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Vacuum system of a laser source of deuterium, nitrogen and oxygen ions for a linear accelerator

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The laser ion source is a universal plasma source for obtaining a wide range of multiply charged ions. To obtain gas ions, targets are used whose chemical composition contains gas atoms. As a result of target evaporation by a focused laser beam, a pressure jump occurs in the vacuum chamber. The pressure of gas atoms depends on the mass of the evaporated substance, the frequency of repetition of laser pulses, the chemical composition of the targets, the volume of the vacuum chamber, and the pumping speed. Estimates of pressures in the vacuum chamber in single and periodic laser operation modes with a frequency of 1–10 Hz for a power density of 10^{11}–10^{12} W/cm^2 are given. When the laser operates at a frequency of 1 Hz, the pressure in the vacuum chamber is at the level of the residual pressure in the vacuum chamber 2×10^{-6} Pa. As the frequency increases, the minimum pressure increases, since the vacuum pump does not have time to pump out the gas atoms before the next laser pulse. For a frequency of 10 Hz, the minimum pressure in the vacuum chamber increases by several orders of magnitude. A diagram of the vacuum system of a laser ion source based on turbo pumps with a pumping rate of 700 l/s is presented.

Keywords: laser ion source, deuterium, oxygen, nitrogen, laser, pulse frequency, pressure, vacuum chamber.

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