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# Nature of excited Ξ baryons with threshold effects

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While various theoretical studies have been performed for the excited $\Xi(1620)$ and $\Xi(1690)$ states, their nature was not well understood due to the lack of experimental data. Recently, the invariant mass distribution of the $\Xi_c \to \pi\pi\Xi$ decay was observed by the Belle collaboration [1].
By fitting the invariant mass distribution with the Breit-Wigner distribution, the mass and decay width of the $\Xi(1620)$ were obtained as $M_R = 1610$ MeV and $\Gamma_R = 30$ MeV, respectively. This result provides precise spectra of the $\Xi(1620)$ and $\Xi(1690)$ resonances, and therefore it is desired to perform detailed theoretical analysis.

In this work, we study the excited $\Xi$ states as dynamically generated resonances in the meson-baryon scattering amplitude using the the chiral unitary approach. In the previous study [2], the mass and width of the $\Xi(1620)$ were predicted to be $M_R = 1607$ MeV and $\Gamma_R = 280$ MeV, with the natural values of the subtraction constants. Further, we find that the peak of the imaginary part does not appear by calculating this scattering amplitude of Ref. [2] on the real axis. Because of the difference between the results of Ref. [2] and those by Belle, it is required to improve the model of $\Xi(1620)$. By adjusting the subtraction constants of $\pi\Xi$ and $\bar{K}\Lambda$ channels, we successfully reproduce the mass and width of $\Xi(1620)$ by Belle. We, however, find that the threshold effect shifts the resonance peak near the threshold, by comparing the coupled channels meson-baryon scattering amplitude with the Breit-Wigner distribution. We conclude that the cation must be paid to determine the resonance pole near the threshold.

In future, studying the invariant mass distribution of the $\Xi_c \to \pi\pi\Xi$ decay in comparison with the Belle data, we aim at the determination of the spin and parity of the $\Xi$ resonances.

References

[1] Belle collaboration, M. Sumihama et al., Phys. Rev. Lett. 122, 072501 (2019).
[2] A. Ramos, E. Oset and C. Bennhold, Phys. Rev. Lett. 89. 252001 (2002).

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