

Description

This is the outline for an AIMS course covering the basics of particle physics and data analysis. It is contextualized primarily in the LHC. The analysis techniques learned are those of event-based analysis.

Details

- Timeline : Three weeks (2 hours lecture per day, 1 assignment per week)
- Resources : Open source software only
- Students : Math skills, overconfident, some very smart
- Check the Arturo physics school with Venezuela
- Possible funding from Physics Without Frontiers in ICTP?

Title :

Dead and Alive - The Life of a Particle

Abstract :

This course introduces students to the basic physics concepts involved in the high energy particle physics research carried out at the CERN laboratory in Geneva, Switzerland. We will start by reviewing particle physics and how we mathematically describe the interactions of things that we cannot see directly. This will lead us to explore both the worlds of quantum mechanics and special relativity and view the world from a probabilistic point of view. We will then connect this new world perspective to the experiments occurring at the Large Hadron Collider and learn how concrete predictions are made using this new world view. This will lead us to develop the idea of the Monte Carlo method as a broad tool, with the aim here of making testable predictions. This ability to make predictions will be put to use in the second phase of the class where we will discuss how measurements are actually performed at the LHC by performing data analysis with the goal of analyzing real data from CERN. Finally, we will learn how to transform the analyzed data into a physically meaningful physics measurement by the use of inferential statistics. This will allow us to tie the technical measurement back to the initial physical model of the world we used to make predictions.

This course assumes some knowledge of physics (e.g. conservation of energy) but attempts to focus on the computational aspects to develop computing skills. This is focused around the three main concepts of (i) the Monte Carlo method , (ii) event-wise data analysis , and (iii) statistical inference/analysis. The tools that they will be using are Python and C++ based and in particular will use the ROOT (<https://root.cern.ch/>) package that is the standard set of tools for high energy particle physics.