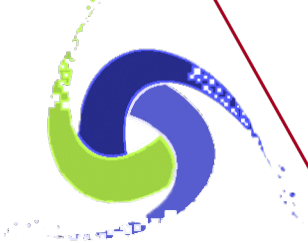


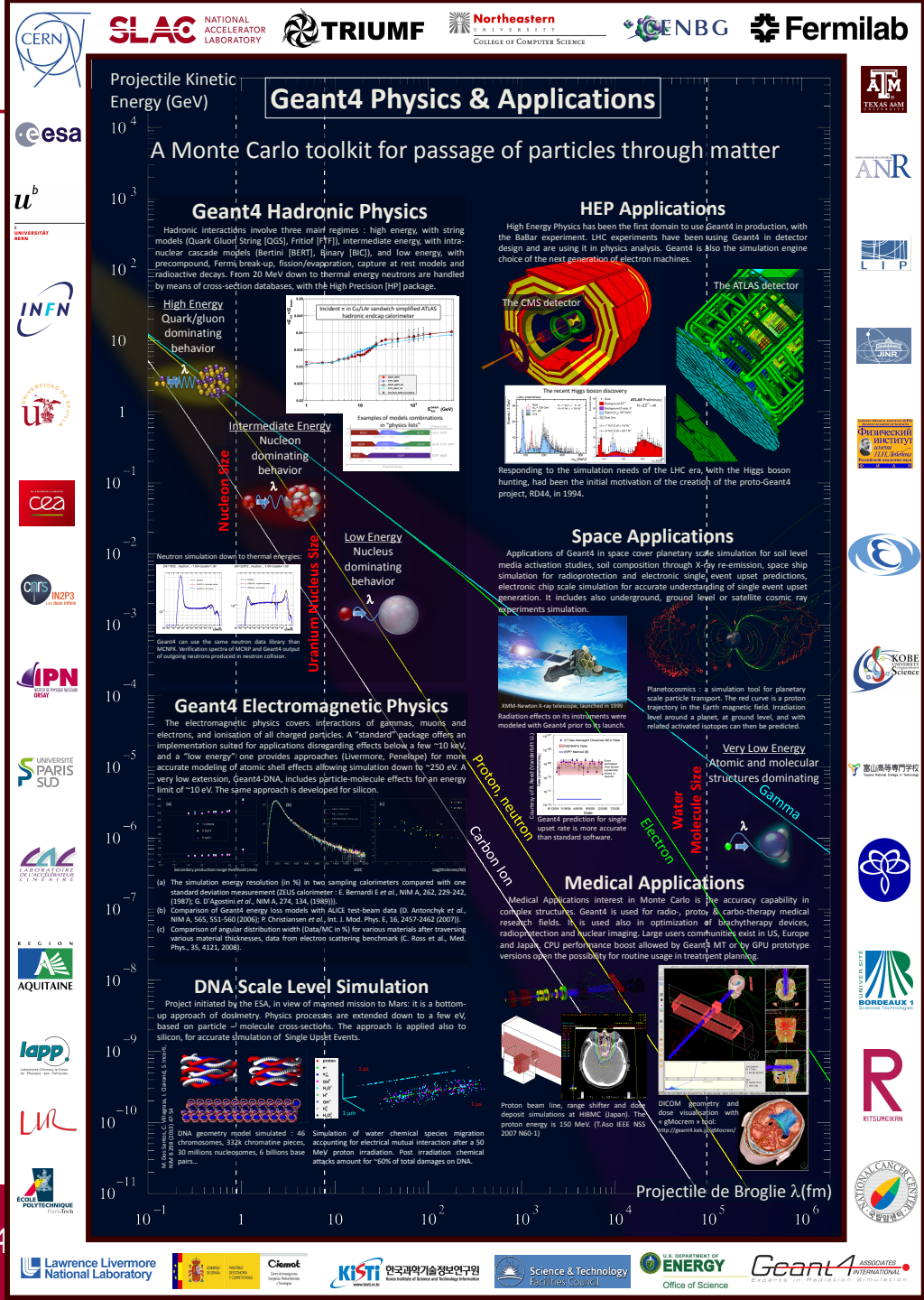
GEANT4
A SIMULATION TOOLKIT
Version 10.7.p02

Geant4
Documents and Examples

Makoto Asai
SLAC National Accelerator Laboratory

Contents

- User documents
- Examples
  - basic
  - extended
  - advanced
- User support
  - LXR source code browser
  - User forum



Your first step – http://www.geant4.org/

Download | User Forum
Contact Us | Bug Reports

Geant4

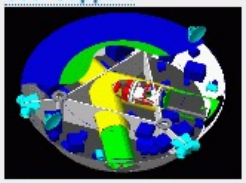
Overview

Geant4 is a toolkit for the simulation of the passage of particles through matter. Its areas of application include high energy, nuclear and accelerator physics, as well as studies in medical and space science. The three main reference papers for Geant4 are published in Nuclear Instruments and Methods in Physics Research A 506 (2003) 250-303, IEEE Transactions on Nuclear Science 53 No. 1 (2006) 270-278 and Nuclear Instruments and Methods in Physics Research A 835 (2016) 186-225.

Applications

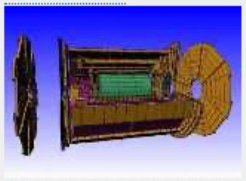
A sampling of applications, technology transfer and other uses of Geant4

User Support



Getting started, guides and information for users and developers

Publications



Validation of Geant4, results from experiments and publications

Collaboration

Who we are: collaborating institutions, members, organization and legal information

News

2021-03-10
2021 planned developments.

2021-02-05
Patch-01 to **release 10.7** is available from the Download area.

2020-11-06
Patch-03 to release **10.6** is available from the Download archive area.

Events

[Virtual] Geant4 Beginners Course @ CERN, CERN (Geneva), **25-31 May 2021**.

[Virtual] 26th Geant4 Collaboration Meeting, **20-24 September 2021**.

Past events

User Support

1. Getting started
2. Training courses and materials
3. Source code
   a. Download page
   b. LXR code browser
   c. doxygen documentation
   d. GitHub
   e. GitLab @ CERN
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   b. Installation Guide: [pdf] [epub] [kindle]
   c. Application Developers Guide [pdf] [epub] [kindle]
   d. Toolkit Developers Guide [pdf] [epub] [kindle]
   e. Physics Reference Manual [pdf] [epub] [kindle]
   f. Physics List Guide [pdf] [epub] [kindle]
9. Examples
10. User Aids
    a. Tips for improving CPU performance
11. Contact Coordinators & Contact Persons

Related Links

- Object Oriented Analysis & Design
- Archive of previous releases
- Mailing list subscription
- User requirements document (pdf)
- Technical Forum

User's guides

- Introduction to Geant4
  - Some blah-blah if you dare to read…
- Installation guide
  - Instruction of installing Geant4 and related libraries
  - To be covered in the next talk
- Application Developers Guide
  - Introduces new users to Geant4 toolkit
  - Describes how to set up and run a simulation application
  - Intended as an overview of the toolkit, not an exhaustive treatment
- Toolkit Developers Guide
  - Guide for users who want to extend the functionality of Geant4
    - E.g. adding new solids, adding new physics models, etc.
- Physics Reference Manual
  - Serves as a reference for the theoretical formulation, model or parameterization of the physics interactions included in Geant4
- Physics List Guide
  - Describes "pre-packaged" physics lists in the distribution

Examples

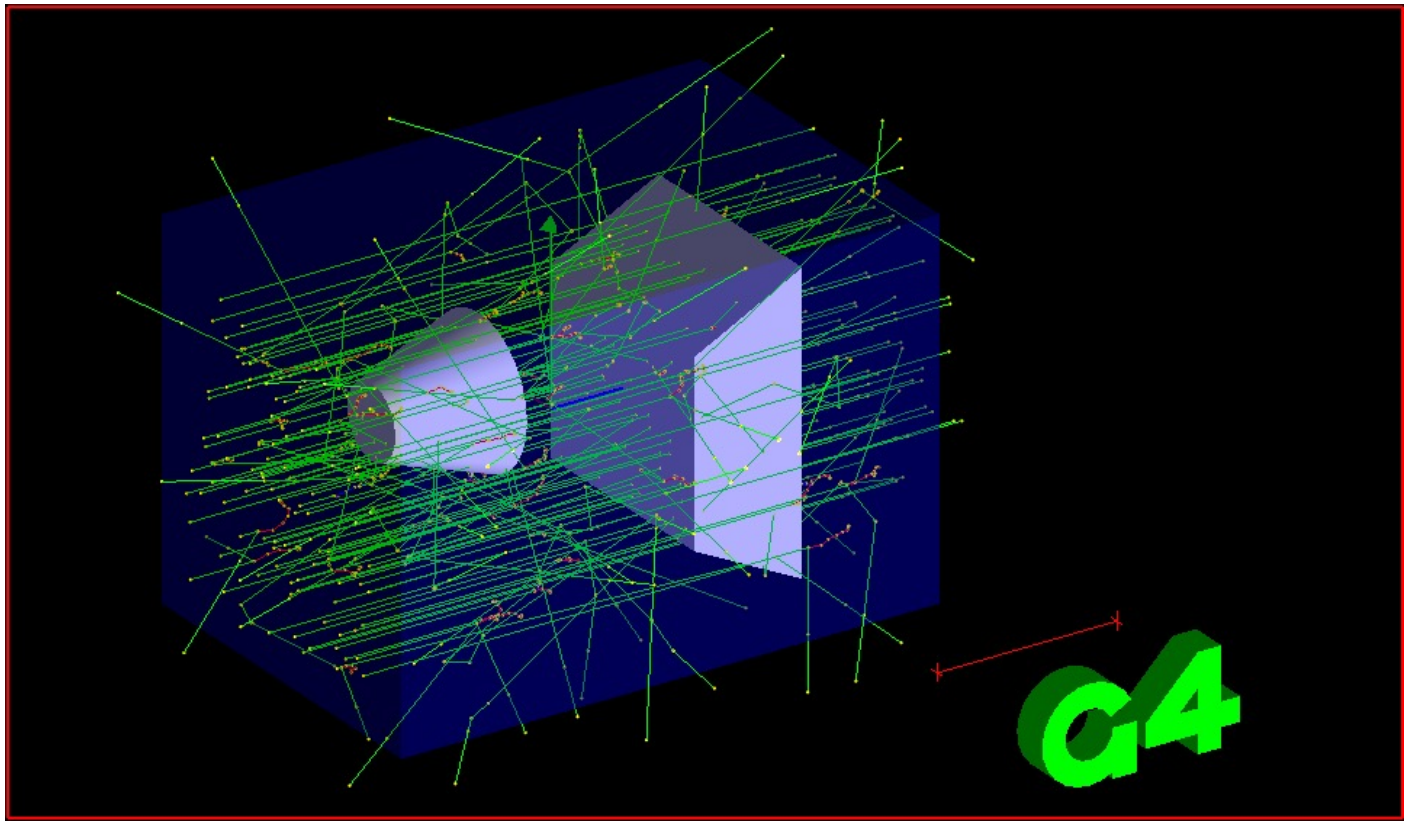
- Extensive set of examples distributed with the toolkit

- Varying complexity:
  - Basic: complete applications demonstrating simple features of toolkit – good for tutorials
  - Extended: demonstrating specific features of Geant4 and more complex use cases – some require external (non-Geant4 libraries)
  - Advanced: complex, “real life” applications with complex geometries and physics focused on specific user communities

- Documentation provided in README files in each example, and web pages

Basic examples

- B1
  - A few simple solids and simple placements
  - Total dose scoring in user-selected volume
  - User action classes



Basic examples

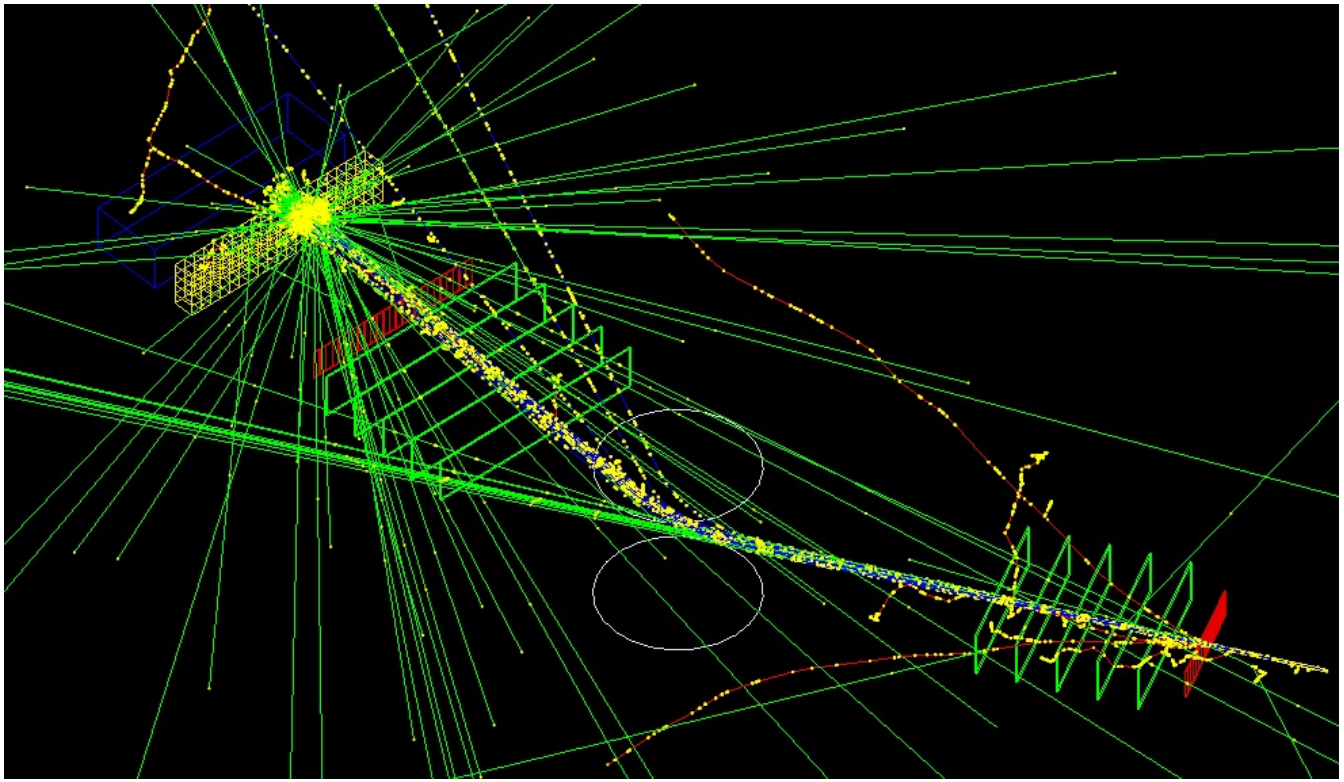
- B2
  - Magnetic field, parameterized placements
  - Scoring in tracker using sensitive detector and hits
  - Geant4 physics list (FTFP_BERT) with step limiter

- B3 (schematic PET system)
  - Simple placements with rotations
  - Scoring within crystals using Geant4 scorers
  - radioactive source, modular physics list using builders

- B4
  - geometry with replicas
  - multiple scoring methods
  - histograms (1D) and n-tuples saved in output file

Basic examples

- B5 (double-arm spectrometer)
  - More complex geometry with rotation, replicas, parameterization
  - Scoring in multiple volumes with sensitive detector and hits
  - Defining local UI commands
  - Histograms (1D, 2D) and n-tuples saved in output file



Extended examples

- demonstrating specific features of Geant4 and more complex use cases
  - some require external (non-Geant4 libraries)

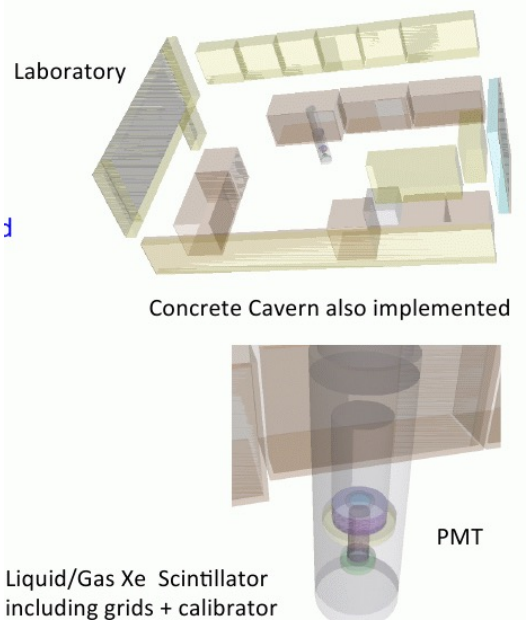
- analysis/
- biasing/
- common/
- electromagnetic/
- errorpropagation/
- eventgenerator/
- exoticphysics/
- field/
- g3tog4/
- geometry/
- hadronic/
- medical/
- optical/
- parallel/
- parameterisations/
- persisitency/
- polarisation/
- radioactivedecay/
- runAndEvent/
- visualization/

Some extended example sub-categories

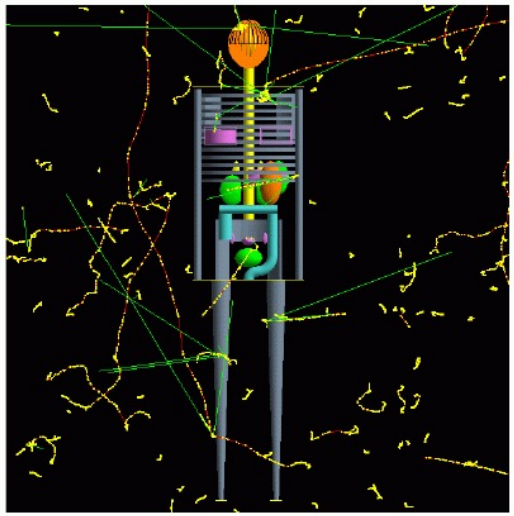
- Analysis – histogramming using G4tools
- Biasing – event biasing and reverse Monte Carlo
- Electromagnetic – many EM physics simulations with histogramming (some also used as part of Geant4 testing)
- Geometry – Variety of solid shapes, geometry descriptions
- Hadronic – same as EM but with hadronic models
- Medical – tools for medical applications
- Optical – optical photon generation and transport
- Parallel – examples of parallel computing
- Persistency – GDML parser
- Run and event – run and event control, sensitive detector, command-based scorer
- Visualization – specific visualization features and graphics customizations

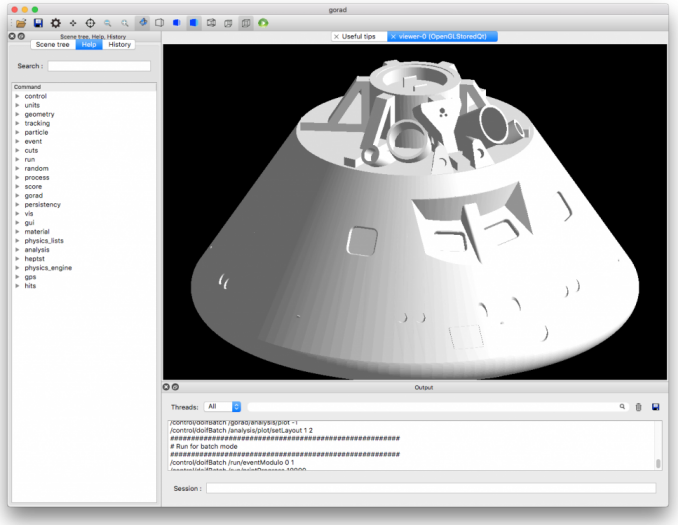
Advanced examples

- Complex, “real life” applications with complex geometries and physics focused on specific user communities
- 27 examples
  - https://geant4.web.cern.ch/collaboration/working_groups/advanced_examples



MIRD Female Phantom with particle tracks





Underground physics

Human phantom

Gorad

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Download page

Geant4 10.7

first released 4 December 2020 (patch-01, released 5 February 2021)

The Geant4 source code is freely available. See the licence conditions.

Please read the **Release Notes** before downloading or using this release. The patch below contains bug fixes to release 10.7, we suggest you to download and apply the latest patch for release 10.7 (see the additional notes for patch-01 , or download the complete source with the patch applied; in any case, it is required to apply a full rebuild of the libraries.

Source files

Please choose the archive best suited to your system and archiving tool:

Download	GNU or Linux tar format, compressed using gzip (34.5Mb, 36217226 bytes) *After downloading, unpack using GNU tar.*
Download	ZIP format (48.9Mb, 51279540 bytes) *After downloading, unpack using e.g. WinZip.*

Please choose the archive best suited to your system and archiving tool:

Data files (*)

For specific, optional physics processes some of the following files are required. The file format is compatible with Unix, GNU, and Windows utilities.

Download	G4NDL4.6, Neutron data files (with thermal cross-sections) - version 4.6 (572.1Mb, 599862135 bytes)
Download	G4EMLOW7.13, data files for low energy electromagnetic processes - version 7.13 (284.8Mb, 298636910 bytes)
Download	G4PhotonEvaporation5.7, data files for photon evaporation - version 5.7 (9.6Mb, 10089240 bytes)
Download	G4RadioactiveDecay5.6, data files for radioactive decay hadronic processes - version 5.6 (1.0Mb, 1059792 bytes)
Download	G4SAIDDATA2.0, data files from evaluated cross-sections in SAID data-base - version 2.0 (37.6kb, 38502 bytes)
Download	G4PARTICLEXS3.1.1, data files for evaluated particle cross-sections on natural composition of elements - version 3.1.1 (8.2Mb, 8613102

Related Links

- **Previous Releases** of Geant4 (since release 9.6).
- LXR source code browser .
- GitHub
- GitLab @ CERN.

LXR code browser

Geant4 LXR

Geant4 Cross Reference

Search Menu:

geant4/ Browse the source code tree.

File Name Search Find
Search for files by name (case sensitive).

Full-Text Search Find
Search through all the text.

Identifier Search Find
Find a class, method, variable, etc.

Hi,

This is an interactive viewing and searching facility for the Geant4 source code.

It offers:

Source-tree browsing and file name search to easily find source files and navigate through the source directorieis.

Full-text indexing for fast retrieval of source files containing a given word or pattern.

Identifier cross-reference for fully hyperlinked source code. The names of classes, methods, and data can be clicked on to find the source files where they are defined and used.

The full-text indexing and retrieval are implemented using Glimpse, so all the capabilities of Glimpse are available. Please see Glimpse document for details. Note that glimpse syntax is avaiable for text and identifier searches. For file name search, please use regular expression.

Note

All source files are rendered into HTML. Do not attempt to download the Geant4 source code from this site!

Links

Yet another version of Geant4 LXR (editor's cut)
Geant4 Reference Guide (Doxygen)

LXR powered.
For feedback, please contact KM.

Geant4 Cross Reference

Cross-Referencing Geant4
Geant4/run/src/

Version: [ReleaseNotes] [1.0] [1.1] [2.0] [3.0] [3.1] [3.2] [4.0] [4.0.p1] [4.0.p2] [4.1] [4.1.p1] [5.0] [5.0.p1] [5.1] [5.1.p1] [5.2] [5.2.p1] [5.2.p2] [6.0] [6.0.p1] [6.1] [6.2] [6.2.p1] [6.2.p2] [7.0] [7.0.p1] [7.1] [7.1.p1] [8.0] [8.0.p1] [8.1] [8.1.p1] [8.1.p2] [8.2] [8.2.p1] [8.3] [8.3.p1] [8.3.p2] [9.0] [9.0.p1] [9.0.p2] [9.1] [9.1.p1] [9.1.p2] [9.1.p3] [9.2] [9.2.p1] [9.2.p2] [9.2.p3] [9.2.p4] [9.3] [9.3.p1] [9.3.p2] [9.4] [9.4.p1] [9.4.p2] [9.4.p3] [9.4.p4] [9.5] [9.5.p1] [9.5.p2] [9.6] [9.6.p1] [9.6.p2] [9.6.p3] [9.6.p4] [10.0] [10.0.p1] [10.0.p2] [10.0.p3] [10.0.p4] [10.1] [10.1.p1] [10.1.p2] [10.1.p3] [10.2] [10.2.p1] [10.2.p2] [10.2.p3] [10.3] [10.3.p1] [10.3.p2] [10.3.p3] [10.4] [10.4.p1] [10.4.p2] [10.4.p3] [10.5] [10.5.p1] [10.6] [10.6.p1] [10.6.p2] [10.6.p3] [10.7] [***10.7.p1***]

- [***source navigation***] - [identifier search] - [freetext search] - [file search] -

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G4AdjointSimManager.cc	29078 bytes	2021-02-05 11:17:16	
G4AdjointSimMessenger.cc	16629 bytes	2021-02-05 11:17:16	
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G4MSSteppingAction.cc	2651 bytes	2021-02-05 11:17:16	
G4MTRunManager.cc	23161 bytes	2021-02-05 11:17:16	
G4MTRunManagerKernel.cc	9557 bytes	2021-02-05 11:17:16	
G4MatScanMessenger.cc	10488 bytes	2021-02-05 11:17:16	
G4MaterialScanner.cc	8132 bytes	2021-02-05 11:17:16	
G4MultiRunAction.cc	2992 bytes	2021-02-05 11:17:16	
G4PhysicsListHelper.cc	35052 bytes	2021-02-05 11:17:16	
G4PhysicsListOrderingParamater.cc	2383 bytes	2021-02-05 11:17:16	
G4PhysicsListWorkspace.cc	4245 bytes	2021-02-05 11:17:16	
G4RNGHelper.cc	2874 bytes	2021-02-05 11:17:16	
G4Run.cc	2791 bytes	2021-02-05 11:17:16	
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G4RunManagerKernel.cc	38296 bytes	2021-02-05 11:17:16	
G4RunMessenger.cc	29254 bytes	2021-02-05 11:17:16	
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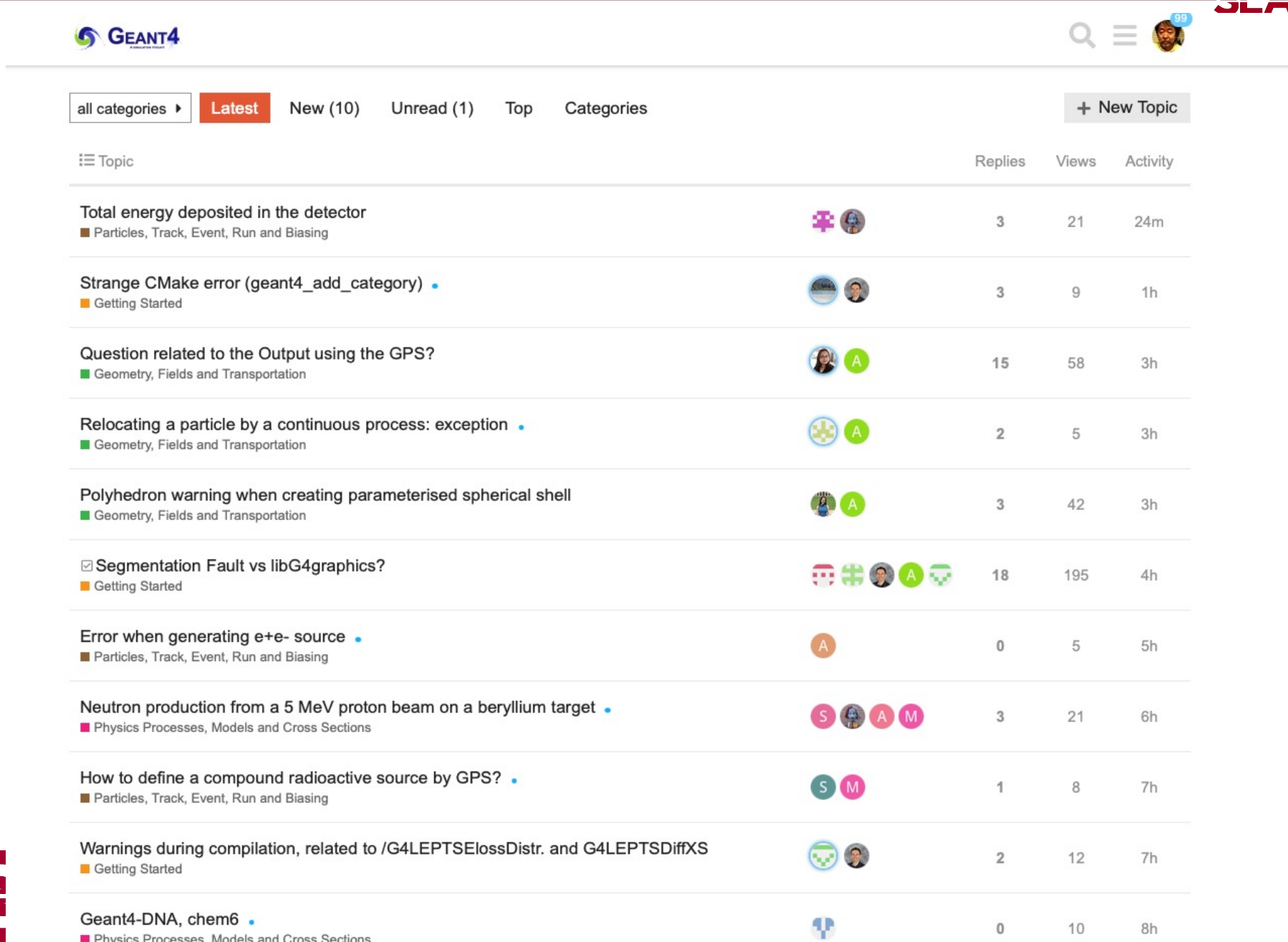
G4UserWorkerInitialization.cc	2140 bytes	2021-02-05 11:17:16	
G4UserWorkerThreadInitialization.cc	5307 bytes	2021-02-05 11:17:16	
G4VModularPhysicsList.cc	13675 bytes	2021-02-05 11:17:16	
G4VPersistencyManager.cc	2056 bytes	2021-02-05 11:17:16	
G4VPhysicsConstructor.cc	4768 bytes	2021-02-05 11:17:16	
G4VUserActionInitialization.cc	2947 bytes	2021-02-05 11:17:16	

```
 1 //
 2 // ********************************************************************
 3 // * License and Disclaimer                                           *
 4 // *                                                                  *
 5 // * The  Geant4 software  is  copyright of the Copyright Holders  of *
 6 // * the Geant4 Collaboration.  It is provided  under  the terms  and *
 7 // * conditions of the Geant4 Software License,  included in the file *
 8 // * LICENSE and available at  http://cern.ch/geant4/license .  These *
 9 // * include a list of copyright holders.                             *
10 // *                                                                  *
11 // * Neither the authors of this software system, nor their employing *
12 // * institutes,nor the agencies providing financial support for this *
13 // * work  make  any representation or  warranty, express or implied, *
14 // * regarding  this  software system or assume any liability for its *
15 // * use.  Please see the license in the file  LICENSE  and URL above *
16 // * for the full disclaimer and the limitation of liability.         *
17 // *                                                                  *
18 // * This  code  implementation is the result of  the  scientific and *
19 // * technical work of the GEANT4 collaboration.                      *
20 // * By using,  copying,  modifying or  distributing the software (or *
21 // * any work based  on the software)  you  agree  to acknowledge its *
22 // * use  in  resulting  scientific  publications,  and indicate your *
23 // * acceptance of all terms of the Geant4 Software license.          *
24 // ********************************************************************
25 //
26 //
27 //
28 //
29
30 // On Sun, to prevent conflict with ObjectSpace, G4Timer.hh has to be
31 // loaded *before* globals.hh...
32 #include "G4Timer.hh"
33
34 #include "G4MTRunManagerKernel.hh"
35 #include "G4RunManager.hh"
36 #include "G4RunManagerKernel.hh"
37 #include "G4WorkerRunManagerKernel.hh"
38
39 #include "G4ApplicationState.hh"
40 #include "G4Material.hh"
41 #include "G4ParallelWorldProcessStore.hh"
42 #include "G4ParticleTable.hh"
43 #include "G4ProcessTable.hh"
```

```
325
326 void G4RunManager::BeamOn(G4int n_event, const char* macroFile, G4int n_select)
327 {
328   if(n_event <= 0)
329   {
330     fakeRun = true;
331   }
332   else
333   {
334     fakeRun = false;
335   }
336   G4bool cond = ConfirmBeamOnCondition();
337   if(cond)
338   {
339     numberOfEventToBeProcessed = n_event;
340     numberOfEventProcessed     = 0;
341     ConstructScoringWorlds();
342     RunInitialization();
343     DoEventLoop(n_event, macroFile, n_select);
344     RunTermination();
345   }
346   fakeRun = false;
347 }
348
349 G4bool G4RunManager::ConfirmBeamOnCondition()
350 {
351   G4StateManager* stateManager = G4StateManager::GetStateManager();
352
353   G4ApplicationState currentState = stateManager->GetCurrentState();
354   if(currentState != G4State_PreInit && currentState != G4State_Idle)
355   {
356     G4cerr << "Illegal application state - BeamOn() ignored." << G4endl;
357     return false;
358   }
359
360   if(!initializedAtLeastOnce)
361   {
362     G4cerr << " Geant4 kernel should be initialized" << G4endl;
363     G4cerr << "before the first BeamOn(). - BeamOn ignored." << G4endl;
364     return false;
365   }
366
367   if(!geometryInitialized || !physicsInitialized)
368   {
369     if(verboseLevel > 0)
370     {
371       G4cout << "Start re-initialization because " << G4endl;
372       if(!geometryInitialized)
373         G4cout << "  Geometry" << G4endl;
374       if(!physicsInitialized)
375         G4cout << "  Physics processes" << G4endl;
376       G4cout << "has been modified since last Run." << G4endl;
377     }
378     Initialize();
379   }
380   return true;
381 }
382
383 void G4RunManager::RunInitialization()
384 {
385   if(!(kernel->RunInitialization(fakeRun)))
386     return;
387
388   runAborted             = false;
```

User Forum – Q/A by users and developers



GEANT4

all categories | Latest | New (10) | Unread (1) | Top | Categories | + New Topic

Topic	Replies	Views	Activity
Total energy deposited in the detector Particles, Track, Event, Run and Biasing	3	21	24m
Strange CMake error (geant4_add_category) Getting Started	3	9	1h
Question related to the Output using the GPS? Geometry, Fields and Transportation	15	58	3h
Relocating a particle by a continuous process: exception Geometry, Fields and Transportation	2	5	3h
Polyhedron warning when creating parameterised spherical shell Geometry, Fields and Transportation	3	42	3h
Segmentation Fault vs libG4graphics? Getting Started	18	195	4h
Error when generating e+e- source Particles, Track, Event, Run and Biasing	0	5	5h
Neutron production from a 5 MeV proton beam on a beryllium target Physics Processes, Models and Cross Sections	3	21	6h
How to define a compound radioactive source by GPS? Particles, Track, Event, Run and Biasing	1	8	7h
Warnings during compilation, related to /G4LEPTSElossDistr. and G4LEPTSDiffXS Getting Started	2	12	7h
Geant4-DNA, chem6 Physics Processes, Models and Cross Sections	0	10	8h

Neutron production from a 5 MeV proton beam on a beryllium target

Physics Processes, Models and Cross Sections

This is the first time shihkailin has posted — let's welcome them to our community!

Jun 8

1 / 4
Jun 8

shihkailin 1d

Hi,

I am trying to generate neutrons from bombarding a 5 MeV proton beam on a beryllium target.
I have tried many different physics lists such as FTFP_BERT, QGSP_BERT, and QBBC, etc.

None of the lists gives me good enough neutron kinematics compared with measurements. In particular, with a 1 mA proton beam on beryllium, I am expecting 3e12 neutrons.
However, I only get 1/4 neutron flux with the QBBC physics list, which is already the list with the most generated neutrons.

Would experts here recommend a physics list, or an example for me to generate neutrons that best match measurements?

Thanks,
Shih-Kai.

1 Reply

created	last reply	3	21	4
S 1d	M 6h	replies	views	users

Selviever 1

Hello!

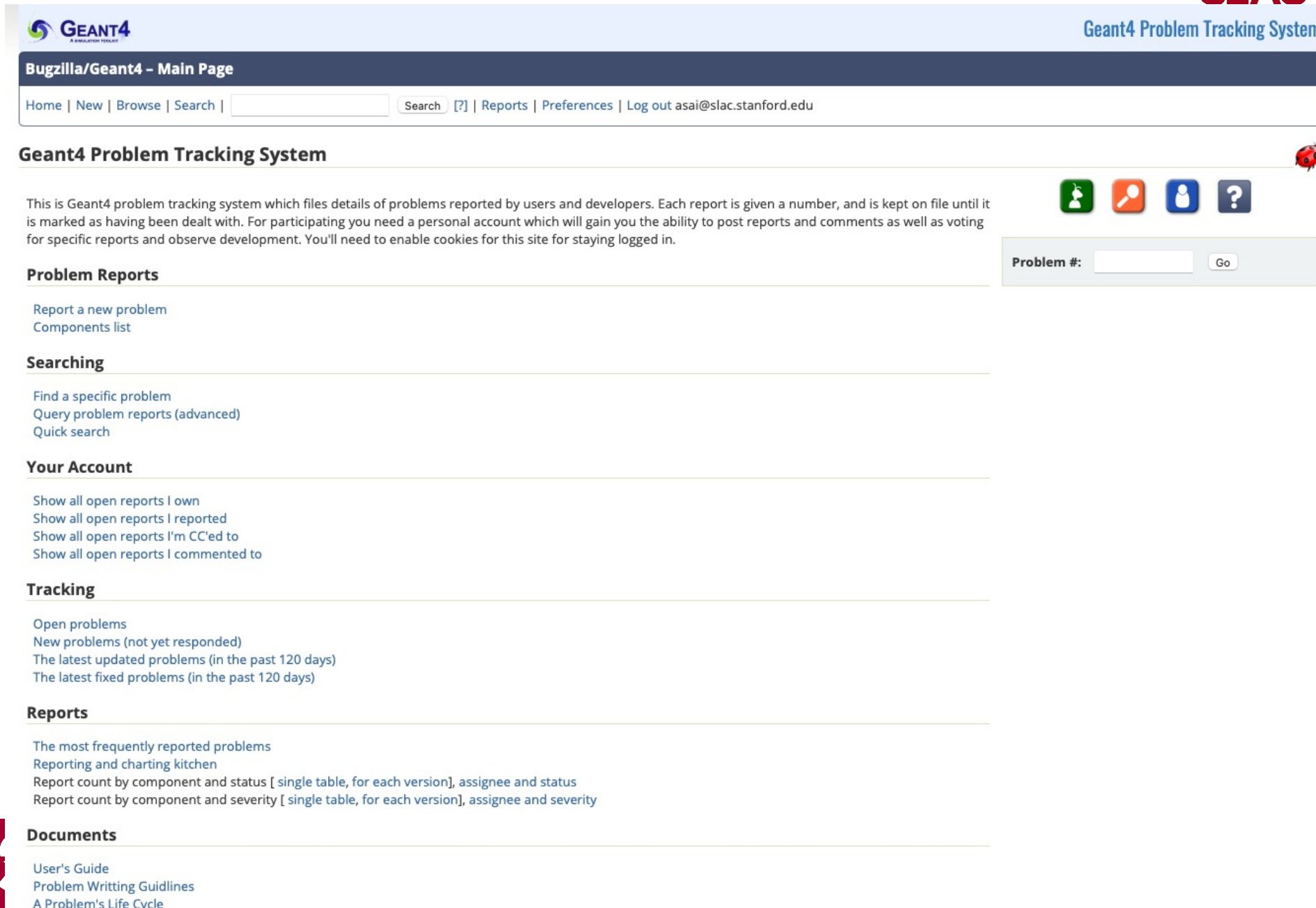
May be you will find this review of physics lists helpful:
https://geant4.web.cern.ch/node/155
Pay special attention to lists with the "_HP" at the end, which indicates using a high precision neutron package.
Note: physics lists with _HP consume a lot more CP-time. For example, in my special case one event with QGSP_BERT generated approximately ten times faster then with QGSP_BERT_HP

Reply

Note :

- Best effort basis
- Please search if someone else had already asked a similar question before you post yours.

Bugzilla – bug report and tracker



Bugzilla/Geant4 – Problem List

Wed Jun 9 2021 21:26:39 CEST

Hide Search Description

Status: UNCONFIRMED, NEW, ASSIGNED

55 problems found.

ID	Product	Comp ▲	Assignee	Status	Resolution	Summary	Changed ▼
2379	Examples	electrom	Vladimir.Ivantchenko@cern.ch	ASSI	---	World volume size messenger behaves differently depending upon when the absorber size is changed	10:54:25
2368	Geant4	run	asai@slac.stanford.edu	ASSI	---	Issue with Reproducibility	Tue 09:58
2373	Geant4	persiste	Witold.Pokorski@cern.ch	NEW	---	the gdml file that's dumped by the G4GDMLParser is not a valid	2021-06-02
2372	Geant4	processe	Vladimir.Ivantchenko@cern.ch	NEW	---	Scintillation process is applied only on charged particles.	2021-05-27
2367	Geant4	processe	dennis.herbert.wright@cern.ch	ASSI	---	Beta-ray energy spectrum shows stepping shape.	2021-05-23
2369	Geant4	geometry	Pedro.Arce@cern.ch	NEW	---	#2 G4PhantomParameterisation still leads to many killed particles, which produces erroneous results.	2021-05-17
2329	Geant4	processe	Vladimir.Ivantchenko@cern.ch	ASSI	---	Inconsistency between electron energy loss formula in PhysicsReferenceManual and G4 code	2021-05-12
2354	Geant4	processe	Vladimir.Ivantchenko@cern.ch	NEW	---	segmentation fault caused when processes are disabled via the user interface.	2021-05-11
2338	Examples	undergro	alexander.howard@cern.ch	ASSI	---	executable crashes when running included macros; corrupt Root files	2021-05-10
2280	Geant4	geometry	John.Apostolakis@cern.ch	ASSI	---	Inconsistent definition of magnetic field for backward error propagation	2021-05-10
2360	Geant4	processe	Alberto.Ribon@cern.ch	ASSI	---	Strange proton energy distributions after a target in geant4 >= 10.5	2021-05-10
2365	Geant4	processe	dennis.herbert.wright@cern.ch	ASSI	---	Improve the branch ratio consistency in RDM: use the enum instead of number	2021-05-10
2300	Geant4	processe	dennis.herbert.wright@cern.ch	ASSI	---	Incorrect output energy using LEND	2021-05-08
2366	Geant4	processe	Vladimir.Ivantchenko@cern.ch	ASSI	---	No transmission asymmetries when using multi-threading mode	2021-05-08
2314	Geant4	geometry	Pedro.Arce@cern.ch	ASSI	---	G4RegularNavigation is broken	2021-04-20
2352	Geant4	processe	emilio.mendoza@ciemat.es	ASSI	---	Gamma Spectrum for Neutron Capture on Gd	2021-04-16
2353	Geant4	physics_	Vladimir.Ivantchenko@cern.ch	ASSI	---	Aborted Events with some EM Options	2021-04-13
2355	Geant4	processe	Vladimir.Ivantchenko@cern.ch	ASSI	---	Abnormal final state in ion-ion collision	2021-04-04
2279	Geant4	processe	Vladimir.Ivantchenko@cern.ch	ASSI	---	problem with dexcitationIgnoreCut	2021-03-31
2331	Geant4	cmake	Ben.Morgan@warwick.ac.uk	ASSI	---	Add optional soversion	2021-03-30
2351	Document	Installa	alexander.howard@cern.ch	NEW	---	Removed from Homebrew	2021-03-30
2346	Geant4	material	Vladimir.Ivantchenko@cern.ch	ASSI	---	Mess in density effect data for hydrogen and helium	2021-03-23
2333	Geant4	processe	dennis.herbert.wright@cern.ch	ASSI	---	Inelastic excitation energy is set to 0 when inelastic collision energy is below 20 keV	2021-03-11
2328	Geant4	processe	dennis.herbert.wright@cern.ch	ASSI	---	Energy conservation law is not obeyed	2021-03-01
2335	Geant4	analysis	ivana@ipno.in2p3.fr	ASSI	---	AnalysisManager fails to find ntuples	2021-02-26
2339	Geant4	material	Vladimir.Ivantchenko@cern.ch	ASSI	---	Different material parameters in G4NistMaterialBuilder and G4DensityEffectData	2021-02-25
2334	Geant4	material	Vladimir.Ivantchenko@cern.ch	ASSI	---	Code is inconsistent with Physics Reference Manual and original source (density correction)	2021-02-22
2332	Geant4	processe	dennis.herbert.wright@cern.ch	ASSI	---	incorrect data in G4NDL	2021-02-17

To sum up

- Installation, Application, Toolkit and Physics Guides take you from making your first Geant4 installation to developing your own application to developing advanced Geant4 features

- Three levels of examples: ranging from very easy to complex
  - basic – getting started
  - extended – exploring specific features of Geant4
  - advanced – real world applications

- User support includes:
  - cross reference code browser
  - user forum is available for sharing ideas, asking questions
  - bug report and tracking