Self-consistent profiles of electron component pressure in the ECRH regime at the L-2M stellarator [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2021.48.1.043

A.I. Meshcheryakov, I.A. Grishina, and I.Yu. Vafin

Prokhorov General Physics Institute of the Russian Academy of Sciences, Moscow, Russia, [meshch@flp.gpi.ru](mailto:meshch@flp.gpi.ru)

In recent years, a lot of data has been accumulated on the self-organization processes of plasma confined in the toroidal magnetic traps [1, 2]. When speaking about plasma self-organization, we mean that, in the course of plasma confinement, the radial profiles of plasma parameters tend to relax from the initial profiles formed as a result of the external action to the canonical profiles. Self-consistent profiles of plasma parameters are called the canonical profiles, the shape of which changes only slightly when the plasma parameters vary in the fairly wide range. Plasma self-organization processes are observed both in tokamaks and stellarators [2].

In this work, we analyze the electron temperature profiles obtained using the data of multi-chord diagnostics of soft X-ray radiation, as well as the pressure profiles of the plasma electron component in the axial ECRH regime at the L-2M stellarator. The operating conditions differed in the plasma density (1.5 < *n*e < 2.8 × 1019 m−3) and microwave power inputted into the plasma (190 < *P*ECRH <600 kW). It is shown that, in the indicated range of plasma densities, when the heating power varies in the range of 190 < *P*ECRH < 250 kW, the electron temperature profiles are self-consistent and have similar peaked shapes; that is, the temperature decreases from the plasma axis to the edge. At heating powers higher than 250 kW, the shape of the temperature profiles changes, they become flat in the core region of the plasma column. This occurs due to a change in the shape of the electron density profiles and a subsequent change in the mechanism for absorption of microwave radiation [3]. Due to the "density pump out" effect, the dip-shaped profiles of the electron density form and the regions with the inverse density gradient appear in the plasma. In these regions, the processes of the extraordinary wave decay occur, which ultimately result in the appearance of the electron Bernstein waves, which are absorbed in these regions with the inverse density gradient. The absorbed power profile changes and the temperature profile changes its shape under the influence of this absorbed power profile.

In this work, we also calculated the plasma pressure profiles using data on the measured profiles of the electron temperature and plasma density. It has been shown that at low ECRH powers (190 < *P*ECRH < 250 kW), when the peak-shaped temperature profiles and slightly dip-shaped density profiles form in plasma, the pressure profile of the electron component has the shape that can be well approximated by the canonical pressure profile calculated for stellarators [2]. Thus, in this range of ECRH powers, the plasma pressure profiles are self-consistent.

References

1. K.A. Razumova1, V.F. Andreev1, L.G. Eliseev1, A.Ya. Kislov1, R.J. La Haye2, S.E. Lysenko1, A.V. Melnikov1, G.E. Notkin1, Yu.D. Pavlov1, and M.Yu. Kantor, Nucl. Fussion **51**, 083024 (2011)
2. Yu.N. Dnestrovskii, *Self-Organization of Plasma* (Kurchatov Institute, Moscow, 2013).
3. A.I. Meshcheryakov, I.Yu. Vafin, and I.A. Grishina, Electron Temperature Profiles Forming under Conditions of the Axial ECR Plasma Heating at the L-2M Stellarator, *Plasma Physics Reports* **46**, 1144 (2020), https://doi.org/10.1134/S1063780X20120041

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/Mu/ru/BC-Meshcheryakov.docx) [↑](#footnote-ref-1)