Seminar

Institute for Plasma Research

Title : Development of a rotating tritium target based D-T Neutron generator system for fusion neutronics studies

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Date : 31st March 2022 (Thursday)

Time : 03.30 PM

Venue : Online - Join the talk: https://lobby.ipr.res.in/Synopsis_SudhirsinhVala

Abstract :

14 MeV neutron, generated during Deuterium-Tritium (D-T) reaction in fusion reactors & its irradiation on the reactor materials is one of the prime concerns of future fusion reactor technology demonstration. In addition to this, there is a great demand on the benchmark experiments for Fusion Evaluated Nuclear Data Library (FENDL), neutron spectroscopy measurements, double differential cross-section measurements, and neutron diagnostics in order to develop the materials for future fusion machines.

In this PhD under Engineering Sciences category, a lab-scale D-T neutron generator has been developed using a 2.45 GHz ECR ion source (ECRIS), abled to produce 20mA deuterium ion current and a water-cooled rotating tritium target, which produce ~10^{12} n/s. In this device, Neutrons are generated from the nuclear reaction 3H(D, n)4He by bombarding accelerated deuterium ion (D+) up to 300 keV via electrostatic accelerator system on a solid tritium (TiT) target. The rotating tritium target has been designed and developed to handle ~ 6kW heat load due to the beam interception maintaining continuous neutron yield, as well as reduce the sputtering of tritium from tritium target. The other subsystems of this D-T neutron generator are ECRIS, High voltage deck, Low Energy Beam Transport (LEBT) system, Acceleration column, Medium Energy Beam Transport (MEBT) system, 300kV HVPS, Tritium handling & recovery system, and beam & neutron diagnostic systems.

The thesis covers a detailed performance study of the complete experimental setup of the neutron generator. The achieved D+ ion beam current, beam diameter and beam emittance are 19.94 mA, ~20 mm, and 0.19 π·mm·mrad, respectively. The neutron generator has been tested for continuous operation with an average neutron yield of ~7× 10^{11} n/s.