Topology in the Momentum Space and Emergent Phenomena: From Electrons to Waves in Solids

Shuichi Murakami[1,2,3]*

[1]*Department of Physics, Tokyo Institute of Technology, Japan*

[2] *TIES, Tokyo Institute of Technology, Japan*

[3] *CREST, JST, Japan*

**Email of Presenting Author: murakami@stat.phys.titech.ac.jp*

The idea of topological phases in solids has been initiated by the discovery of the quantum Hall effect in solids, and has been applied to various systems. Here the wavefunctions have nontrivial topological structure in the momentum space. One of the recent and famous examples in solids is a topological insulators, which has been proposed theoretically and later confirmed experimentally. Because this idea is based on wave nature of electrons, it has also been applied to various waves, such as photons, magnons, and so on.

In the present lecture, we review some theoretical backgrounds of the topological phases in electronic systems, and explain how the idea of topological phases can be applied to metamaterials. In particular, we explain the quantum Hall effect as a typical example of the topological phases, and explain how the topological number is related with edge states. Then we show how the analogous edge modes can be designed in photonic, magnonic, and plasmonic crystals.