

```
ls -la . mmc
```

```
.:
total 80
drwxr-xr-x 3 dima dima 4096 Sep 10 19:23 .
drwxrwxr-x 3 dima dima 4096 Sep 10 19:33 ..
-rw-rw-r-- 1 dima dima 13518 Sep 10 16:24 Amanda.java
-rw-rw-r-- 1 dima dima 4940 Sep 10 16:24 Frejus.java
-rw-r--r-- 1 dima dima 260 Sep 10 16:24 HISTORY
-rw-rw-r-- 1 dima dima 13674 Sep 10 16:24 README
-rw-rw-r-- 1 dima dima 6012 Sep 10 16:24 Test.java
-rwxr-xr-x 1 dima dima 12702 Sep 10 16:24 ammc
drwxrwxr-x 2 dima dima 4096 Sep 10 19:23 mmc
```

```
mmc:
total 220
drwxrwxr-x 2 dima dima 4096 Sep 10 19:23 .
drwxr-xr-x 3 dima dima 4096 Sep 10 19:23 ..
-rw-rw-r-- 1 dima dima 1464 Sep 10 16:24 BremsContinuous.java
-rw-rw-r-- 1 dima dima 3314 Sep 10 16:24 BremsStochastic.java
-rw-rw-r-- 1 dima dima 4766 Sep 10 16:24 Bremsstrahlung.java
-rw-rw-r-- 1 dima dima 3389 Sep 10 16:24 CrossSections.java
-rw-rw-r-- 1 dima dima 198 Sep 10 16:24 DFunctionOfx.java
-rw-rw-r-- 1 dima dima 1603 Sep 10 16:24 Decay.java
-rw-rw-r-- 1 dima dima 1240 Sep 10 16:24 Energy2Loss.java
-rw-rw-r-- 1 dima dima 1440 Sep 10 16:24 Energy2LossE.java
-rw-rw-r-- 1 dima dima 2022 Sep 10 16:24 Energy2LossX.java
-rw-rw-r-- 1 dima dima 1480 Sep 10 16:24 EpairContinuous.java
-rw-rw-r-- 1 dima dima 3324 Sep 10 16:24 EpairStochastic.java
-rw-rw-r-- 1 dima dima 5367 Sep 10 16:24 Epairproduction.java
-rw-rw-r-- 1 dima dima 4229 Sep 10 16:24 FindRoot.java
-rw-rw-r-- 1 dima dima 179 Sep 10 16:24 FunctionInt.java
-rw-rw-r-- 1 dima dima 192 Sep 10 16:24 FunctionInt2.java
-rw-rw-r-- 1 dima dima 174 Sep 10 16:24 FunctionOfx.java
-rw-rw-r-- 1 dima dima 22604 Sep 10 16:24 Integral.java
-rw-rw-r-- 1 dima dima 14478 Sep 10 16:24 Interpolate.java
-rw-rw-r-- 1 dima dima 1999 Sep 10 16:24 IonizContinuous.java
-rw-rw-r-- 1 dima dima 2904 Sep 10 16:24 IonizStochastic.java
-rw-rw-r-- 1 dima dima 2460 Sep 10 16:24 Ionizationloss.java
-rw-rw-r-- 1 dima dima 173 Sep 10 16:24 MathModel.java
-rw-rw-r-- 1 dima dima 8281 Sep 10 16:24 Medium.java
-rw-rw-r-- 1 dima dima 8240 Sep 10 16:24 Output.java
-rw-rw-r-- 1 dima dima 4697 Sep 10 16:24 Particle.java
-rw-rw-r-- 1 dima dima 1474 Sep 10 16:24 PhotoContinuous.java
-rw-rw-r-- 1 dima dima 3311 Sep 10 16:24 PhotoStochastic.java
-rw-rw-r-- 1 dima dima 7530 Sep 10 16:24 Photonuclear.java
-rw-rw-r-- 1 dima dima 2378 Sep 10 16:24 PhysicsModel.java
-rw-rw-r-- 1 dima dima 15650 Sep 10 16:24 Propagate.java
-rw-rw-r-- 1 dima dima 1825 Sep 10 16:24 Scattering.java
-rw-rw-r-- 1 dima dima 2870 Sep 10 16:24 StandardNormal.java
-rw-rw-r-- 1 dima dima 177 Sep 10 16:24 mmcException.java
```

./ammc

Muon Propagation Code in Java v. 1.0

This computer is i386, java was found in "/usr/java/jdk1.3.1/bin"
testing java ... java version "1.3.1"
Java(TM) 2 Runtime Environment, Standard Edition (build 1.3.1-b24)
Java HotSpot(TM) Client VM (build 1.3.1-b24, mixed mode)

Usage: "./ammc [options]". Options are:

- "-compile" to compile the program
- "-compall" to compile everything
- "-run" to run the program
- "-help" for help
- "-amanda" to use program Amanda (default setting)
- "-frejus" to use program Frejus
- "-test" to use program Test
- "-p=[name]" to select some other program
- "-clean" clean up distribution directory
- "-delete" delete everything except class and data files
- "-manual" create javadoc manual pages
- "-test=1" test parametrizations of cross sections
- "-test=2" and of energy and tracking integrals
- "-hifi" generate high precision version of mmc
- "-float" replace doubles with floats (fl mmc)
- "-gcj" compile the program using gcj

```
./ammc -fl
```

Generating float (lower precision) version of mmc ...

This version of MMC has all double variables replaced with floats. It should be faster than the default version. Raw data parametrization tables of the regular version are not compatible with this mmc fl version.

```
./ammc -hf
```

Generating high fidelity version of mmc ...

This version of the program will take longer to initialize, since it computes the values for the parametrization tables with $1.e-7$ precision. The tables are also somewhat larger, since more grid points are added for some integrals. The execution time after initialization should not be affected.

```
./ammc -f -h
```

Use this program for Frejus data processing in pipes

This program propagates muons of given energy through given distance

Available options are: -vcut=[value of vcut: $0 < \text{vcut} \leq 1$]
-ecut=[value of ecut in MeV]
-medi=[medium name]
-tau propagate taus instead of muons
-time also report time of flight
-cont enable continuous loss randomization
-lpm enable lpm treatment
-allm enable allm photonuclear parametrization
-phnu=[1-4] choose another photonuclear formula
-intr=[interpolate: all, crs or ""]
-romb=[num of interpolation points]
-raw save tables in raw format
-debug print debugging information to stderr

```
./ammc -t -h
```

This program tests parametrizations used by mmc

Available options are: -vcut=[value of vcut: $0 < \text{vcut} \leq 1$]
-ecut=[value of ecut in MeV]
-medi=[medium name]
-tau propagate taus instead of muons
-lpm enable lpm treatment
-allm enable allm parametrization
-phnu=[1-4] or choose another one
-proc=[TEST to perform: 1 or 2]
-intr=[interpolate: all, crs or ""]
-romb=[num of interpolation points]
-RND1=[first random number]
-RND2=[second random number]
-raw save tables in raw format

```
./ammc -h
```

Use this program for F2000 stream processing in pipes

This program propagates atmospheric muons through the Ice to the detector

Available options are:

- length=[LENGTH of the detector volume in meters]
- radius=[RADIUS of the detector volume in meters]
- vcut=[value of vcut used for the 1st region]
- ecut=[ecut in MeV used for the 2nd region]
- medi=[medium name]
- sdec enable stopped muon decay treatment
- user enable the mmc_en user line
- user=[z] same, but record energy at z, not CPD
- time precise time of flight calculation
- cont enable continuous loss randomization
- scat enable Moliere scattering
- lpm enable lpm treatment
- allm enable allm photonuclear parametrization
- phnu=[1-4] choose another photonuclear formula
- romb=[num of interpolation points]
- raw save tables in raw format

```

zcat u-000100.f2k.gz | ./ammc -r -raw -user -sdec -time -cont -lpm -allm -scat |
more

Muon Propagation Code in Java v. 1.0
HI length = 720 m radius = 180 m medium ="Ice"
HI vcut = 5e-2 ecut = 500 MeV sdec time cont lpm allm scat romb=5
Parametrization tables will be read in from the file .amanda.mu_ice_all_-1_5e-2_
ttttt_raw.data
Parametrizations apply in the energy range from 105.65839 MeV to 1e14 MeV
Parametrizing ionize ... done
Parametrizing ionizS ... done
Parametrizing bremsE ... done
Parametrizing bremsS ... done
Parametrizing photoP ... done
Parametrizing photoE ... done
Parametrizing photoS ... done
Parametrizing epairP ... done
Parametrizing epairE ... done
Parametrizing epairS ... done
Parametrizing trackE ... done
Parametrizing trackX ... done
Parametrizing trackT ... done
Parametrizing molieS ... done
Parametrizing gaussR ... done
Parametrizing en2ldX ... done
Parametrizing en2ldE ... done
Finished parametrizations
Parametrization tables will be read in from the file .amanda.mu_ice_all_500_-1_t
ttftt_raw.data
Parametrizations apply in the energy range from 105.65839 MeV to 1e14 MeV
Parametrizing ionize ... done
Parametrizing ionizS ... done
Parametrizing bremsE ... done
Parametrizing bremsS ... done
Parametrizing photoP ... done
Parametrizing photoE ... done
Parametrizing photoS ... done
Parametrizing epairP ... done
Parametrizing epairE ... done
Parametrizing epairS ... done
Parametrizing trackE ... done
Parametrizing trackX ... done
Parametrizing trackT ... done
Parametrizing molieS ... done
Parametrizing gaussR ... done
Finished parametrizations
Parametrization tables will be read in from the file .amanda.mu_ice_all_-1_-1_tt
fff_raw.data
Parametrizations apply in the energy range from 105.65839 MeV to 1e14 MeV
Parametrizing ionize ... done
Parametrizing ionizS ... done
Parametrizing bremsE ... done
Parametrizing bremsS ... done
Parametrizing photoP ... done
Parametrizing photoE ... done
Parametrizing photoS ... done
Parametrizing epairP ... done
Parametrizing epairE ... done
Parametrizing epairS ... done
Parametrizing trackE ... down
Parametrizing trackX ... done
Finished parametrizations
--- *** Enter your input in F2000 format now *** ---

```

```

V 2000.1.2
HI Muon Propagation Code in Java v. 1.0
HI Amanda -r -raw -user -sdec -time -cont -lpm -allm -scat
HI length = 720 m radius = 180 m medium ="Ice"
HI vcut = 5e-2 ecut = 500 MeV sdec time cont lpm allm scat romb=5
HI User line mmc_en will be enabled
HI ucr (0.01) F2K043071.gz F2K162035.gz F2K177045.gz F2K163035.gz F2K164035.gz
F2K161035.gz F2K178045.gz F2K059066.gz F2K179045.gz F2K295045.gz F2K293045.gz F
2K180045.gz F2K296045.gz\
HI F2K294045.gz F2K060066.gz F2K047081.gz F2K186044.gz F2K046081.gz F2K188044.g
z F2K045081.gz F2K048081.gz F2K187044.gz F2K185044.gz F2K023067.gz F2K024067.gz
F2K200046.gz F2K215044.gz\
HI F2K041073.gz F2K042073.gz F2K198046.gz F2K199046.gz F2K197046.gz F2K214044.g
z F2K216044.gz F2K213044.gz F2K056068.gz F2K052072.gz F2K055068.gz F2K057072.gz
F2K271046.gz F2K270046.gz\
HI F2K051072.gz F2K269046.gz F2K272046.gz F2K330050.gz F2K050072.gz F2K058072.g
z F2K287046.gz F2K329050.gz F2K332050.gz F2K049072.gz F2K285046.gz F2K288046.gz
F2K286046.gz F2K331050.gz\
HI F2K242043.gz F2K243043.gz F2K241043.gz F2K244043.gz F2K123035.gz F2K144035.g
z F2K142035.gz F2K143035.gz F2K121035.gz F2K122035.gz F2K124035.gz F2K141035.gz
F2K037061.gz F2K324045.gz\
HI F2K038061.gz F2K322045.gz F2K238042.gz F2K240042.gz F2K323045.gz F2K190043.g
z F2K321045.gz F2K237042.gz F2K239042.gz F2K191043.gz F2K192043.gz F2K189043.gz
F2K284047.gz F2K281047.gz\
HI F2K319045.gz F2K283047.gz F2K282047.gz F2K317045.gz F2K318045.gz F2K320045.g
z F2K279044.gz F2K278044.gz F2K264039.gz F2K030070.gz F2K280044.gz F2K277044.gz
F2K029070.gz F2K263039.gz\
HI F2K054068.gz F2K063069.gz F2K064069.gz -out=u-000100.f2k.gz -run=000100 -oms
HI ucr (0.01) -out=../output/F2K043071.gz ../output/RUN043000/DAT043071.gz -tr
=2 -over=1 -cmt=INPUTS -run=043071 -FLUXSUM=0.195762427 -SHOWERS=1000000 -LENGTH
=720 -RADIUS=180 -DEPTH=1730\
HI -HEIGHT=2834 -cutfe=430
HI ! ! FLUXSUM is 0.195762 per meter2 second sr
HI ! ! AREASUM is 1.59888e+06 of meter2 sr
HI ! ! LIFETIME per 1e+06 showers is 3.19489 seconds
HI ! ! Card file follows:
HI ! RUNNR 1 number of run
HI ! EVTNR 1 number of first shower event
HI ! NSHOW 1000000 number of showers to generate
HI ! PRMPAR 14 particle type of prim. particle
HI ! ESLOPE -2.7 slope of primary energy spectrum
HI ! ERANGE 860 1.E7 energy range of primary particle
HI ! THETAP 0. 89.999 range of zenith angle (degree)
HI ! PHIP 0. 360. range of azimuth angle (degree)
HI ! SEED 1 0 0 seed for 1. random number sequence
HI ! SEED 2 0 0 seed for 2. random number sequence
HI ! SEED 3 0 0 seed for 3. random number sequence
HI ! OBSLEV 2834.E2 observation level (in cm)
HI ! ELMFLG T F em. interaction flags (NKG,EGS)
HI ! RADNKG 2.E5 outer radius for NKG lat.dens.determ
.
HI ! ARRANG 0. rotation of array to north
HI ! FIXHEI 0. 0 first interaction height & target
HI ! FIXCHI 0. starting altitude (g/cm**2)
HI ! MAGNET 16.4 -53.4 magnetic field south pole
HI ! HADFLG 0 1 0 1 0 2 flags hadr.interact. & fragmentation
HI ! QGSJET T 0 use qgsjet for high energy hadrons
HI ! QGSSIG T use qgsjet hadronic cross sections
HI ! ECUTS 430 430 .003 .003 energy cuts for particles
HI ! MUADDI T additional info for muons
HI ! MUMULT T muon multiple scattering angle
HI ! LONGI F 20. F F longitud.distr. & step size & fit
HI ! MAXPRT 0 max. number of printed events

```

```

HI ! ECTMAP 100 cut on gamma factor for printout
HI ! STEPFC 1.0 mult. scattering step length fact.
HI ! DEBUG F 6 F 1000000 debug flag and log.unit for out
HI ! DIRECT ../output/ output directory
HI ! ATMOD 13 october atmosphere
HI ! DETCFG 2. detector information (l/d)
HI ! F2000 T choses F2000 format
HI ! LOCUT T enables skew angle cutoff
HI ! RANPRI T random primary
HI ! FSEED T enable random generator seed recover
y
HI ! EXIT terminates input
HI corsika ( 6.003 ) <INPUTS irun=***** idate=*****
! ! Please consult printout for steering commands !
USER_DEF EVT_STAT EL_NUM AGE_PAR WN_HADR WN_MUON WNUM_TOT
USER_DEF mmc_en NR E_INI E_CPD E_IN E_OUT CDP_X CDP_Y CDP_Z Z_IN Z_OUT
TBEGIN ? ? ?
EM 1 100 1970 1 0.0000000000 0
TR 0 ? p+ -324.203 -477.142 12330.7 13.6002 239.285 -1 12740.7 0
TR 2 ? mu+ -321.283 -477.424 1730 13.5943 239.344 2362.1101 693.553 36397
TR 3 2 delta -118.422 -135.15797 84.733094 13.594427 239.34405 0 2.389837 42043.
208
TR 4 2 epair -115.73944 -130.63208 62.976686 13.594287 239.34479 0 10.533044 421
17.871
TR 5 2 epair -112.70701 -125.51574 38.381873 13.594247 239.34513 0 1.7602407 422
02.275
TR 6 2 delta -108.56909 -118.5344 4.8215369 13.59416 239.34391 0 .90038546 42317
.447
TR 7 2 delta -95.013929 -95.662424 -105.12607 13.594164 239.35152 0 7.5145183 42
694.763
TR 8 2 epair -86.76545 -81.742863 -172.03684 13.593891 239.34894 0 .52088451 429
24.386
TR 9 2 epair -80.349756 -70.915855 -224.08257 13.593683 239.35149 0 1.7205754 43
102.995
TR 10 2 delta -80.231046 -70.715514 -225.04561 13.593614 239.35172 0 .60446195 4
3106.3
US EVT_STAT 0 0 0 1 3
US mmc_en 2 693.553 135.78665 179.5666 50.870567 -103.57511 -110.11988 -35.67841
3 85.970028 -360
EE
EM 2 100 1970 1 0.0000000000 0
TR 0 ? p+ 574.672 -1075.4 32438.6 30.3991 293.064 -1 3452.62 0
TR 1 ? mu- 559.145 -1091.94 1730 30.4103 292.991 2304.0048 729.622 118811
TR 2 1 delta 130.91689 -82.634412 -137.97955 30.414086 292.99173 0 .52109371 126
035.9
TR 3 1 delta 122.03487 -61.70049 -176.71854 30.413694 292.99015 0 .6114207 12618
5.74
TR 4 1 e- 103.59608 -18.39169 -257.05987 30.320913 293.20367 0 5.2288168e-2 1295
73.81
US EVT_STAT 0 0 0 2 2
US mmc_en 1 729.622 43.172358 44.0653 -2304.0048 141.70637 -108.08656 -90.887048
-87.40784 -360
EE
EM 3 100 1970 1 0.0000000000 0
TR 0 ? Z2 498.896 202.165 23942.3 11.3709 31.2147 -1 16074 0
TR 1 ? mu- 481.165 179.99 1730 11.3041 31.0701 861.61034 486.062 75632.7
US EVT_STAT 0 0 0 1 1
US mmc_en 1 486.062 ? -861.61034 ? 179.72064 -1.6383769 -30.602142 -29.00576 -36
0
EE
TEND ? ? ?
END

```