Physics 129 Final Project

Fall 2020

Learning Objectives

- Work with real particle physics data from various sources, including datasets from real experiments and material property values from the PDG.
- Apply the computational knowledge you have gained throughout the course to analyze data.
- Apply the theoretical knowledge you have gained throughout the course to draw conclusions from your analysis results.
- Report your results in a technical report with formatting and citations that adhere to standards in the field of particle physics.

Overview

In lieu of a final exam this semester, you will be completing a final project. This project is designed to reinforce concepts you have learned throughout the course while also requiring you to employ the computational skills you have developed while completing the homework assignments. The project will involve two pieces: a computational component that expands upon the work you have done in the python notebooks this semester and a technical report that summarizes your findings. There are four available projects from which you are free to choose, though you are also free to email *both* the Professor and the GSI and propose your own project, subject to approval from both of us. The four available projects are:

1. Discovery of the Higgs Boson at ATLAS
2. Measuring Parity Violation in Electron Scattering
3. Measuring Properties of the Z boson using CMS data
4. Designing a Calorimeter with a Monte Carlo Model of Electromagnetic Showers

Feel free to look through the notebooks of each of the projects before you decide which one you want to do. Please note that Project 4 requires some computational techniques that may be unfamiliar to you, but we are happy to teach you these techniques. It is a fun project that is different in spirit from the other three.

Instructions

The final projects are available as Jupyter notebooks just as the homework assignments have been throughout the course. You are only required to complete one of these four projects. First, complete your analysis in Python or whatever language you choose and acquire all of your results. Be sure to answer every question in the notebook, and save your work and your figures often. Once you complete your analysis, write up your results in the form of a technical paper much like you would see in physics journals such as the Physical Review Letters (PRL) or Nuclear Instruments and Methods in Physics (NIM). **Please use LaTeX to write your report.** A template for a sample PRL write-up can be found here. This template is encouraged, but it is not required. If you do not have easy access to LaTeX, please contact the GSI and/or the Professor. Make sure that all plots in your paper have legends, axis labels, titles, and figure numbers, and make sure to cite all of your technical sources properly.

You may consult with other students, peers, and co-workers for guidance on this project, however all of the work you submit must be your own. This means you may **not** share code, TeX files (besides templates), or any plots that you include in your paper. The project is due on **Friday, December 18 at 5 PM PST**. Submit **all of your code files and a PDF file of your write-up** to bCourses by this deadline. This is the very end of finals week, so we will **not** be accepting late submissions. *Once the assignment deadline is reached, the bCourses assignment will close. Do not wait until the last opportunity to submit your project.* There will be office hours and workshops dedicated to the final project during RRR week. The full workshop schedule will be announced later on bCourses. We encourage you to attend these if you have questions at any point along the way. Good luck!