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 compound containing the investigated nucleus, as well as on the parameters of the medium [1, 2]. In liquefied noble gases one observes complete polarization of the muons, in contradiction to the simple cascade model of depolarization for nuclei with zero spin [3, 4]. This has induced us to measure the residual depolarization in helium and neon in the gaseous state, for in this case a clearer interpretation of the results is possible. The influence of the medium on the depolarization will then be minimal because in the gas phase there are no molecular effects either when the mesic atom is produced (structure of cascade transition) or during its lifetime (absence of chemical interaction).

It is quite simple technically to attain the gas purity needed to be able to neglect the probability of interaction between the mesic atom and the impurity atoms (by circulating the gas through an active absorber).

The experiment was performed in the meson channel of the synchrocyclotron of the Nuclear Problems Laboratory of the Joint Institute for Nuclear Research [5]. The muons stopped in the gas were registered with a controllable gas target developed by us [6]. The target was filled with the gases up to 40 atm pressure (see the table). The procedure guaranteed, when working with a thin target (0.1 g/cm^2), a background of not more than 2% muons stopped in the walls.

Asymmetry parameters measured at the free-muon precession frequency

Target	Magnetic field, Oe	Lifetime λ, μsec	Asymmetry parameter, a	Precession freq.[1] ω, rad/μsec
Ne 40 atNe + 1 atXe	61,2 ± 0,1	1,50 ± 0,01	0,007 ± 0,004	5,23
He 16atHe + 3.5 atXe	61,2 ± 0,1	2,24 ± 0,04	0,013 ± 0,009	5,23
C in gas target	61,2 ± 0,1	2,09 ± 0,06	0,052 ± 0,006	5,23

[1] Corresponds to the free-muon precession frequency.

The polarization was determined by measuring the decay-electron asymmetry parameter at the Larmor precession of the muon spin in a magnetic field. The decay electrons were registered with a 256-channel time analyzer with channel width 50 nsec. In the reduction of the temporal spectrum of the electrons it was assumed that their distribution is given by

$$N(t) = N_0 e^{-\lambda t}[1 + a\cos(\omega t + \phi)] + C,$$

where λ is the muon lifetime in the mesic atom, a is the asymmetry parameter, ω is the precession frequency, ϕ is the phase shift at t = 0, and C is the background of random coincidences. The parameters were determined by least squares. We analyzed the electron spectrum in the interval 1 - 5 msec. The measurements were performed at a magnetic field intensity 61 Oe. The precession period at the free-muon frequency was 1.2 μsec. The measurement results are listed in the table.

The obtained lifetimes in Ne, He, and C agree with the expected values and demonstrate that only decay electrons of the corresponding mesic atoms were registered. The control experiment was performed on carbon with the same gas target. A carbon rod was placed at the center of the target. It follows from the table that, within the limits of experimental error, complete muon depolarization at the precession frequency of the free muon is observed in He and Ne. The asymmetry parameter obtained in the control experiment with carbon had the expected value. Obviously, under the conditions of the performed experiment, the depolarization cannot be ascribed to molecular effect or to chemical interaction of the mesic atom. It is more likely that the complete muon depolarization at the free-muon frequency offers evidence in favor of the paramagnetic depolarization mechanism in noble gases, but direct proof of this mechanism would be the presence of residual polarization at the mesic-atom precession frequency.

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ANOMALOUS SECONDARY EMISSION AT HIGH ENERGIES

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We report here the results of investigations of the anomalous secondary electron emission at high energies, as a function of the film thickness, of the distance between the grid and the film, and of the potential of the drawing grid.

Garwin and Edgecumbe [1] investigated the anomalous secondary electron emission from friable KCl films 25 μ thick and of density 2%, at electron energies 100 - 1000 MeV, at a constant value of collector voltage. The charge was produced by prior bombardment of the film with electrons having an energy ∿10 keV.

We have previously reported [2, 3] controllable secondary electron emission from a friable dielectric to which a voltage is applied with the aid of substrate electrodes and a control grid in contact with the friable film. These investigations have shown that when the grid is in contact with the surface of the friable dielectric, the emission takes place without an additional charge, and acquires a controllable character, i.e., variation of the voltage of the grid on the film surface causes a rapid change of the secondary-emission coefficient.

To compare the character of the processes occurring in the emitters in the case when a grid is placed on the surface of the dielectric film and in the case when the grid is at some distance from the surface, we have investigated the emission characteristics of films with the grid at some distance from the surface, i.e., under the conditions of [1], but at different values of the potential applied to the grid, and without first charging the film with transmitted electrons.