Preparing for Observing

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Summary

A star party can be a way to learn and have fun, especially if you do it with a friend or with a group of friends. You have to prepare for it, especially if you plan to use some instruments. But don't neglect the simple joy of watching the sky with the unaided eye or binoculars.

Goals

- Explain how to choose the correct place, time, and date, what equipment you will take and how to plan the event.
- Learn to use the program Stellarium.
- Recognize the Light Pollution problem.

Choosing the place and date

Atmospheric light greatly affects our perception of the sky. In cities you can only see the sun, the moon, a few planets, and a few bright stars and satellites. It is far better to observe from a dark location, although you might have to give up the advantage of being able to do it at school or from home.

If you want to see more stars and nebulae, you must go to a site away from roads and towns, because cities send up a halo of light that prevents proper vision. This phenomenon is known as "light pollution" and in the case of the globe of light that surrounds a city, it is identified as “radiance”. Also avoid the vicinity of isolated lamps or lights. There should be no large trees nearby, nor roads where cars drive that dazzle or blind us (another form of light pollution) with their headlights.

In choosing a date, of course, you want clear weather without clouds. It's even better when the temperatures are comfortable (we recommend checking the weather at Internet). The phase of the Moon is very important. The worst days are when the moon is full, since it will produce a lot of ambient light and we will see only the brightest stars. When is waning, the moon will rise later, we will not see it unless we stay watching until dawn, but dark skies are assured in the early evening. Perhaps the most interesting are the days when the moon is just under first quarter, since the early hours of the night we can see the craters of the moon, and as the moon sets under the horizon, a few hours later, dark sky for our observing session.

If we have a telescope we should go to chosen location before sunset while we have enough natural light to set up the equipment before darkness.

Equipment needed

Planning the observations (figures 1a and 1b), approximately the date and time of the observation and for the place from which we will observe, is an important material. We need to remember that the sky changes as the observer's latitude. You can get the program Stellarium (www.stellarium.org, a quick guide is provided in the appendix to this chapter), look in astronomy magazines, or examine books and can also be purchased in specialized stores. On the web there are many places to obtain sky charts, for example www.heavens-above.com/skychart or in www.skyandtelescope.com and in particular are among the NASE materials prepared for NASE courses. To obtain any of these sky maps you must indicate the location, (usually latitude and longitude), date, and time of day.

Fig. 1a: Example of plane of the sky (SkyChart). This is for a mid-latitude north, at the middle of July at 22 h.

Fig. 1b: Example of the plane of the sky (SkyChart). This is for a mid-latitude southern, at the middle of July at 22h.

Red flashlight. In the darkness, our eyes slowly open to let in more light, which ensures us to "see" at night; this ability is called "night vision". Night vision is related to one of the two types of photo sensitive cells in the retina: the rods. In the retina there are two types of cells: the cones, sensitive to color and that are activated in bright light, and rods, which are only active at low light levels. If suddenly the area where we are looking become illuminated, the pupil is closed immediately and the rods are disabled. If entering the dark again, the pupil will take a short time to open fully again, but the rods will take at least 10 minutes to allow night vision back. The rods are less sensitive to red light, so using a red light fools the eye into acting as if it was much darker. They will retain night vision better. To create a red flashlight we use a normal flashlight and we add a simple filter using a piece of transparent red paper. On the other hand, the light produced by a campfire does not alter night vision, nor does it significantly reduce the visibility of stars.

Food. We have to consider the real time of the activity will be several hours, counting travel, material preparation, observation, collection and the return journey. The activity will be more pleasant if we share some food and drink (hot or cold depending on the seasonal temperature).

Green laser pointer. It is useful to point out constellations, stars, etc. Be very careful with this type of pointer. Never point towards the eyes of the participants in the observation or to anyone, it can damage them. Never point at airplanes. This tool only can be manipulated by adults. We must remember that this device didn't exist in the past (lasers were first used successfully in 1960, and the green-light laser, in particular, was an invention that emerged around 2012). So, if you have any doubts about the benefits of using one, it's best to point at celestial objects with your fingers. New technologies tend to be a distraction in certain activities, and in this case, observation calls for a more personal, direct, and sensitive contact with the celestial landscape.

Clothes. Even in summer, in the evening, the temperature always goes down, the wind often blows, and we must keep in mind that we need to be there for a few hours and the weather could change. Plan for it to be much cooler than the daytime temperature.

Binoculars, telescopes, camera (see sections corresponding to observation with instruments) these materials change depending the observations that we plan.

If there are clouds. A cloudy sky can upset the whole plan. However we have provided an alternative plan: telling stories about mythology of constellations or talk about any astronomical topic. If we have Internet, we can enjoy the popular Google-Earth, but watching the sky (Google Sky) or Mars, or any other simulation program of the sky, or can see a video about something astronomical in YouTube.

Unaided eye

It is essential to know the sky with the naked eye. That means knowing the names of the major constellations and the bright stars, you only need a chart of the sky. They are also very useful applications for the cell phone, that can line up with the constellations and planets help you orient to the rest of the sky, using the phone GPS. This type of resource does not show you the sky “through the clouds” but a simulation, like the one you see on the internet.

The stars that you see depend on where we are (of the latitude of the place): near the North Pole would see only 50% of the stars across the sky, those in the northern celestial hemisphere. Near the equator, we can see all the stars in the celestial sphere, depending only on the time of year. Near the South Pole, we observe only half again, in this case the ones which are in the southern hemisphere.

The constellations and stars that we recommend knowing, because they are easily identifiable, or because they are best known by most people (even if they do not know exactly where they are in the celestial vault) could be:

NORTHERN HEMISPHERE

- Constellations: Ursa Major, Ursa Minor, Cassiopeia are usually circumpolar, so always visible. In summer also see Cygnus, Lyra, Hercules, Bootes, Corona Borealis, Leo, Sagittarius and Scorpio. The ones you see in winter are: Orion, Canis Major, Taurus, Auriga, Andromeda, Pegasus and Gemini. It is also advisable to include star groups (clusters) such as the Pleiades and the Hyades.
- Stars: Polaris (near the North Celestial Pole), Sirius, Aldebaran, Betelgeuse, Rigel, Arcturus, Antares, etc.
- Galaxies: The galaxy par excellence visible in the northern hemisphere is Andromeda.

SOUTHERN HEMISPHERE

- Constellations: Southern Cross, Sagittarius, Scorpio, Leo, Carina, Puppis and Vela (the three constellations formed the ancient constellation of Argo, the ship of the Argonauts). It is also possible to see Orion and Canis Major from this hemisphere. Clusters visible to the naked eye, such as the Pleiades and the Hyades, are also detectable from the south.
- Star: Antares, Aldebaran, Sirius, Betelgeuse. In the southern hemisphere there is no star that marks the location of the South Celestial Pole, Its position is determined with the help of the Southern Cross.
- Galaxies: The Magellanic Clouds (Major Cloud and Minor Cloud) are the galaxies detectable with the naked eye in the south.

The constellations that are in the region called the "Zodiac", can be seen from most of the northern and southern hemispheres although they change orientation on the celestial sphere (compared to the north, in the south they are inverted).

It is interesting to follow the changing phases of the moon every day, and its changing position against the background of stars. This last can be done also with the planets, noting its slow movement on other planets near or on the stars. This is especially noticeable in the faster moving like Venus or Mercury, when you see at sunset. These planets also may be visible at sunrise and then you can continue recognizing them in the sky beyond the night of observation.

For a couple of hours after sunset, you can see shooting stars (meteors) at any time, with a frequency of about 5 to 10 per hour. At certain times of the year there are "falling stars", which are many more. For example around January 3 are the Quadrantids, with about 120 fireballs per hour, on August 12 Perseids, with 100 / h, on 18 November is the peak of the Leonids, with about 20 / h, and between 12 and 14 December are the Geminids, with 120 / h. The Perseids are not visible from the southern hemisphere.

There are many satellites orbiting the Earth and when they are illuminated by the sun can be seen from Earth, slowly across the sky. As the altitude is usually not much, you just see them if that has long hidden the sun, for example, the ISS (Fig. 2a) is very bright and takes about 2-3 minutes to cover the visible sky. The times of these and many other satellites can be predicted over a given geographical location with a week in advance (see www.heavens-above.com).

Fig. 2a: Path of the ISS

Fig. 2b: Binoculars: 12x (magnification) 50x (objective diameter)

Observations with binoculars

A useful and easily available astronomical instrument is binoculars (Fig. 2b). Although its ability to magnify is usually small, they collect much more light than our pupil, and help us see objects that at first glance are very faint such as star clusters, nebulae, and double stars. Also binoculars have the advantage of increasing the colour differences of stars, especially if slightly out of focus.

They usually bear inscriptions such as 8x30 or 10x50, that speak of its optical characteristics. The first figure gives the magnification and the second the diameter of the front lens in mm. One highly recommended size for this activity is the 7x50. At higher magnifications, the image moves a lot, because it is difficult to keep steady, and larger apertures increase the price enough.

Interesting objects to see with binoculars are:

NORTHERN HEMISPHERE
the Andromeda Galaxy (M31), the Hercules Cluster (M13), the double cluster in Perseus, the Praesepe (M44), the Orion Nebula (M42), the entire area of Sagittarius (nebulae such as the Lagoon M8, Trifid M20, Omega M17, several globular clusters M22, M55, etc-

SOUTHERN HEMISPHERE
Omega Centauri and 47 Tucanae are spectacular globular clusters.
The Jewel Box (Kappa Crucis) and the Pleiades are open clusters that are very easy to locate in the sky, and the Orion Nebula is also detectable from the south, as is 30 Dorado (The Tarantula), a star-forming region in the Large Magellanic Cloud.

For a detailed list of objects that can be observed, sometimes without the aid of instruments and sometimes with binoculars, we recommend the "NGC (NASE General Catalog) for Schools Without a Telescope" (Ros, Moreno, García, 2025).

In general, the Milky Way, which is visible with many more stars than with the naked eye and is detectable from both hemispheres, can also be the subject of detailed observation.

Observational telescope

Most people know that the mission of a telescope is to enlarge distant and detect objects that the eye does not see, because they are beyond the limit of detectable brightness (corresponding to magnitude 6 or 7), that is to say, it has the mission of capturing more light than the human eye. This will allow one to see faint objects that would remain faint even if we increased the magnification.

A telescope has two main parts: the objective and the eyepiece. The objective is a large diameter lens that bends light (refracting telescopes) or a mirror that reflects light (reflecting telescopes). Most objective mirrors are parabolic in shape. The eyepiece is a small lens which, as its name suggests, we place the eye to see. It is usually removable, so that different sizes of eyepiece allow more or less magnification.

The larger the objective is, more light gets collected, and we can see fainter objects. High quality lenses are more expensive than mirrors of the same diameter, so larger telescope are more frequent reflecting telescopes. The most common type is the Newtonian, consisting of a concave mirror at the bottom of the tube, which returns the rays of the top of the tube, where there is a small secondary mirror (flat) at an angle of 45º, which deflects the rays to a point outside the tube, where the eyepiece is placed. The secondary mirror blocks some of the incoming light, but is not significant. Another design is the Cassegrain type, which sends the secondary light toward a central hole of the primary mirror. The eyepiece is placed behind that central hole. This is what professional telescopes are usually like. Finally, there are catadioptics, typically like a Cassegrain but adding a thin lens at the entrance of the tube, there by greatly reduce the length of the tube and make it more light weight and portable.

The magnification of a telescope is given by the ratio of the focal length of objective (either lens or mirror) and focal length of the eyepiece. For example, if we have a telescope with a lens focal length of 1,000 mm and we put an eyepiece of focal length 10 mm, we obtain a magnification of 100 (or 100X). If we want to double the magnification, we will need either a longer focal length objective or put shorter focal length eyepiece. This has a practical limit because eyepieces with small focal lengths are difficult to manufacture and give blurred images.

Fig. 3: Different optical telescopes

Manufacturers often describe telescopes in terms of **focal ratio**, for example f / 6 or f / 8. The focal ratio is the focal length of lens or the primary mirror divided by the opening and it works to meet one of these two quantities, if it know the other. For example, if we have a refractor f / 8 and the objective lens is 60 mm in diameter, the actual focal length of the telescope will be multiplied by aperture, namely 8x60 = 480 mm. At the same lens aperture, the larger focal ratio, the smaller field of view and magnification.

The larger the aperture of a telescope will capture more light, and therefore be brighter, and allow you to see fainter objects. Also, it offers a higher **level of resolution**, which is the ability to see details: when resolution is low you will see a blurred image, and when it is high it looks very clear, with many details. It also influences the darkness of the night: in the days of full moon or light around you can’t see faint stars.

Another important limitation is the **atmospheric stability**. We've all seen how the warm atmosphere of a desert shakes the vision in movie scenes shot with telephoto lenses. When we look through a telescope, small air disturbances make the image move. Astronomers refer to this as the concept of "seeing". The atmosphere is what makes stars twinkle.

The image that you see with a telescope is **reversed**, but this does not matter much: in the Cosmos up and down positions are relative. There are accessories that flip the image and put it correctly, but at the cost of slightly lower brightness.

The mount is an important piece of a telescope. A poor quality mount allows the telescope tube to swing every time you touch. The result is a dance in the view, apart from feeling dizzy, you will be unable to see the details. It is important that mounts are rigid and stable.

Azimuth mount Equatorial mount Dobsonian mount

Fig. 4: Different mounts support telescopes

There are two types of mounts: the azimuth and equatorial. The azimuth mount is the simplest but least useful. It can be rotated left and right about its vertical axis, and up and down around a horizontal axis. The Dobsonian mount is a azimuthal type that is easy to transport and use. In the equatorial mount there are two inclined axes situated at 90 degrees to each other. One, the polar, must be directed to rotational pole of the Earth. It turns in right ascension. The other axis, the equatorial axis, gives us the declinations (remember that right ascension and declination are absolute equatorial coordinates, this system has the celestial equator as its fundamental plane and the axis of rotation of the celestial sphere as its reference axis). This is used by professional astronomers and by many amateur astronomers. They may include a motor in the equatorial axis that compensates for the rotation of the Earth. If not compensated for, especially at high magnifications, the image disappears from the field of view in a surprisingly short time.

If you have an equatorial mount, you should orient it so that the polar axis is aligned with the North Pole (or South) of the sky. That takes time, but is necessary for the equatorial tracking motor, that serves to look at the object, does not move over time, something essential in astrophotography. If we have no motor, exact alignment is less important, but will serve to keep the object in the field of view by moving a single wheel: we will only correct in right ascension or in the local coordinate, which is called the hour angle.

Finally, computerized telescopes, with a database of positions of celestial objects and two motors. Once you are set up correctly, these are easier to use. However, you must align it with three known stars in order to set it up, and beginners often are confused by this step.

The sky’s movements

Basically the sky's movements that we observe respond to relative motions of rotation and translation of the Earth. This situation makes that us perceive the sky as a set with two basic movements: daily and yearly.

The diurnal movement is very important, that is very fast and hardly allows us to perceive the annual movement that is much slower. The Earth rotates around 360º in 24 hours; this is 15º every hour. This movement is very noticeable although not we are making not careful observations. The translational motion is 360º every 365 days, which means about one degree every day (just under one degree per day). If we imagine that there were no rotation, we could see in the night sky from one day to the next, the same star at the same time in the same place but run only one grade (this is about the thickness of an index finger at the extended arm) compared to the previous day. This observation can only be done if we take as a reference one antenna or a post that allows us to relate the observation of a date on the next day. This movement is almost negligible if we do not have a reference and therefore not visible to the naked eye, but what we notice is that the sky of one day of the year is completely different after three months or six months. After three months the translation corresponds to 90º, or about 1/4 the sky and in half a year is ½ sky that is the other side of heaven, diametrically opposed. This movement has been masked night after night because the rotation, but even then we all know that watching naked eye after three months, the constellations we can recognize in the night sky are very different.

Activity 1: Celestial Dome Umbrella

A simple umbrella can allow us to visualize the movements of the sky explained previously. The umbrella used routinely placed over our heads a dome where we can draw the desired constellations. We will use a black gentleman umbrella and on it will draw with white paint (or a corrector using the students).

In this model we will not draw all the constellations, only a few selected ones and within them, the most important stars. We do not search for beautiful result; we want a working model with which we can think.

The best is to prepare two umbrellas one for each hemisphere. Each umbrella will serve to display one hemisphere. The point of intersection between the pole (representing the celestial axis of rotation, parallel to that of the Earth) and the umbrella fabric will be the pole of the hemisphere in question. The area at the edge of the umbrella fabric (where the ends of the ribs are protected with a small piece of plastic), the rib ends, will correspond approximately to the celestial equator.

We will therefore prepare two umbrellas, one for each hemisphere.

In the northern hemisphere you will draw:

- In the vicinity of the North Pole (close to the cane of the umbrella) the Big Dipper, Cassiopeia and the polar star which is precisely where the umbrella's cane passes through the fabric
- In the area of the outer edge of the umbrella will draw four constellations, one for each season, the most common and easily recognized:
  - Spring: Leo
  - Summer: Cygnus
  - Autumn: Pegasus
  - Winter: Orion:

Definitely it is possible to choose any other, but must be distributed in an equidistant way, each one located about 90 ° from the previous one.

In the southern hemisphere represent:

- In the environment of the South Pole (close umbrella's cane) the Southern Cross and the southern celestial pole is located exactly umbrella's cane passes through the fabric
- In the area of the outer edge of the umbrella we will draw four constellations, one for each season, the best known:
  - Spring: Acuarius
  - Summer: Orion
  - Autumn: Leo
  - Winter: Scorpio:

The idea is to choose great constellations and usually above the horizon. This depends a bit of the place of observation, but this proposal can be adapted to each case

If the city where we are is located is in the equatorial zone between 20º north latitude and 20º south latitude, it is necessary to draw the two umbrellas. If we are located in the northern hemisphere, at latitude ranges between 30º and 90º we will draw only the umbrella for this hemisphere and the same thing happens if we are in the southern hemisphere.

Fig.5: Projecting the stars of the northern hemisphere on a screen to draw the desired constellations. We recommend preparing the model over a black umbrella; although to photography have used one of another color in order to explain the process.

To draw constellations with white paint is very convenient to use Stellarium or a similar software and project the light with a multimedia projector on the umbrella's fabric putting the polo exactly at the point of intersection of the umbrella's cane with the fabric. We will project the corresponding hemisphere (Fig. 5). Once completed each umbrella we can use it with students placing it above their heads (Fig. 6).

Fig. 6 Using the northern hemisphere's umbrella with students

We will put the umbrella's cane inclined in the direction of the corresponding hemisphere pole (like the rotation axe of the Earth). Imagine the floor of the room up to our neck, this would be the horizon, so that part of the fabric of the umbrella would be below this horizon. Then we distinguish two parts in this imaginary horizon. The part that is near the pole where the sky observed throughout the year is always more or less the same (when looking at the area of intersection stick umbrella fabric). The Ecuador's area that remains higher above the horizon, is the most interesting part because the constellations change throughout the year (Fig. 7).

Fig. 7: Umbrella's cane inclined in the direction of the pole according to the latitude. We imagine the plane of the horizon that covers part of the umbrella.

We have to insist that the model explains the translational motion. We imagine that there is no rotation, something equivalent to observe every day more or less at the same time. We also noticed that in this simplified model, we visualize the movement of the sky 90º to 90º discretely, ie every 3 months. As the sky movement is continuous and every day, when it is mentioned that a particular constellation is visible during a season, we must understand that is about the constellation that we see in the center of the horizon in the middle months of the season.

HOW TO USE

We like to use the umbrella to understand the translational motion.

Northern Hemisphere.

To fix ideas, suppose that we are in a place of latitude 40 ° North. We put the umbrella of the northern hemisphere with cane North Pole (40º inclined above ground) above our heads.

In the northern hemisphere the polar star (Polaris, in Ursa Minor) is practically located at the North Pole. It is easy to recognize the constellation of the Ursa Major or Cassiopeia. From the Ursa Major or Big Dipper prolong 4 times the distance between the two farthest stars of the tail of the constellation and locates the polar star. Using Cassiopeia, the polar is in the intersection of the two bisectors of each V of the double W representing Cassiopeia.

Northern Horizon

We look to the polar star area. If we introduce a slight rotation we observe the constellations of Ursa Major and Cassiopeia rotate around the North Pole throughout the year (figure 10).

Fig. 8: Relative positions of the Ursa Major around the North Pole throughout the year (at the same hour).

We begin by placing the Ursa Major on the top and Cassiopeia down (which happens in spring), we turn the handle of the umbrella 90º in order to have the Ursa Major in the left and Cassiopeia in the right (then we have the situation of summer). Again we rotate the handle 90° in the same direction, then the Ursa Major is down and Cassiopeia is up (this is the position corresponding to autumn) and finally we rotate 90º leaving the Ursa Major on the right and Cassiopeia left (this is in winter). If we rotate again 90º we reproduce the initial situation and begin the four seasons of a new year (Fig. 8).

As described at the whole process, it is understood that this area of the sky, which is called the northern horizon, this is the area of the horizon corresponding to the North, the constellations that we see throughout the year are always the same and there is more variation

Southern Horizon

We consider now the equatorial area, the area of the lugs of the rods now. The constellations in this area of the southern horizon vary by season. The central spring constellation is Leo, and then we place the umbrella with Leo in the highest part of the horizon. Then we rotate ¼ turn umbrella, or 90º and we have over the southern horizon, the central constellation of summer: the swan is with Lira and Aquila summer triangle. With another ¼ turn we are in autumn and the central constellation will be the great quadrilateral of Pegasus. And we turn another 90º we are in winter, and the constellation Orion with his hounds dominates the horizon sky.

Southern Hemisphere

Consider, for example, latitude of 40º South. We put the umbrella of the southern hemisphere with cane headed south pole (inclined at about 40º from the floor) over our heads.

In the southern hemisphere there is no polar star that allows visualizing the position of the South Pole. The Southern Cross constellation is used to mark the position of the southern celestial pole; to find the South Pole the major axis has to be extended towards the foot of the cross 4.5 times. This constellation makes one revolution around the pole in 24 hours. The position changes throughout the year for the same time, as shown in figure 11. We assume that is the same time to obviate the rotation of Earth and observe only the sky rotation due to the translation.

Southern Horizon

Look to the area of the intersection between umbrella's cane and umbrella's fabric, where is the South pole. We rotate slowly the handle and note that the constellation of the Southern Cross rotates around the south pole throughout the year. We begin by placing the Southern Cross above (what happens in winter), we rotate the handle of the umbrella 90º until to have the Southern Cross on the right (the position on spring). We rotate again 90º in the same direction, then the Southern Cross is down (this is the position corresponding to the summer) and, finally rotate 90º leaving the Southern Cross on the left of the South pole (as it is in autumn). If we rotate again 90º we reproduce the initial situation and begin the four seasons of a year (Fig. 9).

Fig. 9: Relative positions of the Southern Cross around the South Pole during the year (at the same hour).

After the described process it is understood that in that area of the sky, called the southern horizon (the area of the horizon corresponding to the South cardinal point), the constellations that we see throughout the year are always the same and there is more variation.

Northern Horizon

We look at the fabric of the umbrella in the equatorial zone, ie the northern horizon. This area is where the constellations vary more. Which are visible in summer, are not in winter. The Greek goddess Gea (Greek Mythology), mother of Orion, placed the giant Orion in the sky after his death from a scorpion sting, which she herself sent. Orion and Scorpius can be seen simultaneously in the sky, above the horizon, around the March equinox: when Orion sets, Scorpius appears; in the sky, the scorpion eternally pursues Orion, without catching him.

The central constellation during spring is Aquarius. We rotate the umbrella 90º, ie after three months and we have Orion with his hounds on the northern horizon which is the central constellation of summer. With another ¼ turn we are in autumn and the central constellation is Leo. If we rotate the umbrella 90º is winter, and we have the beautiful Scorpios constellation on the horizon sky

Conclusions for both hemispheres

Following the scheme presented above in both hemispheres for two horizons we can understand the observations due to translational motion.

If we want to include the rotation movement in the activity, we must take into account that in addition to the annual movement it describes a daily movement due to the rotation of the Earth. In one day, both the Ursa Major and the Southern Cross make a complete revolution of their respective poles.

Stellar positions, apparent diameters and angular separation between celestial objects

It is possible to measure the apparent angular diameter of a celestial object, its height above the horizon, the position of the Celestial Pole, and the angular separation between two stars with one's hand, on an outstretched arm.

The index finger is approximately 1° thick, the fist is 10° wide, and a fully open hand, from the tip of the thumb to the tip of the little finger, is approximately 20° wide.

Fig. 10. Measurement of the apparent angular diameter of the Moon (Credit: B. García).

For example, knowing that the apparent diameter of the Moon is half a degree (0.5º) and that the apparent thickness of our index finger (at arm's length) is 1º, then half a finger would be enough to completely cover the Moon, both at the horizon and at its maximum height. This is an interesting exercise to demonstrate that the vision of a "giant" full Moon at sunrise is an optical illusion.

Using this physical characteristic of humans, we could also roughly determine, once we locate the Celestial Pole corresponding to the observer's hemisphere, the latitude of the location where the activity is taking place, since the "height of the celestial pole above the horizon" corresponds to the latitude of the location.

Dark skies and light pollution

To observe the stars all the stars that the eye can detect, we must have a dark sky. But this is only possible if we turn away from the cities. Humans have forgotten about the starry sky because we cannot see it. This problem occurs because most of public lighting produces huge amounts of wasted energy lighting up the sky, which is unnecessary. Light pollution is one form of environmental pollution less known than most others. It affects the visibility of the night sky, but also alters the balance of the ecosystem and inside it, and affects human health, since it breaches the biological clocks that are coordinated with periods of light and darkness. To be alert on this subject, learn to recognize the problem, warn others of the consequences, and find solutions.

There are three main types of light pollution:

a) The glow is a phenomenon that occurs, in general, by the public lighting outside. It is evident when we have the opportunity to travel at night and approach a city. We see that a light wraps around the city, a kind of light bubble. The light produced by the light glow is wasted, it is spent on lighting up the sky, which is not needed and, therefore, it not only prevents us from seeing the stars but spends energy unnecessarily. This type of contamination is reduced by choosing careful light fixtures and bulbs.

b) The intrusion: the external light is projected in all directions and some of them entered, even unwittingly, to our homes. If the light is projected into the rooms, we will have to block the windows with curtains or shades at night, if we want to rest properly.

c) The glare: This type of pollution is linked to the lights of cars and even outdoor lighting in cities and homes. It is evident in places with slopes, as the glare occurs when someone finds an unexpected lamp or a reflector. The traffic lights based on LED can also produce this king of light pollution. LED lighting is naturally a source of light pollution and must be used with caution, although it is energy efficient.

It is possible from various programs on the Internet to compile a series of practical activities for working on this issue, and there is more than adequate bibliography to draw attention to this topic (García, 2010, 2019); we will propose in this chapter on preparing a night observation experience, we propose only one that is interactive and easy to perform in any setting.

Activity 2: Light pollution

The objectives of this activity are to illustrate the polluting effect of unprotected light, recognizing the astronomically undesirable effect, to choose a shielded system to control light pollution and to highlight the possibility of improving vision stars in the context of being able to illuminate places where we want more light.

To carry out this experience obtain one cardboard box of certain dimensions that will allow the student to look inward. To draw the constellation that you select (in this example is that of Orion) and mark the stars as points first; later the holes will be made taking into account the diameter of each, depending on stellar magnitude (Fig. 11a and 11b).

Fig 11a and Fig 11b: Cardboard Box, design of the constellation Orion on one side

The constellation as drawn on the outside of the box should be the mirror image of the constellation, so that it will be seen as it appears in the sky when you look inside the box. The box must be painted black on the inside (preferably, but not absolutely necessary) so that if one looks directly inside , the constellation have the appearance of what is shown in figure 12. The "stars", or points that represent them, will be illuminated by the input of the external light inside the box.

Prepare two tennis table balls, making a hole that would allow it to fit over a flashlight. One of the balls is left as it is, and the other is painted with synthetic enamel of any color in the upper hemisphere, representing thus a so-called "shield" that prevents that light from projecting up (fig. 13a and 13b).

Fig. 12: View of Orion from inside the box. Each hole represents a star

Fig. 13a: Tennis table ball unshielded

Fig. 13b: Tennis table ball with a hemisphere painted.

To perform the experiment, you need to use flashlights in which you can remove the protective top and leave the light bulb as shown in figures 14a and 14b. The tennis table ball is inserted into the flashlight.

Fig. 14a: We removed the protector of the flashlight

Fig. 14b: Flashlight with the tennis table ball simulating the street lamp

Fig. 15a: Lamp without shield

Fig. 15b: Shielded Lamp

It's also possible to use ping-pong balls placed directly on a cell phone's LED light (Fig. 16a, 16b and 16c). The effect is only on the sky (in the previous case, due to the flashlight body acting as a column, it's possible to analyze what happens when we change the ground on which the light reflects, contributing to light pollution).

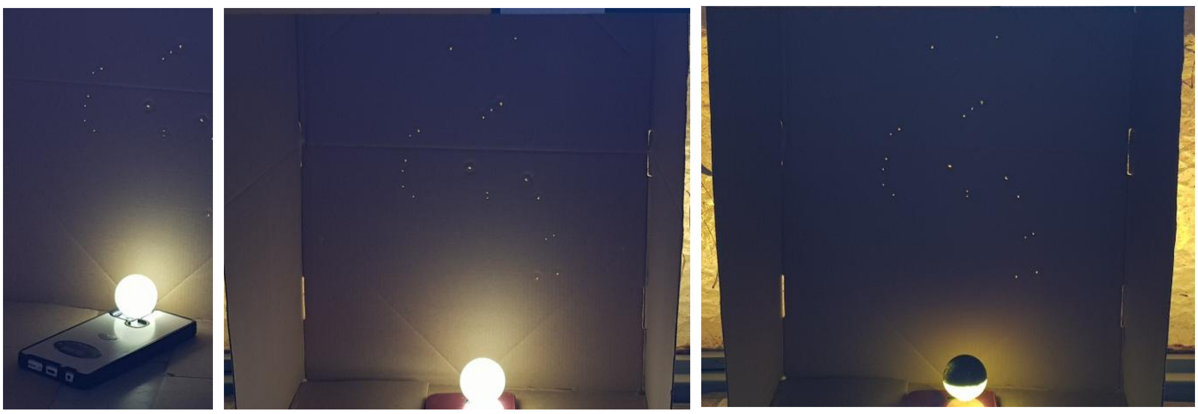

Fig. 16a, 16b and 16c: Experience using the luminaire (ping pong ball with and without shielding, on the LED light of the mobile phone.

The experiment was performed in two stages:

First with just the box. At this time, turn off the lights during the experiment. Both models are tested with the same flashlight to avoid variations in the intensity of light. Project the light both unshielded (Fig. 15a) and shielded (Fig. 15b) projecting the light onto a smooth nearby surface, for example a wall or piece of cardboard.

Second, see what happens inside the box. The situation shown in figures 17a and 17b, for cases with and without shield respectively. You can use a digital camera to take photos of what happens inside the box if it is not possible that participants can look inside. External lights in the room where the experiment takes place should be on.

You will notice what is happening very clearly. In the first situation, in the case of outdoor lighting, we see the situation with the baffle controls light pollution: the emission into the sky is greatly reduced.

In the second situation, when using both types of flashlights inside the box, we are simulating in the case of a night with unshielded lamp that sends extra lighting in the sky, called the glow, which obscures the view of the stars. In the case of digital camera, using automatic exposure, you cannot even focus properly at the stars. By contrast, in the second case of the flashlight adapted to control light pollution, it is clear that this device allows the sky to be much darker and the camera is able to clearly record the constellation of Orion.

Fig. 17a: Appearance of the night sky with lanterns without shielded. Fig. 17b: Appearance of the night sky with lights shielded

Let us remember that the starry sky was declared an "Intangible Heritage of Humanity" (Declaration of La Palma, 2007), and it is our responsibility to protect it. In recent years, a new threat to the visibility of the starry sky—communications satellite constellations—has led the International Astronomical Union to create a special office in 2022, the Centre for the

Protection of the Dark and Quiet Sky from Satellite Constellation Interference (CPS), dedicated to raising awareness on this issue and arbitrating means to mitigate the harmful effects of this type of pollution on our planet in general and on scientific research in the field of astronomy in particular.

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APPENDIX: How to Use Stellarium 0.10.6.1

To fix or not the toolbar (to bring the cursor to the lower left corner)	
Location. You can enter by cities, by coordinates or by clicking on a map	
Date and time that is displayed the sky	
Setting the view of the sky. In turn has four menus, which are explained below	
Number of stars, planets ...and to display or not the atmosphere	
Coordinate lines show in the sky, constellations ... Type of projection of the sky. We recommend Stereo graphic or Orthographic	
Show the landscape, soil, fog.	
Names and figures of the constellations and stars in each culture. The best known are the Western.	
Look for an object (i.e. Saturn, M13, NGC 4123, Altair)	
Setting the language and information of the objects shown on screen	
Help (shortcut keys, etc.).	
Normal rate of time	
Speed up time. Can be given several times	
Speed downtime.	
Back to the current time	
Lines of constellations	
Names of constellations	
Figures constellations	

Grid equatorial	
Grid azimuth + horizon	
Ground/Horizon	
Show cardinal Points	
Atmosphere	
Nebulae and names	
Names of the planets	
Equatorial mount / azimuth	
Center on selected object	
Night mode	
Full screen/ window	
Ocular (like looking to the selected object through a telescope)	
Show satellites in orbit	
Getting around the view	←,→,↑,↓
ZOOM +	**Repág**
ZOOM –	**Avpág**
Define selected planet as the planet from which to see. To return to Earth, look for Earth, and then click Ctrl G (command) to select the planet Earth from which it looks.	**CTRL G**
Leave / omit trace the path of the planets	**May+T**
Screen capture	**CTRL S ó** *PrintScreen*
Exit(complete with Stellarium)	**ó CTRLQ**