

Geant4 developments: the latest releases: 8.3 & 9.0

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for Geant4 collaboration

Geant4 developments 1H 2007

- Geant4 8.3 (4th May 2007):
 - Created to provide physics improvements,
 - in particular new Quasi-elastic channel and FTF revisions
 - without the interface changes, and need for potential migration
- Geant4 9.0 (for 29th June 2007)
 - Scheduled release
 - includes some interface changes, further fixes,

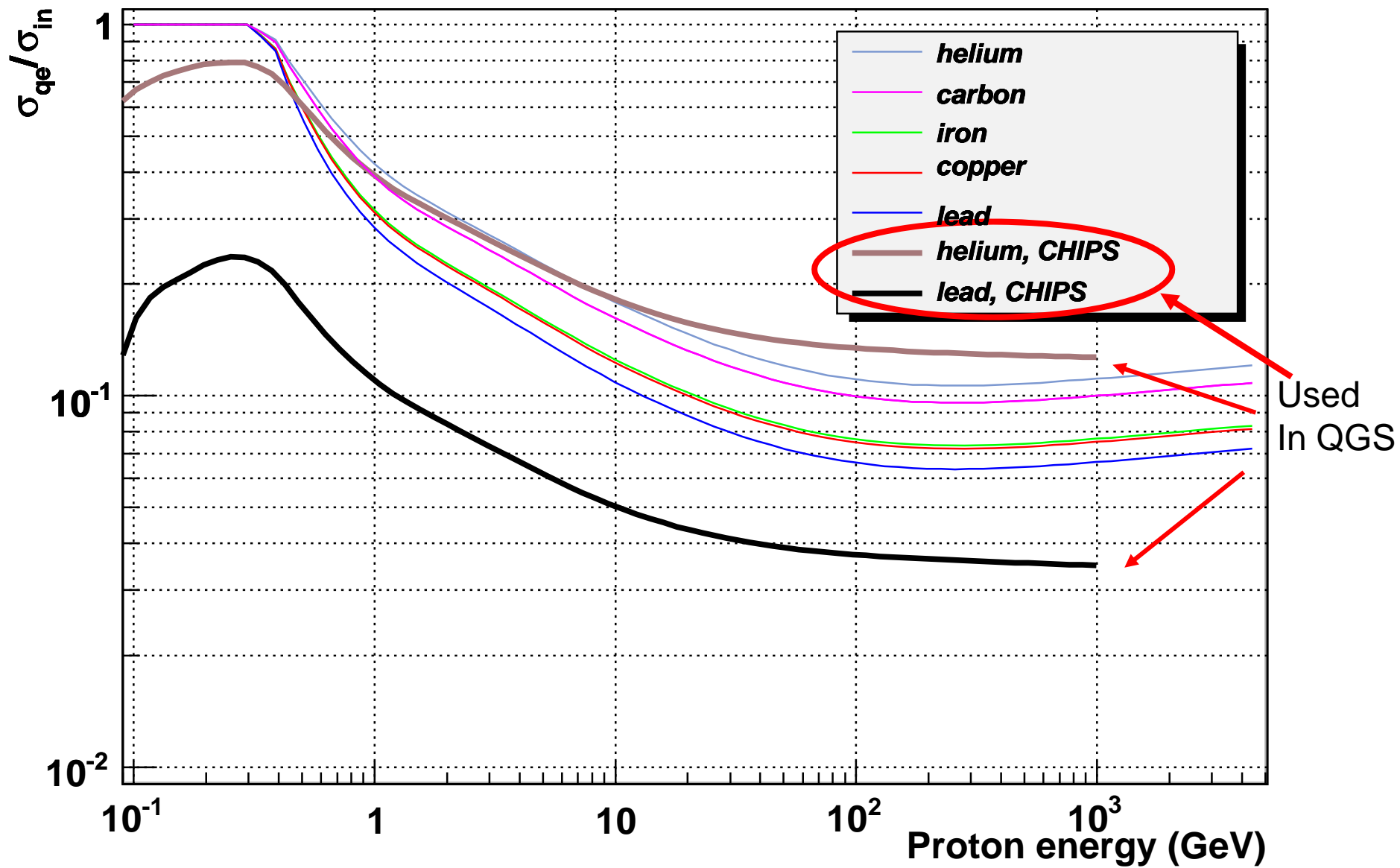
Minor release 8.3

- Geant4 8.3 is a minor release:
 - Existing user code should work without changes
 - No software migration required
 - For other minor releases advanced users might have some.
 - Improvements of existing models
 - More care not to break code.
 - Additions of physics models
 - Changes in physics lists
 - Use mature models, and with care some new options
 - See next slides
 - Fixes
 - Relatively few changes (compared eg to 9.0 or 8.2)

Geant4 8.3

- **New Quasi-elastic channel**
 - replaces part of cross section of QGS model ($E > 12$ GeV)
 - since G4 QGS models deep inelastic interactions only
 - Typically 4-8% of cross-section
 - It is used starting from G4.8.3 in QGSP & variant Physics Lists
 - Including QGSP_EMV, QGSP_BERT, ..
 - Option not to use this channel
 - new lists QGSP_NQE, QGSP_EMV_NEQ, and QGSP_BERT_NQE ignore this new quasi-elastic
 - these as equivalent of QGSP, QGSP_EMV, and QGSP_BERT available in release 8.2 and before
- **Note**
 - Took out 4% artificial reduction in Cu π^+/π^- cross-sections
 - introduced in Geant4 7.0

p-A quasi-elastic/inelastic cross-section ratio



Geant4 8.3

- Significantly revised FTF (Fritiof) model
 - For proton incident
 - Details in V. Uzhinsky's Physics Validation talk (Dec 06)
- Improved model for muon capture (in QGSC)
 - Based on CHIPS modeling
- Change in behaviour of 'default' EM option
 - As used in QGSP (and other non EMV lists)
 - No longer calculate distance to boundary for use in multiple-scattering,
 - Using safety instead

Other changes in 8.3

- New variant of QGSP_BERT, moving transition energy between Bertini & LEP
 - New transition energy is 5 GeV in QGSP_BERT_TRV
 - Old transition energy was 9.9 GeV
 - This was response to Atlas feedback (T. Carli, physics validation)
- Fixes in different places
 - For NaNs found running with floating point exceptions
 - One of these has tripped up Atlas simulation
 - Due to use of high-precision tracking parameters -tracker
 - Issue understood (thanks to A.DiS)
 - Fix included in 9.0 and being 'back-ported' to 8.3

New behaviour, improvements

- Cross sections for user-defined elements:
 - cross sections are now calculated based on user-defined isotope abundances
 - if they are provided
 - Simplified $A^{2/3}$ scaling is used (speed)
 - Natural abundances are used otherwise
 - Details:
 - Extend user-chosen isotope abundance capability to several classes:
- Performance fix for cross sections
 - In parameterised models (LEP/HEP)
 - following report from CMS (of ~6% CPU impact in one case)
 - new code tests by PDG ID instead of name
- Improved overlaps checking tool

For more

- More information at <http://cern.ch/geant4/support/ReleaseNotes4.8.3.html>
- This was source for previous slides

Geant4 9.0 developments

- Significant changes
 - Few % CPU improvement from EM revisions
 - From refinement of EM interfaces
 - Simple test cases see ~5% for QGSP_EMV
 - FTF model revised (for π incident - tbc)
 - Lower threshold for FTF
 - Starts at 4.0 GeV, overlaps with LEP up to 5.0 GeV.
 - Activated quasi-elastic for FTF lists
 - Was only used in QGS in Geant4 8.3
 - New Error Propagation module
 - With functionality of GEANE

Migrations needed for release 9.0

- Geometry 'tolerance' values no longer global constants
 - Enables users to adjust in proportion to world diameter
 - Advanced users (and toolkit classes) now must retrieve values from new class
- EM process methods, options revised
 - Only users creating own physics list (or process) impacted
 - New names
 - New method signature for choose MSc options

Magnetic Field

- Fixes to G4RKG3Stepper, re-enabling use
 - Uses 3 calls to field (rather than 4 of G4ClassicalRK) per integration step
- New class G4HelixMixedStepper
 - mixes helical stepper (for large steps) and Runge-Kutta (for small ones)
- Improved calculation of DistChord()
 - for SteppingAngle > pi
- Relaxed fatal exception in G4PropagatorInField::AccurateAdvance()
 - for case of step zero and return previous value,
 - fixes problem observed by ATLAS in release 8.3 when using seeking very precise movement.

Fixes

- LEP model: correction in units (backward sec)
 - removes an un-physical peak at 180 degrees and reduce the number of very low energy nucleons produced.
 - Typical effects for 2 - 10 GeV incident particles:
 - shift angular distributions forward by ~ 5-10 degrees
 - increase the mean secondary kin energy by 20 - 30 MeV.
 - At higher energies the effect is small.
 - Little change in shower shape benchmarks.

New for precision neutrons

- When using high precision neutron code, user may User can now change the behaviour of the high precision neutron module.
- Choice 1: force use of Photon Evaporation model for neutron capture instead of final state data
 - Set `G4NEUTRONHP_USE_ONLY_PHOTONEVAPORATION`
- Choice 2: Use only exact isotope data files,
 - Instead of allowing nearby isotope files to be used (the default)
 - With this option, if the exact file is not available, the cross section will be set to zero and a warning message will be printed.
 - Set the environment variable `G4NEUTRONHP_SKIP_MISSING_ISOTOPES`.
- Note: renamed `NeutronHPCrossSections` to `G4NEUTRONHPDATA`
 - This is the path for the `G4NDL` data set
 - Must change this user environment variable

New Data Sets

9.0 introduces three new versions of data sets:

- New data for neutron cross-sections, G4NDL.3.11
 - Added Germanium data and Silver data.
 - Added Special file 0_0_Zero which give 0 cross section over all energy range.
- New low-energy data set, G4EMLOW.4.3:
 - Added auger file au-tr-pr-100.dat.
- New data set for radioactive-decay, G4RadioactiveDecay.3.2:
 - Fixed z81.a188 element

Kernel changes

Track & Tracking

- Fixed weight treatment in G4ParticleChange.
- Added non-ionizing energy deposit in G4Step and ParticleChange.
- Added magnetic moment in G4DynamicParticle.

Run

- G4VUserDetectorConstruction: new access methods to the parallel worlds.
- Fixed memory leak in G4VUserPhysicsList
- In G4RunManagerKernel, UpdateRegion() method
 - now invokes CheckRegions() method to ensure region information are updated