Infrared Imaging Video Bolometer (IRVB) Diagnostic for Radiated Power Measurement in Tokamak Plasma

Abstract

The Infrared Imaging Video Bolometer (IRVB) has emerged as a powerful imaging diagnostic technique for measuring the total radiated power loss from magnetically confined plasmas. It can provide spatio-temporal 2D and 3D profiles of plasma radiation from confinement devices. The IRVB technique has been implemented on several plasma devices worldwide and has also been proposed for ITER. The technique offers several important advantages, including immunity to electromagnetic noise from optical signal transmission, a wide spectral response band, radiation hardness for nuclear fusion devices, a wide dynamic range for power-loss measurements, and improved tomographic reconstruction of emissivity profiles with fewer IRVB systems. The IRVB diagnostic systems have been designed and developed at the Institute for Plasma Research (IPR) for the ADITYA, SST-1, and ADITYA-Upgrade tokamaks.

This project aims to study the IRVB diagnostic system for application in the ADITYA-Upgrade tokamak at IPR. The primary objectives include understanding the working principles of IRVB, including radiation absorption, heat diffusion in thin metallic foil, and infrared imaging techniques. The student will perform functional testing of key components, including the absorber foil, pinhole camera geometry, and infrared camera system. Further, the project involves calibration of the diagnostic system, followed by learning operation of the diagnostic system, data acquisition, and analysis techniques.

The scope of work includes learning the fundamentals of the IRVB diagnostic system and heat transfer modeling. The student will be involved in the experimental setup, operation of the system, and acquisition of IR-images. Data analysis will involve solving heat diffusion equations to estimate incident radiated power and reconstruct emissivity profiles using algorithms. This project will provide hands-on experience in advanced plasma diagnostics and contribute to ongoing research in fusion devices.

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

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