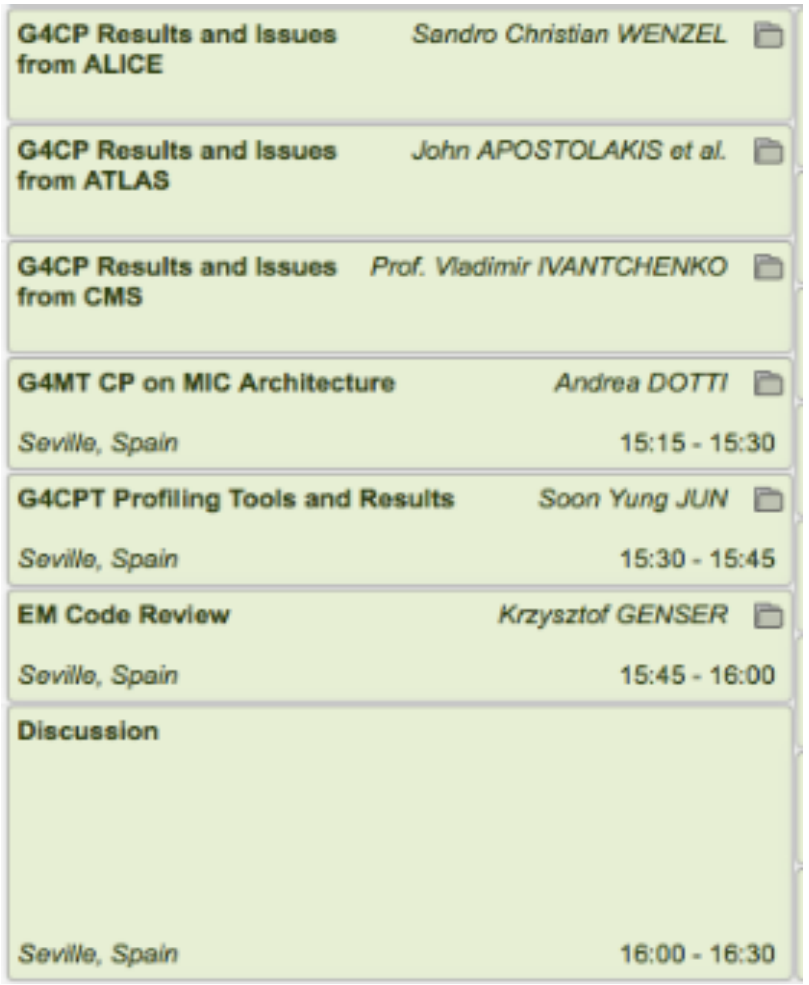
Report From Parallel Session 3A

D. Elvira and S.Y. Jun

Geant4 Collaboration Meeting

September 27, 2014

Seville, Spain



G4CP Results and Issues from ALICE

Sandro Wenzel

- Performance issue of possible transition to 9.6 (from Geant3)
  - CPU(Geant4/Geant3) ~ 3X ➔reduce performance gap
- Understanding profiling results (valgrind, igprof, Intel PIN)
  - 15% of simulation time for G4EnhancedVecAllicator (memory management for G4NavigationHistory) – 30% faster with std::allocator
- Investigating alternatives to libm (fast-math, VDT)
  - VDT speedup 16.5% for Pb-Pb collisions of ALICE simulation
- Tuning Simulation Parameters: step size
  - step limit imposed in low density material
- The total gain: 1.65 so far -> extensive benchmarking and physics validation

G4CP Results and Issues from ATLAS

Zach Marshall & John Apostolaskis

- Benchmarking of the ATLAS simulation with 9.6.p02
- CPU profiling per function
  - B-field under control (15% → 2%) (an error in using steppers)
  - a costly special ATLAS solid (>20%) and the rest are G4 (cuts?)
  - CrossSectionDataStore(~4%), SubstractactNumofIntLeft(~2%)
- Physics profiling
  - bug: low-E photons (from hadronic interactions, no physics interactions enabled) and e-propagation (<100fm/step)
  - Feature: Neutrino propagation (production thresholds), super low-E electrons (range cuts), long tracks (large number of steps for low-E photon and neutrons)
- Memory profiling is underway (expect to reduce footprints)

G4CP Results and Issues from CMS

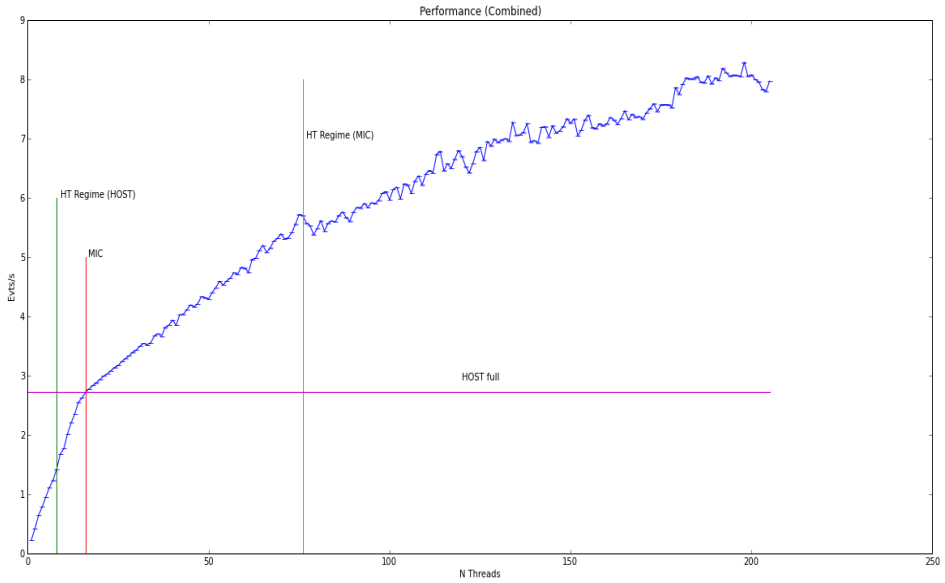
V. Ivanchenko & D. Nikolopoulos

- Need CPU speedup for 13TeV run and Geant4 10.0
- 13 TeV run in 2015
  - Profiling (cpu and memory with IgProf) for MinBias, TTbar, Zee
  - CPU profiling for 8TeV and 13TeV are very similar except that SimTrackManager::idSavedTrack (CMSSW specific, 10-16%)
  - math functions (12%), optional use of vdt functions
  - Hadronic xsec, G4PhysicsVector, G4UrbanMscModel and etc.
- Geant4 10.0 (adopt in 2014 and production in 2015)
  - start from sequential and development with MT and TBB
- CMS requires full tests with QGSP_FTFP_BERT_EMV

G4MT Performance on MIC Architecture

Andrea Dotti

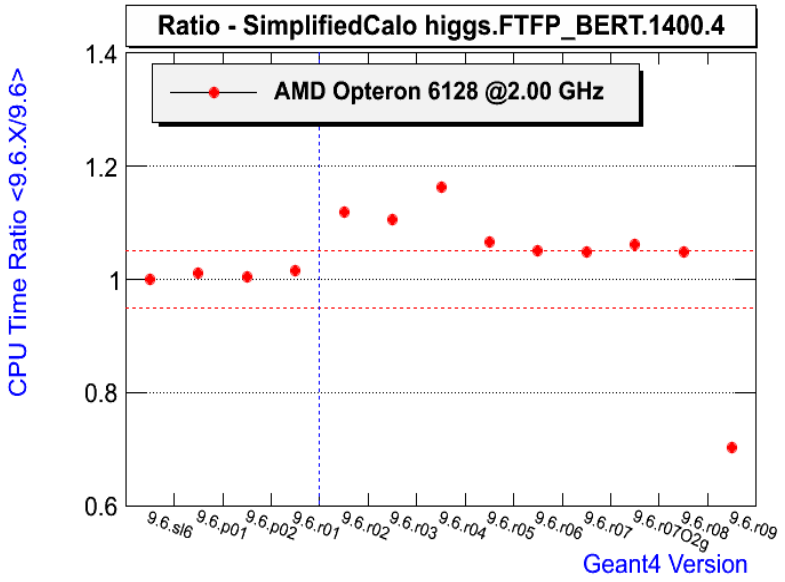
- New Intel Xeon Phi (60 cores x 4HT = 240 threads)
  - very simple to port G4MT codes to the MIC
  - performance sensitive to vectorization, data/instruction locality (efficient use of core caches)
- Performance
  - FullCMS without I/O
  - good scalability with HT up to 210 threads
  - Efficient use of caches due to the split-class

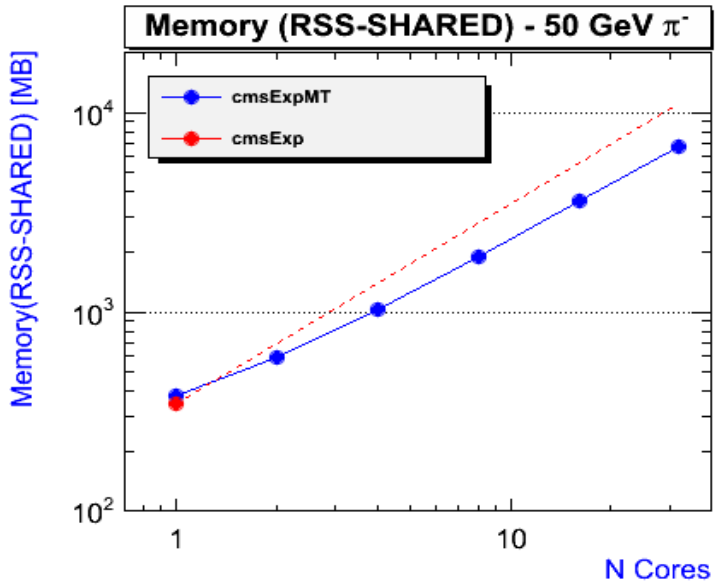


Performance Tools and Results

P. Canal, D. Elvira, K. Genser & S. Y. Jun

- Performance monitoring during the 9.6 release period
- New requirement for multi-threaded applications (scalability, memory reduction, profiling information)
- Tools reviewed: Open|speedshop, HPCToolkits, TAU





Electromagnetic Code Review

Krzysztof Genser

- Scope and plan
  - performance aspects of a subset of EM and related codes
  - Inter-laboratory/interdisciplinary
- Covered so far
  - G4PhysicsVector, G4Physics2DVector, data structure
  - G4VEmProcess (standard EM physics processes)
- Current suggestions
  - use efficient data structure to leverage coalesced memory access
  - eliminate unnecessary code, use std library, pRNG array interface
- Continue review on compute intensive EM functions and write a report

Summary

- G4CP Report from experiments: expect major migrations
  - profiling results are available and analyzed
  - Issues are identified
  - more optimization and validation
- G4MT performance on MIC shows good scalability
- Performance requirements for multithreading applications have been added
- EM code review (performance aspect) is underway