



Indian Institute of Technology Delhi
School of Interdisciplinary Research (SIRe)



SIRe Project Number

2023-01-24

(will be assigned by SIRe)

Project Proposal for Ph.D.

Project Details

Project Title	Cryo-electron Microscopy of virus capsids during disassembly
Project Summary (Minimum 500 and maximum 2000 characters)	We are working on resolving 3D structures of virus capsids during disassembly, which involves shedding of the protein shells surrounding the viral genome prior to replication. Virus capsids are expected to go through multiple transient conformational states during disassembly and capturing these states in high resolution is expected to lead to development of effective inhibitors. The samples are expected to be conformationally transient and heterogeneous, and we expect to carry out reconstructions without application of symmetry to understand the molecular pathway of disassembly, as well as apply novel denoising/signal improvement techniques to extract pertinent information. The project is suitable for students with a background in Biochemistry/Biophysics/Bioinformatics.

Ph.D. Supervisors

Role	Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Prof. Manidipa Banerjee	Kusuma School of Biological Sciences, IIT-Delhi	mbanerjee@bioschool.iitd.ac.in
Supervisor 2	Prof. Dilip Kumar	Ashoka University	dilip.kumar@ashoka.edu.in

Project requirements (Student qualifications, experience required, etc)

- The student must have B.Tech/M.Sc./M. Tech. degree in Biophysics/Biochemistry/Bioinformatics, with excellent academic records throughout.
- The student must have CSIR-JRF/DBT-A JRF/ICMR JRF/GATE qualification (if applicable).
- Experience in programming, coding, image processing or in biochemistry/biophysics techniques will be desirable

Source of fellowship/funding

(CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)

Candidate with his/her own fellowship/ institute fellowship

Role of Faculty Members involved:

Manidipa Banerjee, IIT-D: Prof. Manidipa Banerjee's laboratory at the Kusuma School of Biological Sciences utilizes cryoelectron microscopy and 3D reconstructions to understand the molecular mechanism of virus-host interaction. The laboratory utilizes a variety of molecular virology, biochemistry and structural biology-based methods for understanding conformational alterations in virus capsids under various conditions. The student will receive training in Prof. Banerjee's laboratory according to protocols established in Azad and Banerjee, J Virol, 2019. A state-of-the-art national cryoelectron microscopy facility established at IIT-D will be available for this work.

Dilip Kumar, Ashoka University: Dr. Kumar's lab in Department of Biology at Ashoka University focuses on deciphering the replication and transcription complexes in pathogenic RNA viruses. Dr. Kumar has expertise in cryogenic electron microscopy (cryo-EM) single particle analysis, and he has determined the structures of rotavirus capping machinery in his postdoctoral project. His group utilizes complementary structural biology techniques such X-ray crystallography and cryo-EM to look the atomic details of viral proteins and complexes. Dr. Kumar also has experience in biophysical methods such SPR, ITC, AUC to understand the kinetics of protein-protein and protein-ligand complexes. His group in close collaboration with Prof. Banerjee's group at IIT Delhi will be working on understanding the virus particles disassembly process, and sorting out heterogeneity, to develop a mechanical understanding in viral replication cycle. In addition to handling an biological project, the trainee in this project will get a perfect platform to learn and develop an understanding the cutting-edge technology of cryo-EM.