

Topic 15 – The Higgs Mechanism

Pre-Lecture Reading/Post-Lecture Summary

We will begin with a brief summary of where we are to date. This will include a catalog of free Lagrangians and a reminder of the introduction of interactions through the localization of internal (or gauge) symmetries. We then recall the two outstanding issues with the electroweak part of the story, i.e. the absence of mass terms for gauge bosons and matter fermions in the fully $SU(2)_L \times U(1)_Y$ symmetric version of the theory, both being in stark contrast to experimental observation. To address this, we will introduce a complex scalar Higgs field which we will (as a simple example) couple to a $U(1)$ symmetry with the usual gauging procedure. Allowing the Higgs field to take on a nontrivial background configuration, we will find that in addition to new massive and massless scalar fluctuations (particle), we now have massive gauge field fluctuations...this despite that the underlying theory is gauge invariant. This is the Higgs mechanism for mass generation! Then you will leave and be happy.