On ICR plasma heating by the magnetic Beach method [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2021.48.1.135

A.V. Timofeev, R.S. Chebotarev

НИЦ “Курчатовский институт”, г. Москва, Россия, chebotarev\_rs@nrcki.ru

Ion cyclotron resonance heating (ICR heating) plays a key role in plasma applications such as plasma reprocessing of nuclear fuel, ICR isotope separation, and the VASIMR space plasma engine. However, as a result of the Alfvén resonance phenomenon, the Alfvén oscillations used to heat the ion component of the plasma can be effectively transformed into lower-hybrid ones, which have a significant longitudinal component of the electric field, that, in turn, can lead to preferential heating of electrons, but not ions.

To identify the leading heating mechanism, which is realized under VASIMR conditions, a two-dimensional analysis of ICR heating should be carried out - it is necessary to take into account both the longitudinal inhomogeneity of the magnetic field, which initiates the ICR heating by the magnetic beach method, and the natural transverse inhomogeneity of the plasma density, which predetermines the Alfvén resonance phenomenon.

In the well-known works, only separate mutually exclusive approximations of the longitudinal inhomogeneity of the field with the transverse homogeneity of the density are considered, and vice versa [1,2]; one work takes into account the two-dimensional inhomogeneity of the problem, but considers unimodal heating [3].

An attempt is made in this work to consider a model that takes into account inhomogeneity in both directions and accepts a model of a real helical antenna as a heating source. It has been found that at values of plasma density n0 = 1012-1013 cm-3, as well as the selected configurations of the antenna and magnetic field, absorption occurs mainly in the ion cyclotron resonance region.

References

1. A.V. Timofeev. On RF Heating of Inhomogeneous Collisional Plasma under Ion-Cyclotron Resonance Conditions. Plasma Physics Reports 41, 873–881 (2015).
2. E.A. Bering et al. Observations of Single-Pass Ion Cyclotron Heating on a Trans-Sonic Flowing Plasma. Phys. of Plasmas 17, 043509 (2010).
3. P.A. Piotrowitz et al. Computational Investigation of Ion Cyclotron Heating on Proto-MPEX. Phys. of Plasmas 26, 033511 (2019)
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/Pt/ru/GE-Chebotarev.docx) [↑](#footnote-ref-1)