In such a situation, the material of the sun, where the electrons can apparently be regarded as free, might absorb the neutrinos, whereas under laboratory conditions the effect would be difficult to observe.

If $\Delta\varepsilon$ is insufficient for ionization but exceeds ~ 1 eV, then one could try to observe the appearance of bulk conductivity in semiconductors, or the fluorescence of certain materials. In a metal, the fraction of electrons capable of taking on an energy $\Delta\varepsilon < E_F$ is approximately $(1/2Z)(\Delta\varepsilon/E_F)$, where E_F is the Fermi energy. In a $\tilde{\nu}_e$ flux of 10^{13} $cm^{-2}sec^{-1}$ in a reactor, about $10^6(1/Z)(1/E_F)$ events per second should occur in 1 gram of metal.

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SEPARATION OF ULTRAHIGH ENERGY PARTICLES BY THE TRANSITION-RADIATION METHOD

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The formation of sufficiently intense transition radiation in porous materials is not only of theoretical but also of great practical interest [1 - 3].

There is no doubt at present that transition-radiation detectors in the x-ray band will find extensive use for the identification of ultrahigh-energy particles both in cosmic rays and in large accelerators.

We report here the results of a study of the transition radiation produced in foamed plastic of density 0.04 g/cm^3 at electron energies 1 - 4.5 GeV. We show that the use of the streamer-chamber method with a foamed-plastic emitter permits high-reliability particle separation in the region $\gamma = E/mc^2 > 10^3$.

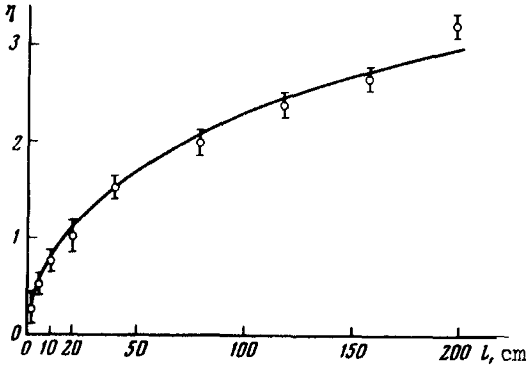

Fig. 1. Plot of η vs. the length of a foamed-plastic emitter.

The measurements were performed with a previously-described setup [1, 2], modified by installing between the emitter and the spark chamber a small magnet to deflect the electron trajectory upwards by 4 cm. By the same token, we were able to observe in the chamber the track of the primary electron alongside the photoelectrons. This facilitated the data reduction, but measurements without the deflecting magnet have shown that in this case the reliability of the separation of the photoelectrons from the delta-electrons is high. The streamer chamber was filled with a mixture of 13% Xe and 87% Ne.

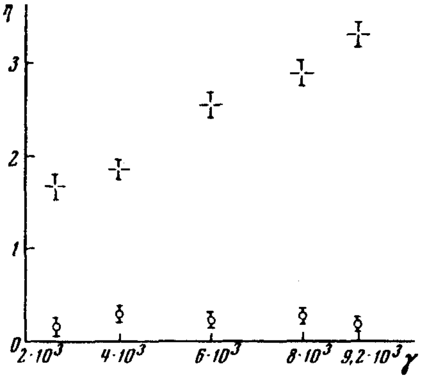

Fig. 2

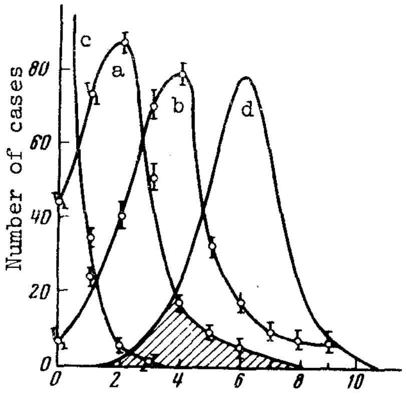

Fig. 3

Fig. 2. Plot of η vs. the electron energy.

Fig. 3. Distribution of the number of photoelectrons at different values of γ.

Figure 1 shows the measured average number of photoelectrons per primary electron, η, as a function of the thickness ℓ of the foamed plastic. The electron energy was 3.0 GeV. It is seen from the figure that at small thicknesses η increases rapidly with increasing emitter thickness, followed by a slower growth.

From this curve we can determine the true number of photons produced in an emitter of length ℓ. If we neglect the photon absorption in foamed plastic $\Delta\ell = 1$ cm thick, i.e., if we assume that at $\Delta\ell = 1$ the number k of photons registered by us is equal to the total number of produced photons (with allowance for their registration efficiency), then ℓk photons are produced per electron in an emitter ℓ cm long. Since the photon registration efficiency in our streamer chamber is $\sim$50%, and $k = 0.3$ according to Fig. 1, we obtain $N = 60$ photons for an emitter of length $\ell = 100$ cm.

The presented experimental data also permit a rough estimate of the average energy of the transition-radiation photons produced in the foamed plastic.

To this end, we find the average coefficient of absorption of the transition-radiation quanta. This quantity can be obtained by equating the experimentally determined number of transition quanta to the number given by the computation formula. In the latter, this number is expressed in terms of the number of quanta emitted per unit length, the total thickness, the density of the material, and the average quantum-absorption coefficient. As a result we obtain the approximate value of this coefficient. We can therefore assume that the maximum of the spectrum of the transition radiation emitted by the foamed plastic occurs approximately at 8 keV.

Figure 2 shows a plot of η against the Lorentz factor of the electrons $\gamma = E/cm^2$ for a foamed-plastic emitter 16 cm long (crosses). The figure shows also the results of measurements in which the foamed plastic was replaced by a solid polystyrene emitter of equivalent thickness (circles).

It is seen from Fig. 2 that the value of η for foamed plastic increases linearly with the energy. For the dense material, on the other hand, the value of η is always smaller than for foamed plastic, and is independent of the energy.

Figure 3 shows the experimental distributions of the number of photoelectrons for foamed plastic 160 cm thick at electron energies 1.3 GeV (curve a) and 4.5 GeV (curve b). The abscissas in this figure represent the number of photoelectrons accompanying individual primary electrons, and the ordinates represent the number of events with a specified number of photoelectrons.

Figure 3 shows also the analogous distribution (curve c) for a dense emitter (organic glass) 6 cm thick.

We consider now the feasibility of separating protons and pions by the described method. Since the proton energy at a Lorentz factor $\gamma = 2.6 \times 10^3$ is 2.4×10^3 GeV, we can ascribe distribution a of Fig. 3 to protons having this energy. When pions of energy 2.4×10^3 GeV pass through the apparatus we obtain, according to Fig. 2, a value $\eta = 6$ for the average number of photoelectrons. Figure 3 (curve d) shows the calculated distribution of the number of electrons for pions of energy $E = 2.4 \times 10^3$ GeV. The separability of the protons and pions at 2.4×10^3 GeV is determined by the area of the overlap of distributions a and d. This area is shown shaded in the figure, and amounts to 14%.

Thus, the results enable us to separate protons from pions, at energies higher than 10^3 GeV, with 86% efficiency. If two similar installations are connected in tandem, the separation efficiency will be 98%.

The average efficiency for the registration of a single photon in the energy interval 10 - 80 keV was $W_1 \sim 0.5$ in the present study. Consequently, the average efficiency of simultaneous registration of photons, $W_N = (0.5)^N$, decreases very rapidly with increasing N, as a result of which the slope of the plot of the number of photoelectrons against the particle energy also decreases.

Obviously, when W_1 approaches unity, the maxima of the distributions in Fig. 3 will move apart and become narrower.

By creating, in addition, conditions under which the majority of the photons produced in the emitter reaches the streamer chamber, we can obtain a sufficiently high separability factor at higher energies, too.

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DEPOLARIZATION OF NEGATIVE MUONS IN HELIUM AND NEON

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The residual polarization of negative muons in different media is 0 - 20% in the initial polarization, and depends on the nuclear spin, on the chemical