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Algorithms and parameters for improved accuracy in physics data libraries

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Physics data libraries play an important role in Monte Carlo simulation systems: they provide fundamental atomic and nuclear parameters, and tabulations of basic physics quantities (cross sections, correction factors, secondary particle spectra etc.) for particle transport.

This report summarizes recent efforts for the improvement of the accuracy of physics data libraries, concerning two complementary areas: the refinement of atomic parameters and the development of software tools for their effective management, and the investigation of interpolation algorithms used in association with physics data libraries.

Results are reported about a large scale validation analysis of atomic parameters used by major Monte Carlo systems (Geant4, EGS, MCNP, Penelope etc.); their contribution to the accuracy of simulation observables are quantitatively documented. A new atomic data management software package, which optimizes the provision of state-of-the-art atomic parameters to physics models, is illustrated. To the best of the authors' knowledge, this is the first comprehensive study in this domain.

A variety of interpolation algorithms have been developed and investigated to improve the accuracy of simulation models based on tabulated data libraries: quantitative results are reported, that illustrate the effects of interpolation algorithms on the physical and computational performance of the simulation.

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