Research Plan

Shohei Uemura

I will proceed with research on the following two topics.

Phenomenology of generalized CP/CP-like symmetry

The origin of the CP-violation in the SM is unclear. CP is violated only through the weak interactions, and it is conserved in the strong interactions. While CP-violation is a necessary condition of the matter dominant universe, CP-violation in the SM is too small to reproduce the observed value of the baryon asymmetry of the universe. They imply that CP-symmetry and its violation corresponds to beyond the SM physics.

Generalized CP symmetry can be an origin of CP-violation, if it is CP-like. CP-like transformation is a transformation which includes non-trivial interchanges of particles and antiparticles which are not related by complex conjugations. CP-like symmetric models contains CP-violating process [H. Ohki, SU, (2023)]. I will apply it to phenomenology. I will construct a CP-like symmetric model which can be a origin of the dark matter and baryon asymmetry. We will also consider a origin of CP-like symmetry. There are following three possibilities of origin of CP-like symmetry:

1. Spontaneous symmetry breaking of internal symmetries.
2. Gauge symmetry and Lorentz symmetry in higher dimensional space-time.
3. Modular symmetry.

I will investigate how to embed CP-like transformation into these symmetries and its phenomenological implications.

String Phenomenology

The low energy effective theory of string theory has various discrete symmetries such as flavor symmetries and modular symmetries. They are perturbative symmetry and non-perturbative effects of the superstrings can violate them. Non-perturbative effects of strings are partially understood, e.g. D-brane instanton. While there have been investigations into how modular symmetry can be broken by these effects in specific models [S. Kikuchi et al. (2022)], I will investigate it in more general models, and determine the actual subgroups that emerge.