

Detector Versioning and Subdetector Status Updates

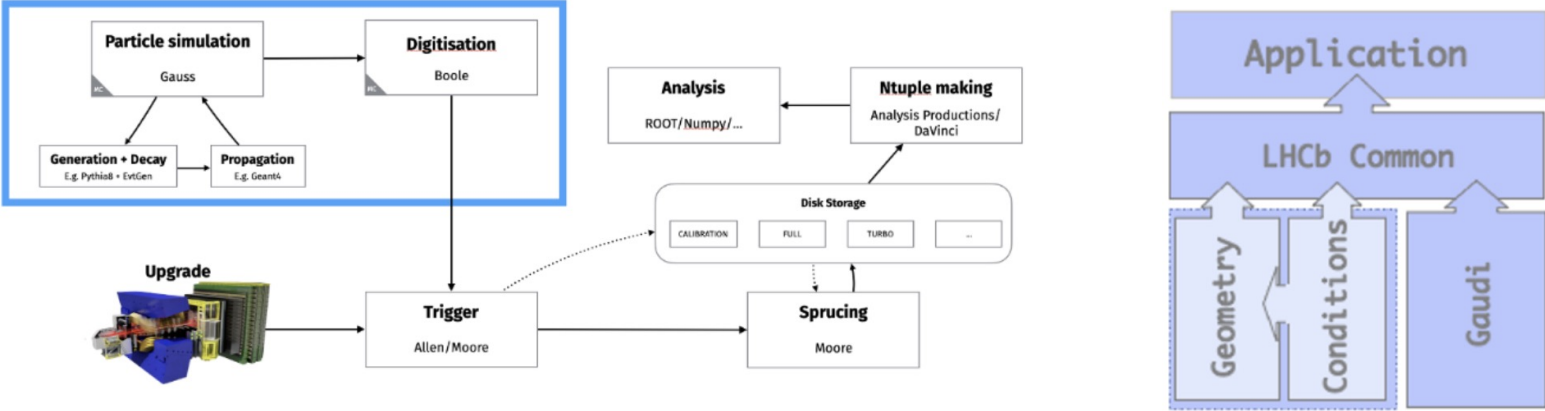
G. Corti, T. Latham, **E. Muhammad**, M. Xu

acknowledge B. Couturier, M. Clemencic, M. Whitehead, S. Ponce

09 Jul 2024 / LHCb-UK Upgrade 2

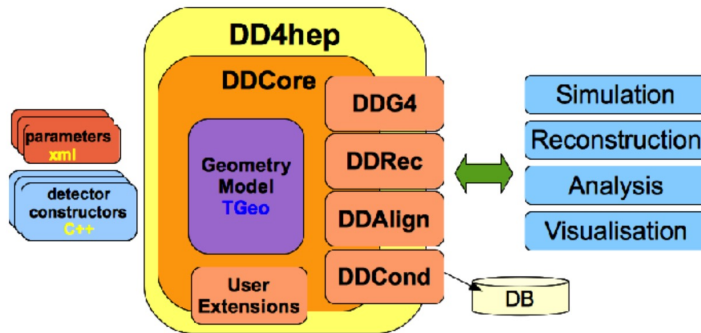
A reminder

- Geometry & Conditions are inputs to all applications and must be consistent through all steps of the simulation processing
- The Detector project is home to the detector description, dependency for other apps
- Gauss is the main app that *runs* the initial particle simulation + detector simulation



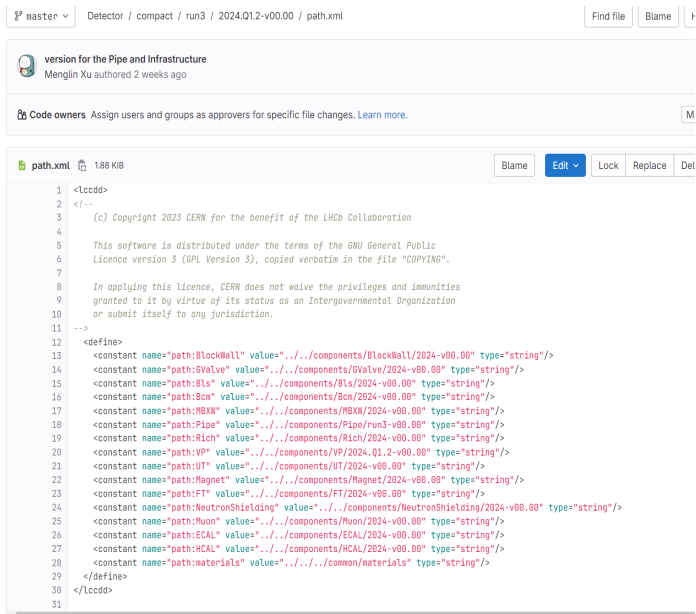
Detector Geometry with DD4hep

- DD4hep framework is used to describe the detector for U2 software (serves as an alternative for Run 3)
- Detector Project: DD4hep geometry = **Compact XML + C++ constructors**
 - Compact XML files contain the parameters for the construction of the geometry
 - Detector elements (in C++) interface Gaudi algorithms with the detector description



Organize Detector Project in a Sustainable Way

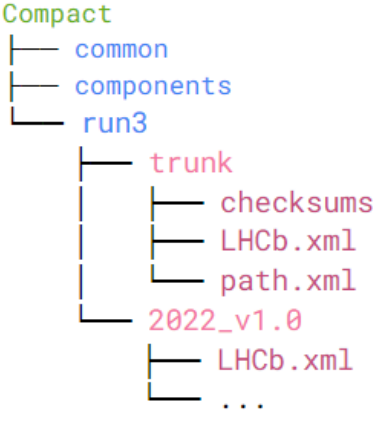
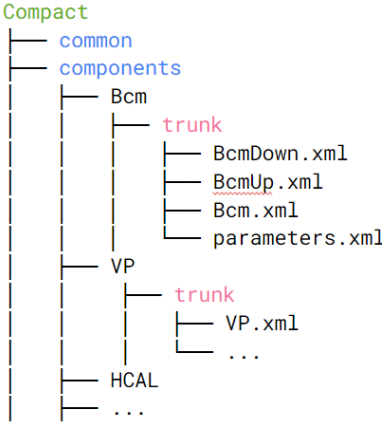
- Need to support different versions of the detector layout in different data taking periods
- **changes between version should be kept to the compact xml as much as possible**
 - Prevents duplication of C++ code
 - can have different versions by just changing the combinations of the xml



```
1 <lcdd>
2 <!--
3 (c) Copyright 2023 CERN for the benefit of the LHCd Collaboration
4
5 This software is distributed under the terms of the GNU General Public
6 Licence version 3 (GPL Version 3), copied verbatim in the file "COPYING".
7
8 In applying this licence, CERN does not waive the privileges and immunities
9 granted to it by virtue of its status as an Intergovernmental Organization
10 or submit itself to any jurisdiction.
11 -->
12 <define>
13 <constant name="path:BlockWall" value=".../components/BlockWall/2024-v00.00" type="string"/>
14 <constant name="path:RValve" value=".../components/RValve/2024-v00.00" type="string"/>
15 <constant name="path:Bls" value=".../components/Bls/2024-v00.00" type="string"/>
16 <constant name="path:Bcn" value=".../components/Bcn/2024-v00.00" type="string"/>
17 <constant name="path:MBXW" value=".../components/MBXW/2024-v00.00" type="string"/>
18 <constant name="path:Pipe" value=".../components/Pipe/run3-v00.00" type="string"/>
19 <constant name="path:Rich" value=".../components/Rich/2024-v00.00" type="string"/>
20 <constant name="path:VPP" value=".../components/VPP/2024_Q1.2-v00.00" type="string"/>
21 <constant name="path:UT" value=".../components/UT/2024-v00.00" type="string"/>
22 <constant name="path:Magnet" value=".../components/Magnet/2024-v00.00" type="string"/>
23 <constant name="path:FT" value=".../components/FT/2024-v00.00" type="string"/>
24 <constant name="path:NeutronShielding" value=".../components/NeutronShielding/2024-v00.00" type="string"/>
25 <constant name="path:Muon" value=".../components/Muon/2024-v00.00" type="string"/>
26 <constant name="path:ECAL" value=".../components/ECAL/2024-v00.00" type="string"/>
27 <constant name="path:HCAL" value=".../components/HCAL/2024-v00.00" type="string"/>
28 <constant name="path:materials" value=".../common/materials" type="string"/>
29
30 </define>
31 </lcdd>
```

Organize Detector Project in a Sustainable Way

- A lot of work on refactoring the files have been done in the last year
 - Components (sub-detectors) are on the same level
 - **Choosing a version by loading a high level LHCb.xml version**



- [See LHCb Week talk for more details](#)

Components Naming Conventions

- Run3-only components,
 - VP/trunk, trunk is a reserved name for the latest developments
 - VP/2024-Q1.2-v01.00, Q1.2: validity between Quarter 1 and 2
- Run5-only components ask more than one branch for different options that need to be maintained
 - MP/branch-run5-middle/low?
 - MP/branch-run5-v01.00 (for a version for run5 from opt1)
- Start by calling the first ones as `branch-run5-baseline`, [Detector!568](#)
- An [issue](#) is created to collect the feedback from sub-detectors for the name for the next iteration

High Level LHCb.xml Naming Conventions

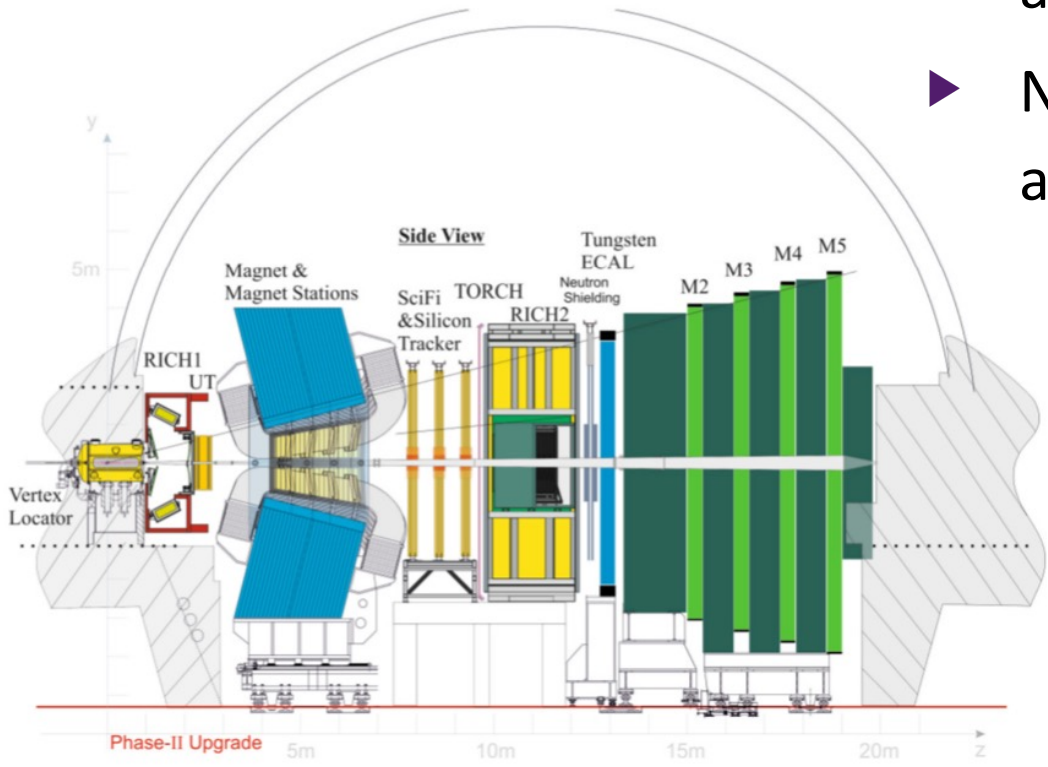
- Run3:
 - run3/trunk
 - run3/2024.Q1.2-v00.00 ...
- Run5:
 - run5/**baseline**
 - run5/proto-v01.00 ...
- **baseline** serves as the trunk. **proto**, the one before the actual one, keeps it separate from the 'expected', which we use for the actual data taking conditions.
- Plans to include a yaml/json file to explain what's in a specific version
 - Use this to autogenerate documentation

Using versioned detector descriptions in Gauss

- Major developments in Gauss to support changes in Detector
 - can now specify the version of each sub-detector separately for DD4Hep in GaussGeometry configurable
 - when not specifying the version of a sub-detector, the default will be what in the Detector top level lhcb version, meaning all existing tests still work
 - throw a warning, if `Version` is used in DetDesc DBTag python script
- In long term: will be **a plugin in Detector or in LHCb** that allows to steer the xml file at run time for all applications

```
GaussGeometry(  
    # adds the geometry of FT and Magnet  
    DetectorGeo = {"Detectors": ["FT", "Magnet"],"Version": {"FT": "trunk","Magnet": "trunk"}},  
    # adds the hit extraction classes for FT and turns on the magnetic field  
    DetectorSim={"Detectors": ["FT", "Magnet"] },  
    # adds the monitoring algorithms for FT (histograms will be produced)  
    DetectorMoni={"Detectors": ["FT"] },  
)
```


Detector status Updates



- ▶ All tracking baseline geometries are *available*
- ▶ Non-detector specific additions also worked on (eg beampipe)
 - ▶ Primarily focused on getting tracking detectors *in* first
 - TV (Velo)
 - UP (UT)
 - MT (SciFi & Silicon Trackers)
 - MS (Magnet Stations)
 - ▶ PID detectors a bit later

VELO Upgrade II Geometry for Future Upgrades Structure

!457 · created 8 months ago by Dan Thompson ◇ Sim11/2024.06 (Gauss v60r1)

Simulation TV Upgrade2 lhcb-sim11-dev lhcb-sim11-run5

Merged

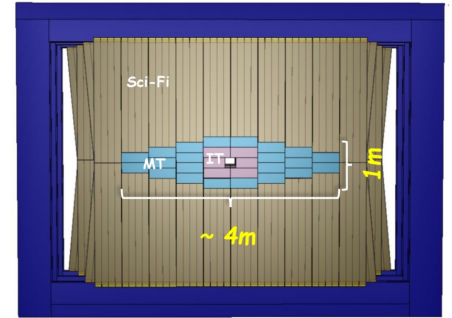


Approved

29

updated 4 weeks ago

- Baseline available for a while
 - Has been merged and available in the Detector project
 - Serves as a baseline for other U2 detectors coming in
- The Heavy scenario is essentially ready and can be put in master anytime
- Further developments in the TV are underway (eg. Improving foil description)



Future upgrade geometry for MightyPix 1 of 3 checklist items completed

!463 · created 8 months ago by Gary Robertson ◇ Sim11/2024.06 (Gauss v60r1)

Upgrade2 **ci-test-triggered** **lhcb-sim11-runs5** **needs checksum update** **update-working-checksum**

- Very nearly ready
- Required a lot of changes to the existing FT
 - Eg. Changed FT from Volume to Assembly
 - Validated in LHCbPR
 - Finishing touches include preparing the FT hole for MP

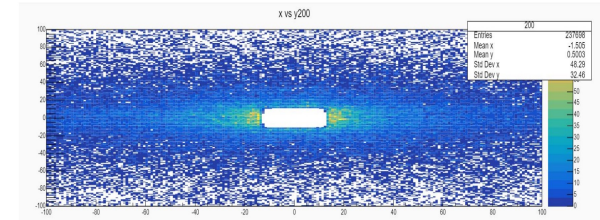
Draft: MP: Adding hole in FT geometry for MP 0 of 3 checklist items completed

!531 · created 3 months ago by Gary Robertson

Upgrade2 **ci-test-triggered** **needs checksum update**

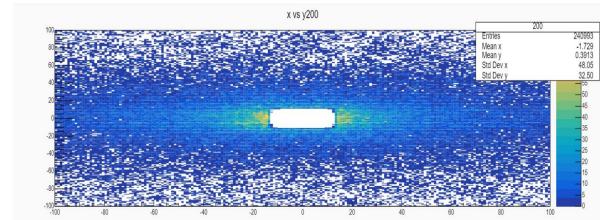
[more plots shown in Simulation Meeting](#)

Before



After

FT Distributions in LHCbPR



UP and MS

Draft: UP new baseline geometry added in compact/component and run5 LHCb.xml added

!554 · created 1 month ago by Mingjie Feng

UP Upgrade2

- UP
 - Baseline geometry MR quite mature
 - A few more changes necessary before it can get merged
 - Should be able to get in within the week
- MS
 - Mainly requires two changes:
 - Any changes to the current magnet/beampipe structure
 - Adding the subdetector itself
 - MR for both is open and being worked on

Draft: Add Magnet Stations 0 of 3 checklist items completed

!546 · created 2 months ago by Michal Krzysztof Kazanecki

Upgrade2 dd4hep

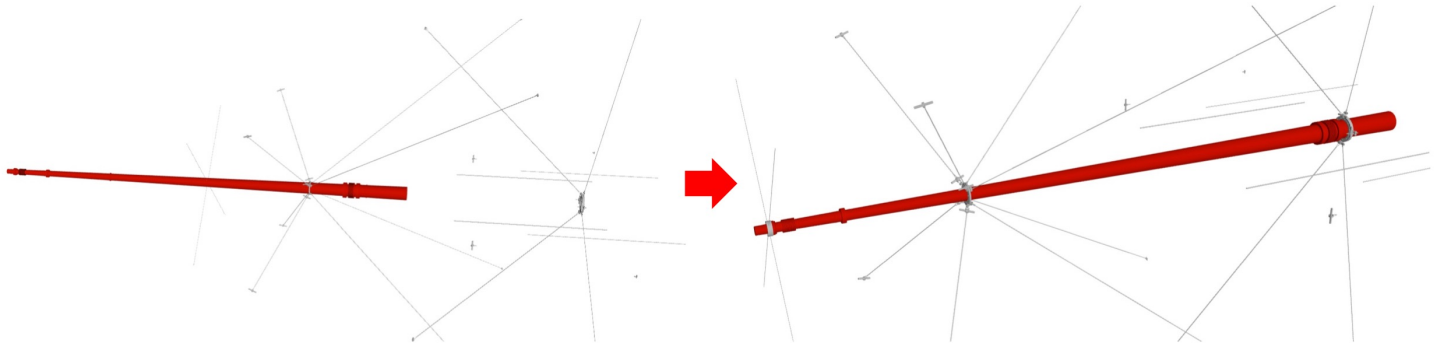
Draft: magnet/beampipe support changes related to Magnet Stations

!563 · created 1 month ago by Michal Krzysztof Kazanecki

Upgrade2 dd4hep

Other components

- TORCH
 - Still needs to find a way to get TORCH and RICH working together
- CALO, Muon
 - In early stages, not quite ready yet
- Beampipe
 - Beampipe support was recently fixed



Summary

- Lots of work has been done for U2 simulation in the past year
 - Revamped Detector project to support multiple (sub)detector versions
 - Updated Gauss to use the newly defined detector versions
- A lot of work has been done by the subdetector teams to get them in
 - Tracking detectors are in good shape, either in or very nearly
 - PID detectors need more work until its ready



Backup