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CORSIKA 8: A modern framework for high-energy cascade simulations

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The proliferation of innovative next-generation cosmic ray and neutrino observatories, with unique geometries (Earth-skimming, orbital, in-ice, etc.), and detection techniques (Cherenkov, radio, radar, etc.), requires the simulation of ultrahigh energy particle cascades which are *challenging*, if not *impossible*, to perform with current simulation tools like CORSIKA 7 and AIRES. These existing codes, which have been developed in FORTRAN for more than three decades, can be challenging to extend or extensively modify due to their fundamental software architecture, as well as due to their rigid assumptions about event geometries, the cascade environment, and the underlying physics models.

CORSIKA 8 is a *completely new simulation framework*, developed in modern C++ from the ground up, and is designed to perform high- and ultrahigh-energy particle cascades in matter. CORSIKA 8 has been designed to be extremely flexible, extensible, and easy-to-use while also being extremely performant via the use of compile-time optimization and HPC techniques like SIMD, parallelization, and GPU acceleration. In particular, CORSIKA 8 provides standard *"pluggable"* components for creating cascade simulations with unique geometries and physics, not only in air, but also in any other media including water, ice, and the lunar regolith.

We present the current status of the CORSIKA 8 project including the currently supported hadronic and electromagnetic physics models, the included radio & Cherenkov emission modelling, and give an introduction to new simulations that will be or are already enabled by the CORSIKA 8 project.

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Primary author: PRECHELT, Remy (University of Hawai'i)

Co-author: COLLABORATION, CORSIKA 8

Presenter: PRECHELT, Remy (University of Hawai'i)

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