

物理实验教学中心

Physics Experiment Center



Michelson Interferometer

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Teaching Frame

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

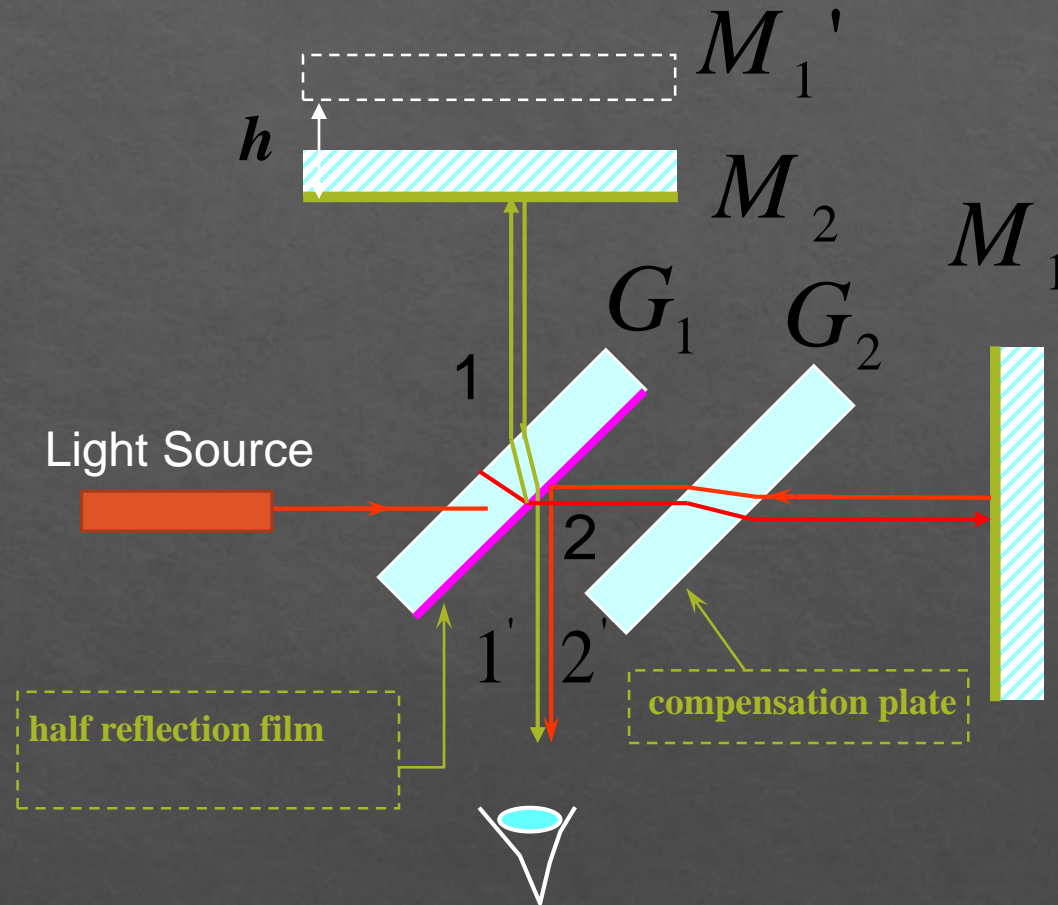


Experimental Goals

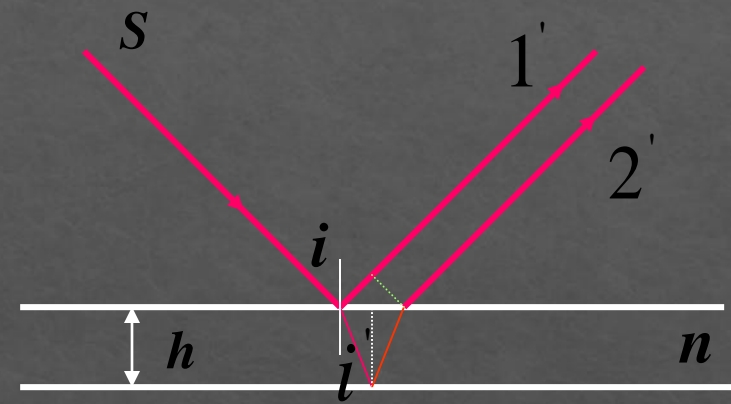
- ◇ To grasp adjustment and application methods of the Michelson's Interferometer
- ◇ To learn the principles and structure of the Michelson's Interferometer
- ◇ To observe the interference of equal inclination
- ◇ To measure the wavelength of red light from He-Ne laser

Experimental Principles

1. The light path



The Michelson Interferometer
light road figure



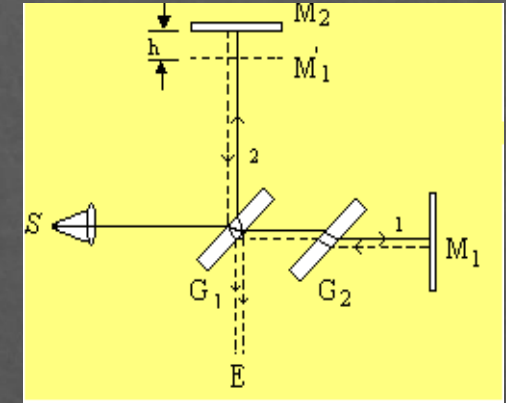
Interference of equal thick thin-film

2. The interference of equal inclination

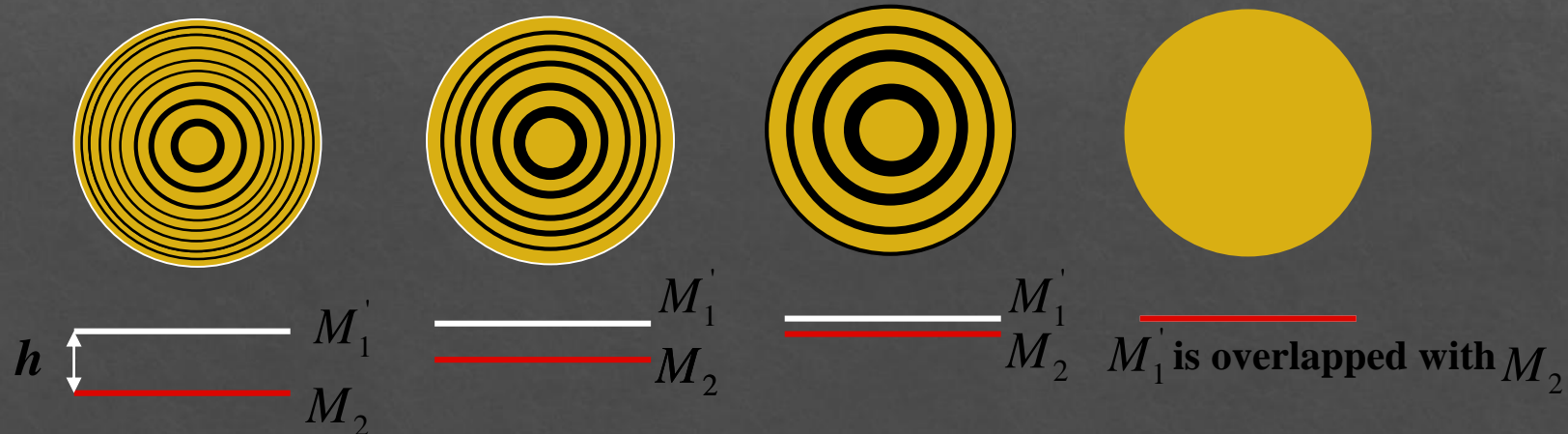
The light path difference:

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

(a) A greater thickness leads to denser stripes.



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



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

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

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

Contents and Steps

Two questions must be understood before adjusting the equipment:

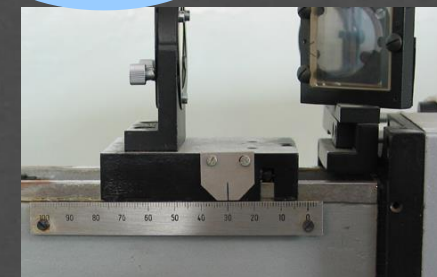
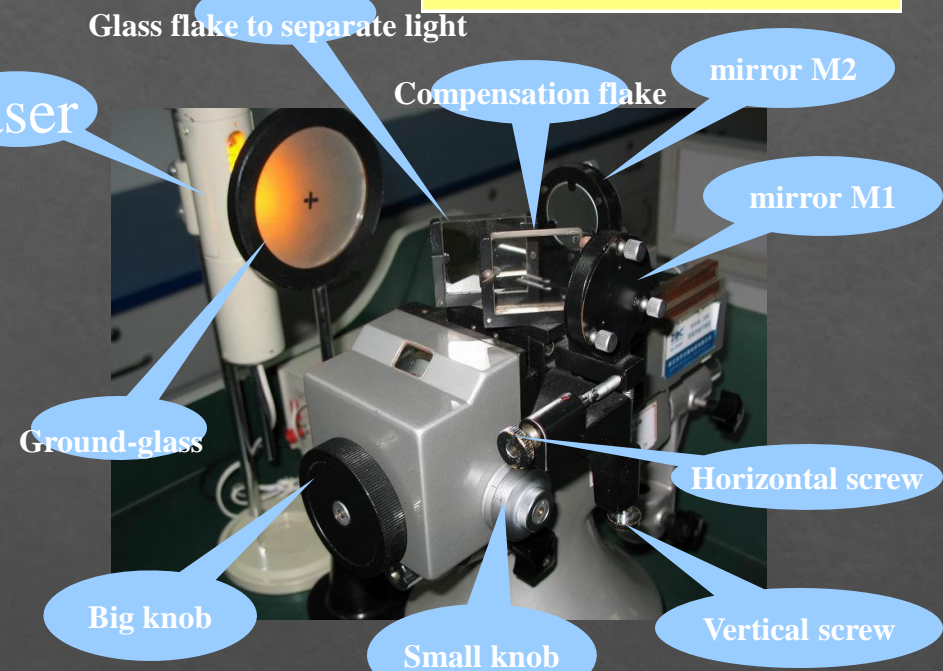
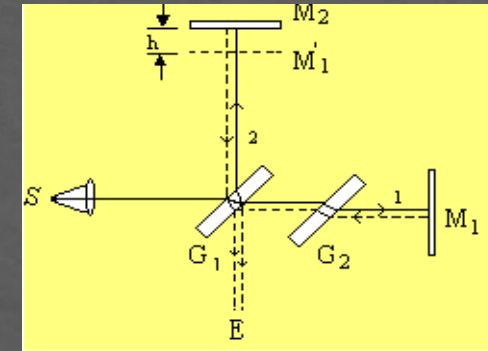
1. The condition to obtain the interference of equal inclination:

two surfaces of thin film are parallel.

2. We observe the stripe diversification of equal inclination by changing film thickness h . (Including stripe shrinking or expanding, the density and visibility changing, and so on)

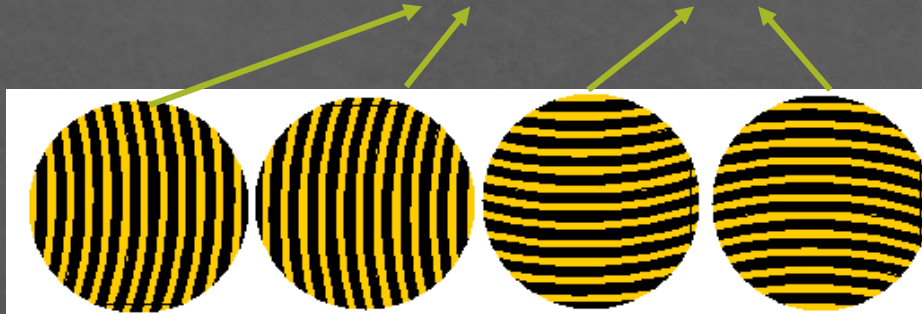


The M_2 position is adjusted by big knob to remove M_2 fleetly and small knob to remove M_2 slightly



Steps:

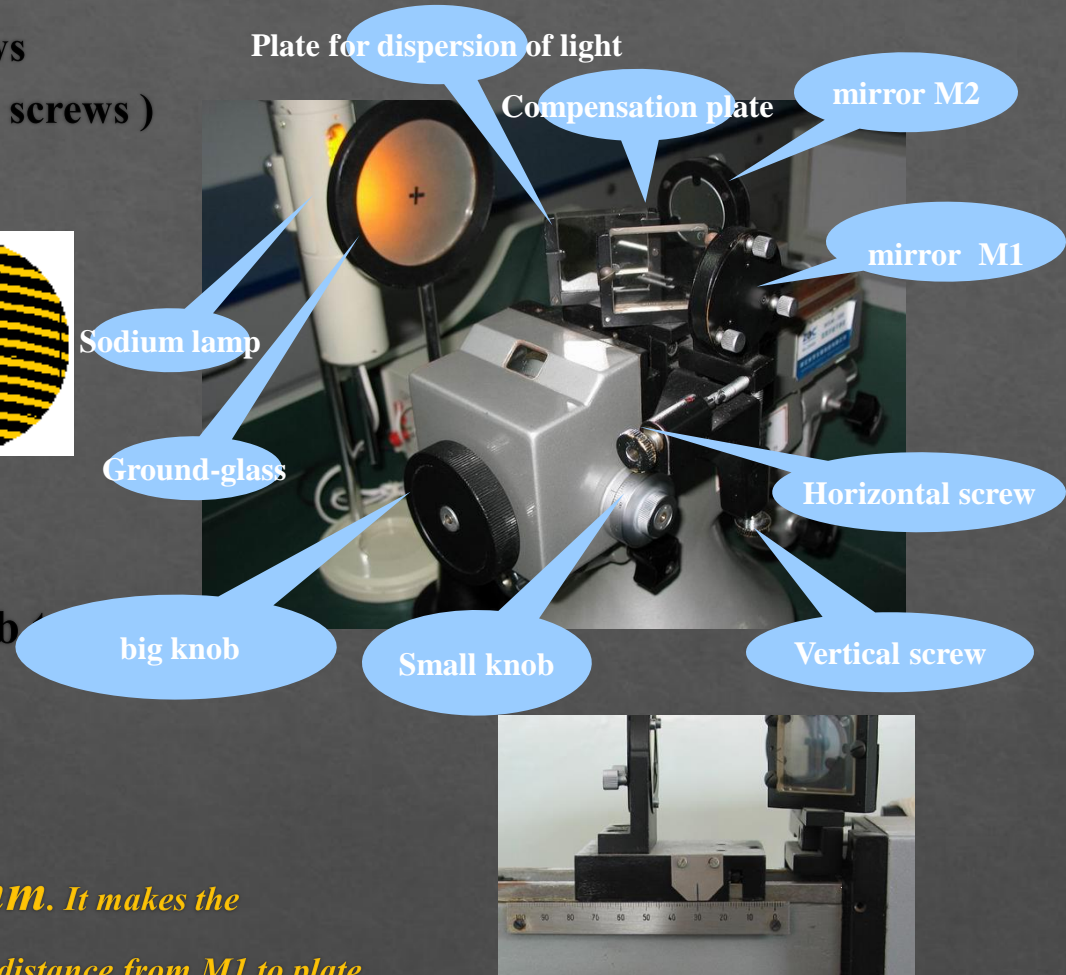
1. To adjust circle center (To adjust three screws behind mirror M1 and horizontal and vertical screws)



2. Make the stripe clear and make its density to be proper (To adjust big knob remove M2.)

3. Make the stripes stable.

*Skill : Before experiment, M2 is adjusted to be about **50 mm**. It makes the distance from M2 to plate to be approximately equal to the distance from M1 to plate.*



4. Read the data and measure the He-Ne laser wavelength :

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

Record: There are five significant digits after the decimal point

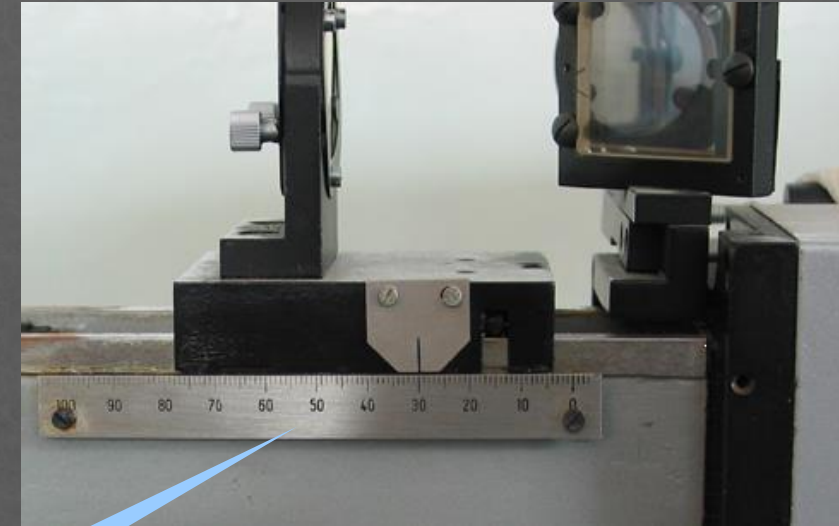
Such as: 31.45 67 8mm

Main ruler

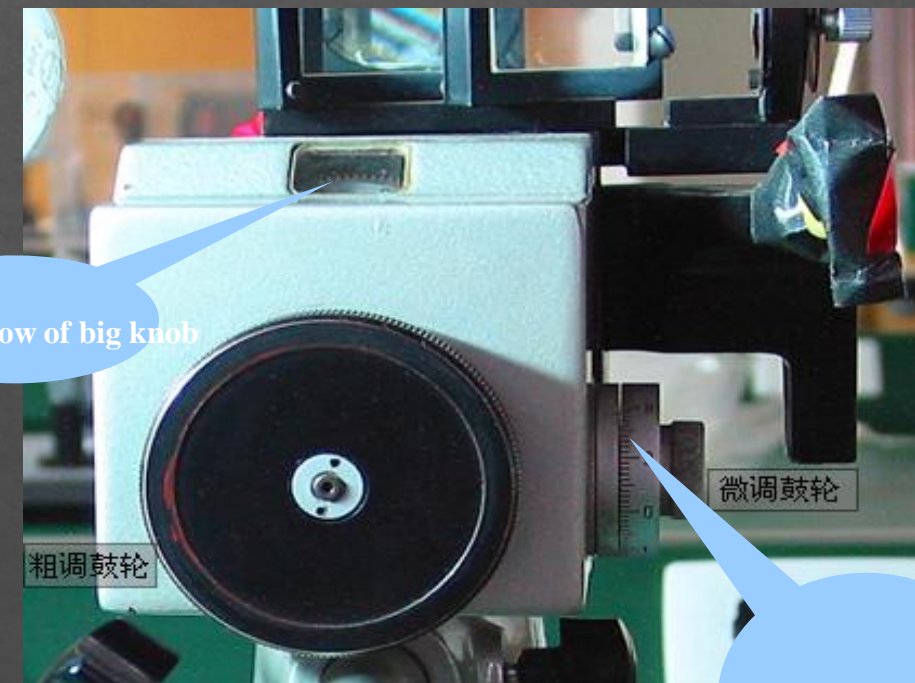
Big knob

Small knob

Estimate



Main ruler



Reading window of big knob

Small knob

Data Processing

TABLE I

i	0	1	2	3	4	5
N	0	50	100	150	200	250
$h_i(\text{mm})$						
$\Delta h'(\text{mm})$	$\Delta h1=h3-h0=$		$\Delta h2=h4-h1=$		$\Delta h3=h5-h2=$	
Average $\Delta h(\text{mm})$	$\Delta h=(\Delta h1+\Delta h2+\Delta h3)/3=$					
$\lambda=2\Delta h/\Delta N$ ($\Delta N=150$)						

END