（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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My international research experience at the Mechanobiology Institute (MBI) at the National University of Singapore (NUS) in 2025 was a valuable opportunity that enhanced my research skills and deepened my global perspective and cultural understanding.

My research experiences at MBI

The NUS is a world-class institution recognized globally (Figure 1). The campus is equipped with numerous dining halls, shops selling daily necessities, and student dormitories, allowing students to meet most of their daily needs on campus. Additionally, free shuttle buses operate throughout the campus, making it easy to move around, even in the hot and humid climate. MBI, where I was based, is located on the ninth and tenth floors of a campus building (Figure 2). The institute brings together researchers from various fields, including physics, biology, and engineering. This fosters an interdisciplinary environment that encourages innovation and collaboration. Mechanobiology is a scientific discipline that explores how physical forces and mechanical properties influence the growth, behavior, and fate of cells.

I conducted my research under the guidance of Dr. Pakorn Tony Kanchanawong, one of the institute's esteemed principal investigators. His research group is renowned for its innovative projects, especially those focused on developing cutting-edge super-resolution microscopy and studying cell adhesion factors. During my time in his lab, I learned a novel observation technique that the group had developed. This method uses the principle of light interference to improve z-directional resolution, which is traditionally lower than lateral (x and y) resolution in conventional microscopy. The ability to resolve nanometer-scale structures, which is impossible with standard methods, will be a significant asset in my future research. This hands-on experience honed my technical skills and deepened my understanding of the physical and engineering principles underlying cutting-edge biological research.

Conducting research in an international environment was truly eye-opening. It made me realize the subtle yet significant differences between Japanese academic culture and others. It forced me to confront the fact that I had unconsciously become comfortable with, and limited by, "Japanese standards." In this environment, I began to understand the deeper meaning of "divergence," a key concept in our FoPM education. Interacting daily with people from a wide variety of nationalities and cultural backgrounds revealed how different countries and personal histories cultivate unique, multifaceted ways of thinking. Through these conversations, I witnessed firsthand how a mix of diverse perspectives can lead to more creative and robust scientific solutions. This level of intellectual stimulation is difficult to achieve in a more uniform environment. It provided a rich space for new ideas and allowed me to view my research from a broader, more global perspective, including its potential applications in different parts of the world.

Another stimulating aspect of my training was experiencing the “open lab” system. In many Japanese laboratories, each lab unit typically acquires, maintains, and occupies its own equipment. This requires researchers to dedicate significant time to administrative and maintenance tasks. At MBI, however, virtually all research equipment is shared by the entire institute and managed by a dedicated team of specialized personnel. This system frees researchers from time-consuming tasks, enabling us to focus entirely on experiments and data analysis. For instance, MBI's "Core Facilities" offer a variety of cutting-edge equipment that is maintained and operated by experts. This greatly reduces the burden on individual researchers, allowing them to dedicate more time to the actual

scientific process. Both the closed-lab model common in Japan and the open-lab model at MBI have respective merits and limitations. My experience with the open-lab system was overwhelmingly positive. It showed me the efficiency gains possible with centralized resources and specialized support. This is an important lesson that I will carry with me throughout my life.

Participation in the MBI-MPG Conference 2025

During the final week of my international research experience, I had the privilege of participating in the MBI-MPG Conference 2025. The conference brought together a global community of mechanobiology researchers to present their work and foster new collaborations. It was a remarkable opportunity to gain insight into the latest unpublished data, as well as to learn about the authors' unique research styles and personalities. Experiencing the human side of scientific work was invaluable. This experience broadened my perspective on mechanobiology, inspiring new ideas for my research. It also allowed me to expand my international network and consider possibilities for future collaborations.

I also had the opportunity to present my research at a poster session and share my findings with researchers from around the world. Unlike large, impersonal conferences, the MBI-MPG Conference had a wonderfully intimate and collegial atmosphere. This enabled me to have in-depth, one-on-one conversations with excellent researchers. These discussions were intellectually challenging and encouraging. They provided invaluable feedback on my work and sparked new ideas for future research directions. Overall, the conference was an exceptional culmination of my training. It reinforced my connection to the global scientific community and reaffirmed my passion for this interesting field.



Figure 1. NUS campus



Figure 2. Floor map of the building