EFFECT OF THE PLASMA PARAMETER PEAKINGS ON THE DD REACTOR OPERATION.

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In connection with the exhaustion of natural resources, the question of new efficient energy sources is especially acute. Therefore, the use of thermonuclear energy - the energy released during the fusion of nuclei of light elements- is very important.

For a long time it was considered that the most promising reactors are those working on DT mixtures. However, there is no tritium in nature and it must be produced in one way or another. In addition, during the operation of a DT reactor, a large number of 14.1 MeV neutrons are released, which cause serious damage to the structural elements of the reactor. So, for example, the vacuum chamber of the reactor will need to be replaced every 5 years. These and other serious shortcomings call into question the practical implementation of an economically viable thermonuclear D-T reactor.

A thermonuclear reactor using deuterium as fuel can provide mankind with an almost inexhaustible source of energy, but the reactions of fusion of two deuterium nuclei with a positive yield require, generally speaking, higher temperatures than the reactions of deuterium-tritium.

Until now, it was generally believed that in order to obtain the maximum production of thermonuclear energy, it is necessary to maintain the most uniform spatial distribution of temperature and plasma density in the reactor. However, the use of steeper plasma temperature and density profiles leads to a decrease in the Lawson criterion and a decrease in the ignition
temperatures of the plasma in the reactor.

In this work, the possibility of reducing the operating temperature of the plasma in the D-D reactor due to the model profiling of the plasma parameters is considered. The decrease in the working temperature of the plasma was considered in relation to the fuel ion temperature with a uniform distribution equal to 80 keV.

It is shown that an increase in the pressure peaking (the ratio of the maximum parameter value to its volume-averaged value) of plasma to 8 in comparison with a uniform distribution (the peaking is equal to unity) can make it possible to reduce the operating temperature from 80 to 15 keV. The energy content of the plasma is also reduced by a factor of 8, which greatly simplifies the requirements for the plasma heating system.

The maximum value of the plasma pressure peaking was achieved in DD experiments on the TFTR tokamak (pulse no. 50862) and was equal to 16. The calculated value of the operating temperature in this case would be 5.5 keV at an ion temperature at the center of the plasma equal to 55 keV. The maximum ion temperature of 41 keV was achieved in the same tokamak in DT experiments.

Thus, the results of this work and experimental data show that the creation of a DD thermonuclear reactor is becoming a very realistic task.