Angular Distributions of Secondary Relativistic Charged Particles Produced in Interactions of Negative Pions in Emulsion at 300 GeV/c.

M. Jurčić, Đ. Krmpotić, O. Adamović and V. Gerc
Institute of Physics, University of Belgrade, YU-11001
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J. Lory, D. Schune, Tsai-Chü and B. Willot
LPNHE, Université de Pierre et Marie Curie - F-75000 Paris, France

K. P. Hong, C. O. Kim, S. N. Kim and K. A. Moon
Department of Physics, Korea University - Seoul 132, Korea

R. Schmidt
Laboratoire du Rayonnement Cosmique - F-69000 Lyon, France

G. Baumann
Université de Nancy - F-54000 Nancy, France

M. López Agüera, R. Niembro, A. Ruiz and E. Villar
Universidad de Santander - Santander, Espana

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Summary. — Angular-distribution data are presented of single relativistic charged particles produced in inelastic and incoherent negative-pion interactions with emulsion nuclei heavier than hydrogen at 300 GeV/c. The obtained results are compared with data from proton nuclei interactions at the same energy.

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1. Introduction.

This is the continuation of a search for fundamental characteristics of secondary charged particles produced in inelastic and incoherent interactions of 300 GeV/c negative pions with emulsion nuclei heavier than hydrogen ($\pi^-$-em). In a previous paper (1) the multiplicities of produced secondary charged particles were analysed and now the characteristics of angular distributions of secondary relativistic charged particles ($\beta > 0.7$, $s$-particles) are investigated. The angular-distribution spectra are one of the basic data sources on one-particle distributions of $s$-particles in multiple particle production in hadron-nucleus (hA) interactions at high energies.

2. The experimental procedure and used parameters.

The general experimental procedure is cited in a previous paper (1). Angular-distribution data are based on 316 ($\pi^-$-em) and 359 (p-em) interactions with 4444 and 5961 $s$-particles, respectively. The following variables were used in the analysis of the angular distributions: the pseudorapidity $\eta = - \ln \tan (\theta/2)$ and/or the variable $\lambda = \log \tan \theta$, $\theta$ being the laboratory polar angle between the primary and the emitted particle. At ultrarelativistic energies for $s$-particles, when $p_l^2 > p_\perp^2 > m^2$, the pseudorapidity $\eta \approx y$, $y$ is the longitudinal rapidity of the $s$-particles ($y = ½ \ln (E + p_\perp)/(E - p_\perp) = \ln (E + p_\perp)/\sqrt{m^2 + p_\perp^2}$, where $E$, $p_\perp$, and $m$ are energies, longitudinal and transverse momenta and masses of $s$-particles, respectively).

The variable $\eta$ may be then conveniently applied to pions as $s$-particles in (hA) interactions at high energies. This is rather important because the rapidity distribution $dN/d\eta$ is invariant under longitudinal Lorentz transformations, i.e. the shape of the distribution remains invariant.

The polar angles $\theta$ of the emitted particles in the laboratory system are related to those in the e.m. system $\theta^*$ by

$$\tan \theta = \beta^* \sin \theta^*/(\beta^* + \beta^* \cos \theta^*) \gamma_e,$$

where $\beta^*$ is the particle velocity in the e.m. system, $\beta^*$ the relative velocity of both co-ordinate systems, and $\gamma_e$ the Lorentz factor of the e.m. system respectively. From eq. (1) at $\beta^*/\beta^* \approx 1$ one obtains $\log \tan \theta = - \log \gamma_e + 0.43 \ln \tan (\theta^*/2)$ and since $\eta^* = - \log (\theta^*/2)$ introducing $\eta^*$ one gets the