

【Grant-in-Aid for Scientific Research (S)】

Science and Engineering (Mathematical and Physical Sciences)



Title of Project : Variety and universality of bulk-edge correspondence in topological phases:
From solid state physics to transdisciplinary concepts

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Research Area : Mathematical and Physical Sciences

Keyword : Bulk-edge correspondence, topological phases, cold atoms, ARPES, photonic crystals

【Purpose and Background of the Research】

Many of the topological phases do not possess characteristic bulk observables which are experimentally accessible. Non-trivial feature of the phase is the existence of generic “edge states” that are localized near the system boundaries or impurities. This relation is the “bulk-edge correspondence” that has been successfully applied for various systems not only for solid state physics.

Based on the previous successful project by 3 groups of theoretical physics, cold atoms and ARPES experiments working together to establish “universality of the bulk-edge correspondence”, we extend the project to include groups of photonic crystals and mathematicians in the new project.

We further pursuit universality of the bulk-edge correspondence in various phases not only for quantum world, that is, some of them are classical. We also try to establish transdisciplinary concepts putting a focus on the bulk-edge correspondence in collaboration with people in wide area such as mathematics and engineering.

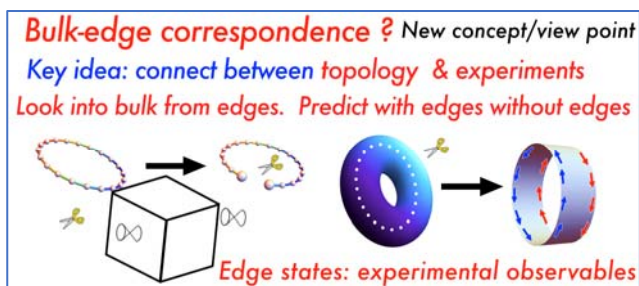


Figure 1: Bulk-edge correspondence

【Research Methods】

Theoreticians and experimentalists in condensed matter physics, cold atoms and photonics as well as mathematicians are working together sharing a common interest for the bulk-edge correspondence. Through the brainstorming discussion, we try to reach a breakthrough in some of the concrete problems. Based on the new results in each field, further developments are expected with close and informal communication between the groups. To achieve the goal, we regularly organize informal meetings among the group members including

young scientists and students. To make the project international and encourage international collaboration, several international workshops will be organized as the important project activities.

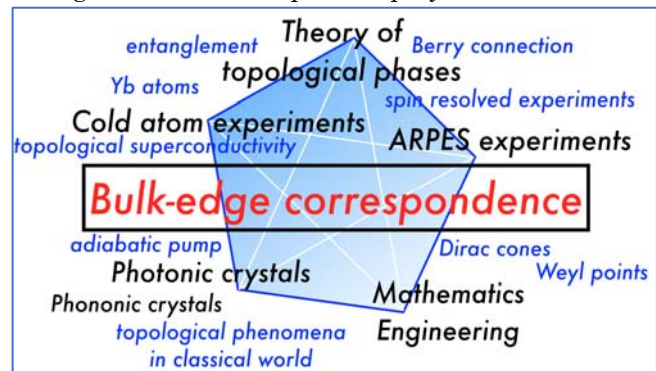


Figure 2: Scheme of the project

【Expected Research Achievements and Scientific Significance】

Since the project members of the project possess unique technique and are well-established in each field, informal communication between them putting a focus on the single interest-shared topic “bulk-edge correspondence” will be certainly productive. We also expect “unexpected” achievements based on the close collaboration over different areas. Our final long-term goal is to establish transdisciplinary sciences based on the bulk-edge correspondence. The present project paves a way to this ultimate goal.

【Publications Relevant to the Project】

- Y.Hatsugai, “Chern number and edge states in the integer quantum Hall effect”, Phys. Rev. Lett. **71**, 3697-3700 (1993)
- Y.Hatsugai, “Edge states in the integer quantum Hall effect and the Riemann surface of the Bloch function”, Phys. Rev. B **48**, 11851-11862 (1993)

【Term of Project】 FY2017-2021

【Budget Allocation】 157,800 Thousand Yen

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