（別紙様式５）

変革を駆動する先端物理・数学プログラム（FoPM）

国外連携機関長期研修　報告書

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I visited Dr. Maarten Zwart's lab at the University of St Andrews in Scotland. This visit is part of joint research between Zwart lab and Akinao Nose's lab at the University of Tokyo. During my visit, I practiced patch-clamp electrophysiological recording from neurons in larval fruit flies.

My research project focuses on how the nervous system maintains muscle relaxation. Animals can generate coordinated movements by contracting muscles in a timely-ordered manner. On the other hand, muscles should be relaxed at other times. How the central nervous system maintains muscle relaxation is a critical but unclear point in motor neuroscience.

We are investigating the mechanism behind muscle relaxation with fruit fly larvae. The fly larval central nervous system is very small and contains about 10,000 neurons. In flies, we can utilize the large genetic line resource and the information of the brain wiring diagram. These tools allow detailed and comprehensive analysis of neural circuits. Fly larvae crawl forward or backward by sequentially contracting muscles along the body axis. We have identified a single class of interneurons in the fly larval ventral nerve cord (~ spinal cord in vertebrates), potentially maintaining muscle relaxation. Since the neuron exhibited tonic calcium activity at the time of muscle relaxation, we named it the tonically active lateral (TAL) neuron. We are curious about the origin of TAL's tonic activity and underlying membrane voltage dynamics. To tackle this question, we decided to perform patch-clamp electrophysiological recording of TAL neurons. In patch clamp recording, a thin glass electrode is attached to the membrane of the target cell body. The resistance between the membrane and the outside of the cell is over giga-ohm. This giga-ohm seal ensures negligible leak current to the outside of the cell. After breaking the cell membrane, you can inject current into the cell or clamp the membrane potential to investigate the electrophysiological properties of the cell.

Zwart lab in St Andrews is a perfect environment to carry out patch-clamp experiments. They are investigating the mechanism of motor control with zebrafish and fruit flies. They have strong expertise in electrophysiology and optical imaging. Moreover, the School of Psychology and Neuroscience of the University of St Andrews has a large division of motor circuit research. Each lab studies motor circuits of different organisms, such as mice, fruit flies, zebrafish, and tadpoles. This diversity makes a suitable environment for discussing our project.

During my stay, I went through all the procedures for electrophysiological recording:

1. I prepare extracellular and intracellular solutions.
2. I set up the patch-clamp recording system by adjusting the alignment of electrode holders and reducing the noise level.
3. I learned the dissection procedure of fly larvae and how to attach the electrode.

Dr. Zwart kindly supervised each process and gave me feedback. After the visit, I better understood the experiments and got the hang of the technique. Now, we are developing our path-clamp rig in Japan. I am going to continue experiments with our new system.

This travel is my first long-term visit outside of Japan. I can get many experiences outside of the research activity. St Andrews is a small town located on the east coast of Scotland. The town is tiny but famous for its old golf course and the university. The University of St Andrews was established in the 15th century and is considered one of the top universities in the UK. University buildings are scattered around the town, and the university is included in daily life. It was a great experience to live in an old college town.

During my stay, I talked with many graduate students at the university. Students and postdocs in Zwart lab kindly taught me experimental procedures and supported my research works. We shared ideas in daily conversations and lab meetings. Students exchanged their opinions rapidly and bravely. I want to follow their

attitude. Furthermore, I joined social events for students and staff in the School of Psychology and Neuroscience. Students planned beer parties regularly and talked about their research and daily lives. It was a great experience to speak with students studying different research fields, such as cognitive neuroscience or psychology. This is also beneficial for improving my English conversation skill.

In summary, this visit gave me many experiences with experimental skills and living abroad. I will continue the joint research between Zwart lab and summarize the results in a research article in the near future. Also, I would like to make the most of my experience for planning my future career. Working abroad is one choice for researchers. The experience during this visit reduced my concern about living abroad, which will surely be advantageous when considering my career after graduation.

Finally, I would like to thank Dr. Maarten Zwart and the lab members for hosting my visit and for their generous support throughout my visit. I want to revisit St Andrews if I have a chance.