

Experimental quantification of Geant4 PhysicsList recommendations: methods and results

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Limited documentation is available in the literature about Geant4 pre-packaged PhysicsLists and their validation. Limited documentation is available in the literature about the validation of Geant4 Physics models, which are instantiated in pre-packaged PhysicsLists. Comparisons with experimental data often rest on qualitative, visual appraisal of plots, lacking rigorous quantification based on statistical methods. Our research aims at improving this situation through a rigorous validation strategy of Geant4 physics and extensive documentation of results in peer reviewed journal.

Validation methods

Due to their own nature, Geant4 PhysicsLists can only be assessed over **specific use cases**, which in turn are limited to **specific observables** (while individual physics models can be quantitatively validated against experimental data independently from any specific application scenario).

Therefore it is essential to **document quantitatively their performance over a large number of experimental use cases**. The body of knowledge deriving from this extensive validation effort, subject to a regular peer review process, provides **guidance to the experimental community** regarding the use of pre-packaged PhysicsLists.

Methods of **uncertainty quantification** can be exploited in some simulation scenarios, which allow the calculation of the uncertainty of simulated observables based on the uncertainty of model parameters. This is a field of active ongoing research.

Example: assessment of Geant4 pre-packaged electromagnetic constructors with respect to electron backscattering

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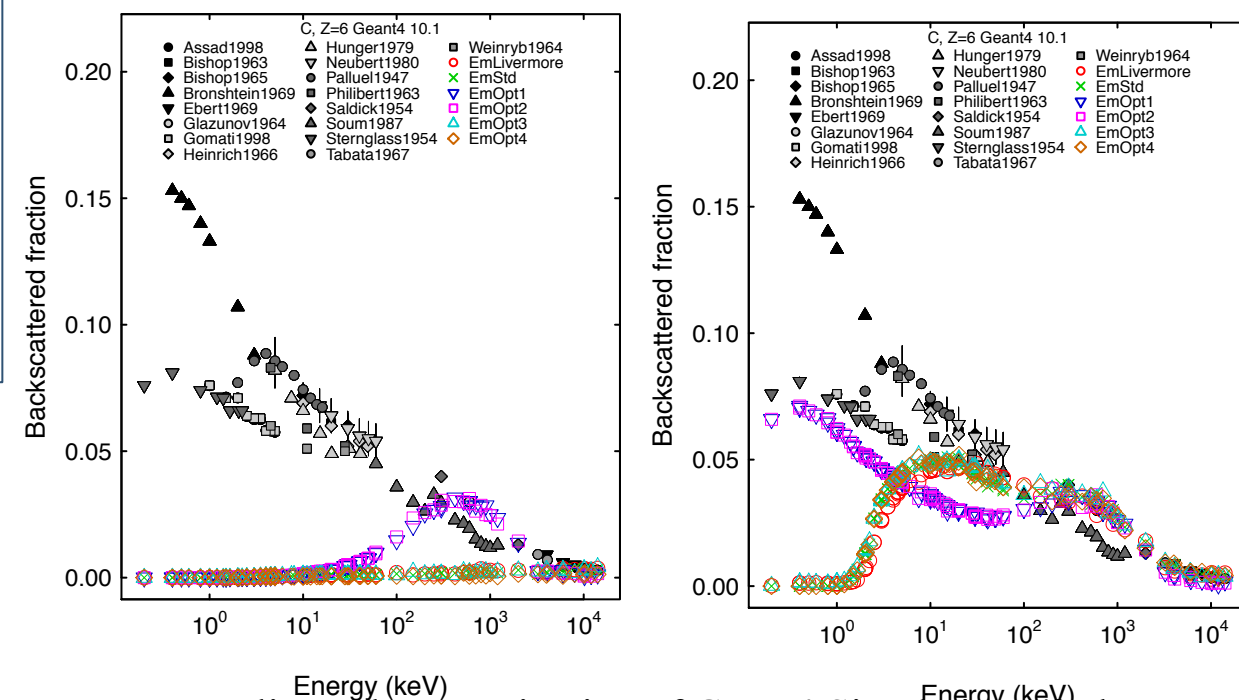
Validation Test of Geant4 Simulation of Electron Backscattering

Sung Hun Kim, Maria Grazia Pia, Tullio Basaglia, Min Cheol Han, Gabriela Hoff, Chan Hyeong Kim, and Paolo Saracco

Validation strategy

- Validation of the physics “ingredients” of Geant4 PhysicsLists: cross sections, secondary particle spectra, angular distributions etc.
- Validation of Geant4 pre-packaged PhysicsConstructors and PhysicsLists over a wide variety of use cases

0.5 picometer makes a difference!



T. Basaglia et al., Investigation of Geant4 Simulation of Electron Backscattering, *submitted to IEEE Trans. Nuc. Sci.*