A study on asymmetrical scattering of secondary charged mesons in the CMS in the proton-nucleus interaction at E=24 GeV in emulsions

1973 J. Phys. A: Math. Nucl. Gen. 6 L19

(http://iopscience.iop.org/0301-0015/6/3/001)

J. Phys. A: Math., Nucl. Gen., Vol. 6, March 1973. Printed in Great Britain. © 1973

LETTER TO THE EDITOR

A study on asymmetrical scattering of secondary charged mesons in the CMS in the proton–nucleus interaction at $E = 24$ GeV in emulsions

B K Bandyopadhyay, I K Daftari and T Roy
Department of Physics, Jadavpur University, Calcutta-32, India

MS received 6 December 1972, in revised form 5 January 1973

Abstract. 220 events with $n_s \geqslant 5$, where the majority of the particles are identifiable, are considered to study the asymmetry parameter of secondary charged pions in the CMS in proton–nucleus interactions at $E = 24$ GeV in emulsion. In this experiment the asymmetry coefficient is found to be 0·24.

The general properties of proton–nucleus interactions have been studied in the last few years with high energy and superhigh energy experiments. Whenever an interaction of this type is observed some model is conceived to account for the showers of secondary mesons. Whatever the mechanism of the production of the showers may be, the numbers of secondary mesons emitted in the forward and in the backward directions in the CMS differ from each other. This asymmetrical distribution of secondary mesons has been discussed recently in a number of papers (Guseva *et al* 1962, Dobrotin *et al* 1962, Gierula and Miesowicz 1963, Friedländer and Spîrchez 1962, Boos *et al* 1965). The most acceptable hypothesis is due to random deviation in the number of charged mesons emitted forward and backward in the CMS from symmetrical separation.

Our present work also supports the same idea with an increased statistical weight and best estimate of the asymmetry coefficient. To investigate the asymmetrical scattering of charged secondary mesons in the proton–nucleus interaction at $E = 24$ GeV we have used pellicles of nuclear emulsions consisting of a stack of 24 plates of Nikfi-R type of dimensions $10 \text{ cm} \times 400\ \mu\text{m}$. This stack was exposed to the 24 GeV/c proton beam of the CERN proton synchrotron. Scanning of these plates was carried out by the 'along the track method' on a Leitz–Wetzlar microscope provided with a Brower travelling stage, using an oil immersion 53·1× objective in conjunction with a 16·8× ocular. 220 events were scanned by following 110 m of proton track length and the mean free path for these events was found to be 38·2 cm. With our selection criteria of $n_s \geqslant 5$ the asymmetry coefficient α for each individual event is calculated according to the relation:

$$\alpha = \frac{n_+ - n_-}{n_+ + n_-}$$

where n_+ and n_- are the number of particles emitted in the forward and in the backward direction respectively in the CMS. A distribution in $|\alpha|$ for the proton–nucleus interaction beginning with $n_s \geqslant 5$ has been plotted and is shown in figure 1. The experimental distribution in $|\alpha|$ is compared to the histogram obtained from the random deviation of the secondary particles from a symmetrical distribution. Assuming independent and symmetrical emission of particles in the CMS, the binomial distribution which is given by

$$p_n(\alpha) = \frac{n!}{n_+!\,n_-!}\,p^{n+}q^{n-}$$

is considered to determine the probability of observing a certain value of α ($p = q = \frac{1}{2}$). This probability was then summed over an interval $\Delta\alpha = 0{\cdot}25$, taking the prong distribution $p_n(\alpha)$ into consideration.

It is seen from our observations that the asymmetry of the showers does not exceed the limits of fluctuations except at small values of α. From our results the asymmetrical coefficient is found to be 0·24 which agrees fairly well with the previous workers' results (Friedländer and Spîrchez 1962, Boos *et al* 1965, Pavlova 1968 and Jain and Shivpuri 1970). Regarding the differences between the experimental and binomial

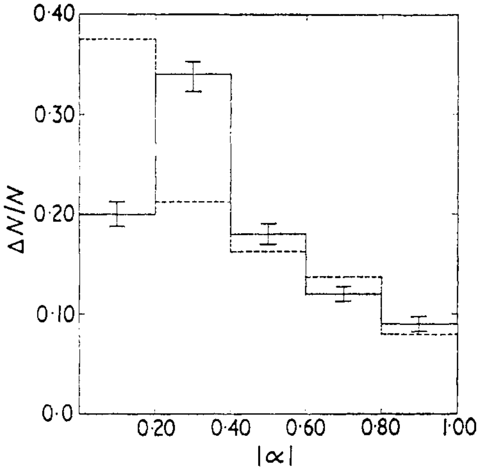

Figure 1. Distribution of $|\alpha|$ for proton–nucleus interactions. The full histogram is the experimental distribution and the broken line is the binomial distribution.

distributions at small values of α, which are apparent from figure 1, we may say that for a small fraction of the unidentified particles we have used the assumption that the transverse momenta are constant and this might be the reason for the distortion in the distribution with respect to α.

Donation of emulsion plates from CERN by Professor A J Herz is gratefully acknowledged.

References

Guseva V V *et al* 1962 *Izvest. Akad. Nauk.* **26** 549
Dobrotin N A *et al* 1962 *Nucl. Phys.* **35** 152
Gierula J and Miesowicz M 1963 *Nuovo Cim.* **27** 149
Friedländer E M and Spîrchez M 1962 *Proc. 7th Int. Conf. on High Energy Physics, Sofia* vol 5 p 5
Boos E G *et al* 1965 *Sov. Phys.–JETP* **20** 1371
avlova N P 1968 *Sov. J. nucl. Phys.* **7** 371–2
Jain P L and Shivpuri R K 1970 *Nuovo Cim.* A **70** 632