ESS bilbao

EUROPEAN SPALLATION SOURCE

Preliminar MAGiC beamline model

Consorcio ESS-BILBAO

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Intro

Aims & scope

This presentation reviews the preliminar model of the MAGiC instrument neutron beamline. The methodology used is explained, the features included and omitted are described, and the initial working is shown. Results are not discussed, as the status is far too early for that.

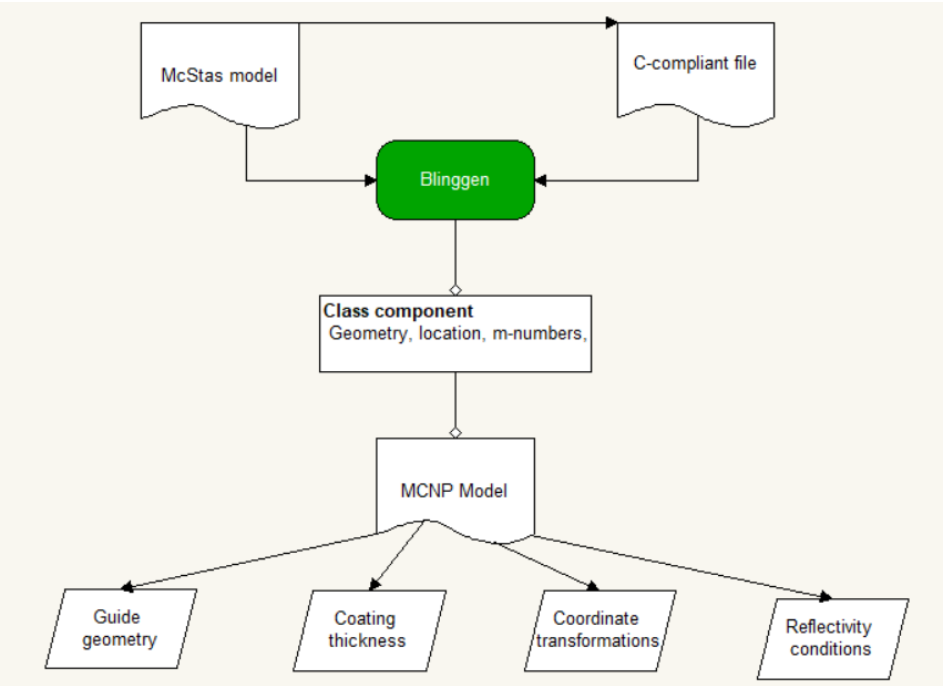
Antecedents

Based on the experience of previous instruments, we wanted to build the MAGiC model in a two-step process: One semi-automated generating the guide itself using McStas models, and a second one that uses some of the previous results to build the shielding blocks. This allows reliable and traceable model generation, because the basis for the geometry and some other data is the neutron optics model

Guide generation: Blinggen module

Automated parsing from instr file

Aside from some refactoring and maintanability changes, we have developed the blinggen module that created guide geometry to be able to parse *.instr files for the data needed. This means that the module is now able to read instrument description from a McStas model, and the variables from a c-compliant file using pycparser, and generate a base model. A circular guide housing, which may or may not be physically present, serves as a interface between the guide model and the shielding.



Limitations

Current status

The blinggen module can be found in GitHub as GPLv3 software. Because McStas has a very wide range of features, it is likely that other instruments need more functions implemented. Notably, Al windows are not present, for reasons that will be set shortly.

Input limitations

Because blinggen reads from the existing instr files, whatever information those are lacking, it is not going to be present in the model. In particular, the MAGiC model, was basically a model for optimizing geometry, and thus, the entire element/gap structure, Al windows, and m-number variation are not present. All that has been implemented after model generation.

Overall information transfer from McStas to MCNP

While the above is certainly dissappointing and meant a significant analyst input, we should still remark that blinggen brought some very important data to the model:

- The two ellipsis of the instrument are accurately defined, using True Elliptical Shape, which the specs actually require for most elements.
- The polarizer itself is not fully defined, but the kinks after and before, critical for its functioning are. The blades can be later defined by hand.
- Transformate cards for all the parts of the guide are generated. This is specially important for the later implementation of the shielding blocks.

Shielding blocks modelling

Initial idea using like...but structure

Initially we built a 4m model of both E01 halls shielding blocks, and D02 hall shielding blocks. Due to the structure of said blocks, it is possible to use a *like...but* structure to repeat those as neccesary throughout the guide, with the needed transformations. This would allow for a very tidy modelling.

Issues when trying to run the model

While we did manage to build and plot a model (which we can send if desired), running it is a different matter altogether. As it turns out, **the initial setup resulted in a runtpe file of 8Gb (!!), which effectively renders it unusable. Further investigation discovered that adding a block of 4m (which is only 20 cells, mind you), bloated the runtpe by 300MB.** This seems to be an issue within MCNP itself, which we will report when possible.

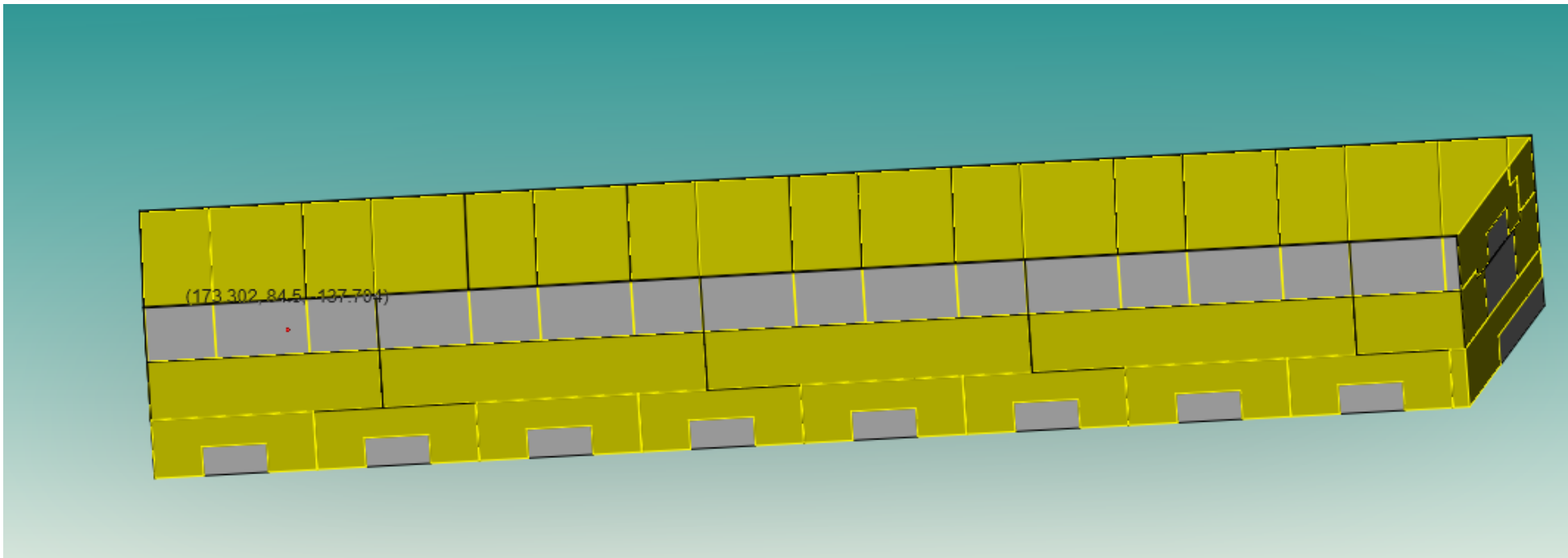
Public Service Announcement

DO NOT USE THE like...but STRUCTURE IN MCNP. Save yourselves the trouble until it is sorted out.

Method chosen for shielding blocks

Blunt blade? pick the sledgehammer

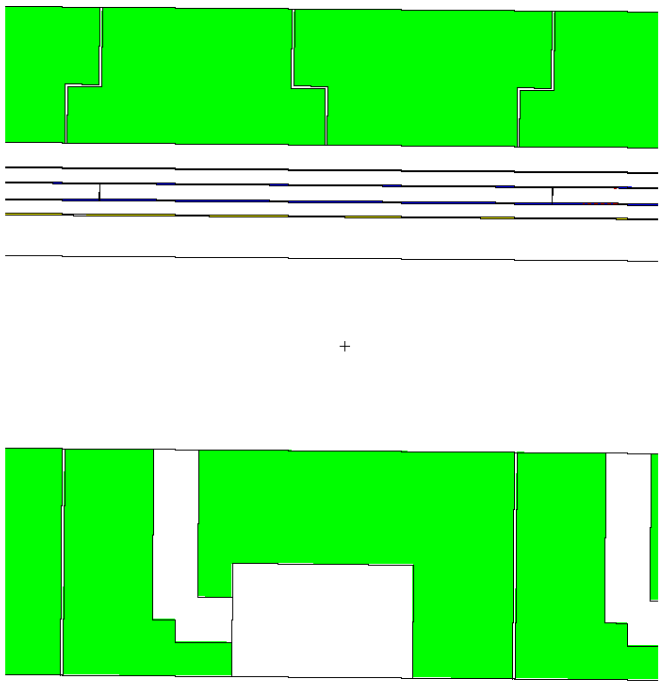
While the ideal like...but structure failed in MCNP, it is still possible to do something equivalent in MCAM. Using the rectangular array feature, we can chain the 4m section of the shielding blocks as needed. We can also slice them using plane surfaces equal to those of the bunker wall, for instance, if needed. This gives a model that is less elegant, but certainly effective

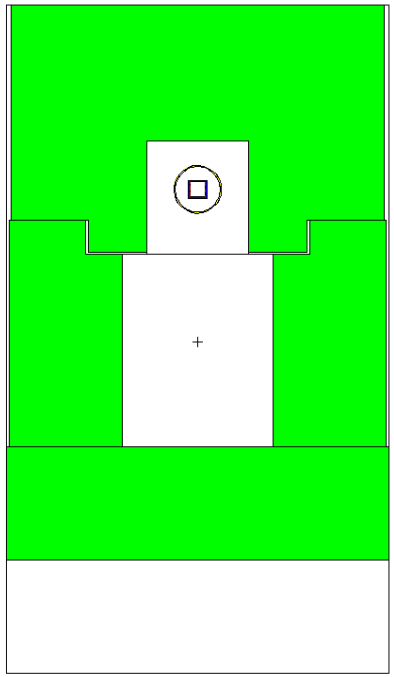


Resulting model

High detail and fidelity to the optics achieved

As noticed in the pics, we have a very nice level of detail, while keeping the model reasonably sane and possible to edit. The Shielding blocks are also available standalone in MCAM, which helps in visualizing and later changes.





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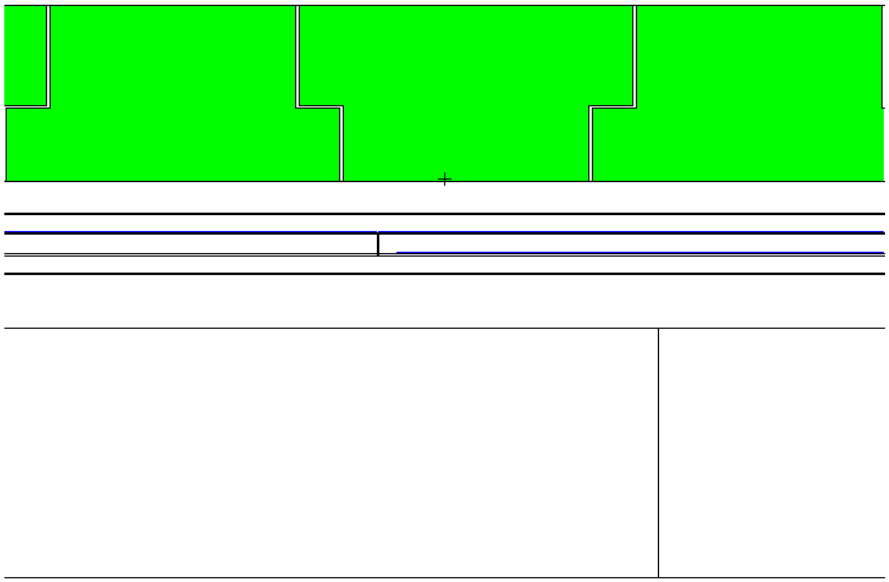

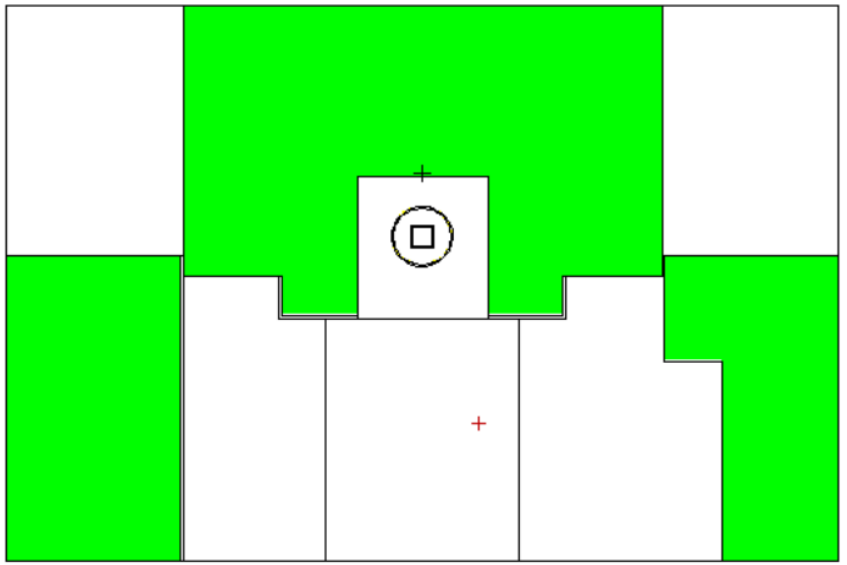

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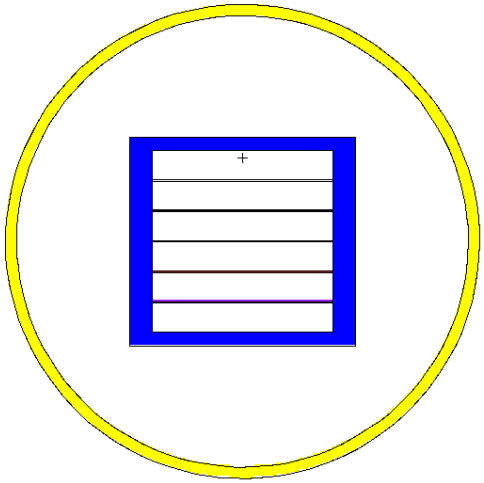

Initial runs and conclusion

slowdown?

The model is significantly slower than others that we have done, but wether this is due to the high detail or the quadratic surfaces is unclear. In any case, we can still get 1E9 thermal neutrons in around 700hours-core, so we are not worried.
Fast source is still pending, Thermal and cold source were already calculated. Overall, this model provides a robust framework to proceed with the calculations, starting with the El2 and ST3 parts, since those will be unaffected by fast neutrons.