Terascale Monte Carlo School 2011

Pythia Tutorial

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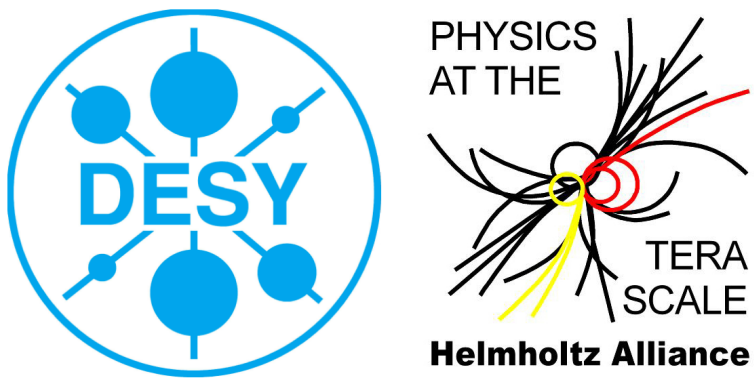


Hamburg, 17th Mar. 2011

What is Pythia and how to use it within ATLAS framework

- `https://twiki.cern.ch/twiki/bin/view/AtlasProtected/TutorialsMCSAT11Pythia`

- Pythia: general purpose generator (hard and soft interactions, parton distributions, initial- and final-state parton showers, multiple interactions, fragmentation and decay).
- Extensively for e+e-, ep and pp(bar) physics, e.g. at LEP, HERA and the Tevatron. Most used generator for LHC physics studies.
- **Fortran77** and C++ versions exist
- For using Pythia within the ATLAS software framework: know how to steer the Pythia event generation + pass Pythia commands so that they are correctly interpreted by the Athena framework.
- Pythia-side info (cd to non-NAF dir):
  `wget http://home.thep.lu.se/~torbjorn/pythia/lutp0613man2.pdf`
- we'll first look at the basic Pythia event generation within Athena, afterwards I'll leave you to explore the Manual, code and a couple of suggested exercises with the solutions. If you want additional info please ask.

Tutorial Setup and Ist Exercise - 1

```
https://twiki.cern.ch/twiki/bin/view/AtlasProtected/TutorialsMCSAT11Pythia

ssh-naf

Tutorial directory is: ~/scratch/mc

mkdir ~/scratch/mc/Pythia
export Pytu=~/scratch/mc/Pythia
export PytuFiles=/afs/naf.desy.de/user/m/mijovic/public/mctut_atlas/Pythia

cd $Pytu
asetup 16.6.2

Let's start with the Exercise1:

mkdir $Pytu/Exercise1
cd $Pytu/Exercise1
cp $PytuFiles/MC10.pythia_template.py  .
emacs MC10.pythia_template.py &

#--------------------------------------------------------------
# process setup and any other parameter settings go here:
Pythia.PygiveCommand += ["MSEL=6"]
#--------------------------------------------------------------

Evgen_trf.py --omitvalidation=ALL 7000 10 1 10 1234 MC10.pythia_template.py evg.pool.root &> out.out
```

Tutorial Setup and Ist Exercise - 2

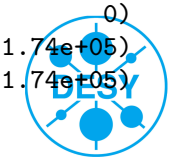
https://twiki.cern.ch/twiki/bin/view/AtlasProtected/TutorialsMCSAT11Pythia

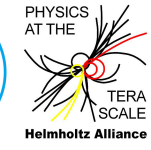
```
 **             *......*                 Welcome to the Lund Monte Carlo!  **
 **         *:::!!::::::::::::*                                           **
 **      *:::::::!!:::::::::::::::*       PPP  Y   Y TTTTT H   H III   A    **
 **    *:::::::::!!:::::::::::::::::*     P  P  Y Y    T   H   H  I   A A   **
 **   *::::::::::!!::::::::::::::::::*    PPP    Y     T   HHHHH  I  AAAAA  **
 **   *::::::::::!!::::::::::::::::::*    P      Y     T   H   H  I  A   A  **
 **    *:::::::::!!:::::::::::::::::*!    P      Y     T   H   H III A   A  **
 **      *:::::::!!:::::::::::::::* !!                                      **
 **      !! *::::!!::::::::::::*    !!     This is PYTHIA version 6.424      **
 **      !!     !* ->><- *         !!     Last date of change: 21 Oct 2010  **
 **      !!     !!                 !!                                       **
 **      !!     !!                 !!     Now is 17 Mar 2011 at  6:28:28    **
 **      !!                        !!                                       **
```

```
GenEvent: #1 ID=110000082 SignalProcessGenVertex Barcode: 0
...
                                  GenParticle Legend
    Barcode   PDG ID Name            Stat  ProdVtx DecayVtx   (       Px,       Py,       Pz,       E ,       m)
-------------------------------------------------------------------------------

 --------------- HepPDT Version 2.06.01 ---------------
found 259 particles
          1     2212 p+                3        0       -1   (       +0,       +0, +3.5e+06, +3.5e+06,      938)
          2     2212 p+                3        0       -2   (       +0,       +0, -3.5e+06, +3.5e+06,      938)
          3       21 g                 3       -1       -3   (     +668,     +414,+4.67e+05,+4.67e+05,        0)
          4       21 g                 3       -2       -4   (-2.75e+03,+1.08e+03,-2.61e+05,+2.61e+05,        0)
          5       21 g                 3       -3       -5   (+6.82e+04,+8.66e+04,+3.03e+05,+3.22e+05,        0)
          6       21 g                 3       -4       -5   (+1.81e+04,-1.21e+04,-1.68e+05,+1.69e+05,        0)
          7        6 t                 3       -5       -6   (-2.77e+04,+1.32e+05,+1.66e+05,+2.75e+05, 1.74e+05)
          8       -6 t~                3       -5       -7   (+1.14e+05,-5.79e+04,-3.11e+04,+2.16e+05, 1.74e+05)

...........
```





Tutorial Setup and Ist Exercise - 3

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/TutorialsMCSAT11Pythia

.....

```
 ================================================================================
 I                                  I                               I            I
 I            Subprocess            I      Number of points         I    Sigma   I
 I                                  I                               I            I
 I----------------------------------I-------------------------------I    (mb)    I
 I                                  I                               I            I
 I N:o Type                         I    Generated         Tried    I            I
 I                                  I                               I            I
 ================================================================================
 I                                  I                               I            I
 I   0 All included subprocesses    I           12           223    I  1.122D-07 I
 I  81 q + qbar -> Q + Qbar, mass   I            2            34    I  1.561D-08 I
 I  82 g + g -> Q + Qbar, massive   I           10           189    I  9.659D-08 I
 I                                  I                               I            I
 ================================================================================
```

....

MetaData: cross-section (nb)= 0.1122

....

Evgen_messageSvc_jobOptions.py - exit code 0.

Tutorial Setup and IInd Exercise

- ATLAS Centrally Produced Samples: how to find what is in the central prod. sample?

  `https://twiki.cern.ch/twiki/bin/view/AtlasProtected/AtlasProductionGroup`

  `http://www-f9.ijs.si/~kersevan/Physics_mc10_7TeV.xls`

  `DSID: 106046`

- inspecting the central production jobOption files:

  `get_files -jo MC10.106046.PythiaZee_no_filter.py`

```
include ( "MC10JobOptions/MC10_Pythia_Common.py" )
Pythia.PythiaCommand += [ "pysubs msel 0",          # Users decay choice.
                          "pydat1 parj 90 20000", # Turn off FSR.
                          "pydat3 mdcy 15 1 0",     # Turn off tau decays.
                          "pysubs msub 1 1",        # Create Z bosons.
                          "pysubs ckin 1 60.0",     # Lower invariant mass.
                          "pydat3 mdme 174 1 0",
                          "pydat3 mdme 175 1 0",
```

- One of the many ways of finding what's in the included files:

  `http://alxr.usatlas.bnl.gov/lxr-stb5/search`