

*Welcome to the workshop...*

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The banner features a background image of the LHC tunnel at CERN. On the left, a red triangle contains the text "MITP TOPICAL WORKSHOP". In the center, a diagram shows a proton (p) colliding with a b-quark (q) to produce a b-baryon ( $\Lambda_b$ ) and a proton (p'). The b-baryon then decays into a Bc meson and a quark (q). The Bc meson decays into  $J/\psi \tau^+ \nu_\tau$  and  $J/\psi \mu^+ \nu_\mu$ . A plot shows the invariant mass distribution of the  $J/\psi \tau^+ \nu_\tau$  and  $J/\psi \mu^+ \nu_\mu$  decays, with the x-axis labeled "IPSD /  $\sigma_{\text{had}}$ " and the y-axis labeled "Frequency". The plot shows two peaks, one for  $B_c^+ \rightarrow J/\psi \tau^+ \nu_\tau$  and one for  $B_c^+ \rightarrow J/\psi \mu^+ \nu_\mu$ . A globe icon and a red arrow point to the URL <https://indico.mitp.uni-mainz.de/event/460/>. The MITP logo (Mainz Institute for Theoretical Physics) is in the bottom right corner.

**MITP  
TOPICAL  
WORKSHOP**

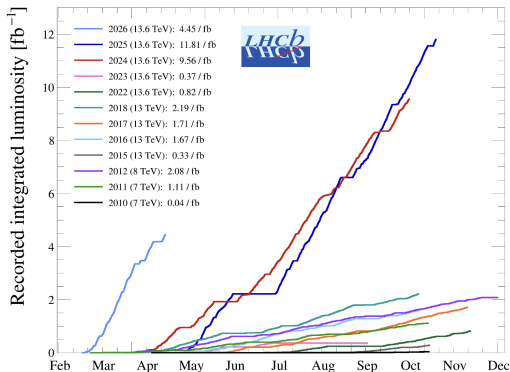
**Flavor Physics with b  
Baryons and Bc Mesons:  
Opportunities for Discoveries**

**May 26 – 29, 2026**  
<https://indico.mitp.uni-mainz.de/event/460/>

**Background image: CERN**

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Theoretical Physics**

# RUN 3 LHCb HARVEST



- $pp$  runs just ended. Almost  $\times 3 \mathcal{L}_{\text{int}}$  than Run 1+2, at  $\times 5$  higher pileup. Higher efficiency for hadronic final states, due to Level-0 trigger removal.
- For CMS, Run 3 is around  $\times 1.5$  that of Run 1+2.
- Our workshop is nicely timed to brainstorm how to make the most of these extraordinary datasets, moving beyond  $B^{0,\pm}$  and  $B_s^0$ .

# FLAVOR ANOMALIES WITH $b$ -BARYONS

figs/frag\_frac.pdf

$$\frac{\mathcal{R}_{\Lambda_c^+}^{\text{expt}}}{\mathcal{R}_{\Lambda_c^+}^{\text{NP}}} = \alpha \frac{\mathcal{R}_D^{\text{expt}}}{\mathcal{R}_D^{\text{NP}}} + \beta \frac{\mathcal{R}_{D^*}^{\text{expt}}}{\mathcal{R}_{D^*}^{\text{NP}}} + \delta$$
$$\alpha \sim \frac{1}{4} \quad \beta \sim \frac{3}{4} \quad \delta \sim 0$$

- Unique access to  $b$ -baryons at LHCb.  $\Lambda_b^0$  and also  $\Xi_b^{0,-}$  important players.
- $\Lambda_b^0 \rightarrow \Lambda_c^+$  has some special advantages.
- $[ud]$ -diquark in  $I = J = 0$  and narrow ground state  $\Lambda_c^+$  makes  $\Lambda_b^0 \rightarrow \Lambda_c^+$  lattice/HQET FF calculations easier than for  $\bar{B} \rightarrow D^*$ .

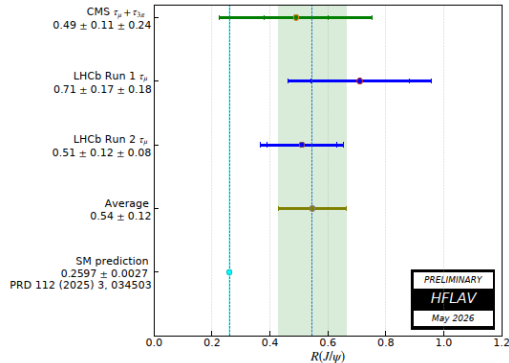
- Sum rules ([1811.09603](#), [2211.14172](#), [2410.21384](#), [2603.15029](#)) reflect the underlying WC structure.
- Currently, there is an excess for  $\mathcal{R}_{D^*}$ , while  $\mathcal{R}_{\Lambda_c^+}$  is slightly lower (but still consistent w/ SM).

## $\Xi_b$ : NEW KID(S) IN TOWN

- Baryonic frag. fraction mostly saturated by  $\Lambda_b^0$ . But with large statistics  $\Xi_b$  (or even  $\Omega_b^-$ ?) emerges as players.
- From 1612.05140  $f_{\Xi_b^-}/f_{\Lambda_b^0} \sim 10\%$ .
- Eg., for  $\mathcal{R}(\Xi_c)$ , the normalization modes,  $\Xi_b^0 \rightarrow \Xi_c^+(\rightarrow pK^-\pi^+)3\pi$  and  $\Xi_b^- \rightarrow \Xi_c^0(\rightarrow pK^-K^+\pi^-)3\pi$ . Nice clean signals with significant statistics.
- $N_{\text{sig}} \sim 200$  for  $\Xi_b \rightarrow \Xi_c\tau\bar{\nu}_\tau$  with hadronic- $\tau$  and Run 1+2+3. First observation might be possible.
- Similarly for  $\Xi_b \rightarrow \Xi\mu^+\mu^-$ .

# $B_c^+$ PERSPECTIVE

- Fragmentation fraction sub-percent, but obviously a key player.
- With LHCb Run 2 added, global tension at  $1.8\sigma$ .



- $B_c^+ \rightarrow \tau^+ \nu_\tau$  prospects.
- On rare decay side:  $B_c^+ \rightarrow D_{(s)}^{*+} \gamma$  or even  $B_c^+ \rightarrow D_{(s)}^{*+} \mu^+ \mu^-$  being searched.

# WISHLISTS

- FFs for both  $b \rightarrow c$  and  $b \rightarrow s$ , including broad  $\Lambda^* \rightarrow pK^-$  states for  $\Lambda_b^0 \rightarrow \Lambda^* \ell^+ \ell^-$ .
- For semitauonic, accessing  $\Lambda_c^+$  and  $\tau$  polarization.
- New (quasi) 2-body  $\Lambda_c^+ \rightarrow \{\Lambda^0 \pi^+, pK_S^0, p\phi, pf_0(980)\}$  introduced in LHCb Run 3. Self-analyzing  $\Lambda^0 \rightarrow p\pi^-$  decay new handle for  $\Lambda_c^+$  polarization.
- Inputs for  $\tau \rightarrow 3\pi\nu_\tau$  + neutrals in TAUOLA from Belle II?
- For semitauonic  $\Xi_b$  decays, understanding the excited  $\Xi_c$  states (backgrounds) will also be critical. Excited charm spectroscopy (especially with neutrals) inputs needed from BESIII and Belle II.

# AGENDA

- We have 12 experimental and 8 theory talks. Ample scope for discussions.
- Looking forward to a fruitful workshop...