

MHD Equilibrium and Stability Analysis for SST-Bharat Tokamak

Abstract

Magnetohydrodynamic (MHD) equilibrium and stability are fundamental to the successful operation of tokamak plasmas. The design and optimization of advanced tokamak configurations such as SST-Bharat require a detailed understanding of plasma equilibrium under realistic conditions, including shaping effects such as elongation and triangularity. These factors strongly influence plasma confinement, stability limits, and operational performance. This project aims to investigate the MHD equilibrium properties of SST-Bharat and assess their stability against various ideal MHD modes. Such studies are crucial for ensuring stable plasma operation and optimizing coil configurations.

Objectives

The primary objectives of this project are:

- To compute axisymmetric MHD equilibria for SST-Bharat using the Grad–Shafranov solver.
- To analyze the effect of plasma shaping parameters (elongation, triangularity) on equilibrium properties.
- To investigate MHD stability with respect to low-n kink modes and high-n ballooning modes.

Methodology

The project will involve:

- Generation of fixed and free-boundary equilibria for SST-Bharat using equilibrium solvers (e.g., Grad–Shafranov-based codes).
- Extraction of key equilibrium quantities such as q-profiles, magnetic shear, and pressure gradients.
- Stability analysis using ideal MHD stability codes to assess:
 - Low-n kink stability limits
 - High-n ballooning stability boundaries

Expected Outcomes

The project is expected to yield:

- A set of validated MHD equilibria for SST-Bharat under various shaping conditions.
- Identification of stability boundaries for kink and ballooning modes.

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: 32 Weeks

(b) Student's presence at IPR for academic project work: 5 Full working Days per week

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