MERIT Internship (Domestic) Report

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MERIT 4th Student
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Period

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Destination

Superconducting Quantum Circuit Research Group, Physical Science Laboratory,
NTT Basic Research Laboratories

Abstract

I stayed at the NTT Basic Research Laboratories located in Atsugi in Kanagawa for about three months. The theme of research was “Generation of highly-entangled states via adiabatic time-evolution and its application to quantum sensing”. The supervisor of this internship was Dr. Yuichiro Matsuzaki. He is one of the specialists in quantum sensing, and thus we worked on subjects related to quantum sensing.

Research

In order to understand phenomena in a given physical system and to utilize them as functional devices, it is important to precisely estimate unknown parameters in the system. Especially, it is of importance to estimate as precise as possible within a given time for practical application. We can perform such high-precision measurement by using quantum systems, of which precision outperforms that utilizing classical systems. We call this quantum-based measurement quantum sensing or quantum metrology.

In this internship, we consider two topics: high-precision measurement using properties of quantum many-body systems and that using quantum control theory. Especially, we consider to use the criticality of quantum many-body systems and to use shortcuts to adiabaticity.

Results

We found that we can perform high-precision measurement by using the criticality of quantum many-body systems. This result was shown by analytical calculation and confirmed by numerical simulations. We also found the possibility of high-precision measurement using shortcuts to adiabaticity. These results will be summarized in the papers, respectively.

I found that theorists and experimentalists discuss each other much frequently in NTTBRL than UT and learned importance to care about experiments not to be a paper plan. This experience is really useful for my career.

Acknowledgment

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