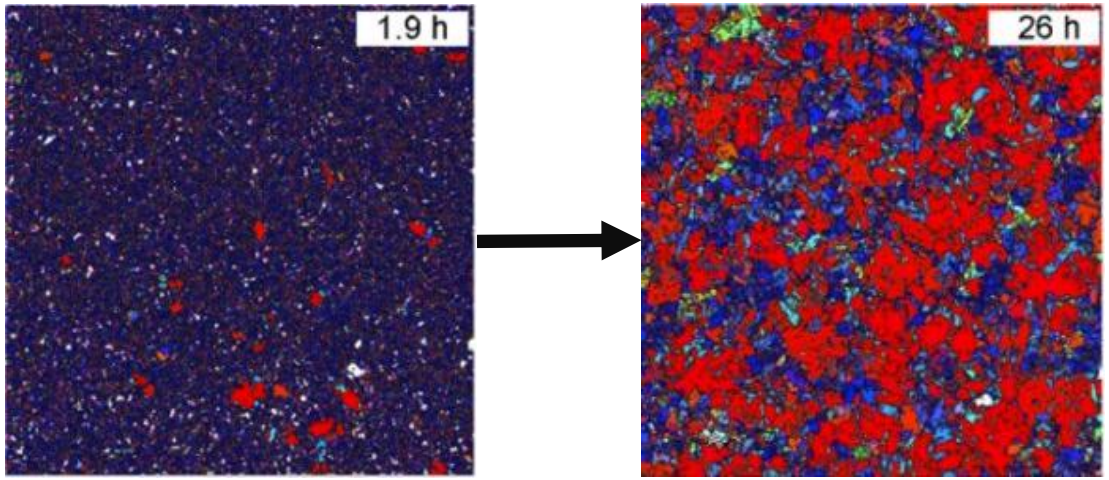
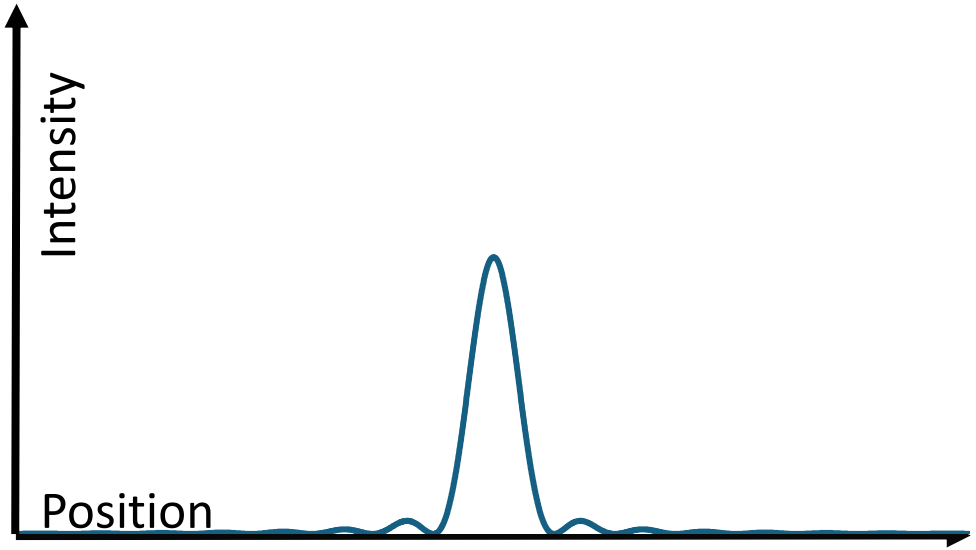
Houghton University's Phase Shifting Laser Interferometer for the Study of Thin Metal Films

Luke Yelle

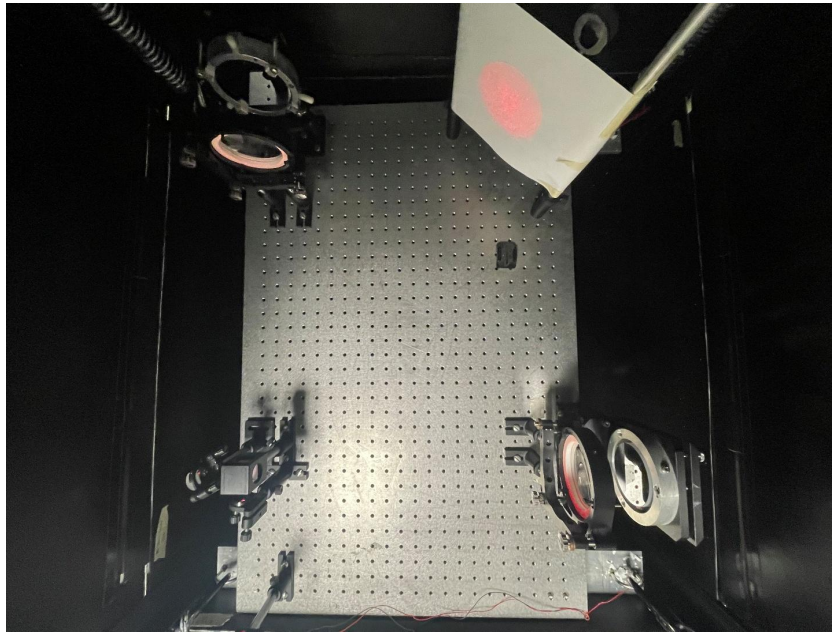
Overview



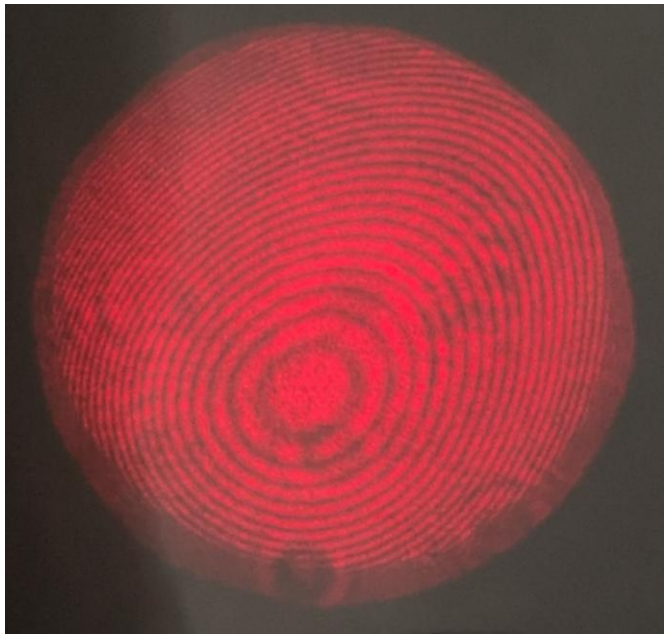
Thin Metal Films



Light Interference

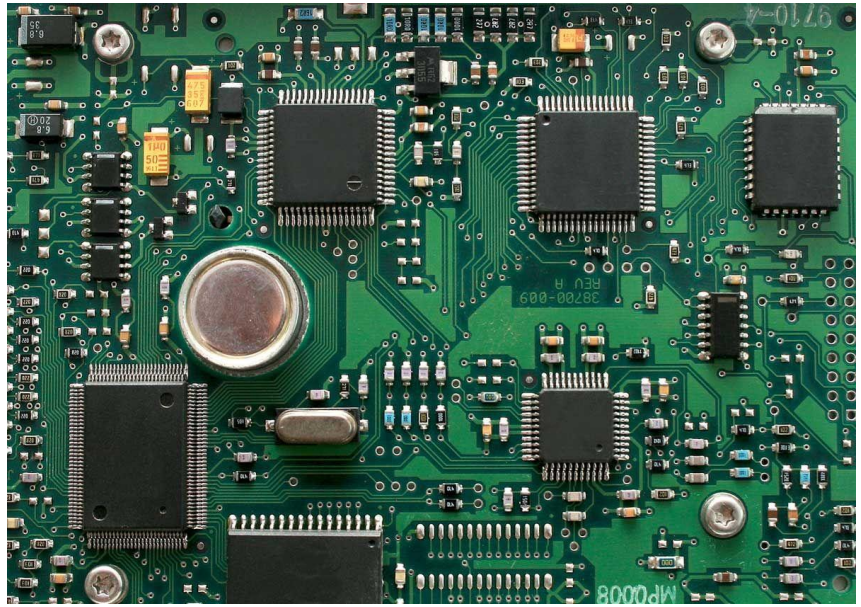


Houghton's Interferometer



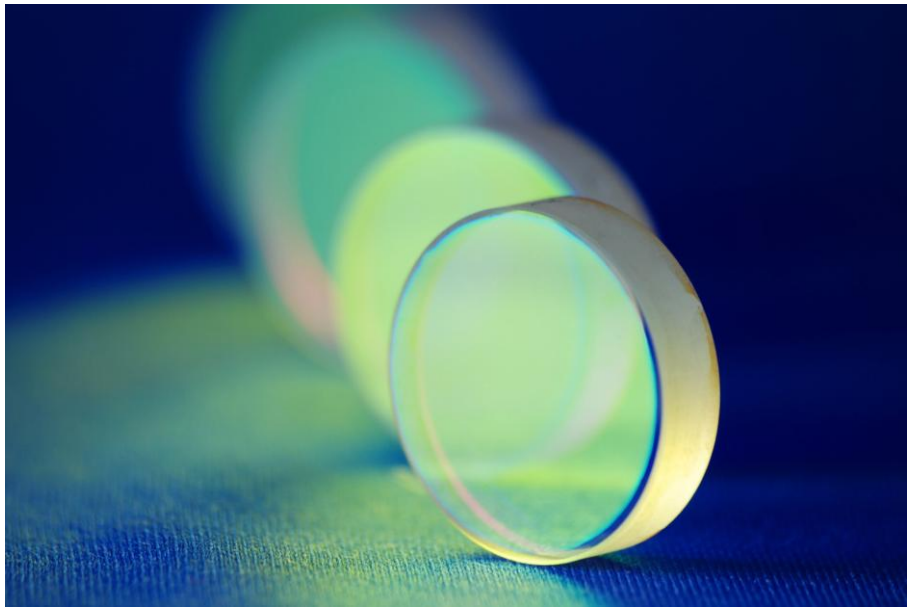
Data Collection and Analysis

Thin Metal Films – why do we care?



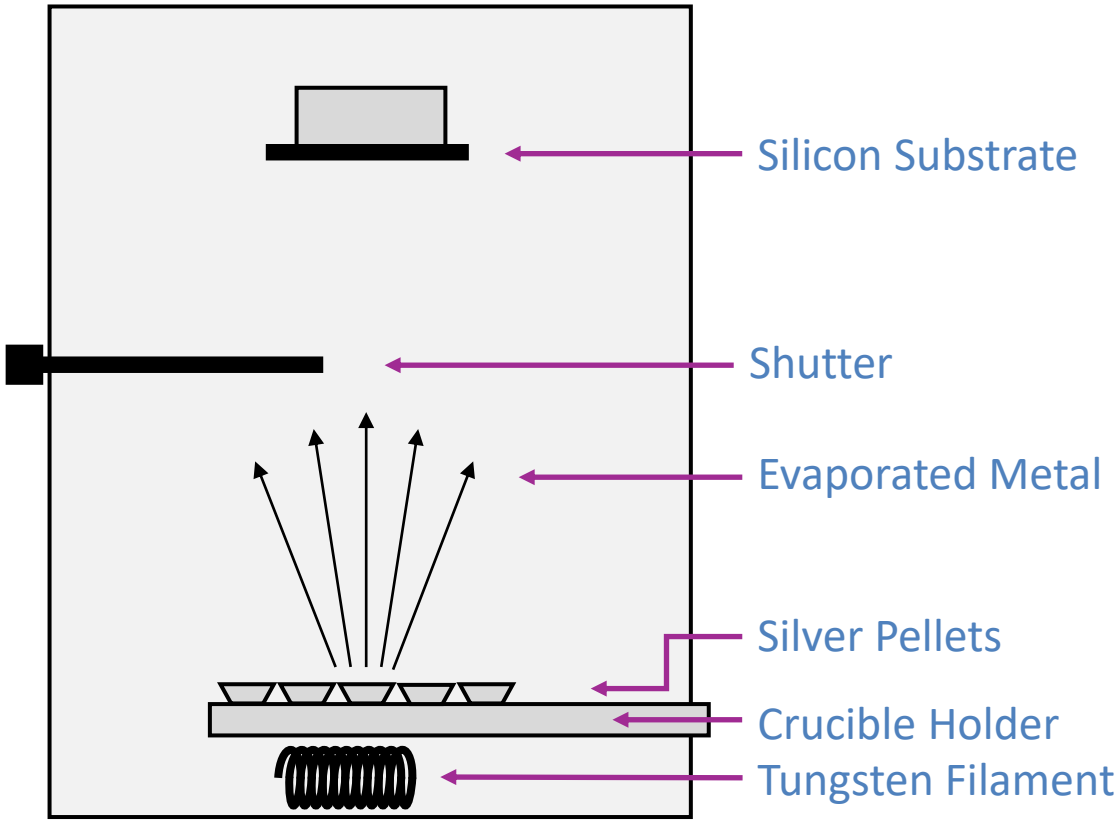
Electronics

Solar Cells

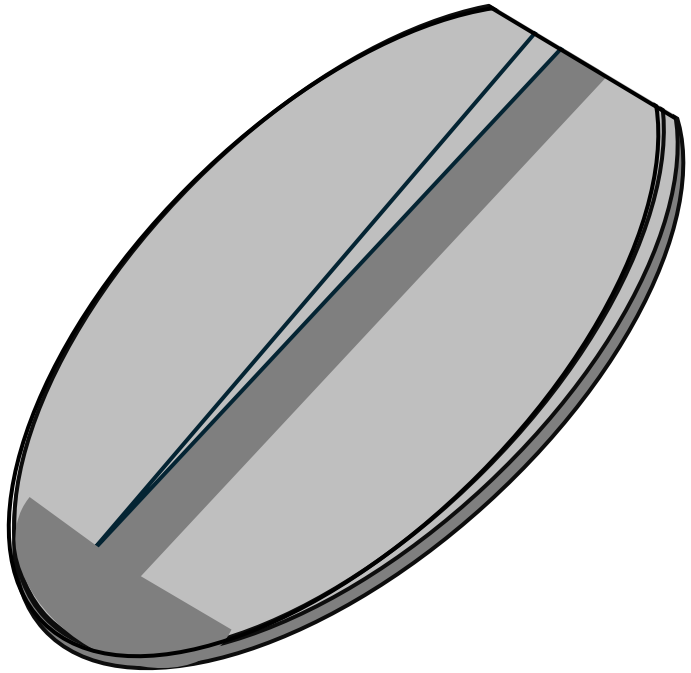


Optic coatings

Thin Metal Films – creation

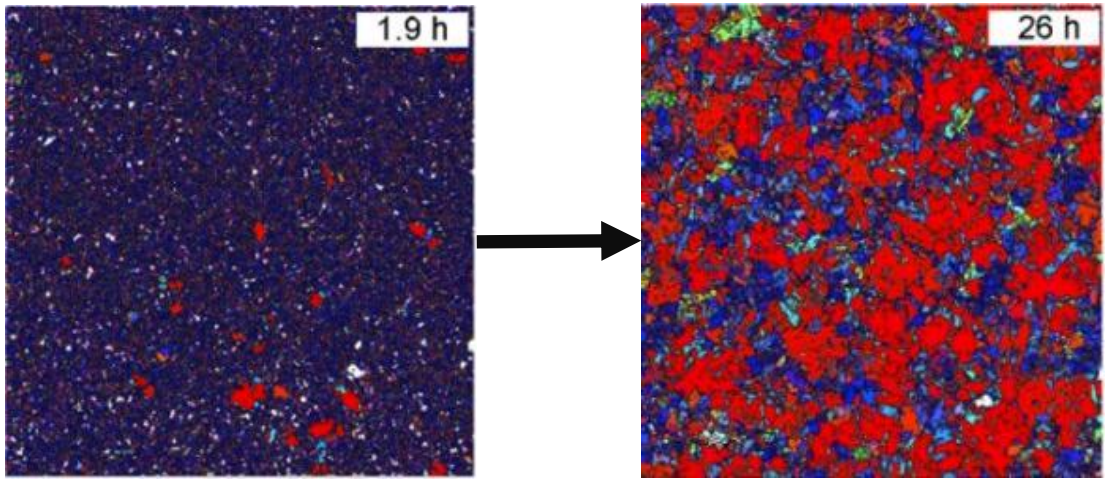


Physical Vapor Deposition Chamber



The Thin Films

Thin Metal Films - transformation



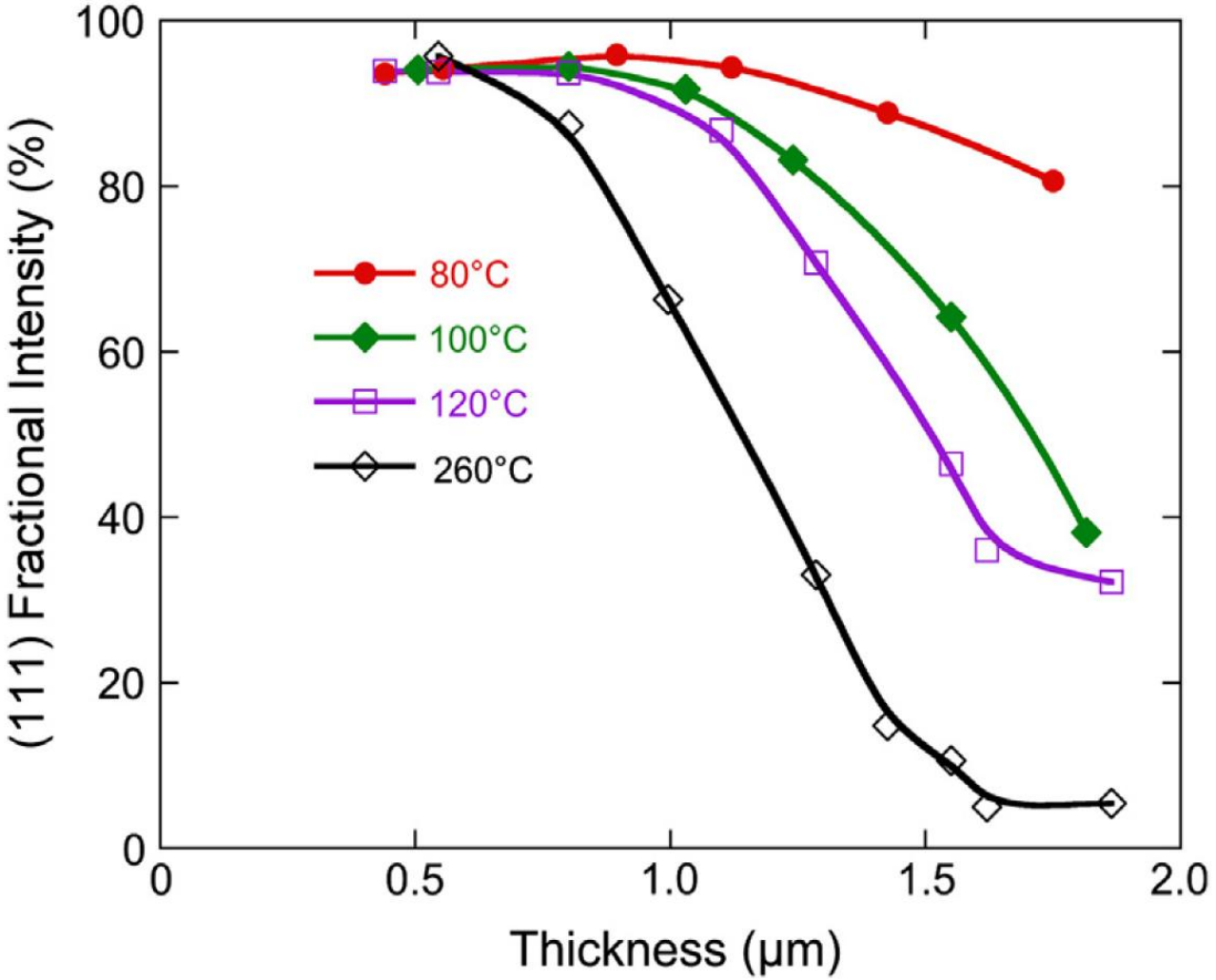
initial film

After annealing

Texture Transformation

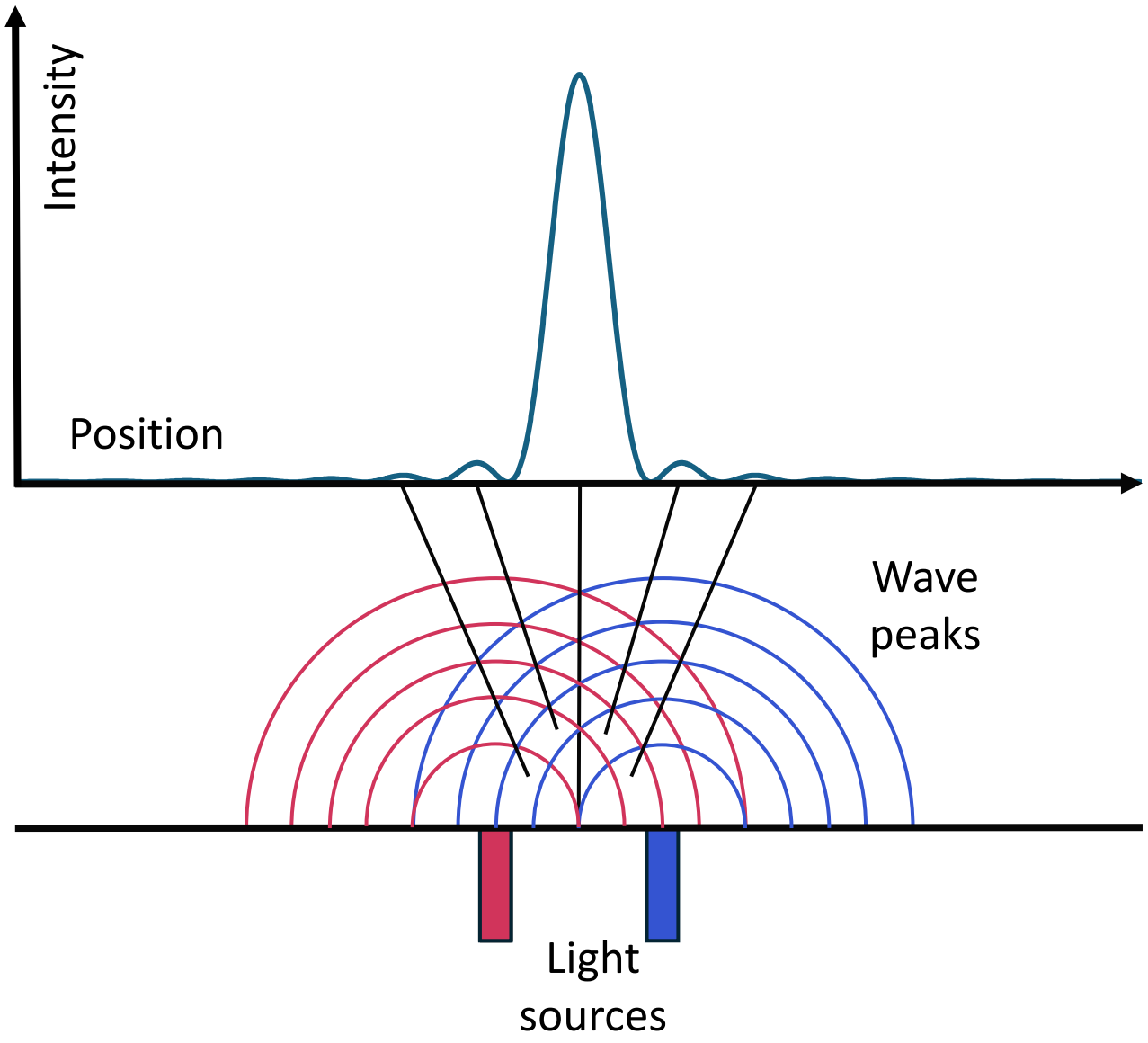
Blue = <111>

Red = <100>

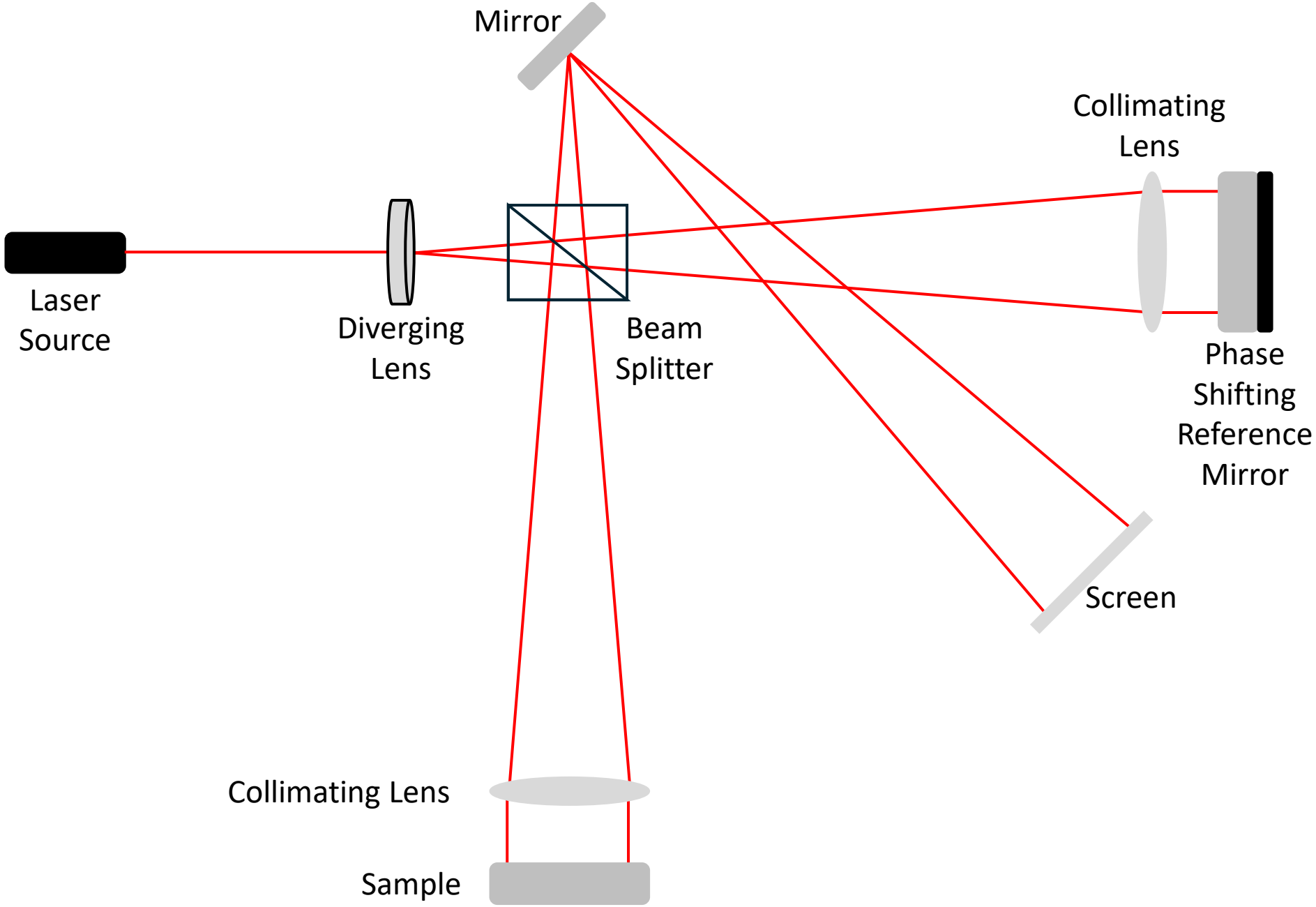


How do we measure the thickness?

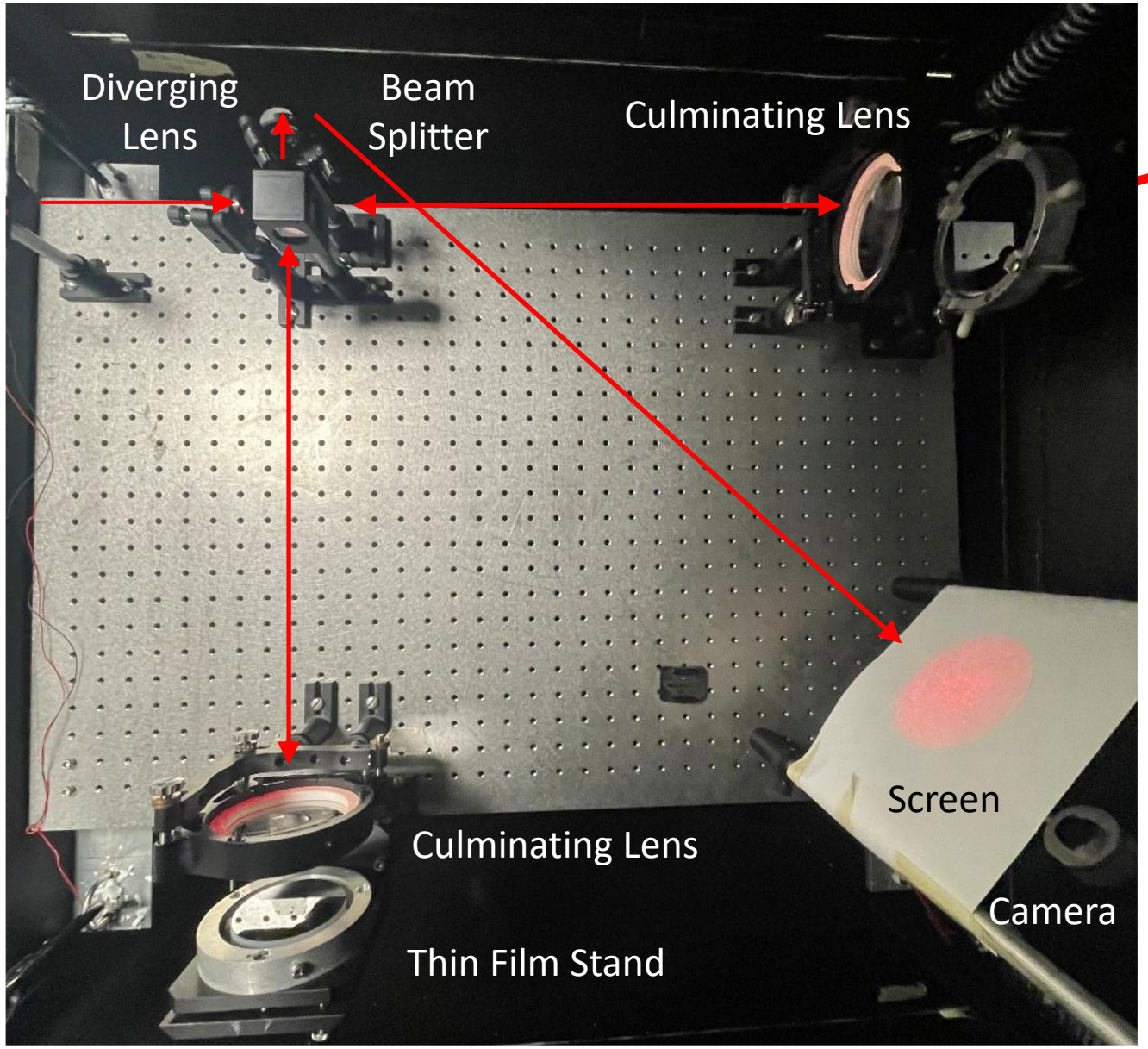
Light Interference



Houghton's Interferometer – Phase Shifting Laser Interferometer



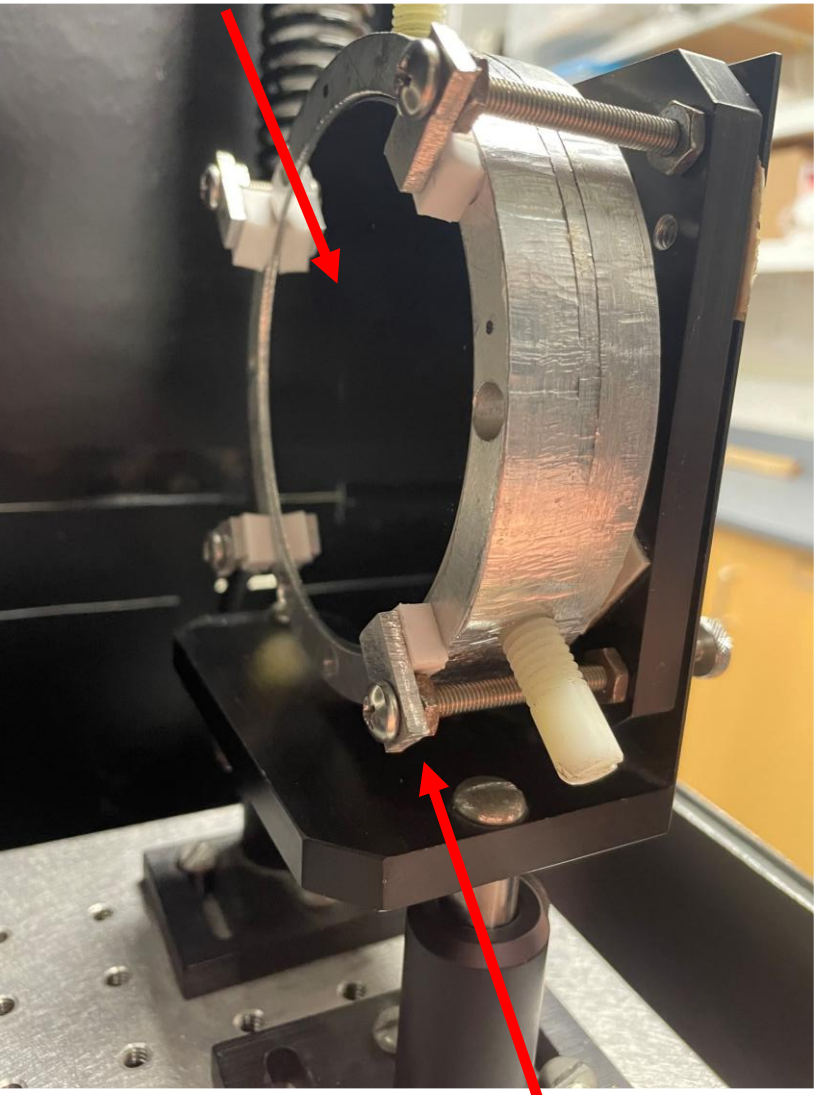
Houghton's Interferometer

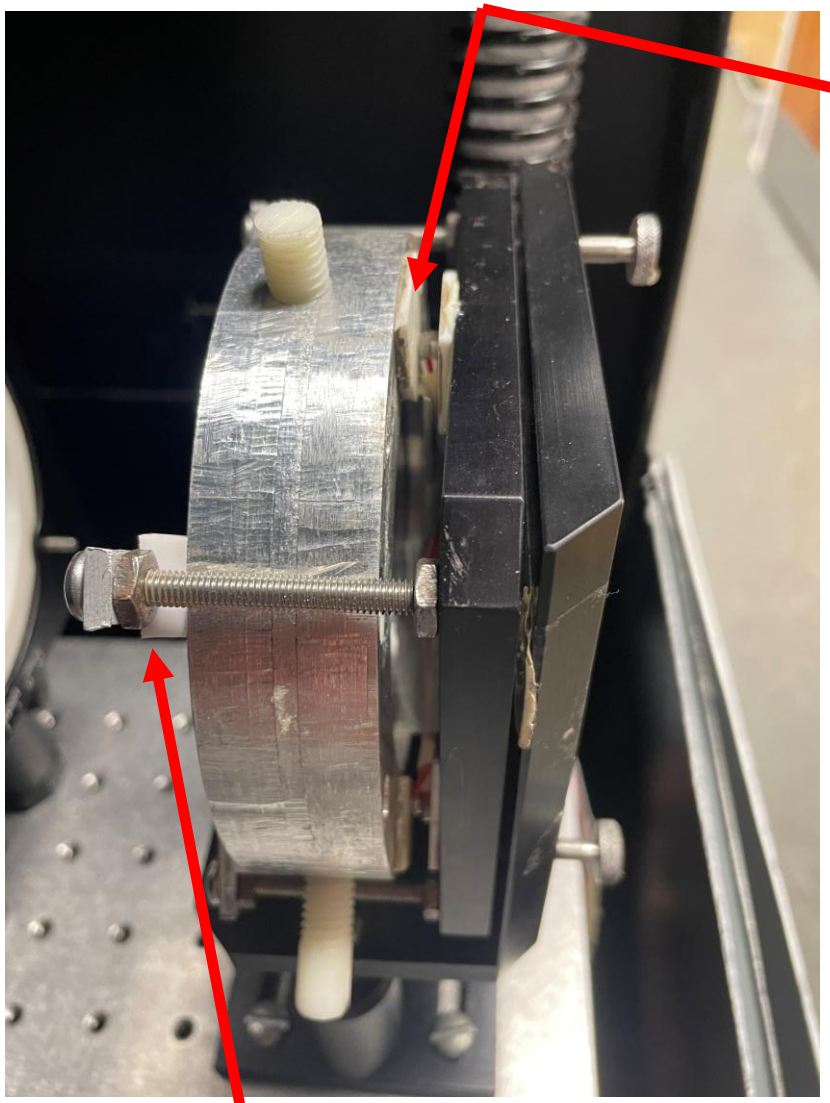


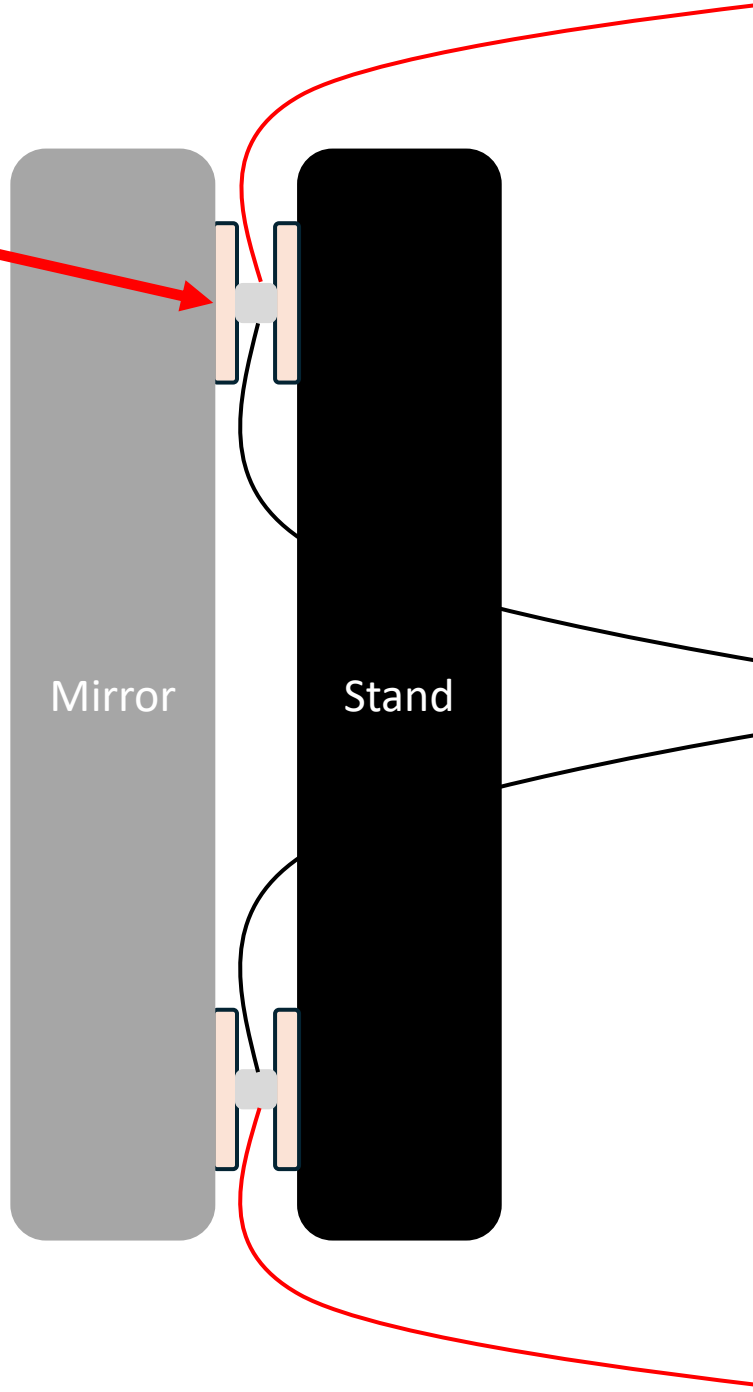
Phase Shifting Reference Mirror

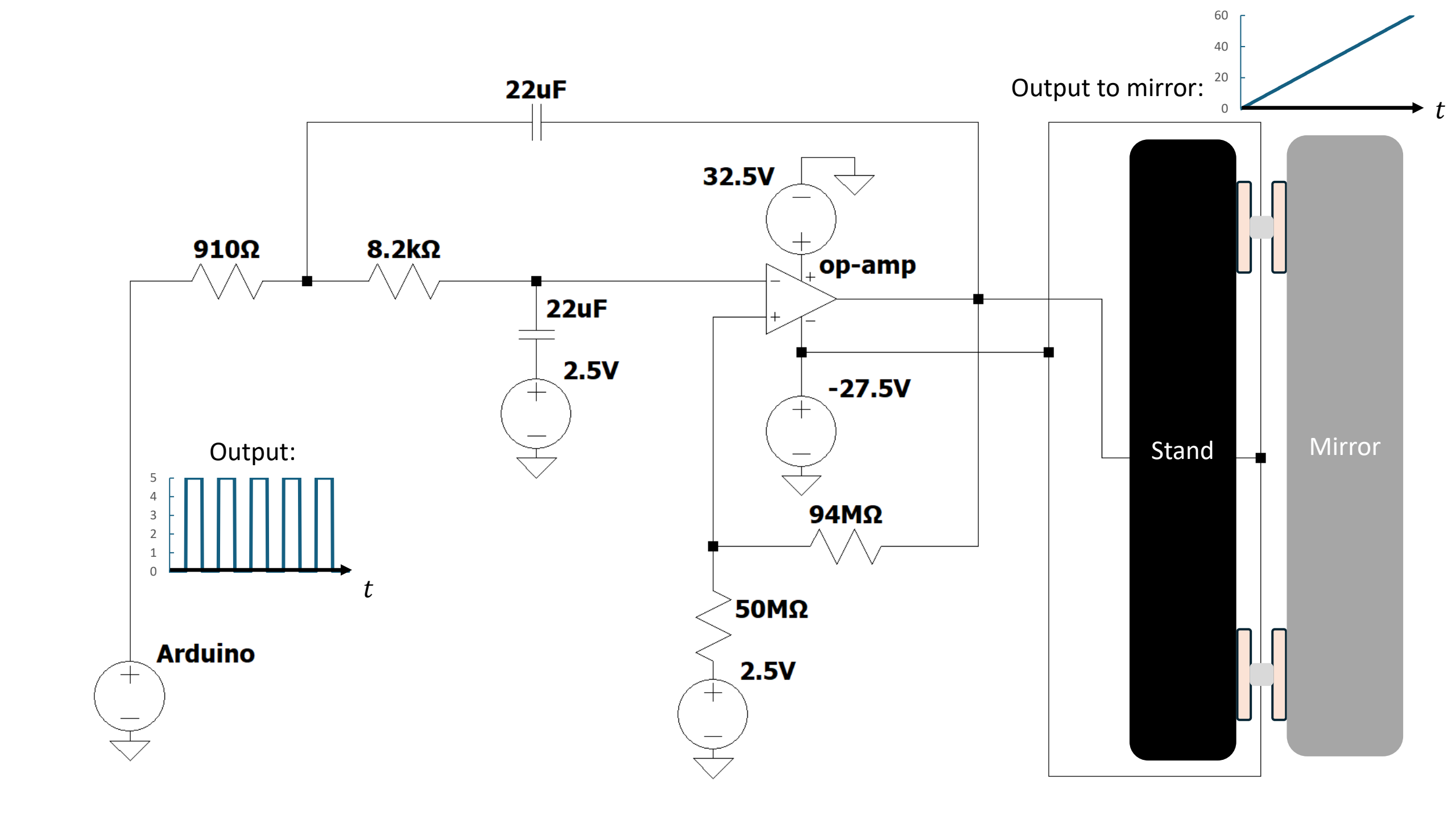
springs

Phase Shifting Mirror

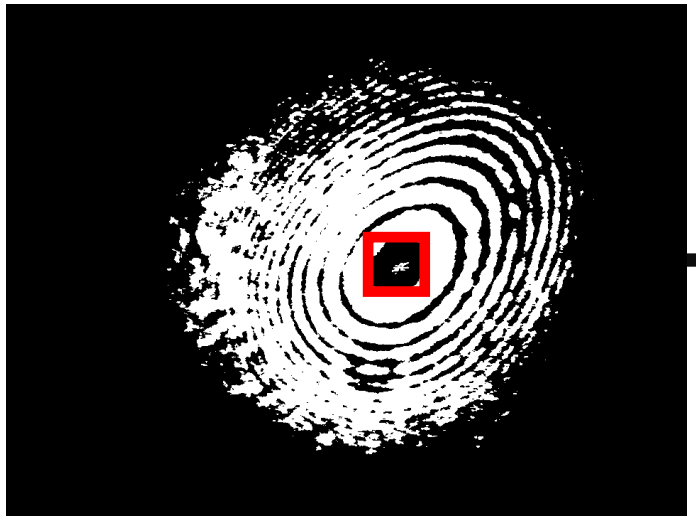




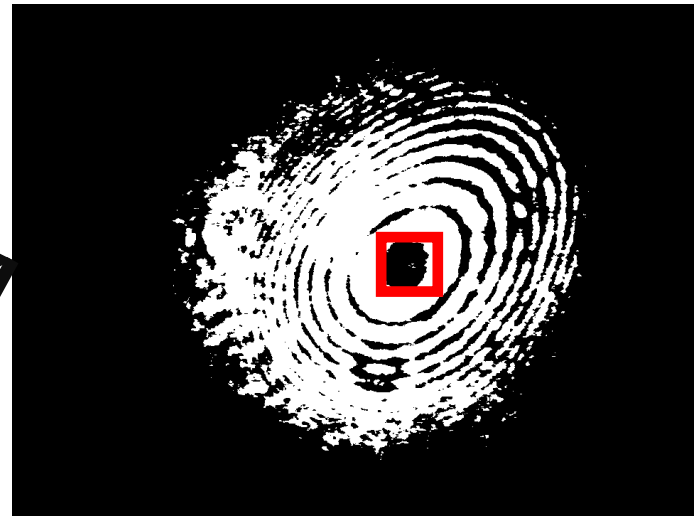



22uF
910Ω
8.2kΩ
32.5V
op-amp
22uF
2.5V
-27.5V
94MΩ
50MΩ
2.5V
Arduino
Output:
5
4
3
2
1
0
t
Output to mirror:
60
40
20
0
t
Stand
Mirror

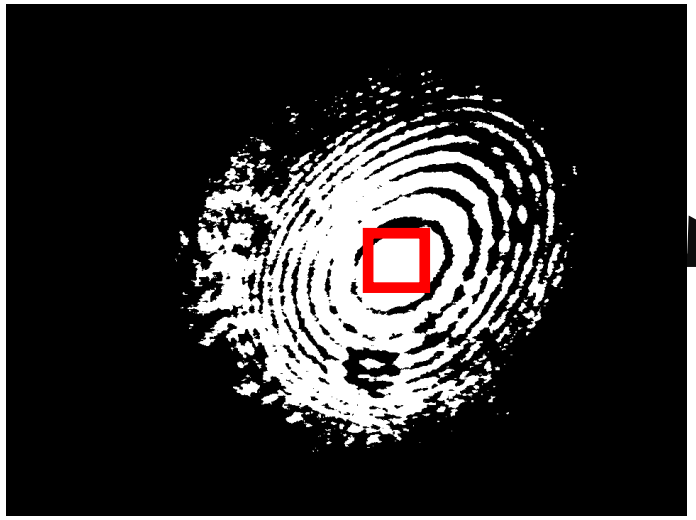
Interference Pattern Created



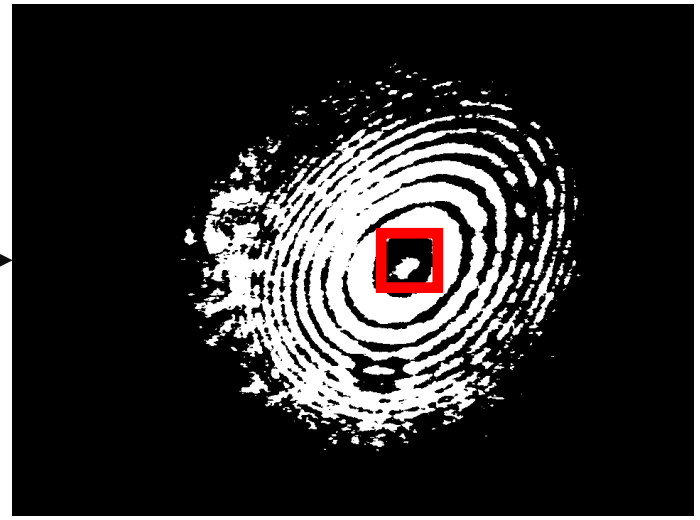
$V = 2.5\ V$



$V \cong 25\ V$

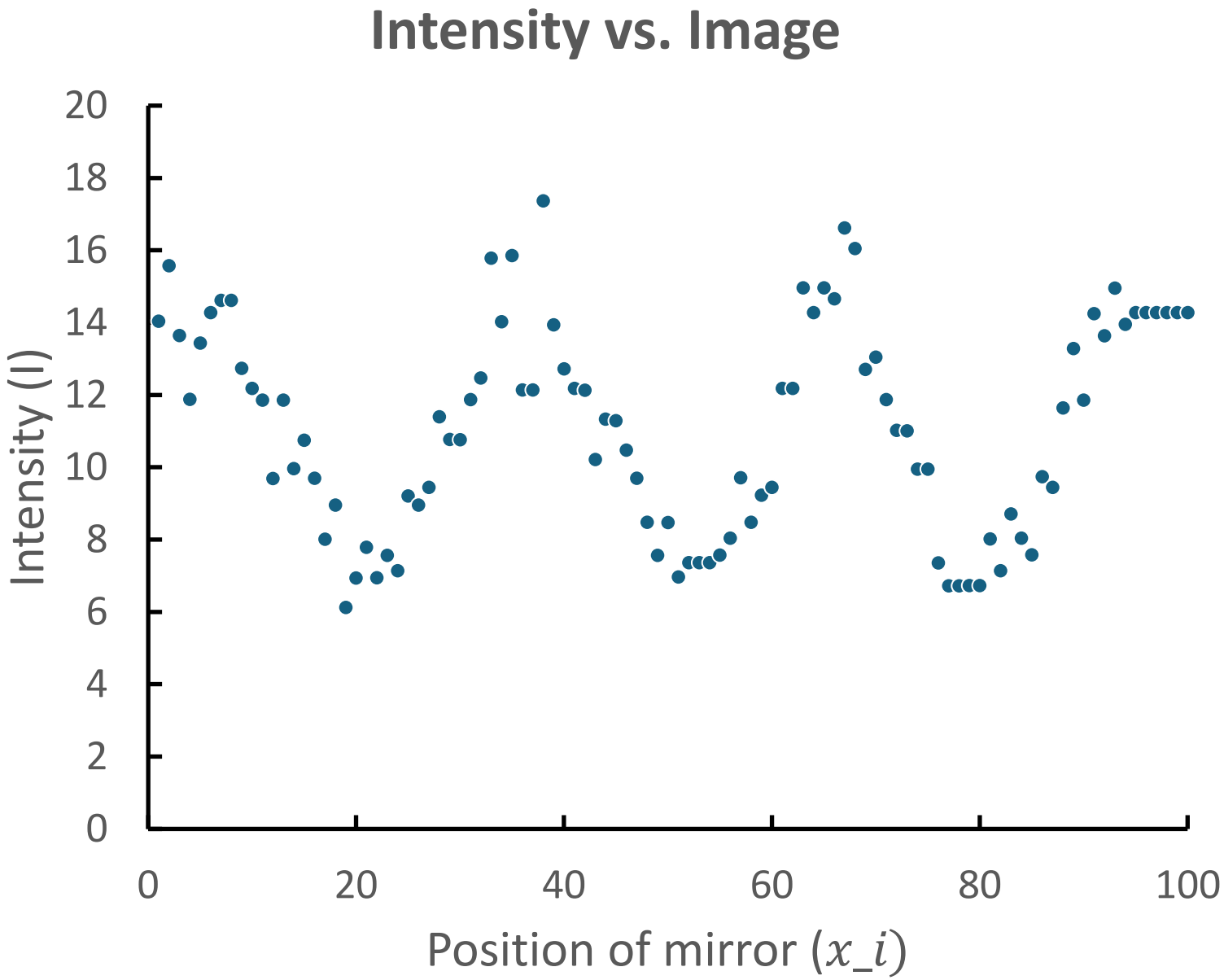


$V \cong 45\ V$



$V = 57.75\ V$

Interference Analysis



Equation for intensity vs. image

$$I(x_i) = \text{asin}(bx_i - c) + d$$

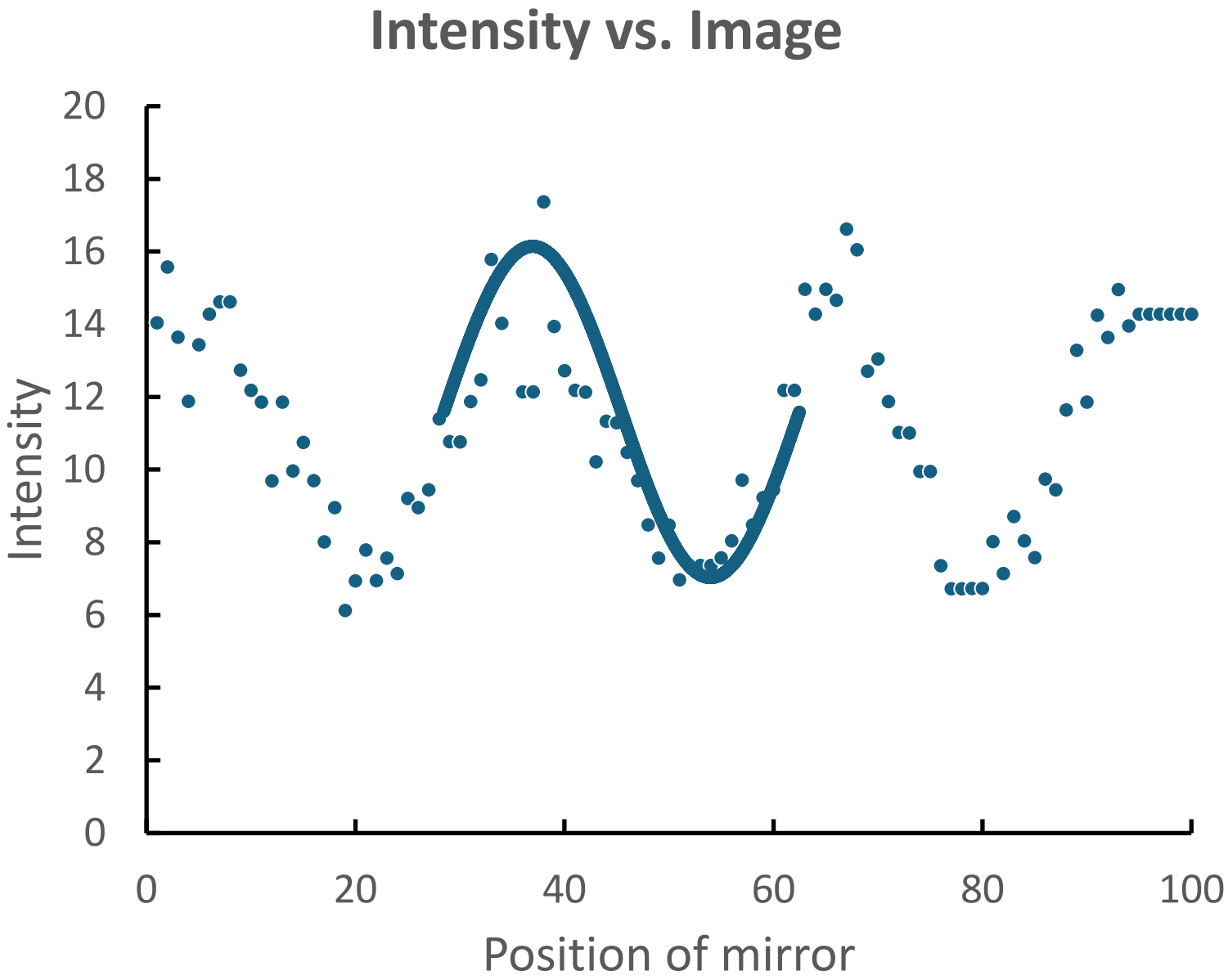
Equation to Determine c

$$c = \arctan\left(-\frac{A}{B}\right), where$$

$$A = \sum_{i=0}^{N} I_i \, cos(bx_i) \text{ and}$$

$$B = \sum_{i=0}^{N} I_i \, sin(bx_i)$$

Interference Analysis



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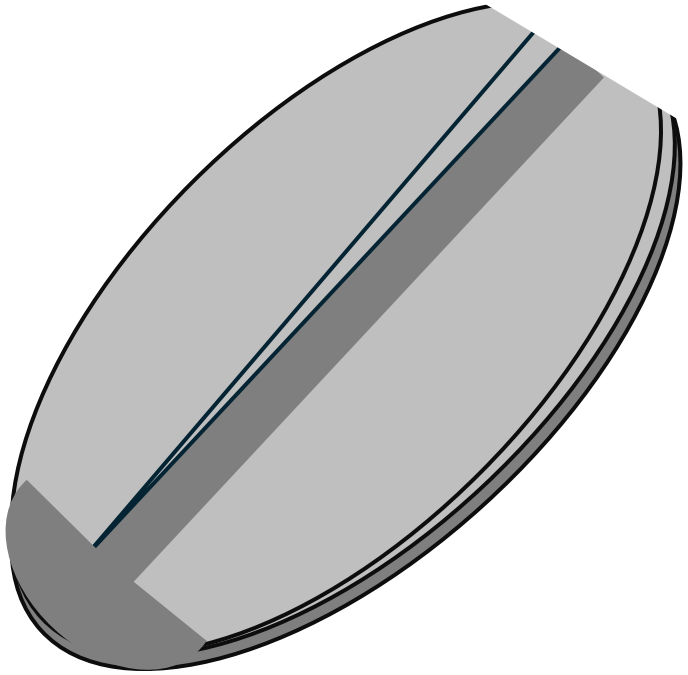
Current Status and Future Plans

Process the data



Bluetooth connection