Indian Institute of Technology Delhi

School of Interdisciplinary Research (SIRe)

SIRe Project Number

2025-01-35

(will be assigned by SIRe)

Project Proposal for Ph.D.

Project Details (The research problem must clearly indicate the need for an interdisciplinary approach)	
Project Title	Laser Induced Fluorescence (LIF) diagnostic development for thrust evaluation of a plasma propulsion engine.
Project Summary (Minimum 500 and maximum 2000 characters)	Laser Induced Fluorescence (LIF) is an optical spectroscopic technique where a target atom or molecule is excited with a laser beam, and subsequently the fluorescence emitted by the target is captured by a photo detector to characterize different properties of the target. LIF techniques are popularly used in many applications, e.g. combustion processes to measure flow velocities, pollutant monitoring in environment, study material properties etc. In this project the LIF is proposed to determine the velocity of ion beam based upon the principle of Doppler shift. Knowledge of the velocity of the ions emanating from a plasma propulsion engine (or thruster) is required to derive the thrust imparted by it. The plasma thrusters possess moderate thrust (~ 100 mN) but high specific impulse (~ 3000 s) which made them suitable for rockets exploring deep space mission without a heavy payload. In Plasma Lab, IIT Delhi a plasma thruster has been developed out of a compact ECR source. Unlike the conventional electric plasma thrusters like e.g. Hall or Gridded ion thruster, this plasma thruster does not need electrodes for ion acceleration or any neutralizer; and hence requires low maintenance and lesser payloads. Using Langmuir probe and Retarding Field Energy Analyzer the thrust value was estimated to be 80 mN. However for more reliable measurement a non-intrusive and high resolution technique like LIF is necessary. In the current thruster set up which uses Ar gas as propellant, a tunable diode laser (peak wavelength 668 nm) is going to be used to realize the LIF scheme. In this project LIF set up will be integrated with the plasma thruster determine the spatial variation of ion velocity over the thruster cross section. This would enable to evaluate the integrated thrust and compare the results with that obtained from other diagnostic techniques.

Ph.D. Supervisors
(Supervisor 1 and Supervisor 2 cannot be from the same department of IITD)

Role	Name of Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Debaprasad Sahu	Department of Energy Science and Engineering	dpsahu@dese.iitd.ac.in
Supervisor 2	Joydeep Ghosh	Institute for Plasma Research	jghosh@ipr.res.in

Project requirements (Student qualifications, experience required, etc)
***The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)**

- B. Tech. in Electrical Engineering or M. Tech. Electronics and Instrumentation Engineering or B. Tech. in Electrical Engineering. M. Sc. (Physics) students may also be considered, if found suitable.
- An exposure to optical spectroscopy and components may be preferable.
- Some knowledge of design and fabrication of electrical and electronic circuits is preferable.

Source of fellowship/funding and project number
(CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)

Candidate with his/her own fellowship /institute assistantship

Role of Faculty Members involved:	
Supervisor-1	Prof Debaprasad Sahu, Faculty, DESE, has experience in developing plasma source and electric probe for plasma diagnostics. He will be mentoring the student with the plasma propulsion engine.
Supervisor-2	Prof. Joydeep Ghosh, Head of ADITYA Tokamak (IPR Gandhinagar), has several years of experience in plasma spectroscopy and he will be mentoring the student with the optical spectroscopy requirements in the proposal.