Developments in Simulation

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Outline

1. CNAO2020 Production
2. Neutron experiment
3. GSI2021 preparation
4. The final design of magnet system
5. Future strategies and new options
6. Conclusions

1) CNAO2020 update of available files
/gpfs_data/local/foot/Simulation/CNAO2020

After the decision taken at the Software Meeting to change class names, on Apr 19, all CNAO2020 files have been reprocessed using the last available SHOE version

em → with $e^+/e^-/\gamma$ transport activated

shoereg → with Region Crossing info (-reg option)

^{12}C at 200 MeV/u on C (5 mm ρ=1.83 g/cm^3):

12C_C_200(em)_shoe.root

12C_C_200(em)_shoereg.root

^{12}C at 200 MeV/u on C_2H_4 (5 mm ρ=0.94 g/cm^3):

12C_C2H4_200(em)_shoe_1.root

12C_C2H4_200(em)_shoe_2.root

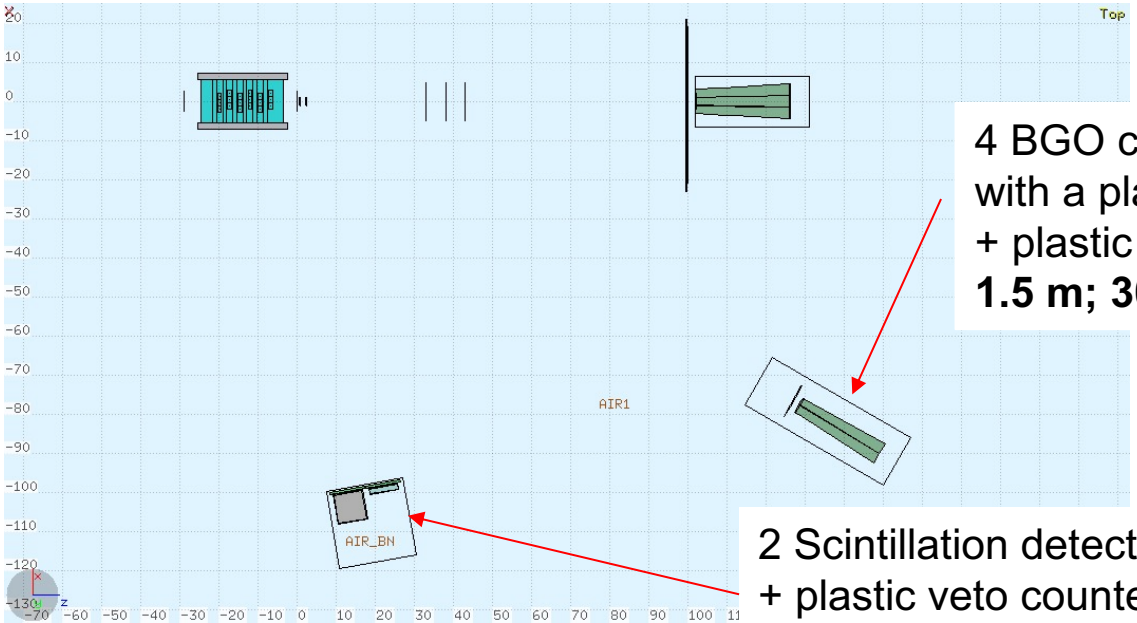
12C_C2H4_200(em)_shoereg_1.root

12C_C2H4_200(em)_shoereg_2.root

2) Neutron experiment study

/gpfs_data/local/foot/Simulation/Neutrons

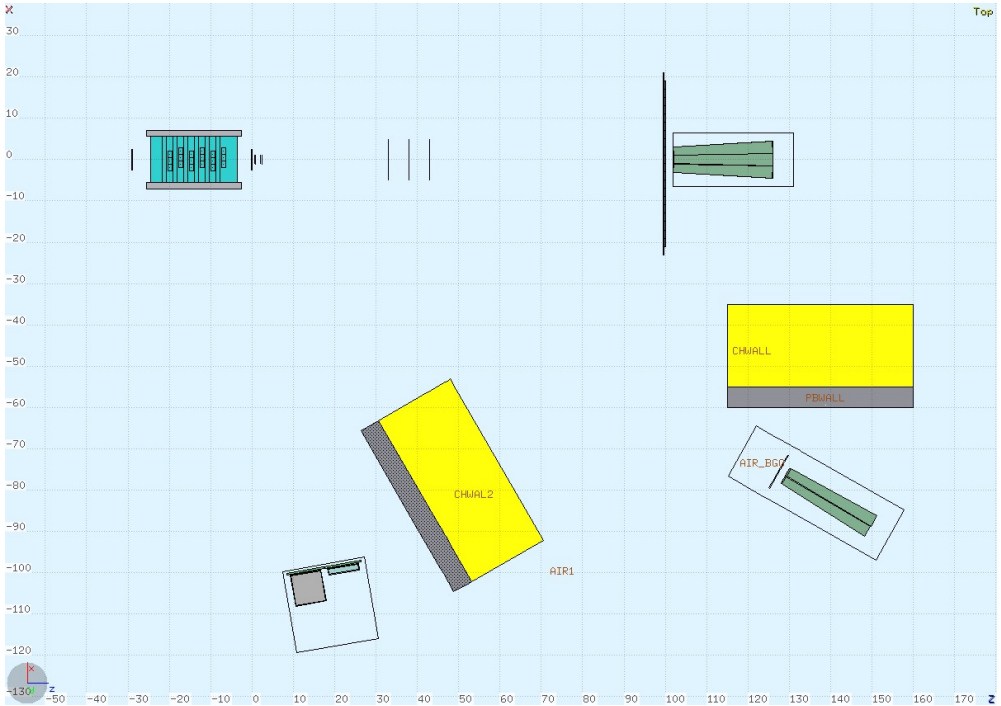
Special dedicated simulation runs have been produced for the neutron experiment group, adding additional detectors to the CNAO2020 setup



4 BGO crystals (in phoswhich configuration with a plastic scintillator in front)
+ plastic veto counter
1.5 m; 30º

2 Scintillation detectors (BC501) and EJ212 BGO
+ plastic veto counter
1.0 m; 30º and 80º

Additional configurations considered to help thermalization of background neutrons and stop gammas

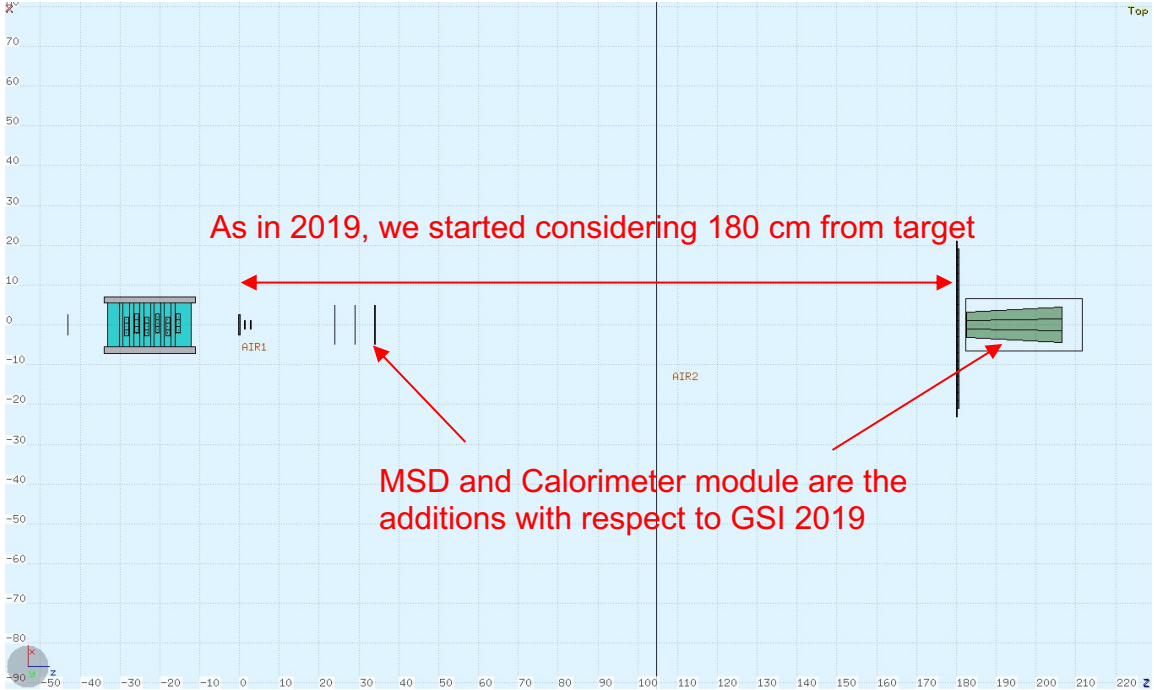


Polyethylene + Pb walls
or Water Tanks

Due to the insertion of additional detectors all analyses must be carried out outside Shoe

3) New GSI2021 campaign

In view of the next data taking at GSI in July, we have preliminary prepared a new campaign (GSI2021) starting CNAO2020 and GSI_MC



Projectile ^{16}O

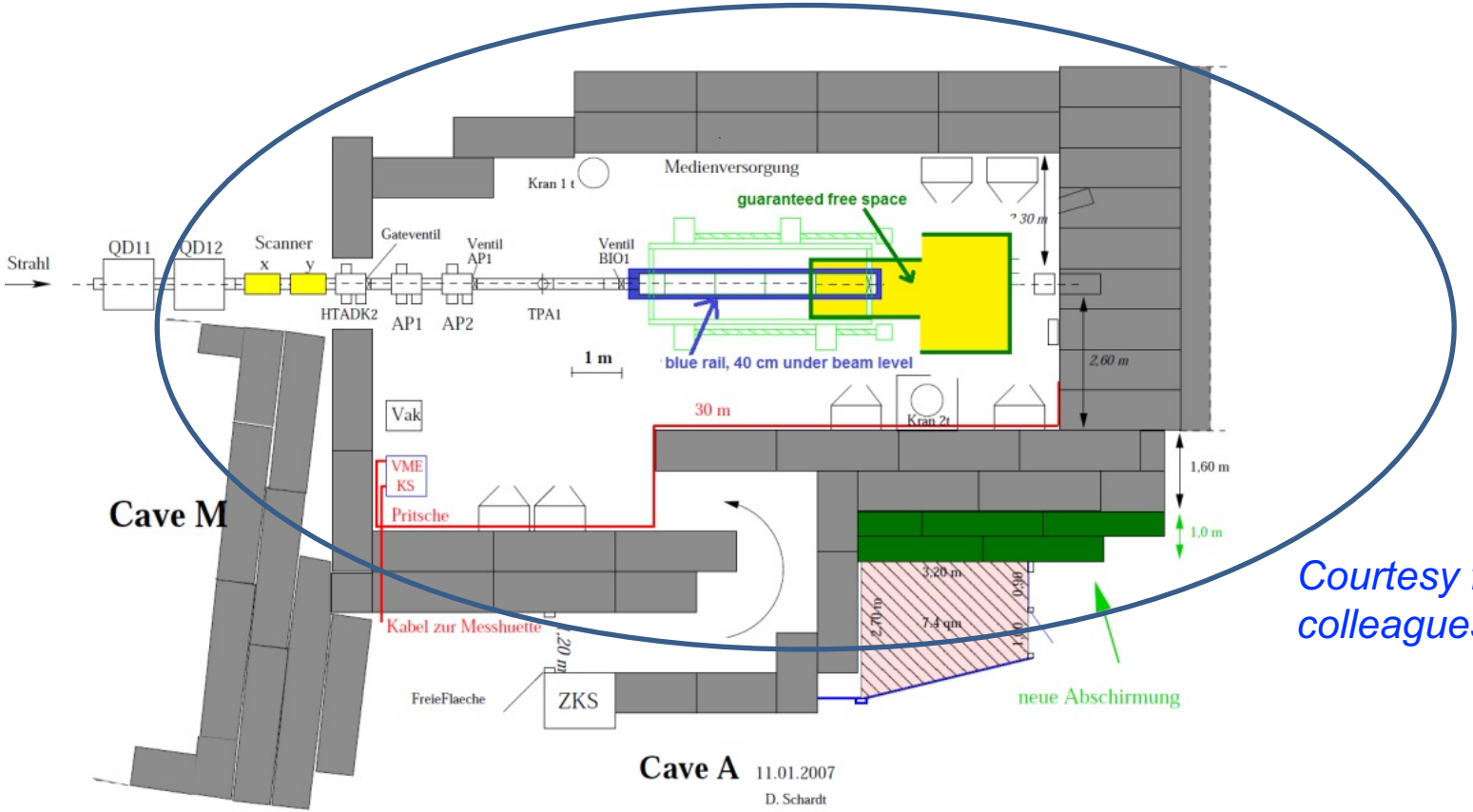
Requested energies:
200 and 400 MeV/u

Positioning of MSD will be discussed with Perugia and Run coordinators next Monday

Are other changes needed for the rest of the setup?

Campaign will be committed if/when agreement is reached

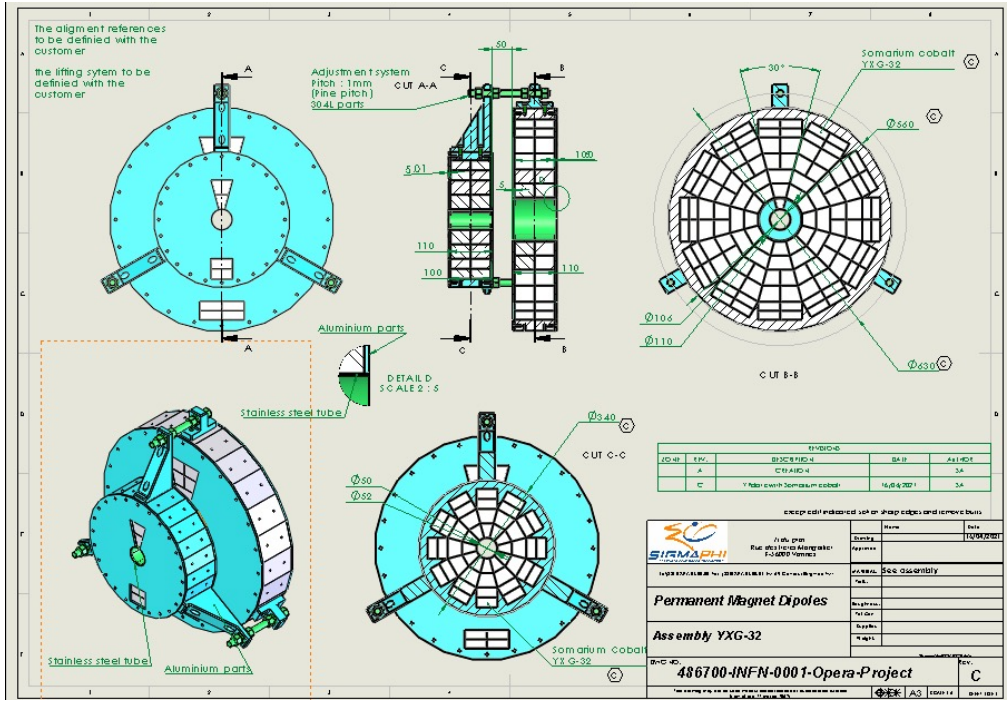
In case someday it becomes necessary, we have the Fluka geometry for Cave A



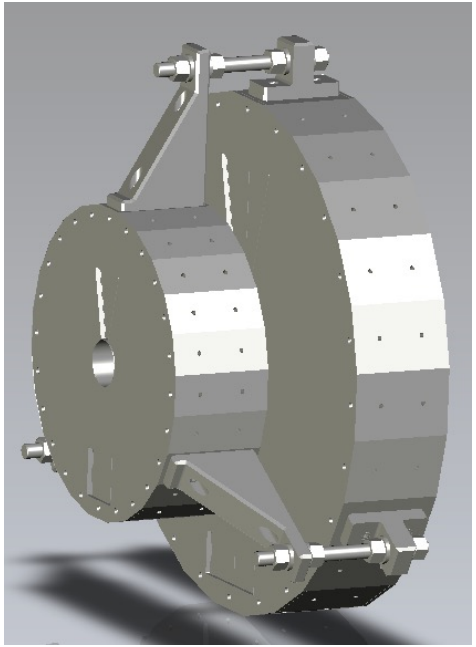
Courtesy from GSI colleagues (D. Boscolo)

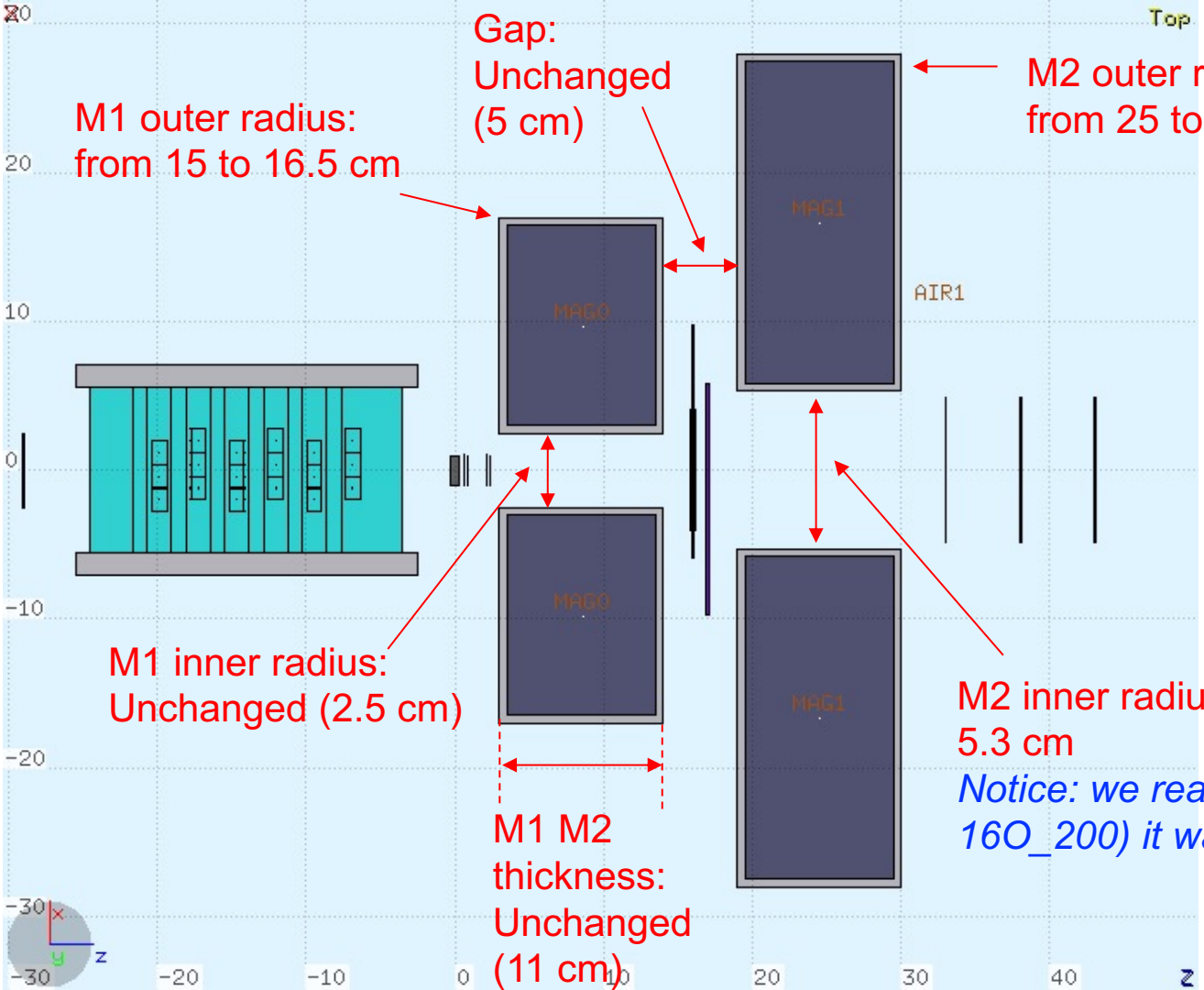
4) Final Magnet Design

- The design proposal from SigmaPhi has been received
- Some small changes with respect to the specification design
- New calculated field map



new material:
SmCo YXG-32





M1 outer radius:
from 15 to 16.5 cm

Gap:
Unchanged
(5 cm)

M2 outer radius:
from 25 to 27.5 cm

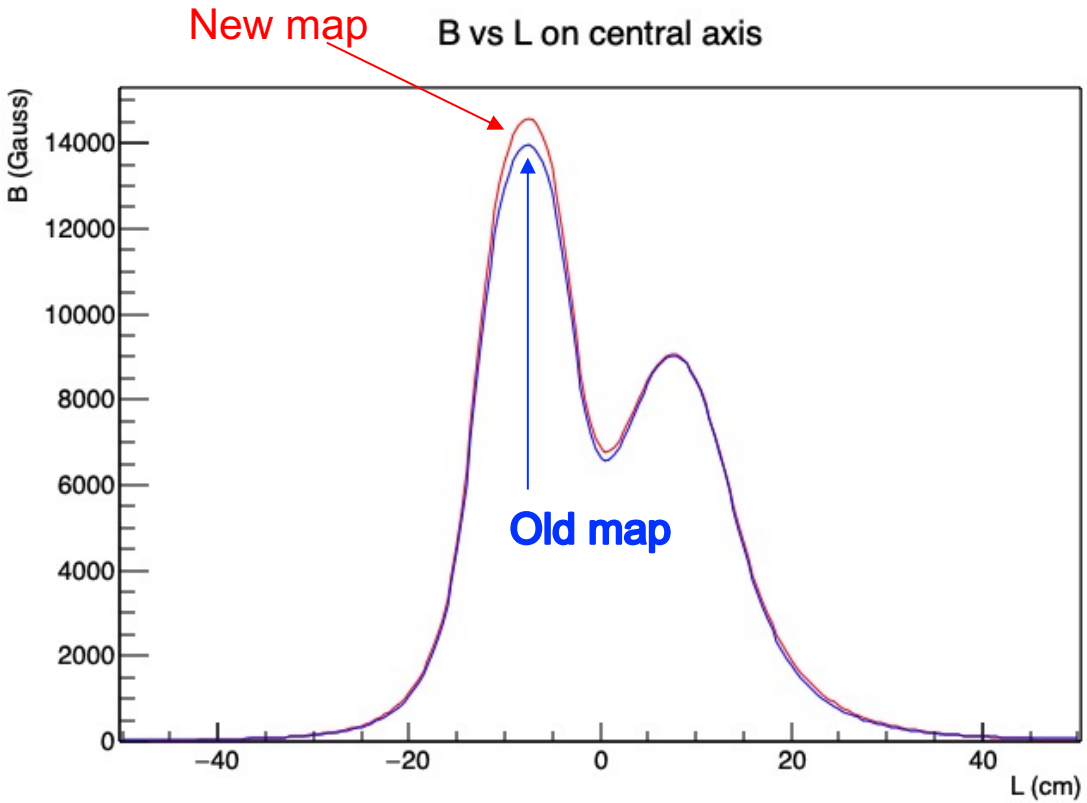
M1 inner radius:
Unchanged (2.5 cm)

M2 inner radius:
5.3 cm

Notice: we realized that before (12C_200, 16O_200) it was set to 5.7 cm by mistake

M1 M2
thickness:
Unchanged
(11 cm)

New B map



Bending power
along central axis:

$$\int B\, dz = \mathbf{0.327\ Tm}$$

in the specification project
it was **0.316 Tm**

Now we can:

a) Add the new map to shoe/Reconstruction/level0/data

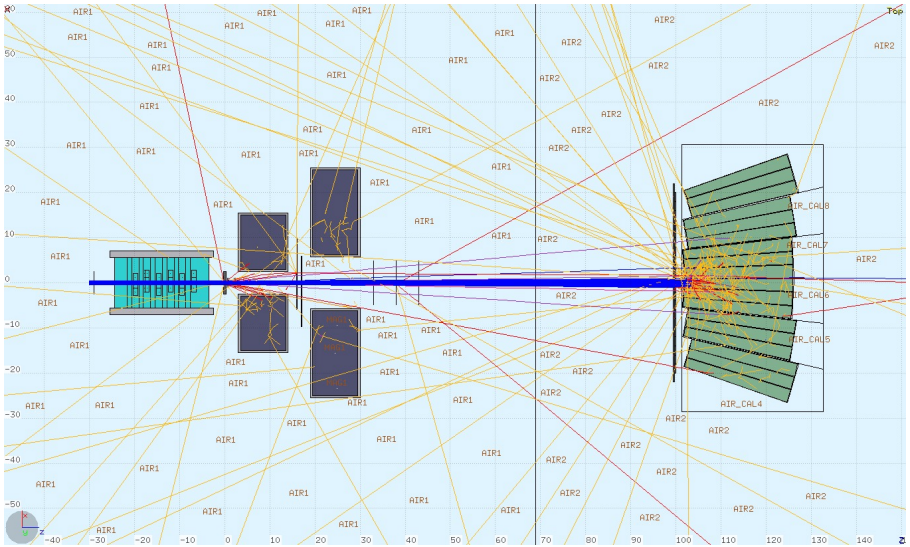
b) Correct the old campaigns 12C_200 and 16O_200 or produce new ones (please suggest)

c) Produce, if you consider it necessary, new simulated data: differences in B field are small…

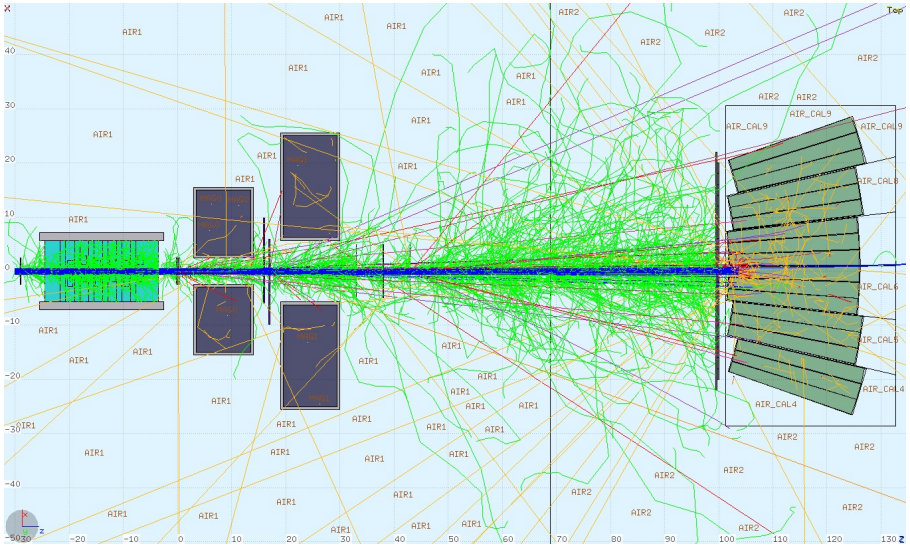
5) Future Strategies and new options - 1

The 500 keV cut for $e^+/e^-/\gamma$ was known to be too high in gases.

500 keV



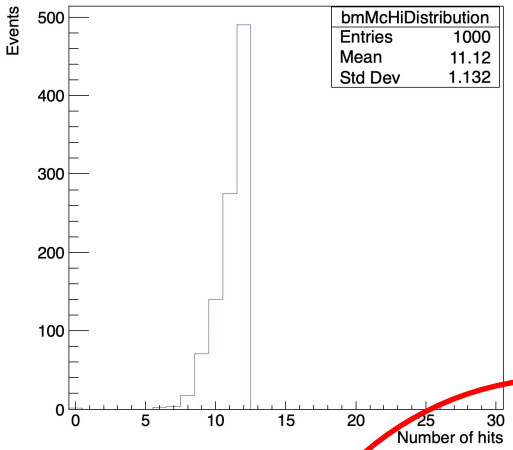
50 keV (green tracks are δ-rays)



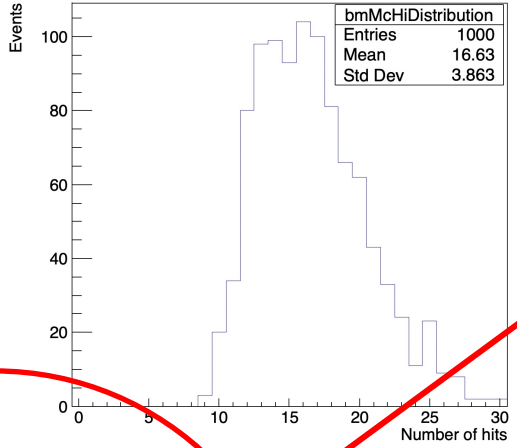
5) Future Strategies and new options - 2

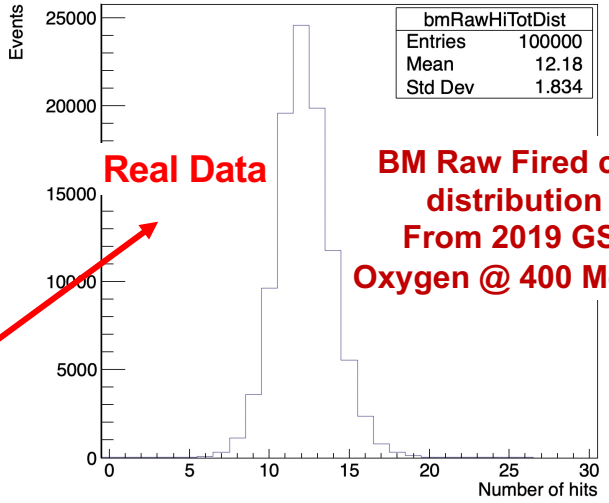
Experience with Beam Monitor suggests that a threshold in MC energy releases has to be considered in order to reproduce the fired cells distribution of experimental data

MC Fired cell distribution
100 KeV energy release cut + BM efficiency



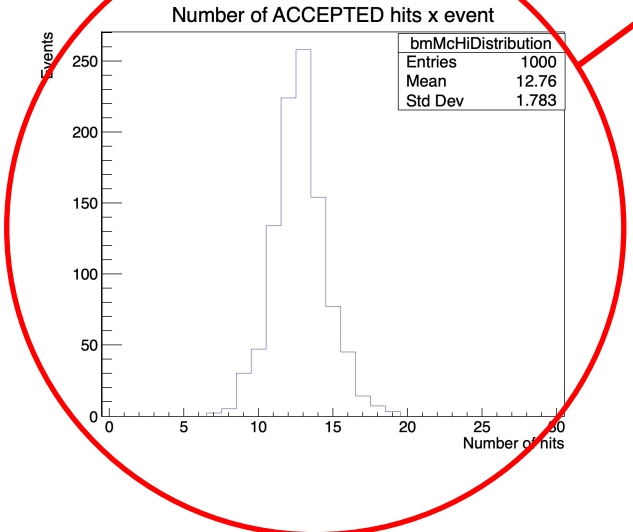
MC Fired cell distribution
1 KeV energy release cut + BM efficiency





Real Data

BM Raw Fired cell distribution
From 2019 GSI
Oxygen @ 400 MeV/u



MC Fired cell distribution
10 KeV energy release cut
+ BM efficiency

With a threshold of 10 KeV on MC energy release and applying the BM efficiency effect, MC prediction is very close to the experimental fired cells distribution

BM track reconstruction efficiency turns out to be ~independent from threshold cut:

100 KeV cut: 978/1000 events with 1 reco track

10 KeV cut: 970/1000 events with 1 reco track

5) Future Strategies and new options - 2

A threshold corresponding to the threshold of the electronic readout is surely necessary for the other detectors as well

Do we need to generate simulated data with low energy cut for δ-rays in gases (larger files…) if their effect is subsequently cut out at reconstruction level?

5) Future Strategies and new options - 3

1) Discussing with M. Toppi et al. in view of GSI 2019 analysis, we realized that the simplified strategy of writing on file only events where the primary had at least an inelastic interaction in target may not be sufficient anymore:
   a) We are missing background events in which the primary interacts elsewhere, producing secondaries detected downstream
   b) "Untriggered" simulation, however, is needed for efficiency evaluation: very large files (>95% of primaries do not interact in target but end their history in calorimeter)

Which is the choice for the future?

2) The visualization of truncated pyramids has been implemented in the user interface (see next talk by L. Scavarda e M. Penna): a more manageable calorimeter geometry is now possible

6) Conclusions

1) New updated files for CNAO2020 (which may become CNAO2021) are available

2) A special production for neutron experiment group has been produced

3) A GSI2021 campaign is almost ready to be committed.
   Decision on positioning has to be made

4) A new updated implementation of the magnetic system, compliant with final specification, has been produced

5) Some choices have to be considered for next simulation campaigns:
   a. Triggered or Untriggered?
   b. Low energy cut for δ-rays?

6) A new and more manageable calorimeter geometry is now possible using truncated pyramids