

Geometry Database for the CBM experiment and its first application to the experiments of the NICA project

Akishina E.P.¹, Alexandrov E.I.¹, Alexandrov I.N.¹,
Filozova I.A.¹, Friese V.², Gertsenberger K.V.¹, Ivanov V.V.
^{1,3}, Rogachevsky O.V.¹

¹JINR, Dubna

²GSI, Darmstadt

³MEPhi, Moscow



Joint Institute for Nuclear Research

Motivation

- Variety of detector modules
- Flexibility: combine the modules for different setups
- Each module can be located in different placement
- Evolution of geometries in accordance with the phases of experiments
- Administration of the geometries variety in a fail-safe, reproducible and transparent way

Tasks

- Store the modules of CBM
- Load the geometry modules for setup construction
- Construct setup from the stored modules
- Support different versions of setup

Basic Definitions

Geometry Module

File in ROOT format with content of detector geometry

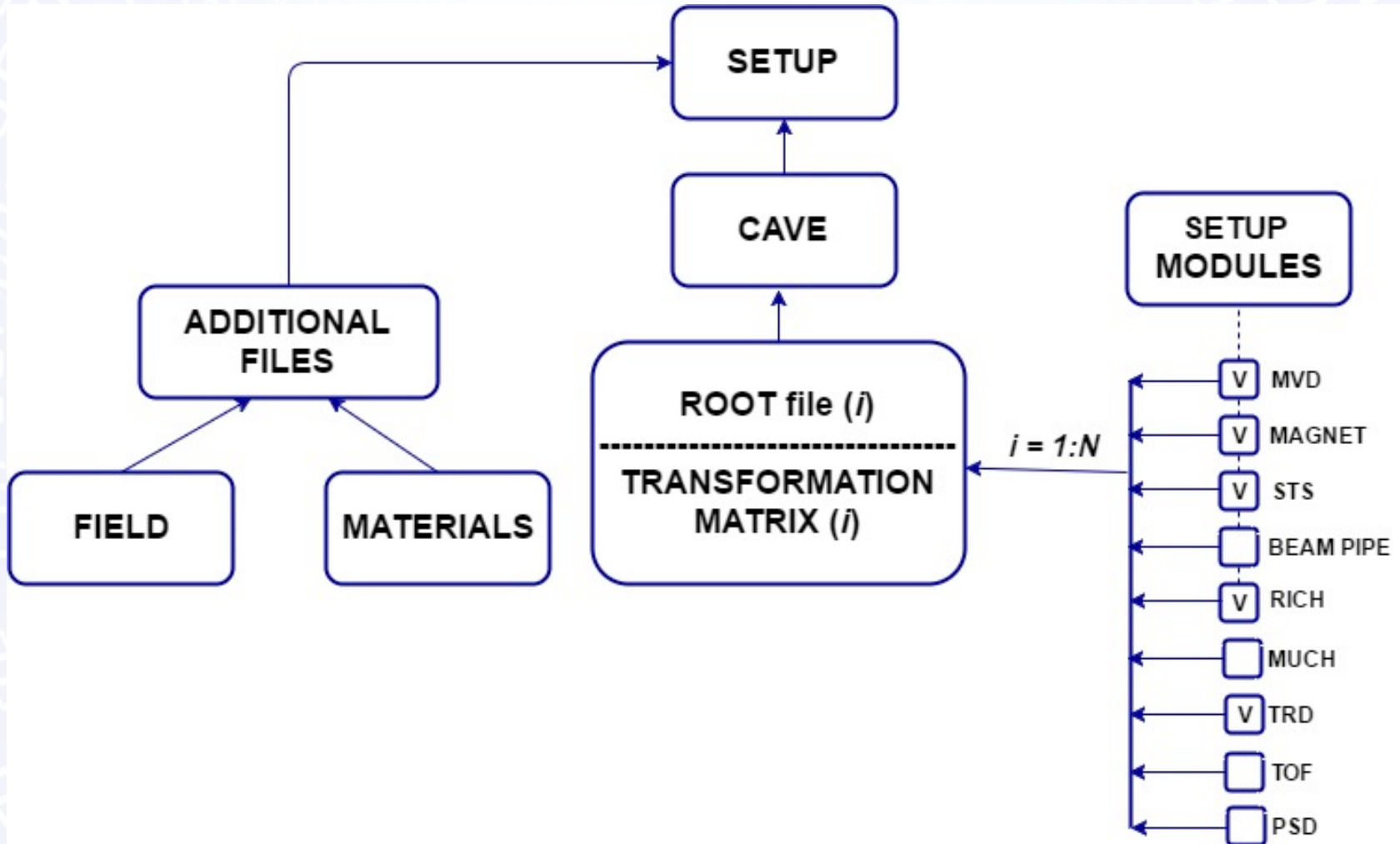
Setup Module

Geometry module, link to the mother geometry module, its placement in the mother module (transformation matrix or object of class TGeoMatrix)

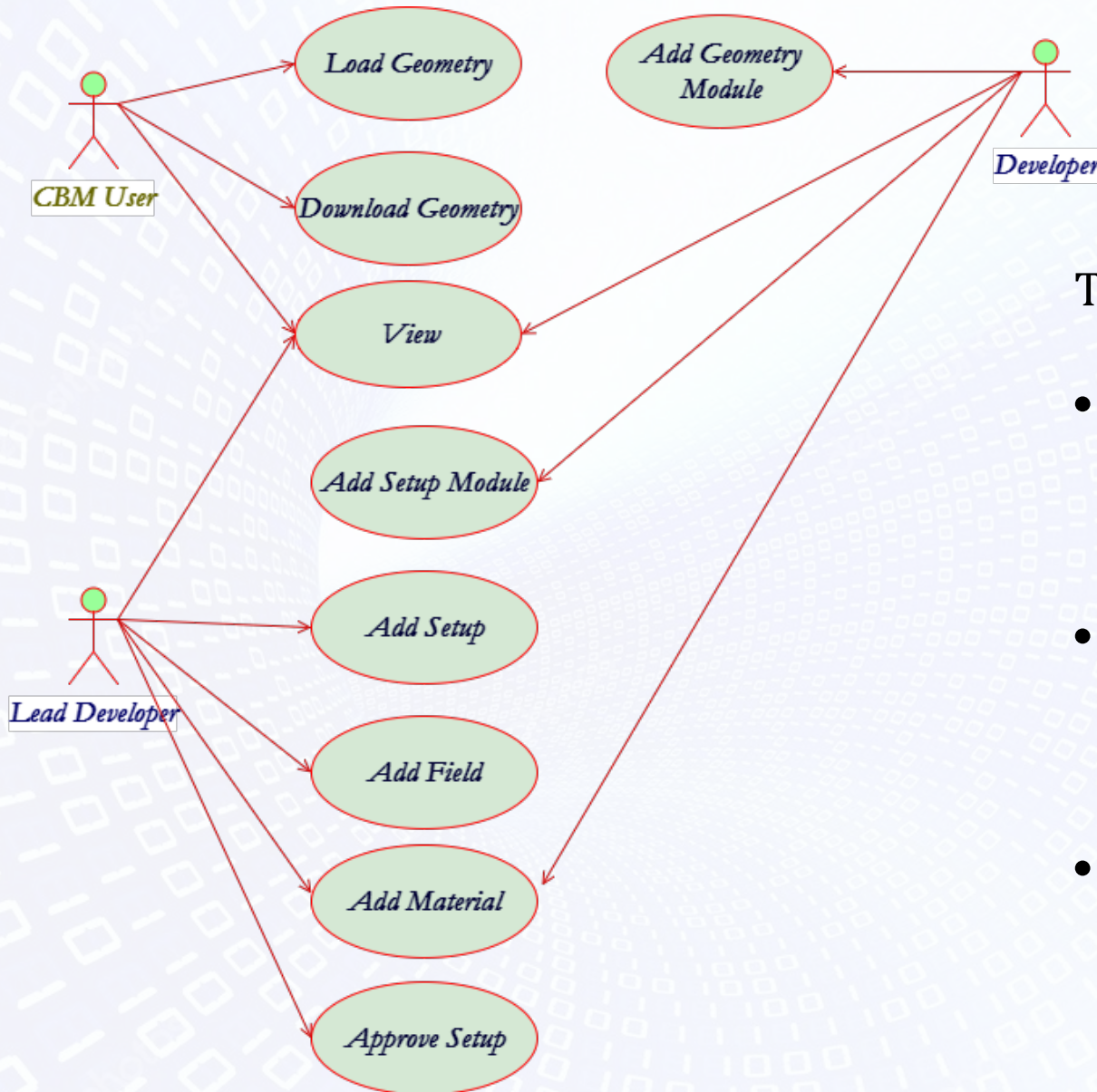
Setup

Combination of setup modules which represents the full geometry

CBM Setup Structure



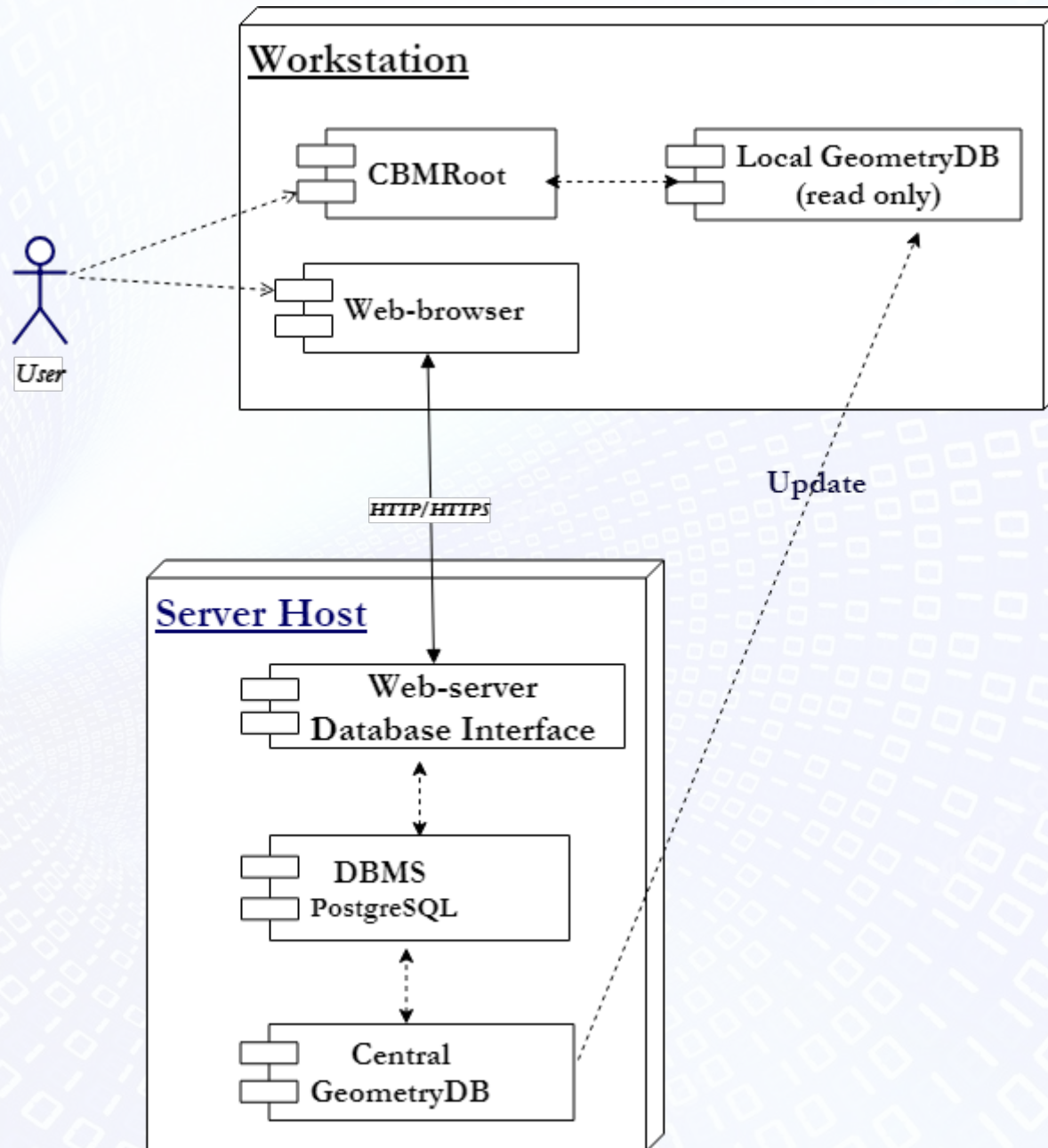
Geometry Database. Use Cases



The Geometry DB is used:

- to provide interfaces to view, retrieve, load and update modules and setups
- to store setups as combination of setup modules, magnetic fields and materials
- to store setup modules as ROOT files and Transformation matrix

CBM Component Diagram

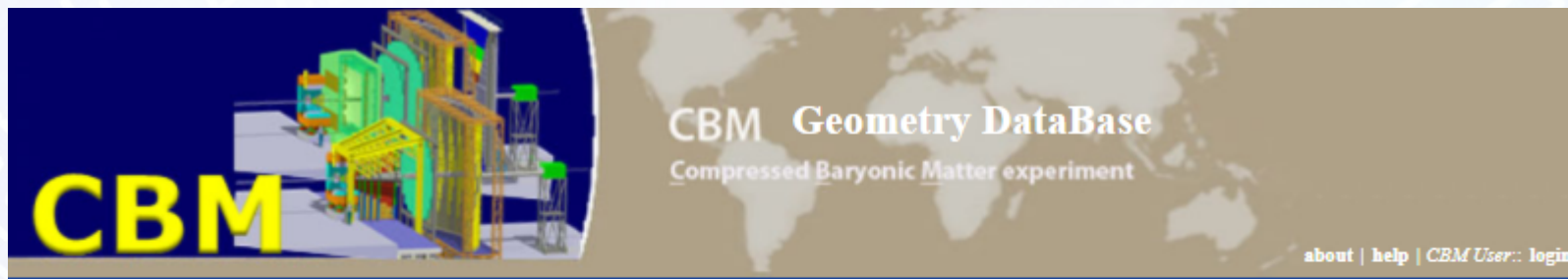


The implementation

- **GUI (Graphical User Interface)** implemented as Web-interface.
 - View;
 - Edit;
 - Download.
- **API (Application Programming Interface)** implemented as macros of the ROOT environment:
 - List of setups;
 - Load setup.

Any macro can be used as executable file or can be called from other ROOT macros.

Web-interface. View Mode



Available Setups

- [View Setups](#)
- [View Setup Modules](#)
- [View Files](#)
- [View Materials](#)
- [View Fields](#)
- [Download GeometryDB](#)

Tag	Date	Description	Status	Author	Download
fake_setup_test1	2018-01-31	Fake setup as test setup object.	Approved	alexand@jinr.ru	
test2 setup	2018-02-01	rrr	Approved	alexand@jinr.ru	
sis100_electron	2018-03-07	sis100_electron	Approved	aleksand@jinr.ru	

Setup	Tag	Date	Status	Author	Description
	test2 setup	2018-02-01	Approved	alexand@jinr.ru	rrr

	Tag	Date	Author	Description
sts	STS_fake_test1	2018-01-30	alexand@jinr.ru	Fake test root file for sts
Field	v12b	2017-11-30	aleksand@jinr.ru	Field for sis100_electron
Material	MATERIAL_test1	2018-01-30	alexand@jinr.ru	

Field Tag: v12b

X	Y	Z	Scale
0.000	0.000	40.000	1.000

Web-interface. Configure Access

Configure WebAccess

Code	Name	Actions	Users
LDV	Lead Developer	Full Set	Grant / Revoke
CBM	CBM User	Read Only	Grant / Revoke
DVP	Developer	MVD	Grant / Revoke
DVP	Developer	PIPE	Grant / Revoke
DVP	Developer	STS	Grant / Revoke
DVP	Developer	RICH	Grant / Revoke
DVP	Developer	MAGNET	Grant / Revoke
DVP	Developer	TRD	Grant / Revoke
DVP	Developer	TOF	Grant / Revoke
DVP	Developer	PSD	Grant / Revoke
DVP	Developer	PLATFORM	Grant / Revoke

Connect user to role Developer

Select user: Connect

Connected users to role Developer MVD:
are absent!

Found 2 matching users:

ID	email	Developer/PIPE/
3	axion2rv@gmail.com	Revoke
15	wwq21@yyyyyy.com	Revoke

WebAccess Admin

Selection for WebAccess Admin

Role Area
To configure administration rights and authorization rules.

User Area
To configure administration rights for the users.

Manage Accounts
To manage user accounts

Accounts Overview

Create New Account

Edit Account

User Administration

Enter part of the user Nickname or Email:

Search

Found 5 matching users:

ID	email	Nickname	Role
1	fia@jinr.ru	adms	show details
4	aleksand@jinr.ru	susu	show details
10	axion2rv@gmail.com		show details
12	fira@cv.jinr.ru		show details
14	ivanov@jinr.ru	Ivanov	show details

Roles connected to user *aleksand@jinr.ru*:

Code	Name	Actions	Role
LDV	Lead Developer	Full Set	Revoke
CBM	CBM User	Read Only	Revoke
			Grant

Web-interface. Edit Mode

Available Setups

Tag	Date	Description	Author	Status	Last Modified	Admin Tools
run6	2018-07-26	run6 without field <input type="text"/> OK!	aleksand@jinr.ru	Approved		
run1	2018-07-11	run1 without field <input type="text"/> OK!	aleksand@jinr.ru	Approved		
bbbb_000	2018-07-27	test <input type="text"/> OK!	fia@jinr.ru	Created		
2	2018-07-11	asd <input type="text"/> OK!	aleksand@jinr.ru	Created		

You may edit the field Please, enter new value for Press button OK!

tag:

OK

Cancel Create New Setup

- Delete this setup: *make this setup unavailable for usage*
- Approve this setup: *change the status to Approved*
- Modify this setup: *go to modification form*

Edit Admin Interface

Selection for Edit Admin

- Edit Setup
To configure and edit setup.
- Edit Material
To configure and edit material.
- Edit File
To configure and edit file.
- Edit Field
To configure and edit field.
- Edit Setup Modules
To configure and edit Setup Module.

Go to the Form for Setup
Compiling →

Web-interface. Setup Compiling (Add New Setup)

Setup Tag:
test_003

Description:
description for test_003

Author:
fia@jinr.ru

Available Setup Modules

Type	Tag	Date	Author	File Tag	Transformation	Translation	Parent	Description	
<input checked="" type="radio"/>	sts	v16x	2017-12-21	aleksand@jinr.ru	v16x_file	1.000 0.000 0.000 0.000 1.000 0.000 0.000 0.000 1.000	0.000 0.000 65.000	cave	use STS v16x as new default, see issue #647
<input type="radio"/>	sts	STS_fake_test1	2018-01-30	alexand@jinr.ru	root_fake_file_sts_t	1.000 0.000 0.000 0.000 1.000 0.000 0.000 0.000 1.000	0.000 0.000 0.000	cave	Fake STS module for test

Available Fields

Tag	Date	Author	X	Y	Z	Scale	Description	
<input checked="" type="radio"/>	v12b	2017-11-30	aleksand@jinr.ru	0.000	0.000	40.000	1.000	Field for sis100 electron
<input type="radio"/>	TESTER	2018-04-02	fia@jinr.ru	1.000	1.000	1.000	2.000	terter description
<input type="radio"/>	v13b	2018-04-02	fia@jinr.ru	2.000	2.000	2.000	3.000	new field
<input type="radio"/>	TESTER2	2018-04-02	fia@jinr.ru	2.000	2.000	3.000	5.000	dfsdfsdfs
<input type="radio"/>	34534534535	2018-04-09	fia@jinr.ru	1.000	1.000	1.000	1.000	trytrytrytrytry
<input type="radio"/>	34534534535	2018-04-09	fia@jinr.ru	1.000	1.000	1.000	1.000	test

Available Materials

Tag	Date	Author	Description
<input checked="" type="radio"/>	1.10	2017-11-30	aleksand@jinr.ru // Revision 1.10 2006/09/12 07:27:58 kresan // media file for new TOF geometry
<input type="radio"/>	MATERIALTEST	2018-04-02	fia@jinr.ru MATERIALTEST_EDIT
<input type="radio"/>	MATERIAL_test1	2018-01-30	alexand@jinr.ru Test material, can not be used for real setup.EDIT

Cancel Add Setup

Web-interface. Setup Modifying (Change the Selected Setup)

Setup Tag:
test_001

Description:
test!

Author:
fia@jinr.ru

List of Setup Modules

Type	Tag	Date	Author	File Tag	Transformation	Translation	Parent	Description
sts	v16x	2017-12-21	aleksand@jinr.ru	v16x_file	1.000 0.000 0.000 0.000 1.000 0.000 0.000 0.000 1.000	0.000 0.000 65.000	cave	use STS v16x as new default, see issue #647
sts	STS_fake_test1	2018-01-30	alexand@jinr.ru	root_fake_file_sts_t	1.000 0.000 0.000 0.000 1.000 0.000 0.000 0.000 1.000	0.000 0.000 0.000	cave	Fake STS module for test
tof	v16a_1e_tof	2017-12-21	aleksand@jinr.ru	v16a_1e_file	1.000 0.000 0.000 0.000 1.000 0.000 0.000 0.000 1.000	0.000 0.000 0.000	cave	No any comments

Available Fields

Tag	Date	Author	X	Y	Z	Scale	Description
v12b	2017-11-30	aleksand@jinr.ru	0.000	0.000	40.000	1.000	Field for sis100 electron
TESTER	2018-04-02	fia@jinr.ru	1.000	1.000	1.000	2.000	terter description
v13b	2018-04-02	fia@jinr.ru	2.000	2.000	2.000	3.000	new field
TESTER2	2018-04-02	fia@jinr.ru	2.000	2.000	3.000	5.000	dfsdfsdfs
34534534535	2018-04-09	fia@jinr.ru	1.000	1.000	1.000	1.000	trytrytrytrytry
34534534535	2018-04-09	fia@jinr.ru	1.000	1.000	1.000	1.000	test

Available Materials

Tag	Date	Author	Description
1.10	2017-11-30	aleksand@jinr.ru	// Revision 1.10 2006/09/12 07:27:58 kresan // media file for new TOF geometry
MATERIALTEST	2018-04-02	fia@jinr.ru	MATERIALTEST_EDIT
MATERIAL_test1	2018-01-30	alexand@jinr.ru	Test material, can not be used for real setup.EDIT

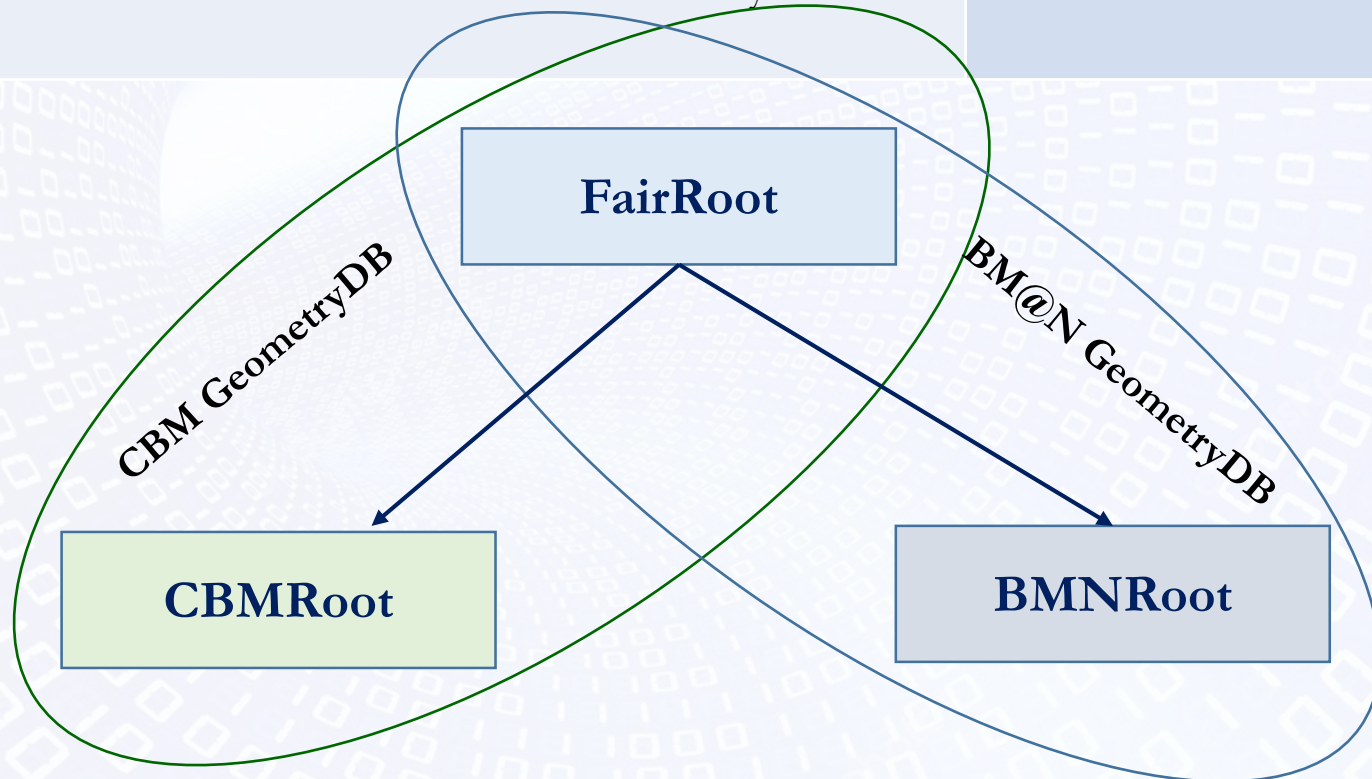
Cancel Save Setup

Macros

<i>Signature</i>	<i>Description</i>	<i>Call Example</i>	<i>Comment</i>
<code>void getSetupList();</code>	Get the list of available setups. Print the list of available setups including tag, date of creation, author and description parameters for each approved setup.	<code>getSetupList.c();</code>	Return the available setups' list
<code>bool loadSetup(const char* setupTag, const char* moduleName);</code>	Load setup into the CBM/BMN ROOT framework. The Geometry can be used in ROOT framework afterwards. Return FALSE if setup is not loaded, and TRUE if the loading is successful.	<code>bool res = loadSetup("sis100_ electron", "*");</code>	"*" – all setup modules to be loaded
<code>bool loadSetup(const char* setupTag, int moduleId);</code>	Load setup into CBM/BMN ROOT environment by module Id to load setup into the CBM ROOT framework. The Geometry can be used in ROOT framework afterwards. Return FALSE if setup is not loaded, and TRUE if loading is successful.	<code>bool res = loadSetup("sis100_ electron",-1);</code>	
<code>bool loadSetup(const char* setupTag, const char* moduleName, const char* xml);</code>	Load setup into the ROOT environment. Geometry can be used in the ROOT environment after this operation. User can use xml file in order to move any setup module during loading. Return false if setup was not loaded because of errors and true if load is successful.	<code>loadSetup("sis100_ electron", "*", "local.xml")</code>	xml file contains information on the setup modules and their shifts.

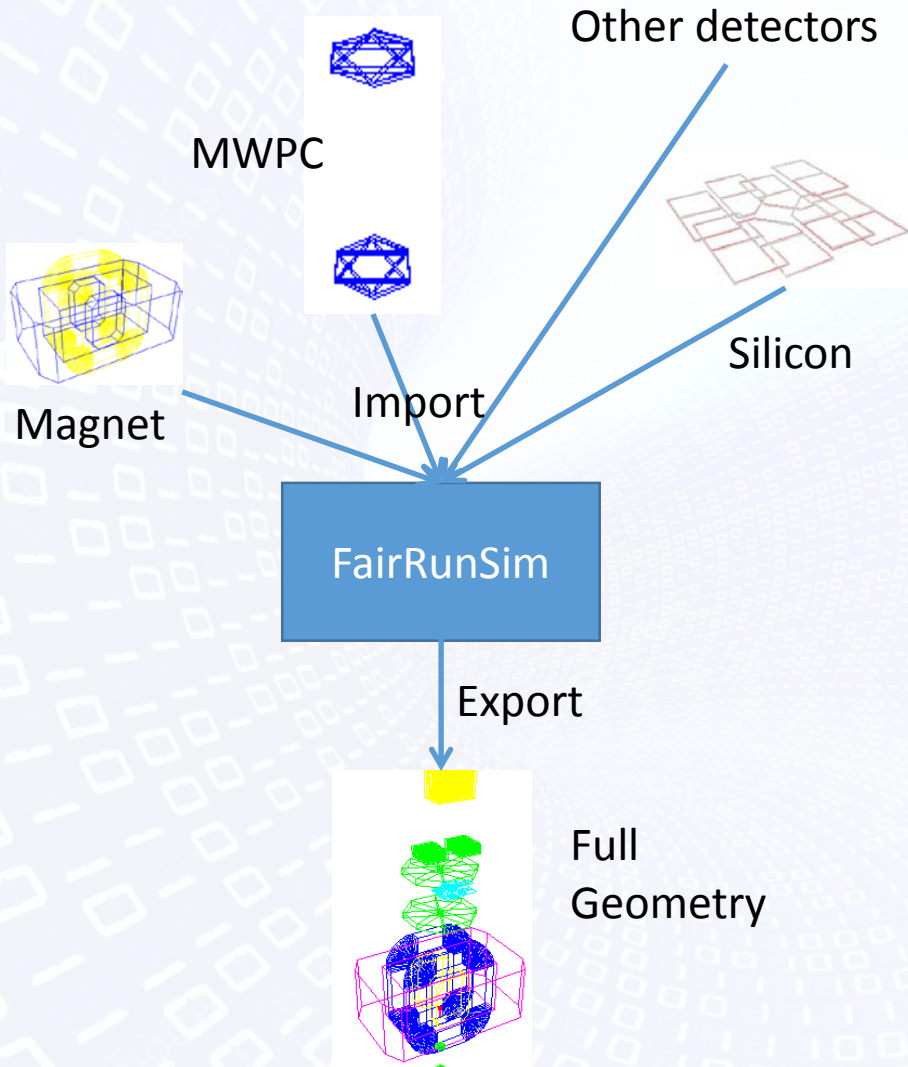
CBM & BM@N

Common features	Difference
Approaches to the methods of simulation and reconstruction	The set of Detectors; BM@N collaboration has the actual data that allows verifying the GeometryDB.
Software: FAIRSOFT, FAIRROOT	
RunManager: <ul style="list-style-type: none">➤ FairRunSim for the simulation runs➤ FairRunAna for the reconstruction or analysis runs	

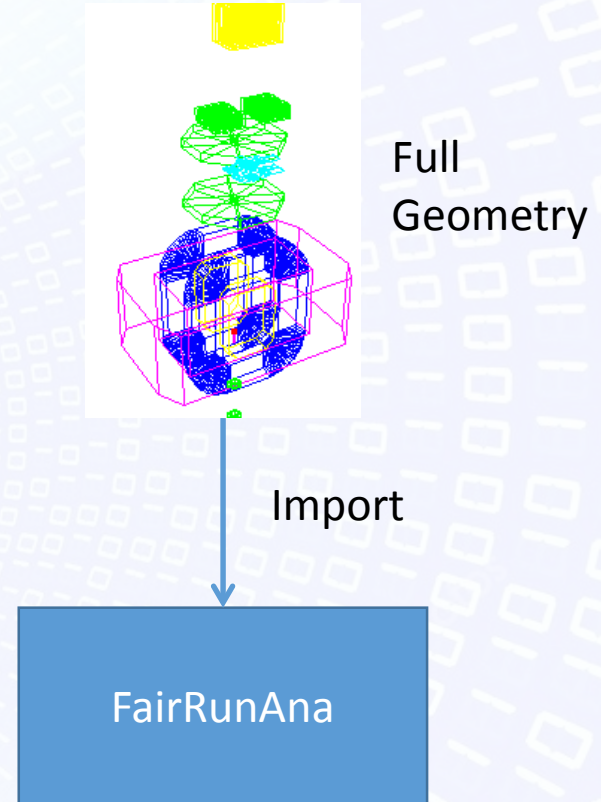


RunManager & Geometry

Simulation



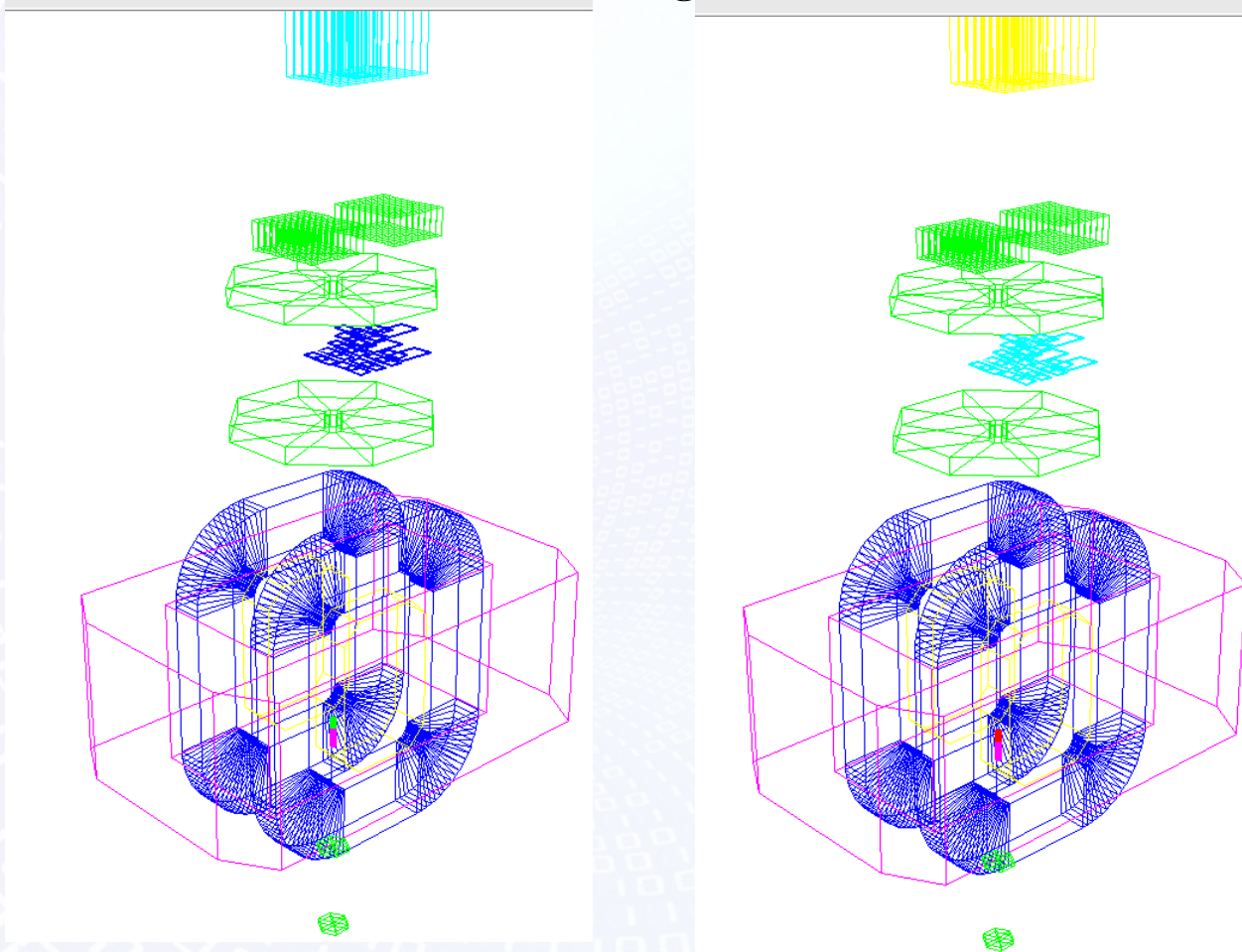
Reconstruction



Verification of BM@N database (1)

Verification using simulation:

- Filling Geometry DB with data for Run6
- Run simulation using Geometry DB
- Comparison of the original geometry (Run 6) and geometry from DB



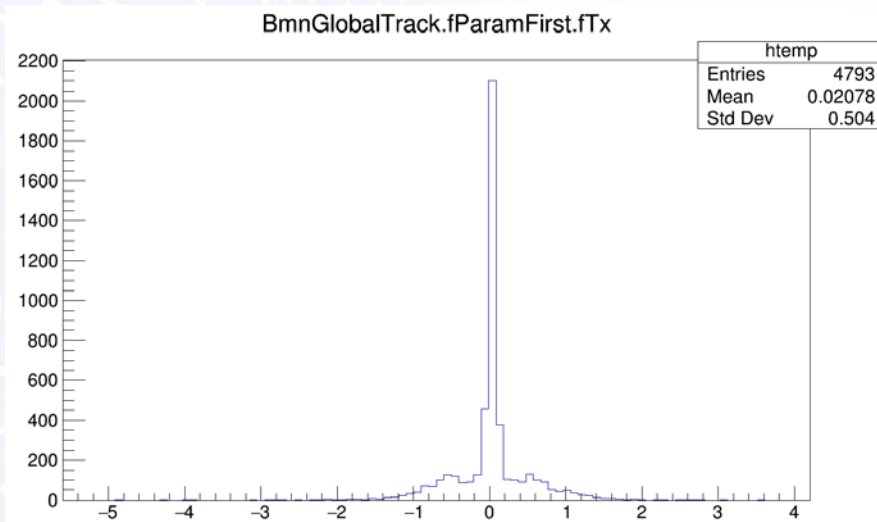
Original geometry

Geometry from DB

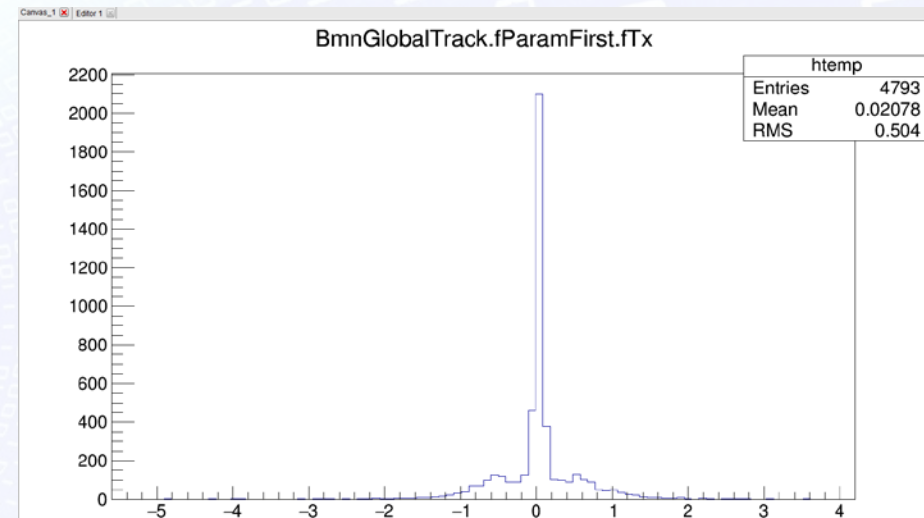
Verification of BM@N database (2)

Verification using reconstruction:

- Reconstruction using original geometry
- Reconstruction using geometry file from DB
- Comparison of the reconstructions results



The reconstruction for Run 6 (10000 events) using original geometry



The reconstruction for Run 6 (10000 events) using geometry from DB with simulation

Conclusion and Next Steps

Geometry DB prototype for storing and retrieving the geometry of CBM/BM@N modules has been developed:

- DB (DBMS PostgreSQL, SQLite);
- GUI (Graphical User Interface) tools;
- API (Application Programming Interface) tools as a set of ROOT macros;
- Beta Testing of CBM database;
- Verification of BM@N database.

- Continue filling the DB;
- Preparing to include into CBMRoot/BMNRot release;
- Approbation of the prototype in the real workflows.

Thanks for your attention!