Research/degree projects on structure-functions of viruses
(Master degree project/Internship/research training)

“Viruses impact on our health and ecosystem worldwide, and some of them involve in profound biological questions. I am looking for motivated students of studying structure-functions of such viruses.”

GLOBAL-LEVEL IMPACT

1) Host-specific algal viruses
The reported cases of harmful algal blooms are increasing every year globally. Algal blooms are an explosive propagation and a sudden disappearance of a certain algae in an aqueous environment. Host-specific algal viruses control the life-and-death patterns of the algal blooms. The unique surface structural traits that are involved in their host-specific transmission mechanism. The accurate understanding of the transmission mechanisms will find a new way to estimate and even control the population dynamics of harmful algal blooms.

An atomic model of two major groups of host-specific algal viruses in oceans (Anna et al., J Virol 2020; Anna et al., unpublished).

2) Coronaviruses including COVID-19
Coronavirus outbreaks have occurred at least three times in the 21st century. In this year, we have all realized how important to predict potential risks of new coronavirus outbreaks. Our group has kicked off researches on coronaviruses with a support of KAW SciLifeLab COVID-19 action plan. Highly pathogenic coronaviruses are thought to have originated from bat coronaviruses. However, most of them are not yet well characterized regarding their ability to infect human cells. Currently, we are ongoing producing large-scale of a bio-safe virus-like particles (VLP) of COVID-19 and chimeric bat betacoronaviruses. The VLPs can be applied to the study of the binding/infection capabilities of these bat coronaviruses, which will lead to finding their responsible human receptors and classifying their risk and non-risk groups.
3) Giant amoebal viruses
What is the definition of a virus? People often imagine that viruses exist in a very small world. We clearly defined viruses as being different from cellular organisms such as bacteria and eukaryotic cells. However, these definitions grew outdated after the first giant amoebal Mimivirus was isolated. Researchers have reported a large variety of giant viruses in terms of shape and size, including the largest-ever Pithovirus (isolated from the 30,000-years-old core of the Siberian permafrost). Beyond size, these giant viruses possess non-virus-like structural properties similar to bacteria or eukaryotic cells; thus, they blur the lines between viruses and cellular organisms. The massive population of giant viruses in our environment continues to remain a mystery.

4) Mosquito negeviruses
How to form an ellipsoid with one protein? There is an unclassified taxon of the mosquito RNA viruses, negeviruses, that could be a first case of mosquito-borne plant viruses. The particle shape of the negeviruses are very unique, an elliptic core and a short stalk. The elliptic core is made up with one virus protein. Our structural studies of negeviruses have revealed that they dynamically change their elliptic shapes in certain chemical conditions. Such weird structure and the structural changes of the negeviruses could have acquired for propagating themself both in mosquitoes and in plants.

The students will focus on studying one of these viruses according to their potential interest. The students are expected to learn following techniques:

Molecular biology: Cloning and mutagenesis, Immunoblotting, Fluorescent imaging, Baculovirus protein expression system, Gene silencing, RT-PCR and qPCR, Cell culture
Virology: Virus detection and titration, Virus purification, Reverse genetics

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