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Geant4 Simulations for Radiation-Induced Atmospheric Effects[1]

TYLER REESE, CHRIS WINSTEAD, University of Southern Mississippi — Computational methods are being employed to model the effects of radiation energy deposition in the atmosphere in conjunction with ongoing validation experiments. The computational approach is based on Geant4, an open source C++ toolkit that incorporates a large selection of models for simulating particle transport for a variety of particle types, materials, and processes in addition to handling the geometry and visualization of the simulation. One of the first tasks explored with Geant4 was using it to aid in the selection of radiation sources for laboratory experimentation. While simple calculation methods using stopping powers and CSDA ranges can be used to determine expected energy deposition and range for various radiation sources, Geant4 simulations of these values provided confirmation that the simulations were well constructed and yielded a much more comprehensive picture of these effects within the experimental setup. Examples and corresponding results will be presented for an alpha source, two beta sources, and a gamma source. These provide a useful perspective when considering the selection of laboratory radiation sources and also demonstrate why alpha and low energy beta sources are the initial choices for experimentation. Subsequent work will extend the capability of the simulations for low energy interactions (e.g. molecular processes) and include the use of these results in chemical kinetics calculations.

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