Particle Physics 2020 Final Exam

Due Thursday May 7th at 5:15pm (email it to me at aflourno@mines.edu)

Feel free to write up or type up your answers.

This was a hard course that likely covered a lot of new and complex ideas. If you are feeling as if you could not possibly recount all of the details of what we have done, please don't worry. The truth is that no one usually does. Rather what happens is that we study something like this, learn it a bit, then feel like we forgot it all. That is, until we go to learn or use it again later, in which case we realize that it is all a bit easier the second time through. I do not expect that any of you will leave this course knowing how to calculate a Feynman amplitude "off the couch", nor should you be able to recite the intricate form of a Higgs'ed Lagrangian. But what I do want you to leave this class with is an ability to talk about the big picture of what you saw and worked with. So to that end, I want you to answer each of the questions below qualitatively. There is no need to pull out fancy equations. Imagine you are trying to explain to an undergraduate physics major what types of things they could learn about in particle physics. If you are not enjoying this exercise, then you are missing the point.

**1)** What is a group? What is a representation of a group? Why are either of these important for particle physics?

**2)** What is special relativity?

**3)** What is a spinor?

**4)** How are the Dirac, Proca and Klein-Gordon equations related?

**5)** What is a gauge theory?

**6)** Explain the Higgs mechanism. Why do we need it? What does it do?

**7)** Explain what you are doing when you draw and evaluate a Feynman diagram and what role Fermi's golden rule plays.

**8)** What are the similarities/differences between QED, QCD and the weak interactions.

**9)** WTF is renormalization, and why does it matter?

**10)** And just because I said so….please draw a turtle.