G4HP

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Introduction

- G4HP is a Geant4 code to simulate interactions of a hadron on a thin target
  - It stores the ntuples with the kinematic information of the particles produced at inelastic interactions.
  - It can be configured to run with different hadron incident, targets and hadronic models.
  - It runs with the Geant v4_10_3_p03b (current LBNF simulation version)
  - It also has some scripts to calculate yields, multiplicities and cross sections using the g4hp ntuples.
- This codes is an updated version of a similar code made for MINERvA flux that lives in G4NuMI.

Redmine

- It is a sub-project of PPFX:
  - https://cdcvs.fnal.gov/redmine/projects/g4hp
  - I added some of you as developers. Please let me know if you want to be included and you are currently not.
- The Wiki section has a brief description on how to get the code:
  - git clone ssh://p-g4hp@cdcvs.fnal.gov/cvs/projects/g4hp
  - cd g4hp
  - source setup_g4hp_cvmfs.sh
  - cmake .
  - make all
  - and run man example: ./g4hp -t C -p proton -e 120 -l FTFP_BERT -n 10000
- I will add more details to the Wiki soon

Code options

```
Usage:
        -t [target name], e.g. C, Al
        -a [mass number]
        -z [atomic number]
        -d [density] in gm/cm3
        -r [radius] in cm, optional (default = 0.3cm)]

        Note: you do not need to define 'a', 'z' and 'd'
        if 't' is on the list of predfined targets (include/HPTargets.hh)

        -p [beam particle], e.g. proton
        -e [beam energy], in GeV
        -l [physics list], optional (default = QGSP_BERT)

        -n [number of events], optional (default = 100k)

        -x [run number], optional (default = 1)

        -f [output ROOT file name], optional (default = particle_energy_target_runnumber.root)

        -k [output directory], optional (default = $G4HP_ROOTDIR or pwd/g4hp_root_files)

        -y to skip checking configuration
```

Run on the GRID

```
Usage: ProcessG4HP.py [options]

Options:
  -h, --help            show this help message and exit

  Grid Options:
    --outdir=OUTDIR     Output flux histograms location. Default =
                        /pnfs/dune/persistent/users/laliaga/testg4hp/.
    --njobs=NJOBS       Number of g4hp jobs. Default = 3.

  Physics Options:
    --physics=PHYSICS   Select physics list.Default = QGSP_BERT.

Beam Options:
  --particle=PARTICLE
                        Select incident particle.Default = proton.
  --energy=ENERGY       Select incident energy.Default = 158.
  --nevts=NEVTS         Select number of events.Default = 10000.

Target Options:
  --target=TARGET       Select target type.Default = C.

Run Options:
  --numrun=NUMRUN       Run number numrun.Default = 1.
```

Scripts

- There is a sub-directory with some scripts for analysis: **“ana”**
  - **CreateYields.C**: creates yields of produced particles using the g4hp ntuples. The output is set to the current PPFX bins for proton-Carbon interactions.
  - **CreateInvXS.C**: reads the created yields and calculates the double-differential invariant cross sections for proton carbon interactions.
  - **CreateMult.C**: creates multiplicities in the same range of the NA61 pion data.
- You can use these script as a base for your study.

A request

- Please commit any improvement you find useful.

- This code is intended to be useful for current analysis and future remake of the studies when new Geant4 and hadron production models.