

Research Plan

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I will develop my research further. In particular, I will study about tensor models and the 2d-4d(5d,6d) connection.

Tensor model

The tensor model appears as a natural extension of the matrix model. The tensor model has received much attention recently in relation to the low-dimensional AdS/CFT correspondence and further research is desired. I have been studying non-trivial sets of operators in tensor models using Op/FD/dessin correspondence and generalized cut operation. Here the dessin is a graph embedded on a two-dimensional surface and has geometric meaning of corresponding to triangulation of the surface. On the other hand, the cut operation generates another operators from one operator and it is also the basic element that constitutes the Virasoro/ $W_{1+\infty}$ constraint together with join operation. Therefore, the cut & join should be also the two dimensional geometric operations if the Op/FD/dessin correspondence is correct. I will clarify the geometric meaning of cut & join operations, and deepen our knowledge of the Virasoro / $W_{1+\infty}$ constraint of the tensor model.

Since correspondence with dessin is limited to rank 3 tensor models, I will explore the possibility of extension to general ranks. In addition, I aim to make further progress with a view to applying Op/FD(/dessin) correspondence to quantum field theory beyond the tensor model.

2d/4d(5d,6d) connection

I will study the AGT relation which states that there exists correspondence between two-dimensional conformal field theory (CFT) and four-dimensional supersymmetric gauge theory. This correspondence is lifted to the 2d/5d correspondence by q -deformation. The original 2d/4d correspondence can be reproduced in the limit $q \rightarrow 1$.

Since the q -Virasoro/ W_N algebra appears in the level N representation of Ding-Iohara-Miki (DIM) algebra, it is considered that the DIM algebra plays an important role behind the 2d/5d connection. The DIM algebra is a kinds of q -deformation of $W_{1+\infty}$ algebra. I will construct the families of matrix models which have the constraints for $W_{1+\infty}$ algebra as the Schwinger-Dyson equations. Based on these research, I will generalize to the DIM algebra. It is expected that the interesting models, such as the Chern-Simons matrix model and ABJM matrix model, belong to the class satisfying the constraints for the DIM algebra. In addition, I will consider its correspondence to the gauge theory.

In a classical limit of the theory of the both side in 2d-4d connection, two different integrable models, the Gaudin model from 2d side(CFT) and the Heisenberg model from 4d side(gauge theory), are obtained. Therefore the 2d-4d connection suggests that there exists a relation between these integrable models. I would like to consider the classical limit of the parafermionic coset CFT and the supersymmetric gauge theory in ALE spacetime and study the corresponding integrable model.