

plane wave matrix model による $\mathcal{N}=4$ 超対称 Yang-Mills 理論の 非摂動的定義について¹

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The AdS/CFT correspondence, which is a conjectured duality between type IIB superstring on $AdS_5 \times S^5$ and $\mathcal{N} = 4$ Super Yang-Mills (SYM), has been intensively studied over a decade. Although it has passed a number of nontrivial consistency checks, it has not been proven yet. This is partially because it is a strong/weak coupling duality. It is, therefore, relevant to give a nonperturbative definition of the $\mathcal{N} = 4$ SYM which should enable us to study its strong coupling regime. One promising candidate for such a nonperturbative definition is the lattice gauge theory. However, it is difficult to construct a lattice gauge theory compatible with supersymmetry.

In [1], based on the work [2], we realize $\mathcal{N} = 4$ SYM on $R \times S^3$ nonperturbatively as the theory around a certain vacuum of PWMM [3]. We restrict ourselves to the planar limit so that we make use of the large N reduction [4]. We provide a matrix regularization of the planar limit of $\mathcal{N} = 4$ SYM on $R \times S^3$, where the size of the matrices plays a role as the UV cutoff. Because PWMM is a massive theory, there is no flat direction, so that the vacua of PWMM are stable against perturbative fluctuations. Our regularization keeps the gauge symmetry and the $SU(2|4)$ symmetry, which is a subgroup of the superconformal symmetry $SU(2, 2|4)$. In particular, 16 supersymmetries which are half of the original 32 supersymmetries are preserved in our regularization. The restriction to the planar limit and the 16 supersymmetries are probably sufficient to suppress the UV/IR mixing. They also completely stabilize the vacua of PWMM. The full $SU(2, 2|4)$ symmetry should be restored in the continuum (large matrix size) limit. By performing the one-loop analysis and comparing the results in the continuum $\mathcal{N} = 4$ SYM, we obtain some evidence that our regularization for $\mathcal{N} = 4$ SYM indeed works, although our final goal is to analyze $\mathcal{N} = 4$ SYM nonperturbatively by using our regularized theory.

参考文献

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