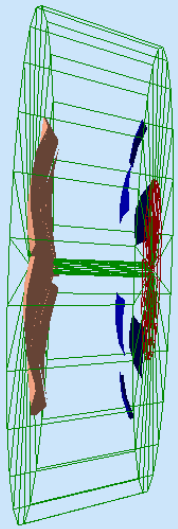
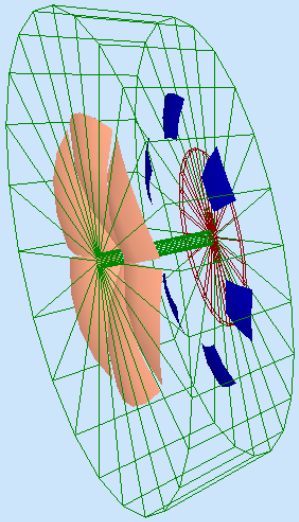
Dual-radiator RICH update: mirror configuration

Alessio Del Dotto
in behalf of the EICPID RICH collaboration
EICPID meeting, April 4 2016

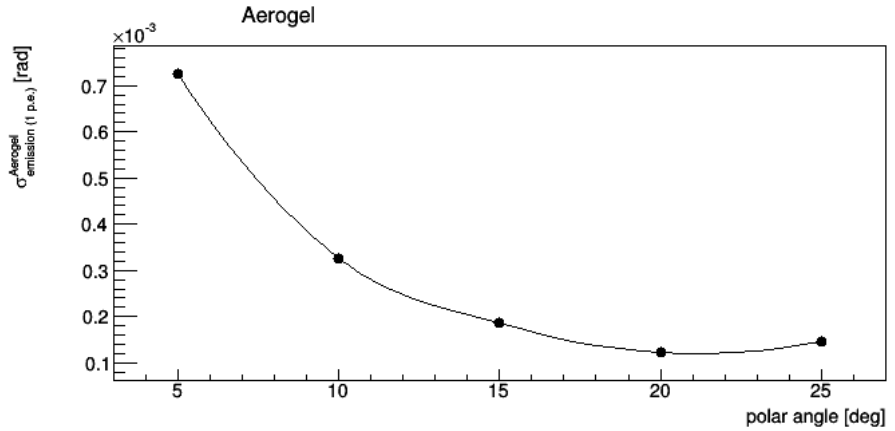
All inside the gas tank

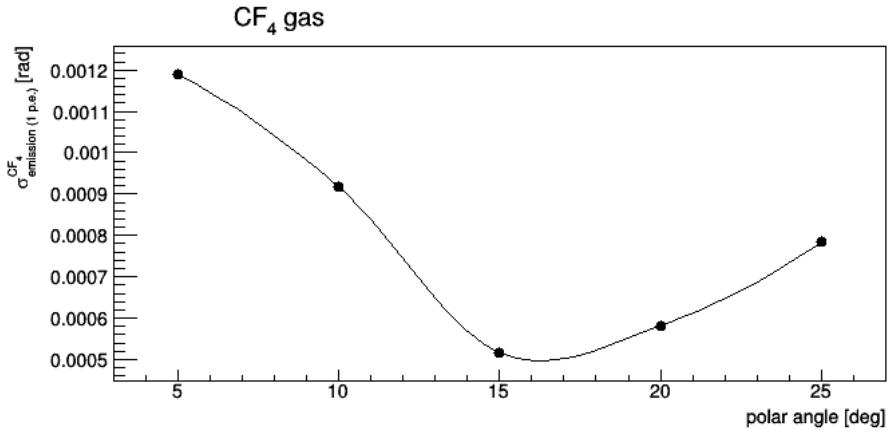




The “real” size of the gas tank shold be set according to the space at disposal

Detector plane configurations





Mirror radius 2.8 m
Mirror tilt angle 26.65°

At 25° 1/2 of the Aerogel photons lost to contain the size of the detector plane

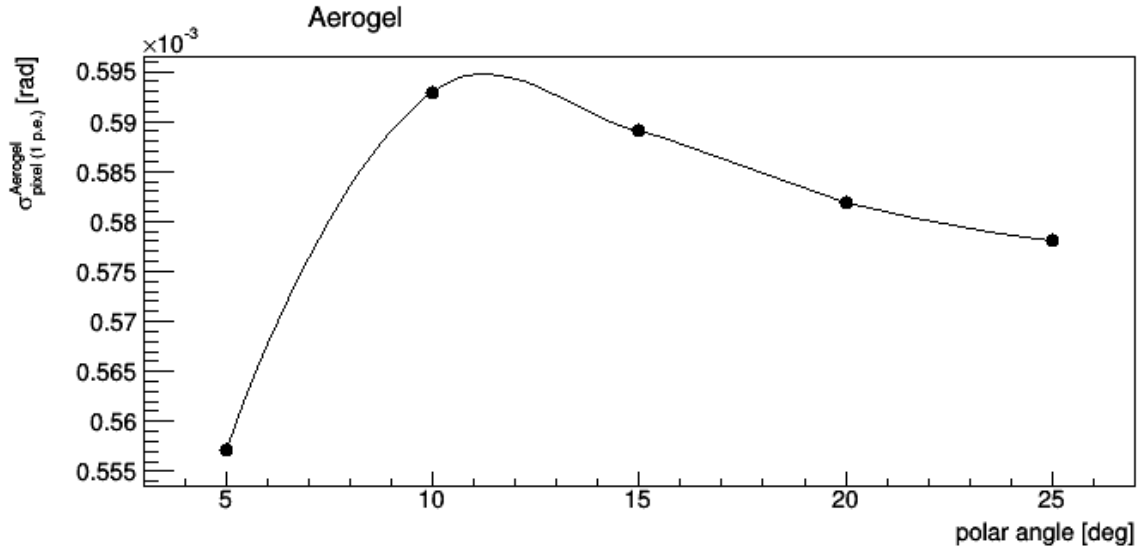
About 8500 cm^2

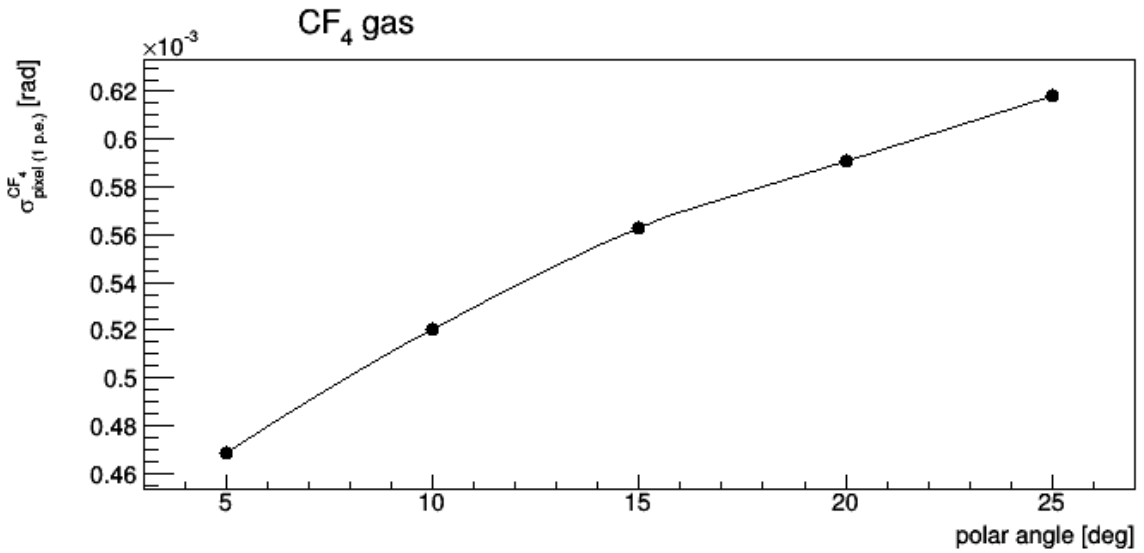
Detector plane: spherical shape

R = 1.55 m
Same center of the mirror

The emission point is assumed to be in midle point of the track in the radiator.

Pixel size uncertanty



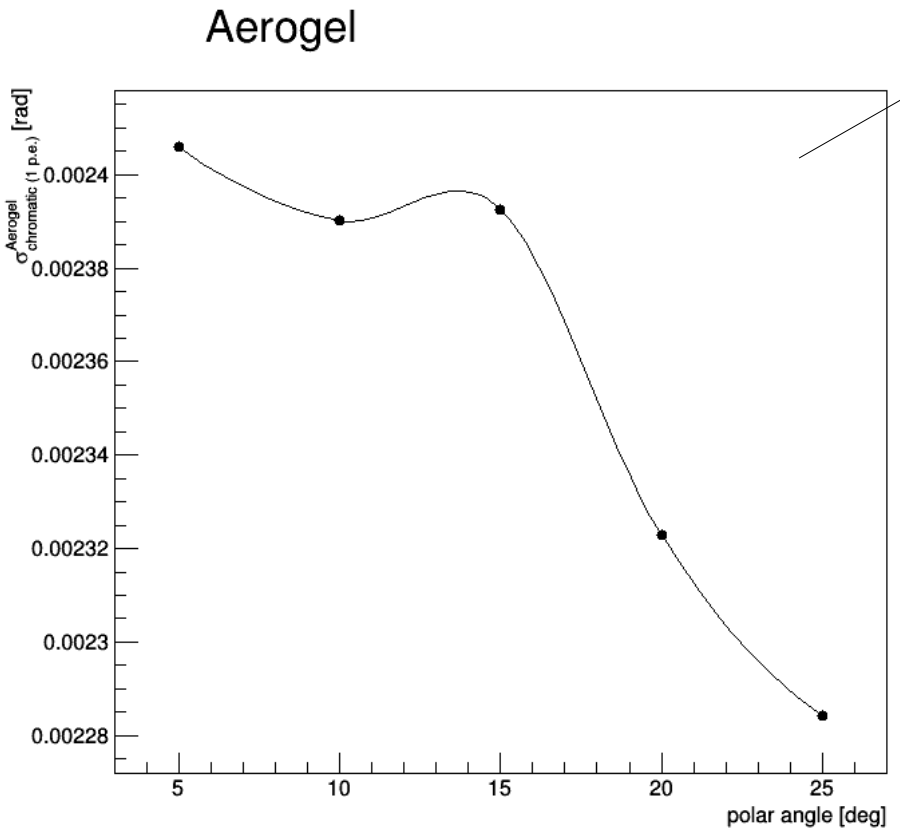


This is for squared pixels of 3mm

In the case of spherical detector, perhaps different shapes can be better

The behavior
is due to the different photons path at different polar angles

Chromatic uncertanty - aerogel



The refractions between aerogel and CF4 play a role in the indirect ray tracing method, there is a chromatic-refraction error which is angular dependent.

Aerogel

$mat{"indexOfRefraction"} = "1.01963 1.01992 1.02029 1.02074 1.02128";

$mat{"photonEnergy"} = "2*eV 2.5*eV 3*eV 3.5*eV 4*eV"

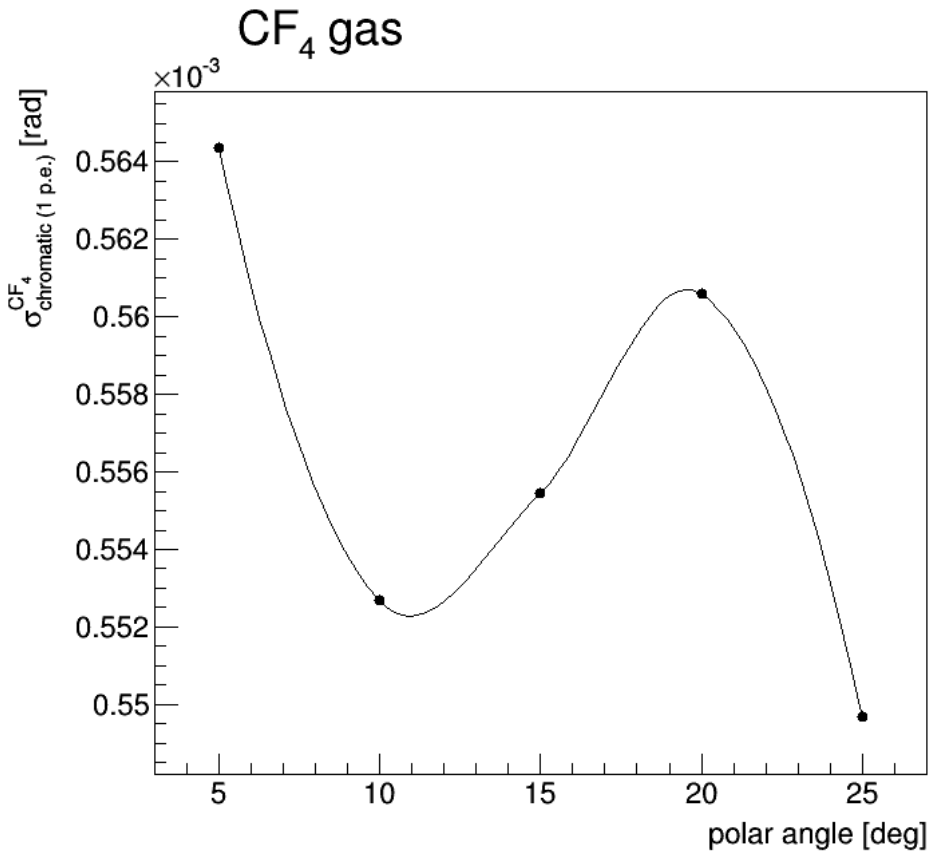
CF4

$mat{"photonEnergy"} = "2*eV 2.5*eV 3*eV 3.5*eV 4*eV
4.5*eV 5*eV 5.5*eV 6*eV 6.5*eV 7*eV";

$mat{"indexOfRefraction"} = "1.00048 1.00048 1.00049 1.00049 1.00050
1.00050 1.00051 1.00052 1.00052 1.00053 1.00054";

The recontruction method intrinsic error order 10^-5 rad

Chromatic uncertanty - CF4



CF4

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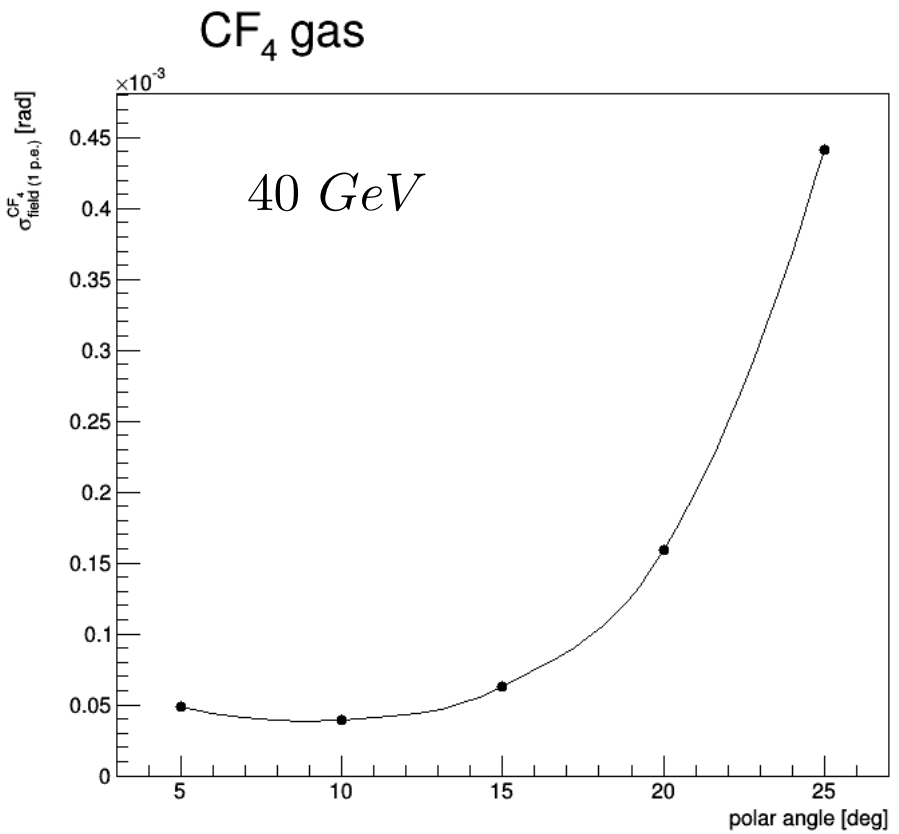
4.5*eV 5*eV 5.5*eV 6*eV 6.5*eV 7*eV";

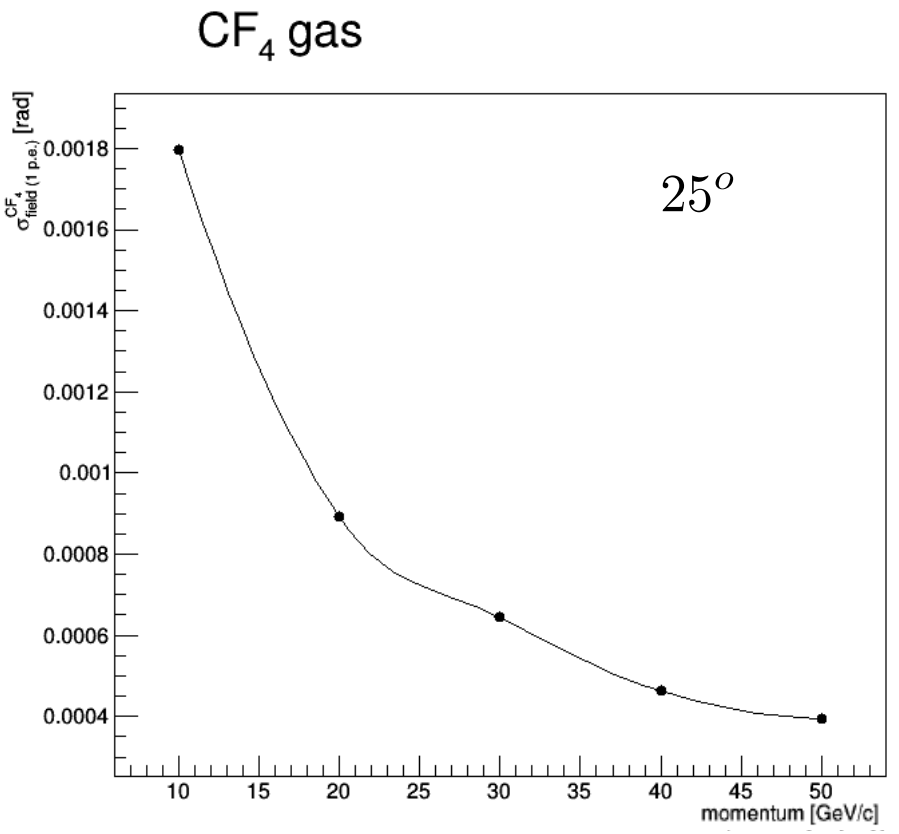
$mat{"indexOfRefraction"} = "1.00048 1.00048 1.00049 1.00049 1.00050
1.00050 1.00051 1.00052 1.00052 1.00053 1.00054";

The recontruction method intrinsic error order 10^-5 rad

40 GeV

Field uncertanty – new hybrid



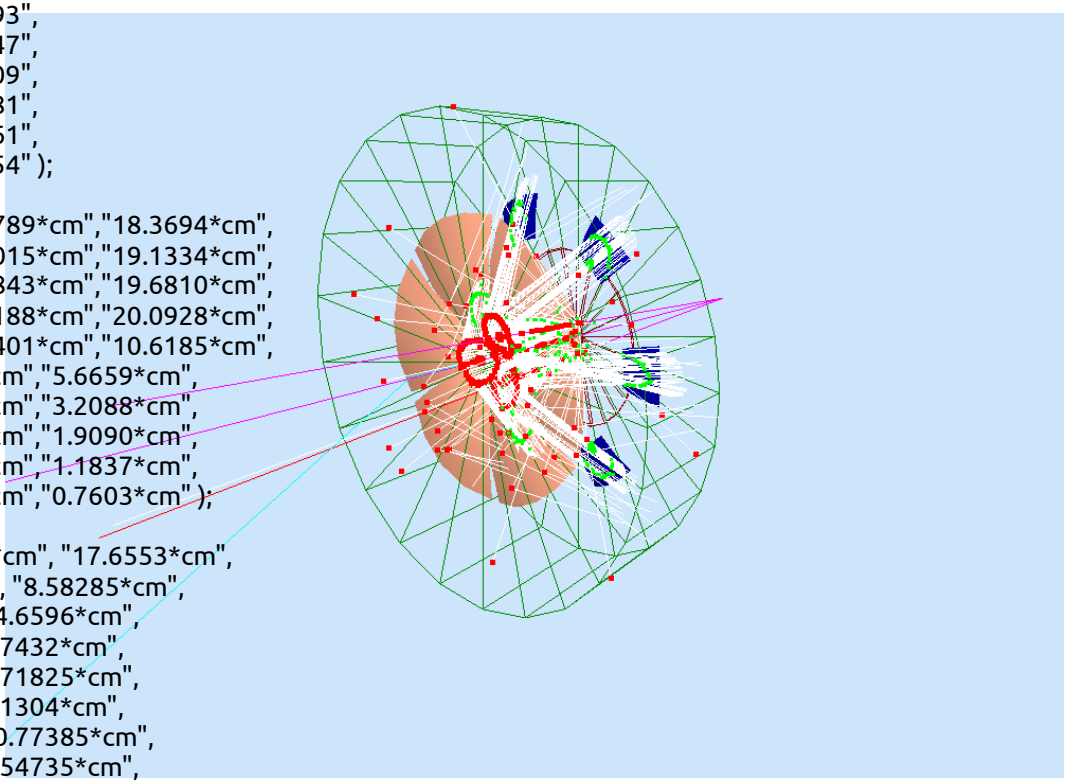


Rayleigh scattering

```
my @RichAerogel_PhoE=
(       "1.87855*eV","1.96673*eV","2.05490*eV","2.14308*eV","2.23126*eV",
        "2.31943*eV","2.40761*eV","2.49579*eV","2.58396*eV","2.67214*eV",
        "2.76032*eV","2.84849*eV","2.93667*eV","3.02485*eV","3.11302*eV",
        "3.20120*eV","3.28938*eV","3.37755*eV","3.46573*eV","3.55391*eV",
        "3.64208*eV","3.73026*eV","3.81844*eV","3.90661*eV","3.99479*eV",
        "4.08297*eV","4.17114*eV","4.25932*eV","4.34750*eV","4.43567*eV",
        "4.52385*eV","4.61203*eV","4.70020*eV","4.78838*eV","4.87656*eV",
        "4.96473*eV","5.05291*eV","5.14109*eV","5.22927*eV","5.31744*eV",
        "5.40562*eV","5.49380*eV","5.58197*eV","5.67015*eV","5.75833*eV",
        "5.84650*eV","5.93468*eV","6.02286*eV","6.11103*eV","6.19921*eV" );
my @RichAerogel_Rind3=
(       "1.01825","1.01829","1.01834","1.01839","1.01844",
        "1.01849","1.01854","1.01860","1.01866","1.01872",
        "1.01878","1.01885","1.01892","1.01899","1.01906",
        "1.01914","1.01921","1.01929","1.01938","1.01946",
        "1.01955","1.01964","1.01974","1.01983","1.01993",
        "1.02003","1.02014","1.02025","1.02036","1.02047",
        "1.02059","1.02071","1.02084","1.02096","1.02109",
        "1.02123","1.02137","1.02151","1.02166","1.02181",
        "1.02196","1.02212","1.02228","1.02244","1.02261",
        "1.02279","1.02297","1.02315","1.02334","1.02354" );
my @RichAerogel_Abs=
(       "17.5000*cm","17.7466*cm","17.9720*cm","18.1789*cm","18.3694*cm",
        "18.5455*cm","18.7086*cm","18.8602*cm","19.0015*cm","19.1334*cm",
        "19.2569*cm","19.3728*cm","19.4817*cm","19.5843*cm","19.6810*cm",
        "19.7725*cm","19.8590*cm","19.9410*cm","20.0188*cm","20.0928*cm",
        "18.4895*cm","16.0174*cm","13.9223*cm","12.1401*cm","10.6185*cm",
        "9.3147*cm","8.1940*cm","7.2274*cm","6.3913*cm","5.6659*cm",
        "5.0347*cm","4.4841*cm","4.0024*cm","3.5801*cm","3.2088*cm",
        "2.8817*cm","2.5928*cm","2.3372*cm","2.1105*cm","1.9090*cm",
        "1.7296*cm","1.5696*cm","1.4266*cm","1.2986*cm","1.1837*cm",
        "1.0806*cm","0.9877*cm","0.9041*cm","0.8286*cm","0.7603*cm" );
my @RichAerogel_Scat_scaled=
( "35.1384*cm", "29.24805*cm", "24.5418*cm", "20.7453*cm", "17.6553*cm",
"15.1197*cm", "13.02345*cm", "11.2782*cm", "9.81585*cm", "8.58285*cm",
"7.53765*cm", "6.6468*cm", "5.88375*cm", "5.22705*cm", "4.6596*cm",
"4.167*cm", "3.73785*cm", "3.36255*cm", "3.03315*cm", "2.7432*cm",
"2.487*cm", "2.26005*cm", "2.05845*cm", "1.87875*cm", "1.71825*cm",
"1.57455*cm", "1.44555*cm", "1.3296*cm", "1.2249*cm", "1.1304*cm",
"1.04475*cm", "0.9672*cm", "0.89655*cm", "0.83235*cm", "0.77385*cm",
"0.7203*cm", "0.67125*cm", "0.6264*cm", "0.58515*cm", "0.54735*cm",
"0.51255*cm", "0.48045*cm", "0.45075*cm", "0.4233*cm", "0.39795*cm",
"0.37455*cm", "0.3528*cm", "0.33255*cm", "0.3138*cm", "0.29625*cm" );
```

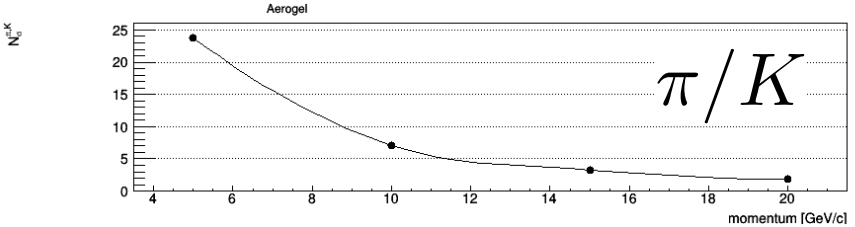
Using Marco's parameters for Aerogel

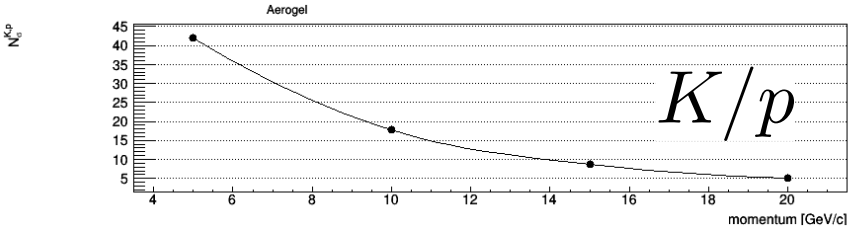
n(λ) scaled to be 1.02 at λ = 400 nm



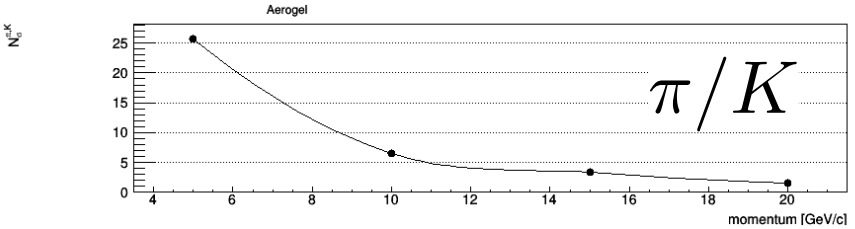
Particles separation – number of sigma

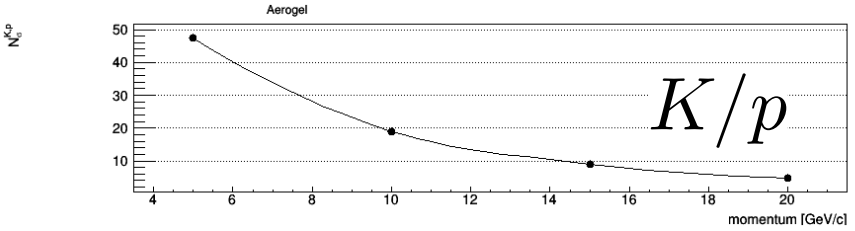
Polar angle 5°



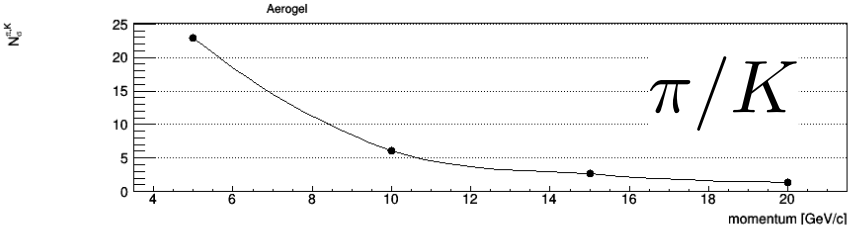


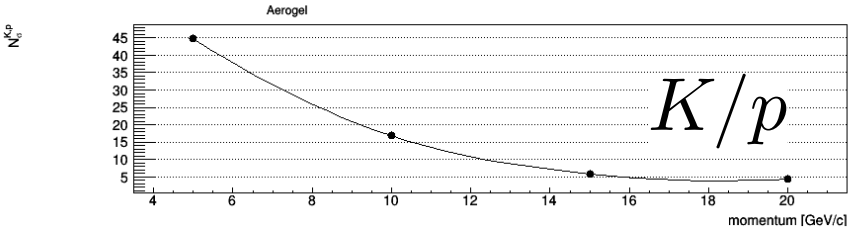
Polar angle 12.5°





Polar angle 25°

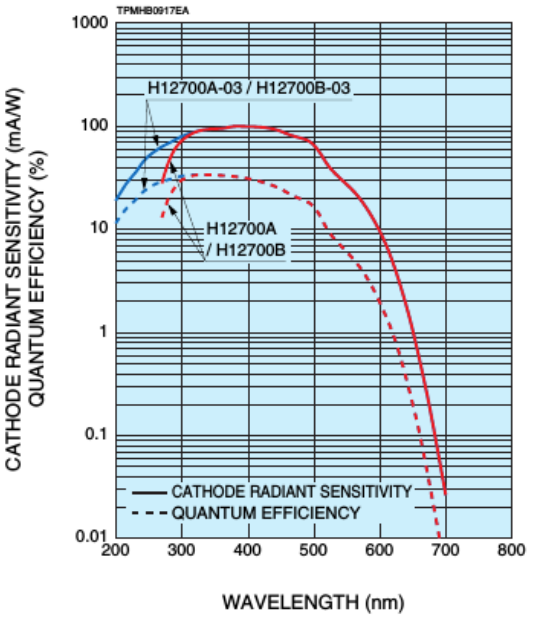




- Photon with λ < 300 nm shielded by software

- tracks reconstruction uncertanty not considered

Figure 1: Typical Spectral Response



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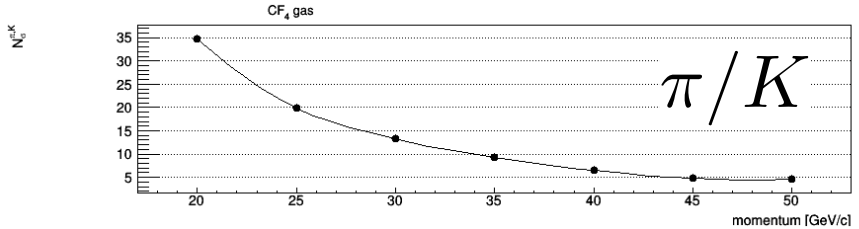
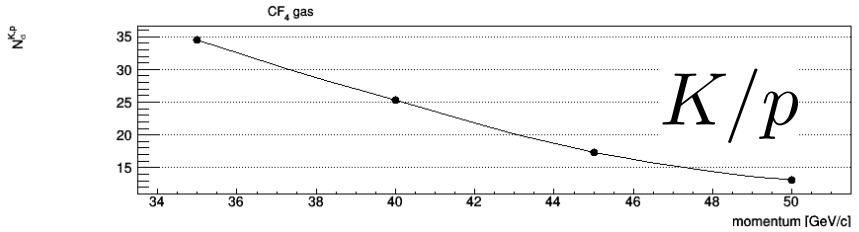
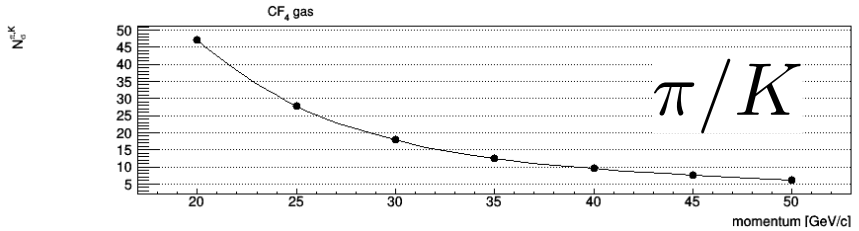
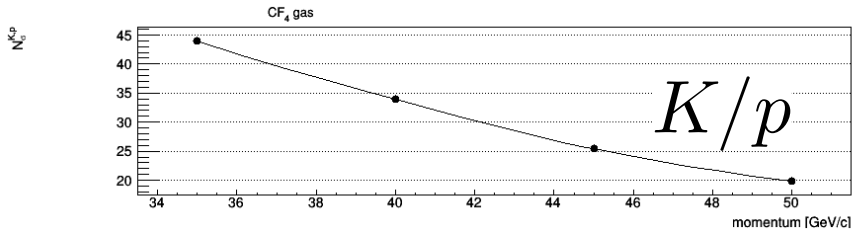


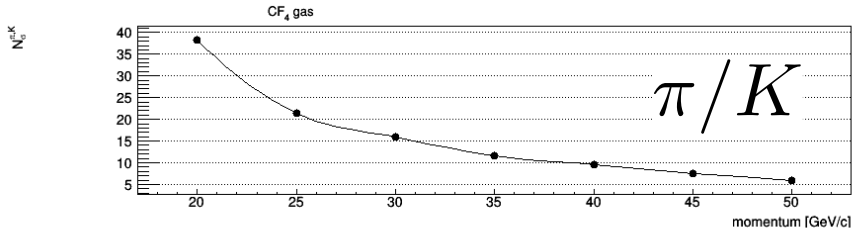


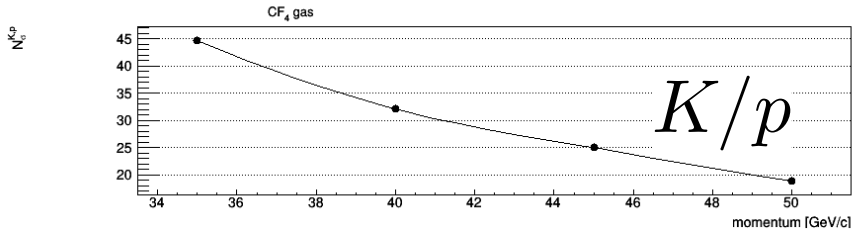
Polar angle 12.5°





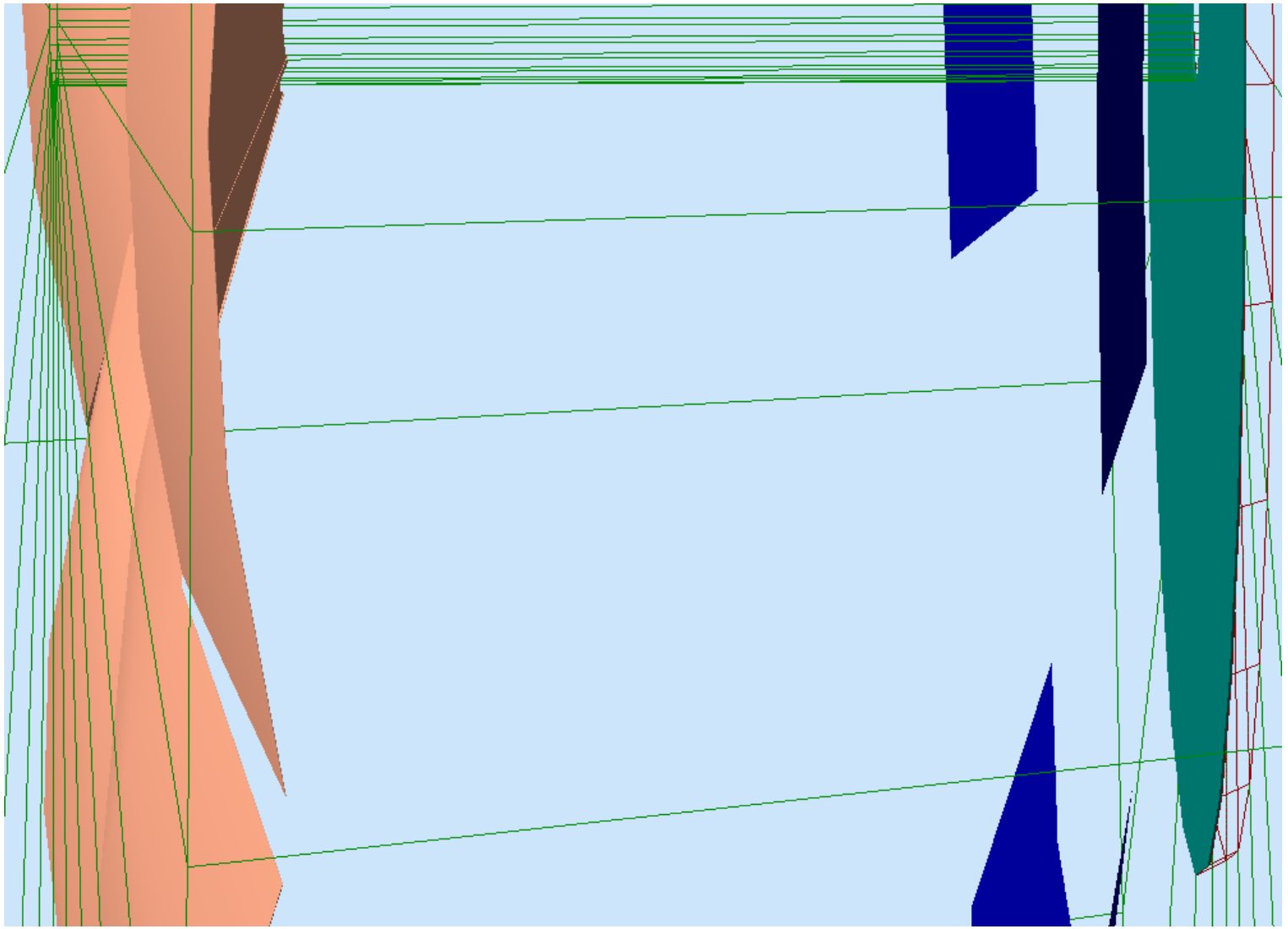
Polar angle 25°





- tracks reconstruction uncertanty not considered

Acrylic shield

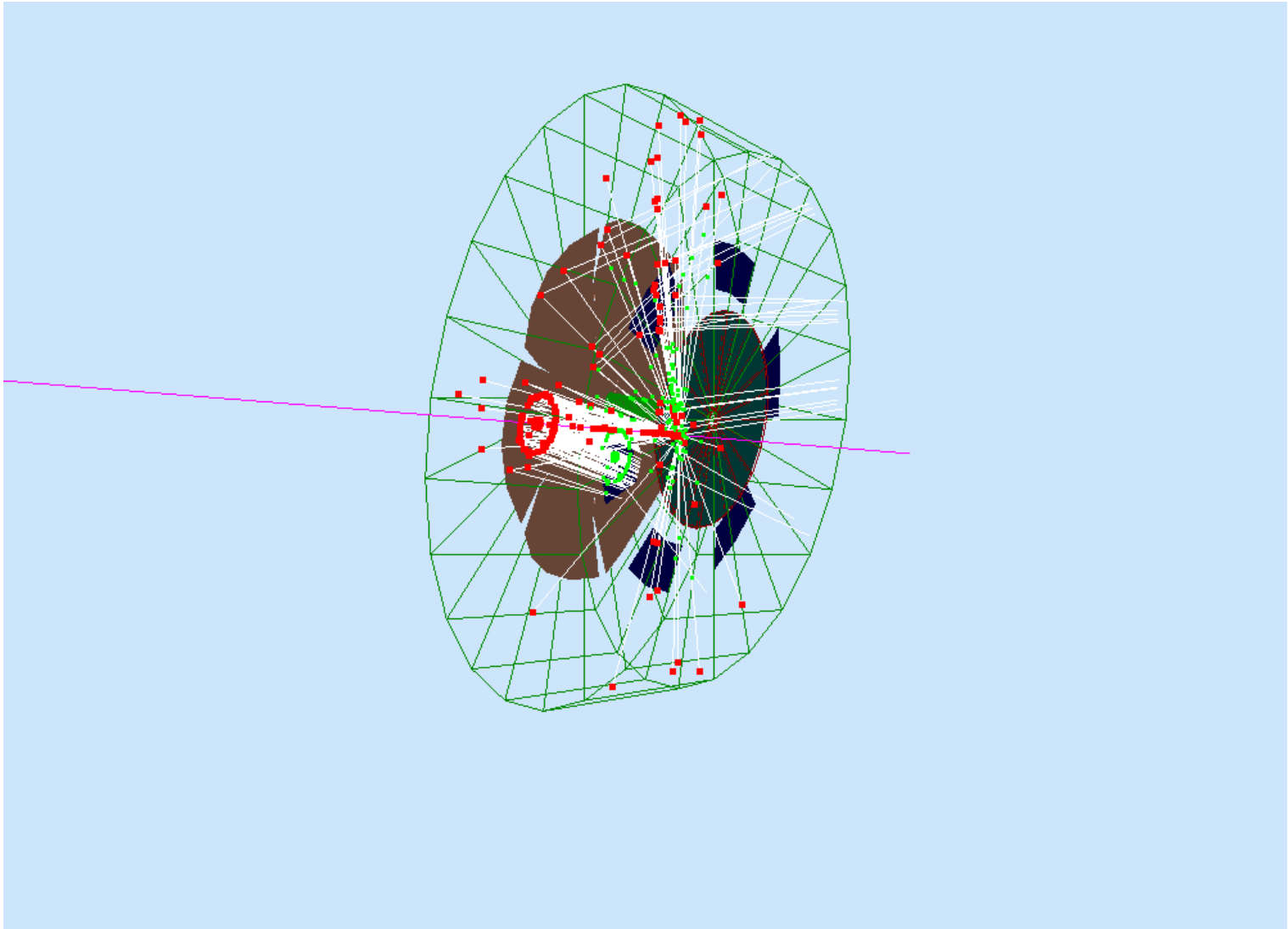


An acrylic shield has been added In front of the Aerogel

Thickness 3 mm

Absorption length about 5 m above 320 nm, about mm below 320 nm

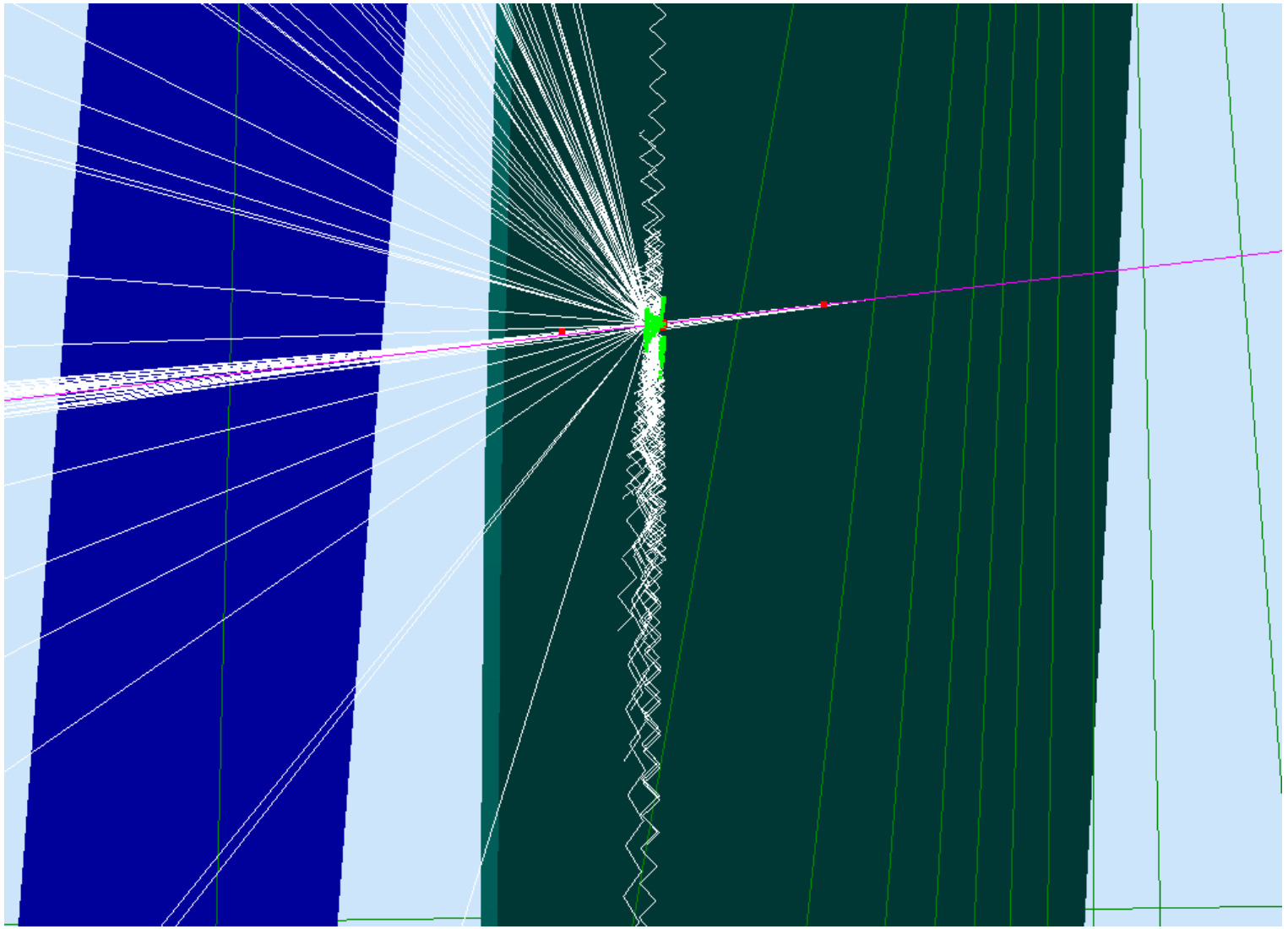
Acrylic shield



Additional background comes from cherenkov photons produced in the acrylic shield

Not all the photons are Internally reflected for tracks angles above 12°

Acrylic shield



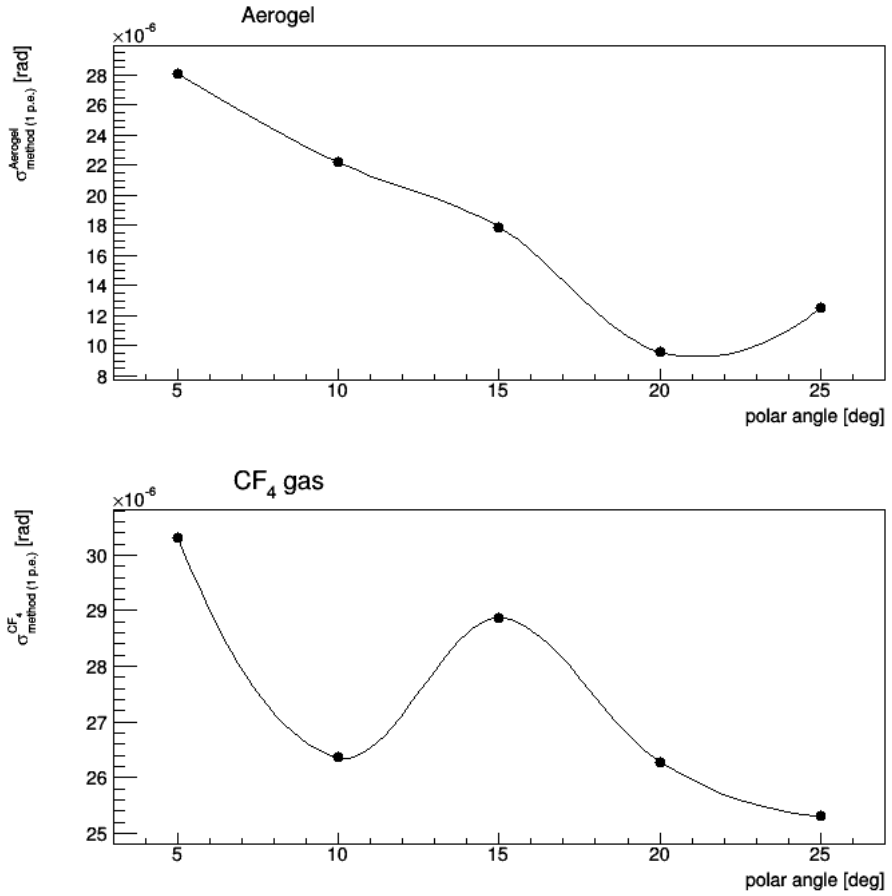
Not all the photons are Internally reflected for tracks angles above 12°

To do Next

- Add tracks smearing

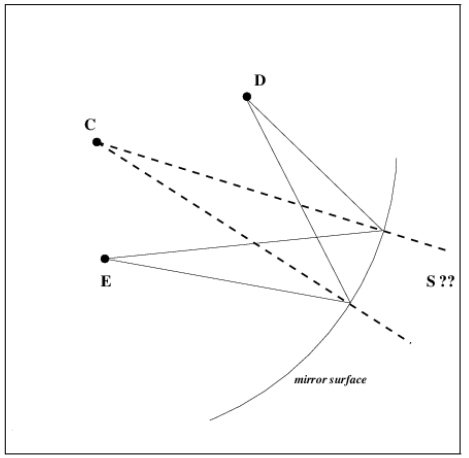
- Study the real acrylic shield configuration

Indirect ray tracing method - resolution



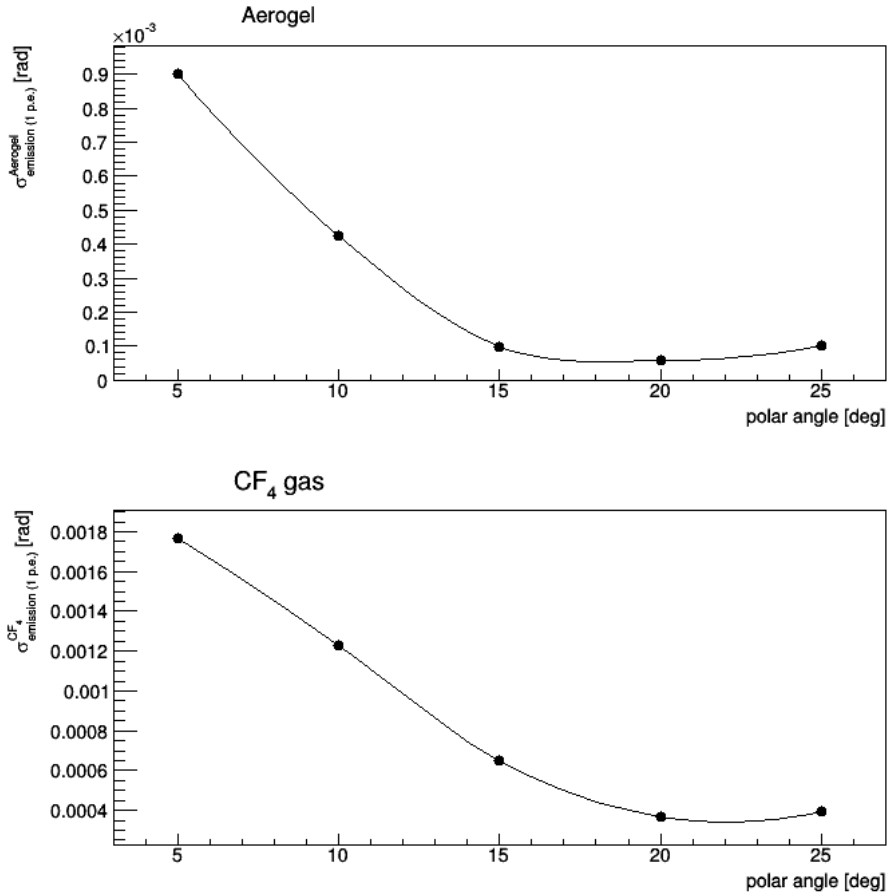
- Constant n(λ), for aerogel and gas

- Assuming to know the emission point, detector hit position and spherical mirror center



The recontruction method intrinsic error order 10^-5 rad

Detector plane configurations 2



Mirror radius 2.8 m
Mirror tilt angle 26.65°

At 25° 1/2 of the Aerogel photons lost to contain the size of the detector plane

About 8500 cm^2

Detector plane: spherical shape

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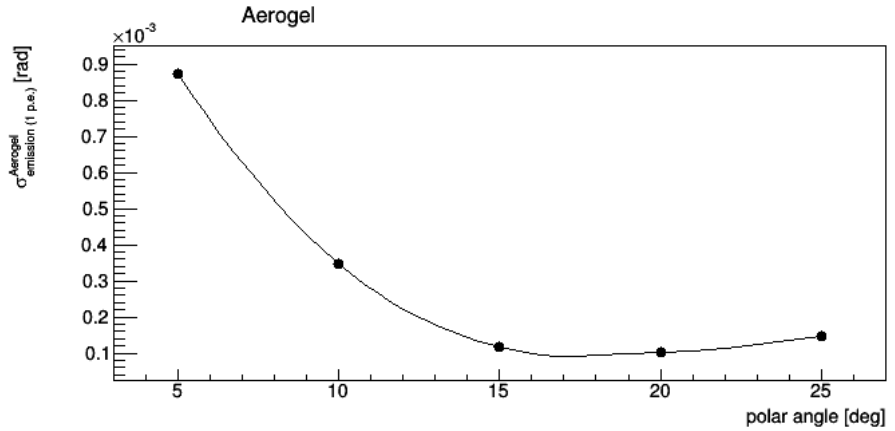
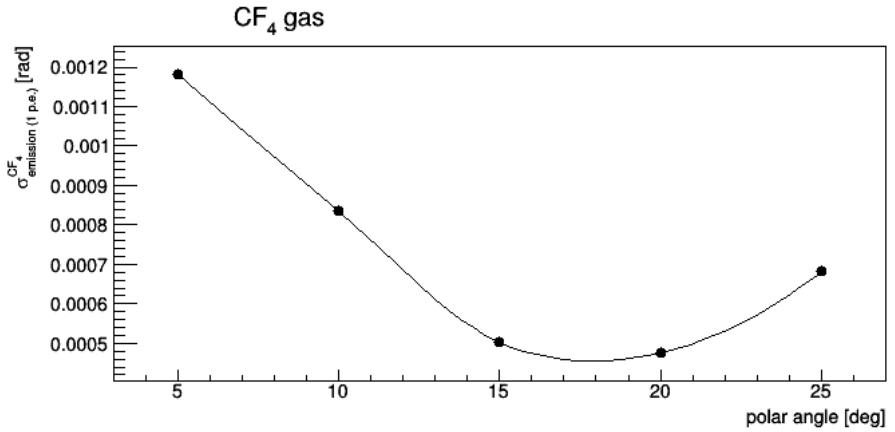
Same center of the mirror

The emission point is assumed to be in midle point of the track in the radiator.

Detector plane configuration 3





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About 8500 cm^2

Detector plane: spherical shape

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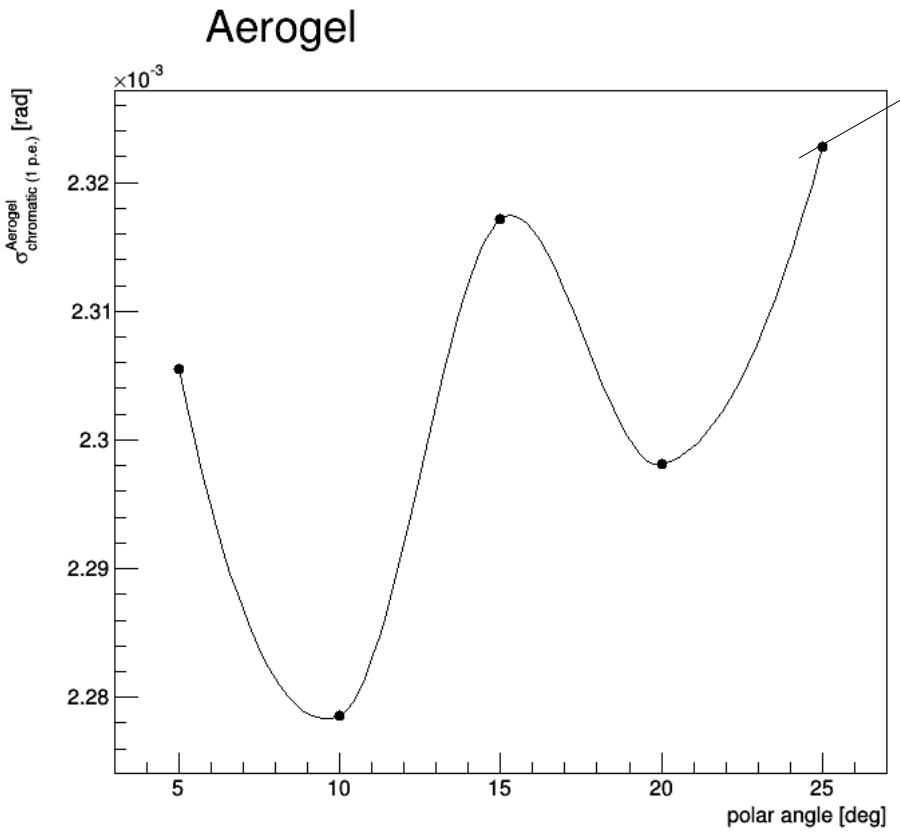
Center shifted of 6 cm respect to the mirror center

The emission point is assumed to be in midle point of the track in the radiator.

Chromatic uncertanty - aerogel



Refractive error ideally can be corrected, but only knowing the energy of the photons!

Aerogel

$mat{"indexOfRefraction"} = "1.01963 1.01992 1.02029 1.02074 1.02128";

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The recontruction method intrinsic error order 10^-5 rad

40 GeV

Field uncertanty – old v9