

LETTERS TO THE EDITOR

HADRON-NUCLEI COLLISIONS WITHOUT PION CREATION AT
200 GeV/c*

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Received 16 January 1981

UDC 539.12

Original scientific paper

We report here the observation of some interesting events produced in interaction of 200 GeV/c proton with nuclei of photoemulsion. At this energy some events are produced where there is no shower or grey track, thus these are the indications of new type of hadron-nuclei interaction unaccompanied by usual multiple pion creation.

In the past several anomalous nuclear interactions or events have been observed in nuclear emulsion bombarded by protons with an energy of hundreds of GeV from accelerator or from cosmic rays and these observations also lead to discovery of new particles.

This paper reports the observation of some interesting events produced in interactions of 200 GeV/c with emulsion nuclei. At this energy some events have been observed where there is no shower or grey tracks. These are the events of a new form of high energy interaction unknown so far, where pions have not been produced at all. It is generally believed that every hadron of sufficient high energy when traversing a massive atomic nucleus at small impact parameter creates multiple secondary particles, mainly multiple pions. The present experimental obser-

* Paper contributed to XX International Conference on High Energy Physics, 1980 Wisconsin, U.S.A.

vations disapprove this belief. The events are discovered in which high energy protons (200 GeV/c) while traversing through nuclear emulsion causes no pion production.

This investigation was done on emulsion exposed to 200 GeV/c proton beam at Fermi National Accelerator Laboratory Batavia. The flux of the proton beam was in the order of 10^5 proton per cm^2 . The scanning of the plates was performed on a Leitz-Wetzlar microscope provided with a Brower travelling stage. The plates scanned using oil immersion 100 x objective in conjunction with 16.8 x ocular.

Table 1

Event No.	Type	Nature of tracks	Spatial emission angles in degree
1	5 + 4 + Op	Black	88.653
		Black	47.183
		Black	91.183
		Black	146.410
		Black	94.943
		Grey	141.601
		Grey	168.091
		Grey	666.870
		Grey	124.511
2	4 + 5 + Op	Black	90.094
		Black	71.438
		Black	154.443
		Black	111.785
		Grey	48.295
		Grey	56.907
		Grey	28.639
		Grey	66.367
		Grey	136.405
3	14 + 3 + Op	Black	139.527
		Black	159.226
		Black	112.314
		Black	97.158
		Black	48.837
		Black	89.405
		Black	52.929
		Black	48.969
		Black	51.161
		Black	34.932
		Black	39.822
		Black	95.358
		Black	164.373
		Black	150.859
		Grey	63.534
		Grey	69.091
Grey	52.881		
4	4 + 0 + Op	Black	41.05
		Black	115.28
		Black	119.07
		Black	139.00

Scanning was done from the area close to the entrance edge of the plates. To avoid the contamination by secondaries only those stars due to the entrance proton beam making an angle $< 1^\circ$ from the original proton beam direction were taken. Each of the events were observed with utmost care under high magnification for distance greater than 1000 micron downstream from the vertex for any neutral particle decay or any interaction. Altogether 300 interactions were observed. The scanning efficiency for observing charged particles or for neutral particle is almost about 100%.

According to the traditional emulsion terminology the tracks associated with each one of the interaction are classified into the following types:

- (a) SHOWER TRACKS (n_s) for which $b^* < 1.4$, where b^* is the normalized blob density.
- (b) GREY TRACKS (n_g) for which $b^* \geq 1.4$ and $g^* \leq 6$, where g^* is the normalized grain density.
- (c) BLACK TRACKS (n_b) for which $g^* > 6$.

Altogether four unusual and interesting events were observed.

Three events (5 + 4 + Op, 4 + 5 + Op, 14 + 3 + Op) were found devoid of any shower tracks and one event (4 + 0 + Op) was found devoid of any shower or grey track.

As mentioned earlier proper scanning was done to ensure that there was no down stream materialization of a gamma from a neutral pion. (Searching volume: radius $> 10^{-4}$ m and length > 2 cms). It was further noted that no other primary or secondary interactions was observed in the vicinity of these events. Moreover from the nature of the interaction it can be said that all these events are not due to peripheral charge exchange collisions. Angular measurements were performed on the black and grey tracks.

We have also observed these types of events at 300 GeV/c proton-emulsion interactions¹⁾. Similar high energy hadronic collision without pion creation was observed by Strugalski²⁾ in bubble chamber (Pion-xenon nuclei collision events). It is interesting to note that in all cases these types of events constitute $\sim 1\%$ of the total sample. Although some interesting explanation has been given by Strugalski to account for these events, more detailed study is required for arriving at some definite conclusion. Nevertheless, it is very interesting to observe these type of events because it may open up new possibilities for the investigation of the hadron structure. Further work are in progress.

References

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- 2) Z. Strugalski, JINR EI — 12522, 1979.

RASPRŠENJE HADRONA NA JEZGRI NA 200 GeV/c BEZ STVARANJA
PIONA

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UDK 539.12

Originalni znanstveni rad

Pri interakcijama protona sa jezgrama emulzije opaženi su sudari bez stvaranja piona. To bi mogla biti indicacija za novi tip međudjelovanja hadrona sa jezgrama u kojim nema višestruke produkcije piona.