Physics Object & Data Analysis School (PO&DAS) 2023 – DESY, Hamburg

POG exercise: MUONS

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MUO-POG Exercise

In this session, we will start by introducing some basic concepts about muons: what they are, the sources of muons in CMS, the muon reconstruction algorithm, and the criteria used to select interesting muons for analyses.

After that, you can familiarize yourself with muons in three tasks resembling real analysis tasks:

The first exercise will get you familiar on how to handle muons in CMSSW: looking at a Drell-Yan simulated sample, you will learn to recognize the different sources of muons and how to use identification methods to classify them.

In the second exercise, you will study the resolution of the muon reconstruction, using $Z \rightarrow \mu\mu$ events as a standard candle. Then, using the same sample, you will try different identification methods and decide which one is more appropriate.

In the third exercise, you will learn how to compute the corrections to cover the difference in efficiency between data and simulated events, using the tag and probe method.

Objectives

- Learn how muons are reconstructed and identified in CMS
- Handling the muon object in CMSSW
- Familiarize with the terminology of the different identification methods
- Learn how the tag&probe method is used to compute muon reconstruction/identification efficiencies using the MUO official code

Structure of the exercise

Section 1: ~1h long, taken from this short DAS exercise

pat::muon object in miniAOD
- edmDumpEventContent an example file (DY MC)
- plot muon variables interactively using ROOT
- Write and run a simple EDAnalyzer (starting from draft in this repo)

Extra (option 1) reco-GEN matching, trigger matching
Extra (option 2) python implementation of the analyser

Section 2: ~1.30h long, taken from this short DAS exercise

Write an EDAnalyzer (again starting from draft in this repo) to
- select muons in DY MC from Z boson decays
- implement GEN matching
- compare generated and reconstructed Z mass distributions
- look at the impact of different muon ID requirements (Loose, Medium, Tight etc) on the resolution

Section 3: ~1.30h long, taken from this pyHEP hands-on session

Run the spark_tnp code, developed by the Muon POG, on a SWAN notebook
- 2018 data vs DY MC
- Compute and plot identification efficiencies (i.e. TightID / TrackerMuons)
- Discuss the results

SOFTWARE REQUESTS:
- Section 1-2: CMSSW
- Section 3: SWAN notebook connected to spark served