D-branes and doubled geometry

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A very important tool in unravelling the non-perturbative theory unifying all string theories is T-duality. However, this useful equivalence principle is still poorly understood in all but the simplest scenarios. Recently a new framework has been developed in a series of papers by Hull and collaborators (see, e.g., [1, 2]) which unifies T-dual sigma models in a geometric description. In this picture, different target spaces of the sigma model are obtained as local projections from a so-called "doubled geometry", on which the group of transition functions includes T-duality transformations. The "doubled metric" defined on this geometry is constructed from the physical background fields (metric and antisymmetric B-field) in a way reminiscent of Buscher's rules.

Since the nonlinear sigma model is invariant under T-duality, one can define a "doubled" nonlinear sigma model on the doubled geometry, from which the physical sigma models may be obtained as projections in different local frames. This projection involves the choice of a polarisation, i.e., a choice of physical local coordinates. The dual coordinates, which were included in the picture through the initial "doubling," are then eliminated by imposing a certain self-duality constraint, analogous to the T-duality map relating dual to original coordinates.

The closed string doubled sigma model was introduced in [2], and in [3] we defined the open string version of their model, which requires the addition of a boundary term. One may define D-branes in the doubled space as boundary conditions of this model, and we derived these conditions in all generality. We then demonstrated a systematic method to derive and classify D-branes in the doubled geometry, by solving the boundary conditions and imposing consistency under global transformations including T-duality. We applied this analysis to a doubled flat three-torus with constant H-flux (a standard toy model in flux compactification, with associated doubled background fields worked out in detail in [4]), and showed how the D-branes obtained on the doubled space correspond to well-defined physical D-branes in those patches where a locally geometric projection to physical space exists. The branes we found correspond in the H-flux local frame to physical D0-, D1- and D2-branes, while D3-branes are prohibited.

References

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[2] C. M. Hull and R. A. Reid-Edwards, to appear

[3] C. Albertsson, T. Kimura and R. A. Reid-Edwards, "D-branes and doubled geometry," arXiv:0806.1783 [hep-th]

[4] G. Dall'Agata, N. Prezas, H. Samtleben and M. Trigiante, "Gauged supergravities from twisted doubled tori and non-geometric string backgrounds," Nucl. Phys. B **799** (2008) 80-109, arXiv:0712.1026 [hep-th]