

# Testing Geant4 using CMake/CTest/CDash

Geant4 Collaboration Meeting, September 2012, Chartres

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*30/08/2012*

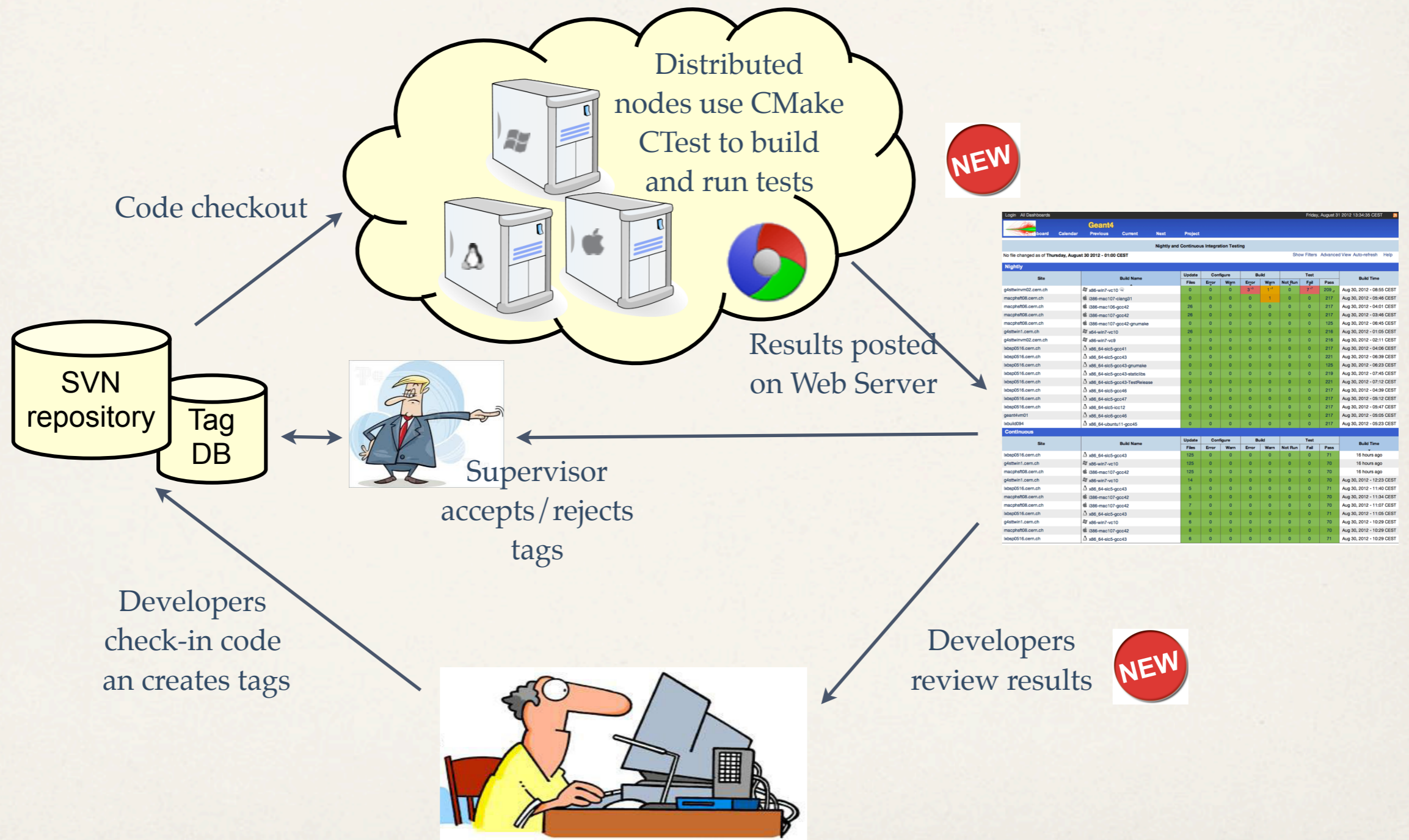
# Goals

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- ❖ To introduce a new *Geant4 Software Process* with much more shared responsibility among developers
- ❖ To ease the development of Unit and Integration Tests
  - ❖ These are full responsibility of developers
- ❖ To share responsibility of integration testing
  - ❖ Developers should be responsible of the consequences of her/his new code does to the rest of Geant4 and for all supported platforms
- ❖ To easily extend the testing system with new tests and new platforms



# Geant4 Software Process





# Main Player: The Developer

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- ❖ Developers are responsible for their code to run correctly and not affecting negatively other G4 functionality
- ❖ The developer typically:
  - ❖ Checks-out, modifies and builds successfully the code (with CMake)
  - ❖ Develops and runs Unit Tests to exercise his/her code in isolation in his/her preferred platform (with CMake/CTest)
  - ❖ Commits code to SVN and creates new “Tags”
  - ❖ Inspects the results of running the new code for all Integration Tests and Examples in all supported platforms (with CDash)
  - ❖ Take corrective actions ASAP: rejecting “Tags”, or committing new code with the fixes





# Distributed Build/Test Nodes

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- ❖ CERN has provided a number of systems to build and run all defined tests in a continuous integration mode
  - ❖ Some of the nodes are physical nodes and others virtual machines
- ❖ They cover all the main supported platforms by Geant4:
  - ❖ Linux (slc5, slc6) with gcc 4.x, icc
  - ❖ Windows (xp, 7) with vc9 and vc10
  - ❖ MacOSX (10.6, 10.7, and soon 10.8) with gcc 4.1 and clang 3.1
- ❖ Every 'build' (checkout, configuration, build, run tests) in CDash has a "**Build Name**" and belongs to a "**Build Group**"
- ❖ We are currently implementing workflows based on the tool ElectricCommander to automate the launching of the builds



# Build Groups

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- ❖ **Nightly** - Runs everyday shortly after midnight (CET) with all 'selected' and 'accepted' tags on top of the monthly reference tag
  - ❖ Full SVN checkout and full re-build for all supported platforms
  - ❖ It includes all integration tests and examples
  - ❖ 'Tags' can only be 'Accepted' if do not break the Nightly group
- ❖ **Continuous** - Runs every time new tags are added on top of the monthly reference including the newly 'Proposed' tags.
  - ❖ SVN update and incremental build (beware that compilation warnings are reported once)
  - ❖ It includes only the integration tests with low statistics
  - ❖ Results should be available in less than 1 hour (not for the first build of the day)
  - ❖ 'Tags' can only be 'Selected' if do not break the Continuous group



# Build Groups (2)

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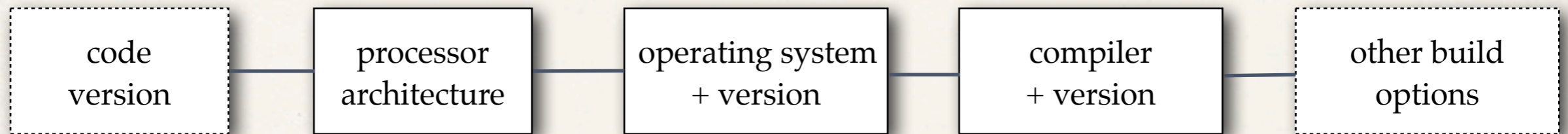
- ❖ **PhysicsChecks** - Extra physics checks. Run every day (or week) with additional physics validation checks (see A.Dotti Parallel session 7A)
  - ❖ It includes validation checks with often long running times
  - ❖ This group is not used for selecting or accepting new 'Tags'
  - ❖ Failures may be long-term reminders for improving the physics quality. The history of when a failure started is kept.
- ❖ **Release** - They only run during release periods on top of candidate branches with all the integration tests and examples
- ❖ **Experimental** - Experimental builds run every day or on demand with new experimental platforms (new compilers, options, etc.)
  - ❖ Once build runs successfully it may be moved to the Nightly group



# Build Names

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- ❖ Build names are composed as follows:



- ❖ The names are intended for humans to describe in a single string the full conditions of the build
- ❖ As much as possible they are obtained automatically
- ❖ Examples:
  - ❖ x86\_64-slc5-gcc43, x86-win7-vc10, x86\_64-slc5-gcc43-staticlibs, 09-05-ref-08\_branch-x86\_64-slc5-gcc43



# Publishing results in CDash

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- ❖ Once the builds at the various nodes are done, CTest uploads the results to the CDash server (cdash.cern.ch)
  - ❖ Results are a set of XML files, one for each build phase (update, configuration, build and test)
  - ❖ Results are 'pushed' to the CDash server
- ❖ CDash makes use of a database to keep the results for as long as necessary
  - ❖ Queries are possible
- ❖ CDash can report by e-mail of failures in submissions
  - ❖ So far enabled for the System Testing mailing list



# Geant4 Dashboard

Login All Dashboards Friday, August 31 2012 16:22:28 CEST

**Geant4**

Dashboard **Calendar** Previous Current Project

Nightly and Continuous Integration Testing

No file changed as of Friday, August 31 2012 - 01:00 CEST Show Filters **Advanced View** Auto-refresh Help

Nightly												
Site	Build Name	Update			Configure		Build		Test			Build Time
		Files	Error	Warn	Error	Warn	Not Run	Fail	Pass			
lxbuid094	x86_64-ubuntu11-gcc45	0	0	0	0	0	0	0	0	217	10 hours ago	
geant4vm01	x86_64-slc6-gcc46	0	0	0	0	0	0	0	0	217	11 hours ago	
lxbsp0516.cern.ch	x86_64-slc5-icc12	0	0	0	0	0	0	0	0	217	2 hours ago	
lxbsp0516.cern.ch	x86_64-slc5-gcc47	0	0	0	0	0	0	0	0	217	2 hours ago	
lxbsp0516.cern.ch	x86_64-slc5-gcc46	0	0	0	0	0	0	0	0	217	3 hours ago	
lxbsp0516.cern.ch	x86_64-slc5-gcc43-TestRelease	0	0	0	0	0	0	0	0	221	51 minutes ago	
lxbsp0516.cern.ch	x86_64-slc5-gcc43-staticlibs	0	1	0	1 <sup>11</sup>	1 <sup>11</sup>	0	0	0 <sub>-219</sub>		5 hours ago	
lxbsp0516.cern.ch	x86_64-slc5-gcc43-gnumake	0	0	0	0	0	0	0	0	125	1 hour ago	
lxbsp0516.cern.ch	<b>x86_64-slc5-gcc43</b>	0	0	0	0	0	0	0	0	221	1 hour ago	
lxbsp0516.cern.ch	x86_64-slc5-gcc41	0	0	0	0	0	0	0	0	217	3 hours ago	
g4sttwinvm02.cern.ch	x86-win7-vc9	506	0	0	0	0	0	0	0	216	14 hours ago	
g4sttwinvm02.cern.ch	x86-win7-vc10	0	0	0	0 <sub>-3</sub>	0 <sub>-1</sub>	0	0 <sub>-7</sub>	216 <sup>-7</sup>		8 hours ago	
g4sttwin1.cern.ch	x64-win7-vc10	145	0	0	0	0	0	0	0	216	15 hours ago	
macphsft08.cern.ch	i386-mac107-gcc42-gnumake	0	0	0	0	0	0	0	0	125	9 hours ago	
macphsft08.cern.ch	i386-mac107-gcc42	145	0	0	0	0	0	0	0	217	12 hours ago	
macphsft08.cern.ch	i386-mac107-clang31	0	0	0	0	1	0	0	0	217	10 hours ago	
macphsft06.cern.ch	i386-mac106-gcc42	145	0	0	0	0	0	0	0	217	12 hours ago	

Continuous												
Site	Build Name	Update			Configure		Build		Test			Build Time
		Files	Error	Warn	Error	Warn	Not Run	Fail	Pass			
lxbsp0516.cern.ch	x86_64-slc5-gcc43	35	1	0	1 <sup>11</sup>	1 <sup>11</sup>	0	0	0 <sub>-71</sub>		5 hours ago	
g4sttwin1.cern.ch	x86-win7-vc10	7	0	0	0	0	0	0 <sub>-4</sub>	70 <sup>-6</sup>		41 minutes ago	
g4sttwin1.cern.ch	x86-win7-vc10	20	0	0	0	0	0	6	64		1 hour ago	
g4sttwin1.cern.ch	x86-win7-vc10	35	0	0	0	0	0	6 <sup>-6</sup>	64 <sub>-4</sub>		5 hours ago	
macphsft08.cern.ch	i386-mac107-gcc42	7	0	0	0	0	0	0 <sub>-5</sub>	70 <sup>-5</sup>		58 minutes ago	
macphsft08.cern.ch	i386-mac107-gcc42	20	0	0	0	0	0	5	65		1 hour ago	
macphsft08.cern.ch	i386-mac107-gcc42	35	0	0	0	0	0	5 <sup>-5</sup>	65 <sub>-5</sub>		5 hours ago	

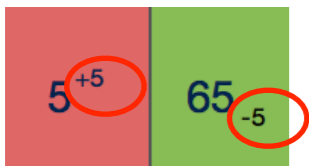
PhysicsChecks												
Site	Build Name	Update			Configure		Build		Test			Build Time
		Files	Error	Warn	Error	Warn	Not Run	Fail	Pass			
lxbsp0516.cern.ch	x86_64-slc5-gcc43	145	1	0	1 <sup>11</sup>	1 <sup>11</sup>	0	0 <sub>-3</sub>	0 <sub>-4</sub>		5 hours ago	

selecting the date

“group” sections

“build” names

changes from previous build on the same group



switching between advanced and simple views



# Navigating in the Dashboard

Site	Build Name	Update		Configure		Build			Test				Build Time	
		Files	Time	Error	Warn	Time	Error	Warn	Time	Not Run	Fail	Pass		Time
g4sttwin1.cern.ch	x86-win7-vc10	20	6s	0	0	1m 42s	0	0	3m 18s	0	6	64	18m 18s	1 hour ago

```
# Date: Fri Aug 31 15:38:11 2012 CET
# Development line #165: geant4-09-05-ref-07 on geant4tags slot g4tags

CHECKOUT SECTION
geant4 geant4-09-05-ref-07

ROOT UPDATE SECTION
./Configure
./config
./examples
./source
./tests
./environments
./cmake

SPECIAL CHECKOUT SECTION
g4tests benchmarks-V09-04-03 ./benchmarks

CATEGORIES SECTION
A g4tests bel-V09-05-01 benchmarks/electromagnetic/bel
A g4tests be2-V09-05-01 benchmarks/electromagnetic/be2
A g4tests cmscal-V09-05-00 benchmarks/calorimeter/HadCalCMS
A g4tests simplifiedcalorimeter-V09-05-01 verification/SimplifiedCalorimeter
A g4tests statest-V09-05-02 verification/StatTest
A geant4 test64-V09-05-02 ./tests/test64
A geant4 interfaces-V09-05-11 ./source/interfaces
A geant4 ctests-V09-05-15 ./tests/ctests
A geant4 vis-V09-05-35 ./source/visualization
A geant4 run-V09-05-05 ./source/run
A geant4 hadr-deex-V09-05-10 ./source/processes/hadronic/models/de_excit
A geant4 test30-V09-05-15 ./tests/test30
A geant4 had-hadronization-V09-05-06 ./source/processes/hadronic/models/parton_s
A geant4 hadr-hpn-V09-05-16 ./source/processes/hadronic/models/neutron_h
A geant4 hadr-chips-body-V09-05-08 ./source/processes/hadronic/models/chiral_in
A geant4 hadr-chips-frag-V09-05-05 ./source/processes/hadronic/models/chiral_in
A geant4 had-abrasion-V09-05-02 ./source/processes/hadronic/models/abrasion
A geant4 emutils-V09-05-32 ./source/processes/electromagnetic/utills
A geant4 gtherapy-V09-05-01 ./examples/extended/medical/GammaTherapy
A geant4 hadr-string-diff-V09-05-17 ./source/processes/hadronic/models/parton_s
A geant4 dnaphysics-V09-05-01 ./examples/advanced/dnaphysics
```

Revision: 61230 Show Activity Graph

Expand all | Collapse all

- Geant4 Updated files (7)
  - source/processes/hadronic/models/binary\_cascade
    - History Revision: -1 by Unknown
    - test Revision: -1 by Unknown
  - source/processes/hadronic/models/bi
    - G4BinaryCascade.hh Revision: -1 by Unkn
    - G4GeneratorPrecompoundInterface.hh Rev
  - source/processes/hadronic/models/bi
    - G4BinaryCascade.cc Revision: -1 by Unkn
    - G4BinaryLightIonReaction.cc Revision: -1
    - G4GeneratorPrecompoundInterface.cc Rev
- Modified files (0)
- Conflicting files (0)

Expand all | Collapse all

Test: test12-FTFBIC (Failed)

Build: x86-win7-vc10 (g4sttwin1.cern.ch) on 2012-08-31 15:05:48

Repository revision: 61230

Exit Value 1

Show Command Line

Show Test Time Graph

Show Failing/Passing Graph

Test output

```
G4Test rc Access violation
G4Test stdout.

*****
Geant4 version Name: geant4-09-05-ref-07 (10-August-2012)
Copyright : Geant4 Collaboration
Reference : NIM A 506 (2003), 250-303
WWW : http://cern.ch/geant4
*****

<<< Geant4 Physics List simulation engine: FTF_BIC 1.2

*
* The Physics list FTF_BIC is an experimental physics list !
*
* Please report your use case for, and your experience with this
* physics list on the Geant4 User Forum dedicated to physics lists:
* http://hypernews.slac.stanford.edu/HyperNews/geant4/get/phys-list.html
*
*****

Test12 using physics list FTF_BIC
```

Testing started on 2012-08-31 13:09:06

Site Name: g4sttwin1.cern.ch

Build Name: x86-win7-vc10

Total time: 36m 29s 90ms

OS Name: Windows

OS Platform: x86

OS Release: 7

OS Version: Service Pack 1 (Build 7601)

Compiler Version: unknown

6 tests failed.

Name	Status	Time	Details
test12-FTFBIC	Failed	1s 480ms	Completed (Failed)
test12-QGSBIC	Failed	1s 250ms	Completed (Failed)
test27	Failed	12s 170ms	Completed (Failed)
test28	Failed	6s 270ms	Completed (Failed)
test46	Failed	29s 840ms	Completed (Failed)
test61	Failed	30s 690ms	Completed (Failed)

The actual list of "tags" used in this build



# Extending the Build/Test Platforms

- ❖ CERN has provided a number of build and test nodes for the 'supported' platforms but we can extend it easily for groups having special requirements on additional platforms or special configurations
  - ❖ Since results are 'pushed' to CDash other build nodes can be setup elsewhere and contribute to the testing infrastructure
- ❖ A simple script like this one needs to be run regularly (e.g. cron job, ElectricCommander, etc.)
- ❖ Other example scripts can be obtained at URL:  
`svn+ssh://svn.cern.ch/repos/geant4/trunk/geant4/tests/tools/ctest`

```
#!/usr/bin/env bash
#-----
#---Xerces-C-----
export XERCEC_ROOT_DIR=/build/externals/xerces-c-3.1.0
export DYLD_LIBRARY_PATH=${XERCEC_ROOT_DIR}/lib:${DYLD_LIBRARY_PATH}
#-----
THIS=$(dirname $0)
WORKDIR=/build/cdash/G4
CONFIG=mac106-gcc42
MODE=nightly

export VERSION=g4tags-dev
export SOURCE=${WORKDIR}/${MODE}/${VERSION}
export BINARY=${WORKDIR}/${MODE}/${CONFIG}

if [ ! -d "${SOURCE}" ]; then
    ${THIS}/g4tagsvn.py update -c ${VERSION} -d ${SOURCE} -q
fi
#---Run the CTest script-----
ctest -V -S ${THIS}/g4${MODE}.cmake
```



# Extending the Set of Tests

- ❖ Adding new tests is very straight forward
  - ❖ Write the test in C++ in the directory `tests/testXX` following the standard structure (`/src`, `/include`)
    - ❖ Note that test will fail if `RC != 0` or any output in the `err` stream
  - ❖ Provide test definitions in `CMakeLists.txt` file

- ❖ example:

- ❖ Commit and create new 'Tag'
- ❖ It will be automatically added to 'Continuous' and 'Nightly' groups

```
cmake_minimum_required(VERSION 2.6 FATAL_ERROR)
project(test74)
find_package(Geant4 REQUIRED)
include(${Geant4_USE_FILE})

GEANT4_EXECUTABLE(test74 test74.cc src/*.cc)

#---Test definitions-----
GEANT4_ADD_TEST(test74
    COMMAND test74 ${CMAKE_CURRENT_SOURCE_DIR}/test74.in
    BUILD test74
    LABELS Nightly Continuous
    ENVIRONMENT ${GEANT4_TEST_ENVIRONMENT})

GEANT4_ADD_TEST(test74-largeN
    COMMAND test74 ${CMAKE_CURRENT_SOURCE_DIR}/test74.large_N.in
    DEPENDS test74
    LABELS Nightly Continuous
    ENVIRONMENT ${GEANT4_TEST_ENVIRONMENT})
```



# Summary

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- ❖ Introduced a new Software Process in which the **Developer has a major role in the Integration Testing**
- ❖ Making extensive use of the Kitware software development tools: CMake, CTest and CDash
- ❖ Since discovering problems earlier has huge advantages we have introduced a **continuous integration** and testing
- ❖ Encouraging and facilitating the enlargement of the set of tests with new quality tests, with new platforms and the introduction of poorly tested configurations

