Updated Backward EMC Geometry

Luigi Capozza

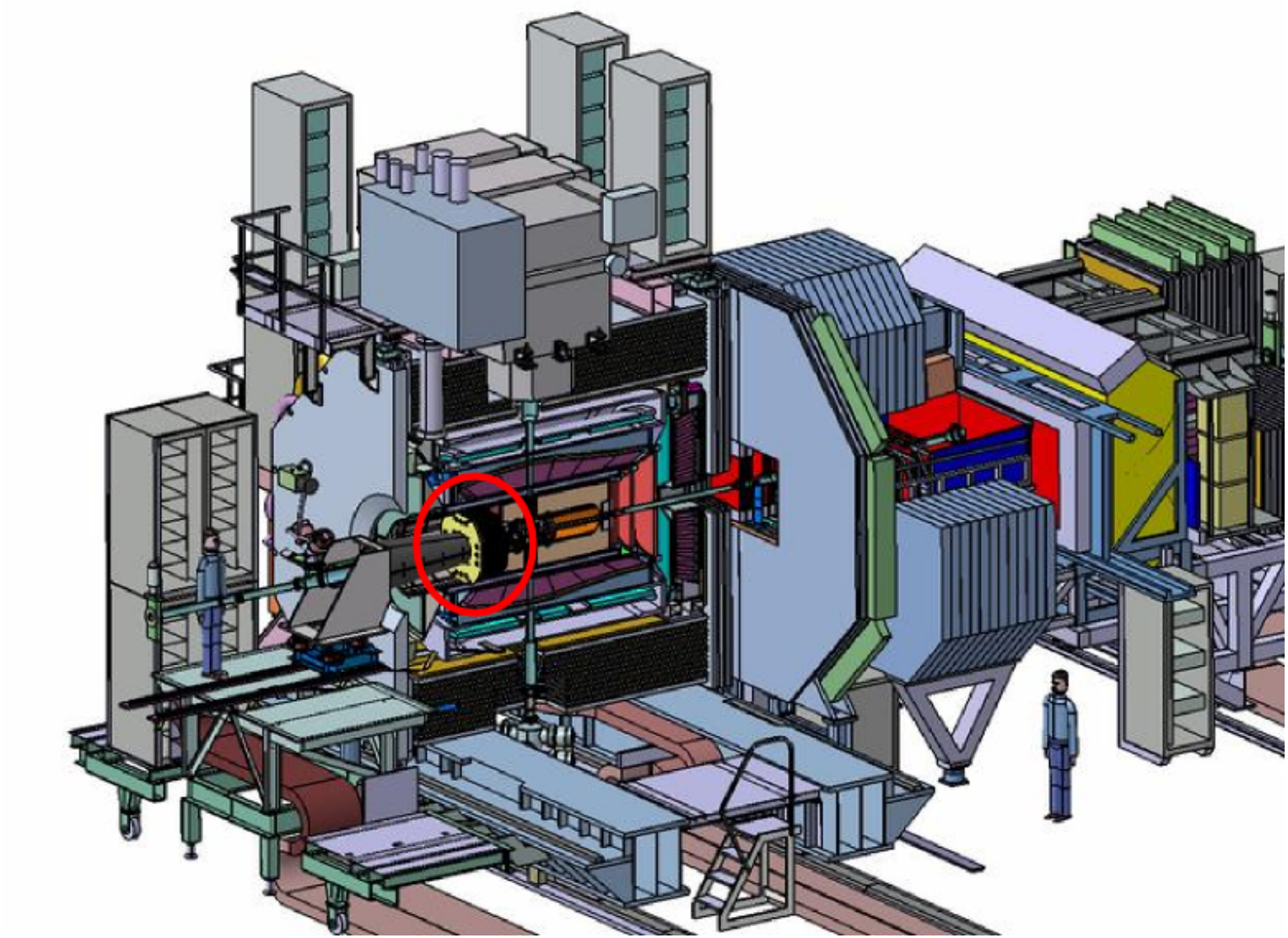
for the Mainz EMC group

PANDA CM 17/2 – Computing Session
7 June 2017

Outline

- Current status of the backward EMC description
- Details on the new geometry
- Work to be done on reconstruction

The backward EMC



Geometry description: current status

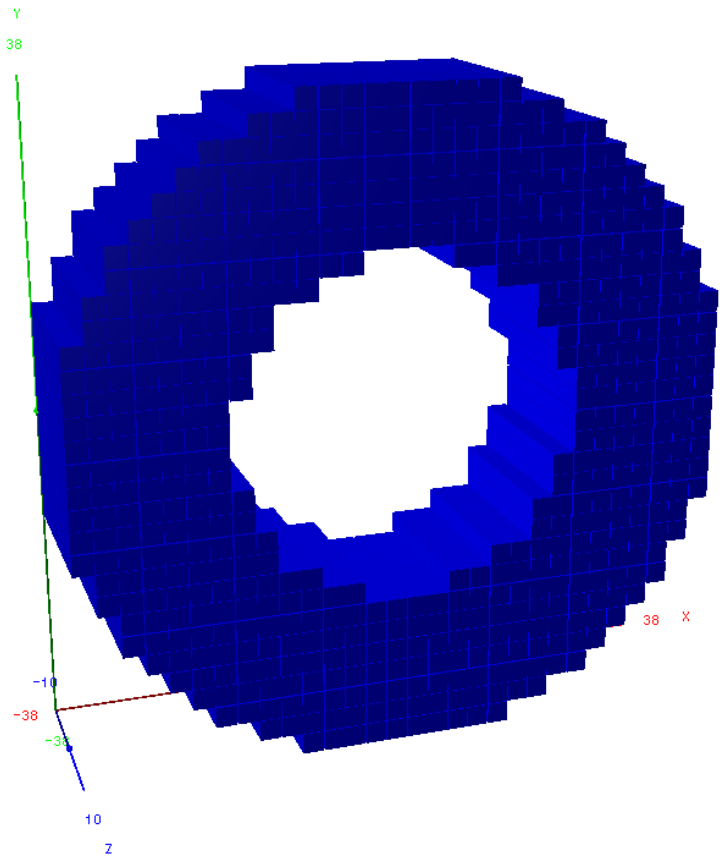
- Last update: 2009 by Dmitry Khaneft
- PWO crystals in air because of lack of info on mechanical design
- Old crystal arrangement: changed due new geometrical constraints

Needed updates:

- description of dead materials
- also in the backward part
- current crystal arrangement
- (some updates in the reconstruction)

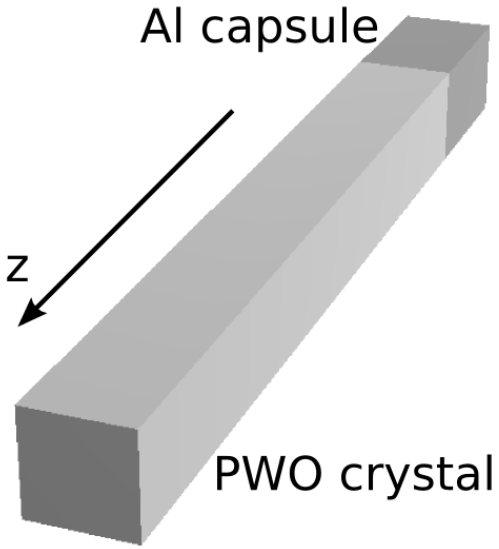
Choice: Using ROOT geometry classes

- more efficient tracking
- “easier” to implement (for me)



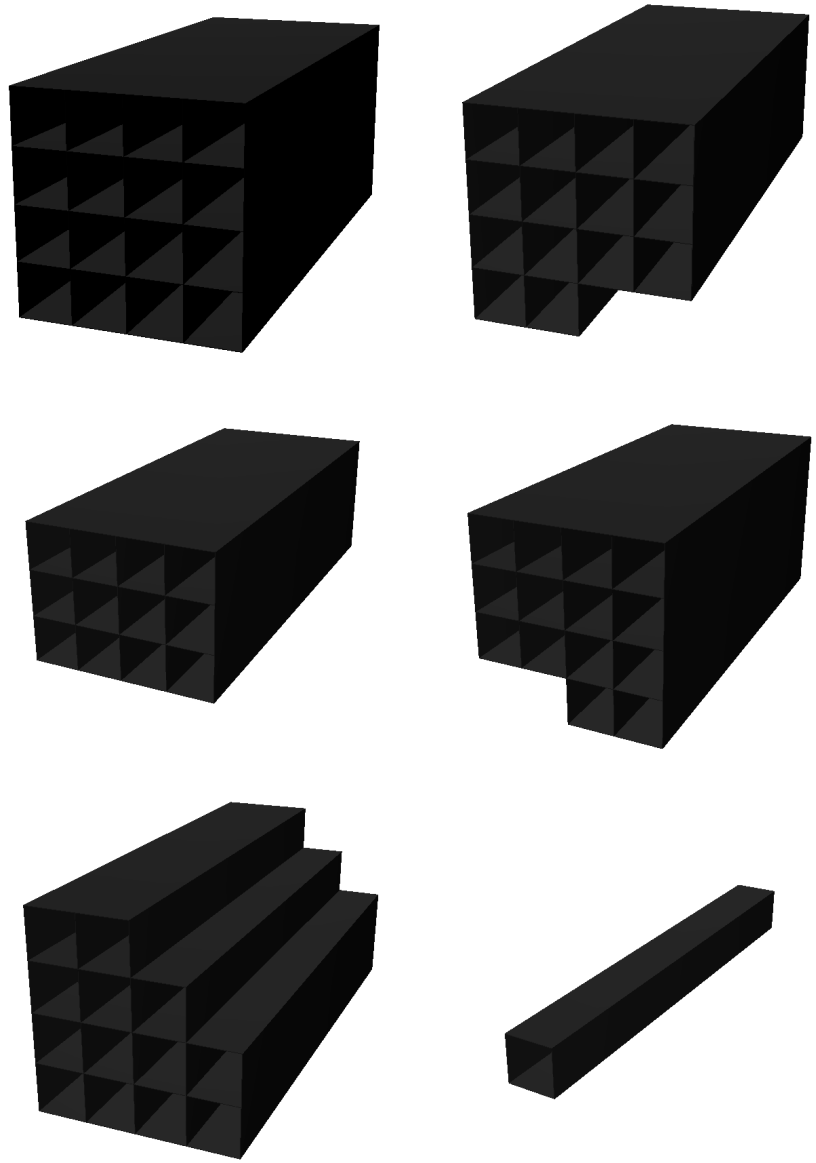
PWO crystals

- 524 (new but preliminary) $PbWO_4$ crystals
- Straight geometry: $200.0 \times 24.4 \times 24.4$ mm^3
- Aluminium capsule in the back side (new)
  - $42.0 \times 24.4 \times 24.4$ mm^3
  - should contain preamp $\rightarrow$ here only Al

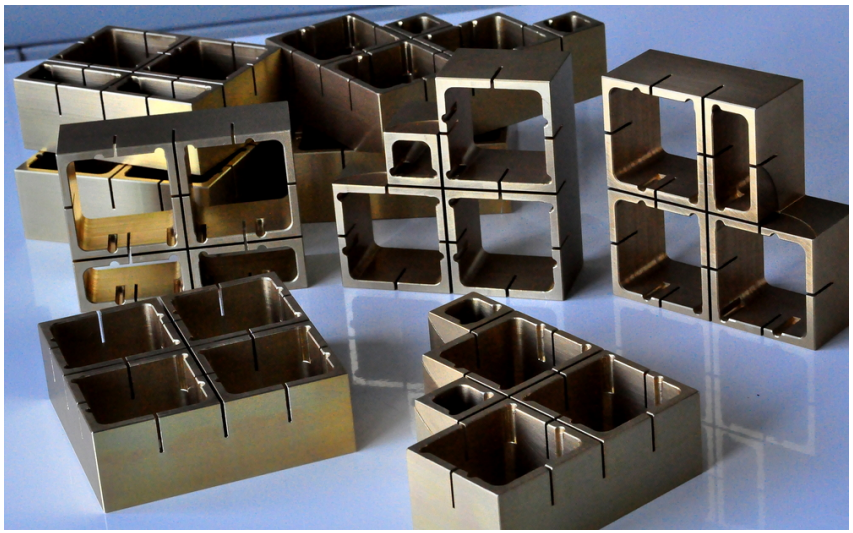


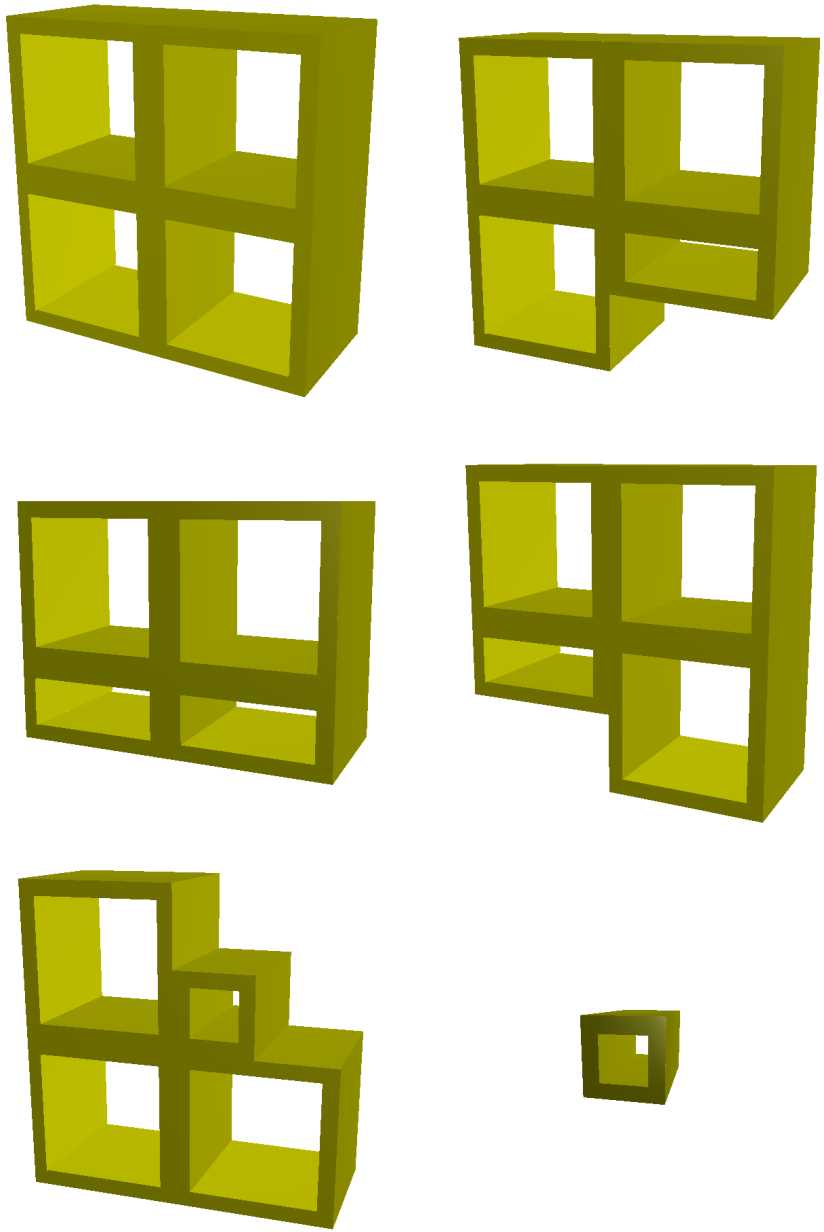
Carbon fibre alveoles

- Outer shape: `TGeoXtru`
- Holes with `TGeoCompositeShape`
- Length: crystal+capsule
- Wall thickness: 0.3 mm
- Material: prepreg (57% C, 43% epoxy)



Aluminium inserts



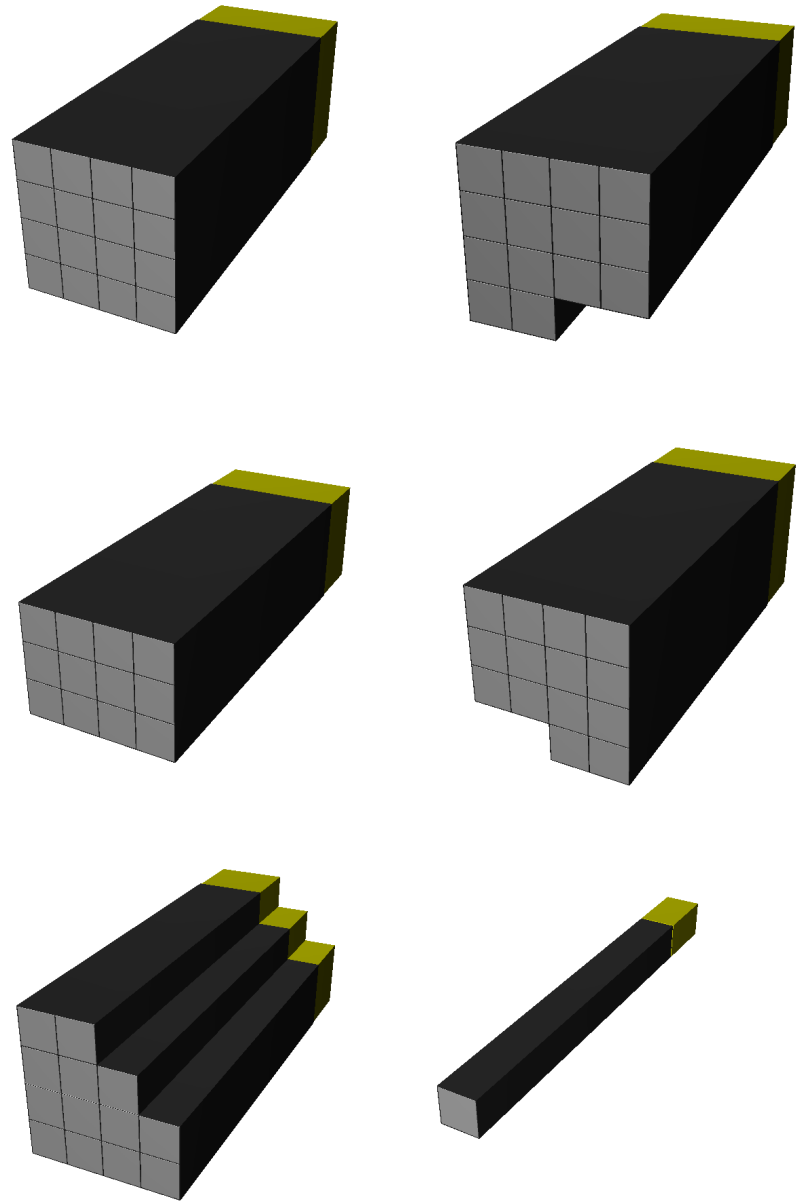


- Simplified geometry (it might change)
- Outer shape: `TGeoXtru`
- Holes with `TGeoCompositeShape`
- Length: 45 mm
- Material: aluminium

Complete submodules

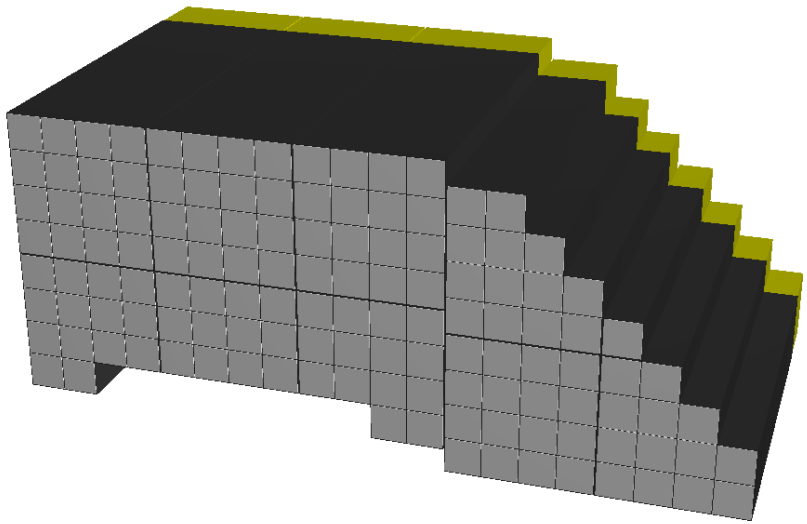
- In total 6 different types
- `TGeoVolumeAssembly` with:
  - 1 alveole
  - 1 insert
  - 16, 14, 12, 14, 13, 1 crystals
- Simplification:
  - there is no 1-crystal submodule
  - in reality: 13+1 glued together
  - here treated as independent

  $\Rightarrow$ error: shift by 0.55 mm



Crystal arrangement

- Subdivision in quarters (`TGeoVolumeAssembly`)
- 1 quarter is made of
  - side: 6 submodules
  - corner: 3 submodules (4 in MC)
- Distance between alveoles: 0.55 mm



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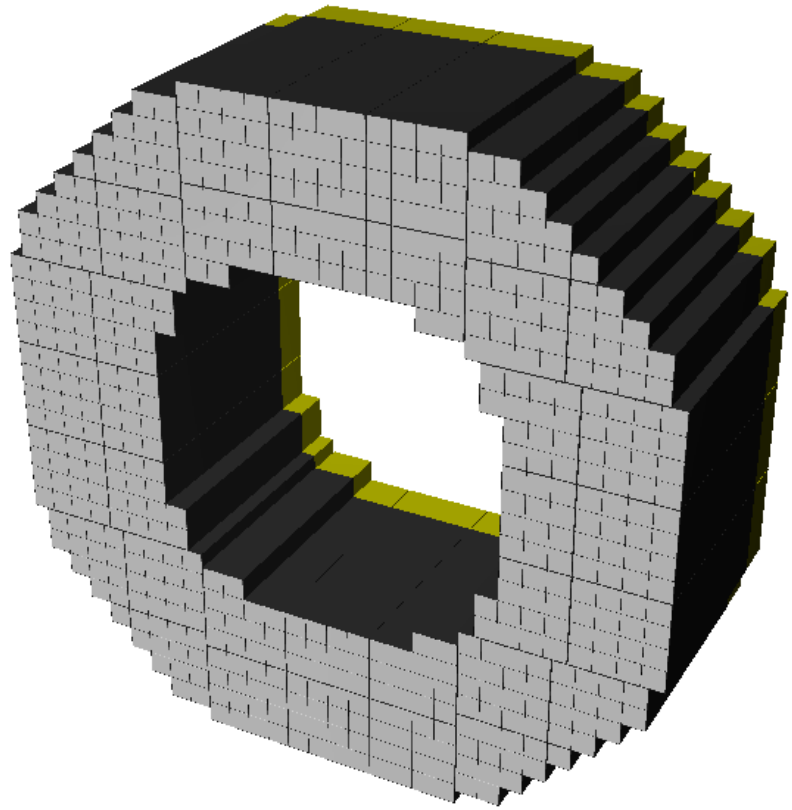
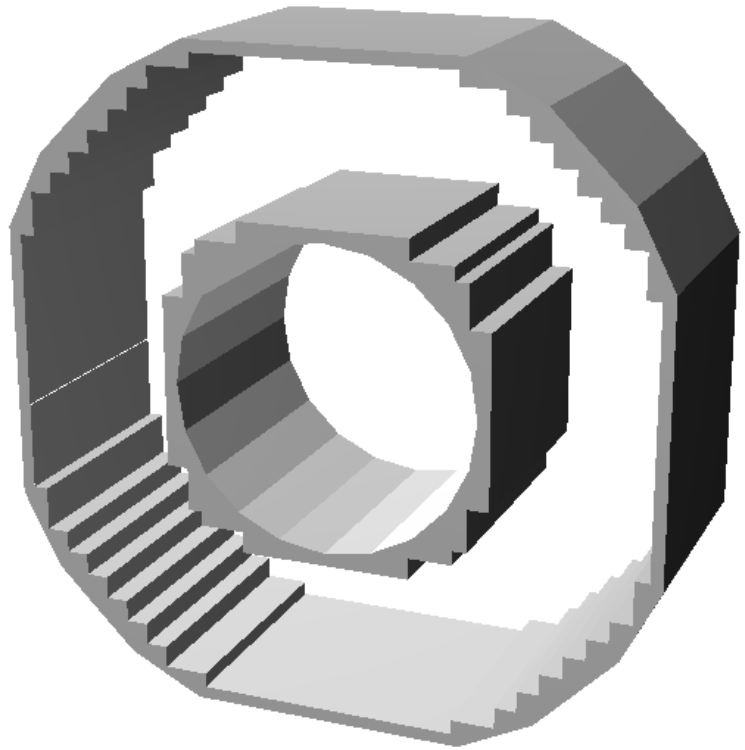
- Complete backward EMC: 4 quarters rotated w.r.t. z-axis



Cooling shells

Side cooling

- Complicated shape (`TGeoCompositeShape`)
- Thickness: 10 mm
- Material: aluminium (small holes neglected)



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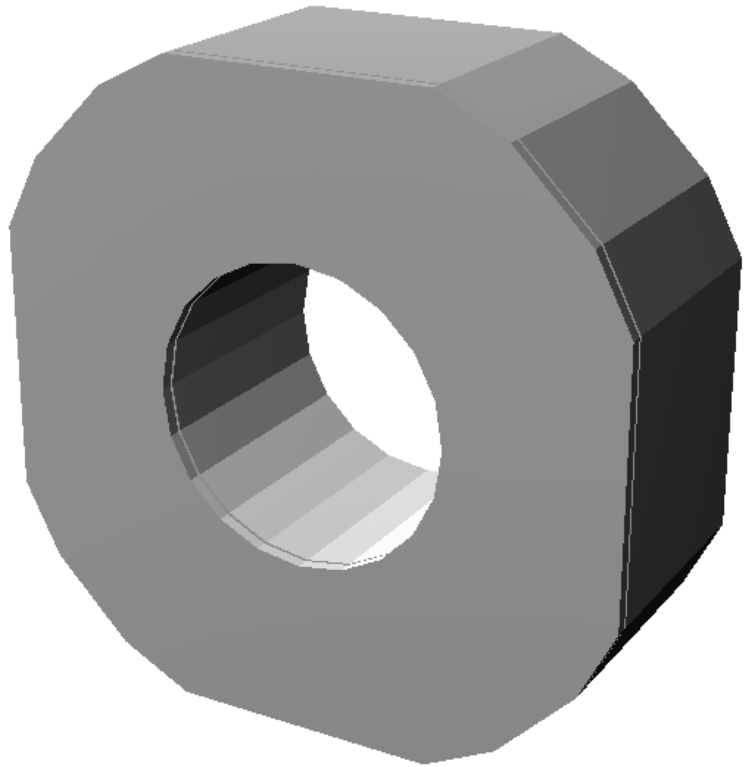
Front cooling

- Plate covering the full BWEC
- Thickness: 10 mm
- Materials
  - shell HDPE with tubes
  - coolant: water/methanol (WM) ($\rho = 0.93$ g/cm^3)
  - here: common mixture (60% HDPE/40% WM)



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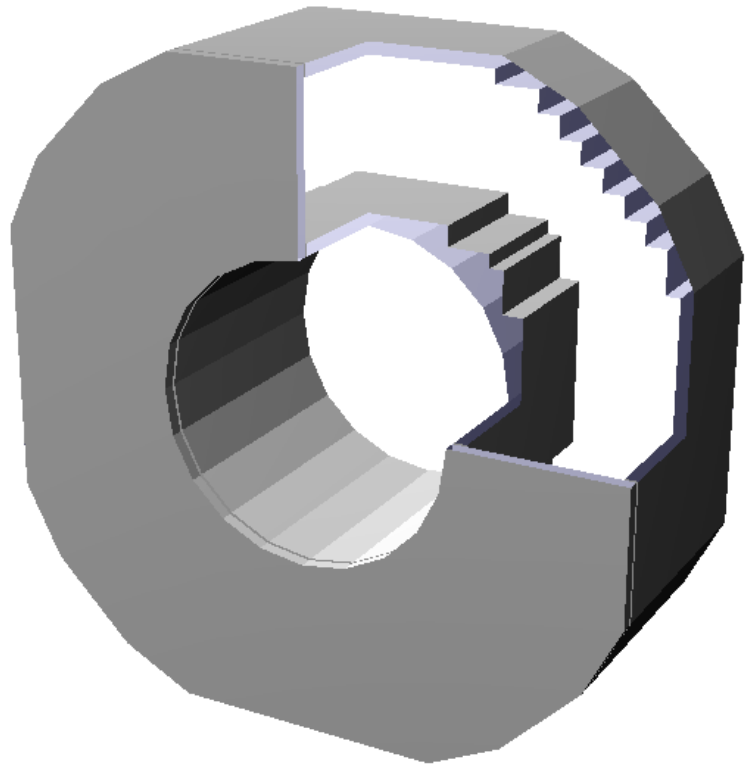
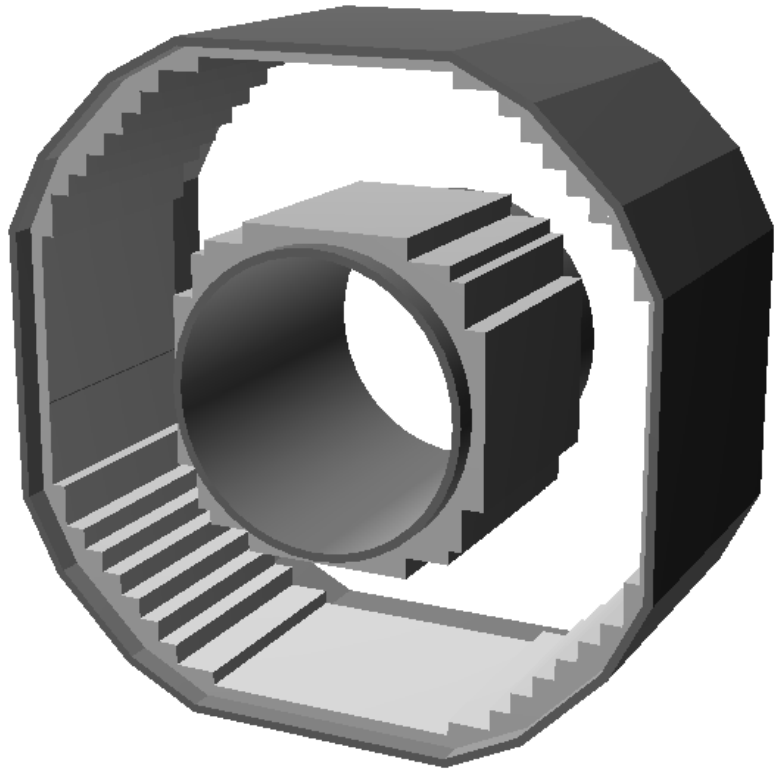


Insulation

- Vacuum Insulating Panels (VIP)
- Thickness: 10 mm
- Material: Fumed silica (SiO_2) ($\rho = 0.2$ g/cm^3)
- Side (in/out) and front VIPs



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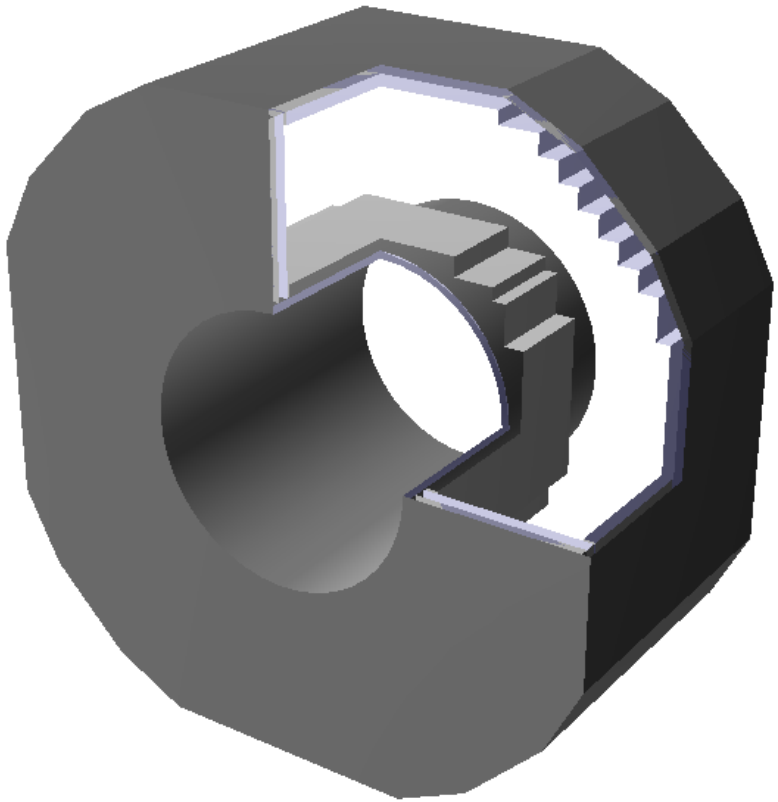


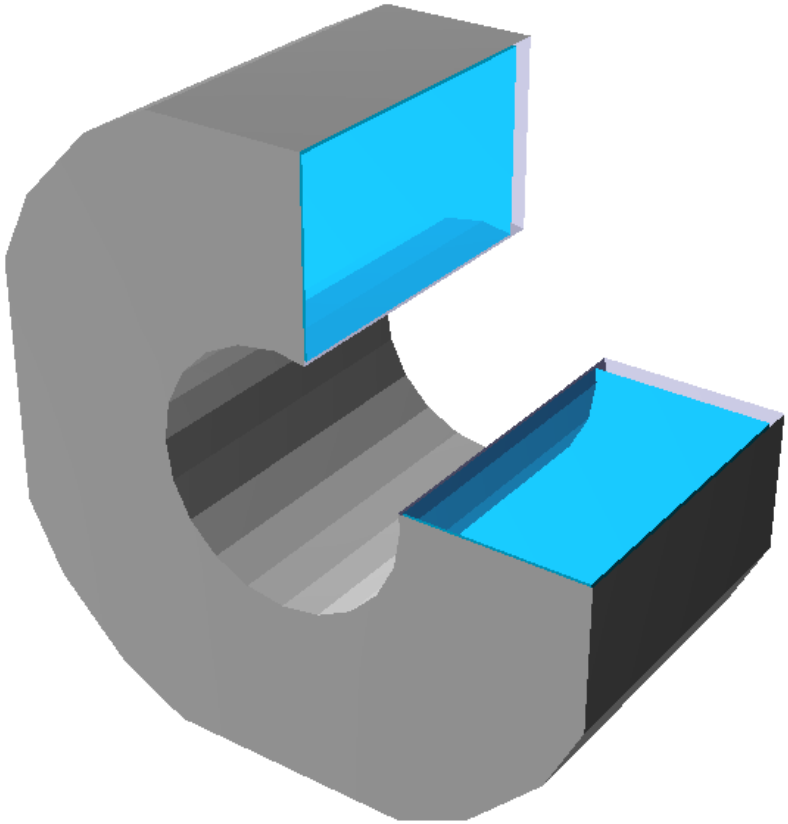
Outer and inner volumes

Outer volume

- Mounting plate on the back: 30 mm
- Outer cover on the rest: 4 mm
- Material: aluminium

Inner volume

- Material: gas N_2 ($\rho = 1.359 \cdot 10^{-3}$ g/cm^3)



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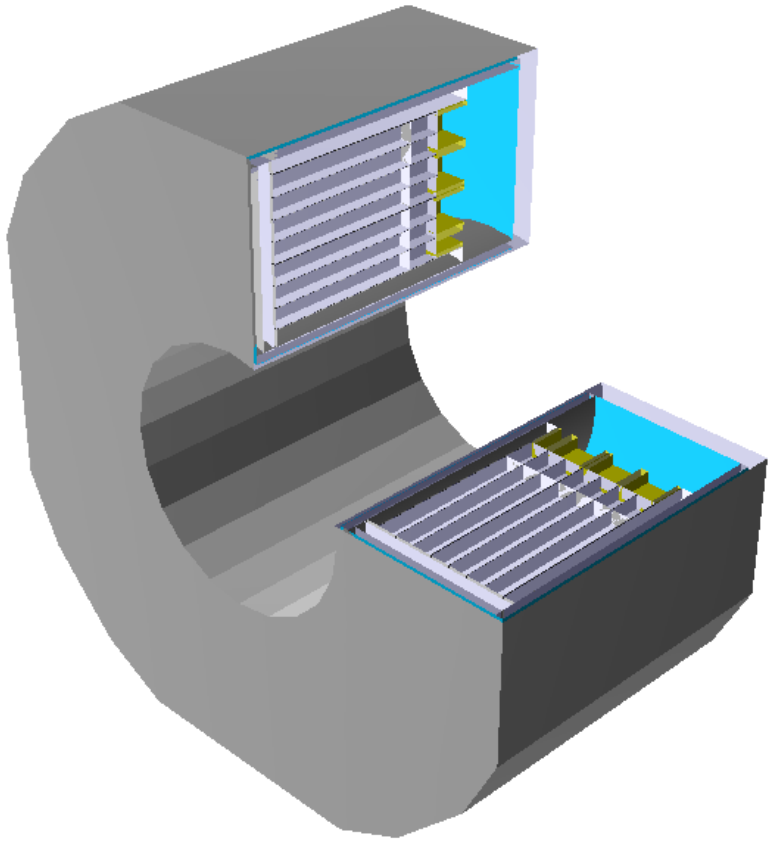

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Volume hierarchy

`Emc4` (top)
- `BWECouterVol` (outer Al volume)
  - `BWECinnerVol` (inner N_2 volume)
    - 4 quarters + cooling shells + VIPs

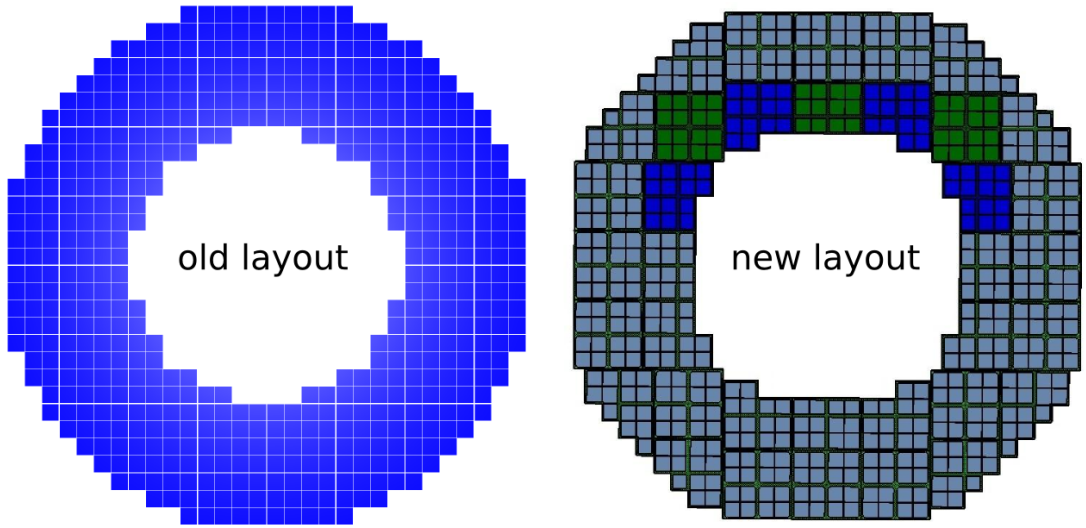
Material summary

- 6 media used in total
- 4 new media defined
  - added to file `media_pnd.geo`
  - could be useful for the rest of EMC

	elements	density [g/cm^3]	rad. length [cm]	
PWO	Pb,W,O	8.29	0.89	
aluminium	Al	2.70	8.88	
prepreg	C,H,Cl,O	1.8	22.27	new
fumed silica	Si,O	0.20	134.90	new
HDPE+water/methanol	C,H,O	0.95	42.78	new
nitrogen gas ($-25°$C)	N	$1.36 \cdot 10^{-3}$	$27.83 \cdot 10^{3}$	new

To be done

Crystal numbering scheme and mapping



- To be modified (according to D. Melnychuk, 2012): `PndEmcMapper`, `PndEmcStructure`
- Does anybody have more information/advice?

To be done

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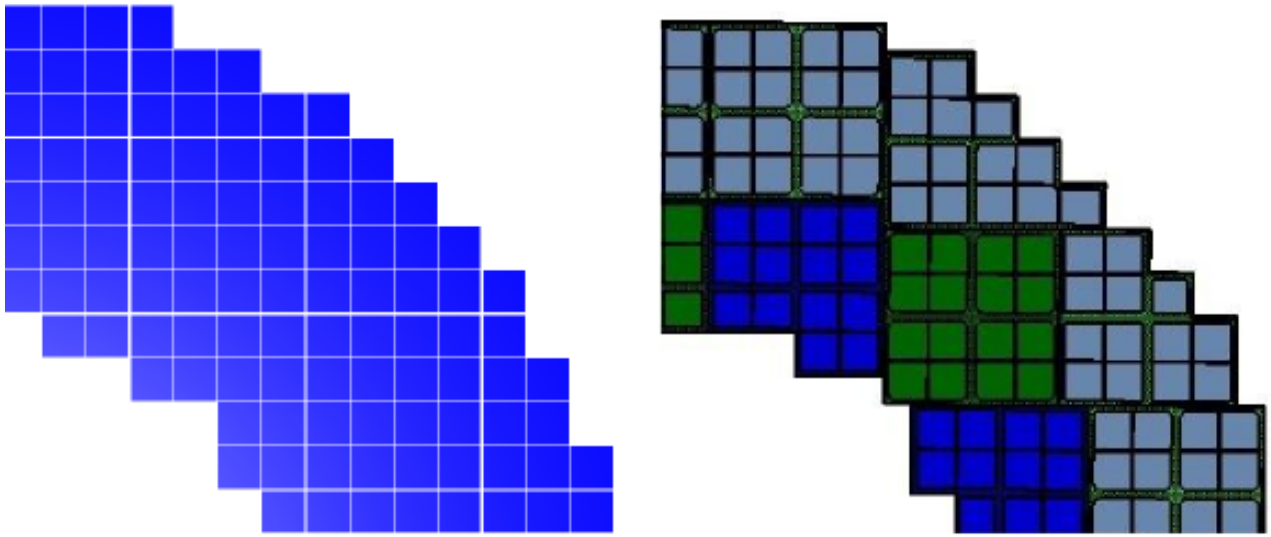
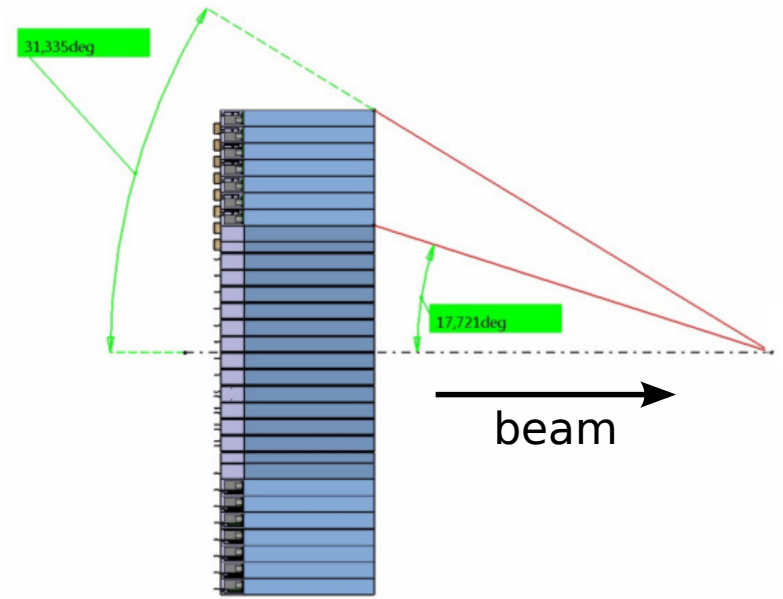
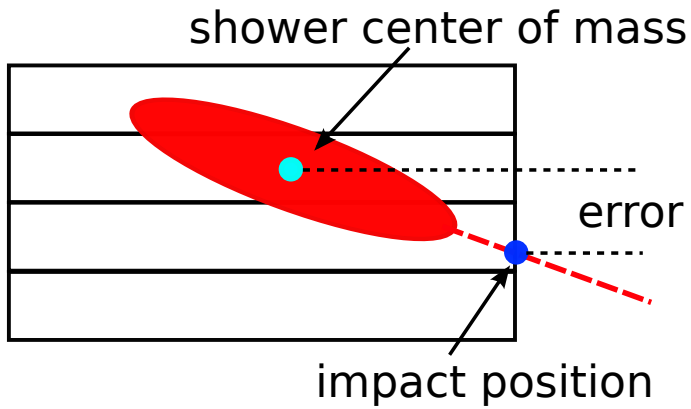


- To be modified (according to D. Melnychuk, 2012): `PndEmcMapper`, `PndEmcStructure`
- Does anybody have more information/advice?
- The crystals are not always aligned anymore
  $\Rightarrow$ needs to be taken into account in the cluster reconstruction

To be done

Reconstruction upgrade?





- The crystals do not point to the target
- Error in the cluster position has to be taken into account (already done?)
- Some simulations are needed to estimate the correction
- Prototype test data are available and will be used too (more beam tests are foreseen)

Summary

- The current geometry of the backward EMC is implemented
- A script defines a ROOT geometry tree and saves it to disk
- New materials were defined and can be used by others
- The code has to be checked in to svn
- The EMC mapping utility classes need to be updated
- The cluster position reconstruction might need an upgrade:
  - is the angle of entrance taken into account?
  - we have prototype test data for estimating the effect