# The Belle-II experiment at SuperKEKB

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# Outline

- SuperB, Belle-II and the Flavour
- SuperKEKB and Belle-II status and plans
- Italian participation
- Pisa interest and proposed committment
- Outlook

# SuperB, Belle-II and the Flavour

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or why are we still looking for flavour

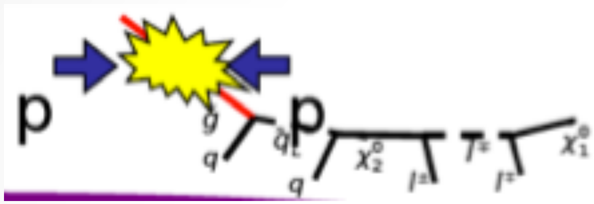
# SuperB and Belle-II

- We have been proposing for years the SuperB project as a tool complementary to LHC to explore new physics
- The SuperB project was better than Belle-II, at least on paper, but Belle-II has an outstanding physics program

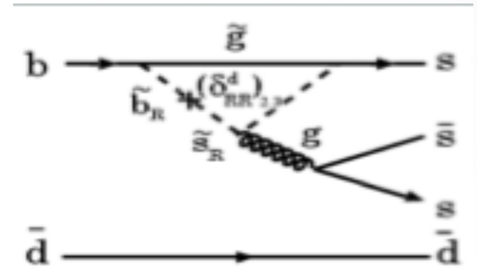
- Questions are:
  - Are KEK-B and SuperB discovery machines in the LHC era ?
  - Why is a high luminosity required ?
  - Why LHCb is not enough for flavor studies ?

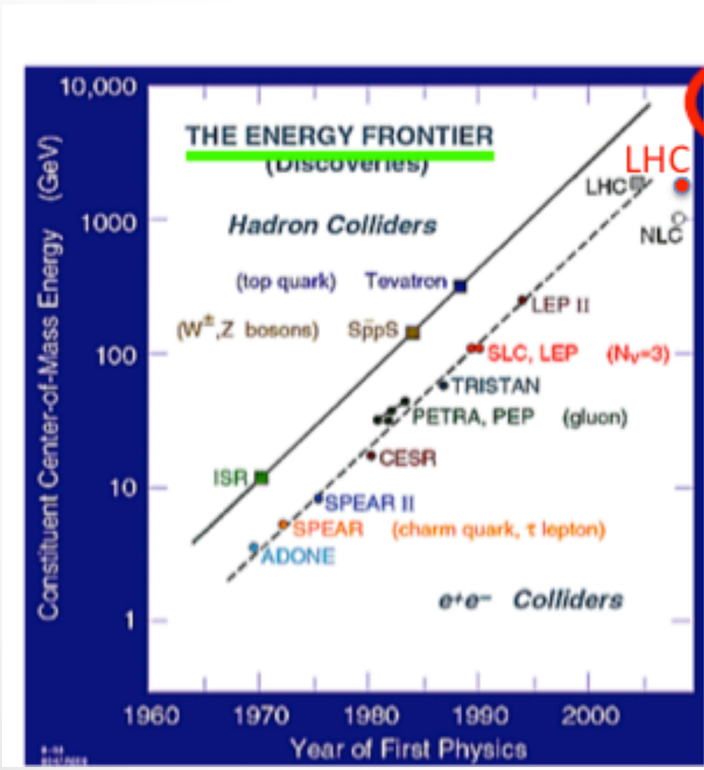
# 2-way street to New Physics

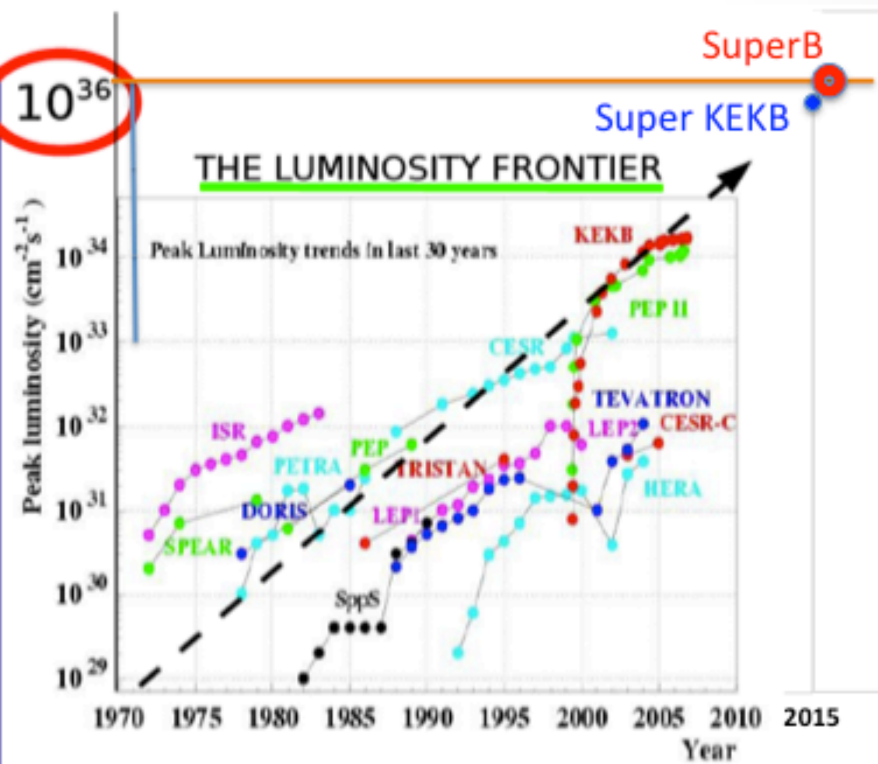
## Relativistic path




## Quantum path



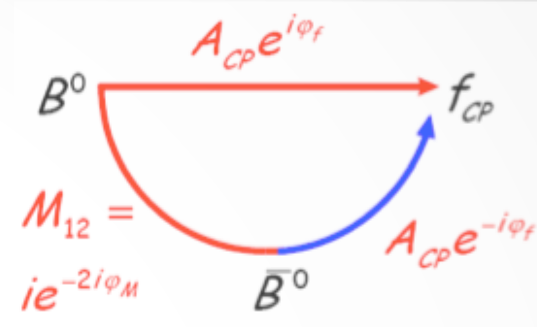



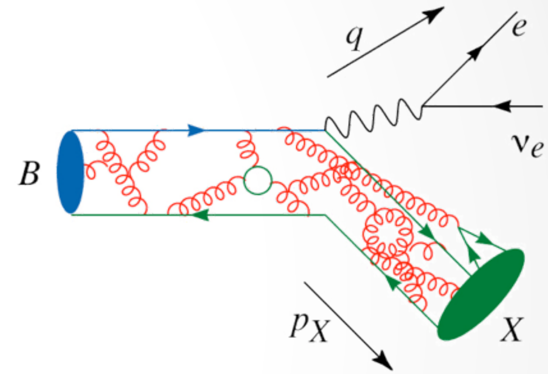



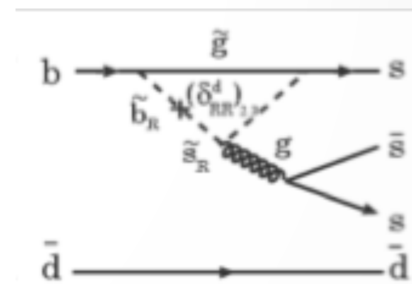
# Why flavour physics

Statistics

1. Explore the origin of CP violation
   - Key element for understanding the matter content of our present universe
   - Established in the B meson in 2001
   - Direct CPV established in B mesons in 2004
2. Precisely measure parameters of the standard model
   - For example the elements of the CKM quark mixing matrix
   - Disentangle the complicated interplay between weak processes and strong interaction effects
3. Search for the effects of physics beyond the standard model in loop diagrams
   - Potentially large effects on rates of rare decays, time dependent asymmetries, lepton flavour violation, …
   - Sensitive even to large New Physics scale, as well as to phases and size of NP coupling constants



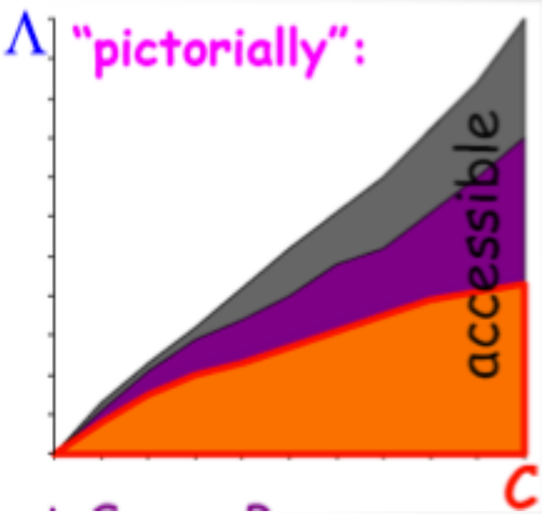




# Future Super B Factories

| | SuperB | Super KEKB |
|---|---|---|
| Peak Luminosity | $>10^{36}$ | $0.8 \times 10^{36}$ |
| Integrated Luminosity | 75 $ab^{-1}$ | 50 $ab^{-1}$ |
| Site | Green Field | KEKB Laboratory |
| Collisions | mid 2016 | 2015 |
| Polarization | 80% electron beam | No |
| Low energy running | $10^{35}$ @ charm threshold | No |
| Approval status | Approved | Approved |

# Power of Intensity

- Precision measurements in the flavour sector are sensitive to New Physics (NP)
  - Intereference effects in known processes
  - SM Rare or forbidden decays
- NP effects are controlled by
  - NP scale Λ and effective couplings: C
    - Different coupling intensity (different interactions)
    - Different patterns (e.g. because of simmetries)




- With 5 to 10 x $10^{10}$ bb, cc, ττ pairs (50-100 $ab^{-1}$) one can:

LHC finds NP(Λ)
- Determine detailed structure of couplings of NP
- Look for heavier states
- Study NP flavour structure

LHC does not find NP(Λ)
- Look for indirect NP signals
- Connect them to models
- Exclude regions in parameters space

Some channels, such as the LFV decays of τ are unambiguous signals of NP

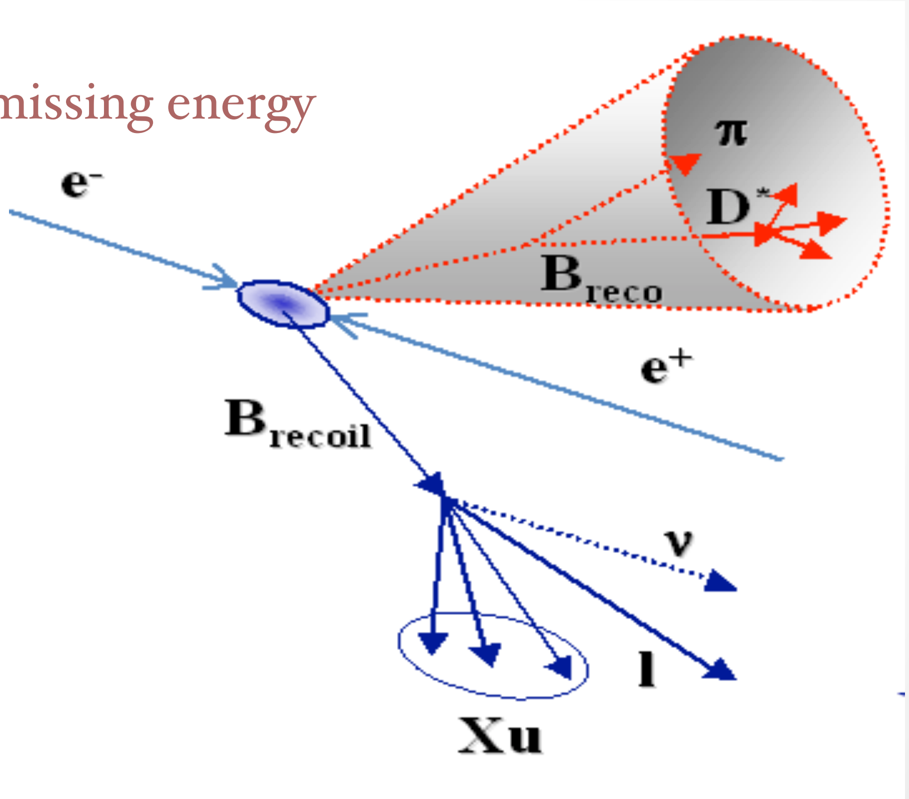
$L \sim 10^{34}\ cm^{-2}\ s^{-1} \leftrightarrow$ EW scale ~100GeV
$L \sim 10^{36}\ cm^{-2}\ s^{-1} \leftrightarrow$ TeV scale

# Cross section is not everything

- Hadron machines do have the advantage of an enormously larger B production cross section, ....BUT...
- SuperB has a super-easy ½ track trigger
- Initial state is coeherent, allowing interference measurements
- SuperB can do τ physics.
- Has access to states with a loss of missing energy

## B-Beam Method

- Fully reconstruct one the two Bs in hadronic modes
  - High efficiency: a few per mille
  - > $10^7$ recoil Bs in $10ab^{-1}$
- Obtain a pure B Beam on the other side
  - High purity sample
  - Can look at channels with a lot of missing energy.
  - For example BR(B→nothing) measured.

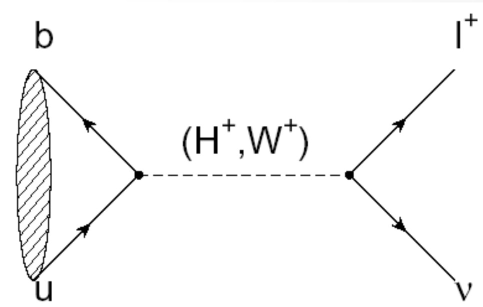



Recoil kinematics well known
Recoil flavor and charge is determined

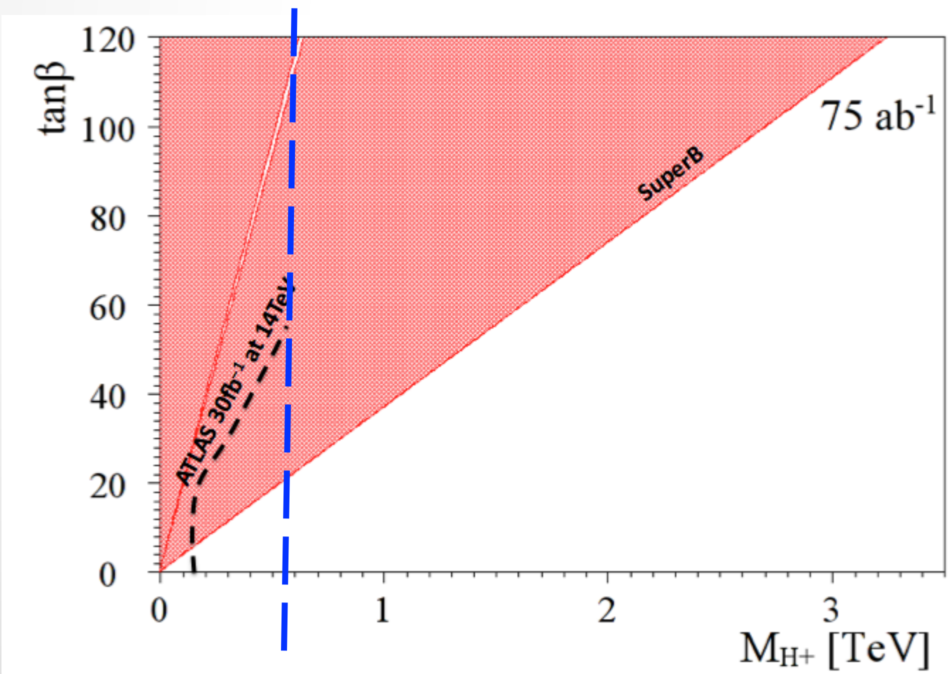
# $B_{u,d}$ physics: Rare Decays

- Example: $B^{\pm} \to \ell^{\pm}\nu$
  - Rate modified by presence of $H^+$

$$r_H = \frac{\mathcal{B}_{SM+NP}}{\mathcal{B}_{SM}} \qquad r_H = \left(1 - \frac{m_B^2}{m_H^2}\tan^2\beta\right)$$




| Observable | $B$ Factories (2 ab$^{-1}$) | Super$B$ (75 ab$^{-1}$) |
|---|---|---|
| $\mathcal{B}(B \to \tau\nu)$ | 20% | 4% (†) |
| $\mathcal{B}(B \to \mu\nu)$ | visible | 5% |
| $\mathcal{B}(B \to D\tau\nu)$ | 10% | 2% |




Currently the inclusive b to sγ channel excludes $m_{H+} < 295$ GeV/c$^2$.

The current combined limit places a stronger constraint than direct searches from the LHC for the next few years.

# Charged Lepton Flavour Violation (LFV)

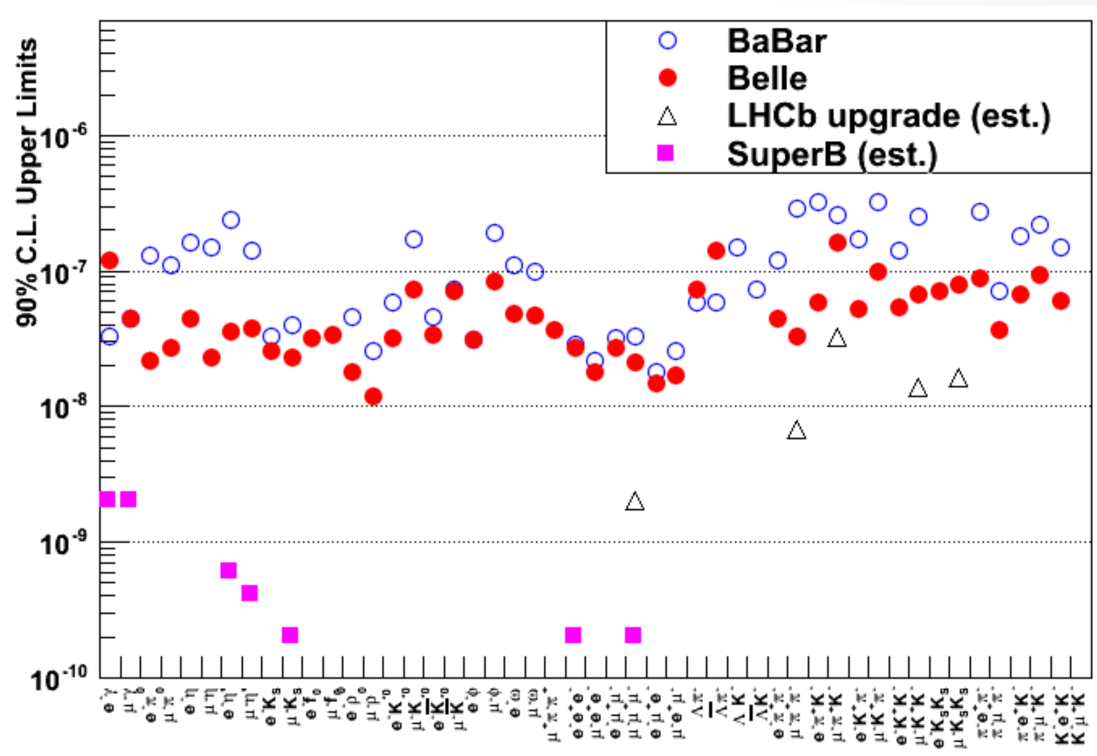
- ν mixing leads to a low level of charged LFV ($B \sim 10^{-54}$).
  - Enhancements to observable levels are possible with new physics scenarios.
  - Searching for transitions from 3rd generation to 2nd and 1st, i.e.

$$\tau \longrightarrow \mu \quad \text{and} \quad \tau \longrightarrow e$$

Almost two orders of magnitude improvement at SuperB(Belle-II) over current limits.

- ➢x80 for background-free channels (3 leptons)
- ➢x10 for channels with irreducible backgrounds (μγ)

- ➢Hadron machines are not competitive with $e^+e^-$ machines for this.

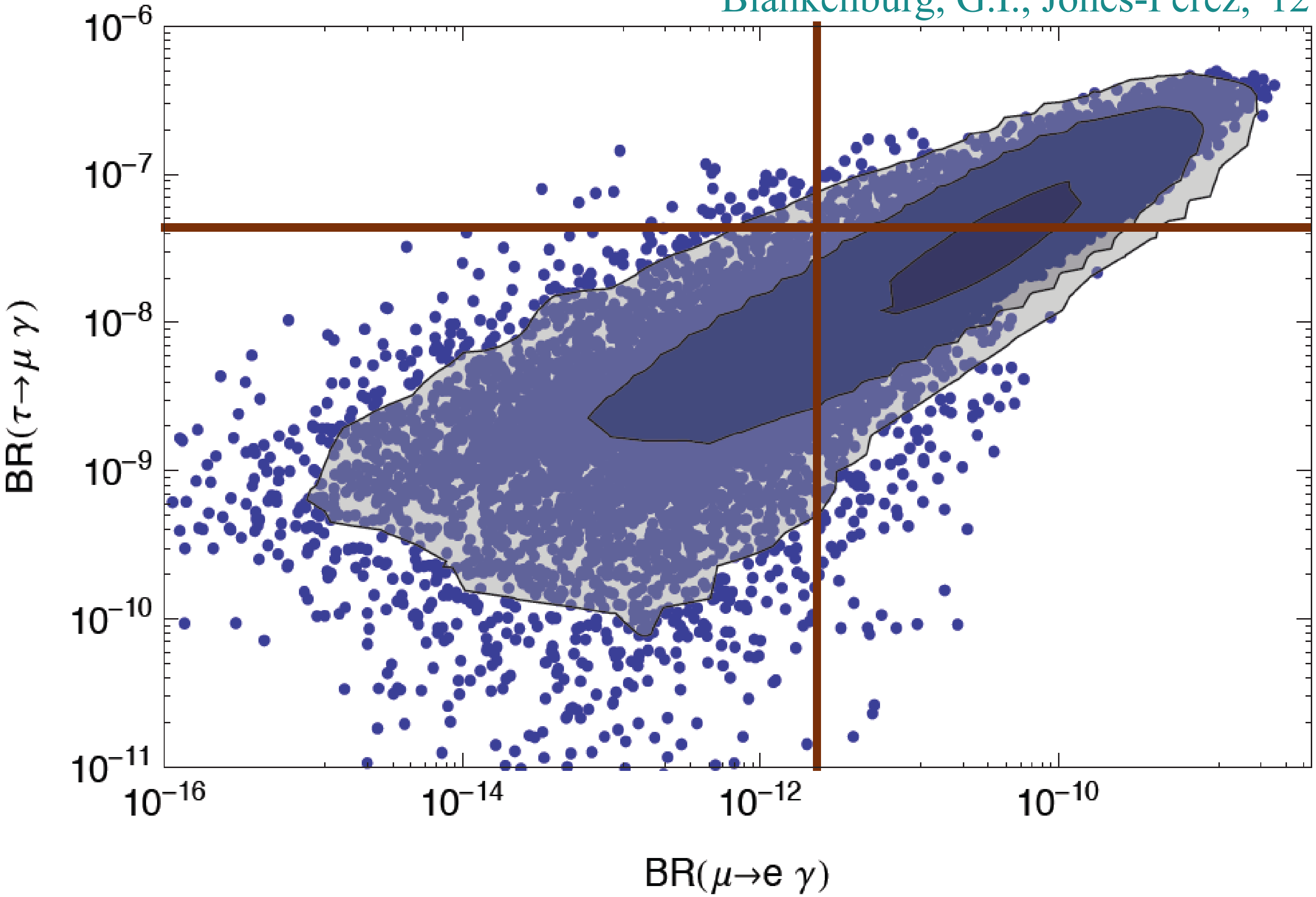


## ✯ *The key role of LFV and EDMs*

...and there is no doubt that if MEG will see a positive signal, then all other LFV searches would be extremely important to understand the nature of the effect.

E.g.: SUSY with minimally broken $U(3)^5$

Blankenburg, G.I., Jones-Perez, '12



# Comparison

- Luminosity assumptions
- Belle-II: $50ab^{-1}$
- LHCb: $10ab^{-1}$

| Observable | Expected th. accuracy | Expected exp. uncertainty | Facility |
|---|---|---|---|
| CKM matrix | | | |
| $\|V_{us}\|$ $[K \to \pi \ell \nu]$ | ** | 0.1% | $K$-factory |
| $\|V_{cb}\|$ $[B \to X_c \ell \nu]$ | ** | 1% | Belle II |
| $\|V_{ub}\|$ $[B_d \to \pi \ell \nu]$ | * | 4% | Belle II |
| $\sin(2\phi_1)$ $[c\bar{c}K_S^0]$ | *** | $8 \cdot 10^{-3}$ | Belle II/LHCb |
| $\phi_2$ | | $1.5^\circ$ | Belle II |
| $\phi_3$ | *** | $3^\circ$ | LHCb |
| CPV | | | |
| $S(B_s \to \psi\phi)$ | ** | 0.01 | LHCb |
| $S(B_s \to \phi\phi)$ | ** | 0.05 | LHCb |
| $S(B_d \to \phi K)$ | *** | 0.05 | Belle II/LHCb |
| $S(B_d \to \eta' K)$ | *** | 0.02 | Belle II |
| $S(B_d \to K^*(\to K_S^0 \pi^0)\gamma))$ | *** | 0.03 | Belle II |
| $S(B_s \to \phi\gamma))$ | *** | 0.05 | LHCb |
| $S(B_d \to \rho\gamma))$ | | 0.15 | Belle II |
| $A_{SL}^d$ | *** | 0.001 | LHCb |
| $A_{SL}^s$ | *** | 0.001 | LHCb |
| $A_{CP}(B_d \to s\gamma)$ | * | 0.005 | Belle II |
| rare decays | | | |
| $\mathcal{B}(B \to \tau\nu)$ | ** | 3% | Belle II |
| $\mathcal{B}(B \to D\tau\nu)$ | | 3% | Belle II |
| $\mathcal{B}(B_d \to \mu\nu)$ | ** | 6% | Belle II |
| $\mathcal{B}(B_s \to \mu\mu)$ | *** | 10% | LHCb |
| zero of $\mathrm{A_{FB}}(\mathrm{B} \to \mathrm{K}^* \mu\mu)$ | ** | 0.05 | LHCb |
| $\mathcal{B}(B \to K^{(*)}\nu\nu)$ | *** | 30% | Belle II |
| $\mathcal{B}(B \to s\gamma)$ | | 4% | Belle II |
| $\mathcal{B}(B_s \to \gamma\gamma)$ | | $0.25 \cdot 10^{-6}$ | Belle II (with 5 $ab^{-1}$) |
| $\mathcal{B}(K \to \pi\nu\nu)$ | ** | 10% | $K$-factory |
| $\mathcal{B}(K \to e\pi\nu)/\mathcal{B}(K \to \mu\pi\nu)$ | *** | 0.1% | $K$-factory |
| charm and $\tau$ | | | |
| $\mathcal{B}(\tau \to \mu\gamma)$ | *** | $3 \cdot 10^{-9}$ | Belle II |
| $\|q/p\|_D$ | *** | 0.03 | Belle II |
| $arg(q/p)_D$ | *** | $1.5^\circ$ | Belle II |

F.Forti: Belle-II

# SuperKEKB

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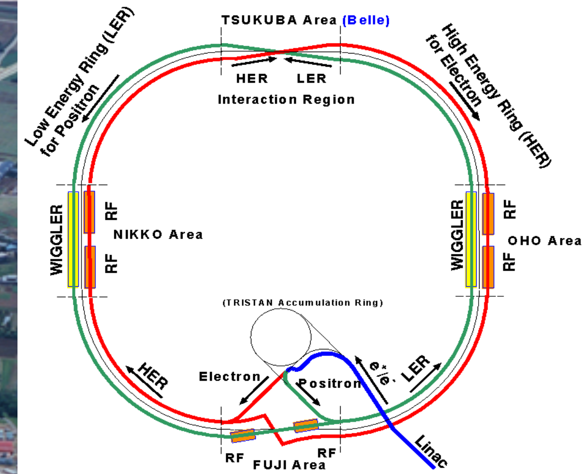
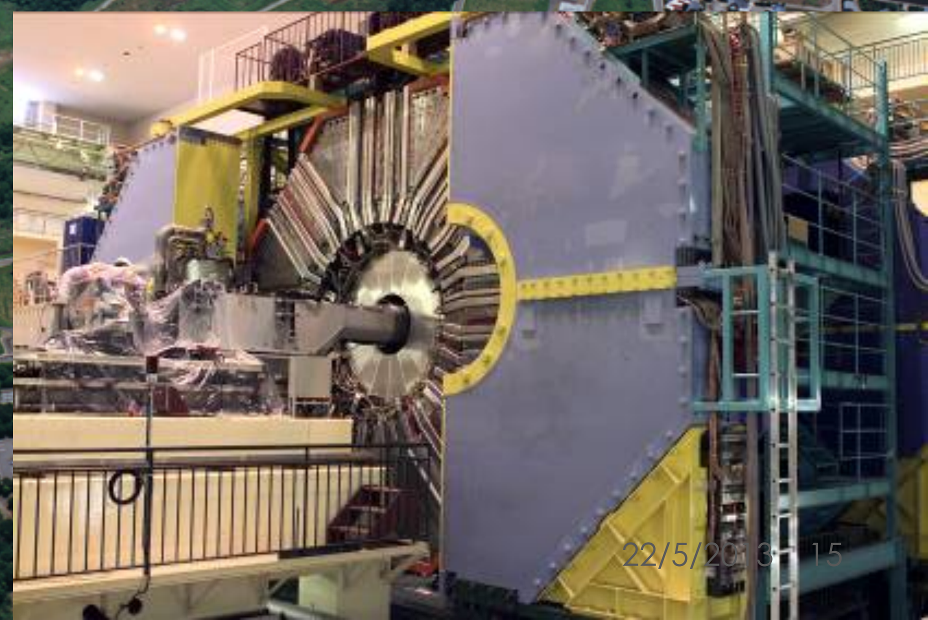
the path to high luminosity.

# SuperKEKB and Belle II
# → Major upgrade of KEKB and Belle



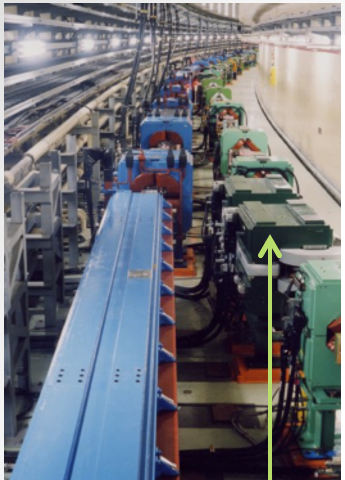



# Machine design parameters

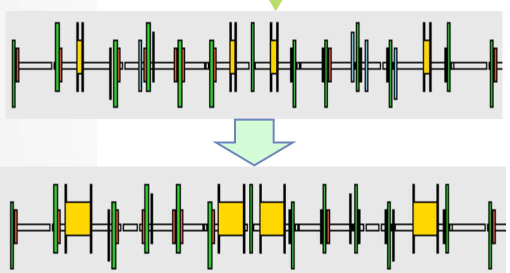
| parameters | | KEKB | | SuperKEKB | | units |
|---|---|---|---|---|---|---|
| | | LER | HER | LER | HER | |
| Beam energy | $E_b$ | 3.5 | 8 | 4 | 7 | GeV |
| Half crossing angle | $\phi$ | 11 | | 41.5 | | mrad |
| **Horizontal emittance** | $\varepsilon_x$ | 18 | 24 | 3.2 | 4.6 | nm |
| Emittance ratio | $\kappa$ | 0.88 | 0.66 | 0.37 | 0.40 | % |
| **Beta functions at IP** | $\beta_x^* / \beta_y^*$ | 1200/5.9 | | 32/0.27 | 25/0.30 | mm |
| **Beam currents** | $I_b$ | 1.64 | 1.19 | 3.60 | 2.60 | A |
| beam-beam parameter | $\xi_y$ | 0.129 | 0.090 | 0.0881 | 0.0807 | |
| Luminosity | L | $2.1 \times 10^{34}$ | | $8 \times 10^{35}$ | | $cm^{-2}s^{-1}$ |

- **Nano-beams and a factor of two more beam current** to increase luminosity
- **Large crossing angle**
- **Change beam energies** to solve the problem of short lifetime for the LER

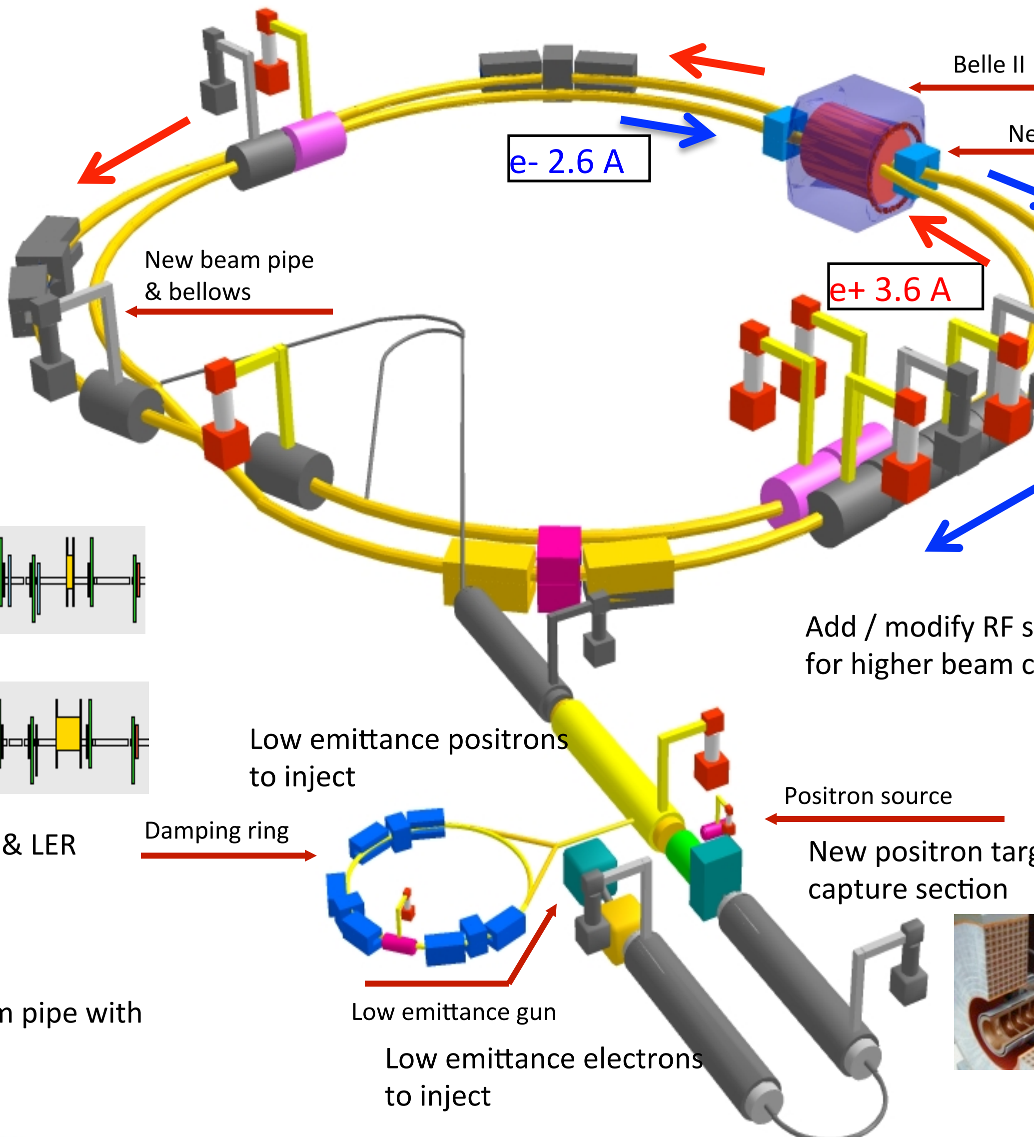
# KEKB to SuperKEKB



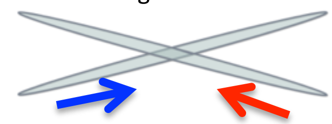
Replace short dipoles with longer ones (LER)



Redesign the lattices of HER & LER to squeeze the emittance



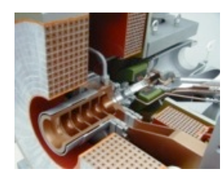

Colliding bunches



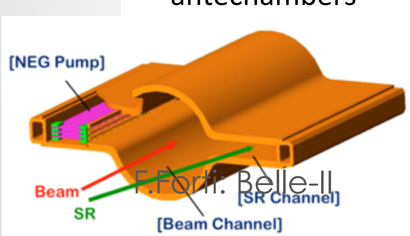
New superconducting / permanent final focusing quads near the IP

Add / modify RF systems for higher beam current

New positron target / capture section



TiN-coated beam pipe with antechambers



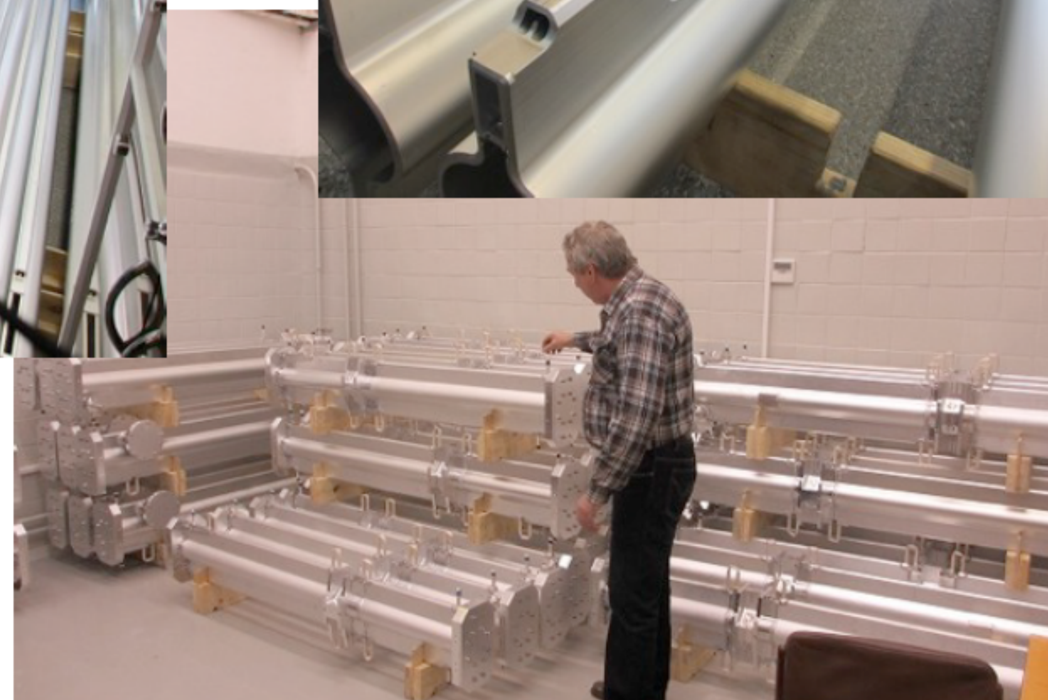

***To obtain x40 higher luminosity***


All 100 4 m long dipole magnets have been successfully installed in the low energy ring (LER)!

***Three magnets per day !***

Installing the 4 m long LER dipole **over** the 6 m long HER dipole (remains in place).

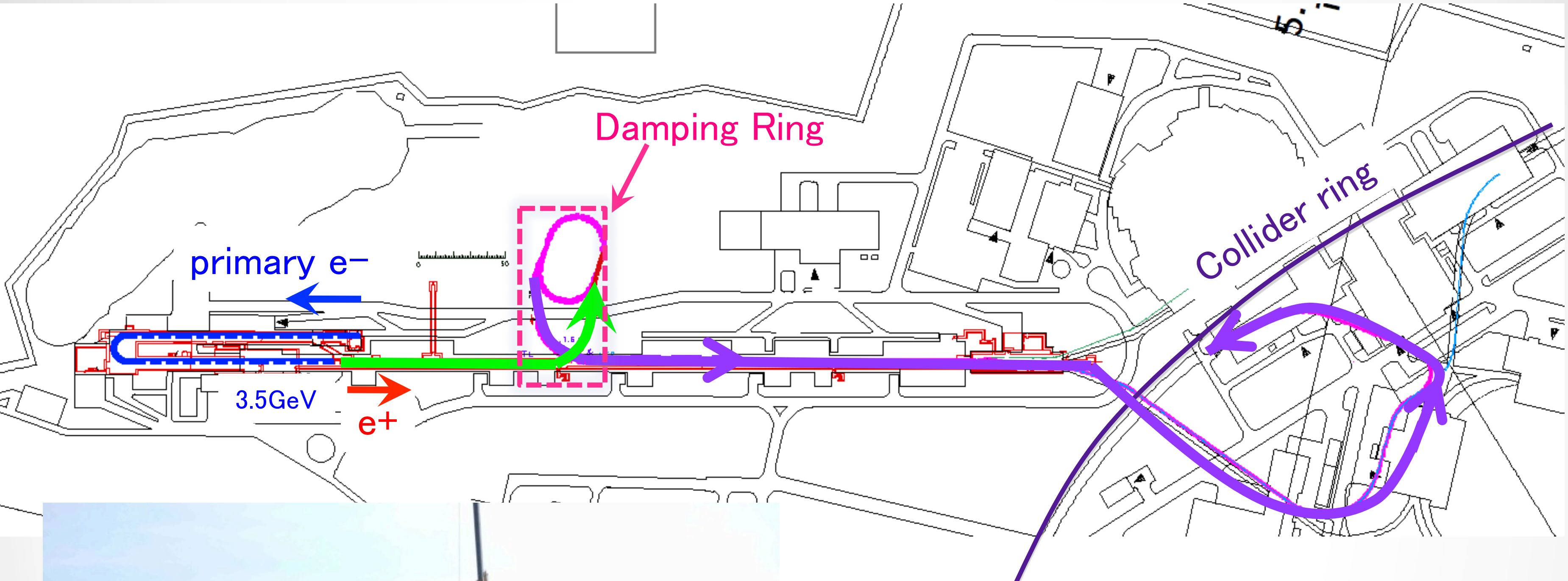
# Entirely new LER beam pipe with ante-chamber and Ti-N coating



Beam pipe is made of aluminum.

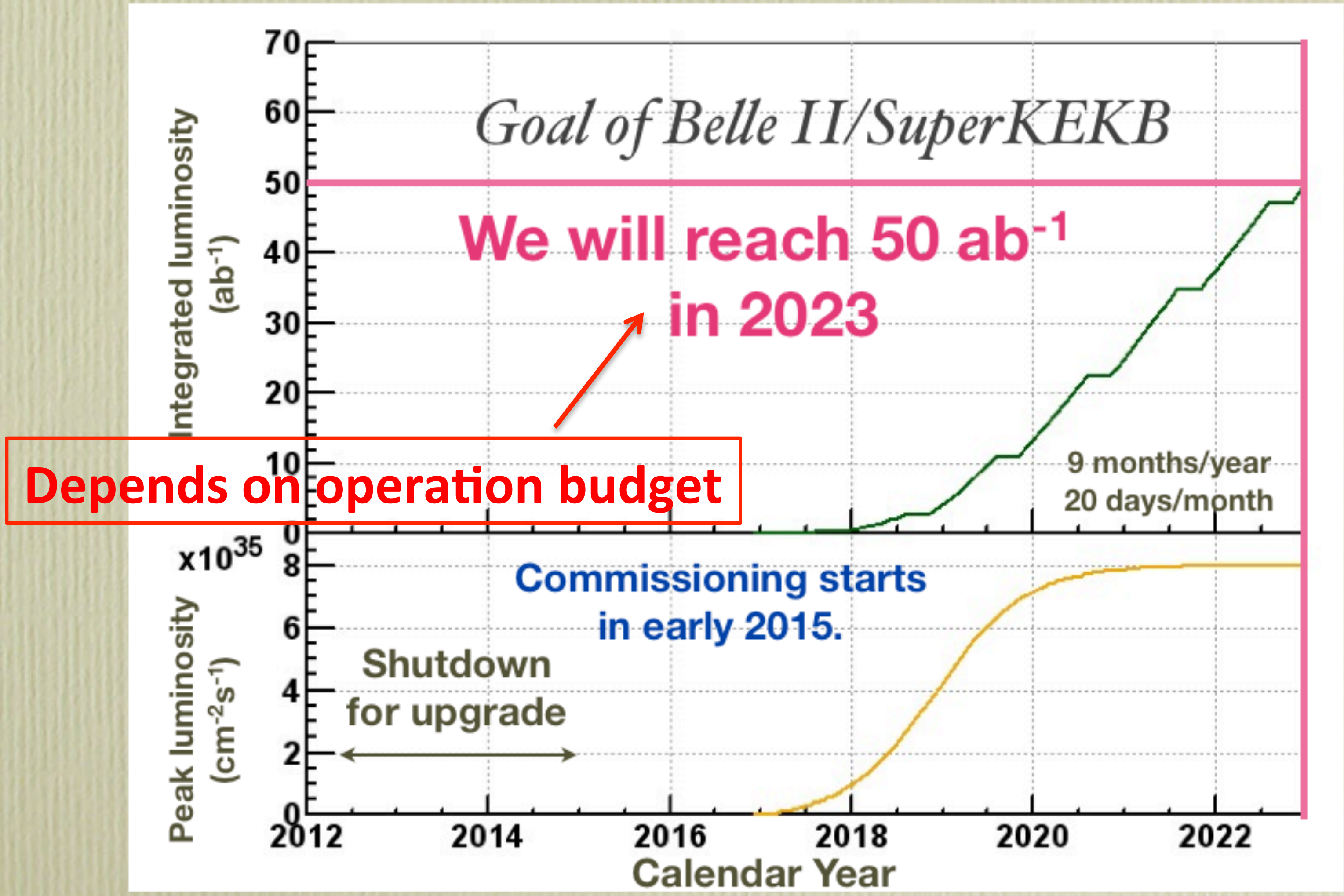
Fabrication of the LER arc beam pipe section is completed

# Damping ring: construction started in Jan 2012




- Fabrication of accelerator components ongoing.
- Buildings will be constructed in JFY2012-13 after the tunnel is completed
- Damping ring will be completed by the end of JFY2014.

# SuperKEKB luminosity projection



# Belle-II

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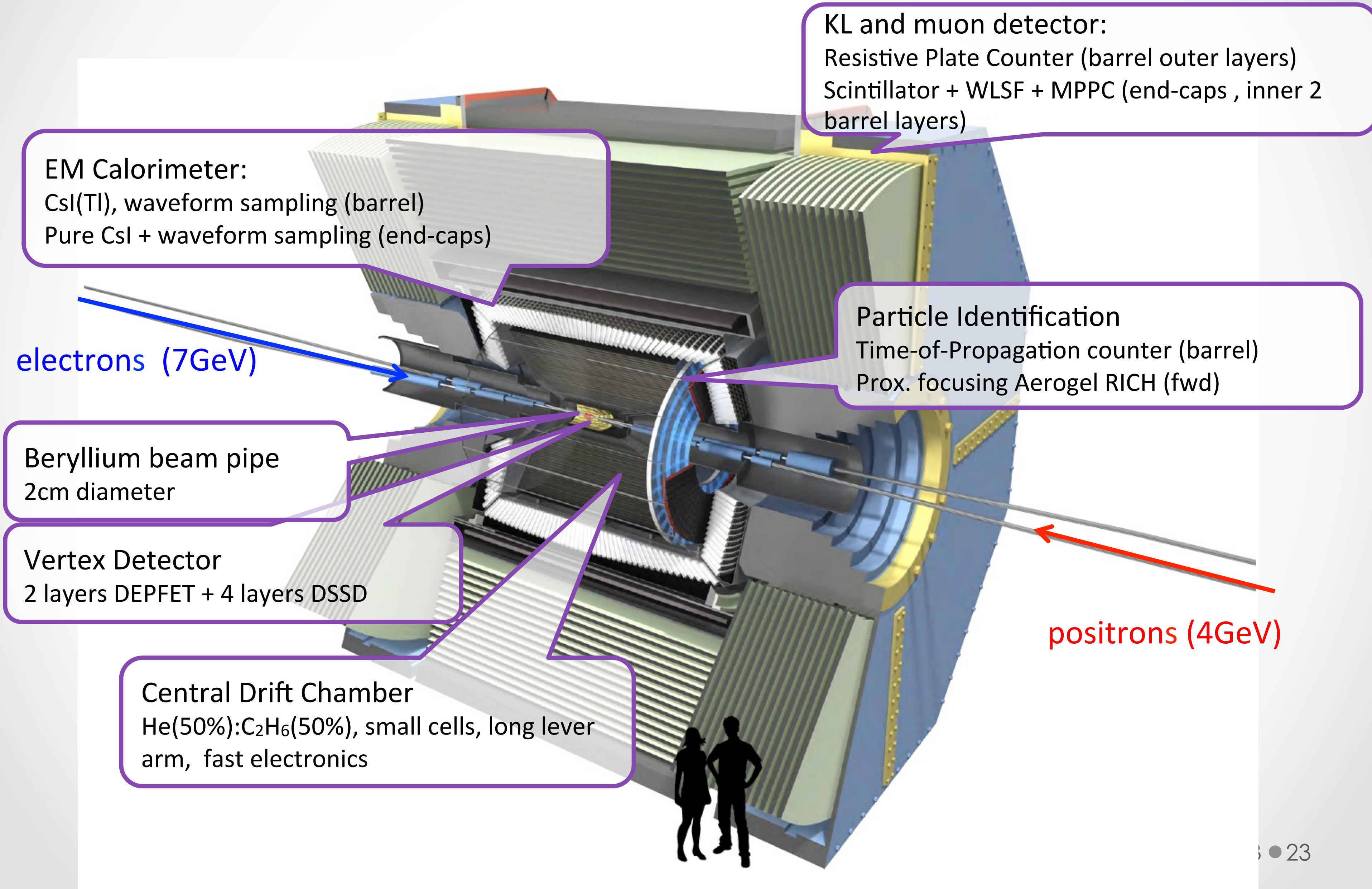
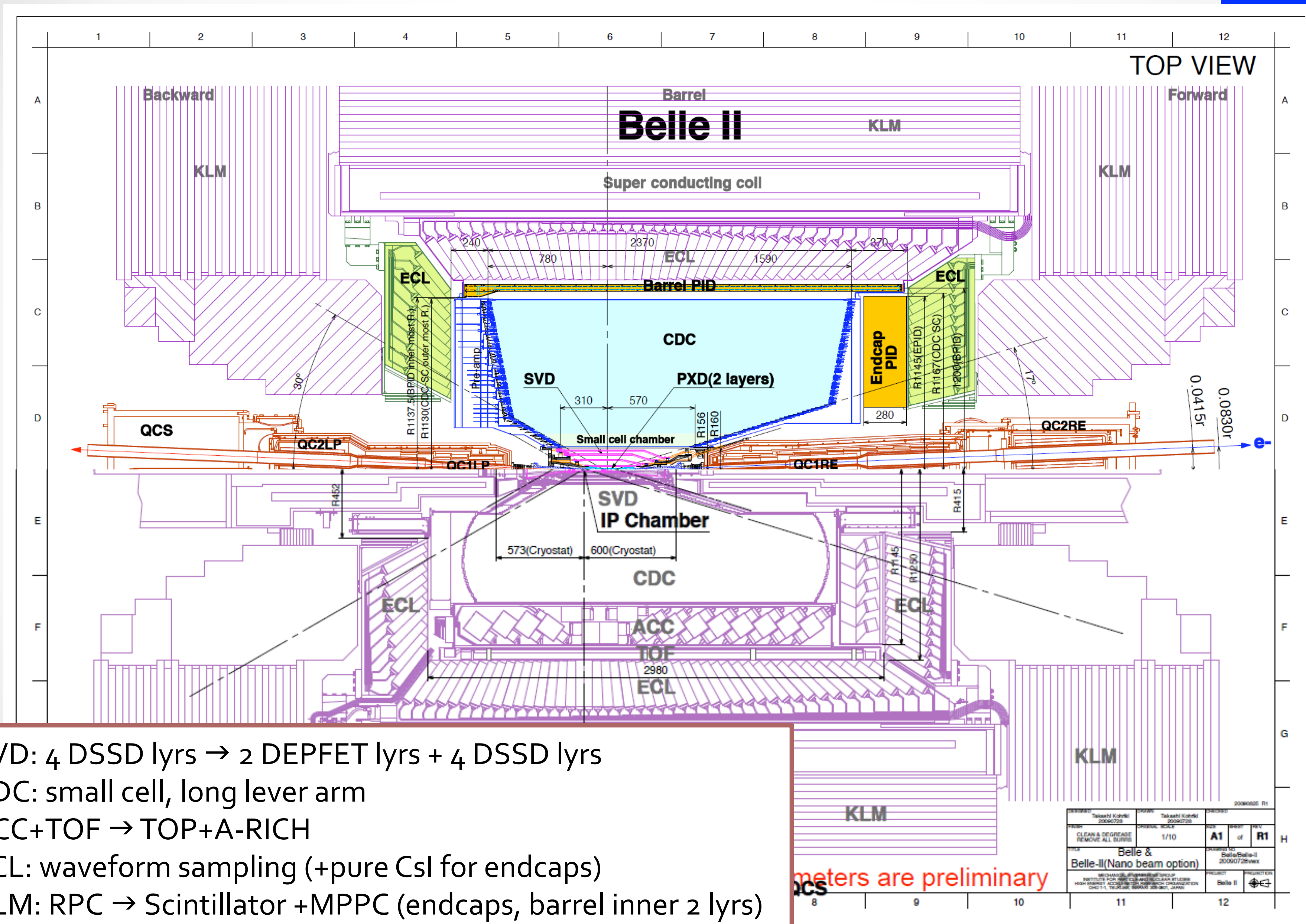
the path to high sensitivity.

# Belle II Detector

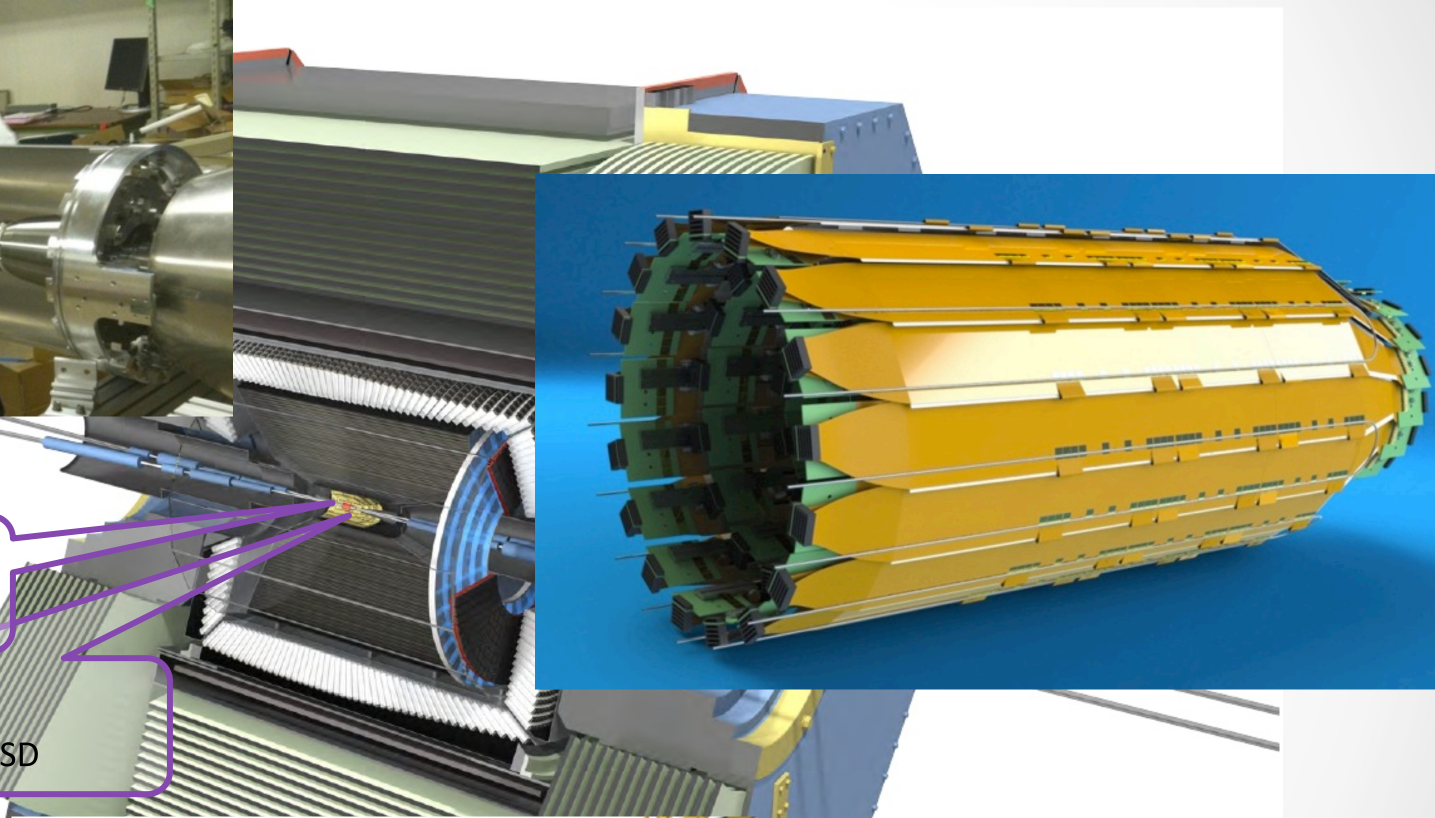


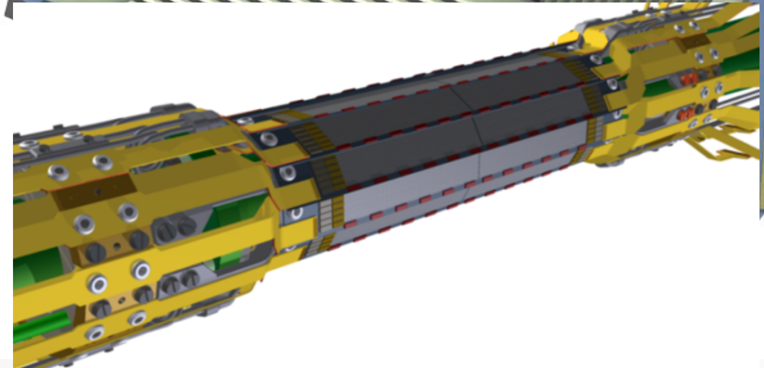
# Belle II Detector (in comparison with Belle




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 endcaps)
KLM: RPC → Scintillator +MPPC (endcaps, barrel inner 2 lyrs)

# Belle II Detector – vertex region



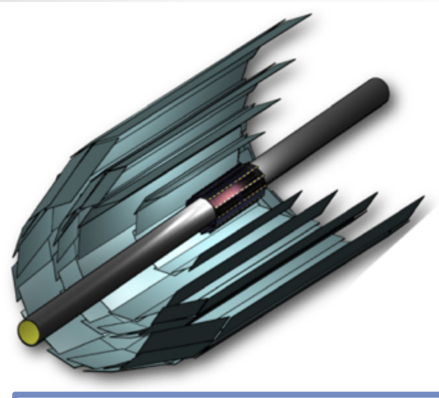


Beryllium beam pipe
2cm diameter

Vertex Detector
2 layers DEPFET + 4 layers DSSD

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

# Vertex Detector



**Beam Pipe** **r = 10mm**

**DEPFET**

**Layer 1r = 14mm**

**Layer 2r = 22mm**

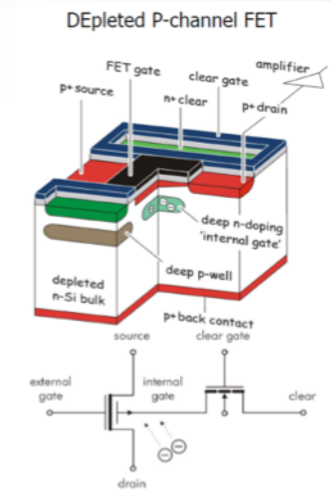
**DSSD**

**Layer 3r = 38mm**

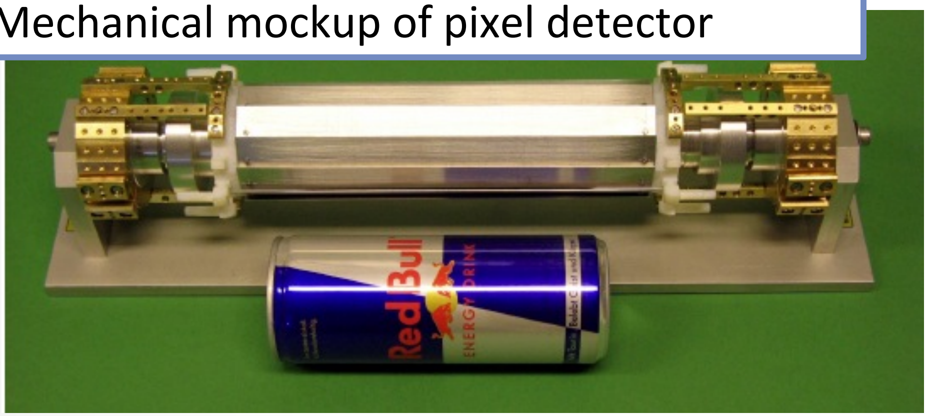
**Layer 4r = 80mm**

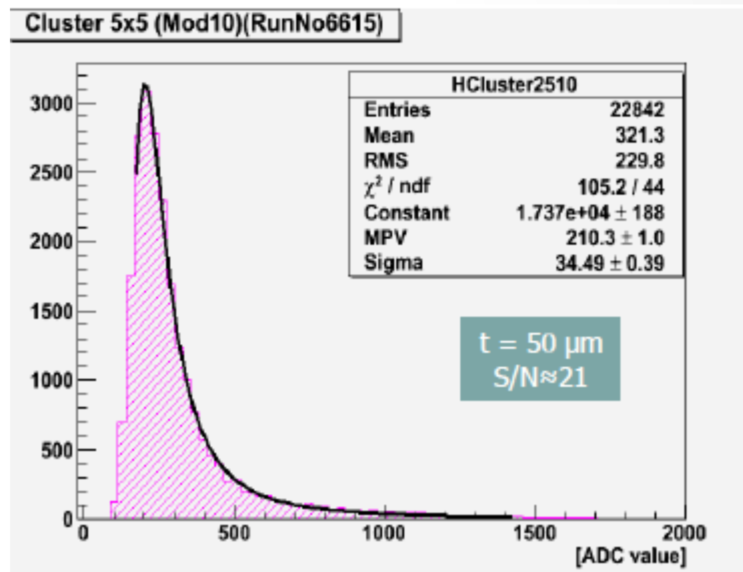
**Layer 5r = 115mm**

**Layer 6r = 140mm**




Mechanical mockup of pixel detector



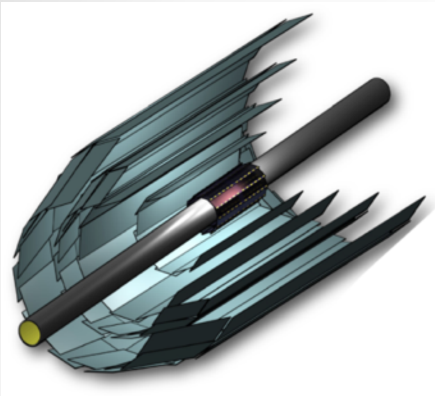




DEPFET pixel sensor

DEPFET sensor: very good S/N

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

# Vertex Detector



**Beam Pipe** r = 10mm
**DEPFET**
- Layer 1r = 14mm
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- Layer 3r = 38mm
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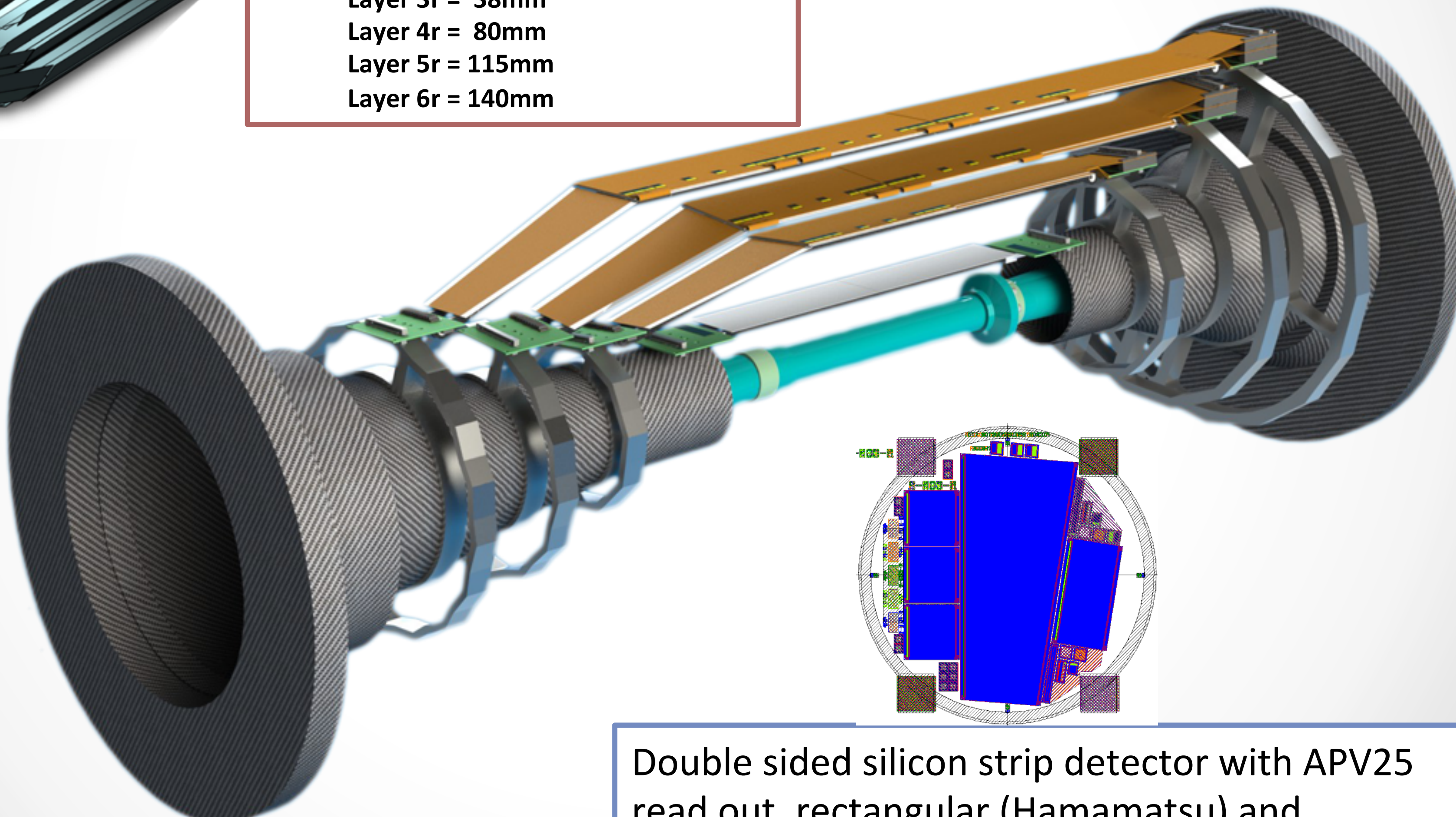
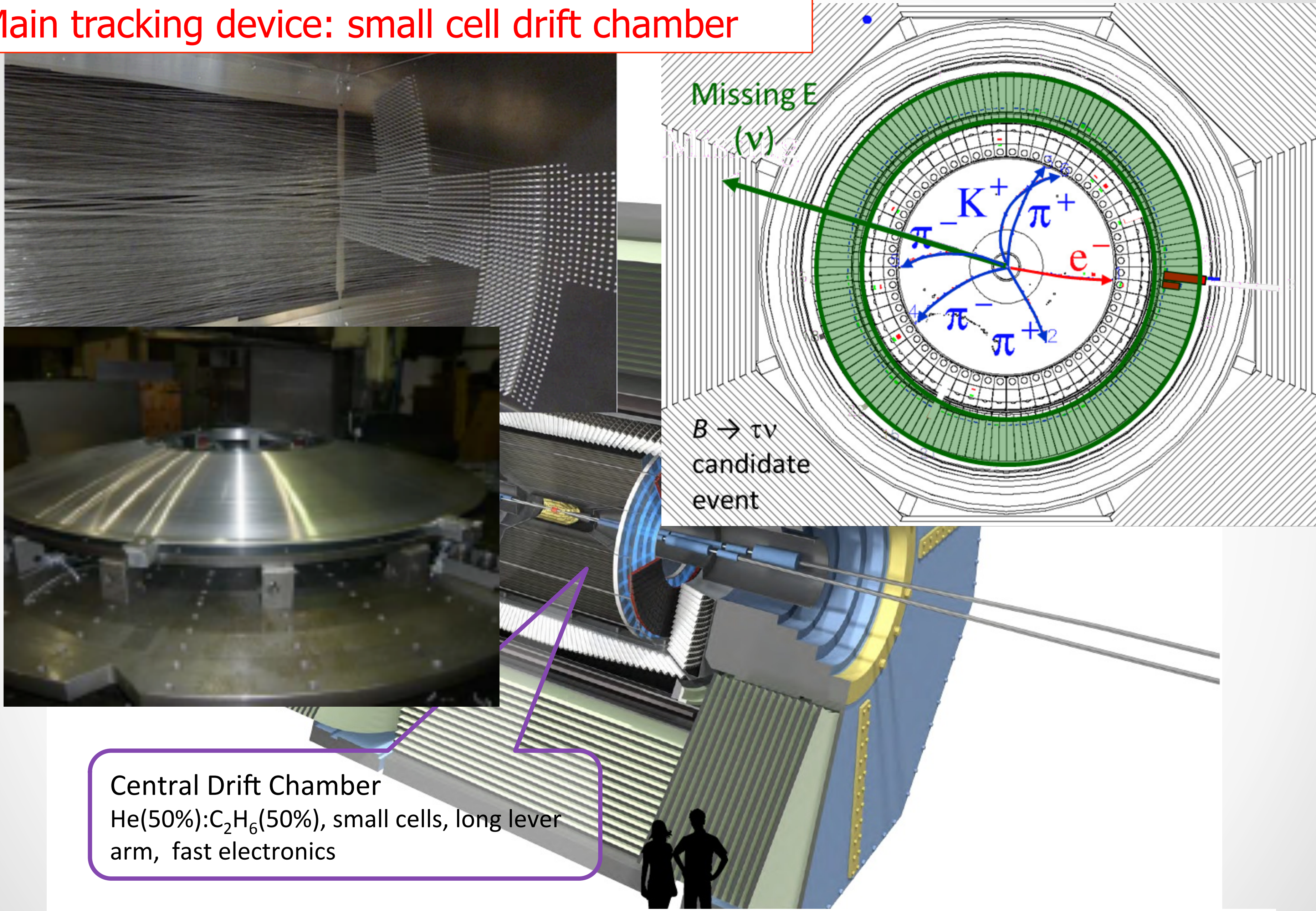


Double sided silicon strip detector with APV25 read out, rectangular (Hamamatsu) and trapezoidal sensors (Micron)

# Main tracking device: small cell drift chamber

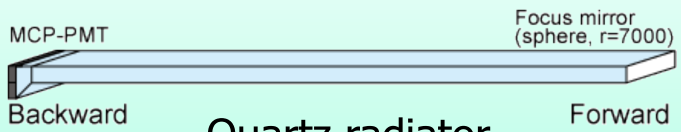



Central Drift Chamber
He(50%):$C_2H_6$(50%), small cells, long lever arm, fast electronics

Status: drift chamber wires are being strung.

# Particle Identification Devices

## Barrel PID: Time of Propagation Counter (TOP)



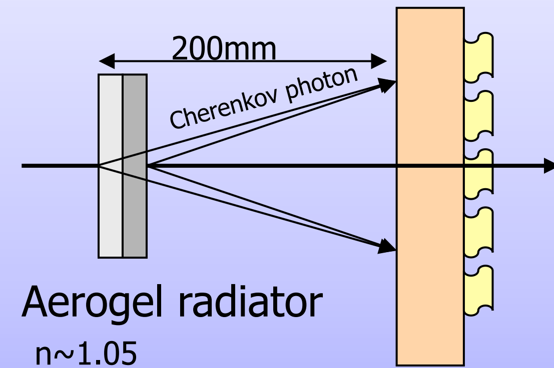

Quartz radiator

Focusing mirror

Small expansion block

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

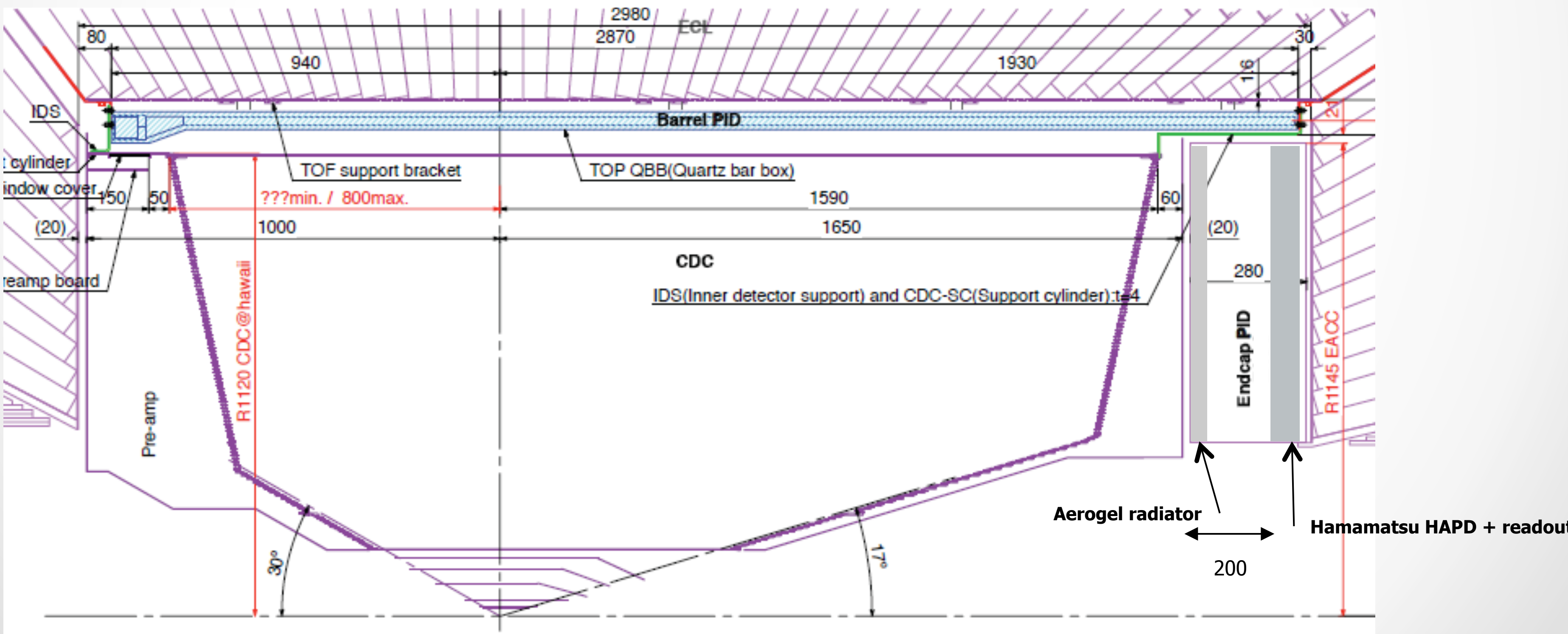
## Endcap PID: Aerogel RICH (ARICH)




Aerogel radiator

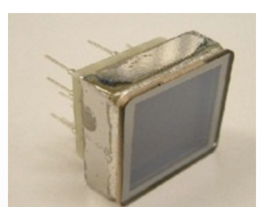
n~1.05

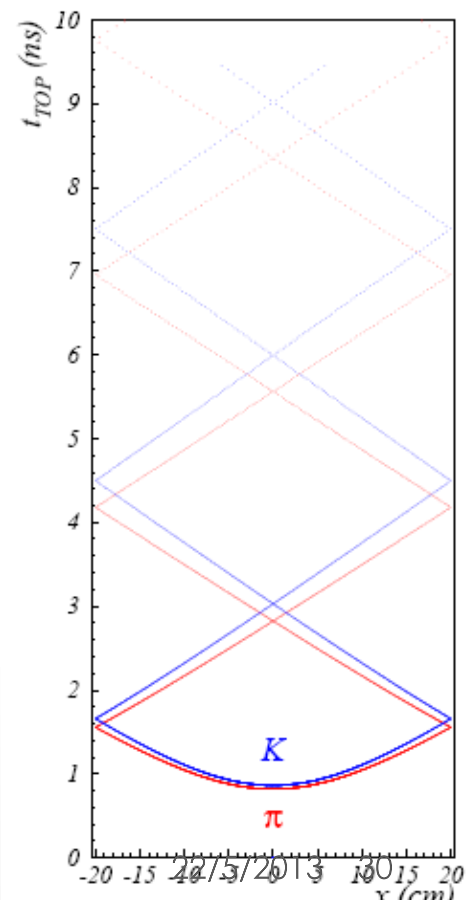
Hamamatsu HAPD + new ASIC



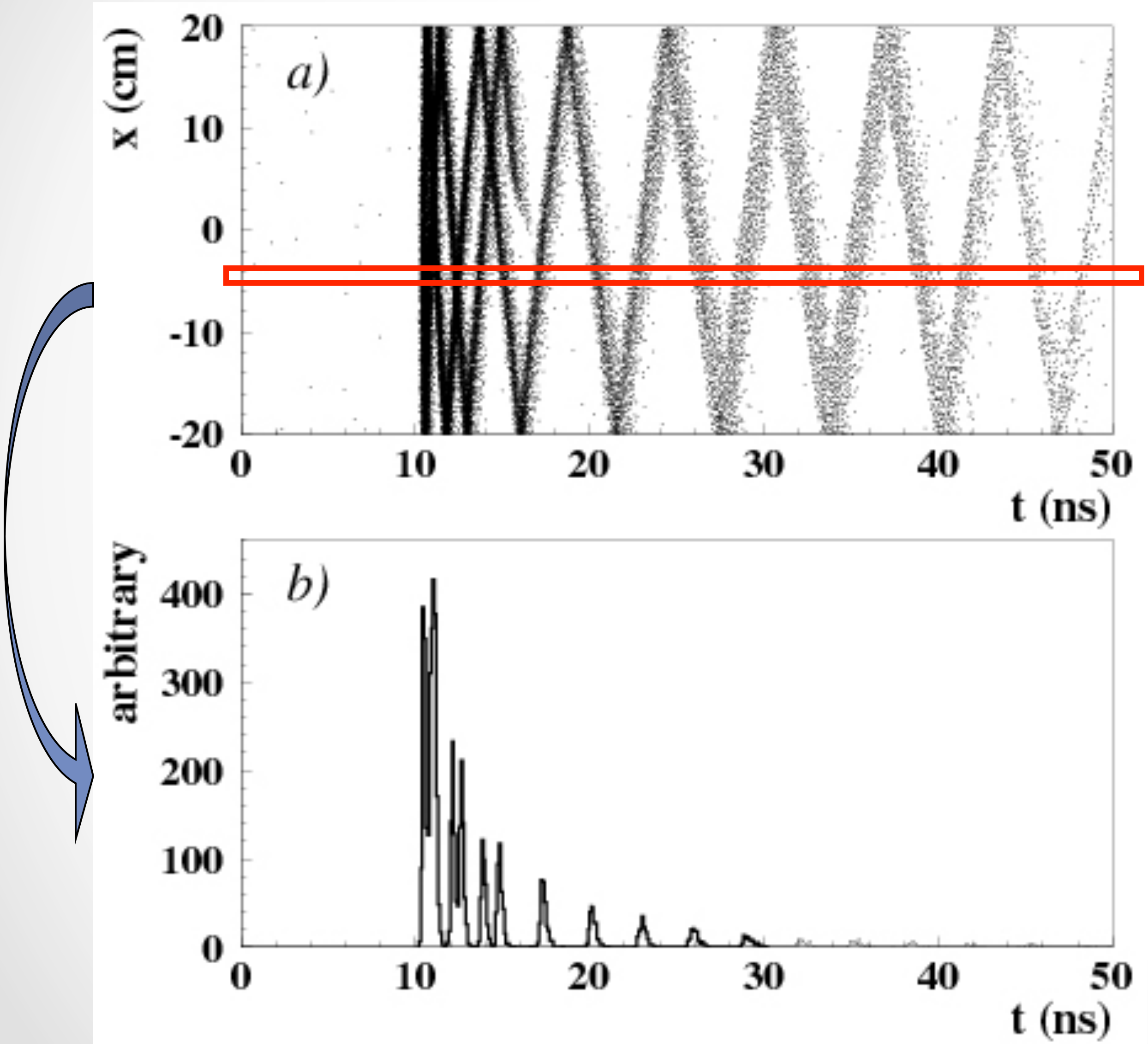
# Barrel PID: Time of propagation (TOP) counter


- Cherenkov ring imaging with precise time measurement.
- Device uses internal reflection of Cerenkov ring images from quartz like the BaBar DIRC
- Reconstruct Cherenkov angle from two hit 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 field
    - Hamamatsu SL10





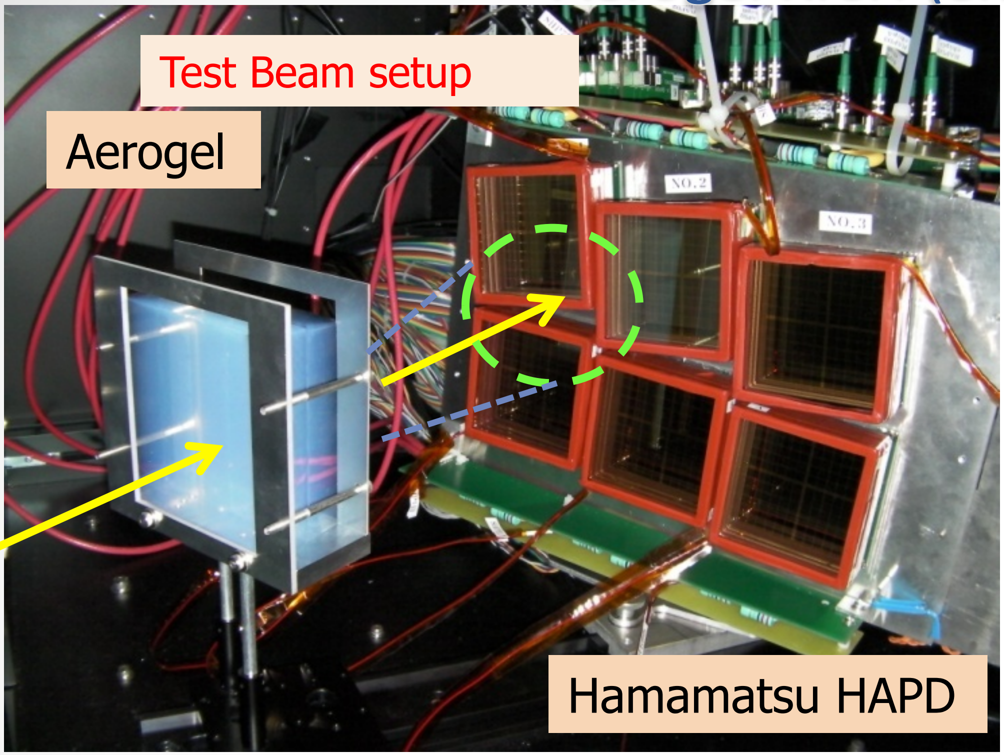
# TOP image

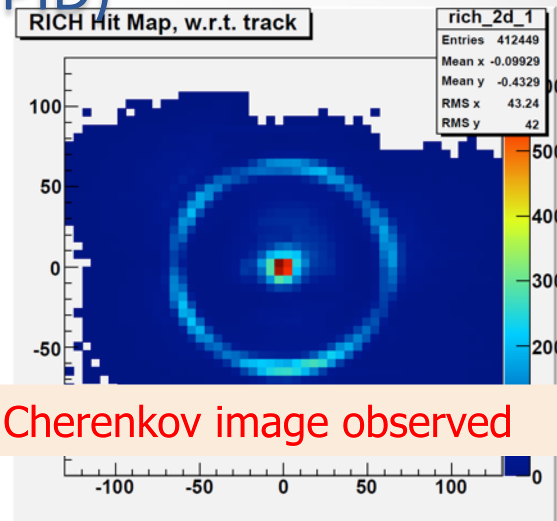



Pattern in the coordinate-time space ('ring') of a pion hitting a quartz bar with ~80 MAPMT channels

Time distribution of signals recorded by one of the PMT channels: different for $\pi$ and K (~shifted in time)

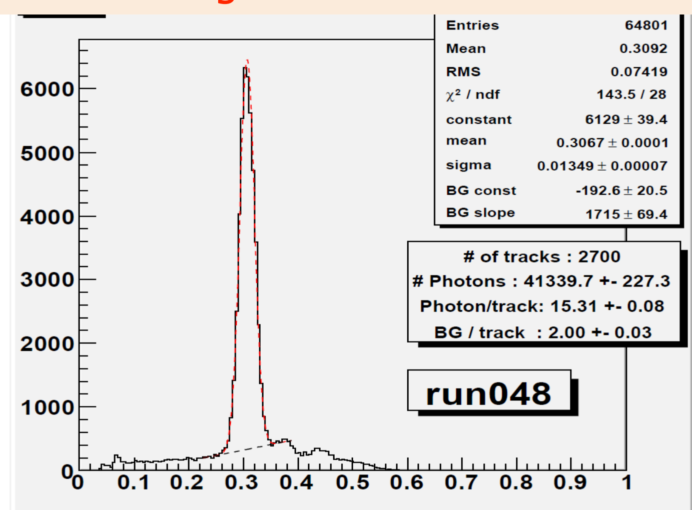
# Aerogel RICH (endcap PID)



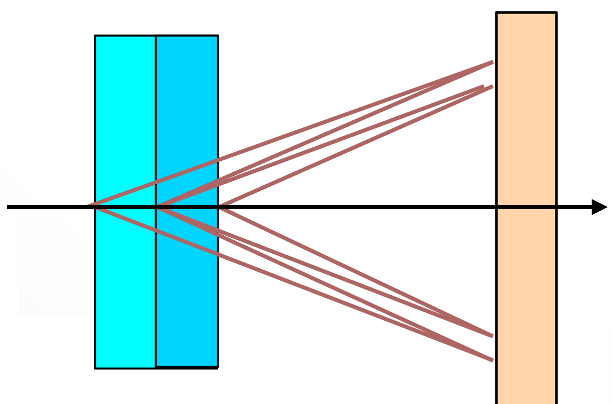




Clear Cherenkov image observed

Cherenkov angle distribution




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



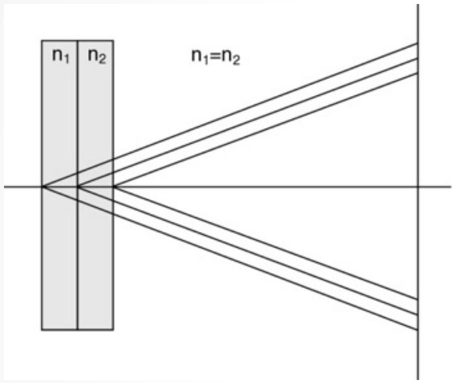
Employ multiple layers with different refractive indices→ Cherenkov images from individual layers overlap on the photon detector.

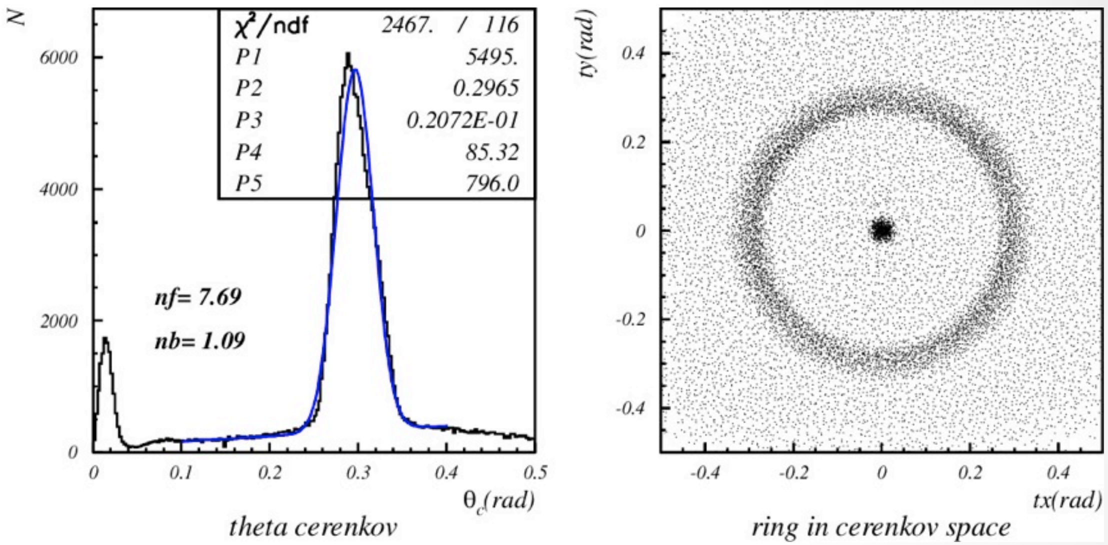
**6.6 $\sigma$ $\pi$/K at 4GeV/c !**

# Focusing configuration – data

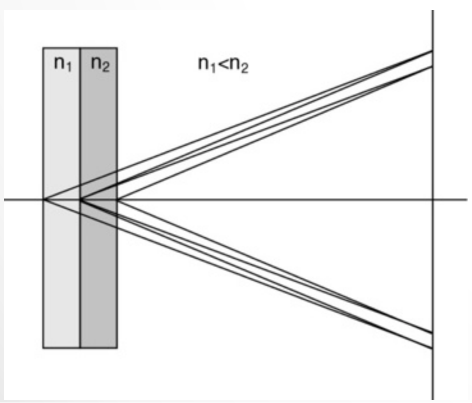
Increases the number of photons without degrading the resolution

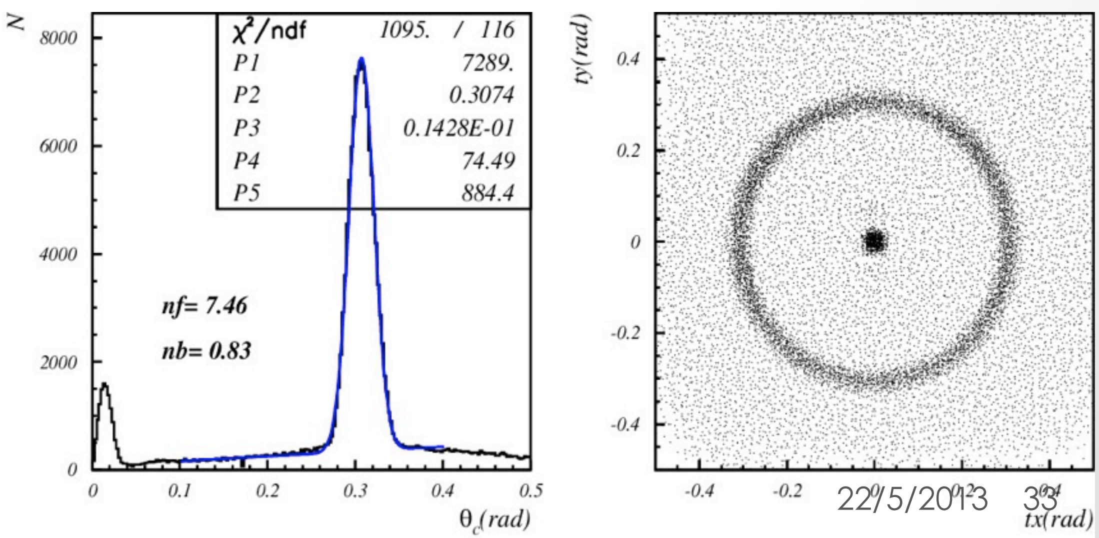
## 4cm aerogel single index



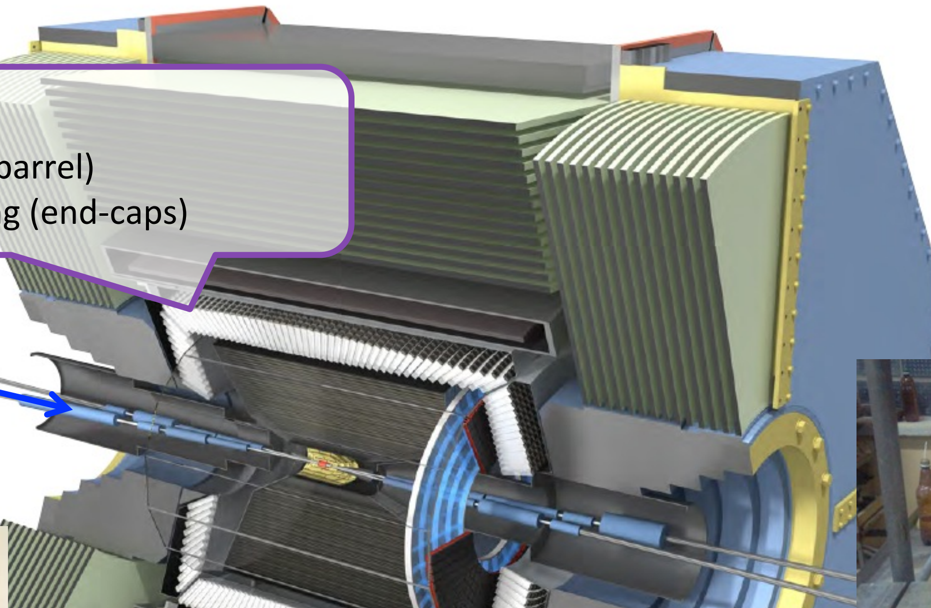

## 2+2cm aerogel

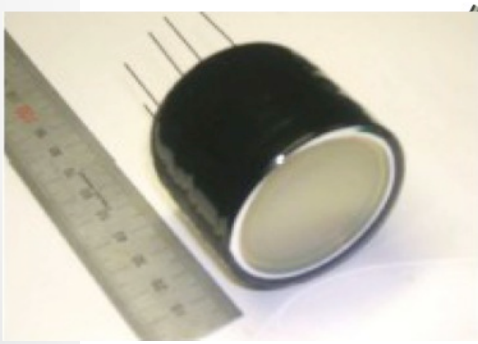



→NIM A548 (2005) 383

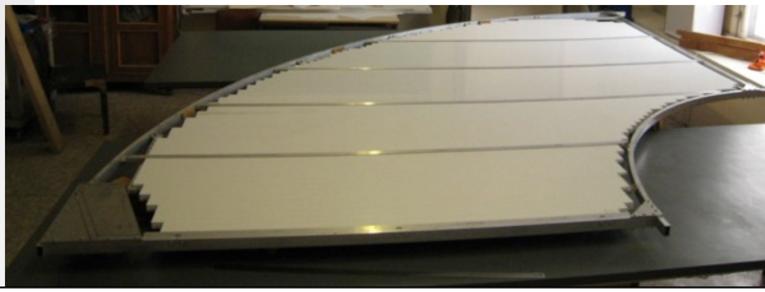
EM calorimeter: upgrade needede because of higher rates and radiation load (barrel: electronics, endcap: electronics and CsI(Tl) → pure CsI)

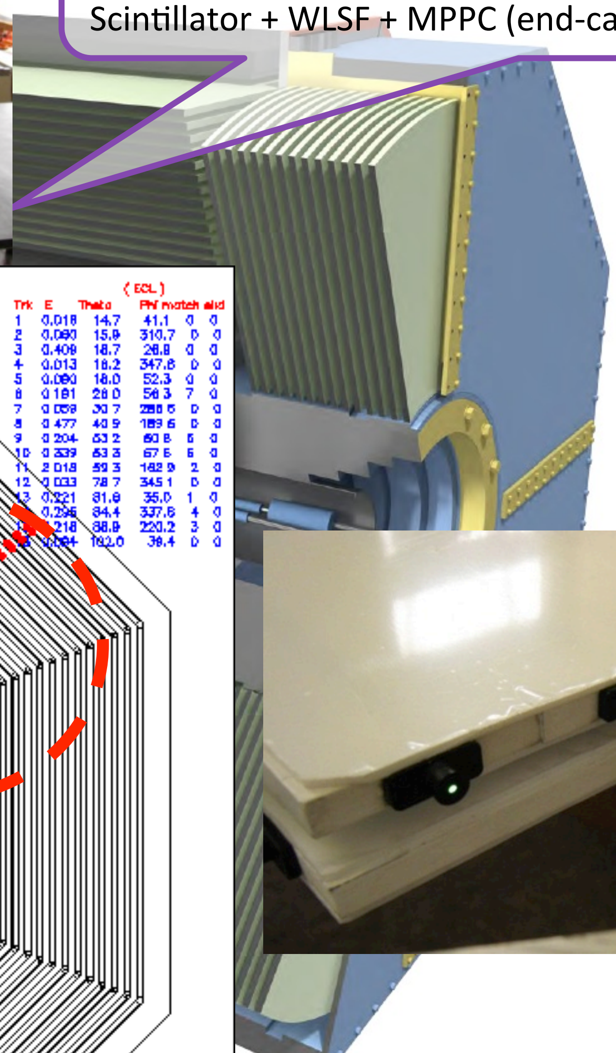


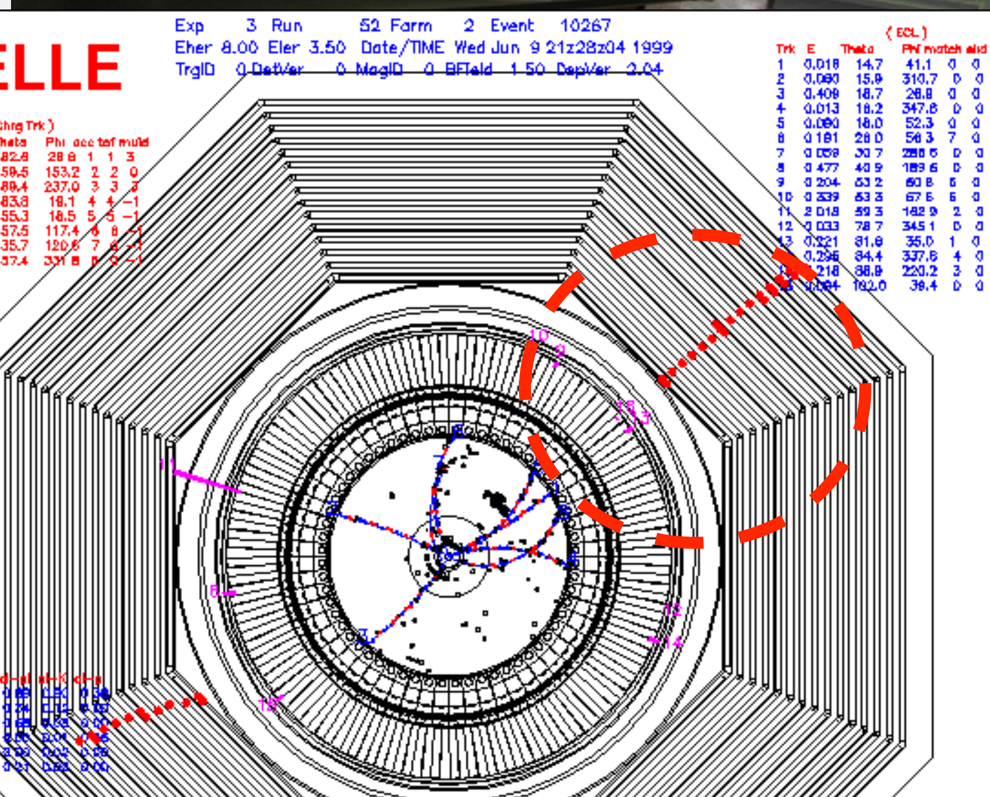



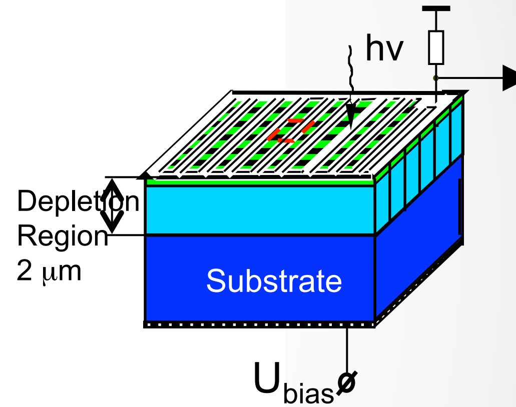
Detection of muons and KLs: Parts of the present RPC system have to be replaced to handle higher backgrounds (mainly from neutrons).

$K_L$ and muon detector:
Resistive Plate Counter (barrel)
Scintillator + WLSF + MPPC (end-caps + barrel 2 inner layers)





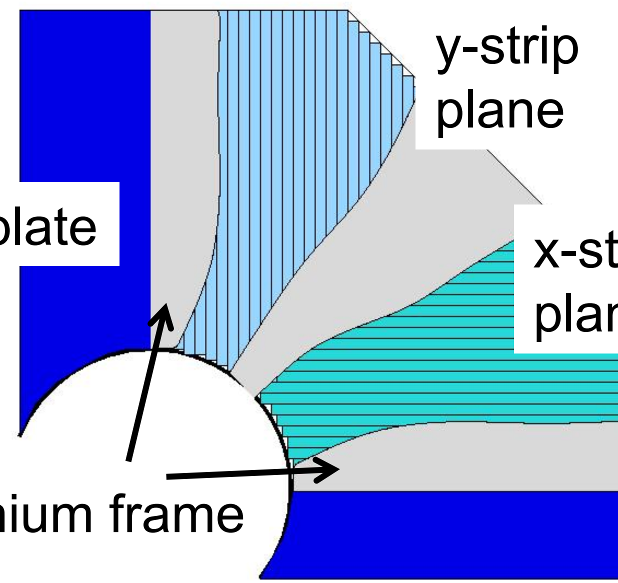


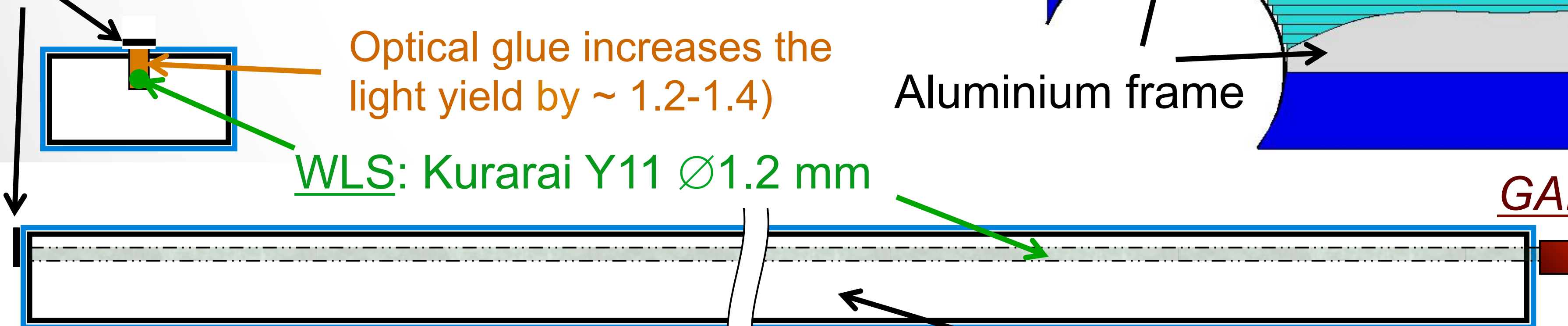




# Muon detection system upgrade in the endcaps

## 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%



# SuperKEKB/Belle II Status

Funding

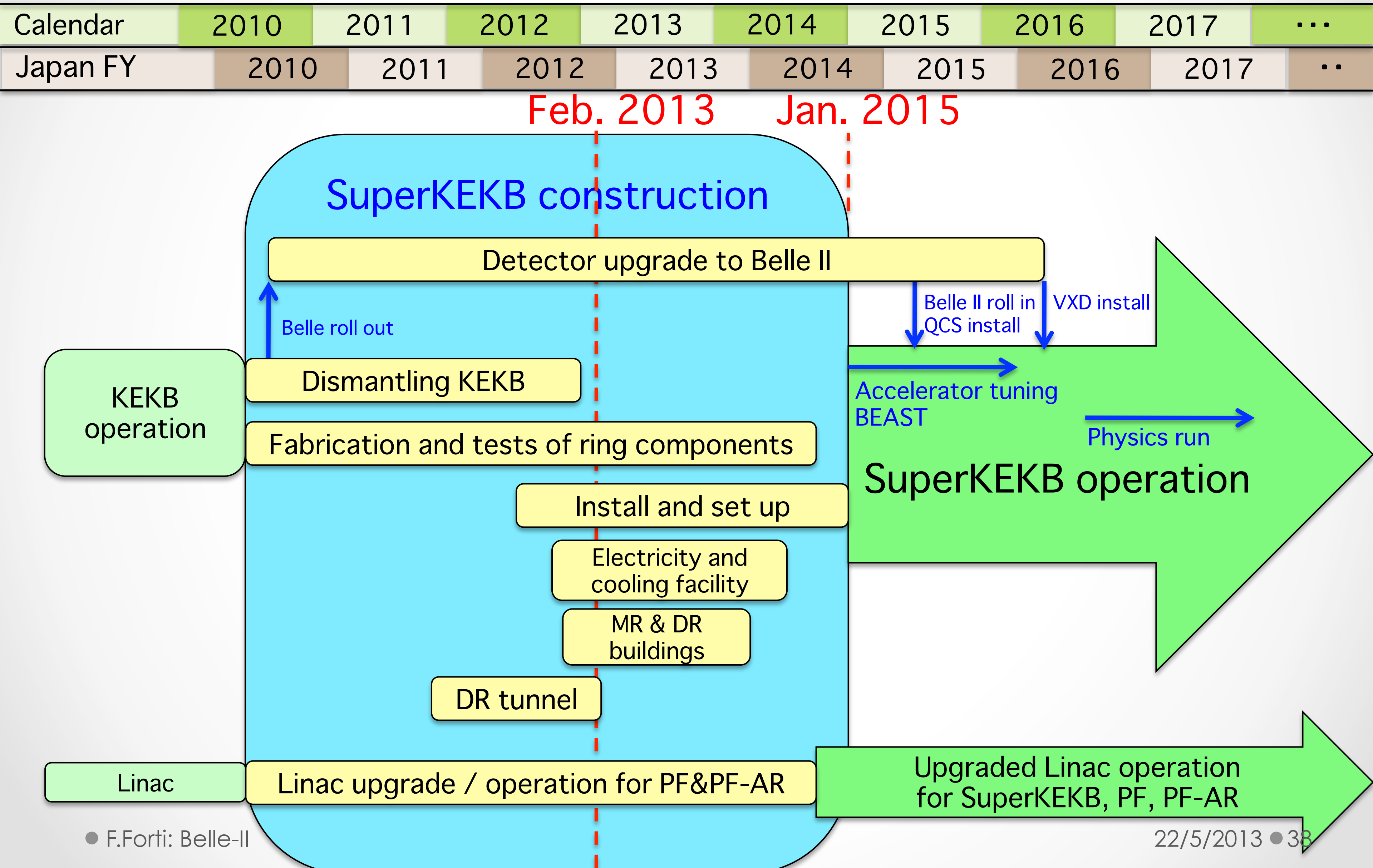
- ~100 MUS for machine approved in 2009 -- Very Advanced Research Support Program (FY2010-2012)
- Full approval by the Japanese government in December 2010; the project was finally in the JFY2011 budget as approved by the Japanese Diet end of March 2011
- Most of non-Japanese funding agencies have also already allocated sizable funds for the upgrade of the detector.

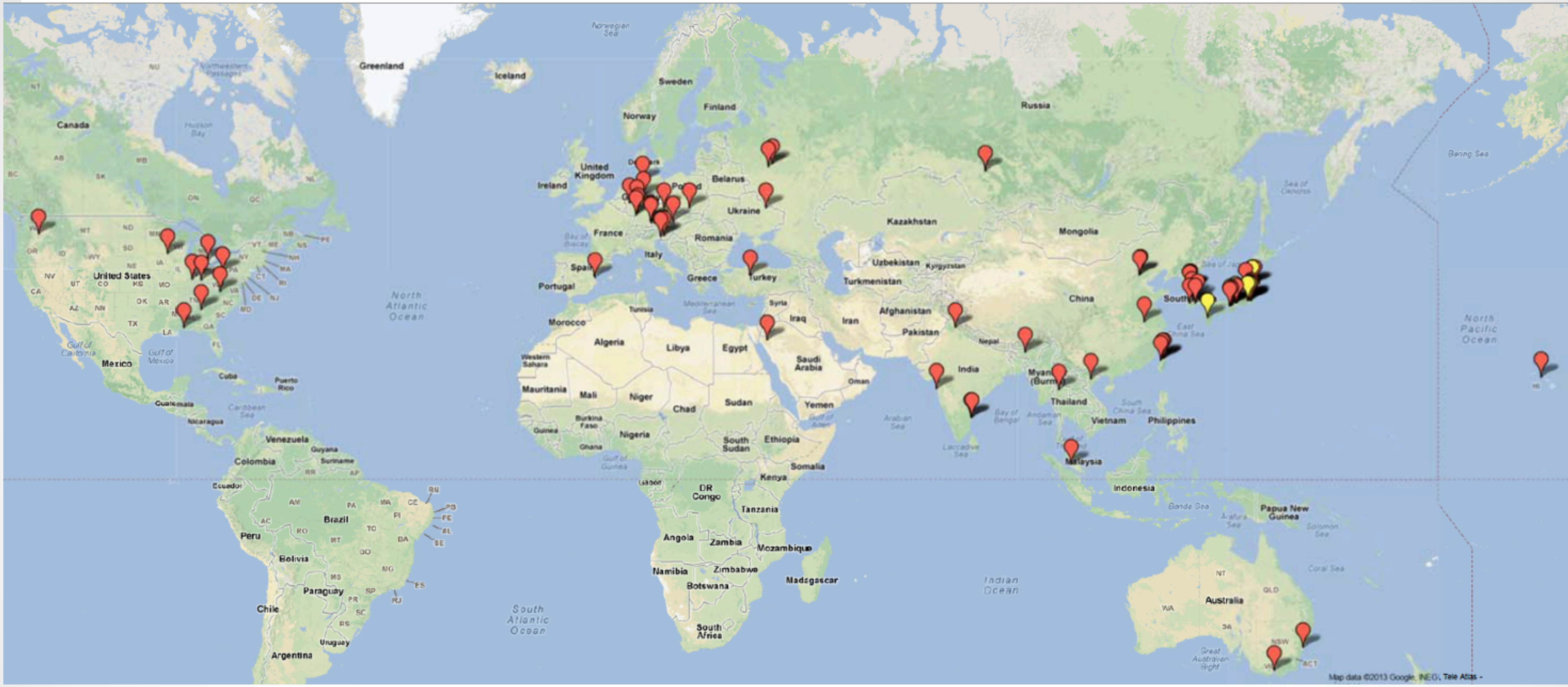
→construction started in 2010!

Fortunately little damage during the March 2011 earthquake → no delay

- Not enough money for forward and backward calorimeter cristal replacement for Day 1
- Fwd/Bwd ECL replacement needed for full luminosity operation

# SuperKEKB/Belle II schedule






# 452 physicists, 70 institutions, 20 countries

# Belle II Organization

**Executive Board**
Chair : H. Aihara
aihara@phys.s.u-tokyo.ac.jp

D.M.Asner, T.Aziz, A.E.Bondar, A.Bozek, T.Browder, P.Chang, Z.Dolezal, T.Iijima, T.Muller, Y.Sakai, C.Schwanda, M.Sevior, E.Won, C.Yuan, K.Akai

**Spokesperson : Peter Krizan**
peter.krizan@ijs.si

**Project Manager : M. Yamauchi**
masanori.yamauchi@kek.jp

**Institutional Board**
Chair : E. Won
eunil@hep.korea.ac.kr

**Speakers Committee**
Chair : Y.Sakai
Yoshihide.Sakai@kek.jp

T.Iijima, C.Schwanda, A.Schwartz

**Physics Coordinator**
: B.Golob/K.Trabelsi
bostjan.golob@ijs.si
karim.trabelsi@kek.jp

- t-independent : B.R.Ko
- t-dependent : M.Staric
- Dalitz : J.Dalseno
- Missing E : K.Hara
- Analysis Model : P.Urquijo

**Technical Coordinator**
: Y.Ushiroda
ushiroda@post.kek.jp

- PXD : H.G.Moser, C.Kiesling
- SVD : T.Tsuboyama, M.Friedl
- CDC : S.Uno
- PID : I.Adachi, S.Korpar, K.Inami, G.Varner
- ECL : A.Kuzmin
- KLM : P.Pakhlov, L.Piilonen
- DAQ/TRG : R.Itoh, Y.Iwasaki
- IR : H.Nakayama
- STR : J.Haba

**Soft/Computing Coordinator**
: T.Hara/T.Kuhr
takanori.hara@kek.jp
Thomas.Kuhr@kit.edu

- Distributed Computing : M.Sevior
- Data Handling System : K.Cho
- Database : M.Bracko
- Cord Management
- Software Framework : R.Itoh
- Tracking : M.Heck
- Simulation tools
- Web, mail servers

# Italian Participation

• • •

or capitalize on expertise.

# SuperB groups evolution

- The SuperB group was large and active.
- Many R&D activities and a lot design work.
- Added value of a very friendly and effective collaboration
- Special effort to keep the collaboration together to capitalize on previous work
- Not easy to move such a large and strong group into an existing collaboration

| Sede | N Fis | N Tec | N Star | FTE Fis | FTE Tec | FTE Tot |
|---|---|---|---|---|---|---|
| BA | 13 | 5 | | 4.3 | 1.2 | 5.5 |
| BO | 17 | 3 | 3 | 4.3 | 0.5 | 4.8 |
| CNAF | | 2 | | | 0.8 | 0.8 |
| CA | 8 | 1 | | 1.8 | 0.2 | 2 |
| FE | 10 | 4 | 3 | 6.9 | 1.2 | 8.1 |
| LE | 3 | 3 | | 0.9 | 2 | 2.9 |
| LNF | 7 | 4 | | 3 | 1 | 4 |
| LNL.DTZ | | 4 | | | 0.8 | 0.8 |
| MIB.DTZ | 3 | 0 | | 1.5 | | 1.5 |
| MI | 5 | 5 | 1 | 2.8 | 2.6 | 5.4 |
| NA | 10 | 3 | 8 | 4.3 | 0.9 | 5.2 |
| PD | 8 | 6 | 2 | 5.3 | 2.7 | 8 |
| PG | 5 | 1 | 1 | 2.6 | 0.5 | 3.1 |
| PI | 14 | 4 | | 7.9 | 2.2 | 10.1 |
| PV | 1 | 6 | | 0.5 | 3.8 | 4.3 |
| RM1 | 8 | 4 | 6 | 2.6 | 1.1 | 3.7 |
| RM3 | 5 | 1 | | 1.7 | 0.3 | 2 |
| RM2 | 9 | 1 | 4 | 1.8 | 0.3 | 2.1 |
| TO | 6 | 2 | | 2.4 | 0.6 | 3 |
| TN | 0 | 4 | 2 | 0 | 2.1 | 2.1 |
| TS | 4 | 2 | 1 | 2.7 | 0.9 | 3.6 |
| TOTALI | 136 | 65 | 31 | 57.3 | 25.7 | 83 |

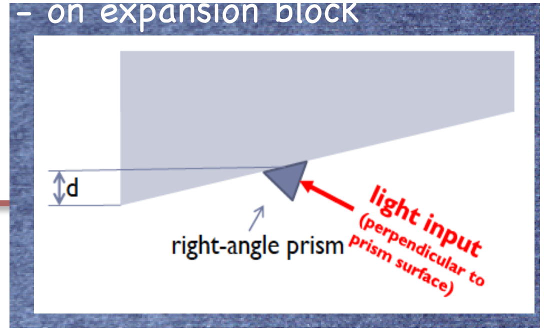
- People who joined SuperB from LHC experiments went back
- The other groups mostly are joining Belle-II and LHCb.
  - Physics interest is dominating the choice
  - Support by INFN to differentiate activities

# Belle-II opportunities

- We had various meeting with Belle-II collaboration.
- Very open and positive about our joining.
- Many opportunities to contribute even in a experiment during construction phase.
- Identified possible contributions from italian groups in:
  - Vertex detector
  - Particle identification
  - Electromagnetic calorimeter
  - Computing
  - Software development
  - Physics analysis
- Specific responsibilities are still in discussion.
- Many other opportunities exist for additional contributions.

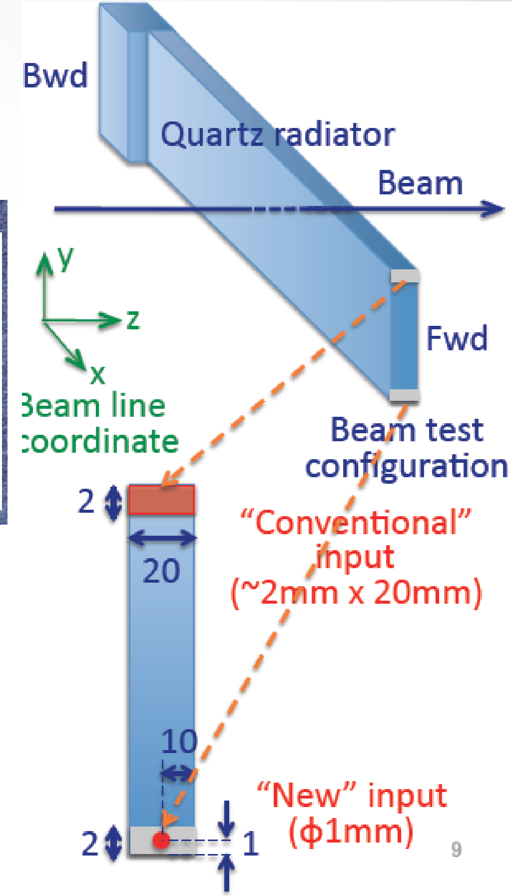
# Particle identification

- Torino, Bari, Padova



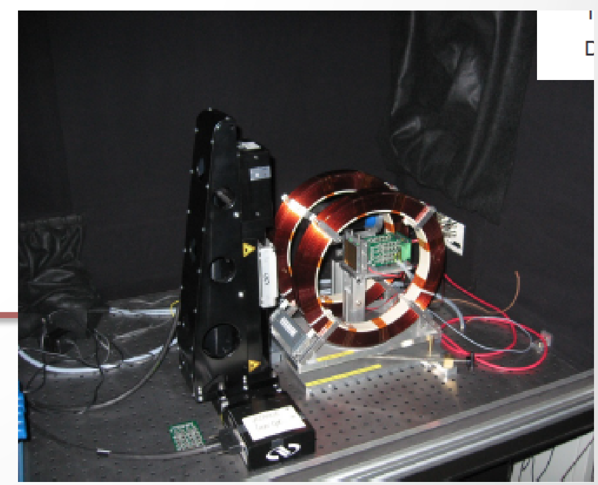

**TOP**

- Calibration system
  - Laser and fiber optics
  - Laser operation system
  - Online calibration
- Environment monitor
- Software work collaborating with Ljubljana
  - Convertion from raw data to reconstruction level
  - Applying calibration constant
  - Alignment scheme
  - Database handling
- Power supply
- Cooling system

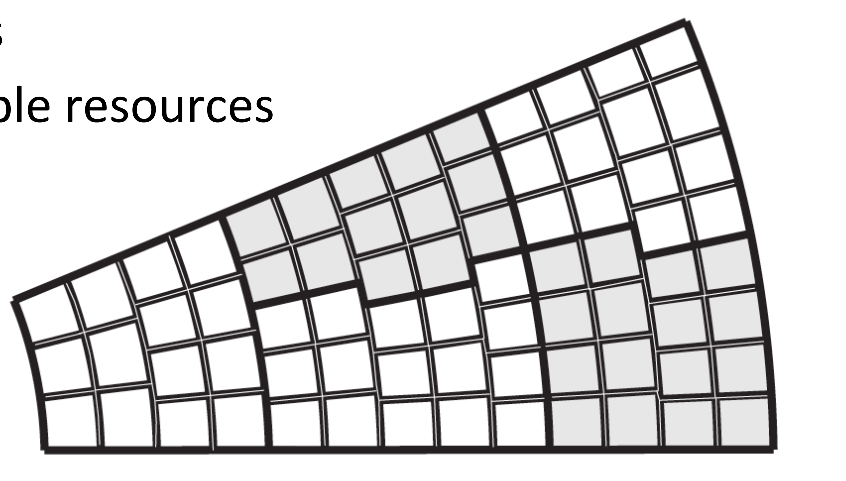

**ARICH**

- mirror system (planar mirrors at the edge of acceptance)
- low voltage power supplies for read-out electronics
- quality assessment (cross check) of (a few) selected HAPD



# Electromagnetic Calorimeter

- Perugia, Roma3, Napoli, Frascati, Casaccia (Roma1)
- For day one software activities
  - Simulation
  - Calibration software
- For phase 2 (2017-2018)
  - Contribution to endcap construction (expensive pure CsI)
  - Possibility of one complete endcap module
  - Possibile contribution to electronics
  - Detailed plan will depend on available resources
- R&D
  - R&D for different solutions (especially for backward endcap)



# Computing

- Torino, Bari, Napoli, Pisa
- Amount of needed resources still not fully understood
  - Probably underestimated

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tape [PB] | 0.00 | 0.00 | 0.00 | 0.12 | 0.33 | 1.17 | 9.23 | 28.51 | 52.45 | 76.80 | 102.32 |
| Disk [PB] | 0.00 | 0.20 | 0.20 | 0.66 | 0.43 | 1.53 | 12.08 | 37.31 | 53.75 | 70.47 | 88.00 |
| CPU [kHepSPEC] | 0.00 | 0.01 | 0.05 | 5.56 | 13.42 | 38.71 | 239.06 | 444.50 | 555.64 | 592.37 | 646.10 |

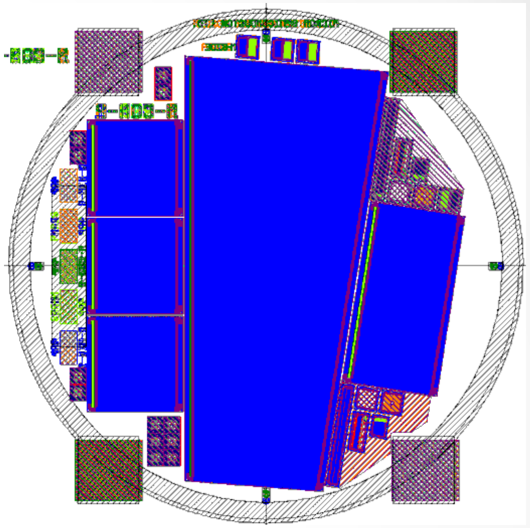
- Contribution in terms of computing resources
  - In the Tier centers and in PON-RECAS infrastructure
- Contribution for infrastrustructure management and distributed framework
  - Extensive experience in SuperB can be exported

# Vertex Detector

- Pisa, Trieste

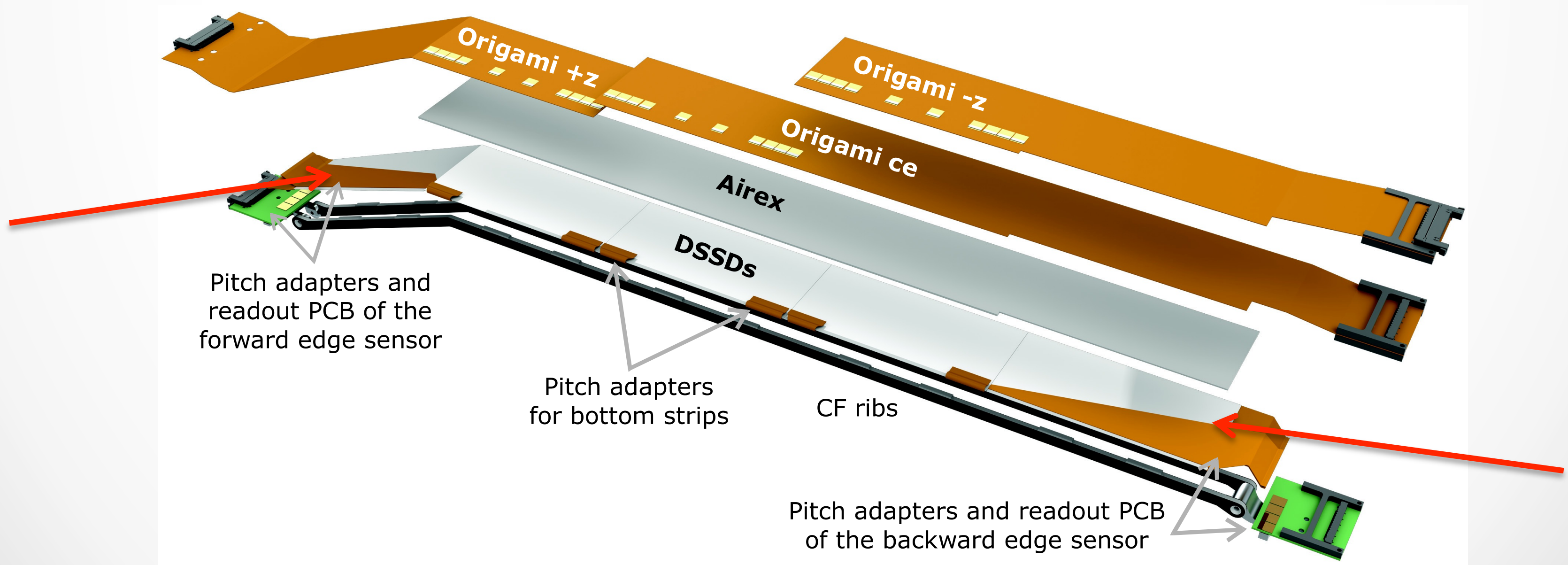
Trieste:

- Contribution to silicon detector testing
  - Not yet clear whether sample testing of production testing
- Environmental monitoring
- Radiation monitoring
  - Take advantage of development funded in SuperB for diamond detectors with fast remote readout



# Vertex Detector

- Pisa: contribution to assembly of strip detector modules
  - On critical path
  - Assemble the forward and backward sensors of layer 4,5,6
  - Ship to other assembly sites (Melbourne, Vienna, IPMU Tokyo)
  - Participate in overall mechanical design and assembly



# Attività di assemblaggio a Pisa

- Ricezione, ispezione e test componenti
  - Sensori, pitch adapter (PA) – solo ispezione
  - Ibridi – ispezione e test
- Incollaggi
  - PA a sensore e a ibrido – procedure da definire
  - Necessario studio su tecnica di incollaggio
- Microsaldatura
  - Su due livelli con pitch 45um
  - Da fare in due(phi) + due(z) fasi con test intermedio
  - Canali con problemi da non connettere (o staccare)
- Test finale
  - Teststand, laser, sorgente
  - Forse da fare burn-in, ma non ancora definito
- Spedizione
  - Sistema di trasporto da definire

# Scala temporale

- La scala temporale è vicina, ma umana
- Entro il 2013
  - Design dei jig
  - Costruzione del primo modulo completo meccanico
- Febbraio 2014
  - Inizio assemblaggio di produzione
- Periodo di produzione
  - Nell'ipotesi più ottimista (8+8): 6-7 mesi
  - Più realisticamente (6+6): 8-9 mesi
- Fine 2014
  - Conclusione assemblaggio a Pisa
- Poi
  - Assemblaggio dei ladder
  - Da metà 2015 - montaggio dei ladder sulla struttura meccanica a KEK

- Si è svolto il 17/5 un Incontro con il gruppo Alte Tecnologie per valutare la compatibilità
  - Non sembrano esserci grosse difficoltà

# Opzioni

- Power supplies
  - Interessante sia per VXD sia per PID, per le possibili ricadute sull'industria italiana
- Maggiore contributo nella costruzione del calorimetro
  - Dipende fortemente dalle risorse disponibili
- Contributo per i layer PXD 1-2
  - Il progetto DEPFET è molto ambizioso e un po' marginale.
    - Potrebbe essere in ritardo per le difficoltà di produzione
    - Potrebbe non avere la performance richiesta a causa dei background e della complessità del sistema
  - Possibilità di (ma sono tutte da capire)
    - Costruire un layer a striplets con APV25 da inserire in caso di ritardo
    - Concludere l'R&D su INMAPS iniziato in SuperB in modo da proporre un sistema a pixel veloci

# Belle-II Pisa

(Ancora qualche incertezza)

- Angelini
- Batignani
- Bettarini
- Casarosa
- (Fella)
- Forti
- Giorgi
- (Lusiani)
- (Oberhof)
- Paoloni
- (Perez Perez)
- Rizzo
- Walsh → LHCb

- Circa 8-10 persone con 4 FTE
- Mantenuta partecipazione in Babar
- Apertura anche di un progetto di CNS5

- Risorse di sezione ancora da quantificare esattamente

- Laboratori puliti e gruppo alte tecnologie
- Progettazione ed officina
- Elettronica (opzioni)

# Belle-II Italia

- Numeri ancora da verificare

| Sede | N Fis | N Tec | FTE Fis | FTE Tec | FTE Tot |
|---|---|---|---|---|---|
| BA | 3 | | 1.1 | | 1.1 |
| CNAF | | | | | 0.0 |
| LNF | 6 | 1 | 2.8 | 0.2 | 3.0 |
| MI | | | | | 0.0 |
| NA | 5 | 3 | 1.9 | 0.7 | 2.6 |
| PD | 5 | 1 | 2 | 0 | 2.2 |
| PG | 5.0 | | 3.1 | | 3.1 |
| PI | 8.0 | | 4.0 | | 4.0 |
| PV | | | | | 0.0 |
| RM1 | 3.0 | | 0.6 | | 0.6 |
| RM3 | 5.0 | 1.0 | 2.0 | | 2.0 |
| TO | 3.0 | | 2.1 | | 2.1 |
| TS | 3.0 | | 2.1 | | 2.1 |
| TOTALI | 46.0 | 6.0 | 21.7 | 1.1 | 22.8 |

- Risorse finanziarie necessarie compatibili con un budget costante di CSN1.
  - Piano finanziario globale verrà presentato in CSN1 il 3 giugno

# CSN1: Tempi e sigle

- A gennaio 2013 le assegnazioni di SuperB sono state per la maggior parte riprese dalla commissione, lasciando solo poco metabolismo
- 3 giugno: presentazione proposta Belle-II alla CSN1 ed approvazione di massima
- 4-7 luglio: Belle2 General Meeting dove fare l'application e diventare formalmente membri della collaborazione
- 15 luglio: assegnazione (su sigla P-SuperB) dei fondi necessari per arrivare a fine 2013 sulle nuove attività
- Settembre – presentazione attività dettagliata
- 2014 – apertura sigla Belle-II.

# Outlook

- Belle-II at SuperKEKB is an exciting physics opportunity
  - Precision measurements allowing to detect discrepancies from the standard model
    - Rare decay measurements
    - Lepton flavour violation
    - CP violation in Charm
  - Synergic and complementary to LHC program
- The collaboration is open and welcoming new contributions
  - A strong and motivated group exists in Italy
  - Important contribution to multiple systems
  - Compatible with available resources
- Ready to start the new adventure