

# **Geant4 in ATLAS**

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**Geant4 Technical Fourm**  
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# Current Production (I)

- **New 13 TeV MC production (MC16) has started**
  - **Default production release uses G4 10.1 patch03, CLHEP 2.2, 64-bit, gcc 4.9, SLC6/CC7, 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.**
  - **First campaign that could include multithreading (!!)**
- **3.9B events simulated so far with this configuration! (Out of 4.0B events requested to be produced so far.)**

# Current Production (II)

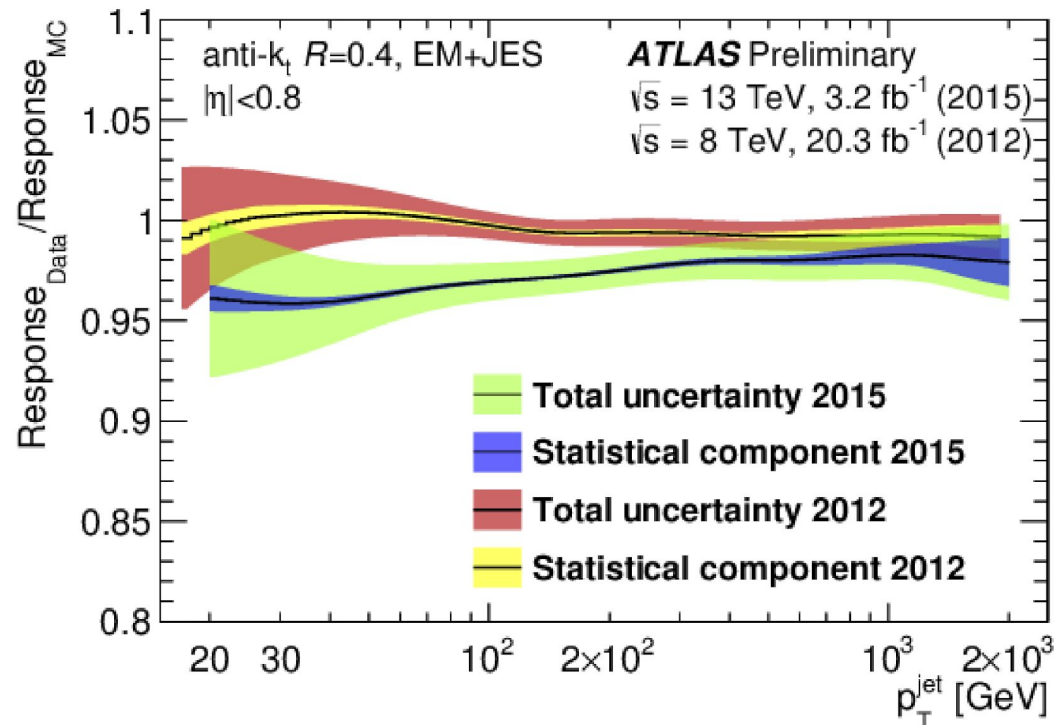
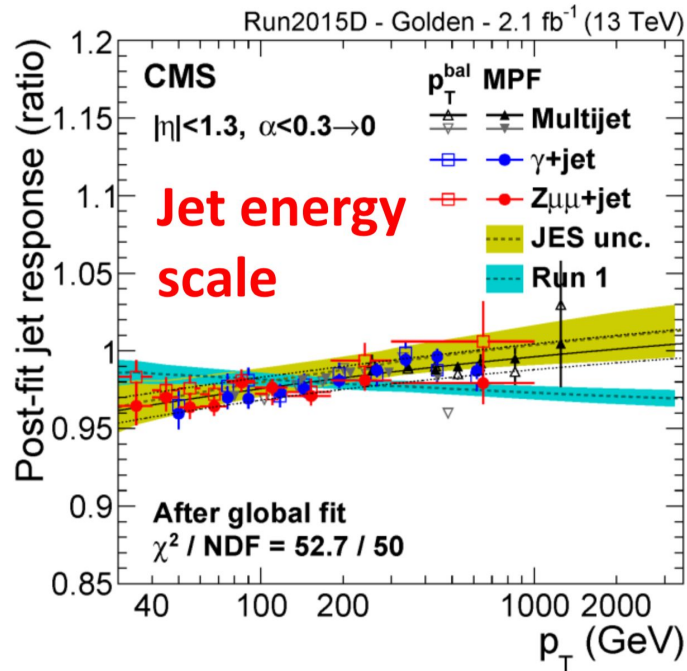
- **MC16 will be the main campaign well into 2018**
  - **We felt we should move to the newest gcc version to start this campaign, which is why we moved to gcc 6.2.**
- **Still running tails of (much) older production campaigns:**
  - **MC15**
    - **Geant4 9.6 patch03, CLHEP 2.1, 64-bit, gcc 4.7, SLC6, 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).**

# Intel vs AMD vs KNL

- **Significant exploration of differences between Intel and AMD results**
  - Thanks to Alberto Ribon for debugging the differences in output when running on Intel vs AMD architectures.
  - Due to differences in behaviour of the sincos function.
  - Differences are not seen when compiling without optimization.
- **Investigating performance issues on KNL (Cori @ NERSC)**
  - 60% frontend bound stalls; instruction cache thrashing
  - CPI of 3 (pretty bad)
  - New effort at NERSC to try to understand this.

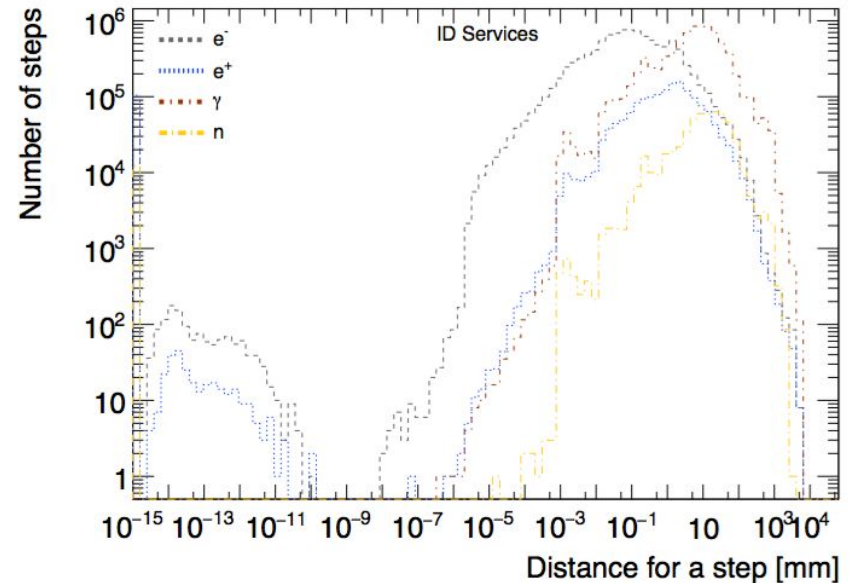
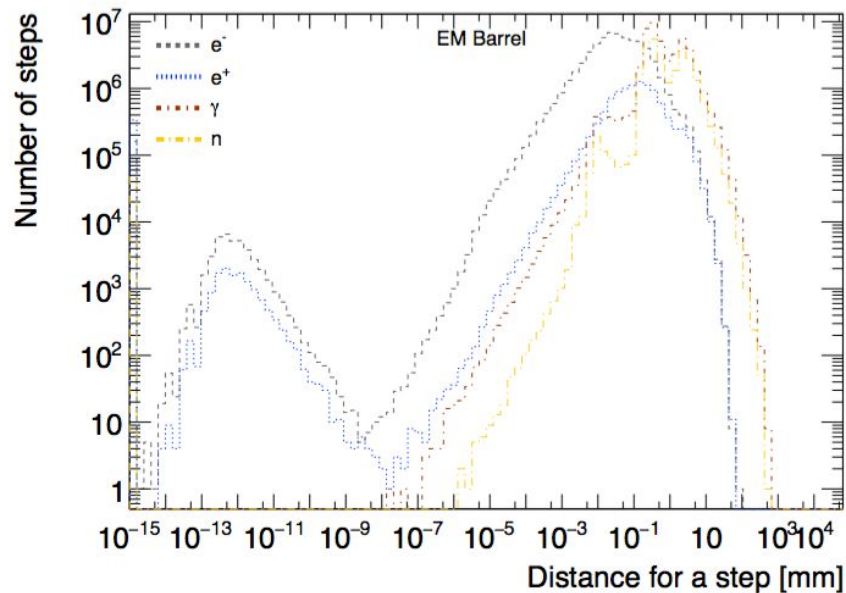
# JES Issue

- FTFP\_BERT\_ATL Physics List provided by G4 Team is in use in MC16 Campaign.
- Working on producing full recommendations, so that we can see the impact of the new Physics List.



# 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 3.9B 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 is working on 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

- **Infrastructure upgrades, mentioned previously are now complete**
  - **Rewrote ATLAS simulation code to be more Athena-based introducing concepts of tools and services, matching Geant4 concepts like sensitive detectors and user actions**
  - **We can now run simulation jobs with AthenaHive + G4MT 10.1.**
    - **G4Atlas Simulation code is now largely thread safe.**
    - **A **thread-safe random number service** was the last piece of the puzzle. Finished by Sami Kama and Steve Farrell this year.**
    - **Focussing on robustness at the moment - fixing rarer race-conditions as they show up.**
  - **Thank you for the help and for the interface tweaks (multi-SD, multi-useraction, changes to const-ness) that we have discussed to make our lives easier!**



# 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.**
- **Next on the list to investigate is 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.**

# Questions and Feature Requests

- **Part of ATLAS is keen to move away from CLHEP.**
  - GeoModel geometry being moved to be based on Eigen.
  - Does Geant4 have any plans in this regard?
- **Noticed some weaknesses in the robustness of the G4UIManager implementation during our recent re-writes.**
  - It would be good to improve this for future G4 versions.
  - I think plans are already being made?
- **Lots of interest with ATLAS in simulating particles with pre-determined decays specified by generators. Mainly when these particles would decay outside the beam-pipe.**
  - We are working on an initial approach, but some particles will only have EM-interactions for example.
  - Does Geant4 have any plans to look into this area? Including possibly expanding the range of physics processes available?