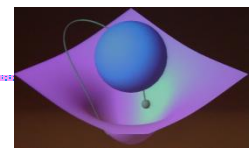
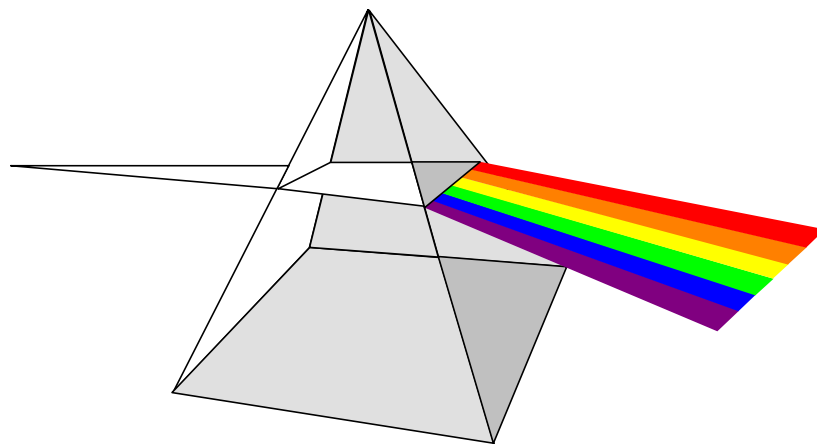


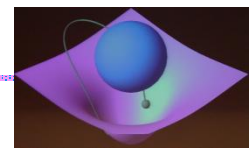
分光计的调节与使用

—— 折射率的测量



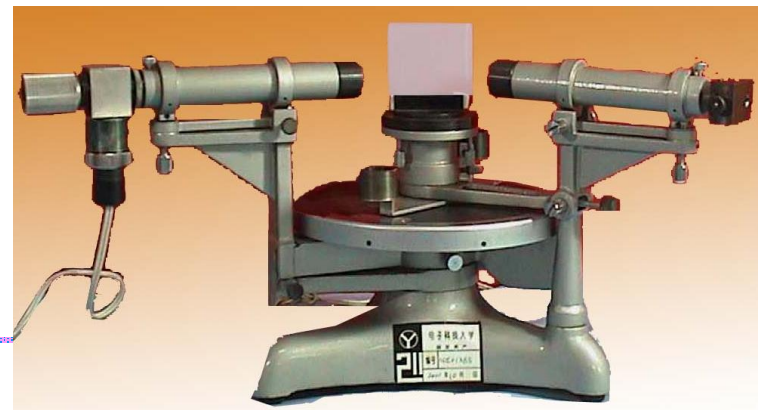
实验目的

1. 了解分光计的结构及基本原理；
2. 学习光学系统的自准直原理和方法；
3. 掌握分光计的基本调整方法与技术；
4. 系统误差的产生与消除；
5. 观察棱镜光谱；
6. 利用分光计进行一些光学参数的测量（三棱镜的顶角、折射率）。



思考与讨论的问题

1. 分光计的用途？测定光线偏转角度
2. 分光计的组成部分、结构？
3. 调整要求、如何进行调整？
4. 光学系统的自准自原理和方法？
5. 系统误差的消除。



实验仪器介绍

分光计主要组成部分

望远镜

平行光管

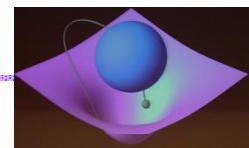
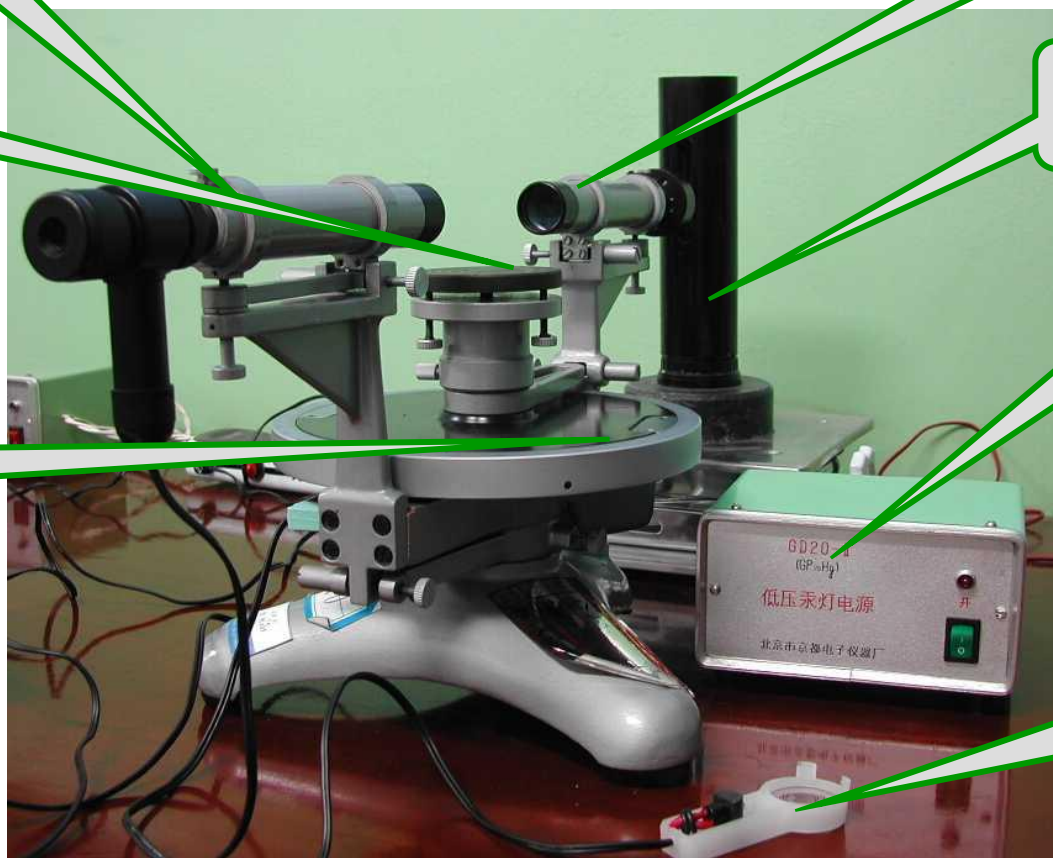
载物盘

汞灯

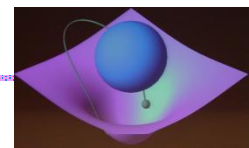
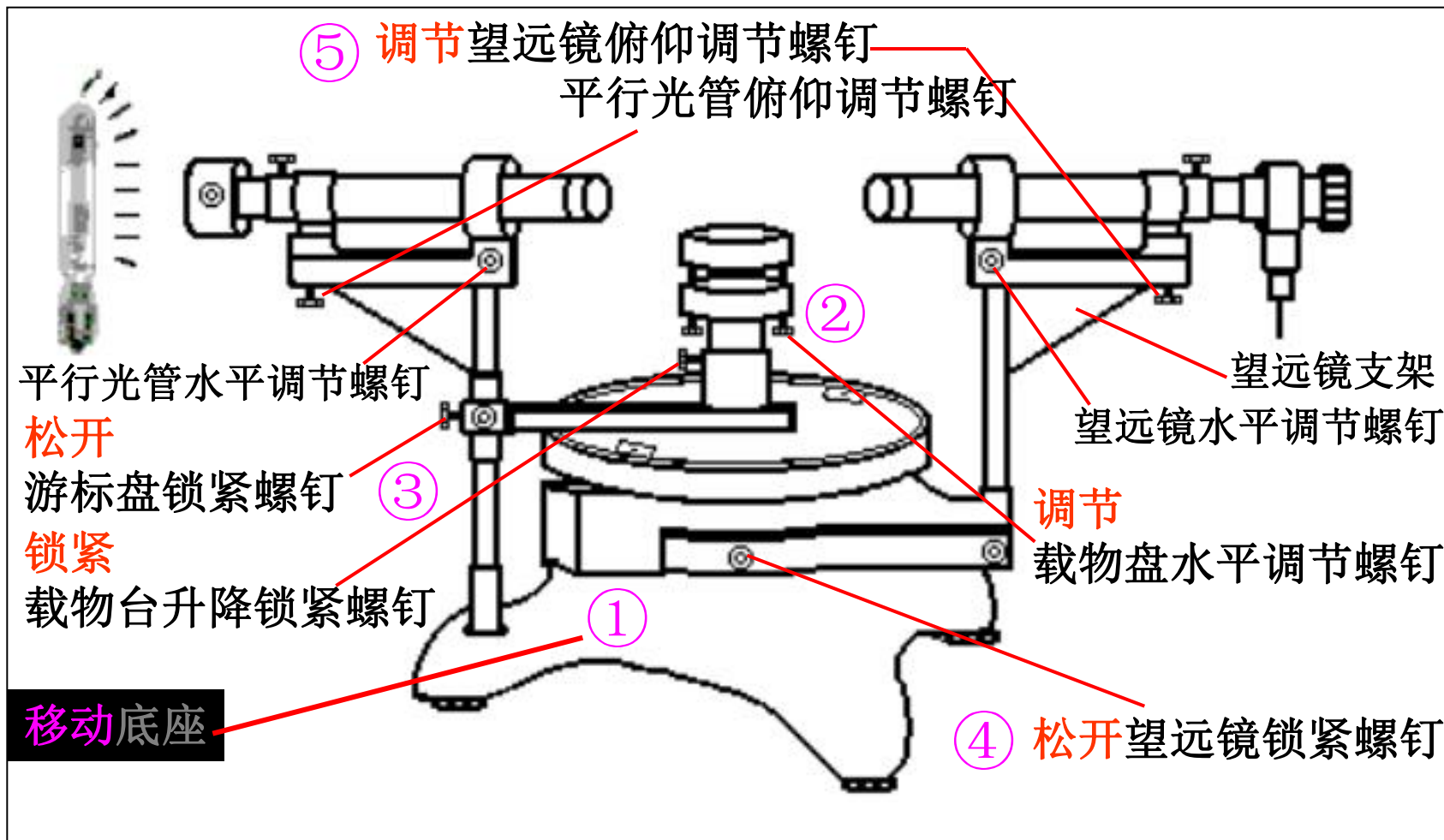
读数盘

光源控制

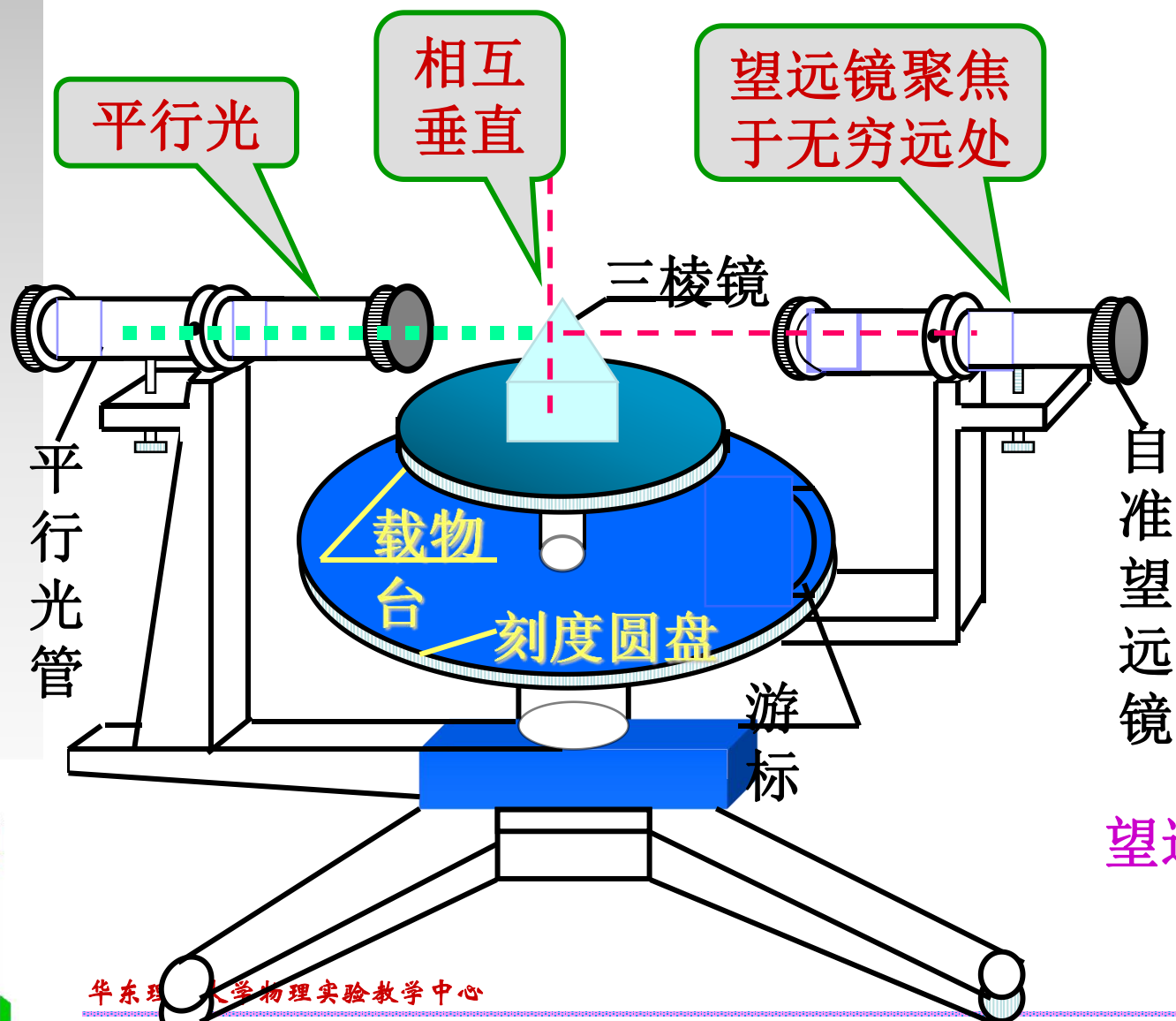
读数照明



仪器结构与作用



分光计的调节要求



1. 望远镜聚焦无穷远, 即接收平行光。

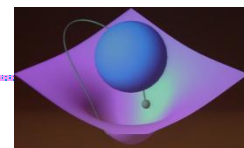
2. 望远镜光轴与分光计的中心轴相互正交。

3. 平行光管出射平行光, 其光轴与分光计的中心轴线相互正交。

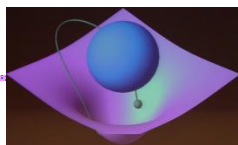
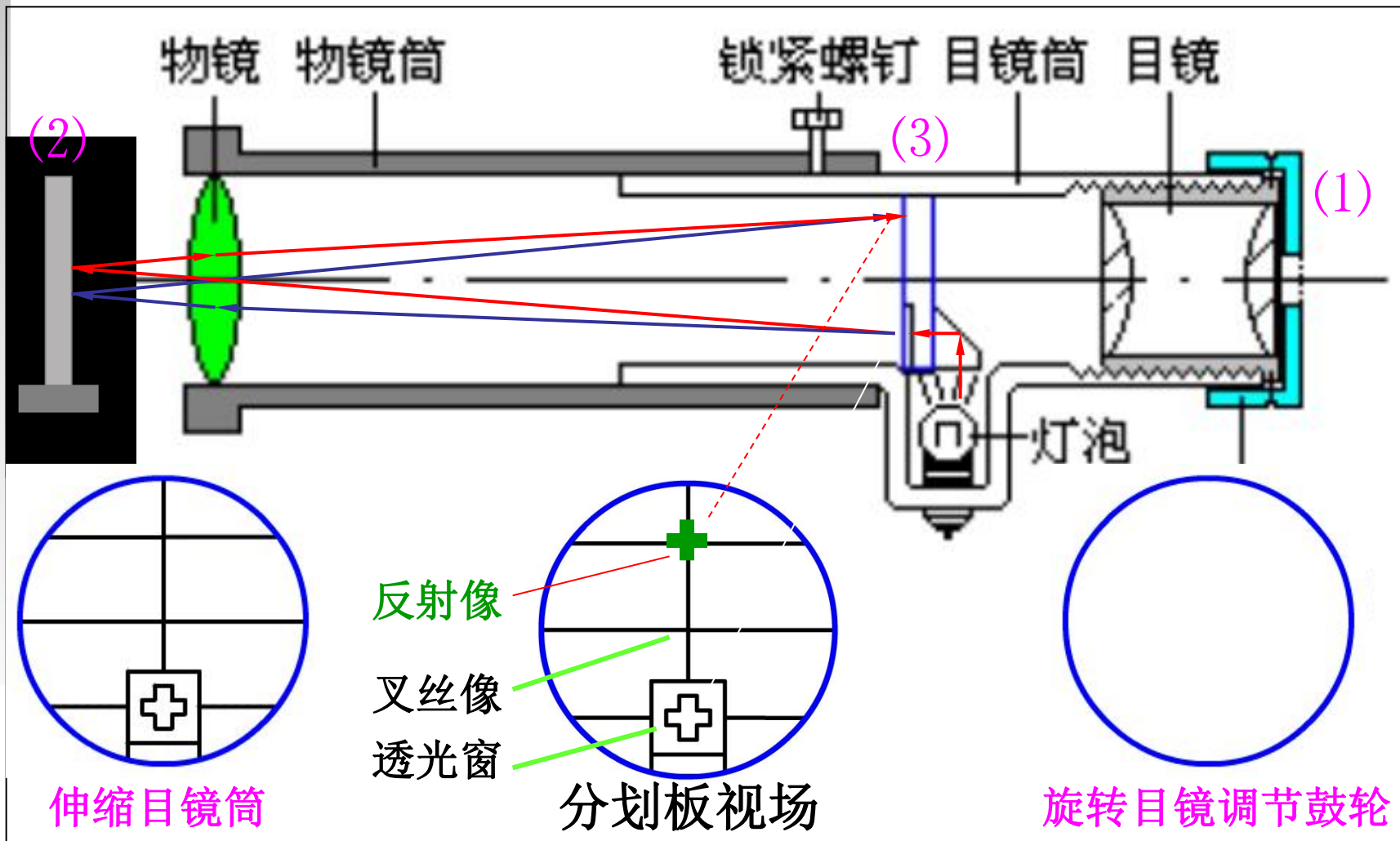
望远镜与平行光管
等高共轴



中国航天

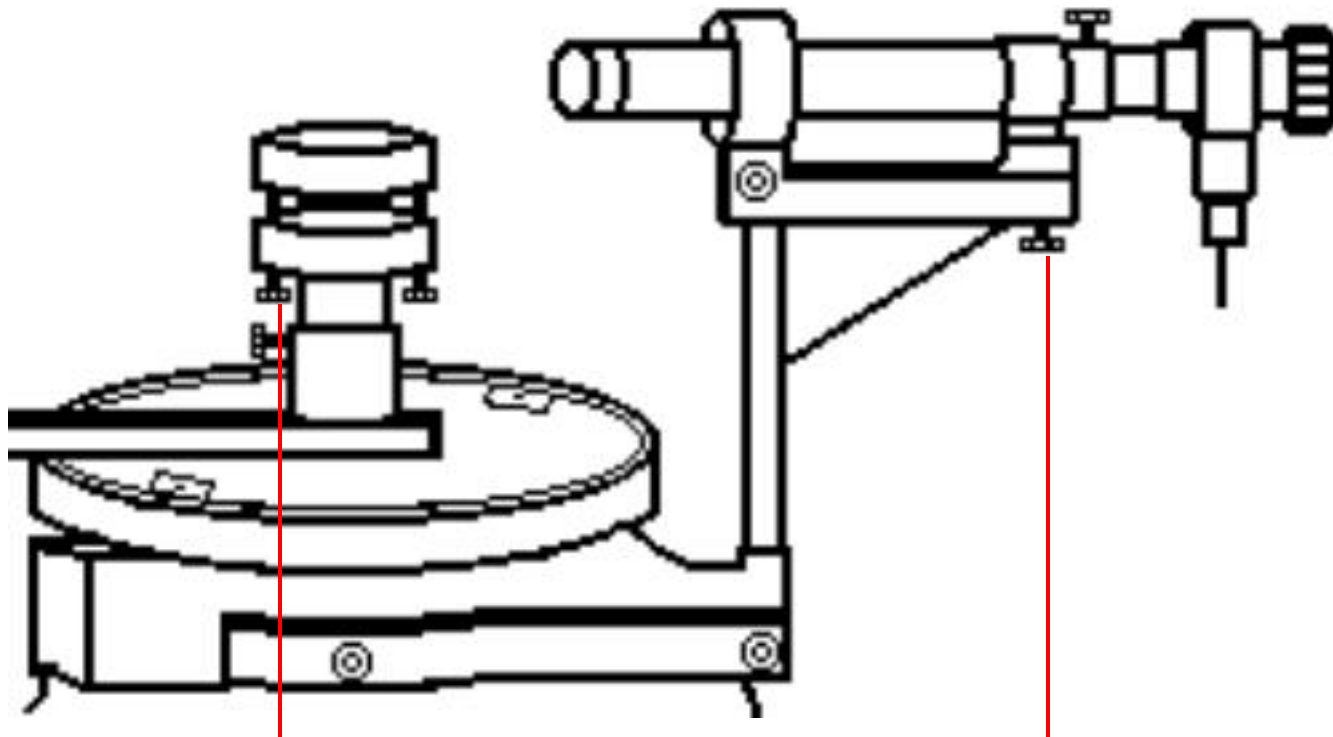


自准直法将望远镜调焦到无穷远

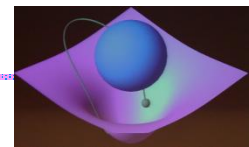


调节望远镜光轴与中心转轴垂直

粗调

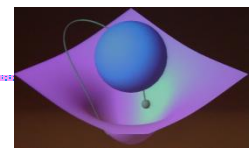
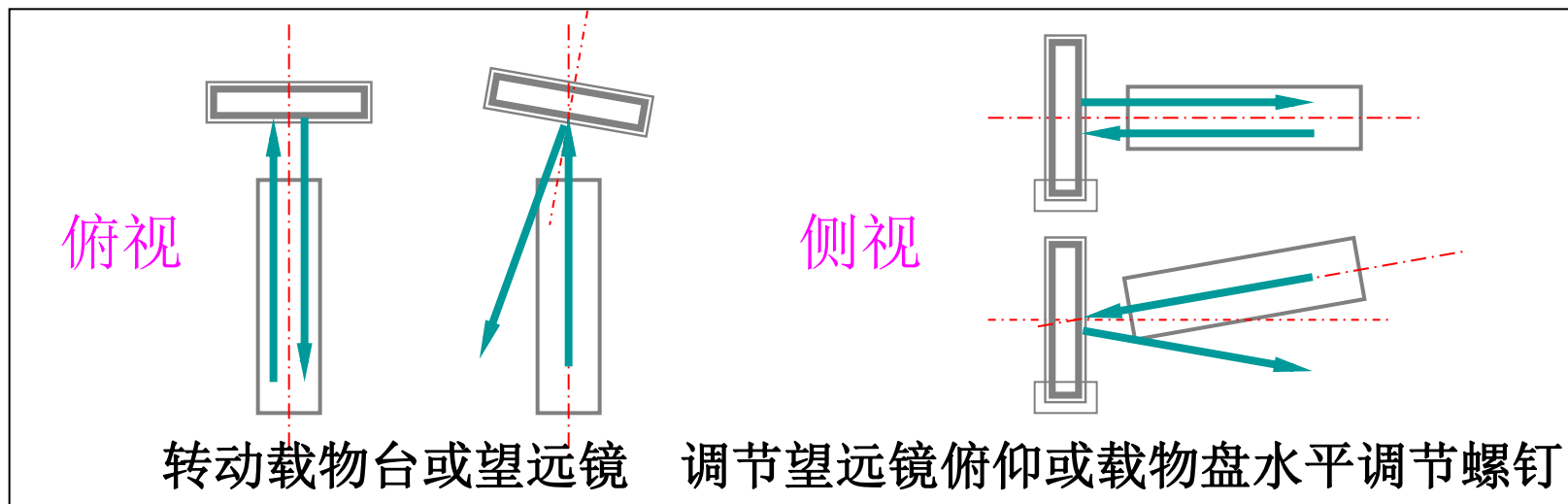


调节载物盘水平调节螺钉或望远镜俯仰调节螺钉

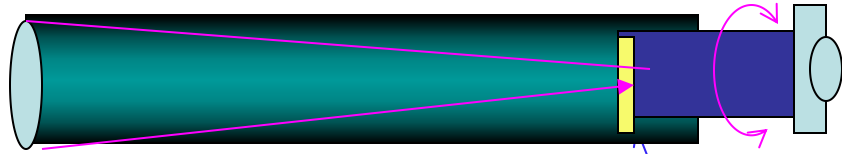
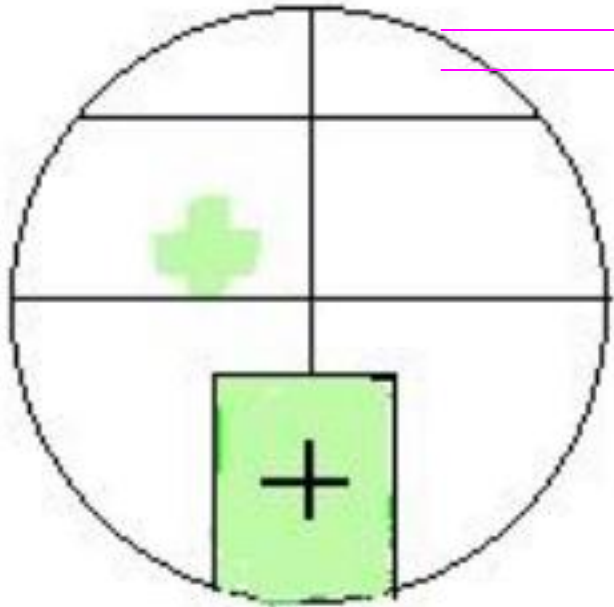


观察不到反射像的原因

- 目镜中观察到的叉丝和透光窗中黑色十字的像模糊。（转动目镜调节鼓轮）
- 望远镜没有聚焦于无穷远。（松开目镜筒锁紧螺钉，前后移动目镜筒）
- 平面反射镜的镜面与望远镜的光轴不垂直。

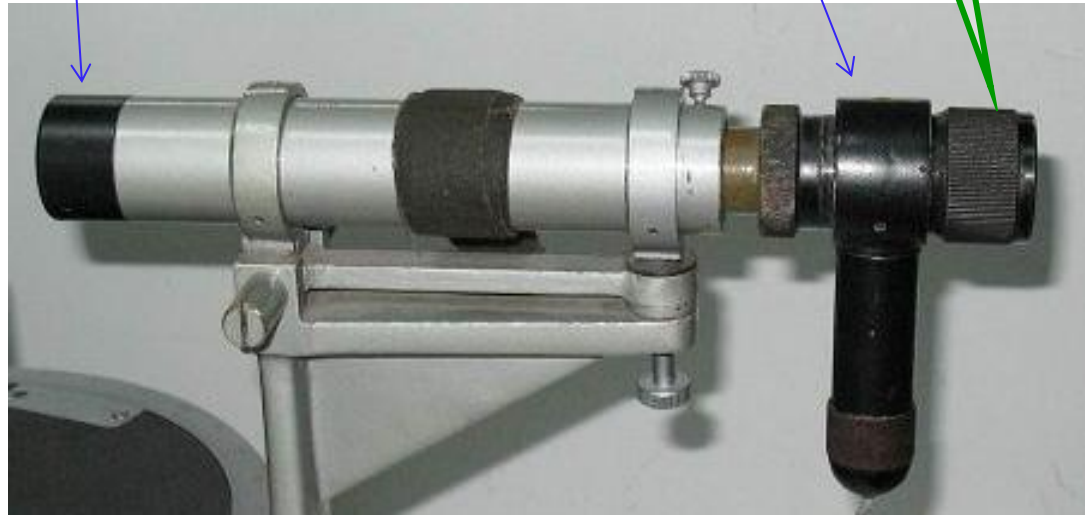


望远镜目镜聚焦



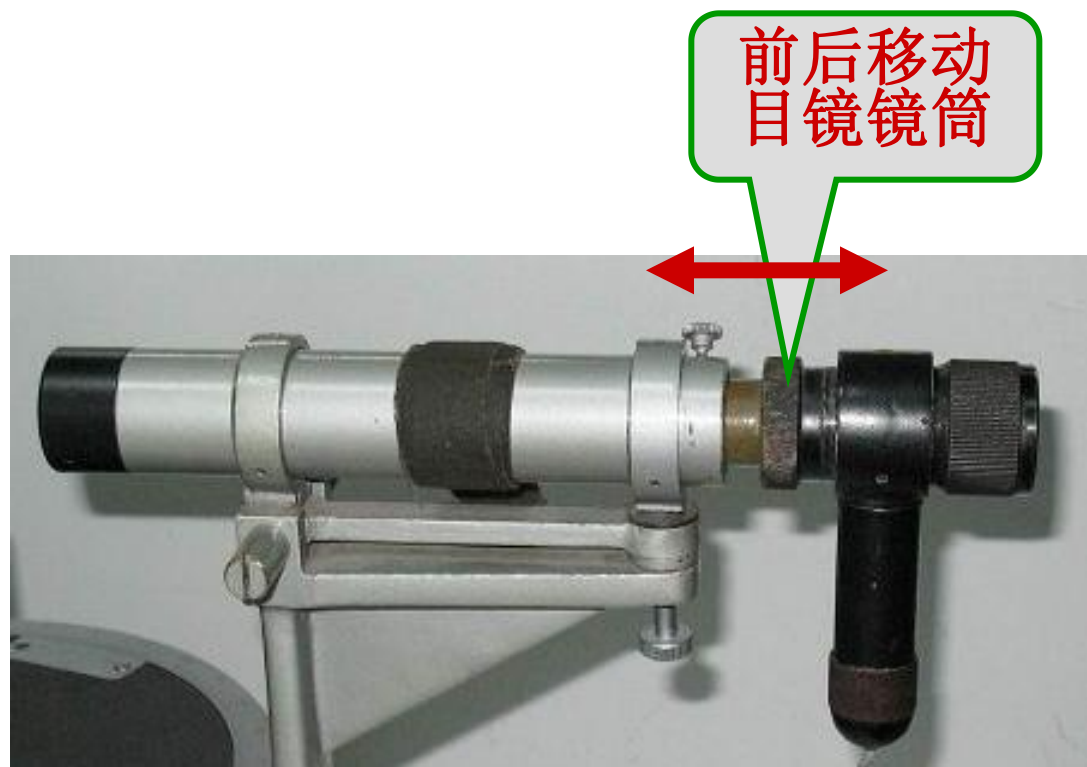
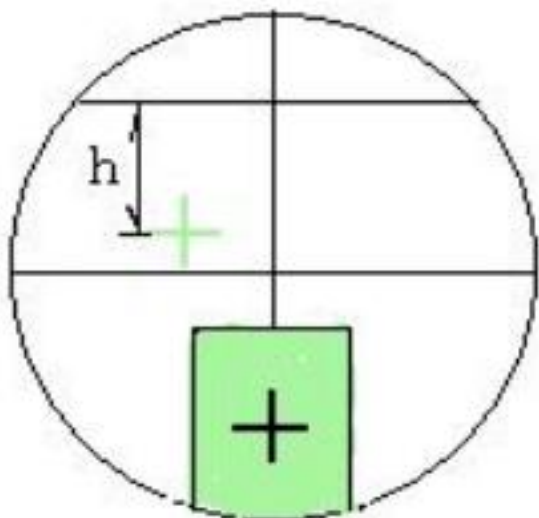
物镜

旋转
目镜

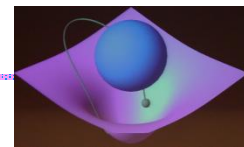


- 明视距离
- 聚焦
- 消除视差

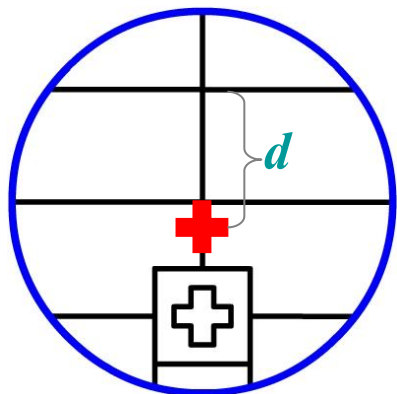
望远镜聚焦



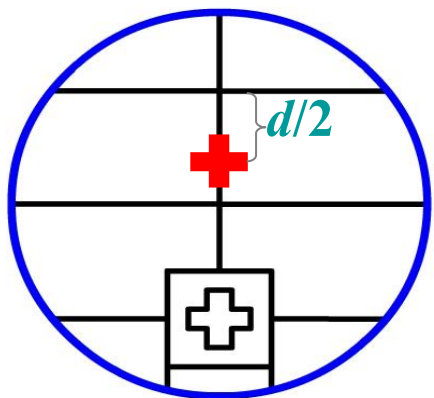
- 明视距离
- 聚焦
- 消除视差



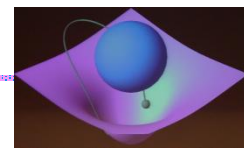
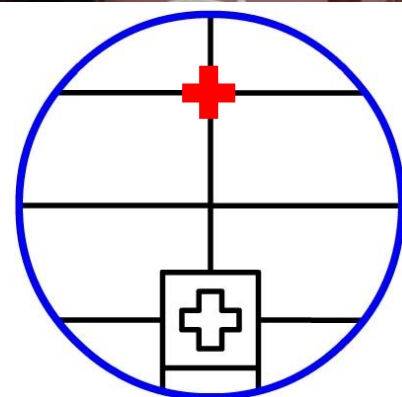
减半逐次逼近法 - 望远镜光轴与分光计中心轴垂直



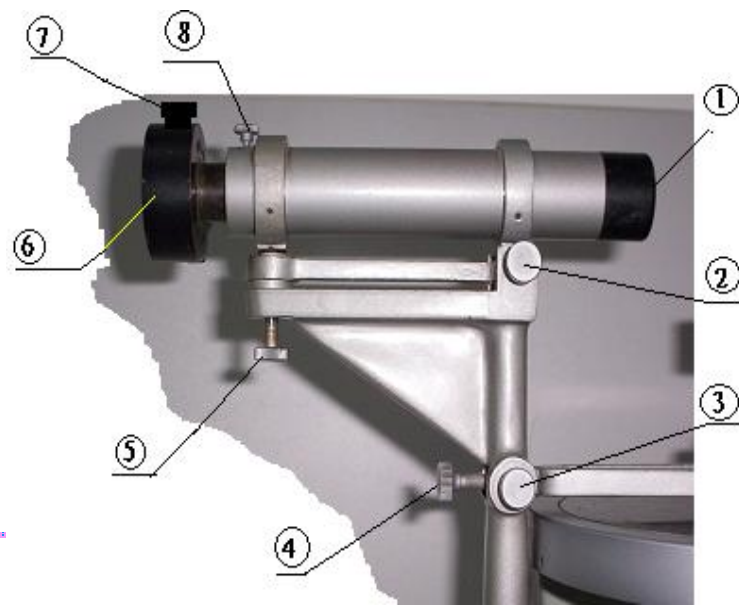
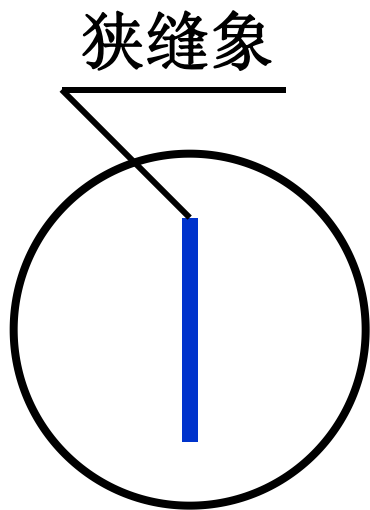
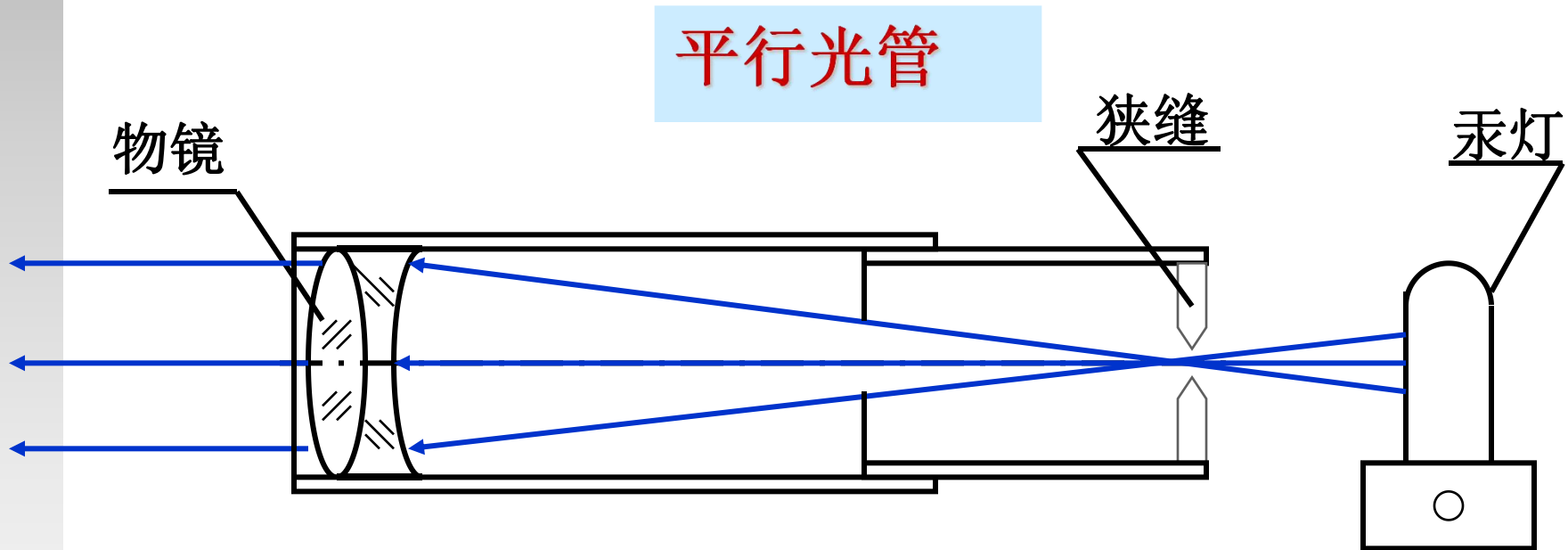
调节望远镜俯仰调节螺钉



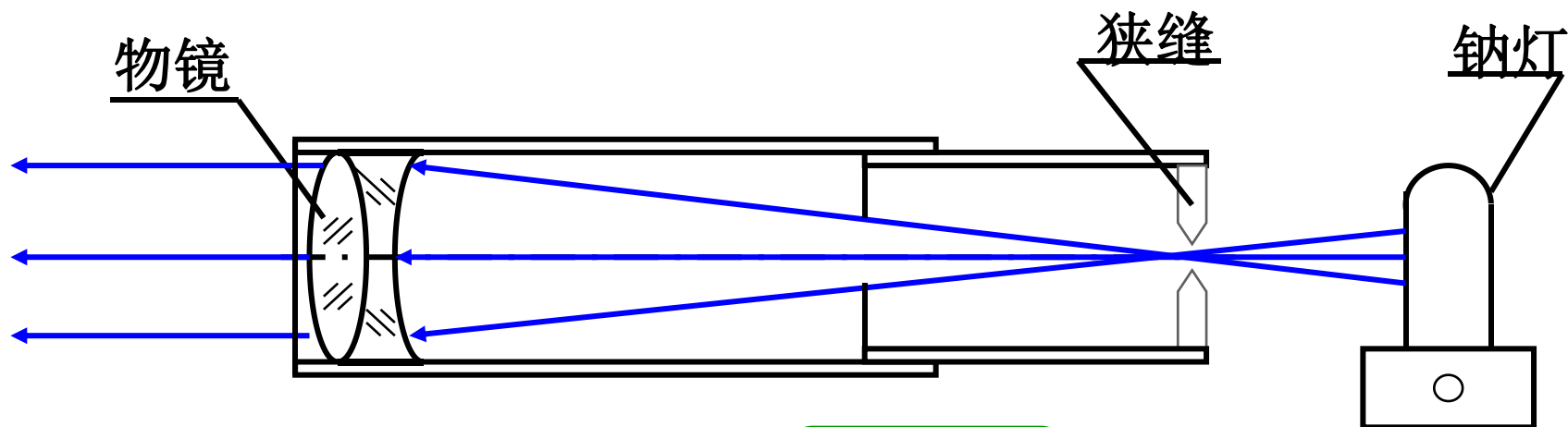
调节载物盘水平调节螺钉



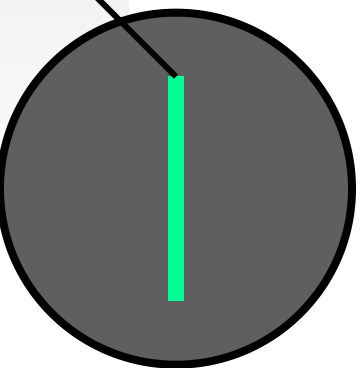
平行光管：由狭缝和准直透镜组成



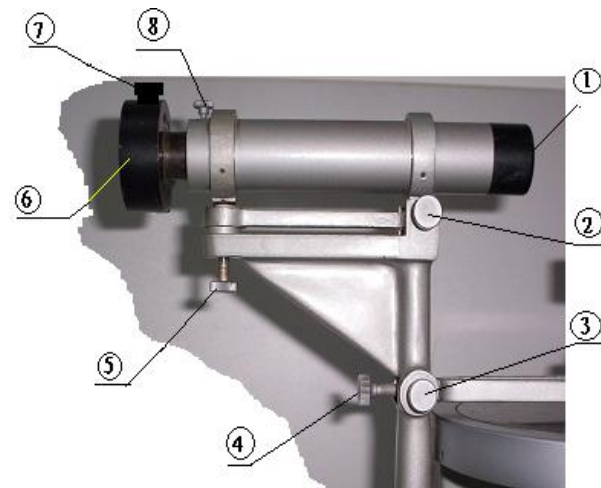
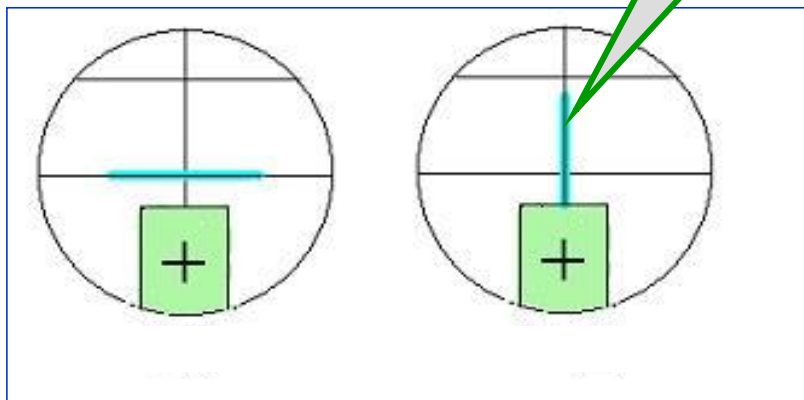
平行光管调节



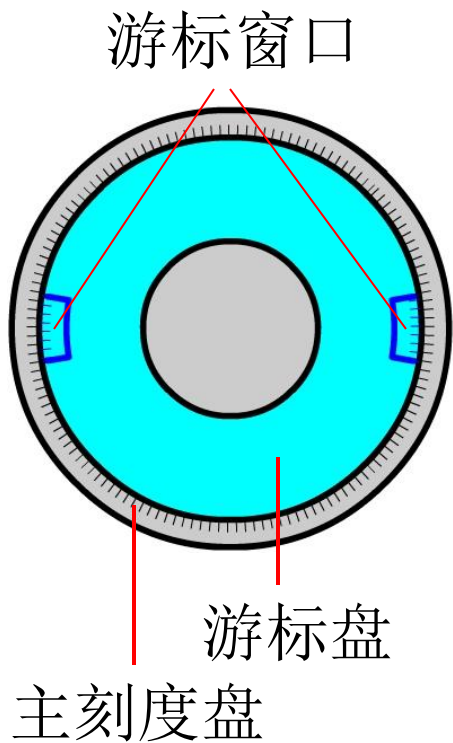
狭缝象



望远镜中观察

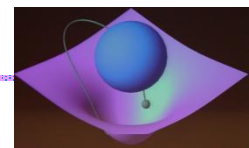


角游标读数

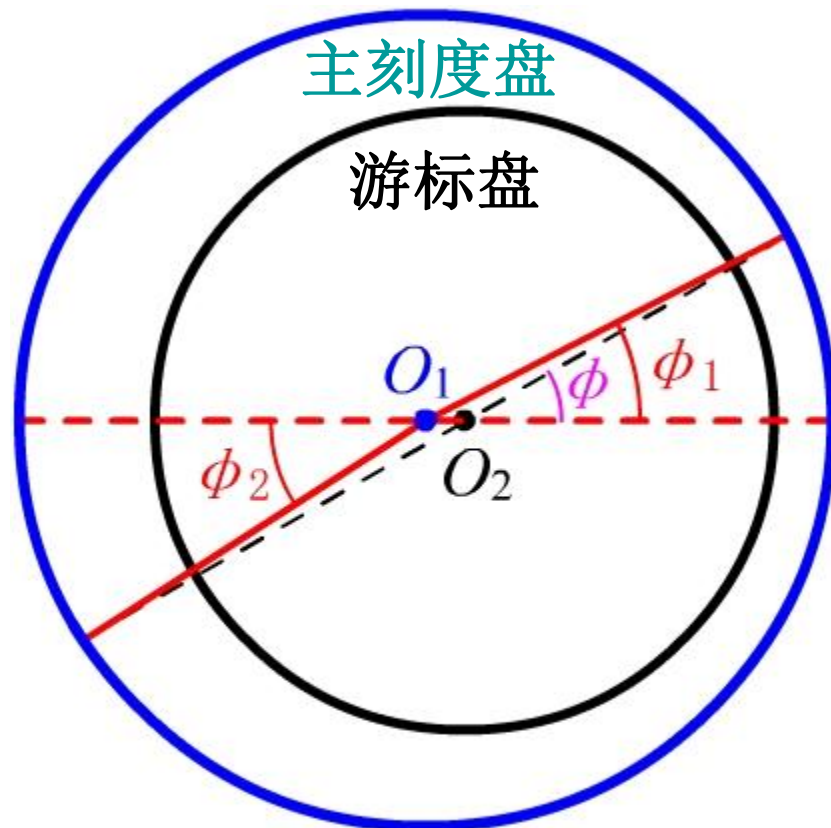
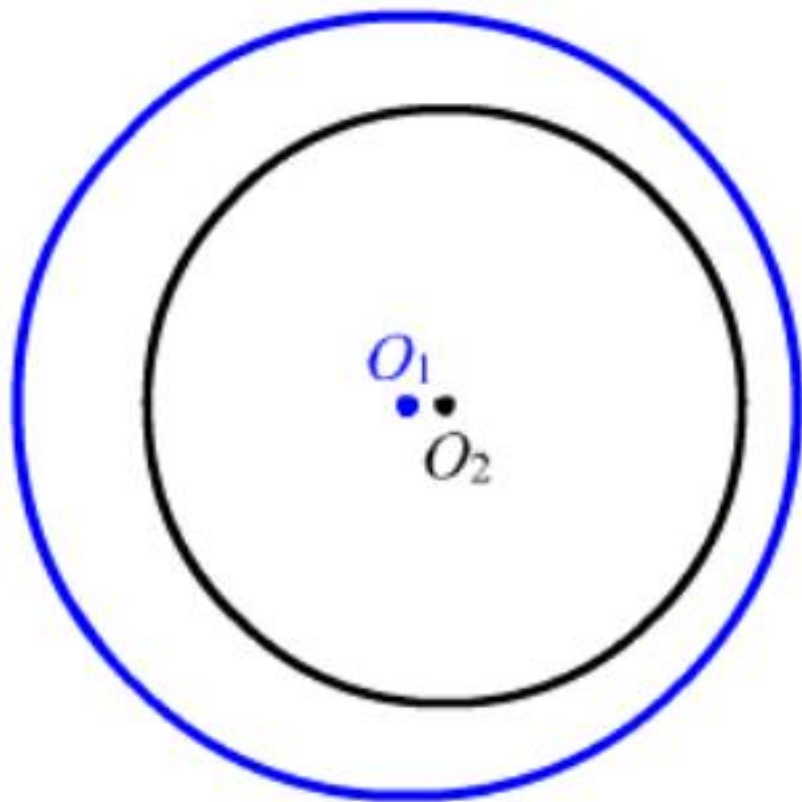


$22^{\circ}30'$

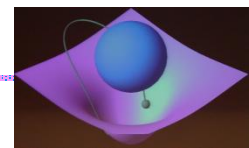
$22^{\circ}39'$



偏心误差



$$\phi = (\phi_1 + \phi_2) / 2$$

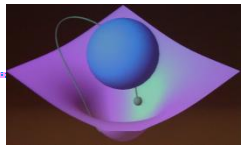
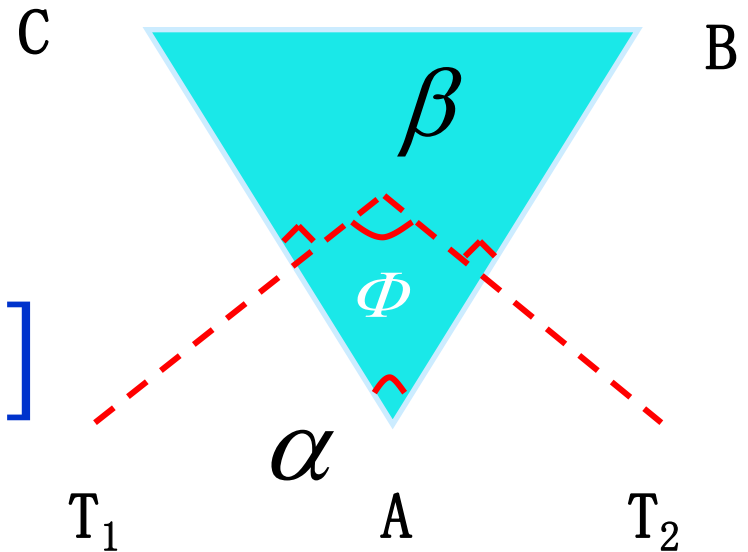


自准直法测量三棱镜顶角

自准直法测三棱镜顶角 α

$$\Phi = \frac{1}{2} [|T_2 - T_1| + |T_2' - T_1'|]$$

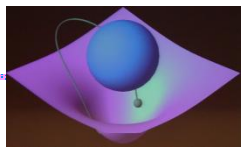
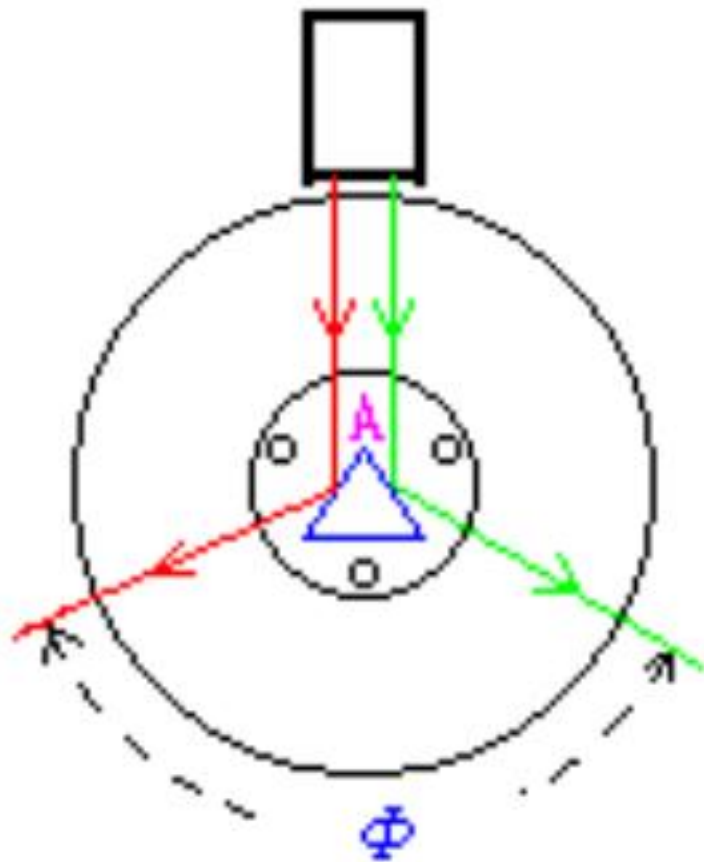
$$\bar{\alpha} = 180^\circ - \bar{\Phi}$$



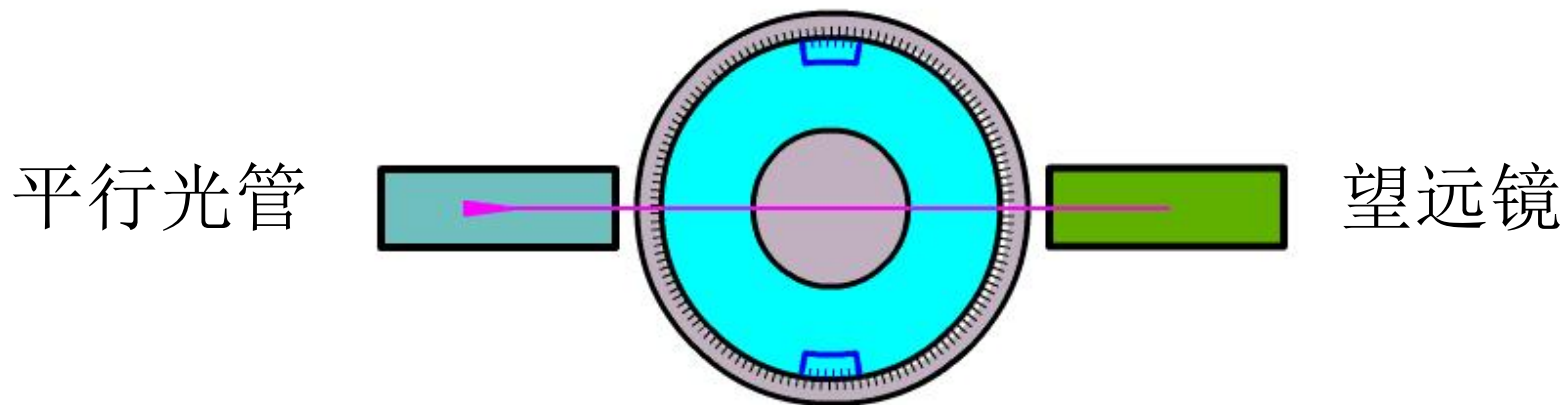
反射法测三棱镜顶角

- 平行光管出射的平行光射向三棱镜的两个光学表面，用望远镜分别接收两表面的反射光，就可计算出两束光的夹角 Φ 。由几何关系可以证明 Φ 与三棱镜顶角 A 的关系为：

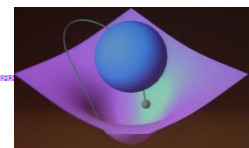
$$\Phi = 2A$$



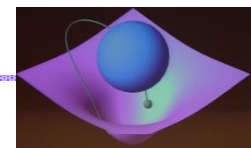
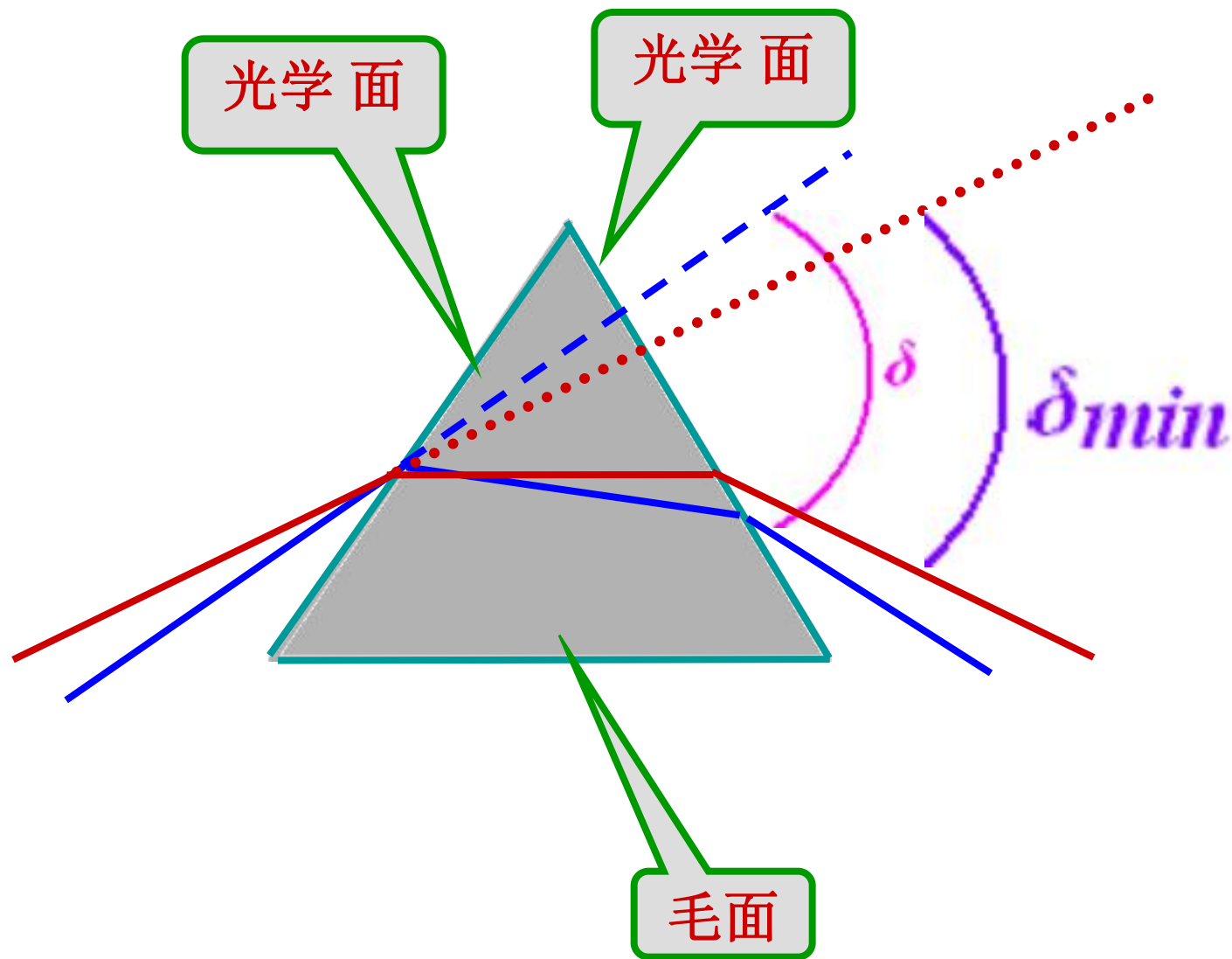
动画演示



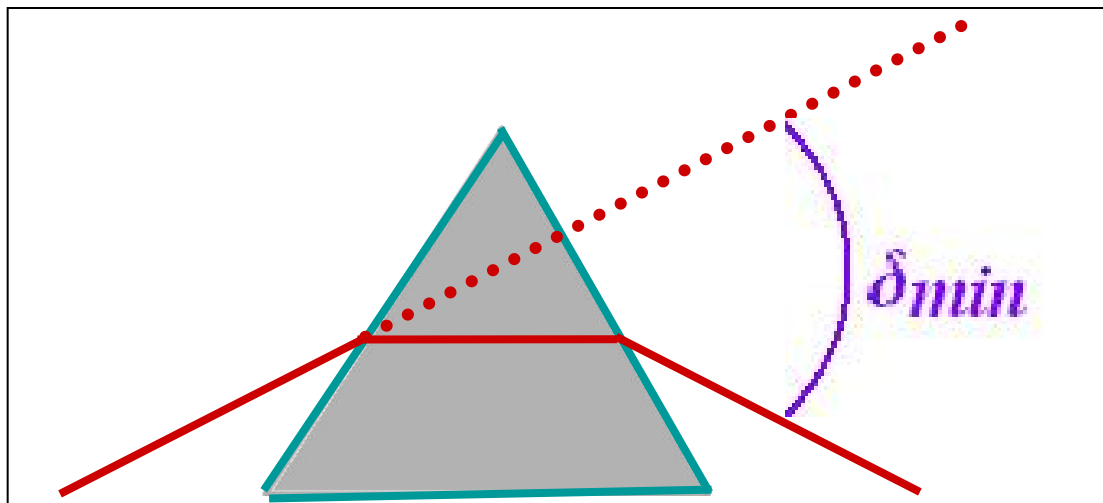
$$A = (|\alpha_2 - \alpha_1| + |\beta_2 - \beta_1|) / 4$$



偏向角与最小偏向角



最小偏向角法测三棱镜折射率

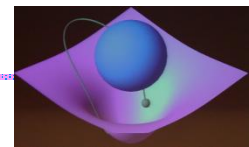


$\delta = \delta_{min}$ 时

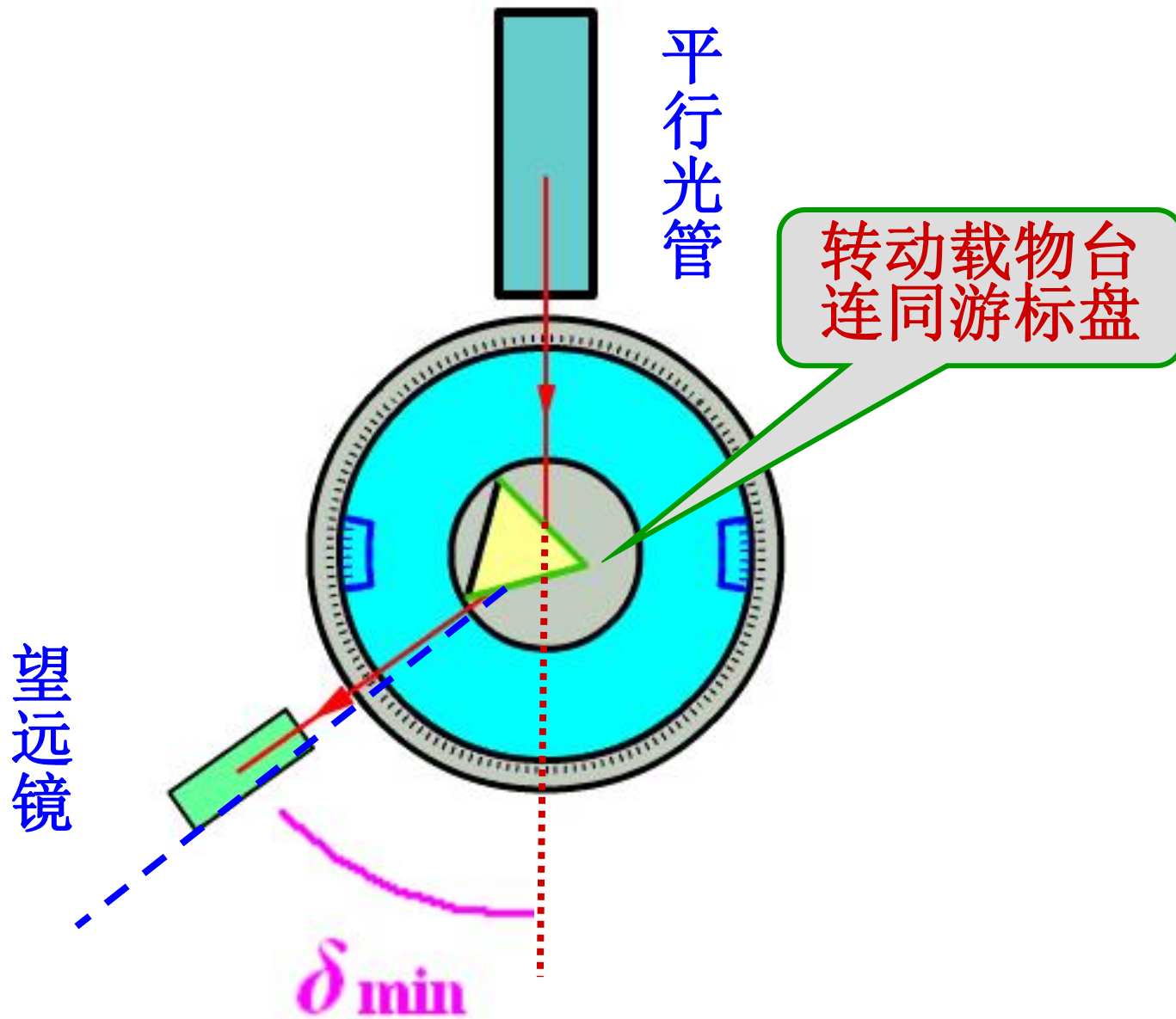
$$n = \frac{\sin \frac{\delta_{min} + \alpha}{2}}{\sin \frac{\alpha}{2}}$$

三棱镜顶角

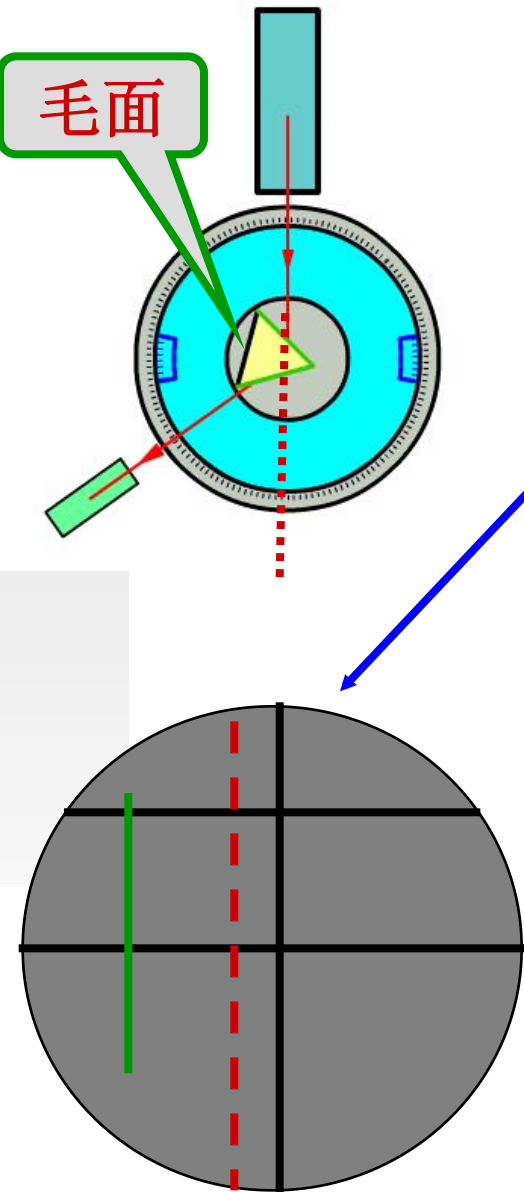
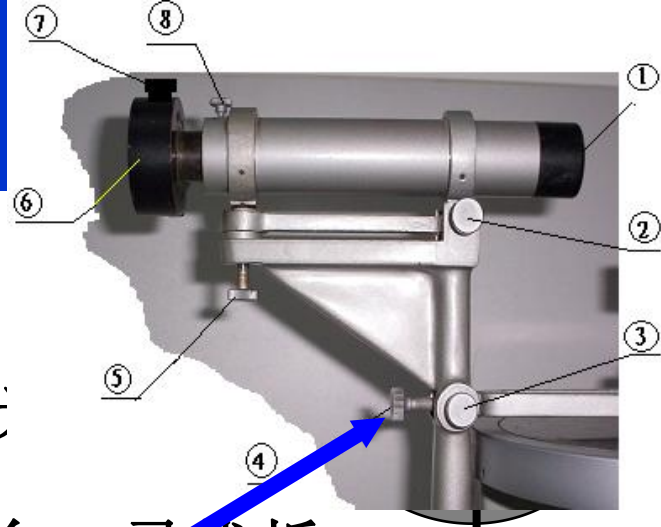
自准直法测



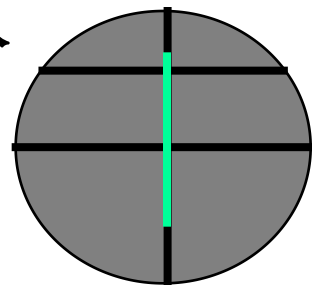
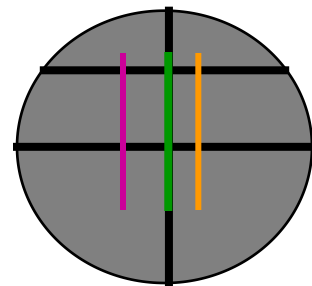
如何找最小偏向角



测量最小偏向角

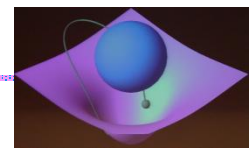


1. 按图示放置三棱镜;
2. 转动望远镜, 观察汞灯;
3. 转动游标盘连同载舞台, 寻找折回点 (紧固游标盘螺丝);
4. 将望远镜的十字准线的竖线对准折回点 (所要测量的谱线), 读出出射光的方位角 (T_5 、 T_5');
5. 将望远镜对准平行光管, 读出入射光的方位角 (T_6 、 T_6');



数据处理要求

1. 计算三棱镜的顶角及其不确定度；
2. 计算三棱镜对汞灯黄光、紫光和绿光的最小偏向角，得到玻璃的折射率及其不确定度；



注意事项

1. 严禁用手摸光学表面, 也不可用一般布或纸擦拭。
2. 狭缝不能闭拢, 否则会损坏狭缝。
3. 分光计是较精密的光学仪器, 各部件和螺丝转动时要轻, 部件不要用力过大, 以免损坏零件。
4. 调节过程中, 每一步调节好之后, 在调节下一步的时候, 不要再破坏原来的调节。
5. 掌握“先粗调, 后细调”的原则

不要把光源
当作手柄转
动望远镜!

