Diffusion Scan and interaction lenght calculation from data

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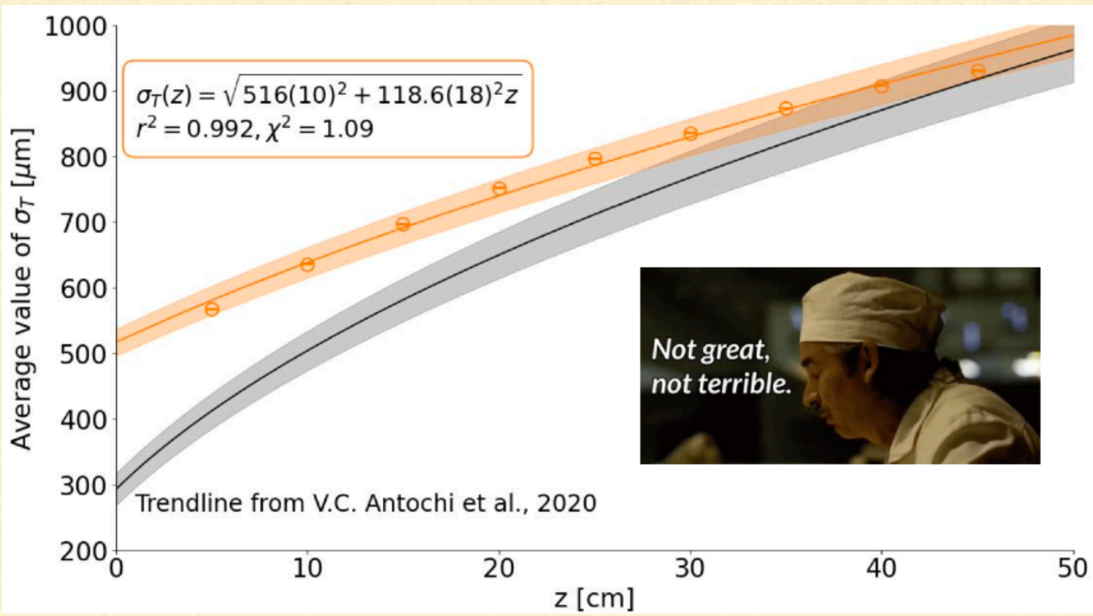
Data production

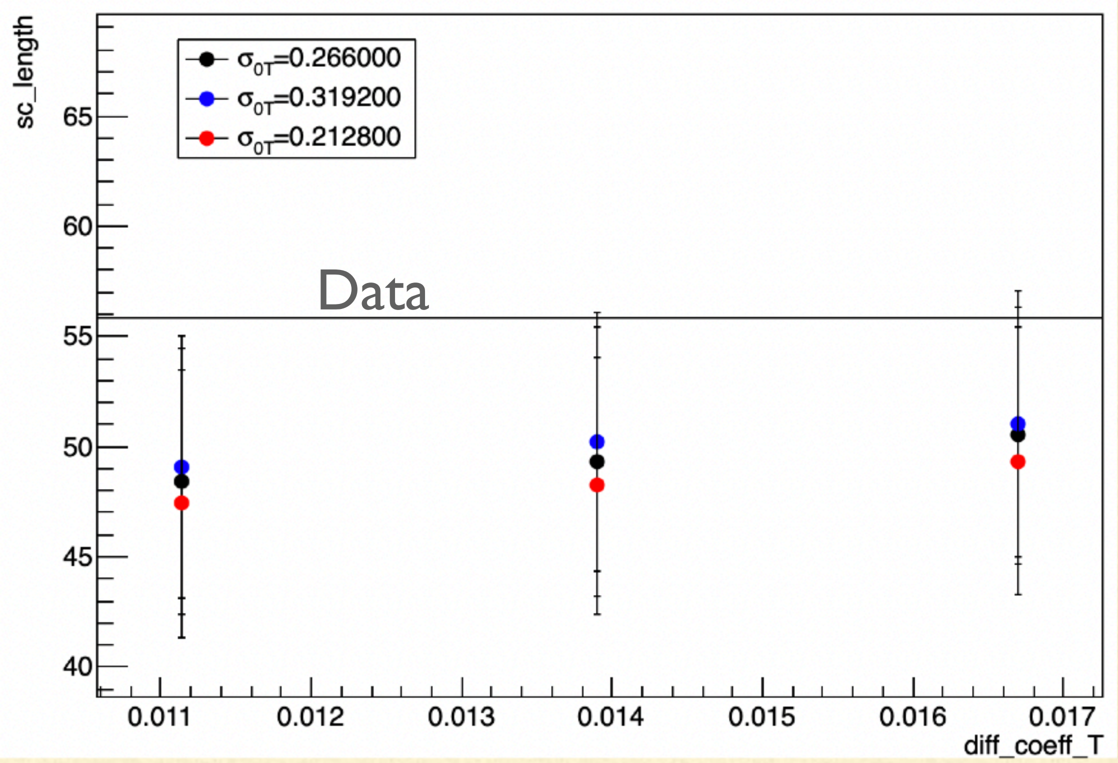


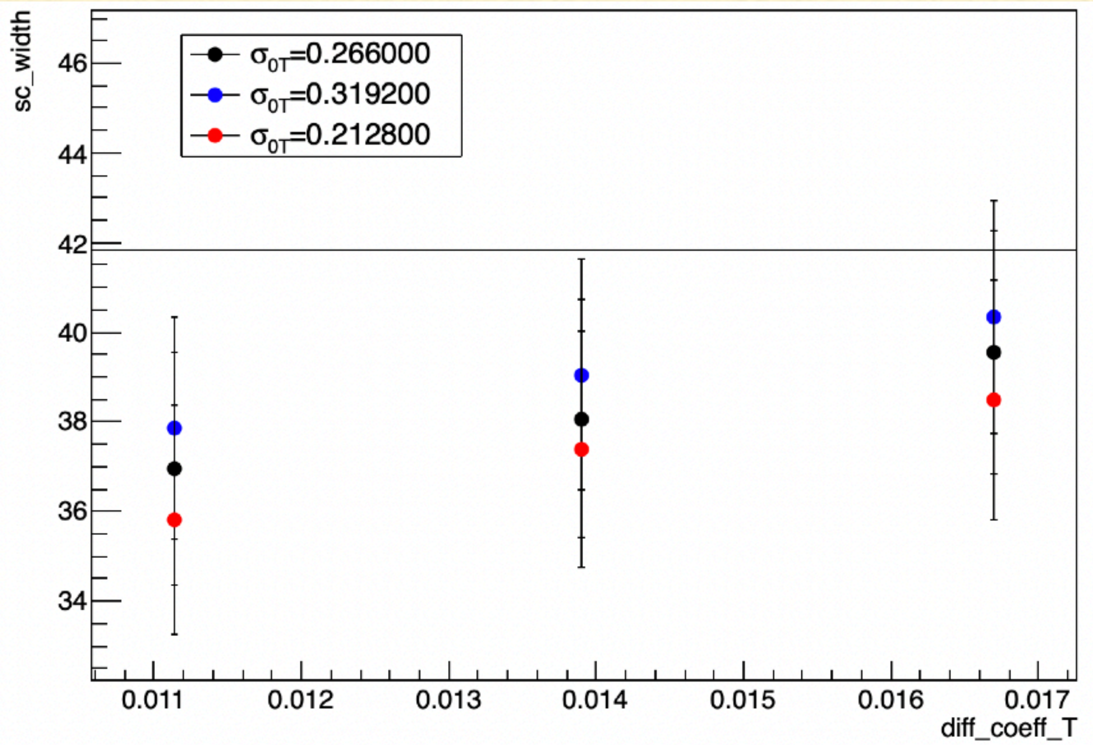
- 18 keV tested
- Scan done with the two parameters found by Rita ±20% of variation
- Total of 3x3 parameters: all the 9 combination tested
- Same longitudinal and transversal diffusion used

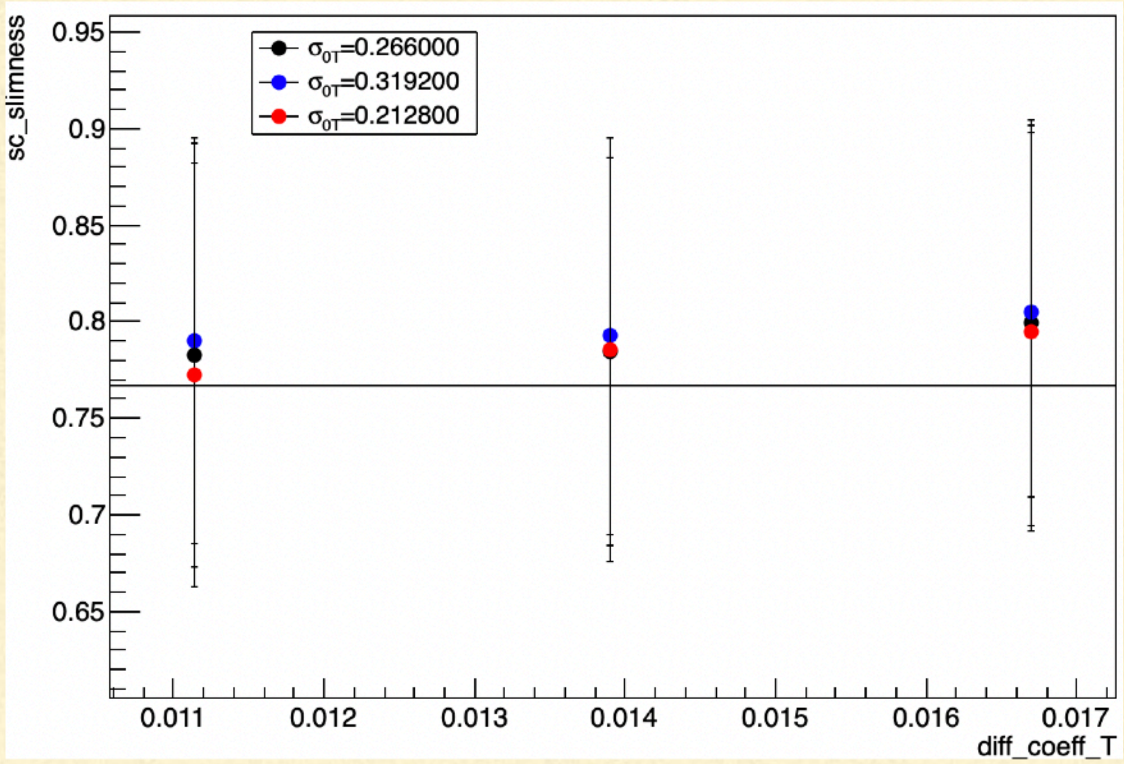
```
ConfigFile_new_1.txt
'diff_const_sigma0T'    : 0.266,     # diffusion constant [mm]^2
'diff_coeff_T'          : 0.01392,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
'diff_const_sigma0L'    : 0.266,     # diffusion constant [mm]^2
'diff_coeff_L'          : 0.01392,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
ConfigFile_new_2.txt
'diff_const_sigma0T'    : 0.266,     # diffusion constant [mm]^2
'diff_coeff_T'          : 0.01670,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
'diff_const_sigma0L'    : 0.266,     # diffusion constant [mm]^2
'diff_coeff_L'          : 0.01670,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
ConfigFile_new_3.txt
'diff_const_sigma0T'    : 0.266,     # diffusion constant [mm]^2
'diff_coeff_T'          : 0.011136,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
'diff_const_sigma0L'    : 0.266,     # diffusion constant [mm]^2
'diff_coeff_L'          : 0.011136,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
ConfigFile_new_4.txt
'diff_const_sigma0T'    : 0.3192,    # diffusion constant [mm]^2
'diff_coeff_T'          : 0.01392,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
'diff_const_sigma0L'    : 0.3192,    # diffusion constant [mm]^2
'diff_coeff_L'          : 0.01392,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
ConfigFile_new_5.txt
'diff_const_sigma0T'    : 0.3192,    # diffusion constant [mm]^2
'diff_coeff_T'          : 0.01670,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
'diff_const_sigma0L'    : 0.3192,    # diffusion constant [mm]^2
'diff_coeff_L'          : 0.01670,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
ConfigFile_new_6.txt
'diff_const_sigma0T'    : 0.3192,    # diffusion constant [mm]^2
'diff_coeff_T'          : 0.011136,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
'diff_const_sigma0L'    : 0.3192,    # diffusion constant [mm]^2
'diff_coeff_L'          : 0.011136,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
ConfigFile_new_7.txt
'diff_const_sigma0T'    : 0.2128,    # diffusion constant [mm]^2
'diff_coeff_T'          : 0.01392,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
'diff_const_sigma0L'    : 0.2128,    # diffusion constant [mm]^2
'diff_coeff_L'          : 0.01392,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
ConfigFile_new_8.txt
'diff_const_sigma0T'    : 0.2128,    # diffusion constant [mm]^2
'diff_coeff_T'          : 0.01670,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
'diff_const_sigma0L'    : 0.2128,    # diffusion constant [mm]^2
'diff_coeff_L'          : 0.01670,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
ConfigFile_new_9.txt
'diff_const_sigma0T'    : 0.2128,    # diffusion constant [mm]^2
'diff_coeff_T'          : 0.011136,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
'diff_const_sigma0L'    : 0.2128,    # diffusion constant [mm]^2
'diff_coeff_L'          : 0.011136,    # diffusion parameter [mm/sqrt(cm)]^2 for 1 kV
```

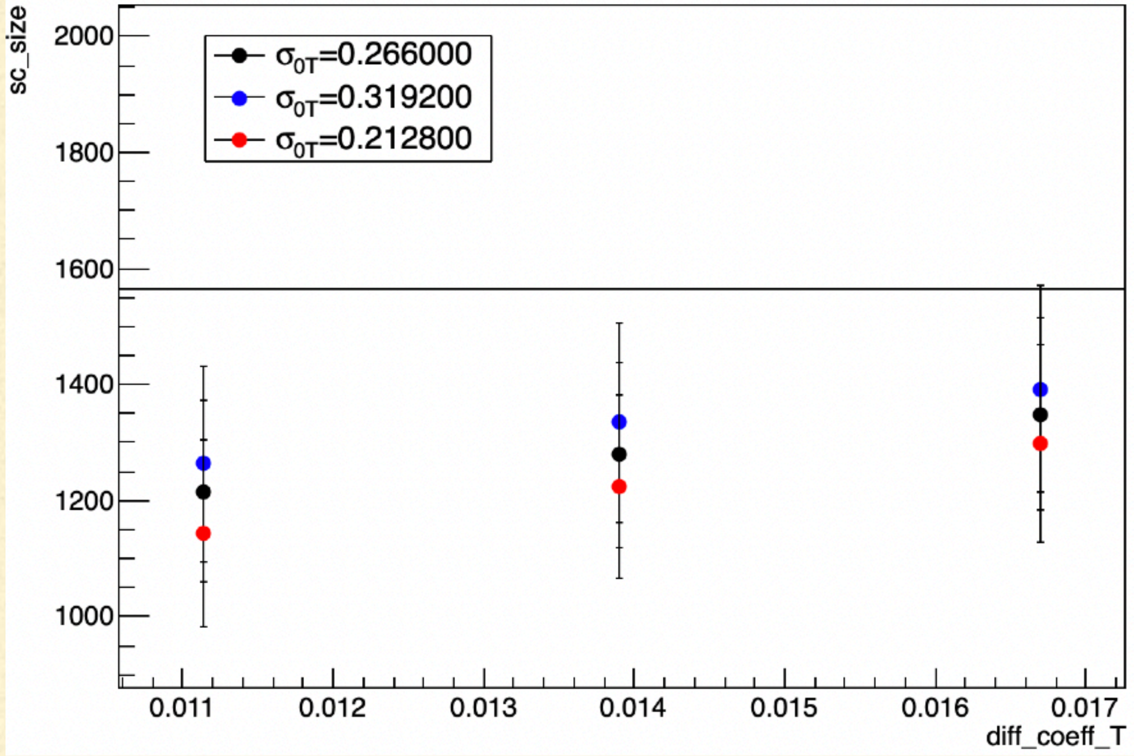
Results

Comparable sigma for data

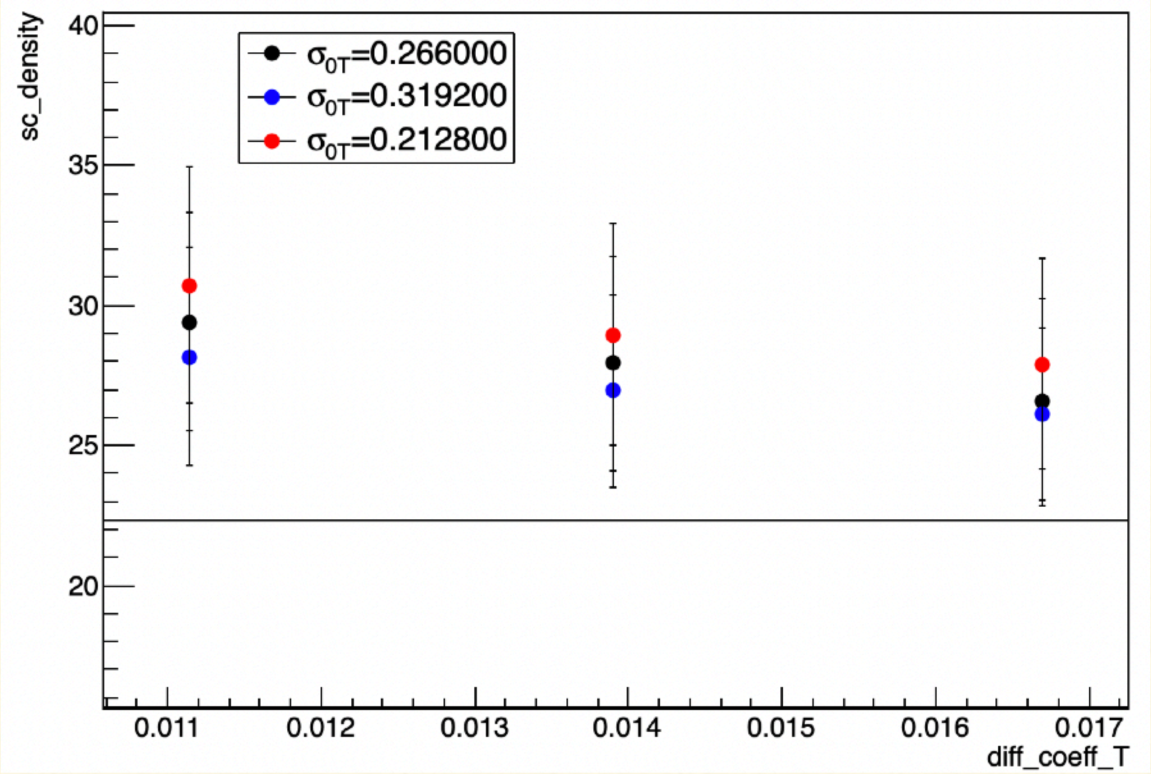


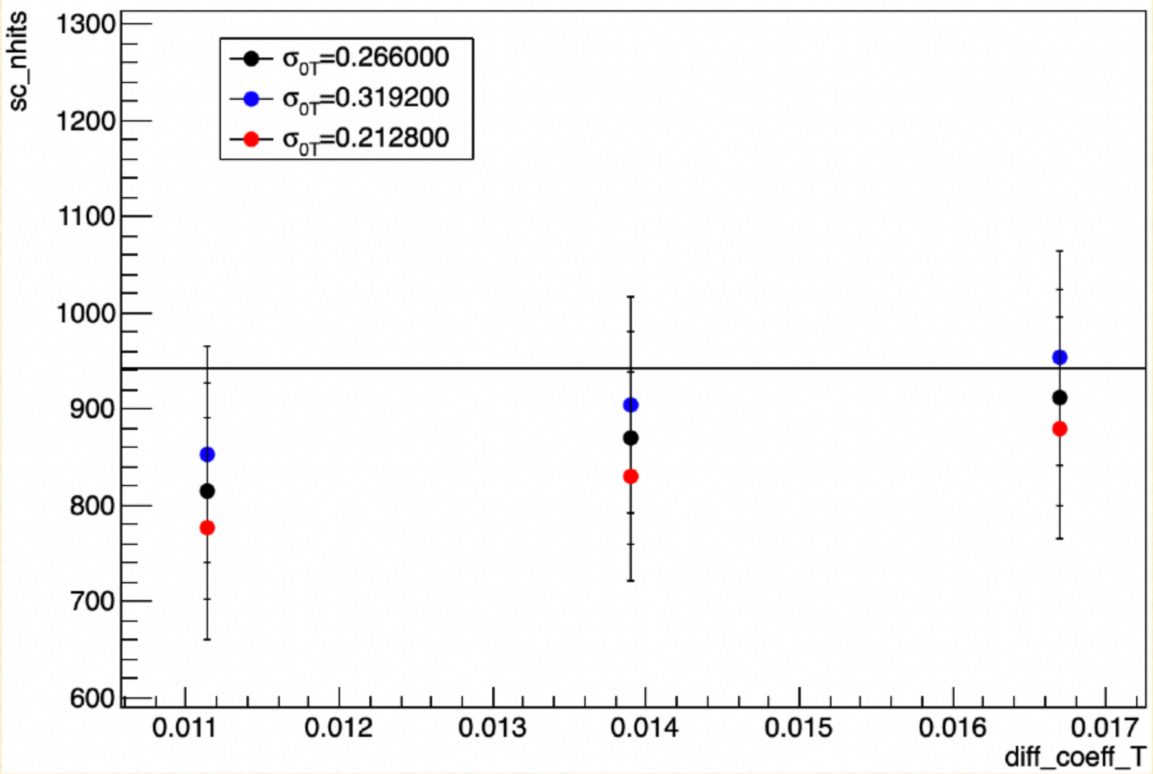


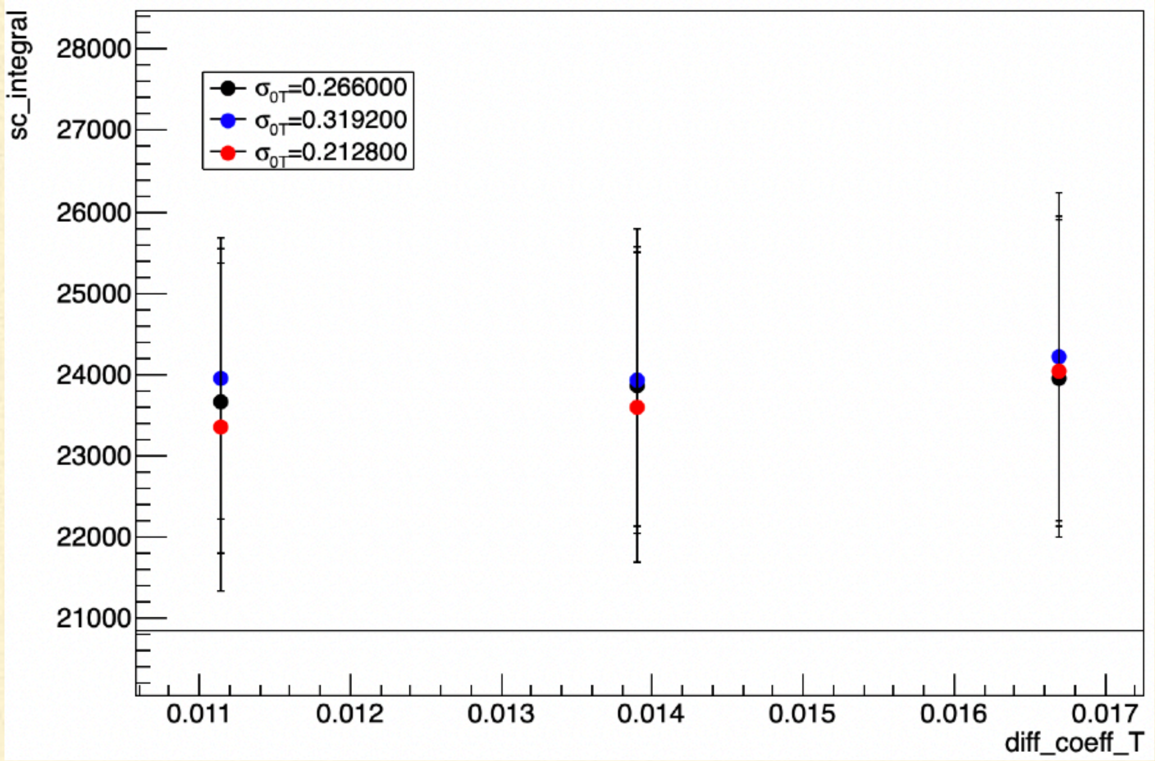


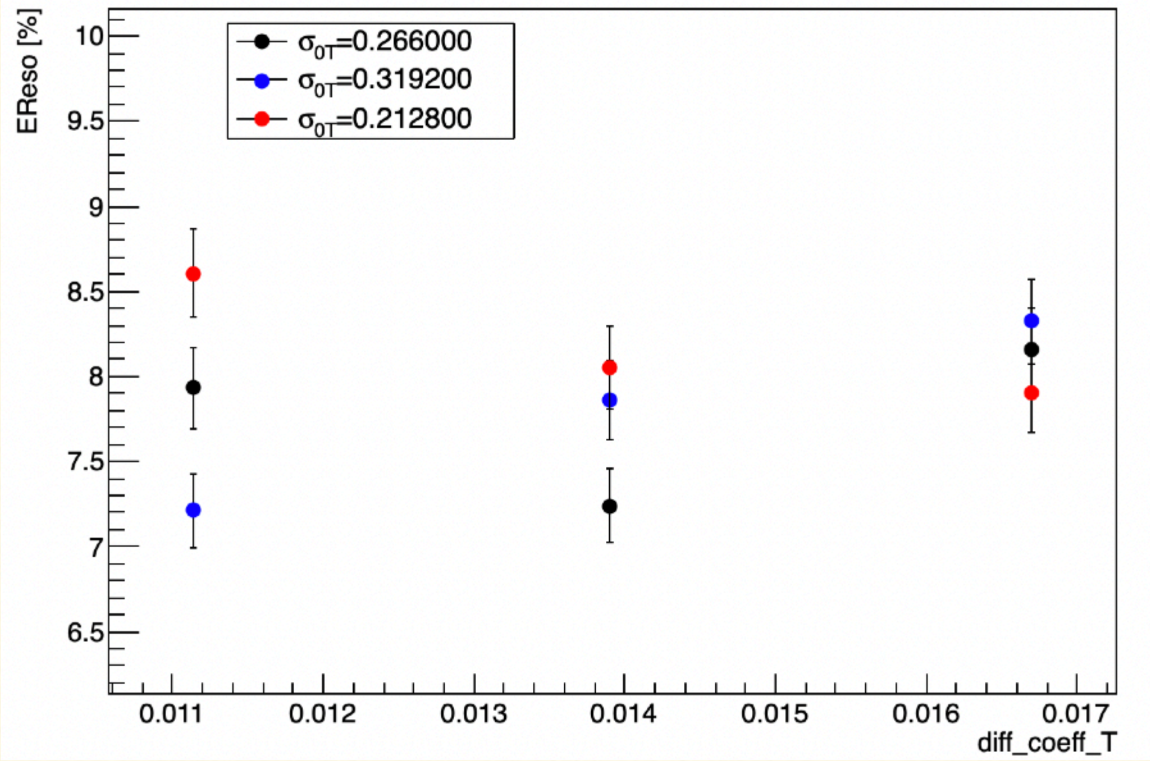


Results

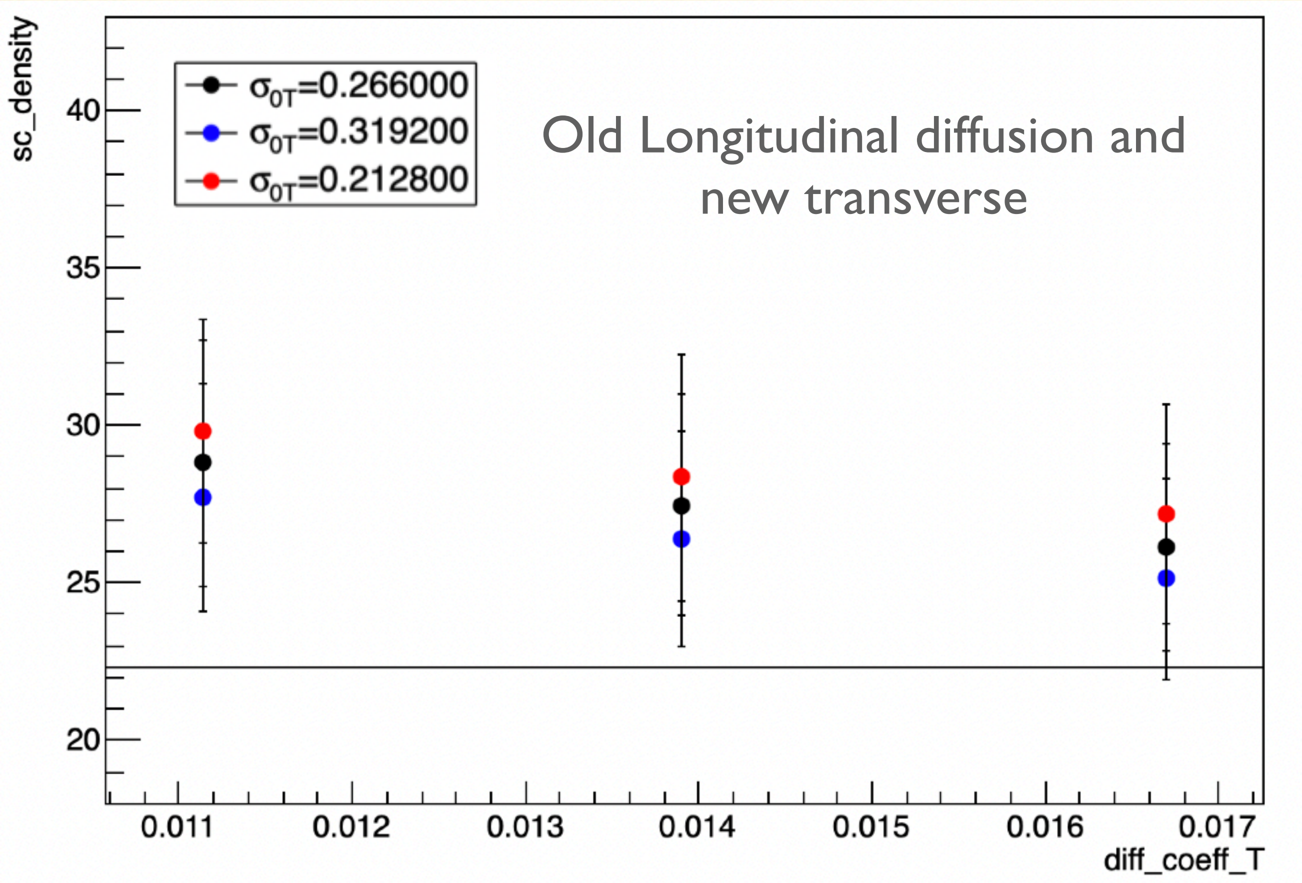

sc_density
40
35
30
25
20
σ_{0T}=0.266000
σ_{0T}=0.319200
σ_{0T}=0.212800
0.011
0.012
0.013
0.014
0.015
0.016
0.017
diff_coeff_T

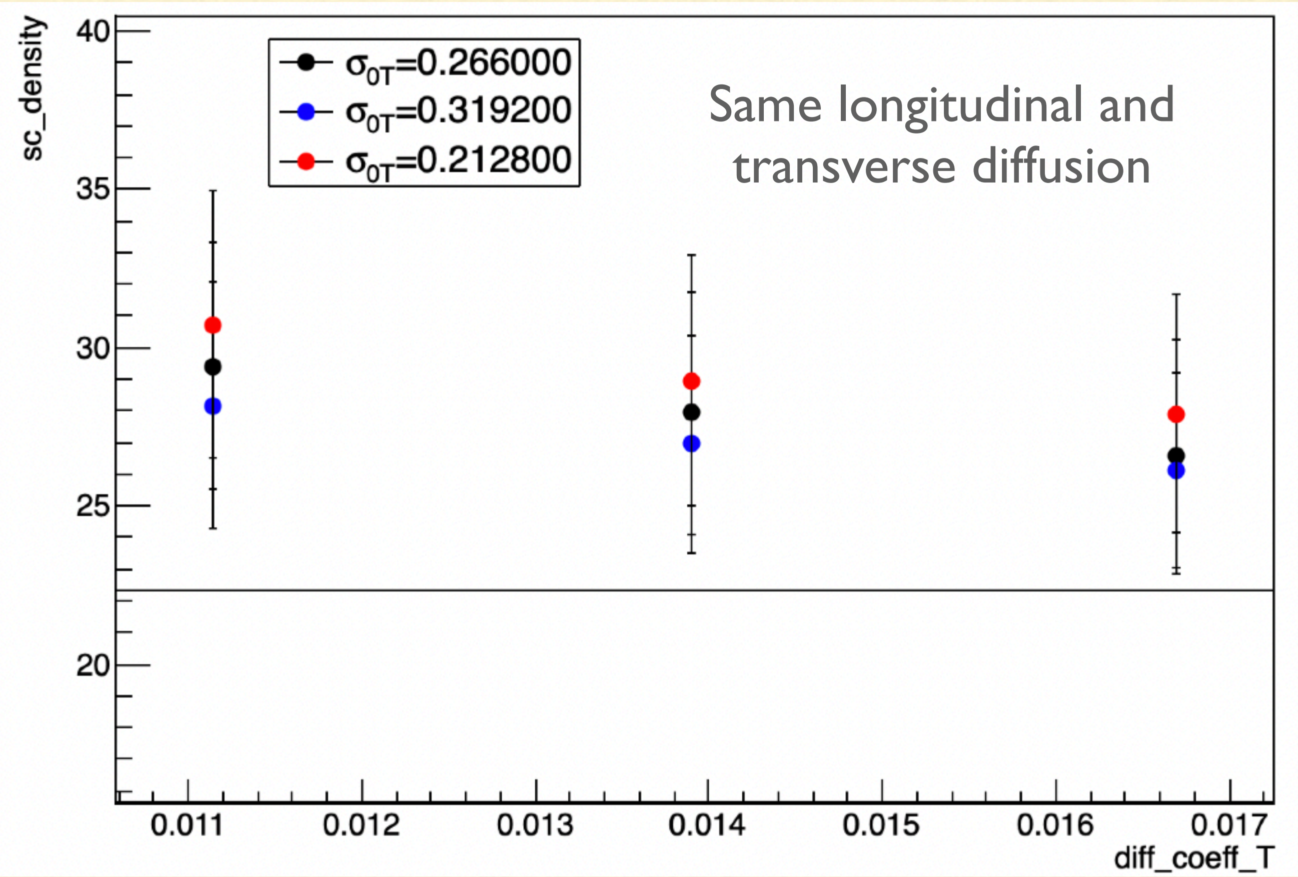

sc_nhits
1300
1200
1100
1000
900
800
700
600
σ_{0T}=0.266000
σ_{0T}=0.319200
σ_{0T}=0.212800
0.011
0.012
0.013
0.014
0.015
0.016
0.017
diff_coeff_T


sc_integral
28000
27000
26000
25000
24000
23000
22000
21000
σ_{0T}=0.266000
σ_{0T}=0.319200
σ_{0T}=0.212800
0.011
0.012
0.013
0.014
0.015
0.016
0.017
diff_coeff_T


EReso [%]
10
9.5
9
8.5
8
7.5
7
6.5
σ_{0T}=0.266000
σ_{0T}=0.319200
σ_{0T}=0.212800
0.011
0.012
0.013
0.014
0.015
0.016
0.017
diff_coeff_T

Effect of different longitudinal diffusion on density



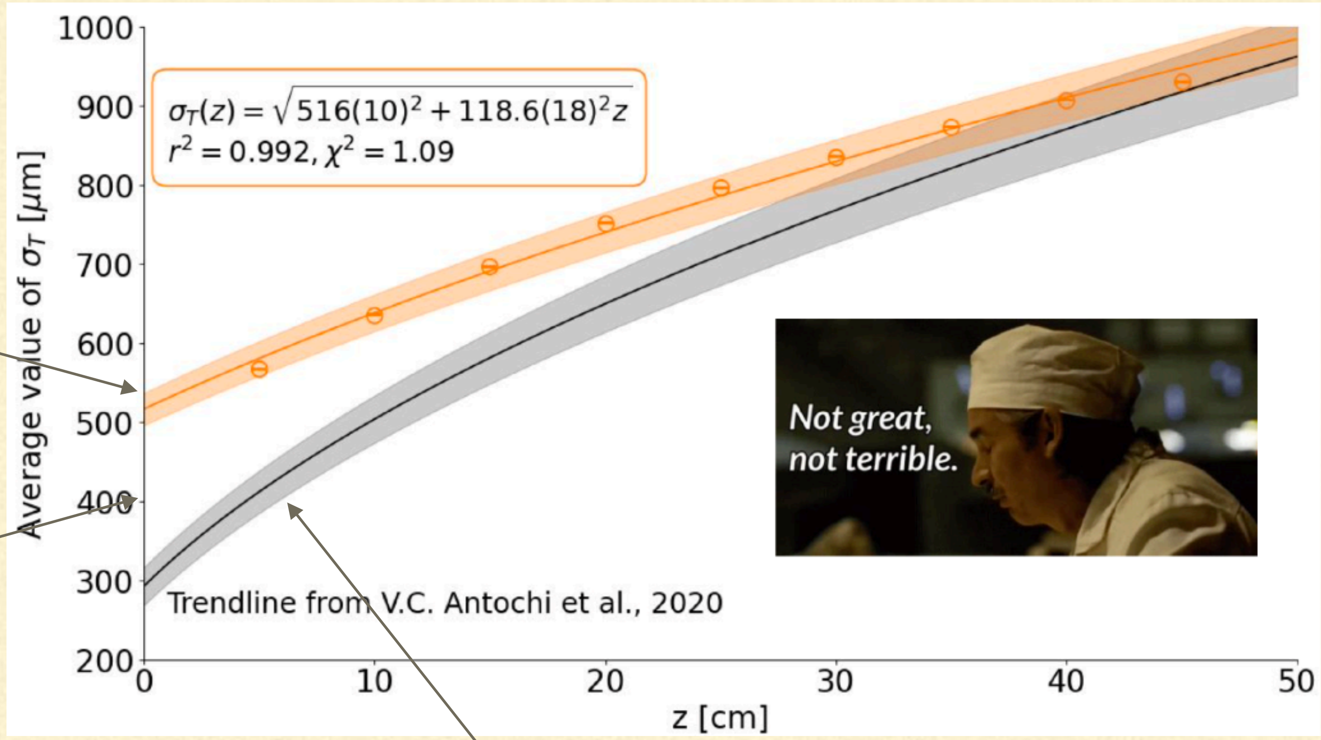


A variation in longitudinal diffusion have a small effect on sc density

Diffusion as a function of the released energy?

Curve obtained with Iron spot

Super saturated



Is there some curve in the middle that is function to the energy density released?

Plot obtained with MIP (high energy electrons at BTF)

Non saturated

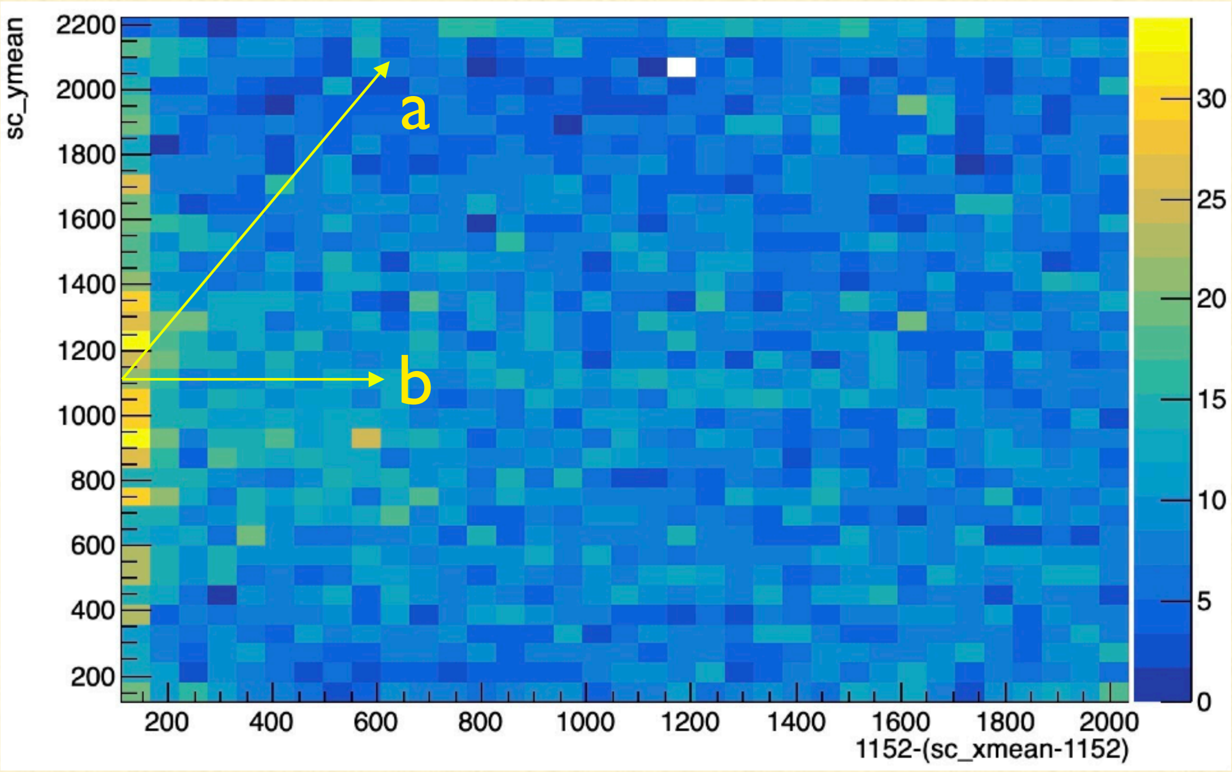
We should investigate more in deep if there is some effect that lead to an increase of the track diffusion with the primary carrier density

e.g. trivially the repulsion of a baunch of electron can increase with the electron density

Interaction lenght calculation strategy

Given a beam of photon of intensity N_0, the Number N(d) after the beam travelled a distance d is $N(d) = N_0 \cdot e^{-\frac{x}{\lambda}}$

1) scatter plot sc_x-sc_y and take the projection on x:

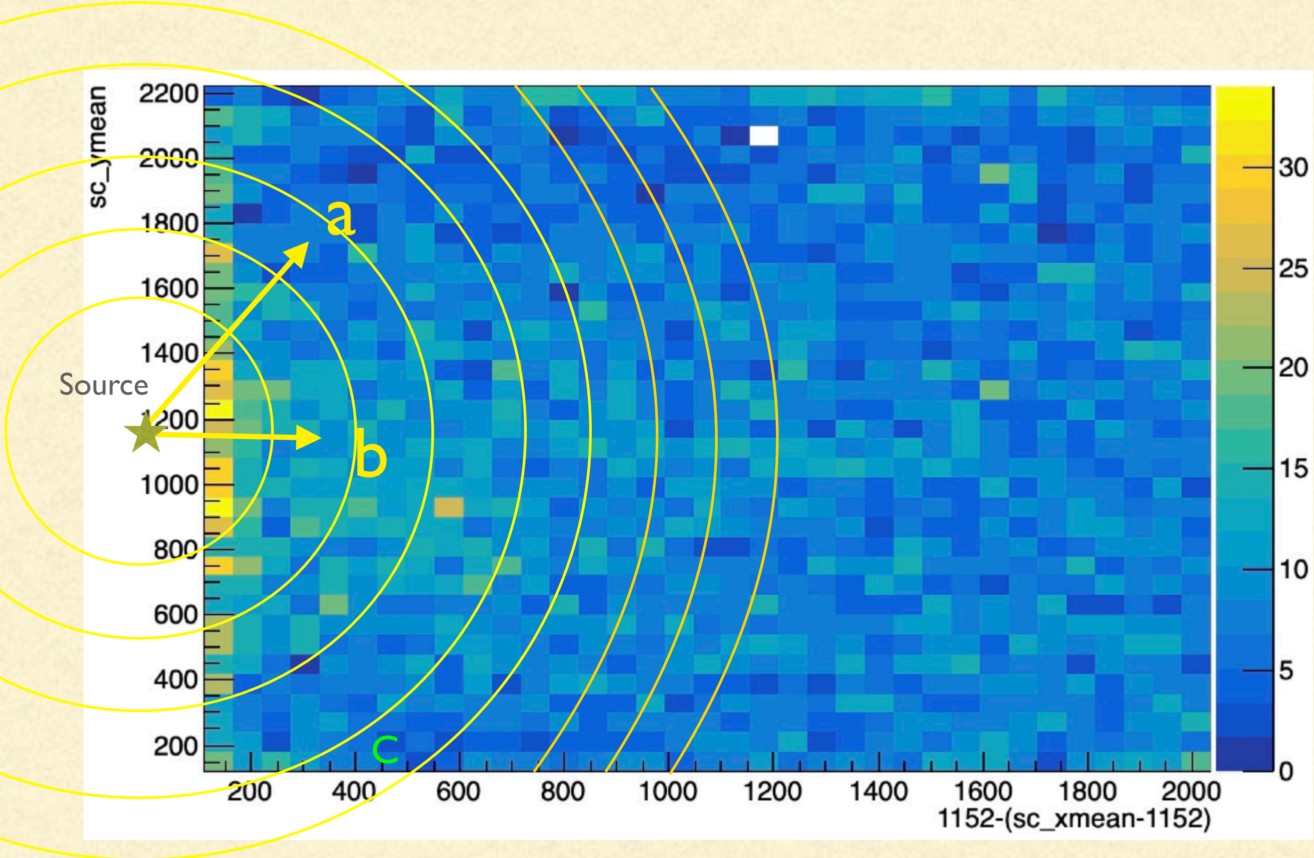


But here the path length of photon a is evaluated as the one of photon b

This will create an excess of photon in the initial region, leading to a smaller value of λ

Interaction lenght calculation strategy

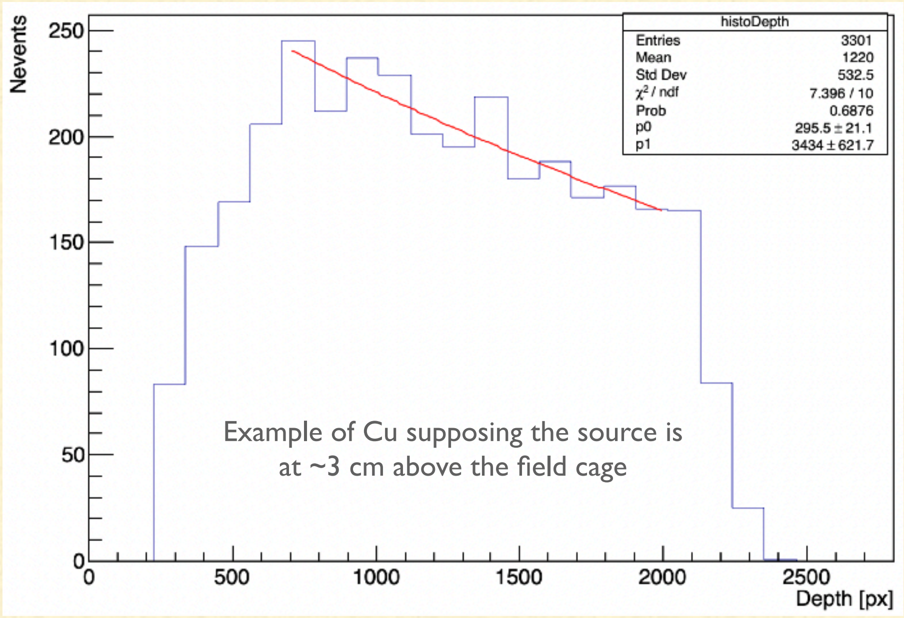
2) plot sc_x-sc_y and take the projection by circumferences:



Now the path of the photon a will be different from the one of the photon b and correctly evaluated

But there is now a problem in therm of area normalization

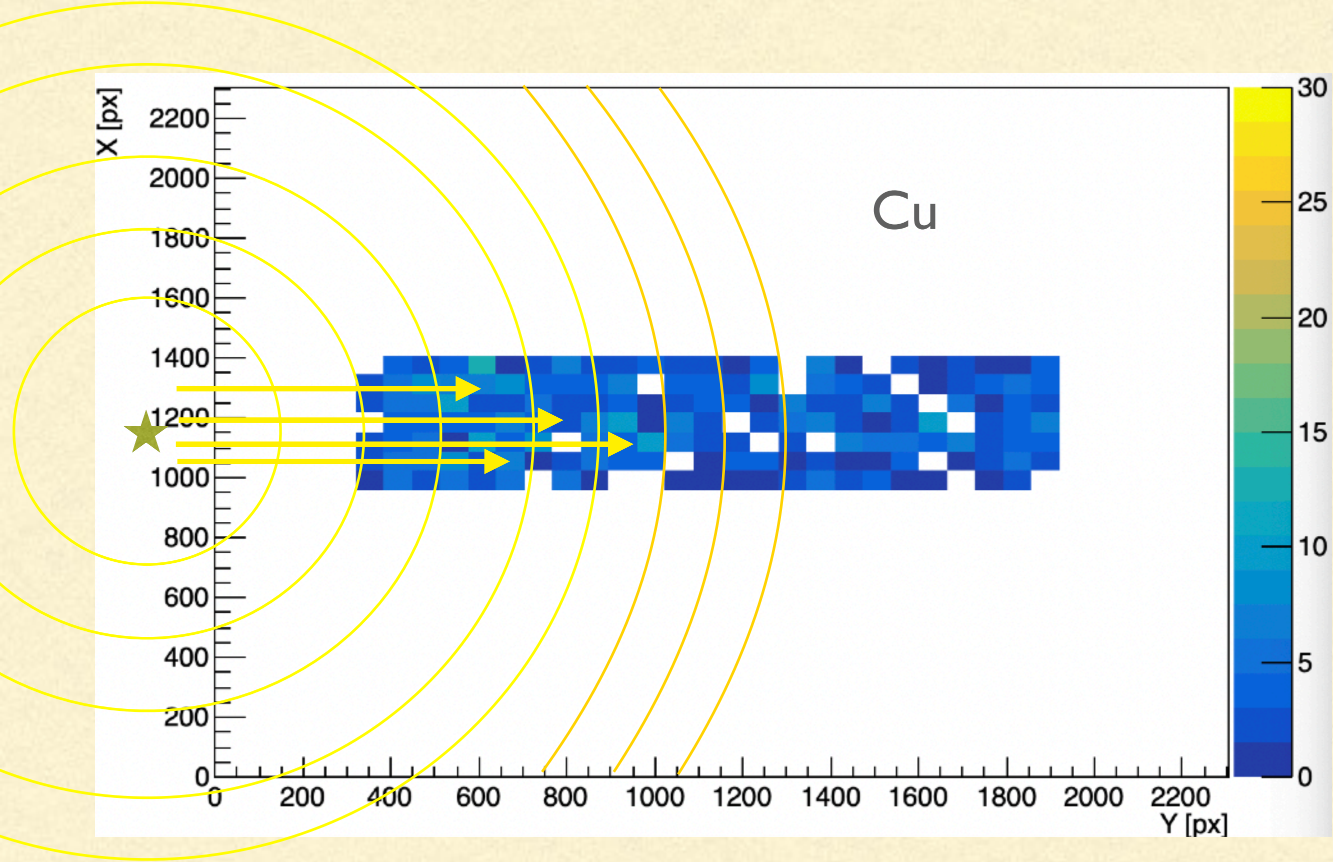
In the first two regions there will be less events than in the other beacause the "integration" area is smaller



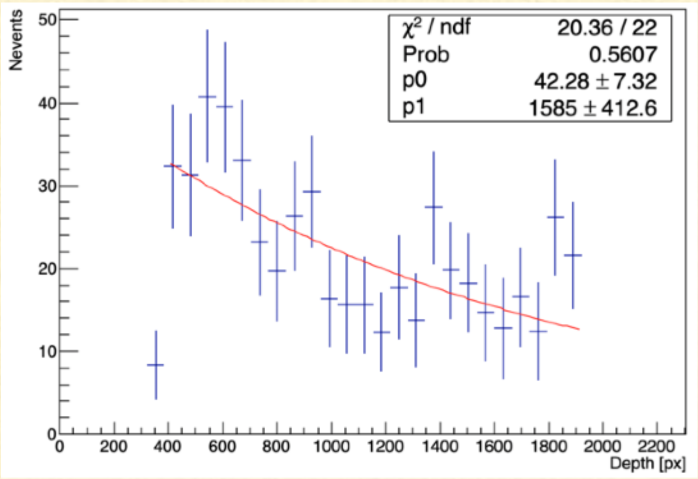
Starting from the ring labled as C, there will be no problems of area but I will throw the higher statistic region

Interaction lenght calculation strategy

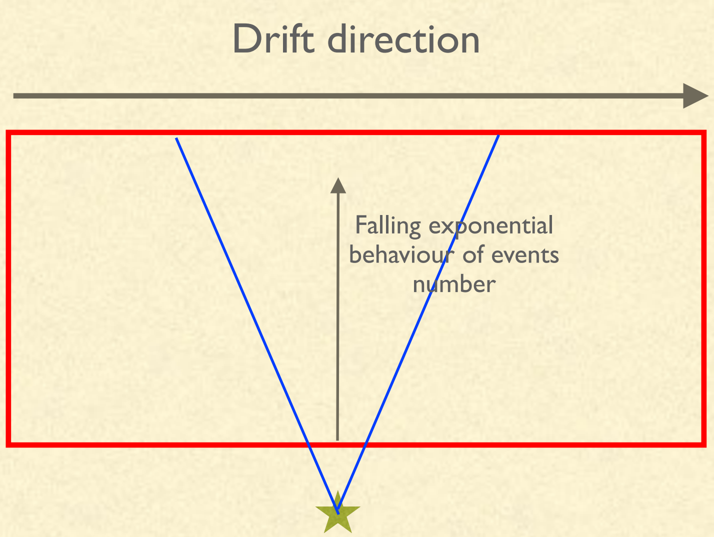
3) consider only the central region of the X-Y plot

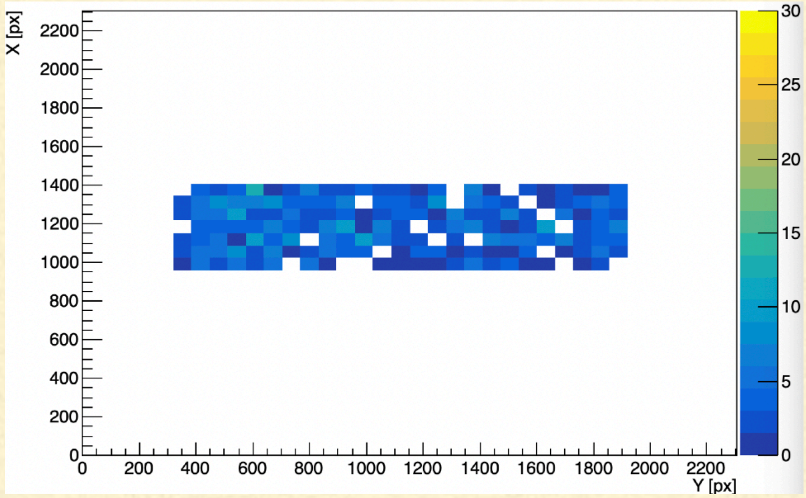


Good approximation of a beam-like behaviour



But…

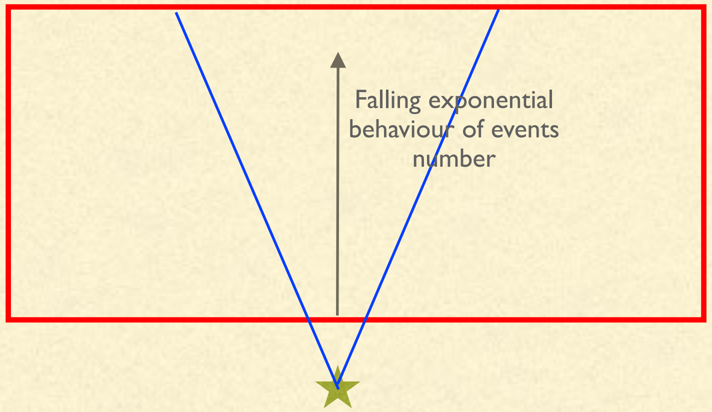


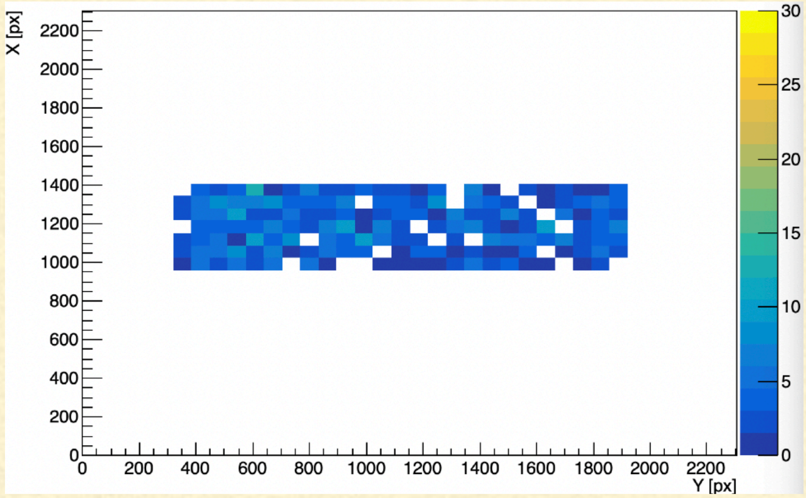


What we see is the projection of all the events that take place in the 3D cone

And it is a convolution of many effects that lead to this distributions

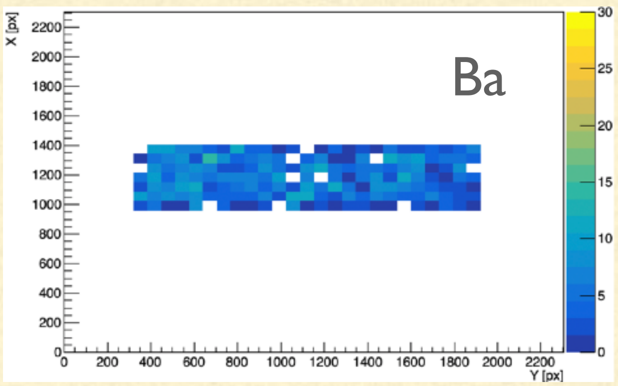
Interaction lenght calculation strategy

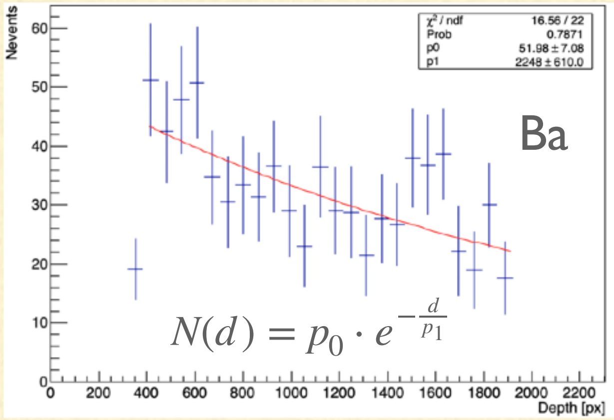


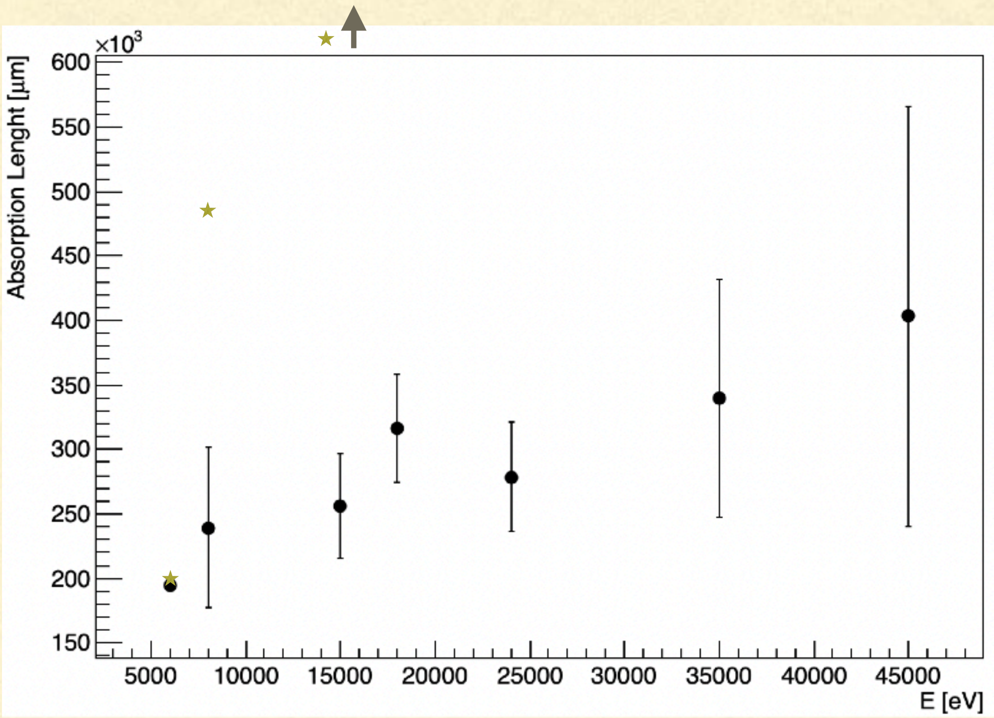


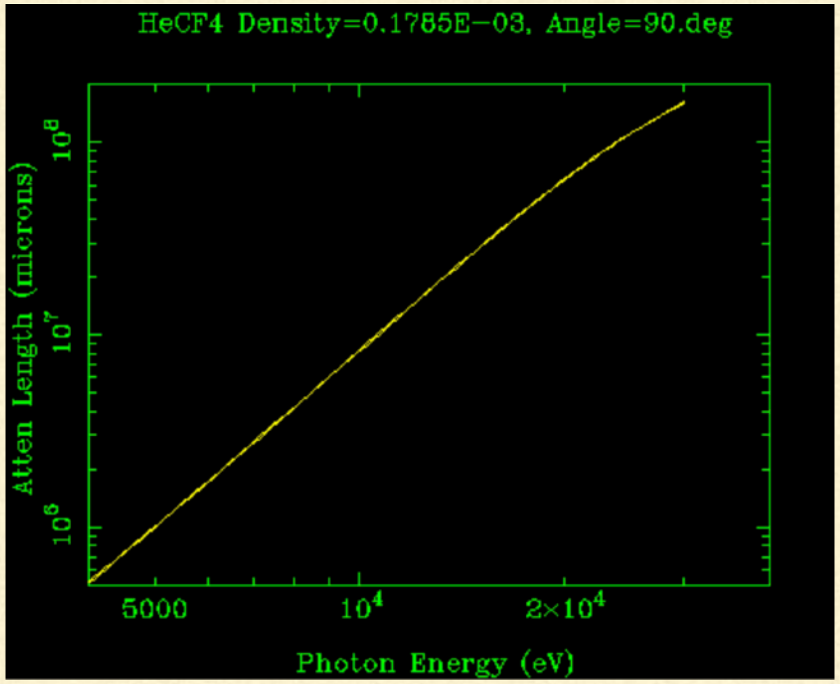
The effect of this would be a larger amount of photons near the source

Leading to a lower interaction length than expected









Factor 10 of difference at 6 keV

Higher difference at higher energy

Conclusion

- We could start to think to the diffusion as a function of the released Energy
- The interaction length with the methods defined up to now is largely underestimated (excess of photons at the beginning)
- We should think about producing a GEANT4 simulation to compare it with the data or to implement some detailed analysis that take into account all the effects