DYNAMICS OF PLASMA CONFINMENT AND SOME PROPERTIES OF PLASMA SELF-CONSISTENCY UNDER ECRH CONDITIONS AT THE L-2M STELLARATOR [[1]](#footnote-1)\*)

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Meshcheryakov A.I., Grishina I.A.

Prokhorov General Physics Institute of the Russian Academy of Sciences, Moscow, Russia, meshch@fpl.gpi.ru

The dynamics of plasma confinement in the L-2M stellarator is studied in the ECR heating regime in the stages of initial plasma heating, its quasi-stationary confinement, and cooling after switching off the microwave radiation. The properties of plasma self-consistency at different ECRH stages are also considered. During the ECR heating, four phases were distinguished, and in each of them, plasma confinement has its own characteristics.

In the first phase, the plasma is heated, its energy content increases, while the plasma edge remains cold. In fact, the plasma does not contact the wall (detachment regime), which ensures the low thermal conduction and diffusion losses. The measurements showed that in the first ECRH phase, in the absence of plasma-wall interaction, the pressure profiles of the plasma electron component are not self-consistent.

Next, there occurs a rapid transition (in less than 400 µs) to the quasi-stationary phase of the shot (phase 2). In phase 2, an additional loss channel opens in the plasma, which is associated with the appearance of the intense flux of particles and energy onto the wall (thermal conduction and diffusion). As a result, plasma self-consistency mechanisms are activated, and they tend to establish the canonical pressure profiles [1]. However, the external effect of ECR heating prevents from establishing the exactly canonical pressure profiles. Therefore, in phase 2, the pressure profiles are close to the canonical ones (but do not coincide with them) [2].

After switching off the microwave heating pulse, the plasma cools down at a constant density. As the plasma cools, two more phases can be distinguished. In phase 3, the self-consistency mechanisms continue to operate, and, in the absence of external effects on the plasma, it relaxes to the canonical pressure profiles of the electron component. From the experimental data obtained at tokamaks, it is known that the canonical profiles are established in times less than a tenth of the energy lifetime (Δt < 0.1 τE) [3]. While in phase 3, the drop in the energy content occurs over times of the order of the energy lifetime. Therefore, in phase 3, during the plasma cooling, we can assume that the plasma passes through a sequence of states characterized by the canonical pressure profiles. During this process, the power of energy losses is minimal for the concrete facility [3]. Based on the experimental data for the L-2M stellarator, the following dependence of the minimum loss power in phase 3 on the energy content and density was obtained: Ploss(W) ~W3⋅ne−2. We note that the dependence Ploss(W, ne) obtained experimentally in phase 3 is fundamental for the L-2M stellarator, since it characterizes the plasma confinement by the magnetic system of this facility.

As the plasma edge cools, the third phase smoothly passes into the fourth one, when the plasma periphery becomes cool and the plasma again ceases to contact the wall. As a result, the losses due to thermal conduction are considerably reduced. In phase 4, radiation losses become dominant.

References

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