Indian Institute of Technology Delhi

School of Interdisciplinary Research (SIRe)

Project Proposal for Ph.D.

SIRe Project Number

2025-01-24

(will be assigned by SIRe)

Project Details (The research problem must indicate the need for an interdisciplinary approach)	
Project Title	Development of an ion beam extraction system for mini-ELNIBS, a large area plasma device.
Project Summary (Minimum 500 and maximum 2000 characters)	Ion beam extraction from a large volume hydrogen plasma (~ 100 – 1000 m^3) for neutral beam injectors (NBI) for fusion application is a challenging task. The plasma needs to meet certain attributes like high plasma number density (n ~10^{16} – 10^{18} m^{-3}), good plasma uniformity (Δn / n ~ 1-5 %), and high system efficiencies to ensure uniform ion beam profile for efficient fusion plasma heating. Plasma Lab, IIT Delhi has been associated in developing a prototype ECR-based large area plasma source (mini-ELNIBS) and its characterization for the past few years. The lab has recently obtained a relatively large area uniform (40-60 cm diameter), high density (n ~10^{17} m^{-3}) hydrogen plasma in mini-ELNIBS. This proposal expects the student to utilize the mini-ELNIBS plasma device and develop a large area ion beam extraction system for large-area plasma-based ion beam applications. Plasma and beam characterization will be a part of the project.

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) & Contact Number
Supervisor 1	Prof. Ramesh Narayanan	Department of Energy Science and Engineering, Indian Institute of Technology Delhi	rams@dese.iitd.ac.in
Supervisor 2	Prof. Mainak Bandyopadhyay	(Professor in Homi Bhabha National Institute [HBNI], DAE) Scientific Officer- H, DNB Group, ITER-India, Institute for Plasma Research (IPR), Bhat, Gandhinagar, India, PIN 382428.	mainak@iter-india.org mainak.bandyopadhyay@iter-india.org mainakband@gmail.com

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

- M. 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 high power supplies and / or vacuum systems 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. Ramesh Narayanan will mentor the student in planning the beam plasma experiments and their characterization for optimal H-ion extraction in the experimental system already available at IIT Delhi.
Supervisor-2	Prof. Mainak Bandyopadhyay has experience working on the beam extraction grid in the Institute for Plasma Research (IPR), Gandhinagar. The development and integration of this grid will be the most crucial part of this research proposal. Hence, Prof. Bandyopadhyay will mentor the student for the same. The visit of the student to IPR, Gandhinagar, to obtain exposure and training may be needed or a visit of Prof. Bandyopadhyay may be needed from time-to-time.