Geometry System: Web Interface. User Guide

Last updated: 26 November 2026

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1. About the Geometry Database

The Geometry Database stores every version of the detector geometry of the experiment in one place. BmnRoot loads from it the setup geometry for simulation and reconstruction. It is the main component of the Geometry Information System. The central database runs on PostgreSQL, and a full local copy is downloaded as an SQLite file to each BmnRoot installation to reduce network traffic and errors caused by network failures.

There are two ways to work with the database:

- **The Web Interface** at https://bmn-geometry.jinr.int. Use it to browse and download geometries, upload new versions of geometry files, materials and magnetic fields, build setups from geometry modules and approve them. This guide describes it in detail.
- **The Application Programming Interface (API)**: the C++ geometry library (`GeoDb`) and ROOT macros in BmnRoot (`database/geo_db`). These select a setup geometry and load it into simulation, reconstruction and physics analysis.

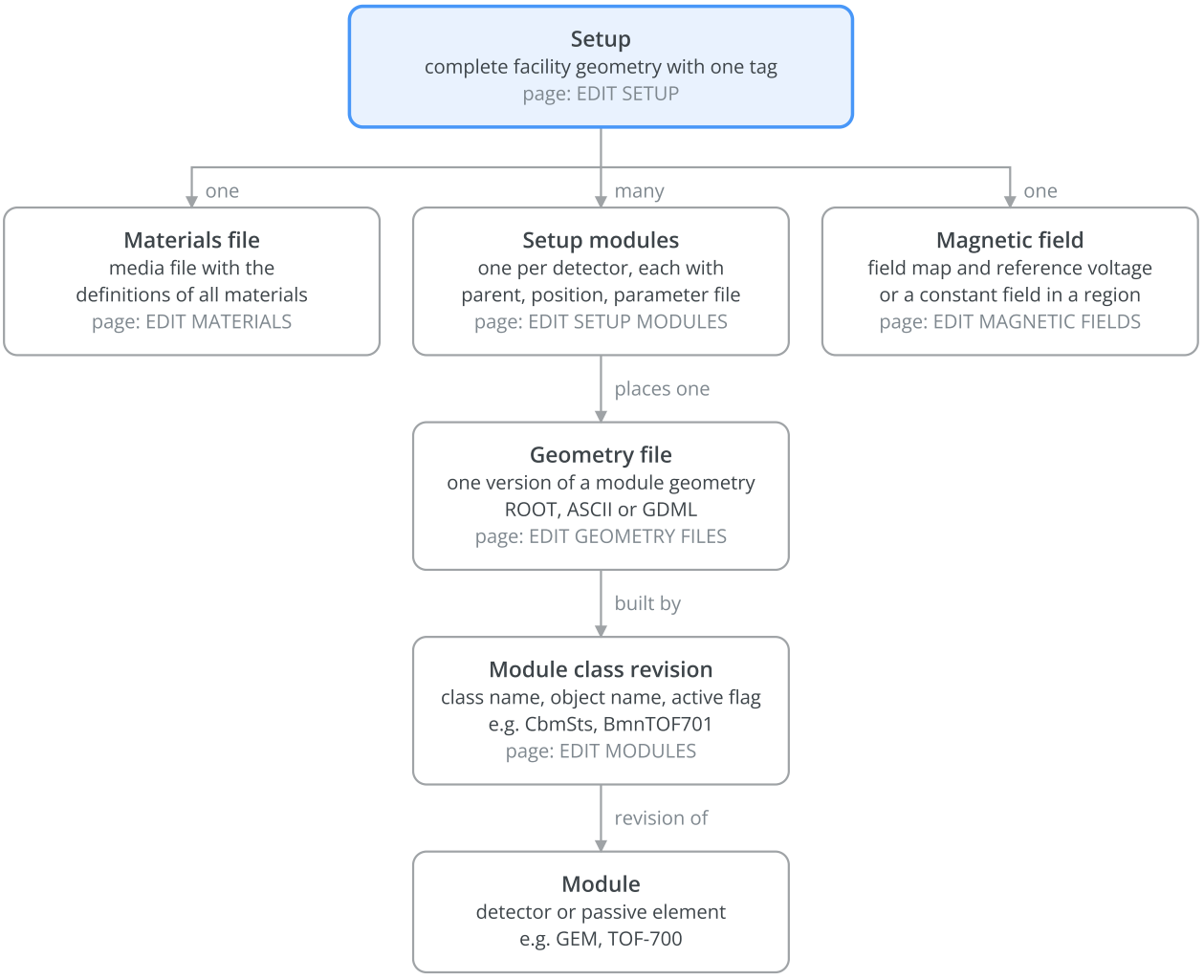
What you can do depends on your user category:

User category	Signed in?	What they can do
General user	No	View setups, setup modules, geometry files, materials and magnetic fields; download any of them and the full local copy of the database
Developer (detector expert)	Yes	Everything above, plus upload and edit geometry versions of the detectors they have rights for, add materials files, and create setups and change them until they are approved (menu **EDIT GEOMETRY**)
Lead developer	Yes	Everything above, plus register new modules, add magnetic fields, approve and delete setups, and grant rights to other users (button **CONFIGURE USER ACCESS**)

2. Key concepts

A **setup** is the complete geometry of the experimental facility, identified by one unique tag. It is assembled from setup modules, plus one materials file and one magnetic field. Each setup module places one version of one detector geometry at a position in the cave.

A setup is assembled from placed versions of detector geometries



Read the diagram from the top: a setup takes one materials file, one magnetic field and many setup modules that place the detectors at specific positions, each with its parameter file if needed. Each setup module places one geometry file, which belongs to one class revision of a module (the common name of a detector or passive element, such as the beam pipe).

Object	What it is	Example	View page	Edit page
Module	A detector or passive element of the setup, together with the BmnRoot class that implements it	`GEM` (class `CbmSts`), `TOF-700`	(shown on other pages)	EDIT MODULES
Geometry file	One version of a module's geometry, in ROOT (`.root`), ASCII (`.geo`) or GDML format	`CSC_Run9_detailed.root`	VIEW GEOMETRY FILES	EDIT GEOMETRY FILES

Object	What it is	Example	View page	Edit page
Setup module	A geometry file placed in a setup: its tag, its parent module, its transformation (translation and rotation) and, if needed, the detector's XML parameter file	`FD_run9.root`, parent `Cave`	VIEW SETUP MODULES	EDIT SETUP MODULES
Materials file	The media file with the definitions of all materials	`media_24.12`	VIEW MATERIALS	EDIT MATERIALS
Magnetic field	A field map, with the reference voltage at which it was measured, or a constant field in a given region	(field map of the magnet)	VIEW MAGNETIC FIELDS	EDIT MAGNETIC FIELDS
Setup	A list of setup modules, plus one materials file and one magnetic field; it also has a ROOT file with the full geometry of the facility	`run9_26.10.0`	VIEW SETUPS	EDIT SETUP

Every object has a **tag**, a creation **date**, an **author** and a **description**. The tag is the name by which the object is found in the database and in BmnRoot.

Setup tags

Setup tags start with the run period and follow one of two patterns:

- `run<N>_<YY.MM.P>` for a **production** setup, where `YY.MM.P` is the BmnRoot release tag and P is the patch number, starting from 0. Example: `run9_26.09.0`.
- `run<N>_dev_<YY.MM.DD>` for a **development** setup, where `YY.MM.DD` is its creation date. Example: `run9_dev_26.05.19`.

Setup status

A setup is in one of two states:

- **Created** — just assembled, not yet recommended for use (intended for preliminary testing).
- **Approved** — confirmed by the people responsible for the geometry. Approved setups are the ones recommended for data processing, and only they are chosen when BmnRoot asks for "the latest setup of Run N".

Placement of a module

The **parent** of a setup module is the module it is located in, usually `Cave` for detectors and passive elements. The **transformation matrix** gives the module's shift and rotation in the parent's coordinate system. It lets you move a detector without changing its geometry file. Entries that are no longer current can be **archived**; the View pages then hide them unless you explicitly switch them on.

3. Getting started

Open https://bmn-geometry.jinr.int in a web browser. Browsing and downloading need no account; adding or changing geometry elements requires one to sign in.

3.1 Page layout

Every page has the same three areas, marked A, B and C in Figure 1:

- **A — Header bar.** It has the database title, the database download button, the account controls and the HELP button.
- **B — Menu.** The left-hand menu has HOME, the **VIEW GEOMETRY** group, the **EDIT GEOMETRY** group once you are signed in, and HELP at the bottom. The groups may open folded: click a group's name or arrow to unfold it.
- **C — Content area.** It shows the selected page: the general information on HOME, and a table or a form on the other pages.

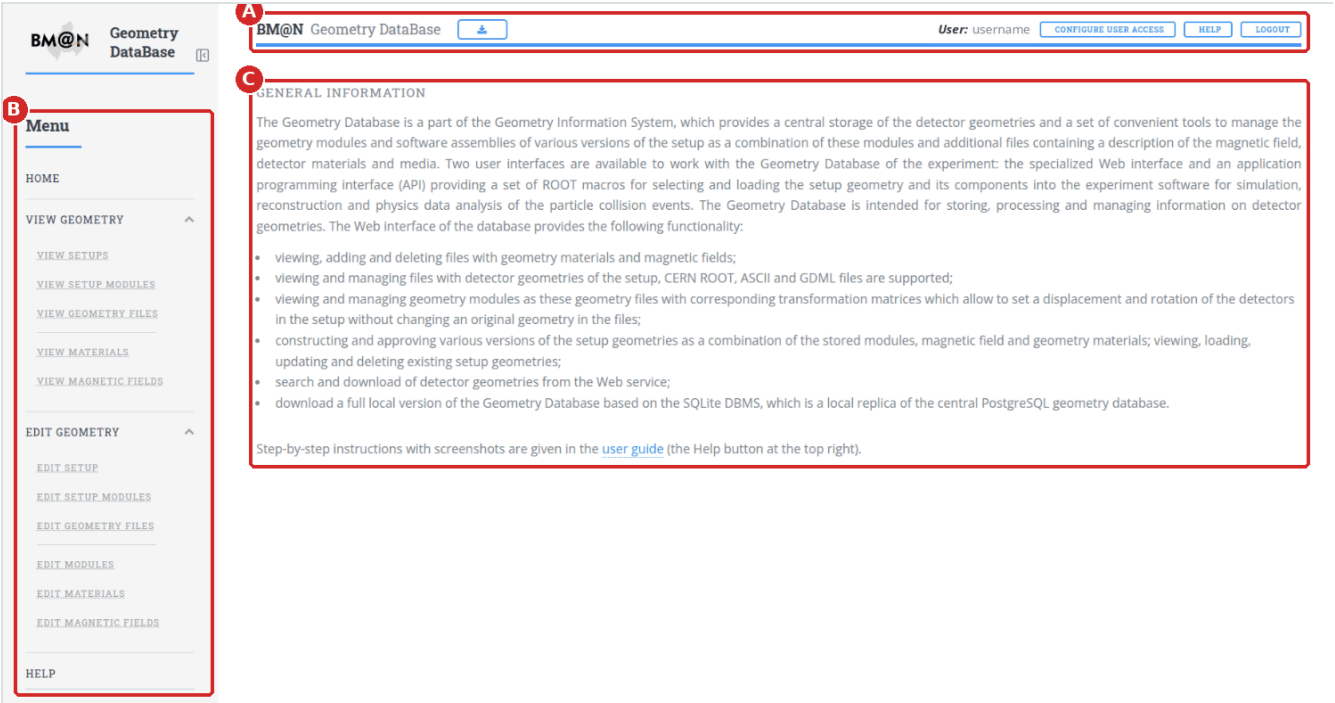


Figure 1. The home page for a signed-in user

3.2 Header bar

The controls of the header bar are numbered in Figure 2.

#	Control	What it does
1	**BM@N Geometry DataBase**	Returns to the home page from anywhere
2	Download button (arrow icon, tooltip "Download Local Geometry Database")	Downloads the whole database as one archive, `localdb.tar` (see 3.5)
3	**User:** *name*	Shows who is signed in. When nobody is signed in, a **LOGIN** button is shown here instead (Figure 4)
4	**CONFIGURE USER ACCESS**	Opens the management of user rights. Only lead developers see it (Section 7)

#	Control	What it does
5	**HELP**	Opens this user guide in a new tab (tooltip "User Guide"), so that an unsaved form is not lost. It is shown to everyone, signed in or not
6	**LOGOUT**	Signs you out

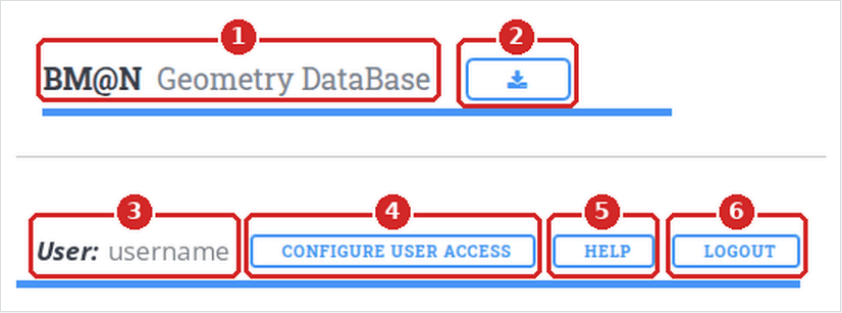


Figure 2. Controls of the header bar

3.3 Menu

The menu items are numbered in Figure 3. Items 7–12 are visible only after you sign in. Detector developers see items 7–11: magnetic fields are added by lead developers only.

#	Menu item	Page	Section
1	HOME	General information about the database	—
2	VIEW SETUPS	Table of the setups	4.1
3	VIEW SETUP MODULES	Table of the setup modules	4.2
4	VIEW GEOMETRY FILES	Table of the geometry files	4.3
5	VIEW MATERIALS	Table of the materials files	4.4
6	VIEW MAGNETIC FIELDS	Table of the magnetic fields	4.5
7	EDIT SETUP	Create, change and approve setups	5.6
8	EDIT SETUP MODULES	Place geometry files in the cave as setup modules	5.5
9	EDIT GEOMETRY FILES	Upload new versions of module geometries	5.4
10	EDIT MODULES	Register modules and their BmnRoot classes	5.3
11	EDIT MATERIALS	Upload materials files	5.1
12	EDIT MAGNETIC FIELDS	Add magnetic fields: field maps or constant fields	5.2
13	Fold button	Hides the menu to give the tables more room; click it again to bring the menu back	—
14	HELP	Opens this user guide in the same tab. It is shown to everyone, signed in or not	—

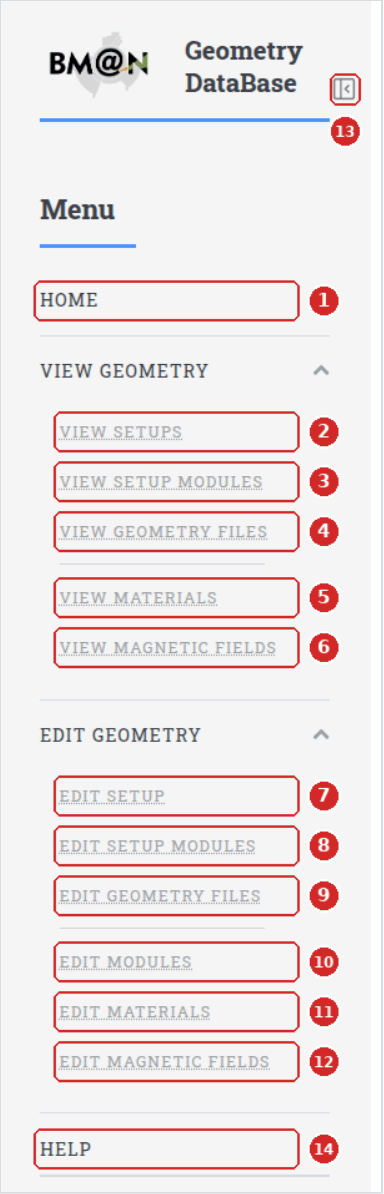


Figure 3. The menu of a signed-in user

3.4 Signing in and out of the web interface

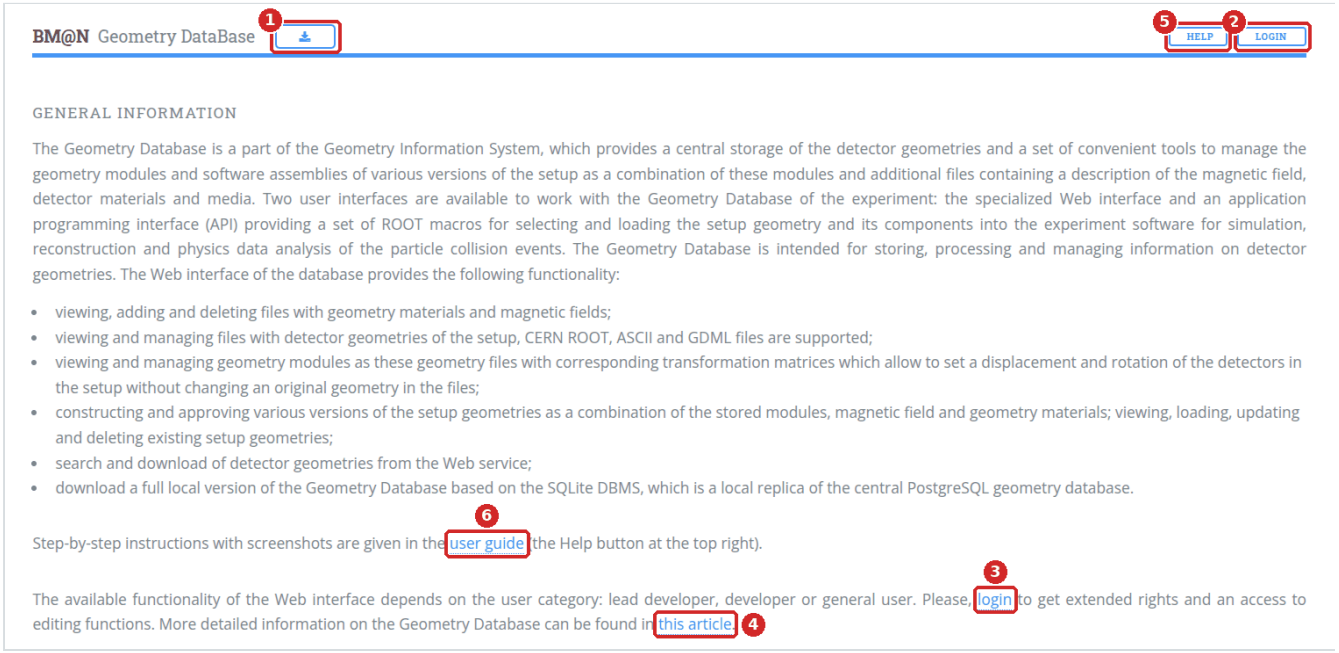


Figure 4. The home page before signing in: (1) download of the whole database, (2) LOGIN, (3) the login link in the text, (4) the article about the database, (5) HELP, (6) the link to this user guide

1. Click **LOGIN** at the right of the header bar (2 in Figure 4), or the **login** link in the text of the home page (3).
2. The **JINR Single Sign-On** page opens (Figure 5). Under **Sign in with a JINR account**, enter your **User name** (1) and **Password** (2) of the JINR account and click **Sign In** (3).
3. You return to the Geometry Database. Check that the header shows **User:** with your login and that the **EDIT GEOMETRY** group has appeared in the menu.
4. When you have finished, click **LOGOUT**.

If you have forgotten the password, use **Recovery password** (4). If you have no JINR SSO account yet, follow **How to get SSO login for user** (5).

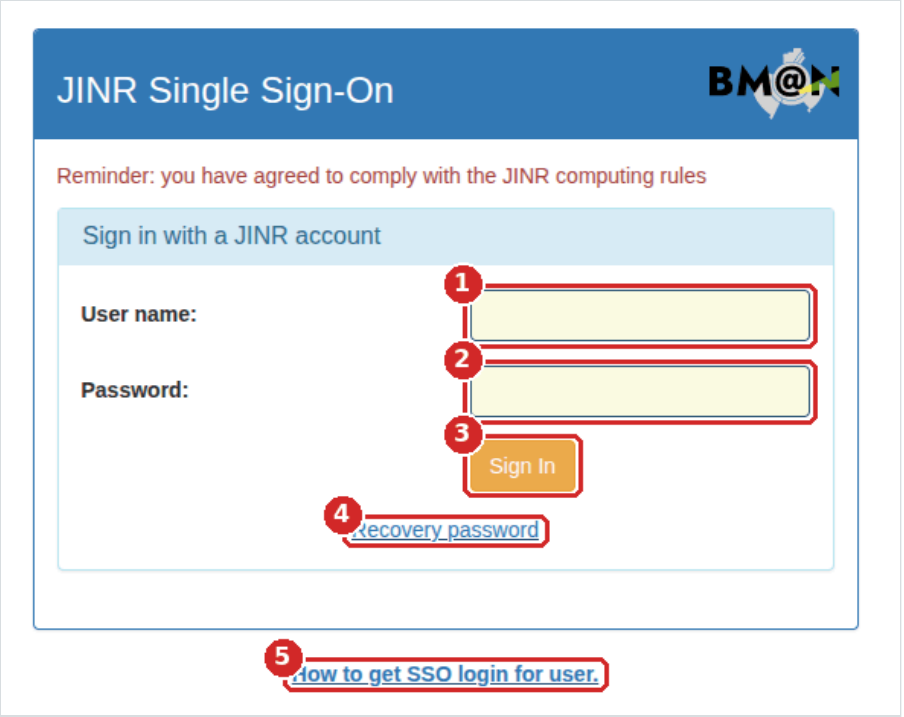


Figure 5. The JINR Single Sign-On page: (1) User name, (2) Password, (3) Sign In, (4) Recovery password, (5) How to get SSO login for user

Getting access

To sign in, your JINR account must belong to the corresponding group in the authorisation system (Keycloak). Groups, including the group for editing in the web interface of the Geometry System, are requested through the **BM@N Software Access** form:

1. Open the experiment website bmn.jinr.int.
2. In its menu, choose **Software › Registration › BM@N Software Access**. The form https://bmn.jinr.int/registration/ opens.
3. Fill it in for your JINR account. Download the paper form (a PDF) with the link at the top of the page, sign it and attach it, then click **Request Access**.

What a signed-in user may edit then depends on their roles (Section 7). If you cannot sign in after your request has been granted, or need rights for another detector, ask the lead developers (Section 9).

3.5 Downloading the whole database

The download button (control 2) gives you `localdb.tar`. It is a full replica of the central database: the SQLite file `local.db` and the `storage` folder with all geometry, materials and magnetic field files. You rarely need to download it by hand: BmnRoot downloads and refreshes its own copy automatically (Section 8). To use the archive yourself:

1. Unpack it: `tar -xf localdb.tar -C <target_dir>`.
2. Point the software to it: `export GEOMPATH=<target_dir>/storage/`. The `local.db` file must sit in the parent folder of `storage`.

3.6 Opening this guide on the site

This guide is also published on the web service itself. You can open it from any page, without signing in:

- **HELP** in the header bar (5 in Figure 2) opens it in a new tab. Use it while you are filling in a form: the form stays open in its own tab.
- **HELP** at the bottom of the menu (14 in Figure 3) opens it in the same tab.
- The **user guide** link on the home page (6 in Figure 4) also opens it in the same tab.

The page starts with a list of contents: click a section to go to it. The header bar and the menu stay in place, so you can return to work from the guide at any time.

4. Viewing geometry

The five VIEW GEOMETRY pages are open to everyone. Each shows one table with the same controls:

- **Sort:** click a column header (the small arrows next to its name).
- **Filter:** type into the box under a header, e.g. `run9` under **Tag**. The table narrows as you type.
- **Show archived:** this switch above the table also lists entries that were archived (see "Deleting and archiving" in Section 5).
- **Pages:** long tables are split into pages; the page buttons and the **Rows** selector (25 by default) are under the table.
- **Icons:** hover over an icon to see its tooltip, e.g. "Download File". The icon in the Transform column shows the coefficients of the transformation matrix.

4.1 View setups

1. In the menu, click **VIEW GEOMETRY › VIEW SETUPS**. The **Geometry Setups** table opens.
2. While the **Approved only** switch (1 in Figure 6) is on, only approved setups are listed. Switch it off to see the non-approved setups with status `Created` as well; their rows are tinted violet.
3. Use the filter boxes (2) to find a setup, e.g. type `run9_26` under **Tag**.
4. Use the buttons in its row:
   - **Download Setup** (4): an archive with the setup components, as a small local database (`local.db` and its `storage` files).
   - **Download Full Geometry** (5): one ROOT file with the full geometry of the facility, ready for `TGeoManager::Import()`.
   - **Visualize Geometry** (6): a 3D view of the whole setup in a window (Figure 9). Drag to rotate, scroll to zoom, close it with **×**.
5. Click the tag of a setup (3) to see what it consists of (4.1.1).

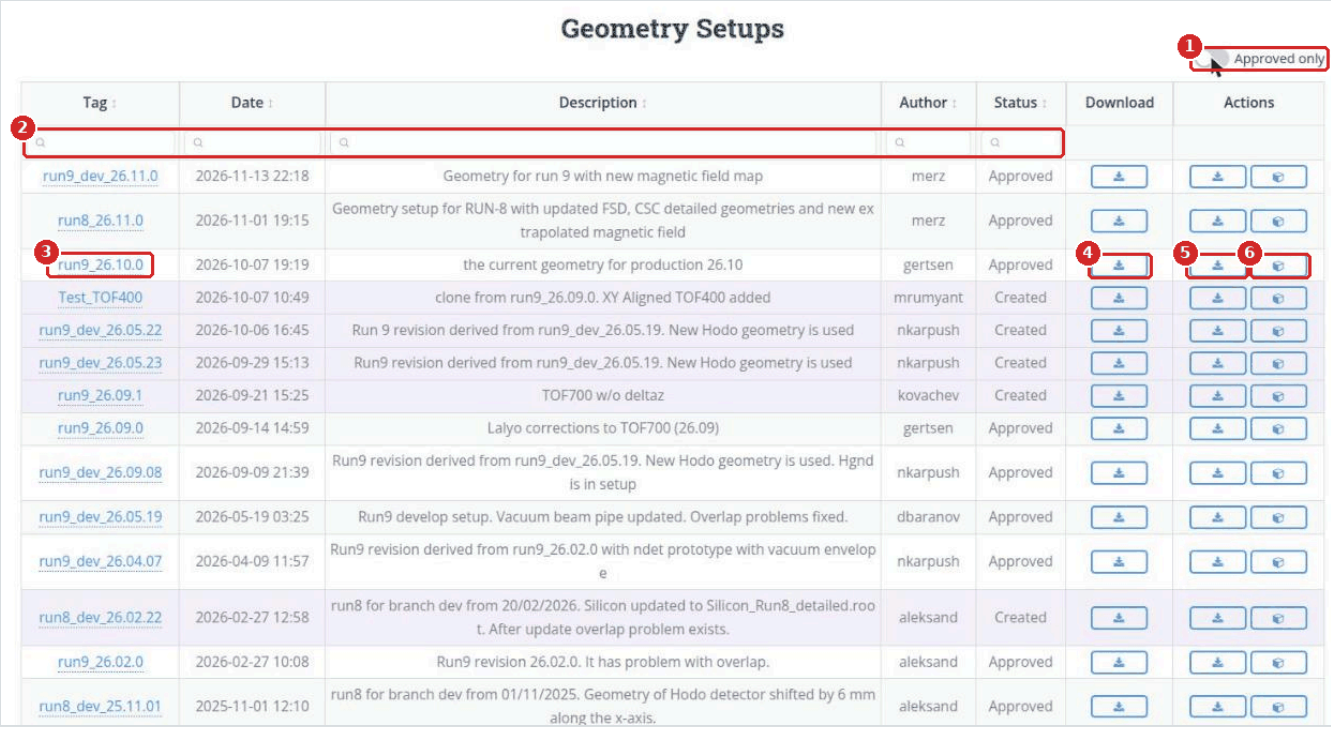


Figure 6. VIEW SETUPS: (1) Approved only, (2) filters, (3) setup tag, (4) Download Setup, (5) Download Full Geometry, (6) Visualize Geometry

4.1.1 Contents of a setup

Clicking a tag adds the table **<tag> setup contains:** under the setup list (Figure 7). It has one row per setup module, then one row for the magnetic field (**Field**) and one for the materials file (**Material**).

- Click the tag of a setup module (2) to see its position: a panel **<Module> / <tag>** appears below with the **Transformation** (3×3 rotation matrix), **Scale**, **Translation** (X, Y, Z in cm) and **File Tag** (Figure 8).
- Click **View** (3) to see the module in 3D.

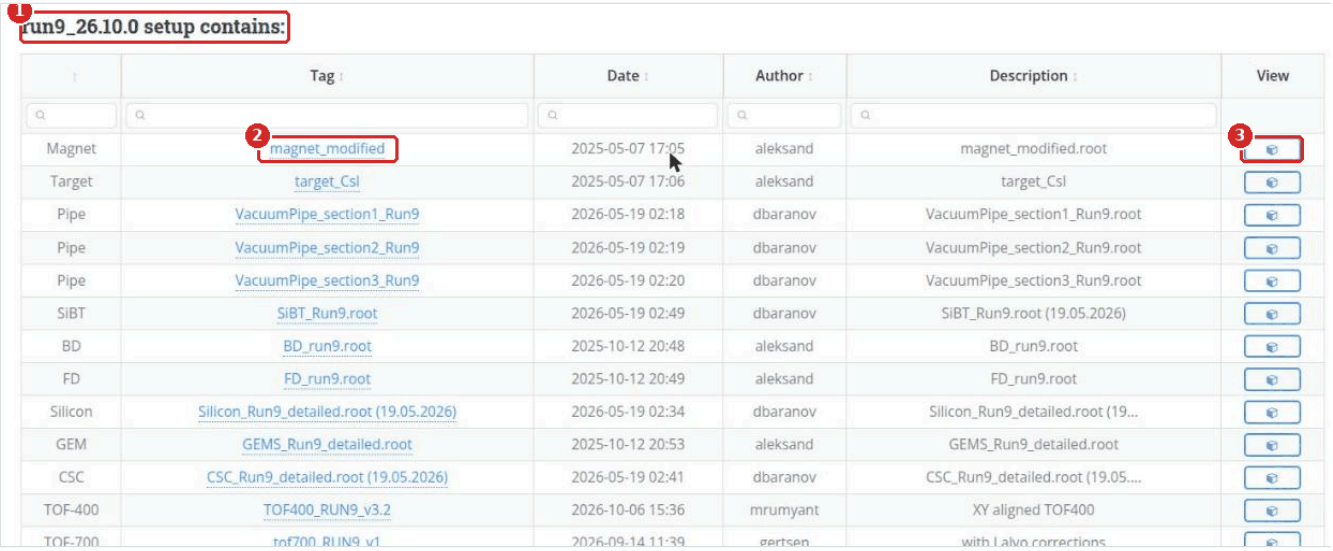


Figure 7. The contents of setup `run9_26.10.0`: (1) heading, (2) tag of a setup module, (3) 3D view of the module

Field	FieldMap_1900_extrap_noPed	2026-10-07 16:43	aleksand	FieldMap_1900_extrap_noPed.roo...
Material	media_24.12	2025-05-06 17:24	aleksand	media_24.12

Magnet / magnet_modified

Transformation			Scale			Translation			File Tag
1.000	0.000	0.000							
0.000	1.000	0.000	1.000;	1.000;	1.000	0.000;	0.000;	124.500	magnet_modified
0.000	0.000	1.000							

Figure 8. Position of the setup module `magnet_modified`: identity rotation, shift of 124.5 cm along Z

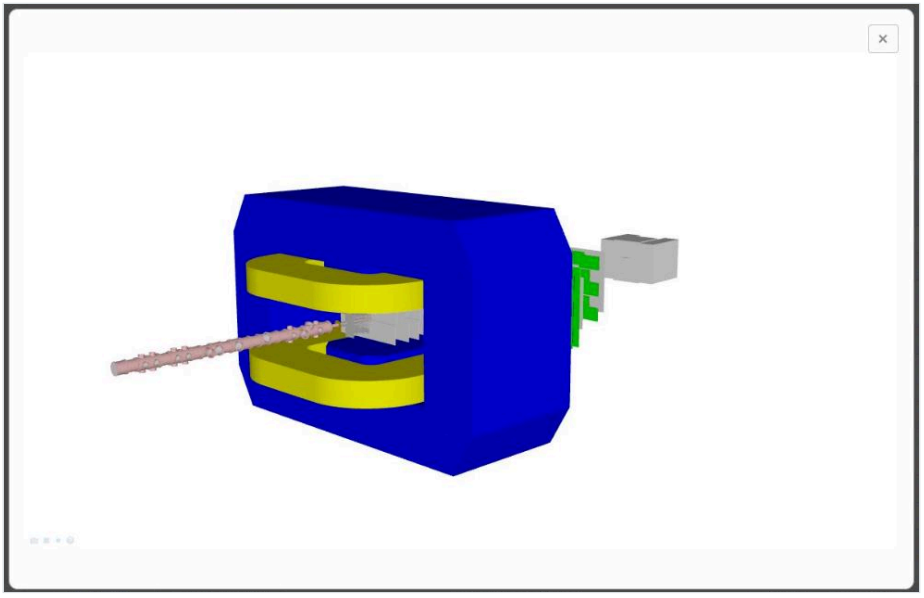


Figure 9. The 3D view opened by Visualize Geometry

4.2 View setup modules

1. In the menu, click **VIEW GEOMETRY › VIEW SETUP MODULES**.
2. The **Setup Modules** table lists every placement of every geometry file, sorted by module.
3. Download a detector's parameter file with the button in the **ParFile** column (3 in Figure 10). Use the **Actions** buttons (4) to download the setup module or see it in 3D.

Column	Contents
Module	Detector or passive element
Setup Module	Tag of the setup module; BmnRoot prints it as "Loading module with tag=..."
Date, Author	Creation time and author of the setup module
File	Geometry file placed by this setup module
Transform	Hover over the icon (2) to see the coefficients of the transformation matrix
Parent	Setup module it is placed in, usually `Cave`; `none` for the cave itself
ParFile	XML parameter file of the detector, if it has one
Description	Free description of the setup module

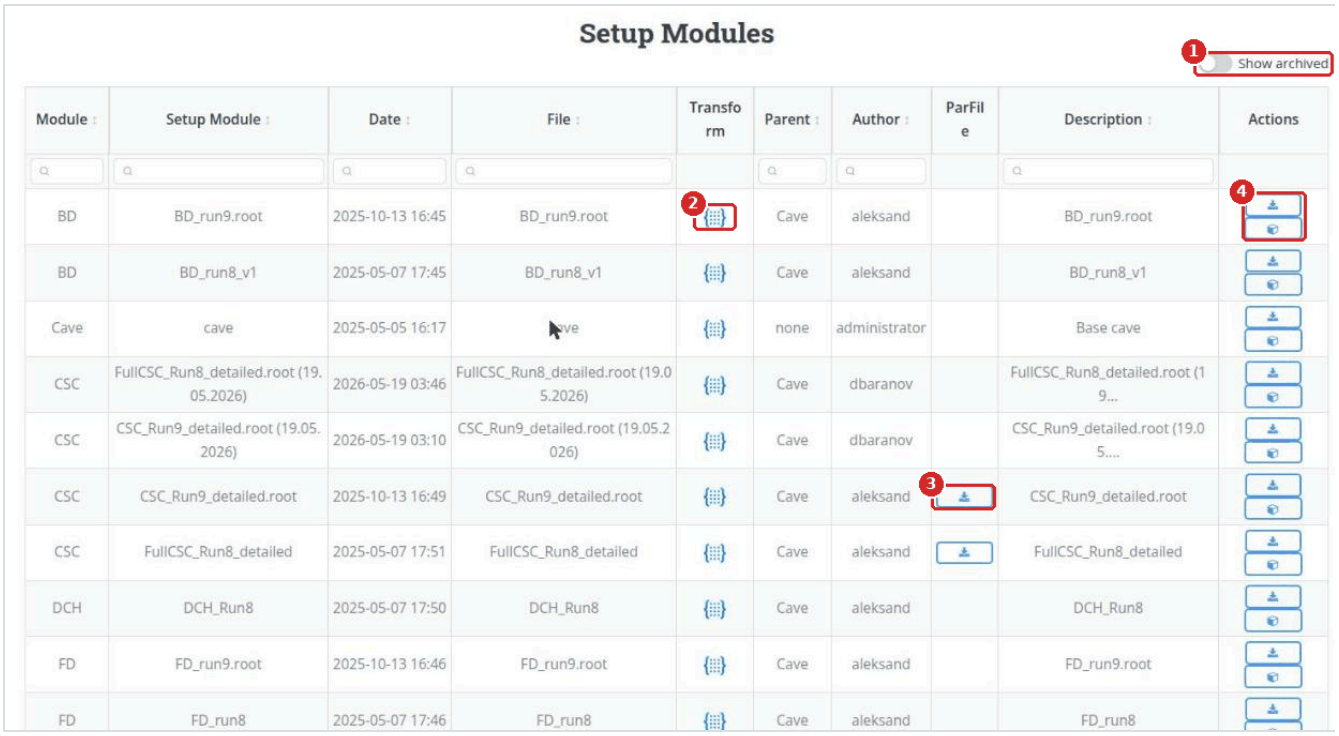


Figure 10. VIEW SETUP MODULES: (1) Show archived, (2) Transform, (3) parameter file, (4) download and 3D view

4.3 View geometry files

1. In the menu, click **VIEW GEOMETRY › VIEW GEOMETRY FILES**.
2. Find the file in the **Geometry Files** table. Columns: **Module**, **Revision** and **Class Name** of the module class, **File Tag**, **Transform**, **Date**, **Author**, **Description**.
3. Click **Download File** (2 in Figure 11) in its row.

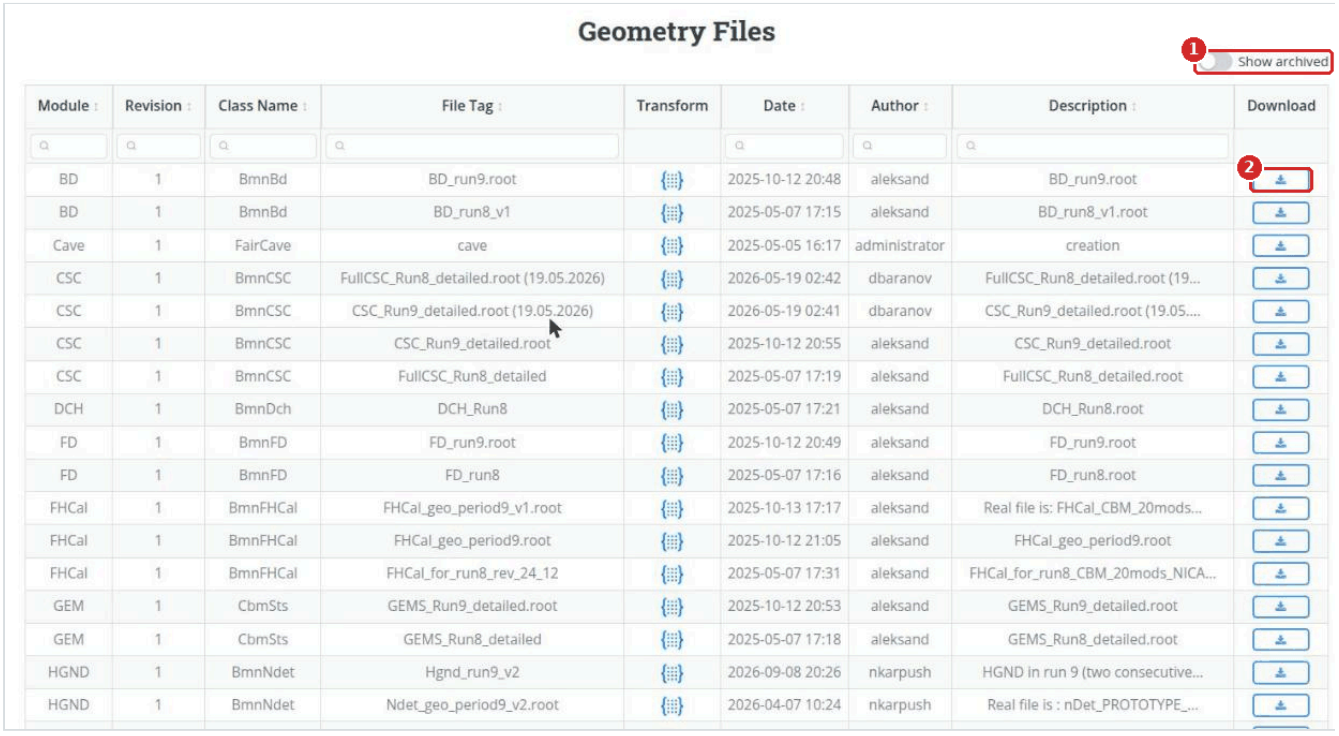


Figure 11. VIEW GEOMETRY FILES: (1) Show archived, (2) Download File

4.4 View materials files

1. In the menu, click **VIEW GEOMETRY › VIEW MATERIALS**.
2. The **Material Files** table lists the media files with **Tag**, **Date**, **Author** and **Description**, e.g. `media_24.12`.
3. Click **Download Material** (2 in Figure 12) in a row to get the file. Switch on **Show archived** (1) to see old versions as well.



Figure 12. VIEW MATERIALS: (1) Show archived, (2) Download Material

4.5 View magnetic fields

1. In the menu, click **VIEW GEOMETRY › VIEW MAGNETIC FIELDS**.
2. The **Magnetic Field Maps** table lists the magnetic fields defined by a field map, with **Magnetic Field Tag**, **Date**, **Author**, **Ref Voltage** and **Description**. **Ref Voltage** is the voltage at which the map was measured (`112` for the current maps).
3. Click the download button in a row to get the magnetic field map file.
4. If the database has constant magnetic fields, a second table, **Magnetic Const Fields**, is shown below **Magnetic Field Maps**. Its columns are **Magnetic Field Tag**, **Date**, **Author**, the field components **bx**, **by**, **bz**, the region bounds **xmin**, **xmax**, **ymin**, **ymax**, **zmin**, **zmax** and **Description**. In the example shown there are no constant magnetic fields, so Figure 13 shows only the field maps table.

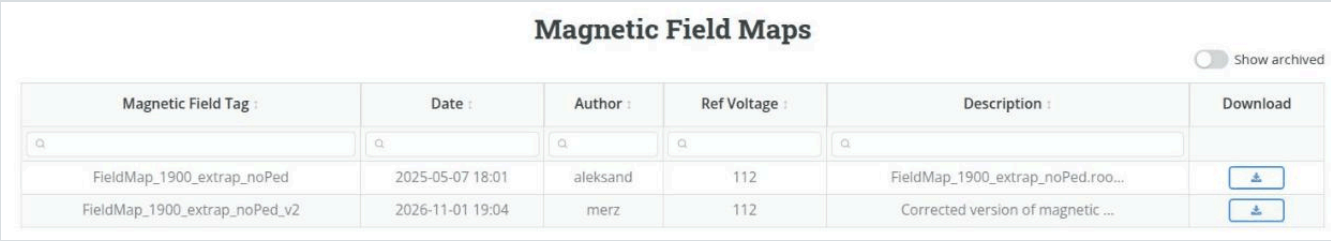


Figure 13. VIEW MAGNETIC FIELDS

5. Editing geometry

The EDIT GEOMETRY pages appear in the menu after you sign in (3.4). Each page is a table of the existing entries with a **CREATE NEW ...** button above it; the button replaces the table with a form. Add objects in the order below, because each form lets you pick only from what is already in the database.

Step	What you add	Page and button	Needs first
1	Materials file	EDIT MATERIALS › **CREATE NEW MATERIAL** (5.1)	—
2	Magnetic field	EDIT MAGNETIC FIELDS › **CREATE NEW FIELD MAP** or **CREATE NEW CONST FIELD** (5.2)	—
3	Module, or a new revision of it	EDIT MODULES › **CREATE NEW MODULE** or **+** (5.3)	The class in BmnRoot
4	Geometry file	EDIT GEOMETRY FILES › **CREATE NEW FILE** (5.4)	Module
5	Setup module	EDIT SETUP MODULES › **CREATE NEW SETUP MODULE** (5.5)	Geometry file
6	Setup, then its approval	EDIT SETUP › **CREATE NEW SETUP** or **Make a copy** (5.6)	Setup modules, field, materials

Rules for every page:

- **Required fields** are marked with a red `*`. Every form ends with an **ADD ...** (or **SAVE ...**) button that saves and a **CANCEL** button that leaves without saving.
- **Tags.** Use only Latin letters, digits, `.`, `_` and `-`, as the hint in the Setup Tag field says. BmnRoot refuses to download a setup whose tag has other characters.
- **Descriptions can be edited in the table.** Each page says: "You can edit the Description field. A new value is saved when the focus is lost." Click a description, type, then click elsewhere: the text is saved at once. Do not click into descriptions you do not mean to change.
- **Check before upload.** Open the geometry in ROOT and look for overlaps, e.g. `gGeoManager->CheckOverlaps(0.001); gGeoManager->PrintOverlaps();`.

Deleting and archiving

The red **×** at the end of a row opens a dialog that first shows where the entry is used:

- **Archive** hides a module, file, setup module, material or field from the lists for new setups. The setups that already use it keep working. Switch on **Show archived** to see it again, and use **Restore** in the same dialog to bring it back.
- **Delete** removes the entry and its file permanently. It is greyed out while the entry is used by any setup.
- The base cave is a service record: it cannot be deleted or archived.
- **Cancel** closes the dialog without changes.

Prefer **Archive** to **Delete**: old setups and the data processed with them stay reproducible.

5.1 Edit materials

1. In the menu, click **EDIT GEOMETRY › EDIT MATERIALS**. The **Material Files** table opens (Figure 14).
2. Click **CREATE NEW MATERIAL** (3 in Figure 14).
3. Fill in the form (Figure 15):
   - **Material Tag** (1): name of this version of the media file, e.g. `media_26.11`.

- **Description** (2): what was added or changed.
- **Choose file** (3): the media file from your computer.

4. Click **ADD MATERIAL** (4), then check the entry in **VIEW MATERIALS**.

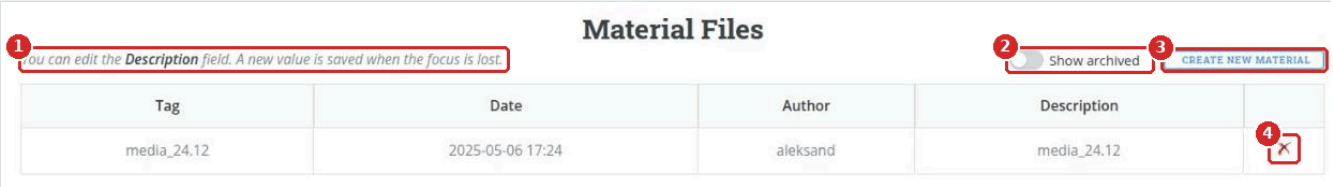


Figure 14. EDIT MATERIALS: (1) editable descriptions, (2) Show archived, (3) CREATE NEW MATERIAL, (4) delete or archive

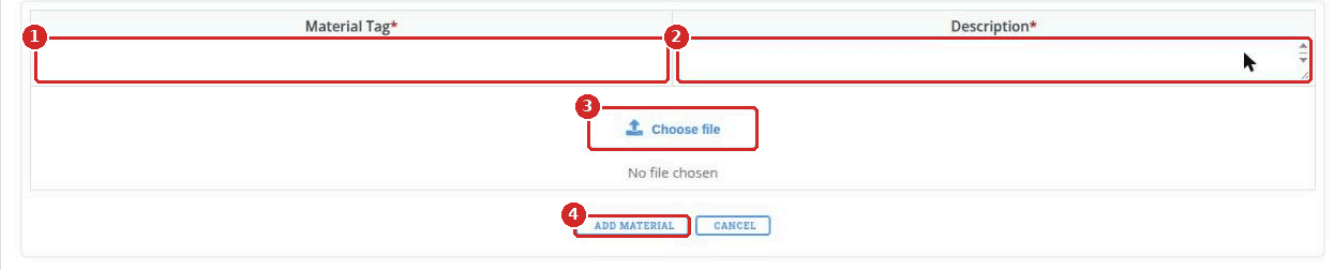


Figure 15. The CREATE NEW MATERIAL form

5.2 Edit magnetic fields

Only lead developers have this page: magnetic fields are added by them only. The page has two tables: **Magnetic Field Maps** (fields read from a map file) and **Magnetic Const Fields** (a uniform, constant field in a box).

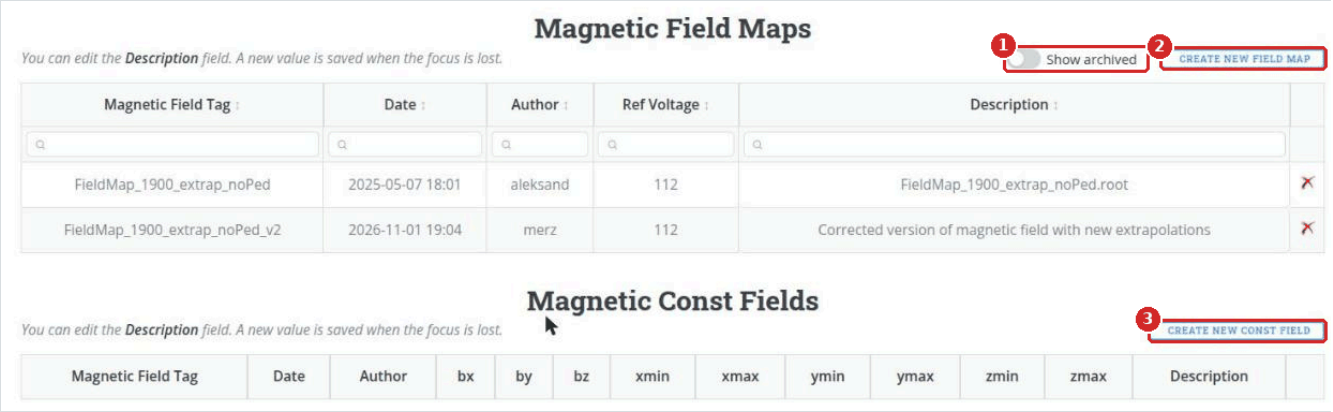


Figure 16. EDIT MAGNETIC FIELDS: (1) Show archived, (2) CREATE NEW FIELD MAP, (3) CREATE NEW CONST FIELD

To add a field map:

1. In the menu, click **EDIT GEOMETRY › EDIT MAGNETIC FIELDS**, then **CREATE NEW FIELD MAP**.
2. Fill in the form (Figure 17):
   - **Magnetic Field Tag** (1), e.g. `FieldMap_1900_extrap_noPed_v2`.
   - **Description** (2): the magnet, the measurement or the extrapolation used.
   - **Choose file** (3): the ROOT file with the map.
   - **Reference Voltage** (4): the voltage at which the map was measured, e.g. `112`. BmnRoot scales the map by the run's field voltage divided by this value, so a wrong value gives a wrong field in every

run.

3. Click **ADD FIELD MAP** (5).

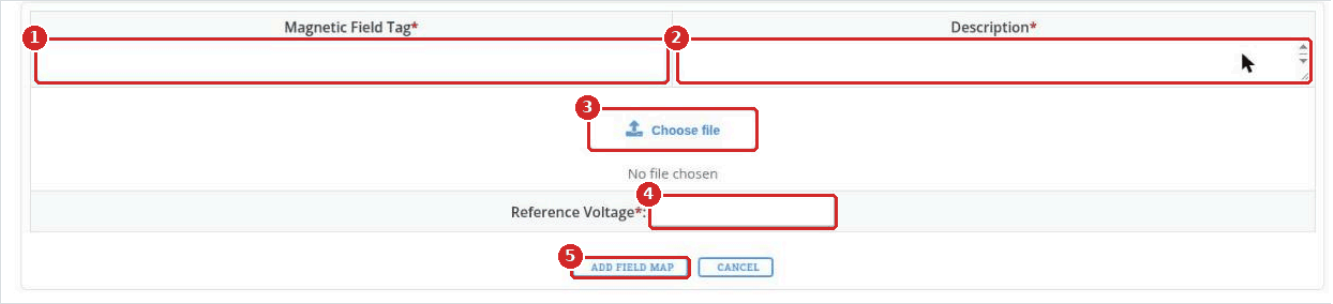


Figure 17. The CREATE NEW FIELD MAP form

To add a constant field, click **CREATE NEW CONST FIELD** and fill in the tag, the description, the **Region of Field (Global Coordinates)** — **Xmin**, **Xmax**, **Ymin**, **Ymax**, **Zmin**, **Zmax** (1 in Figure 18) — and the **Field Values [kG]** — **Bx**, **By**, **Bz** (2). Then click **ADD CONST FIELD** (3).

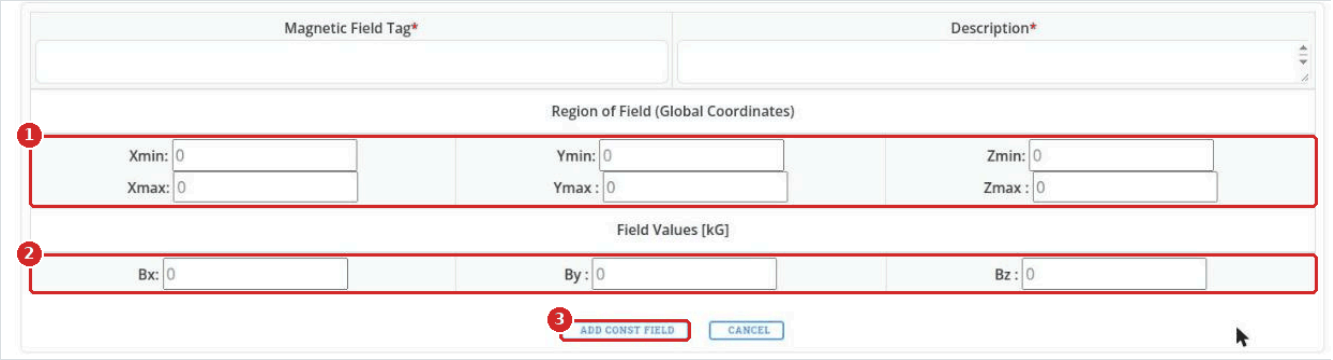


Figure 18. The CREATE NEW CONST FIELD form

5.3 Edit modules

The **Geometry Modules** page lists every module with its revisions: **Module Name**, **Revision**, **Object Name**, **Class Name**, **Sensitivity**, **Author**, **Date**, a **+** button (**Add Revision**) and **×**.

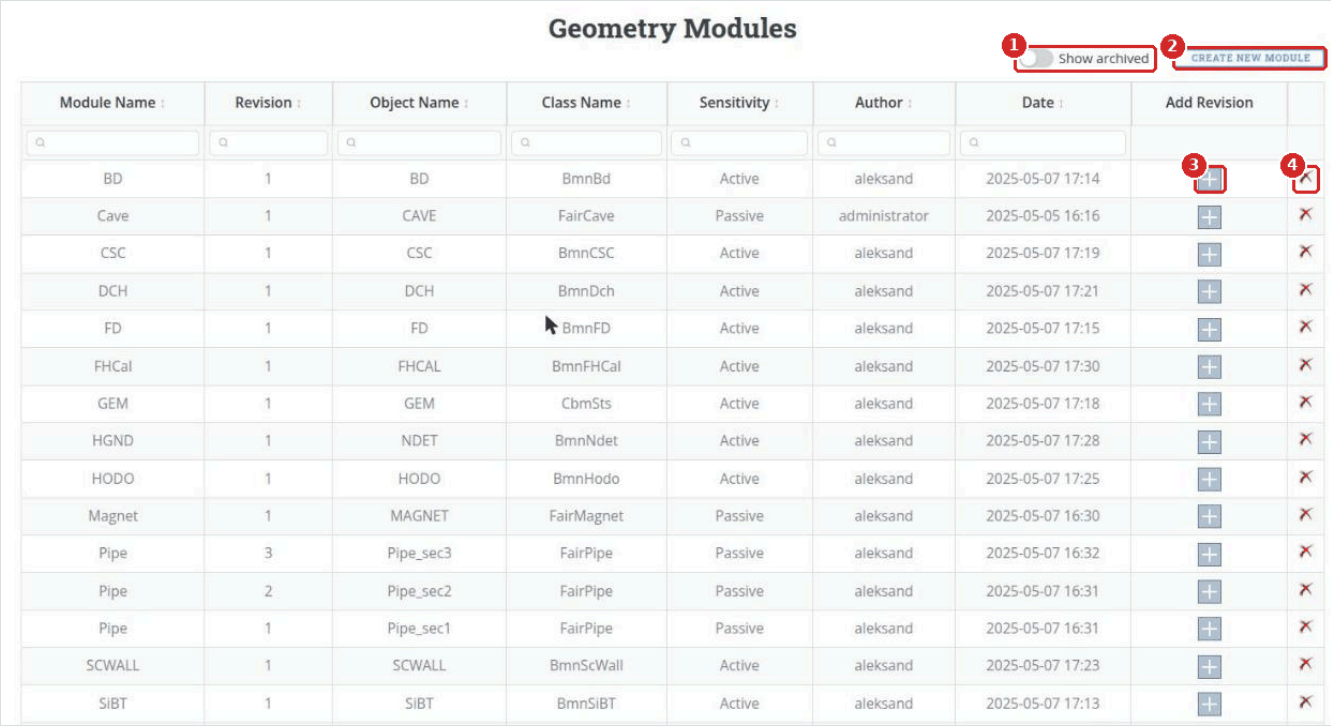


Figure 19. EDIT MODULES: (1) Show archived, (2) CREATE NEW MODULE, (3) Add Revision, (4) delete or archive

Only lead developers see the **CREATE NEW MODULE** button. Add a **new module** only for a detector that is not in the database yet:

1. In the menu, click **EDIT GEOMETRY › EDIT MODULES**, then **CREATE NEW MODULE**.
2. Fill in the form (Figure 20):
   - **Module Name** (1): name of the detector or passive element, e.g. `GEM`.
   - **Object Name** (2): name passed to the class constructor, e.g. `GEM`, `NDET`, `MAGNET`. FairRoot uses it for branches and parameter containers. By convention it is in upper case; use letters, digits, `_`, `.` and `-` only.
   - **Sensitivity** (3): `Active` for a detector whose sensitive volumes record MC points, `Passive` for the cave, magnet, target and beam pipe.
   - **Revision Number** (4): `1` for a new module.
   - **Class Name** (5): the BmnRoot class derived from `FairModule`, e.g. `BmnCSC`, `CbmSts` (GEM), `FairMagnet`.
3. Click **ADD MODULE** (6).

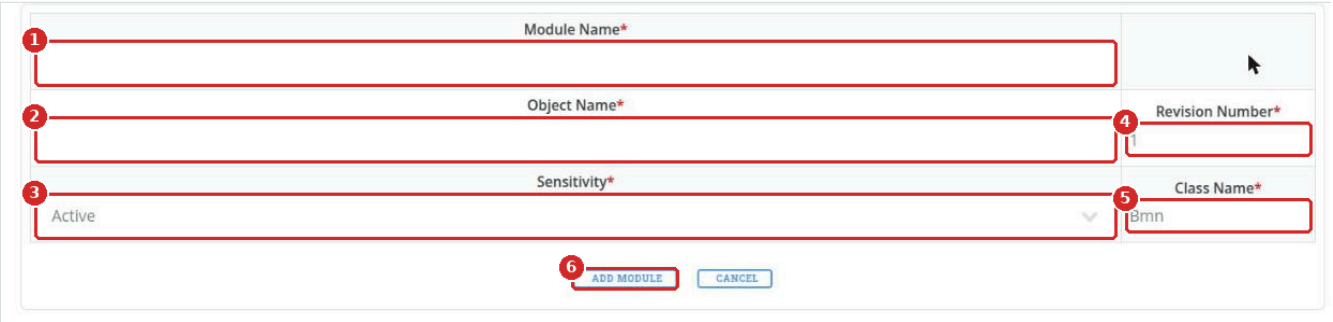


Figure 20. The CREATE NEW MODULE form

Add a **new revision** of an existing module, with **+** in its row (this needs the rights for that module), when its class, object name or sensitivity changes, or when the setup needs another instance of the module. Example: `Pipe` has revisions 1, 2 and 3 with the object names `Pipe_sec1`, `Pipe_sec2` and `Pipe_sec3`, one per section of the beam pipe. A new geometry file of the same detector does not need a new revision.

To add a revision:

1. On **EDIT MODULES**, click **+** in the **Add Revision** column of the module's row (3 in Figure 19). The form opens in place of the table (Figure 21).
2. **Module Type** (1) shows the module and cannot be changed.
3. Check **Object Name** (2), **Revision Number** (3) and **Class Name** (4). The form shows the current object name and class name and the next free revision number; change what differs in the new revision.
4. Click **ADD REVISION** (5), or **CANCEL** (6) to leave without saving.

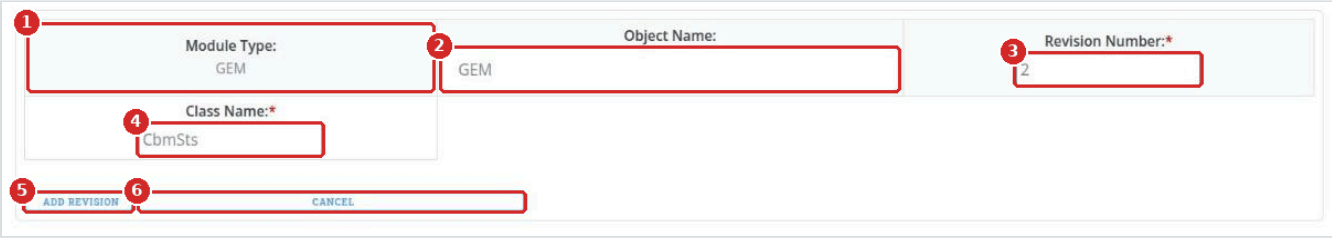


Figure 21. The Add Revision form for the module `GEM`: (1) Module Type, (2) Object Name, (3) Revision Number, (4) Class Name, (5) ADD REVISION, (6) CANCEL

The class must exist in the BmnRoot version that loads the geometry; otherwise the setup fails to load with "no ... class inherited from FairModule is found".

5.4 Edit geometry files

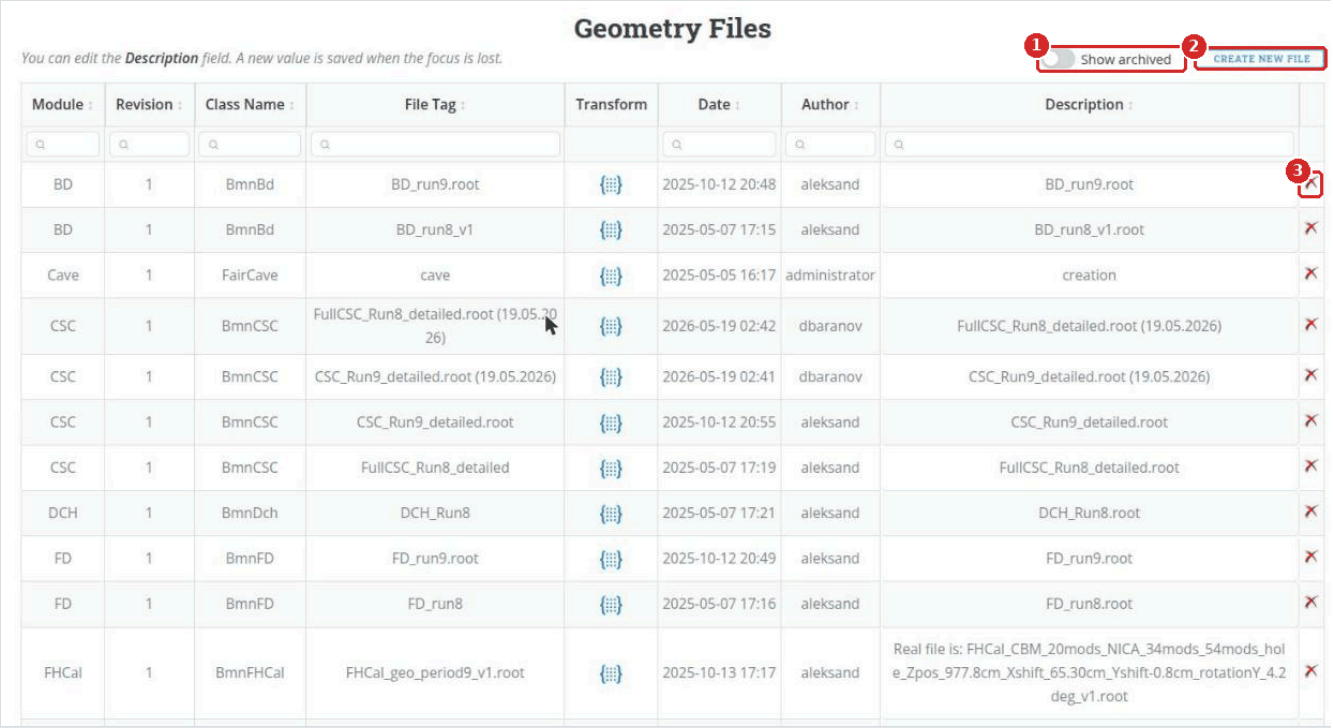
A geometry file is one version of one module's geometry, in ROOT (`.root`), ASCII (`.geo`) or GDML format. Before you upload it:

- Prepare the file, e.g. with the module's macro in `macro/geometry` of BmnRoot. A ROOT file must hold the module as the first node inside the top volume, with its position matrix.
- Keep the names of the sensitive volumes that the detector classes and digitisers rely on.
- ROOT files are strongly preferred: an ASCII (`.geo`) geometry has no position matrix and cannot be shifted.

Then:

1. In the menu, click **EDIT GEOMETRY › EDIT GEOMETRY FILES**. The **Geometry Files** table opens (Figure 22).
2. Click **CREATE NEW FILE**.
3. Fill in the form (Figure 23):
   - **File Tag** (1), e.g. `CSC_Run9_detailed_26.11.26.root`.
   - **Description** (2): what differs from the previous version.
   - **Module** (3): choose the detector in the list.
   - **Class Name / Revision / Object Name** (4): appears after you choose the module, e.g. `BmnCSC / 1 / CSC`. Choose the revision the file belongs to.
   - **Choose file** (5): the geometry file from your computer.

4. Click **ADD FILE** (6), then check the file in **VIEW GEOMETRY FILES**.



Module	Revision	Class Name	File Tag	Transform	Date	Author	Description
BD	1	BmnBd	BD_run9.root		2025-10-12 20:48	aleksand	BD_run9.root
BD	1	BmnBd	BD_run8_v1		2025-05-07 17:15	aleksand	BD_run8_v1.root
Cave	1	FairCave	cave		2025-05-05 16:17	administrator	creation
CSC	1	BmnCSC	FullCSC_Run8_detailed.root (19.05.2026)		2026-05-19 02:42	dbaranov	FullCSC_Run8_detailed.root (19.05.2026)
CSC	1	BmnCSC	CSC_Run9_detailed.root (19.05.2026)		2026-05-19 02:41	dbaranov	CSC_Run9_detailed.root (19.05.2026)
CSC	1	BmnCSC	CSC_Run9_detailed.root		2025-10-12 20:55	aleksand	CSC_Run9_detailed.root
CSC	1	BmnCSC	FullCSC_Run8_detailed		2025-05-07 17:19	aleksand	FullCSC_Run8_detailed.root
DCH	1	BmnDch	DCH_Run8		2025-05-07 17:21	aleksand	DCH_Run8.root
FD	1	BmnFD	FD_run9.root		2025-10-12 20:49	aleksand	FD_run9.root
FD	1	BmnFD	FD_run8		2025-05-07 17:16	aleksand	FD_run8.root
FHCal	1	BmnFHCal	FHCal_geo_period9_v1.root		2025-10-13 17:17	aleksand	Real file is: FHCal_CBM_20mods_NICA_34mods_54mods_hole_Zpos_977.8cm_Xshift_65.30cm_Yshift-0.8cm_rotationY_4.2deg_v1.root

Figure 22. EDIT GEOMETRY FILES: (1) Show archived, (2) CREATE NEW FILE, (3) delete or archive

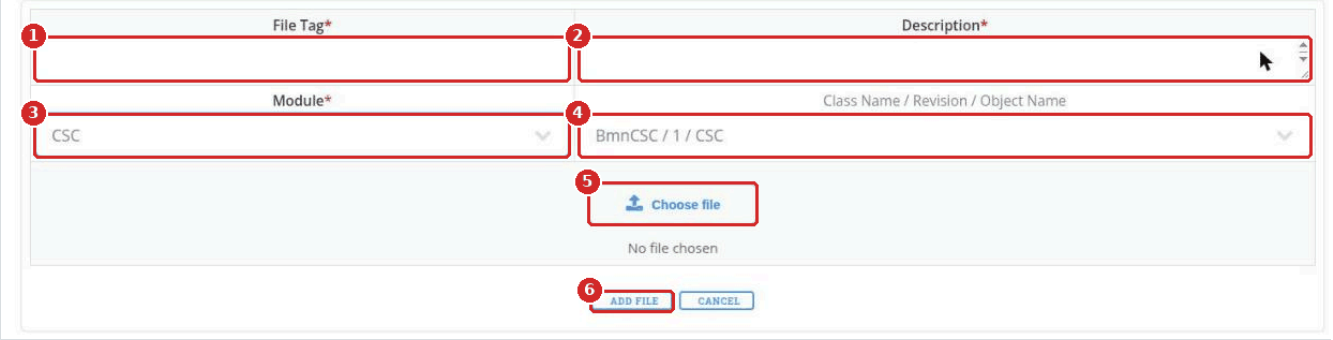


Figure 23. The CREATE NEW FILE form after choosing the module `CSC`

5.5 Edit setup modules

A setup module places one geometry file in the setup. Several setups can share one setup module.

1. In the menu, click **EDIT GEOMETRY › EDIT SETUP MODULES**. The **Setup Modules** table opens (Figure 24).
2. Click **CREATE NEW SETUP MODULE**.
3. Fill in the form (Figure 25):
   - **Setup Module Tag** (1): name of this placement. Users refer to it in local customisation files (8.3).
   - **Description** (2): what this placement is for and how it differs from the previous one, e.g. "FD for Run 9" or "TOF-400 position after XY alignment".
   - **Module** (3): choose the detector. The next two fields appear only after this.
   - **Parent Module** (4): the module this one sits in, `Cave` by default.
   - **File with the Module** (5): tick the geometry file to place.
   - **Transformation** (6): the rotation matrix, **r11** to **r33**. Leave the unit matrix for no rotation.

- **Translation** (7): the shift **X**, **Y**, **Z** in cm, in the parent's coordinate system. Leave zeros to keep the position from the file.
- **Parameter File** (8): optional XML parameter file of the detector, e.g. `GemRun9.xml`. BmnRoot reads it through `GetParameterFile()`.

4. Click **ADD NEW SETUP MODULE** (9), then check the entry in **VIEW SETUP MODULES**.

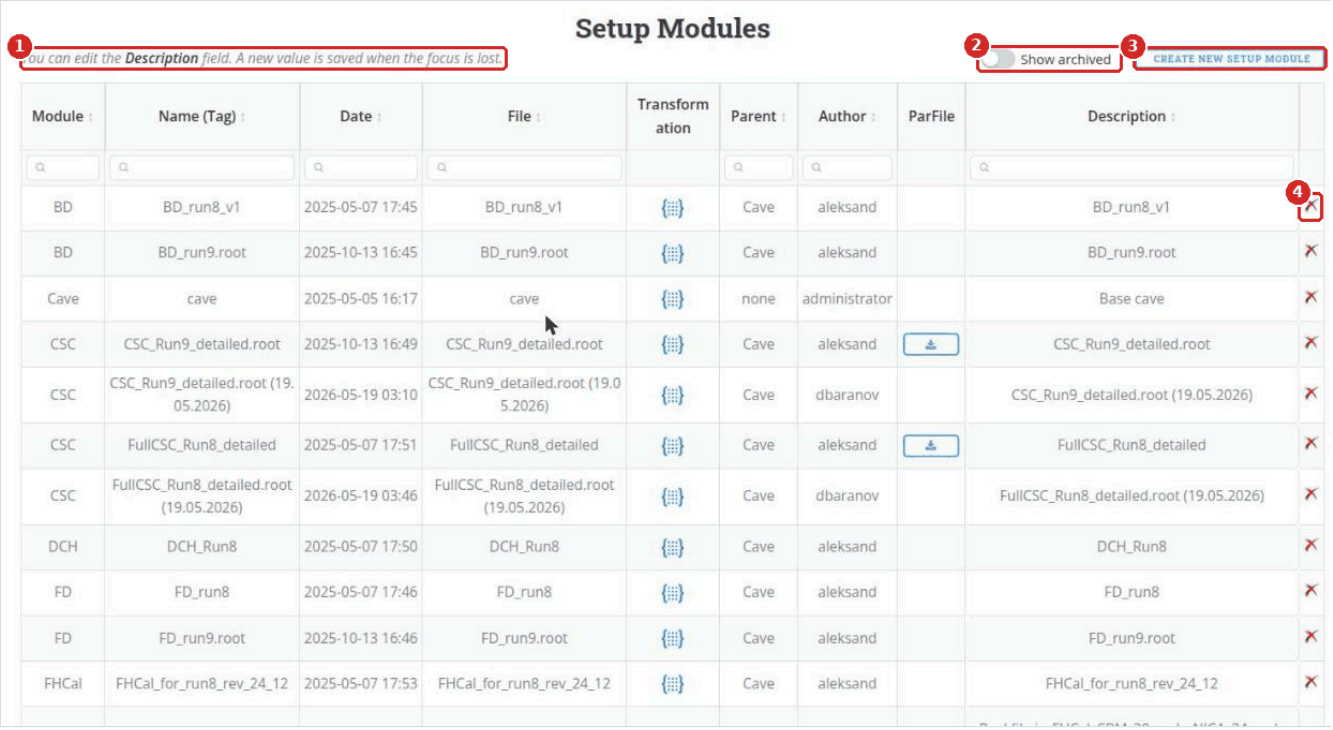


Figure 24. EDIT SETUP MODULES: (1) editable descriptions, (2) Show archived, (3) CREATE NEW SETUP MODULE, (4) delete or archive

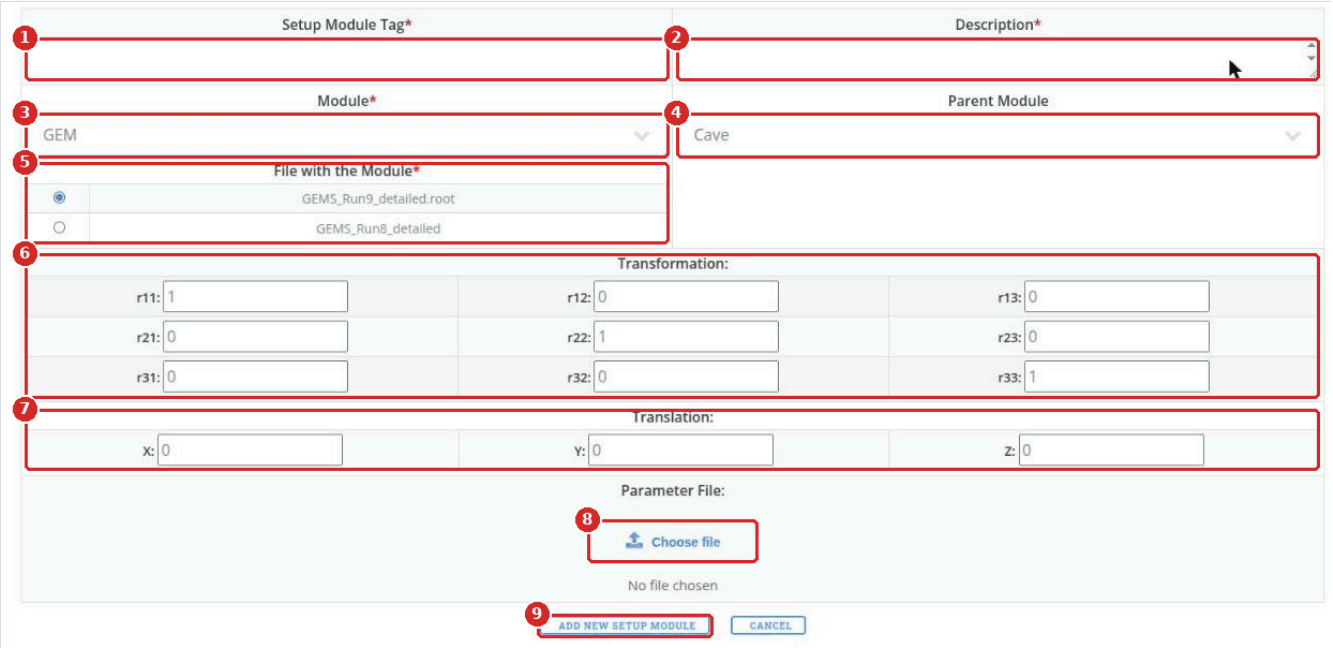


Figure 25. The CREATE NEW SETUP MODULE form after choosing the module `GEM`

To move a detector without changing its geometry, create a new setup module with the same file and a new translation; the original file stays untouched.

5.6 Edit setup

The **Geometry Setups** page lists the complete setups with an icon for each action (Figure 26). **Show approved** (2) adds the approved setups to the list. Every developer can create setups and change them until they are approved; only lead developers approve and delete setups.

Icon	Tooltip	What it does	Shown for
✔ (4)	Approve	Approves the setup after you confirm	`Created` setups; lead developers only
✎ (5)	Modify	Opens the setup form to change it	`Created` setups
× (6)	Delete	Deletes the setup after you confirm	`Created` setups; lead developers only (the icon is shown for approved ones too, but they cannot be deleted)
⧉ (7)	Make a copy	Opens a new setup form filled from this one, after you confirm	All setups

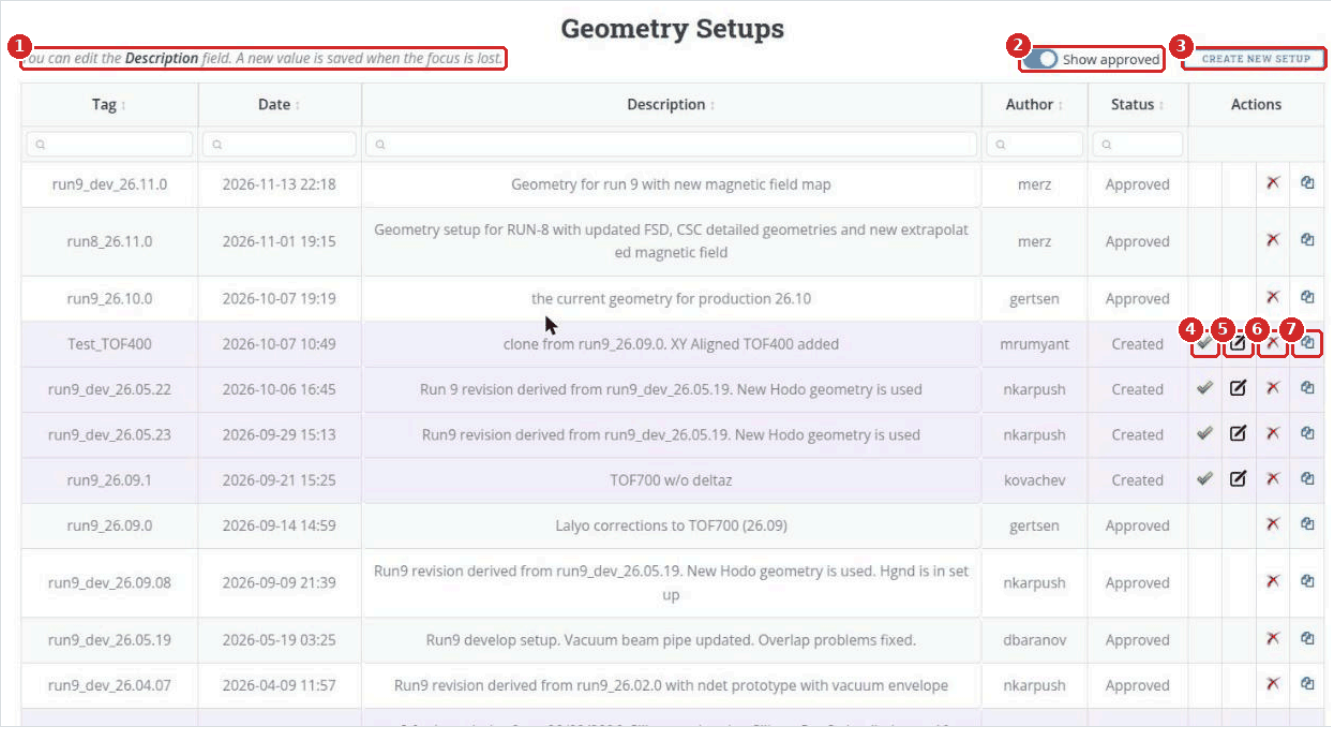


Figure 26. EDIT SETUP: (1) editable descriptions, (2) Show approved, (3) CREATE NEW SETUP, (4) Approve, (5) Modify, (6) Delete, (7) Make a copy

Creating a setup

There are two ways to start: from an empty form, with **CREATE NEW SETUP** (3 in Figure 26), or from a copy of an existing setup, with **Make a copy** (7). Copying is usually quicker if most of the setup stays the same.

From an empty form:

1. Enter the **Setup Tag** (1 in Figure 27): `run<N>_dev_<YY.MM.DD>` for development or `run<N>_<YY.MM.P>` for production, e.g. `run9_dev_26.11.26`.
2. Enter the **Description** (2): what changed compared with the setup it was derived from.

3. Under **Setup Modules**, each module has a green bar. Click a bar (3) to unfold it, then tick the setup module to include (4). Each row shows the tag, file, transformation and parent of the setup module. Tick one setup module per detector, and exactly one cave; tick several only where the setup needs several pieces, e.g. the three pipe sections.
4. Below the modules, choose one entry under **Magnetic Fields** (1 in Figure 28), or under **Magnetic Const Fields**, and one under **Geometry Materials** (2).
5. Click **ADD SETUP** (3). The setup gets the status `Created`. On saving, the system automatically builds the ROOT file with the full geometry of the facility, `full_geometry_<tag>.root`, from the selected setup modules, magnetic field and materials. This takes some time: wait until saving has finished, and do not click the button again or leave the page.
6. Load the setup in BmnRoot and run a short simulation to check it (8.2).

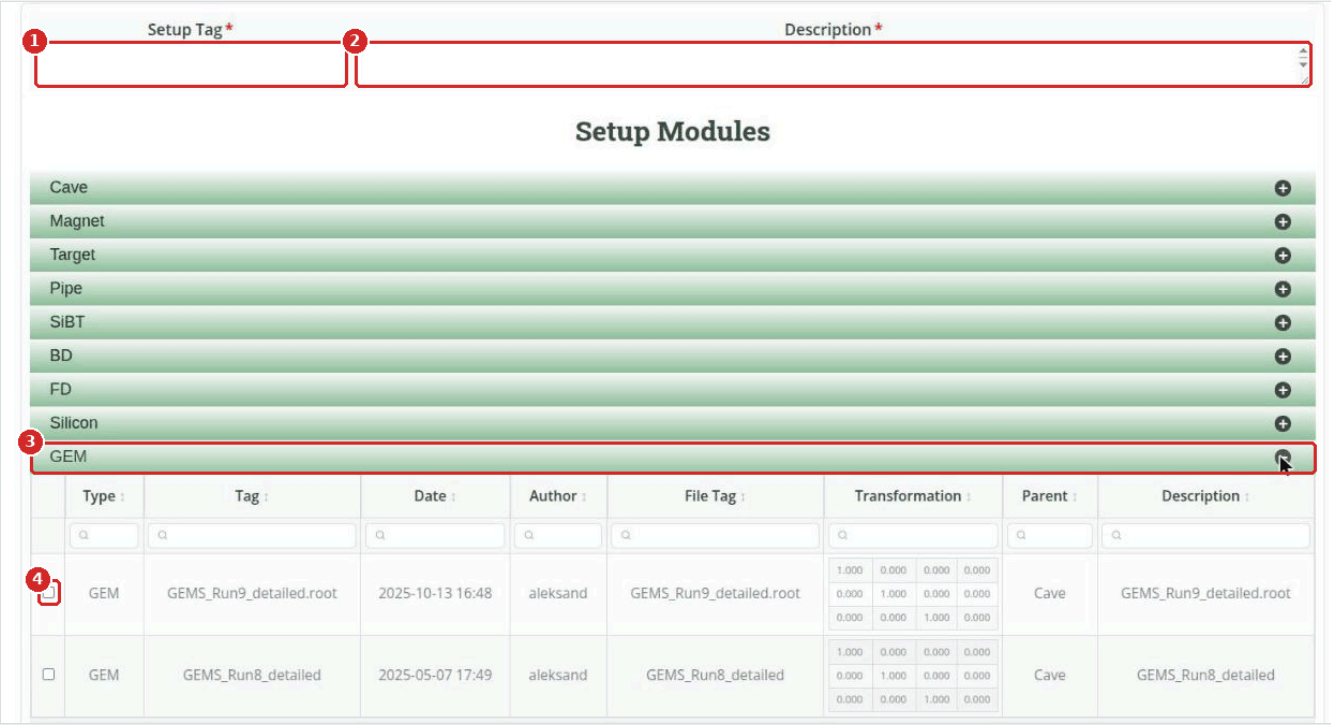


Figure 27. The CREATE NEW SETUP form: (1) Setup Tag, (2) Description, (3) a module bar, (4) the checkbox of a setup module

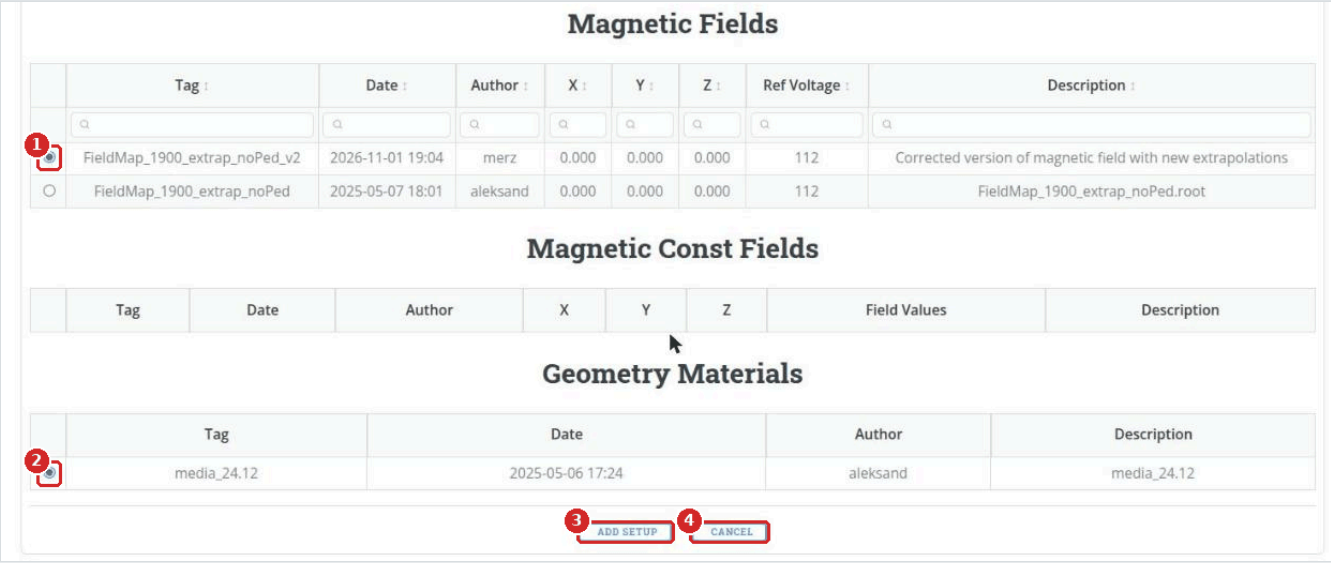


Figure 28. The end of the form: (1) magnetic field, (2) materials file, (3) ADD SETUP, (4) CANCEL

From a copy: click **Make a copy** (7 in Figure 26) in the row of the setup you start from and confirm "Are you sure you want to copy this setup to configure a new one?". The form opens with the mark *!Mode: Create a new setup from existing* (1 in Figure 29), filled in from that setup. Then:

1. Replace the **Setup Tag** (2): it still holds the tag of the original setup, and every setup needs its own tag.
2. Rewrite the **Description** (3), which is copied from the original, to say what changed.
3. Check the setup modules: those of the original are ticked (4), and their bars are unfolded. Untick the ones you replace and tick the new ones.
4. Check the magnetic field (5) under **Available Fields** and the materials file (6) under **Available Materials**: they are chosen as in the original.
5. Click **SAVE SETUP** (7). The new setup gets the status `Created`, and its full geometry file is built as with **ADD SETUP**, so saving takes some time. **CANCEL** (8) leaves without creating anything; the original setup stays as it is.
6. Load the setup in BmnRoot and run a short simulation to check it (8.2).

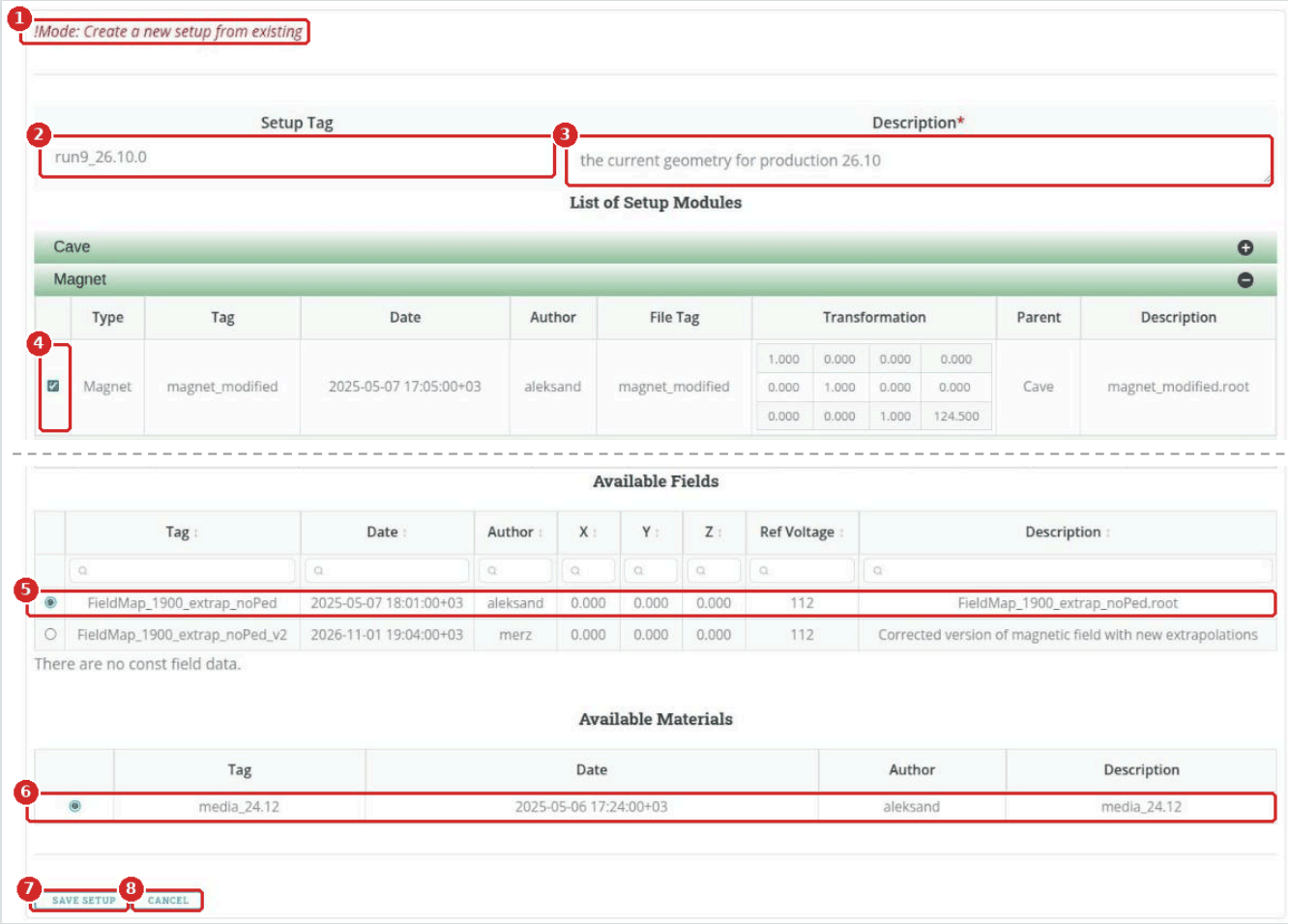


Figure 29. The form opened by Make a copy for `run9_26.10.0`: (1) mode, (2) Setup Tag, (3) Description, (4) a ticked setup module, (5) magnetic field, (6) materials file, (7) SAVE SETUP, (8) CANCEL

Changing a setup that is not approved yet

Click **Modify** (5 in Figure 26). The same form opens with the ticked setup modules (3 in Figure 30), the field and the materials of the setup. It also shows the setup's full geometry file, `full_geometry_<tag>.root`, with a download button (2), and the author. Change what you need and click

SAVE SETUP, or **CANCEL** to leave it as it was. Saving rebuilds the full geometry file from the new set of components automatically, so it also takes some time.

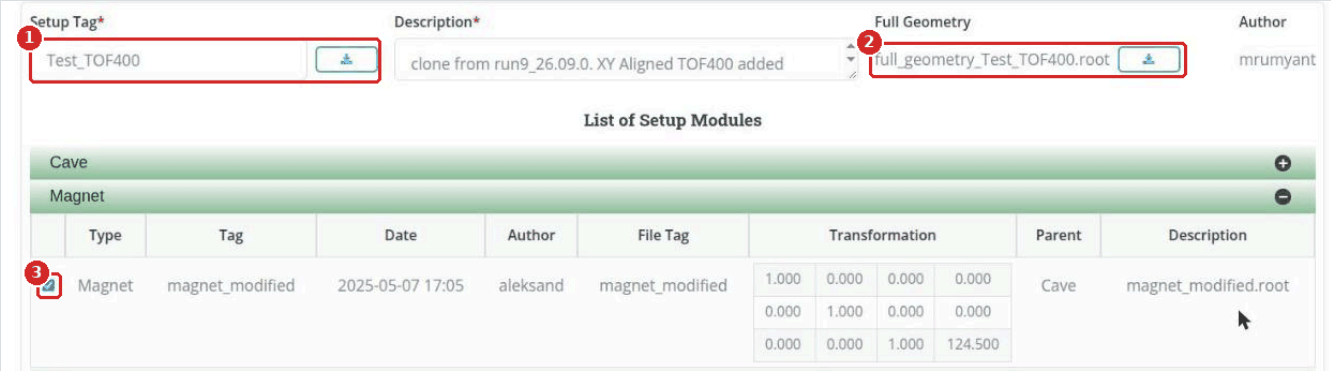


Figure 30. The Modify form: (1) Setup Tag with its download button, (2) full geometry file, (3) a setup module included in the setup

Approving a setup

Only lead developers approve setups. Once approved, the setup becomes the latest one for its run: every macro that asks for `run<N>:` loads it.

1. On **EDIT SETUP**, click **Approve** (4 in Figure 26) in the setup's row.
2. Confirm "Are you sure you want to approve this setup?".
3. Check that the status is now `Approved`. The **Approve** and **Modify** icons disappear from the row.

An approved setup can no longer be modified. This is deliberate, so that results can be reproduced when data are reprocessed. To change it, use **Make a copy** and save the copy under a new tag.

Deleting a setup

Only lead developers delete setups, and only setups that are not approved yet (status `Created`) can be deleted; approved setups cannot be deleted. To delete a `Created` setup, click **Delete** (6 in Figure 26) in its row. The dialog warns that "Delete removes the setup and its geometry file permanently"; there is no archive option for setups.

6. Typical workflows

Most work is one of three tasks: bringing a new detector geometry into a new version of the setup, moving a detector, or creating a new version of an approved setup. Each of these tasks ends with a new setup in the database; existing approved setups are never changed.

6.1 A new version of a detector geometry

Example: the CSC group has a detailed geometry for Run 9.

1. Build the geometry file with the corresponding CSC macro and check it for overlaps between its volumes.
2. Detector expert: in **EDIT GEOMETRY FILES**, upload the file for module `CSC`, with a tag such as `CSC_Run9_detailed_26.05.19.root` and a description of what changed (5.4).
3. Detector expert: in **EDIT SETUP MODULES**, create a setup module for the new file with parent `Cave`, and attach the parameter file if the detector needs one (5.5).
4. Optionally, test it before it enters a new version of the setup: simulate the current setup with a local customisation that swaps in the new file (8.3).
5. Detector expert or lead developer: in **EDIT SETUP**, click Make a copy for the setup in which your detector is to be replaced, untick the old CSC setup module, tick the new one and save the copy with a development tag, e.g. `run9_dev_26.05.19` (5.6).
6. Lead developer: check the new setup in BmnRoot, then approve it.

6.2 Moving a detector, e.g. after alignment

1. In **EDIT SETUP MODULES**, create a new setup module with the same geometry file and the new transformation (5.5). The geometry file is not touched.
2. In **EDIT SETUP**, copy the latest setup with Make a copy and tick the new setup module instead of the old one.
3. Check and approve as in 6.1.

For a quick study of a shift in simulation only, no database change is needed: use `moveX`, `moveY`, `moveZ` in a local customisation file (8.3). Experimental data, however, are always reconstructed with a database setup, so real corrections must go into a new setup.

6.3 A production setup for a BmnRoot release

1. When a BmnRoot release is tagged, e.g. `26.10.0`, take the development setup that was validated for it (or create a new one).
2. In **EDIT SETUP**, copy it with Make a copy and save the copy with the production tag `run9_26.10.0` and a description such as "the current geometry for production 26.10".
3. Approve it. From then on, `run9:` in the macros resolves to this setup until a newer one is approved.

7. Configuring user access

Rights are given through **roles**: one **Lead Developer** role with the full set of rights, and one **<Module> Developer** role per module (BD Developer, CSC Developer, GEM Developer, ..., VSP Developer) that allows editing that module's geometries; any developer can also add materials files and create setups. Only lead developers see the **CONFIGURE USER ACCESS** button (control 4 in Figure 2). A user first needs the group for editing in the Geometry System, requested through the BM@N Software Access form (3.4); the roles below then decide which modules they may edit.

1. Click **CONFIGURE USER ACCESS**. The **User Access Admin** page offers three links (Figure 31):
   - **Role Area** (1): roles and their users.
   - **User Area** (2): the rights of one user.
   - **Manage Accounts** (3): an **Account Overview** with the total number of accounts and the number of accounts with the Lead Developer role (Figure 34).
2. To give a person a role, open **Role Area**. The **Role Administration** table lists each **Role Name** with its **Permissions** (1 in Figure 32).
3. Click **Grant** (2) in the row of the role. The page **Connect user to <role> role** opens: choose the person under **Select user** and click **CONNECT**. The list **Connected users to <role> role** below shows who already has the role.
4. To take a role away, click **Revoke** in the same row and remove the user from the role.
5. To check one person's access rights, open **User Area**, type any part of their login or e-mail under "Enter any part of the user Login or Email" and click **SEARCH** (Figure 33).

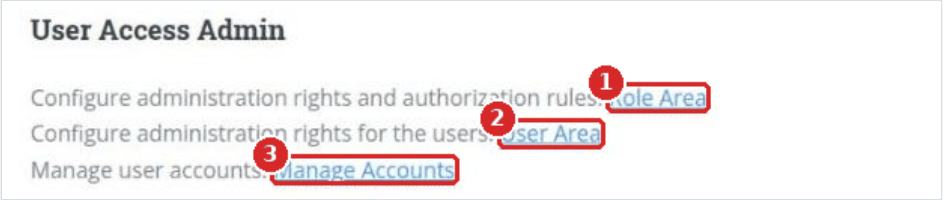


Figure 31. CONFIGURE USER ACCESS: (1) Role Area, (2) User Area, (3) Manage Accounts



Figure 32. Role Area: (1) roles and their permissions, (2) Grant / Revoke

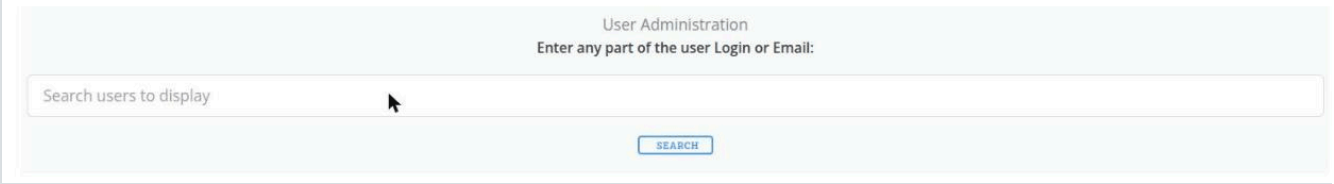


Figure 33. User Area

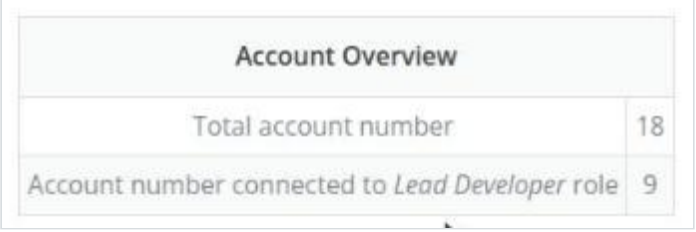


Figure 34. Manage Accounts: the Account Overview

Give editing rights only for the detectors a user is responsible for. Keep the Lead Developer role, which allows approving and deleting setups, registering new modules and adding magnetic fields, for the few people responsible for the geometry as a whole.

8. Using database geometries in BmnRoot

BmnRoot loads every setup by its tag through the `GeoSetup` class of the C++ interface in `database/geo_db`. You never need to copy files from the web interface by hand.

8.1 Local copy of the database

BmnRoot works with a local replica: `local.db` plus the `storage` folder. The `GEOMPATH` variable points to `storage`, and `config.sh` of the BmnRoot build sets it to `database/geo_db/storage`.

- The replica is downloaded when BmnRoot is built (on the first run of cmake), by the service macro `macros/installLocalDB.C`.
- A setup missing from the replica is downloaded from the central database when it is requested. So is a newer version of a setup that is not approved.
- If the replica's directory is read-only, e.g. on the specialised CVMFS file system, the download goes to a fallback writable directory instead: `$TMPDIR` or `/tmp/<user>`. That directory is removed when the job ends.

To list the setups in your replica:

```
root -b -q $VMCWORKDIR/database/geo_db/macros/getSetupList.C
```

8.2 Choosing a setup by tag

The simulation macro takes a geometry tag. A tag that ends with `:` means "the latest approved setup whose tag starts with this prefix":

Geometry tag	Loads
`run9:`	The latest approved Run 9 setup
`run9_26.10.0`	Exactly this setup, approved or not
`run9:;my_setup.xml`	The latest approved Run 9 setup with a local customisation (8.3)

For experimental data, `run_reco_bmn.C` loads the latest approved setup of the run period by default. The tag used is written into the `FairGeoParSet` container of the output file, so the analysis and event display use the same geometry.

In your own macro:

```
GeoSetup gSetup;
string tag = gSetup.GetLastApprovedSetupTag("run9");   // e.g. run9_26.10.0
if (gSetup.LoadSetupToGeoManager(tag) != 0)
    cout << "ERROR: the geometry was not loaded" << endl;
gGeoManager->GetTopVolume()->Draw("ogl");
```

Other methods: `LoadSetupToFairRunSim()` for simulation, `GetMagneticField()` and `GetRefVoltage()` for the field, `GetParameterFile(detector)` and `GetMaterialFile()` for the files of the setup.

8.3 Local customisation without changing the database

To test a change in simulation before it goes into the database, describe it in an XML file and append its path to the tag after `;`. The file can disable a module, replace its geometry file, shift it, add a new module, or replace the field map:

```
<setup>
  <editSetupModule tag="FHCal_geo_period9_v2.root" enable="false"/>
  <editSetupModule tag="Ndet_geo_period9_v2"
file_path="$VMCWORKDIR/my_geometry/ND_new_run9.root"/>
  <editSetupModule tag="CSC_Run9_detailed.root" moveX="0.5" moveZ="1.0"/>
  <addSetupModule class_name="BmnDch" active="true" object_name="DCH"
file_path="DCH_Run8.root"/>
  <editFieldMap file_path="$VMCWORKDIR/my_field/FieldMap_test.root"/>
</setup>
```

```
root -b -q '$VMCWORKDIR/macro/run/run_sim_bmn.C("", "bmnsim.root", 0, 100, BOX,
"run9:;$VMCWORKDIR/my_setup.xml")'
```

The `tag` attribute is the setup module tag shown in **VIEW SETUP MODULES** (4.2). Ready-made examples are in `database/geo_db/examples`: `setup_without_detectors.xml` and `setup_without_calorimetry.xml`. Shifts are in cm and apply only to ROOT-format modules; rotations cannot be changed this way.

9. Getting help

To get access to the Geometry System or a new group, send the BM@N Software Access form (3.4).

For editing rights or problems with the web interface, write to Konstantin Gertsenberger, gertsen@jinr.ru ("Get in touch" at the bottom of every page). Include the page address, the tag of the object and what you expected to happen.

If BmnRoot cannot load a setup, run the macro again with the log level `debug1`. The log names the setup module that failed to load (`setup_module_id=…`).

Sources

- Geometry Web Service: home page
- Geometry C++ API repository (BmnRoot sub-module `database/geo_db`)
- BmnRoot Start Guide, Section 6.2 "Geometry Database"
- Development of the Geometry Database for the BM@N Experiment of the NICA Project, EPJ Web of Conferences 226, 03001 (2020)
- BM@N Software Access: the form for requesting access groups