



Plan for Gauss release for real data

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G4 Technical Forum on 26th Feb 2008





Introduction

- **Gauss validated for big production last time for DC06 (April-July 2006)**
 - ❑ **Many, many versions: the last (v26r0) at beginning of February**

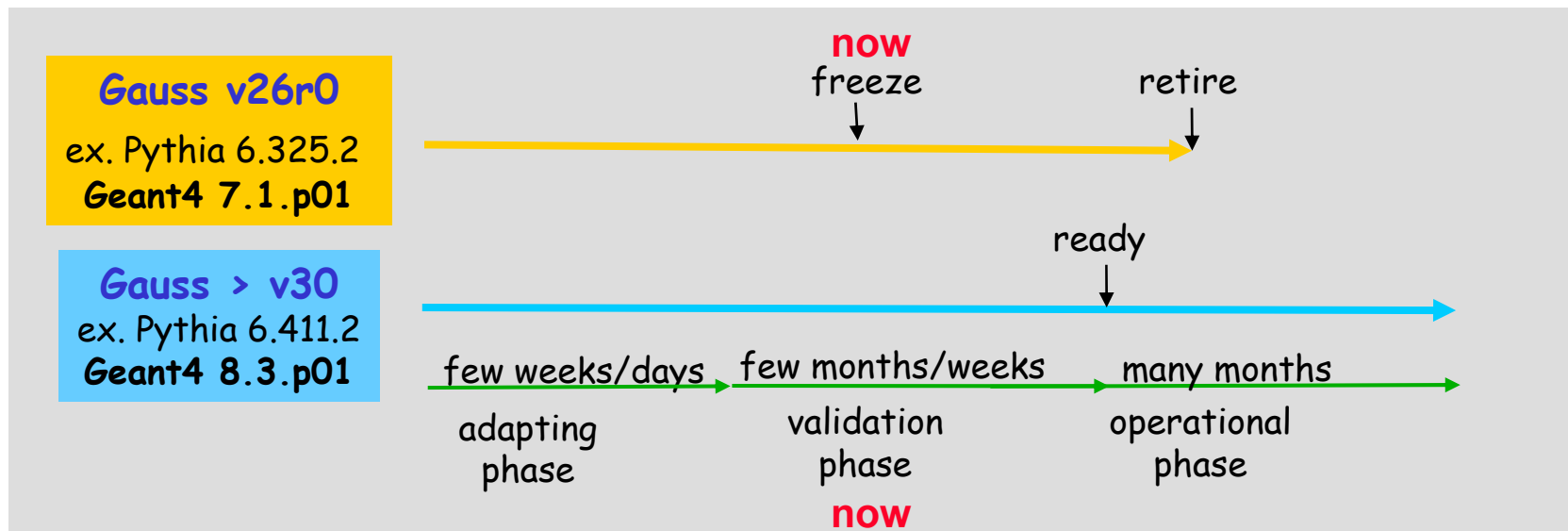
- **Requirements for new version to be fully operational for production**

- “compatible” with other applications (Boole, Brunel, etc.)
 - **use latest Gaudi + LHCb + DDDB**
 - complete
 - **any new necessary/desirable features introduced (e.g. detectors as built)**
 - stable
 - **low crash rate, reasonable CPU time**
 - physics validated (generator and Geant4)
 - **comparison with the previous version**
 - **comparison with (test beam) data**
-
- ❑ **Generator libraries and Geant4 versions frozen as to have consistent physics for whole DC06**
 - ❑ **New features in generators introduced**
 - **event type, external generators, ...**



Development

- **Development version of Gauss \geq v30r0, since last year (G4 8.2, 8.3)**
 - ❑ used for alignment studies
 - ❑ gives latest features... but to be used with caution



- **Need to prepare Gauss for when real data arrive**

- ❑ Latest generators: Pythia 6, Pythia 8
- ❑ Migrate to HepMC 2.0
 - does not depend on CLHEP
 - affect all code using GenEvent
- ❑ Latest Geant4 version if possible

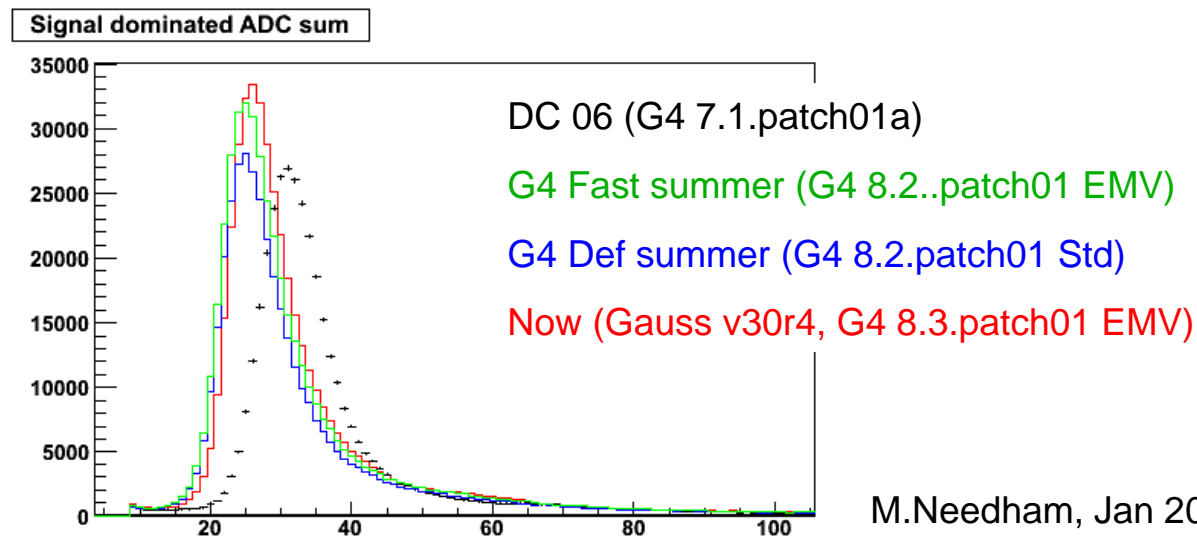
All of them keep evolving and will keep doing it when data taking starts

Try to make cycle shorter



Gauss “dependencies”

- New versions of external packages all to be validated software and physics wise
 - ❑ Some validation done at LCG Genser level, see <http://lhcb-release-area.web.cern.ch/LHCb-release-area/DOC/gauss/generator/>
- Effect of new Geant4 version require quite a bit of effort to be understood and validated
- Studies in progress with Gauss v30r2 → v30r4
 - ie. Geant4 8.2.p01 → 8.3.p01
 - ❑ dE/dx have been evolving up to now, latest versions supposed to do it less...



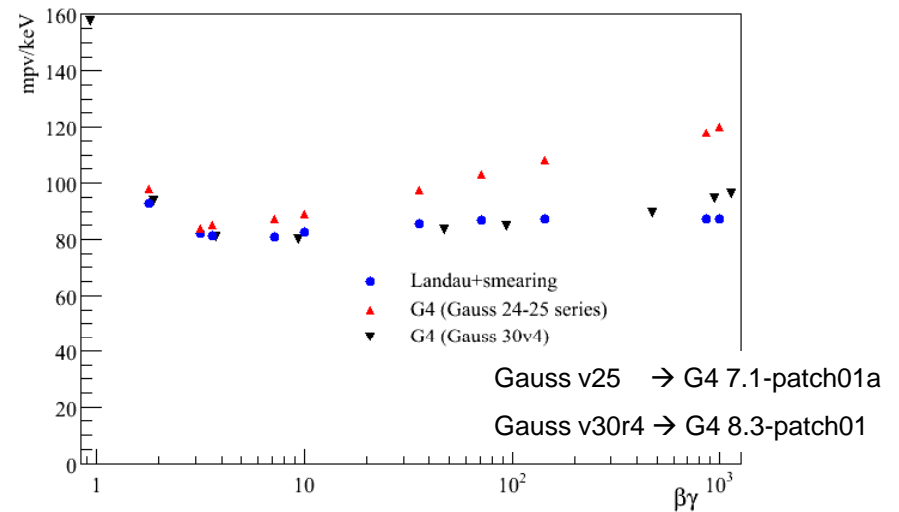


Open issues: dE/dx in thin silicon (1)

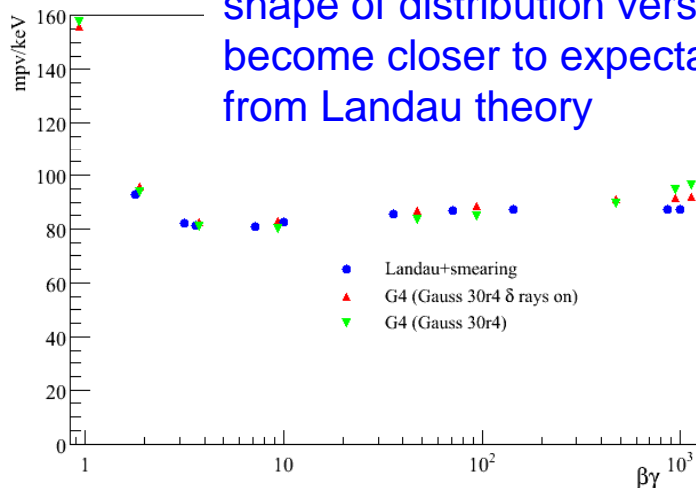
M.Needham, Jan 2008

mu particle gun looking at all energy deposited in Silicon layer

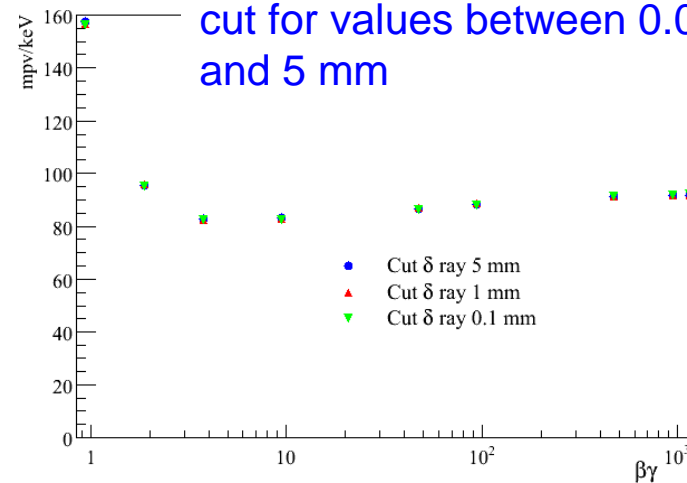
Energy loss with new version of Gauss
 much closer to expectations
 even without δ -rays
 Why is not clear...



Turn on δ -rays
 shape of distribution versus $\beta\gamma$
 become closer to expectation
 from Landau theory



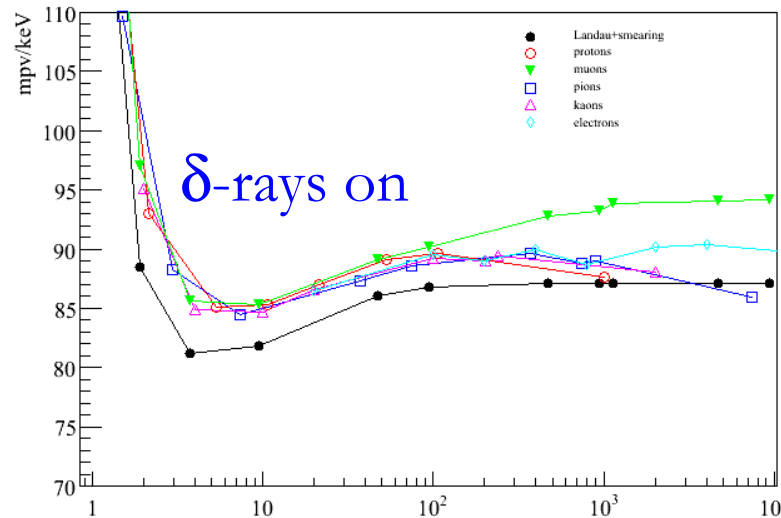
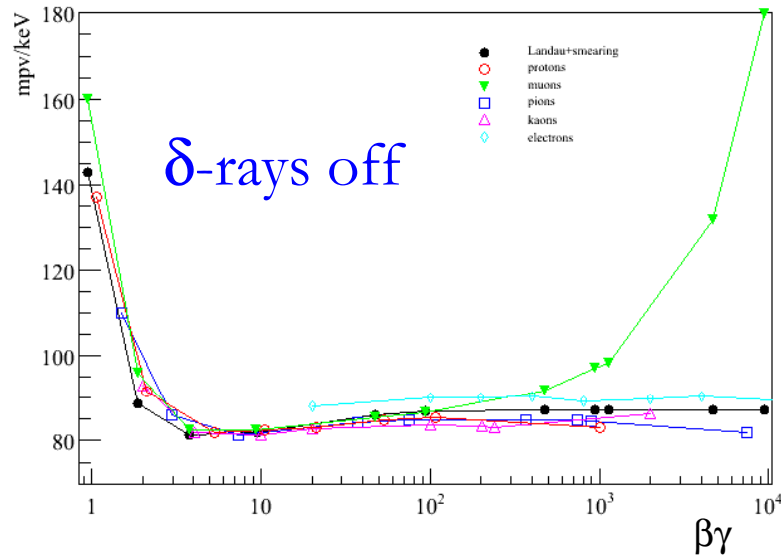
Results independent of δ -rays range
 cut for values between 0.001 mm
 and 5 mm





Open issues: dE/Dx in thin silicon (2)

M.Needham, Jan 2008



Differences for different particle types

Electrons, muon and hadrons behave differently

Energy loss 5 % higher for electrons than hadrons

Difference due to different physics models/threshold settings for different particle types ?

Again different δ -rays on/off

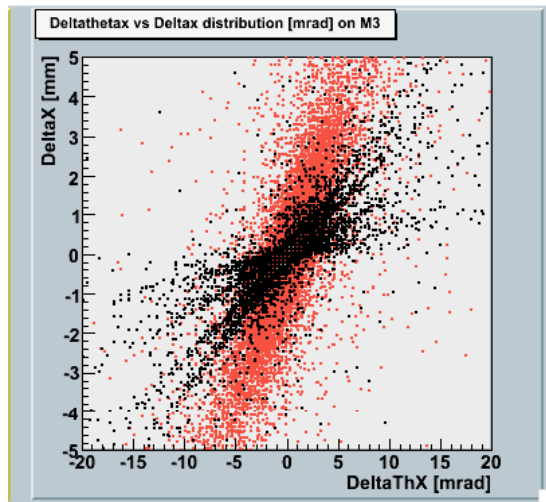
Discussions in progress with V.Ivanchenko (Geant4) to understand this



S. Vecchi, August 2007

Open issue: Multiple scattering in Muon System

- Muon trajectories are dominated by multiple scattering interaction in the Calorimeters and in the Muon Filters.



Red = PDG,
black = Gauss (GEANT 7.1.p01a)
muons $p=[5-100]$ GeV/c (particle gun)

- Correlation between displacement and angular deviation was not included for small number of steps like in muon filters for muons

- Understood this was fixed from Geant4 8.0 forcing more than one step in each volume

EM Standard

EM 71

Expected behavior with δ -ray on in filters
→ need to check steps limitation

G4 8.2p01

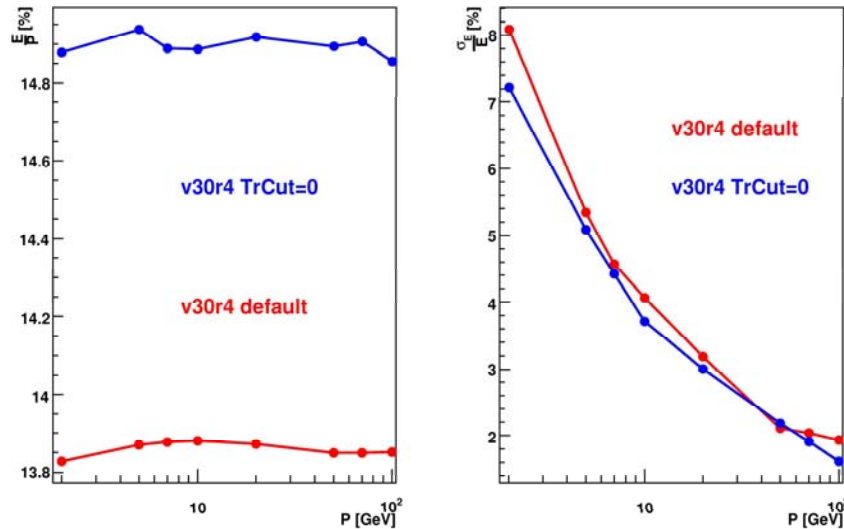
discussed with
V. Ivanchenko
(Geant4)



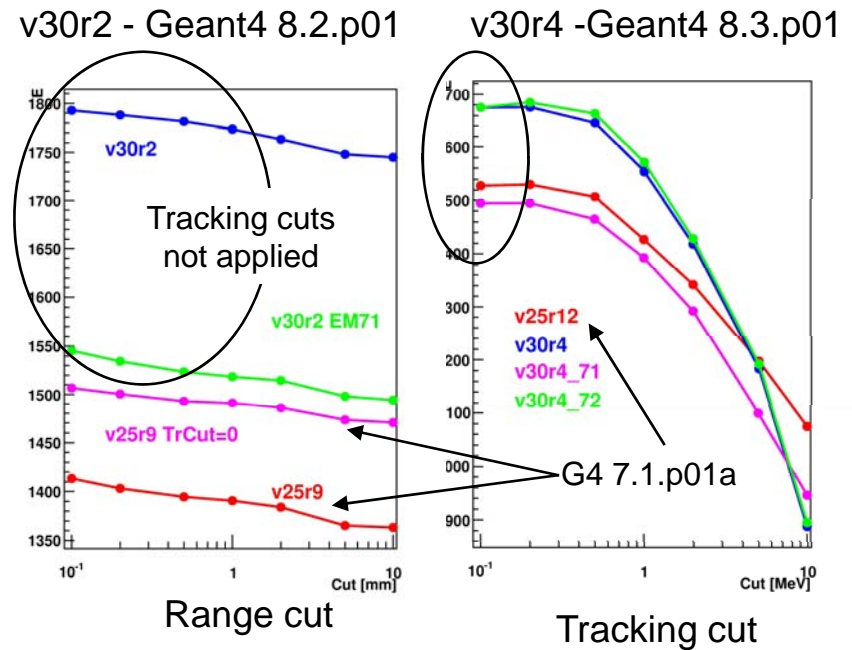
Calorimeters

- Choice of EM physics (and cuts) to run with affect visible energy and resolution in calorimeters
 - calibration for reconstruction

- EM physics list has to be unique in simulation, cuts can be chosen detector by detector
 - influence on time



Geant4 8.2.p01
electron gun in ECAL



V.Romanovsky, June and December 2007





How to validate (1)

- **Finding problems as early as possible eases and speeds up the process**
- **Once we will have data want to do it as fast and with as little impact (but the wanted one!) as possible**
 - ❑ **Untested features can generate possible unpredictable delays in the whole chain**
- **LHCb intend to define reference quantities to be looked up when looking at new release to verify physics evolution and if we want/can adopt it at a given moment**
 - ❑ **Prepare list of options/code to run to check the various quantities**
 - **Particle guns, reduced geometry, etc. etc.**
 - ❑ **Eventually automatize the whole process**
- **Agree with Geant4 for a possible set of quantities we would like you to monitor (with our cuts) when you prepare a release**
 - ❑ **very important to have access to results of tests performed before a release**



How to validate (2)

- **Discuss with experiments new Geant4 major features and impact (when known) in detail**
 - ❑ **List of tasks are presented at G4 Technical Forum BUT should be done before a release**
 - Appreciated for Geant4 8.0 they gave us advanced warning about CPU increase of EM physics
 - Once LHCb has validation setup could test Geant4 before official release (~ 1 month)
 - ❑ **At G4Review last year asked to have in their release note higher level reasons for the changes in addition to the specifics to help to understand the impact and better judge if/when to adopt the release.**
 - Now have an entry “Expected effects on physics and performance”



Gauss next future

- **Parallel releases of Gauss coming up: identical but for Geant4 version**
 - and whatever changes are necessary to compile it/run it with

Gauss	v31r0	v31r1	v32r0	v33r0	v30r5
Geant4	8.3.p01	8.3.p02	9.0.p02	9.1.p01	8.3.p01

Pre-released in \$LHCBDEV
New Gaudi, LHCb, DDDB

Current release

Concentrate
studies on
these versions

- **Establish “validation jobs” for Gauss and reference quantities for Geant4**
- **Goal to have a “ready-for-data” version end of May**
 - define and agree on physics settings