Summary of my works

Superstring theory is unified theory of elementary particle and gravitation. It will describe physics of early universe and quantum nature of space-time. However, in order to investigate these subjects, we must develop non–perturbative treatment of this theory.

String Field Theory is one of such non–perturbative formulations of string theory. Especially, Chern–Simon string field theory (CSFT), proposed by Witten, is a string theory version of Chern–Simons gauge theory. In Witten's famous work on Chern–Simons gauge theory, various knot or link invariants are derived. From this fact, CSFT will describe topological nature of string theory.

In fact, there exist classical solutions of CSFT, called "Universal Solutions", which is found by T. Takahashi and S. Tanimoto. Moduli space of this solutions corresponds to moduli space of flat connections in Chern–Simons gauge theory.

On the other hand, a lot of works have been done about unstable D–branes. Unstable D–branes decay into stable vacuum, and this process is called "Tachyon condensation". The moduli space of universal solutions is known to have some singularity, corresponding to this stable vacuum.

I and Takahashi have found some important results about universal solutions listed below.

In paper 2, We expanded CSFT around universal solutions, and gauge fixed it using BRST procedure. On singularity of moduli space, we found that physical states have ghost number 0 or -1, therefore they cannot contribute physical scattering amplitudes. This result implies that open strings disappear with unstable D–branes.

In paper 3, we have derived closed string scattering amplitude emitted from D–branes, using gauge invariant closed string operator. All calculation have been done with no approximations, since we have constructed the conformal map from flat open string world sheet (ρ–plane) to upper half complex plane (z–plane). Furthermore, we have derived this amplitude using an oscillator expression of the closed string operator.

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