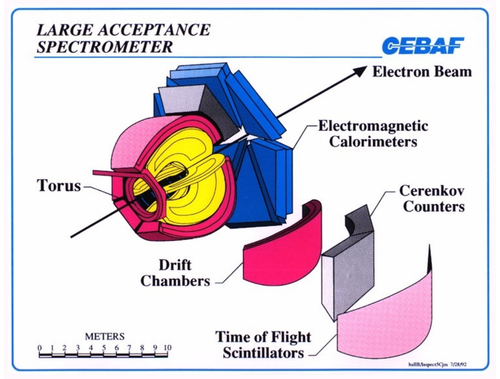

Fiducial Cuts for the CLAS G3 Data Set

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Abstract

Fiducial cuts have been determined for protons and charged pions produced by photons with energies between 0.3 and 1.5 GeV incident on Helium targets in the CEBAF Large Acceptance Spectrometer (CLAS) at the Thomas Jefferson National Accelerator Facility. This work is part of a systematic study of meson photoproduction from the proton and light nuclear targets to investigate nuclear-medium modifications of nucleon resonances and meson-nucleon interactions. The fiducial cuts are performed to eliminate data from regions of the detector with non-uniform acceptance. The cuts were determined by fitting a trapezoidal function to the ϕ spectra binned in scattering angle and momentum for each particle type. The ϕ position of the corners of the trapezoids were then fitted as a function of scattering angle, and the parameters of these fits were fitted as a function of momentum to obtain the functions that are applied to the data to produce the cuts.

CEBAF Accelerator

The Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Lab is a superconducting, 6-GeV, electron accelerator. An aerial photograph of the facility is shown in Figure 1. The electron beam at CEBAF is used simultaneously for scattering experiments in three halls that contain complimentary experimental equipment.

Figure 1: Aerial photograph of the Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Lab.

CLAS Detector

The primary instrument in Hall B is the CEBAF Large Acceptance Spectrometer (CLAS) [1] shown in Figure 2. Six superconducting coils produce a toroidal magnetic field around the beam axis and divide the detector into six sectors. The spaces between the coils are filled with three regions of drift chambers to track charged particles, Cerenkov counters for electron identification, scintillation counters for time-of-flight measurements, and electromagnetic calorimeters to detect electrons, photons, and neutrons. Hall B also houses a photon tagging system that allows for experiments with real photon beams.

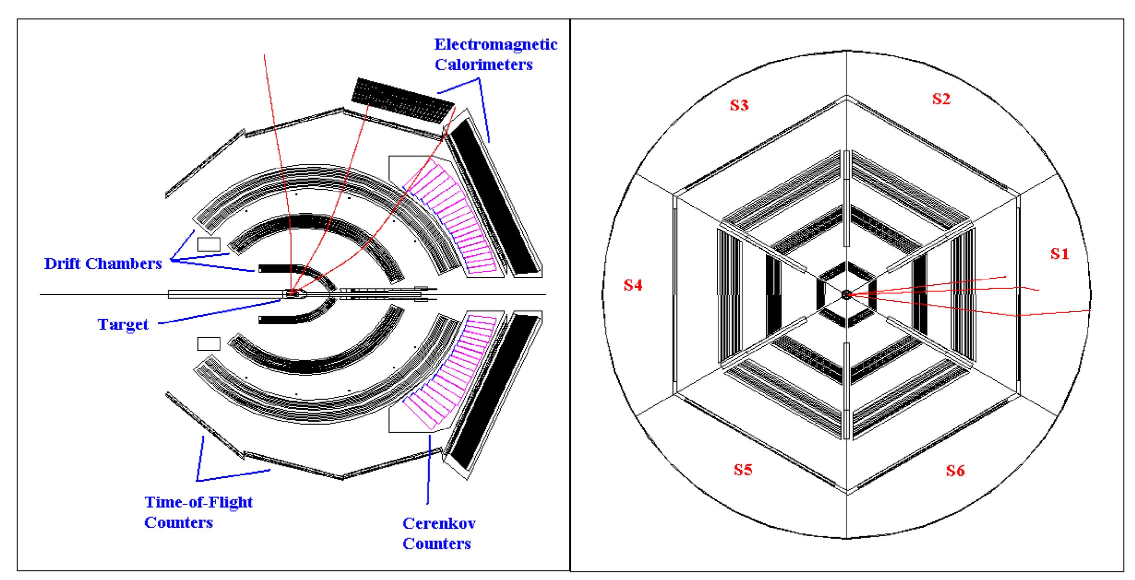

Figure 2: Schematic diagrams of the CEBAF Large Acceptance Spectrometer in Hall B at Jefferson Lab. The left (right) panel shows a slice parallel (perpendicular) to the beam axis. The red curves are simulated proton tracks [2].

Procedure

The determination of the uniform acceptance region for the CLAS detector involved a three step fitting process [3] using the ROOT analysis package [4].

1st Generation Fits: Data were divided into 50 MeV/c bins in momentum and 2º bins in scattering angle for each sector and charged particle type, producing approximately 18,000 ϕ spectra. These ϕ spectra were fitted with a trapezoidal function as shown in Figure 3.

2nd Generation Fits: The ϕ position of the corners of the trapezoids were then fitted as a function of scattering angle for each momentum bin as shown in Figure 4.

3rd Generation Fits: The five parameters from the 2nd generation fits were then fitted as functions of momentum. Examples of these fits are shown in Figure 5.

The results of these fits were applied in the analysis code to determine which particles fell within the fiducial region of uniform acceptance.

1st Generation Fits

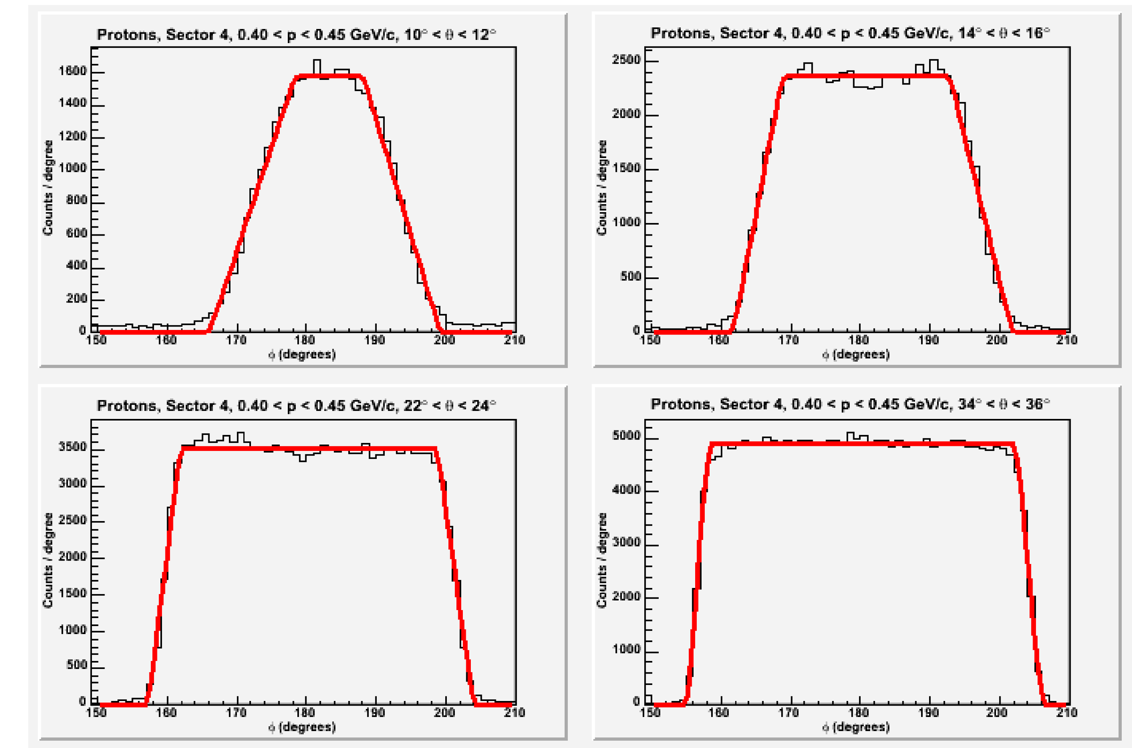

Figure 3: Azimuthal angle distributions for protons detected in Sector 4 with momenta between 0.40 and 0.45 GeV/c for several different bins in scattering angle. The trapezoidal fits are shown in red. The ϕ range between the top corners of each trapezoid represents the region of flat acceptance for that bin.

2nd Generation Fits

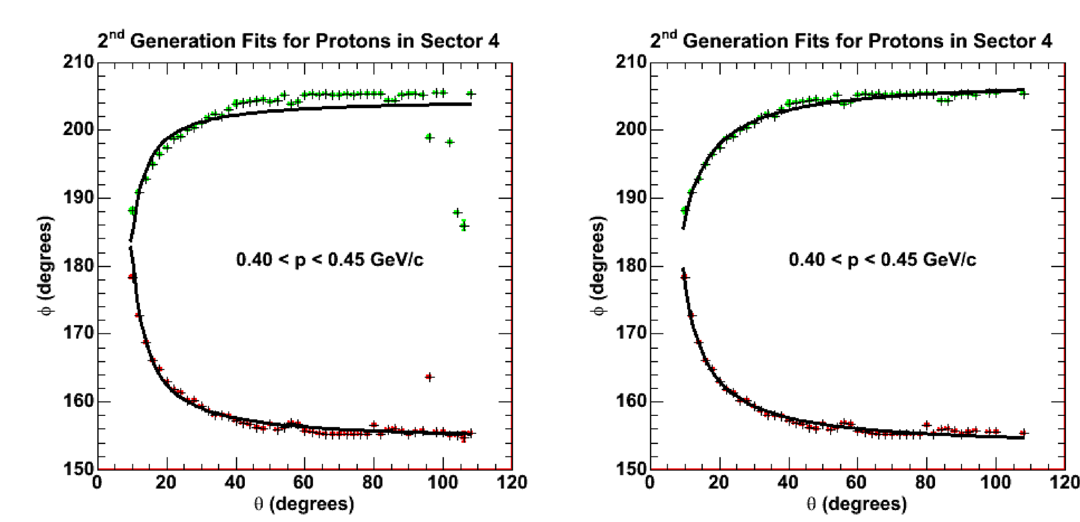

Figure 4: Fits of the ϕ position of the corners of the trapezoids as a function of scattering angle for protons in Sector 4 with momenta between 0.40 and 0.45 GeV/c. The left and right panels show the fits before and after a few outlying points at large scattering angle were removed.

3rd Generation Fits

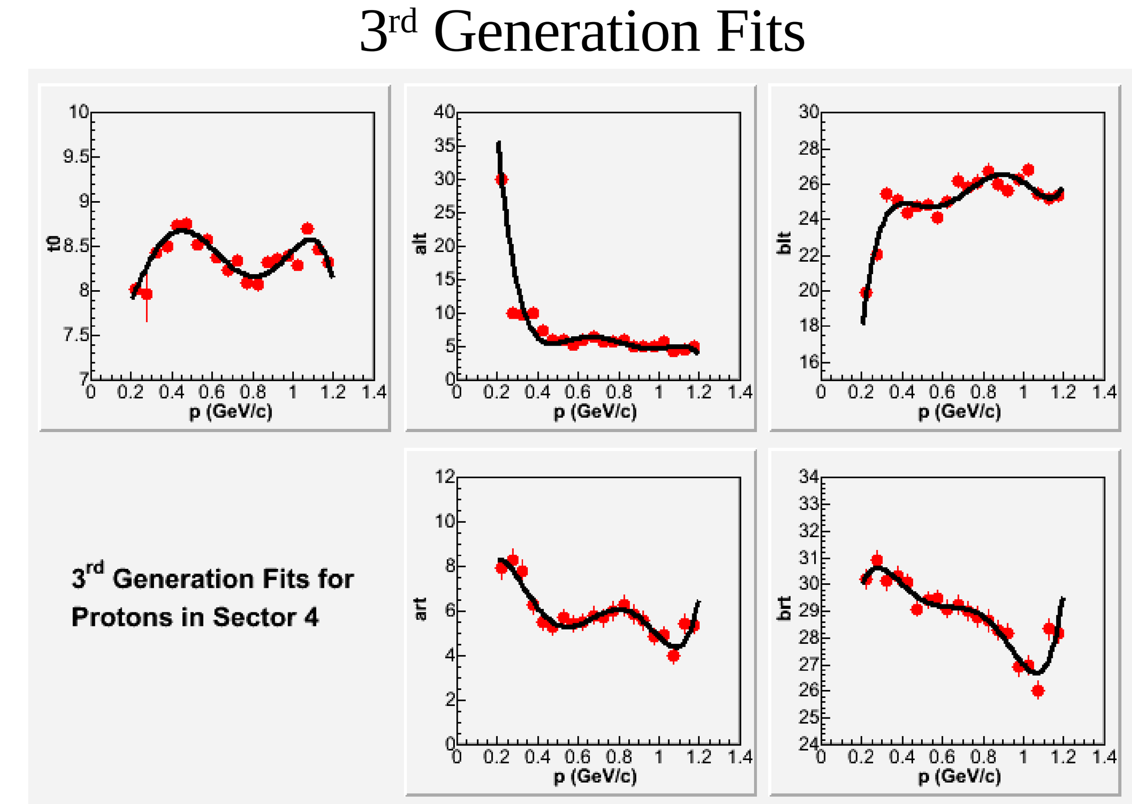

Figure 5: Fits of the parameters from the 2nd generation fits as functions of momentum for protons in Sector 4.

Results

The results of the fiducial cuts applied to the data for each charged particle type are illustrated in Figure 6. Comparisons of the azimuthal angle vs. scattering angle distributions before (blue) and after (red) the cuts show that the holes in the ϕ acceptance due to the magnets are clearly defined. Also shown in the figure are the effects of the cuts on a single ϕ spectrum illustrating that the cuts successfully eliminate data in regions with non-uniform acceptance. These fiducial cuts are currently being used in our analysis of the G3 data set.

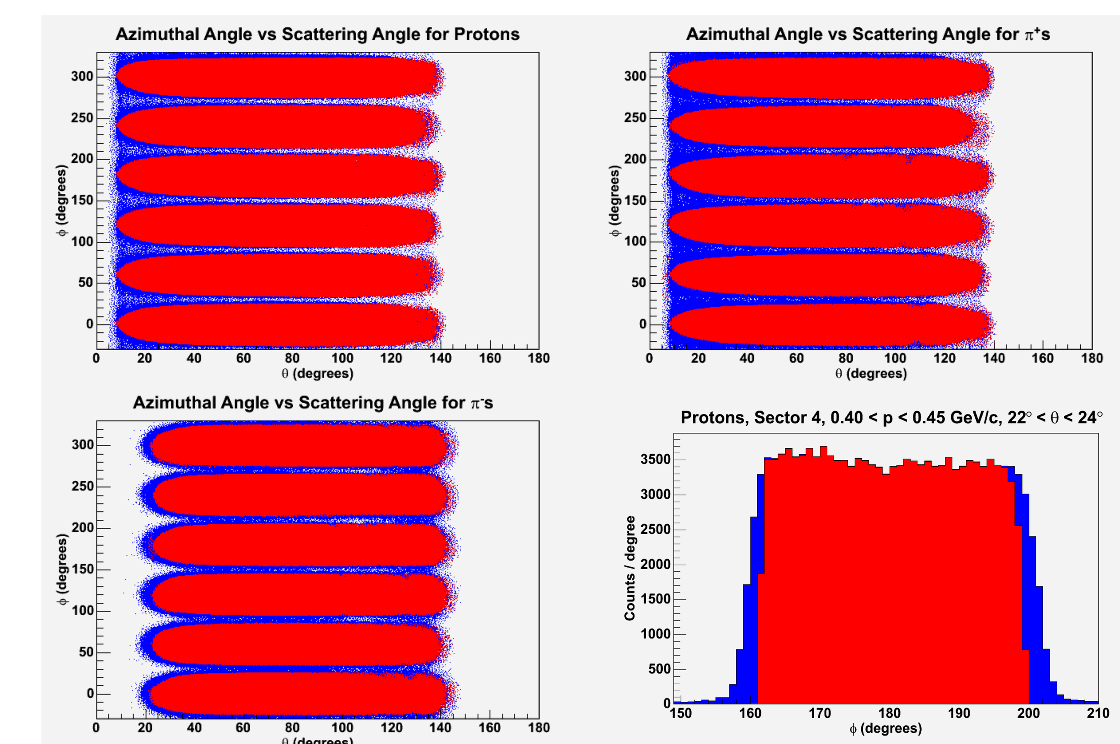

Figure 6: Azimuthal angle vs scattering angle histograms showing particles accepted before (blue) and after (red) fiducial cuts were applied for protons (top-left), π^+'s (top-right), and π^-s (bottom-left). The bottom-right histogram shows the ϕ distributions for protons in Sector 4 for a single bin in momentum and scattering angle before (blue) and after (red) fiducial cuts.

References

[1] B. Meckling *et al*. (The CLAS Collaboration), Nuclear Instruments and Methods **503/3**, 513 (2003).

[2] CLAS GEANT Simulation Code, http://www.physics.unh.edu/~maurik/gsim_info.shtml

[3] D. Protopopescu *et al*., CLAS-NOTE 2000-007 (2000); G. Gilfoyle, private communication.

[4] The ROOT System Home Page, http://root.cern.ch/

Acknowledgements

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