

# Preparation for an astronomical observation 天文观测准备

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# Objectives

## 学习目标

- How to choose a suitable time and place.  
■ 如何选择合适的时间和地点
- What equipment should I bring?  
■ 需要携带哪些设备
- What kind of astronomical objects can I observe?  
■ 观测什么天体
- How to plan the departure?  
■ 如何规划行程
- Learning how to use the program Stellarium (an introduction).  
■ 学习使用“虚拟天文馆”



# Place 地点

- Objects of interest when observing from cities:  
Sun, Moon, planets and constellations.
- 城市可以观测的天体：太阳、月亮、行星、星座。
- Problems: Dark skies reduced by light pollution:  
streetlights, security lights, advertising signs and  
motor vehicles.
- 问题：被光污染影响的暗夜、路灯、安保照明、  
广告牌、汽车灯光。



# Date

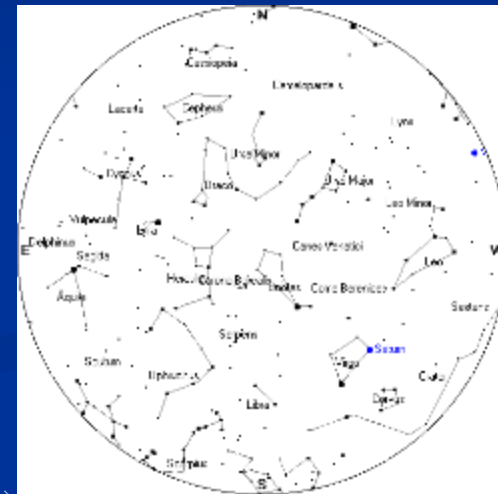
## 日期

- Try to choose a time of good weather with no clouds.
- 好天气、无云  
See for example: [www.accuweather.com](http://www.accuweather.com).
- 利用网站查询
- Moon Phase: Crescent?. Check the phase when planning the date of the observation.
- 月相：新月？规划日程的时候查好月相。
- Arrive early enough to mount all the instruments during the daylight.
- 提早到达观测地，利用日光架好全部设备



# Available Material 可用设备

- Celestial Map (on paper, phone or computer)
- 星图 ( 纸质的、手机里或电脑上 )
- Red light flashlight
- 红光手电
- Food, drink and warm clothes
- 食物、水、厚衣服
- Binoculars, telescope, if available
- 双筒望远镜、望远镜
- Alternatives if there are clouds:  
Stories, books, DVDs and web resources.
- 有云时候的备选：故事书、书籍、DVD、网站



# Observations with the naked eye

## 裸眼观测

- Applications for iPhone, iPad and Android
- 手机、平板电脑上的应用
- Recognition of constellations 辨认星座
- Best with Moon between new and crescent
- 最好是新月前后



SkyMap



Star Map

# Observations with the naked eye

## 裸眼观测

### Northern Hemisphere Constellations

#### 北半球星座

Ursa Major, Ursa Minor, Cassiopeia, Cygnus,  
Lyra, Hercules, Bootes, Corona Borealis, Orion,  
Canis Major, Auriga, Pegasus and the zodiac  
大熊座、小熊座、仙后座、天鹅座、天琴座、  
武仙座、牧夫座、北冕座、猎户座、大犬  
座、御夫座、飞马座、黄道。

### Stars, Clusters, Galaxies

#### 恒星、星团、星系

Polaris, Sirius, Aldebaran, Betelgeuse, Rigel,  
Arcturus, Antares, Pleiades and Andromeda

北极星、天狼星、毕宿五、参宿四、参宿  
七、大角星、心宿二、昴星团、仙女座大  
星云。

### Southern Hemisphere Constellations

#### 南半球星座

Southern Cross, Carina, Puppis, Vela, Orion,  
Canis Major and the zodiac

南十字座、船底座、船尾座、船帆座、猎户  
座、大犬座和黄道。

### Stars, Clusters, Galaxies

#### 恒星、星团、星系

Alpha Centauri, Omega Centauri, 47 Tucanae  
and the Magellanic Clouds (there is no "southern  
pole star")

半人马 $\alpha$ 、半人马 $\Omega$ 、杜鹃47、大小麦云（没  
有“南极星”）





# Observations with the naked eye

## 用肉眼观察

- Change of the Moon's phases and its motion through the constellations for one month.  
一个月内月相的变化和它在星座中的运动。

- Movement of the planets: Venus, Mars, Jupiter and Saturn for one month and one year.

行星的运动。金星、火星、木星和土星的一个月 and 一年。

- Meteor showers: Perseids, Quadrantids, Leonids, among others depending on the date and the hemisphere.

流星雨。英仙座流星雨、象限仪座流星雨、狮子座流星雨，以及其他取决于日期和半球的流星雨。



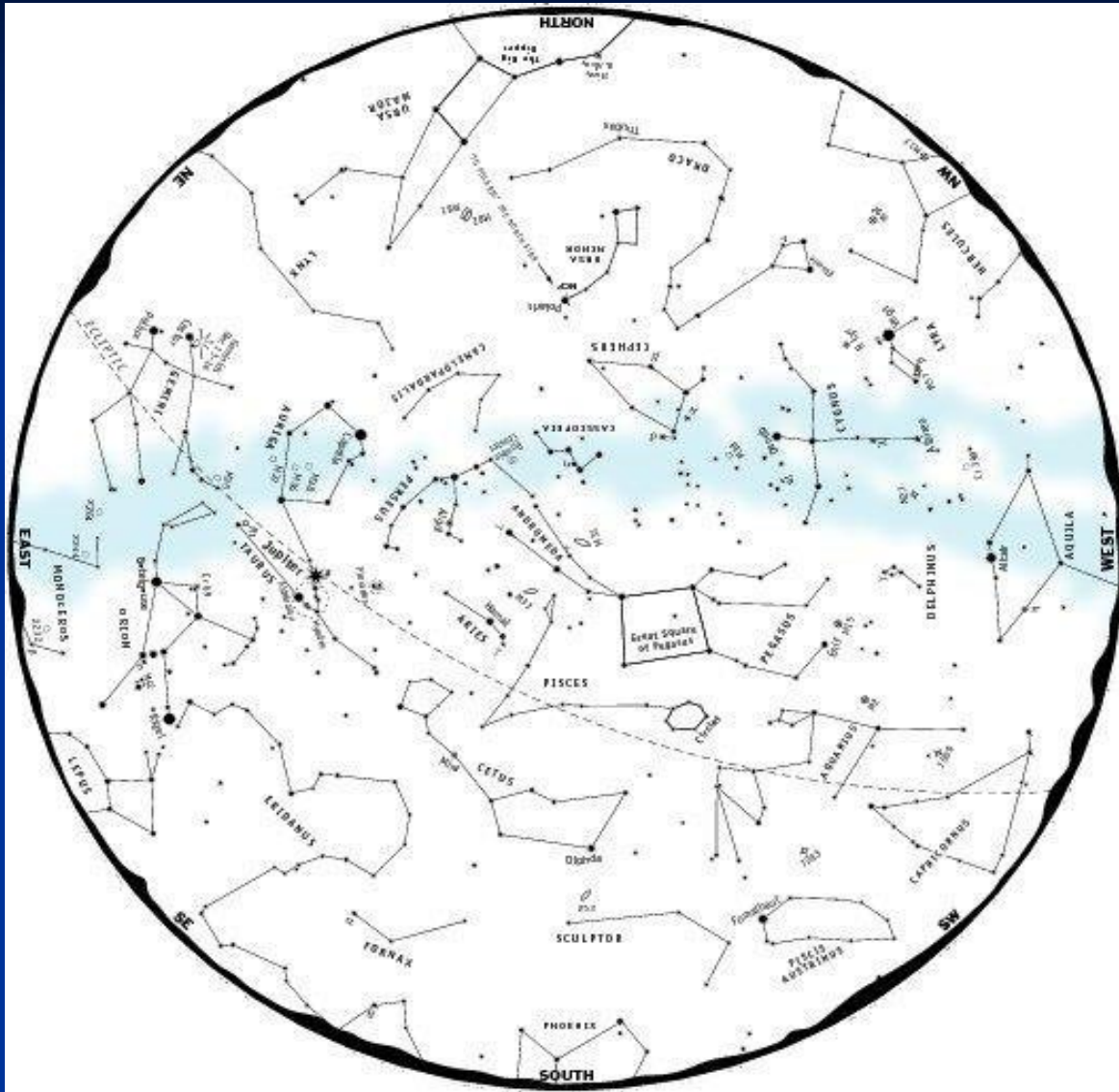




# Example of Sky Map for the Northern Hemisphere 北半球星图样例

The map must be prepared for the observer's location and the date and time of the activity.

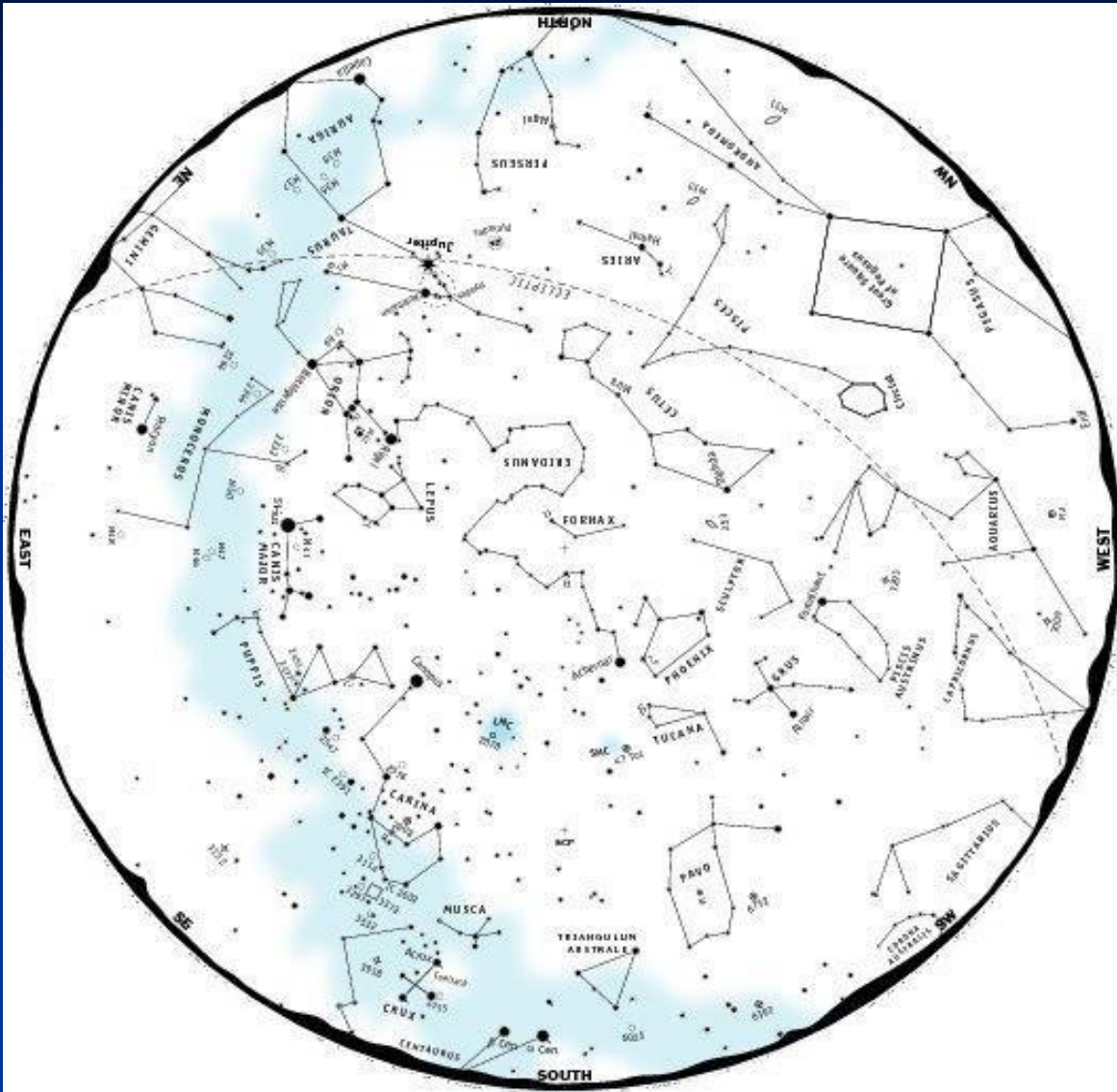
星图需要和观测者所在的位置、观测到时间和日期相符。



# Example of Sky Map for the Southern Hemisphere 南半球星图样例

The map must be prepared for the observer's location and the date and time of the activity.

星图需要和观测者所在的位置、观测到时间和日期相符。



# Observations with binoculars

## 双筒观测

- Low magnification, but collects more light
- 放大倍率有限但可以有效的聚光
- Recommended: 7x50  
(7 times magnification and 50mm aperture, i.e. the diameter of the objective lens)
- 推荐：7x50（放大倍率7，物镜口径50mm）





# Observations with binoculars

## 双筒观测

### Northern Hemisphere

#### 北半球

Andromeda Galaxy - M31

(Andromeda), 仙女座大星系 (仙女座)

Orion Nebula - M42 (Orion), 猎户星云  
(猎户座)

Globular Cluster - M13 (Hercules), 球  
状星团 (武仙座)

Pleiades Open Cluster - M45 (Taurus),  
昴星团 (金牛座)

Praesepe - M44 (Cancer), 鬼星团 (巨  
蟹座)

Crab Nebula - M1

(Taurus), 蟹状星云 (金牛座)

Whirlpool Galaxy - M51 (Canes

Venatici). 涡状星系 (猎犬座)

### Southern Hemisphere

#### 南半球

Large Magellanic Cloud (Dorado), 大麦  
哲伦云 (剑鱼座)

Small Magellanic Cloud (Tucana), 小麦  
哲伦云 (杜鹃座)

Eta Carinae - NGC 3372 (Carina), 海山  
二星 (船底座)

Centaurus A - NGC 5128 (Centaurus),  
半人马A (半人马座)

47 Tucanae Globular Cluster (Tucana),  
杜鹃47球状星团 (杜鹃座)

Jewell Box Open Cluster - NGC 4755  
(Crux). 珠宝盒疏散星团 (南十字座  
)

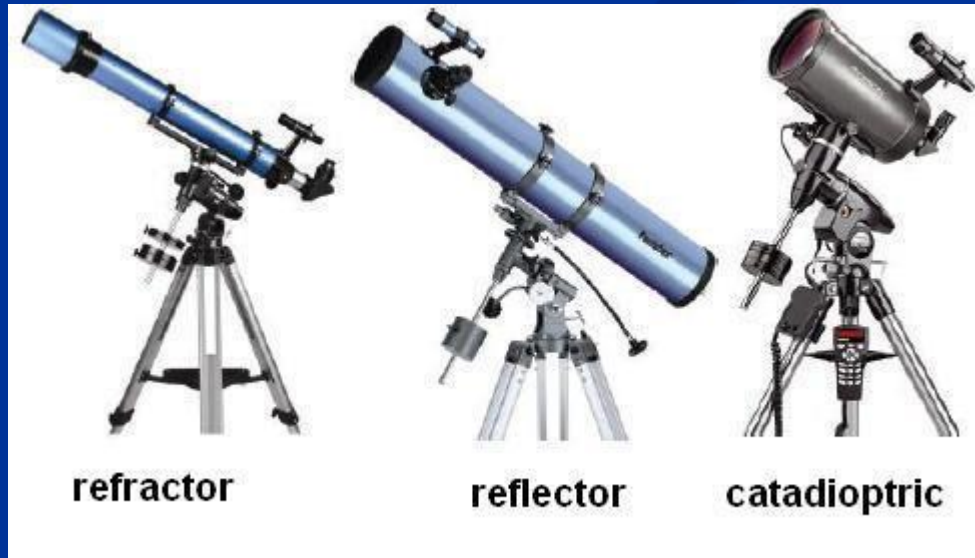


# Observations with a telescope

## 望远镜观测

- ❑ Mission: To collect more light 使命：聚光
- ❑ Optics: Objective and eyepiece 物镜和目镜
- ❑ Types: Refractor and reflector; Newtonian, Cassegrain and catadioptric

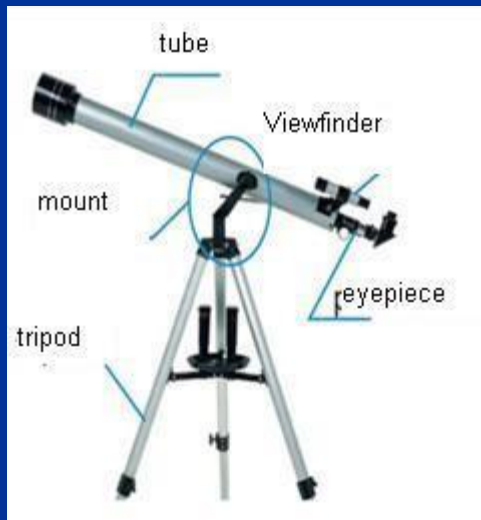
类型：折射，反射：牛顿、卡塞格林，折反射



# Observations with a telescope

## 望远镜观测

- ❑ Image: Could be inverted
- ❑ 图像：倒立
- ❑ Telescope mount: azimuthal, equatorial or Dobsonian.
- ❑ 望远镜基座：地平式、赤道式或道步森式
- ❑ Sky charts are required for proper and easier identification of the field to be observed
- ❑ 利用望远镜观测时需要准备好星表，方便辨别天区





# Commissioning of a telescope 望远镜的调试

Axes of an equatorial mount 赤道仪的轴

Polar axis 极轴

Declination axis

赤纬轴



# Commissioning of a telescope 望远镜的调试

- Leveling of the mount  
安装的平整度



- Balance the tube  
平衡管



- Balance polar axis  
平衡极轴



# Commissioning of a telescope 望远镜的调试

- Set latitude and direct the polar axis to the pole

NH at the North Pole is the polar star  
北极的NH是北极星

设置纬度并将极轴指向极点

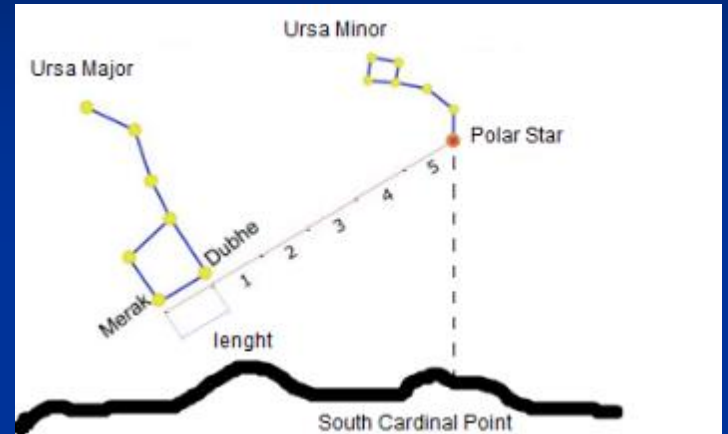
Pole  
杆子

polar axis  
极轴



Latitude  
纬度

Horizon  
地平线



SH at the South Pole there is no star and the place with the South Cross is located  
南极那里没有星，用南十字座来确定SH





# Commissioning of a telescope 望远镜的调试



Aligning the polar axis to the N or the S  
Orient the base of the mount to the N or the S:

"Turn right or left

the base of the mount or tripod "

将极轴对准N或S方向 将支架的底座对准N或S方向。

“右转或左转 支架或三角架的底座”。

# Commissioning of a telescope 望远镜的调试



Aligning the polar axis to the N or the S

“test the aligning turning the tube around the polar axis  $360^\circ$  without loosing the polar star or the South Pole“

将极轴对准北方或南方

“测试对准，在不丢失极星或南极的情况下围绕极轴旋转 $360^\circ$ 的管子”

# Commissioning of a telescope 望远镜的调试

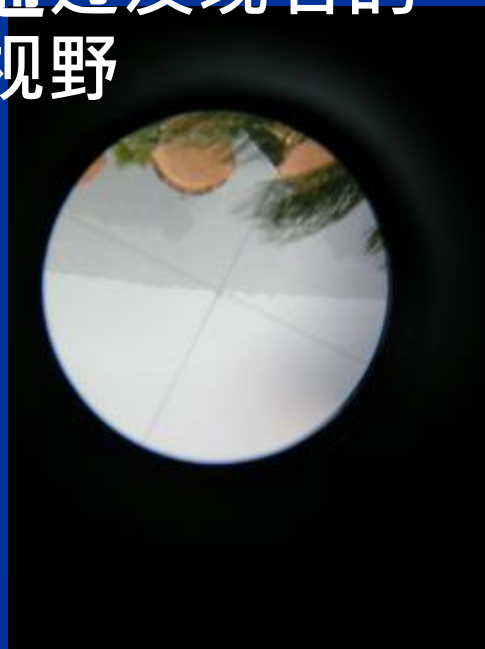
Finder alignment on a  
terrestrial object  
地面物体上的查找器对准



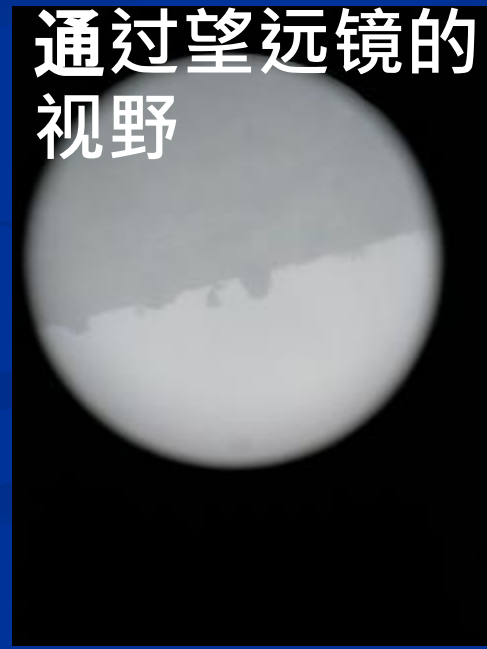
Naked eye  
vision  
裸眼视觉



Vision through  
the finder  
通过发现者的  
视野



Vision through  
the telescope  
通过望远镜的  
视野





# Commissioning of a telescope 望远镜的调试

Telescope oriented  
east of the meridian  
子午线以东方向的  
望远镜

Telescope oriented  
west of the meridian  
子午线以西方向的望  
远镜



Tracking using the flexible control of the polar  
axis

利用极轴的灵活控制进行跟踪



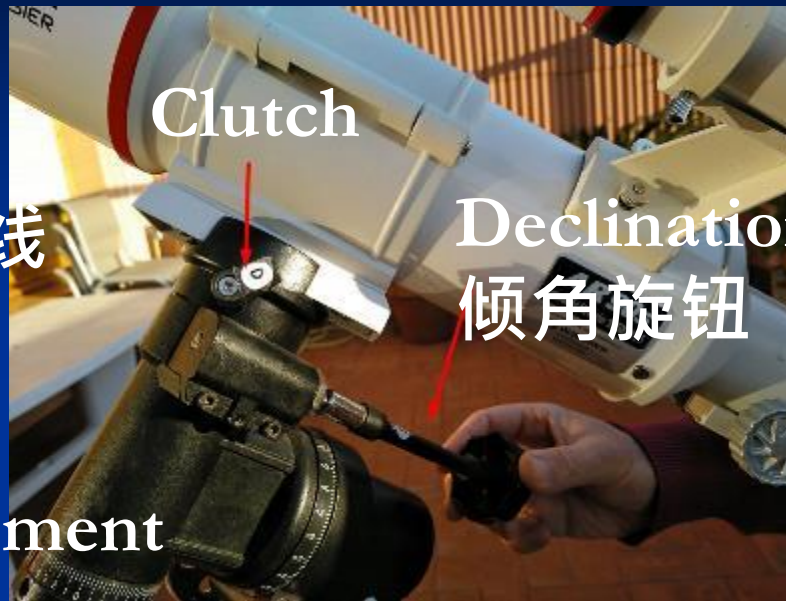
Tracking using the wheel  
使用轮子追踪



# Commissioning of a telescope 望远镜的调试

Declination

Axis 倾角 轴线



Declination knob  
倾角旋钮

Eyepiece placement  
目镜位置

Focus  
焦点



# Commissioning of a telescope 望远镜的调试

To locate and track different objects you only have to operate the polar axis (Right Ascension) and the declination axis (Declination)

为了定位和追踪不同的物体，你只需操作极轴（赤经）和赤纬轴（落差）。

*Don't misalign the telescope during the observation!*

在观察过程中，不要把望远镜对错位！要把望远镜对准。



# The sky's movements

## 天空的运动

The movement of the sky that we observe corresponds to relative motion of rotation and translation (orbit) of the Earth.

我们看到的星空的运动是由于地球的自转和公转引起的  
Diurnal movement: Fast, the Earth rotates around  $360^\circ$  in 24 hours; this is  $15^\circ$  every hour.

周日运动：快，地球在24小时内自转 $360^\circ$ ，每小时转 $15^\circ$ 。

Translational motion (orbit): Slow,  $360^\circ$  every 365 days, about one degree each day.

周年运动：慢，每365天转 $360^\circ$ ，大概一天转一度。

# The sky's movements

## 天空的运动

- ❑ Imagine that the Earth did not rotate.
- ❑ 假设地球不转。
- ❑ We would see the same night sky from one night to the next.
- ❑ 我们整晚将看到同样的星空。
- ❑ The same star would be in almost the same position each night.
- ❑ 每晚同样的星星会在几乎同样的位置出现。
- ❑ It would have moved by only about one degree (i.e. the thickness of an index finger at the extended arm) compared to the previous day.
- ❑ 相较于前一晚，星星只移动了一度。（伸直胳膊时看到的食指的宽度。）

# The sky's movements

## 天空的运动

The translation movement of the Earth is almost negligible. If we do not have a reference it is not visible to the naked eye, but what we do notice is that the sky from one night of the year is completely different after three or six months.

地球的公转可以忽略不计。如果没有参照物，那么裸眼看不出地球在公转，但我们会发现相隔三个月或半年的星空将完全不同。

After three months the translation corresponds to  $90^\circ$ , or about  $\frac{1}{4}$  of the sky. In half a year it is  $\frac{1}{2}$  of the sky, that is the other side of heavens, diametrically opposed to our starting point.

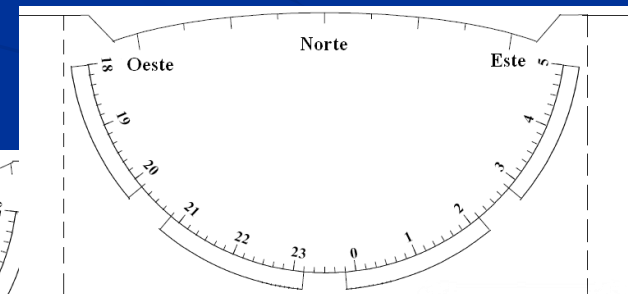
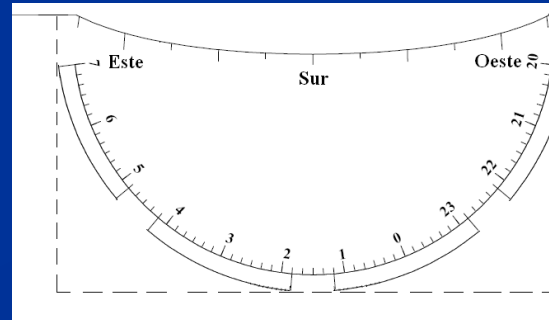
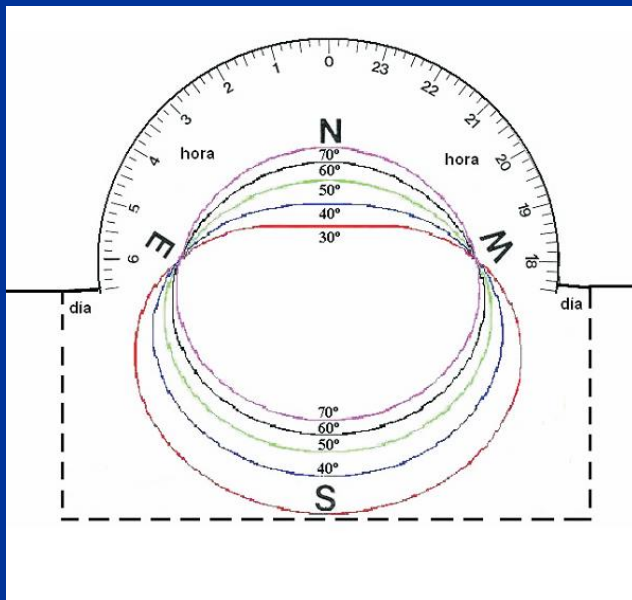
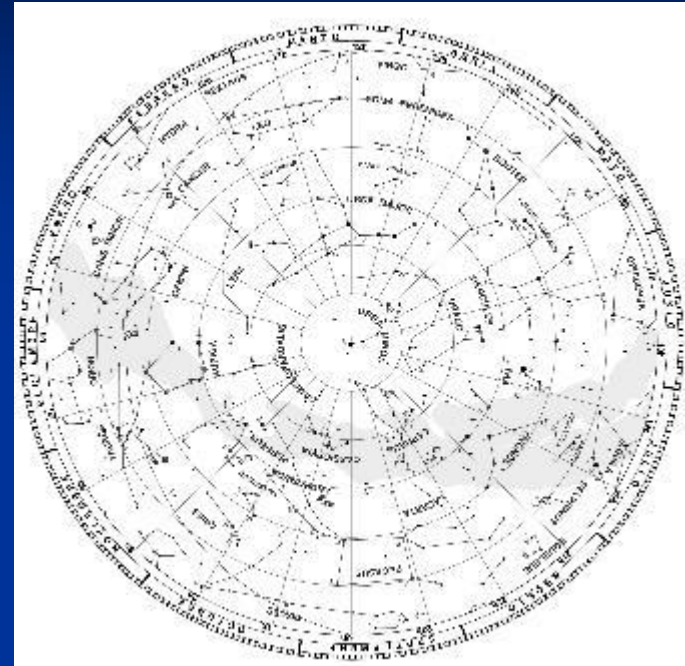
三个月里，地球会公转 $90^\circ$ ，或 $\frac{1}{4}$ 个星空。半年后，相较于起点，星空会完全相反。



# Activity 1: Construction of the Planisphere

## 活动1：建造平面仪

- Constellation disk  
星座盘
- Inside the Latitudes bag  
在纬度袋子内



# Actividad 1: Construcción del Planisferio

## 活动1：建造平面仪



- Latitude  $30^{\circ}$ - $70^{\circ}$  N or S  
南或北纬30度-70度



- Latitude  $0^{\circ}$ - $20^{\circ}$  N or S  
南或北纬  $0^{\circ}$ - $20^{\circ}$  N



# Activity 2: Celestial Dome Umbrella

## 活动2：天穹伞

### Objectives

### 目标

- Understanding the translation movement of the Earth and compare it to the rotation movement.
- 理解地球的公转，比较与自转的区别
- Display the translation movement “without rotation movement”.
- 演示“没有自转”的地球公转
- Consider some constellations in the opposite hemisphere - North/South umbrella.
- 考虑南北半球的星座，制作南北伞。

# Activity 2: Celestial Dome Umbrella

## 活动2：天穹伞

Draw the umbrella of one Hemisphere

画一个半球的伞

### ❖ North Pole Environment:

Ursa Major and Cassiopeia

北半球：大熊星座和仙后座

### ❖ Outermost area:

#### ❖ 外围区域：

Leo (Spring) 狮子座 (春)

Cygnus (Summer) 天鹅座 (夏)

Pegasus (Autumn) 飞马座 (秋)

Orion (Winter) 猎户座 (冬)

### ❖ South Pole Environment:

Southern Crux

南半球：南十字座

### ❖ Outermost area:

#### ❖ 外围区域：

Aquarius (Spring) 宝瓶座 (春)

Orion (Summer) 猎户座 (夏)

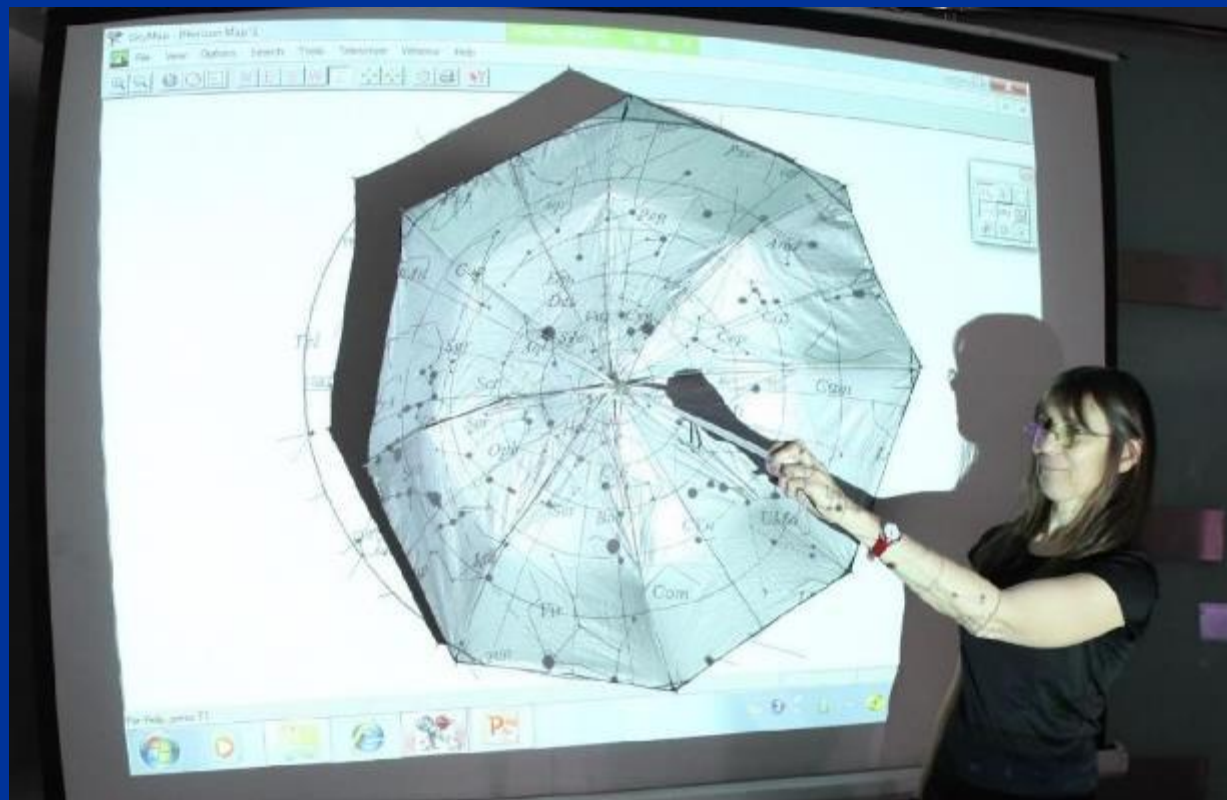
Leo (Autumn) 狮子座 (秋)

Scorpius (Winter) 天蝎座 (冬)

# Activity 2: Celestial Dome Umbrella

## 活动2：天穹伞

Locate the constellations by projecting a planisphere hemisphere using Stellarium  
投影出半个天区的星座图从而定位星座



# Activity 2: Celestial Dome Umbrella

## 活动2：天穹伞

Use a black umbrella and draw the constellations on it with white paint, chalk or corrector fluid. 用一把黑色的伞，用白色颜料、粉笔或修正液在上面画出星座。

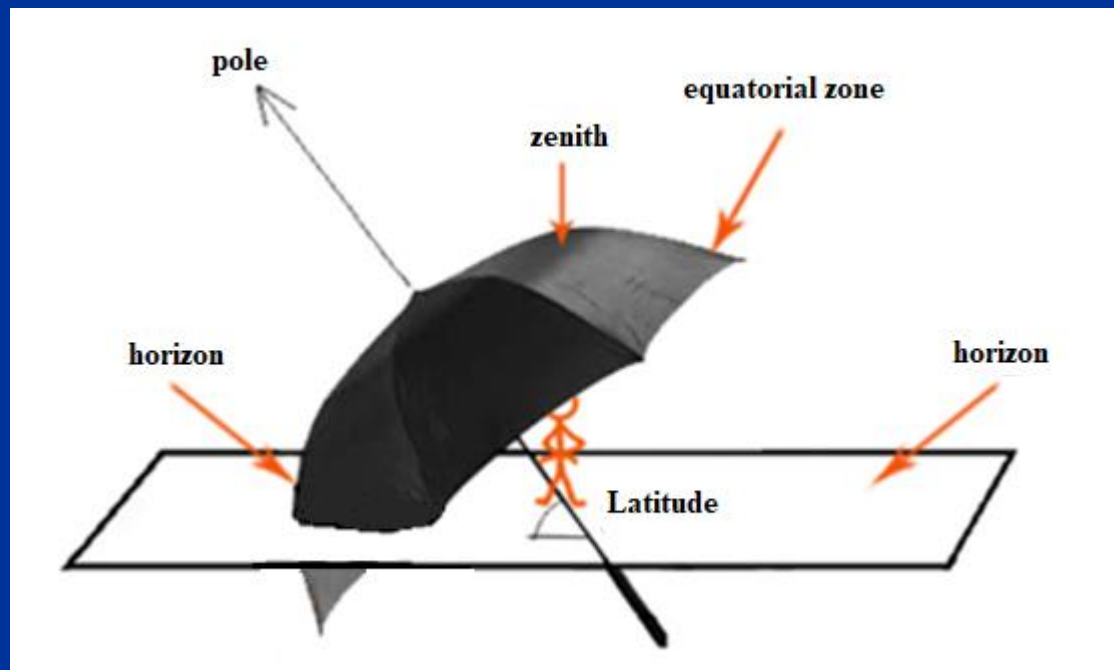


# Activity 2: Celestial Dome Umbrella

## 活动2：天穹伞

Use the umbrella over our heads with the stick of the umbrella directed towards the pole (inclined at the latitude of our location).

把雨伞举过头顶，并把伞柄指向极点（使雨伞的倾角等于我们的地理纬度）。



# Activity 2: Celestial Dome Umbrella

## 活动2：天穹伞

Using the umbrella in the Northern Hemisphere

北半球天穹伞的用法

Northern Hemisphere  
北半球



Local midnight  
当地午夜时分

- ❑ **SPRING:** Looking to the North, the Big Dipper is above the Pole Star, Leo is to the South.
- ❑ 春：向北看，北斗七星在北极星上面，狮子座在南边。
- ❑ **SUMMER:** Looking to the North, the Big Dipper is to the left of the Pole Star, Cygnus is to the South.
- ❑ 夏：向北看，北斗七星在北极星的左侧，天鹅座在南边。
- ❑ **AUTUMN:** Looking to the North, when the Big Dipper is below the Pole Star, Pegasus is to the South.
- ❑ 秋：向北看，北斗七星在北极星的下面，飞马座在南边。
- ❑ **WINTER:** Looking to the North, the Big Dipper is to the right of the Pole Star, Orion to the South.
- ❑ 冬：向北看，北斗七星在北极星的右侧，猎户座在南边。



# Activity 2: Celestial Dome Umbrella

## 活动2：天穹伞

Northern Hemisphere

### 北半球

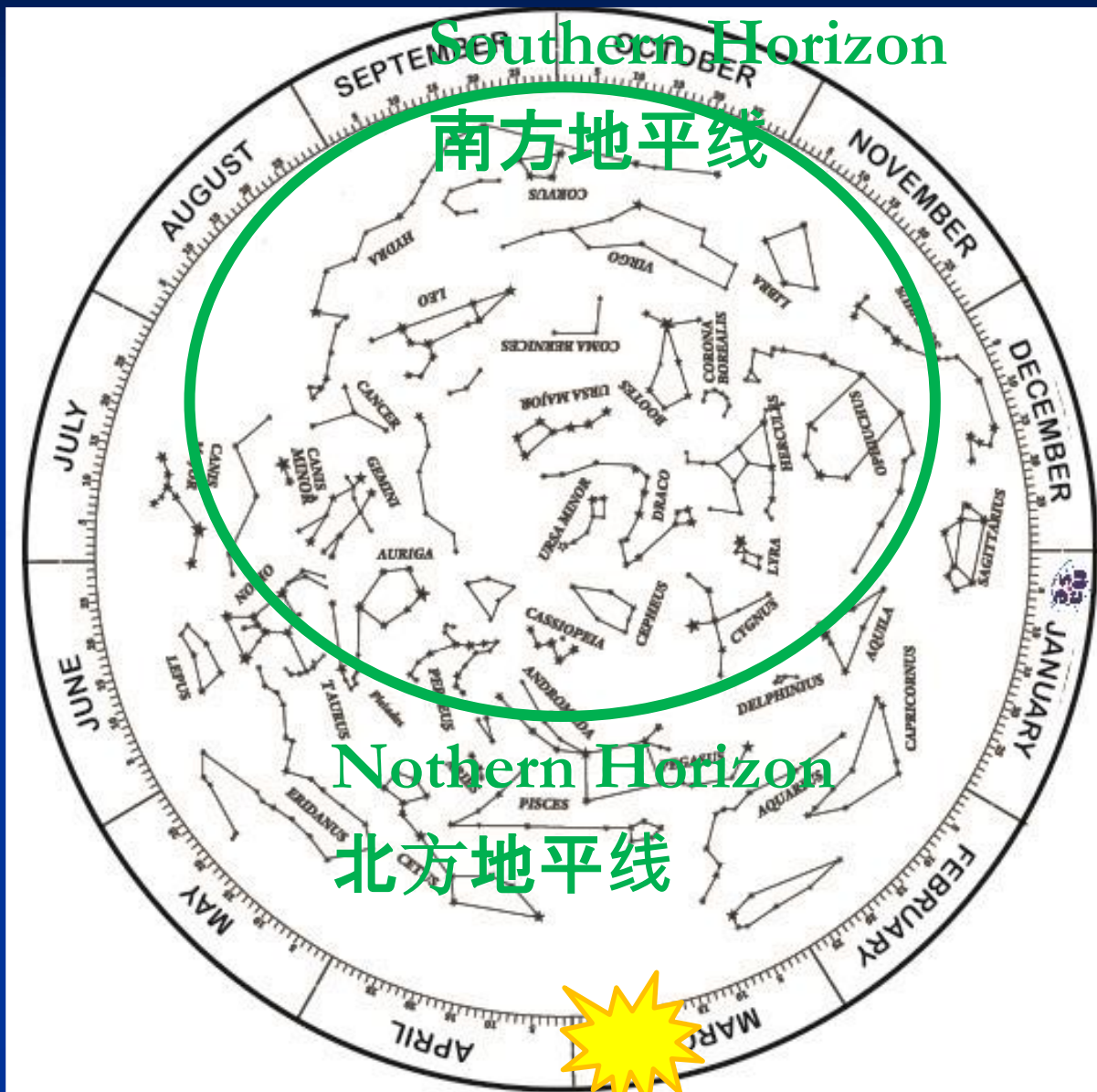
### Spring 春天

Northern Horizon

### 北方地平线



Local midnight  
当地午夜时分











# Activity 2: Celestial Dome Umbrella

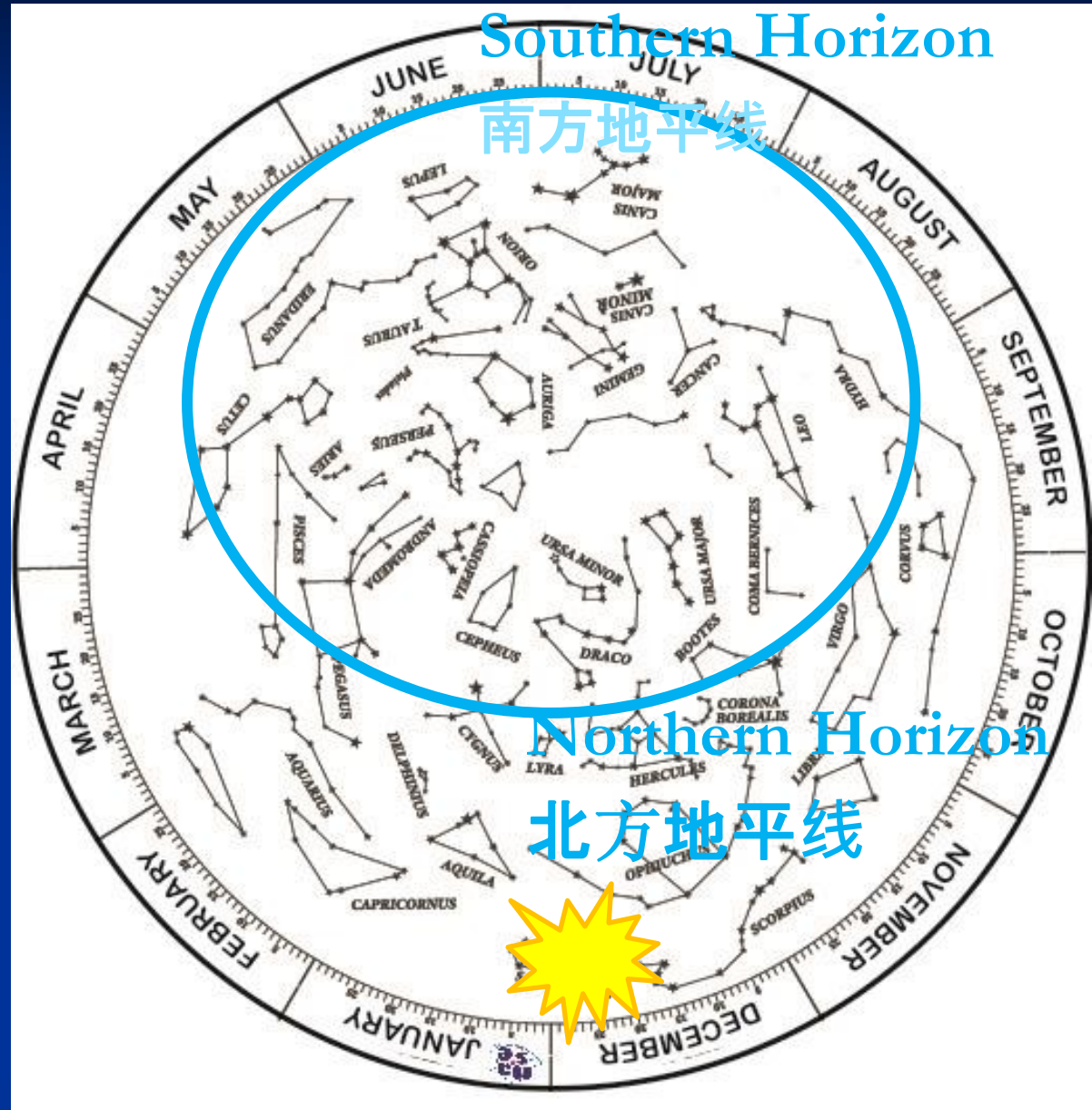
## 活动2：天穹伞

Northern Hemisphere  
北半球

Winter 冬季  
Northern Horizon  
北方地平线



Local midnight  
当地午夜时分



# Activity 2: Celestial Dome Umbrella

## 活动2：天穹伞

Using the umbrella in the Southern Hemisphere

Southern Hemisphere

and

Southern Horizon

南半球  
和  
南地平线

南半球天穹伞的用法

**SPRING:** to the South Horizon, when the Cross is to the right of the pole, Aquarius is to the North Horizon.

春：向南看，当南十字座在南天极右侧时，宝瓶座在北地平线

**SUMMER:** to the South Horizon, when the Cross is under the pole, Orion is to the North Horizon.

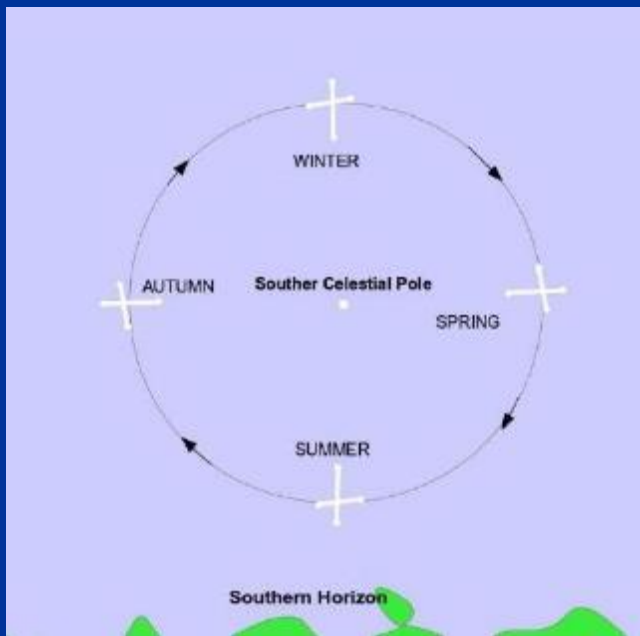
夏：向南看，当南十字座在南天极下面时，猎户座在北地平线。

**AUTUMN:** to the South Horizon, when the Cross is at the left of the pole, Leo is to the North Horizon.

秋：向南看，当南十字座在南天极左侧时，狮子座在北地平线。

**WINTER:** to the South Horizon, when the Cross is above the pole, Scorpio is to the North Horizon.

冬：向南看，当南十字座在南天极左侧时，天蝎座在北地平线。



Local midnight  
当地午夜时分

# Activity 2: Celestial Dome Umbrella

## 活动2：天穹伞

Southern Hemisphere

南半球

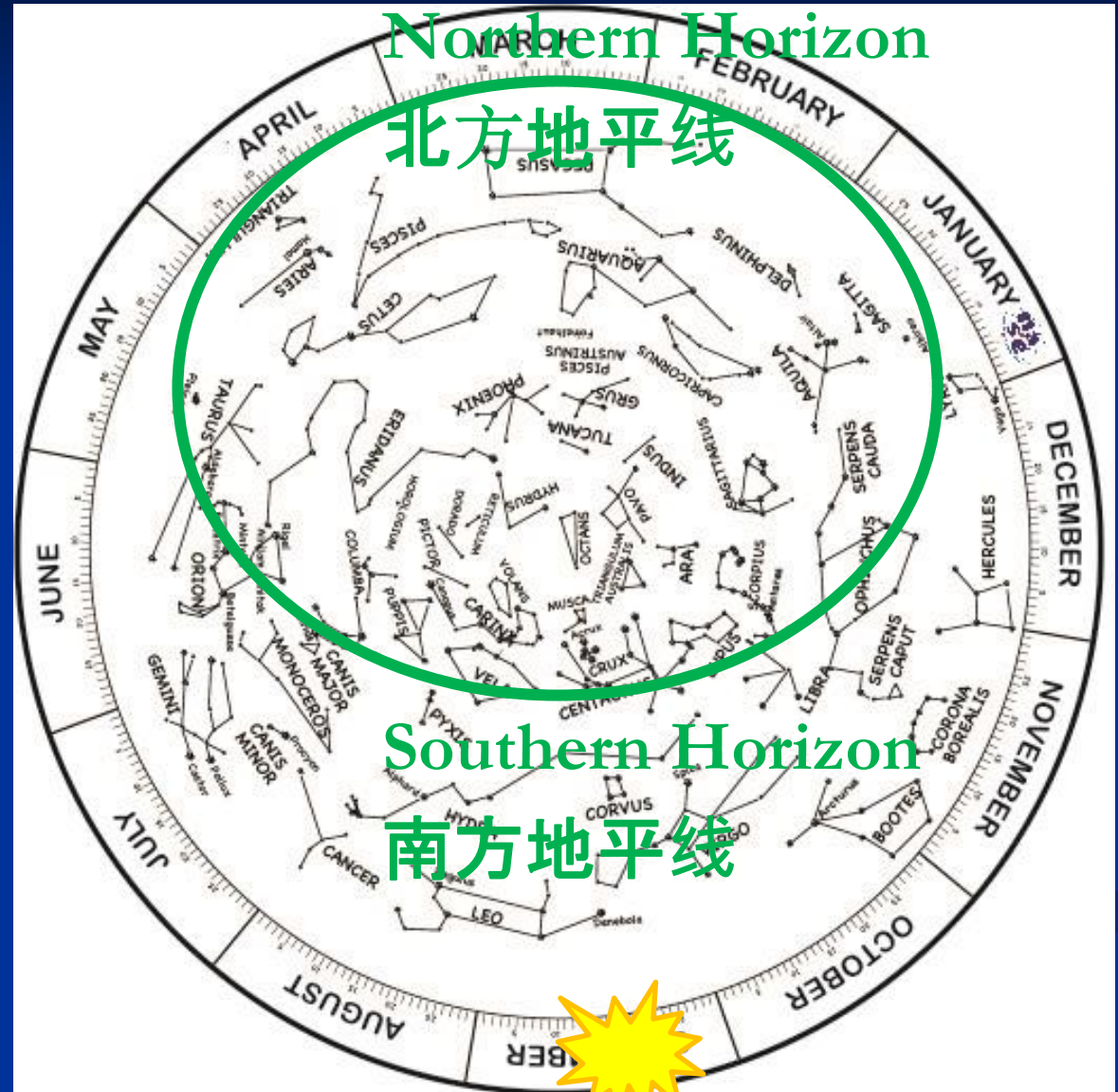
Spring 春天

Southern Horizon

南方地平线



Local midnight  
当地午夜时分





# Activity 2: Celestial Dome Umbrella

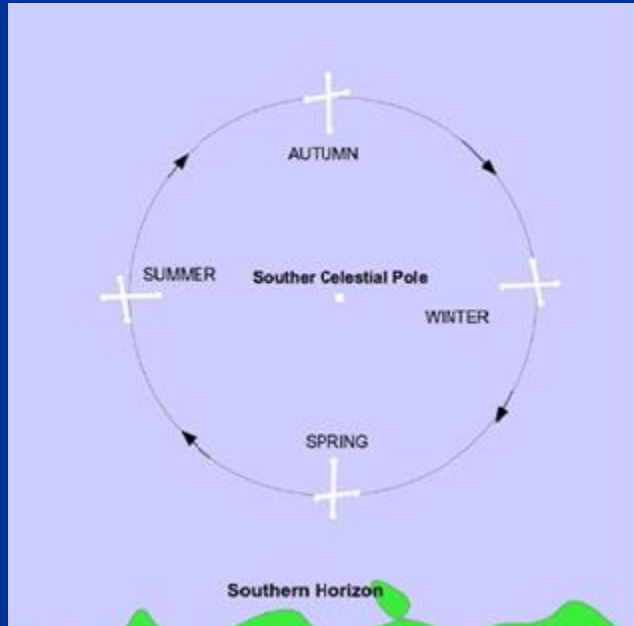
## 活动2：天穹伞

Southern Hemisphere

南半球

Summer 夏天

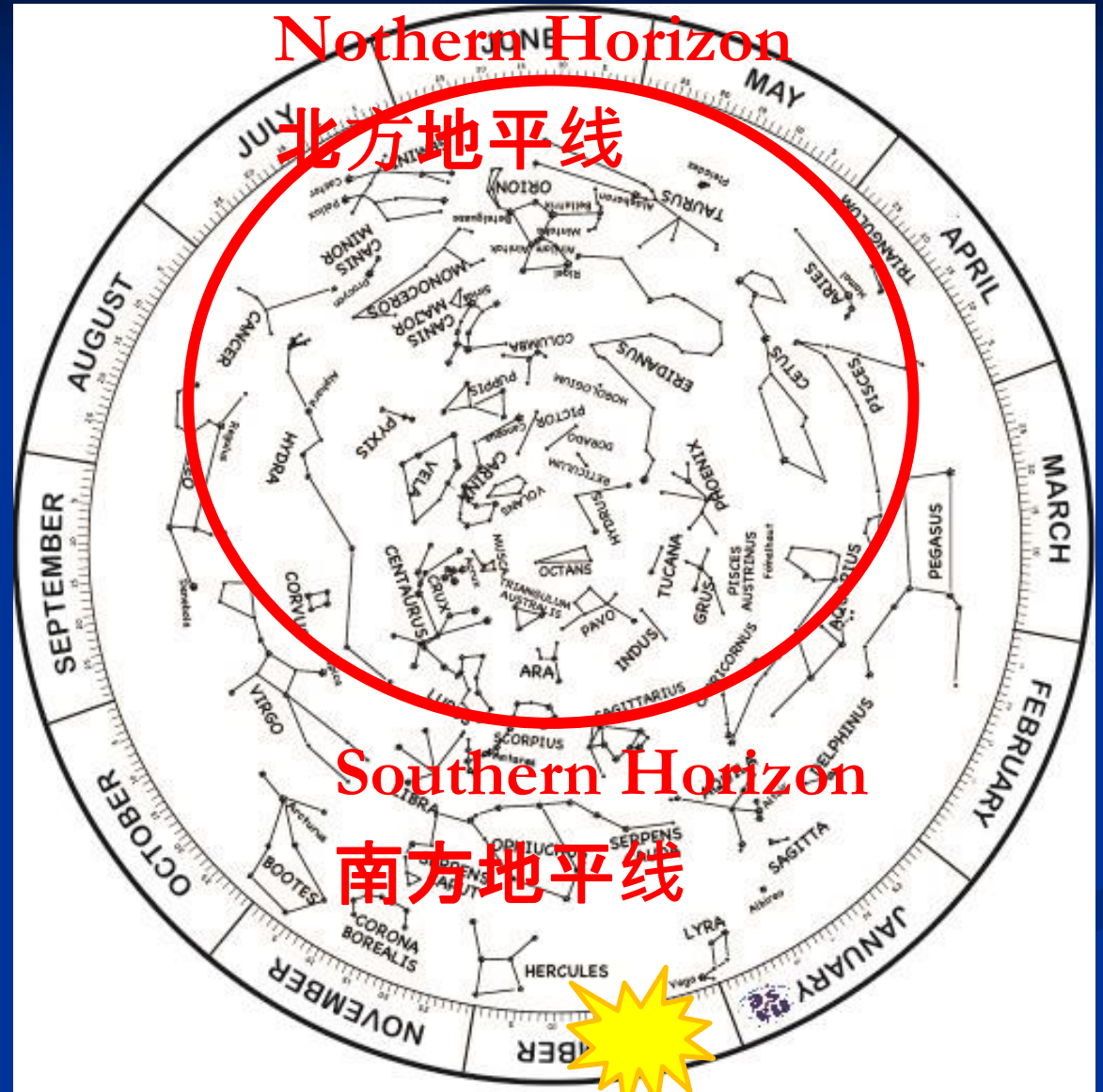
Southern Horizon  
南方地平线



Local midnight  
当地午夜时分

Northern Horizon

北方地平线





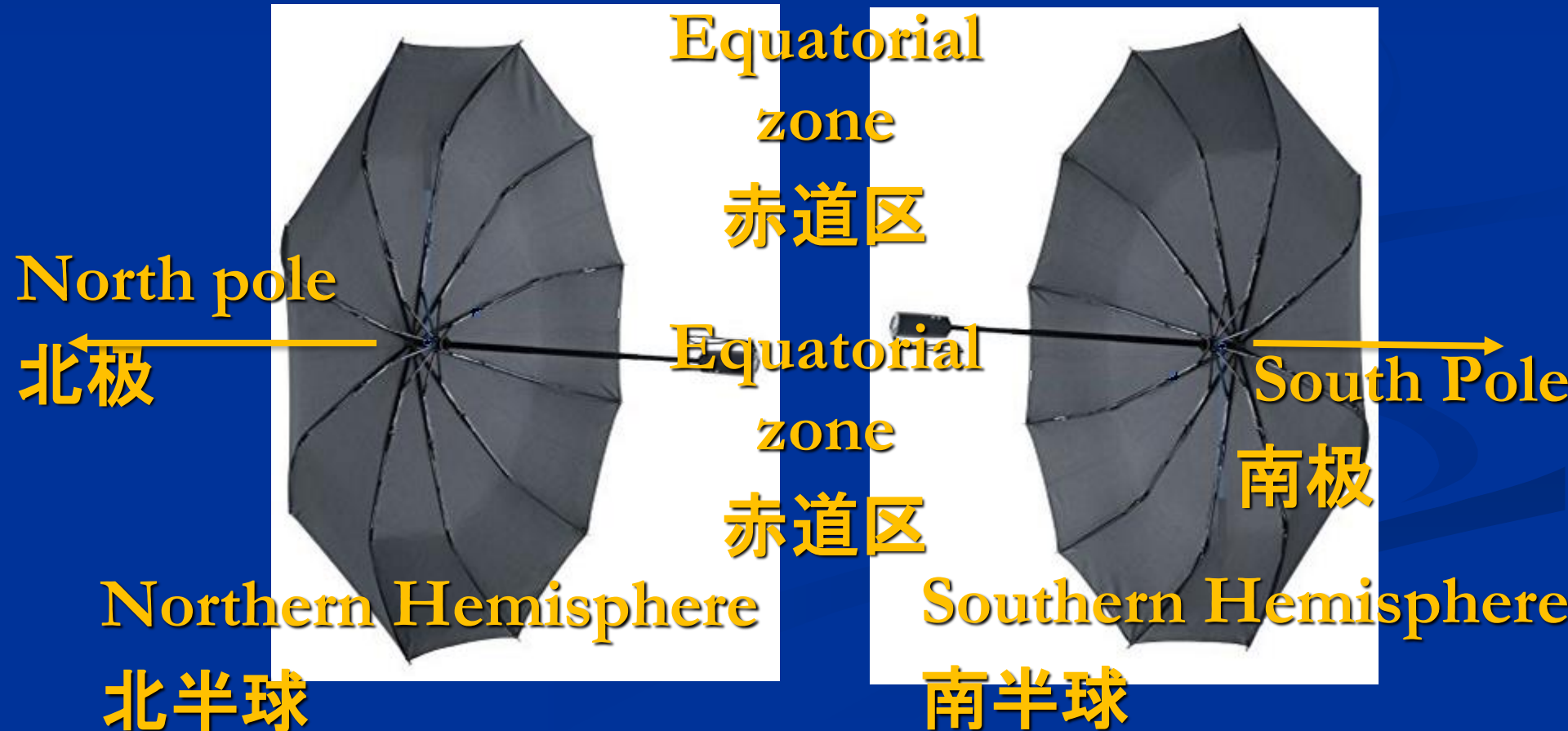




# Activity 2: 2 Umbrellas of the Equatorial Zone

## 活动2：赤道区的2把雨伞

We use 2 umbrellas with the handle parallel to the Horizon 我们使用2把雨伞，伞柄与地平线平行。





# Activity 2: 2 Umbrellas of the Equatorial Zone

## 活动2：赤道区的2把雨伞

### Northern Horizon

#### 北方地平线



Local midnight

当地午夜时分

### Southern Horizon

#### 南方地平线



Local midnight

当地午夜时分

- MARCH: Spring with Leo in the equatorial zone
- 三月：狮子座在赤道区的春天
- JUNE: Summer with Swan in the equatorial zone
- 六月：天鹅座在赤道区的夏天
- SEPTEMBER: Autumn with Pegasus in eq. z.
- 九月：飞马座在赤道区的秋天
- DECEMBER: Winter with Orion equatorial zone
- 十二月：猎户座在赤道区的冬天

- MARCH: Autumn with Leo in the equatorial zone
- 三月：狮子座在赤道区的秋天
- JUNE: Winter in Scorpio in equatorial zone
- 六月：天蝎座在赤道区的冬天
- SEPTEMBER: Spring with Aquarius in the eq. z.
- 九月：宝瓶座在赤道区的春天
- DECEMBER: Summer with Orion in the eq. z.
- 十二月：猎户座在赤道区的夏天。

# Activity 2: 2 Umbrellas of the Equatorial Zone

## 活动2：赤道区的2把雨伞

### NH March

北方地平 三月

(Spring) (春天)

Equatorial Zone

赤道区

Northern Horizon

北方地平线

### SH March

南方地平三月

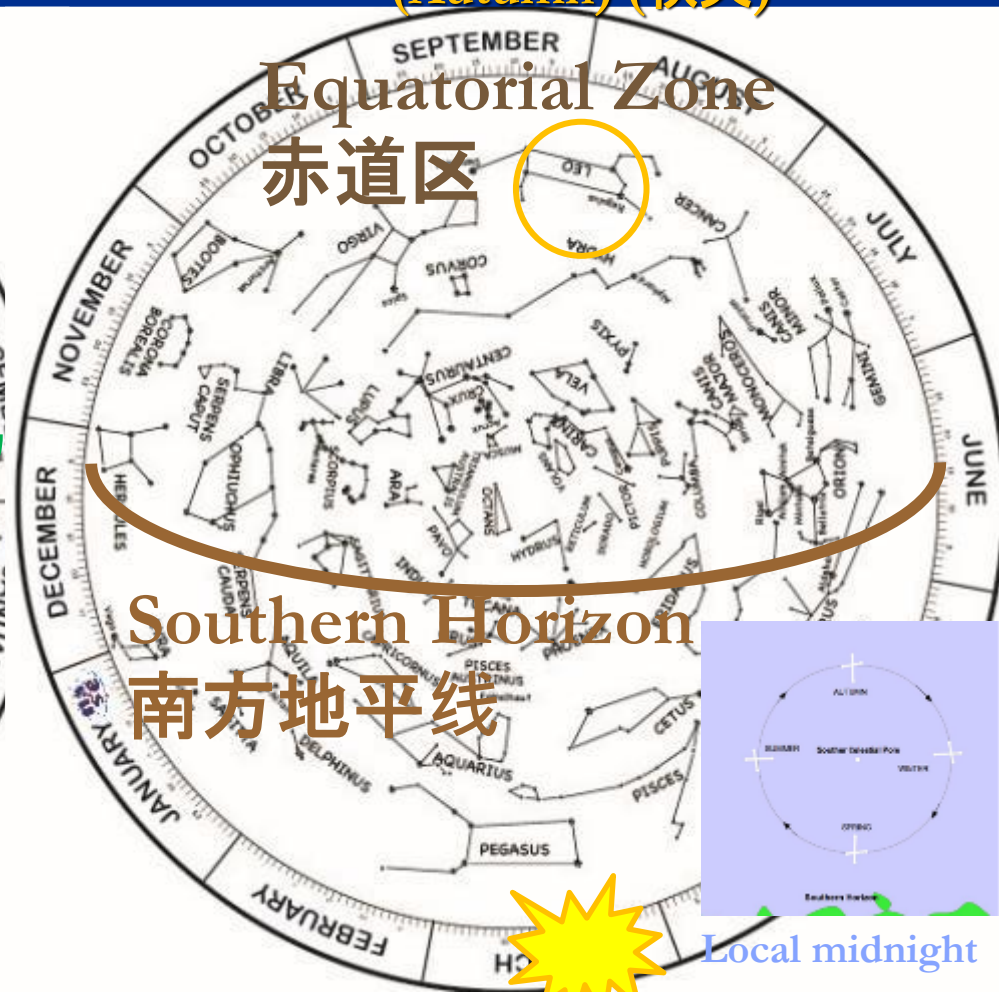
(Autumn) (秋天)

Equatorial Zone

赤道区

Southern Horizon

南方地平线



Local midnight

Local midnight



# Activity 2: 2 Umbrellas of the Equatorial Zone

## 活动2：赤道区的2把雨伞

NH June

北地平6月

(Summer) (夏季)

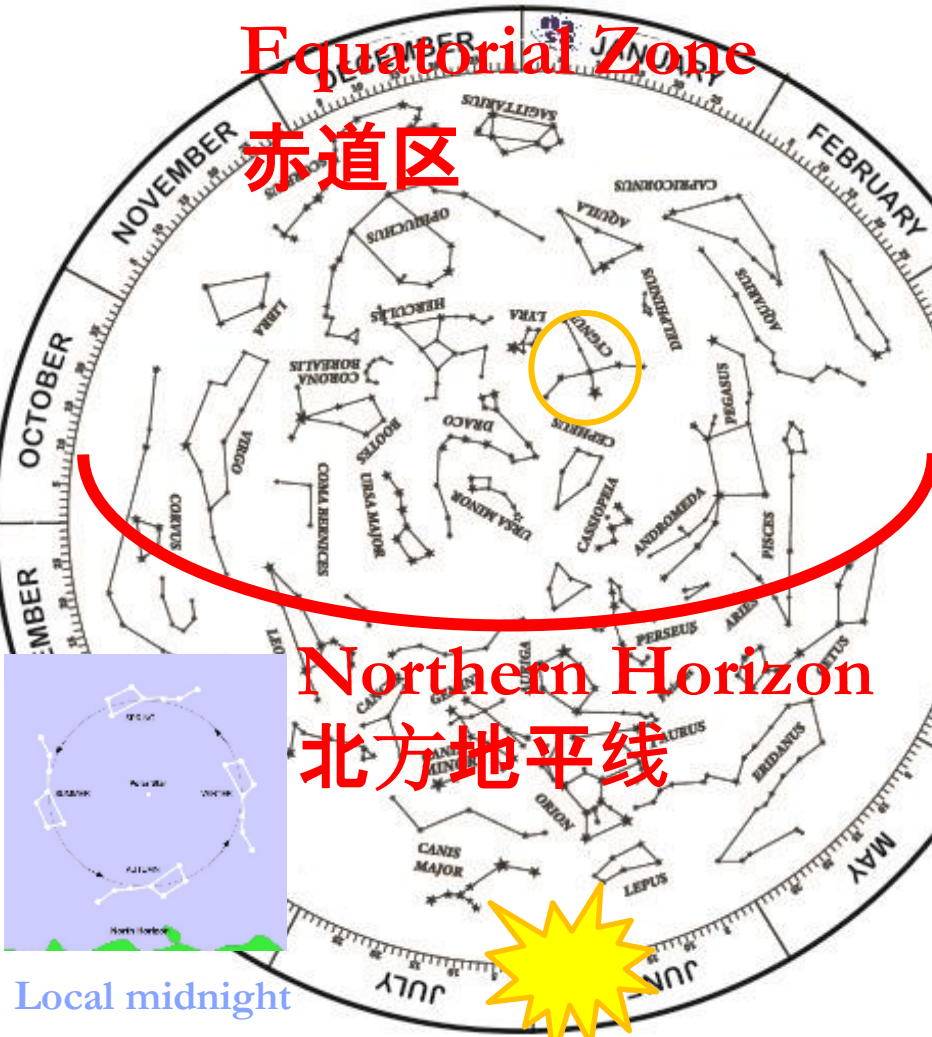
SH June

南地平6月

(Winter) (冬季)

Equatorial Zone

赤道区



Northern Horizon

北方地平线



Local midnight

Equatorial Zone

赤道区



Southern Horizon

南方地平线



Local midnight



# Activity 2: 2 Umbrellas of the Equatorial Zone

## 活动2：赤道区的2把雨伞

NH September

北地平9月 (Autumn) (秋天)

SH September

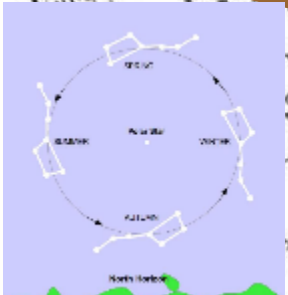
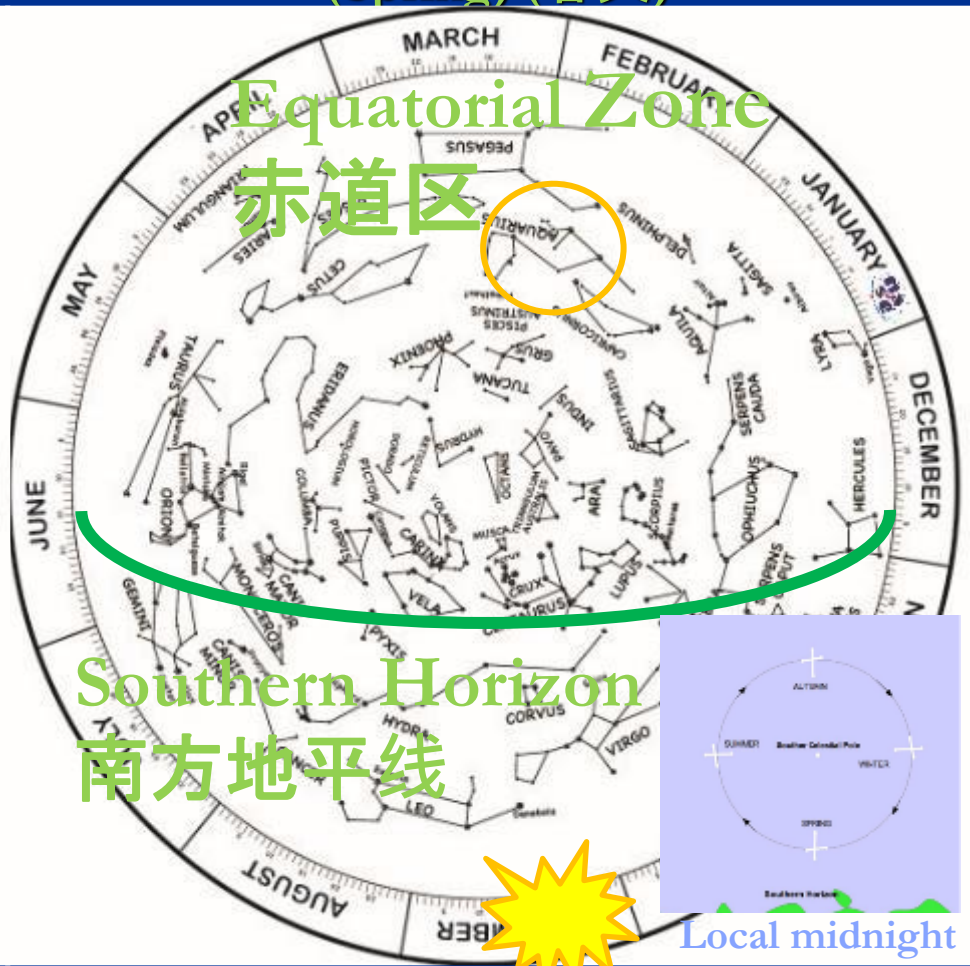
南地平9月  
(Spring) (春天)

Equatorial Zone  
赤道区

Equatorial Zone  
赤道区

Northern Horizon  
北方地平线

Southern Horizon  
南方地平线



Local midnight

Local midnight

# Activity 2: 2 Umbrellas of the Equatorial Zone

## 活动2：赤道区的2把雨伞

SH December

NH December

北地平12月

(Winter) (冬季)

南地平12月

(Summer) (夏季)

Equatorial Zone

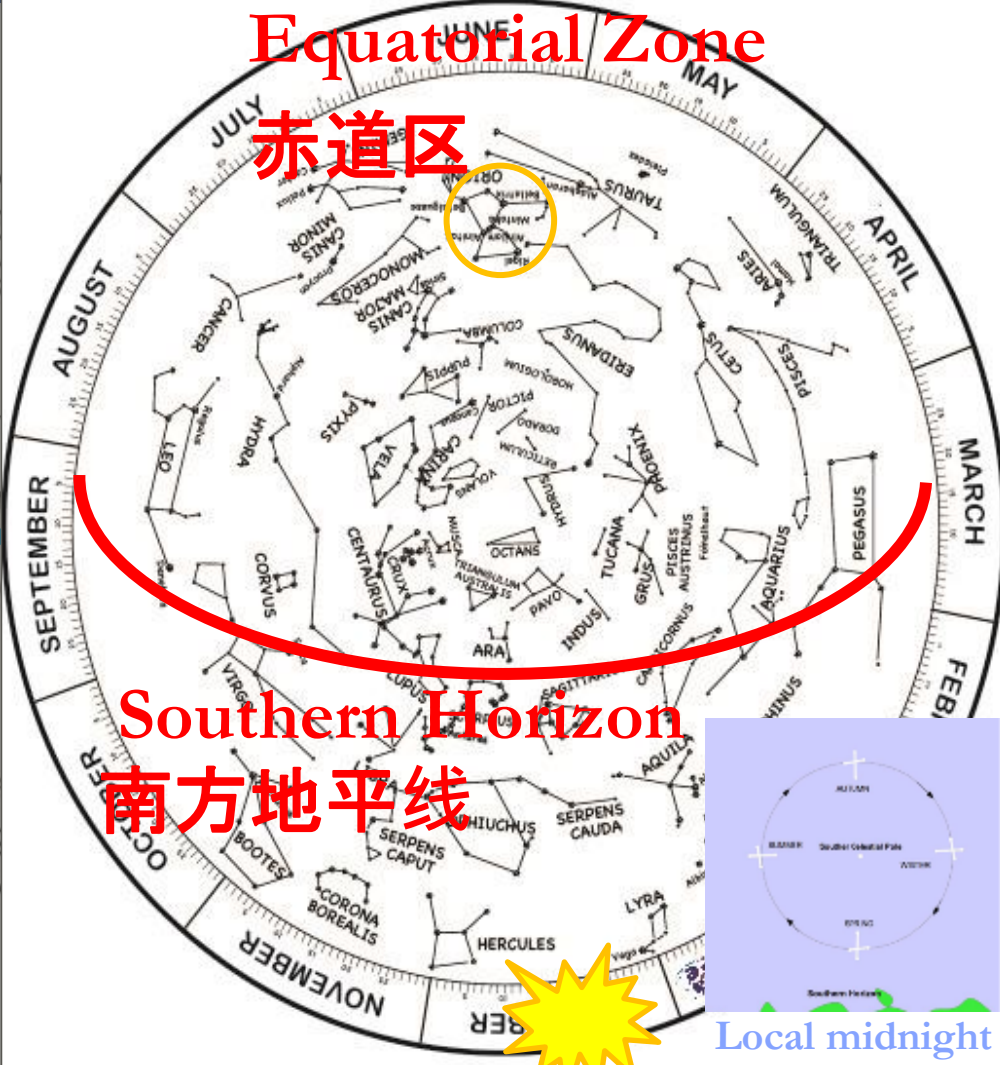
赤道区



Northern Horizon  
北方地平线

Equatorial Zone

赤道区



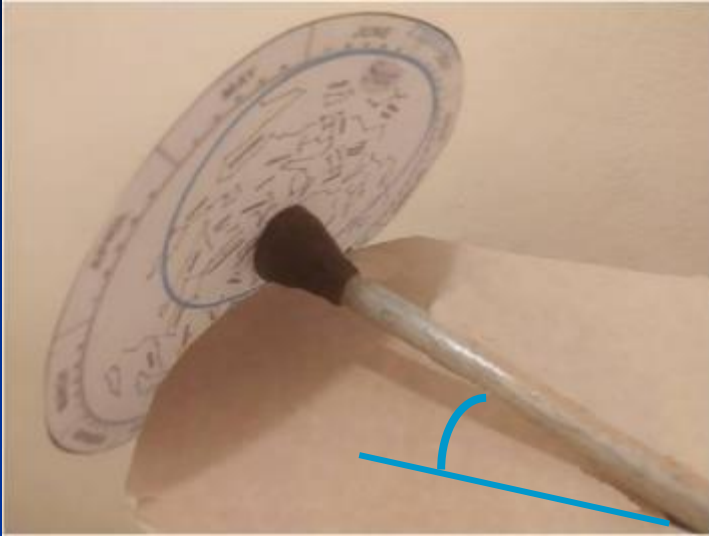
Southern Horizon  
南方地平线

Local midnight

Local midnight
















The previous schemes are those that we consider in the umbrella according to the season. The only difference is that the umbrella is represented in a simplified way and allows an easier understanding. 前述的星座雨伞是我们根据季节制作的。唯一的区别是，雨伞是以简化的方式让人更容易理解星座的变化。



# Stellarium Resource Guide

## 虚拟天文馆指南

Table below describes the operations of buttons on the main tool-bar and the side tool-bar, and gives their keyboard shortcuts.

Feature	Tool-bar button	Key	Description
Constellations		c	Draws the constellation lines
Constellation Names		v	Draws the name of the constellations
Constellation Art		r	Superimposes artistic representations of the constellations over the stars
Equatorial Grid		e	Draws grid lines for the RA/Dec coordinate system
Azimuth Grid		z	Draws grid lines for the Alt/Azi coordinate system
Toggle Ground		g	Toggles drawing of the ground. Turn this off to see objects that are below the horizon
Toggle Cardinal Points		q	Toggles marking of the North, South, East and West points on the horizon
Toggle Atmosphere		a	Toggles atmospheric effects. Most notably makes the stars visible in the daytime
Nebulae & Galaxies		n	Toggles marking the positions of Nebulae and Galaxies when the FOV is too wide to see them
Planet Hints		p	Toggles indicators to show the position of planets
Coordinate System		Enter	Toggles between Alt/Azi & RA/Dec coordinate systems
Goto		Space	Centres the view on the selected object
Night Mode		[none]	Toggle "night mode", which changes the coloring of some display elements to be easier on the dark-adapted eye.

# Dark skies and light pollution

## 暗夜与光污染

- We need a dark sky to see more stars
- 为了看到更多星星，我们需要暗夜。
- This is only possible if we move away from the built-up areas
- 只有离开建筑区才能实现这一点
- We have forgotten how the night sky looks since we cannot see it clearly from the cities
- 因为在城市里看不见，我们已经记不得繁星满天的场景了。
- Light pollution is one of the least recognised forms of pollution. It prevents us from seeing the stars, affects the nocturnal ecosystem, human health and represents a waste of energy.
- 相较于其他类型的污染，光污染是一种知之甚少的污染形式。它会影响夜空的能见度，也会影响生态系统的平衡，影响人类的健康，浪费能源。



# Forms of light pollution

## 光污染的形式

There are three types of light pollution:

光污染大体上可分为三类：

a) **Glow:** Associated with public lighting projected toward the sky. It looks like a bubble of light above the city.

光晕：公共照明引起。城市上空围绕着的光圈。

b) **Trespass:** The external light that spreads in all directions and into houses and gardens.

侵入式光害：向各个方向投射的灯光，会潜入室内。

c) **Glare:** Related to the illuminated signs or vehicles that affects the eye directly and also by surprise.

眩光。城市照明或车灯产生的强烈照明，突发性直射人的眼睛。

# Activity 3: Light pollution – Glow

## 活动3：光污染-光晕

### Objectives:

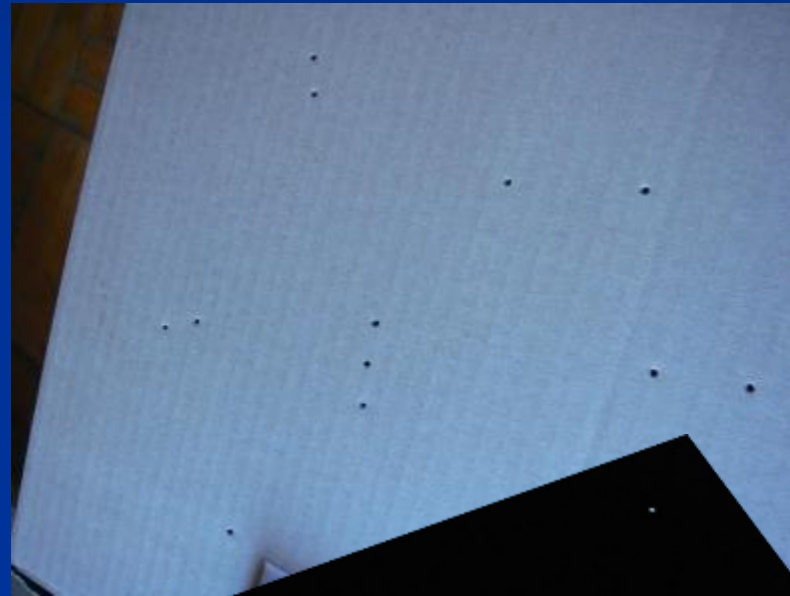
#### 目标：

- Show the polluting effect of unshielded lighting.
- 展示不加遮挡的光会造成的污染效应。
- Recognize the beneficial effect of a well-chosen lamp.
- 了解合理选择灯罩的益处。
- Recognize the possibility of improving the night sky observations, even then there is some artificial light.
- 给出改善观星条件的可行性，即使环境中存在一些人造灯光的干扰。

# Activity 2: Light pollution – Glow

## 活动2：光污染-光晕

### Procedure 过程



Preparing the black box  
准备黑盒子

# Activity 3: Light pollution – Glow

## 活动3：光污染-光晕



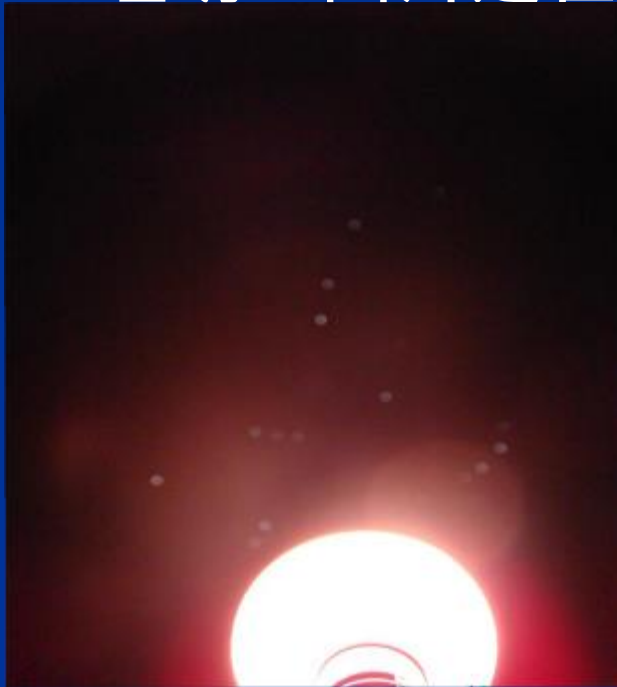
Test the streetlights with and without shielding, special for controlling the glare

测试带灯罩和不带灯罩对路灯发出的刺眼光线的影响。

# Activity 3: Light pollution – Glow

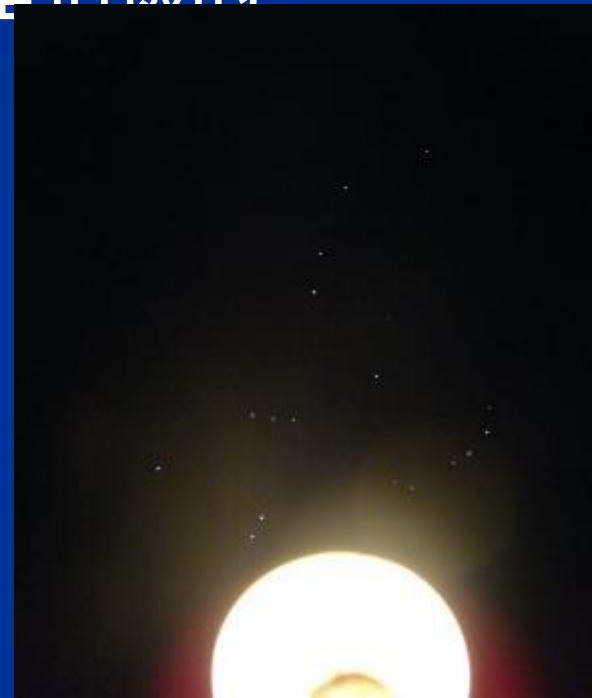
## 活动3：光污染-光晕

Proof: Pictures are taken inside the box  
证明。图片是在盒子里拍摄的



Appearance of the sky  
with lantern unshielded

没有灯罩时看到的夜空



Appearance of the sky  
with lantern shielded

有灯罩时看到的夜空



# The Stellarium Program

## 虚拟天文馆









[www.stellarium.org](http://www.stellarium.org)



# Stellarium Resource Guide














## 虚拟天文馆指南

Help Window		F1	Show the help window, which lists key bindings and other useful information
Configuration Window		F2	Show the display of the configuration window
Search Window		F3 or CTRL+f	Show the display of the object search window
View Window		F4	Show the view window
Time Window		F5	Show the display of the help window
Location Window		F6	Show the observer location window (map)

# Stellarium Resource Guide

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Thank you for  
your attention!

谢谢！

