Version 11.2.1

Geant4 Tutorial Course
Jefferson Lab, Newport News, VA, USA
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Upgrading Your Geant4 Release

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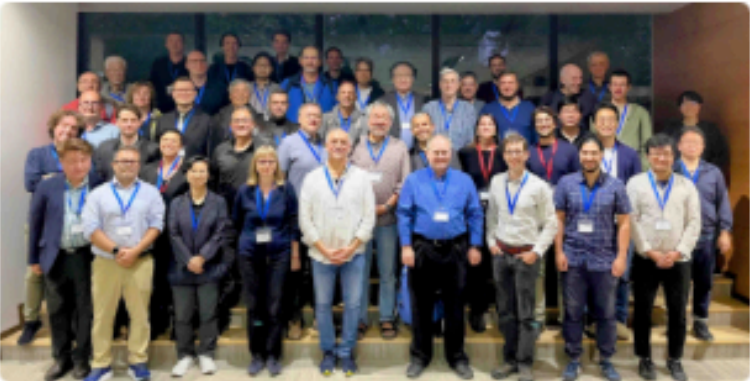Dennis Wright (SLAC)*

Introduction

✦ Major versus Minor releases

✦ What to look for in the release notes

✦ How to upgrade

✦ In case of trouble

Geant4 Releases on geant4.org

Download

Geant4 source code and installers are available for download, with source code under an open source license.

Latest: 11.2.1

Docs

Documentation for Geant4, along with tutorials and guides, are available online.

Read documentation

News

16 Feb 2024
Release 11.2.1

08 Dec 2023
Release 11.2

10 Nov 2023
Release 11.1.3

30 Jun 2023
Release 11.2.beta

19 Jun 2023
Release 11.1.2

» More

News

- **Release 11.2.1** 16 Feb 2024
  Patch release 11.2.1 of Geant4 is now available.
  Source code - Download area
  List of fixes introduced since release...

- **Release 11.2** 08 Dec 2023
  The new public release of Geant4, Geant4 11.2, is available.
  Release notes - Notes
  Source code - Download...

- **Release 11.1.3** 10 Nov 2023
  Patch release 11.1.3 of Geant4 is now available.
  Source code - Download area
  List of fixes introduced since release...

- **Release 11.2.beta** 30 Jun 2023
  Release 11.2-BETA is available from the BETA Download area.

- **Release 11.1.2** 19 Jun 2023
  Patch release 11.1.2 of Geant4 is now available.
  Source code - Download area
  List of fixes introduced since release...

- **2023 Planned Features** 23 Mar 2023
  Items in this list are related to developments scheduled for the cur

Minor/Major releases in December

Major versus Minor Releases

Geant4 release numbers are of the form X.Y

- ✦ **X** is the Major release number
- ✦ **Y** is the Minor release number

> **11.0** was a **Major** release
>
> **11.1, 11.2** are **Minor** release

- ✦ Minor releases **ARE NOT ALLOWED** to break user code.

  - So, for example, moving from release 11.0 to 11.2, you will not need to change your user code
  - You may get slightly different results in the new minor release
  - And you may have access to **additional new features**
  - But nothing in your code should break as a result of the upgrade

- ✦ Major releases **ARE ALLOWED** to break user code.

  - Going from release 10.X to 11.X, you may need to change your user code.
  - The release notes will tell you what you might need to change.

Patch Releases

✦ A Patch adds a 3rd number **Z** to the release number:
X.Y.Z

- For example, **11.2.1,** the version used in this
  tutorial, is a patch release

- Release 11.2.1 16 Feb 2024

  Patch release 11.2.1 of Geant4 is now available.

  Source code - Download area

  List of fixes introduced since release...

✦ A Patch contains **only bug fixes**

- No new features

✦ It is always advisable to download the latest patch

- The patch release notes will tell you exactly what has changed, so you can
  decide whether you absolutely need to upgrade

(!) ***NOTE**: In previous releases the patches were named 'p01', 'p02' etc. This change makes the
archived files, datasets, and source code and installation directories naming consistent with
each other.

Beta Releases

✦ A Beta release introduces new features before they have been deemed sufficiently tested for general users

   - Release number ends in **.beta**

   - For example **11.2.beta**

   - A chance for a thorough user test of many of the changes intended for the December release

✦ Not intended for general users but only for those who are willing to take the risk inherent in a beta

✦ Users should move to this release only if they really love testing things, or if a Geant4 collaborator informs them that this Beta will solve their specific problem

Release Notes

Click on the desired release on geant4.org

Download Geant4-11.2.1

First released 16 Feb 2024   **Old releases**

License

See the license conditions.

RELEASE NOTES

See:
Main Release Notes - Patch-1 -

Source code

Source code is freely available from CERN GitLab or through GitHub.
Source code can also be browsed through the LXR source code browser.

Download zip	Download tar.gz	Download tar.bz2	Download tar

Binary releases

Download tar.gz	MacOS Sonoma, clang-15.0.0
Download tar.gz	Linux Alma9, g++-11.4.1
Download exe	Windows 10, Visual Studio Code-17.7.6
Download zip	Windows 10, Visual Studio Code-17.7.6

Datasets

G4NDL	G4EMLOW	PhotonEvaporation	RadioactiveDecay	G4PARTICLEXS
G4PII	RealSurface	G4SAIDDATA	G4ABLA	G4INCL
G4ENSDFSTATE	G4TENDL			

Geant4 11.2 Release Notes

December 8th, 2023

The code and binary libraries for the supported systems are available through our Source Code Web page.

We are grateful for the efforts of Geant4 users who have provided detailed feedback or comprehensive reports of issues. We thank in particular those who have contributed corrections, improvements or developments included in this release.

Please refer to the Geant4 User Documentation for further information about using Geant4.

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Supported Platforms, Compilers

✦ May change at Major or Minor release

✦ If your platform and compiler are no longer in the supported list, either upgrade them or just try with what you have:

- If Geant4 still builds and starts OK, don't worry

- If there are problems with build or startup, try upgrading to the new supported platform or compiler

1. Supported and Tested Platforms

Platforms:

- Linux, gcc-11.3.1.
  Tested on 64 bit architectures (Intel or AMD) with Alma Linux 9 (based on RedHat Linux Enterprise 9).
- macOS 14.1.1 Sonoma with Apple LLVM/Clang-15.
  Tested on 64 bit architectures (Intel or Apple Silicon).
- Windows-10 with Visual C++ 14.36 (Visual Studio 2022).

More verified and tested configurations (64 bits):

- Linux, gcc-9.4/10.3/11.3/12.1/13.2, clang-14/16/17
- Linux, Intel-icx 2022.2
- macOS 13.6 Ventura with Apple LLVM/clang-15
- macOS 12.7 Monterey with Apple LLVM/clang-14
- Windows/10 with Visual C++ 14.29 (Visual Studio 2019)

CLHEP Version

✦ May change at Major or Minor release

✦ We don't change CLHEP versions very often, but when we do change it is for a good reason

✦ If you use the wrong CLHEP version, your code may still link and run but your results may not be correct.

✦ If you follow default installation procedure, you'll use the internal CLHEP version and so won't have to pay attention to this issue at all.

2. Supported CLHEP, VecGeom and PTL versions

This release of Geant4 has been verified with CLHEP, release **2.4.7.1**. Use of a different CLHEP version may cause incorrect simulation results. NOTE: an internal module of the relevant CLHEP classes is provided and can be used as alternative to an external CLHEP library installation.

Items for Migration of the User Code

✦ For a Minor release, there will not be much here. Example for 11.2.1:

3. Items for migration of the user code

Listed here is some relevant information on developments included in this release. Note that for all users a full re-installation of libraries (or a full re-compilation) and a re-compilation of user applications is required.

General

- Added support for declaring headers of a source code module private. Headers declared private are not installed. Partial refactoring of modules.
- Removed deprecated GNUmake scripts for libraries build.

Geometry, Fields and Transportation

- The inheritance level for G4TouchableHistory has been removed, simplifying touchables handling. G4VTouchable is now a simple typedef of G4TouchableHistory, therefore forward declarations of G4VTouchable in the code will have to be promoted to concrete inclusion of the related header file.
- Unused concrete touchable types G4GRSSolid and G4GRSVolume have been retired and are no longer available.

Electromagnetic and optical physics

- G4NeutrinoPhysics constructor is now added.
- New dataset G4EMLOW-8.5 is required and should be used.

Hadronic physics

- The default value of the time threshold for radioactive decays of ions - above which these decays are ignored - has been changed, from 10^{27} ns (i.e. about twice the age of the universe) to 1 year. For applications where radioactive decays of ions do play an important role, it is recommended to increase the default time threshold of these decays to a very high value, e.g. 1.0e+60 years. This can be done in either one of the following three ways:
    1. Via UI command, e.g. /process/had/rdm/thresholdForVeryLongDecayTime 1.0e+60 year, (command to be used after /run/initialization);
    2. Via C++ interface, e.g. G4HadronicParameters::Instance()->SetTimeThresholdForRadioactiveDecay(1.0e+60*CLHEP::year) (to be placed in the main program before run initialization);
    3. Via the second parameter of the constructor of the class G4RadioactiveDecay (for analogue mode only) or G4Radioactivation (for both analogue or biased mode), e.g. G4RadioactiveDecay("RadioactiveDecay", 1.0e+60*CLHEP::year) or G4Radioactivation("Radioactivation", 1.0e+60*CLHEP::year) (this is for custom physics lists, before run initialization).
  In the examples, the first method is adopted.
- Renamed classes for capture from G4ParticleHPCapture to G4NeutronHPCapture. Removed unused G4NeutronHP*.hh headers for elastic and inelastic.

Items for Migration of the User Code

✦ For a Major release, pay careful attention to the 'general' section (but read all). Example for 11.0:

3. Items for migration of the user code

Listed here is some relevant information on developments included in this release. Note that for all users a full re-installation of libraries (or a full re-compilation) and a re-compilation of user applications is required.

General

- Simplified G4String interfaces and implementation with C++11/17. Removed obsolete/std::string synonym member functions and deprecated non-std::string member functions, replacing with new free functions in G4StrUtil namespace. Might require user code adaptation where G4String functions are explicitly used; for details see Section 10 of this document.
- Major update the G4PhysicsVector and related classes; introduced new public access methods; removed obsolete unused methods; introduced possibility to use different Spline methods.
- Removed deprecated classes G4LPhysicsFreeVector and G4PhysicsLnVector; redirect G4PhysicsOrderedFreeVector to G4PhysicsFreeVector.
- New version of G4PhysicsModelCatalog, the catalog of physics models. Introduced a modelID (a unique integer for each physics model, with close values for similar/related physics models), besides an index (the position in a vector) and the name (string) of the model. The main difference with respect to the previous version is that the three identifiers of each physics model - modelID, index and name - must stay constant and the same for all applications, physics lists and future versions of Geant4.
- C++17 is the minimum ISO C++ Standard required to compile Geant4 and all applications using it.
- Multithreading support is now enabled in the build of Geant4 by default.
- CMake 3.16 is the minimum version required to build Geant4.

Analysis

- Major revision in analysis classes. Migration to G4ThreadLocalSingleton in all specific analysis manager and reader classes. The singleton instances are now deleted by the Geant4 kernel; their explicit deletion in client code has to be removed.
- New G4AnalysisReader.hh header, defining G4AnalysisManager as G4GenericAnalysisManager; G4GenericAnalysisManager can handle all supported file formats, so file names should be provided with an extension (.csv, .hdf5, .root or .xml). To continue using file names without extensions, users can set the default file type using the new function SetDefaultFileType(...). Output specific headers have been removed.
- Also removed g4analysis.hh header with the G4Analysis::MasterInstance() factory method.
- Added new G4VAnalysisReader public function CloseFiles() to be called by user before the end of program and its implementation for all readers.

Geometry, Fields and Transportation

- Removed deprecated accessors in G4Sphere and G4Tubs.
- G4[Partial]PhantomParameterisation: renamed Get/SetNoVoxel*() accessors to Get/SetNoVoxels*() for coherence. Might imply user code migration.

Electromagnetic and optical physics

- G4EmProcessOptions class has been removed. Adaptation of custom user made physics-lists may be required.
- Removed deprecated material properties for G4Scintillation. Now the "enhanced" time constants of version 10.7 are the only way to specify scintillation properties.
- Added protection against typos in material property names. To create a user-defined material property (or material constant property), add the createNewKey=true argument to Add(Const)Property().
- Removed redundant optical UI commands.

Hadronic physics configuration

- Constructors for inelastic processes have changed signature, as well as for elastic and inelastic cross-sections. This affects the internal configuration in physics-lists. See the details in Section 10 of this document, for the required adaptations in *custom* physics-lists.
- Deprecated environmental variables used in NeutronHP, ParticleHP and Radioactive Decay have been removed: they have been replaced by equivalent UI commands (already introduced in previous versions).

Expected effects on physics and computing performance

✦ This section tells you what to expect in terms of changed results, changed running time and changed memory. Example for 11.2.1:

5. Expected effects on physics and computing performance

Electromagnetic physics

- Consistent with measurements obtained in Geant4 11.1 series.

Hadronic physics

- The hadronic showers remain the same as in Geant4 11.1 series.
- Physics results of HP-based physics lists are expected to remain unchanged (i.e. the same as Geant4 11.1 series), regardless several technical code improvements; the only exception is when using QGSP_BERT_HP, for which there might be some changes in the physics results (validation is still on-going).

PTL threading library

- The `PTL::ThreadPool::execute_thread()` member function is compiled unoptimised on Intel-based macOS systems to avoid GPFLT errors (see Bugzilla ticket #2564). No significant performance degradation is observed or expected.

How to Upgrade

✦ Check release notes to see if your existing OS and Compiler are still OK

- Minor release upgrades generally do not require changes to any of these, but check the notes

- Just because your versions are no longer "supported" doesn't mean they won't work. It only means we are not testing them any more. So if your versions are not supported and it is not convenient for you to update, go ahead and try building with your old setup.

- Upgrade your OS or Compiler if you need to

✦ If you've followed the recommended installation instructions, you will have your user code in a work area that is NOT inside your Geant4 installation directory

- **Good:**

  • Geant4 Installation   `~/mydir/geant4.11.2.1`

  • Your code / Examples: `~/mydir/myUserCode`

- **Not so Good:**

  • Geant4 Installation   `~/mydir/geant4.11.2.1`

  • Your code / Examples: `~/mydir/geant4.11.2.1/myUserCode`

✦ The point of keeping your user code separate from the Geant4 installation is that your user code may work with several different Geant4 versions, and if you decide later to delete a particular Geant4 version, you won't accidentally delete your user code

How to Upgrade

✦ If you are getting a patch version, take the full new Geant4

- If you instead just take the minimal patch and try to overlay it on your Geant4, you are more likely to have problems

✦ Unpack the new Geant4 version to a new place.

- For example: `~/mydir/geant4.11.2.1`

✦ You do not need to delete your old Geant4 version unless you really want to. It is perfectly fine to have multiple Geant4 versions, such as:

- `~/mydir/geant4.10.7.4`

- `~/mydir/geant4.11.2.1`

✦ Make sure you do not have any left over G4 environment variables

- printenv | grep "G4"

- Get a new session, clean up your .login or .cshrc, or do whatever is necessary

✦ Make a fresh geant4-build directory and do a fresh cmake and make from there

In Case of Trouble

✦ Did you review the release notes?

✦ Did you remember to remove all pre-existing G4 environment variables?

- Otherwise you may be pointing to some mix of old and new releases

✦ Did you remember to do your new build in a new build area?

- Otherwise you may have part of your code compiled against one Geant4 release and part compiled against another G4 release

✦ Check the Geant4 "Getting Started" **User Forum**

- past issues for Installation and Configuration can be found there

- **very good search function** at the top of that page

- someone might have had the same issue and the solution may already be there

- if it's something new, post it there