

Options in CORSIKA

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KIT, Karlsruhe
December the 13th 2017

Models Selection

First selection is the high energy hadronic interaction model :

➡ See other talks on models to select the most suitable for your application

- ➡ up-to-date:
 - EPOS LHC, QGSJETII-04 and SIBYLL 2.3c
 - DPMJETIII.17-1 to come

- ➡ references:
 - QGSJET01

- ➡ special use:
 - others

Low energy hadronic interaction model

➡ FLUKA, Gheisha, UrQMD

```
-----  
Which high energy hadronic interaction model do you want to use ?
```

- 1 - DPMJET 2.55
- 2 - EPOS LHC
- 3 - NEXUS 3.97
- 4 - QGSJET 01C (enlarged commons) [DEFAULT]
- 5 - QGSJETII-04
- 6 - SIBYLL 2.1
- 7 - VENUS 4.12

```
r - restart (reset all options to cached values)  
x - exit make
```

```
(only one choice possible):  
SELECTED      : QGSJET01
```

```
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Which low energy hadronic interaction model do you want to use ?
```

- 1 - GHEISHA 2002d (double precision) [DEFAULT]
- 2 - FLUKA
- 3 - URQMD 1.3cr

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(only one choice possible):  
SELECTED      : GHEISHA
```

```
-----  
Which detector geometry do you have ?
```

- 1 - horizontal flat detector array [DEFAULT]
- 2 - non-flat (volume) detector geometry
- 3 - vertical string detector geometry

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```
(only one choice possible):  
SELECTED      : HORIZONTAL
```

```
-----  
options:  HORIZONTAL TIMEAUTO QGSJET01 GHEISHA
```

Geometry Selection

Detector geometry (only change the angular distribution of showers)

➡ Horizontal flat detector
(KASCADE, Pierre Auger Obs,...)

➡ Non-flat (volume) detector
(Magic, HESS,...)

➡ Vertical String detector
(AMANDA, IceCube, Antares, ...)

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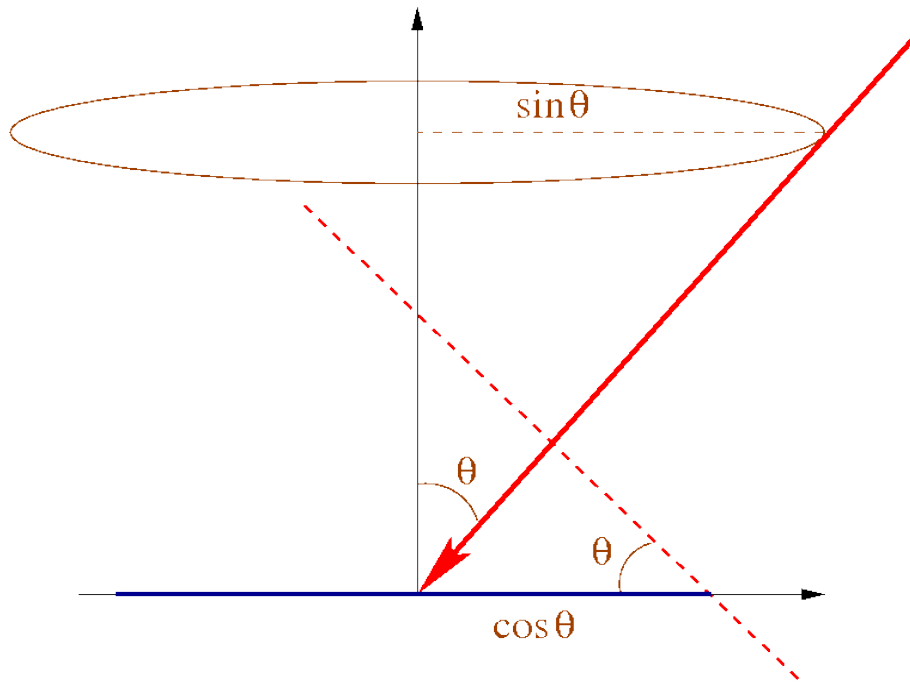
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(only one choice possible):  
SELECTED      : HORIZONTAL
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options:  HORIZONTAL TIMEAUTO QGSJET01 GHEISHA
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(KASCADE, Pierre Auger Obs,...)

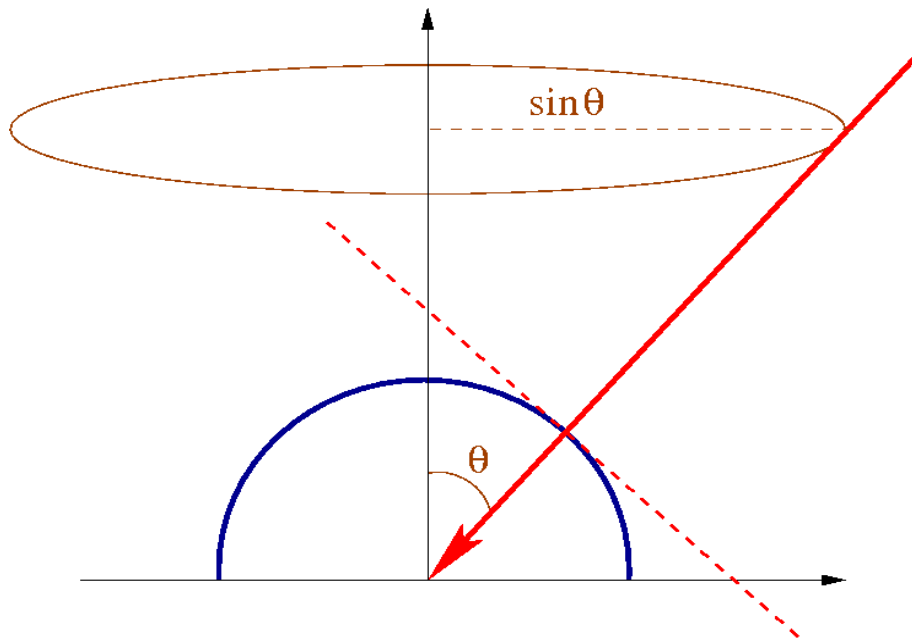
$$\rightarrow I \propto \sin\theta \cdot \cos\theta$$

- ➡ Non-flat (volume) detector
(Magic, HESS,...)

- ➡ Vertical String detector
(AMANDA, IceCube, Antares, ...)

Geometry Selection

Detector geometry (only change the angular distribution of showers)



➡ Horizontal flat detector
(KASCADE, Pierre Auger Obs,...)

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$$\text{➡ } I \propto \sin\theta$$

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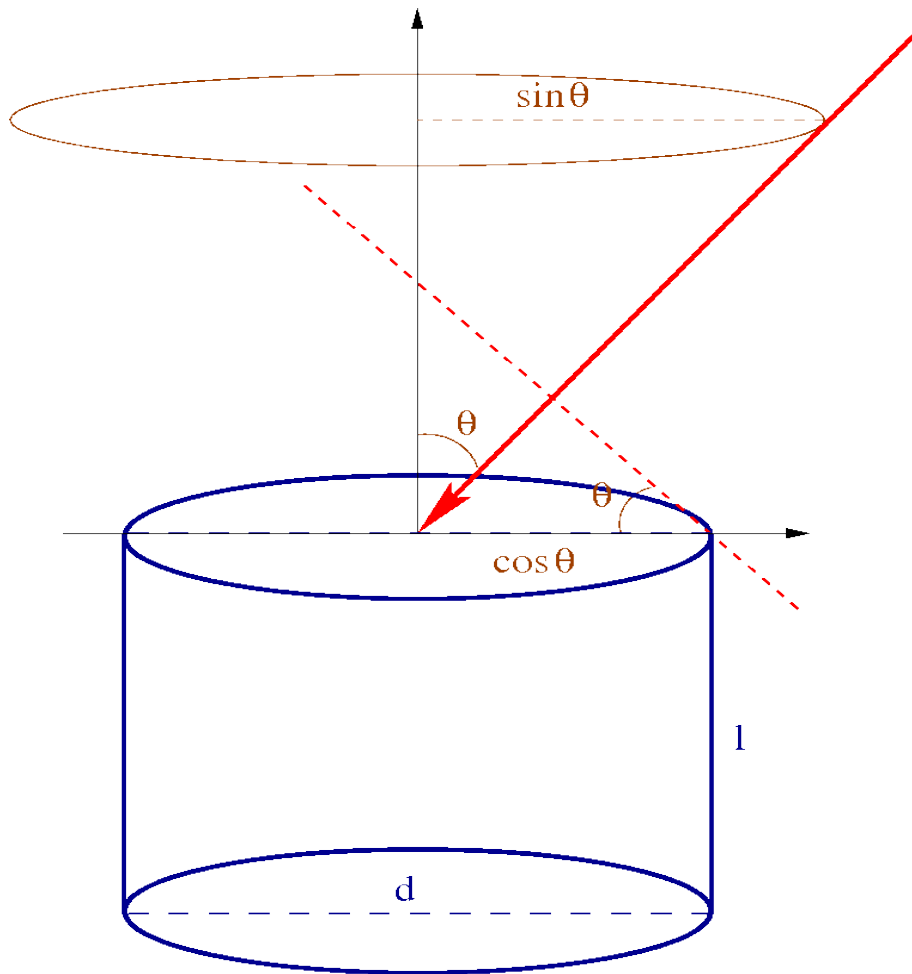
Detector geometry (only change the angular distribution of showers)

➡ **Horizontal flat detector**
(KASCADE, Pierre Auger Obs,...)

➡ **Non-flat (volume) detector**
(Magic, HESS,...)

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(AMANDA, IceCube, Antares, ...)

$$I \propto (d/2)^2 \cdot \pi \cdot \sin\theta \cdot (\cos\theta + 4/\pi \cdot l/d \cdot \sin\theta)$$



Cherenkov Light

1a – Cherenkov for rectangular grid

- ➡ cherenkov array at ground

1b – Cherenkov for det. system (IACT)

- ➡ HESS, Magic ...

- ➡ with extension for more informations on particles

1c – atmospheric corrections (CEFFIC)

- ➡ suppression of part of the cherenkov photons (use to speed-up simulations)

- ➡ light absorption in atmosphere

- ➡ mirror reflectivity

- ➡ quantum efficiency

```
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4c - ICECUBE2 gzip/pipe output
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8e - MUON-histo file
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d1 - Inclined observation plane
d2 - ROOT particle OUTput file
d3 - Use an external COAST user library (COrsika data Access Tool)
e - interaction test version (only for 1st interaction)
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Options ...

1d – Auger Cherenkov long. prof.

- ➡ not full simulation but time consuming

1e – Trajectory

- ➡ follow motion of source on the sky

2 – LPM effect

- ➡ only if no thinning and high energy showers (with thinning, LPM included)

2a – Thinning

- ➡ Needed for high energy simulations to save time and disk space

2b – MULTIPLE THINNING

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Options ...

3 – PRESHOWER

- ➡ preshowering of gamma primary before atmosphere

4 – Neutrino version

- ➡ add neutrino into list of particle

4a – NUPRIM

- ➡ use HERWIG to have neutrino as primary particle

- ➡ only primary neutrino will interact

4b – ICECUBE1 (fifo)

4c – ICECUBE2 (pipe output)

5 – STACKIN

- ➡ start shower with a list of particle

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Options ...

6 – CHARM

- ✚ track and decay (using PYTHIA) charmed particles produced by QGSJET01 or DPMJET 2.55

6a – TAULEP

- ✚ for Tau lepton propagation and decay (using PYTHIA)

7 – Slant

- ✚ longitudinal profile as a function of slant depth and not vertical depth (default)

7a – Curved

- ✚ use a curved atmosphere instead of flat (default)

✚ needed for large angles ($>70^\circ$)

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Options ...

7b – Upward

- ➡ track particle going upward
- ➡ allows upward going showers

7c – View-cone

- ➡ restrict primary angle generation to a cone around a given direction
- ➡ to be used for atmospheric cherenkov detectors.

8a – PLOTSH

- ➡ only to make a “picture” of the shower

8b – PLOTSH2

- ➡ more compact output for PLOTSH (need some special library)

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Options ...

8c – ANAHIST

- ➡ plot various particle distributions from air shower in hbook file

➡ Longitudinal prof, LDF, time, weight, ...

8d – Auger-histos

- ➡ hbook file but with many layers

8e – MUON-histo

- ➡ hbook file for muon production depth and muon distribution study

9 – External atmosphere

- ➡ Using Bernlohr C-routines.

9a – Efield

9b – RIGIDITY (Grappes)

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Options ...

10a – DYNSTAC

10b – REMOTE control

a – CONEX

- ➡ use cascade equations to reduce simulation time

- ➡ various option for 1D or 3D

b – PARALLEL

- ➡ parallel calculation

- ➡ shell script or MPI

c – CoREAS

- ➡ radio signal emission from air shower

- ➡ needs more input files

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COAST Options ...

(see R. Ulrich talk)



d1 – Inclined

- ➔ arbitrary direction for obs. level

d2 – ROOTOUT

- ➔ produce the DAT file in ROOT

(d3 – COASTUSERLIB)

- ➔ appear only if COAST is installed
- ➔ to use COAST as external package for shower analysis

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9b - RIGIDITY Ooty version rejecting low-energy primaries entering Earth-magnetic field
10a - DYNamic intermediate particle STACK
10b - Remote Control for Corsika
a - CONEX for high energy MC and cascade equations
b - PARALLEL treatment of subshowers (includes LPM)
c - CoREAS Radio Simulations
d1 - Inclined observation plane
d2 - ROOT particle OUTput file
d3 - Use an external COAST user library (COrsika data Access Tool)
e - interaction test version (only for 1st interaction)
f - Auger-info file instead of dbase file
g - COMPACT particle output file
h - MUPROD to write decaying muons
h2 - prEHISTORY of muons: mother and grandmother
k - annitest cross-section version (obsolete)
l - hit Auger detector (steered by AUGSCT)
-----
y - *** Reset selection ***
z - *** Finish selection *** [DEFAULT]

r - restart (reset all options to cached values)
x - exit make

(multiple selections accepted, leading '-' removes option):
```

Options ...

e – Interaction test

- ➔ only first interaction to plot particle distributions (hbook)

f – Auger info file

- ➔ special output file on generated showers (primary parameters)

g – COMPACT output

- ➔ compact output file to be used for low energy showers with few particles at ground

h – MUPROD

- ➔ write in particle list produced muons which do not reach observation level

```
-----
options:  TIMEAUTO GHEISHA HORIZONTAL EPOS

Which additional CORSIKA program options do you need ?
1a - Cherenkov version
1b - Cherenkov version using Bernlohr IACT routines (for telescopes)
1c - apply atm. absorption, mirror reflectivity & quantum eff.
1d - Auger Cherenkov longitudinal distribution
1e - TRAJECTory version to follow motion of source on the sky
2 - LPM-effect without thinning
2a - THINning version (includes LPM)
2b - MULTiple THINning version (includes LPM)
3 - PRESHowER version for EeV gammas
4 - NEUTRINO version
4a - NUPRIM primary neutrino version with HERWIG
4b - ICECUBE1 FIFO version
4c - ICECUBE2 gzip/pipe output
5 - STACK INput of secondaries, no primary particle
6 - CHARMed particle/tau lepton version with PYTHIA
6a - TAU LEPTon version with PYTHIA
7 - SLANT depth instead of vertical depth for longi-distribution
7a - CURVED atmosphere version
7b - UPWARD particles version
7c - VIEWCONE version
8a - shower PLOT version (PLOTSH) (only for single events)
8b - shower PLOT(C) version (PLOTSH2) (only for single events)
8c - ANALYSIS HISTos & THIN (instead of particle file)
8d - Auger-histo file & THIN
8e - MUON-histo file
9 - external atmosphere functions (table interpolation)
   (using bernlohr C-routines)
9a - EFIELD version for electrical field in atmosphere
9b - RIGIDITY Ooty version rejecting low-energy primaries entering Earth-magnetic field
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k - annitest cross-section version (obsolete)
l - hit Auger detector (steered by AUGSCT)
-----
y - *** Reset selection ***
z - *** Finish selection *** [DEFAULT]

r - restart (reset all options to cached values)
x - exit make

(multiple selections accepted, leading '-' removes option):
```

Options ...

h2 – preHISTORY

➡ to get information about mother and grandmother particles of particles arriving at ground

➡ MUADDI : muons

➡ EMADDI : electrons and photons

k – annist test

➡ nothing

l – Auger Hit

```
-----
options:  TIMEAUTO GHEISHA HORIZONTAL EPOS

Which additional CORSIKA program options do you need ?
1a - Cherenkov version
1b - Cherenkov version using Bernlohr IACT routines (for telescopes)
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k - annistest cross-section version (obsolete)
l - hit Auger detector (steered by AUGSCT)
-----
y - *** Reset selection ***
z - *** Finish selection *** [DEFAULT]

r - restart (reset all options to cached values)
x - exit make

(multiple selections accepted, leading '-' removes option):
```


If Cherenkov

```
-----
Cherenkov light vertical (longitudinal) distribution option ?
 1 - Photons counted only in the step where emitted [DEFAULT]
 2 - Photons counted in every step down to the observation level
    (compatible with old versions but inefficient)
 3 - No Cherenkov light distribution at all

r - restart (reset all options to cached values)
x - exit make

(only one choice possible):
SELECTED      : INTCLONGSTD

-----

Do you want Cherenkov light emission angle wavelength dependence ?
 1 - Emission angle is wavelength independent [DEFAULT]
 2 - Emission angle depending on wavelength

r - restart (reset all options to cached values)
x - exit make

(only one choice possible):
SELECTED      : CERWLENOFF
SELECTED      : CERENKOV
NOT COMPATIBLE TO: COMPACT VOLUME CORR INTTEST ANAHIST AUGERHIST MUONHIST AUG
RLONG
```

Che. longitudinal distribution

- ➡ differential (prod. per bin)
- ➡ integrated (sum in bin)
- ➡ none

Che. light emission

- ➡ refraction index wavelength independent
- ➡ refraction index wavelength dependent
 - ➡ emission angle change at low energy

Time Selection

Date and time :

- ➡ Available only in expert mode
 - ➡ coconut -e
- ➡ Used only to print date in output file
 - ➡ default correct in most of the case
 - ➡ try something different only in case of problem before or after compilation when “date” appears.

```
(only one choice possible):  
SELECTED      : NOM32
```

```
-----  
Which high energy hadronic interaction model do you want to use ?
```

- 1 - DPMJET 2.55
- 2 - EPOS LHC
- 3 - NEXUS 3.97
- 4 - QGSJET 01C (enlarged commons) [CACHED]
- 5 - QGSJETII-04
- 6 - SIBYLL 2.1
- 7 - VENUS 4.12

```
r - restart (reset all options to cached values)  
x - exit make
```

```
(only one choice possible):  
SELECTED      : QGSJET01
```

```
-----  
Which low energy hadronic interaction model do you want to use ?
```

- 1 - GHEISHA 2002d (double precision) [CACHED]
- 2 - FLUKA
- 3 - URQMD 1.3cr

```
r - restart (reset all options to cached values)  
x - exit make
```

```
(only one choice possible):  
SELECTED      : GHEISHA
```

```
-----  
Which routine for date and time ?
```

- 1 - automatic detection by configure
(only use other choices if this one fails) [DEFAULT]
- 2 - new date_and_time routine
- 3 - old date routine
- 4 - timerc routine
- 5 - date and time for IBM risc
- 6 - old date routine for pgf77

```
r - restart (reset all options to cached values)  
x - exit make
```

```
(only one choice possible): █
```

Output Types

4 different types of output files :

- ➡ Control output (text file)
- ➡ Particle list (binary files)
 - ➡ DAT file for secondary particles of shower
 - ➡ CER file for Cherenkov photons
- ➡ Histograms
 - ➡ LONGitudinal profile and energy deposit (ASCII)
 - ➡ ANAHIST (CERNLIB)
 - ➡ AUGERHIST (CERNLIB)
 - ➡ MUONHIST (CERNLIB)
 - ➡ First Interaction (CERNLIB)
 - ➡ COAST (with or without ROOT) (see R. Ulrich talk)
- ➡ Infos on shower production
 - ➡ DBASE
 - ➡ INFO (Auger)