ANALYSIS OF THE EFFICIENCY OF PARTICLE CAPTURE IN THE AUTORESONANCE MODE IN A LONG MIRROR TRAP [[1]](#footnote-1)\*)

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The aim of this work was to determine the particles' trapping efficiency of primary plasma under autoresonant acceleration mode in a long mirror with a time-varying magnetic field profile [1, 2].

The experimental setup is an axially symmetrical system, in which microwave cavity (TE118) and pulsed magnetic field coils combined in a single unit are disposed in the interpolar space of electromagnets that creates a steady state magnetic field of the long mirror. The stationary magnetic field is created by three pairs of coaxial coils supplied from three dc sources. This makes it possible to maintain the stationary magnetic field at the required level or vary it gradually under preserved or variable axial profile of the magnetic field. The cavity was excited from an magnetron generator (2450 MHz, 2.5kW) in a pulse-periodic mode with a duration 1ms and a pause of 1–100 ms. The pulsed magnetic field generated by pair of coils axisymmetric with the cavity and the coils of the stationary magnetic field (Вpulse = 500 G, τ = 450 μs). The coils of the pulsed magnetic field are placed symmetrically with respect to the position of the minimum of the magnetic field in the trap. The direction of the current in the pulsed coils located in maximum of the electric field of the standing wave is such that the magnetic field generated by them is directed opposite to the stationary magnetic field. This allows for a reduction of the local value of induction of the stationary magnetic field to a level corresponding to the ECR value, that is, 875G for the generator’s operating frequency (initial plasma production), a decrease in current in the pulsed coils and the restoration of the initial profile of the stationary magnetic field within UHF- pulse provides trapping and acceleration of electrons of the initial ECR plasma (autoresonance). Within the operating cycle: the formation of the initial plasma, trapping and further acceleration of initial plasma electrons in two symmetric zones of the setup, the generation and subsequent confinement of ring plasma bunch with an energetic electron in long mirror.

XR emission was recorded by two pulse multichannel analyzer with detectors (X-123-CdTe и NaI(Ta)) with maximum spectral sensitivity in the range 1-60 кeV и 30-3000 кeV respectively and radiography (7-100 кeV energy range).

The study of the change in the intensity of the characteristic lines from the gas target made it possible to determine the optimal conditions for the particles' trapping, which is directly related to the number of energetic electrons in the bunch. Changes in the intensities of spectral lines of characteristic radiation from a gas target at various pressures of the plasma-forming gas are experimentally determined. The spectrum and quantum yield of X-ray radiation from the gas target together with X-ray radiography showed that the electrons of the accelerated plasma bunch during confinement are localized in the minimum of the mirror trap and are concentrated in a thin ring layer. The results of this work explain the previously obtained results and can be used to determine the number of accelerated electrons, their energy spectrum, and the dynamics of its change within the operating cycle: acceleration and confinement of generated bunches in a long mirror.

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Reference

1. Andreev V.V., Novitskiy A.A., Umnov A.M., Chuprov D.V. Instruments and Experimental Techniques. 2012. Т. 55. № 3. С. 301-312.
2. Andreev V. V., Chuprov D V, Ilgisonis V I, Novitsky A A and. Umnov A M 2017 Physics of Plasmas 24 093518, doi: 10.1063/1.4986009
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/Lt/ru/EW-Andreev.docx) [↑](#footnote-ref-1)