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Flavor SU(3) symmetry for charmed baryons

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A large amount of data on hadronic two-body weak decays of antitriplet charmed baryons $T_{c\bar{3}}$ to an octet baryon T_8 and an octet or singlet pseudoscalar meson P, $T_{c\bar{3}}\to T_8 P$, have been measured. The SU(3) flavor symmetry has been applied to study these decays to obtain insights about weak interactions for charm physics. Combined with known data on decay, much information can be derived with SU(3) flavor symmetry. Furthermore, using SU(3) relations between different decay modes, one can give some predictions based on the new measurements which can be tested with the high luminosity experiments in the future.
Previous studies based on the flavor SU(3) symmetry predicted a large value close to one for $\alpha(\Lambda_c^+ \to \Xi^0 K^+)$ assuming real decay amplitudes which also lead to zero strong phase shifts. However, the new data now show the needs to have nonzero strong phase shifts, calling for a new theoretical understanding. In 2023, the BESIII collaboration has reported the first-time measurement of the decay asymmetry $\alpha(\Lambda_c^+ \to \Xi^0 K^+) = 0.01\pm0.16\pm0.03$ and also a sizable phase shift of ${}_P-_S = -1.55\pm0.25$ or 1.59 ± 0.25 between S- and P-wave amplitudes. This implies significant strong phase shifts in the decay amplitudes. The strong phases indicate the existence of rescattering or loop effects, which are challenging to calculate due to nonperturbative effects. By employing the flavor SU(3) symmetry and applying the Körner-Pati-Woo theorem to reduce the number of parameters, we find that the current data already allow us to obtain, for the first time, model-independent decay amplitudes and their strong phases. The establishment of the existence of sizable strong phases also opens a window for investigations into CP violations.

Primary author: 杨/YANG, 畅/Chang

Presenter: 杨/YANG, 畅/Chang

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