Geant4 in ATLAS

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Geant4 Technical Forum

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Current Production

- Just starting new 13 TeV MC production (MC16)
  - G4 10.1 patch03, CLHEP 2.2, 64-bit, **gcc 6.2**, SLC6/CC7, C++14
  - Compiling G4 as part of our nightly builds
  - Significant number of ATLAS-specific updates (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 should include multithreading (!!)
- This 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 are on gcc 6.2 (not formally a supported configuration)
  - **What level of support can we expect for this setup?**
- Still running tails of (much) older productions
  - Geant4 9.6 patch03, CLHEP 2.1, 64-bit, gcc 4.7, SLC6, C++11
  - Geant4 9.4+ patches for "MC12" production

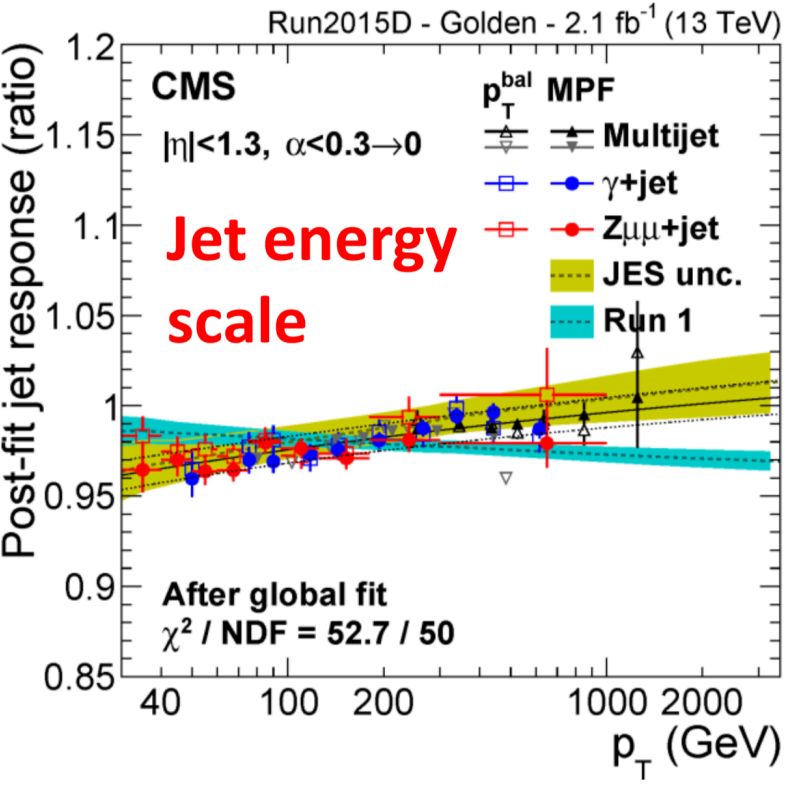
Intel vs AMD vs KNL

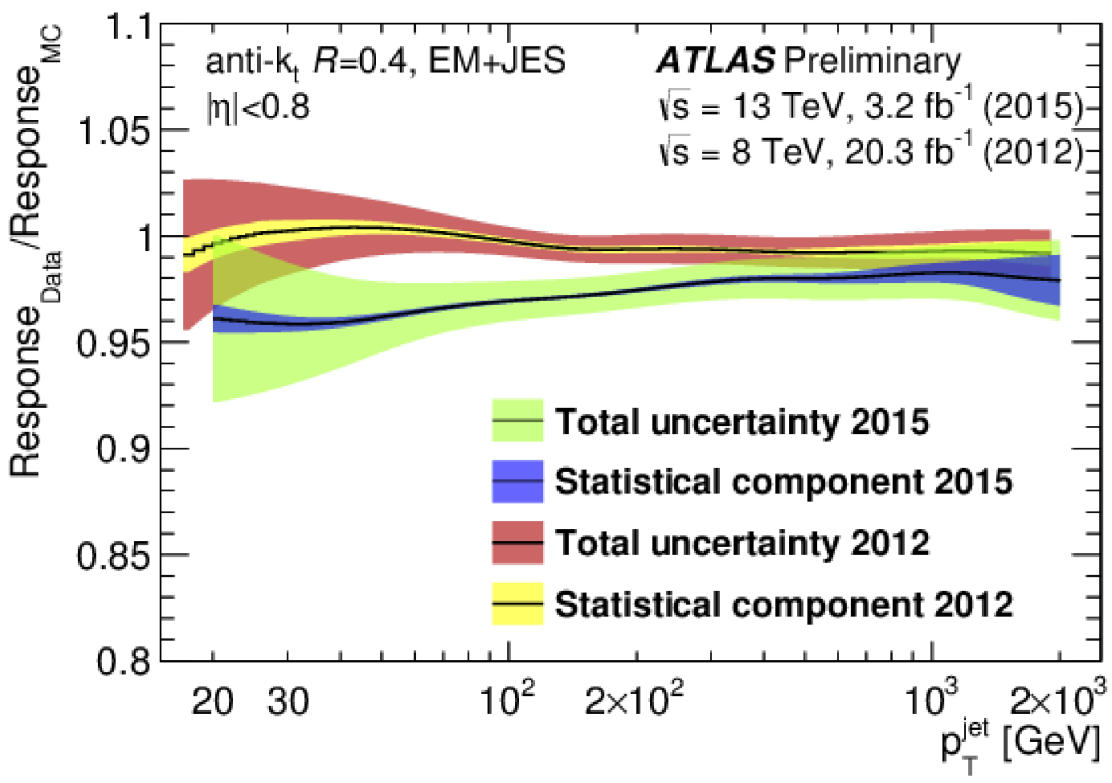
- Significant exploration of differences between Intel and AMD results
- These differences are a bit annoying in production, as they prevent us from reproducing crashes on different hardware
- Appears to be down to a change in the angles of the secondaries in a neutron inelastic collision at low energy in the Bertini model
- Outgoing angles have O(1) changes
- Under investigation with the G4 team

- Investigating performance issues on KNL (Cori @ NERSC)
- 60% frontend bound stalls; instruction cache thrashing
- CPI of 3 (pretty bad)
- Similar results in G4 standalone – we want to try to understand this!!

JES Issue

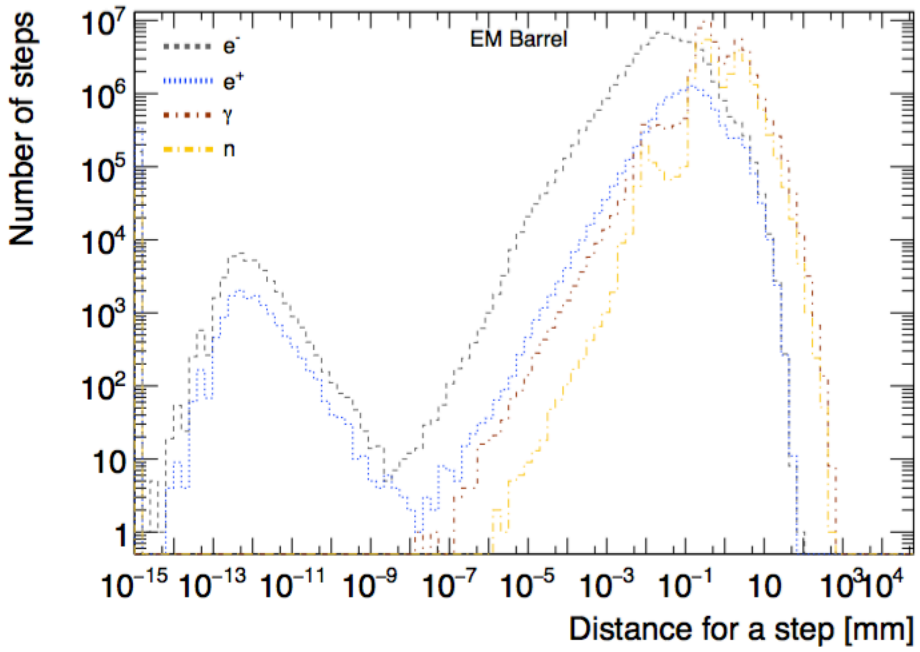
- Have not yet produced full recommendations to show the impact of the new physics list (FTFP_BERT_ATL) – expecting these to come soon

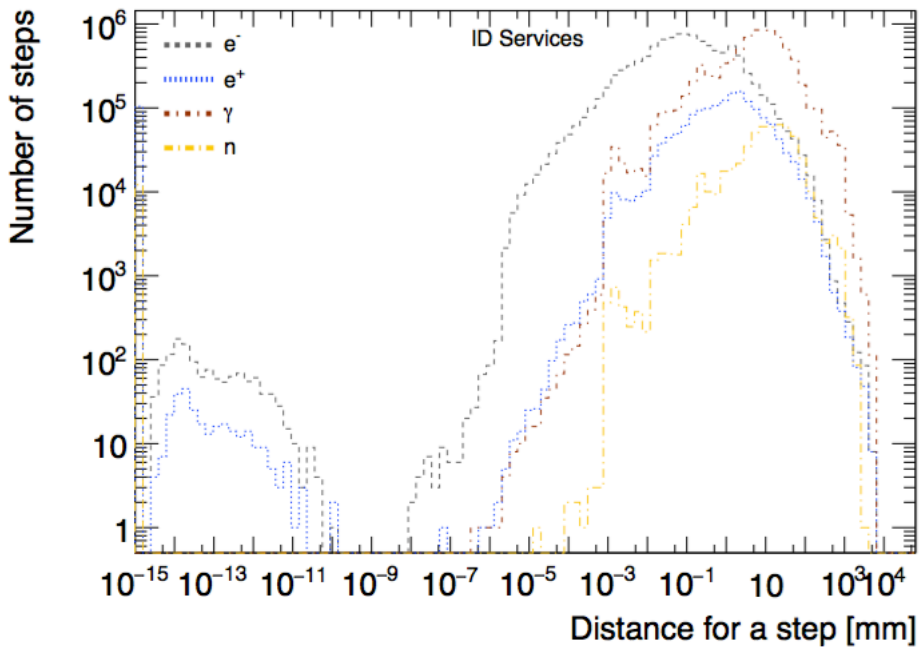




Bugs and Crashes

- G4 10.1 crash rate seems to be no higher than G4 9.6
- No firm crash rate, but first indications are good
- Small step issue appears to still be with us, even after this patch





Miscellanea

- Slightly annoying field design issue discovered almost two years ago – any hope to resolve this?
  - Reminder: G4FieldManager and G4Stepper own copies of the field pointer, and even for steppers owned by specific managers these are not required to be in sync.
- Taking hadronic cross sections from a DB instead of small files?
- Infrastructure upgrades, mentioned last time, are almost complete
  - Rewrite of simulation code to be more Athena/Gaudi-friendly; introducing concepts of tools and services, matching Geant4 concepts like sensitive detectors and user actions
  - Making some serious progress on GaudiHive running with G4 10.1
  - Final issues with the LAr calorimeter in progress now
  - Thank you for the help and for the interface tweaks (multi-SD, multi-user-action, changes to const-ness) that we have discussed to make our lives easier!
- Starting to look at biasing options for producing some "fake" samples

Cool Things Here Now

- Paper on hadronic interactions in the inner detector arXiv:1609.04305
- Paper on calorimeter particle response arXiv:1607.08842
- Several interesting studies of secondaries (multiplicity and species) from hadronic interactions still coming
- Several students working on:
  - Optimization of simulation (https://cds.cern.ch/record/2227212)
  - "Physics" benchmarking (small steps, hyperspace…)
- Interesting discussion recently about build and linking options for saving significant amounts of run time. Stay tuned for more on this.
  - This could potentially help with the KNL issues

- Time to arrange an LPCC Simulation Meeting?