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Precision analysis of Geant4 condensed transport effects in detectors

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Physics models and algorithms operating in the condensed transport scheme - multiple scattering and energy loss of charged particles - play a critical role in the simulation of energy deposition in detectors.

Geant4 algorithms pertinent to this domain involve a number of parameters and physics modeling approaches, which have evolved in the course of the years. Results in the literature document their effects on physics observables in detectors, but comparisons with experiment for model validation are relatively scarce, and a comprehensive overview of the problem domain is still missing, despite its relevance to experimental applications.

In-depth analysis of Geant4 models operating in the condensed transport scheme is reported. A simultaneous validation is performed to evaluate the accuracy of backscattering and energy deposition: accurate rendering of both observables through the same physics settings is a known issue in Monte Carlo simulation, and a sensitive test of the robustness of the algorithms. The analysis involves the contributions of Geant4 charged particle interaction models, energy loss and multiple scattering algorithms: quantitative results highlighting the role of the various components are presented.

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