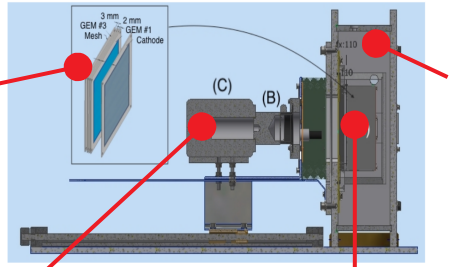
GRAN SASSO SCIENCE INSTITUTE
CENTER FOR ADVANCED STUDIES INFN

CYGNO Experiment

MANGO Data Analysis

G. Dho, E. Baracchini

SETUP



GEMs:

Plastic gas-tight box

TPC volume:

Max volume 500 cm^3 ($10x10\ cm^2$) area

$He:CF_4$ mixture 60/40

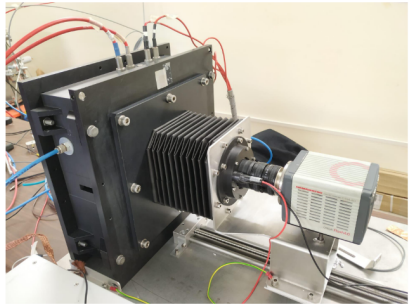
1 atm

sCMOS Camera
Orca fusion C14440

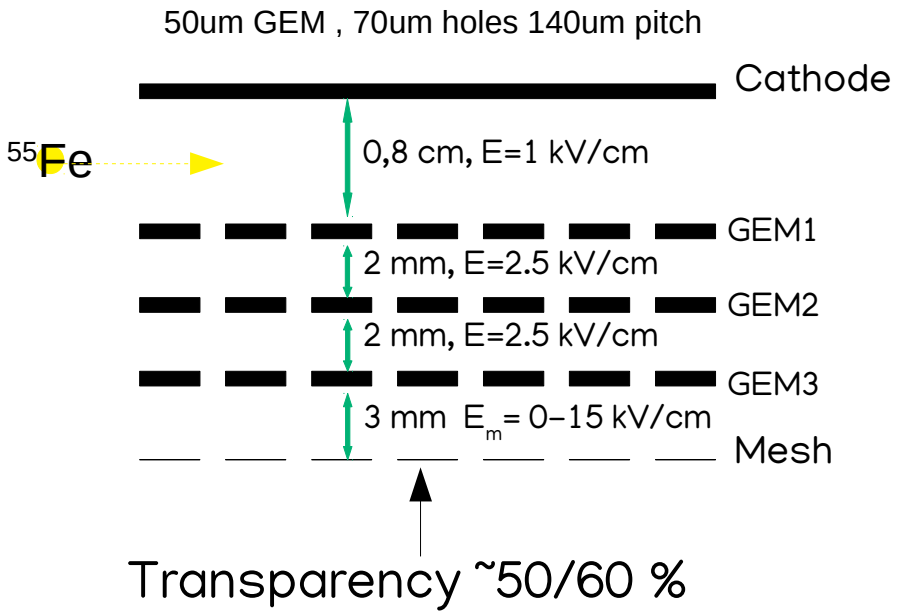
2304x2304 pixels

noise <1 ph/pixel

www.hamamatsu.com.



- Typical setup used in the past with DAQ system to acquire waveforms together with picture

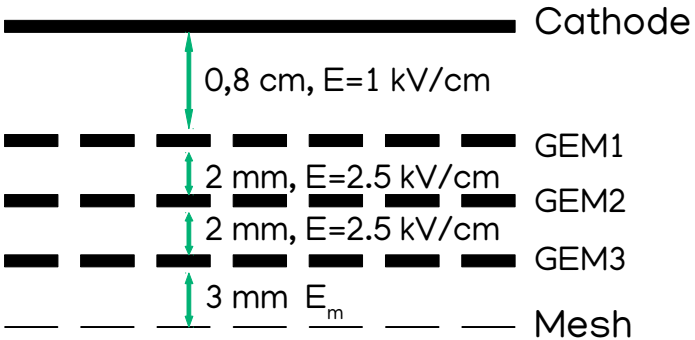


Setup

- Since March we started changing the GEM stack configurations

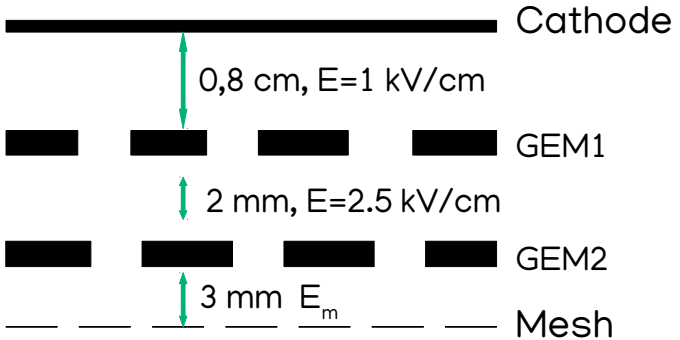
50um GEM , 70um holes 140um pitch

1.



125um GEM , 175 um holes 350 um pitch

2.



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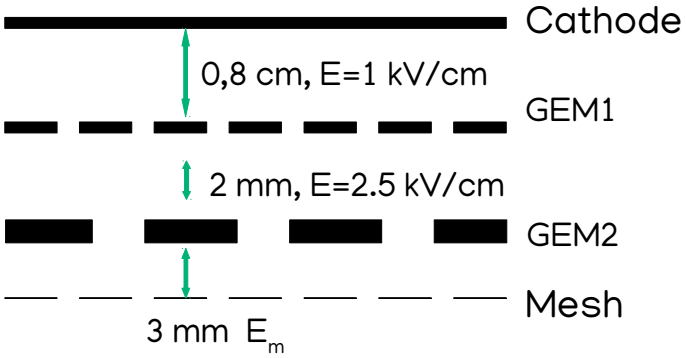

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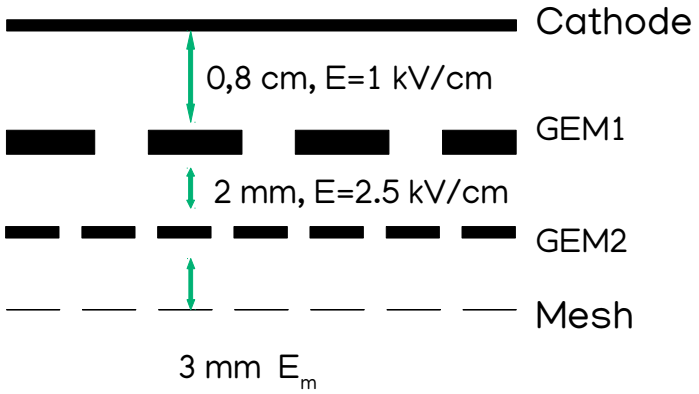

SETUP

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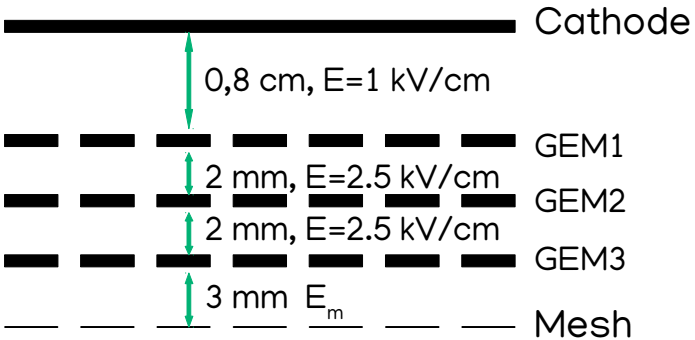
1.



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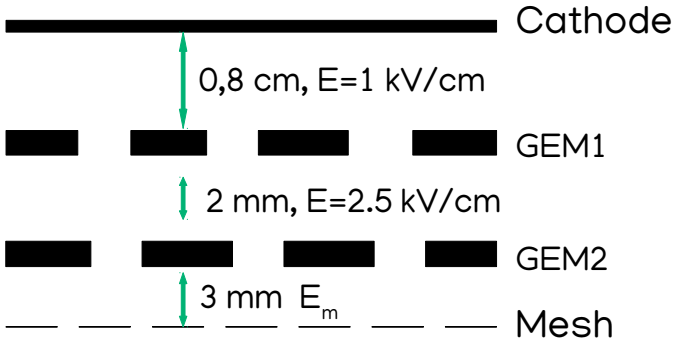
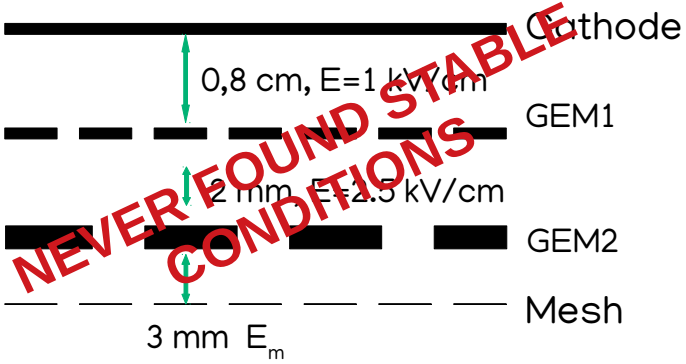
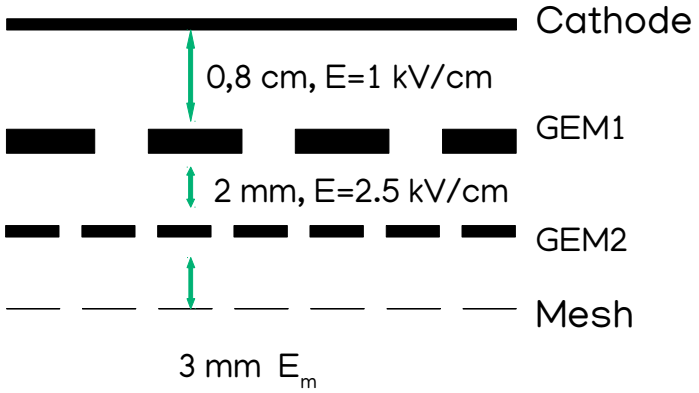


3.



NEVER FOUND STABLE CONDITIONS

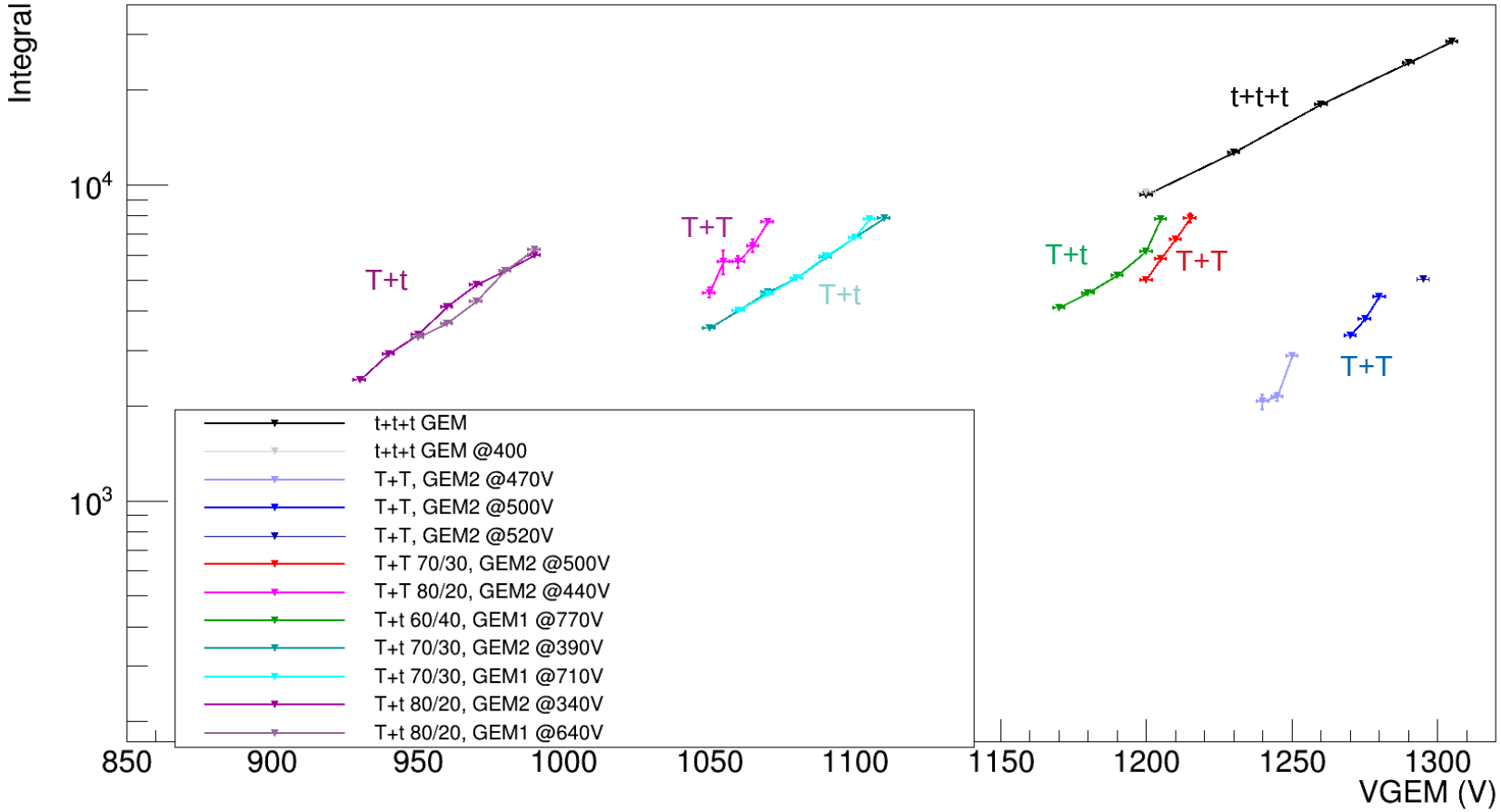
4.



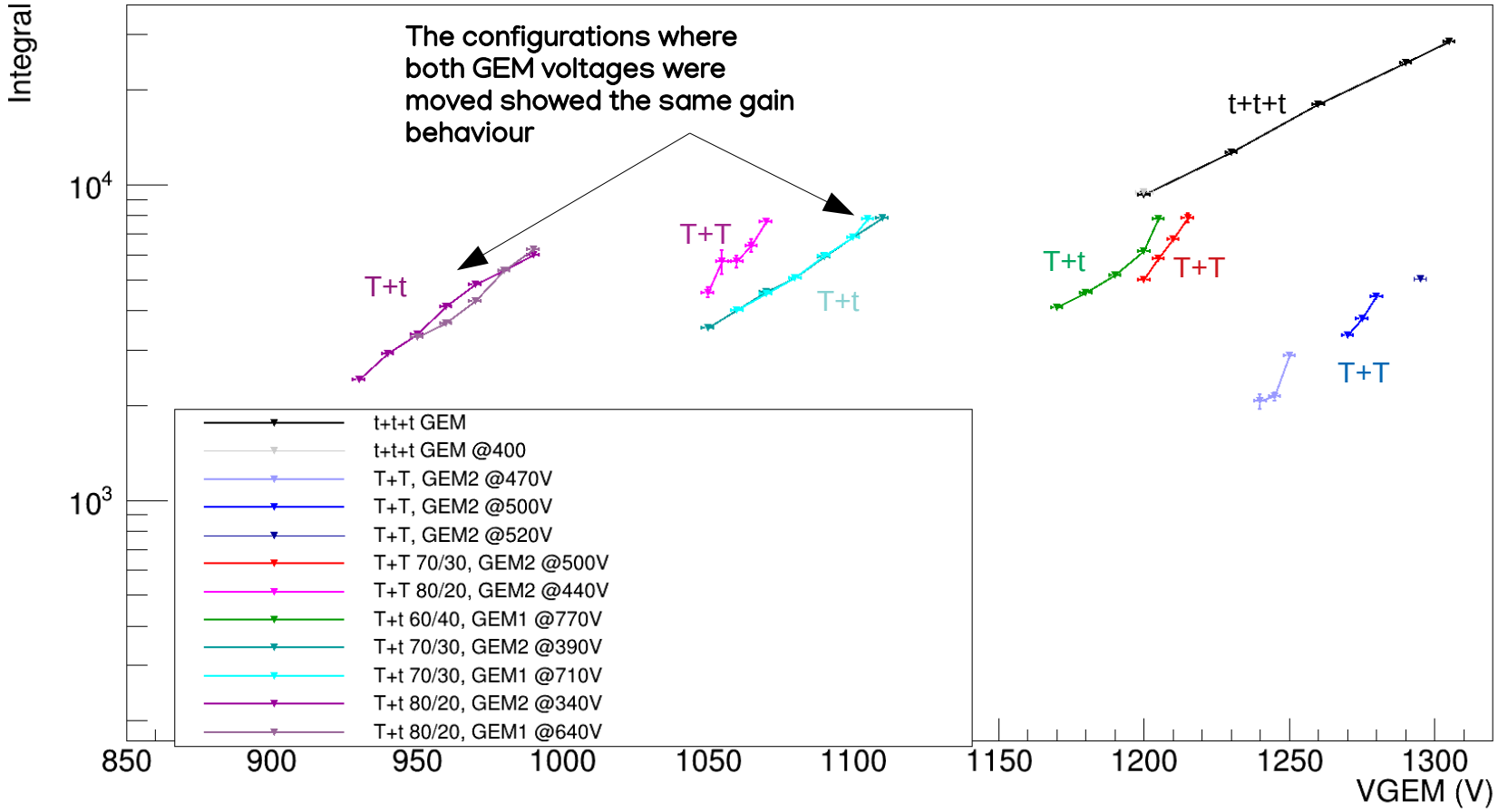
GAIN SCAN

Gain Scan

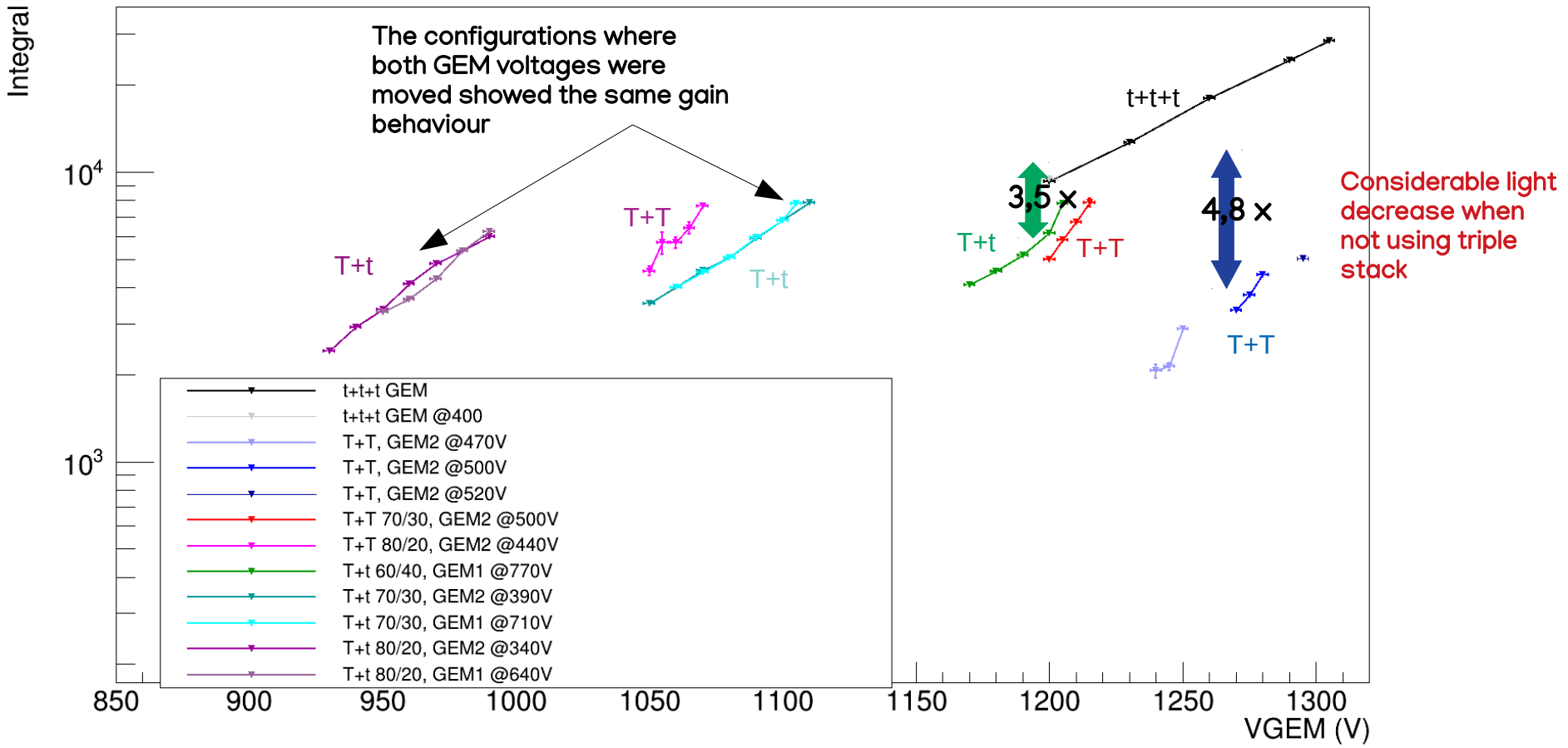
- Looking at the light collected with the camera



Gain Scan


Integral
10^4
10^3
The configurations where both GEM voltages were moved showed the same gain behaviour
T+t
T+T
T+t
t+t+t
T+t
T+T
T+T
t+t+t GEM
t+t+t GEM @400
T+T, GEM2 @470V
T+T, GEM2 @500V
T+T, GEM2 @520V
T+T 70/30, GEM2 @500V
T+T 80/20, GEM2 @440V
T+t 60/40, GEM1 @770V
T+t 70/30, GEM2 @390V
T+t 70/30, GEM1 @710V
T+t 80/20, GEM2 @340V
T+t 80/20, GEM1 @640V
850
900
950
1000
1050
1100
1150
1200
1250
1300
VGEM (V)

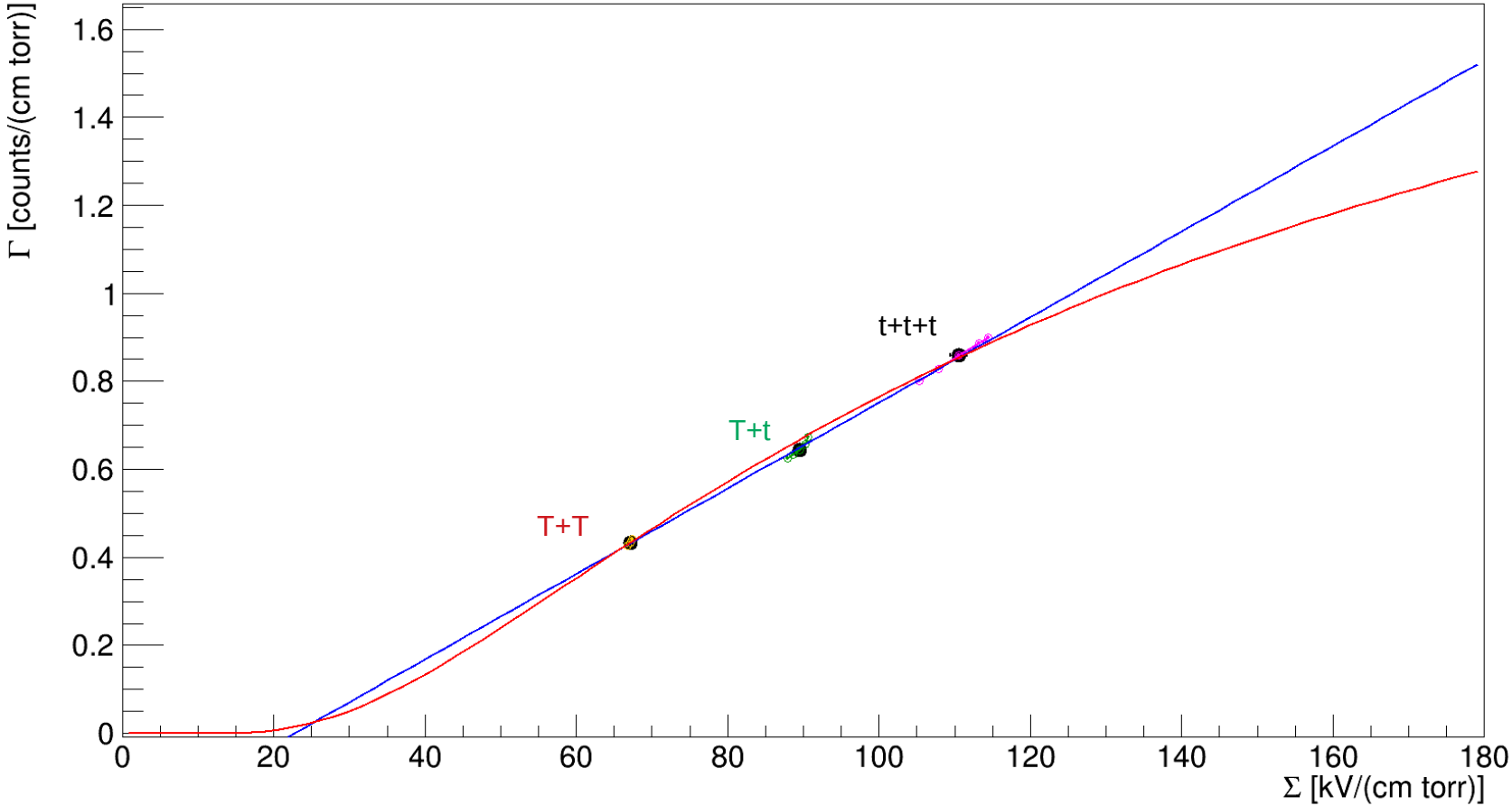
Gain Scan



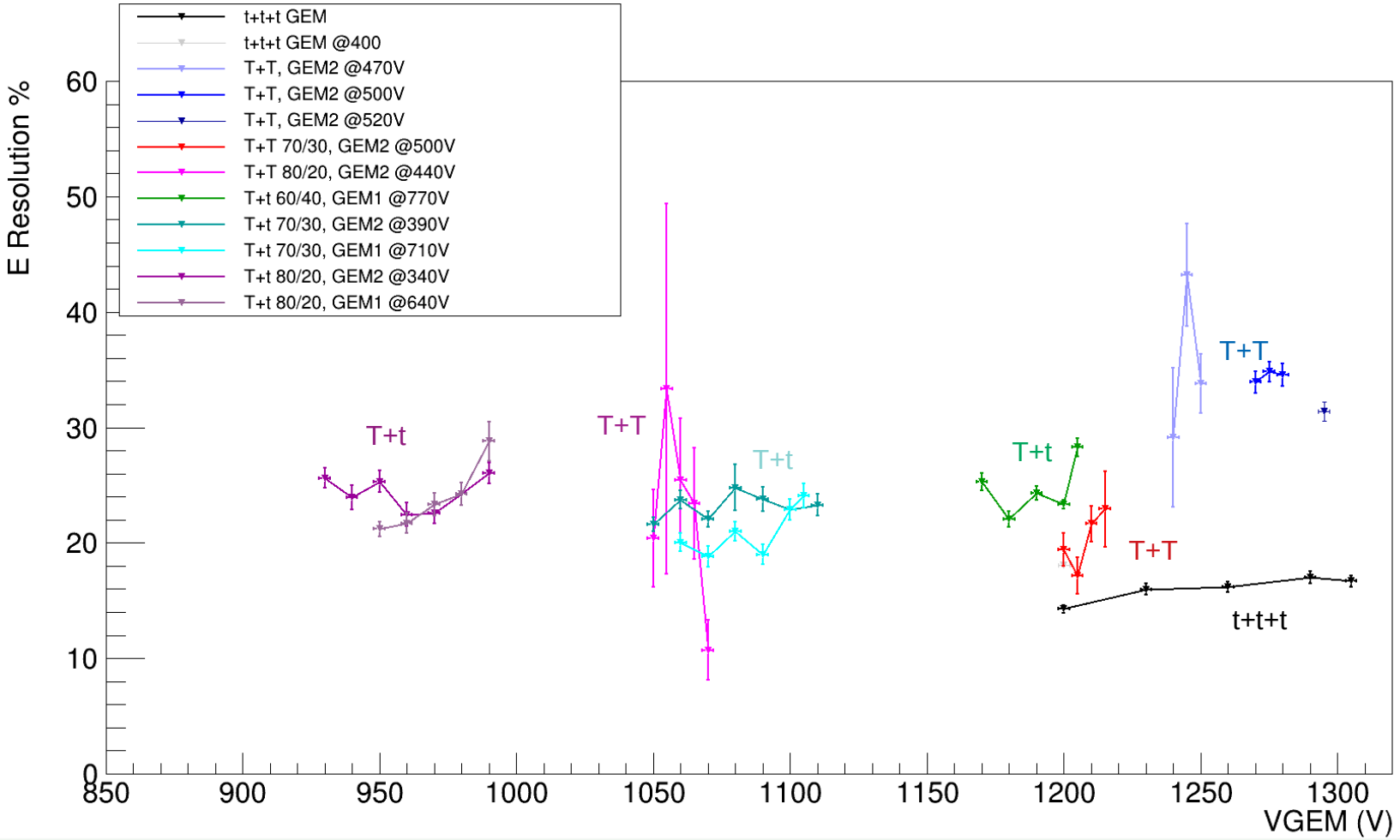
Considerable light decrease when not using triple stack

Gain Scan

- Following Tom's latest presentation, we tried something similar for the 60/40 mixture

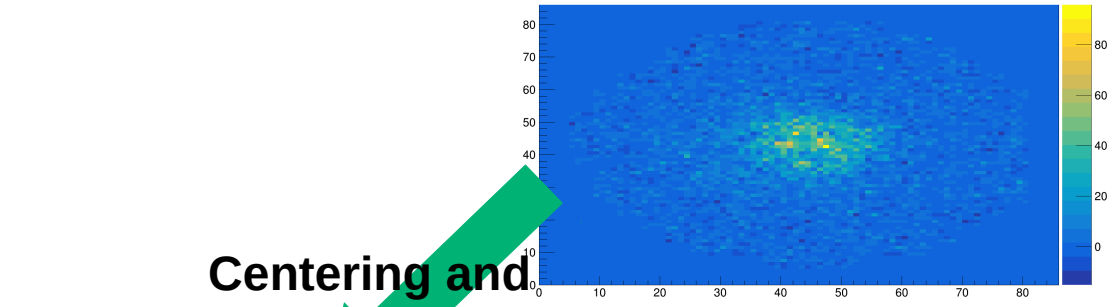


Energy Resolution



New Method to Estimate the Spot Size

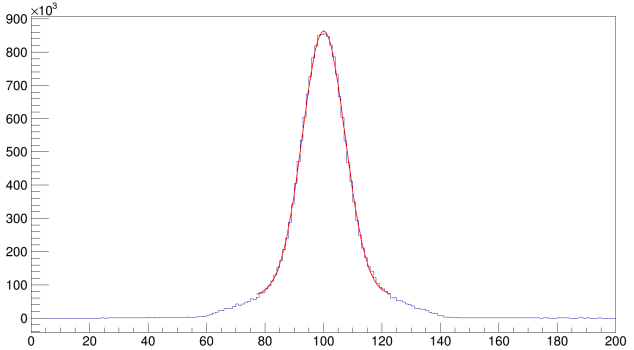
- To quantify the dimension of the spots, trying to be independent from the light output, all the spots are centred and summed and the sigma of the shape is fitted with a gaussian



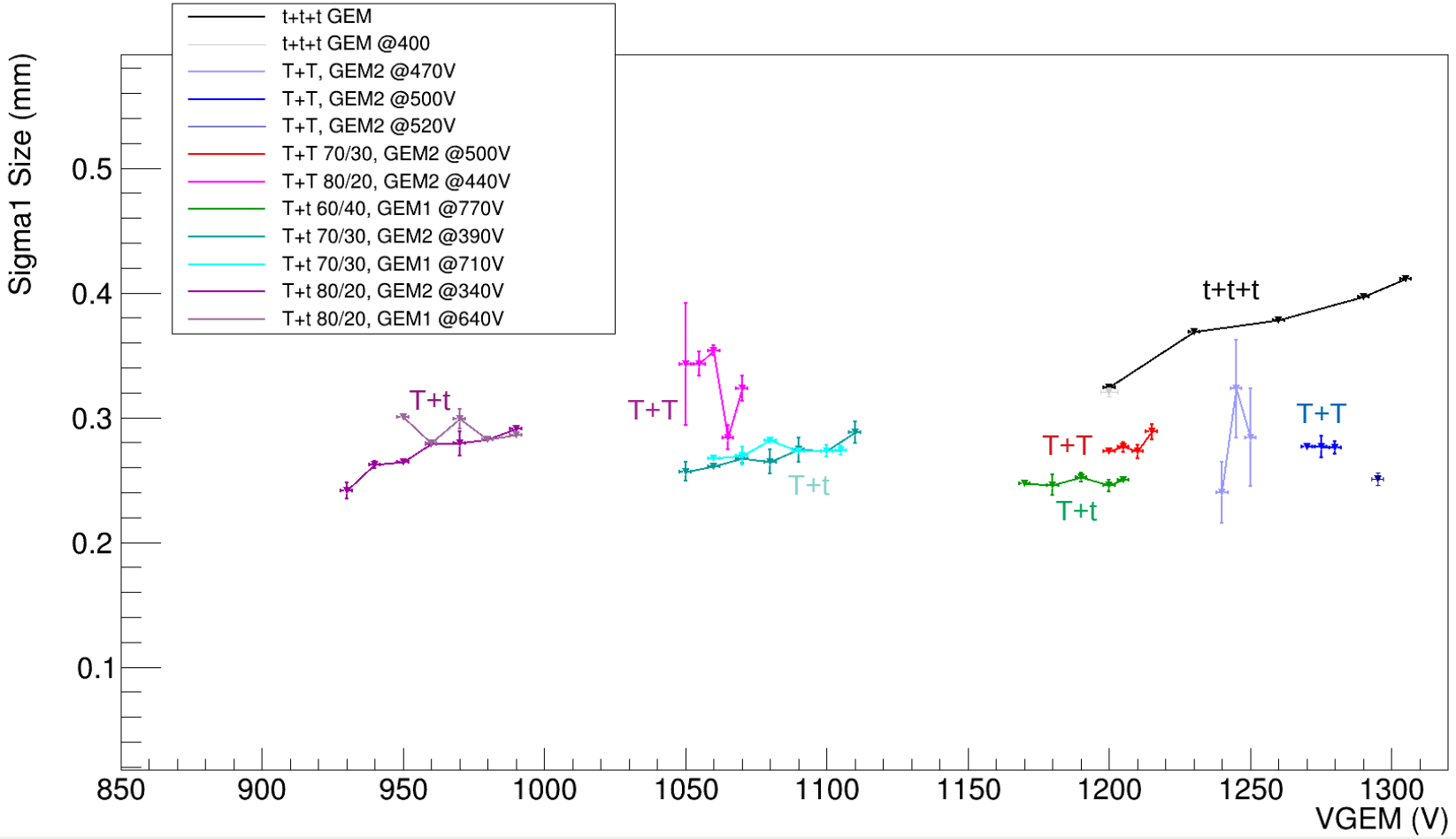
Centering and summing tracks

The sigma should depend only the shape

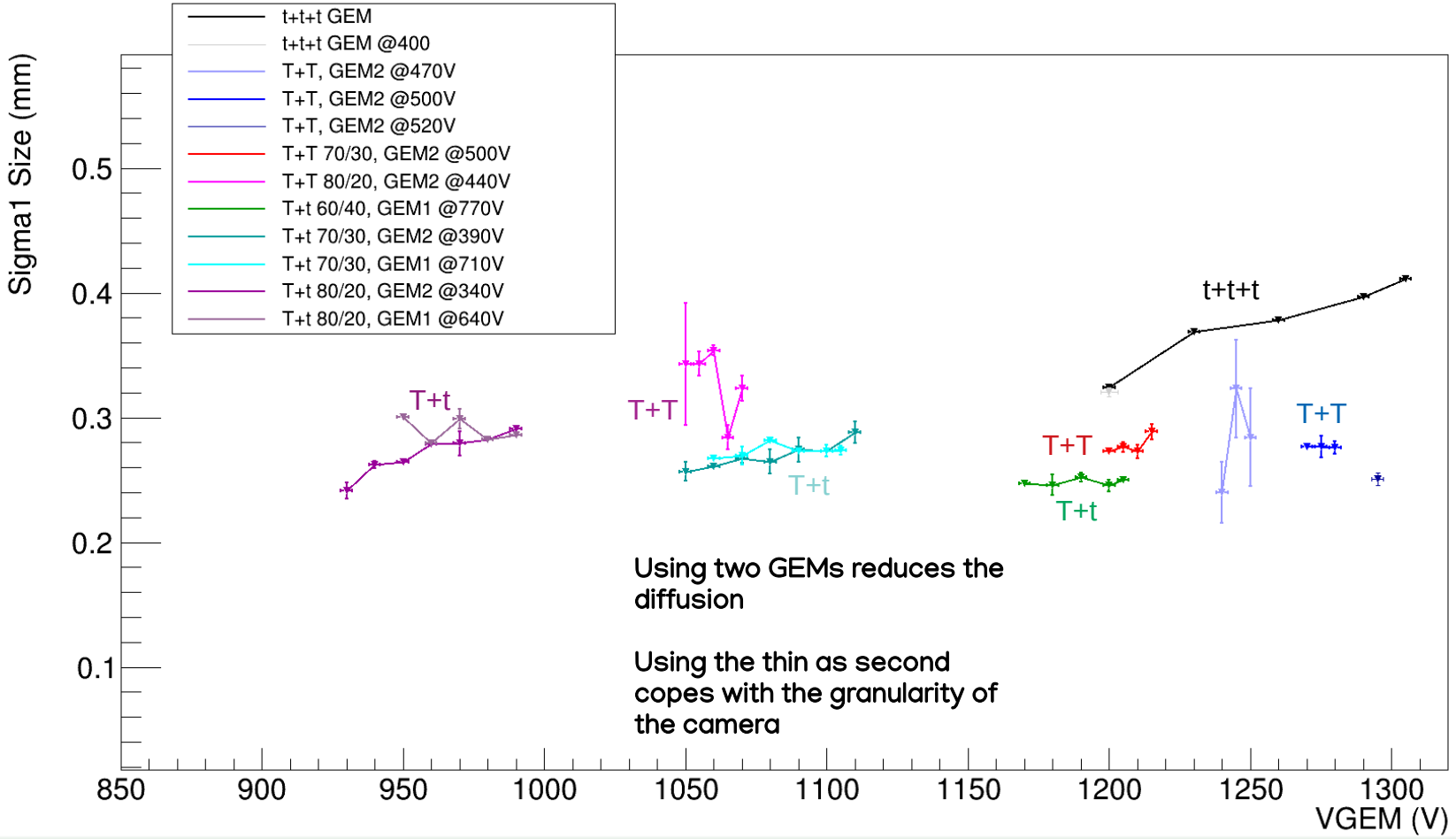
Projections



SpotSize

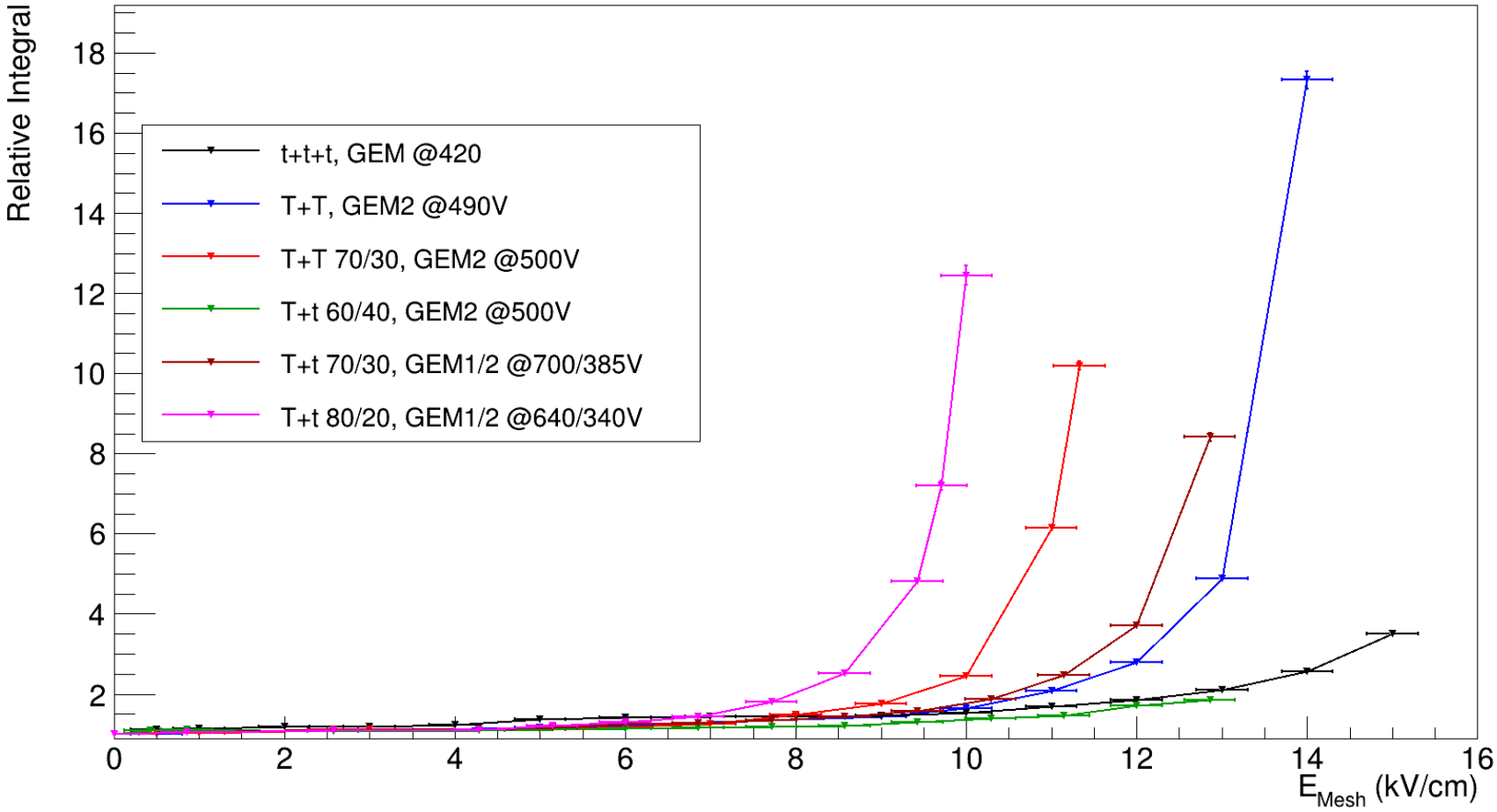

t+t+t GEM
t+t+t GEM @400
T+T, GEM2 @470V
T+T, GEM2 @500V
T+T, GEM2 @520V
T+T 70/30, GEM2 @500V
T+T 80/20, GEM2 @440V
T+t 60/40, GEM1 @770V
T+t 70/30, GEM2 @390V
T+t 70/30, GEM1 @710V
T+t 80/20, GEM2 @340V
T+t 80/20, GEM1 @640V
Sigma1 Size (mm)
0.5
0.4
0.3
0.2
0.1
850
900
950
1000
1050
1100
1150
1200
1250
1300
VGEM (V)
T+t
T+T
T+t
t+t+t
T+T
T+T
T+t
T+T

SpotSize

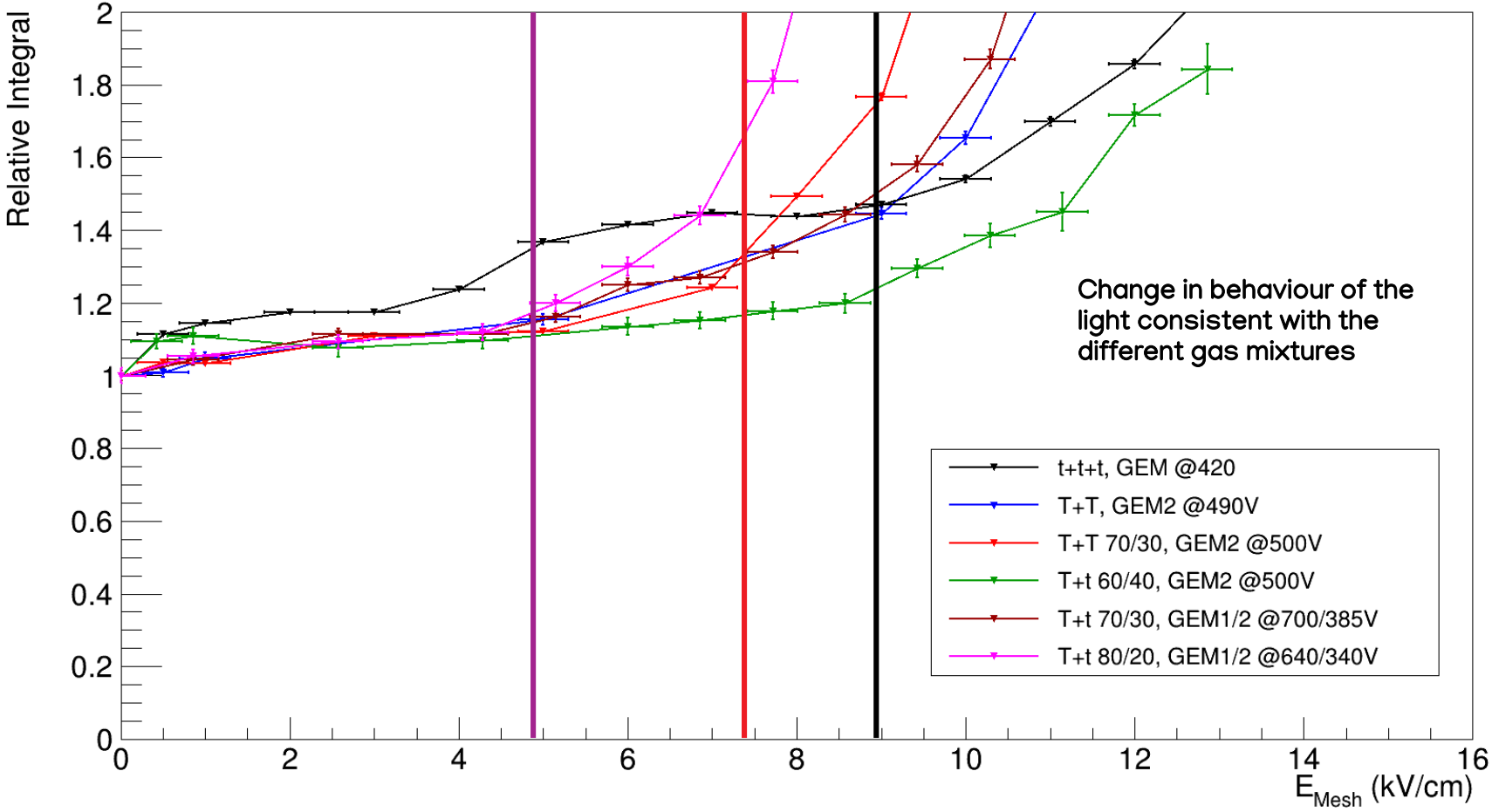

t+t+t GEM
t+t+t GEM @400
T+T, GEM2 @470V
T+T, GEM2 @500V
T+T, GEM2 @520V
T+T 70/30, GEM2 @500V
T+T 80/20, GEM2 @440V
T+t 60/40, GEM1 @770V
T+t 70/30, GEM2 @390V
T+t 70/30, GEM1 @710V
T+t 80/20, GEM2 @340V
T+t 80/20, GEM1 @640V
Sigma1 Size (mm)
0.5
0.4
0.3
0.2
0.1
850
900
950
1000
1050
1100
1150
1200
1250
1300
VGEM (V)
T+t
T+T
T+t
t+t+t
T+T
T+T
T+t
Using two GEMs reduces the diffusion
Using the thin as second copes with the granularity of the camera

EL

Light From The Camera

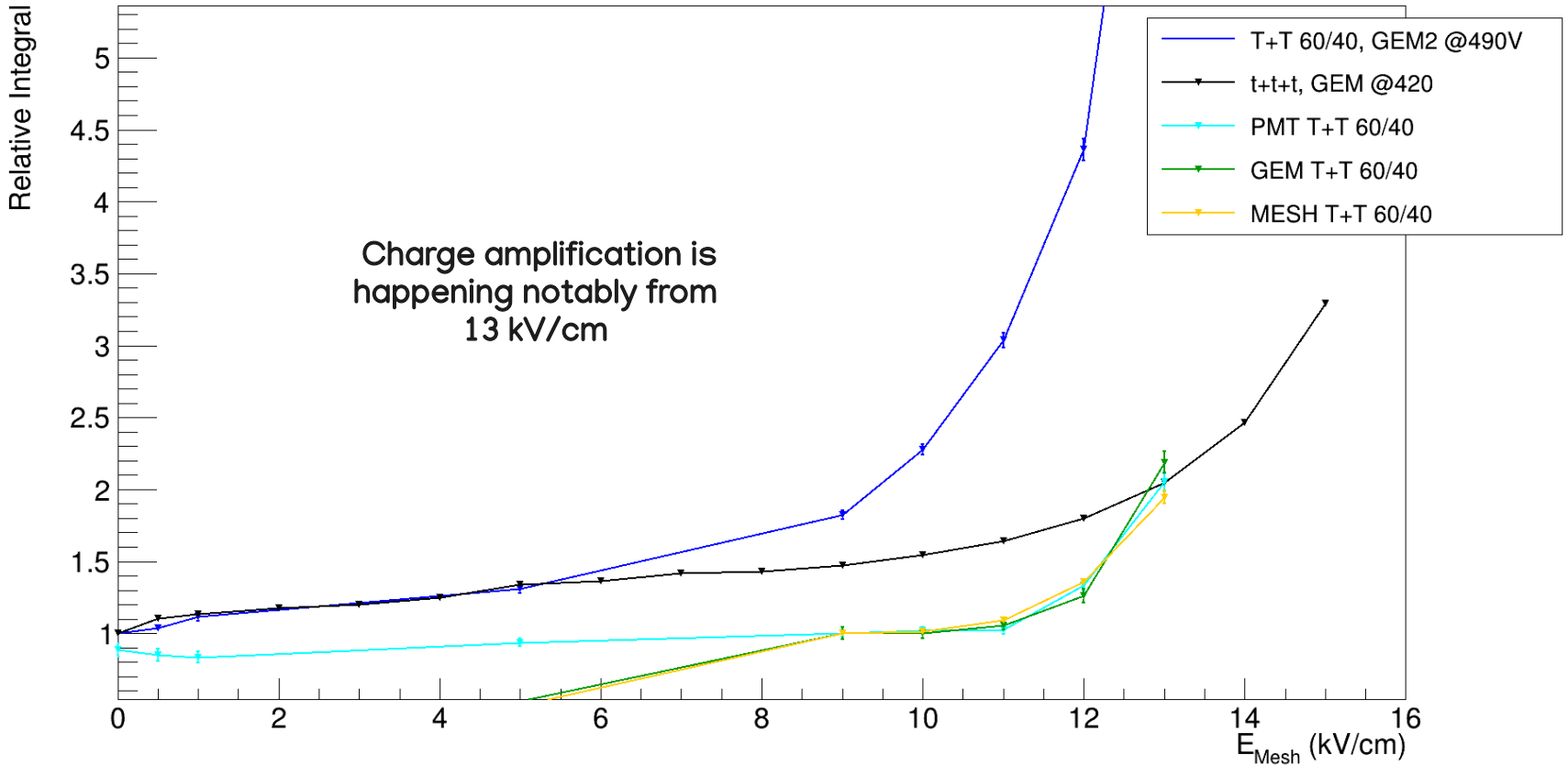


Light From The Camera

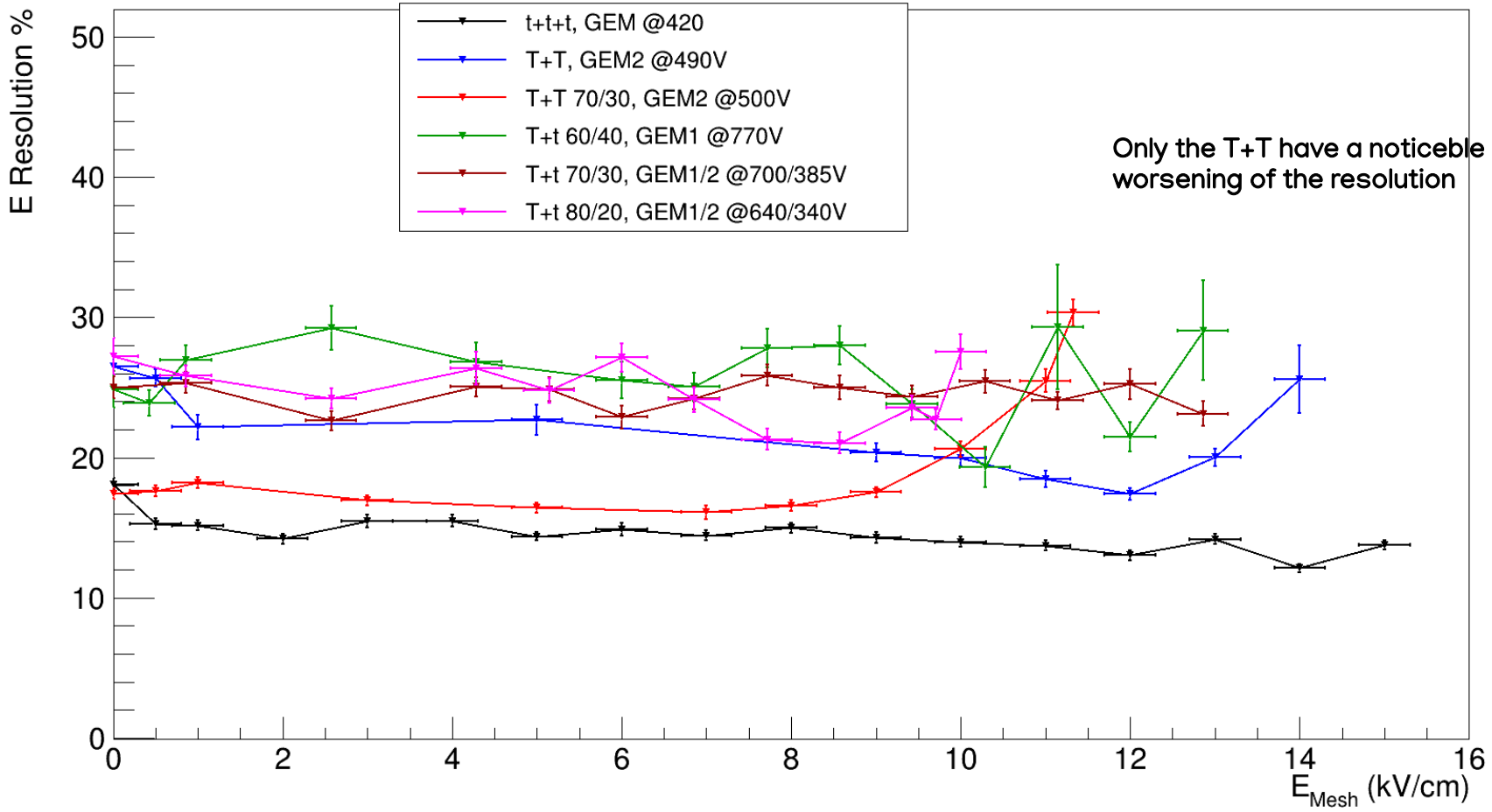


EL 60/40

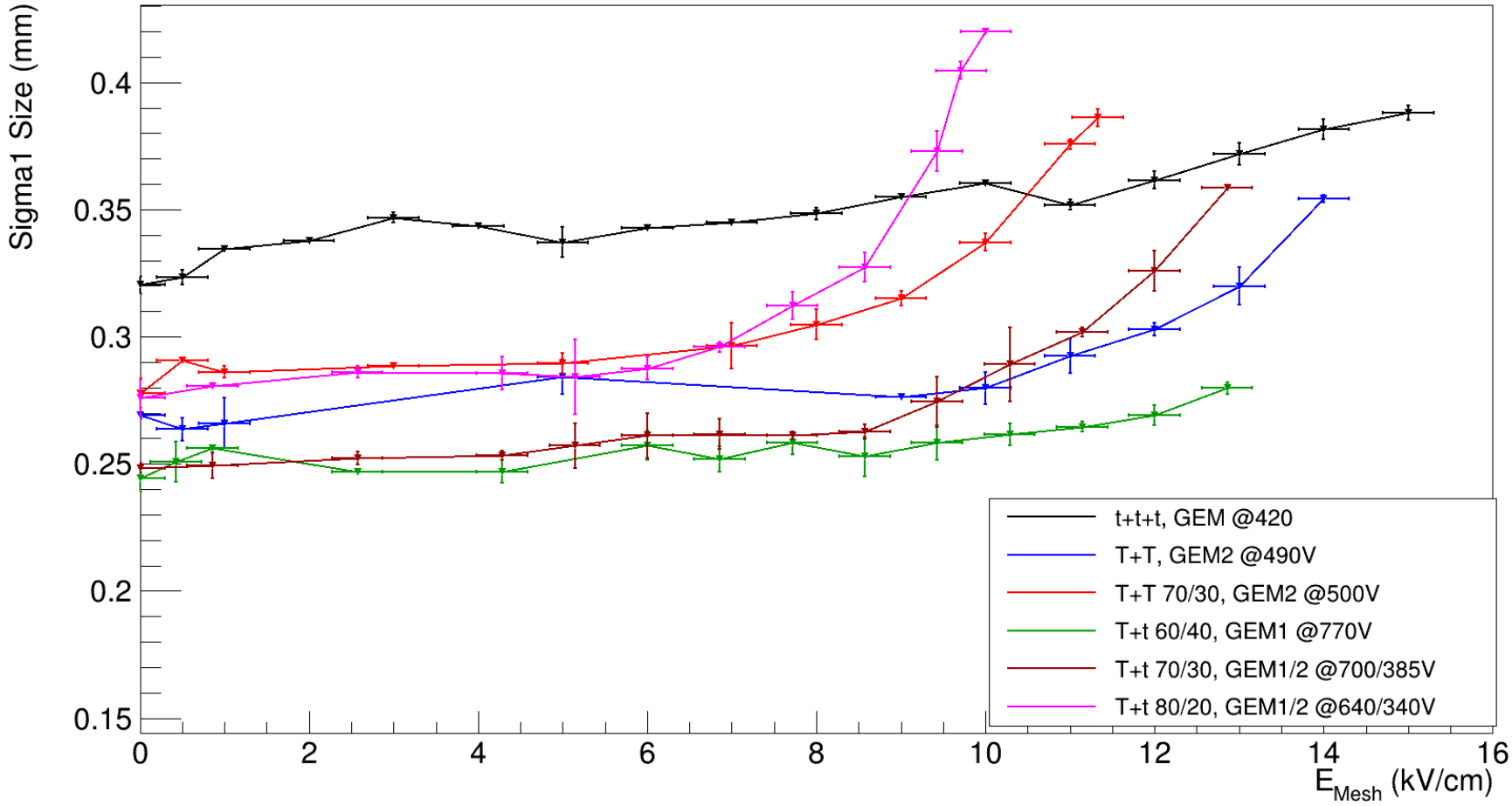
• This is an example of the typical behaviour of the charge and the light. There is an increase at higher intense electric fields, but lower than the light increase



Energy Resolution



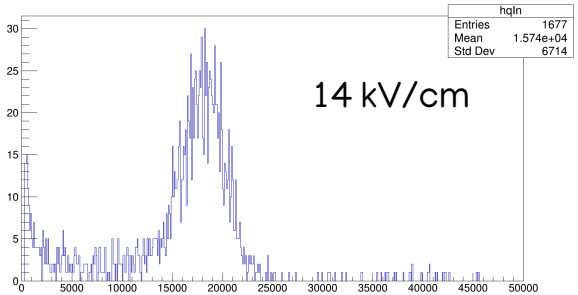
Size

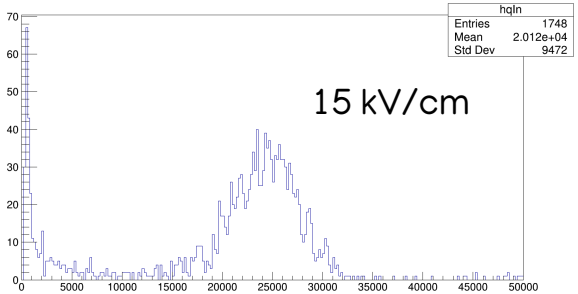

Sigma1 Size (mm)
0.4
0.35
0.3
0.25
0.2
0.15
0
2
4
6
8
10
12
14
16
E_Mesh (kV/cm)
t+t+t, GEM @420
T+T, GEM2 @490V
T+T 70/30, GEM2 @500V
T+t 60/40, GEM1 @770V
T+t 70/30, GEM1/2 @700/385V
T+t 80/20, GEM1/2 @640/340V

LIGHT FROM THE CAMERA

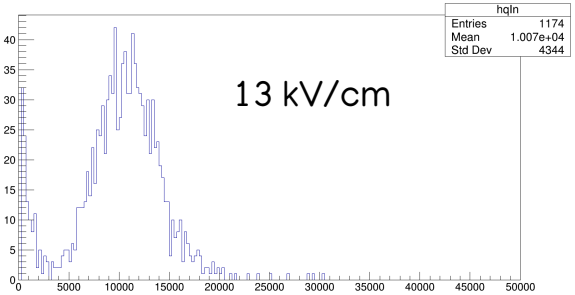
- Looking at the signal distribution at the highest electric fields the thick ones seem to behave differently

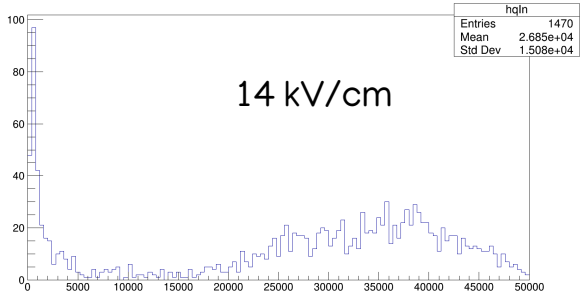
t + t + t (60/40)



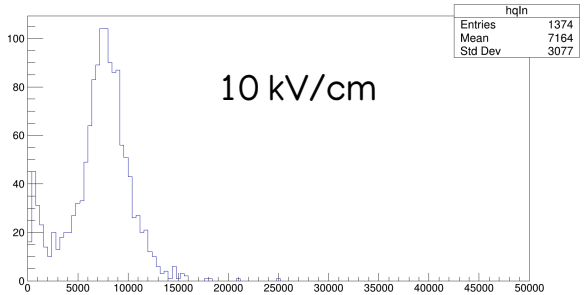


T + T (60/40)

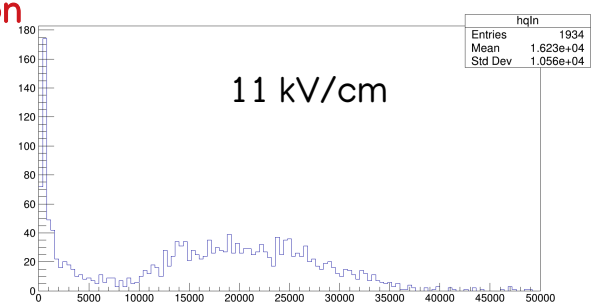




T + T (70/30)

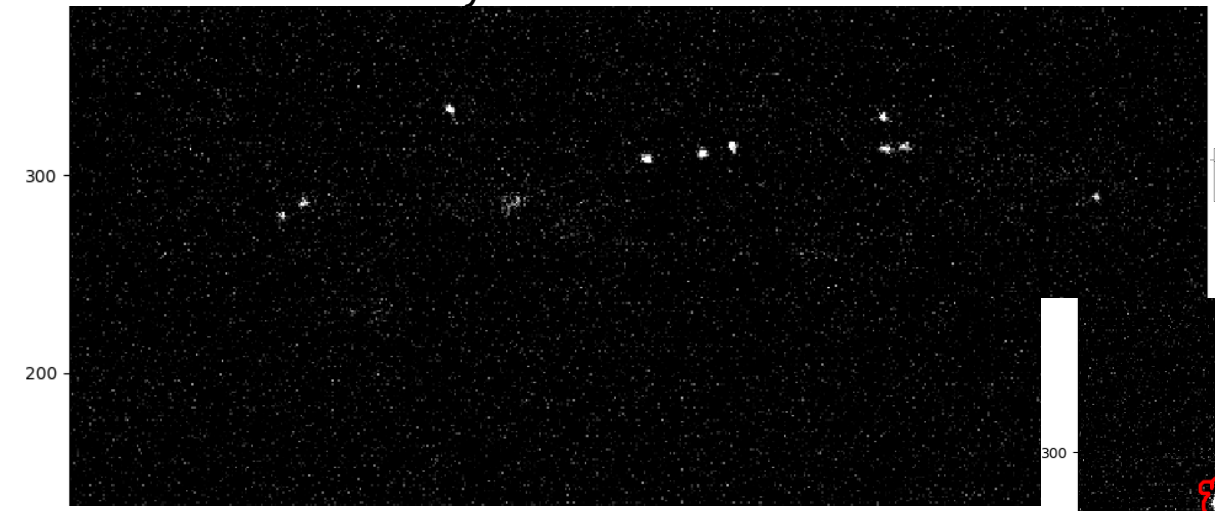


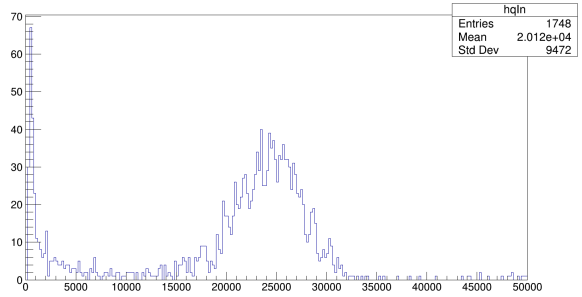
Strong degradation of resolution

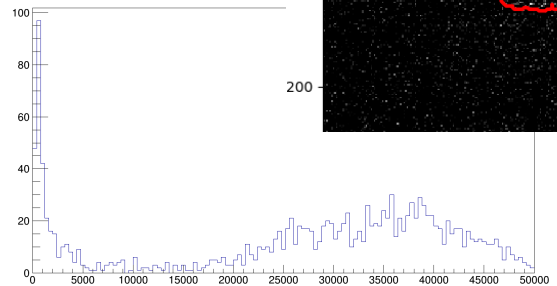


Light from the camera

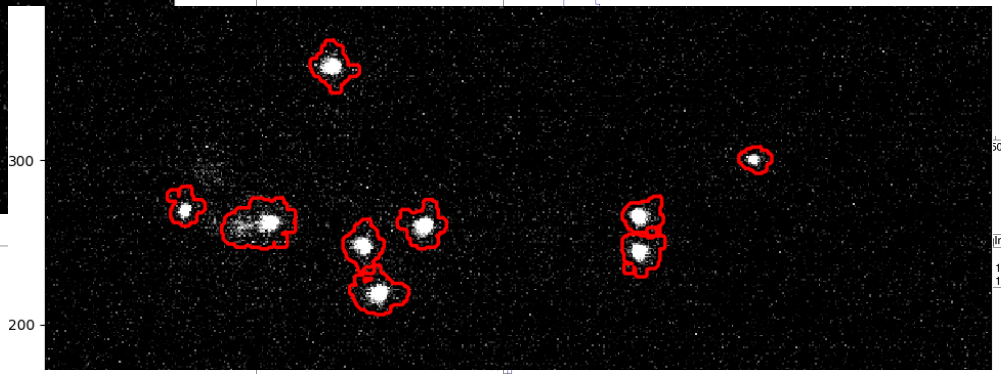
- Looking at the signal distribution at the highest electric fields the thick ones seem to behave differently







T + T (70/30)



Why?

- We still do not know

  - The last GEM being thick, may influence the field lines in the induction region

  - There is a small amount of charge created at high electric fields, around 20 % more than without field.

    The lower the original amount charge produced from the GEMs, the lower the one created in the gap.

    These secondary charge may affect the effective electric field that acts on the moving charge

TO FURTHER STUDY

Conclusion

- Different configurations of GEM stacks were tested in order to optimize GEM induced diffusion and light output
- When adding a strong electric below the last GEM in all configurations a increase in light output was found, with limited amount of charge increase
- The different configurations though did not equally perform and the reasons are still to be clarified
- To minimize diffusion and still have intense light ouput we will test a configuration with 2 thin GEMs with the EL enhancement

Backup

Voltages Used

- We looked for the working point of this configuration moving GEM voltages until we could see signal on the camera with a certain stability (based on the number of sparks)

Config	GEM1 (V)	GEM2 (V)	GEM3 (V)
t+t+t 60/40	420	420	420
T+T 60/40	775	500	/
T+T 70/30	705	500	/
T+T 80/20	620	440	/
T+t 60/40	770	430	/
T+t 70/30	700	385	/
T+t 80/20	640	340	/