ANGULAR DISTRIBUTION AND MULTIPLICITY OF BACKWARD HADRONS IN hFe INTERACTIONS AT 0.5-5.0 TEV ENERGIES (PION Experiment)

V.V.AVAKIAN, M.O.AZARIAN, K.SH.EGIYAN, E.A.MAMIDJANIAN, G.ZH.OHANIAN, S.V.TER-ANTONIAN

Yerevan Physics Institute, Markarian st.2
375036, Yerevan, Armenia, USSR

ABSTRACT

Basing on the analysis of $\sim 5 \cdot 10^3$ events registered on the PION installation, data are obtained on the angular distribution and multiplicity of particles, flying back into the laboratory coordinate system (LCS) that are identified mainly as hadrons produced in the reactions of $hFe \rightarrow h'x$ type. The inclusively produced hadron energy is > 200 MeV. The experimental data are compared to the results of the cumulative particle production in hA processes observed on accelerators at lower energies.

A large number of experimental studies (see e.g./1/) were devoted to the regularities and nature of backward particles. In generating the energetic charged and albedo particles the cumulative processes may also play a significant role /2/.

Basing on the analysis of $\sim$ 5000 events we report here the experimental data on multiplicity and angular distribution of albedo particles generated at $t > 100$ g/cm^2 depths of the PION installation calorimeter material. The detailed description of the installation is given in /3/. It consists of an ionization calorimeter (IC) and an X-ray transition radiation detector (XTR). The summary quantity of material in the IC is equal to ~ 900 g/cm^2. A 5-module XTR detector is located above the calorimeter. The efficiency of the charged particle registration by one XTR proportional chamber is 96-98%, the accuracy of measuring the azimuthal angle of the charged hadron trcak is $\pm 2^o$.

The average number of backward particles is determined by the expression

$$< W_3 > = \frac{\Sigma n_3}{N}$$

where Σn_3 is the number of backward charged particles tracks in events considered.

The efficiency of detection of particles, having escaped backward at various angles, versus the interaction depth and the zenith angle was defined by the Monte-Carlo calculations. ~ 78% of the 5346 events considered are the cases with albedo. The multiplicity of detected backward charged particles averaged over the whole effective depth of the calorimeter per one event equals $<W_3> = 0.55 \pm 0.06$ at the hadron energy $E > 500$ GeV.

The multiplicity of charged backward particles generated by hadrons with the same energy at the calorimeter material depths > 100 g/cm^{-2} equals $<W_3> = 0.37 \pm 0.04$.

Figure 1 shows the multiplicity distribution of backward charged particles produced at the depths > 100 g/cm^2. The data from /1/ are given ibidem. As is seen from the figure, the probability to observe backward particles with the large multiplicity grows with the increase in the primary hadron energy.

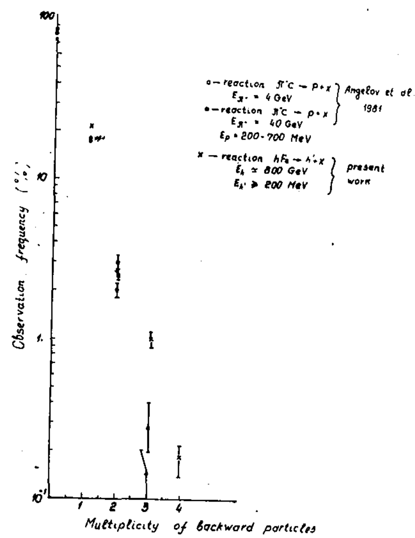

Fig.1. Probability of observing the cases with various multiplicities of backward charged particles produced at the IC material depths > 100 g/cm .

The dependence of the backward particle multiplicity on their generation depth in the interval > 100 g/cm^2 obeys the exponential law $\sim \exp(-t/\lambda)$, where λ equals 181 ± 32 g/cm^2. Such a large value of λ may testify the presence of hadrons with the energy > 400 MeV in the albedo flux.

Figure 2 presents the distributions of amplitudes of signals from backward particles generated by hadrons with the energy > 500 GeV for the calorimeter two depths: small ($Pb_1 + Pb_2$) and middle ($Fe_2 \ldots Fe_5$), on the output of the multiwire proportional chambers (MWPC) of the XTR detector first row. The average values of the amplitude are equal to 84.67±3.62 and 58.19±2.10 relative units, respectively, and this result confirms our assumption that the nature and energy spectrum of backward charged particles detected on the installation from various depths are not identical. To a similar conclusion leads also the experimental fact that the average amplitude of energy release in the MWPC from charged particles of the average depths (t > 100 g/cm^2) 1.30 times exceeds the single charged hadron averaged energy release, while the corresponding ratio for the small depth of production ($Pb_1 + Pb_2$) equals ~ 1.9.

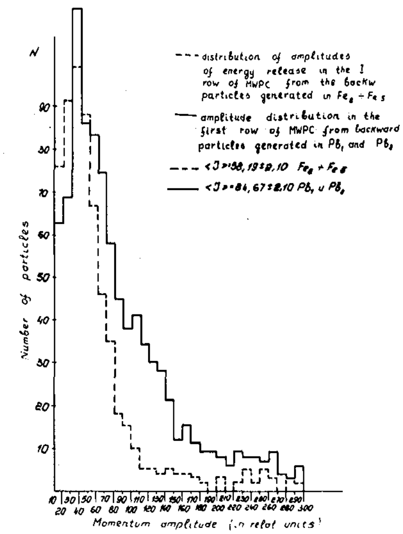

Fig.2. The backward particle energy release amplitude distribution in the first row of MWPC.

Figure 3 presents the backward angular distribution of 3 particles with the registration efficiency corrections. The 3 particles production cross section in the 120°-160° angle interval does not contradict the results obtained at the primary hadron low energies for cumulatively produced protons and pions /4/. In the $\gtrsim$ 160° interval a peculiarity is observed at $\Theta \approx 170°$ as a minimum. For the first time a similar behaviour of the angular distribution has been observed for cumulative protons and π -mesons

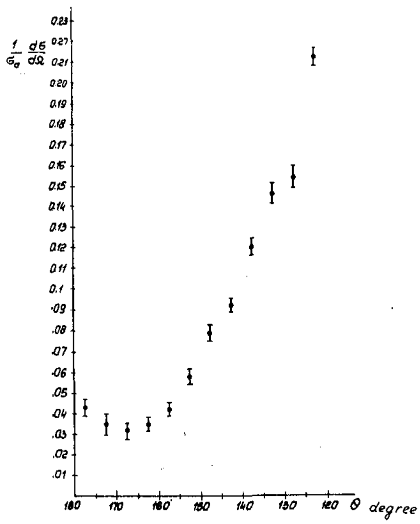

Fig.3. Angular distribution of backward charged particles generated at the calorimeter material depths > 100 g/cm^2.

produced in dA collisions at the primary energy ~ 4.5 GeV/nucleon /4/.

The authors are indebted to A.Ts.Amatuni, S.G.Matinyan, A.G.Oganessian for helpful discussions.

REFERENCES

/1/ Azarian M.O., Zazian M.Z., Mamidjanian E.A., Yad.Fiz., 1977, 26, N.1.

Avakian V.V. et al., Izv.AN SSSR, ser.fiz., 1981, 45, N.7, 1249-1254.

Ellsworth R.-W., Goodman J.A., Ito A.S. et al., NIM, 1982, 203, 167-177.

Angelov N., Litpulaev S.L., Nikitina V.F., Yad.Fiz., 1981, 33, N.1, 190-193.

/2/ Baldin A.M., E.Ch.A.Ya., 1977, 8, 429.

/3/ Avakian V.V. et al., 17th ICRC, Kyoto, 1980, 13, 61.