

THE POTENTIAL PROFILE AND ITS INFLUENCE ON THE NEUTRON YIELD OF INERTIAL ELECTROSTATIC CONFINEMENT FUSION DEVICE

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An IECF (Inertial Electrostatic Confinement Fusion) device is small and simple, and is expected to be used as a compact neutron source. This device consists of two spherical electrodes, an outer anode and an inner grid-cathode. After filled with low pressure deuterium gas, high voltage is applied. Then discharge occurs and deuterium ions converge on the center by the high electric field, and this causes fusion reactions.

In order to reveal the mechanism of IECF such as potential profile, NPR (Neutron Production Rate), current, voltage and their relation, we have developed a one dimensional PIC simulation code including atomic processes. It is expected that the NPR increases in proportion to the squared ion current from simple estimation, but the space charge is considered to affect the potential profile on large current operation. In this study, the potential profile and its influence on the NPR are analyzed.

Preliminary results show that a potential structure (virtual anode) is built up inside of the cathode by converged ions when the current increases. It results in less increase than the estimation because of the low density of ions in the center spot. The density of electron is far lower than that of ion (less than 1/100), and is not enough to cancel the charge of ions. As electron sources, ionization process and secondary electron emission are included in this code, the former hardly occurs at low pressure and secondary electrons don't stay inside of the cathode for the following reasons; a) the potential structure is unstable and electrons easily escape to outside of the cathode, which never return, b) even if energy and current of electron are same as those of ion, the density of electron is lower than that of ion because the velocity of electron is higher. Therefore we consider that some techniques which can supply electrons within the cathode, such as additional electrodes emitting thermo electrons, are required. We are calculating some cases and the results are discussed in the presentation.