Student's projects on acquired structure-functions of viruses

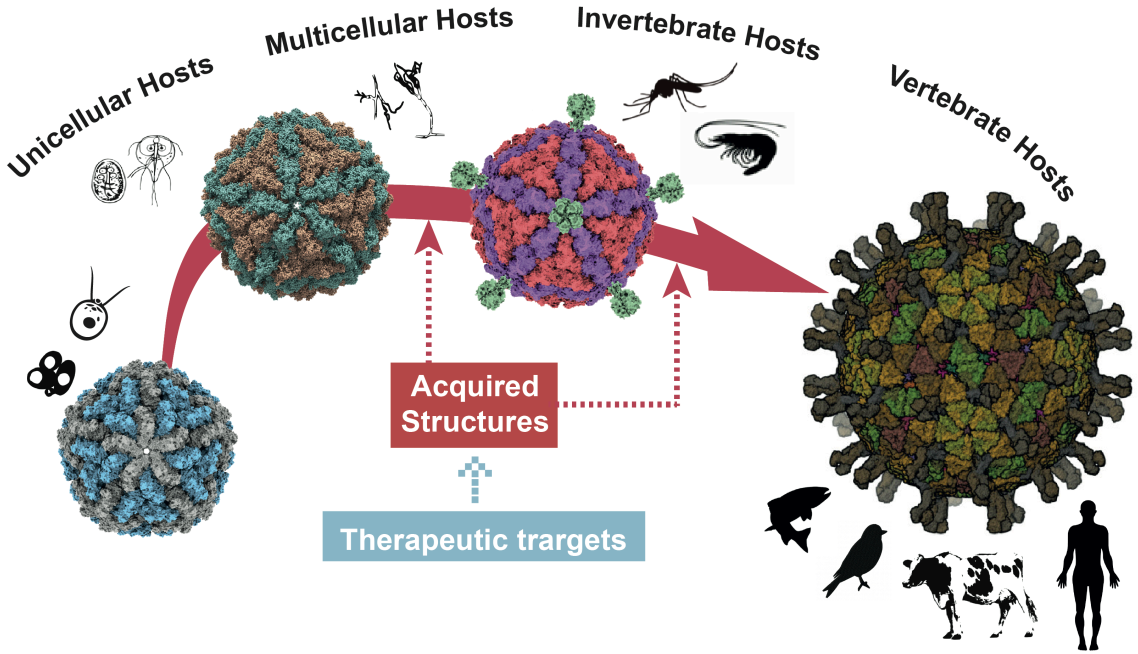
(Master degree project, 30/45/60 hp; Research training: 7/10/15 hp)

"Viruses impact on our health and food resources worldwide. I am looking for motivated students of studying structure-functions of viruses."

In the projects, students will learn following multidisciplinary techniques according to their expectations and interests. **Molecular and Cellular biology:** Cloning and mutagenesis, Fluorescent imaging, qPCR, Protein purification, and Cell culture. **Virology:** Virus detection and titration, Virus purification. Infectious cloning. In situ viral RNA hybridization. Endocytosis assays. **Structural biology:** Cryo-electron microscope imaging. Atomic modeling and the refinement of virus proteins. Structural analysis and rendering. **Biophysics:** DSF (Differential Scanning Fluorimetry), MST (MicroScale Thermophoresis)

Acquired Structure-Functions in Viruses

Over their long evolutionary history, viruses have acquired structural features to adapt to diverse hosts, which can be observed as acquired structural remnants in contemporary viruses. Our extensive structural comparison between the so-called primordial viruses and the phylogenetically closely related viruses in the same evolutionary lineages can reveal **acquired functional structures** in pathogenic viruses that infect higher eukaryotes, such as humans, animals and crops (Okamoto et al., ***Structure*** 2020; Munke et al., ***J Virol*** 2020; ***mBio*** 2021; Wang et al., ***PLoS Pathog*** 2023; ***PLoS Pathog*** 2024). The gain and loss of such structural segments is significant for transmission, immune response, host tropism, and virulence of these viruses.



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We offer the studies on structural acquisitions in artiviruses such as mosquito Omono River virus (OmRV) and shrimp infectious myonecrosis virus (IMNV), and in human flaviviruses such as Dengue virus (DENV) that have originated from invertebrate flaviviruses such as Culex flavivirus (CxFV). To attest our hypothesis using mutagenesis and functional assays, we have generated the first infectious DNA clone of the OmRV (Wang et al., ***Virology*** 2022), IMNV (Hernandez et al., ***unpublished*** 2024) and CxFV (provided by NIID, Japan). Artiviruses pose tremendous economic losses in fishery industry due to their high-mortality to shrimps and fishes, while flaviviruses pose diverse health issues in domestic animals and humans, and therefore, the offered projects will lead to find new precautions of controlling these problematic viruses.

Degree Project Topic 1: Elucidating structure-functions of acquired surface crown protein in shrimp IMNV.

Degree Project Topic 2: Cryo-EM structural studies on CxFV and DENV single-round infectious particle (SRIP).

Research Training Topics: Depends on the students' interests, we will offer studies on following topics.

- Cellular assays for testing in situ nascent single-stranded RNA transcription
- Cellular and molecular assays for testing virus transmission
- In vitro biophysical assays for testing particle stability and protein-protein interactions
- Structural studies on the virus transcription/replication in the atomistic levels

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