GEMC

A database-driven Monte Carlo simulation program

Homepage source

CLAS Collaboration Meeting

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Run Dependent Simulations

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Run-dependent simulations

- Current simulations use a fixed run number and get run-group dependent conditions (e.g. list of malfunctioning elements) reading CCDB tables from different variations

  - Sufficient to account for main or average conditions in a data set
  - High maintenance because of multiplication of CCDB variations, gcards, and yamls
  - Impractical for implementing run-by-run changes such as temporarily dead elements

- Ongoing efforts toward running simulations with “real run numbers”, to pick up changes in detector configuration and performance (resolutions and efficiency) from CCDB tables

Real run numbers simulations

- Requirements:

  - CCDB geometry, status, resolutions, and efficiency tables needs to be properly populated for the relevant run ranges
  - GEMC should load run-dependent geometry (NEW) and detector response constants (already in place based on CCDB calibration tables)
  - Reconstruction of MC events should work when using “real run number” calibration constants, i.e. the GEMC digitization algorithm has to be fully consistent with the reconstruction algorithm used for real data

- OSG Mechanism:

  - The user will choose a data set, i.e. a predefined list of runs, or provide a list of run numbers
  - Run numbers from the list will be assigned to the simulation jobs
  - The number of jobs per run will be automatically determined based on accumulated charge information
  - The resulting batch will reproduce the features of the data set
  - Requires #jobs>>#runs

Calibration Constants in GEMC Digitization Routines

- CCDB Calibration Constants can be selected using the following GEMC options:

  - `RUNNO`: specify CCDB Run Number. Currently using RUN 11, will switch to real run numbers.

  - `DIGITIZATION_VARIATION`: the CCDB variation.

    Currently using “_mc” variations (i.e. `rgc_summer2022_mc`).

    The idea is to switch to `default`.

  - `DIGITIZATION_TIMESTAMP`: selects a specific time snapshot of CCDB. Currently not used.

TEXT Database for GEMC Geometry

- Currently we are using TEXT databases, which are files with `variation` in the name:

```
ec__geometry_default.txt
ec__geometry_rga_fall2018.txt

ec__materials_default.txt
ec__materials_rga_fall2018.txt
```

```
ec_s1   |    fc  |Forward Calorimeter - Sector 1  |      230.9490788*cm 0*cm 720.269274*cm
ec_s2   |    fc  |Forward Calorimeter - Sector 2  |    115.4745394*cm 200.0077692*cm 720.269274*cm
ec_s3   |    fc  |Forward Calorimeter - Sector 3  |   -115.4745394*cm 200.0077692*cm 720.269274*cm
ec_s4   |    fc  |Forward Calorimeter - Sector 4  |     -230.9490788*cm 0*cm 720.269274*cm
ec_s5   |    fc  |Forward Calorimeter - Sector 5  |  -115.4745394*cm -200.0077692*cm 720.269274*cm
ec_s6   |    fc  |Forward Calorimeter - Sector 6  |   115.4745394*cm -200.0077692*cm 720.269274*cm
eclid1_s1 |  ec_s1 |        Stainless Steel Skin 1  |                    0*cm 0*cm -27.917225*cm
eclid2_s1 |  ec_s1 |                  Last-a-Foam  |                    0*cm 0*cm -24.02775*cm
eclid3_s1 |  ec_s1 |        Stainless Steel Skin 2  |                    0*cm 0*cm -20.138275*cm
eclid1_s2 |  ec_s2 |        Stainless Steel Skin 1  |                    0*cm 0*cm -27.917225*cm
```

- One line / volume. One giant string, CSV style, parameters delimited by “|” (pipe char)

Variation, Run Number for TEXT DB

- Detectors using GEOMETRY SERVICE (BST, CTOF, DC, FTOF, EC, RICH):

  - `RUNNO`: set to `11`.
  - `VARIATION`: set to one or more of:

    `default`, `rga_fall2018`, `rgc_summer2022` (RICH), `rga_spring2018` (CTOF)

  - Geometry built using `factory.groovy --variation $variation --runnumber $runNumber`
  - At run time, geometry selected using `RUNNO` option, `VARIATION`: requested on the gcard. For example:

```
<option name="RUNNO" value="11"/>
<detector name="experiments/clas12/ec/ec" factory="TEXT" variation="rga_fall2018"/>
```

- Detectors not using GEOMETRY SERVICE do not build geometry using `RUNNO`, and have hardcoded if statements for the `VARIATIONs`

TEXT Database Distribution

- When releasing a new `clas12Tags`:
  - All relevant detectors in gemc/detectors/clas12 geometry are re-built from scratch
  - Geometry and Source Code changes against current clas12Tags are analyzed / verified
  - New files /dirs added / old deprecated
  - Release notes compiled
  - Push to clas12Tags, new release
  - Release installed on CUE machines
  - Release installed on CVMFS
  - ‘Dev’ docker containers auto build trigger on docker hub

NOTE: this is the optimal chain that wasn’t always followed. Trying to be stricter and stricter on this.

```
.
├── alert
│   ├── ahdc
│   └── atof
├── band
│   ├── band.gcard
│   ├── band__bank.txt
│   ├── band__geometry_main.txt
│   ├── band__hit_main.txt
│   └── band__materials_main.txt
├── beamline
│   ├── beamline.gcard
│   ├── beamline2__geometry_TransverseUpstreamBeampipe.txt
│   ├── beamline2__materials_TransverseUpstreamBeampipe.txt
│   ├── beamline__geometry_ELMO.txt
│   ├── beamline__geometry_FTOff.txt
│   ├── beamline__geometry_FTOn.txt
│   ├── beamline__geometry_TransverseUpstreamBeampipe.txt
│   ├── beamline__geometry_rghFTOn.txt
│   ├── beamline__geometry_rghFTOut.txt
│   ├── beamline__materials_ELMO.txt
│   ├── beamline__materials_FTOff.txt
│   ├── beamline__materials_FTOn.txt
│   ├── beamline__materials_TransverseUpstreamBeampipe.txt
│   ├── beamline__materials_rghFTOn.txt
│   ├── beamline__materials_rghFTOut.txt
│   ├── cadBeamline
│   ├── cadBeamlineELMO
│   ├── cadBeamlineFTOFF
│   └── vacuumLine
├── bst
│   ├── README
│   ├── bst.gcard
│   ├── bst__bank.txt
│   ├── bst__geometry_default.txt
│   ├── bst__hit_default.txt
│   ├── bst__materials_default.txt
│   ├── bst__parameters_default.txt
│   ├── bst__parameters_java.txt
│   ├── bst__parameters_original.txt
│   └── bst__volumes_default.txt
├── bstShield
│   ├── bstShield.gcard
│   └── bstShield__geometry_w51.txt
├── cnd
│   ├── README
│   ├── cnd.gcard
```

SQLITE Database for GEMC Geometry

- GEMC PERL API has been modified to add SQLITE output
- GEMC Source Code has been modified to include SQLITE INPUT
- Changes are transparent to users. Included in GEMC 5.7

SQLITE Database for GEMC Geometry

- Single Sqlite file Geometry Database: `clas12.sqlite`

	id	system	variation	run	name	mother	description
	Filter	Filter	Filter	Filter	Filter	Filter	Filter
1	35643	fc	default	11	fc	root	Forward Carriage (FC) detector env
2	35644	fc	TorusSymmetric	11	fc	root	Forward Carriage (FC) detector env
3	35645	forwardCarriage	default	11	fc	root	Forward Carriage (FC) detector env
4	35646	forwardCarriage	TorusSymmetric	11	fc	root	Forward Carriage (FC) detector env
5	35647	ec	default	11	ec_s1	fc	Forward Calorimeter - Sector 1
6	35648	ec	default	11	ec_s2	fc	Forward Calorimeter - Sector 2
7	35649	ec	default	11	ec_s3	fc	Forward Calorimeter - Sector 3
8	35650	ec	default	11	ec_s4	fc	Forward Calorimeter - Sector 4
9	35651	ec	default	11	ec_s5	fc	Forward Calorimeter - Sector 5
10	35652	ec	default	11	ec_s6	fc	Forward Calorimeter - Sector 6
11	35653	ec	default	11	eclid1_s1	ec_s1	Stainless Steel Skin 1
12	35654	ec	default	11	eclid2_s1	ec_s1	Last-a-Foam
13	35655	ec	default	11	eclid3_s1	ec_s1	Stainless Steel Skin 2
14	35656	ec	default	11	eclid1_s2	ec_s2	Stainless Steel Skin 1
15	35657	ec	default	11	eclid2_s2	ec_s2	Last-a-Foam
16	35658	ec	default	11	eclid3_s2	ec_s2	Stainless Steel Skin 2
17	35659	ec	default	11	eclid1_s3	ec_s3	Stainless Steel Skin 1
18	35660	ec	default	11	eclid2_s3	ec_s3	Last-a-Foam
19	35661	ec	default	11	eclid3_s3	ec_s3	Stainless Steel Skin 2
20	35662	ec	default	11	eclid1_s4	ec_s4	Stainless Steel Skin 1
21	35663	ec	default	11	eclid2_s4	ec_s4	Last-a-Foam
22	35664	ec	default	11	eclid3_s4	ec_s4	Stainless Steel Skin 2
23	35665	ec	default	11	eclid1_s5	ec_s5	Stainless Steel Skin 1
24	35666	ec	default	11	eclid2_s5	ec_s5	Last-a-Foam
25	35667	ec	default	11	eclid3_s5	ec_s5	Stainless Steel Skin 2
26	35668	ec	default	11	eclid1_s6	ec_s6	Stainless Steel Skin 1
27	35669	ec	default	11	eclid2_s6	ec_s6	Last-a-Foam
28	35670	ec	default	11	eclid3_s6	ec_s6	Stainless Steel Skin 2
29	35671	ec	default	11	lead_2_s1_view_2_stack_1	ec_s1	Forward Calorimeter lead layer 2
30	35672	ec	default	11	lead_3_s1_view_3_stack_1	ec_s1	Forward Calorimeter lead layer 3
31	35673	ec	default	11	lead_4_s1_view_1_stack_1	ec_s1	Forward Calorimeter lead layer 4
32	35674	ec	default	11	lead_5_s1_view_2_stack_1	ec_s1	Forward Calorimeter lead layer 5

```
.
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│   ├── beamline__geometry_ELMO.txt
│   ├── beamline__geometry_FTOff.txt
│   ├── beamline__geometry_FTOn.txt
│   ├── beamline__geometry_TransverseUpstreamBeampipe.txt
│   ├── beamline__geometry_rghFTOn.txt
│   ├── beamline__geometry_rghFTOut.txt
│   ├── beamline__materials_ELMO.txt
│   ├── beamline__materials_FTOff.txt
│   ├── beamline__materials_FTOn.txt
│   ├── beamline__materials_TransverseUpstreamBeampipe.txt
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│   ├── cadBeamlineFTOFF
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│   ├── bst__materials_default.txt
│   ├── bst__parameters_default.txt
│   ├── bst__parameters_java.txt
│   ├── bst__parameters_original.txt
│   └── bst__volumes_default.txt
├── bstShield
│   ├── bstShield.gcard
│   └── bstShield__geometry_w51.txt
├── cnd
│   ├── README
│   ├── cnd.gcard
```

- Database have all detectors, all run numbers, all variations.
- A detector / run number / variation is selected in gemc using SQL SELECT commands.
- detector / run number / variation are specified in the gcard.

SQLITE Materials, Banks, Hit definitions

	id	system	bank_name	variable_name	description	int_id	type
	Fi...	Filter	Filter	Filter	Filter	Filter	Filter
1	1	ec	ecal	bankid	ecal bank ID	1600	Di
2	2	ec	ecal	sector	sector (1-6)	1	Di
3	3	ec	ecal	layer	layer (1..9)	2	Di
4	4	ec	ecal	component	strip	3	Di
5	5	ec	ecal	ADC_order	always 0	4	Di
6	6	ec	ecal	ADC_ADC	ADC value	5	Di
7	7	ec	ecal	ADC_time	time from pulse fit	6	Dd
8	8	ec	ecal	ADC_ped	pedestal from pulse analysis	7	Di
9	9	ec	ecal	TDC_order	always 2	8	Di
10	10	ec	ecal	TDC_TDC	TDC value	9	Di
11	11	ec	ecal	hitn	hit number	99	Di

- Also contains materials, banks, hit definitions
- Similar SQL SELECT algorithms as geometry

	id	system	variation	run	name	description	density	ncomponents	components
	...	Filter	Filter	Fil...	Filter	Filter	Filter	Filter	Filter
1	1	ec	default	11	scintillator	ec scintillator material	1.032	2	C 9 H 10
2	2	ec	default	11	LastaFoam	ec foam material	0.24	4	G4_C 0.4045 G4_H 0.0786 G4_N 0.1573 G4_O 0.3596
3	3	ec	default	101	scintillator	ec scintillator material	1.032	2	C 9 H 10
4	4	ec	default	101	LastaFoam	ec foam material	0.24	4	G4_C 0.4045 G4_H 0.0786 G4_N 0.1573 G4_O 0.3596

	id	system	variation	run	name	description	identifiers	SignalThreshold	TimeWindow	ProdThreshold	MaxStep	riseTime	fallTime	mvToMeV	pedestal	delay
	...	Filter	Filter	Fil...	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter
1	1	ec	default	11	ecal	ecal hit definitions	sector layer strip	0.5*MeV	400*ns	5.0*mm	5.0*mm	1*ns	2*ns	100	-20	50*ns
2	2	ec	default	101	ecal	ecal hit definitions	sector layer strip	0.5*MeV	400*ns	5.0*mm	5.0*mm	1*ns	2*ns	100	-20	50*ns

SQLITE Variation, Run Number

- All detectors (using or not using GEOMETRY SERVICE):
  - `RUNNO`: set to real run numbers
  - `VARIATION`: set to: `default`

NOTE: this may not be possible for all detectors, for example some real misalignments (MM) may be hard to implement in GEMC

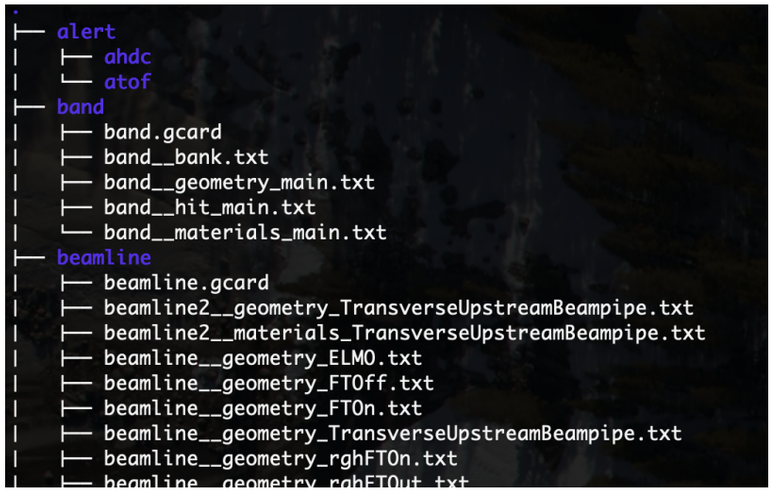
```
<detector name="ec" factory="SQLITE"/>
```

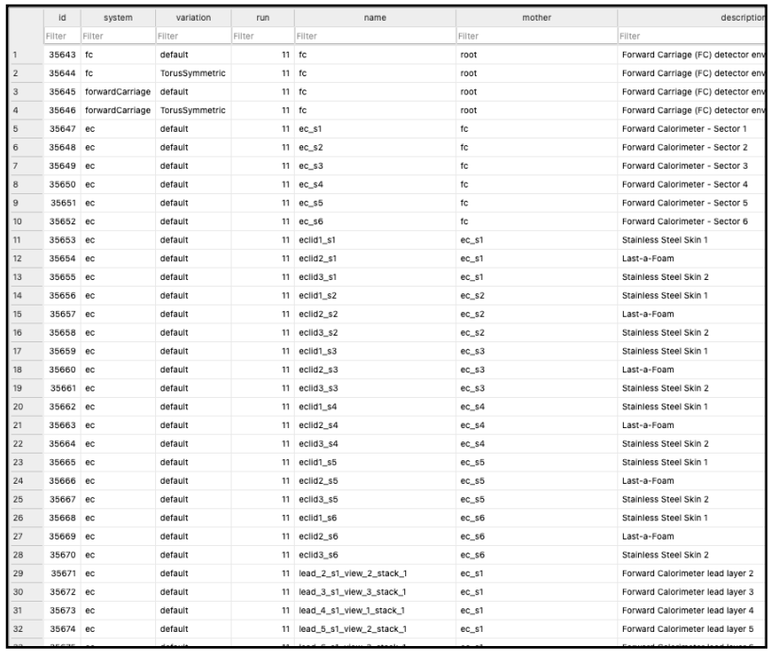
```
<detector name="ec" factory="SQLITE" run_number="12" variation="rga_fall2018"/>
```

TEXT + SQLITE Databases Distribution

- When releasing a new `clas12Tags`:

  - All relevant detectors in gemc/detectors/clas12 geometry are re-built from scratch
  - Geometry and Source code changes against current clas12Tags are analyzed / verified
  - New files /dirs added / old deprecated
  - Release notes compiled
  - Push to clas12Tags, new release
  - ‘Dev’ docker containers auto build trigger on docker hub
  - TEXT DB produced
  - Single SQLITE file produced containing all geo / mats / banks / hits definitions
  - Release installed on CUE machines
  - Release installed on CVMFS





	id	system	variation	run	name	mother	description
	Filter	Filter	Filter	Filter	Filter	Filter	Filter
1	35643	fc	default	11	fc	root	Forward Carriage (FC) detector env
2	35644	fc	TorusSymmetric	11	fc	root	Forward Carriage (FC) detector env
3	35645	forwardCarriage	default	11	fc	root	Forward Carriage (FC) detector env
4	35646	forwardCarriage	TorusSymmetric	11	fc	root	Forward Carriage (FC) detector env
5	35647	ec	default	11	ec_s1	fc	Forward Calorimeter - Sector 1
6	35648	ec	default	11	ec_s2	fc	Forward Calorimeter - Sector 2
7	35649	ec	default	11	ec_s3	fc	Forward Calorimeter - Sector 3
8	35650	ec	default	11	ec_s4	fc	Forward Calorimeter - Sector 4
9	35651	ec	default	11	ec_s5	fc	Forward Calorimeter - Sector 5
10	35652	ec	default	11	ec_s6	fc	Forward Calorimeter - Sector 6
11	35653	ec	default	11	eclid1_s1	ec_s1	Stainless Steel Skin 1
12	35654	ec	default	11	eclid2_s1	ec_s1	Last-a-Foam
13	35655	ec	default	11	eclid3_s1	ec_s1	Stainless Steel Skin 2
14	35656	ec	default	11	eclid1_s2	ec_s2	Stainless Steel Skin 1
15	35657	ec	default	11	eclid2_s2	ec_s2	Last-a-Foam
16	35658	ec	default	11	eclid3_s2	ec_s2	Stainless Steel Skin 2
17	35659	ec	default	11	eclid1_s3	ec_s3	Stainless Steel Skin 1
18	35660	ec	default	11	eclid2_s3	ec_s3	Last-a-Foam
19	35661	ec	default	11	eclid3_s3	ec_s3	Stainless Steel Skin 2
20	35662	ec	default	11	eclid1_s4	ec_s4	Stainless Steel Skin 1
21	35663	ec	default	11	eclid2_s4	ec_s4	Last-a-Foam
22	35664	ec	default	11	eclid3_s4	ec_s4	Stainless Steel Skin 2
23	35665	ec	default	11	eclid1_s5	ec_s5	Stainless Steel Skin 1
24	35666	ec	default	11	eclid2_s5	ec_s5	Last-a-Foam
25	35667	ec	default	11	eclid3_s5	ec_s5	Stainless Steel Skin 2
26	35668	ec	default	11	eclid1_s6	ec_s6	Stainless Steel Skin 1
27	35669	ec	default	11	eclid2_s6	ec_s6	Last-a-Foam
28	35670	ec	default	11	eclid3_s6	ec_s6	Stainless Steel Skin 2
29	35671	ec	default	11	lead_2_s1_view_2_stack_1	ec_s1	Forward Calorimeter lead layer 2
30	35672	ec	default	11	lead_3_s1_view_3_stack_1	ec_s1	Forward Calorimeter lead layer 3
31	35673	ec	default	11	lead_4_s1_view_1_stack_1	ec_s1	Forward Calorimeter lead layer 4
32	35674	ec	default	11	lead_5_s1_view_2_stack_1	ec_s1	Forward Calorimeter lead layer 5

NOTE: clas12.sqlite will be released with clas12Tags. It may be through LFS (large files storage) tracking

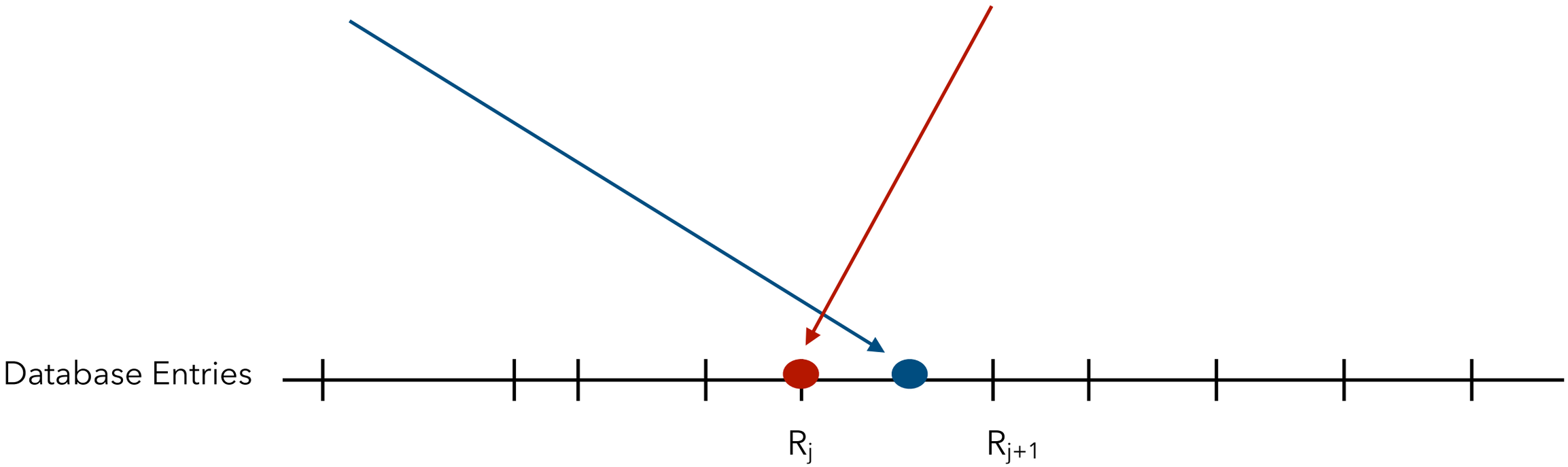
GEMC Run Number Selection

User Request:

R

Database Pick

$$R_j \leq R < R_{j+1}$$



[Run Number]

Perl API changes

`config.dat` streamlined:

```
# Detector name and variation
detector_name: ec
comment: CLAS12 EC detector

# MYSQL server / SQLITE file
dbhost: ../clas12.sqlite

# Verbosity controls the perl script output
verbosity: 0
```

System name

Sqlite filename

No changes to API that produces the geometry

Add these lines main pl to insert Run-Based Geometry into SQLITE database

```
# SQLITE Factory
$configuration{"factory"} = "SQLITE";
my $variation = "default";
my @runs = (11, 101);

foreach my $run (@runs) {
    $configuration{"variation"} = $variation;
    $configuration{"run_number"} = $run;
    create_ec($variation, $run);
}
```

Same for both TEXT and MYSQL

Gcard changes

```
<!-- TEXT Factory ->

<option name="RUNNO" value=“11"/>

<detector name="experiments/clas12/ec/ec"                factory="TEXT" variation="rga_fall2018"/>
<detector name="experiments/clas12/fc/forwardCarriage" factory="TEXT" variation="default"/>
```

```
<!-- SQLITE Factory ->

<option name="RUNNO" value=“11"/>

<detector name="ec"                factory=“SQLITE"/>
<detector name="forwardCarriage" factory="SQLITE"/>
```

Geometry Consistency Checks - method 1

- Comparison between TEXT / SQLITE database: `$GEMC/api/perl/db_compare.py`
- Command line documented in each detector README.

```
$GEMC/api/perl/db_compare.py ec__geometry_rga_fall2018.txt ../clas12.sqlite ec 101 default


Number of lines in the file (8910) matches the number of lines in the database (8910).
Line 8910 out of 8910 is in the database.
All lines match the database.
```

- Compare number of SQLITE entries for that variation, run number with TEXT DB file
- If number of entries is the same, iterate through TEXT entries - compare all parameters.
- Success if all parameter match for each entry

Geometry Consistency Checks - method 2

- RUN TEXT / SQLITE using same seed. Results must be identical.

```
gemc –USE_GUI=0 ec_sqlite.gcard –N=100 –OUTPUT="hipo, gemc_sqlite.hipo” –RANDOM=123

gemc –USE_GUI=0 ec_text.gcard   –N=100 –OUTPUT="hipo, gemc_text.hipo” –RANDOM=123
```

```
$ hipo-utils -dump gemc_text.hipo
reader:: *****>>>>> openning file : gemc_text.hipo
reader:: ***** dictionary entries :          36
reader:: ************ file size   :      290948
reader:: **** scan trailer #bytes :          56
reader:: ***** number of  records :           1
reader:: ***** number of  events  :         100
reader:: ************ file size   :      290948
reader:: **** scan trailer #bytes :          56

Choose (n=next,p=previous, q=quit, h=help), Type Bank Name or id : n
*** event *** ::: tag = 0 mask = 00000000000000000000000000000000 size = 4312 node count = 0
   0 |                    ECAL::adc |    20700 |       11 |       32 |       82 |      480
   1 |                    ECAL::tdc |    20700 |       12 |       32 |      570 |      288
   2 |                  MC::Particle |       40 |        2 |        1 |      866 |       32
   3 |                     MC::True |       40 |        4 |       32 |      944 |     3360
   4 |                RASTER::adc |    22200 |       11 |        2 |      906 |       30
   5 |                 RUN::config |    10000 |       11 |        1 |       16 |       38
   6 |                     RUN::rf |    10000 |       12 |        2 |       62 |       12

Choose (n=next,p=previous, q=quit, h=help), Type Bank Name or id : ECAL::adc
 position for [ECAL::adc] == 82
* NODE * group =  20700, item =  11, type = 11, size =      480
        sector :          1         1         1         1         1         1         1         1         1         1
             +          1         1         1         1         1         1         1         1         1         1
             +          1         1         1         1         1         1         1         1         1         1
             +          1         1
         layer :          4         5         6         8         9         7         4         5         4         7
             +          8         9         8         6         7         8         5         8         7         7
             +          6         5         9         9         4         7         8         9         4         5
             +          6         8
     component :         18        29        27        29        27        17        17        28        16        18
             +         28        28        30        28        19        26        27        27        16        15
             +         29        30        29        30        13        20        31        26        19        31
             +         26        32
         order :          0         0         0         0         0         0         0         0         0         0
             +          0         0         0         0         0         0         0         0         0         0
             +          0         0         0         0         0         0         0         0         0         0
             +          0         0
           ADC :       6216     12869     19685      2938      2357      4533     12951      1438       160      1538
             +        498      1280       352      4448       289        49        69         0         0       141
             +         16       131         0       136         0         0         0      1251         0       117
             +        113         0
          time :  246.0000  253.9375  245.5625  253.8750  244.7500  246.2500  246.2500  252.0000  238.1875  245.6250
             +  251.2500  244.3750  251.1250  245.5000  243.1250  239.1875  241.5000    0.0000    0.0000  238.9375
             +  220.6875  246.6875    0.0000  239.2500    0.0000    0.0000    0.0000  243.2500    0.0000  245.9375
             +  236.6250    0.0000
           ped :          0         0         0         0         0         0         0         0         0         0
             +          0         0         0         0         0         0         0         0         0         0
             +          0         0         0         0         0         0         0         0         0         0
             +          0         0
```

```
$ hipo-utils -dump gemc_sqlite.hipo
reader:: *****>>>>> openning file : gemc_sqlite.hipo
reader:: ***** dictionary entries :          36
reader:: ************ file size   :      290956
reader:: **** scan trailer #bytes :          56
reader:: ***** number of  records :           1
reader:: ***** number of  events  :         100
reader:: ************ file size   :      290956
reader:: **** scan trailer #bytes :          56

Choose (n=next,p=previous, q=quit, h=help), Type Bank Name or id : n
*** event *** ::: tag = 0 mask = 00000000000000000000000000000000 size = 4312 node count = 0
   0 |                    ECAL::adc |    20700 |       11 |       32 |       82 |      480
   1 |                    ECAL::tdc |    20700 |       12 |       32 |      570 |      288
   2 |                  MC::Particle |       40 |        2 |        1 |      866 |       32
   3 |                     MC::True |       40 |        4 |       32 |      944 |     3360
   4 |                RASTER::adc |    22200 |       11 |        2 |      906 |       30
   5 |                 RUN::config |    10000 |       11 |        1 |       16 |       38
   6 |                     RUN::rf |    10000 |       12 |        2 |       62 |       12

Choose (n=next,p=previous, q=quit, h=help), Type Bank Name or id : ECAL::adc
 position for [ECAL::adc] == 82
* NODE * group =  20700, item =  11, type = 11, size =      480
        sector :          1         1         1         1         1         1         1         1         1         1
             +          1         1         1         1         1         1         1         1         1         1
             +          1         1         1         1         1         1         1         1         1         1
             +          1         1
         layer :          4         5         6         8         9         7         4         5         4         7
             +          8         9         8         6         7         8         5         8         7         7
             +          6         5         9         9         4         7         8         9         4         5
             +          6         8
     component :         18        29        27        29        27        17        17        28        16        18
             +         28        28        30        28        19        26        27        27        16        15
             +         29        30        29        30        13        20        31        26        19        31
             +         26        32
         order :          0         0         0         0         0         0         0         0         0         0
             +          0         0         0         0         0         0         0         0         0         0
             +          0         0         0         0         0         0         0         0         0         0
             +          0         0
           ADC :       6216     12869     19685      2938      2357      4533     12951      1438       160      1538
             +        498      1280       352      4448       289        49        69         0         0       141
             +         16       131         0       136         0         0         0      1251         0       117
             +        113         0
          time :  246.0000  253.9375  245.5625  253.8750  244.7500  246.2500  246.2500  252.0000  238.1875  245.6250
             +  251.2500  244.3750  251.1250  245.5000  243.1250  239.1875  241.5000    0.0000    0.0000  238.9375
             +  220.6875  246.6875    0.0000  239.2500    0.0000    0.0000    0.0000  243.2500    0.0000  245.9375
             +  236.6250    0.0000
           ped :          0         0         0         0         0         0         0         0         0         0
             +          0         0         0         0         0         0         0         0         0         0
             +          0         0         0         0         0         0         0         0         0         0
             +          0         0
```

Reconstruction - GEMC digitization consistency Checks

- Eliminate “ad-hoc” conditions used by reconstruction when running on MC events:
  - For example, `if(runNumber==11) {…}` or `if(event.hasBank(“MC::Particle”) {…}`
  - Verified rigorously by reconstructing MC events generated with a “real run number” but the same constants as the predefined MC run 11 and comparing to regular simulations
  - Identified two packages that need work:
    - **ECAL**: update of time walk and time offset correction in GEMC to match reconstruction in progress
    - **DC**: account for event start time, particle TOF, and signal propagation along the wire in GEMC (see Mariana’s talk)

- Verify the GEMC digitization algorithms match reconstruction algorithms when using “real run number” calibration constants
  - Started

Summary

- GEMC PERL API has been modified to add SQLITE output
- GEMC Source Code has been modified to include SQLITE INPUT
- CAD not implemented yet. Will be additional table on SQLITE
- GEMC SQLITE DB filled with EC parameters. Need to go through all detectors
- Two independent way to verify GEMC geometry consistency
- Reconstruction - GEMC digitization consistency: very careful checks are ongoing