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PENETRATION OF NEUTRAL ATOMS INTO A CYLINDRICAL PLASMA PINCH

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The penetration of neutral atoms into a hot highly-ionized plasma exerts an appreciable influence on the processes occurring in them. In fact, we are dealing with an entire set of problems, such as the role of these neutral atoms in the material balance of the plasma and its energy balance, the feasibility of plasma diagnostics by using the spectrum of the neutral charge-exchange atoms, etc.

It is therefore necessary to calculate, for configurations close to the geometries of real installations, the distribution of the plasma concentration over the plasma cross section, the albedo of the plasma relative to the incident atoms, and the energy spectrum of the atoms escaping from the plasma. In this paper we present a Monte Carlo calculation of these quantities for a cylindrical geometry. The results are compared with the approximate analytic solution and with the experimental data obtained in investigations of several regimes of the T-3 installation.

The Monte Carlo calculations were made under the following assumptions: 1) We considered a cylindrical plasma pinch, inside which the ion temperature T_i,

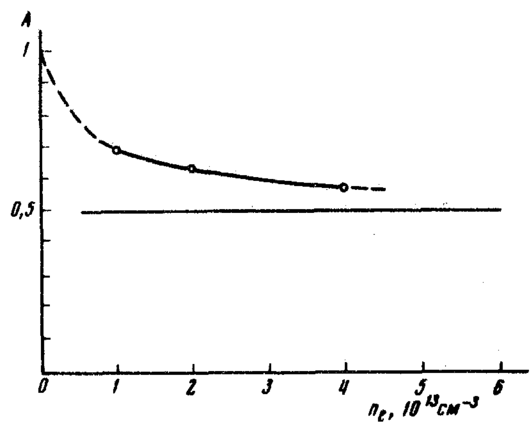

Fig. 1

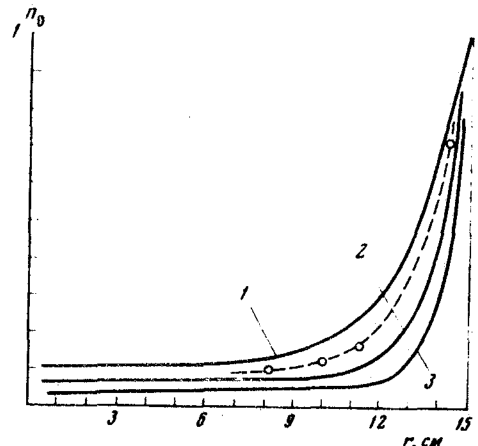

Fig. 2

Fig. 1. Albedo of plasma as a function of n_e; dashed curve - asymptote as $N_e \to \infty$ (cf. [2, 3]).

Fig. 2. Distribution of the concentration of the neutral atoms over the radius of the pinch at different densities. Curves 1, 2, and 3 correspond to $n_i = (1, 2, \text{and } 4) \times 10^{13}$ cm^{-3}. Dashed - experimental curve (T-3 setup, current 60 kA, field H_z = 17 kOe).

the ion concentration n_i, and the quantity $\langle\sigma_i v_e\rangle$ (σ_i - cross section for the ionization of the atom by the electrons) is assumed to be constant. 2) A pure hydrogen plasma is considered. 3) The cross section $\sigma(v_r)$ for the charge exchange of the atom with the proton is a function of the relative velocity v_r in the form $\sigma = A + B \log v_r$, in accord with the experimental and theoretical data given in [1]. 4) An isotropic monenergetic flux of neutral hydrogen atoms of energy 1 eV is incident on the plasma surface.

The purpose of the investigation was to calculate the distribution of the neutral atoms $n_0(\rho)$, the albedo of the plasma, and the energy spectrum of the escaping particles within the framework of this simple model, to ascertain whether this model is suitable for the description of the distribution $n_0(\rho)$ in the T-3 apparatus, and to analyze various approximations that facilitate the solutions of more complicated problems (in which account is taken of the dependence of the plasma parameters on the spatial coordinate ρ). The chosen plasma parameters were close to those realized in certain regimes of the T-3 setup, viz., T_i = 200 eV, $\langle\sigma_i v_e\rangle = 1.7 \times 10^{-8}$ cm^3/sec, radius of plasma pinch a_0 = 15 cm. The density n_i had three values: (1, 2, and 4) $\times 10^{13}$ cm^{-3}. The calculations were made with the M-220 computer.

We estimated the effect of the anisotropy of the charge-exchange cross section (in the laboratory frame) [2], and found it to be negligible.

An approximate analytic formula was derived for the distribution of the atoms in a cylindrical plasma pinch under conditions when the plasma is "black" to the incoming particles and sufficiently transparent to atoms of energy on the order of T_i. The results of the Monte-Carlo calculation are in good agreement with the formula.

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INFLUENCE OF ρ^0-ω MIXING ON THE SPIN DENSITY MATRIX OF THE ω MESON IN THE REACTIONS $\pi N \to \omega N$ AND $\pi N \to \omega\Delta$

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Destructive and constructive interferences between the ρ^0 and ω mesons in the mass spectrum of decay pions were recently observed in the reactions $\pi^+p \to \pi^+\pi^-\Delta^{++}$ and $\pi^-p \to \pi^+\pi^-(n,\Delta^0)$ respectively [1 - 3]. It was also established experimentally that the $\pi N \to \rho(N,\Delta)$ differential cross sections are