New MC campaigns including passive materials

G. Battistoni, Y. Dong, S. Muraro

INFN Milano

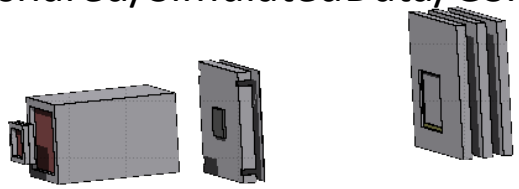
Summary of previous episodes:

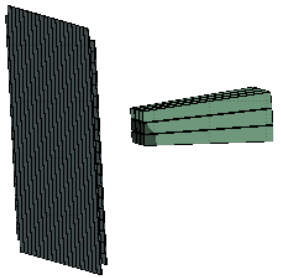
In Shoe newgeom an attempt was made, introducing “by hand” (= not managed by Shoe) passive regions for SC, VTX and MSD.

Some preliminary production was run:

1) GSI2021_MC run 400 and 401 (C and C_2H_4 target)

Tier1: /storage/gpfs_data/foot/shared/SimulatedData/GSI2021pass_MC



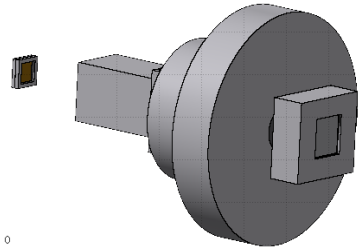


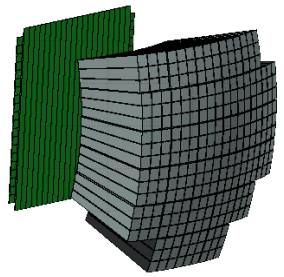
16O_C_400pass_shoereg.root $5\ 10^6$ primaries

16O_C2H4_400pass_shoereg.root $5\ 10^6$ primaries

2) CNAO2023_MC run 1

12C_C_200pass_shoereg.root 10^6 primaries





After the last analysis meetings:

It was realized that a few items had to be modified (e.g.: differences in VTX box geometry) and few others were discussed (e.g.: proper beam size and position)

A new (provisional) dedicated branch of shoe was started, originating from newgeom, to achieve a complete management of the new geometries

SimPass

Originating from newgeom_v1.0

Main novelties

TASTbase/TASTparGeo.cxx & .hxx ➔ to create Al frame regions in SC

TAVTbase/TAVTbaseParGeo.cxx & .hxx
TAVTbase/TAVTparGeo.cxx & .hxx
➔ to create passive regions in VTX [PCB and box]

TAMSDbase/TAMSDparGeo.cxx & .hxx ➔ to create passive regions in MSD [PCB and box(es)]

TAGbase/TAGmaterials.cxx
TAGbase/TAGbaseMaterials.cxx
TAITbase/TAITparGeo.cxx
➔ to create and manage PCB materials

Some new parameters are read from geomaps files to specify main parameters of passive regions/materials, making use of the SupportInfo flag (already created for IT):

> 0 passive materials parameters are required
= 1 GSI2021
= 2 CNAO2022, HIT2022
= 3 CNAO2023

New separate MC campaigns with passive materials

To keep them separate from the old ones and make the comparison easier:

GSI21PS_MC (to be compared with GSI2021_MC)
run: 400 (C), 401 (C2H4), 402 (AIR), 200, 201, 202

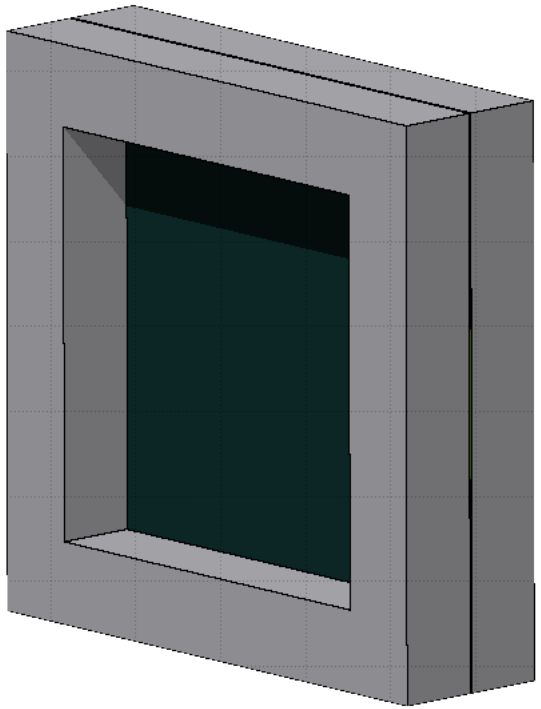
HIT22PS_MC (to be compared with HIT2022_MC)
run: 100, 140, 200, 220

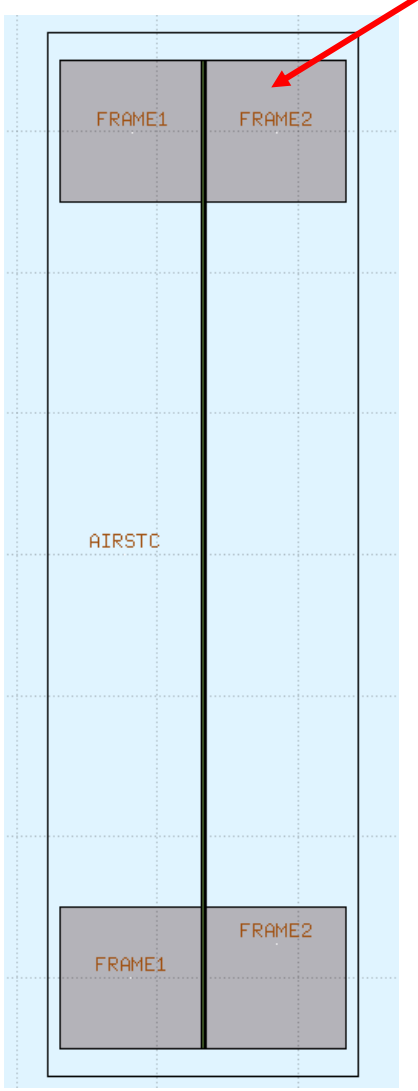
CNAO22PS_MC (to be compared with CNAO2022_MC)
run: 200 (C), 201 (C2H4)

CNAO23PS_MC (to be compared with CNAO2023_MC)
run: 200 (C), 201 (C2H4), 202 (AIR)

Warning: so far in MC campaigns run number was just set to 1. **We prefer, from now on, to use the convention of having a run number in MC always connected to energy and target**

SC





1 cm + 1 cm Al frame

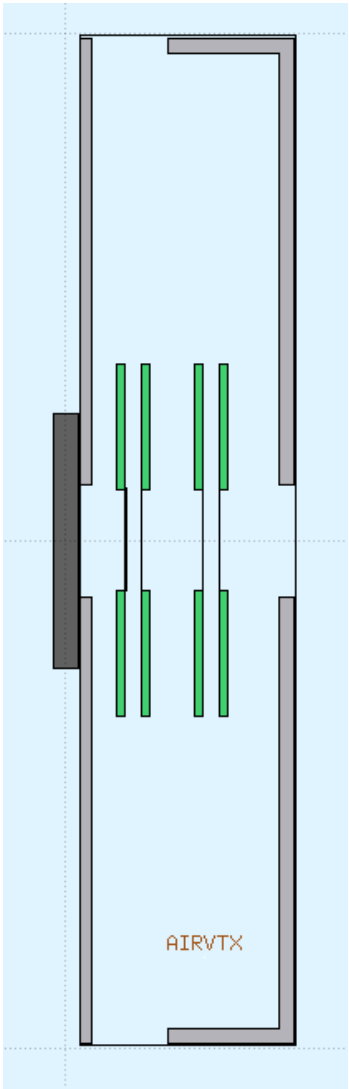
Warning:
The plastic box around is not considered: actually if the beam had such a large width it would be a useless run for physics

The Al frame in SC will be created for all campaigns, even when no passive materials are requested for VTX and MSD

For technical reasons, now SC, VTX and MSD are each one enclosed into an air box

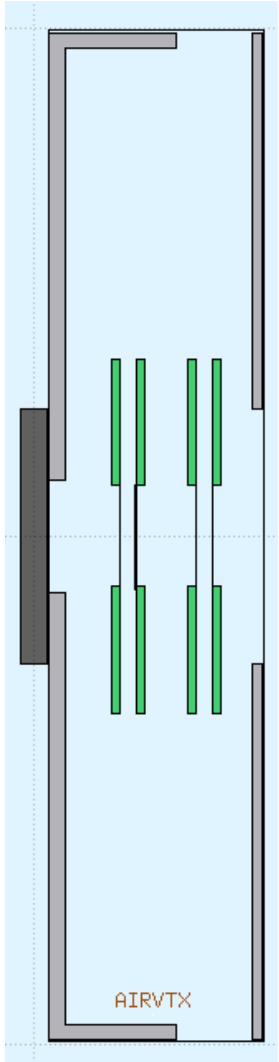
That means: **if you use “crossings” in MC analysis, then you need to take into account that particles entering, for instance, in STC are no more coming from AIR1 but from AIRSTC (AIR1 → AIRSTC → STC)**

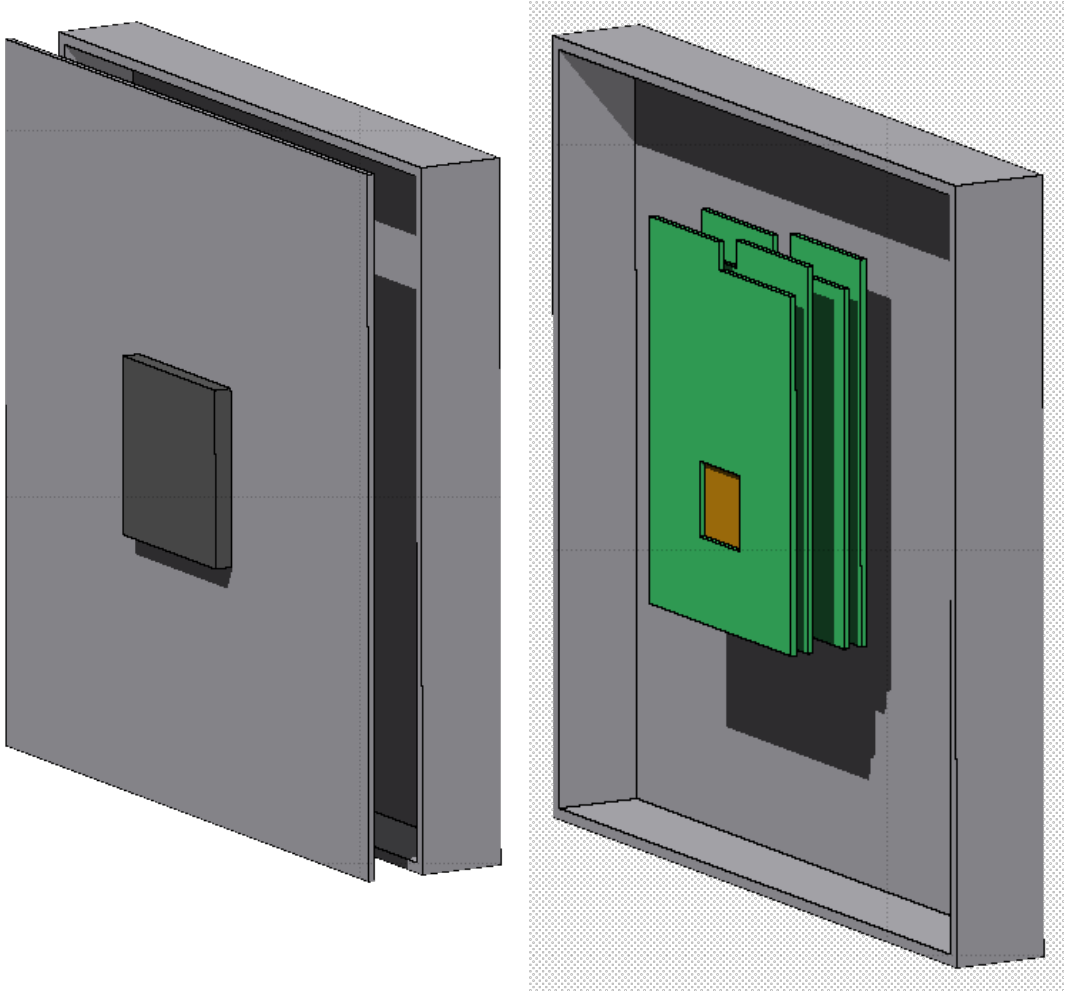
VTX



GS21PS_MC (SupportInfo=1)

CNAO22PS_MC (SupportInfo=2)



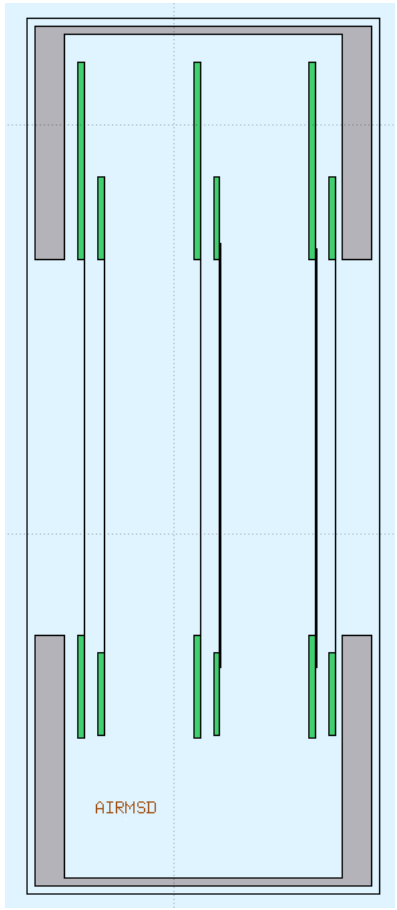


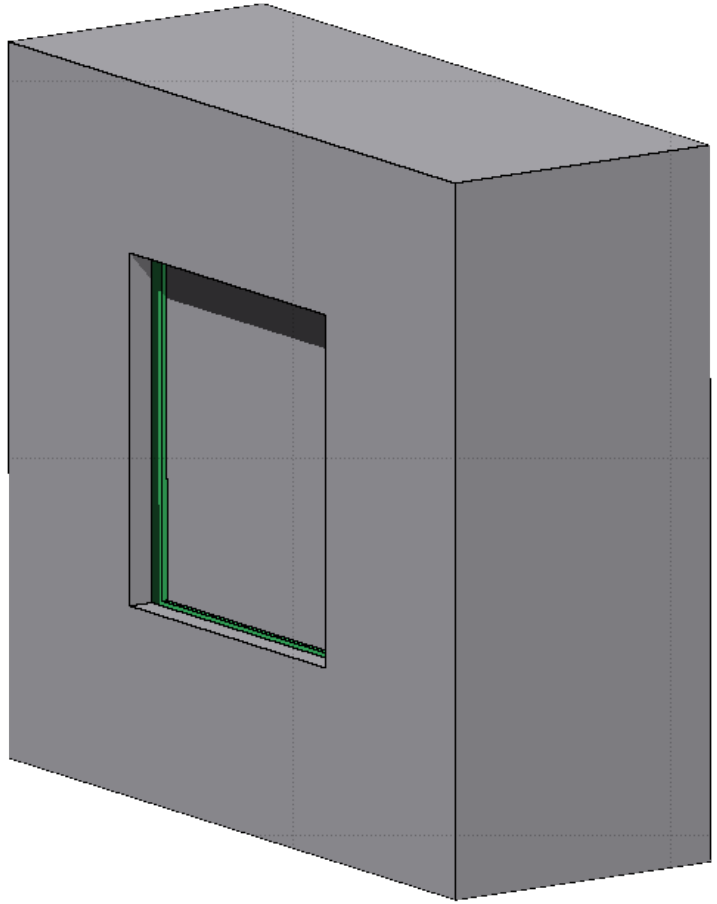
CNAO23PS_MC (SupportInfo=3)

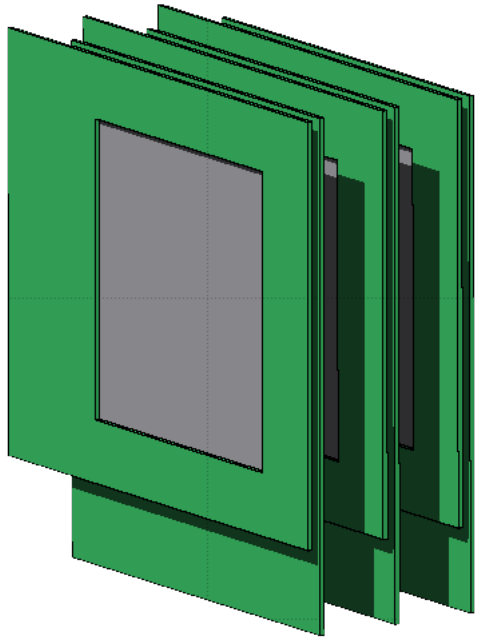
Example of supplementary infos in geomaps/TAVTdetector.geo

```
//
SupportInfo:        1
//
EpoxyMat:                "Epoxy"
EpoxyMatDensity:         1.18
EpoxyMat:                "Eg"
EpoxyMatDensity:         2.61
PCBMat:                  "Epoxy/Eg"
PCBDensities:            "2.61/1.19"
PCBProp:                 "0.6/0.4"
PCBDensity:              1.85
PCBSizeX:                6.95    PCBSizeY:     9.8      PCBSizeZ:     0.16
PCBOffsetX:              0.0     PCBOffsetY:   1.779    PCBOffsetZ:   0.0
PCBHoleSizeX:            1.9884  PCBHoleSizeY: 1.92096  PCBHoleSizeZ: 0.16
BoxMat:                  "Al"
BoxDensity:              2.7
Box1SizeX:               19.8  Box1SizeY:   19.8    Box1SizeZ:    0.2
Box2SizeX:               19.8  Box2SizeY:   19.8    Box2SizeZ:    2.5
BoxOffX:                 0.0  BoxOffY:         0.0   BoxOffZ:      0.0
BoxHole1X:               2.2  BoxHole1Y:      2.2   BoxHole1Z:    0.2
BoxHole2X:               2.2  BoxHole2Y:      2.2   BoxHole2Z:    0.3
```

MSD CNAO23PS_MC

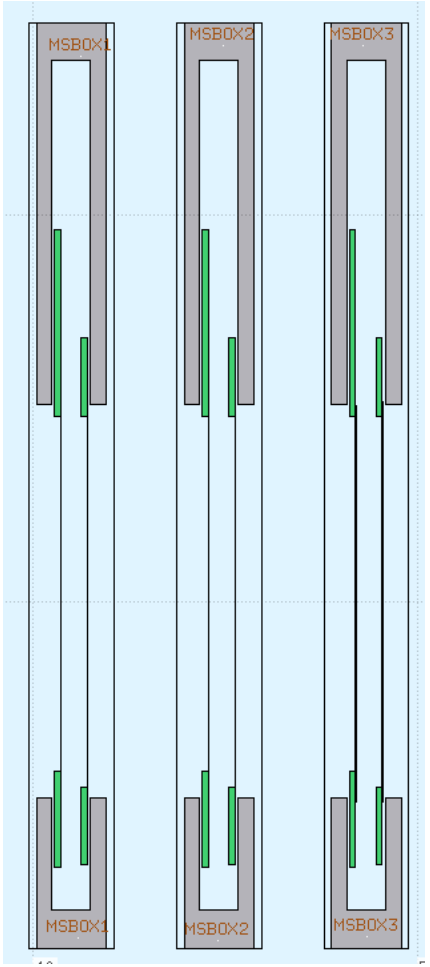




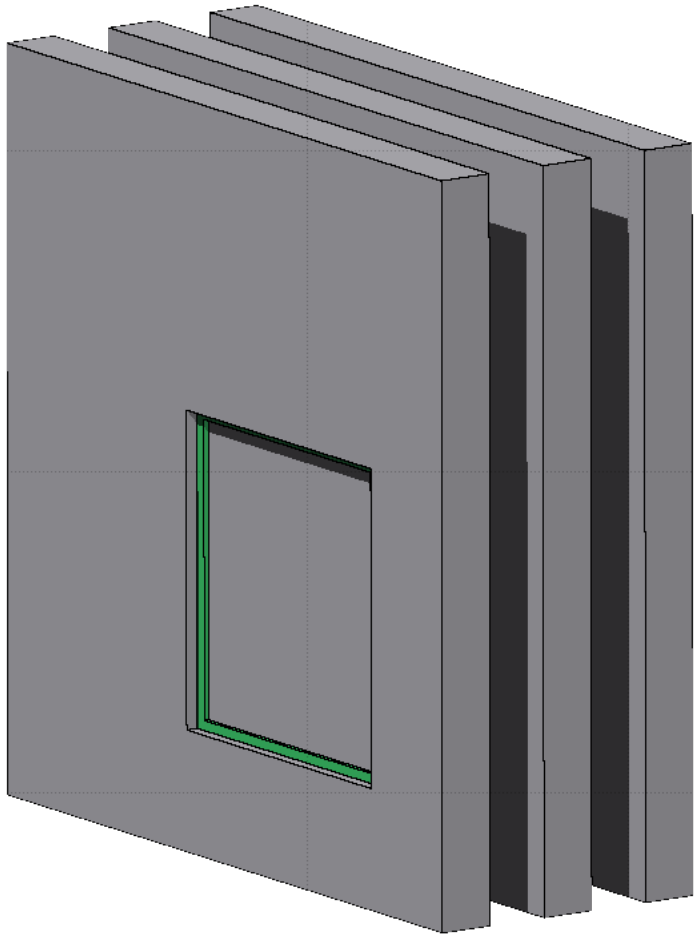


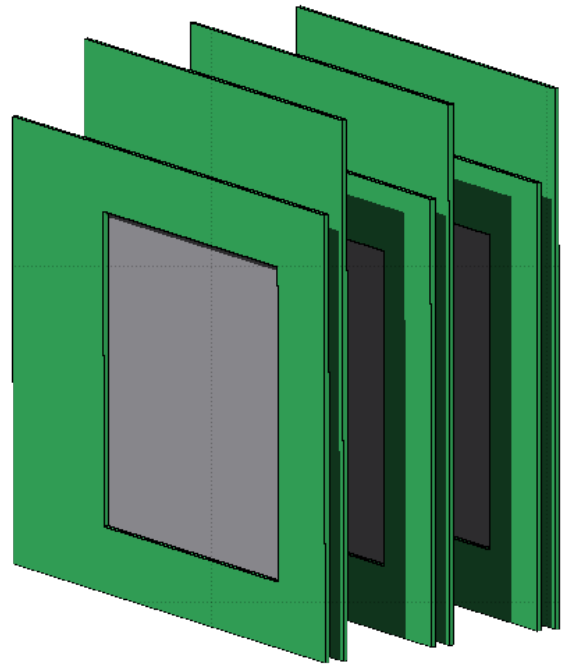
MSD GSI21PS_MC

3 boxes (3 different AIRMSD)



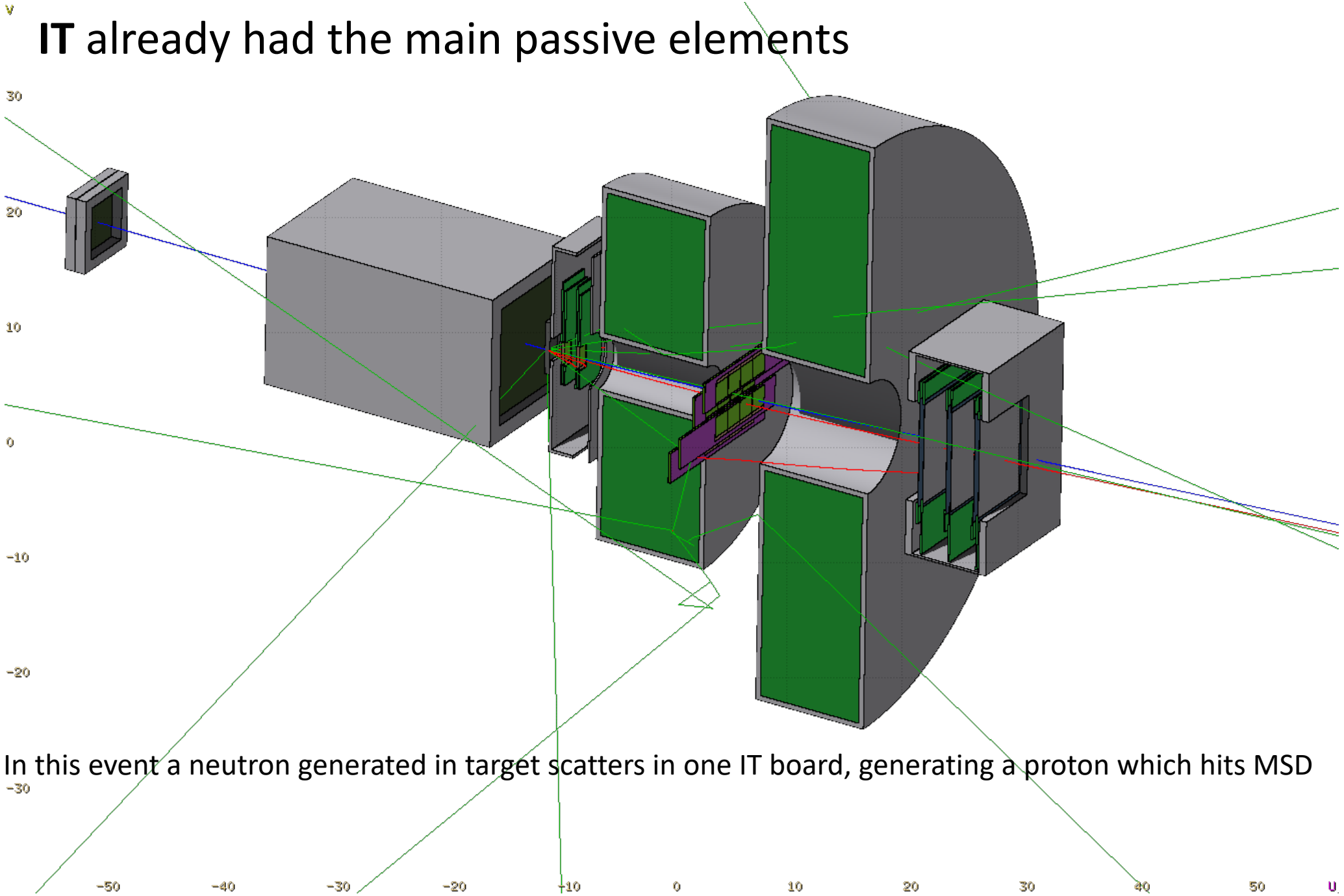
Similar, but different orientations, distances etc for CNAO22PS_MC and HIT22PS_MC





Warning: we assumed that boxes for CNAO2022 and HIT2022 were the same: actually we have no info about that

IT already had the main passive elements



In this event a neutron generated in target scatters in one IT board, generating a proton which hits MSD

Region numbering

New passive regions have been defined at the end in geomaps/FOOT.reg : that means that all active regions are numbered exactly as before, to make analysis easier

The new regions (after calorimeter) in CNAO23PS_MC:

```
Region n.      658 AIRSTC   Air box
Region n.      659 FRAME1   1st Al frame
Region n.      660 FRAME2   2nd Al frame
Region n.      661 AIRVTX   Air box
Region n.      662 VBOXF    Front part of VTX box
Region n.      663 VBOXB    Rear part of VTX box
Region n.      664 VTXB0    PCB 0
Region n.      665 VTXB1    PCB 1
Region n.      666 VTXB2    PCB 2
Region n.      667 VTXB3    PCB 3
Region n.      668 AIRMSD   Air box
Region n.      669 MSBOX    Al box
Region n.      670 MSDB0    PCB 0
Region n.      671 MSDB1    PCB 1
Region n.      672 MSDB2    PCB 2
Region n.      673 MSDB3    PCB 3
Region n.      674 MSDB4    PCB 4
Region n.      675 MSDB5    PCB 5
```

SC

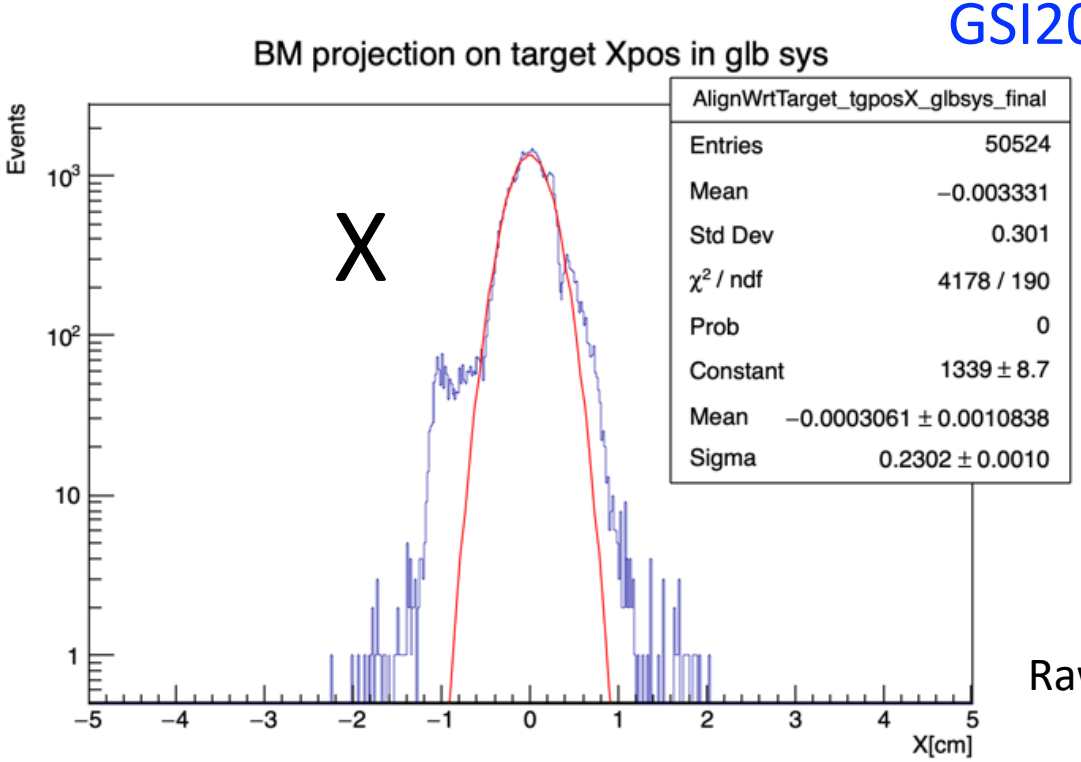
VTX

MSD

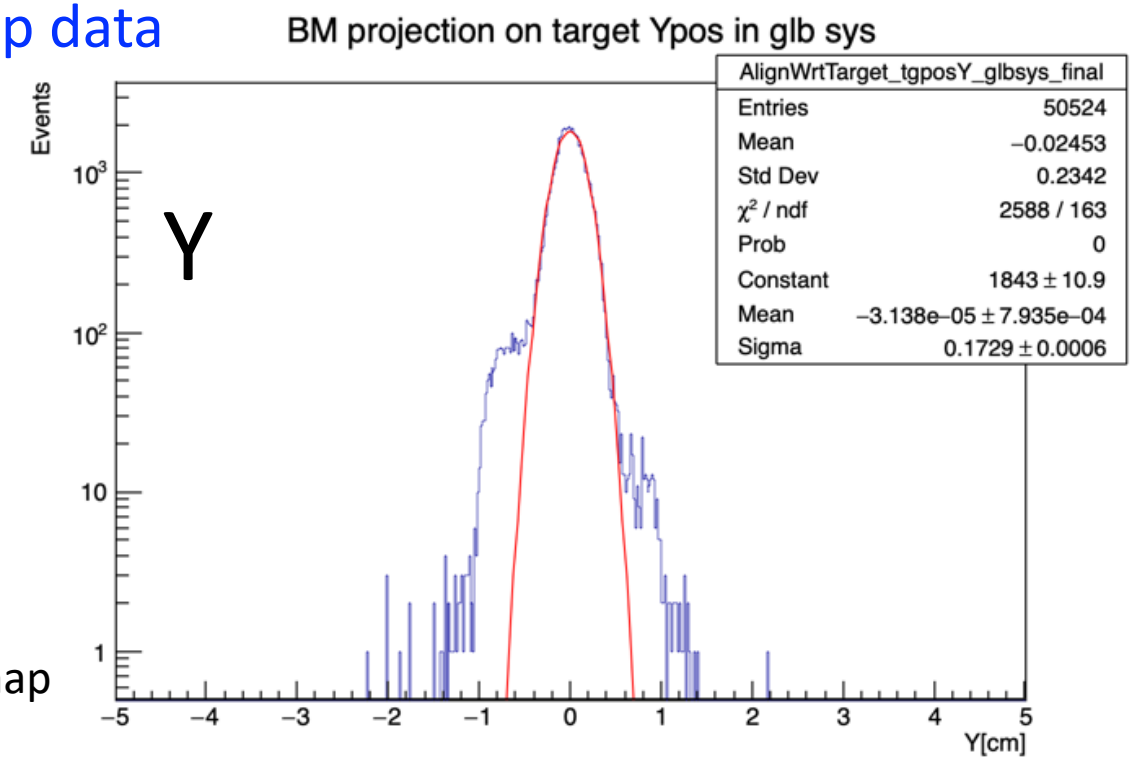
Towards a meaningful simulation

The main issue is the Beam Model and its lateral structure (otherwise the addition of passive material might be not considered in the correct way)

GSI2021 exp data



Raw BM map



Discussed with Physics coordinator and others: to center the beam according to the translation of the VTX in FOOT.geo **AFTER** alignment. This means to take the position of the beam from NO-TG run for clean events in VTX with one single track.

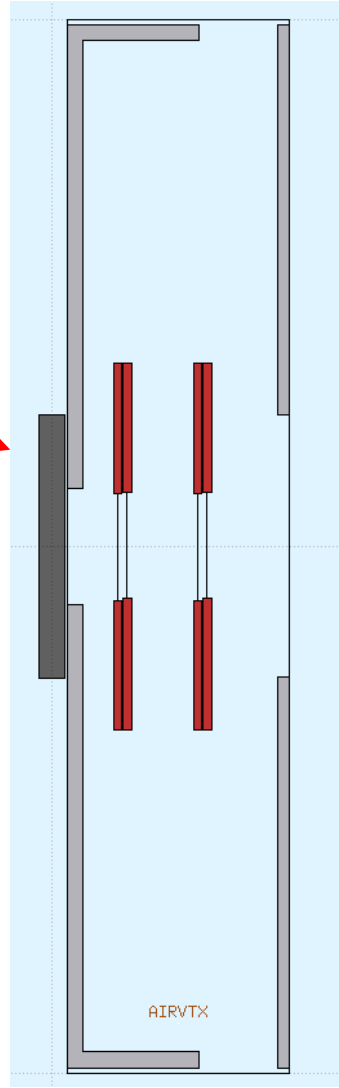
Also: we shall use the X and Y rms as measured with BM. We will try to study a systematic effect of this choice for the first analysis with tracking

The issue of Target+VTX and their roto-translations

So far in our geomaps, TG ad VTX are considered as separate objects, but in reality we have always attached TG to the VTX box

We have 2 separate local frames for TG and VTX since the beginning, but this is wrong.
As we have been working so far, TARGET is a part of VTX

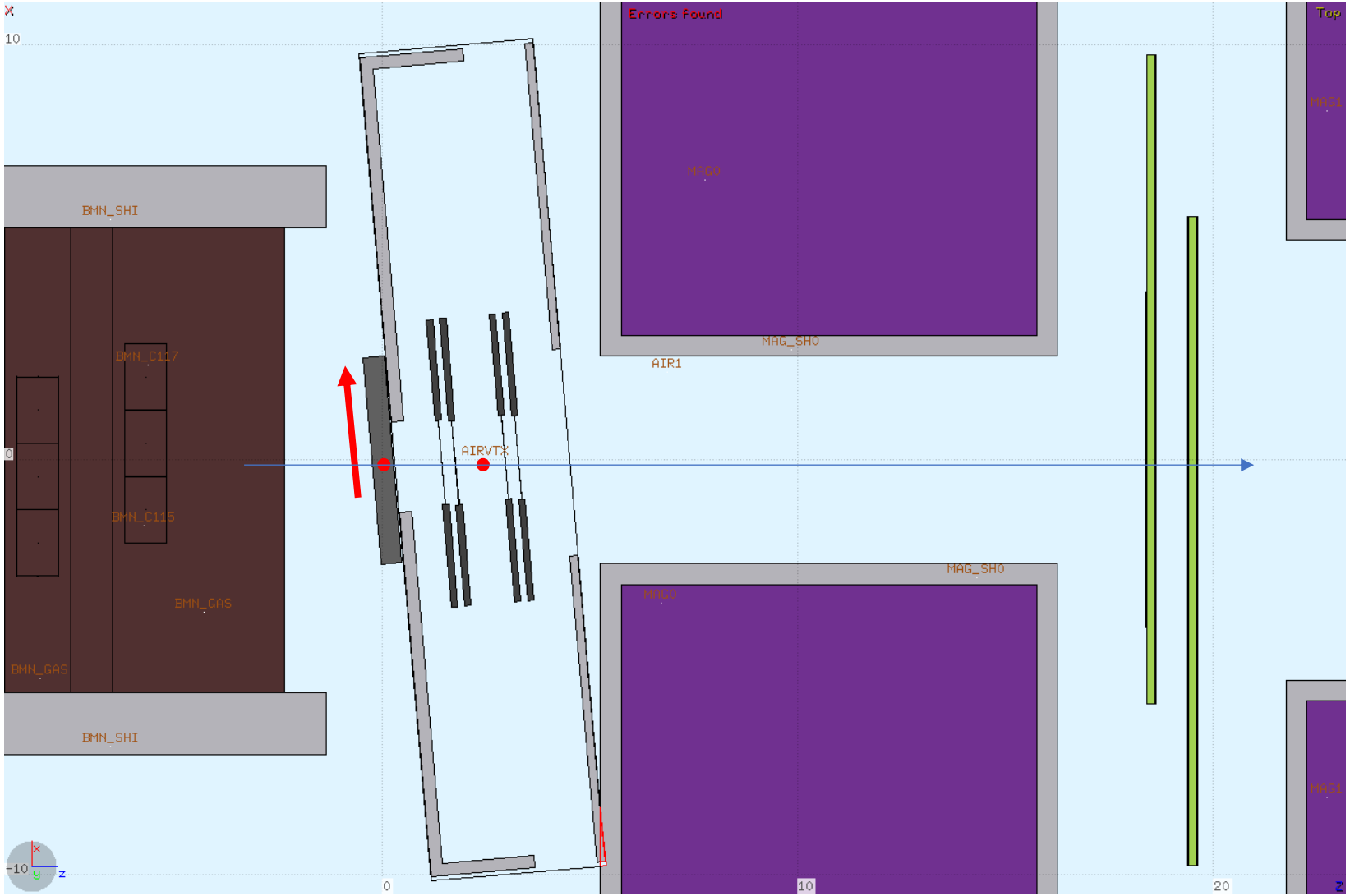
They should be moved together



The issue of Target+VTX and their rotations

However: the present system allows to rotate VTX by a few degrees (max 3-4 degrees) before having geometry problems

During rotation TARGET shifts up or down the VTX box, but for small angles this is negligible



Conclusions and “To do” list:

- The SimPass branch of Shoe has been successfully (apparently…) created
- The MC geometry works, but there is still one thing left: one should also create the ROOT geometry for GenFit tracking
- After discussing with some people, the idea is that this is surely something to be considered, but it can be done later
- Therefore if there are no objections we would like to merge SimPass with newgeom
- We are ready to produce GSI21PS_MC (actually this is ready within SimPass)
- Other production priorities are CNAO23PS_MC and HIT22PS_MC, but we need to receive an input about the beam model to be used, as for GSI2021