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SUMMARY of
2015 RESEARCH RESULTS REPORT
For International Collaborative Research with IPR, Osaka University

Research Title		Structural studies on viruses with X-ray lasers and electron microscopy
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	Present Title	Professor
Research Collaborator (Host PI)		Atsushi Nakagawa

Summary

In our collaboration, we aim to study native viruses using ultrafast diffractive imaging with X-ray free electron lasers in combination with cryo-EM. The project tackles single particle imaging of large algae virus, Paramecium bursaria chlorella virus 1 (PBCV-1) in 3D using coherent X-ray lase diffraction imaging (CXDI), and the structural determination of Nam Dihn virus (NDiV), PR772 bacteriophage, and MS2 bacteriophage at near-atomic resolution using cryo-EM single particle reconstruction (SPR). During the grant period, the new worldwide CXDI project, the Single Particle Imaging (SPI) initiative, has been kicked off by Linac Coherent Light Source (LCLS), Stanford Linear Accelerator Center (SLAC) and leading universities including Uppsala University and Osaka University. The SPI project aims for reconstructing reproducible virus particles in 3D as high resolution as possible.

The collaboration was successful and provided three major achievements; First, we developed targeted image classification tools, reconstruction pipelines for CXDI data set of the PBCV-1 and an automated 2D reconstruction tools. Secondary, we reconstructed the large number of the PBCV-1 particles in 2D projections using our developed tools. Tertiary, NDiV, PR772, and MS2 were observed in cryo-freezing condition using energy-filter cryo-EM with direct electron detector and determined the cryo-EM 3D model of the MS2 particle at an intermediate resolution. The cryo-EM data supports the interpretation of diffraction data and Mie scattering data recorded this year at the LCLS (SPI project) and in Uppsala. The results contribute to a work on sample delivery with aerosol injectors for the CXDI.