BMN Operators from Wilson Loop

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The AdS/CFT correspondence is a conjecture that type IIB superstring theory on $AdS_5 \times S^5$ is equivalent to the four-dimensional $\mathcal{N} = 4$ super Yang-Mills theory (SYM). Since this conjecture was proposed, lots of aspects of it have been investigated. In particular in [1] the correspondence between exited string states and certain local operators (BMN operators) of SYM are proposed. On the other hand there is another interesting connection between string theories and gauge theories, that is the correspondence between the Wilson loop operator and the string field. The authors of [2] argued that the Hamiltonian of the string field can be derived from the loop equation of the Wilson loop of the type IIB matrix model. So it is interesting to study the correspondence between the Wilson loop and the string field in the context of the AdS/CFT correspondence. We discussed such correspondence from two points of view.

• BMN Operators from Wilson loop

First we showed that the BMN operators can be derived by expanding the Wilson loop of four-dimensional $\mathcal{N} = 4$ SYM with respect to the loop fluctuations [3]. The Wilson loop we considered depends on ten coordinates. The extra six directions correspond to the six scalar fields of the SYM. So the expansion of the Wilson loop quite resembles to the expansion of the string field with respect to the string states. We also discussed that locally supersymmetric condition is necessary to derive the correct BMN operators corresponding to the transverse eight fluctuations of the string.

• Loop Equation of Four-Dimensional $\mathcal{N} = 4$ SYM[1]

The aim of this work is to investigate the correspondence between the loop equation of four-dimensional $\mathcal{N} = 4$ SYM and the Hamiltonian of the string field on $AdS_5 \times S^5$. We derived the explicit form of a loop equation as the first step of such an investigation. In order to derive the loop equation, we must extend the Wilson loop operator to include the fermionic fields and we also need to introduce the Grassmann coordinates accordingly. We have succeeded in deriving a rather simple form of loop equation [4]. The relation between our loop equation and the Hamiltonian of the string field is under investigation.

References

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[1] This part of the talk is based on the work with H.Hata [4].