



Geant4 Performance : CMS View

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Geant4 Performance in CMS Application: Revisit History

- **Spring 2006: CMS Simulation team investigated why Geant4.7.1-based simulation went into infinite loop on NaN**
- **CMS opted for a temporary solution:**
 - **“NaN-trap” based on the system function isnan(...)**
 - **“traps” placed in MagFld and SD methods**
 - **skip event if NaN detected**
- **NaN rates from CMS MCProduction tests:**
 - **Minbias: 0-2 events skipped out of 1000 (mult. 20-1500)**
 - **QCD: ~15% of events skipped (mult. several hundreds)**
 - **Heavy Ion: ~65% of events skipped (mult. 2500-40000)**
- **However, use of isnan(...) costs ~3% CPU overhead**

CMS Simulation: Debugging NaN's

- **Debugging CMS simulation code with FPE switched ON:**
 - **Several flaws in the CMS application (geometry)**
 - **Cases of numerical instabilities in Geant4 core code: unprotected $\sqrt{a-b}$ in geometry, hadronic physics**
- **Bug reported to Geant4 developers, fixed in Geant4.8.1**
- **Preliminary tests of the Geant4.8.1(p01)-based release with Heavy Ion events indicate significant performance improvement – 75 events went without any NaN**
- **In the near future CMS plans production-type tests of the release based on Geant4.8.1(p01), for more reliable estimates**
- **Whether we caught all NaN's – most likely, not...**

Further Look at the Geant4 Performance

- **Several software experts plan to look at the Geant4 performance aspects, starting from CMS application:**
 - **Mark Fishler (Fermilab)**
 - **Jim Kowalkowski (Fermilab)**
 - **Marc Parerno (Fermilab)**
- **Aspects to address :**
 - **Timing performance – profile CMS application using VTune (commercial perf. analysis suite from Intel)**
 - **Safety features, numerical (in)stabilities**
- **Work has began, expect more detailed information in the near future**