Radiative Correction Framework
A Quick Start Guide

Fady Shaker

February 8, 2022

Contents

0.1 Introduction

This document will walk you through how to use and modify the radiative correction framework starting from creating the particle guns till producing the efficiency ratios required for a fake data study.

The full code is accessible at:
`https://github.com/f-shaker/radiative_correction`
and the generated root files for the analysis are available at:

0.1.1 Framework Overview

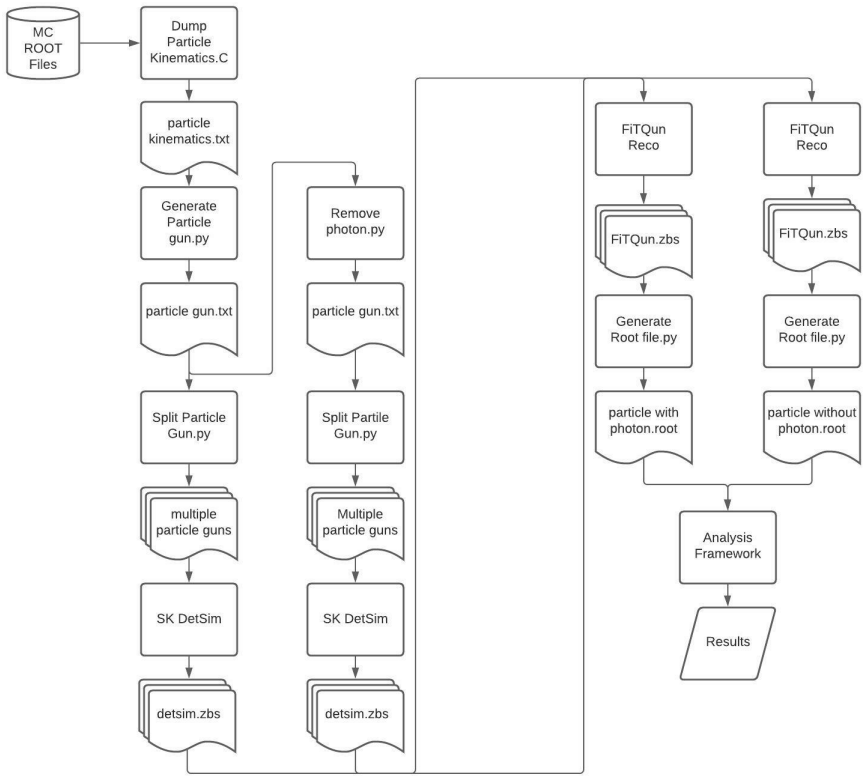

Figure 1: Radiative Correction Framework

0.1.2 Creating the Weight Branches

The main idea is to merge the two root files: lepton kinematics with photons (radiative) and lepton kinematics without photon (non-radiative) to produce a realistic particle gun. The created mixed-weighted root file must, at least, has a new branch that indicate if this event is radiative or not. It can also calculate the correct radiative (non-radiative) weight as well as the oscillation probabilities. However this functionality is currently overwritten in the main code. To produce the mixed weight files, use the following function

Listing 1: Creating Weight Branch Example

```
/*void create_weight_branches(std::string in_file_name,
bool is_sim_gamma,
fq_particle i_particle,
bool is_antiparticle)
*/
create_weight_branches(``muplus_ginft180_5e4.root",
true, MUON, true)
create_weight_branches(``muplus_init_5e4.root",
false, MUON, true)
// then use hadd -f muplus_g_weighted.root
 muplus_ginft180_5e4.root muplus_init_5e4.root
```

Bibliography

[1] Konosuke Iwamoto. *Neutrino Oscillation Measurements with An Expanded Electron Neutrino Appearance Sample in T2K, 2017.*

[2] Kevin McFarland and Konosuke Iwamoto. *Radiative CCQE and T2k's Oscillation Analyses, 2018*

[3] A. De Rujula, R. Petronzio and A. Savoy-Navarro *Radiative Corrections to High-Energy Neutrino Scattering. Nucl.Phys. B154 (1979) 394. CERN-TH-2593.*