# 論文の内容の要旨

# Photoinduced phenomena in organic conductors

# （有機導体における光誘起現象）

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Photoinduced phenomena have become a central focus in recent condensed-matter physics, with numerous studies utilizing light. However, most of these studies has focused on toy models or two-dimensional systems, such as graphene, silicene, and transition metal dichalcogenides. In contrast, bulk materials have been largely overlooked in this area of research. To further advance this promising field, it is crucial to expand the range of target materials. Theoretical studies on real bulk materials with complex crystal and electronic structures are highly desirable.

In this context, we investigate photoinduced phenomena in the organic conductor α-(BEDT-TTF)$_2$I$_3$. Employing two different methods, perturbation theory and Floquet theory, we uncover novel photoinduced phenomena categorized into (i) topological phase transitions and (ii) photovoltaic effects.

In (i), using Floquet theory, we demonstrate three distinct topological phase transitions: a transition to the Chern insulator phase induced by circularly polarized light, the pair annihilation of magnetic charges in momentum space induced by linearly polarized light, and a novel type of photoinduced topological phase transition induced by elliptically polarized light. We explore the reasons behind these photoinduced phase transitions and discuss the feasibility of experimental observation.

In (ii), we examine two nonlinear optical responses: the shift and injection

currents. Predicting the dependence of these currents on the frequency of light using perturbation theory, we find that the direction of these currents strongly depends on the frequency. Furthermore, we delve into the nonperturbative effects on these currents using Floquet theory.

These findings highlight that α-$(BEDT\text{-}TTF)_2I_3$ is a unique material offering a rare opportunity to explore a variety of photoinduced phase-transition phenomena. This work expands the scope of target materials for research on photoinduced phenomena, contributing to the development of optical manipulations of electronic states in condensed matter.