PRINCETON
UNIVERSITY

Discussion on EM Physics problems

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27th Geant4 Collaboration Meeting, 26–30 Sept 2022

Outline

- Report of Li Zhuxin and Claire Michelet on EPICS2017
- Bug reports
- Pending problems
- Validation efforts for the release 11.1 and beyond
- AOB

Implementation of EPICS2017 for Livermore photon models

Z. Li, C. Michelet, S. Incerti, V. Ivanchenko, M. Novak, S. Guatelli

- Database EPICS2017 (Electron Photon Interaction Cross Section library) contains physical data (cross section…) for electron and photon transport calculation, has been implemented for Livermore photon models, available from Geant4 11.0.
- EPICS2017 database is triggered by ***/process/em/LivermoreData epics_2017*** if G4EmLivermorePhysics is used.
- **Models involved**:
  - G4LivermoreGammaConversionModel
  - G4LivermoreGammaConversion5DModel
  - G4LivermoreComptonModel
  - G4LivermorePhotoElectricModel
  - G4LivermoreRayleighModel
- Tabulated cross-sections have been updated, new parameterizations with better precision regarding scattering functions of Compton effect, cross-sections of photoelectric and form factors of Rayleigh scattering have been applied.
- **Publication**: *Z. Li, C. Michelet, S. Incerti, V. Ivanchenko, M. Novak, S. Guatelli, H. Seznec. Implementation of the EPICS2017 database for photons in Geant4, Physica Medica 95 (2022) 94-115. https://doi.org/10.1016/j.ejmp.2022.01.008*
- **Technical notes** are available on the *Geant4@IN2P3* website*: http://geant4.in2p3.fr/styled-4/styled-8/*

Work on EPICS2017 electron data

Z. Li, C. Michelet, S. Incerti, V. Ivanchenko, M. Novak

Method:

The following comparisons were performed:

- Subshell ionization cross-section for Z: 1-100 between EPICS2017 and previous version EPICS2014 (=EEDL91)
- Ionization cross-section and stopping power for Z: 1-97 calculated by Livermore, Penelope and MollerBhabha models
- Ionization stopping power between Livermore ionization models and ESTAR data.
  - for elements: H, C, Si, Fe, Cs, Pb, U
  - for materials: air, graphite and water

Conclusion:

There is no need to update Livermore electron ionization model for EPICS2017 electron data.

A technical note summarizing the work is in progress and will be available soon on the *Geant4@IN2P3* website.

Bugzilla bug reports (1/2)

- The state of the problem:
  - Green – responsible person knows what to do and the problem can be resolved for 11.1
  - Red – responsible person does not know how to address
  - Blue – responsible person does not yet have an opinion
  - Black – responsible person is no optimally chosen, replacement required
- 2510 (D. Sawkey) boundary reallocation step doesn't happen
- 2503 (A. Howard) Physicslist for alpha particle
- 2495 (V. Ivantchenko) Problem dEdx and ranges for low-energy ions
- 2494 (V. Ivantchenko) RadioactiveDecay process do not work with emstandard_opt0 or local physics list
- 2488 (A.Howard) Wrong name is given for optical physics parameter TRANSMITTANCE
  - Should be D.Sawkey
- 2475 (P. Cirrone) Phantom data files are incorrectly read in from file
  - Should be S.Guatelli
- 2465 (S. Incerti) Excess in fluorescence peaks Livermore
  - Who can volunteer for the problem?
- 2452 (V. Ivantchenko) SIGFPE issue in G4VRestDiscreteProcess

Bugzilla bug reports (2/2)

- 2442 (D. Sawkey) Wrong velocity after an optical transition with non-polished surface
- 2431 (D. Sawkey) Optical photon reflection probability is being calculated first without regard to UNIFIED model reflection constants
- 2412 (V. Ivantchenko) DNA physics deactivates radioactive decay physics
- 2368 (V. Ivantchenko) Issue with Reproducibility
- 2354 (V. Ivantchenko) Segmentation fault caused when processes are disabled via the user interface
- 2353 (V. Ivantchenko) Aborted Events with some EM Options
- 2293 (F. Longo) Something wrong in angular distribution of photoelectron from a polarized beam
  - Who can take care on this problem? Luciano
- 2279 (V. Ivantchenko) problem with dexcitationIgnoreCut
- 2246 (V. Ivantchenko) Wrong X-ray de-excitation of Am241 decay daughter if PIXE is OFF
- 2235 (H. Tran) G4Track returns incorrect coordinates and step lengths of chemical species

Pending problems

- Ion ionisation
  - For Geant4 11.1 we have prepared G4LindhardSorensenIonModel
  - It would be good if medical user double check if Bragg peak and ion range is fine or damaged before the release
- Standard/DNA combined physics
  - See Jay Archer talk
- Technical problems in MicroElec models
  - See Coverity analysis

Validations before the release 11.1

- It seems that have full set of results for
  - 11.0.6 (11.1beta) – we have what we have not needed rerun tests
  - 11.0.8 (will be available likely next week) – we should request full set of EM tests
  - Candidate versions for 11.1
    - Due to limited time request for the full set of EM tests may be not available
- Who check EM tests after each reference version?
  - I am looking into EM testing suite results, also Mihaly Novak
  - Mihaly Novak and Dmitry Konstantinov control geant-val
  - Other group members control problems of interest
- Local tests of candidate versions of Geant4 are always useful
  - Several group members are doing this and report results before the release
- Can we do more?
  - There is a list of Coverity static analyzer report
    - Is updated after each reference version
    - Developers, please, have a look
  - If it would be possible to have volunteers who will help with EM tests control?
  - We may benefit of fresh look by extra peoples on results
    - This would be equivalent to shifts for nightly testing
  - Amount of test results is big, so independent checks may identify problems before the release
  - Possible tasks for volunteers:
    - Check EM testing suite results
    - Check geant-val results
    - Check User Forum talks if there are problems which we miss