CORSIKA Cosmic Ray Simulation Workshop

17-20 June 2019, Karlsruhe.

CORELib:COsmic Ray Event Library

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The main focus of CORELib is to provide a collection of simulated showers induced by cosmic rays and a common framework to produce and manage such large production.

CORELib was originally developed for the Research Infrastructures (ESFRI) in ASTERICS, especially KM₃NeT, but it is potentially useful for a wider community, e.g. air shower experiments, muography, etc.





- CORSIKA 7.5000 as generator
- •Sea level as observation level
- Standard European Atmosphere



Istituto Nazionale di Fisica Nucleare

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Two production with different spectral index:





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Two production with different spectral index:

- Proton Nuclei (He- CNO-Fe) induced showers with **spectral index** = **-2**
- Proton induced showers with **flat spectrum**



Proton – Nuclei (He-CNO-Fe) induced showers:

• HE models : QGSJET-01 with CHARM, QGSJET-01 with TAULEP, QGSJET-II with TAULEP, EPOS with TAULEP



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- 7 energy bins (2×10^2 GeV 10^3 GeV + equally logarithmically spaced from 1 TeV to 10^9 TeV)
- power law spectrum with spectral index = -2



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- zenith angle between 0 and 89 degrees
- Cherenkov radiation (only for proton induced showers)



Proton induced Showers (Flat Log Spectrum)

- HE models : QGSJET-01 with CHARM, QGSJET-01 with TAULEP, QGSJET-II with TAULEP, EPOS with TAULEP
- LE model : GHEISHA
- about 10 MEvents per HE model
- 7 energy bins (2×10^2 GeV 10^3 GeV + equally logarithmically spaced from 1 TeV to 10^9 TeV)
- Flat Log Spectrum in each bin



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- 7 energy bins ($2\times10^2~GeV$ $10^3~GeV$ + equally logarithmically spaced from 1 TeV to $10^9~TeV$)
- Flat Log Spectrum in each bin
- zenith angle between 0 and 89 degrees
- NO Cherenkov radiation

KM3Ne



Status of production for proton induced shower

PROTON INDUCED SHOWERS											
High energy model	Low energy model	Option		v energy model Option Cherenkov Radiation		enkov ation	Status				
		TAULEP	CHARM	with	without	α = -2	α = 0				
QGSJET01	GHEISHA		х	х	х	DONE	DONE				
QGSJET01	GHEISHA	х		х	х	DONE	DONE				
QGSJETII-04	GHEISHA	х		х	х	DONE	DONE				
EPOS LHC	GHEISHA	x		х	х	DONE	70% DONE				



Status of production for Heavy Nuclei (He,C,N,O,Fe) without Cherenkov radiation

KM3Ne

HEAVY NUCLEI (He-CNO-Fe) INDUCED SHOWERS											
High energy model	Low energy model	Option		Cherenkov Radiation		Status					
		TAULEP	CHARM	with	without	α = -2					
QGSJET01	GHEISHA		х		х	DONE					
QGSJET01	GHEISHA	х			х	DONE					
QGSJET01	GHEISHA	х			x	DONE					
QGSJETII-04	GHEISHA	x			x	DONE					
EPOS LHC	GHEISHA	x			x	DONE					



OUTPUT FILES:

- Control output (file.txt containing all the standard output of the corresponding run, first of all the datacard of the event);
- Particle list (binary files compress in a tar file)
 - DAT file (particles shower produced by interaction of primary CR)
 - CER file (photons produced by Cherenkov effect only p-induced shower)



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CORANT:

• dedicated tool developed by T.Chiarusi,L.A. Fusco, C.Pellegrino and improved by B.Spisso and S.M.Stellacci on purpose;

•Extract from CORSIKA output files information about secondary cosmic ray and put them in separated ASCII files

- electromagnetic component;
- muons;
- neutrinos;
- hadrons + tau



CORANT status:

KM3N



CORANT status:

completed

Proton induced showers with power law spectral index -2

Nuclei induced showers with power law spectral index -2



CORANT status:

completed

ongoing

Proton induced showers with power law spectral index -2

Nuclei induced showers with power law spectral index -2 Proton induced showers with flat spectrum



DATA STORAGE AND SHARING



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Production are stored at CNAF; the transfer is **completed for:**

proton induced showers

- power law spectral index -2
 - CORSIKA output + ASCII files
- flat spectrum
 - CORSIKA output
- Cherenkov effect



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➢ nuclei (He-CNO-Fe) induced showers

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- power law spectral index -2
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The productions can be downloaded through gridFTP with an X509 certificate





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- easy to browse and use (common output format)
- supported in a growing community



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The CORELib endeavor provides results that are:

- ➢ flexible
- easy to browse and use (common output format)
- supported in a growing community
- easily and safely accessible with X509 certificate



Thank you for your attention!