about 10^{-2} at a pressure of about 10^{-6} mm Hg, which corresponds to particle losses of several percent.

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CHARGE-EXCHANGE CROSS SECTION OF NITROGEN IONS IN GASES

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We have determined the cross sections for capture and loss of electrons by N^{+2}, N^{+3}, and N^{+4} ions in nitrogen, argon, and hydrogen. The ions were accelerated in the 72-centimeter cyclotron to energies between 1.3 and 9.7 Mev. The extracted and focused beam of ions with charge i passed through a 0.1 cm by 1 cm channel 3 cm long and entered into a cylindrical chamber about 40 cm long. The exit channel of the chamber had a cross section 0.3 cm by 1 cm and a length of 3 cm. After passing through the chamber the beam was analyzed in a magnetic field and recorded with proportional counters. The pressure was measured by an ionization manometer, which was calibrated for the different gases with an oil compression manometer. When the gas was admitted into the chamber, the pressure was increased from between 1 and 2×10^{-5} mm Hg (pressure remaining after evacuation) to between 4 and 10×10^{-4} mm Hg. When this was done, the relative numbers n_{i+1} and n_{i-1} of particles with charges $i \pm 1$ formed as a result of loss and capture of a single electron were increased from 3 — 5% to 8 — 15%, respectively. In calculating the cross sections $\sigma_{i,\,i\pm1}$ for loss and capture of an electron, we accounted both for interactions with the gas remaining after evacuation and for the small deviation from linearity in the relation between $n_{i\pm1}$ and the gas pressure. The error in the value of $\sigma_{i,\,i\pm1}$ was between 10 and 20%. We also evaluated the cross section for loss and capture of two electrons ($\sigma_{i,\,i\pm2}$). This cross section was found to be one order of magnitude smaller than the corresponding value of $\sigma_{i,\,i\pm1}$. From the values obtained for $\sigma_{i,\,i\pm1}$ and the experimental data on the equilibrium distribution of nitrogen ions in gases[1] we calculated the cross sections $\sigma_{i\pm1,\,i}$.

The results of the determination of the electron capture and loss cross sections for nitrogen ions in nitrogen are shown in the figures. These same figures give the values obtained previously.[2,3] The value of $\sigma_{i,\,i-1}$ (Fig. 1a for doubly, triply, and quadruply ionized ions varies as $v^{-k} i^m$, where v is the velocity of the ion. It is seen from the figure that the exponent k is close to 5, and that $m \sim 2.5$. When ions pass through argon and hydrogen, the charge dependence is the same as in nitrogen ($m \approx 2.5$), though k is somwhat larger (about 6) only in hydrogen. The absolute magnitude of $\sigma_{i,\,i-1}$ with $v \sim 6 \times 10^8$ cm/sec in argon is about 2 times greater, and in hydrogen is about 4 times less than in nitrogen. The values obtained for the capture cross section of an electron by nitrogen ions in nitrogen and in argon can be written approximately in the form

$$\sigma_{i,\,i-1} = 2\pi a_0^2 (v_0 / v)^5 i^{5/2} Z^{2/3},$$

where a_0 and v_0 are the radius of the first Bohr orbit and the velocity of the electron in the hydrogen atom, and Z is the atomic number of the medium. (The values calculated according to the formula are shown in Fig. 1a by the solid lines.)

A theoretical calculation of the electron capture cross section performed by Nikolaev[2,4] gives a dependence of $\sigma_{i,i-1}$ on v, i and Z which is close to the experimental one. The electron capture cross sections in argon, as calculated by Gluckstern,[5] differs significantly from the experimental values. According to these calculations, the cross sections are proportional to $v^{-3,5}$, and are 1.5 times greater than the experimental values for $v \sim 7 \times 10^8$ cm/sec.

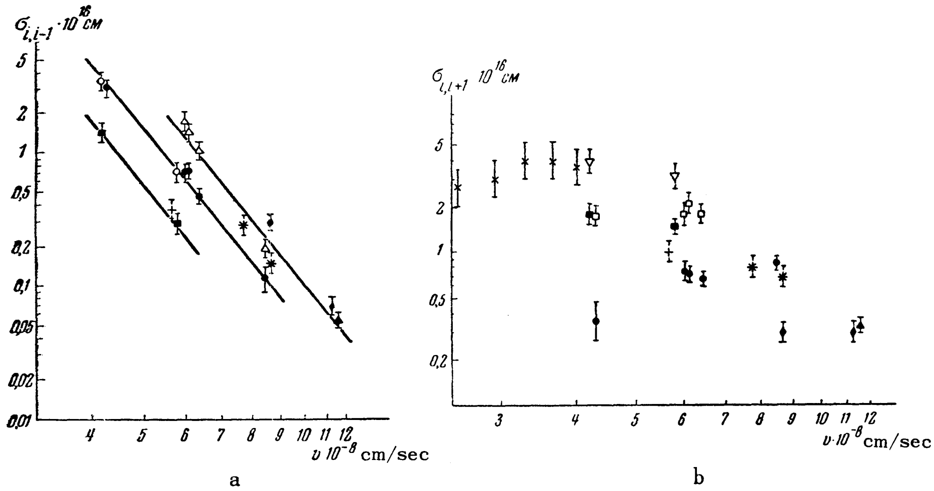

FIG. 1. Cross sections for (a) electron capture and (b) electron loss by nitrogen ions in nitrogen. The blacked-in symbols indicate directly measured values, and the symbols not blacked in indicate those calculated from the data on the equilibrium charge distribution. ∇ — i = 1, ■ — i = 2, ● — i = 3, ▲ — i = 4; +, *, ◆ — results of Nikolaev[2]; × — the values of σ_{12} obtained by Korsunskii et al.[3]

The cross sections $\sigma_{i,\,i+1}$ for electron loss (Fig. 1b) in the velocity region investigated hardly depend on v. This is in agreement with the assumption that $\sigma_{i,\,i+1}$ have maxima close to these velocities, since at high velocities the cross sections for loss should decrease,[2,6] and at velocities less than those of the removal electrons, they should also be small due to the adiabatic character of the collisions. The value of $\sigma_{i,\,i+1}$ in argon is between 2 and 2.5 times greater than, and in hydrogen is between 6 and 10 times less than, the cross section for loss in nitrogen.

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CAPTURE OF POLARIZED μ^--MESONS BY NUCLEI

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As has been shown by Lederman's[1] experiments, μ^--mesons coming from the decay of π^--mesons are polarized to a large degree, and this polarization is maintained to a measurable extent even after the μ^--meson is captured into a Bohr orbit. A theoretical examination of the capture of polarized μ^--mesons by nuclei is of definite interest, since a comparison of the experimental and theoretical results would then make it possible to arrive at certain conclusions on the character of the weak interaction between