average current duration ~5 msec. The discharge voltage had a nearly rectangular waveform.

This accelerator makes it possible to obtain an ion current on the order of 1 kA with particle energy ~3 kV. Inasmuch as the principal problem of the investigation at this stage was to ascertain the main physical features of the accelerator operation, the measurements were made essentially not in a mode in which the instrument operates at its extremal parameters with respect to the current and particle energy, but in some intermediate regime, in which the discharge voltage was 2 kV, the discharge current 0.78 kA, the hydrogen input was $\dot{m} = 7 \times 10^{-3}$ g/sec, and the characteristic value of the magnetic field in the channel was 450 Oe.

The energy of the ions leaving the accelerator was measured by two methods, with an electrostatic ion analyzer [3] and with a multielectrode probe. The ion analyzer was mounted on the rear flange of the vacuum chamber at a distance of approximately 2.5 meters from the accelerator cutoff. The obtained particle spectrum, which is shown in Fig. 2, leads to the conclusion that the ion flux contains besides the main group of ions, which have an energy close to the discharge voltage, a considerable number of particles of lower energy, and this may be connected with the existence of an ionization zone which is "smeared" over the volume of the accelerator. The average ion energy in this operating mode, calculated from the obtained curve, is 1.3 keV. With increasing discharge voltage, the average ion energy increases accordingly.

The results obtained in measurements with a multielectrode probe mounted 15 cm from the cutoff of the instrument, opposite the center of the accelerator gap, agrees sufficiently well with the results presented above. The same probe was used to measure the ion current from the instrument. The ion-current radial distribution is shown in Fig. 3. The current of the ions, summed over the entire cross section of the flux, is about 70% of the discharge current in the given mode.

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THE POMERANCHUK EFFECT AND MAXIMUM ENERGY OF COSMIC ELECTRONS

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For galactic magnetic fields, $H = (3 - 10) \times 10^{-6}$ Oe [1], the condition for the applicability of the formulas for radiation deceleration [2] of electrons is satisfied up to values

$$\frac{E}{mc^2} = 10^{25} - 10^{26},$$

where E and m are the total energy and mass of the electron.

Inasmuch as the force of deceleration of an ultrarelativistic particle by radiation is proportional to the square of the energy, we find by considering the energy loss due only to this phenomenon that, as shown by Pomeranchuk, the final energy at $E_0 \to \infty$ does not depend on the initial electron energy E_0 after a distance S is covered, and is equal to

$$E_S = \left\{\frac{2}{3}\frac{e^4}{m^4c^8}\int_{S_1}^{S_2} H_\perp^2(S)\,dS\right\}^{-1} = \frac{3}{2}\frac{m^4c^8}{e^4 S\bar{H}_\perp^2} \text{ erg}; \tag{1}$$

Here $\bar{H}_\perp$ is the average field intensity in the galaxy in a direction perpendicular to the particle velocity vector.

Regardless of whether the electrons are accelerated to high energies in some source or are produced as a result of nuclear interactions in interstellar medium, the average distance traversed by the electrons registered at some point of space can be assumed equal to $S = (3 - 5) \times 10^{22}$ cm - the radius of the volume in which the cosmic rays are located [1].

Substituting in (1) the values of $\bar{H}_\perp = H$ and of S, as assumed above, we find that the maximum energy of the cosmic electrons cannot exceed

$$E_S = 1.6 \times 10^{12} \text{ to } 2.8 \times 10^{13} \text{ eV}. \tag{2}$$

If we assume that the field-intensity component perpendicular to the particle velocity vector does not exceed 10^{-6} Oe in the galaxy, then we have for $S \sim 10^{22}$ cm

$$E_S = 8 \times 10^{14} \text{ eV}. \tag{3}$$

We note that in this case no account is taken of all the other possible losses. From [1], however, it follows that when $E \geq 10^{12}$ eV and $H = 10^{-6}$ Oe, the concentrations of the interstellar gas $n = 10^{-2}$ cm^{-3} and the photon energy is $\epsilon = 1$ eV, it is possible to neglect the Compton, radiation, and ionization losses of the electron compared with the losses considered above. The existence in the universe of isotropic radiation with $\epsilon \sim 10^{-4}$ eV [3] makes it impossible to disregard the Compton losses up to electron energies $E \sim 10^{15}$ eV, but this nonetheless does not influence the conclusions drawn above concerning the maximum energy of the electron.

We have assumed that the acceleration of the electron moving in the interstellar medium is not effective, this being apparently the accepted point of view at present (see, however, [4]).

All the arguments presented above apply directly to positrons. Although positrons are subject to annihilation, the probability of this process is negligible under galactic conditions when $E_0 \geq 10^{12}$ eV.

Thus, the maximum energy of the electrons and positrons in the galaxy apparently does not exceed the value given by (3).

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