CEBAF EXPERIMENT 99-108

N* Excitations at High Q^2 in the Two-Pion Channel

V. Burkert * (spokesperson),
CEBAF, Newport News, Virginia
*E-mail : Burkert@CEBAF.gov
Ph: (804) 249-7540
Fax: (804) 249-7363

M. Ripani ** (spokesperson),
Istituto Nazionale di Fisica Nucleare, Genova, Italy
**E-mail : Ripani@GE.INFN.IT
Ph: 01139 (010) 353-6458
Fax: 01139 (010) 313358

and

the CLAS collaboration

Experiment approved for Hall B

The excited baryons made from light quarks are known to decay in single meson as well as in multimeson final states. In particular, the double pion production is sensitive to many excited states of proton and neutron[1]. Quark models[2] predict such decays and also that some resonances could decouple from single meson channels and appear predominantly in multipion production reactions via electromagnetic excitation: the so called "missing resonances". These issues are part of the CLAS collaboration scientific program at Jefferson Laboratory, where the reaction

$$e\, N \rightarrow e'\, N\, \pi\, \pi$$

is already being measured in the mass region between threshold and 2.2 GeV to investigate baryon resonances and test quark models.

On the other hand, a main issue in the nucleon resonance physics is the Q^2 evolution of the resonance couplings. For instance, constituent quark models[3] make very different predictions depending on whether and how relativistic effects are incorporated; also constituent quark form factors have been recently discussed as a possible ingredient in the description of nucleon structure[4]. If a satisfactory description of the excitation of higher mass resonances at high Q^2 can not be provided by a relativistic constituent quark model or by the introduction of new ingredients such as constituent quark form factors, an explanation in terms of the onset of different physics (pQCD) may be in order[5].

To help clarify this aspect, it is fundamental to provide more experimental information on the transition form factors of various N^* states as a function of the momentum transfer Q^2, in a large Q^2 range, typically up to 5-6 GeV^2/c^2. In this respect, the two pion exclusive channel provides acces to states which are weakly coupled to the pion and eta mesons and are therefore barely measurable in single pion and eta electroproduction; moreover, due to the isospin nature of the final state, both isospin 1/2 and 3/2 resonances can appear in the two pion electroproduction.

From some recent CLAS analysis performed using data at 5.5 GeV beam energy, it is seen that resonance contributions still appear at relatively high Q^2, therefore suggesting that additional measurements at high momentum transfer with a 6 GeV electron beam could shed light on the high Q^2 behavior of poorly known as well as possible new baryonic states.

References

1. Particle Data Book, 1998
2. R. Koniuk and N. Isgur, Phys. Rev. Lett., 44 N° 13, 845 (1980) ;
   M.M. Giannini, Rep. Prog. Phys., 54 , 453 (1990)
3. S. Capstick and B. Keister, Phys. Rev. D51 , 3598 (1995)
4. F. Cardarelli et al., Proceedings of the Workshop on N* physics and nonperturbative QCD, Trento, Italy, 18-29 May 1998, Few Body Sys. Suppl. vol. 11, 1999.
5. C.E. Carlson and J.L. Poor, Phys. Rev. D38 , 2758 (1988)