

User/Development Support Systems and Tools

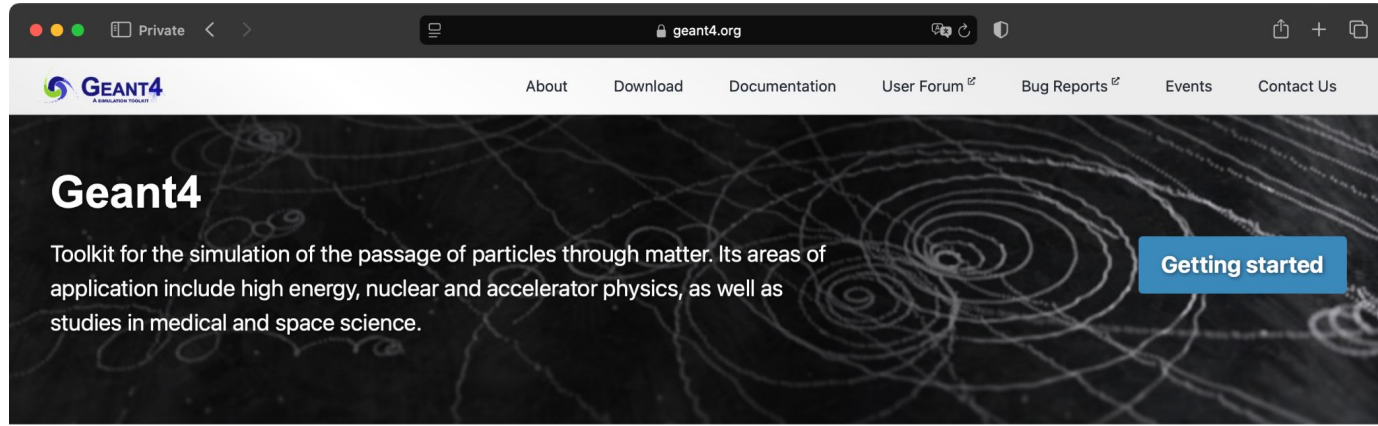
Geant4 Collaboration Workshop

Ben Morgan (The University of Warwick)



- Running stably, both at CERN and KEK mirror, minor updates since Sapporo

- *Releases, workplans, members*



Get started

Everything you need to get started with Geant4.

[I'm ready to start!](#)

Download

Geant4 source code and installers are available for download, with source code under an [open source license](#).

Latest: 11.2.2

Docs

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

[Read documentation](#)

News

[» More](#)

10 Sep 2024
[Announcement of the 62nd Geant4 Technical Forum \(Updated\)](#)

28 Jun 2024
[Release 11.3.beta](#)

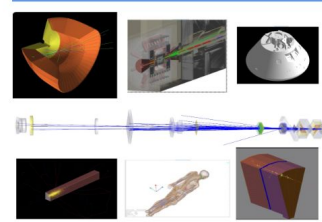
21 Jun 2024
[Release 11.2.2](#)

11 Mar 2024

[2024 Planned Features](#)

16 Feb 2024

[Release 11.2.1](#)



Collaboration

```
template <typename T>
class G4TaskingSingletonEvaluator
{
public:
    using key_type = typename G4TaskingSingletonKey::type;
    using data_type = G4TaskingSingletonData;

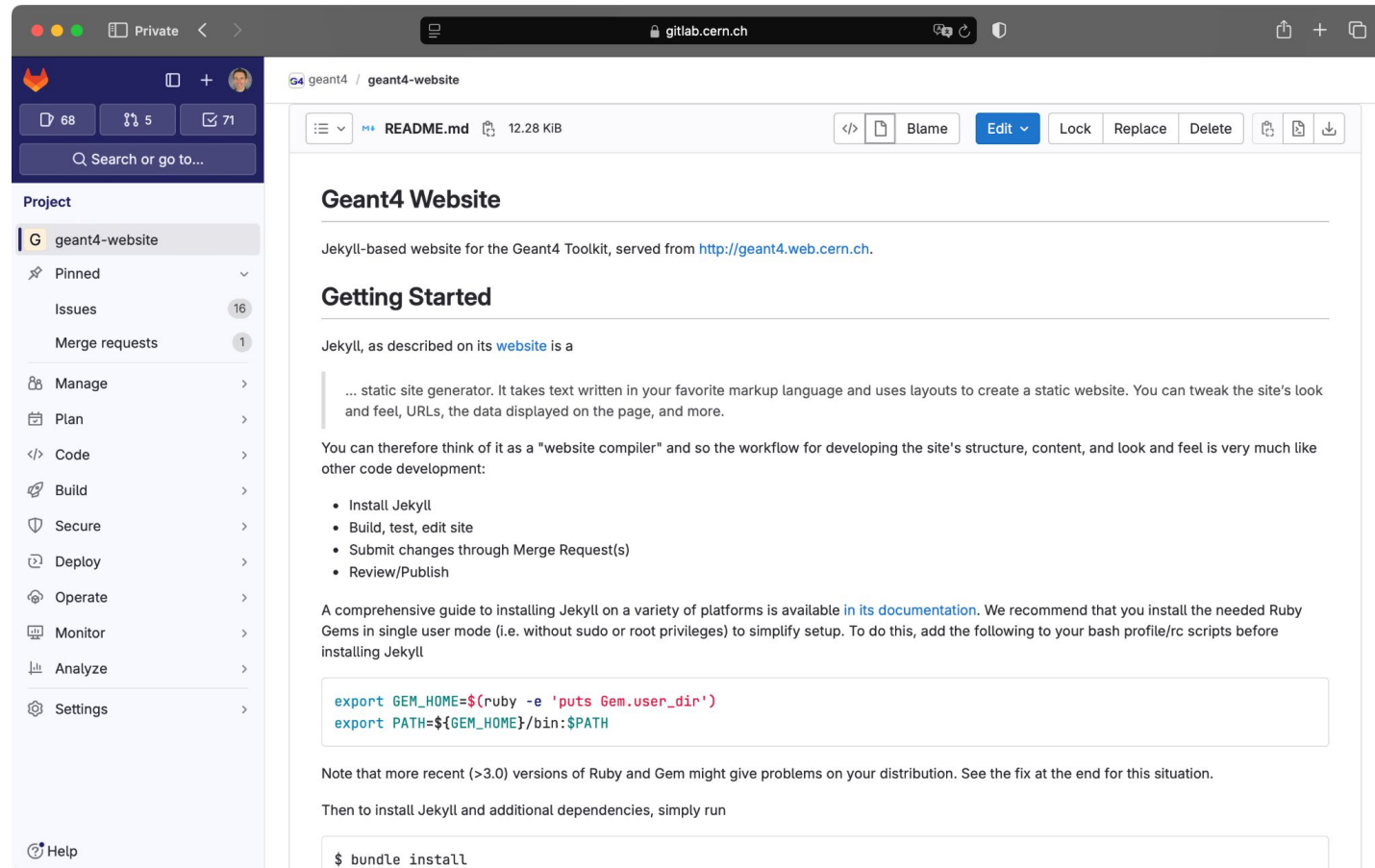
    template <typename... Args>
    G4TaskingSingletonEvaluator(key_type, Args&&...)
    {
        throw std::runtime_error("Not specialized!");
    }
};

template <typename T>
class G4TaskingSingletonLogger
{
public:
    using pointer = T*;
    using evaluator_type = G4TaskingSingletonEvaluator<T>;
    using data_type = G4TaskingSingletonData;
    using key_type = typename G4TaskingSingletonKey::type;

    template <typename... Args>
    static void configure(Args&&... args)
    {
    }
};
```

Contributions Welcome!

- Full docs on how to contribute to content on GitLab
- If you have any problems of issues, just ask!



The screenshot shows a web browser displaying the GitLab interface for the repository 'geant4/geant4-website'. The left sidebar contains navigation options like 'Project', 'Issues', 'Merge requests', 'Manage', 'Plan', 'Code', 'Build', 'Secure', 'Deploy', 'Operate', 'Monitor', 'Analyze', and 'Settings'. The main content area shows the 'README.md' file with the following text:

Geant4 Website

Jekyll-based website for the Geant4 Toolkit, served from <http://geant4.web.cern.ch>.

Getting Started

Jekyll, as described on its [website](#) is a

... static site generator. It takes text written in your favorite markup language and uses layouts to create a static website. You can tweak the site's look and feel, URLs, the data displayed on the page, and more.

You can therefore think of it as a "website compiler" and so the workflow for developing the site's structure, content, and look and feel is very much like other code development:

- Install Jekyll
- Build, test, edit site
- Submit changes through Merge Request(s)
- Review/Publish

A comprehensive guide to installing Jekyll on a variety of platforms is available [in its documentation](#). We recommend that you install the needed Ruby Gems in single user mode (i.e. without sudo or root privileges) to simplify setup. To do this, add the following to your bash profile/rc scripts before installing Jekyll

```
export GEM_HOME=$(ruby -e 'puts Gem.user_dir')
export PATH=${GEM_HOME}/bin:$PATH
```

Note that more recent (>3.0) versions of Ruby and Gem might give problems on your distribution. See the fix at the end for this situation.

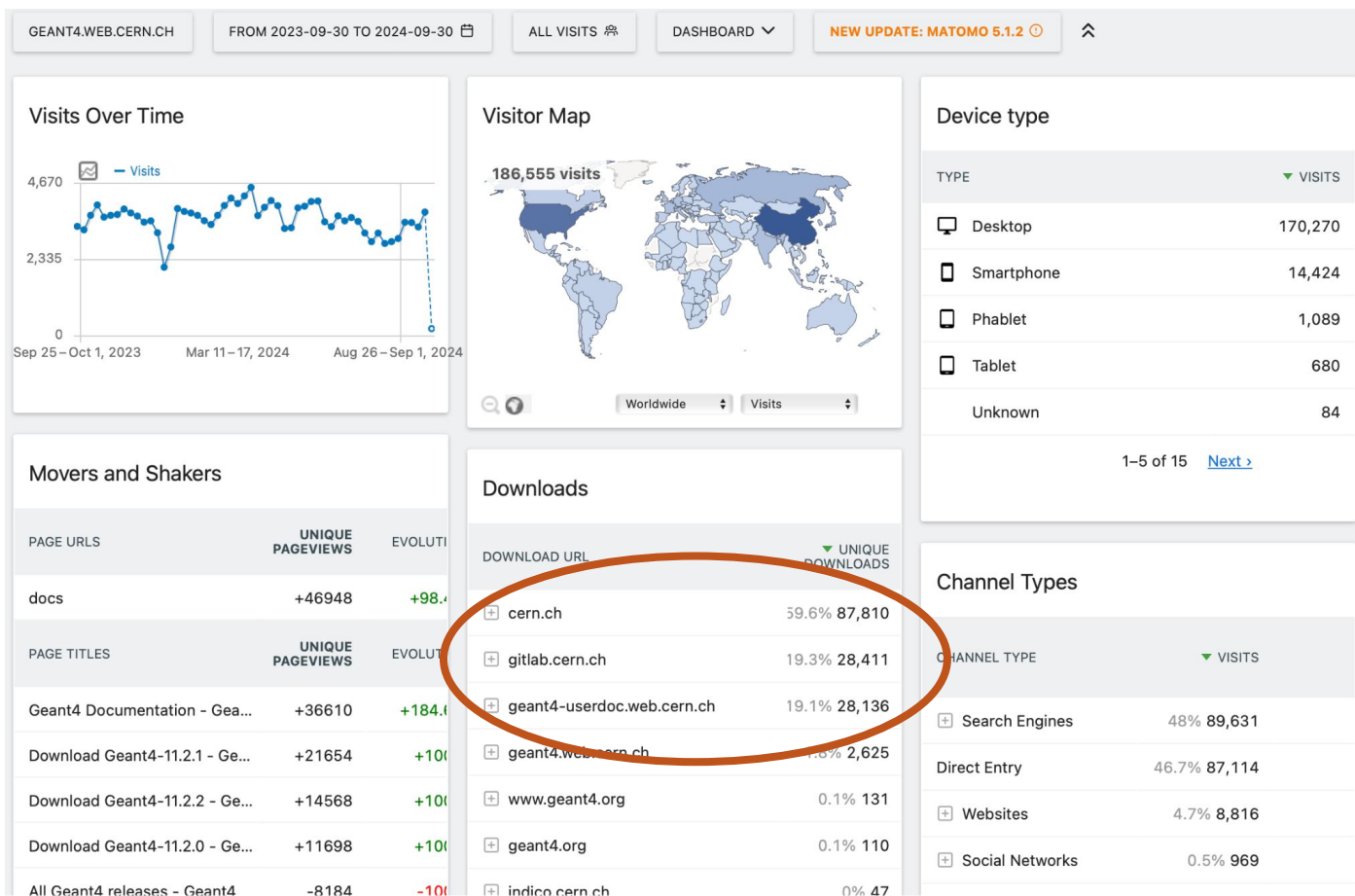
Then to install Jekyll and additional dependencies, simply run

```
$ bundle install
```

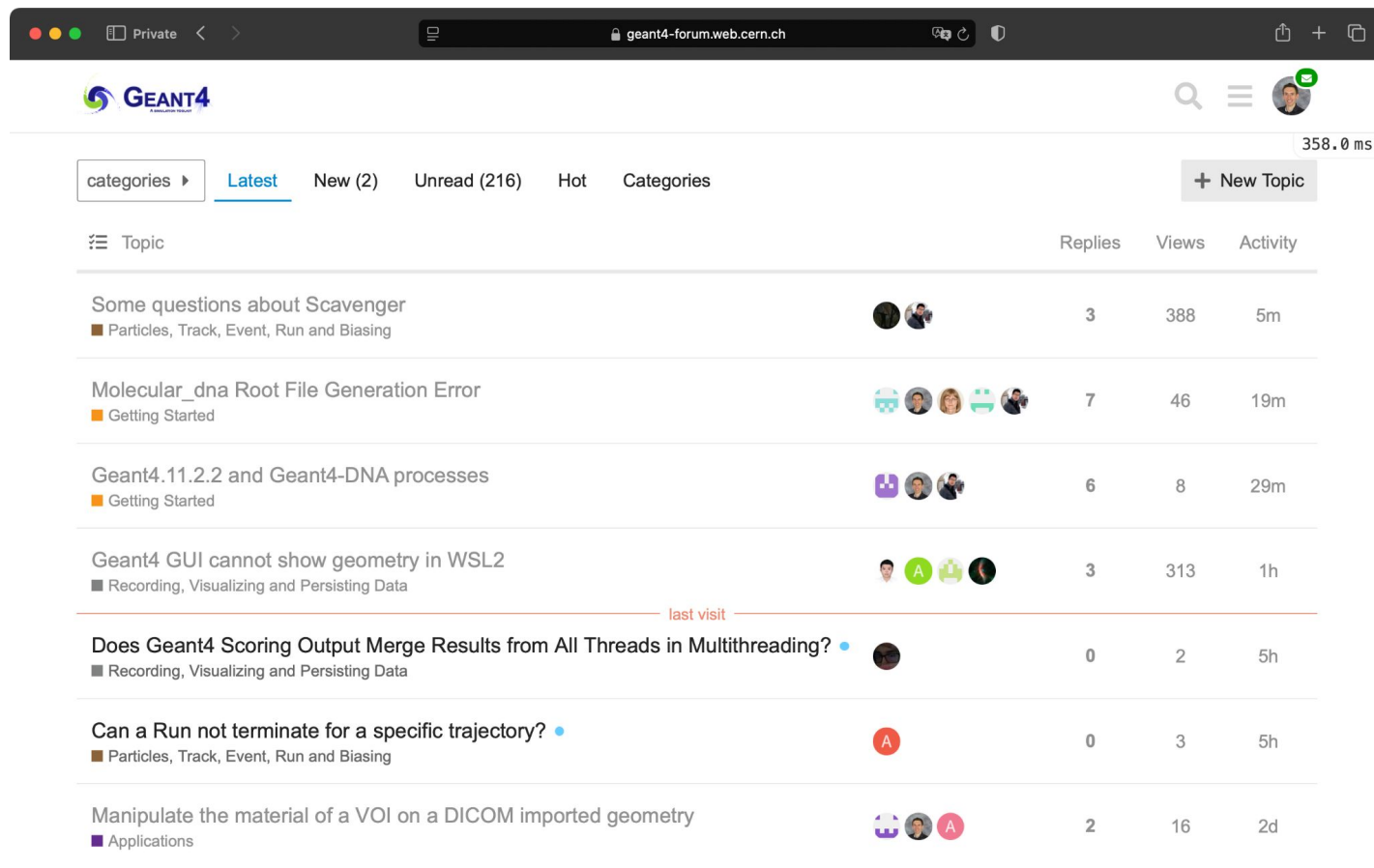
<https://gitlab.cern.ch/geant4/geant4-website>

Website/Download Analytics

- Steady number of visitors over time
- Documentation and Downloads most visited as might be expected.
- >28K downloads of source code
 - Primarily 11.X and 10.7
 - Tail of older versions



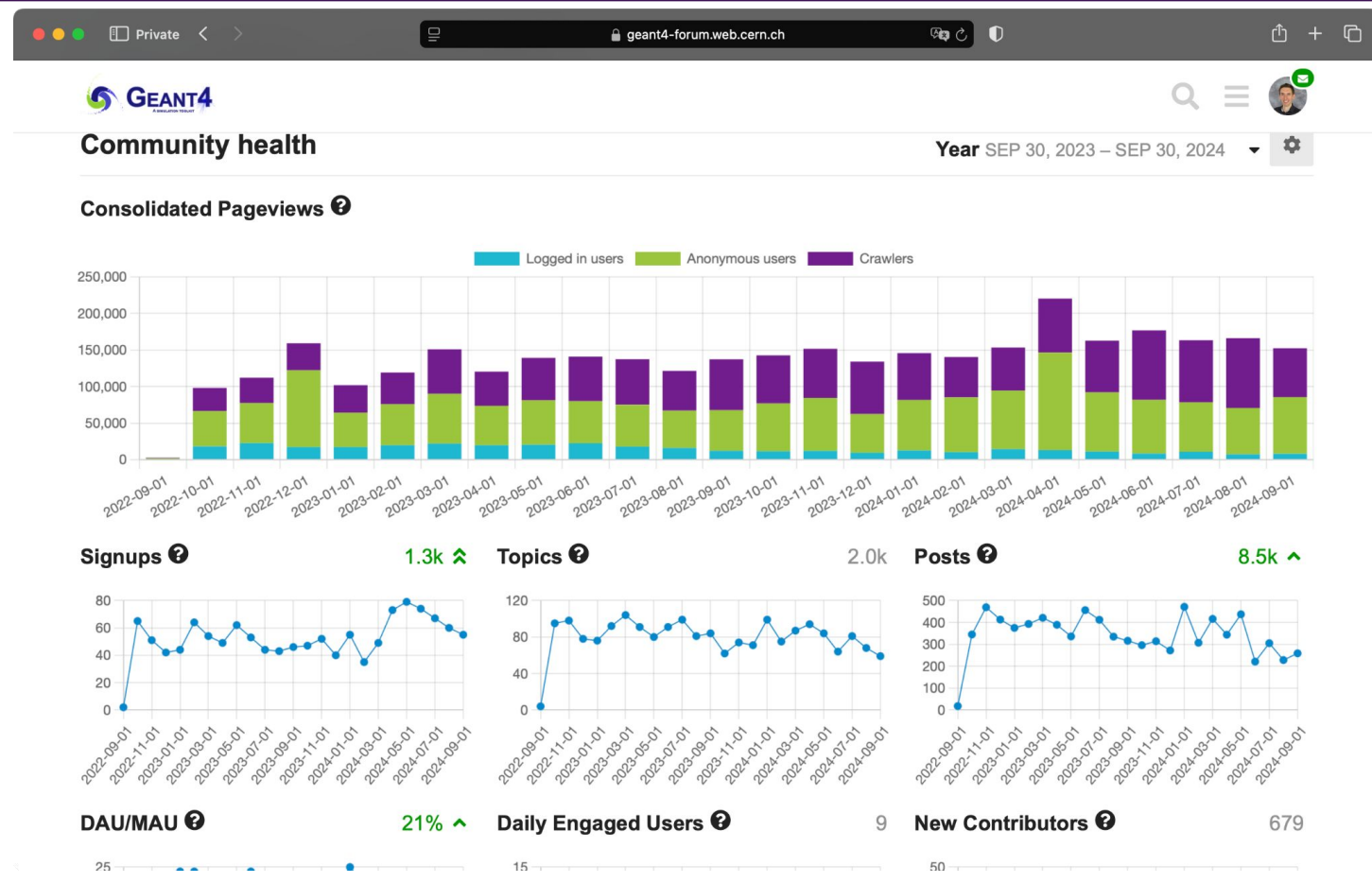
- Our main online day-to-day Q&A with users.
- **Please review and answer posts!**
 - *Only a few of us regularly answering questions.*
 - *Leaving posts unanswered gives a bad impression.*



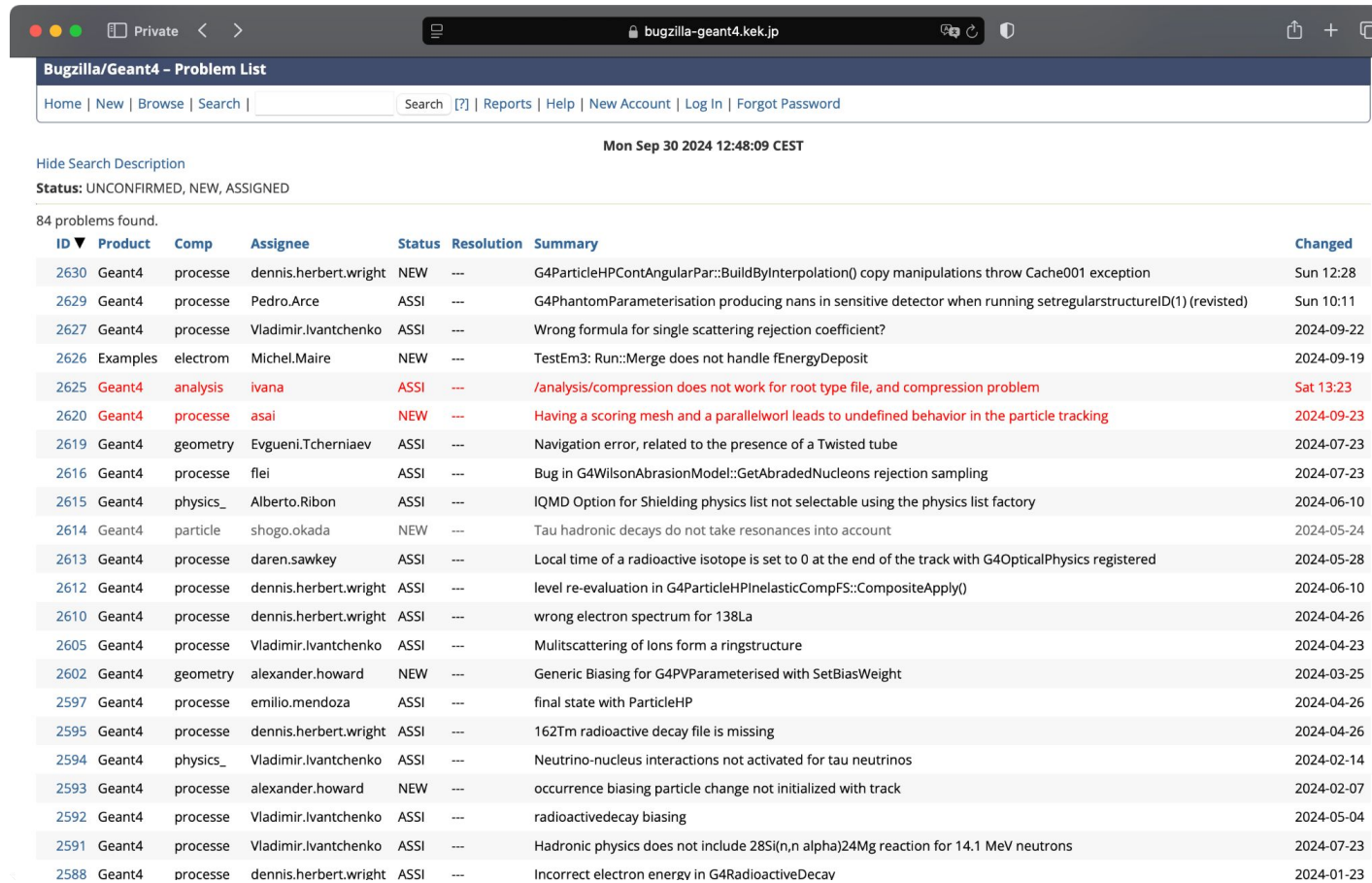
The screenshot shows the Geant4 Forum interface. At the top, there's a navigation bar with the Geant4 logo, a search icon, a menu icon, and a user profile icon. Below the navigation bar, there are tabs for 'categories', 'Latest', 'New (2)', 'Unread (216)', 'Hot', and 'Categories'. A '+ New Topic' button is also visible. The main content area displays a list of forum topics with columns for 'Topic', 'Replies', 'Views', and 'Activity'. A red line separates the 'last visit' section from the rest of the list.

Topic	Replies	Views	Activity
Some questions about Scavenger ■ Particles, Track, Event, Run and Biasing	3	388	5m
Molecular_dna Root File Generation Error ■ Getting Started	7	46	19m
Geant4.11.2.2 and Geant4-DNA processes ■ Getting Started	6	8	29m
Geant4 GUI cannot show geometry in WSL2 ■ Recording, Visualizing and Persisting Data	3	313	1h
last visit			
Does Geant4 Scoring Output Merge Results from All Threads in Multithreading? ● ■ Recording, Visualizing and Persisting Data	0	2	5h
Can a Run not terminate for a specific trajectory? ● ■ Particles, Track, Event, Run and Biasing	0	3	5h
Manipulate the material of a VOI on a DICOM imported geometry ■ Applications	2	16	2d

- Users still visiting, posting, but...
- Slight signs of a decline
- Answers per topic remains low...
- Again, critical we engage and answer questions!



- Don't forget to respond to bugs on Bugzilla, and provide regular feedback to the reporter.
- Should really have a push to try and resolve especially long standing reports



The screenshot shows the Geant4 Bugzilla Problem List page. The browser address bar displays 'bugzilla-geant4.kek.jp'. The page title is 'Bugzilla/Geant4 - Problem List'. The navigation bar includes links for Home, New, Browse, Search, and a search input field. The current date and time are 'Mon Sep 30 2024 12:48:09 CEST'. The status is 'UNCONFIRMED, NEW, ASSIGNED'. A message indicates '84 problems found.' Below this is a table with columns for ID, Product, Comp, Assignee, Status, Resolution, Summary, and Changed. The table lists various bugs, including those related to G4ParticleHP, G4Phantom, and G4Wilson models.

ID	Product	Comp	Assignee	Status	Resolution	Summary	Changed
2630	Geant4	processe	dennis.herbertywright	NEW	---	G4ParticleHPContAngularPar::BuildByInterpolation() copy manipulations throw Cache001 exception	Sun 12:28
2629	Geant4	processe	Pedro.Arce	ASSI	---	G4PhantomParameterisation producing nans in sensitive detector when running setregularstructureID(1) (revisted)	Sun 10:11
2627	Geant4	processe	Vladimir.Ivantchenko	ASSI	---	Wrong formula for single scattering rejection coefficient?	2024-09-22
2626	Examples	electrom	Michel.Maire	NEW	---	TestEm3: Run::Merge does not handle fEnergyDeposit	2024-09-19
2625	Geant4	analysis	ivana	ASSI	---	/analysis/compression does not work for root type file, and compression problem	Sat 13:23
2620	Geant4	processe	asai	NEW	---	Having a scoring mesh and a parallelworl leads to undefined behavior in the particle tracking	2024-09-23
2619	Geant4	geometry	Evgueni.Tcherniaev	ASSI	---	Navigation error, related to the presence of a Twisted tube	2024-07-23
2616	Geant4	processe	flei	ASSI	---	Bug in G4WilsonAbrasionModel::GetAbradedNucleons rejection sampling	2024-07-23
2615	Geant4	physics_	Alberto.Ribon	ASSI	---	IQMD Option for Shielding physics list not selectable using the physics list factory	2024-06-10
2614	Geant4	particle	shogo.okada	NEW	---	Tau hadronic decays do not take resonances into account	2024-05-24
2613	Geant4	processe	daren.sawkey	ASSI	---	Local time of a radioactive isotope is set to 0 at the end of the track with G4OpticalPhysics registered	2024-05-28
2612	Geant4	processe	dennis.herbertywright	ASSI	---	level re-evaluation in G4ParticleHPInelasticCompFS::CompositeApply()	2024-06-10
2610	Geant4	processe	dennis.herbertywright	ASSI	---	wrong electron spectrum for 138La	2024-04-26
2605	Geant4	processe	Vladimir.Ivantchenko	ASSI	---	Multiscattering of Ions form a ringstructure	2024-04-23
2602	Geant4	geometry	alexander.howard	NEW	---	Generic Biasing for G4PVPParameterised with SetBiasWeight	2024-03-25
2597	Geant4	processe	emilio.mendoza	ASSI	---	final state with ParticleHP	2024-04-26
2595	Geant4	processe	dennis.herbertywright	ASSI	---	162Tm radioactive decay file is missing	2024-04-26
2594	Geant4	physics_	Vladimir.Ivantchenko	ASSI	---	Neutrino-nucleus interactions not activated for tau neutrinos	2024-02-14
2593	Geant4	processe	alexander.howard	NEW	---	occurrence biasing particle change not initialized with track	2024-02-07
2592	Geant4	processe	Vladimir.Ivantchenko	ASSI	---	radioactivedecay biasing	2024-05-04
2591	Geant4	processe	Vladimir.Ivantchenko	ASSI	---	Hadronic physics does not include 28Si(n,n alpha)24Mg reaction for 14.1 MeV neutrons	2024-07-23
2588	Geant4	processe	dennis.herbertywright	ASSI	---	Incorrect electron energy in G4RadioactiveDecay	2024-01-23

- Our user support systems are functioning well, with high interest and apparent use of Geant4 across the globe
 - *At least 28K downloads of the source code over last year (lower limit as we only record those through the website, not directly on GitLab/Hub).*
- **However, I think we need to increase our engagement with and support of users through the Discourse Forum and Bugzilla systems**
 - *Questions/queries on the Forum are going unanswered, with only a handful of collaborators regularly/actively posting*
 - *Similarly, we have a relatively high number of outstanding bugs (though it's appreciated that sometimes the reporter does not respond back in kind!) that it would be good to address (even if as WONTFIX/OBSOLETE)*
- **It's on all of us as collaborators and contributors to support our users through these channels just as much as developing toolkit code, examples and docs!**

Development Tools: <https://coverity.cern.ch>

- Our primary **static analysis tool**
- Finds more defects than compiler or clang-tidy
- Major update this year with more modern C++ fixes.
- Means more issues have been flagged, so make sure you follow up on the reports sent out to you each month!

The screenshot shows the Coverity web interface. At the top, there's a navigation bar with the user name 'Benjamin Morgan' and a search bar. Below that is a table of issues. The table has columns for CID, Type, Impact, Status, First... (date), Owner, Classification, Severity, Action, and Component. Issue CID 105693 is highlighted in blue. To the right of the table is a detailed view for issue 105693, titled 'Variable copied when it could be moved'. It includes a description: 'Unnecessary object copies can affect performance. In PTL::GetNumberOfPhysicalCpus(): Creating a copy of a variable that is no longer used instead of using std::move()'. Below the description are triage controls for Classification (Unclassified), Severity (Minor), Action (Fix Required), and Owner (bmorgan [cerndc] (Benjamin Morgan)). There is also a text area for comments and 'Apply + Next' and 'Apply' buttons. At the bottom of the detailed view, there is a suggestion: 'Use std::move(line) instead of line.' with a code snippet: `core_ids.insert(line);`

CID	Type	Impact	Status	First...	Owner	Classification	Severity	Action	Component
105624	Structural...	Medium	New	06/20/24	bmorgan	Unclassified	Minor	Fix Required	Other
105642	Division o...	Medium	New	06/28/24	bmorgan	Unclassified	Moderate	Fix Submitt...	Other
105693	Variable c...	Low	New	07/11/24	bmorgan	Unclassified	Minor	Fix Required	Other
58721	Uninitializ...	Medium	Triaged	08/27/14	dmancusi	Bug	Minor	Fix Submitt...	Other
104935	Division o...	Medium	New	06/28/24	dsawkey	Unclassified	Unspecified	Undecided	Other
105274	Division o...	Medium	New	06/28/24	dsawkey	Unclassified	Unspecified	Undecided	Other

```

97     {
98         static auto _npos = std::string::npos;
99         auto _npos = _npos;
100        while((_npos = line.find(itr)) != _npos)
101            line = line.replace(_npos, itr.length(), "");
102    }
103
104    core_ids.insert(line);
105    }
106    core_id_count = static_cast<unsigned>(core_ids.size());
107    if(core_id_count > 0)
108        return core_id_count;
109    }
110    return GetNumberOfCores();

```

- Package cache “helper” file that stores buildtime paths to dependencies like Xerces-C no longer installed by default
 - *Quite a few posts on the forum about errors caused by this after system upgrades, since stored paths change, particularly on macOS*
- Link-Time Optimization builds tested in Nightly to forewarn of issues previously only reported back to us by CMS/ATLAS internal builds that use this
- **Initial support for building/running [GoogleTest](#)-based unit tests for kernel code**
 - *Initially in intercoms, global categories, migrating code from, e.g. source/intercoms/tests*
- **Not CMake directly, but note that three new datasets have been added this year**
 - *Three currently optional, but means that **we have 15(!) in total***
 - *[Bugzilla 2506](#), and other questions on the forum and in packaging ([Spack](#)) about “when do I need dataset X”*
 - *Combined build/config/documentation issue, so open to discussion on what we can do to make things clearer for both ourselves and users here...*
 - *See also tomorrow’s session on Initialization in Parallel (where datasets are read)*

- Lot of work behind the scenes this year by Gunter Folger and SFT to upgrade CDash and roll out new platforms like alma9/RHEL9, Win11, macOS 15!
- Functional improvements to CI/CDash completed or in progress
 - *Example guidelines checks now run in Nightly (violations tracked in [Issue #183](#))*
 - *Speed up reporting of CI results to CDash, so problems can be identified sooner and to reduce upload load on CDash*
 - *Filtering of MR changes to disable full CI build for non-code changes, or, **if MR changes an example, add it to the CI build (See [Issue #175](#))***
- **A particularly important one will be automatic Nightlies for patch branches**
 - *Make workflow identical to master branch: Test/merge a patch as soon as MR is made*
 - *Increased automation patches branch is always in “ready to validate” state, easing patch release process*
 - [See Issue #218](#)

- **Basic idea:** find a better grouping of *source code modules* into *libraries*

```
+--foo/  
+- CMakeLists.txt  
+- bar/  
| ...  
+- baz/  
  +- sources.cmake  
  +- include/  
  | +-G4Baz.hh  
  | +- ... public headers...  
+- private/  
  +-G4ImplementationDetail.hh  
  +- ... only used in baz ...  
+- src/  
  +- G4Baz.cc  
  +- G4ImplementationDetail.cc  
  +- ...source code files...
```

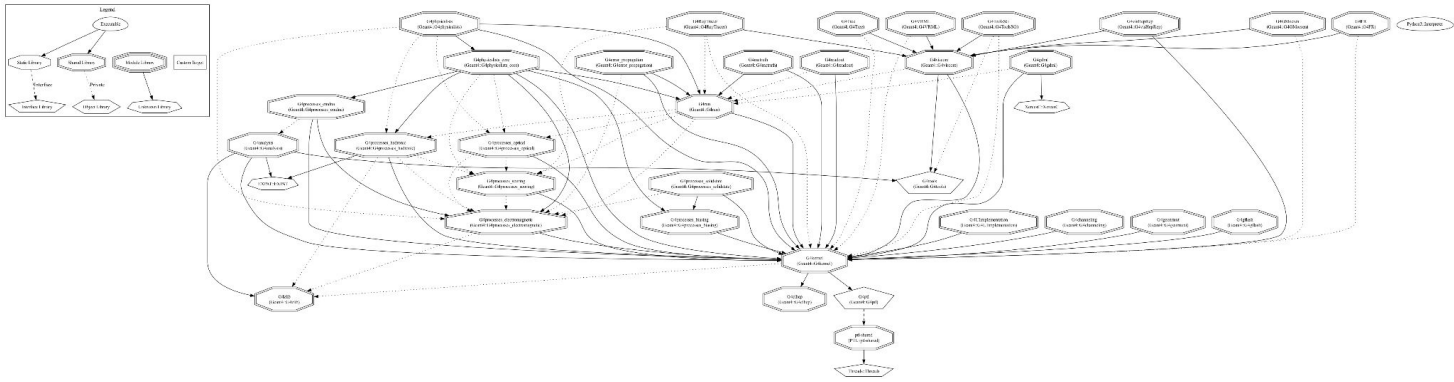
```
# CMakeLists.txt  
include(bar/sources.cmake)  
include(baz/sources.cmake)  
geant4_add_category(G4foo MODULES G4bar G4baz)
```

```
# sources.cmake  
geant4_add_module(G4baz  
  PUBLIC_HEADERS  
    G4Baz.hh  
    ...  
  PRIVATE_HEADERS  
    G4ImplementationDetail.hh  
    ...  
  SOURCES  
    G4Baz.cc  
    G4ImplementationDetail.cc  
  ...)
```

```
+-- install/  
+- include/  
  +- Geant4/  
  | +- G4bar.hh  
  | +- G4baz.hh  
+- lib/  
  +- libG4foo.a
```

- So why change the current set of so-called “global” libraries?
 - Some are too big (*libG4processes*), so lack modularity or are problematic to use
 - Some are small (*core kernel*), and can lack coherence in use (i.e. practically always link to all of them)
 - Some have optional modules/classes, which makes use awkward (“if I link to X, does it supply Y?”)
- Initial approach is to group modules into libraries along a rough boundary of
 - “Kernel”: the core Geant4 types/data, run/event/track/step loop, and abstract interfaces
 - “Implementation”: concrete implementations, mostly physics processes/models
 - “Addons”: optional components such as GDML

● Issue 122 lays out this potential structure/organisation in a dependency graph



1. Dependencies/coupling between modules to be understood/resolved
 - a. *G4processes_emdna has a dependency on G4analysis*
 - b. *G4run has dependencies on several process modules: G4scoring, G4optical, G4hadronic_mgt, G4emutils*
2. **Check for modules to split/merge based on capability**
 - a. *E.g. AdjointMC in G4event, G4run, G4particles, processes, split/merge into “G4adjoint” module/library?*
3. **Backward compatibility of library names**
 - a. *E.g. User code links `libG4event.so` now, but would need to link `libG4kernel.so` after modularization*
 - b. *Requires some design/development to provide solution: [Issue #343](#), [Issue #209](#)*
 - c. **May** *require deferment of modularization to next major release if robust solution can't be found*

- **Reminder** to check the monthly [Coverity reports](#), fix reports assigned to you!
- Initial support/migration of global, intercoms unit tests to GoogleTest
 - *More to come...*
- Now 12(15) datasets in use in toolkit
 - *Need to think about better solutions to document where/when used*
 - *Not discussed today, but related, how to develop/report tags, formats for HPC*
- Work in progress to speed up integration of MRs into patch branches
 - *Easing process of preparing patch releases*
- Long-running library modularization task still going, but some technical issues to be understood and resolved
 - *Suspect overall change will be for the next major release, but should address dependency/coupling issues identified now*