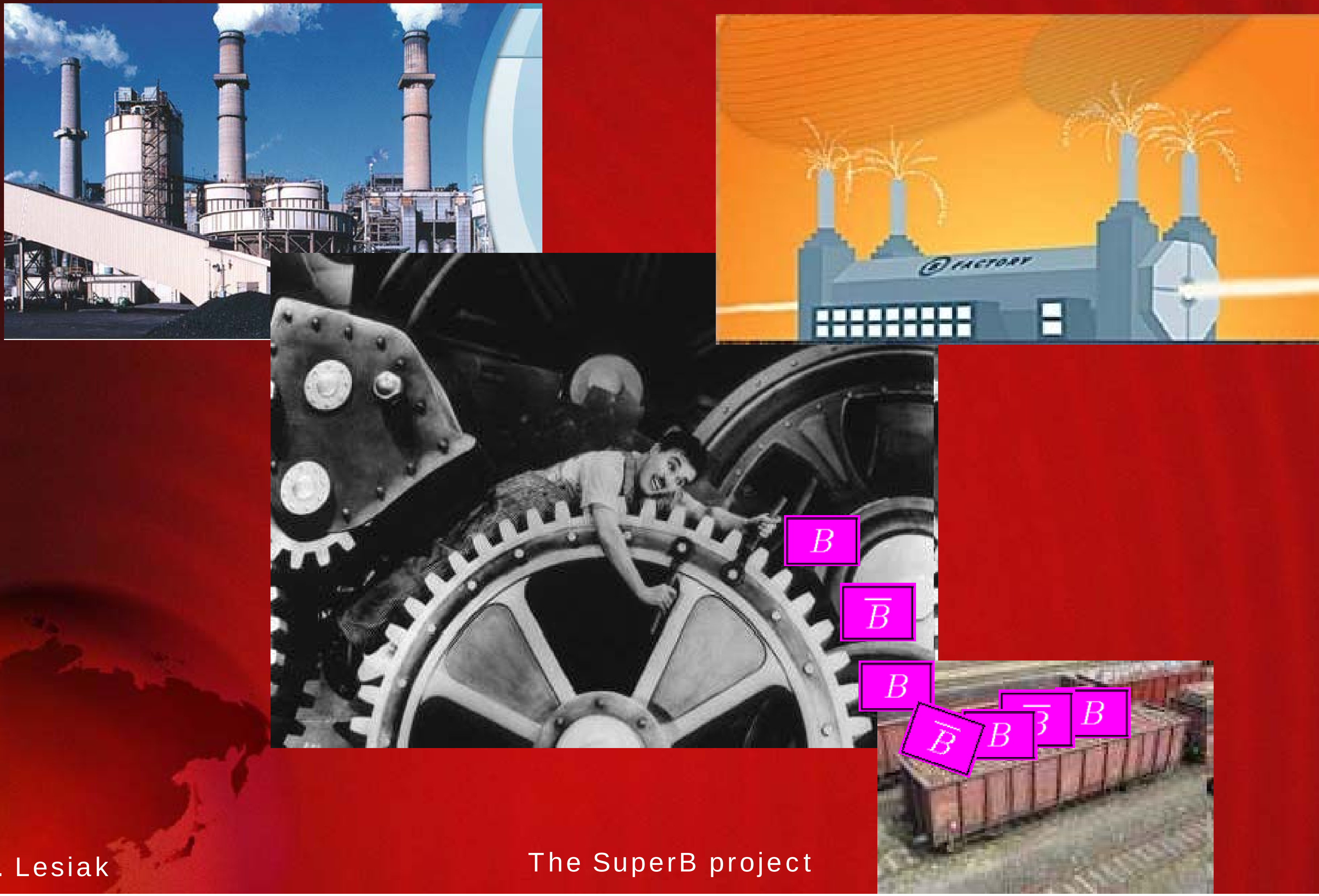
The SuperB Project

Tadeusz Lesiak

Institute of Nuclear Physics PAS, Cracow
&
Cracow University of Technology

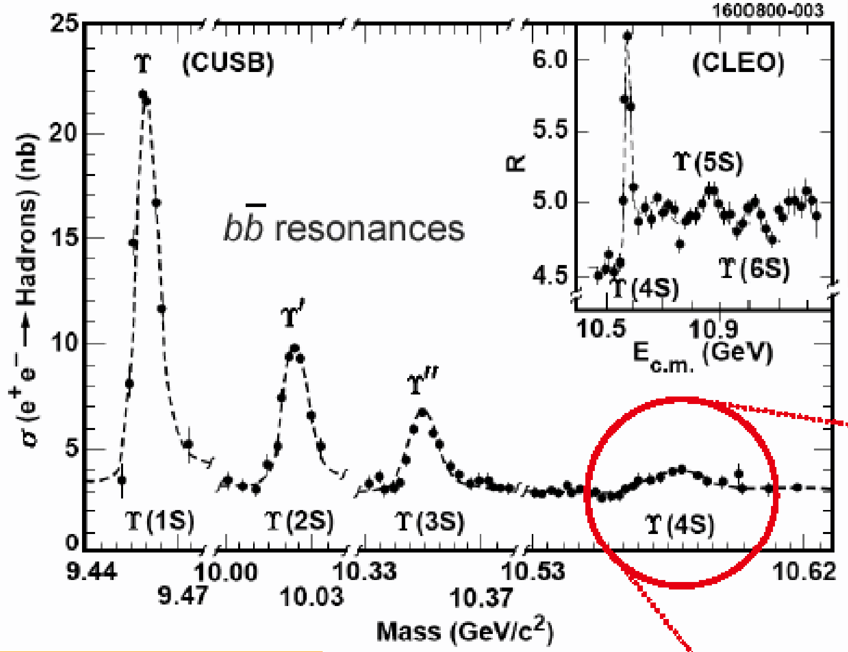
B-factories ⇔ tremendous physics

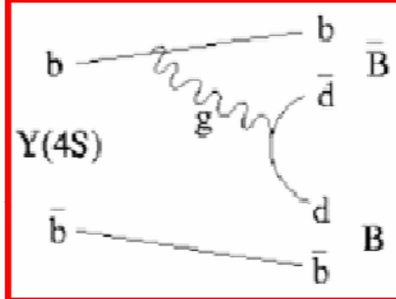


B physics at the Υ(4S)

$\Upsilon(4S)(b\bar{b})$

$M(\Upsilon(4S)) \approx 10.58\ GeV, \quad M(B\bar{B}) \approx 10.56\ GeV$

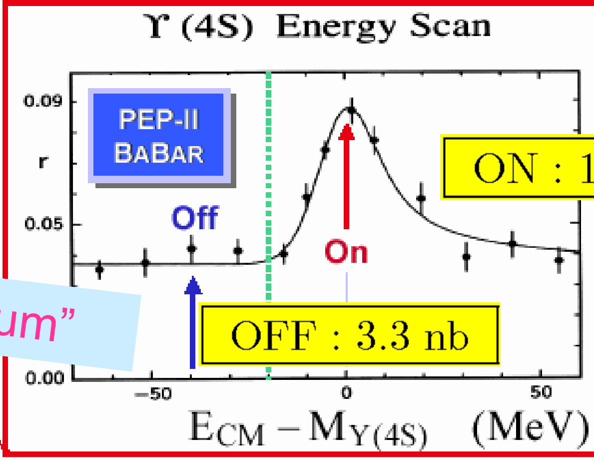




e^+e^- collisions at $E_{CMS} \approx M(\Upsilon(4S))$ ➔ the cleanest way to produce B mesons

$$\frac{\mathcal{B}(\Upsilon(4S)\to B^+B^-)}{\mathcal{B}(\Upsilon(4S)\to B^0\overline{B}^0)} \approx 1$$

$\Gamma(\Upsilon(4S) \to B\bar{B}) > 96\ \%$



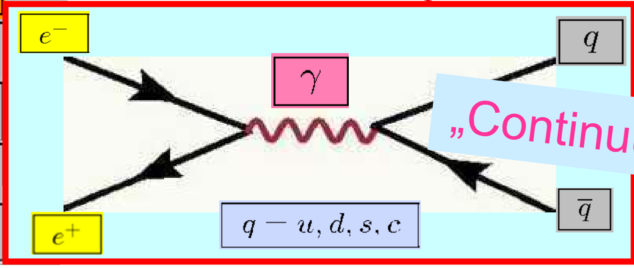
$\sigma(b\bar{b}) = 1.1\ \text{nb}$

$\sigma(c\bar{c}) = 1.3\ \text{nb}$

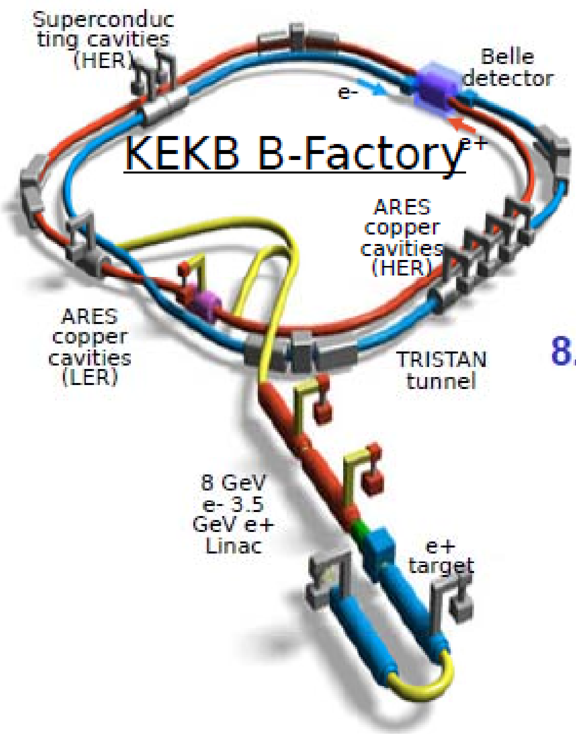
$\sigma(s\bar{s}) = 0.3\ \text{nb}$

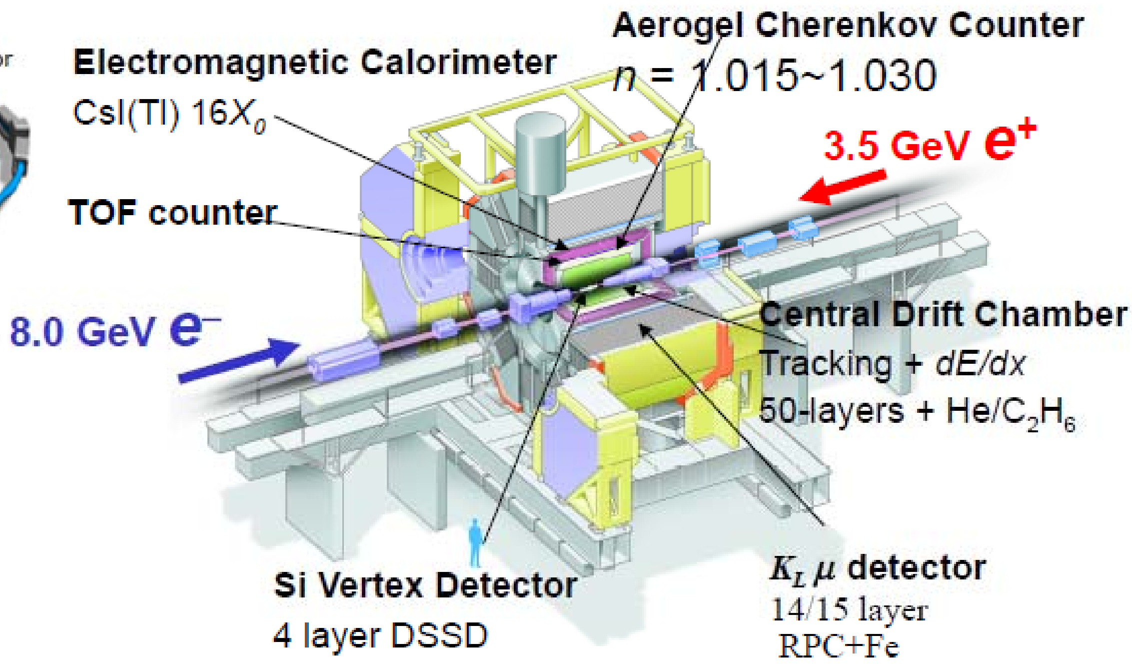
$\sigma(d\bar{d}) = 0.3\ \text{nb}$

$\sigma(u\bar{u}) = 1.4\ \text{nb}$



B factories: the 1st generation





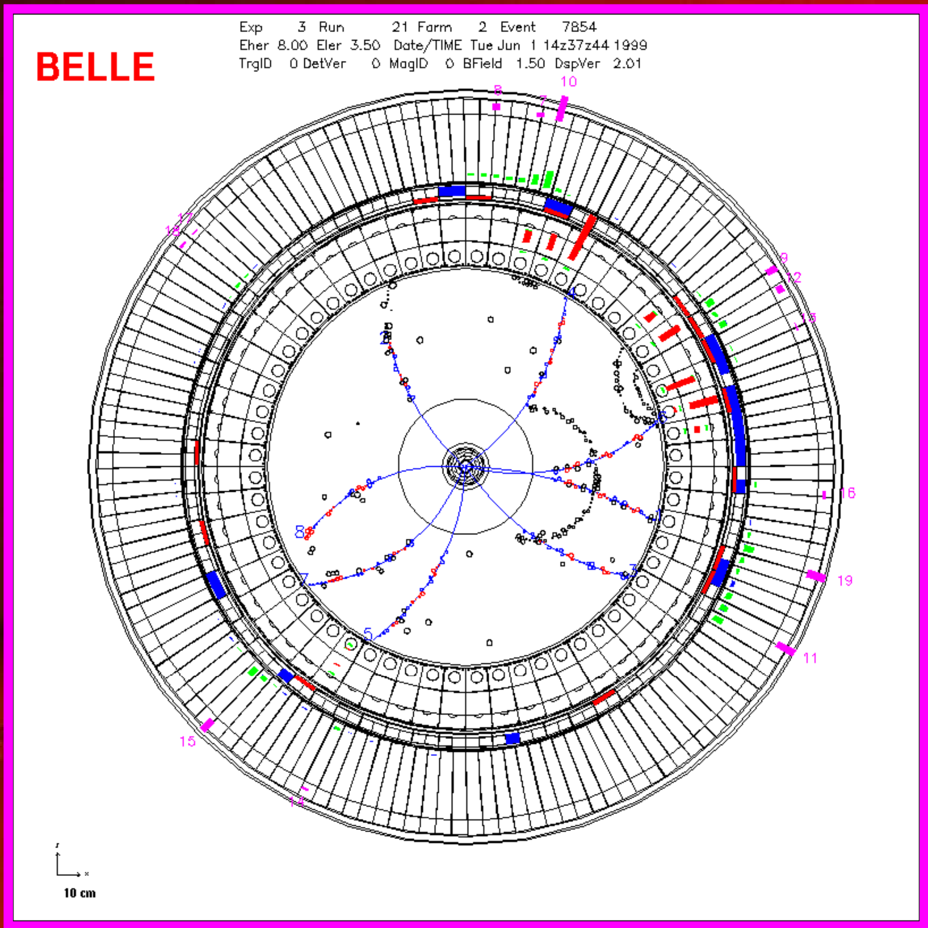
Plenty of rare decays of B mesons ➔ a very large statistics of B mesons is a must

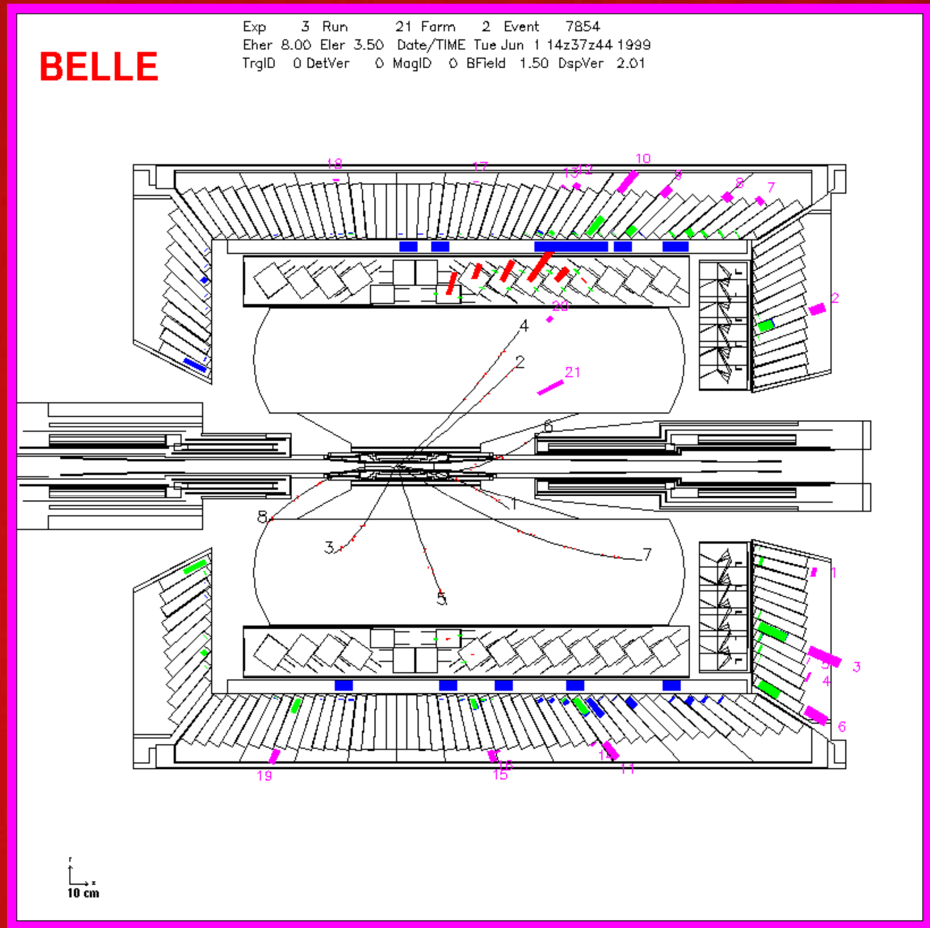
CP violation measurements = (often) time dependent asymmetries

➔ beam energies are asymmetric too (to boost the B mesons in the LAB frame)

B physics is clean…

x-y ← projection → y-z

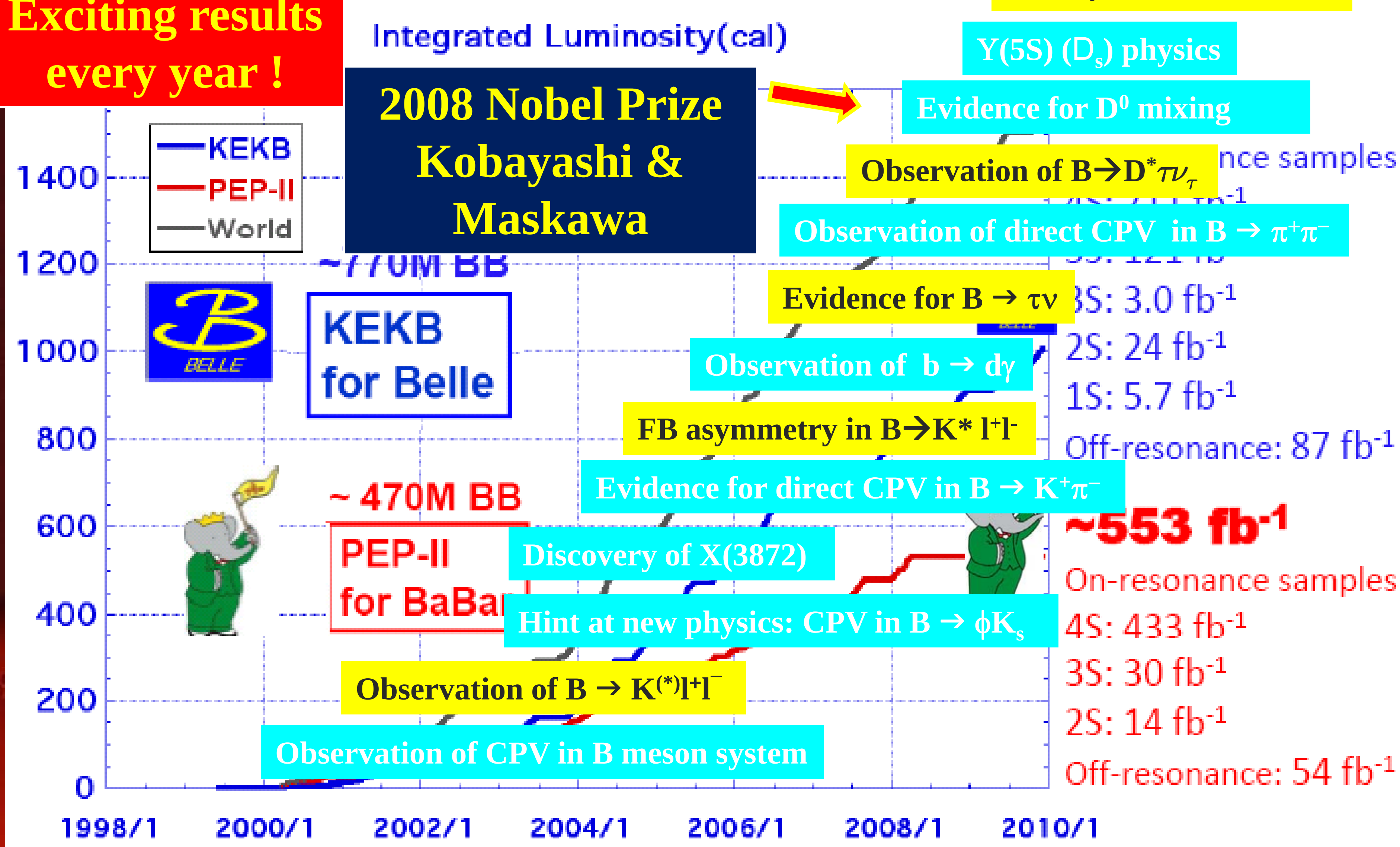




Achievements at B-factories

Exciting results every year !

2008 Nobel Prize Kobayashi & Maskawa

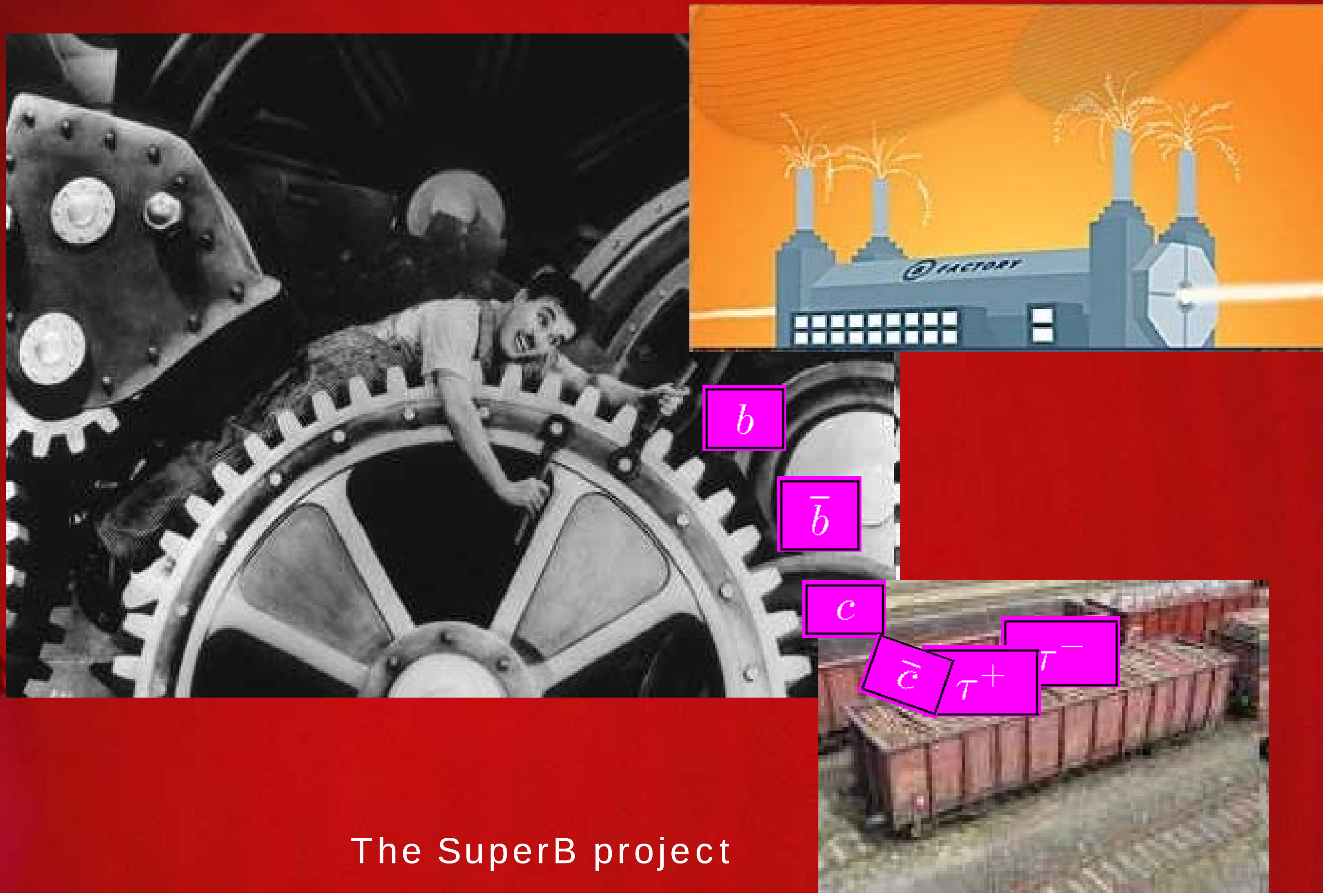


- τ decays: limits on LFV
- $\Upsilon(5S)$ (D_s) physics
- Evidence for D^0 mixing
- Observation of $B \to D^* \tau \nu_\tau$
- Observation of direct CPV in $B \to \pi^+\pi^-$
- Evidence for $B \to \tau\nu$
- Observation of $b \to d\gamma$
- FB asymmetry in $B \to K^* l^+l^-$
- Evidence for direct CPV in $B \to K^+\pi^-$
- Discovery of X(3872)
- Hint at new physics: CPV in $B \to \phi K_s$
- Observation of $B \to K^{(*)}l^+l^-$
- Observation of CPV in B meson system

B factories → (Super) Flavour Factories

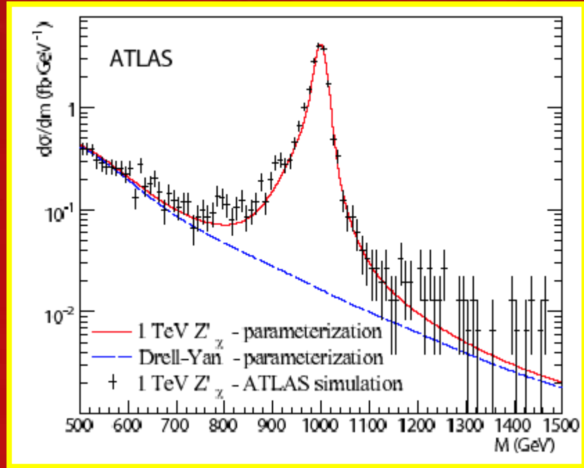
GENERATION ONE　　GENERATION TWO

Expectations from the Super Flavor Factories

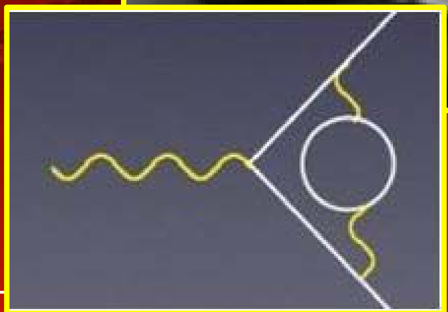


SuperB vs LHC

- **LHC ➔ energy frontier**
  ➔ potential for discoveries
  e.g. peaks of new particles



- **2nd generation of B-factories: flavour physics**
  a precise tool (virtual loops, rare or forbidden processes)



- Both QUARK (b,c) and LEPTON (tau) sectors to be probed
- Tau physics particularly exciting (CPV, LFV, EDM, g-2,…)
- Connections with astroparticle physics …

- **The complementarity with the LHCb physics program**

SuperB: main Physics goals

(In descending order of masses of heavy flavour particles)

1. Υ(4S): improvement by an order of magnitude in the precision (to compare with BaBar and Belle)
2. Tests of the CKM paradigm at the 1% level
3. Potential spectroscopy discoveries
4. b physics at Upsilon resonances other than (4S)
5. CPV in charm, also with time dependent asymmetries
6. Tau physics
   - ✓ LFV sensitivity
     - → improvement by one-two orders of magnitude
   - ✓ CP and T-violation
   - ✓ Magnetic structure ofthe tau

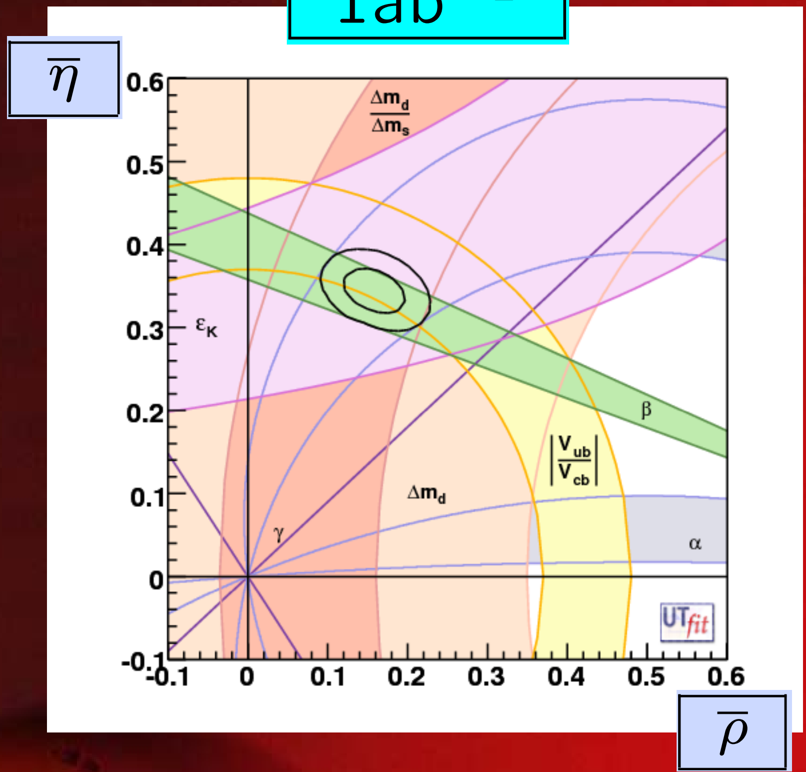
High luminosity needed (items 1, 2, 3)

Scan in CM energy (items 4, 5)

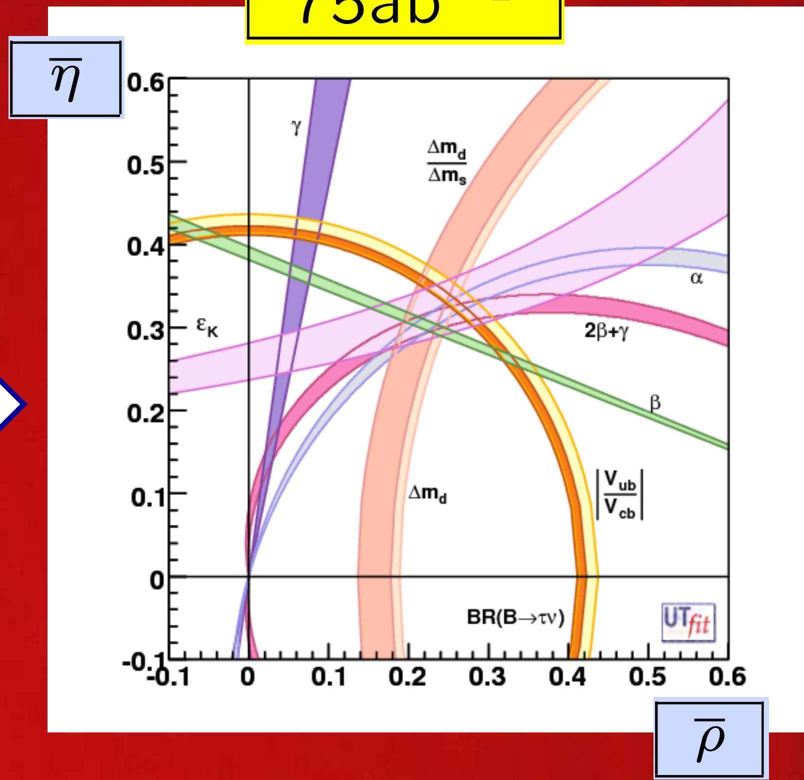
Longitudinal polarization of the electron beam (item 6)

CKM precision measurements

$1ab^{-1}$



$75ab^{-1}$



$\Delta\bar{\rho} = 0.028$

$\Delta\bar{\eta} = 0.016$

$\Delta\bar{\rho} = 0.0028$

$\Delta\bar{\eta} = 0.0024$

B physics @ Y(4S) (from A.Bevan DESY sem).

Variety of measurements for any observable

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
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° (∗)
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°
$2\beta+\gamma$ ($D^{(*)\pm}\pi^\mp$, $D^\pm K^0_S\pi^\mp$)	20°	5°
$S(\phi K^0)$	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 (∗)
$\|V_{cb}\|$ (exclusive)	4% (∗)	1.0% (∗)
$\|V_{cb}\|$ (inclusive)	1% (∗)	0.5% (∗)
$\|V_{ub}\|$ (exclusive)	8% (∗)	3.0% (∗)
$\|V_{ub}\|$ (inclusive)	8% (∗)	2.0% (∗)

Observable	B Factories (2 ab^{-1})	Super$B$ (75 ab
$\mathcal{B}(B \to \tau\nu)$	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

Possible also at LHCb

Similar precision at LHCb

Example of « SuperB specifics »

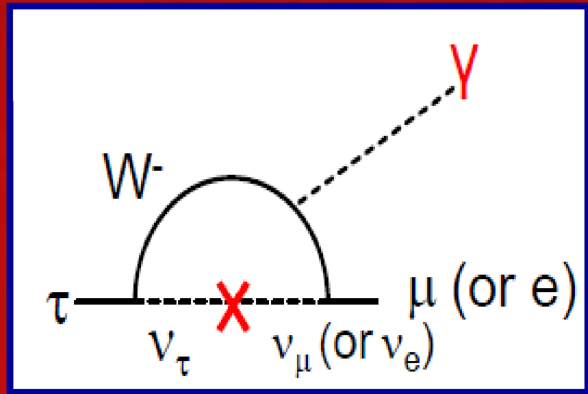
- inclusive in addition to exclusive analyses
- channels with π^0, γ's, ν, many Ks…

Lepton Flavour Violation (LFV) in tau decay

- The tau is the most suitable lepton to search for LFV effects
  (the heaviest charged lepton with many possible LFV decay modes)

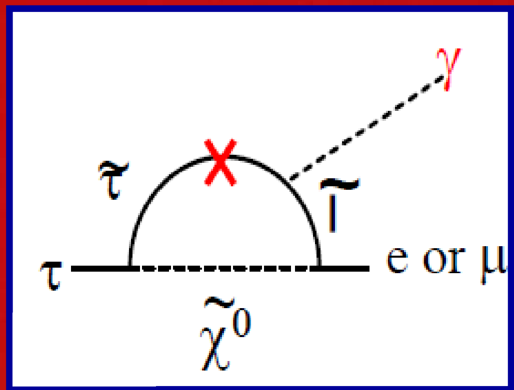
- LFV for charged lepton is negligibly small in the SM
  (even after taking into account neutrino oscillations)

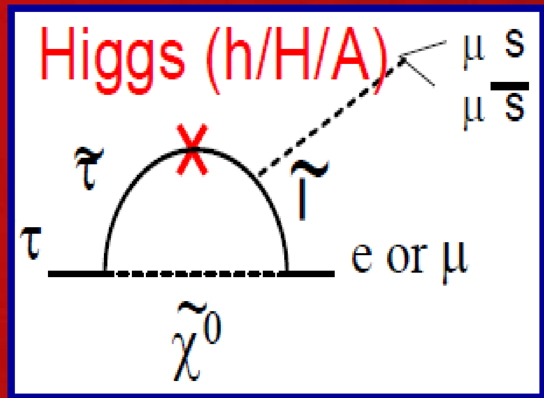
$\mathcal{B}(\tau \to l\gamma) < 10^{-54}$ $\mathcal{B}(\tau \to lll) < 10^{-14}$



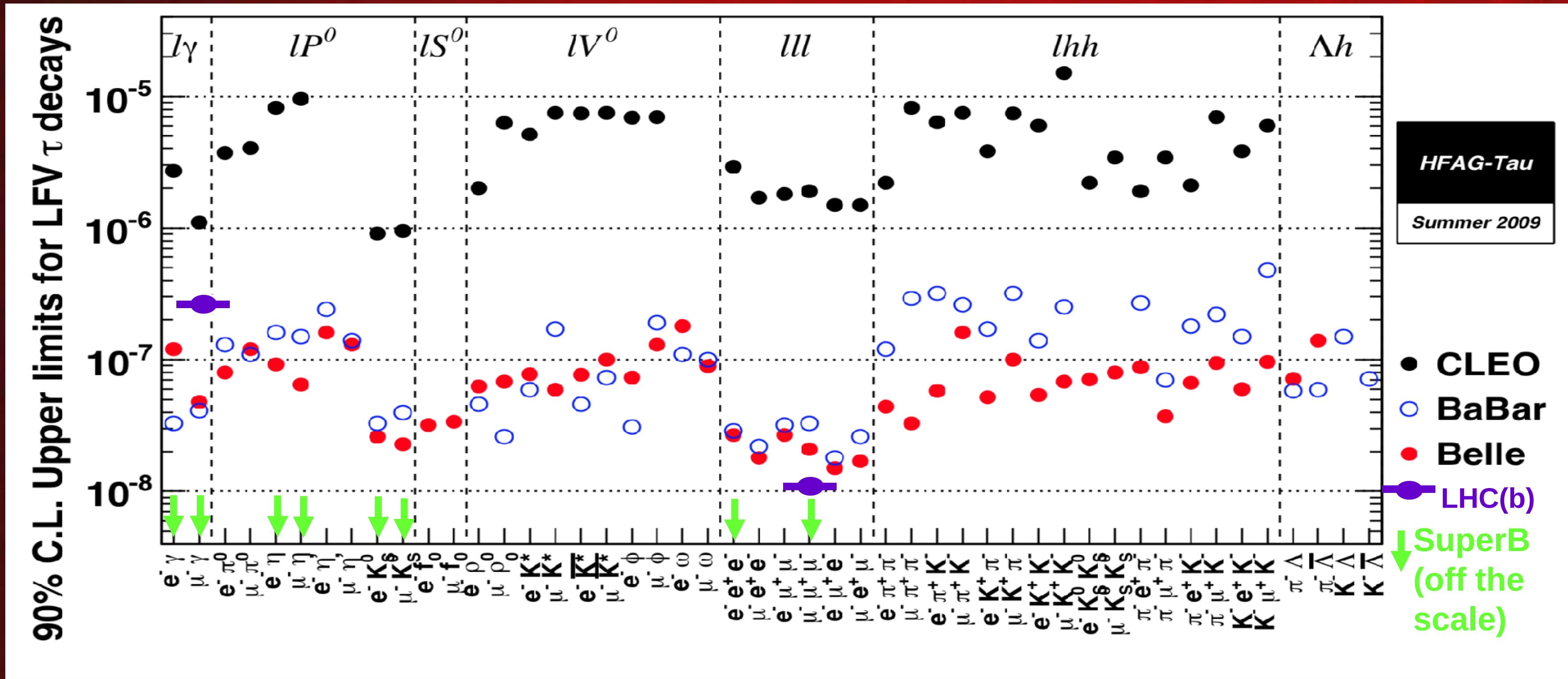
- LFV decays occur in many extensions of the SM e.g. SUSY

- ➔ **their branching fractions could be enhanced** to the level as high as the experimental sensitivity of the SuperB





LFV in tau decay



- The sensitivity of SuperB is **10-50 times below** overall predictions of New Physics e.g.

$\mathcal{B}(\tau \to \mu\gamma) \sim 2 \times 10^{-9}$ $\mathcal{B}(\tau \to \mu\mu\mu) \sim 2 \times 10^{-10}$

To compare with current limits: $> 4.4 \times 10^{-8}$ (BaBar) $> 2.1 \times 10^{-8}$ (Belle)

- Other „SuperB speciific" channels: $\tau \to lh, \quad \tau \to h\gamma, \quad h = \pi^0, \eta^{(\prime)}, K^0_S, \ldots$

CPV in tau decay

- CP violation in charged lepton decays – no observation yet
- The SM: CP violating asymmetries are expected to be vanishingly small e.g.

$$A_{CP} = \frac{\Gamma(\tau^+ \to K^+\pi^0\bar{\nu}_\tau) - \Gamma(\tau^- \to K^-\pi^0\nu_\tau)}{\Gamma(\tau^+ \to K^+\pi^0\bar{\nu}_\tau) + \Gamma(\tau^- \to K^-\pi^0\nu_\tau)} \sim o(10^{-12})$$

- only in a few NP frameworks (RPV SUSY, non-SUSY multi-Higgs models)

  the CPV asymmetries in angular distributions can be enhanced even up to **o(10^{-1});**

  sizeable effects for $\tau \to K\pi\nu_\tau,\ \tau \to K\eta^{(\prime)}\nu_\tau,\ \tau \to K\pi\pi\nu_\tau$

- CLEO : study of tau charge-dependent asymmetry of the angular distribution of the hadronic system produced in $\tau \to K_s^0\pi\nu_\tau$ (also for $\tau \to \pi\pi\nu_\tau$)

CLEO estimate **(13.3 fb^{-1}):** $\xi(\tau \to K_s^0\pi\nu_\tau) = (-2.0 \pm 1.8) \times 10^{-3}$

ξ – the mean of the optimal asymmetry observable

SuperB sensitivity **(75 ab^{-1}):** $\xi(\tau \to K_s^0\pi\nu_\tau) \sim 2.4 \times 10^{-5}$

Measurement of the tau g-2

- Long standing discrepancy for the muon g-2: $\Delta a_\mu = a_\mu^{\text{exp}} - a_\mu^{\text{SM}} \approx (3 \pm 1) \times 10^{-9}$
- The natural scaling: $\frac{\Delta a_\mu}{\Delta a_\tau} \sim \frac{m_\tau^2}{m_\mu^2}$
- interpreting the Δa_μ as a signal of NP ➔ $\Delta a_\tau \approx 10^{-6}$
- The tau g-2 (as the tau EDM) influences both the angular distributions and the polarization of the tau produced in e^+e^- annihilation
- SuperB **(75 ab^{-1}):** can measure both the real and imaginary part of the g-2 form factor with the resolution of $(0.75 - 1.5) \times 10^{-6}$
- Proposed measurements :

1. Fit to the polar angle distribution of the tau lepton
2. **Measurement of the transverse and longitudinal polarization of the tau from tha angular distribution of its decay products**

Crucial role of beam polarization

similar considerations for the electric dipole moment (EDM) of the tau

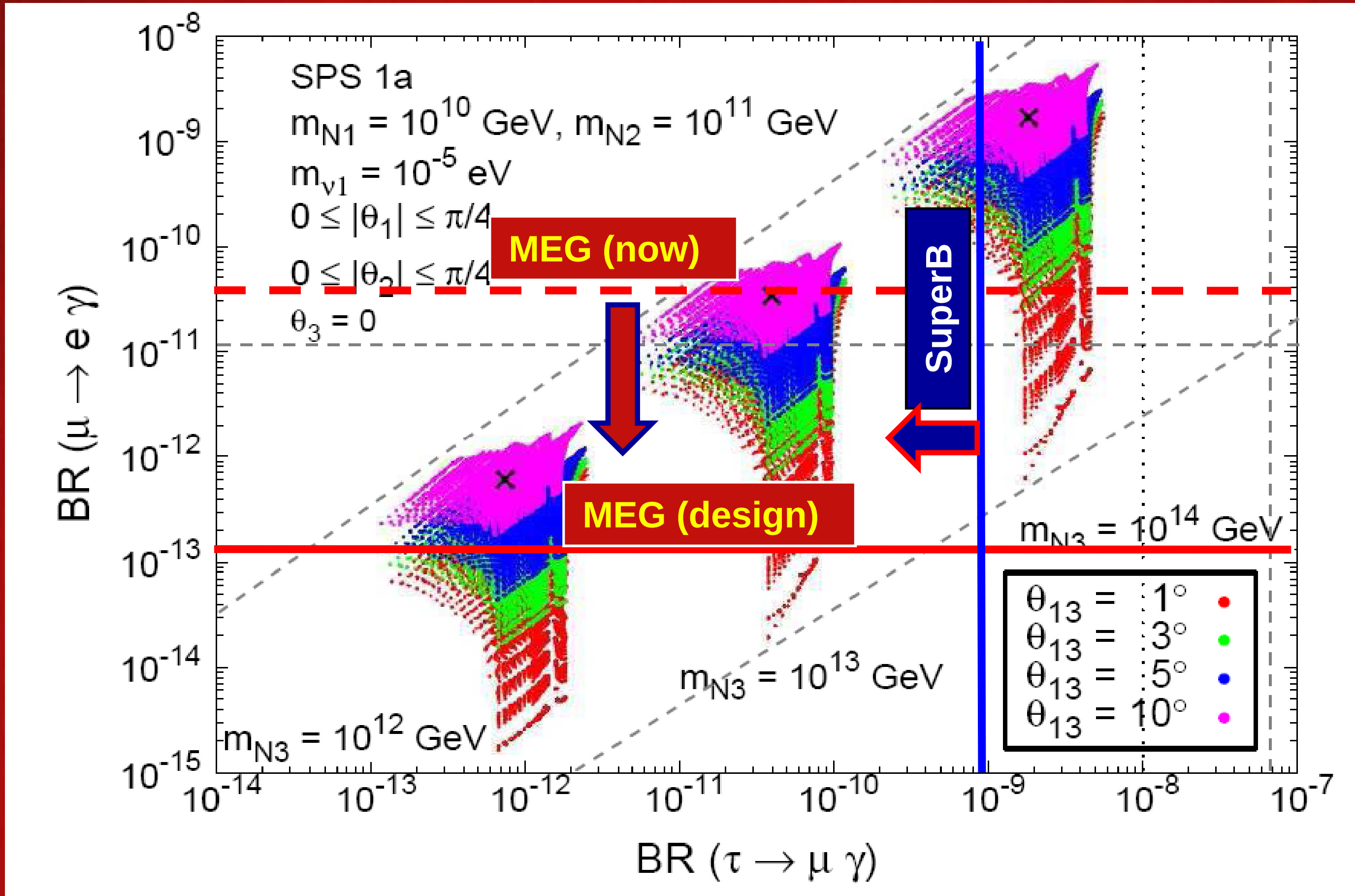
LFV in tau decays

- $\mathcal{B}(\tau \to \mu\gamma)$ UL can be correlated with
  1. $\mathcal{B}(\mu \to e\gamma)$ UL (MEG experiment)
  2. Θ_{13} (neutrino mixing/CPV)

SUSY seasaw
= CMSSM + $3\nu_R + \nu$

Herreo et al. 2006

Plot for three reference values of the heavy right-handed neutrino mass (m_{N3}) and several values of Θ_{13}



B_s at Υ(5S)

- B_s-related measurements
  – domain of the LHCb (and ATLAS and CMS)

- BUT: short runs at the Υ(5S) (CLEO, Belle) indicated the potential for e+e- machines to contribute in this area

- **Potential highlights from the SuperB:**

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
$\mathcal{B}(B_s \to \mu^+\mu^-)$	-	$< 8 \times 10^{-9}$
$\|V_{td}/V_{ts}\|$	0.08	0.017
$\mathcal{B}(B_s \to \gamma\gamma)$	38%	7%
β_s from $J/\psi\phi$	16°	6°
β_s from $B_s \to K^0\bar{K}^0$	24°	11°

(from A.Bevan DESY sem.)

1. B_s decays involving neutral particles:

$B_s \to J/\psi\eta$ $\quad$ $B_s \to J/\psi\eta'$ $\quad$ $B_s \to D_s^{(*)+}D_s^{(*)-}$ $\quad$ $B_s \to D^{(*)}K^0_S$

$B_s \to D^{(*)}\phi$ $\quad$ $B_s \to J/\psi K^0_S$ $\quad$ $B_s \to \phi\eta'$ $\quad$ $B_s \to K^0_S\pi^0$

2. Measurement of $\mathcal{B}(B_s \to \gamma\gamma)$ SM: Br ~ (2-8) × 10^{-7}, NP (e.g. SUSY) 5× 10^{-6}
   SuperB precision (30 ab^{-1}) 7% (stat), 5% (syst) (assuming the Br of the SM)

3. Measurement of the semileptonic asymmetry of the B_s:

$$A^s_{SL} = \frac{1-\left|\frac{q}{p}\right|^4}{1+\left|\frac{q}{p}\right|^4} = \frac{N_1-N_2}{N_1+N_2}$$

   SuperB precision (30 ab^{-1}): 0.004

$$N_1 = \mathcal{B}(B_s \to \overline{B}_s \to D_s^{(*)-}l^+\nu_l) \qquad N_2 = \mathcal{B}(\overline{B}_s \to B_s \to D_s^{(*)+}l^-\nu_l)$$

Charm

- SuperB: plans for running at $D\bar{D}$ threshold
- Possible scenario: 500 fb^{-1} at the $\psi(3770)$ – few months of running (10^{35} cm^{-2} s^{-1})
- For charm physics equivalent of at least 100 times integrated luminosity at the $\Upsilon(4S)$
- $D\bar{D}$ pair is entagled: tagging events in which one D meson is identified → the other D can be studied with very small background contamination
- Potential highlights from the SuperB:
  1. Improved precision in mixing parameters x_D and y_D
  2. Measurement of the asymmetry α_{SL}
  3. Search for $D^0 \to \mu^+ \mu^-$
  4. Quantum correlations in decays od D's can allow for measurement of their relative strong phases

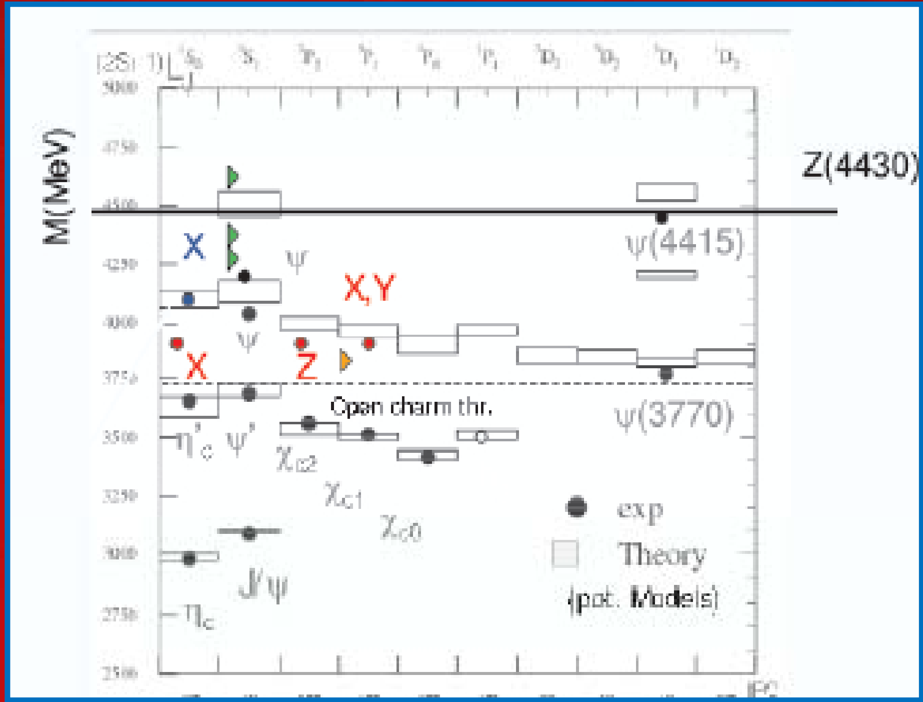
Mode	Observable	B Factories (2 ab^{-1})	Super$B$ (75 ab^{-1})
$D^0 \to K^+K^-$	y_{CP}	$2\text{–}3 \times 10^{-3}$	5×10^{-4}
$D^0 \to K^+\pi^-$	y'_D	$2\text{–}3 \times 10^{-3}$	7×10^{-4}
	x'^2_D	$1\text{–}2 \times 10^{-4}$	3×10^{-5}
$D^0 \to K^0_S\pi^+\pi^-$	y_D	$2\text{–}3 \times 10^{-3}$	5×10^{-4}
	x_D	$2\text{–}3 \times 10^{-3}$	5×10^{-4}
Average	y_D	$1\text{–}2 \times 10^{-3}$	3×10^{-4}
	x_D	$2\text{–}3 \times 10^{-3}$	5×10^{-4}

(from A.Bevan DESY sem.)

Channel	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}
$D^0 \to \pi^0e^\pm\mu^\mp$	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}

Spectroscopy

- B factories: a plethora of new states



- Most of them do not fit into conventional mesons and baryons
  ➔ hybrid mesons, molecules, tetraquarks …
- All the new $c\bar{c}$ states (apart from the X(3872)) have been observed in only a single decay channel, each with a significance barely above 5σ
- SuperB: x100 more events
  → much more detailed studies of these states, also in several other modes
- Natural expectations of new discoveries at the SuperB
- Bottomonium: SuperB can look for not yet observed singlet states (parabottomonia)
- Other players (both for charm and spectroscopy): LHCb, BESIII and PANDA (FAIR)

The Accelerator and Detector

The Quest for Luminosity

Luminosity
2×10^{34} cm^{-2} s^{-1} KEKB
1×10^{36} cm^{-2} s^{-1} SuperB

Lorentz factor

Beam current
1.7/1.4 A e+e$^-$ KEKB
1.9/2.5 A SuperB

Beam-beam parameter
0.09 KEKB
0.125 SuperB

$$L = \frac{\gamma_\pm}{2er_e}\left(1+\frac{\sigma_y^*}{\sigma_x^*}\right)\frac{I_\pm \xi_{y\pm}}{\beta_{y\pm}^*}R$$

Geometrical reduction factor
0.8 -1.0

Classical electron radius

Beam aspect ratio at IP
0.5 – 1 % (flat beam)

β* - beta-function
(trajectories envelope) at IP
6.5/5.9 mm KEKB
0.3 mm SuperB

Moderate beam requirements

- 1.9/2.5 A beam current
- moderate RF power (17 MW)
- 5 mm bunch length (σ_z)
- Low emittance: $\epsilon_x^* \times \epsilon_y^*$ = 2 nm $\times$ 5 pm
- continuous injection

All of these have been done at other facilities

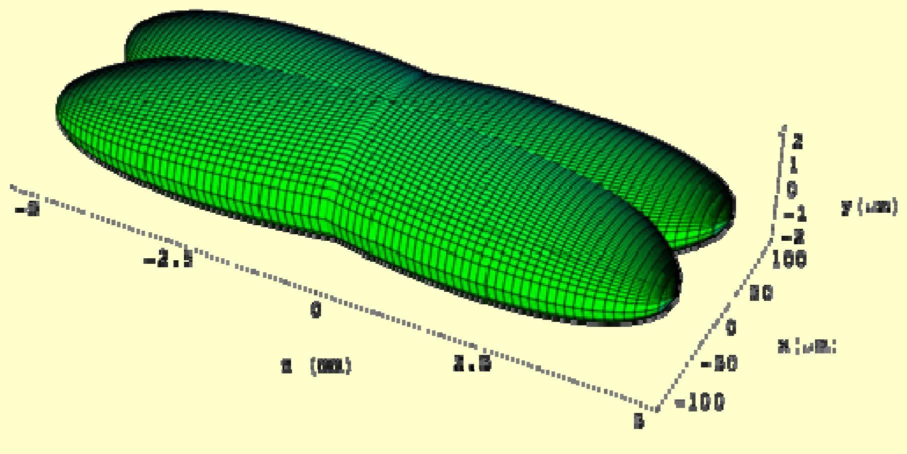
Tight focus at the IP

- $\sigma_x^* \times \sigma_y^*$ = 8 μm $\times$ 0.036 μm

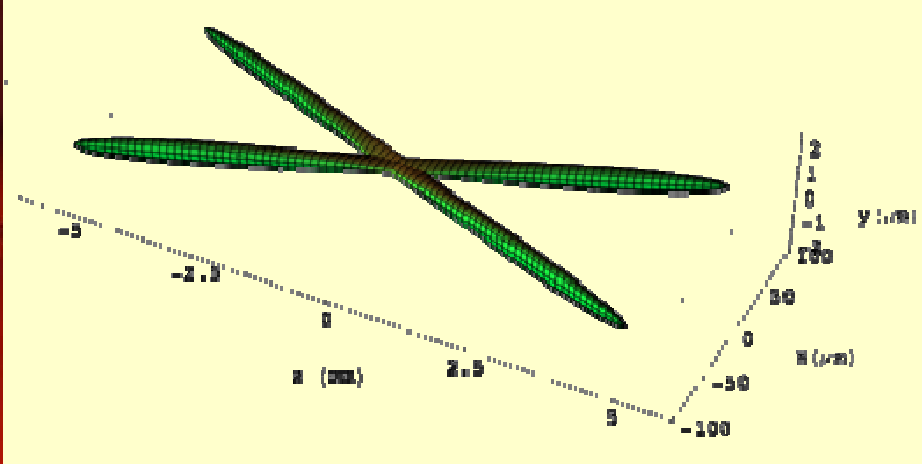
smaller than done so far

Beam envelopes: KEKB vs SuperB

IP beam distributions for KEKB



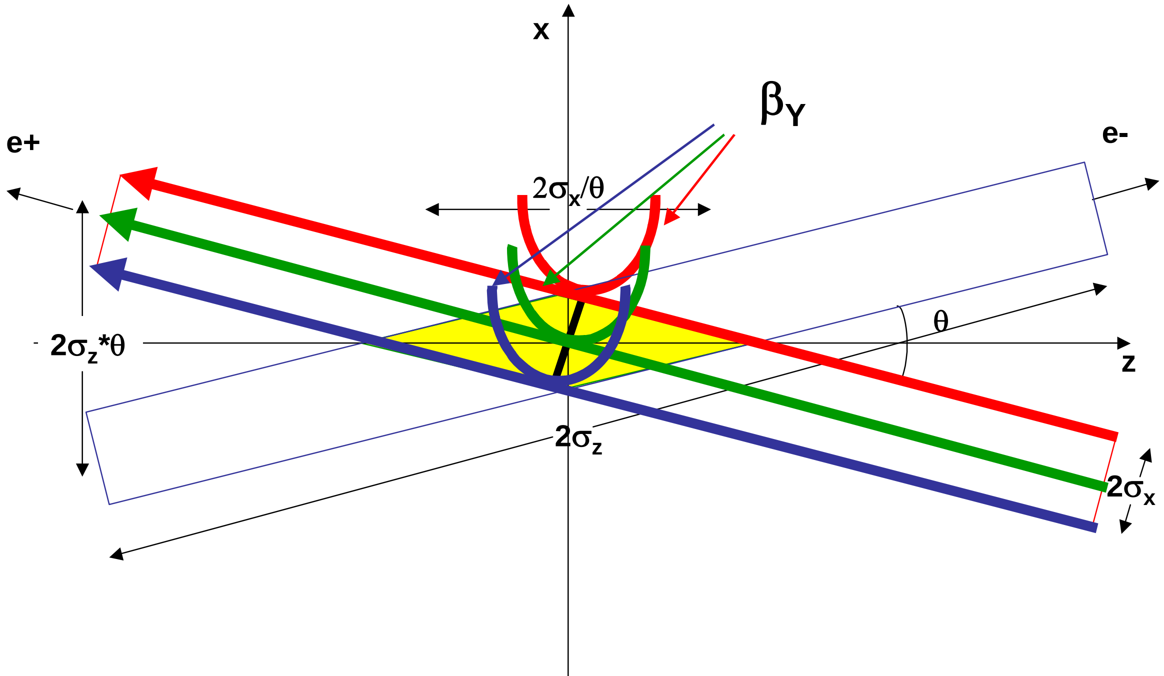
IP beam distributions for SuperB

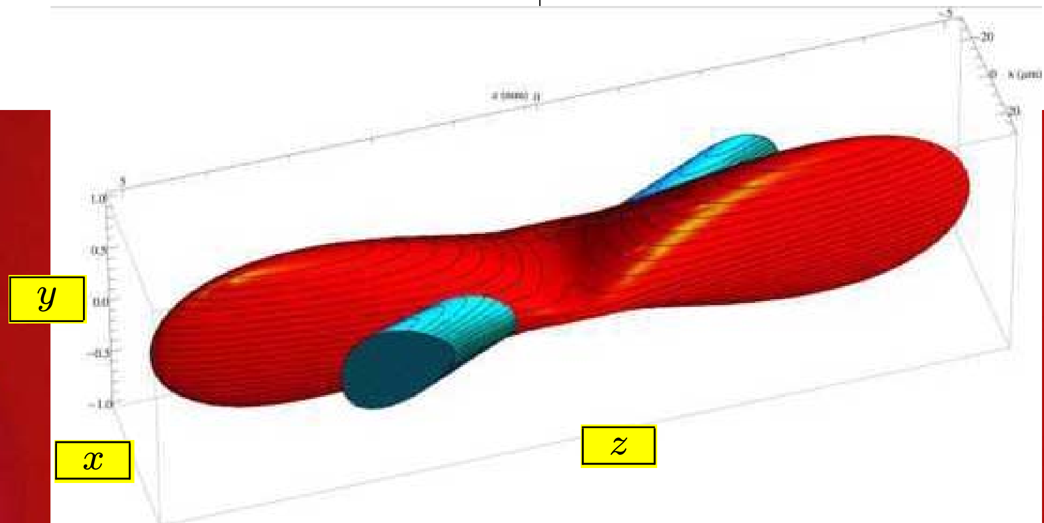


	KEKB	SuperB
I (A)	1.7	2.
β_y^* (mm)	6	0.3
β_x^* (mm)	300	30
σ_y^* (μm)	3	0.036
σ_x^* (μm)	80	7.5
σ_z (mm)	6	5
L ($cm^{-2}s^{-1}$)	1.7×10^{34}	1×10^{36}

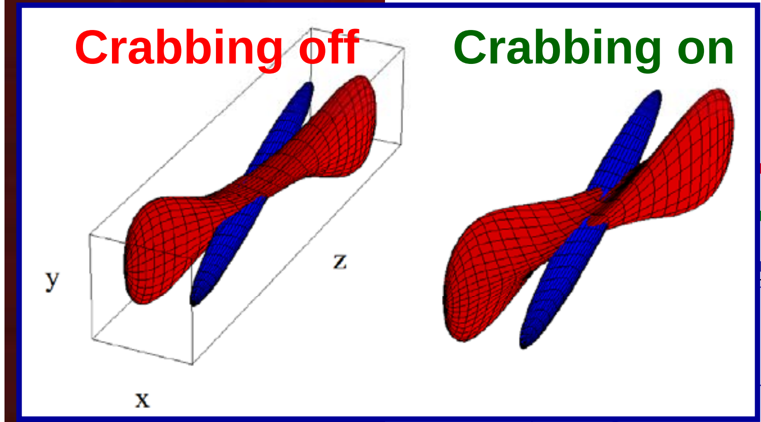
Here is Luminosity gain

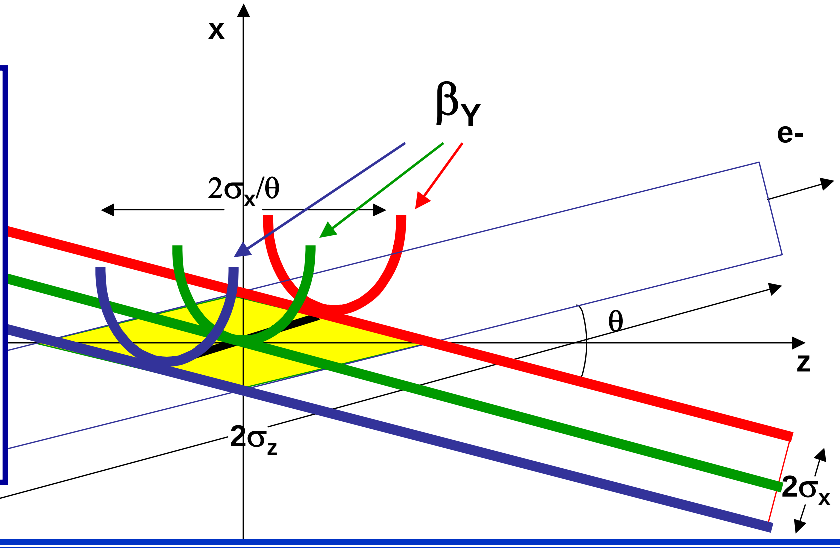
The crab waist





The crab waist



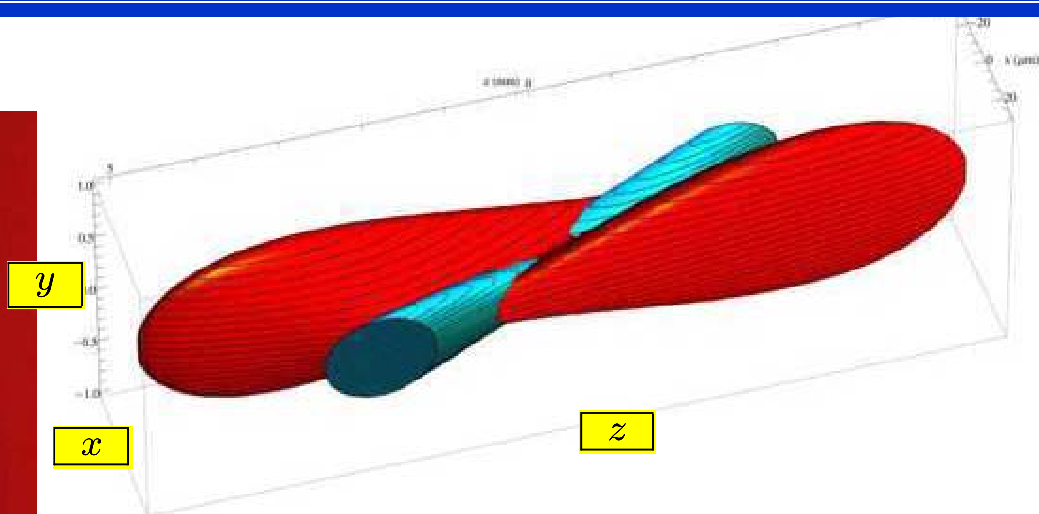


Crab sextupoles ON: Waist moves parallel to the axis of other beam: maximum particle density in the overlap between bunches

Realization:

sextupole
&
anti-sextupole

on both sides
of the IR



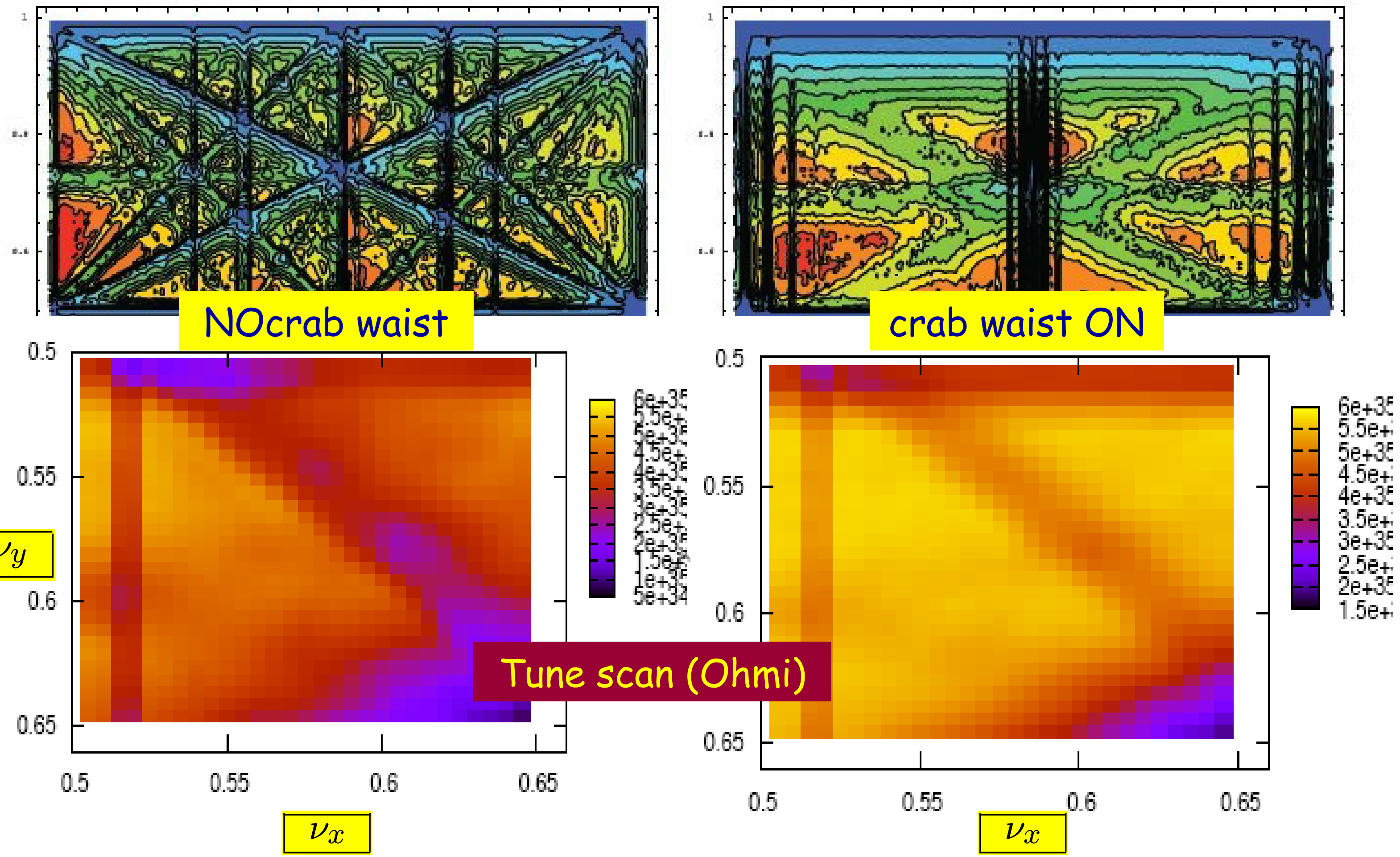
Luminosity improvement

by a factor 2-4

Positive tests at DAΦNE

Suppression of Synchro-Beta Resonances

Example



$$m\nu_x + n\nu_y \neq l, \quad m, n, l = 0, \pm 1, \pm 2, \ldots$$

Polarization

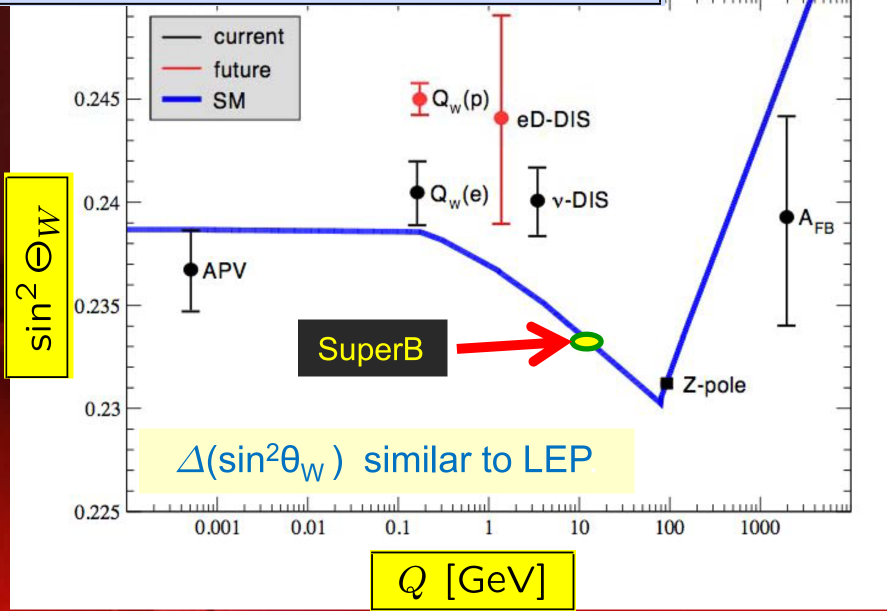
- The electron beam (HER) will be longitudinally polarized (**80%**) The unique feature of the SuperB

- The polarized e^- source (similar to SLAC SLC source) → transverse polarization
- Spin rotators (solenoids) placed before and after IP → longitudinal polarization

- The polarization would play a crucial role in several measurements e.g. precise determination of $\sin^2\Theta_W$, g-2, tau EDM, LFV processes…

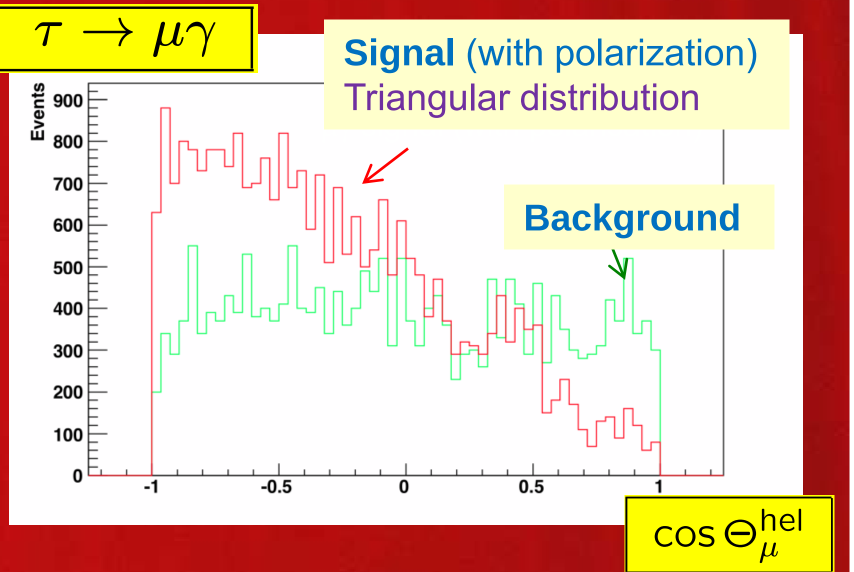
$e^+e^- \to \mu^+\mu^-$

$$A_{LRFB} = \frac{(\sigma_F-\sigma_B)_L-(\sigma_F-\sigma_B)_R}{(\sigma_F+\sigma_B)_L+(\sigma_F+\sigma_B)_R}\frac{1}{<|P_e|>} \Rightarrow \sin^2\Theta_W$$



Polarisation → additional discriminating variable to τ LFV searches → background suppression:

$\tau \to \mu\gamma$

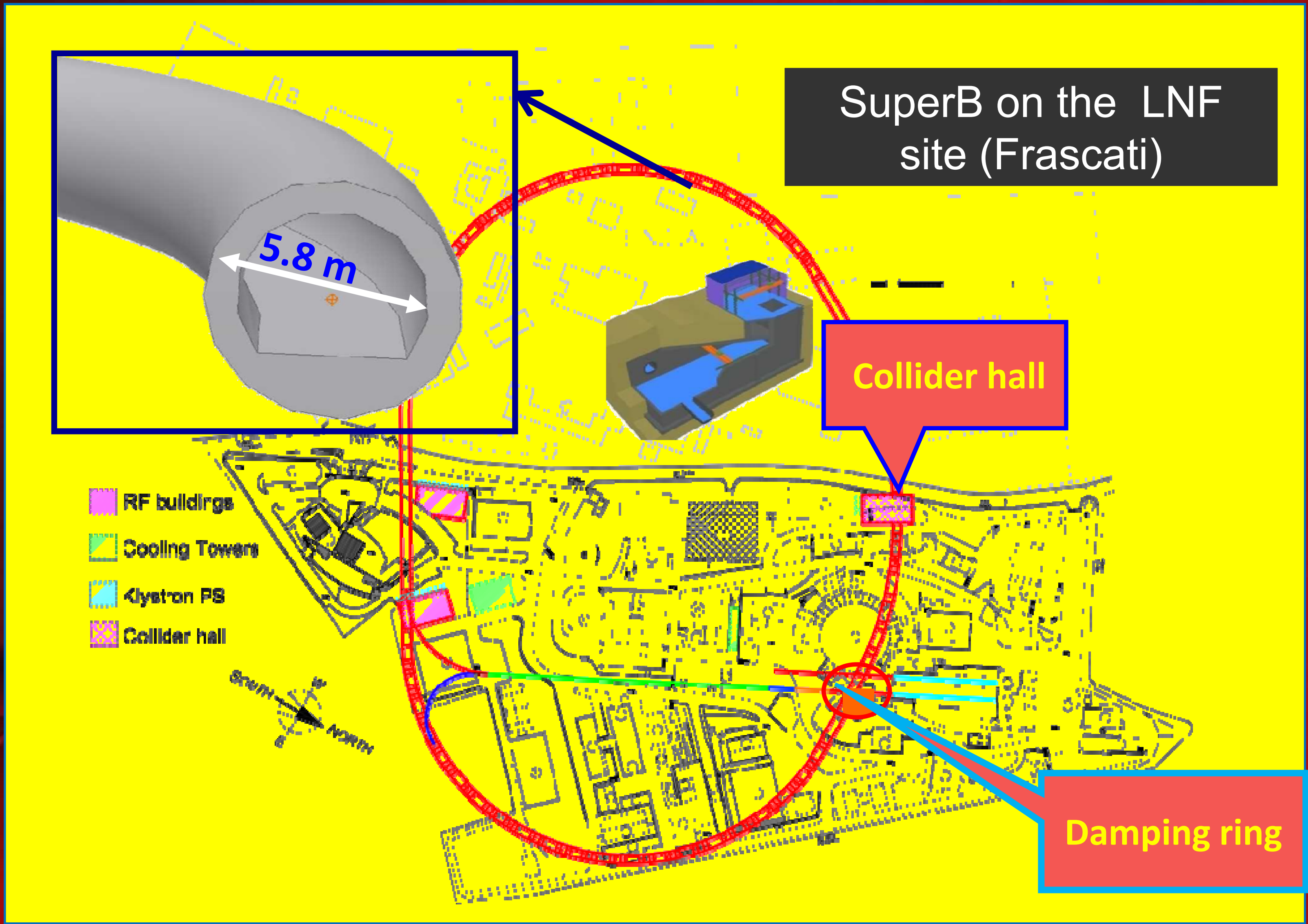


SuperB vs SuperKEKB

Parameter	Units	SuperB	Super-KEKB Old scheme	Super-KEKB Italian scheme
Energy	GeV	4x7	3.5x8	3.5x8
Luminosity	$10^{36}/cm^2/s$	1 – 1.5	0.5 to 0.8	0.8
Beam currents	A	2.0x2.0	9.4x4.1	3.8x2.2
$N_{bunches}$		2400	5000	2230
ϵ_y^* (L/H)	pm	7/4	240/90	34/11
ϵ_x^* (L/H)	nm	2.8/1.6	24/18	2.8/2
β_y^* (L/H)	mm	0.21/0.37	3	0.21/0.37
β_x^* (L/H)	cm	3.5/2.0	20	4.4/2.5
σ_z^* (L/H)	mm	5/5	5/3	5/5
Crossing angle (full)	mrad	60	30 to 0	60
RF power (AC line)	MW	26	90	>50
Tune shifts (L/H)		0.125/0.125	0.3/0.51	0.081/0.081

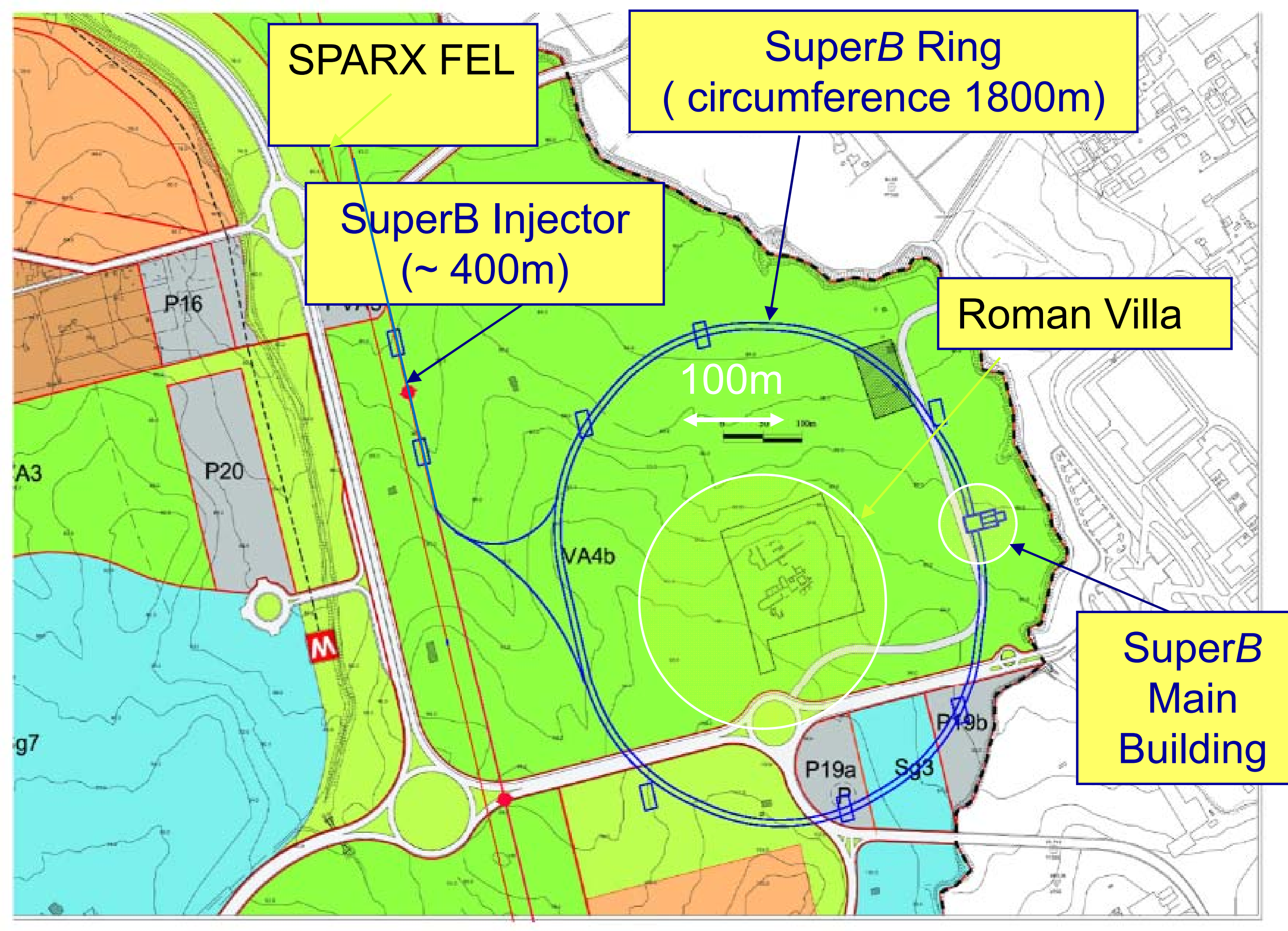
e^- polarization	**80%**	**none**
Run at $\psi(3770)$	yes	no

Where to dig the tunnel?



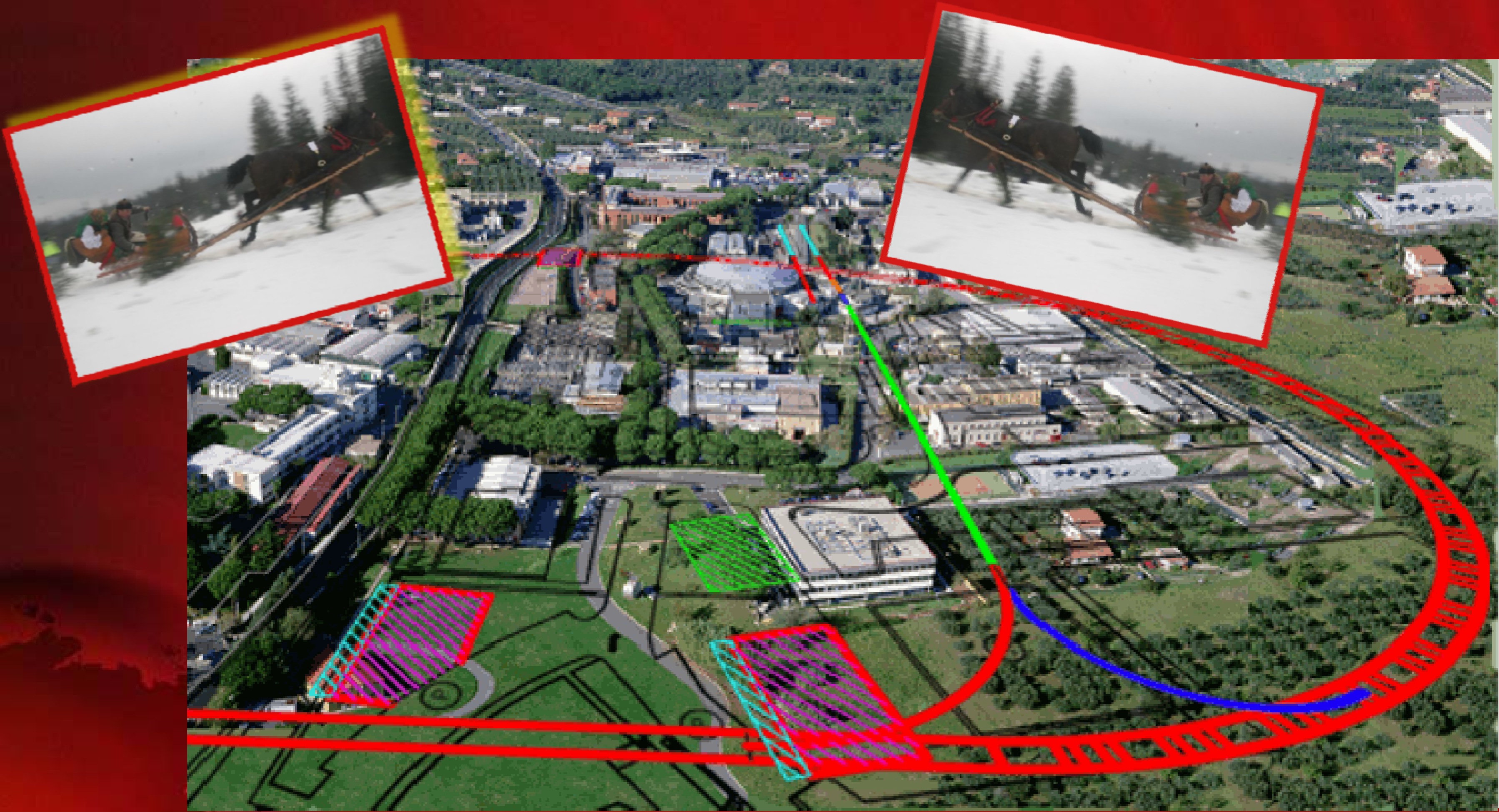
Where to dig the tunnel?

SuperB on Tor Vergata site



Where to dig the tunnel?

SuperB on the LNF site

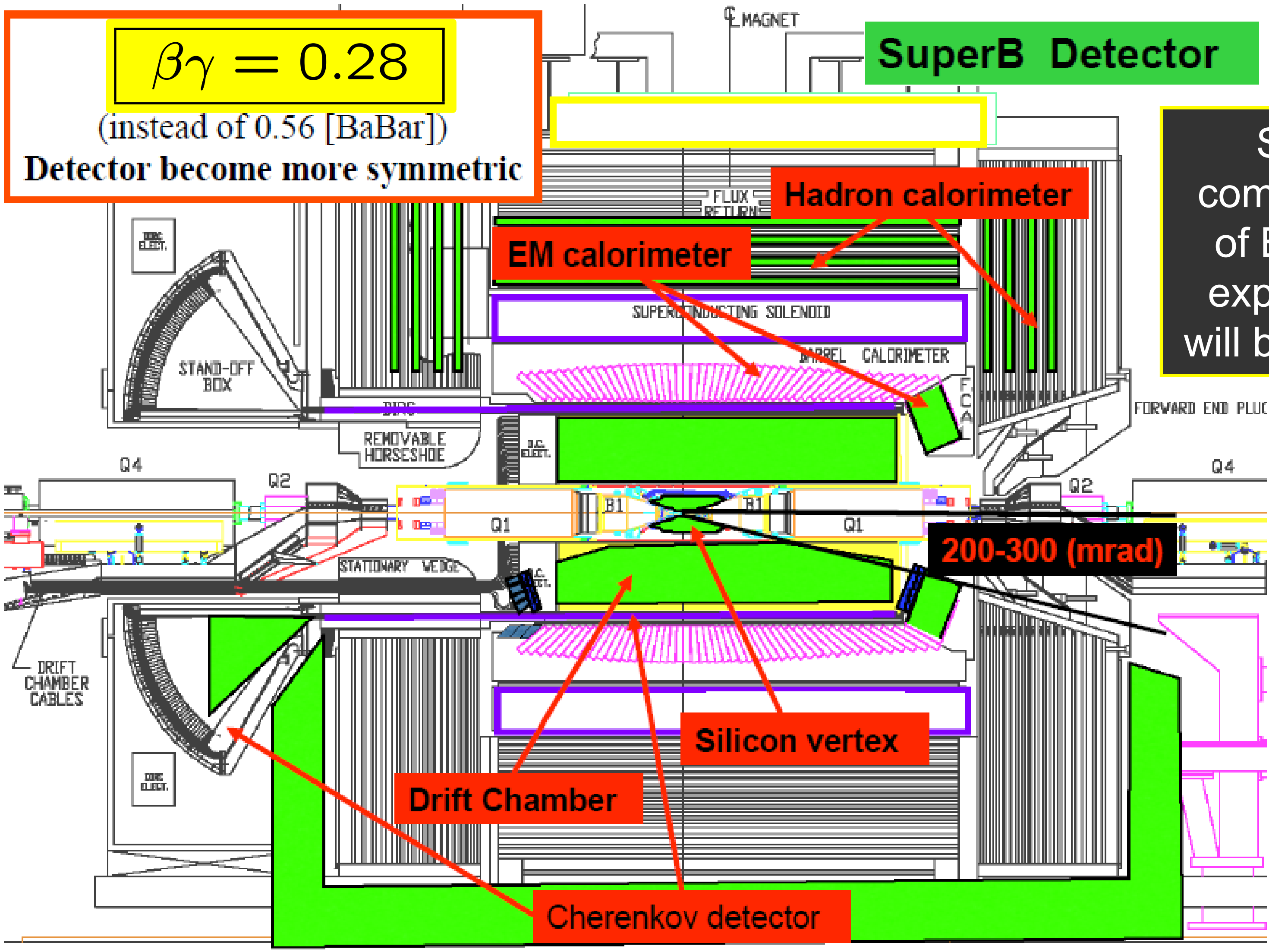


SuperB detector

$\beta\gamma = 0.28$

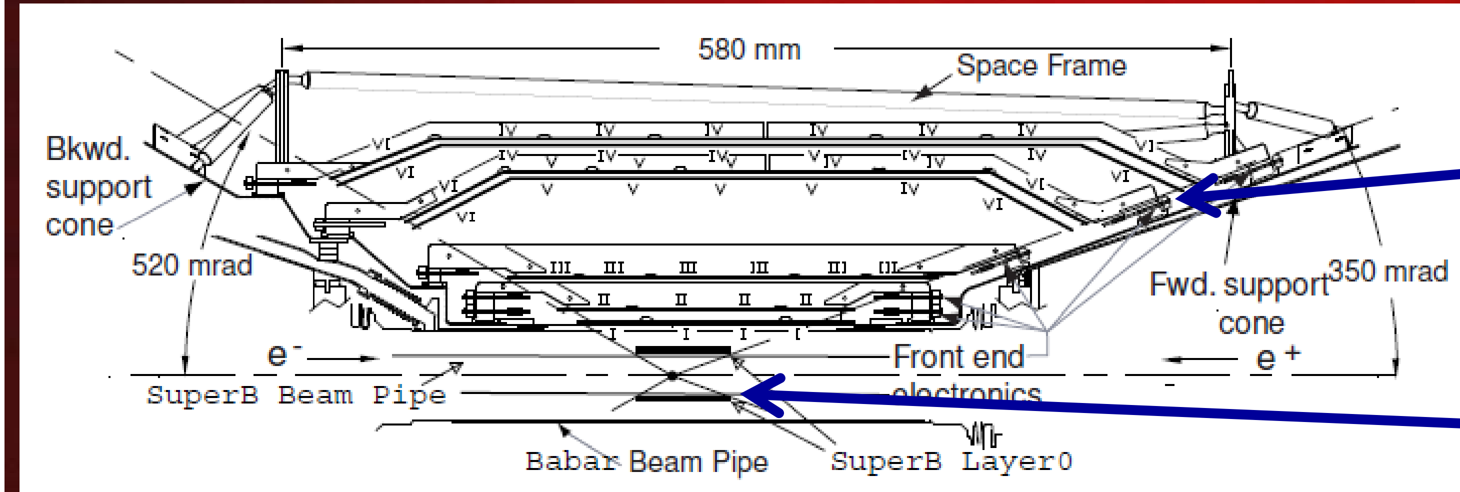
(instead of 0.56 [BaBar])

Detector become more symmetric



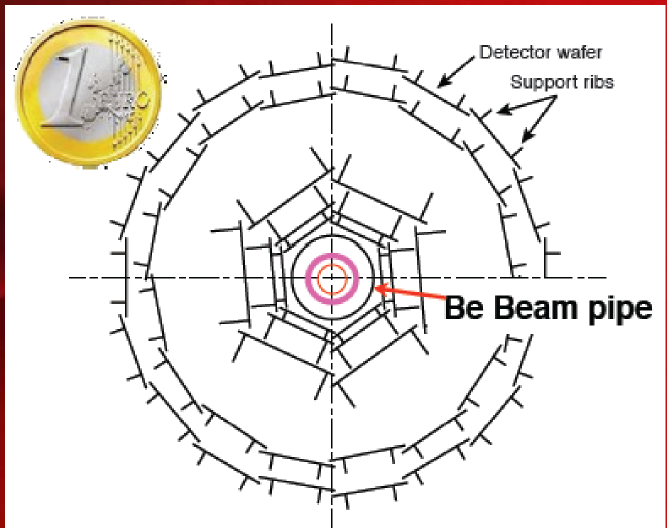
Some components of BaBar's experiment will be reused

The silicon Vertex Detector (SVT)



Layers 1-5:
Strips or Pixels

Layer 0:
Striplets or Pixels



Beam pipe radius 1-1.2 cm

Beam pipe material 0.5 % X_0

Layer 0 radius 1.2 – 1.5 cm

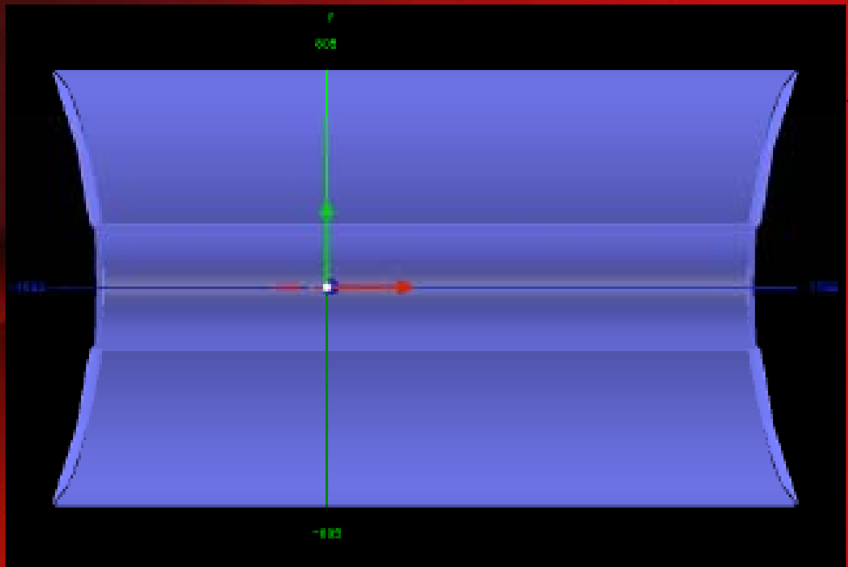
The Drift Chamber (DCH)

Work on optiimisation of the design: geometry, cell size, gas mixture …

Composition:

- **40** layers of cm-sized cells strung parallel to the beam line
- $\approx$ **10 000** cells

The occupancy: **3.5%** (**5%** inner layers)

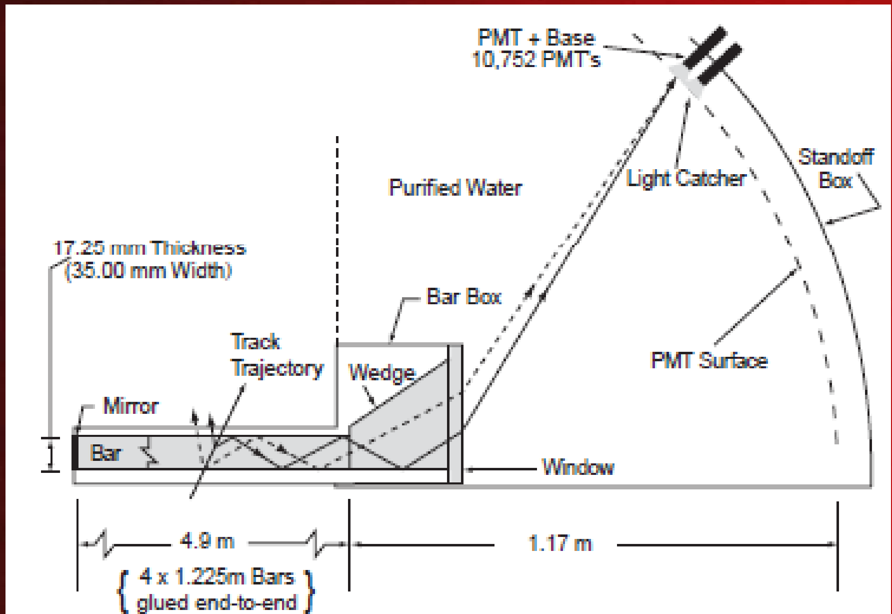


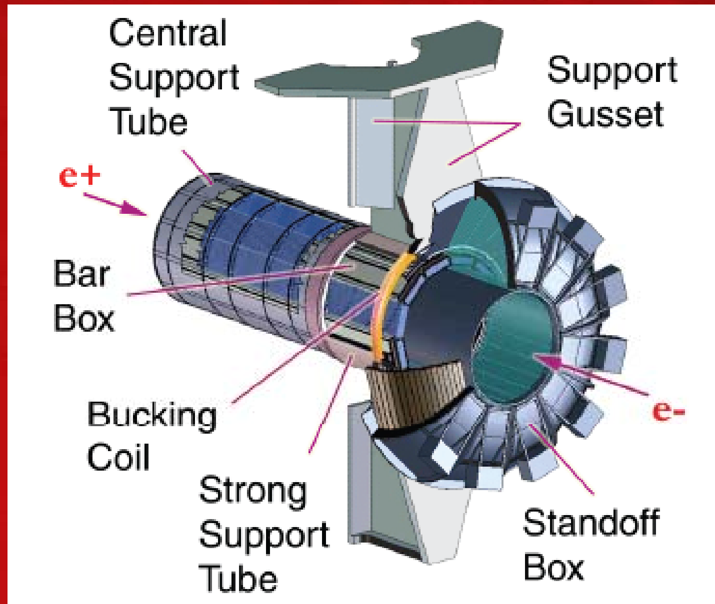
The baseline design with spherical endcaps (carbon fibres)

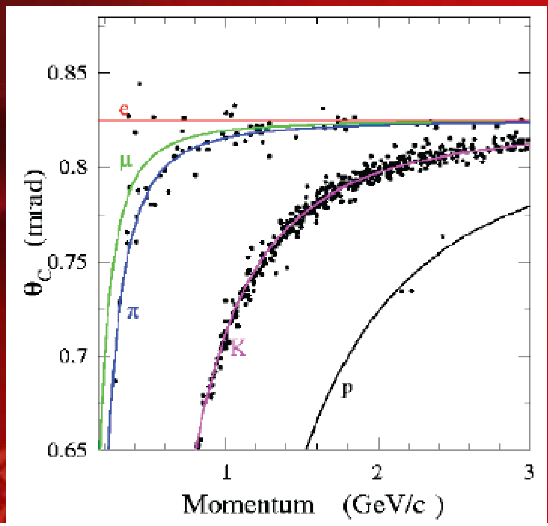
The measurement of momenta of slow particles (p < 700 MeV/c)

The Cherenkov Detector

Based on the concept of DIRC (Detector of Internally Reflected Cherenkov light)







Momentum range: 0.7 – 4 GeV/c

The radiator: synthetic fused silica

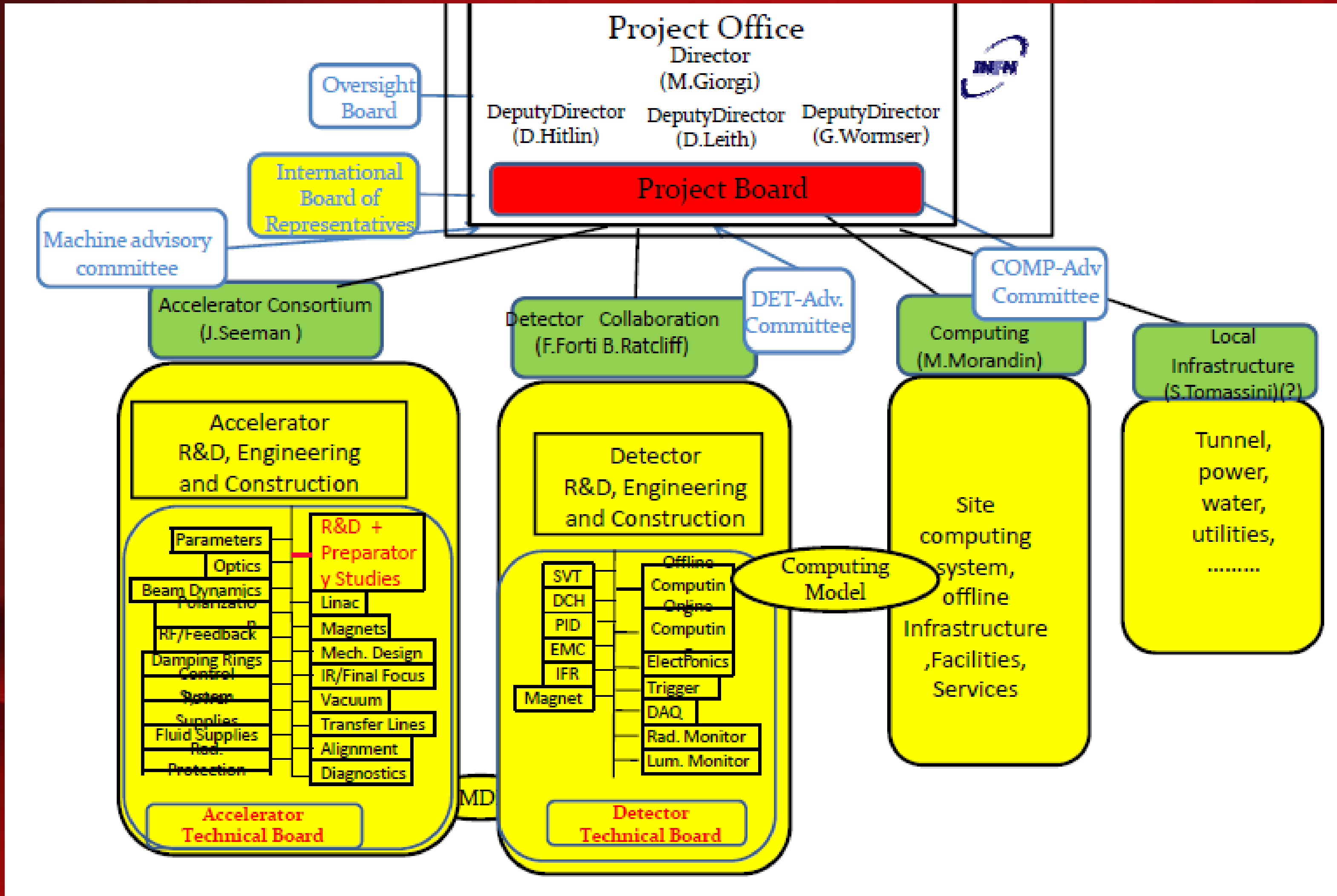
SuperB Collaboration

- The regular meetings of the collaboration, organized every three months, gather 130 participants

- In the full swing, the collaboration would be composed of 400-500 members

SuperB Collaboration

Organization chart



On the way to approval…

- **The progress in Italy**

  - support from the INFN
  - the first position among flagship projects in Italian National Research Plan 2010
  - project located in the Roadmap for Research Infrastructure
  - expectations for formal approval and decision about by Italian government in 2010

- **The progress in Europe**

  - support from ECFA and the CERN Council
  - plans for applications for **UE funds: ERIC** (European Research Infrastructure Consortium) and **TIARA** (Test Infrastructure and Accelerator Research Area)

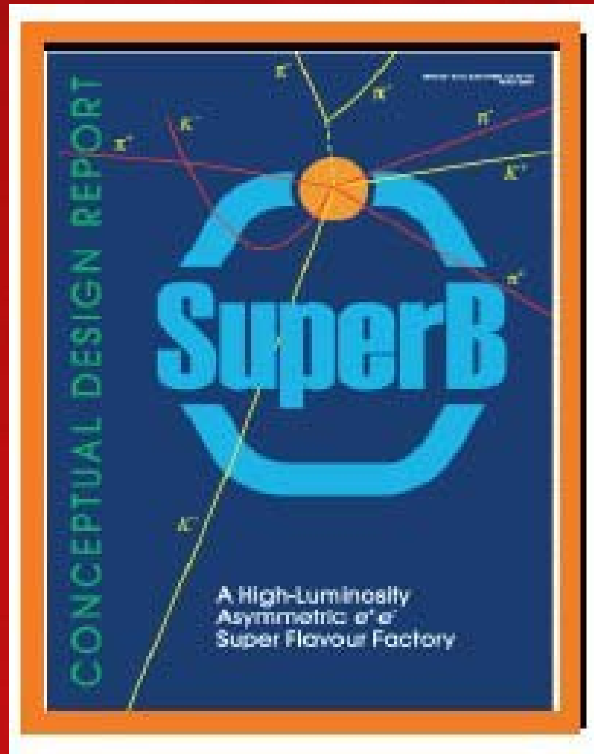
- **Support from USA, UK, Canada…**

- **Interactions with SuperKEKB project**

References

A Conceptual Design Report (CDR), signed by 85 Institutions was published in March 2007 (arXiv:0709.0451 [hep-ex])

White Papers (on accelerator/detector/physics) are almost ready



The work on the Technical Design Report (TDR) will start soon

See the web page:

http://www.pi.infn.it/SuperB/

Summary

- New era: B-factories → Super Flavour Factories
- The Super Flavour Factory SuperB aims to be a precise tool to elucidate New Physics in a way competitive to the LHC
- To achieve this goal, the reach of luminosity 10^{36} cm^{-2} s^{-1} and the total sample of 75 ab^{-1} is expected
- The SuperB offers two unique features:
  - the polarization of e^{-} beam (vital for tau physics)
  - possibility of scan in CM energy (vital for charm physics)

SuperB (In a Nutshell)

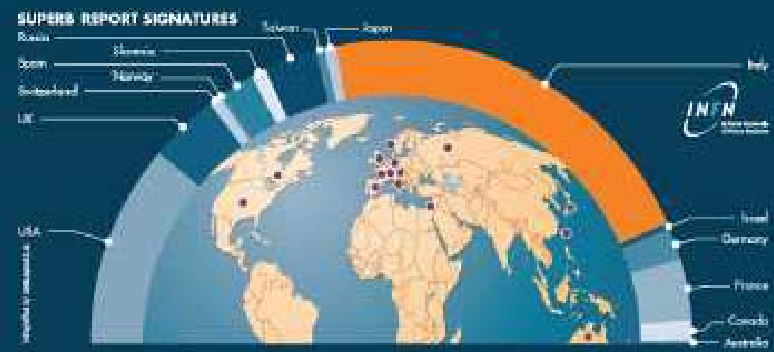
- Asymmetric energy e^+e^- collider, with roughly 7GeV e^- on 4GeV e^+.
- Low emittance operation (like LC).
- Polarised beams [60-80%].
- Luminosity 10^{36} $cm^{-2}s^{-1}$
  - $75ab^{-1}$ data at the $\Upsilon(4S)$.
  - Will collect data at other Υ resonances, and at charm threshold.
  - Start data taking as early as 2015.
- Crab Waist technique developed to achieve these goals.

- MAC approved the machine design earlier this year.

http://www.pi.infn.it/SuperB/

Precision B, D and τ decay studies and spectroscopy.

- New Physics in loops.
  - 10 TeV reach at $75ab^{-1}$.
  - Rare decays.
  - ΔS CP violation measurements.
- Lepton Flavour & CP Violation in τ decay.
- Light Higgs searches.
- Dark Matter searches.
- Sample of data at the $\psi(3770)$ can utilize quantum correlations in $D^0\overline{D}^0$.



Geographical distribution of CDR signatories.