Wrapped supermembrane on vanishing 2-torus[1]

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M-theory includes the supermembrane in 11 dimensions [2] which is expected to play an important role to understand the fundamental degrees of freedom in M-theory. Actually, it was shown that the supermembrane in 11 dimensions, or $\mathbb{R}^{10} \times S^1$, is related to type IIA superstring in 10 dimensions by means of the double dimensional reduction [3]. On the other hand, type IIB superstring is related to type IIA superstring via T-duality, or type IIA superstring on $\mathbb{R}^9 \times S^1$ leads to type IIB superstring on $\mathbb{R}^{10}$ in the shrinking limit of S^1. Hence, type IIB superstring in 10 dimensions is to be deduced from supermembrane on a vanishing 2-torus.

Schwarz showed an $SL(2,\mathbb{Z})$ family of string solutions of type IIB supergravity [4]. The (p,q)-strings [4, 5, 6] are considered to be the bound states of the fundamental strings (F-strings) and D1-branes (D-strings) in type IIB superstring. Furthermore, it was pointed out that the supermembrane which is wrapping p-times around one of two compact directions and q-times around another direction gives a (p,q)-string, which was, however, not derived directly from the supermembrane action. In this talk we consider shrinking the 2-torus to approach type IIB superstring. Actually we deduce type IIB superstring, or F-string from the wrapped supermembrane on $\mathbb{R}^9 \times T^2$ in the lightcone gauge by taking a proper shrinking limit of the 2-torus. And we also obtain (p,q)-strings by taking another shrinking limit of the 2-torus.

The plan of this talk is as follows. We consider the supermembrane on $\mathbb{R}^9 \times T^2$ in the lightcone gauge with a successive shrinking of the two cycles of the 2-torus. Using the area-preserving diffeomorphism (APD) of the spacesheet we first deduce a free F-string action on $\mathbb{R}^9 \times S^1$, which corresponds to type IIA superstring winding around the compactified one spatial direction, and hence the shrinking of the S^1 leads to type IIB superstring. Next we consider another shrinking limit of the 2-torus to deduce a free string action with (p,q)-string tension.

References

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[1] This talk is based on [1]