

CLAS Collaboration Meeting

Jefferson Lab, Newport News, VA, USA

June 29 - July 2 2026

Real Run Number Simulations

And GEMC Updates

Real Run Number Simulations

Reminder: what are RRNS?

- Geometry built based on #RUN
- Load Calibration Constants from CCDB #RUN

Why?

- No more variations proliferation: one number to rule geometry/constants
- Real Calibration constants in digitization routines makes simulation more realistic
- Can run several run numbers with weights proportional to luminosity

Simulation Implementation

- Digitization routines modified by Raffaella to use real run number calibration constants
- Geometry, CAD definitions stored in SQLITE database instead of ASCII
 - Some API / CODE changes needed
 - Detector by detector implementation
 - Variations <> RUN mapping

Real Run Number Simulations

GitHub Issue #72

- EC
- PCAL
- DC
- FTOF
- CTOF
- CND
- BST
- HTCC
- Micromegas
- LTCC
- RICH
- FT
- Beamline
- Magnets
- Alert ATOF
- Alert AHDC
- Targets
- Band
- Upstream
- rtpc
- urwell

6.0 Latest May 8 <https://github.com/gemc/clas12Tags/releases/tag/6.0>

Based on [Coatjava Release](#) 13.8.3

Major release

This major release supports real run numbers: it allows running gemc with run number different than 11 and enable realistic constants during digitization.

```
<option name="DATABASE" value="clas12.sqlite"/>

<!-- CLAS12 Setup -->
<detector name="target_cad" factory="SQLITECAD"/>
<detector name="target" factory="SQLITE"/>
<detector name="band" factory="SQLITE"/>
<detector name="solenoid" factory="SQLITE"/>
<detector name="magnets_cad" factory="SQLITECAD" />
<detector name="bst" factory="SQLITE"/>
<detector name="micromegas" factory="SQLITE" />
<detector name="ctof" factory="SQLITE" variation="empty"/>
<detector name="ctof_cad" factory="SQLITECAD" />
<detector name="cnd" factory="SQLITE"/>
<detector name="htcc" factory="SQLITE"/>
<detector name="htcc_cad" factory="SQLITECAD"/>
<detector name="ft" factory="SQLITE"/>
<detector name="beamline_cad" factory="SQLITECAD"/>
<detector name="beamline" factory="SQLITE"/>
<detector name="dc" factory="SQLITE"/>
<detector name="ftof" factory="SQLITE"/>
<detector name="ec" factory="SQLITE"/>
<detector name="pcal" factory="SQLITE"/>
<detector name="ltcc" factory="SQLITE"/>
<detector name="ltcc_cad" factory="SQLITECAD"/>
<detector name="rich" factory="SQLITE"/>
<detector name="rich_cad" factory="SQLITECAD"/>
```

- Geometry selected by RUNNO
- Digitization uses RRN constants.
- All gcards looks quite similar. In fact we may end up with one for all experiments.

Geometry Tests

Compare geometry from ASCII / SQLITE using CI

Detector	Geometry Variation	Run	Status
beamline	default	11	✓
beamline	rgk_winter2018	5874	✓
beamline	rgb_spring2019	6150	✓
beamline	rgf_spring2020	11620	✓
beamline	rgc_summer2022	16043	✓
beamline	rgc_fall2022	16843	✓
beamline	rge_spring2024	20000	✓
bst	default	11	✓
bst	rge_spring2024	20000	✓
cnd	default	11	✓
cnd	rga_spring2018	3029	✓
cnd	rga_fall2018	4763	✓
ctof	default	11	✓
ctof	rga_spring2018	3029	✓
ctof	rga_fall2018	4763	✓
dc	default	11	✓
ec	default	11	✓
ec	rga_spring2018	3029	✓
ft	default	11	✓
ft	rgk_winter2018	5874	✓
ft	rgb_spring2019	6150	✓
ft	rgf_spring2020	11620	✓
ft	rgc_summer2022	16043	✓
ft	rge_spring2024	20000	✓

Detector	Geometry Variation	Run	Status
ftof	default	11	✓
ftof	rga_spring2018	3029	✓
htcc	default	11	✓
htcc	rga_spring2018	3029	✓
htcc	rga_fall2018	4763	✓
ltcc	default	11	✓
ltcc	rga_spring2018	3029	✓
ltcc	rga_fall2018	4763	✓
ltcc	rgb_spring2019	6150	✓
ltcc	rgb_winter2020	11323	✓
ltcc	rgm_winter2021	15016	✓
micromegas	rga_spring2018	3029	✓
micromegas	rgf_spring2020	11620	✓
micromegas	rgm_winter2021	15016	✓
pcal	default	11	✓
pcal	rga_spring2018	3029	✓
rich	default	11	✓
rich	rga_spring2018	3029	✓
rich	rgc_summer2022	16043	✓

Many more pages like these to check all systems and all runs. However:

- visual checks revealed a few issues
- tests (Dan and Krishna) revealed a digitization bug

Upcoming GEMC 6.1

Additional bugs to be fixed. This is being tested.

Patch release

This release focuses on CLAS12 run-dependent SQLite geometry fixes after the 6.0 real-run-number release. It fixes several mismatches found while comparing the 5.14 TEXT/CAD gcards with the 6.0 SQLite gcards.

Release notes

- Fixed SQLite run fallback selection by sorting run candidates before choosing the latest run less than or equal to `RUNNO`. This avoids selecting stale rows when SQLite returns distinct runs in insertion order.
- Fixed the RGK winter 2023 SQLite gcard/run mapping so the SQLite geometry uses the correct RGK run number instead of falling back to run 11.
- Added and populated RGK target rows for run-dependent target geometry.
- Populated target CAD SQLite rows for run-dependent variations, including RGD, RGE, and RGK target configurations.
- Stored CLAS12 magnet CAD rows under `magnets_cad`, matching the SQLite gcards.
- Imported HTCC CAD from gxml into SQLite, matching the beamline/CTOF CAD import pattern and preserving the full CLAS12-relative CAD path.
- Fixed beamline CI run mapping so comparisons use the same run/variation map as the geometry source.
- Applied CLAS12 gcard BMT/FMT shifts directly through micromegas parameters and corrected RGD micromegas positions and dimensions.
- Raffaella: new DDVCS fluxes
- Band added to Real Run Numbers

Comparison notes

- `rgk_winter2023` comparison uses `RUNNO=19200`.
- `rgd_fall2023_Cu` and `rgd_fall2023_Sn` use the `rgd_fall2023_CuSn` target variation; matching SQLite runs include `18347`, `18372`, `18560`, `18660`, `18874`, and `19061`.
- CTOF CAD in 5.14 `rga_fall2018` is missing the upstream lightguides. The extra upstream lightguides in SQLite are a known 5.14 omission, not a 6.1 regression.

Changes on the OSG Portal

Currently available on the test portal https://gemc.jlab.org/test/web_interface/index.php

- We want to maintain current non RRN enabled workflows, like RGA, RGB, etc
- Add seamless RRN enabled workflow

New Entry in setup.json for RRN-enabled experiments

Example for RGK 2023

```
"runs": {  
  "19205": {  
    "title": "RGK Winter23",  
    "target": "LH2",  
    "beam_current": "75nA",  
    "beam_energy": "6394.63MeV",  
    "torus": "+1.00",  
    "solenoid": "-1.00",  
    "lumi_weight": 1.00  
  },  
}
```

Magnets values, current, etc hardcoded for now, but will be replaced by RCDB, QADB values

```
"winter_2023": [19205, 19210,  
19212, 19213, 19214,  
19217, 19218, 19219 ]  
}
```

Testing 'golden runs' features

Example: RGD

Currently available on the test portal https://gemc.jlab.org/test/web_interface/index.php

- `rgd_fall2023_ID2`, `rgd_fall2023_CxC`, etc still exists
- A new '`rgd_fall2023`' is RRN-enabled...when you select that:

The screenshot shows a web interface for configuring an RGD run. The interface is divided into several sections:

- Configuration:** A dropdown menu is set to `rgd_fall2023`.
- Software Versions:** A dropdown menu is empty.
- MC Gen Versions:** A dropdown menu is set to `3.18`.
- Run:** A dropdown menu is open, showing a list of runs:
 - select a run –
 - ✓ Run 18305 RGD Fall23 LD2 35nA 10547.3 tor-1.00 sol-1.00 lw=1.00
 - Run 18339 RGD Fall23 CxC 50nA 10547.3 tor-1.00 sol-1.00 lw=1.00
 - Run 18347 RGD Fall23 CuSn 130nA 10547.3 tor-1.00 sol-1.00 lw=1.00
 Below the list, there is a text input field containing `e.g. 18300, 18301, 18302`.
- Magnetic Fields:** A dropdown menu is set to `tor-1.00_sol-1.00`.

A note on the left side of the interface reads: "Consider **testing the generators** before submission."

- One RGD gcard only
- Target is selected using the run number
- Select a run from the drop down menu OR (mutually exclusive) provide a list of runs.

Example: RGK

Currently available on the test portal https://gemc.jlab.org/test/web_interface/index.php

- A new 'rgk_winter2023' is RRN-enabled
- Can choose runs 19205 (no band), 19324 (band)
- For tests: mock golden run list: **winter_2023**

Configuration	rgk_winter2023 ↕
Software Versions	gemc/dev coatjava/14.1.1 ↕
MC Gen Versions Consider testing the generators before submission.	3.18 ↕
Run	List: winter_2023 ↕
	or enter run numbers manually (comma-separated): 19205, 19210, 19212, 19213, 19214, 19217, 19218

```
"rgk": {
  "19205": 47.0, "19210": 12.0,
  "19212": 88.0, "19213": 63.0,
  "19214": 5.0, "19217": 71.0,
  "19218": 34.0, "19219": 96.0,
  "19359": 22.0, "19365": 59.0,
  "19366": 81.0, "19391": 14.0,
  "19392": 68.0, "19393": 39.0,
  "19394": 92.0, "19395": 27.0
}
```

- New json file **runs.json** with run / weight mapping
- Could be gated faraday cup
- These are random values for testing
- **runs.json** will be produced periodically using **QADB** and **RCDB**
- Submission with N jobs. Node will pick a run based on the normalized weights
- GEMC / Reconstruction runs with the picked run, which selects geometry and calibration constants

Example: RGK

Currently available on the test portal https://gemc.jlab.org/test/web_interface/index.php

run	weight	expected	observed	Normalized weight	Observed pct	sigma
19205	47	225.8	200	11.30	10.0	-1.8
19210	12	57.7	57	2.88	2.9	-0.1
19212	88	422.9	488	21.15	24.4	3.6
19213	63	302.7	281	15.14	14.1	-1.4
19214	5	24.0	33	1.20	1.7	1.8
19217	71	341.3	338	17.07	16.9	-0.2
19218	34	163.4	142	8.17	7.1	-1.7
19219	96	461.3	460	23.08	23.0	-0.1
total	416	1999.0	1999	100.00	100.0	

What is left for RRN

Currently available on the test portal https://gemc.jlab.org/test/web_interface/index.php

To be completed

- GEMC digitization bug fix / tests
- Web interface / algorithms tweaks
- Getting weights from QADB, RCDB
- Need golden run lists

Not show stoppers

- SVT positions from CCDB
- RFSTART from CCDB
- Map displacements from CCDB
- Remaining Detectors use RRN

Notes:

1. Coatjava YAML file is the general **mc-ai.yaml**
2. RUNNO is part of the output filenames
3. The DIGITIZATION_VARIATION is **mc2026**

Summary, Outlook

Real Run Numbers

- GEMC / Coatjava RRN software is ready... minus some bugs that are being fixed
- RRN Weights Distribution Infrastructure is in place on OSG
- Undergoing more tests

Meson Branch

- New Geant4 **11.4.2** vs **10.7.4**
- Qt6 from Qt5
- No more scon
- No more mlibrary
- CMAG, CCDB, HIPO are automatically installed as part of the build
- Installation is streamlined, with less stringent requirements
- Improved CI workflow **TEST** → **DEPLOY** → **Binary Tarballs** (includes requested new pr-image workflow)

GEMC v3

- Progress on CLAS12 Implementation
- Target testing by next collaboration meeting

<https://github.com/gemc/src>