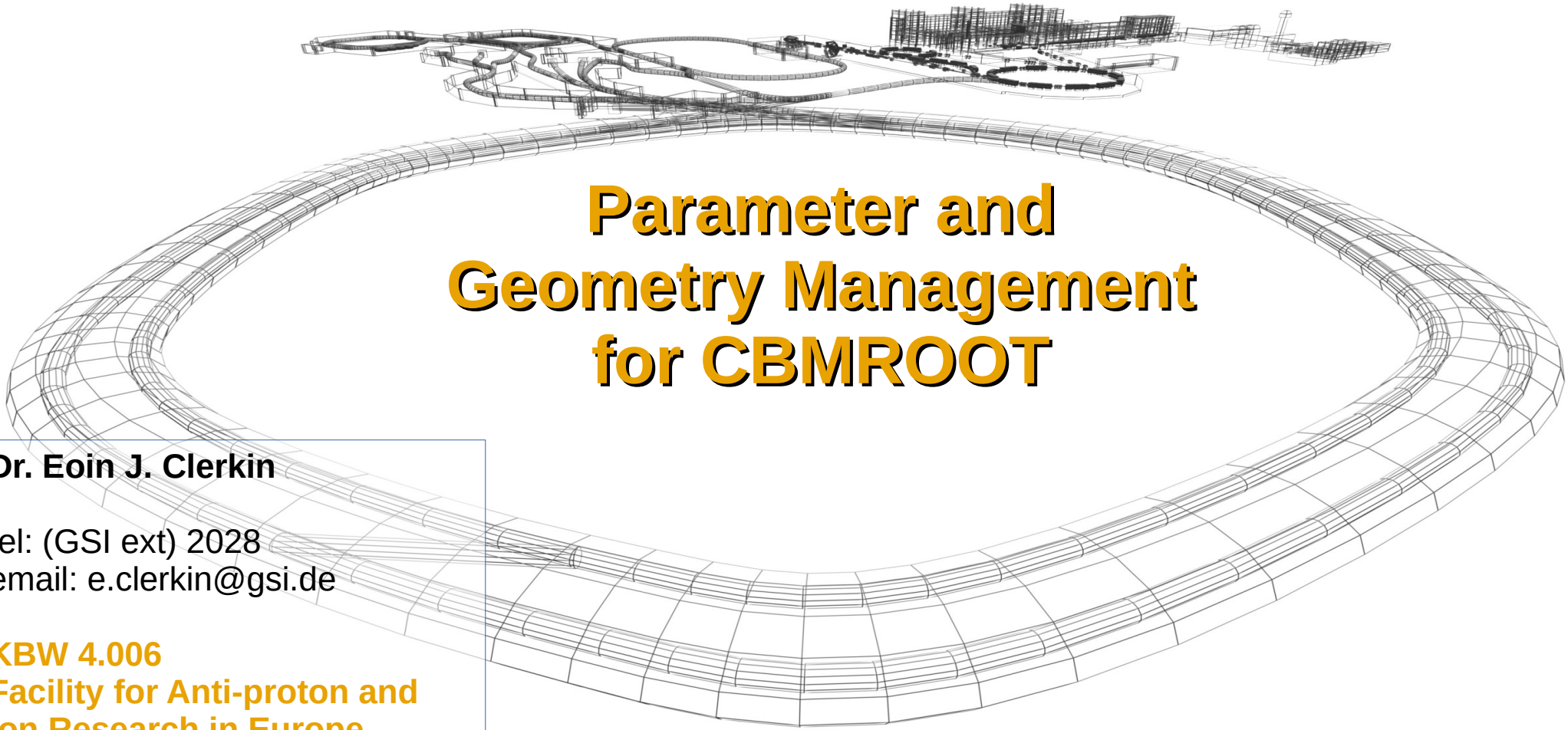
46th CBM
Collaboration Meeting

Institute of Physics, Lanzhou, Gansu, China 2025-10-22 12:15 - 12:35

FAIR — Facility for Antiproton and Ion Research in Europe



Parameter and Geometry Management for CBMROOT

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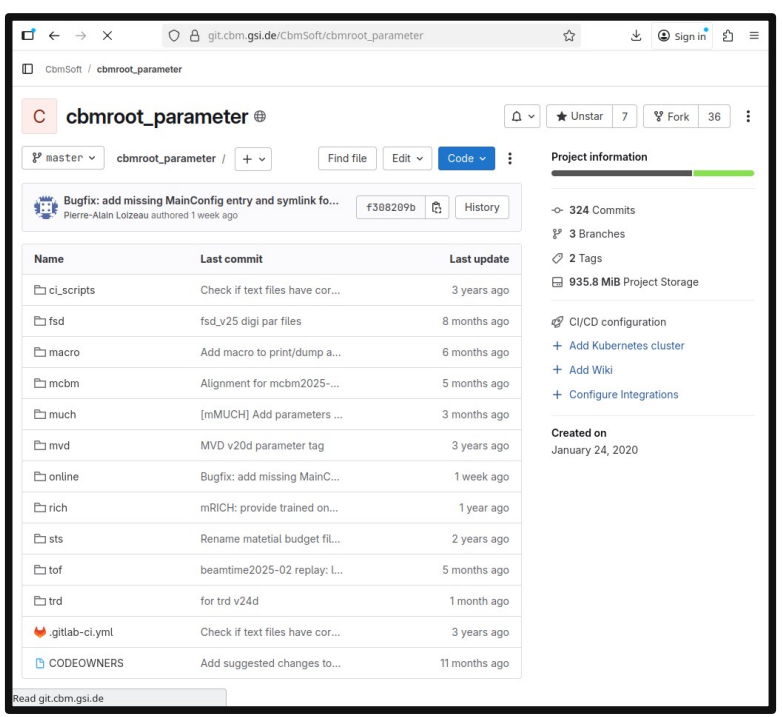
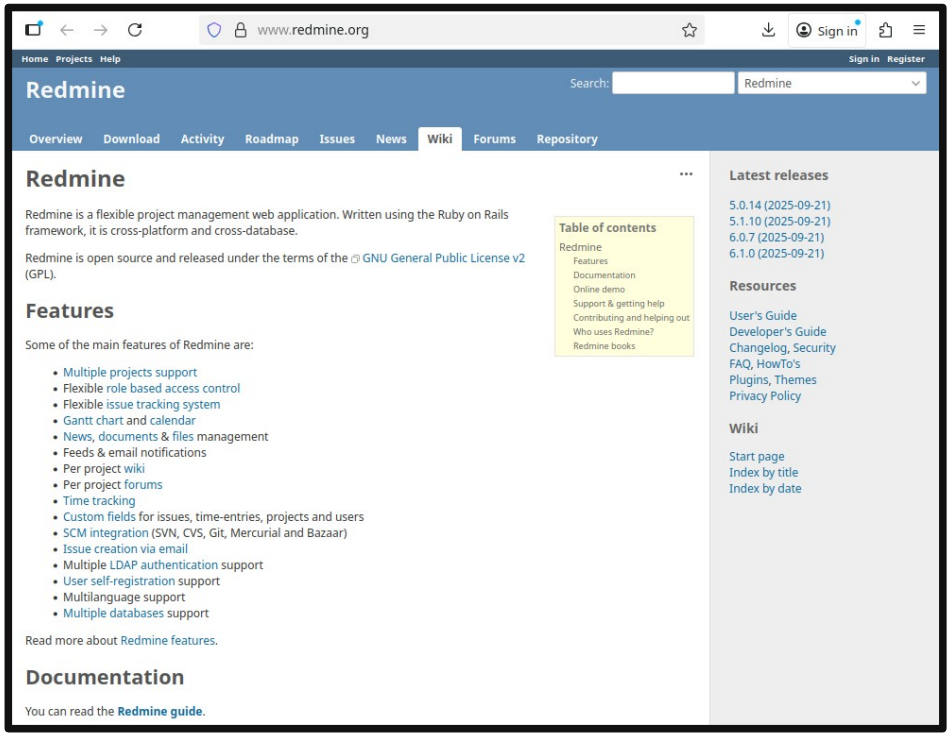
Planckstraße 1

Geometry and Parameter Community Management Tools

GitLab is an extension of git version control, which allows for collaborative development of software framework.



Redmine keeps track of known work-to-be-done as well as shared record of topic specific communication.



GitLab - HowTo
Geometry or Parameter Submissions

- Spend 1 hour onboarding to Gitlab to save 10 hours by doing interactive howto prepared by Pierre-Alain
  https://git.cbm.gsi.de/notes/computing/gitlab-tutorial

- Below is the basic steps for making a submission to the geometry or parameter repo (or indeed cbmroot)

Steps to submit to the CBMROOT geometry repository.

[1] Login/register for access to our git lab repository http://git.cbm.gsi.de
[2] Make your own private fork of the cbmroot geometry repository https://git.cbm.gsi.de/CbmSoft/cbmroot_geometry
[3] Clone your fork locally, i.e. `git clone git@git.cbm.gsi.de:your-username/cbmroot_geometry.git`
[4] Make your changes and commit locally, i.e. `git add subsystem.geo.root; git commit`
[5] Git push remote to your own fork, i.e. `git push`
[6] Login in to the git lab. It will inform you that it has detected a recent push by you to the server.
[7] Follow the large plus button and click “New merge request”. Fill out the form requesting a merge between branch/fork of your change and the master branch of the “CbmSoft/cbmroot_geometry”
[8] Wait for someone on our side to accept the request, probably Florian or Pierre.

This follows the same steps for making a change to CbmRoot code base. If anything here is confusion a technical note and tutorial is available at https://git.cbm.gsi.de/notes/computing/gitlab-tutorial/-/jobs/10802/artifacts/file/CBM_GitLab_Tutorial.pdf

Today’s Agenda

Three main parts to this presentation:

- Overview of changes to geometry and parameter repositories
  - Focusing just on some highlights since last collaboration meeting
  - Pending merge requests

- Focus on the target region
  - Segmented and more exotic target types
  - Target Shells and update to the beam window
  - Target chamber

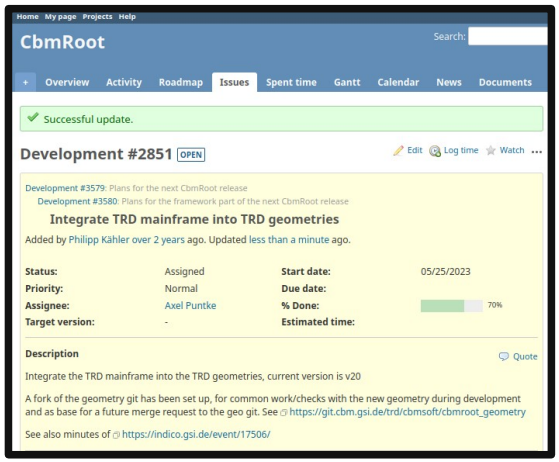
- Promotion of Geant4 over Geant 3
  - Requested V&V studies by detector groups

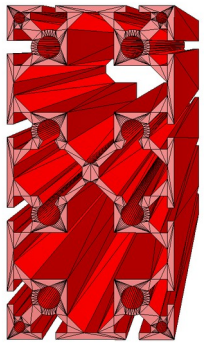
Pending Merge Request
Geometry and Parameter GitLab Repos

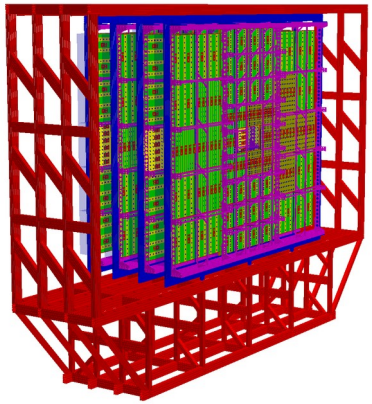
Geometry Repo

Parameter Repo

Realistic TRD frame
My Request answered mostly



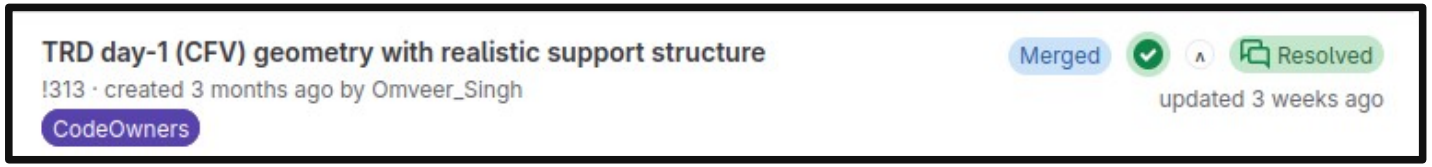




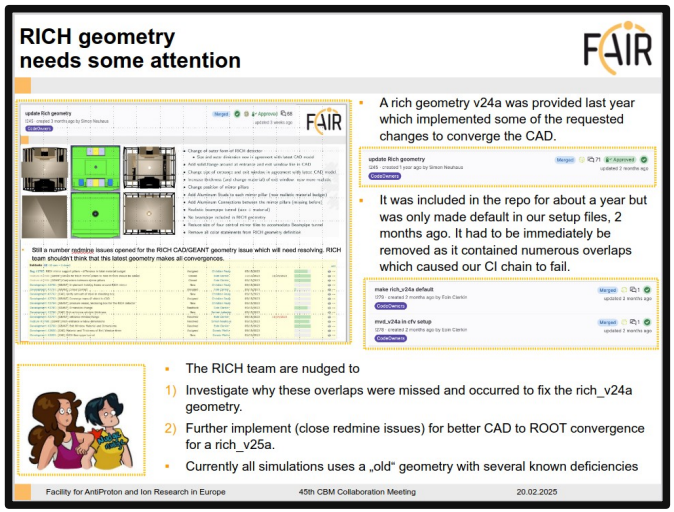
Tessellated Objects

- The additional complexity in the GDML files comes with GEANT simulation processing time increase (upper limit: +110% for TRD).
- Committed in trd_support branch
  https://git.cbm.gsi.de/trd/cbmsoft/cbmroot_geometry

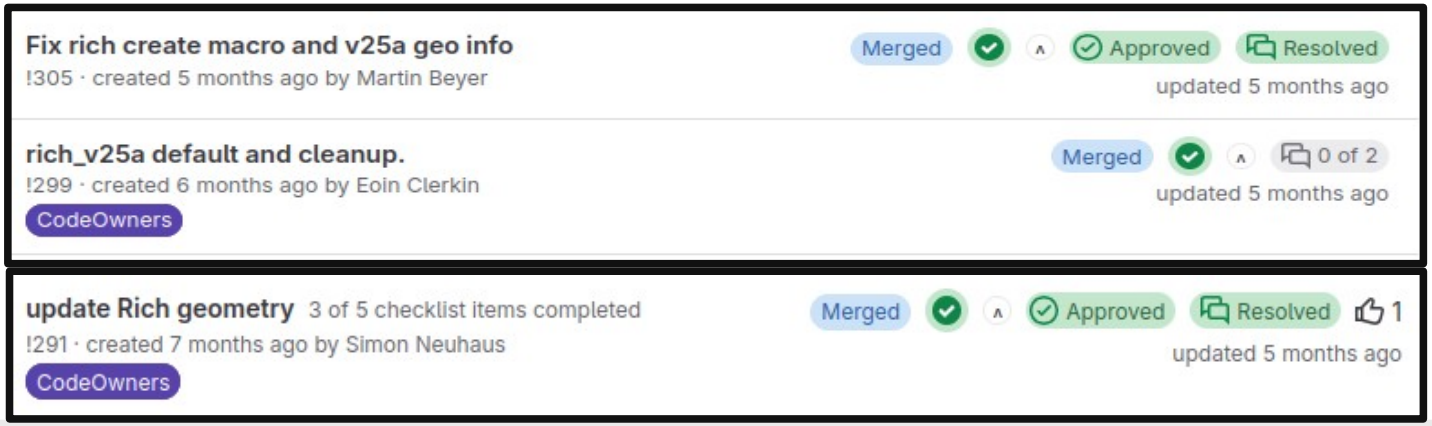
- Discussed for sometime and implemented twice, now the TRD has a realistic frame and available as default for simulation.



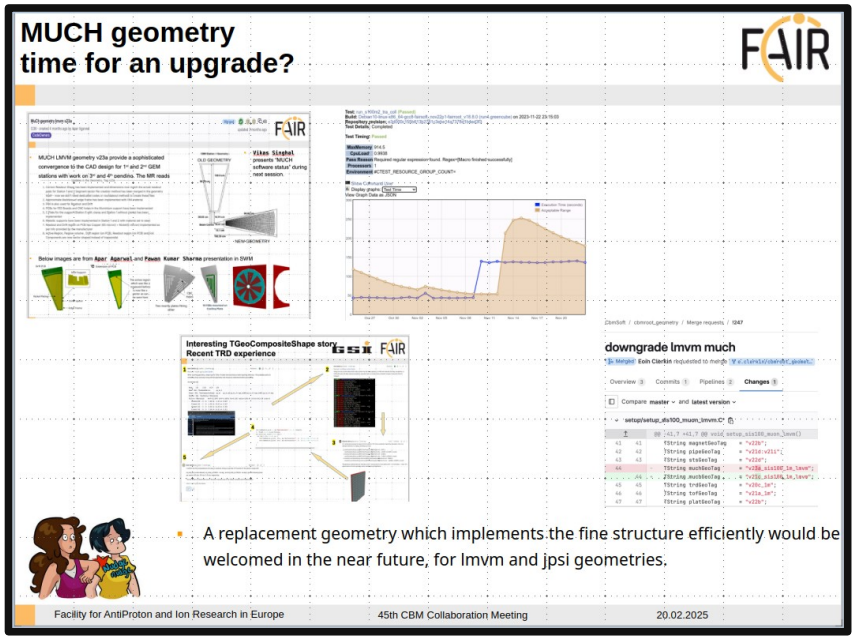
New RICH geometry
My Request mostly answered



- Redesign of the mirror holders
- Replace old MirrorSupportBelts by new MirrorFixing which looks like the CAD model and the prototype
- Add a small plate at end of mirror support studs to fit the weight
- Fixing all overlaps in the geometry
- Fixing newly discovered bug in implementation of exit window
- change of geometry hierarchy at exit window
- similar change at entrance window to avoid potential of similar bug
- Additionally small changes (small regarding physics impact)
- changes in the volume hierarchy to reduce the depth
- changes in code of creator file to make it more efficient
- replacing some hard coded numbers by variables
- replacing double definitions of same volumes by copying



New MUCH geometry
My Request is being answered



Eoin Clerkin @e.clerkin 1 month ago Maintainer

Transport Timing Test using Geant3 for setup_sis100_muon_lmvm, done on local machine for 10 events. The macro noticeably pauses at the initialization of the much.

Initialization and run time per event.

Wall Time	default (v21c)	rejected (v23a)	proposed (v23b)
Init (s)	5.20	45.97	23.14
Run (s/e)	10.53	63.24	17.76

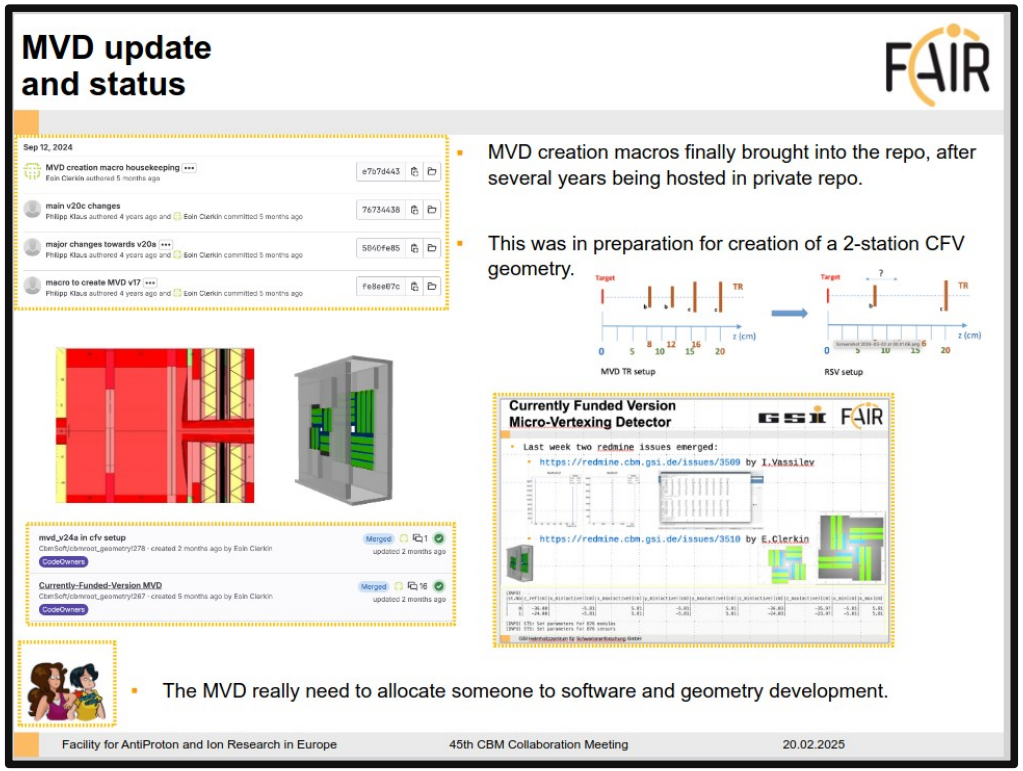
Conclusion: Substantial increase in initialization and runtime per event compared to current default, but substantial decrease in initialization and runtime per event compared to geometry which was rejected as default in 2023.

Edited 1 month ago by Eoin Clerkin

New MuCh geometry v23b
!312 · created 3 months ago by Pawan Kumar Sharma
CodeOwners
As Re 12 of 14 1
updated 5 days ago

Sector file for v23b MuCh geometry
!249 · created 1 month ago by Pawan Kumar Sharma
CodeOwners
updated 1 month ago

New MVD geometry
My request resolved



- MVD issues at the 45th Collaboration
  - MVD hits not properly recreated. (resolved issue #3509)
  - MVD geometry sensor extent (resolved issue #3510)
- Main Issues resolved sitting down with Joachim on the Friday night of the 45th CBM CM.
- Ajit Kumar now takes over MVD software related tasks.

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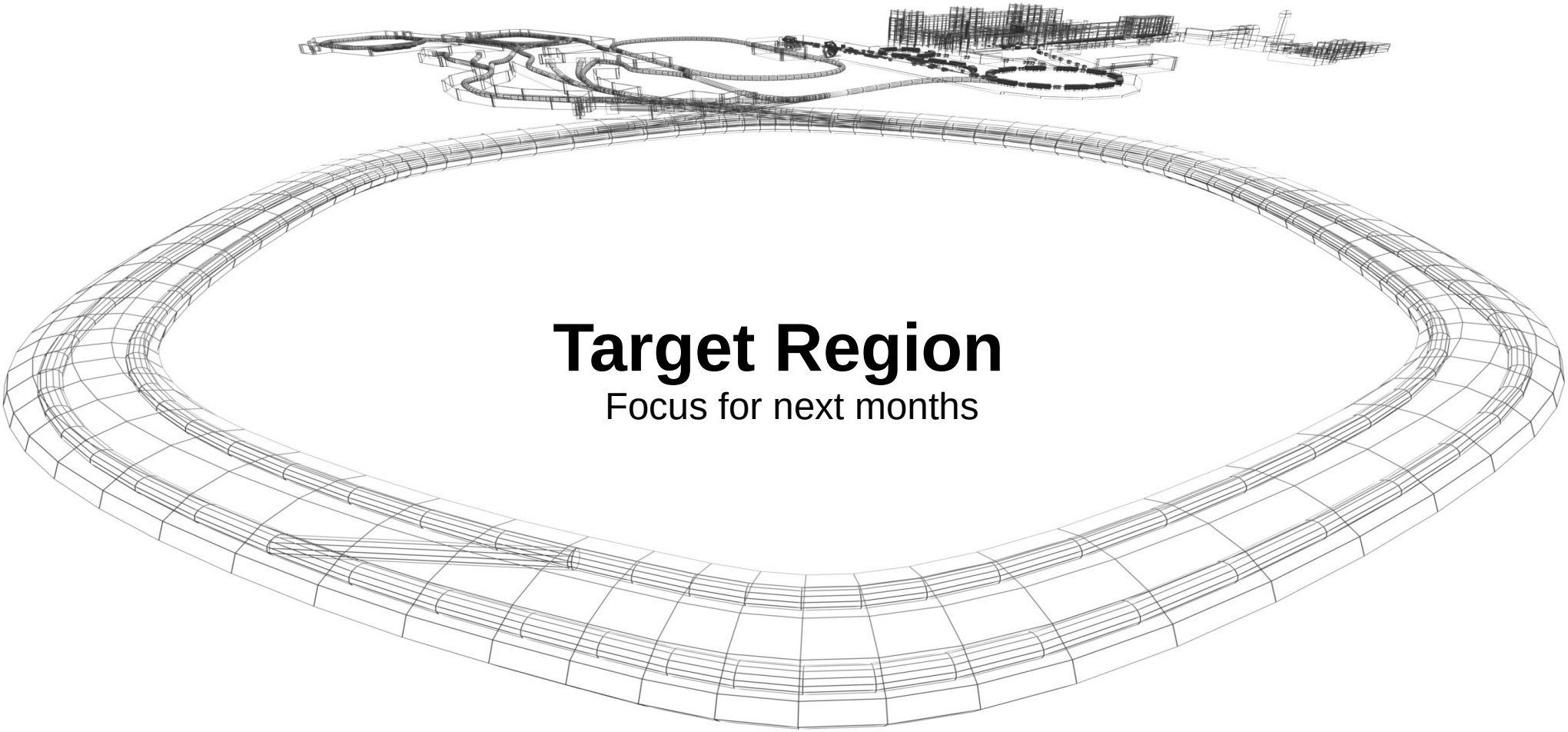


Target Region

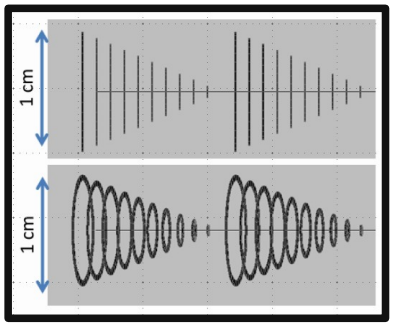
Focus for next months

Motivation
Why it must happen now?

- Requests for support for segmented targets and exotic target types.
- Target chamber tender, material study.
- Target exchanger with target shells
- BMON support code present in cbmroot for 1 year now.
- Lots of legacy work and geometries sitting in repo not actively being utilised by our analysis teams.
- This should all be implemented well in advance of the next VT in 2026

Segmented targets
Support for standalone and exotic targets

- Coordinated and recorded in redmine #3695
- Merge request in draft mode Gitlab-2184 (not ready yet)
- Possible ring-shaped segmented targets in series from Tetayana's 2020 presentations. (see ref in #3695). Technical considerations nfor the target shell must also be considered.



- Clearly, support for a proton target will also be required, although I know of no discussions on this.

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y="0.0" z="1.0" />

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<solidref ref="world" />
<positionref ref="center" />
<physvol>
<volumeref ref="vol_Be"/>
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</physvol>
<physvol>
<volumeref ref="vol_Au"/>
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</physvol>
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<positionref ref="Layer-1" />
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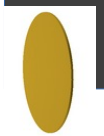
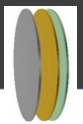
</volume>
```



target_v21a.geo.root



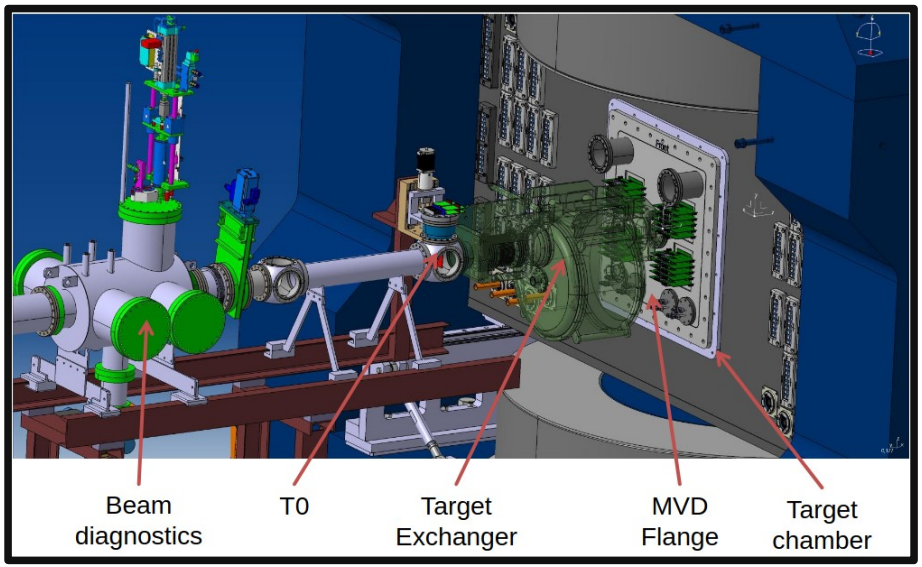
target_v21b.geo.root

Present Focus on Target Region

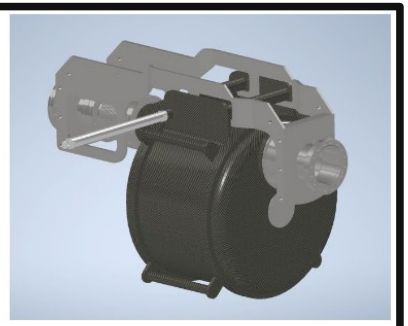
- Presentation given on Monday

CAVE - target region — *Patrick Dahm*

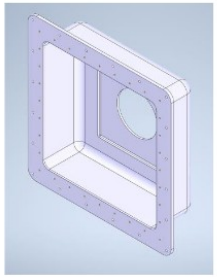
Conference Hall, 3rd floor, No. 6 Building, IMP, Institute of Modern Physics, Chinese Academy of Sciences — 08:25 - 08:40



- Target Exchanger

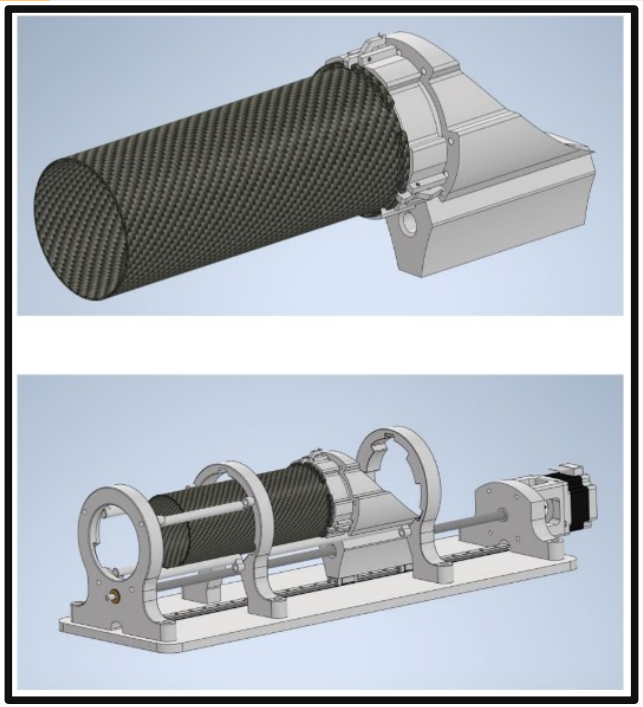


- Target Chamber

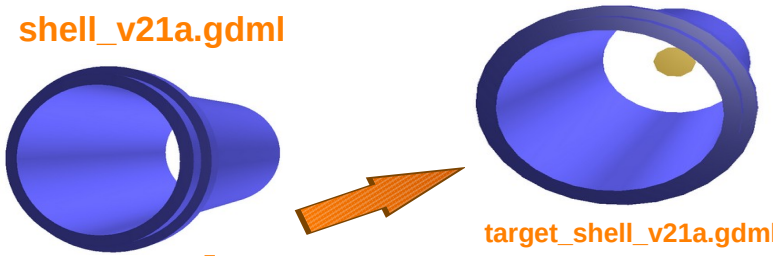


- P.Dahm discussed the multiple affected system: BMON/T0, MVD, and STS. Similar to the CAD, multiple detector systems have to change in tandem.
- On the target shell of the target exchanger is current envisaged to be implemented for simulations.

Inclusion of the holding shell requires demotion of legacy target/MVD chamber

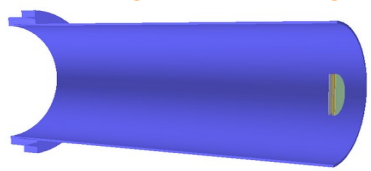


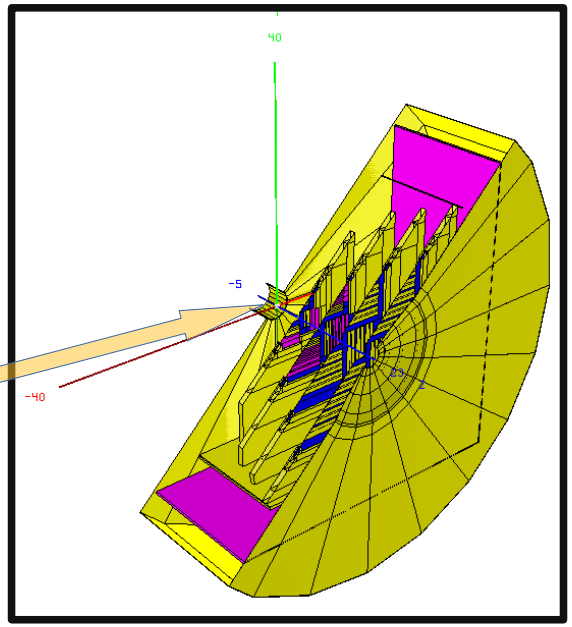
shell_v21a.gdml



target_shell_v21a.gdml

target_shell_v21b.gdml

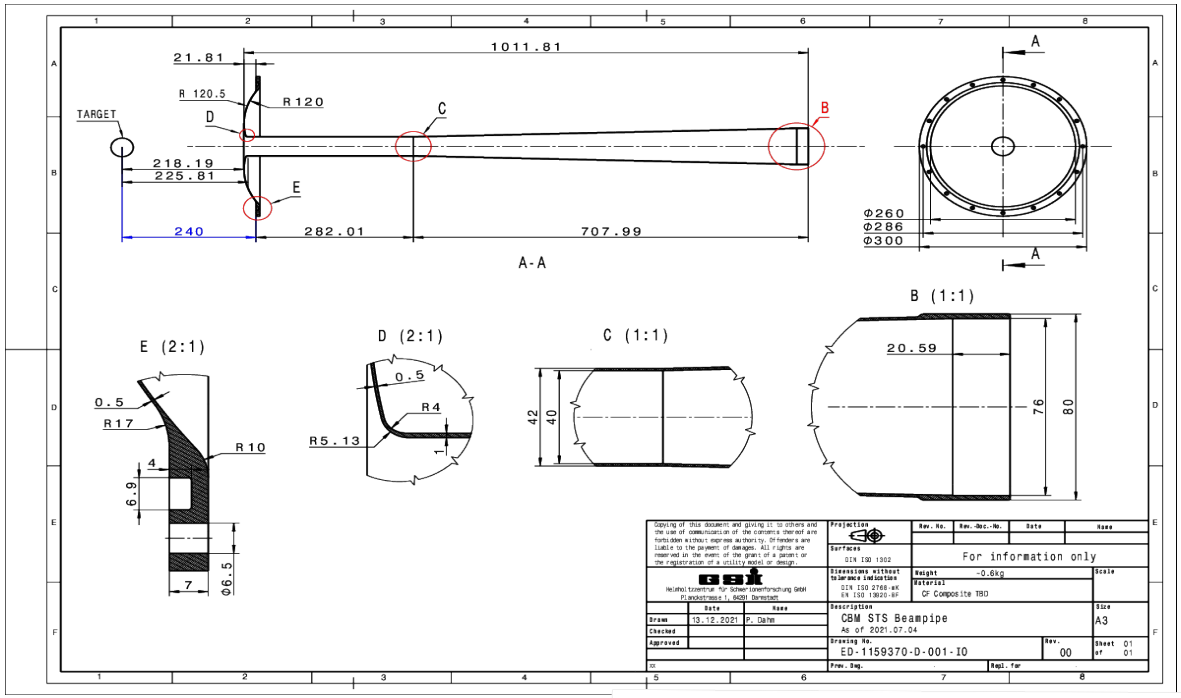




- Volume in legacy target/MVD chamber is not large enough for a shell.

- Shells available for some time, two issues prevent easy use for simulations.
- Draft merge request for Target introduced as FairModule - #2184
  - Initial data has not correct placement.

basic upsteam pipe with updated beam window + STS beampipe



STS-Beam Pipe, ICM succeeded

ICM-Composites

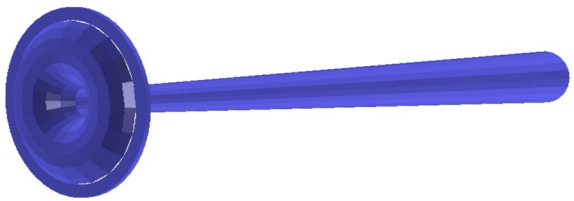
- second prototype delivered
  - → very satisfactory
- tested **straight** and within tolerances
- tested **mechanically stable** under vacuum
- tested **vacuum tight**
- **1 mm** wall thickness on tube
- **0.5 mm** thickness on track membrane
- **~ 4 g/cm** tube length

We will order a second one as spare

45th CBM collaboration meeting, GSI, Feb. 16 - 21, 2025 12

Inclusion

- Torodial window
- Initial cylindical section removed.
- Carbon fibre in tubular section reduced to 6 mm.



Candidate SIS100 beampipe geometries for simulation

Eoin Clerkin *
Facility for Anti-Proton and Ion Research, Darmstadt, Germany

Several new beampipe simulation geometries were created during the course of last two years, though they were not widely distributed, in order not to confuse the community with a myriad of technically infeasible designs. This decision was counter-balanced by a need to rapidly provide a realistic beampipe geometry which could in tandem influence incremental design improvements. Evidently, as the section of the beampipe which transverses a detector, can heavily affect detector's design, construction, maintenance and operation, detector groups rightly have vested self interest and responsibility to ensure the quality and performance of their section of the pipe. Conversely, the beampipe itself is an extensive subsystem with transverses the entire experiment, affects every detector subsystem, introduces crucial mechanical challenges to overcome by physically connecting detector subsystems and thus requires global-experiment-design-considerations at each step. The beampipe is thus an area were coordination and communication in the spirit of the CBM collaboration is vital to ensure that physics performance is prioritised whilst robustness of the technical design is assured.

Reference [1] of this report, indirectly discusses the creation of the many simulation geometries over the last year based upon the previous ("v16a_1e") default. Each corresponds to the creation of slightly varying trial STS geometry. As some of geometries in Ref. [1] are the current default beampipe simulation geometries distributed with our DEC21 CBMROOT software release, of particular importance is Tab. [1] which shows which beampipe to use with which STS and then the recommended placement for the target along the nominal beam axis. Ref. [2] contains the technical design considerations used for the STS beampipe section, with some advancements, especially in the beampipe window, which at present are not in the default simulation geometries mentioned above. This is at least partially addressed in Sec. [2] of this document. Ref. [1] also contains the STS back-wall flange which is used, and the target box which is used with some modifications, in Sec. [3] of this manuscript.

From the STS back wall, the beampipe is to transverse the RICH/MUCH section, through the TRD, and the TOF, and finally on to the PSD and the beam dump. Information regarding the technical considerations such as vacuum and connector inlets of the cylindrical beampipe from the TRD on, is contained in Ref. [3] of this report. Ref. [4] contains the beampipe simulation geometry for the entire downstream section. Primarily, it comprises of downstream

* e.clerkin@gsi.de

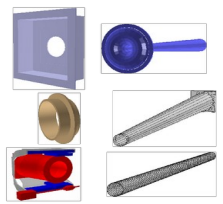
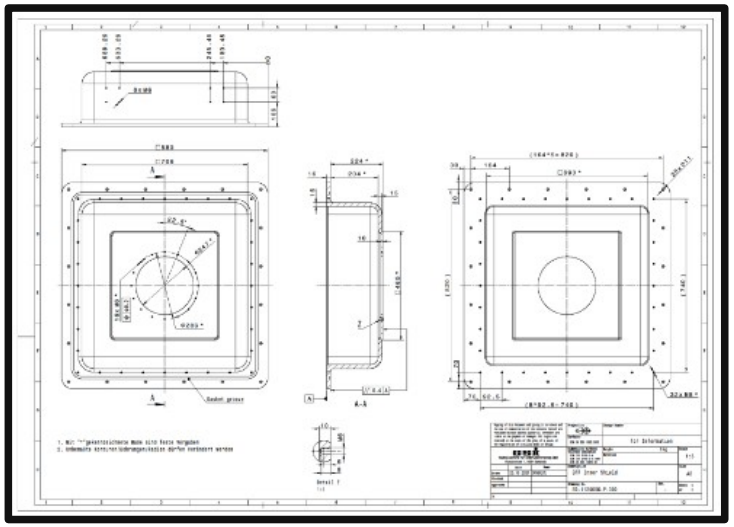


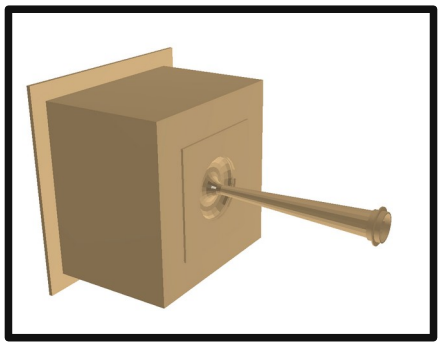
Figure 1: Size of beampipe parts are not to any fixed scale. **Top-left** shows the target box which houses the MVD and target. **Top-right** shows the beampipe window along with a wide conical section. **Middle-left** shows the STS flange which is supported by the back of the STS box. **Middle-right** shows the narrow conical section which transverses through the MUCH/RICH detectors. **Bottom-left** shows the implementation of the bellows. **Bottom-right** shows a simple cylindrical tube used for the downstream section.

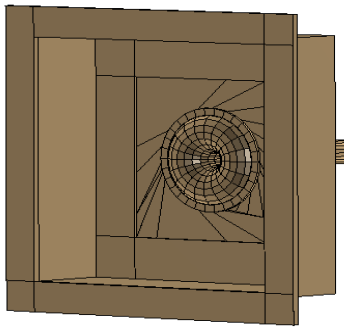
cylinder, and the narrowed conic-based tube which transverses the RICH/MUCH. Between these two sections, a bellow assembly (see Ref.[5]) is added to allow a deflection angle for the beam between the downstream cylinder and narrowed conical section. Creation of a sophisticated representation of the bellows for simulation is contained in Ref. [4]. The bellow assembly is responsible for a significant percentage of the overall material budget of the beampipe as part of its structure and supports needs, and it was a noteworthy advance to add a small deflection angle of 1.2° between the STS and RICH/MUCH conic sections, so latter conic could have its directrix significantly reduced, reducing its material budget but more importantly the material budget of the entire bellows part. Ref. [6] highlights this case. It is a necessity for simulation geometries, unlike their CAD equivalents, to have an accurately specified

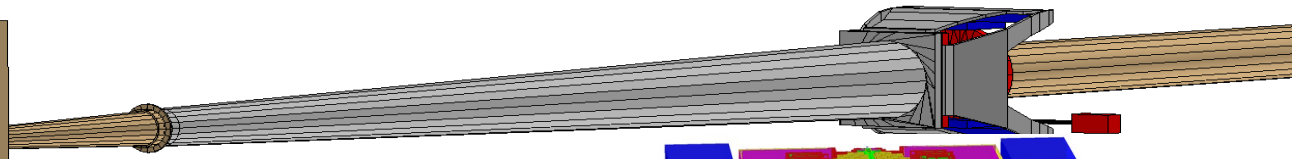
pipe_v22b
beampipe with new beam window and target box



- CAD (see P.Dahm presentation) and GEANT used same schematic report for design so excellent agreement.
- Material study (steel, aluminium, carbon fibre) needed for tender proposal. See redmine https://redmine.cbm.gsi.de/issues/3719
- Mehul did the initial gdml implementation for the STS v22.







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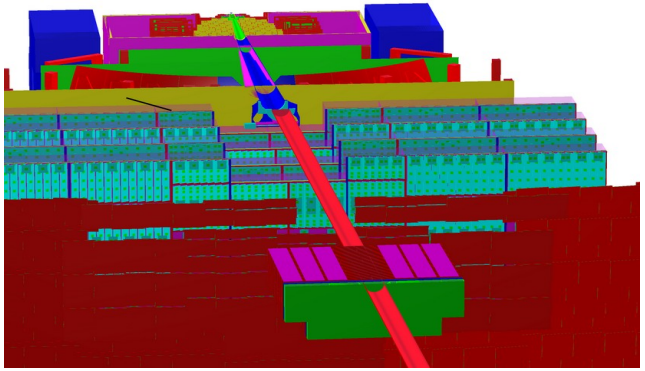
full setup ->



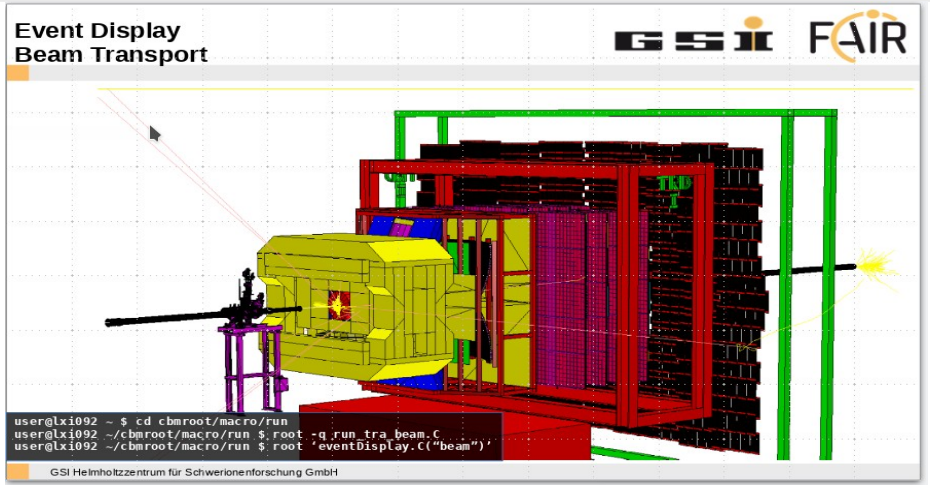
- pipe_v22b is a version which combines these components together and the user may specify any angle for beam deflection. Some internal volumes in the bellows have been removed though.

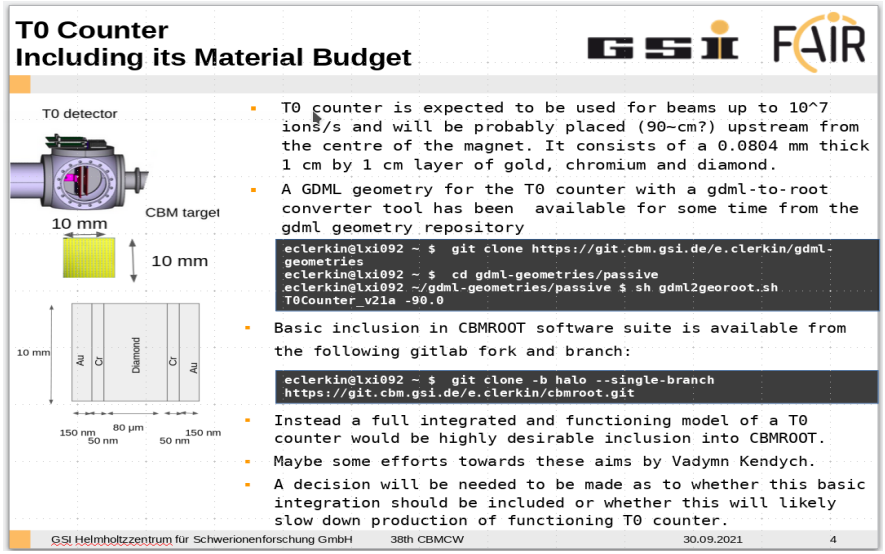
BMON geometries

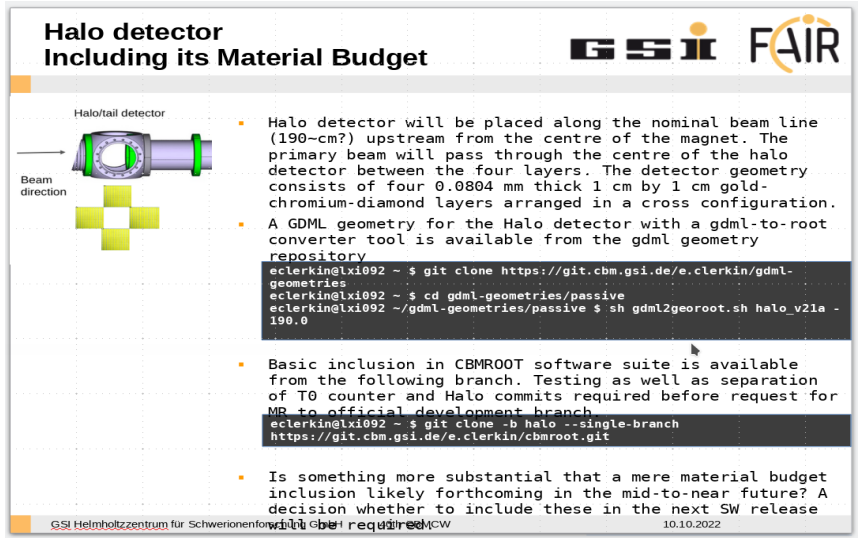
- CBM support provided and reported at the 43rd CBMCM

Provide BMON
!1325 · created 2 years ago by Eoin Clerkin ◇ OCT23
CodeOwners | Geometry | Simulation
Merged | Approved | Resolved
updated 1 year ago

- Requires enlargement of the vaccumm structure before the target.







Planned steps for target region update

- Standalone volume for target. Placement of generated events has to be generalised. If done well, later steps may be simpler.

- New beampipe with beam window, sts beampipe, with integrated target chamber. Repositioned MVD detector may be needed.

- Target with integrated shell → Segmented targets → Complex annular targets.

- (Optionally) Inclusion of BMON, and integration of beam transport meters before the target. You may remember that the code base was included to facilitate a BMON detector for the 43rd Collaboration Meeting. (needs enlargement of the vaccuum space before target chamber)

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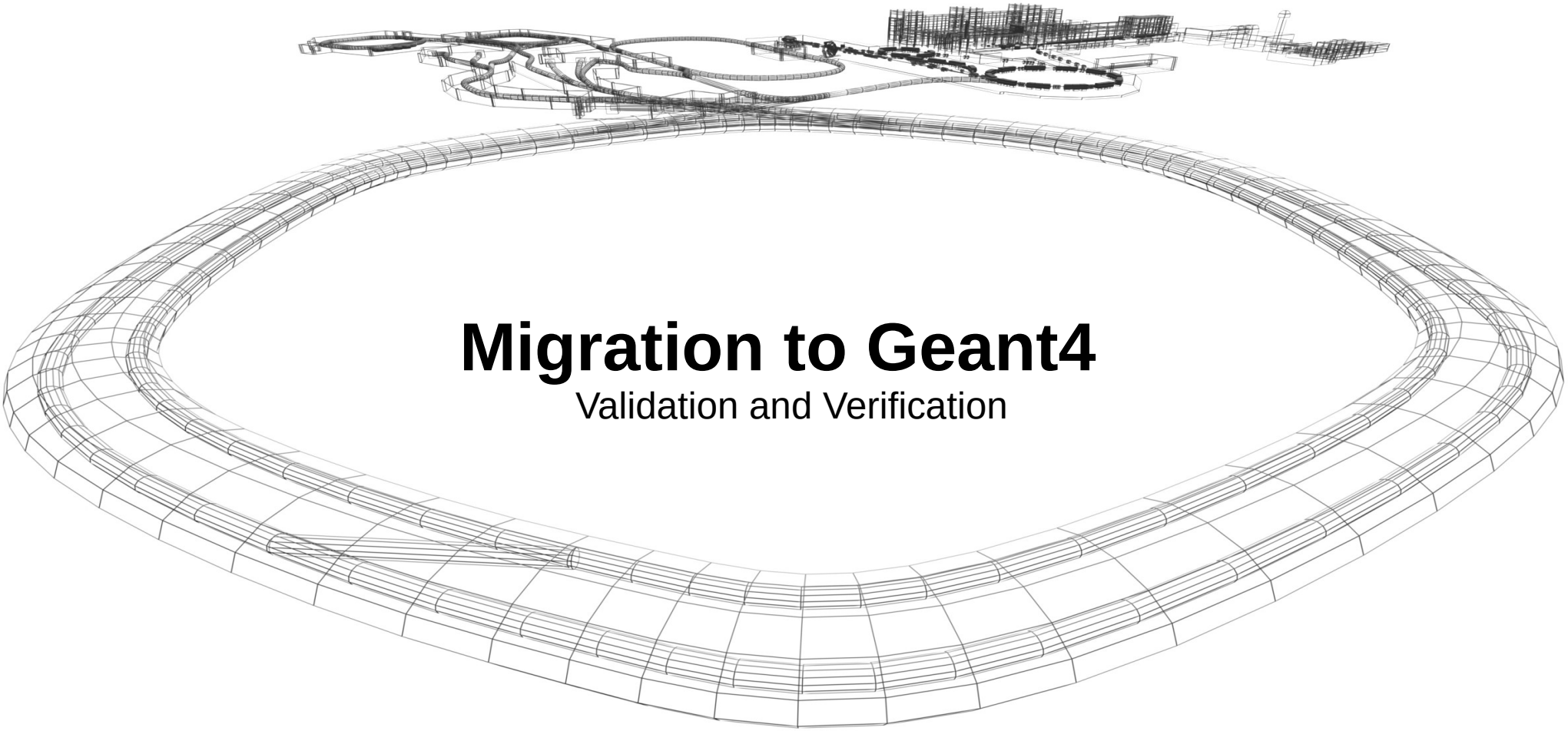
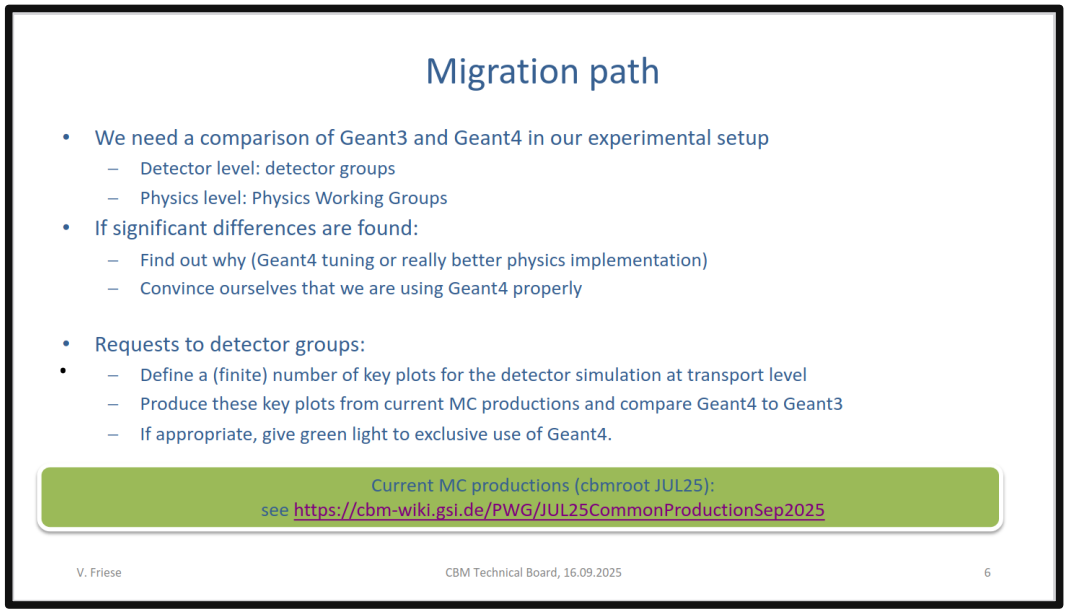


Migration to Geant4

Validation and Verification

Geant4 migration
replacing Geant3 as the default transport engine

- You may recall Anna Senger and Florian Uhlig presentations at the 45th CBM Collaboration Meeting.

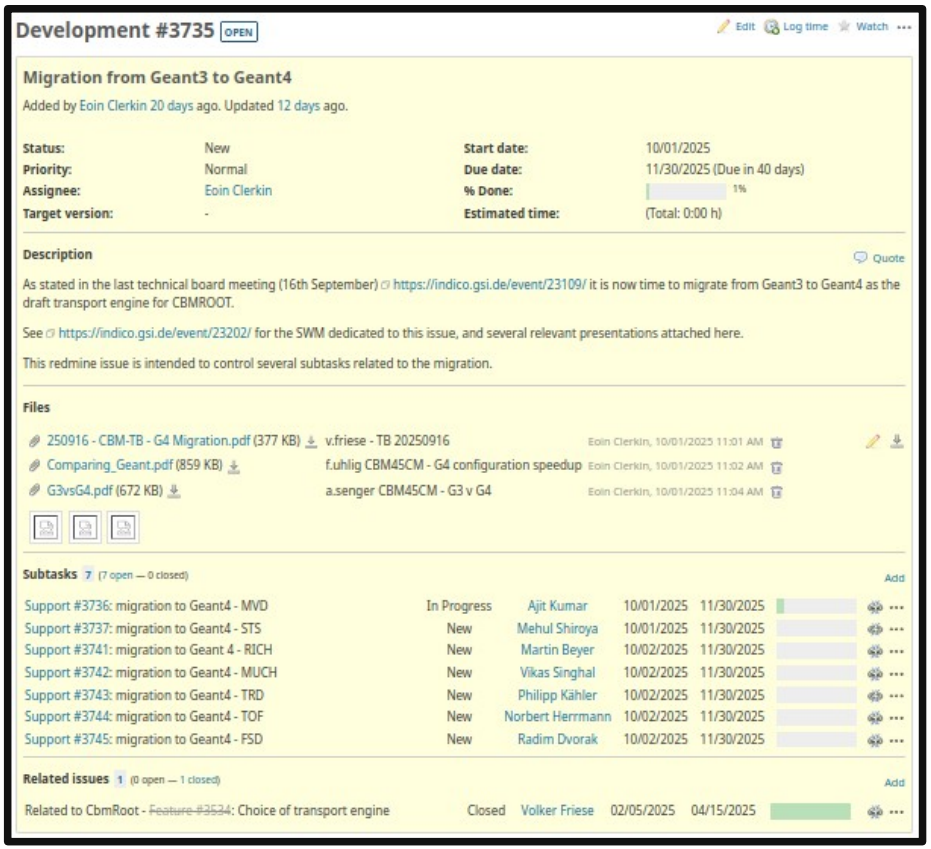


Migration path

- We need a comparison of Geant3 and Geant4 in our experimental setup
  - Detector level: detector groups
  - Physics level: Physics Working Groups
- If significant differences are found:
  - Find out why (Geant4 tuning or really better physics implementation)
  - Convince ourselves that we are using Geant4 properly
- Requests to detector groups:
  - Define a (finite) number of key plots for the detector simulation at transport level
  - Produce these key plots from current MC productions and compare Geant4 to Geant3
  - If appropriate, give green light to exclusive use of Geant4.

Current MC productions (cbmroot JUL25):
see https://cbm-wiki.gsi.de/PWG/JUL25CommonProductionSep2025

V. Friese CBM Technical Board, 16.09.2025 6



Development #3735 OPEN — Edit · Log time · Watch

Migration from Geant3 to Geant4

Added by Eoin Clerkin 20 days ago. Updated 12 days ago.

Status:	New	**Start date:**	10/01/2025
Priority:	Normal	**Due date:**	11/30/2025 (Due in 40 days)
Assignee:	Eoin Clerkin	**% Done:**	1%
Target version:	-	**Estimated time:**	(Total: 0:00 h)

Description — Quote

As stated in the last technical board meeting (16th September) https://indico.gsi.de/event/23109/ it is now time to migrate from Geant3 to Geant4 as the draft transport engine for CBMROOT.

See https://indico.gsi.de/event/23202/ for the SWM dedicated to this issue, and several relevant presentations attached here.

This redmine issue is intended to control several subtasks related to the migration.

Files

250916 - CBM-TB - G4 Migration.pdf (377 KB)	v.friese - TB 20250916	Eoin Clerkin, 10/01/2025 11:01 AM
Comparing_Geant.pdf (859 KB)	f.uhlig CBM45CM - G4 configuration speedup	Eoin Clerkin, 10/01/2025 11:02 AM
G3vsG4.pdf (672 KB)	a.senger CBM45CM - G3 v G4	Eoin Clerkin, 10/01/2025 11:04 AM

Subtasks 7 (7 open — 0 closed) — Add

Support #3736: migration to Geant4 - MVD	In Progress	Ajit Kumar	10/01/2025	11/30/2025
Support #3737: migration to Geant4 - STS	New	Mehul Shiroya	10/01/2025	11/30/2025
Support #3741: migration to Geant 4 - RICH	New	Martin Beyer	10/02/2025	11/30/2025
Support #3742: migration to Geant4 - MUCH	New	Vikas Singhal	10/02/2025	11/30/2025
Support #3743: migration to Geant4 - TRD	New	Philipp Kähler	10/02/2025	11/30/2025
Support #3744: migration to Geant4 - TOF	New	Norbert Herrmann	10/02/2025	11/30/2025
Support #3745: migration to Geant4 - FSD	New	Radim Dvorak	10/02/2025	11/30/2025

Related issues 1 (0 open — 1 closed) — Add

Related to CbmRoot - ~~Feature #3534~~: Choice of transport engine	Closed	Volker Friese	02/05/2025	04/15/2025

- And of course, redmine will be used to managing and document this effort.

In Summary

- Motivated community encouraging software tools GitLab and Redmine through the not-so-suttle repetition throughout presention.
- Discussed the fulfilling of my geometry related requests by the RICH team, the TRD team, and the MUCH team since the last collaboration meeting fulfilling my redmine requests.
- Furture focus for big changes to the whole target region for the VT in 2026 and the next collaboration meeting.
- Highlight my many redmine requests for V&V studies for Geant4 migration over next months.
- And if you want to make me happy, change “new” to “in progress”, “in-progress” to “resolved”, and “resolved” to “closed” in your redmine issue.

Thanks for listening

Questions are welcome.

CBM

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