Validation of Geant4 Releases with distributed resources

Andrea Dotti (CERN, PH-SFT), andrea.dotti@cern.ch

Introduction

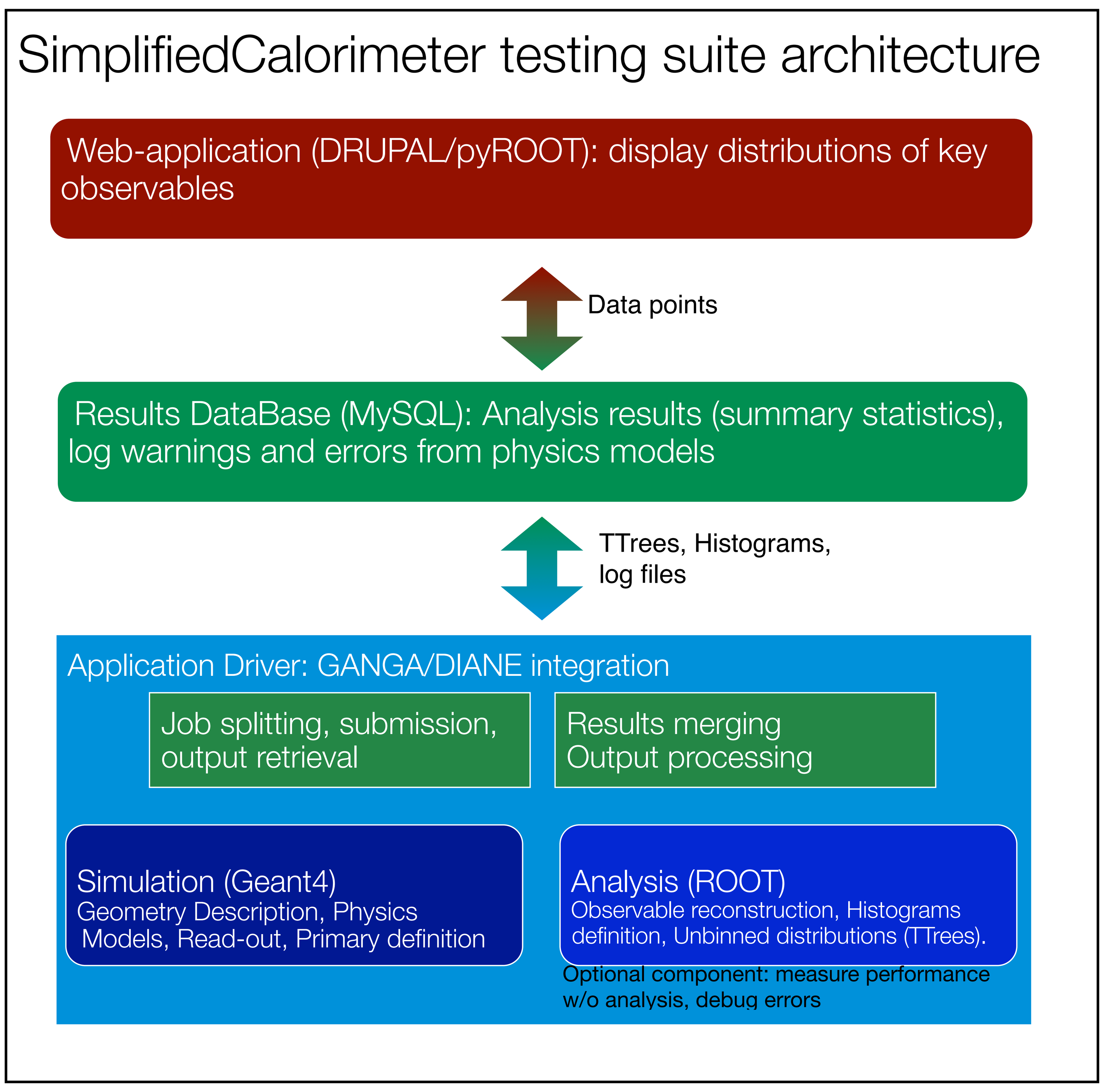
The validation of new Geant4 developments is extensively tested with unit tests and semi-realistic setups. In this paper we present the strategy and tools used to accomplish physics validation.
Geant4 [1] is a toolkit for the simulation of passage of radiation through matter. It is successfully used by all LHC experiments as well as by medical applications, space physics and industrial applications. An improved version of Geant4 (currently 9.5) is released every year and a beta preview release is also made available.

SimplifiedCalorimeter

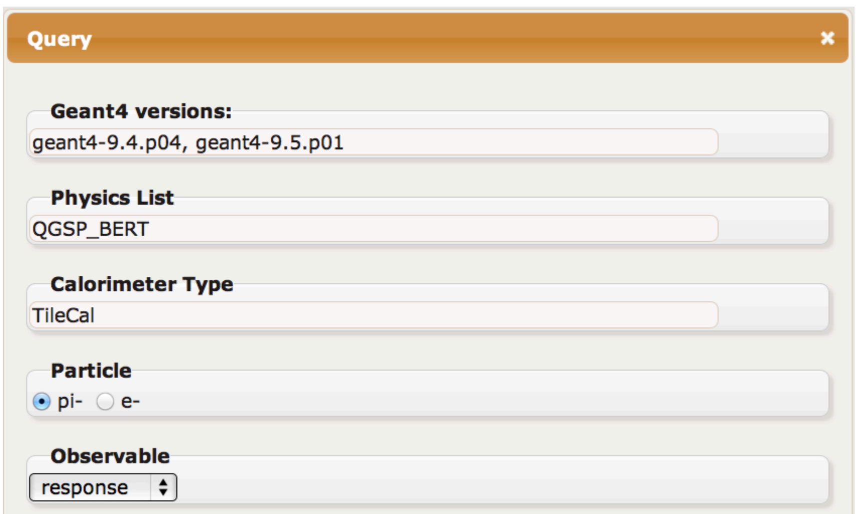
One of the most challenging use-cases is the simulation of the LHC detectors. The description of calorimeters is particularly demanding: it challenges all aspects of physics modeling. Simplified versions of HEP calorimeters has been implemented with Geant4. All LHC calorimeter materials and technologies have been implemented. The most important variables for calorimetric measurements (response, resolution and shower shapes) are reconstructed and recorded for analysis [6].
This application is used to test and verify physics improvements and new developments.

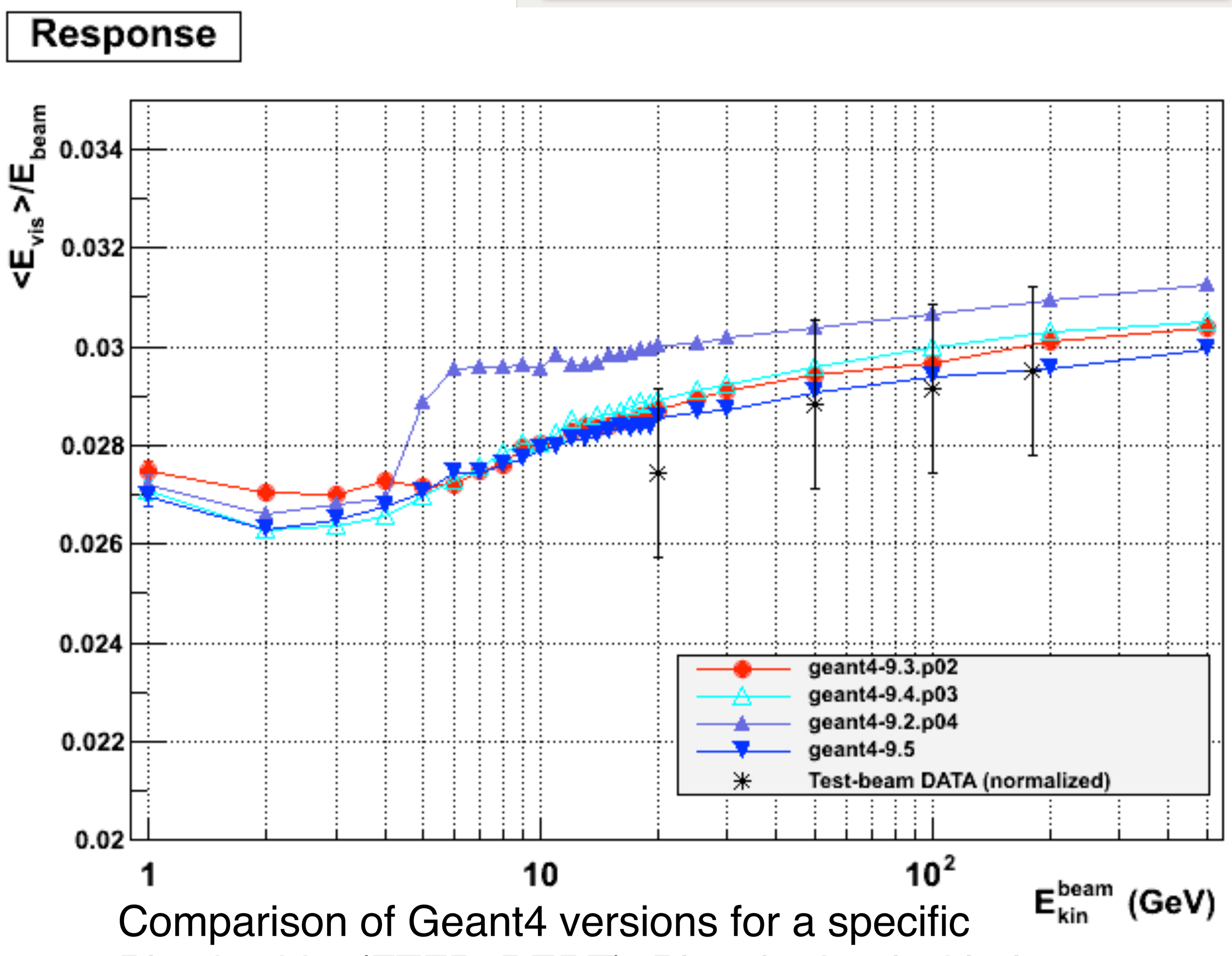
Testing Strategy

Data produced with the application are used to verify the stability of Geant4 code. Each new development is tested on a set of well defined conditions: five different calorimeter types (all LHC materials), eight physics models combination (*physics lists*) and both hadrons and leptons as primary beam. Primary energy ranges from 1 to 500 GeV.
Detailed log files are produced and checked for unexpected output. Any warning or error message from simulation code results in a run failure.
In addition physics observables (response, resolution, shower shapes) are calculated [5] and compared to results obtained with reference Geant4 versions and, when available, against real data.



Web-application querying tool: select experimental conditions and simulation versions and models

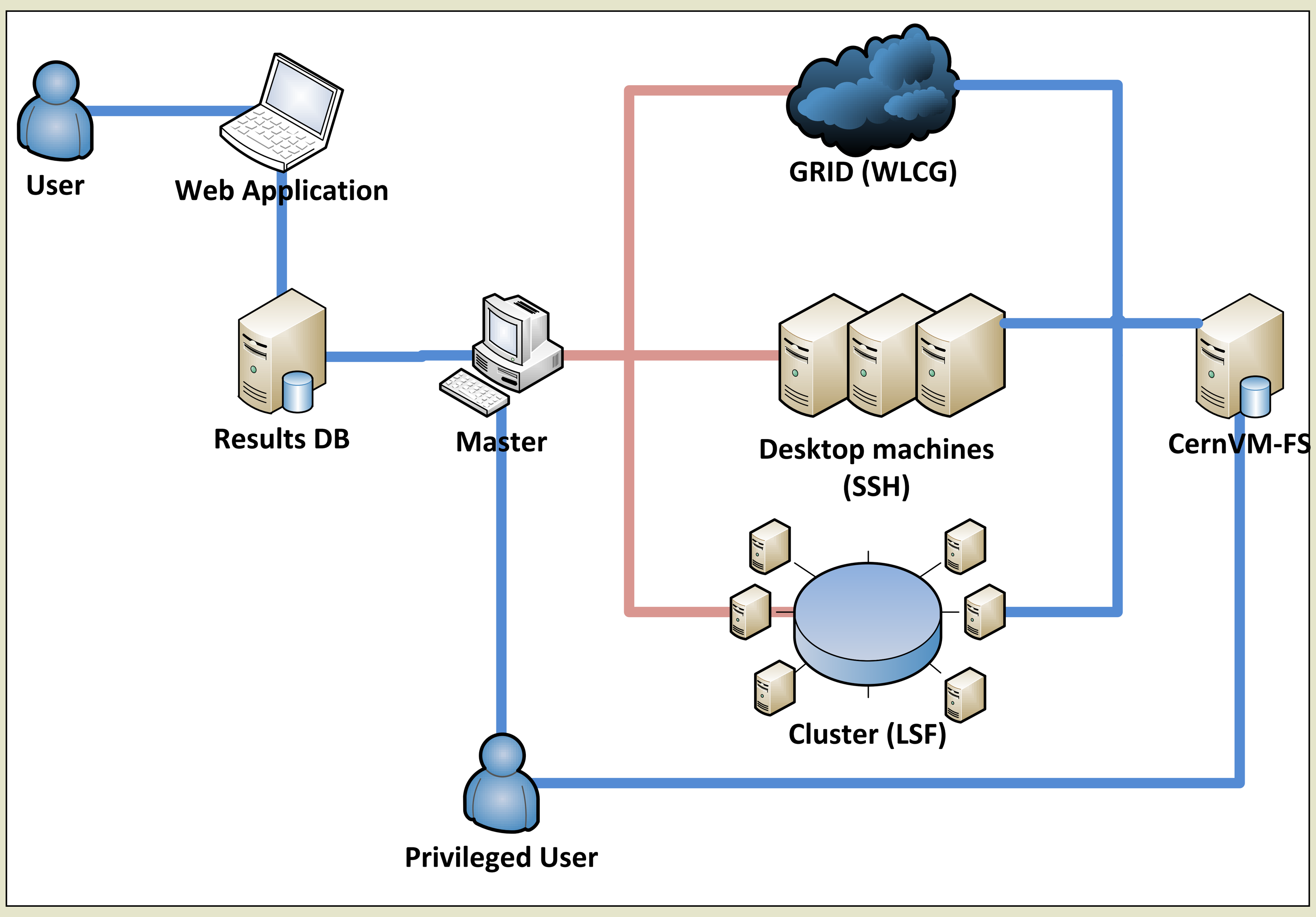




Comparison of Geant4 versions for a specific Physics List (FTFP_BERT). Plot obtained with the web-application

Deployment

Geant4 code is distributed via CernVM-FS [3]. Candidate Geant4 versions are compiled for all needed platforms and published on CernVM-FS servers. The code is available on remote sites in few hours. Jobs are submitted to resources via DIANE and GANGA [2]. This allows to transparently use local resources, batch queue and GRID resources.



Web interface

Once the results have been collected from distributed worker nodes, physics results and summaries from log files are uploaded to a DB.
Analysis macros (pyROOT) [4] have been developed to produce relevant plots.
A simple web-application based on DRUPAL has been developed to automatically produce the most significant plots: the DB is queried for specific Geant4 versions or physics models and plots are produced.
When test-beam data from LHC are available these are also included.
A subset of the most significant results are also copied to the official Geant4 validation results and made available for users [7,8].

Conclusions

The use of heterogeneous distributed resources (batch queues, GRID) provided the capacity to significantly extend the validation of Geant4 developments.
Each month the internal Geant4 development release is tested with a limited sample of about 10 millions events. The June (beta) and the November (production) releases are validated with a sample at least 10 times larger.
The use of CernVM-FS, GANGA and DIANE supports submission of jobs on local (LXBATCH) or GRID resources (KEK, CERN, IN2P3/CEA, RAL, NIKHEF).
The system is in production since 2011 and soon a "shift" rota will be established to share the validation responsibility among the collaboration.

Resources and further reading

[1] Geant4: http://www.geant4.org
[2] DIANE / GANGA: http://cern.ch/diane;http://cern.ch/ganga
[3] CernVM-FS: http://cernvm.cern.ch
[4] ROOT: http://root.cern.ch
[5] CERN-LCGAPP-2012-01
[6] Journal of Physics: Conference Series 293 (2011) 012022
[7] CERN-LCGAPP-2011-04
[8] CERN-LCGAPP-2011-01

PH-SFT BOOTH @ Kimmel