

Report on ALPS Internship hosted by Azuma Atomic, Molecular, and Optical Physics Laboratory

For my ALPS research internship, I attended the Azuma Atomic, Molecular, and Optical Physics laboratory at RIKEN from September 14-26. The group is lead by Dr. Toshiyuki Azuma and is comprised of several researchers, post-docs, and students. Their research focuses on studying cold chemical reactions relevant to astrochemistry and the chemical evolution of the universe. This work requires experimentally reproducing the environment of space, where molecules can exist in high vacuum and cryogenic temperatures for time periods long enough to reach their lowest vibrational and rotational energy states. Though this kind of environment is difficult to create on Earth, Azuma group accomplishes it in the RIKEN Cryogenic Electrostatic Storage Ring (RICE),¹ which can store ions in a high-vacuum, sub-5 Kelvin environment for extended periods of time. RICE is one of three such cryogenic ion storage rings in the world, with counterparts in Sweden and Germany. These rings are used to study phenomena such as molecular cooling dynamics, rotational and vibrational ground states, and sub-thermal ion-ion/neutral-ion merged beam experiments.

At Azuma-group I assisted with the set up for RICE'S first neutral-ion merged beam experiment. This consisted of the installation of a sputtered-Cesium-based negative ion source and a downstream neutral detector. Following installation, we cooled the ring to 4.2 K and established vacuum at a room-temperature equivalent of 1×10^{-10} Pa, then began finding beam storage parameters.

I enjoyed the hands-on work I was able to perform in the lab, and the great discussions about science I had with the group members. While there is some overlap between my own research in nonlinear optical spectroscopy and the optical components and lasers used in RICE's systems, the ion-beam based chemical physics of RICE is far enough apart from my current field that I found new insights into how molecular spectroscopy can be performed. It was also good to speak with Azuma-san and receive his advice on pursuing a career in science. I have deep gratitude to both the Azuma group and the ALPS program for enabling this opportunity.

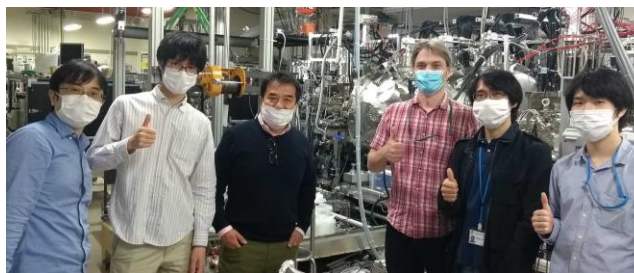


Image: Posing with Azuma-san (third from left) and group members in front of the RIKEN Cryogenic Electrostatic Storage Ring.

1. Nakano, Y., et al. "Design and commissioning of the RIKEN cryogenic electrostatic ring (RICE)." *Review of Scientific Instruments* 88.3 (2017): 033110.