

物理实验教学中心

Physics Experiment Center



Michelson Interferometer

Li Bin
NJUPT

- ◇ **Experimental Goals**
- ◇ **Experimental Principles**
- ◇ **Contents and Steps**
- ◇ **Data Processing**



Experimental Goals

- ◇ Adjustment and application methods of the Michelson's Interferometer
- ◇ The principles and structure of the Michelson's Interferometer
- ◇ Observe the interference of equal inclination
- ◇ Measure the wavelength of red light from He-Ne laser

The Michelson–Morley experiment

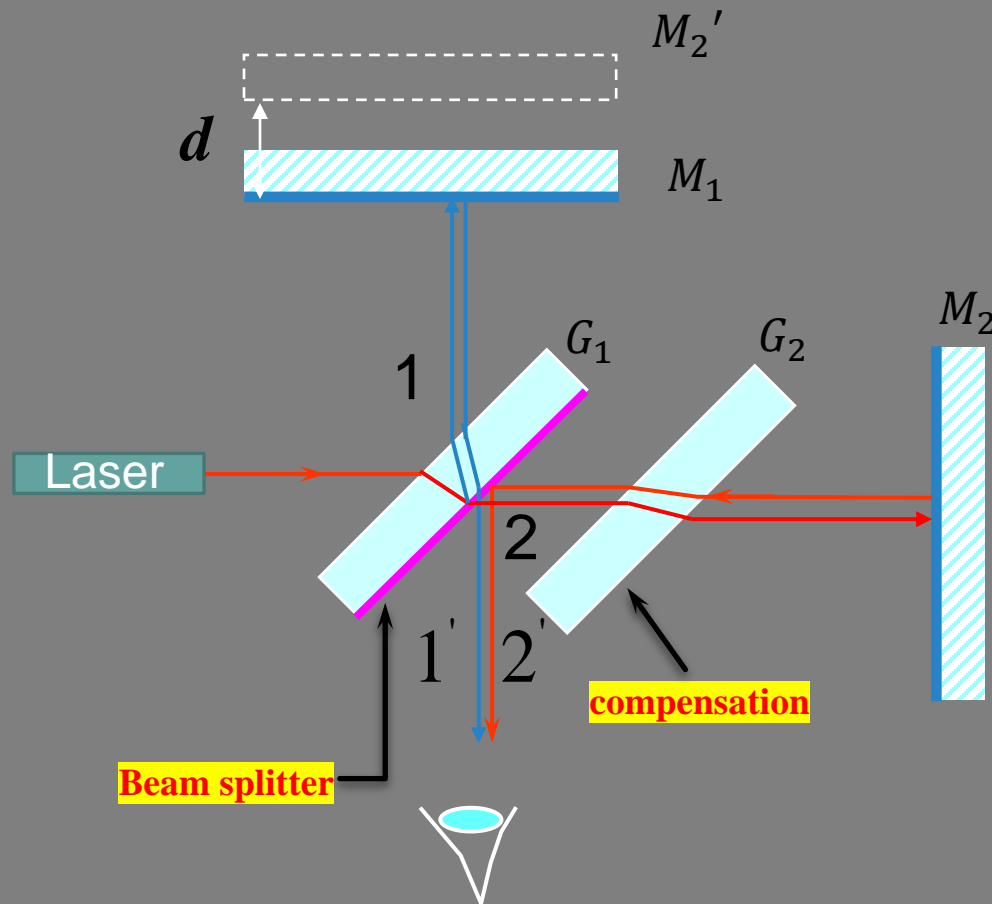
- ◆ The Michelson–Morley experiment was an attempt to detect the existence of the luminiferous aether, a supposed medium permeating space that was thought to be the carrier of light waves.

----Wikipedia

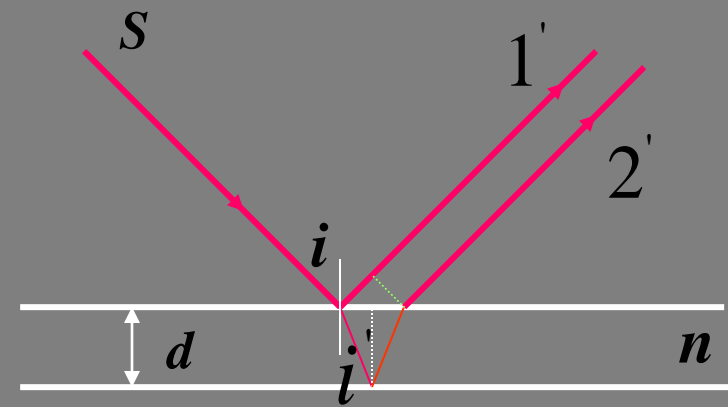


Experimental Principles

1. The light path



The Michelson Interferometer
light route



Interference of equal thick thin-film



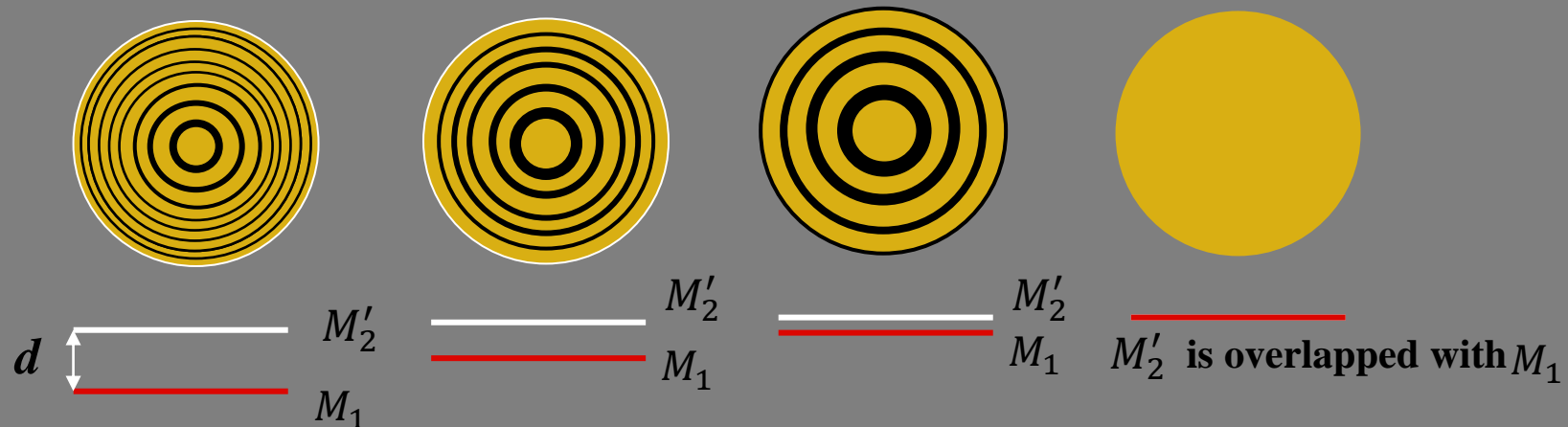
2. The interference of equal inclination

The light path difference:

$$\delta = 2d \cos i' = \begin{cases} K\lambda & (K=0,1,2,\dots) \quad \text{Bright stripes} \\ (2K+1)\frac{\lambda}{2} & (K=0,1,2,\dots) \quad \text{Dark stripes} \end{cases}$$

(a) A bigger thickness leads to denser stripes.

(b) When d increases, the stripes pop up; when d reduces, the stripes shrink in.



Regarding to central level of stripes (**i=0**) :

$$\left. \begin{array}{l} 2d = k\lambda \\ d = k\lambda/2 \\ d' = (k+1)\lambda/2 \end{array} \right\} \Rightarrow \Delta d = \Delta N \frac{\lambda}{2}$$

Wavelength: $\lambda = \frac{2\Delta d}{\Delta N}$

Contents and Steps

1. The condition to obtain the interference of equal inclination:

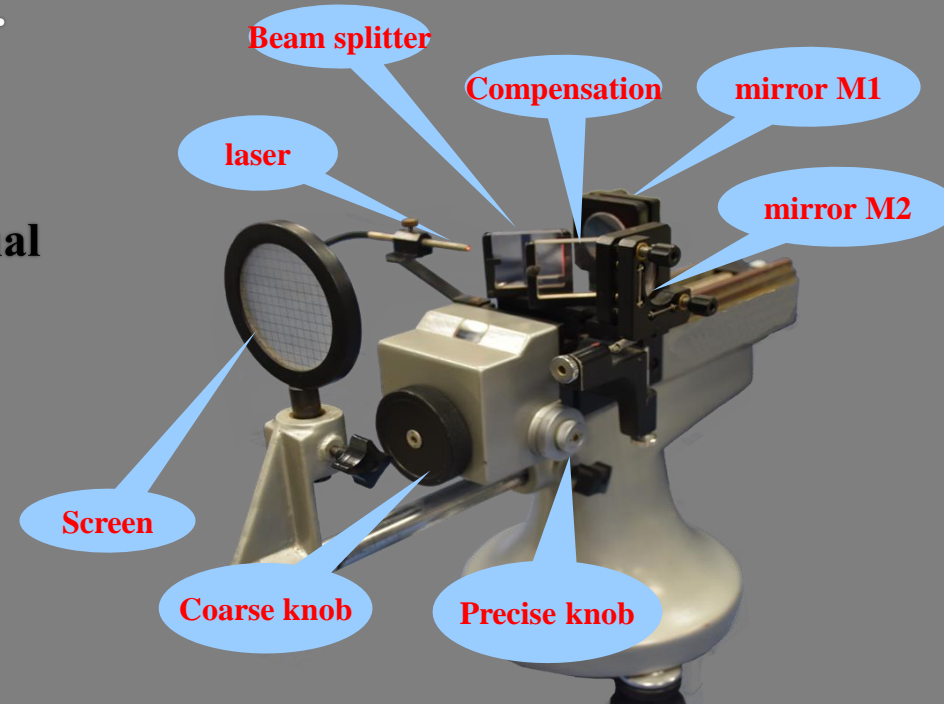
Two brightest light dots must be overlapped.

2. We observe the stripe diversification of equal inclination by changing d .

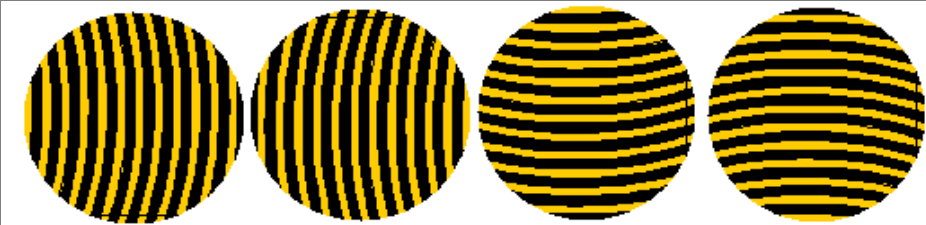
(Stripes shrink or expand by rotating the coarse knob and precise knob.)



The M_1 position is adjusted by coarse knob to remove M1 fleetly and precise knob to remove M1 slightly

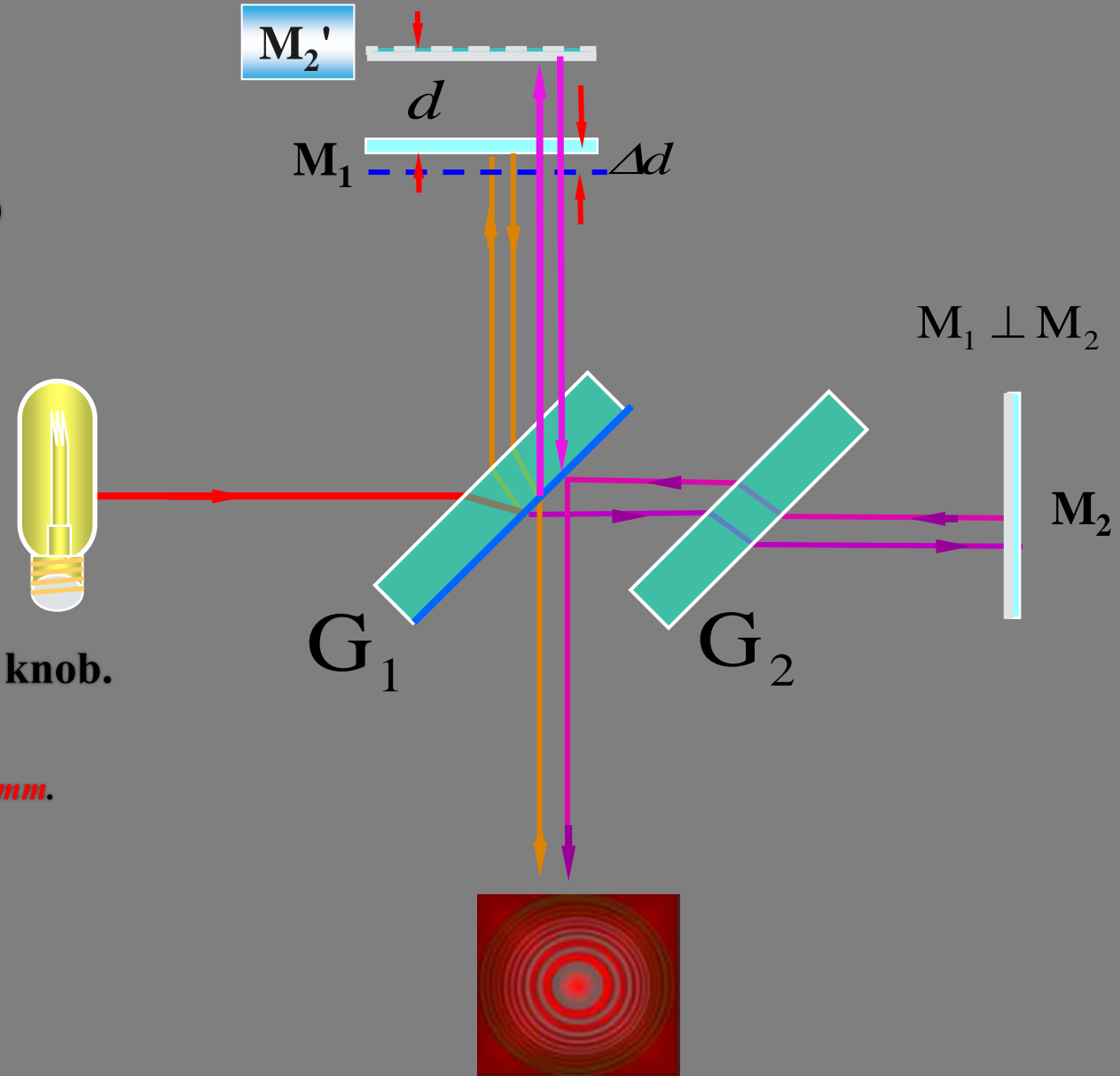


3. To adjust circle center (Adjust screws behind mirror M2 including horizontal and vertical screws)

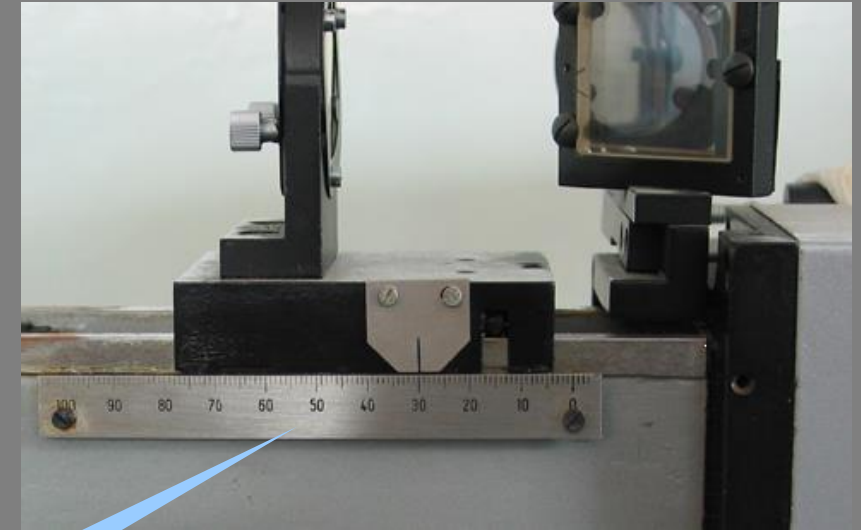


4. Make the stripe clear and stable by adjusting coarse knob.

Note: Before the measurement, M1's position was adjusted to be at about 50 mm.



5. Count the circle number and read the data when the number reaches **50**.



Main ruler

Attention: The precise knob has to be rotated toward a fixed direction during measurement.

Record: There are five significant digits after the decimal point

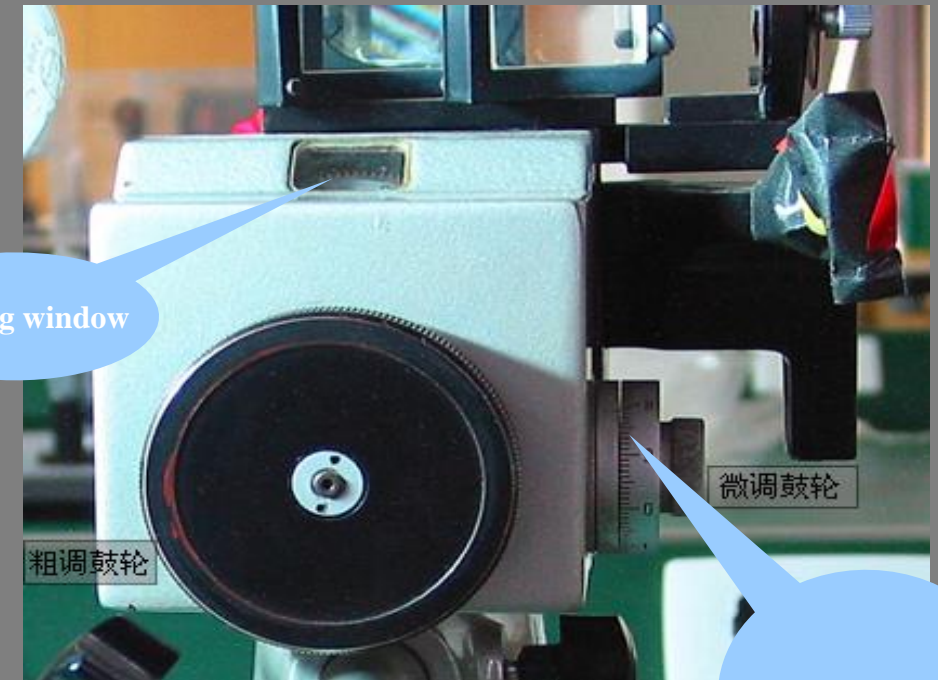
Such as: **31.45 67 8mm**

Main ruler

Big knob

Small knob

Estimate



Reading window

Precise knob

Operation video 1



迅捷视频剪辑软件

Operation video 2

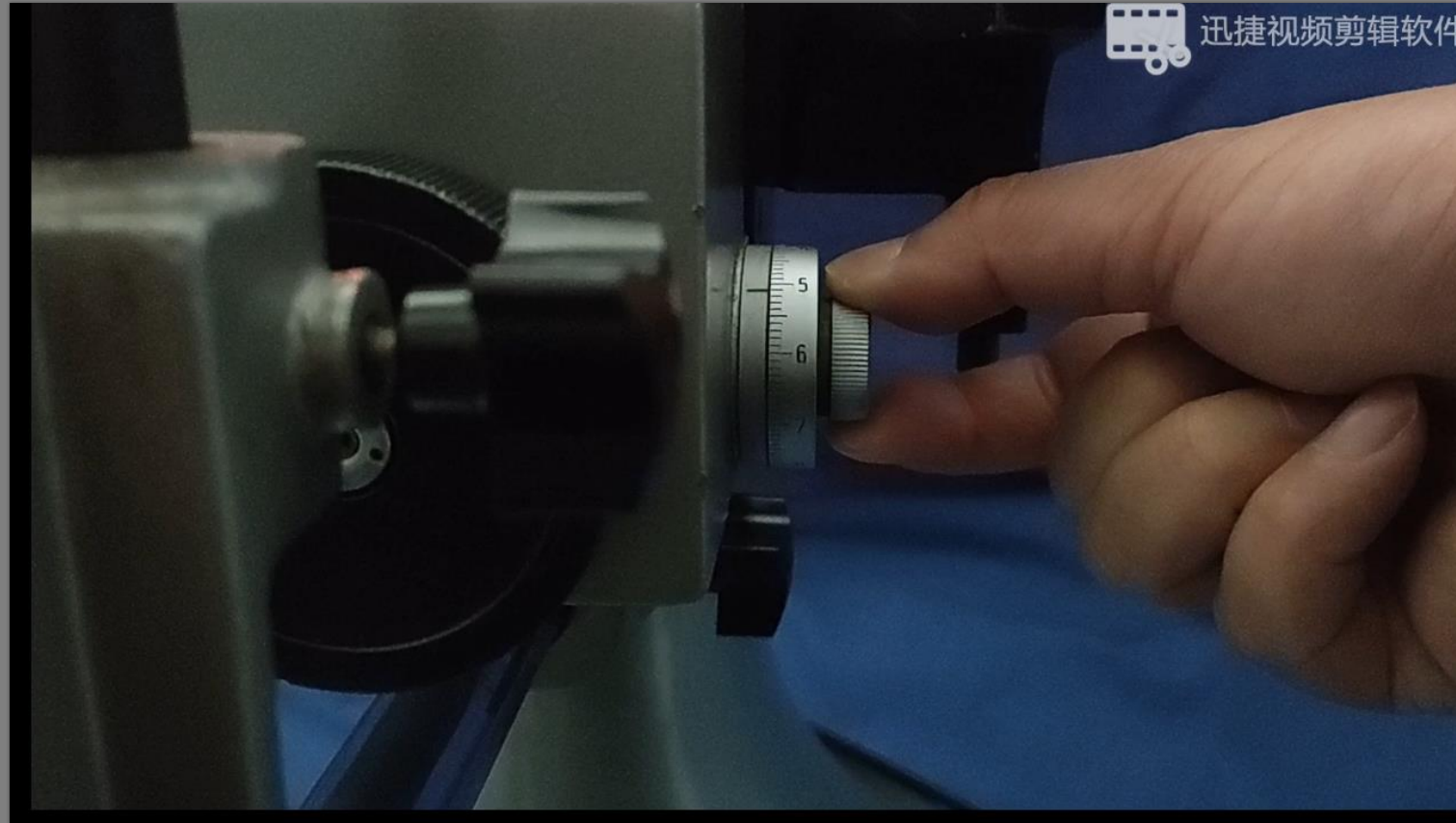


TABLE I

i	0	1	2	3	4	5
N	0	50	100	150	200	250
d _i (mm)	50.07068	50.08669	50.10280	50.11896	50.13513	50.15144
Δd (mm)	Δd ₁ =d ₃ -d ₀ =		Δd ₂ =d ₄ -d ₁ =		Δd ₃ =d ₅ -d ₂ =	
Average Δd (mm)	Δd=(Δd ₁ +Δd ₂ +Δd ₃)/3=					
λ=2Δd/ΔN (ΔN=150)						

Noted: wavelength(λ) of He-Ne laser is 632.8nm

Here is the weblink of this slide:

<https://github.com/bliseu/phylab/blob/master/Michelson%20Interferometer.pdf>

Some useful links:

<https://www.ligo.caltech.edu/page/what-is-interferometer>

1. Please calculate and finish the table on the slide,
 2. Write a 500-word essay to describe the “The **Michelson** Interferometer”, and the “**LIGO**” Interferometer.
- The **DEADLINE** is April 26, 2022.

END