MOLLER Simulation General Updates

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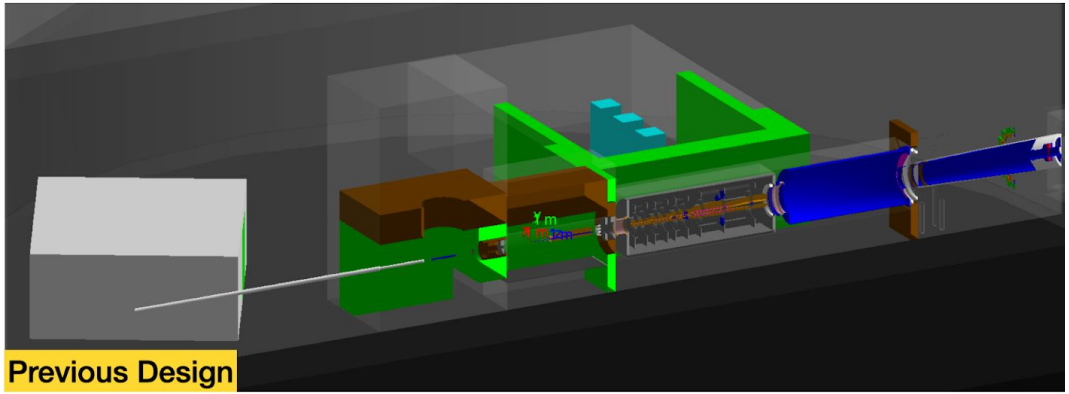
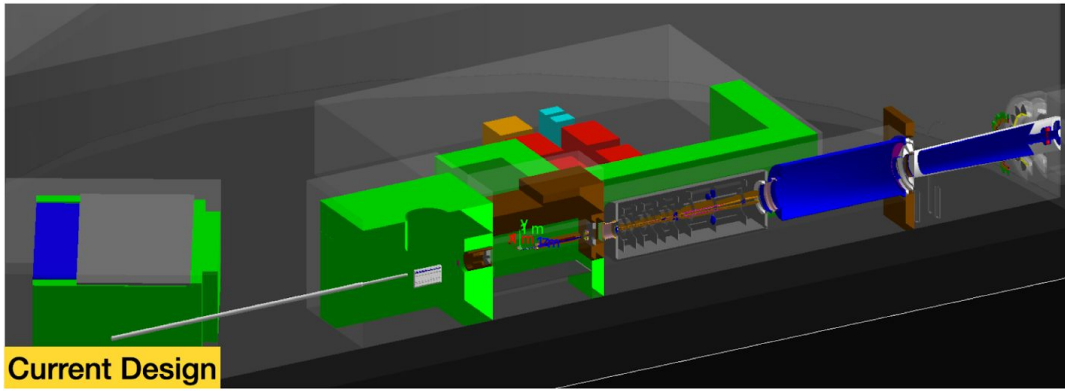
Since December 2021…

- Shielding and local radiation dose estimates: Ciprian/*Zuhal* *doc-db-862*
- Ferrous material budget: Kent/Caryn/Eric *doc-db-891*, *doc-db-860*
- Signal sculpting and background reduction with collimation/collar: Chandan/KK *doc-db-906*
- Boundary dose estimation: Kent/Ciprian/Vassu *doc-db-915*, *doc-db-916*
- Spectrometer shielding and coil dose: Juliette/Zuhal/Sakib
  - *Doc-db-913*,
- Detector Simulation by different subsystem groups
  - Pion detectors
  - Showermax
  - Main detector
  - LAM/SAM and scanner
- Software management updates: Paul/Wouter/Ciprian/Rakitha

Shielding and Local Radiation Dose Estimates

- **Target Region:**
  - The underneath of DS and beam-right wall of the target bunker is extended all the way to the floor. The material of roof is changed from the barite to concrete.
- **Upstream Torus Region:**
  - Used less thick barite in the US-side of the roof in order to allow the placement of HRS right's nose.
  - The thickness of the DS-wall is increased to 60cm.
  - 15cm Pb wall is used instead of 35.2cm Pb.
- **Collar2 Region:**
  - Increased the radial overlap between the outer and inner ring of the collar2 from 12.7mm to 25.4mm to have less hot spots around the inner ring.
- New power supply bunker design is implemented.





Shielding and Local Radiation Dose Estimates: Summary

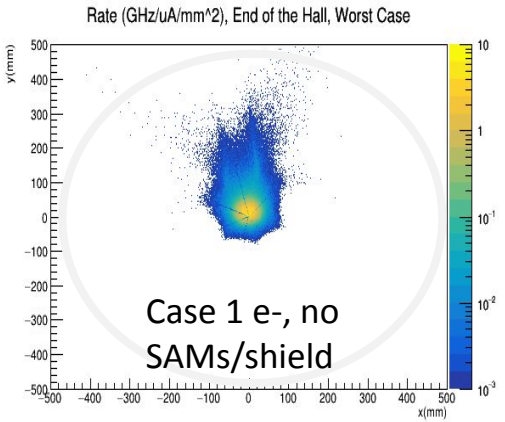
- Shielding-branch (configuration 20) is merged with the develop-branch.
  - Fixed the overlap issues in the downstream hybrid region.
- The current develop-branch includes the geometry updates from shielding configuration 23.
- Total ionizing dose calculation is done for GEM planes, DS coil water-cooled leads, vacuum pumps, PS boxes, bellows, and o-rings in the target/US/DS torus regions (docDB872, docDB861, docDB888, docDB873, docDB867).
- The total neutron flux is calculated for the US coils (docDB898).

- **To-do list:**
  - Run the simulations for the radiation calculations to support the engineering design team (if needed).
- Key personnels: Ciprian Gal, Vassu Doomra, Zuhal Seyma Demiroglu

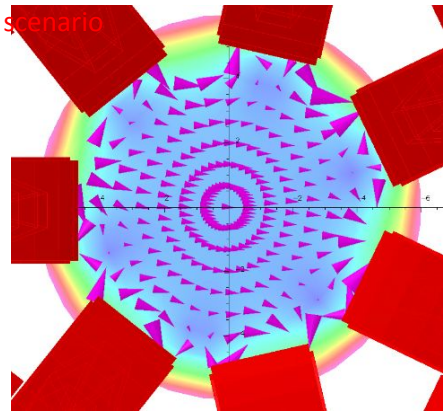
Spectrometer Simulation Summary

- positron dose on the upstream torus sufficiently reduced by side plates – “wedge shields”
- DS epoxy shielding being designed (2-bounce shield not needed for 2-bounce)
- checked field map radial extent – now 50 (75) cm default in US(DS)
- Still could optimize coarseness and interpolation in sim
- Fixed conductor configuration (segmented torus) – modulo manufacturing issues
- Still optimizing epoxy shielding wrt weight and location of high stresses
- Collimators 5 and 6a,b work with worst-case offset (Sakib is double-checking latest CAD and simulation geometries)
- Dipole specification for bore still needs to be determined
  - depends on whether we can tolerate epoxy dose or any backgrounds in the worst-case offset

Looking upstream

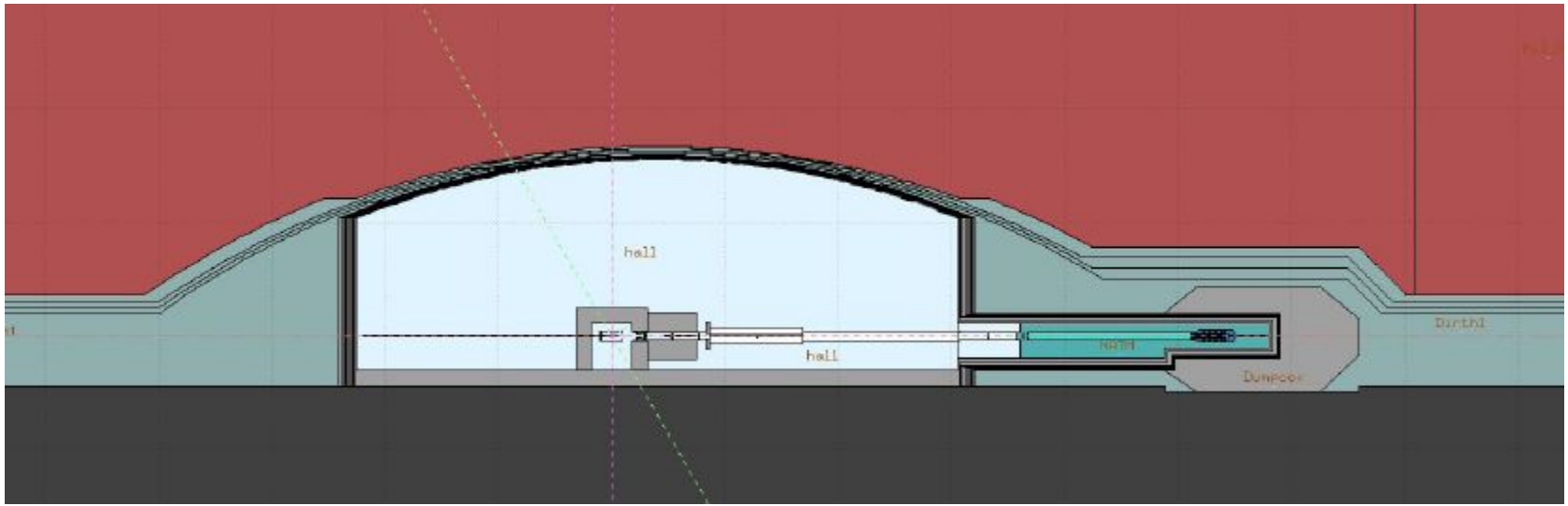


Worst case scenario



FLUKA for activation

- We have a FLUKA model with minimum shielding and no spectrometer coils
- So far we did not have manpower for maintain both Geant4 and FLUKA geometry models. Hopefully we will have it soon
- Currently a new student getting ready to work on FLUKA



Detector Simulation

Detector subgroups only present studies relevant for shielding, background, ferrous material use to simulation working group. We get some updates from following detector groups

1. Pion detector system : No shielding/dose/ferrous studies
2. Showermax
3. LAM/SAM and scanner

Detector Simulation: LAM/SAM and Scanner Progress

1. Design optimization for LAMs, SAMs, and Upstream Scanner
2. Design Downstreams scanner and Diffuse Beam Monitors (DBMs)
3. Rate study on LAM and SAM --> LAM rate is nearly a factor of two larger than December due to new geometry in remoll (aluminum exit window flange of drift pipe and outer ring of collar 2)
4. Spectrometer field map study using LAMs, SAMs, and DBMs --> SAMs seem to be very sensitive to the asymmetric field
5. Ferrous material content in upstream scanner motors and its background on the main detector --> The effect seems to be very small, will present the detailed analysis in a future simulation meeting
6. SAM lead shielding is no longer required (it was mentioned in the December meeting as well)

Detector Simulation: LAM/SAM and Scanner Next Steps

1. Detailed study on PE yield for all the scattered beam monitors and scanner detectors via optical simulations
2. Do a little more study on scanner motors' ferrous material and come to a conclusion
3. Lightguide background and radiation dose study for the scattered beam monitors

Main Contact: Devi Adhikari (adhidevi@vt.edu)

Detector Simulation: Showermax

Progress:

- Updated Shower-max design in the Remoll geometry
  - Relevant for back-splash on main detectors, general hall radiation loads, and pion detector development
- Performed radiation dose estimation for shower-max quartz layers, long pass filter, pmt cathode window, and preamp silicon wafers

Next Steps: refine our dose estimates and refine design parameters for shower-max

Key personals: Dustin McNulty and Sudip Bhattarai

Software Management Updates

Remoll Geometry

Develop branch geometry updates:

- Removed redundant files
- Removed files not in use
- Renamed all the “merged” files to just their name

Currently geometry commits are merged to develop branch using pull requests.

Require “An expert” to approve the pull request before the merge. This will ensure only proper geometry changes introduced to develop

We still needs to proper mechanism for minimizing geometry overlaps in develop branch (A student in charge of checking for overlaps??)

Important Rule to Follow with Remoll Geometry

Anyone working on geometry implementation at branch level must keep track of geometry overlaps and try to avoid or minimize them.

Please report geometry issues to the simulation meeting

Simulation Output Rootfile Tape Storage

We are saving finalized simulation outputs into tape storage

- The `/mss/halla/moller12gev/simulation/` directory has been created, and should now be usable for everyone in the `moller12gev` group.
- You should be able to submit files to the MSS system from your directories on volatile.
- We have proposed that everyone would create their own subdirectories, and would do so by doing the first jput like this:

```
jput <full_path_of_one_file>
/mss/halla/moller12gev/simulation/<username>/<projectname>/<
filename_of_the_file>
```

Proper Steps to be followed for Simulation Reproducibility

Presentations with final results for various simulation studies must include

1. Location of root file saved in the tape:
   a. Naming conventions for backup root files: Include the output root files under the subsystem/group directory and provide a name to match study, owner and geometry information
2. Description of scripts utilized for the study: a copy in Git repository or create a tar file of scripts and place at the same location as output root files.
   a. Note that git software version, Geant4 version, macro file and many other metadata are already stored in the simulation output file
3. Upload the presentation to the doc-db
   a. Add the label "`simBackup`" for the doc-db entry for final studies with simulation output saved to tape

Completed Simulation Tasks

- Signal envelopes
- Energy deposition on different beamline elements placed near the high flux particles
- Collimator-1 optimization
- beam-pipes,drift-pipes and bellows in the drift region
- Bellows and O-ring dose estimation using symmetric magnetic fields
- Study background under vacuum degradation
- Designing alignment run plan
  - Initial look at the plan completed
  - Cip's last collaboration meeting slides
- Beamline optimization: target-Col1, col1-col2
- Workflow/script for two-bounce photon estimation/optimization
- Site boundary dose estimation

Completed before December 2021, Completed between December 2021 and now

On-Going

- Beamline optimization: waiting for Engineering feedback
  - We have a initial design of the beamline
- Background estimation at Ring-5 (exit window backgrounds, etc.)
- Ferrous material studies
- Shielding optimization and Local radiation estimates
- Optimizing Background and Minimizing radiation dose at ring-7
- Spectrometer coil shielding and radiation dose
- Bellows and O-ring dose estimation
  - asymmetric field to-do
- Designing alignment run plan
- Detector optimization
- Beam position angle sensitivities

To-do List

- FLUKA geometry updates and activation studies (UMass new student Jhih-Ying Su)
- GEM readout radiation estimates
- Detailed design of the drift exit window and then update the background and signal
- Flagging overlaps and checking for inconsistencies in the development branch
- Need to have a software expert for code and geometry management