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TH/P6-28: Numerical Simulations for Fusion Reactivity Enhancement in D-3He and D-T Plasmas due to 3He and T Minorities Heating

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One of the possible techniques to decrease neutron load on plasma facing components and superconducting coils in fusion reactor is to use fuel cycle based on D–3He as alternative to D–T [1]. Taking into account that the thermal reactivity of D–3He is much lower than that of D–T, the approach such as ICRF catalyzed fusion should be developed. The main idea of this technique is to modify reagent distribution function in order to achieve favorable reaction rate for nuclear fusion energy production [2]. Recent experimental results show high efficiency of ICRH acceleration of 3He minority in D plasma in order to increase fusion reaction rates. From the other hand this technique could be used to achieve the favorable distribution of T ions in D plasma and hence to reduce the amount tritium needed for sustainable fusion plasma burning [3]. The effect of transition to non-Maxwellian plasma is essential for reactor aspects studies both in tokamaks and heliotrons.
The objective of present study is to clarify the effect of non-Maxwellian distribution function of plasma minorities 3He and T on fusion reactivity. This study is done by means of numerical code, based on test-particle approach [4, 5]. This code solves the guiding center equation of a general vector form. To simulate the Coulomb collisions of test-particle with the other species the discretized collision operator based on binomial distribution is used [6]. A simplified model for ICRF heating is included in code as well [7].
We simulate the possibility to increase the averaged reactivity by modification of distribution function of 3He and T minorities in D plasma due to selective ICRF heating. In our model we observe an increment of reactivity for both either D-3He due to heating on main harmonic and D-T on second harmonic heating. The increase of reactivity is an important issue for the performance of fusion reactors, which needs further detailed studies.

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