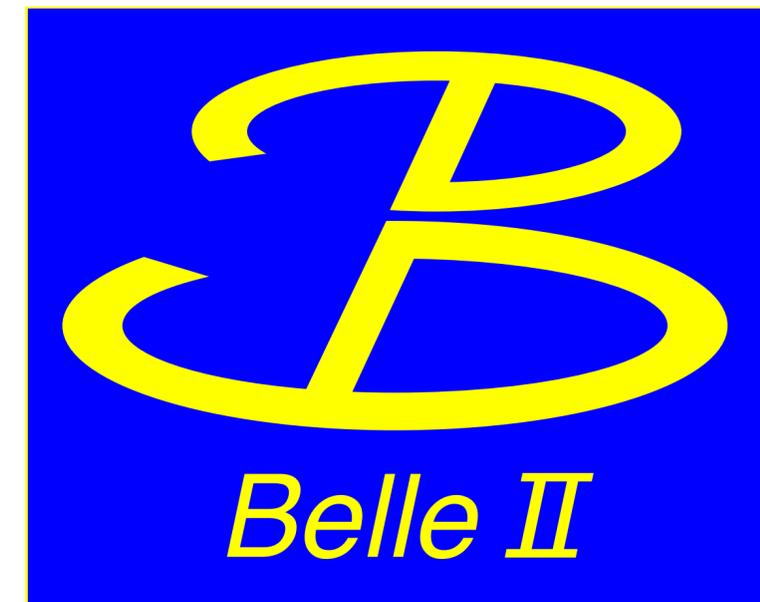


Current Status and Future Prospects of Belle II



Yu Nakazawa (KEK)
KEK-PH 2026
February 16th, 2026



Belle II @ SuperKEKB

Asymmetric e^+e^- collider ($\sqrt{s} = 10.58$ GeV)

$e^+e^- \rightarrow \Upsilon(4S) \rightarrow B\bar{B}, D\bar{D}, \tau\tau, \dots$

B ($\beta \gamma \sim 0.28$): precision meas. of the CKM matrix, rare decays

τ : cLFV, test of LFU

D, dark sector, hadron physics, etc.

Luminosity	Accomplished
Integrated	623 fb ⁻¹
Peak	4.7 x 10 ³⁴ /cm ² /s

World Record!!

Target: 50 ab⁻¹ (Belle x50)

K_L and μ Detection

K_L⁰ p resolution: 15 MeV
 μ identification eff.: ~90%

Vertex Detector

vertex resolution: 15 μ m

Central Drift Chamber

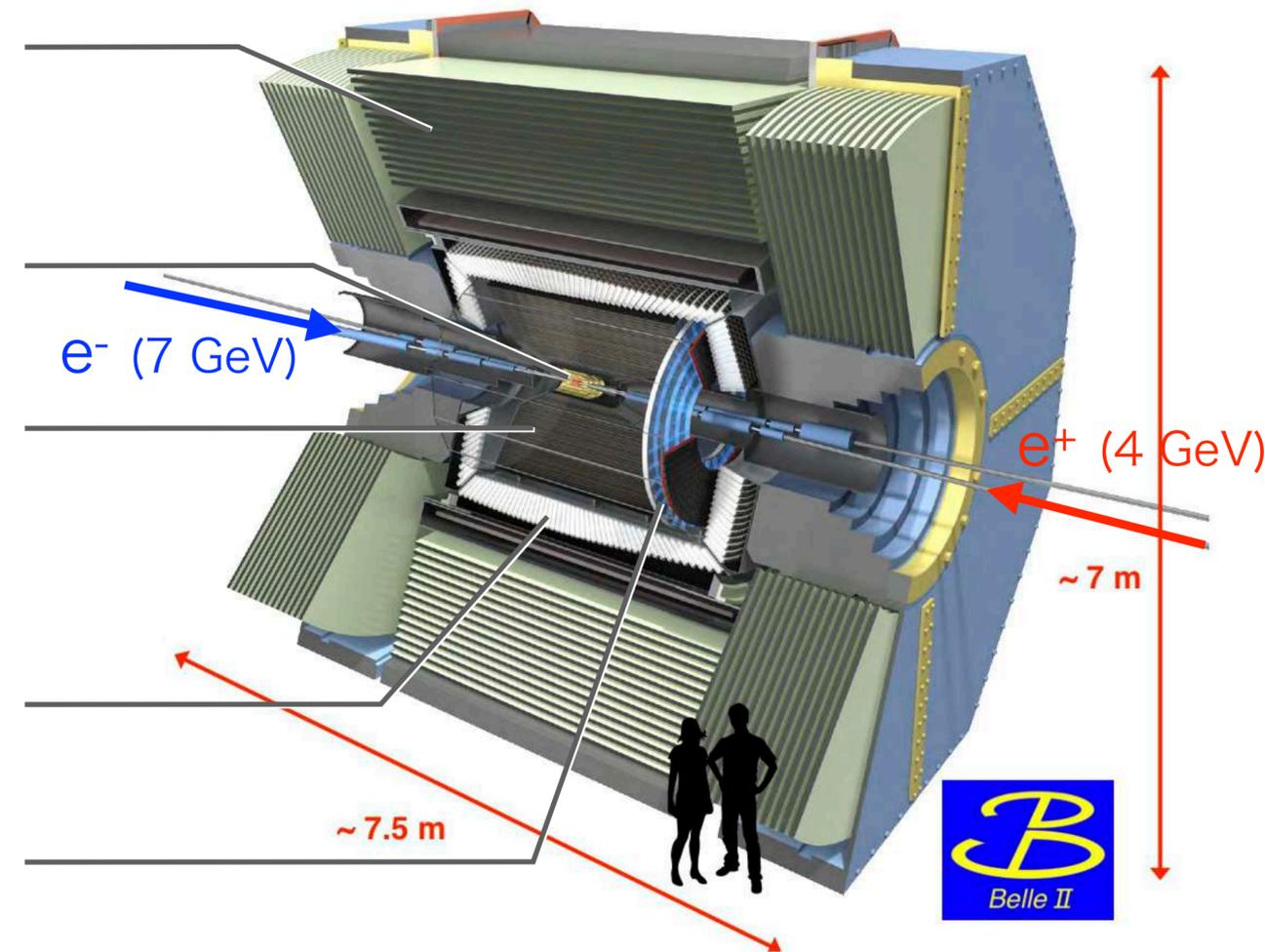
spatial resolution: 100 μ m
 dE/dx resolution: 5%
 P_T resolution: 0.4%

EM Calorimeter, CsI(Tl)

energy resolution: 1.6%-4%

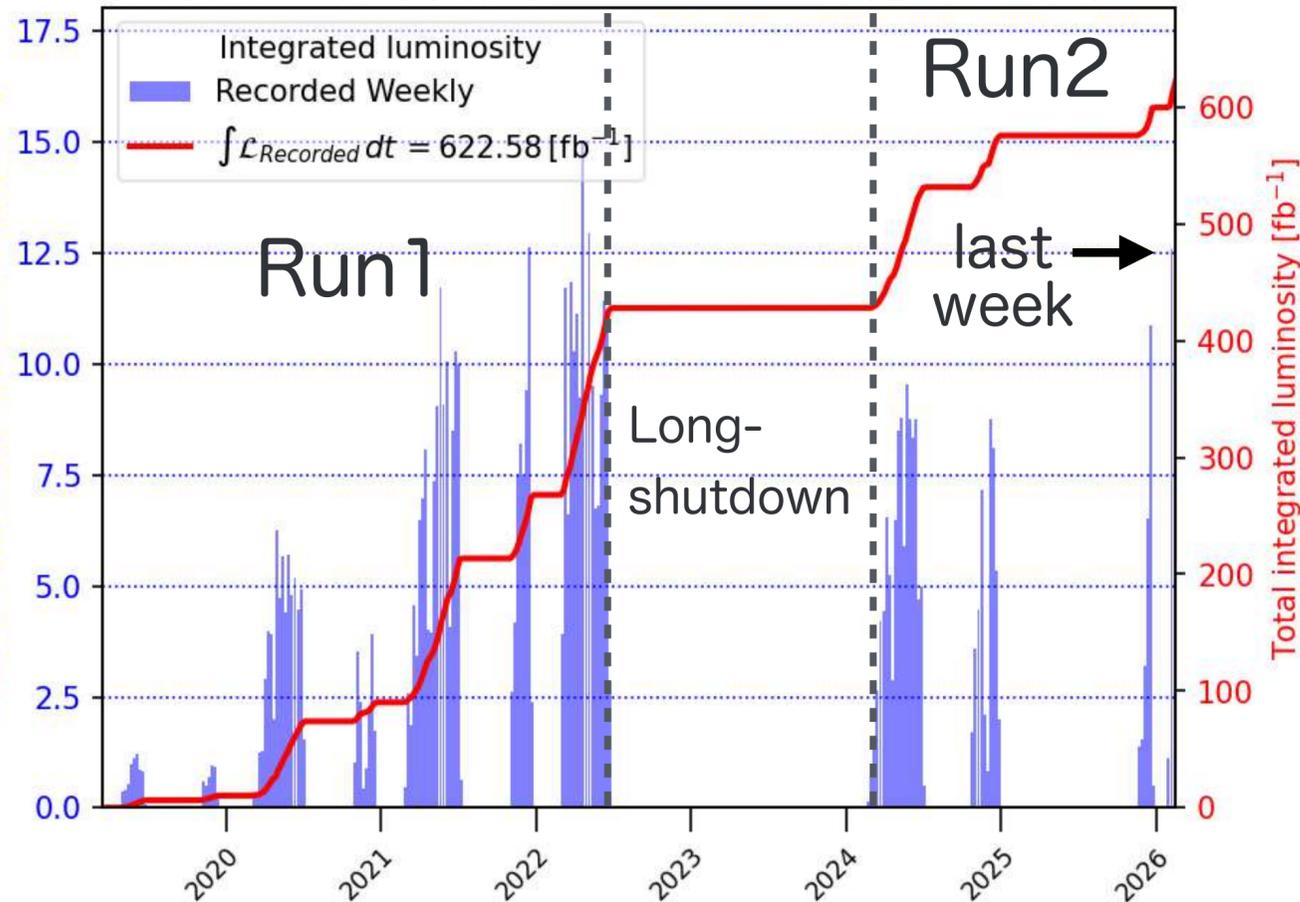
Particle Identification

K eff.: 90%, fake π rate: 5%



Belle II Online luminosity

Exp: 7-39 - All runs



Belle II Physics

From SM precision measurement to BSM searches



- 4. $R(D^{(*)})$
- 5. $B \rightarrow \ell \nu$
- 3. $b \rightarrow s \gamma$

- 1. $B \rightarrow K \nu \nu$
- 2. $B \rightarrow K \tau \tau$

6. τ LFC

Key analysis technique: B tagging

94 physics publications in total

List of our recent publications in backup

B tagging technique at Belle II

- Major strength: ability to reconstruct event with missing energy
 - Constraint the kinematics of B_{sig} by the initial state at an e^+e^- collider

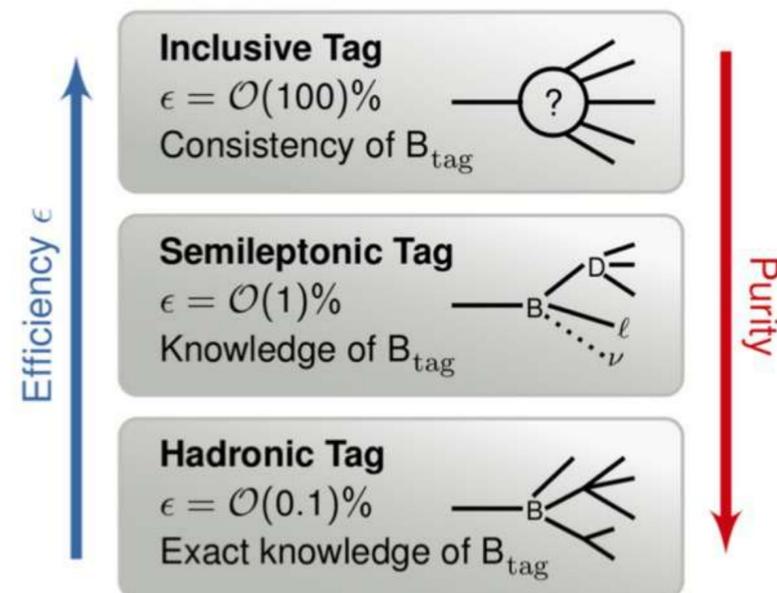
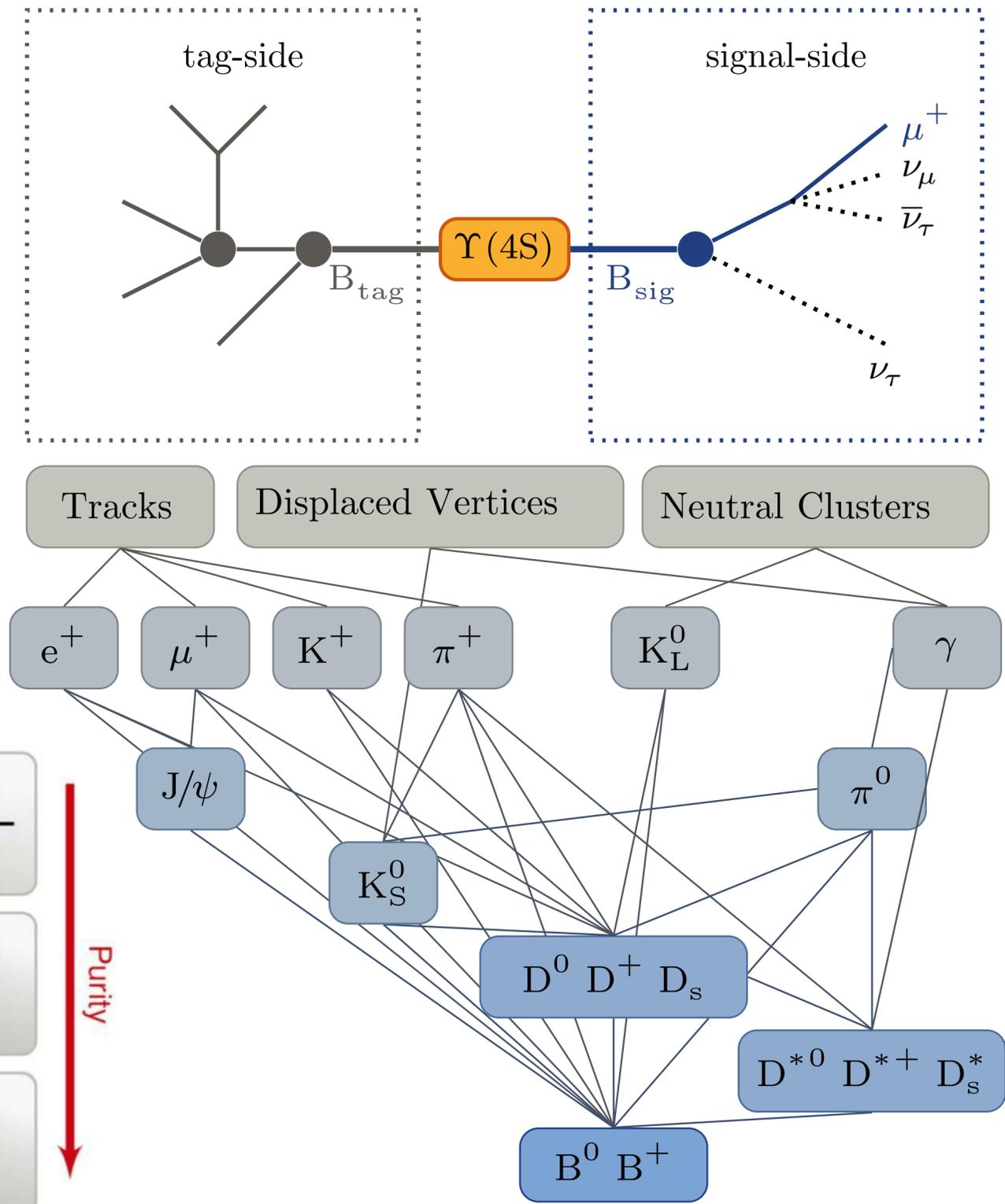
Hadronic / semileptonic tagging

- Reconstruct B_{tag} in low multiplicity, high branching fraction decay modes using Full Event Interpretation
- FEI consists of >200 BDTs, reconstructing $O(10k)$ decay chains
- Tagging samples dominated by large-BF mode with low-background

Inclusive tagging

- Reconstruct B_{sig} and assign everything else to the rest-of-event (ROE)

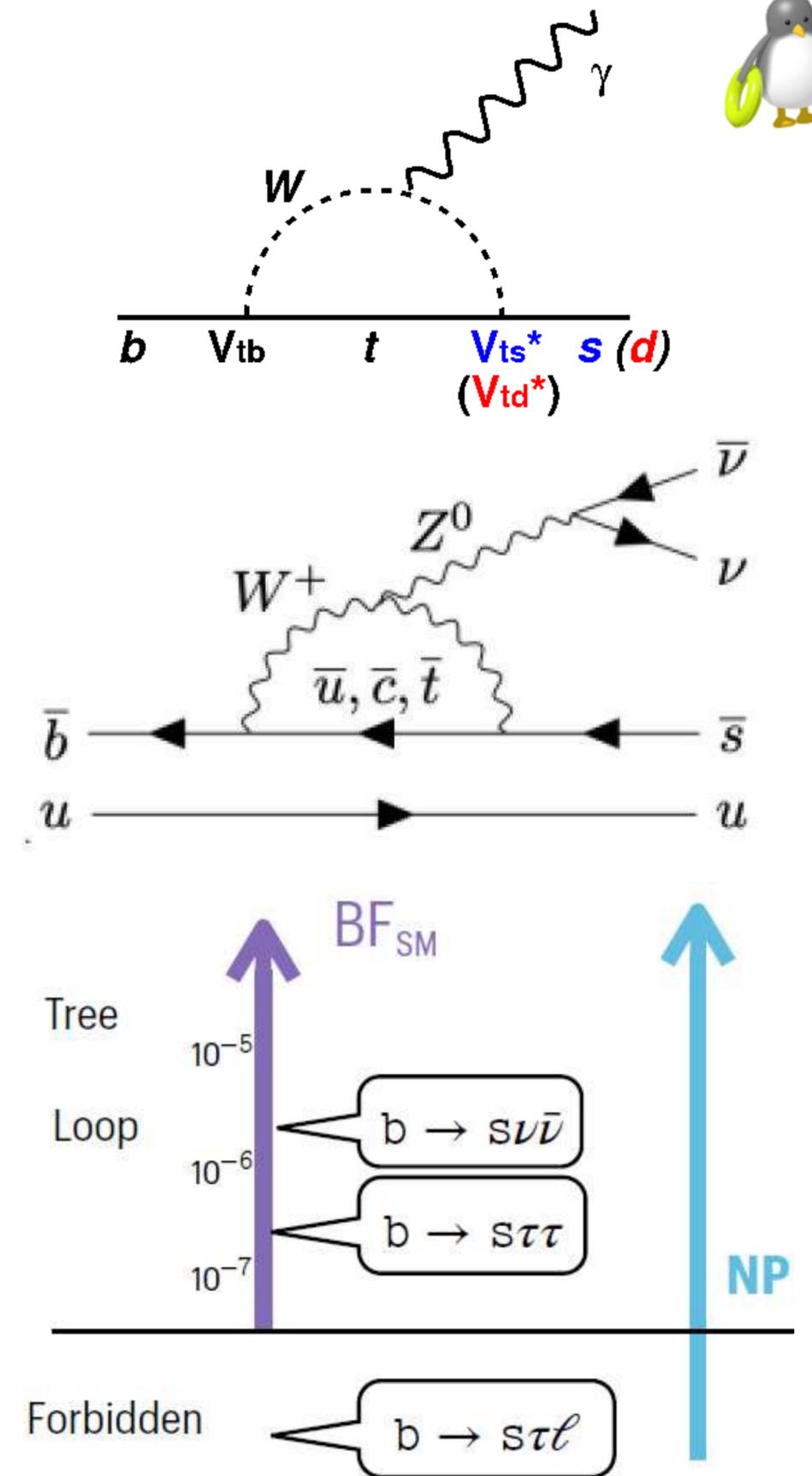
[Comp. Soft. for Big Science 3 \(2019\) 6](#)



Electroweak Penguin Decays



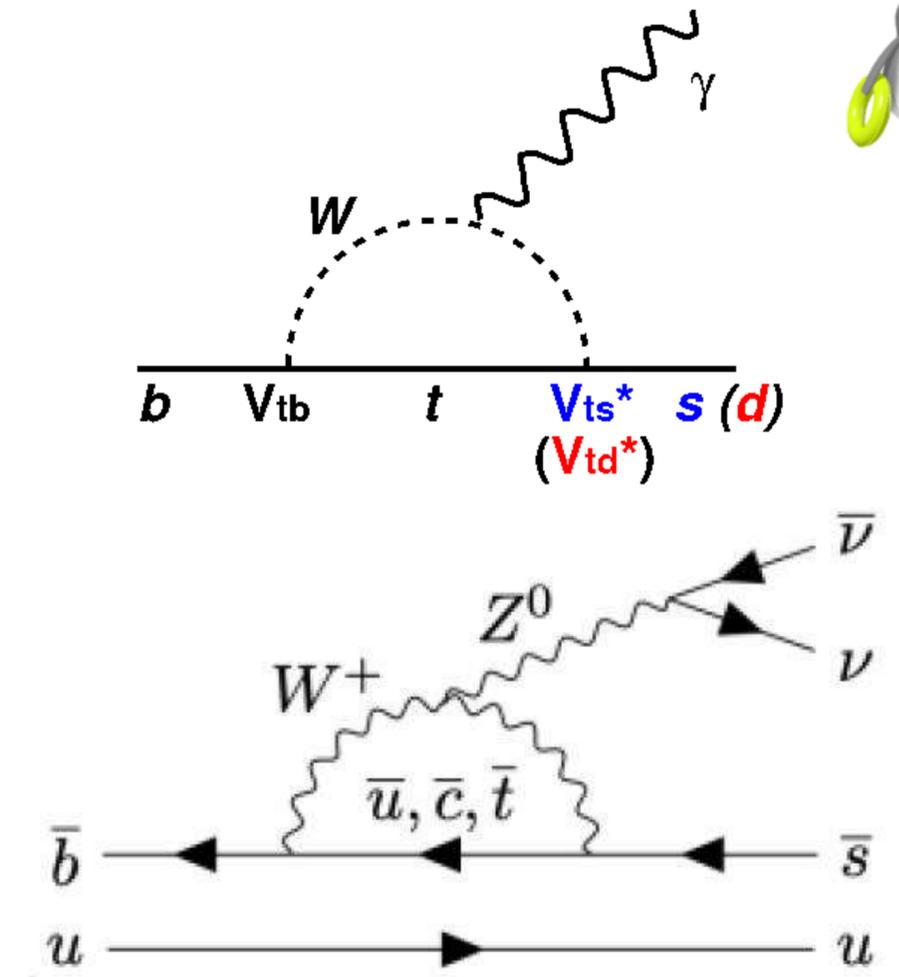
- Flavor Changing Neutral Current (FCNC)
 - Forbidden at the tree level in the SM
 - Small branching fraction in the SM ($<10^{-5}$)
- Sensitive to New Physics (NP)
 - Heavy new particles can enter the loop
- Key channels: $b \rightarrow s \gamma$, $d \gamma$, $s \ell \ell$, $d \ell \ell$, $s \nu \nu$, ...
- Precise theoretical prediction for the inclusive process
- The branching fraction of exclusive processes has large uncertainty, except for $b \rightarrow s \nu \nu$
- Many observables
 - Branching fractions, CP asymmetries, Angular distribution, Photon polarization



Electroweak Penguin Decays

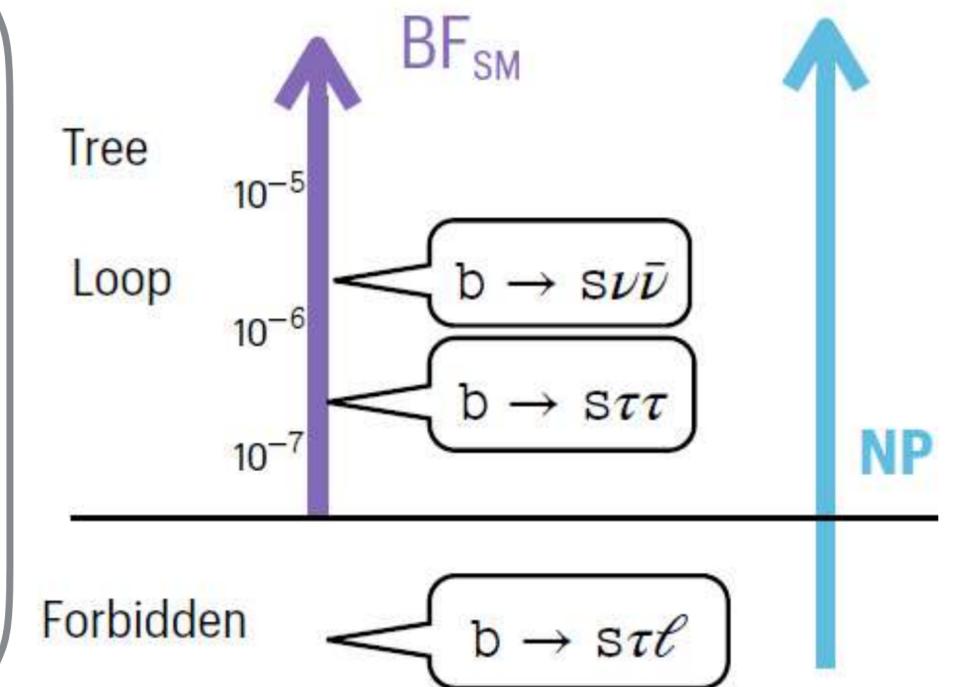


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Analysis covered in this talk

- $B^+ \rightarrow K^+ \nu \nu$ reinterpretation
- $B \rightarrow X_s \nu \nu$
- Search for $B^+ \rightarrow K^+ \tau \tau$
- $b \rightarrow s(d) \gamma$ transitions
- Time-dependent CP violation in $B^0 \rightarrow K_s \pi \pi \gamma$



$B^+ \rightarrow K^+ \nu \nu$ reinterpretation

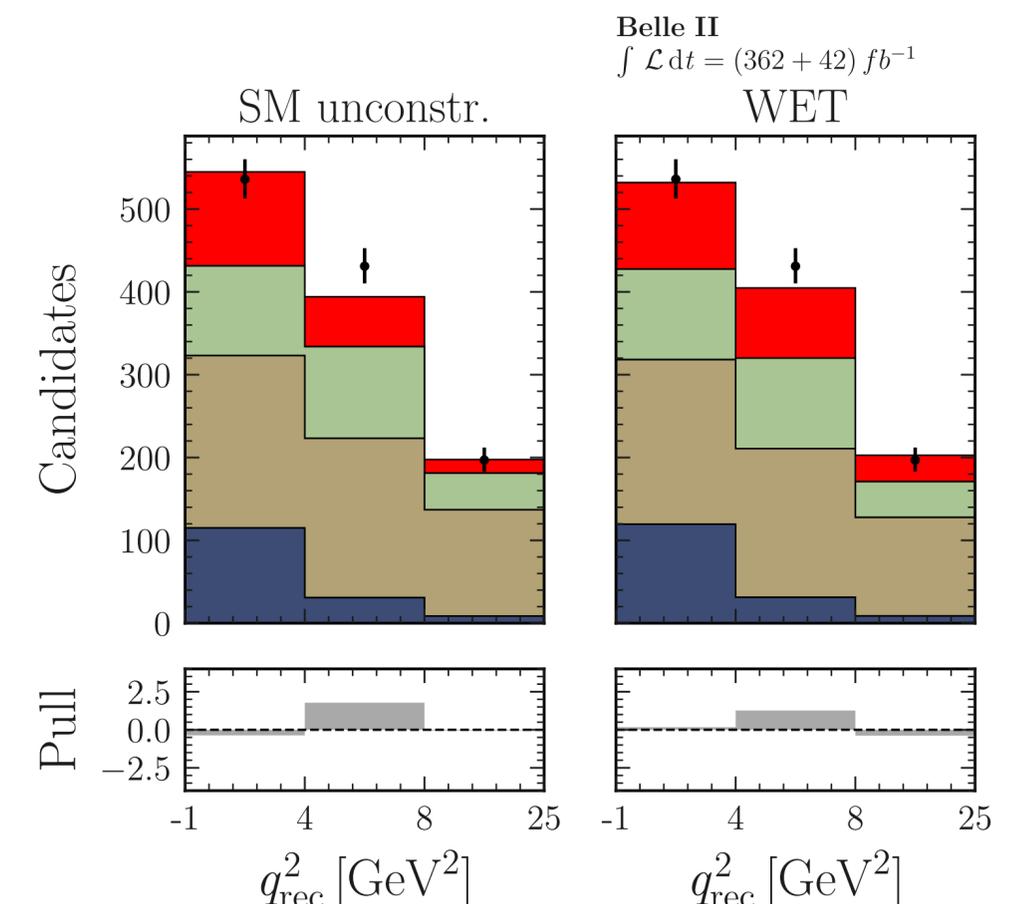
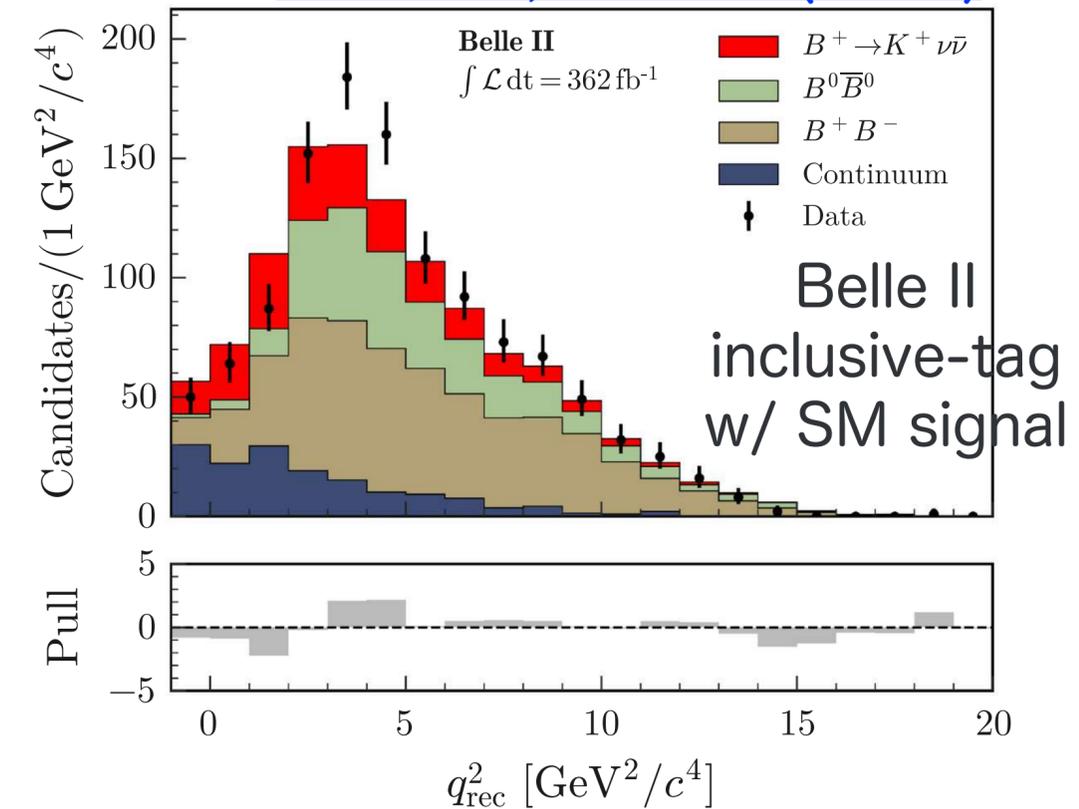
- Originally measured $\mu_{\text{SM}} = 4.6 \pm 1.3$ (B-only; 3.5σ ; SM: 2.7σ)
- A model-agnostic likelihood enabling consistent reinterpretations beyond the SM.
- Re-weight SM signal in true q^2 :
 $w(q^2) = \sigma_{\text{BSM}} / \sigma_{\text{SM}}$ (keeps q^2 -dependent efficiencies)
- Bayesian week effective theory fit to $|C_{\text{VL}} + C_{\text{VR}}|$, $|C_{\text{SL}} + C_{\text{SR}}|$, $|C_{\text{TL}}|$
- Fit prefers an enhanced vector contribution (in SM, $C_{\text{VL}} = 6.6$) and a non-zero tensor component

[PRD 112, 092016 \(2025\)](#)

Parameters	Mode	68% HDI	95% HDI
$ C_{\text{VL}} + C_{\text{VR}} $	11.3	[7.8, 14.6]	[1.9, 16.2]
$ C_{\text{SL}} + C_{\text{SR}} $	0.0	[0.0, 9.6]	[0.0, 15.4]
$ C_{\text{TL}} $	8.2	[2.3, 9.6]	[0.0, 11.2]

Likelihood and reinterpretation tool are publicly available on [HEPData](#)

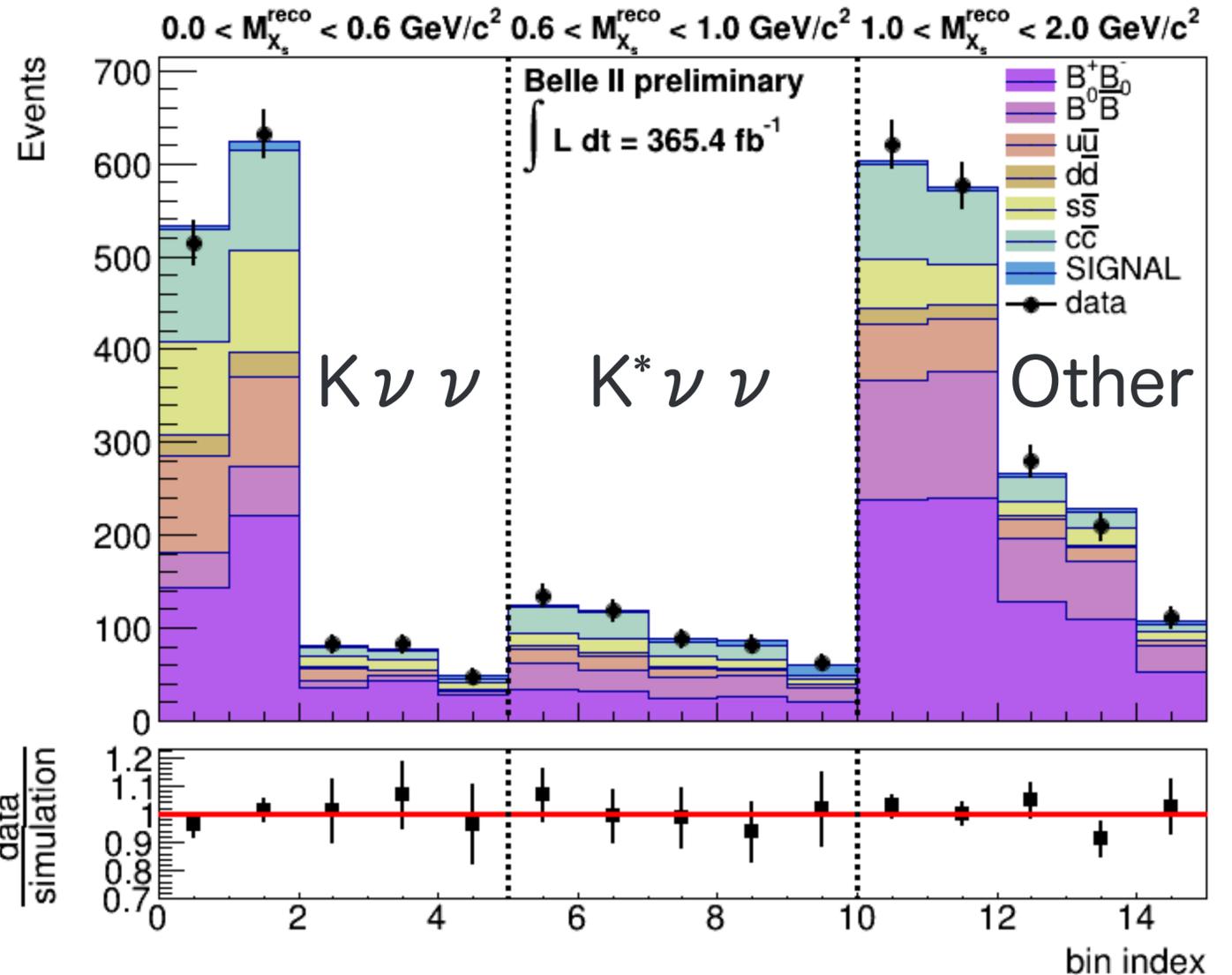
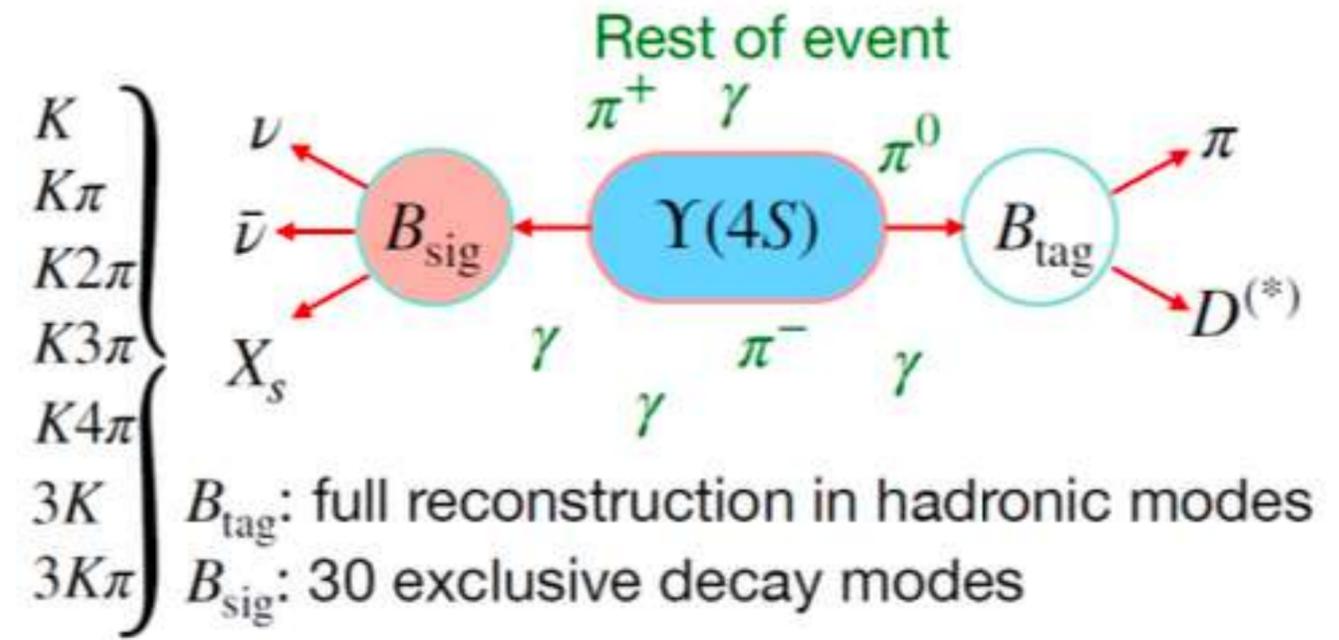
[PRD 109, 112006 \(2024\)](#)



$B \rightarrow X_s \nu \nu$

[arXiv:2511.10980v1](https://arxiv.org/abs/2511.10980v1)

- Reconstruct X_s from $K + n\pi$ ($n=0, 1, \dots, 4$)
 - Sum-of-exclusives: 93%
- Hedonic tag method ($\sim 0.1\%$)
- Fit to the bins of M_{X_s} and BDT output
 - BDT: background suppression variable
- First search of inclusive $B \rightarrow X_s \nu \nu$



$M_{X_s} [\text{GeV}/c^2]$	$\epsilon [10^{-3}]$	N_{sig}	$\mathcal{B} [10^{-5}]$		
			central value	UL_{obs}	UL_{exp}
(*) $[0, 0.6]$	2.93	6_{-17}^{+18+19}	$0.3 \pm 0.8_{-0.7}^{+0.9}$	2.2	2.0
$[0.6, 1.0]$	1.32	36_{-26}^{+27+31}	$3.5_{-2.5}^{+2.6+3.1}$	9.5	6.6
$[1.0, m_B]$	0.62	24_{-43}^{+44+62}	$5.1_{-8.8}^{+9.2+12.9}$	31.2	26.7

(*) compatible with hadronic-tag $B \rightarrow K \nu \nu$ Belle II meas.

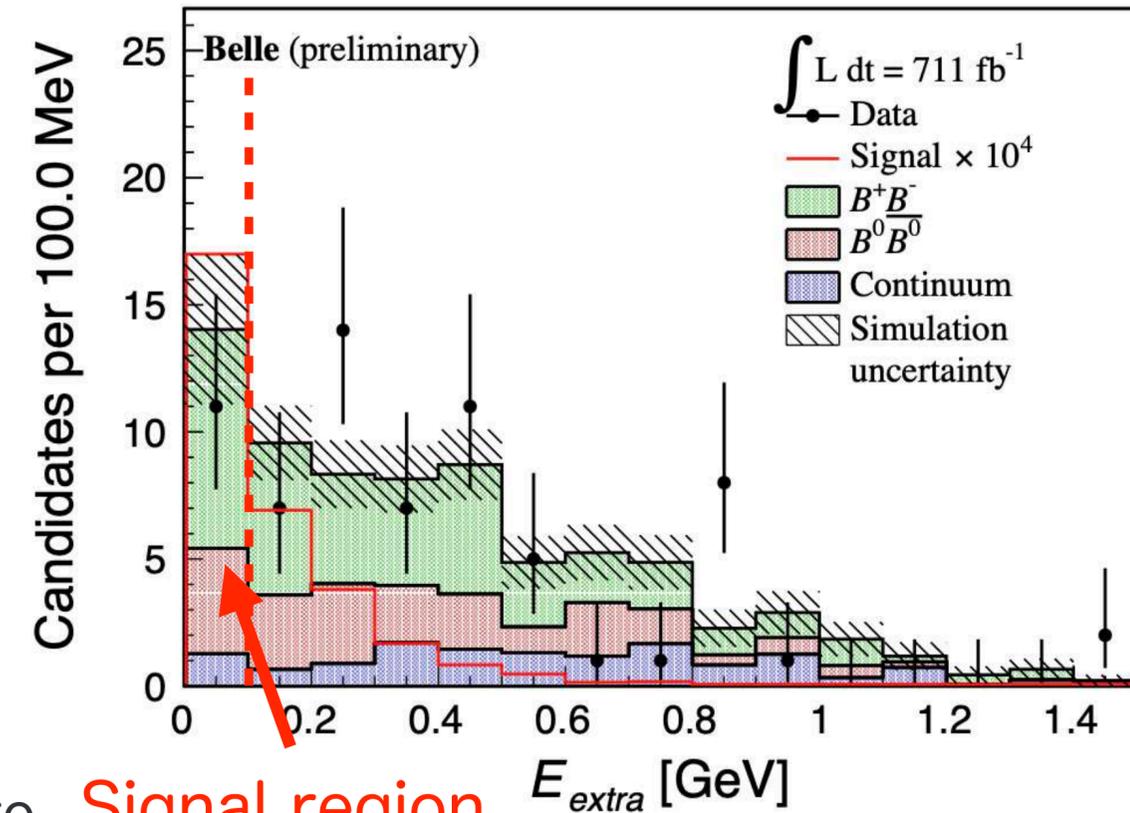
$$\mathcal{B}(B \rightarrow X_s \nu \bar{\nu}) = [8.8_{-8.2}^{+8.5}(\text{stat})_{-10.8}^{+12.6}(\text{syst})] \times 10^{-5}$$

$$< 3.2 \times 10^{-4} \quad (90\% \text{ C.L.})$$

- SM prediction: $(2.9 \pm 0.3) \times 10^{-4}$
- Main syst.: limited MC and background normalization

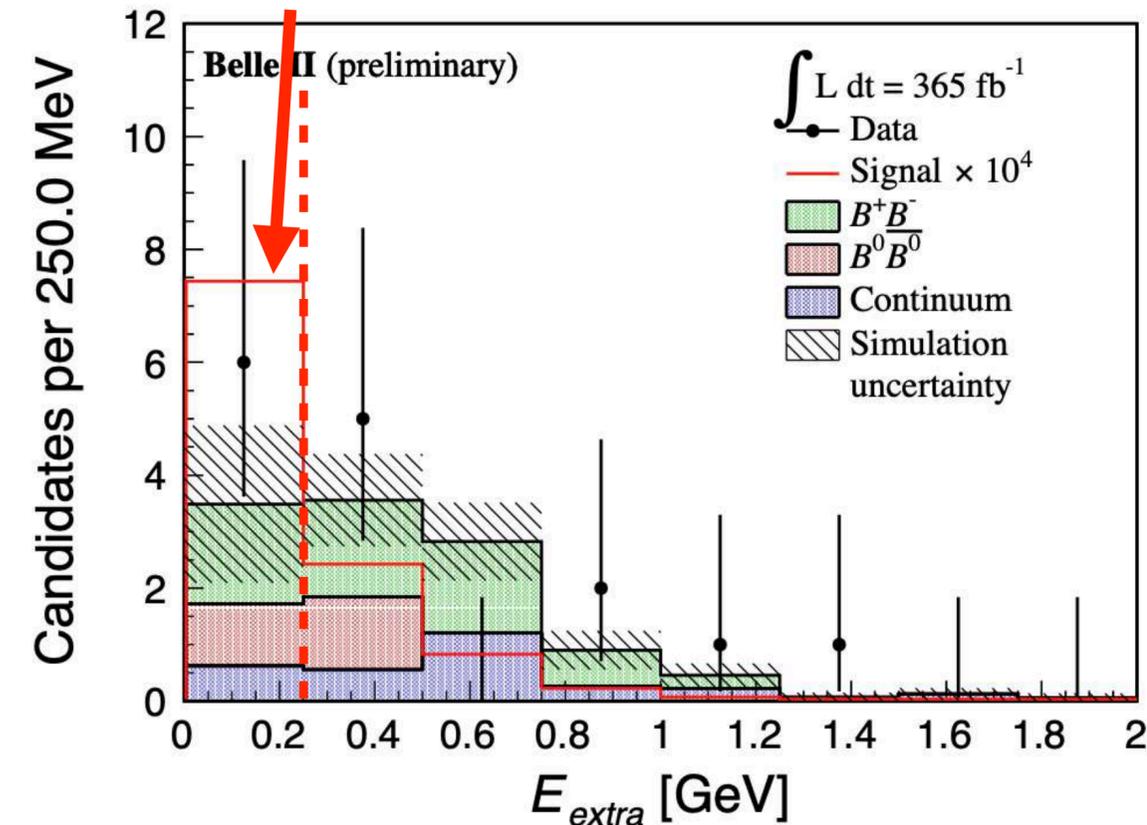
Search for $B^+ \rightarrow K^+ \tau^+ \tau^-$

- Previous best UL (BABAR): $< 2.25 \times 10^{-3}$ (90% C.L.)
- Combined analysis: Belle (711 fb⁻¹) + Belle II (365 fb⁻¹)
 - Reconstruct the other B with a hadronic-tag (full reconstruction)
 - On signal-side, consider only leptonic τ decays ($\ell \nu \nu$)
 - Use cut-based selections to suppress background
 - Extract signal by event counting in E_{ECL} variable
 - E_{ECL} : total energy not assigned to the tag B and the signal candidate



Signal region

	Belle	Belle II
N_{bkg}	$14.1 \pm 1.6 \pm 1.9$	$3.5 \pm 0.7 \pm 0.9$
N_{obs}	11	6
$\mathcal{B}(B^+ \rightarrow K^+ \tau^+ \tau^-) \times 10^4$	$-2.7^{+3.2}_{-2.6} \pm 2.2$	$5.1^{+5.6}_{-4.3} \pm 2.5$
Obs. (exp.) limit (10^{-3})	0.4 (0.7)	1.6 (0.9)



- Combined result: $< 8.7 \times 10^{-4}$ (90% C.L.) — World-best
 - Dominant systematics: background estimation
 - More data will improve the background estimation in the sidebands

$b \rightarrow s(d) \gamma$ transitions

- Theoretically clean, clear experimental signature (high energy photon)
- Test NP also with CP, Isospin, and helicity observables.

Recent Belle II results

Exclusive channels:

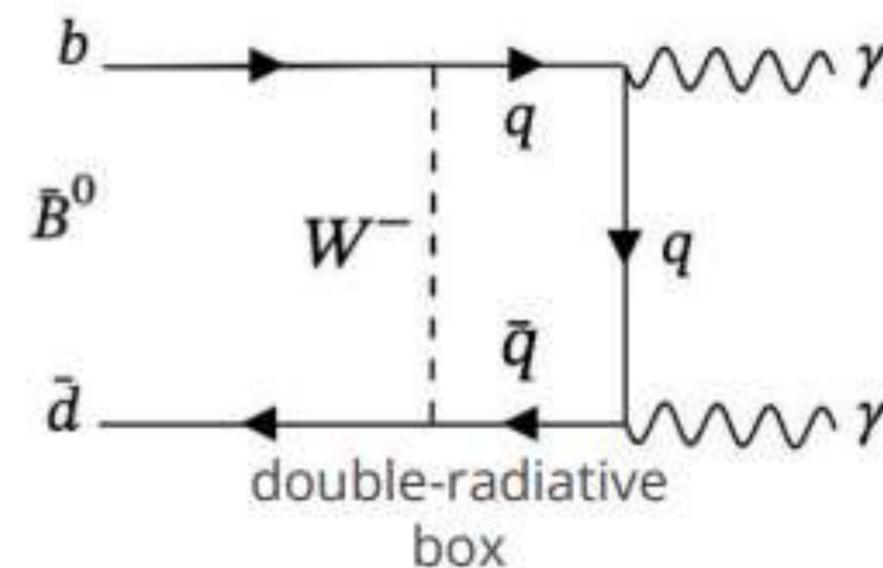
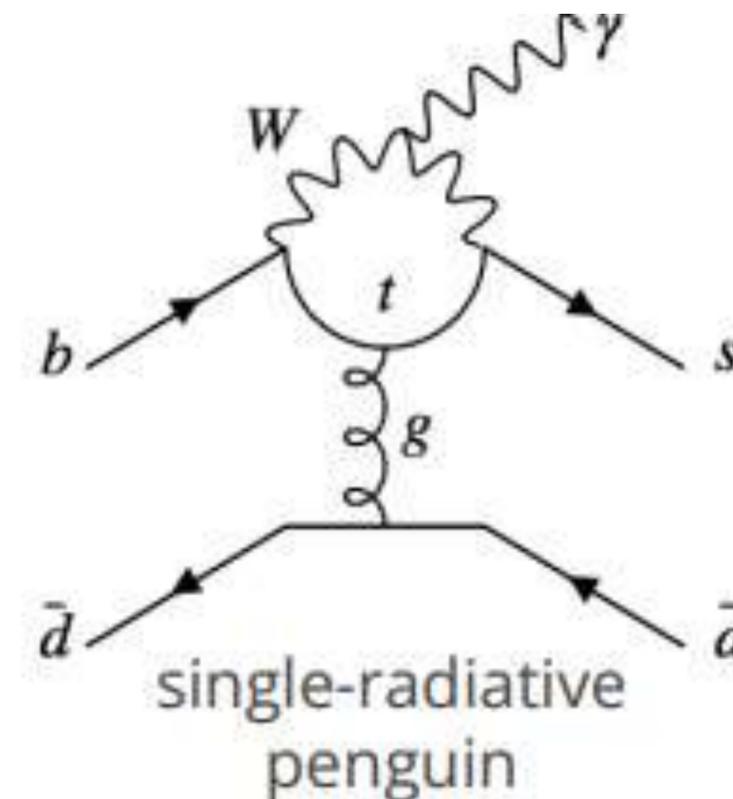
- $B \rightarrow \rho \gamma$ (Belle + Belle II): [PRD 111, L071103 \(2025\)](#)
- $B \rightarrow \gamma \gamma$ (Belle + Belle II): [PRD 110, L031106 \(2024\)](#)
- $B \rightarrow K^* \gamma$ (Belle II): [JHEP09 \(2025\) 024](#)

Inclusive channels:

- $B \rightarrow X_s \gamma$ (Belle II, 189 fb⁻¹): [arXiv:2210.10220](#)

→ Belle II already competitive, entering precision regime for $b \rightarrow s \gamma$

Recent results: Time-dependent CP violation in $B^0 \rightarrow K_s \pi \pi \gamma$



Time-dependent CP violation in $B^0 \rightarrow K_s \pi \pi \gamma$

[arXiv:2510.01331v2](https://arxiv.org/abs/2510.01331v2)

accepted by JHEP

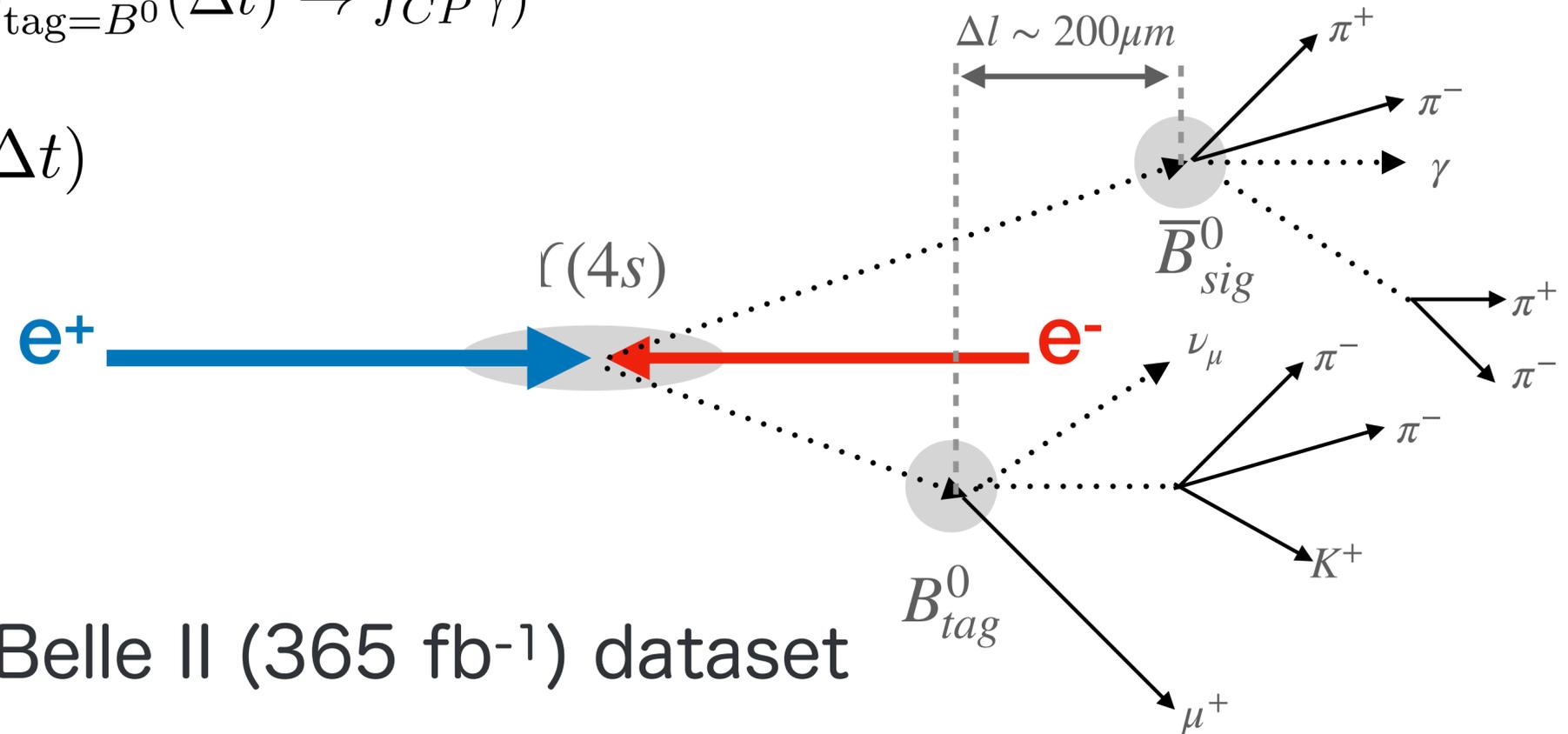
- In the SM, $S_{CP} \sim 0$ due to suppressed right-handed currents
- Sensitive to NP contributions in the loop

$$A_{CP}(\Delta t) = \frac{\Gamma(B_{\text{tag}}=B^0(\Delta t) \rightarrow f_{CP}\gamma) - \Gamma(B_{\text{tag}}=\bar{B}^0(\Delta t) \rightarrow f_{CP}\gamma)}{\Gamma(B_{\text{tag}}=B^0(\Delta t) \rightarrow f_{CP}\gamma) + \Gamma(B_{\text{tag}}=\bar{B}^0(\Delta t) \rightarrow f_{CP}\gamma)}$$

$$= S \sin(\Delta m \Delta t) - C \cos(\Delta m \Delta t)$$

Mixing-induced
CP violation

Direct
CP violation



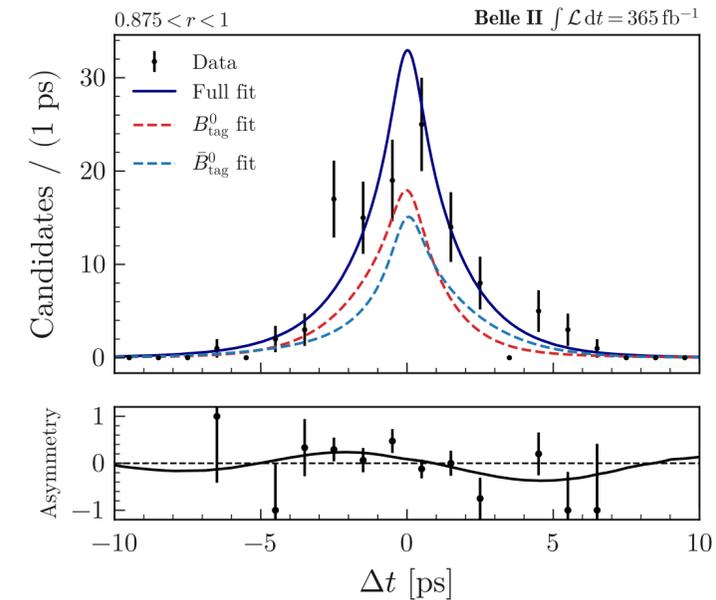
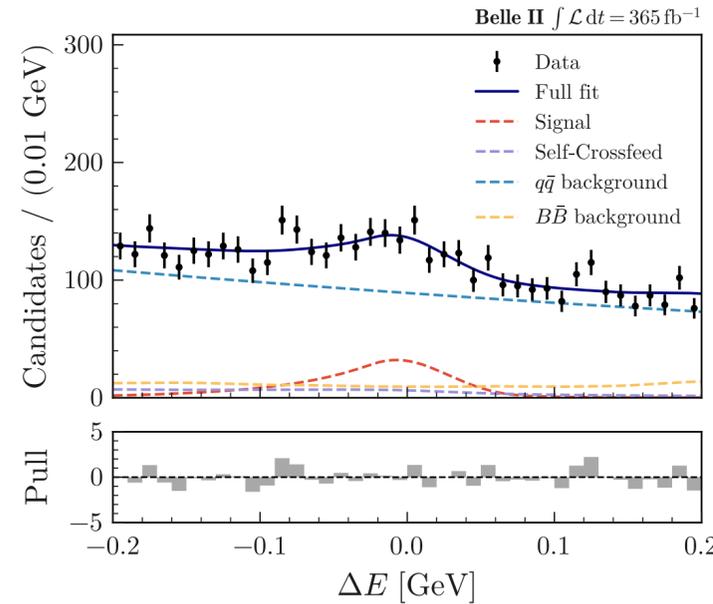
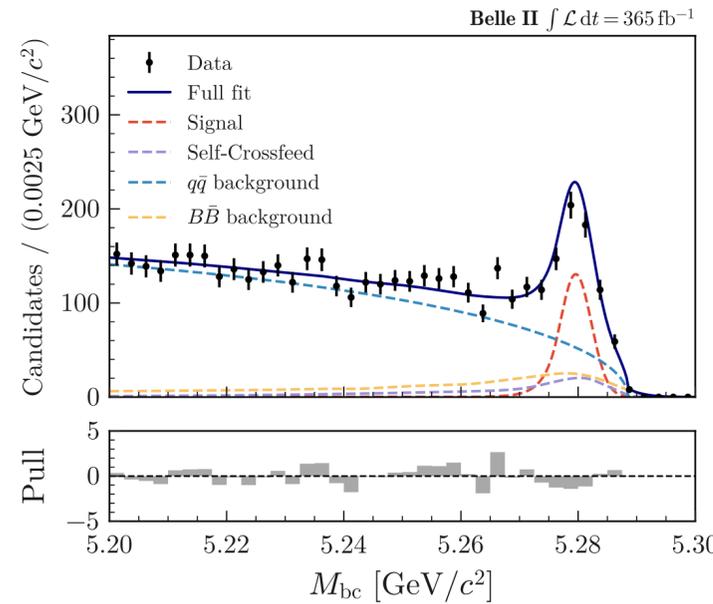
- Analyze full Belle (711 fb^{-1}) and Belle II (365 fb^{-1}) dataset

- $E_\gamma > 1.5$ (1.4) GeV for Belle II (Belle), K_s : Belle II standard MVA

- Continuum suppression via event shape, Vertexing and flavor tagging for Δt

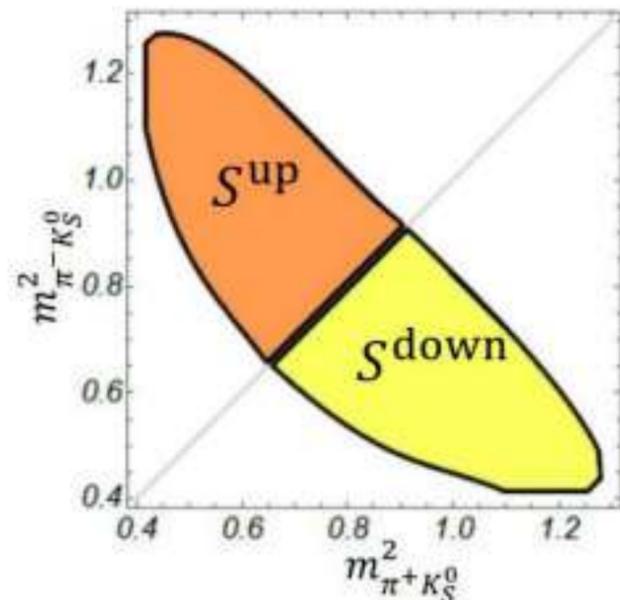
Time-dependent CP violation in $B^0 \rightarrow K_S \pi \pi \gamma$

- Time-dependent CP fit
- Unbinned ML 3D fit
- New observables S^+ , S^-
 - Dalitz plane: S^{up} , S^{down}
- Exploit $\pi^+ \leftrightarrow \pi^-$ symmetry of the Dalitz plane:
 - even (symmetric) vs odd (antisymmetric) components
 - e.g.) even-dominated: $K_S \rho^0 \gamma$, odd-dominated: $K^{*\pm} \pi^\mp \gamma$



[arXiv:2510.01331v2](https://arxiv.org/abs/2510.01331v2)

accepted by JHEP



New observables:

- $S^+ = S^{\text{up}} + S^{\text{down}}$
- $S^- = S^{\text{up}} - S^{\text{down}}$

Result: Most precise in S and C

$$C = -0.17 \pm 0.09 \pm 0.04$$

$$S = -0.29 \pm 0.11 \pm 0.05$$

New approach

$$S^+ = -0.57 \pm 0.23 \pm 0.10$$

$$S^- = 0.31 \pm 0.24 \pm 0.05$$

Statistically dominant,
 Belle: vertex-detector misalignment,
 Belle II: CP-fit validation bias

LFU in $R(D^{(*)})$

- Lepton flavor Universality (LFU) test

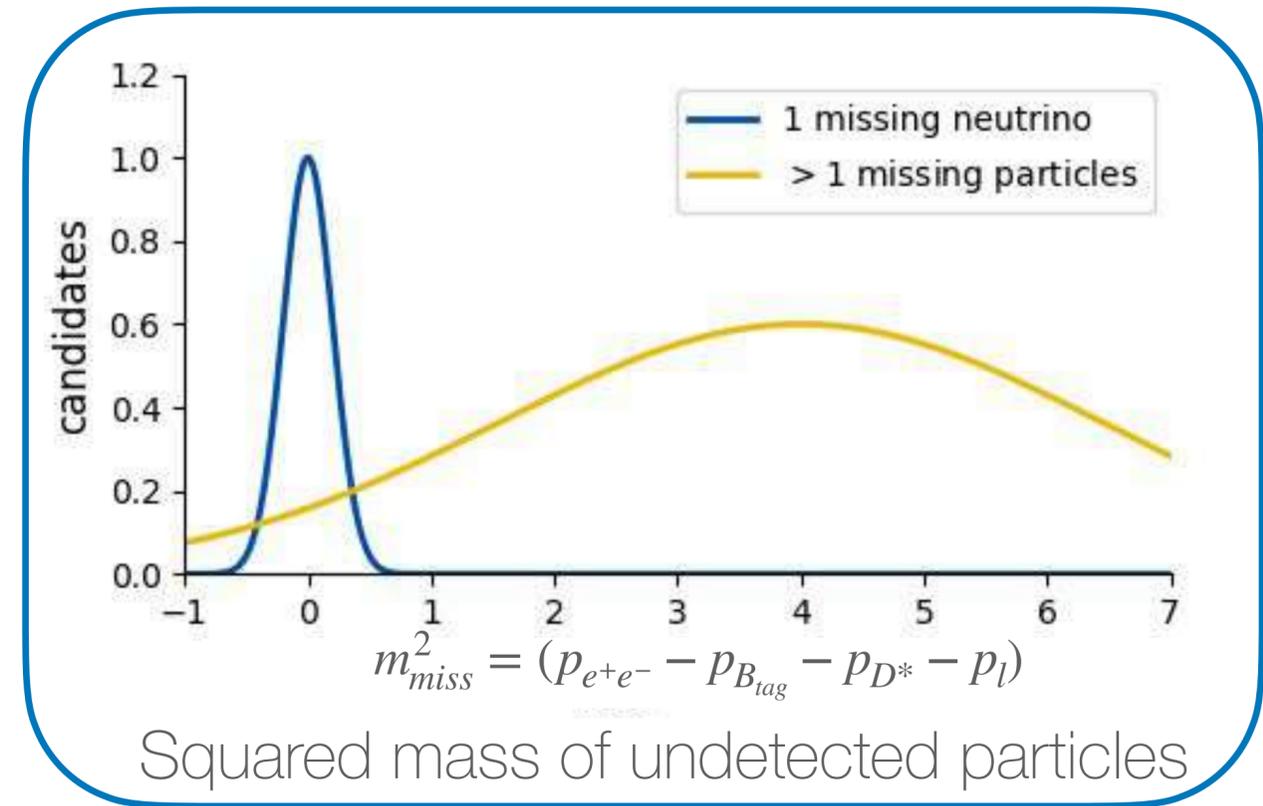
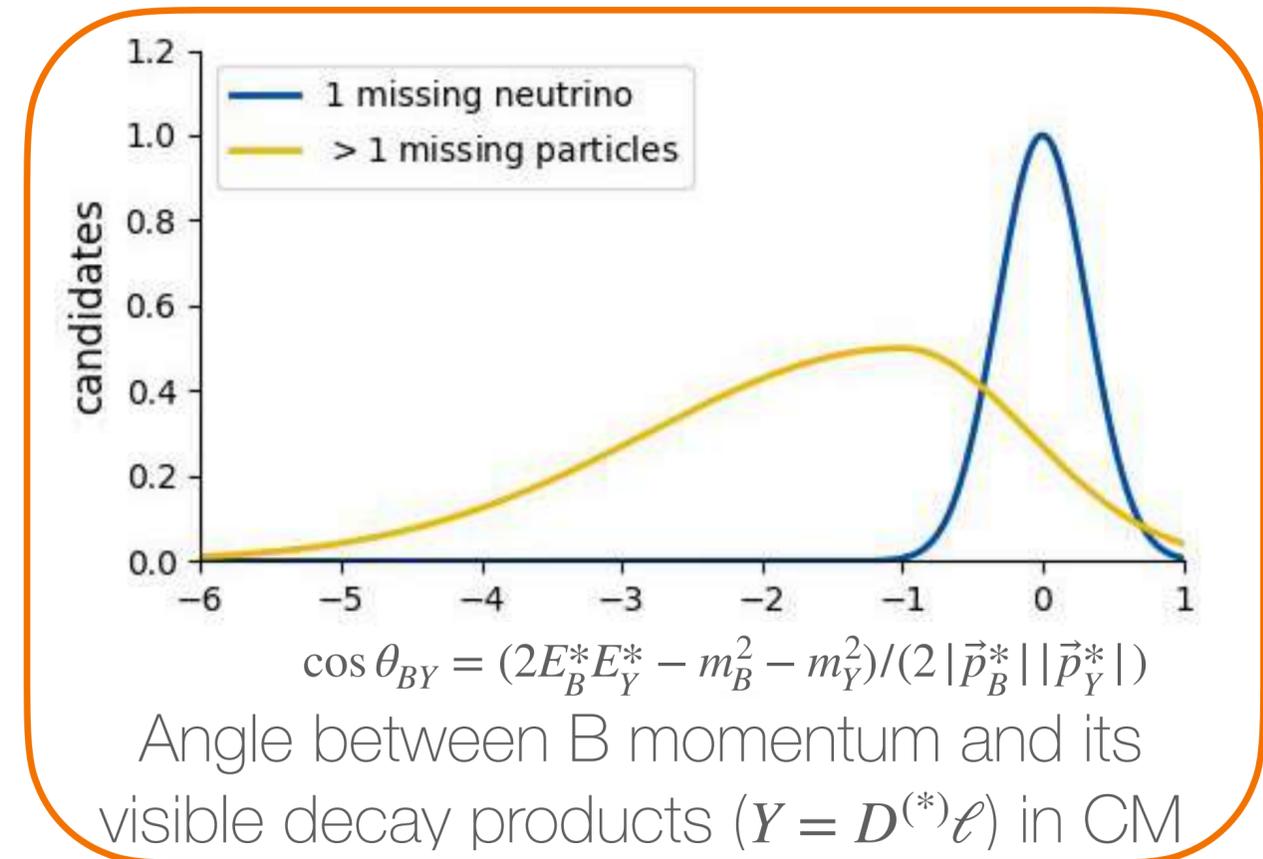
$$R(D^{(*)}) = \frac{\mathcal{B}(\bar{B} \rightarrow D^{(*)} \tau^- \bar{\nu}_\tau)}{\mathcal{B}(\bar{B} \rightarrow D^{(*)} \ell^- \bar{\nu}_\ell)} \quad \ell = e, \mu$$

Reconstruct signal $D^{(*)}$ and $\tau \rightarrow \ell \nu \nu$

- Partially reconstruct **semileptonic** B_{tag}
- Fully reconstruct **hadronic** B_{tag}

Unassigned energy in ECL (E_{extra} , E_{ECL})

- Low for neutrinos,
- High for missing detectable particles



Semileptonic tag $R(D^{(*)+})$

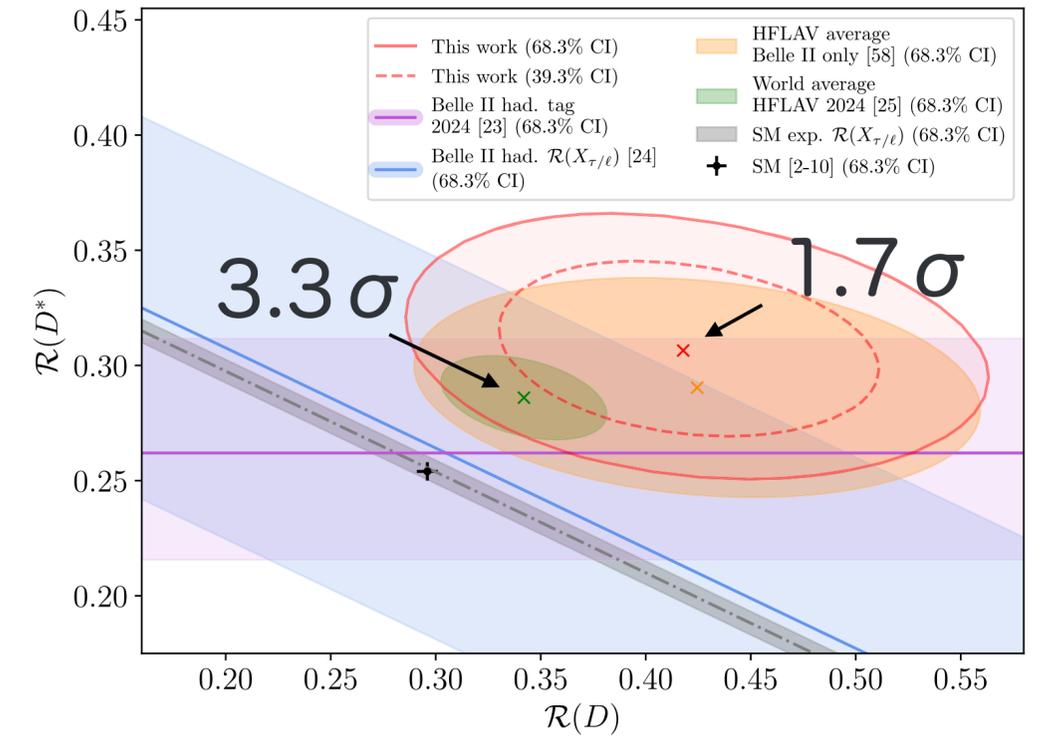
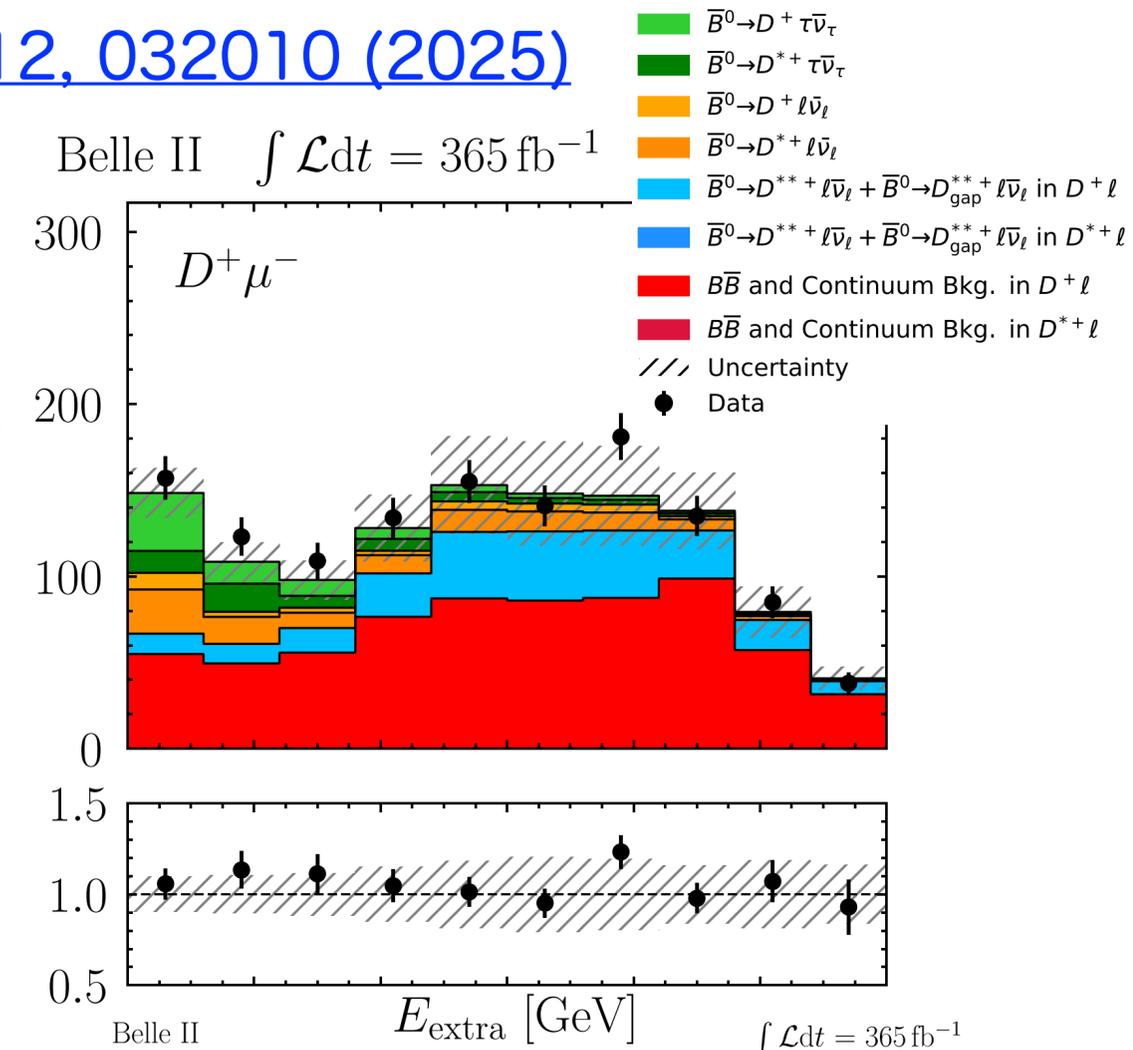
- Fit to multi-class BDT outputs to simultaneously separate semitauonic signal, semileptonic normalization, and backgrounds
-> enabling extraction of $R(D^{(*)})$

- Most powerful variables: E_{extra} and $\cos \theta_{BY}$

$$\mathcal{R}(D^+) = 0.418_{-0.073}^{+0.075} (\text{stat})_{-0.056}^{+0.049} (\text{syst})$$

$$\mathcal{R}(D^{*+}) = 0.306_{-0.033}^{+0.035} (\text{stat})_{-0.018}^{+0.016} (\text{syst})$$

- First measurement using SL tag at Belle II
- Leading systematics
 - Size of MC samples for signal shaping, normalization and backgrounds
 - Backgrounds from unmeasured semileptonic decays



Hadronic tag $R(D^{(*)})$

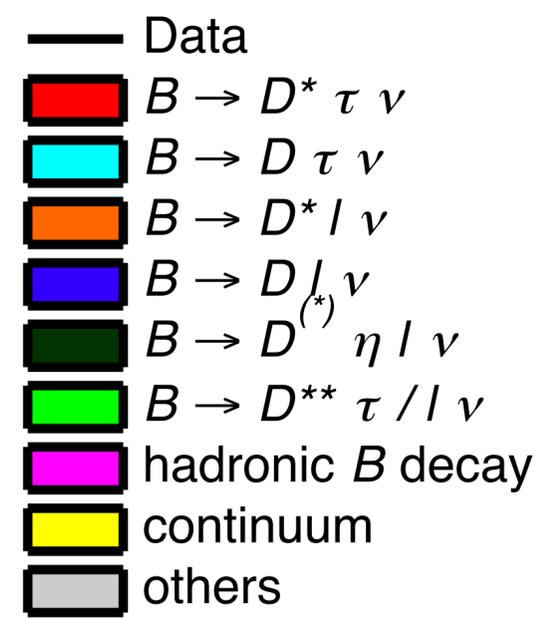
Paper in preparation

- 2D binned template likelihood fit, simultaneously in 5 channels

(E_{ECL} and M_{miss}^2)

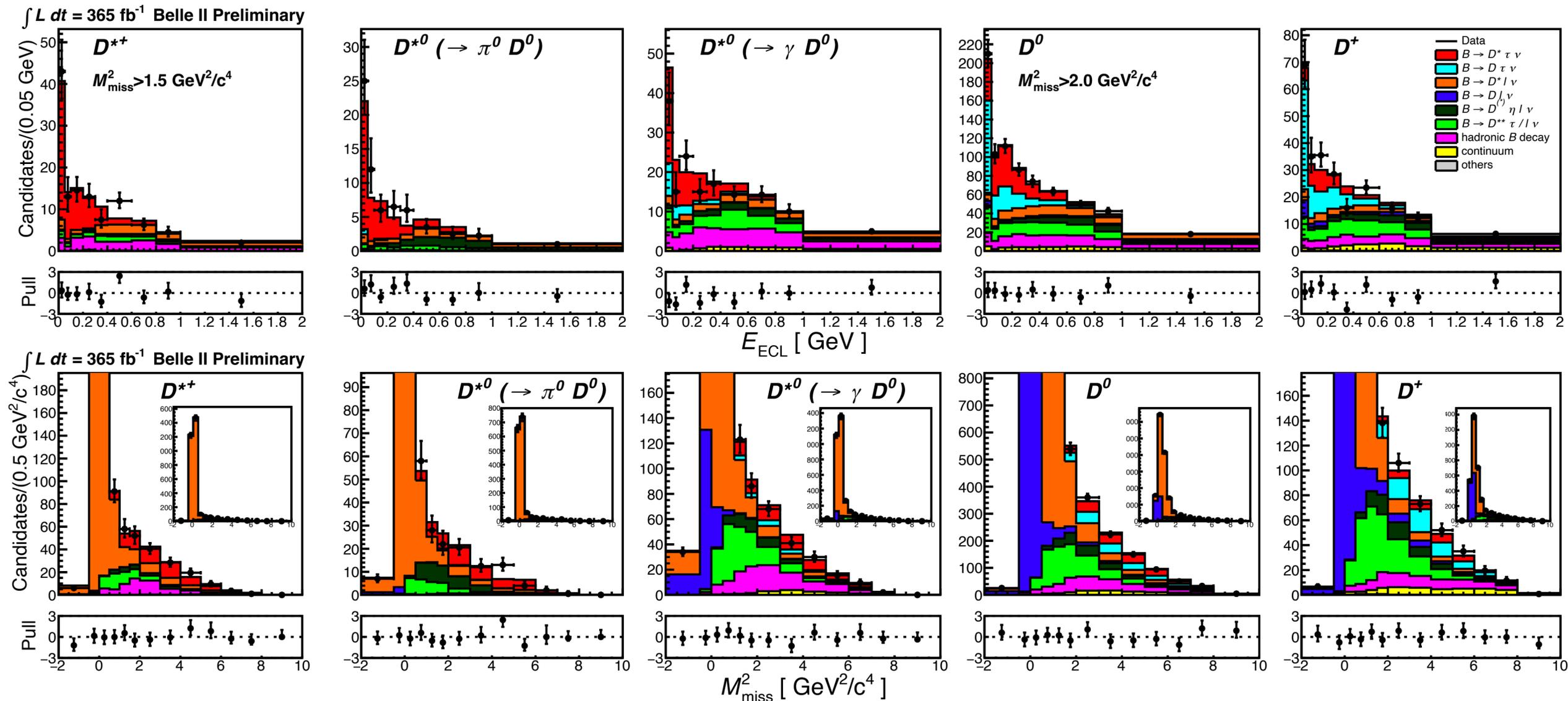
$$R(D^*) = 0.242 \pm 0.019(\text{stat}) \pm 0.016(\text{syst})$$

$$R(D) = 0.439 \pm 0.055(\text{stat}) \pm 0.046(\text{syst})$$

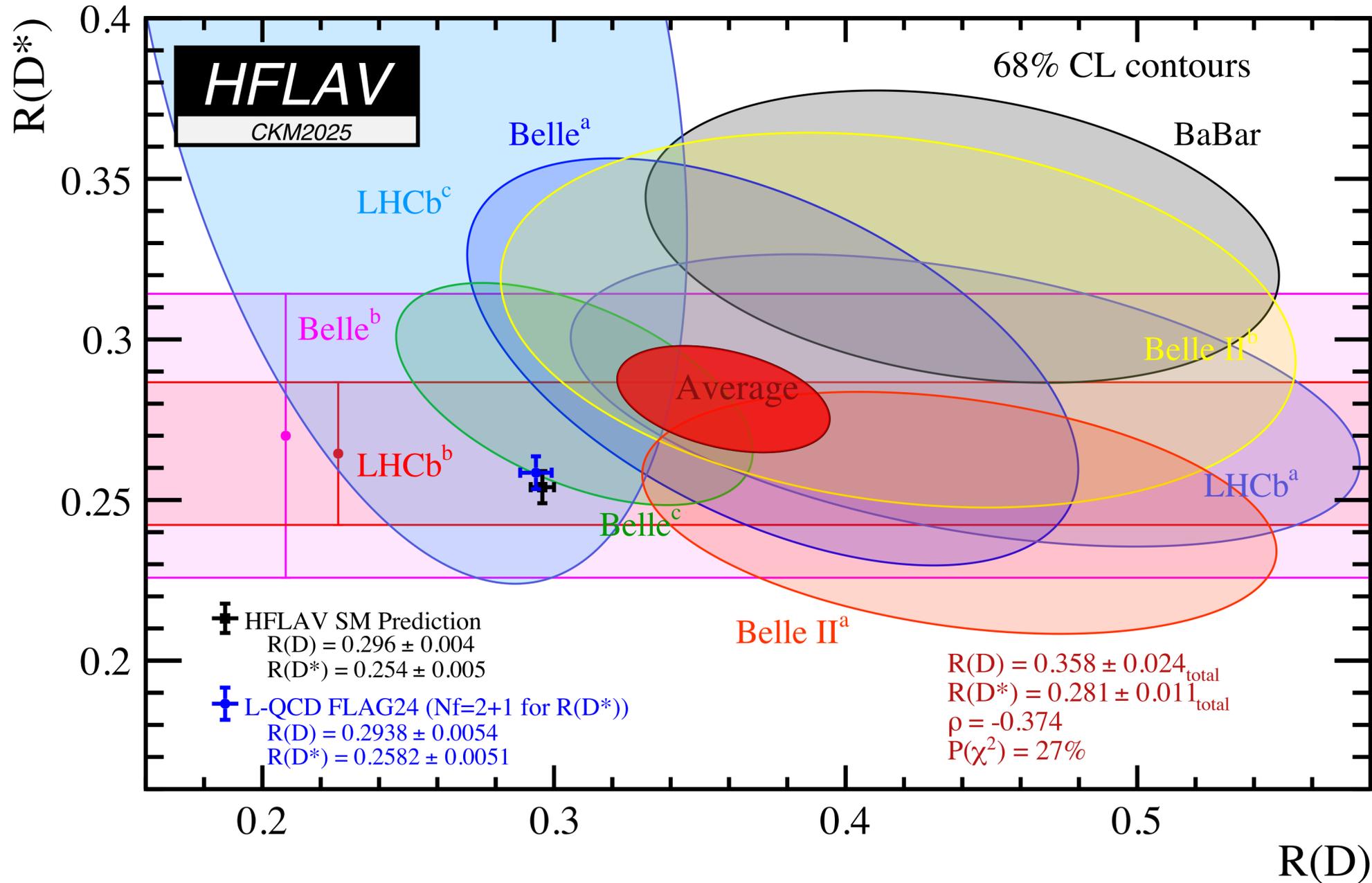


- Most precise meas. with hadronic-tag

- Leading syst. are the same as SL-tag



LFU in $R(D^{(*)})$



Belle II^a = Hadronic-tag

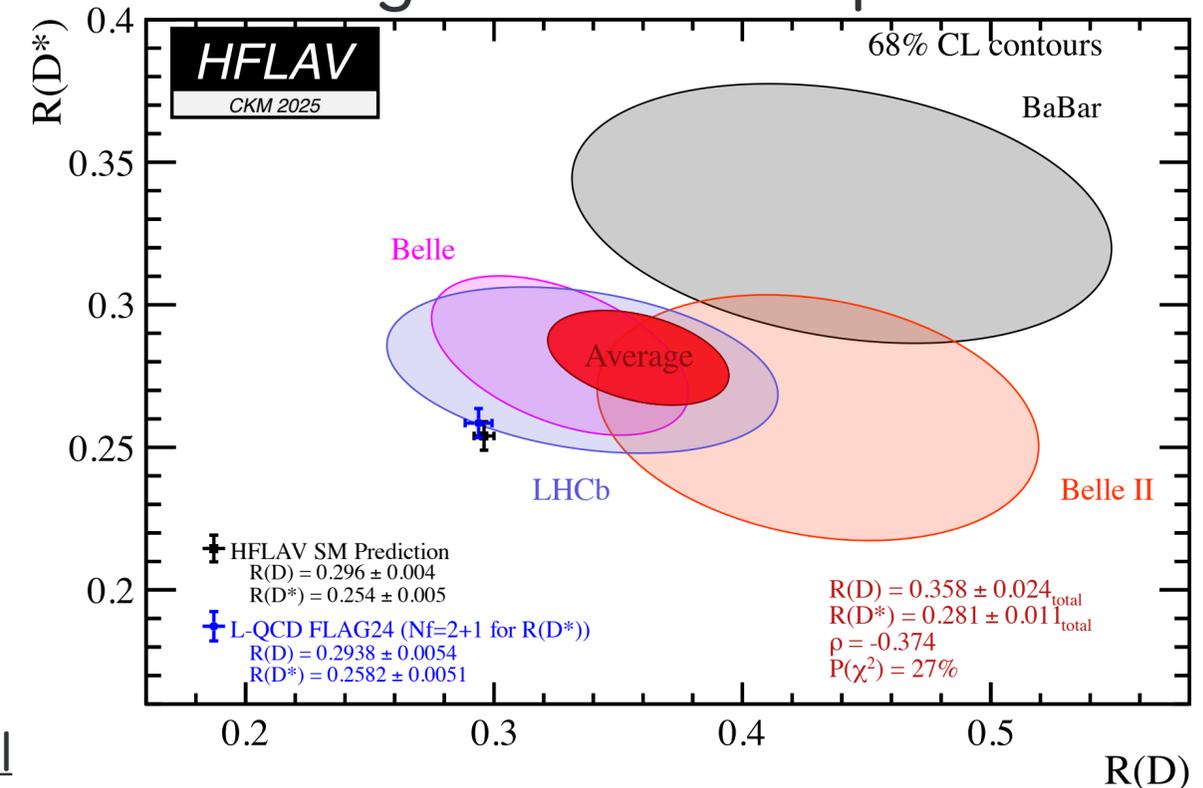
Belle II^b = Semileptonic-tag

3.8 σ tension with SM prediction

- $R(D)$ tension with SM: 2.5 σ

- $R(D^*)$ tension with SM: 2.3 σ

Average for each experiment



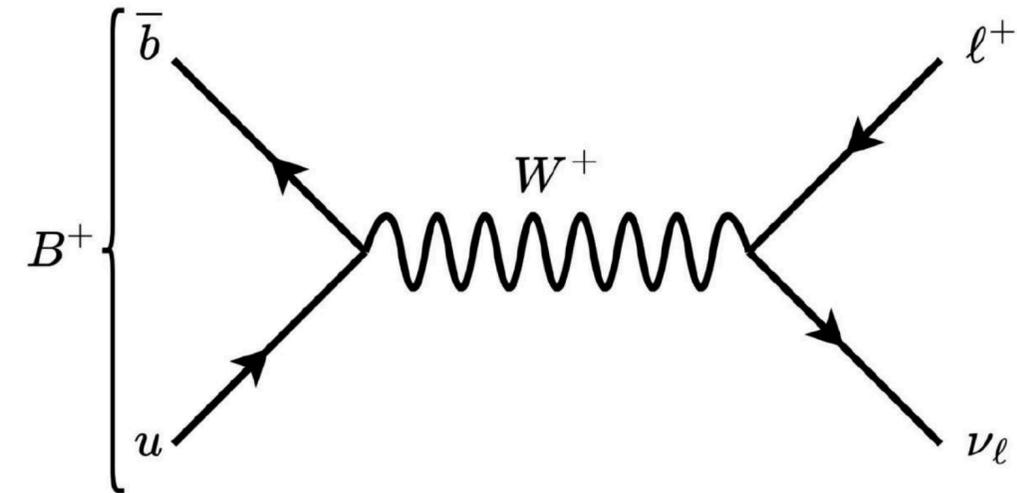
<https://hflav-eos.web.cern.ch/hflav-eos/semi/ckm25/html/RDsDsstar/RDRDs.html>

Leptonic B decays: $B \rightarrow \ell \nu$ ($\ell = \tau, \mu$)

Key points

- Theoretically clean: no hadrons at the B decay vertex
-> decay rate directly proportional to $f_B^2 |V_{ub}|^2$

$$\mathcal{B}(B^+ \rightarrow \ell^+ \nu) = \frac{G_F^2 m_B m_\ell^2}{8\pi} \left(1 - \frac{m_\ell^2}{m_B^2}\right)^2 f_B^2 |V_{ub}|^2 \tau_B$$



- Complementary determination of $|V_{ub}|$: independent of semileptonic form-factor systematics

Two channels, different experimental challenges:

- $\tau \nu$: large BF, but multiple neutrinos -> missing-energy reconstruction
- $\mu \nu$: two-body kinematics, but tiny BF -> strong background suppression

Search for $B \rightarrow \tau \nu$

[PRD 112, 072002 \(2025\)](#)

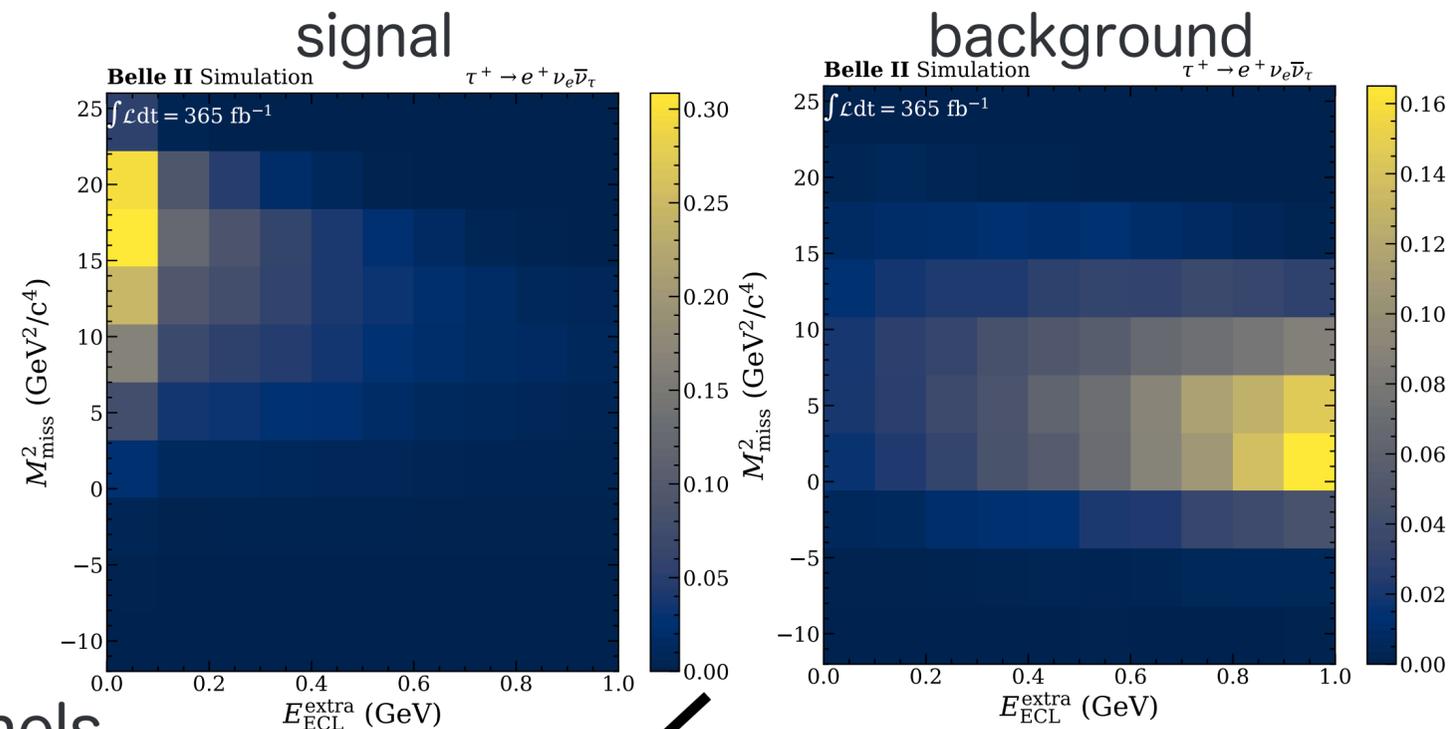
Strategy

- Reconstruct the tag-side B hadronic decay
- Use four tau decay channels covering ~72%:
 $e \nu \nu, \mu \nu \nu, \pi \nu, \rho \nu$
- Simultaneous 2D fit in (M^2_{miss} vs. E_{ECL}) across channels

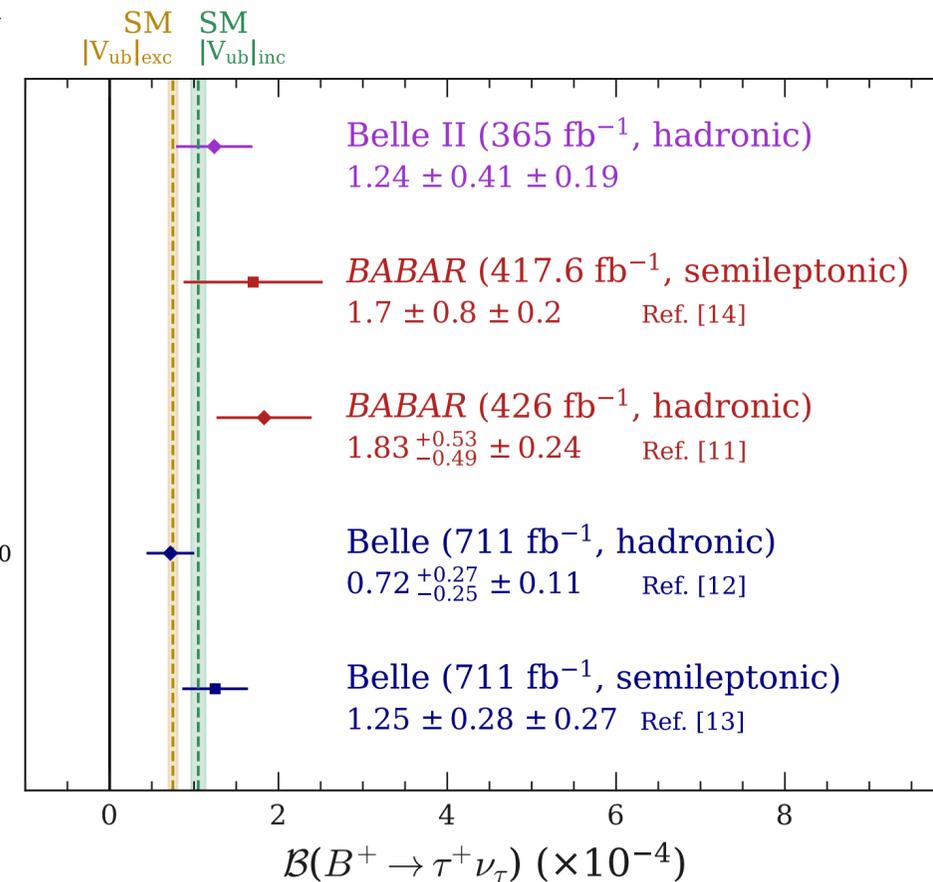
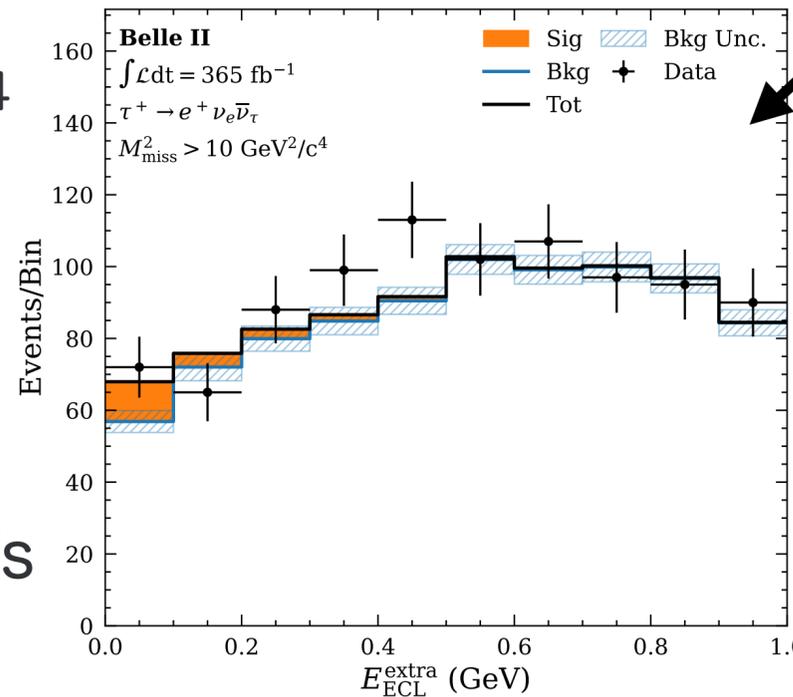
Observe $\text{BF} = (1.24 \pm 0.41 \pm 0.19) \times 10^{-4}$

- Evidence at the 3σ level
 - consistent with others
 - Statistical-limited.
 - Main syst.: limited MC statistics in 2D PDFs
- ## Extract $|V_{ub}|$ from BF
- Consistent with HFLAV and SM expectation

$$|V_{ub}|_{B^+ \rightarrow \tau^+ \nu_\tau} = [4.41^{+0.74}_{-0.89}] \times 10^{-3}$$



projection to E_{ECL}



Search for $B \rightarrow \mu \nu$

- Analysis strategy
 - Single high-momentum muon + missing energy
 - Inclusive tag to infer the signal-side B kinematics
 - qq suppression with event-shape classifier

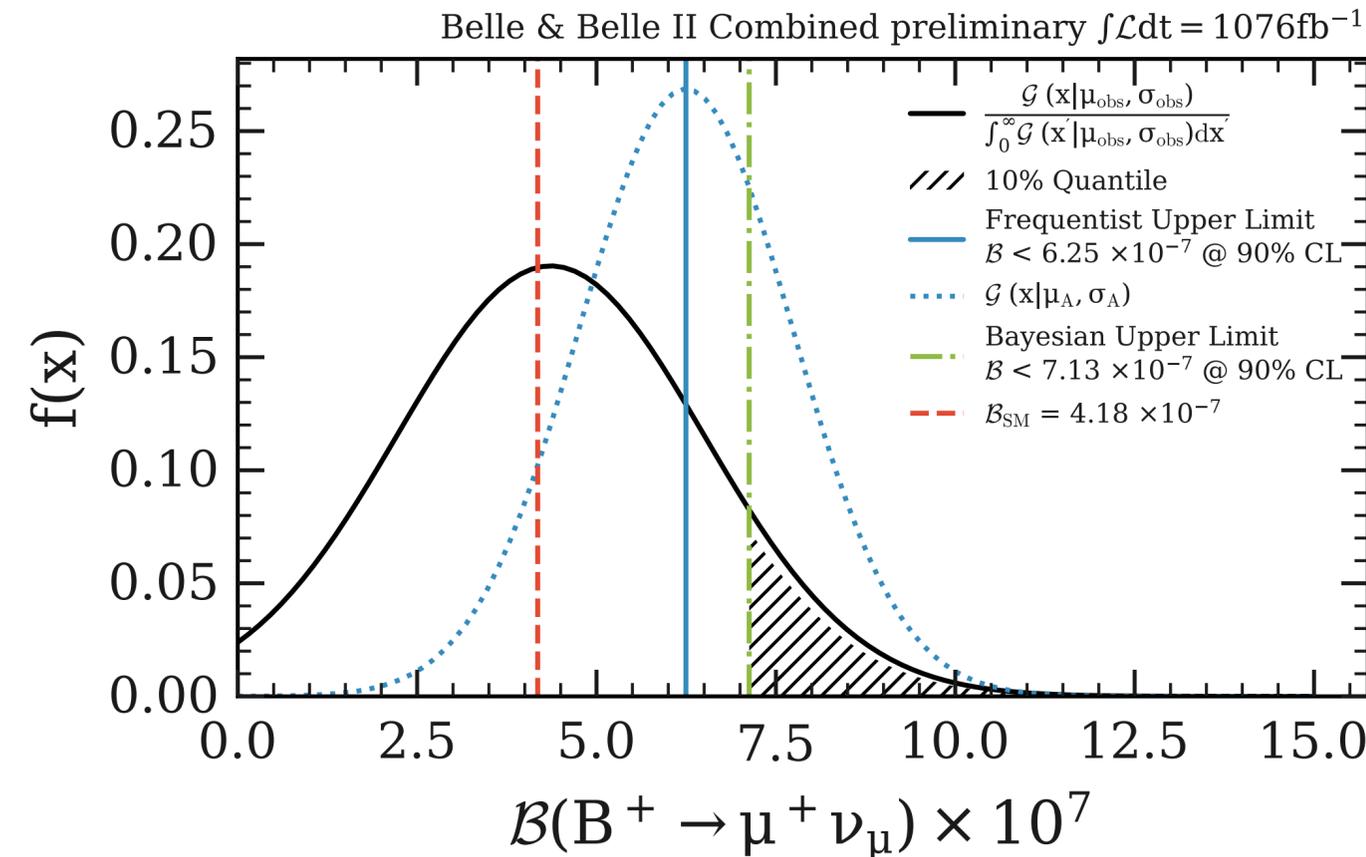
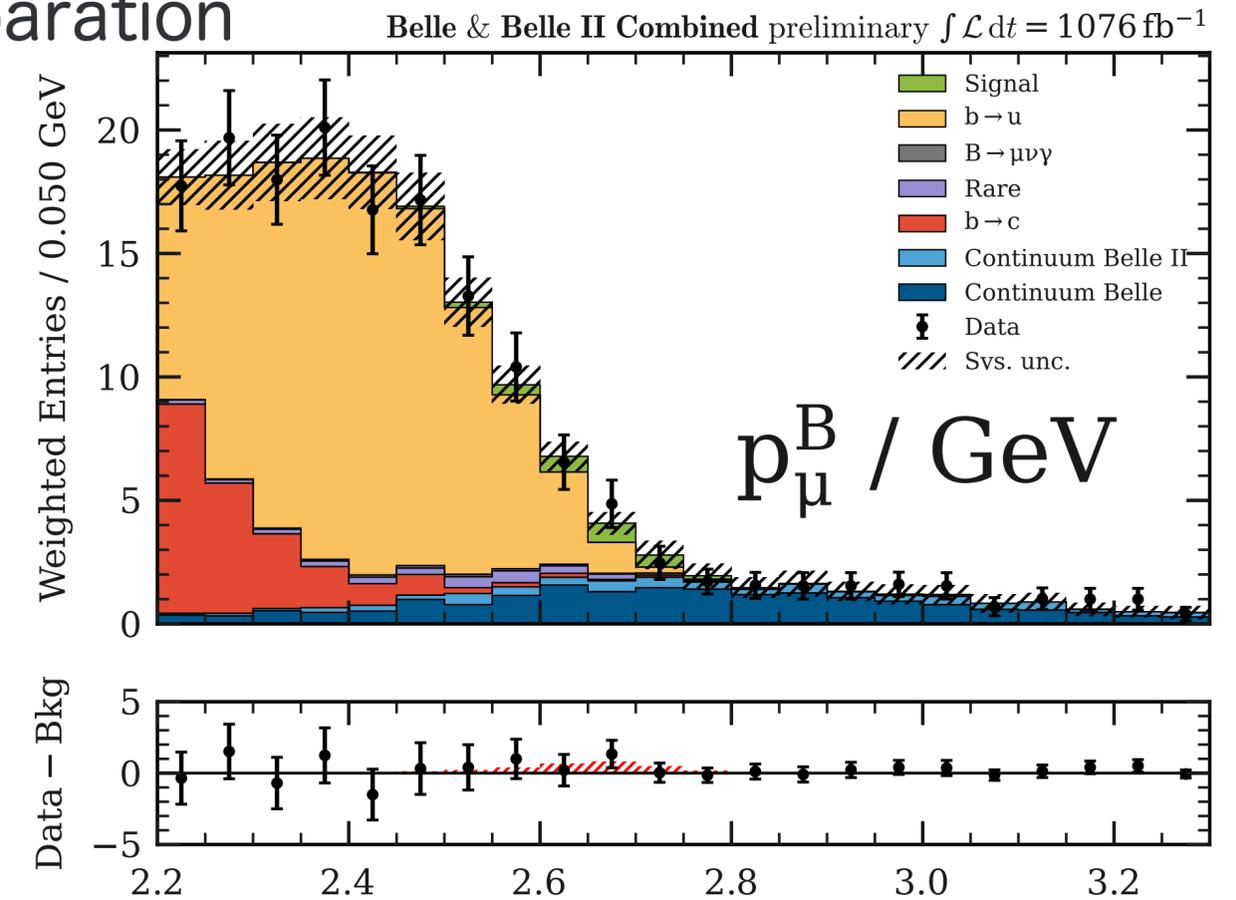
- Observe $BF = (4.2 \pm 1.9 \pm 1.9) \times 10^{-7}$
 - Significance: 2.4σ ; Statistical-limited.
 - Main systematic: $b \rightarrow u$ and qq modelings ($\sim 30\%$)

$$\text{Bayesian} < 7.13 \times 10^{-7} \quad (90\% \text{ C.L.})$$

$$\text{Frequentist} < 6.25 \times 10^{-7}$$

- Extract $|V_{ub}|$ from BF
 - Consistent with HFLAV and SM expectation

$$|V_{ub}| = (3.90^{+0.77}_{-0.96} (\text{stat.})^{+0.43}_{-0.49} (\text{sys.}) \pm 0.03 (\text{theo.})) \times 10^{-3}$$



Tau physics and Belle II

- CLEO
- + ATLAS
- ★ CMS
- * LHCb
- ▼ BaBar
- ▲ Belle
- ◆ Belle II (5 ab⁻¹)
- Belle II (50 ab⁻¹)

Tau is the heaviest lepton -> highly sensitive to new physics

- Many decay modes (~200)

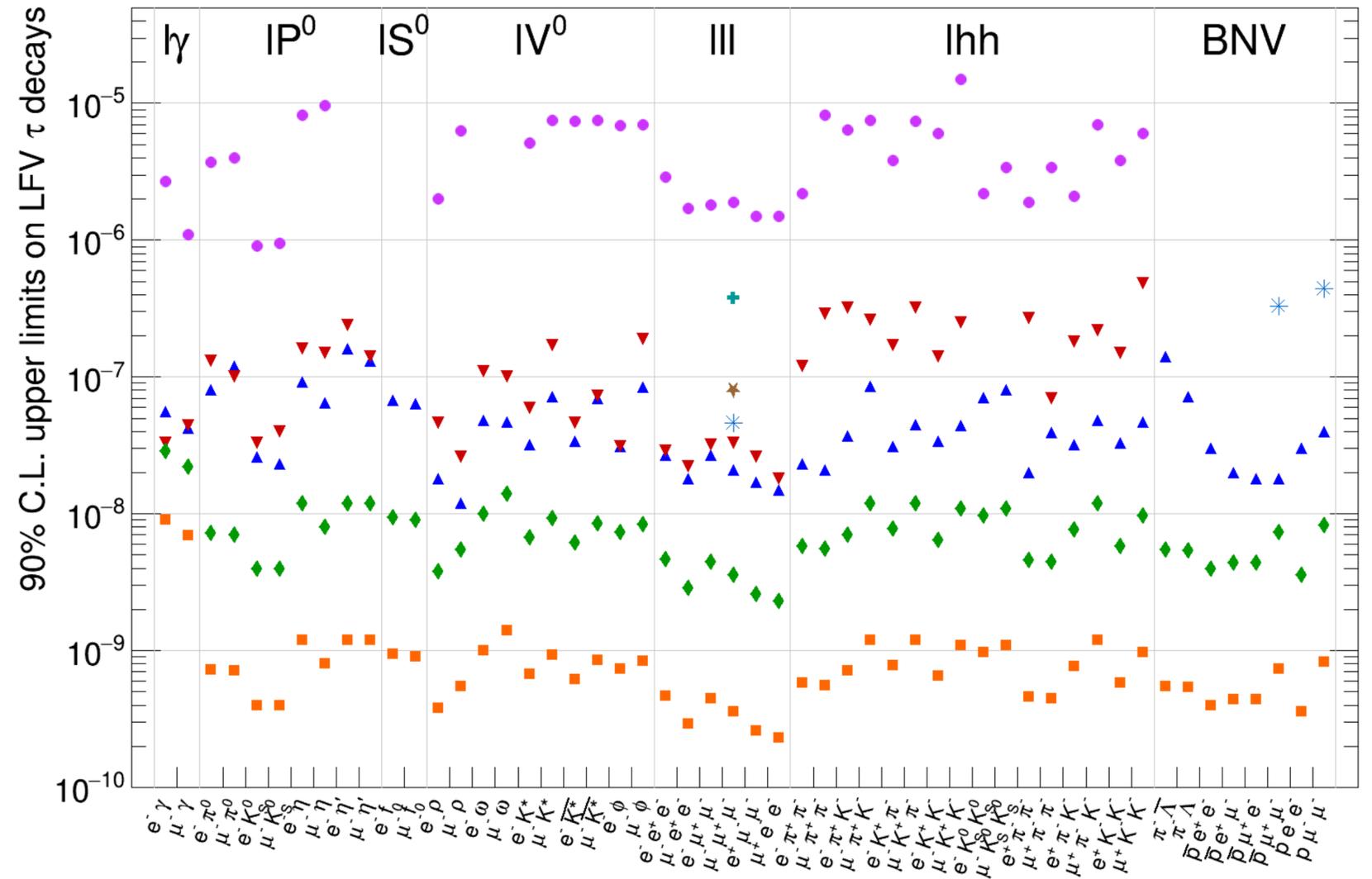
Cross section: 0.9 nb @Belle II

- Comparable to BB production (1.1 nb),
- i.e., excellent statistics = “Tau factory”

Tau physics outcomes:

- LFV ($\tau \rightarrow 3\mu$, $\tau \rightarrow e\gamma$, ...)
- LFU test, mass measurement, ...

- With ML-based analysis and improved systematic control, we are producing competitive results even at early statistics.



Snowmass 2021 White Paper:
Charged lepton flavor violation
in the tau sector

LFV: $\tau \rightarrow \mu \gamma$

Paper in preparation

Belle II preliminary $\int \mathcal{L} dt = 427.9 \text{ fb}^{-1}$

- Forbidden in the SM (LFV)
- Many NP models predict B.F. of $10^{-8} \sim 10^{-10}$,
- Belle (988 fb^{-1}): $< 4.2 \times 10^{-8}$

Analysis strategy

- Single charged track in tag side.
- BDT for background suppression
- Unbinned 2D ML fit to $(M_{bc}, \Delta E)$

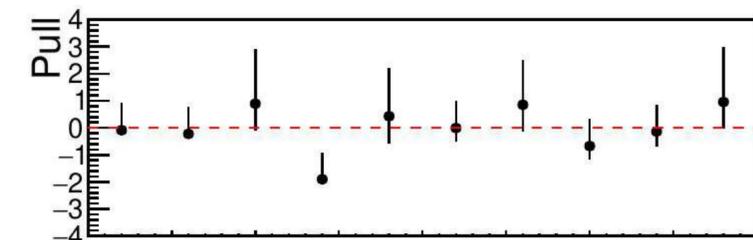
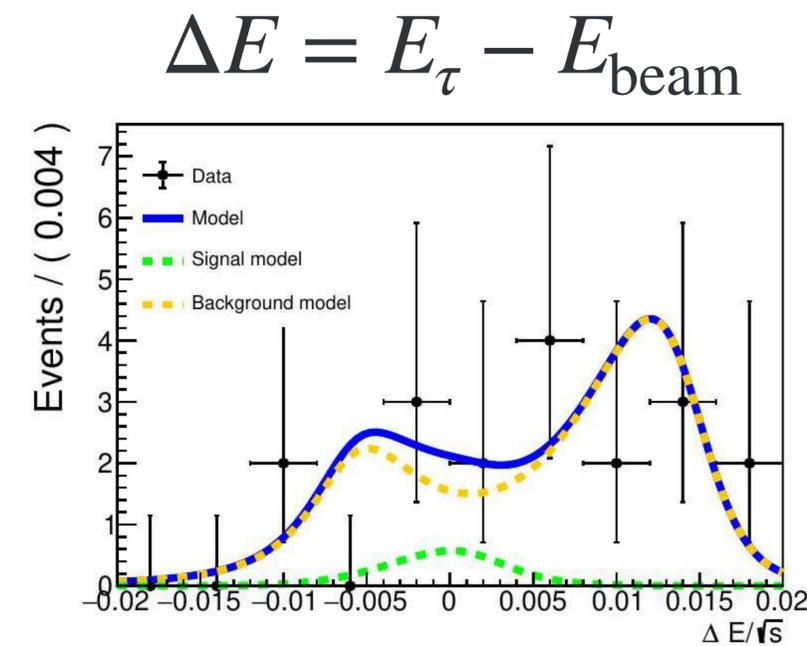
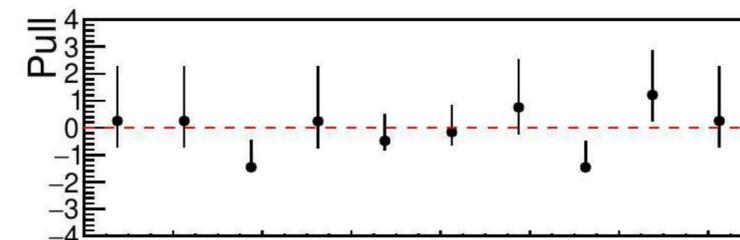
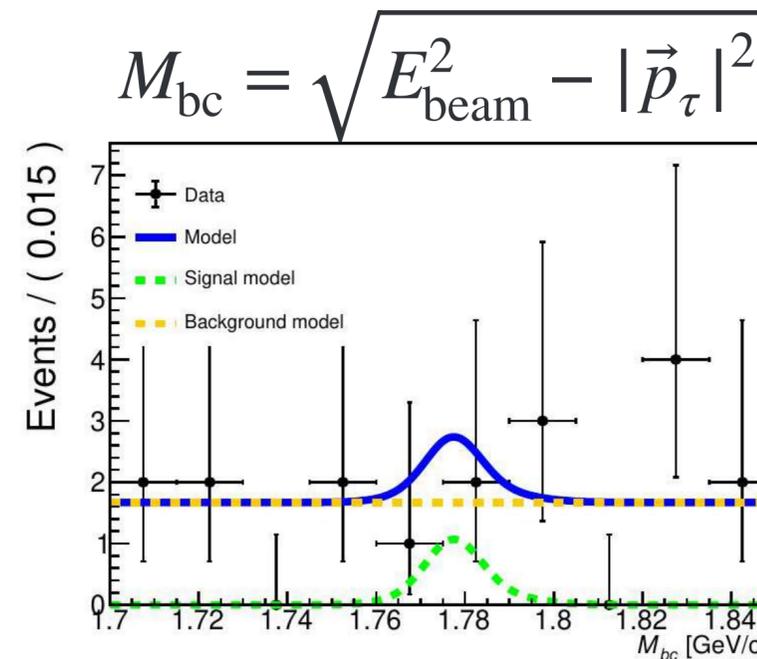
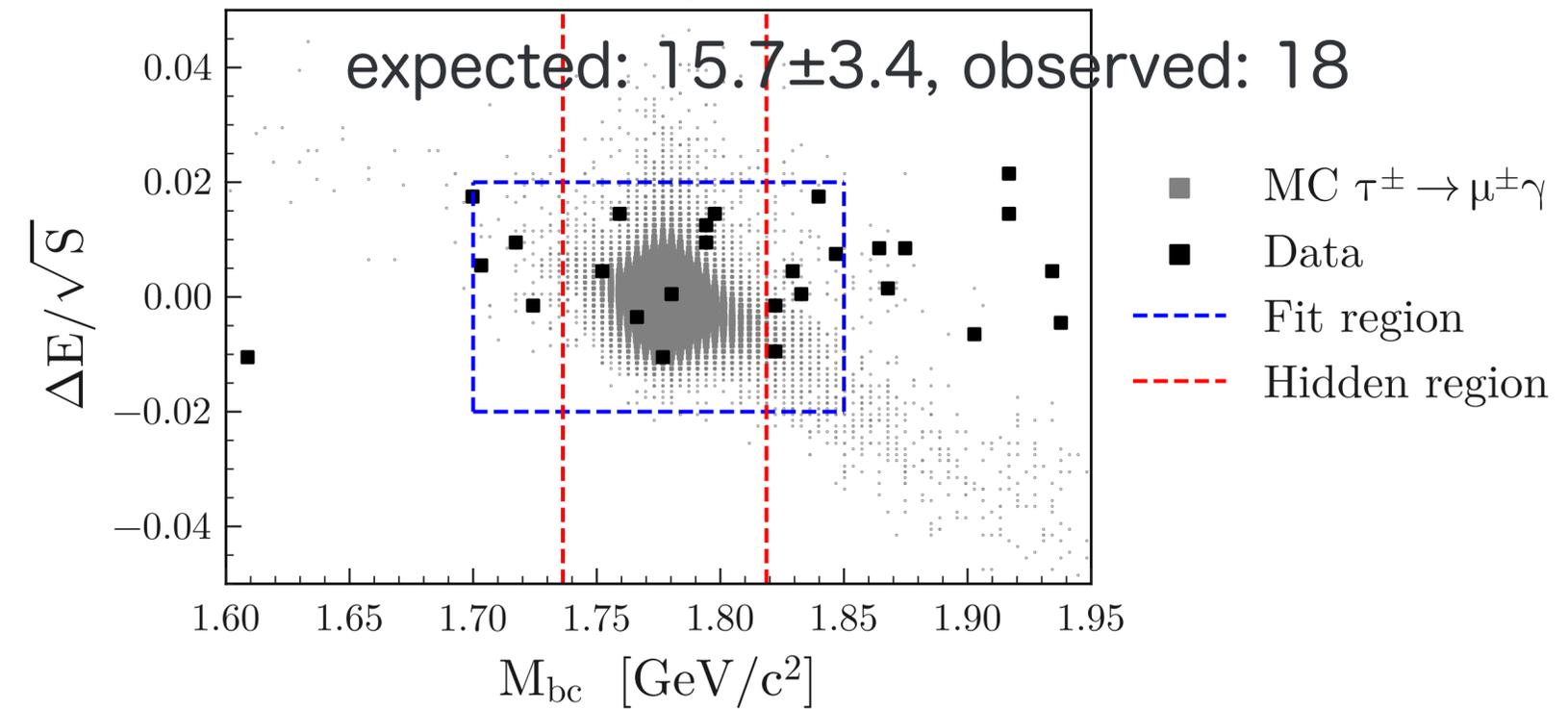
Results

$$\mathcal{B}(\tau^- \rightarrow \mu^- \gamma)^{\text{exp}} < 5.8 \times 10^{-8}$$

$$\mathcal{B}(\tau^- \rightarrow \mu^- \gamma)^{\text{obs}} < 9.5 \times 10^{-8}$$

(90% C.L.)

- Similar sensitivity even with lower statistics compared to Belle



Search for $\tau \rightarrow e \ell \ell'$ (5 channels)

Challenge: dominant low multiplicity background due to electron

- $e^+e^- \rightarrow \ell \ell (\gamma)$ and $e^+e^- \rightarrow ee \ell \ell (\gamma)$

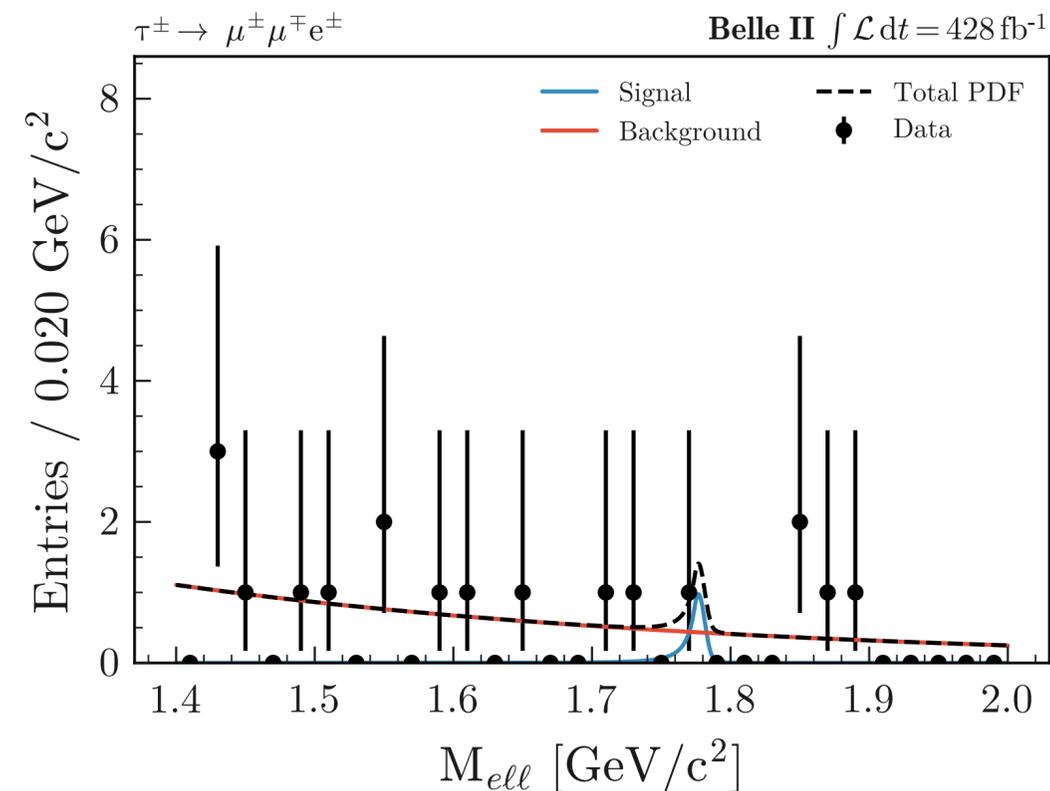
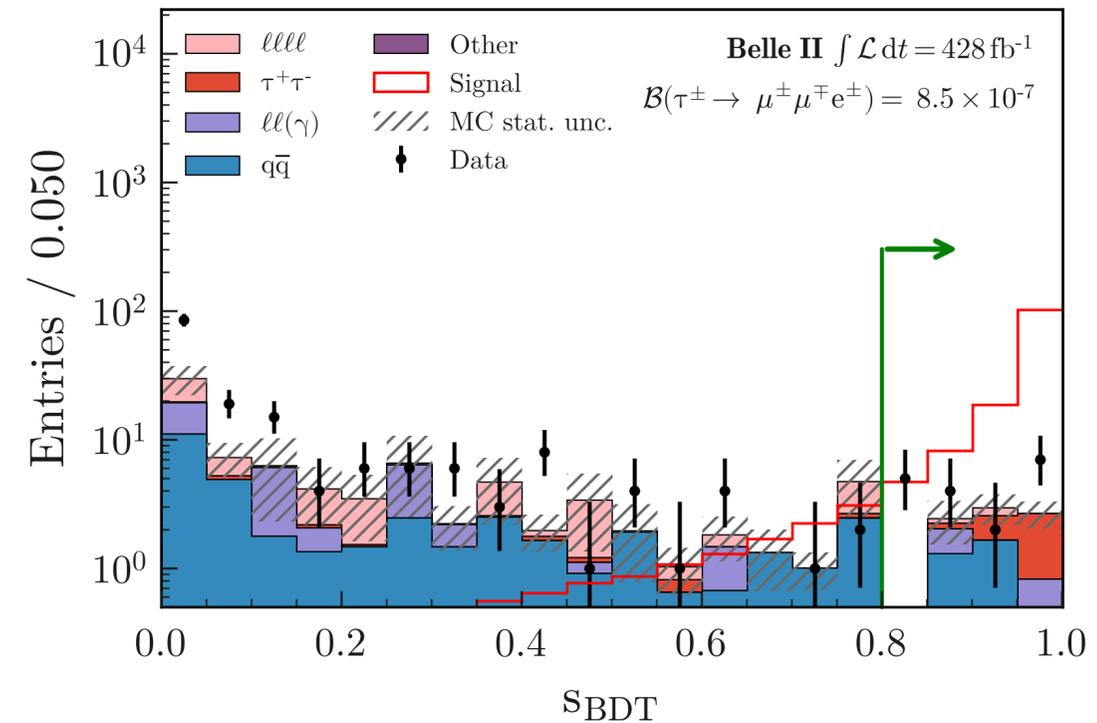
Analysis strategy

- Tag side τ : reconstruct with the remaining particles, without exclusive mode reconstruction.
- Mode-dependent BDTs for background suppression
- Signal extraction with unbinned fit to $M(3 \ell)$

	$B_{obs}^{90\%UL} \times 10^{-8}$	$B_{Belle}^{90\%UL} \times 10^{-8}$	ϵ_{sig}	ϵ_{Belle}
$e^- e^+ e^-$	★ 2.5	2.7	15.0%	6.0%
$e^- e^+ \mu^-$	★ 1.6	1.8	20.4%	9.3%
$e^- \mu^+ e^-$	1.6	1.5	23.5%	11.5%
$\mu^- \mu^+ e^-$	★ 2.4	2.7	20.1%	6.1%
$\mu^- e^+ \mu^-$	★ 1.3	1.5	24.1%	10.1%

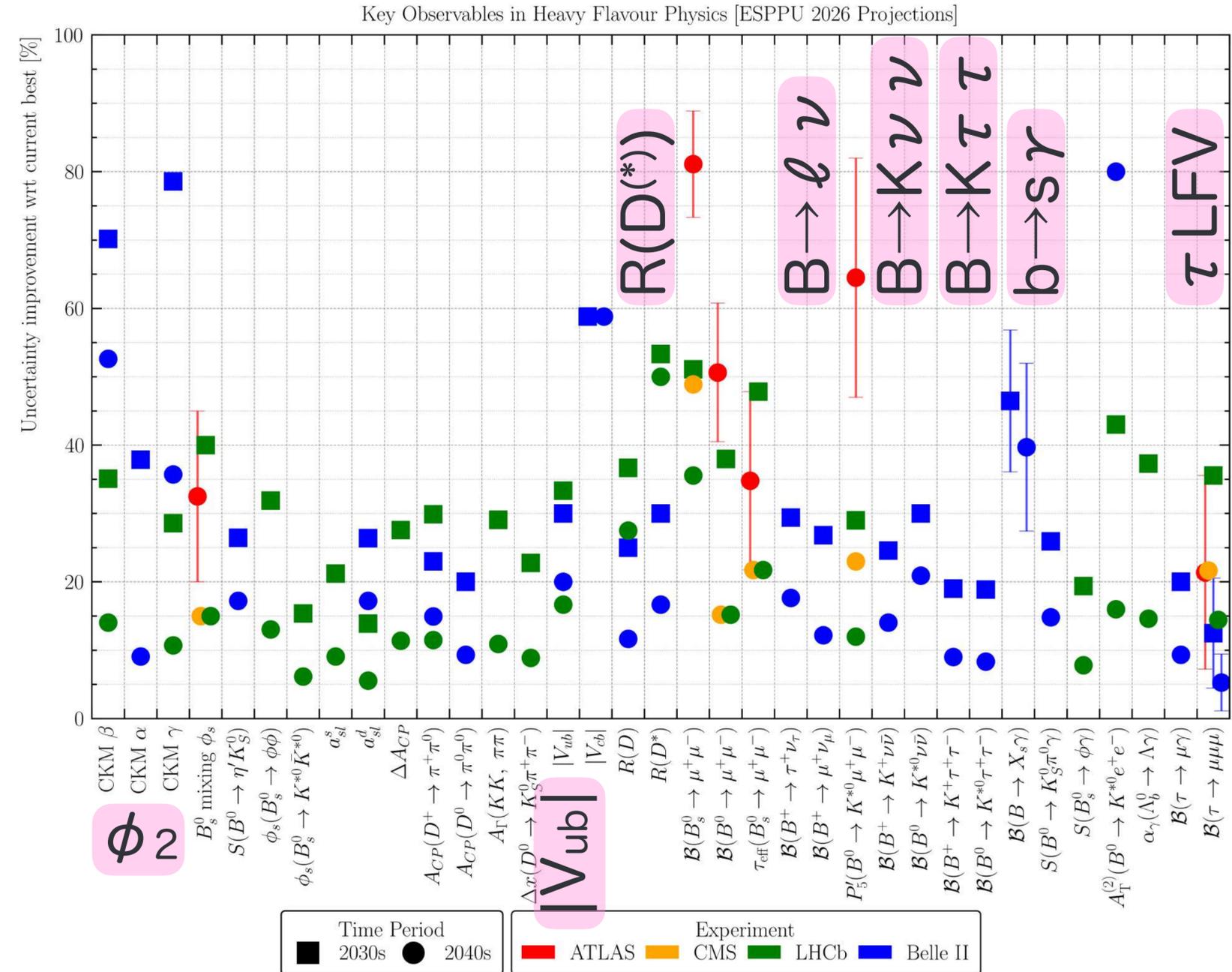
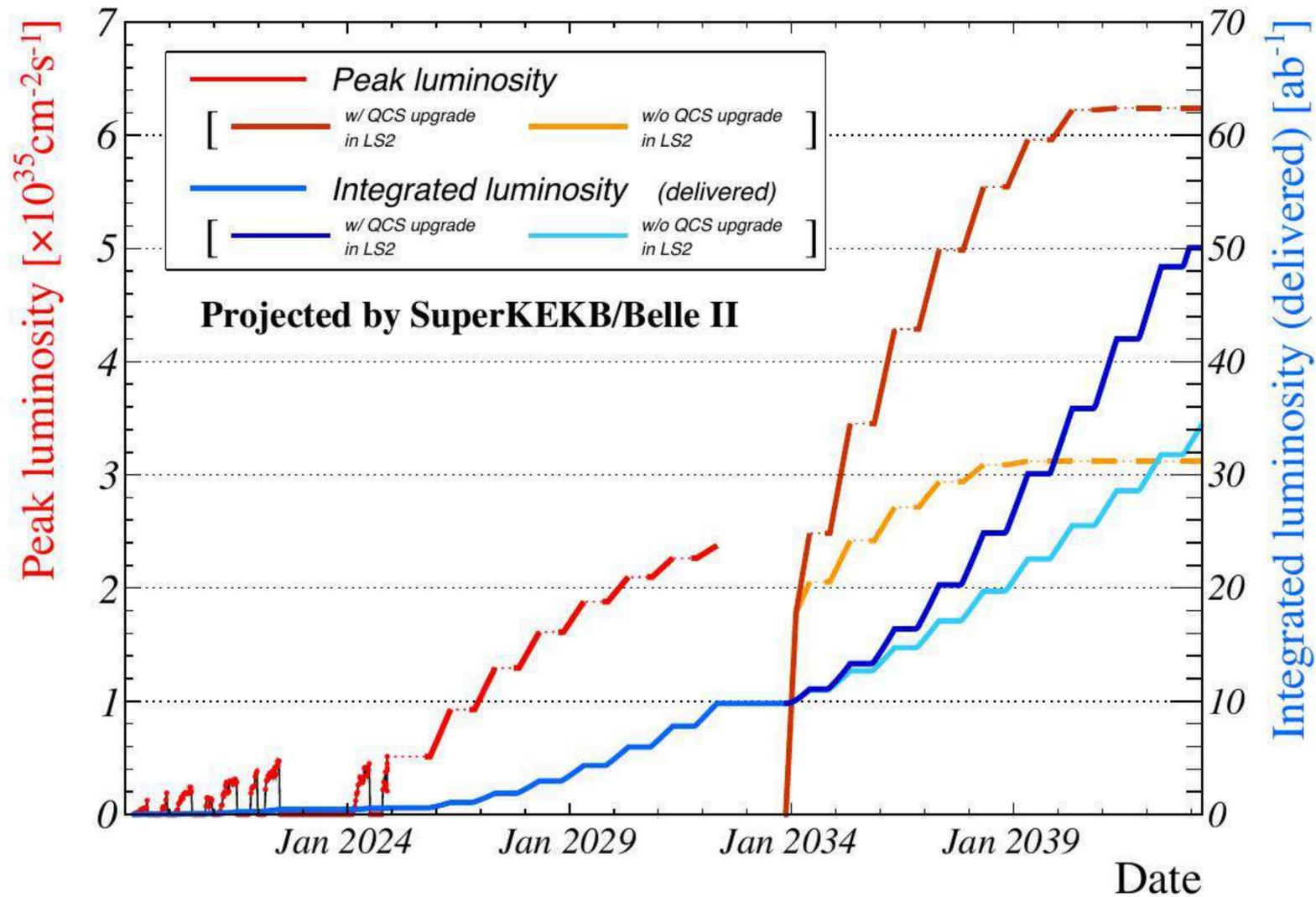
@ 428 fb⁻¹ @ 782 fb⁻¹

- Inclusive tag-side reconstruction + BDT give higher efficiency than Belle.



Prospects

- 2026: We plan to run until ~July and reach a total integrated luminosity of 1 ab⁻¹.
- During the long shutdown starting in 2032, upgrades are planned for the SuperKEKB accelerator and the Belle II detectors.
- TDR plan to be published within the next ~2 years.



Summary

Belle II has a broad physics program, including B, D, and τ decays, hadron spectroscopy/exotics, and dark-sector searches.

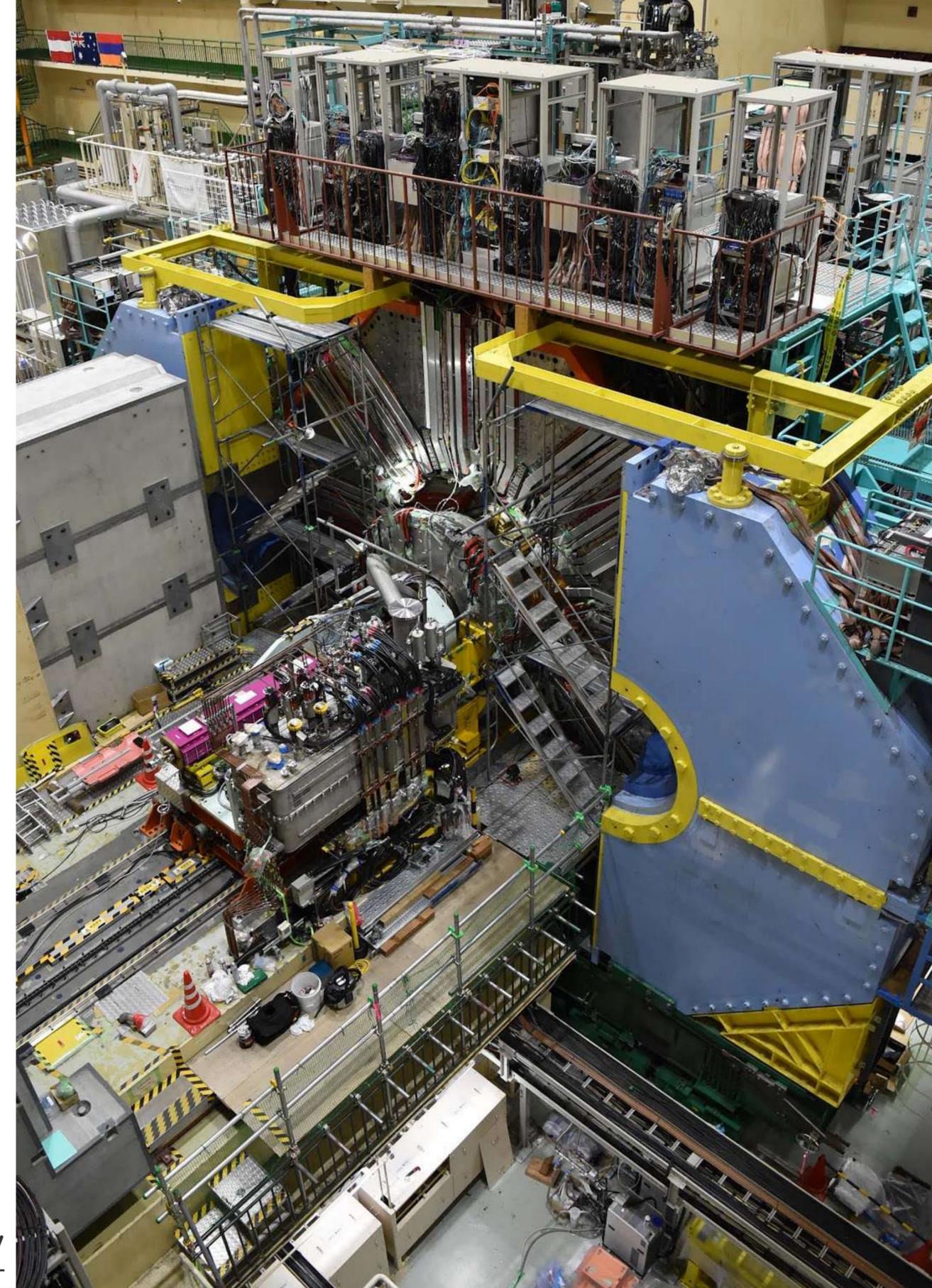
Thanks to detector performance and improved analysis methods, we are already producing competitive physics results.

Next:

1 ab^{-1} by July 2026, and push precision and discovery reach with the world's leading integrated luminosity.

Data taking continues today.

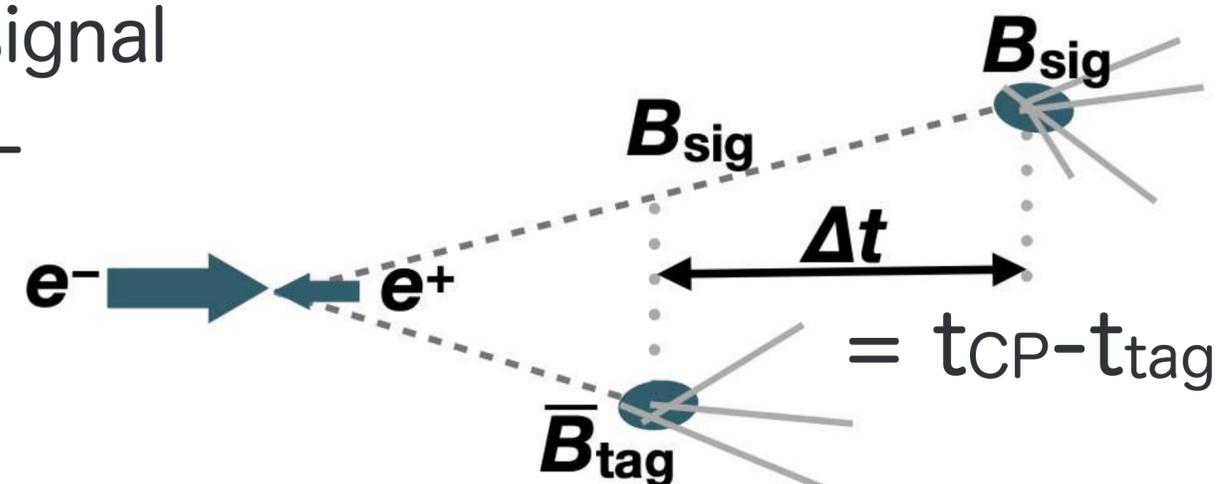
Live event display: <https://evdisp.belle2.org/>



What's next:

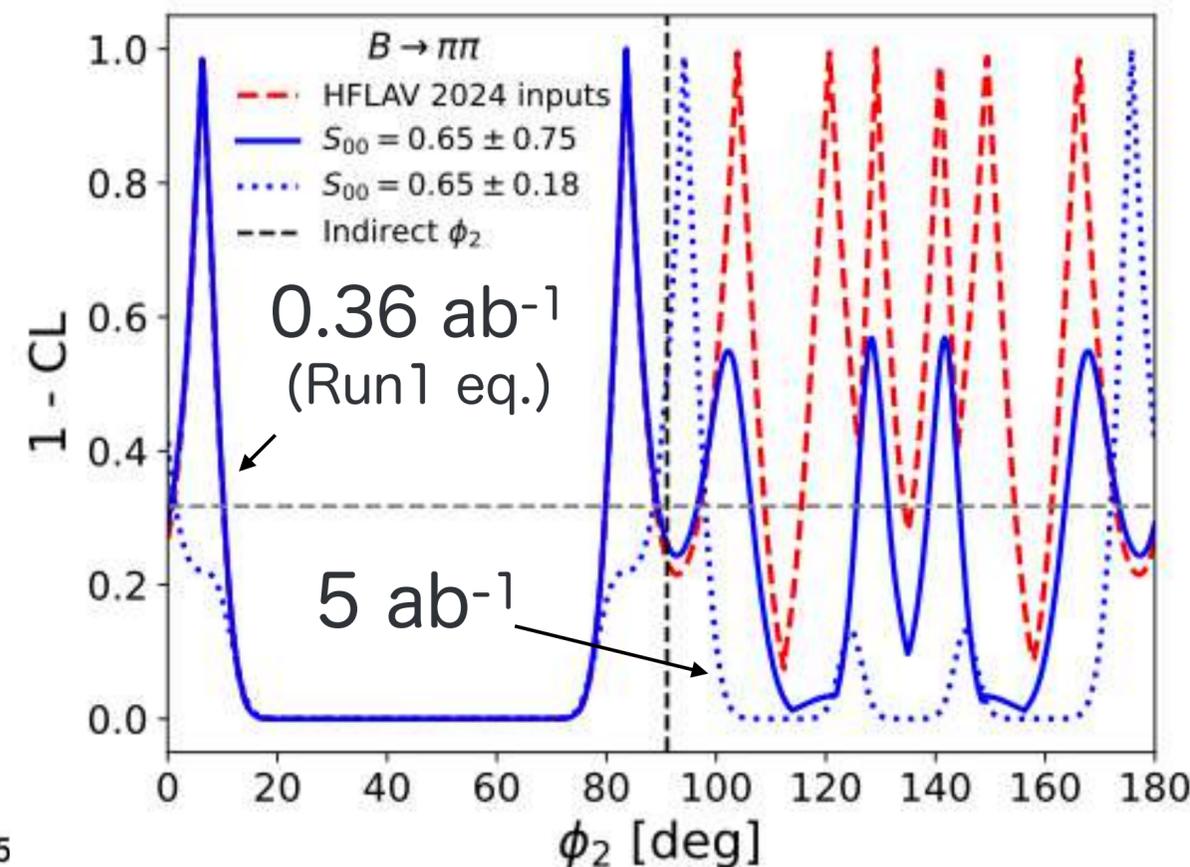
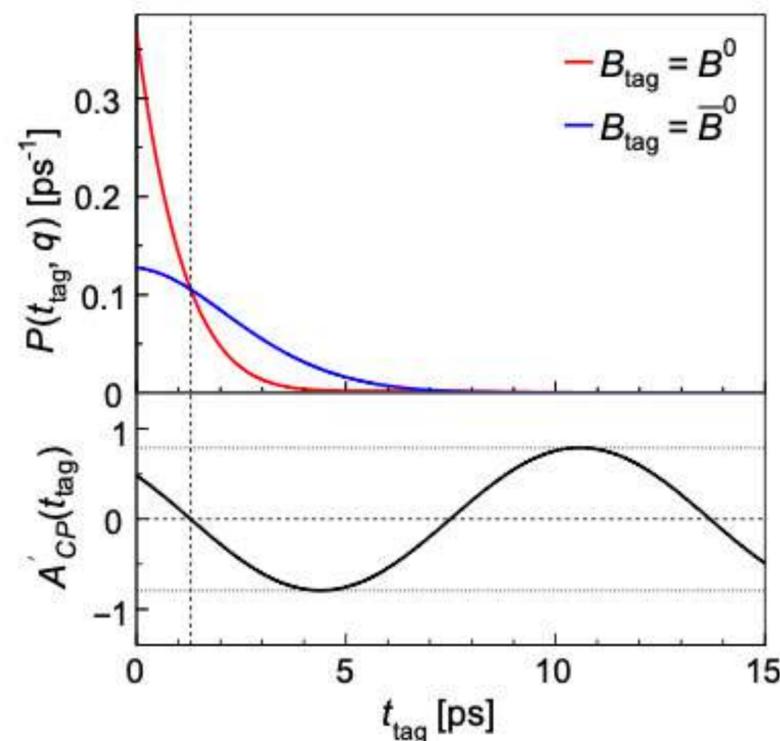
Time-dependent CP violation measurement without a signal vertex

- $B^0 \rightarrow \pi^0 \pi^0$: essentially a 4γ final state, so the signal vertex is unavailable, and we are limited to time-integrated CPV.



- ϕ_2 from $B \rightarrow \pi\pi$ has an eight-fold ambiguity.
- Integrate the TDCPV formula over t_{CP} ; then t_{tag} can constrain S_{CP} and C_{CP} .
- This was quite challenging at Belle/BABAR due to limited B-vertex resolution.
- Belle II enables a precision reconstruction of the B_{tag} vertex.

$$\mathcal{P}(t_{tag}, t_{CP}, q) = \frac{e^{-\frac{t_{CP} + t_{tag}}{\tau}}}{2\tau^2} (1 + q[S \sin \Delta m(t_{CP} - t_{tag}) - C \cos \Delta m(t_{CP} - t_{tag})]),$$



$S_{00}=0.65$: favored by an indirect ϕ_2 determination.

- The analysis is ongoing.

Backup

=====
CP violation in B decays (6)

- 1) Observation of time-dependent CP violation and branching fraction of $B^0 \rightarrow J/\psi \pi^0$, PRD 111, 012011 (2025)
- 2) Measurement of CP asymmetries in $B^0 \rightarrow K_S \pi^0 \gamma$ decays at Belle II, PRL 134, 011802 (2025)
- 3) Measurement of branching fractions, asymmetry, and isospin asymmetry for $B^0 \rightarrow \rho^0 \gamma$ using Belle and Belle II data, PRD 111, L071103 (2025)
- 4) Measurement of branching fraction, polarization, and time-dependent CP violation in $B^0 \rightarrow \rho^+ \rho^-$ and constraint on CKM angle ϕ_2 , PRD 111, 092001 (2025)
- 5) Measurement of the branching fraction and CP-violating asymmetry of $B^0 \rightarrow \pi^0 \pi^0$ using Belle II data, PRD 111, L071102 (2025)
- 6) Measurement of time-dependent CP asymmetries in $B^0 \rightarrow K_S \pi^+ \pi^- \gamma$ decays at Belle and Belle II, arXiv:2510.01331 (to appear in JHEP)

=====
CP violation in D decays (6)

- 1) Measurement of the time-integrated CP asymmetry in $D^0 \rightarrow K_S K_S$ using Belle and Belle II data, PRD 111, 012015 (2025)
- 2) Search for CP violation in $D^{+(s)} \rightarrow K_S K^- \pi^+ \pi^+$ decays using triple and quadruple products, JHEP 04 (2025) 036
- 3) Measurement of the CP asymmetry in $D^+ \rightarrow \pi^+ \pi^0$ at Belle II, PRD 112, L031101 (2025)
- 4) Measurement of the time-integrated CP asymmetry in $D^0 \rightarrow \pi^0 \pi^0$ at Belle II, PRD 112, 012006 (2025)
- 5) Measurement of the time-integrated CP asymmetry in $D^0 \rightarrow K_S K_S$ using opposite-side flavor tagging at Belle and Belle II, PRD 112, 012017 (2025)
- 6) Measurement of the CP asymmetry in $D^0 \rightarrow \pi^+ \pi^- \pi^0$ at Belle II, arXiv:2510.21224 (submitted to PRD)

=====
Charm baryons (5)

- 1) Observations of the singly Cabibbo-suppressed decays $\Xi_{c^+} \rightarrow p K_S, \Lambda \pi^+, \Sigma^0 \pi^+$ at Belle and Belle II, JHEP 03 (2025) 061
- 2) Measurements of branching fractions of $\Xi_{c^+} \rightarrow \Sigma^+ K_S, \Xi^0 \pi^+, \Xi^0 K^+$ at Belle and Belle II, JHEP 08 (2025) 195
- 3) Measurement of the branching fraction of $\Lambda_{c^+} \rightarrow p K_S \pi^0$ at Belle, PRD 112, 012013 (2025)
- 4) First measurements of branching fractions for $\Xi_{c^0} \rightarrow \Lambda \eta, \Lambda \eta'$ and search for $\Xi_{c^0} \rightarrow \Lambda \pi^0$ using Belle and Belle II data, arXiv:2510.20882 (submitted to PRD)
- 5) Search for CP violation in $\Xi_{c^+} \rightarrow \Sigma^+ h^+ h^-$ and $\Lambda_{c^+} \rightarrow p h^+ h^-$ at Belle II, arXiv:2509.25765 (submitted to PRD)

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Tau decays (2)

- 1) Search for lepton-flavor-violating $\tau^- \rightarrow \ell^- K_S$ decays at Belle and Belle II, JHEP 08 (2025) 092
- 2) Search for lepton-flavor-violating $\tau \rightarrow e \ell \ell$ decays at Belle II, JHEP 12 (2025) 169

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Semileptonic/leptonic B decays (5)

- 1) $|V_{ub}|$ from simultaneous untagged $B^0 \rightarrow \pi^- \ell^+ \nu$ and $B^+ \rightarrow \rho^0 \ell^+ \nu$ decays, PRD 111, 112009 (2025)
- 2) Measurement of $B^+ \rightarrow \tau^+ \nu$ branching fraction with a hadronic tagging method at Belle II, PRD 112, 072002 (2025)
- 3) Determination of $|V_{cb}|$ using $B \rightarrow D \ell \nu$ decays at Belle II, PRD 112, 112009 (2025)
- 4) Test of lepton flavor universality with measurements of $R(D^+)$ and $R(D^{*+})$ at the Belle II experiment, PRD 111, L071102 (2025)
- 5) Measurement of inclusive $B^0 \rightarrow X_u \ell \nu$ partial branching fractions and $|V_{ub}|$ at Belle II, arXiv:2512.08056 (submitted to PRD)

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Electroweak penguin B decays (2)

- 1) First search for $B \rightarrow X_s \nu \nu$ decays at Belle II, arXiv:2511.10980 (submitted to PRL)
- 2) Model-agnostic likelihood for the reinterpretation of the $B^+ \rightarrow K^+ \nu \nu$ measurement at Belle II, PRD 112, 092016 (2025)

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Searches for Exotica (6)

- 1) A search for feebly-interacting particles in B decays with missing energy (Belle, Belle II Collaborations), arXiv:2601.07104
- 2) Search for $B^0 \rightarrow K^{*0} \tau^+ \tau^-$ decays at the Belle II experiment, arXiv:2504.10042 (to appear in PRL)
- 3) Search for lepton flavor-violating $B^0 \rightarrow K_S \tau \ell$ ($\ell = \mu, e$) with hadronic B-tagging at Belle and Belle II, PRL 135, 041801 (2025)
- 4) Search for a dark Higgs boson produced in association with inelastic dark matter at the Belle II experiment, PRL 135, 131801 (2025) (arXiv:2505.09705)
- 5) Search for lepton-flavor-violating $B^0 \rightarrow K^{*0} \tau \ell$ ($\ell = e, \mu$) with hadronic B-tagging at Belle and Belle II, JHEP 08 (2025) 184
- 6) Search for an axion-like particle in $B \rightarrow K^{(*)} a$ ($a \rightarrow \gamma \gamma$) decays at Belle, JHEP 12 (2025) 109

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Additional category: Quarkonium / spectroscopy (2)

- 1) Search for $e^+ e^- \rightarrow \gamma \chi_{bJ}$ ($J=0,1,2$) near $\sqrt{s} = 10.746$ GeV at Belle II, arXiv:2508.16036
- 2) Observation of the radiative decay $Ds_0^*(2317)^+ \rightarrow Ds^{*+} \gamma$ using Belle and Belle II data, arXiv:2510.27174

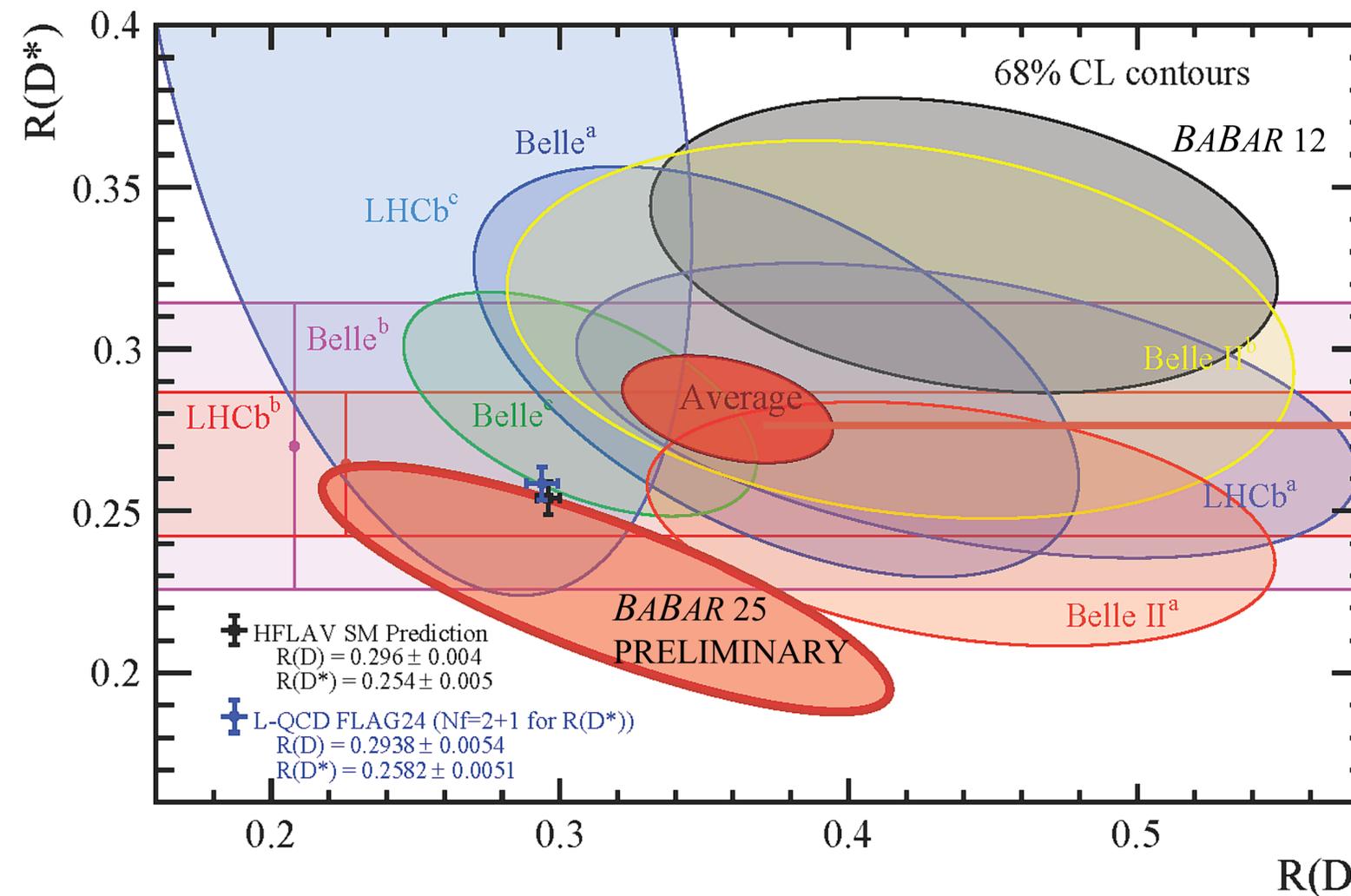
New inputs(?) from BABAR

Experiment	$R(D)$	$R(D^*)$	Correlation
<i>BABAR</i> 12 (hadronic tag)	$0.440 \pm 0.058 \pm 0.042$	$0.332 \pm 0.024 \pm 0.018$	-0.27
HFLAV (CKM 2025 average)	0.281 ± 0.011	0.358 ± 0.024	-0.374
<i>BABAR</i> 25 (leptonic tag) PRELIMINARY	$0.316 \pm 0.062 \pm 0.019$	$0.226 \pm 0.022 \pm 0.012$	-0.82

Systematics still under discussion:

- Normalization BFs
- D^{**} modeling
- Limited MC for D^{**}
- π^0 efficiency
- Fit/PDF shape modeling

We await the final result and its finalized systematics.



This average does not include the *BABAR* 25 preliminary result

