Research plans

I am working on quantum field theory and superstring theory. I am interested in how our universe is described by these theories.

I have been studied formal aspects of matrix models which are the candidates of non-perturbative formulations of superstring theory, and also noncommutative gauge theory which is a powerful tool of investigating matrix models. One of their applications to cosmology is to describe the cosmological singularity like the big bang.

I) I develop the framework to introduce the stringy effects into inflation models.

Tachyon condensation means a scalar field rolling along an unstable direction in its potential which is of interest in inflation. Thus,

I-i) I derive closed string tachyon condensation from matrix theory dual description, especially from IIB matrix model. This would place inflation in the UV complete framework.

If we aim at realizing our universe on D-branes, the localization of gravity on D-branes is one of the most significant subjects to be verified. In our studies [4,5] by using noncommutative gauge theory, we have shown that two point correlation functions of graviton vertex operators constructed by supersymmetry transformations in IIB matrix model behave as massless gravitons on D-branes. This result provides us a simple localization mechanism of gravity theory like a Randall-Sundrum scenario. As a development of these analyses,

I-ii) I calculate multi-point correlation functions in order to realize the interactions of four dimensional gravity theory. Non-gaussianity in the fluctuations of the cosmic microwave background would be estimated through the investigation.

II) I am interested in string phenomenology.

Intersecting D-brane models are promising models to describe the standard model of particle physics. It is interesting to construct the model which consistently works with the inflation scenario.

III) I investigate the quantum structure of the black holes.

Black hole entropy is understood by the stringy degrees of freedom. However, each microscopic degree of freedom of black holes is not well understood and many subjects remain to be unsolved. One of the approaches to solve these subjects is to use the gauge/gravity correspondence. I investigate the relations between matrix models and black holes and shed light on the questions concerning black holes.