LHCb software performance regression testing From SW commissioning to testing and validation

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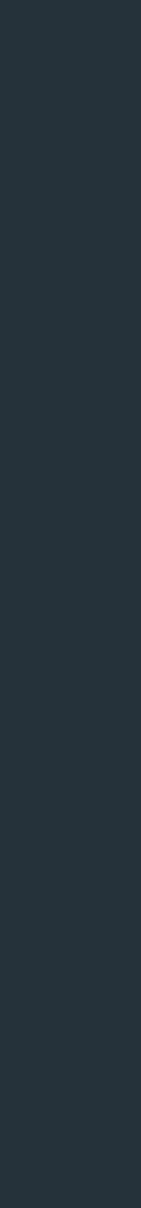




Outline

Introduction

- SW development and testing in LHCb
 - Performance and regression testing
- LHCbPR in a nutshell and its workflow
 - Some examples of LHCbPR results
 - Summary

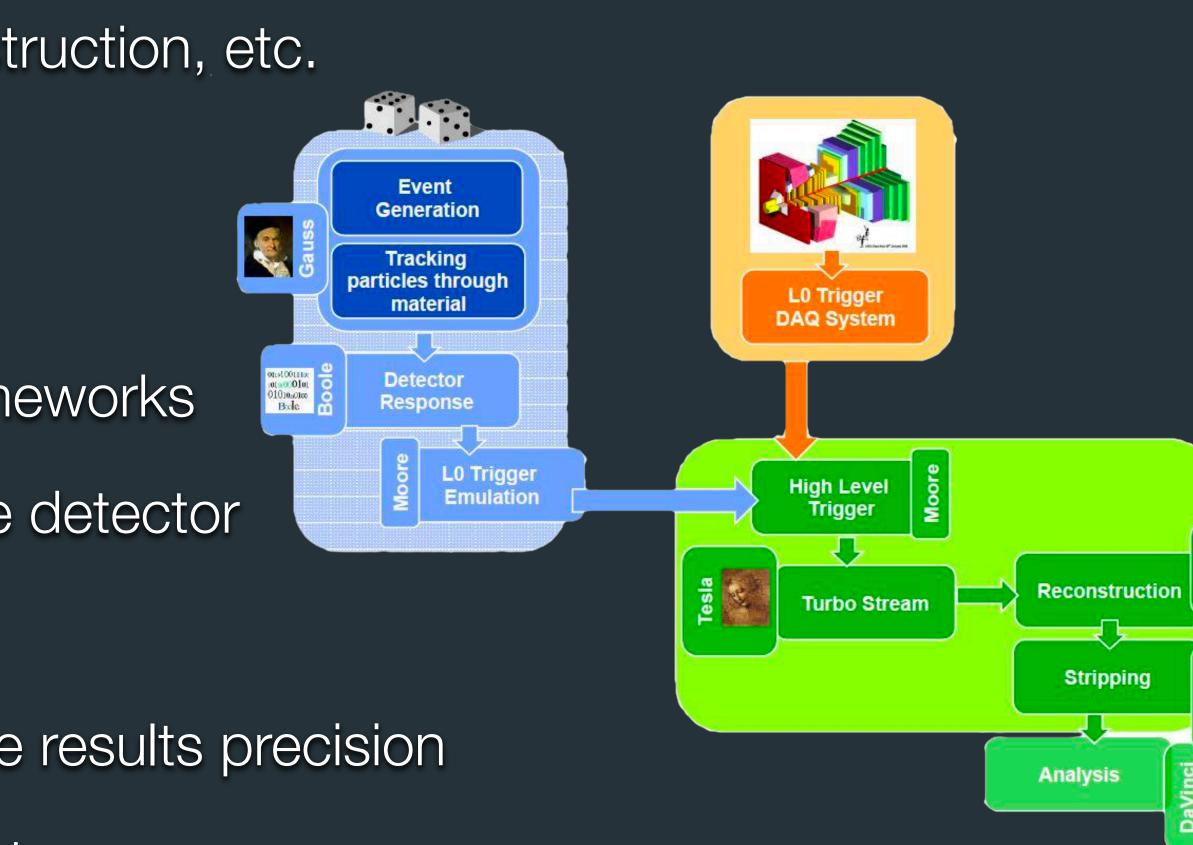


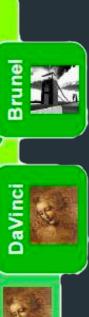


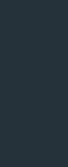
Research relies on software tools

LHCb software is a large code base

- Data acquisition, simulation, reconstruction, etc. ullet
- Developed by the collaboration •
- External dependencies and tools
 - Compilers, MC generators, frameworks
- Development for the LHCb upgrade detector •
- Focus is results in physics
 - Quality of SW tools directly influence results precision
 - Increased data flows drive error cost



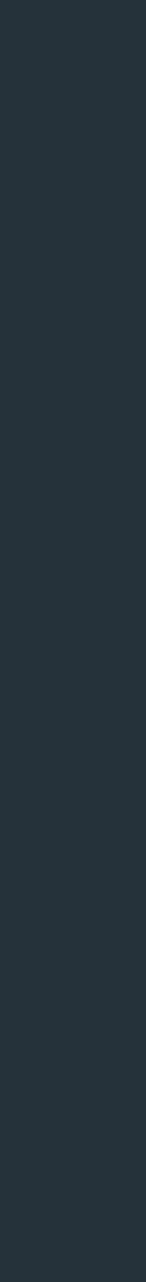






LHCb SW development

- Projects hosted on CERN GitLab, nightly builds (Jenkins)
- Main development relies on unit-/QM-/PR tests *
 - Major changes to applications, frameworks, building tools
 - Simple, quick tests O(1 evtent), project builds/runs
- Continuous code polishing **~**
- PR tests longer/more sophisticated/physics observables O(1K events) Some projects validated in production/data quality monitoring O(1M events)

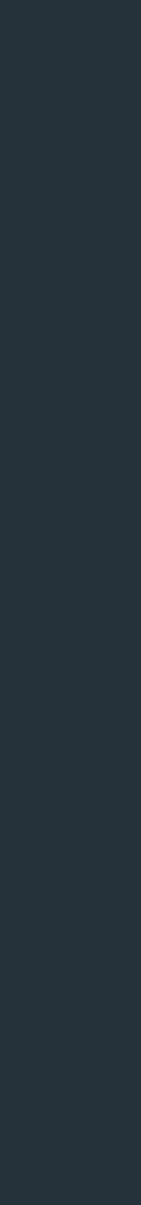


LHCb Performance and Regression tests

- Run LHCb applications, various configurations
 - MC generators, LHC beam conditions, detector geometry



- Application behaviour: timings, memory footprint
- Physics: numbers of tracks/vertices, momentum, energy deposits
- Size of data samples are a compromise between time and statistics
- Store results in various forms: basic types/JSON/files (e.g. ROOT)



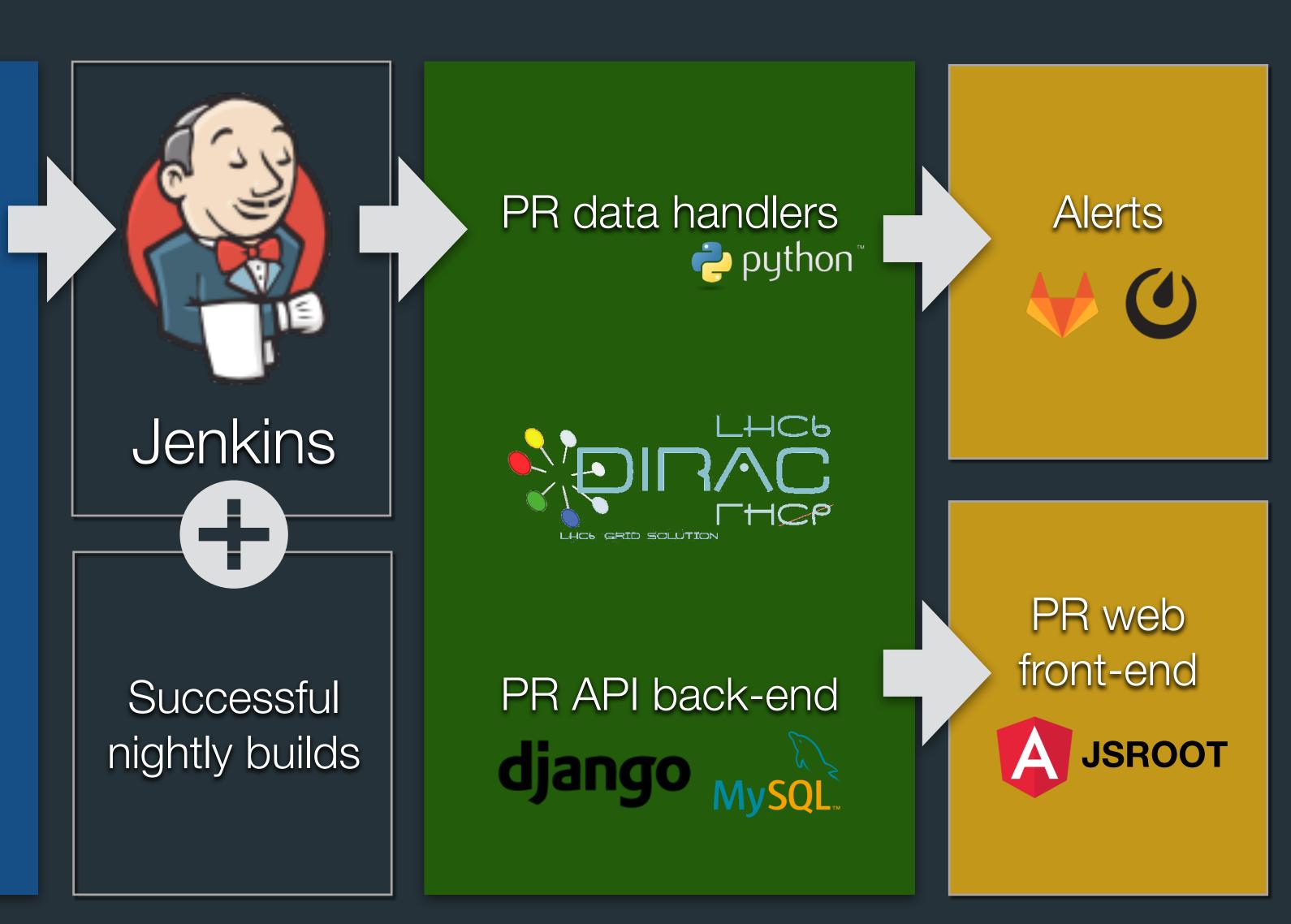


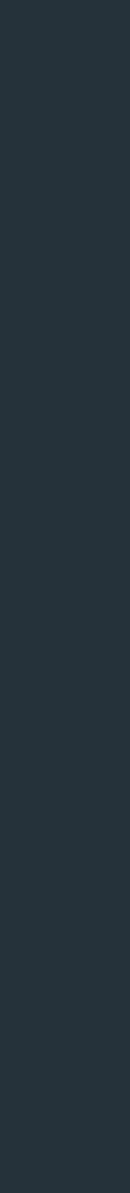
LHCbPR workflow

PR tests queue

On demand (web/GitLab Cl)

Schedule

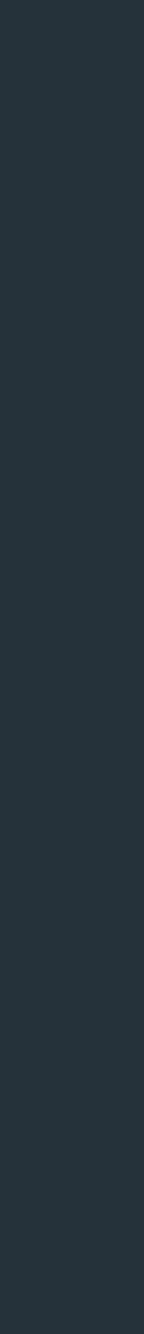






Adoption within LHCb

- LHCbPR was initially developed for LHCb simulation
 - Tests cover everything from GEANT4 to MC generators
 - Became a go-to tool for simulation checks
 - Validation of LHCb simulation stack releases
- Since then used by other LHCb projects (digitisation, reconstruction)
- A valuable tool for upgrade detector SW development
 - Now coupled with CERN GitLab CI
 - Test separate MRs, compare to references, issue alerts, link results



Example of LCHbPR simulation tests

GEANT4 tests

Hadronic X-section

Calorimeter

Multiple Scattering

Simplified RICH Simulation

Hadron

Muon Mu

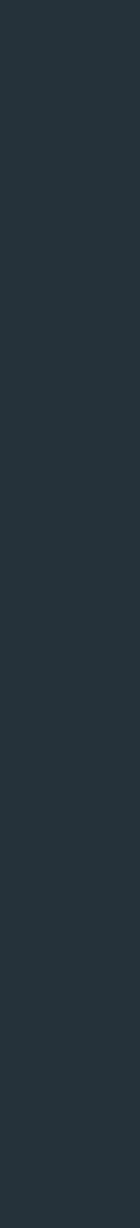
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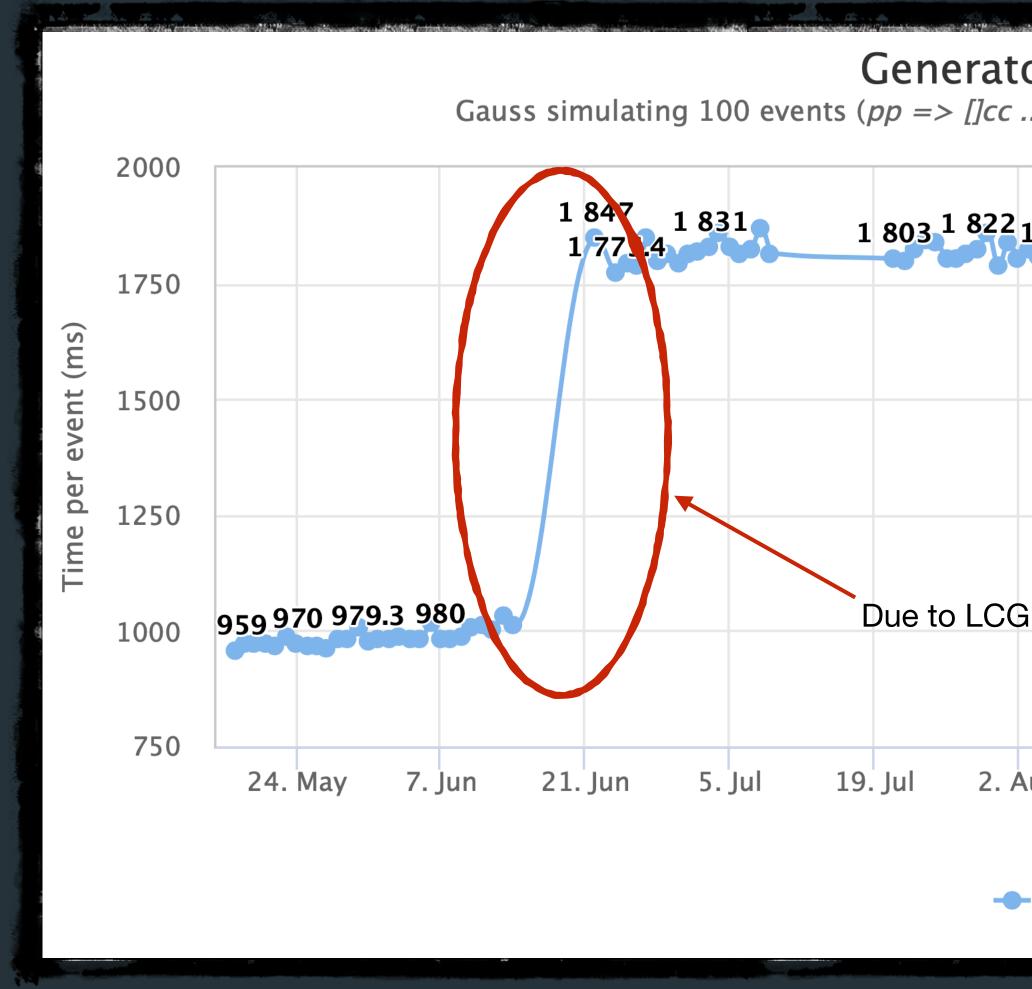
Gauss tests

nic Multiplicities	Radiation Length and Absorption Map
ultiple Scattering	dE/dx in Thin Layer
nergy Deposits	Detailed Timing in Detector Volumes
nsstrahlung	CPU & Memory Consumption

Simulation Validation



Examples of LHCbPR visualising results

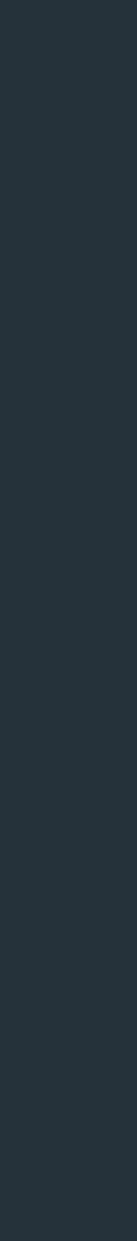


Generator phase timing

Gauss simulating 100 events (*pp => []cc ...*) with PYTHIA8, GEANT4 and LHCb 2016 conditions

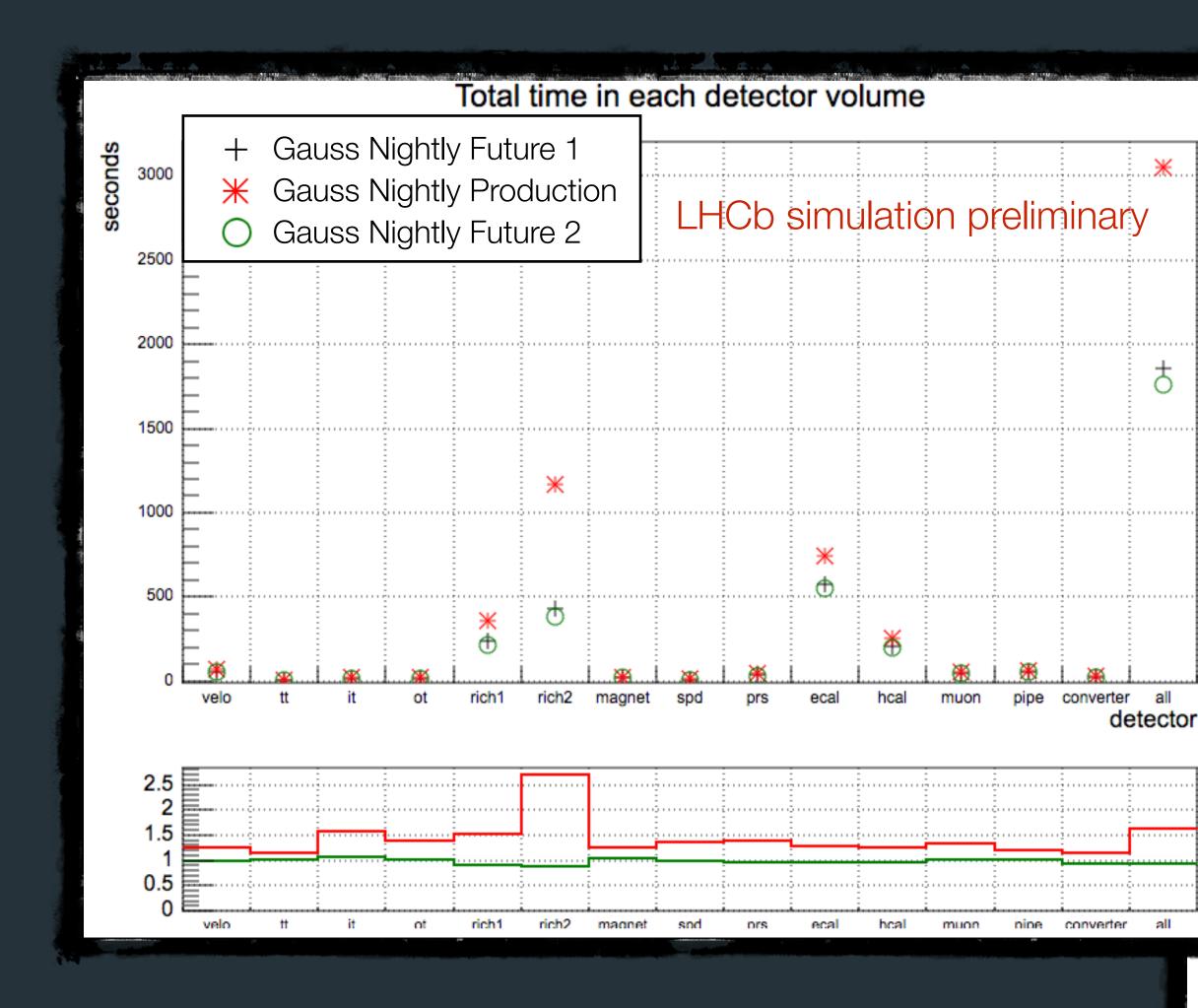
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- Gauss Nightly Future 1

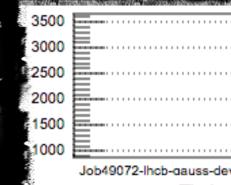




Examples of LHCbPR visualising results



"Detailed timing in G4 volumes" results comparison in PR



LHCb simulation preliminary

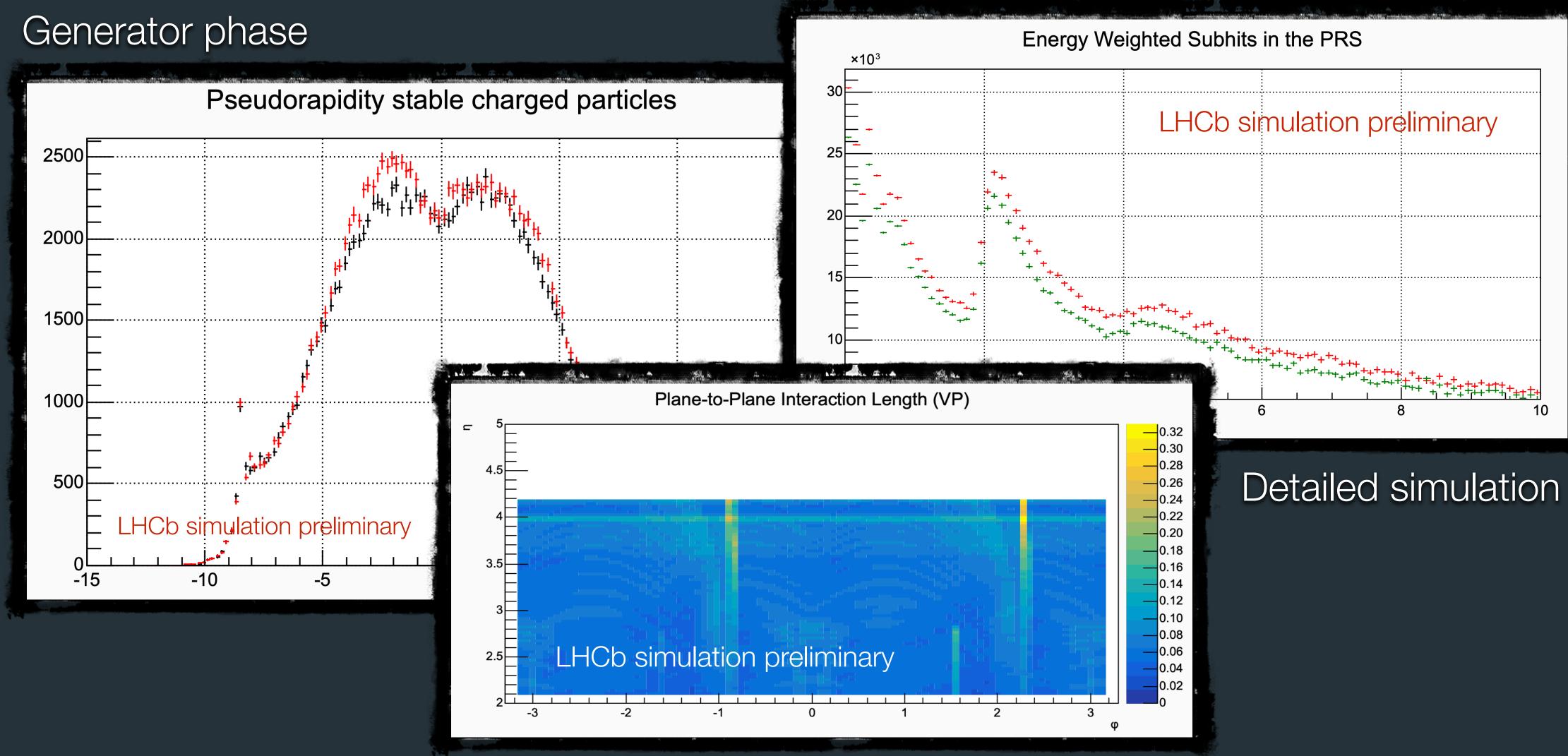
072-lhcb-gauss-dev.1680-x86_64-slc6-gcc62-opt Job49109-lhcb-sim09-cmake.292-x86_64-slc6-gcc49-opt ______Job49130-lhcb-g4r103.399-x86_64-slc6-gcc62-opt ________ Timing of particle groups per detector for Job49072-lhcb-gauss-dev.1680-x86_64-slc6-gcc62-opt

other	0.0200	0.6400	0.9500	1.7100	0.2000	0.0500	0.0300	0.3400	0.5200	0.5100	0.1300	0.1100	6.1200	5.3800
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е	10.1900	13.8500	15.2100	5.7400	7.5600	1.9700	3.0500	13.0100	9.5000	27.4500	3.3600	2.8700	65.1800	241.1700
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Examples of LHCbPR visualising results





Summary

- Delivering reliable SW tools for physics analysis is a complicated task
- LHCb has adopted a multilevel verification approach
 - ✓ Simple, not time consuming nightly tests
 - ✓ More complex LHCbPR checks
 - ✓ Validation in small productions for some projects
- LHCbPR is now used by other projects in LHCb
 - Proved to be a valuable asset in development
 - Work on modernised back-end is ongoing
- Together these steps help to spot the majority of potential problems

Thank you for your attention!