

Compiling **GEANT4**

A SIMULATION TOOLKIT

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A lot of material by J. Pipek

Geant4 Course

at the XXI Seminar on software for nuclear, subnuclear and
applied physics

Alghero, June 9th- 14th, 2024



Installation process

1. Check that you **meet** all the **requirements**
2. Download **Geant4 source code**
3. **Configure** the build using **CMake**
4. **Make & install**
5. **Configure your environment** to use Geant4

<https://geant4.web.cern.ch/geant4/UserDocumentation/UsersGuides/InstallationGuide/html/index.html>

1) Supported platforms and requirements

Virtual Machine:
CentOS 7 with gcc 8.3.1

■ Operating system

- “recent” Linux (e.g. CentOS 7), best support
- macOS 10.10+
- Windows 10 (limited support, not recommended)

■ Compilers

- C++11 compliance
- such as GCC 8+, clang 8+, Visual C++ 2019+

■ CMake (configuration generation tool) 3.16+

■ System libraries (as development packages):

- expat, xerces-c

These may or may not be necessary. Just keep this in mind when compilation fails.

Pre-requirement: CMake intallation

The VM has CMake installed

- Geant4 build is configured by **CMake** (version >3.16)
- Depending on the OS installation, **CMake** may not be installed by default. In that case you have to install it:
 - **Linux**: it is recommended to use the CMake provided by the package management system of your distribution.
If version **3.16+** is not available:
 1. [download](http://www.cmake.org/) the latest version (<http://www.cmake.org/>)
 2. [unzip](#) the tar-ball
 3. [./bootstrap](#), [make](#), [make install](#)
 - **macOS**: install it using the Darwin64 [dmg installerpackage](#)
 - **Windows**: install it using the Win64/32 [exe installerpackage](#)

Pre-requirements: optional libraries

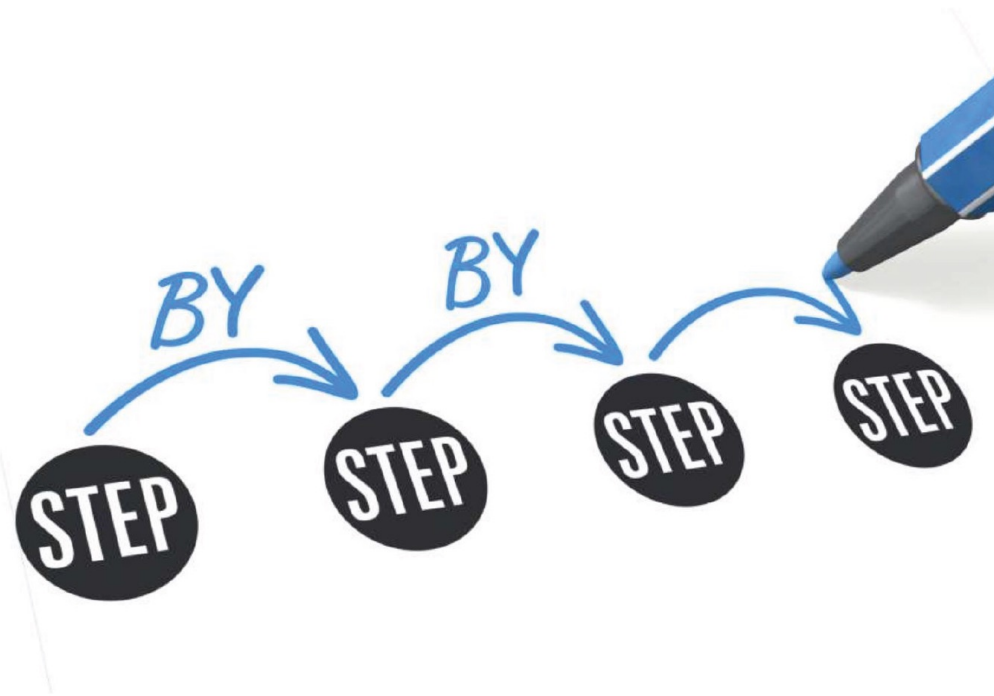


- **X11** for simple graphical user interface and ray-tracing
- **OpenGL** for visualization
- **Qt4** or **Qt5** for graphical user interface
- **ROOT** for data analysis (even inside Geant4)

Less frequently used libraries/tools:

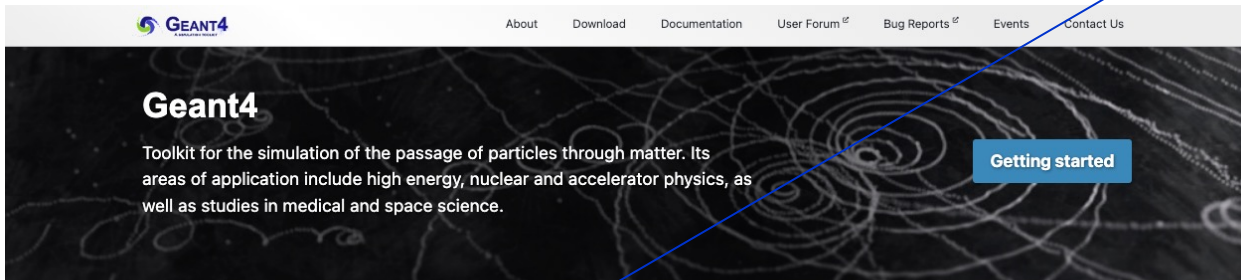
Motif, OpenInventor, DAWN, RayTracer X11, HepRApp, WIRED JAS Plug-in, AIDA, VRML browser, (external) CLHEP, Wt...

Installation steps



2) Download

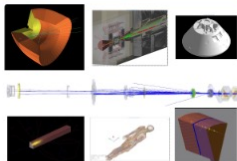
- Go to the Geant4 webpage:
<http://geant4.org>



Get started

Everything you need to get started with Geant4.

I'm ready to start!



About us

Download

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

Latest: [11.2.1](#)



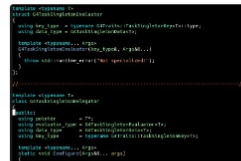
Collaboration

[Geant4 team and documents](#)

Docs

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

[Read documentation](#)



Contribute

News

» More

11 Mar 2024

[2024 Planned Features](#)

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](#)

... download **GEANT4**

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<http://www.geant4.org/geant4/support/download>

[Home](#) > [Download](#) > [Download Geant4-11.2.1](#)

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

EXTRACT THE FILE

```
$ cd Downloads
```

```
$ tar -xzf geant4-v11.0.1.tar.gz
```

Click
here



Download data (optional)

Option 1: download manually (slow connections)



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
G4ENSDSTATE	G4TENDL			

Option 2: use CMake to download data automatically (preferred)

Pre-3) Directories for installation

Source directory: where you **unpack the source**

`/usr/local/geant4/geant4-v11.2.0`

VM

Build directory: where you run **CMake** and build Geant4
(**"working directory"**)

`/usr/local/geant4/geant4-v11.2.0-build`

VM

Installation directory: where you **install** Geant4 to and
which the applications compile against

`/usr/local/geant4/geant4-v11.2.0-install`

VM

Only the **installation dir** is necessary to
compile & run user apps.



3) Configuration with CMake

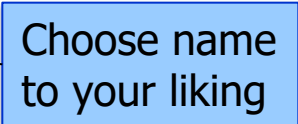
- Extract the package into **source directory**

```
tar xzf geant4-v11.2.0
```

- Create the **build directory**

```
mkdir geant4-build
```

Choose name
to your liking



- **Run CMake** in the **build directory**

```
cd geant4-build
```

```
cmake [options...] ../geant4-v11.2.0
```



CMake configuration options

Install directory



Important options:

- `-DCMAKE_INSTALL_PREFIX=...installation_path...`
- `-DGEANT4_INSTALL_DATA=ON/OFF`
- `-DGEANT4_BUILD_MULTITHREADED=ON/OFF`

Further options:

- `-DGEANT4_USE_OPENGL_X11=ON/OFF`
- `-DGEANT4_USE_QT=ON/OFF`
- `-DCMAKE_BUILD_TYPE=Release/Debug/RelWithDebInfo`
- ...

Running CMake

- CMake configures the build and generates Unix **Makefiles** to perform the actual build:

```
cmake -DGEANT4_INSTALL_DATA=ON -DGEANT4_BUILD_MULTITHREADED=OFF  
-DCMAKE_INSTALL_PREFIX=/usr/local/geant4/geant4.10.05.p01-install  
/usr/local/geant4/geant4.v11.2.0
```

```
-- The C compiler identification is GNU 4.8.5  
-- The CXX compiler identification is GNU 4.8.5  
-- Check for working C compiler: /usr/bin/cc  
-- Check for working C compiler: /usr/bin/cc - works  
-- Detecting C compiler ABI info  
-- Detecting C compiler ABI info - done  
-- Detecting C compile features  
-- Detecting C compile features - done  
...(~50 lines)...  
-- Configuring done  
-- Generating done  
-- Build files have been written to:  
/usr/local/geant4/geant4.10.05.p01-build
```

If you see that, you are successful !!!



If you see **errors** at this point, carefully **check the messages output** by CMake





(Random) installation notes

- Windows: See the installation guide (and good luck!)

<http://geant4-userdoc.web.cern.ch/geant4-userdoc/UsersGuides/InstallationGuide/html/installguide.html#on-windows-platforms>

- Binary packages: Installation without compiling Geant4 is **possible** (but **not recommended**)
- Data packages: If you haven't used CMake to download them, **unpack the downloaded files** in the **share/Geant4-v11.2.0/data/** sub-directory of your installation

4) Compile



- Run **make** (and get a cup of coffee)

```
make -j2
```

Tip: If you have a **multi-core machine**, you can run the compilation in parallel using multiple jobs. Just add the `-jN` parameter, where N is the **number of cores**

```
Scanning dependencies of target G4ENSDFSTATE
Scanning dependencies of target G4NDL
[ 0%] Creating directories for 'G4ENSDFSTATE'
[ 0%] Creating directories for 'G4NDL'
[ 0%] Performing download step (download, verify and extract) for 'G4NDL'
...(4029 lines, ~1 hour of execution)
[100%] Built target G4visXXX
[100%] Building CXX object
source/visualization/gMocren/CMakeFiles/G4GMocren.dir/src/G4GMocrenIO.cc.o
[100%] Building CXX object
source/visualization/gMocren/CMakeFiles/G4GMocren.dir/src/G4GMocrenMesseng
er.cc.o
[100%] Linking CXX shared library
../.././BuildProducts/lib64/libG4GMocren.so
[100%] Built target G4GMocren
```



If you see that, you are successful !!!



... and install

- Run **make install** (this takes much less time)

make install

```
[ 0%] Built target G4ENSDFSTATE
[ 0%] Built target G4NDL
[ 0%] Built target PhotonEvaporation
[ 0%] Built target RadioactiveDecay
[ 0%] Built target G4ABLA
...(42830 lines, ~2 minute of execution)
-- Installing: /usr/local/geant4/geant4.10.05.p01-
install/include/Geant4/G4VModelCommand.hh
-- Installing: /usr/local/geant4/geant4.10.05.p01-
install/include/Geant4/G4VModelFactory.hh
-- Installing: /usr/local/geant4/geant4.10.05.p01-
install/include/Geant4/G4VTrajectoryModel.hh
-- Installing: /usr/local/geant4/geant4.10.05.p01-
install/include/Geant4/G4VisTrajContext.hh
-- Installing: /usr/local/geant4/geant4.10.05.p01-
install/include/Geant4/G4VisTrajContext.icc
```




5) Set-up your environment

- Geant4 needs properly set environment variables:

```
G4ABLADATA="/usr/local/geant4/geant4.10.05.p01-install/share/Geant4-10.5.1/data/G4ABLA3.0"
G4ENSDFSTATEDATA="/usr/local/geant4/geant4.10.05.p01-install/share/Geant4-10.5.1/data/G4ENSDFSTATE2.1"
G4LEDATA="/usr/local/geant4/geant4.10.05.p01-install/share/Geant4-10.5.1/data/G4EMLOW6.50"
G4LEVELGAMMADATA="/usr/local/geant4/geant4.10.05.p01-install/share/Geant4-10.5.1/data/PhotonEvaporation4.3.2"
G4NEUTRONHPDATA="/usr/local/geant4/geant4.10.05.p01-install/share/Geant4-10.5.1/data/G4NDL4.5"
...
G4REALSURFACEDATA="/usr/local/geant4/geant4.10.05.p01-install/share/Geant4-10.5.1/data/RealSurface1.0"
G4SAIDXSDATA="/usr/local/geant4/geant4.10.05.p01-install/share/Geant4-10.5.1/data/G4SAIDDATA1.1"
LD_LIBRARY_PATH="...:/usr/local/geant4/geant4.10.05.p01-install/lib64"
PATH="...:/usr/local/geant4/geant4.10.05.p01-install/bin"
```

- To set them up properly in your shell, **run the script** in Geant4 installation directory:

```
source /usr/local/geant4/geant4.v11.2.0-install/bin/geant4.(c)sh
```

- You can put this line your **~/ .bashrc file** (or similar for other shells)



Your **GEANT4** is ready now

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