

EM Standard Status and Plans

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Outline

- New EM parameters schema
- Multiple scattering validation results
- Option4 Physics List configuration
- List of open problems/bug reports
- Standard EM working group plan for 2015

New EM parameters schema

- In previous versions of Geant4 EM parameters were defined via UI commands and c++ interface G4EmProcessOptions
- Experience with release 10.0 where MT mode has been introduced demonstrates some limitations of both methods
 - G4EmProcessOptions class cannot be instantiated in any place of user code anymore as it was in sequential mode
 - Not all UI commands were effective – several cases when parameters were not set at all
- In Geant4 10.1 a new G4EmParameters singleton class is introduced which keeps all EM parameters
 - Parameters are static and shared between threads
 - They may be modified by user at any moment
 - EM processes/models access parameters at initialisation of a run
 - Changing parameters during the run are not applied until the next run

New EM parameters schema

- After 10.1 was released number of new reports about problems arrived (the recent from D. Sawkey)
- Problems come from the fact that G4EmParameters were introduced just before dead-line for the release and there was an attempt to keep old and new interface
 - There are problems in the case if different parameters are used for different particle type
- **Current proposal:**
 - Split parameters on two groups:
 - First group of static parameters belonging to G4EmParameters class which are valid for all particle/processes
 - Smaller group of parameters which are different for different particle type/process
 - Step function, number of bins, emin, emax, integral option
 - For the second group if UI command is issued apply this command to all particle/processes in all threads
 - Adiabatically remove G4EmProcessOptions class from examples/tests
- **Please, make your validation and report problems**

List of new options

- **New interfaces of G4EmParameters:**
 - SetMuHadLateralDisplacement
 - SetMscMuhadRangeFactor
 - SetMscMuHadStepLimitType
- **Corresponding UI commands:**
 - /process/msc/MuHadLateralDisplacement
 - /process/msc/RangeFactorMuHad
 - /process/msc/StepLimitMuHad
- **Old commands are working only for e+-**
- **Can we disable sampling of displacement for LHC and other applications?**

Tests to validate lateral displacement for muons/hadrons

- In the EM testing suite there are few tests which are sensitive to the lateral displacement:
 - MSCL3 - displacement radius of high energy muons from the decay $Z \rightarrow \mu + \mu^-$ – measured by L3 detector at LEP
 - MSCP – 160 MeV proton scattering angles for variety of targets (Gottshalk et al., 1993)
 - Zmumu test – prepared by not yet in production (recently delivered by A.Bagulya)

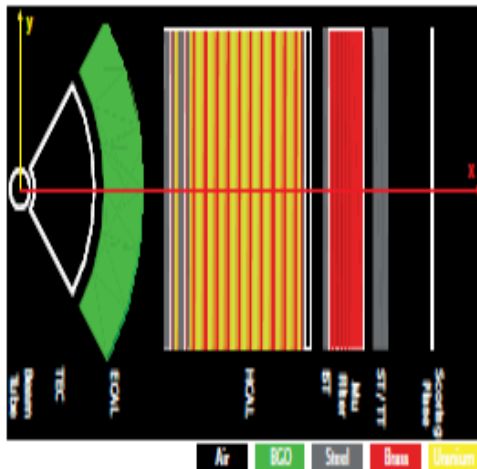
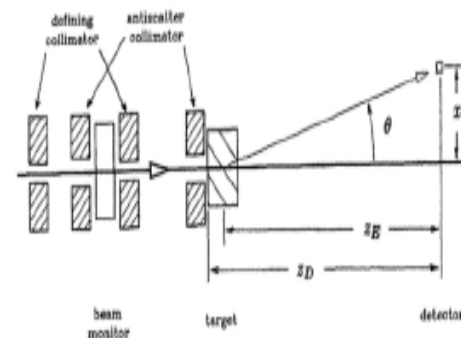


Figure 7: Detector geometry – Cut through the $r\phi$ -plane.

top: Schematic of the L3 detector.
[<http://l3.web.cern.ch/l3/>]

bottom: Geometry used in MSCL3.

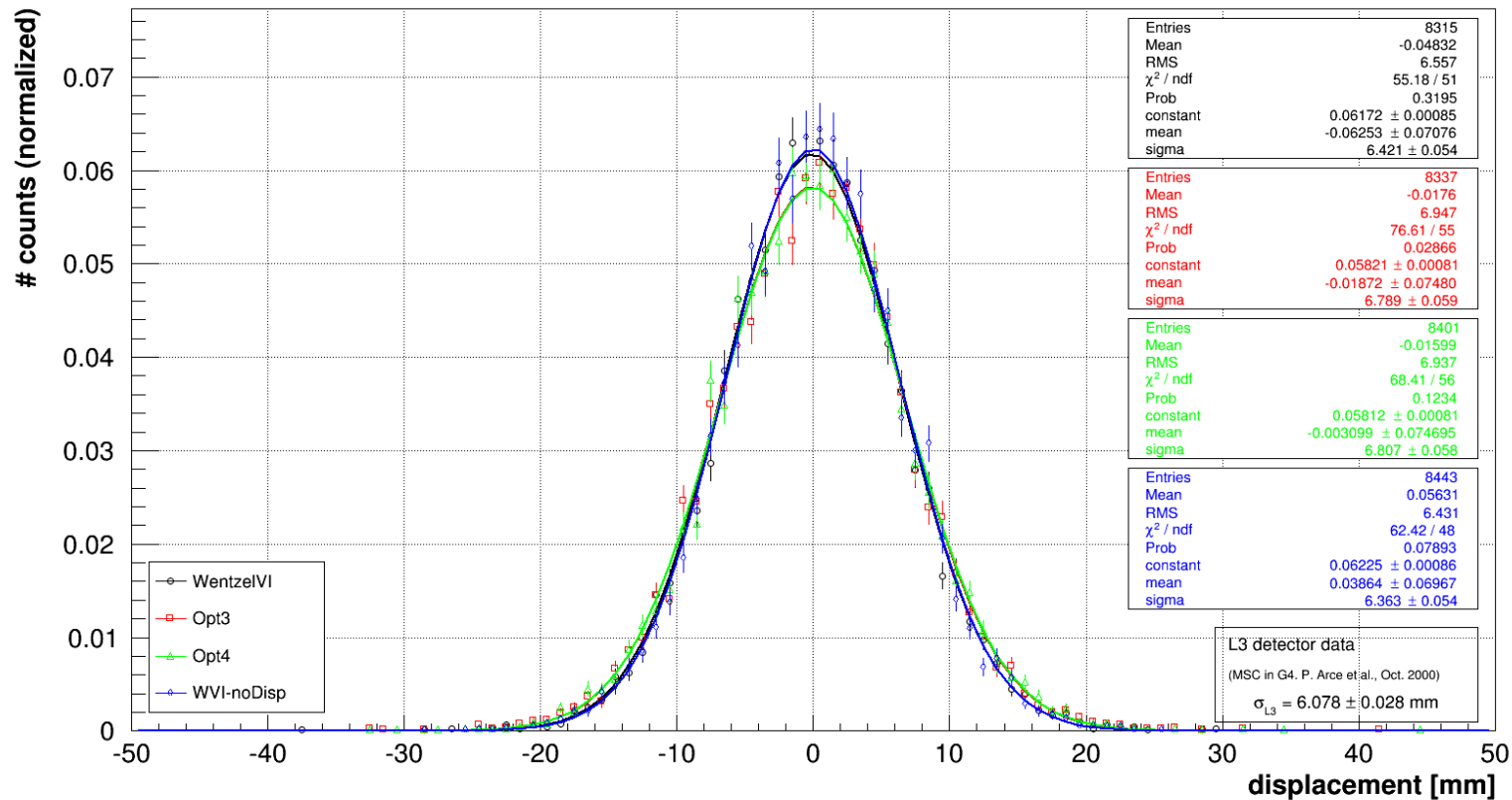


[Gottschalk et al., 1993]

L3 test of high energy muons

Endpoint Displacement of μ^- in the $r\phi$ Plane

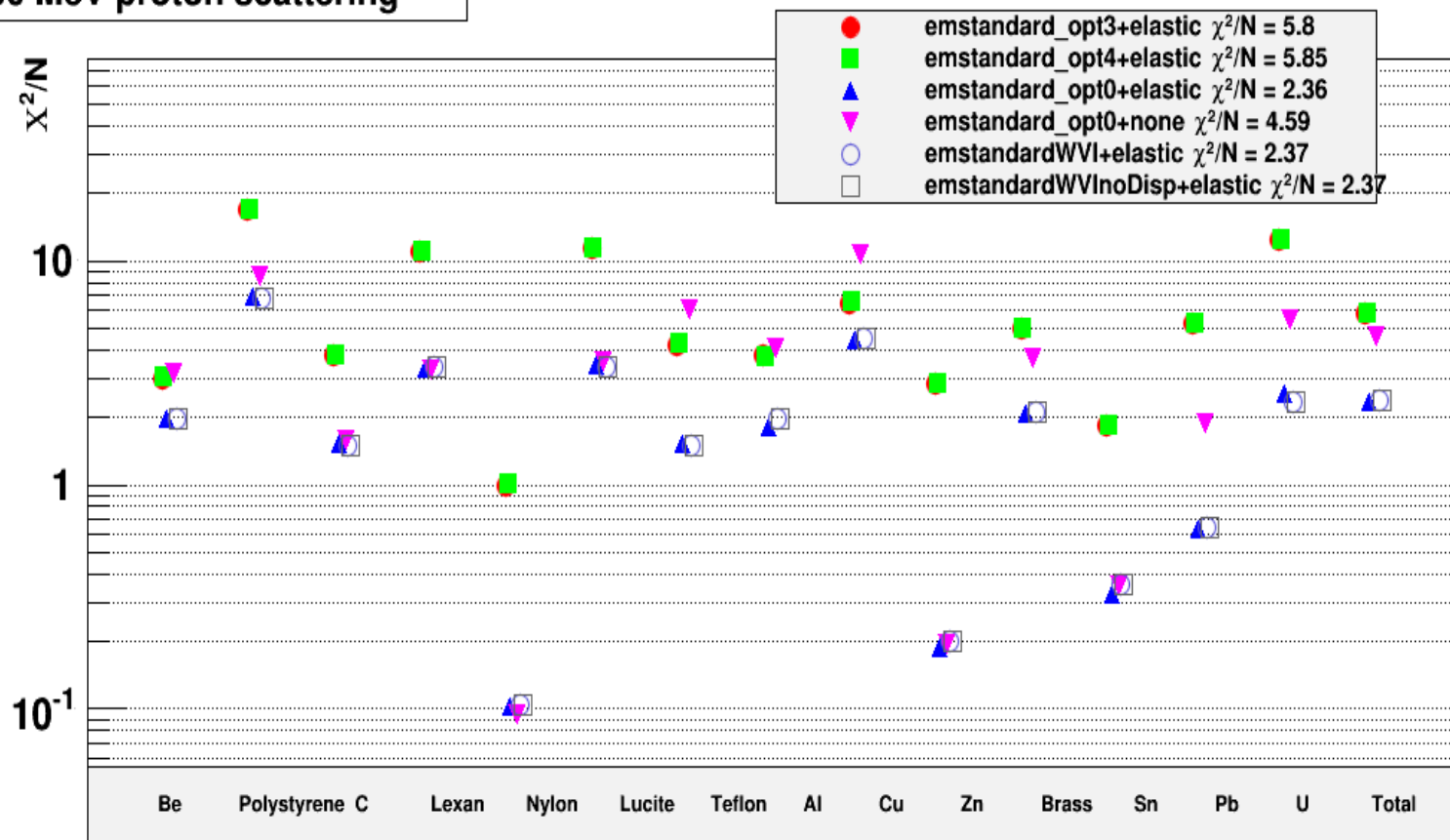
geant4-10-01-ref-02, All MSC models, ARealisticRun, Gaussian fits



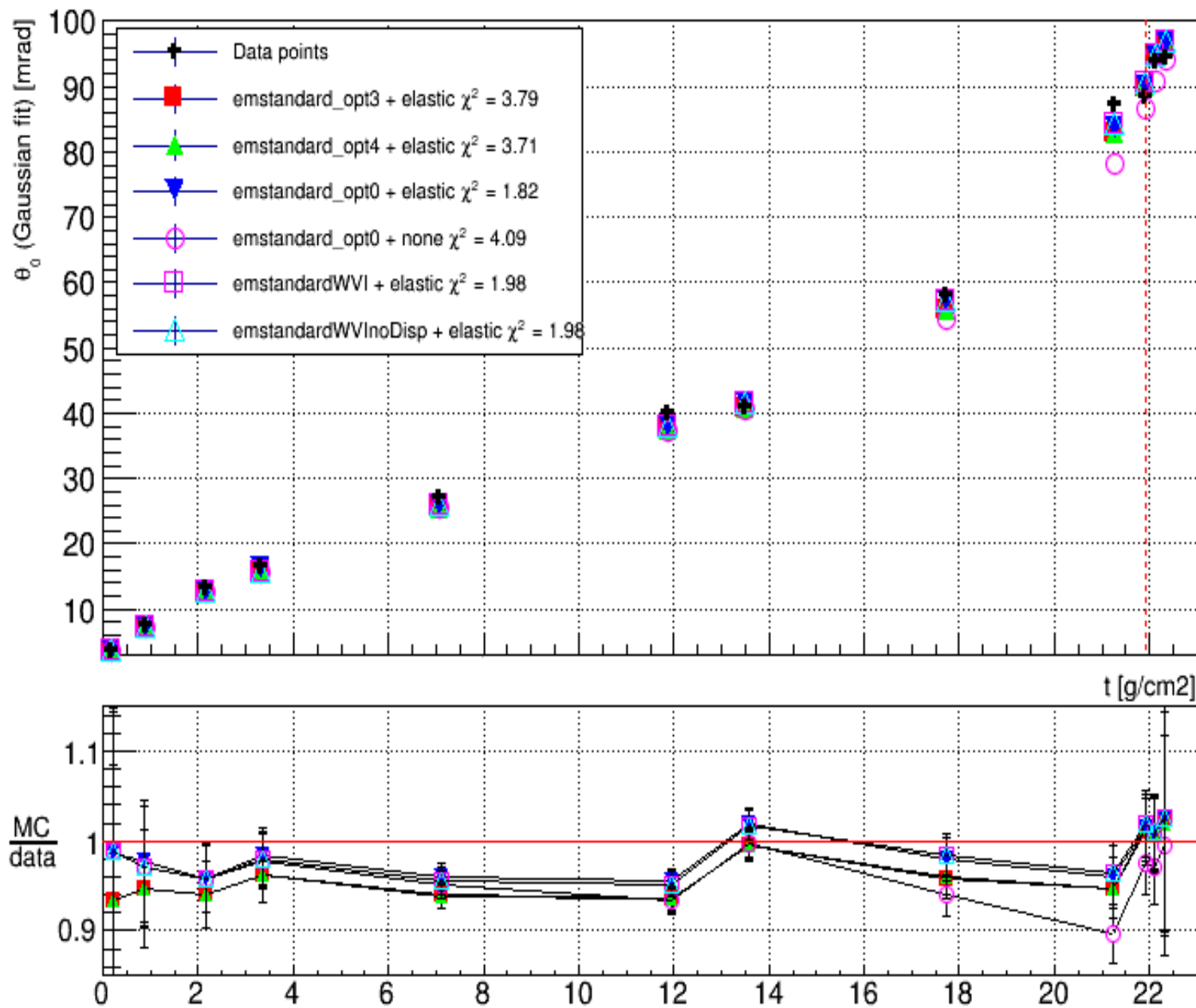
- WVI without displacement and WVI default shows no difference
- Opt4 provides the most worse agreement with the data

Proton thick target test (10.1ref02)

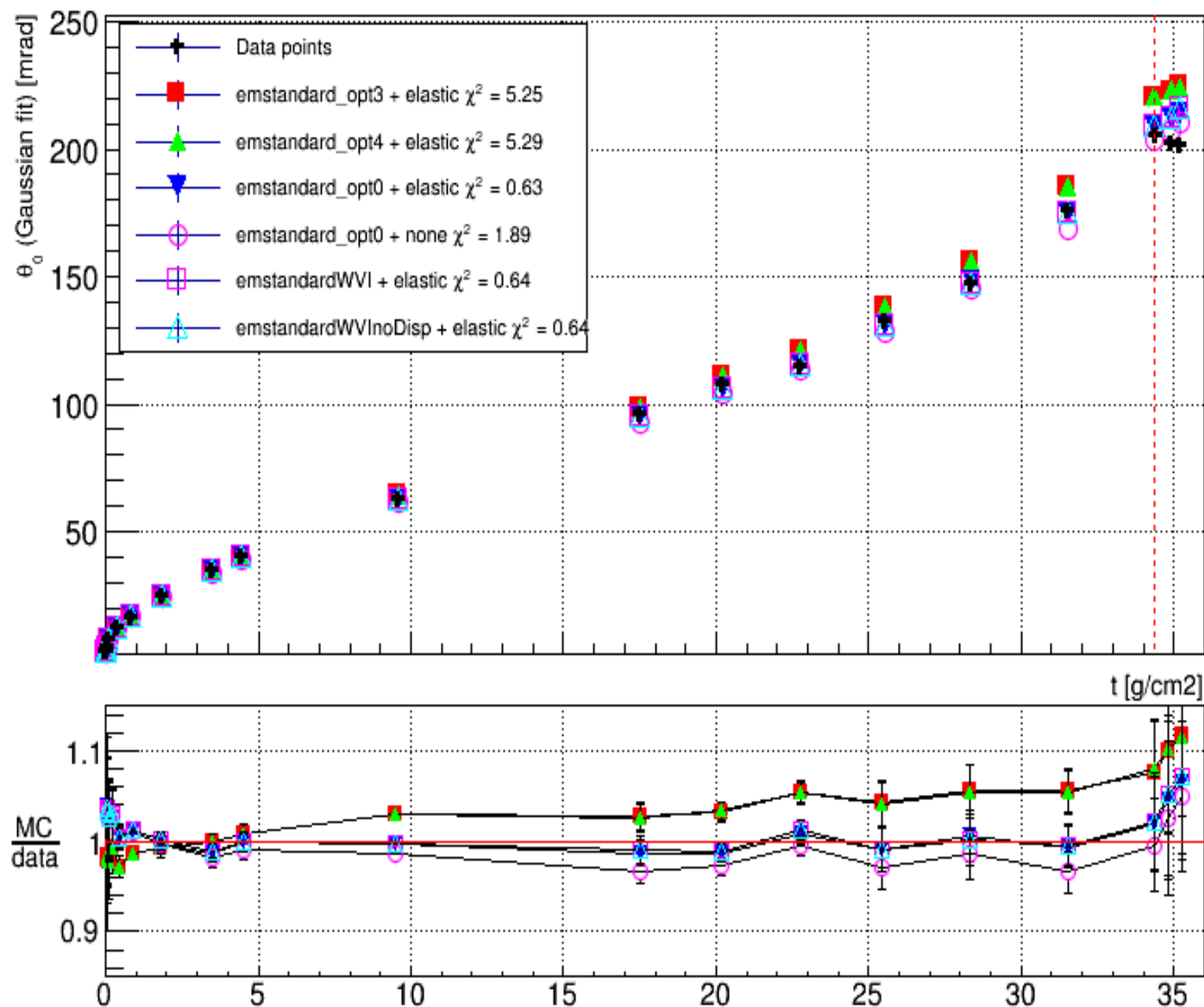
160 MeV proton scattering



Charachteristic Angle Distribution for Aluminium



Charachteristic Angle Distribution for Lead



Option4 Physics List configuration

- It turn out that users are happy with an idea “the best EM Physics List constructor” Opt4
 - There are reports indicating that Opt4 not the best in all cases
 - I would propose that we take this seriously and should really select best physics configuration for Opt4
- Main concerns to the choice of
 - RangeFactor
 - Step limit type for e+-
 - Displacement options
 - Electron ionisation
 - Gamma conversion
 - Compton scattering
- I would suggest to take time thinking, to critically examining, and proposing the best configuration options

Standard EM working group plan for 2015

- The draft is done using proposals of EM working group members:
http://geant4.cern.ch/collaboration/working_groups/electromagnetic/plan2015.txt
- There are several problems which we need to address:
 - Displacement beyond boundary needs fix or full re-thinking
 - If we will introduce e⁺ corrections proposed by Laszlo we will need also extend validation
 - Introduce web base tool for better handling of validation results
 - Polarisation sub-library needs support
- List of unresolved problem reports
 - #1698 - Polarization Asymmetries are different in the latest GEANT4 releases
 - #1702 – Zero backscattering of electrons from solid media
 - #1711 - Bug in the production of Cherenkov photons