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SIMULTANEOUS NEUTRON AND PROTON MEASUREMENTS OF D-D AND D-^{3}He FUSION REACTION IN AN INERTIAL ELECTROSTATIC CONFINEMENT FUSION DEVICE

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An Inertial Electrostatic Confinement Fusion (IECF) device is a compact fusion neutron/proton source with an extremely simple configuration consisting of a gridded hollow cathode concentrically held at the center of a spherical anode. An IECF device can be operated with reasonably high D-^{3}He fusion reaction as well as D-D and D-T as a neutron source. The protons from the D-^{3}He reactions are highly energetic enough to produce radioisotope for medical use, i.e. Positron Emission Tomography.

Our experimental device consists of a 340-mm-diameter spherical vacuum chamber which serves as the anode and a 60-mm-diameter transparent cathode. Up to now D-D neutrons and protons of more than 10^7 sec^{-1} have been achieved at - 63 kV bias voltage at the cathode. Very recently we have started D-^{3}He runs with this device. Presented in this paper is an upgrade of proton counting system in order to obtain reaction rates of both D-D and D-^{3}He simultaneously.

We use a semiconductor diode (Solid-State Detector: SSD) for counting protons with a sufficient energy resolution. Originally a lead foil of 25 mm thickness was set up in front of the SSD to block sputtered metallic ions, electrons from the hollow cathode, and X-rays that cause the noise in the counting system. It is however found numerically in this study that the foil is almost useless in terms of shielding from X-rays, i.e. X-rays of up to 100 keV corresponding to the bias voltage have higher transmittance than the objective 3.03 MeV protons from D-D reactions. Moreover, due to the energy losses of D-D protons through the foil, it turned out to be difficult to identify signals from false signals due to X-rays.

Therefore, we focus on shielding from sputtered metallic ions and electrons of up to 100 keV with least energy losses of D-D protons. We selected a 10-μm thick aluminum foil. We also designed a deflection magnet for blocking the 100 keV electrons, which is found in experiments to be effective in reducing the noises due to X-rays from electrons hitting the SSD directly. Comparisons will be presented in the meeting between the present and old counting systems, as well as results of simultaneous measurements of D-D neutrons, protons, and D-^{3}He protons, and their dependencies on the bias voltage applied to the gridded hollow cathode.