First observation of the Charmless Baryonic decay $B^+ \to \bar{\Lambda}^0 p\bar{p}p$

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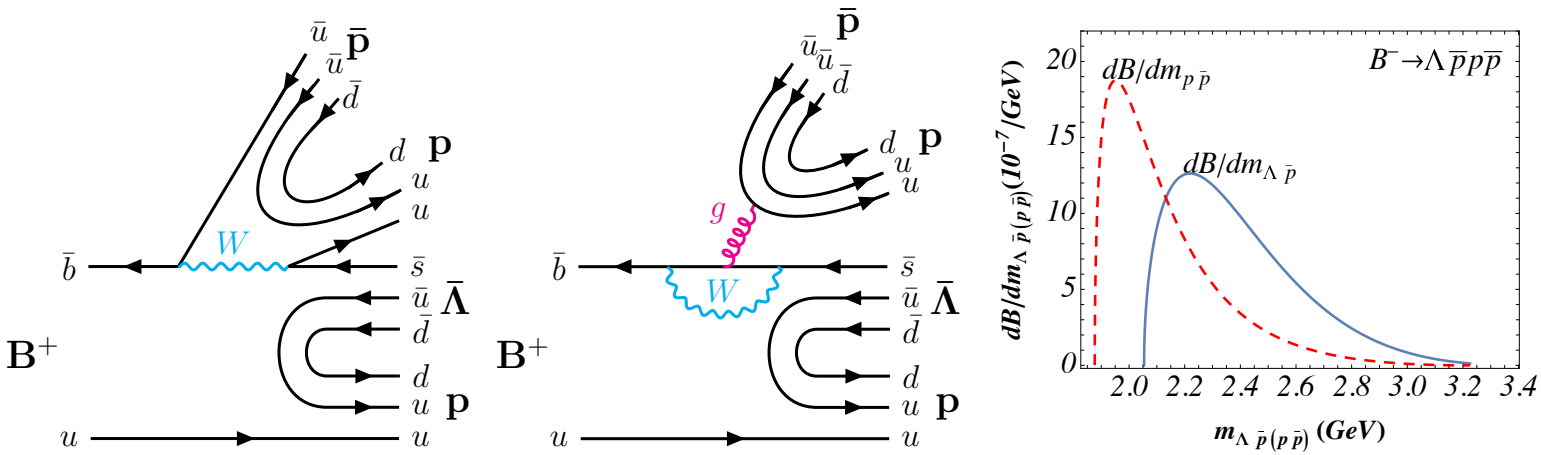
16th Sept. 2025

Motivation

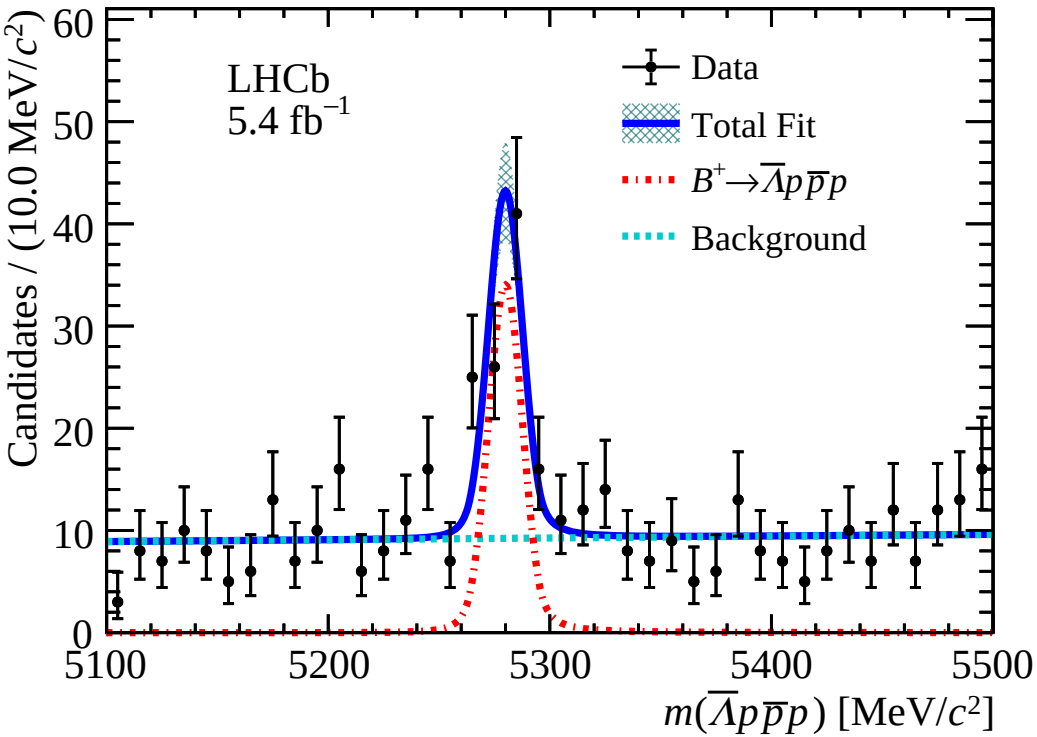
- Counterpart of recently observed decay $B^0 \to p\bar{p}p\bar{p}$ [PRL**131**(2023)091901]
- $B^+ \to \bar{\Lambda}^0 p\bar{p}p$ is dominated by $b \to s$ transition[*] at loop level, and $b \to u$ transition at tree level are color suppressed
- Prediction of $\mathcal{B}(B^+ \to \bar{\Lambda}^0 p\bar{p}p) = (7.4^{+0.6}_{-0.2} \pm 0.03^{+3.6}_{-2.6}) \times 10^{-7}$[*]
- Explore the mass spectra (double threshold effect) and extend the study of baryonium-like bound states such as the $X(1835)$ and $X(2085)$



*[PLB**845**(2023)138158]

Observation of $B^+ \to \bar{\Lambda}^0 p\bar{p}p$ decay

- The signal yield is $N(B^+ \to \bar{\Lambda}^0 p\bar{p}p) = 78 \pm 12$, with a significance greater than 5 standard deviations



LHCb measurement : $\mathcal{B}(B^+ \to \bar{\Lambda}^0 p\bar{p}p) = (2.08 \pm 0.34 \pm 0.12 \pm 0.26) \times 10^{-7}$

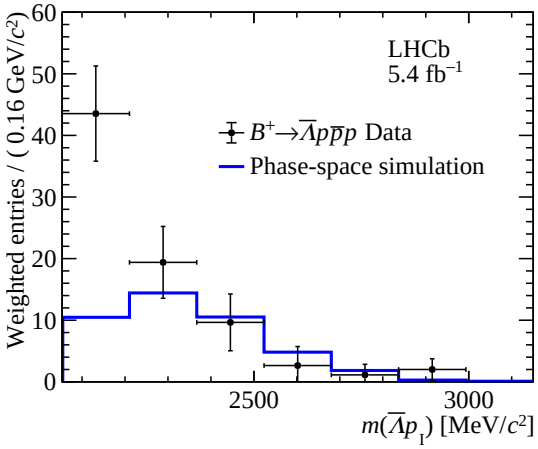
Theory prediction : $\mathcal{B}(B^+ \to \bar{\Lambda}^0 p\bar{p}p) = (7.4^{+0.6}_{-0.2} \pm 0.03^{+3.6}_{-2.6}) \times 10^{-7}$

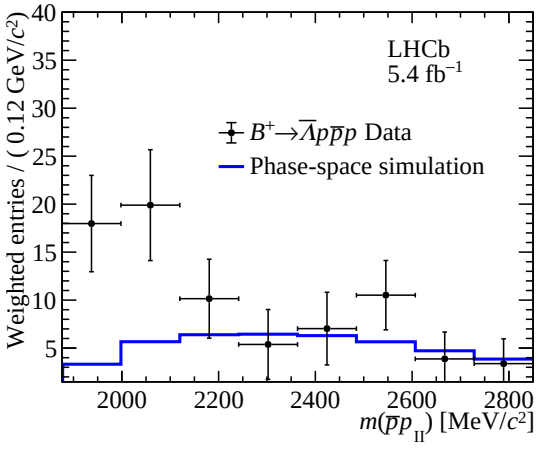
PLB845(2023)138158

Double-threshold enhancement

- The background-subtracted invariant-mass spectra of $\bar{\Lambda}p$ and $\bar{p}p$, exhibit clear **threshold enhancement** near both the baryonantibaryon mass thresholds:

Figure 1: $m(\bar{\Lambda}p_1) < m(\bar{\Lambda}p_2)$





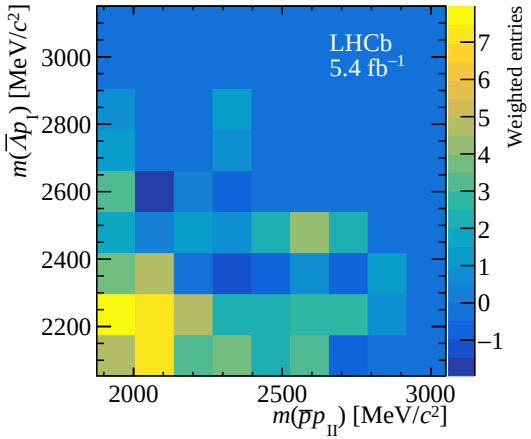
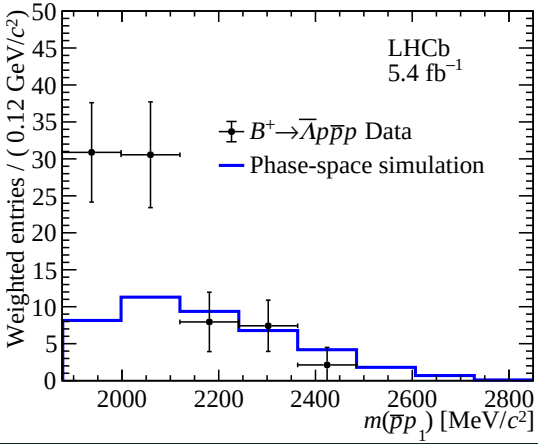
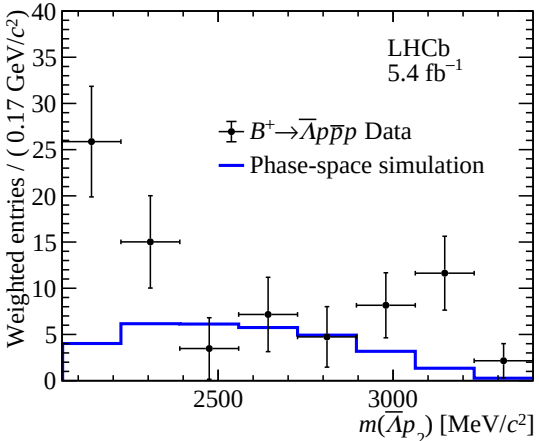
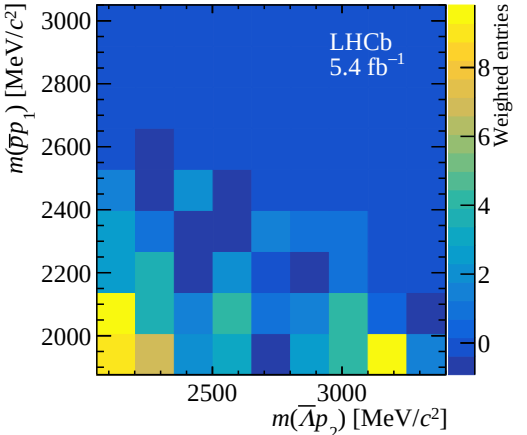


Figure 2: $m(\bar{p}p_1) < m(\bar{p}p_2)$







Summary

- Obervation of B^+ purely four-body baryonic decay:
$$\mathcal{B}(B^+ \to \bar{\Lambda}^0 p\bar{p}p) = (2.08 \pm 0.34_{\text{stat.}} \pm 0.12_{\text{sys.}} \pm 0.26_{\text{ext.}}) \times 10^{-7}$$
- 2σ lower than the prediction: $\mathcal{B} = (7.4^{+0.6}_{-0.2} \pm 0.03^{+3.6}_{-2.6}) \times 10^{-7}$
- A double threshold enhancement is observed by exploring the mass spectra
- CP asymmetry is measured to be: $\mathcal{A}_{\text{CP}} = (5.4 \pm 15.6_{\textit{stat.}} \pm 2.4_{\textit{syst.}})\%$