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## CALCULATIONS OF EC CURRENT DRIVE USING THE GENRAY CODE IN THE T-15MD TOKAMAK $^{\ast)}$

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In the T-15MD tokamak, one of the primary methods for auxiliary heating and non-inductive current drive to achieve quasi-stationary stable operation with improved plasma confinement is electron cyclotron (EC) resonance heating and EC current drive [1]. The selection and optimization of EC heating system parameters for various stages of the T-15MD tokamak operation have been thoroughly reviewed in studies [2-6]. The first experiments on the T-15MD tokamak during the autumn-winter campaign of 2023 [7] were conducted using a gyrotron with a frequency of 82.6 GHz for heating at the second harmonic of the extraordinary wave mode with wave injection from the low magnetic field side. EC power was used to create a plasma discharge (as a result of pre-ionization of the working gas) and subsequent heating.

The interaction between the electron cyclotron wave and the plasma at the initial stage of the discharge can be complicated due to several effects: incomplete single-pass absorption of EC radiation and the resulting multiple reflections of radiation from the walls of the vacuum chamber [8], deviation of the electron velocity distribution function from the Maxwellian, leading to a nonlinear dependence of wave absorption on the input power [9], radial transport of fast electrons as a possible cause of the increased spatial width of the generated current density profile [10], [11].

This work focuses on the analysis of experimental data on EC heating and EC current drive in the T-15MD tokamak. The fraction of absorbed power in these experiments can be estimated from bolometric system measurements, while numerical modeling is necessary to evaluate the profile of the non-inductive current. The results of calculations for EC heating and EC current drive in T-15MD using the GENRAY code [12] are presented.

## References

- [1]. Khvostenko P.P., Anashkin I.O., Bondarchuk E.N. // Problems of Atomic Science and Technology, ser. Thermonuclear Fusion, 2019, v. 42, № 1, p. 15 (in Russian).
- [2]. Minashin P.V., Kukushkin A.B., Harvey R.W. // Problems of Atomic Science and Technology, ser. Thermonuclear Fusion, 2017, v. 40, № 2, pp. 65-72.
- [3]. Kirneva N.A., Kislov D.A., Roy I.N. // Problems of Atomic Science and Technology, ser. Thermonuclear Fusion, 2020, v. 43, № 1, p. 64-74 (in Russian).
- [4]. Kirneva N.A., Borshchegovskii A.A., Kuyanov A.Yu. *et al.* // Problems of Atomic Science and Technology, ser. Thermonuclear Fusion, 2021, v. 44, № 4, pp. 24-36 (in Russian).
- [5]. Minashin P.V., Kukushkin A.B. // Proc. of the L Zvenigorod International Conference on Plasma Physics and Controlled Fusion, March 20–24, 2023, p. 89 (in Russian)
- [6]. Minashin P.V., Kukushkin A.B. // Problems of Atomic Science and Technology, ser. Thermonuclear Fusion, 2023, v. 46, № 3, pp. 55-64 (in Russian).
- [7]. Velikhov E.P., Kovalchuk M.V., Anashkin I.O. *et al.* // Problems of Atomic Science and Technology, ser. Thermonuclear Fusion, 2024, v. 47, № 2, pp. 5-14 (in Russian).
- [8]. Stober J., Schubert M., Schneider M. et al. // EPJ Web Conf., 2023, v. 277, p. 02007.
- [9]. Harvey R.W., Mccoy M.G., Kerbel G.D. // Physical Review Letters, 1989, v. 62, № 4, pp. 426-429.
- [10]. Harvey R.W., Mccoy M.G. // Proc. IAEA Technical Committee Meeting on Advances in Simulation and Modeling of Thermonuclear Plasmas, Montreal, Canada, 15 – 17 June 1992.
- [11]. Nikkola P., Sauter O., Behn R. et al. // Nucl. Fusion, 2003, v. 43, № 11, p. 1343.
- [12]. Smirnov A.P., Harvey R.W., Kupfer K. // Bull. Am. Phys. Soc., 1994, v. 39, № 7, p. 1626.

<sup>\*)</sup> abstracts of this report in Russian