How to run Corsika in HT Condor

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This document is a guide to make flux simulations using ARTI framework. For this guide we use Corsika-77500 to simulate the flux of cosmic rays in Medellin, Colombia. In order to make the proccess faster, the simulations were held in HT Condor.

To start with, request acces to Corsika and once you have it, run `./coconut` and install it with the next options:

- 1a - Cherenkov
- 2 - LPM-effect
- 7a - Curved atmosphere
- 9 - External atmosphere
- 9a - EFIELD

Then download ARTI framework from `https://github.com/lagoproject/arti`.

Now we produce the data cards for corsika, in terminal go to the arti/sims folder, then enter the next command:

```
./do_sims.sh -w yourPath/corsika-77500/run -p flux -t 43200 -v 77500 -u you
```

- -p flux : folder created in yourPath/corsika-77500/run
- -t 60 : time in seconds during which you are going to simulate the flux
- -v 77500 : Corsika version
- -u you : user

Once you run the command, ARTI will ask you for some parameters, in our case we used:

- THETAPR(1): 1
- THETAPR(2): 87
- LLIMIT: 4 GeV
- ULIMIT: 200 GeV
- RIGIDITY: DEFAULT
- ATMOSPHERIC MODEL: DEFAULT
- OBSLEV: 1479E2
- Bx: 26.7873
- Bz: 15.2962

This proccess will created .sh files in yourPath/corsika-77500/run. You must run these files with the next command:

```
for i in go-flux-*.sh; do while pgrep -fau $(id -un) 'SCREEN.*-flux';
do sleep 3s; done; ./"$i"; sleep 3s; done && pkill corsika
```

This command will run the .sh files and kill Corsika proccesses in order to get only the data cards for Corsika. Create a folder in yourPath/corsika-77500/run with the name inputFiles, then copy `.inputs` files from yourPath/corsika-77500/run/flux to inputFiles folder. This `.inputs` files need a little change, in order to do this create and run a python file with the following code:

```
import os

path = '/yourPath/corsika-77500/run/inputFiles/'
ext = '.input'

filesInFolder = [file for file in os.listdir(path) if file.endswith(ext)]

for file in filesInFolder:
   with open(path + file, 'r+') as file:
      lines = file.readlines()
      lines[29] = "DIRECT      ./\n"
      file.seek(0)
      file.writelines(lines)
      file.close()
```

Create a folder named corsika_run_files and copy the next files from yourPath/corsika-77500/run:

- EGSDAT6_.05
- EGSDAT6_.15
- EGSDAT6_3.
- gr3.txt
- qgsdat-II-04
- EGSDAT6_1.
- EGSDAT6_.25
- EGSDAT6_.4
- NUCNUCCS
- sectnu-II-04

Now you need to generate the submit files to run Corsika in HT Condor, create a folder named submits and outs, then run the following python code:

```
import os


path_input_files = 'yourPath/corsika-77500/run/inputFiles/'
input_files = [archivo for archivo in os.listdir(path_input_files) if archivo.endswith('.input')]

i = 1
for input in input_files:
    shs = "submits/runCorsika_" + str(i) + ".sh"
    with open(shs, 'w') as shs:
        shs.write("#!/bin/sh\n")
        shs.write(f"./corsika77500Linux_QGSII_gheisha < {input} > {input[:-5] + 'lst'}\n")
        shs.write(f"tar -czvf {input[:9]}.tar.gz {input[:9]} {'CER' + input[3:9]} {input[:9] + '.long'} {input[:-5] + 'lst'}")
    shs.close()

    archivo = "submits/submit_" + str(i)
    with open(archivo, 'w') as archivo:
        archivo.write("Universe   = vanilla\n")
        archivo.write(f"Executable = yourPath/corsika-77500/run/submits/runCorsika_{i}.sh\n")
        archivo.write("Log        = test.log.txt\n")
```

```
        archivo.write("Output     = test.out.txt\n")
        archivo.write("Error      = test.error.txt\n")
        archivo.write("initialdir = yourPath/corsika-77500/run/\n")
        archivo.write("should_transfer_files = yes\n")
        archivo.write(f"transfer_input_files = corsika77500Linux_QGSII_gheisha, submits/runCorsika_{i}.sh, inputFiles/,
        corsika_run_files/\n")
        archivo.write("when_to_transfer_output = ON_EXIT\n")
        archivo.write(f"transfer_output_files = {input[:9]}.tar.gz\n")
        archivo.write(f'transfer_output_remaps = "{input[:9]}.tar.gz = outs/{input[:9]}.tar.gz"\n')
        archivo.write("request_cpus = 4\n")
        archivo.write("request_memory = 20000\n")
        archivo.write('+JobFlavour = "tomorrow"\n')
        archivo.write("Queue\n")
    archivo.close()
    i += 1

path_submit_files = 'yourPath/corsika-77500/run/submits/'
submit_files = [archivo for archivo in os.listdir(path_submit_files)]

with open("submits/submit_all.sh", 'w') as sh_file:
    sh_file.write("#!/bin/sh\n")

    for submit in submit_files:
        if submit[:-2] != ".sh" and submit[0] == "s":
            sh_file.write("condor_submit " + submit + "\n")
```

Go to yourPath/corsika-77500/run/submits/ and run:

```
chmod 777  submit_all.sh && ./submit_all.sh
```

This will submit the jobs to HT Condor and return `.tar.gz` files in the folder outs with the results of running Corsika, this proccess can take hours. Please note that you must edit `+JobFlavour` as needed. Once you have the `.tar.gz`, generate `.PRI` and `.SEC` files, in order to do this run:

```
for i in DAT??????.tar.gz; do j=$(echo $i | sed -e 's/.tar.gz//'); u=$(echo $j
| sed -e 's/DAT//'); tar -xvf $i; echo $j | yourPath/arti/analysis/lagocrkread |
yourPath/arti/analysis/analysis -p -v $u; rm $j; done
```

```
bzcat *sec.bz2 | yourPath/arti/analysis/showers -a 20 -d 20 -c seaLevelInMeters
-v Salida
```

counter=1; for i in ??????.sec.bz2; do bzcat $i | yourPath/arti/analysis/showers -a 20 -d 20 -c seaLevelInMeters. -v Salida_$counter; mv Salida_$counter.dst dst; mv Salida_$counter.hst hst; bzip2 -dk Salida_$counter.shw.bz2; mv Salida_$counter.shw shw; rm Salida_$counter.shw.bz2; counter=$((counter + 1)); done