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ON NEW STRANGE PARTICLES

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Gell-Mann's/1/ elementary particle systematics implies the possibility of existence of yet unknown barions and mesons, in particular, of the particle Z^+ ($T = 0$, $S = +1$, barion number $N = 1$) and D^+ ($T = 0$, $S = 2$, $N = 0$). At present there are serious arguments indicating that the Z^+ barion does not exist. Indeed, if the Z^+ mass is such that it can disintegrate according to the scheme $Z^+ \to N + \pi$, it would have been found already without difficulties, and if its mass is close to the nucleon mass, it would have been produced together with Λ -particles in the reaction $p + n \to Z^+ + \Lambda$, which is in contradiction with the experiment/2/.

At the Kiev conference on high-energy physics Wang Kan-chang and collaborators/3/ have reported an interesting event of pion interaction in a bubble chamber. The event can be interpreted by assuming that there exists a new particle with a mass of 750 MeV, disintegrating according to the scheme

$$D^+ \to K + \pi \begin{cases} K^0 + \pi^+ \\ K^+ + \pi^0 \end{cases}$$

If we identify this particle with the positive meson D^+ having a strangeness $+2$ and the isospin equal to zero, the mean life of such a hypothetical D-particle is expected to be 10^{-10} sec. Indeed, the isospin of the final system ($K\pi$) can be ½ or 3/2 and consequently the selection rule $\Delta T = ½$ cannot slow down the decay as it does in the case of K^+ decay.

Below it is assumed that the mean life of the hypothetical D-particle does not exceed several units of 10^{-10}sec. It is then impossible to obtain collimated beams of these particles in an ordinary way, and it becomes desirable to search for a new method of detecting this particle. A characteristics of the new particle, distinguishing it from all the well-known particles, is its decay mode with the emission of K-mesons. This peculiarity can be used in the following way. Imagine a target which is bombarded by high energy particles. Near the target the decay of D-particles in vacuum will produce K-mesons which can be registered after their passage through a collimator arranged in such a way that it does not view the target. Such a method reminds the experiments of the Garvin type in which strange particles were investigated by registering photons emitted in vacuum by neutral pions produced in the decay of strange particles. (See, for instance,/2/).

Roughly speaking, the ratio of the intensities of K and π mesons from the target $(K/\pi)_{target}$ and from the vacuum near the target $(K/\pi)_{vac}$, correspond respectively to the fraction of the interactions in the target which lead to production of strange particles and to the relative probability of D- and usual strange particle production. It is clear that a negligible probability of D-particle production will be characterized by the inequality $(K/\pi)_{vac} \ll (K/\pi)_{target}$.

If for example, the produced D-mesons are assumed to be 10^{-4} of the number of interactions caused in the target, say, by 10 BeV protons and if the produced K-mesons are $\sim 10^{-2}$ of this number, then 1%

of the whole K-meson beam is of D-meson origin. At a distance of several meters from the target the intensity of K-mesons having pure D nature, i.e. the intensity of K-mesons obtained under such conditions of collimation that the detector does not see the target, will be $\sim 100\alpha$ times less that the intensity of K-mesons from the target. The factor $\alpha \gtrsim 10$ takes into account the intensity loss caused by the fact that the K-mesons from D-particles are emitted at some distance from the target.

Let us consider first the emission of K^o -mesons from D- particles. As is known, half of the neutral K-mesons (K^o_2) has a mean life of $\sim 10^{-7}$ sec/4/ and can be detected at distances of several meters from the synchrophasotron target under conditions of good collimation insuring that the target is not viewed by the detector. Clearly, the detector shielding from the target must be massive. Unfortunately, the detecting efficiency of K^o- mesons is small . Nevertheless with high intensity synchrophasotrons ($10^{10} - 10^{11}$ prt/pul) the ^{2} experiment can be carried out if K^o_2 - mesons are registered with either large decay cloud and bubble chambers or with an emulsion chamber. Since in the considered experiment the target is not seen by the detector, the main background is caused by π^0 and neutrons emitted in the strange particle decay.

As far as photoplates are concerned it is convenient to to use the ability of K^o_2 -mesons in producing hyper-fragments/5/. Whatever the method employed may be, it is necessary to measure the ratios $(K^o_2/\pi^o)_{target}$ and $(K^o_2/\pi^o)_{vac.}$

The detection of K^+ -mesons from D^+ -particles ($D^+ \to K^+ + \pi^0$) disintegrating near the target may be accomplished with photoemulsion techniques or with electronic methods. In this case also the comparison of (K^+/π^+) target and $(K^+/\pi^+)_{vac.}$ should serve as a test for the D-particle existence.

It is necessary to take into account that a K-meson from the decay of a D-particle with a mass ~ 750 MeV can be emitted at large angles with respect to the direction of the parent D-particle only when the energy of the latter is small. This makes it difficult to ensure the condition that the target should not be viewed by the K-meson detector for D- particles having an energy, say, more that 100 MeV (the maximum angle at which particles can be emitted is about 43°, when $E_D = 100$ MeV and rises quickly when E_D decreases). It should be noted, however, that the emission of slow mesons at large angles in proton collision with complex nuclei should occur comparatively often. This is brought about by analogy with the experiment (5), when 6 BeV protons produced K^o_2 -mesons at 90° with an average energy of only 50 MeV. It should be pointed out also that favourable conditions for the experiment are obtained if the K-particle collimator looks at a region near the target lying above or below the target. This decreases the background from the accelerator walls and gives an opportunity to observe K-particles emitted at angles of $\gtrsim 45°$ to the D-particle direction.

In conclusion it is worth noting that D^+ -particles (if D^+ N forces are attractive) should form

'D -nuclei', i.e. systems analogous to hyperfragments in which a D^+-particle may exist in nuclear matter before its (quasifree) decay. This is due to the fact that even in the presence of several nucleons there is no possibility for D^+-particles to undergo strong interaction processes.

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