

Problem set # 2

1) Using the massless field content of Type IIB, find the set of BPS branes which are electrically and magnetically charged under the various massless fields. Notice the appearance of the D(-1) brane. What is its magnetic dual?

2) Write down all possible central charges which can appear in the superalgebra of the following models: a) Type IIA b) Type IIB c) Heterotic theories. For each central charge identify its corresponding BPS brane and comment on the BPS bound. Are there any missing charges?

3) Using the relations between the string coupling and string length of Type IIB at strong coupling to that of the dual Type IIB at weak coupling, verify the following: a) The tension of the D5 brane is mapped to the tension of the NS5 brane b) The opposite: tension of NS5 mapped to tension of D5 c) The tension of the D3 brane is an invariant d) What is the tension of the S dual to the D7 brane? How does it scale with the string coupling?

4) Derive the gauge invariant combination which appears each time a brane ends on another brane for cases a-d of problem 1 in problem set 1. Recall that for the case of a fundamental string, $F1$, ending on a Dp brane, the gauge invariant combination was $F \cdot B$ where F is the 2-form field strength living on the brane and B is the 2-form gauge field in the bulk that couples electrically to the $F1$. Specify the gauge variations in each case.