Development and Validation of an Integrated Tokamak Scenario Modelling Workflow

Abstract

Integrated modelling tools have become indispensable for the design, interpretation, and optimization of tokamak plasma discharges due to their ability to rapidly simulate the coupled evolution of plasma equilibrium, current profiles, energy confinement, particle balance, and auxiliary heating systems. The proposed project aims to develop a comprehensive understanding of a reduced-order integrated tokamak modelling framework and assess its capability for predictive plasma scenario studies. The student will investigate the underlying physical models governing magnetic equilibrium reconstruction, current diffusion, energy transport, and heating/current-drive mechanisms, followed by the simulation of representative tokamak discharge scenarios. Systematic parametric studies will be carried out by varying key operational parameters such as plasma current, density trajectory, auxiliary heating power, and confinement assumptions to evaluate their influence on important performance indicators including stored energy, safety-factor evolution, bootstrap current fraction, confinement quality, and plasma beta. The simulated results will be benchmarked against published experimental observations wherever possible to assess model reliability and predictive accuracy. The work is expected to provide valuable insights into tokamak scenario development while establishing a computational workflow that can support future experimental interpretation and predictive modelling studies.

Academic Project Requirements:

1) Required No. of student(s) for academic project: 1

2) Name of course with branch/discipline: M.Sc. Physics

3) Academic Project duration:

(a) Total academic project duration: 50 Weeks
(b) Student's presence at IPR for academic project work: 2 Full working Days per week

Email to: suman.aich@ipr.res.in[Guide's e-mail address] and
project_phy@ipr.res.in [Academic Project Coordinator's e-mail address]

Phone Number: 079 -079-23962248 [Guide's phone number]