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Study of the parity violation in the $\Delta(1232)$ region

Response of the A4 calorimeter in the region of the $\Delta(1232)$ resonance using MC simulations

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Abstract. A measurement of the parity violation (PV) asymmetry in electron-proton scattering using a polarised electron beam is performed at MAMI. The experimental apparatus is able to detect electrons, that are scattered exciting the $\Delta(1232)$ resonance. In order to study the PV in such process, it is important to understand the energy spectrum in the corresponding region. The aim of this work is a simulation including all relevant processes in order to extract an estimate of the PV asymmetry in the $\Delta(1232)$ region.

PACS. 12.15.-y Electroweak interactions – 11.30.Er Charge conjugation, parity, time reversal, and other discrete – 14.20.Gk Baryon resonances with S=0 – 13.40.-f Electromagnetic processes and properties

1 Introduction

Up to now, the measurements of the A4 experiments have been used for studying spin observables in the elastic scattering of polarised electrons off unpolarised protons [1]. Nevertheless, the A4 experiment offers also the possibility to study the inelastic electron scattering off the proton. In fact, both elastically and inelastically scattered electrons are detected simultaneously by the lead fluoride calorimeter. In particular, the A4 detector allows the detection of the scattered electrons exciting the $\Delta(1232)$ resonance. Therefore, the measurement of spin observables in the electroproduction of the $\Delta(1232)$ is possible within the A4 experiment. Among these observables the parity violation (PV) asymmetry can be measured by scattering longitudinally polarised electrons on protons. It has been shown [2, 3,4], that the PV asymmetry in the cross section for the electroexcitation of the $\Delta(1232)$ resonance can yield an important insight into the proton structure.

The scattering cross section asymmetry is obtained, in the A4 experiment, counting the number of electrons scattered with each state of helicity. The energy of the scattered electrons is measured by the lead fluoride calorimeter and histogrammed, giving an energy spectrum. By analysing this energy spectrum, it is possible to distinguish between electrons scattered elastically or inelastically, e.g. exciting the $\Delta(1232)$. For the analysis of the data in the energy region of the $\Delta(1232)$ resonance, a detailed study of the energy spectrum is necessary for having a better knowledge of the background. This is in particular necessary in this energy range, where the ratio of the signal to the background is smaller than in the case of the elastic scattering range. This results from the smaller absolute value of the signal cross section and the larger background.

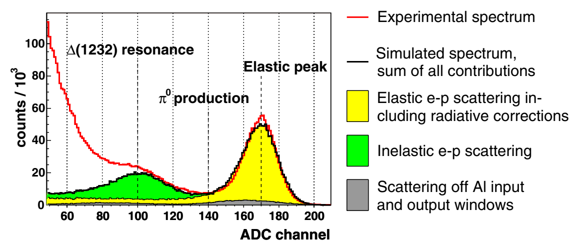

Fig. 1. Comparison of simulated and experimental spectra

Within this work a detailed study of the lead fluoride detector response to the scattered electrons has been carried out by means of Monte Carlo simulations. In addition, an event generator has been implemented, which includes the elastic *e*-*p* scattering considering radiative corrections, the inelastic *e*-*p* scattering and the electron scattering off the aluminium input and output windows. These simulations can reproduce quite well the experimental energy spectrum in the range between the pion production threshold and the maximum of the $\Delta(1232)$ peak, as shown in Fig. 1. For this energy region, in principle, the PV asymmetry could be already extracted and compared with the theoretical predictions. More effort has to be provided in order to extend our understanding of the spectrum to include the whole $\Delta(1232)$ peak.

References

1. F.E. Maas et al.: Phys. Rev. Lett. **93**, 022002 (2004)
2. L.M. Nath et al.: Phys. Rev. D **25**, 9 (1982) 2300–2305
3. H.W. Hammer, D. Drechsel: Z. Phys. A **353**, 321–331 (1995)
4. N.C. Mukhopadhyay et al.: Nucl. Phys. A **633**, 481–518 (1998)

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