

Installation of CORSIKA

Tanguy Pierog

Karlsruhe Institut of Technology ,Institut für Kernphysik,
Karlsruhe, Germany



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For CORSIKA School

USB stick distributed with CORSIKA/ with

- ➔ airshowerMovies : some examples
- ➔ archives
 - ➔ CORSIKA v6.970 (+QGSJETII dat files)
 - ➔ COAST v4.1
 - ➔ CONEX v2.3i
 - ➔ REAS 3
 - ➔ ROOT (has to be installed for tomorrow exercises)
- ➔ documentations
- ➔ exercises
 - ➔ REAS
- ➔ usefulStuff
 - ➔ various small text and code (not necessary for school)

For CORSIKA School

USB stick distributed with CORSIKA/ with

→ airshowerMovies : some examples

Make sure, you have ROOT installed on your system

Get ROOT from ftp://root.cern.ch/root/root_v5.28.00.source.tar.gz

or use the tar file provided on the USB stick

On Ubuntu/Debian or similar systems it is better to use the package manager (apt-get) to install root. Take care to include the "dev" packages, too!

If you want (or have) to to install from source, consider <http://root.cern.ch/drupal/content/build-prerequisites> before you start! After unpacking

define ROOTSYS shell environment variable

run plain `./configure` in root unpacked directory

"make" (this can run ~hour, depending on your machine, so make sure ROOT is installed **BEFORE the exercises)**

→ various small text and code (not necessary for school)

For CORSIKA School

USB stick distributed with CORSIKA/ with

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- ➔ archives
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 - ➔ ROOT (has to be installed for tomorrow exercises)
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- ➔ exercises
 - ➔ REAS
- ➔ usefulStuff
 - ➔ various small text and code (not necessary for school)

How does it work ?

PAST : options (part of Fortran code) selected manually with `CMZ`

- ➔ Not universal and not developed any more

since 2005 : automake/autoconf standard GNU installation scheme

- ➔ options selected by precompilation commands (C-like in Fortran)
- ➔ machine dependent options and compilation selected automatically
- ➔ call of `configure` and `make` done by external shell script :
 - ➔ `corsika-install` : user interface for installation
- ➔ sometimes problem with newest Linux distribution (`corsika-install` doesn't follow strictly the GNU format)

2009 : 100% GNU compatible scripts : `coconut`

- ➔ same user interface but technically different

How does it work ?



How to install CORSIKA ?

Downloading and unpacking the code :

- ➔ `ftp corsika-6970.tar.gz` (and `QGSDAT-II-03` for QGSJETII model)
from `ftp://ftp-ik.fzk.de/pub/corsika/v690`
- ➔ unpack using : `tar -zxvf corsika-6970.tar.gz`
- ➔ move `QGSDAT-II-03` to `corsika-6970/run/`
- ➔ enter subdirectory : `cd corsika-6970/`

“Normal” Linux distribution with `gcc` and `g77` (or `gfortran`) :

- ➔ use directly : `./coconut`
- ➔ select options (see following)

Different compiler :

- ➔ use the standard `$F77`, `$FFLAGS`, `$CC`, ...

```
File Edit View Terminal Help
=====
Welcome to COCONUT (v3)
-- the CORSIKA CONFIGURATION UTILITY --
=====

create an executable of a specific CORSIKA version

Please read the documentation for a detailed description
of the options and how to use it.

Try './coconut -h' to get some help about COCONUT
Use './coconut --expert' to enable additional configuration steps.

(press 'Enter' to select an option followed by "[DEFAULT]" or "[CACHED]")
=====

*****
* WARNING:
* Your system does support 64bit binaries.
* Some CORSIKA features are only supported in 32bit mode (because of
* incompatible binary data structures)!
* Therefore by default CORSIKA uses the "-m32" flag to force 32bit mode.
*****

-----
Compile in 32 or 64bit mode ?
 1 - Force 32bit mode [DEFAULT]
 2 - Use compiler default ('-m64' on a 64bit machine)

r - restart
x - exit make

(only one choice possible): 2

-----
Create binaries in 32 or 64bit compatible mode ?
 1 - Out(in)put binary files compatible with 32bit machines (only with GFORTRAN v>
4.2 compiler: uses 4 bytes record markers)
 2 - Use compiler default for record marker (8 bytes for 64bit compilation) [DEFAU
LT]

r - restart
x - exit make

(only one choice possible):
```

Compatibility Mode

System check the compilation mode of your machine

➔ Choose between 32 bits or 64 bits compilation

➔ choose 2 if you don't know and don't care about compatibility

➔ no problem with 64 bits if DAT file reader compiled the same way.

Recent gfortran allows 32 bits output with 64 bits compilation

➔ best option if available

➔ compatible with older simu.

➔ smaller disk space

Models Selection

```
File Edit View Terminal Help
-----
Which high energy hadronic interaction model do you want to use ?
 1 - DPMJET 2.55
 2 - EPOS 1.99
 3 - NEXUS 3.97
 4 - QGSJET 01C (enlarged commons) [DEFAULT]
 5 - QGSJETII.3
 6 - SIBYLL 2.1
 7 - VENUS 4.12

r - restart
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) [DEFAULT]
 2 - FLUKA 2008
 3 - URQMD 1.3cr

r - restart
x - exit make

(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

r - restart
x - exit make

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

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 and QGSJETII

➔ references:

- QGSJET01 and SIBYLL 2.1

➔ special use:

- others

Low energy hadronic interaction model

➔ Do not forget to define `$FLUPRO` (installation path) to use FLUKA

Geometry Selection

```
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Which high energy hadronic interaction model do you want to use ?
 1 - DPMJET 2.55
 2 - EPOS 1.99
 3 - NEXUS 3.97
 4 - QGSJET 01C (enlarged commons) [DEFAULT]
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 6 - SIBYLL 2.1
 7 - VENUS 4.12

r - restart
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 2008
 3 - URQMD 1.3cr

r - restart
x - exit make

(only one choice possible):
SELECTED      : GHEISHA

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Which detector geometry do you have ?
 1 - horizontal flat detector array [DEFAULT]
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 3 - vertical string detector geometry

r - restart
x - exit make

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

Detector geometry (only change the angular distribution of showers)

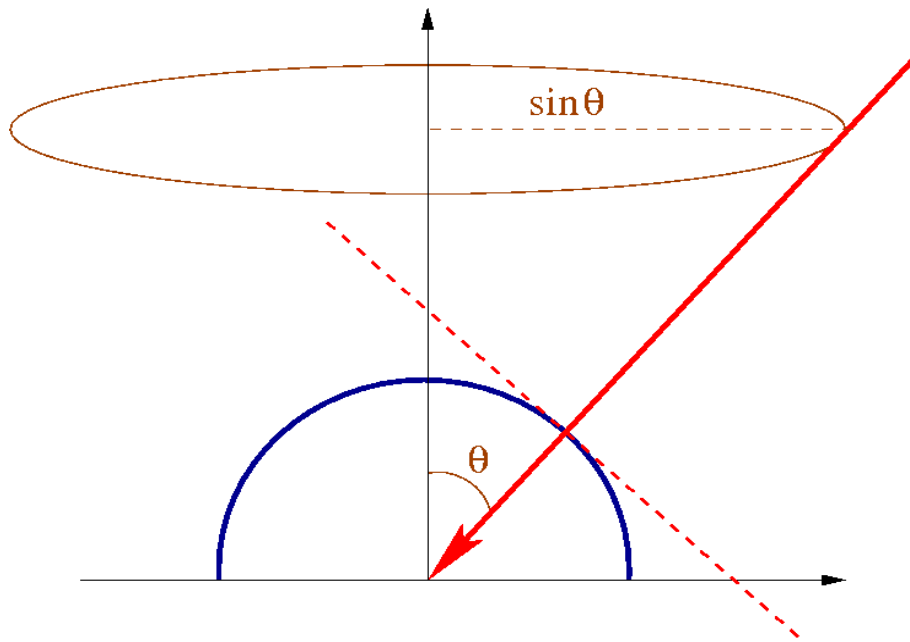
➔ **Horizontal flat detector**
(KASCADE, Pierre Auger Obs,...)

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

➔ **Vertical String detector**
(AMANDA, IceCube, Antares, ...)

Geometry Selection

Detector geometry (only change the angular distribution of showers)



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

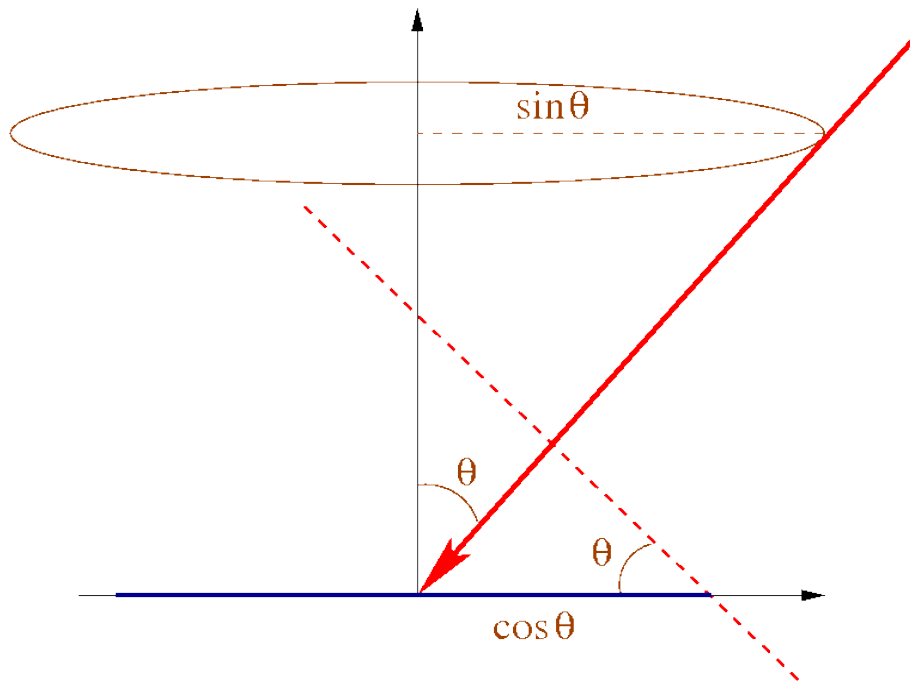
➤ Non-flat (volume) detector
(Magic, HESS,...)

$$➤ I \propto \sin\theta$$

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

Geometry Selection

Detector geometry (only change the angular distribution of showers)



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

$$\text{➤ } I \propto \sin\theta \cdot \cos\theta$$

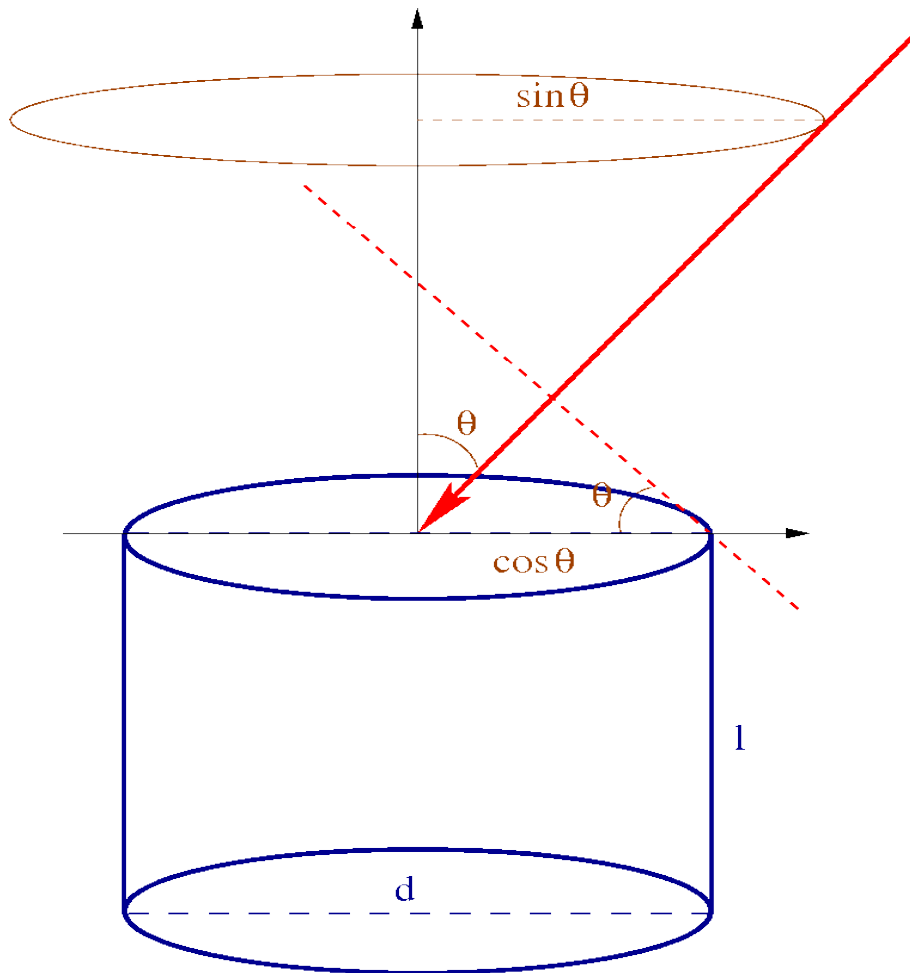
- Non-flat (volume) detector
(Magic, HESS,...)

$$\text{➤ } I \propto \sin\theta$$

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

Geometry Selection

Detector geometry (only change the angular distribution of showers)



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

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

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

$$I \propto \sin\theta$$

- Vertical String detector
(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

```
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 3 - apply atm. absorption, mirror reflectivity & quantum eff.
 4 - external atmosphere functions (table interpolation)
    (using bernlohr C-routines)
 5 - THINning version
 6 - NEUTRINO version
 7 - shower PLOT version (PLOTSH) (only for single events)
72 - shower PLOT(C) version (PLOTSH2) (only for single events)
 8 - interaction test version (only for 1st interaction)
 9 - SLANT depth instead of vertical depth for longi-distribution
 a - CURVED atmosphere version
 b - UPWARD particles version
 c - view-cone version
 d - ANALYSIS HISTos & THIN (instead of particle file)
 e - Auger-info file instead of dbase file
 f - Auger-histo file & THIN
 g - Auger Cherenkov longitudinal distribution
 h - PRESHOWER version for EeV gammas
 i - STACEE experiment output Cherenkov photons
    (includes: CERENKOV CEFFIC THIN)
 j - COMPACT particle output file
 k - annitest cross-section version (obsolete)
 l - LPM-effect without thinning
 m - STACK INput of secondaries, no primary particle
 n - primary neutrino version with HERWIG (NUPRIM)
 o - ROOT particle OUTput file
 p - ROOT particle TRACKing option
 q - CHARMed particle/tau lepton version with PYTHIA
 s - preHISTORY of muons: mother and grandmother
 t - TAU LEPTON version with PYTHIA
 .....
 y - *** Reset selection ***
 z - *** Finish selection *** [DEFAULT]

 r - restart
 x - exit make

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

1 – Cherenkov for rectangular grid

➔ cherenkov array at ground

2 – Cherenkov for det. system (IACT)

➔ HESS, Magic ...

➔ with extension for more informations on particles

3 – atmospheric corrections (CEFFIC)

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

➔ light absorption in atmosphere

➔ mirror reflectivity

➔ quantum efficiency

Options ...

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```

4 – External atmosphere

5 – Thinning

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

6 – Neutrino version

- ➔ add neutrino into list of particle

7 – PLOTSH

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

72 – PLOTSH2

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

Options ...

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 y - *** Reset selection ***
 z - *** Finish selection *** [DEFAULT]

 r - restart
 x - exit make

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

8 – Interaction test

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

9 – Slant

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

a – Curved

- ➔ use a curved atmosphere instead of flat (default)
 - ➔ needed for large angles ($>70^\circ$)

b – Upward

- ➔ track particle going upward
 - ➔ allows upward going showers

Options ...

```
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-----
y - *** Reset selection ***
z - *** Finish selection *** [DEFAULT]

r - restart
x - exit make

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

c – View-cone

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

d – ANAHIST

- ➔ plot various particle distributions from air shower in hbook file
- ➔ Longitudinal prof, LDF, time, weight, ...

e – Auger info file

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

f – Auger-histos

- ➔ hbook file but with many layers

Options ...

```
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 .....
 y - *** Reset selection ***
 z - *** Finish selection *** [DEFAULT]

 r - restart
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(multiple selections accepted, leading '-' removes option): []
```

g – Auger Cherenkov long. prof.

➔ not full simulation but time consuming

h – PRESHOWER

➔ preshowering of gamma primary before atmosphere

i – STACEE

➔ cherenkov photons as used by the STACEE experiment

j – COMPACT output

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

Options ...

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 y - *** Reset selection ***
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 r - restart
 x - exit make

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

k – annist test

➔ nothing

l – LPM effect

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

m – STACKIN

➔ start shower with a list of particle
➔ first interaction given by external program (Neutrino...)

n – NUPRIM

➔ use HERWIG to have neutrino as primary particle

➔ only primary neutrino will interact

Options ...

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 .....
 y - *** Reset selection ***
 z - *** Finish selection *** [DEFAULT]

 r - restart
 x - exit make

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

o – ROOTOUT

- ➔ produce the DAT file in ROOT format using COAST

p – ROOTTRACK

- ➔ appear only if COAST is installed
- ➔ to use COAST as external package for shower analysis (see R. Ulrich talk)



Options ...

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 s - preHISTORY of muons: mother and grandmother
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 .....
 y - *** Reset selection ***
 z - *** Finish selection *** [DEFAULT]

 r - restart
 x - exit make

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

q – CHARM

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

s – EHISTORY

- ➔ to get information about mother and grandmother particles of muons arriving at ground (using MUADDI keyword)

t – TAULEP

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

Other Options ...

```
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    (includes: CERENKOV CEFFIC THIN)
 j - COMPACT particle output file
 k - annitest cross-section version (obsolete)
 l - LPM-effect without thinning
 m - STACK INput of secondaries, no primary particle
 n - primary neutrino version with HERWIG (NUPRIM)
 o - ROOT particle OUTput file
 p - ROOT particle TRACKing option
 q - CHARMed particle/tau lepton version with PYTHIA
 s - preHISTORY of muons: mother and grandmother
 t - TAU LEPTon version with PYTHIA
 .....
 y - *** Reset selection ***
 z - *** Finish selection *** [DEFAULT]

 r - restart
 x - exit make

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

y – reset selection

z – Finish selection

➔ just press “return” key

r – restart

➔ from the beginning (model selection)

x – exit make

➔ stop installation

If Cherenkov

```
File Edit View Terminal Help
-----
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
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
x - exit make

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

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

Source and Compilation

```
File Edit View Terminal Help
-----
Configuration is finished. How do you want to proceed ?
 f - Compiling and remove temporary files [DEFAULT]
 k - Compile and keep extracted CORSIKA source code
 n - Just extract source code. Do not compile!

 r - restart
 x - exit make

 (only one choice possible):
  SELECTED      : COMPILE
checking whether to enable maintainer-specific portions of Makefiles... no
checking build system type... x86_64-unknown-linux-gnu
checking host system type... x86_64-unknown-linux-gnu
checking for a BSD-compatible install... /usr/bin/install -c
checking whether build environment is sane... yes
checking for a thread-safe mkdir -p... /bin/mkdir -p
checking for gawk... gawk
checking whether make sets $(MAKE)... yes
checking for pgf77... no
checking for ifc... no
checking for g77... no
checking for gfortran... gfortran
checking for Fortran 77 compiler default output file name... a.out
checking whether the Fortran 77 compiler works... yes
checking whether we are cross compiling... no
checking for suffix of executables...
checking for suffix of object files... o
checking whether we are using the GNU Fortran 77 compiler... yes
checking whether gfortran accepts -g... yes
checking for cc... cc
checking whether we are using the GNU C compiler... yes
checking whether cc accepts -g... yes
checking for cc option to accept ISO C89... none needed
checking for style of include used by make... GNU
checking dependency style of cc... gcc3
checking for g++... g++
checking whether we are using the GNU C++ compiler... yes
checking whether g++ accepts -g... yes
checking dependency style of g++... gcc3
checking for cpp... cpp
checking how to run the C preprocessor... cpp
checking for a sed that does not truncate output... /bin/sed
checking for grep that handles long lines and -e... /bin/grep
```

By default the program is compiled

➔ answer “n” (no) only if you know why !

Source file not saved by default

➔ using “k” source (after precompilation) can be saved if you want to see what is really used in the code

System Check

System check important only if something goes wrong ...

- ➔ Please send it with your email if you have unsolved problem during your installation.
- ➔ In case of incompatible option or missing declaration (like path variables) an error message appears here and program stops
 - ➔ no compilation !
- ➔ if you can't solve the problem, please send us screen output and `config.status` file.

```
File Edit View Terminal Help
checking interaction test... (cached) no
checking slant profile... (cached) no
checking curved atmosphere... (cached) no
checking upward particles... (cached) no
checking viewcone... (cached) no
checking produce analysis histograms... (cached) no
checking augerinfo... (cached) no
checking augerhist... (cached) no
checking cerenkov longitudinal profile... (cached) no
checking photon preshower... (cached) no
checking STACEE... (cached) no
checking compact output... (cached) no
checking annitest... (cached) no
checking LPM effect... (cached) no
checking stack input... (cached) no
checking for herwig... no
checking herwig neutrino production (NUPRIM)... (cached) no
checking for coast... no
checking for root... no
checking rootout... (cached) no
checking for coast_lib... no
checking rootrack... (cached) no
checking for pythia... no
checking pythia charm production... (cached) no
checking pythia tau lepton production... (cached) no
checking particle history... (cached) no
checking do not compile binaries, just extract CORSIKA compilefile... (cached) no
checking to keep the CORSIKA compilefile... (cached) no
config.status: creating ./config.status
config.status: creating Makefile
config.status: creating bernlohr/Makefile
config.status: creating dpmjet/Makefile
config.status: creating epos/Makefile
config.status: creating pythia/Makefile
config.status: creating herwig/Makefile
config.status: creating nexus/Makefile
config.status: creating urqmd/Makefile
config.status: creating src/Makefile
config.status: creating run/Makefile
config.status: creating doc/Makefile
config.status: creating lib/Makefile
config.status: creating include/config.h
config.status: executing depfiles commands
.....
```

Installation Complete

```
File Edit View Terminal Help
make[2]: Entering directory `/home/pierog/corsika/corsika-6970/src'
test -z "/home/pierog/corsika/corsika-6970/run" || /bin/mkdir -p "/home/pierog/corsika/corsika-6970/run"
/bin/bash ../libtool --mode=install /usr/bin/install -c 'corsika' '/home/pierog/corsika/corsika-6970/run/corsika'
/usr/bin/install -c corsika /home/pierog/corsika/corsika-6970/run/corsika
/bin/bash ../libtool --mode=install /usr/bin/install -c 'corsikaread' '/home/pierog/corsika/corsika-6970/run/corsikaread'
/usr/bin/install -c corsikaread /home/pierog/corsika/corsika-6970/run/corsikaread
/bin/bash ../libtool --mode=install /usr/bin/install -c 'corsikaread_thin' '/home/pierog/corsika/corsika-6970/run/corsikaread_thin'
/usr/bin/install -c corsikaread_thin /home/pierog/corsika/corsika-6970/run/corsikaread_thin
/bin/bash ../libtool --mode=install /usr/bin/install -c 'corsikaread_history' '/home/pierog/corsika/corsika-6970/run/corsikaread_history'
/usr/bin/install -c corsikaread_history /home/pierog/corsika/corsika-6970/run/corsikaread_history
/bin/bash ../libtool --mode=install /usr/bin/install -c 'plottracks' '/home/pierog/corsika/corsika-6970/run/plottracks'
/usr/bin/install -c plottracks /home/pierog/corsika/corsika-6970/run/plottracks
make[2]: Nothing to be done for `install-data-am'.
make[2]: Leaving directory `/home/pierog/corsika/corsika-6970/src'
make[1]: Leaving directory `/home/pierog/corsika/corsika-6970/src'
Making install in .
make[1]: Entering directory `/home/pierog/corsika/corsika-6970'
make[2]: Entering directory `/home/pierog/corsika/corsika-6970'
make install-exec-hook
make[3]: Entering directory `/home/pierog/corsika/corsika-6970'

--> "corsika6970Linux_QGSJET_gheisha" successfully installed in :
    /home/pierog/corsika/corsika-6970/run/

--> You can run CORSIKA in /home/pierog/corsika/corsika-6970/run/ using for instance
:
    ./corsika6970Linux_QGSJET_gheisha < all-inputs > output.txt

make[3]: Leaving directory `/home/pierog/corsika/corsika-6970'
make[2]: Nothing to be done for `install-data-am'.
make[2]: Leaving directory `/home/pierog/corsika/corsika-6970'
make[1]: Leaving directory `/home/pierog/corsika/corsika-6970'
/home/pierog/corsika/corsika-6970 :
```

If no compilation problem

- ➔ CORSIKA installed in the run/ subdirectory
- ➔ follow instructions and enjoy CORSIKA !

Time Selection

```
File Edit View Terminal Help
-----
Which high energy hadronic interaction model do you want to use ?
 1 - DPMJET 2.55
 2 - EPOS 1.99
 3 - NEXUS 3.97
 4 - QGSJET 01C (enlarged commons) [CACHED]
 5 - QGSJETII.3
 6 - SIBYLL 2.1
 7 - VENUS 4.12

r - restart
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 2008
 3 - URQMD 1.3cr

r - restart
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
x - exit make

(only one choice possible): |
```

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.