



Project Proposal for Ph.D.

Project Details (The research problem must clearly indicate the need for an interdisciplinary approach)

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| Project Title                                                    | Vibrational Energy Migration in Protein Polymers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Project Summary<br><br>(Minimum 500 and maximum 2000 characters) | Vibrational energy transfer is the redistribution of vibrational energy from an photoexcitation to other coupled vibrational modes within or between molecular sites. In proteins, once a vibrational mode is excited, energy can redistribute across through-bond or through space contacts, allowing the successful dissipation of thermal energy, and ultimately aiding the maintenance of temperature in a biological cell. How far this energy can be transported in protein polymers is thus far unclear, and will be a central focus of this project. Our approach will be to subject polymers such as microtubules and collagen filaments to Raman spectroscopy, photoexciting artificially introduced bonds with well known signatures. Subsequently, we will study how Raman spectra are altered as a function of conjugated dye concentration, in the presence of local biochemical agents. Our project will hence help answer the question of whether protein polymers, in addition to transporting macromolecules, can also transport thermal energy across the cell. |

| Ph.D. Supervisors*<br>(Supervisor 1 and Supervisor 2 cannot be from the same department of IITD) |                   |                                                     |                                            |                                                                  |
|--------------------------------------------------------------------------------------------------|-------------------|-----------------------------------------------------|--------------------------------------------|------------------------------------------------------------------|
| Role                                                                                             | Name of Faculty   | Date of Superannuation <sup>§</sup><br>(DD/MM/YYYY) | Academic Unit in IITD/Institute/University | Email ID (Official) & Contact Number                             |
| Supervisor 1*                                                                                    | Aarat P Kalra     | 01/09/2059                                          | CBME                                       | <a href="mailto:aaratkalra@iitd.ac.in">aaratkalra@iitd.ac.in</a> |
| Supervisor 2                                                                                     | Soumik Siddhantha | 25/07/2050                                          | Chemistry                                  | <a href="mailto:soumik@iitd.ac.in">soumik@iitd.ac.in</a>         |

\*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)

- One prior publication (including those in pre-print servers) a biophysics or biophysical chemistry related area.
- One year research experience in the broad area of quantum biology.

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

DBT project number: BT/PR52349/BSA/33/158/2024 (CN-20044)  
Title: ‘Harnessing Proteins to Build All-Organic Solar Cells’  
IRIS project number: **20240058 (RP04863)**

Role of Faculty Members involved:

|              |                                                                                          |
|--------------|------------------------------------------------------------------------------------------|
| Supervisor-1 | Will mentor the protein polymer preparation, conjugation and biological sample handling. |
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| Supervisor-2 | Will mentor the instrumentation and Raman spectroscopy thrust of the project. |
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**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 SIRe.
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 SIRe 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.