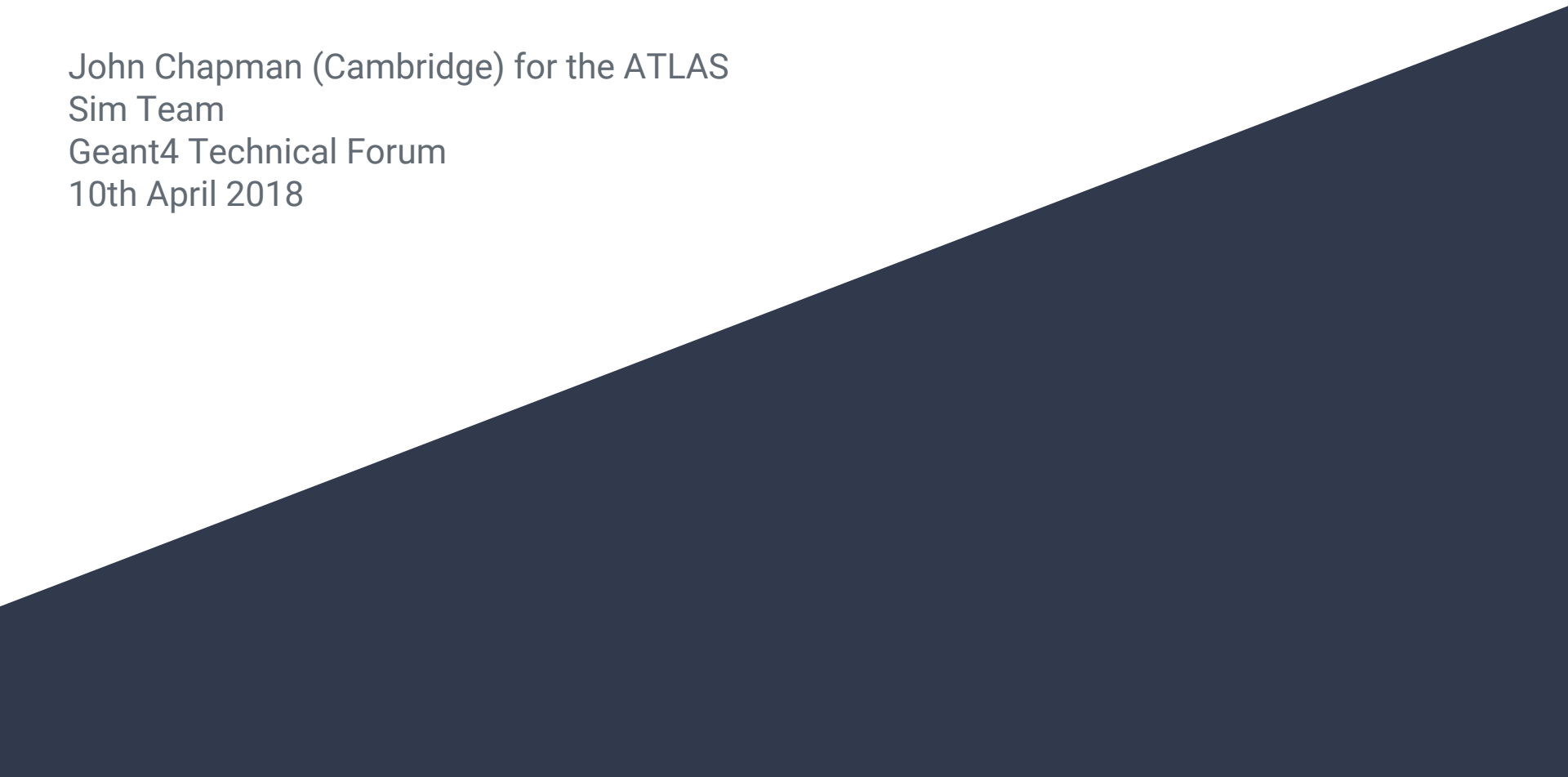


Geant4 in ATLAS

John Chapman (Cambridge) for the ATLAS
Sim Team
Geant4 Technical Forum
10th April 2018

A dark blue diagonal gradient bar that starts from the bottom left corner and extends towards the top right corner, covering the lower half of the slide.

Current Production (I)

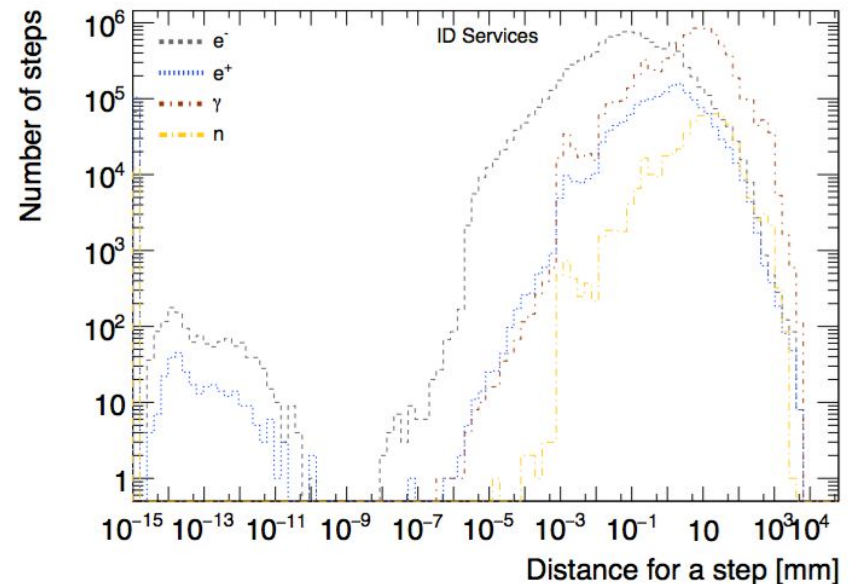
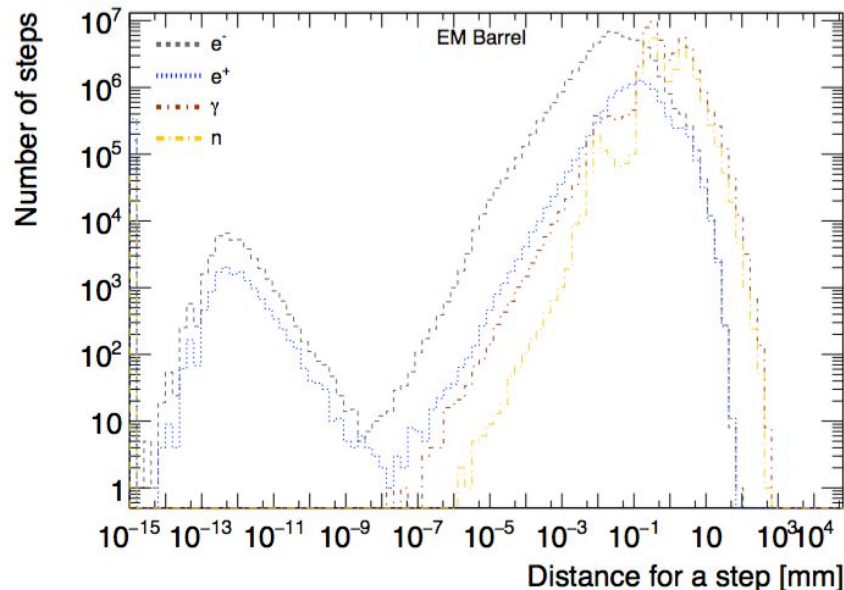
- **New 13 TeV MC production (MC16) well underway now**
 - **Default production release uses G4 10.1 patch03, CLHEP 2.2, 64-bit, gcc 4.9, SLC6, C++14**
 - **Some samples produced with later releases built using **gcc 6.2**.**
 - **Compiling G4 as part of our nightly builds**
 - **Significant number of updates to ATLAS user code (geometry and detector response), including several speed ups.**
 - **HPCs, Amazon cloud, BOINC in use; Testing underway for icc, clang, and ARM builds. Could be used for production if they prove useful.**
- **11.1B events simulated so far with this configuration!**

Current Production (II)

- **MC16 will be the main campaign for 2018**
 - **We felt we should move to the newest gcc version to start this campaign, which is why we moved to gcc 6.2.**
- **Will soon move MC16 Simulation to use Geant4 10.1.patch03.atlas05 which contains G4Solid improvements from G4 10.4. This gives a 4% speed-up in our simulation.**
- **Still running tails of (much) older production campaigns:**
 - **MC15**
 - **Geant4 9.6 patch03, CLHEP 2.1, 64-bit, gcc 4.7, SLC6, C++11**
 - **MC12**
 - **Geant4 9.4+ patches for “MC12” production**
- **The next MC campaign (preparing for LHC Run 3) will most likely use Geant4 10.3 (outside possibility that we will use Geant4 10.4 - depending when the campaign starts).**

Bugs and Crashes (I)

- **G4 10.1 crash rate seems to be no higher than G4 9.6**
- **No firm crash rate, but MC production managers have not been complaining after 11.1B events, so the rate is very low.**
- **Small step issue is still hanging around in G4 10.1.**



Bugs and Crashes (II)

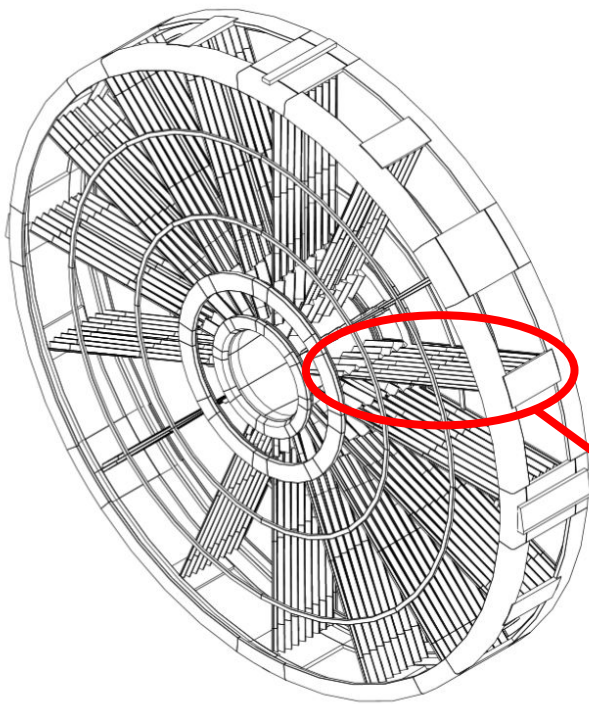
- **The issue in G4NystromRK4 stepper found by ALICE also affects our home-grown G4AtlasRK4 stepper.**
 - **The effect of the bug is thought to be small.**
 - **John Apostolakis has provided a fix, which we will test out later this year.**
 - **At the same time we will also re-examine using other steppers.**

Geant4 MT work

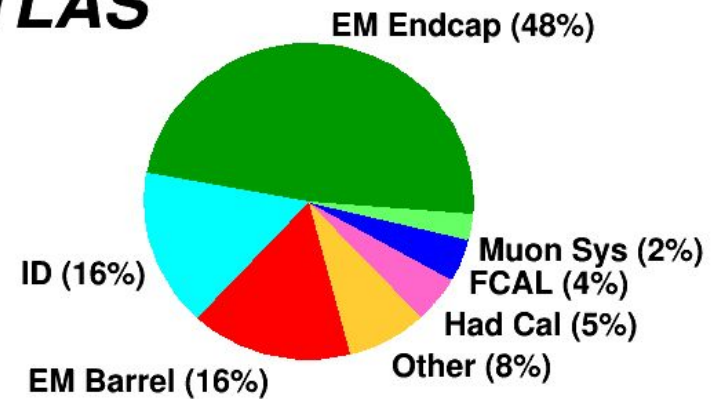
- **Built Athena Release 22.0.0 for Geant4MT testing.**
 - **Uses Geant4 10.1.patch03.atlas02, CLHEP 2.2, 64-bit, gcc 6.2, SLC6, C++14**
- **Currently doing detailed comparisons of MT versus ST simulation output to tease out problems. Two found so far:**
 - **Neutrons not being killed after 150ns in MT mode.**
 - **Understood to be due to a G4UIManager Command not being applied to workers. Working on a fix in our code.**
 - **Different behaviour of the safety calculation for G4PolyCone in MT and ST.**
 - **Still trying to understand this one.**

Geometry work (I)

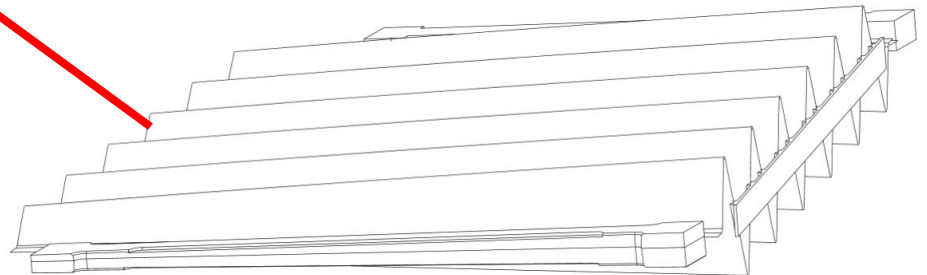
EM Endcaps dominate the simulation time.
Very complex region of the detector.



ATLAS



Subdetector CPU fraction for 50 ttbar events
MC16 Candidate Release



Geometry work (II)

- Back in 2001, a custom G4Solid implementation was written to work around features not present in G4 at the time.
- Single LArWheelSolid to describe a whole wheel was the most efficient implementation at the time.
- Accompanying “calculator” class used in sensitive detector to work out sensitive regions in the solid.
- The custom solid has served us well, but it has some drawbacks:
 - **it can't be written out to GDML**
 - **maintenance overhead** to make sure it always responds as G4 expects.
- Implementation of Wheels in terms of standard G4Solids was last compared in 2010-2011. (1 year of work to implement!)
 - Required ~1.5GB per wheel - abandoned.
- Significant improvements in G4Solids since then, so will check again using the latest code.
 - May take some time...
- If the implementation is faster then sensitive detector code will have to be re-written to work with the new volumes.

Other good stuff

- **Andrea Dotti is making good progress on merging all ATLAS code with a G4 dependency into a single library which we will statically link to Geant4. Hope to be able to test later this year.**
- **Ben Morgan is looking into building Athena on top of G4 10.4 with vecGeom. Again we hope to get some performance numbers from this soon.**
- **Have started looking into profile guided optimization.**
- **After this will look into biasing options for further speed-ups.**
- **Have started a collaboration with Katalin Nikolics et al. to make it easier to test new Geant4 versions using ATLAS Test Beam Simulations.**