X-61

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ON PHOTOEMULSION EXPERIMENTS WITH A HYDROGEN-JET TARGET

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X-62

The hydrogen-jet target that crosses the orbit of high-energy protons at the end of their acceleration cycle enables to perform a number of precision experiments among them experiments by the photoemulsion method.

The hydrogen-jet in the form of drops or crystals with a density per unit areaper perpendicular to the proton beam $\sim 10^{-7}$ - 10^{-4} gr/cm^2 enables to have the multiplicity of protons passing through it up to 10^6 which leads to nuclear interactions of most of the accelerated protons. In [1] various designs of such a target are proposed.

1. The condensation of gaseous hydrogen by a scheme analogous to the ones used in [2] and [3].

2.The feeding of a liquid hydrogen jet with the aid of a value device. If the jet is passed through an intermediate helium cooled chamber before it enters the accelerator, suppercooled drops can be obtained or crystals can be produced.

3.Simultaneously, at the end of the proton acceleration cycle, a coating of snow that crosses the proton orbit while falling is taken off of the solid hydrogen prism.

The possible influence of the hydrogen jet, for example, on the operation of the High Energy Laboratory 10BeV proton synchrotron of the Joint Institute for Nuclear Research is considered [1].

It was shown that even at the highest density of hydrogen 10^{-4} gr/cm^2 in the jet it doesn't essentially affect upon the main parameters of which the operation of the accelerators depends on : worsening of vacuum, the ionization drag and the forced radial and vertical oscillations owing to a multiple proton scattering. This enables a multiple 10^6 times passing of protons through the jet, i.e. carry out in a small volume the P-P interactions of the main part of initial protons. For experiments in which the absolute values of cross sections are to be determined it is advisable to perform monitoring, measuring, for example, the proton yield from the elastic scattering at a 2 ÷ 4° l.s. angle range where the differential cross sections are large and well-known . The secondary particles will fly out, practically, without interactions and scattering. The hydrogen density 10^{-5} gr/cm^2 can be, for example, created by 130 μ jet. If the emulsions are placed in a way that the recorded particle flux is collinear to the jet, we obtain a target near to a point one. This creates conditions for a number of experiments on short distances from the target with a high angular resolution peculiar for photoemulsions. We explain a few examples [4].

Elastic P-P Scattering

In the investigation of elastic p-p scattering analogous to the experiment with a thin hydrogeneous film [5] it is possible to advance to still smaller angles of scattering, conserving the possibility to use the angle range relation. The jet density 10^{-5} gr/cm^2 is enough for the experiment, the number of elastic p-p scatterings being $\sim$ 10 times more than in [5].

The Investigation of Isobar Excitation in p-p Collisions

In [6] it was shown that the kinematic conditions enable to separate the process of isobaric excitation of the protons in p-p collisions. from elastic scattering. This experiment can be performed more effectively as edited in [5] using a hydrogen target.

Experiments with a Deuterium Target

A deuterium jet can be produced easier as the liquefying point is 3° higher than in hydrogen.

The investigation of elastic p-d scattering in the small angle region is interesting, because there is no Coulomb term and the comparison with p-p scattering enables to find out what role the spin plays. The investigation of elastic scattering with a large ($\sim$ 1 Gev/c) momentum transfer [7]. If the protons have a 10 GeV energy, summary flow 10^{13}, deuterium jet density 10^{-5} gr/cm^2 $\frac{d\sigma}{d\omega} = 10^{-30}$ sm^2/ster , onto 1 cm^2 of emulsion at a 3 m distance from the target 10^3 deuterons will fall which have a 72^o angle with the direction of protons. The proton range in emulsion is 9.5 cm and the proton quasi-elastic and inelastic collision range $\leq$ 9 cm. In the principle role of the investigation theory for two-particle processes was stressed, for example, elastic charge exchange:

As a result of the deuteron decay in this process there should be an escape of two protons with a small aperture angle and n near energy. It will be possible to observe and distinguish this process in the photoemulsion, for instance, from the electron-positron pairs.

The Investigation of P K Λ γ Spectra in p-p and p-D Collisions

The hydrogen and deuterium target in good geometry conditions and at an intensive generation of particles enables to carry out cross section investigations of secondary particle energetic and angular spectra that are not distorted by the following interactions. Let, for instance, the total proton flux at 10 GeV be 10^{13}, the hydrogen jet density 10^5 gr/cm^2. 1)If the generation K^+ cross section $\sigma \sim 0.5\ 10^{-27}$ cm^2 and half of K^+ fly out in a cone with an aperture angle θ_K equal to : $\frac{m_\pi}{m_K} \cdot \theta_\pi$ (an equality of transverse impulses is assumed and , analogous angle for π , and m_π and m_K -mass). In this case, 10 meters from the target taking account of the decay, $\sim 10^4$ K^+ will drop onto 1 cm^2.

2) Experiments are possible in hyperon beams, for example, if the cross section of the generation Λ: $\sigma \sim 0{,}5\ 10^{-27} cm^2$, $\langle P_\perp \rangle \simeq 0{,}5$ GeV/c, in 1 cm^3 of emulsion placed 1 m from the target ~ 10 Λ at 7 GeV will decay.

3) The investigation of γ -quantum generation in direct p-p interactions is possible. If $\frac{d\sigma}{d\omega} = 10^{-30}$ cm^2/stera , 20 electron-positron pairs will be produced in 1 cm^3 of emulsion.

X-66

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