Research Plan

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Quantized K-theoretic Coulomb branch in supersymmetric gauge theory

In our previous research [1], we have shown that the algebras of monopole operators and scalars in 3d $\mathcal{N} = 4$ gauge theories are isomorphic to the quantized Coulomb branches. In our future research, we are going to find the physical observables in supersymemtric gauge theories which correspond to quantized K-theoretic Coulomb branches by Braverman-Finkelberg-Nakajima and give new insight on the structure of K-theoretic Coulomb branches.

First, a candidate for quantized K-theoretic Coulomb branch in a supersymmetric gauge theories is given by "An algebra of Wilson-'t Hooft loops (Wilson loops, 't Hooft loops, Dyonic loops) in a 4d $\mathcal{N} = 2$ supersymmetric gauge theory on $S^1 \times \mathbb{R}^3$. "

The reason for the above expectation is following. In the limit where the radius of S^1 is zero, i.e., dimensional reduction, a 4d $\mathcal{N} = 2$ gauge theory is reduced to a 3d $\mathcal{N} = 4$ supersymmetric gauge theory. In this limit, Wilson loops wrapping on S^1 is reduced to scalars, 't Hooft and Dyonic loops are reduced to monopole operators. Then the algebra of scalar and monopole operators becomes quantized Coulomb branch. Since the algebra of loop operators on $S^1 \times \mathbb{R}^3$ is regarded as trigonometric deformation of the quantized Coulomb branch corresponding to 3d gauge theory, this trigonometric deformation leads to K-theoretic uplift of quantized Coulomb branch.

The algebra of these loop operators can be read off from supersymmetric localization technique. For example, when gauge group is $U(n)$, one can show that the algebra of a mass deformation of 4d $\mathcal{N} = 4$ gauge theory is isomorphic to a spherical Double affine Hecke algebra of $\mathfrak{gl}_n$ type which is a trigonometric deformation of spherical rational Cheredinick algebra that appear as a qunatized Coulomb branch. Therefore we conjecture that K-theoretic Coulomb branch for this theory is isomorphic to the spherical Double affine Hecke algebra of $\mathfrak{gl}_n$ type. In similar manner, we can determine the algebraic structure of loop operators in other gauge theories and predict the algebras of quantized K-theoretic Coulomb branches.

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].