

MERIT Long-time overseas dispatch report

11th, Applied Physics

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Group : Henning Schomerus, Lancaster University

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Introduction

I recently spent approximately one month at Lancaster University (UK) doing research in Professor Henning Schomerus's group. Professor Schomerus, who previously worked as a research fellow at RIKEN, has ties to Japan and was extremely kind and accommodating. His primary research area is condensed matter physics, covering a range of topics from classical transport phenomena and optical responses to cutting-edge fields like non-equilibrium open systems, where he has achieved significant accomplishments. Given that my research also focuses on non-equilibrium open systems, we shared a natural alignment, and Professor Schomerus was highly interested in discussing it.

Additionally, I received invaluable support from Professor Alessandro Romito and Lecturer Amos Chan, both in other condensed matter theory groups at Lancaster. Their research areas greatly overlap with mine, and we had numerous productive discussions. Overall, I had a highly enriching month.

Research Activities

During my stay at Lancaster University, I achieved two main objectives: (1) presenting a seminar on my research conducted in Japan, and (2) improving the efficiency of numerical simulation for quantum system dynamics induced by measurements.

(1) Seminar Presentation on My Research Conducted in Japan

Just before this overseas visit, I was working in Japan on the spectral analysis of measurement-induced phase transitions, which overlaps with the research areas of Professors Schomerus, Romito, and Chan. I was given an opportunity to present my findings in a seminar. Since the topic was closely related to one of Professor Romito's past papers, he provided valuable feedback and deepened our mutual understanding through post-seminar discussions. Although Professor Chan specializes in a slightly different field, he identified common aspects between his work and mine and actively helped me explore new research themes.

(2) Improving the Efficiency of Measurement-induced Dynamics Calculations

In response to my seminar, Professor Schomerus proposed an innovative idea for fundamentally enhancing the computational efficiency of my numerical simulations. In my program, the QR decomposition posed a bottleneck for scalable computation. This method is widely used globally, but no fundamental improvements had been made so far. Professor Schomerus proposed an elegant approach to avoid QR decomposition by using a trick derived from physical insights. Upon implementing this approach, I observed a significant improvement in computation time, though at the cost of reduced accuracy. However, I realized that by using intermediate expressions before obtaining the final result, I could potentially increase computational accuracy. By doing so, I successfully achieved both faster computation and maintained precision, which I consider a substantial personal accomplishment.

Conclusion

I am deeply grateful to Professor Schomerus for welcoming me so warmly and engaging in discussions as if I were a member of his group. I also extend my gratitude to Professors Romito and Chan for their support, despite belonging to different research groups. Additionally, the graduate students offered invaluable help not only in research discussions but also in guiding me through daily life in Lancaster and the university's systems. This overseas dispatch was immensely rewarding, thanks to the support of many people.



Lancaster Castle, the site of 17th-century witch trials