第21届
全国重味物理与CP破坏研讨会

THE 21ST NATIONAL SYMPOSIUM ON HEAVY FLAVOR PHYSICS AND CP VIOLATION

HFCPV2024 湖南 衡阳 2024.10.25–10.29

LHCb实验近期物理成果及展望

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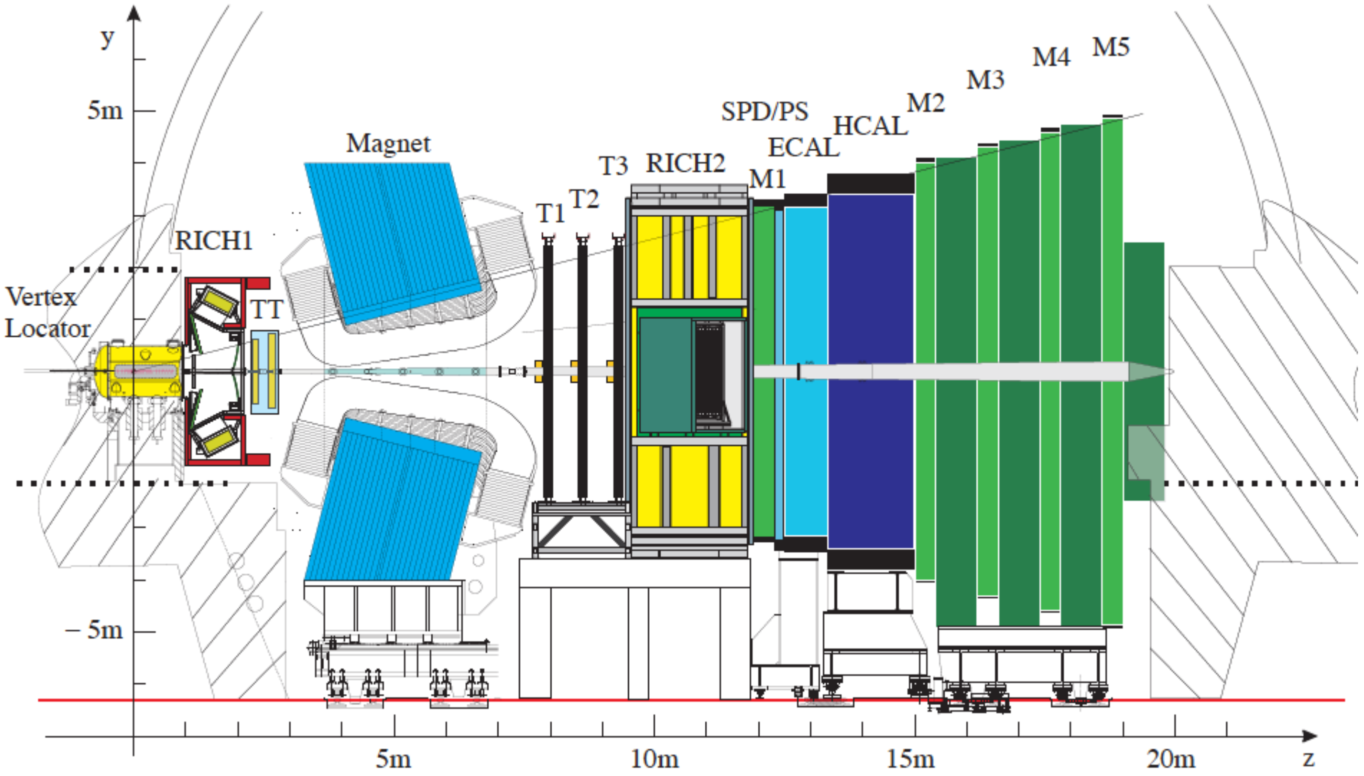
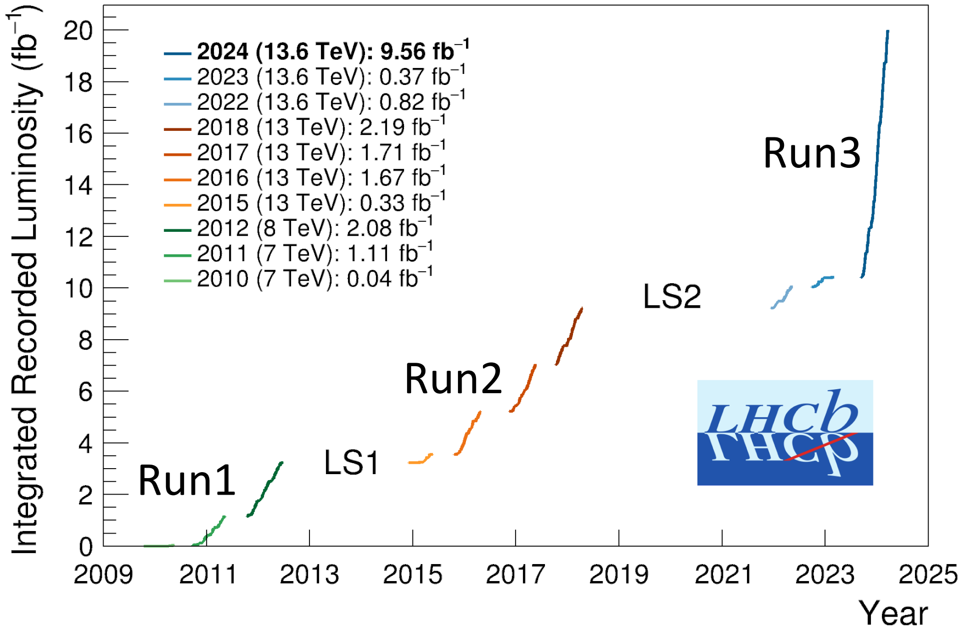
Large Hadron Collider

Proton energy: up to 7 TeV (10^{12} eV)
speed: 0.999999991 c

The LHCb experiment

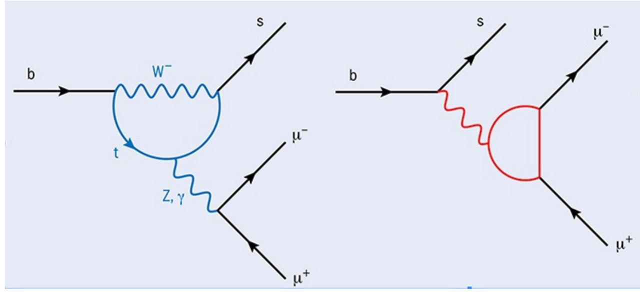


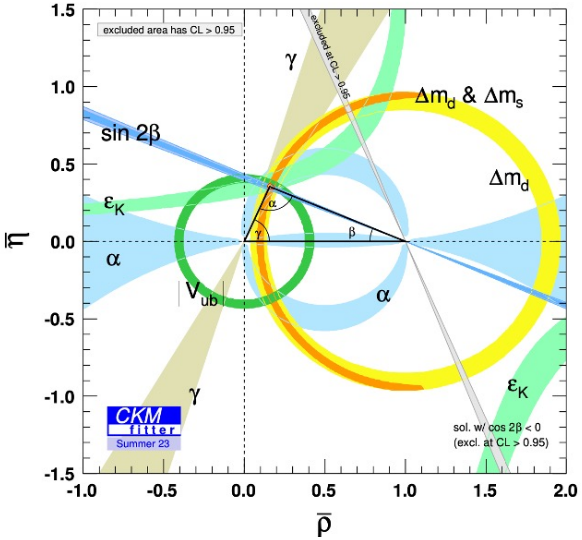


Vertex Locator	$\sigma_{PV,x/y} \sim 10\ \mu m$, $\sigma_{PV,z} \sim 60\ \mu m$
Tracking (TT, T1-T3)	$\Delta p/p$: 0.4% at 5 GeV/c, to 0.6% at 100 GeV/c
RICHs	$\varepsilon(K \to K) \sim 95\%$, mis-ID rate $(\pi \to K) \sim 5\%$
Muon system (M1-M5)	$\varepsilon(\mu \to \mu) \sim 97\%$, mis-ID rate $(\pi \to \mu) = 1 - 3\%$
ECAL	$\sigma_E/E \sim 10\%/\sqrt{E} \oplus 1\%$ (E in GeV)
HCAL	$\sigma_E/E \sim 70\%/\sqrt{E} \oplus 10\%$ (E in GeV)

- Run3
  - Luminosity: 9 fb^{-1} (2024) + 7 fb^{-1} (2025)
  - Yields, compared to Run 1+2
    - Muon modes ~2
    - Hadronic modes ~4 (higher trigger eff.)

Physics programs at LHCb

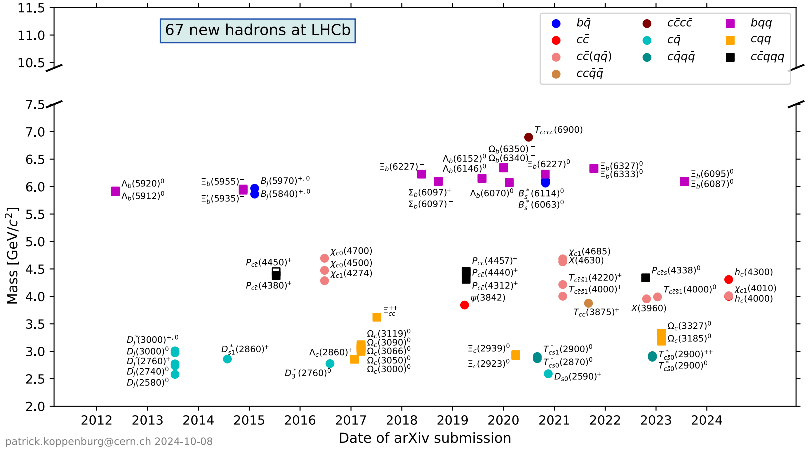


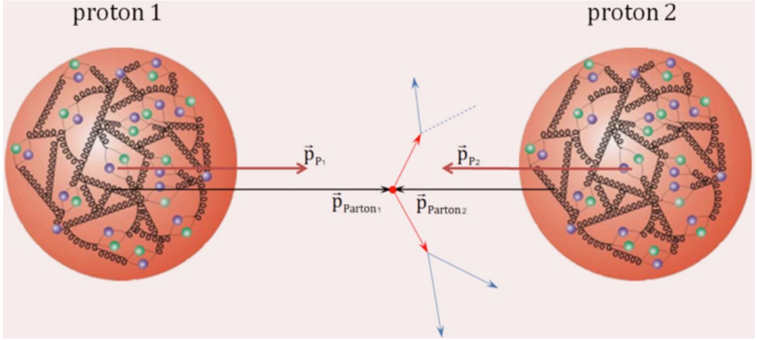


- Indirect search for New Physics
  - Rare decays
  - CP Violation

李佩莲 LHCb上的CP破坏研究
戴鑫琛 LHCb上的重子CP破坏研究
俞洁晟 LHCb上含重子末态的研究

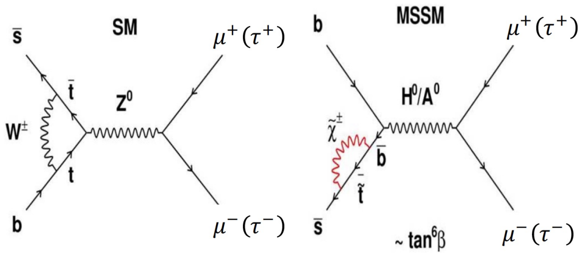
- Quantum Chromodynamics
  - Spectroscopy (Quark model + strong interaction)
  - Production (PDF, hard scattering, fragmentation)



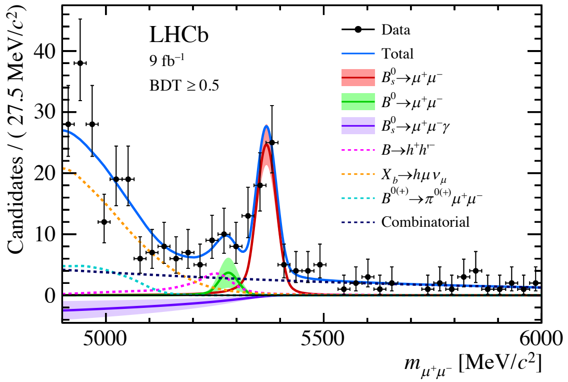


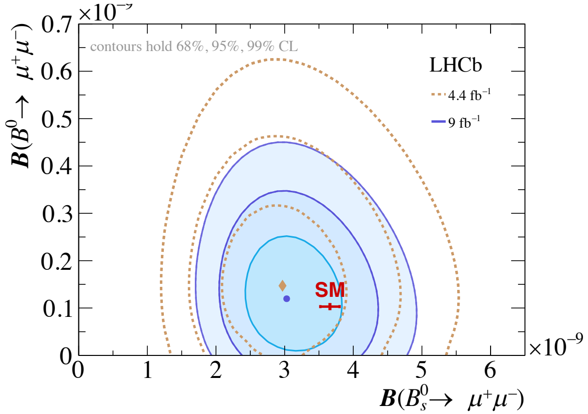
- Heavy Ions
- Electroweak

$B_s^0 \to \mu^+\mu^-(\gamma)$

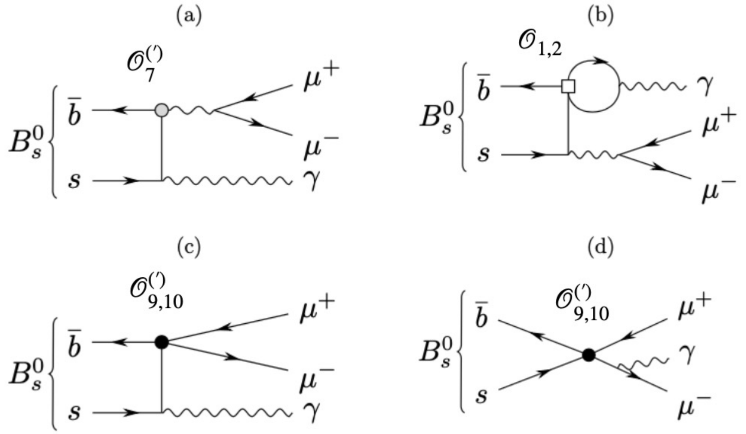


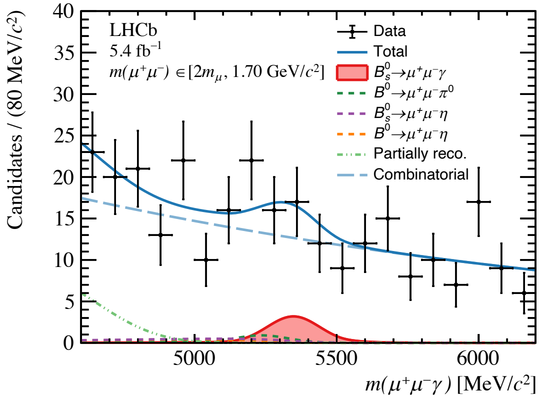
[PRL 128 (2022) 041801]

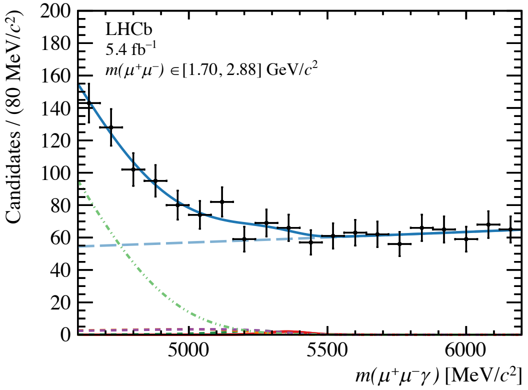


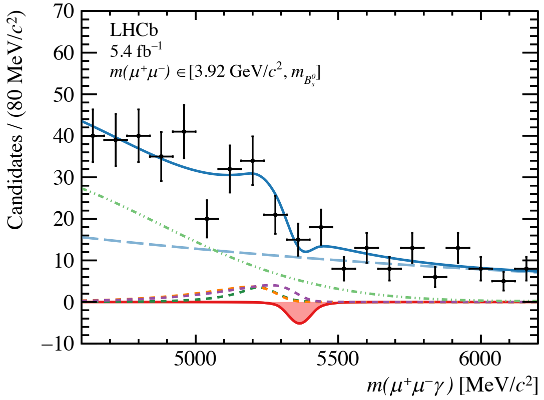


- $B_s^0 \to \mu^+\mu^-\gamma$, less chiral suppressed, but with $B_s^0 \to \gamma$ form factor



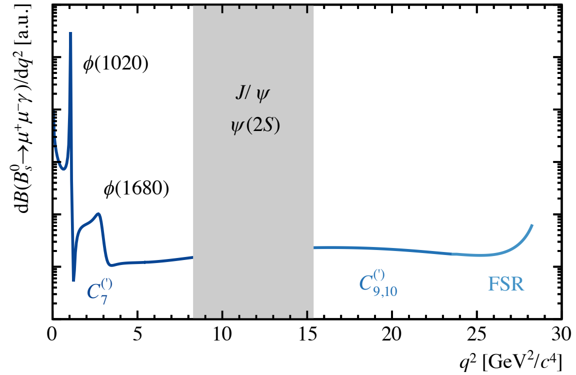


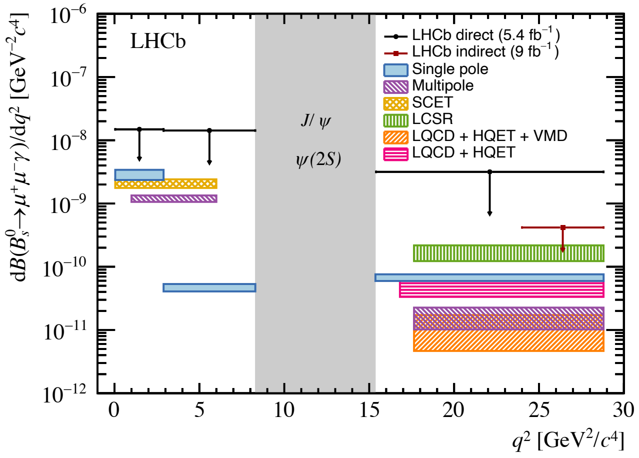




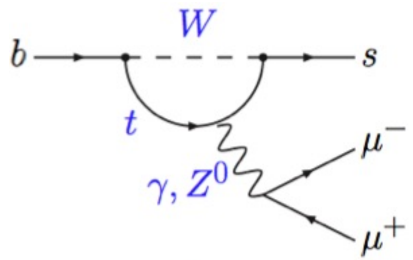
$$\mathcal{B}(B_s^0 \to \mu^+\mu^-\gamma)_{\rm I} < 3.6\,(4.2) \times 10^{-8}$$
$$\mathcal{B}(B_s^0 \to \mu^+\mu^-\gamma)_{\rm II} < 6.5\,(7.7) \times 10^{-8}$$
$$\mathcal{B}(B_s^0 \to \mu^+\mu^-\gamma)_{\rm III} < 3.4\,(4.2) \times 10^{-8}$$
$$\mathcal{B}(B_s^0 \to \mu^+\mu^-\gamma)_{\rm I,\ with\ \phi\ veto} < 2.9\,(3.4) \times 10^{-8}$$
$$\mathcal{B}(B_s^0 \to \mu^+\mu^-\gamma)_{\rm comb.} < 2.5\,(2.8) \times 10^{-8}$$

[JHEP 07 (2024) 101]

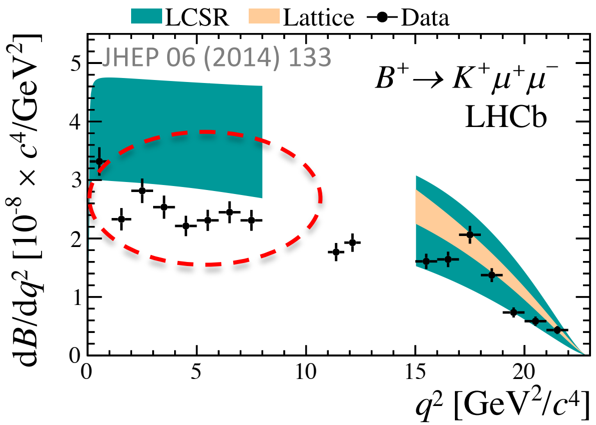


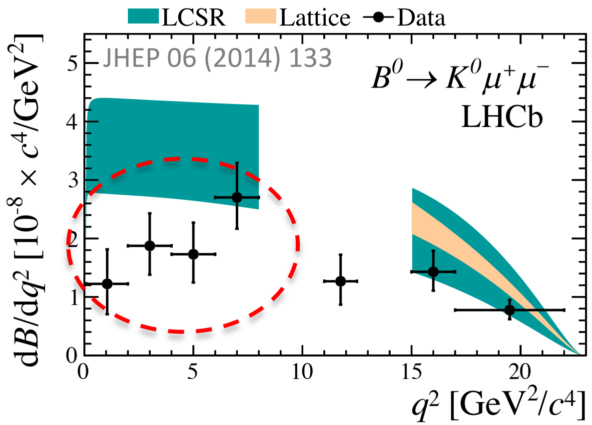


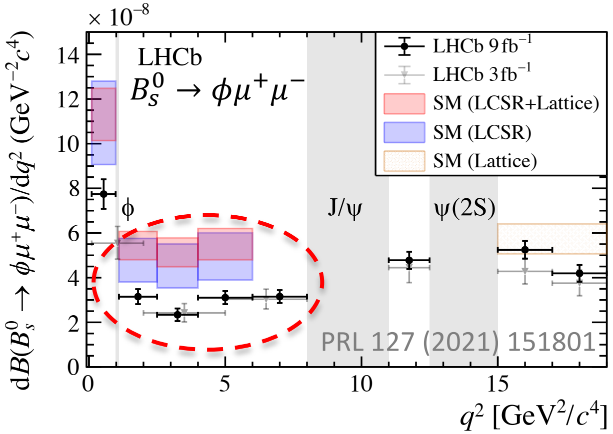
Branching fraction of $b \to s\mu^+\mu^-$

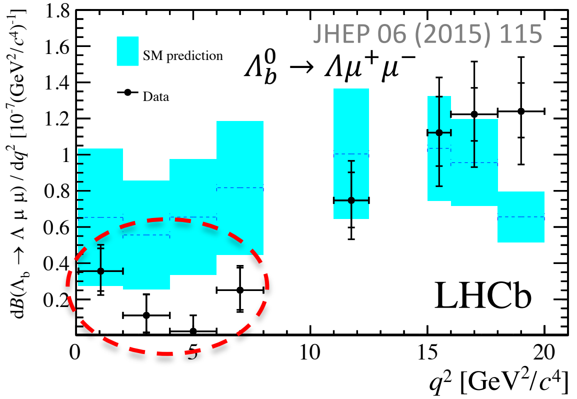


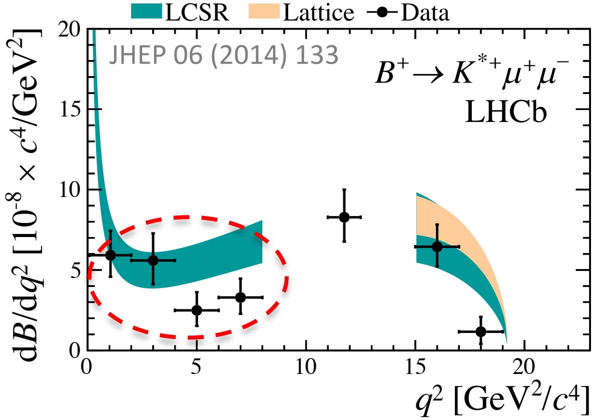
- Pattern of tensions seen, theoretical uncertainty?

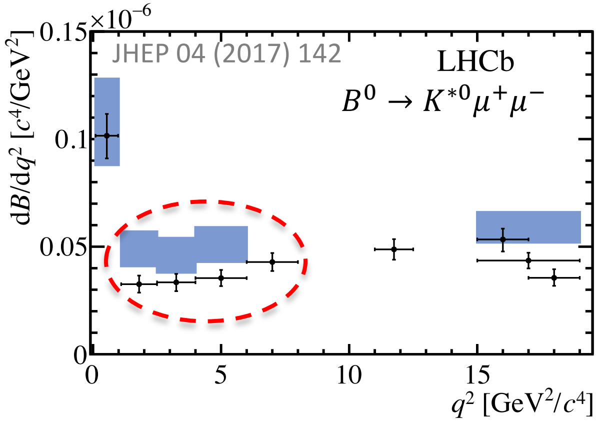


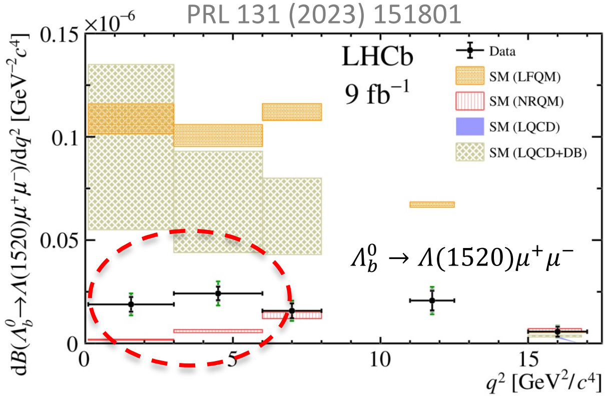




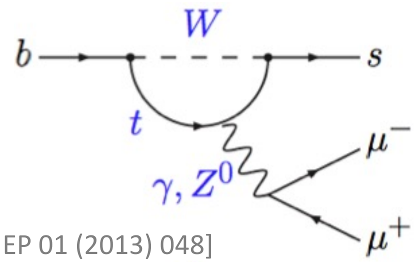








P_5' with $B^0 \to K^{*0}\mu^+\mu^-$

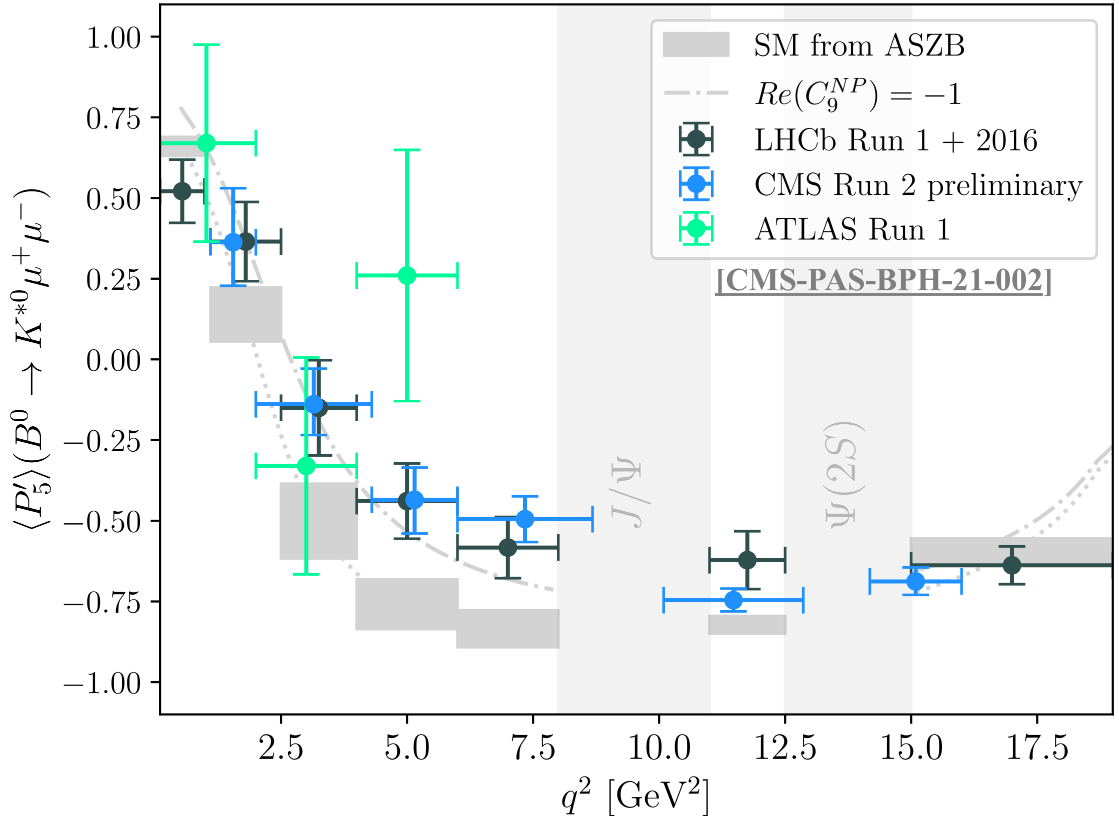


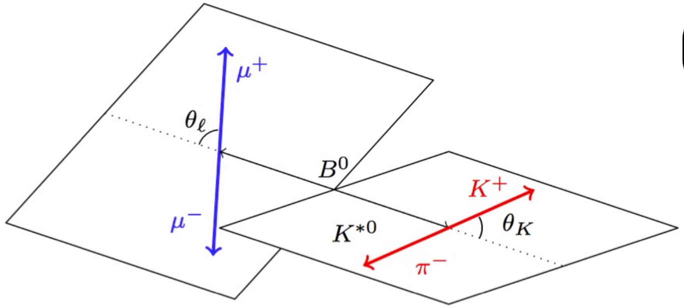
- $P_5' = \frac{S_5}{\sqrt{F_L(1-F_L)}}$, less form-factor dependent

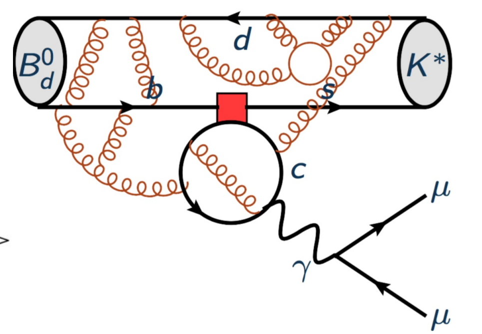
[S. Descotes-Genon, *et al.*, JHEP 01 (2013) 048]

$$\frac{1}{\mathrm{d}(\Gamma+\bar{\Gamma})/\mathrm{d}q^2}\frac{\mathrm{d}^3(\Gamma+\bar{\Gamma})}{\mathrm{d}\vec{\Omega}} = \frac{9}{32\pi}\Big[\tfrac{3}{4}(1-F_{\mathrm{L}})\sin^2\theta_K + F_{\mathrm{L}}\cos^2\theta_K + \tfrac{1}{4}(1-F_{\mathrm{L}})\sin^2\theta_K\cos 2\theta_\ell$$
$$- F_{\mathrm{L}}\cos^2\theta_K\cos 2\theta_\ell + S_3\sin^2\theta_K\sin^2\theta_\ell\cos 2\phi$$
$$+ S_4\sin 2\theta_K\sin 2\theta_\ell\cos\phi + S_5\sin 2\theta_K\sin\theta_\ell\cos\phi$$
$$+ \tfrac{4}{3}A_{\mathrm{FB}}\sin^2\theta_K\cos\theta_\ell + S_7\sin 2\theta_K\sin\theta_\ell\sin\phi$$
$$+ S_8\sin 2\theta_K\sin 2\theta_\ell\sin\phi + S_9\sin^2\theta_K\sin^2\theta_\ell\sin 2\phi\Big]$$

[PRL 125 (2020) 011802]

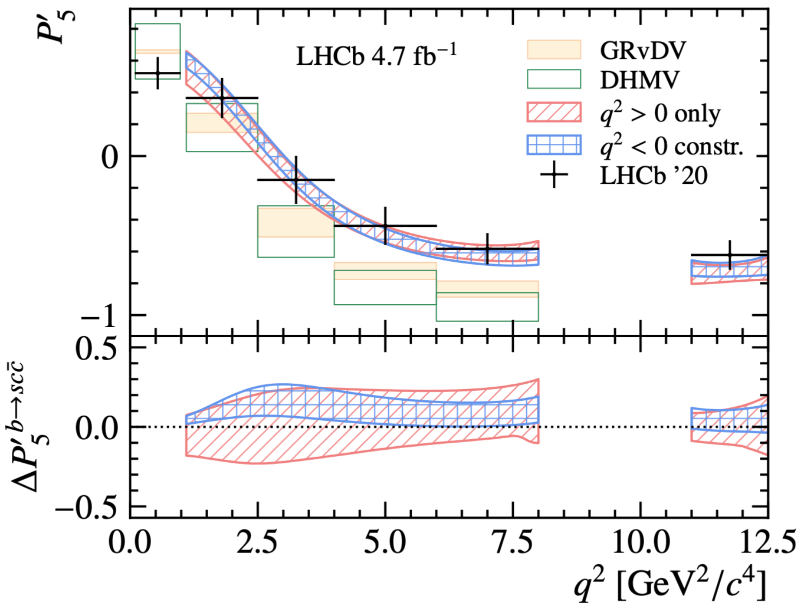


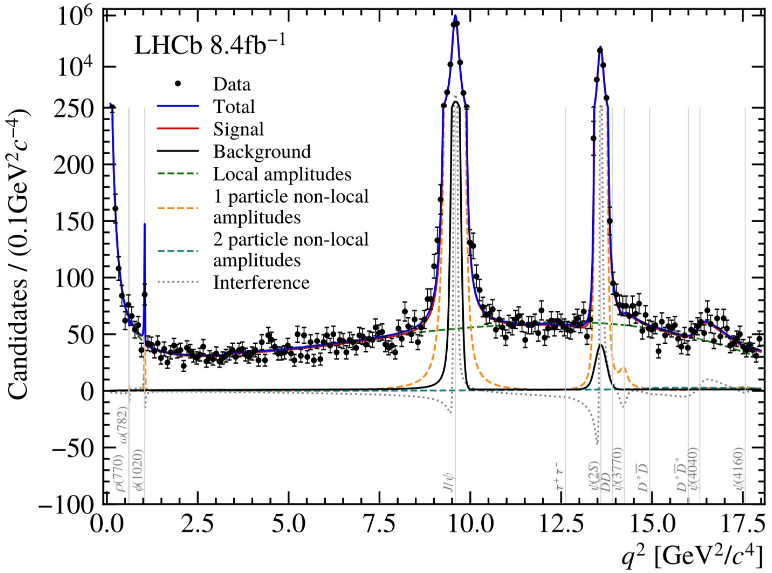


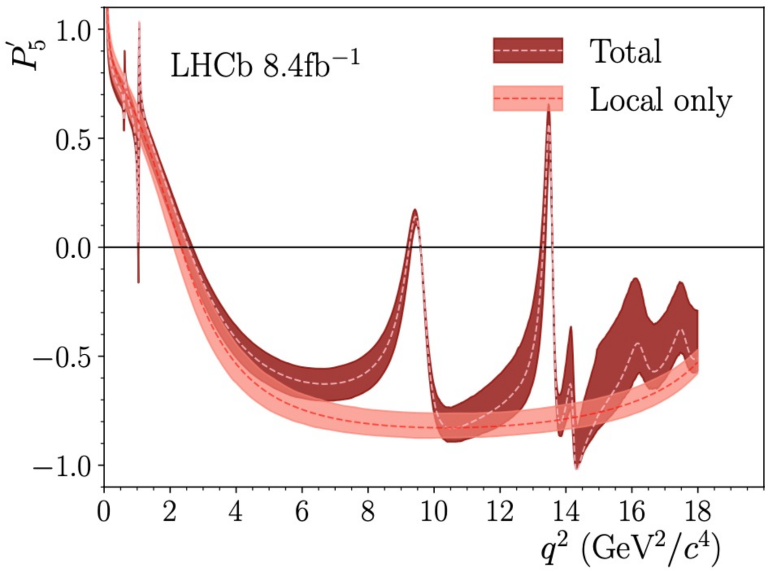


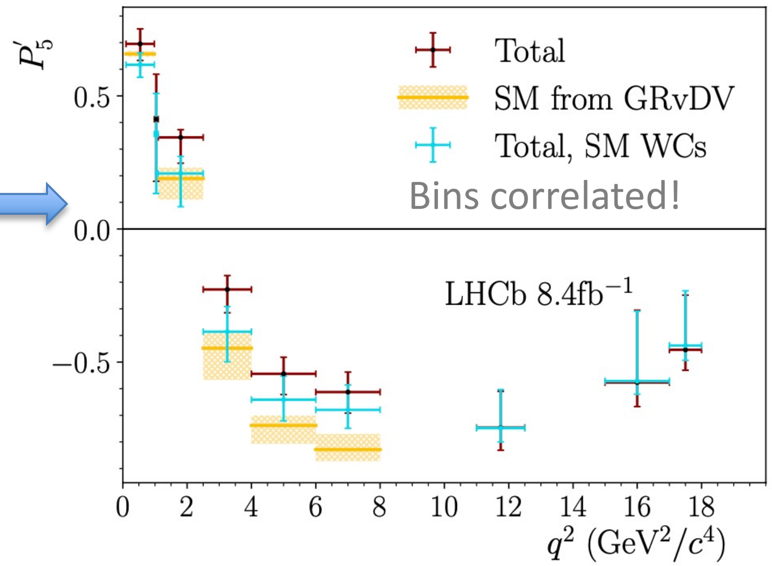
Charm loop

- Model of local and nonlocal contributions to extract Wilson co-efficiency [PRL 132 (2024) 131801]
- Model of both 1-(2-) particle amplitudes, whole dimuon region [JHEP 09 (2024) 026]



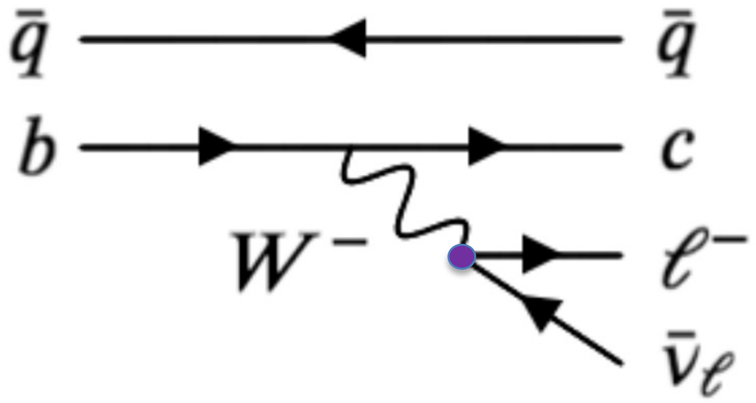


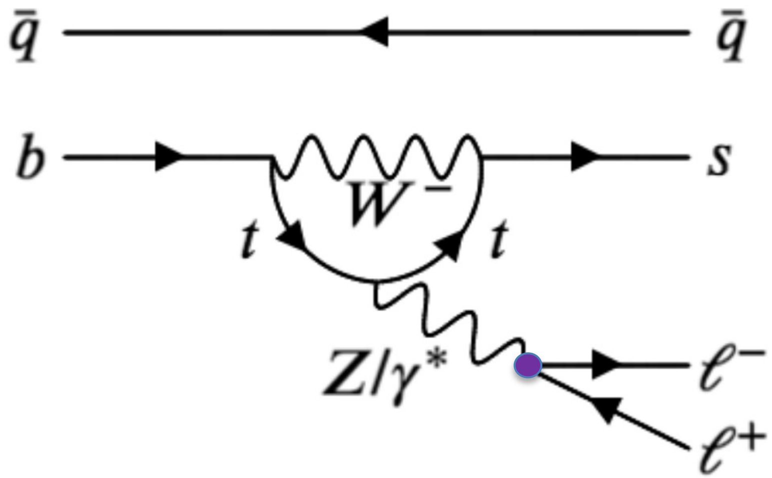




Lepton flavour universality

- Leptons (e, μ, τ) have identical coupling to gauge bosons





  - which means, e.g.,

$$R_K = \frac{\mathcal{B}(B^+ \to K^+\mu^+\mu^-)}{\mathcal{B}(B^+ \to K^+e^+e^-)} \cong 1$$

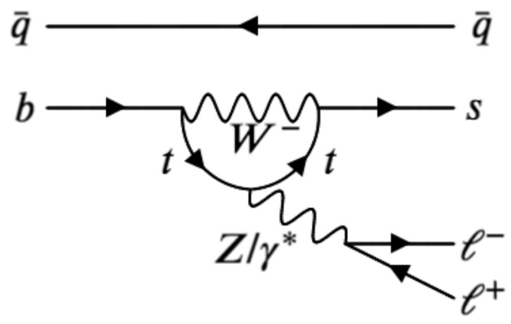
$\mathcal{O}(10^{-4})$ uncertainty
[C. Bobeth *et al.*, JHEP 12 (2007) 040]

$\mathcal{O}(1\%)$ QED correction
[M. Bordone *et al.*, EJPC 76 (2016) 440]

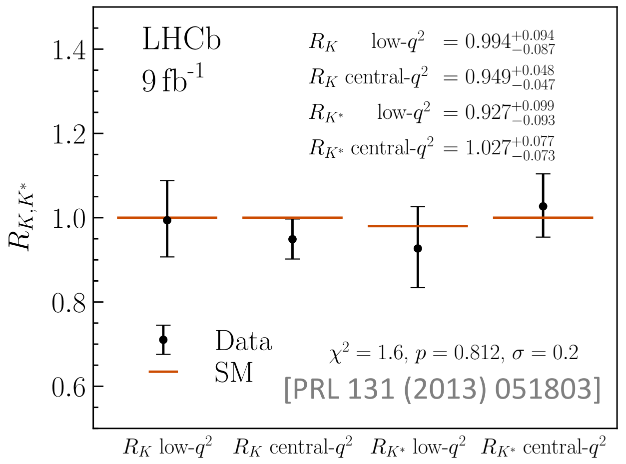
- Lepton flavour universality violation? New Physics!

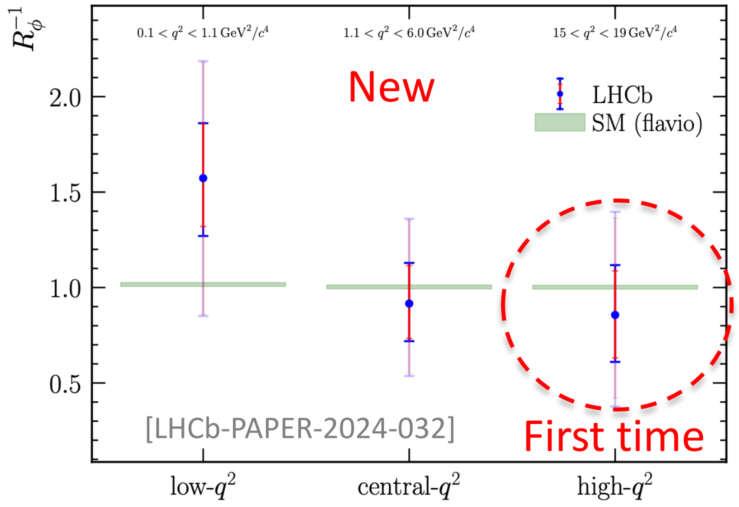
LFU in $b \to s\ell^+\ell^-$ decays

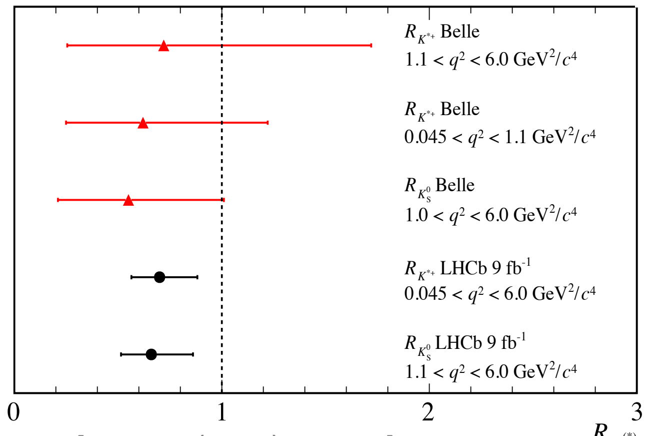
- All consistent with Standard Model for now



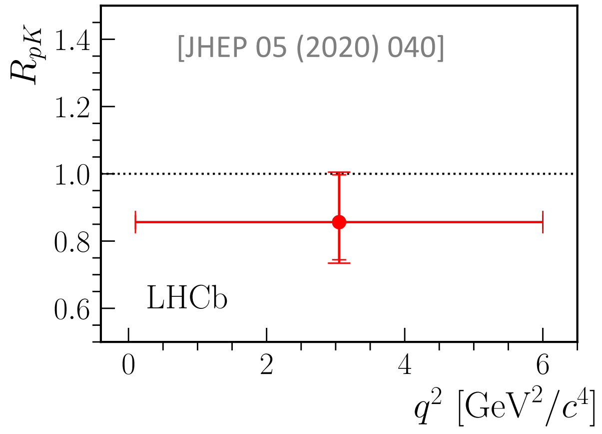
$$R_X = \frac{\mathcal{B}(H_b \to X\mu^+\mu^-)}{\mathcal{B}(H_b \to Xe^+e^-)}$$

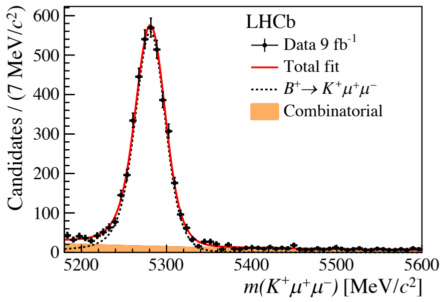


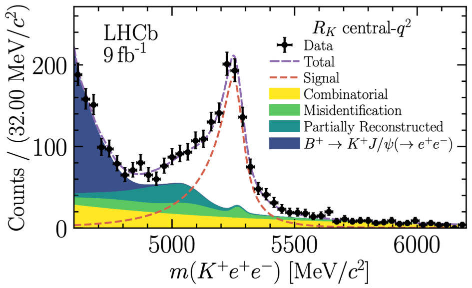




[PRL 128 (2022) 191802]



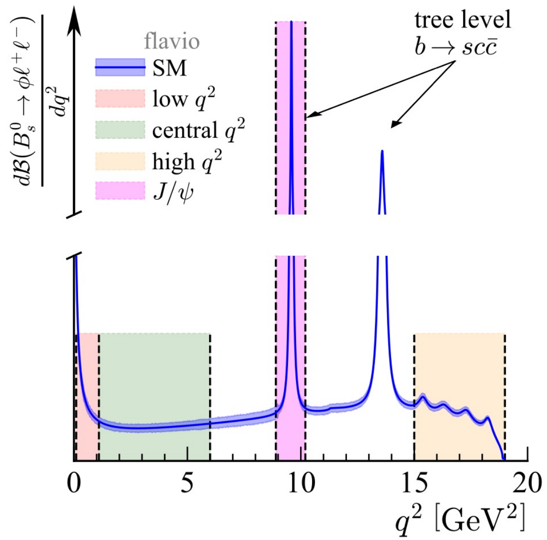


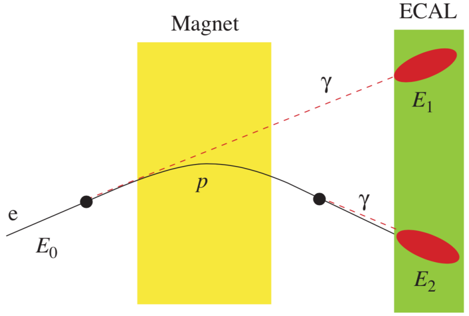


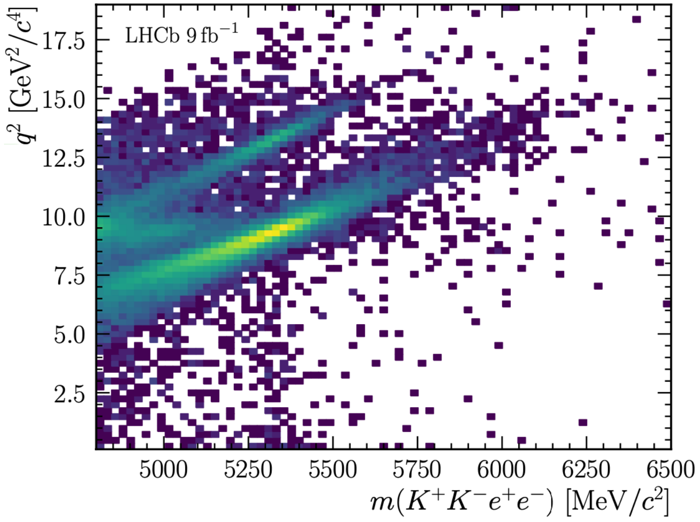
LFU in $B_s^0 \to \phi\ell^+\ell^-$, R_ϕ

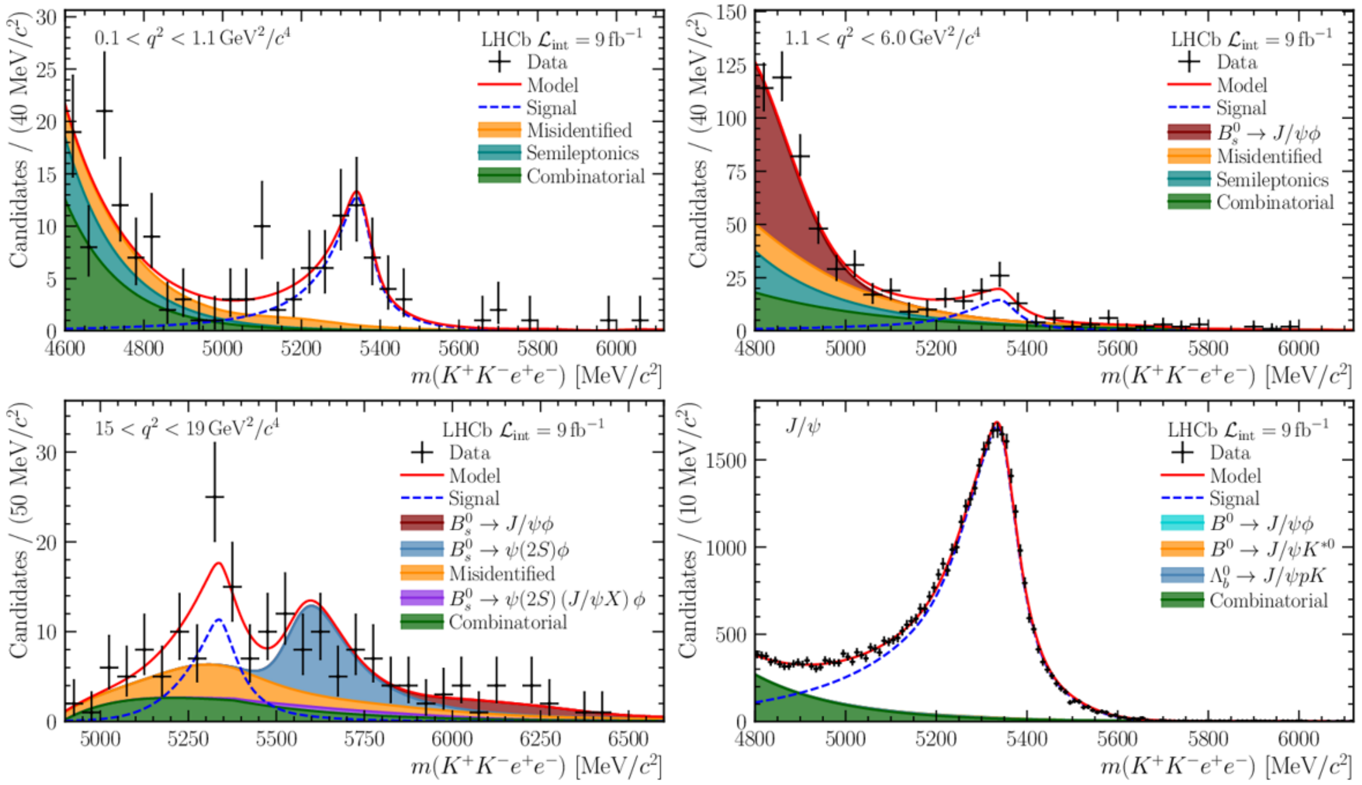
- First measurement of R_ϕ, and first for high-q^2

$$R_\phi^{-1}(\mathrm{low}-q^2) = 1.57\,^{+0.28}_{-0.25} \pm 0.05$$
$$R_\phi^{-1}(\mathrm{central}-q^2) = 0.91\,^{+0.20}_{-0.19} \pm 0.05$$
$$R_\phi^{-1}(\mathrm{high}-q^2) = 0.85\,^{+0.24}_{-0.23} \pm 0.09$$





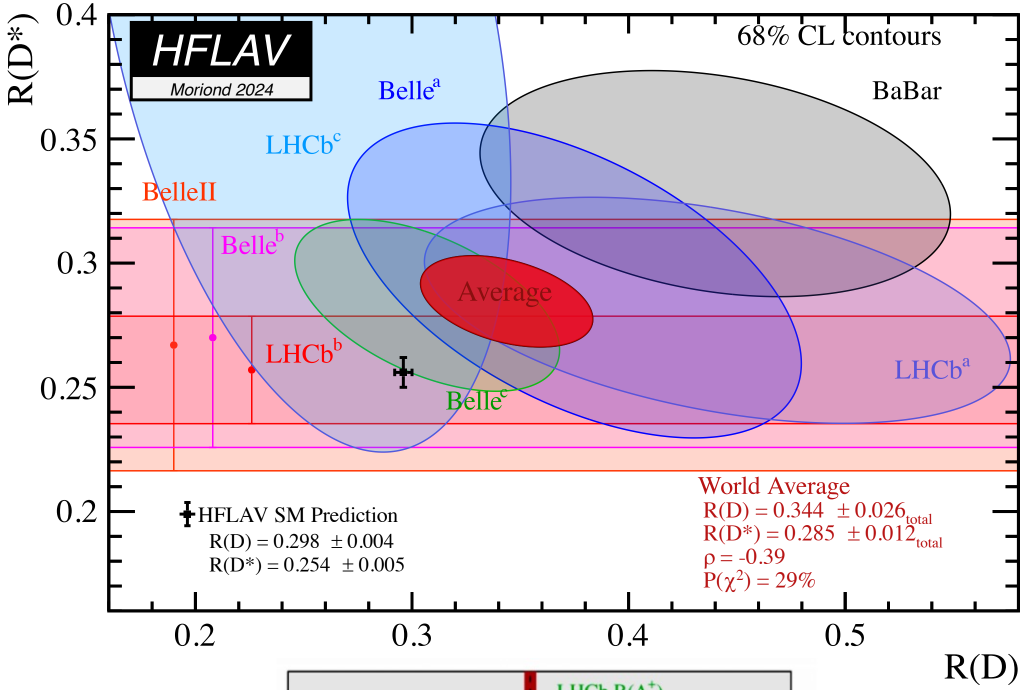


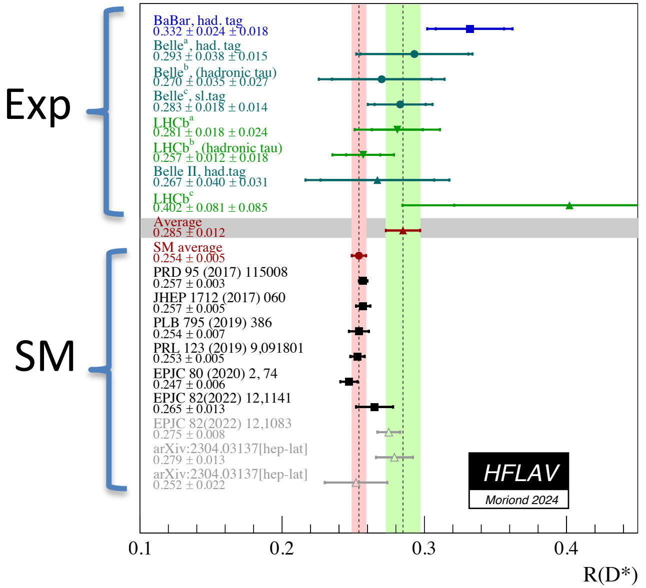


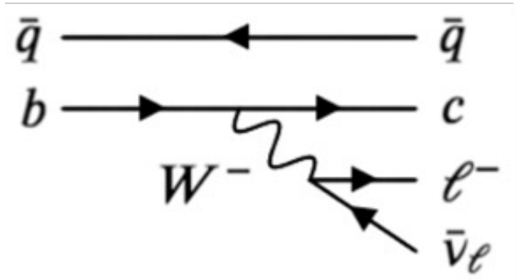
[LHCb-Paper-2024-032]

LFU in $b \to c\ell\nu$ decays

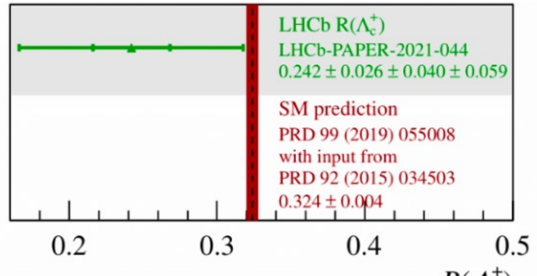
- Deviations from SM seen by Babar/Belle/LHCb



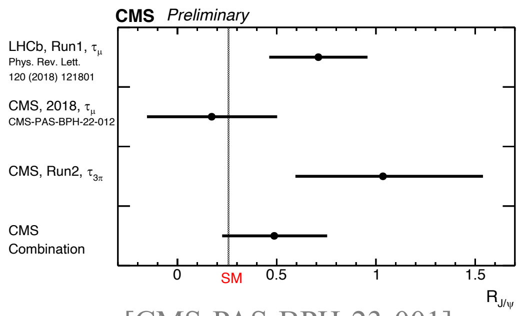




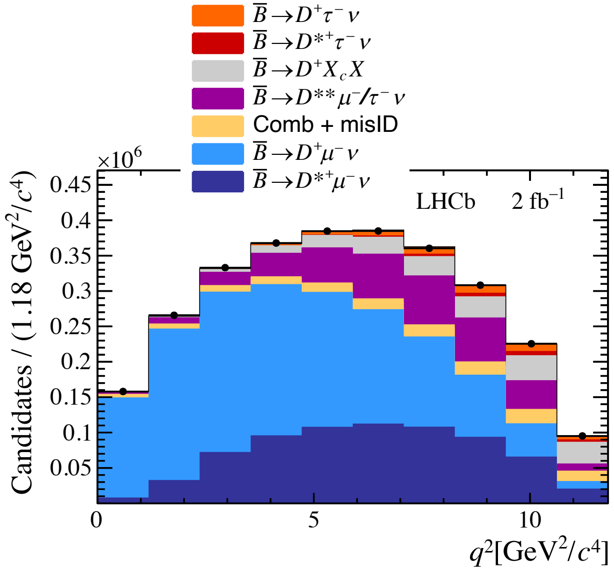
$$R(H_c) = \frac{\mathcal{B}(H_b \to H_c \tau^- \bar{\nu}_\tau)}{\mathcal{B}(H_b \to H_c \mu^- \bar{\nu}_\mu)}$$



[PRL 128 (2022) 191803]

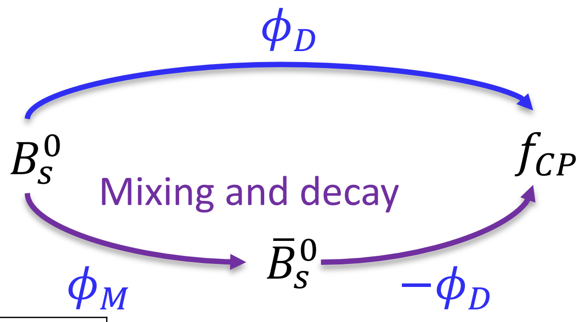


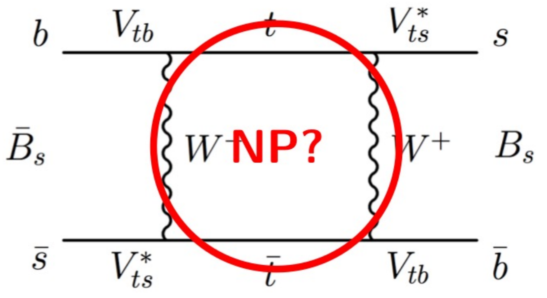
[CMS-PAS-BPH-23-001]



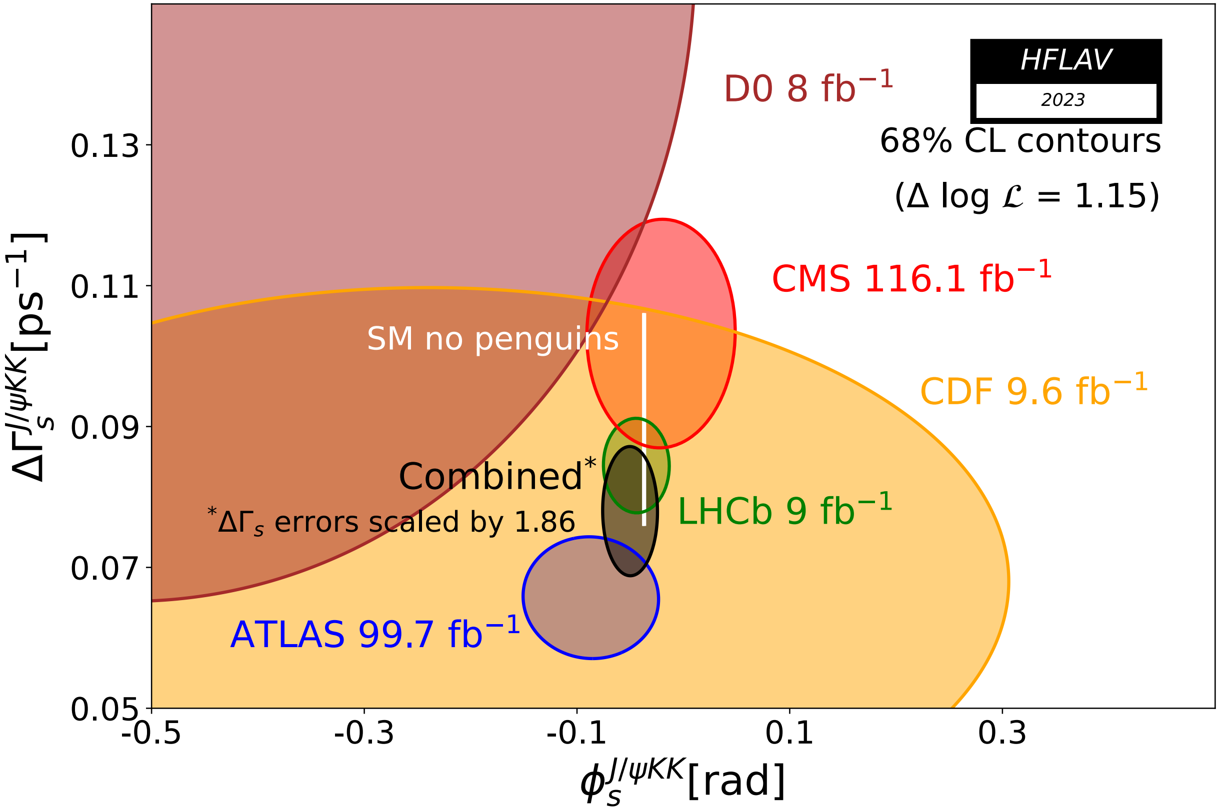
CPV in mixing

- $\phi_s = \phi_M - 2\phi_D$, small in SM
- $B_s^0 \to J/\psi h^+ h^-$



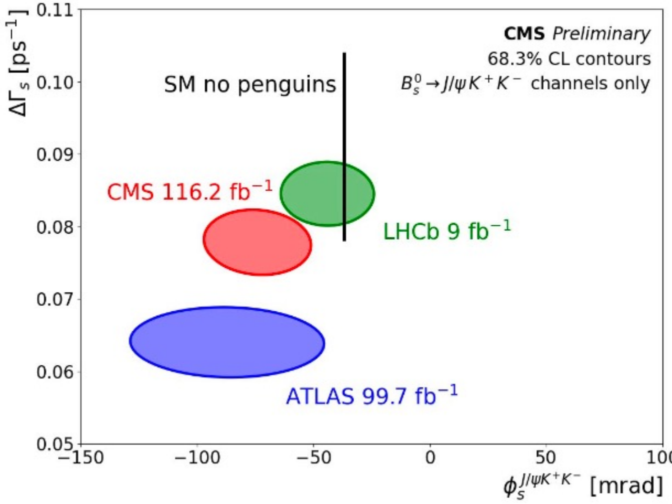


[PRL 132 (2024) 051802]



Flavour tagging?

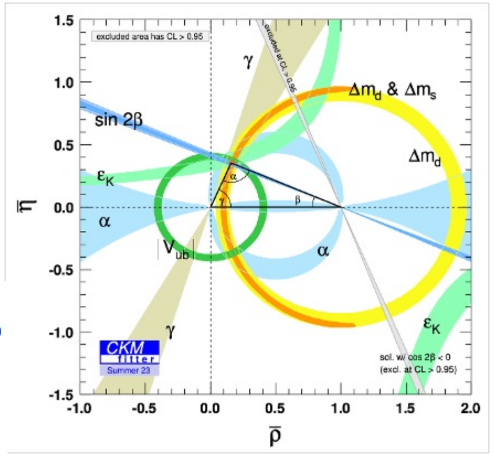
[CMS-PAS-BPH-23-004]

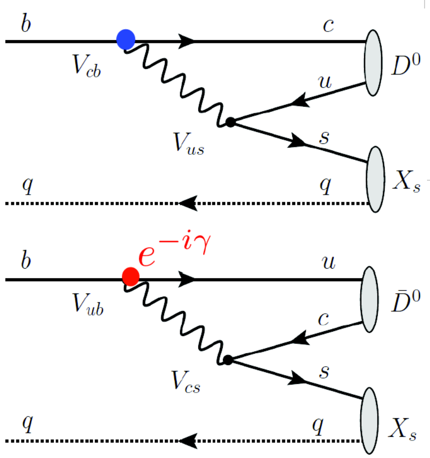


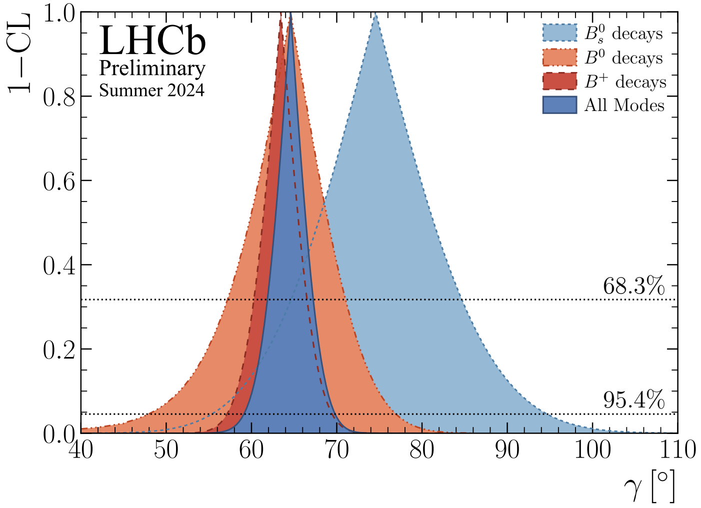
CKM-γ combination

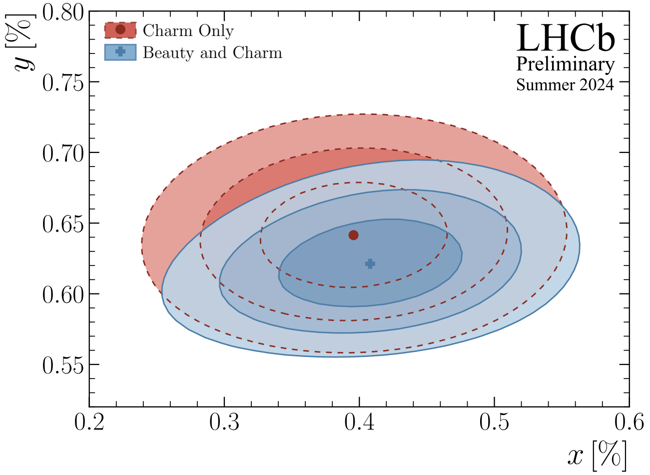
- Simultaneous determination of CKM-γ & charm mixing parameters
  - CKM $\gamma = (64.6 \pm 2.8)^\circ$
  - Charm mixing $x = (0.41 \pm 0.05)\%$,

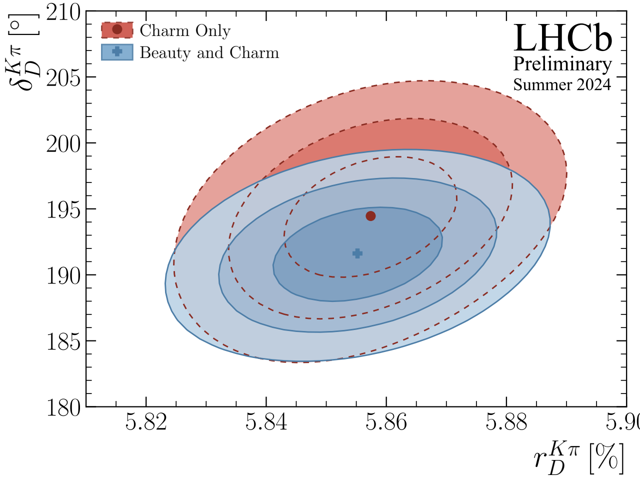
    $y = (0.621^{+0.022}_{-0.021})\%$











[LHCb-Conf-2024-004]

NEW

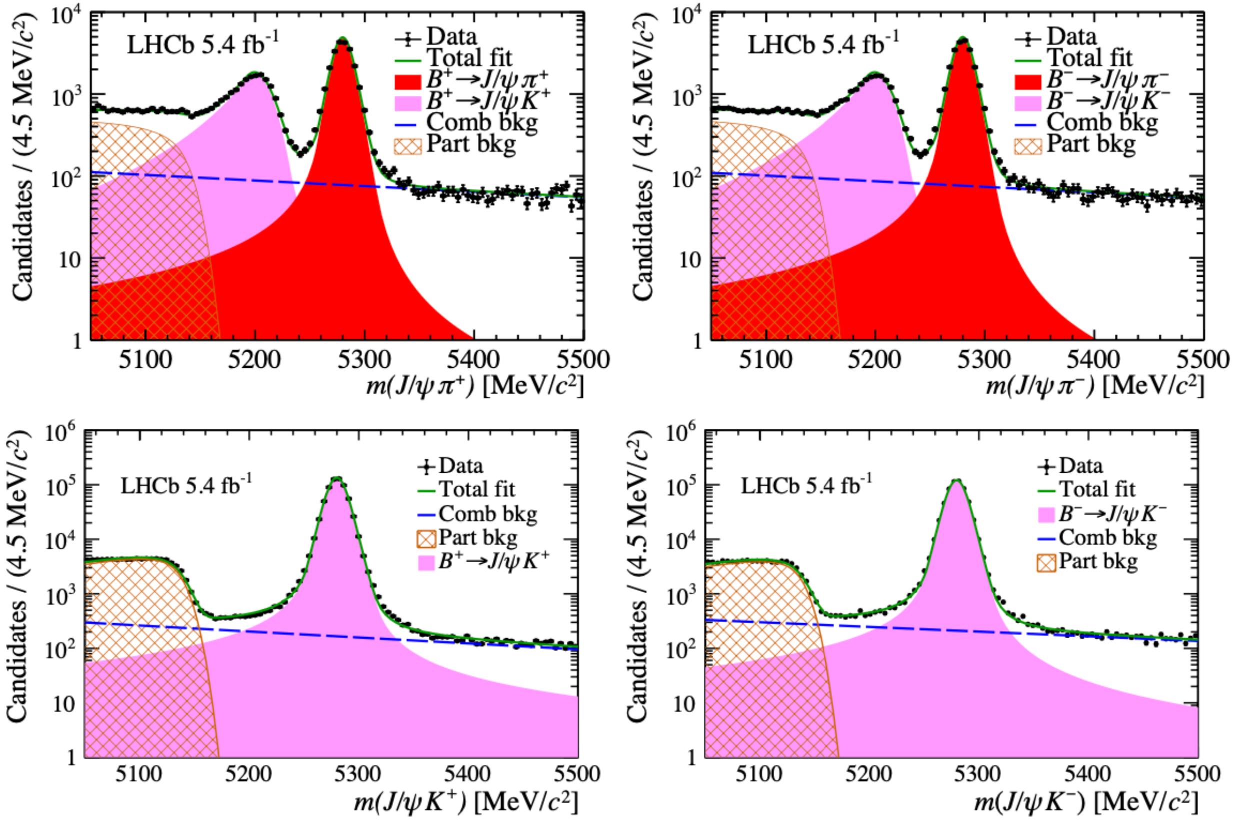
Preliminary

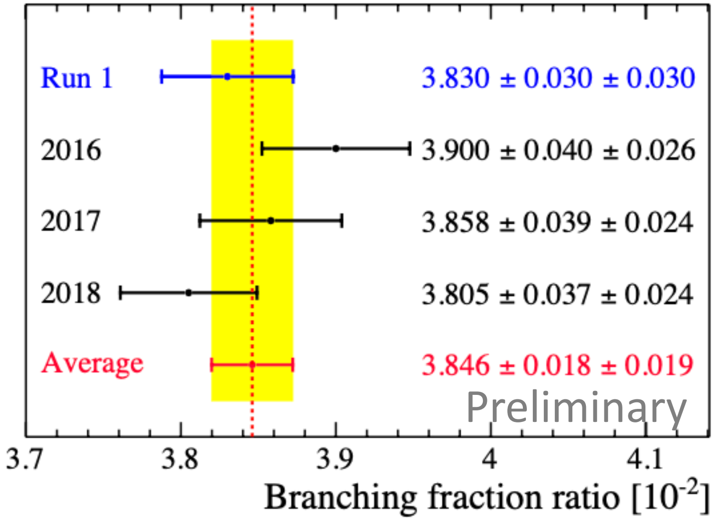
Direct CPV in $B^+ \to J/\psi h^+$ decays

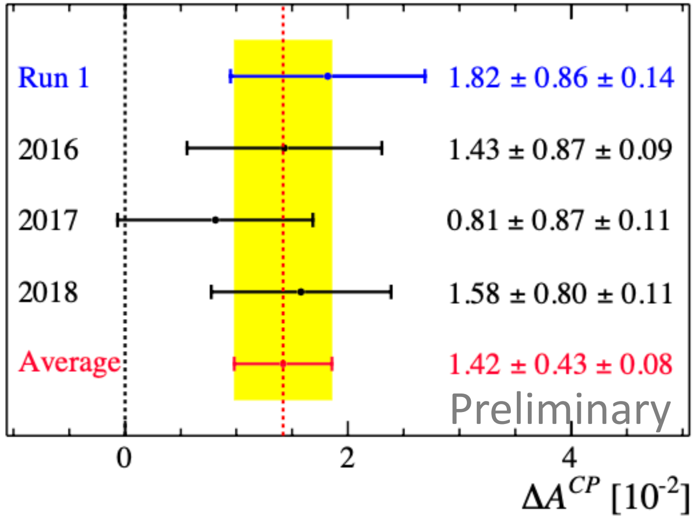
- **First evidence** after combining w/ Run-1

$$\Delta\mathcal{A}^{CP} = \mathcal{A}^{CP}(B^+ \to J/\psi\pi^+) - \mathcal{A}^{CP}(B^+ \to J/\psi K^+)$$

[LHCb-Paper-2024-031]







NEW

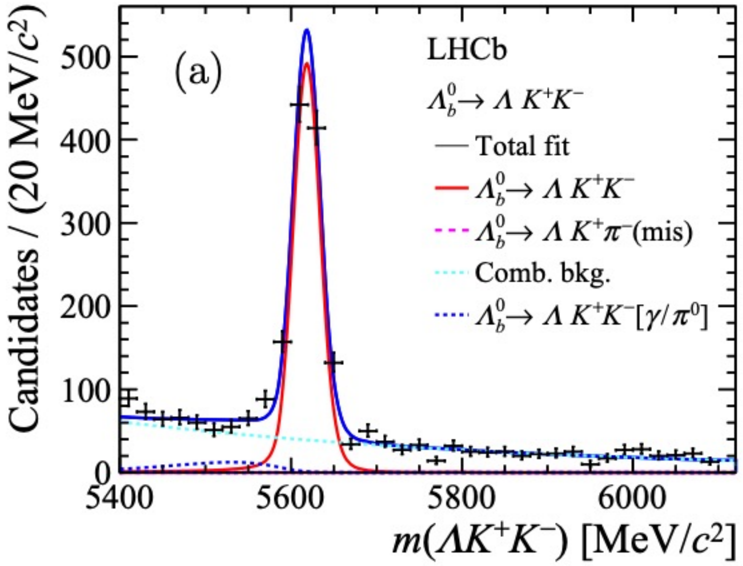
Preliminary

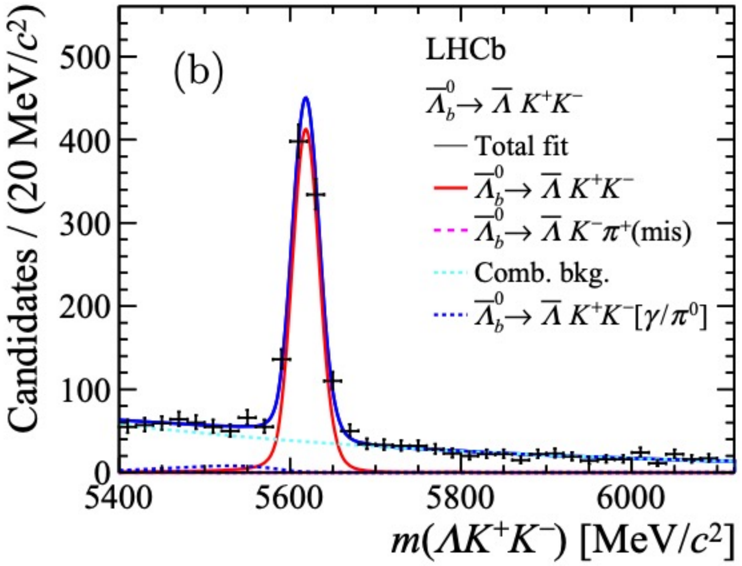
Study of $\Lambda_b^0, \Xi_b^0 \to \Lambda h^+ h'^-$

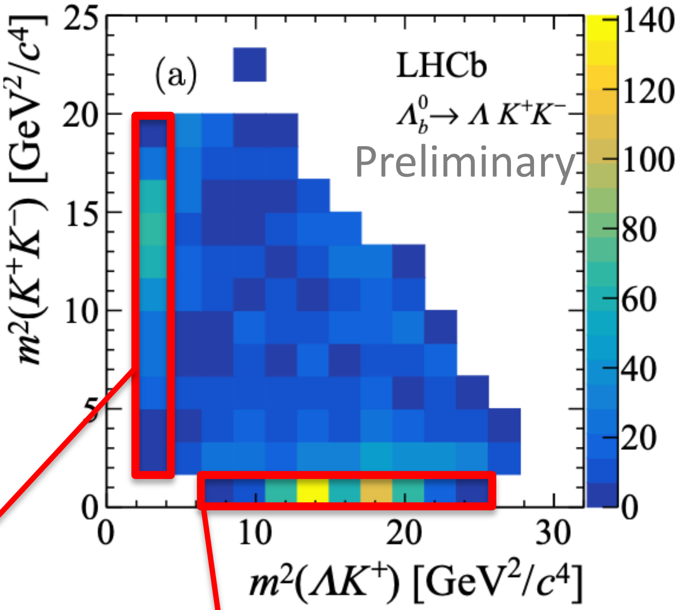
- First evidence of direct CPV in baryon
- Possible interpretation: enhancement from $N^{*+} \to \Lambda K^+$ and $\phi \to K^+K^-$

$$\Delta\mathcal{A}^{CP}(\Lambda_b^0 \to \Lambda\pi^+\pi^-) = -0.013 \pm 0.053 \pm 0.018,$$
$$\Delta\mathcal{A}^{CP}(\Lambda_b^0 \to \Lambda K^+\pi^-) = -0.118 \pm 0.045 \pm 0.021,$$
$$\Delta\mathcal{A}^{CP}(\Lambda_b^0 \to \Lambda K^+K^-) = 0.083 \pm 0.023 \pm 0.016,$$
$$\Delta\mathcal{A}^{CP}(\Xi_b^0 \to \Lambda K^-\pi^+) = 0.27 \pm 0.12 \pm 0.05,$$

[LHCb-Paper-2024-043]







$\Delta\mathcal{A}^{CP} = (16.5 \pm 5.1)\%$

$\Delta\mathcal{A}^{CP} = (15.0 \pm 5.9)\%$

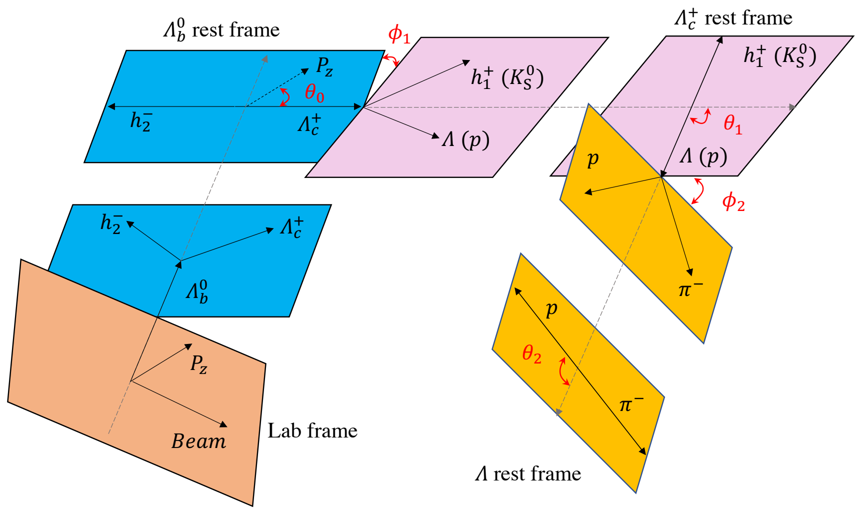
$\Lambda_b^0, \Lambda_c^+, \Lambda$ decay parameters

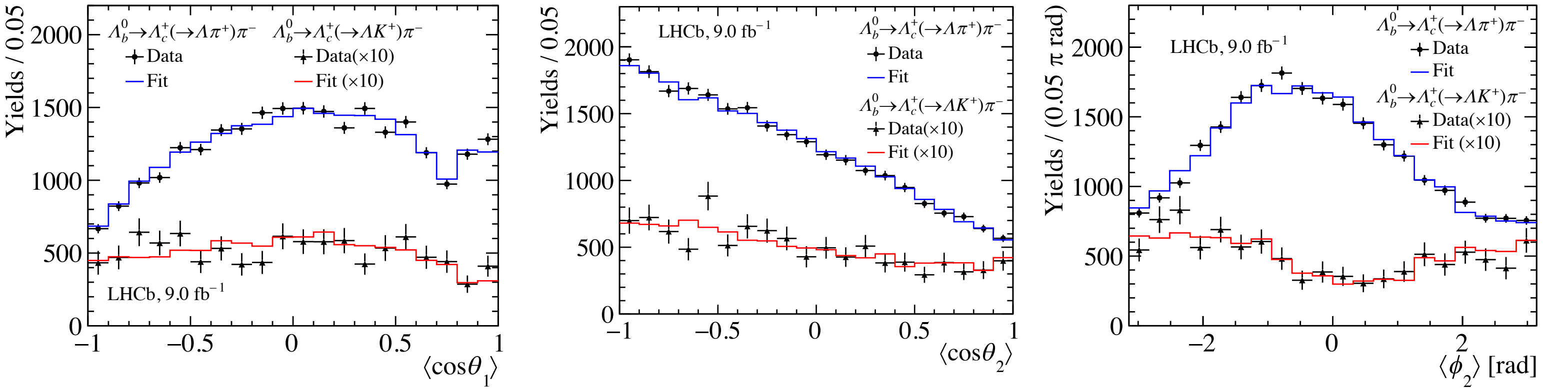
- First proposed by Lee and Yang to seach for parity violation

$$\alpha \equiv \frac{2\Re(s^*p)}{|s|^2+|p|^2}, \quad \beta \equiv \frac{2\Im(s^*p)}{|s|^2+|p|^2}, \quad \gamma \equiv \frac{|s|^2-|p|^2}{|s|^2+|p|^2}, \quad \alpha^2+\beta^2+\gamma^2 = 1$$

s/p, parity-violating S-wave and parity-conserving P-wave amplitudes

[arXiv:2409.02759]



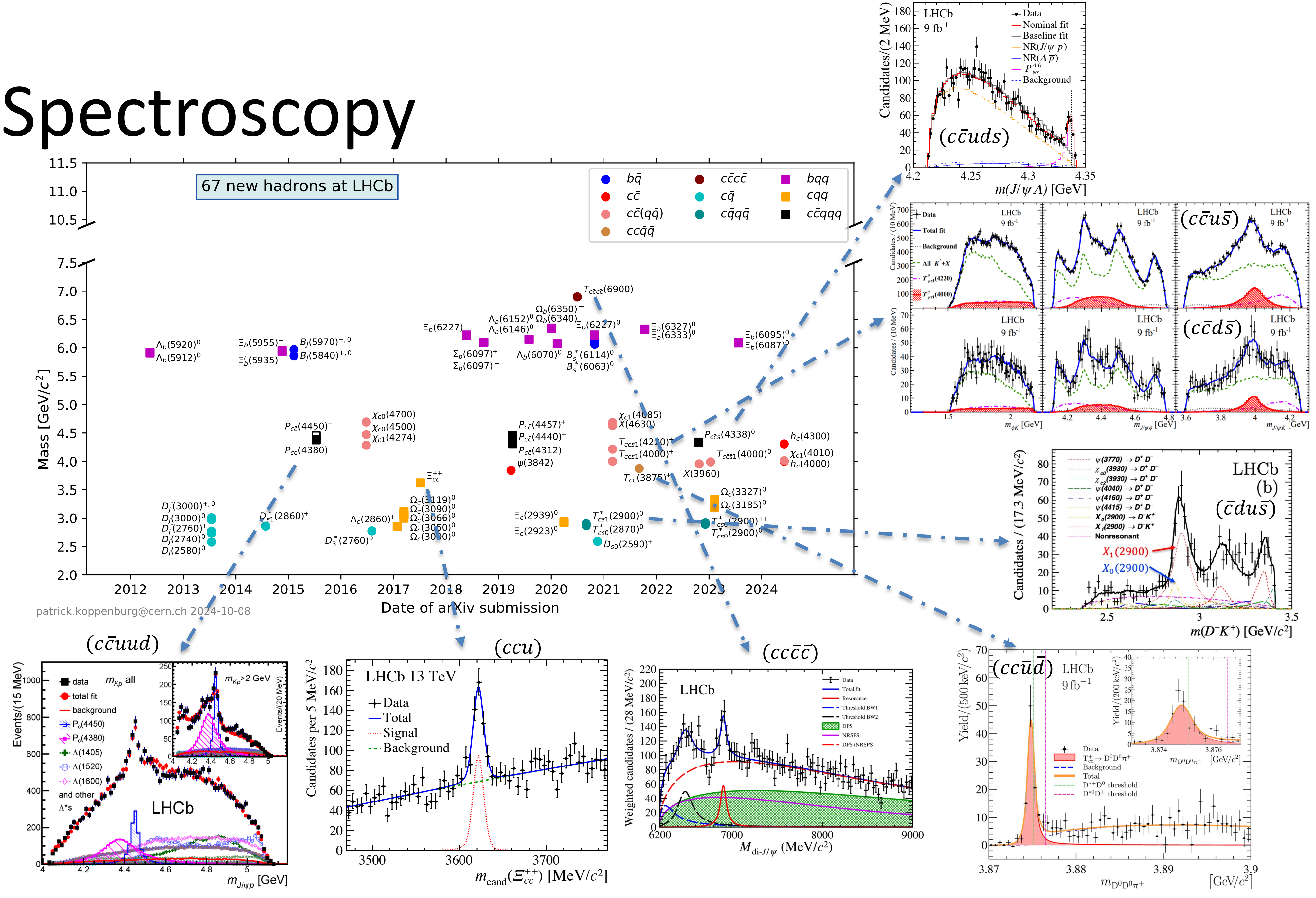


Decay	α	$\bar{\alpha}$	$\langle\alpha\rangle$	A_α
$\Lambda_b^0 \to \Lambda_c^+\pi^-$	$-1.010 \pm 0.011 \pm 0.003$	$0.996 \pm 0.011 \pm 0.003$	$-1.003 \pm 0.008 \pm 0.005$	$0.007 \pm 0.008 \pm 0.005$
$\Lambda_b^0 \to \Lambda_c^+ K^-$	$-0.933 \pm 0.042 \pm 0.014$	$0.995 \pm 0.036 \pm 0.013$	$-0.964 \pm 0.028 \pm 0.015$	$-0.032 \pm 0.029 \pm 0.006$
$\Lambda_c^+ \to \Lambda\pi^+$	$-0.782 \pm 0.009 \pm 0.004$	$0.787 \pm 0.009 \pm 0.003$	$-0.785 \pm 0.006 \pm 0.003$	$-0.003 \pm 0.008 \pm 0.002$
$\Lambda_c^+ \to \Lambda K^+$	$-0.569 \pm 0.059 \pm 0.028$	$0.464 \pm 0.058 \pm 0.017$	$-0.516 \pm 0.041 \pm 0.021$	$0.102 \pm 0.080 \pm 0.023$
$\Lambda_c^+ \to pK_S^0$	$-0.744 \pm 0.012 \pm 0.009$	$0.765 \pm 0.012 \pm 0.007$	$-0.754 \pm 0.008 \pm 0.006$	$-0.014 \pm 0.011 \pm 0.008$
$\Lambda \to p\pi^-$	$0.717 \pm 0.017 \pm 0.009$	$-0.748 \pm 0.016 \pm 0.007$	$0.733 \pm 0.012 \pm 0.006$	$-0.022 \pm 0.016 \pm 0.007$

$$\frac{d^3\Gamma}{d\cos\theta_1 d\cos\theta_2 d\phi_2} \propto (1 + \alpha_{\Lambda_b^0}\alpha_{\Lambda_c^+}\cos\theta_1 + \alpha_{\Lambda_c^+}\alpha_\Lambda\cos\theta_2 + \alpha_{\Lambda_b^0}\alpha_\Lambda\cos\theta_1\cos\theta_2$$
$$- \alpha_{\Lambda_b^0}\gamma_{\Lambda_c^+}\alpha_\Lambda\sin\theta_1\sin\theta_2\cos\phi_2 + \alpha_{\Lambda_b^0}\beta_{\Lambda_c^+}\alpha_\Lambda\sin\theta_1\sin\theta_2\sin\phi_2)$$

No sign of CP violation

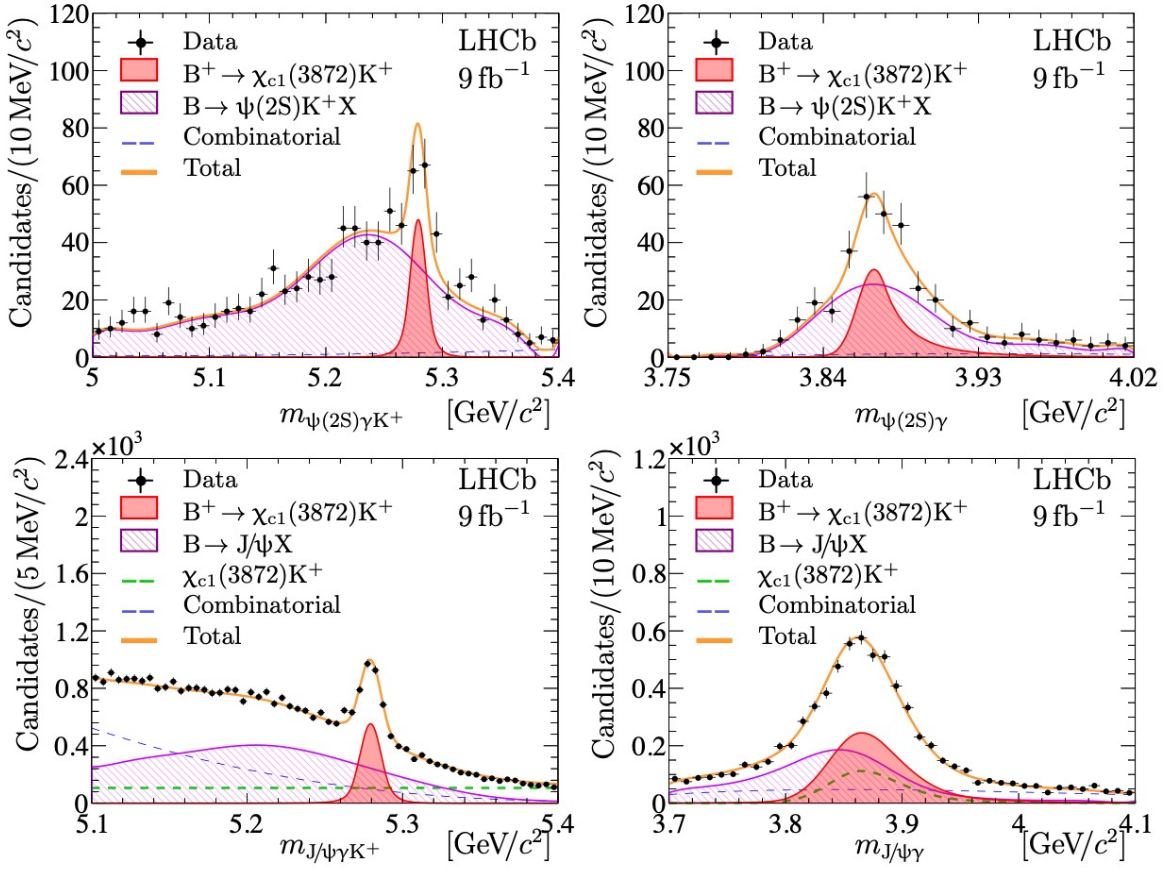
Spectroscopy

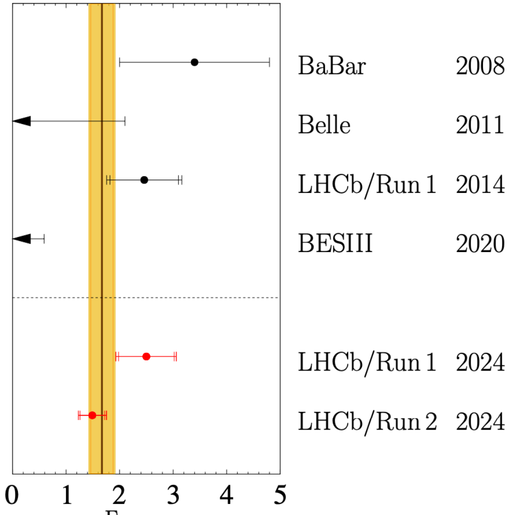


Radiative decays of $X(3872)$

- First observation of $X(3872) \to \psi(2S)\gamma$

[arXiv:2406.17006]





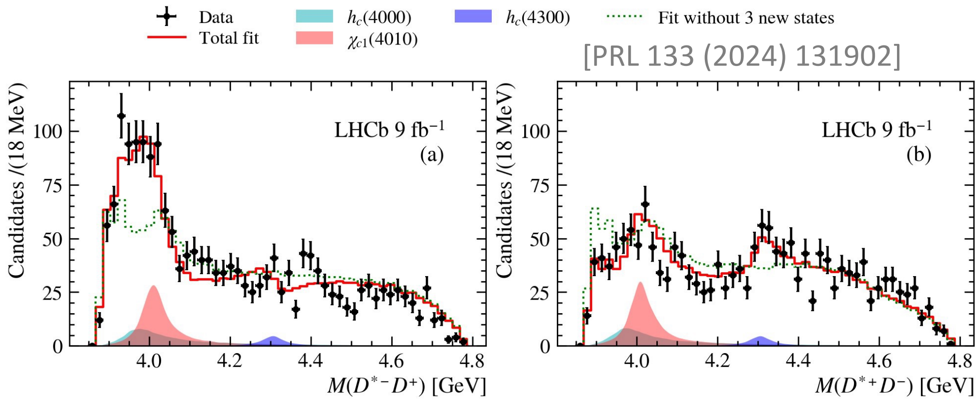
$$\mathscr{R}_{\psi\gamma} = \frac{\Gamma_{\chi_{c1}(3872)\to\psi(2S)\gamma}}{\Gamma_{\chi_{c1}(3872)\to J/\psi\gamma}} = 1.67 \pm 0.21 \pm 0.12 \pm 0.04$$

Reference		$\mathscr{R}_{\psi\gamma}$	
T. Barnes and S. Godfrey	[67]	5.8	$c\bar{c}$
T. Barnes, S. Godfrey and S. Swanson	[69]	2.6	$c\bar{c}$
F. De Fazio	[84]	(1.64 ± 0.25)	$c\bar{c}$
B.-Q. Li and K. T. Chao	[85]	1.3	$c\bar{c}$
Y. Dong *et al.*	[86]	$1.3 - 5.8$	$c\bar{c}$
A. M. Badalian *et al.*	[87]	(0.8 ± 0.2)	$c\bar{c}$
J. Ferretti, G. Galata and E. Santopinto	[88]	6.4	$c\bar{c}$
A. M. Badalian, Yu. A. Simonov and B. L. G. Bakker	[89]	2.4	$c\bar{c}$
W. J. Deng *et al.*	[90]	1.3	$c\bar{c}$
F. Giacosa, M. Piotrowska and S. Goito	[71]	5.4	$c\bar{c}$/vc
E. S. Swanson	[81]	0.38 %	$D\bar{D}^*$
Y. Dong *et al.*	[86]	0.33 %	$D\bar{D}^*$
D. P. Rathaud and A. K. Rai	[91]	0.25	$D\bar{D}^*$
R. F. Lebed and S. R. Martinez	[92]	0.33 %	$D\bar{D}^*$
B. Grinstein, L. Maiani and A. D. Polosa	[93]	3.6 %	$D\bar{D}^*$
F.-K. Guo *et al.*	[82]	$0.21(g_2'/g_2)^2$	$D\bar{D}^*$
D. A.-S. Molnar, R. F. Luiz and R. Higa	[83]	$2 - 10$	$D\bar{D}^*$
E. Cincioglu *et al.*	[94]	< 4	$D\bar{D}^*$
S. Takeuchi, M. Takizawa and K. Shimizu	[95]	$1.1 - 3.4$	$D\bar{D}^*$
B. Grinstein, L. Maiani and A. D. Polosa	[93]	$> (0.95^{+0.01}_{-0.07})$	$c\bar{c}q\bar{q}$

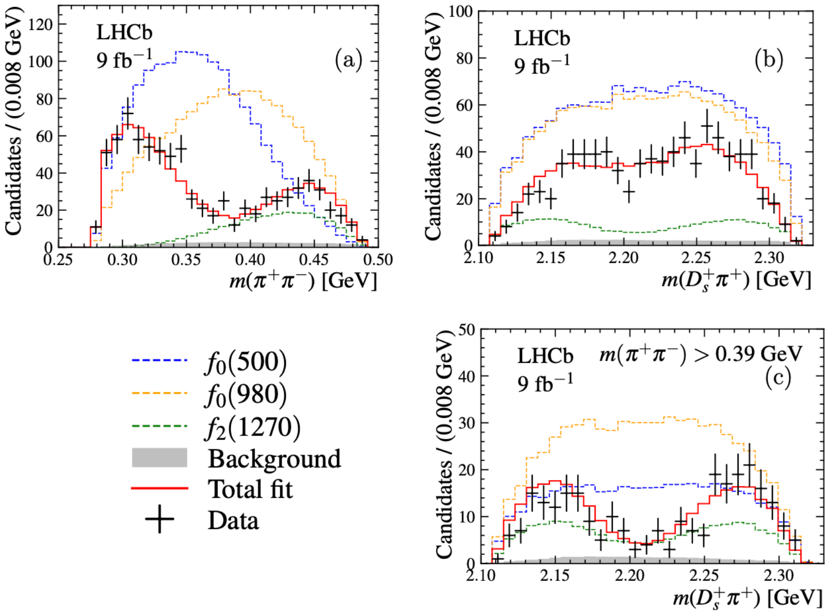
Spectroscopy in $B \to DDX$ decays

- $h_c(4000), \chi_{c1}(4010), h_c(4300)$ in $B^+ \to D^{*\pm} D^{\mp} K^+$ decays
- T_{cs} in $B \to \bar{D}^{(*)} D_s^+ \pi^+ \pi^-$

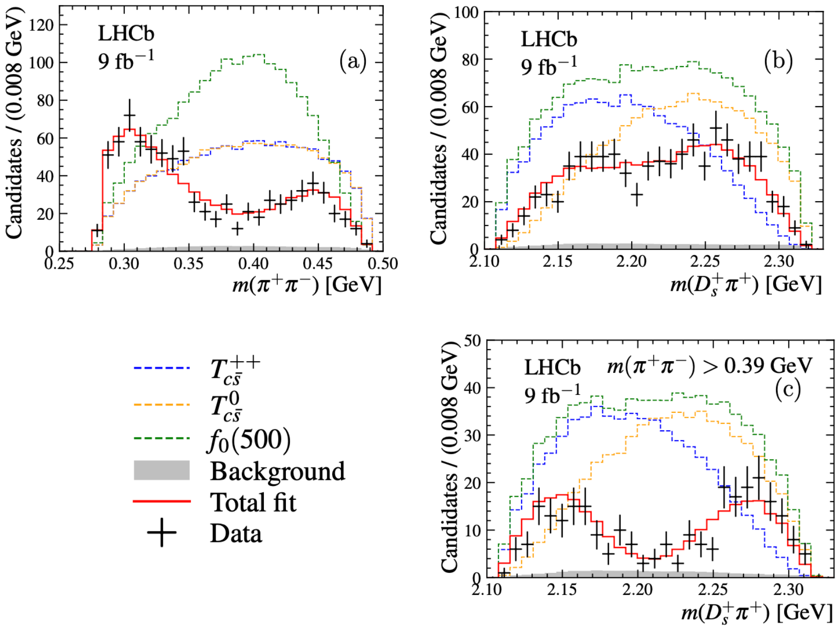
[PRL 133 (2024) 131902]



[LHCb-Paper-2024-033]



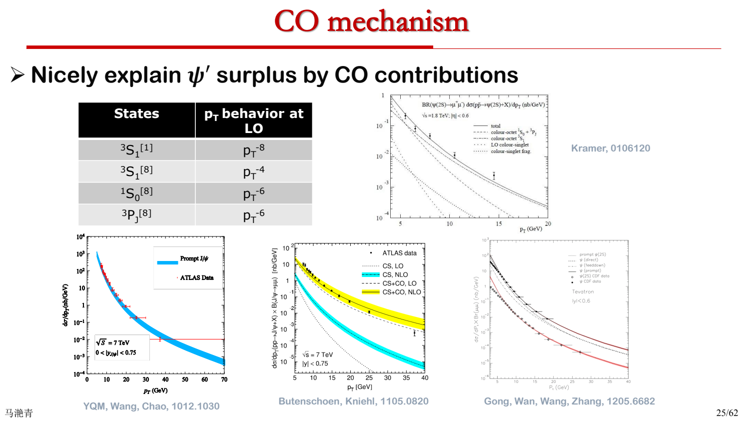
or

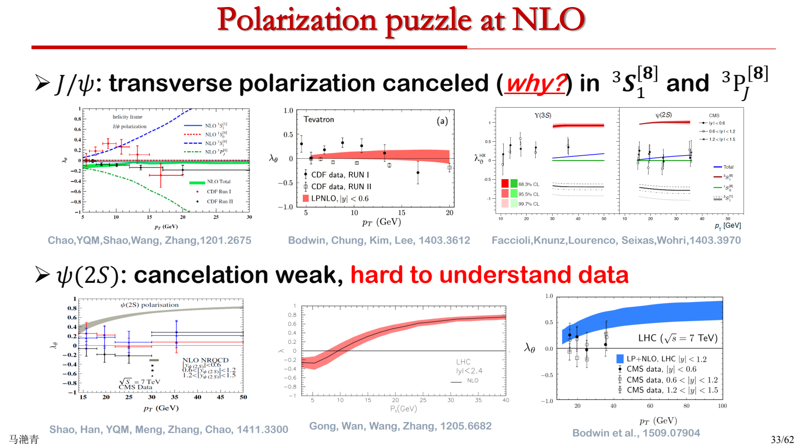


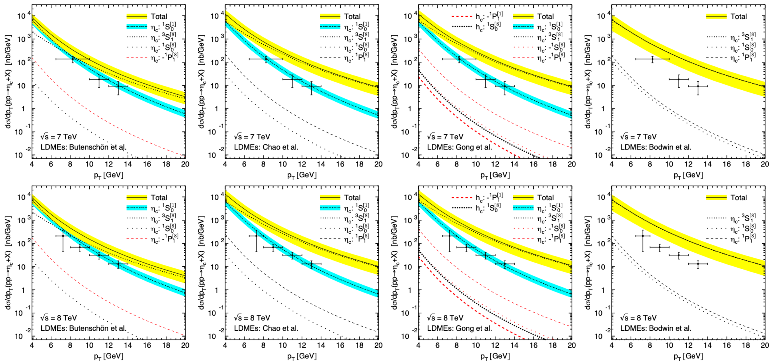
η_c production

[arXiv:2407.14261]

- 50 years after J-particle's discovery, hadroproduction mechanism?







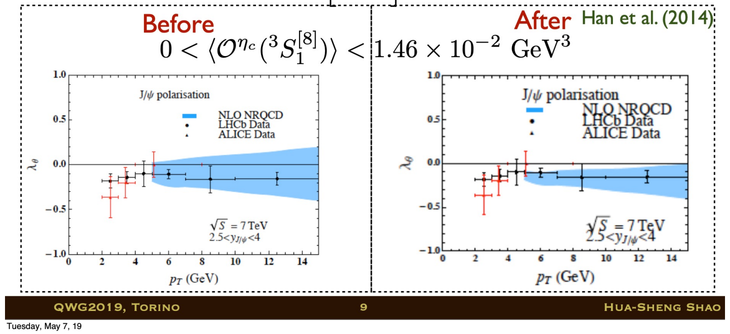
[M. Butenschoen, et al., PRL 114 (2015) 092004]

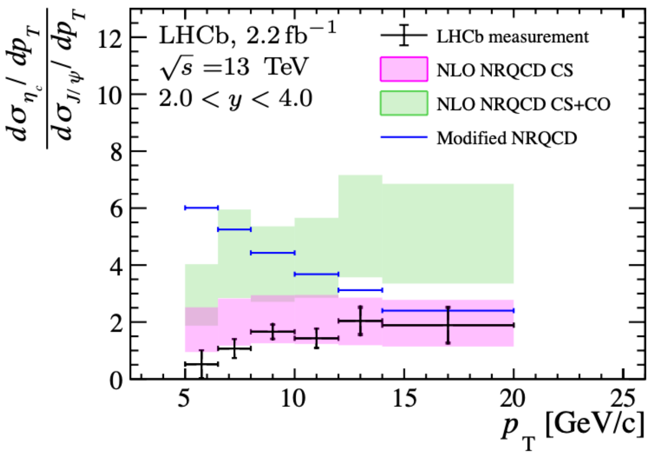
- LHCb data + HQSS helps to constrain $\langle \mathcal{O}^{J/\psi}(^1S_0^{[8]})\rangle$

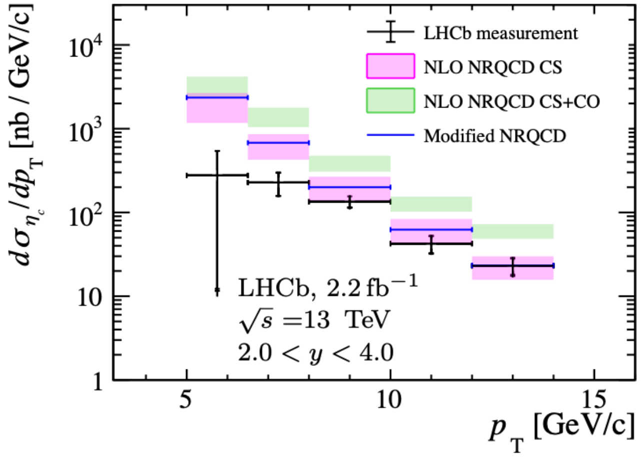
$$\langle \mathcal{O}^{J/\psi}(^1S_0^{[8]})\rangle = \langle \mathcal{O}^{\eta_c}(^3S_1^{[8]})\rangle$$

- A conservative upper limit was set via

$$\langle \mathcal{O}^{\eta_c}(^3S_1^{[8]})\rangle \hat{\sigma}(c\bar{c}\left[^3S_1^{[8]}\right]) = \sigma_{\text{LHCb data}}$$



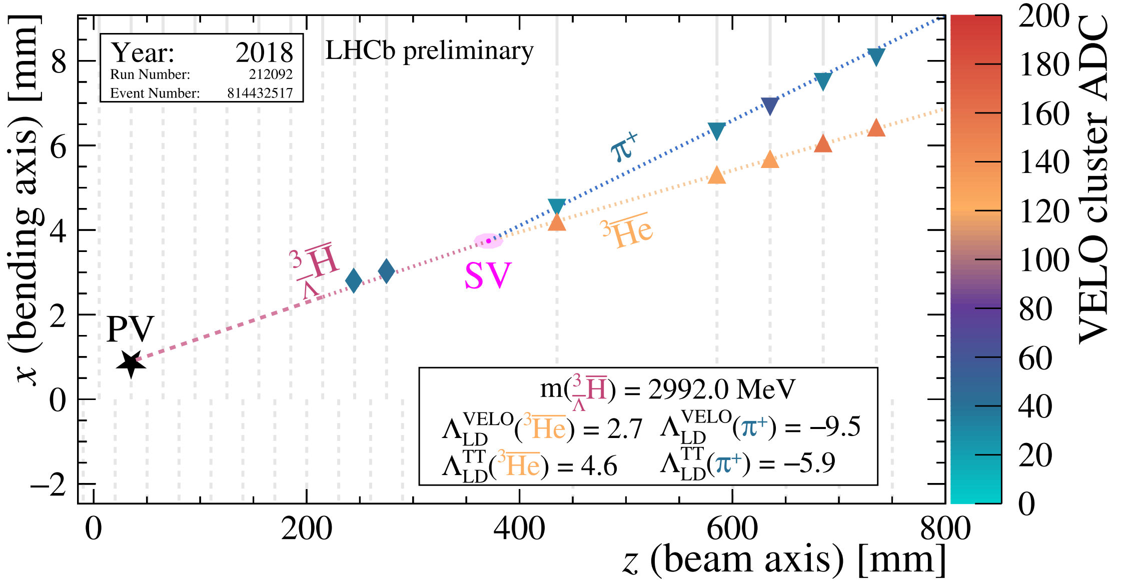


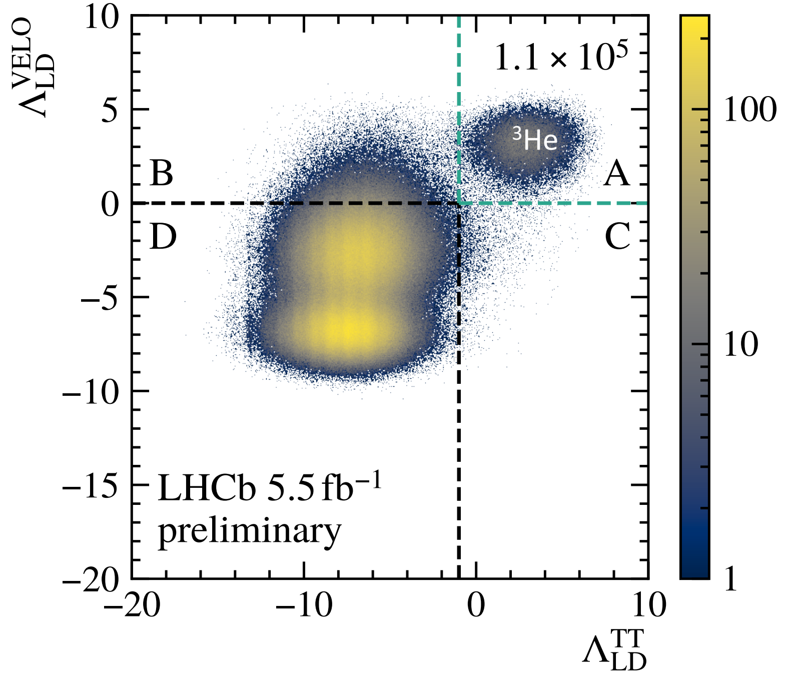


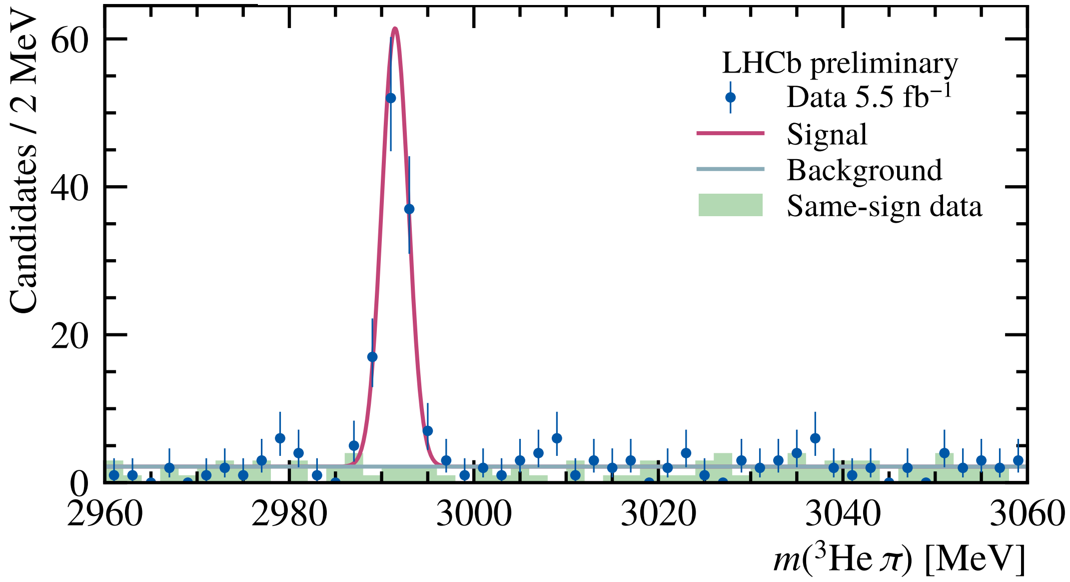
Nuclei production

- New method to identify *d* and ^{3}He
- Clean sample of (anti)hypertritons

[LHCb-Conf-2023-002]



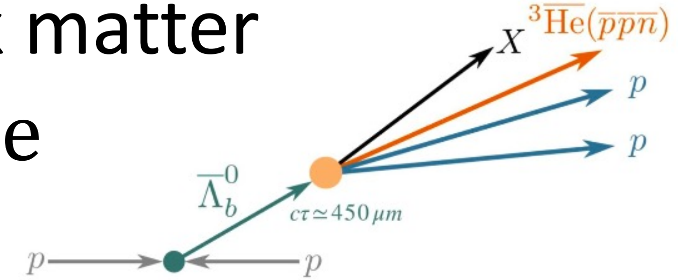




Event display of hypertriton candidate – ^{3}He identified by dE/dx in silicon layers

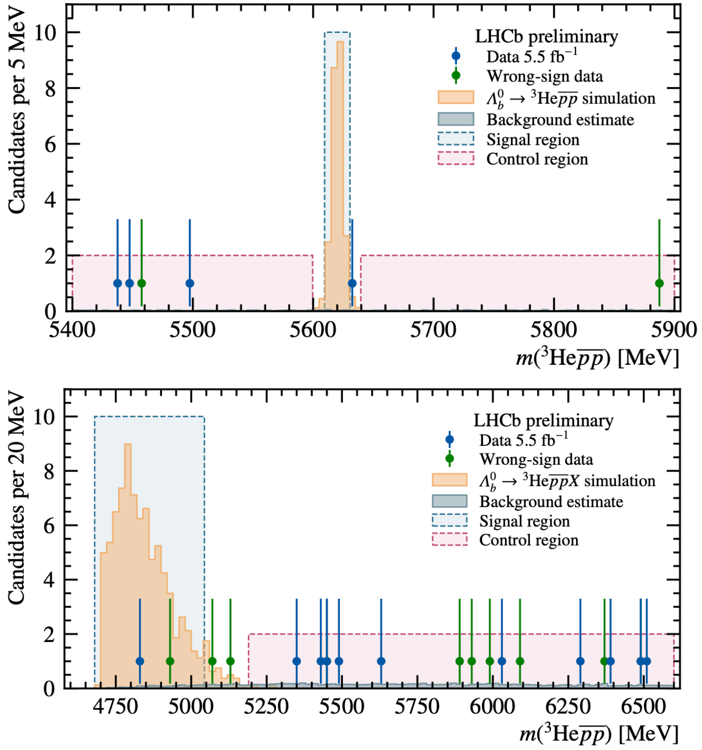
Antihelium production in $\bar{\Lambda}_b^0$ decays

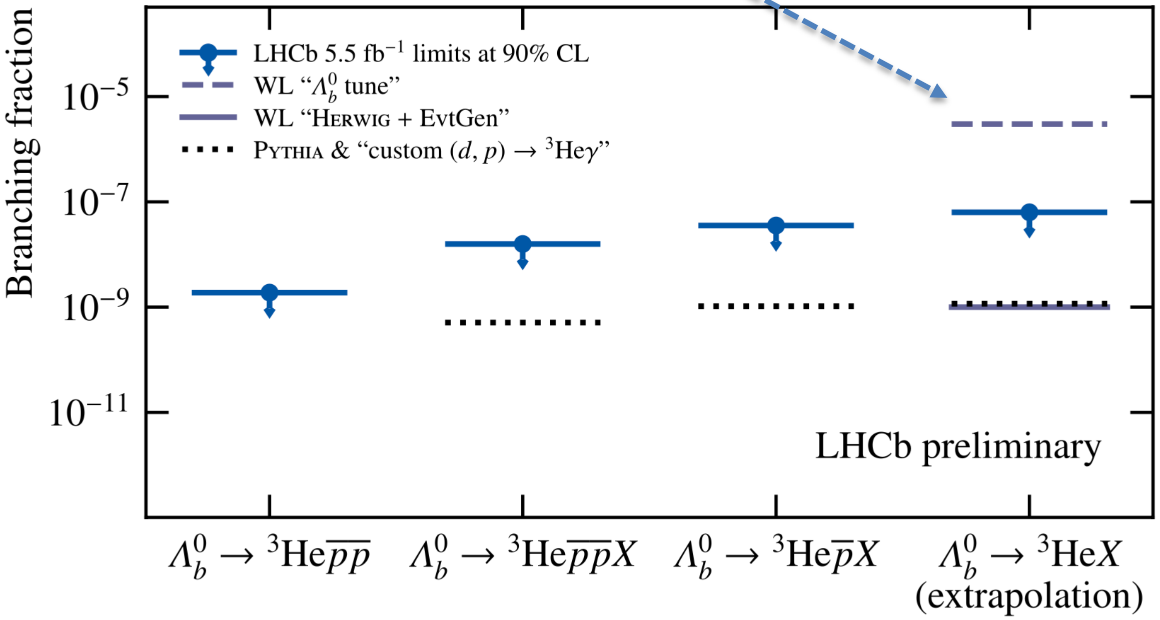
- Antihelium in cosmic rays, “Smoking gun” for new physics
- One explanation of antihelium by AMS02, dark matter annihilations to $b\bar{b}$, $\bar{\Lambda}_b^0$ has significant BR to $^3\overline{\mathrm{He}}$



[PRL 126 (2021) 101101]

[LHCb-Conf-2024-005]

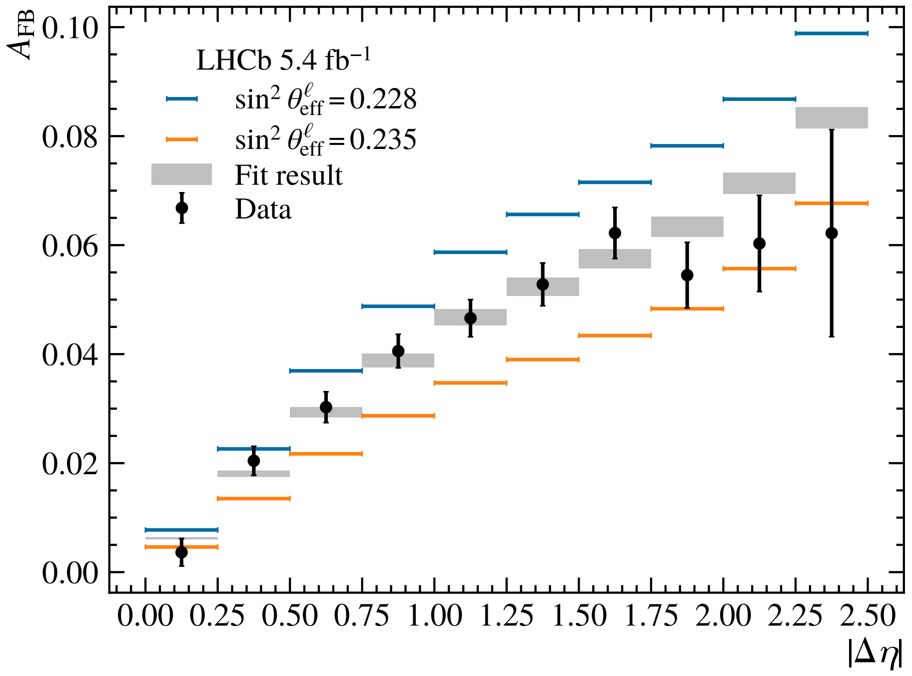




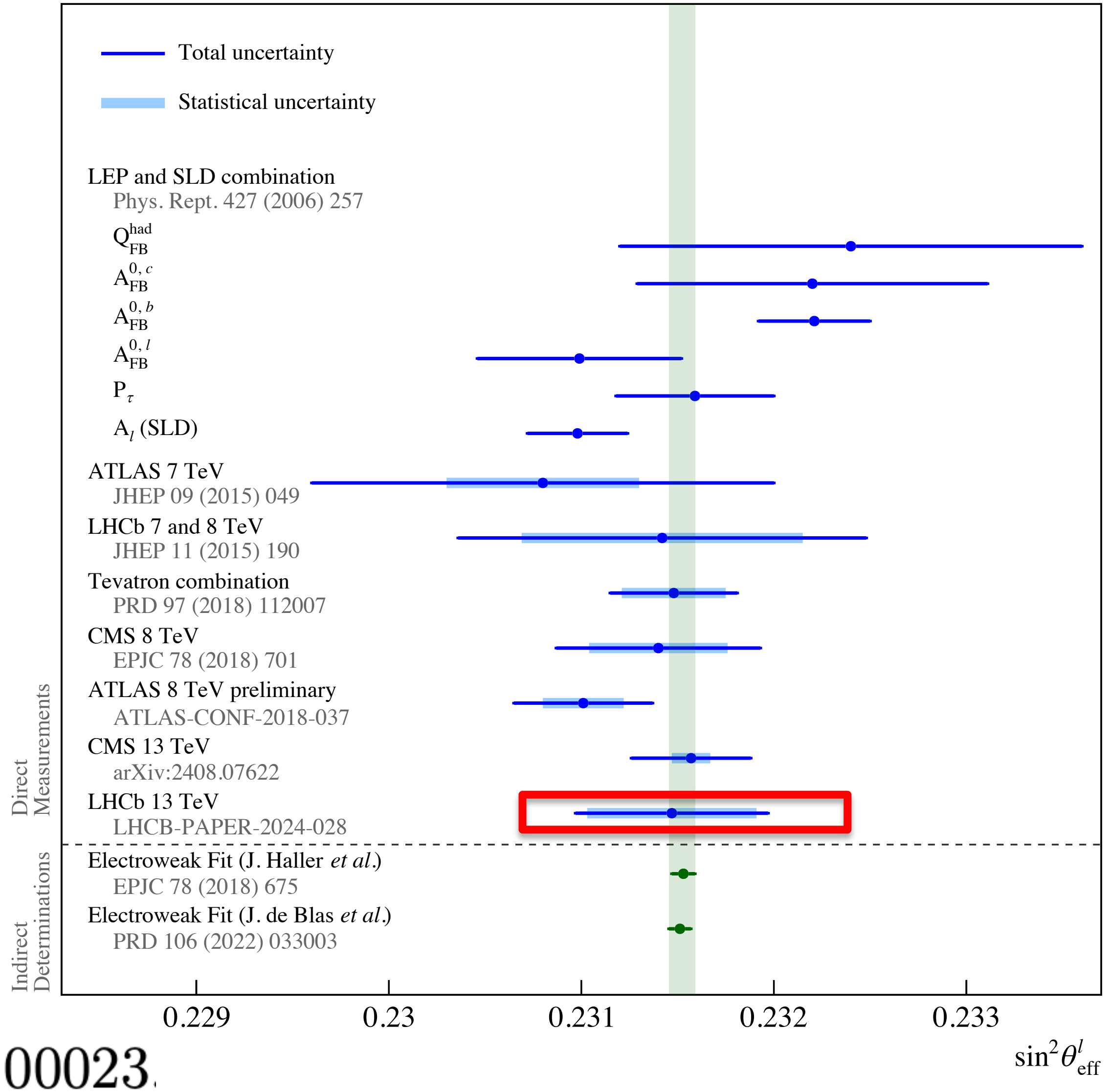
Effective leptonic weak mixing angle

- $\sin^2\theta^{\ell}_{\text{eff}}$ from comparing A_{FB} with predictions at NLO in the strong and EW couplings

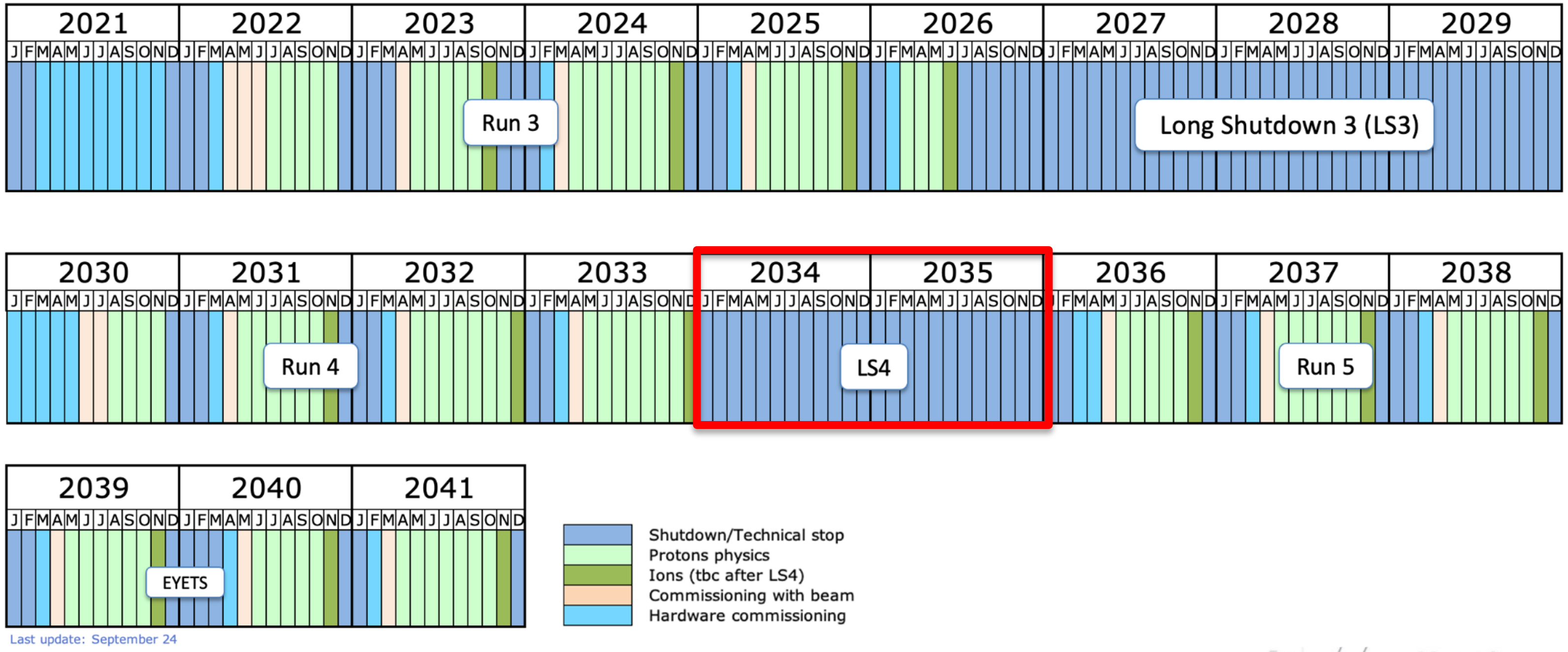
[arXiv:2410.02502]

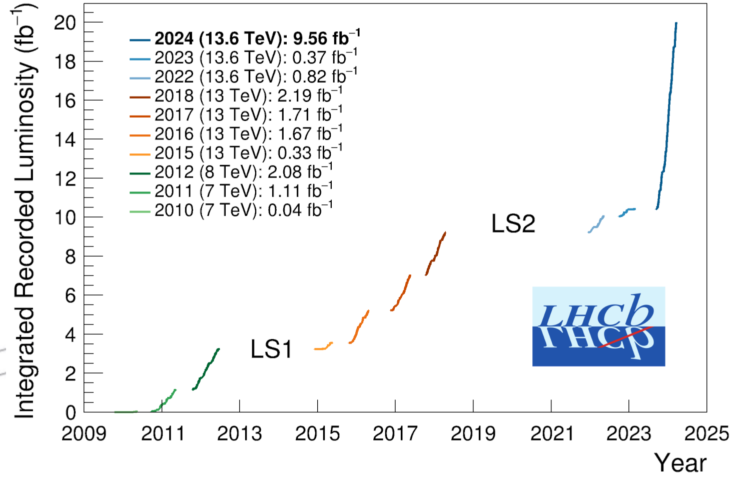


$$\sin^2\theta^{\ell}_{\text{eff}} = 0.23147 \pm 0.00044 \pm 0.00005 \pm 0.00023$$



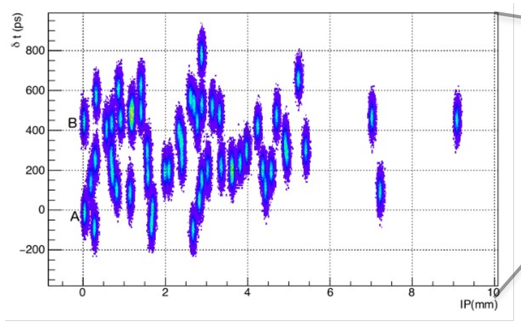
The LHCb upgrades

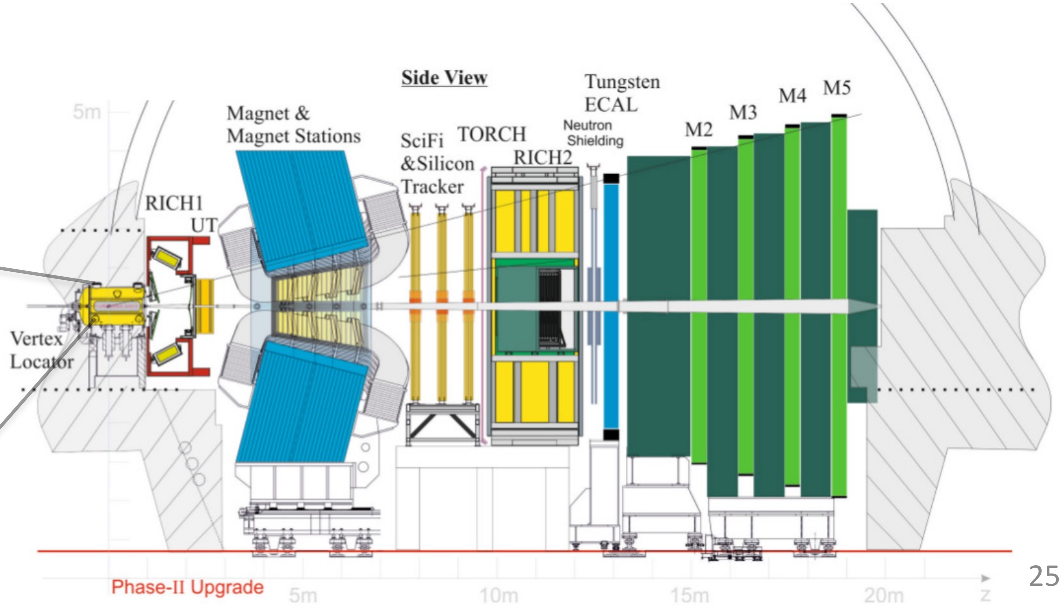




[CERN-LHCC-2018-027, 2021-012]

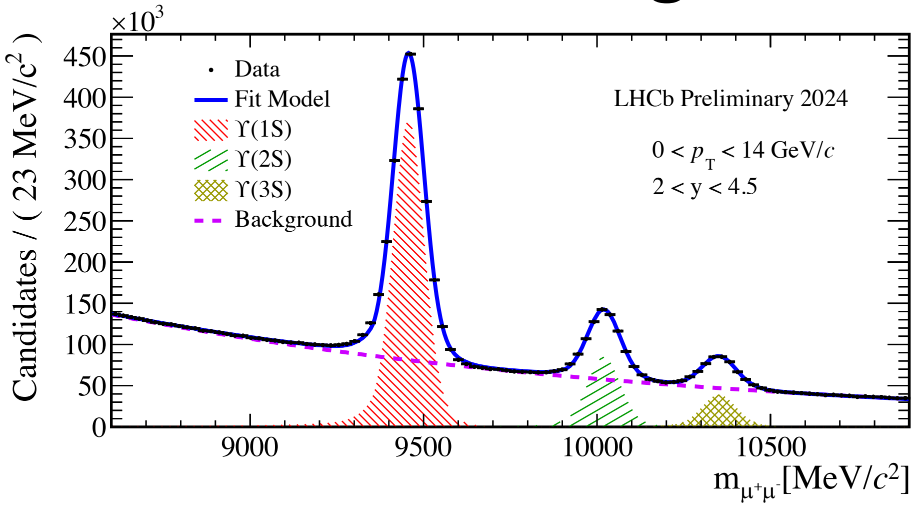
Upgrade II, 4D detector ,
Timing, $\mathcal{O}(10\ \text{ps})$, is essential

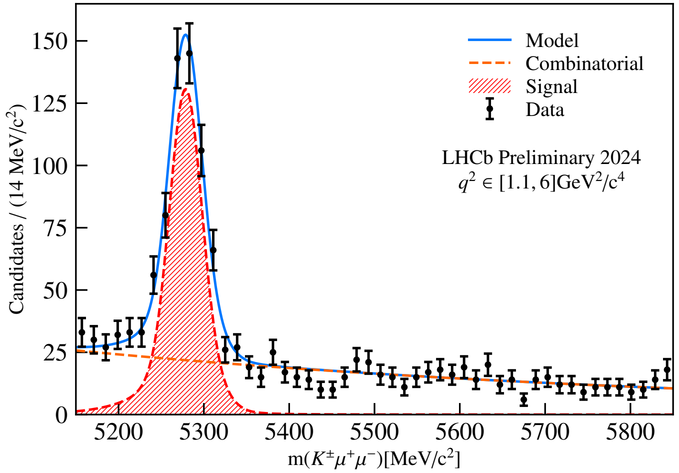


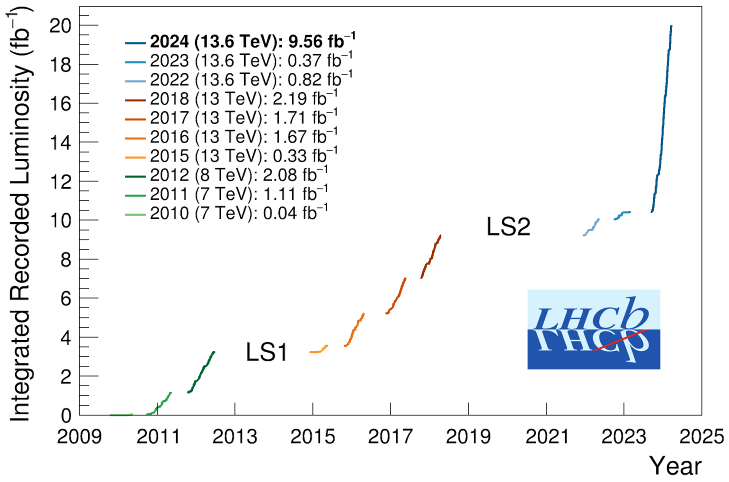


Data-taking in 2024

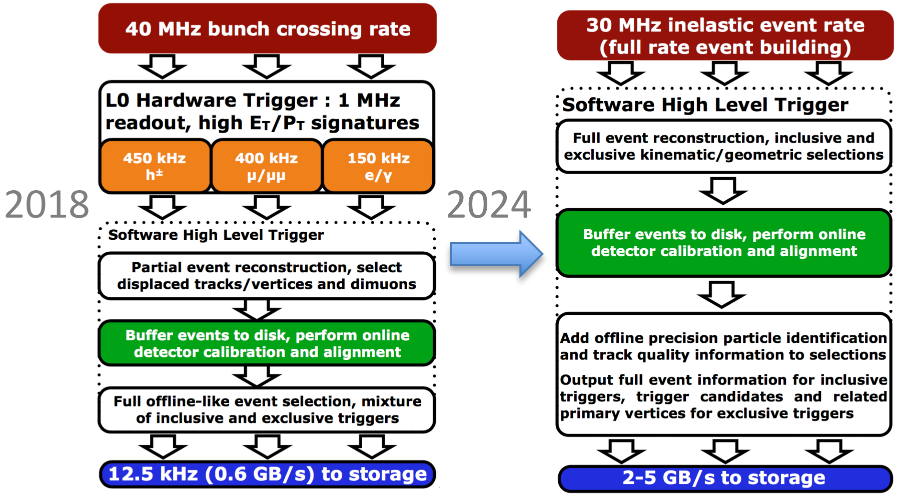
- Calibration / alignments much improved

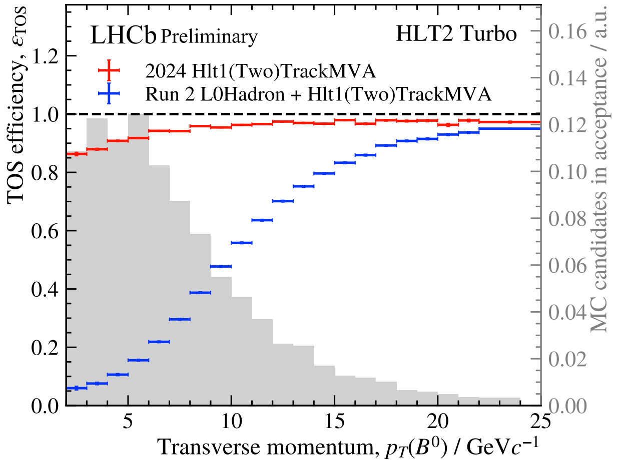


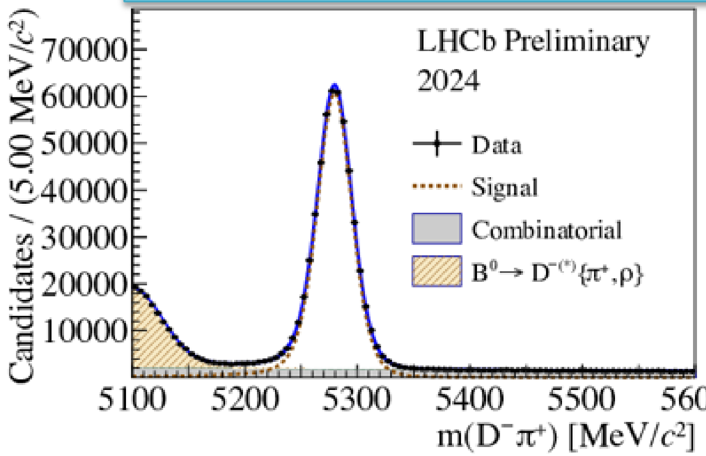




Trigger efficiency for hadronic modes improved by ~2

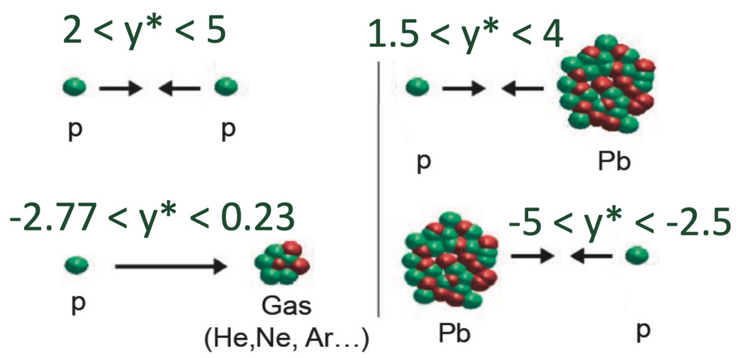


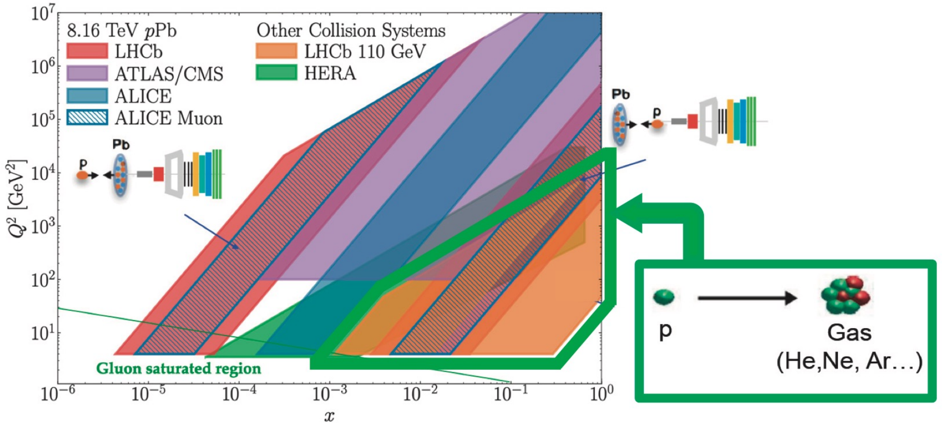




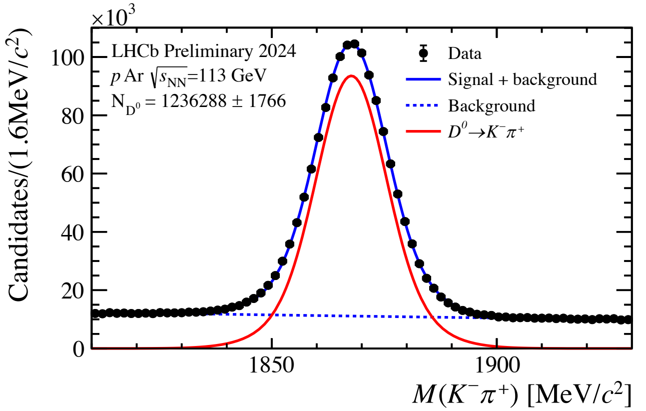
SMOG (System for Measuring Overlap with Gas)

[LHCb-Figure-2023-008]

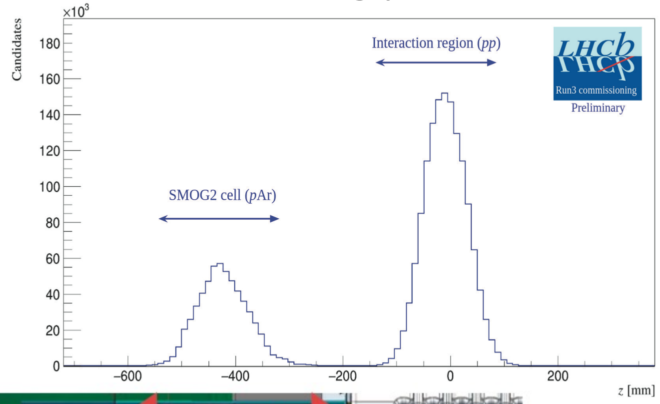


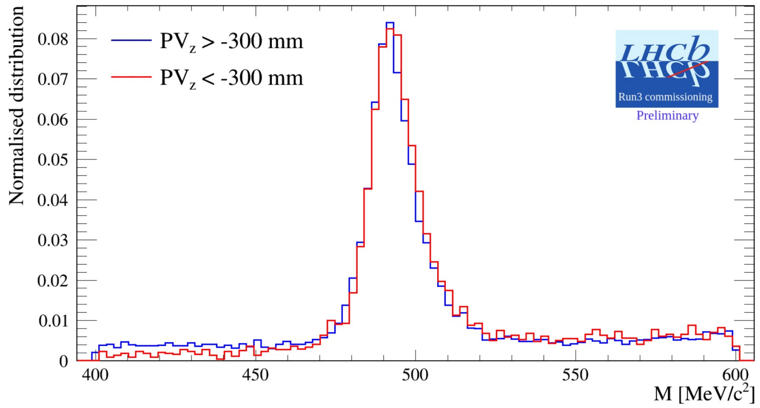


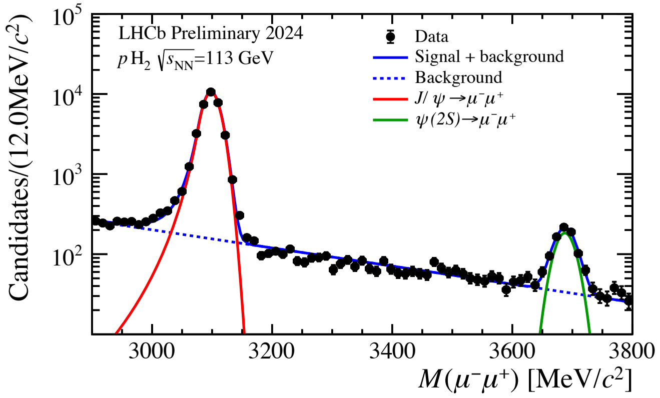
[LHCb-Figure-2024-003]

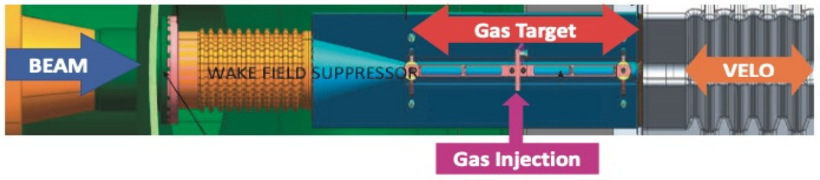


Simultaneous data-taking possible







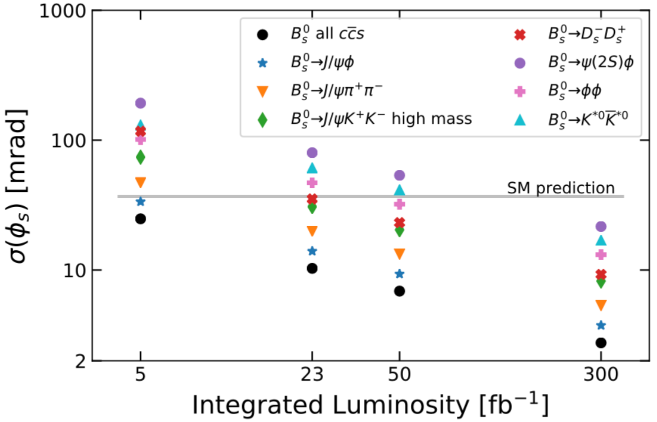


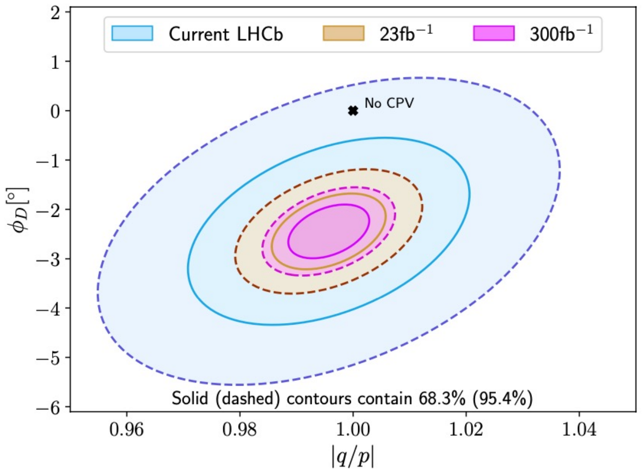
Prospects

- LHCb upgrades (2025: 23 fb^{-1}, Upgrade-II: 300 fb^{-1})

[CERN-LHCC-2018-027, 2021-012]

Observable	Current LHCb	LHCb 2025	Belle II	Upgrade II	ATLAS & CMS
EW Penguins					
R_K $(1 < q^2 < 6\,\mathrm{GeV}^2c^4)$	0.1 [274]	0.025	0.036	0.007	–
R_{K^*} $(1 < q^2 < 6\,\mathrm{GeV}^2c^4)$	0.1 [275]	0.031	0.032	0.008	–
R_ϕ, R_{pK}, R_π	–	0.08, 0.06, 0.18	–	0.02, 0.02, 0.05	–
CKM tests					
γ, with $B_s^0 \to D_s^+ K^-$	$(^{+17}_{-22})^\circ$ [136]	4°	–	1°	–
γ, all modes	$(^{+5.0}_{-5.8})^\circ$ [167]	1.5°	1.5°	0.35°	–
$\sin 2\beta$, with $B^0 \to J/\psi K_S^0$	0.04 [606]	0.011	0.005	0.003	–
ϕ_s, with $B_s^0 \to J/\psi\phi$	49 mrad [44]	14 mrad	–	4 mrad	22 mrad [607]
ϕ_s, with $B_s^0 \to D_s^+ D_s^-$	170 mrad [49]	35 mrad	–	9 mrad	–
$\phi_s^{s\bar{s}s}$, with $B_s^0 \to \phi\phi$	154 mrad [94]	39 mrad	–	11 mrad	Under study [608]
a_{sl}^s	33×10^{-4} [211]	10×10^{-4}	–	3×10^{-4}	–
$\lvert V_{ub}\rvert/\lvert V_{cb}\rvert$	6% [201]	3%	1%	1%	–
$B_s^0, B^0 \to \mu^+\mu^-$					
$\mathcal{B}(B^0 \to \mu^+\mu^-)/\mathcal{B}(B_s^0 \to \mu^+\mu^-)$	90% [264]	34%	–	10%	21% [609]
$\tau_{B_s^0 \to \mu^+\mu^-}$	22% [264]	8%	–	2%	–
$S_{\mu\mu}$	–	–	–	0.2	–
$b \to c\ell^-\bar{\nu}_l$ LUV studies					
$R(D^*)$	0.026 [215, 217]	0.0072	0.005	0.002	–
$R(J/\psi)$	0.24 [220]	0.071	–	0.02	–
Charm					
$\Delta A_{CP}(KK - \pi\pi)$	8.5×10^{-4} [610]	1.7×10^{-4}	5.4×10^{-4}	3.0×10^{-5}	–
A_Γ $(\approx x \sin\phi)$	2.8×10^{-4} [240]	4.3×10^{-5}	3.5×10^{-4}	1.0×10^{-5}	–
$x \sin\phi$ from $D^0 \to K^+\pi^-$	13×10^{-4} [228]	3.2×10^{-4}	4.6×10^{-4}	8.0×10^{-5}	–
$x \sin\phi$ from multibody decays	–	$(K3\pi)$ 4.0×10^{-5}	$(K_S^0\pi\pi)$ 1.2×10^{-4}	$(K3\pi)$ 8.0×10^{-6}	–





Summary

- Many interesting results from LHCb
  - Flavour anomalies, $b \to s\mu^+\mu^-$ BR, $\mathcal{R}_\phi$, $\mathcal{R}_{D^{(*)}}$
  - CP Violation, CKM-γ combination, ϕ_s, in $B \to J/\psi h$ and baryon
  - Spectroscopy, $\chi_{c1}(3872) \to \psi(2S)\gamma,\ h_c(4000), \chi_{c1}(4010)$, …
  - Production, $\eta_c(1S)$
  - Heavy-Ion, antihelium
  - EW, $\sin^2\theta^{\ell}_{\mathrm{eff}}$
- Stay tuned w/ LHCb upgrade (50 fb^{-1}) & upgrade-II (300 fb^{-1})
  - Trigger efficiency for hadronic modes improved by factor of ~2
- Your suggestions are always appreciated!