GenEx

Implementation of the generator into LHCb software chain

Challenges in Photon Induced Interactions

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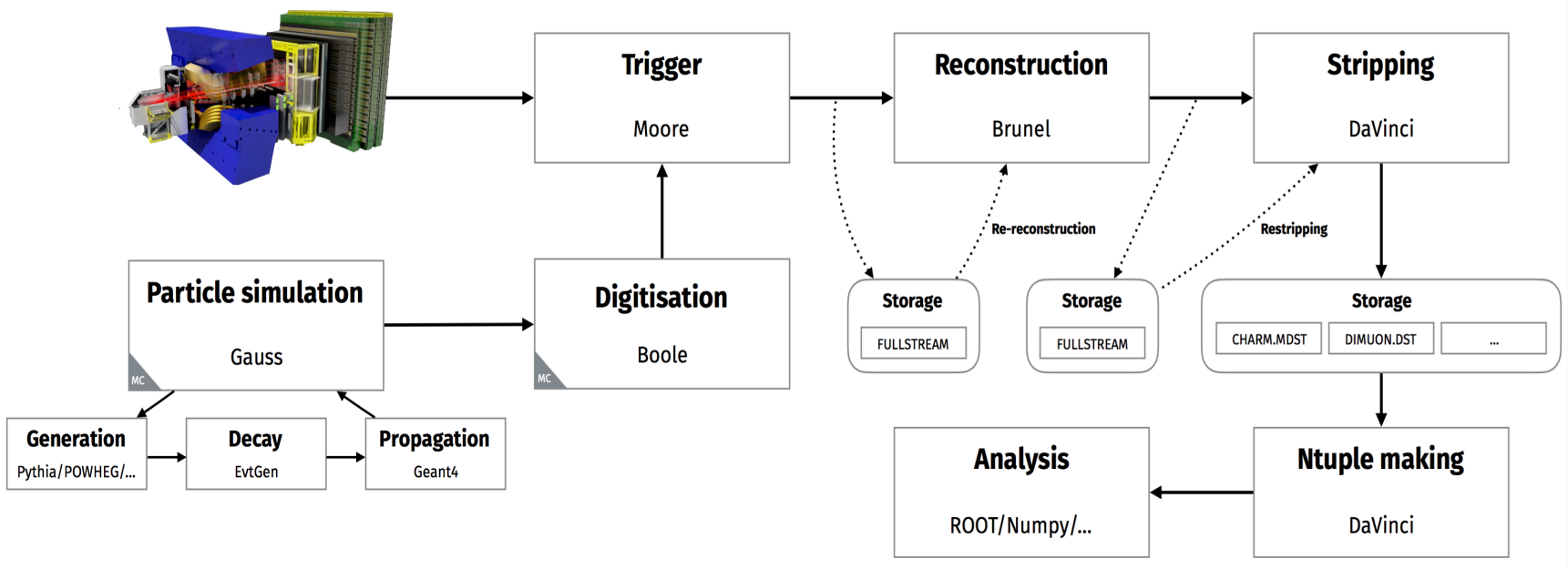
LHCb software overview



Main premise:

- Treat MC in the same way that real data is processed

Preparation steps:

- Generate MC data (Gauss)
- Simulate detector response, add spillover and LHC background (Boole)
- Send processed MC to the trigger alongside experimental data

Gauss application

Phases:

- Generator Phase - particle production and their decays
  - Pythia8 as default
- Simulation Phase - particle tracking and their passage through detector matter
  - Geant4

Standard interfaces:

- HepMC 2: GenEvent, GenParticle

GenEx generator

Key ideas:

- Meant for processes produced exclusively - less complexity
- Written completely in C++ - clean and transparent implementation
- Class based approach makes it easy to extend existing processes and add new
- Foam for phase space integration (random number distribution)

Work on a more general, standalone version is in progress.
Publication: arXiv:1411.6035v1 [hep-ph]

Available processes:

- Common vector meson - proton amplitude calculation implemented for Upsilon, J/Psi, Phi, Rho and Omega with a choice of *unintegrated gluon density function*
- Default, one formfactor, $pp \to pVp$ amplitude calculation with optional absorption corrections implemented

Implementation into s/w chain

GenEx:

- generating particles
- LHCb geometry constraints
- Generator-level statistics
- matrix elements implementation (process definitions)

LbGenEx:

- standardized Gauss generator interface
- run options

Important features

Random numbers:

- Foam $\rightarrow$ TRandom class from ROOT
- LHCb $\rightarrow$ Gaudi random number service
- RNS wrapped in a class deriving from TRandom
- Result - consistency and reproducibility

Settings:

- Separate settings class with its object passed between the interface and generator - defined in the latter
- Transparency - available settings clearly visible and described
- Safety - forces the interface to create a pre-defined object with default settings and basic checks implemented

GenExProcessBase class:

- Contains pointers to beam particles and the outgoing particles
- Production kinematics calculations
- $\gamma p \to Vp$ amplitude calculation
- Default $pp \to pVp$ amplitude calculation
- Each process is a class deriving from this base

Advantages:

- New process implementation completely separated from the core generator code - matrix element calculations and additional decays can be easily added for each process in their respective classes

Plans and prospects

- Standalone version
- Finalizing implementation with its official release in Gauss
- Collaboration with theoreticians on adding new processes
- Analysis dedicated to CEP processes in LHCb