EM Biasing

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Outline

- Design of EM built-in biasing options
- Russian roulette results
- Bremsstrahlung splitting results

EM built-in biasing options

- Available since Geant4 9.5
- Fully functional with Geant4 9.6
- List of options:
  - Cross section biasing
  - Force interaction
  - Secondary splitting
  - Russian roulette
  - Electron range
- Basing options are enable via UI commands or C++ interface per process and detector region, for example
  - /process/em/setSecBiasing eBrem World 0.5 5 MeV

Design of EM built-in biasing options

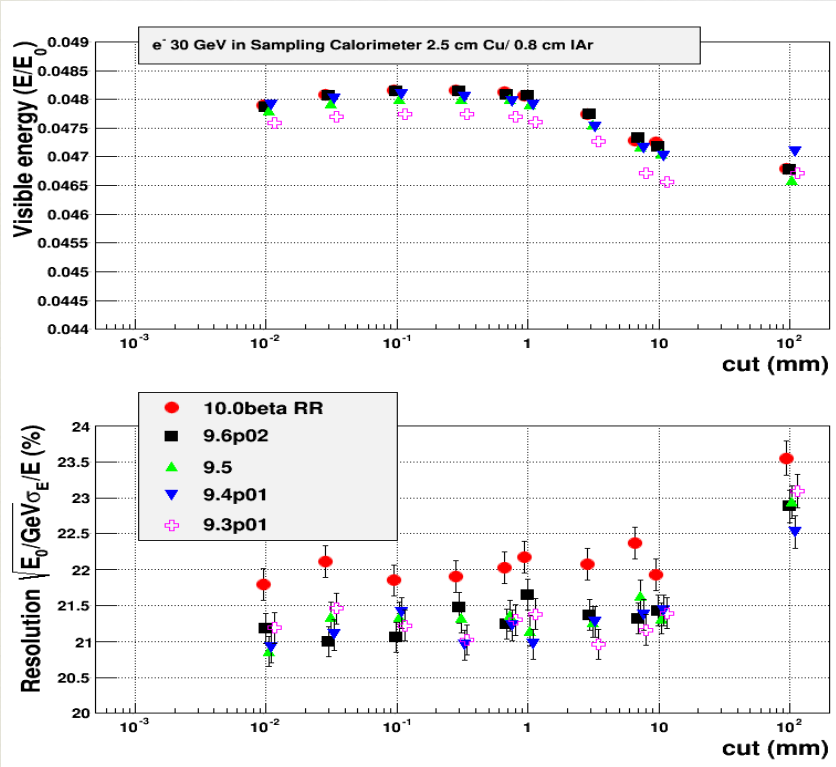
- The main requirement: do not disturb mainstream simulation
  - Minimize CPU overhead
- G4EmBiasingManager class is owned by EM generic classes G4VEmProcess or G4VEmEnergyLossProcess
- If biasing disabled the pointer is NULL
- If is enabled G4EmBiasingManager perform its actions
  - Splitting or deletion
  - weight computations
  - Limitation on multiple actions
    - Only split high weight particles; only play Russian Roulette with low weight particles
- Weight is propagated from primary to secondary tracks
- Transition to MT did not require any change

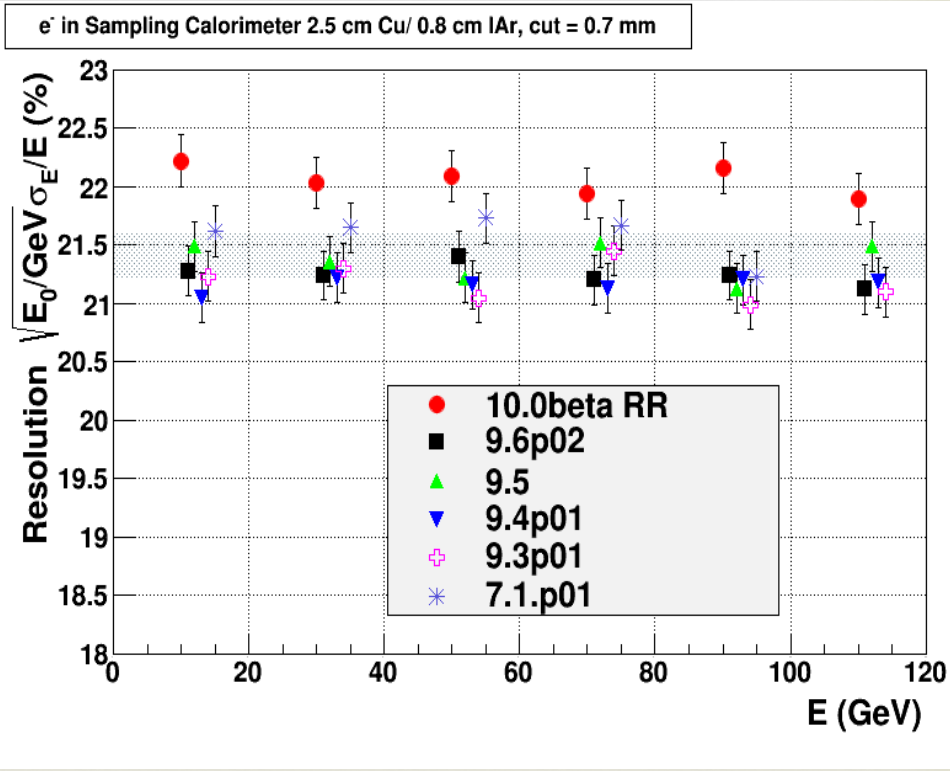
Wrapper versus built-in

Some Results

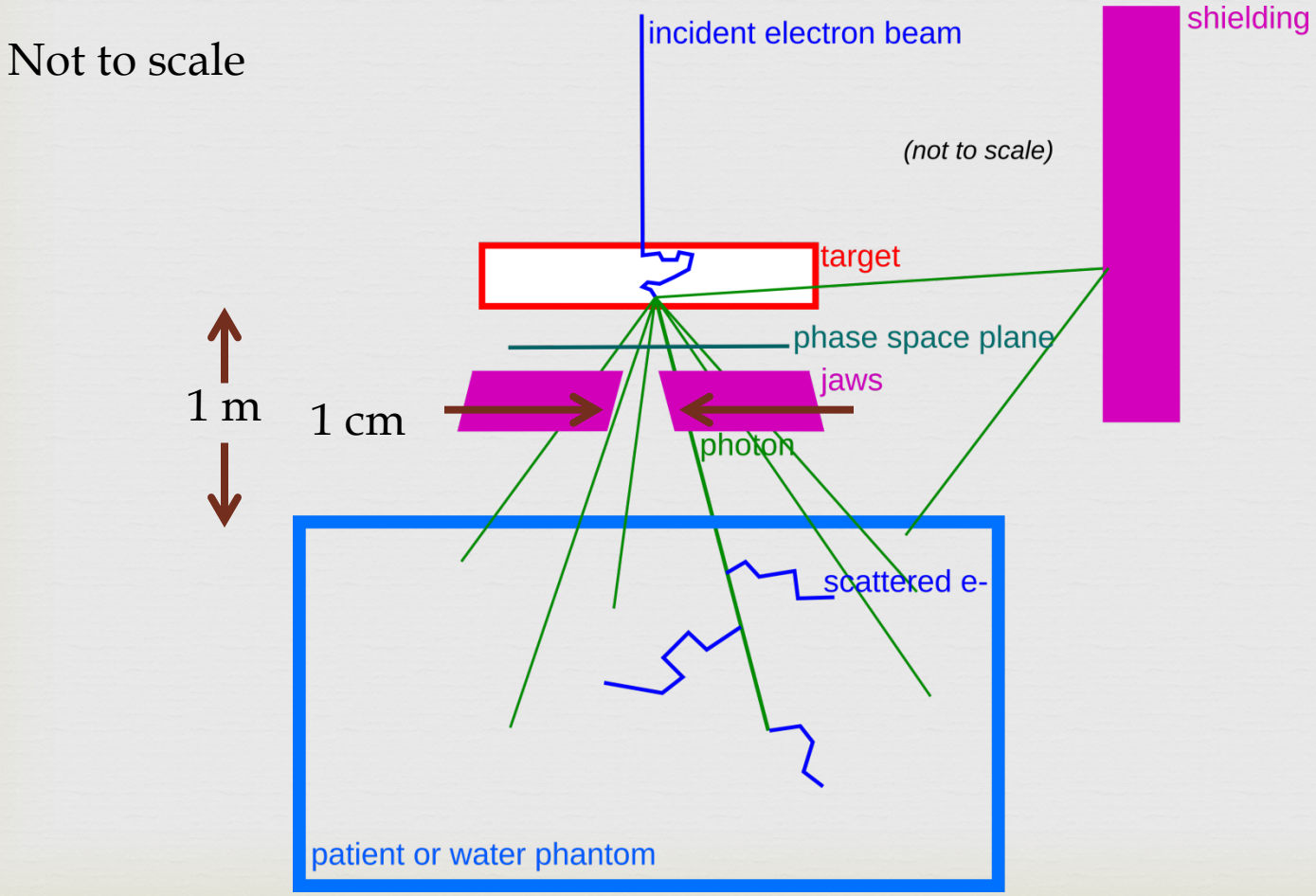
Russian roulette for ATLAS-hec type calorimeter

Russian roulette is applied on Gamma below 5 MeV with the factor 0.5 – some CPU is saved

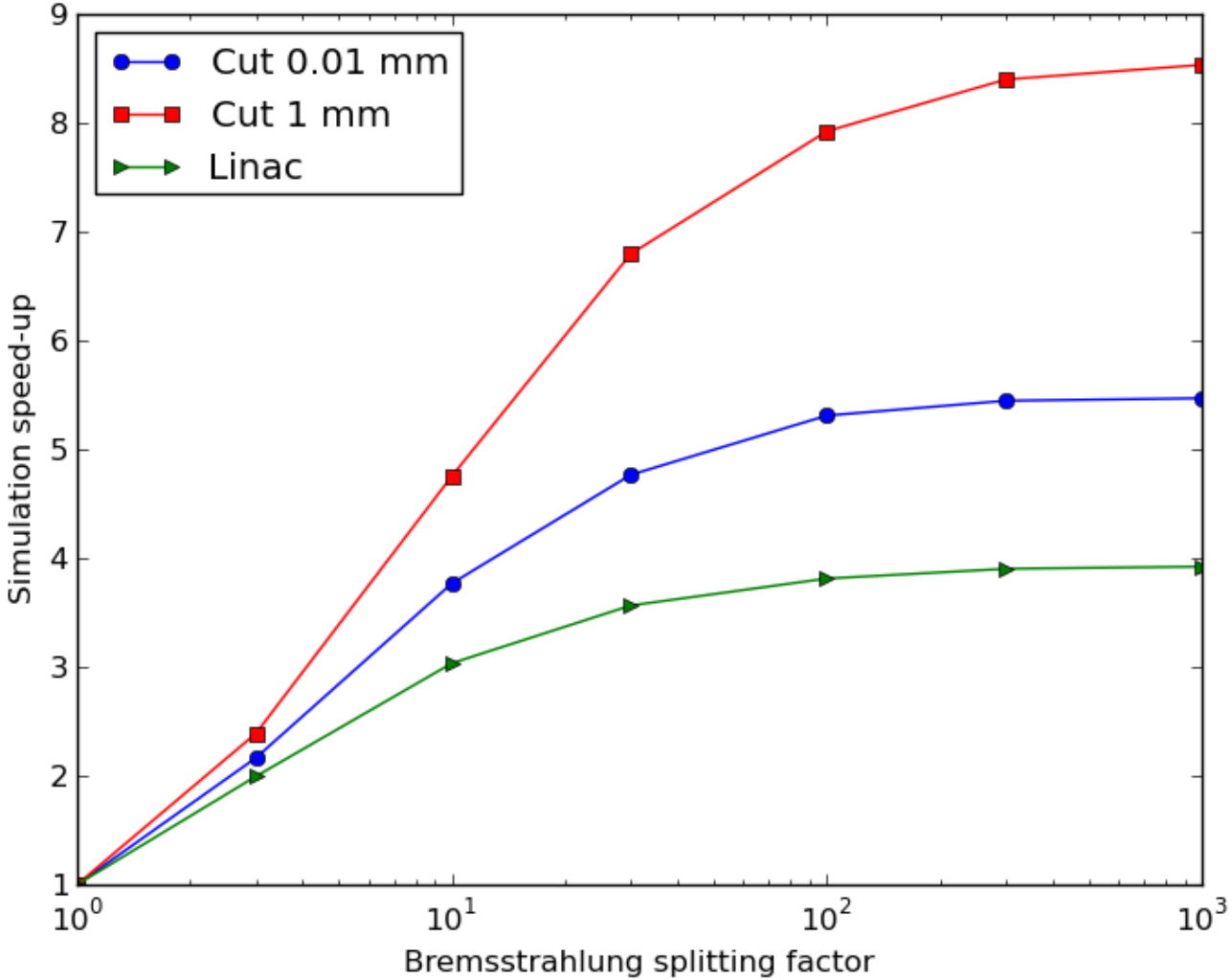




Brem splitting for medical linac



Brem splitting for medical linac

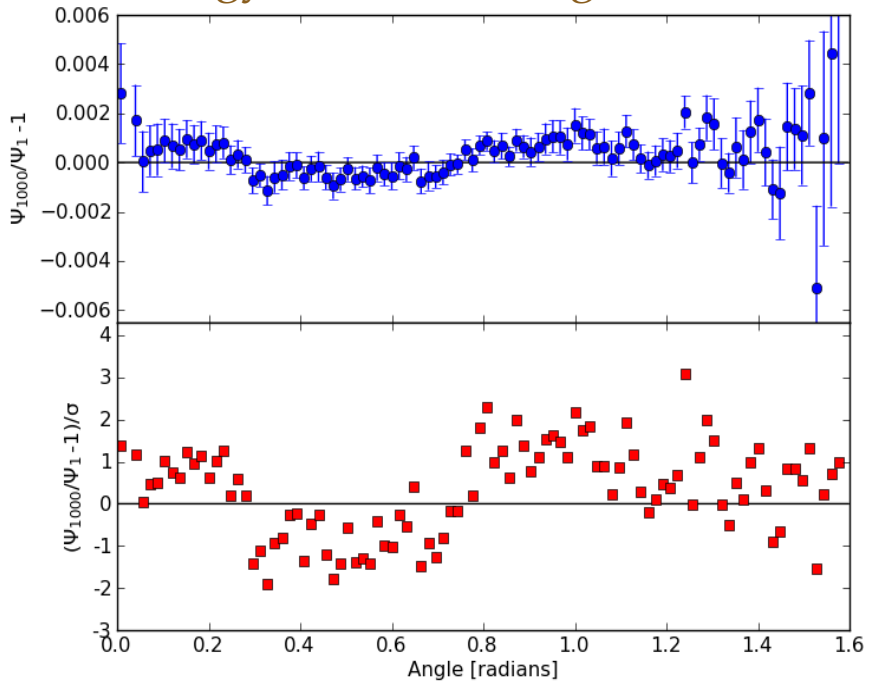


Validating N=1000 splitting

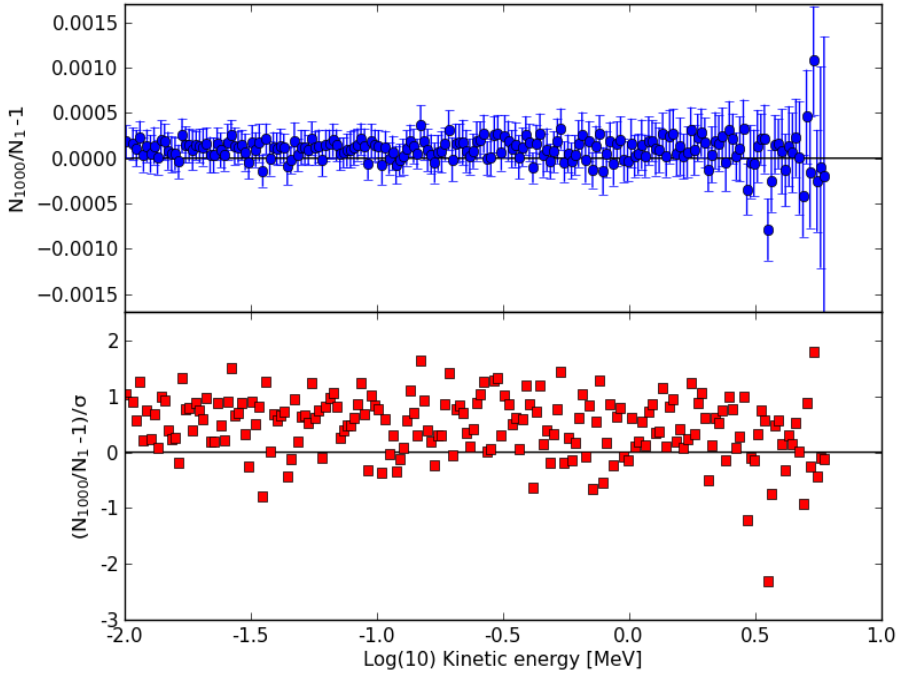
(compared to no splitting)

TestEm5; W target, 6 MeV electron beam

Energy fluence vs. angle



Energy spectrum



Summary

- EM biasing is established
  - Design is simple
  - Is validated in several applications
- Possible wrapper process is not excluded
  - EM biasing by default is disabled
  - Wrapper will have extra CPU cost due to extra calls to virtual functions
  - Wrapper is more sofisticated for implementation and maintanence
  - Wrapper is not needed for traditional EM biasing but probably may be useful for other kind of biasing