Stato di Belle2 e prospettive 2025

Riunione CSN1 LNF
25/09/2024

G. Finocchiaro
INFN - LNF

Outline e contenuto quasi totalmente dalla presentazione in CSN1 di A. Passeri

- Stato e prospettive del run
- Intensa attività di analisi
- Upgrade
- Stato della collaborazione italiana e conclusioni

Run Plan 2024-26

Fiscal year	4	5	6	7	8	9	10	11	12	1	2	3
2021	2021b						2021c					2022a
2022	2022b			LS1								
2023									2023c	①	2024a	
2024	2024b			③			2024c			②		2025a
2025	2025b							2025c		①	2026a	
2026	2026b							2026c		①	2027a	

Assumption: 7 months operation per fiscal year with sufficient budget

① Pause of operation for new year holidays instead of a usual winter shutdown (decided to try it first in FY2023; to be discussed for FY2025 and beyond)

② Power restriction due to renewal of the central electric power substation

③ Renovation work of the roof of Tsukuba Hall in parallel to the operation

SuperKEKB work during LS1 (a non complete list)

Upgrade items during LS1 (BT)

Y. Arimoto

- MR
  - Replacement of HER injection chamber.
  - Replacement of HER septum magnet (SE1) and modification of the power supply to improve field quality
  - Re-alignment of HER 4th arc quadrupole magnets
  - Install OTR screen monitors as many as possible
  - Modification of voltage divider circuits of LER kickers to increase reliability
  - Replacement of ceramic chambers for LER kicker K1 to make the same pulse shape between K1 and K2 kickers
  - Modification of thyratron's trigger circuit of HER/LER abort kickers for faster triggering
- DR
  - Replacement of main capacitors of DR ext. kickers to improve stability

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Beam dynamics issues (cont'd)

Y. Arimoto

- TO-DO list of investigations during LS1
  - Impedance budgeting (T. Ishibashi): Impedance models are ready for both LER and HER. Benchmarks and further refinements are ongoing.
  - Strong-strong beam-beam simulations with impedances: Use the latest impedance models as input.
  - Strong-strong beam-beam simulations with impedances and complete lattices: Codes are under development considering GPU-boosting (K. Ohmi, Joint SuperKEKB-CEPC team)
  - Strong-strong beam-beam simulations with impedances and other factors (such as space charge, realistic feedback, etc.): Code development, benchmark, and investigations
  - Impact of the nonlinear collimator (NLC) on machine performance
- International collaboration on accelerator physics challenges at SuperKEKB
  - Joint efforts on simulation codes for reliable predictions of luminosity: Teams of SuperKEKB, CEPC, and FCC-ee
    - An international workshop on "Luminosity of colliders: Predictions, experiments, and machine tunings" (Tentative title) is under preparation
  - Joint efforts on theories/simulations of impedance modeling and impedance effects in colliders
    - The first international workshop on "Impedance modeling and impedance effects at SuperKEKB and future colliders" (Tentative title) is under the organization
- From the viewpoint of beam dynamics, during LS1, we must develop an executable strategy/ plan of luminosity tuning/optimization, and machine studies, together with the Belle II team

D. Zhou

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Update items during LS1 (Control group)

Y. Arimoto

- Apply "Bunch Current Equalizing" system for two-bunches injection
- Revise the algorithm of the injection efficiency determination
  - Bunch current after injection is monitored one pulse later.
- Improve the timestamp synchronization for Abort Trigger modules
  - utilize White Rabbit module
  - need discussion of the software development for the abort analysis.
- Upgrade the Beam Gate system for HER
  - delayed control signal based on White Rabbit to synchronize the control of the gun and septum/kicker magnet triggers.
  - that for LER is followed in 2024.

H. Kaji

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- Linac upgrade items during LS1
  - [1] Installation of 8 pulsed quads at J-arc matching section
    for independent optics matching for each mode (summer of 2023)
  - [2] Installation of 4 pulsed quads at Sector-1, 2
    for e- beam betatron function reduction (summer of 2023)
  - [3] Installation of ceramic chamber type fast kicker
    for 1st, 2nd bunch orbit difference tuning
    first prototype (installed in summer of 2022),
    operation test (this winter)
    2nd, 3rd model (summer of 2023)

SuperKEKB work during LS1 (a non complete list)

Upgrade items during LS1 (BT)

Anche Belle II ha avuto un nutrito programma di interventi

Coinvolgimento italiano

PI, TS	PXD/SVD	PXD commissioning plan in KEK, and VXD reinstallation. SVD 3/6-mixed mode.
	CDC	Improvement in gas circulation and monitoring
PD, TO	TOP	TOP MCP-PMT replacement
PG, NA	ECL	Improvement in pedestal correction Gain adjustment on ShaperDSP
RM3, LNF	KLM	BB2 efficiency recovery Reinforcement of monitoring system
	TRG	Optimization of trigger veto. TOPTRG
	DAQ	PCIe40 long-term stability test with realistic high-occupancy data
	Background	Additional neutron shields
	MDI	Installation of additional loss monitors and speed-up of abort signal

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Beam dynamics issues (cont'd)

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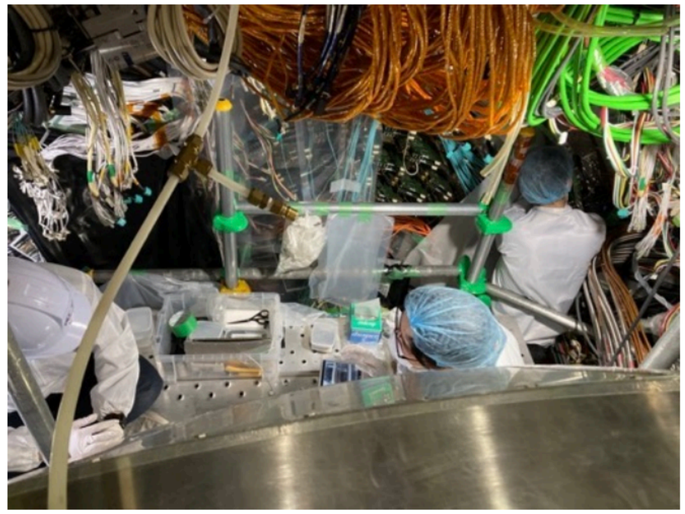
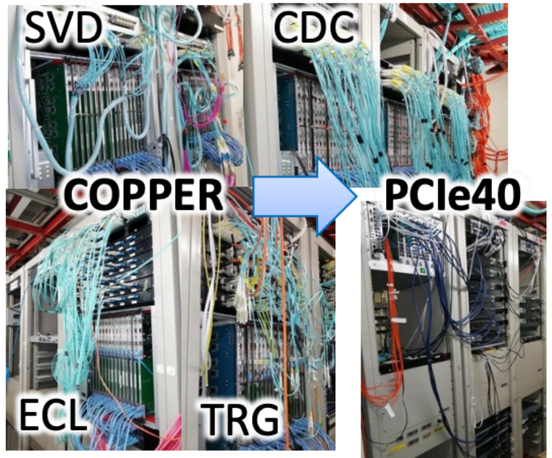
	Background	Additiona
	MDI	Installation of adc speed-u

TOP MCP-PMT replacement



CDC FE reinstallation



VXD reinstallation

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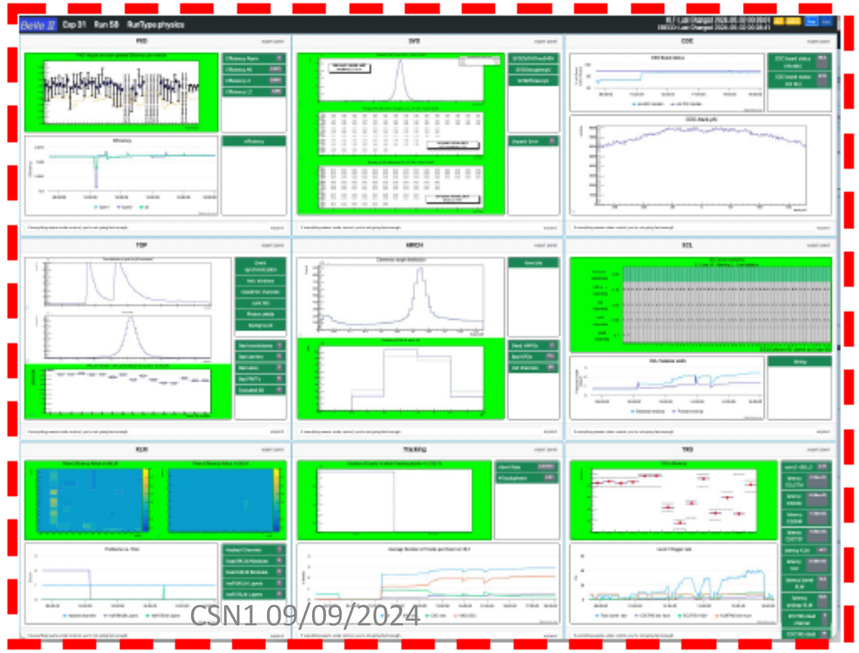
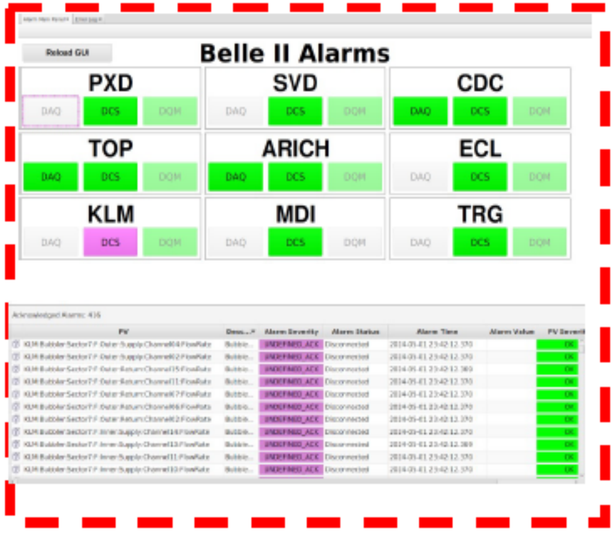
From LS1 to Run2 first collision on Feb 20th 2024

- Important cosmic commissioning campaigns Sept ‘23 → Jan ‘24
  - Verify detector performance are re-established & VXD re-installed with new PXD2!
  - TOP recovered low-eff channels thanks to PMT replacement. Other detectors in good shape.
  - Data taking with new PCIe40 for entire Belle II & switch to release 8 in HLT
  - Deployment/debug of the new features to improve data quality & detector safety/stability:
    - new DQM framework, Alarm system, HV control & Injection Inhibit scheme





Il Run 2024 a-b:

Un bilancio: cosa ha funzionato e cosa no?

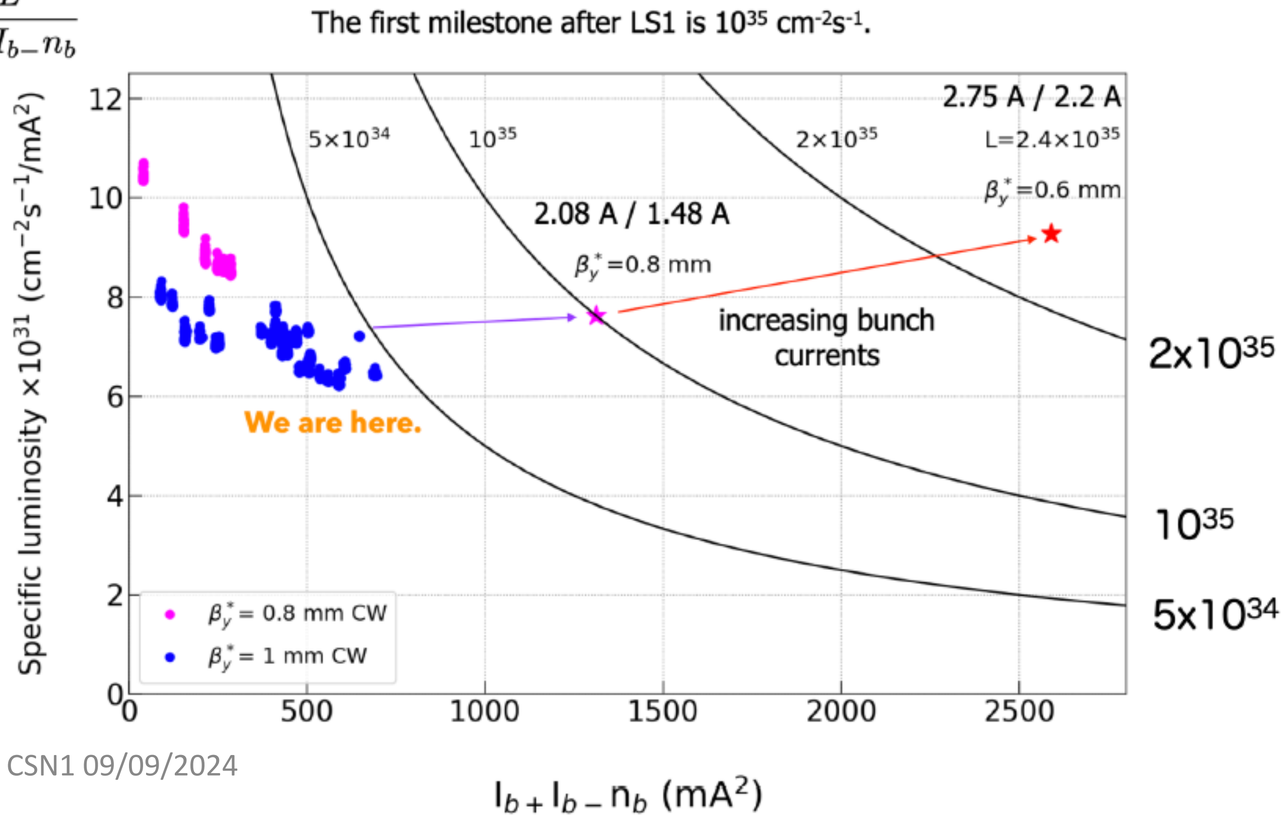
verso il Run 2024 c:

alcune (contro)misure per migliorare

- Jan29th beam operation resumed
  - 2024ab run (Jan29th—Jul1st)
- Jan29th-Feb20th
  - Vacuum scrubbing, Machine tuning, Machine study
- Feb20th First Run2 collision

Target di luminosità specifica per il Run2

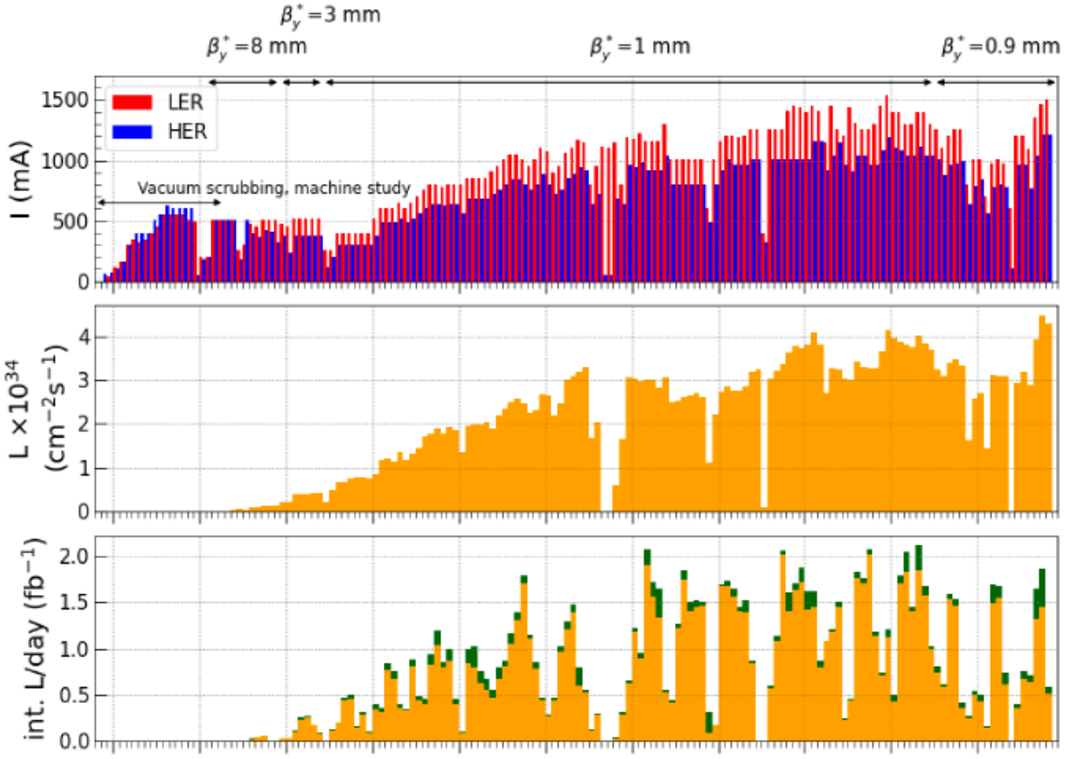
$$L_{sp} = \frac{L}{I_{b+} I_{b-} n_b}$$

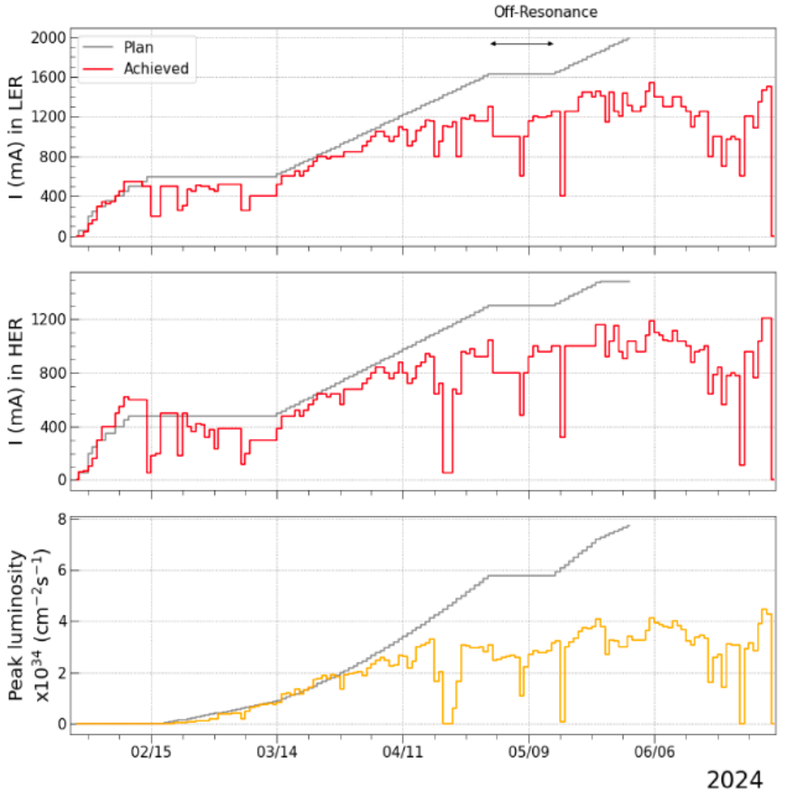


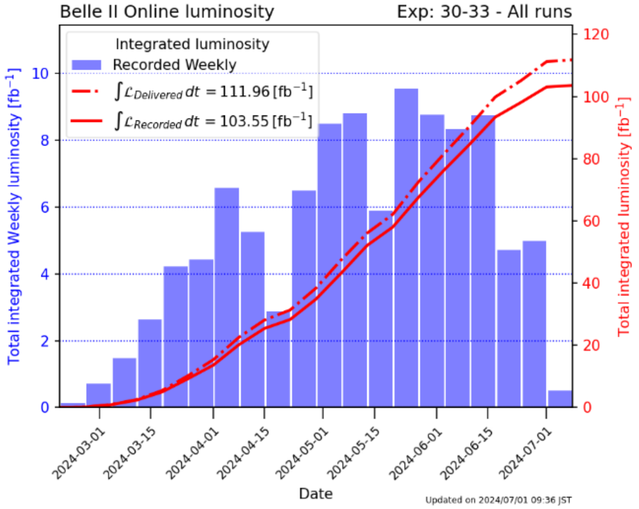
Performance raggiunte al termine del Run 1

L_{peak}	4.7×10^{34} cm^{-2}s^{-1}
I_{beam} (LER)	1.3 A
I_{beam} (HER)	1.1 A
N_{bunch}	2249
β^*	1 mm
tot L_{int}	428 fb^{-1}
max daily L_{int}	2.5 fb^{-1}

Run fermato il 30 giugno per shutdown estivo: Operation history







L_{int} inferiore al previsto anche perché si è data priorità agli studi di macchina

SuperKEKB Targets vs achievements

High Current: $I_{LER} > 1.8$ A and $I_{HER} > 1.4$ A	↔ 1.5 A and 1.21 A
Beta Squeezing: β_y^* down to 0.8 mm	↔ 0.9 mm
$L_p > 8 \times 10^{34}$ cm^{-2}s^{-1}	↔ 4.47×10^{34} cm^{-2}s^{-1}

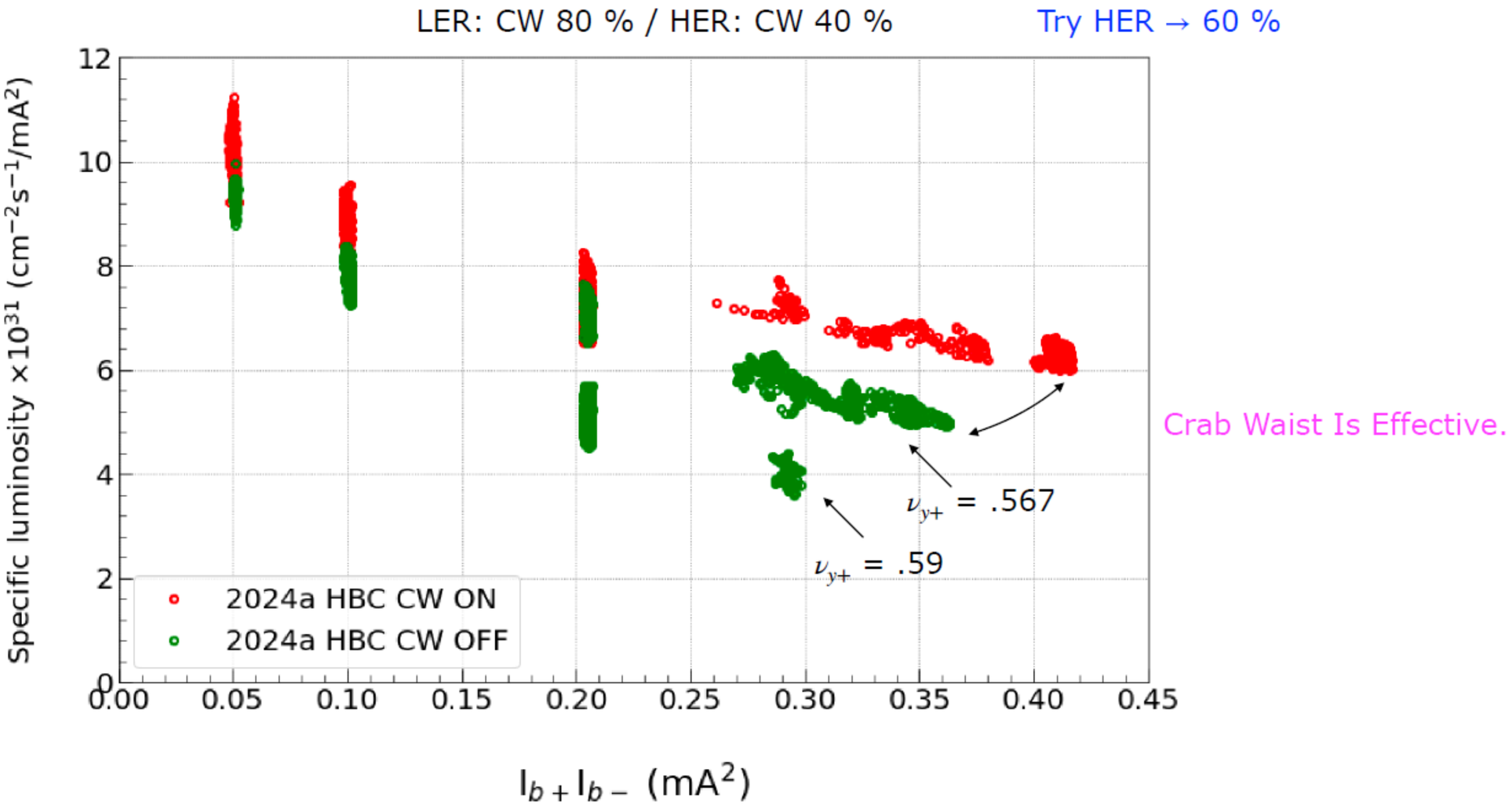
Riprodotte in generale le performances del 2022 ma i target previsti sono stati mancati a causa di:

- Frequenti beam loss, molti dei quali «sudden», ovvero senza precursori e con tempi caratteristici < 10 μs (1 giro). SBL pericolosi: danno spesso perdite grandi nella zona di IR e possono causare danni nel detector (PXD delicato su spikes di dose), QCS, collimatori.

- Problemi di iniezione (bassa efficienza)

- Limitazioni in corrente, in parte causate dai problemi di iniezione, ma forse anche da altri effetti in corso di studio.

Crab waist OK



Crab Waist Is Effective.

A marzo riprodotto working point equivalente al 2022.

A maggio in condizioni simili, ottenuta luminosita' specifica minore con la stessa corrente dei bunch--> condizioni della macchina ancora non stabili, anche legati ai problemi di iniezione, in corso di studio.

Belle II detector generally in good shape:

Pre-LS1 performances reached in all systems

Good data taking efficiency (90%-dead time)

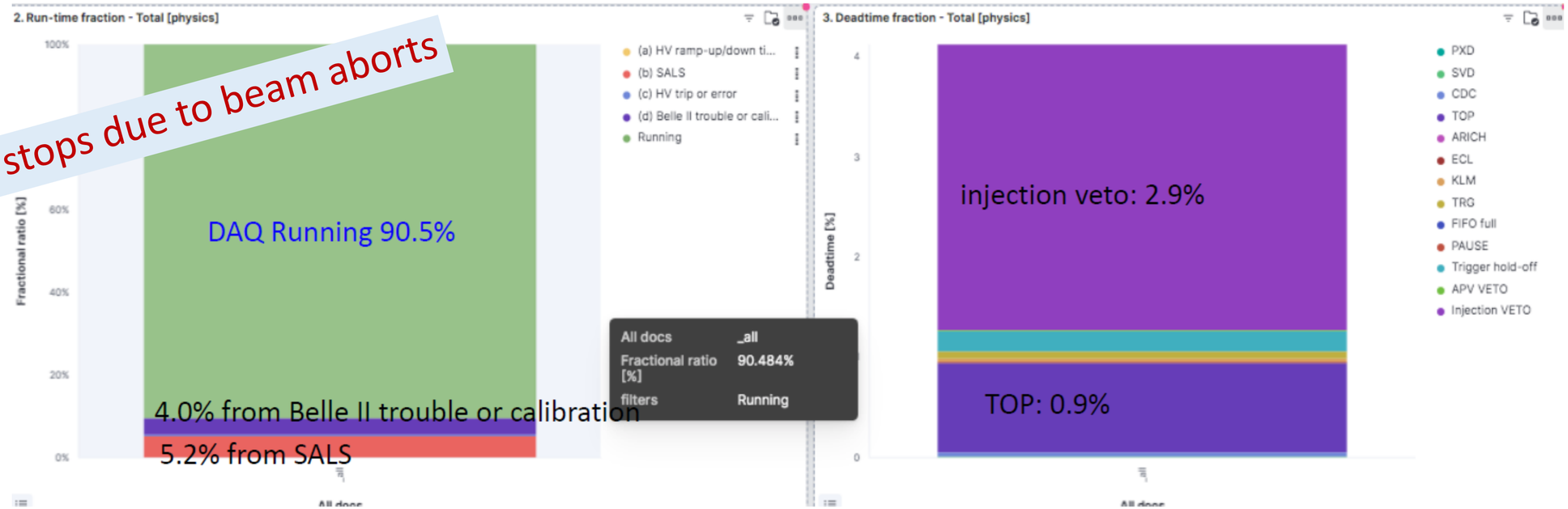
BUT:

- 75.6% of physics runs < 1-hour;
- 5.6% runs are > 3-hours ;

Data taking efficiency

In the past week, we have ~45% time for physics run.
In physics run, Belle II DAQ running time is 90.5%, DAQ dead time ~4.1%,
Belle II data taking efficiency is: 90.5% x (100-4.1)% = **86.8%.**

DAQ dead time



26% of run stops due to beam aborts

Sudden Beam losses

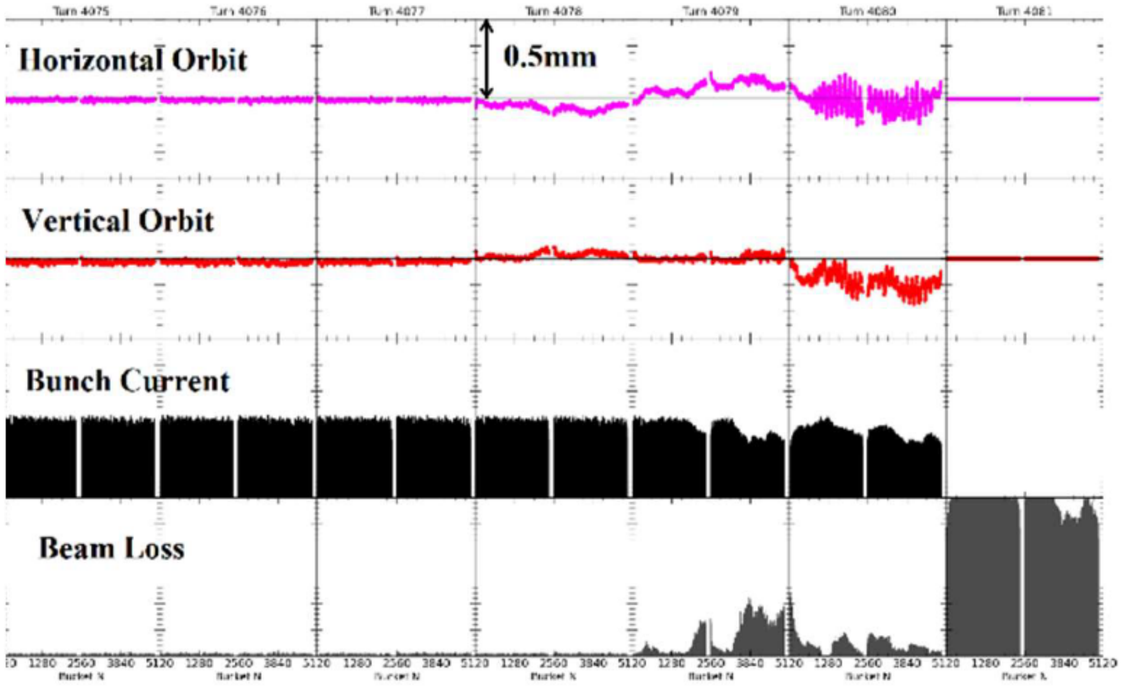
Beam loss that occurs suddenly within 1 turn (10μs) without precursory phenomena. ＝ Sudden Beam Loss（SBL）

- The cause of SBL has been unknown.
- A significant percentage of the beam is before the abort trigger is issued and stored beam is dumped

→ Harmful effects of SBL;

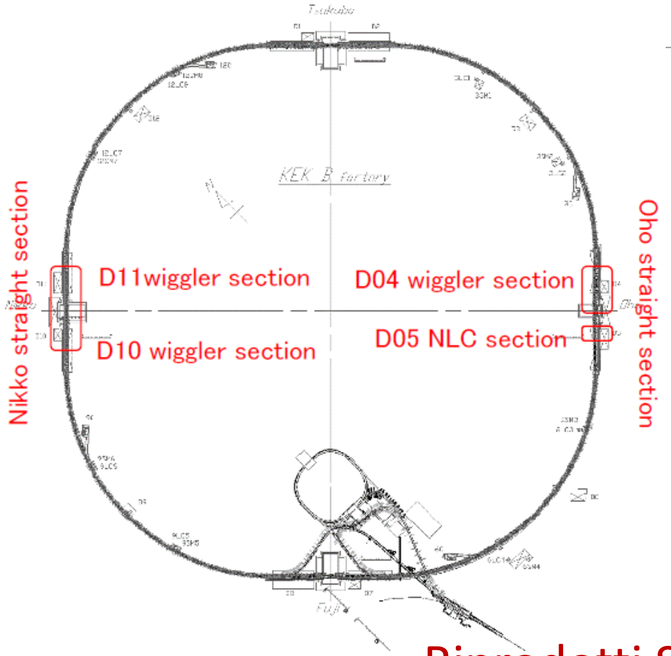
- Damage to collimators and other accelerator components,
- Quench of the final focusing superconducting magnets (QCS),
- Large backgrounds to the Belle-II detector,
- Inability to store high current due to beam abort.

Beam signal measured by
Bunch Oscillation Recorder(BOR) & Bunch Current Monitor(BCM)

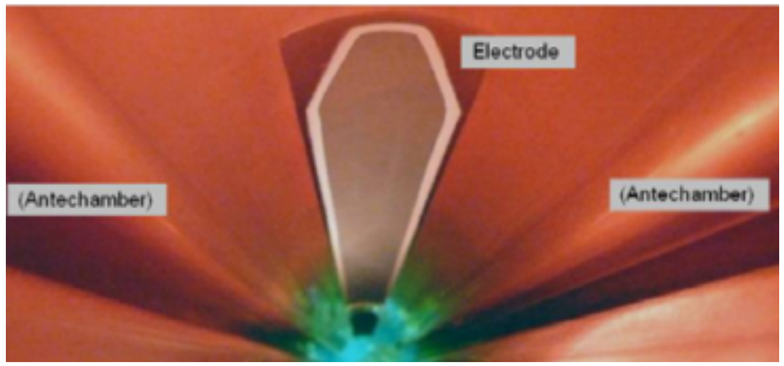


Analyse EPICS PV Belle II data to identify the root cause of the SBL
==> first indication of the location of the origin of LER SB

Dust events: possibile causa di SBL nel LER (positron beam) :



Nei wiggler del LER sono installati dei clearing electrodes in ceramica all'interno della beam pipe, sulla superficie superiore, da cui può occasionalmene cadere «polvere»



Riprodotti SBL «bussando» sulla beam pipe nei punti sospetti.

→ 13 tratti di beam pipe (su 50 possibili) vengono capovolti durante lo shutdown estivo. Visual check and dust cleaning dei restanti tratti di beam pipes sospetti. Se necessario saranno capovolti durante lo shutdown invernale.

In parallelo ottimizzazione del beam abort:

tuning di soglie più alte, ottimizzazione del veto di iniezione per massimizzare l'efficienza di presa dati.

=> forte impegno italiano

SBL, protezione del detector, impatto sulle prestazioni

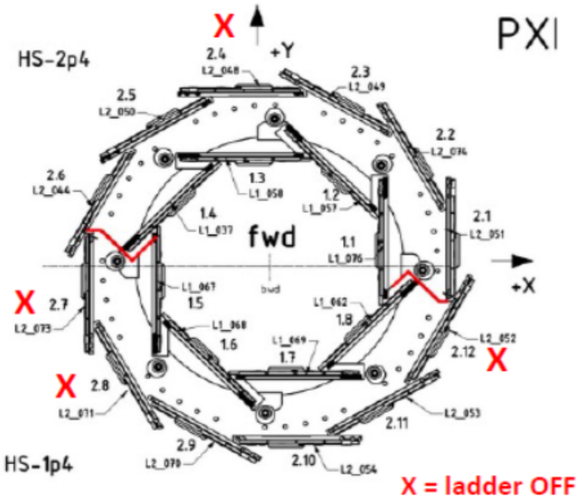
In due eventi, il 22/4 ed il 6/5, fascio perso in IR:

- danneggiato il PXD: meno del 2% di pixel morti, aumentata la temperatura di alcuni ladder
- Danneggiato il readout dei diamanti : sostituiti DCU, poi riparati.

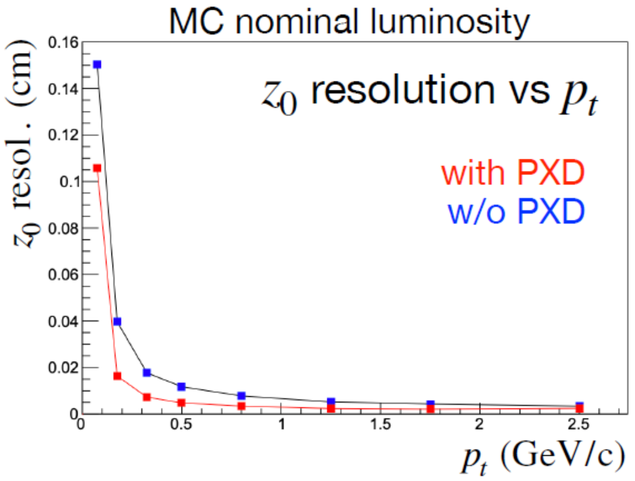
Di conseguenza:

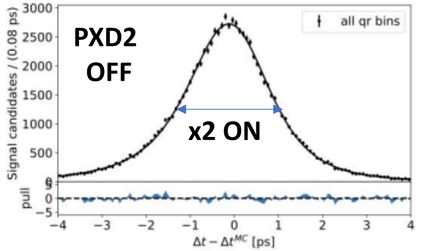
→ Belle II ha deciso di tenere PXD spento dal 6-5-2024 in poi.

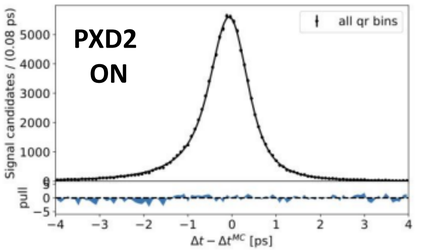
→ Si prevede di continuare così fino a condizioni più sicure: è evidente che anche a ottobre il run sarà ripreso nelle stesse condizioni.



Studi MC mostrano in assenza di PXD un peggioramento di un fattore 2 della risoluzione sui parametri d'impatto delle tracce ==> circa 20% l'impatto ad esempio sulla risoluzione su sin2β in misure time-dependent con $B^0 \to J/\psi K_S$







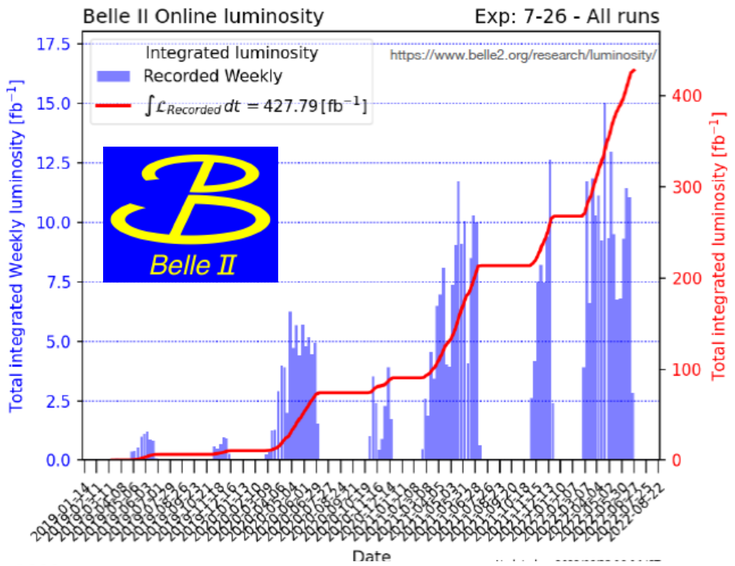
sin 2β value and uncertainty with and without PXD

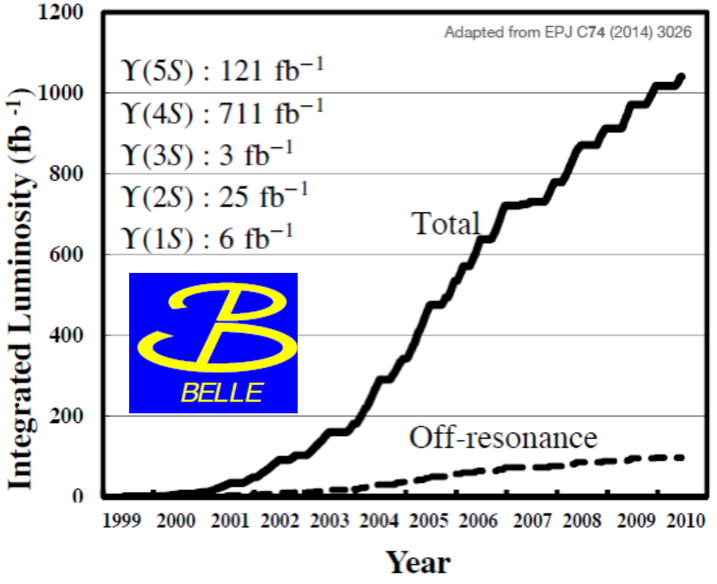
Exp 0	PXD ON	PXD OFF
mean	0.715 ± 0.003	0.713 ± 0.003
width	0.035 ± 0.002	0.042 ± 0.002

L’output di fisica

Numerosi risultati recenti in tutti i campi del programma di fisica di Belle II

Uso combinato dei dataset Belle e Belle2 ove possibile





EW-radiative penguins:

- BR, A_{CP} and Δ_{+0} of $B \to K^* \gamma$
- Search for $B^0 \to \gamma\gamma$
- $b \to d\, ll$
- Evidence of $B^+ \to K^+ \nu\bar{\nu}$

Semileptonic decays:

- V_{ub} untagged $B \to \pi/\rho\, l\, \nu$
- Update of $B \to D^*\, l\, \nu$

low multiplicity and τ

- $\sigma(e^+e^- \to \pi^+\pi^-\pi^0)$
- LFU in τ decays
- $\tau \to \mu\mu\mu$

b, c hadronic decays:

- BR of $B^- \to D^0 \rho^-$
- BR and A_{CP} of $B^0 \to \pi^0\pi^0$
- BR of $\Xi^0_c \to \Xi^0\pi^0, \Xi^0\eta, \Xi^0\eta'$
- γ angle Belle+Belle II determination

Time dependent CPV:

- $B^0 \to \eta'\, K_S$
- $B^0 \to K_S\, \pi^0\, \gamma$
- $B^0 \to J/\psi\, K_S$ using Gflat tag

Quarkonia and spectroscopy:

- $\Upsilon(10753)$ rediscovery
- Search $\Upsilon(10753) \to \omega\, \eta_b(1S)/\chi_{b0}(1P)$

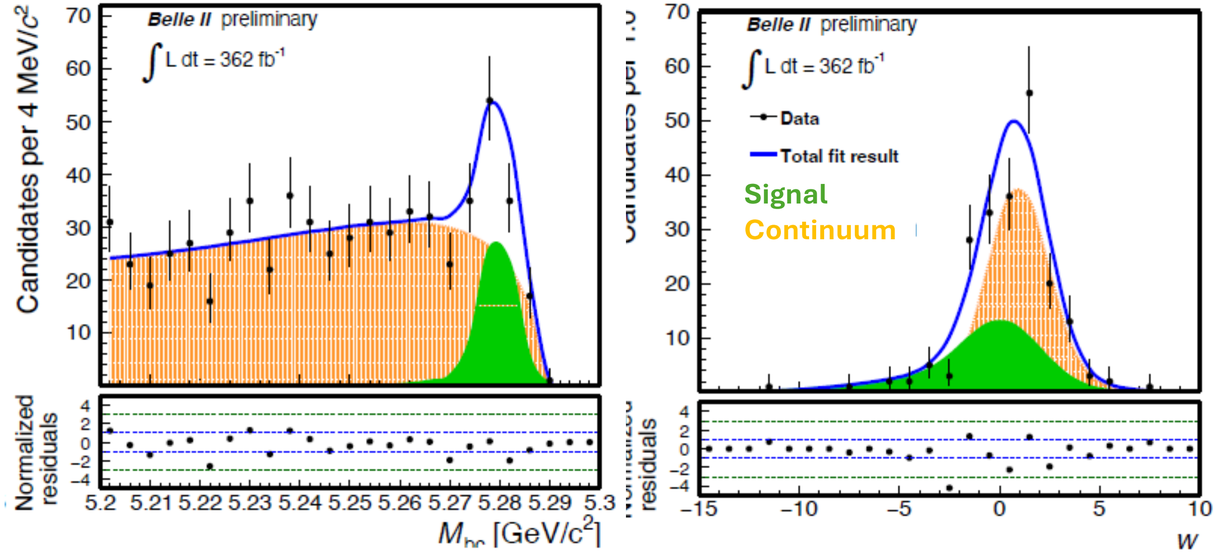
In 2023-24: 29 published or accepted journal papers + 11 submitted and being reviewed. **7 new results presented at ICHEP 2024**.

Highlights from ICHEP: $B^0 \to \pi^0\pi^0$ (α/ϕ_2)

Paper in preparation

Prev. PRD.107.112009 (2023)

- α/ϕ_2 now the least precise angle of the unitarity triangle
- Isospin relations among all $B \to \pi\pi$ branching fractions and CP asymmetries provide constraints
  - **Gronau and London PRL 65 3381 (1990)**
- Weakest link: **$B^0 \to \pi^0\pi^0$**
- New result with full Run 1 data
  - 4-D fit including tagging probability
  - Improved methods reduce uncertainties by 10% over the 189 fb^{-1} result
  - Graph-neural-network based tagger
    - 18% more powerful than before
    - **arXiv:2402.17260 [hep-ex] (acc. PRD)**



Beam-energy constrained $\pi^0\pi^0$ invariant mass

Transformed wrong-flavour-tag probability

$$\mathcal{B} = (1.26^{+0.20}_{-0.19} \pm 0.11) \times 10^{-6}$$
$$A_{CP} = 0.06 \pm 0.30 \pm 0.06$$

BF: world best,

A_{CP}: comparable with the world average

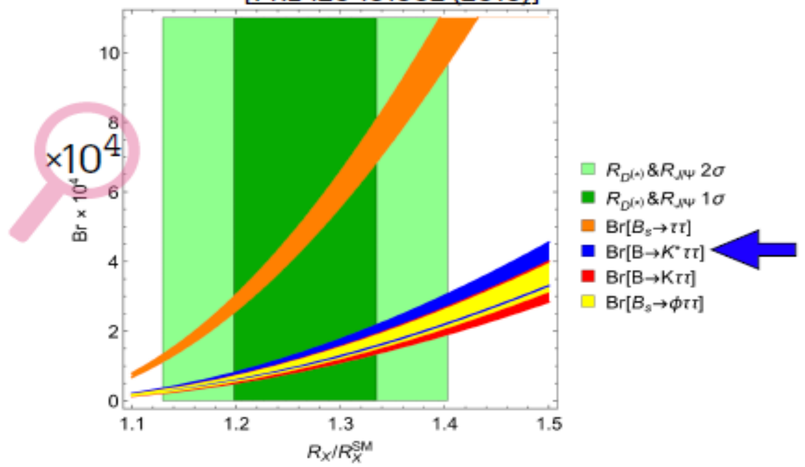
Highlight from ICHEP: $B \to K^* \tau\tau$

- FCNC processes are suppressed in SM at tree level.

$$\mathrm{BF}_{\mathrm{SM}} = (0.98 \pm 0.10) \times 10^{-7}$$ [PRD 53, 4964 (1996)]

- NP models that accommodate the $b \to c\tau\ell$ anomalies predict an **enhancement of several orders of magnitude with $\tau\tau$ pair** in the final state.
- NP couplings are those involving the **third-fermion generation**.

[PRL 120 181802 (2018)]



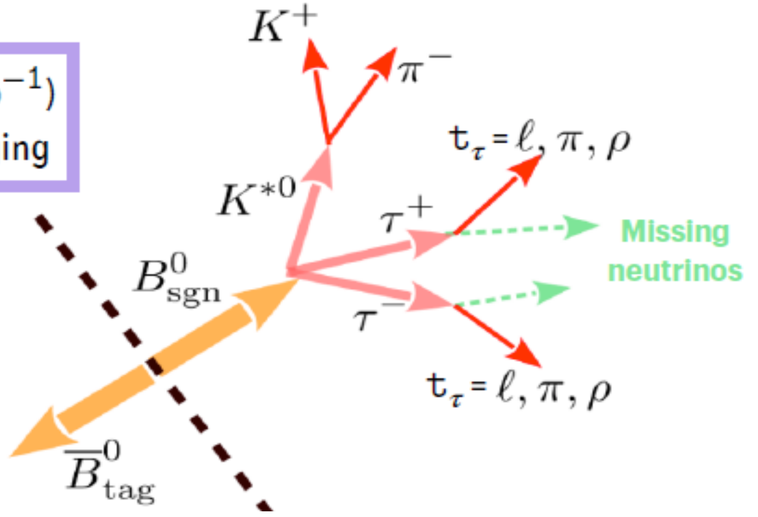
Belle (711 fb^{-1}) $\mathcal{B}^{\mathrm{UL}}(\mathrm{B}^0 \to \mathrm{K}^{*0}\tau^+\tau^-) < 3.1 \times 10^{-3}$ @ 90% CL [PRD 108 L011102 (2023)]

Challenges

Similar as $\mathrm{B}^+ \to \mathrm{K}^+\nu\bar{\nu}$

- Low BF
- No signal peaking kinematic observable
- Large backgrounds+more than 3 prompt track
- Up to **4 neutrinos** orignating from τ
- K^{*0} has **low momentum** due to the phase space

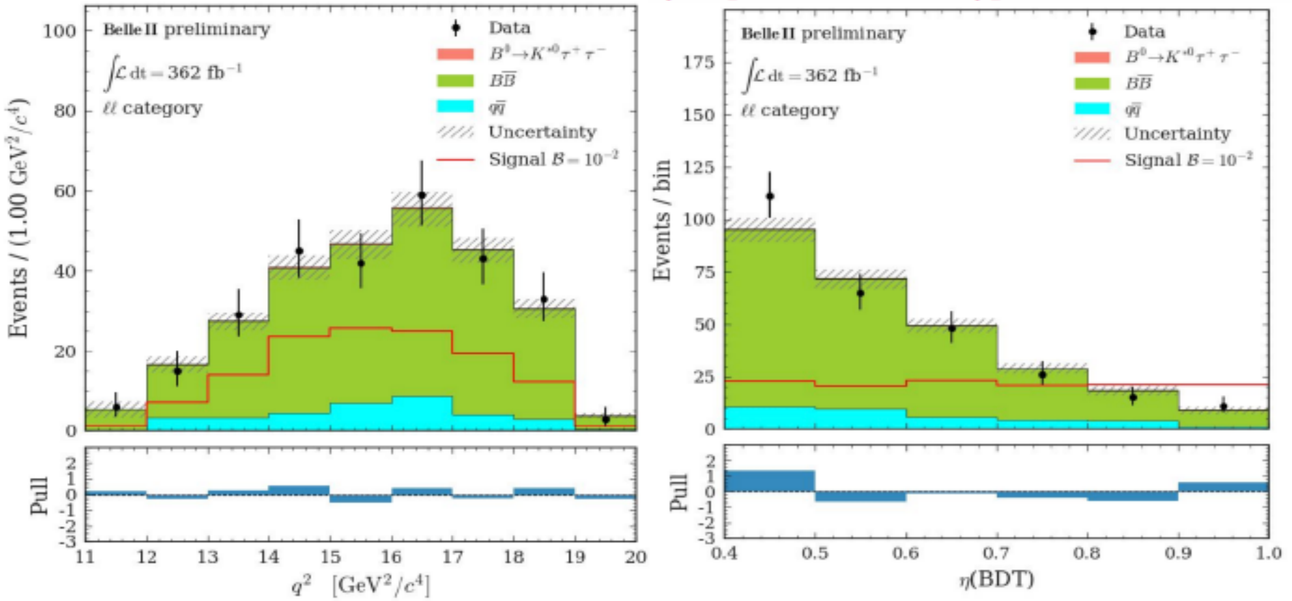
Belle II (364 fb^{-1})
hadronic B-tagging



Highlight from ICHEP: B→K* $\tau\tau$

- Combinations of sub-track from τ lead to 4 categories: $\ell\ell$, $\ell\pi$, $\pi\pi$, ρX
- **BDT** is trained using missing energy, extra cluster energy in EM calorimeter, $M(K^{*0}t_\tau)$, q^2, etc.
- BDT output η(BDT) is used to extract the signal yield with simultaneous fit to 4 categories

$\ell\ell$ as an example [best sensitivity]



Validation:

- Total efficiency and Peaking $B^0\bar{B}^0$: $B^0 \to K^{*0} J/\psi$ sample, replace $K^{*0} J/\psi$ with $K^{*0}\tau^+\tau^-$ (14% uncertainty)
- Non-peaking $B\bar{B}$: sample with B_{sig} and B_{tag} having same flavor
- $q\bar{q}$ background is scaled by off-resonance data

$$\mathcal{B}^{UL} = 1.8 \times 10^{-3} \text{ at } 90\% \text{ CL}$$

Twice better with only half sample wrt Belle!
Better tagging + more categories + BDT classifer...

The most stringent limit on the $B^0 \to K^{*0}\tau^+\tau^-$ decay and in general on $b \to s\tau\tau$ transition!

Other new results presented at ICHEP 2024

- Search for LFV in $B^0 \to K^0_S \tau^\pm \ell^\mp$, $\ell = \{e, \mu\}$
- 5σ observation of mixing induced *CP* violation in $B \to J/\psi\, \pi^0$
- First separate BR measurement of B^0, $B^+ \to J/\psi\, X$
- Search for CPV in $D^+_{(s)} \to K_S K^- \pi^+ \pi^+$
- BR of $\Lambda^+_c \to p K_S \pi^0$ (*)
- Evidence for Pentaquark state at 4459 MeV decaying into Λ J/ψ (*)

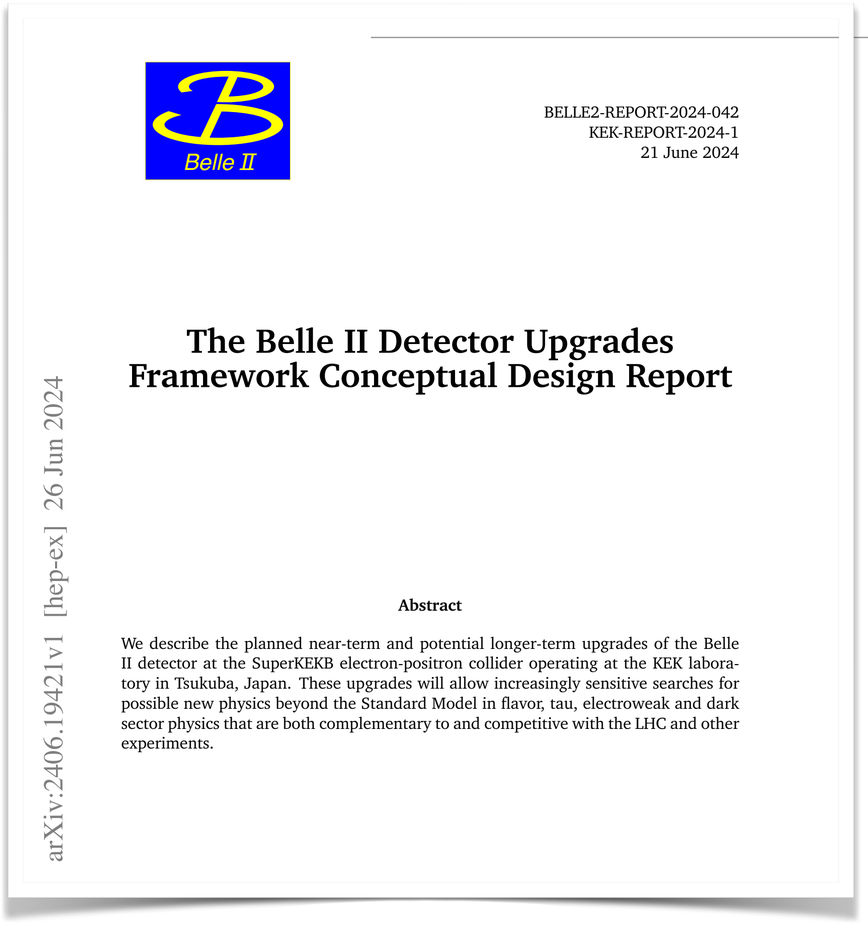
(*) *Solo dati di Belle*

Analisi italiane in corso

Search for $B \to \tau\nu$	NA
Ricerca di $e^+e^- \to \eta\, h_b(1P)$ sopra la Y(4S)	TO
Ricerca di $B^+ \to K^+$ tau tau	TS
$B \to K\nu\nu$ with semileptonic tag	PG
Invisible Z' and h'	RM3-NA-PI
Vcb from $B \to D^* l\, \nu$	TS
A_{CP} in $D \to \pi^+\pi^-\pi^0$	PI
$B^0 \to J/\psi K_L$, $B^0 \to \eta' K_L$ $B^0 \to \phi K_L$	LNF-RM3
Y(1S) decay studies (LFV, pp correlations)	TO

Prospettive di upgrade a medio e lungo termine

Upgrade CDR pubblicato su arxiv



BELLE2-REPORT-2024-042
KEK-REPORT-2024-1
21 June 2024

The Belle II Detector Upgrades Framework Conceptual Design Report

Abstract

We describe the planned near-term and potential longer-term upgrades of the Belle II detector at the SuperKEKB electron-positron collider operating at the KEK laboratory in Tsukuba, Japan. These upgrades will allow increasingly sensitive searches for possible new physics beyond the Standard Model in flavor, tau, electroweak and dark sector physics that are both complementary to and competitive with the LHC and other experiments.

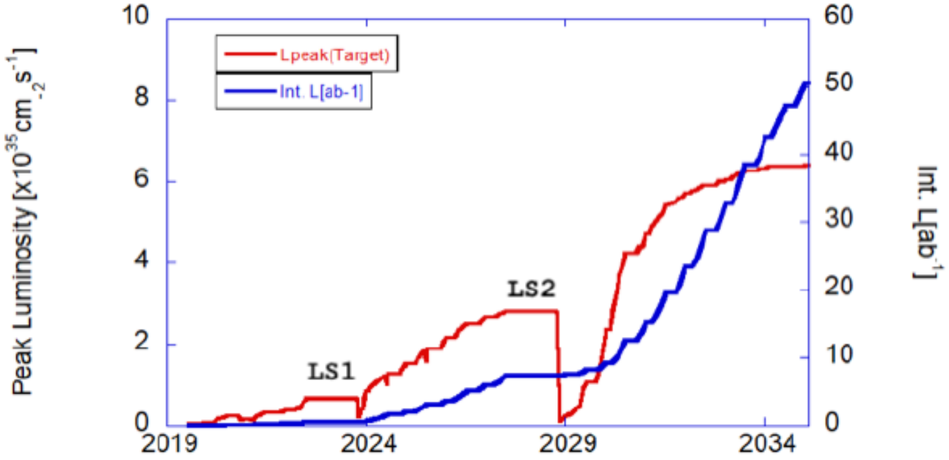
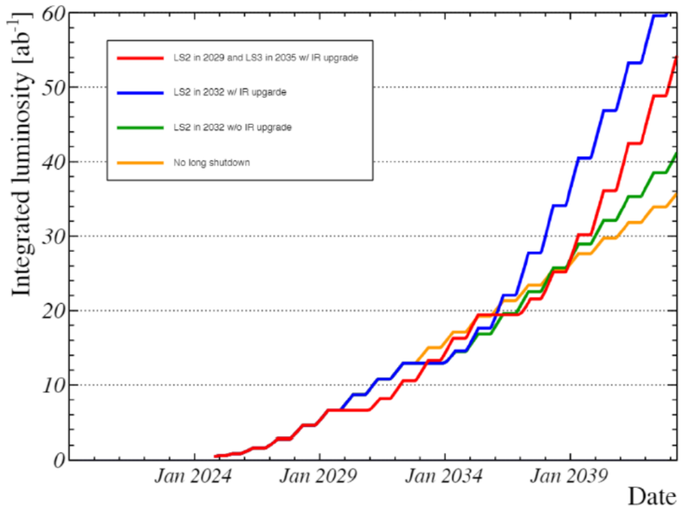


Figure 1.3: Projected luminosity for SuperKEKB.

- Tollerare i fondi macchina nel run ad alta luminosità
- Migliorare le performance in modo da produrre più fisica per ab^{-1}
- Essere in grado di adattare il detector a possibili cambi di IR
- Possibili scenari in discussione (1 o 2 LS, con upgrade o meno della IR)



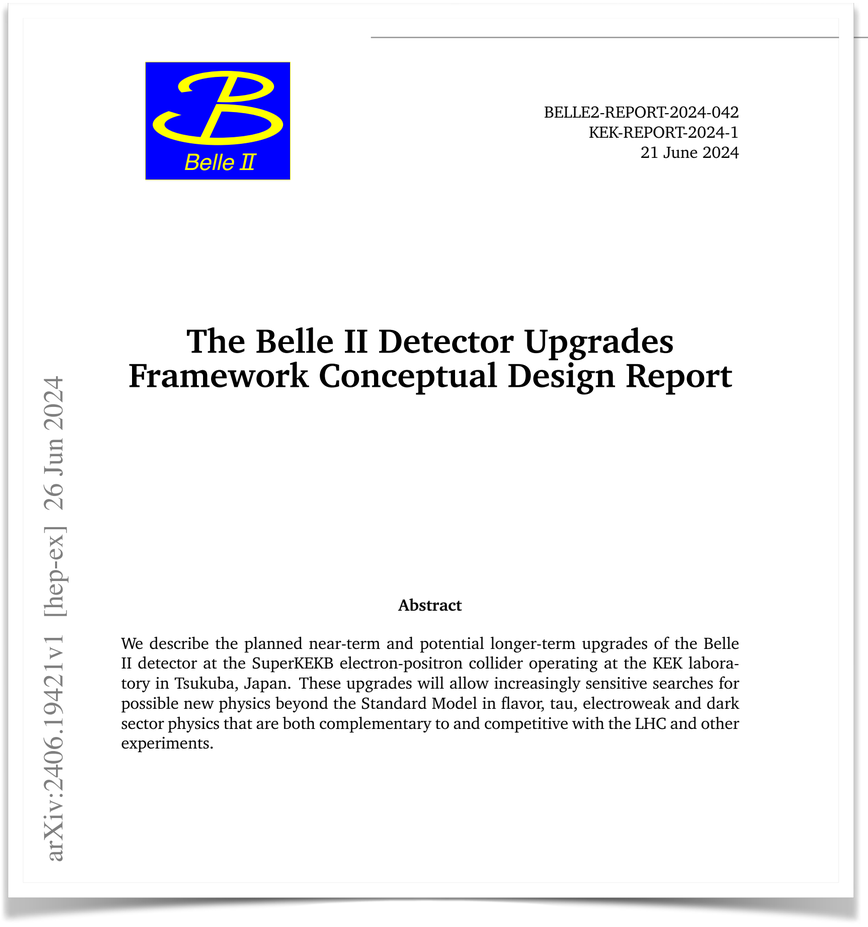
LS in 2032, w/ IR upgrade

LS in 2029 and 2035, w/ IR upgrade

LS in 2032, w/o IR upgrade

0 LS

Upgrade CDR pubblicato su arxiv



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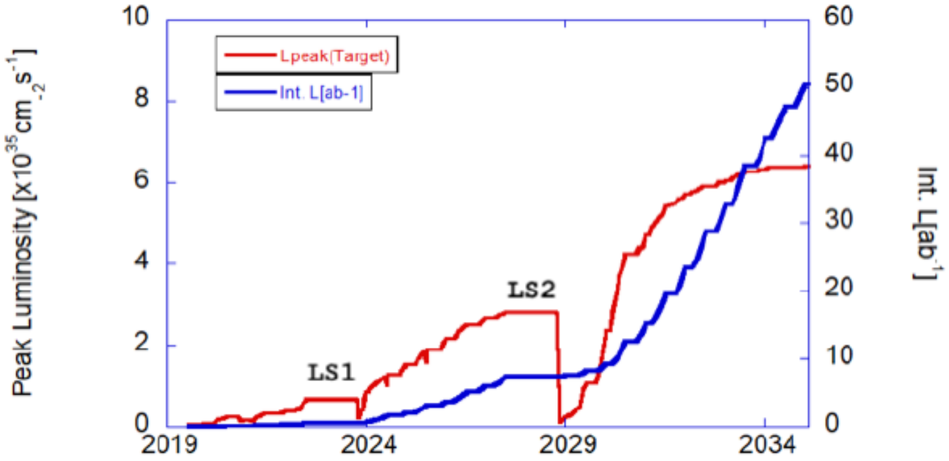

Figure 1.3: Projected luminosity for SuperKEKB.

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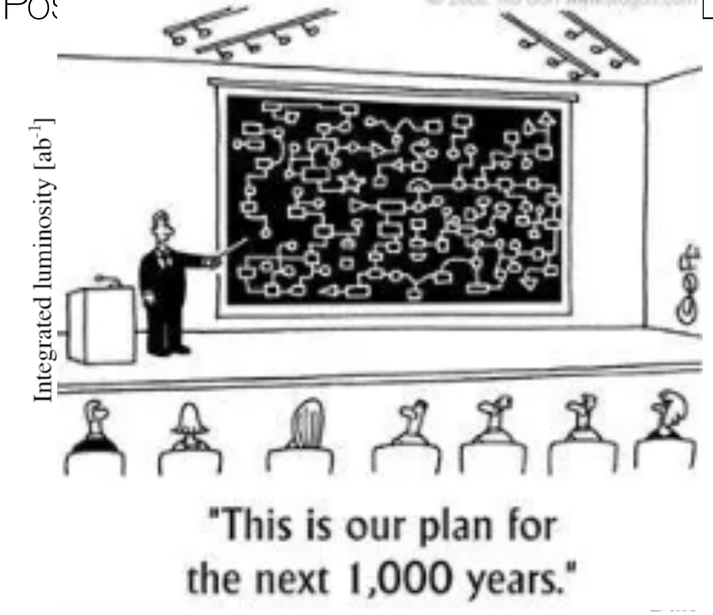
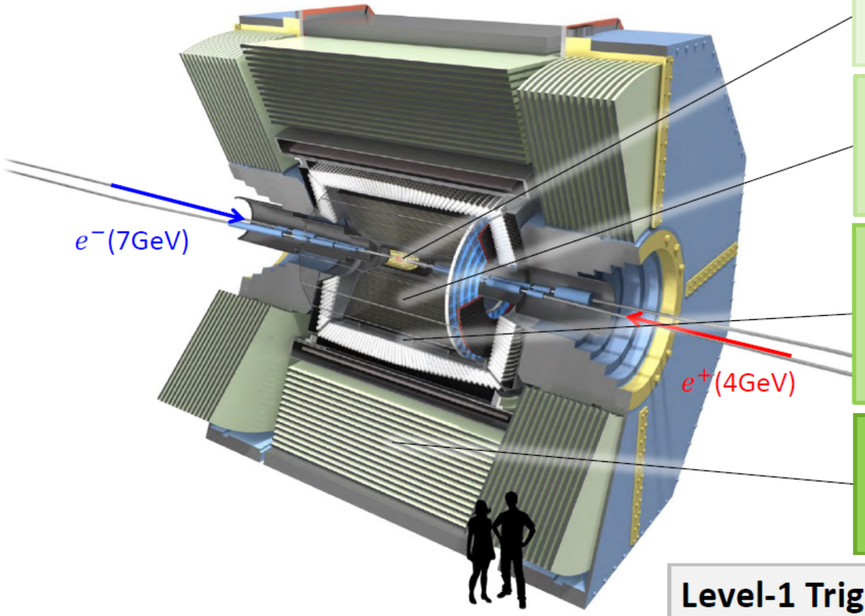
- Essere in grado di adattare il detector a possibili cambi di IR
- Po[illegible] LS, con upgrade o meno della IR)



Possibili upgrade a medio termine (LS2)

Middle-term upgrade plan during LS2 (2028 or later)



Vertex detector
- Fully-pixelated CMOS DMAPS detector

Drift chamber (CDC)
- New front-end electronics (less cross-talk, better radiation hardness, and less power)

Particle identification

Barrel: Time-Of-Propagation counters (TOP)
- Replace w/ life-extended PMTs
- New front-end electronics (less power)

K_L/μ detector (RPC + scintillator)
- Option 1: Replace RPC w/ scintillator
- Option 2: RPC avalanche mode operation

Level-1 Trigger
- Replace electr
  sophisticated

	Subdetector	Function	upgrade activity	time scale
TS PI	MDI	RMBA	Faster and more performant electronics	medium-term
PI	VXD	Vertex Detector	all-pixels DMAPS CMOS sensors (VTX)	medium-term
	CDC	Tracking	upgrade front end electronics	short/medium-term
PD, TO	TOP	PID, barrel	Replace not-life-extended ALD MCP-PMTs	medium-term
			Front end electronics upgrade	medium-term
			Replace PMTs with SiPMs	long-term
LNF, RM3	KLM	K_L, μ ID	replace 13 barrel layers of legacy RPCs with scintillators	medium/long-term
			upgrade of electronics readout and proportional mode RPC readout	medium/long-term
			timing upgrade for K-long momentum measurement	medium/long-term
			hardware and firmware improvements	continuous
	DAQ		add 1300-1900 cores to HLT	short/medium-term
	ARICH	PID, forward	replace HAPD with Silicon PhotoMultipliers	long-term
			replace HAPD with Large Area Picosecond Photodetectors	long-term
PG, NA	ECL	γ, e ID	Add pre-shower detector in front of ECL	long-term
			Complement ECL PiN diodes with APDs or SiPM	long-term
			Replace CsI(Tl) with pure CsI crystals	long-term

Medium term → 2029-30

R&D on KLM barrel upgrade maintaining the RPCs

A possible upgrade path for the KLM described in the “Belle II Upgrades CDR” is to keep the current RPC chambers but change the operating conditions to improve the rate capability.

$$\text{Rate Capability} \propto \frac{1}{\rho t \langle Q \rangle}$$

Since the resistivity ρ and the gap thickness t are fixed, we can only play with the charge.
In particular, the proposal is to run the RPCs in *avalanche mode* rather than *streamer mode* as done presently, and since the Belle times. Typical $\langle Q_{streamer} \rangle$ ~ 100pC, could be reduced to ~ 10pC or less

Several possibilities to obtain the goal: a) reduce the HV; b) increase quenching in the gas mixture; c) do both.

In all cases, new FEE is needed to amplify the signal, with its much smaller $\langle Q \rangle$. Of course the amplifiers must be placed as close as possible to the signal source — this should be possible without dismantling the RPC chambers

We (LNF+RM3 group) proposed an R&D program (approved by CSN1) using a small RPC chamber provided by the KLM KEK group (shipping planned in November). RM3 will design the new preamplifiers and readout electronics, LNF study the RPC response to different gas mixtures, etc. with a CR test-stand.

Stato della collaborazione italiana e conclusioni

Dai referee

Attilio Andreazza (MI), Francesca Bucci (FI), Paolo Camarri (RM2), Benedetto Giacobbe (BO), Andrea Contu (CA), Fabio Cossutti (TS)

P. De Simone

BELLE II Italia nel 2024

	N Fis	N Tecn	N Tot	FTE Fis	FTE Tecn	FTE sigle sinergiche	FTE Tot
LNF	3	0	3	2.4	0.0	0.0	**2.40**
NA	8	1	9	4.4	0.3	0.3	**5.00**
PD	7	1	8	5.6	0.4	0.0	**5.95**
PG	5	0	5	4.6	0.0	0.1	**4.70**
PI	11	4	15	8.8	0.5	0.9	**10.05**
PV-DTZ	1	4	5	0.2	0.4	0.0	**0.60**
RM3	18	3	20	11.7	0.8	0.5	**12.85**
TO	12	1	13	6.9	0.2	0.0	**7.12**
TS	10	0	10	8.0	0.0		**8.00**
TOTALI	**75**	**14**	**88**	**52.5**	**2.5**	**1.7**	**56.67**

Importante contributo a elettronica VTX upgrade

- FTE Tot **56.67**, 56.8 nel 2024**,** sostanziale stabilità

Belle II Italia

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
FTE	24.2	30.1	34.6	34.9	40.2	42.3	46.7	47.7	48.5	56.8	**56.8**	**56.67**
PERSONE	51	63	63	65	68	71	76	74	76	91	**86**	**88**
FTE/PERS.	0.475	0.479	0.549	0.537	0.591	0.596	0.614	0.650	0.640	0.624	**0.660**	**0.65**

La commissione dei referee si congratula con i gruppi italiani della collaborazione Belle II per l'enorme lavoro svolto in questi anni, per la costante crescita del contributo italiano e per la proficua collaborazione con i referee.

Dai referee

Milestones 2025

Data	Descrizione
31/12/2025	Stoccaggio su TAPE del 20% RAW dati prodotti presso il CNAF (seconda copia)
31/12/2025	Produzione 14% del MonteCarlo.
31/12/2025	Z' invisible update con run 1
31/12/2025	lepton-id performance
31/12/2025	B->K+ tau tau
31/12/2025	K-long performance descritta in paper di fisica ?
30/10/2025	Test Obelix-1
30/06/2025	Efficienza di run singoli sottorivelatori

Conclusioni

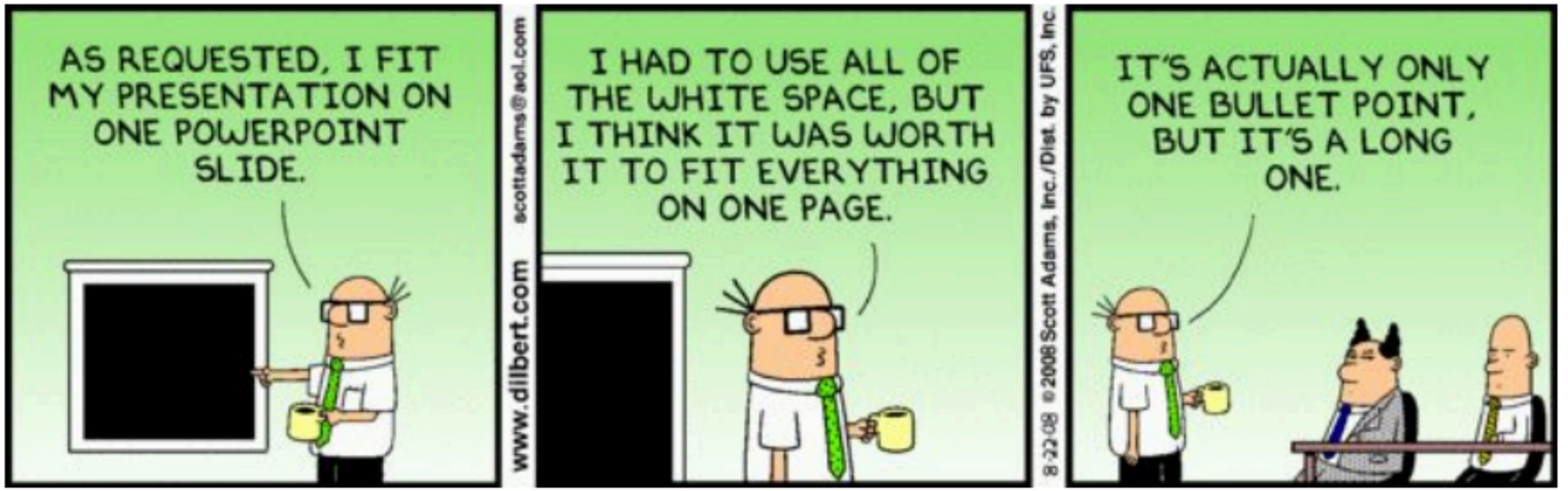
- Belle II è continua a produrre ottimi risultati di fisica e la parte italiana della collaborazione gioca un ruolo fondamentale.
- Tuttavia il comportamente dell'acceleratore continua a essere problematico e pensiamo sia necessaria una riflessione sulle prospettive dell'esperimento

✓ Collaborazione SuperKEKB-Belle2, MAC…
➡ Chiarimenti scopo upgrade

In sintesi:

- Il Run 2 è iniziato con importanti problemi di macchina che sono in corso di studio e che per il momento impongono di tenere spento il PXD
- Durante lo stop estivo sono implementate alcune contromisure. Da ottobre riprenderà il run per verificarne gli effetti ai fini della stabilità della presa dati e dell'incremento della luminosità
- Nel 2025 si prevedono 5.5 mesi di run, causa anche lavori di rifacimento del tetto della Tsukuba hall.
- L'attività di analisi dati e miglioramento delle performance è sempre molto intensa e continua a dare frutti in termini di pubblicazioni e misure competitive
- Continuano gli R&D per l'upgrade del tracciatore di vertice VTX con tecnologia DMAPS. Se il progetto di upgrade sarà approvato la costruzione deve partire per tempo con l'obiettivo di installare nel prossimo long shutdown (LS2), la cui esatta collocazione temporale è in corso di discussione ma sarà fra il 2029 ed il 2032.

BACKUP


AS REQUESTED, I FIT MY PRESENTATION ON ONE POWERPOINT SLIDE.
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IT'S ACTUALLY ONLY ONE BULLET POINT, BUT IT'S A LONG ONE.
www.dilbert.com scottadams@aol.com
8-22-08 ©2008 Scott Adams, Inc./Dist. by UFS, Inc.

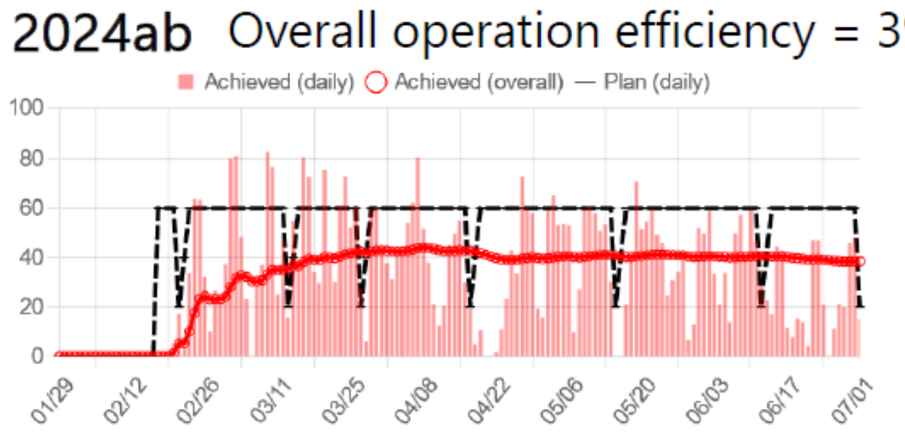
Proposta M&O per FY2025 (e proiezione successiva) approvata dal FB

	FY2024 (plan on Jun-6 2024)	FY2025 (estimation on Jun-6 2024)	FY2026 (estimation on Jun-6 2024)	FY2027 (estimation on Jun-6 2024)	FY2028 (estimation on Jun-6 2024)	FY2029 (estimation on Jun-6 2024)
Secretaries	12,500	12,500	12,500	12,500	12,500	12,500
Video conf.+Outreach+Publication	4380	4380	4380	4380	4380	4380
KLM Gas etc.	12,000	12,000	12,000	12,000	12,000	12,000
Gas for CDC	4,500	4,500	4,500	4,500	4,500	4,500
Electricity	**102,180**	**109,980**	109,980	109,980	109,980	109,980
Solenoid M&O	109,730	**117,810**	117,810	117,810	117,810	117,810
SVD CO2 etc.	500	500	500	500	500	500
BEAST2/IR op.	500	500	500	500	500	500
DAQ maintenance	23,000	28,000	23,000	28,000	23,000	28,000
Core DAQ experts	24,000	24,000	0	0	0	0
Core computing experts	19,500	**21,450**	**21,450**	**21,450**	0	0
Injection background mitigation expert	8,000	0	0	0	0	0
Collab. Utilities	10,000	10,000	5,000	5,000	5,000	5,000
Full time safety expert	20,889	20,889	20,889	20,889	20,889	20,889
Belle II operation fellowship	10,000	10,000	10,000	10,000	10,000	10,000
General M and repair	**9,470**	20,000	20,000	20,000	20,000	20,000
Total	**381,679**	**396,509**	362,509	367,509	341,059	346,059

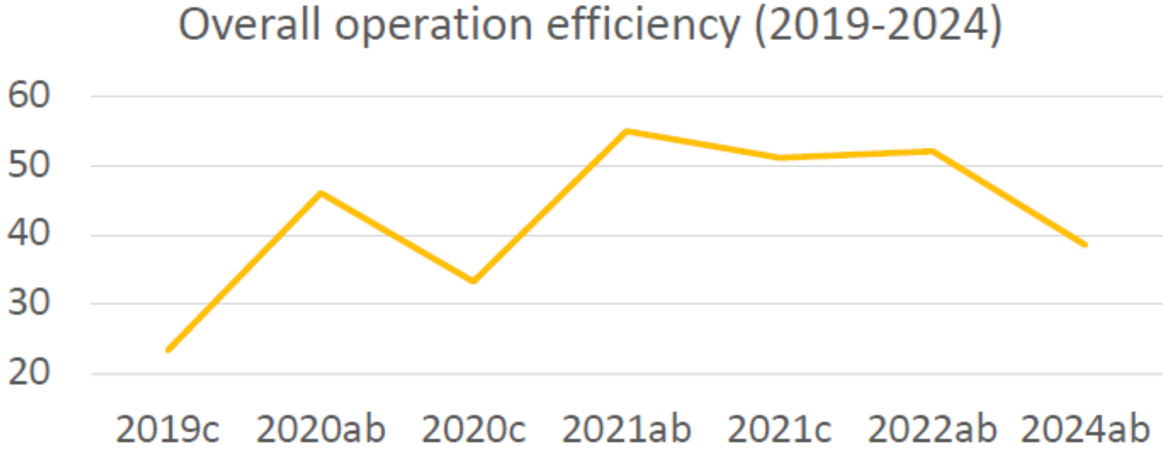
Aumento contenuto rispetto a FY2024 → contributo italiano stimabile in 28.800 kyen

165.5 k€ al favorevolissimo cambio attuale. Tenendo conto di un'oscillazione fino a +20% preventiviamo 200 k€ s.j.

Operation efficiency in 2024ab



[Daily efficiency] = [Daily delivered $\int L$] / [Highest-ever delivered L_{peak} at the time] / [86400 sec]
Highest-ever delivered L_{peak} is reset to 0 at the beginning of each run period.
Start-up period and scheduled maintenance days are excluded in the overall efficiency calculation.



Operation efficiency :

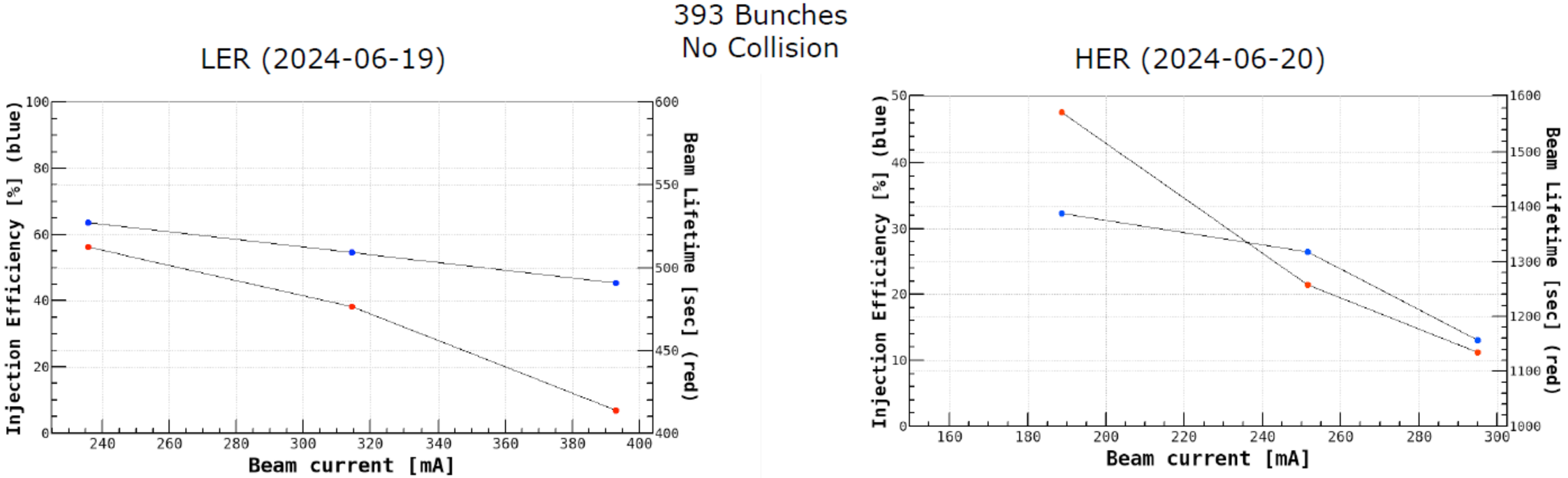
Integrated luminosity/(Highest-ever peak luminosity × Operation time)

- One of the main causes of operation efficiency loss was frequent beam aborts
  - Luminosity recovery after the abort: ~60 min
- Aborts due to Sudden Beam Loss (SBL)
  - About 3-5 aborts per day (about half in 2022ab)
  - → 10-20% loss in integrated luminosity
- Aborts due to beam injection
  - About 1-2 events per day
  - → 5-10% loss in integrated luminosity
- By eliminating these aborts, the efficiency should be improved up to about 60%.
- Additionally, the stabilization of the machine operation will improve the efficiency further.

Limitazione in corrente come effetto di problemi diversi

- Numerosi beam abort in fase di iniezione a bassa corrente (non pericolosi ma ostacolano il tuning del fascio)
- Effetti di interazione beam-beam: fatti vari studi alzando le soglie di beam abort sui diamanti. Possibile contromisura: aumento della beta function orizzontale nel punto di iniezione.

correlazione fra injection efficiency e beam lifetime:



Non è aumentato solo il costo dell'energia…….

Il «mese-persona» al KEK è stato tradizionalmente valutato 5.5 k€ pari a 3.9 k€ di diaria + 2 viaggi A/R a 800 € l'uno.

Nel compilare i preventivi abbiamo chiesto ai referees di considerare il costo medio dei voli a 1.3 k€, che porterebbe il «mese-persona» a 6.5 k€.

Purtroppo per i viaggi in programma ad ottobre il costo medio dei biglietti si avvicina ormai a 2.0 k€ !!!

Se la CSN1 decide di continuare a calcolare il mese-persona al KEK come in passato (5.5 k€), configura implicitamente un taglio del 15% delle richieste, che con i costi di ottobre è in realtà un taglio effettivo del 27% sui costi reali.

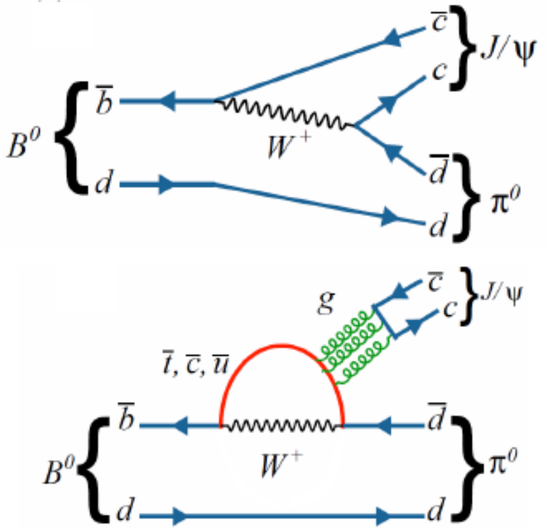
$B^0 \to J/\psi\pi^0$

- Mediated by b→cc̄d transition, probe for loop contributions to b→cc̄s for determination of ϕ_1
- Apply GFlaT and 3 BDTs for fake photon, beam background, and qq̄ suppression
- Fit ΔE and m($\ell\ \ell$) for background subtraction (separately for ee and μμ);
  Fit Δt for CPV-parameter extraction

$$\mathrm{BF} = (2.00 \pm 0.12 \pm 0.10) \times 10^{-5}$$
$$S_{CP} = -0.88 \pm 0.17 \pm 0.03$$
$$C_{CP} = 0.13 \pm 0.12 \pm 0.03$$

- First 5σ observation of mixing-induced CP in this mode

Color/CKM suppressed



PRD.98.112008

New for ICHEP2024

Paper in preparation

203±17 (J/ψ→μμ)

186±17 (J/ψ→ee)