Seminar

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Institute for Plasma Research

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Title: Experimental Studies of Confinement Improvement, Disruption Mitigations and Runaway Electrons (REs) Mitigations in ADITYA and ADITYA-U tokamak

Speaker: Mr. Rakesh L. Tanna
Institute for Plasma Research, Gandhinagar

Date: 02nd August 2024 (Friday)

Time: 10.30 AM

Venue: Seminar Hall, IPR

Abstract

This thesis presentation focuses on extensive experimental research on ADITYA and ADITYA-U in the frontline areas of magnetically confined hot plasmas, including experimental demonstration of novel disruption and REs mitigations techniques along with experimentation for improving the energy confinement time τ_E of discharges. The experimental challenges addressed in this thesis are considered to be crucial for the safe and secure functioning of future large-scale fusion devices. The learnings from ADITYA tokamak is successfully utilized in designing the ADITYA-Upgrade tokamak and the results from both the tokamaks are compared in terms of error-fields, machine down-time and obtained plasma parameters etc. A novel technique for runaway electrons mitigation, using a local vertical field application is conceived and demonstrated in both ADITYA and ADITYA-U tokamaks, which can be used in large tokamaks like ITER. Furthermore, thousands of discharges are analysed to characterize the disruption in ADITYA, which led to devising novel techniques for their avoidance, such as by application of radial electric field and ion-cyclotron waves, and mitigation through injecting micro-particles using an electromagnetic drive. In absence of a complete physical model describing the energy confinement time of a tokamak plasma, semi-empirical scaling laws are used to obtain its dependency on machine and plasma parameters. A detailed analysis has been carried out to model the achieved energy confinement time in ADITYA and ADITYA-U. Deuterium plasmas are also produced in ADITYA-U tokamak to estimate the mass dependency of energy confinement time.

The overall research work constituting this thesis, which underscores the significant contributions of ADITYA and ADITYA-U to advancing fusion energy research, particularly in optimizing plasma parameters, developing disruption and REs mitigation strategies, and enhancing overall operational safety and efficiency will be highlighted in this presentation.