

# **Phase change detection of the Intermediate Frequency signal of a Laser Interferometer.**

## **Abstract**

The aim of this project is to demonstrate phase detection in a laser interferometer using a 633 nm laser to measure plasma electron density in a laboratory discharge plasma. The primary goal is to introduce undergraduate students to the fundamentals of lasers, interferometry and plasma diagnostics. The project will provide an understanding of the interaction between electromagnetic waves and plasma, with a particular focus on the change in refractive index caused by free electrons. A stable 633 nm laser will serve as the coherent light source in a Mach–Zehnder interferometer configuration. One beam will pass through the discharge plasma, while the other will serve as a reference. The two laser beams will have a frequency difference of a few tens of MHz. The resulting interference fringes will have this intermediate frequency and will be detected using a photodetector. When plasma is formed in one of the arms of the interferometer, a phase shift is introduced to that particular arm. This phase shift needs to be measured in order to estimate the plasma electron density. Through this project, students will gain hands-on experience in optical alignment, interferometer construction, data acquisition and basic signal analysis. The experiment will demonstrate how interferometric techniques can be used to measure plasma parameters, while also developing practical, experimental, and analytical skills that are relevant in physics laboratories.

## **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: 8 Weeks**

**(b) Student's presence at IPR for academic project work: 4 Full working Days per week**

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