

Decoding Weak Phase Amplitudes in Charmed Baryon Decays

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In this Letter, we present a strategy to decode decay amplitudes with different weak phases in two-body charmed baryon decays, addressing a long-standing challenge to understanding CP violation in this sector. Using SU(3) flavor symmetry, we disentangle the amplitudes defined through $M = \lambda_s A_s + \lambda_b A_b$ ($\lambda_i = V_{ui} V_{ci}^*$), enabling a data-driven determination of their relative hierarchy across Cabibbo-favored, singly, and doubly Cabibbo-suppressed modes.

Applying this framework to current data, we find that the ratio

A_b/A_s is approximately 100 times larger than expectation of $\mathcal{O}(1)$ at 2.1σ level.

This unexpected pattern may be accommodated by SU(3) breaking effects, but it can also point to new physics.

We further show that the Lee-Yang parameters provide an independent and complementary probe.

To resolve this ambiguity in the origin of the enhancement, we propose a decisive discriminator using decay modes insensitive to large SU(3) breaking, in particular $\Xi_c^0 \rightarrow pK^-$ and $\Xi_c^0 \rightarrow \Sigma^+ \pi^-$ as golden channels.

Measurements of these modes will distinguish between symmetry breaking effects and new physics, establishing a clean pathway to probe CP violation in the charm baryon sector.

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