

Status and plans for Standard EM

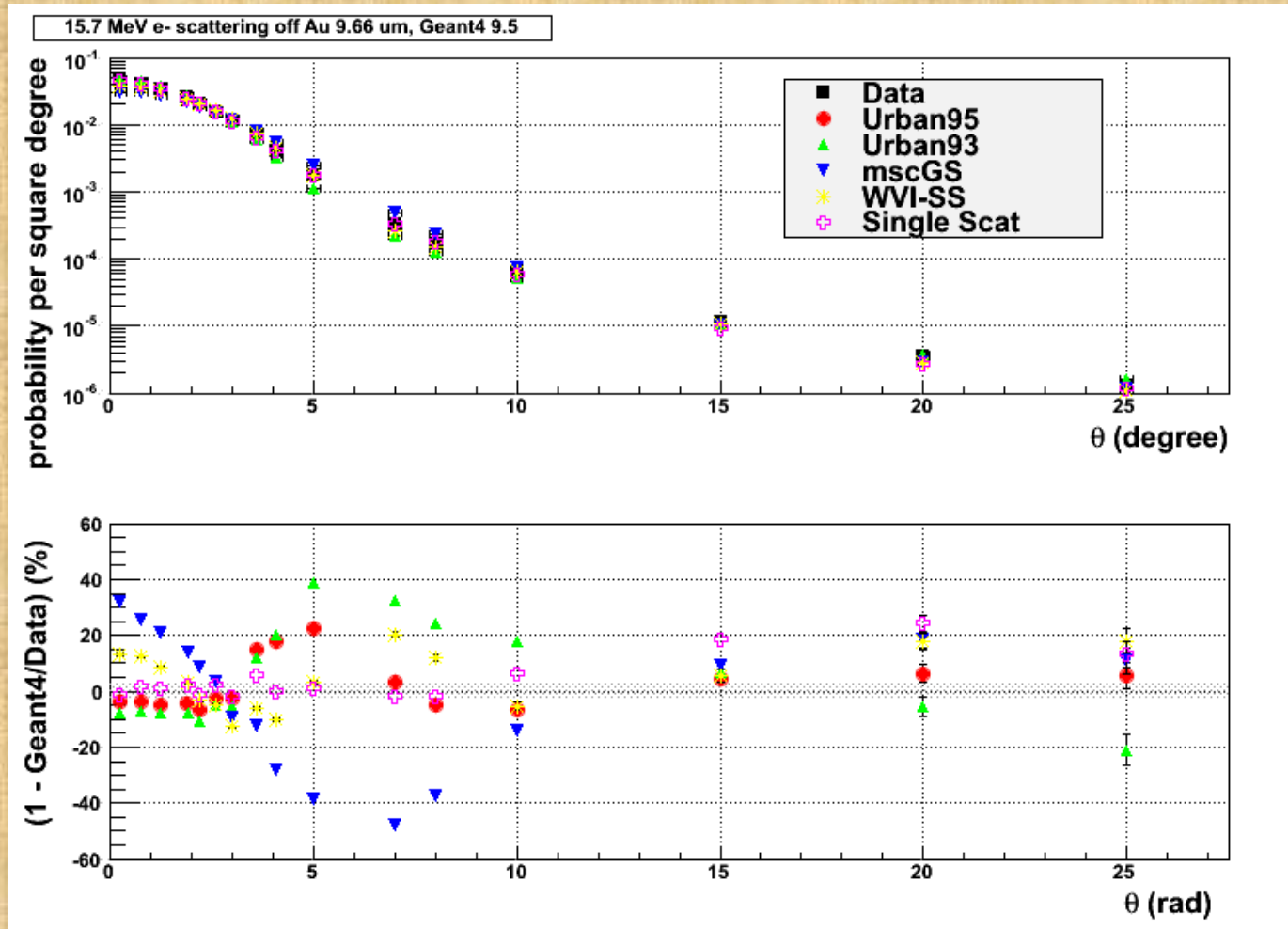
V.Ivanchenko

19 January 2012

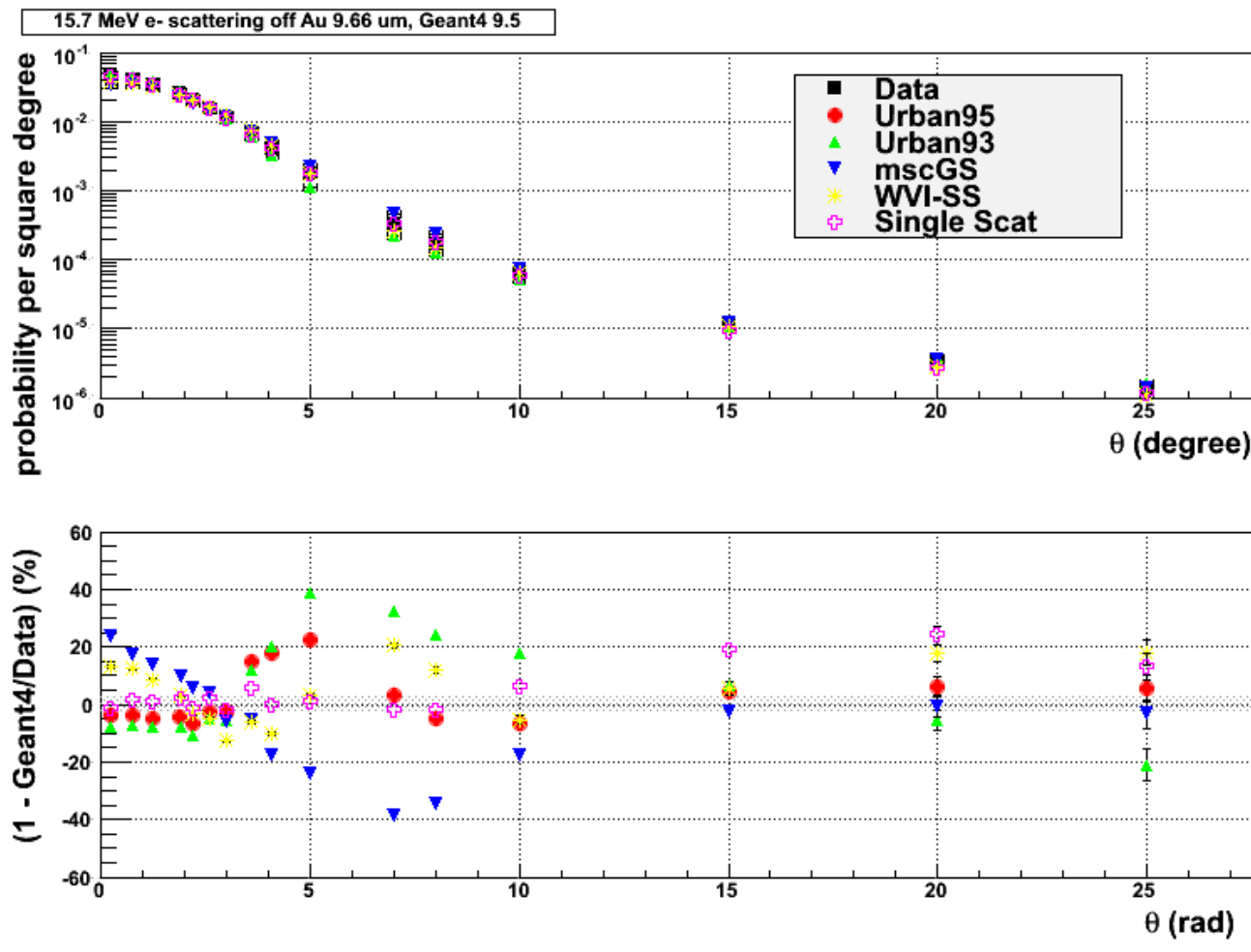
Outline

- Few recent results
- Main problems for standard EM
- Preliminary list of standard model developments
- Preliminary list of validations
- Proposals for upgrades in EM infrastructure
- **Main messages from LHC:**
 - Geant4 simulation describe well LHC experiments
 - There are number of hot problems
 - One can predict growing number of requirements from LHC
- **Our response: we have to provide better understanding of EM physics, more fast and more precise EM modeling**

Hanson data Geant4 9.5

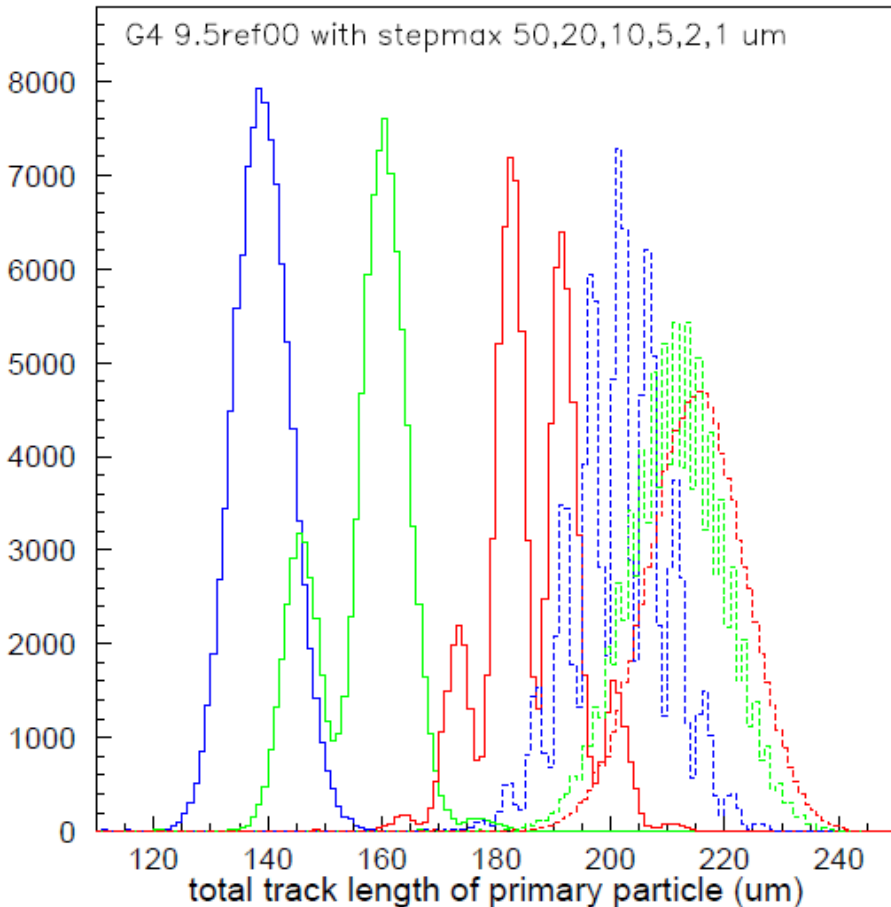


Hanson data Geant4 9.5 with new G4EMLOW – O.Kadri update

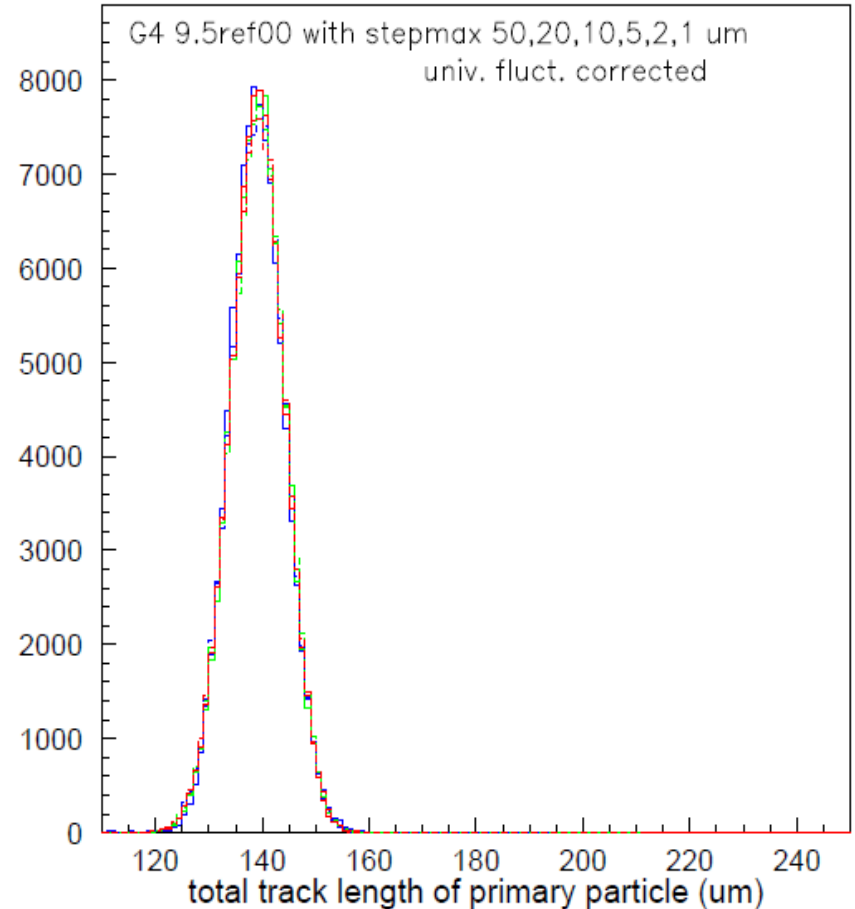


Instability of 3 MeV muon range and Laszlo Urban fix

range of 28 MeV/c muon in tungsten



range of 28 MeV/c muon in tungsten



List of main problems for standard

- EM shower shape (ATLAS, CALICE)
 - New bremsstrahlung model improving CMS simulation
 - We have to restart full study on EM cross sections and final state
- Multiple scattering for relativistic particles
 - SLAC and FNAL reported problems for GeV electrons
 - We need provide a possibility that Urban model is working at low energy WVI model – at high energy
- Accuracy of msc models for medical applications
 - GS model is less accurate than Urban model
 - WVI model is not yet capable to have good precision for MeV electrons
- Alternative fluctuation model
 - Gaseous detectors and Si-detectors required more advanced model than universal Urban
 - Microdosimetry

Preliminary list of model developments for standard

- GS model (O.Kadri)
- WVI and CoulombScattering models (V.Ivanchenko)
- Urban msc and fluctuation model fixes (L.Urban)
- SeltzerBerger model upgrade (F.Garay, A.Schaelicke)
- Migration of gamma- \rightarrow mu+mu- to model design (H.Burkhardt)
- Update of model of e+e- production by muons (A.Bogdanov)
- MSC and transportation (J.Apostolakis, V.Ivanchenko)
- Standard Rayleigh scattering (V.Grichine tbc)
- Bremsstrahlung angular generator (V.Grichine tbc)
- New fluctuation model (tbc)
- Please, add new proposals

Preliminary list of validations running on regular base Std&LowE

- EM testing suite at CERN (V.Ivanchenko)
- CPU benchmark (J.Jacquemier)
- Fano cavity (S.Elles)
- Electron scattering benchmark (D.Sawkey)
- Dose kernel (S.Incerti)
- Bremsstrahlung test (L.Pandola)
- Proton Bragg peak (T.Yamashita)
- Completing of bremsstrahlung benchmark (V.Grichine, tbc)
- Deployment of test on dEdx (A.Bagulya)
- Deployment of backscattering test (tbc)
- New test on cross sections (tbc)
- New test on shower shape (tbc)
- New tests on hadron msc (tbc)
- New test on LHC high momentum reconstruction (tbc)

PROPOSALS FOR UPGRADES IN EM INFRASTRUCTURE

Materials

- Hadronic working group:
 - Provide isotope composition for all type of element and material constructions
- V.Grichine requested methods for G4Material:
 - GetPlasmaEnergy()
 - GetMeanZ()
- My request for G4Element:
 - GetZ_asInt()
- Other proposals?

Atomic de-excitation management

- Current UI commands:

/run/initialize

/process/em/deexcitation world true true true

/process/em/fluo true

/process/em/auger true

/process/em/pixe true

- Problems:

- We need guarantee that for LHC applications no data table for Auger or PIXE are built
- Everything is working fine if the first “deexcitation” command was issued, if not – no de-excitation at all

Multiple usage of processes/model

- Currently for each new process a new set of models should be declared
- Muon models have internal tables required significant CPU at initialisation and memory at run time
- Tables are identical for μ^+/μ^- ; π^+/π^- , K^+/K^- , p/p_{bar} – we may save factor 2 in memory and initialisation
- Possible solutions:
 - Use the same process for several particles
 - Problem of building dedx table
 - Share the same model between several processes
 - G4ParticleChange pointer should not belong to a model but should be given as an argument of SampleScattering method – affect all models

Multiple scattering upgrade I

- Problems:

- Base material approach is not implemented for msc processes
- currently is not possible to combine Urban model for low-energy and Wentzel-VI model for high energy
 - smoothing of transport x-sections

- Proposal:

- Do not use common transport cross section table for a multiple scattering process
- Let a model to decide what tables are needed
- Build transport x-section table in G4VMscModel class in the energy interval of model applicability

Multiple scattering upgrade II

- Problems:

- To get reliable results in sampling calorimeters a significant reduction of step depending on safety
- After the step the displacement may be reduced

- Possible solution:

- Change sequence of actions with more close cooperation between transportation and multiple scattering

Multiple scattering upgrade II

Current sequence

- PreStep:
 - Processes propose true step
 - Msc proposes geom step
 - Transportation proposes geom step
- AlongStep:
 - Transportation make a step
 - Msc recomputed true step
- PostStep:
 - Msc propose deflection and displacement

Proposed sequence

- PreStep:
 - Processes propose true step
 - Msc proposes correction to geom step
 - Transportation proposes geom step
- AlongStep:
 - Transportation make a step
 - Msc recomputed true step sample scattering and compute true length
- PostStep:
 - A process may not happen due to shorter true length