Research Plan

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Matrix model

As mentioned in the "Research Results", I have obtained phase diagrams for an extended GWW model with two coupling constants, successfully identifying phase transition lines corresponding to the Argyres-Douglas singularity in gauge theory [Paper List 2]. However, details regarding the correspondence remain unclear. Currently, investigations into extended models with three or more coupling constants are progressing [Paper List 1] and the data of the matrix model side is accumulating. I would like to establish a clear correspondence. It is also necessary to clarify the significance of each phase and triple point in gauge theory. Through these studies, I hope to build a bridge toward understanding the full structure of the correspondence between gauge theory and matrix models.

I have considered the irregular limit of the β-A_{n-1} type multi-matrix model and revealed part of the rich mathematical structure of this model [Paper List 3,4,5]. However, with the currently used method, only two of the $2n$ mass parameters can be taken to the infinity limit and three or more are not possible. This is why in the limit to the $N_f \leq 2n-3$ models, we face the difficulty that the size of the matrix, which also appears as an important parameter in correspondence with gauge theory, goes to infinity. It is expected that this difficulty can be resolved by deforming the model using the spin chain technique, which is closely related to this matrix model. I would like to realize $N_f = 1$ and $N_f = 0$ models in the A_1-type ($n = 2$) case.

I also want to continue research on 2d/5d(6d) correspondence, which is an extension of 2d/4d correspondence [Paper List 11,14,15,16]. 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.

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 gauge -navariant operators in tensor models by using Op/FD/dessin correspondence and generalized cut operation [Paper List 6,7,8]. Here the dessin is a graph embedded on a two-dimensional surface and corresponds 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.