Center for
BRIGHT BEAMS
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Measuring Work Function Variations on Photocathode Surface Using PEEM

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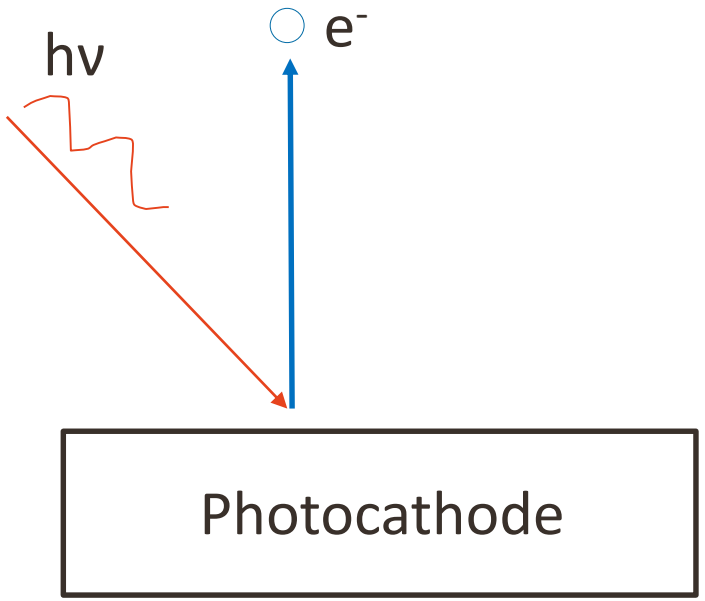
Photocathodes

- A surface which produces electrons when an incident light is shone on it
- Number of electrons released per photon determines the photocathodes quantum efficiency



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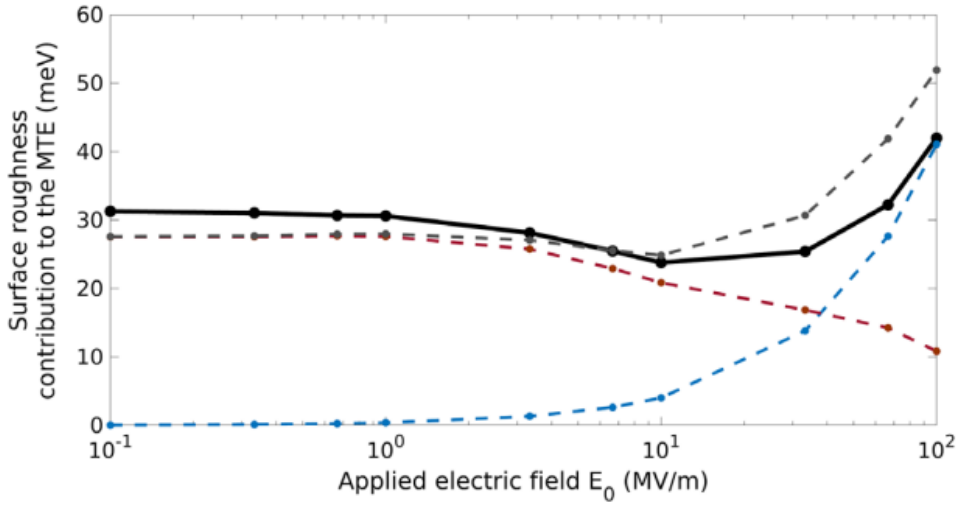
Brightness

- $B \propto 1/MTE$
- At high Electric field MTE dominated by surface roughness
- At low electric field MTE is dominated by variations in surface potential (work function variation)



Gevorkyan, G. S., et al *Physical Review Accelerators and Beams* 21.9 (2018): 093401.

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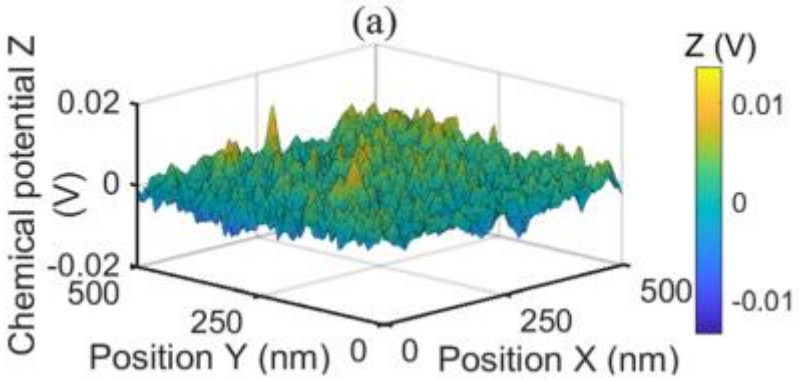
Measuring WF using KPFM

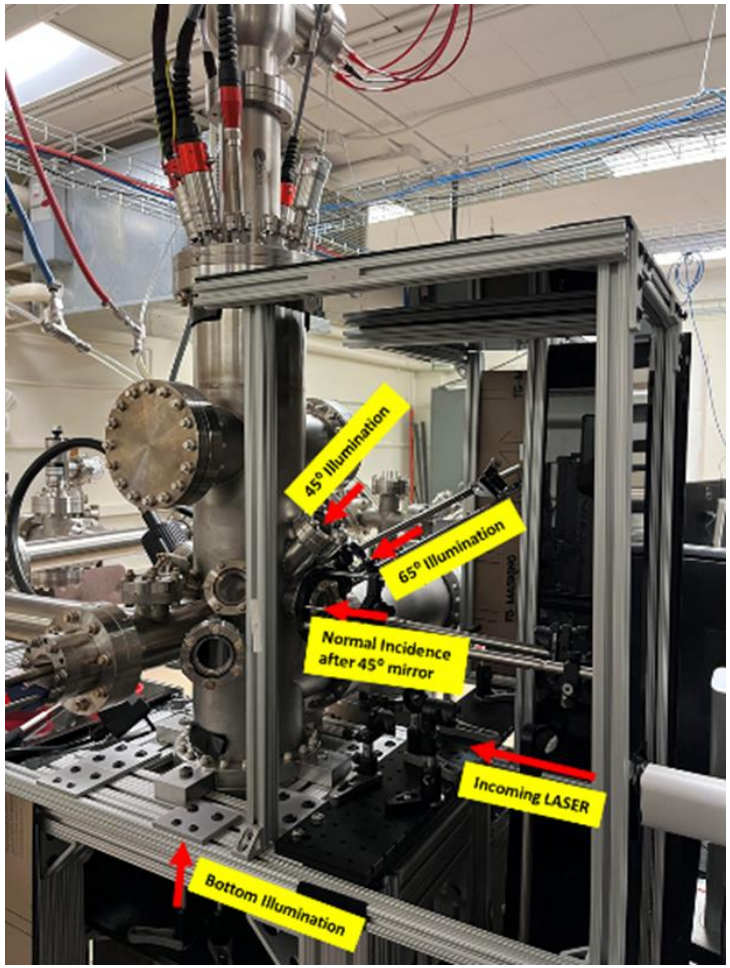
- Works by calculating potential difference between the sample and the AFM tip
- Gives a relative work function with respect to the tip not absolute work function
- Can only do 6µm x 6µm area



Saha, Pallavi, et al. *Applied Physics Letters* 120.19 (2022): 194102.

Measuring WF using PEEM

- Can produce absolute work function
- Can do 1mm sample area
- Using the PEEM images are taken of photoemission at wavelength ranging from 250nm to 290nm in steps of 2nm for 460 µm FOV
- Laser spot was defocused to cover entire FOV



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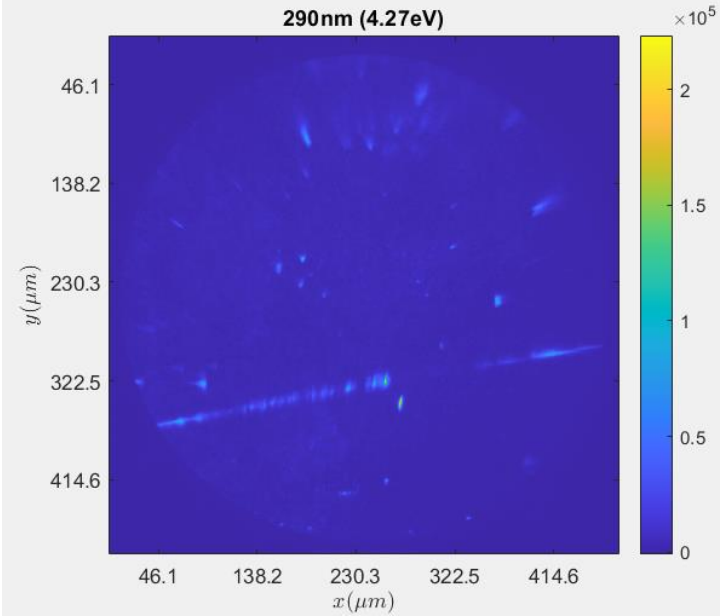
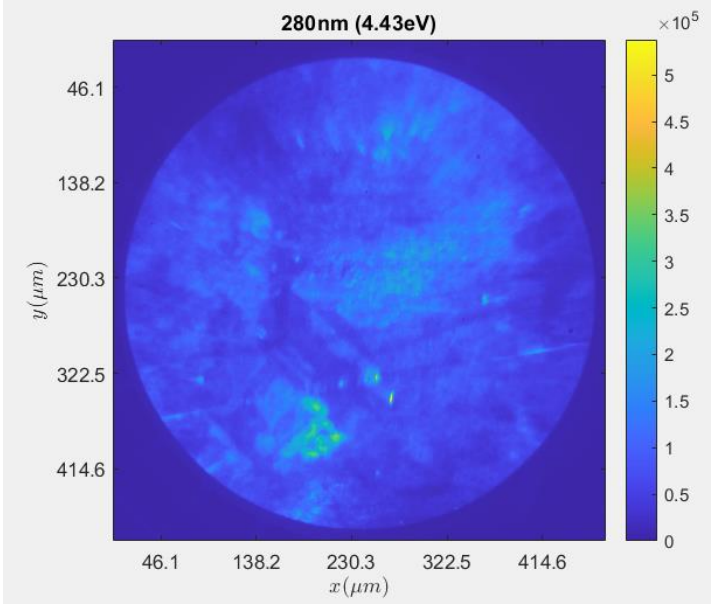
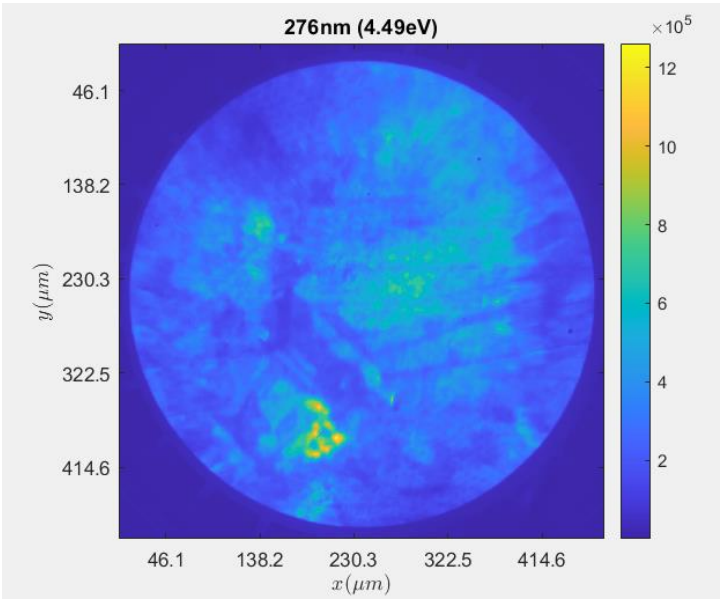
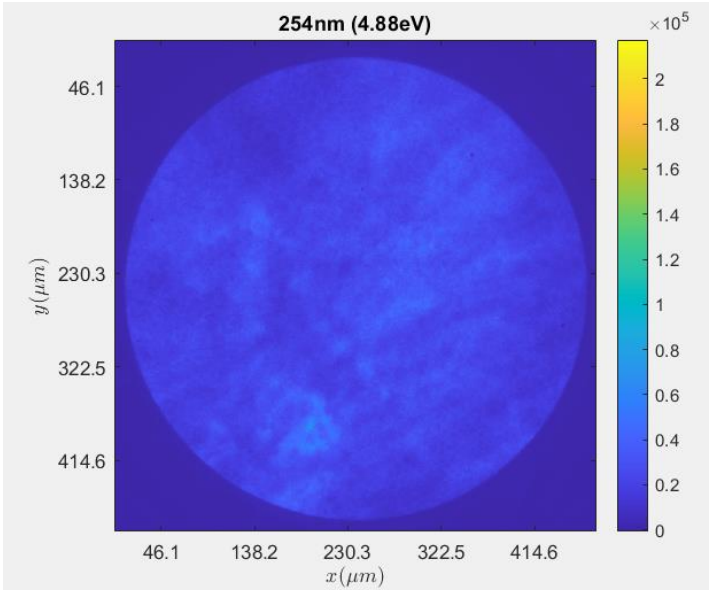

290nm (4.27eV)
×10^5
2
1.5
1
0.5
0
46.1
138.2
230.3
322.5
414.6
y(μm)
x(μm)

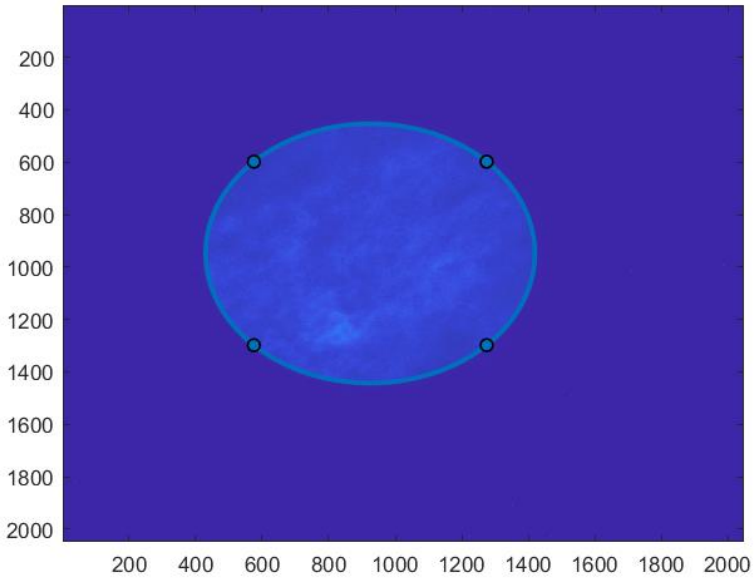

280nm (4.43eV)
×10^5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
46.1
138.2
230.3
322.5
414.6
y(μm)
x(μm)


276nm (4.49eV)
×10^5
12
10
8
6
4
2
46.1
138.2
230.3
322.5
414.6
y(μm)
x(μm)


254nm (4.88eV)
×10^5
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
46.1
138.2
230.3
322.5
414.6
y(μm)
x(μm)

My work

- Calculated QE using the CPS at each pixel within a region of interest



	983	984	985	986
687	15511	16301	16037	15469
688	15878	16689	16287	15844
689	16388	19714	16964	17014
690	15980	16116	16784	15391
691	14891	14807	14818	15210
692	14725	14015	14449	15246
693	13711	14471	15468	16002

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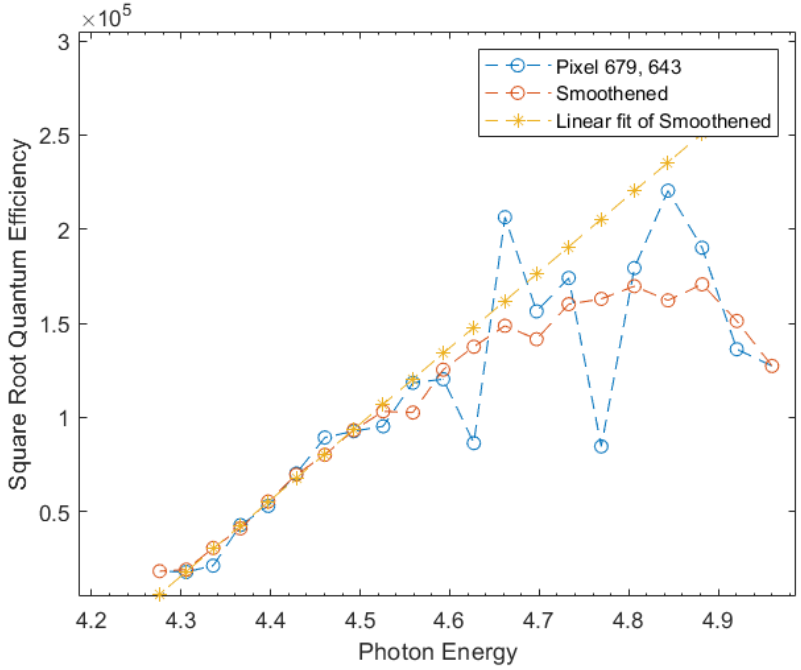
My work

- Plotted $\sqrt{QE}$ Against Photon Energy (eV)
- Smoothened data to reduce noise
- Linear Fit is applied to the plot
- This was done for every pixel within the region of interest (detector area)



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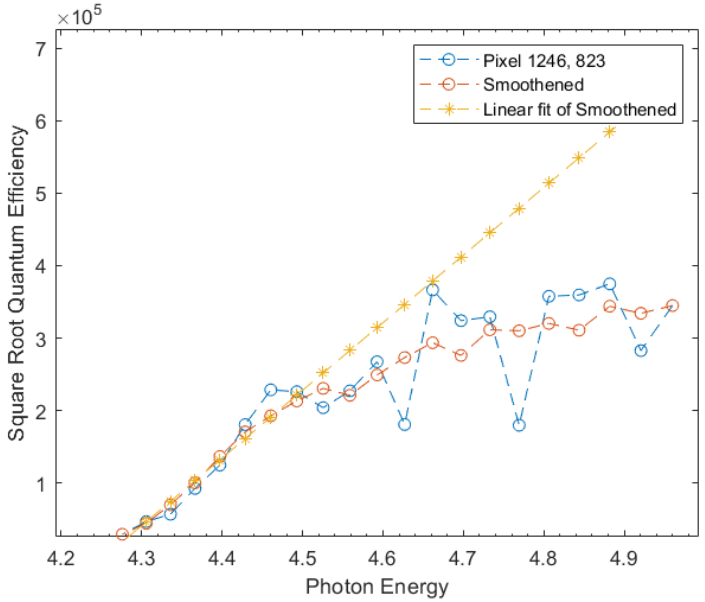
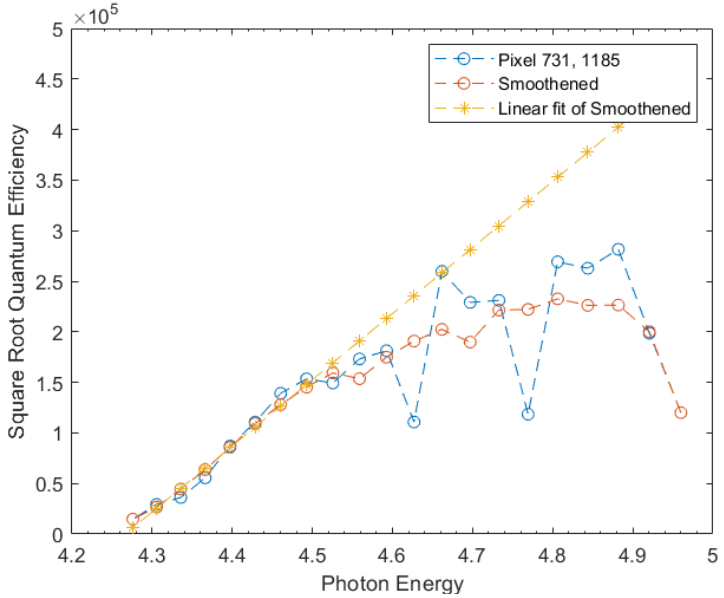
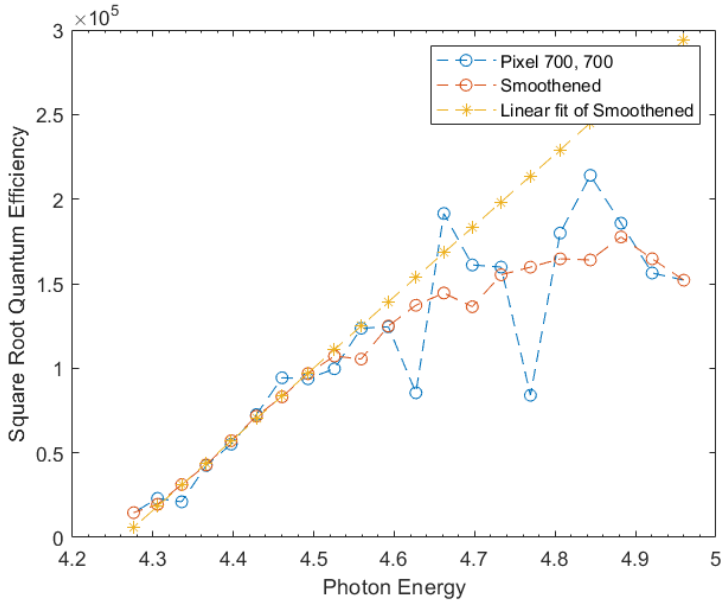
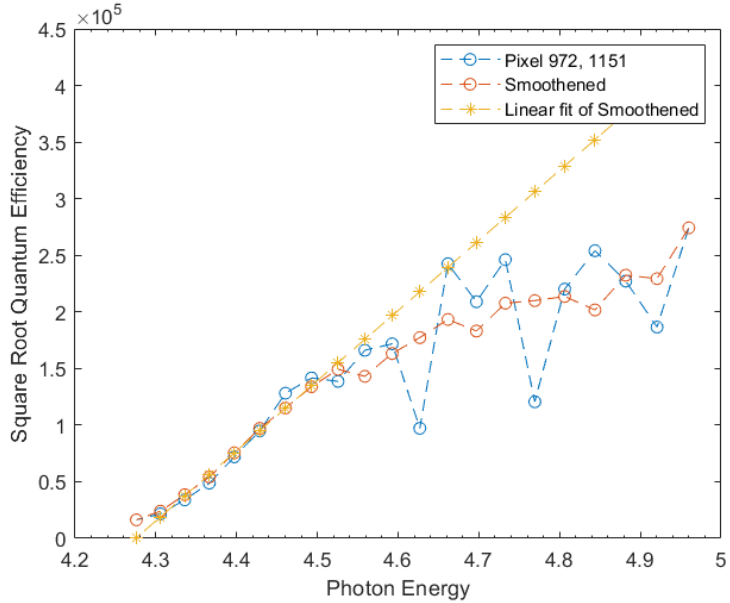
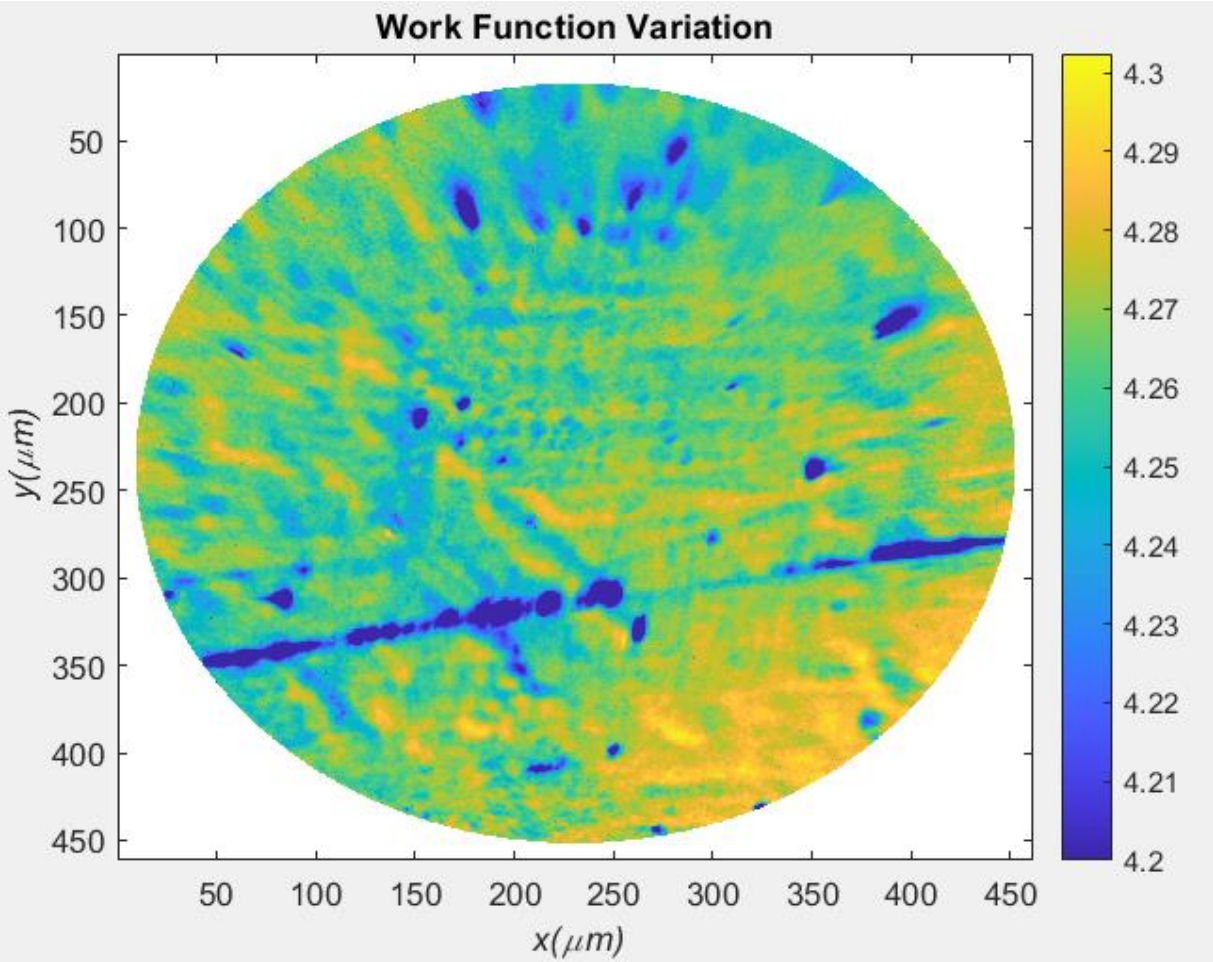

×10^5
Pixel 1246, 823
Smoothened
Linear fit of Smoothened
Square Root Quantum Efficiency
Photon Energy


×10^5
Pixel 731, 1185
Smoothened
Linear fit of Smoothened
Square Root Quantum Efficiency
Photon Energy


×10^5
Pixel 700, 700
Smoothened
Linear fit of Smoothened
Square Root Quantum Efficiency
Photon Energy


×10^5
Pixel 972, 1151
Smoothened
Linear fit of Smoothened
Square Root Quantum Efficiency
Photon Energy

Result



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Thank you!

Questions?

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