The Michelson Interferometer

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

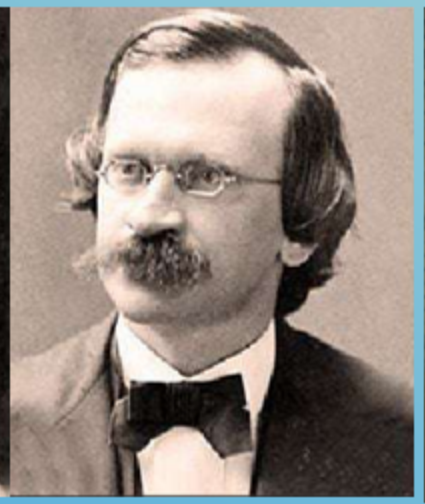
Experimental Goals

- 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

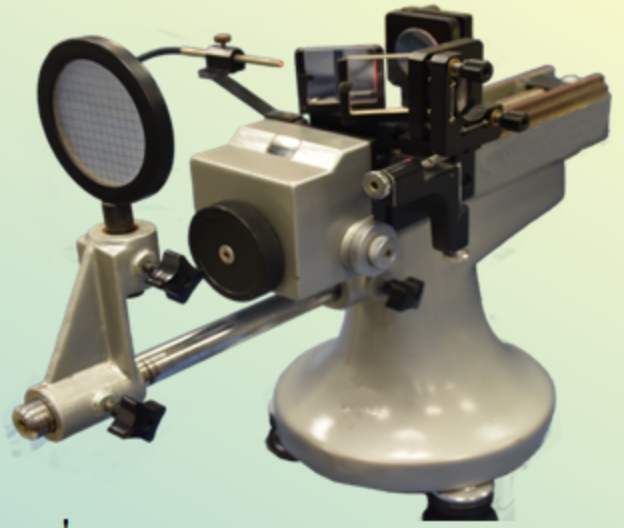
The Michelson–Morley experiment

- 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.

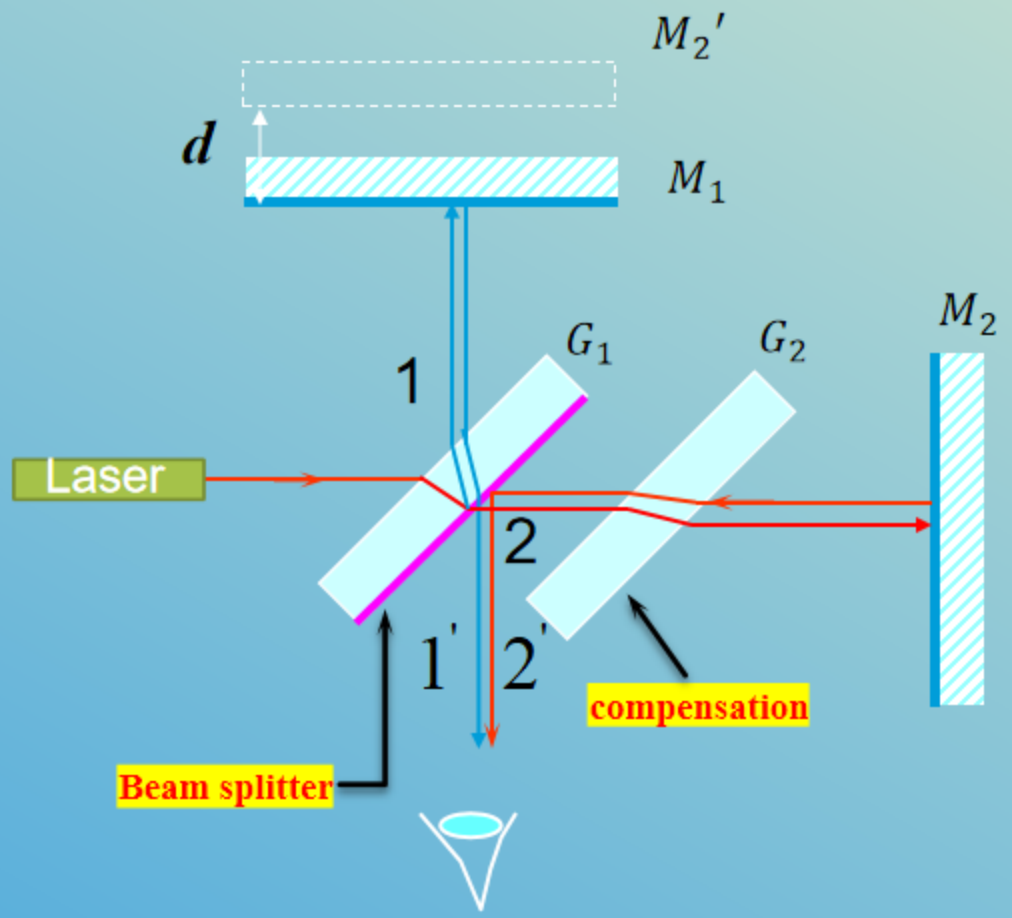
----Wikipedia



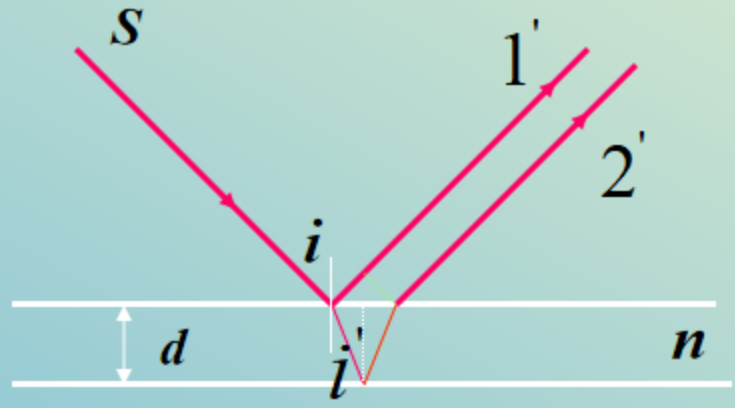
Experimental Principles



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:

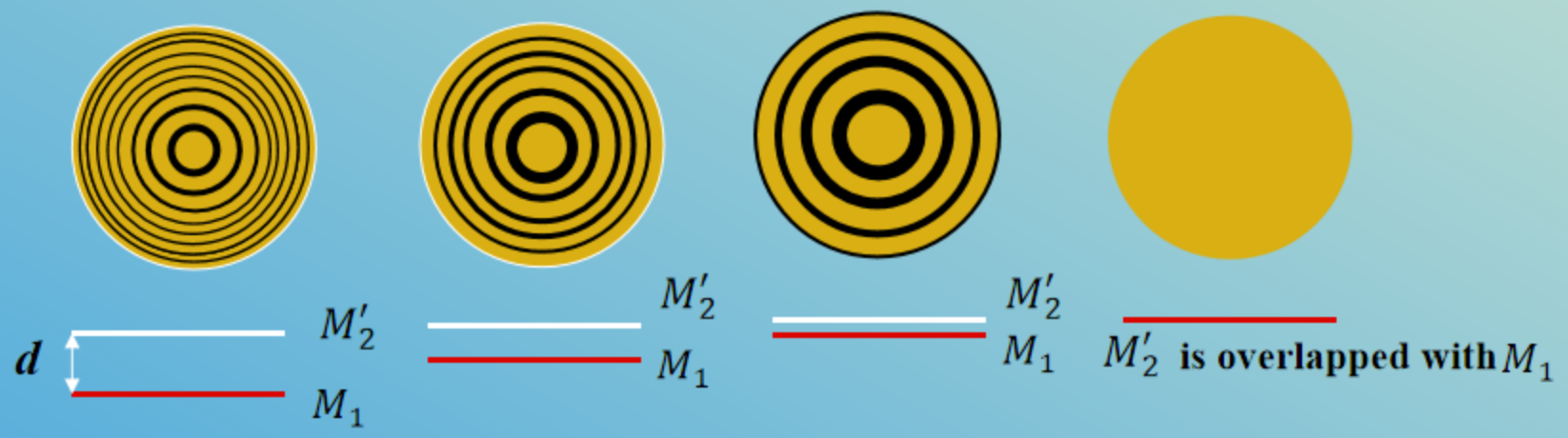
$$\delta = 2d\cos i' = \begin{cases} K\lambda \\ (2K+1)\dfrac{\lambda}{2} \end{cases}$$

(K=0,1,2…) **Bright stripes**

(K=0,1,2…) **Dark stripes**

(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)：

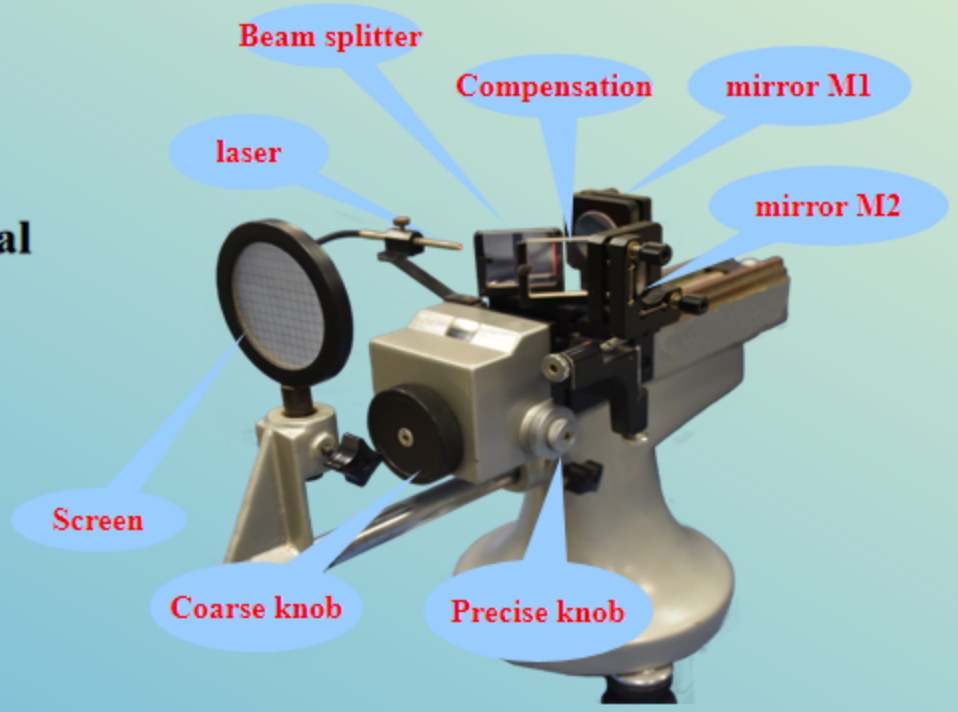
$$\left.\begin{array}{l} 2d = k\lambda \\ d = k\lambda/2 \\ d' = (k+1)\lambda/2 \end{array}\right\} \Longrightarrow \Delta d = \Delta N \frac{\lambda}{2}$$

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

Contents and Steps

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

Two brightest light dots must be overlapped.

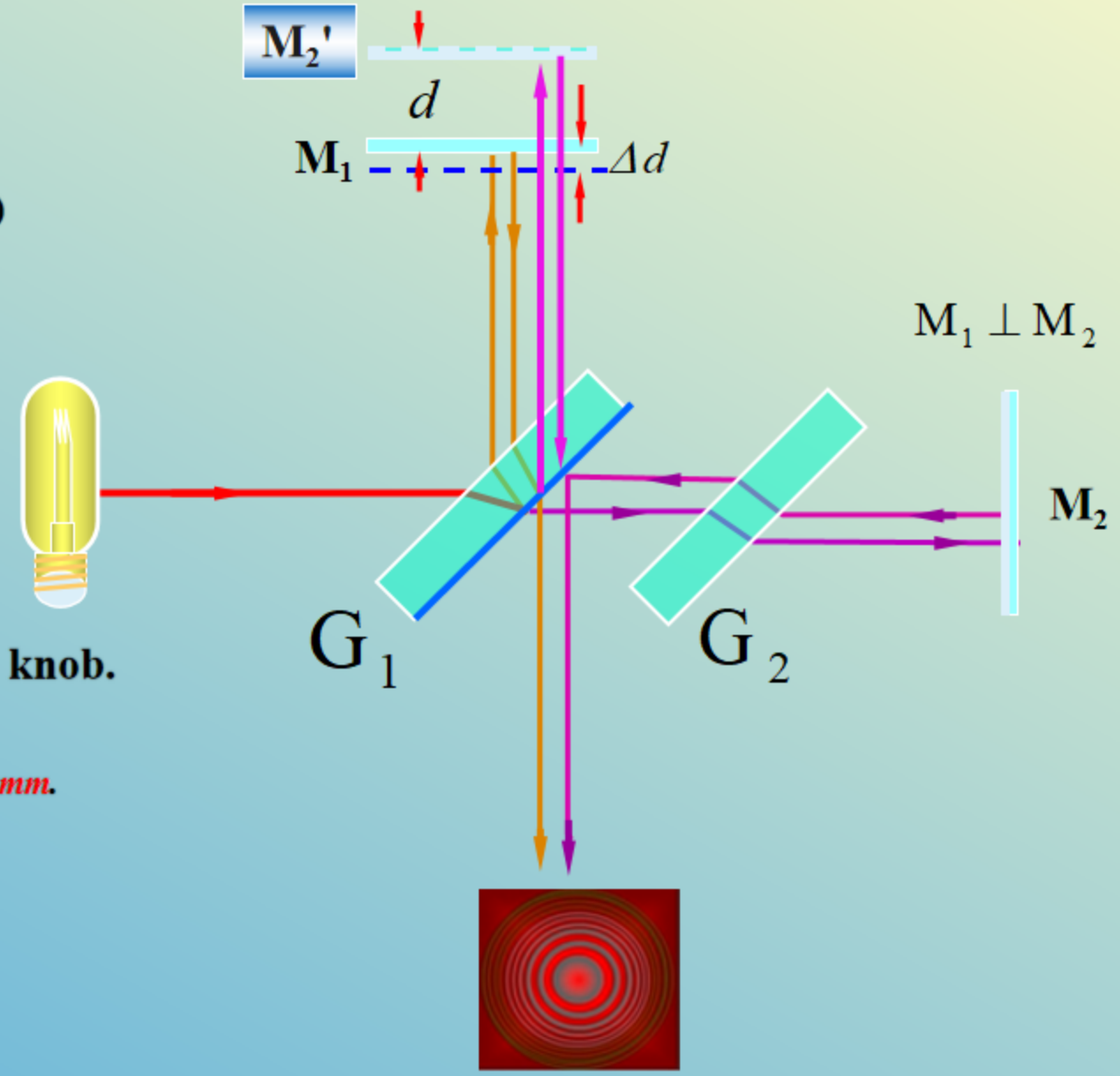


2. We observe the stripe diversification of equal inclination by changing *d*.

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

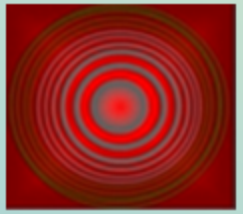
The M_1 position is adjusted by coarse knob to remove M1 fleetly and precise knob to remove M1 slightly

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

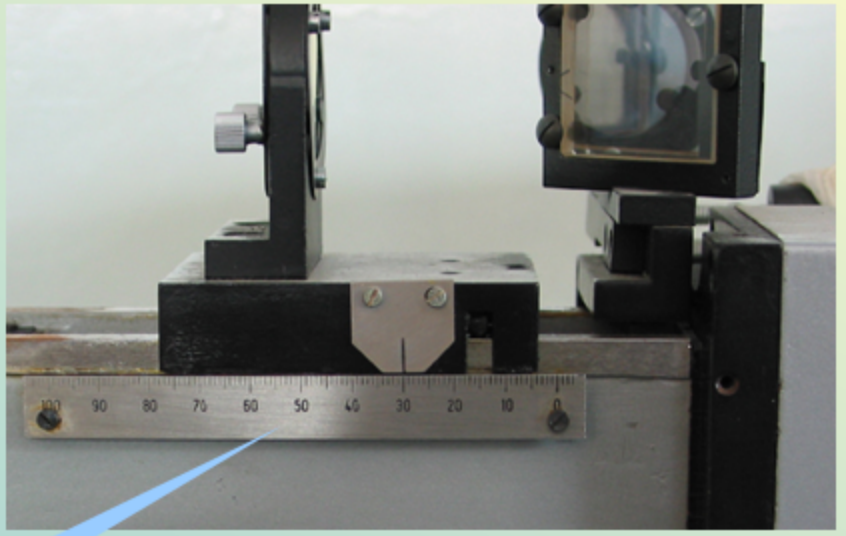


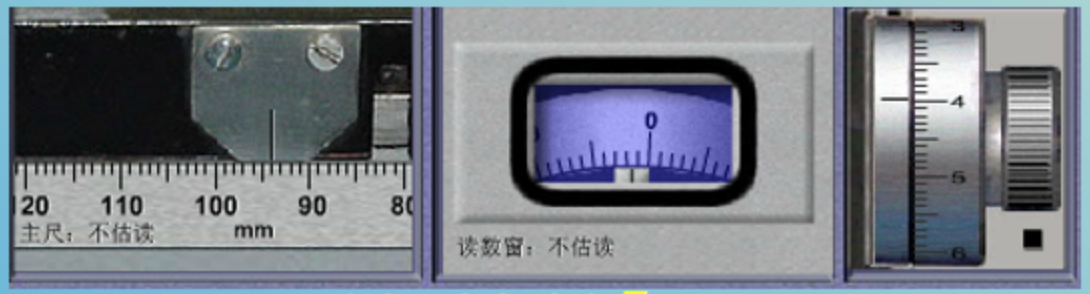
4. Make the stripe clear and stable by adjusting coarse knob.

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

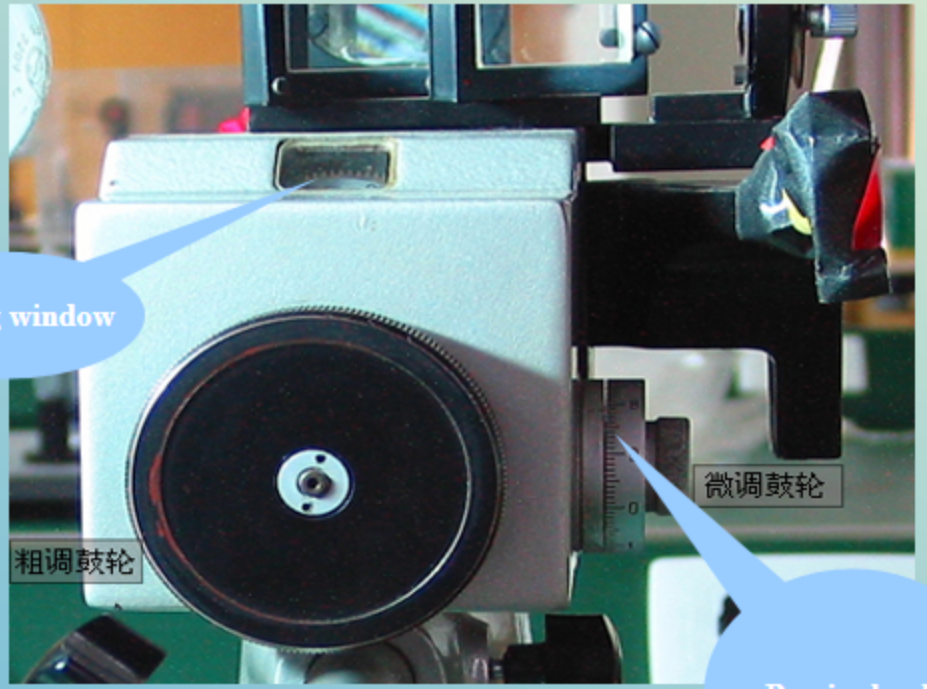


5. Count the circle number and read the position when the number reaches 50.





93. 98 395 mm



Record: There are five significant digits after the decimal point

TABLE I

i	0	1	2	3	4	5
N	0	50	100	150	200	250
d_i (mm)						
Δd (mm)	$\Delta d_1=d_3-d_0=$		$\Delta d_2=d_4-d_1=$		$\Delta d_3=d_5-d_2=$	
Average Δd (mm)	$\Delta d=(\Delta d_1+\Delta d_2+\Delta d_3)/3=$					
$\lambda=2\Delta d/\Delta N$ ($\Delta N=150$)						

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

Here is the weblink of this slide:
https://github.com/bliseu/phylab
https://www.ligo.caltech.edu/page/what-is-interferometer

1. Please calculate and finish the table on the slide,
2. Complete the report to describe the “The Michelson Interferometer”, and the “LIGO” Interferometer.

The DEADLINE is May 2, 2024.

END