Geant4 Collaboration
- Organization and management

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Geant4 Collaboration organization, management
and communication review

Contents

- Geant4 Collaboration
- Collaboration membership
- Structure of the Collaboration
- Oversight Board
- Steering Board
- Working groups and their representatives
- Spokesperson
- Technical Forum
- Collaboration processes

References

- The Geant4 Collaboration is governed by the Collaboration Agreement (CA) and associated regulations listed here:
- Collaboration Agreement
  - https://geant4.cern.ch/collaboration/agreement/geant4-agreement-2005.pdf
- Annexes to Collaboration Agreement
  - https://geant4.cern.ch/collaboration/agreement/geant4-agreement-annex1.pdf
  - https://geant4.cern.ch/collaboration/agreement/geant4-agreement-annex2.pdf
- Geant4 Software License
  - https://geant4.cern.ch/license/LICENSE.html
- Geant4 tag and release policy
  - https://geant4.cern.ch/collaboration/tag_release.shtml
- Publication Policy and associated procedures
  - https://geant4.cern.ch/collaboration/Geant4CollaborationPublicationPolicy.pdf
  - https://geant4.cern.ch/collaboration/pub_policy.shtml
- Election regulation
  - https://geant4.cern.ch/collaboration/steering_board/internal/meetings/SB_Feb2012_2/RevisedRegulationOfGeant4SpokespersonElection.doc (*)
- Note: The Review Board members have full access to all the restricted areas of collaboration web pages. To see the restricted pages indicated with (*), Please use Username and Password provided at the top of the input report.

Geant4 Collaboration

Collaboration agreement

- The Geant4 Collaboration was launched in 1999 after the successful termination of CERN RD44 project.
- Originally, the Collaboration was governed by “Memoranda of Understandings” signed by collaborating institutions and experiments.
  - Experiments provided resources.
- In 2006, new Collaboration Agreement was created and signed by institutions.
  - Current signing parties: CERN, ESA, G4AI, IN2P3, INFN, KEK, LIP, LPI, Spain, STFC, TRIUMF, US_DOE
- Signed institutions provide resources (manpower and computing).
- Individual collaborators are not mandated to sign to CA, but confirm their compliance to CA every year.

Geant4 collaboration (as of 2012 census)

- 2012 – 102 collaborators, 31.34 FTE (2011 – 102 collaborators, 35.73 FTE)

WG	FTE	WG	FTE	WG	FTE
Run, Event & Detector	0.72 (0.95)	Standard EM	3.95 (4.55)	Novice& Extended Example	1.31 (0.93)
Tracking	0.15 (0.15)	Low-Energy EM	6.07 (7.77)	Advanced Example	2.06 (3.24)
Particle & Track	0.20 (0.20)	Hadronics	10.04 (9.27)	Testing and Q/A	1.36 (2.02)
Geometry	0.80 (1.30)	GUI	0.85 (0.85)	Software Management	0.51 (0.51)
Gen Proc & Material	0.56 (0.50)	Visualization	1.45 (1.80)	Collaboration Management	0.50 (0.50)
Persistency	0.30 (0.45)	Documentation	0.51 (0.51)		

Geant4 collaboration (as of 2012 census)

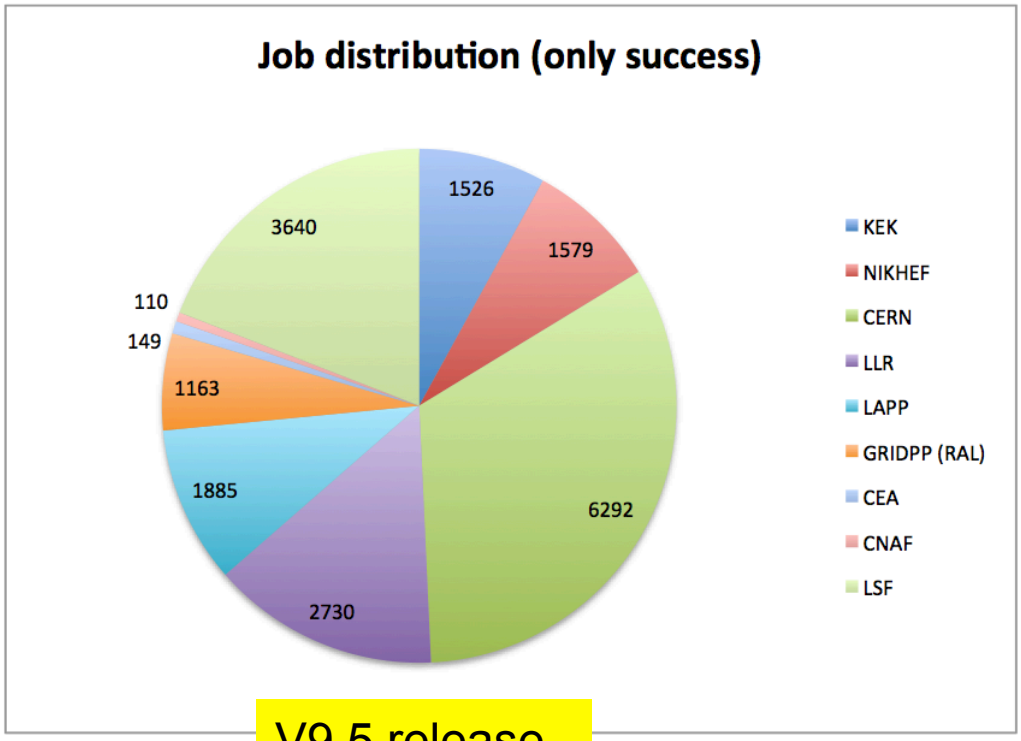
Country/ Organization	FTE	Country/ Organization	FTE	Country/ Organization	FTE
US	6.97	Japan	1.90	Canada	0.70
CERN	6.71	Russia	1.65	Portuguese	0.52
France	5.43	Spain	1.19	ESA	0.35
Italy	3.69	UK	0.80	Other	1.43

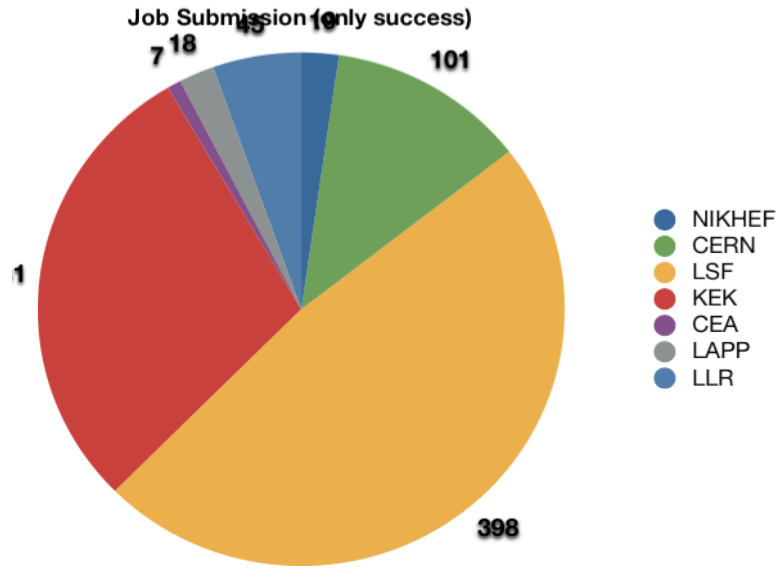
- HENP-bound 15.11, Space/Medical-bound 5.87, free research 10.36

- Note : numbers are approximate.
  - FTE numbers are self-declared and not audited.
  - FTE includes contributions from students who declare large FTE numbers.
  - ESA's contribution is spread over several countries.
  - Some of Russian contribution may belong to CERN.

Computing resources

- Nightly test on build and low-statistic tests
- Regular benchmarking tests associated with monthly tag
- Physics quality monitoring associated with monthly tag
  - 200-300 CPUs for 3-4 days
- Large statistic physics quality monitoring for public release
  - ~1000 CPUs for 2-3 weeks





V9.5 release

9.5-ref01 monthly

Computing resources in 2012

- In 2012, we have following computing resources (CPUs) in peak time of public release phase for validating the releases by running stress tests and benchmarks (for both regular and patch releases).
  - CERN (local batch + grid) : 200 + 200
  - KEK (Japan) : 200
  - CEA (France) : 100
  - LAPP (France) : 100
  - LLR (France) : 100
  - NIKHEF (The Netherlands), RAL (UK), CNAF (Italy)
    - Some configuration issues – use in parasitic mode
  - KISTI (Korea) : new ~1000

- LHC massive simulation production now hits very rare incidents. For example, ATLAS recently found a bug which happens a few times in billion events.
  - Larger scale validation tests are required.

Other computing resources

- CERN
  - SVN repository, Nightly test management, collaboration web pages, mailing lists, Quality Assurance (Coverity, Valgrind, etc.)
- KEK
  - LXR source code browser, JIRA requirements tracking
- SLAC
  - HyperNews
- FNAL
  - Memory usage and CPU performance monitoring, physics validation web portal

Note: These services require allocated human resources as well.

Budget

- The Geant4 Collaboration does not have a central budget. Individual collaborators, their institutes and/or their funding agencies allocate budgets for their salaries and necessary travel expenses.
- Major collaborating institutes offer their computing resources to the Collaboration for benchmarks, storage and web-based services.
  - Such contributions include not only the hardware resources but also human resources for operations.

Collaboration membership

Geant4 Collaboration membership

- The members of the Collaboration are the individuals who perform the scientific and technical development and maintenance of the Geant4 toolkit.
- A census is conducted at the beginning of each year. As a part of the census, every collaborator is requested to renew his/her collaboration membership by
  - maintaining his/her CERN AFS account (e.g. updating IT security course)
  - clicking the confirmation button in a web dialogue, which has links to the CA and current regulations.
- We had 102 collaborators at the time of 2012 census, and welcomed 13 new collaborators this year.
- New membership is granted by the Steering Board (SB). The coordinator of the working group in which the new collaborator wants to contribute makes the request to the SB for membership.
  - The WG coordinator reports to the SB the new member's expected contribution, responsibility, continuity and other information. The SB then discusses and decides on the new membership.
  - For a student whose thesis supervisor is already a collaboration member, membership is automatically granted once the WG coordinator's report is given.

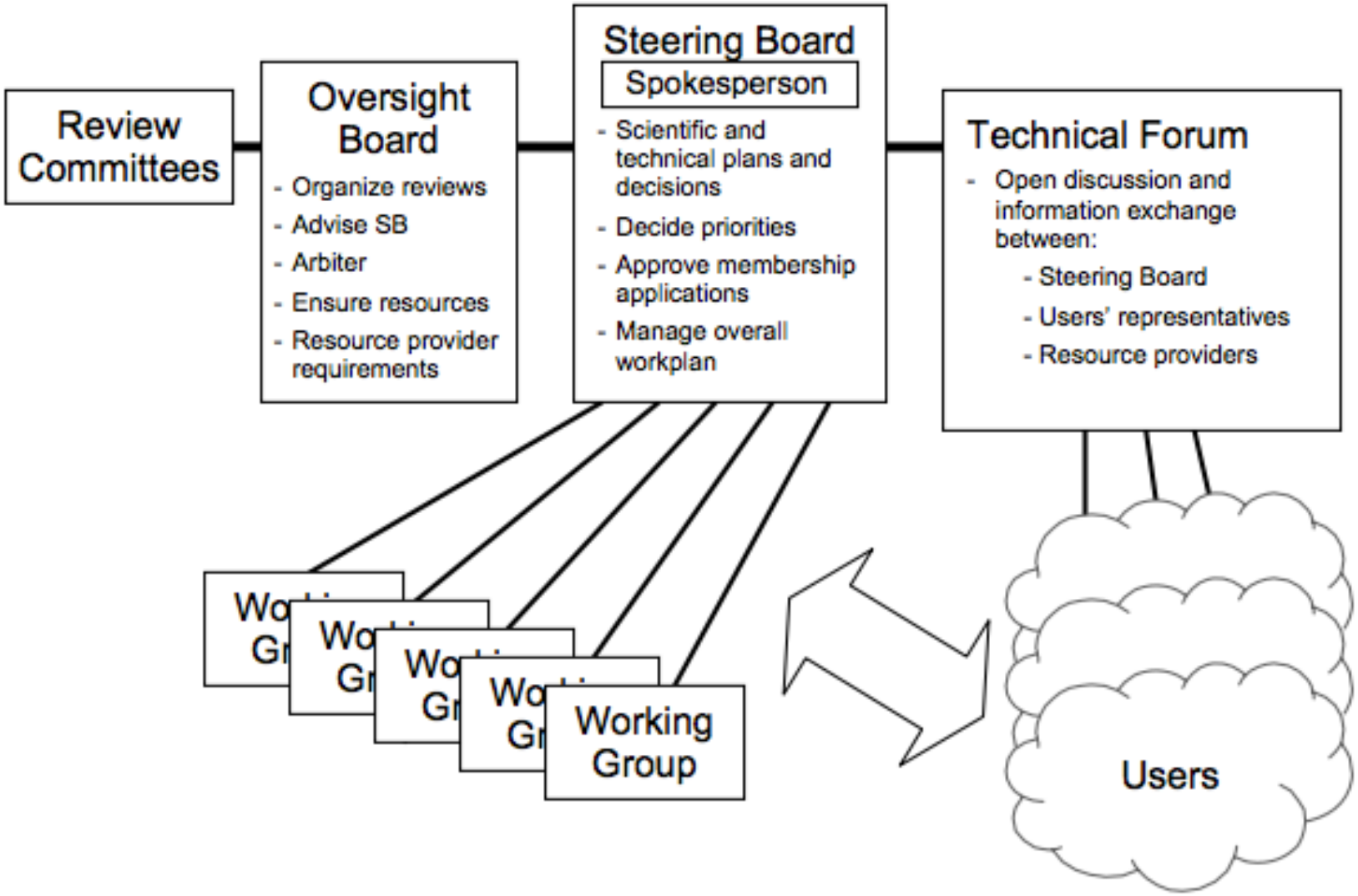
Geant4 Collaboration membership

- We have two types of collaborators:
  - those who are tasked to work for Geant4; they are typically employees of major HEP labs which signed the Collaboration Agreement, and
  - those who voluntarily work for Geant4; they are typically university researchers who devote some of their research time.
- We do need both of them.
  - To maintain the quality of the code and to conduct large-scale validation tests, stable commitments of tasked collaborators of large institutes are essential.
  - Contributions of university researchers are vital to maintain the diversity of options available in such areas as physics models, visualization and GUI.
- Stable positions for younger researchers are important.
  - Some key developers have retired. Some others are “tired”.
    - We need to encourage and promote new generation collaborators.

Two extreme case study

- Problems with strong top-down management
  - It would require forcing a collaborator to do or not to do something.
    - Neither Spokesperson nor WG coordinators serve as supervisors of collaborators.
  - We would lose volunteer-based collaborators who have contributed and/or will contribute to the diversity of options in particular in physics models, visualization and GUI.
- Problems with open-source style
  - It would be hard to have collaboration-wide large-scale development or migration which requires considerable amount of preparation, including work planning, resource assessment and mitigation of potential conflicts with other developments.
  - It would become hard to manage software quality in both physics and computing performance.
- We believe consensus-based approach is the practical way to drive and enforce decisions to the collaboration that is composed by variety of commitment styles.

Structure of the Collaboration


Review Committees
Oversight Board
- Organize reviews
- Advise SB
- Arbiter
- Ensure resources
- Resource provider requirements
Steering Board
Spokesperson
- Scientific and technical plans and decisions
- Decide priorities
- Approve membership applications
- Manage overall workplan
Technical Forum
- Open discussion and information exchange between:
- Steering Board
- Users' representatives
- Resource providers
Working Group
Users

Current collaboration management

- Spokesperson : Makoto Asai (SLAC)
- Deputy spokesperson : Marc Verderi (IN2P3/LLR)
- Release coordinator : Gabriele Cosmo (CERN)

Current term
Apr. 2012 – Mar. 2014

- Technical Forum chair : Andreas Morsch (CERN)
- Deputy Technical Forum chair : Bruce Faddegon (UCSF)

- Publication Board chair : Dennis Wright (SLAC)

Oversight Board

Oversight Board

Institution	Representative
CERN	L. Mapelli
ESA	P. Nieminen
INFN	M. Paganoni
IN2P3	C. Diaconu (Chair)
KEK	K. Amako
LIP and TRIUMF	F. Retiere
LPI	V. Grichine
Spain	N. Colino
STFC (formerly PPARC) and HIP	J. Allison
US DOE	R. Mount

- The Oversight Board (OB) is composed of representatives of the signing parties or groups of signing parties committing more than the minimum threshold of resources into the Collaboration.
  - Currently, the threshold is set to 2 FTE contribution.

Oversight Board

- Responsibilities:
  - Monitor the overall activity of the Geant4 collaboration and advise the Steering Board;
  - Monitor the level of resources contributed by each group of members represented by a signing party. When necessary take steps to ensure that committed resources are available and adequate to meet the needs of the Collaboration;
  - Organize appropriate reviews to assist in the above processes;
  - Make recommendations on the admission of new members requiring new signing parties (as detailed in the Regulations).
  - Approve amendments to the Collaboration Agreement proposed by the Steering Board.
  - At the request of the Steering Board, act as final arbiter to resolve issues that may arise.
- The OB meets at least twice every year.
  - Since 2010, one OB/SB joint meeting is held during the annual Collaboration meeting.

Communication between OB and SB

- Institute tends to want its employees to work on the issues directly addressing to its needs. On the other hand, no institute has expertise that covers all Geant4 categories.
- In reality, no single scale of priority exists. Give-and-take relation between agencies/institutes is mandatory.
  - Also institutes get benefit from voluntary-based collaborators.
- SB is the place where priority is negotiated and applied. Spokesperson monitors and enforces priorities.
  - Priorities are driven by various aspects, including requirements from institutes, agencies, experiments and users, and also affected by available resources and developers' interests.
  - We should avoid priorities to be set simply proportional to FTE commitments. It results in inflated FTE declaration.
- This means SB (and Spokesperson) has the responsibility to explain to the funding agencies and institutes and justify the priority.
- OB is the place for such explanation, but direct communication of individual agency/institution and Spokesperson could do even better.

Steering Board

Steering Board (23+3)

Role	Name	
Chair of SB and Spokesperson of Geant4	Makoto Asai	
Deputy spokesperson of Geant4	Marc Verderi	
Chair Technical Forum	Andreas Morsch	
Deputy Chair Technical Forum	Bruce Faddegon	
Release Manager	Gabriele Cosmo	
Oversight Board liason	John Allison	
Working Group	**Coordinator**	**Deputy and Representatives**
Advanced Examples	G. A. Pablo Cirrone	(Luciano Pandola)
Documentation Management	Michael Kelsey	(Dennis Wright)
Electromagnetic Physics	Vladimir Ivanchenko	Peter Gumplinger Michel Maire
Geometry and Transport	Gabriele Cosmo	(John Apostolakis)
Hadronic Physics	Alberto Ribon	Dennis Wright Gunter Folger, Michael Kelsey
Low Energy Electromagnetic Physics	Sebastien Incerti	Ziad Francis Luciano Pandola
Novice and Extended Examples	Ivana Hrivnacova	(Peter Gumplinger)
Particles and Track	Hisaya Kurashige	(Makoto Asai)
Persistency	Gabriele Cosmo	(Witold Pokorski)
Processes and Materials	Marc Verderi	(Vladimir Ivanchenko)
Run, Event and Detector Responses	Makoto Asai	(Hisaya Kurashige)
Software Management	Ben Morgan	(Gunter Folger)
Testing and Quality Assurance	Gunter Folger	(Daniel Elvira)
Tracking	Takashi Sasaki	(Katsuya Amako)
User and Category Interfaces	Koichi Murakami	(Hajime Yoshida)
Visualisation	Joseph Perl	(John Allison)
Task Force	**Leader**	
Physics Validation	Andrea Dotti	
Code Reviews and Improvements	Daniel Elvira	
Reference Physics Lists	Gunter Folger	

Names in parentheses are delegates on absences of coordinators

Steering Board

- The Steering Board governs the Collaboration as the representative of its members, except for those cases in which members vote directly.
- The Steering Board is responsible for the scientific and technical goals of the Geant4 Collaboration, and to plan and manage the work required to reach these goals.
- The Steering Board is responsible for:
  - coordinating the Geant4 development, maintenance and user support.
  - setting priorities. In setting priorities the Steering Board will make maximal use of any consensus on priorities reached by the Technical Forum.
  - deciding about the admission of new members to the Collaboration. In the case of new members that require new signing parties, a recommendation should be sought from the Oversight Board, according to the procedure specified in the Regulations, before the Steering Board makes its decision.
  - amending the Collaboration Agreement, subject to subsequent approval of the Oversight Board.
  - amending the regulations governing the Collaboration activities.
  - setting up and revising the structure (working groups, tasks etc.) to accomplish these responsibilities.

Steering Board

- The spokesperson chairs the SB, and deputy spokesperson is the deputy chair.
- The SB also organizes tasks, which are described in the following slide, and invites leaders of these tasks to the SB meeting.
- The SB meets at least six times per year. The agenda and internal minutes of each SB meeting can be found at this page.
  - https://geant4.cern.ch/collaboration/steering_board/internal/ (*)
- and public minutes are available at this page.
  - https://geant4.cern.ch/collaboration/steering_board/minutes/
- Public minutes are created and circulated to the entire Collaboration within two working days after each SB meeting.

Tasks

- From time to time the SB may identify a task, which is of concern/interest of the entire Collaboration, and allocate collaboration resources for it.
  - Such a task likely transcends any single working group and may or may not be temporary.
- The SB appoints the task leader and mandates the leader to report to the SB in regular basis.
- Currently, there are three tasks.
  - Physics performance monitoring
    - https://twiki.cern.ch/twiki/bin/view/Geant4/PhysicsValidationTaskForce
  - Computing performance monitoring
    - http://oink.fnal.gov/perfanalysis/g4p/admin/task.html
  - Physics lists configuration
    - https://geant4.cern.ch/support/proc_mod_catalog/physics_lists/referencePL.shtml

Liaisons

- The SB appoints liaisons to major user groups.
- Liaisons regularly participate in meetings of appointed user groups, and capture their requirements and inform them of our developments.
- Currently we have liaisons to ATLAS, CMS, LHCb, ALICE and GATE Collaborations.
- In the past, we had liaisons to BaBar and HARP as well.
- The Collaboration also has direct contacts with several other experiments, including CALICE, ILC, Mu2e, CDMS, Belle-2, GERDA, etc.

Steering Board

- Most of the SB members are very actively contributing to the collaboration.
- We understand some OB members are concerned that the size of the SB is too large as a management body.
  - But in reality, SB is the agency that adds legitimacy / legality to decisions. We can reach consensus on decisions while avoiding the situation in which someone feels unrepresented and therefore without a say.
- Practically, the collaboration management body (spokesperson, deputy spokesperson, release manager, etc.) creates SB meeting agenda and drives the discussion.
  - In general, agenda items proposed by the collaboration management are endorsed with only few changes.
  - The SB is not however a dummy "recording chamber" and more active discussions happen sometimes. In particular, when some difficult points, in particular for collaboration policy, arise, the SB has shown its capability to generate valid responses.
- From this point of view, one may see the SB as having a role which is more "council-style" in response to a steering activity that is more in the hands of the management body.

Working groups and their representatives

Working groups and their representatives

- Each working group (WG) is responsible for particular scientific, technical or operational aspects of the work of the Collaboration.
- Working Group coordinator and additional representatives are elected by the working group members and approved by the Steering Board.
- Each WG coordinator has a seat on the SB. If the coordinator cannot attend an SB meeting, the deputy WG coordinator may be his/her delegation.
- WGs having more than 2 FTE are entitled to additional seats on the SB for every 2 additional FTE.
- The term of WG coordinator and additional representative is two years.
  - Current term: Mar. 2012 – Feb. 2014
- A list of current working groups appears on this web page, and contains links to WG web pages where their responsibilities are described as well as their activities and regular meetings.
  - https://geant4.cern.ch/collaboration/working_groups.shtml

Working groups and their representatives

- Currently there are 16 working groups.
  - Many collaborators belong to more than one WGs.

Working Group	Coordinator	Deputy and Representatives
Advanced Examples	G. A. Pablo Cirrone	(Luciano Pandola)
Documentation Management	Michael Kelsey	(Dennis Wright)
Electromagnetic Physics	Vladimir Ivanchenko	Peter Gumplinger Michel Maire
Geometry and Transport	Gabriele Cosmo	(John Apostolakis)
Hadronic Physics	Alberto Ribon	Dennis Wright Gunter Folger, Michael Kelsey
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Tracking	Takashi Sasaki	(Katsuya Amako)
User and Category Interfaces	Koichi Murakami	(Hajime Yoshida)
Visualisation	Joseph Perl	(John Allison)

Spokesperson

Spokesperson

- The spokesperson is elected by all active collaborators in a vote conducted by the election management team, as described in the election regulations.
- The spokesperson has a term of two years, and appoints his/her deputy.
- The spokesperson and the deputy spokesperson share the following responsibilities:
  - call SB meetings, create their agendas, chair the meetings, and create internal and public minutes,
  - monitor activities in the Collaboration and suggest iterations if necessary,
  - promote discussions within the Collaboration and with external people on topics of interest,
  - identify Collaboration-wide issues and drive and implement improvements,
  - collaborate with the Technical Forum chair to schedule a TF, and present status and issues on behalf of the Collaboration, and also make sure captured requirements are integrated into the development plan,
  - report to Oversight Board, and
  - represent the Collaboration to users, at conferences, etc.

Technical Forum

Technical Forum

- The role of the Technical Forum is to provide a forum for discussion between the user community and the Geant4 Collaboration.
- The Technical Forum (TF) is organized by the Geant4 Collaboration through the Steering Board. The TF provides a forum for discussing:
  - major user and developer requirements and priorities,
  - software implementation issues,
  - physics validation issues, and
  - user support issues
- The Technical Forum is open to all interested parties.
- The TF is held four times per year.
  - Among these four TFs, the first one is held in March and puts emphasis on discussion of the work plan of the Collaboration for the year.
  - The fourth TF is held near the time of the end-of-year release and puts emphasis on deliverables of the release.
  - The second and third TFs are usually associated with conferences or workshops of certain application domains.

Technical Forum

- Agendas and minutes of past TFs are linked here.
  - https://geant4.cern.ch/collaboration/technical_forum/index.shtml
- Next TF is scheduled on December 6th (Thursday) at 16:00-18:00 at CERN, right after the release of Geant4 version 9.6.
  - All reviewers are invited to participate to this TF to evaluate how we communicate with the users.

Collaboration processes

Collaboration processes

- Collaboration census
  - Every year in January
- Elections
  - Every two years
  - WG coordinators and other representatives are elected by the members of each WG and endorsed by SB in February.
  - Spokesperson election takes place in March and April. Election is conducted by the election management team in the SB.
- Publication board
  - Three board members with three-year term each. Every year SB elects one new board member.
- New regulation or modification of existing regulation is firstly discussed by SB and then circulated to the entire collaboration for their comments. Then the SB makes the final decision.

Annual work plan

- The annual work plan is developed in two ways.
- Bottom-up
  - Individual collaborators and/or groups of collaborators propose a work plan, either motivated by their own research interest or driven by captured user requirements.
  - Proposals are coordinated by a working group and then by the SB.
- Top-down
  - The Collaboration-wide or cross-category work plan is developed by the SB.
  - For large-scale development, typically the development/migration that affects at least several categories or the entire toolkit, the work plan is firstly created by the Architecture Team (AT) in the SB.
    - For each large-scale development, the AT invites additional members who have expertise in the particular development target.
    - The AT proposes the work plan to the SB, and the SB integrates it with the general Collaboration work plan.
  - The plan is then brought to WG's and implemented.
- The SB monitors the progress for both cases.

Annual work plan

- The work plan for a year is compiled before the end of February and publicized for user's feedback.
- At the first TF of the year, which is usually scheduled in March, one of the major topics of discussion is the annual work plan.
- The work plan is then finalized by the end of March and posted on a public web page.
  - The work plan for 2012 is here:
    - https://geant4.cern.ch/support/planned_features.shtml
- Near the time of the end-of-year release, when the release is introduced to the 4th TF, the work plan is consulted in order to point out which development items were delivered and which were not.

Longer term work plan

- A longer-term development plan is initiated in many ways, for example by discussions at the SB meeting, annual Collaboration meeting, WG meetings, and at any other occasions.
  - Such a development plan can be initiated by user requirements or collaborators' assessments of trends.
- The SB/AT conducts the discussion both inside the SB and Collaboration-wide to reach consensus.
- Our current view of longer-term plan is described in the document submitted to the European Strategy Preparatory Group.
  - https://indico.cern.ch/abstractDisplay.py/getAttachedFile?abstractId=170&resId=0&confId=175067
- Large-scale development or migration requires considerable amount of preparation, including work planning, resource assessment and mitigation of potential conflicts with other developments.
- Longer-term work plan is then decomposed to annual work plans and implemented as the "top-down" development plan described in the previous slide.

Longer term work plan

- In the past, the Collaboration has experienced some major developments and migrations which affected many or all categories. These include:
  - Migration from RogueWave template library to the C++ Standard Template Library (STL)
  - Introduction of "Cuts-per-region" functionality, and
  - Introduction of "Parallel world navigation" functionality
- The Collaboration is now targeting a major migration to multi-threading and thread-safety.
  - The Collaboration started studies in this context in 2009 and had made two prototype releases in 2011 and 2012.
  - A new prototype release is planned in early 2013 and a Beta-release in June 2013, targeting for a full production release by the end of 2013.

Perspectives

- Three major tasks will go in parallel

1. Maintain/improve current code in both physics and usability
   - With some benefit-driven kernel improvements
2. G4MT is promising
   - By early 2013 we plan the integration of G4MT into the main code-base.
   - Also make use of G4MT as the base of our design iterations.
3. Further design iterations
   - Through the internal architecture review in 2010, we identified several areas of potential improvements in either computing performance or maintainability.
   - For example,
     - reducing number of abstract layers, virtual methods
     - relocating transient data members from geometry or physics to track
   - At least for next 5-10 years, total memory size for each core seems to be OK, but cache-hit-rate is the key area of improvements.
   - Try to avoid forcing massive revisions/re-implementations of user's code.

New trends?

- Hardware
  - GPGPU, Intel MIC, etc.
- Programming language
  - CUDA, OpenCL, DSL, etc.
- They all look charming, but we believe they all are still premature.
  - Also, all these technologies currently imply adoption of programming paradigms are too tightly bound to specific hardware solutions. Thus investment in anything more than exploration would cause a serious risk of losing generality and flexibility.
- We will keep eyes on them, keep in touch and/or participating with external projects which explore them, and get whatever the useful bits into our design iterations.
  - For example,
    - through “concurrency project” at CERN/FNAL, we expect to learn the most efficient way of grouping tracks to improve cache-hit-rate as well as the associated requirements from LHC experiments.
    - through SLAC/Stanford/KEK/NVIDIA project, we expect to learn the most efficient way to deal with a large data table (e.g. a large cross-section table) in terms of memory/cache.

Communications inside the Collaboration

- The Geant4 Collaboration holds a general annual Collaboration Meeting (CM).
  - It lasts for one working week.
- The CM is open only to the Collaboration members, but external members participation is still doable, by invitation.
- The CM is organized in plenary and parallel sessions. At CM, the Collaboration states on its developments, and discusses issues, evolutions and future plans.
- The most recent Collaboration meeting was held at Chartres (France). The meeting web site, where agenda and all presentations are publicly available, is here:
  - http://llr.in2p3.fr/sites/g4-2012/home.html
- Links to past Collaboration meetings can be found either in the past events list, or in this page:
  - https://geant4.cern.ch/collaboration/workshops.shtml
- There are several kinds of regular meetings, which include the annual Collaboration meeting, Steering Board meetings and Working Group meetings.
- The Collaboration has several internal mailing lists, including the Collaboration-wide list, WG lists, lists dedicated to tasks and projects, etc.

Following presentations

- In the following three presentations, we will continue describing our collaboration processes for:
  - Communication with users and requirement capturing
  - Publication, and
  - Release

Backup slides

Geant4—a simulation toolkit 10.1016/S0168-9002(03)01368-8 : Nuclear Instruments and Methods in Phys...rch Section A: Accelerators, Spectrometers, Detectors and Associated Equipment | ScienceDirect.com

http://www.sciencedirect.com/science/article/pii/S0168900203013688

Geant4 Frequent News

SciVerse ScienceDirect Hub | ScienceDirect | Scopus | Applications | Register | Login | Go to SciVal Suite

Home | Browse | Search | My settings | My alerts | Shopping cart | Help

Export citation | PDF (2862 K) | More options... | Search ScienceDirect | Search

Show thumbnails in outline

ELSEVIER

Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment

Volume 506, Issue 3, 1 July 2003, Pages 250–303

GEANT4—a simulation toolkit

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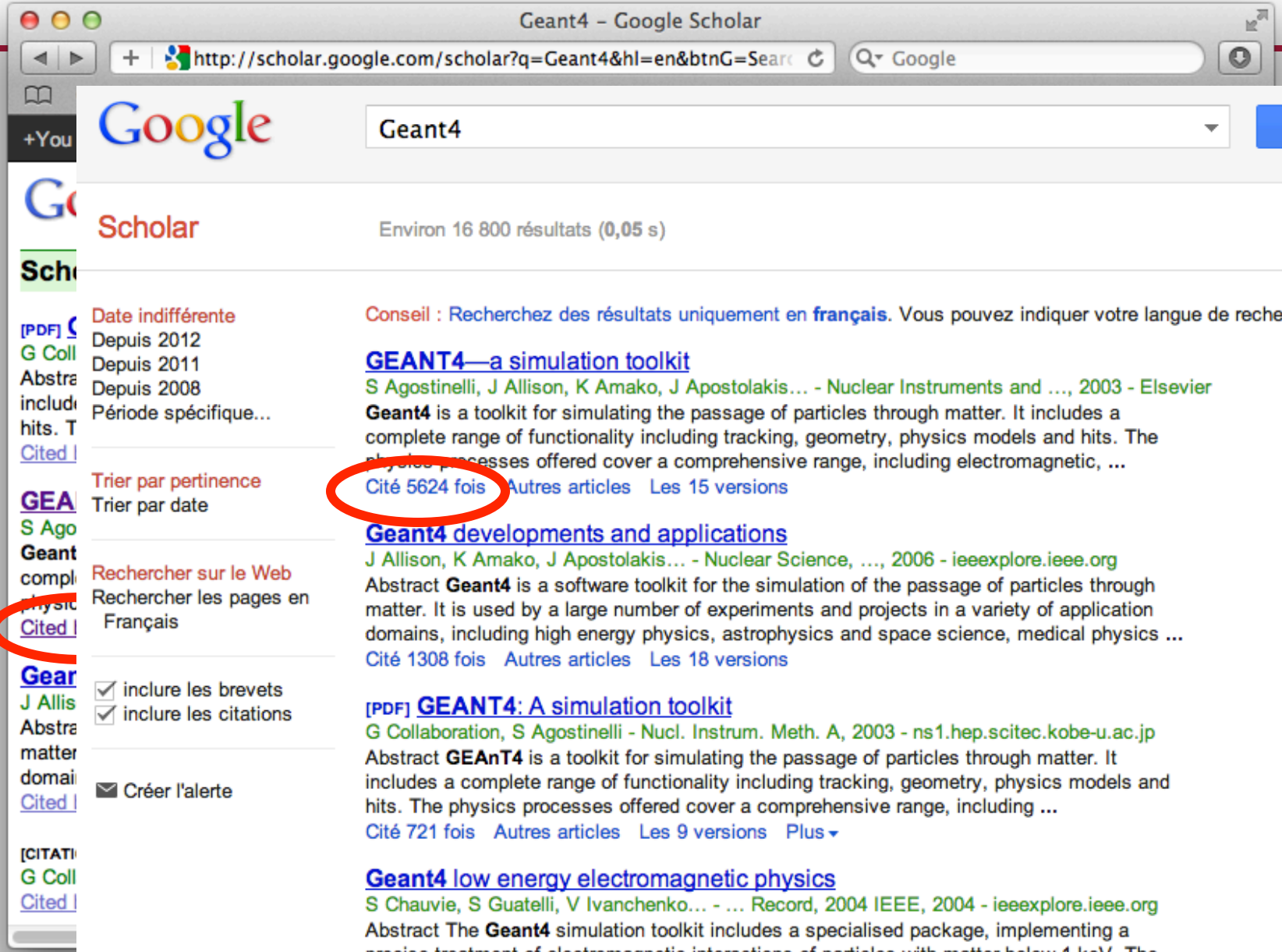
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GEANT4—a simulation toolkit
S Agostinelli, J Allison, K Amako, J Apostolakis... - Nuclear Instruments and ..., 2003 - Elsevier
Geant4 is a toolkit for simulating the passage of particles through matter. It includes a complete range of functionality including tracking, geometry, physics models and hits. The physics processes offered cover a comprehensive range, including electromagnetic, ...
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J Allison, K Amako, J Apostolakis... - Nuclear Science, ..., 2006 - ieeexplore.ieee.org
Abstract Geant4 is a software toolkit for the simulation of the passage of particles through matter. It is used by a large number of experiments and projects in a variety of application domains, including high energy physics, astrophysics and space science, medical physics ...
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G Collaboration, S Agostinelli - Nucl. Instrum. Meth. A, 2003 - ns1.hep.scitec.kobe-u.ac.jp
Abstract GEAnT4 is a toolkit for simulating the passage of particles through matter. It includes a complete range of functionality including tracking, geometry, physics models and hits. The physics processes offered cover a comprehensive range, including ...
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S Chauvie, S Guatelli, V Ivanchenko... - ... Record, 2004 IEEE, 2004 - ieeexplore.ieee.org
Abstract The Geant4 simulation toolkit includes a specialised package, implementing a precise treatment of electromagnetic interactions of particles with matter below 1 keV. The Geant4 low energy electromagnetic package provides a variety of models describing the ...
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Geant 4

Closing remarks

Makoto Asai and Marc Verderi

2012 Geant4 Collaboration Meeting

Chartres

SLAC NATIONAL ACCELERATOR LABORATORY

Before we conclude the collaboration meeting

- Before we move to the final slides, let's see some presentations outside of this collaboration meeting.
  - CHEP2012
  - Transforming Geant4 to the Future Workshop
  - Open Symposium of European Strategy Preparatory Group

High Energy Physics and Computing – Perspectives from DOE

CHEP
May 21, 2012

Dr. Glen Crawford
Office of High Energy Physics
Office of Science, U.S. Department of Energy

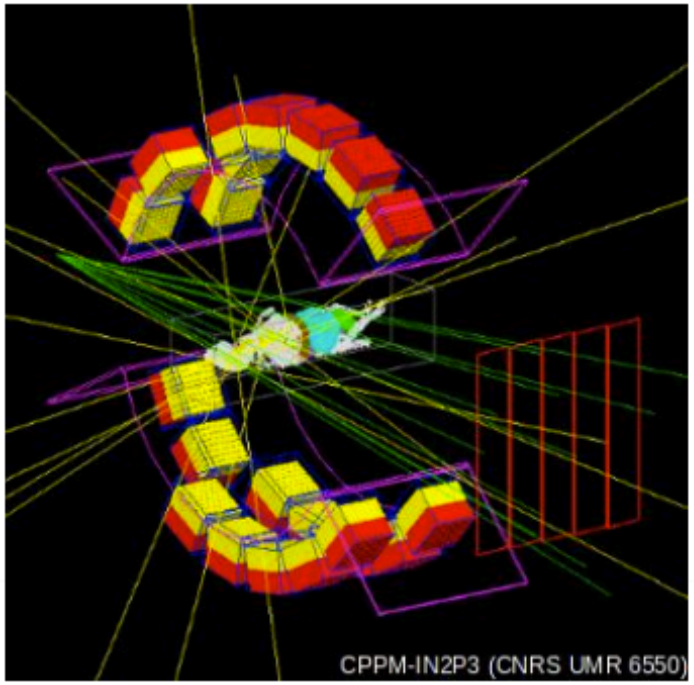
Applications Beyond HEP

- **In addition to being vital for our ongoing detector simulation, GEANT4 captures the experience and knowledge of particle physics about what happens when particles pass through matter.**
- **GEANT4 is freely available to the public and has found important uses in industry.**

• Aerospace and medical devices companies use the software in their work. Boeing and Lockheed Martin use it to study the effects of cosmic rays on the electronics in satellites.

- Electronics have become so sensitive that a single cosmic ray can affect the proper operation.
- Monte Carlo Radiative Energy Deposition (MRED) software uses GEANT4.

•Geant4 Application for Tomographic scanning



EmissionSimulation of PET scans and Radiotherapy using GEANT4 as its base.

Transforming Geant4 for the Future Workshop

Sponsored by the U.S. Department of Energy, Office of Advanced Scientific Computing Research and Office of High Energy Physics

Rockville Hilton, Rockville MD, May 8–9, 2012

Home

Agenda

Contacts

Documents

Lodging

Presentations

Participant List

Registration

Change font size A A A

The Department of Energy's (DOE) Office of Advanced Scientific Computing Research (ASCR) and Office of High Energy Physics (HEP) are co-sponsoring a workshop to identify opportunities and needs for leveraging the powerful physics capabilities of Geant4 into a robust, sustainable software infrastructure.

Geant4 is a software toolkit that was developed for the simulation of particle-matter interactions for high energy physics (HEP) research. One of the most commonly used simulation tools in experimental HEP, GEANT 4 is critical for LHC experiments at the Energy Frontier. It is an important tool in the design of high energy physics detectors and their subsequent data handling, and thus a key component of an experiment's overall physics analysis toolkit.

The workshop will identify applied mathematics, computer science and algorithm development challenges in effectively transitioning Geant4 to new computer architectures and will examine opportunities for discovery enabled by numerical algorithms and optimization tools to meet these challenges. Transforming the code will increase its performance and allow the incorporation of additional physical models that will further increase its accuracy. This transformation will also facilitate handling of the exponentially increasing volume of experimental and simulation data that must be collected, stored, simulated and analyzed to enable further discovery of the fundamental workings of nature.

The Department of Energy's (DOE) Office of Advanced Scientific Computing Research (ASCR) and Office of High Energy Physics (HEP) are co-sponsoring a workshop to identify opportunities and needs for leveraging the powerful physics capabilities of Geant4 into a robust, sustainable software infrastructure.

Closing Session

https://europeanstrategygroup.web.cern.ch/EuropeanStrategyGroup/

Open Symposium

Cracow, Poland, 10-12 September 2012

T. Nakada

EPFL-LPHE

Lausanne, Switzerland

Scientific Secretary for Strategy Session of CERN Council

Chair of Strategy Group and Preparatory Group

Instrumentation, Computing and General Infrastructure

Detector R&D for Discovery Science:

-Many ongoing R&D efforts in Tracking (50%) / Calorimetry / PID / electronics

-New technologies: ~15 years R&D from conception to production ➔ need to start early

-Step from R&D to realization requires industrialization / Technology transfer.

Discussion: More coherent / collaborative work among R&D communities.
More effort on education of and recognition for young physicists on detectors.
Is there a need to revive the DRDC committee?

Large scale projects / Infrastructures:

-LHC experiments pioneered an approach applicable to future large projects,

-Project management and strong host laboratory is pivotal to deliver large scale projects,

-Maintain local expertise at large laboratories to cope with production/commissioning.

Discussion: Training and education of young generation via specialized schools has to be supported / stronger role of Universities advisable.
Support of small size experiments as training platform for next generation.
How best to provide infrastructure/support for "greenfield" experiments?

Computing:

-Great success of LHC computing / WLCG, but needed ~15 years development

-Tier-structure lead to speedy delivery of results. Future funding uncertainties ? new computing model needed ?

-Must handle multiple core processors in future ➔ Experienced computing engineers needed

-GEANT4 very successful, but need further developments to cope with experiments and detector R&D of the future.

COMPUTING AND DATA MANAGEMENT FOR PARTICLE PHYSICS IN 2020

Tommaso Boccali – INFN Pisa

Event Simulation

- Particle-matter simulation toolkits, born in HEP for HEP, are a huge gift to non-HEP world, and are widely used in science and industry. Citations' count for Geant4, for example, exceeds 3.2k and still growing fast (and, most of these are not references from HEP!)

- **In the close future, we need to:**
  - Have an improved descriptions of microscopic interactions. This is needed to cope with next generation detector R&D, where new materials are beyond the scope of current approximations.
    - Do not assume that since today simulations are usable, they have reached end of development phase

- **Ensure a better use of resources:**
  - **Geant4 is the single software component which takes more CPU in HEP processing**
  - If you want, the toolkit is responsible for most $$$ spent on computing, OR
  - A 1% performance improvement here is more $$$ than elsewhere
    - **Be it via use of new architectures or by rewriting critical parts of the code**

These slides should read…

- We have achieved tremendous job and Geant4 now wins a big success. But we need to do more, and people expect our further achievements.
- Physics performance and rich functionality are essential. No doubt on this.
- But we need to put our major efforts on improving the cost performance of Geant4-based simulation. No single solution here.
  - Code cleanup, data locality improvements, richer event biasing options, multi-threading, code reengineering, new trends e.g. GPGPU, etc.
  - Just a 10% performance improvement benefits millions of dollars for LHC, for example.