

Simulation of Vacuum and Plasma Magnetic Fields of ADITYA-U Tokamak

Abstract

The magnetic confinement in a tokamak is decided by the different magnetic fields produced inside a tokamak. In such systems, precise control of magnetic fields is essential to contain and manipulate the plasma. This proposal outlines a research project to simulate the magnetic field through a cylindrical geometry, which will be scaled up and modified to a toroidal shape to better understand the behavior of plasma under different magnetic field configurations, particularly of ADITYA-U tokamak. The primary aim of this project is to simulate the vacuum and plasma magnetic fields in ADITYA-U tokamak.

Objectives:

Simulate the magnetic field distribution inside and around a cylindrical structure with toroidal field coils.

Modify and Scale this model to a toroidal geometry (resembling tokamak designs).

Study plasma behavior under different magnetic field parameters, with a focus on movement of plasma column etc.

Steps:

Magnetic Field Simulation in Cylindrical Geometry: Using numerical methods and Python-based simulation tools, the Biot-Savart equation will be solved to simulate the magnetic field inside and around a cylindrical structure.

Scaling to Toroidal Geometry: Once the magnetic field for the cylinder is modeled, the next step is to extend this simulation to a toroidal geometry, which closely resembles the magnetic field configurations found in tokamaks.

Plasma column position estimation considering plasma as a conductor of different sizes and shapes.

Deliverables:

? Simulation of Vacuum magnetic fields in cylindrical and toroidal geometries with toroidal magnetic field coils.

? Vacuum magnetic fields of ADITYA-U tokamak with all coils.

? Magnetic field structure in ADITYA-U with and without plasma.

Project Duration: Six Months

Academic Project Requirements:

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

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

3) Academic Project duration:

(a) Total academic project duration: 24 Weeks

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

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