spectra of the created Λ hyperons can be reconciled by making more detailed assumptions concerning the cross section of the πK interaction. This is due to the fact that the cross section $\sigma_t^{K\pi}$ does not enter in the expression for $d\sigma^{(2)}/dp$ under the integral sign (see the analogous formula (4) in [4]). Since the contribution of the cross section $\sigma_\Lambda^{(2)}$ is the basic one, the summary momentum spectrum of the Λ hyperons turns out to be quite sensitive to the energy dependence of the πK-interaction cross section.

In order for the theoretical spectrum to have a second maximum that agrees with experiment, it is necessary to assume that there is resonant πK interaction in the energy interval 0.6—1.2 BeV. This corresponds precisely to the resonances of M and K observed in many investigations 2) near 0.73 and 0.89 BeV. If $\sigma_{res}^{K\pi}/\sigma_t^{K\pi} \sim 10-20$, then theory and experiment are in good agreement.

Estimates of the contribution of multimeson intermediate states, carried out in the resonance approximation (more on this approximation in [9]), have shown that within the accuracy limits of modern experimental data it is possible to neglect the contribution of multi-meson states.

The "double hump" spectrum of Σ hyperons is similarly explained.

The second maximum in the recoil-nucleon spectrum can be attributed to resonant ππ interaction. In this case the predominant collisions at high energies are πN collisions, described by means of a diagram in which the pions are produced only in the upper node. This deduction agrees with the results which we obtained previously [4] by a somewhat different method.

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1)Institute of Nuclear Physics in Bucharest.

2)If the beam of initial negative pions is sufficiently monoenergetic, it is possible to determine in this manner the energy dependence of $\sigma_t^{\pi K}$ in the region of both resonances.

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CONCERNING ONE REACTION WITH COLLIDING ELECTRON BEAMS

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EXPERIMENTS with colliding electron beams have recently been widely discussed in the literature. Several experiments are already being prepared in a number of laboratories. The colliding beam technique also uncovers new experimental possibilities for μ-meson physics. Thus, it has been proposed[1] to use colliding electron and positron beams to investigate μ-meson pair production in electron and the positron annihilation: $e^+ + e^- \rightarrow \mu^+ + \mu^-$. This process can be used to determine the form factor of the μ meson, the radiative corrections, and to solve other problems concerning the μ meson.

However, it is technically much more difficult to obtain colliding electron-positron beams than electron-electron beams, and although the cross section for μ-meson pair production in electron scattering on electrons (σ_{sc}) at relatively low energies is much smaller than the cross section for the μ pair production in electron-positron annihilation (σ_{an}), the latter decreases with increasing energy while σ_{sc} increases. However, σ_{sc} increases more slowly for large angles ($\sim \pi/2$) (see below) and also at high energies, where σ_{sc} is of the order of σ_{an}. In the range of large angles ($\sim \pi/2$), which is most interesting for the experiments with colliding beams, we have nevertheless $\sigma_{an} > \sigma_{sc}$. With increasing energy, the range of angles for which $\sigma_{an} > \sigma_{sc}$ decreases. It is therefore interesting to determine quantitatively for which energies and at what angles the cross section for μ-meson pair production in electron-electron beams becomes greater than the cross section for μ-meson pair production in electron-positron beams. If such energies and angles were experimentally attainable, we would have a convenient method for an experiment with electron-electron beams.

The estimate given below has been made both for the integral and differential cross sections, using the Weizsäcker-Williams method. For the integral cross section for the $e^- + e^+ \rightarrow e^- + e^+ + \mu^+ + \mu^-$ reaction we have, in the c.m.s.,

$$\sigma_{sc} \approx \frac{28}{27}\frac{r_0^2}{\pi}\alpha^2\frac{m^2}{\mu^2}\left(\ln\frac{E}{m}\right)^3,$$

where $\hbar = c = 1$, m is the electron mass, μ is the μ-meson mass, r_0 is the classical electron radius, $\alpha = 1/137$, and E is the energy of the incident electron in the rest system of the other electron ($E = 2E_{cms}^2/m$). The differential cross section at small angles is

$$\frac{d\sigma_{sc}}{d\Omega} \approx \frac{\alpha^2 r_0^2}{12\pi^2}\frac{m^2}{\mu^2}\left(\ln\frac{2E_{cms}^2}{\mu^2}\right)^4, \quad \theta \ll \mu / E_{cms}$$

where θ is the angle of the μ meson in the c.m.s.

The range of the angles under consideration decreases with the energy. However, in the experiments using colliding beams, small angles are for technical reasons completely uninteresting, and for large angles we obtain

$$\frac{d\sigma_{sc}}{d\Omega} \approx \frac{2\alpha^2 r_0^2}{\pi^2}\frac{m^2}{\mu^2}\left[A(\beta) + \frac{B(\beta)}{1-\varphi^2}\right];$$

$$\frac{\pi}{2} - \theta \equiv \varphi \ll 1, \qquad \beta = \frac{2E_{cms}^2}{\mu^2},$$

$$A(\beta) = \tfrac{1}{16}\ln^3\beta + \tfrac{3}{8}\ln 2\ln^2\beta - \tfrac{15}{16}\ln^2 2\ln\beta + \tfrac{1}{4}\ln^3 2,$$

$$B(\beta) = \tfrac{1}{15}\ln^3\beta + (0.4\ln 2 - 0.6)\ln^2\beta + (1.2\ln 2 - \ln^2 2)\ln\beta + \tfrac{4}{15}\ln^3 2 - 0.6\ln^2 2.$$

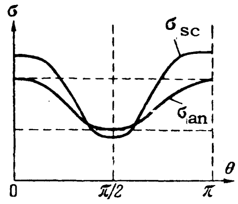
In the limit of very high energies ($\ln\beta \gtrsim 6$) we obtain a simpler expression

$$\frac{d\sigma_{sc}}{d\Omega} \approx \frac{2\alpha^2 r_0^2}{\pi^2}\frac{m^2}{\mu^2}\left(\ln\frac{2E_{cms}^2}{\mu^2}\right)^3\left[\frac{1}{16} + \frac{1}{15}\frac{1}{1-\varphi^2}\right].$$

Let us compare this with the differential cross section for the μ-meson pair production in electron-positron annihilation, which, as is well known, is given by the equation[1]

$$\frac{d\sigma_{an}}{d\Omega} = \frac{r_0^2 m^2}{16}\frac{\sqrt{E_{cms}^2-\mu^2}}{E_{cms}^3}\left(1 + \frac{\mu^2}{E_{cms}^2} + \frac{E_{cms}^2-\mu^2}{E_{cms}^2}\cos^2\theta\right).$$

From the comparison it follows in particular that, for an electron energy $E_{cms} \sim 1.5-2$ BeV, σ_{sc} is greater than the annihilation cross section for practically all angles. The change from $\sigma_{an} > \sigma_{sc}$ to $\sigma_{sc} > \sigma_{an}$ occurs approximately at ~ 1.2 BeV in the c.m.s., and even at energies only a little lower than the critical value there is a large range of angles near $\theta = \pi/2$ in which $\sigma_{an} > \sigma_{sc}$, as can be seen from the expression for the cross section and the figure.



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SPIN ECHO IN A LOCAL FIELD

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IN conventional experiments on spin echo the signal is due to the reversible merging of individual magnetic moments due to inhomogeneities in the external magnetic field. It is not possible to make use of the inhomogeneities of the internal local field due to neighboring nuclei, because the second (180°) pulse simultaneously changes the direction of the nuclear magnetization as well as of the local field.[1] Such an echo has been observed[2] in ferromagnetic substances, in which the local field is due to electrons.

We have observed spin echo of F^{19} nuclei in the inhomogeneous field of the paramagnetic ions Gd^{3+}, present in the form of an impurity with concentration $\sim 0.01\%$ in the single-crystal CaF_2 under study. The effect was absent at room and at liquid nitrogen temperatures and was easily observable at 4.2°K and below.