Requirements from Domains: Medical Physics

16th Geant4 Collaboration Meeting
SLAC
19-23 September 2011

Physics Lists

- We've taken one of our our greatest assets, flexibility, and turned it into our greatest liability:
  - accomplished scientists feel stupid when they encounter Geant4 physics lists
  - makes them reluctant to try alternatives

Geometry

- We are unsurpassed

- but sometimes leave our users without needed guidance:

  - *** G4Exception : Notification
    issued by : G4Sphere::DistanceToOut(p,v,..)
    Undefined side for valid surface normal to solid.
    *** This is just a warning message.

- Detracts from user confidence in our toolkit

Parallel Geometry

- **Extremely valuable**
  - And when we add Layered Mass Geometry, they are blown away

- **Just need to finish the job**
  - Optimize the CPU performance

Accuracy and Validation

- **For a limited set of particles, energies, materials**
  - Particles:
    - e- & gamma, to 25 MeV
    - proton to 250 MeV
    - Carbon to 400 MeV/nucleon
  - Materials:
    - materials of the treatment head
    - materials of the patient

- **Users do not expect us to be perfect, but need to know where we stand**
  - Clear explanation of materials, ionization potentials, special features in the code for G4_Water, etc.

Contributions from Medical Physics

- Medical Physicists are willing to help with ongoing validation tasks.
  - Quality Assurance is a routine part of every medical physicist's job

- They do not expect to get something for nothing
  - They will help get us experimental data
  - They will help run validation tests
  - They will help analyze validation results
  - And if they could understand our physics lists and models a little better, they would contribute to improving the models

- They will become full collaborators, taking real work off the rest of us

Stability

- Accuracy must remain same or improve over time
- Users are very distressed if we regress

Detailed Requests from GATE

- ## MT:
  - Very interested in MT prototype.
  - Selected by Intel Scientific Council.
    Will hire a post doc. One year project.

- ## Validation:
  - They run many validations for proton and carbon.
  - Say physics models are not satisfactory.
  - Best results are with binary cascade + precompound off.
  - Can spot problems but do not have capability to fix them.
  - Would be glad to help on these issues and provide data.

- ## Materials:
  - Defining materials by themselves, setting same parameters as NIST materials, still get different results from NIST materials