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So far, it seems, there has not been observed direct evidence of antiproton production in (πN) interaction. We have found some events of antiproton production by negative pions on nucleons. In this note two of such events are described.

The experiment is being performed at the JINR synchrophasotron by means of propane bubble chamber/1/ placed in the steady magnetic field of 13.700 gauss.

Fig. 1 shows an event in which the primary negative pion of an energy of about 7 BeV gives rise to a four-prong star at the point O. The prong α is indentified as an antiproton. From the point 0 after the flight over 2.3 cm the prong α suffers a scattering approximately 5° and further travels a distance of about 3.3 cm. Then it stops at the point 0 where it annihilates, very likely, with a proton, and produces, besides neutral particles, two charged ones f and g.

The momentum of f is 138 $\pm$ 6 MeV/c, and that of g is 170 $\pm$ 12 MeV/c. The angle between f^- and g^+ is 126° $\pm$ 1°.

It should be emphasized that the star at 0 is due to no other process but annihilation, for the following reasons.

We consider possible reactions:

1. $K^- + p \rightarrow \Lambda^0 + \pi^+ + \pi^-$ (for free and bound p).
2. $K^- \rightarrow \pi^- + \pi^0 + \pi^0$
3. $K^- \rightarrow \pi^- + \pi^0$
4. $p + \tilde{p} \rightarrow \pi^+ + \pi^- + (n\pi^0)$

1. Positive and negative pions /fg/ in reaction (1) cannot be produced because of lack of energy. The conclusion remains true if K^- meson is assumed to interact in flight since the angle between α and f in $0'$ is larger than 90° whereas the angle between α and g is close to 90°.

2. Reaction (2) is forbidden also because of lack of energy even if it is assumed that one of the γ-quanta from π^0-meson decay gives rise to a positron at once, and the electron fails to receive any energy at all.

3. If we assume that reaction (3) occurs, then negative pions must have a momentum of 205 MeV/c. The measurements, however, yield 138 $\pm$ 6 MeV/c. Moreover, the positive particle g must be a positron and possess a total γ-quantum momentum of the order of 100 MeV/c. But the measurement gives 170 $\pm$ 12 MeV/c.

4. There remains the last possibility: g and f are π^+ and π^- mesons produced in association with other neutral particles in the annihilation process.

The second event of slow antiproton generation by a 8 BeV/c negative pion is shown in Fig. 2. π^--meson interacts with a carbon nucleus and gives rise to a three-prong star at the point

0 . The particle α which has a negative charge travels a distance of 12.9 cm in the chamber and comes to rest at the point 0′ where it annihilates with a nucleon in the carbon nucleus forming a star consisting of seven prongs, three of which have the minimum ionization.

The track b , one of the three prongs with the minimum ionization, is a positive particle and has a momentum of 566 ± 34 MeV/c. Therefore, it is considered a π^{+}-meson.

This confirms that the particle α is an antiproton (or less probable $\tilde{\Sigma}^{+}$), since neither of the other known particles when they come to rest, can produce a $\tilde{\pi}$-meson of such a large momentum. The momenta of other prongs of this star cannot be measured reliably accurately as they are very short and all ascape the illuminated region of the chamber.

The mechanism of the production of these two antiprotons as well as some events of the generation of the antiprotons with the momenta greater than 1.5 BeV/c will be described in more detail in another paper.

An estimate of the cross section for antiproton production by negative pions with an energy of 7–8 BeV/c in propane yields a lowest value of $10^{-30}cm^{2}$ per nucleon.

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References

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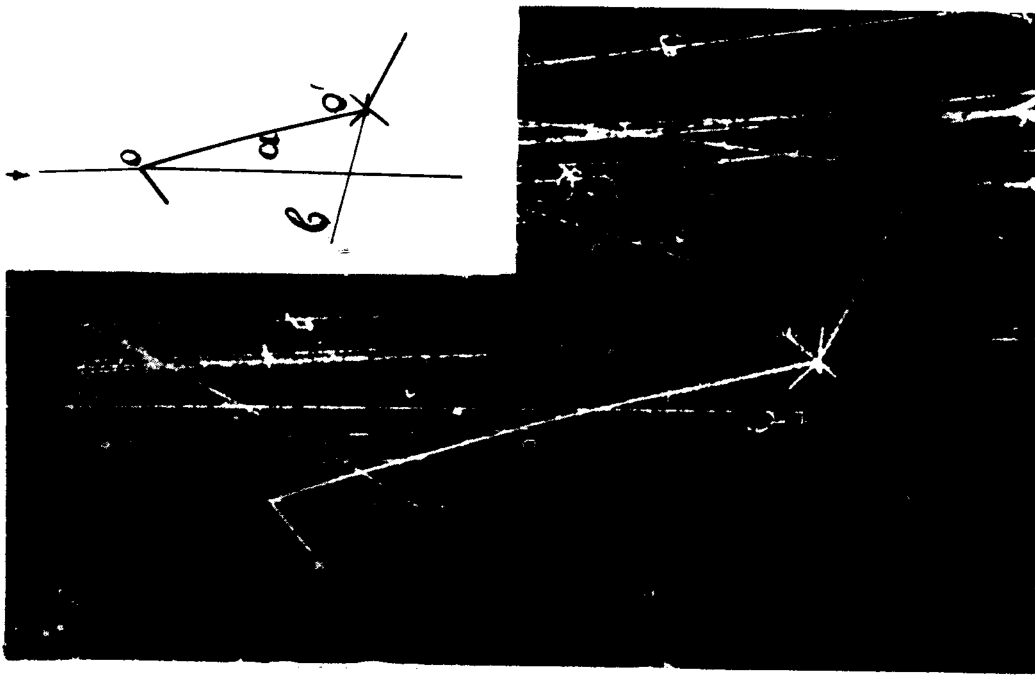

Fig. 2.

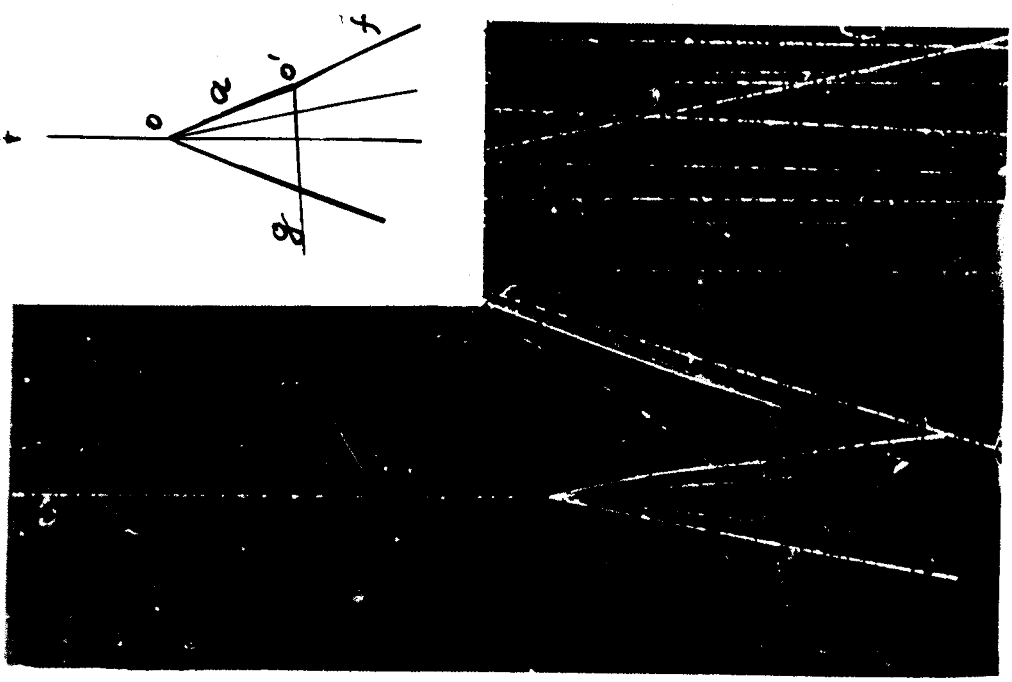

Fig. 1.