InFLUENCE OF iNHOMOGENEITY OF PLASMA PRODUCED BY MULTIPHOTON IONIzATION OF INERT GAS ATOMS ON ELECTROMAGNETIC RADIATION PENETRATION [[1]](#footnote-1)\*)

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The inhomogeneity influence of the electron density profile of a plasma, formed during multiphoton ionization of inert gases, on the penetration of electromagnetic radiation has been studied. It was assumed that in a layer with width L the photoelectron density increases linearly with increasing distance to the plasma boundary and then remains constant. The form of photoelectron distribution dependence on the velocity, describing the narrow peak without the broadening, is approximated by the Dirac delta-function δ(v-v0), where v0 is the average velocity of photoelectrons acquired in the multiphoton ionization process [1]. The electric field in the plasma and the absorption coefficients are found from the kinetic equation for the distribution function and Maxwell's equations. The high-frequency and normal skin effects modes have been considered. It is found that if width of inhomogeneous layer is smaller than the skin layer depth δ in the mentioned modes of penetration, absorption and reflection of the probe radiation are described by expressions reducible to those obtained earlier with the assumption of sharp change of electron density at the plasma boundary (see [2]). By increasing L to values at which the distance to the critical density point ρ is considerably smaller than the incident electromagnetic radiation wavelength, the absorption coefficient and the penetration depth of the field increase as the cubic root of the inhomogeneous layer thickness ~(L/δ)1/3. A subsequent increase in the layer width L causes the field to penetrate to distances on the order of ρ and the absorption coefficient to reach values close to unity. Taking into account the photoelectron scattering features on neutral inert gas atoms, corresponding to the Ramsauer-Townsend effect, leads to an increase in the absorption coefficient. The magnitude of this increase depends on the photoelectrons average energy in the plasma and the choice of inert gas. For example, in a xenon plasma with an average photoelectron energy 2.87eV the absorption coefficient increases by ~2.5 times.

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References

1. K.Yu. Vagin, T.V. Mamontova, S.A. Uryupin. Phys. Rev. Е 104 (2021).
2. K.Yu. Vagin, T.V. Mamontova, S.A. Uryupin. Phys. Rev. A 102 (2020).
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/Lt/ru/ES-Mamontova.docx) [↑](#footnote-ref-1)