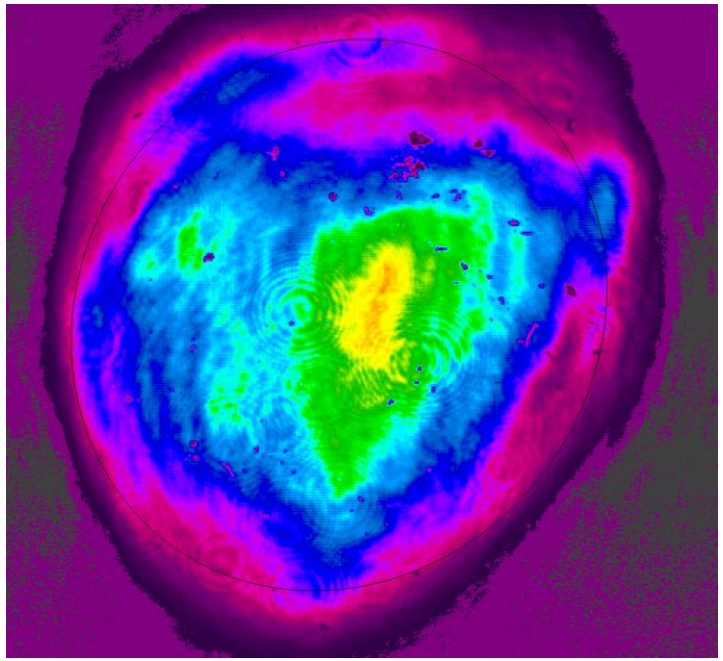
Implementing the laser profile * QE scan profile as a one image into GPT

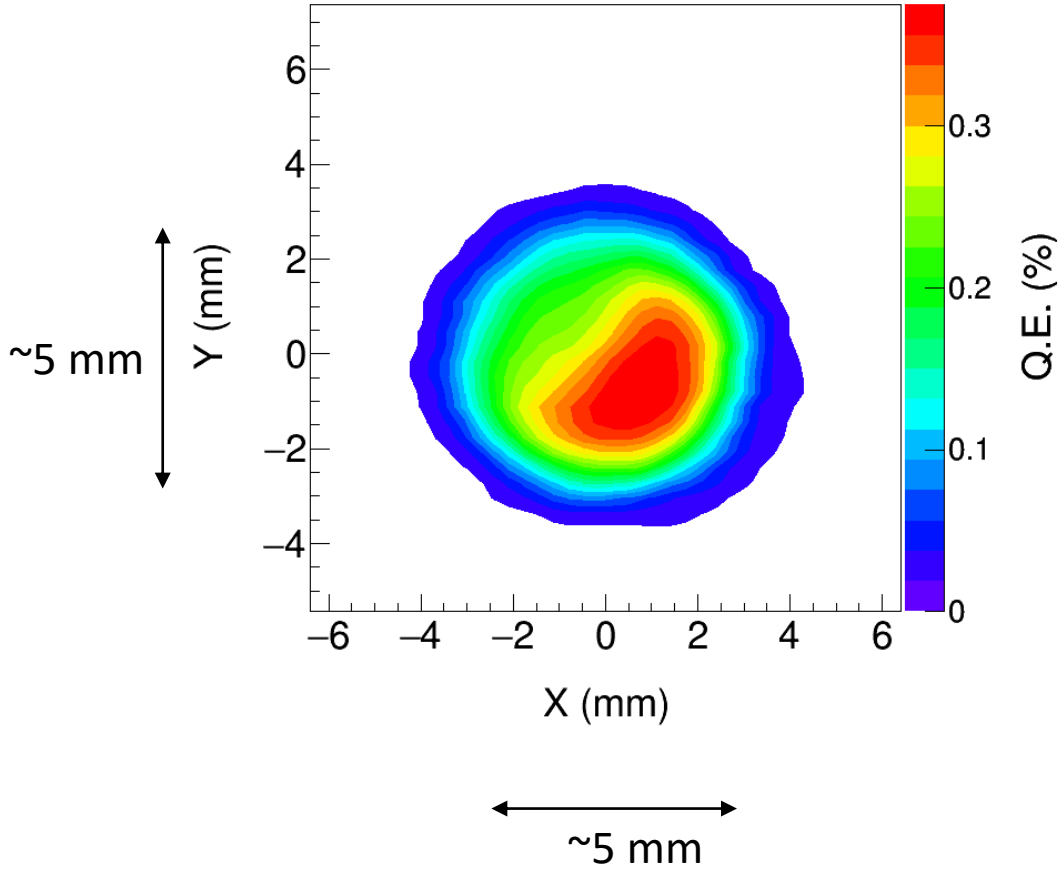
07/24/2019

Laser profile for σ =1.64 mm

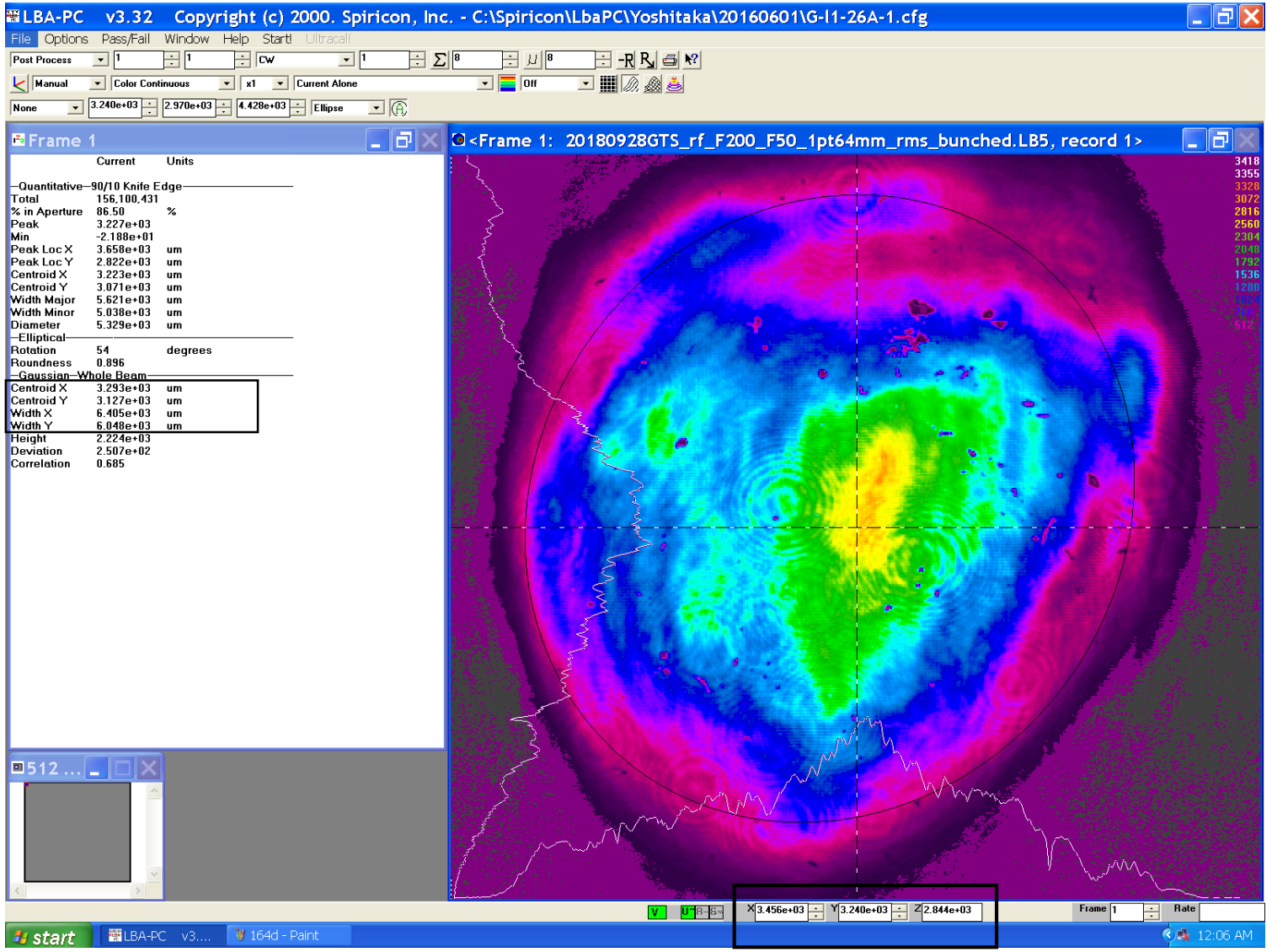


1 px=0.01347 mm

QE scan of the 90 min Sb photocathode
(Full active area)

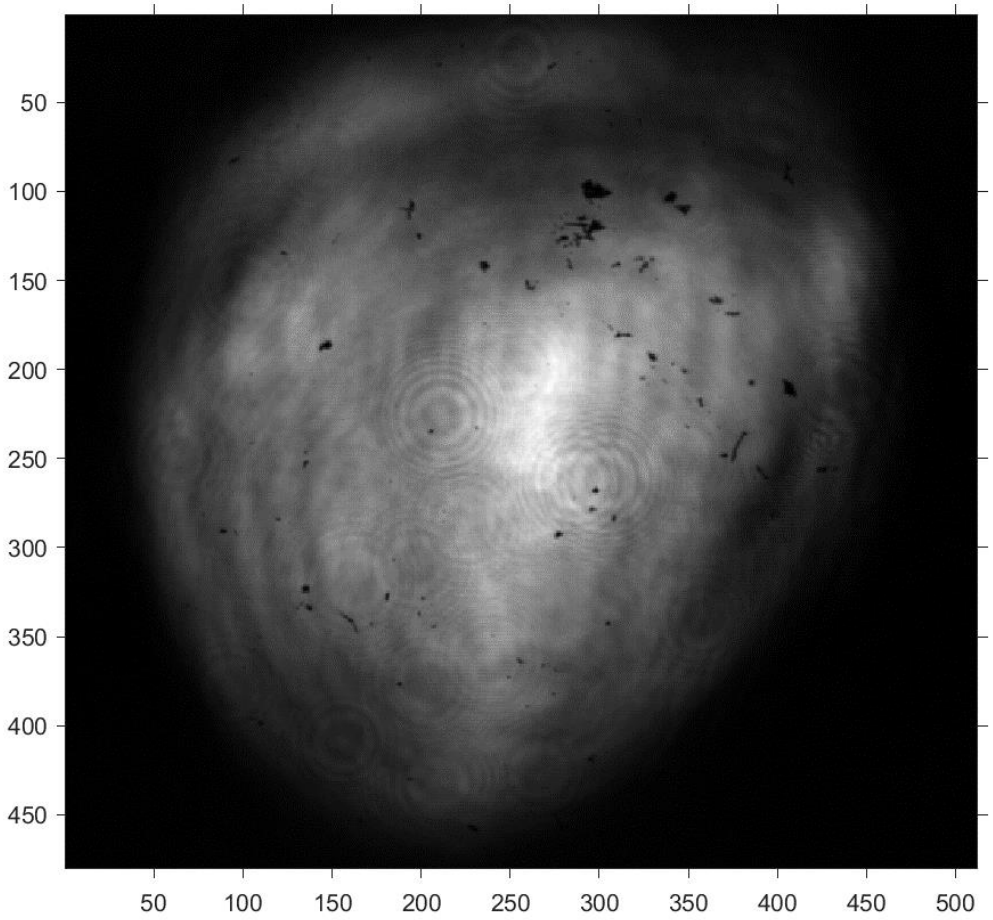


- In order to use an image as the initial particle distribution in GPT it has to be grayscale, 8-bit per pixel .bmp file.
- Image details shows in the Spiricon software:



Steps

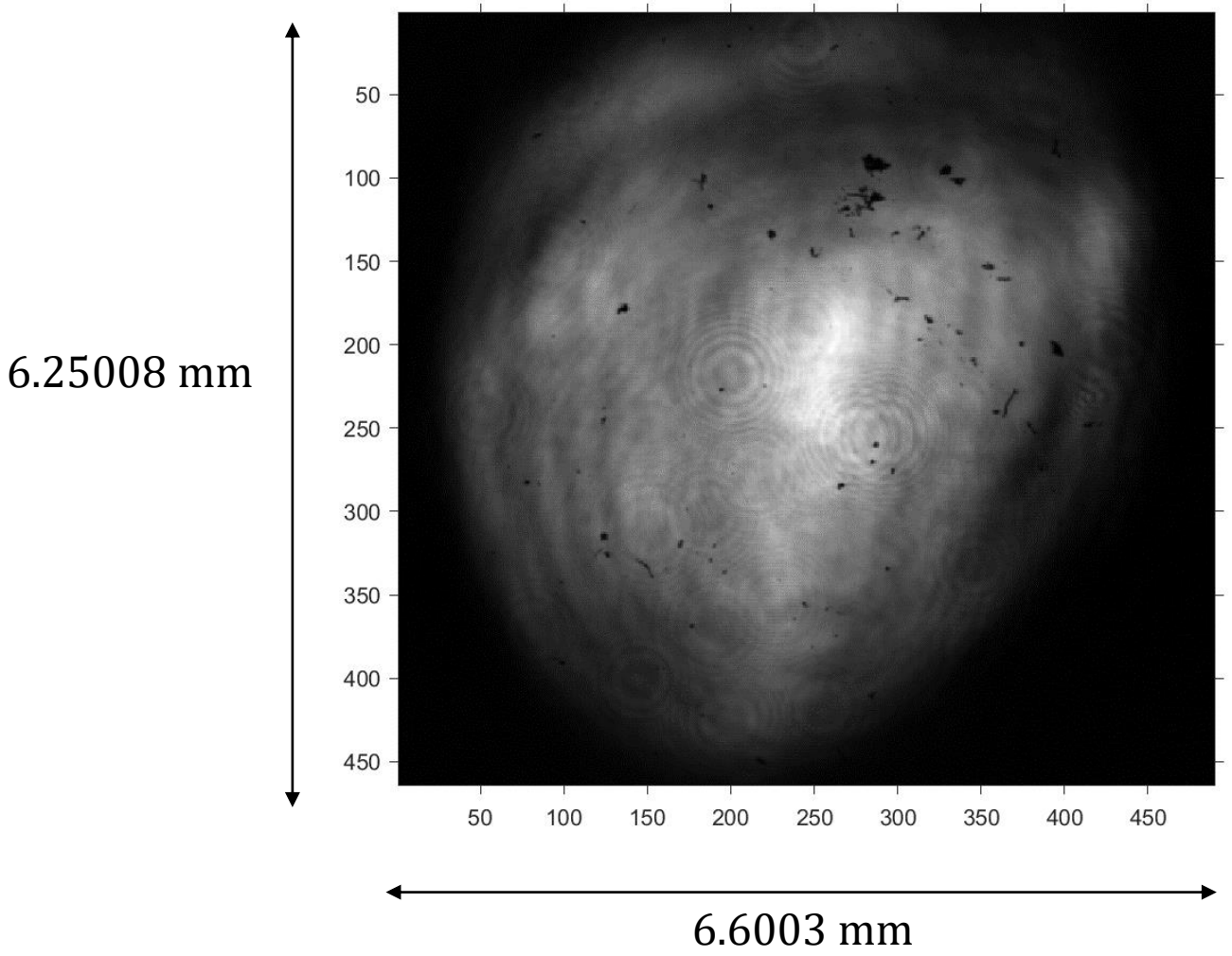
- Get the .cma file from Spiricon software, which is a 480*512 matrix.
- Convert it into a grayscale image (converts the matrix to an intensity image that contains values in the range 0 (black) to 1 (white)).



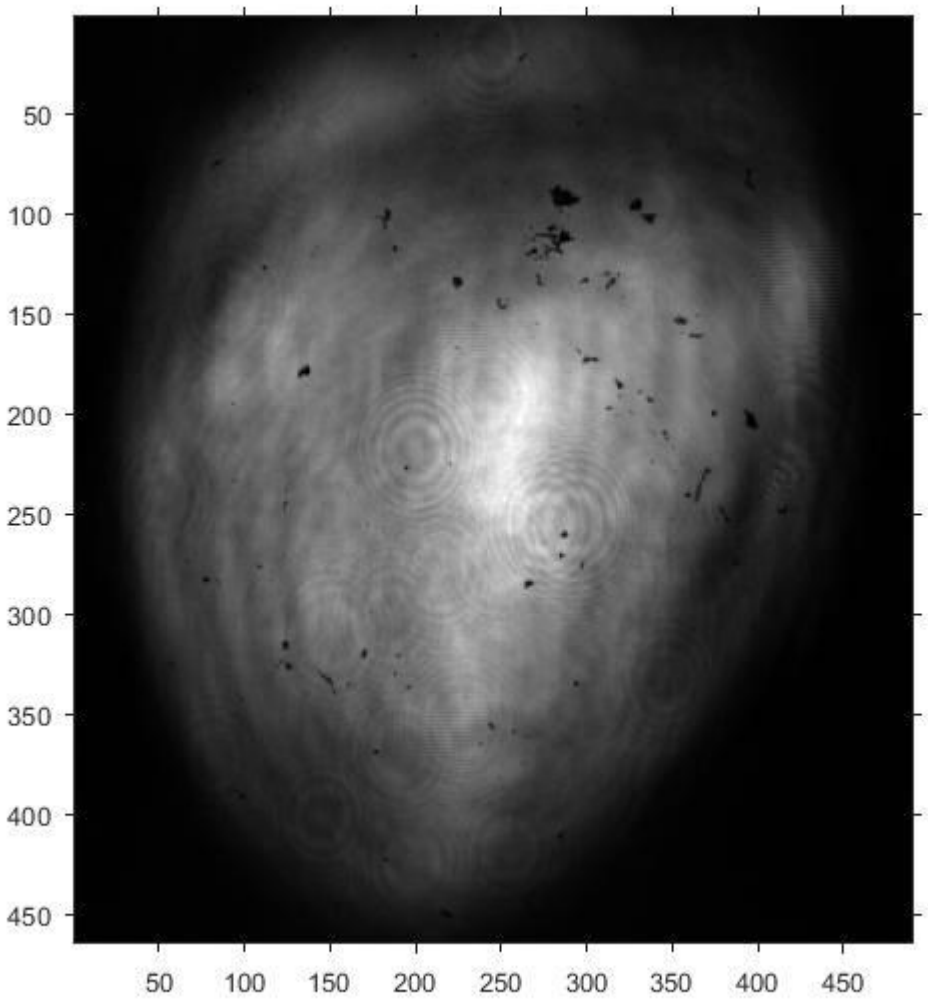
- Crop the image such that the center of the image is the center of the laser spot.

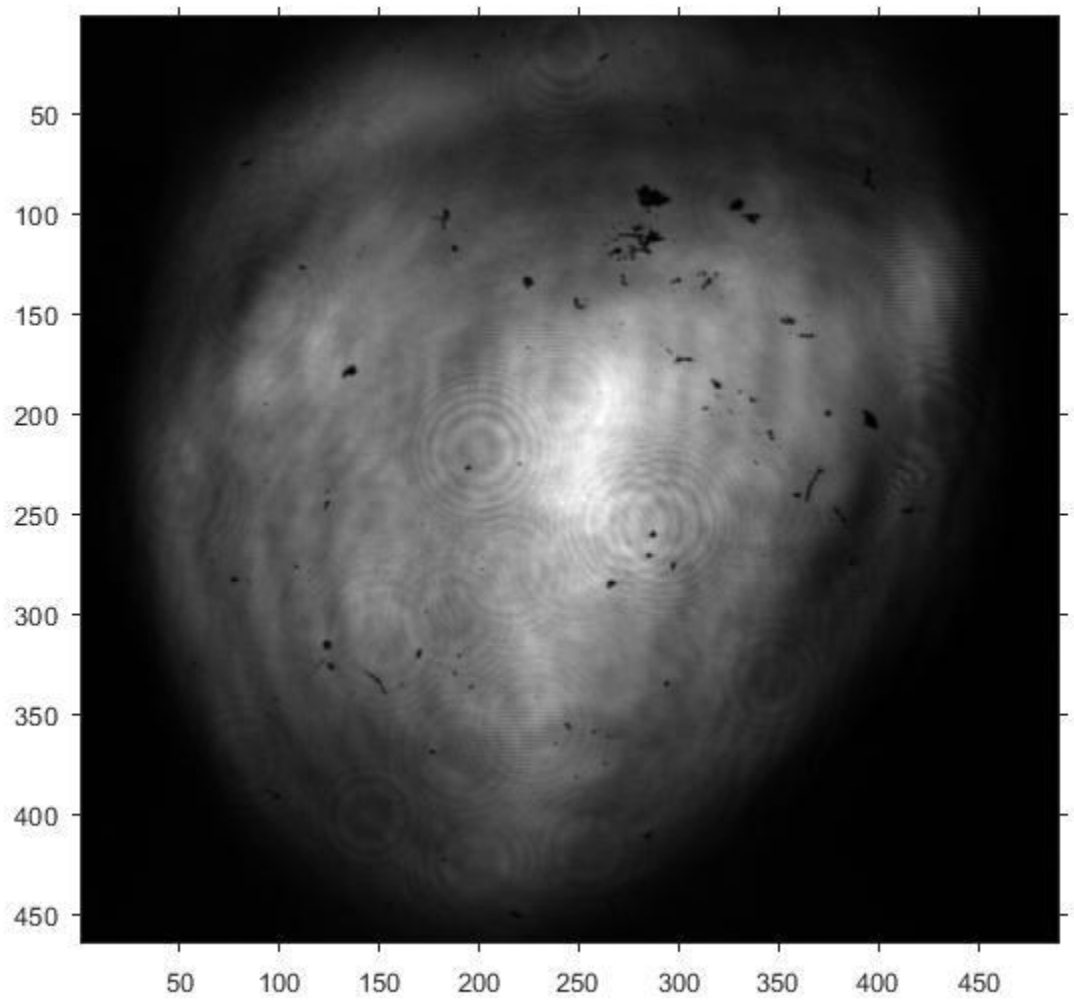
Centroid coordinates X= 3.293 mm, Y=3.127 mm

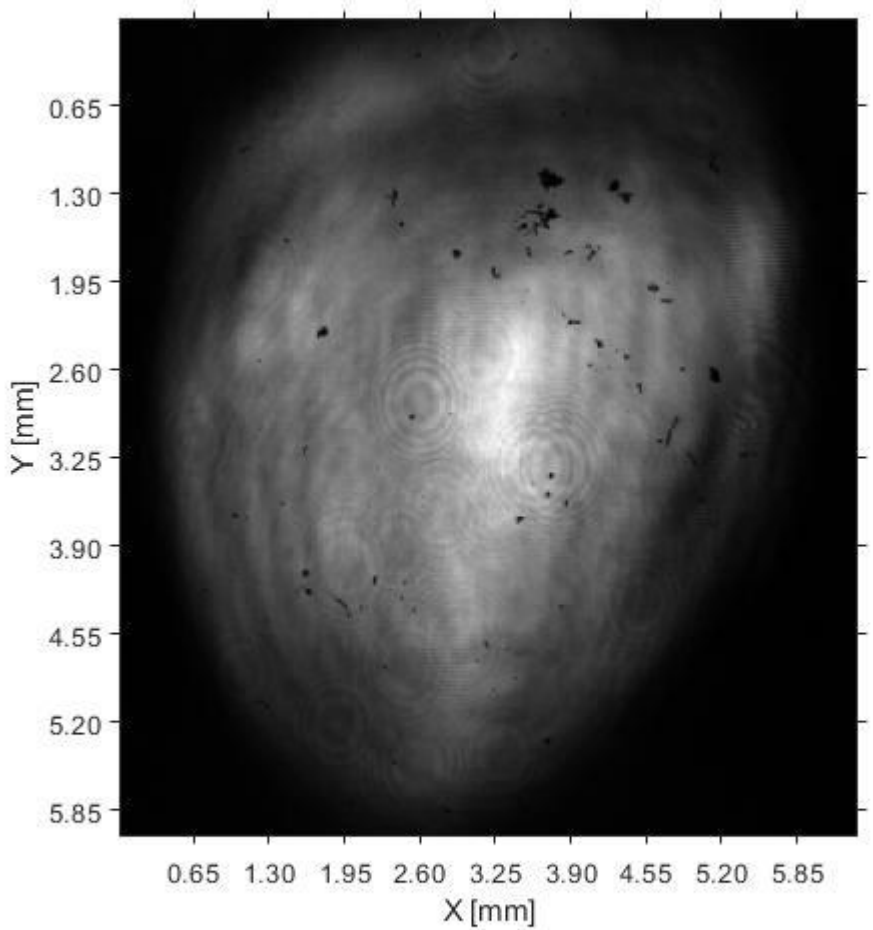
$\frac{1}{e^2}$ $\mathrm{X} = 6.405\ \mathrm{mm}, \mathrm{Y} = 6.048\ \mathrm{mm}$

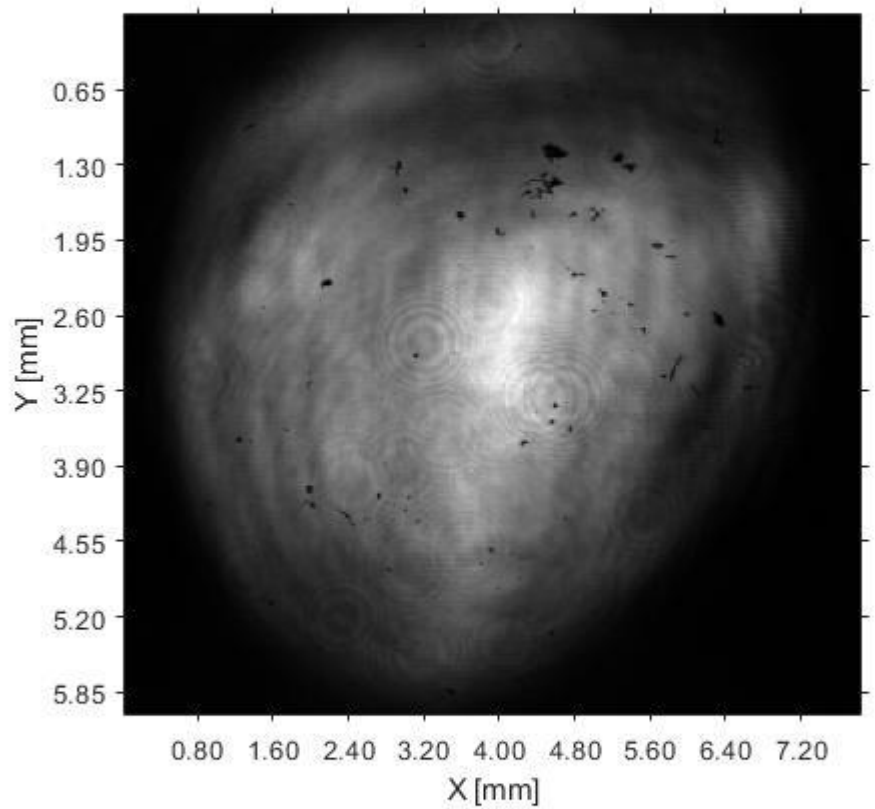


- Since the laser hit the cathode at 25 degree angle, updated the aspect ratio of the image. $\frac{x}{y} = 1.1690$

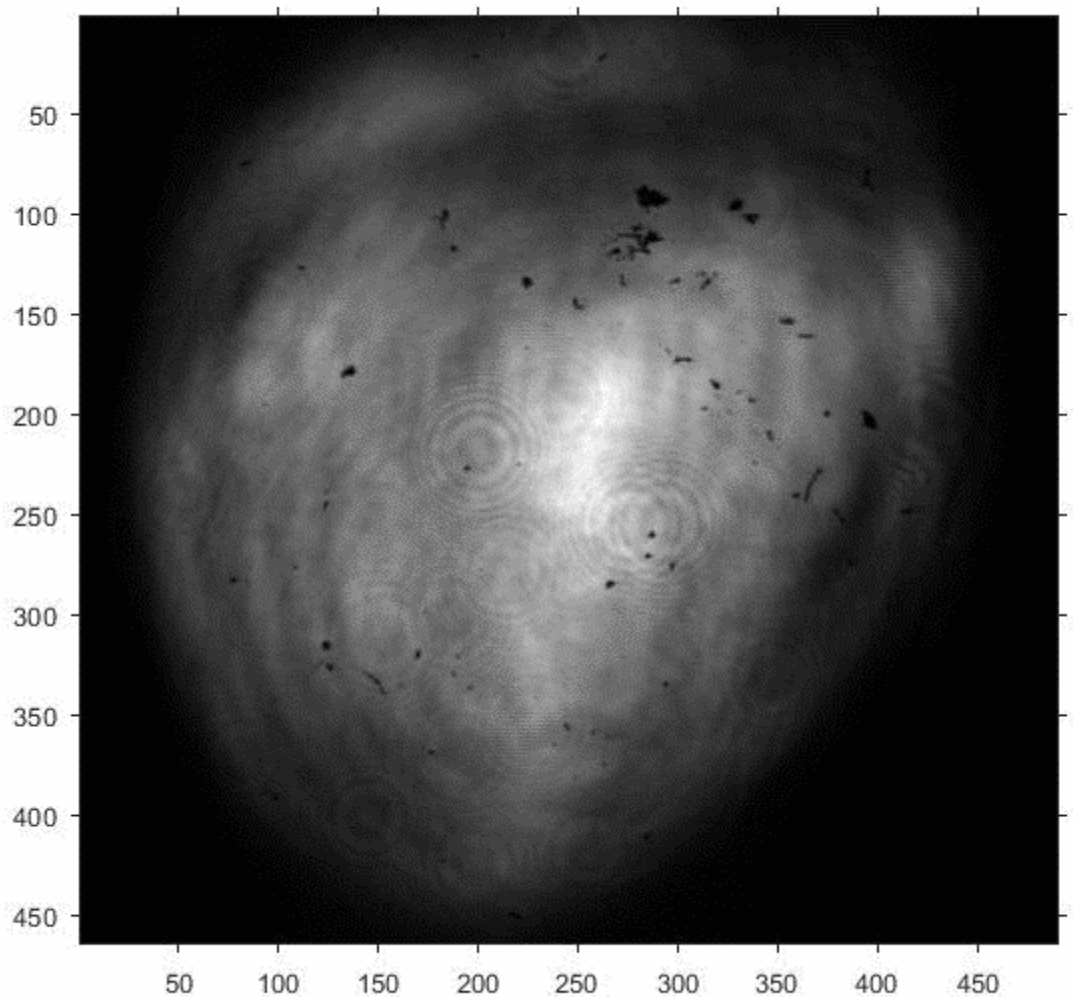





0.65
1.30
1.95
2.60
3.25
3.90
4.55
5.20
5.85
Y [mm]
0.65 1.30 1.95 2.60 3.25 3.90 4.55 5.20 5.85
X [mm]


0.65
1.30
1.95
2.60
3.25
3.90
4.55
5.20
5.85
Y [mm]
0.80 1.60 2.40 3.20 4.00 4.80 5.60 6.40 7.20
X [mm]

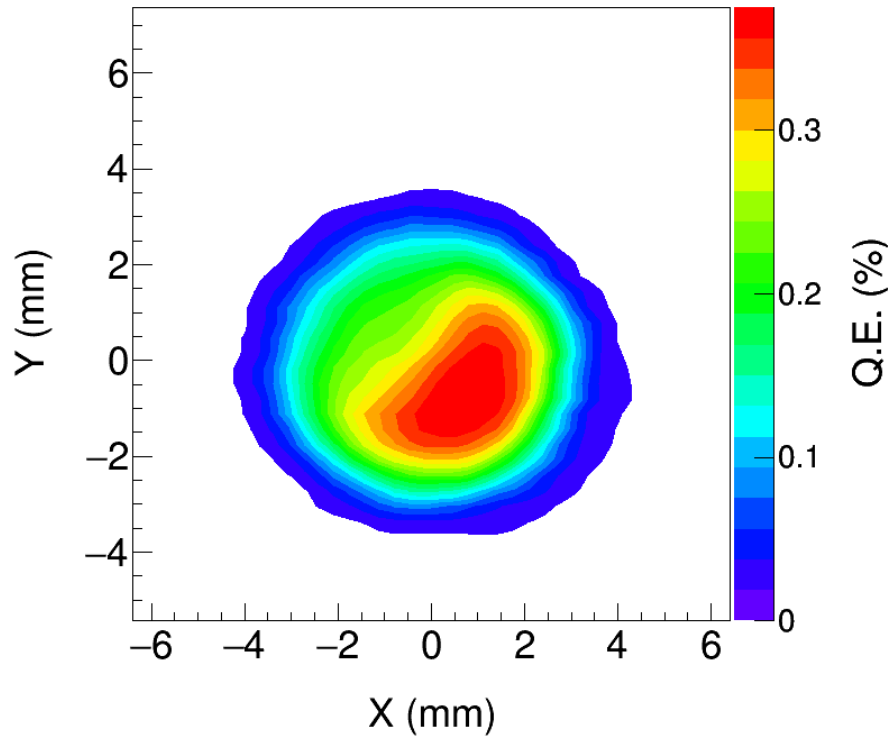
- Convert the 24 bit image to 8 bit image.

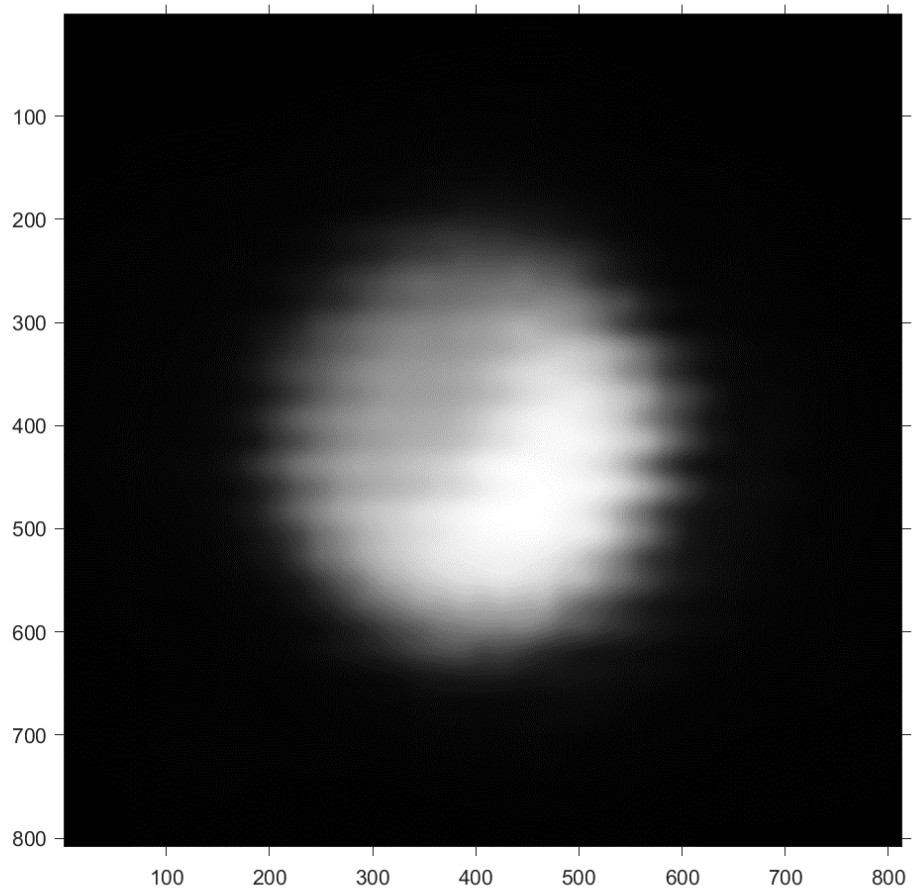


QE scan image

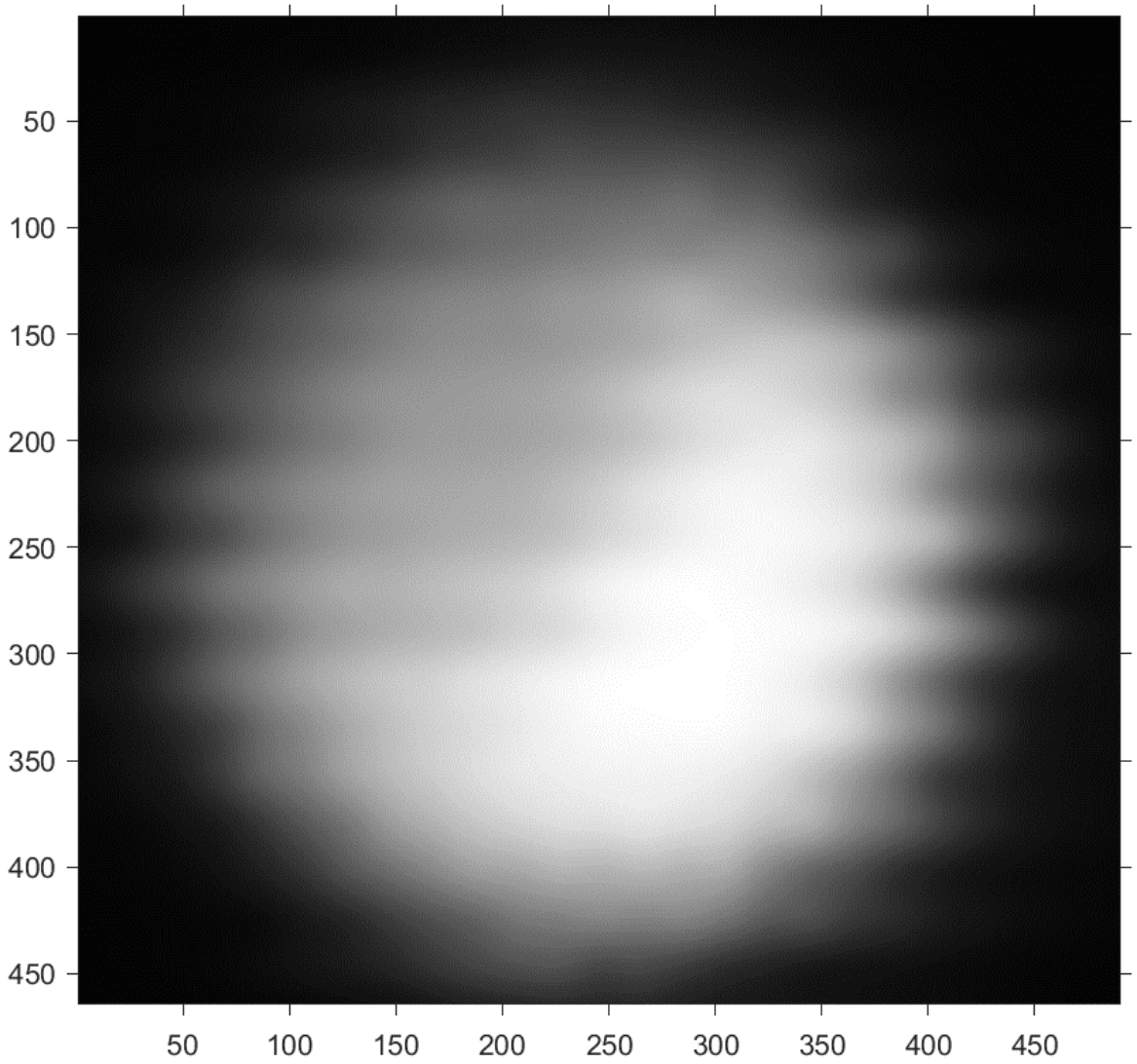
Steps

- Get the matrix of the QE profile and make the center of the active area the center of the QE image.
- Normalized to 1.

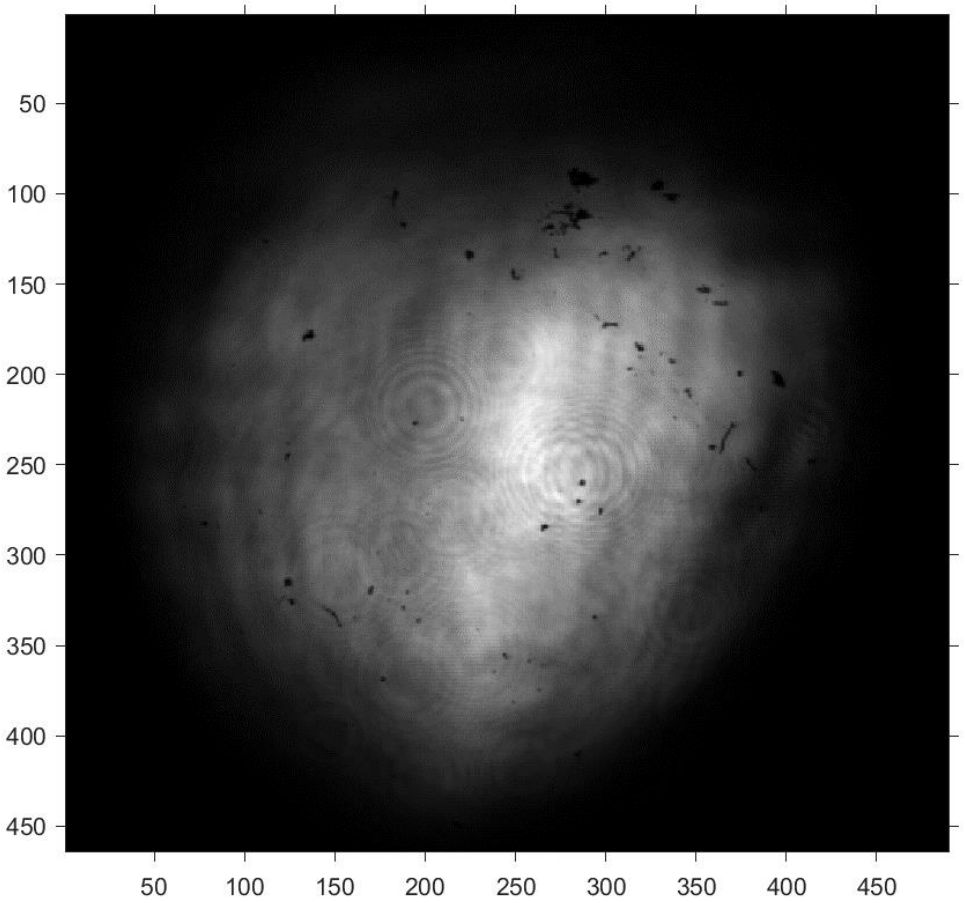




- Scale it to match the px/m ratio of the laser image.
- Crop the QE image to the size of the laser image.



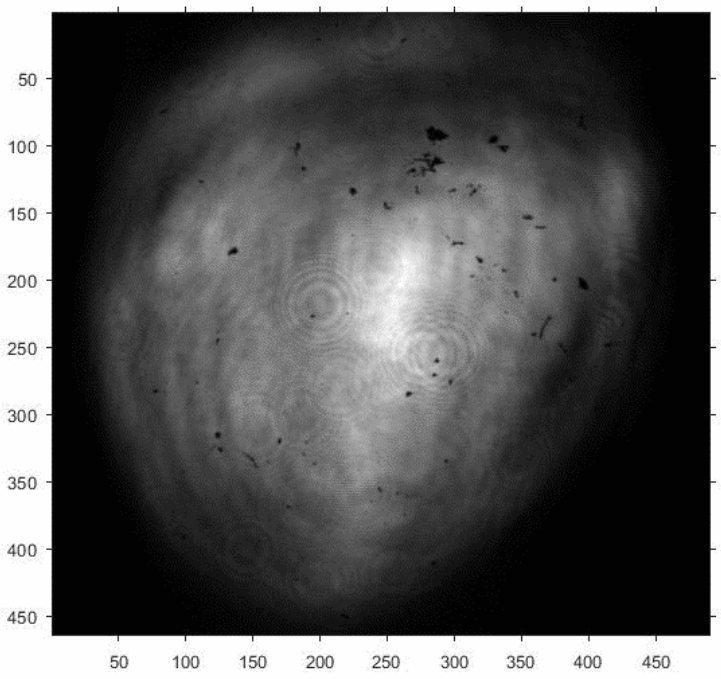
- Multiply the to matrix (laser image*QE).
- Normalized to 1.



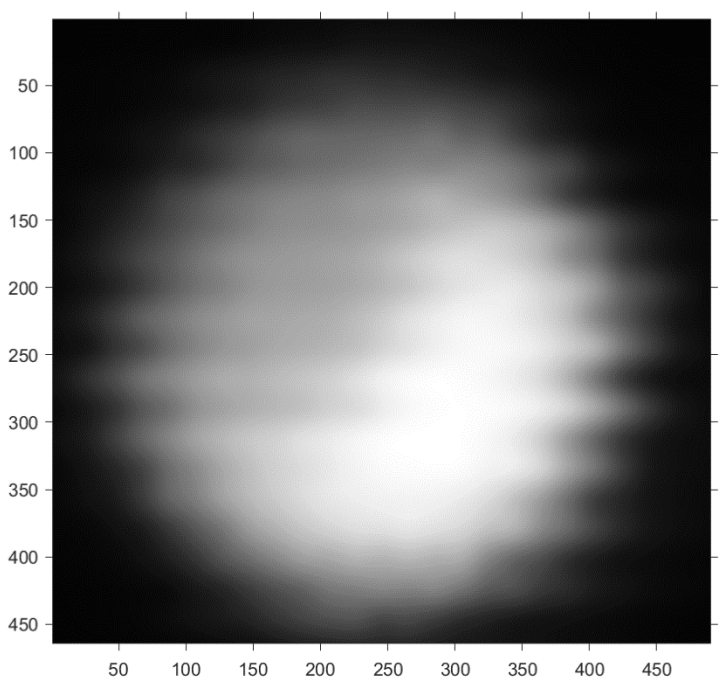
- Convert the 24 bit image to 8 bit image.

Summary

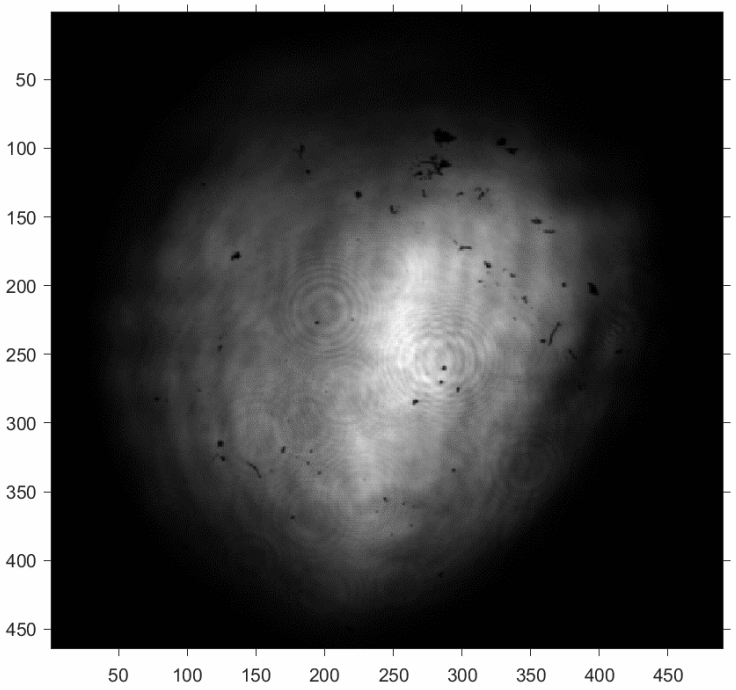
Laser profile



QE scan

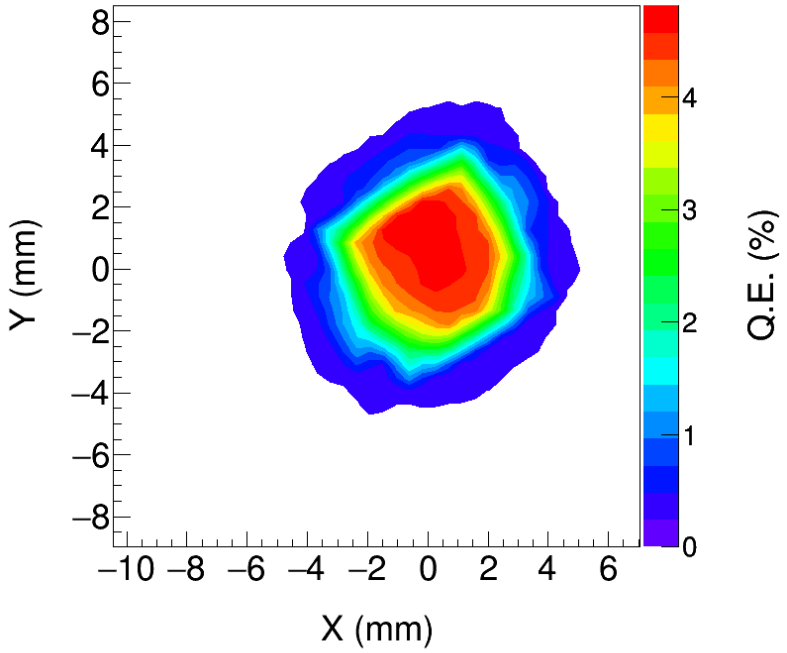


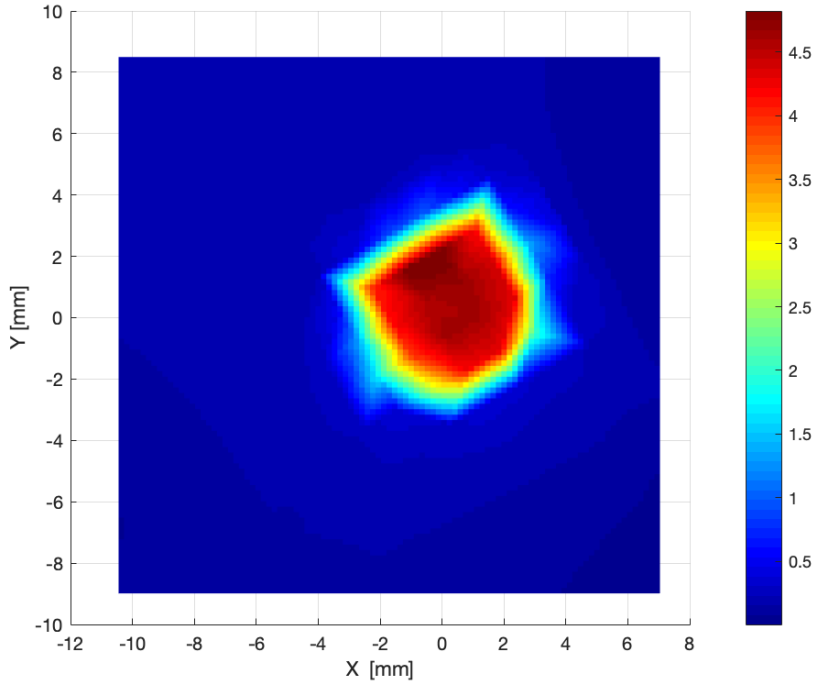
Laser*QE



QE scan did in June'18 for 90 min Sb photocathode

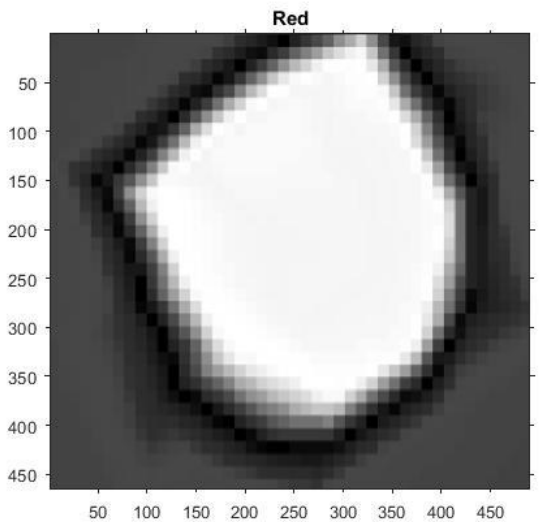
- Plot the original scan data from the .sdds file in X Y coordinates by making the center (0,0) and save that data file in .txt format.
- Make a surface plot from the .txt file (as the step size of the rotated data is large and not a constant, have to do interpolation)
- Save that surface plot as image and convert it to a matrix.

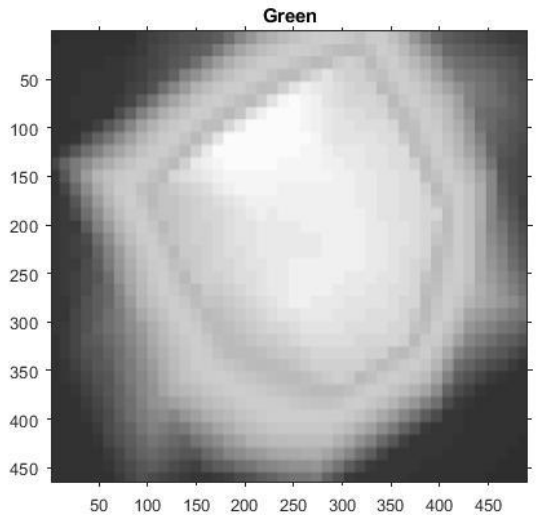


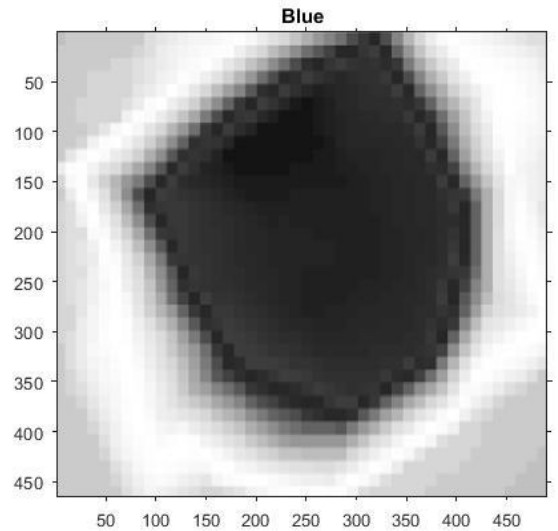


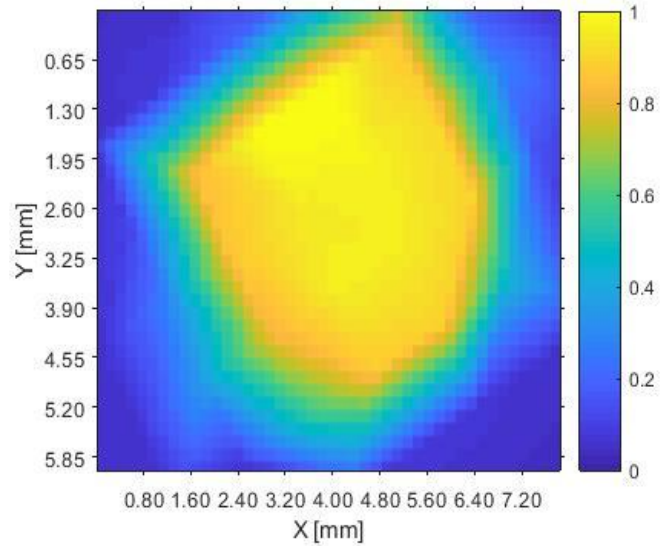
- Matrix comes out as a RGB matrices (3 matrices) which by concatenating the 3rd degree gives the original image.
- Therefore do the further calculations separately for the 3 matrices and finally concatenate them.

- Cropped the image such that the center of the image is the center of the QE scan.
- Scale it to match the px/m ratio of the laser image.
- Crop the QE image to the size of the laser image.

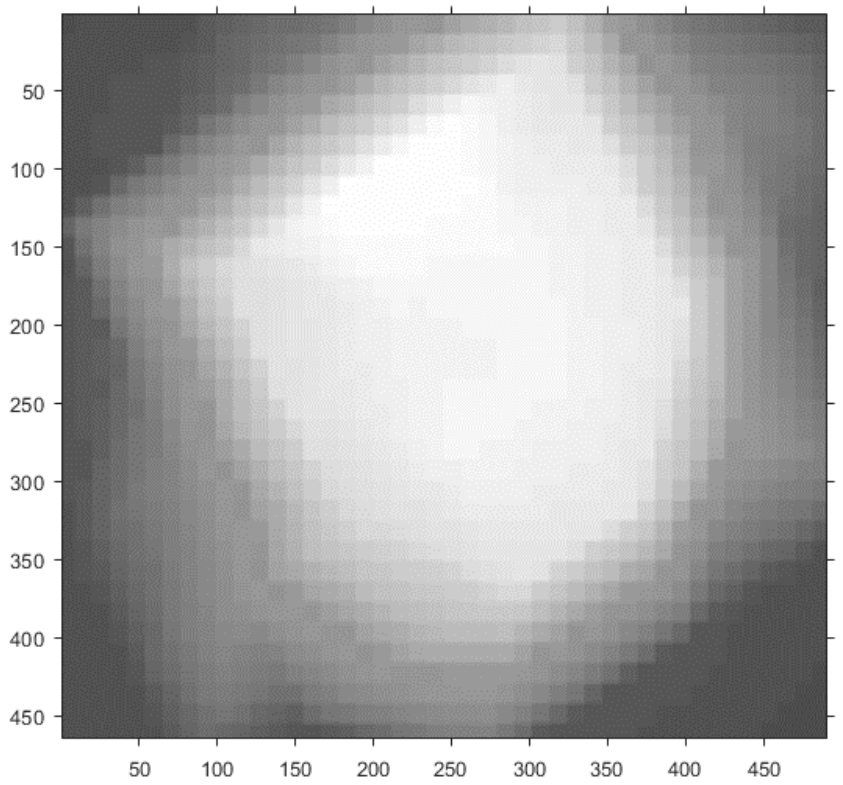








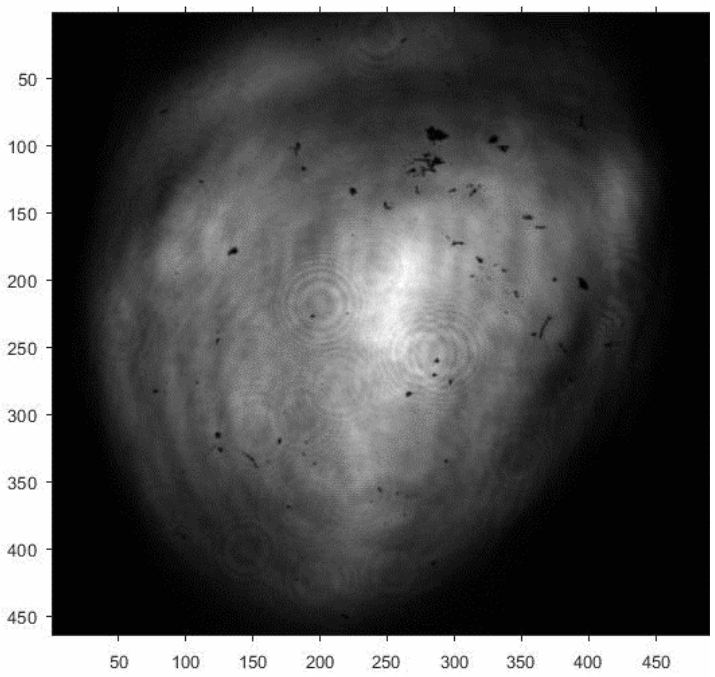
- Convert to a gray scale image.
- Normalize.



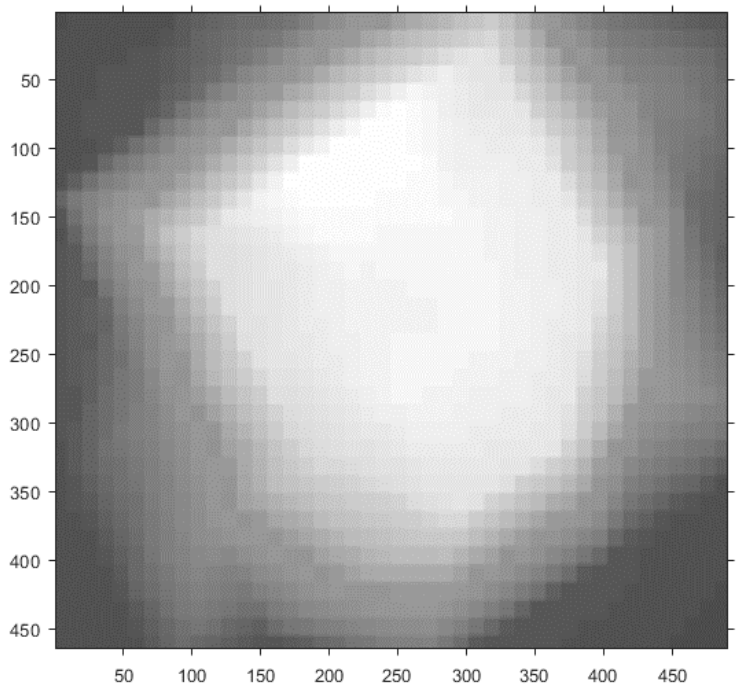
- Multiply the two matrices (Laser * QE)
- Normalize.
- Convert 24 bit to 8 bit image.

Summary

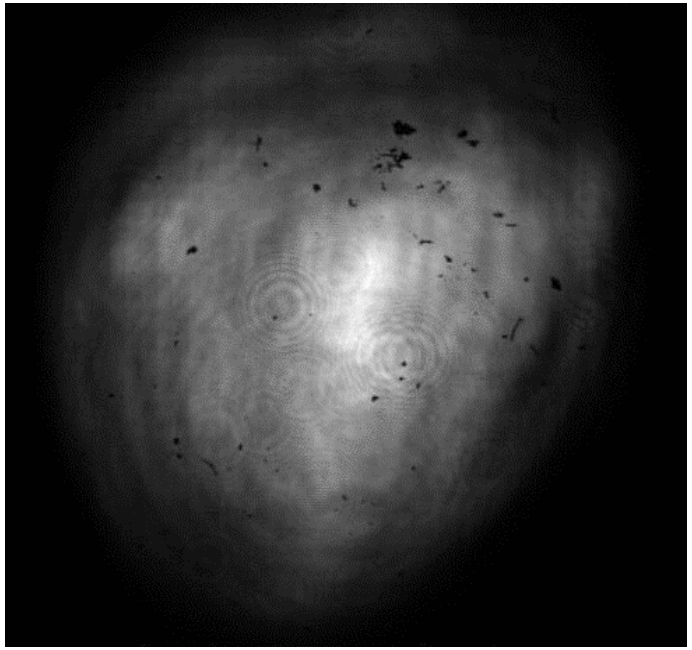
Laser profile



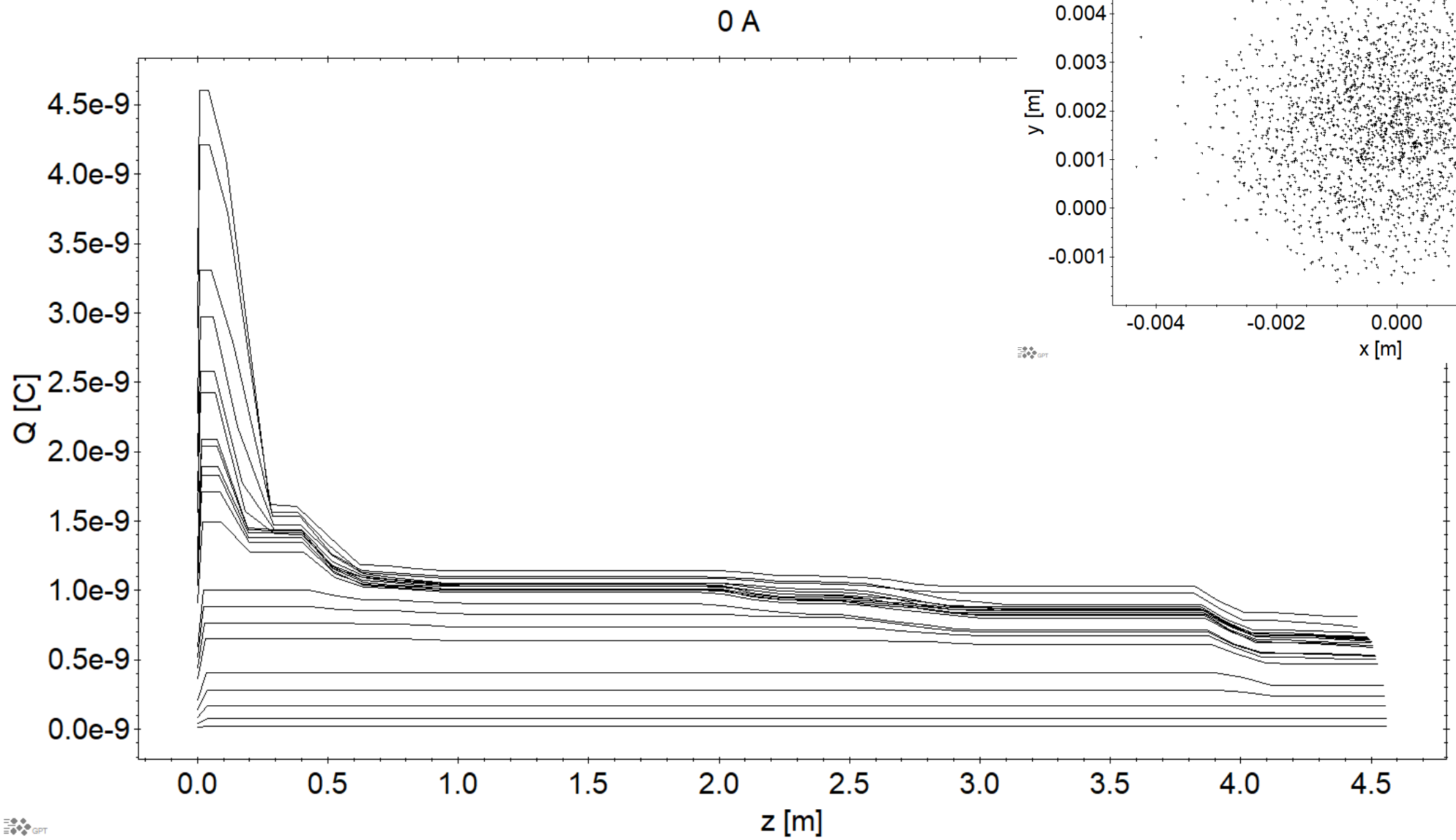
QE scan

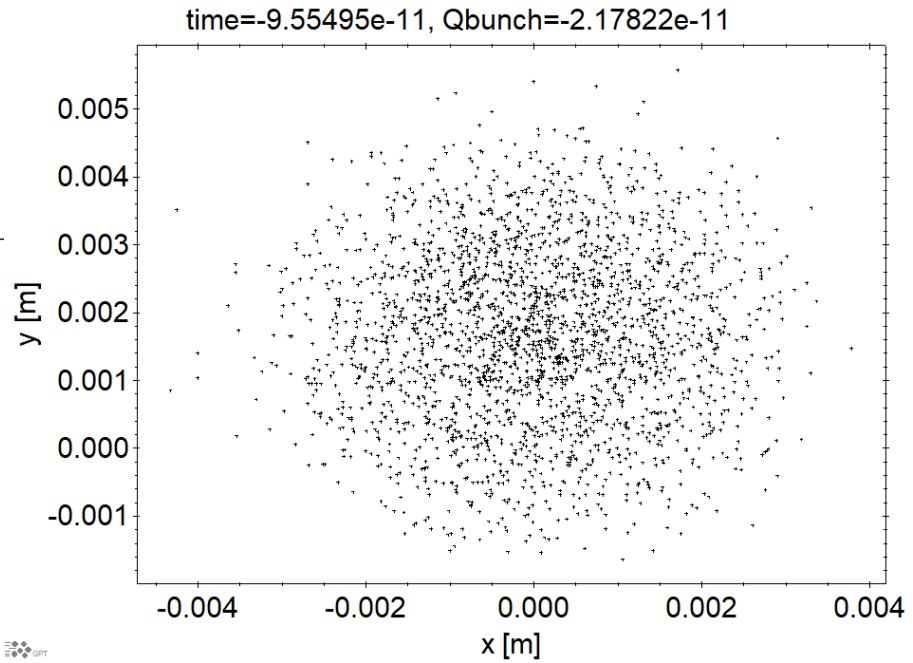


Laser*QE

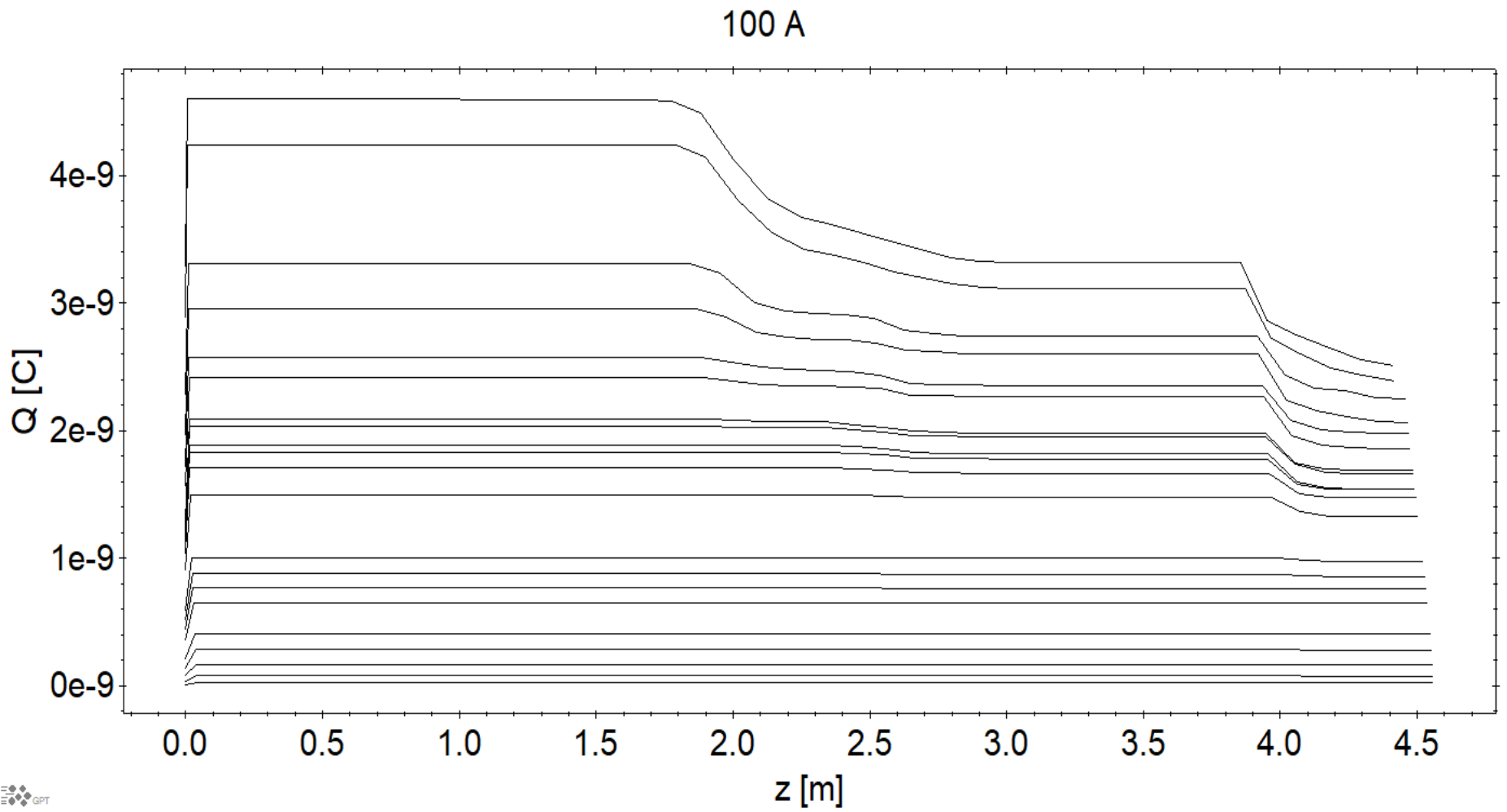


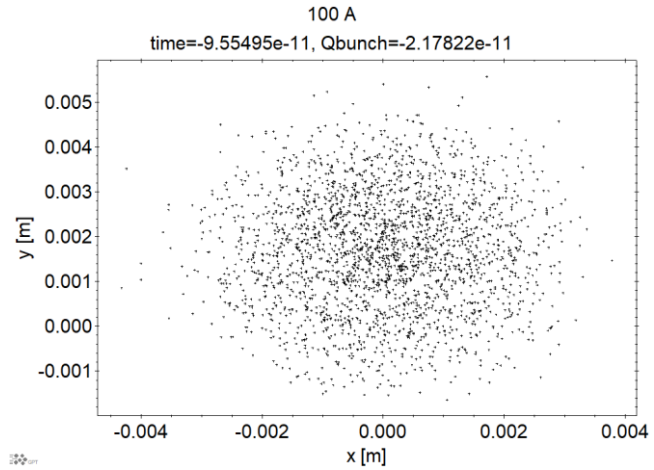
0 A

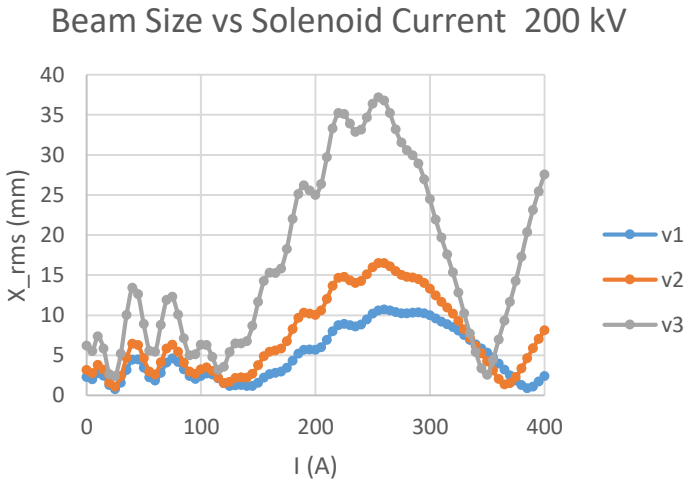

0 A
Q [C]
4.5e-9
4.0e-9
3.5e-9
3.0e-9
2.5e-9
2.0e-9
1.5e-9
1.0e-9
0.5e-9
0.0e-9
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
z [m]

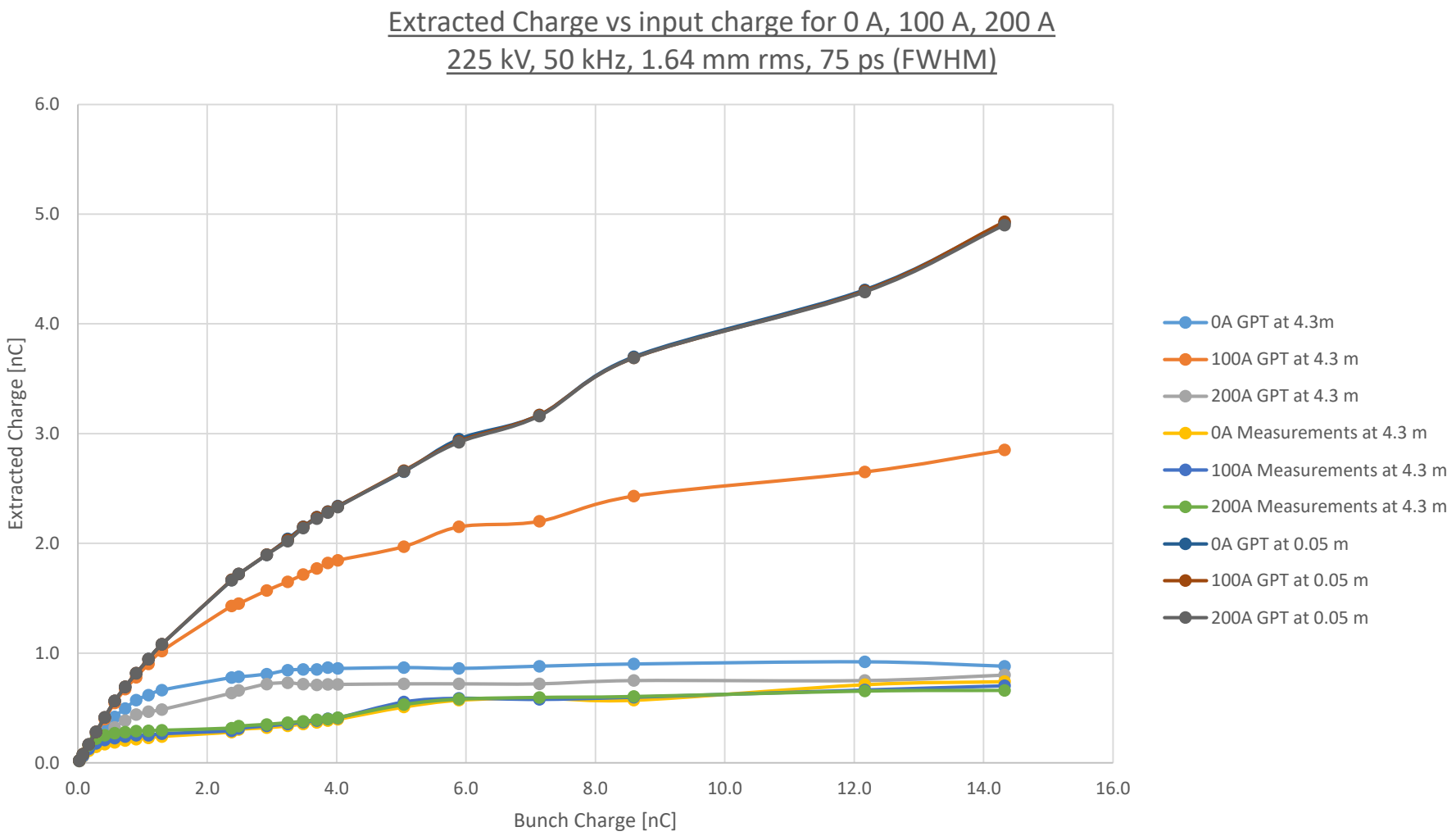

time=-9.55495e-11, Qbunch=-2.17822e-11
y [m]
0.005
0.004
0.003
0.002
0.001
0.000
-0.001
-0.004
-0.002
0.000
0.002
0.004
x [m]

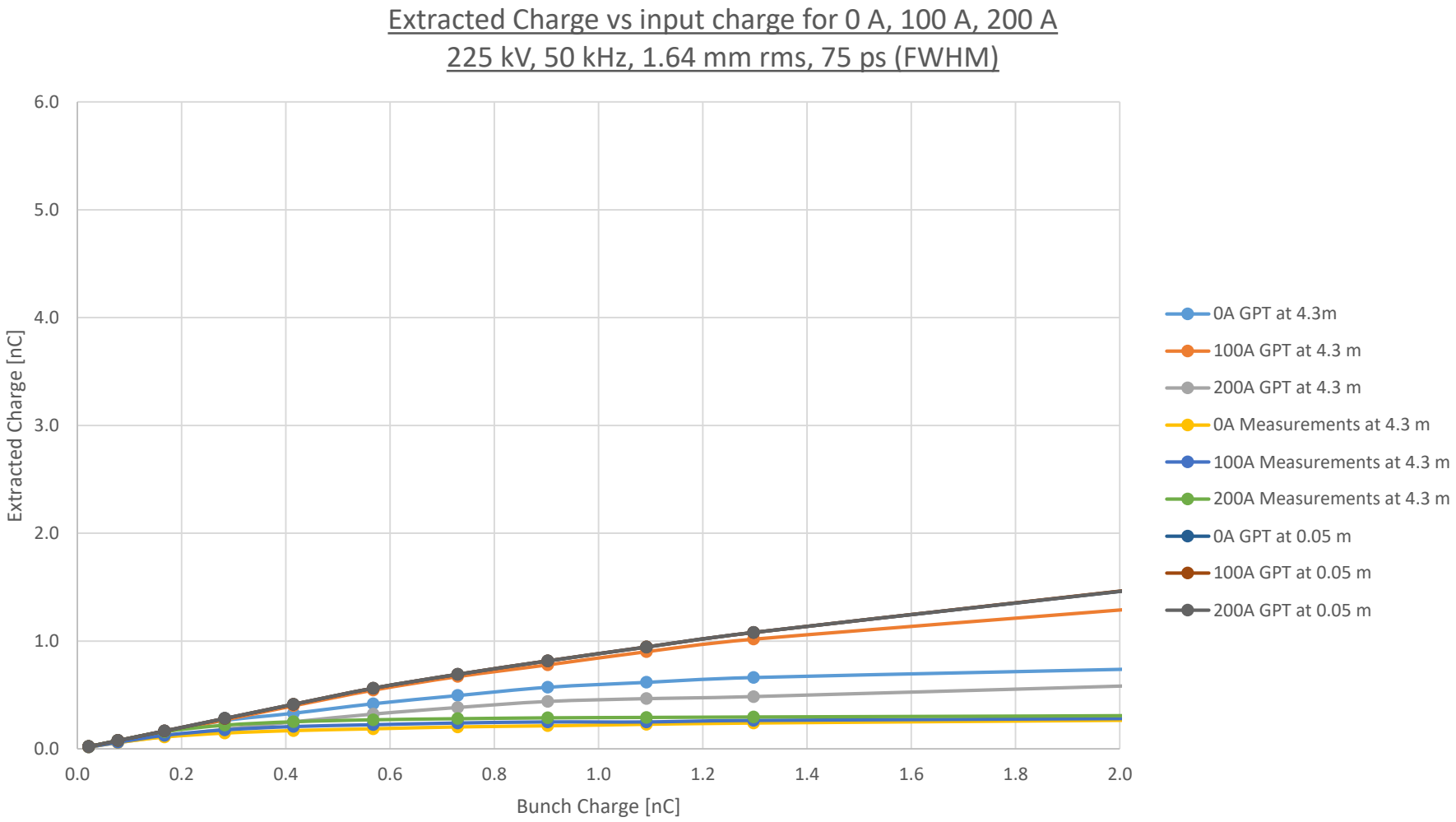
100 A


100 A
Q [C]
4e-9
3e-9
2e-9
1e-9
0e-9
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
z [m]


100 A
time=-9.55495e-11, Qbunch=-2.17822e-11
0.005
0.004
0.003
0.002
0.001
0.000
-0.001
y [m]
-0.004
-0.002
0.000
0.002
0.004
x [m]


Beam Size vs Solenoid Current 200 kV
40
35
30
25
20
15
10
5
0
X_rms (mm)
0
100
200
300
400
I (A)
v1
v2
v3


Extracted Charge vs input charge for 0 A, 100 A, 200 A
225 kV, 50 kHz, 1.64 mm rms, 75 ps (FWHM)
Extracted Charge [nC]
Bunch Charge [nC]
0.0
1.0
2.0
3.0
4.0
5.0
6.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
0A GPT at 4.3m
100A GPT at 4.3 m
200A GPT at 4.3 m
0A Measurements at 4.3 m
100A Measurements at 4.3 m
200A Measurements at 4.3 m
0A GPT at 0.05 m
100A GPT at 0.05 m
200A GPT at 0.05 m


Extracted Charge vs input charge for 0 A, 100 A, 200 A
225 kV, 50 kHz, 1.64 mm rms, 75 ps (FWHM)
Extracted Charge [nC]
Bunch Charge [nC]
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0A GPT at 4.3m
100A GPT at 4.3 m
200A GPT at 4.3 m
0A Measurements at 4.3 m
100A Measurements at 4.3 m
200A Measurements at 4.3 m
0A GPT at 0.05 m
100A GPT at 0.05 m
200A GPT at 0.05 m