PLASMA BUNCHES OBTAINED UNDER AUTORESONANCE INTERACTION CHARACTERIZATION BY X-RAY SPECTROSCOPY AND X-RAY IMAGING [[1]](#footnote-1)\*)

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The study of charged particle acceleration processes remains one of the most important directions in the study of laboratory, space, and astrophysical plasmas. One of the possible types of interaction is cyclotron autoresonance [1]. The nature of the autoresonant acceleration of particles essentially depends on the type of interaction: in a traveling wave or in a standing wave. In the scheme of an autoresonant microwave accelerator on a traveling wave (waveguide) is supported by profiling the leading magnetic field along its axis, and most of the beam energy is stored in the axial velocity component [2]. The mechanism for maintaining cyclotron resonance in the field of a standing wave is maintained by varying the external magnetic field with time or space [3, 4]. Previously [5], it was shown that the implementation of this interaction mechanism under conditions of a long mirror cell leads to the generation of stable plasma bunches with an energetic electronic component on the scale of hundreds of keV.

Current studies were carried out with the following parameters: plasma gas pressure (Ar) - 1∙10-5 Torr, microwave power - PUHF = 2.5 kW, timp = 1.1 ms, pulsed magnetic field duration - timp = 900 µs, Bpulse = 350 ÷ 500 Gs, cycle time T = 35 ms. The studies were focused on elucidating the possible degree of influence of the interaction parameters and the experimental setup on the efficiency of electron capture in the acceleration mode, which was estimated from the main parameters of the recorded spectra of bremsstrahlung and characteristic X-ray radiation emitted by a plasma bunch during its interaction with gas and solid targets. The positive aspects of the applied diagnostics are: monochromaticity and isotropy of radiation, which provides the necessary accuracy and does not impose strict requirements on the spatial placement of the spectrometer detector. Joint analysis of signals from diagnostic systems, recorded spectra, X-ray patterns and parameters of pulsed fields that provide the operating mode, made it possible to identify trends in the behavior of the spectral and integral characteristics of recorded radiation. The observed correlation of radiation patterns, parameters of the bremsstrahlung and characteristic radiation spectra, as well as the temporal characteristics of PMT signals made it possible to establish general patterns in the dynamics of plasma bunches within the mirror cell. An analysis of the reconstructed bremsstrahlung and characteristic radiation spectra in absolute units, obtained with allowance for absorption in the detection windows and spatial and angular characteristics of collimation detection systems, made it possible to determine the dependence of the number of electrons trapped in the autoresonant interaction mode.

Reference

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