（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

氏　　名	小河 健介
所属部局	理学系研究科物理学専攻
受入先	University of Washington
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I stayed at Prof. Kai-Mei's laboratory at University of Washington, located in the city of Seattle as a visited student for a month. In particular, I belonged to the Quantum Technologies Training and Testbed (QT3) lab and worked on a diamond quantum processor (DQP) project.

Defects in crystals have historically played an essential role in classical electronic/optical devices. Among them, nitrogen-vacancy (NV) center in diamond has recently attracted significant attention as a quantum sensor or quantum bit because it has excellent optical and spin properties. The QT3 was founded in 2022 by Prof. Kai-Mei and the DQP project aims to realize quantum systems which utilizes a single NV center and its surrounding nuclear spins as quantum memory.

My research theme in PhD course is widefield magnetic field imaging using ensemble NV centers and focuses on applying them to probe condensed matter physics. Therefore, the DQP project is complementary research to my PhD research and believed that it enabled me to deepen my understanding of this field.

In the DQP project, I engaged myself in developing an experiment setup to apply strong and aligned magnetic field in cryostat. Strong aligned magnetic field is essential for quantum information application because it can isolate unused state of NV spin and mitigate undesired effect of nuclear spin. Also, low temperature environment is useful because it lengthens coherence time of NV spin. However, applying strong and aligned magnetic field in this condition is not easy because there is a physical constraint of magnet because of the existence of cryostat.

A previous member of this project conceived a magnet setup to meet conditions and demonstrated it by numerical simulation. I took over it and implemented the setup and evaluated the system experimentally by taking magnetic resonance spectrum of NV center using a confocal system in the QT3 laboratory.

I compared the experimental results and the simulation result of the original plan and found that it was necessary to modify some parameters of the magnet. Also, I conceived an easier way to achieve this goal and proposed it. Due to time constraints, I couldn't achieve the goal, but I believe that my work during the stay will be a concrete step to complete the development.

Besides the experiment I have done, I learned a lot through the activities in the laboratory. For example, on the first day of the stay, I attended the seminar of Prof. Jelezko, who is one of the most famous researchers of NV centers and was visiting the university then, and got to know cutting-edge research of this field. Also, many members in Kai-Mei's lab have various research theme regarding quantum defects such as ZnO donor qubit, integrated photonics and colloidal quantum dots. Listening to various research topics from them broaden my perspective.

It was also a good experience for me to experience directly the differences between laboratories in Japan and those in the U.S. There was a diverse mixture of people in the laboratory compared to Japan, some from the U.S., some from Asia, and some from Europe, and each member has great respect to other member. I also felt that they place more emphasis on teamwork compared to Japan. I want to learn this attitude from them.

This was my first time living alone abroad, so the life there was also interesting for me. Seattle was rich in nature and I enjoyed views of lakes and mountains everywhere. Initially, there were many cases where I couldn't communicate accurately in English, and sometimes I felt disheartened by my lack of proficiency. However, it was good that I gradually became accustomed to speaking English and was able to expand my range of activities.

Finally, I would like to thank Prof. Kai-Mei for accepting me to the laboratory, and Dr. Max Parsons who is the director of the QT3 laboratory for giving me the opportunity to utilize the experimental system.
I appreciate the financial support of the FoPM program. I believe that this internship was precious experiment for me.