Week 7 (due May 18)

Reading: Terning chapter 9.

1. (a) Consider $N = 1$ super-Yang-Mills theory with gauge group $SO(N_c)$. What is the non-anomalous R-symmetry in this theory? Write down the analog of the Veneziano-Yankielowicz superpotential and determine the number of SUSY vacua that the theory has.

(b) Repeat (a) for gauge groups E_6, E_7 and E_8. Hint: all the necessary group theory facts can be found in a review by R. Slansky, "Group theory for unified model building".

2. Consider $N = 1$ SUSY gauge theory with gauge group $USp(2N_c)$ (the group of unitary symplecitc $2N_c \times 2N_c$ matrices) and $2N_f$ chiral superfields in the fundamental (i.e. $2N_c$-dimensional) representation. The number of chiral superfields must be even to avoid non-perturbative gauge anomaly; we discussed this anomaly in the special case $N_c = 1$, when $USp(2) = SU(2)$. Take the tree-level superpotential to be zero.

(a) Determine for which values N_f and N_c the theory is asymptotically free. Determine the charges of the chiral superfields with respect to the unique non-anomalous R-symmetry.

(b) Find the dimension of the classical moduli space as a function of N_f (Hint: determine the unbroken gauge symmetry at a generic point in the space of SUSY vacua and figure out how many chiral superfields are eaten by the super-Higgs mechanism).

(c) Find the analog of the Affleck-Dine-Seiberg superpotential. Determine the range of N_f for which it applies. Show that within this range the superpotential destabilizes all the classical vacua.