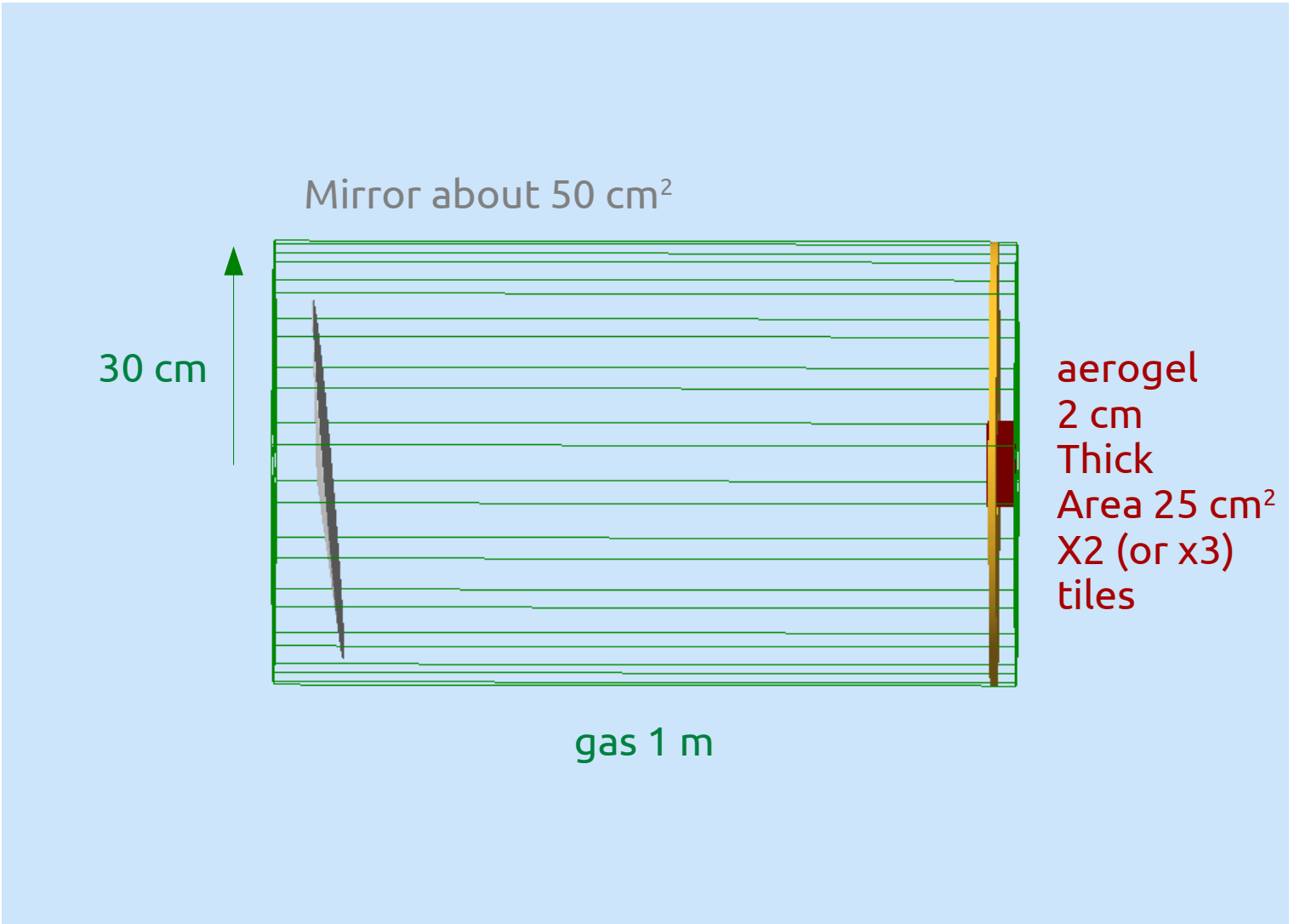
Dual-radiator RICH: update

Alessio Del Dotto for the EIC PID/RICH collaboration
May 27, 2017

Prototype – a first version



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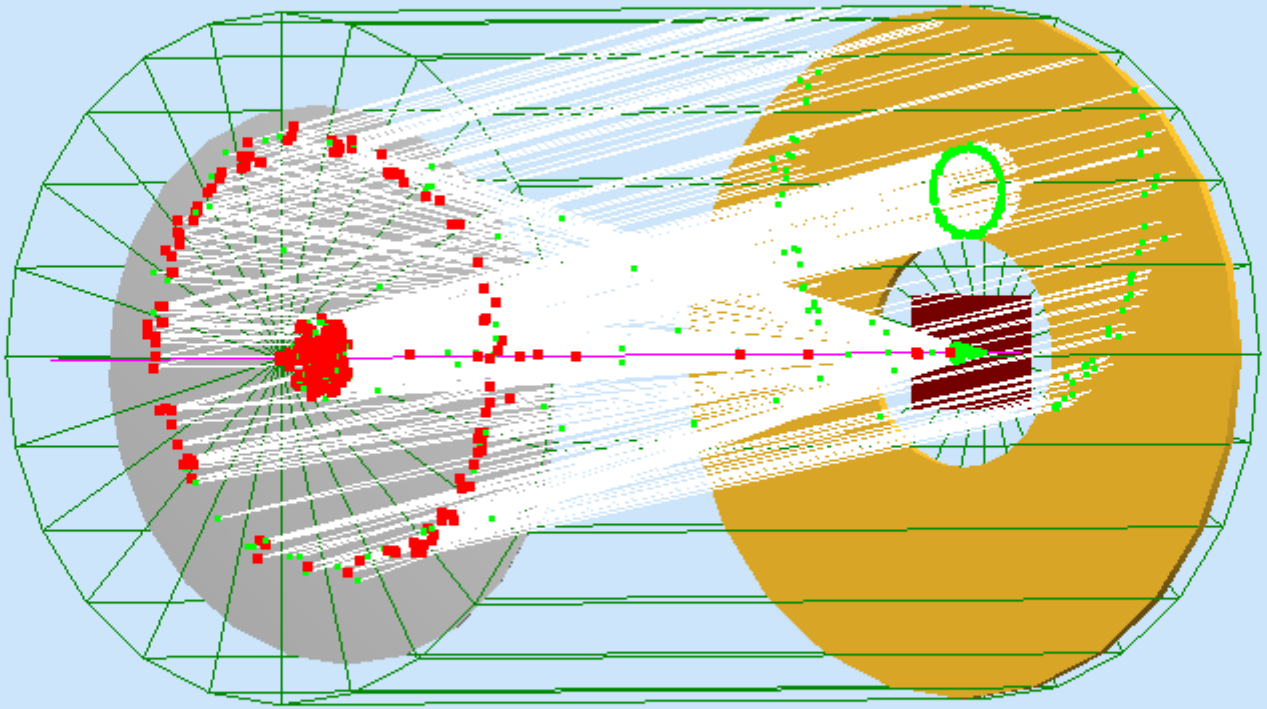
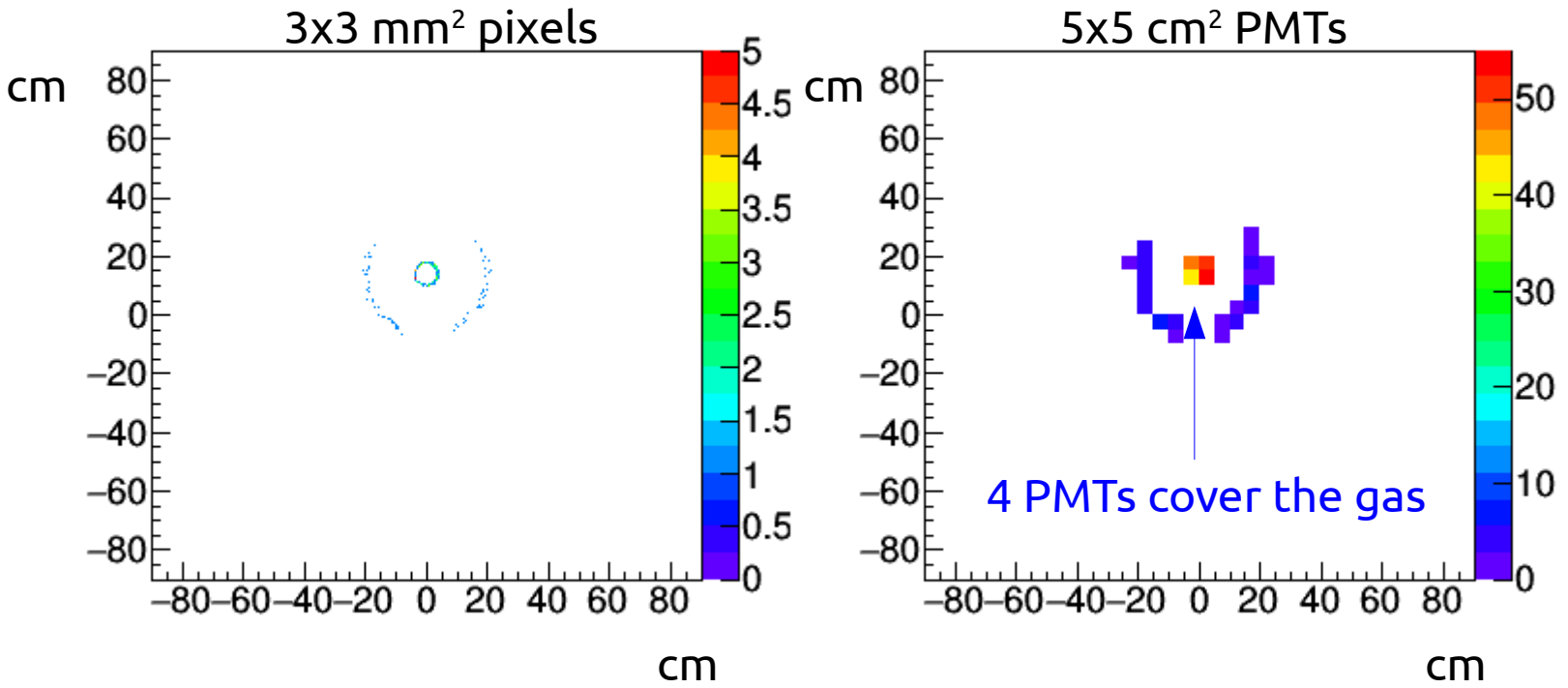


Prototype – coverage with 4 PMTs



Prototype - List of needs

- Gas tank , maybe a cylinder
- Aerogel at n=1.02
- A mirror, if possible about 50 cm^2
- 4 PMTs / SiPMs
- CAD design of the real prototype ...

- Some tests can be done in laboratory, i.e. optical characterization of the aerogel

dRICH with SiPMs

Pixel area: a = 3x3 mm^2 ≈ 10^{-1} cm^2

Noise rate: R_N = 10^6 Hz/pixel

Area of a sector of the photon detector: A ≈ 8500 cm^2

Mean rate of photons per track ≈ 10 for the aerogel

Assumption on the tolerable noise: one fake cherenkov in 100 cm^2: N_{ch} = 10^{-2} cm^{-2}
(iducial area of the crown around an aerogel ring)

Therefore finally we need a temporal resolution such that:

$$\frac{R_N}{a} \cdot \sigma_t = N_{ch}$$

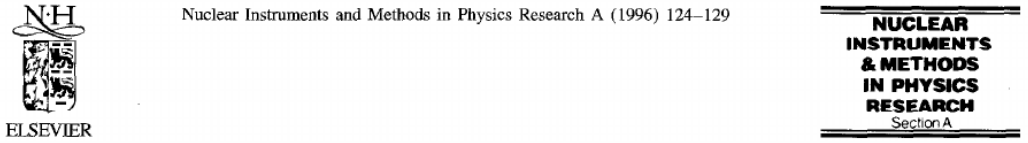
That means

$$\sigma_t = N_{ch} \cdot \frac{a}{R_N} \leq 1ns$$

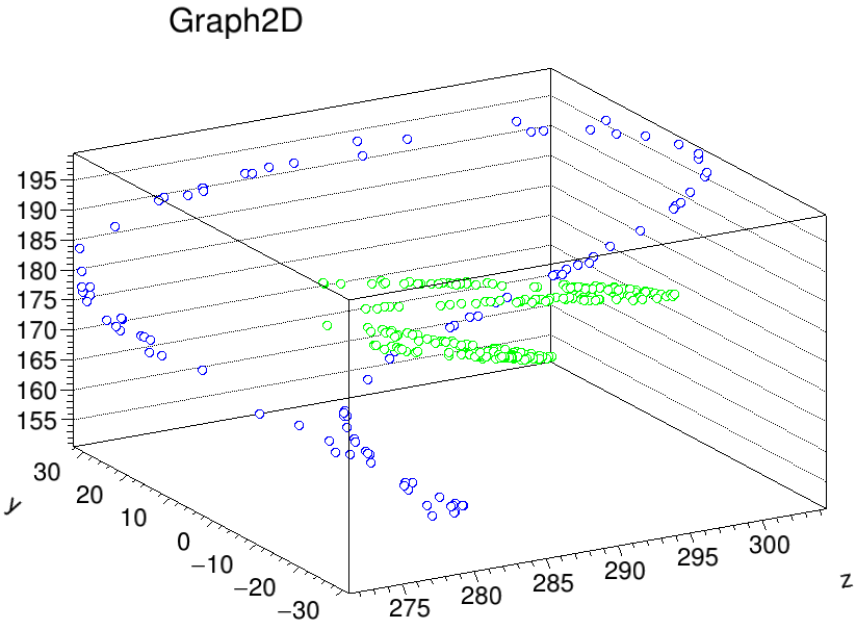
Remark of Marco Contalbrigo: In addition, the cooling of SiPMs is also necessary otherwise at room temperature the baseline is quite unstable.

Optimal (realistic) focal surface

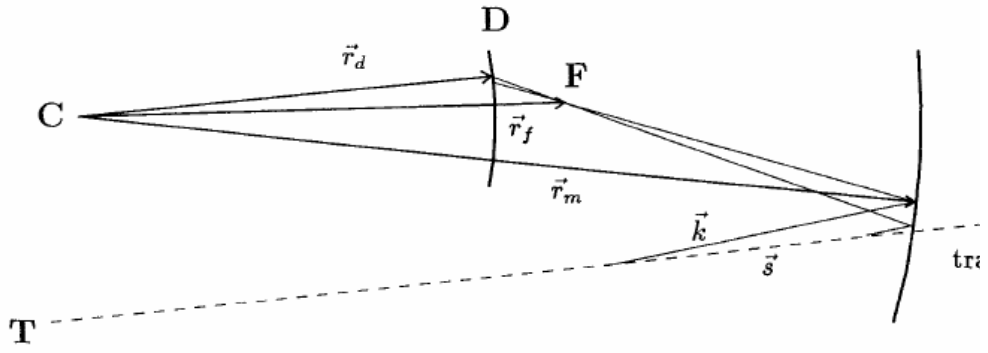
Analytic exact calculation of the 3D focal surface providede by:



Focal reconstruction
for 1 single track event
in the first sector
GEMC generated



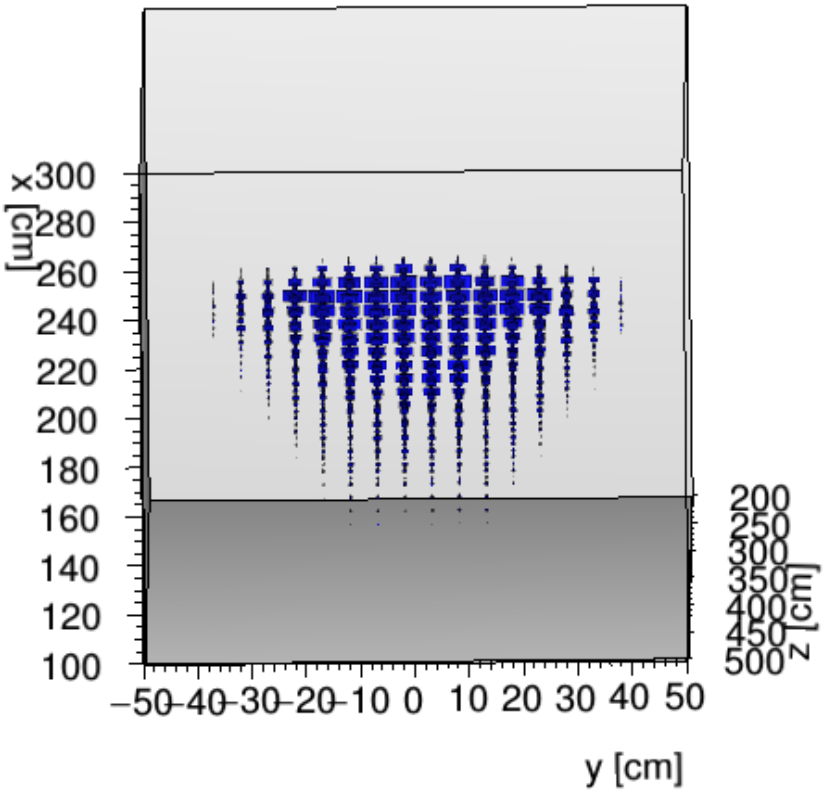
We want to find a realistic "buildable" surface D

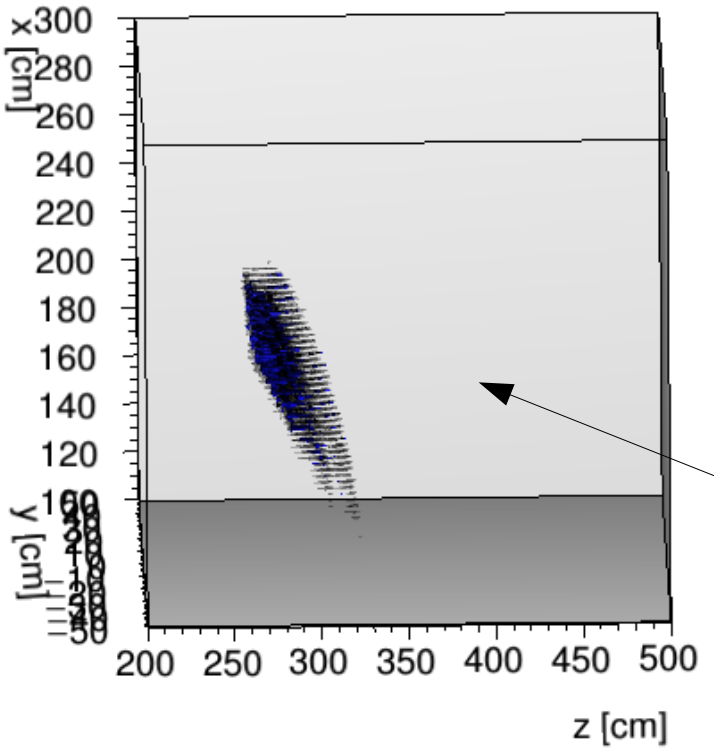


If F = D -> emission angular error = zero

Gas focal space HIsto for 5000 events (GEMC generated)

One sector of the RICH





Tracks' direction

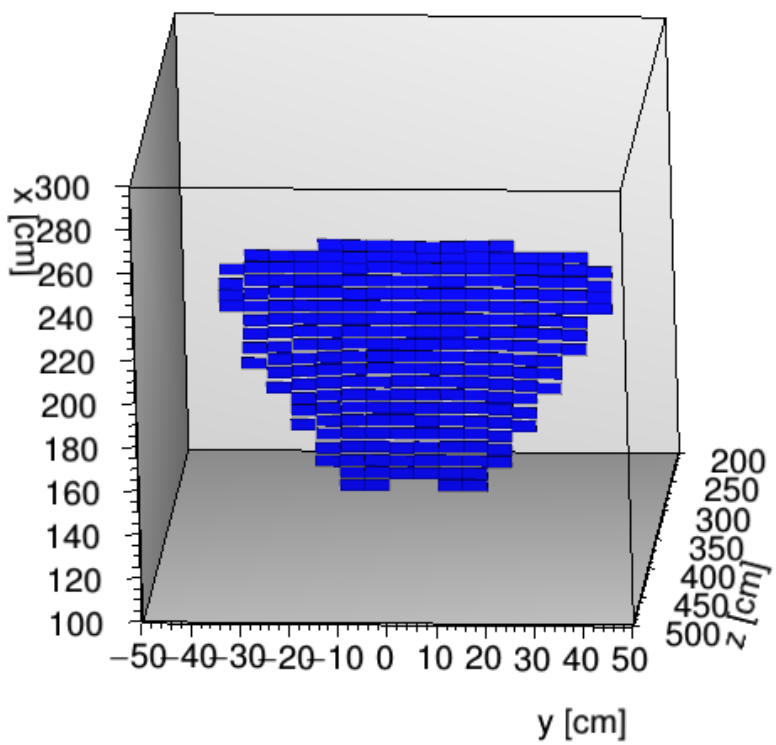
There are several focal voxel in z

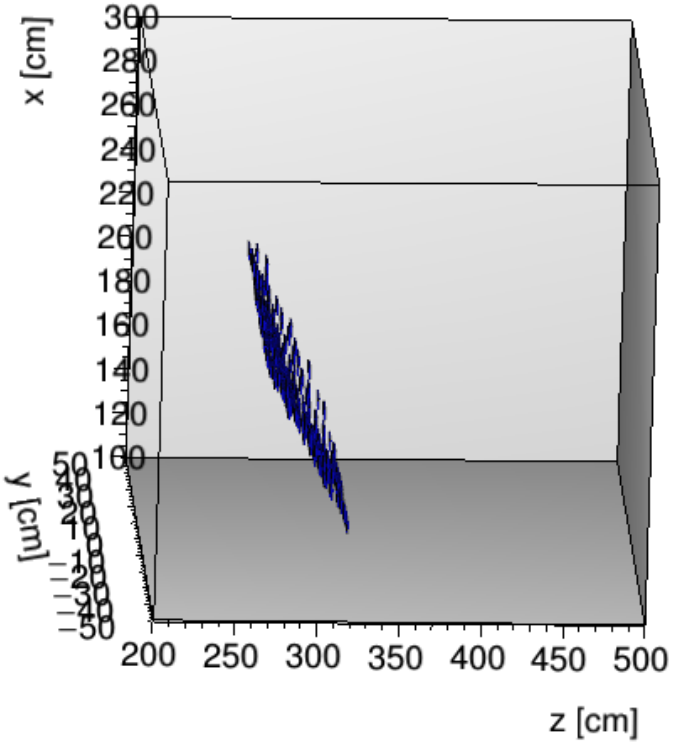
Binning of the voxels (x,y,z) : 5 x 5 x 1 cm^3

Detector surface

One sector of the RICH's detector in tiles of 5 x 5 cm^2

<Weighted (per number of photons) average z position>





A first implementation in GEMC

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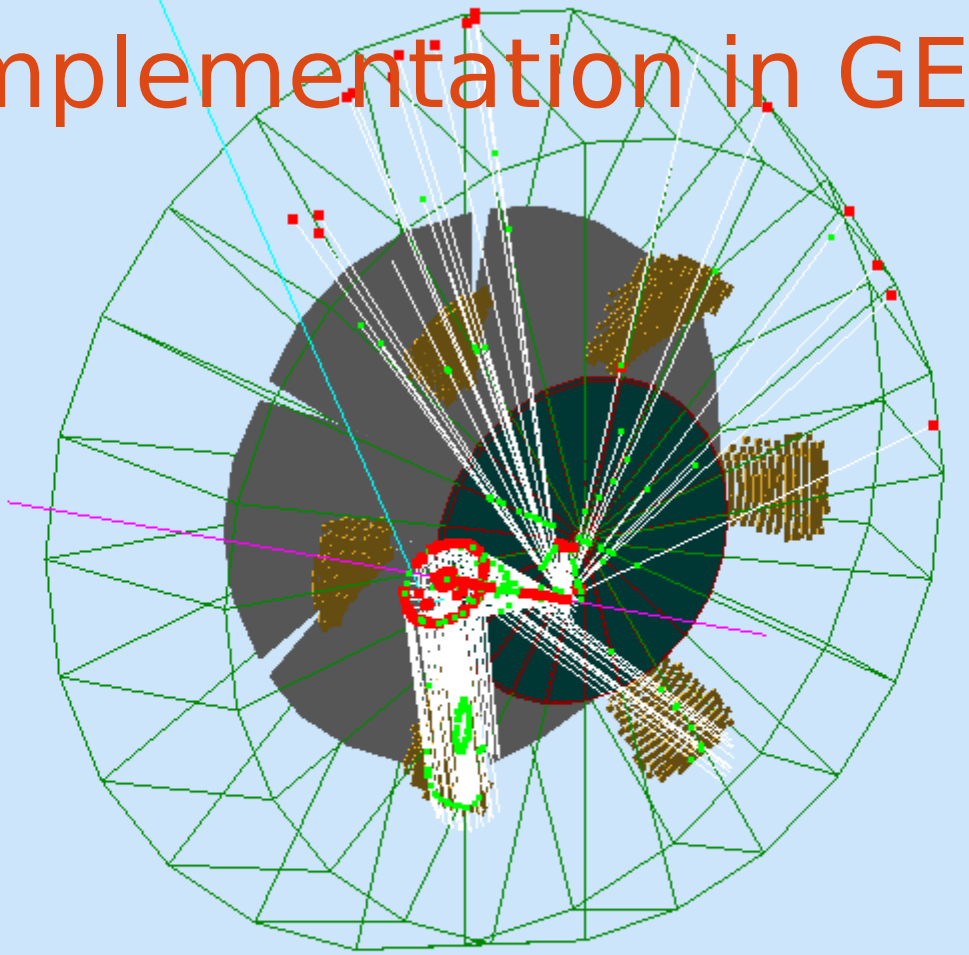

The distribution of the
photons from the aerogel
can be important at the edges
--> next step, include aerogel's
Photons in the study

Next steps

- GEMC study of the new photo-detector configuration
- Synergies for the prototype