New CAD / Mirrors Import Mechanism in GEMC

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**Abstract**

The CAD import mechanism in GEMC has been generalized to account for variations in the CAD factory and Run Number indexing in a new CADSQLITE factory.

**Overview**

Current GEMC simulations specify a directory containing CAD imported files. An additional JSON file is optionally read to specify additional attributes of the volumes such as displacements, material, mother volume. This approach has the following drawbacks:

* Geometry variations are not accounted for; to go around this limitation for CLAS12 we have been duplicating directories to include the variation in the path and specifying the full path on the gcard. For example:

<detector name="ctof/javacad\_rga\_fall2018/" factory="CAD"/>

This is an ugly workaround and is eliminated in this work.

* All files in the directory are loaded instead of just the files specified in the JSON file; to go around this limitation additional attributes have been used in the steering card to mark volumes as non-existent. This is an ugly workaround and is eliminated in this work.
* It cannot be generalized and used for other geometry factories like SQLITE

To provide a cleaner, general mechanism, the following changes have been implemented:

* The variations have been implemented by using the JSON filename
* Only volumes specified in the JSON files are loaded
* SQLITE support has been added

This will eliminate the need of duplicating directories and using additional attributes in the steering cards.

**API Changes: CAD factory in the steering card**

The usual CAD factory mechanism has been modified to include the variation. Entries in the steering cards such as:

<detector name="htcc/cad\_fall18/" factory="CAD"/>

To:

<detector name="htcc/cad/" factory="CAD" variation="fall18"/>

This will load the file htcc/cad/cad\_fall18.gxml.

The file contains the list of volumes to be loaded. If a volume is not wanted for that variation, its absence in the gxml file will tell GEMC not to loaded, as opposed to load all the files in the CAD directory.

This way the cad directory can be shared among all variations.

**API Changes: API PERL SQLITE factory for CAD volumes**

A new entry in the api/perl/sqlite.py utility has been added to create a table cad with all the modifiers supported in the JSON api.

A new PERL api has been added to fill the cad table with the entries.

As an example, in Fig. 1 the HTCC cad definitions are shown for the original (run=11), spring18 (run=3029) and fall18 (run= 4763) configurations.

Text

Description automatically generated with low confidence

*Figure 1: the HTCC cad definitions in the SQLITE database.*

In addition, a new utility file clas12\_runs\_and\_variations.pm has been added to return the experiment configuration given a variation or run number input. This will ensure code is not duplicated when having to change parameters based on a variation or a run number in the perl scripts.

**API Changes: API PERL SQLITE factory for Mirrors**

**API Changes: SQLITECAD factory in gemc/source**

**Gcards changes in clas12-config**

**HTCC**

The proper variations have been replaced in all the gcards. For example entries such as:

<detector name="htcc/htcc" factory="TEXT" variation="original"/>

<detector name="htcc/cad\_fall18/" factory="CAD"/>

Have been replaced with:

<detector name="htcc/htcc" factory="TEXT" variation="fall18"/>

<detector name="htcc/cad/" factory="CAD" variation="fall18"/>

The HTCC displacements in all gcards have been removed as they are incorporated in the variations.

**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: CLAS12 systems affected**

Below is the list of changes to gemc/detectors that are affected by this change:

* htcc: cad\_spring18/cad.gxml, cad/cad.gxml, cad\_fall18/cad.gxml: merged into cad/cad\_default.gxml cad/cad\_fall18.gxml cad/cad\_spring18.gxml
* ltcc/cad\_cone/cad.gxml
* ltcc/cad/cad.gxml
* ddvcs/cad/cad.gxml
* targets/hdIce/cad.gxml
* targets/rge-dt/Pb/cad.gxml
* targets/rge-dt/Empty/cad.gxml
* targets/rge-dt/Al/cad.gxml
* targets/rge-dt/Cu/cad.gxml
* targets/rge-dt/common/cad.gxml
* targets/rge-dt/Sn/cad.gxml
* targets/rge-dt/C/cad.gxml
* targets/ltarget/cad.gxml
* targets/transverseTargetCad/cad.gxml
* targets/cade/cad.gxml
* targets/cad/cad.gxml
* targets/cadrgm/cad.gxml
* targets/flagCad/cad.gxml
* targets/PolTarg/cad.gxml
* ctof/javacad\_default\_upstream/cad.gxml
* ctof/javacad\_rga\_fall2018\_upstream/cad.gxml
* ctof/javacad\_rga\_spring2018/cad.gxml
* ctof/javacad\_rga\_fall2018/cad.gxml
* ctof/javacad\_rga\_spring2018\_upstream/cad.gxml
* ctof/javacad\_default/cad.gxml
* magnets/cad/cad.gxml
* rich/cad\_default/cad.gxml
* rich/cad\_rgc\_summer2022/cad.gxml
* rich/cad\_rga\_fall2018/cad.gxml
* nuclearTargetTest/cad/cad.gxml
* beamline/cadBeamline/cad.gxml
* beamline/cad\_downstream\_beamline/cad.gxml
* beamline/cadBeamlineELMO/cad.gxml
* beamline/cadBeamlineFTOFF/cad.gxml
* beamline/transverseTargetMagnets/forwardWedges/cad.gxml
* beamline/transverseTargetMagnets/midpointWedges/cad.gxml
* beamline/transverseTargetMagnets/noWedges/cad.gxml