Run-Dependent CLAS12 Simulations

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**Abstract**

This document describes the changes done in GEMC to run simulations accounting for changes in detector geometry and performance (resolutions and efficiency) from CCDB using real run numbers instead of variations.

**Overview**

Current GEMC simulations use a fixed run number to set geometry and run-group dependent conditions (e.g. list of malfunctioning elements), reading CCDB tables from different variations at run time. This approach becomes impractical due to the multiplication of CCDB variations, gcards, and yamls necessary as the number of experiments increases.

Furthermore, the constants used in the simulations are different than the real data calibration constants used in reconstruction.

**Run Number, Variations in Digitization Routines**

The CCDB calibration constants used in the simulations are set in GEMC by using the configuration flags

* RUNNO: sets the CCDB run number
* DIGITIZATION\_VARIATION: sets the CCDB variation
* DIGITIZATION\_TIMESTAMP: selects a specific time snapshot of CCDB

For our simulation we have been using RUNNO=11 and variations corresponding to the real data variations, with a “\_mc” added in the string, for example: “rgc\_summer2022\_mc”. Some experiments share the same strings, which can be confusing.

The reconstruction of simulated events uses similar strings for its configuration YAML files, and the right combination to use in simulation / reconstruction is maintained by keeping up to date the various repositories involved.

Using real run number solves any ambiguity: the simulation and reconstruction use the same calibration constants. Furthermore, it removes the need of using variations: both simulation and reconstruction can use ‘default’, provided all run groups keeps it up to date.

**Variations in the TEXT Geometry Database**

The GEMC TEXT database uses strings in the filenames to distinguish variations in geometry and materials between different configurations. For examples:

* ec\_\_geometry\_default.txt
* ec\_\_geometry\_rga\_fall2018.txt
* ec\_\_materials\_default.txt
* ec\_\_materials\_rga\_fall2018.txt

Some systems use run numbers to get the parameters from the geometry databases using groovy to get it from the coatjava geometry service. For example:

factory.groovy --variation $variation --runnumber $runNumber

where the run number is set to 11 for the TEXT database.

The geometry is loaded into GEMC using the gcards configuration files, for example:

<detector name="experiments/clas12/ec/ec" factory="TEXT" variation="rga\_fall2018"/>

Notice the run number is not specified in the TEXT database, and the run number information used in the geometry service is lost in the DB, only kept by the files in the perl files generating the geometry.

**API Changes**

**Detectors Summary**

**Summary**

**Conclusions**

Both the rates and the radiation damage benefit from 51 microns of tungsten shield around the CLAS12 scattering chambers. There is no benefit in additional thicknesses. The rates have been compared with physics run data at several beam currents. There is a good agreement between the real and the simulated data.

**References**

[1] *M. Ungaro*, clas12 simulation software / geometry tags: https://github.com/gemc/clas12Tags.

**Appendix A: Run ranges for CLAS12 experiments**

**See Calcom Link**

**Appendix B: System by System comparison**

The CLAS12 detectors API is kept in the repository gemc/detectors in subdirectories of “clas12”.

In each system a README.md file has instructions on how to run the comparison in two ways:

1. comparing TEXT and SQLITE databases, line by line and entry by entry. Result is satisfactory only if there are no differences.
2. comparing running GEMC with TEXT DB vs SQLITE DB using the same seed. Result is satisfactory only if the outputs are identical.

Note: the first CLAS12 Good Run was 3029. Historically we have been using the **rga\_fall2018** variation that start with Run 4763 in many systems as the default for many experiments. For those, we use extend **rga\_fall2018** back to Run 3029 to apply **rga\_fall2018** also to **rga\_spring2018**.

**EC:**

The first CLAS12 Run was 3029. Historically we have been using the 'rga\_fall2018' variation that start with Run 4763. Here we use Run 3029 to apply rga\_fall2018 also to rga\_spring2018.

|  |  |  |  |
| --- | --- | --- | --- |
| **Variation** | **CCDB/SQL Run** | **Geometry** | **Output** |
| default | 11 | ✅ | ✅ |
| rga\_fall2018 | 3029 | ✅ | ✅ |

**PCAL:**

The first CLAS12 Run was 3029. Historically we have been using the 'rga\_fall2018' variation that start with Run 4763. Here we use Run 3029 to apply rga\_fall2018 also to rga\_spring2018.

|  |  |  |  |
| --- | --- | --- | --- |
| **Variation** | **CCDB/SQL Run** | **Geometry** | **Output** |
| default | 11 | ✅ | ✅ |
| rga\_fall2018 | 3029 | ✅ | ✅ |

**DC:**

The first CLAS12 Run was 3029. However, we never changed anything in the DC configuration,

so, we use Run 11 for all runs.

|  |  |  |  |
| --- | --- | --- | --- |
| **Variation** | **CCDB/SQL Run** | **Geometry** | **Output** |
| default | 11 | ✅ | ✅ |

**FTOF:**

The first CLAS12 Run was 3029. Historically we have been using the 'rga\_fall2018' variation that start with Run 4763. Here we use Run 3029 to apply rga\_fall2018 also to rga\_spring2018.

|  |  |  |  |
| --- | --- | --- | --- |
| **Variation** | **CCDB/SQL Run** | **Geometry** | **Output** |
| default | 11 | ✅ | ✅ |
| rga\_fall2018 | 3029 | ✅ | ✅ |

**HTCC:**

The first CLAS12 Run was 3029. Historically we have been using the 'rga\_fall2018' variation that start with Run 4763. Here we use Run 3029 to apply rga\_fall2018 also to rga\_spring2018.

|  |  |  |  |
| --- | --- | --- | --- |
| **Variation** | **CCDB/SQL Run** | **Geometry** | **Output** |
| original | 11 | ✅ | ✅ |
| rga\_spring2018 | 3029 | ✅ | ✅ |
| rga\_fall2018 | 4763 | ✅ | ✅ |