

Measurement of Ion Energy Distributions in a Cylindrical Inertial Electrostatic Confinement Fusion (C-IECF) Device

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An Inertial Electrostatic Confinement Fusion (IECF) is a device injecting ions and electrons towards the spherical center, trapping both species in the electrostatic self-field and giving rise to fusion reactions in the dense core. However, within the current experimental pressure (0.1Pa~10Pa), the majority of the fusion reaction occurs as collisions between the beam and the neutral gas because the gas density is much higher than density of high-energy particles, and the contribution of beam collision reaction (Beam-Beam Fusion) is little. The cylindrical IECF (C-IECF) device is proposed as simplification of the device at such an area where the increase of the density of the ion by spherical convergence is not important, and we have been carrying out experimental works aiming at search of the IECF principle using variety of the experiment shape and a handy nuclear fusion neutron source.

As the D-D fusion reaction cross-section increases with energy, it is clear that increase of the ion energy and of the ion longevity are shorter ways to increase neutron production and efficiency of the C-IECF device. Therefore, the method of using an external ion source to assisted glow discharge has been tried to reduce gas pressure, due to increase of ion average energy and decreasing of the ion loss by the charge exchange reaction between D_2^+ beam and background gas. As results, operating gas pressure has reduced from 1.5 Pa to 0.5 Pa, the neutron production has increased about 20%.

These results are considered as shown in the above-mentioned scenario. To confirm that an increase in the ion energy is a factor of an increase in the neutron production, the ion energy distribution of the C-IECF device has been measured. As the method, the part of the neutral particle beam (with the ion energy distribution and strong relation) was drawn out from the hole made at center of the anode, and was gone through re-ionization chamber, then it's energy was measured by energy analyzer. The primary result shows the change of the ion energy distribution at the low energy element along the pressure.