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Reverse Monte Carlo in Geant4 and in GRAS

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The Monte Carlo (MC) method is very accurate for simulating the interaction of radiations with complex geometries. However MC simulations need most of the time a lot of computing power before reaching the expected precision of the simulation results. This represents an important drawbacks of the RMC method when it is used in engineering tool, as for example Spenvis, where the time available for of a computation is rather limited. However different Monte Carlo biasing techniques can be used to reduce the computing time.

When the sensitive part of a geometry is small compared to its entire size and to the size of the source, a lot of computing time is spent in the simulation of particle showers that are not contributing to the computed signal. This is typically the case in radiation simulation for space where only the effects of radiation on some specific components of the geometry have to be known. In such case the Reverse Monte Carlo(RMC) biasing method, also known as the Adjoint Monte Carlo method, can be used. In this method particles are generated in the sensitive volume of the instrument and then are tracked backward in the geometry till they reach the source surface, or exceed an energy threshold. By this way the computing time is limited to particle tracks reaching the sensitive part of the geometry and the simulation is much faster.

Within different projects, sponsored by the european space agency (ESA), we have implemented the RMC method in Geant4 for e-, proton and ion electromagnetic physics. The different reverse processes that are at the moment available in Geant4 are the reverse e-, ion, and proton ionization , the multiple scattering, the e- bremsstrahlung, the photo-electric effect, and the Compton scattering. Since the Geant4.9.3 realease the ReverseMC1 extended biasing example is available to illustrate the modification needed to a Geant4 application to use the Reverse MC mode. Recently we have extended the ESA GRAS tool in order to use the Geant4 Reverse Monte Carlo capability. In this paper we will report on the status of our different Geant4 and GRAS RMC developments. We will illustrate how to use the Reverse Monte Carlo mode in a Geant4 application, by

describing the ReverseMC01 G4 extended example,
and in GRAS by describing a GRAS RMC application case. Comparison of results obtained with forward and reverse simulations will be also presented.

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