

Summary on recent patch release & 2017 work plan – EM physics part

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The logo for Geant 4, featuring the text "Geant 4" in a stylized, brown, serif font with a slight shadow effect, set against a light green rectangular background.

Outline

- List of modifications for 10.3p01
- Some validation results for 10.3p01
- Planned EM physics model developments
 - EM standard libraries
 - EM low-energy libraries

List of modifications for 10.2p03

- **dna:**
 - Removed check of c++ version for `unique_ptr/auto_ptr` selection in `G4MoleculeCounter`.
- **lowenergy:**
 - Removed verbosity in `G4AtomicTransitionManager`.
 - Addressing problem report #1874.
 - Fixed typo in `G4hParameterisedLossModel`.
 - Addressing problem report #1876.
- **utils:**
 - `G4EmBiasingManager`: fixed typo in condition.
 - Addressing problem report #1876.

List of modifications for 10.3p01

- **EM Physics constructors**

- Added “__SS” EM option to G4PhysListFactory – possibility to easy use of G4EmStandardPhysicsSS physics constructor
- Added 'setCerenkov/ScintillationStackPhotons' commands to G4OpticalPhysicsMessenger and use them in G4OpticalPhysics

- **EM adjoint**

- Correction for cases of FPE in G4AdjointForcedInteractionForGamma

- **EM utils**

- Fixed typo in G4EmParametersMessenger (problem #1929)

- **EM dna – fixes for radiochemistry**

- Prevent a crash when calling G4ITTrackingManager::EndTracking() from the UserTimeStepAction::PostTimeStepAction.
- Added missing call to tracking-manager.
- Code cleanup in G4KDNode and G4KDMap.

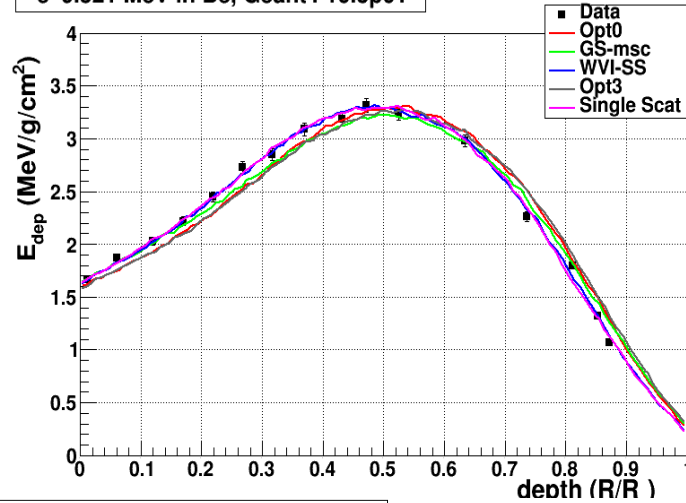
Some validation results

Full set of EM validation suite url:

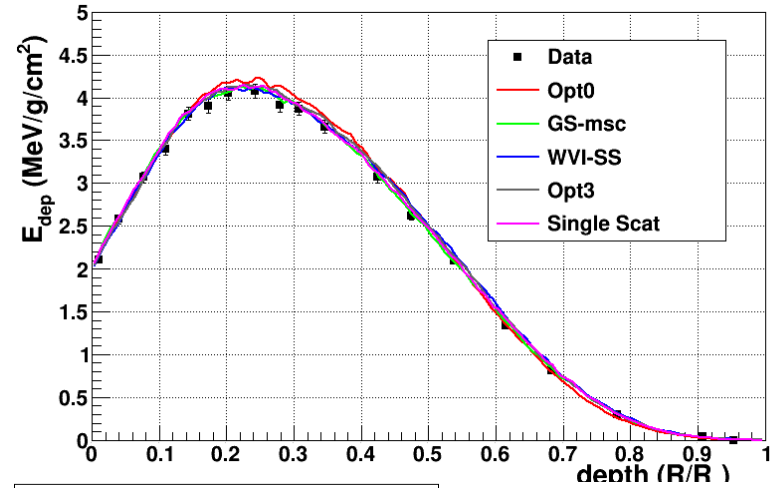
<http://vnivanch.web.cern.ch/vnivanch/verification/verification/electromagnetic/>

Electron tracking in semi-infinite media

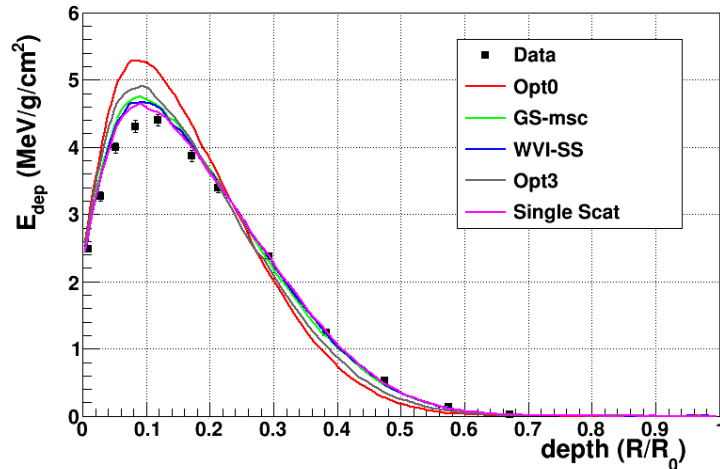
e^- 0.521 MeV in Be, Geant4 10.3p01



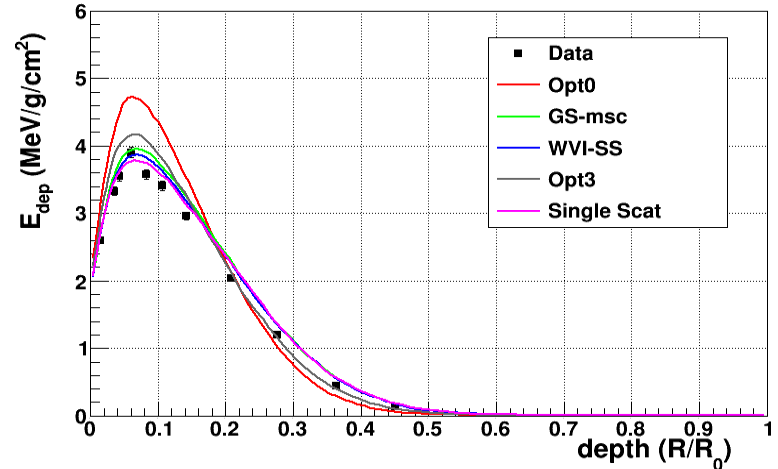
e^- 0.521 MeV in Al, Geant4 10.3p01



e^- 0.5 MeV in Mo, Geant4 10.3p01

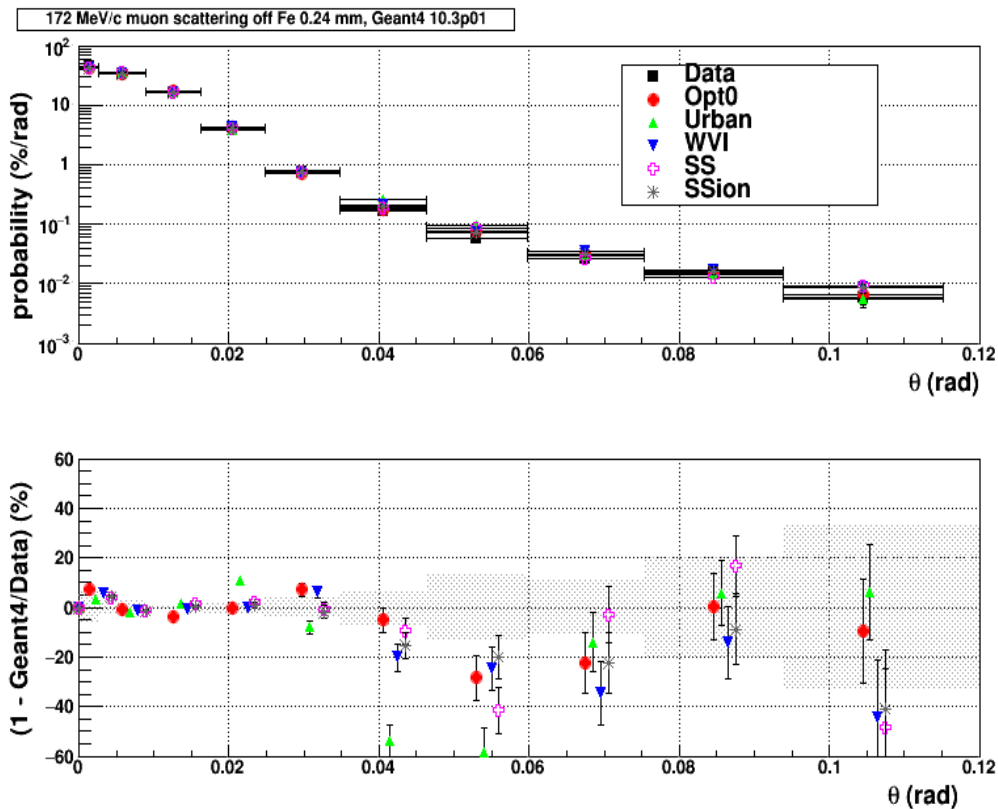


e^- 1.0 MeV in Ta, Geant4 10.3p01



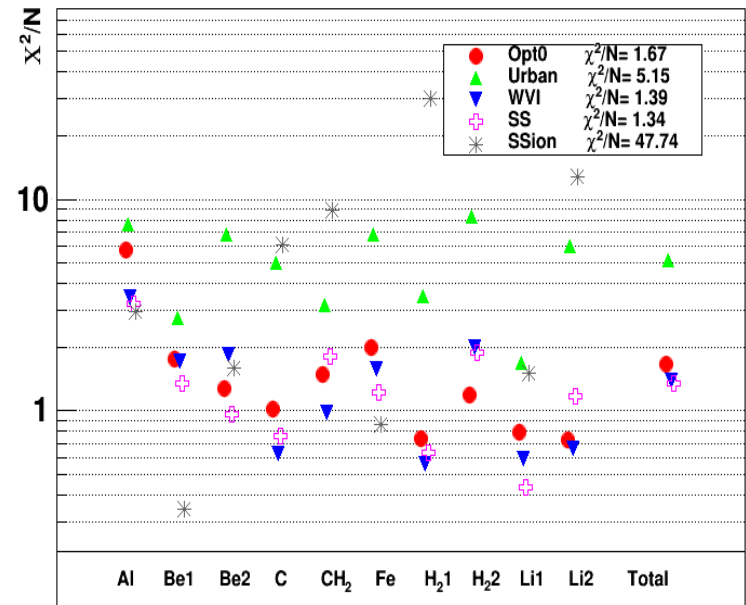
Muon scattering benchmark

Iron foil



Summary

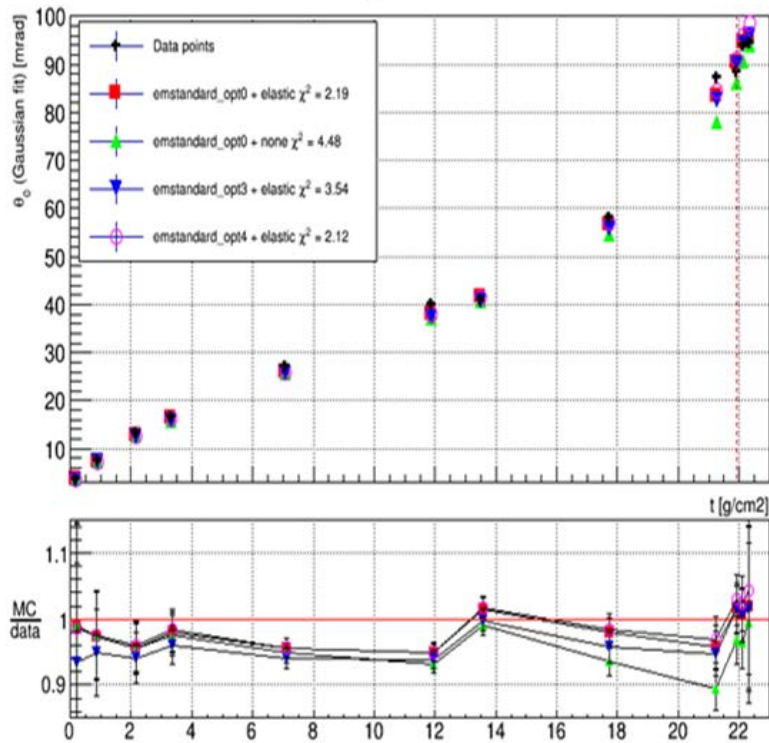
172 MeV/c muon scattering - MuScat, Geant4 10.3p01



Proton scattering benchmark

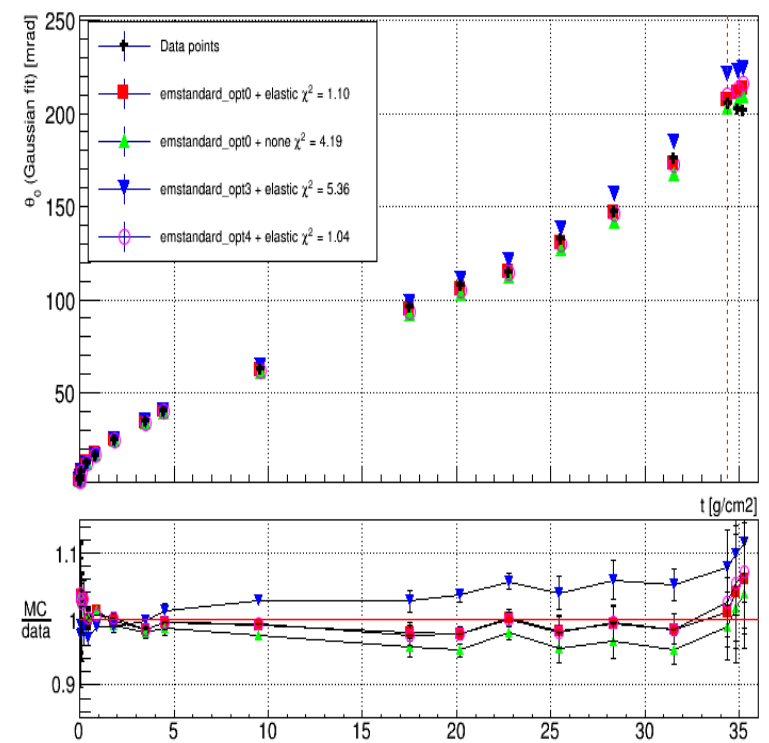
Aluminum

Charachteric Angle Distribution for Aluminium

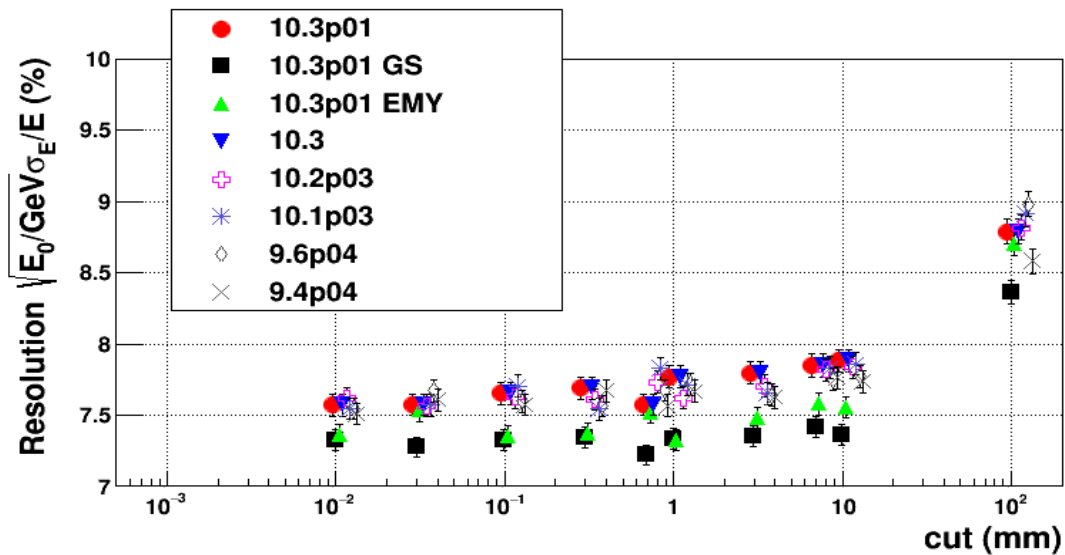
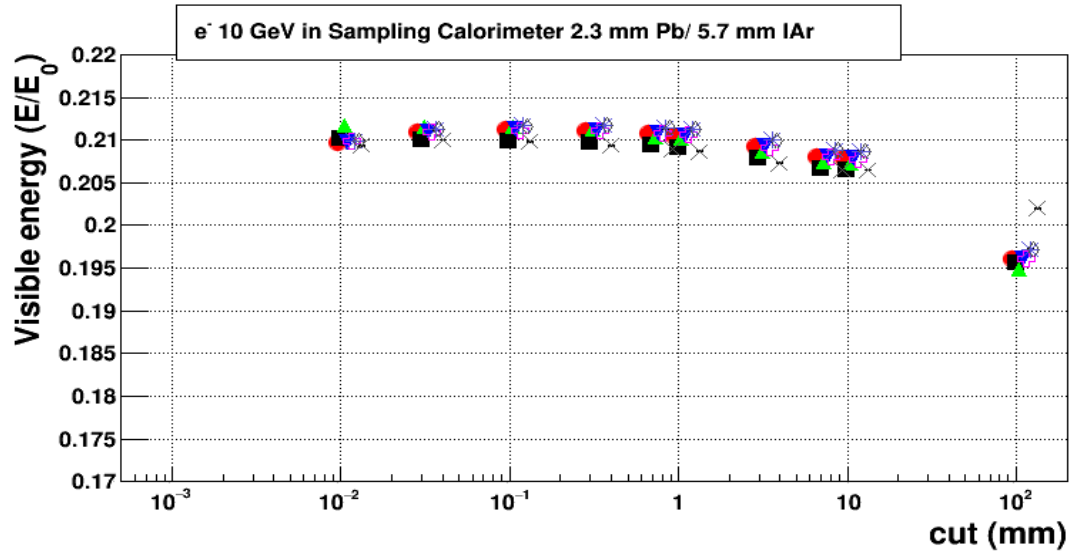


Lead

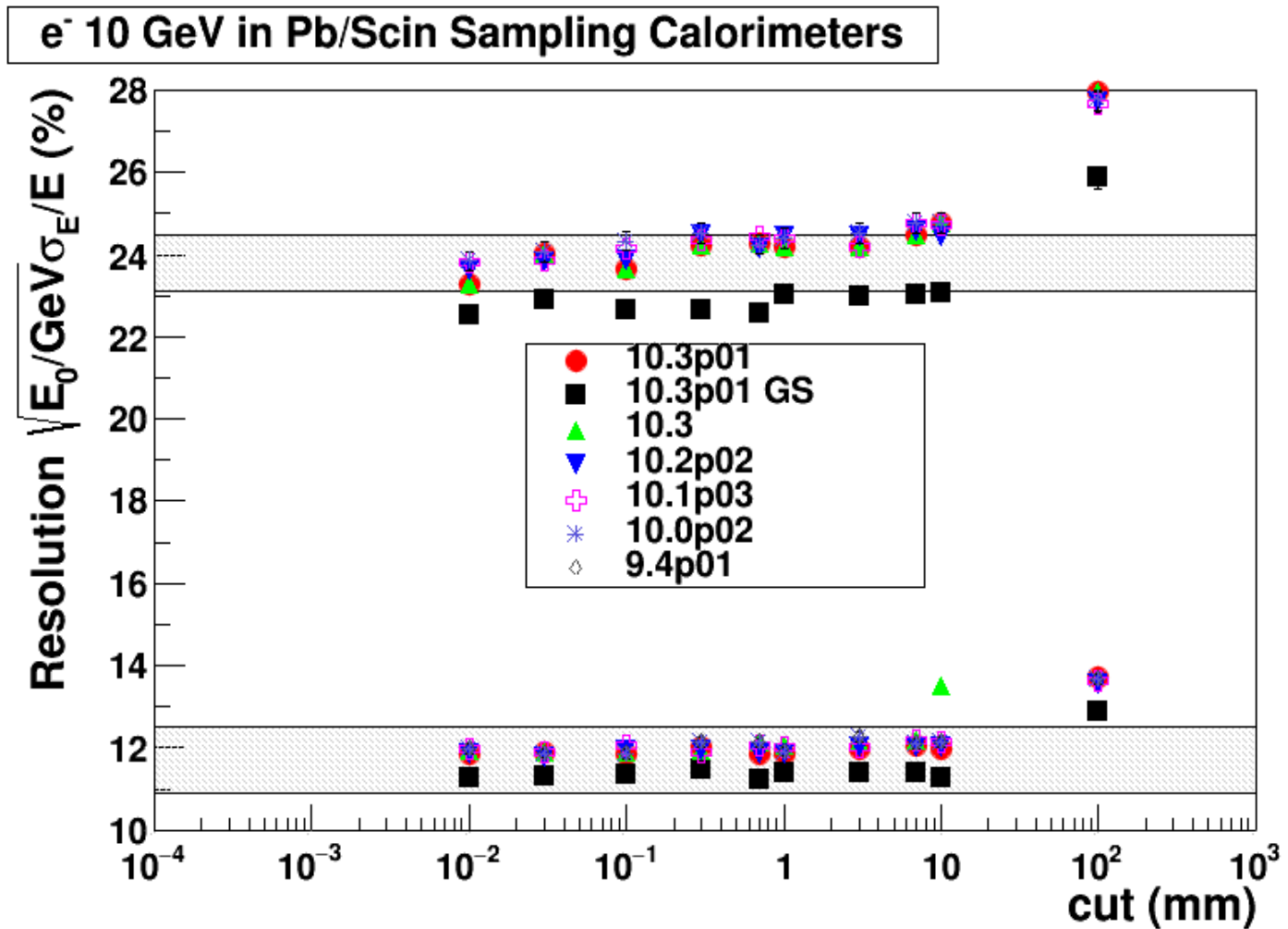
Charachteric Angle Distribution for Lead



Simplified ATLAS-type sampling calorimeters



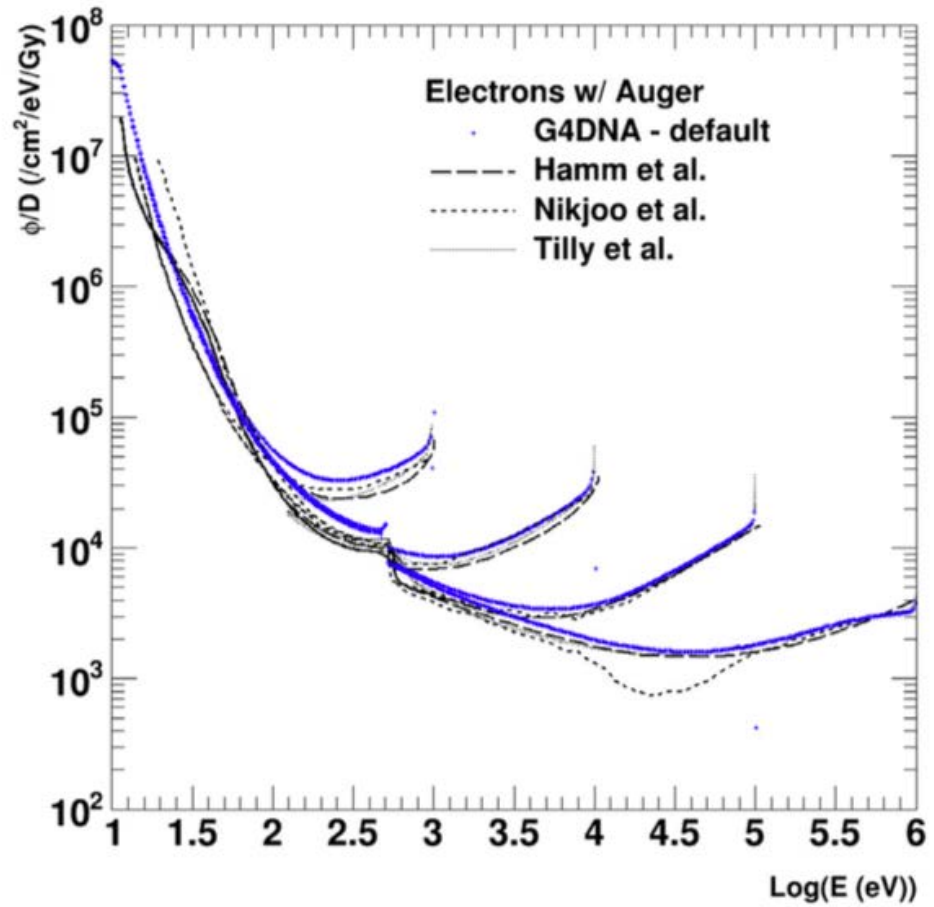
Simplified lead/scintillator calorimeter



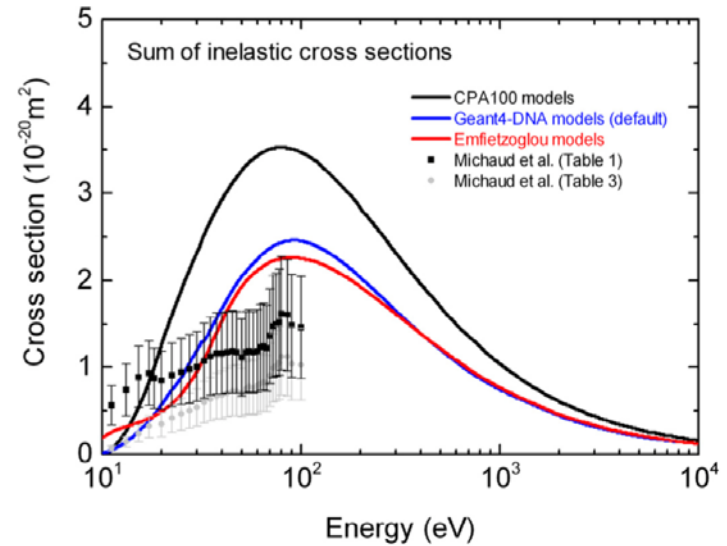
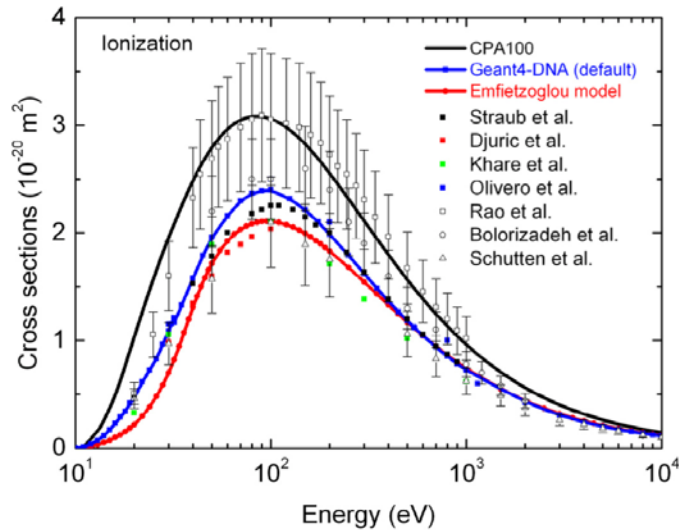
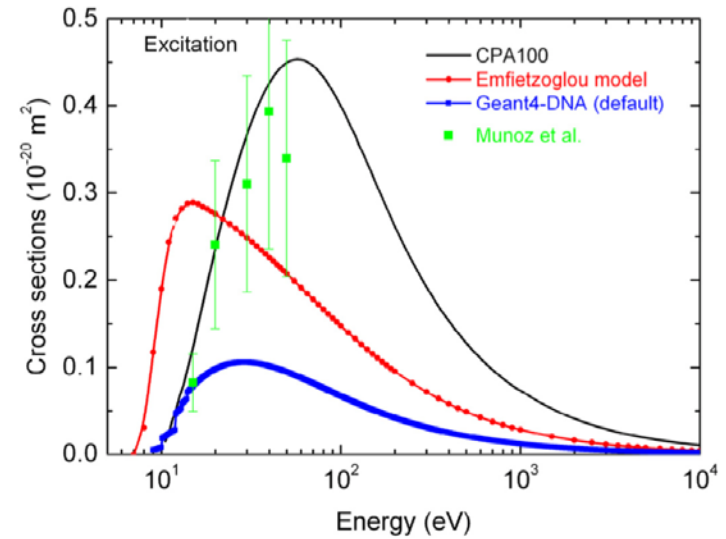
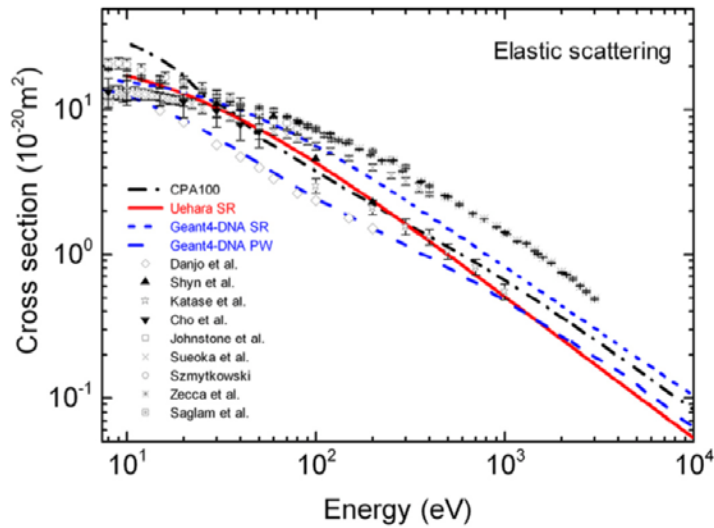
Geant4-DNA: slowing down spectra

Slowing-down electron spectra for 1 keV, 10 keV, 100 keV and 1 MeV incident electrons simulated with Geant4-DNA “default” models (blue points), compared to literature data. Auger electron production has been activated as well as electron sub-excitation processes.

new « slowing » extended example



Geant4-DNA: status of electron cs. models for 10.4 Beta



Plans for 2017 for EM physics developments

Planned Standard EM physics model developments 1/2

- **Infrastructure:**

- EM shower shape validation and improvement
- Migration of the EM testing suite to CVMFS and grid

- **Bremsstrahlung and Gamma models:**

- Incorporation of three gamma annihilation - (1)
- Review and improvement of Seltzer-Berger model - (1)
- Migration to the recent data for atomic shells - (1)
- Introduction of bremsstrahlung on atomic electrons at high and moderate energies - (1)/(2)
- Validation and improvement of the gamma conversion models including cross-section and final state generation in the full energy range - (1)/(2)
- Introduction of direction splitting for bremsstrahlung - (2)
- Update Compton scattering model by adding radiative corrections by e- and e+ - (2)/(*)

Planned Standard EM physics model developments 2/2

- **High energy processes:**
 - Study on effect of high energy muon scattering due to high energy radiative processes - (1)
 - Usage of rare processes for muon backgrounds for CLIC and FCC studies - (1)/(2)
 - Extension of Synchrotron radiation process simulation for FCC (angular distribution, X-ray reflection) - (1)/(2)
 - Evaluation on existing models and R&D on new for search of particles beyond the Standard Model - (1)/(2)
- **Ionisation processes:**
 - Reviewed model for sampling fluctuations of e^+ - (1)/(2)
 - Refinement of effective ion charge approach - (2)/(*)
 - Alternative ion ionisation models for moderate energies - (2)/(*)
- **Multiple and single scattering:**
 - Updates to Goudsmit-Saunderson model - (1)
 - Introduce relativistic corrections to WVI and SS models - (1)
 - Evaluation of WentzelVI model performance with 2nd order corrections enabled - (2)
- **Optical photon processes:**
 - Extension to the unified surface model to have both specular and diffuse components for the transmitted photons - (2)
 - Modeling of optical transport in a volume that has different optical treatments on different sides - (2)

Planned Low-energy EM physics model developments 1/2

- **Livermore models**
 - Upgrade of Livermore electron ionisation - (*)
 - Finalize migration of polarized gamma models to same software design as non-polarized Livermore models - (*)
 - Implementation of pair production in the electron field and usage within low-energy physics lists - (2)
- **Monash U. models**
 - Complete recalculation of atomic electron momentum PDFs and Compton profiles for elements $Z=1$ to $Z=100$ - (2)
 - Implementation of a new low energy photoelectric absorption model - (2)
- **Atomic de-excitation**
 - Extension of shell ionisation cross sections - (2)

Planned Low-energy EM physics model developments 2/2

- **DNA**
 - Cross-section models for other biological materials and incident particles - (2)
 - New chemistry models - (2)
- **MicroElec models**
 - Update to more easily implement different materials - (2)
 - Addition of extra materials to Geant4 DB - (*)
- **Other**
 - Addition of Remizovich scattering model for grazing angles - (2)
 - RBE modules for biological damage computation - (2)