Summary of research

Yutaka Yoshida (Kavli IPMU, Univ. of Tokyo)

Research on quantized Coulomb branch in 3d $\mathcal{N} = 4$ gauge theory

First we briefly explain backgrounds of researches of Coulomb branch. In 3d $\mathcal{N} = 4$ supersymmetric gauge theories, there are two types of moduli spaces of vacua; one is the moduli space of Higgs branch defined by the expectation values of of scalars in the hypermultiplet, the other is the moduli space of Coulomb branch defined by the expectation values of scalar in the vector multiplet and monopole operators. The Higgs branch does not receive any quantum corrections. On the other hand, Coulomb branches receive (non-perturbative) correctiones and it has been difficult to determine the structure of Coulomb branch moduli space.

In 2015 and 2016, there is breakthrough about research on Coulomb branches and their deformation quantization called quantized Coulomb branches by Bullimore–Dimofte–Gaiotto (BDG) in supersymmetric gauge theory and also by Braverman-Finkelberg-Nakajima (BFN) in mathematics. BFN defined quantized Coulomb branches in terms of Borel-Moore homologies of a moduli space associated to the gauge group and its representation. They also defined quantized K-theoretic Coulomb branches in terms of K-theory instead of Borel-Moore homology. On the other hand, BDG determined the quantized Coulomb branch by the restriction of the gauge group to the maximal torus and 3d mirror symmetry. In general, these two constructions are expected to agree each other.

Since BDG used 3d mirror symmetry, quantized Coulomb branches have not been directly derived in literature of supersymmetric gauge theory. In order to derive quantized Coulomb branches directly, we have constructed 3d supersymmetric gauge theories on an omega background [1]. Moreover we have formulated supersymmetric localization[1] for these theories and evaluated correlation function of scalars and monopole operators. We have revealed that the operator product expansions for scalars and monopole operators realize quantized Coulomb branches. Here we have found that omega background parameter is the Planck constant for the deformation quantization.

References

[1] Takuya Okuda and Yutaka Yoshida, "SUSY localization for Coulomb branch operators in omega-deformed 3d N=4 gauge theories," arXiv:1910.01802 [hep-th].

[1]Supersymmetric localization is a method to perform the path integral. When the localization is applied to the theory, one can perform the path integral without approximation.