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4P32 - Parametric Study of a Cylindrical Inertial Electrostatic Confinement Fusion Device and its Application

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Portable and cheap neutron sources are in demand for various applications such as cancer therapy, fusion material study, explosive materials etc. Among various neutron sources, inertial electrostatic confinement fusion (IECF) is an extremely simple device that produces neutron yield typically ~ 10^8 DD n/s. IECF is basically a fusion concept where the lighter fuel ions (deuterium, tritium) are trapped in a converging electrostatic field inside a cylindrical or spherical geometry.
A compact cylindrical IECF device is under operation at Centre of Plasma Physics-Institute for Plasma Research. This device mainly comprises of a cylindrical grid assembly housed inside a cylindrical vacuum chamber, a vacuum pumping system, a gas injection system, a high voltage feedthrough and a high voltage negative polarity power supply. Deuterium plasma is produced in it by the filamentary glow discharge as well as cold cathode discharge. The plasma is characterized using electrostatic probes. Plasma parameters such as the electron temperature (T_e), plasma potential (V_p) and plasma density (n_i) are evaluated. The plasma temperature and density are estimated at optimum experimental conditions and it is noted that the plasma temperature is 3 eV in the case of hot cathode discharge whereas 10 eV in the case of the cold cathode discharge. The plasma density as determined is two orders more in the case of the hot cathode discharge ($10^{15} m^{-3}$) than the other. Neutron Production Rate of the order 10^6 n/s is measured in this device by applying 80 kV to the cathode grid. The neutrons produced from the device have been characterized using various detectors such as neutron area monitor, He-3 proportional counter, bubble detector etc. The X-rays and neutrons emitted from the device were utilized for demonstrating the radiography and detection of explosives, respectively. A detailed of the recent results will be presented.

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