南京邮电大学
Nanjing University of Post & Telecom

物理实验教学中心

Physics Expeiment Center

QUALITATIVE STUDY OF ATOMIC SPECTRA

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NJUPT
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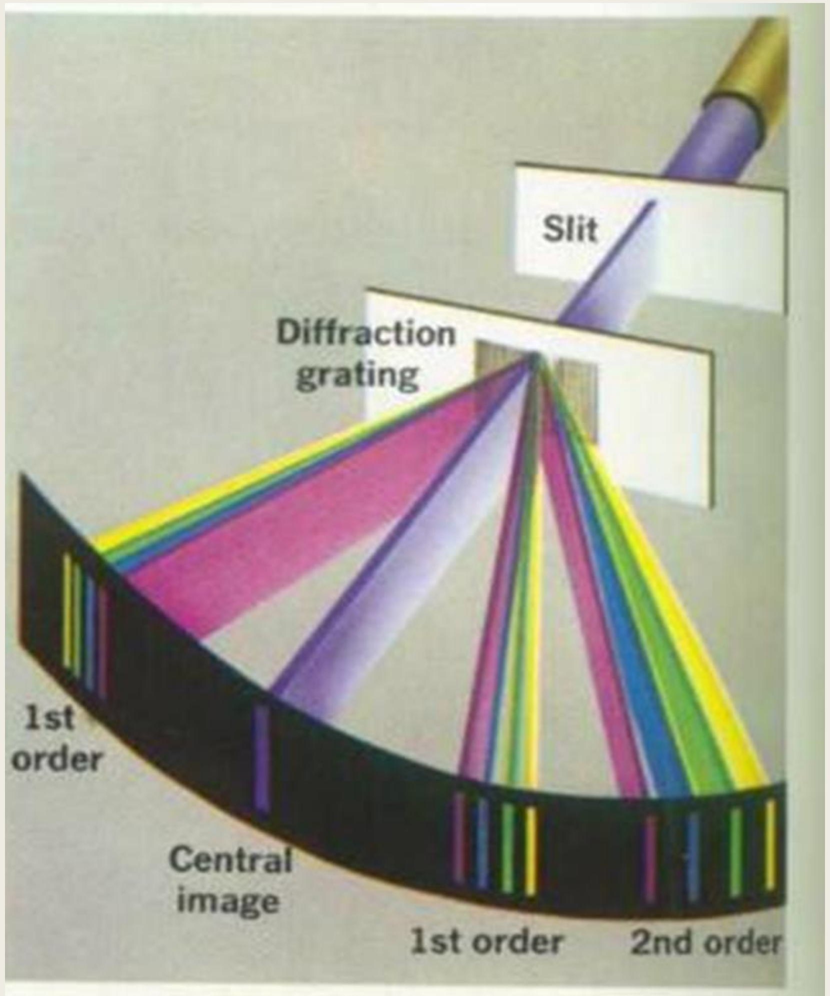
I. Diffraction grating



Mercury light through a diffraction grating.

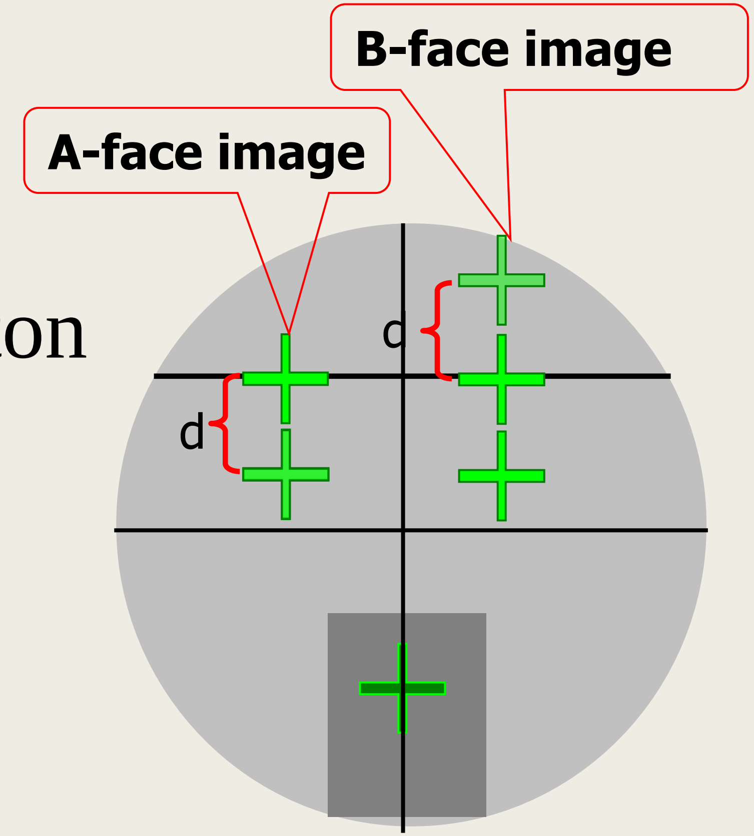
diffraction equation:

$$d*\sin\theta = k*\lambda,\ k=0, \pm 1, \pm 2\ldots.$$

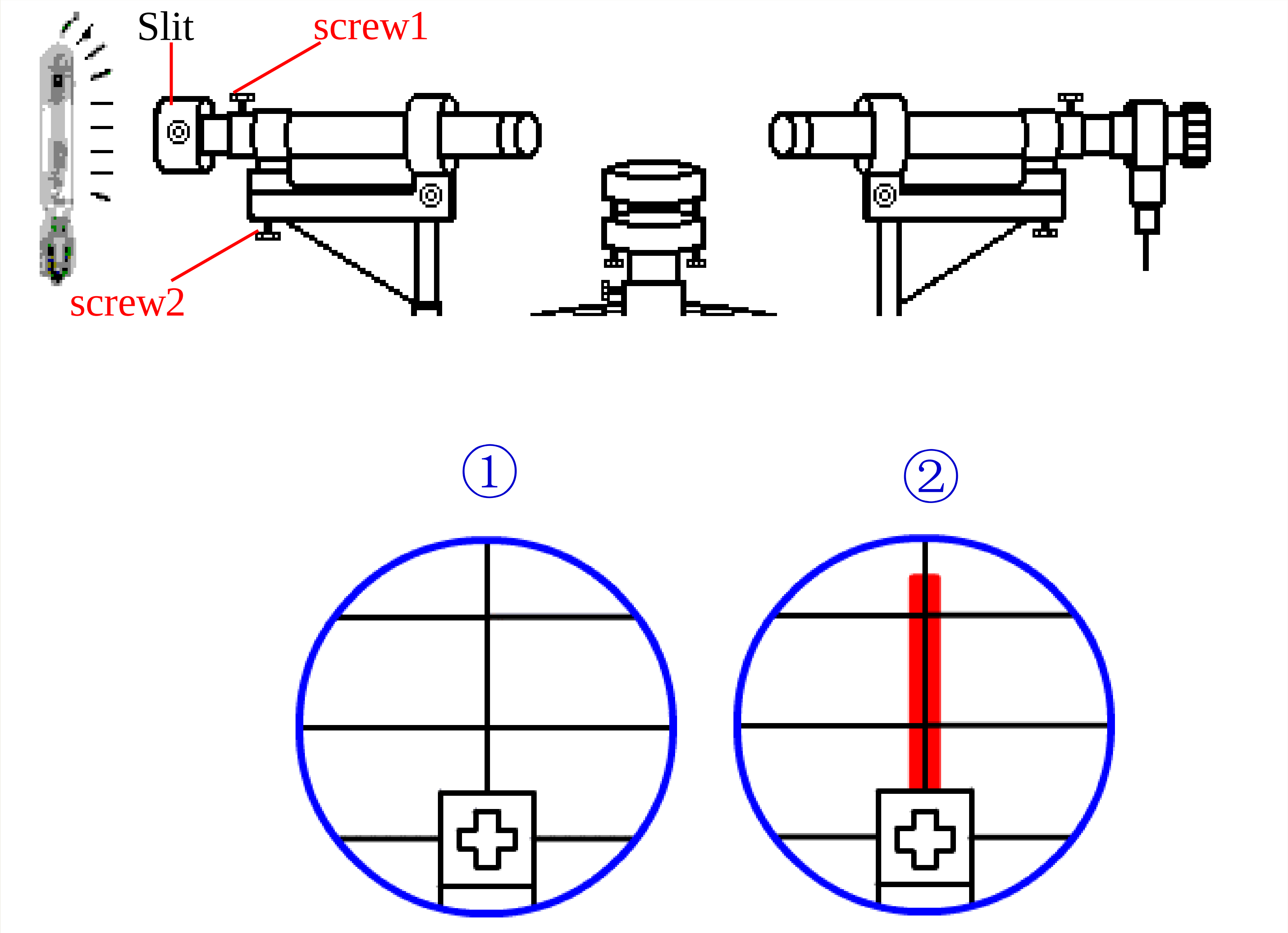
d: diffraction factor
θ: diffraction angle
k: order
λ: wavelength

II. The adjustment of spectrometer

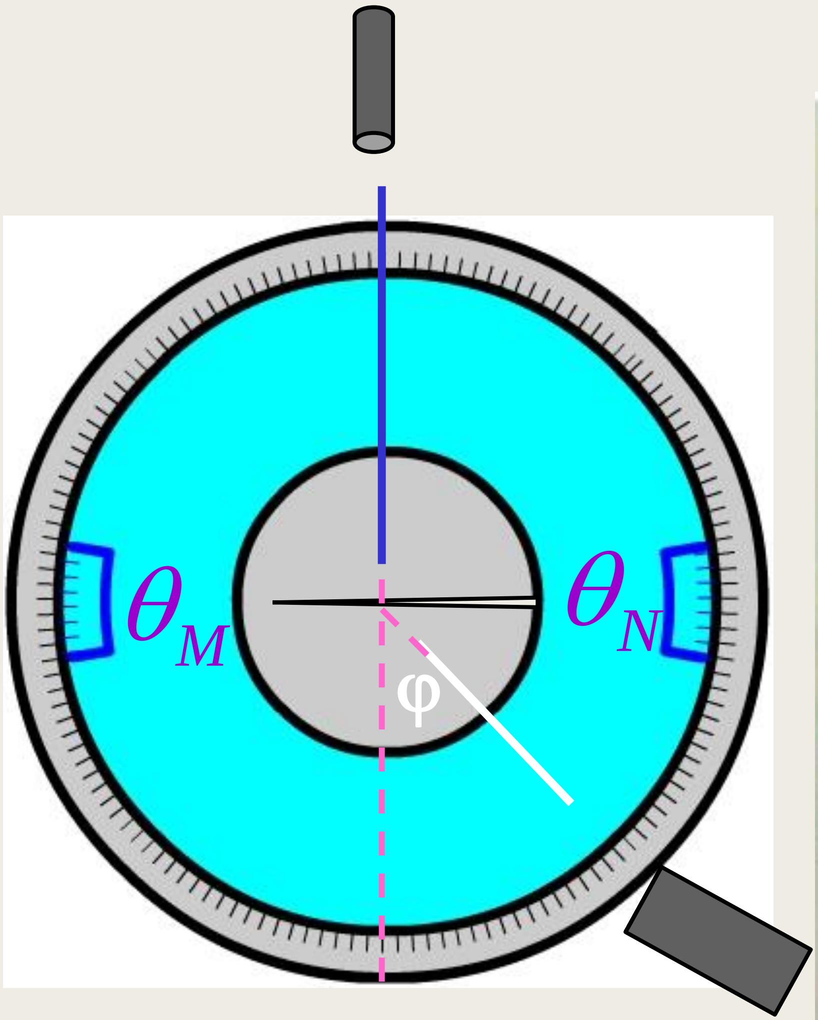
- Final vision： see right
- **Methods：**
  - Three adjusting screw button under the loading platform
  - The telescope elevation adjusting screw
- Steps：
  - Coarse adjustment
  - Fine ajustment



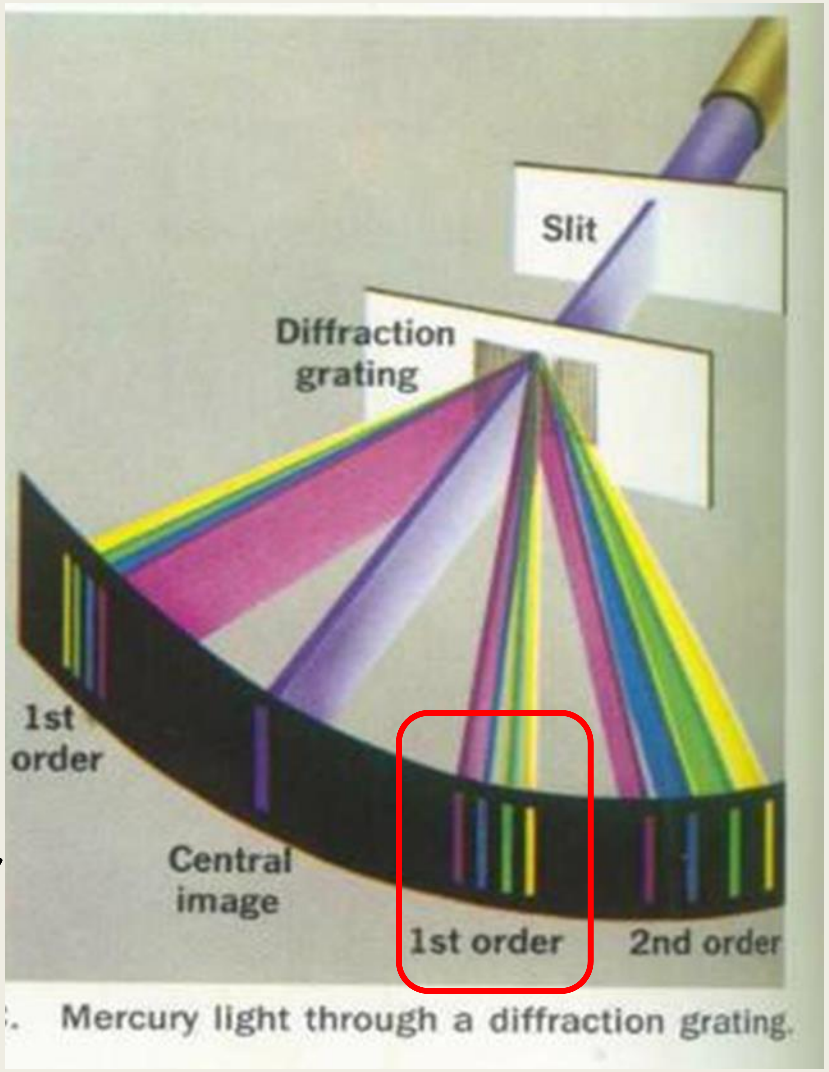
collimator

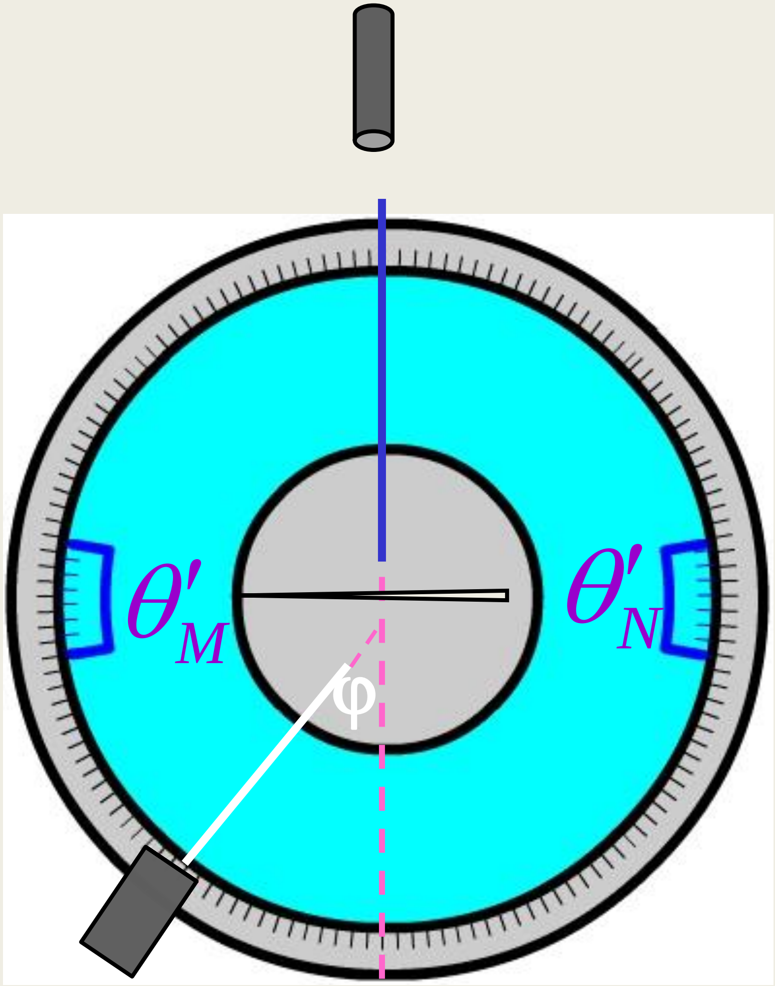


Measurement of the first-order diffraction angles



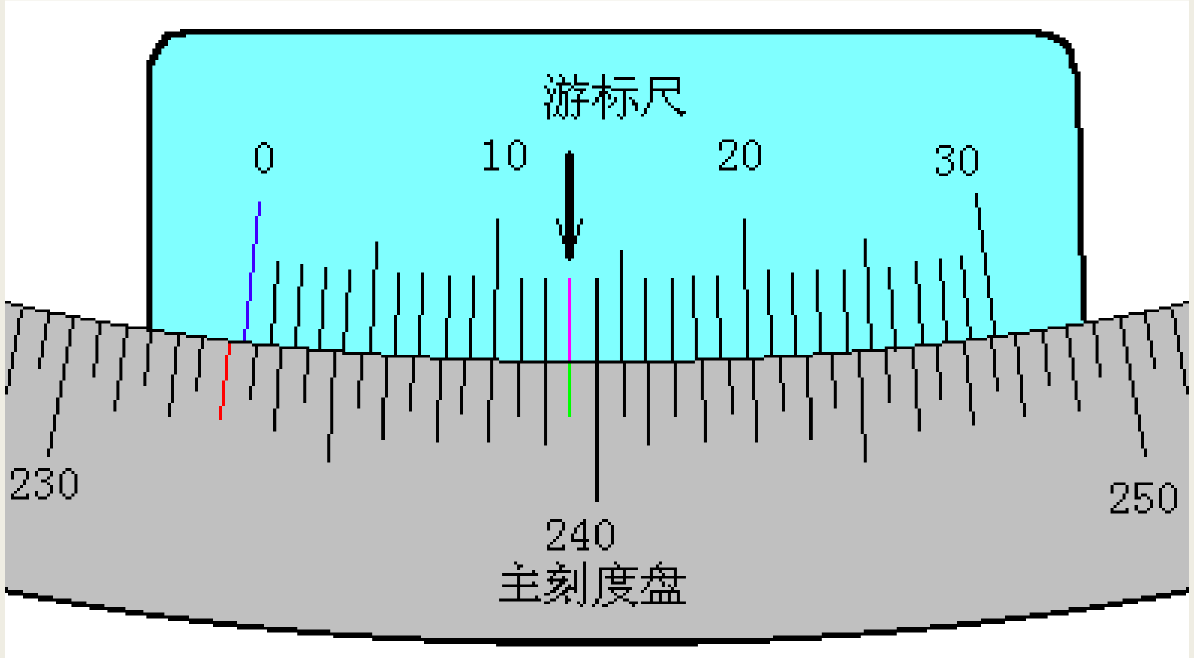
Right side





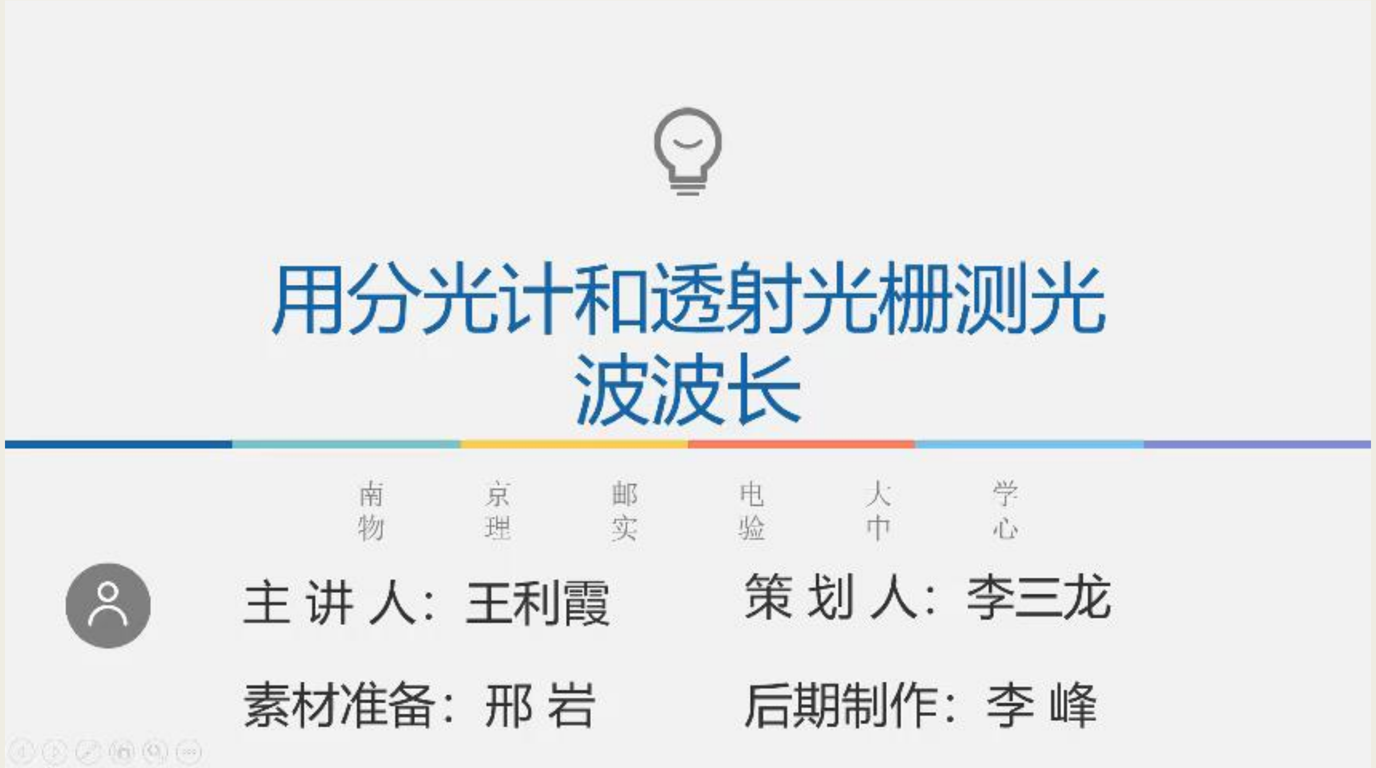
Left side

Read the angle



233°13′

III. Operation video

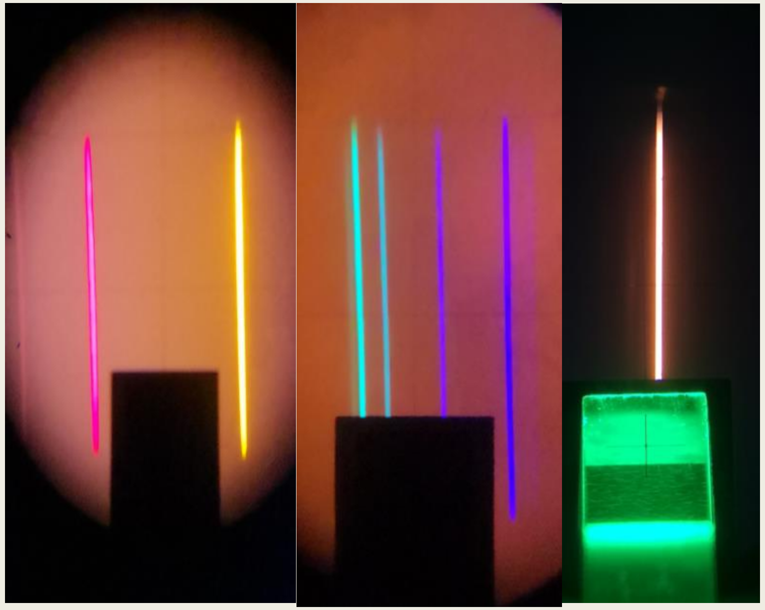


IV. Experiment contents

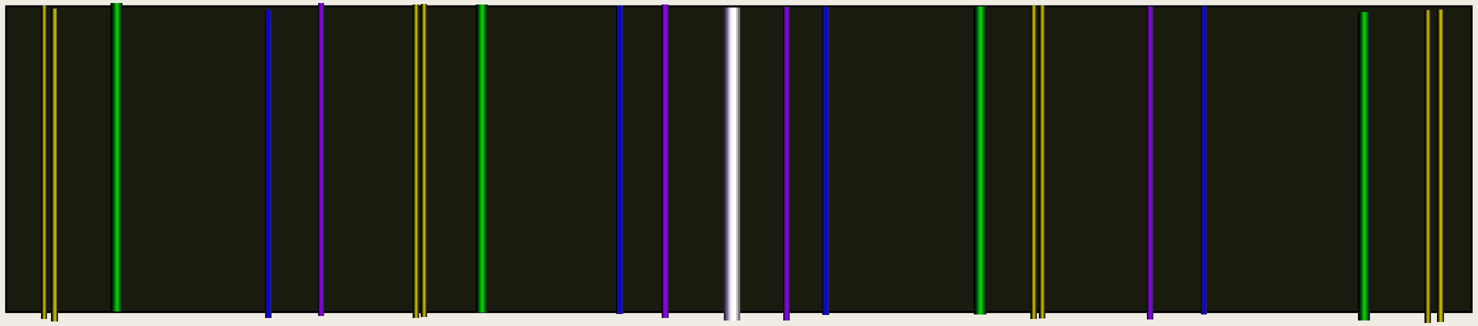
1. Measure the first-order diffraction angle of helium, determine the diffraction factor *d* according to the known helium spectral wavelength. Note that $d \cdot \sin\varphi = k \cdot \lambda (k=1)$

Color	Wavelength (nm)	Color	Wavelength (nm)	Color	Wavelength (nm)
Red(dark)	706.52	Green(light)	504.77	Blue	471.31
Red	667.82	Green	501.57	Purple	447.15
Yellow	587.56	Cyan	492.19	Purple (dark)	438.79

2. Measure the first-order diffraction angle of mercury lamp, find out the corresponding wavelength(λ) of mercury according to the diffraction formula $d \cdot \sin\varphi = k \cdot \lambda (k=1)$.

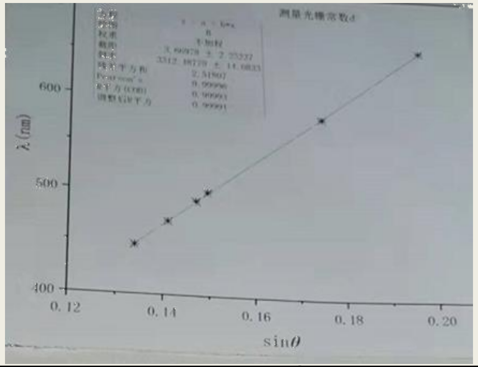


Spectrum of helium



Spectrum of mercury

V. Original data



d•sinφ = k•λ, (k=1)

Table 1. Helium lamp data

Color	$\lambda(nm)$	θ_M	θ_N	θ'_M	θ'_N	$\varphi = \frac{1}{4}(\lvert\theta'_M - \theta_M\rvert + \lvert\theta'_N - \theta_N\rvert)$	sin φ
Red	667.82	264º42'	84º46'	241º34'	61º39'		
Yellow	587.56	263º24'	83º28'	243º4'	63º8'		
Green	501.57	261º49'	81º53'	244º34'	64º38'		
Cyan	492.19	261º41'	81º45'	244º44'	64º48'		
Blue	471.31	261º21'	81º25'	245º7'	65º10'		
Purple	447.15	260º56'	80º59'	245º31'	65º35'		

Plot sinφ-λ curve for Helium.

The slope of the curve is d, $d = (\lambda_{Red}-\lambda_{Purple})/(\sin\varphi_{Red}-\sin\varphi_{Purple})$

Table 2. Mercury lamp data

Color	θ_M	θ_N	θ'_M	θ'_N	$\varphi = \frac{1}{4}\left(\lvert\theta'_M - \theta_M\rvert + \lvert\theta'_N - \theta_N\rvert\right)$	sin φ	$\lambda(nm)$
Orange	272º35’	92º33’	252º37’	72º34’			
Yellow	272º33’	92º31’	252º38’	72º36’			
Green	272º3’	92º2’	253º11’	73º9’			
Purple	270º6’	90º4’	255º6’	75º4’			

Using d•sinφ = k•λ, (k=1) to calculate λ for each color.

Note that d is obtained from page 11.

END