Plotting BIB from FLUKA

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with many thanks to Camilla Curatolo and Francesco Collamati, who provided the initial inputs

Detector performance meeting, 14/02/2023

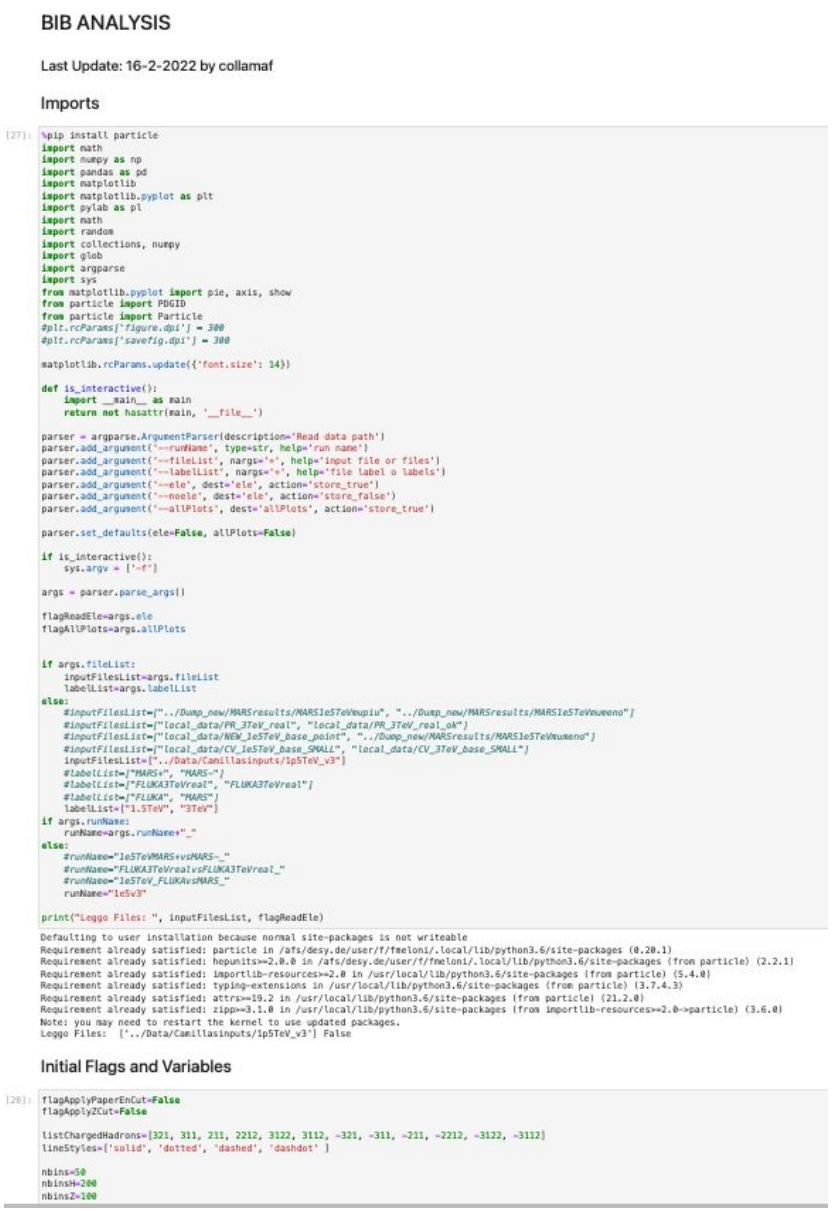
Restoring code and setting up for the future

In preparation for the EPJC report, we had to harmonise the style for a few BIB plots with the rest of the paper.

Got FLUKA input files used for Snowmass reports from Nazar/Camilla and previous plotting scripts from Francesco.

Reworked (and strongly simplified) code structure.

- Still as notebook, but can now be broken in scripts



BIB ANALYSIS

Last Update: 16-2-2022 by collamaf

Imports

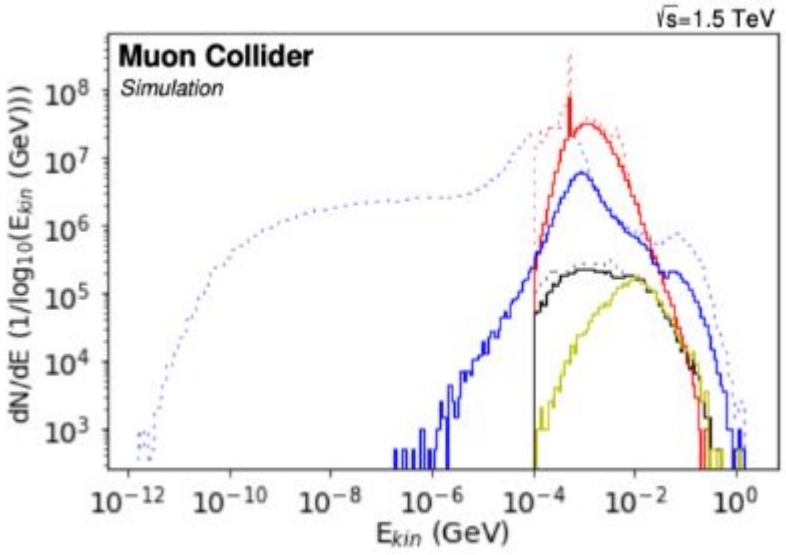
```
%pip install particle
import math
import numpy as np
import pandas as pd
import matplotlib
import matplotlib.pyplot as plt
import pylab as pl
import math
import random
import collections, numpy
import glob
import argparse
import sys
from matplotlib.pyplot import pie, axis, show
from particle import PDGID
from particle import Particle
#plt.rcParams['figure.dpi'] = 300
#plt.rcParams['savefig.dpi'] = 300

matplotlib.rcParams.update({'font.size': 14})

def is_interactive():
    import __main__ as main
    return not hasattr(main, '__file__')

parser = argparse.ArgumentParser(description='Read data path')
parser.add_argument('--runName', type=str, help='run name')
parser.add_argument('--fileList', nargs='+', help='input file or files')
parser.add_argument('--labelList', nargs='+', help='file label o labels')
parser.add_argument('--ele', dest='ele', action='store_true')
parser.add_argument('--noele', dest='ele', action='store_false')
parser.add_argument('--allPlots', dest='allPlots', action='store_true')

parser.set_defaults(ele=False, allPlots=False)

if is_interactive():
    sys.argv = ['-f']

args = parser.parse_args()

flagReadEle=args.ele
flagAllPlots=args.allPlots


if args.fileList:
    inputFilesList=args.fileList
    labelList=args.labelList
else:
    #inputFilesList=["../Dump_new/MARSresults/MARS1e5TeVeupiu", "../Dump_new/MARSresults/MARS1e5TeVnumeno"]
    #inputFilesList=["local_data/PR_3TeV_real", "local_data/PR_3TeV_real_ok"]
    #inputFilesList=["local_data/NEW_1e5TeV_base_point", "../Dump_new/MARSresults/MARS1e5TeVnumeno"]
    #inputFilesList=["local_data/CV_1e5TeV_base_SMALL", "local_data/CV_3TeV_base_SMALL"]
    inputFilesList=["../Data/Camillasinputs/1p5TeV_v3"]
    #labelList=["MARS+", "MARS-"]
    #labelList=["FLUKA3TeVreal", "FLUKA3TeVreal"]
    #labelList=["FLUKA", "MARS"]
    labelList=["1.5TeV", "3TeV"]
if args.runName:
    runName=args.runName+"_"
else:
    #runName="1e5TeVMARS+vsMARS-_"
    #runName="FLUKA3TeVrealvsFLUKA3TeVreal_"
    #runName="1e5TeV_FLUKAvsMARS_"
    runName="1e5v3"

print("Leggo Files: ", inputFilesList, flagReadEle)
```

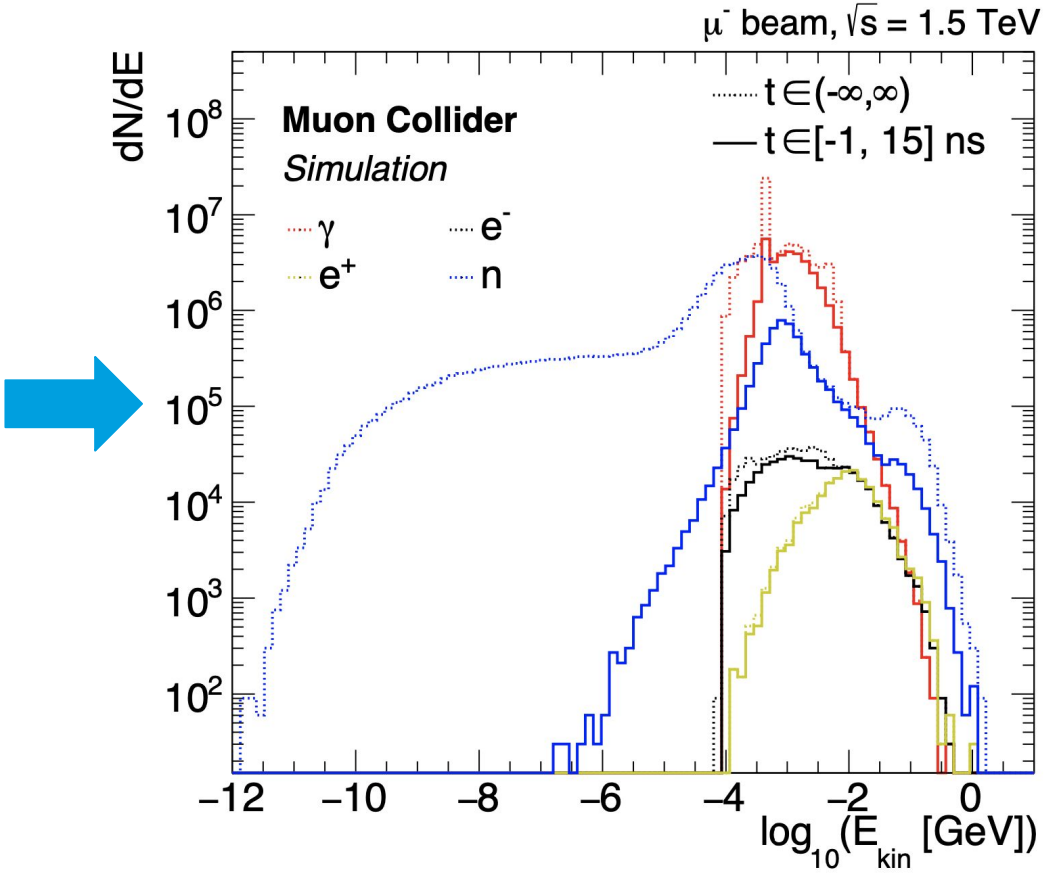
```
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: particle in /afs/desy.de/user/f/fmeloni/.local/lib/python3.6/site-packages (0.20.1)
Requirement already satisfied: hepunits>=2.0.0 in /afs/desy.de/user/f/fmeloni/.local/lib/python3.6/site-packages (from particle) (2.2.1)
Requirement already satisfied: importlib-resources>=2.0 in /usr/local/lib/python3.6/site-packages (from particle) (5.4.0)
Requirement already satisfied: typing-extensions in /usr/local/lib/python3.6/site-packages (from particle) (3.7.4.3)
Requirement already satisfied: attrs>=19.2 in /usr/local/lib/python3.6/site-packages (from particle) (21.2.0)
Requirement already satisfied: zipp>=3.1.0 in /usr/local/lib/python3.6/site-packages (from importlib-resources>=2.0->particle) (3.6.0)
Note: you may need to restart the kernel to use updated packages.
Leggo Files:  ['../Data/Camillasinputs/1p5TeV_v3'] False
```

Initial Flags and Variables

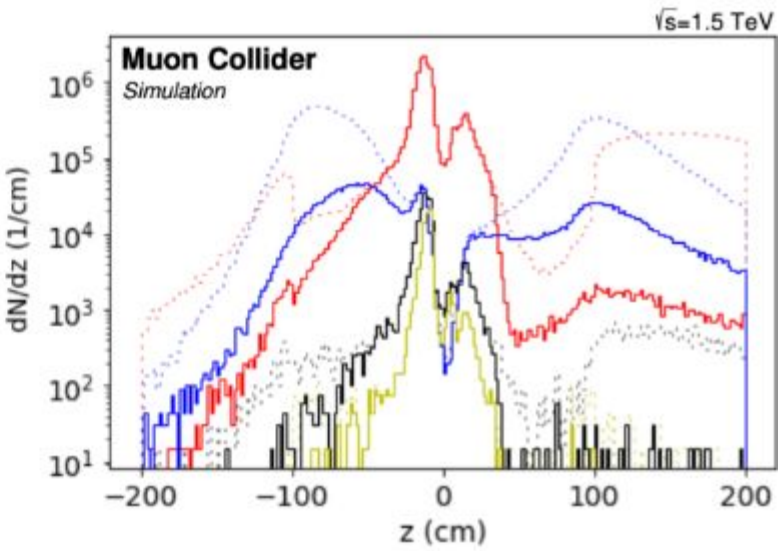
```
flagApplyPaperEnCut=False
flagApplyZCut=False

listChargedHadrons=[321, 311, 211, 2212, 3122, 3112, -321, -311, -211, -2212, -3122, -3112]
lineStyles=['solid', 'dotted', 'dashed', 'dashdot' ]

nbins=50
nbinsH=200
nbinsZ=100
```

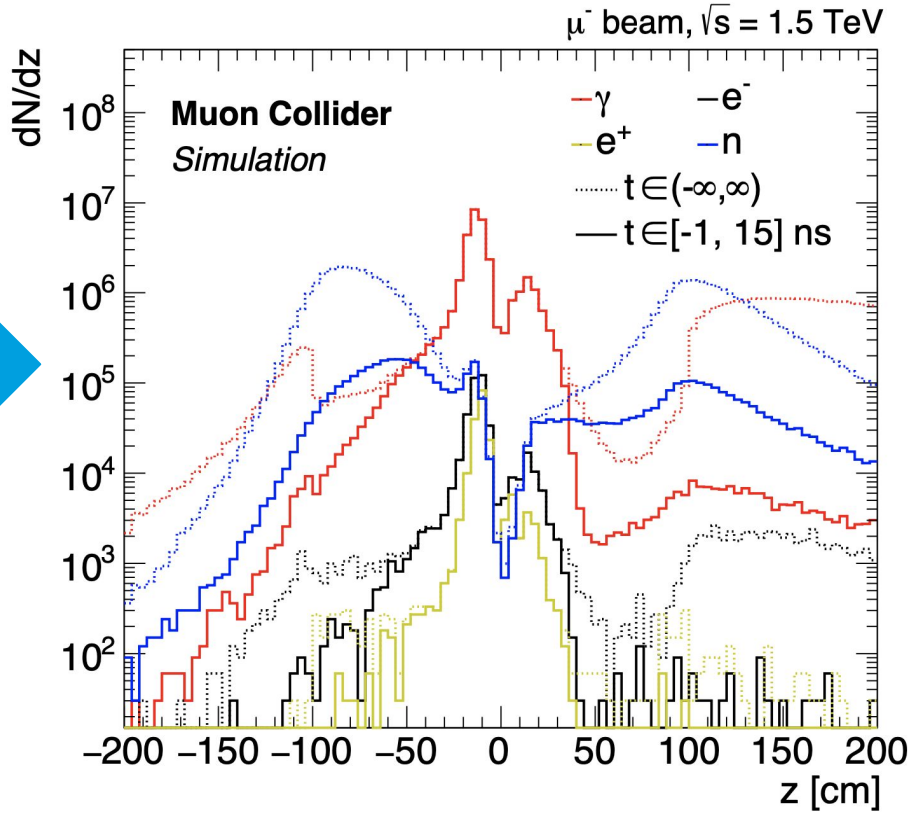
Lethargy


√s=1.5 TeV
Muon Collider
Simulation
dN/dE (1/log10(Ekin (GeV)))
Ekin (GeV)

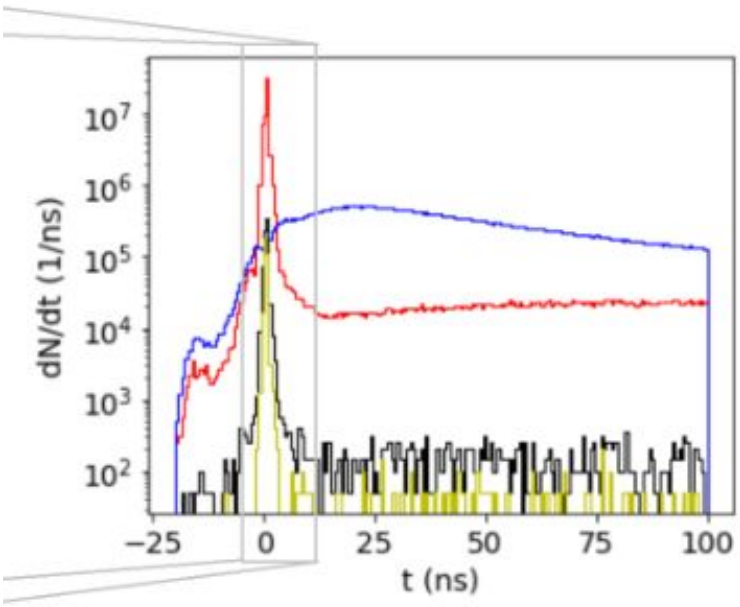

μ- beam, √s = 1.5 TeV
Muon Collider
Simulation
t∈(-∞,∞)
t∈[-1, 15] ns
γ
e-
e+
n
dN/dE
log10(Ekin [GeV])

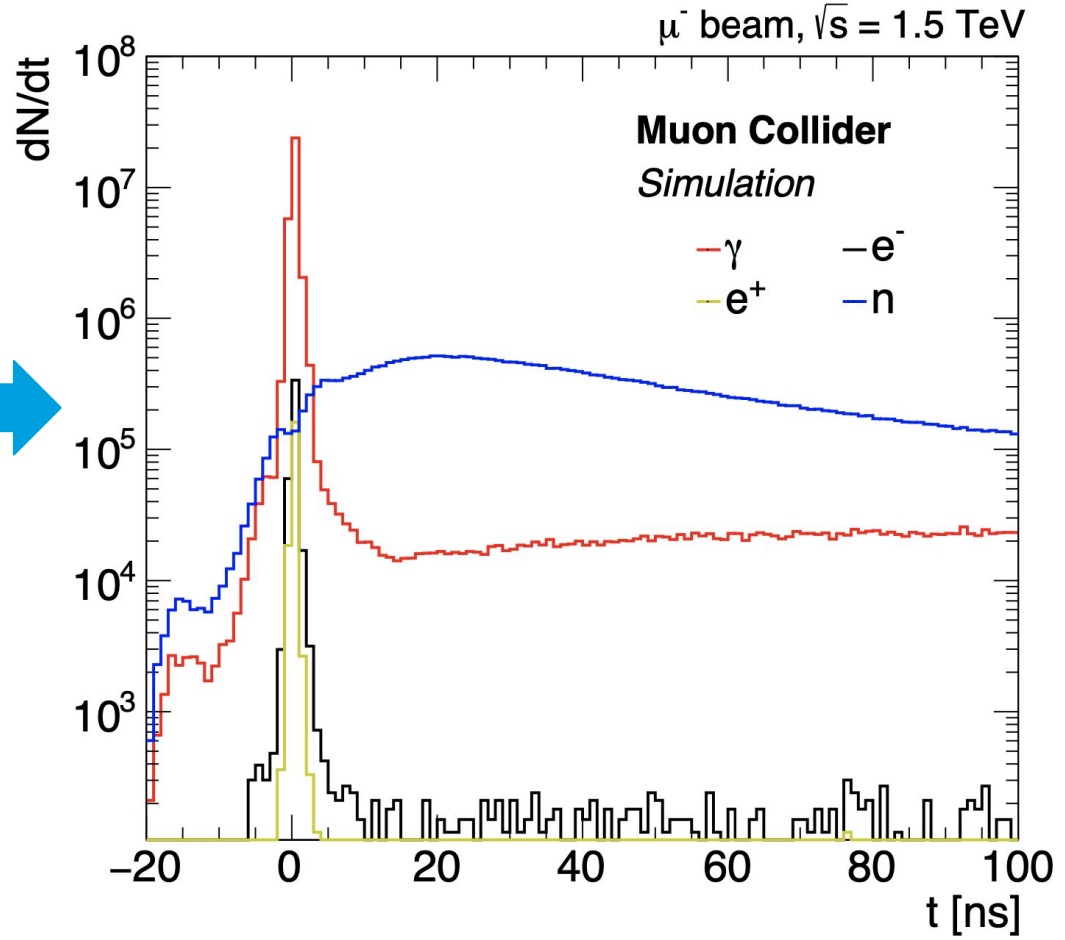
Longitudinal entry in detector volume



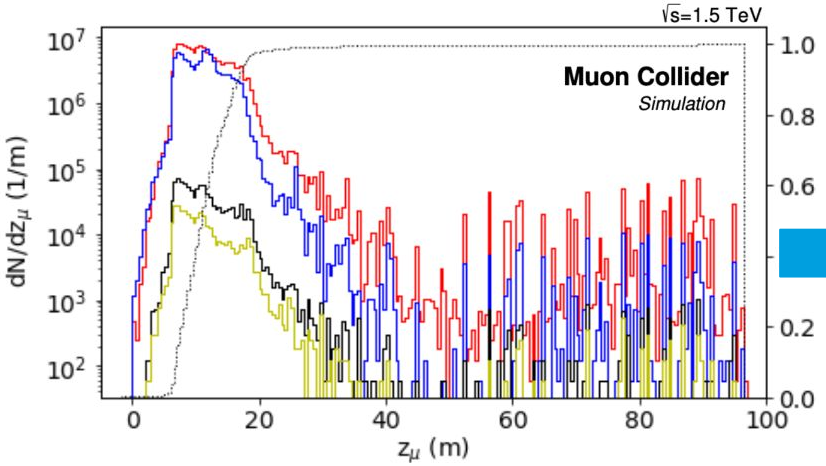


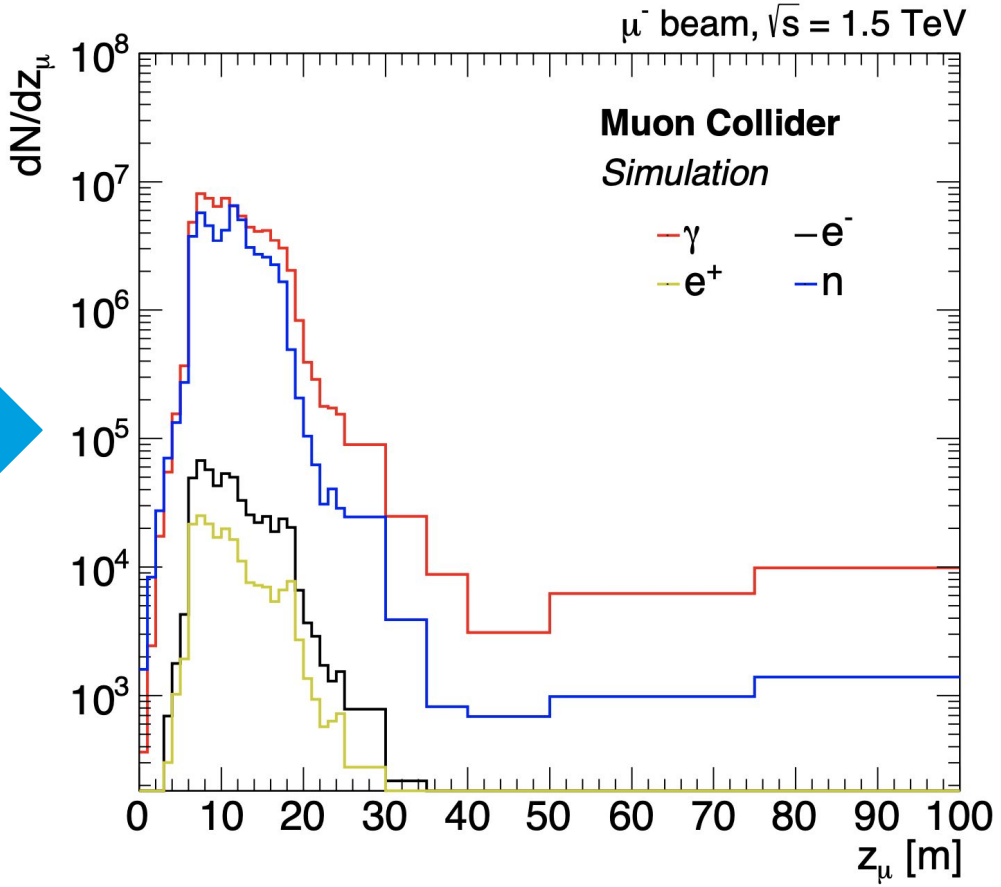
Time


dN/dt (1/ns)
10^7
10^6
10^5
10^4
10^3
10^2
−25
0
25
50
75
100
t (ns)


μ^- beam, $\sqrt{s}$ = 1.5 TeV
Muon Collider
Simulation
γ
e^-
e^+
n
dN/dt
10^8
10^7
10^6
10^5
10^4
10^3
−20
0
20
40
60
80
100
t [ns]

Muon longitudinal decay position





Collecting EPJC report plotting scripts?

We should probably systematically collect the plotting scripts that were used to produce the performance results of the EPJC report.

- Reduce duplication of work and go towards automation of benchmarks/performance studies (as discussed at FNAL)

How to organise this?

- Karol et al. started with a tracking-focused package.
  - Replicate for jets, electrons/photons, muons and flavour tagging?

Thank you!