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A versatile and efficient cosmic muon generator for secondary cosmic-ray muon applications

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In the last years, muon radiography (aka muography, based on the flux attenuation) and muon tomography (based on the scattering angle) have made important progress in a wide field of applications, reaching impressive results. And besides these imaging techniques, secondary cosmic ray muons are also used for detector testing and alignment practically in every Nuclear Physics or Particle Physics experiment.

From the simulation point of view, a fair number of cosmic-ray muon generators are already available, based on different software frameworks and on various models of the angular/momentum distribution of the cosmic muons flux. As a matter of fact, the implementation of a realistic flux can make the generator time-consuming, which is a strong limit when high statistics is needed.

Recently, we have developed a new Monte Carlo generator for cosmic-ray muons, named Efficient COsmic MUon Generator (EcoMug), conceived with a particular emphasis on the efficiency ($> 10^5$ muons generated per second on a standard machine) and on the flexibility (it is supplied with a standard muon angular/momentum distribution implemented by default, but it is expected to be easily reconfigured by the user implementing its own angular/momentum distribution).

Differently from other similar tools, EcoMug is able to generate muons from different kind of surfaces (plane, cylinder and half-sphere), while keeping the correct angular/momentum distribution of generated tracks inside a fiducial volume. This allows to optimise the generation surface according to the system under study, and makes it possible a further improvement of the overall simulation efficiency.

Moreover, this generator is written as a header-only C++11 library, ready to be integrated into whatever C++ code, in particular C++ code based on Geant4 simulation tool.

In this contribution we will briefly present the main features of EcoMug.

References

D. Pagano, G. Bonomi, A. Donzella, A. Zenoni, G. Zumerle and N. Zurlo EcoMug: An Efficient COsmic MUon Generator for cosmic-ray muon applications Nucl.Instrum.Meth. A 1014 (2021) 165732

Muon dipole moments (magnetic and electric): theory, experiments and future perspectives

none

Charged lepton flavor violation: theory, experiment and future perspectives

none

New Physics opportunities with low and high energy muon beams

none

Neutrino physics with muon beams: theory, experiments and future perspectives

none

Muons beams technologies: production, cooling and acceleration at different energy

none

Advancements in Muon-based Facilities and Broader Applications

none

Muons in other fields: muography, muon spin spectroscopy, muon-catalyzed fusion

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