Stopping power measurement for 100 keV/u Fe ions in hydrogen plasma

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The study of energy loss processes of heavy charged particles in plasma refers to the fundamental problems of plasma physics and physics of high energy density in matter. Investigation of heavy ions with energies in the range 40—500 keV/u interacting with strongly ionized plasma is of great importance because of the lack of experimental data. Results of a stopping experiment with Fe^{+2} ions of 100 keV/u in hydrogen plasma are presented. The plasma parameters of the high-current gas-discharge target were measured by the two-wave laser interferometry method. The linear electron density remains in the range from $2.4{\cdot}10^{17}$ cm^{-2} to $1.2{\cdot}10^{18}$ cm^{-2} while the initial hydrogen pressure changes from 1 to 4.5 torr and the capacitor voltage from 1.5 to 5 kV. The maximum observed plasma ionization degree (0.82 ± 0.08) was achieved at the initial hydrogen pressure of 1 torr and the voltage of 5 kV. The temperature of the hydrogen plasma was in the range 1.01—1.06 eV and varied slightly depending on the initial discharge parameter. The energy losses of 100 keV/u Fe^{+2} ions in the hydrogen plasma were measured at the "TIPr" linear accelerator in the ITEP. For Fe^{+2} ions with an initial energy of 5.6 MeV the total energy losses in the plasma were in the range from 0.4 up to 1.15 MeV. According to the experimental data obtained, the stopping power of free electrons was 860 ± 130 MeV/(mg/cm^2) for the ions under consideration. This result was compared with previously performed theoretical calculations and the numerical simulation using the SRIM code. It has been shown that the stopping power of ionized hydrogen exceeds the stopping power of cold gas more than 15 times.