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GeantV validation

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Geant R&D Retreat

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GeantV performance and validation

- Goals:
  - validate the future (beta) release of GeantV
  - assess performance improvements with respect to Geant4
  - understand where improvements are coming from and why

  [see Soon's presentation on GeantV performance]

- Sunanda and Kevin results:
  - discrepancies in total number of steps, hit timing distributions, etc.
  - pushed us back into standalone GeantV validation

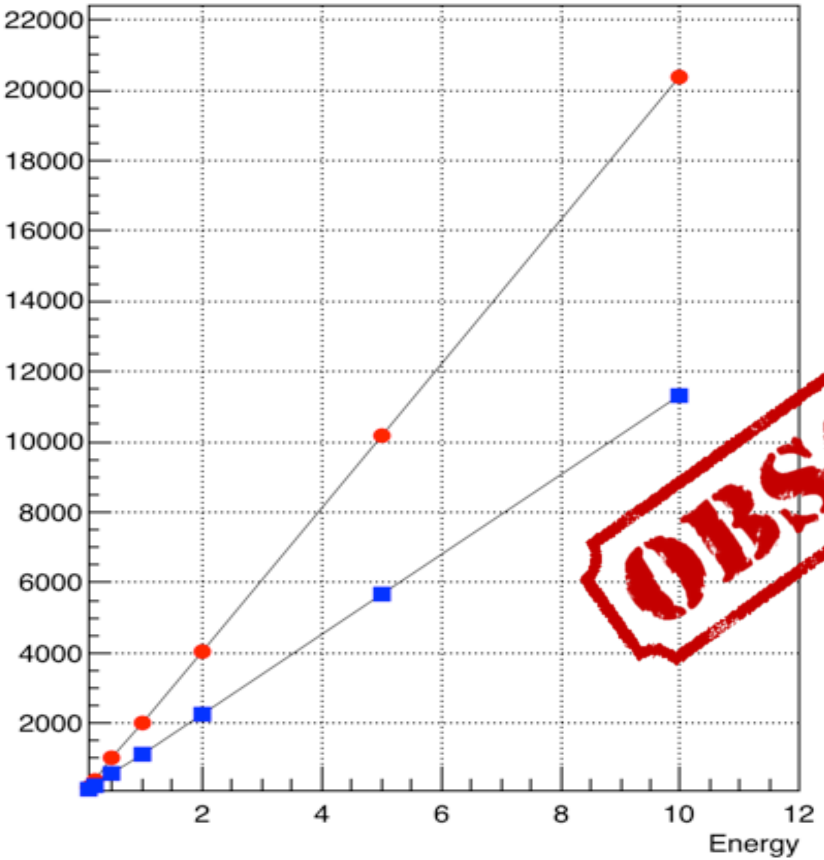
GeantV validation

- Comparing GeantV tag pre-beta-7 with Geant4 10.04.p03
- Start with a very simple geometry
  - TestEm3 with single-material configuration – 100 layers of iron
  - other materials were used as well with similar results
  - variable layer thicknesses, to compensate for energy increase

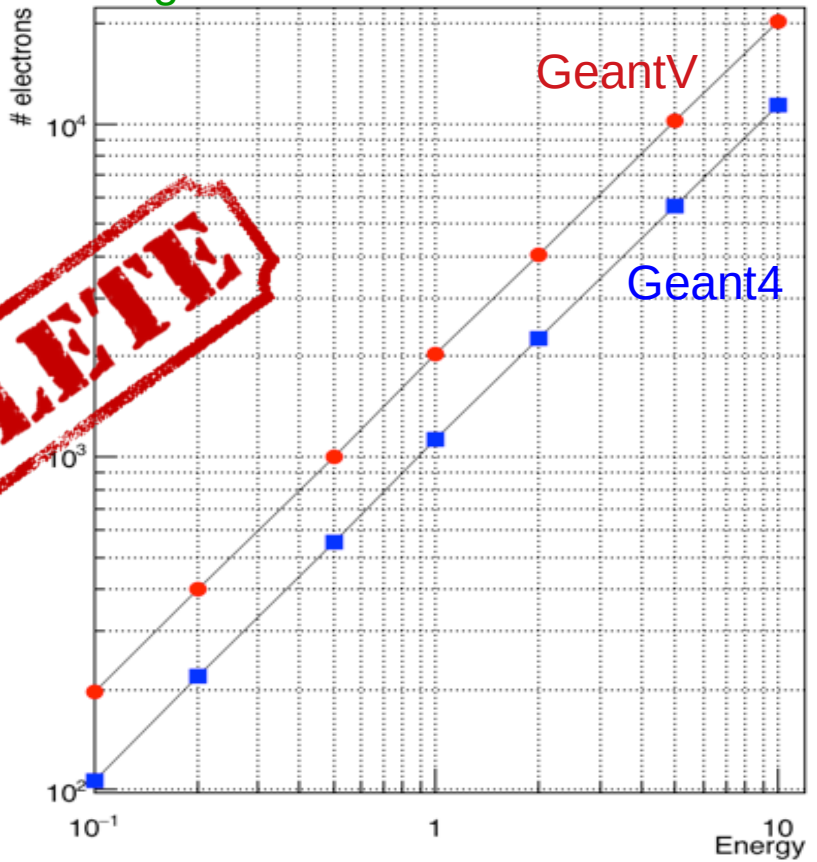
- Jobs run on single-thread, scalar mode
- Observables:
  - Mean number of secondaries: photons, e-, e+
  - Mean number of charged and neutral steps

Mean number of electrons per event

Linear scales



Log scales

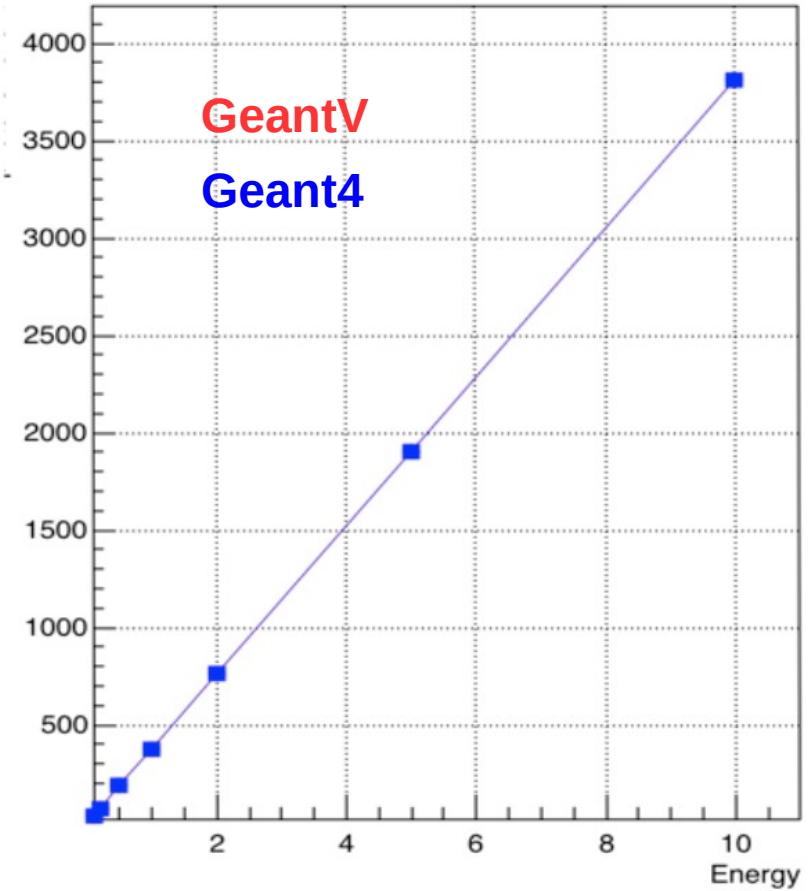


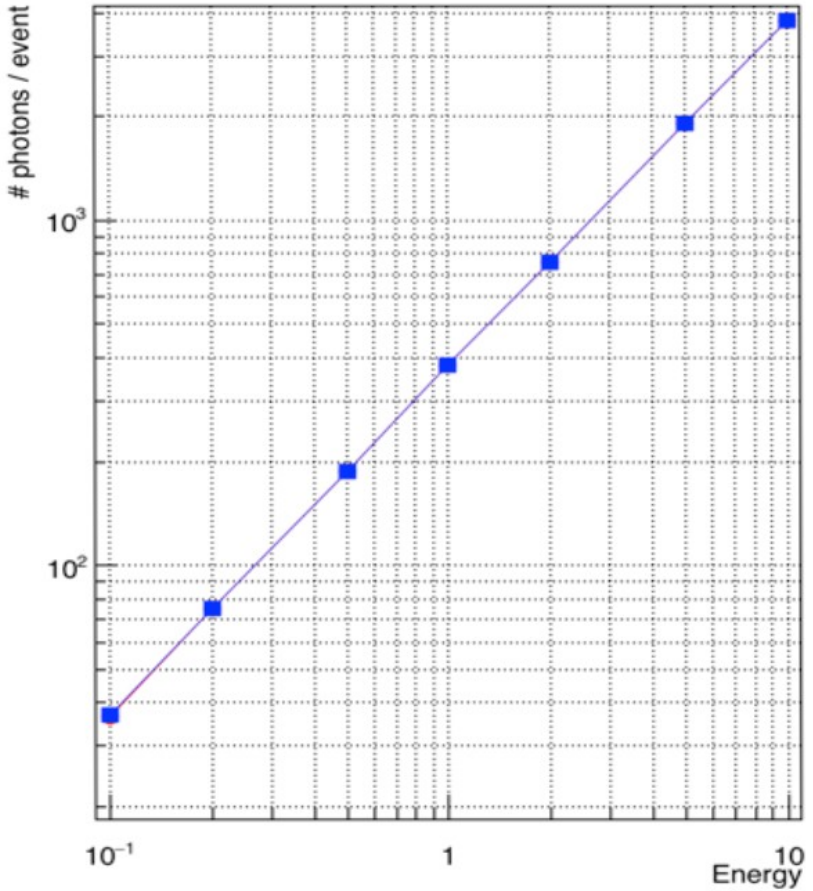
OBSOLETE

Recent changes

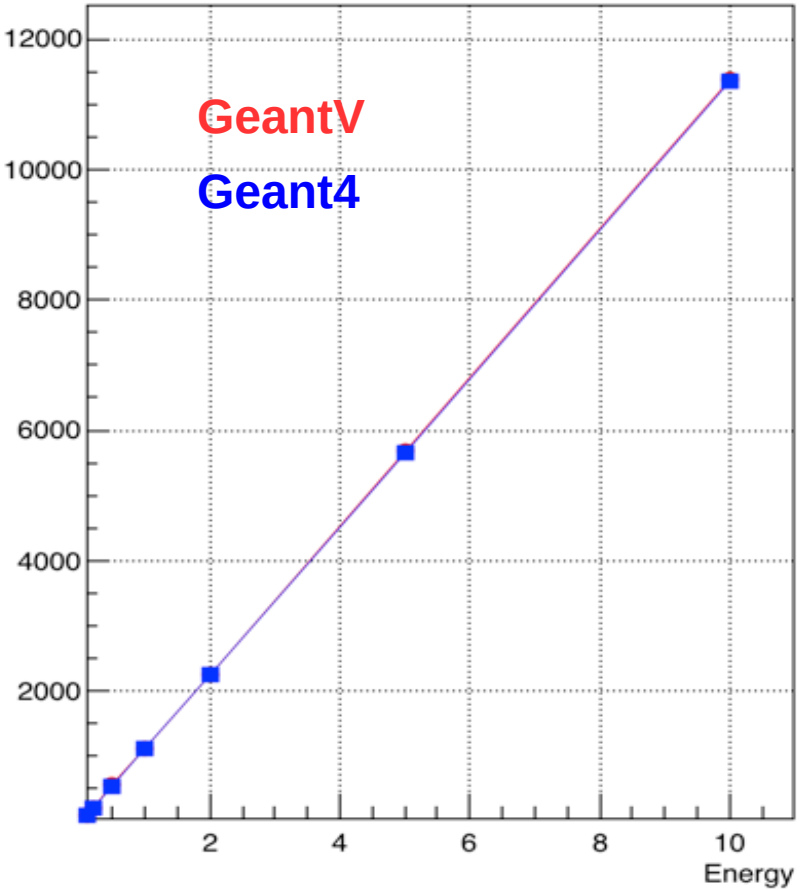
- Reviewed our configuration, since Mihaly does not confirm our discrepancies
- Found different production cuts of 0.7mm for Geant4 vs. 0.01mm for GeantV
- Now setting both cuts to 0.7mm fixes the discrepancies previously observed.

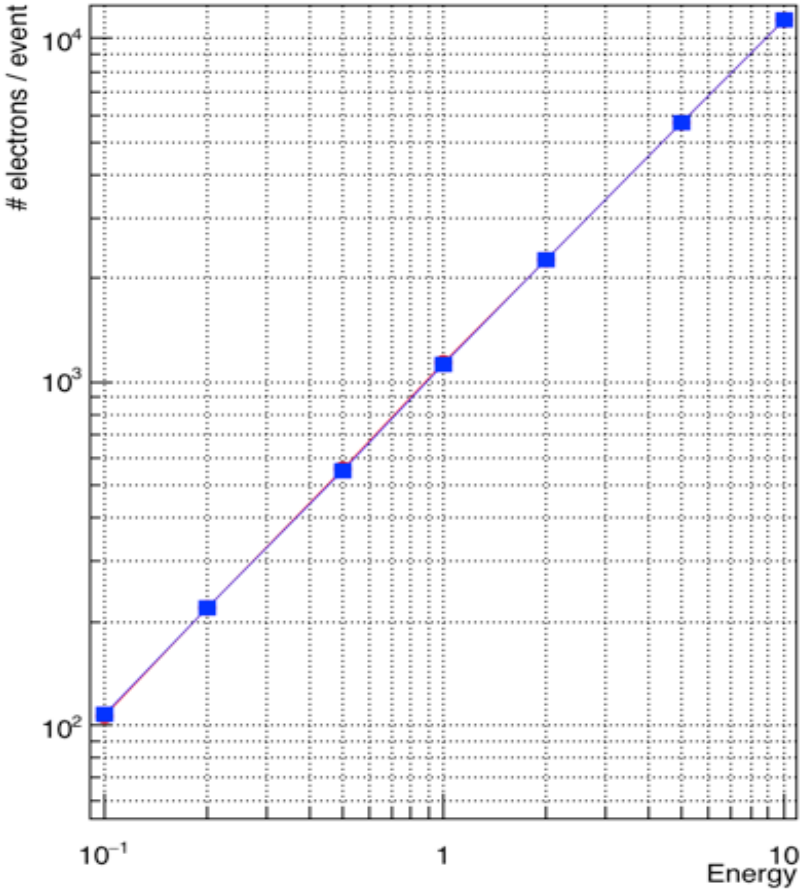
GeantV vs. Geant4 – Mean # photons



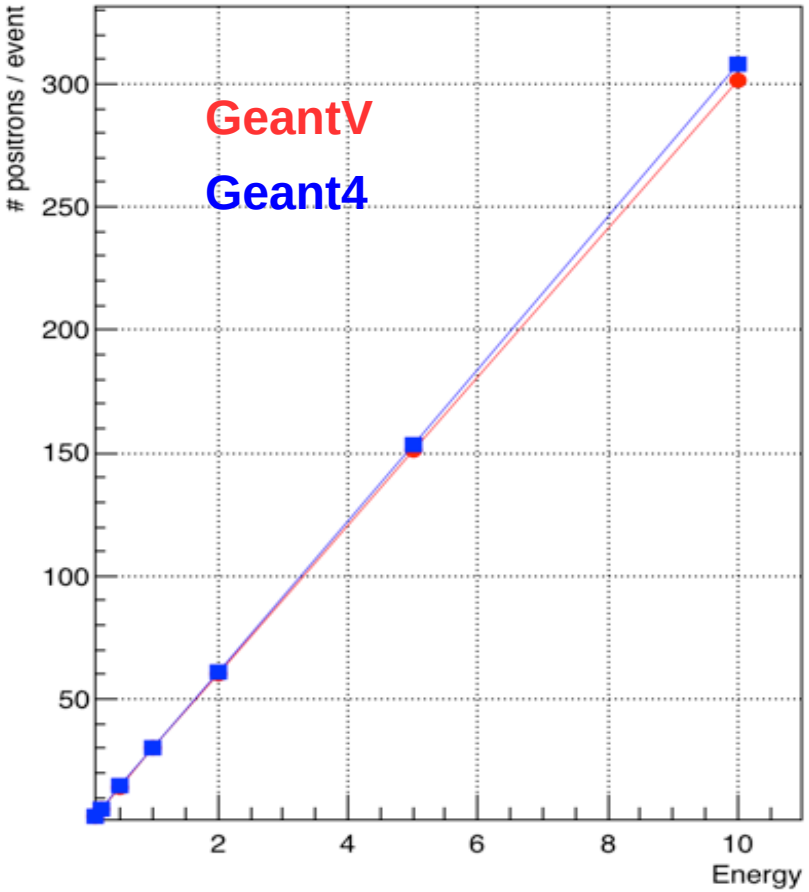


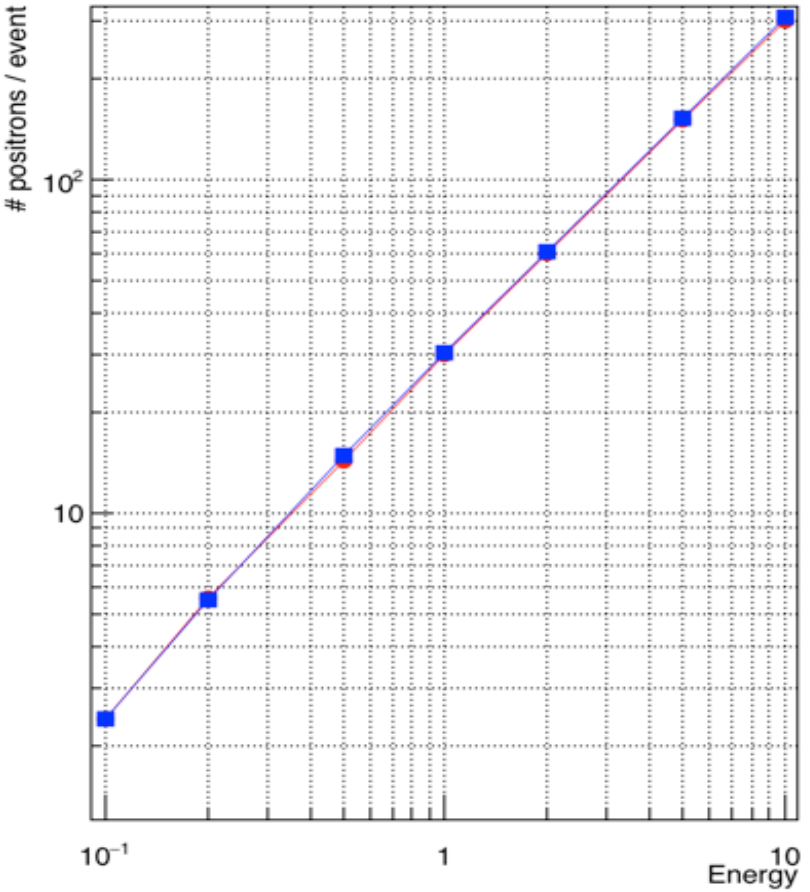
GeantV vs. Geant4 – Mean # electrons



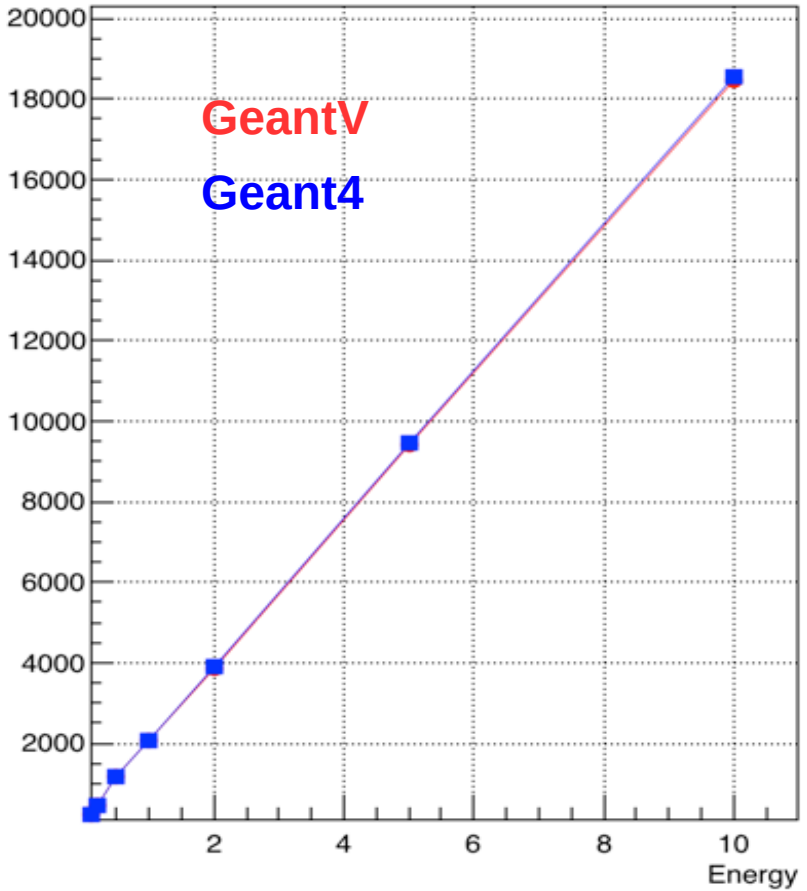


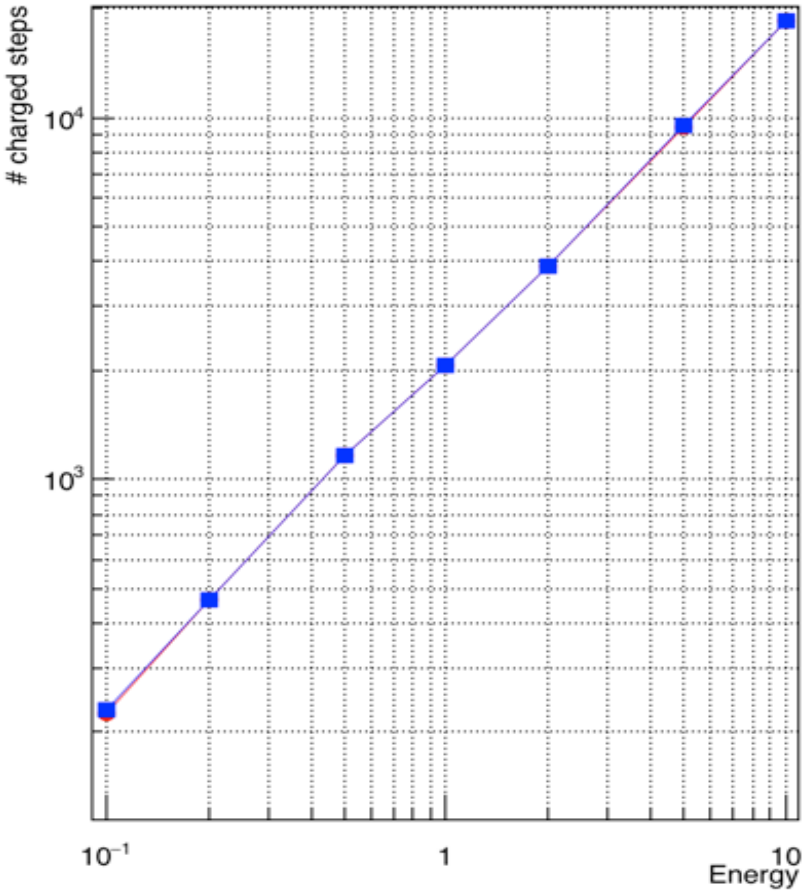
GeantV vs. Geant4 – Mean # positrons



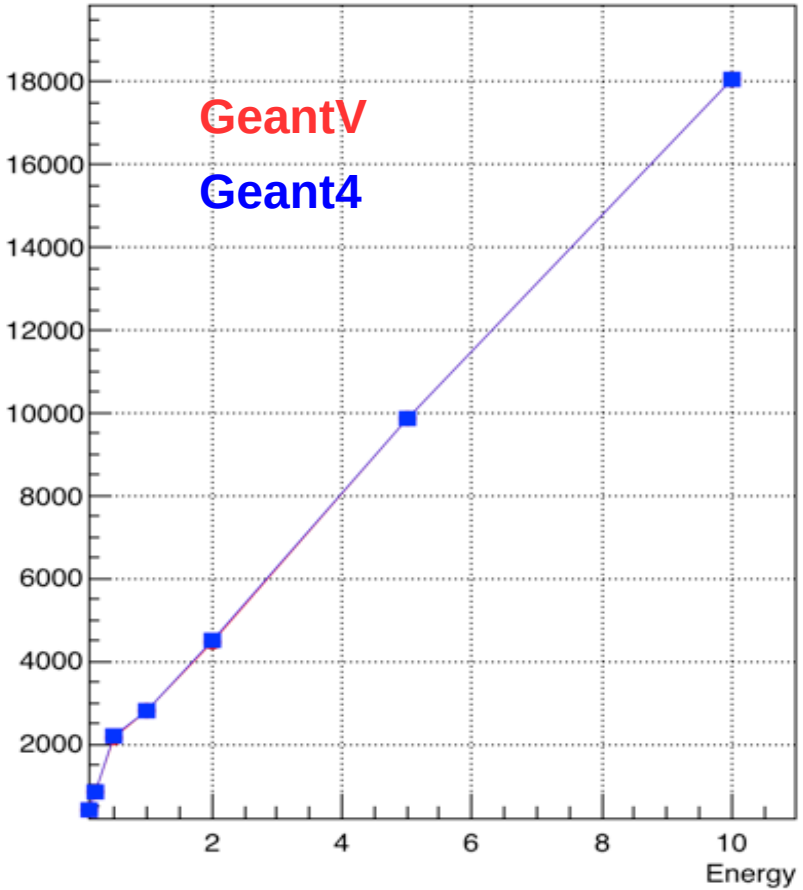


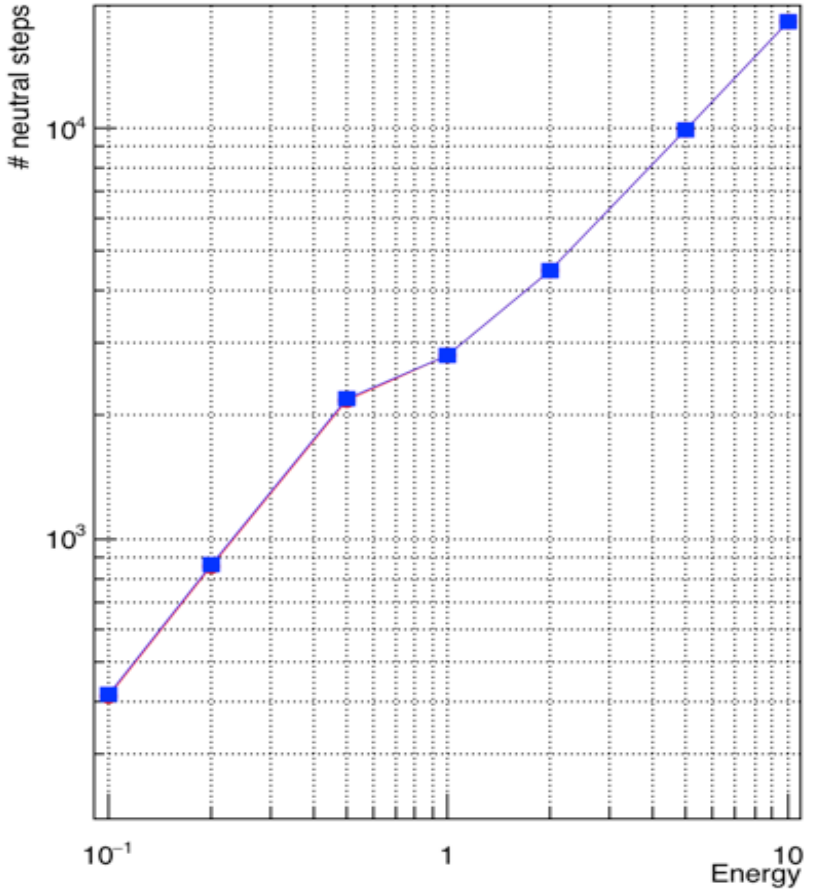
GeantV vs. Geant4 – Mean # charged steps





GeantV vs. Geant4 – Mean # neutral steps

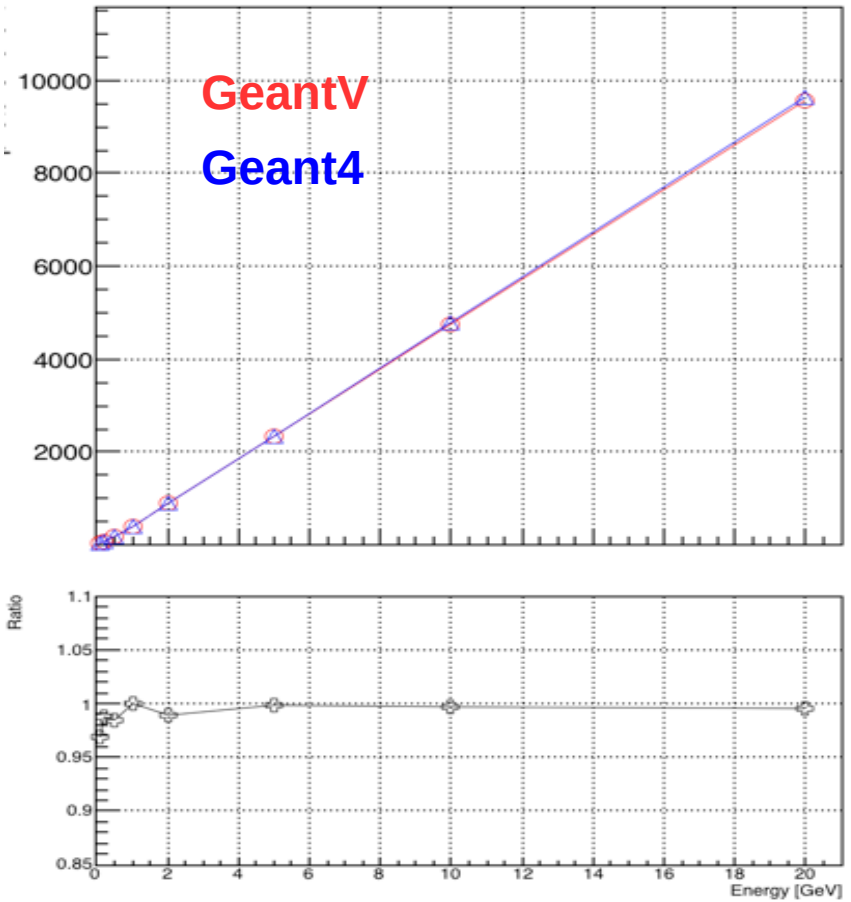


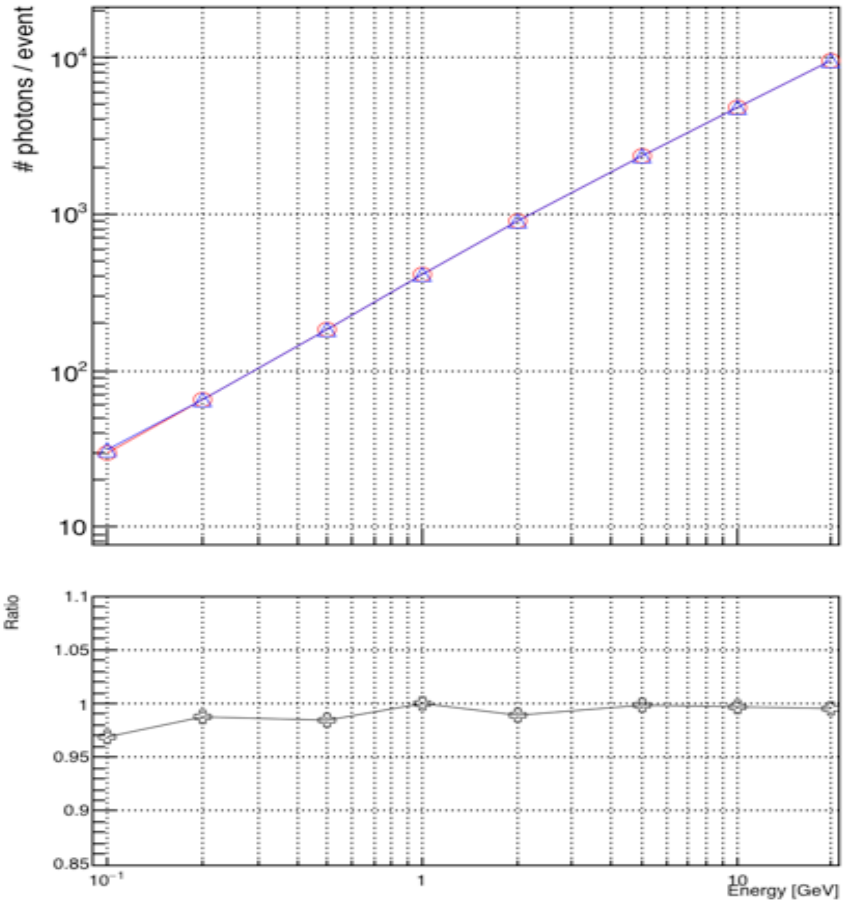


CMS standalone validation

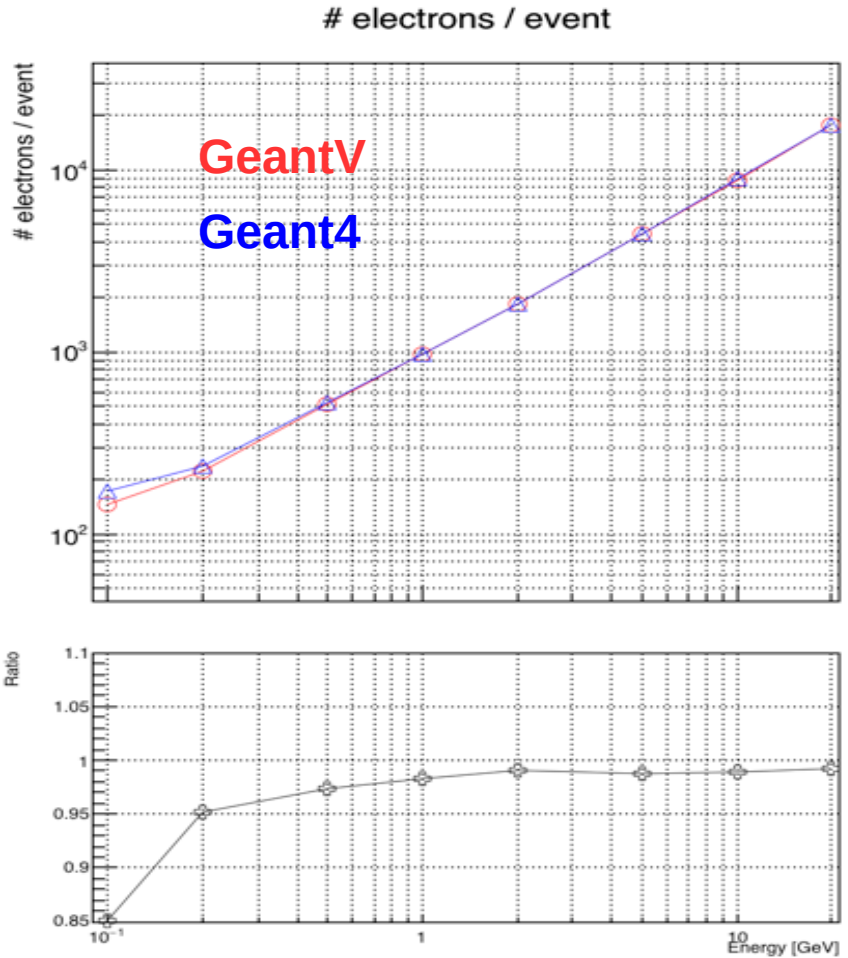
- Once TestEm3 was validated, next one was Full CMS
- Using cms2018.gdml and full magnetic field map
- Good agreement for fixed directions (theta=45deg or eta=2.5, both at phi=90deg)
- Then used random directions, 1000 events, 1 e-/event, different energies
- Jobs run on single-thread, scalar mode
- Observables (adding ratio plots):
  - Mean number of secondaries: photons, e-, e+
  - Mean number of charged and neutral steps
  - Mean number of charged and neutral track lengths

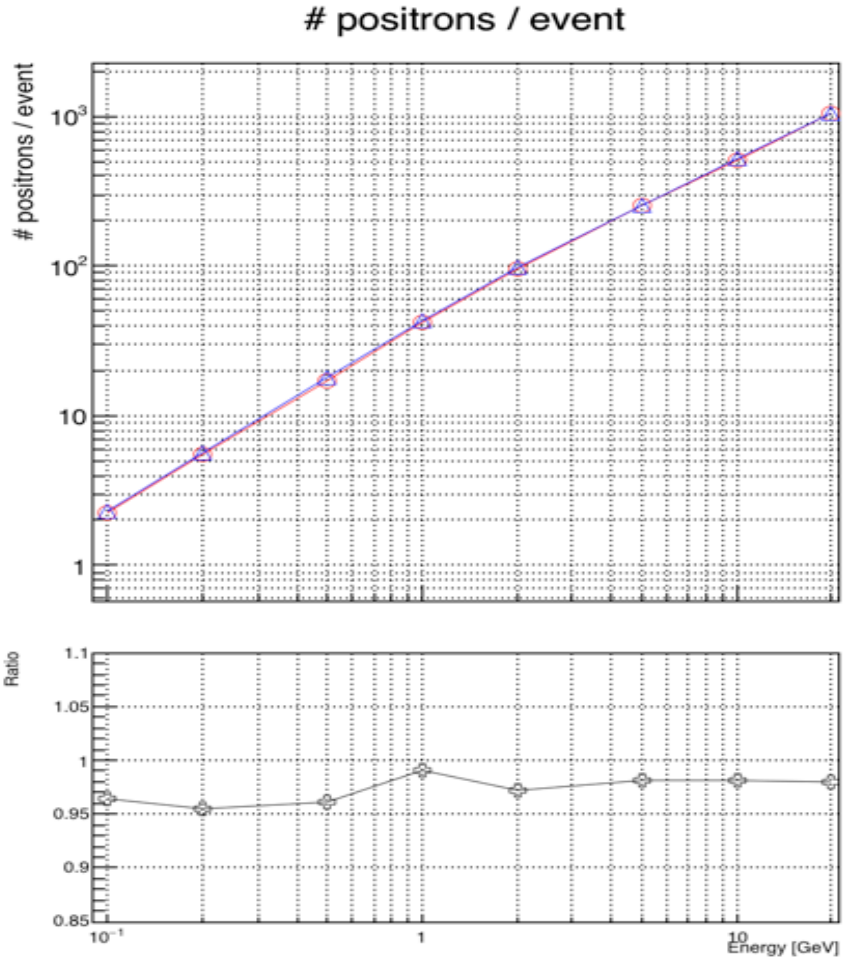
Standalone Full CMS – avg # photons per event



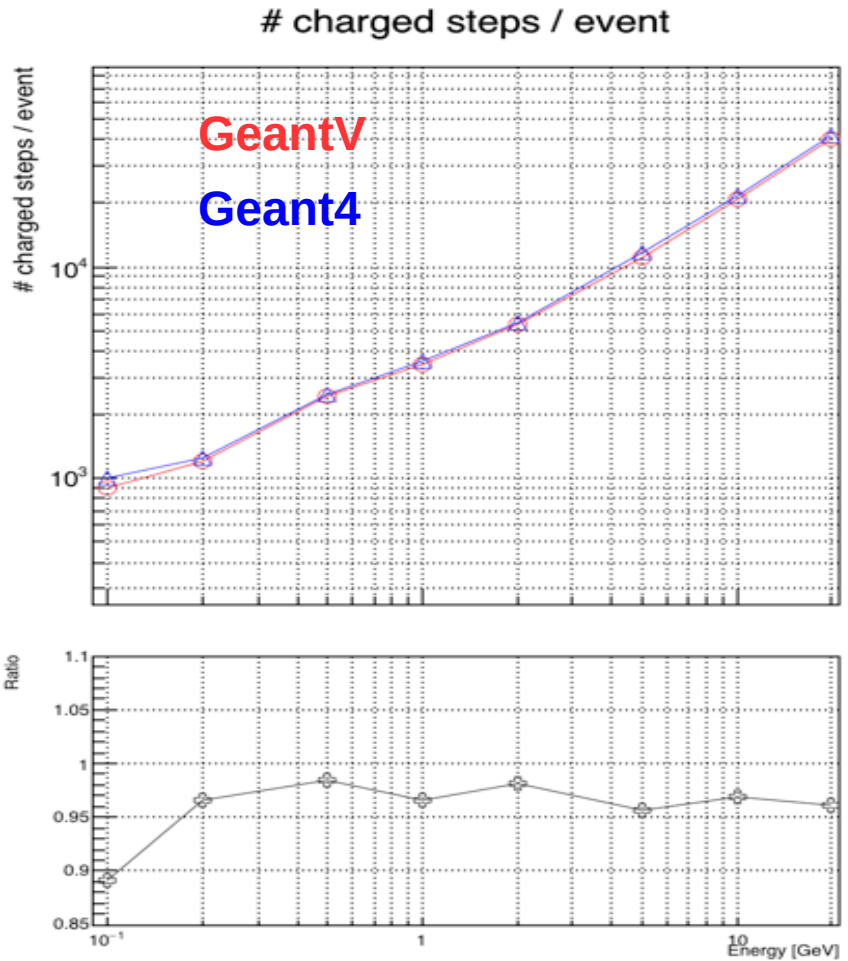


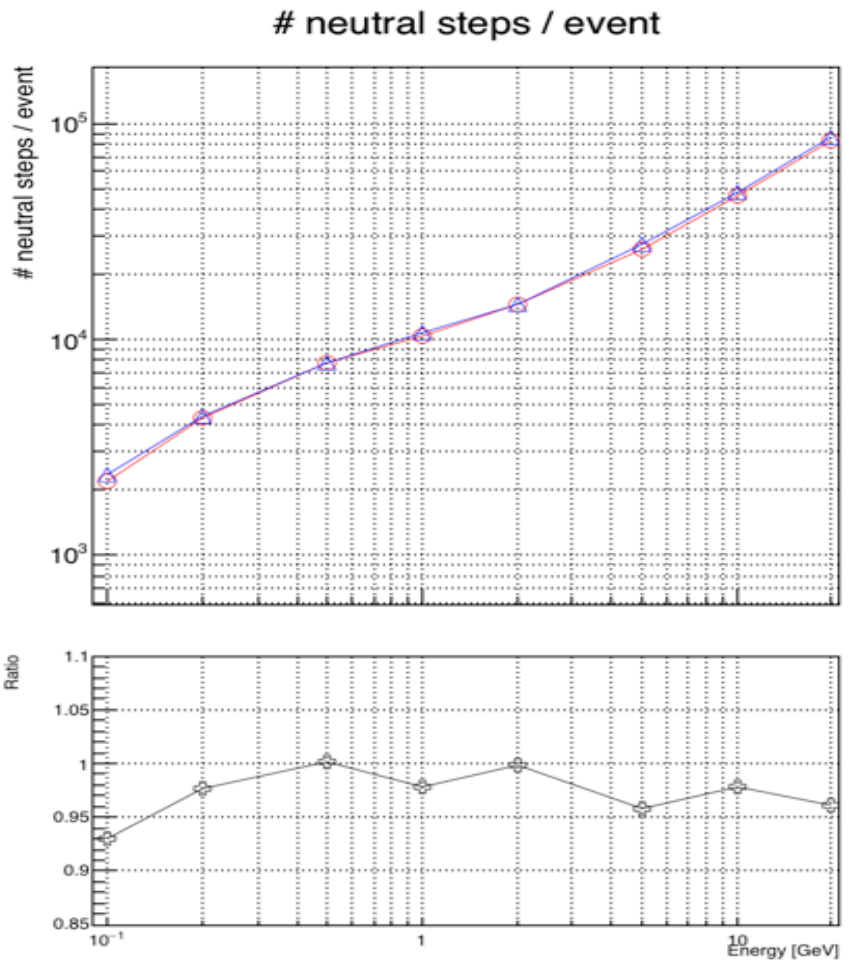
Standalone Full CMS – avg # e-,e+ per event



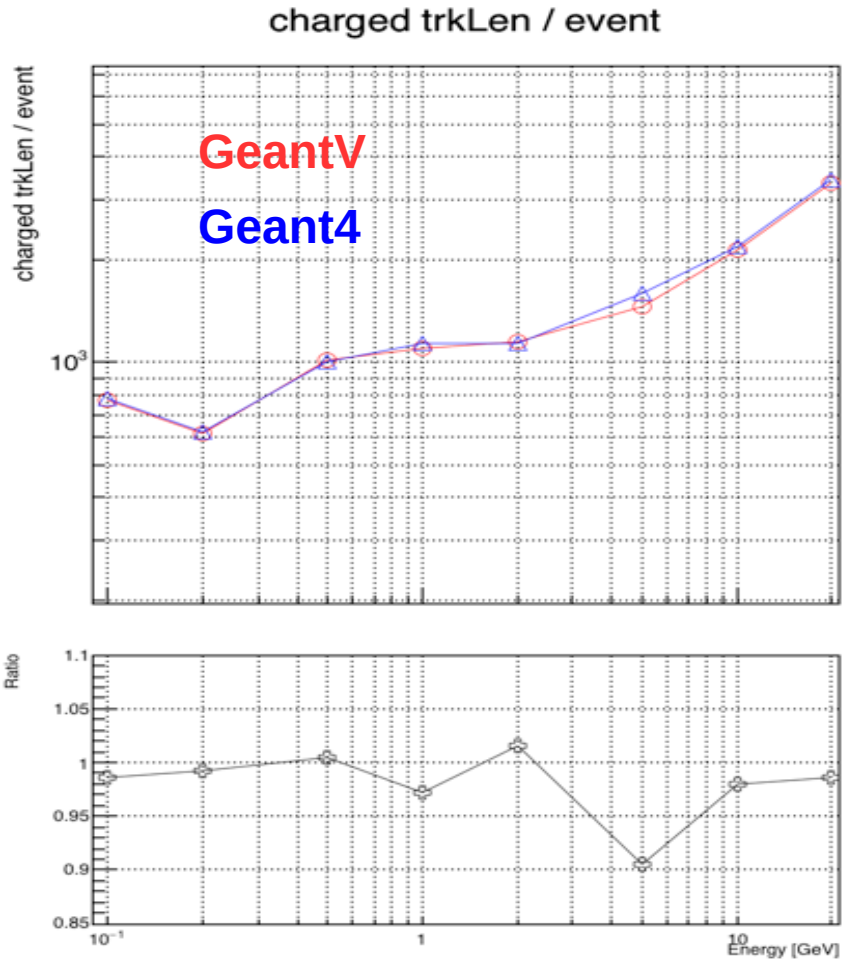


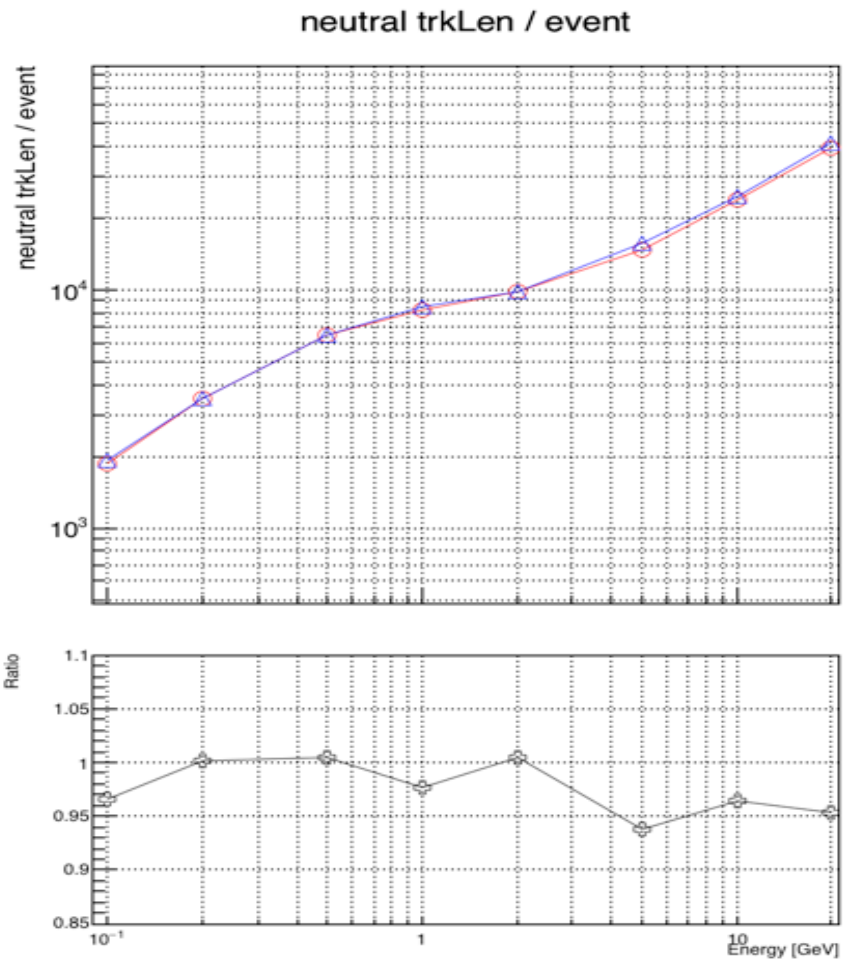
Standalone Full CMS – avg # steps per event





Standalone Full CMS – avg track length per event





Summary

- Good agreement between Geant4 and GeantV, for both TestEm3 and FullCMS standalone tests
  - Incorrect setting for cuts in GeantV was the reason for the discrepancies previously observed
- Good agreement also observed for magnetic field on/off
  - actually, no significant change was observed in TestEm3 distributions due to a magnetic field Bz = 0 or 5T
- See Soon's talk on the performance perspectives for GeantV