New PROPOSAL release 7.4
PR 445

BERGISCHE
UNIVERSITÄT
WUPPERTAL

New PROPOSAL version

- On CORSIKA 8 master: PROPOSAL 7.3.1
- New PROPOSAL release 7.4.0 on August 17
  - Shortly afterwards bugfix release 7.4.1, fixing numerical problem in photoeffect at very low energies (found while testing with C8)
  - Several improvements of interest to CORSIKA 8

C8-relevant improvements and additions in PROPOSAL 7.4

- Photoeffect is included as a process, enabled by default; should have an effect on low-energy photons
- Kinematic limits for electron bremsstrahlung are now calculated in a more appropriate way (cf. presentation on August 11); should have an effect on low-energy electrons and positrons
- Calculation of interaction length is implemented as 1D-interpolation, should save ~20% of time spent in PROPOSAL within C8 (solves issue 519)
- Warning is generated when tables are built (solves issue 522)
- Tables are now saved as `.dat` instead of `.txt` (solves issue 500)

Comparison of a few showers with the same random seed

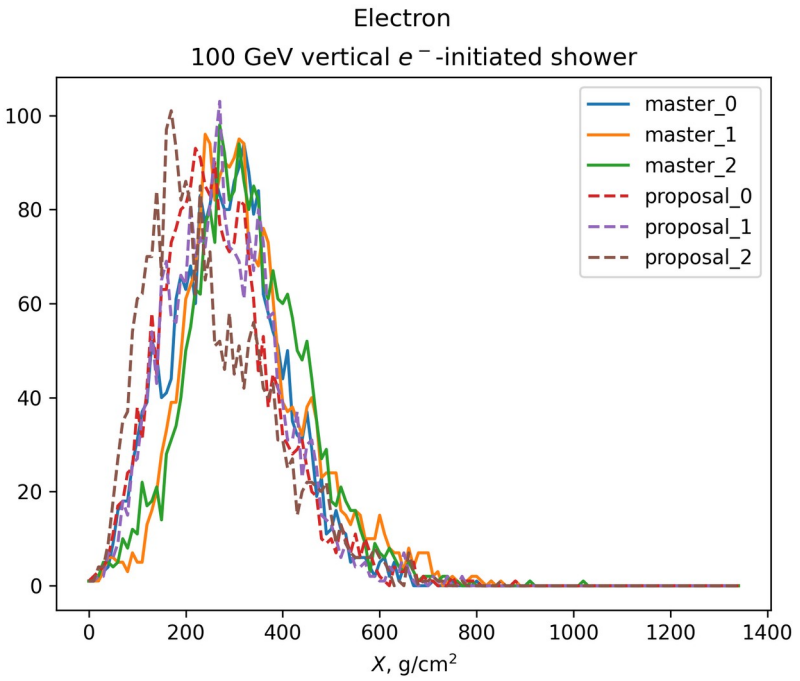
- Three 100 GeV showers with random seeds `1031927609, 2065554331, 566012400` using `em_shower.cpp` from the `examples` folder
- Detailed comparisons with more statistics will follow later

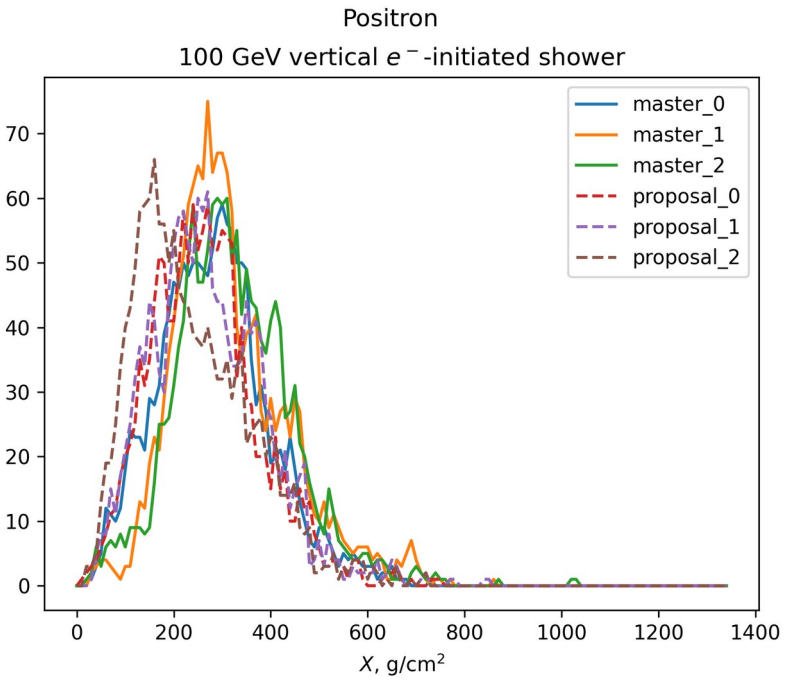
The new warning

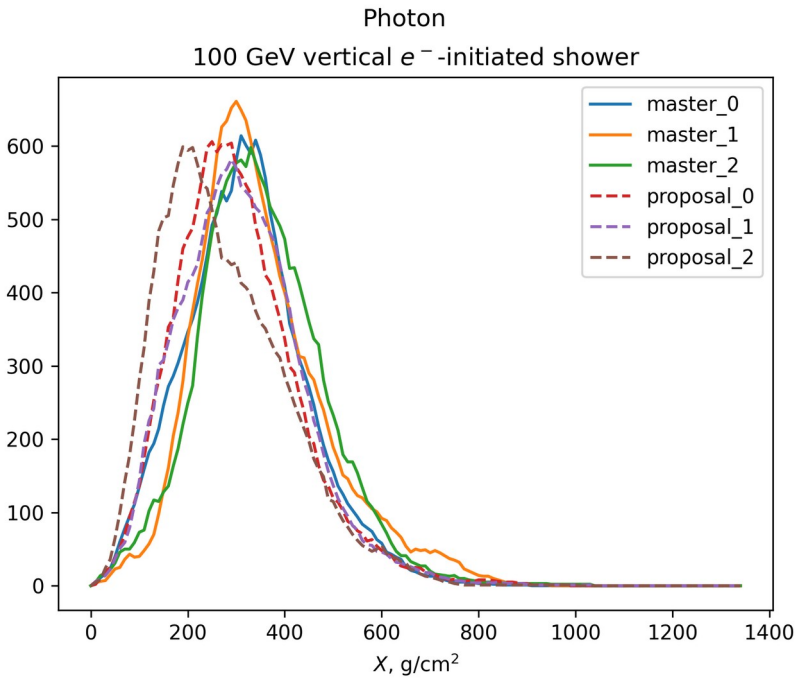
```
alexander@alexander-ThinkPad-T550:~/Software/corsika-work/build$ ls
bin  CMakeCache.txt  CMakeFiles  cmake_install.cmake  em_shower_outputs  example_outputs  Makefile  master_0  master_1  master_2
alexander@alexander-ThinkPad-T550:~/Software/corsika-work/build$ mv master_* ..
alexander@alexander-ThinkPad-T550:~/Software/corsika-work/build$ cd ..
alexander@alexander-ThinkPad-T550:~/Software/corsika-work$ ls
boundary_example.cpp  cascade_proton_example.cpp  corsikaExamples.cmake  geometry_example.cpp  mars.cpp  master_2                staticsequence_example.cpp
build                 CMakeLists.txt              em_shower.cpp          helix_example.cpp     master_0  particle_list_example.cpp  stopping_power.cpp
cascade_example.cpp   corsika.cpp                 environment.cpp        hybrid_MC.cpp         master_1  stack_example.cpp          vertical_EAS.cpp
alexander@alexander-ThinkPad-T550:~/Software/corsika-work$ ./build/bin/em_shower 1e2 1031927609; mv em_shower_outputs/ proposal_0
input particle: e-
input angles: theta=0
input momentum: (0 0 -100) [], norm = 1e+11 eV
point of injection: (0 0 6.48375e+06) m
[corsika:info    (em_shower.cpp:155)] shower axis length: 115005 m
[output:info    (OutputManager.inl:43)] Output library: "/home/alexander/Software/corsika-work/em_shower_outputs"
 ==================================================
 |                                                |
 |                S I B Y L L  2.3d               |
 |                                                |
 |         HADRONIC INTERACTION MONTE CARLO       |
 |                     BY                         |
 |            Eun-Joo AHN, Felix RIEHN            |
 |      R. ENGEL, A. FEDYNITCH, R.S. FLETCHER,    |
 |       T.K. GAISSER, P. LIPARI, T. STANEV       |
 |                                                |
 | Publication to be cited when using this program: |
 | Eun-Joo AHN et al., Phys.Rev. D80 (2009) 094003  |
 | F. RIEHN et al., Phys.Rev.D 102 (2020) 6, 063002 |
 | last modifications: F. Riehn (08/15/2021)      |
 ==================================================

  Calculating cross section tables...
 SIG_AIR_INI: initializing target: (i,A)          1          0 air..
 SIG_AIR_INI: initializing target: (i,A)          2         14 nit..
 SIG_AIR_INI: initializing target: (i,A)          3         16 oxy..
[corsika:error   (NuclearInteractionModel.inl:116)] Invalid target type nucleus for hadron interaction model.
[corsika:error   (NuclearInteractionModel.inl:59)] Invalid target type nucleus for hadron interaction model.
[corsika:info    (CorsikaData.inl:29)] opening data file="../corsika-install/share/corsika/data/PROPOSAL"
[corsika:info    (CorsikaData.inl:29)] opening data file="../corsika-install/share/corsika/data/PROPOSAL"
[corsika:info    (Cascade.inl:46)]
  ,ad8888ba,     ,ad8888ba,    88888888ba    ad88888ba   88  88      a8P          db             ad88888ba
 d8""    `"8b   d8"'    `"8b   88      "8b  d8"     "8b  88  88    ,88'         d88b           d8"     "8b
d8'            d8'        `8b  88      ,8P  Y8,          88  88  ,88"          d8'`8b          Y8a     a8P
88             88          88  88aaaaaa8P'  `Y8aaaaa,    88  88,d88'          d8'  `8b          "Y8aaa8P"
88             88          88  88""""88'      `""""""8b,  88  8888"88,        d8YaaaaY8b         ,d8""8b,
Y8,            Y8,        ,8P  88    `8b           `8b  88  88P   Y8b      d8""""""""8b       d8"     "8b
 Y8a.    .a8P   Y8a.    .a8P   88     `8b  Y8a     a8P  88  88     "88,    d8'        `8b      Y8a     a8P
  `"Y8888Y"'     `"Y8888Y"'    88      `8b   "Y88888P"   88  88       Y8b  d8'          `8b      "Y88888P"

[corsika:info    (Cascade.inl:47)] This is CORSIKA 8.0.0.0
[corsika:info    (Cascade.inl:49)] Tracking algorithm: LeapFrog-curved (version 1.0.0)
[2022-09-08 15:58:57.060] [TableCreation] [warning] Tables are not available and need to be created. They will be written to '../corsika-install/share/corsika/data/PROPOSAL'. This can take some minutes.
[CORSIKA8]0:corsika  1:corsika-build- 2:corsika-install  3:corsika-work* 4:ECRS  5:htop                                                                  "alexander-ThinkPad-T5" 16:02 08-Sep-22
```


Electron
100 GeV vertical e^--initiated shower
master_0
master_1
master_2
proposal_0
proposal_1
proposal_2
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400
X, g/cm^2


Positron
100 GeV vertical e^--initiated shower
master_0
master_1
master_2
proposal_0
proposal_1
proposal_2
0
10
20
30
40
50
60
70
0
200
400
600
800
1000
1200
1400
X, g/cm^2


Photon
100 GeV vertical e^--initiated shower
master_0
master_1
master_2
proposal_0
proposal_1
proposal_2
0
100
200
300
400
500
600
0
200
400
600
800
1000
1200
1400
X, g/cm^2