

*GEANT4 9.2
and patch-01 highlights*

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Outline

- ✧ Major features and fixes in release 9.2

- ✧ Geometry & persistency

- ✧ Physics

- ✧ Kernel

- ✧ All details in:

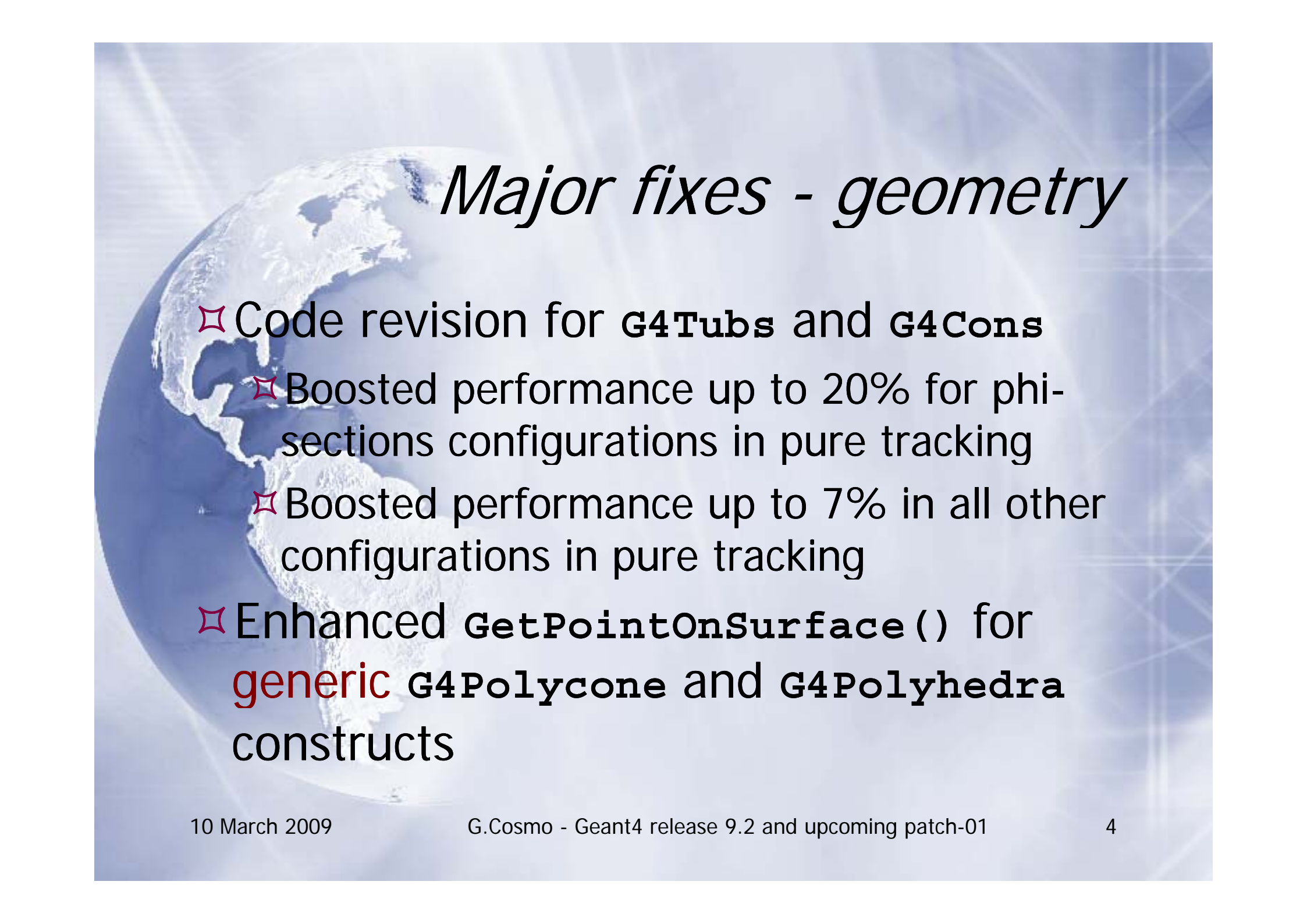
- ✧ <http://geant4.cern.ch/support/ReleaseNotes4.9.2.html>

- ✧ Highlights on 9.2.p01



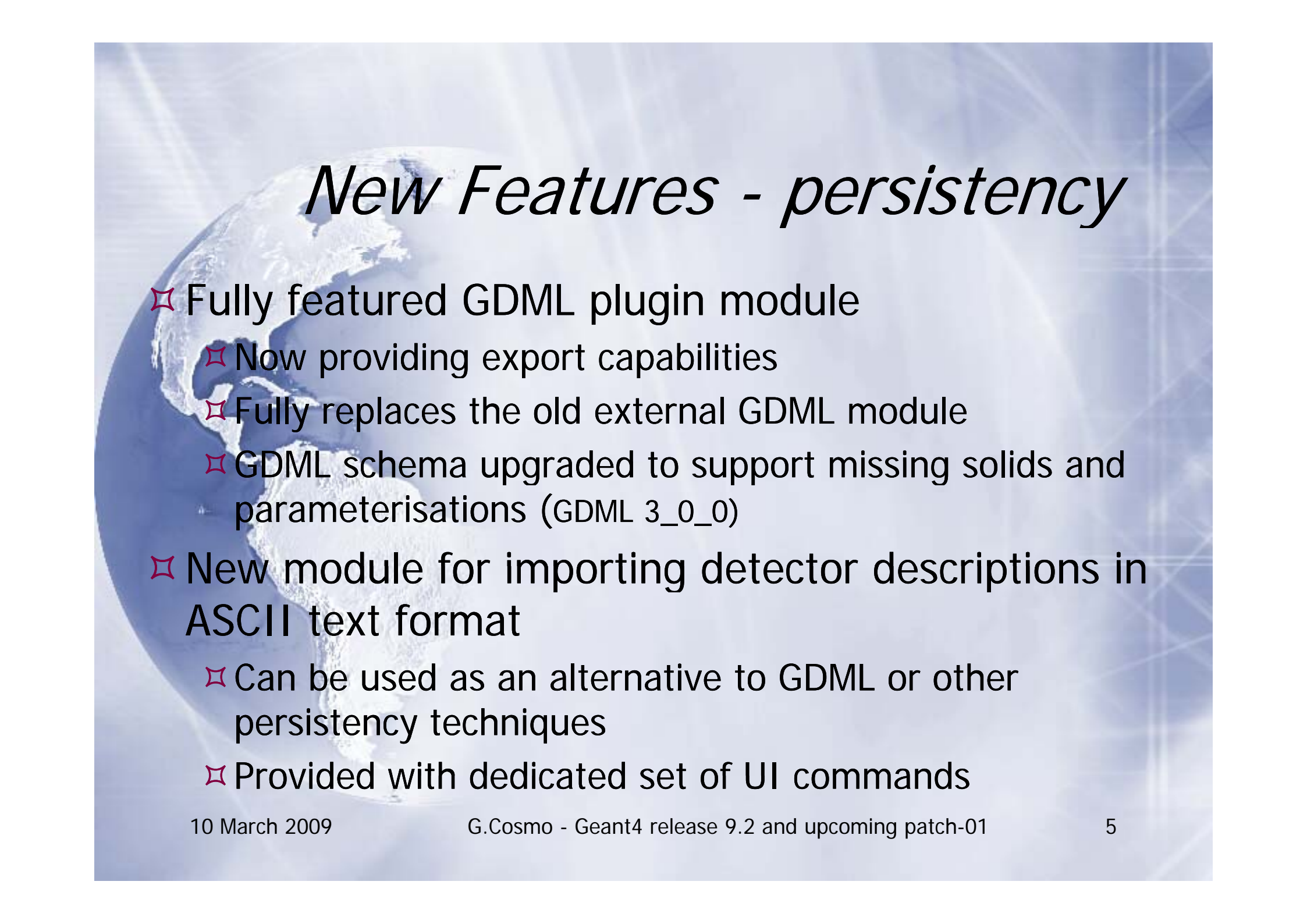
New Features - geometry

- ✧ New **locator classes** and options for transportation in field
 - ✧ Identification of the intersection point of a charged particle in a field
 - ✧ Simple, Brent, and Multi-level (default) locators
 - ✧ Allow the user to investigate tradeoffs between increased accuracy and CPU speed according to the use case
- ✧ Refined treatment of *geometrical safety* in **G4Navigator**
 - ✧ Avoid to modify state of the navigator when not necessary (use by MSC processes and other cases)



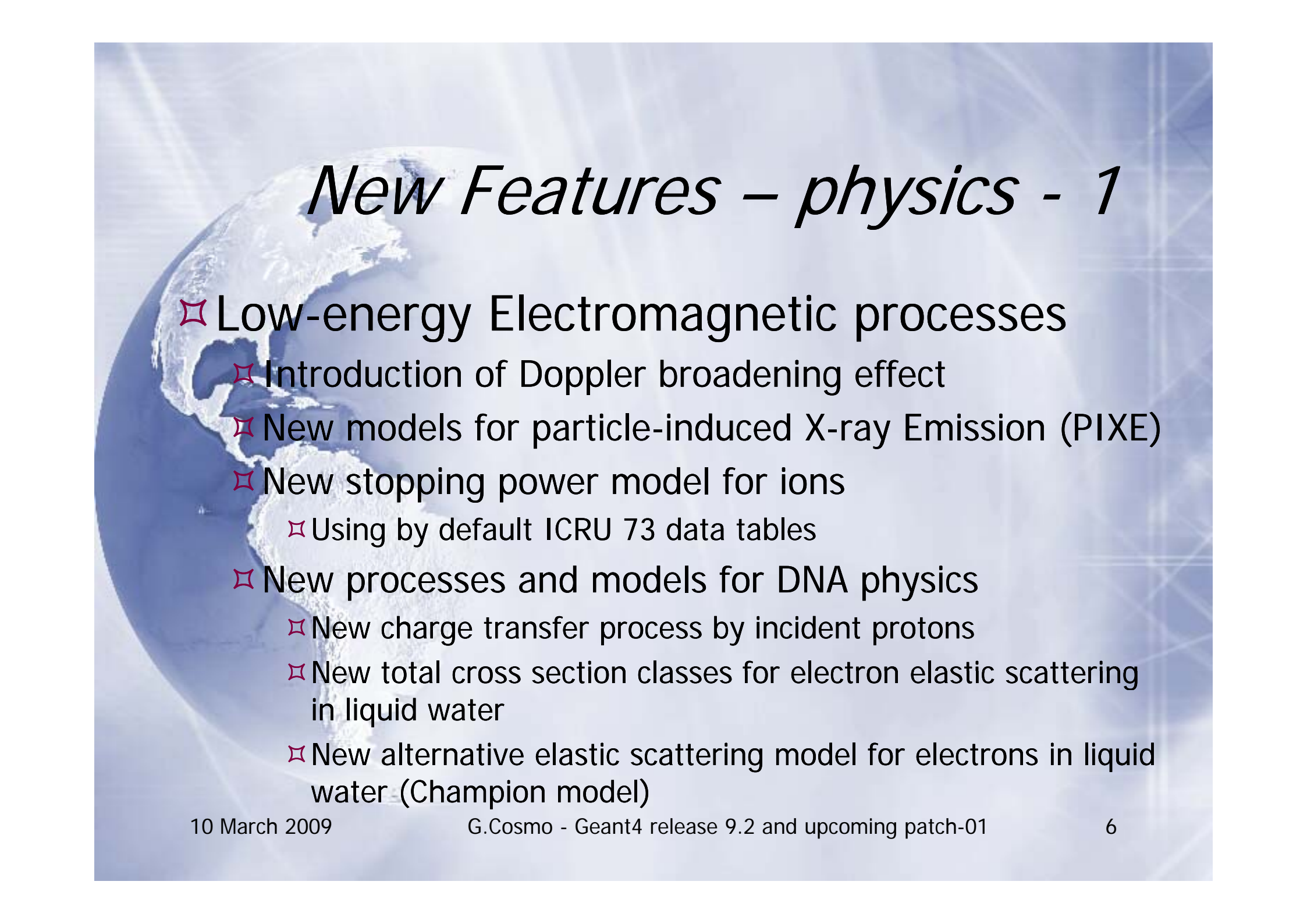
Major fixes - geometry

- ✧ Code revision for **G4Tubs** and **G4Cons**
 - ✧ Boosted performance up to 20% for phi-sections configurations in pure tracking
 - ✧ Boosted performance up to 7% in all other configurations in pure tracking
- ✧ Enhanced **GetPointOnSurface()** for **generic G4Polycone** and **G4Polyhedra** constructs



New Features - persistency

- ✧ Fully featured GDML plugin module
 - ✧ Now providing export capabilities
 - ✧ Fully replaces the old external GDML module
 - ✧ GDML schema upgraded to support missing solids and parameterisations (GDML 3_0_0)
- ✧ New module for importing detector descriptions in ASCII text format
 - ✧ Can be used as an alternative to GDML or other persistency techniques
 - ✧ Provided with dedicated set of UI commands



New Features – physics - 1

- ✧ Low-energy Electromagnetic processes
 - ✧ Introduction of Doppler broadening effect
 - ✧ New models for particle-induced X-ray Emission (PIXE)
 - ✧ New stopping power model for ions
 - ✧ Using by default ICRU 73 data tables
 - ✧ New processes and models for DNA physics
 - ✧ New charge transfer process by incident protons
 - ✧ New total cross section classes for electron elastic scattering in liquid water
 - ✧ New alternative elastic scattering model for electrons in liquid water (Champion model)

New Features – physics - 2

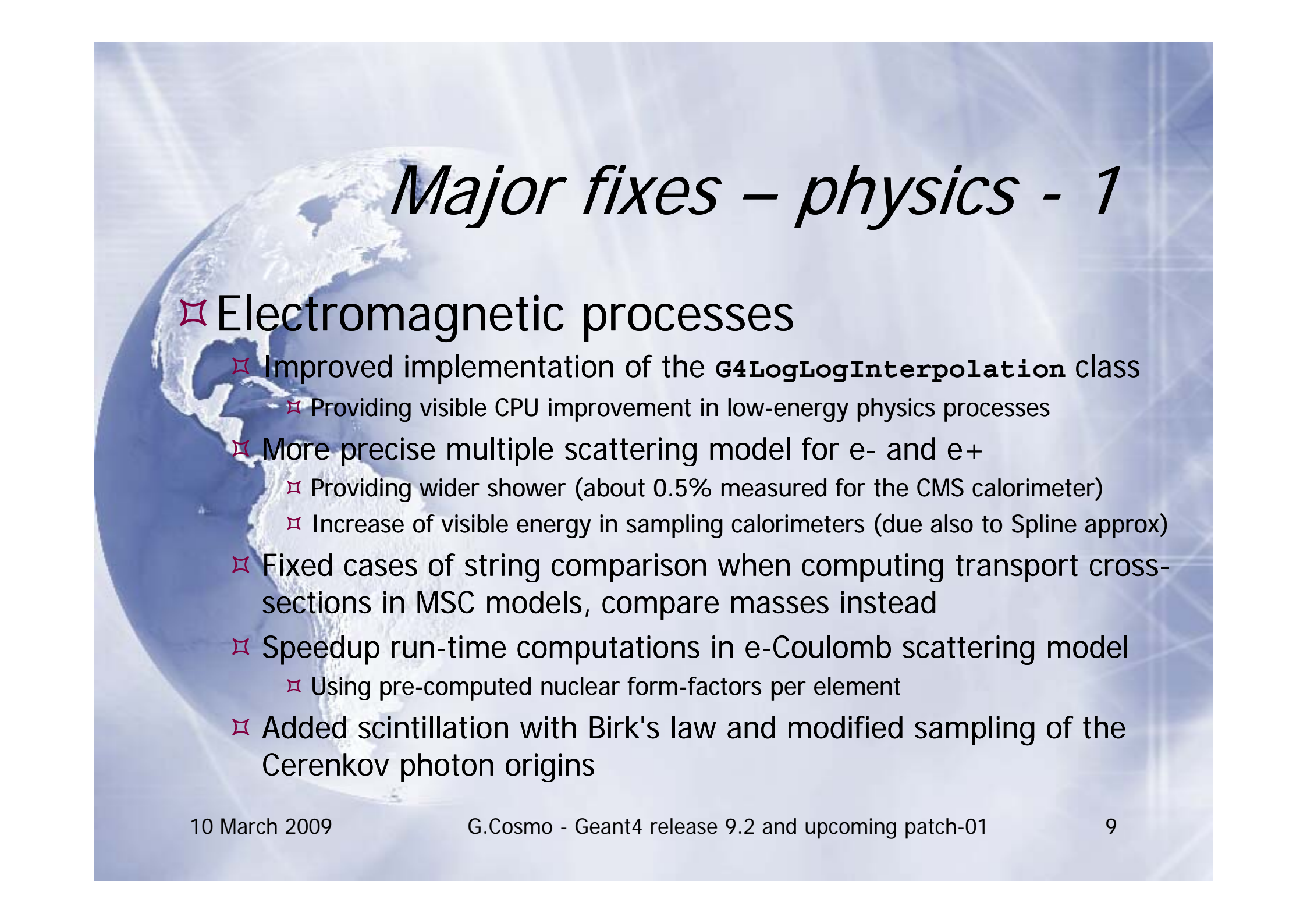
❖ Standard Electromagnetic processes

- ❖ Enabled by default Cubic Spline interpolation of d_{edx} and cross section tables
- ❖ New multiple-scattering process and model
 - ❖ **G4eMultipleScattering**, specialized for simulation of e^+ and e^-
 - ❖ **G4WentzelVIModel** for multiple scattering of muons and hadrons
- ❖ New Bremsstrahlung model, **G4eBremsstrahlungRelModel**, including advanced description of LPM effect
- ❖ New utility classes
 - ❖ **G4EmSaturation** for sampling of Birks saturation; **G4ElectronIonPair** based on the ICRU'31 report for sampling electron/ion pairs in sensitive detectors; **G4EmConfigurator** for configuration of models in physics lists
- ❖ Initialization of **SubType** added for all processes

New Features – physics - 3

✧ Hadronic processes

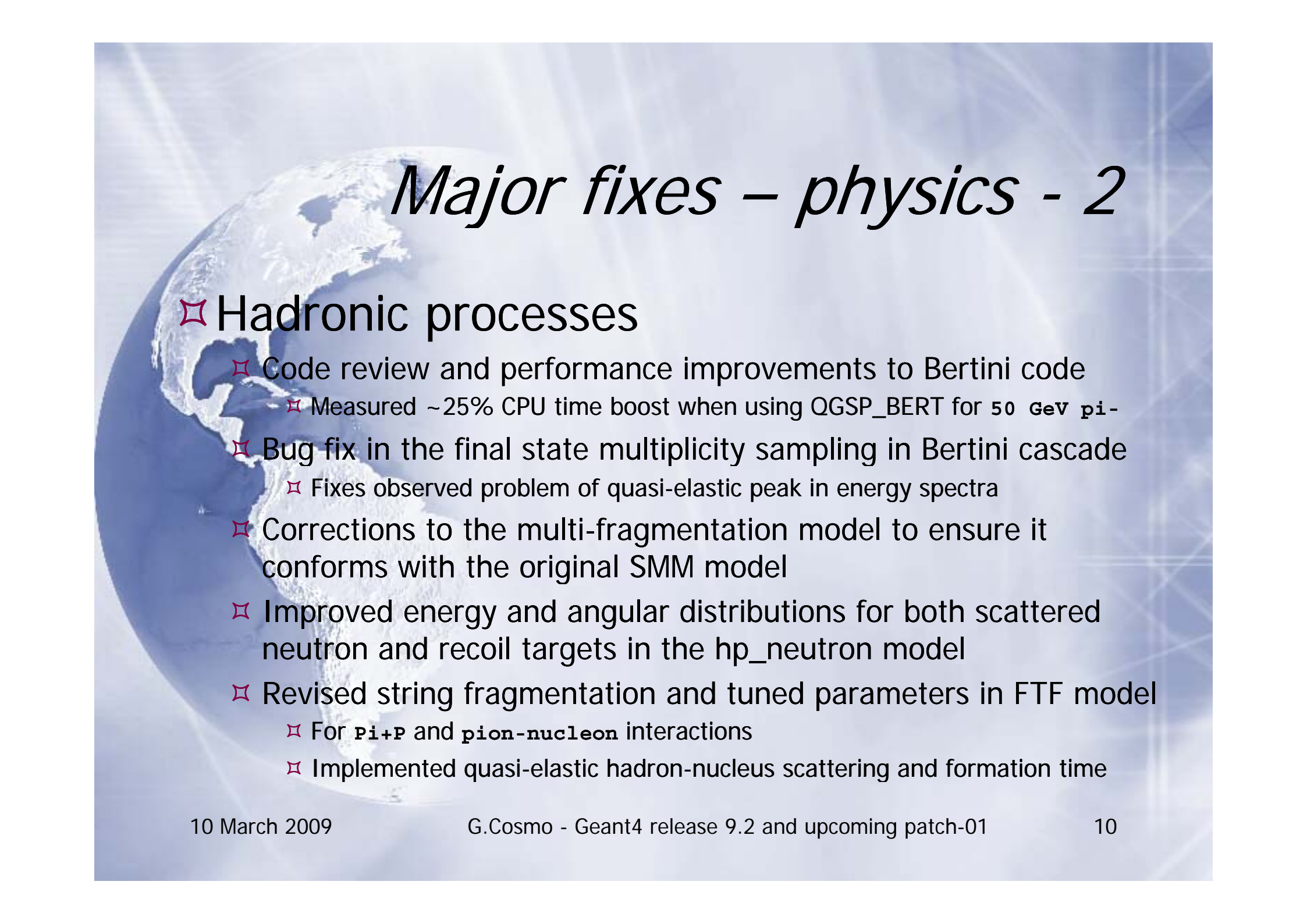
- ✧ Added barrier penetration to the Coulomb barrier in Bertini cascade
- ✧ Tuning in pre-compound and de-excitation code affecting results for low-energy secondaries in Binary cascade
- ✧ INCL/ABLA cascade/evaporation model officially released
 - ✧ Can be used for incident **p, n, d, t, ^3He , alpha** and **pions** from **200 MeV** up to **3 GeV**, on nuclei ranging from carbon to uranium
- ✧ *Beta* release of quantum molecular dynamics (QMD) model
 - ✧ For nucleus-nucleus collisions; valid from **50 MeV** to **5 GeV**
- ✧ Rationalised usage of the nuclear mass tables
- ✧ Definition and initialization of **SubType** added for all processes



Major fixes – physics - 1

✧ Electromagnetic processes

- ✧ Improved implementation of the `G4LogLogInterpolation` class
 - ✧ Providing visible CPU improvement in low-energy physics processes
- ✧ More precise multiple scattering model for e- and e+
 - ✧ Providing wider shower (about 0.5% measured for the CMS calorimeter)
 - ✧ Increase of visible energy in sampling calorimeters (due also to Spline approx)
- ✧ Fixed cases of string comparison when computing transport cross-sections in MSC models, compare masses instead
- ✧ Speedup run-time computations in e-Coulomb scattering model
 - ✧ Using pre-computed nuclear form-factors per element
- ✧ Added scintillation with Birk's law and modified sampling of the Cerenkov photon origins



Major fixes – physics - 2

✧ Hadronic processes

- ✧ Code review and performance improvements to Bertini code
 - ✧ Measured ~25% CPU time boost when using QGSP_BERT for 50 GeV pi-
- ✧ Bug fix in the final state multiplicity sampling in Bertini cascade
 - ✧ Fixes observed problem of quasi-elastic peak in energy spectra
- ✧ Corrections to the multi-fragmentation model to ensure it conforms with the original SMM model
- ✧ Improved energy and angular distributions for both scattered neutron and recoil targets in the hp_neutron model
- ✧ Revised string fragmentation and tuned parameters in FTF model
 - ✧ For pi+p and pion-nucleon interactions
 - ✧ Implemented quasi-elastic hadron-nucleus scattering and formation time



New Features - kernel

✧ Particles

- ✧ Updated masses and widths of particles to PDG-2008
- ✧ Requires new CLHEP version: 2.0.4.2
- ✧ Added UI command for setting verbosity level in particle-table

✧ Scoring

- ✧ *Beta* release of cylindrical scoring meshes

✧ Physics Lists

- ✧ New utility, **G4PhysicsListFactory**
 - ✧ Allowing any reference physics list to be built
- ✧ New **option3** physics constructor for EM physics
 - ✧ Can be used for simulation, requiring spatial precision is \ll **1mm**



More

- ❖ Interfaces & Visualization

- ❖ New drivers based on Qt graphics

- ❖ Compatible with either Qt-3 and Qt-4 packages

- ❖ Updated G4py Python interface

- ❖ New and updated examples

- ❖ New data sets

- ❖ G4NDL.3.13

- ❖ added isotopes in neutron files and updated Elastic and Inelastic x-sections from "JENDL-HE 2007"

- ❖ G4EMLOW.6.2

- ❖ new DNA tables



Platforms

- ✧ Linux SLC4, gcc-3.4.6, 32/64 bits
- ✧ Linux SLC5, gcc-4.2.1, 32/64 bits
- ✧ MacOSX 10.5, gcc-4.0.1
- ✧ Windows/XP and CygWin Tools with:
Visual C++ 9.0 (Visual Studio 2008)

- ✧ Also tested: gcc-4.3.X, icc-11.X



9.2.p01



Upcoming fixes – 9.2.p01 - 1

✧ Hadronic Physics

- ✧ Activate proper deletion of processes, models and cross-sections at job closure
- ✧ Fix in the computation of the emission probability in `de_excitation` model and added smearing of Coulomb barriers for `d`, `t`, `he3` and `alpha` particles
- ✧ Tuned absorption coefficient in Bertini cascade
- ✧ Fixed probability of light ion emission in pre-compound

✧ Electromagnetic Physics

- ✧ Fixes in Penelope low-energy processes

Upcoming fixes – 9.2.p01 - 2

✧ Particles

- ✧ Fixed values of masses for some light ions
- ✧ Optimised `G4IonTable::IsIon()` implementation

✧ Persistency

✧ Ascii module:

- ✧ Fixes in the definition of delta angles for solids with section in `Phi`

✧ GDML

- ✧ Fixed association of entities in nested loops
- ✧ Corrected treatment of brackets and indexes for matrices
- ✧ Fixed incorrect treatment of auxiliary information in separate modules
- ✧ Activated ability to check overlaps in construction and fixed some cases in provided GDML samples



Upcoming fixes – 9.2.p01 - 3

✧ **Tracking**

- ✧ Fixed issue in `G4SteppingManager` for the special cases of skipping voxel boundaries in `G4RegularNavigation`

✧ **Scoring**

- ✧ Resolved one limitation documented in 9.2 notes related to cylindrical parameterised meshes and scorers

✧ **Field locators**

- ✧ Fixed rare cases of negative steps when using Brent locator

✧ **Materials**

- ✧ Added 4 missing materials from ICRU'73

✧ **Configuration**

- ✧ Corrected generation of paths for a couple of data sets



Thanks!