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Enhancement of Fusion Rate by Superthermal Tritium Ions

CARMINE CASTALDO, ENEA Frascati Italy, ALESSANDRO CARDINALI, ENEA, MASSIMO MARINUCCI, ENEA Frascati Italy — We propose a new concept of a nuclear fusion reactor. It is based on the enhancement of the DT fusion rate in tokamak plasmas by a superthermal population of Tritium ions heated by ICRH. It was already shown that break-even conditions might be reached [C. Castaldo and A. Cardinali, Phys. Plasmas 17, 072513 (2010)]. Here we show that Q≈20, suitable for nuclear fusion power station, can be achieved in a compact tokamak configuration (major radius R=160cm, minor radius a=55cm, elongation k=1.9, triangularity δ=0.4, q95=3.5), operating with I_P=8MA plasma current, B_T=11.3T toroidal field, line averaged plasma density n=$5X10^{20}m^{-3}$, and 40% D, 35% H, 25% T concentrations of the Hydrogen isotopes. The burning plasma is obtained by the injection of 15 MW ICRF power, coupled by six antennas, with radiating areas of $0.25m^2$, at the operating frequency f=125 MHz and toroidal wave number $n_{//}$=4. The heating scenario has been analyzed by the code TORIC, and approximated analytical equilibria are considered. As a result the total fusion power expected for the proposed scenario is about 350MW, with Q≈20, assuming that at least 70% of the fusion power carried by the α particles is absorbed by the electrons in the plasma core so that the expected central plasma temperature is about 10keV.

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