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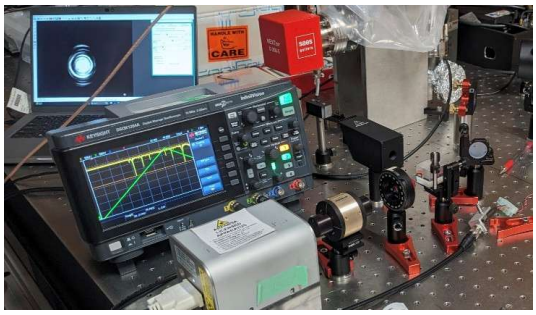
変革を駆動する先端物理・数学プログラム（FoPM）

国外連携機関長期研修　報告書

氏　　名	町永　明海
所属部局	工学系研究科　物理工学専攻
受入先	Australian National University
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From September to November 15, 2025, I spent approximately two and a half months at the Australian National University (ANU), working in the laboratory of Professor Ben Buchler. I normally conduct research on optical quantum memories at the University of Tokyo, but Gradient Echo Memory (GEM) employs a different physical mechanism from the systems I had previously studied. Because of this contrast, I had been interested in gaining hands-on experience with GEM for some time. When I learned that the Buchler group was building up a new experimental platform, I decided that joining the laboratory during this phase would be an ideal opportunity to broaden my perspective.

During my stay, I mainly contributed to the preparation and construction of optical setups for the upcoming GEM experiments. A central theme of the group's efforts was the introduction of machine-learning-assisted auto-alignment. I worked on evaluating automatic adjustment methods for mirrors and lenses, testing feedback algorithms, and examining how these techniques could stabilize the memory operation. In addition, I participated in early-stage experiments using a spatial light modulator (SLM) for wavefront correction. Since I had never worked with SLMs or auto-alignment systems before, gaining practical knowledge of these techniques was one of the most valuable aspects of the training. In particular, wavefront shaping with an SLM is closely related to improving the performance of quantum optical experiments, and learning its implementation will directly benefit my future work.



Apart from experimental activities, I joined the laboratory's journal clubs and weekly meetings. These covered a broad range of topics in quantum optics, nonlinear optics, and precision measurement. Discussing papers with students and researchers from different backgrounds helped me understand alternative approaches to similar problems and broadened my scientific outlook. This environment also provided many opportunities to improve my English communication skills naturally through daily discussions.

Life in Canberra and on the ANU campus was also enriching. The campus is spacious and surrounded by nature, making it a comfortable environment for focused research. The laboratory members were friendly and supportive, which made it easy to adapt to both the research and daily life. Interacting with students from various countries strengthened my ability to communicate across cultures and enhanced my confidence in working in international research environments.

Overall, the training program allowed me to acquire new experimental skills while exposing me to different scientific perspectives. Experiencing GEM firsthand and comparing it with the optical quantum memories used in my home laboratory helped deepen my understanding of both systems. I believe that the knowledge and techniques I gained at ANU will be highly beneficial for the future development of quantum memory research in the Takeda Laboratory. I intend to make full use of the experience and apply it to the advancement of my own research projects.