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Digitization and track reconstruction with beam-induced background

Muon Collider meeting

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Event simulation process: start

MCParticles:

Signal ~10

BIB $\sim 10^8$

Event simulation process: ddsim

MCParticles:

GEANT4 >

SimHits:

Signal ~10

~1 seconds

SimCalorimeterHits

SimTrackerHits

BIB ~10⁸

~10⁴ seconds

SimCalorimeterHits

SimTrackerHits

Event simulation process: overlay

MCParticles:

Signal ~10

BIB ~10⁸

GEANT4 >

~1 seconds

~10⁴ seconds

SimHits:

SimCalorimeterHits

SimCalorimeterHits

SimTrackerHits

SimTrackerHits

merging >

SimHits:

SimTrackerHits

SimCalorimeterHits

Each collection has a configurable merging time window

default: [-0.25ns, 0.5ns] - **TOF taken into account**

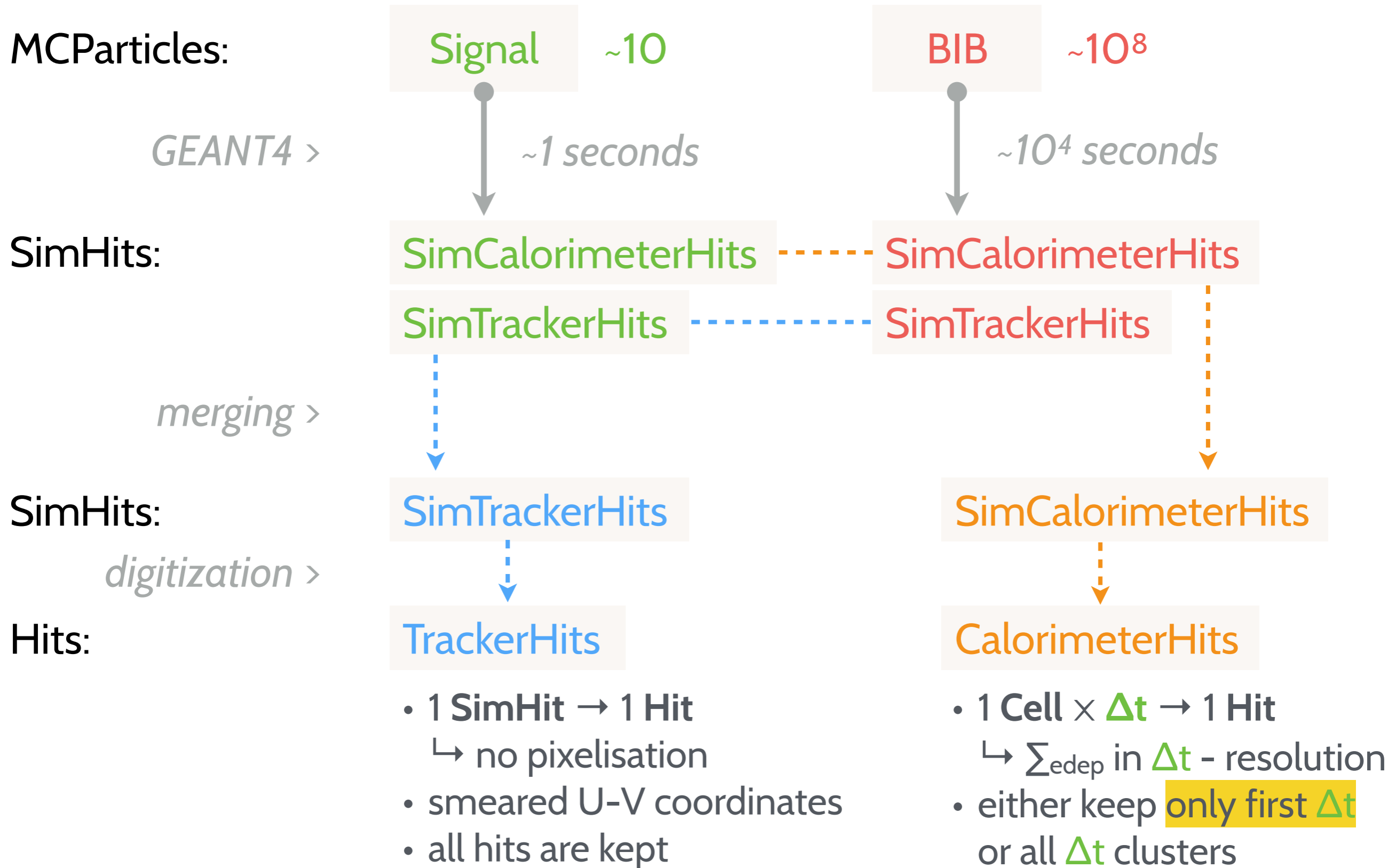
hardcoded configurable

tested: [-0.25ns, 0.5ns] for Vertex 3.7M

[-0.25ns, 1ns] for Tracker 5M

[-0.25ns, 5ns] for Calorimeter 6M

Event simulation process: digitization



Tracker digitization

Full-featured Tracker digitization under development by CLIC people

- will take ~2 months, which is a long time

We can do meaningful studies with a simplified approach

- **spatial resolution** already in place: smearing of hit positions on the surface
- **timing resolution** missing: smearing of hit time
- **acquisition window** missing: time window cut with TOF correction
 - essential to reduce the load on the track reconstruction algorithm

Timing resolution and cuts implemented in an extended version of the [DDPlanarDigiProcessor](#) available in our [repository](#)

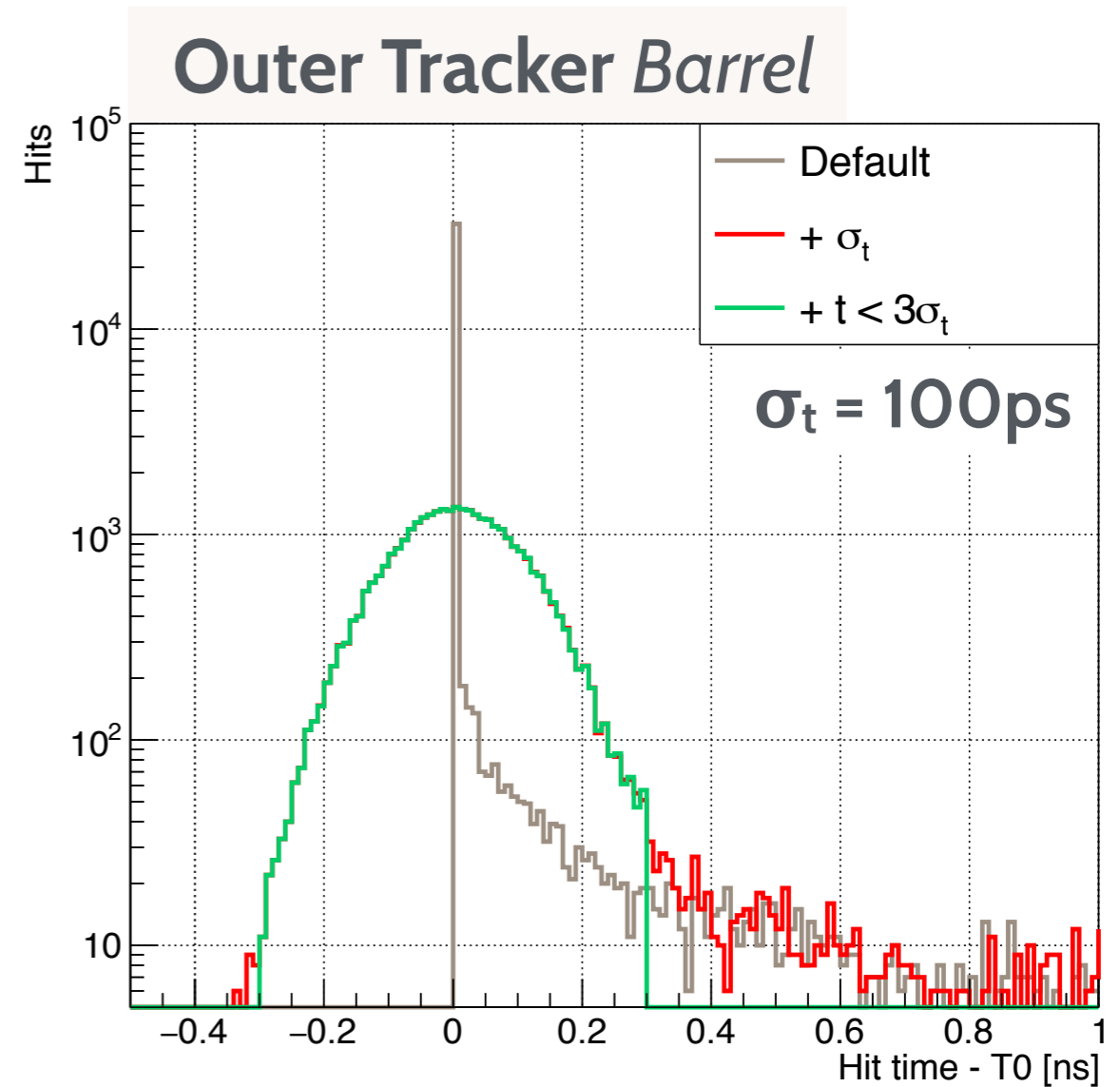
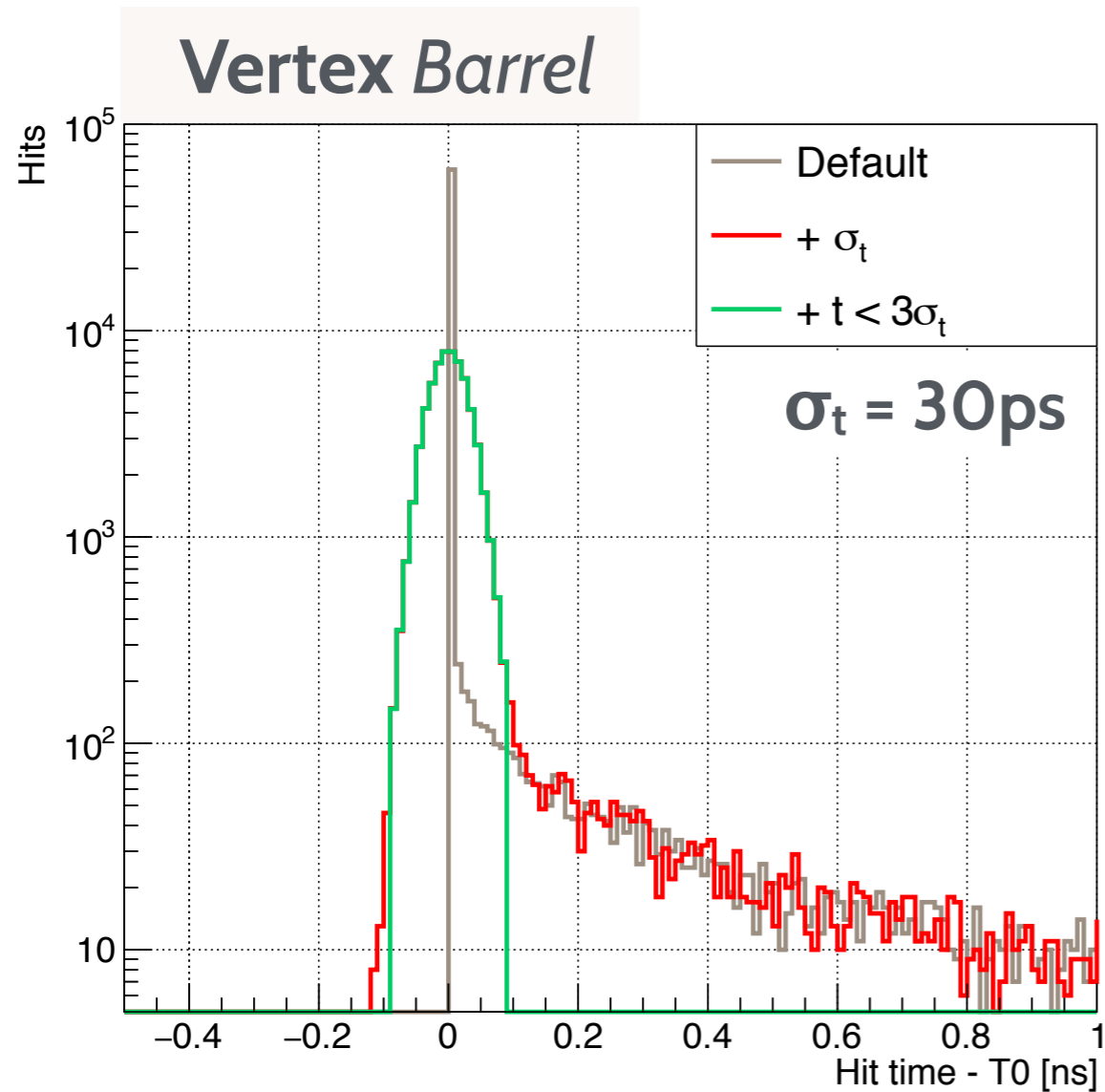
```
<processor name="VXDBarrelDigitiser" type="DDPlanarDigiProcessor">
  <parameter name="SubDetectorName" type="string">Vertex </parameter>
  <parameter name="IsStrip" type="bool">>false </parameter>
  <parameter name="ResolutionU" type="float"> 0.003 0.003 0.003 0.003 0.003 0.003 </parameter>
  <parameter name="ResolutionV" type="float"> 0.003 0.003 0.003 0.003 0.003 0.003 </parameter>
  <parameter name="ResolutionT" type="float"> 0.03 </parameter>
  <parameter name="UseTimeWindow" type="int"> 1 </parameter>
  <parameter name="CorrectTimesForPropagation" type="int"> 1 </parameter>
  <parameter name="TimeWindowMin" type="float"> -0.09 </parameter>
  <parameter name="TimeWindowMax" type="float"> 0.09 </parameter>
```

30ps time resolution
±90ps time window

Tracker digitization: TrackerHits

Timing properly handled by the updated digitization code

Simulated 10K single μ^- events: $p_T = 10$ GeV, $\eta = 0$



Currently trying to run the full cycle of single μ^- reconstruction with full BIB to evaluate track reconstruction efficiencies