# EM Physics Highlights

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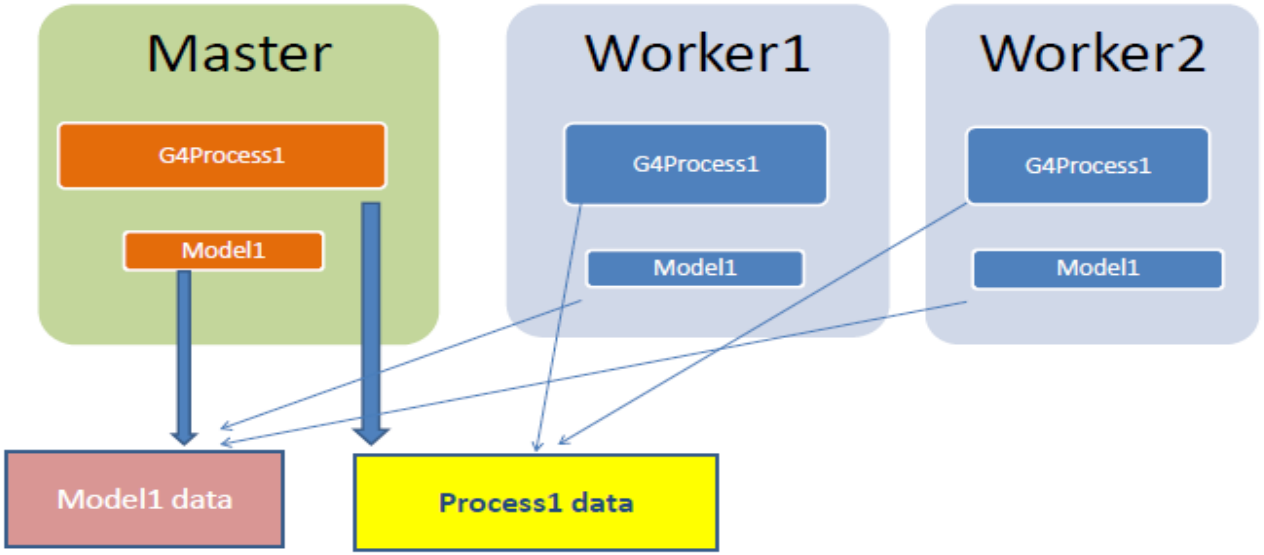
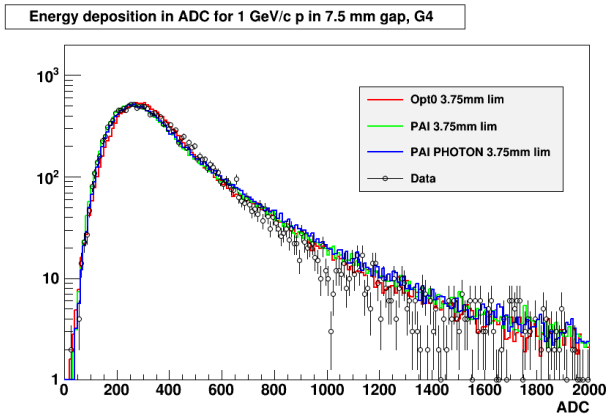
# Migration to Multi-Threading

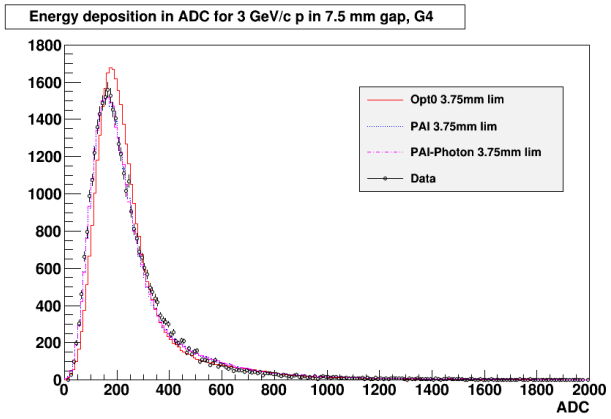
- Material sub-library was modified to have in run time only const interfaces
  - Material/element/isotope properties are read-only
    - Isotopes are always created independently on method to create G4Element
  - The most modifications were done for G4SandiaTable
- Initialisation of EM processes is done differently for master and worker threads
  - Physics tables which belong to process class are created by master
  - Workers are given pointers to shared tables
  - Majority of standard, Livermore, and Penelope models are migrated to this scheme



# Ionisation models

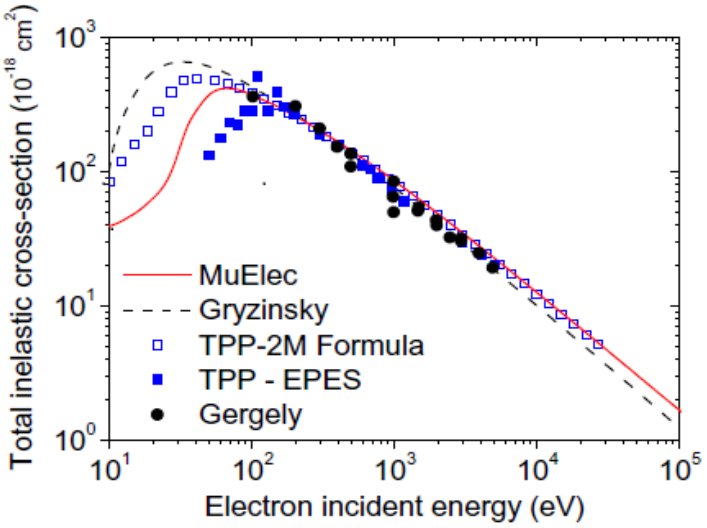
- PAI models have been reviewed and updated
  - Can work with cut equal to zero
  - Improved tail delta-electron production spectra for electron incident
  - New G4PAIPhotModel is recommended instead of the old G4PAIPhotonModel which will be deprecated soon
- An interface to angular generator is added to majority of ionisation models
  - For PAI models active by default
  - For other standard models may be activated by users
- Magnetic monopole ionisation model is upgrated for very non-relativistic case
  - Before was correct for Silicon only, now is fixed for all materials

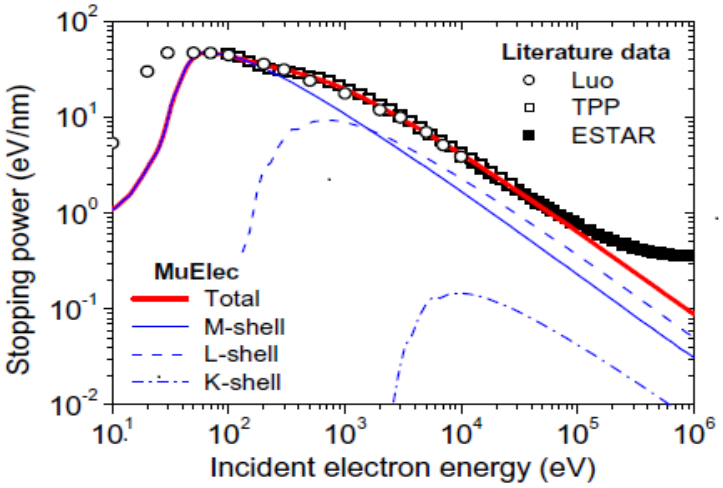


# Microdosimetry models for ionisation in Silicon based on dielectric functions computation

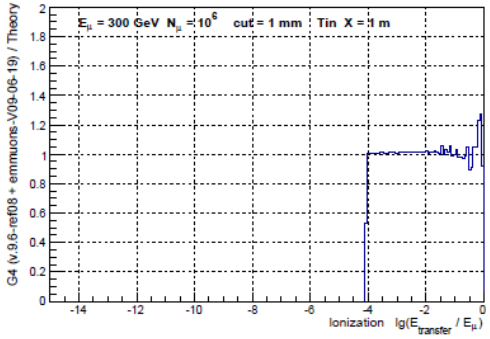
- A. Valentin, M. Raine, J.-E. Sauvestre, M. Gaillardin, P. Paillet. Geant4 physics processes for microdosimetry simulation: Very low energy electromagnetic models for electrons in silicon. NIM B 288 (2012) 66–73.
- For 10.0 upper limit of validity is extended from 1 MeV/u to 10 GeV/u
- Recommended model in 10.0 are G4MicroElec* instead of old G4MuElec*

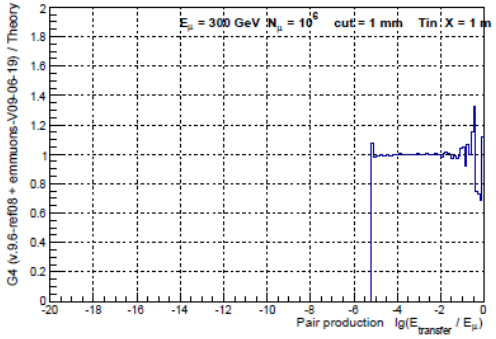


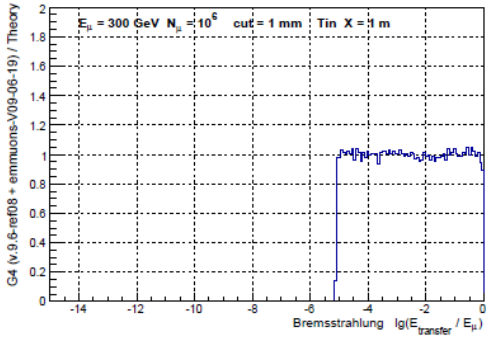



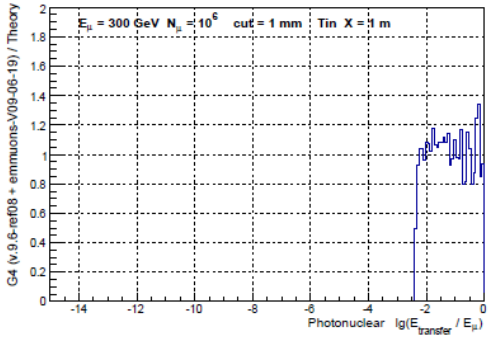
# Electron-positron pair production by muons and hadrons

- Recently observed deviation (up to 10%) from the theory is only because of a relatively small size of 2-D internal tables for double differential cross sections
  - In 9.6 it was 8 x 1000 with default maximum energy 10 PeV
- Structure of model tables have been reviewed and optimised for 10.0
  - Size become function of maximum energy required by user application
  - For the default 10 TeV it is 16 x 1000



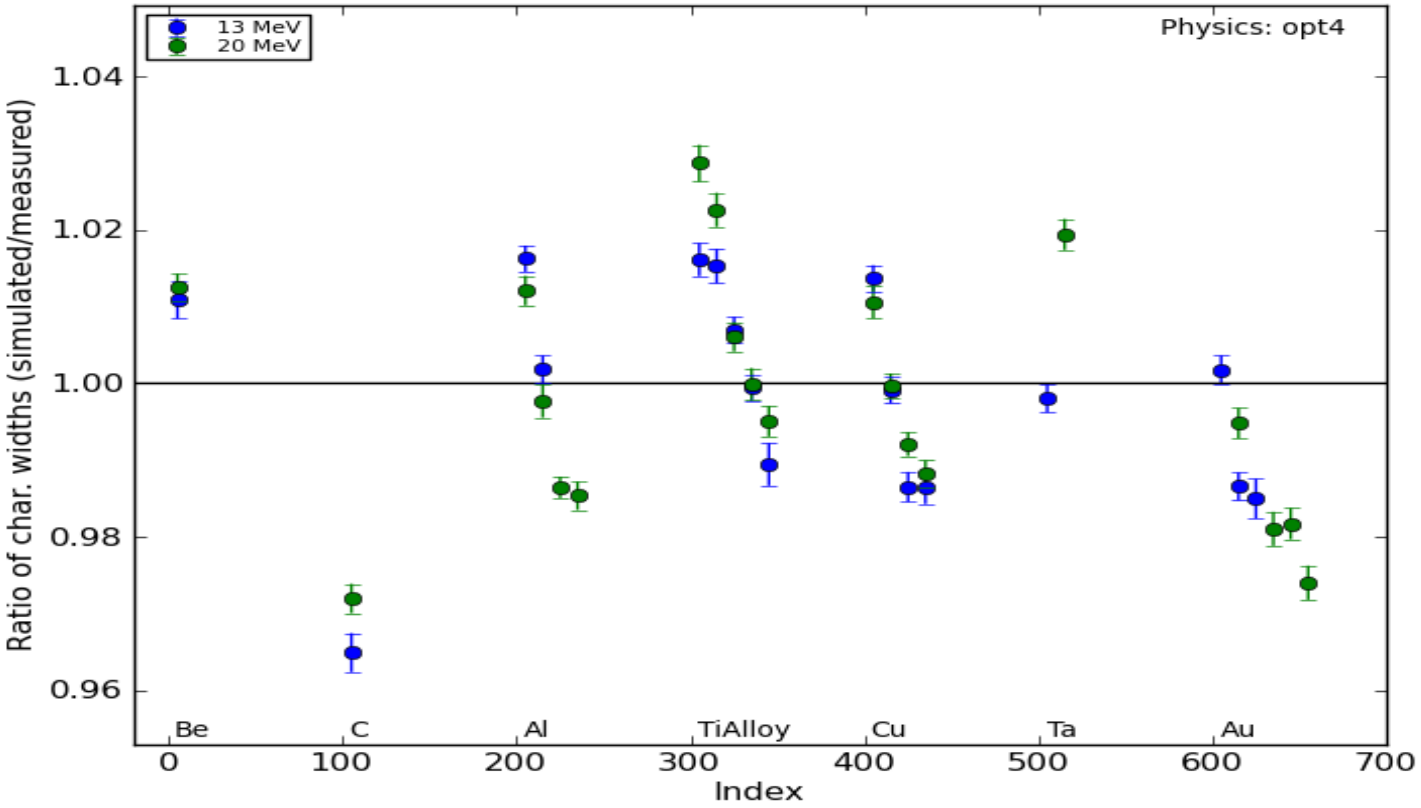



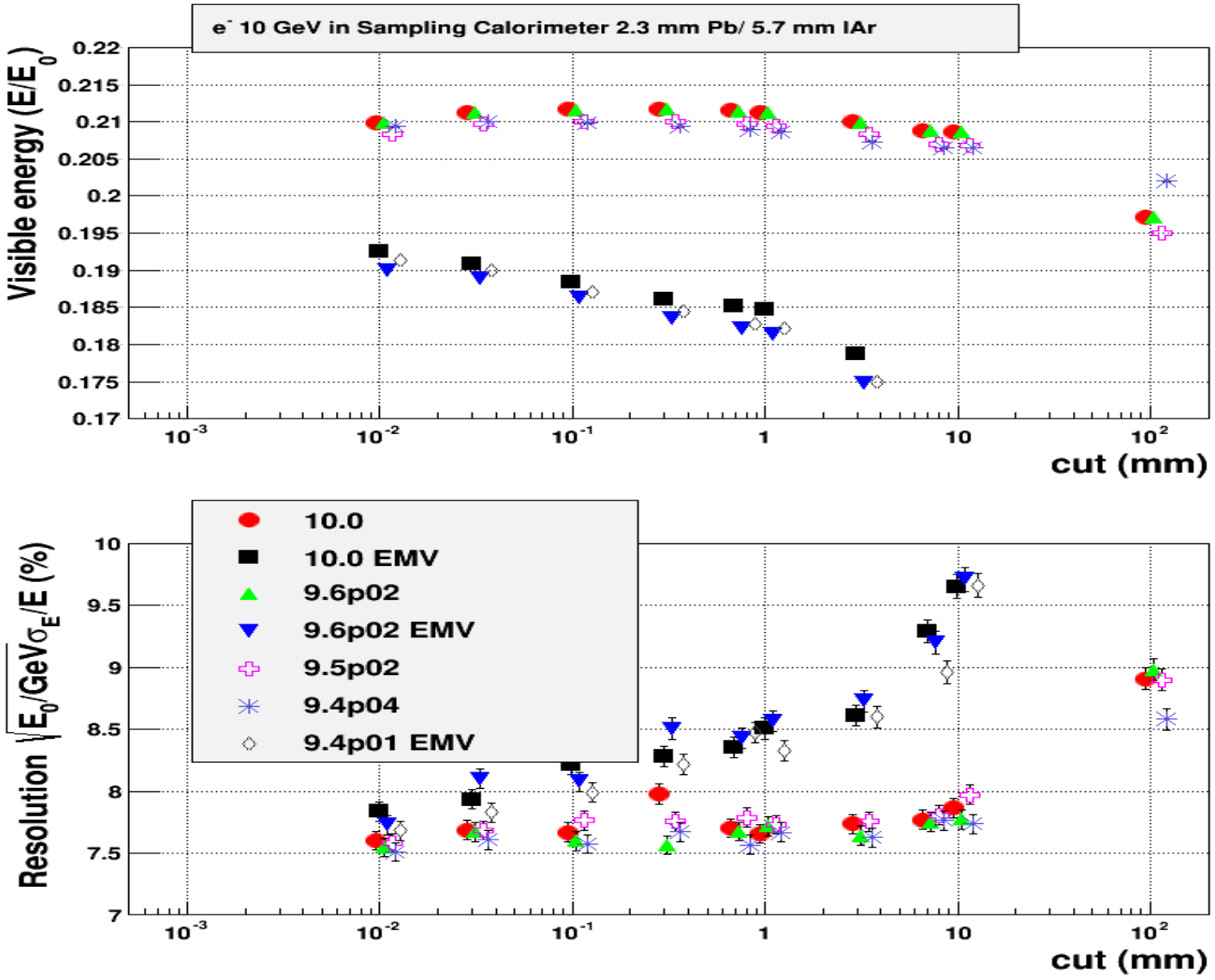
# Multiple scattering

- Only one consolidated G4UrbanMscModel is available
  - All Urban90, 93, 95, 96 are removed
  - SampleZ option for the model is set to false
  - Problems reported by ATLAS are fixed
- EM testing suite results shows the best agreement of the final model to all data than any previous flavor of Urban model
- Simplified calorimeter response for 10.0 is the same as in 9.6

# Electron scattering benchmark Ross et al., Med. Phys. 35, (2008) 4121



# Simplified ATLAS-barrel type calorimeter



# EM infrastructure for 10.0

- EM Physics constructors are the same as in 9.6p02
- Widely used G4Log , G4Exp, G4Pow mathematical functions provides more performant computations
  - About 5% CPU advantage compared to 9.6p02 is expected
- The data set G4EMLOW6.35 is required