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雷逸鸣　　实验十九　分光计的调节和掠入射法测量折射率.　　11.20

1. 分光计的调节步骤.

1) 粗调：用眼睛估测，调节望远镜、平行光管的水平方向或垂直方向的调节螺钉，使望远镜、平行光管的光轴通过载物平台的中心转轴，并处于水平状态，调节载物平台下的三个调节螺钉，使小平台大致成为水平平面，然后固定载物台，锁紧螺钉，使游标盘与载物台固连，拧紧螺钉3-1，使刻度盘与望远镜相连.

2) 调节目镜：望远镜聚焦于无穷远点（自准直法），旋转调节望远镜目镜，使分划板上的"十"刻线看得最清楚，把平面镜放上载物小平台，如果粗调合适，通过缓慢转动游标盘，应能在望远镜目镜视野内找到亮"十"字反射像，转动游标盘将平面镜绕转轴转过180°，在目镜视野内仍然能找到亮"十"字反射像，松开螺钉3-3，前后移动望远镜套筒，直到亮"十"反射像看得清楚，调节这个反射像与分划板上刻线之间无视差，这时望远镜已聚焦于无穷远，拧紧螺钉3-3锁定套筒.

3) 调节望远镜光轴垂直于仪器转轴：调节的目的是使望远镜光轴与圆刻度盘平行，从而可从刻度盘准确读出与望远镜光轴的角坐标，现借助平面镜来调节，在(2)的基础上进一步把亮"十"字反射像调到"十"刻线上方十字交点处，（调节采用二分逼近法）.

4) 调节平行光管产生平行光，~~调然发出平行光~~ → 且无视差 调节狭缝使像大小合适.

I) 调节平行光管光轴与仪器转轴平行.

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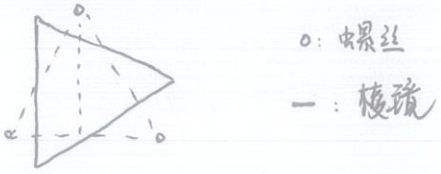
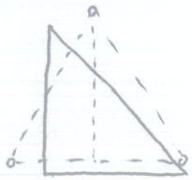
[6) 分光计的刻度圆盘角度读数].

2. 先调节小平台下的调节螺钉，把亮"十"字像移近MN线一些，再调节望远镜下面的螺钉，使亮"十"像落在MN线上，转动游标圆盘使平面镜转过180°反复以上方法，逐渐逼近，直到平面镜转动180°，前后，亮"十"字反射像都准确地落在MN线上.

3.



4.



5.

(1) 掠入射法：

$$n = \sqrt{1 + \left(\frac{\cos A + \sin\phi}{\sin A}\right)^2}$$

$$\frac{\partial \ln n}{\partial \phi} = \frac{1}{n} \cdot \frac{\frac{\partial}{\partial \phi}\left(\frac{\cos A + \sin\phi}{\sin A}\right)\frac{\cos\phi}{\sin A}}{1 + \left(\frac{\cos A + \sin\phi}{\sin A}\right)^2}$$

$$\frac{\partial \ln n}{\partial A} = \frac{1}{n} \frac{\frac{\partial}{\partial A}\left(\frac{\cos A + \sin\phi}{\sin A}\right)\left(1 - \frac{\cos^2 A + \sin\phi\cos A}{\sin^2 A}\right)}{1 + \left(\frac{\cos A + \sin\phi}{\sin A}\right)^2}$$

$$\therefore \frac{\sigma_n}{n} = \sqrt{\left(\frac{\partial \ln n}{\partial \phi}\sigma_\phi\right)^2 + \left(\frac{\partial \ln n}{\partial A}\sigma_A\right)^2}$$

$$\sigma_n = \frac{1}{n}\sqrt{\left[\left(\frac{\cos A + \sin\phi}{\sin A}\right)\frac{\cos\phi}{\sin A}\sigma_\phi\right]^2 + \left[\left(\frac{\cos A + \sin\phi}{\sin A}\right)\left(1 - \frac{\cos^2 A + \sin\phi\cos A}{\sin^2 A}\right)\sigma_A\right]^2}$$

(2) 最小偏向角法：

$$n = \frac{\sin\frac{A+\delta_m}{2}}{\sin\frac{A}{2}}$$

$$\frac{\partial \ln n}{\partial A} = \frac{\frac{1}{2}\cos\frac{A+\delta_m}{2}}{\sin\frac{A+\delta_m}{2}} - \frac{\frac{1}{2}\cos\frac{A}{2}}{\sin\frac{A}{2}} = \frac{1}{2}\cot\frac{A+\delta_m}{2} - \frac{1}{2}\cot\frac{A}{2}$$

$$= \frac{1}{2}\left[\cot\frac{A+\delta_m}{2} - \cot\frac{A}{2}\right]$$

$$\frac{\partial \ln n}{\partial \phi} = \frac{\frac{1}{2}\cos\frac{A+\delta_m}{2}}{\sin\frac{A+\delta_m}{2}} = \frac{1}{2}\cot\frac{A+\delta_m}{2}$$

$$\therefore \sigma_n = n \cdot \sqrt{\left[\frac{1}{2}\left(\cot\frac{A+\delta_m}{2} - \cot\frac{A}{2}\right)\sigma_A\right]^2 + \left[\frac{1}{2}\cot\frac{A+\delta_m}{2}\,\sigma_{\delta_m}\right]^2}$$

分光计.

A+
预习
11.22

1. 棱镜折射率测量:

1) 测量三棱镜顶角A:

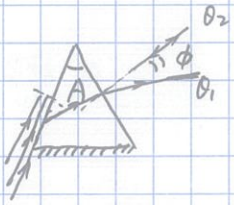
θ_1	θ_1'	θ_2	θ_2'
129°01'	309°08'	9°06'	189°06'
129°00'	309°08'	9°05'	189°06'
129°00'	309°09'	9°06'	189°06'

$\bar{\theta}_1 = 129°04'20'' \pm 1'02''$

$\bar{\theta}_2 = 9°05'50'' \pm 1'01''$

$\therefore \angle A = \bar{\theta}_1 - \bar{\theta}_2 = 180° - (\bar{\theta}_1 - \bar{\theta}_2) = 60°01'30'' \pm 1'24''$

2) 掠入射法测折射率. (Na灯). $\lambda = 589.00\ nm$.



θ_1	θ_1'	θ_2	θ_2'
327°34'	147°30'	189°01'	8°59'
327°37'	147°33'	189°00'	9°00'
327°35'	147°32'	189°00'	8°59'

$\bar{\theta}_1 = 147°33'30'' \pm 2'25''$

$\bar{\theta}_2 = 188°59'40'' \pm 1'05''$

$\phi = 41°26'10'' \pm 2'39''$

$n = 1.6482 \pm 0.0011$

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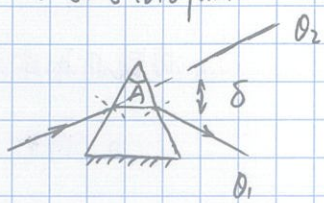
3) 最小偏向角法测折射率（Hg绿光） λ=和546.07nm



θ_1	θ_1'	θ_2	θ_2'
69°58"	250°00"	124°06'	304°10'
69°59"	250°01"	124°03'	304°10'
70°00"	250°01"	124°04'	304°10'

$\bar{\theta}_1$ = 69°59'50" ± 1'10"

$\bar{\theta}_2$ = 124°07'10" ± 1'8"

δ = 54°7'20" ± 1'37"

n = 1.6625 ± 0.0005

4) 最小偏向角法测（Hg灯其他谱线）对应折射率.

① 暗紫 λ = 404.66 nm.

θ_1	θ_1'	θ_2	θ_2'	$\bar{\theta}_1$	$\bar{\theta}_2$
68°21'	248°28'	125°57'	306°00'	68°24'30"	125°58'30"

δ = 57°34' ± 1'

n = 1.6935 ± 0.0005

② 紫 λ = 435.84nm

θ_1	θ_1'	θ_2	θ_2'	$\bar{\theta}_1$	$\bar{\theta}_2$
~~68°26'~~ 69°06'	249°10'	125°34'	305°39'	69°08'	125°36'30"

δ = 56°28'30" ± 1'

n = 1.6838 ± 0.0005

③ 黄光. $\lambda = 579.07\,nm$.

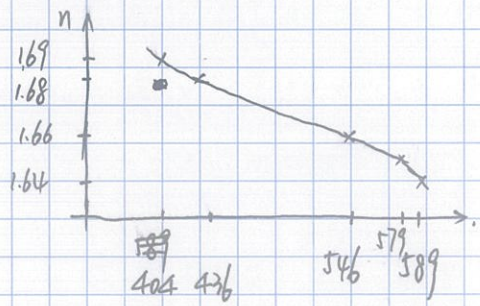
θ_1	θ_1'	θ_2	θ_2'	$\bar{\theta}_1$	$\bar{\theta}_2$
70°11'	250°17'	123°53'	303°59'	70°14'	123°56'

$\delta = 53°42' \pm 1'$

$n = 1.6586 \pm 0.0005$

2. 棱镜折射率色散关系.

$n = n(\lambda)$.



(大致规律)

3. 光栅测量.

1) Hg灯绿线测光栅常数.

θ_{-2}	θ_{-1}	θ_0	θ_1	θ_2
124°38'	102°52'	83°40'	64°30'	42°44'
304°41'	282°56'	~~263°45'~~	244°33'	222°47'

"平均值": 124°40' 102°54' 83°42' 64°31' 42°45'

$\Delta\theta = 19°11'$.

$d\sin\theta = k\lambda$.

$\therefore d = \dfrac{k\lambda}{\sin\Delta\theta} = \dfrac{(1.592 \pm 0.0011)\,\mu m}{(1.661 \pm 0.0011)\,\mu m}$