

G4PenelopeIonisationModel and Bugzilla #1761

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e^- ionisation models in Geant4

- Three models available to describe e^- ionisation
 - **G4PenelopeIonisationModel** (applies also to e^+)
 - **G4LivermoreIonisationModel**
 - **G4MollerBhabhaModel** (applies also to e^+), Opt3
- All models are interfaced to the atomic de-excitation (PIXE) interface **G4UAtomicDeexcitation**
- The **PIXE** interface is activated by a **flag** (false, by default)
 - The PIXE de-excitation takes a set of **shell ionization cross sections**
 - The de-excitation cascade is generated **statistically**, based on the individual shell ionization cross sections
 - **No correlation** with the δ -ray which is emitted in the PostStep()
- **Livermore** is the **default dataset** for ionisation XS, but there are alternative datasets (Penelope, "empirical"), controlled by UI
 - **/em/process/pixeElecXSmodel**

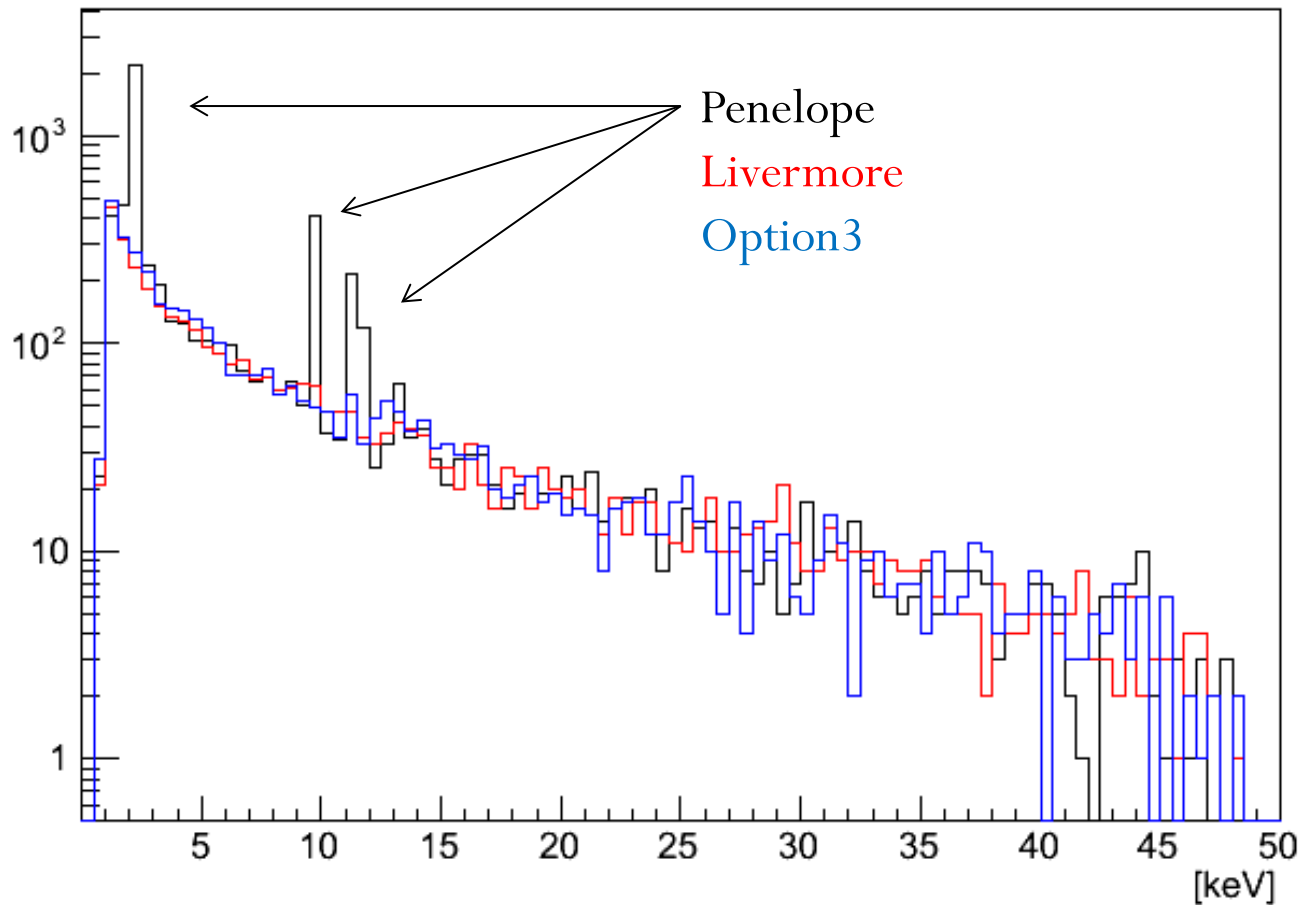
e⁻ ionisation models in Geant4

- The PenelopeIonisation model has a **built-in management** of the atomic de-excitation
 - **Samples** the **shell** which is ionized and follows the **de-excitation cascade**
 - Very same approach as for all γ -ray models (Std and LowEn)
 - Controlled by the **Fluo()** flag of **G4UAtomicDeexcitation**
 - Keeps the **correlation** with the **δ -ray** in the PostStep()
 - De-excitation is always produced (provided that the Fluo flag is on), **even if the PIXE flag is off**
- The Livermore and Standard model do **not** yield the information of the **shell vacancy**
 - **Statistical** atomic de-excitation, based on the shell ionisation XS
 - Produced **only if the PIXE flag is on**
- <http://hypernews.slac.stanford.edu/HyperNews/geant4/get/phys-list/892.html>

Application with TestEm5

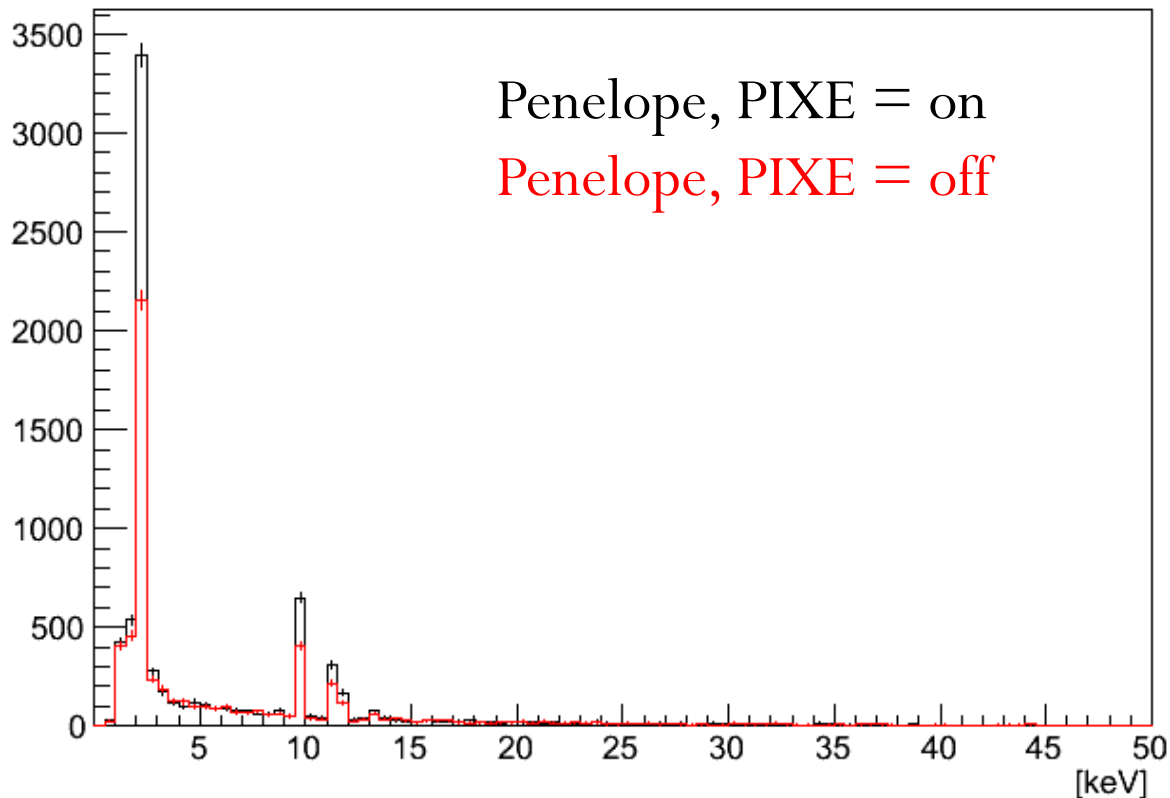
- 50 keV electron in Au

energy of neutral secondaries at creation, **PIXE = off**



Bugzilla #1761 (reported by Michel)

- If the PIXE flag is on, the Penelope model **produces the de-excitation cascade twice**
 - Once via the internal mechanism and once via the PIXE interface
 - The net result is an **over-production of the x-rays**



- TestEm 5 ,50 keV electron in Au

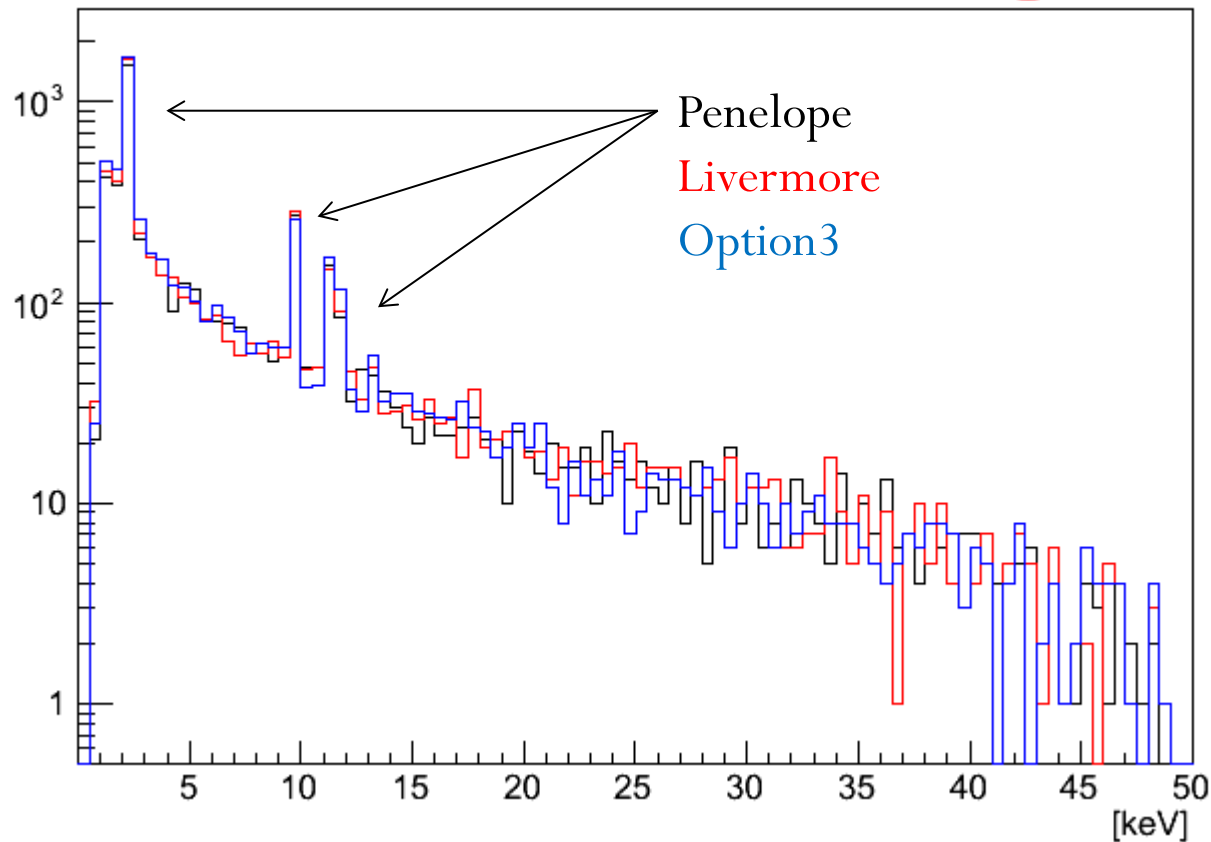
Bugzilla #1761 (reported by Michel)

- Fixed in **emlowen-V10-01-04**
 - **Didn't** make it in **ref-06** (and in 10.2 beta)
 - Tag accepted, Jun 28th
- The Penelope model will use **its own internal mechanism** for atomic de-excitation **when PIXE=off**
 - **Correlation** with the δ -ray is **preserved**
 - The **Penelope** ionisation **cross sections** are used
 - Produces de-excitation if the **Fluo flag is on**
- Will use the **PIXE interface** when **PIXE=on**
 - **Same behaviour** as the other two models
 - Can use **alternative XS datasets** (e.g. Livermore)
 - The **correlation** with the δ -ray is **lost**
 - A G4Exception ("**JustWarning**") is issued to make sure that this setting is actually *intended* by the user
 - **Internal** de-excitation mechanism **disabled**

Application with TestEm5 (post fix)

- 50 keV electron in Au, Livermore XS model for e-Ioni

energy of neutral secondaries at creation, **PIXE=on**



Application with TestEm5 (post fix)

- 50 keV electron in Au, different XS models for e-Ioni

energy of neutral secondaries at creation **PIXE=on**

