

# Tachyons in Compact Spaces

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In this talk, we propose a prescription which seems to be applicable to a general kinds of tachyon condensations. It has been believed that the final state of a tachyon condensation can be obtained by following the corresponding RG flow induced by a relevant operator related to the vertex operator of the tachyon. This prescription works well when the relevant perturbation does not change the central charge of the worldsheet theory. On the other hand, when one considers a generic closed string tachyon condensation, the corresponding perturbation would decrease the central charge, and the consistency of the final state as a string theory is not clear.

Our proposal for describing tachyon condensations is the following. The RG flow of a two-dimensional field theory *coupled to gravity* describes an *on-shell* tachyon condensation. This proposal is based on the fact that a CFT coupled to gravity can be regarded as a string theory by identifying the Liouville mode of the worldsheet metric as a coordinate field of a string. When one considers a generic two-dimensional field theory coupled to gravity, the corresponding string theories for UV and IR limits are different, and the RG flow connecting them would describe a time-dependent background describing an on-shell condensation.

We apply this prescription to a specific string theory; Type II string theory compactified on  $(S^1 \times T^2/\mathbf{Z}_3)/\mathbf{Z}_3$ . It is easy to check that this string theory has tachyons which are localized at singularities of the  $T^2/\mathbf{Z}_3$  orbifold. It is easy to find a two-dimensional field theory coupled to gravity which corresponds to the above string theory. By perturbing this theory by a relevant operator, this flows into an IR fixed point which corresponds to a supersymmetric compactification of Type II string theory. This implies that some of vacua with closed string tachyons can be stabilized via tachyon condensations.

The prescription explained above is a worldsheet description of tachyon condensations. Since we claim that it describes an on-shell process, it is expected that there is the corresponding classical solution of the low energy effective theory. We assume a simple form of the effective action which is expected to describe tachyon condensations, and find that there exists a classical solution which has some properties related to the worldsheet RG flow. One of the interesting observations is that the dilation field becomes non-trivial after the condensation.

We also discuss a condensation of a bulk tachyon since our prescription seems to be applicable even in this case. The relevant operator corresponding to the bulk tachyon is the unit operator. By analogy with the case of open string tachyons, we expect that the pair-annihilations of closed strings may occur during the condensation. It is not clear what happens during the bulk tachyon condensation. One possible final state of the condensation would be the one in which a kind of D-branes is the fundamental degrees of freedom.