Geant4.8.1(px) in CMS Application: production-type tests, physics aspects

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Production-type Tests - Overview

- Objectives - robustness, timing performance
- Approach - “parallel” builds of the same CMS application: CMSSW_1_2_0 (G4.7.1) & CMSSW_1_2_0_g4_81 (G4.8.1.p02)
- Resources: OSG
- Full-scale CMS geometry, magnetic field ON
- Test samples & statistics:
  -- 1TeV single e-, pi-, mu+; scan within eta=-/+3.0
  500events x 10jobs for each particle type
  -- minbias, 1000events x 10jobs
  -- H->ZZ->4mu (explicit, no UE), 1000events x 10jobs
  -- Z'->dijets, 100events x 100jobs
- Physics lists: QGSP, QGSP_EMV

Production-type Tests - Robustness

- **Successful jobs:**
  -- single particle scans – all
  -- minbias – G4.7.1/QGSP, G4.8.1.p02/QGSP_EMV
  -- H->4mu – all
  -- Z'->dijets – G4.7.1/QGSP, G4.8.1.p02/QGSP_EMV,
  3 jobs of 100 with G4.8.1.p02/QGSP
- **Failed jobs:**
  -- minbais – all with G4.8.1.p02/QGSP
  -- Z'->dijets – 95 of 100 with G4.8.1.p02/QGSP
  (2 jobs killed for running for > 1week)
- **Failure diagnostics: G4Navigator; ~20% of logfiles point at the new mult.scatt. model (G4UrbanMscModel)**

Production-type Tests - Skipped Events, CPU

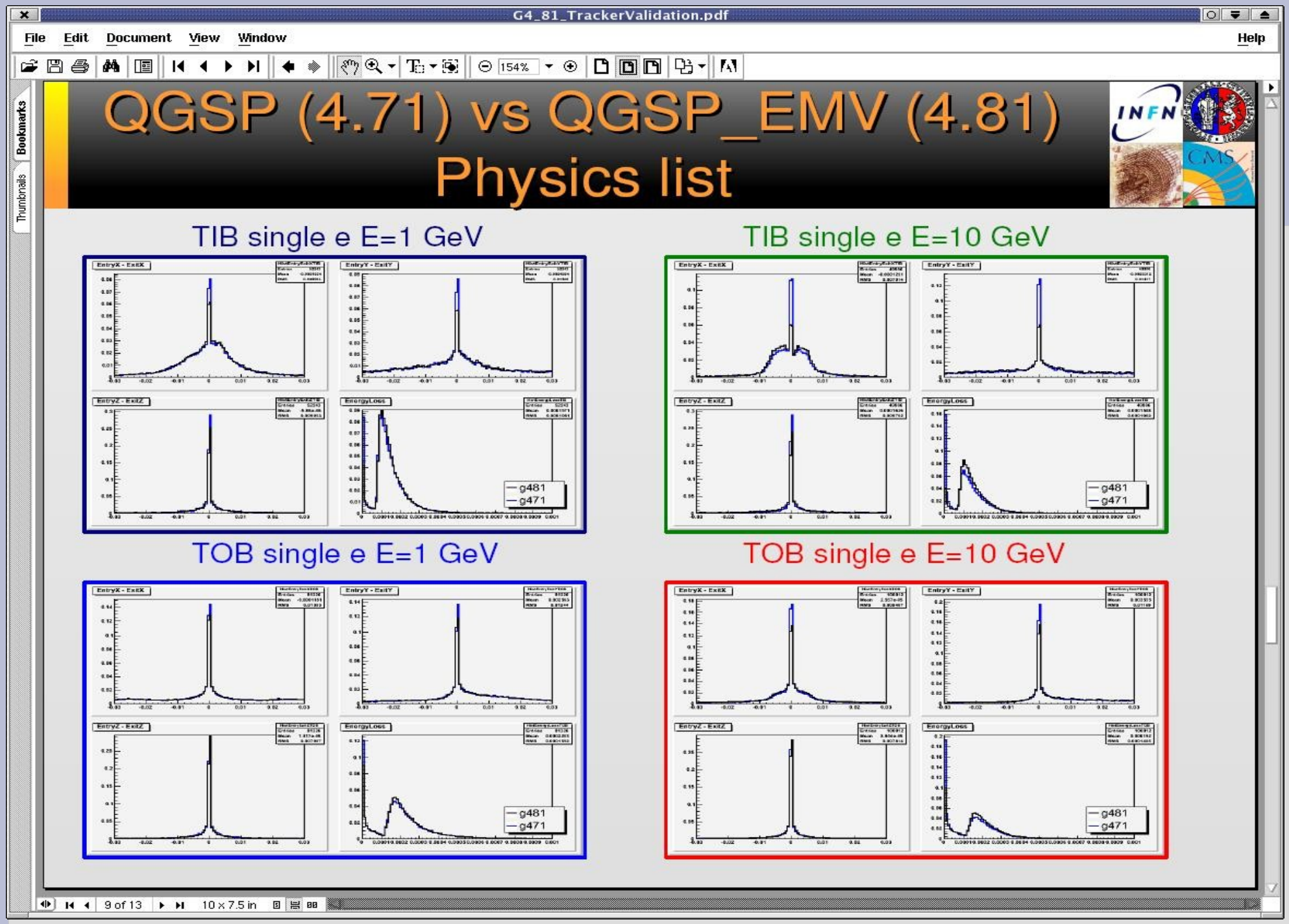
- Rates of NaN-corrupted events with G4.7.1:
  -- 1TeV single pi – 9 events of 5,000
  -- minbias – 5 events of 10,000
  -- Z'->dijets – 52 events of 10,000
- G4.8.1.p02/QGSP_EMV: NO NaN-corruped events so far
- G4.8.1.p02/QGSP – excluded, due to massive failures

- CPU Performance of G4.8.1.p02:
  -- QGSP_EMV comparable to G4.7.1 or better (15-20%)
  -- QGSP – slowdown by ~15-60%
  but!... Z' jobs show slowdown by factor ~5-15,
  due to several events taking “insane” amount of CPU

Physics Performance (I): CMS Tracker response to single e-

- Full-scale CMS geometry, mag.field ON
- Physics lists: QGSP, QGSP_EMV (also LHEP)
- Samples: scan with 1GeV, 10GeV e-; 10k/sample
- CPU estimates – as expected
- Focus on: spacial distribution of sim.hits, energy loss
- Observations – G4.7.1/QGSP vs G4.8.1.p02/QGSP _EMV:
  -- distributions are close at the macroscopic level
  -- spacial distributions of sim.hits blown slightly wider with QGSP_EMV, energy distributions shifting towards larger values
- Detailed report by Filippo Ambroglini (INFN-Perugia):

http://cmsdoc.cern.ch/cms/cpt/Software/html/General/simulation/CMSG4Releases.html



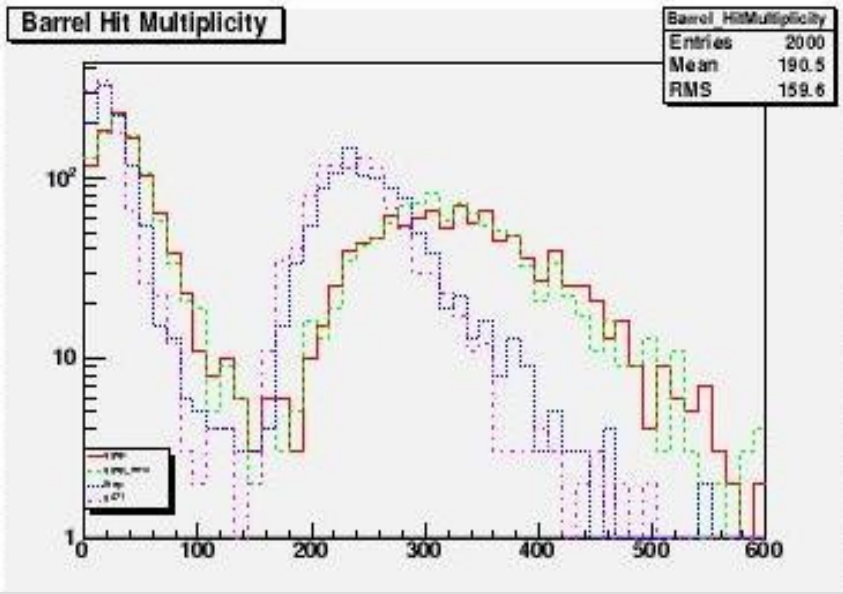
Plots from Filippo Ambroglini's talk at the CMS Sim. meeting 01/18/2007

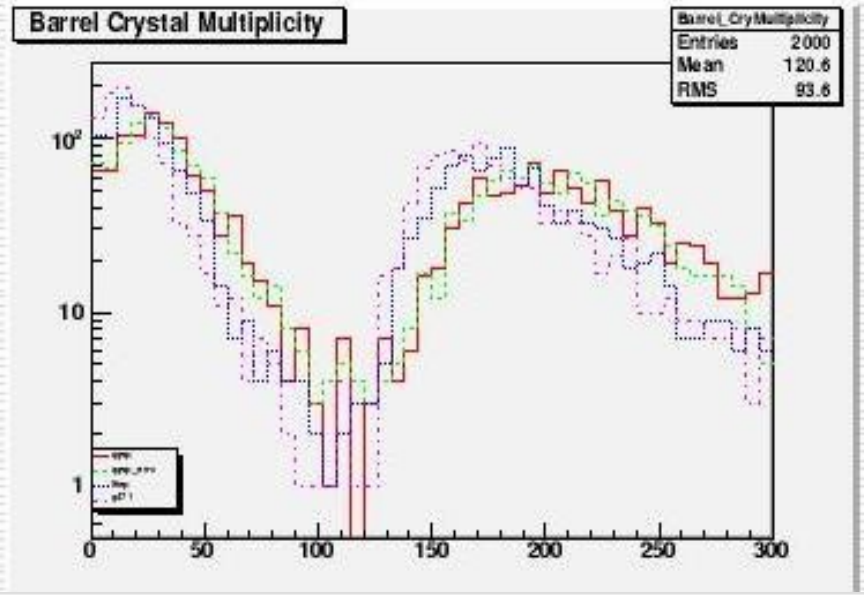
Physics Performance (II): EM showers in CMS Ecal

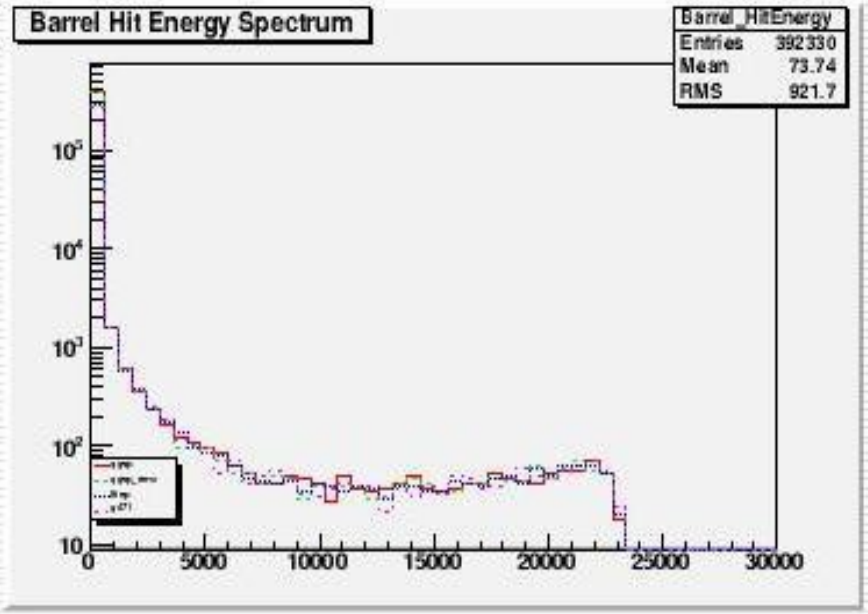
- Ecal-only geometry, mag.field ON/OFF
- Physics lists: QGSP, QGSP_EMV (also LHEP)
- Samples: γ 30GeV, π pt=60GeV (at eta=0.2 or 2.2), 2k/sample
- CPU estimates – as expected
- Focus on:
  energy dep., long., trans. shower profile, sim.hit multiplicity
  remark: Ecal sim.hit = energy deposit in a given sensitive volume by a given track, in a given (1ns) time slot
- Obvervations – G4.7.1/QGSP vs G4.8.1.p02/QGSP_EMV:
  -- EM showers characteristics – close at macroscopic level
  -- larger number of low-energy hits arriving at later time
- Detailed report by Fabio Cossutti (INFN-Trieste):

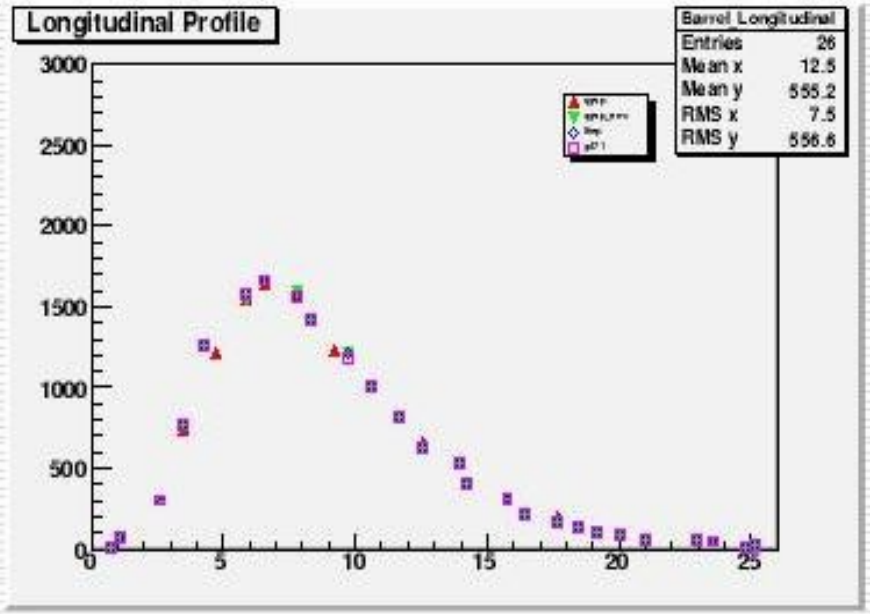
http://cmsdoc.cern.ch/cms/cpt/Software/html/General/simulation/CMSG4Releases.html

30GeV photon on Ecal (Barrel), mag.field ON







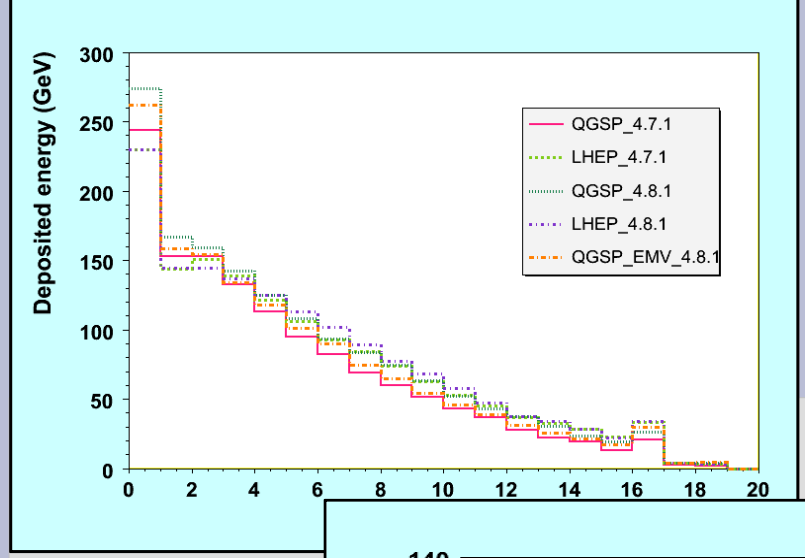


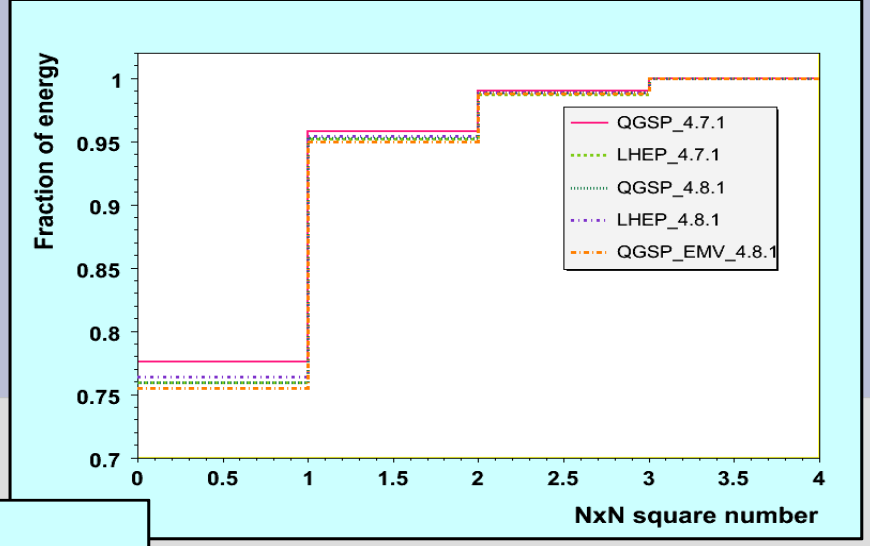
Plots from Fabio Cossutti's talk at the CMS Sim. meeting 01/18/2007

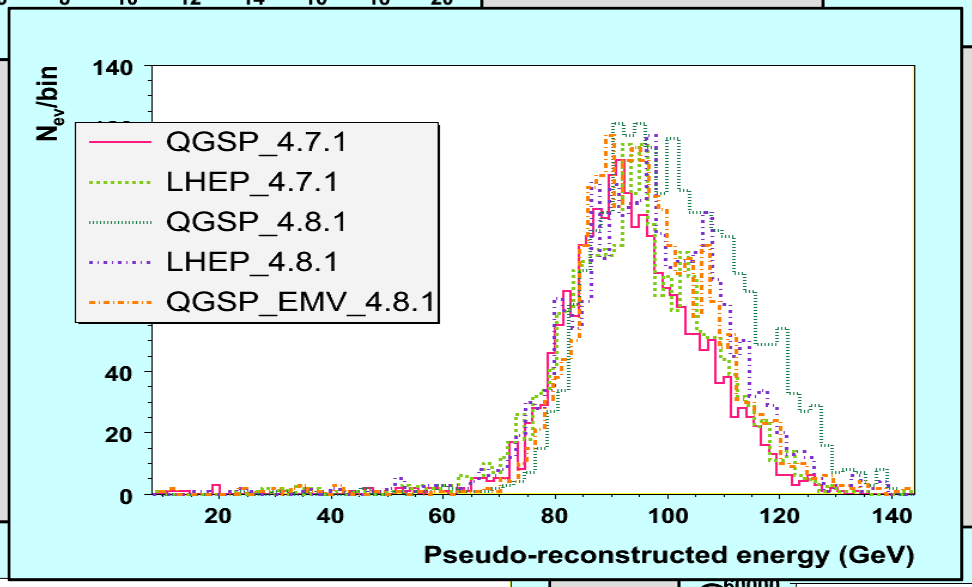
Physics Performance (III): HAD showers in CMS Ecal+Hcal

- Ecal+Hcal-only geometry, mag.field ON/OFF
- Physics lists: QGSP, QGSP_EMV (also LHEP)
- Sample: π 100GeV, 2k
- CPU estimates – significant speedup with QGSP_EMV !
- Focus on:
  energy dep., long., trans. profile, sim.hits multiplicity
  remark: sim.hit definition is similar to Ecal, edep sum over scint.layers
- Observations – G4.7.1/QGSP vs G4.8.1.p02/QGSP_EMV (similar to Ecal's):
  -- shower characteristics - close
  -- larger number of low-energy hits arriving at later time
- Detailed report by Salavat Abdullin (FNAL/ITEP-Moscow):

http://cmsdoc.cern.ch/cms/cpt/Software/html/General/simulation/CMSG4Releases.html

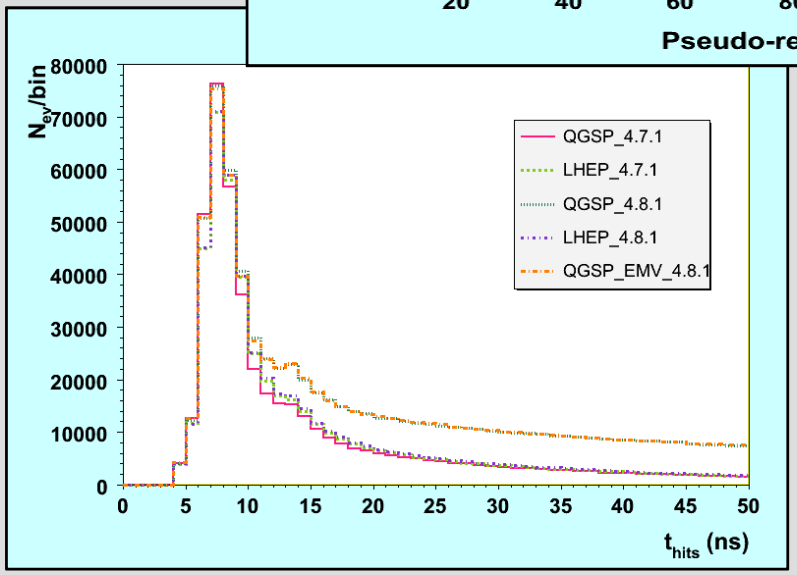


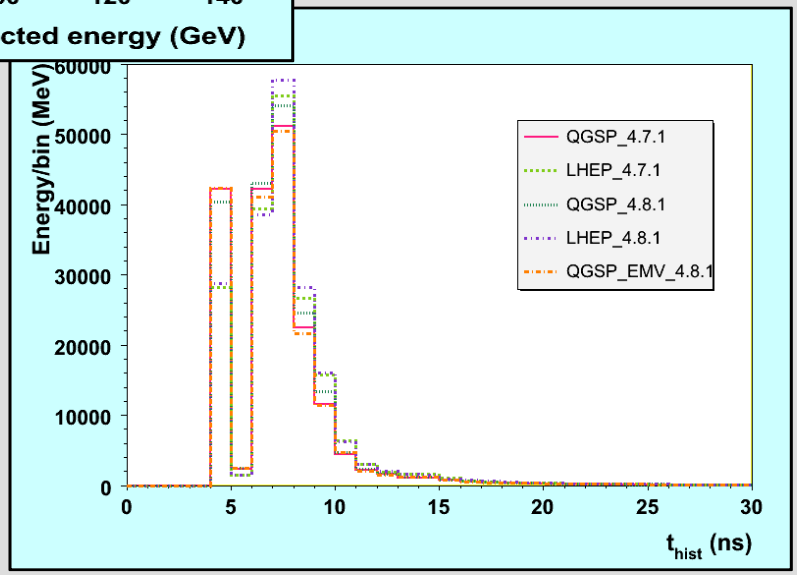




Plots from Salavat Abdullin

CMS Sim. meeting 01/18/2007





Summary

- Large-scale production tests of Geant4-based CMS application ran in grid & yielded useful results
- Unfortunately, G4.8.1.p02/QGSP is not operational with CMS application
- G4.8.1.p02/QGSP_EMV is operational & features somewhat better CPU performance
- Physics performance of G4.8.1.p02/QGSP_EMV similar to G4.7.1, at macroscopic level; small differences found
- G4.8.1.p02 appears more robust as NO NaN-corrupted events have been detected (so far)