Chiral unitary approach to S-wave πN scattering with meson-baryon and 3-body $\pi\pi N$ channels

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It is known that the 3-body $\pi\pi N$ channels are important in the π-N scattering. However, their role has not been well understood yet because of some difficulties in the theory and data analysis. We investigate the S-wave π-N scattering in a chiral unitary approach focusing on the $\pi\pi N$ channels and $\pi N \leftrightarrow \pi\pi N$ transitions.

We consider the Bethe-Salpeter equation with eight coupled channels including two $\pi\pi N$ states, namely $\{\ \pi^- p,\ \pi^0 n,\ \eta n,\ K^0\Lambda,\ K^+\Sigma^-,\ K^0\Sigma^0,\ \pi^0\pi^- p,\ \pi^+\pi^- n\ \}$. The transition kernels for the meson-baryon 2-body sector are essentially given by the lowest order chiral Lagrangians. The amplitudes of S-wave $\pi N \to \pi\pi N$ transitions are extracted from the cross section data by several authors [1,2], however they are not settled. We leave free the kernels for the transitions and determine them in this study.

Finally, we find the reasonable kernels, with an appropriate renormalization scheme, we succeed to reproduce both the elastic and inelastic πN scattering data, namely phase-shifts, in-elasticities and so on, including the dynamical generation of the $N^*(1535)$ resonance and its decay width into different channels [3]. As shown in Fig.1, the S-wave

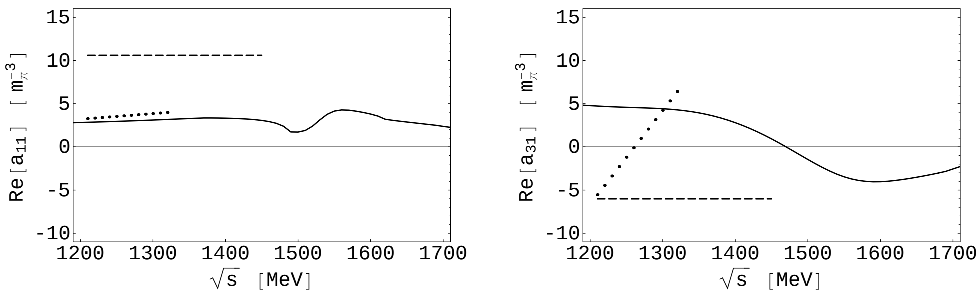

Figure 1: The S-wave $\pi N \leftrightarrow \pi\pi N$ amplitudes a_{11} (isospin 1/2) and a_{31} (isospin 3/2), where the dashed and dotted lines correspond to those of [1] and [2] respectively.

$\pi N \leftrightarrow \pi\pi N$ amplitudes which we obtain are quite different from two previous fits. While it is possible to reproduce the $\pi N \to \pi\pi N$ cross sections with these three sets of amplitudes, a simultaneous description of the $\pi N \to \pi\pi N$ cross sections and the $\pi N \to \pi N$ scattering data is not possible with the amplitudes of [1] and [2]. We also find that, when we incorporate the $\pi\pi N$ channels, a pole appears in the pure isospin 3/2 amplitude, at energy around 1620 MeV in the complex energy plane. This is consistent with the existence of $\Delta(1620)$ resonance which is known to couple strongly to the $\pi\pi N$ channels. We will report on our formulation and results in detail at the conference.

References

[1] D. Mark Manley, Phys. Rev. **D30**(1984)536

[2] H. Bukhardt and J. Lowe, Phys. Rev. Lett. **67**(1991)2622

[3] T. Inoue, E. Oset and M.J. Vicente Vacas, Phys. Rev. **C65**(2002)035204