Seminar

Institute for Plasma Research

Title : Comprehensive analysis of ADTYA and ADITYA-U tokamak plasmas using DEGAS2 and UEDGE codes

Speaker : Dr. Ritu Dey
IPR, Gandhinagar

Date : 22 January, 2019 (Tuesday)

Time : 03.30 PM

Venue : Seminar Hall, IPR

Abstract:

The fuel neutrals present in the confined plasma of a tokamak are known to play several important roles in overall performance of the discharge. There exist different sources of neutral entering into the plasma during a discharge, such as: gas-puffs/SMBI/pallet injection, mainly for maintaining the plasma density and the neutral recycling from the limiter/divertor/vessel wall. These neutrals enter in the plasma as a molecule and interact with plasma particles and decide the global plasma parameters. The temporal and spatial variation of electron density and temperature profiles affect the neutral particle penetration inside the plasma. The penetrated neutrals in turn change the radial profiles of temperature and density. Due to the several limitations in measurements of neutrals inside the plasma, simulations are required for thorough understanding of the processes involved in molecular dissociation, atomic ionization/recombination etc.

The neutral penetration in ADITYA and ADITYA-U tokamak plasma has been carried out using DEGAS2 code and the neutral concentration is estimated in case of constant profiles of temperature and density [1]. It has also been shown that the molecules penetrate quite far inside (~ 4 cm) the limiter radius. In an attempt to observe the neutral penetration and subsequent changes in the temperature and density profiles due to gas-puffs, the DEGAS2 code has been coupled with UEDGE, which is a two dimensional edge-plasma fluid transport code. UEDGE, which evaluates the plasma parameters at edge and SOL regions, is implemented for the first time with slab geometry for ADITYA and ADITYA-U tokamaks. The change in plasma density in the edge region due to gas injection has been simulated using the coupled codes. The estimated change in the plasma density is found to be good agreement with that measured using an array of Langmuir probes [2]. Furthermore, from the estimation of the recycled neutrals through the modeling of experimental H-alpha emissivity profile [3], the particle confinement time is calculated for ADITYA plasmas [4], which agrees well with the experimental measurements [5].

References:

1. Dey R. et al, “Investigation of neutral particle dynamics in Aditya tokamak plasma with DEGAS2 code”, Nucl. Fusion, 57 086003 (2017).
2. Dey R. et al, “Studies of edge plasma parameters along with the neutrals of ADITYA-U tokamak using combined UEDGE-DEGAS2 code”, submitted to Nucl. Fusion, 2019.
3. Dey R. et al, “Investigation of atomic and molecular processes in Hα emission through modelling of measured Hα emissivity profile using DEGAS2 in ADITYA tokamak”, under revision in Nucl. Fusion (2018).
4. Dey R. et al, “Analysis of radial profile of particle confinement time estimated from Hα emissivity profile in Aditya tokamak”, under preparation.
5. R. Jha, A. Sen, P. K. Kaw, P. K. Atrey, S. B. Bhatt, N. Bisai, K. Tahiliani, R. L. Tanna and the ADITYA Team, Plasma Phys. Control. Fusion **51**, 095010 (2009).