The Art of Scientific Computing: Neutrinos

Innes Bigaran

February 21, 2018

1 Overview

Neutrinos are a key component of the Standard Model (SM) of particle physics. They rarely interact with other matter as they only interact weakly and via the gravitational force, which is very weak on the subatomic scale. In order to investigate these rare interactions, neutrino beams can be used to produce a high concentration of neutrinos. The existence of neutrino mass is not predicted by the SM, therefore neutrinos are regularly studied in the search for new physics beyond the SM. Here, you will investigate the physics of neutrino mass as determined from experimental measurements.

2 Prerequisites and key skills

Linear Algebra, Calculus 2 (differential equations and integration), First-year physics, or equivalent.

3 Overview

1. Neutrinos in single β decay
   (a) Line-fitting
   (b) Error propagation
   (c) Data processing
2. Monte-Carlo simulation of a neutrino beam
   (a) Uniform/Non-uniform distributions
   (b) Monte-carlo simulation
3. Defence against the dark arts
   (a) Numerical DE solving
   (b) Analytic solutions