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Analysis of Dibaryon Resonances based on Diquark Cluster Model

N.Konno, H.Nakamura and H.Noya†

Department of Physics,College of Science and Engineering,
Aoyama Gakuin University,Tokyo Japan
†Institute of Physics,Faculty of Economics,Hosei University
Tokyo Japan

The existence of several dibaryon resonances with $\Gamma \sim$ 100 MeV has been suggested by many authers [1,2]. Recent experimental analyses by König et al[3] and Tatischeff et al [4] revealed the striking evidences that some narrow resonances with the widths of a few tens MeV coexist with these broad dibaryon resonances in the same energy region.

In the previous paper [5], we presented the diquark cluster model based on the six-quark picture for dibaryon resonances, which reproduced the mass spectrum satisfactorily well. In this short note, we would like to show that the diquark cluster model can predict the coexistence of the narrow resonances with $\Gamma \sim$ 10 MeV together with the broad ones.

We take the following picture for the decay mechanism of (q^6) system. The decay is dominated by the emission of a pion from one of the baryon clusters in either end of the deformed (q^6) system of rod-like shape. Based on this picture, we introduce a non-local effective interaction for pion emission involving three free parameters. We adjusted these parameters to fit the four experimental data ; $\Gamma^{\pi NN}$ and $\Gamma^{\pi d}$ of $B_1{}^2(2.14)2^+$ and those of $B_1{}^2(2.22)3^-$. The results for the $\Gamma^{\pi NN}$ and $\Gamma^{\pi d}$ are shown in table I. The calculated ratio $\Gamma^{\pi d}/\Gamma^{\pi NN}$ agrees well with the experimental value. Note that the theoretical value in the usual (q^6) model is much smaller than the experimental value because of the short separation between two baryon clusters.

		$\Gamma^{\pi NN}$(MeV)	$\Gamma^{\pi d}$(MeV)
$B_1{}^2(2.14)2^+$	Th.	48.2	19.7
	Exp.	$\sim$ 47 [6,7]	20 [7]
$B_1{}^2(2.22)3^-$	Th.	105.9	11.1
	Exp.	$\sim$ 118 [6,7]	10 [7]
$B_0{}^2(2.22)3^-$	Th.	28.3	
	Exp.	$\sim$ 44 [8]	

Table I. The partial decay width $\Gamma^{\pi NN}$ and $\Gamma^{\pi d}$.

The level structure of dibaryon resonances in diquark cluster model is illustrated in fig.I. In this model, each dibaryon resonance involves at least four states

M(GeV)	I=0	I=1
2.22	$3^-2^-1^-0^-$	$3^-2^-1^-0^-$
2.14	1^+	$2^+1^+0^+$

Fig.I. The level structure of dibaryon resonances in diquark cluster model.

except $B_1{}^2(2.14)2^+$, $B_1{}^2(2.22)3^-$ and $B_0{}^2(2.22)3^-$ and, therefore, their energy levels are possibly supposed to have a fine structure. Generally, the phase shift in each channel depends strongly on the fine structure. In fact, the energy dependence of $J^P=1^+$ π-d phase shift varies sharply with the structure of $B_1{}^2(2.14)1^+$ which involves four states in this model. We illustrate in fig.II one typical example in which two of the states are in 2.14 GeV, and the rest two are in 2.10 GeV. In this example,

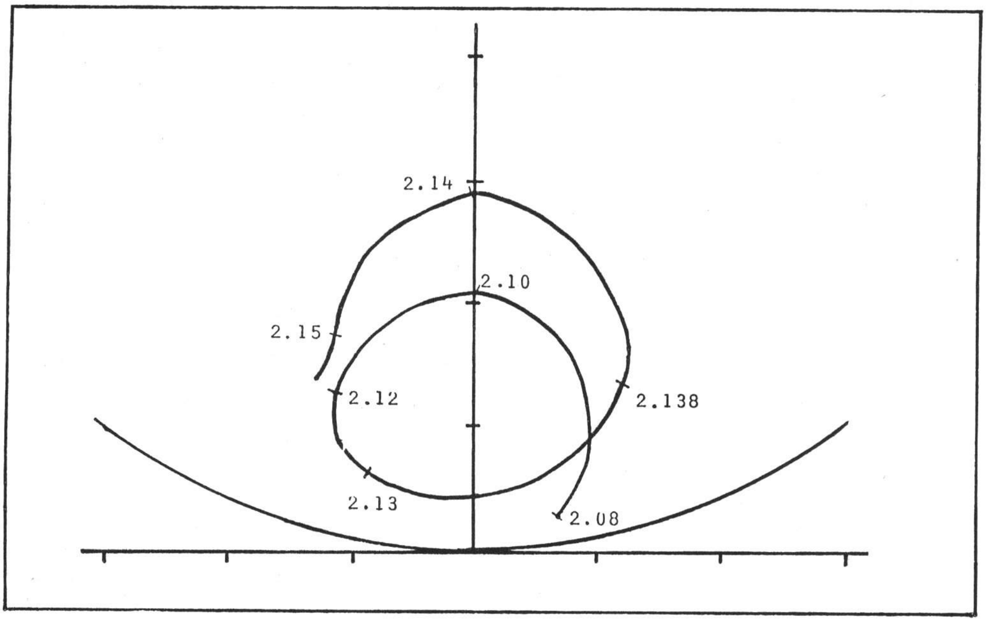

Fig.II The typical example of the Argand plot for $J^P=1^+$ π-d phase shift in diquark cluster model.

the Argand plot shows a clear double structure, i.e., a small circle at around 2.10 GeV and a larger circle at around 2.14 GeV with $\Gamma \sim 10$ MeV. Though this example is a rather special case and, in many other cases, the Argand plot is reduced to single circle with $\Gamma \sim 80$ MeV, we would like to emphasize that the diquark cluster model can explain the existence of narrow $B_1{}^2(2.14)1^+$ resonance with $\Gamma \sim 10$ MeV. We also remark there is a strong possiblity that the other states $B_1{}^2(2.14)0^+$, $B_1{}^2(2.22)2^-$, 1^-, 0^-, $B_0{}^2(2.14)1^+$ and $B_0{}^2(2.22)2^-,1^-,0^-$ involve some narrow resonances and they may be observable by an appropriate experiment. The details of calculation and discussion will be presented elsewhere.

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