Validation of EM Physics – 1
Wednesday, 14:00-15:10

- Session will be focused on validation of EM physics for medical applications
- The list of presentations:
  - A.Bagulya et al., Proton/ion Bragg peak validation
  - T.Aso Validation of proton range in water
  - J.Jacquemier, M.Maire, How to check proton CSDA range?
  - J.Jacquemier, M.Maire, Electron ranges
  - S.Elles, M.Maire, Fano cavity setup

Validation of EM Physics – 2

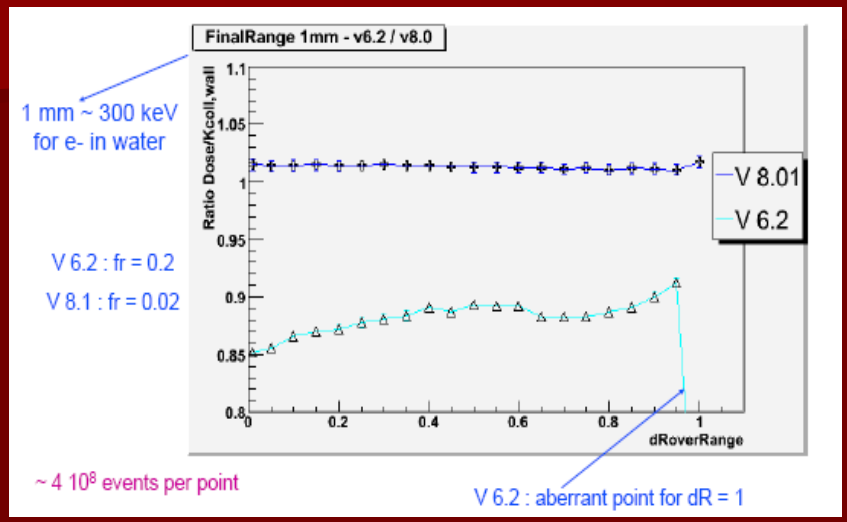
Wednesday 11 October 2006 at 15:30

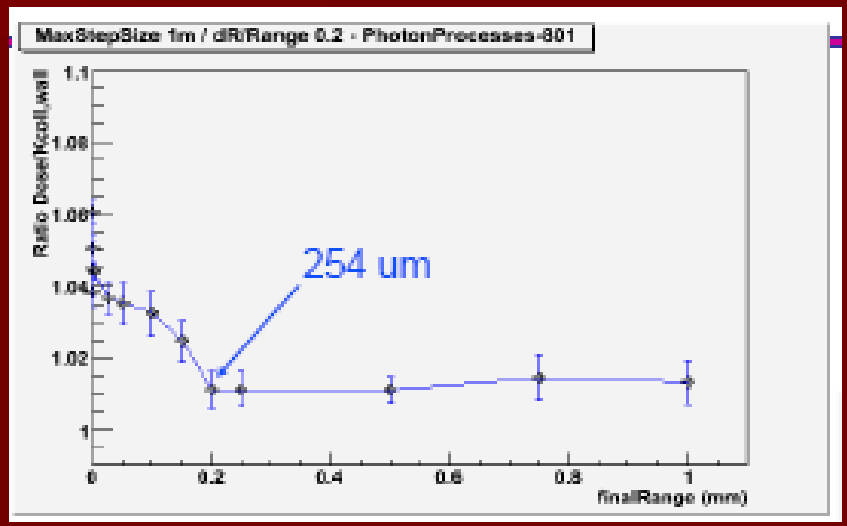
- 15:30 **Revision of Synchrotron Radiation** by V. Grichine/H. Burkhardt
  Updated to new magn. field design to work with fields set in regions. Add good parametrization widely used in accelerator community.
- 15:45 **On Validation of EM Models in G4.8.1** by V. Ivantchenko/O. Kadri
  Comparison of SANDIA data on 1MeV beam penetration in semi-infinite media with G4 models.
- 16:00 **Stopping Powers Validation** by V. Ivantchenko, A.Ivantchenko
  Description of updates of hadron/ion ionization models and validation against
  NIST data on stopping powers.
- 16:10 **Stopping Powers in Gases** by M. Maire/J. Jacquemier
  Electron stopping powers in gases is investigated.
- 16:20 **Extension of Optical Models** by P. Goncalves
  The LIP proposed extensions to the UNIFIED model and microfacet surface sampling will be summarized. Mie scattering is being suggested as a new optical photon process.

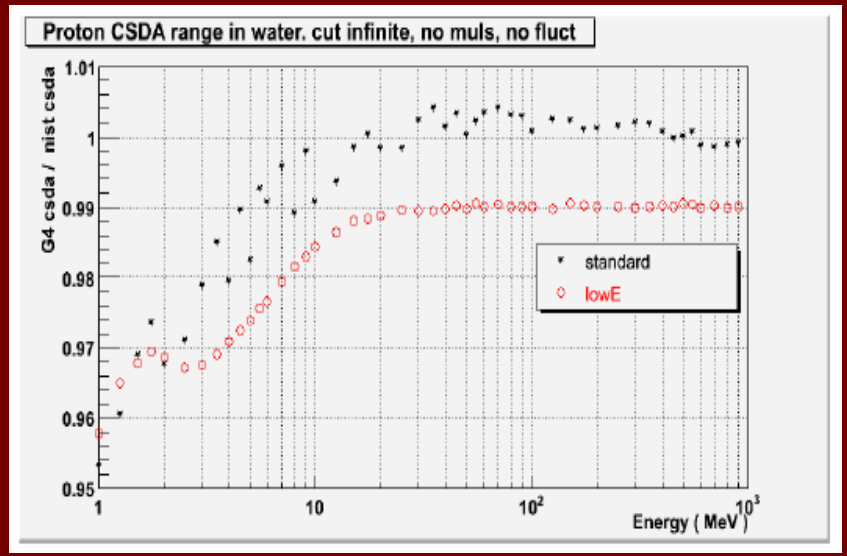
EM Parallel Sessions

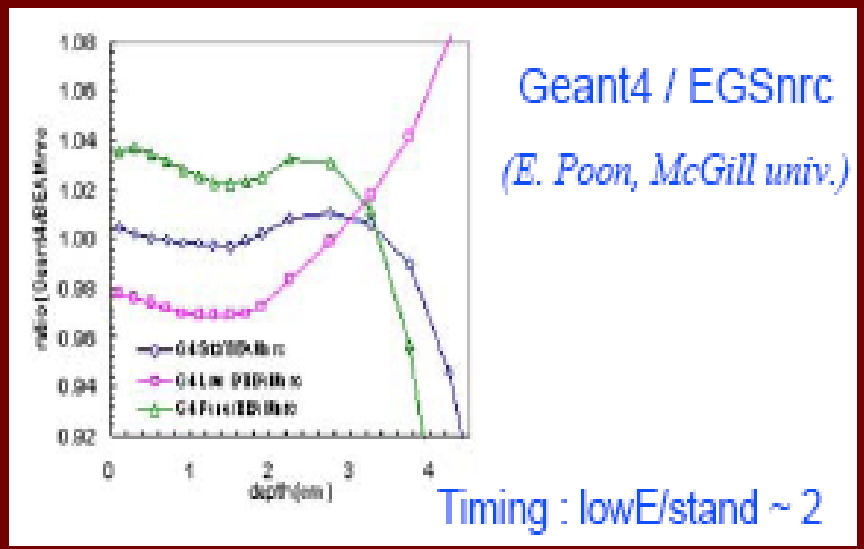
- Standard EM group increase manpower and efforts delivered for different validation studies
  - M. Maire et al., complete the set of TestEm
  - The number of new results were reported by LAPP group
  - Also CERN and Lebedev Institute contribute to regular tests
  - It is shown that quality of MSC model is significantly increased
- Number of issues raised
  - T.Aso pointed out instability of Bragg peak position
  - M.Maire show the level of instability of range calculation
  - V.Ivanchenko show the difference between evaluated data from NIST and SRIM-2006
  - These is more problem for medical application but may be also problem for space applications

Important Plots from LAPP









Objective (Tsukasa Aso)

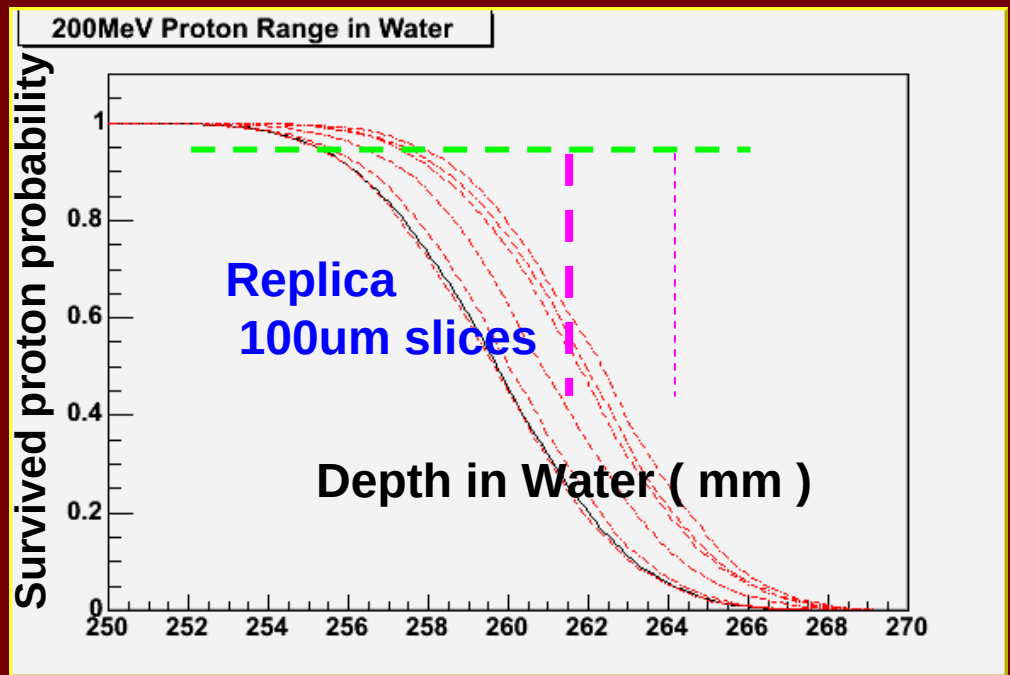
- Hadron therapy using protons for cancer treatment requests better than 1% agreement with measurements and ICRU/NIST protocol data.
- We had reported a proton range shift problem in water about 3 year before. e.g. the range of **200 MeV** proton become longer about 3 mm than NIST prediction by applying a long production cut.

200MeV Proton, ICRU predicts259.6mm

G4hLowEnergyIonisation
No ChemicalFormula
NuclearStoppingOff

Production Cut

G4v7



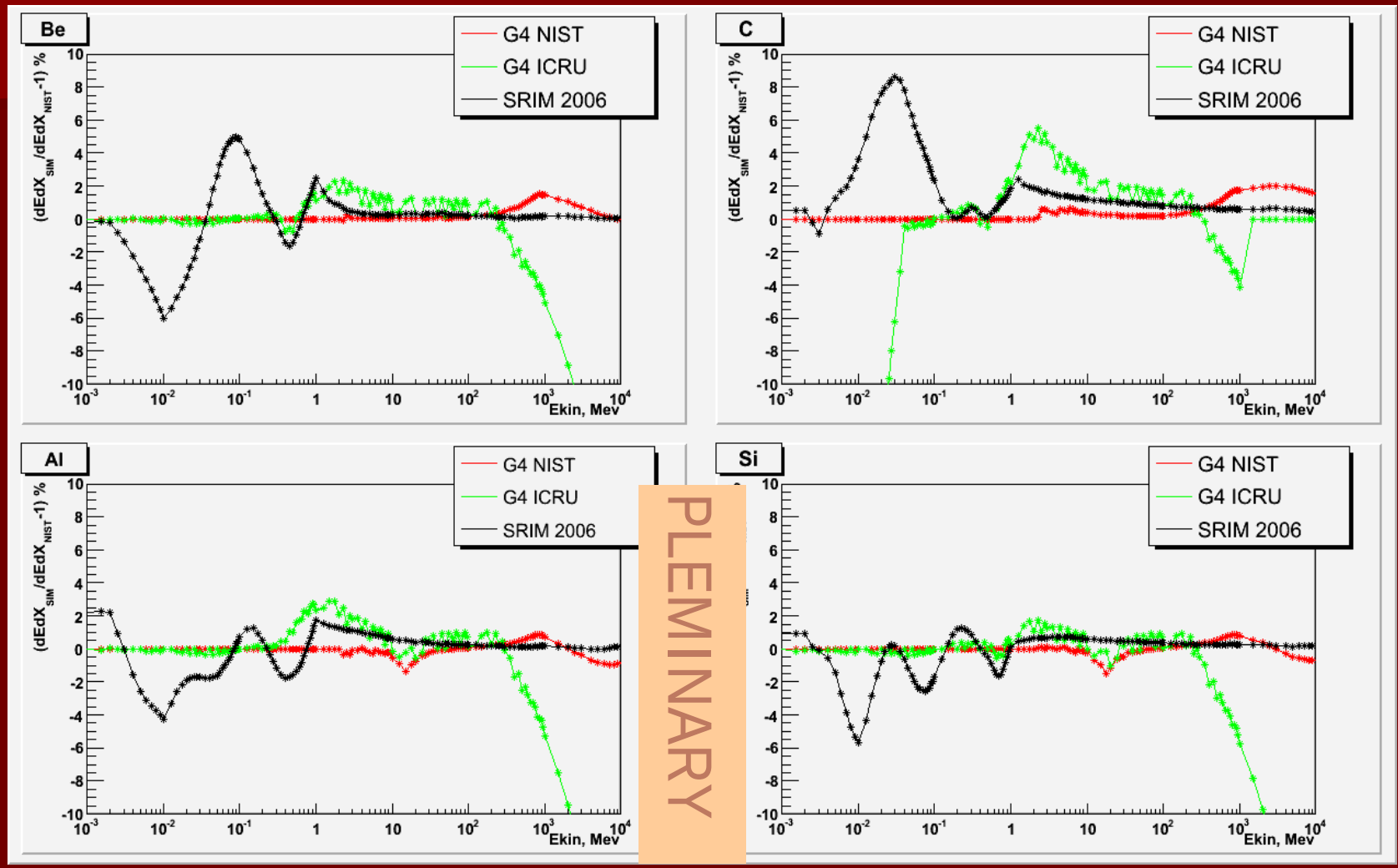
500um
100um
50um
10um
5um
3um
1um

Summary/Discussion (Tsukasa Aso)

- Import stopping power function
  - Low EM has many options of parameterization at low energy region and has capability to change the transition energy between Bethe-Bloch and parameterization.
  - Std EM: There is no option to replace parameterization, and there is no way to change transition energy.
    - Since v.8, G4_WATER uses PSTAR stopping power. But it is applied only at the energy region below 2 MeV.
      - Is the PSTAR stopping power available only for G4_WATER?
    - Can we import stopping power function of PSTAR in whole range?

- Choice of Energy fluctuation model
  - Low Energy EM : ElectronicFluctuationModel() method
  - Std EM: G4UniversalFluctuation class
    - Can we use more general fluctuation model such as a model based on landau distribution?
    - It will be convenient for users to give a chance to switch the model.

Proton Stopping in Light Materials



Conclusions

- NIST PSTAR and ASTAR stopping powers are included inside G4 standard
  - However, NIST and SRIM-2006 stopping powers are different
  - Further study required
- To deliver correct stopping power and cross sections (static values) is not enough
- Simulation is dynamic
  - G4 models need to be stable against cut variation
  - Low-energy model dynamic should be repaired
  - There are smaller issues for standard also

X-rays and Optical Photons

- Review and update of Synchrotron radiation process
- Optical photons improvements by LIP group will be available in the coming release
  - Extensions to the UNIFIED model
  - Microfacet surface
  - New process: Mie scattering