study of the impurities and Main gas nuclei transport in modes with electron cyclotron resonance heating on the t-10 tokamak[[1]](#endnote-1)\*)

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Impurities in thermonuclear plasma is one of the main problems for fusion energy. Accumulation of light impurities in the core plasma leads to main gas ions dilution which reduces efficiency of fusion reactor. Besides the impurities can significantly influence the efficiency of all types of plasma heating, transport processes and plasma stability.

The problem of the impurity transport has been studied for more than 40 years on different tokamaks in various modes (L-, H-, I-modes) and with various plasma heating methods (ohmic, by neutral beam and by ECR, ICR, LHR radiation).

The aim of this work is to determine the degree of influence of electron cyclotron resonance heating (ECRH) for the transport of carbon impurity nuclei (С6+) and main gas ions (D+). The work is based on the experiment results obtained on T-10 tokamak in 2015-2018. The experimental data were processed with subsequent modeling of С6+ and D+ transport using the ASTRA and STRAHL codes for chosen discharges with various ECRH configuration. С6+ and D+ ions density and temperature were measured by CXRS-diagnostics. The electron temperature measurements were carried out using measurements of plasma EC emission on 2nd harmonic and the plasma emission in the soft X-ray region. The electron density was measured using 16-channel interferometer.

It was found that off-axis ECRH leads to an accumulation of С6+ nuclei in the plasma center with absolute concentration increase during the discharge. Simultaneously with this effect, the main gas D+ density profile is flattened and decrease of D+ ions in plasma center is observed. As a result, off-axis ECRH should aggravate the negative effect of D+ dilution in tokamak-reactor. With on-axis ECRH there is some deterioration of carbon confinement besides pump-out effect (deterioration of electron confinement). In this case, removal of D+ ions from plasma during ECRH appears either explicitly or is masked to a certain extent by process of deuterium influx into the discharge (“pump-in”) in the case of high saturation of the vacuum chamber walls with deuterium.

ECRH experiments carried out in lithized T-10 plasma with a low level of deuterium recycling revealed that deterioration of D+ confinement ions during on-axis ECRH due to the pump-out effect significantly exceeds the corresponding deterioration of confinement of C6+ nuclei. As a result, an absolute decrease of working gas D+ ions density in the plasma center accompanied by a noticeable increase in the dilution of its concentration by nuclei of light impurities is observed during on-axis ECRH. In the case of off-axis ECRH in addition to the deterioration of D+ ions and the appearance of “pump-out” ejection of deutons from the plasma, the process of dilution of D+ ions by nuclei of light impurities in the central regions sharply increases.

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