

Measurements of Electroproduction of π^0 near Threshold

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for the E04-007 collaboration

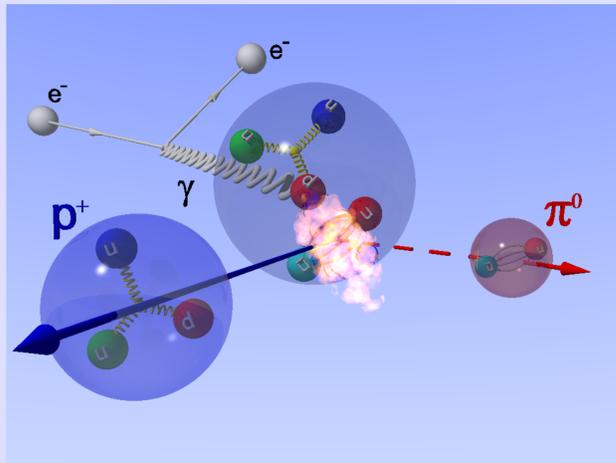
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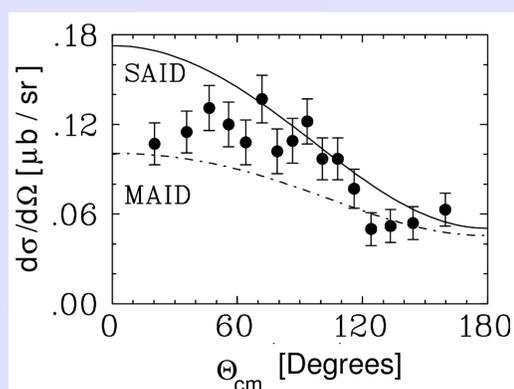
Introduction

The goal of the experiment E04-007 [1] is to make high precision cross-section measurements of the $p(e, e'p)\pi^0$ reaction near threshold.



Motivation

The scientific motivation for the experiment is to extend and re-examine existing measurements of electroproduction near threshold, in particular those from Mainz [2, 3], which have shown strong disagreement with the predictions of Chiral Perturbation Theory (ChPT). Since this theory is firmly grounded on the symmetries of Quantum Chromodynamics (QCD), these possible violations are very fundamental and require substantiation by more than on experiment. Measured cross-sections also disagree with phenomenological models (SAID [4], MAID [5]).



Experimental Requirements

- Liquid hydrogen target
- Electron beam with 1.2 GeV energy
- Two spectrometers in coincidence (e, p)
- $Q^2 = -0.05$ [GeV/c]² to -0.10 [GeV/c]² with $\delta Q^2 = 0.01$ [GeV/c]²
- $\Delta W = 1$ MeV to 20 MeV with $\delta(\Delta W) = 1$ MeV

References

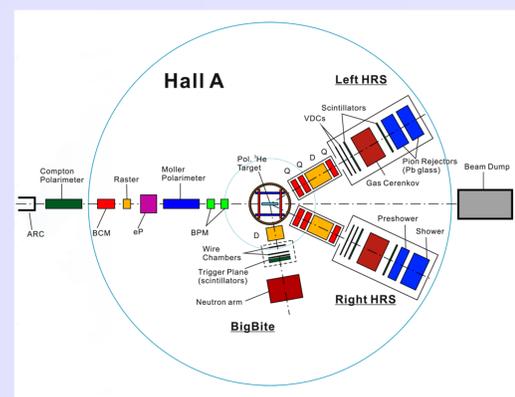
- [1] R. Lindgren *et al.*, E04-007 Threshold π^0 Production, Jefferson Lab PAC25 Proposal, December 2003
- [2] M. O. Distler *et al.*, Phys. Rev. Lett. **80** (1998) 2294
- [3] H. Merkel *et al.*, Phys. Rev. Lett. **88** (2002) 012301
- [4] R.A. Arndt *et al.*, Phys. Rev. C **53** (1996) 430
- [5] D. Drechsel *et al.*, Nucl. Phys. A **645** (1999) 145
- [6] J. Alcorn *et al.*, Nucl. Instr. and Meth. A **522** (2004) 294
- [7] D.J.J. Lange *et al.*, Nucl. Instr. and Meth. A **406** (1998) 182

Thomas Jefferson National Accelerator Facility

The Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Lab was built to investigate the structure of nuclei and hadrons in the region below the high-energy regime at intermediate energies and the underlying fundamental interactions. CEBAF's 6 GeV, polarized continuous wave electron beam is an ideal probe for the study of non-perturbative QCD. The beam is delivered independently to JLab's three experimental halls A, B and C. All Halls can simultaneously receive the maximum energy beam. Hall B with its Large Acceptance Spectrometer (CLAS) requires low beam currents, while high-intensity beams are delivered to Halls A and C.



Hall A Collaboration



The instrumentation in Hall A [6] was designed to study electro- and photo-induced reactions at very high luminosity and good momentum and angular resolution. The central components of Hall A are two high-resolution spectrometers with the momentum resolution better than 2×10^{-4} . The research program is aimed at a variety of subjects, including nucleon form factors, nucleon electromagnetic and spin structure functions, and properties of the nuclear medium.

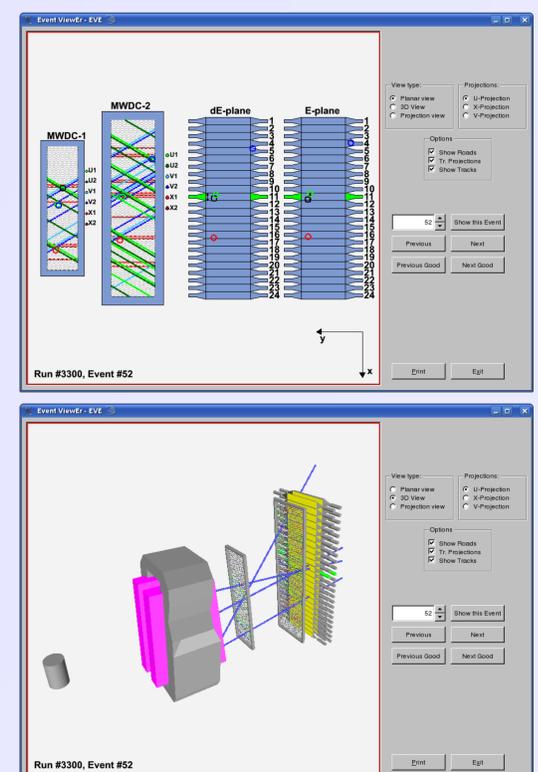
New BigBite Spectrometer



Main design characteristics [7]

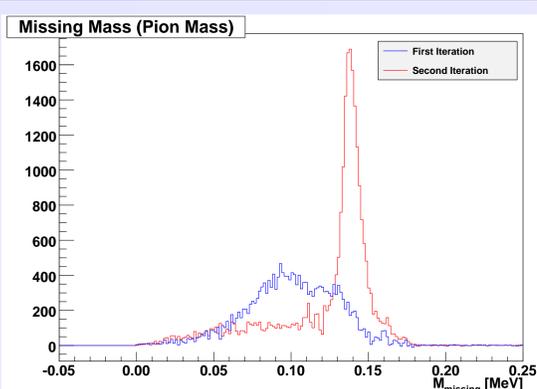
Configuration	Dipole
Momentum range	200 – 900 MeV
Momentum acceptance	$-0.6 \leq \frac{\delta p}{p} \leq 0.8$
Momentum resolution	4×10^{-3}
Angular acceptance	≈ 100 msr
Angular resolution	≈ 1 msr

Eve - The Event Display



Eve is highly configurable event display for the BigBite spectrometer. It displays hits in scintillation planes and wire-chambers and shows all possible particle trajectories through the detector package.

Data Analysis - Spectrometer Calibration



The data analysis is currently focused on the calibration of the BigBite spectrometer, which was used in this configuration for the first time in this experiment. We are presently trying to understand the optical properties of the spectrometer before analyzing real data. We expect to have first preliminary results of the measured cross-sections analysis by the end of 2008.