Research Plan

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I will promote the research for the tensor models and the 2d / 4d (5d, 6d) correspondence.

Tensor model

The tensor model appears as a natural extension of the matrix model. The tensor model has received much attention in relation to the low-dimensional AdS/CFT correspondence and further research is desired. I have been studying non-trivial sets of gaige -navariant operators in tensor models by 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, corresponding to to triangulation of the surface. On the other hand, the cut operation generates other operators from one operator and it is also the basic element that constitutes the Virasoro constraint together with join operation. As mentioned in "Research Result", the efforts of the cut & join operations on dessins are clarified by the Op/dessin correspondence. Its two-dimensional geometric meaning was also revealed. I would like to utilize these results for deepening our knowledge of the Virasoro constraint of the tensor model.

Since the correspondence with dessin is limited to the rank 3 tensor model, I will explore the possibility of the 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/5d(6d) correspodence and elliptic DIM algebra

I will study the 2d/5d(6d) correspondence, which is an extended version of the 2d/4d correspondence (AGT correspondence) between two-dimensional conformal field theories and four-dimensional supersymmetric gauge theories. The 2d/5d correspondence is obtained by the q-transformation of the 2d/4d correspondence. The 2d/6d correspondence corresponds to the elliptic 2d/5d correspondence. In the limit where the elliptic parameter $p \to 0$, the 2d/5d correspondence is reproduced, and in the limit where the deformation parameter $q \to 1$, the 2d/4d correspondence is reproduced.

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. There is also a known prescription for extending to elliptic DIM algebra, which can be used to extend to 2d/6d correspondence. I will clarify the role of the (elliptic) DIM algebra and establish the understanding of the 2d/6d correspondence. It is expected that the 2d/4d(5d) correspondence can be understood as a special limit of the 2d/6d correspondence. In addition, I would like to clarify the whole picture, including the root of unity limit which I have established in the previous research.

The elliptic DIM algebra itself is also very interesting. The (elliptic) DIM algebra yields the (elliptic) Macdonald operator. The $q \to 1$ limit of the (elliptic) Macdonald operator is the (elliptic) Calogero-Sutherland model. As mentioned in "Research results", in the root of unity limit of the q-Virasoro algebra, the enhancement to the supersymmetric Virasoro algebra is observed. By considering the root of unity limit of 1 in the elliptic DIM algebra, it is expected to help us understand various many-body models in a unified way.

According to Langmann, in the elliptic Calogero-Sutherland model, the elliptic parameter can be related to the temperature. This suggests that the 2d/6d correspondence may be regarded as a 2d/5d correspondence at finite temperature.