

Research Plan

Reiji Yoshioka

I will develop my research further. In the studies for matrix model, the central target is about the emergence of four-dimensional spacetime and the unified treatment of elementary particles. In the studies of conformal field theory and its relevant fields, the main theme is the correspondence with the gauge theory. I will progress this research by using the relation to the integrable models and the techniques of matrix model.

Matrix Model

- Emergence of Four-Dimensional Spacetime

USp matrix model was proposed as the constructive definition of T^6/\mathbb{Z}_2 compactified type I superstring theory. The model is given from IIB matrix model by matrix orientifolding that preserves the maximal supersymmetries. My current research suggests that the four-dimensional spacetime emerges by the attractive force acting between the spacetime points in the USp matrix model. I will study spontaneous breaking of Lorentz symmetry for the matrix models by studying the effect of fermionic part of the action, which has no physical meaning clearly. This study relates closely to the stability of emerging spacetime.

In addition, I would like to clarify the natural interpretation for the origin of USp algebras. For this purpose, I will discuss the physical process from IIB matrix model to USp matrix model.

- Behavior of Matter

The above studies aim purely to clarify the spacetime structure in the USp matrix model. In addition, We will study the behavior of the matter in this spacetime. In order to introduce the matter, it is necessary to add the matrices belonging to the fundamental representation of the USp algebra to the model. The matter and spacetime are described in the same standpoint. That is, both relate mutually and intimately and then the matters affect spacetime and vice versa. After adding the matter fields, We will study the eigenvalue distribution and calculate the partition function etc. and then I would like to study the influence of matter to spacetime structure.

AGT

In two-dimensional conformal field theory, Virasoro algebra generating the conformal symmetry has the deep relation with the Calogero-Sutherland model. Jack symmetrical polynomial which describes the excited states of this model corresponds to the singular vector in Virasoro algebra. In the relation with four-dimensional gauge theory, so called Gaiotto state which constructs Nekrasov partition function can be expressed by using Jack symmetrical polynomials. Similar discussions are also available for the q -deformed Virasoro algebra. In this case, Macdonald symmetrical polynomial appears instead of Jack symmetrical polynomial and the conformal field theory corresponds to five-dimensional gauge theory.

In the conformal field theory with current algebra symmetry, I expect that there is correspondence with supersymmetric gauge theory via appropriate integrable system and the correspondence can be studied by taking a limit of the parameters in q deformed Virasoro algebra can. I will clarify this correspondence and also the relation with five-dimensional gauge theory.