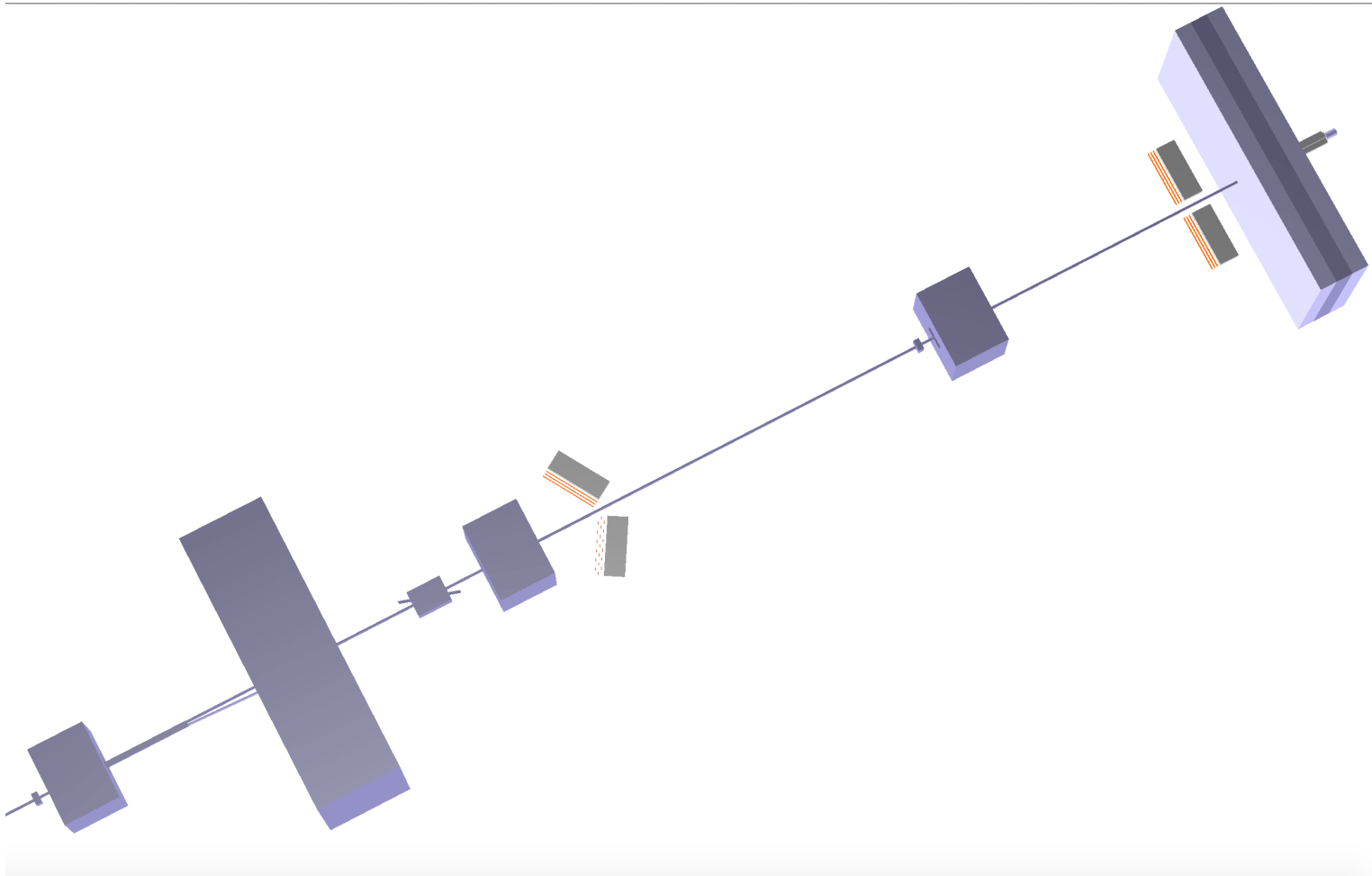


Update on the Simulation integration in the CAD model

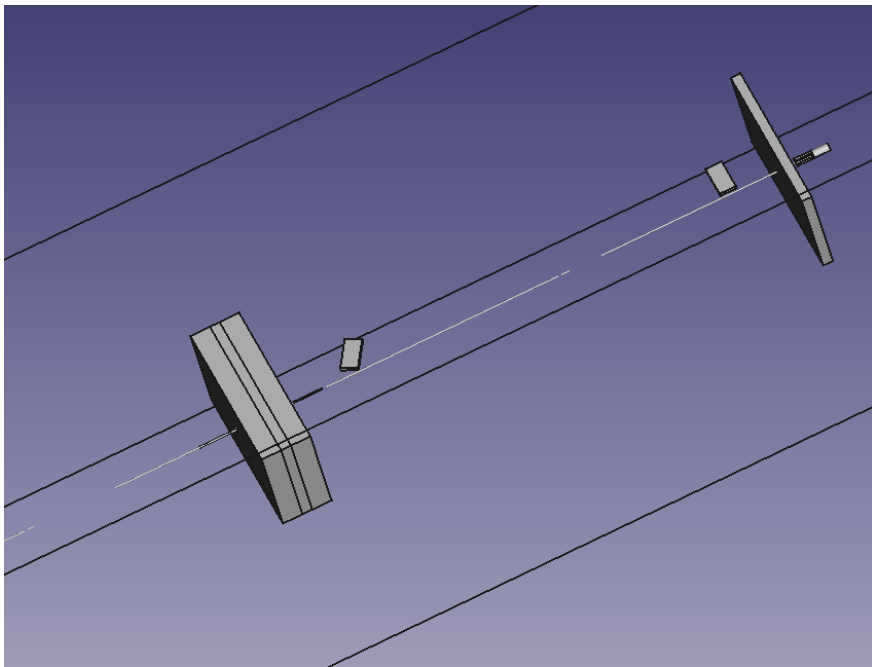
Louis Helary – DESY

April 2nd 2020



Managed to extract gdml file from the simulation some time ago:

- Allow quick (and very easy) visualization and inspection of the geometry in eg ROOT:
 - `TGeoManager::Import("./luxex.gdml");`
 - `gGeoManager->GetTopVolume()->Draw("ogl");`



CAD-GDML on FreeCAD

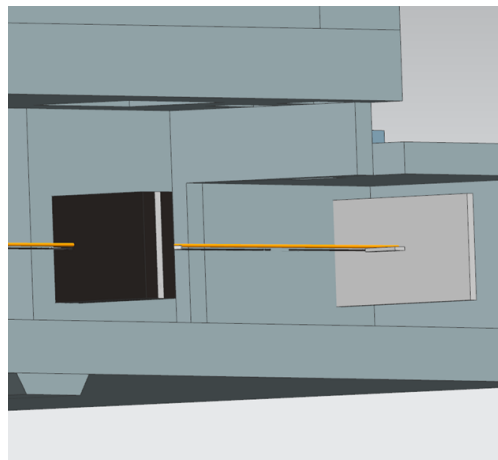
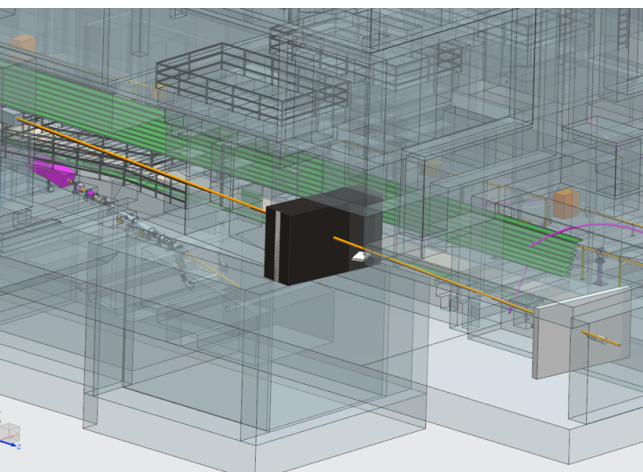
* **Last news** January 2020 : Keith Sloan provide a [GDML workbench for FreeCAD](#) allowing installation via FreeCAD's AddonManager tool. Currently needs FreeCAD developer version.

* September 11 2017 (NO MORE AVAILABLE) : Thanks to Werner Meyer and Keith Sloan '**C++ FreeCAD GDML module**' was updated for latest FreeCAD version (mainly OpenCascade library compatibility)

FORUM : <https://forum.freecadweb.org/viewtopic.php?f=8&t=21120#p163638>
<https://forum.freecadweb.org/viewtopic.php?f=4&t=23221&p=181139&hilit=GDML#p181139>

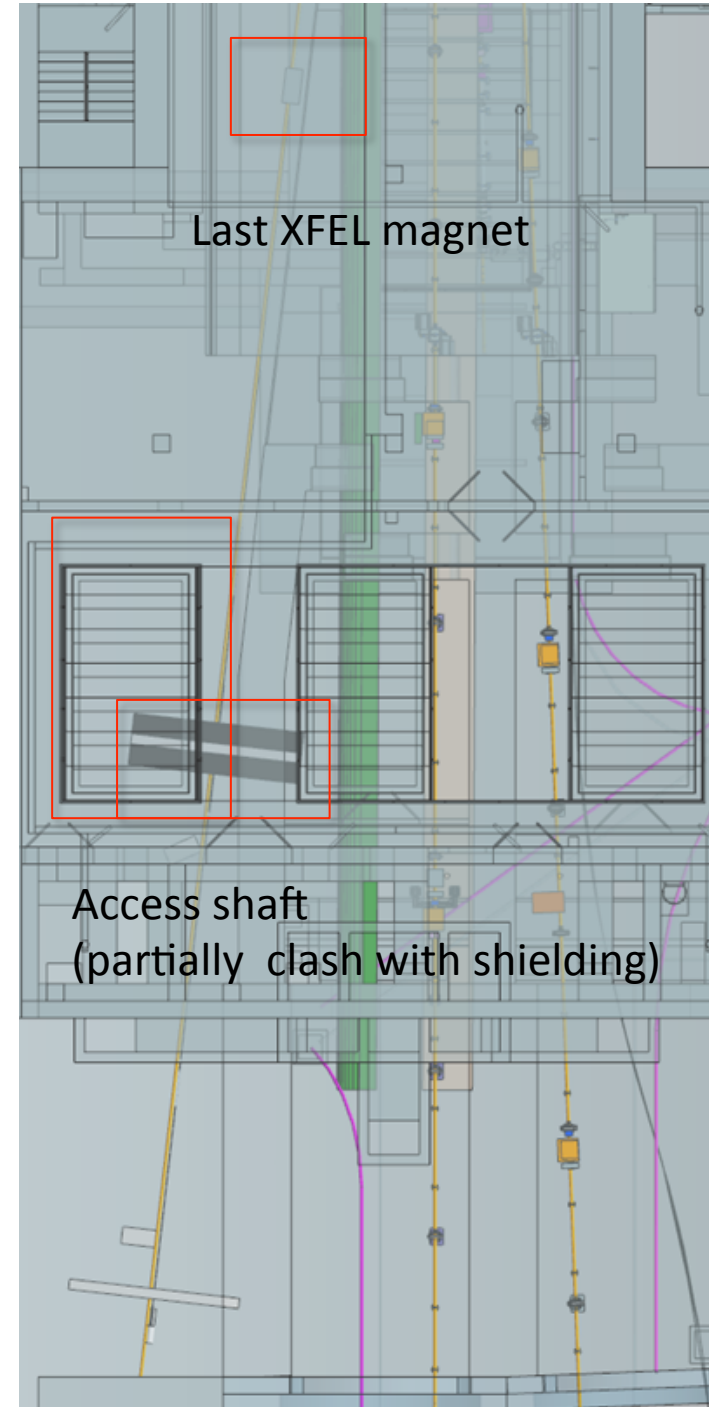
Unfortunately integration in Computer Assisted Design (CAD) software not easy

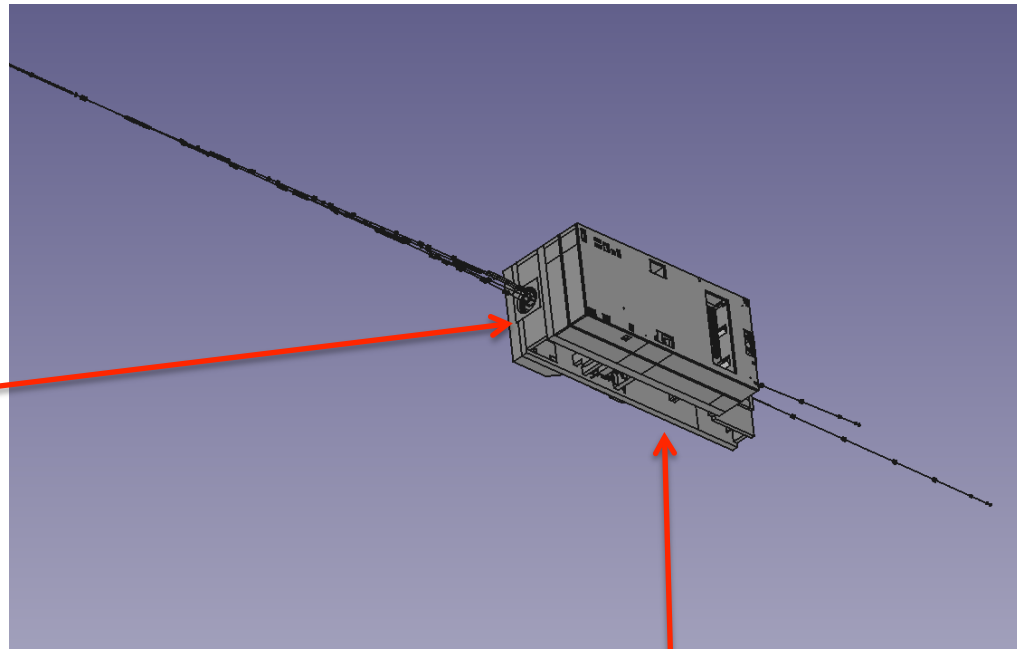
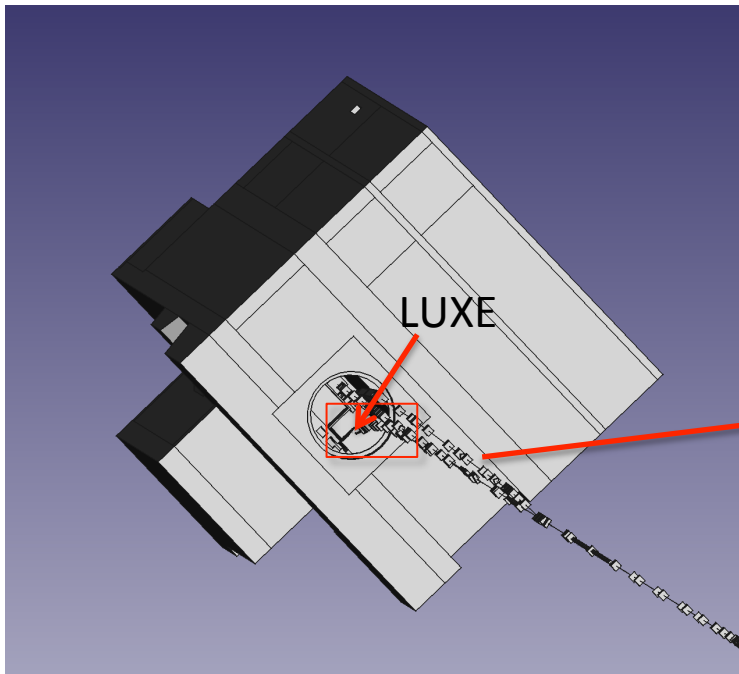
- Multiple non-free solution such as CATIA, FASTRAD, ...
 - Not all allow Geant4 geometry integrations.
 - Multi-thousand euros license with yearly fees.
- DESY uses NX for the CAD model of the accelerator infrastructure.
 - Again it is a non free software.
 - Does not allows the integration of gdml files.
- One option free and open-source is FreeCAD:
 - There is one module that was originally developed by a CNRS researcher (E. Delage) and was take over by a non HEP-person (K. Sloan).
 - Used by people at Jefferson lab apparently.
 - First attempt import, show many missing pieces of instruments... But size looks fine (O(1))



Nevertheless met with D. Thoden from DESY CAD designer accelerator team mid-march to make a first attempt of import of our simulation in the NX CAD of XS1.

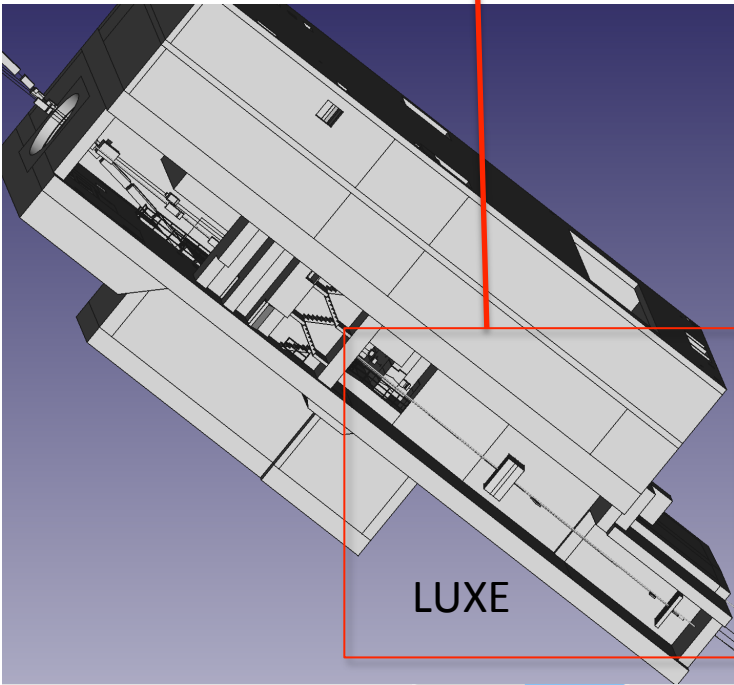
- Worked with caveats.
 - Not all instruments are present.
 - Size of experimental area seems to fit area available @XS1.
 - Shielding overlap with wall and access shaft.
- Daniel made these screenshots and made available an export file (STEP) of XS1 in his public area.
 - Since works on windows disk space, I had to use an ethernet dongle not registered under my name to get his files...
 - Tried to follow UCO instructions but couldn't managed to...

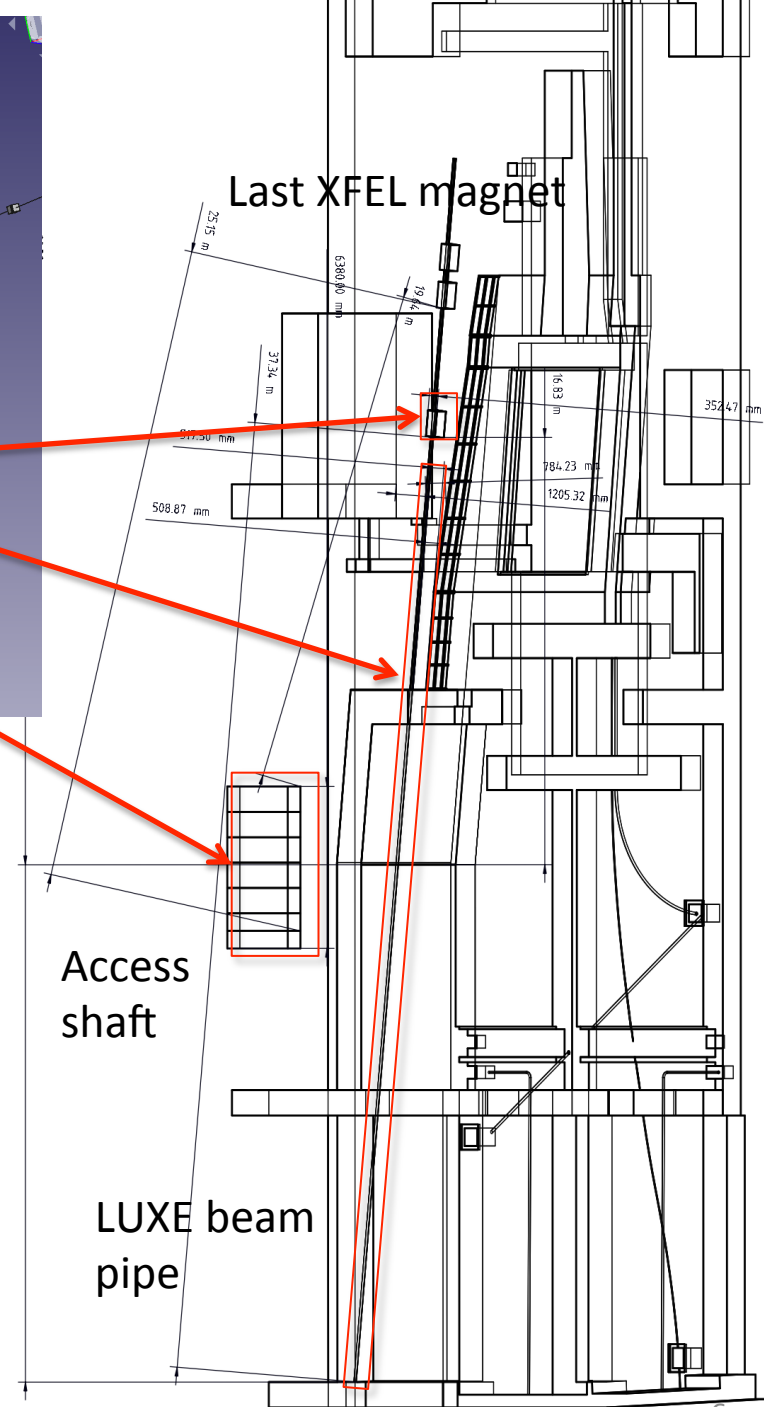
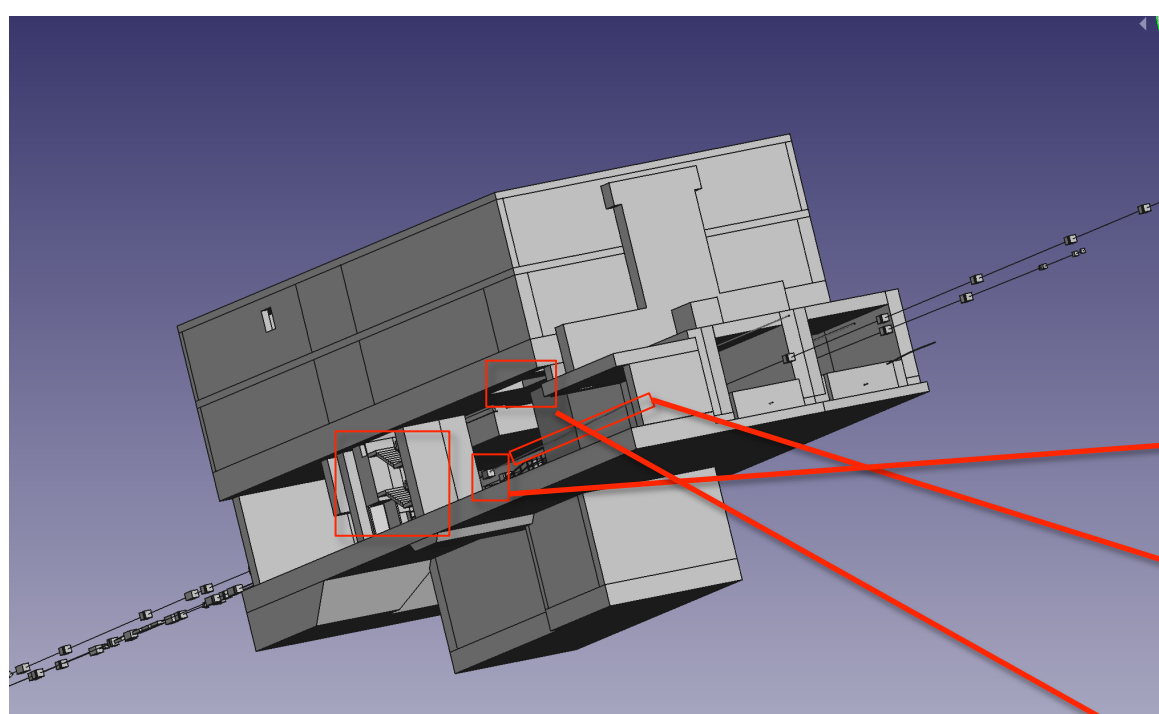




Managed to read back the STEP file in FreeCad.

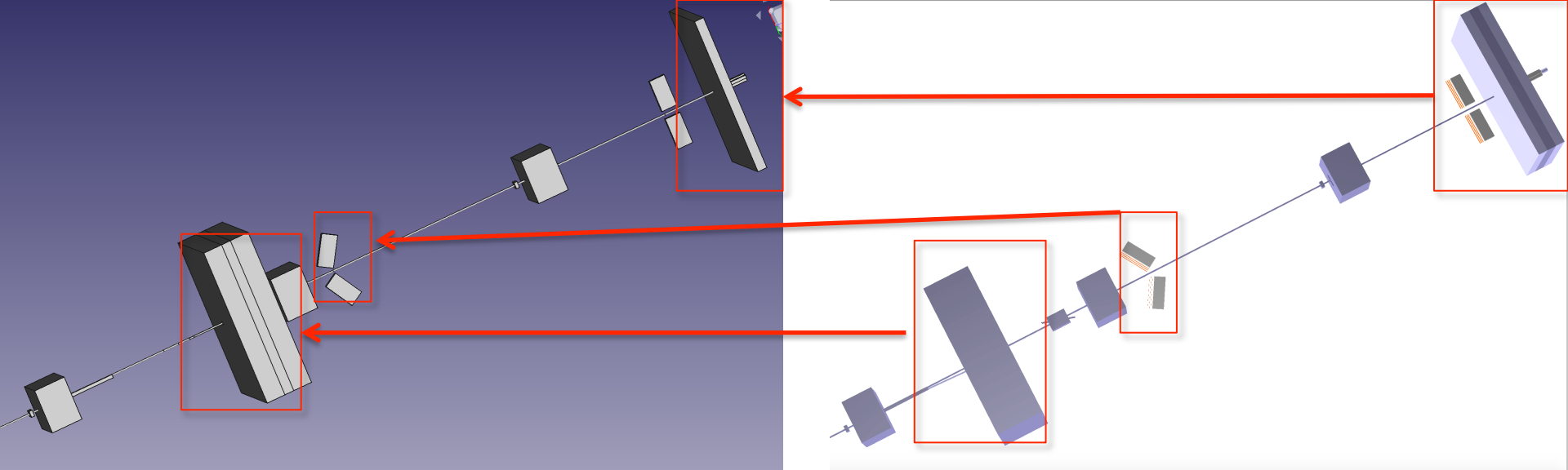
- 3d Model is rather complicated
 - Need a powerful computer to play with it.
 - Good news with the confinement can play with a few powerful computer at home!
 - Experiment is floating in thin air and clashing with the walls...





Decided to remove LUXE from the CAD file of SX1 and play a bit with it...

- 3d Model is even more complicated when each surfaces are decoupled from each others..
- Can see the important elements of the area
 - Stair case.
 - Last XFEL magnet
 - Access shaft
 - Beam pipe (implemented by accelerator team)
- Can easily create 2d projections of wanted elements and get distances to feed back the simulation!

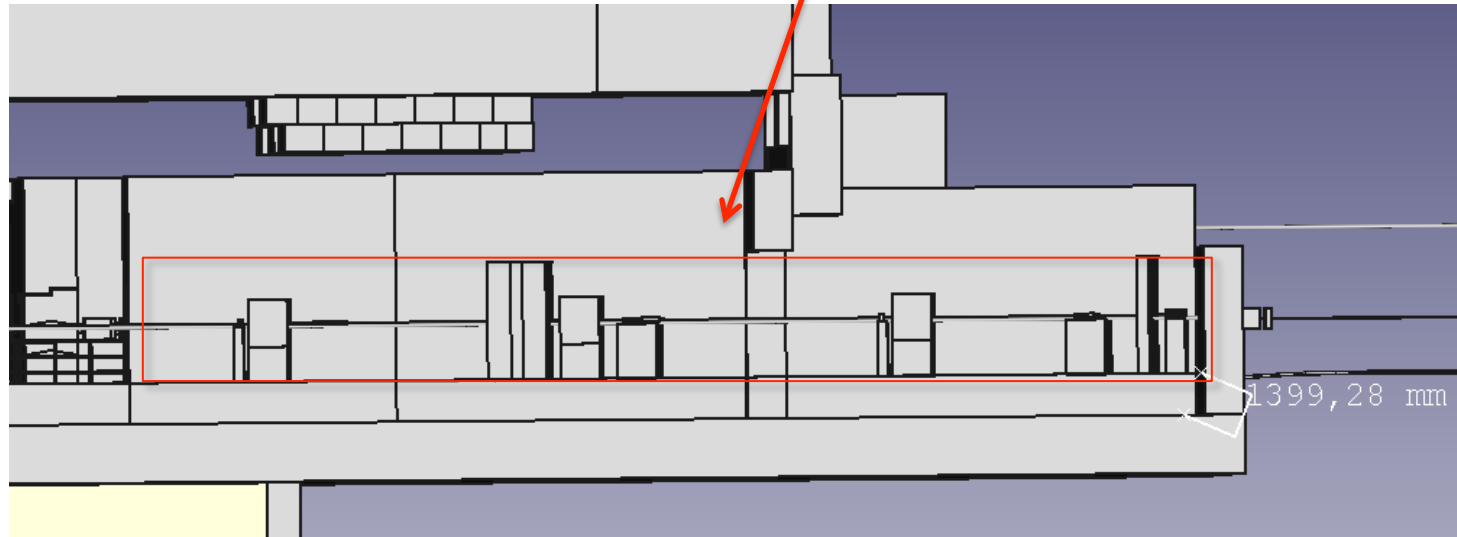
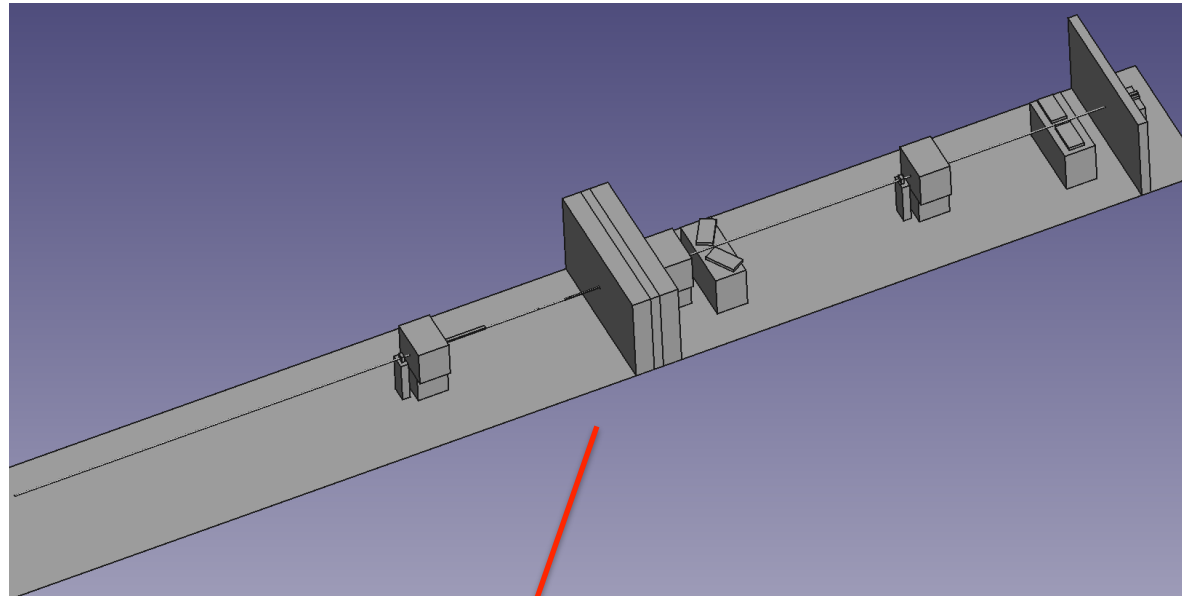


Second attempt to import simulation in FreeCad (changing software version) gives much better result (but still not perfect...)

- Shielding before IP seems to be shifted by a few meters.
- The dump beam pipe seems to be absent.
- Rotation axis of the tracker and calo seems to be inverted.
 - I'm not sure the tracker are actually there btw..
- Part of the back shielding seems to be missing too.
- Investigating further it seems that all the pieces are now there but some of them have been concatenated in the axis origin when the import position is not properly interpreted.
 - Need to understand what's going on, I'm in contact with K. Sloan for debugging.
 - We are developing a macro to make the conversion GDML -> STEP to ease on this process.

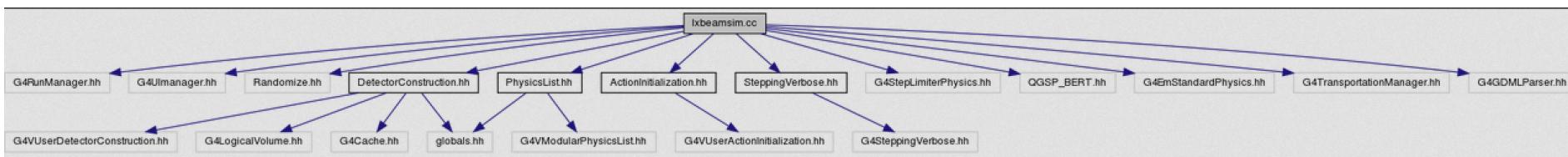
Added a floor and structure elements below each piece of equipment (1.5m high) and feed it back in the CAD model of SX1:

- Total length still fit.
- Beam pipe is ~1.5m too high
 - Although my understanding is that this can easily be changed from the accelerator side.



Other news:

- Work on the simulation:
 - First attempt to include GDML module to read back geometry seems to be partially working, need further debugging.
 - Added Doxygen documentation to the version of the simulation I have locally
 - Mostly for myself to understand dependencies between classes.
 - If useful I could share it.
 - Need to add some documentation inside the code to help on the readability in this case...



- Got FLUKA geometry from Gianluca, need to understand how to interface it with Geant4.