THE CB-ELSA EXPERIMENT*

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The Crystal Barrel detector used before at LEAR (CERN) has been modified and installed at the electron stretcher accelerator (ELSA) in Bonn. It will be used to study photo- and electro-production of neutral mesons. One of the major aims of this experiment is the search for missing baryon resonances and to achieve a better understanding of the baryon spectrum. First data from test runs at low energy (250 MeV $< E_\gamma <$ 800 MeV) show photoproduction of π^0 and of $2\pi^0$-pairs.

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1. Introduction

After seven years of successful operation at the low energy antiproton ring LEAR, the Crystal Barrel detector was brought from CERN to Bonn. The detector now is used to study (γp)- and $(e^- p)$-physics at the electron stretcher accelerator ELSA. The CB-ELSA experiment takes place in the former SAPHIR area.

An optimized extraction beam line together with the modified tagger from the SAPHIR experiment is used to provide a tagged photon beam covering an energy range from 31–94.4% of the incoming electron energy. The maximum electron energy which can be reached with ELSA is 3.5 GeV.

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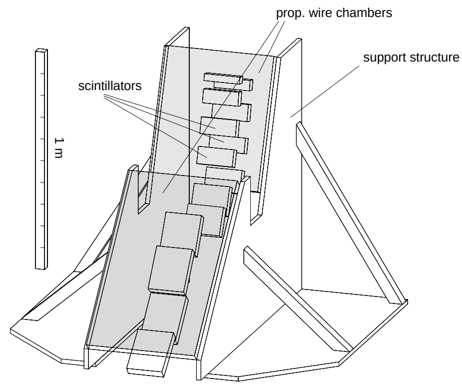

Fig. 1.

The primary electron beam not producing photons is bent downwards and absorbed in about 1 m of shielding (see Fig. 2).

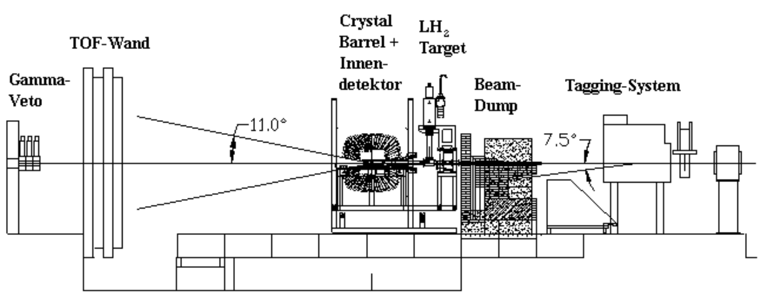

Fig. 2. Experimental setup of the CB-ELSA experiment.

The Crystal Barrel detector consists of 1380 CsI(Tl) crystals covering 98% of 4π. Charged particles leaving the target are detected by three layers of 2 mm scintillating fibres. The layers are bent under $\pm 25^\circ$ and 0° proving an intersection point for the charged particle. Paticles like protons or neutrons produced under small angles in forward direction are detected with a Time-Of-Flight (TOF) wall covering the forward opening angle of the Crystal Barrel.

2. Physical motivation

At present there are four accepted proposals for photoproduction experiments:

- Study of baryon resonances decaying into $\Delta(1232)\pi^0$ in the reaction $\gamma p \to p\pi^0\pi^0$ with the Crystal Barrel detector at ELSA, U. Thoma *et al.* (1998).

- Study of Δ^* resonances decaying into $\Delta(1232)\eta$ and search for the exotic meson $\hat{\rho}(1380)$ in the reaction $\gamma p \to p\pi^0\eta$, J. Smyrski *et al.* (1999).
- Photoproduction of η and η' mesons using the Crystal Barrel detector at ELSA, A. Fösel *et al.* (1999).
- Inelastic photon scattering in the exclusive channels $p(\gamma,\pi^0\gamma p)$ and $p(\gamma,\eta\gamma p)$, R. Gothe *et al.* (1999).

The first proposal is related to the search for missing resonances, for baryon resonances predicted by the quark model but experimentally not or not yet observed. Lichtenberg proposed [1] that baryons could have a quark–diquark structure. This would freeze one internal degree of freedom and thus lead to a smaller number of expected resonances. One other possible solution is that these resonances simply have not been discovered up to now. Nearly all existing data result from πN–scattering experiments. If the missing resonances do not couple to πN they would not have been observed. This latter conjecture is supported by theory [2,3]. If the missing resonances do not have anomalously small couplings to the photon and couple to channels like $\Delta\pi$, $N\eta$, $N\rho$, $N\omega$ or $N\eta'$ there should be a big discovery potential for photoproduction experiments investigating channels like $\Delta\pi$ in $\gamma p \to p\pi^0\pi^0$.

3. First data

Data from the first test runs in 2000 are shown in the following pictures.

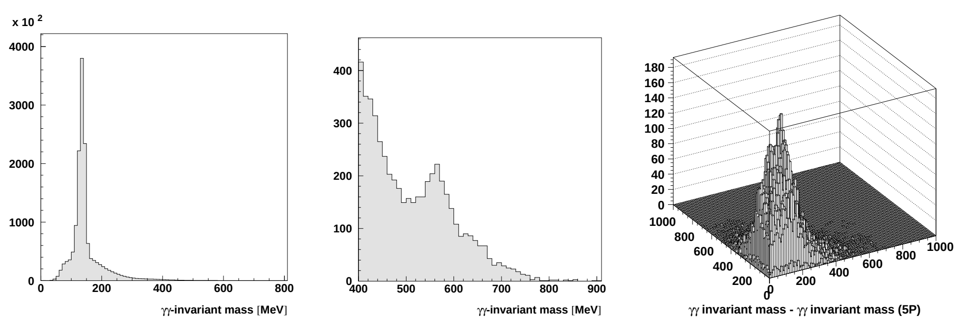

Fig. 3.

The first two pictures show data taken with an energy of the incoming electron of 800 MeV. The proton is identified by the scintillation fibre detector surrounding the target. The left and the middle pictures show the $\gamma\gamma$ invariant mass for events with two recontructed photons. A π^0-signal above a small background and a signal from the η decay in two photons is clearly visible. The third picture shows data from a short run at a electron energy of 2.8 GeV. Plotted is the two gamma invariant mass against the two gamma invariant mass for events with four recontructed photons. The signal at the crossing point of the π^0 masses is produced by double π^0 production events.

REFERENCES

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[2] S. Capstick, W. Roberts, *Phys. Rev.* **D47**, 1994 (1993).
[3] S. Capstick, W. Roberts, *Phys. Rev.* **D49**, 4570 (1994).