

Report of MERIT Long-Term Dispatch

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Overview

I participated in the workshop “Topological Quantum Matter: Concepts and Realizations” at Kavli Institute for Theoretical Physics (KITP). In this report, I describe my research and daily life in Santa Barbara.

Research

The mathematical notion “topology” plays a key role in physics, especially condensed matter physics. Recently, considerable effort has been devoted to exploring topological materials.

One can diagnose topological phases of matters by topological invariants which characterize topological features. In general, it is difficult to compute topological invariants by following the definitions. However, when spatial symmetries exist, it is effortless to diagnose topological phases partially by using information of spatial symmetries. A prototypical example of this relation is Fu-Kane formula. This formula can compute topological invariant of insulators from eigenvalues of the inversion symmetry. In recent years, this idea has been generalized to all combinations of crystalline symmetries, called symmetry indicators [1]. This method is a basis of recent comprehensive surveys of topological materials among existing crystal structure databases [2-4]. As a result, thousands of materials candidates have been discovered.

Another typical example of topological materials is the topological superconductor. A hallmark of topological superconductors is the presence of robust surface states which correspond to Majorana fermions. These Majorana excitations might be harvested for topological quantum computation. The topology in superconductor helps us to understand the superconductivity. For example, nodal structures of unconventional superconductors are closely related to their topologies.



Figure 1: The discussion with a participant of the workshop.

However, there are no comprehensive methods to discover topological superconductors. Then, I discussed how to extend the method of symmetry indicators to other systems such as superconductors [5] with other participants of the workshop.

Daily life in Santa Barbara

The air of Santa Barbara is arid, and it has not rained for the term I have visited. Moreover, near KITP is very safe, and there are many roads for only bicycles (called bike path). For these reasons, I haven't felt any stress.

I have been to Solvang on a holiday. At that time, "Danish Days" was held, which is an annual event to celebrate Danish folk traditions. I had "Æbleskiver" which is one of the traditional foods of Danish. Indeed, Æbleskiver is made by using almost the same cookware as Takoyaki. (Fig. 2)



Figure 2: Display of Æbleskiver.

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References

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