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High-energy lepton and photon propagation with the simulation framework PROPOSAL

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Current challenges in astroparticle physics like the muon puzzle in air shower physics or the upcoming launch of next-generation neutrino and gamma observatories require modern tools for the simulation of particle propagation, both from a technical and a physical standpoint.

For those purposes, PROPOSAL is a simulation framework that provides 3D Monte Carlo simulations of charged leptons and high-energy photons.
PROPOSAL, which is usable in both C++ and Python, provides a high level of customizability, allowing the user to customize both the propagation environment and the underlying physical parametrizations, where up-to-date energy loss cross sections are available.

In this contribution, we present PROPOSAL as a framework, as well as current applications where PROPOSAL is used.
This includes the usage of PROPOSAL as an electromagnetic model for the shower simulation framework CORSIKA 8, as well as the usage of PROPOSAL for underground measurements of muon numbers, for example in the context of muography.

Primary authors: Dr SANDROCK, Alexander (Bergische Universität Wuppertal); ALAMEDDINE, Jean-Marco (TU Dortmund University); Dr SOEDINGREKSO, Jan (TU Dortmund University); Prof. RHODE, Wolfgang (TU Dortmund University)

Presenter: ALAMEDDINE, Jean-Marco (TU Dortmund University)

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