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MONTE–CARLO CODE FOR SIMULATION OF THE LARGE ANGLE ELECTROMAGNETIC SHOWER CALORIMETER FOR CLAS DETECTOR

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ABSTRACT

The Monte–Carlo program for simulation of the Large Scattering Angles Electromagnetic Shower Calorimeter, which will be istalled in Hall B CEBAF US laboratory, is presented. The code test and simulation results are considered.

1. Introduction

The Frascati–Genova collaboration participates to the experimental activities of Hall B at CEBAF; the main research lines being presently the following:

–N^* photo– and electroproduction off nucleon and ^{3}He. We propose to study the resonances excitation in the nucleon as well as in light nuclei in the exclusive channels for W<2.0 GeV and up to the highest Q^2 range available at CEBAF. The prominent N^* will be investigated by the single pion and η–production channels; the 2–pion electroproduction processes will be used to study poorly known N^* and to search for the "missing" resonances;

–The investigation of the nuclear three–body correlation effects in the ^{3}He(γ,ppn) reaction, looking for the events with maximum non–complanarity;

–The ρ,ω,ϕ vector mesons photoproduction at large t on the nucleon possibly on the few body nuclei, focusing on hard process mechanisms to investigate the quark–gluon structure in

nucleons by few GeV real photons. The analysis of the existing vector meson photoproduction data shows, that two gluon exchange diagram between vector meson quark pair and on constituent quark of the proton explain the differential cross-section at high t, presenting as a signature a pronounced minimum at t=2-3 fm^{-2}, in the CEBAF range;

-Two-body photodisintegration of the deuteron in the region of small momentum transfer to check the prediction of the Regge phenomenology and of the quark-gluon string model;

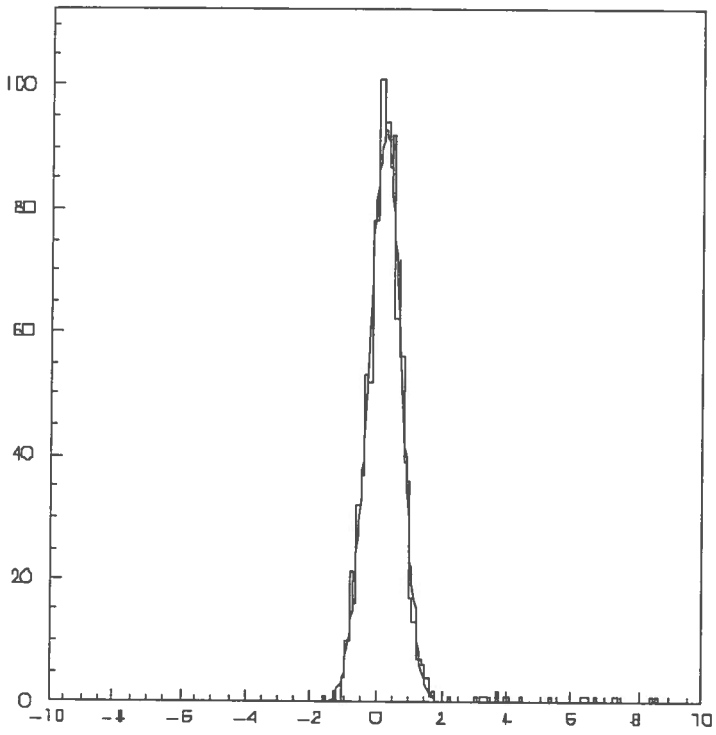
-The measurement of the total photoabsorption cross-section on C, Al, Cu, Sn, and Pb , and the photofission cross-section for ^{238}U, ^{237}Np and ^{232}Th from 0.4 to 2.0 GeV, in order to study the quenching of nucleonic resonances and shadowing effects.

The proposed experiments require many particles detection in the reactions induced by real and virtual photons: the CLAS spectrometer of the Hall B at CEBAF[1] gives a unique opportunity for these experiments, providing a complete kinematical reconstruction.

The CLAS performance will be significantly upgraded by the Large scattering Angle extension of the Electromagnetic Shower Calorimeter (LA-ESC) proposed by Frascati-Genova collaboration. The main functions of the calorimeter are: a)photon momentum measurement and π^0, η^0 momentum and mass reconstruction; b) electron/pion separation; c) neutron momentum measurement with more than 40% efficiency. The LA-ESC is composed by up to 12 segments. Each segment covers a region of about $\pi/3$ in ϕ and 35° in θ. This extension allows to increase the accessible Q^2 region and the phase space for the detection of neutral particles: therefore, it will be very useful for the experimental activity mentioned above. Presently the collaboration is realising two modules that could cover either one $\pi/3$ region in ϕ and $48°$-111° in θ, or $2\pi/3$ in ϕ and $48°$-75° in θ.

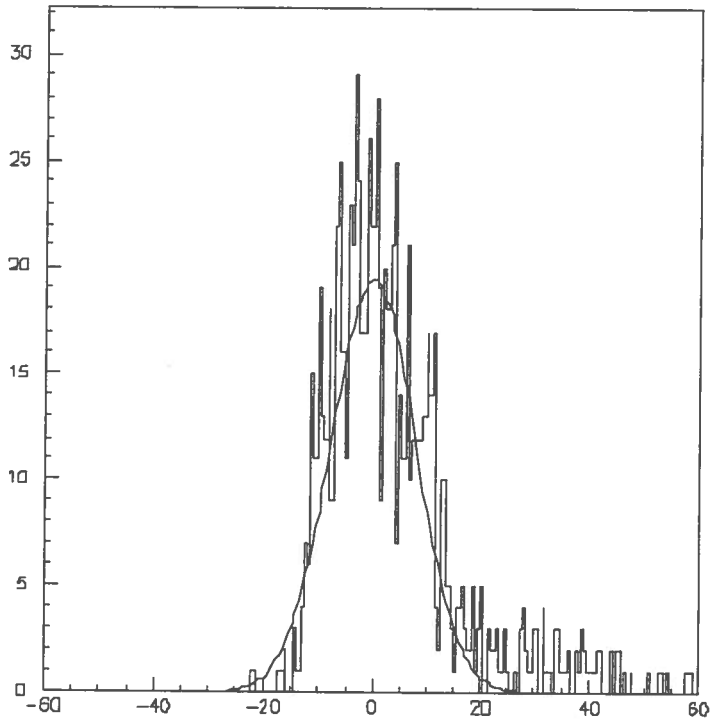
2. - The module design

Each modules, whose structure is shown in Fig1, is a tapered parallelepiped made of successive layers of plastic scintillators strips 1.5 cm thickness alternated with lead converter layers 0.2 cm. thick. The strips in one layer are rotated by 90° with respect to the neighbouring ones, providing a stereo readout, which is necessary to resolve the multiparticle hit. The module is composed by 33 plastic and lead layers: 24 longer plastic in the X-direction layer, 40 shorter plastics in the Y-direction layer. The total thickness amounts to 11.8 radiation lengths or 1.01 total (0.62 inelastic) nuclear interaction lengths. The module is subdivided in a lower (internal) part (16 layers) closer to the target and an upper (external) part (17 layers). These two parts are read out independently. The correlation between the energy deposition in the lower and in the upper sections delivers the information about the longitudinal energy distribution of the shower useful for electron/pion discrimination. The optical guides system provides the light collection from each side of the vertical scintillator stack. The sum of the signals from the two sides of the stack is used for the ADC acquisition, while in the TOF measurements pulses from each side are analysed independently.



T_{real}-T_{rec} nsec

Fig.22 The difference between the real and reconstructed first neutron interaction time



L_{real}-L_{rec} cm

Fig. 23 The difference between the real and reconstructed target-first neutron interaction point distance

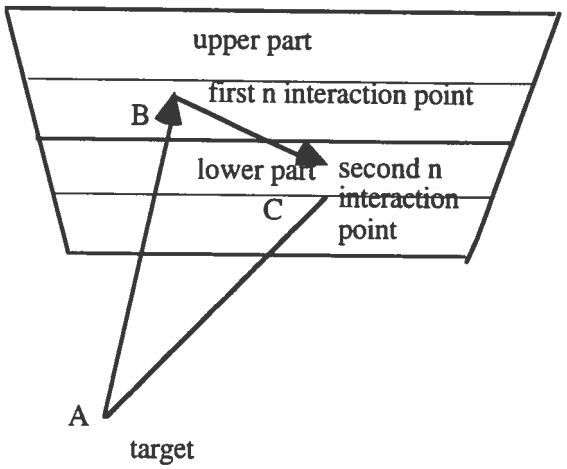


Fig.24 The tail formation for the L_{real}-L distribution

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