



Project Proposal for Ph.D.

Project Details (The research problem must clearly indicate the need for an interdisciplinary approach)	
Project Title	Development of Compact D-D Neutron Source based on 2.45 GHz ECR Ion Source
Project Summary (Minimum 500 and maximum 2000 characters)	Compact neutron generators are important tools for neutron imaging, neutron activation analysis (NAA), material characterization, and nuclear science research. Conventional neutron facilities based on research reactors or large accelerator systems require substantial infrastructure, shielding, and operational resources. The development of a compact accelerator-based neutron source can provide a flexible and cost-effective alternative for laboratory-scale neutron applications. This research proposes the development and experimental characterization of a compact deuterium–deuterium (D–D) neutron generator based on a 2.45 GHz Electron Cyclotron Resonance (ECR) ion source. The ECR ion source will be investigated for producing a stable, high-current deuterium ion beam (20 mA), which will be extracted, accelerated, and transported onto a self-loaded deuterium target to generate neutrons through the $D(d,n)^3He$ nuclear reaction. The primary objective is to establish a reliable neutron source with a target neutron yield of (10^9) neutrons per second. The research will encompass the design and optimization of the ECR ion source, ion extraction and beam transport, high-voltage acceleration, target design and thermal management, and neutron yield measurement. Experimental investigations will focus on the influence of microwave power, magnetic field configuration, deuterium gas pressure, extraction voltage, beam current, and target conditions on source performance. The neutron field will be characterized by using calibrated neutron detection techniques appropriate to the expected neutron energy and intensity. The suitability of the developed source for neutron imaging and neutron activation analysis will be investigated through selected demonstration experiments. The proposed work is expected to establish the feasibility of a compact, laboratory-scale D–D neutron generator with improved accessibility, operational flexibility, and potential for wider application in neutron-based research.

Ph.D. Supervisors* (Supervisor 1 and Supervisor 2 cannot be from the same department of IITD)				
Role	Name of Faculty	Date of Superannuation [§] (DD/MM/YYYY)	Academic Unit in IITD/Institute/University	Email ID (Official) & Contact Number
Supervisor 1*	Prof. RAMESH NARAYANAN	30/04/2040	Department of Energy Science and Engineering, Indian Institute of Technology Delhi	rams@dese.iitd.ac.in
Supervisor 2	Dr Sudhirsinh Vala	31/10/2039	Institute for Plasma Research	sudhir@jpr.res.in

*Supervisor 1 must be from IIT, Delhi.

+All cells in this table are mandatory fields that need to be filled by faculty for consideration of proposal.

§The date of superannuation of supervisors should be at least three years from the date of registration of selected candidates.

Project requirements (Student qualifications, experience required, etc) *The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)
B. Tech. / M. Tech. in Electrical Engineering or Electronics and Instrumentation Engineering or Electrical and Electronics Engineering. M. Sc. (Physics) students may also be considered, if found suitable. - An exposure to high power supplies, radiation detectors 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)
CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE or any other scholarship holder students can apply (preferable) If not, then Institute Fellowship (FIA) can be considered.

Role of Faculty Members involved:	
Supervisor-1	Dr Ramesh will serve as a major research partner in the design, development, and optimization of the 2.45 GHz Electron Cyclotron Resonance (ECR) ion source. He will provide primary academic and technical guidance on the ion-source design and plasma-related investigations.
Supervisor-2	Dr Sudhir will provide specialised technical guidance and research support for the development of the compact D–D neutron generator, particularly in ion extraction and acceleration, neutron-production physics, target design, neutron simulation, and experimental characterisation

Note :-

1. Approval from the respective DRC/CRC/ScRC of your Department/Centre/School will be required for using the "Full-time Institute Assistantship (Category-wise) (FIA)" for selecting the students in SRe.
2. Declaration:- Faculty members, please ensure that you have at least 3 years of service left before superannuation along with adequate sitting space & lab facilities for the SRe student.
3. PI/s are also encouraged to submit joint proposals with AIIMS, NII, JNU and institutes with which IITD has an existing MoU. If the Co-PI (Supervisor 2) is from outside IITD, kindly share his/her detailed CV.
4. If a research scholar is to be considered for selection under the project fellowship, then the project should have a minimum of two-year duration remaining.
5. A candidate applying with a valid JRF/INSPIRE/any national level fellowship should have at least two-year validity from the date of joining the Ph.D. program.
6. The third supervisor’s name (if required) can be added only after the formation of Student Research Committee (SRC) subject to a strong recommendation of SRC and subsequent approval from the competent authority.
7. If institute fellowship is being sought then the DRC approval of the parent departments of both supervisors is required at the time of selection.