REFLECTION OF A PLASMA WAVE FROM A POTENTIAL BARRIER, COMMENSURATE WITH THE WAVELENGTH [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.147

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With the development of research on plasma retention in open-type magnetic traps (probcotrons) [1, 2] the study of oscillations in plasma waveguides, the problem of reflecting plasma oscillations from the plasma boundary, the width of which is commensurate with the wavelength, becomes relevant. The reflection of plasma oscillations from the flat boundary of the half-space occupied by the plasma was considered in a linear approximation in [3, 4]. It is shown in [5] that the problem of reflection of plasma oscillations from a potential barrier whose width is commensurate with the wavelength is essentially nonlinear. The main feature of the reflection of a plasma wave from a potential barrier, the height of which is much higher than the potential of the wave, and the width of the order of the wavelength, is that plasma oscillations inside the barrier are destroyed. However, due to inertia in each electron beam with the same energy, the density modulation in the barrier region is preserved for a time shorter than the relaxation time. This imposes a limit on the width of the barrier: it should not exceed half the length of the wave. In the barrier region, such convective or drift oscillations in beams with different energies move at different speeds and pass paths of unequal magnitude. Moreover, electron beams with higher energy in the region of the potential barrier travel a longer path than beams with lower energy. Therefore, the phase of convective oscillations in a beam with higher energy lags behind the phase of convective oscillations in a beam with lower energy. After reflection from the potential barrier and the beams return to the base of the barrier, convective vibrations in beams of different energies come together, their interference occurs. Based on the law of conservation of momentum and energy, it is shown that there is no loss of energy of plasma oscillations in the process of reflection. The reflection coefficient of the wave is equal to one. Since convective oscillations in beams with different velocities have a phase lag in the barrier region, after their interference, the reflected wave has a phase lag relative to the phase of the incident wave. In the case of a parabolic barrier, this delay is calculated accurately, it does not depend on temperature. The delay of the phase of the reflected wave relative to the phase of the incident wave after reflection from the parabolic barrier increases with an increase in the width of the barrier and the magnitude of the phase velocity of the wave and decreases with an increase in the height of the barrier. In the case of linear growth of the barrier potential, the phase delay of the incident wave depends on the plasma temperature. If the plasma is low-temperature, then the phase lag of the reflected wave from the phase of the incident wave is small. As the plasma temperature increases, the phase delay of the reflected wave increases linearly until the thermal energy of the electrons is less than half of the maximum potential energy of the barrier. Then the growth of the delay in the phase of the reflected wave stops, and it tends to the value . With an increase in the width of the barrier, this delay also first grows linearly, then the growth stops, and the phase delay does not exceed the value .

References

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Lt/ru/HS-Matveev.docx) [↑](#footnote-ref-1)