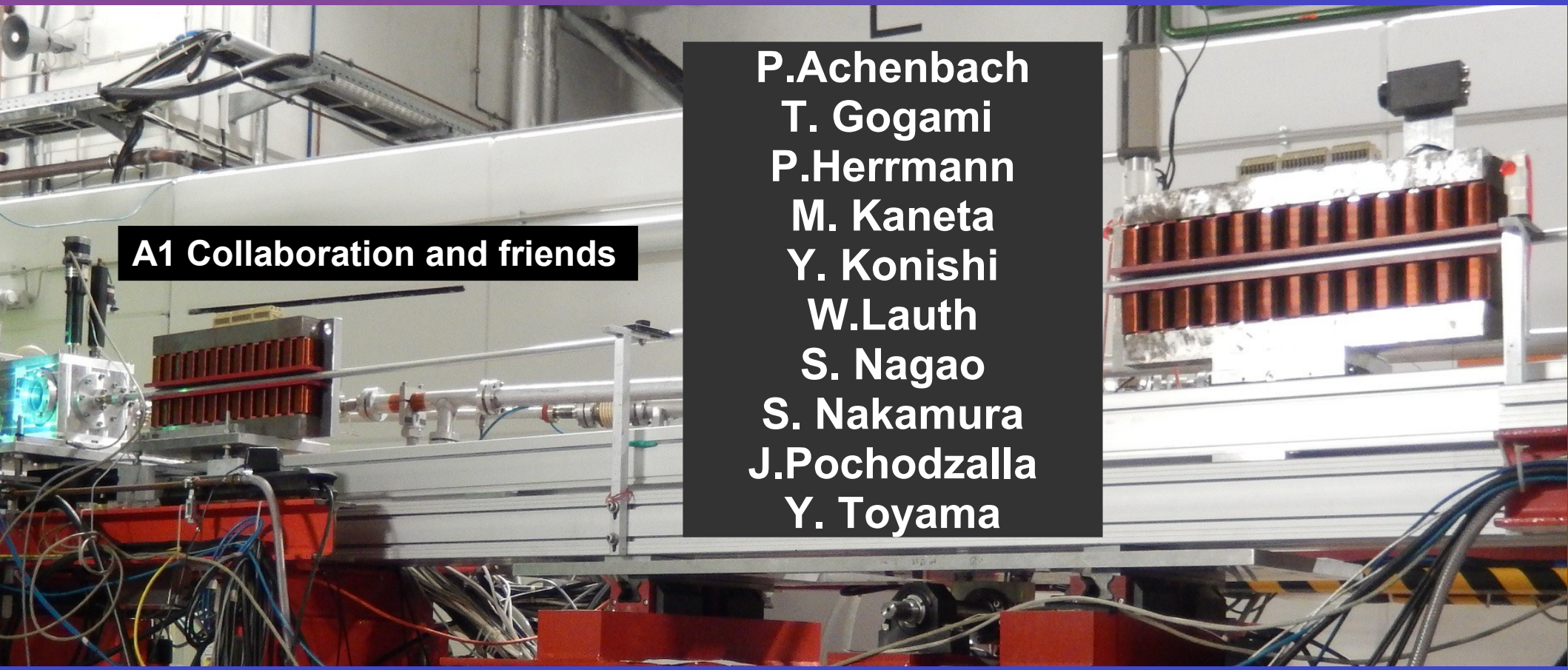
Discussion of the error of the Fresnel diffraction fitting



A1 Collaboration and friends

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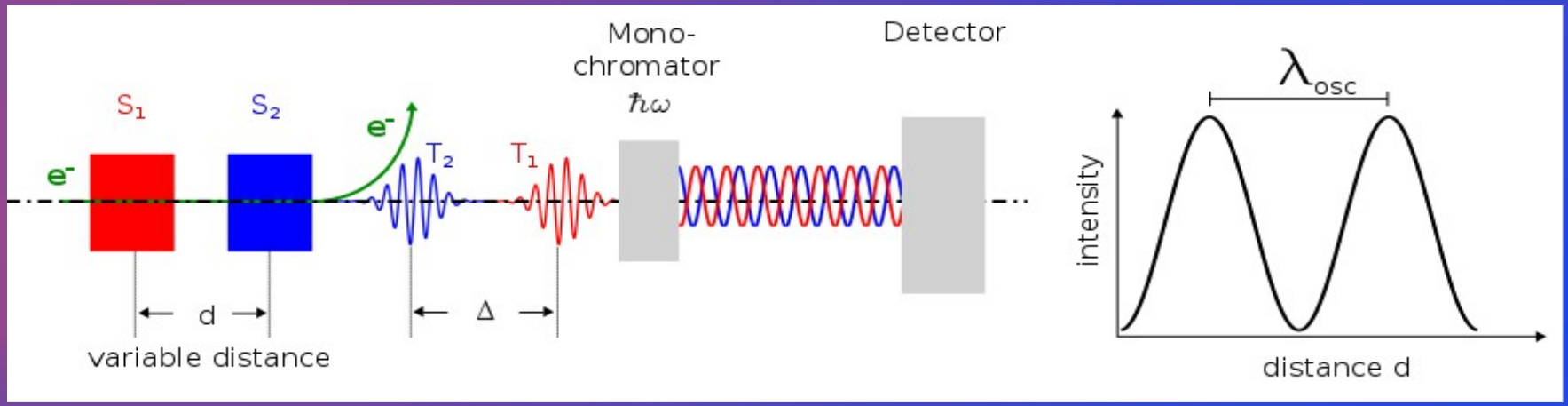
Method

Coherent sources	Wave packets	Monochro-matic light	Light intensity of selected wavelength

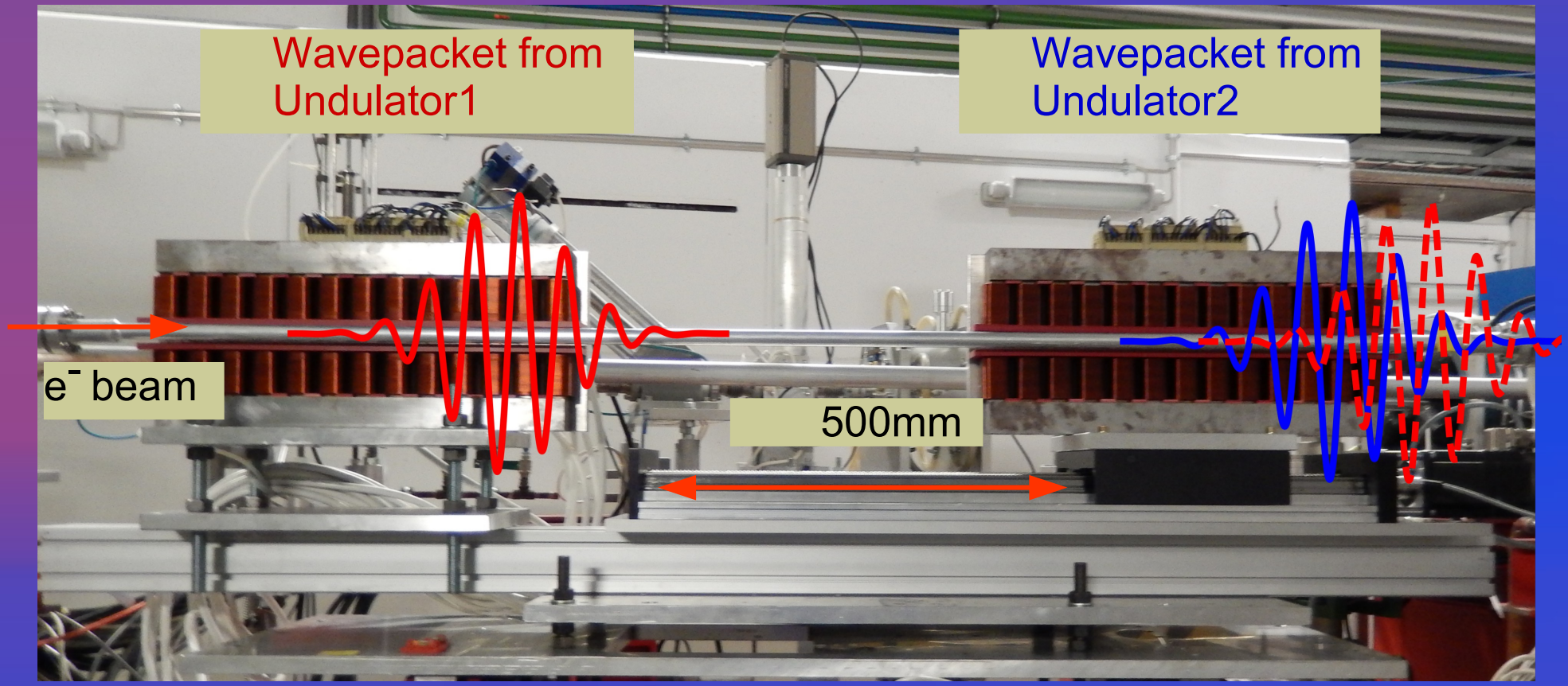


$$\lambda_{osc} = 2\gamma^2 \lambda_L$$

Example for wavelength and period

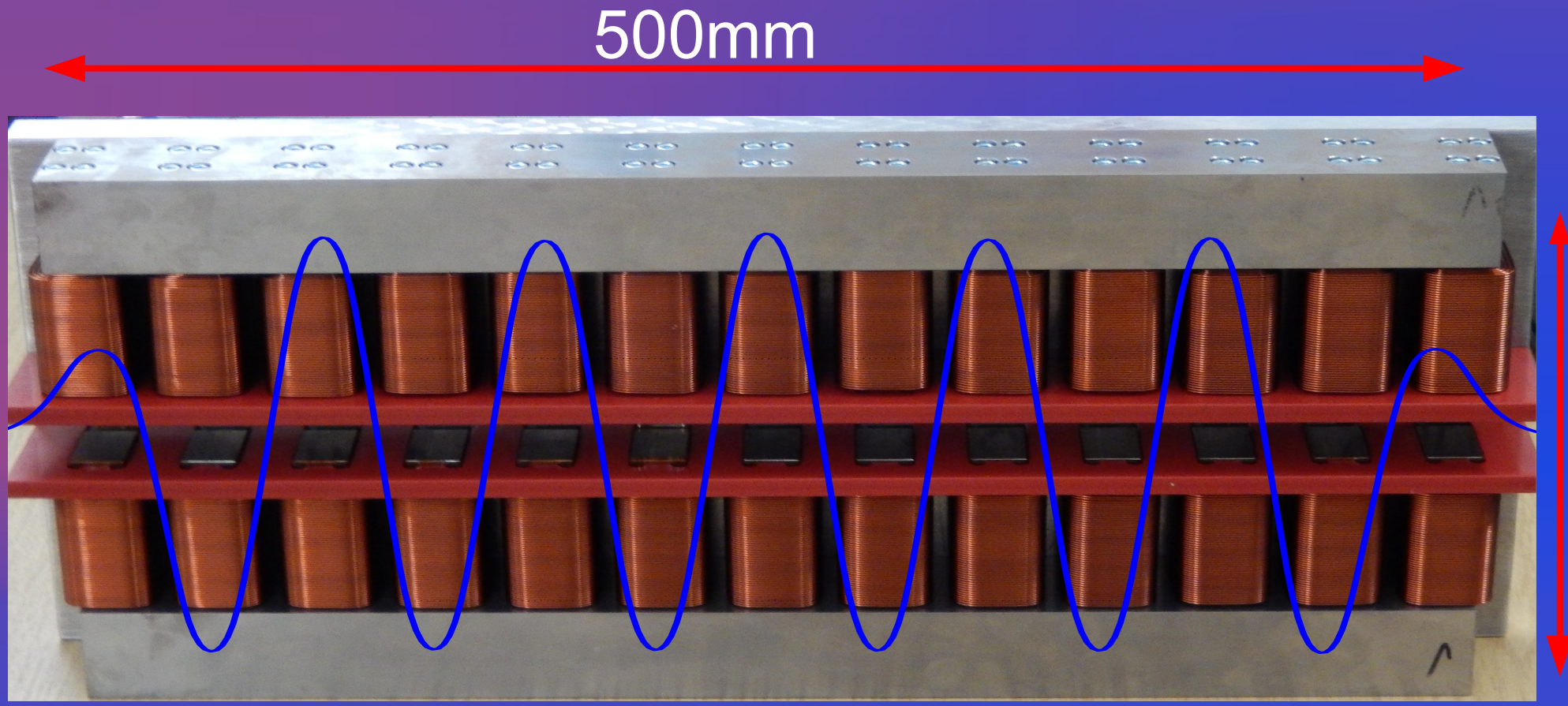
$$\left.\begin{array}{l} \lambda_L \approx 400\text{nm} \\ \gamma \approx 381\text{ ,E=195MeV} \end{array}\right\} \lambda_{osc} \approx 116\text{mm}$$

Undulators as sources for coherent radiation (former setup)

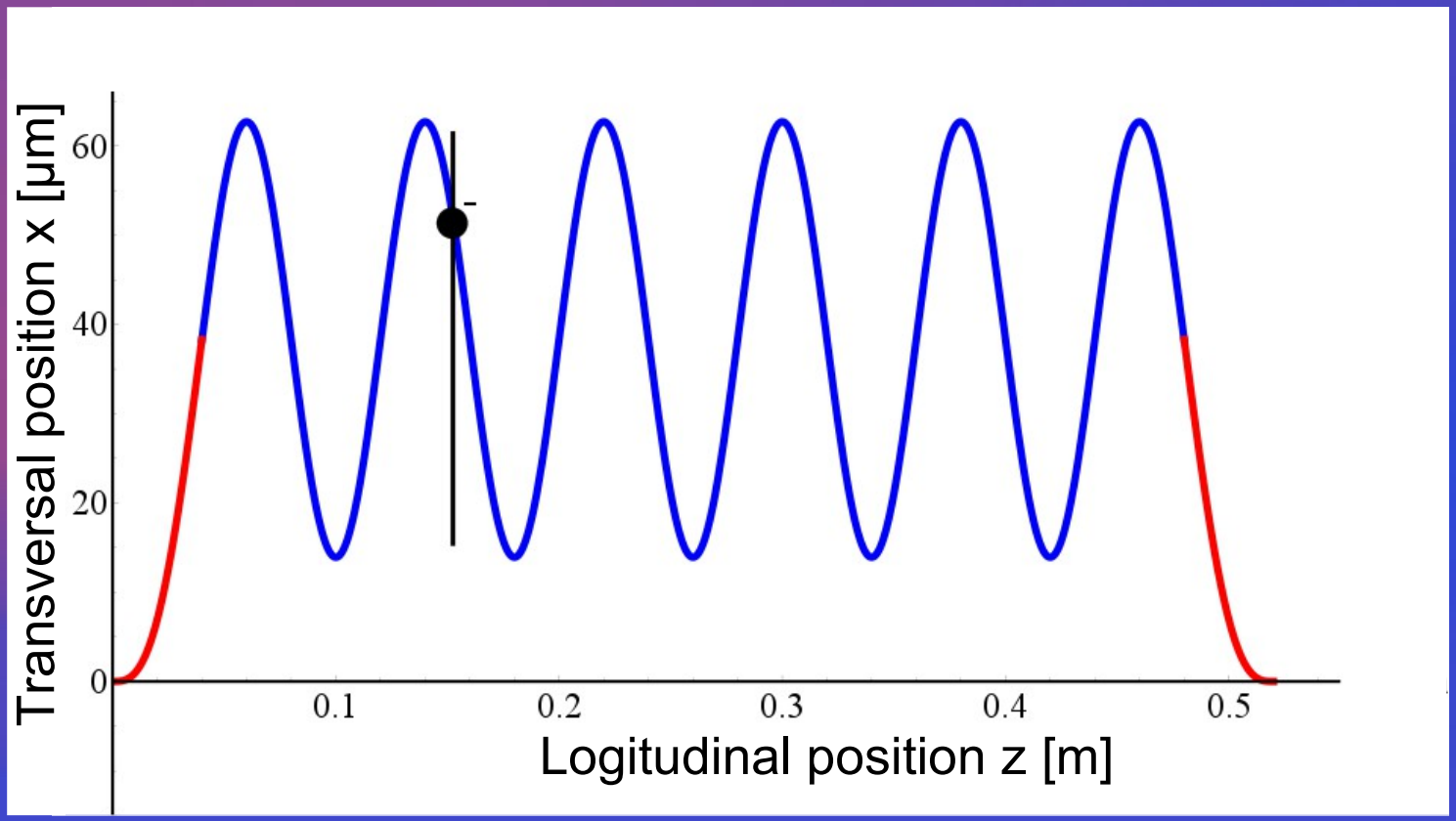


To Measure the oszillation period the second undulator ist moved by a motorized stage

Undulatorfield

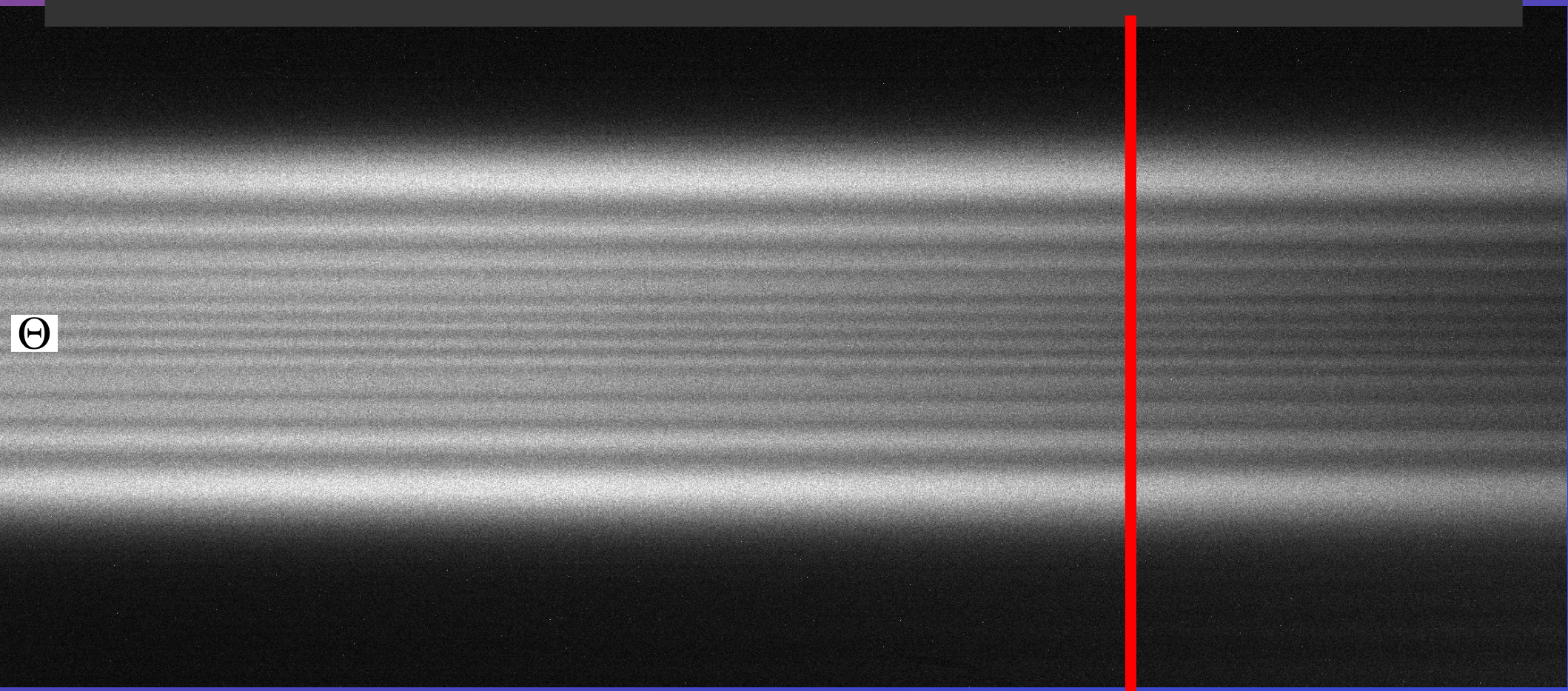


Emission of synchrotron radiation

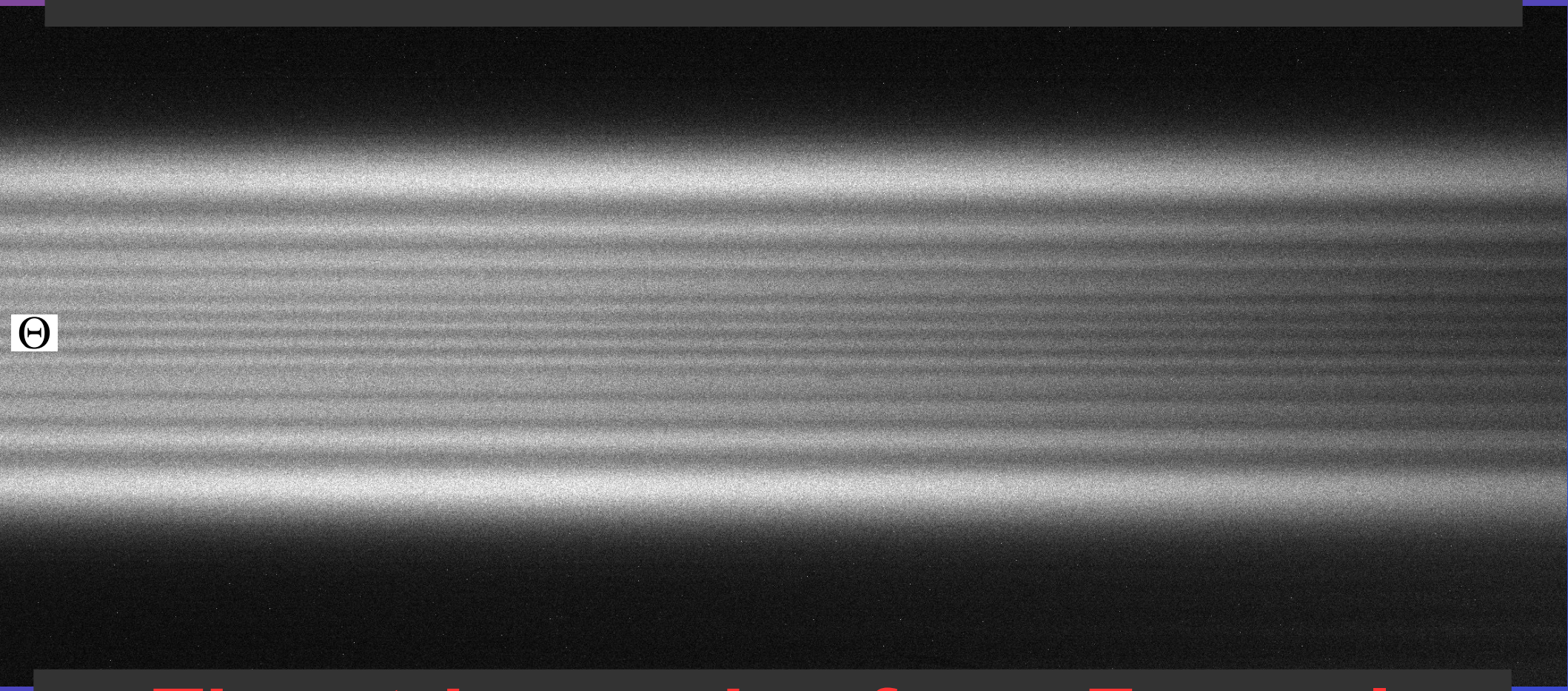


- Electrons oscillate perpendicular to the z-Axis
- The black bar suggests the idea of a high relativistic antenna moving towards the observer
- Emission takes place only in a finite length

Typical Undulator spectrum

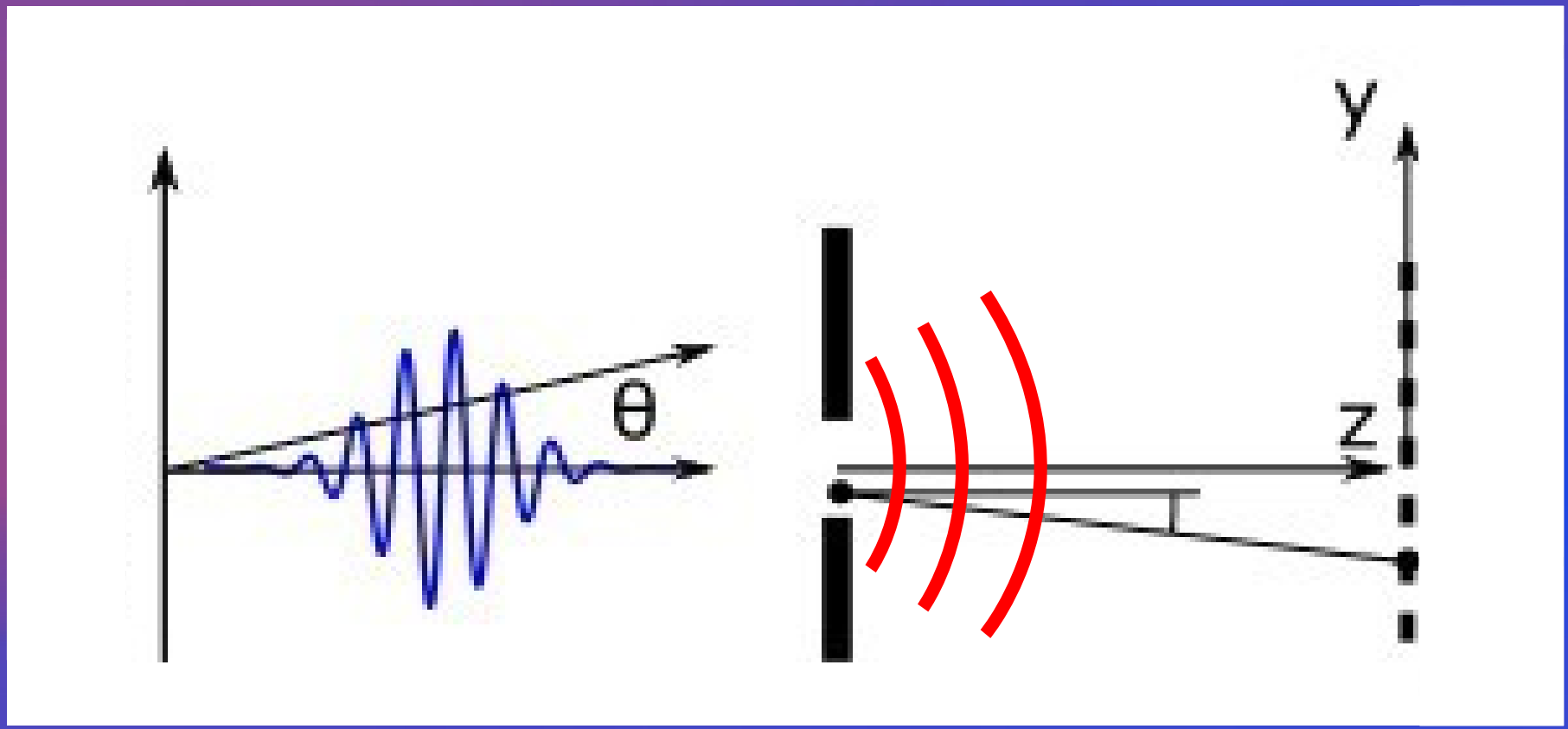


Typical Undulator spectrum

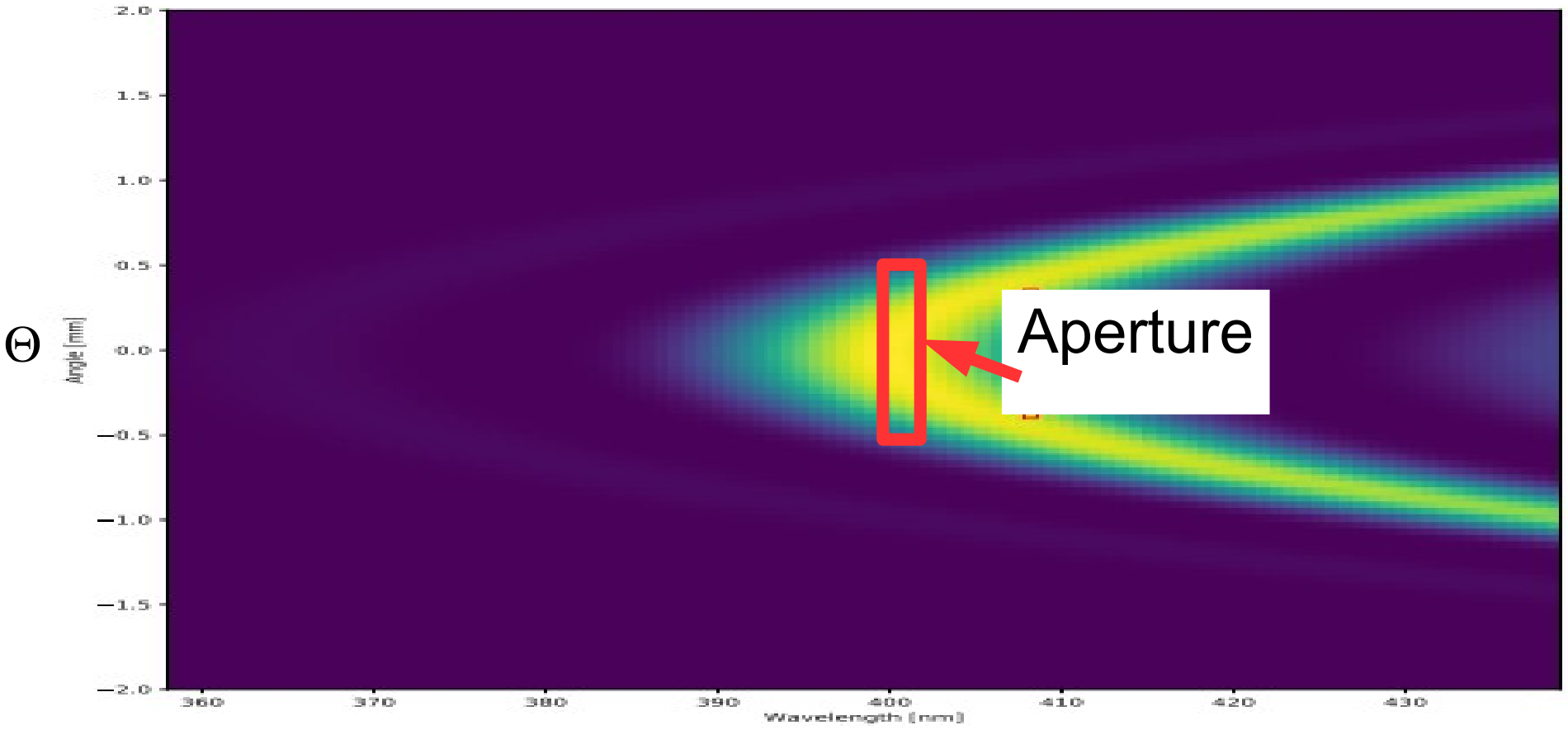


The stripes arise from Fresnel diffraction

Where diffraction occures



Undulator spectrum no Diffraction



Apparent gamma

Phase Φ depends also on the angle θ:

$$\Phi(d) = k_L \left((L_U + d) \frac{\Theta^2}{2} + \frac{d}{2\gamma^2} \right)$$

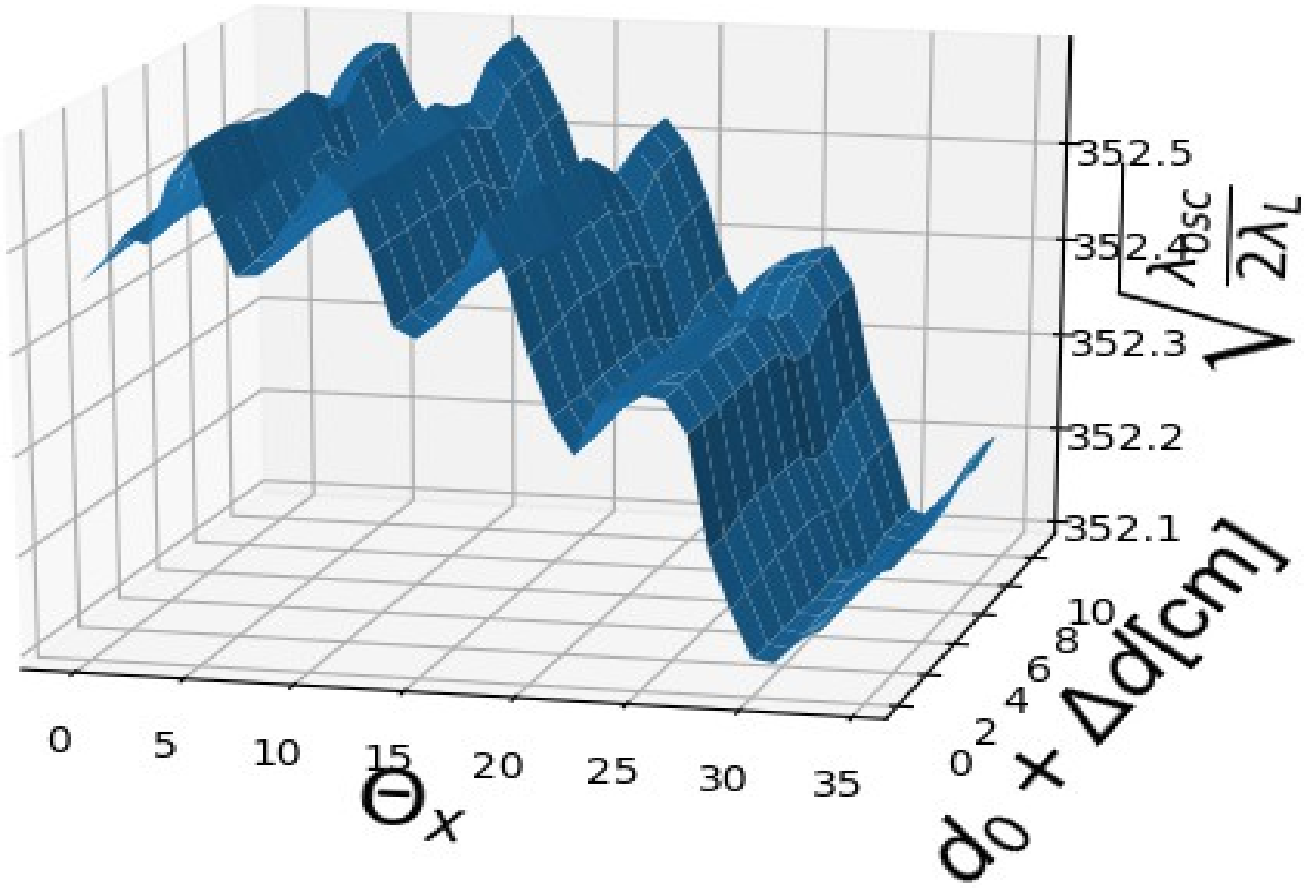
By setting Φ=2π an apparent gamma, „depends“ on the angle

$$\gamma(\Theta) = \sqrt{\frac{\lambda_{osc}}{2\lambda_L}}(\Theta) \propto \sqrt{\frac{1}{1+\Theta^2}}$$

(The real physics is, λosc depends on θ!!)

Gamma is affected by the Pattern

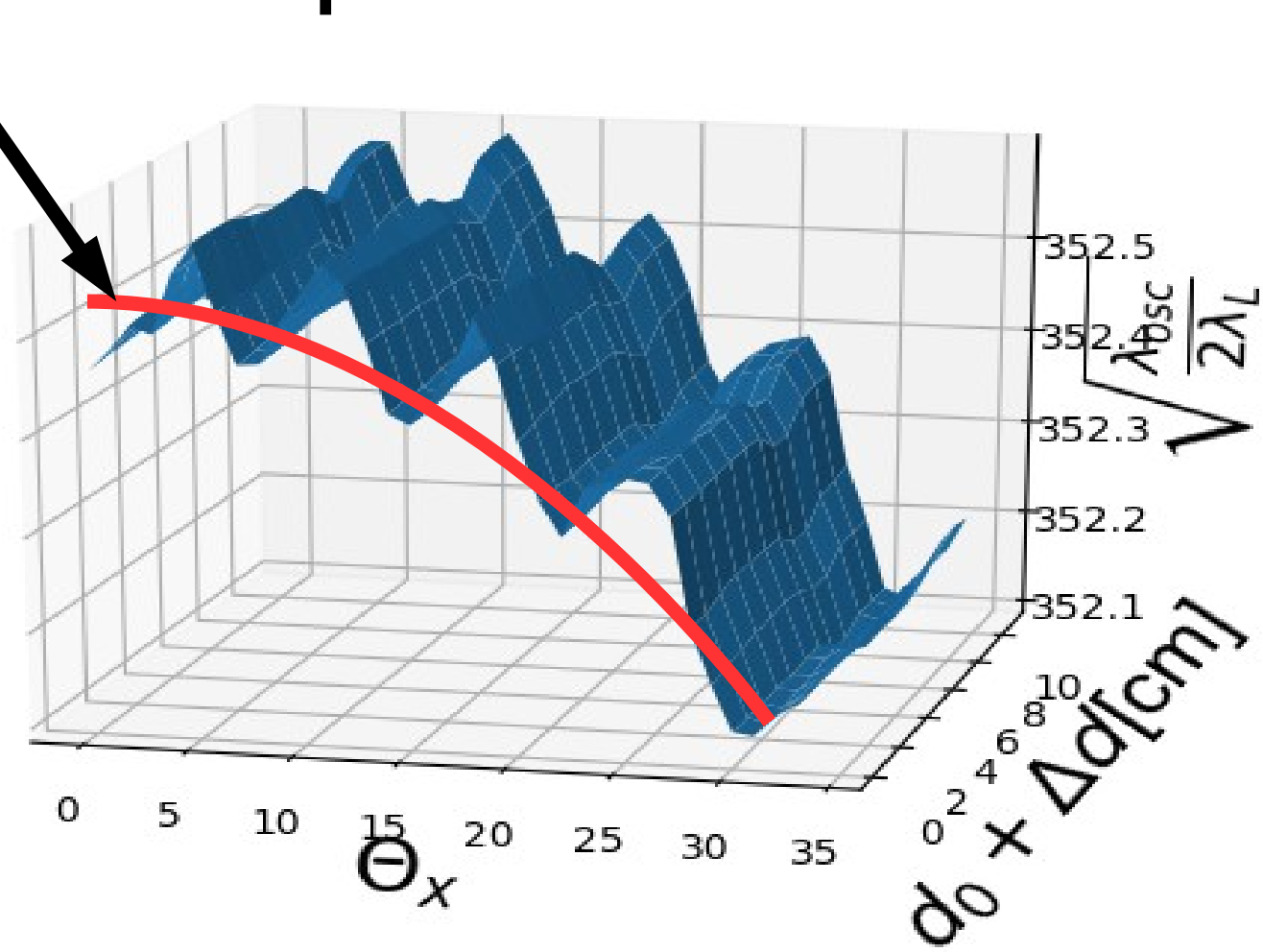
Analysis at one specific wavelength λ_L

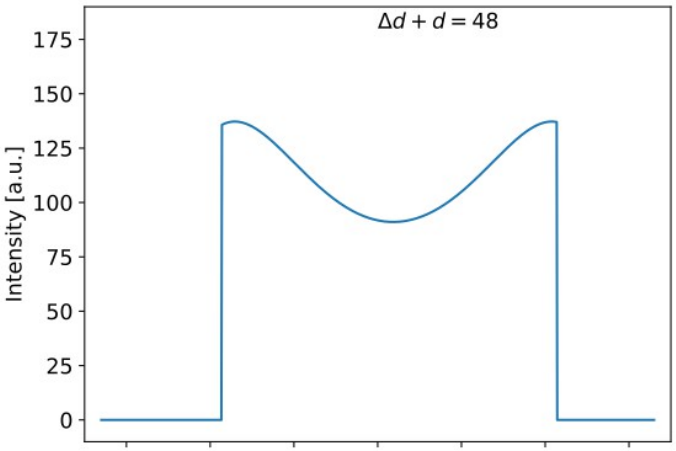


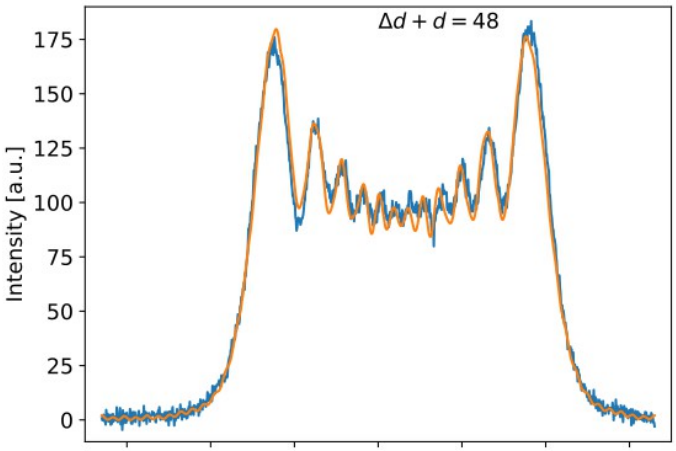
Gamma is affected by the Pattern

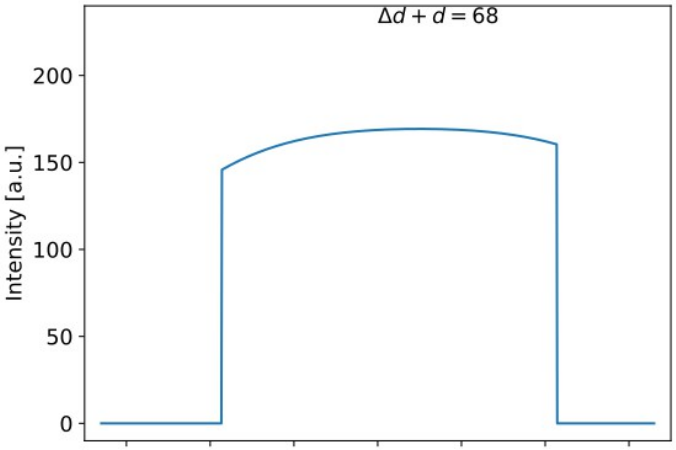
According to the equation it must be monotonic

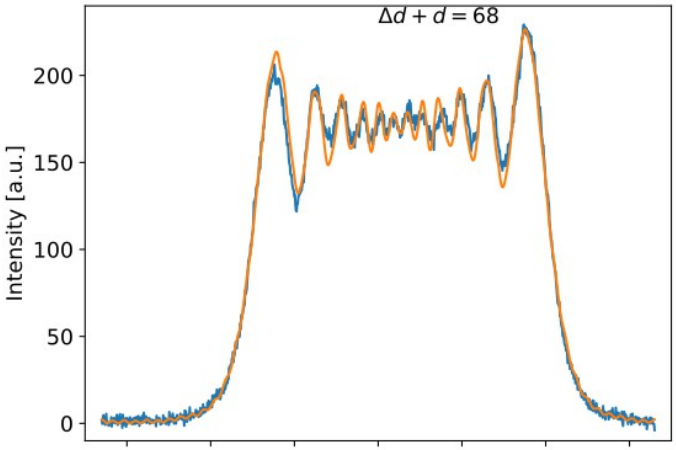
$$\sqrt{\frac{1}{1+\Theta_2^2}}$$

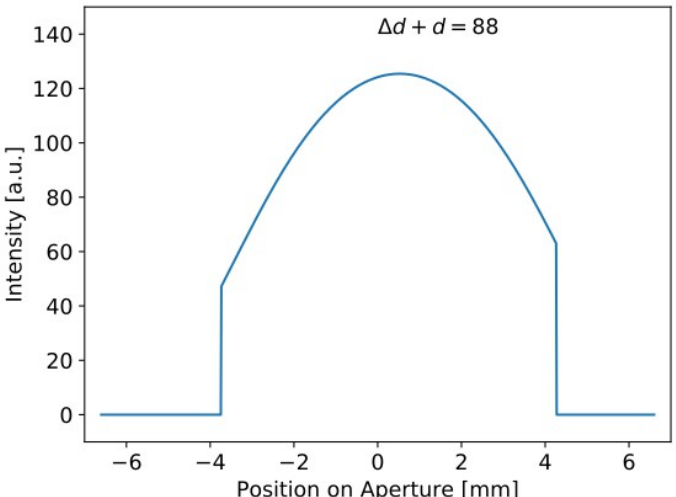


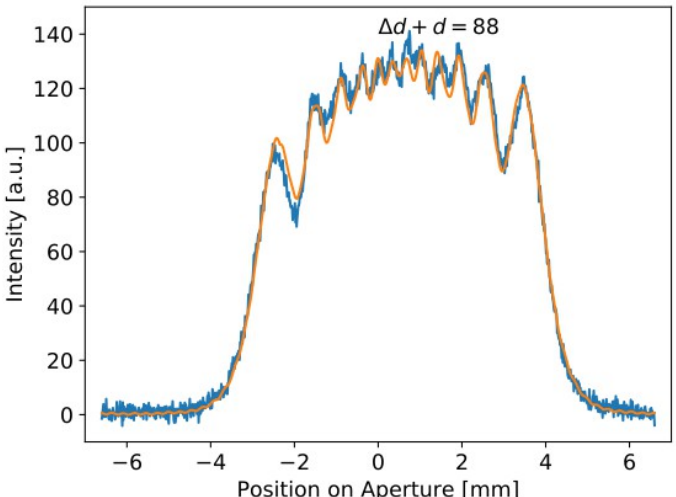

Δd + d = 48
Intensity [a.u.]
175
150
125
100
75
50
25
0

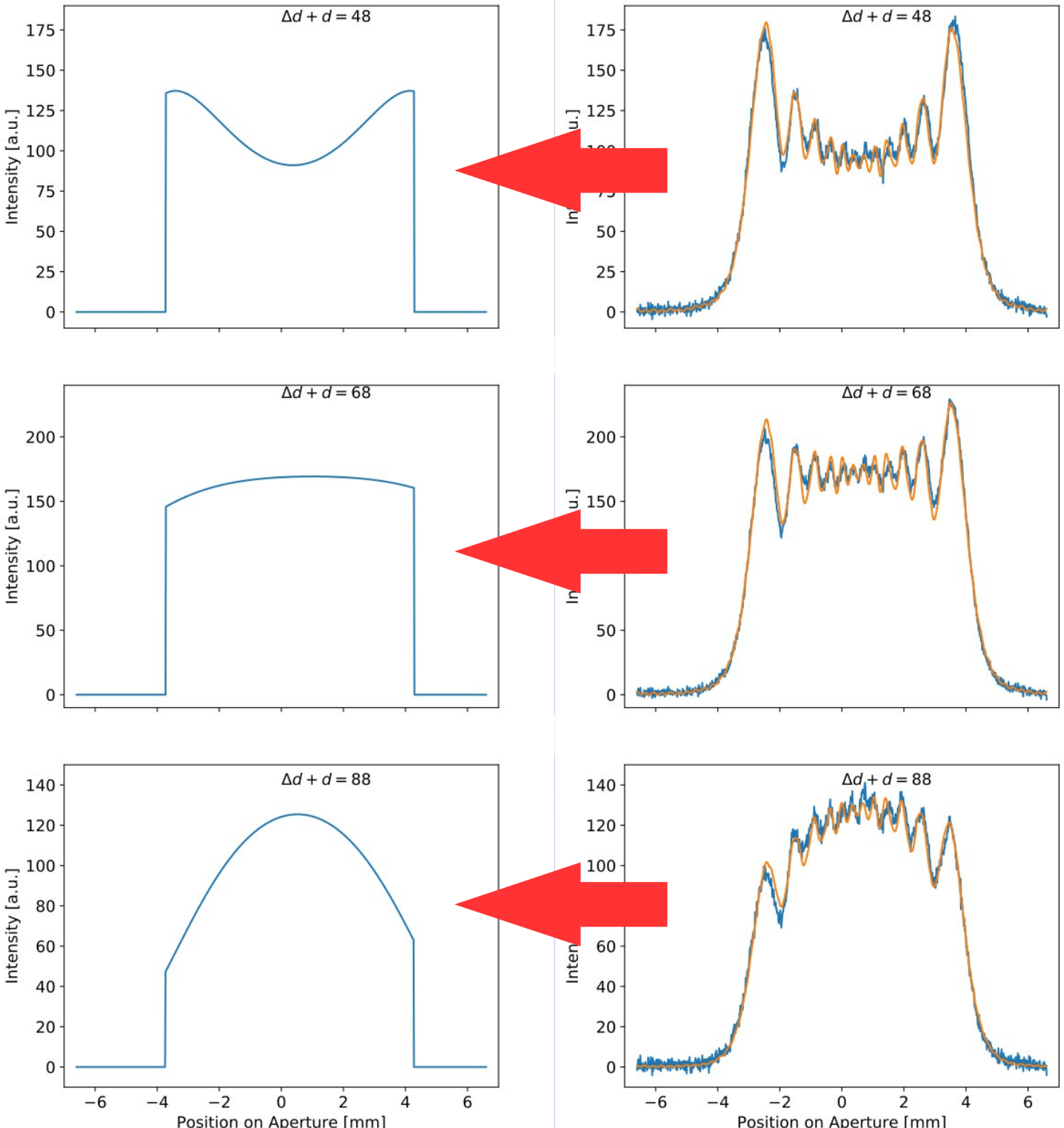

Δd + d = 48
Intensity [a.u.]
175
150
125
100
75
50
25
0


Δd + d = 68
Intensity [a.u.]
200
150
100
50
0

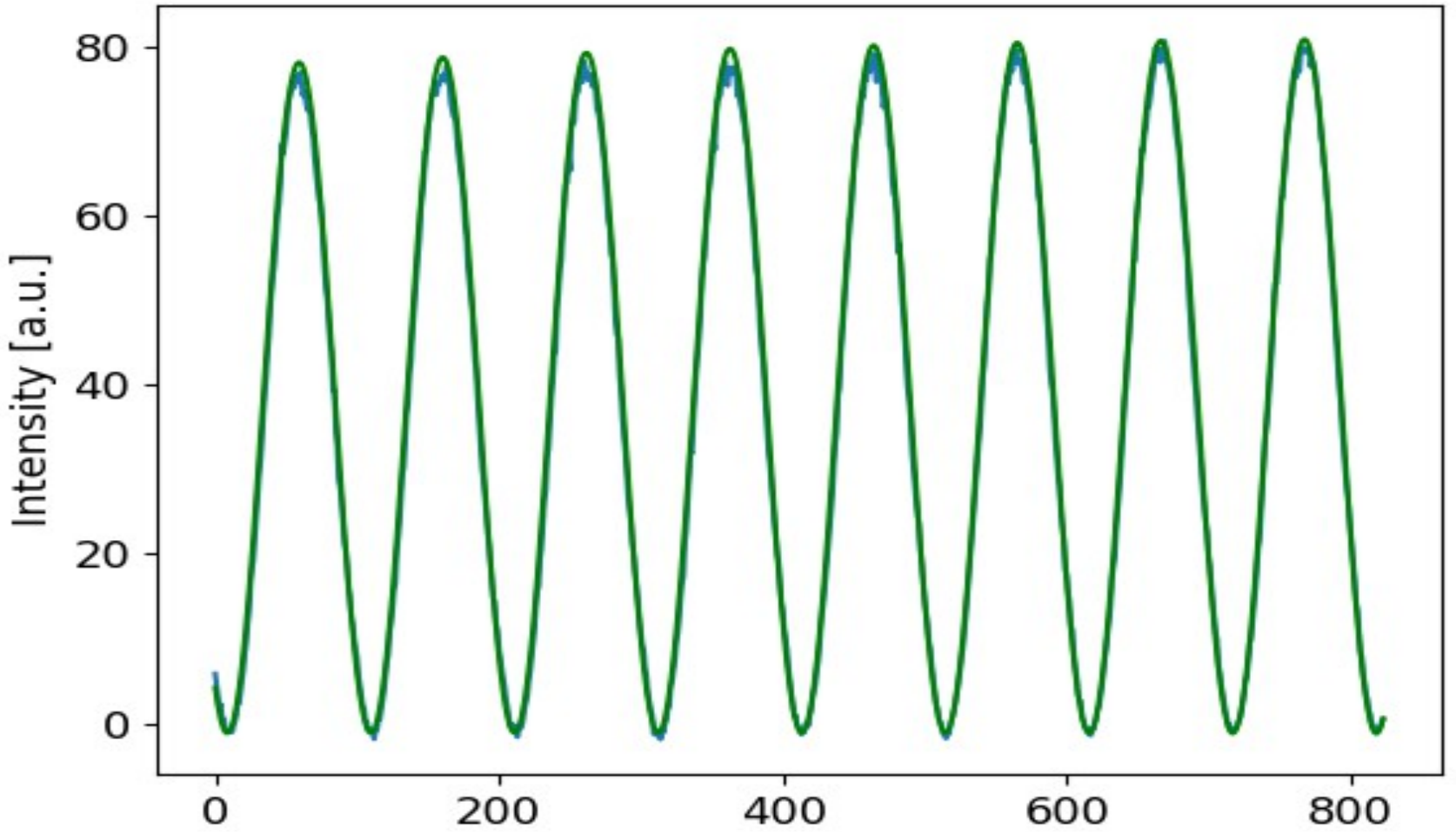

Δd + d = 68
Intensity [a.u.]
200
150
100
50
0


Δd + d = 88
Intensity [a.u.]
140
120
100
80
60
40
20
0
−6
−4
−2
0
2
4
6
Position on Aperture [mm]

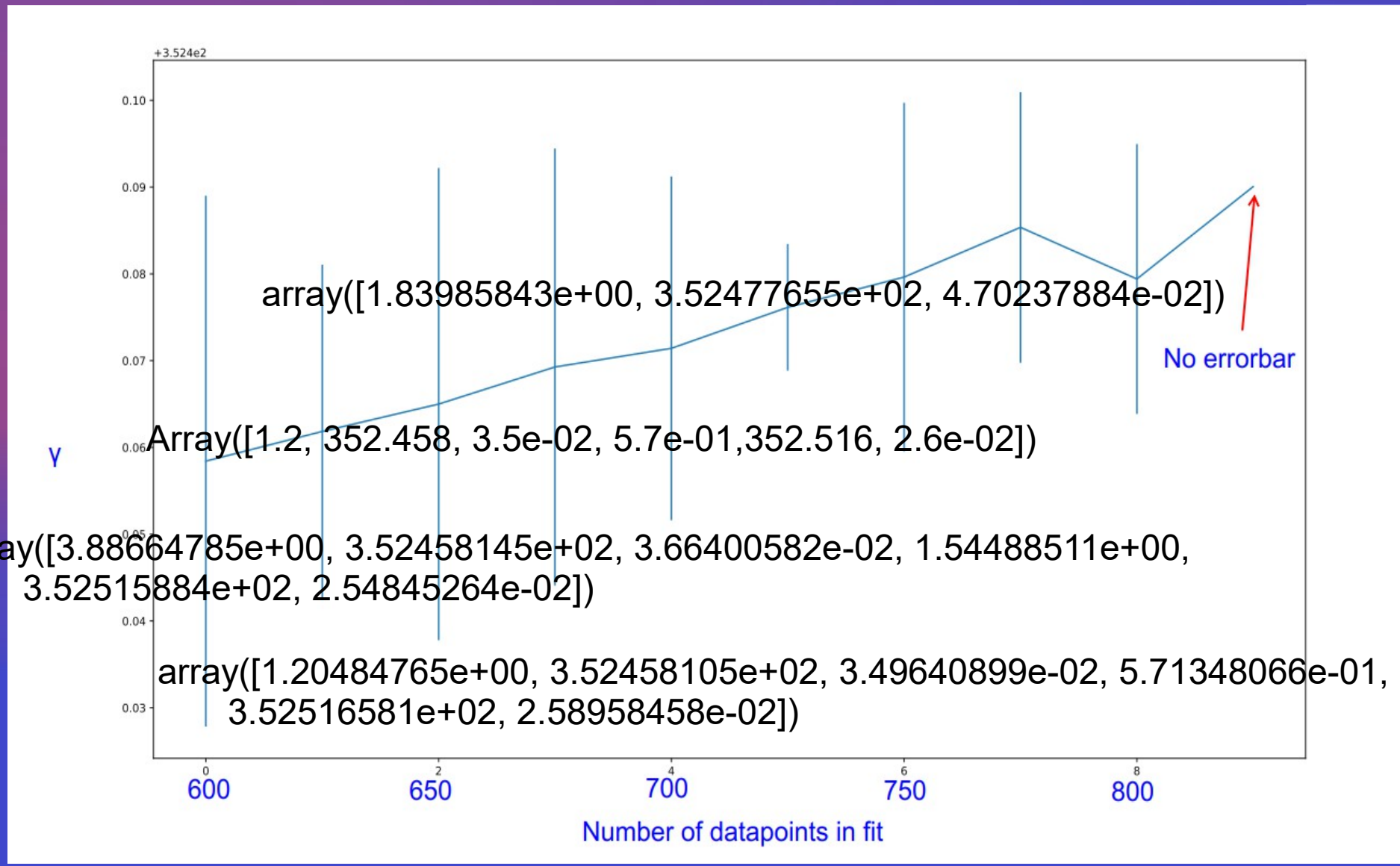

Δd + d = 88
Intensity [a.u.]
140
120
100
80
60
40
20
0
−6
−4
−2
0
2
4
6
Position on Aperture [mm]


Δd + d = 48
Intensity [a.u.]
Δd + d = 68
Intensity [a.u.]
Δd + d = 88
Intensity [a.u.]
Position on Aperture [mm]
Position on Aperture [mm]

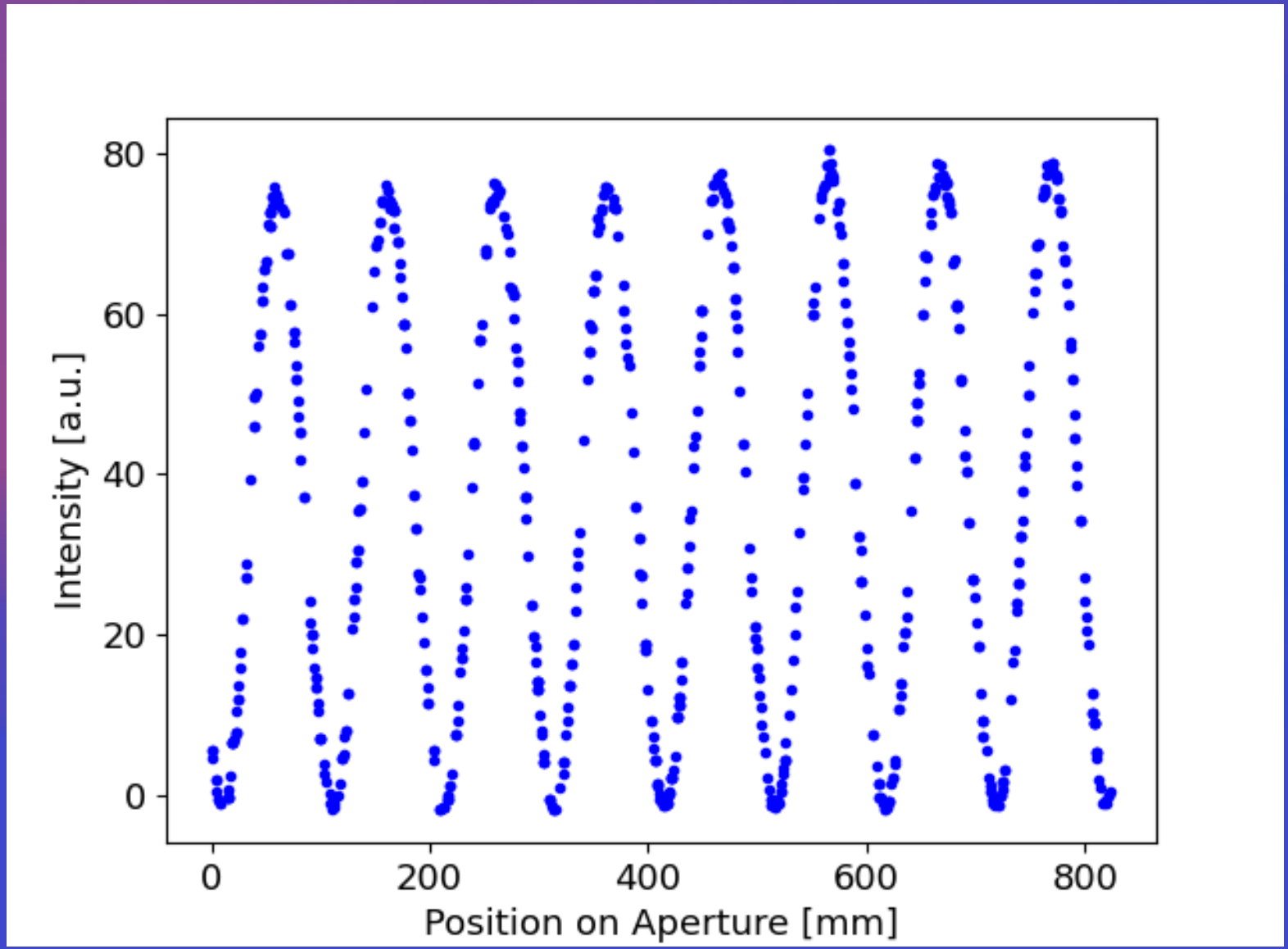
Fitting works but how to determine the error for the fit?



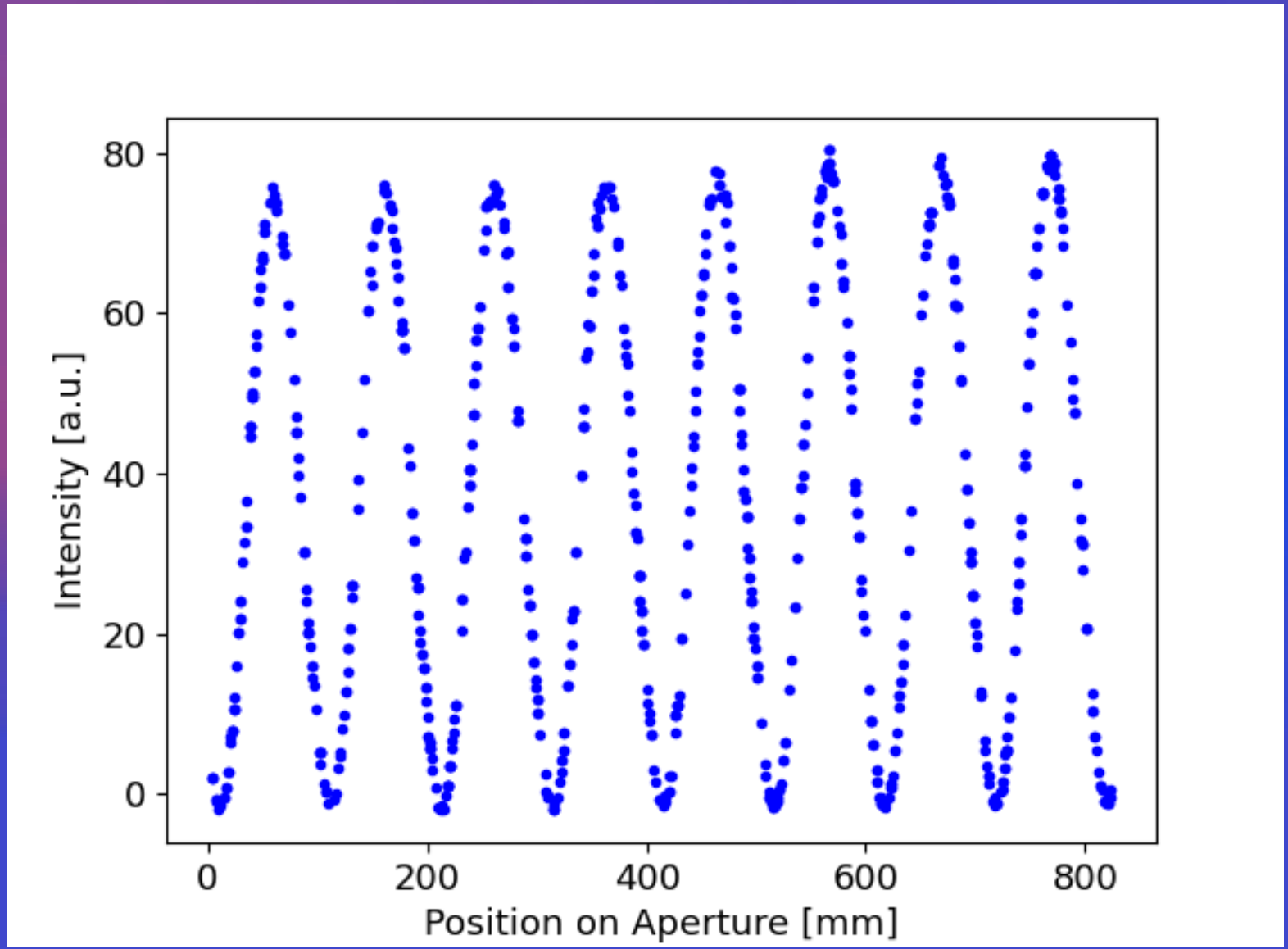
Improvements



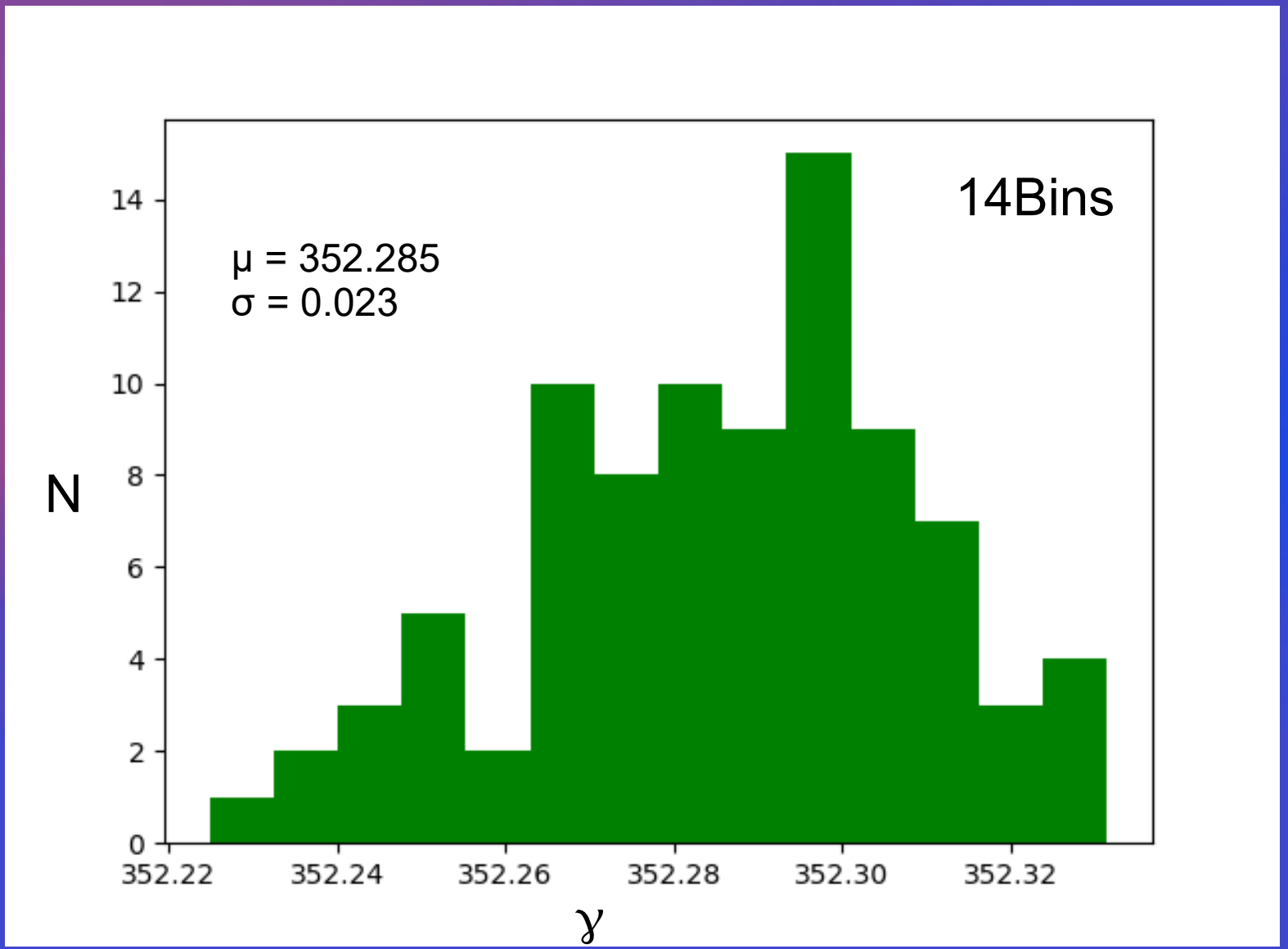
Sample1 825


Intensity [a.u.]
0
20
40
60
80
0
200
400
600
800
Position on Aperture [mm]

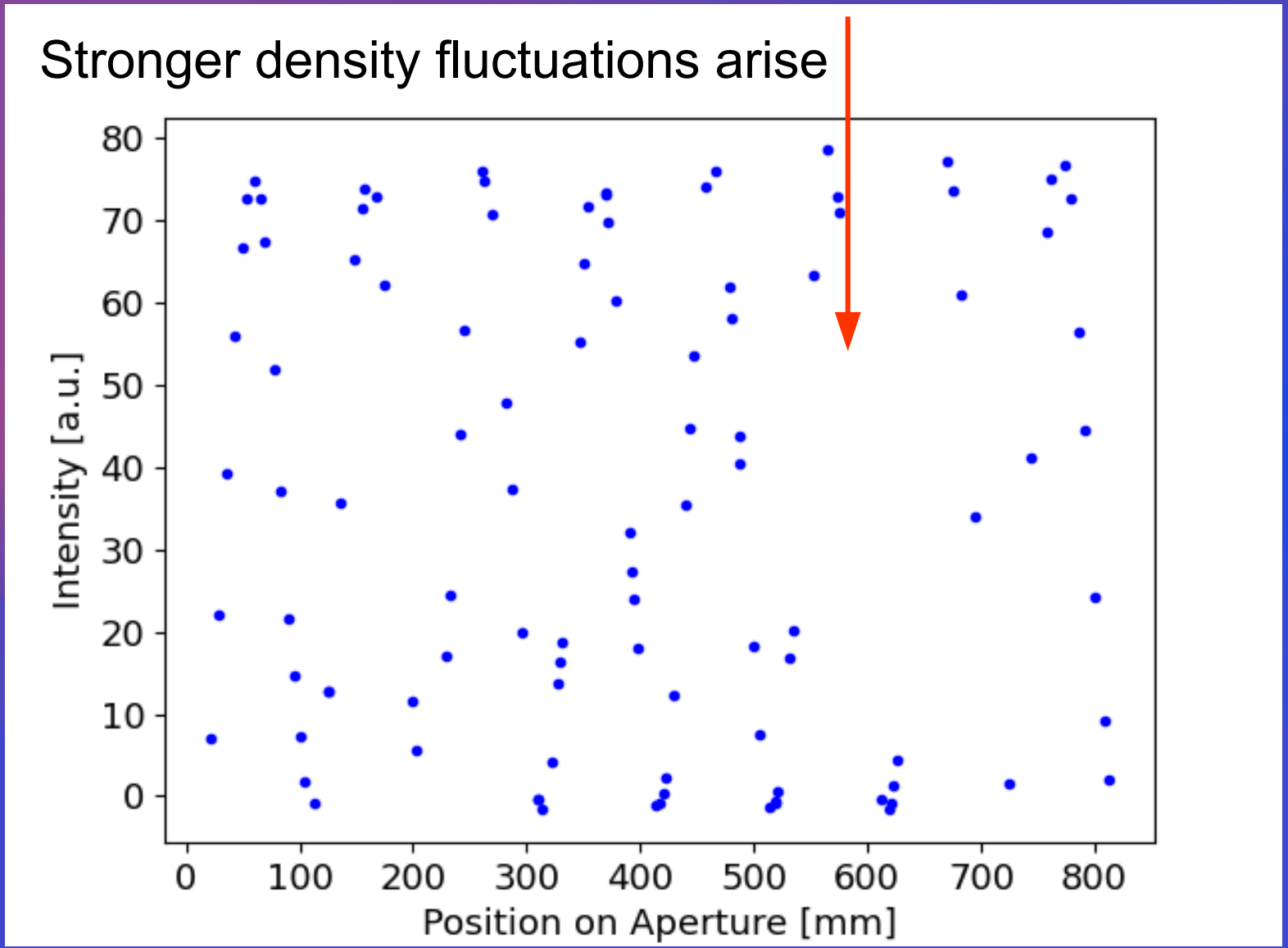
Sample2 825


Intensity [a.u.]
0
20
40
60
80
0
200
400
600
800
Position on Aperture [mm]

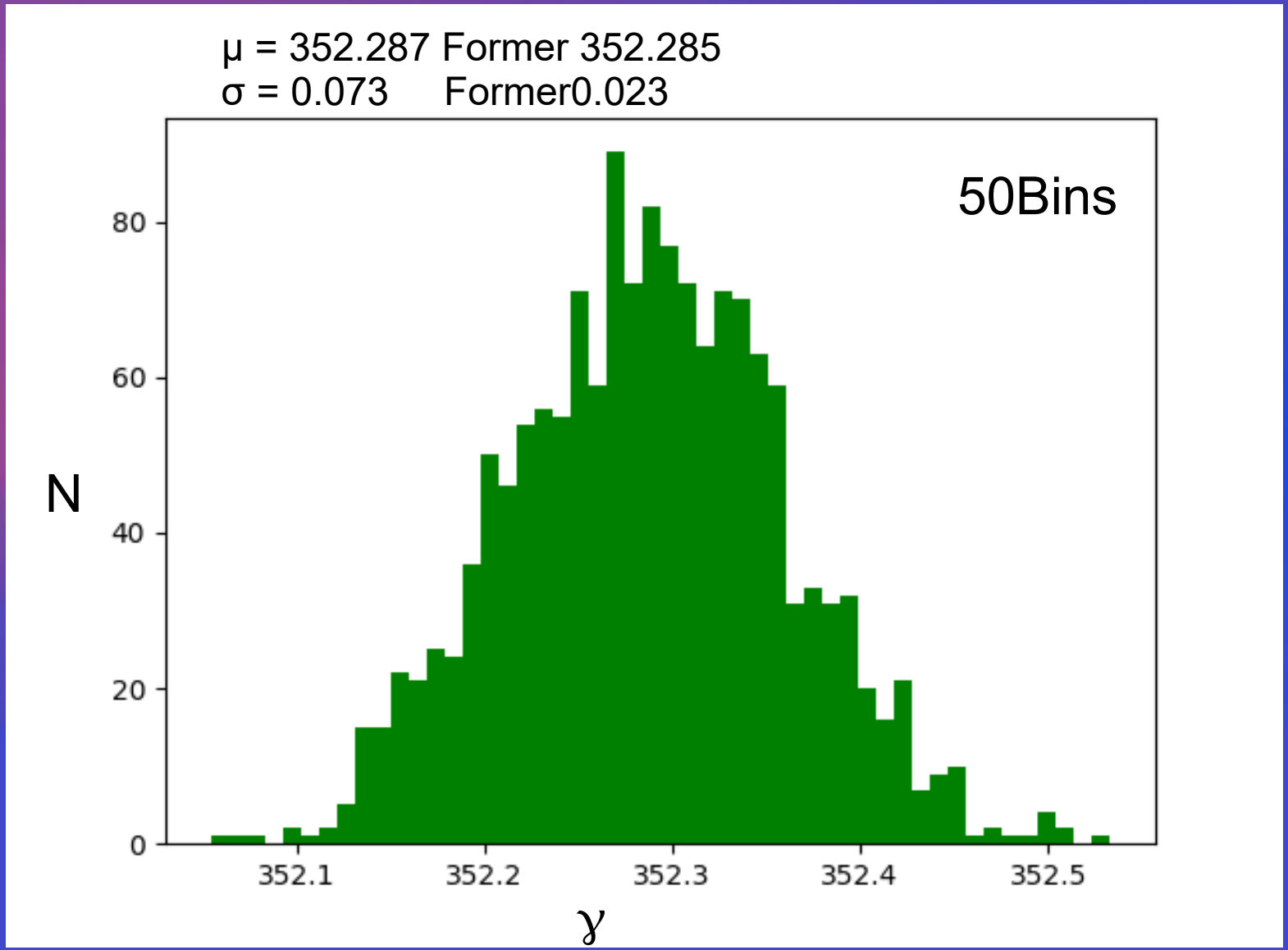
Histogram 825 samples and 825p



Stresstest Sample2 100

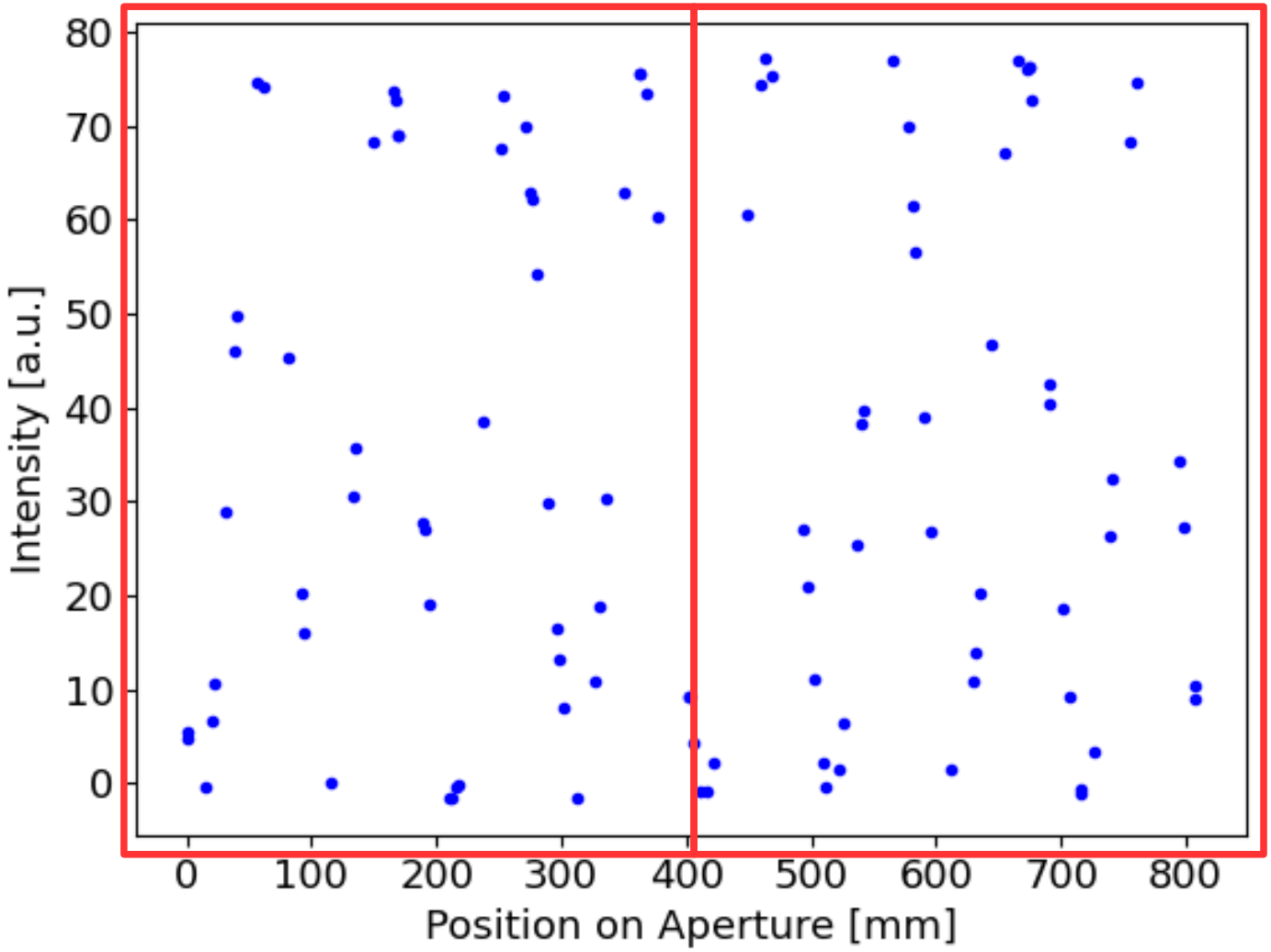


Histogram 100 samples and 825p

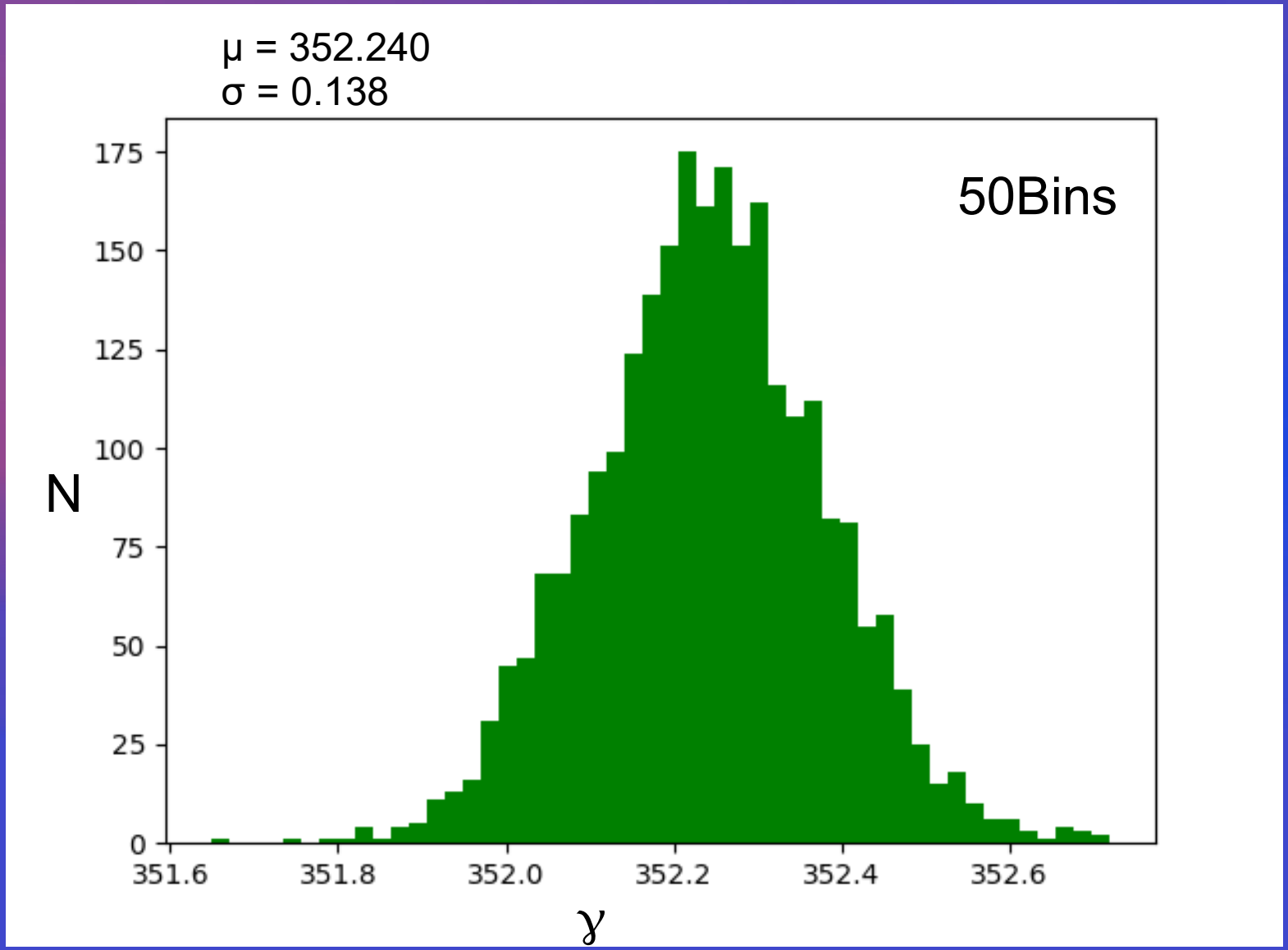


More stressy test Sample 50:50

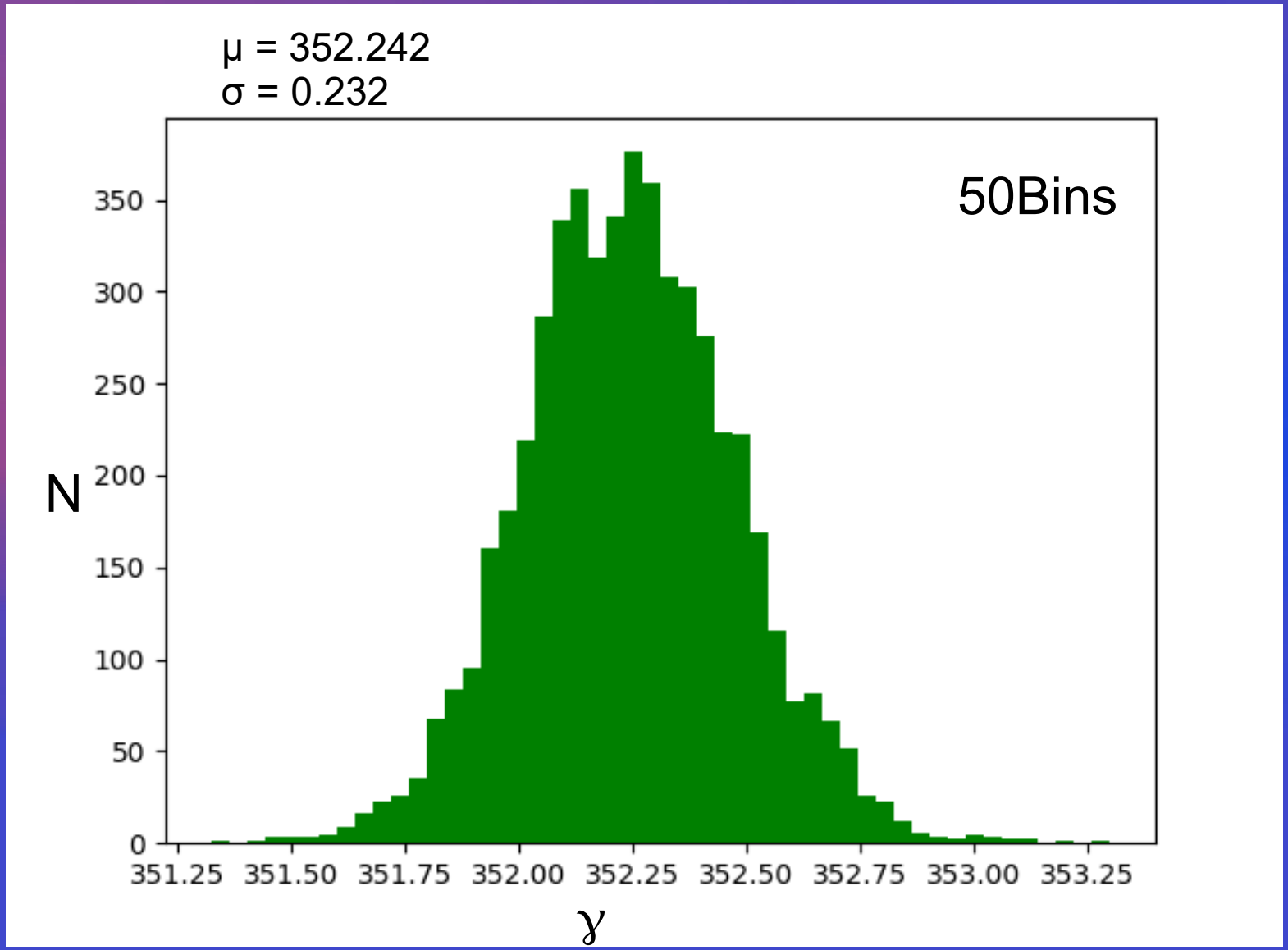
50 Data points are only inside [0,400]
50 Data points are only inside [400,825]



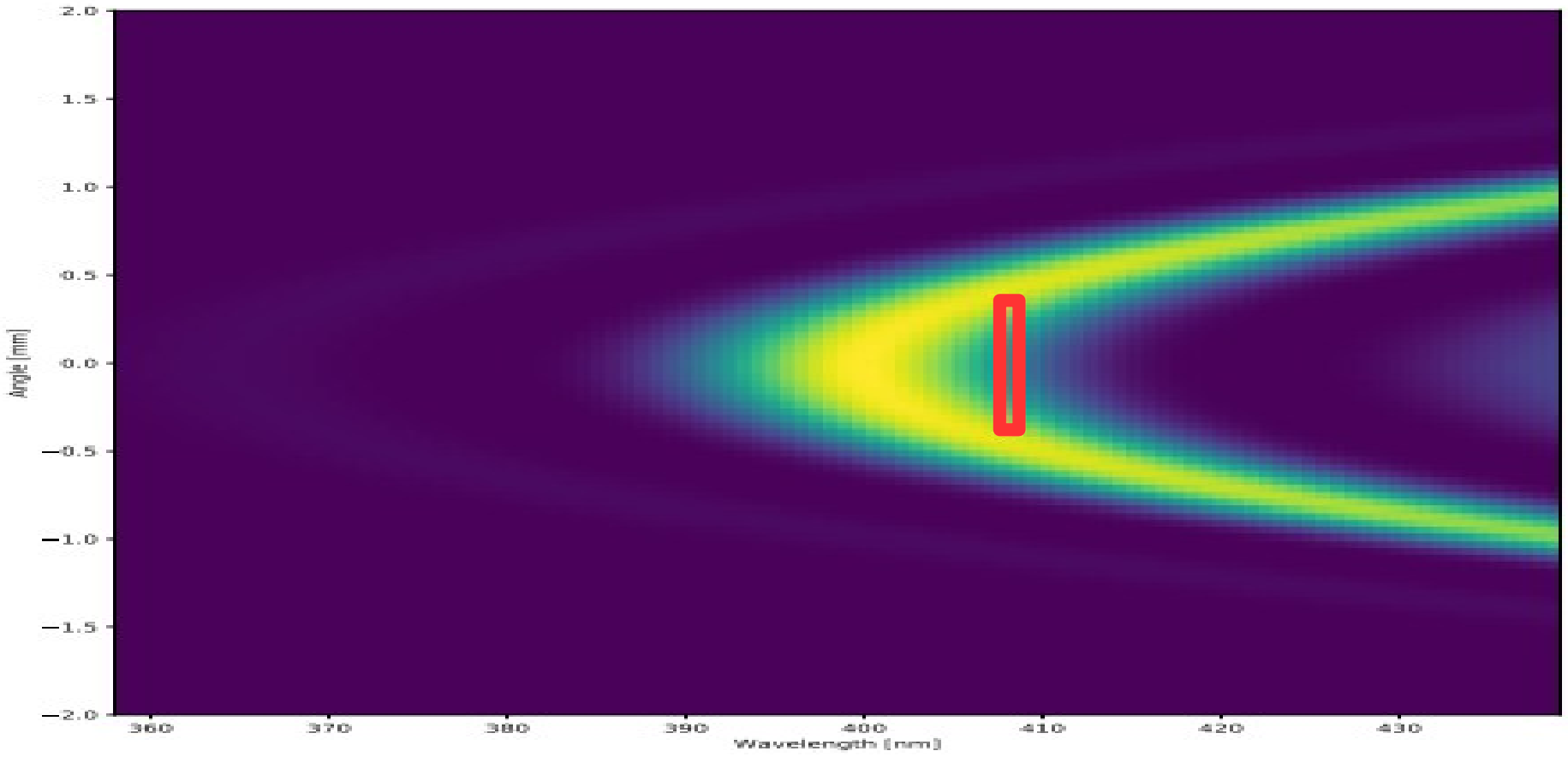
Histogram 50 samples and 400p



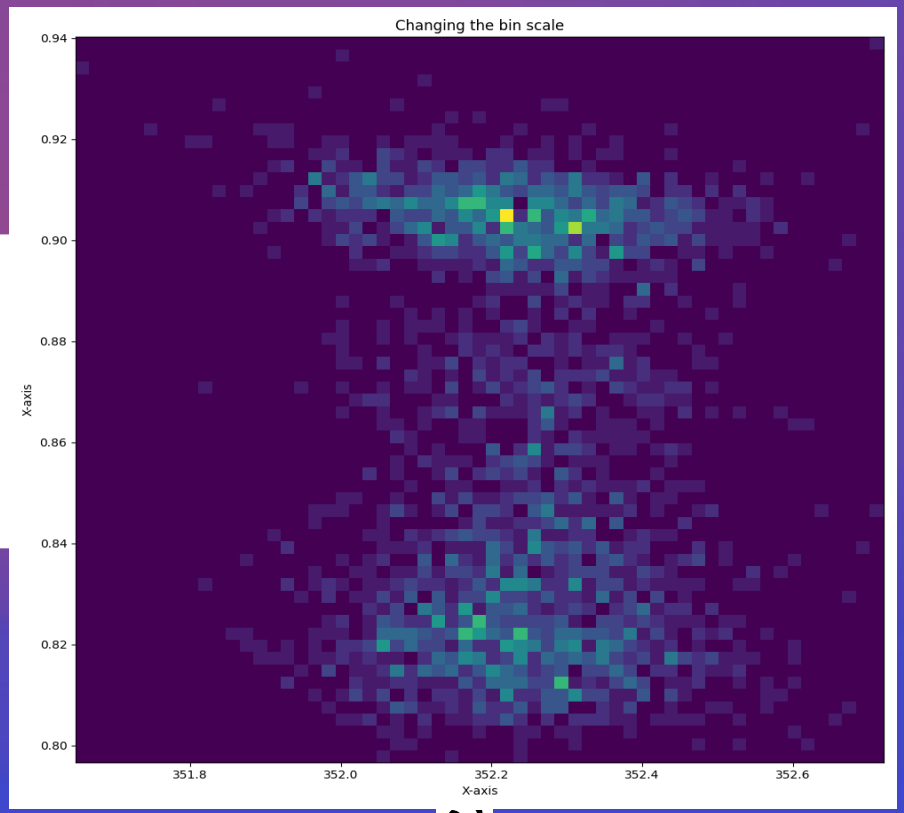
Histogram 50 samples and 425p



Thank you for you attention

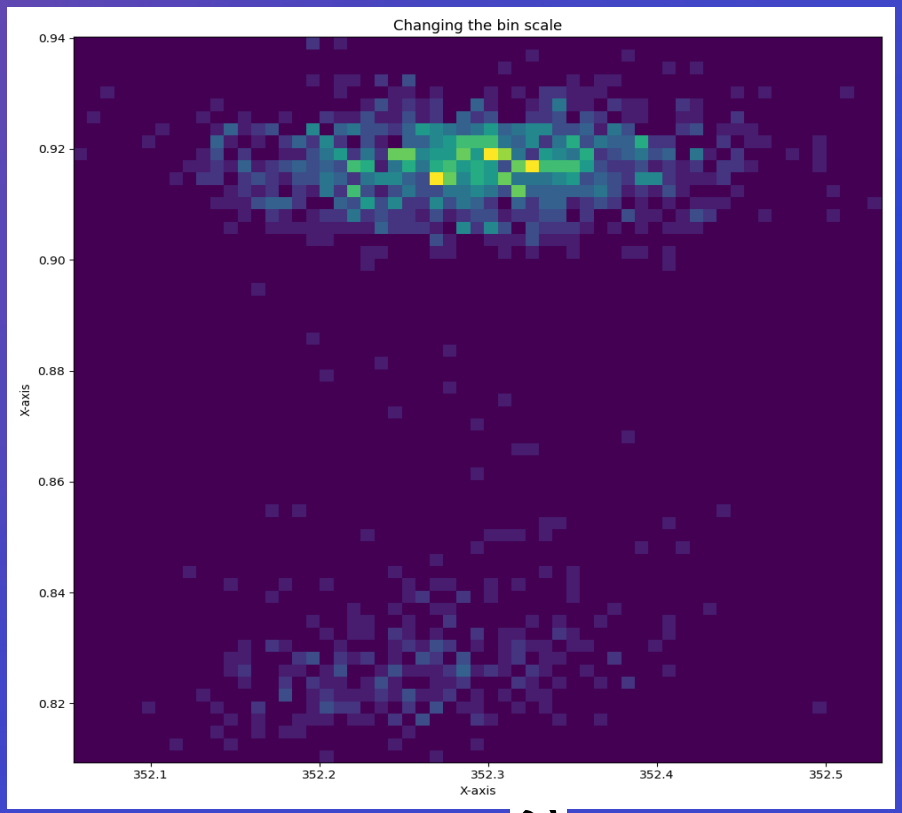


Histogram 50 samples and 400p



Amplitude

y



y