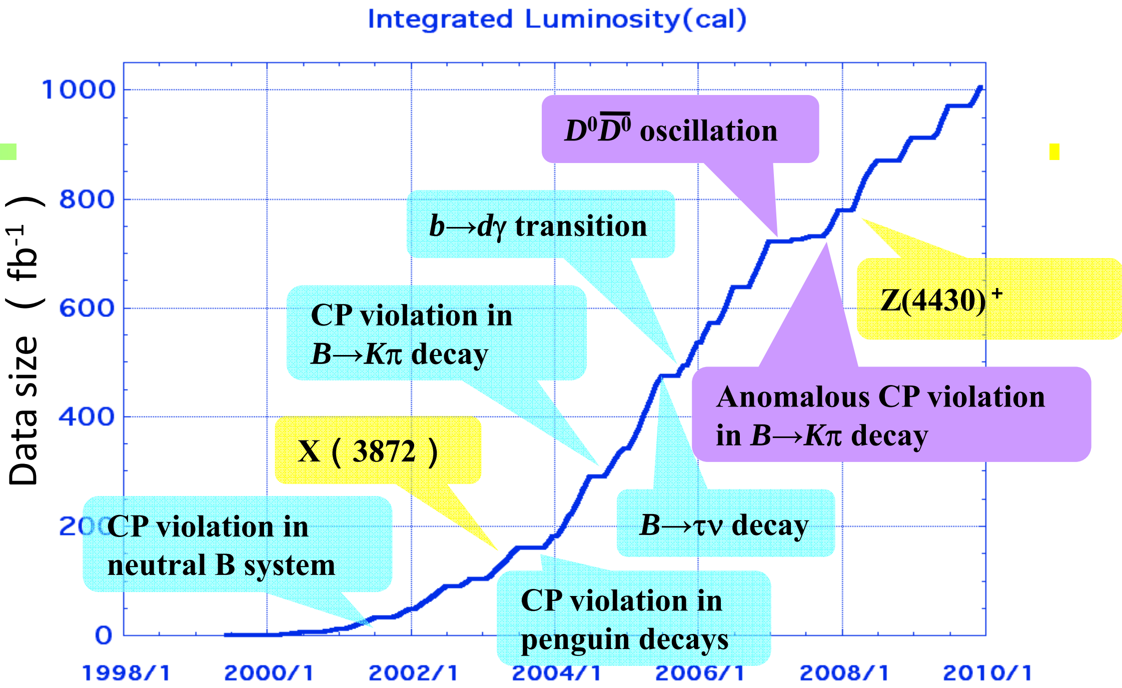
Peak luminosity (WR!) :

$2.1 \times 10^{34}\ cm^{-2}s^{-1}$

=2x design value

First physics run on June 2, 1999
Last physics run on June 30, 2010
$L_{peak} = 2.1 \times 10^{34}/cm^2/s$
$L > 1 ab^{-1}$

Completion of KEKB/Belle after 11 years of successful experiment



"Last beam abort" ceremony on June 30, 2010

What next?

B factories → is SM with CKM right?

Next generation: Super B factories → in which way is the SM wrong?

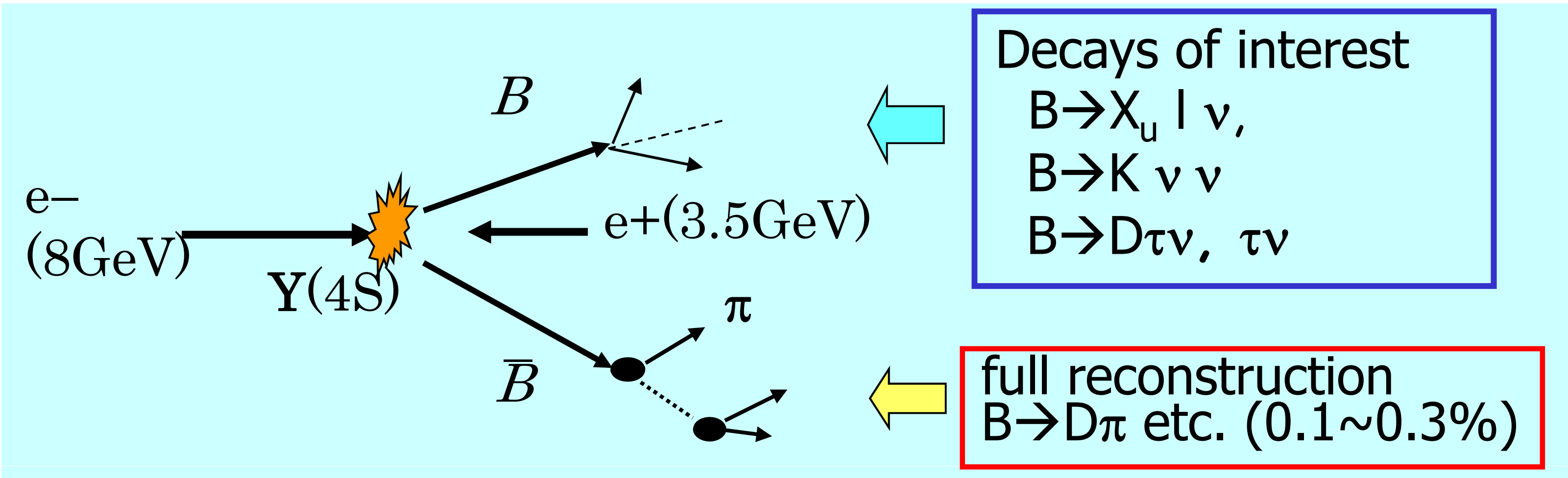
→ Need much more data (two orders!) because the SM worked so well until now → Super B factory

However: it will be a different world in four years, there will be serious competition from LHCb and BESIII

Still, e^+e^- machines running at (or near) Υ(4s) will have considerable advantages in several classes of measurements, and will be complementary in many more

Power of e^+e^-, example: Full Reconstruction Method

- Fully reconstruct one of the B's to
  - Tag B flavor/charge
  - Determine B momentum
  - Exclude decay products of one B from further analysis

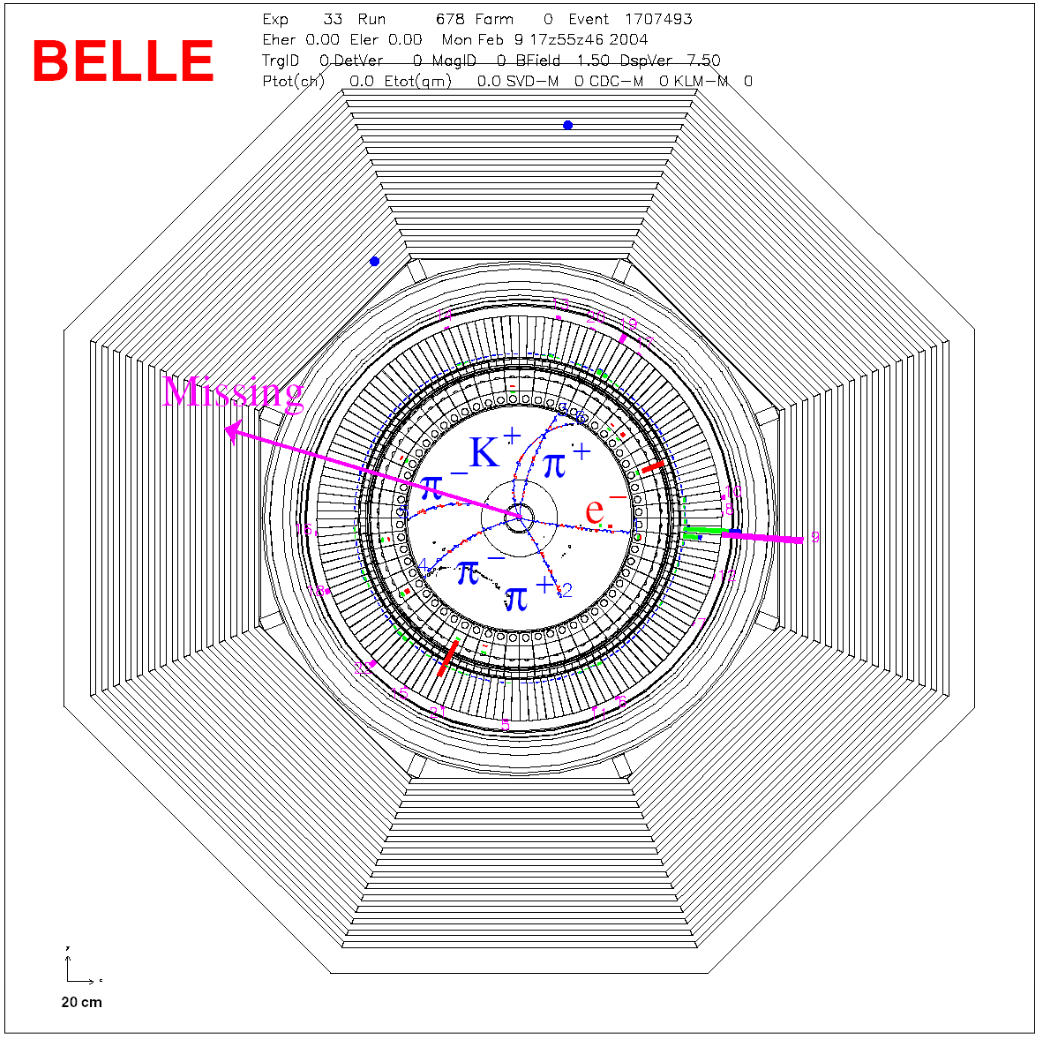


→ Offline B meson beam!

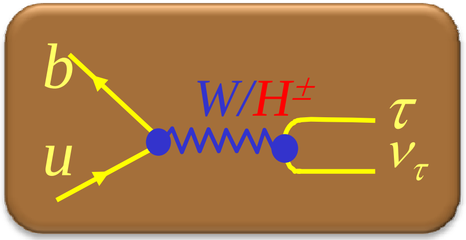
Powerful tool for B decays with neutrinos

Event candidate $B^- \rightarrow \tau^- \nu_\tau$

$$B^+ \to D^0 \pi^+$$
$$(\to K\pi^-\pi^+\pi^-)$$
$$B^- \to \tau(\to e\nu\bar{\nu})\nu$$

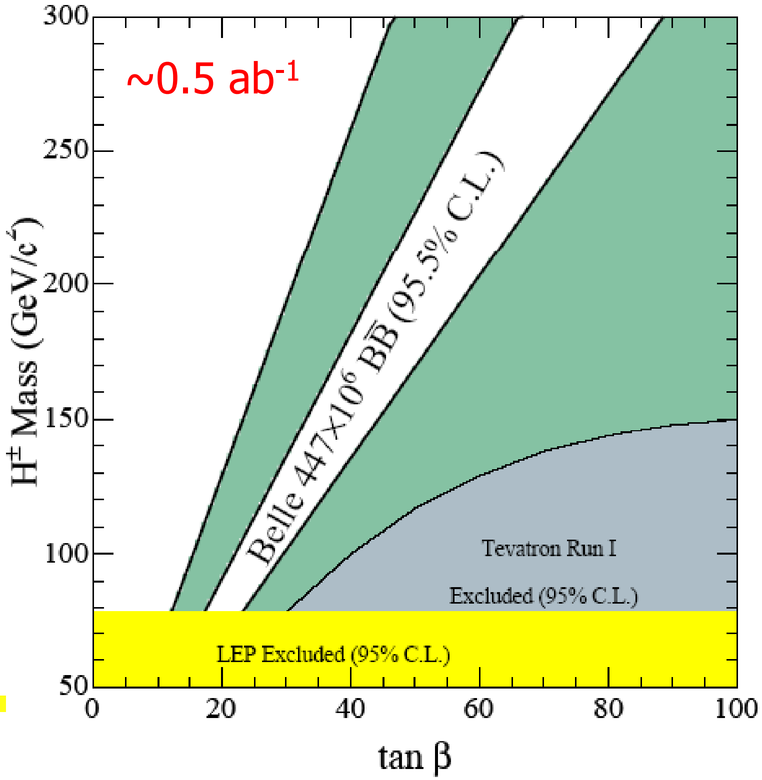


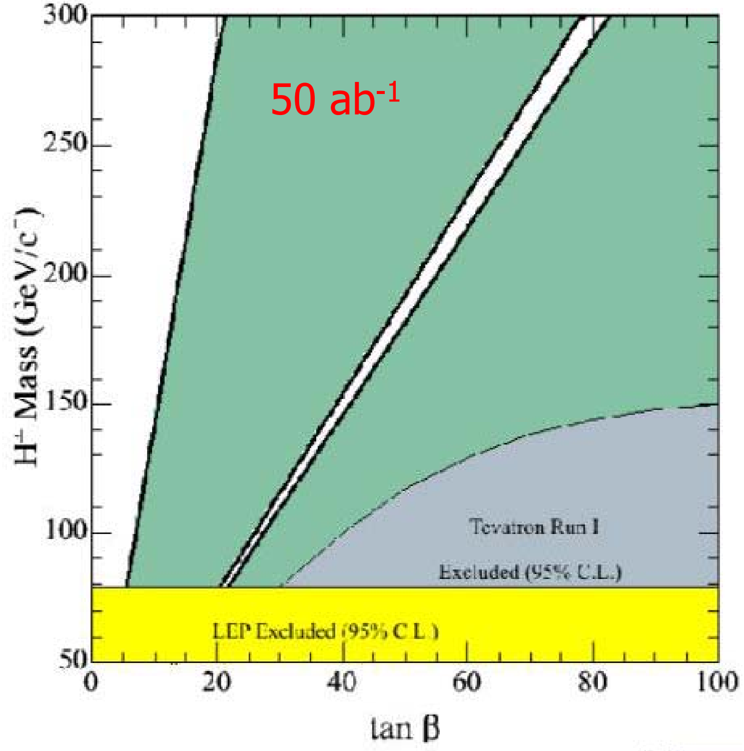
Charged Higgs limits from $B^- \to \tau^- \nu_\tau$



$$r_H = \frac{BF(B \to \tau\nu)}{BF(B \to \tau\nu)_{SM}} = \left(1 - \frac{m_B^2}{m_H^2}\tan^2\beta\right)^2$$

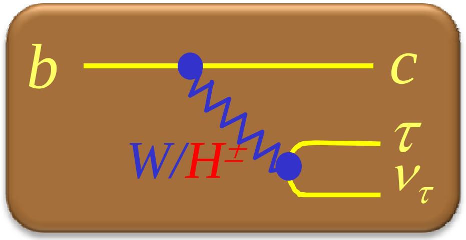
→ limit on charged Higgs mass vs. tanβ





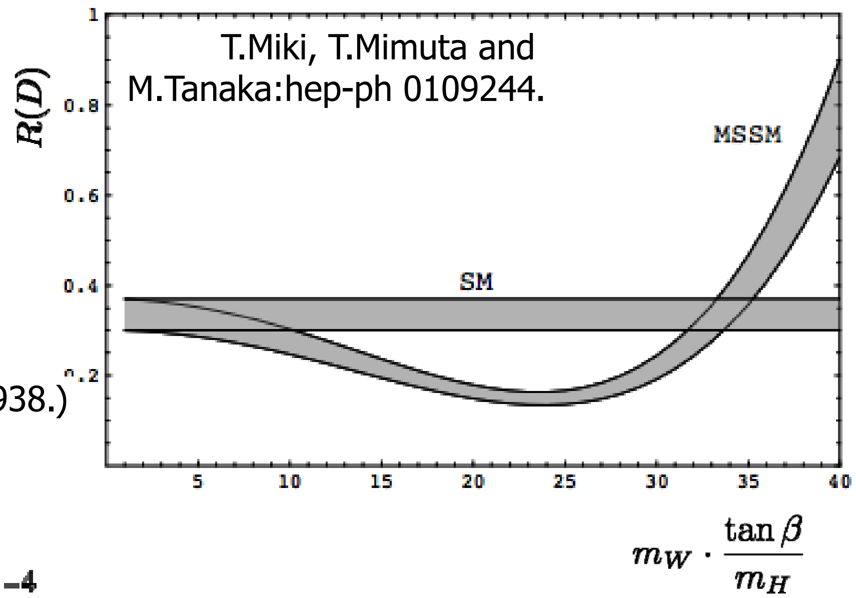
B→D$^{(*)}$τν

Semileptonic decay sensitive to charged Higgs



Ratio of τ to μ,e could be reduced/enhanced significantly

$$R(D) \equiv \frac{\mathcal{B}(B \to D\tau\nu)}{\mathcal{B}(B \to D\ell\nu)}$$



Compared to B→τν

1.Smaller theoretical uncertainty of R(D)

(For B→τν,
There is O(10%) f_B uncertainty from lattice QCD)

2.Large expected Br (Ulrich Nierste arXiv:0801.4938.)

$$\mathcal{B}(B^- \to D^0\tau^-\bar{\nu}_\tau)^{SM} = (0.71 \pm 0.09)\%$$

$$\mathcal{B}(\bar{B}^0 \to D^+\tau^-\bar{\nu}_\tau)^{SM} = (0.66 \pm 0.08)\%$$

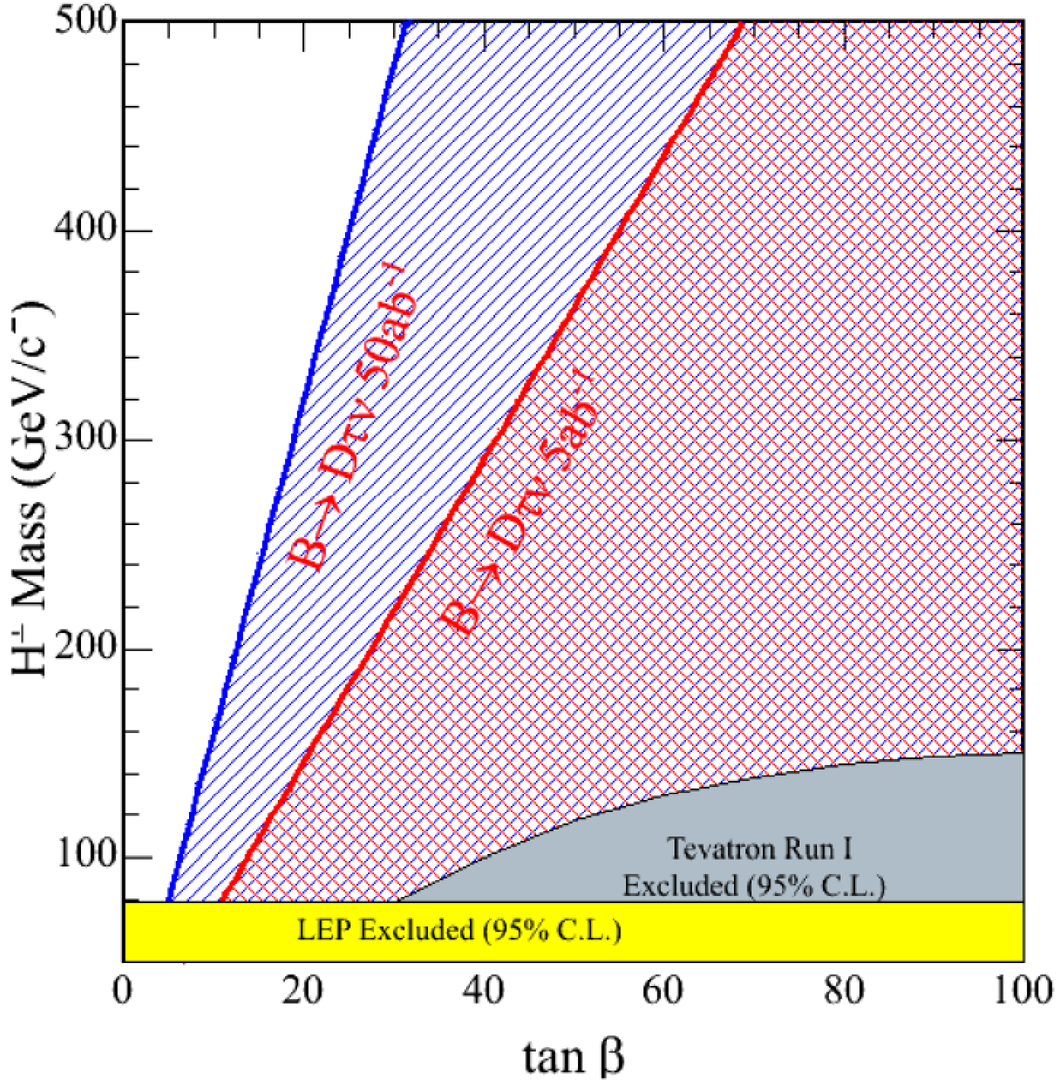
$$\mathcal{B}(B \to \tau\nu) = [1.65^{+0.38}_{-0.37}(stat)^{+0.35}_{-0.37}(syst)] \times 10^{-4}$$

3. Differential distributions can be used to discriminate W$^+$ and H$^+$

4. Sensitive to different vertex B→τ ν: H-b-u, B→Dτν: H-b-c
(LHC experiments sensitive to H-b-t)

$B \rightarrow D\tau\nu$

Exclusion plots for
tanβ and H^+ mass
for $5ab^{-1}$ and $50ab^{-1}$



B→D*τν – similar constraints on H+

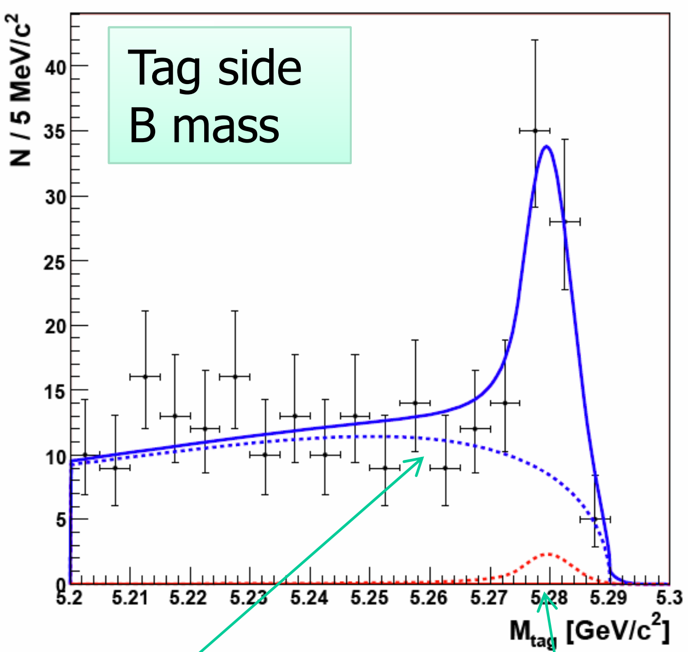
[PRL 99, 191807 (2007)]

535M $B\bar{B}$

FIRST OBSERVATION - 2007

$$BF(B^0 \to D^{*-}\tau^+\nu_\tau) = (2.02\ ^{+0.40}_{-0.37}(stat) \pm 0.37(syst)) \times 10^{-2}$$

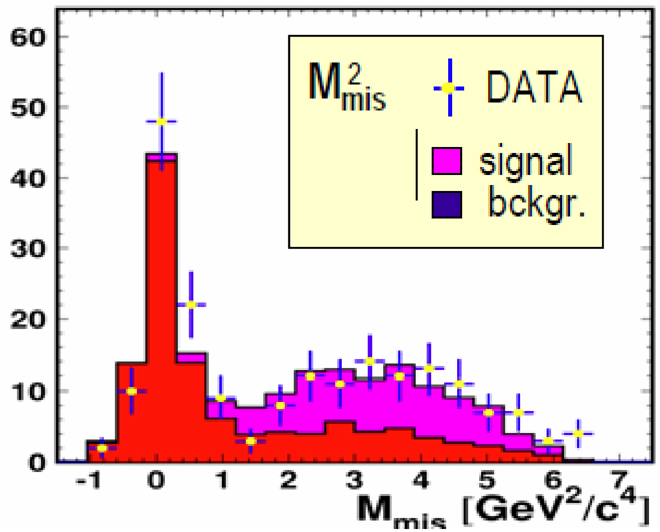
SIGNAL YIELD $N_s = 60\ ^{+12}_{-11}$ **6.7σ (5.2σ with syst.)**



combinatorial background

peaking background ($D^*e\nu$)

$$M_{mis}^2 = (E_b - E_{D^{(*)}} - E_{l/h})^2 - (-\vec{p}_{tag} - \vec{p}_{D^{(*)}} - \vec{p}_{l/h})^2$$



$B \to K^{(*)}\nu\nu$

arXiv:1002.5012

adopted from W. Altmannshofer et al., JHEP 0904, 022 (2009)

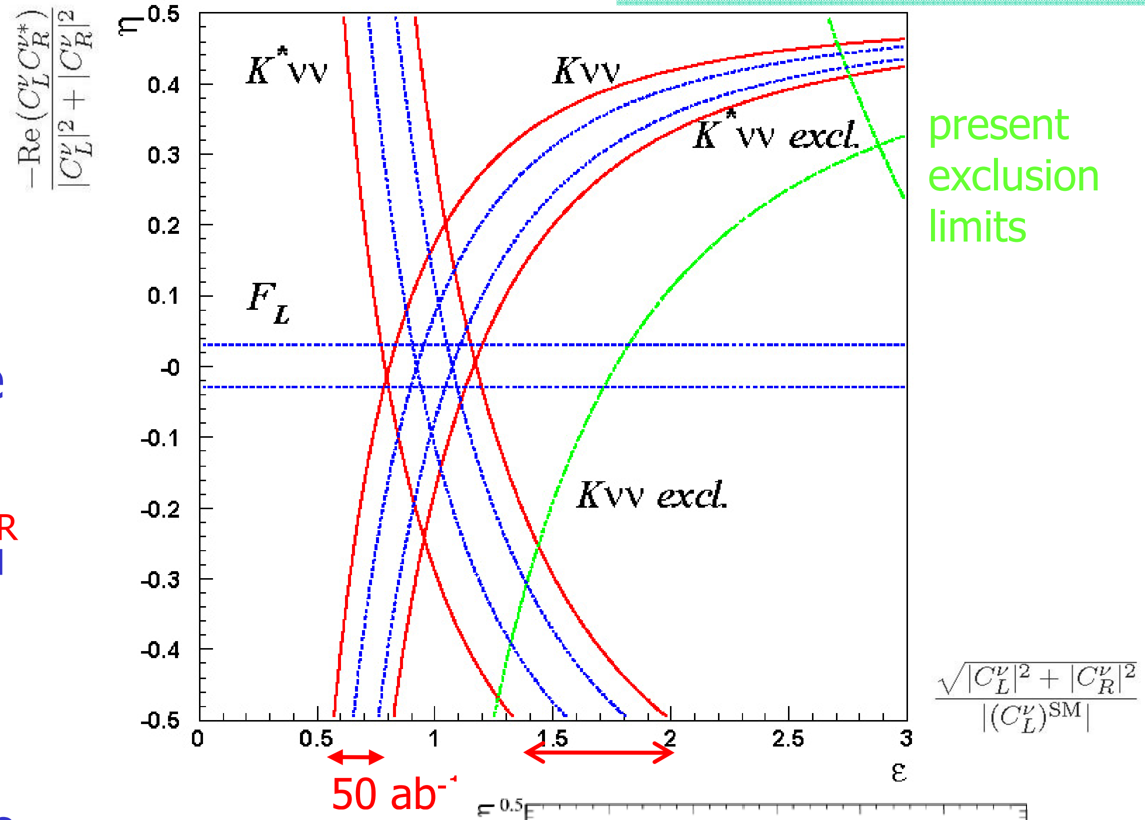
↔ Theory

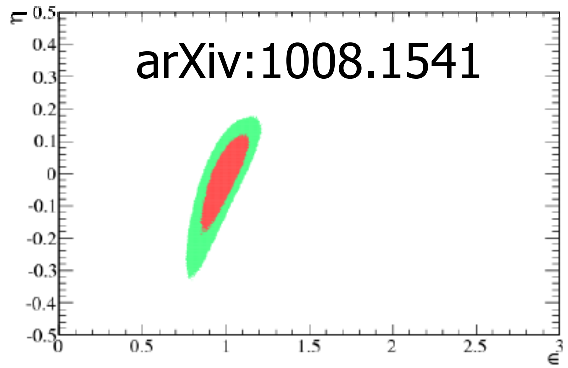
$B \to K\nu\nu,\ \mathcal{B} \sim 4{\cdot}10^{-6}$
$B \to K^{*}\nu\nu,\ \mathcal{B} \sim 6.8{\cdot}10^{-6}$

SM: penguin+box

Look for departure from the expected value → information on couplings C^{ν}_{R} and C^{ν}_{L} compared to $(C^{\nu}_{L})^{SM}$

Again: fully reconstruct one of the B mesons, look for signal (+nothing else) in the rest of the event.





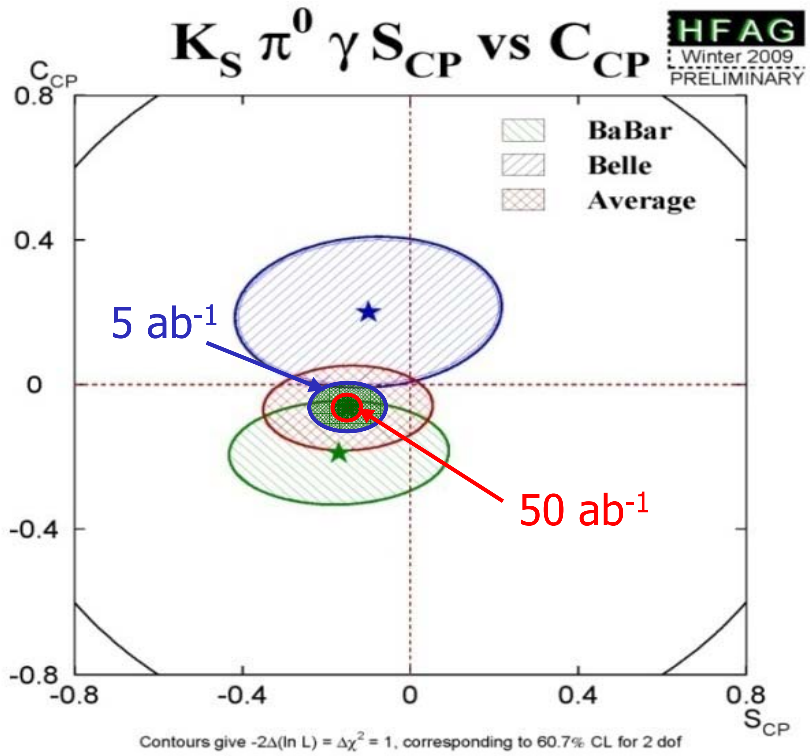
not possible @ LHCb

CP violation in $B \to K_S \pi^0 \gamma$

CP violation in $B \to K_S \pi^0 \gamma$ decays:
Search for right-handed currents

$B \to K^* \gamma$, $\mathcal{B} \sim 4.0 \cdot 10^{-5}$

$\delta S \sim 0.2$ (present)
→ ~a few % at 50 ab^{-1}

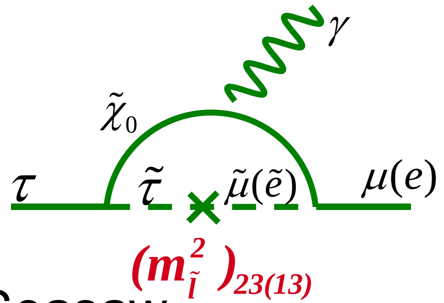


adopted from HFAG

not possible @ LHCb

LFV and New Physics

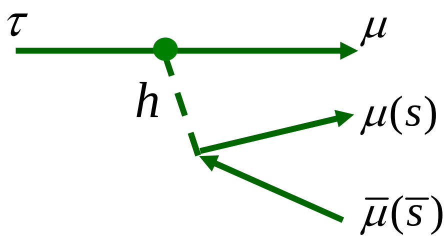
τ→lγ



- SUSY + Seasaw
- Large LFV Br(τ→μγ)=O(10$^{-7\sim 9}$)

$$Br(\tau \to \mu\gamma) \simeq 10^{-6} \times \left(\frac{(m^2_{\tilde{L}})_{32}}{\bar{m}^2_{\tilde{L}}}\right)\left(\frac{1TeV}{m_{SUSY}}\right)^4 \tan^2\beta$$

τ→3l,lη



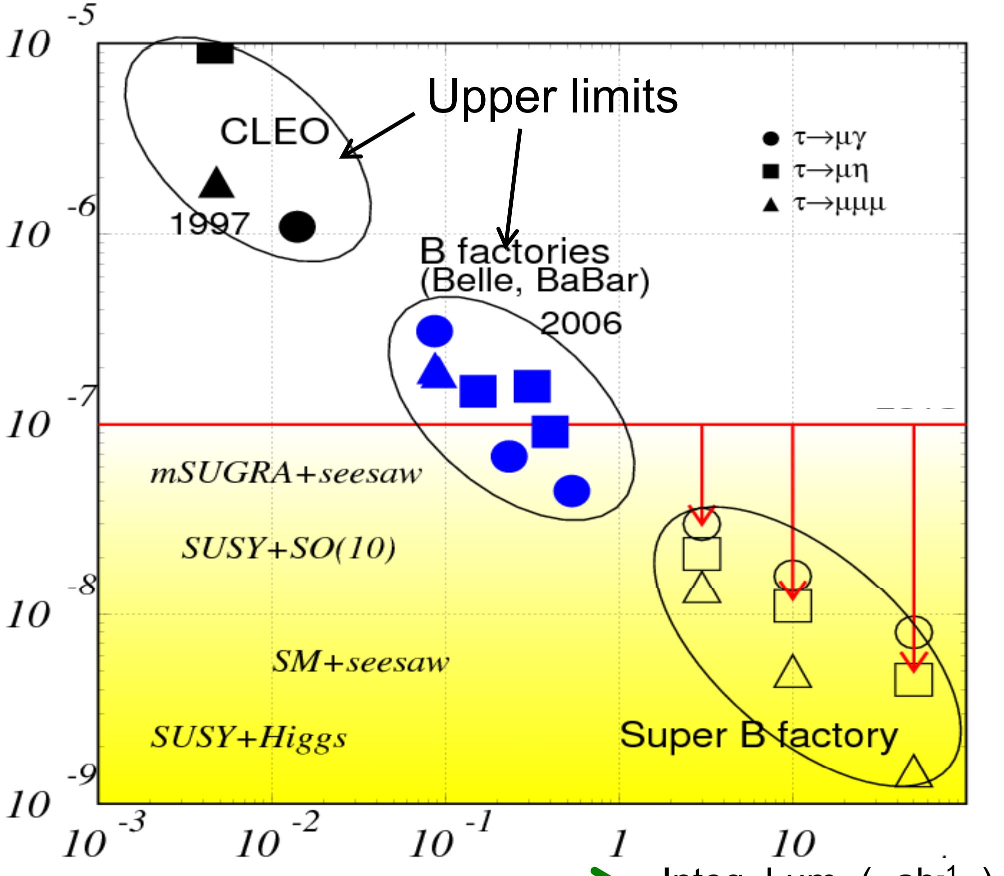
- Neutral Higgs mediated decay.
- Important when MSUSY >> EW scale.

$$Br(\tau \to 3\mu) = 4\times 10^{-7} \times \left(\frac{(m^2_{\tilde{L}})_{32}}{\bar{m}^2_{\tilde{L}}}\right)\left(\frac{\tan\beta}{60}\right)^6\left(\frac{100GeV}{m_A}\right)^4$$

model	Br(τ→μγ)	Br(τ→lll)
mSUGRA+seesaw	10^{-7}	10^{-9}
SUSY+SO(10)	10^{-8}	10^{-10}
SM+seesaw	10^{-9}	10^{-10}
Non-Universal Z’	10^{-9}	10^{-8}
SUSY+Higgs	10^{-10}	10^{-7}

Rare τ decays

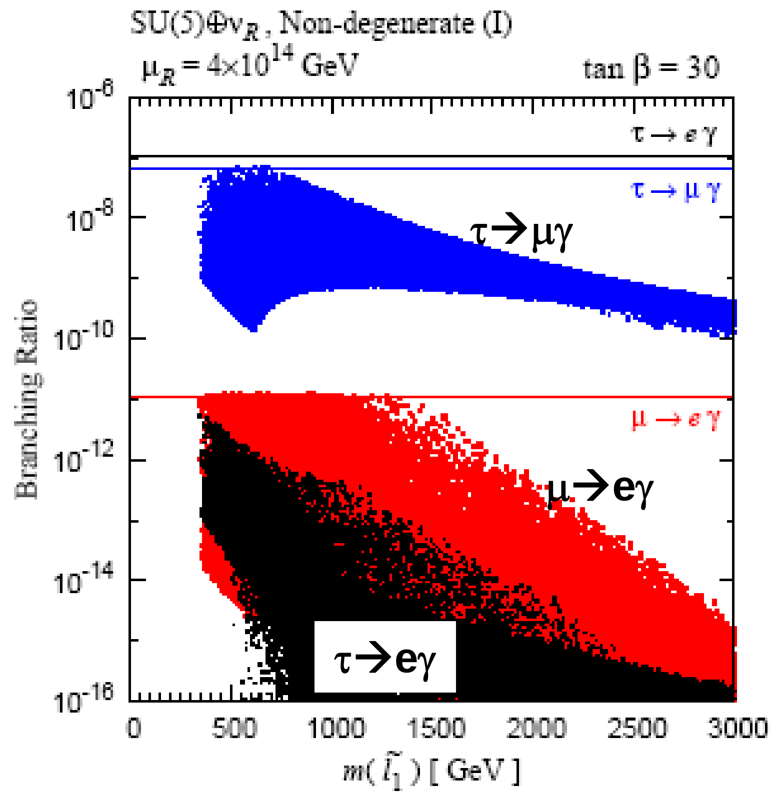
LF violating τ decay?



Reach of B factories

Super B factories

Theoretical predictions compared to present experimental limits



T.Goto et al., 2007

B Physics @ Υ(4S)

Observable	B Factories (2 ab^{-1})	Super$B$ (75 ab^{-1})
$\sin(2\beta)$ ($J/\psi K^0$)	0.018	0.005 (†)
$\cos(2\beta)$ ($J/\psi K^{*0}$)	0.30	0.05
$\sin(2\beta)$ (Dh^0)	0.10	0.02
$\cos(2\beta)$ (Dh^0)	0.20	0.04
$S(J/\psi \pi^0)$	0.10	0.02
$S(D^+D^-)$	0.20	0.03
$S(\phi K^0)$	0.13	0.02 (∗)
$S(\eta' K^0)$	0.05	0.01 (∗)
$S(K^0_S K^0_S K^0_S)$	0.15	0.02 (∗)
$S(K^0_S \pi^0)$	0.15	0.02 (∗)
$S(\omega K^0_S)$	0.17	0.03 (∗)
$S(f_0 K^0_S)$	0.12	0.02 (∗)
γ ($B \to DK$, $D \to CP$ eigenstates)	$\sim 15°$	2.5°
γ ($B \to DK$, $D \to$ suppressed states)	$\sim 12°$	2.0°
γ ($B \to DK$, $D \to$ multibody states)	$\sim 9°$	1.5°
γ ($B \to DK$, combined)	$\sim 6°$	1–2°
α ($B \to \pi\pi$)	$\sim 16°$	3°
α ($B \to \rho\rho$)	$\sim 7°$	1–2° (∗)
α ($B \to \rho\pi$)	$\sim 12°$	2°
α (combined)	$\sim 6°$	1–2° (∗)
$2\beta+\gamma$ ($D^{(*)\pm}\pi^\mp$, $D^\pm K^0_S \pi^\mp$)	20°	5°

Observable	B Factories (2 ab^{-1})	Super$B$ (75 ab^{-1})
$\lvert V_{cb}\rvert$ (exclusive)	4% (∗)	1.0% (∗)
$\lvert V_{cb}\rvert$ (inclusive)	1% (∗)	0.5% (∗)
$\lvert V_{ub}\rvert$ (exclusive)	8% (∗)	3.0% (∗)
$\lvert V_{ub}\rvert$ (inclusive)	8% (∗)	2.0% (∗)
$\mathcal{B}(B \to \tau\nu)$	20%	4% (†)
$\mathcal{B}(B \to \mu\nu)$	visible	5%
$\mathcal{B}(B \to D\tau\nu)$	10%	2%
$\mathcal{B}(B \to \rho\gamma)$	15%	3% (†)
$\mathcal{B}(B \to \omega\gamma)$	30%	5%
$A_{CP}(B \to K^*\gamma)$	0.007 (†)	0.004 († ∗)
$A_{CP}(B \to \rho\gamma)$	~ 0.20	0.05
$A_{CP}(b \to s\gamma)$	0.012 (†)	0.004 (†)
$A_{CP}(b \to (s+d)\gamma)$	0.03	0.006 (†)
$S(K^0_S \pi^0 \gamma)$	0.15	0.02 (∗)
$S(\rho^0\gamma)$	possible	0.10
$A_{CP}(B \to K^*\ell\ell)$	7%	1%
$A^{FB}(B \to K^*\ell\ell)s_0$	25%	9%
$A^{FB}(B \to X_s\ell\ell)s_0$	35%	5%
$\mathcal{B}(B \to K\nu\bar{\nu})$	visible	20%
$\mathcal{B}(B \to \pi\nu\bar{\nu})$	–	possible

Charm mixing and CP

Mode	Observable	$\Upsilon(4S)$ (75 ab^{-1})	$\psi(3770)$ (300 fb^{-1})
$D^0 \to K^+\pi^-$	x'^2	3×10^{-5}	
	y'	7×10^{-4}	
$D^0 \to K^+K^-$	y_{CP}	5×10^{-4}	
$D^0 \to K^0_S\pi^+\pi^-$	x	4.9×10^{-4}	
	y	3.5×10^{-4}	
	$\lvert q/p\rvert$	3×10^{-2}	
	ϕ	$2°$	
$\psi(3770) \to D^0\overline{D}^0$	x^2		$(1-2) \times 10^{-5}$
	y		$(1-2) \times 10^{-3}$
	$\cos\delta$		$(0.01-0.02)$

Charm FCNC

	Sensitivity
$D^0 \to e^+e^-$, $D^0 \to \mu^+\mu^-$	1×10^{-8}
$D^0 \to \pi^0 e^+e^-$, $D^0 \to \pi^0\mu^+\mu^-$	2×10^{-8}
$D^0 \to \eta e^+e^-$, $D^0 \to \eta\mu^+\mu^-$	3×10^{-8}
$D^0 \to K^0_S e^+e^-$, $D^0 \to K^0_S\mu^+\mu^-$	3×10^{-8}
$D^+ \to \pi^+ e^+e^-$, $D^+ \to \pi^+\mu^+\mu^-$	1×10^{-8}
$D^0 \to e^\pm\mu^\mp$	1×10^{-8}
$D^+ \to \pi^+ e^\pm\mu^\mp$	1×10^{-8}
$D^0 \to \pi^0 e^\pm\mu^\mp$	2×10^{-8}
$D^0 \to \eta e^\pm\mu^\mp$	3×10^{-8}
$D^0 \to K^0_S e^\pm\mu^\mp$	3×10^{-8}
$D^+ \to \pi^- e^+e^+$, $D^+ \to K^- e^+e^+$	1×10^{-8}
$D^+ \to \pi^-\mu^+\mu^+$, $D^+ \to K^-\mu^+\mu^+$	1×10^{-8}
$D^+ \to \pi^- e^\pm\mu^\mp$, $D^+ \to K^- e^\pm\mu^\mp$	1×10^{-8}

τ Physics

	Sensitivity
$\mathcal{B}(\tau \to \mu\gamma)$	2×10^{-9}
$\mathcal{B}(\tau \to e\gamma)$	2×10^{-9}
$\mathcal{B}(\tau \to \mu\mu\mu)$	2×10^{-10}
$\mathcal{B}(\tau \to eee)$	2×10^{-10}
$\mathcal{B}(\tau \to \mu\eta)$	4×10^{-10}
$\mathcal{B}(\tau \to e\eta)$	6×10^{-10}
$\mathcal{B}(\tau \to \ell K^0_S)$	2×10^{-10}

B$_s$ Physics @ Υ(5S)

Observable	Error with 1 ab^{-1}	Error with 30 ab^{-1}
$\Delta\Gamma$	0.16 ps^{-1}	0.03 ps^{-1}
Γ	0.07 ps^{-1}	0.01 ps^{-1}
β_s from angular analysis	20°	8°
A^s_{SL}	0.006	0.004
A_{CH}	0.004	0.004
$\mathcal{B}(B_s \to \mu^+\mu^-)$	-	$< 8 \times 10^{-9}$
$\lvert V_{td}/V_{ts}\rvert$	0.08	0.017
$\mathcal{B}(B_s \to \gamma\gamma)$	38%	7%
β_s from $J/\psi\phi$	10°	3°
β_s from $B_s \to K^0\bar{K}^0$	24°	11°

M. Giorgi, ICHEP2010

Physics with $50ab^{-1}$

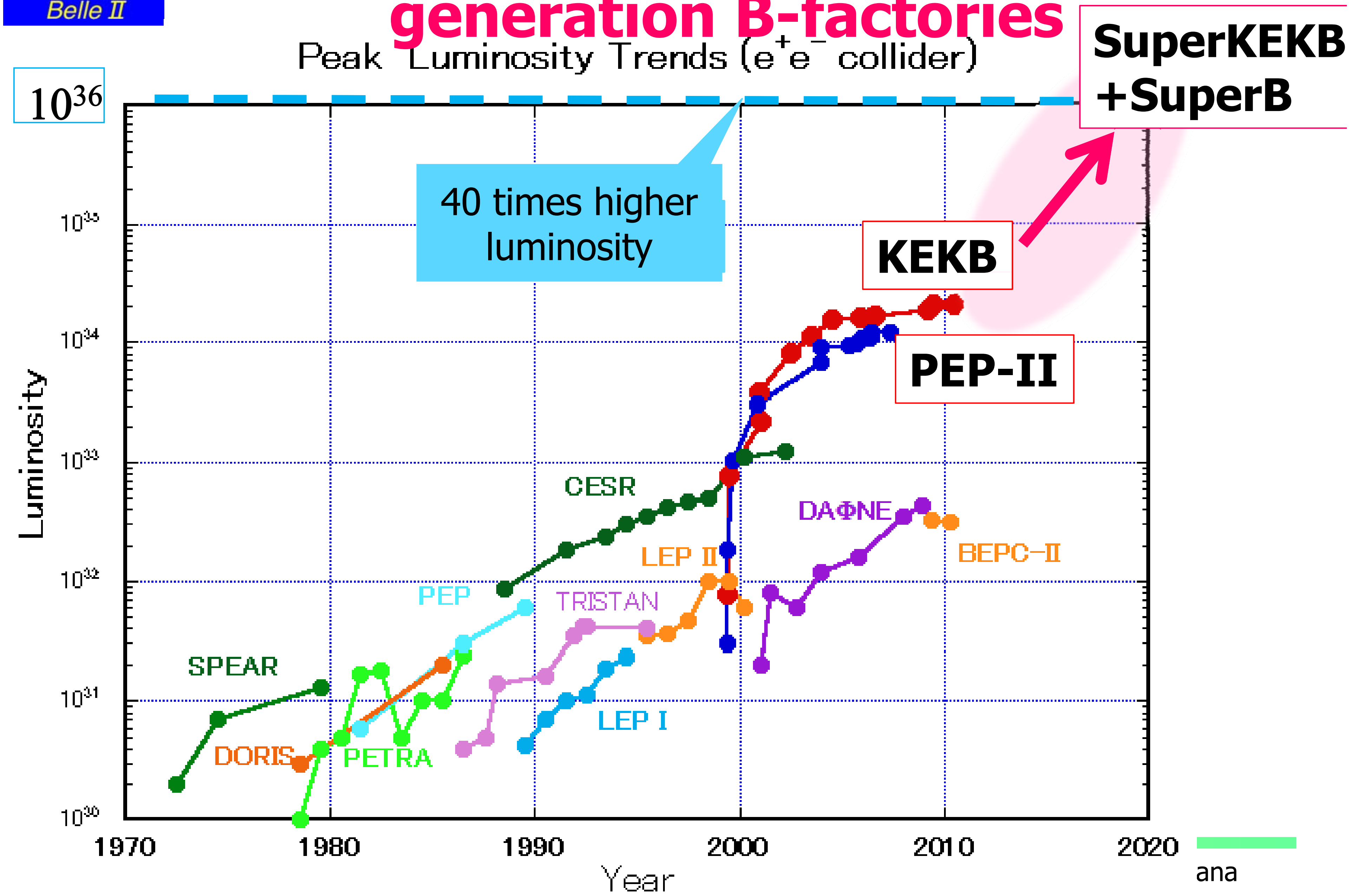
Recent update:

- Physics at Super B Factory (Belle II authors + guests)

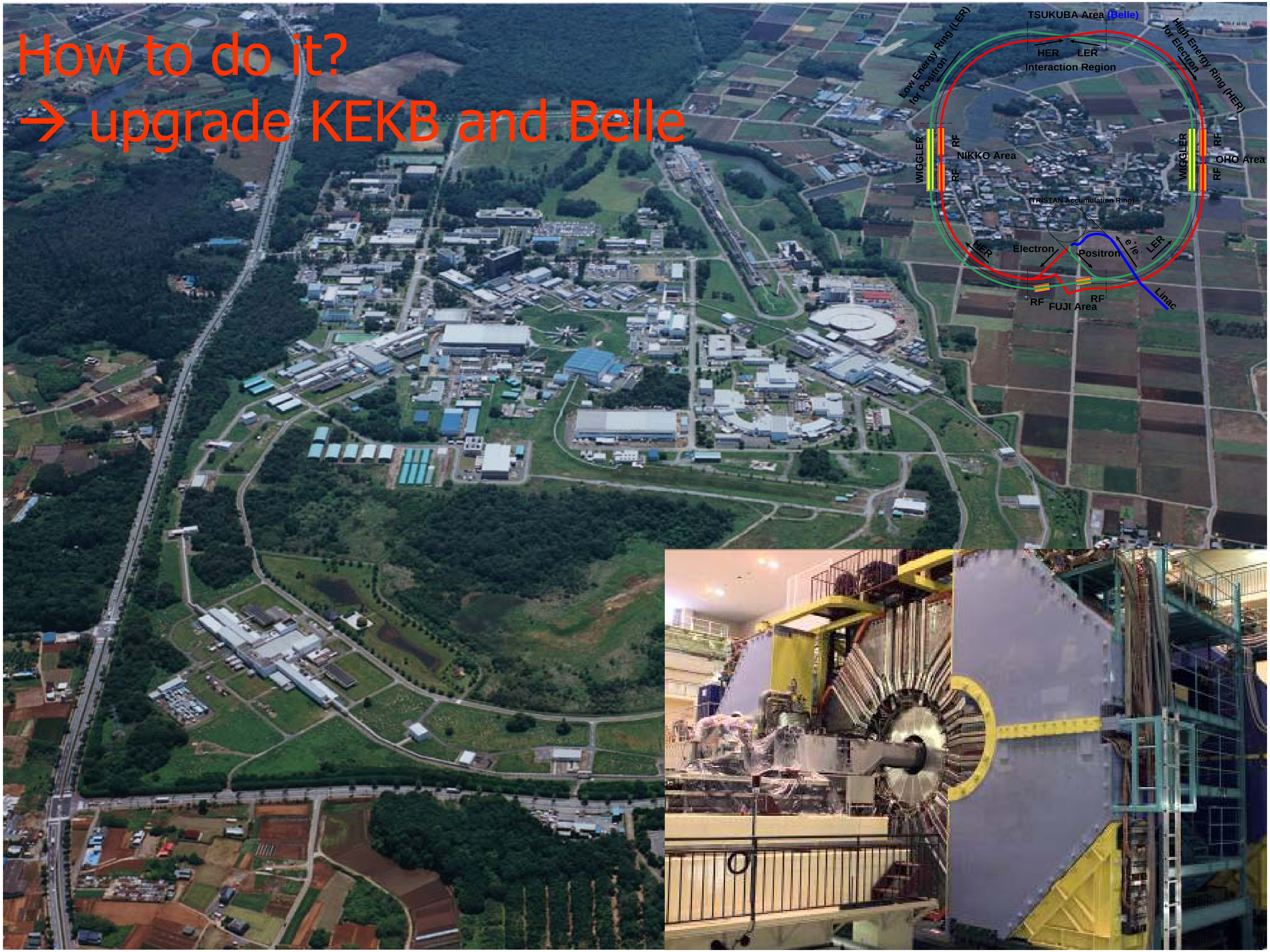
hep-ex > arXiv:1002.5012

Accelerator

Need O(100x) more data →Next generation B-factories



How to do it?
→ upgrade KEKB and Belle



Strategies for increasing luminosity

Beam-beam parameter

Lorentz factor

Beam current

$$L = \frac{\gamma_{e\pm}}{2 e r_e}\left(1+\frac{\sigma_y^*}{\sigma_x^*}\right)\left(\frac{I_{e\pm}\xi_y^{e\pm}}{\beta_y^*}\right)\left(\frac{R_L}{R_{\xi_y}}\right)$$

Lumi. reduction factor (crossing angle)&
Tune shift reduction factor (hour glass effect)
0.8 - 1
(short bunch)

Classical electron radius

Beam size ratio@IP
1 - 2 % (flat beam)

Vertical beta function@IP

(1) Smaller β_y^*

(2) Increase beam currents

(3) Increase ξ_y

“Nano-Beam” scheme

Collision with very small spot-size beams

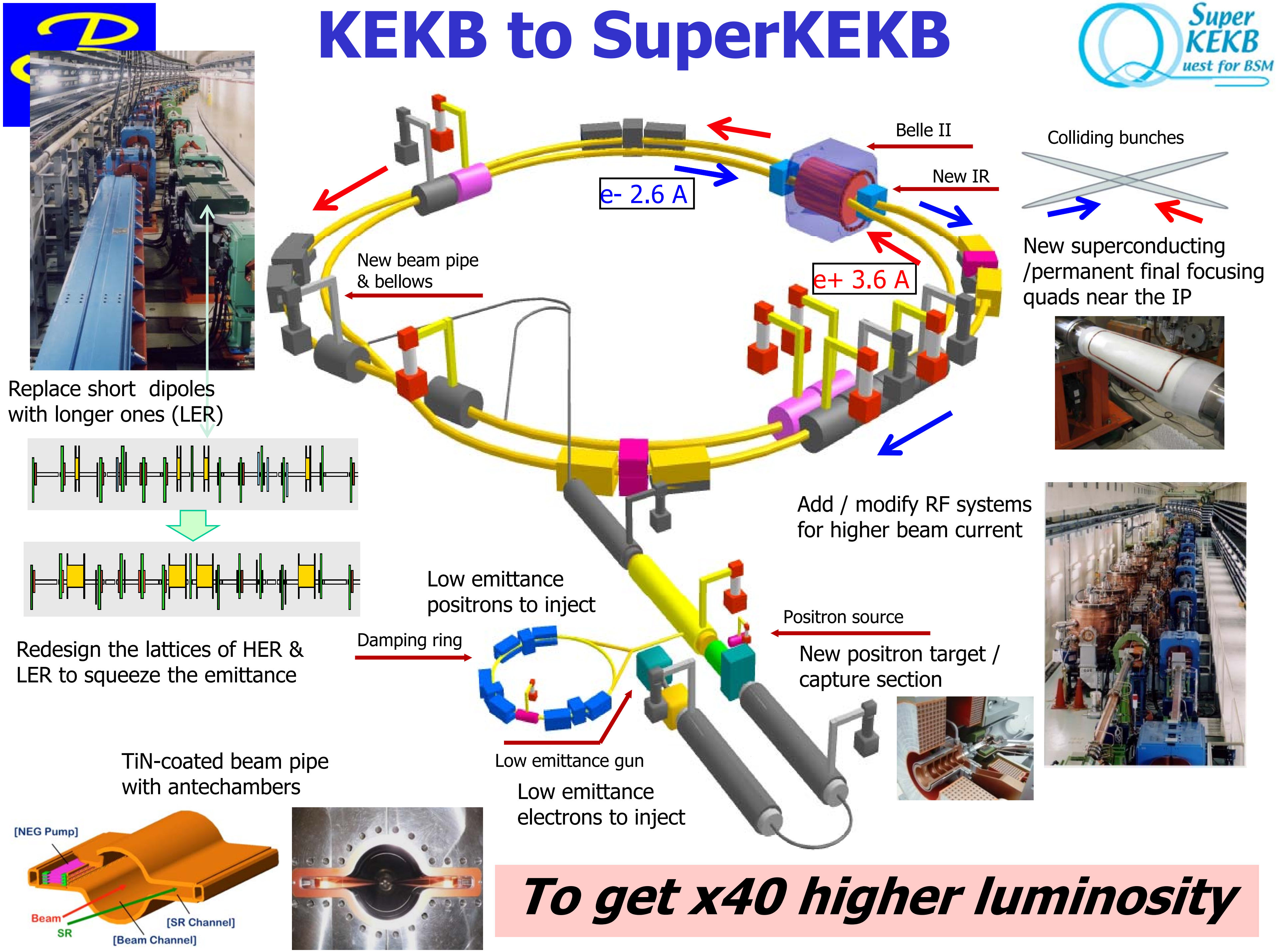
Invented by Pantaleo Raimondi for SuperB

Machine design parameters

parameters		KEKB		**SuperKEKB**		units
		LER	HER	LER	HER	
Beam energy	E_b	3.5	8	4	7	GeV
Half crossing angle	φ	11		41.5		mrad
Horizontal emittance	ε_x	18	24	3.2	4.3-4.6	nm
Emittance ratio	κ	0.88	0.66	0.27	0.25	%
Beta functions at IP	β_x^*/β_y^*	1200/5.9		32/0.27	25/0.31	mm
Beam currents	I_b	1.64	1.19	3.60	2.60	A
beam-beam parameter	ξ_y	0.129	0.090	0.0886	0.0830	
Luminosity	**L**	**2.1×10^{34}**		**8×10^{35}**		**$cm^{-2}s^{-1}$**

- **Small beam size & high current** to increase luminosity
- **Large crossing angle**
- **Change beam energies** to solve the problem of LER short lifetime

KEKB to SuperKEKB

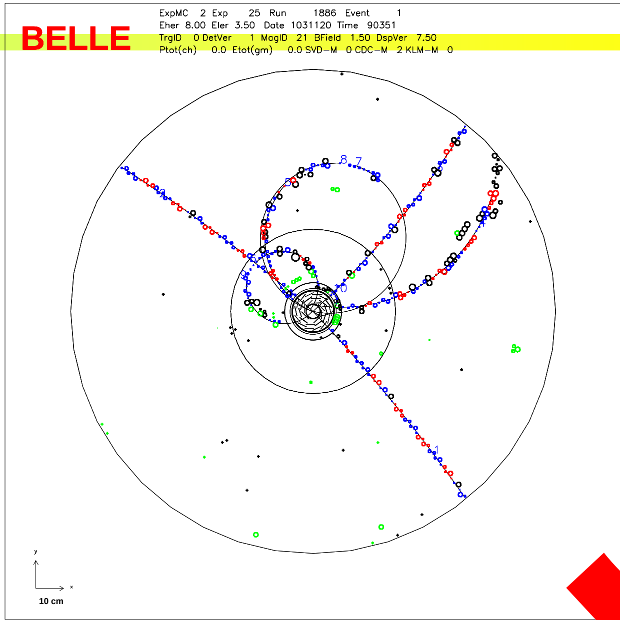


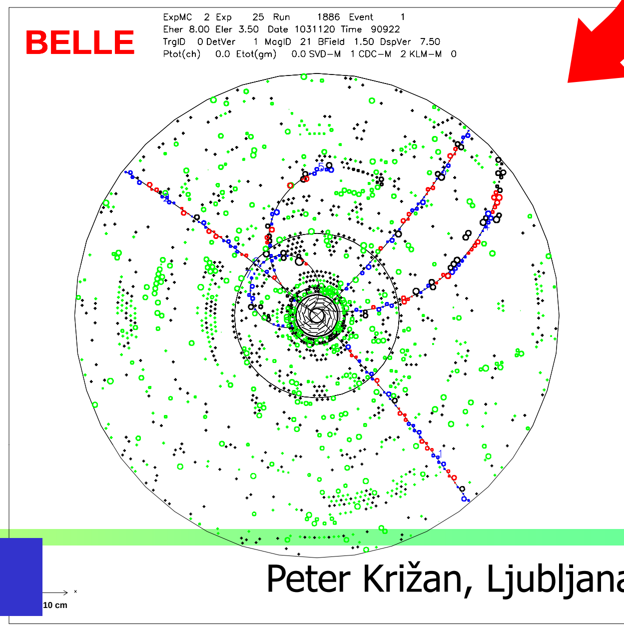
Detector

Requirements for the Belle II detector

Critical issues at L= 8 x 10^{35}/cm^2/sec

- **Higher background (×10-20)**
  - radiation damage and occupancy
  - fake hits and pile-up noise in the EM
- **Higher event rate (×10)**
  - higher rate trigger, DAQ and computing
- **Require special features**
  - low p μ identification $\leftarrow s\mu\mu$ recon. eff.
  - hermeticity $\leftarrow \nu$ "reconstruction"



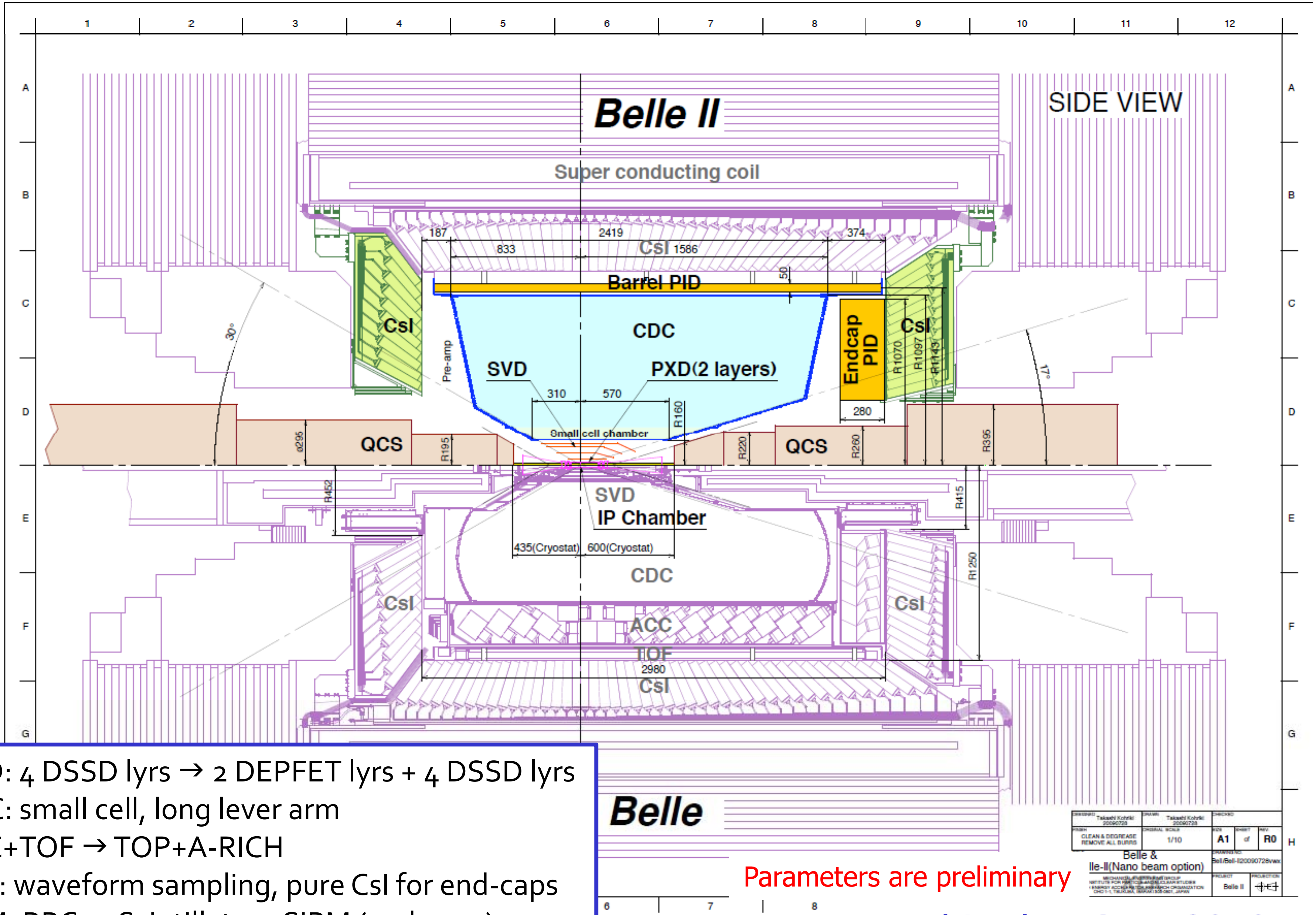


Solutions:

- Replace inner layers of the vertex detector with a pixel detector.
- Replace inner part of the central tracker with a silicon strip detector.
- Better particle identification device
- Replace endcap calorimeter crystals
- Faster readout electronics and computing system.

TDR published arXiv:1011.0352v1 [physics.ins-det]

Belle II in comparison with Belle



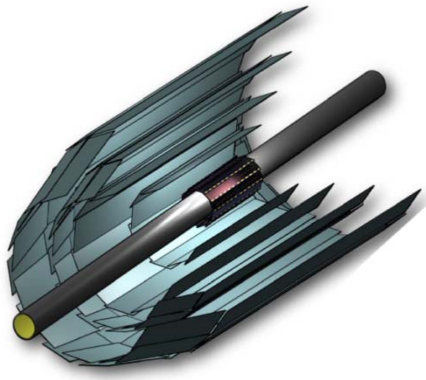
SVD: 4 DSSD lyrs → 2 DEPFET lyrs + 4 DSSD lyrs
CDC: small cell, long lever arm
ACC+TOF → TOP+A-RICH
ECL: waveform sampling, pure CsI for end-caps
KLM: RPC → Scintillator +SiPM (end-caps)

Parameters are preliminary

Y. Ushiroda, ICHEP2010

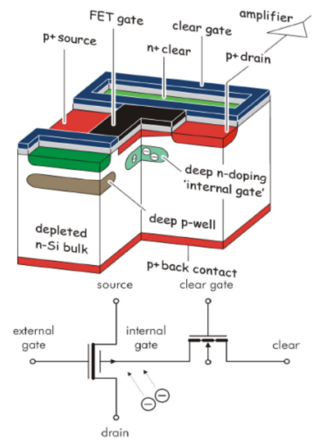
Vertex Detector

DEPFET:
http://aldebaran.hll.mpg.de/twiki/bin/view/DEPFET/WebHome

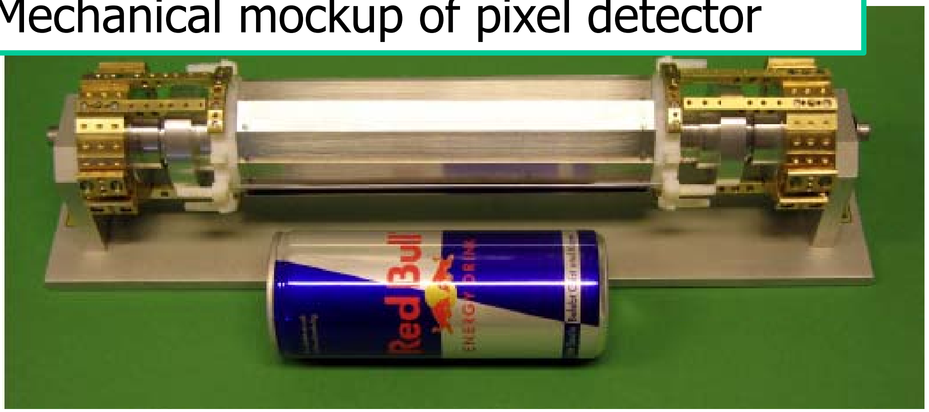


Beam Pipe		**r = 10mm**
DEPFET		
	Layer 1	**r = 14mm**
	Layer 2	**r = 22mm**
DSSD		
	Layer 3	**r = 38mm**
	Layer 4	**r = 80mm**
	Layer 5	**r = 115mm**
	Layer 6	**r = 140mm**

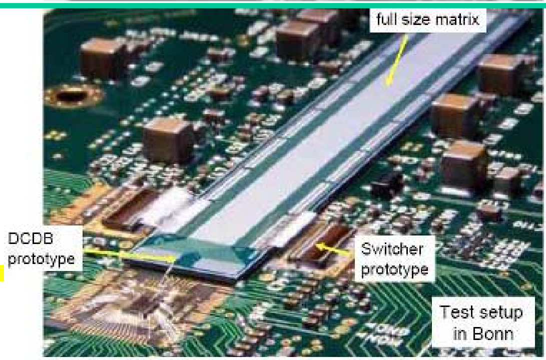
DEpleted P-channel FET

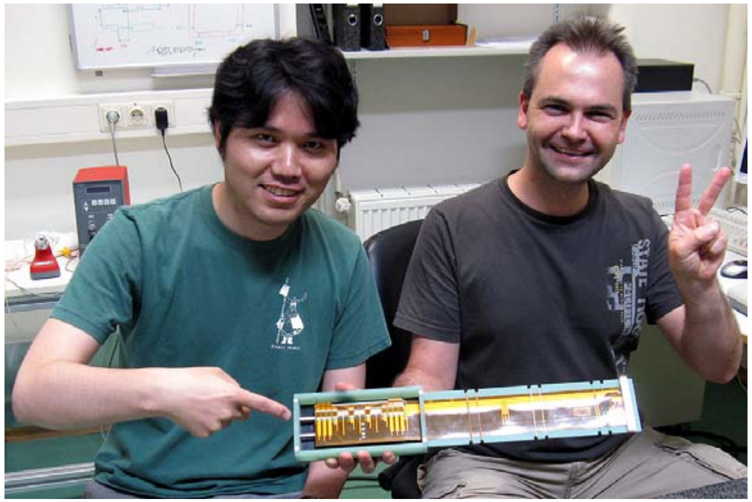


Mechanical mockup of pixel detector



Prototype DEPFET pixel sensor and readout

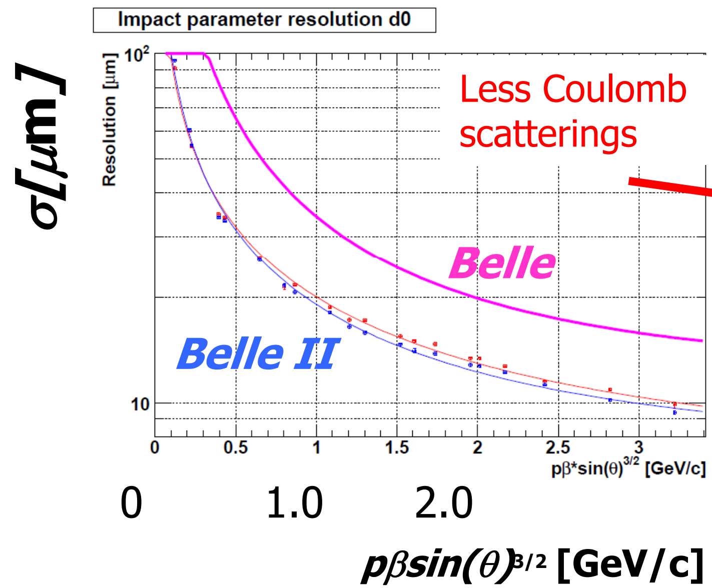


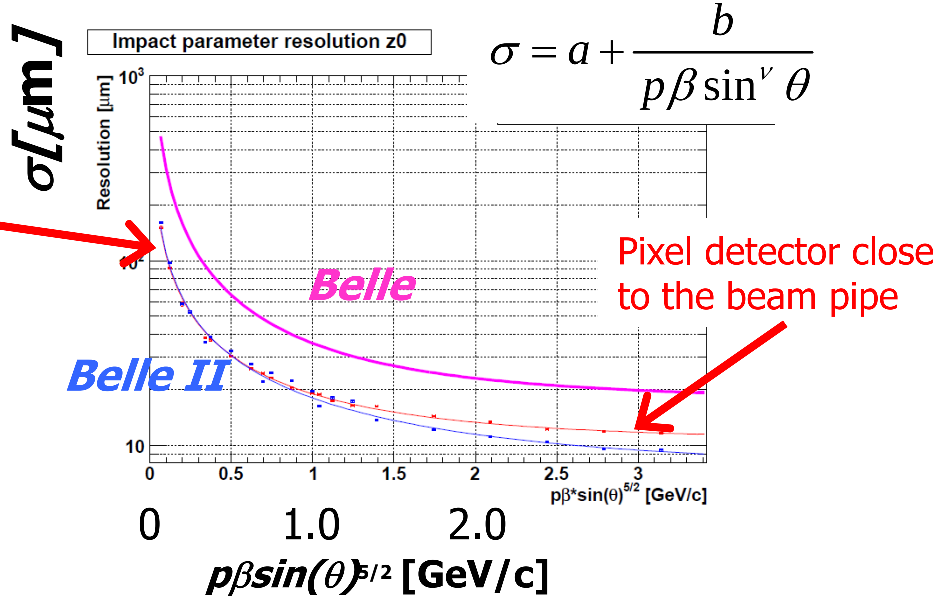


A prototype ladder using the first 6 inch DSSD from Hamamatsu has been assembled and tested.

Expected performance: vertexing

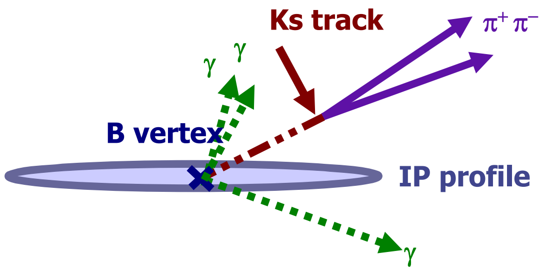
Significant improvement in IP resolution!



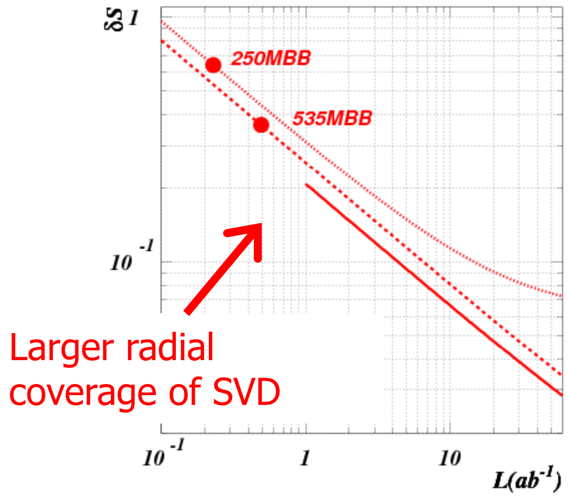


$$\sigma = a + \frac{b}{p\beta \sin^{\nu}\theta}$$

Significant improvement in $\delta S(K_S \pi^0 \gamma)$

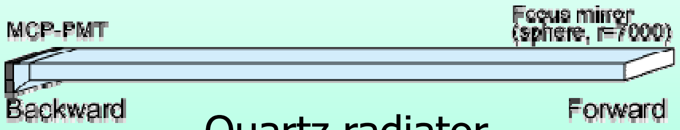


B decay point reconstruction with K_S trajectory



Particle identification systems

Barrel PID: Time of Propagation Counter (TOP)



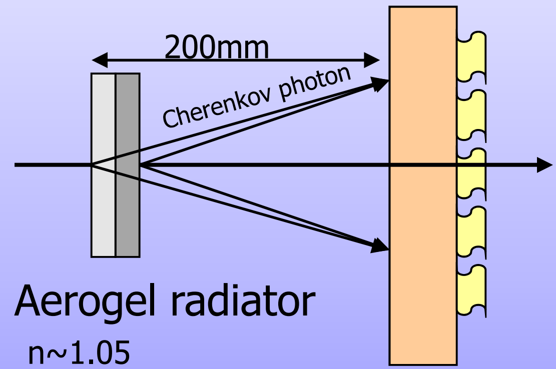
Quartz radiator

Focusing mirror

Small expansion block

Hamamatsu MCP-PMT (measure t, x and y)

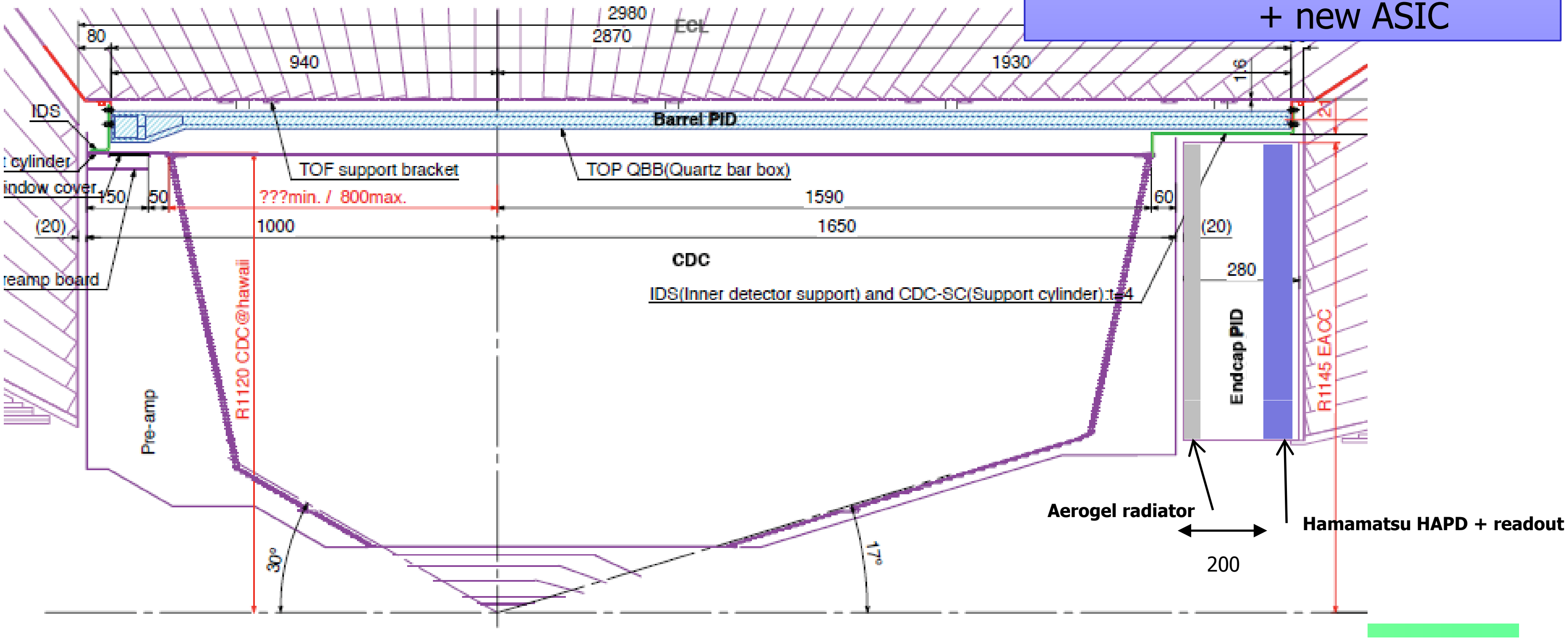
Endcap PID: Aerogel RICH (ARICH)



Aerogel radiator

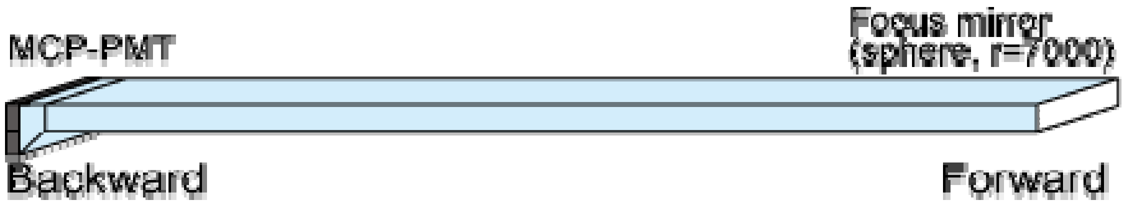
n~1.05

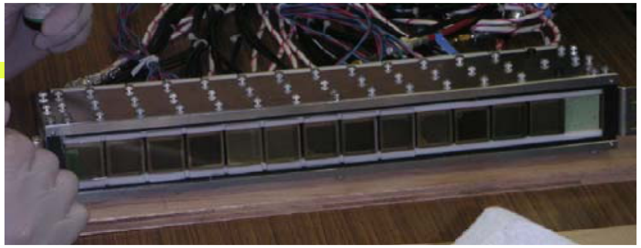
Hamamatsu HAPD
+ new ASIC



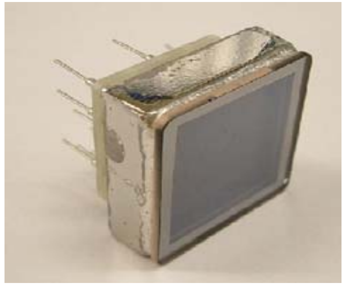
Peter Križan, Ljubljana

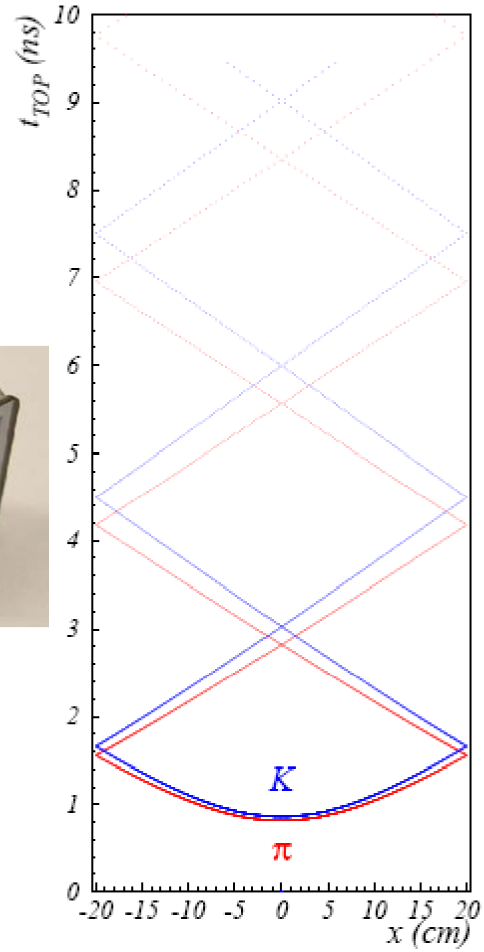
Barrel PID: Time-of-propagation (TOP) counter

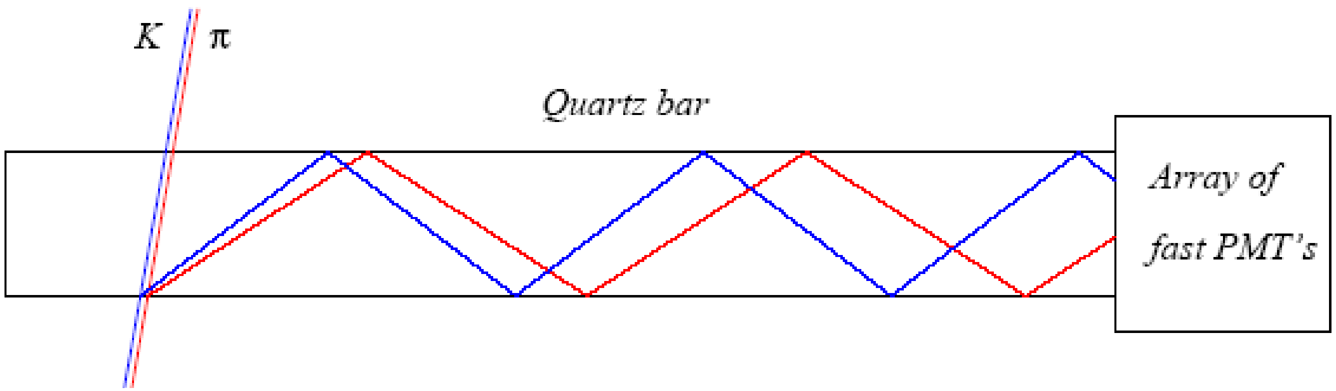




- Cherenkov ring imaging with precise time measurement.
- Reconstruct angle from two coordinates and the time of propagation of the photon
  - Quartz radiator (2cm)
  - Photon detector (MCP-PMT)
    - Good time resolution ~ 40 ps
    - Single photon sensitivity in 1.5 T
    - Wave-form sampling read-out

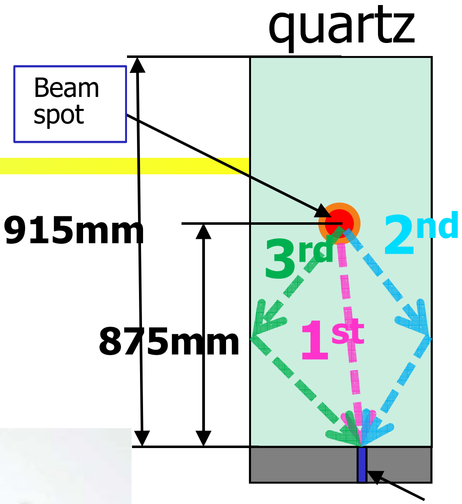


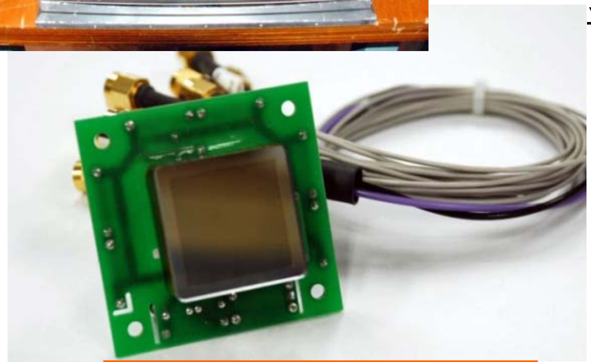


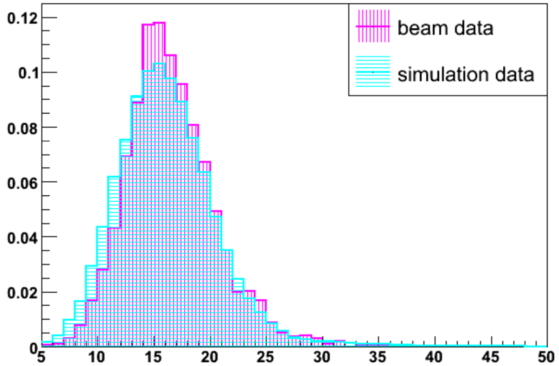


TOP (Barrel PID)

- Quartz radiator
  - $2.6m^L \times 45cm^W \times 2cm^T$
  - Excellent surface accuracy
- MCP-PMT
  - Hamamatsu 16ch MCP-PMT
    - Good TTS (<35ps) & enough lifetime
    - Multialkali photo-cathode → SBA
- Beam test in 2009
  - # of photons consistent
  - Time resolution OK

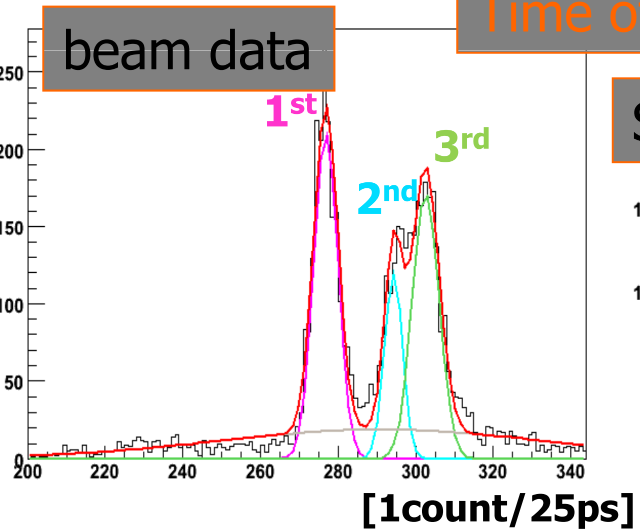


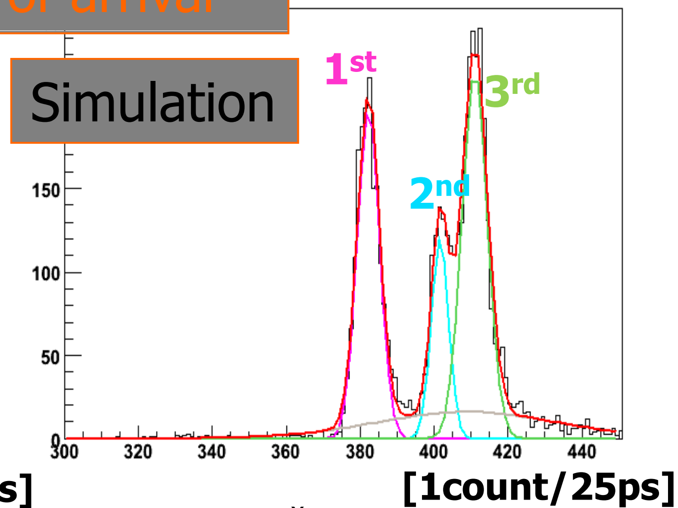




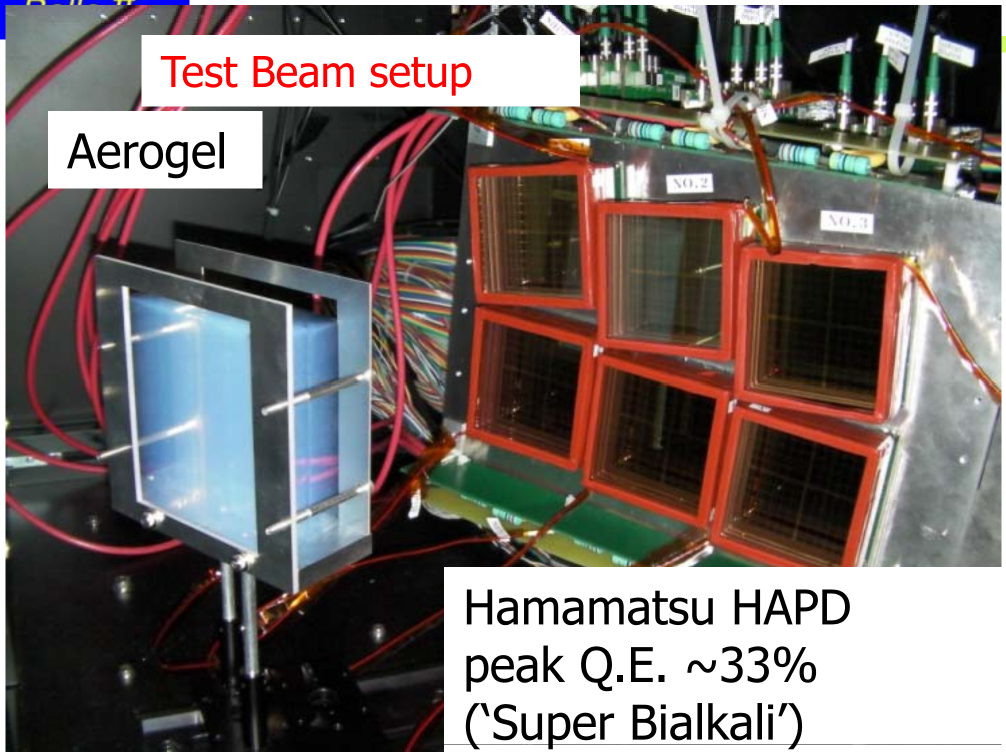
# of photons

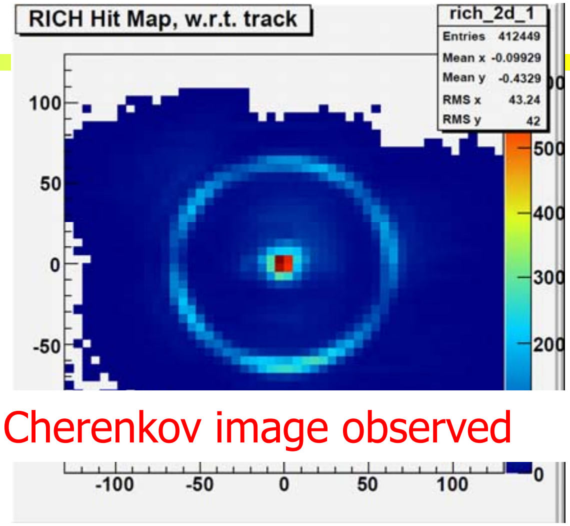
Time of arrival





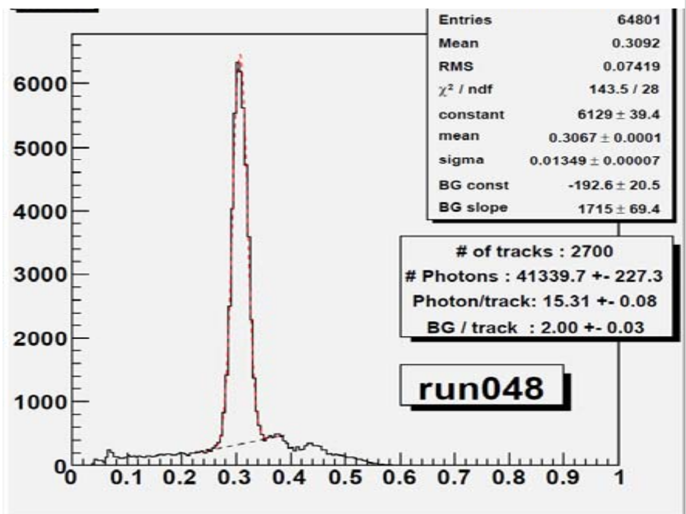
Aerogel RICH (endcap PID)





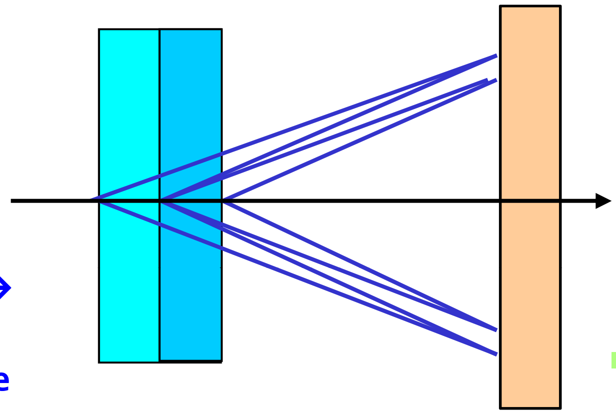
Clear Cherenkov image observed

Cherenkov angle distribution



RICH with a novel "focusing" radiator – a two layer radiator

Employ multiple layers with different refractive indices → Cherenkov images from individual layers overlap on the photon detector.



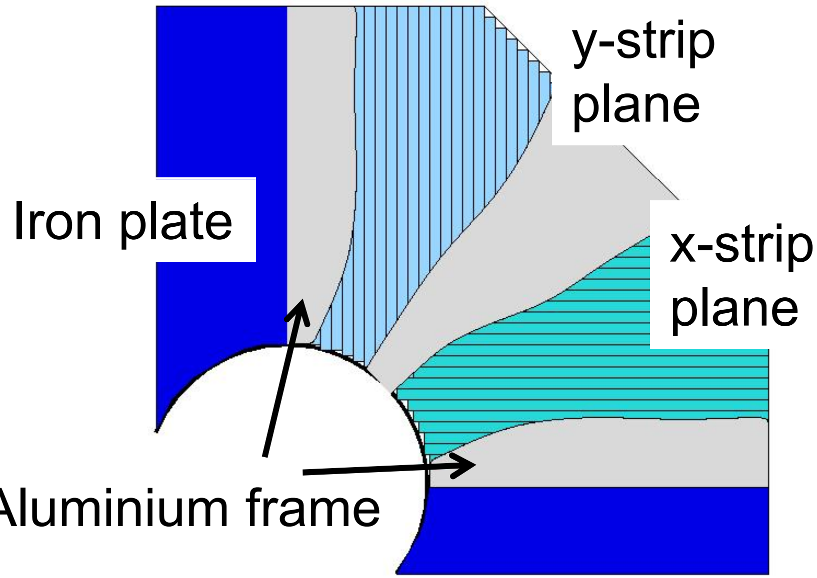
6.6 σ π/K at 4GeV/c !

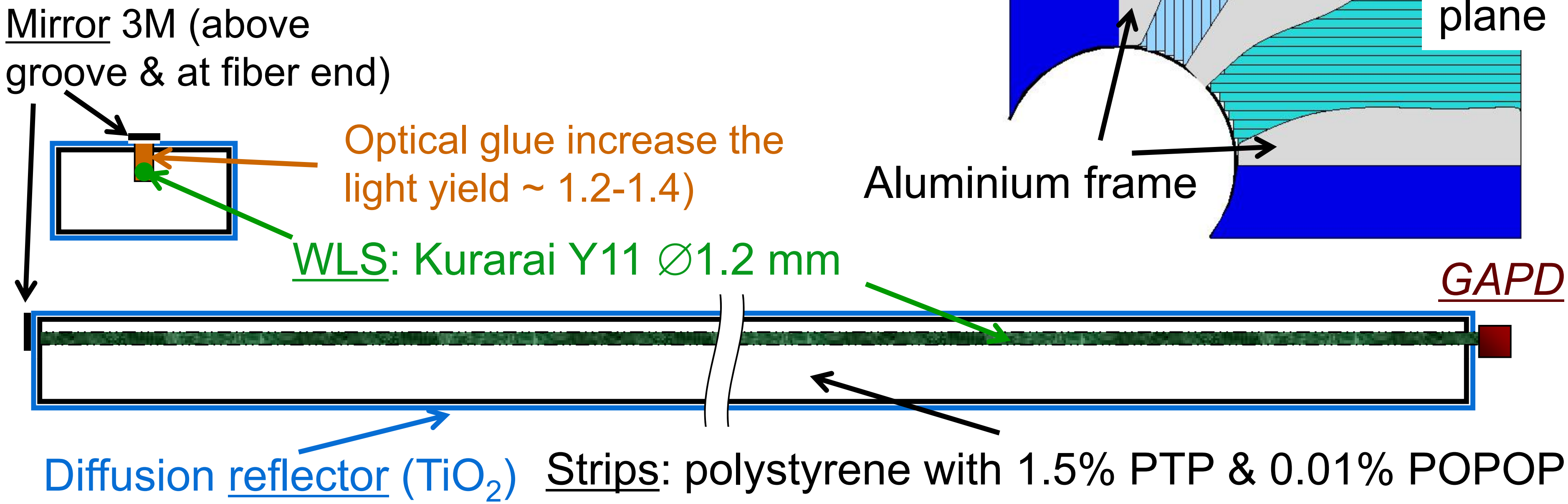
Peter Križan, Ljubljana

KLM upgrade in the endcaps

Scintillator-based KLM (endcap)

- Two independent (x and y) layers in one superlayer made of orthogonal strips with WLS read out
- Photo-detector = avalanche photodiode in Geiger mode (SiPM)
- ~120 strips in one 90º sector
  (max L=280cm, w=25mm)
- ~30000 read out channels
- Geometrical acceptance > 99%

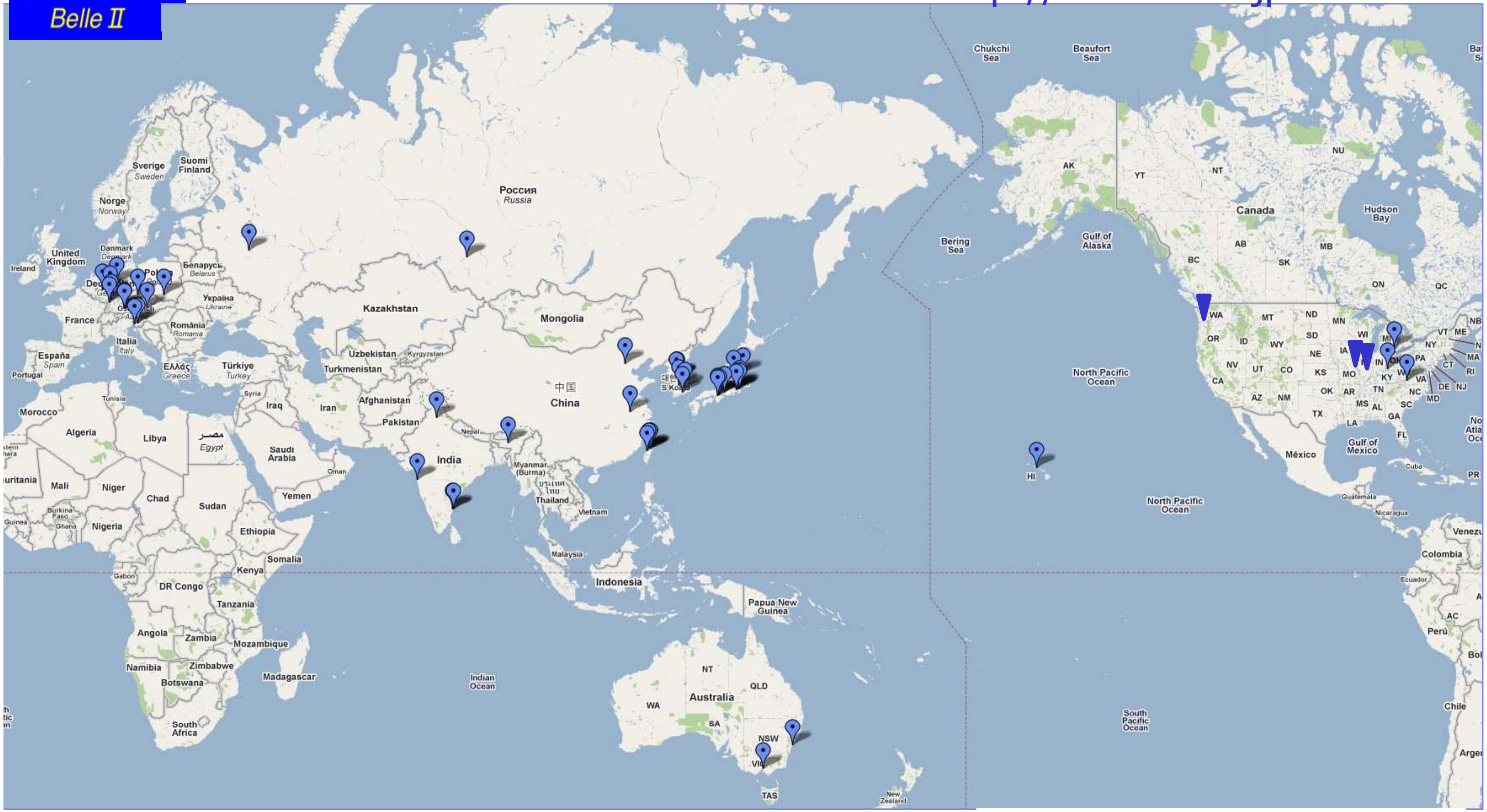




Status of the project

Belle II Collaboration

http://belle2.kek.jp



13 countries/regions, 56 institutions

~350 collaborators,
~110 from Europe

Peter Križan, Ljubljana

European groups of Belle-II

- Austria: HEPHY (Vienna)
- Czech Republic: Charles University in Prague
- Germany: U. Bonn, U. Giessen, U. Goettingen, U. Heidelberg, KIT Karlsruhe, LMU Munich, MPI Munich, TU Munich
- Poland: INP Krakow
- Russia: ITEP (Moscow), BINP (Novosibirsk), IHEP (Protvino)
- Slovenia: J. Stefan Institute, U. Ljubljana, U. Maribor, U. Nova Gorica

Sizeable fraction of the collaboration: in total ~110 collaborators out of ~350!

European groups of Belle-II

The European groups have major responsibilities in some essential detector systems:

- Pixel vertex detector (DEPFET)
- Silicon strip vertex detector
- Particle identification systems (endcap Aerogel RICH, barrel Time-of-Propagation counter)
- Electromagnetic calorimeter
- Muon detector based on scintilator strips

They are also contributing substantially to the computing and software, as well as to the set-up of the physics program.

Open Collaboration Meeting Series


7th Open Meeting of the Belle II Collaboration

November 17 - 20, 2010, KEK, Japan

Top | Bulletin | Registration | Participants
Program | Access | Accommodation | Others

Registration

To register, please fill the 7th B2GM registration form
If you have trouble to access the registration page, please send your name, affiliation, country, status (staff/student), and e-mail address to the Belle secretariat (FAX number and e-mail address can be found here).

Goals

Following the KEK roadmap, the KEKB accelerator will be upgraded in 3~4 year to reach an initial target luminosity of 8 x 10^{35} $cm^{-2}s^{-1}$. This meeting is expected to be an important step towards finalizing the design of the Belle-II spectrometer.

- 6th Open Meeting of the Belle II Collaboratior
  (July 5-7, 2010, KEK, Japan)
- 5th Open Meeting of the Belle II Collaboration
  (March 31 – April 2, 2010, KEK, Japan)
- 4th Open Meeting of the Belle II Collaboration
  (November 18-20, 2009, KEK, Japan)
- 3rd Open Meeting of the Belle II Collaboration
  (July 7-9, 2009, KEK, Japan)
- 2nd Open Meeting of the Belle II Collaboration
  (March 17-19, 2009, KEK, Japan)
- 1st Open Meeting of the Belle II Collaboration
  (December 10-12, 2008, KEK, Japan)

- 2nd Open Meeting of the SuperKEKB proto-collaboration
  (July 3-4, 2008, KEK, Japan)
- 1st Open Meeting of the SuperKEKB proto-collaboration
  (March 19-20, 2008, KEK, Japan)

na

Big step forward

一般向けページ >> 研究者向けページ >> English Pages >>

大学共同利用機関法人 KEK 高エネルギー加速器研究機構

Press Release

Top | Access | For Visitors | Map & Guide | Document | Site Map | Search

>Top >PressRelease >this page

last update: 10/06/23

Press Release

KEKB upgrade plan has been approved

June 23, 2010
High Energy Accelerator Research Organization (KEK)

The MEXT, the Japanese Ministry that supervises KEK, has announced that it will appropriate a budget of 100 oku-yen (approx $110M) over the next three years starting this Japanese fiscal year (JFY2010) for the high performance upgrade program of KEKB. This is part of the measures taken under the new "Very Advanced Research Support Program" of the Japanese government.

"We are delighted to hear this news," says Masanori Yamauchi, former spokesperson for the Belle experiment and currently a deputy director of the Institute of Particle and Nuclear Studies of KEK. "This three- year upgrade plan allows the Belle experiment to study the physics from decays of heavy flavor particles with an unprecedented precision. It means that KEK in Japan is launching a renewed research program in search for new physics by using a technique which is complementary to what is employed at LHC at CERN."

[Media Contact] Youhei Morita,
Head of Public Relations Office, KEK
tel. +81-29-879-6047

SuperKEKB/Belle II funding Status

- 5.8 oku yen (~7 MUSD) for Damping Ring (FY2010)
- 100 oku yen (~110 MUSD) for the machine→
  Very Advanced Research Support Program (FY2010-2012)

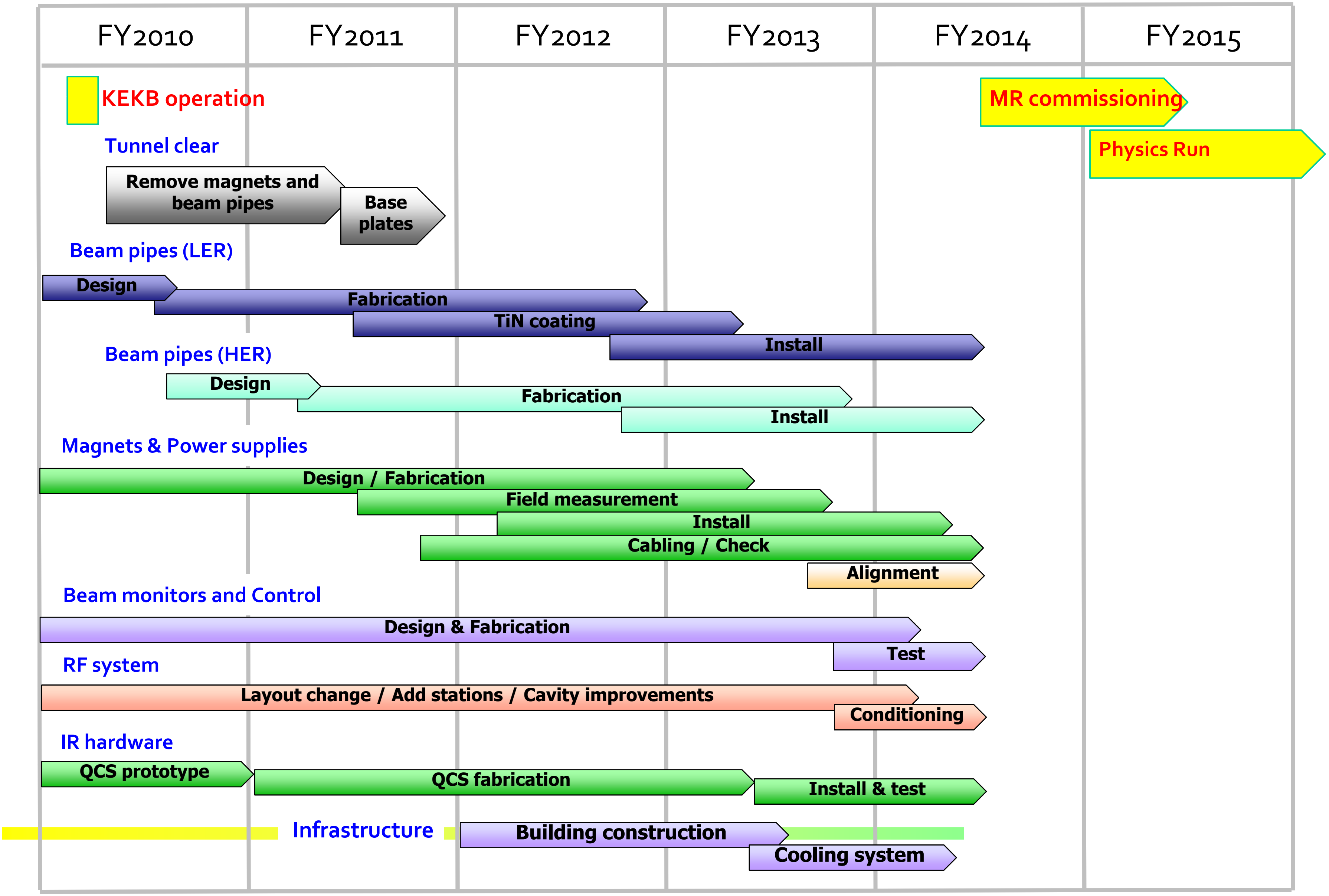
Continue efforts to obtain additional funds to complete construction as scheduled – regular Japanese budget.

Several non-Japanese funding agencies have already allocated sizable funds for the upgrade.

→construction started!

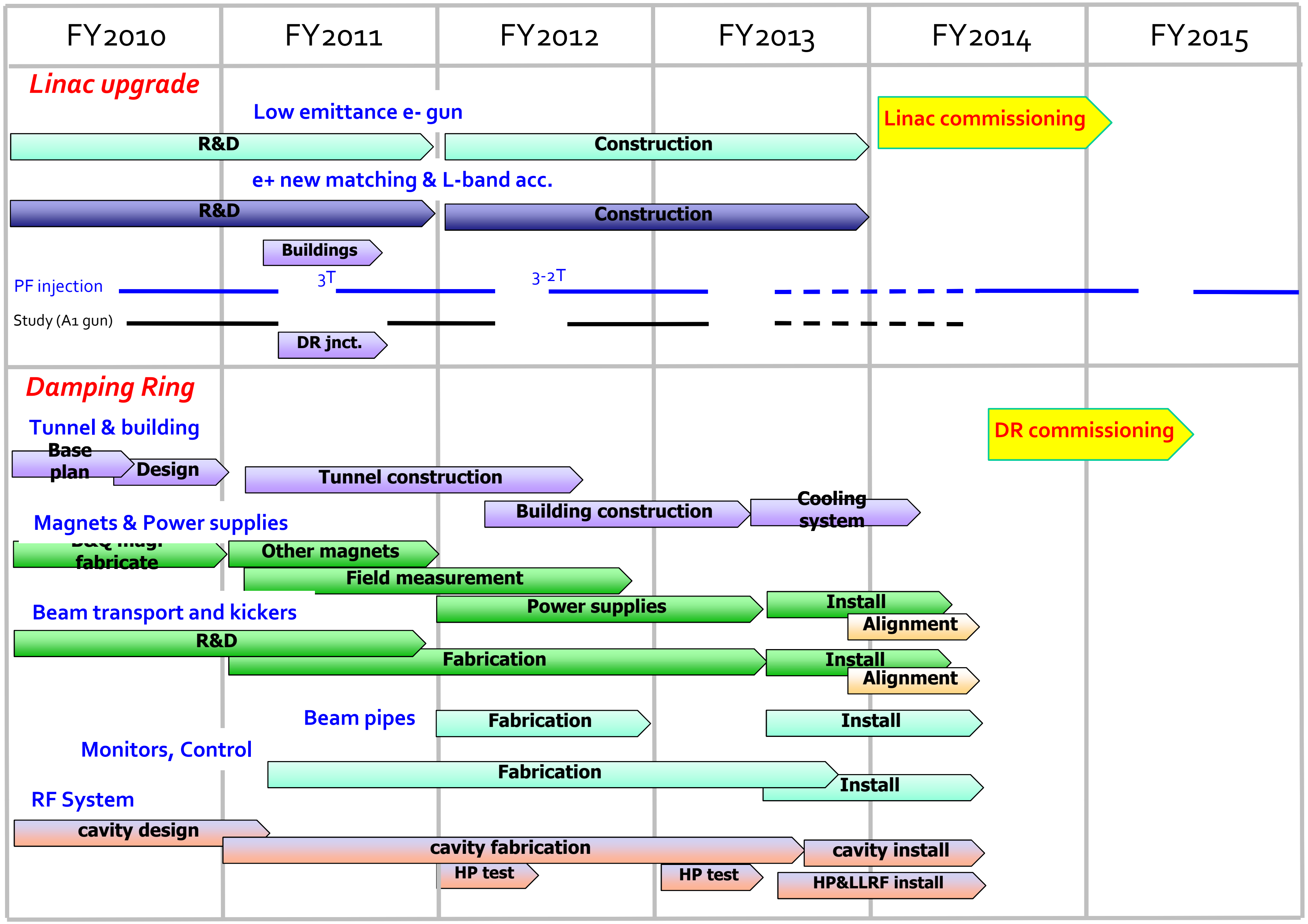
SuperKEKB Main Ring schedule

Oct. 20, 2010

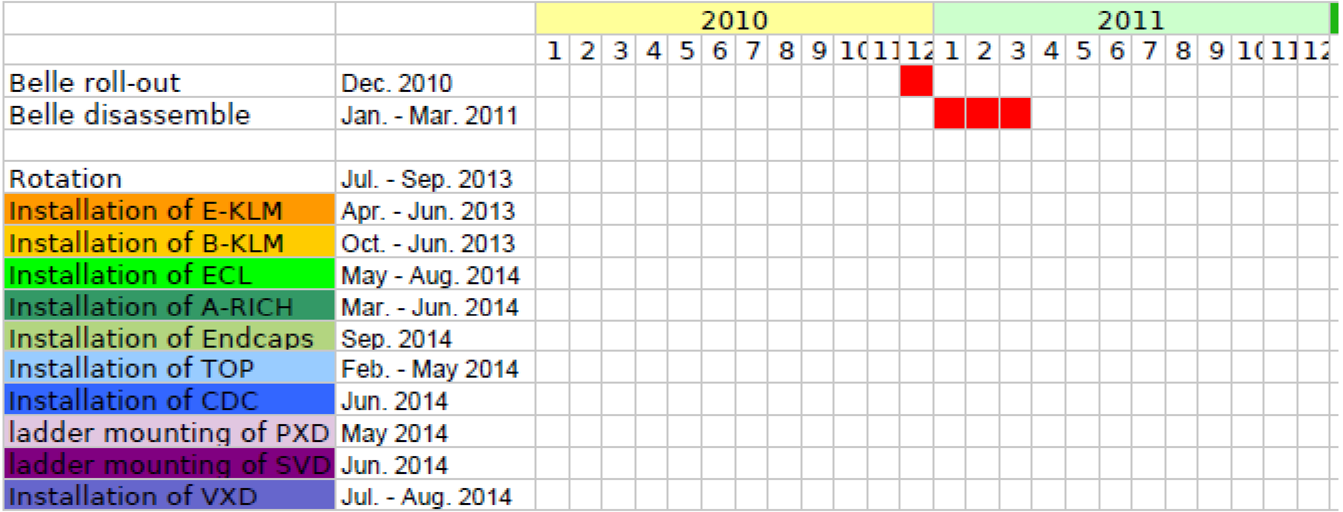


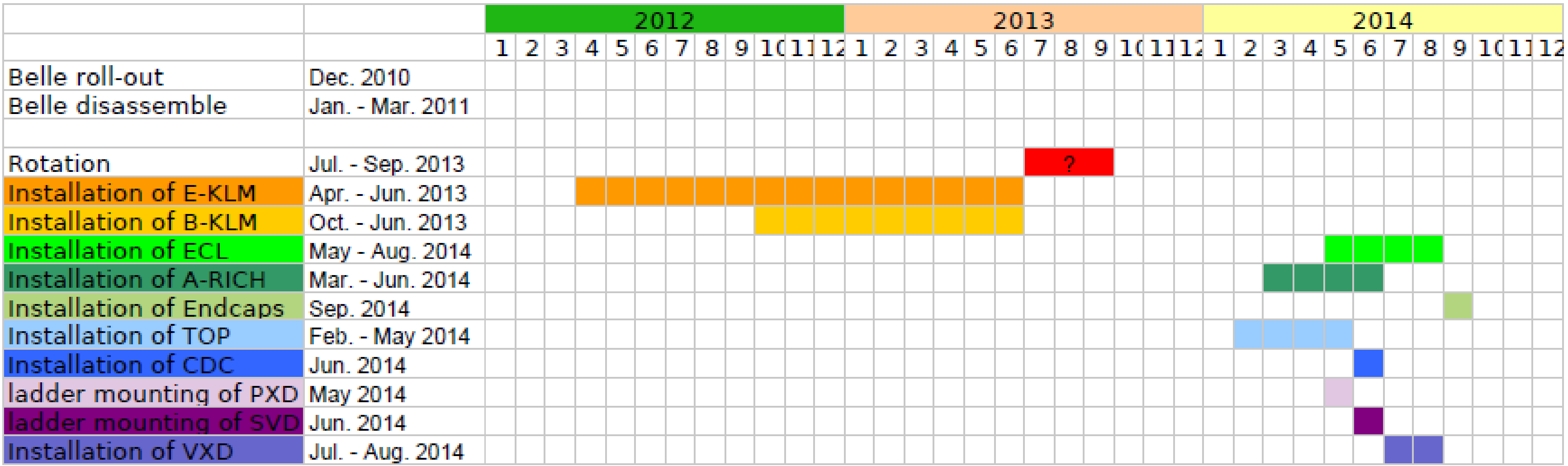
Linac upgrade and DR construction schedule

Oct. 20, 2010

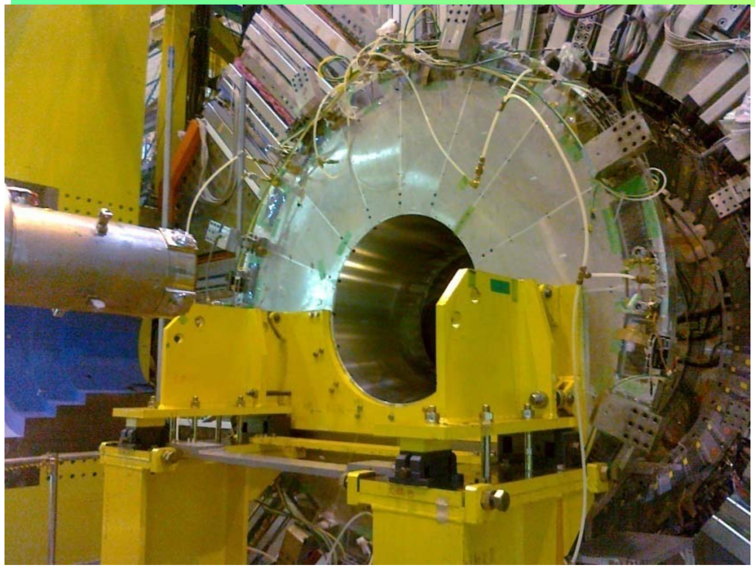


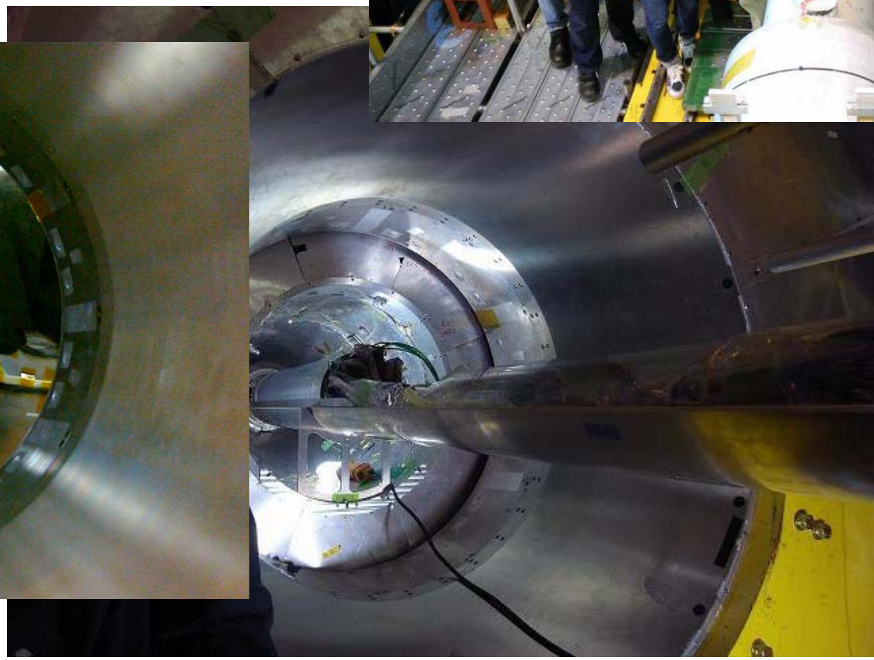
Installation Schedule of Belle II

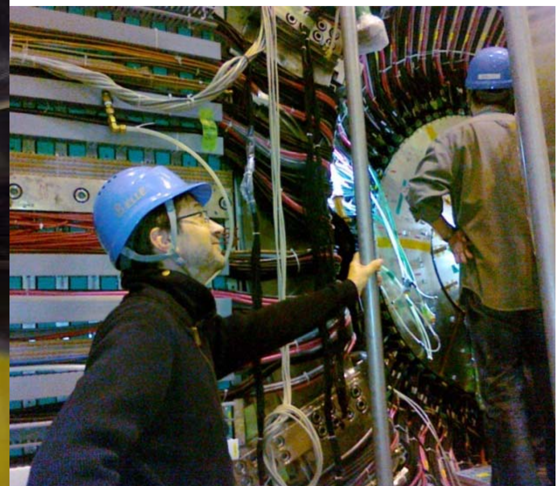




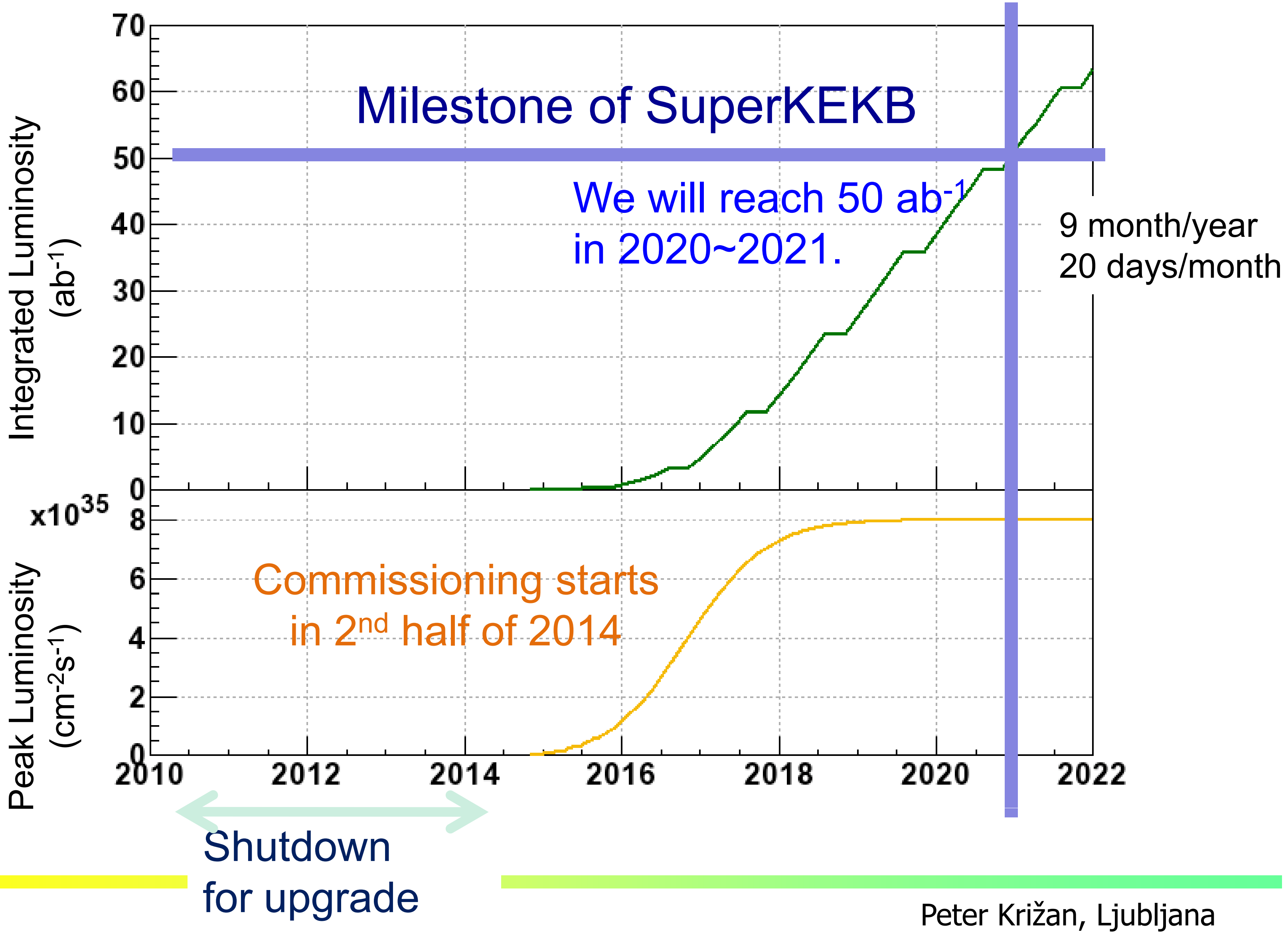
Two weeks ago: taking out the SVD2 – vertex detector







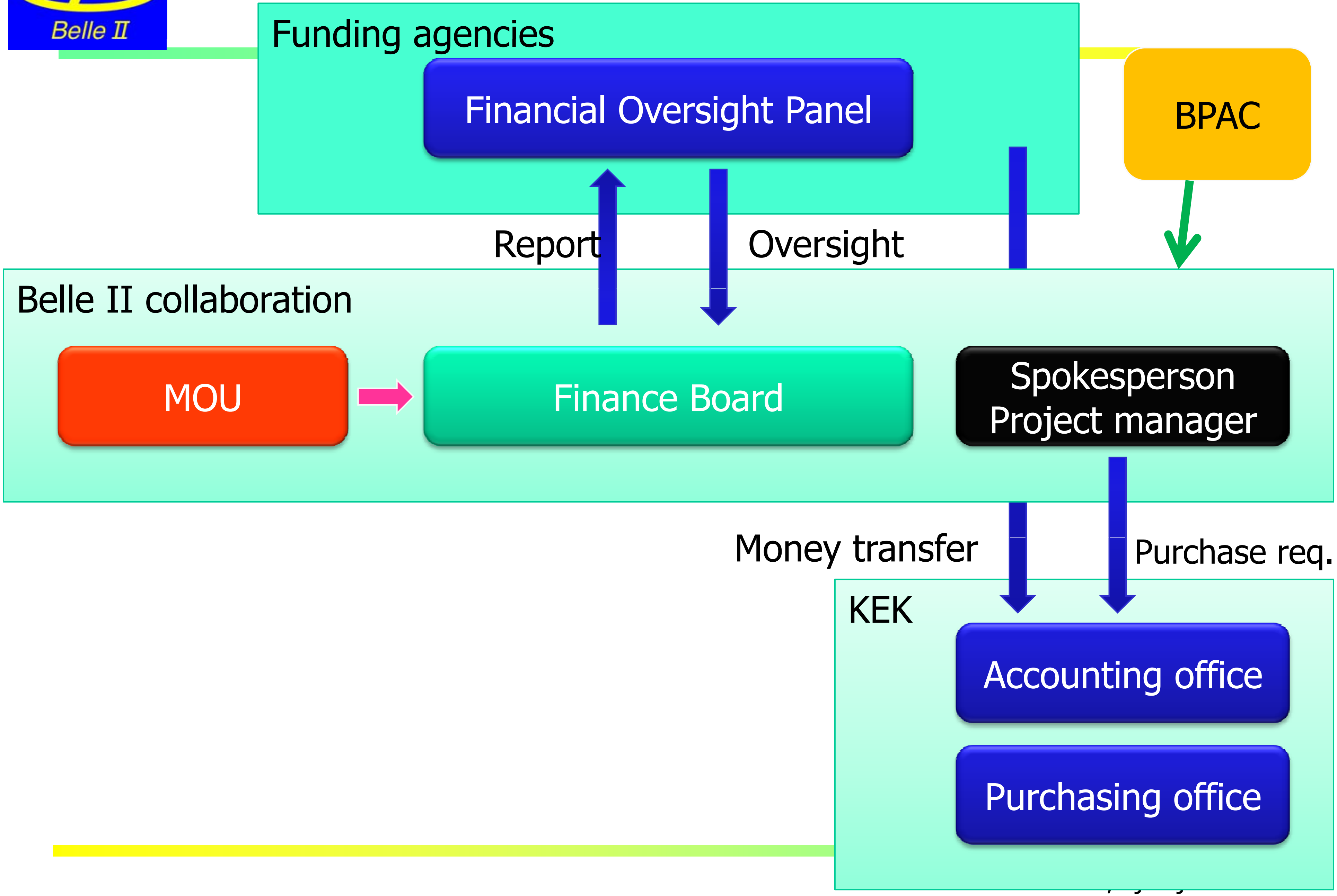
Luminosity prospect



Summary

- B factories have proven to be an excellent tool for flavour physics, with reliable long term operation, constant improvement of the performance, achieving and surpasing design perfomance
- Major upgrade at KEK in 2010-14 → SuperKEKB+Belle II, L x40, construction started
- The project has a strong European participation (~1/3!), including major responsibilities in several essential subsystems
- Physics reach updates available
- Technical design report published
- Expect a new, exciting era of discoveries, complementary to the LHC

Additional slides



Funding agencies
Financial Oversight Panel
BPAC
Report
Oversight
Belle II collaboration
MOU
Finance Board
Spokesperson
Project manager
Money transfer
Purchase req.
KEK
Accounting office
Purchasing office

Belle-II Collaboration

2004.06: LoI for SuperKEKB
2008.01: KEK Roadmap → identified as high priority project at KEK
2008.12: New collaboration (Belle-II) officially formed

❖ 13 countries/region, 43 institutes, ~300 members

Separate group/organization from Belle

- Executive Board (Chair: H. Aihara)
- Spokesperson: P. Križan
  Project manager: M. Yamauchi
- Institutional Board (Chair: L. Piilonen)
- Physics coordinator: B. Golob
- Technical coordinator: Y. Ushiroda
- Software /computing coordinators: T. Hara / T. Kuhr

2010.11: 7th Open Collaboration Meeting

Physics at a Super B Factory

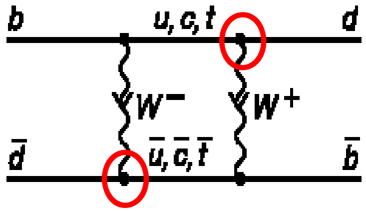
- There is a good chance to see new phenomena;
  - **CPV in B decays from the new physics (non KM).**
  - **Lepton flavor violations in τ decays.**
- They will help to diagnose (if found) or constrain (if not found) new physics models.
- $B \rightarrow \tau\nu$, $D\tau\nu$ can probe the charged Higgs in large tanβ region.
- **Physics motivation is independent of LHC.**
  - If LHC finds NP, precision flavour physics is compulsory.
  - If LHC finds no NP, high statistics B/τ decays would be a unique way to search for the >TeV scale physics (=TeV scale in case of MFV).

There are many more topics: CPV in charm, new hadrons, …

Super B Factory Motivation 2

- Lessons from history: the top quark

<u>Physics of top quark</u>
First estimate of mass: BB mixing → ARGUS
Direct production, Mass, width etc. → CDF/D0
Off-diagonal couplings, phase → BaBar/Belle



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

- Even before that: prediction of charm quark from the GIM mechanism, and its mass from K^0 mixing

Recent update of the physics reach with 50 ab^{-1}:
Physics at Super B Factory (Belle II authors + guests)
hep-ex > arXiv:1002.5012