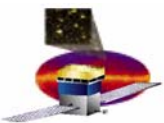# Geant4 Update
A possible strategy

Francesco Longo
University and INFN, Trieste, Italy
**francesco.longo@ts.infn.it**

Discussion

- **G4 8.0 new release**

  - **http://geant4.cern.ch/geant4/source/ReleaseNotes4.8.0.html**

  - **Official platforms:**

    - **Linux, gcc 3.2.3.**
      ***32 bits architectures (Intel)* and *64 bits architectures (AMD)* with the Scientific Linux CERN 3 (SLC3) distribution (based on RedHat Linux Enterprise 3). Compiled successfully on other Linux distributions, like Debian, Suse or other RedHat systems.**

    - **Windows/XP and CygWin Tools with: Visual C++ 7.1 .NET (Tested also with Visual C++ 8.0)**

  - **CLHEP issue**

    - **Tests have been performed with CLHEP-1.9.2.2 The software has been verified also with CLHEP-2.0.2.2.**

CLHEP - issue
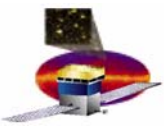
- **CLHEP**
  - **http://proj-clhep.web.cern.ch/proj-clhep/INSTALLATION/clhep-1.9.html**
- **This is the first release with the packages rearranged so that they can be extracted and built separately if desired.**
- **Also, all packages are now in namespace. CLHEP 1.9 has backwards compatibility code so that old user code will still work. Backwards compatibility code is disabled in CLHEP 2.0, and will be disabled in all future major releases.**
- **CLHEP contains HepMC 1.24.**
- **Split the code into the new structure. Headers are in CLHEP/package/package, *.cc files are in CLHEP/package/src, tests are in CLHEP/package/test, and documents are in CLHEP/package/doc.**
- **A "make docs" rule has been added that will optionally build documents. "make install-docs" will copy the documents to the installation directory.**
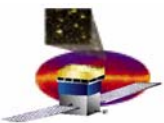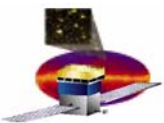
Migration of User Code

- **Creating and instantiating physics lists : impact of the revised, "non-static", particle definitions**

- **All particle-definition objects are instantiated dynamically when the method ConstructParticle() of the user's G4VUserPhysicsList is called.**

- **This method is invoked when the user's physics list is assigned to the G4RunManager (whereas previously it was called at the time of G4RunManager::Initialize()).**

- **The new scheme allows the user to set a number physics quantities to alternative values (e.g. masses of elementary particles) before particles are instantiated with the values provided by Geant4. (?)**

- **This new scheme creates some restrictions:**

    - **Physics processes and models must be instantiated in the ConstructProcess() method of the user's physics list.**
    The reason is that some existing physics processes and models require that particles have been instantiated already.

    - **A user adopting his/her own physics list, will need to perform a similar revision in case a G4Exception occurs when the physics list is instantiated:**
    Fix: **All physics processes and models defined as data members of the physics list must be moved to the ConstructProcess() method, and must be explicitly instantiated by new operator. The revised physics lists provide a reference for this revision.**

    - **User action classes must be instantiated after the physics list is instantiated and after it is set to G4RunManager. Please note that the user's detector construction class is a user initialization class and thus is not affected by this restriction.**

    - **The user should revise the main() function if the following G4Exception occurs:**
    Error message **(for G4VUserPrimaryGeneratorAction): You are instantiating G4VUserPrimaryGeneratorAction BEFORE your G4VUserPhysicsList is instantiated and assigned to G4RunManager. Such an instantiation is prohibited by Geant4 version 8.0.** *Fix:* **Edit main() to make sure all user action classes are instantiated after the physics list is set to G4RunManager.**
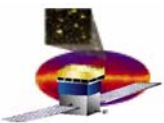
Migration of User Code

- **Multiple Scattering electromagnetic process (?)**

- In the electromagnetic standard package major changes have been introduced concerning the Multiple Scattering process. To improve the behaviour of low energy particles (electrons in particular, but affecting also hadrons), the Multiple Scattering now limits the step size for the particles. This restriction is undertaken using several criteria, and is applied systematically, in all volumes and materials. In addition a model of the correlation between lateral displacement and final direction has been implemented

- As a result, most physical observables become more stable when varying production cuts (i.e. less "cut dependent").

- There is a corresponding cost, a CPU-time penalty, when utilising the same value of the production thresholds. This penalty can be significant, depending on the user's setup and the cut values.

- For many use cases the increased stability will allow the choice of higher production thresholds, recovering computing performance while maintaining physics performance.
  To enable the user to investigate its benefits, a mechanism is provided to deactivate this step limitation. The new method MscStepLimitation(bool) of G4MultipleScattering disables these new step limitations. In addition, in order to help the transition, the old version is available for this release 'frozen' in the class G4MultipleScattering71.

Migration of User Code

- **Migration to <sstream> from deprecated <strstream>**
  - **<strstream> types are no longer in use by the Geant4 kernel in this release. Also any protection from compilation warnings by the compiler for deprecation of such header are no longer implicitely included. User code therefore will be exposed to implement such migration to <sstream>, if not already done.**

- **System of Units and Physical Constants**
  - **Geant4 8.0 can be used either with version 1.9.2.2 of CLHEP or 2.0.2.2. Explicit usage of the CLHEP and HepGeom namespaces is made in the Geant4 code. However, for what concerns Units and Physical Constants, these are still kept available in the global namespace for convenience and backward-compatibility.**
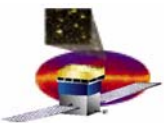
Items for GLAST SW

- **Compilation of GEANT4TEST to test G4 8.0 implementation (with the required changes done on Linux with G4 8.0 compiled at SLAC)**
- **Test of compilation of G4Generator with new release (this week)**
  - **Other packages changes due to CLHEP (gui (done), astro, …)**
  - **Problems in Astro (e.g. CLHEP::pi and healpix constants?)**
  - **Postpone the changes of CLHEP – maintaing 2 versions of CLHEP, is it possible?**
  - **Changes in RunManager**
  - **Changes in PhysicsList**
  - **No more static particles → problems for McRootWriter?**
- **G4Propagator update (is really needed?)**
- **Usage of CLHEP – next version which tests?**
- **Physics Tests**
  - **Physics validation at G4 level**
  - **Physics validation at TestBeam (maintaining two versions of Simulations?)**
  - **Update of Hadronic Physics to be verified at TestBeam**
- **First trial on Geant4 7.0 series?**