



Geant4 – Requirements from CMS

Outline

- ❑ Geant4 usage in CMS
- ❑ CMS Plans
- ❑ Requirement from Geant4



Geant4 Usage in CMS



- ❑ During 2010, CMS has been using Geant4 versions 9.3 and 9.3.p01 (+ some specific bug fixes in consultation with the Geant4 team)
- ❑ The default physics list is QGSP_BERT_EML (EMV with “ApplyCut” option)
- ❑ CMS has 3 major simulation production phases:
 - Spring 10 production
 - ❖ 200 million events at 7 TeV cm energy from different generators using the version 9.3
 - Summer 10 production
 - ❖ 160 million events at 7 TeV and 125 million events at 0.9 TeV cm energy using the version 9.3
 - Fall 10 production
 - ❖ More than 1 billion events at 7 TeV cm energy using the version 9.3.p01



Some Performance Measurements



- Measurements with 9.3.p01 and current CMSSW (3_9) version on a quad core 3 MHz processor with slc5_ia32_gcc434 system and using ideal CMS geometry

Channel	CPU (second)	Memory (MB)	Data Size (Mb)
t-tbar	67.7	496.4	1.32
MinBias	9.07	478.0	0.17
Z \rightarrow e ⁺ e ⁻	35.8	485.7	0.61
QCD (p _T = 3-3.5 TeV)	234.6	524.8	2.30

Performance within CMS computing model numbers



CMS plans



- Next major releases: 3_10 and 4_0
 - Development has ended for 3_10 and will end by the end of the year for 4_0
 - Should be “the release” for a mass MC production.

- There is a plan to migrate to Geant4 9.4
 - + patches?
 - ❖ Whatever will be available to make a stable production cycle
 - The migration depends on the results of our validations
 - ❖ Validation is ongoing with the 9.3 reference tags and we do not foresee major issues



CMS Requirements



- ❑ After the success of data/MC agreement with 0.9 and 7.0 TeV data, we are planning for increased cm energy and large pile-up conditions
- ❑ We will rely on Geant4.9.3(4).pXX for Monte Carlo corrections. We will try to have a homogeneous Monte Carlo sample changing Geant4 versions for
 - Bug fixes which do not seriously impact physics results
 - Performance improvements
- ❑ Of course we are willing to use further improved Geant4 for the longer term future



Various Considerations



- Consider moving to different physics list which will provide
 - better physics for kaons and anti-particles at least at the level of cross sections (for trackers) and possibly for calorimeter response as well
 - better neutron cross section treatment for regular (not paying high CPU penalty) as well as dedicated studies (background as well as standalone tests)
 - better performance matrix (CPU performance, memory churn, ...)
- Consider utilizing a more performing stepper (Nystrom) in magnetic field or other hybrid version
- Utilize Geant4 for upgrade studies
 - radiation background estimation
 - radiation damage in crystal calorimeters



One Concern



- ❑ Geant4 usually comes out with the major release just before Christmas
- ❑ CERN traditionally has a shutdown of their accelerator system during December-January
- ❑ The experiments get the opportunity to change the detector and software running condition during this break and try to get ready with large Monte Carlo (and data) production with the latest version of software starting from late December/early January
- ❑ This leaves very little time to validate the latest (and greatest) version of Geant4 and to utilize this in the large production cycle
- ❑ It will benefit all LHC experiments (in particular CMS) if Geant4 has its major release one month before the Christmas vacation.