

# Experiences on Grid production for Geant4



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# Outline

- The Geant4 Toolkit
- Principles of Operation
- Geant4 and the Grid
- Results
- Conclusions



# The Geant4 Toolkit

- General purpose toolkit for simulating the tracking and interaction of particles through matter
- Currently used in production in several particle physics experiments (BaBar, HARP, ATLAS, CMS and LHCb). Also used in other areas as space science, medical applications and radiation studies
- **Object-Oriented** (more than 500,000 lines of C++ code) project modular and extensible
- Careful testing of all of Geant4 components needed before **major releases (twice per year: June and December)**
  - ❑ Detection of differences between 2 Geant4 versions by comparing large number of physics observables
  - ❑ Only those distributions statically different are visually examined by Geant4 developers to understand the origin of the difference (bug?, improvement?)

- Electromagnetic physics of Geant4 and even more Hadronic physics are quite complex fields
- During the testing phase of the new software release only High Energy Physics are included
  - ❑ It is fundamental to test their models covering the widest possible range of particles, materials and energies
- Simplified Calorimeter setup to be tested
  - ❑ It reproduces in a simplified way, all the LHC calorimeters
    - Fe-Sci, Cu-Sci, Cu-Lar, W-Lar, Pb-Sci, Pb-Lar, PbWO4
  - ❑ Beam particle type
    - pi+, pi-, k+, k-, K0L, p, n, e-
  - ❑ Beam Energy
    - 1, 2, 3, ..., 10, 20, 30, 40, 50, 60, 80, 100, 120, 150, 180, 200, 250, 300 (1000) GeV
  - ❑ 5 physics list
    - LHEP, QGSP, QGSC, QGSP\_BIC, QGSP\_BERT



# Geant4 and the Grid

- 7 calorimeters X 8 particles X 24 beam energies X 5000 events X 5 Geant4 physics configurations
- Tests extremely CPU demanding:
  - ❑ 1 event of 1GeV about 0.03 s (2.4Hz) and 1 event of 300GeV about 9-10 s
- Overall it takes few years of CPU time, but concentrated in 2 weeks before the final release of the new Geant4 version

## o GRID IS NEEDED

- Some history
  - ❑ 1st Production in December 2004 as VO: “dteam”
  - ❑ 2nd Production in June 2005 as VO: “alice”
  - ❑ From December 2005 they are a new official EGEE VO: “geant4”



## Geant4 and the Grid (2)

- During the 1st week of production:
  - ❑ Software installation (access to a share file system through the env VO\_GEANT4\_SW\_DIR is mandatory) and sites debugging
  - ❑ CERN as Geant4 participant site provides the central services
    - RB (access to 2 RB)
    - LFC
    - SE
    - UI (Ixplus)
  - ❑ Sites are required to provide access to the software area and dedicated queues for Geant4
    - Extremely good response of sites during the production
    - Thanks to all sites providing Geant4 resources from the 1st production as new VO
- During the 2nd week of production:
  - ❑ Jobs are executed in all sites that passed the debugging phase
  - ❑ The whole output (hbook files of few GeV) retrieved in a afs area delivered for the production at CERN



# Strategy during the Production

- The reference Geant4 version to compare with is copied in the software area of geant4 at each site
  - ❑ Together with external packages as g++, AIDA, PAW, PI, etc
  - ❑ This version will not change during the whole production
- The new candidate version is copied in a SE at CERN and downloaded for each job
  - ❑ Strategy chosen during the last June06 production
  - ❑ This candidate changes until 5 or 6 times during the whole week
  - ❑ Each job will produce 5000 per each Geant4 version and inside the same job it will perform the statistical comparisons
  - ❑ The environment to run inside the Grid must be extremely flexible and easy to use

- A software able to submit large bunches of jobs and make their monitoring was provided to Geant4
  - ❑ Each job will pass through the RB
  - ❑ Easy tool to use, full Grid unaware
    - Very useful for new applications and users
- In order to optimize the use of the resources we have implemented the use of Ganga/Diane for the Geant4 production
  - ❑ First tests during the last production





## Results of the last Production

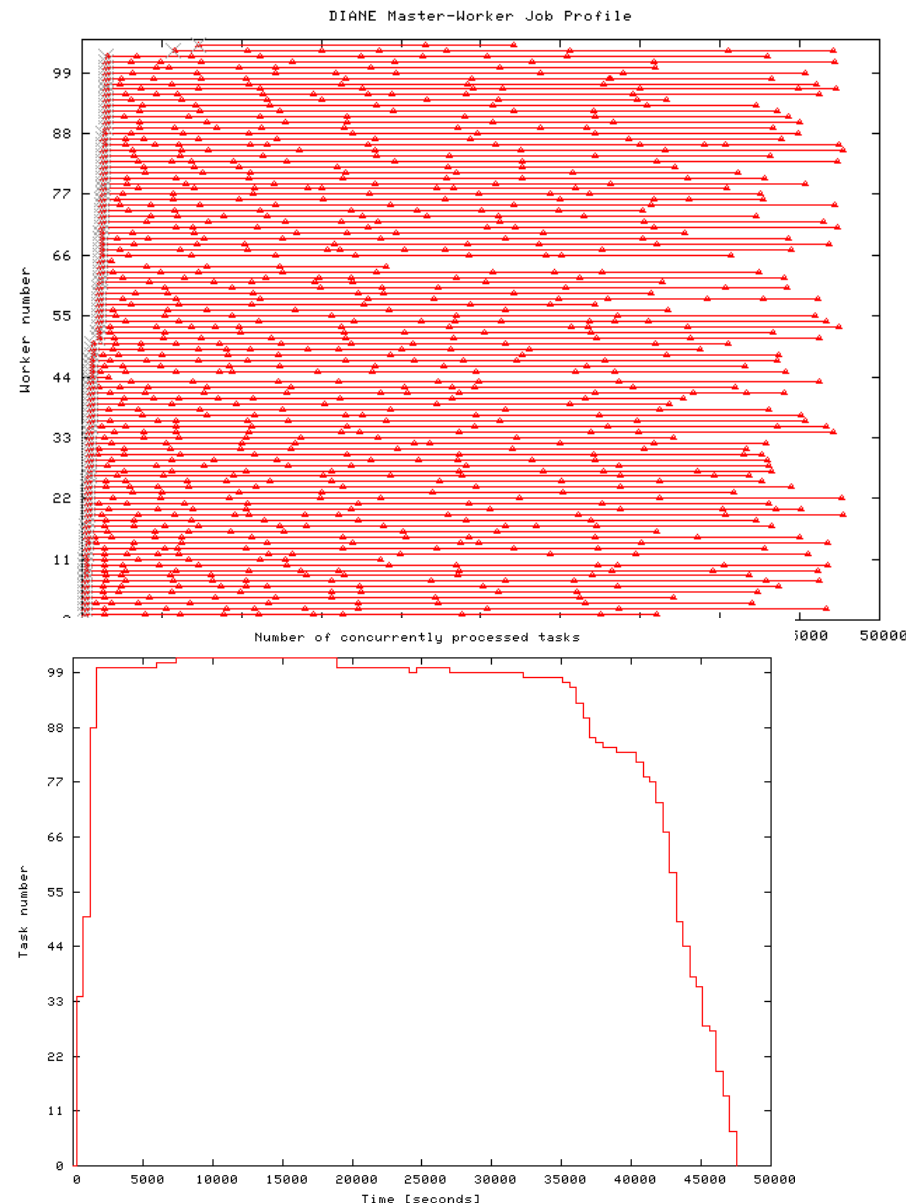
- 7 candidate Geant4 versions tested
- Around 20000 jobs submitted to the Grid
- 99.9% GRID success rate
- A majority of job result were analyzed
  - ❑ Earlier results already shown Geant4 problems
  - ❑ Sometimes lack of space in afs
- Geant4 has access to both Tier1 and Tier2 sites
  - ❑ Both types of sites are treated identically for the production
- Checking the viability of OSG
  - ❑ Several OSG places work also for Geant4

## GANGA

- User Interface to the GRID
- Transparent access to different backends
- Keep history of the jobs
- Automatic monitoring of the status of the jobs
- 3 kinds of interfaces available:
  - CLI, GUI, scripts

## DIANE

- Dynamic user-level scheduler in a beyond master/worker model
- Application independent



- Geant4 is a simulation toolkit widely used by many applications including HEP
- Two major releases are performed per year
- Because of the large CPU required and the short time GRID is the ideal infrastructure to perform their tests
- Geant4 is in Grid production since 2004
- Full EGEE VO since 2005
- Very good results and high efficiency shown by the Grid (99%)
- Ganga/Diane will be the production toolkit for the next December 2006 production