EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

CPLEAR Collaboration

CALO/OFF/1

Study of the Calorimeter Detection Efficiency for Photons, Electrons, Pions and Kaons

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Abstract

The calorimeter detection efficiency for photons was studied using events $p\overline{p} \rightarrow \Phi\pi^o \rightarrow K^+K^-\gamma\gamma$ as tagged γ-events. Events with a photon converted inside the tracking chambers were used as a clean sample of electron and positrons. Selected long lifetime events of the type $p\overline{p} \rightarrow K^+\pi^-K^o \rightarrow K^+\pi^-\pi + \pi-$ were used to study the kaon and pion detection efficiency in the calorimeter. The data were taken from the run periods P13 and P14. Only clusters in the calorimeter with more than 2 hits in at least two layers are accepted.

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1 Photon Efficiency

The $\Phi\pi^o$ events are selected by requiring exactly two charged particles and at least one neutral shower. A shower is defined to originate from a neutral particles if it is separated in $r-\varphi$ and in z by 25 cm from any charged track. The charged particles are identified to be kaons with dE/dx and/or Č. Only events with an invariant K^+K^--mass (see fig.1) of less than 1040 MeV/c^2 are accepted. The events were a second neutral shower is found in the expected region are counted as efficient. The efficiency as a function of the γ-energy is shown in figure 4. The efficiency reaches a plateau of about 89% for γ-energies above 200 MeV. About 5% of the inefficiency is due to the support structure of the calorimeter.

2 Electron Efficiency

Events with a converted photon are easily selected by requiring that the opening angle of two secondary tracks is less than 3^o (see fig.2). The electron and positron tracks are extrapolated to the calorimeter. Only the events were accepted where the electron and positron impact points are well separated in order to have no ambiguities with the association of showers and tracks. The number of events where a shower was found near a charged tracks divided by the number of all charged tracks extrapolated to the calorimeter as a function of the charged particle momentum is shown in figure 5. Due to the energy losses in the material in front of the calorimeter the efficiency curve is shifted by $\sim 40\ MeV$ compared to the γ efficiency.

3 Kaon and Pion Efficiency

A clean sample of kaon and pion tracks is obtained from Golden $\pi^+\pi^-$ events (selection according to Christos Touramanis). The charged tracks are followed to the calorimeter. The distance between the impact points of the charged tracks and the shower foots is plotted in figure 3. The efficiencies obtained from this analysis are shown in figure 6 for kaons and in figure 7 for pions. The efficiency for Kaons reaches almost the maximum possible value of 95%. The overall efficiency for kaons in Golden events is about 90%.

The efficiency for pions is only 80% and lower as for kaons. The threshold for pions to be detected in the calorimeter is at about 150 MeV/c. The rise of the efficiency at very high momentum ($> 800\ MeV/c$) could be due to pion-kaon misidentification, because in this region kaons could also produce light in the Č-counters. There might be also a kaon-pion misidentification at low momenta ($\sim 300 MeV/c$) because the kaon-efficiency increases with decreasing momentum and reaches the value obtained for pions.

The K^+ and K^- efficiencies differ only by a few percent (see figure 8). There is no difference visible for the π^+ and π^- efficiencies within the errors (see figure 9).

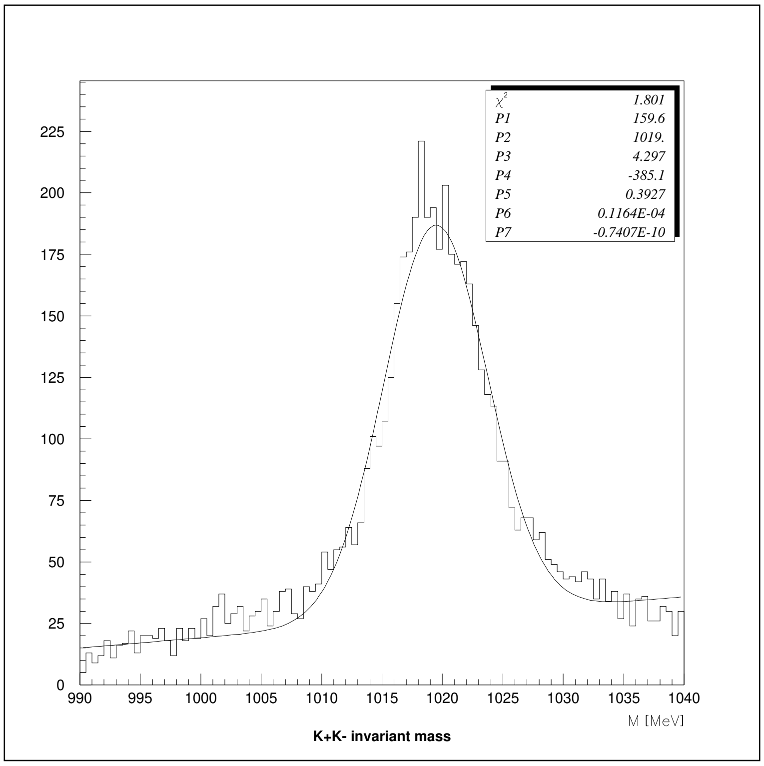


Figure 1: K^+K^- invariant mass

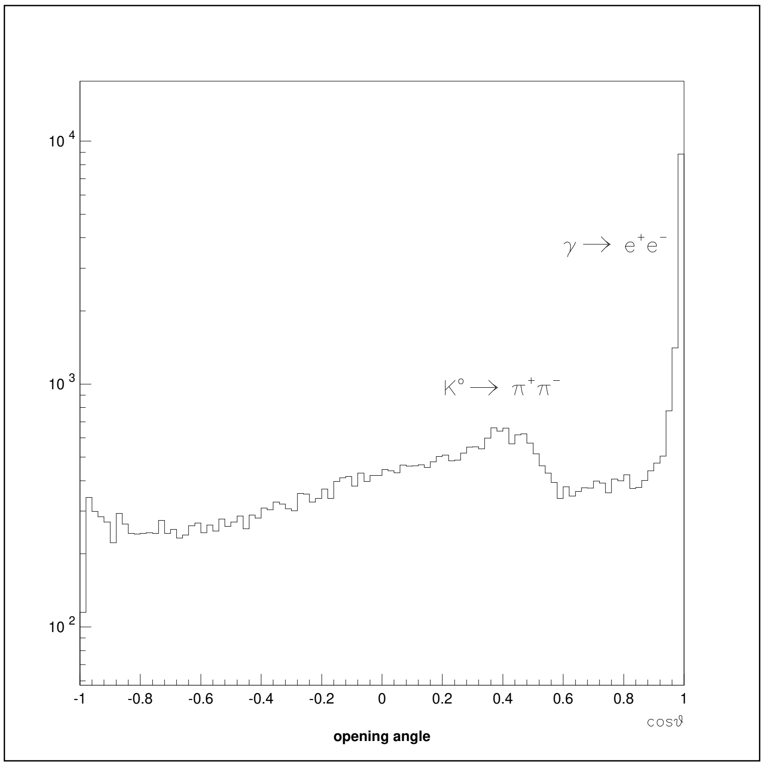
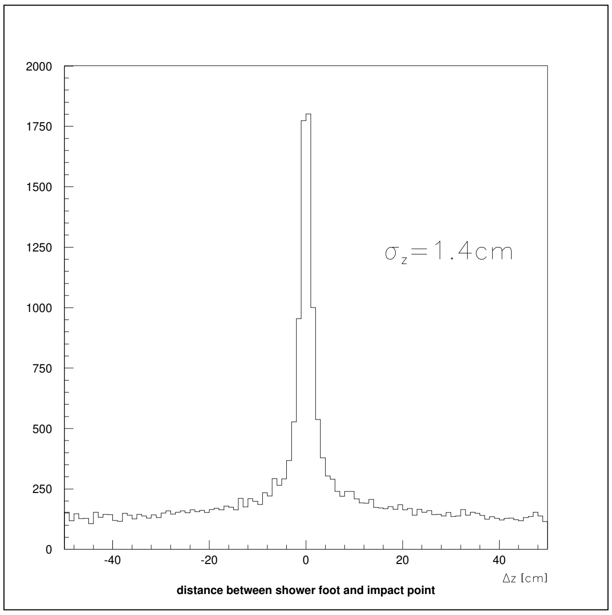


Figure 2: Opening angle of secondary tracks



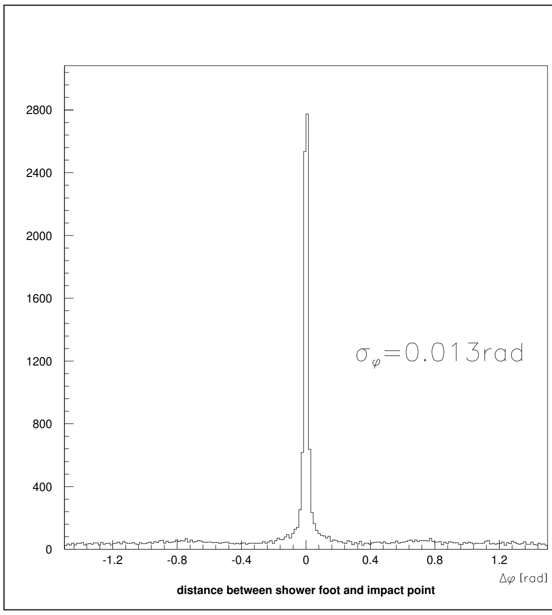


Figure 3: Distance of impact point to shower foot

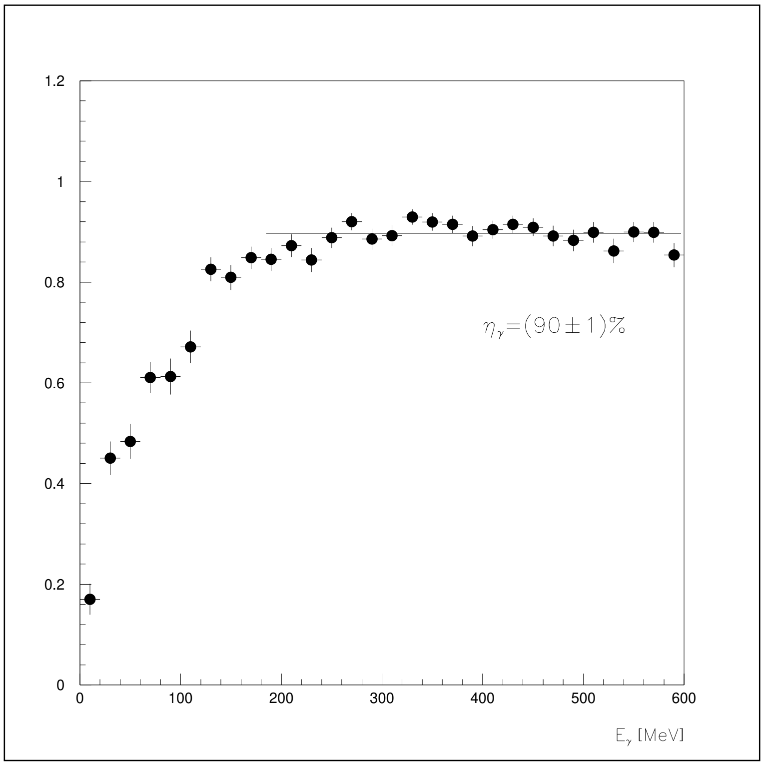


Figure 4: γ efficiency as a function of the energy

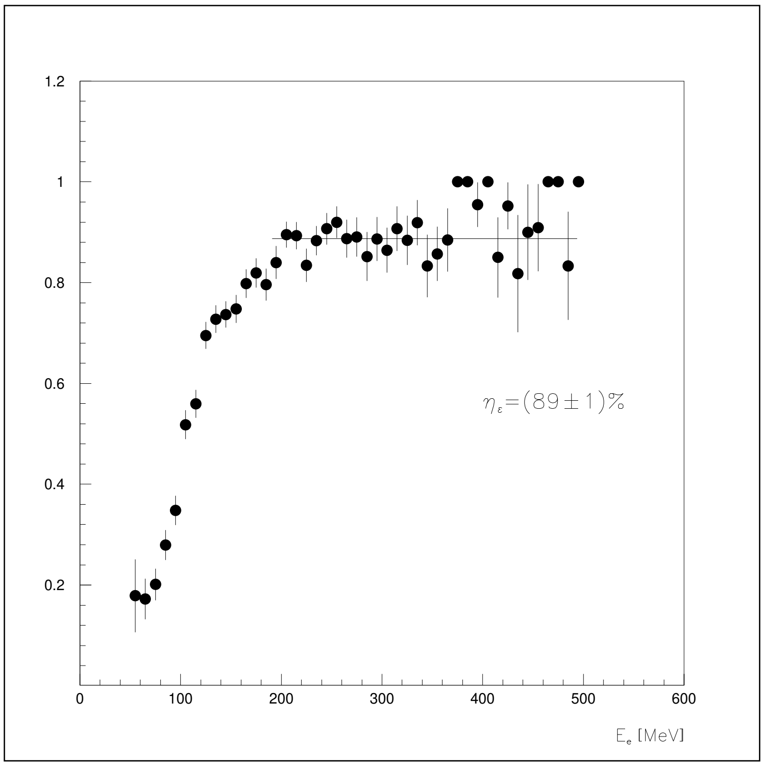


Figure 5: Electron efficiency as a function of the momentum

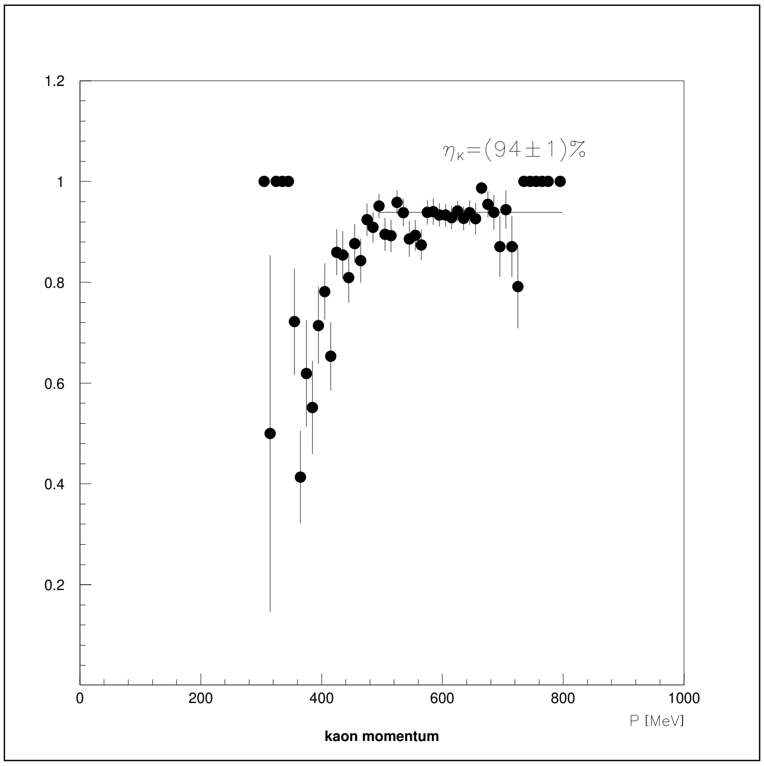


Figure 6: Kaon efficiency as a function of the momentum

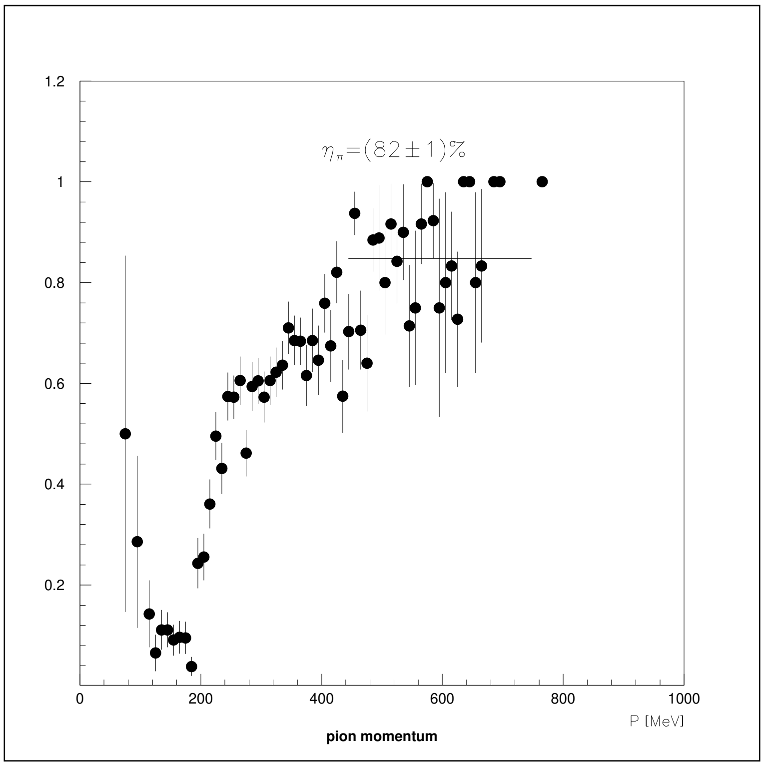


Figure 7: Pion efficiency as a function of the momentum

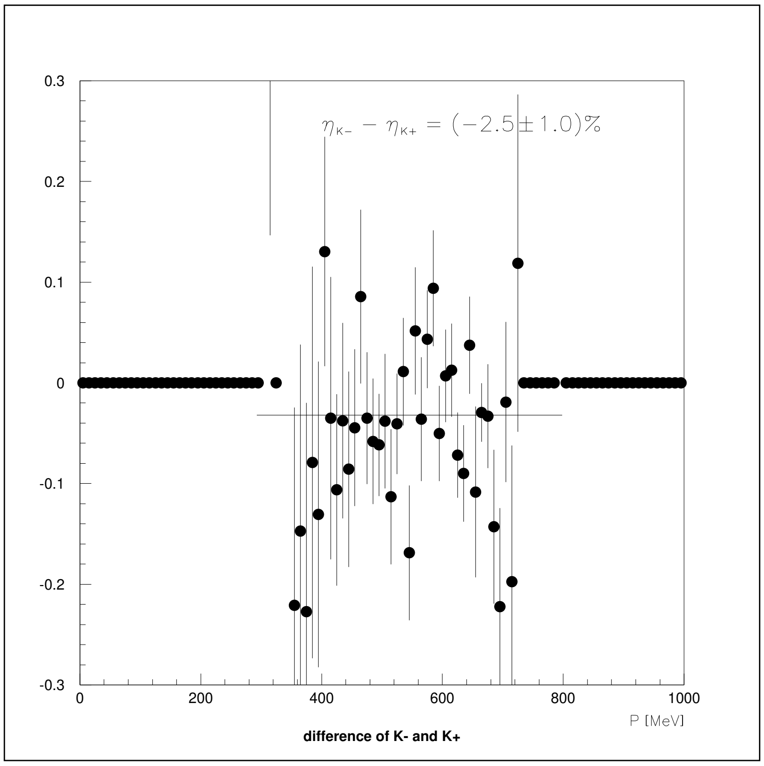


Figure 8: Difference of K^+ and K^- efficiencies

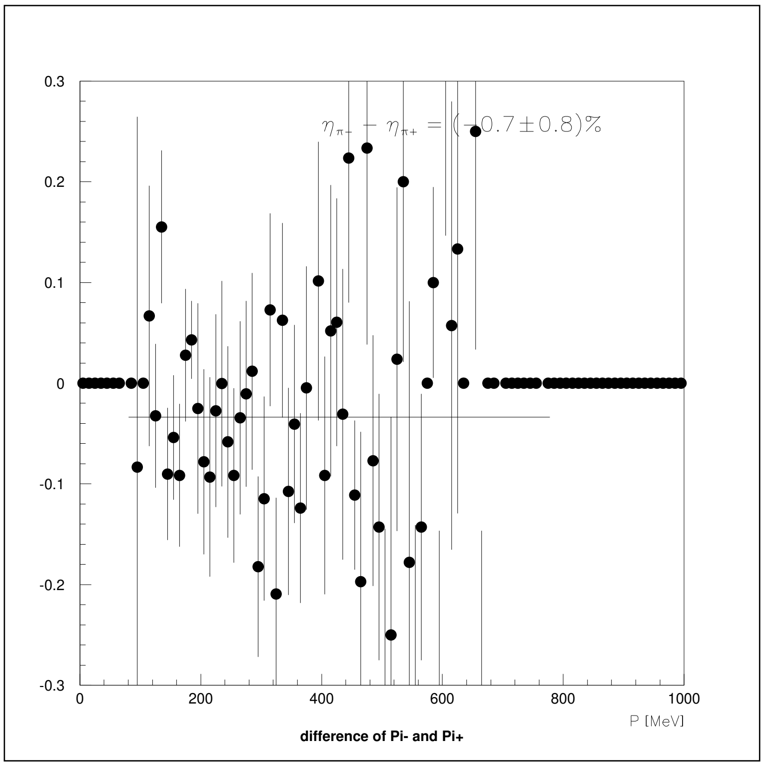


Figure 9: Difference of π^+ and π^- efficiencies