Stopping Power Validation for Hadrons and Ions

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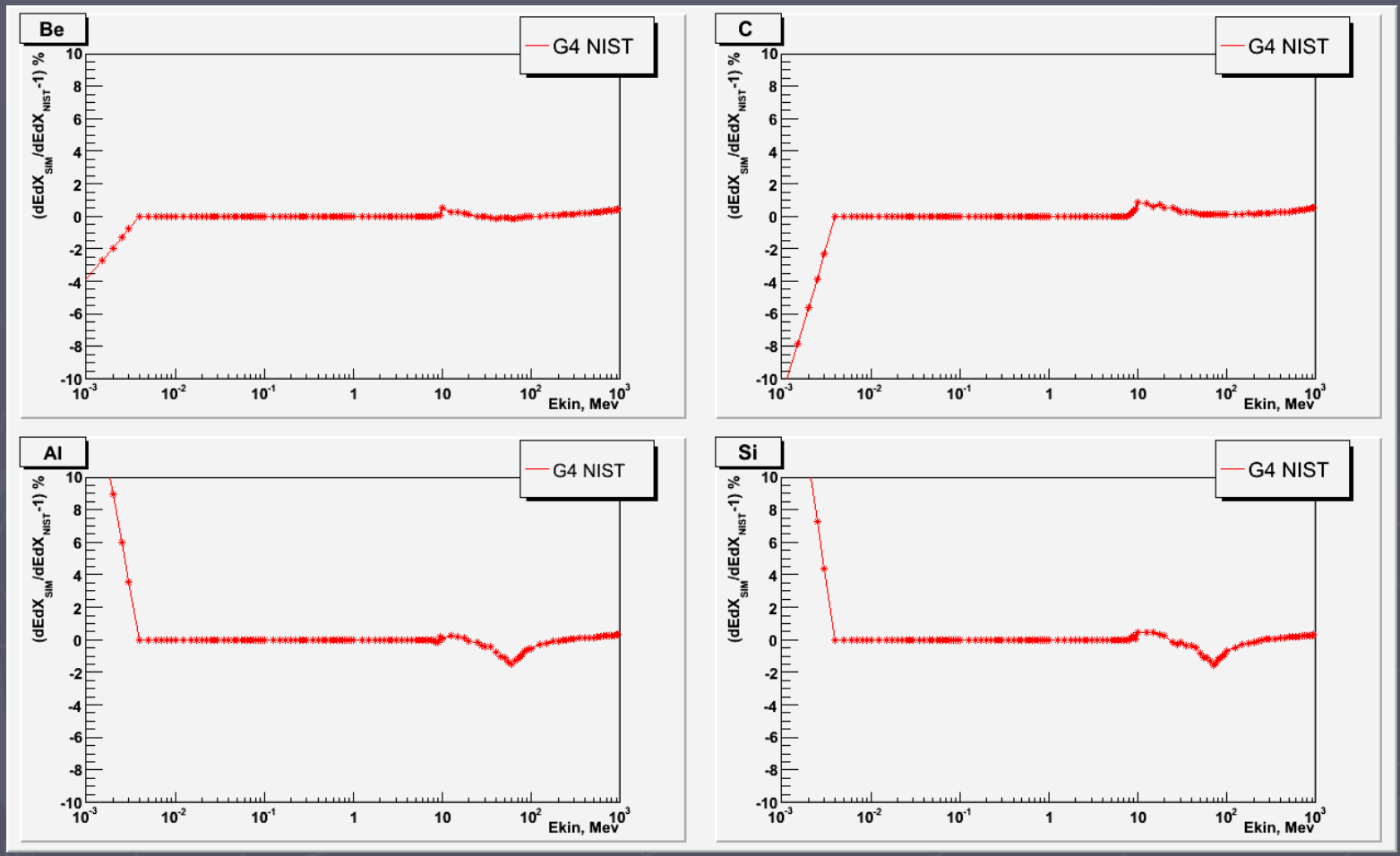
Motivation

- Energy loss of hadrons and ions contribute significantly to radiation application (medical, space…)
- Energy loss of protons and ions contribute to hadronic shower response in HEP calorimetry
- The review of implementation of stopping powers for hadrons and ions was carried out and the number of improvements were introduced in recent releases into standard EM package
- SRIM-2006 code is available

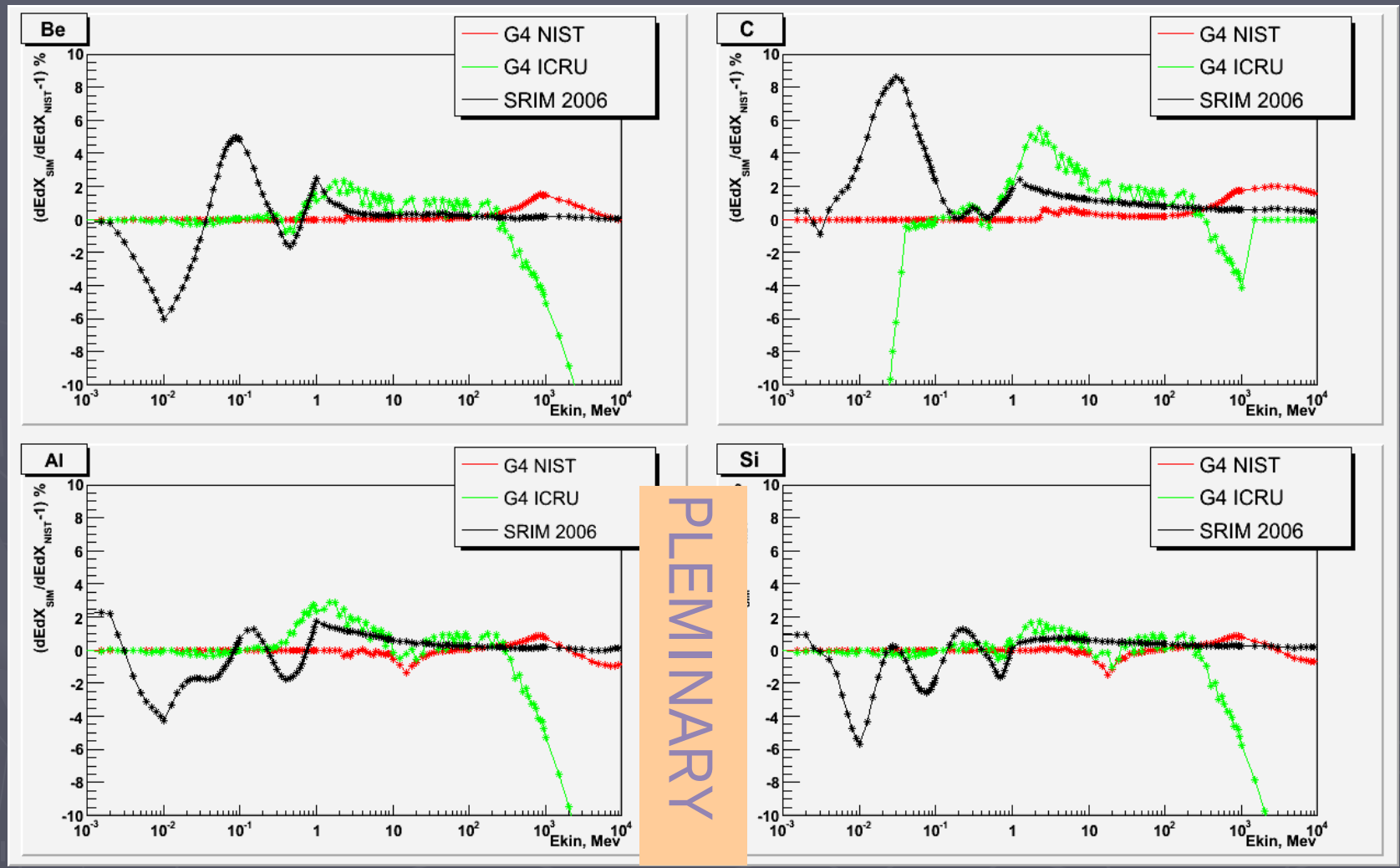
Validation Technique

- NIST ASTAR and PSTAR databases have been accessed
- SRIM-2006 results were obtained
- Geant4 standard stopping powers were obtained from TestEm0
  - NIST material description
    - NIST stopping powers below 2 MeV
  - Hard-type material description
    - ICRU'49 parameterization below 2 MeV

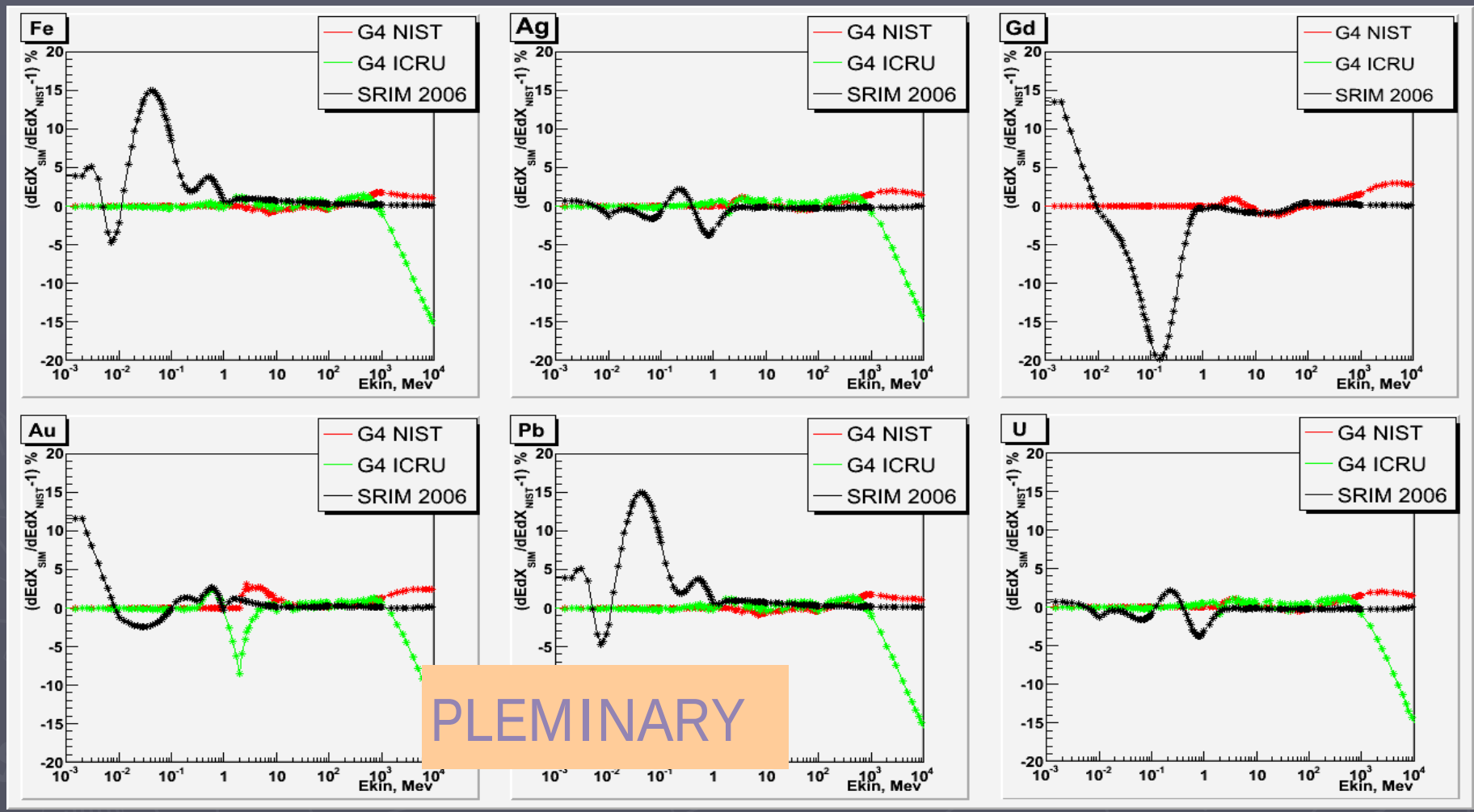
He4 Stopping Power G4 Standard/NIST in NIST materials



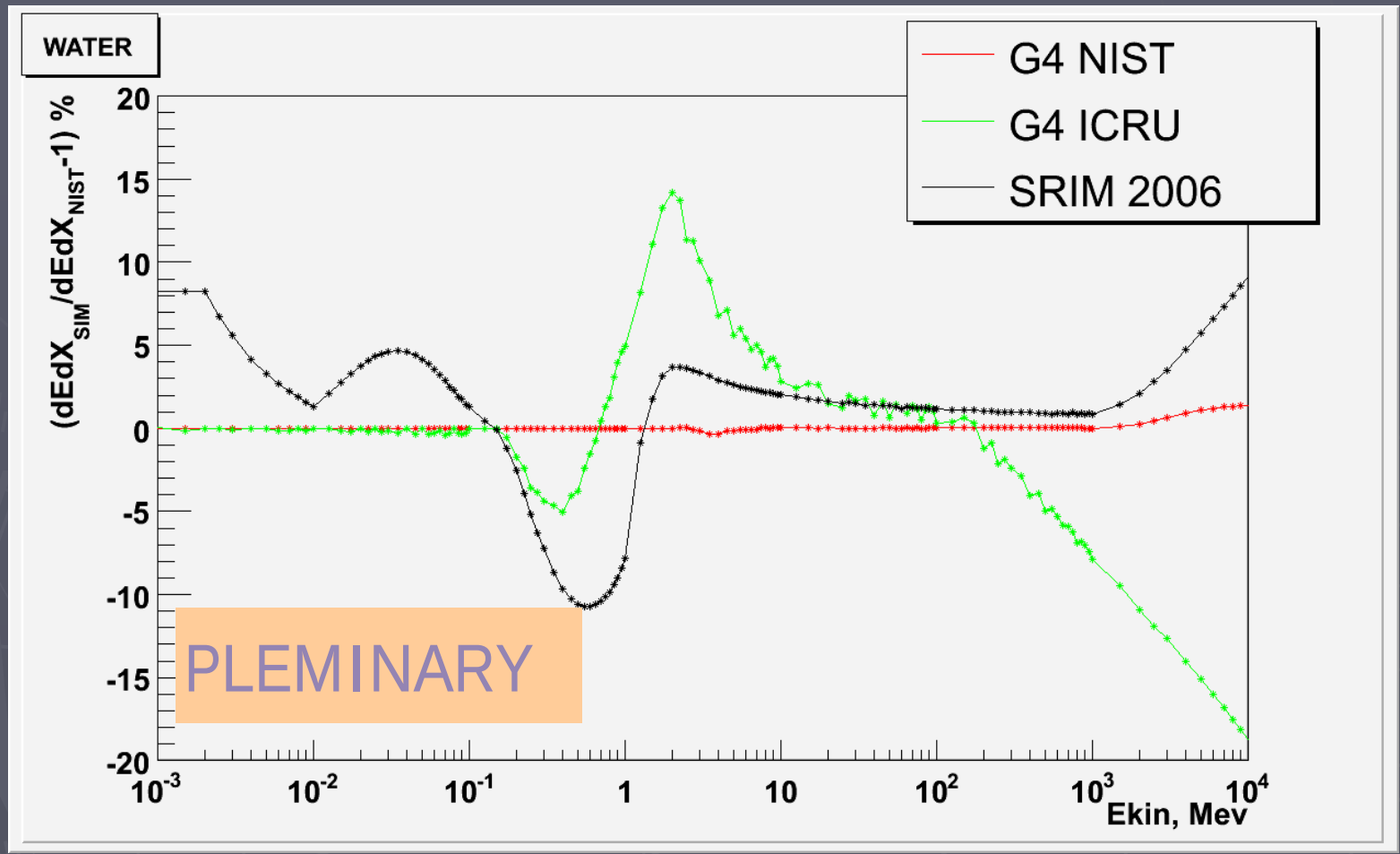
Proton Stopping in Light Materials



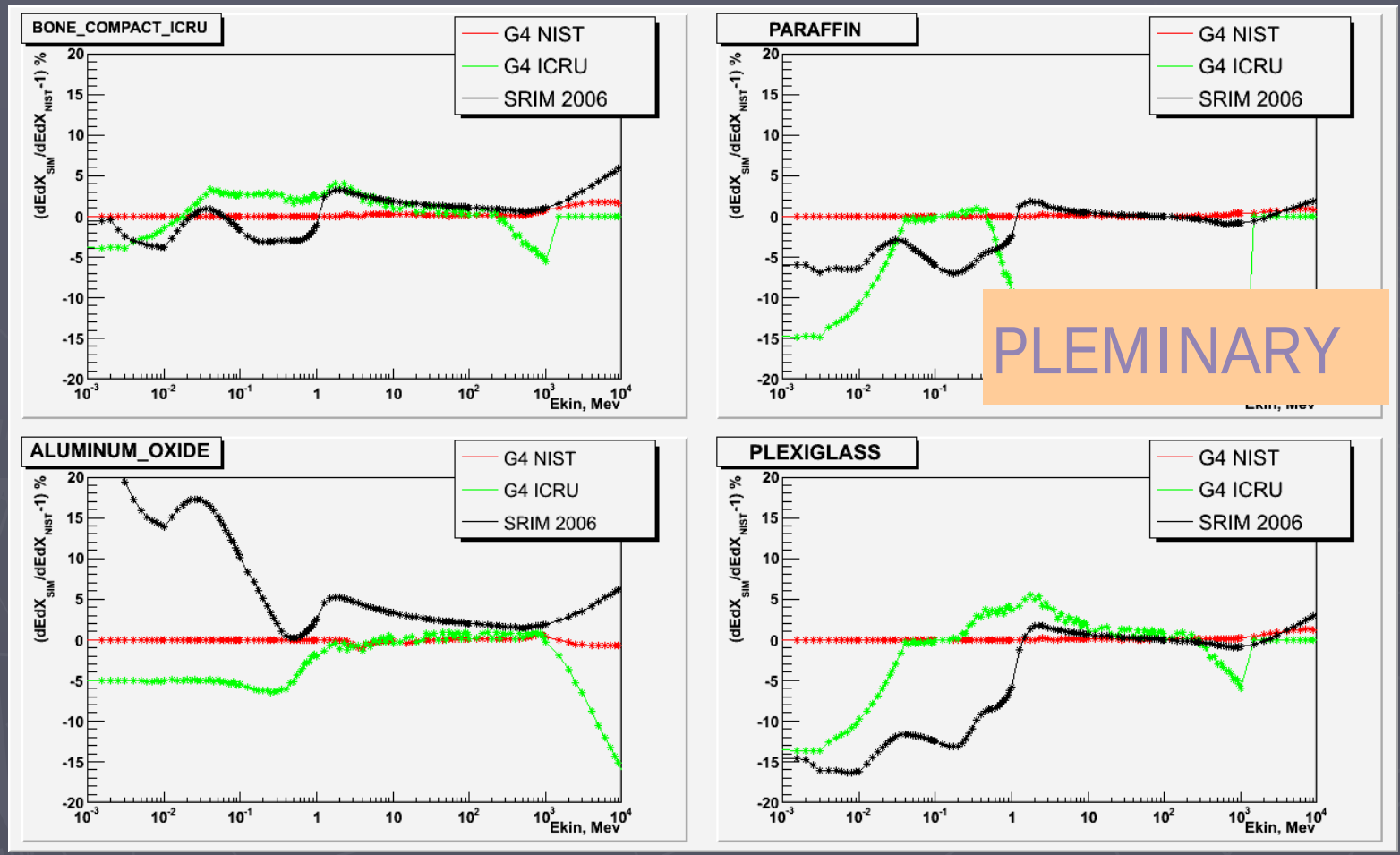
Proton Stopping in Dense Materials



Proton Stopping in Water



Proton Stopping in Compounds



Comments

- SRIM-2006 declare systematic accuracy 5%
- NIST declare 3%
- Larger difference is observed below 1 MeV, which was predicted by J.Ziegler
  - For some pure materials below 100 keV
  - For water at 1 MeV and above 1 GeV
  - For some compounds
- Geant4 standard with NIST materials agree with NIST stopping powers
- There is a problem for hard-typed materials at energies above 1 GeV, which need to be understood
- The study on ranges should be repeated