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## A planetarium of your own

If you have ever visited a Planetarium, you must be so impressed by the performance presented by the planetarium because the wonderful astronomical performance has unveiled the mysterious look of the universe right in front of you.

Now you finally have your own planetarium, which can display the stars on your walls and ceilings, and guide you into the hall of science and accompany you in the exploration of the mysterious universe!

## The Uses of Mini-planetarium

1. It is the key of enlightenment for the astronomy enthusiasts to understand constellations and the astronomical phenomena.

2. It is cheap and practical equipment for the school teaching or science activities.

3. It is a pretty and simple celestial globe that can be placed anywhere.

## The Structure of Mini-planetarium

As showed in picture 1 is the appearance of a Mini-planetarium.

### In the Figure:

1. Fixed Stars
2. Polar altitude plate ( 2pieces )
3. Polar altitude handwheel ( 2 pieces )
4. Base
5. Compass
6. Support
7. Date dial
8. Time dial
9. Permanent
10. The main power socket
11. U-shaped Bar

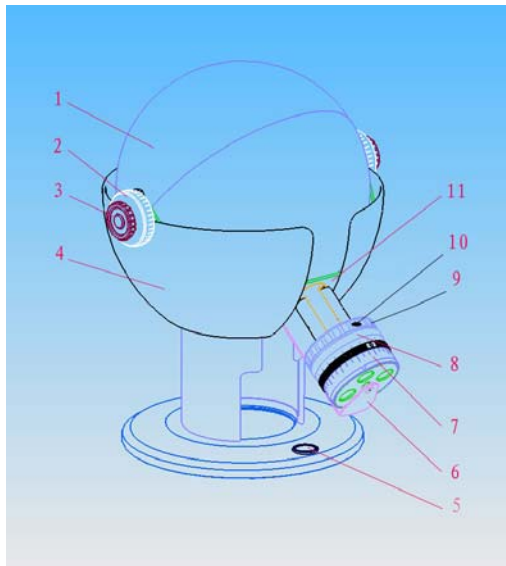


Figure 1

## **The Functions of Mini-planetarium**

- 1.It can represent the beautiful sky in a room without light at any time, and any place.
- 2.It can simulate an observation on the sky from any latitude of the earth.
- 3.It can simulate the real time sky or a sky intercepted at any time.
- 4.It can automatically generate diurnal apparent motion.
- 5.It can simulate a sky that's synchronized with the real one.

## **The Use and Maintenance of Mini-planetarium**

### **1. The correct setting for the planetarium**

The purpose of setting the planetarium right is to keep the artificial sky projected by the equipment unanimous with the outdoor actual sky. By doing so, we can get familiar with the constellations in advance, which helps us easily identify the corresponding actual constellations in nature. The settings include: ①The Polar altitude setup: loose the Polar altitude handwheel 3, swing the U-shaped Bar 11 with hand until the reading of the Polar altitude plate becomes consistent with your local geographic latitude, and then re-lock the Polar altitude handwheels 3. See the Appendix A for the geographic latitude of the world's major cities.② Date and time setup: First of all, aim the 0:00 triangular markings on the time dial at the corresponding date on the Date Dial. Then, rotate the Date Dial 7, and adjust the current hour and minute on the Time Dial into the middle of notch of the Base 4 (for example, it is 8:20 PM now, then switch 20:20 PM into the middle of notch of the Base 4). ③ Position setup: confirm the due south direction with the compass, and then conduct an overall rotation of the Base 4, and put the notch toward the due south. Now, the setup of the planetarium is finished, the artificial sky projected by the equipment shall be totally consistent with the actual one.

### **2. Preparations before the projection**

Put the installed planetarium in the center of a spacious room, the height should be level with eyes; Connected up the main power , turn off all the indoor lights.

### **3. The Screening of artificial sky**

Key 17: Flashlamp switching key and motor closure key. Take out the Antenna 14 of the Remote Control (Figure 2), the Key 17 shall be the on-off of the Flashlamp 13, the Fixed Stars stop rotating.

Key15: motor corotation key. When the is bright, push the Key 15 once, the diurnal of the Fixed Stars 1 conduct a fast corotation, push the key again, it becomes a slow corotation, and click stop, cycle thuswise.

Key 16: Motor contrarotating key. When the is bright, push the Key 16 once, the diurnal of the Fixed Stars 1 conduct a fast contrarotating, push the key again, it becomes a slow contrarotating, and click stop, cycle thuswise.

#### 4. Observe stars by comparison with the real sky

The role of artificial sky only helps identify stars. Your ultimate goal is to learn the actual sky of the nature. It is suggested to put the planetarium in front of your window in the south direction, or in the yard where you can see the natural sky, and carry a piece of white paper as screen, thereby the artificial starry sky will be clearly projected on the white paper. If you have correctly set up the planetarium, then the artificial sky projected on the white paper shall completely represents the actual sky. By repeated identification of the two, it should be easy for you to understand the actual sky.

By comparison with star atlas, the Mini-planetarium is more suitable for beginners to identify stars as the planetarium only projects the stars need for identification, while the excessive scope of star atlas makes it too difficult to find corresponding star areas. Besides, constant lighting is needed when observing star atlas, which makes the eyes ineffective when looking at the real sky.

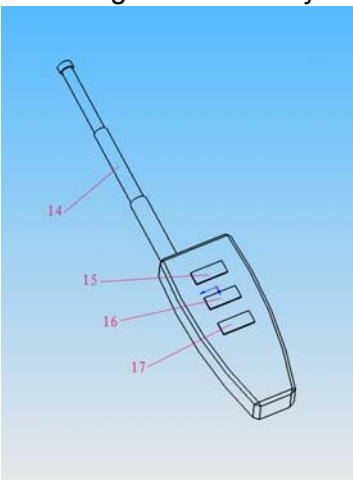
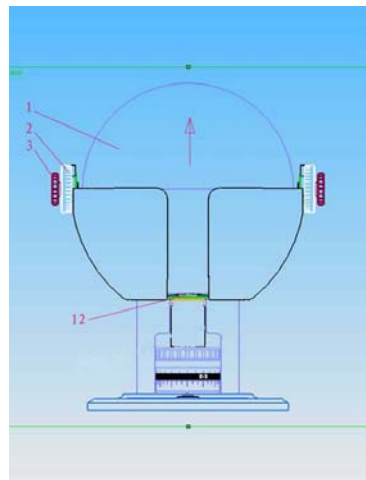


Figure2

Figure

3

5.



Replace lamp

Rotate the Date Dial 7, adjust the spring 12 into the middle of notch of the Base 4; then loose the Polar altitude handwheel 3. As figure 3 shows, hold up the instrument; use mini screwdriver to press spring 12, at the same time draw Fixed Stars 1 .

As figure 4 shows, pull at lamp 13; then pull in new lamp; then install the Fixed Stars 1.

### Important Notes

1. Mini-planetarium must stay away from sources of heat; the wall mount switching Adapter must be removed for disuse .

2. Abandoned batteries should go to the designated recycling sites required by the relevant local departments.

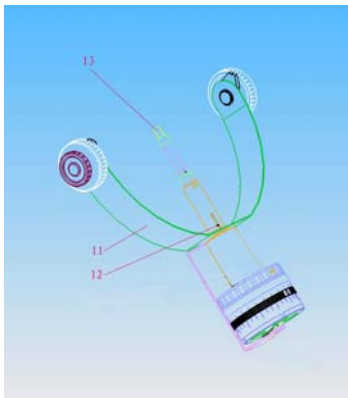


Figure 4

### Preparations before the Observation

How to start the observation in the boundless sky? Firstly, we must understand a lot about the sky and have star atlas ready.

Roughly, the stars can be divided into 1-6 grades by the brightness. (May be credited as m). The brightest 20 stars are classified as the 1<sup>st</sup> grade, the stars that can be seen by the naked eyes are classified as the 6<sup>th</sup> grade, that is, the smaller the grade is, the brighter the star is. Now, it has already established a formula, which enables the brightness level to be adjustable, for example, the 0 grade or negative grade stars can be brighter than the 1<sup>st</sup> grade stars, and the sun is grade -26.75. The stars that are darker than the 6<sup>th</sup> grade stars may come from the grade 7,8,9, ... 25, etc.

| Star Grade  | 1m | 2m | 3m  | 4m  | 5m   | 6m   |
|-------------|----|----|-----|-----|------|------|
| Star Number | 13 | 40 | 100 | 500 | 1000 | 4800 |

Star observation should start from the primary bright stars and the constellations, not too many however. We not only need to recognize the image of a single constellation, but also need to know the mutual association of location of the constellations in order to understand the stars in general. By referring to the legends and stories of constellations, plus the Pithy Formula, our memories can usually be

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enhanced.

## The Vast Universe

The vast universe is of infinite charm, whenever looking up to the sky, we would be attracted by the mysterious and magnificent scene. As early as several thousand years ago, the human had begun its exploration of the mysteries of the sky due to life and agricultural production needs, leading to the birth of the ancient astronomy, and writing the first page of the history of human civilization. Modern astronomy is the science for the understanding of the universe, which plays a subtle role for the formation of a correct worldview and the enhancement of self-cultivation for young people.

The winter sky (Figure 5) is particularly spectacular, when the Orion shows up and the Tri-star sparkles-- this is a symbol of auspiciousness. The Tri-star is the belt of the Orion, with swords hanging underneath, the Orion holds an arc-shaped shield on his left hand, and is ready to shoot the Taurus leaping to him. The faithful big dog follows closely with the Orion, also ready for battle. Moving along the Tri-star on the belt and extending to the lower right part of the Orion, we will be able to find the Sirius. The Sirius is the head of the Greater Dog, which is the brightest star in one day.

Can you identify the Orion and Greater Dog from this sky picture? If you cannot for the time being, no need to despair, because the mini-planetarium will teach you the sky. With its help, it does not take much time until you become familiar with the major constellations of the day.

In the best conditions, people can probably see about 3,000 stars, most of them are fixed stars. Although these stars rise and fall as a whole every day, their mutual position remains unchanged. To facilitate understanding and memory, people composed the brighter stars in graphics for identification,

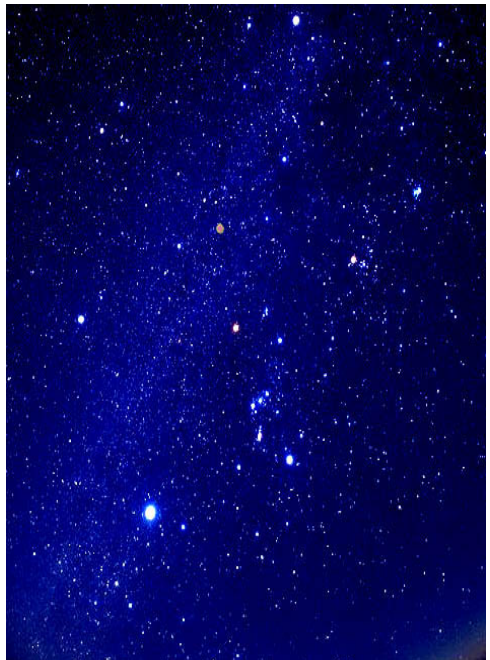


Figure 5

which is the constellation. In the early age of human civilization, each nationality independently developed its own astronomy and formed its own constellations. For example, China has the Plough, the Cowherd and the Weaving Maid, the Three Enclosures and the Twenty-eight Lunar Mansions, etc. The current international 88 constellations (see Appendix B) were developed based on the ancient Greece Constellation system. Each constellation was given the image of people or animals in accordance with its inter-connection scenario. Also, combing the circumstances in the Greek myth, they were given appropriate names, which is the origin of international constellations.

After giving names to the constellations and combing with the beautiful legends, the originally dazzling, seemingly haphazard sky becomes methodical and orderly. For example, by imaging the Orion uses a shield to resist the Taurus, with the big dog following behind, the sky becomes easier for identification and memorization.

In addition to the brilliant little stars in the night sky, there is also the Milk Way Galaxy. As it can be seen in Figure 5, the cloud-covered light band slumping from the top of the picture bypassing the right shoulder of the Orion and the back of the Greater Dog is the Milk Way Galaxy. As long as we keep in mind that the Waggoner, Cassiopeia, Cygnus, Aquila, Centaurus, Scorpio and Crux are all on the Milk Way Galaxy belt, it would be easy to rapidly recognize the stellar sky in general.

The Milk Way Galaxy is actually the group of fixed stars, which is made up of about 300 billion stars formed together, a rotating windmill shaped (see figure 6,7). It consists of galactic nucleus, the galactic disk, galactic halo and spiral arms, with a

diameter of about 100,000 light-years, and the thickest part is about 20,000 light-years. Our sun is located in one of the rotating arms of the Milk Way Galaxy. It is a very ordinary star and also the closest star from the Earth. The distance from sun to the Earth is 150 million km, while other stars in the Milk Way Galaxy, even if the nearest distance from the Earth is 4.3 light-years (one light-years = 10 trillion kilometers, the distance that the light transmits per year, ly for short), several hundred

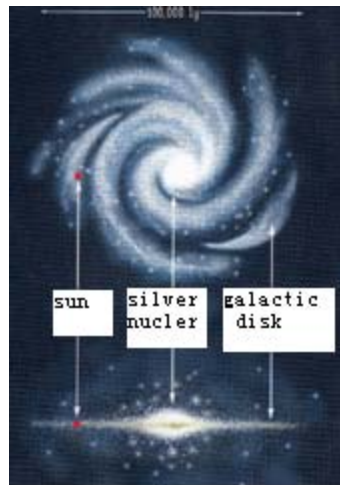


Figure 6

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thousand times further than the sun.

Due to close distance between the Earth and the sun, we are able to see the luminous flame of the sun while other thousands of stars, which are comparatively near the Earth (most of the hundreds of light-years within), can only show a faint glimmer in the night sky.



Figure 7

The tremendous contrast between sun and fixed stars made people unable to recognize. The sun and the

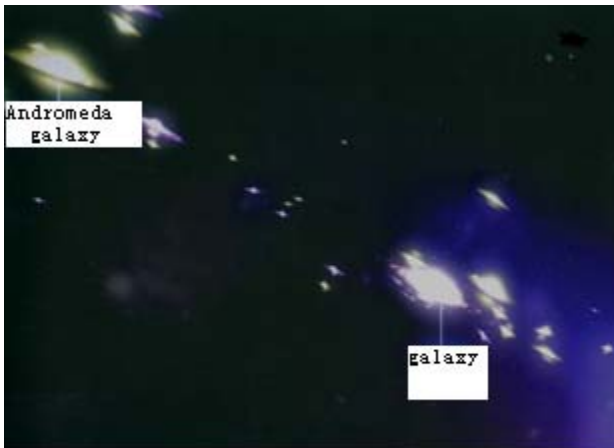


Figure 8

fixed stars actually belong to the same celestial body for quite a period of time. As for the more distant several hundred billion stars in the Milky Way Galaxy, although they are suns, they are too far for the eyesight to reach. They only appear to be a cloud-covered band around the sky. The Milky Way Galaxy does not cover the whole

universe, as indicated in Figure 8, and there are also many galaxies similar to the Milky Way Galaxy, for example, the Andromeda Galaxy M31 that is more than two million light years from the Earth can be observed with the naked eye. These galaxies are outside the Milky Way Galaxy, known as the external galaxies.

Currently, the observation area of the largest telescopes and other detecting devices have reached 15 billion light years, with more than one hundred billion external galaxies have been found. Obviously, with scientific and technological progress and the improvements of the detecting means, the observation area of the universe will continue to expand and the number of external galaxies will continue to increase, as the universe is boundless.



When we observe the astronomical phenomena at night, we will find some unexpected objects loitering between the constellations, which are the planets. For example, in Figure 5, the bright star locating on the right shoulder of the Orion with slightly red color is the Mars. The planets visible to the naked eyes include Mercury, Venus, Mars, Jupiter and Saturn. There are also the Uranus and the Neptune, which can be visualized using telescopes. These planets and along with our Earth and thousands of small comets are rotating around the sun, forming the solar system. Figure 9 represents the full picture of the solar system.

Now let us make a figurative analogy for the universe scale described above: If put one sesame in the palm of the hand, make the size of the sesame as the orbit for the Earth's revolution around the sun - 300 million km in diameter, then the size of the solar system is equivalent to the palm of the hand. Accordingly, the nearest fixed stars are 500 meters away, the Milky Way Galaxy will occupy the entire North America or even greater.

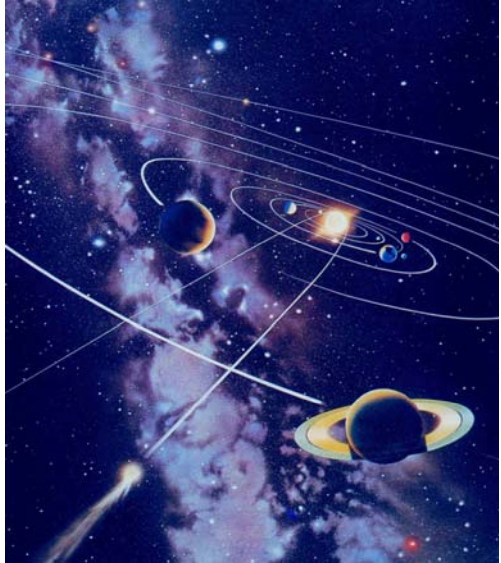


Figure 9

Even more than 10,000 Earths cannot accommodate the currently known observable universe. Please give full play to your imagination to understand all this!

In the face of this vast universe, how insignificant the mankind is; By contrast to the billions of age of the immemorial universe, how short life is. However, it's through generations of indomitable exploration of the human, sometimes even paid a high price for it, and gradually overcame the ignorance and superstition, and finally achieved a basic understanding of the universe, which is constantly deepening. The Mini-planetarium is to help you understand the universe, study science, and be ready to be a modern citizen in the 21st century.

## **The Rotation and Revolution of the Earth**

In general sense, the sky assembles a huge covering hemisphere,

which is called coelosphere in astronomy. The coelosphere is a ball that has the observer as the center and with an infinite radius. When we cannot tell the difference of distance between the stars, we would feel the stars are embedded on the coelosphere. The coelosphere's rise from the east and falling from the west, along with rotation is called diurnal apparent motion. The diurnal apparent motion of the coelosphere is a reflection of the Earth's rotation. As showed in Figure 10 is actually the Earth's weekly rotation around the rotating axis, but we are not able to be aware of our rotation, on the contrary, we refer it as the diurnal apparent motion of the coelosphere. The most visible manifestation of diurnal apparent motion is the shift of day and night, because the sun participates in the diurnal apparent motion.

While the Earth conducts a rotation, it also conducts a revolution around the sun, with the cycle of one year. The Earth's revolution is reflected in the diurnal apparent motion of the sun. As it can be seen from Figure 10, as the Earth conducts a 360-degree rotation on the revolution orbit, it also conducts a revolution around the sun for about one degree. We can not sense the revolution of the Earth, what we see

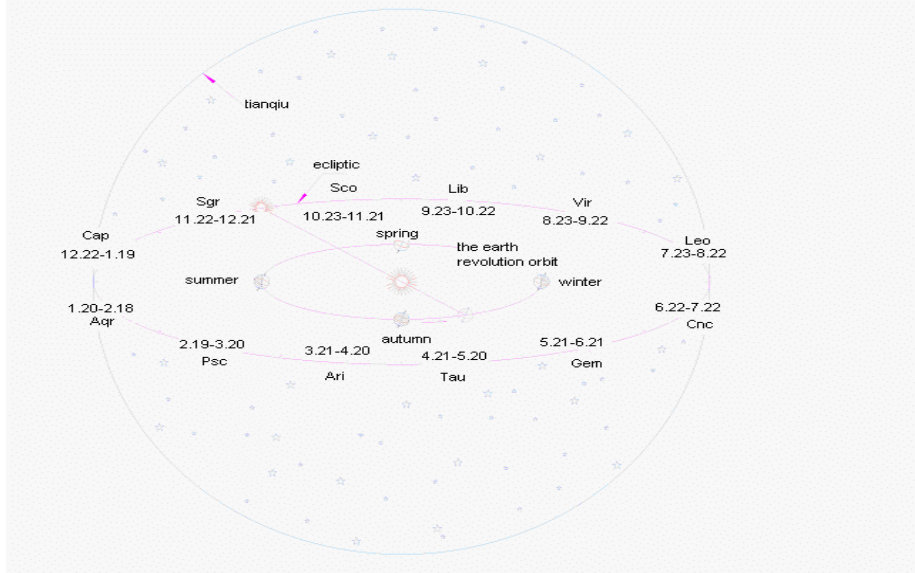


Figure 10

is the sun that cycles for one round on the coelosphere from west to east bypassing the background stars, which is called the diurnal apparent motion of the sun.

It may also be illustrated as: Suppose a circular runway surrounds a soccer field, one side is the rostrum, the opposite is the auditorium, and put a football in the center of the field. If an athlete were running on the runway, when he went to the rostrum he would see the football on the side of the auditorium. If he watches the football simultaneously while he is running, he would see the football keep moving relative to the background. When the athlete finished a half round and arrived at the auditorium, he would see the football has moved to the side of the rostrum. This shows that when observers move, the close fixed targets would mobile on the far background. In this case, the athlete is equivalent to the Earth, while the runway is its revolution orbit, and the football is the sun. Rostrum and the auditorium are different constellations on the celestial sphere. This example can help us to understand why the sun would scour among the background constellations when the Earth is conducting revolution on the orbit.

The orbit that the solar plane mobiles on the celestial sphere is called ecliptic. It is apparently the projection of the Earth revolution orbit on the celestial sphere.

As Figure 10 shows, in different dates of each year, due to the Earth revolution, the solar plane will be located in different location on the ecliptic – or in other words, in different constellations. We refer the 12 constellations on the ecliptic belt as the Ecliptic 12 Constellations, their names and the corresponding dates are shown as below:

|               |            |             |             |             |           |           |
|---------------|------------|-------------|-------------|-------------|-----------|-----------|
| Constellation | Aries      | Taurus      | Gemini      | Cancer      | Leo       | Virgo     |
| Date          | 3.21-4.20  | 4.21-5.20   | 5.21-6.21   | 6.22-7.22   | 7.23-8.22 | 8.23-9.22 |
| Constellation | Libra      | Scorpio     | Centaurus   | Capricornus | Aquarius  | Pisces    |
| Date          | 9.23-10.22 | 10.23-11.21 | 11.22-12.21 | 12.22-1.19  | 1.20-2.18 | 2.19-3.20 |

If you were born on December 1, then you are considered as Centaurus, born on May 1, then you would be Taurus... Do you know where you are in the vast sky? It has been said that constellations can decide people's character and destiny, which is clearly unfounded.

### **Why the stars are different in different seasons?**

This is due to impact of diurnal apparent motion caused by the Earth revolution, because we can only view the stars at night instead

of the daytime due to the strong sunlight. As it shows in Figure 10, half of the Earth that is facing the sun is the day, while the back half that faces away from the sun is the night. Each year in early December, when the apparent sun locates at the Centaurus we will not able to see the Centaurus – this is because the Centaurus is blinded by the brilliant sunlight. However, it is right time for the observation of the Taurus and Gemini, because they are 180 degrees apart the Centaurus. In fact, this is easy to understand: suppose that the sun can be switched on and off as arbitrary as electric light, the 24 hours after turning off the sun would be night when the stars can be observed. The sky remains the same throughout the year. However, when the sun reaches the Centaurus, we suddenly turn on the Sun, the glow of the sun would instantly overshadow the Centaurus (it becomes daytime), then we will not be able to see the Centaurus. We are only able to see the Taurus and the Gemini 12 hours later at night (after a 180 degree rotation of the Earth). Thus, the apparent annual motion of the sun does not only present the solar plane travels from west to east along the ecliptic, it also decides that the stars that can be seen at night in different seasons of a year are different.

### **Why the Polaris can guide direction?**

As mentioned earlier, the Earth revolves on its axis every day, which results in the diurnal apparent motion. The rotating axis can intersects with the celestial sphere at two points (i.e. the South celestial pole and North celestial pole) by extending toward the south and north. The diurnal apparent motion of the celestial sphere is in effect the celestial sphere rotates around the two poles. Figure 11 is the sky picture near the celestial pole after a long exposing filming. Figure 11 shows that the diurnal



Figure 11

apparent motion of the fixed stars are traveling along the circular orbit, but the farther the fixed star is from the North celestial pole, the bigger the circular radius is. The small arc near the rotation center (North celestial pole) is mapped by the Little Dipper  $\alpha$ . Thus it can be seen, it

holds a fixed position in the diurnal apparent motion of the fixed stars, which can be used to guide the direction of the true north. It's called the Polaris. Figure 11 also shows that the farther the fixed stars away from the celestial pole, their diurnal apparent motion can draw a bigger circle. They show up in the east from some time and then show up in the west for some time in an uncertain direction, which apparently cannot be used to guide directions.

## The astronomical phenomena in special latitudes and special seasons - show you around the world

① The astronomical phenomena at the equator: the latitude of the equator is 0 degree, therefore adjust the Polar altitude plate 2 to be 0 degree, as shown in Figure 12. At this time, the two poles are located at the north and south points of the horizon respectively. The celestial equator is perpendicular to the horizon and circle through the zenith point. Screening the artificial sky and rapidly starting the diurnal apparent motion, all the stars rise and fall perpendicular to the horizon. Every fixed star can be observed for 12 hours every day, while another 12 hours are invisible. The majority of the stars can be observed on the equator because all the fixed stars on the celestial sphere appear alternately.

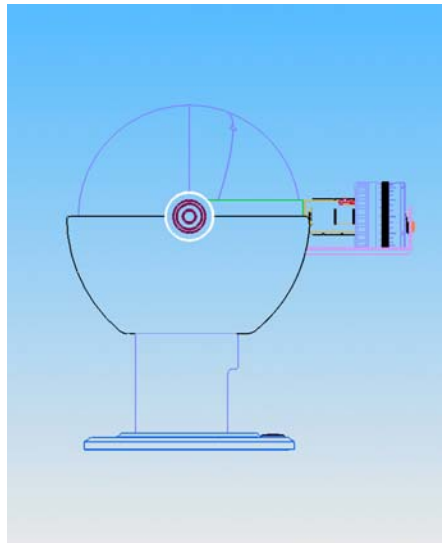


Figure 12

② The astronomical phenomena of: The latitude of the North Pole is 90 degrees, thus the planetarium is settled as Figure 2. At this time, the celestial equator superimposes with the equator, and the North Pole superimposes with the zenith point. By screening the artificial sky and rapidly starting the diurnal apparent motion, we can see all the

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fixed stars rotate parallel to the horizon. The fixed stars do not only fail to rise or fall, but also maintain the same height. They always cycle from east to west around the zenith. As mentioned in the diurnal apparent motion of the sun (P9), the sun moves on the ecliptic for one week per year, in the half year from the Spring Equinox to the Summer Solstice and then to the Autumnal Equinox when the sun reaches the north of the equator, that is, it's always above the horizon, however, the sun never falls in the half year in the North Pole. Starting from the Spring Equinox, the sun rises from the horizon, and then spirals up. It would reach the highest point in the Summer Solstice three months later when the height of the sun is 23.5 degrees above the horizon. After the Summer Solstice, the sun spirals down, with the rotating circle approaching the horizon. Until the Autumnal Equinox, the sun would fall below the horizon, and that's why the North Pole has the daytime for half a year. On the contrary, in the half year from the Autumnal Equinox to the Winter Solstice and then to the Spring Equinox when the sun reaches the south of the equator, that is, it's always below the horizon, however, the sun never rises in the half year in the North Pole- polar night, which is a startling astronomical sight. However, there is also a great pity in the North Pole, that is, few fixed stars can be observed because in the North Pole, none of the fixed stars from Southern Hemisphere can be observed. While the astronomical phenomena in the South Pole is to the contrary. The polar day of the North Pole means the polar night of the South Pole, vice versa. It is also true that none of the fixed stars from the Northern Hemisphere can be observed in the South Pole.

③The astronomical phenomena between the two poles and the equator: The setup of the planetarium is shown in Figure 1. After starting the diurnal apparent motion please observe closely. Some of the fixed stars will never fall below the horizon, while the other fixed stars never rise above the horizon. With the change of the polar altitude, the two kinds of fixed stars will change accordingly. Between the two poles and the equator, the stars will not rise and fall perpendicular to the horizon like on the equator, either rotate in parallel to the horizon like on the pole. By careful observation of the planetarium's diurnal apparent motion we can see the Fixed Stars 1 rotate around the sloping axis. This sloping axis is the polar axis of the celestial sphere. The included angle of the polar axis and the horizon is the height of the celestial pole, polar altitude for short. The numerical value of the polar altitude is equal to the latitude of the observation

point, which can be easily proved by geometric mapping.

### Circumpolar Constellation

As mentioned earlier, in the mid-latitude area of the Northern Hemisphere, we can see the fixed stars that never fall throughout the year, these constellations are known as the Circumpolar Constellation.

The most important circumpolar constellations include the Great Bear, the Little Dipper, and the Cassiopeia and so on (see Figure 13). The most eye-catching star in this picture is the Plough of the Great Bear. The Plough is the tail of the Great Bear, which looks like a handled spoon. Extend 5 times by tying lines along the two stars on the Plough spoon head, we can find the Little Dipper  $\alpha$ , which is the Polaris that provides directions for navigation. The Polaris is very easy to identify, because it is the only and brightest 2-grade star near the North Pole. In addition, tie a line between the Star  $\alpha$  and  $\kappa$

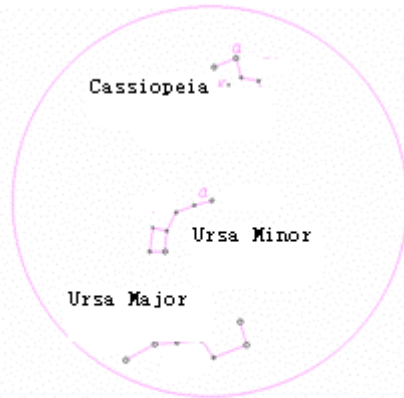


Figure 13

from the W-shaped openings of the Cassiopeia and extend the line for 5 times, we can also find the Polaris.

Because the Polaris locates near the North Pole, when the stars of the day revolve, it looks like they are rotating around the Polaris, as the Figure 13 assembles the big dial plate of a clock.

In addition, due to the impact of the Earth's revolution, the bucket arm of the Plough points at different directions in different dusks of the seasons, by which the seasons can be roughly judged. One proverb says: when the bucket arm points the east, the whole world is in spring; when the bucket arm points the south, the whole world is in summer; when the bucket arm points the west, the whole world is in autumn; when the bucket arm points the north, the whole world is in winter. Of course, this proverb applies only to the Earth's northern hemisphere, while the southern hemisphere is just the opposite.

### The Stars in the spring



In the spring sky, the Plough of the Great Bear near the zenith is the most eye-catching, other major constellations include the Leo, Bootes, Virgo and Hercules. The Little Dipper where the Polaris locates can be seen throughout the seasons. Naturally bend down along the radian of the bucket arm, we can see two bright stars: the close orange one is the Arcturus (Bootes  $\alpha$ ), the distant blue and white one is Spica (Virgo  $\alpha$ ). This is the spring arc.

Under the Plough is the Leo whose head directs the west.

The Leo is the representative constellation in the spring. The lion head looks like the curved sickle. The blue and white bright star locates at his forepaw is the Regulus (Leo  $\alpha$ ), with the triangular tail toward the east. The spring sky can be summarized as: when the bucket arm bends to the east, the Bootes and Virgo followsuit; the lion lies under the bear, jointly heading for the west.

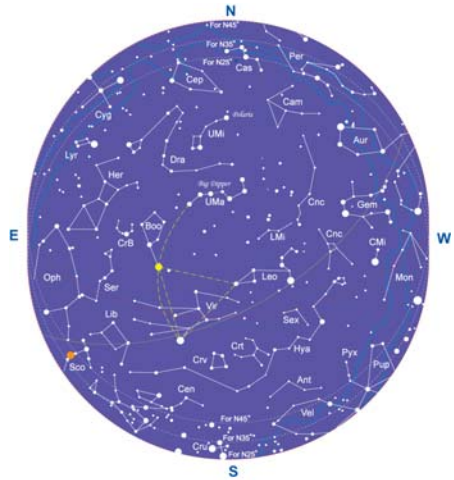


Figure 14

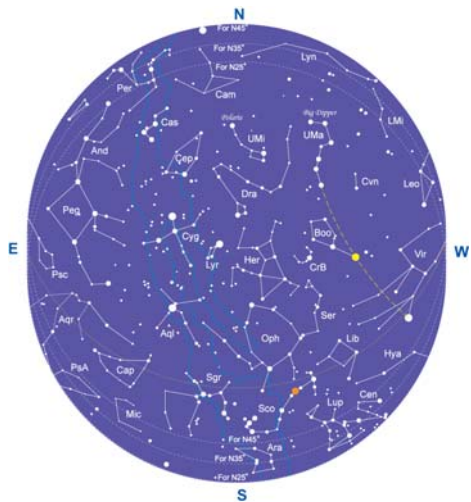


Figure 15

### The Stars in the summer

The summer sky is full of legends, the Milk Way Galaxy across from northwest to southeast in the whole day. The cross-shaped Cygnus flies on the Milk Way Galaxy. The Cowherd (Aquila  $\alpha$ ) is opposite to the Weaving Maid blocked by the Milk Way Galaxy (Messier  $\alpha$ ). It is said that the dark stars next to the Cowherd are the son and daughter loaded by a shoulder pole, they are waiting for the Tanabata meet. As long as we first find the Milk Way Galaxy, it is



easy to find the Cygnus and the Cowherd and Weaving Maid. The summer triangle composed by the Cowherd (grade 0.77), the Weaving Maid (grade 0.03) and the Cygnus  $\alpha$  (grade 1.25) is very eye-catching in the night sky. In the southern sky is the Scorpio, which has a vivid image, with the Scorpion clamp heads the west, and the hook-shaped tail directs the east. At the heart of the Scorpion locates a red Star Scorpio  $\alpha$  (grade 0.92). Close to the east of the Scorpio is the Sagittarius.

The summer sky can be summarized as: when the Plough refers to the south, the sky is gleaming, the Weaving Maid riding geese to meet the Cowherd, while the Scorpio and the Centaurus appear in the southern sky.

### The Stars in the autumn

The autumn sky was clear and starry, with the Milk Way Galaxy shifted to the east-west direction. In the bottom of the Milk Way Galaxy hangs the autumn quadrilateral of the Pegasus. Above the Pegasus lie the W-shaped Cassiopeia and Polaris, which are supposed to be familiar to us. Between the Pegasus and Pegasus is the Andromeda, and the Cepheus is between the Cassiopeia and Cygnus. Below the Pegasus are Pisces, Piscis Austrinus and the Aquarius.

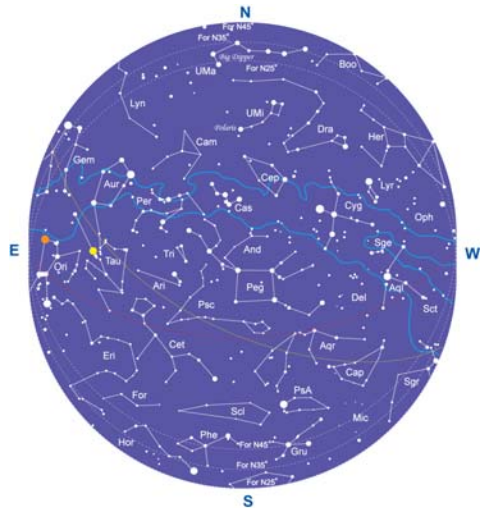


Figure 16

The autumn sky can be summarized as: when the Plough refers to the west, autumn wind starts, the Andromeda and Cassiopeia fly to welcome the Cepheus, the Pisces and the Piscis Austrinus are bottled by the Aquarius.

### The Stars in the winter

The winter sky is bespangled with stars. Most striking is the Orion hanging in the southern and the Greater Dog that follows it. The brightness level of the Star  $\alpha$  locating at the head of the Greater Dog is  $-1.47$ , which is called Sirius and is the brightest star of the day. The Orion's right shoulder (Betelgeuse), the Sirius and the Little Dog component the Winter Hexagon, which just across the strait of the Milk Way Galaxy.

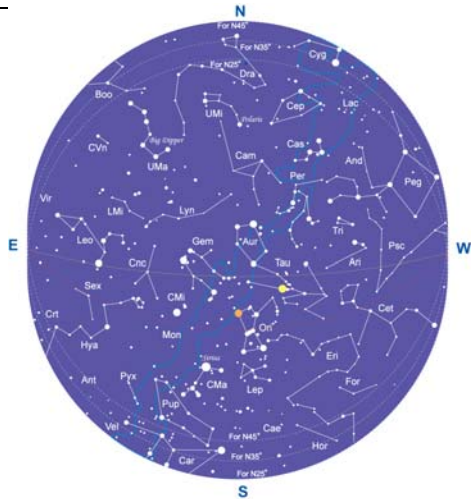


Figure 17

In the west of Orion locates the Taurus, it is raising its horn shooting up to the Orion. Around the Orion, located above are the Waggoner, and the Gemini in the Northeast, the Little Dog in the East, Greater Dog in the Southeast, the Lepus in the South, the Eridanus in the West, and the Taurus in the Northwest.

The stars in winter can also be summarized as: when the Plough refers to the north, it is the most spectacular scene, when the Orion fights the Taurus on the riverside, the two dogs seizing for the rabbit while the Waggoner and Gemini viewing on the riverside.

## Fault Analysis & Troubleshooting

| Fault  | Cause   | Troubleshooting                                    |
|--|---|--|
| Lamp turns off<br>Celestial sphere does not rotate | No electric power source supply                 | Failure of electric fence                          |
|  |   | Refer to "failure of wall mount switching Adapter" |
| Lamp turns off<br>Celestial sphere rotates         | Lamp is damaged                                 | Refer to "failure of remote controller"            |
|  |   | Replace lamp                                       |
| Failure of remote controller                       | Battery energy of remote controller is too low. | Replace battery                                    |
|  | Chip is damaged                                 | Buy a new remote controller                        |
| failure of wall mount switching Adapter            | Chip is damaged                                 | Buy a new wall mount switching Adapter             |

## Appendix A the geographic latitude of the world's major cities

### North America

|               |           |           |
|---------------|-----------|-----------|
| Winnipeg      | Canada    | 49° 55' N |
| Montreal      | Canada    | 45° 30' N |
| Chicago       | USA       | 41° 50' N |
| New York      | USA       | 40° 40' N |
| Washington    | USA       | 38° 55' N |
| San Francisco | USA       | 37° 45' N |
| New Orleans   | USA       | 30° 00' N |
| Mexico City   | Mexico    | 19° 25' N |
| Caracas       | Venezuela | 10° 35' N |

### South America

|         |         |          |
|---------|---------|----------|
| Cologne | Panama  | 9° 20' N |
| Quito   | Ecuador | 0° 15' S |

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|                |           |           |
|----------------|-----------|-----------|
| La Paz         | Bolivia   | 16° 30' S |
| Rio de Janeiro | Brazil    | 22° 55' S |
| Santiago       | Chile     | 33° 30' S |
| Buenos Aires   | Argentina | 34° 40' S |

### Europe

|                |                |           |
|----------------|----------------|-----------|
| Hamburg        | Germany        | 53° 35' N |
| Berlin         | Germany        | 52° 30' N |
| Warsaw         | Poland         | 52° 15' N |
| PRAGUE         | Czech Republic | 50° 05' N |
| Vienna         | Austria        | 48° 15' N |
| Munich         | Germany        | 48° 10' N |
| Belgrade       | Yugoslavia     | 44° 50' N |
| St. Petersburg | Russia         | 59° 55' N |
| Moscow         | Russia         | 55° 45' N |
| BUCHAREST      | Romania        | 44° 25' N |
| Bergen         | Norway         | 60° 25' N |
| Stockholm      | Sweden         | 59° 20' N |
| London         | United Kingdom | 51° 30' N |
| Brussels       | Belgium        | 50° 50' N |
| Paris          | France         | 48° 50' N |
| Geneva         | Switzerland    | 46° 15' N |
| Rome           | Italy          | 41° 55' N |
| Istanbul       | Turkey         | 41° 00' N |
| Madrid         | Spain          | 40° 25' N |
| Lisbon         | Portugal       | 38° 45' N |
| Athens         | Greece         | 38° 00' N |

### Asia

|                  |             |           |
|------------------|-------------|-----------|
| Beijing          | China       | 39° 55' N |
| HongKong         | China       | 22° 20' N |
| Taipei           | China       | 25° 02' N |
| Omsk             | Russia      | 55° 00' N |
| Vladivostok      | Russia      | 43° 10' N |
| Tashkent         | Uzbekistan  | 41° 15' N |
| Ankara           | Turkey      | 39° 55' N |
| Tehran           | Iran        | 35° 40' N |
| Tokyo            | Japan       | 35° 40' N |
| Baghdad          | Iraq        | 33° 20' N |
| New Delhi        | India       | 28° 40' N |
| Calcutta         | India       | 22° 35' N |
| Bombay           | India       | 18° 55' N |
| Manila           | Philippines | 14° 35' N |
| Ho Chi Minh City | Vietnam     | 10° 45' N |
| Singapore        | Singapore   | 1° 20' N  |
| Jakarta          | Indonesia   | 6° 10' S  |

### Africa

|           |                  |           |
|-----------|------------------|-----------|
| Tripoli   | Libya            | 32° 55' N |
| Cairo     | Egypt            | 30° 05' N |
| Kinshasa  | Congo (Kinshasa) | 4° 20' S  |
| Pretoria  | South Africa     | 25° 45' S |
| Durban    | South Africa     | 9° 55' S  |
| Cape Town | South Africa     | 33° 55' S |

### Oceania

|           |           |           |
|-----------|-----------|-----------|
| Honolulu  | USA       | 21° 20' N |
| Sydney    | Australia | 33° 55' S |
| Melbourne | Australia | 37° 45' S |

## Appendix B The designations of 88 constellations

Triones, Little Bear, Draco, Cassiopeia, Cepheus, Andromeda, Lacerta, Camelopardalis, Waggoner, Canes Venatici, Vulpecula, Cygnus, Triangulum, Leo Minor, Perseus, Bootes, Hercules, Coma Berenices, Corona Borealis, Lynx, Sagitta, Lyra, Delphinus, Pegasus, Cancer, Aries, Gemini, Aquarius, Virgo, Leo, Taurus, Pisces, Capricornus, Centaurus, Scorpio, Libra, Equuleus, Little Dog, Aquila, Ophiuchus, Serpens, Monoceros, Hydra, Orion, Cetus, ARA, Pictor, Musca, Mensa, Horologium Tucana, Circinus, Apus, Volans, Norma, Dorado, Chamaeleon, Hydrus, Phoenix, Pavo, Octans, Reticulum, Grus, Corona Australis, Carina, Puppis, Pyxis, Vela, Sculptor, Eridanus, Scutum, Fornax, Antlia, Caelum, Crater, Lupus, Greater Dog, Columba, Corvus, Piscis Austrinus, Lepus, Sextans, Indus, Triangulum Australe, Telescopium, Crux, Centaur, Miniscopeium



Type A : 3pcs AA batteries driving



Type B: 12V DC adapter driving