Problems 4

Frank Wilczek

April 25, 2003

1. Calculate the renormalization of the Higgs field self-coupling due to its interactions with gauge bosons, fermions, and itself. Find the algebraic condition that insures the effective stays positive at large scales. Then put in numerical values, and express your result as a condition on the Higgs mass.

2. One might expect that if this coupling goes negative there is no stable ground state, since it parametrizes the leading behavior for large field strengths. See if you can make this argument rigorous. Specifically, how are the states with arbitrarily low energy constructed, concretely ?

3. Compare the predictions for renormalization of m_b/m_τ in minimal versus supersymmetric unified gauge theories. Which works better?