Homework 5, due Thursday, April 10, 2008

Problem 1 (10 Points)

Consider a complex scalar with scalar potential

\[ V(\phi) = -\mu^2 |\phi|^2 + \lambda |\phi|^4. \]

Show that for particular values of the coupling constants the gauge symmetry is broken. What is the mass of the corresponding gauge boson?

Problem 2 (10 Points)

Fill in the calculations for the masses of the neutral Higgs bosons, \( h \) and \( H \) discussed in class.

Problem 3 (10 Points)

Show that the spectrum of the O’Raifeartaigh model obeys the sum rule \( \Sigma (-1)^F m^2 = 0 \).

Problem 4 (10 Points)

The Georgi-Glashow model is a SU(2) gauge theory with a (3 component) Higgs field \( \phi \). Assuming that \( \phi \) gets an expectation value, determine the masses of the gauge bosons. Identify the photon and the \( W^\pm \) bosons. Is there a candidate \( Z \) boson?