Flavor independent systematics of excited baryons and intra-band transition

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More than eighty baryons have been observed in experiment, and their masses, spins, flavors, and parities are known [1]. Among them, it is known that the Gell-Mann-Okubo (GO) mass formula works well to describe the pattern of the flavor octet and decuplet baryons in the ground states; the difference of masses among different flavor baryons can be explained by that of the constituent quarks.

Recently, we have applied the GO mass formula to all observed baryons not only ground states but also excited states, and found that there is a flavor independent systematics in spectra [2, 3]. The mass difference between grounds states and the first excited states is 500 MeV, and the next excited states 700 MeV, etc. Remarkably, we have found that these patterns of mass spectra have a behavior quite similar to the *rotational band* in the deformed nuclei, which seems to imply spatial deformation of excited states of baryons. We have then investigated these spectra in terms of an effective non-relativistic quark model with a deformed harmonic oscillator potential, which we call the deformed oscillator quark (DOQ) model, and shown that almost all data can be reproduced with only one parameter by the DOQ model.

In the deformed nuclei, typical transitions are observed among rotational bands such classified as *inter*-band transition or *intra*-band transition. We expect that we can also observe similar transitions in the excited baryons if the pattern of their spectra is nothing but a rotational band. In fact, transition data for excited baryons are poor at the moment. However, since new, rich and accurate experimental data will be available soon, for example, from JLab, USA or SPring8, Japan, it makes sense to provide a theoretical prediction in transitions, in particular, with respect to spatial deformation of excited baryons [4, 5].

We shall present several transition properties of excited baryons through the emission of pions in the framework of the DOQ model. As a preliminary result we find that there is an interesting *selection rule* in the transition between positive parity baryons, which leads to remarkable enhancement of transition amplitudes in some channel [5].

References

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