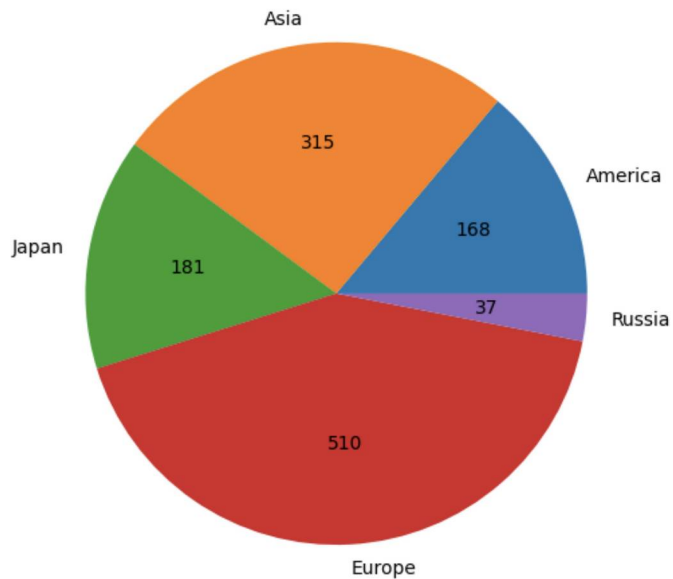
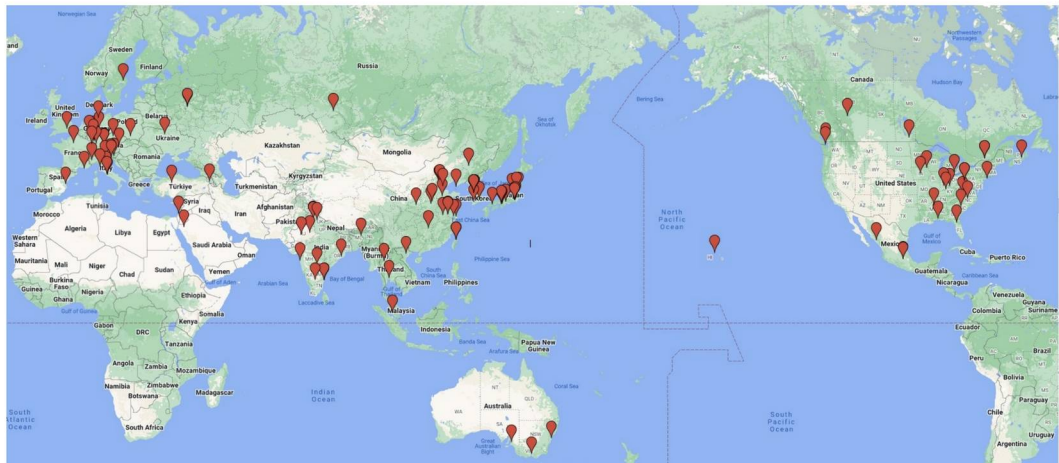
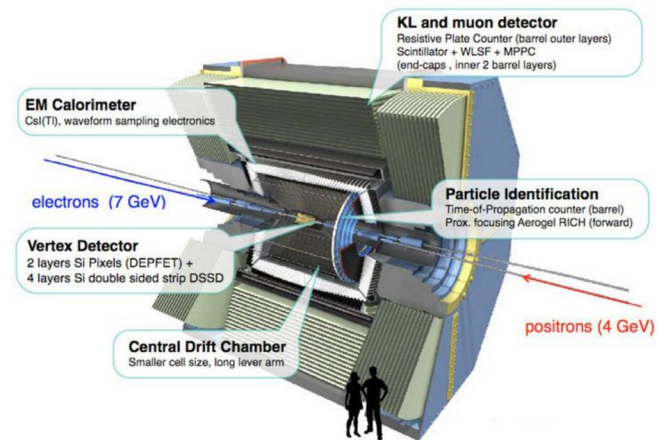
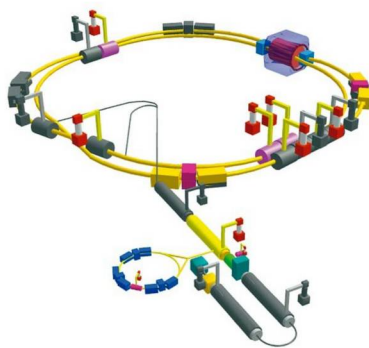


Belle-II

Roberto Mussa



Asymmetric e^+e^- collider
 $\Rightarrow J^{PC}=1^{--}$ states directly produced



Torino 17/10/24

ECFA

European Committee for Future Accelerators

$\sqrt{s} \sim 9 - 11 \text{ GeV} \Rightarrow b\bar{b}$ energy region

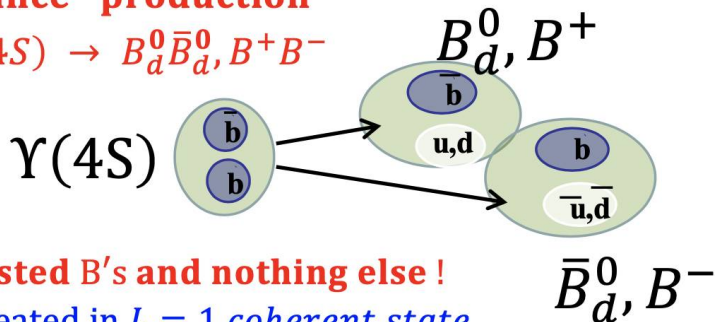


Belle-II is a Super Flavor Factory



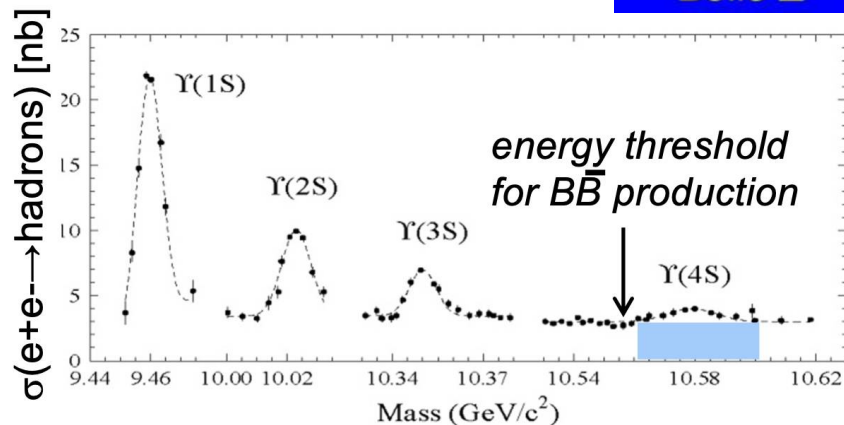
– a *Super B Factory* ($\sim 1.1 \times 10^9 B\bar{B}$ pairs per ab^{-1})

"on resonance" production
 $e^+e^- \rightarrow \Upsilon(4S) \rightarrow B_d^0\bar{B}_d^0, B^+B^-$

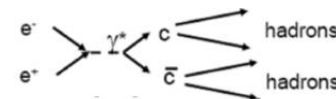


- 2 boosted B's and nothing else!
- 2 B's created in $L = 1$ coherent state

Running also: $\left\{ \begin{array}{l} - \text{ at } \Upsilon(1,2,3S) \text{ peaks for bottomonium studies} \\ - \text{ at } \Upsilon(5,6S) \text{ for } B_s \text{ and QCD studies} \end{array} \right.$



– a *Super Charm Factory* ($\sim 1.3 \times 10^9 c\bar{c}$ pairs per ab^{-1})



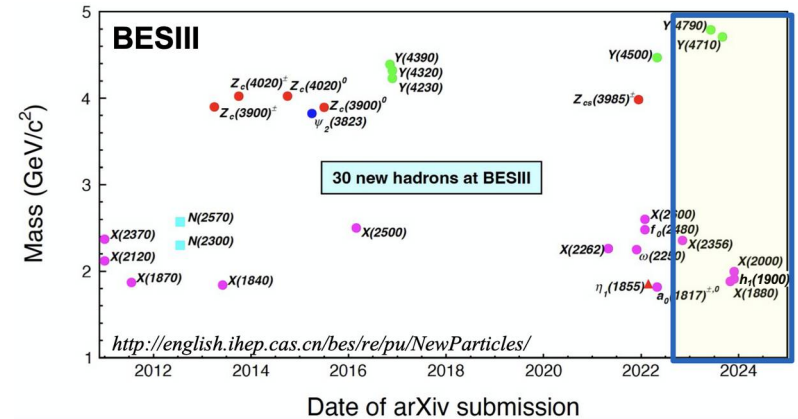
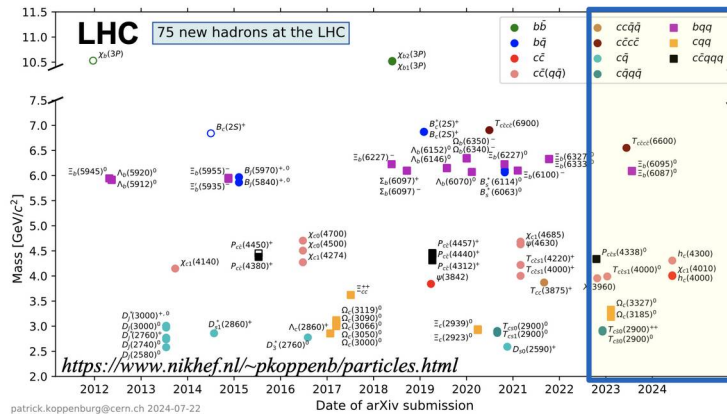
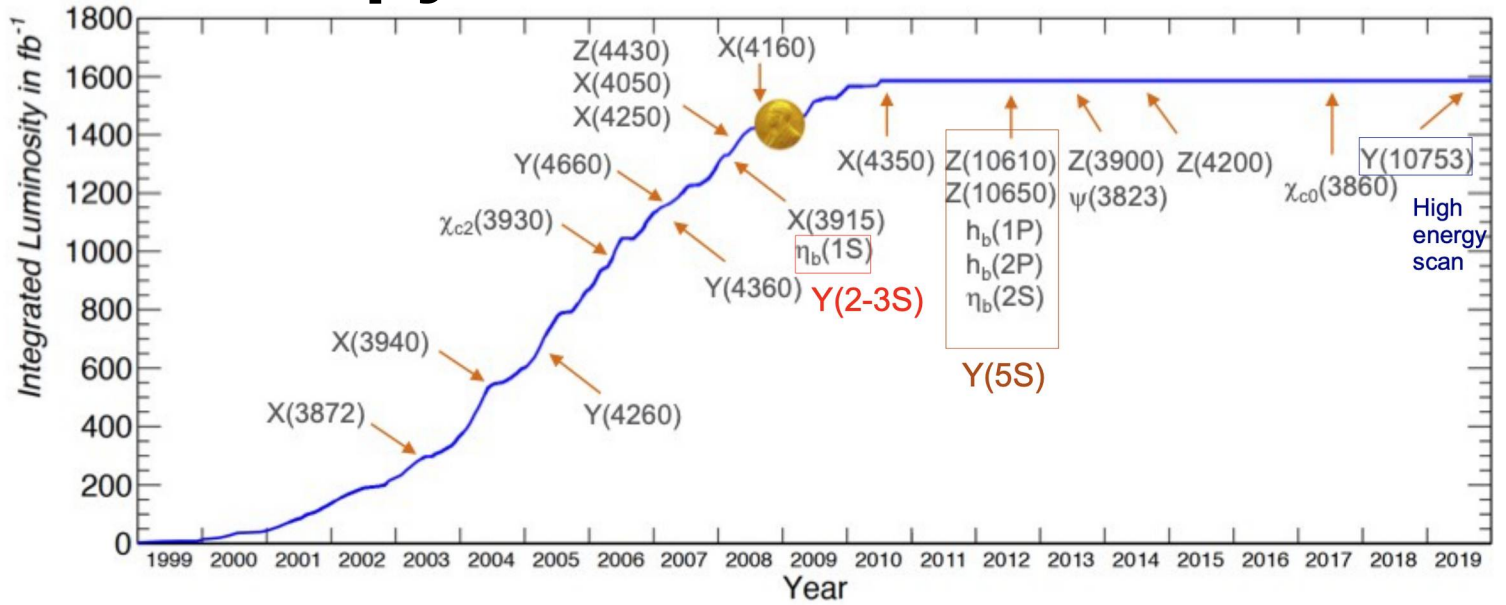
– a *Super tau Factory* ($\sim 0.9 \times 10^9 \tau^+\tau^-$ pairs per ab^{-1})

– exploit the clean e^+e^- environment to search for exotic hadrons, dark photons/Higgs, light Dark Matter particles, ALPs, LLPs ...

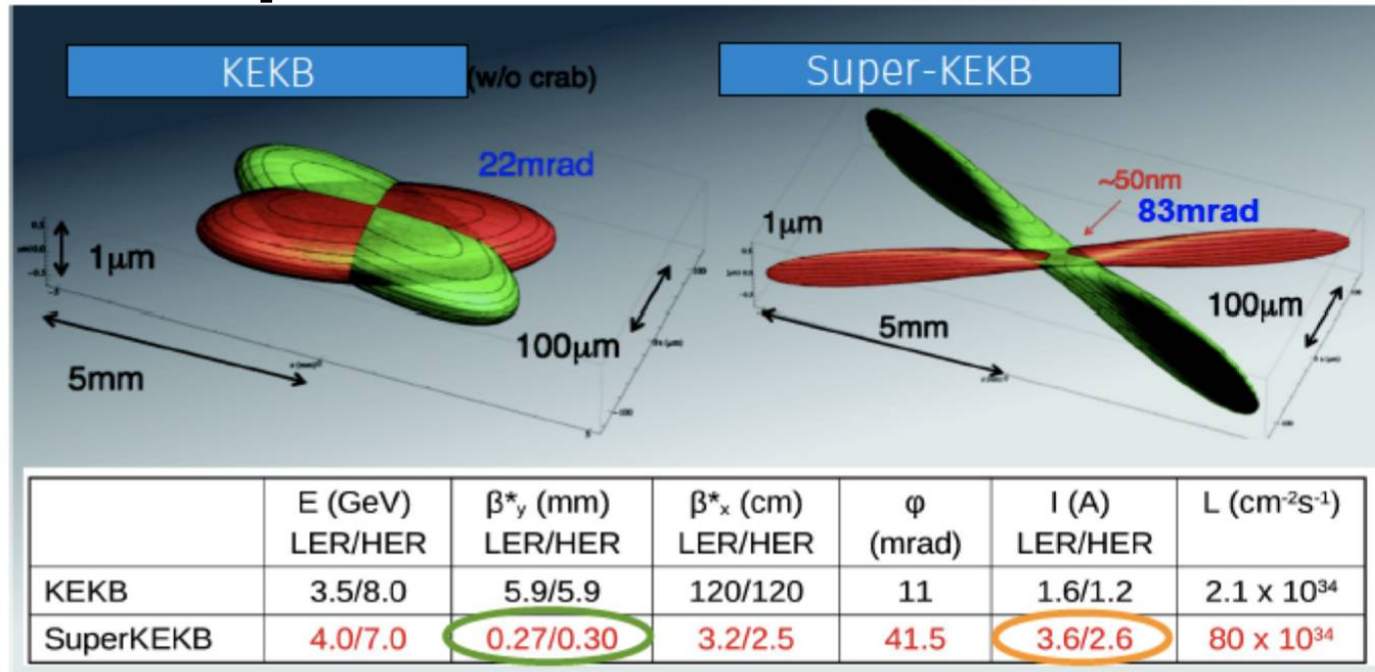
Belle-II : the Big Questions in SM and beyond

- *Are there **new CP-violating phases** in the quark sector ? SM CPV cannot explain baryon-antibaryon asymmetry.*
 - *CPV in B loop decays and charm*
- *Does nature have **multiple Higgs bosons** ?*
 - *Flavor transitions involving the tau lepton ($B \rightarrow \tau \nu$ & $B \rightarrow D^{(*)} \tau \nu$)*
- *Does nature have a **left-right symmetry**, and are there flavor changing neutral currents beyond the SM ?*
 - *CPV in $B \rightarrow K^{*0} (K_s \pi^0) \gamma$; $B \rightarrow K^{(*)} \nu \nu$, angular variables in $b \rightarrow s, d l^+ l^-$*
- *Are there sources of **lepton flavor violation** ?*
 - *LFV τ decays*
- *Is there a **dark sector** of particle physics at the same mass scale as ordinary matter ?*
 - *Search for MeV – GeV dark matter particles*
- *What is the **nature of the strong force** in binding hadrons?*
 - *In-depth study of recently discovered new states and search for new ones*

Hadron Spectroscopy: a Pandora Box



From KEKB to Super KEKB



factor 20

factor 2-3

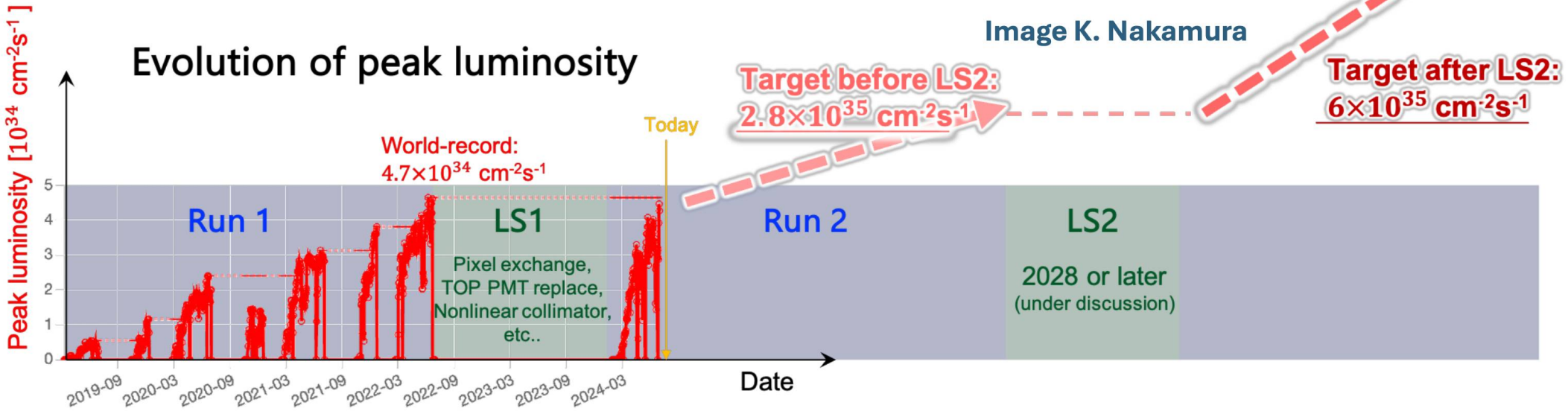
4 steps: *Intermediate luminosity* (1×10^{35} /cm²/sec, 5 ab⁻¹)

High Luminosity (6×10^{35} /cm²/sec, **50 ab⁻¹**) with a detector upgrade

Polarization Upgrade, Advanced R&D

Ultra high luminosity (4×10^{36} /cm²/sec, 250 ab⁻¹), R&D Project

SuperKEKB/Belle II status and plans



- Run 2 is long – end 2028 or later
 - Steady accumulation at $\sim 2 \times 10^{35} \text{ cm}^{-2}\text{s}^{-1}$ for several ab^{-1} – 2nd generation
 - After Run 2 – upgrade proposal for reach design luminosity and tens of ab^{-1}