Recent Developments in Geant4 of Interest to Medical Users

http://geant4.slac.stanford.edu/g4namu/
Geant4 Release 4.8.0

- Released December 2005
- Patch 4.8.0p1 released 10 February 2006

Recent Developments:
- Changes to Multiple Scattering
- You No Longer have to Write your own Scoring Classes
- GRAPE Volume Renderer
Changes to Multiple Scattering

- Electromagnetic standard package major changes have been introduced concerning the Multiple Scattering process.

- To improve the behavior of low energy particles (electrons in particular, but affecting also hadrons), Multiple Scattering now limits the step size for the particles.

- A model of the correlation between lateral displacement and final direction has been implemented (see the Physics Reference Manual for further information).
Step Limitation

- Multiple Scattering now limits the step size for the particles.
  - Previously only limited after a boundary

- Step = $fr \cdot \text{Max (range, lambda)}$
  - New default $fr = 0.02$ (instead of 0.2)
  - Strong constraint only for low energy particles

- Ensure that a track always does few steps in any volume
  - more than 1
Final State

- A model of the correlation between lateral displacement and final direction has been implemented.

- Correlate final direction with lateral displacement
  - \( u.d = f(\lambda) \) taken from Lewis theory
Changes to Multiple Scattering

- Most physical observables are now more stable when varying production cuts (i.e. less "cut dependent").

- There is a corresponding cost, a CPU-time penalty, when utilizing the same value of the production thresholds. This penalty can be significant, depending on the user's setup and the cut values.

- For many use cases the increased stability will allow the choice of higher production thresholds, recovering computing performance while maintaining physics performance.

- Backward compatibility: to restore old behavior you can use either of these two methods:
  - muls -> MscStepLimitation (false)
  - or use the old code, still available in the release as G4MultipleScattering71
You no longer have to write your own scoring classes

- Introduced new base classes G4VPrimitiveScorer and G4VSDFilter, G4THitsMap template class, G4MultiFunctionalDetector class and several concrete scorer and filter classes.
- These enhancements make it much easier to write scoring applications, in particular for medical and space applications such as dose or energy-deposition scoring.
- See section 4.4.5 G4MultiFunctionalDetector and G4VPrimitiveScorer of the Users Guide for Application Developers
- The hands-on examples in this week’s four day tutorial will make extensive use of these new scorers.
This year, the Geant4 collaboration will be working on issues of how to visualize volume data, such as DICOM data.

In today’s talk by Takashi Sasaki about Geant4 medical activities in Japan, you will hear about a new rendering solution for these purposes, GRAPE.